



# CIRCUIT PROTECTION PRODUCTS CATALOG 2016

- Hybrid Protection
- Overtemperature Protection
- Overvoltage Protection
- Overcurrent Protection

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This catalog is intended to present application, product, and technical data to assist the user in selecting circuit protection products, including PolySwitch Polymeric Positive Temperature Coefficient (PPTC) resettable devices, Reflowable Thermal Protection (RTP) devices, Metal Hybrid PPTC (MHP) devices, PolyZen devices, 2Pro devices, Electrostatic Discharge (ESD) protection devices, chip fuses and Gas Discharge Tubes (GDTs).

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## TE CIRCUIT PROTECTION

TE Connectivity Ltd. (NYSE: TEL) is a \$12 billion global technology leader. Our connectivity and sensor solutions are essential in today's increasingly connected world. We collaborate with engineers to transform their concepts into creations - redefining what's possible using intelligent, efficient and high-performing TE products and solutions proven in harsh environments. Our 75,000 people, including 7,300 design engineers, partner with customers in over 150 countries across a wide range of industries.



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We believe **EVERY CONNECTION COUNTS** - [www.TE.com](http://www.TE.com).

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TE Connectivity's business unit, TE Circuit Protection, began almost 40 years ago as part of Raychem Corporation. From the first, we defined ourselves as industry pioneers in the field of PPTC (polymeric positive temperature coefficient) technology with our PolySwitch product line. Having had patents granted for the use of a PPTC device as a variable resistor in circuit protection applications in the early 1980s, we have continued to expand the PolySwitch family to include wider voltage, current and temperature ranges in a variety of form factors.

Today our circuit protection devices help to make your world safer and your electronics more reliable. Our products can be found in your cellphone, tablet, car, home appliances, LED lighting fixtures and a myriad of other everyday applications.

## Overcurrent Protection

- **PolySwitch devices** — PolySwitch PPTC devices provide resettable circuit protection. Device types include: Automotive, Radial-leaded, Strap Battery and Surface-mount Devices (SMDs)
- **Single-use fuses** — These devices are for applications that need to disable the circuit rather than isolate it. The family comprises: Fast-acting Chip, High-current Rated and Slow-blow Chip fuses

## Overvoltage Protection

- **Gas discharge tubes (GDTs)** — Low-capacitance GDT devices help protect applications such as telecom and appliances damage from potentially harmful surge events

## ESD (Electrostatic Discharge) Protection

- **Polymer ESD (PESD) devices** — Help provide protection for today's highest-speed interface applications (USB, HDMI, DisplayPort, etc.).
- **ChipSESD devices** — Bi-directional, silicon-based devices in 0201 and 0402 sizes are easier to install and re-work than traditional semiconductor-packaged ESD devices

## Hybrid Protection

- **PolyZen devices** — Each PolyZen device integrates a precision Zener diode and a PolySwitch PPTC device. Devices are offered in “LS”, “YC” and “YM” options to help protect a broad range of applications requiring overcurrent/overvoltage protection
- **2Pro devices** — Combining an MOV and PPTC in a single device helps provide space-efficient protection against overvoltage/overcurrent events. The 2Pro AC device family provides AC-line protection and can offer better space and reliability benefits than discrete solutions

## Thermal Protection

- **Metal Hybrid PPTC (MHP) devices** — Combining the best attributes of a PPTC and bimetal breaker in one device helps protect lithium battery applications.
- **Reflowable Thermal Protection (RTP) devices** — The surface-mount-packaged RTP device helps manufacturers dramatically speed assembly time and reduce board space, while helping protect against potential damage from thermal runaway in automotive and industrial designs

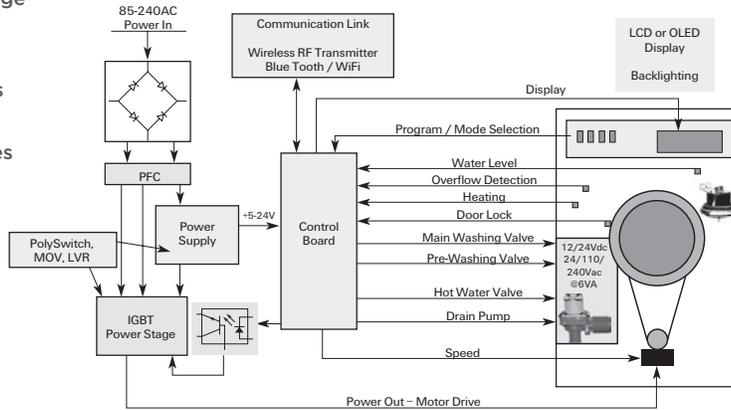
To date, billions of TE Circuit Protection devices are being used to help protect a wide range of electronic products in computer, battery and portable electronics, consumer, automotive, industrial, home appliance, HVAC, and telecommunications applications. Our products help manufacturers meet strict regulatory standards while diminishing warranty returns.

TE Circuit Protection offers a dedicated engineering sales force along with worldwide manufacturing and design centers. Our history in circuit protection, combined with local engineering support, enables us to think globally - and act locally - to meet our customers' needs.

### Washing Machines

A number of circuit protection devices can be used to help provide overtemperature, overcurrent and overvoltage protection for the small electric motors, LED displays and control electronics found in home appliances.

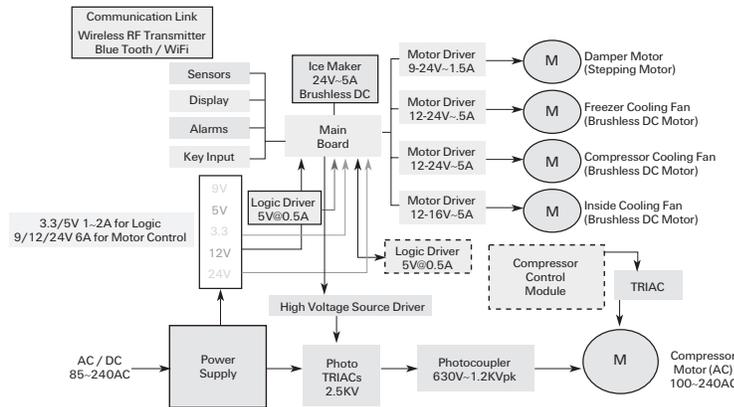
- PolySwitch Line-voltage radial-leaded devices
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- ESD devices
- Surface-mount fuses
- GDTs



### Refrigerators / Freezers

Our circuit protection devices help protect the small electric motors and fans, controllers, touchpads, displays and interface circuitry required by sophisticated appliances.

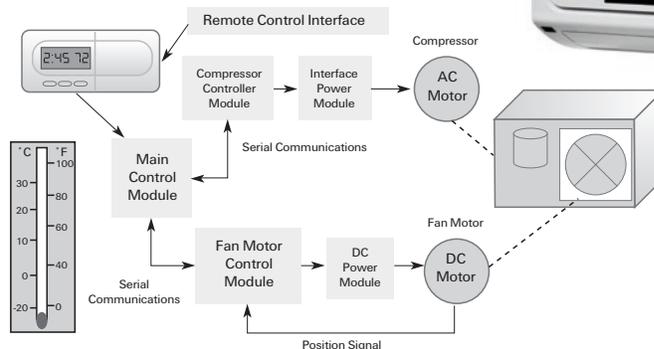
- PolySwitch Line-voltage radial-leaded devices
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- ESD devices
- Surface-mount fuses



### Air Conditioning Units

Resettable PolySwitch devices, ESD devices and chip fuses help provide coordinated overcurrent and overvoltage protection for the small electric motors, fans, displays and interface circuits used in modern HVAC equipment.

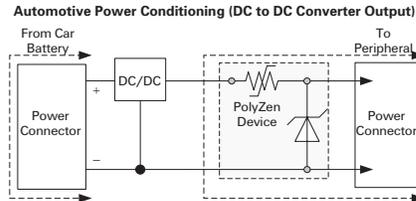
- PolySwitch Line-voltage radial-leaded devices
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- ESD devices
- Surface-mount fuses



## Automotive Electronics

PolyZen devices help protect automotive electronics and peripherals and/or portable electronics that can be charged in the vehicle from damage caused by inductive voltage spikes, voltage transients and reverse polarity. Providing coordinated overcurrent, overvoltage and reverse polarity protection, the PolySwitch device protects like a Zener diode but is capable of withstanding the high-power fault conditions that can occur in automotive applications.

- PolyZen devices

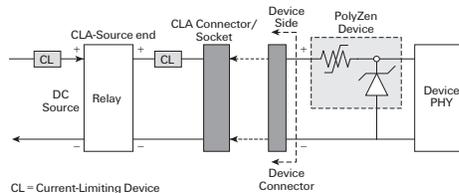


## DC Cigarette Lighters and Power Plug Adapters

Charger circuits for mobile phones, iPods, after-market hands-free devices, or other rechargeable battery operated equipment, use connectors to plug into automobile cigarette lighter or power outlets. These assemblies must operate over a wide range of temperatures, charging conditions and in harsh automotive environments.

Typically, overcurrent protection, such as a PolySwitch polymer positive temperature coefficient (PPTC) device, and overvoltage protection are coordinated at the input to the charger to help meet the stringent electrical requirement. A single PolyZen device or PolyZen-AS device can be used to help protect against damage caused by overcurrent, overvoltage, or reverse polarity faults.

- PolySwitch automotive devices
- Surface-mount fuses
- PolyZen devices



## Liquid Crystal Display Backlight Heaters

There are an increasing number of displays -- such as navigation systems, instrumentation displays, video and TV screens -- being designed into automobiles. A temperature-sensing PolySwitch PPTC current-limiting device can be employed to help prevent thermal runaway due to a failure in the control circuitry. In most cases, the circuit will be powered off on a regular basis (i.e., when the ignition is turned off) and a resettable PolySwitch device may be desired. In other cases, a single-use RTP (Reflowable Thermal Protector) device or single-use fuse may be preferred.

- PolySwitch automotive devices
- Surface-mount fuses
- HCRTTP devices



## Driver-Side Door Console

The switch console on the driver-side door allows the driver to control multiple functions, including power windows, side mirrors and power door locks. Small Surface-mount PolySwitch devices help protect low current membrane switches and PCB traces against damage caused by overheating in the event of an overcurrent or short circuit condition. A variety of designs include PolySwitch devices that help protect PCB traces leading to high-current power window motors, as well as low-current delicate carbon membrane microswitches, transistors in LED backlighting circuits and small traces of the side mirror control circuits.

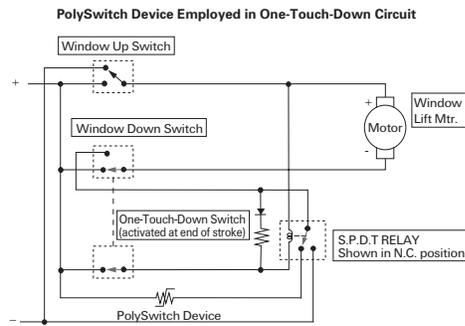
- PolySwitch automotive devices
- Surface-mount fuses



## One-Touch-Down Circuits for Power Windows and Power Sunroofs

Lower cost one-touch-down circuits can employ a PolySwitch PPTC device to function both as a sense component and a switch component. This functionality allows a PolySwitch device to replace a number of other devices, such as the sense resistor, comparator, driver and control circuitry used in traditional power window and sunroof circuits. As a result, designers can help to achieve net cost savings through reduced component count and reduction in wire size.

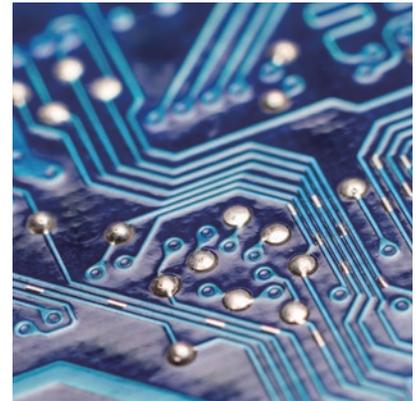
- PolySwitch automotive devices



## Printed Circuit Board Traces

The width of the copper traces must be reduced to provide more space for the tighter-packed and smaller printed circuit boards. These “Black Box” control modules handle a large number of high-powered accessories such as power windows, power seat adjusters, remotely controlled door locks, and radio & GPS antennae. PolySwitch resettable devices can be used to help protect these delicate printed circuit board traces against damage caused by overcurrent conditions.

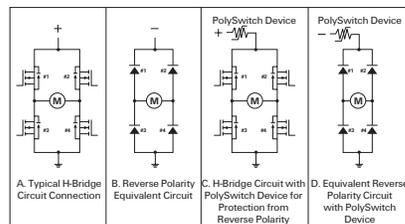
- PolySwitch automotive devices
- Surface-mount fuses
- HCRTP devices



## H-Bridge Circuits

Automotive FET switched H-bridges must be protected from reverse polarity power sources. This may occur when jumper cables are connected to the wrong polarity of a dead or excessively discharged battery or when a new battery is installed backwards. Without protection, excessive heating can lead to failures in electronic modules or inadvertent activation of vehicle loads such as solenoids and motors, which can lead to unsafe conditions.

- PolySwitch automotive devices
- HCRTP devices



## Automotive Control Application and Multimedia Busses

Connecting lifestyles from the home to the vehicle has become a reality in the automotive industry. MOST, Flexray, IEEE1394 and other networks now co-exist with CAN and LIN. Their main goal is to facilitate equipment interfacing and information sharing for embedded equipment, while also enabling after-market electronic equipment such as Portable Navigation (PNDs), smart phones, DVD players, etc. In a hot-pluggable automotive environment, where the consumer is connecting and disconnecting peripherals on a powered port, the potential for short-circuit damage is clearly present. PolySwitch devices and ESD protection devices can be used to help protect the connected equipment.

- PolySwitch automotive devices
- Surface-mount fuses
- ESD devices



## Navigation and Infotainment Systems

Infotainment and navigation systems are packed with electronics and connectivity elements. Circuit protection devices help protect a wide variety of functions such as powered antennae, CAN-bus, touch screen, USB ports, HDMI ports, RF tuners, I/O lines, HDD, etc. Overcurrent and overvoltage protection devices help prevent system breakdown and enhance design safety.

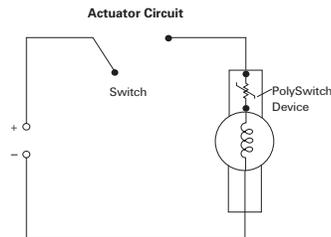
- PolySwitch automotive devices
- ESD devices
- Surface-mount fuses
- PolyZen devices



## Automotive Actuators and Medium-Size DC Motors

Automotive electric motors can overheat and cause damage to internal temperature sensitive components. To help protect these components, custom and semi-custom PolySwitch devices can be designed to meet specific customer thermal protection needs. Installing a PolySwitch device in close proximity to the motor or solenoid offers the added benefit by limiting current due to excessive heat. In particularly high-current motor applications, such as engine cooling fans, HVAC fans, electric power steering motors and ABS pump motors, the higher currents or continuous duty cycles may be more appropriately supported by the use of an RTP (Reflowable Thermal Protection) device.

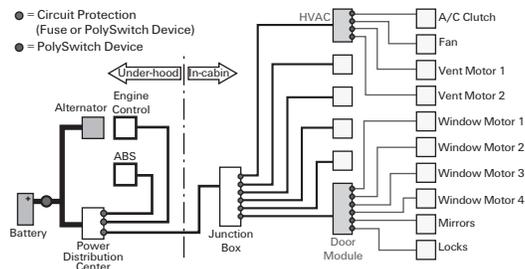
- PolySwitch automotive devices
- Surface-mount fuses
- HCRTD devices



## Automobile Harnesses

The wiring harness architectures of light and heavy vehicles have undergone considerable change due to increased electrical and electronic content. PolySwitch PPTC resettable circuit protection devices, which do not require driver accessibility, can be embedded in distributed electronic control modules and power controlling switches throughout the vehicle. This approach of creating separate circuits helps to enable fault isolation as well as the downsizing of wire gauges and PCB traces.

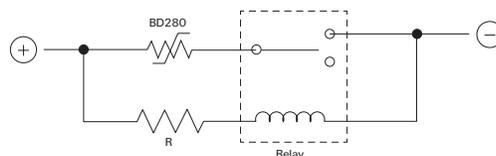
- PolySwitch automotive devices
- Surface-mount fuses



## Automobile Relays

Relay contacts can pit during high current interrupt events. A PolySwitch PPTC device helps reduce current prior to contact switching events. This circuit design becomes a tuned system that uses the normally open contacts and works in coordination with relay inertia. During an overload condition, the relay energizes and latches in the off state. Once the power is cycled and/or the load is removed, the relay de-energizes and the circuit immediately resets and is able to deliver full power. The use of a PolySwitch device in this circuit can help achieve vehicle power outlet protection, but it can also be used to help protect isolated trailer lighting circuits.

- PolySwitch devices



## Glow Plug ECU

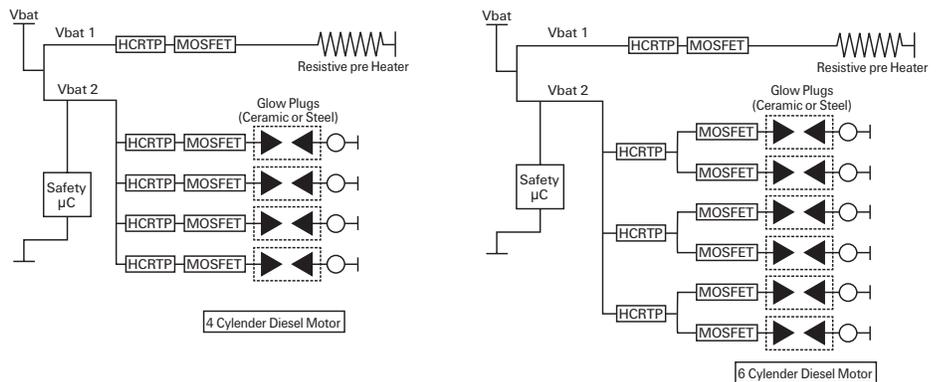
To address the growing need to increase reliability and safety in extremely harsh automotive environments, the HCRTTP device is specifically suited to high-current automotive applications such as glow plug electronic control units (ECUs). The robust HCRTTP device (model: RTP200HR010SA) can withstand hold currents of up to 90A at room temperature (23°C) and 45A at 140°C.

In addition to helping automotive designers comply with stringent AECQ automotive standards, including the AECQ vibration test, the surface-mountable HCRTTP device enables cost-effective and simple installation, while also optimizing thermal coupling with the printed circuit board.

Based on the functional safety concept provided by a major OEM, multiple uses for the HCRTTP device is possible. For example, in a six-cylinder glow plug ECU application, an HCRTTP device can prevent damage from thermal runaway in case of a resistive short on the PCB. Depending on current requirements and the glow plug technology, different arrangements are possible; such as placing one HCRTTP device per one FET line or placing two HCRTTP devices per pair of power FETs.

Furthermore, ceramic glow plugs in particular are distinguished by a long-duration cool down and aggressive inrush currents. Compared to competitive approaches, the ultra-low resistance of the HCRTTP device offers benefits in terms of time life and reliability.

- HCRTTP devices



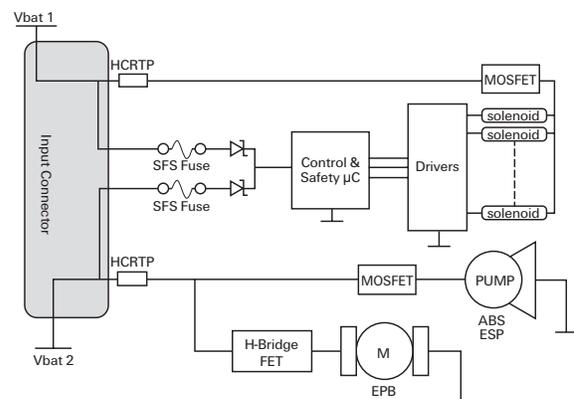
## Electrical Brake Systems ABS & EPS

A popular trend in automotive applications is for state-of-the-art ABS modules to integrate an electronic stability control or program (ESC/ESP) as well as an electrical parking brake (EPB) system on the same board. For such high-current applications, some OEMs require a functional safety automotive standard, the ASIL D. To help meet this standard, a secondary, non-active and irreversible thermal fuse can be placed as close as possible to the input connector to avoid thermal propagation outside the vehicle when power FETs, capacitors or other power components fail due to thermal runaway.

As an alternative to typical protection approaches, an HCRTTP thermal protection device can be installed near the input connector in two places on the board. Electrical brake systems have two separate power lines that can achieve thermal protection using HCRTTP device, one for valves/solenoids and the other for the oil pump motor. This design helps mitigate damage from a power FET failing due to a resistive short – a fault condition that produces severe temperatures through  $I^2R$  heating in which the device's resistance rises too high. In each instance, the HCRTTP acts as a “one-shot” protect solution that complies with the AECQ vibration test and other automotive standards that mandate the use of thermal protection devices.

For safety reasons, redundant power supplies are required to feed the control IC. Some OEMs mandate the use of an overcurrent protection device in case the dual rectifier diode experiences a short-circuit event. In this case, a slow-blow chip fuse can be used to provide space-saving protection.

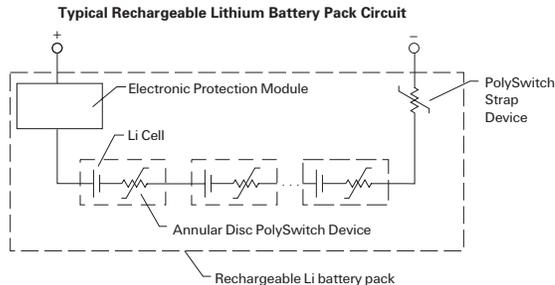
- HCRTTP devices
- Surface-mount fuses



## Lithium Cells and Battery Packs

External shorts, runaway charging conditions, or abusive charging can cause considerable damage to primary and secondary lithium (Li) cells. PolySwitch disc and strap circuit protection devices can help protect rechargeable lithium batteries used in notebook computers and cellular phones, as well as other portable electronic applications.

- PolySwitch strap devices
- PolySwitch disc devices

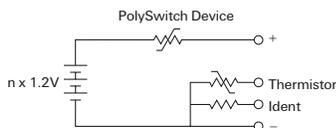


## Rechargeable Battery Packs

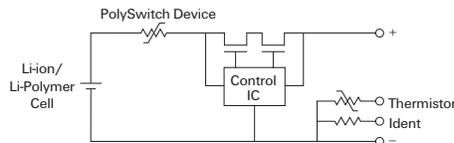
Due to external shorts, runaway charging conditions, or abusive charging, considerable damage can be sustained in both battery cells and pack surroundings. The most common applications for PolySwitch devices are for helping to protect lithium-ion (Li-ion) battery packs used in cellular phones, digital cameras and laptop/notebook computers, or for helping to protect nickel-cadmium (NiCd) and nickel-metal-hydride (NiMH) battery packs used in other portable electronic applications.

- PolySwitch strap devices

**NiMH/NiCd Battery Pack Circuit Diagram**



**Single Cell Li-ion/Li-Polymer Battery Pack Circuit Diagram**

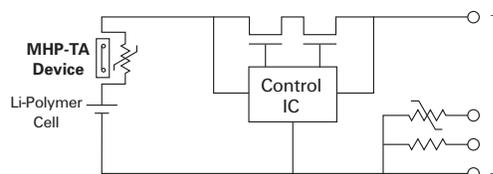


## Rechargeable Lithium Polymer Cells

Tablets, ultra-thin notebook PCs and other small portable electronics use high-capacity lithium polymer and prismatic cells that require overtemperature protection to help prevent the cells from overheating. The combination of thin form factors, high cell capacities and high battery discharge rates typical of these applications create a unique set of circuit protection requirements, which are low thermal cut-off temperatures ( $<90^{\circ}C$ ), high hold current ratings ( $>6A$ ) and compact size.

The MHP-TA series of MHP (Metal Hybrid PPTC) devices addresses these design concerns by offering two levels of current carrying capacity (6A or 15A hold current at  $25^{\circ}C$ ) as well as an ultra-thin package (L:5.8mm x W: 3.85mm x H: 1.15mm).

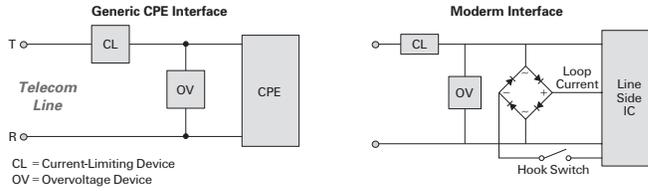
- MHP devices



### Customer Premise Equipment

To protect subscribers against damage caused by faults entering from outside wiring, customer premise equipment (CPE) is designed with power cross and lightning protection components. The following are recommended circuit protection solutions based on regional requirements.

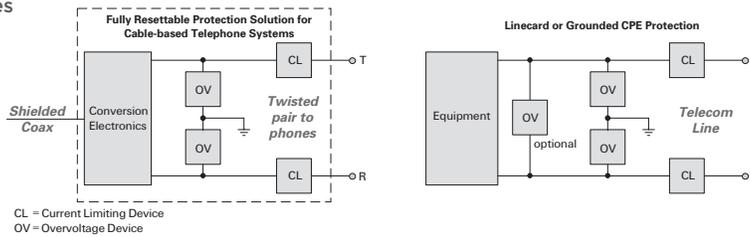
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs
- 2Pro devices



### Short-haul/Intrabuilding Protection Requirements

Communications equipment that is not directly connected to the PSTN is subjected to lower level hazards. Here are a few circuit protection recommendations for LAN, WLL, VoIP and other intrabuilding applications.

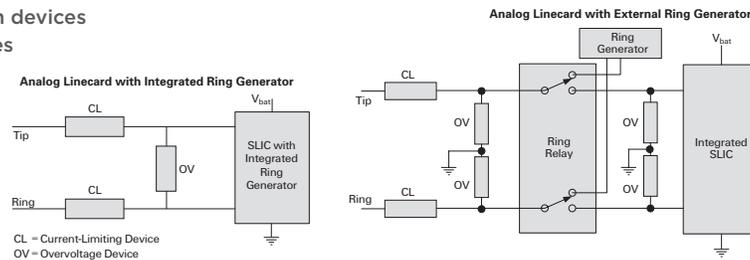
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



### Analog Linecards

Central office linecards are subject to transient overcurrent and overvoltage faults, which may be generated from nearby power cross, power induction and lightning events. Circuit protection recommendations based on regional agency specifications are provided below.

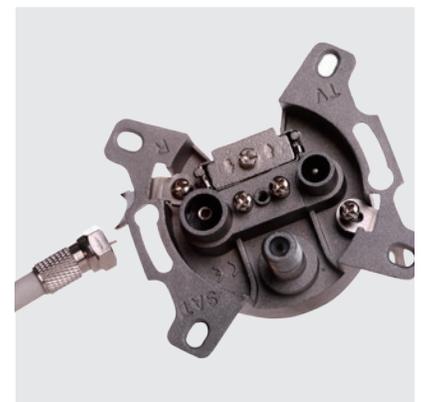
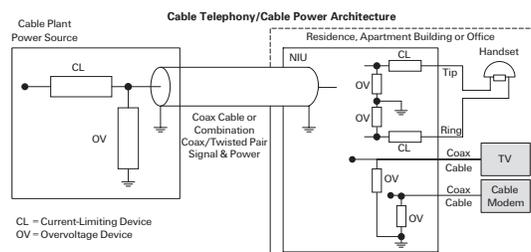
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



### Cable Telephony/Cable Power Passing Taps

Cable telephony electronics that are powered via twisted pair or coaxial cable are susceptible to power faults passed through the cable plant. The circuit protection solutions listed below can help decrease the risk of these faults in power passing taps.

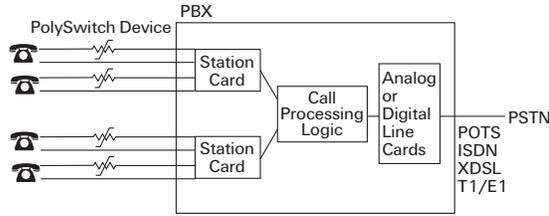
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



### PBX and Key Telephone Systems

Below are circuit protection device recommendations to help protect PBX and key telephone systems against damage caused by power faults and short circuits.

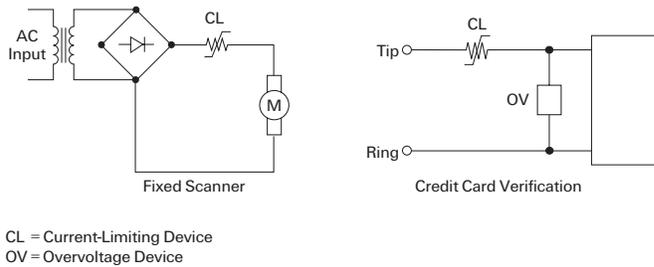
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



### POS Equipment

Equipment connected to telephone lines can be subject to power cross, induction, and lightning surge hazards. We recommend the devices below to help protect scanner motors and ditherers against damage caused by jams and stalls.

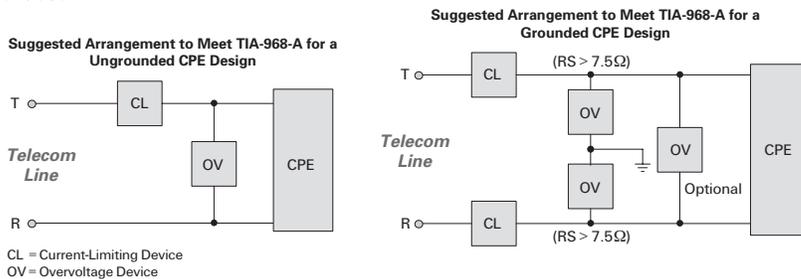
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- PolySwitch telecom devices
- Surface-mount fuses
- 2Pro devices



### UL60950 and TIA-968-A (formerly FCC part 68) Requirements

The UL60950 and TIA-968-A cover standards electrical hazards from which customer premise equipment (CPE) in North America must be protected. Below are resettable circuit protection recommendations.

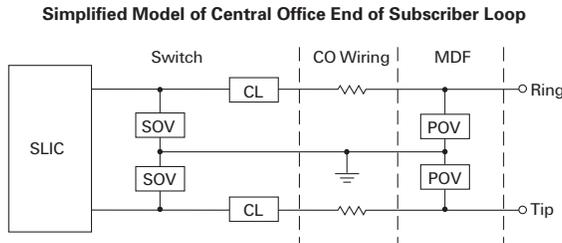
- PolySwitch telecom devices
- 2Pro devices
- Surface-mount fuses
- GDTs



## GR-1089 : Public Switched Telephone Network Equipment

GR-1089 describes the electrical hazards which public switched telephone network (PSTN) equipment in North America should be protected against. The figure below shows several recommended resettable circuit protection solutions for a simplified model of the central office end of a subscriber loop system.

- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



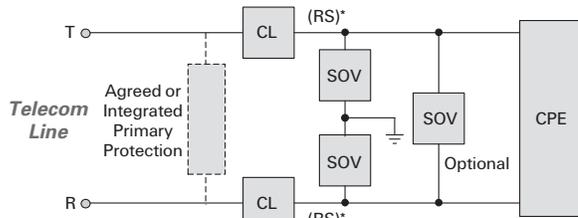
CL = Current-Limiting Device  
CO = Central Office  
MDF = Main Distribution Frame  
POV = Primary Overvoltage Protection Device  
SLIC = Subscriber Line Interface Card  
SOV = Secondary Overvoltage Protection Device



## GR-1089-CORE, Issue 5: Public Switched Telephone Network Equipment

According to the GR-1089-CORE, Issue 5 standard, to help prevent damage to telecom equipment, circuits connected to outside lines generally need protection from lightning and power fault events. The equipment must be able to withstand the surges that the primary protector lets through. For this reason, secondary, and even tertiary, protection is included to help limit the potential damage of the surge let through. To be effective, the secondary protection must coordinate with the primary protection.

TE Circuit Protection offers a broad line of overcurrent and overvoltage devices that can help Public Switched Telephone Networks equipment conserve valuable board space and meet emerging safety and performance standards.



CL = Current-Limiting Device  
SOV = Secondary Overvoltage Device  
\*RS is equal to the total coordinating resistance of the application

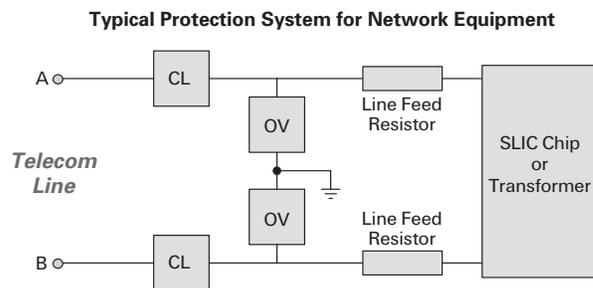
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



## ITU-T Recommendations

The ITU-T standard lists several recommendations for central office (K.20), customer premise (K.21) and access network (K.45) equipment. Below is an overview of our device recommendations, including resettable circuit protection solutions.

- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



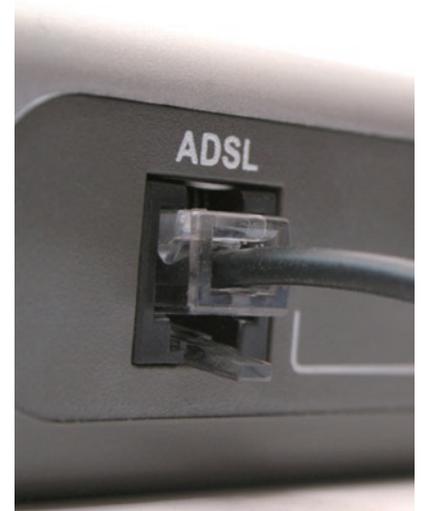
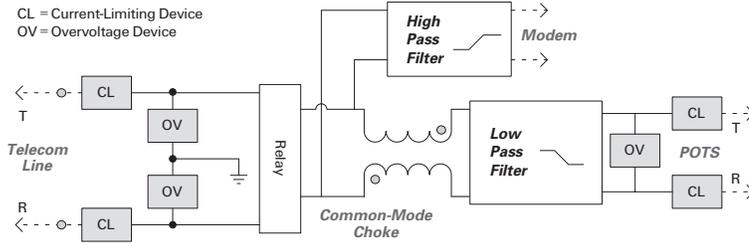
CL = Current-Limiting Device  
OV = Overvoltage Device



### DSL Equipment

DSL equipment, such as splitters, must be protected against damage caused by both external and intrabuilding faults. Recommendations for resettable protection solutions are provided here, based on regional requirements.

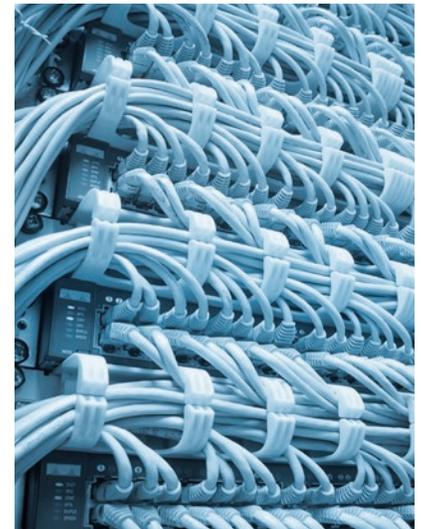
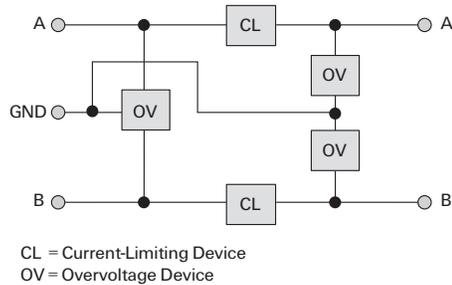
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



### Main Distribution Frame (MDF) Modules

Telecom systems, such as MDF modules, typically have multi-stage circuit protection. Primary protection is used closest to the “outside world” where the highest surge withstand capability is typically needed. Secondary protection is needed to help protect against damage caused by hazardous power cross and lightning faults until the primary protection component activates. The following devices are recommended for helping to protect these systems.

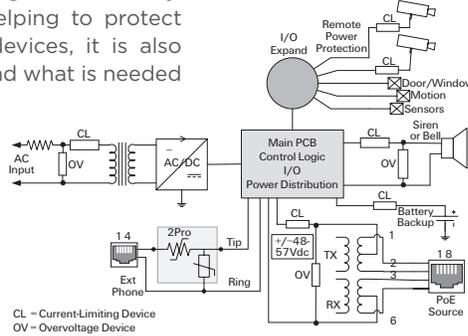
- PolySwitch telecom devices
- Surface-mount fuses
- GDTs



## Security and Fire Alarm Systems

Security and fire alarm systems have a need for circuit protection, due to fault conditions experienced by these applications as well as safety requirements. Possible faults include short circuits in the sensor lines or overheating of the battery. The devices below are recommended for helping to protect these systems. When choosing protection devices, it is also important to consider the different currents and what is needed to meet the requirements of UL864.

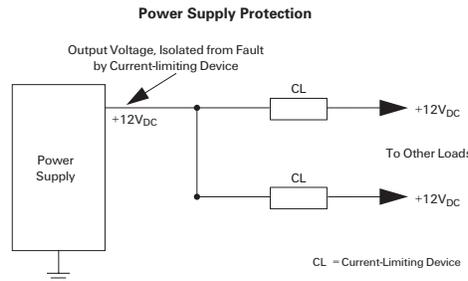
- PolySwitch Radial-leaded devices
- PolySwitch telecom devices
- GDTs
- ESD devices
- 2Pro devices



## Test and Measurement Equipment

Power supplies, communication ports, test probes, and battery packs are all vulnerable to overcurrent faults and electrostatic discharge (ESD). Incorrect termination of outputs may lead to system damage.

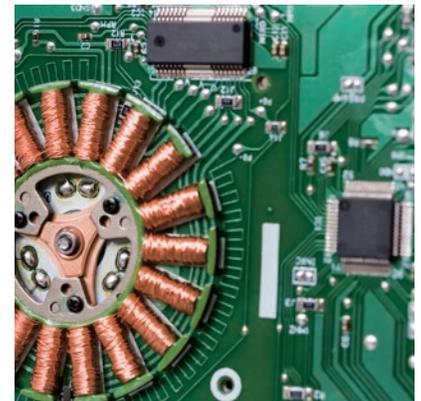
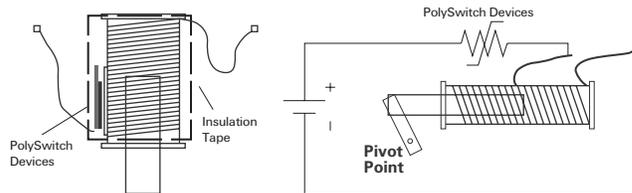
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- PolySwitch telecom devices
- ESD devices
- Surface-mount fuses
- PolyZen devices



## Solenoids

Solenoids are used in various PC and peripheral applications such as printer feed trays and CD/CD-RW/DVD tray mechanisms. A PolySwitch device can be used to help protect the coil assembly of the solenoid when a sensor fails or if the armature fails to retract, thus causing the coil temperature to increase and burn out the coil wire.

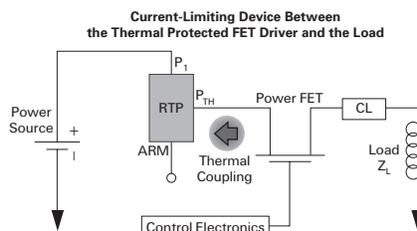
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses



## Electromagnetic Loads

Electromagnetic loads can be susceptible to many problems. Incorrect use of solenoids, valves and motors can potentially lead to device failure and circuit damage. The devices below are recommended as circuit protection solutions for these applications.

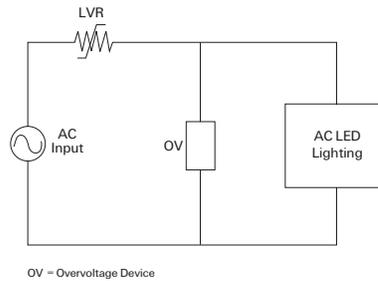
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses
- HCRTTP devices



## Protection for AC LEDs

Lighting fixtures powered by AC power can be put at risk from high voltage or power transients due to lightning strikes, load switching transients and their associated surge currents. We recommend the following circuit protection devices to help protect AC LEDs.

- PolySwitch Line-voltage-rated
- PolySwitch Surface-mount devices
- 2Pro devices

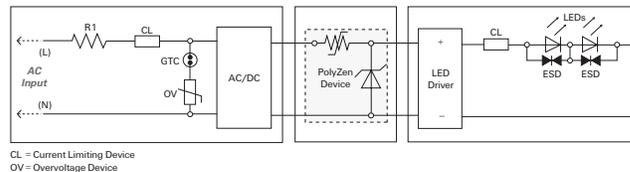


## Protection for DC Solid State Lighting (SSL)/LED Lighting

LED driver integrated circuits (ICs) used in many LED applications require a protected DC input to provide a regulated-current output to the LED. Listed below are devices that help protect these lighting applications.

A PolySwitch device placed in series with the LED driver IC and combined with a parallel voltage-limiting device, such as a Zener or transient suppression diode, can help provide effective protection against damage caused by faulty DC input voltages. A PolyZen device with an integrated PolySwitch PPTC device and Zener diode help provide both protection capabilities in one package.

- PolyZen devices
- PolySwitch Radial-leaded devices
- GDTs
- Surface-mount fuses
- ESD devices



## CFL Electronic Ballasts

There are two types of ballasts in compact fluorescent lamps (CFLs): electronic ballasts and magnetic ballasts. The electronic ballasts help prevent the fluorescent light from flickering when turning on. The electronic ballasts are more delicate and can be at risk from high-voltage or power transients due to lightning strikes, load switching transients and their associated surge currents.

A PolySwitch device helps provide effective protection for the electronic components inside the ballast against damage caused by faulty transients. TE Circuit Protection's 2Pro device and surface-mount fuses also help to provide effective protection in CFL ballasts.

- 2Pro devices
- Surface-mount fuses



## Street Lighting Electronic Ballasts

Lighting ballasts for street lighting can be at risk from high-voltage or power transients due to lightning strikes, load switching transients and their associated surge currents.

A PolySwitch device in series with the LED driver IC, and combined with a parallel voltage limiting device such as metal oxide varistors, can help provide effective protection against damage caused by faulty transients. Our recommended devices for street lighting also include the following:

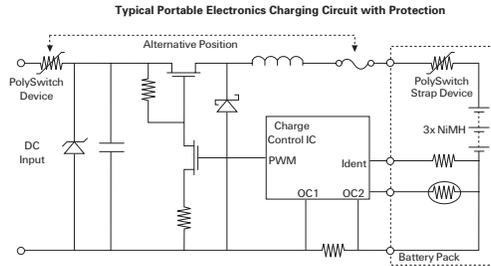
- PolySwitch Telecom devices
- Telecom fuses
- GDTs



### Portable Electronics Input Ports

The use of an incorrect or faulty adapter/charger can irreparably damage unprotected portable electronics equipment. Typical applications include cell phones, digital cameras, and tablets. The devices listed below are recommended for these applications.

- PolySwitch Surface-mount devices
- Surface-mount fuses
- PolyZen devices

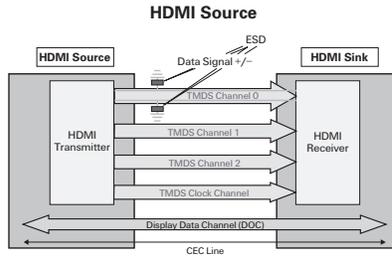


### HDMI: LCD & Plasma Displays, HDTVs, Set-top Boxes, DVD Players

High definition multimedia interface (HDMI) applications, such as LCD displays, plasma displays, high-definition television set-top boxes and DVD players, are susceptible to electrostatic discharge (ESD devices). To help protect the high-speed TMDS lines against damage caused by our ESD or SESD protection devices can be used two-per-line in HDMI designs.

- PolySwitch Surface-mount devices
- ESD devices
- Surface-mount fuses
- PolyZen devices

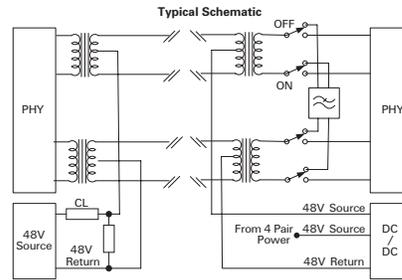
**Note:** HDMI 1.3 reference layout, whitepaper and testing results available upon request



### IEEE 802.3 Ethernet LAN (Powered Ethernet)

The auxiliary unit interface (AUI) consists of signal circuits, power and ground. Per the IEEE 802.3 standard, the Voltage Plus circuit is capable of operating at 12-15VDC for currents up to 500mA. In addition, per section 7.5.2.5, the source shall provide protection for this circuit against damage caused by an overload condition. Powering IP devices such as IP phones over the Ethernet cable introduces the potential for a short circuit and/or FET failure, causing service interruption. Devices recommended for circuit protection are:

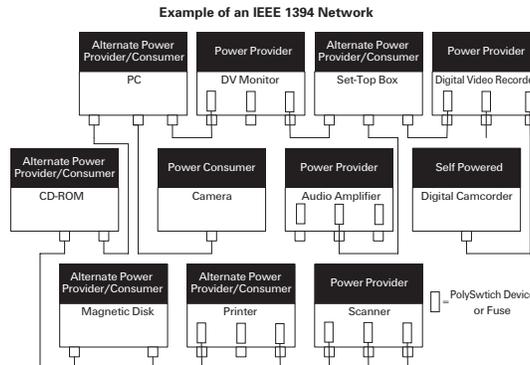
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses



### IEEE 1394: FireWire, i.Link

The IEEE 1394's complex power architecture provides up to 1.5A at voltages of 8-33V. PolySwitch devices help provide short-circuit protection in this high-power, hot-plugging environment.

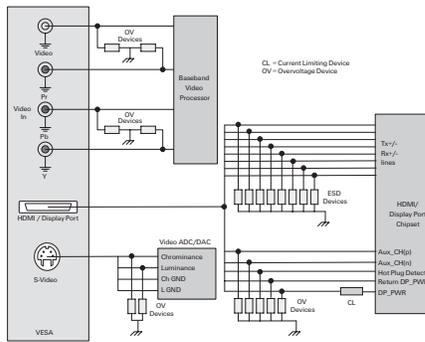
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses



## Video Ports: VESA, DDC, DVI, HDMI, DisplayPort

PolySwitch devices help protect video ports on PCI video cards and motherboard video ports from faults on the 5V interface line in Display Data Channel (DDC) circuits. These ports are designed for Energy Star compliance. TE Circuit Protection devices suitable for these applications include:

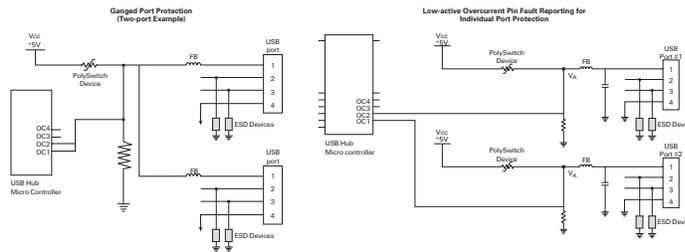
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses
- PolyZen devices
- ESD devices



## Universal Serial Bus (USB)

PolySwitch devices help provide short-circuit protection in this hot-plugging environment for USB hosts, self-powered and bus-powered hubs. Recommended circuit protection devices are:

- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses
- PolyZen devices
- ESD devices



## Audio Input/Output Ports

ESD protection devices can help protect analog audio ports from electrostatic discharge (ESD) during installation, or any time the user disconnects the source from the receiver. Additionally, our PolySwitch surface-mount devices and surface-mount fuses can be used.

- ESD devices
- Surface-mount PolySwitch devices
- Surface-mount fuses



## Power Input

PolySwitch devices help protect against overcurrent and overtemperature fault conditions by limiting the flow of current in the DC input power port circuit. Surface-mount fuses and PolyZen devices are also recommended for this application.

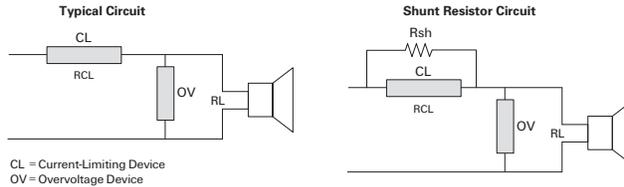
- Surface-mount fuses
- PolyZen devices
- Surface-mount PolySwitch devices



### Loudspeakers

High-powered amplifiers used with low-powered speakers may overdrive the speaker coils with excessive power during sustained high volumes. Low-powered amplifiers may be overdriven so that clipping occurs. This causes an upward frequency shift of power that can overload the tweeters. Digital recordings, with their ability to reproduce high-frequency material, place extra strain on tweeters. TE Circuit Protection devices, including PolySwitch devices, can help the design engineer solve these problems.

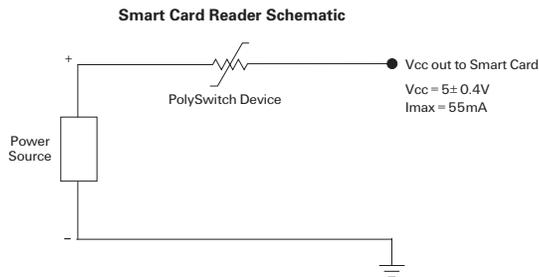
- PolySwitch Radial-leaded devices
- Surface-mount fuses
- PolyZen devices



### Smart Card Readers

Smart cards are powered from the readers' Vcc output. Defective cards or foreign objects placed into the reader can cause a short circuit and permanently damage the reader. The PolySwitch device can be used for circuit protection in smart card reader designs.

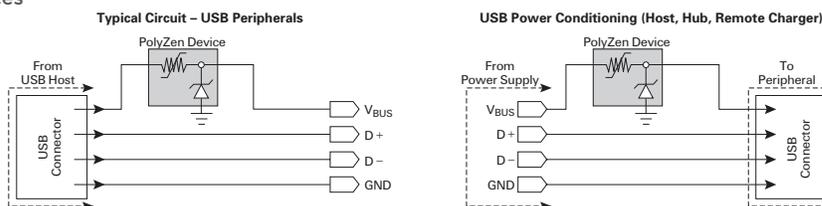
- PolySwitch Surface-mount devices



### USB Peripherals

PolyZen devices can help protect against damage caused by overvoltage on USB peripherals and devices on the 5V computer bus. The component helps protect sensitive follow-on electronics – such as flash memory and other 6V capable silicon – from inductive voltage spikes, incorrect power supplies, dirty power and other voltage transients. The RoHS-compliant device offers massive power-handling in a 4mm package. PolyZen devices and ESD protection devices are also suitable for this application.

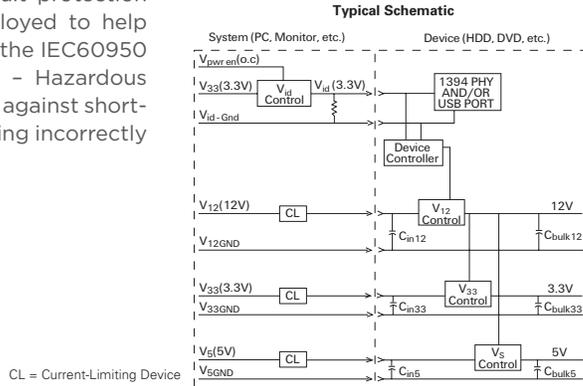
- PolySwitch Surface-mount devices
- PolyZen devices
- ESD devices



## Backplane and Redundant Array of Inexpensive Disks (RAID)

Power backplane applications allow for field-serviceable and field-replaceable cards and drives to maximize the “up-time” of products. During card or drive replacements, the power on the backplane is live. The circuit protection devices listed below can be employed to help minimize safety risks, comply with the IEC60950 safety requirement (clause 1.2.8.7 - Hazardous Energy Levels), and to help protect against short-circuit damage caused by cards being incorrectly inserted.

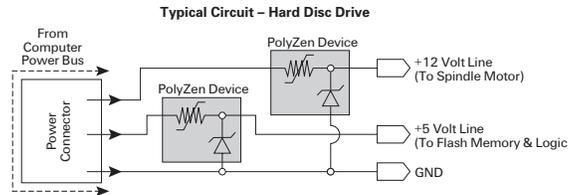
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses



## Hard Disk Drives (HDDs)

Integrated PolyZen devices can help protect devices on the 5V and 12V computer bus from overvoltage events and inductive voltage spikes resulting from a rapid change in current. The PolyZen device incorporates a stable Zener diode for precise voltage clamping and a resistively non-linear, polymer positive temperature coefficient (PPTC) layer that responds to either diode heating or overcurrent events by transitioning from a low to a high resistance state. This unique device helps manufacturers meet safety requirements and reduce warranty costs. In addition to the PolyZen device, the following circuit protection products are recommended for HDDs.

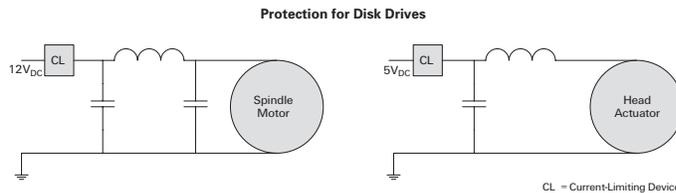
- PolySwitch Surface-mount devices
- PolyZen devices
- Surface-mount fuses
- ESD devices



## 5V/12V Power Lines

The connection of a 12V line from the power supply instead of a 5V line can cause a high-current inrush that can damage the other components in the circuit. Reverse polarity can cause damage to the tantalum capacitors, causing the capacitor to fail in a short-circuit mode. Applications suitable for the circuit protection devices listed below include hard disk drives, CD-ROM, CD-RW, DVD and other storage devices.

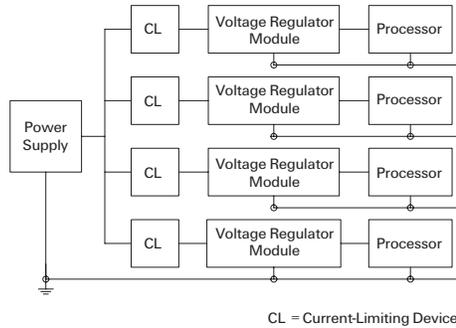
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses
- PolyZen devices



## Voltage Regulation Modules (VRMs)

Voltage regulation modules (VRMs) are used to supply power to central processing units. Due to load-change transients, processors can draw up to 13A. Also, during normal operation the current demand can change by as much as 7A as processor activity levels change. These high-current immediate demands can cause components to fail. The following Circuit Protection can help prevent the VRM from damaging the processor in the event of a VRM failure.

- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses



## Device Bays

The specifications for hot-swappable bays used in high-availability applications, such as servers and industrial computers, typically recommend overcurrent protection. An externally accessible port such as IEEE1394 or USB may also be used. The devices below are recommended for hot-swappable bay designs.

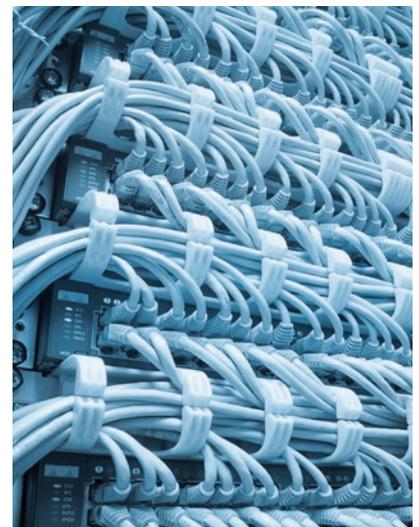
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses



## Fibre Channel

A fault, such as a short circuit, that occurs during testing or hot-swapping a peripheral component interconnect (PCI) card can cause significant damage. Incorrect insertion of the gigabit interface converter (GBIC) or a foreign object placed into the connector can also cause permanent damage to the system. Protection on the PCI bus input is typically used as well as a secondary protector for the GBIC I/O. We recommend the following TE Circuit Protection devices for this application.

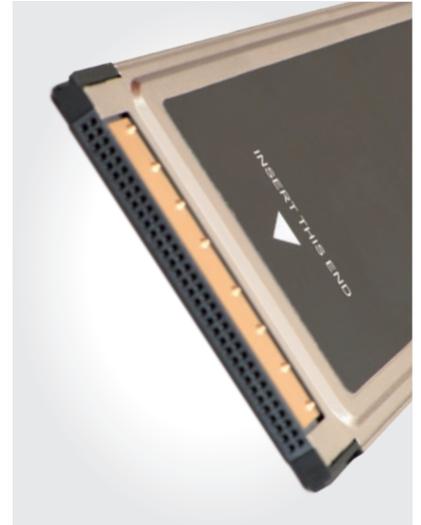
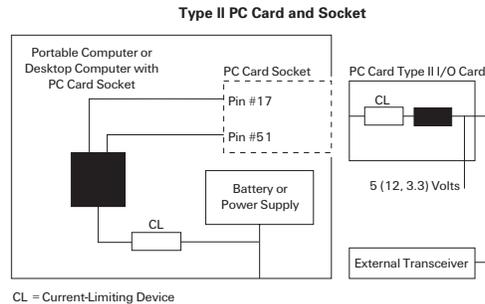
- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses



## PC Cards and Sockets

Short circuits from external sources are the primary hazards for PC cards. The devices below can help protect against large current inrushes that can damage the PC card or the PC card bus.

- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses
- ESD devices
- PolyZen devices



## Motherboard Components

Since power-sensitive computer electronics such as flash memory can be exposed to voltages well in excess of the bus voltage, they require protection. Voltage spikes can result from a hot disconnect of a peripheral, an internal system shutdown or other internal power fluctuation. The integrated PolyZen device protects like a Zener diode while being capable of withstanding the high-power fault conditions that can occur in computer electronics. A coordinated protection scheme using the devices below is recommended as a solution in this application.

- PolySwitch Surface-mount devices
- Surface-mount fuses
- ESD devices



## Antennas

When used in antenna applications, PolySwitch devices can help limit the flow of dangerously high currents during fault conditions. As resettable polymer positive temperature coefficient (PPTC) devices, PolySwitch devices can reset back to normal operating mode once the fault condition is removed.

- PolySwitch Surface-mount devices



## LCD Monitors

Power for LCD monitors is supplied from the 5V and 12V buses. The LCD controller itself and the surrounding controller logic are powered from the 5V bus. The LCD inverter and the electronics on the board are powered from the 12V bus. Misconnections and mishandling of the monitors during assembly or while in use can cause large overloads and short circuits in the system, damaging expensive components. For this reason, the following TE Circuit Protection devices are recommended for LCD monitor applications.

- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses
- ESD devices



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## Displays

PolySwitch resettable devices can be thermally linked to the LCD glass. They can protect the power module if the control circuitry fails to turn off the element and help prevent thermal runaway. The following devices are suitable for use in display applications:

- PolySwitch Radial-leaded devices
- PolySwitch Surface-mount devices
- Surface-mount fuses
- ESD devices



|                               |                                     | Overcurrent Circuit Protection |             |                                 |                       |                       |                       |                |                    |           |              | Overvoltage Circuit Protection |                     | Overtemperature Protection |                                   | Hybrid Protection |                 |
|-------------------------------|-------------------------------------|--------------------------------|-------------|---------------------------------|-----------------------|-----------------------|-----------------------|----------------|--------------------|-----------|--------------|--------------------------------|---------------------|----------------------------|-----------------------------------|-------------------|-----------------|
|                               |                                     | Chip Fuses                     |             |                                 |                       |                       |                       |                |                    |           |              |                                |                     |                            |                                   |                   |                 |
|                               |                                     | PolySwitch Devices             | Fast-Acting | 0603 Thin-Film Very Fast-Acting | 2410 Very Fast-Acting | 1206 Very Fast-Acting | 0603 Very Fast-Acting | Pulse Tolerant | High-Current-Rated | Slow-Blow | PESD Devices | ChipSESD Devices               | Gas Discharge Tubes | MHP-TAM Devices            | High-Current RTP (HC RTP) Devices | 2Pro Devices      | PolyZen Devices |
| APPLIANCES                    | Buttons                             |                                |             |                                 |                       |                       |                       |                |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                               | Compressors                         | •                              |             |                                 |                       |                       |                       |                |                    |           |              |                                |                     |                            |                                   |                   |                 |
|                               | Displays                            | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            |                                   |                   |                 |
|                               | Motors                              | •                              |             |                                 |                       |                       |                       | •              |                    | •         |              |                                |                     |                            |                                   |                   |                 |
|                               | Power supplies                      | •                              | •           | •                               | •                     | •                     | •                     | •              |                    |           |              | •                              |                     |                            |                                   | •                 | •               |
|                               | Transformers                        | •                              |             |                                 | •                     |                       |                       |                |                    |           |              |                                |                     |                            |                                   | •                 |                 |
|                               | TRIACs                              | •                              |             |                                 | •                     |                       |                       |                |                    |           |              |                                |                     |                            |                                   |                   |                 |
| AUTOMOTIVE                    | ABS systems                         | •                              | •           |                                 | •                     | •                     |                       |                |                    | •         |              |                                | •                   | •                          |                                   |                   |                 |
|                               | Glow Plug ECU                       |                                |             |                                 |                       |                       |                       | •              |                    | •         |              |                                |                     | •                          |                                   |                   |                 |
|                               | Diesel Motor Preheater              |                                |             |                                 |                       |                       |                       | •              |                    | •         |              |                                |                     | •                          |                                   |                   |                 |
|                               | Antennae                            | •                              |             |                                 |                       |                       |                       |                |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                               | Cigarette lighter accessories       | •                              | •           | •                               |                       | •                     | •                     | •              | •                  | •         |              |                                |                     |                            |                                   |                   | •               |
|                               | Connectors                          | •                              |             |                                 |                       |                       |                       |                |                    |           |              |                                |                     |                            |                                   |                   |                 |
|                               | Displays                            | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            |                                   |                   |                 |
|                               | Electronic control units            | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                | •                   | •                          |                                   |                   |                 |
|                               | HVAC and climate control            | •                              |             |                                 |                       |                       |                       |                | •                  |           |              |                                | •                   | •                          |                                   |                   | •               |
|                               | Infotainment and navigation systems | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            | •                                 |                   | •               |
| Motors                        | •                                   |                                |             |                                 |                       |                       |                       | •              |                    |           |              | •                              |                     |                            |                                   |                   |                 |
| Wire harness                  | •                                   |                                |             |                                 |                       |                       |                       | •              |                    |           |              |                                |                     |                            |                                   |                   |                 |
| BATTERIES                     | Li-ion                              | •                              | •           |                                 |                       |                       |                       | •              | •                  | •         | •            |                                | •                   | •                          |                                   |                   |                 |
|                               | Ni-Cd                               | •                              | •           |                                 |                       |                       |                       |                |                    | •         | •            |                                | •                   |                            |                                   |                   |                 |
|                               | Ni-MH                               | •                              | •           |                                 |                       |                       |                       |                |                    | •         | •            |                                | •                   |                            |                                   |                   |                 |
| BUSINESS AND RETAIL EQUIPMENT | Antennae                            |                                |             |                                 |                       |                       |                       |                |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                               | Audio Input / Output                | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            |                                   |                   |                 |
|                               | Batteries                           | •                              |             |                                 |                       |                       |                       | •              | •                  | •         |              |                                |                     | •                          |                                   |                   |                 |
|                               | Buttons                             | •                              |             |                                 |                       |                       |                       |                |                    |           |              |                                |                     |                            |                                   |                   |                 |
|                               | Displays                            | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            |                                   |                   |                 |
|                               | Motherboard components              | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     | •                          |                                   |                   |                 |
|                               | Ports                               | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            |                                   |                   |                 |
|                               | HDDS                                | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            |                                   |                   | •               |
|                               | Power Input                         | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     | •                          |                                   |                   | •               |

|                    |                           | Overcurrent Circuit Protection |             |                                 |                       |                       |                       |                |                    |           |              | Overvoltage Circuit Protection |                     | Overtemperature Protection |                                   | Hybrid Protection |                 |
|--------------------|---------------------------|--------------------------------|-------------|---------------------------------|-----------------------|-----------------------|-----------------------|----------------|--------------------|-----------|--------------|--------------------------------|---------------------|----------------------------|-----------------------------------|-------------------|-----------------|
|                    |                           | Chip Fuses                     |             |                                 |                       |                       |                       |                |                    |           |              |                                |                     |                            |                                   |                   |                 |
|                    |                           | PolySwitch Devices             | Fast-Acting | 0603 Thin-Film Very Fast-Acting | 2410 Very Fast-Acting | 1206 Very Fast-Acting | 0603 Very Fast-Acting | Pulse Tolerant | High-Current-Rated | Slow-Blow | PESD Devices | ChipsESD Devices               | Gas Discharge Tubes | MHP-TAM Devices            | High-Current RTP (HC RTP) Devices | 2Pro Devices      | PolyZen Devices |
| COMMUNICATIONS     | Antennae                  |                                |             |                                 |                       |                       |                       |                |                    |           | •            | •                              | •                   |                            |                                   |                   |                 |
|                    | Audio Input / Output      | •                              |             |                                 |                       |                       |                       |                |                    |           | •            | •                              | •                   |                            |                                   |                   | •               |
|                    | Batteries                 | •                              |             | •                               |                       |                       |                       | •              | •                  | •         |              |                                |                     | •                          |                                   |                   |                 |
|                    | Buttons                   | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Displays                  | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Fans                      | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         |              |                                |                     |                            |                                   |                   |                 |
|                    | HDDs                      | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         | •            | •                              |                     |                            |                                   |                   | •               |
|                    | HPNA                      | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Low-speed test ports      | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         | •            | •                              | •                   |                            |                                   | •                 |                 |
|                    | MoCA                      | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         | •            | •                              | •                   |                            |                                   |                   |                 |
|                    | Motherboard components    | •                              | •           | •                               | •                     | •                     | •                     | •              |                    | •         |              |                                |                     | •                          |                                   |                   |                 |
|                    | Networking over powerline | •                              | •           | •                               | •                     | •                     | •                     | •              |                    | •         | •            | •                              | •                   |                            |                                   | •                 |                 |
|                    | Ports                     | •                              | •           | •                               | •                     | •                     | •                     | •              |                    | •         | •            | •                              | •                   |                            |                                   | •                 |                 |
|                    | Power input               | •                              | •           | •                               | •                     | •                     | •                     | •              |                    | •         |              |                                | •                   |                            |                                   | •                 | •               |
|                    | Power over Ethernet       | •                              | •           | •                               |                       | •                     | •                     | •              |                    | •         | •            | •                              | •                   |                            |                                   | •                 |                 |
| ENERGY AND SOLAR   | Batteries                 | •                              | •           |                                 | •                     |                       |                       | •              | •                  | •         | •            |                                |                     | •                          |                                   |                   |                 |
|                    | Charge controllers        | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            | •                              |                     | •                          | •                                 |                   |                 |
|                    | Combiner boxes            | •                              |             |                                 | •                     |                       |                       | •              | •                  |           |              | •                              |                     |                            |                                   |                   |                 |
|                    | Inverters                 | •                              |             |                                 | •                     |                       |                       | •              | •                  | •         | •            | •                              |                     | •                          |                                   |                   |                 |
|                    | Junction boxes            |                                |             |                                 | •                     |                       |                       | •              |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Disconnect Boxes          | •                              |             |                                 | •                     |                       |                       | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   |                 |
| HOME ENTERTAINMENT | Audio Input / Output      | •                              |             |                                 |                       |                       |                       |                |                    |           |              | •                              |                     |                            |                                   |                   | •               |
|                    | Batteries                 | •                              | •           |                                 | •                     |                       |                       | •              | •                  | •         | •            |                                | •                   |                            |                                   |                   |                 |
|                    | Buttons                   |                                |             |                                 |                       |                       |                       |                |                    | •         | •            |                                |                     |                            |                                   |                   |                 |
|                    | Displays                  | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            |                                   |                   |                 |
|                    | HDDS                      | •                              | •           | •                               |                       | •                     | •                     | •              | •                  | •         | •            |                                |                     |                            |                                   |                   | •               |
|                    | Motors                    | •                              | •           | •                               |                       | •                     | •                     | •              | •                  | •         |              |                                |                     |                            |                                   |                   |                 |
|                    | PCB components            | •                              |             | •                               |                       | •                     |                       |                |                    |           |              |                                |                     | •                          |                                   |                   |                 |
|                    | Ports                     | •                              |             | •                               |                       | •                     |                       |                |                    |           | •            | •                              | •                   |                            |                                   |                   |                 |
| Power Input        | •                         | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  |           |              | •                              |                     | •                          | •                                 | •                 |                 |

|                    |                         | Overcurrent Circuit Protection |             |                                 |                       |                       |                       |                |                    |           |              | Overvoltage Circuit Protection |                     | Overtemperature Protection |                                   | Hybrid Protection |                 |
|--------------------|-------------------------|--------------------------------|-------------|---------------------------------|-----------------------|-----------------------|-----------------------|----------------|--------------------|-----------|--------------|--------------------------------|---------------------|----------------------------|-----------------------------------|-------------------|-----------------|
|                    |                         | Chip Fuses                     |             |                                 |                       |                       |                       |                |                    |           |              | ChipSESD Devices               | Gas Discharge Tubes | MHP-TAM Devices            | High-Current RTP (HC RTP) Devices | 2Pro Devices      | PolyZen Devices |
|                    |                         | PolySwitch Devices             | Fast-Acting | 0603 Thin-Film Very Fast-Acting | 2410 Very Fast-Acting | 1206 Very Fast-Acting | 0603 Very Fast-Acting | Pulse Tolerant | High-Current-Rated | Slow-Blow | PESD Devices |                                |                     |                            |                                   |                   |                 |
| INDUSTRIAL         | Buttons                 | •                              |             |                                 |                       |                       |                       |                |                    |           | •            | •                              | •                   |                            |                                   |                   |                 |
|                    | Compressors             | •                              |             |                                 |                       |                       |                       |                |                    |           | •            |                                |                     | •                          |                                   |                   |                 |
|                    | Displays                | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Electromagnetic loads   | •                              |             |                                 |                       |                       |                       | •              |                    | •         |              |                                |                     |                            |                                   |                   |                 |
|                    | Motors                  | •                              |             |                                 |                       |                       |                       | •              |                    | •         |              |                                |                     |                            |                                   |                   |                 |
|                    | Power Input             | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                | •                   |                            | •                                 | •                 | •               |
|                    | Transformers            | •                              |             |                                 | •                     |                       |                       |                |                    | •         |              |                                |                     |                            | •                                 |                   |                 |
|                    | UPS Backup              | •                              |             |                                 | •                     |                       |                       |                |                    | •         |              |                                | •                   | •                          | •                                 |                   |                 |
| LIGHTING           | CFL electronic ballasts | •                              |             |                                 | •                     |                       |                       |                |                    |           |              |                                |                     |                            |                                   | •                 |                 |
|                    | LED ballasts            | •                              | •           | •                               | •                     | •                     | •                     | •              |                    |           |              |                                |                     |                            | •                                 | •                 |                 |
|                    | LED controllers         | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            | •                                 | •                 | •               |
|                    | LED drivers             | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            | •                                 | •                 | •               |
|                    | PN junction             |                                |             |                                 |                       |                       |                       |                |                    | •         |              |                                |                     |                            | •                                 |                   |                 |
|                    | Power input             | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            |                                   | •                 | •               |
|                    | Power supplies          | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            | •                                 | •                 | •               |
|                    | TRIACs                  | •                              |             |                                 |                       |                       |                       |                |                    | •         |              |                                |                     |                            |                                   |                   |                 |
| MOBILE DEVICES     | Antennae                |                                |             |                                 |                       |                       |                       |                |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Audio Input / Output    | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   | •               |
|                    | Batteries               | •                              |             |                                 |                       |                       |                       |                |                    | •         |              |                                | •                   | •                          |                                   |                   |                 |
|                    | Buttons                 | •                              | •           |                                 | •                     |                       |                       | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Displays                | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | LEDs                    | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            |                                   |                   |                 |
|                    | Ports                   | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Power Input             | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            |                                   |                   | •               |
| PERSONAL COMPUTERS | Antennae                | •                              |             |                                 |                       |                       |                       |                |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Audio Input / Output    | •                              | •           |                                 | •                     |                       |                       | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Batteries               | •                              | •           |                                 | •                     |                       |                       | •              | •                  | •         | •            | •                              |                     | •                          |                                   |                   |                 |
|                    | Buttons                 | •                              |             |                                 |                       |                       |                       |                |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Displays                | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Motherboard components  | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         | •            | •                              |                     |                            | •                                 |                   |                 |
|                    | Ports                   | •                              |             | •                               |                       | •                     |                       |                |                    |           | •            | •                              |                     |                            |                                   |                   |                 |
|                    | Power Input             | •                              | •           | •                               | •                     | •                     | •                     | •              | •                  | •         |              |                                |                     |                            |                                   |                   | •               |



# POLYZEN DEVICES

## Polymer Protected Zener Diode

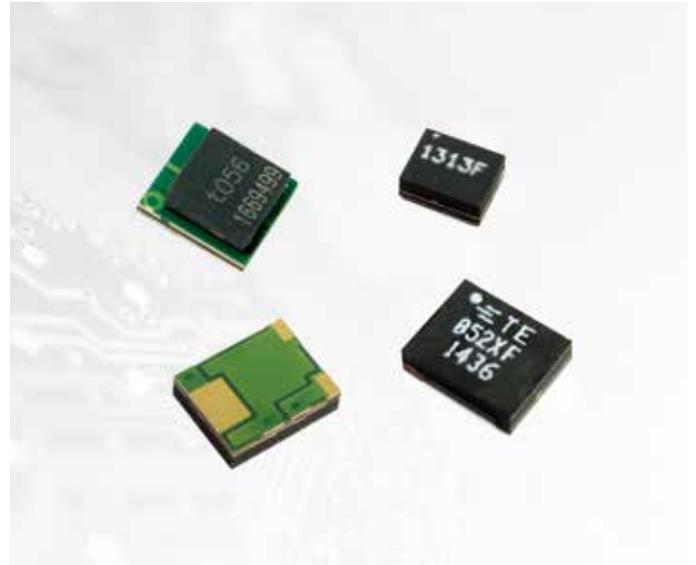
PolyZen devices are polymer-enhanced, precision Zener diodes. They offer resettable protection against multi-Watt fault events without the need for multi-Watt heat sinks.

The Zener diode used for voltage clamping a PolyZen device was selected due to its relatively flat voltage vs. current response. This helps improve output voltage clamping, even when input voltage is high and diode currents are large.

An advanced feature of the PolyZen device is that the Zener diode is thermally coupled to a resistively non-linear, PPTC (polymer positive temperature coefficient) layer. This PPTC layer is fully integrated into the device and is electrically in series between  $V_{IN}$  and the diode clamped  $V_{OUT}$ .

This advanced PPTC layer responds to either extended diode heating or overcurrent events by transitioning from a low to high resistance state, also known as “tripping.” A tripped PPTC will limit current and generate voltage drop. It helps to protect both the Zener diode and the follow-on electronics and effectively increases the diode’s power handling capability.

The polymer-enhanced Zener diode helps protect sensitive portable electronics from damage caused by inductive voltage spikes, voltage transients, incorrect power supplies and reverse bias. These devices are particularly suitable for portable electronics and other low-power DC devices.



### BENEFITS

- Stable Zener diode helps shield downstream electronics from overvoltage and reverse bias
- Trip events shut out overvoltage and reverse bias sources
- Analog nature of trip events helps minimize damage from upstream inductive spikes
- Minimal power dissipation requirements
- Single component placement

### FEATURES

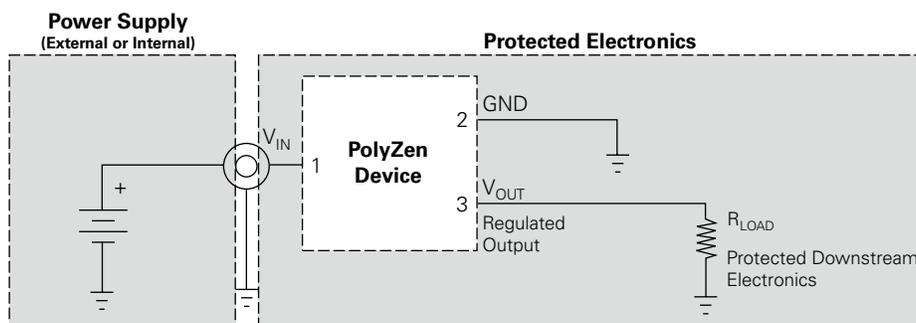
- Overvoltage transient suppression
- Stable  $V_Z$  vs. fault current
- Time delayed, overvoltage trip
- Time delayed, reverse bias trip

### APPLICATIONS

- DC power port protection in portable electronics
- DC power port protection for systems using barrel jacks for power input
- Internal overvoltage and transient suppression
- DC output voltage regulation
- Tablet PCs and portable electronics

- Multi-Watt power handling capability
- Integrated device construction
- RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)

## Figure PZ1 – Typical Application Block Diagram



## Table PZ1 – Electrical Characteristics

(Performance ratings @ 25°C unless otherwise specified)

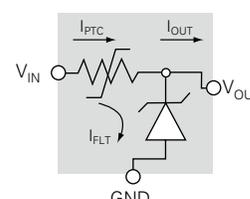
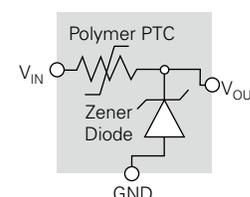
| Part Number         | $V_Z$ (V) |       |       | $I_{ZT}$ (A) | $I_{HOLD}$ @ 20°C (A) | $R_{Typ}$ ( $\Omega$ ) | $R_{1MAX}$ ( $\Omega$ ) | $V_{INT MAX}$     |                  | $I_{FLT MAX}$     |                  |
|---------------------|-----------|-------|-------|--------------|-----------------------|------------------------|-------------------------|-------------------|------------------|-------------------|------------------|
|                     | Min       | Typ   | Max   |              |                       |                        |                         | $V_{INT MAX}$ (V) | Test Current (A) | $I_{FLT MAX}$ (A) | Test Voltage (V) |
| ZEN056V130A24LS     | 5.45      | 5.60  | 5.75  | 0.10         | 1.30                  | 0.12                   | 0.16                    | 24                | 3                | +10/-40           | +24/-16          |
| ZEN059V130A24LS†    | 5.80      | 5.90  | 6.00  | 0.10         | 1.30                  | 0.12                   | 0.15                    | 24                | 3                | +6/-40            | +24/-16          |
| ZEN065V130A24LS     | 6.35      | 6.50  | 6.65  | 0.10         | 1.30                  | 0.12                   | 0.16                    | 24                | 3                | +6/-40            | +24/-16          |
| ZEN098V130A24LS     | 9.60      | 9.80  | 10.00 | 0.10         | 1.30                  | 0.12                   | 0.16                    | 24                | 3                | +3.5/-40          | +24/-16          |
| ZEN132V130A24LS     | 13.20     | 13.40 | 13.60 | 0.10         | 1.30                  | 0.12                   | 0.16                    | 24                | 3                | +2/-40            | +24/-16          |
| ZEN164V130A24LS     | 16.10     | 16.40 | 16.60 | 0.10         | 1.30                  | 0.12                   | 0.16                    | 24                | 3                | +1.25/-40         | +24/-16          |
| ZEN056V230A16LS     | 5.45      | 5.60  | 5.75  | 0.10         | 2.30                  | 0.04                   | 0.06                    | 16                | 5                | +5/-40            | +16/-12          |
| ZEN065V230A16LS     | 6.35      | 6.50  | 6.65  | 0.10         | 2.30                  | 0.04                   | 0.06                    | 16                | 5                | +3.5/-40          | +16/-12          |
| ZEN098V230A16LS     | 9.60      | 9.80  | 10.00 | 0.10         | 2.30                  | 0.04                   | 0.06                    | 16                | 5                | +3.5/-40          | +16/-12          |
| ZEN132V230A16LS     | 13.20     | 13.40 | 13.60 | 0.10         | 2.30                  | 0.04                   | 0.06                    | 16                | 5                | +2/-40            | +20/-12          |
| ZEN056V075A48LS     | 5.45      | 5.60  | 5.75  | 0.10         | 0.75                  | 0.28                   | 0.45                    | 48                | 3                | +10/-40           | +48/-16          |
| ZEN132V075A48LS     | 13.20     | 13.40 | 13.60 | 0.10         | 0.75                  | 0.28                   | 0.45                    | 48                | 3                | +2/-40            | +48/-16          |
| ZEN056V115A24LS     | 5.45      | 5.60  | 5.75  | 0.10         | 1.15                  | 0.15                   | 0.18                    | 24                | 3                | +10/-40           | +24/-16          |
| NEW ZEN056V130A16YM | 5.35      | 5.60  | 5.85  | 0.10         | 1.30                  | 0.110                  | 0.160                   | 14                | 3                | +3/-40            | +16/-12          |
| NEW ZEN056V175A12YM | 5.35      | 5.60  | 5.85  | 0.10         | 1.75                  | 0.050                  | 0.095                   | 12                | 4                | +3/-40            | +12/-12          |
| NEW ZEN132V130A16YM | 13.20     | 13.40 | 13.80 | 0.10         | 1.30                  | 0.110                  | 0.160                   | 14                | 3                | +1/-40            | +20/-12          |
| NEW ZEN132V175A12YM | 13.20     | 13.40 | 13.80 | 0.10         | 1.75                  | 0.050                  | 0.095                   | 12                | 4                | +1/-40            | +20/-12          |
| NEW ZEN056V130A24YC | 5.35      | 5.60  | 5.85  | 0.10         | 1.30                  | 0.110                  | 0.170                   | 24                | 3                | +4/-40            | +24/-16          |
| NEW ZEN056V230A16YC | 5.35      | 5.60  | 5.85  | 0.10         | 2.30                  | 0.040                  | 0.070                   | 16                | 5                | +3/-40            | +16/-12          |
| NEW ZEN056V260A16YC | 5.35      | 5.60  | 5.85  | 0.10         | 2.60                  | 0.040                  | 0.055                   | 16                | 5                | +3/-40            | +16/-12          |
| NEW ZEN132V130A24YC | 13.20     | 13.40 | 13.80 | 0.10         | 1.30                  | 0.110                  | 0.170                   | 24                | 3                | +1/-40            | +24/-16          |
| NEW ZEN132V230A16YC | 13.20     | 13.40 | 13.80 | 0.10         | 2.30                  | 0.040                  | 0.070                   | 16                | 5                | +1/-40            | +20/-12          |
| NEW ZEN132V260A16YC | 13.20     | 13.40 | 13.80 | 0.10         | 2.60                  | 0.040                  | 0.055                   | 16                | 5                | +1/-40            | +20/-12          |

LS module height is 1.7mm typical. YM module height is 1.2mm typical. YC module height is 1.3mm typical.

† Typical operating current is 500µA @ 5.0V which meets USB suspend mode requirement.

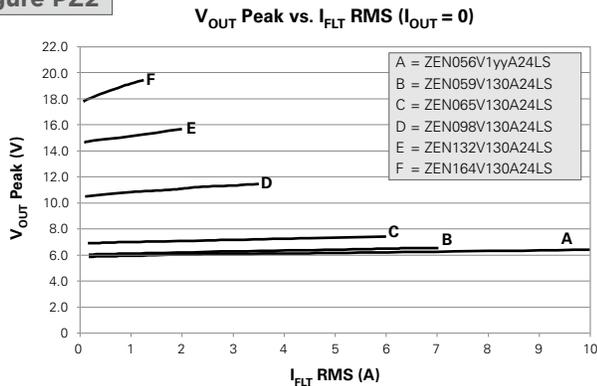
## Table PZ2 – Definition of Terms

|               |   |
|---------------|---|
| $V_Z$         | Zener clamping voltage measured at current $I_{ZT}$ and 20°C.   |
| $I_{ZT}$      | Test current at which $V_Z$ is measured.  |
| $I_{HOLD}$    | Maximum steady state current $I_{PTC}$ that will not generate a trip event at the specified temperature. Ratings assume $I_{FLT} = 0A$ .  |
| $R_{Typ}$     | Typical resistance between $V_{IN}$ and $V_{OUT}$ pins when the device is at room temperature.  |
| $R_{1MAX}$    | The maximum resistance between $V_{IN}$ and $V_{OUT}$ pins, at room temperature, one hour after first trip or after reflow soldering.   |
| $I_{FLT}$     | Current flowing through the Zener diode.  |
| $I_{FLT MAX}$ | Maximum RMS fault current the Zener diode component of the device can withstand and remain resettable; testing is conducted at rated voltage with no load connected to $V_{OUT}$ .  |
| $V_{INT MAX}$ | The voltage ( $V_{IN} - V_{OUT}$ "post trip") at which typical qualification devices (98% devices, 95% confidence) survived at least 100 trip cycles and 24 hours trip endurance when "tripped" at the specified voltage and current ( $I_{PTC}$ ). |
| $I_{PTC}$     | Current flowing through the PPTC portion of the circuit.  |
| $I_{OUT}$     | Current flowing out the $V_{OUT}$ pin of the device.  |
| Trip Event    | A condition where the PPTC transitions to a high resistance state, thereby limiting $I_{PTC}$ , and significantly increasing the voltage drop between $V_{IN}$ and $V_{OUT}$ .  |

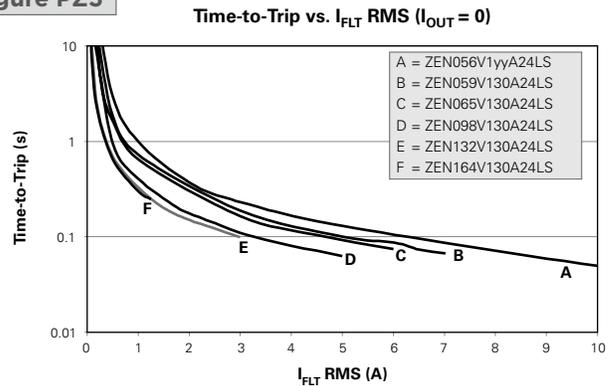


## Figures PZ2-PZ9 – Typical Performance Curves for PolyZen Devices - LS Series

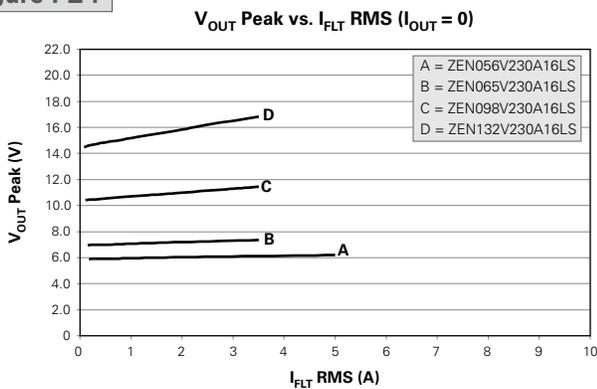
**Figure PZ2**



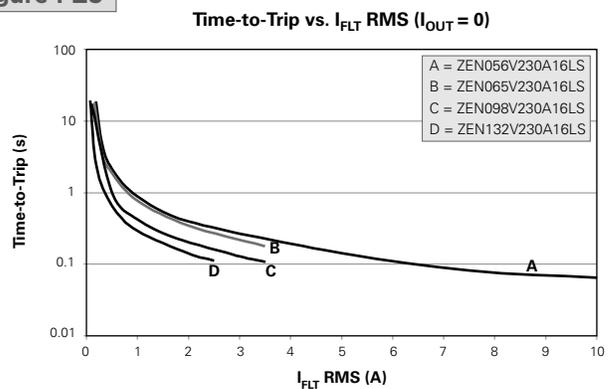
**Figure PZ3**



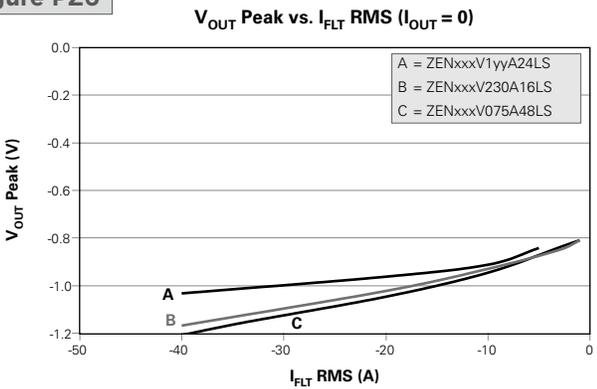
**Figure PZ4**



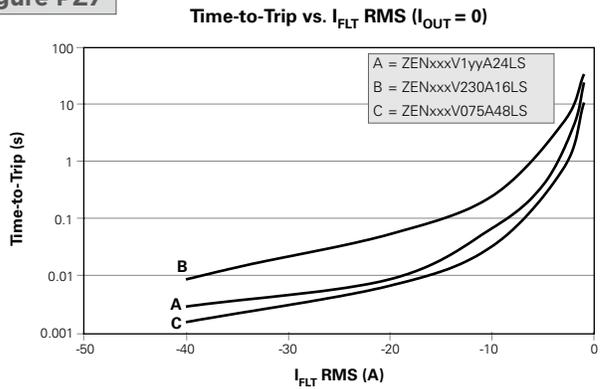
**Figure PZ5**



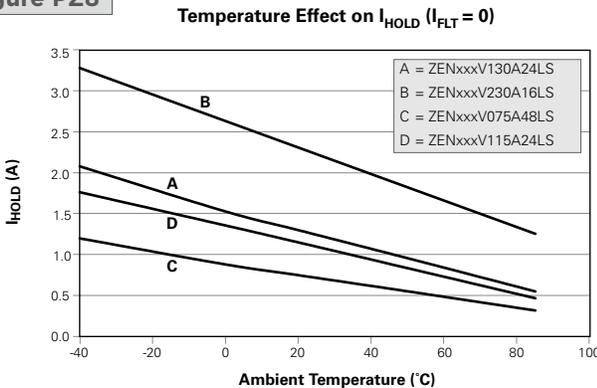
**Figure PZ6**



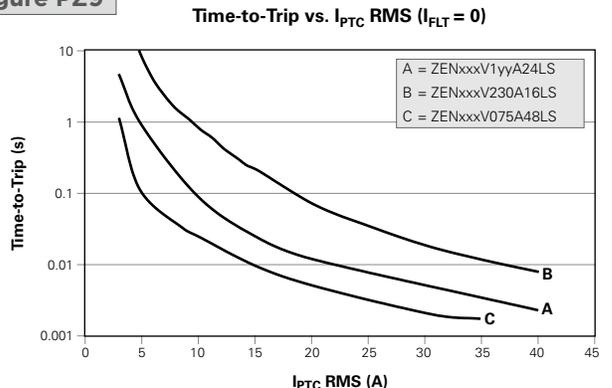
**Figure PZ7**



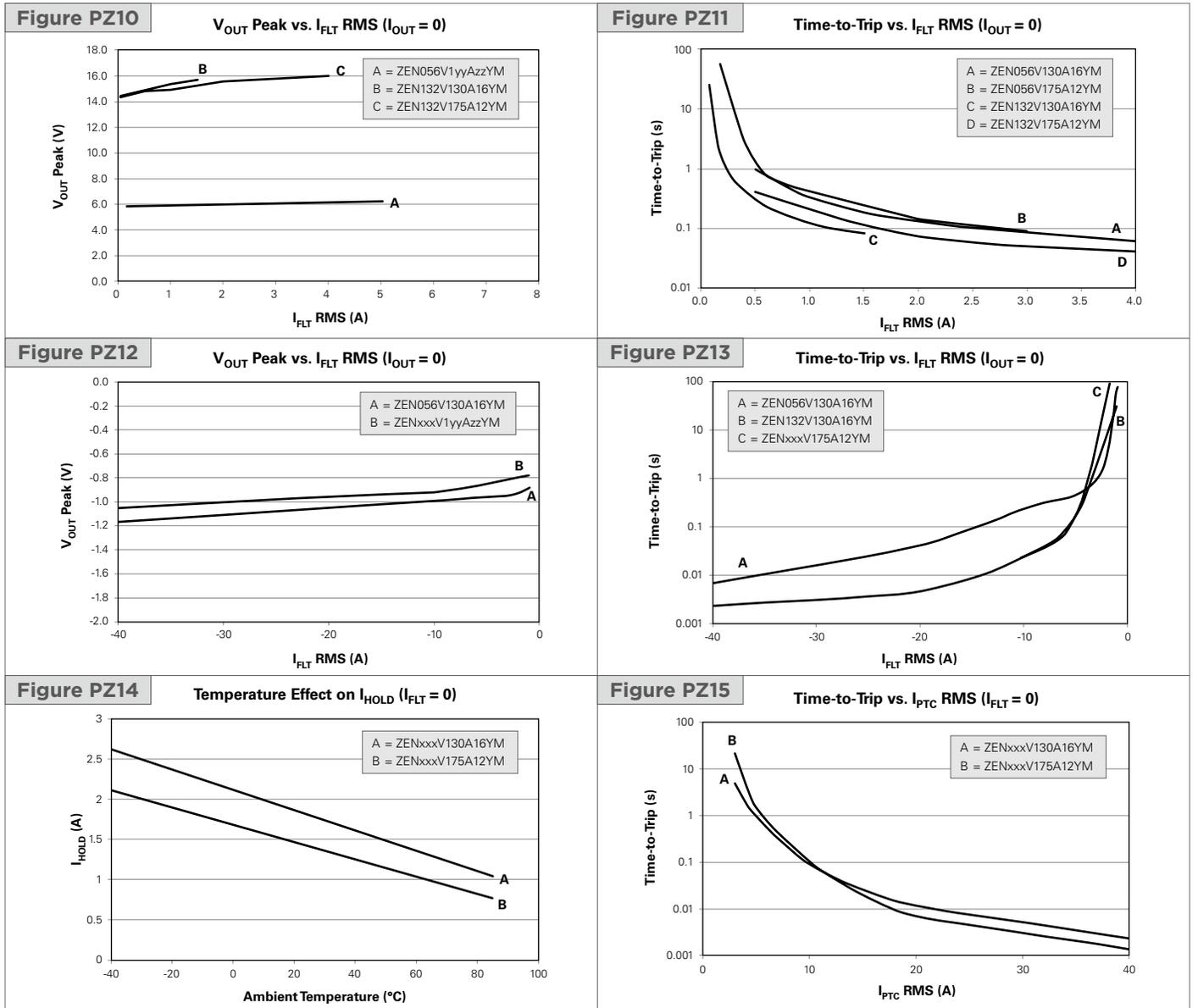
**Figure PZ8**



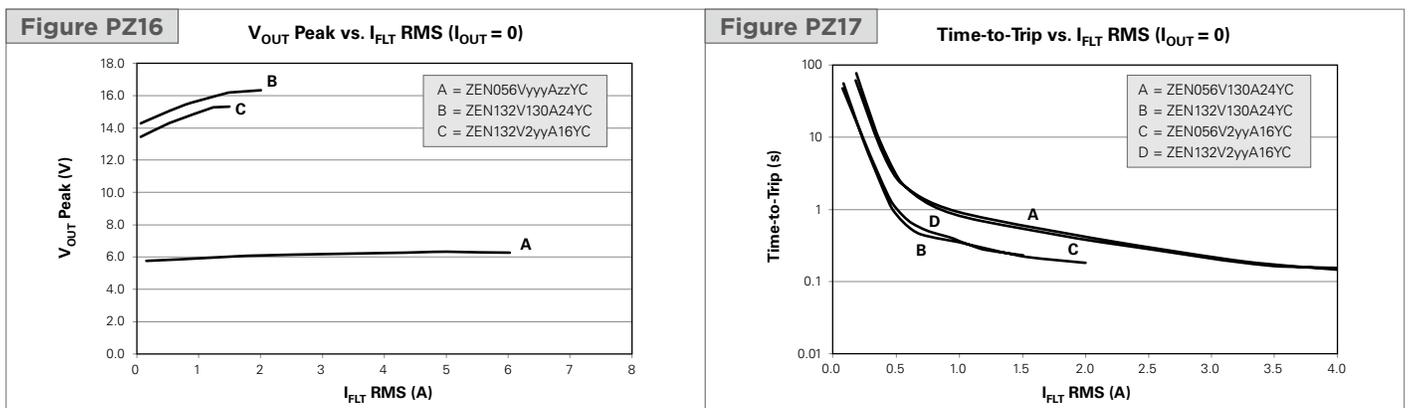
**Figure PZ9**



Figures PZ10-PZ15 – Typical Performance Curves for PolyZen Devices - YM Series

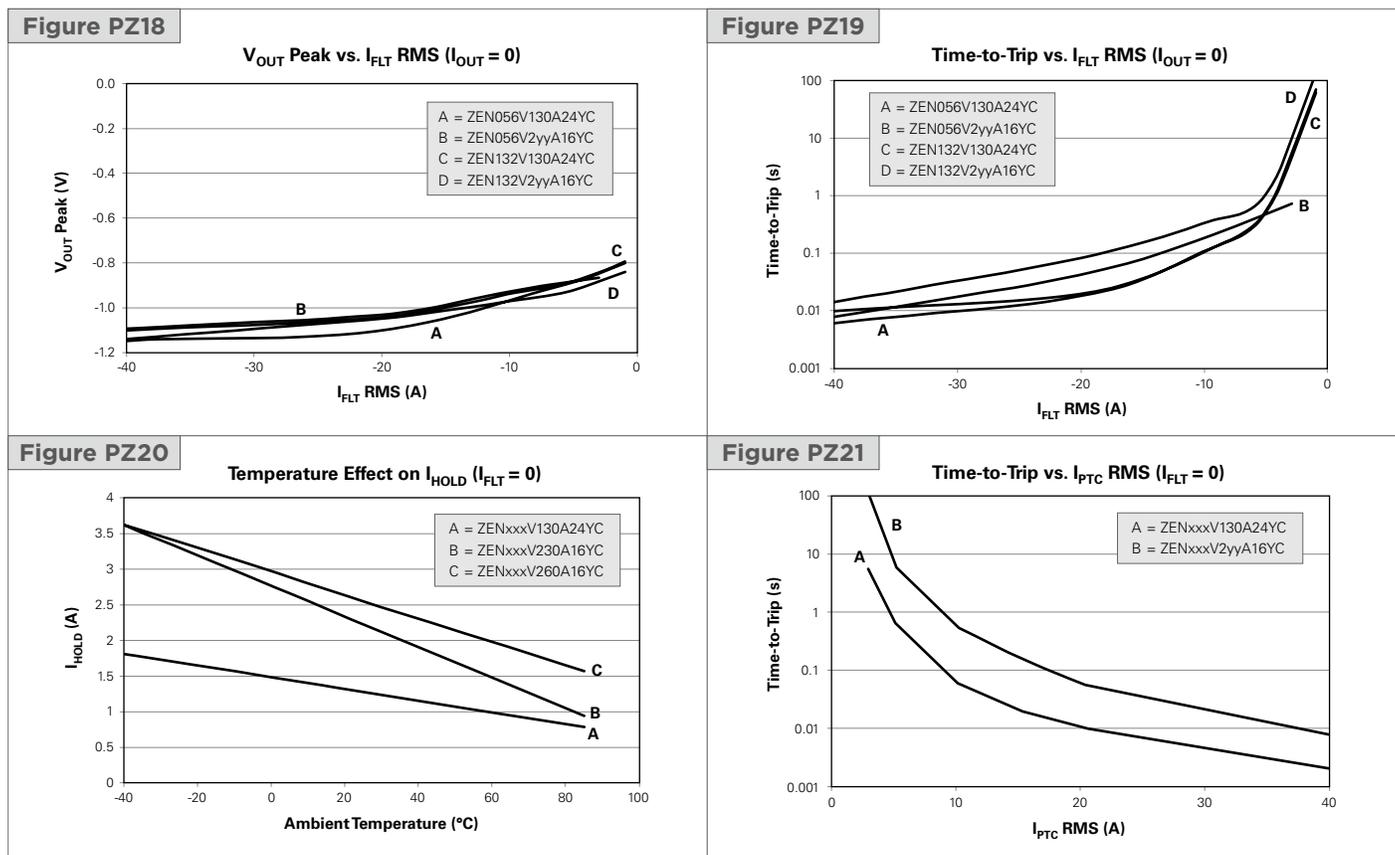


Figures PZ16-PZ21 – Typical Performance Curves for PolyZen Devices - YC Series



# 4 PolyZen Devices Polymer Protected Zener Diode

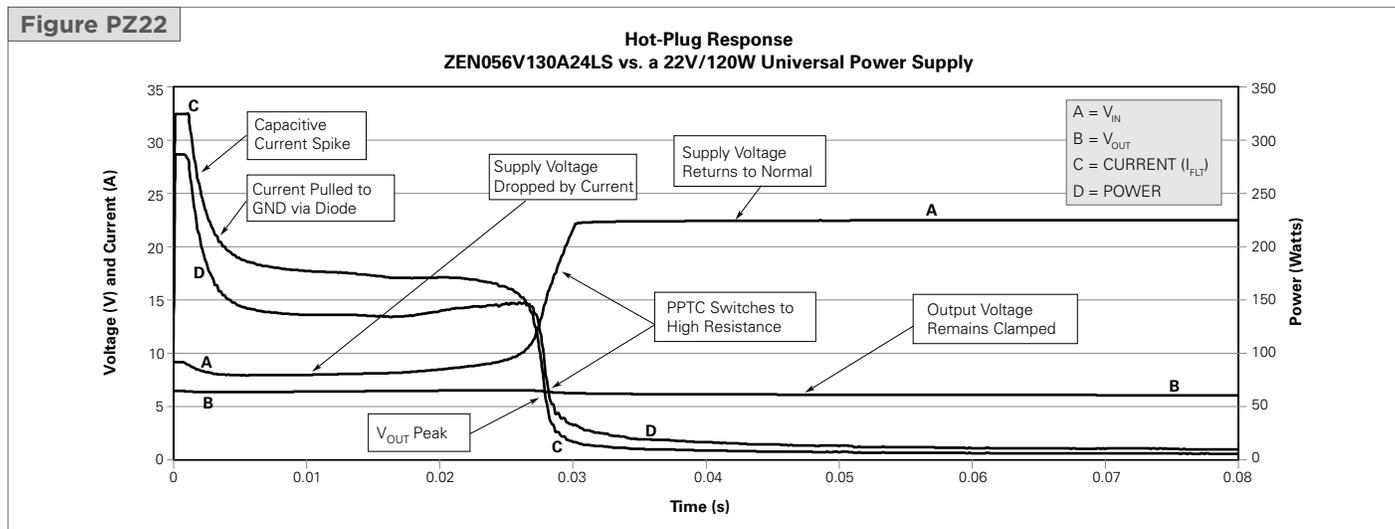
## Figures PZ16-PZ21 — Typical Performance Curves for PolyZen Devices - YC Series (Cont'd)



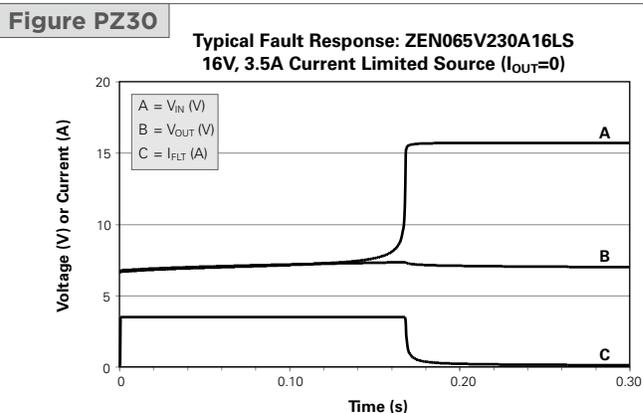
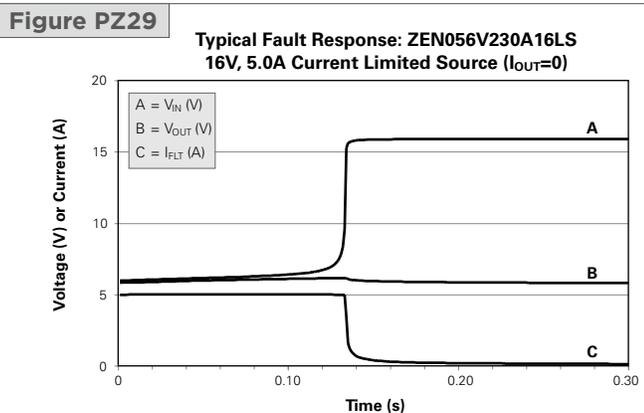
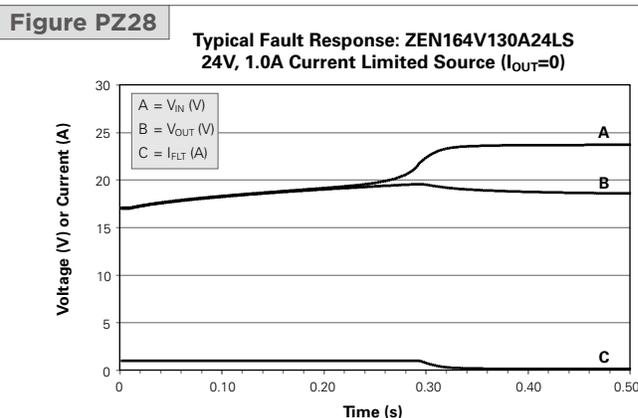
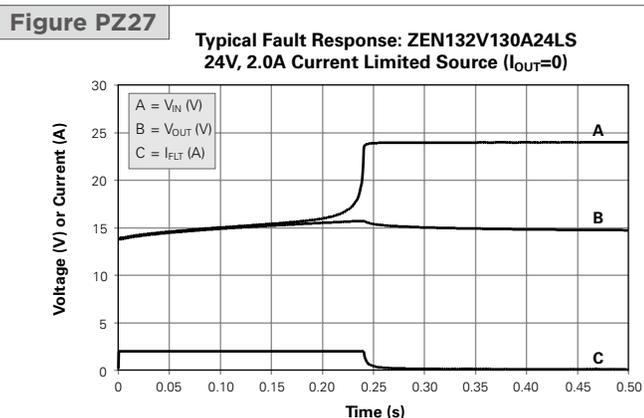
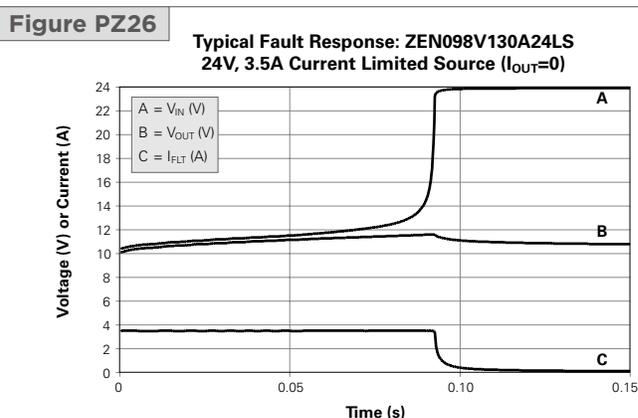
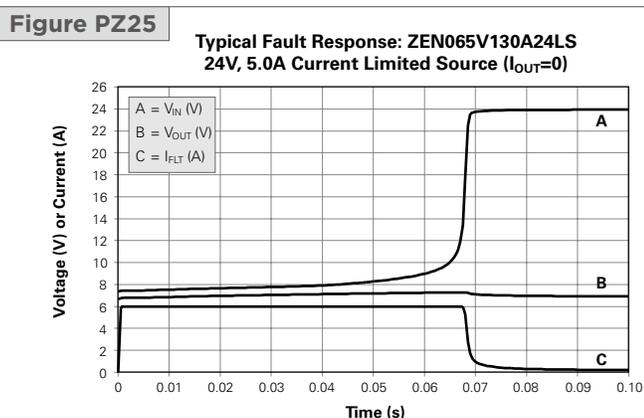
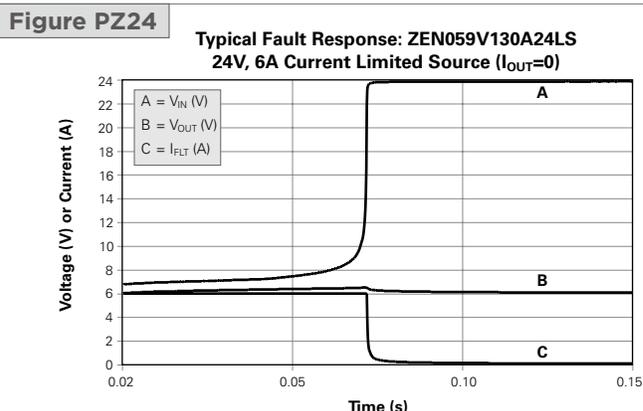
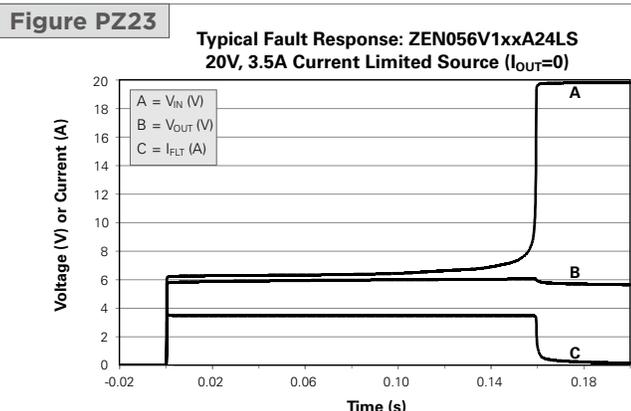
## Table PZ3 — General Characteristics for PolyZen Devices

|                             |                                    |
|-----------------------------|------------------------------------|
| Operating temperature range | -40 $^{\circ}$ to +85 $^{\circ}$ C |
| Storage temperature         | -40 $^{\circ}$ to +85 $^{\circ}$ C |
| ESD withstand               | 15kV Human body model              |
| Diode capacitance           | 4200pF Typical @ 1MHz, 1V RMS      |
| Construction                | RoHS compliant                     |

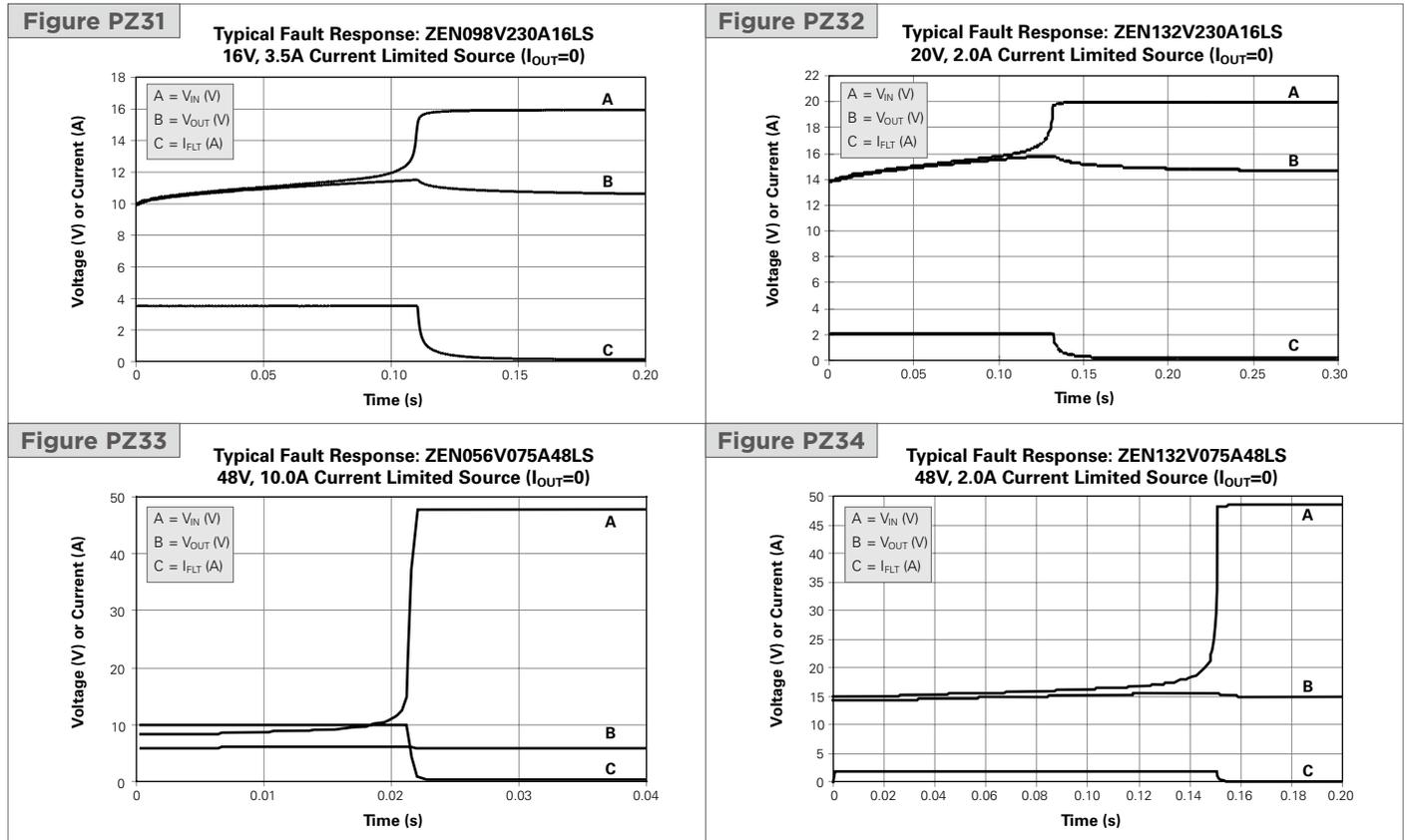
## Figures PZ22-PZ34 — Basic Operation Examples for PolyZen Devices - LS Series



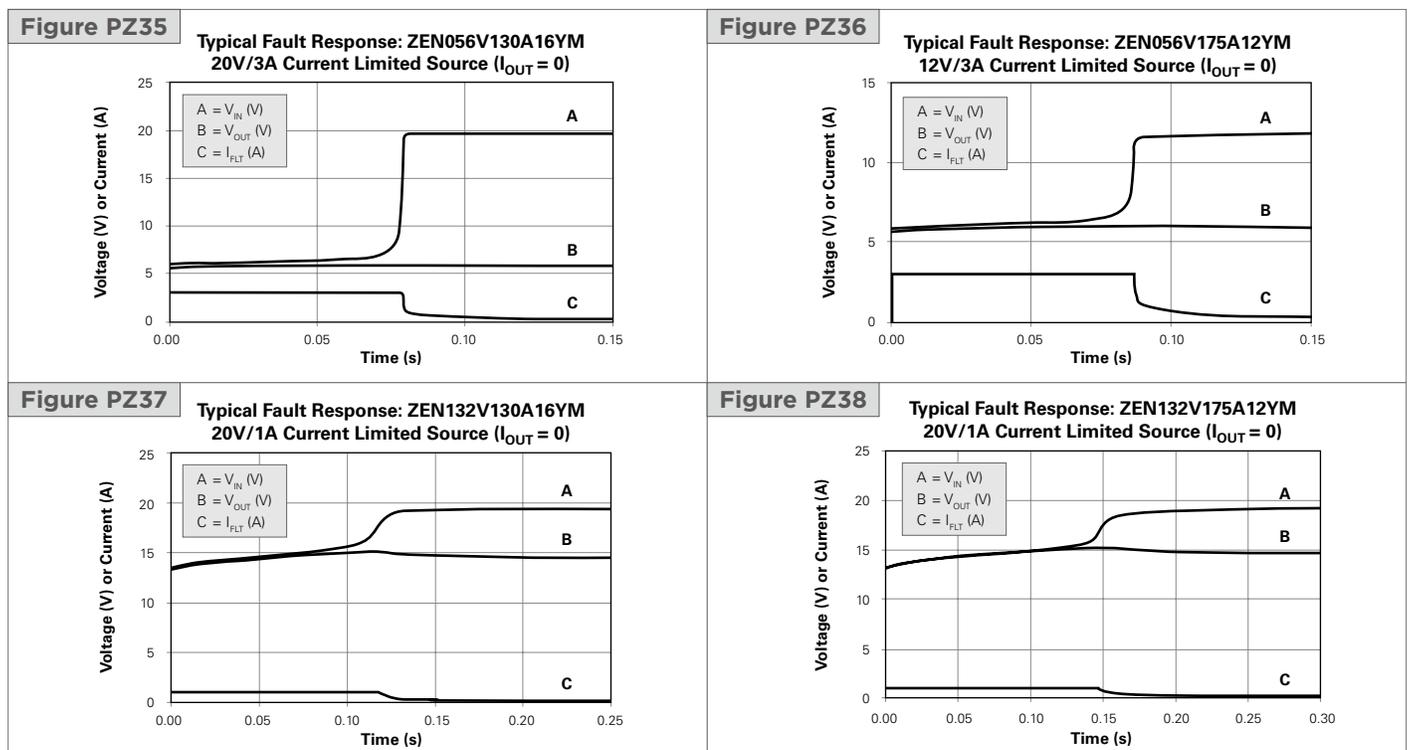
## Figures PZ22-PZ34 — Basic Operation Examples for PolyZen Devices - LS Series (Cont'd)



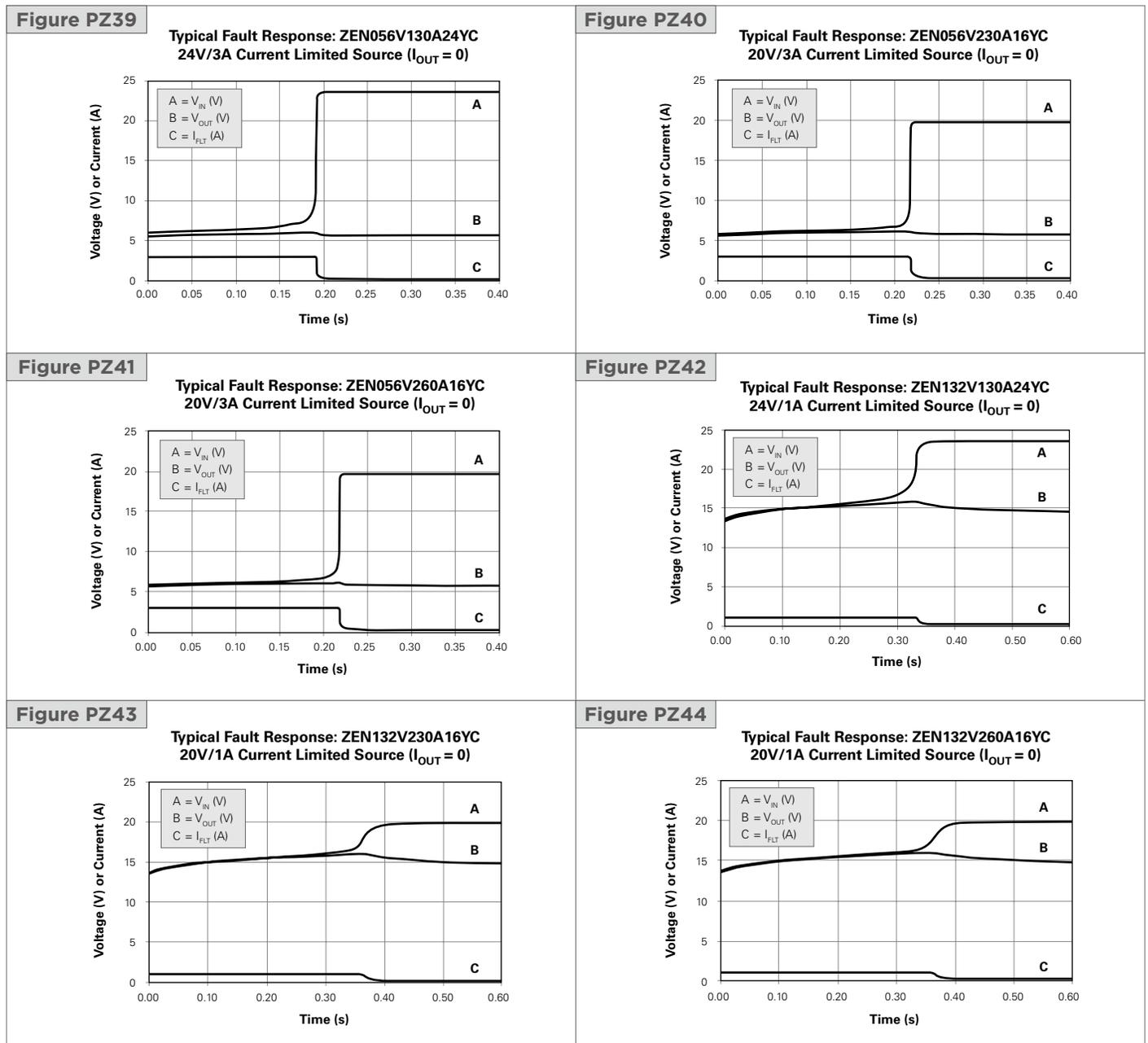
## Figures PZ22-PZ34 – Basic Operation Examples for PolyZen Devices - LS Series (Cont'd)



## Figures PZ35-PZ38 – Basic Operation Examples for PolyZen Devices - YM Series



## Figures PZ39-PZ44 – Basic Operation Examples for PolyZen Devices - YC Series



## Table PZ4 - Packaging and Marking Information for PolyZen Devices

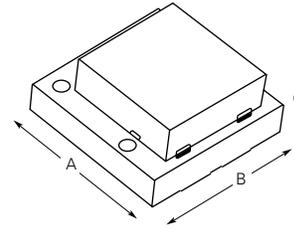
| Part Number     | Bag Quantity | Tape & Reel Quantity | Standard Package |
|-----------------|--------------|----------------------|------------------|
| ZENxxxVyyyAzzLS | —            | 3,000                | 15,000           |
| ZENxxxVyyyAzzYM | —            | 3,000                | 30,000           |
| ZENxxxVyyyAzzYC | —            | 4,000                | 20,000           |

# 4 PolyZen Devices Polymer Protected Zener Diode

Table PZ5 – Dimensions in Millimeters and (Inches)

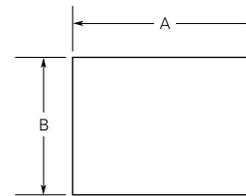
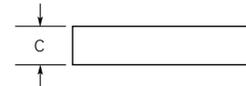
### ZENxxxVyyyAzzLS Devices

|    | A       |         | B       |         | C       |         |
|----|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 3.85    | 4.15    | 3.85    | 4.15    | 1.40    | 2.00    |
| in | (0.152) | (0.163) | (0.152) | (0.163) | (0.055) | (0.081) |



### ZENxxxVyyyAzzYM Devices

|    | A       |         | B       |         | C       |         |
|----|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 3.00    | 3.40    | 2.30    | 2.70    | 1.10    | 1.30    |
| in | (0.118) | (0.134) | (0.091) | (0.106) | (0.043) | (0.051) |



### ZENxxxVyyyAzzYC Devices

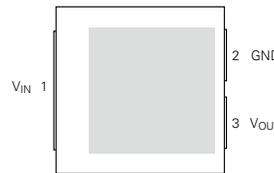
|    | A       |         | B       |         | C       |         |
|----|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 4.80    | 5.20    | 3.80    | 4.20    | 1.20    | 1.40    |
| in | (0.190) | (0.206) | (0.150) | (0.166) | (0.047) | (0.055) |

Table PZ6 – Pad Layout and Configuration Information

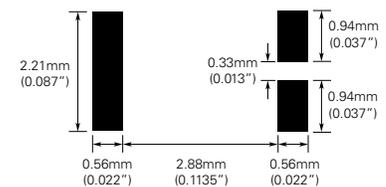
### ZENxxxVyyyAzzLS Devices

| Pin Number | Pin Name  | Pin Function                               |
|------------|-----------|--|
| 1          | $V_{IN}$  | $V_{IN}$ = Protected input to Zener diode  |
| 2          | GND       | GND = Ground                               |
| 3          | $V_{OUT}$ | $V_{OUT}$ = Zener regulated voltage output |

Pin Configuration (Top View)



Pad Dimensions



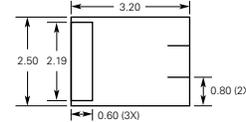
### ZENxxxVyyyAzzYM Devices

| Pin Number | Pin Name  | Pin Function                               |
|------------|-----------|--|
| 1          | $V_{IN}$  | $V_{IN}$ = Protected input to Zener diode  |
| 2          | GND       | GND = Ground                               |
| 3          | $V_{OUT}$ | $V_{OUT}$ = Zener regulated voltage output |

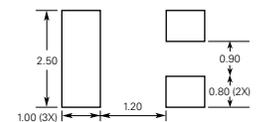
Pin Configuration (Top View)



Recommended Pad Dimensions (mm)



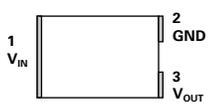
Recommended Pad Layout (mm)



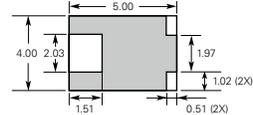
### ZENxxxVyyyAzzYC Devices

| Pin Number | Pin Name  | Pin Function                               |
|------------|-----------|--|
| 1          | $V_{IN}$  | $V_{IN}$ = Protected input to Zener diode  |
| 2          | GND       | GND = Ground                               |
| 3          | $V_{OUT}$ | $V_{OUT}$ = Zener regulated voltage output |

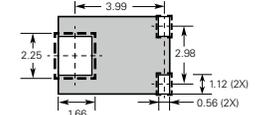
Pin Configuration (Top View)



Recommended Pad Dimensions (mm)



Recommended Pad Layout (mm)

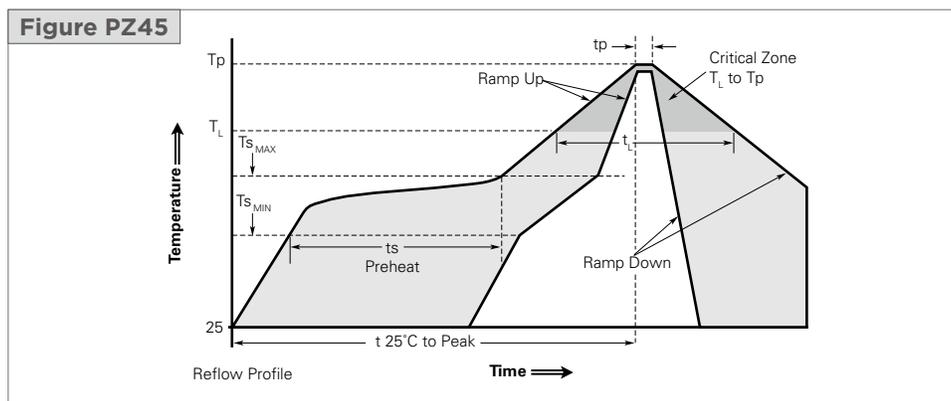


## Solder Reflow and Rework Recommendation

### Classification Reflow Profiles

| Profile Feature                                      | ZENxxxVyyyAzzLS Devices | ZENxxxVyyyAzzYM Devices | ZENxxxVyyyAzzYC Devices |
|--|-------------------------|-------------------------|-------------------------|
|  | Pb-Free Assembly        |                         | Pb-Free Assembly        |
| <b>Average Ramp Up Rate (Ts<sub>MAX</sub> to Tp)</b> | 3°C/ s Max              |                         | 3°C/ s Max              |
| <b>Preheat</b>                                       |                         |                         |                         |
| • Temperature Min (Ts <sub>MIN</sub> )               | 150°C                   |                         | 150°C                   |
| • Temperature Max (Ts <sub>MAX</sub> )               | 200°C                   |                         | 200°C                   |
| • Time (ts Preheat)                                  | 60-180 s                |                         | 60-180 s                |
| <b>Time Maintained Above:</b>                        |                         |                         |                         |
| • Temperature (T <sub>L</sub> )                      | 217°C                   |                         | 217°C                   |
| • Time (t <sub>L</sub> )                             | 60-150 s                |                         | 60-150 s                |
| <b>Peak/Classification Temperature (Tp)</b>          | 260°C                   |                         | 250°C                   |
| <b>Time within 5°C of Actual Peak Temperature</b>    |                         |                         |                         |
| Time (tp)  | 20-40 s                 |                         | 20-40 s                 |
| <b>Average Ramp Down Rate (Tp to T<sub>L</sub>)</b>  | 6°C/ s Max              |                         | 3°C/ s Max              |
| <b>Time 25°C to Peak Temperature</b>                 | 8 Minutes Max           |                         | 8 Minutes Max           |

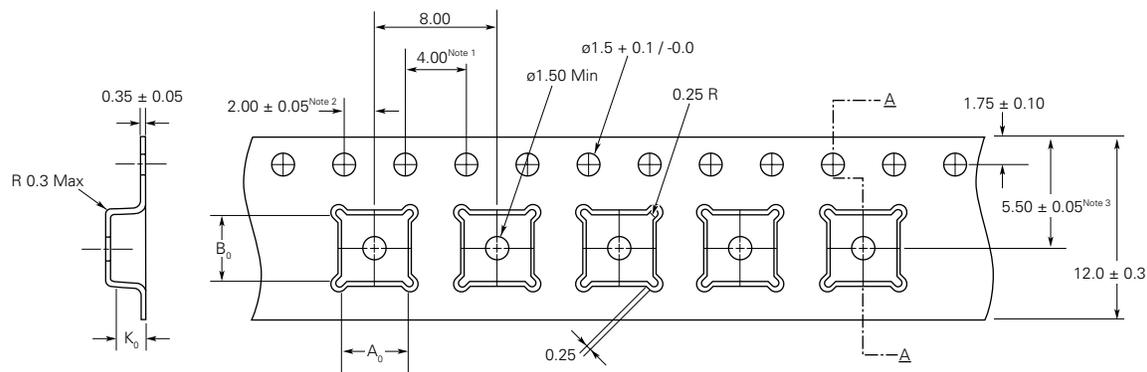
**Note:** All temperatures refer to top side of the package, measured on the package body surface.



## Tape and Reel Specifications for PolyZen Devices in Millimeters

Figure PZ46 – EIA Referenced Taped Component Dimensions for ZENxxxVyyyAzzLS Devices in Millimeters (mm)

| Description    | ZENxxxVyyyAzzLS Devices |
|----------------|-------------------------|
| A <sub>0</sub> | 4.35                    |
| B <sub>0</sub> | 4.35                    |
| K <sub>0</sub> | 2.30                    |



**Notes:** 1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.2$   
 2. Camber in compliance with EIA 481  
 3. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole

# 4 PolyZen Devices Polymer Protected Zener Diode

Figure PZ47 – Reel Dimensions for ZENxxxVyyyAzzLS Devices in Millimeters (mm)

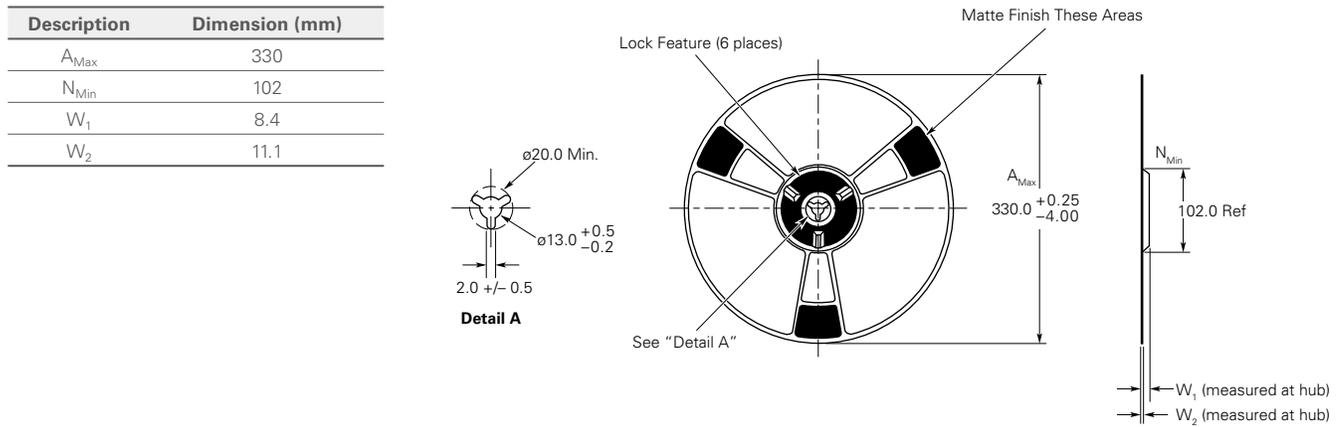


Figure PZ48 – EIA Referenced Taped Component Dimensions for ZENxxxVyyyAzzYM Devices in Millimeters (mm)

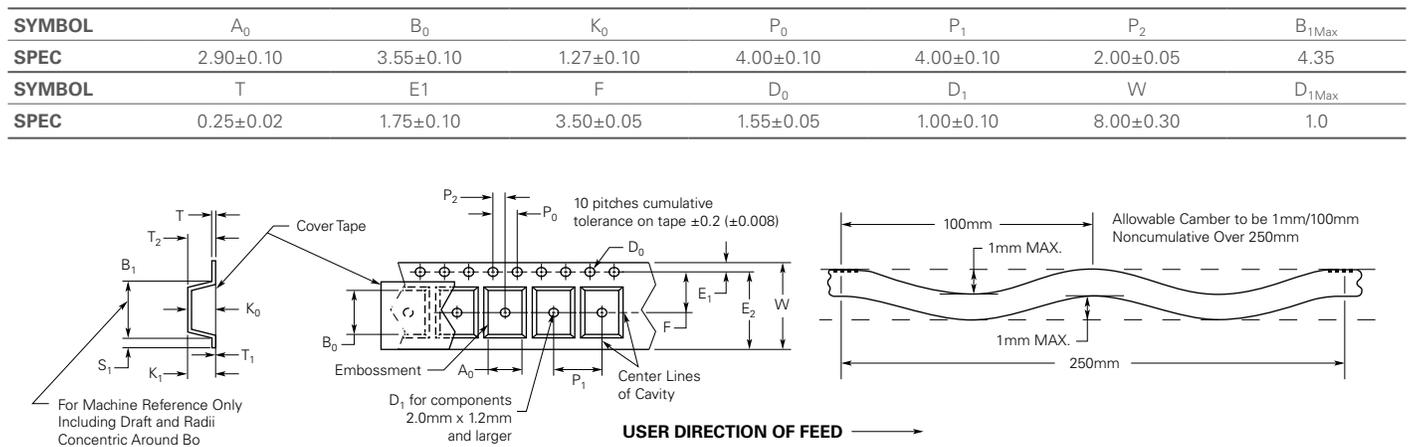
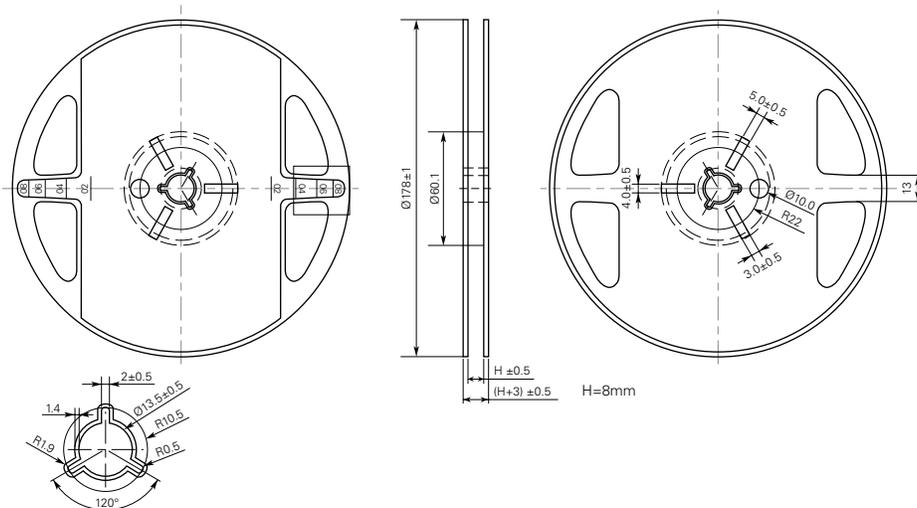


Figure PZ49 – Reel Dimensions for ZENxxxVyyyAzzYM Devices in Millimeters (mm)



## 4 PolyZen Devices Polymer Protected Zener Diode

Figure PZ50 – EIA Referenced Taped Component Dimensions for ZENxxxVyyyAzzYC Devices in Millimeters (mm)

| Item             | Dimension | Tolerance      |
|------------------|-----------|----------------|
| W                | 12.00     | ±0.10          |
| P                | 8.00      | ±0.10          |
| E                | 1.75      | ±0.10          |
| F                | 5.50      | ±0.10          |
| P <sub>2</sub>   | 2.00      | ±0.10          |
| D                | 1.50      | +0.10<br>-0.00 |
| D <sub>1</sub>   | 1.50      | ±0.10          |
| P <sub>0</sub>   | 4.00      | ±0.10          |
| 10P <sub>0</sub> | 40.00     | ±0.20          |
| A <sub>0</sub>   | 4.20      | ±0.10          |
| B <sub>0</sub>   | 5.25      | ±0.10          |
| K <sub>0</sub>   | 1.40      | ±0.10          |
| t                | 0.24      | ±0.05          |

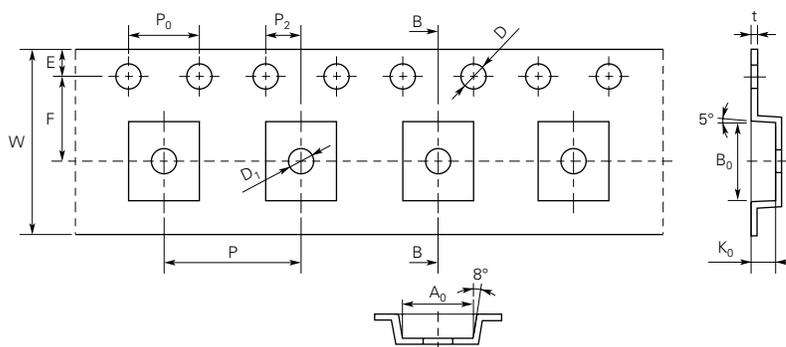
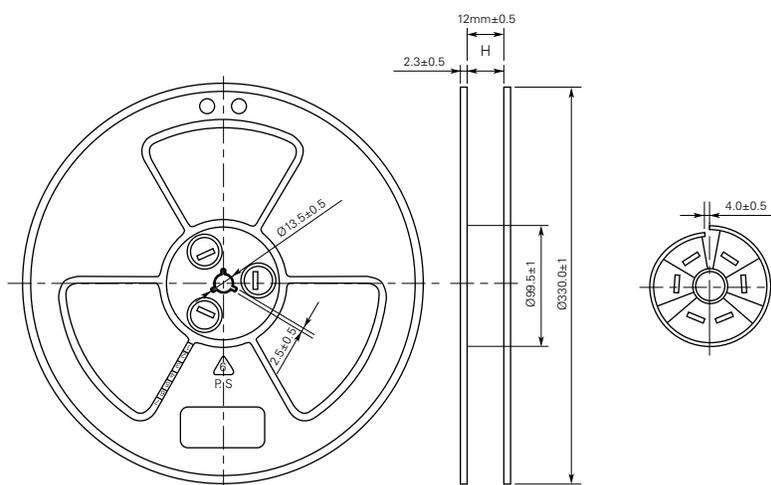


Figure PZ51 – Reel Dimensions for ZENxxxVyyyAzzYC Devices in Millimeters (mm)



### Part Numbering System

ZEN 056V 130A 24 LS & YC & YM

#### Special Labeling

LS = 4.0 \* 4.0mm package size typical

YM = 2.5 \* 3.2mm package size typical

YC = 4.0 \* 5.0mm package size typical

V<sub>INT</sub> Max Rating (24 = 24V)

PPTC Hold Current Group (130 = 1.3A)

Zener Voltage Group (056 = 5.6V)

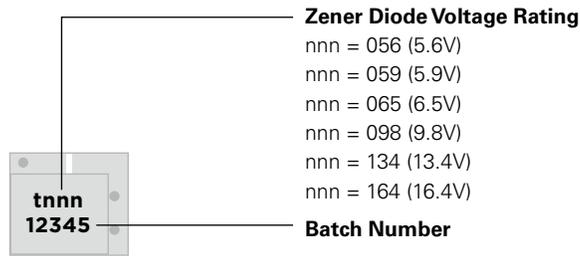
PolyZen Series

# 4

## PolyZen Devices Polymer Protected Zener Diode

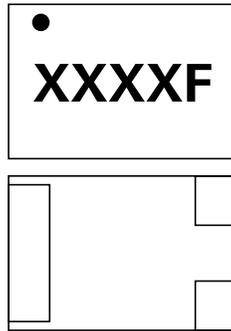
### Part Marking System

#### ZENxxxVyyyAzzLS Devices



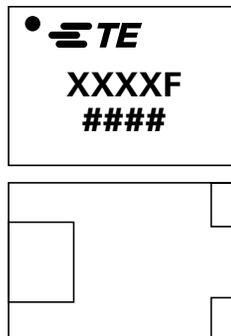
#### ZENxxxVyyyAzzYM Devices

| Markings | V <sub>Z</sub> | Hold Current | Special Code | Part Description |
|----------|----------------|--------------|--------------|------------------|
| 0513F    | 5.6V           | 1.3A         | F            | ZEN056V130A16YM  |
| 0517F    | 5.6V           | 1.75A        | F            | ZEN056V175A12YM  |
| 1313F    | 13.2V          | 1.3A         | F            | ZEN132V130A16YM  |
| 1317F    | 13.2V          | 1.75A        | F            | ZEN132V175A12YM  |



#### ZENxxxVyyyAzzYC Devices

| Markings | V <sub>Z</sub> | Hold Current | Special Code | Part Description              |
|----------|----------------|--------------|--------------|-------------------------------|
| 0513F    | 5.6V           | 1.3A         | F            | ZEN056V130A24YC               |
| 052XF    | 5.6V           | 2.3A         | F            | ZEN056V230A16YC               |
| 052XF    | 5.6V           | 2.6A         | F            | ZEN056V230A16YC               |
| 1313F    | 13.2V          | 1.3A         | F            | ZEN132V130A24YC               |
| 132XF    | 13.2V          | 2.3A         | F            | ZEN132V230A16YC               |
| 132XF    | 13.2V          | 2.6A         | F            | ZEN132V230A16YC               |
| ####     |                |              |              | Last 4 digits of batch number |



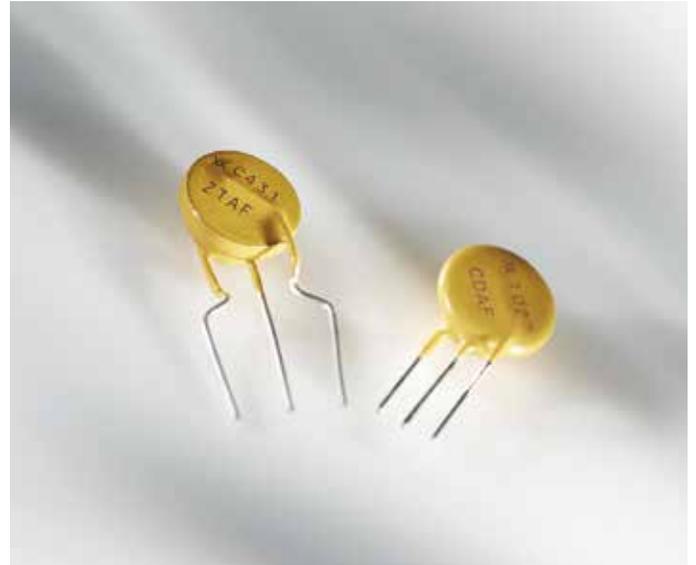
**Notice:**

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# 2PRO DEVICES

The 2Pro product is an integrated overcurrent/over-voltage protection device. The RoHS-compliant component incorporates PolySwitch PPTC (Polymeric Positive Temperature Coefficient) technology and MOV (Metal Oxide Varistor) technology in a single device to help reduce board space requirements and component count.

Damage to telephony communications equipment can be caused by various sources including lightning, electrostatic discharge (ESD), power contact and induction with AC lines. The 2Pro TM2P-10271 devices help provide current limiting during overcurrent events and voltage clamping during overvoltage events. After a fault condition is removed and power is cycled, 2Pro devices will reset so that the equipment remains operational.



The 2Pro device helps address the need for resettable circuit protection devices for use in cost-sensitive PSTN (Public Switched Telephone Network) and VoIP (Voice over Internet Protocol) telephony equipment. The widespread use of VoIP gateways in homes and enterprise environments as the primary means of voice delivery requires the utmost safety and reliability in equipment. 2Pro circuit protection devices help manufacturers comply with global safety standards, including UL 60950, TIA-968-A, IEC 60950 and ITU-T K.20/K.21. The UL 497A listed protector also helps provide ESD protection.

## BENEFITS

- Single device helps reduce component count and footprint
- Helps reduce warranty returns
- Helps equipment comply with surge tests per: TIA-968-A, IEC 60950, ITU-T K.20/K.21
- Helps simplify UL 60950 testing
- Helps equipment comply with UL 60950

## FEATURES

- RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Single overcurrent, overvoltage and ESD protection device
- Resettable overcurrent protection
- UL 497A listed protector (#E258475)

## APPLICATIONS

- Cordless telephones
- VoIP gateways
- Fax machines
- Data modems
- Set-top boxes
- Security systems
- MDF modules
- Analog and ISDN linecards

Table 2P1 – Electrical Characteristics

| Overcurrent (terminals 1 – 2) – Performance ratings @ 20°C |                       |                       |                             |                  |                     |                               |      |       |
|--|-----------------------|-----------------------|-----------------------------|------------------|---------------------|-------------------------------|------|-------|
| Part Number  | I <sub>HOLD</sub> (A) | I <sub>TRIP</sub> (A) | Resistance <sup>†</sup> (Ω) |                  |                     | Time-to-Trip (s) <sup>†</sup> |      |       |
|  |                       |                       | R <sub>MIN</sub>            | R <sub>MAX</sub> | R <sub>1 MAX*</sub> | Typ                           | Max  |       |
| TM2P-10271   | 0.15                  | 0.30                  | 6.50                        | 14.00            | 16.00               | 0.90                          | 3.00 | (@1A) |
| LVM2P-015R10431  | 0.15                  | 0.30                  | 6.50                        | 14.00            | 16.00               | 0.90                          | 3.00 | (@1A) |
| LVM2P-035R14431  | 0.35                  | 0.75                  | 1.40                        | 2.20             | 2.80                | 0.50                          | 2.00 | (@3A) |
| LVM2P-075R14431  | 0.75                  | 1.50                  | 0.37                        | 0.80             | 1.00                | 0.90                          | 1.20 | (@7A) |

| Overvoltage (Terminals 2 – 3) |                          |           |                           |                      |                   |
|-------------------------------|--------------------------|-----------|---------------------------|----------------------|-------------------|
| Part Number                   | Varistor Voltage V @ 1mA |           | DC Resistance @ 100V (MΩ) | Maximum Clamping (V) | Rated Wattage (W) |
|                               | DC (V)                   | Tolerance |                           |                      |                   |
| TM2P-10271                    | 260                      | +14% -7%  | >10                       | 455 (@25A)           | 0.25              |
| LVM2P-015R10431               | 430                      | +10% -10% | >10                       | 710 (@ 25A)          | 0.25              |
| LVM2P-035R14431               | 430                      | +10% -10% | >10                       | 710 (@ 50A)          | 0.60              |
| LVM2P-075R14431               | 430                      | +10% -10% | >10                       | 710 (@ 50A)          | 1.00              |

\* Maximum device resistance at 20°C measured 1 hour post trip.  
 † Corresponds to operation below varistor voltages.

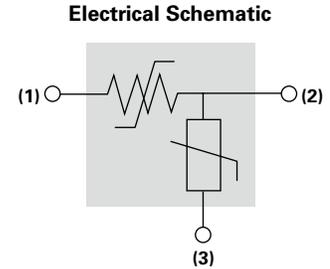


Table 2P2 – Dimensions in Millimeters and (Inches\*)

| Part Number            | A   |        | B   |        | C   |        | D      |        | E      | F   |        | Figure |
|------------------------|-----|--------|-----|--------|-----|--------|--------|--------|--------|-----|--------|--------|
|                        | Min | Max    | Min | Max    | Min | Max    | Min    | Max    | Nom    | Min | Max    |        |
| <b>TM2P-10271</b>      |     |        |     |        |     |        |        |        |        |     |        |        |
| mm                     | —   | 12.0   | —   | 15.0   | —   | 6.6    | 6.0    | —      | 2.5    | —   | 12.0   | 2P1    |
| in*                    | —   | (0.47) | —   | (0.59) | —   | (0.26) | (0.24) | —      | (0.10) | —   | (0.47) |        |
| <b>LVM2P-015R10431</b> |     |        |     |        |     |        |        |        |        |     |        |        |
| mm                     | —   | 12.0   | —   | 17.0   | —   | 7.4    | 8.5    | 11.5   | 5.1    | —   | —      | 2P2    |
| in*                    | —   | (0.47) | —   | (0.67) | —   | (0.29) | (0.34) | (0.45) | (0.20) | —   | —      |        |
| <b>LVM2P-035R14431</b> |     |        |     |        |     |        |        |        |        |     |        |        |
| mm                     | —   | 16.0   | —   | 21.0   | —   | 7.4    | 3.0    | 5.0    | 5.1    | —   | —      | 2P2    |
| in*                    | —   | (0.63) | —   | (0.83) | —   | (0.29) | (0.12) | (0.20) | (0.20) | —   | —      |        |
| <b>LVM2P-075R14431</b> |     |        |     |        |     |        |        |        |        |     |        |        |
| mm                     | —   | 16.0   | —   | 21.0   | —   | 7.4    | 3.0    | 5.0    | 2.5    | —   | —      | 2P3    |
| in*                    | —   | (0.63) | —   | (0.83) | —   | (0.29) | (0.12) | (0.20) | (0.10) | —   | —      |        |

\* The dimensions in inches are rounded approximations.

Figures 2P1-2P3 – Dimension Figures

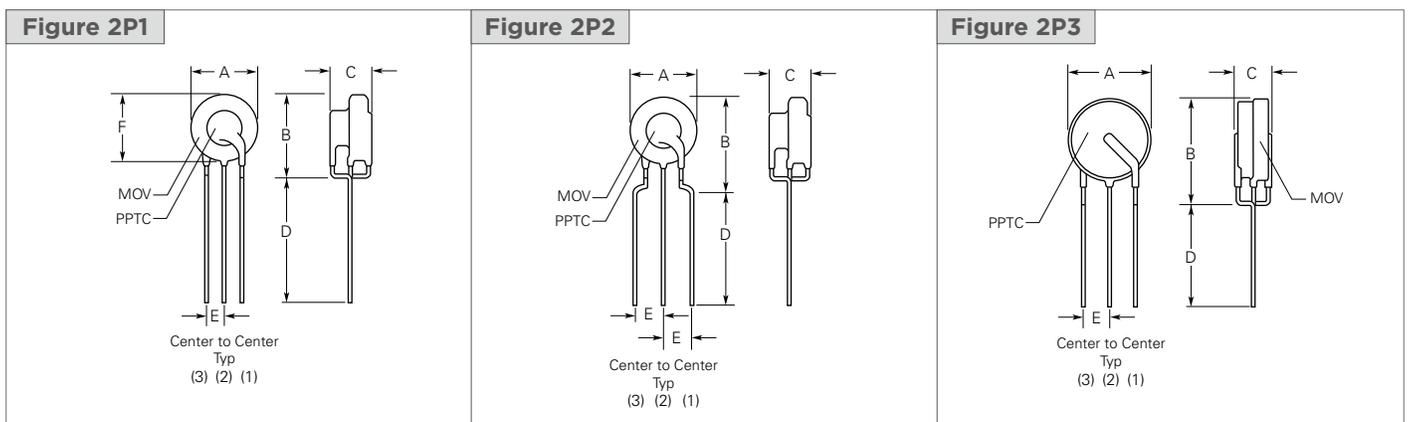


Figure 2P4 — Typical Time-to-Trip at 25°C

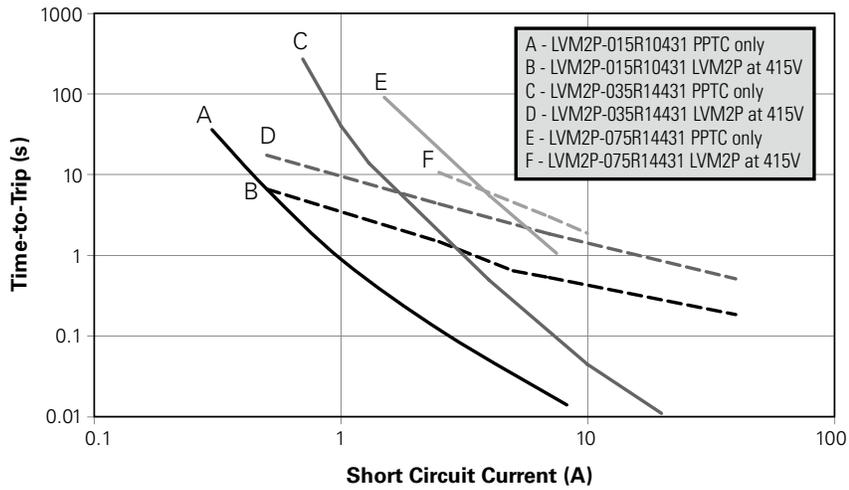


Table 2P3 — Physical Characteristics and Environmental Specifications

| Physical Characteristics     |  |
|------------------------------|--|
| Lead Material                | Tin-plated Copper, 0.33mm <sup>2</sup> (22AWG), 0.64mm (0.025in)                             |
| Flammability                 | IEC 695-2-2 Needle Flame Test for 20s  |
| Soldering Characteristics    | ANSI Approved IPC/EIA/JEDEC J-STD-002, Category 3  |
| Solder Heat Withstand        | per IEC-STD 68-2-20, Test Tb, Method1A, Condition B, can withstand 10 Seconds at 260°C ± 5°C |
| Environmental Specifications |  |
| Test                         | Conditions   |
| Passive Aging                | 60°C, 1000 Hours / 85°C, 1000 Hours  |
| Humidity Aging               | 85°C, 85% RH, 500 Hours  |
| Active Aging                 | 60°C, 90% RH, 60VDC Bias, 1000 Hours   |
| Thermal Shock                | 125°C, -55°C (10 Times)  |
| Solvent Resistance           | MIL-STD-202, Method 215K   |

**Note:** Storage conditions: 40°C max, 70% RH max, devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

Table 2P4 – Packaging and Marking Information

| Part Number     | Bag Quantity | Tape and Reel Quantity | Standard Package | Part Marking   | Agency Recognition   |
|-----------------|--------------|------------------------|------------------|----------------|--|
| TM2P-10271      | 250          | —                      | 3,000            | 1027 & Batch # | UL 497A/File No. E258475                                     |
| TM2P-10271-2    | —            | 1,000                  | 5,000            | 1027 & Batch # | UL 497A/File No. E258475                                     |
| LVM2P-015R10431 | 250          | —                      | 3,000            | C431 & Batch # | MOV UL 1449/File No. E332226<br>PPTC UL 1434/File No. E74889 |
| LVM2P-035R14431 | 250          | —                      | 3,000            | A431 & Batch # |  |
| LVM2P-075R14431 | 250          | —                      | 3,000            | B431 & Batch # |  |

Table 2P5 – Ordering Information

|             |       |             |
|-------------|-------|-------------|
| Bulk        | 250   | pieces/bag  |
|             | 3,000 | pieces/box  |
| Tape & Reel | 1,000 | pieces/reel |
|             | 5,000 | pieces/box  |

## Wave Soldering and Rework Recommendations

### Recommended Wave Soldering for Radial-leaded Devices

- Soldering temperature profile  
(Temperature characteristic at component terminal with dual wave soldering)

### Rework

- If a device is removed from the board, it should be discarded and replaced with a new device

Figure 2P5

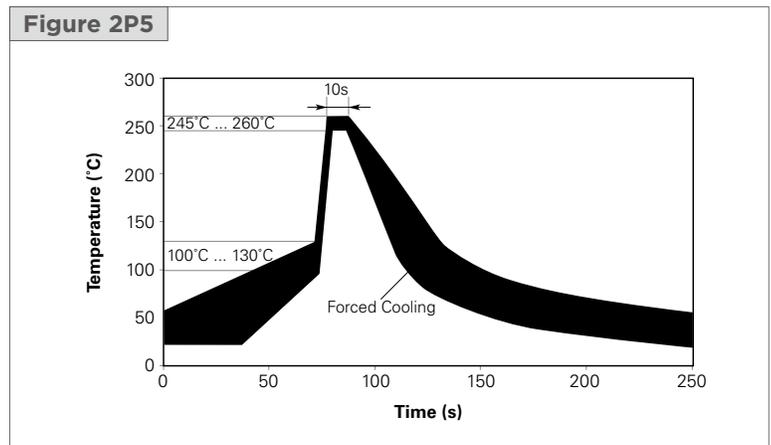


Table 2P6 — Tape and Reel Specifications in Millimeters (mm)

2Pro devices are available in tape and reel packaging per EIA 468-B standard. See Figures 2P6 and 2P7 for details.

| Description                           | EIA Mark                        | IEC Mark                        | Dimension (mm) | Tolerance   |
|---------------------------------------|---------------------------------|---------------------------------|----------------|-------------|
| Carrier Tape Width                    | W                               | W                               | 18             | -0.5/ +1.0  |
| Hold Down Tape Width                  | W <sub>4</sub>                  | W <sub>0</sub>                  | 5              | Min         |
| Top Distance Between Tape Edges       | W <sub>6</sub>                  | W <sub>2</sub>                  | 3              | Max         |
| Sprocket Hole Position                | W <sub>5</sub>                  | W <sub>1</sub>                  | 9              | -0.5/ +0.75 |
| Sprocket Hole Diameter                | D <sub>0</sub>                  | D <sub>0</sub>                  | 4              | ±0.2        |
| Abcissa to Plane (Kinked Lead)*       | H <sub>0</sub>                  | H <sub>0</sub>                  | 16             | -0.5/0.6    |
| Abcissa to Top                        | H <sub>1</sub>                  | H <sub>1</sub>                  | 32.2           | Max         |
| Overall Width with Lead Protrusion    | —                               | C <sub>1</sub>                  | 43.2           | Max         |
| Overall Width Without Lead Protrusion | —                               | C <sub>2</sub>                  | 42.5           | Max         |
| Lead Protrusion                       | L <sub>1</sub>                  | l <sub>1</sub>                  | 1.0            | Max         |
| Protrusion of Cut-out                 | L                               | L                               | 11             | Max         |
| Protrusion Beyond Hold Down Tape      | l <sub>2</sub>                  | l <sub>2</sub>                  | Not Specified  | —           |
| Sprocket Hole Pitch                   | P <sub>0</sub>                  | P <sub>0</sub>                  | 12.7           | ±0.3        |
| Pitch Tolerance                       | —                               | —                               | 20 Consecutive | ±1          |
| Tape Thickness                        | t                               | t                               | 0.9            | Max         |
| Tape Thickness with Splice*           | t <sub>1</sub>                  | —                               | 2.0            | Max         |
| Splice Sprocket Hole Alignment        | —                               | —                               | 0              | ±0.3        |
| Body Lateral Deviation                | Δh                              | Δh                              | 0              | ±0.1        |
| Body Tape Plane Deviation             | Δp                              | Δp                              | 0              | ±1.3        |
| Ordinate to Component Center Lead     | P <sub>2</sub>                  | P <sub>2</sub>                  | 6.35           | ±0.7        |
| Lead Spacing*                         | F <sub>1</sub> , F <sub>2</sub> | F <sub>1</sub> , F <sub>2</sub> | 2.54           | -0.1/+0.4   |
| Reel Width                            | w <sub>2</sub>                  | w                               | 56             | Max         |
| Reel Diameter                         | a                               | d                               | 370            | Max         |
| Space Between Flanges                 | w <sub>1</sub>                  | —                               | 51.2           | Max         |
| Arbor Hole Diameter                   | c                               | f                               | 26             | ±12.0       |
| Core Diameter                         | n                               | h                               | 80             | Max         |
| Box                                   | —                               | —                               | 56/372/372     | Max         |
| Consecutive Missing Pieces*           | —                               | —                               | 3 Max          | —           |
| Empty Places Per Reel*                | —                               | —                               | Not Specified  | —           |

Note: \*Differs from EIA specification.

Figure 2P6 — EIA Referenced Taped Component Dimensions

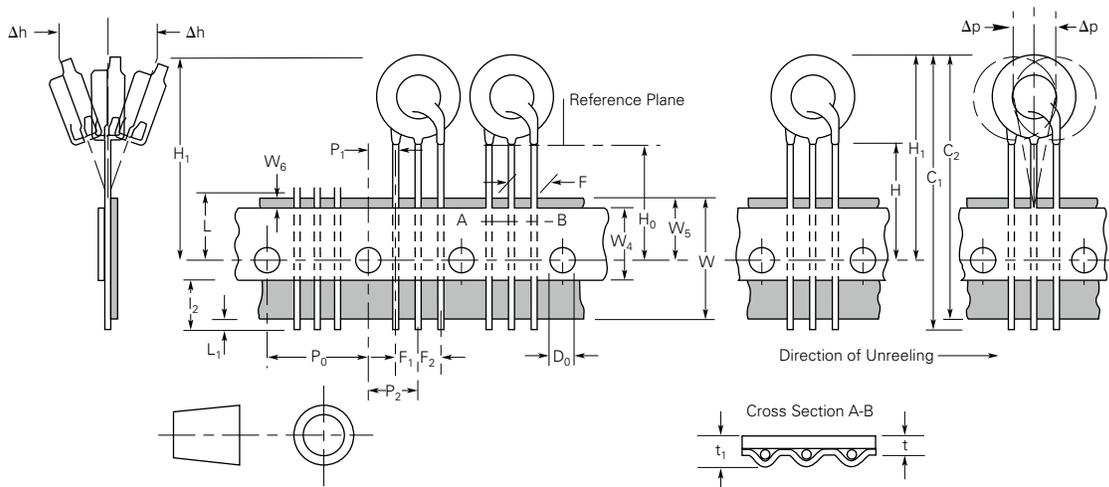
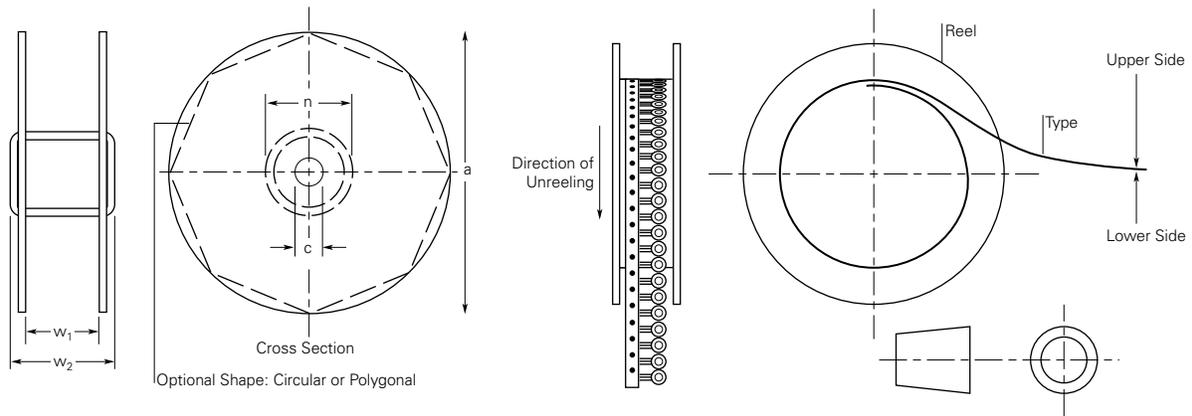
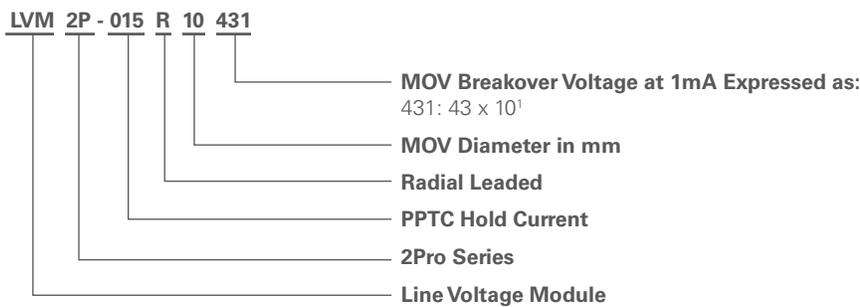
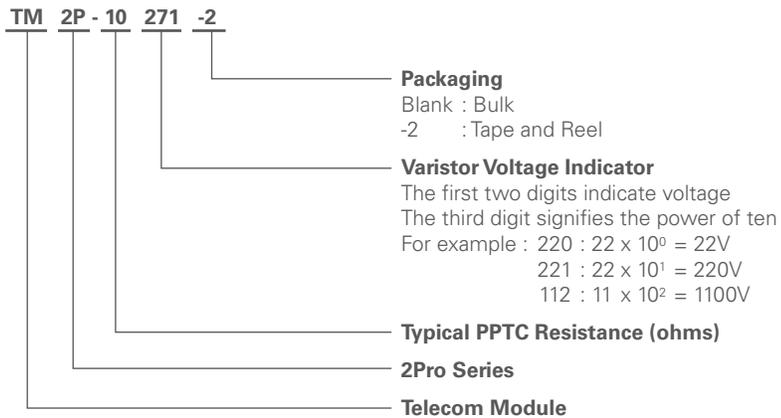


Figure 2P7 – EIA Referenced Reel Dimensions



## Part Numbering System



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# MHP-TAM DEVICES:

## MHP with Thermal Activation

The rapidly expanding market for ultra-thin portable electronic devices, such as media tablets and ultra-thin PCs, has created demand for very thin, low-profile, lightweight and high-capacity Lithium Polymer (LiP) and prismatic cells.

A new MHP (Metal Hybrid PPTC) device, the MHP-TAM device, offers a 9V<sub>DC</sub> rating and a higher current rating than typical battery strap devices. This helps them meet the battery safety requirements of higher-capacity LiP and prismatic batteries found in the latest tablet and ultra-thin computing products. Hybrid MHP technology connects a bimetal protector in parallel with a PPTC (polymeric positive temperature coefficient) device. The resulting MHP-TAM (Thermal Activation) series helps provide resettable overtemperature protection, while utilizing the PPTC device to act as a heater and to help keep the bimetal latched until the fault is removed.



### BENEFITS

- Capable of handling the higher voltages and battery discharge rates found in high-capacity LiP and prismatic cell applications
- Helps provide resettable overtemperature protection in high-capacity LiP and prismatic cell applications

### FEATURES

- 9V<sub>DC</sub> rating
- Two levels of current carrying capacity:
  - Low current (nominal 6A hold current @25°C)
  - High current (nominal 15A hold current @25°C)
- Multiple activation temperature ratings (72°C, 77°C, 82°C, 85°C, 90°C)
- Compact size (L: 5.8mm x W: 3.85mm x H: 1.15mm) allows for ultra-thin battery pack designs

### APPLICATIONS

Battery cell protection for high-capacity Lithium Polymer and prismatic cells used in:

- Notebook PCs
- Ultra-book
- Tablets
- Smart phones

Table M1 – Electrical Characteristics for MHP-TAM15 Series

| Model Number   | Rating<br>[°C]<br>Nominal | Operation<br>Temperature<br>[°C] |     | Reset<br>Temperature<br>[°C] |            | Reference Resistance<br>[mohms]<br>25°C |     |
|----------------|---------------------------|----------------------------------|-----|------------------------------|------------|---|-----|
|                |                           | Min                              | Max | Min                          | $\Delta T$ | Typ                                     | Max |
| MHP-TAM15-9-72 | 72                        | 67                               | 77  | $\geq 40$                    | $\geq 7$   | 2.5                                     | 5   |
| MHP-TAM15-9-77 | 77                        | 72                               | 82  | $\geq 40$                    | $\geq 10$  | 2.5                                     | 5   |
| MHP-TAM15-9-82 | 82                        | 77                               | 87  | $\geq 40$                    | $\geq 10$  | 2.5                                     | 5   |
| MHP-TAM15-9-85 | 85                        | 80                               | 90  | $\geq 40$                    | $\geq 10$  | 2.5                                     | 5   |
| MHP-TAM15-9-90 | 90                        | 85                               | 95  | $\geq 40$                    | $\geq 10$  | 2.5                                     | 5   |

Maximum breaking current  $5V_{DC} / 80A$  (100 cycles)  
Contact Rating  $9V_{DC} / 25A$  (6000 cycles)

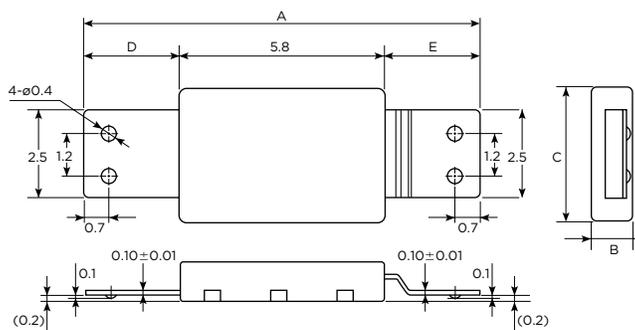
Table M2 – Electrical Characteristics for MHP-TAM6 Series

| Model Number  | Rating<br>[°C]<br>Nominal | Operation<br>Temperature<br>[°C] |     | Reset<br>Temperature<br>[°C] |            | Reference Resistance<br>[mohms]<br>25°C |     |
|---------------|---------------------------|----------------------------------|-----|------------------------------|------------|---|-----|
|               |                           | Min                              | Max | Min                          | $\Delta T$ | Typ                                     | Max |
| MHP-TAM6-9-72 | 72                        | 67                               | 77  | $\geq 40$                    | $\geq 7$   | 10                                      | 15  |
| MHP-TAM6-9-77 | 77                        | 72                               | 82  | $\geq 40$                    | $\geq 10$  | 10                                      | 15  |
| MHP-TAM6-9-82 | 82                        | 77                               | 87  | $\geq 40$                    | $\geq 10$  | 10                                      | 15  |
| MHP-TAM6-9-85 | 85                        | 80                               | 90  | $\geq 40$                    | $\geq 10$  | 10                                      | 15  |

Maximum breaking current  $5V_{DC} / 40A$  (100 cycles)  
Contact Rating  $9V_{DC} / 12A$  (6000 cycles)  
 $\Delta T$  is the minimum temperature differential between the actual operation temperature of the device and the reset temperature

Table M3 – Dimensions in Millimeters and Mechanical Characteristics

|     | A    |      | B    | C    |      | D   |     | E   |     |
|-----|------|------|------|------|------|-----|-----|-----|-----|
|     | Min  | Max  | Max  | Min  | Max  | Min | Max | Min | Max |
| mm: | 10.9 | 11.4 | 1.15 | 3.75 | 3.85 | 2.6 | 2.8 | 2.6 | 2.8 |



Figures M1-M2 — Hold Current vs. Temperature Curves (Typical)

Figure M1

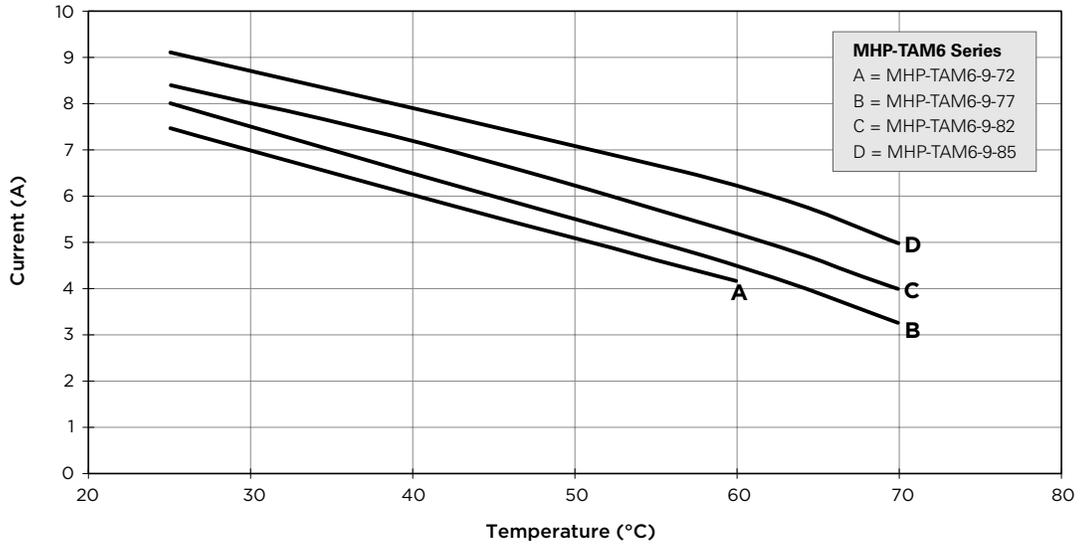
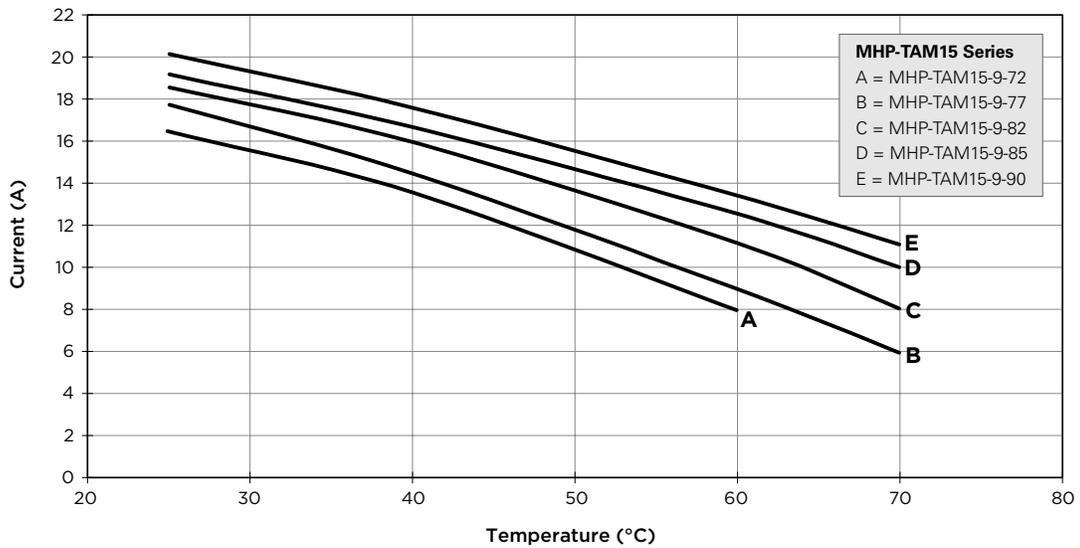


Figure M2



## Physical Characteristics

|                 |                              |
|-----------------|------------------------------|
| Terminals       | Copper Alloy                 |
| Molding Plastic | LCP (Liquid Crystal Polymer) |

## RoHS and Halogen-Free Compliance

RoHS Compliant  
Halogen Free per IEC 61249-2-21

## Storage Conditions

Device must be stored in the original, unopened bag.  
Suggested storage temperature (except for packaging material)  
Temperature:  $-10^{\circ}\text{C} - 40^{\circ}\text{C}$   
Humidity: 75%RH (max)

The following environments should be avoided for storage:  
Areas with salt air or with corrosive gas, such as  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$  and  $\text{NO}_x$ .  
Areas exposed to direct sunlight.  
Areas outside of the suggested storage temperature range, as indicated above.

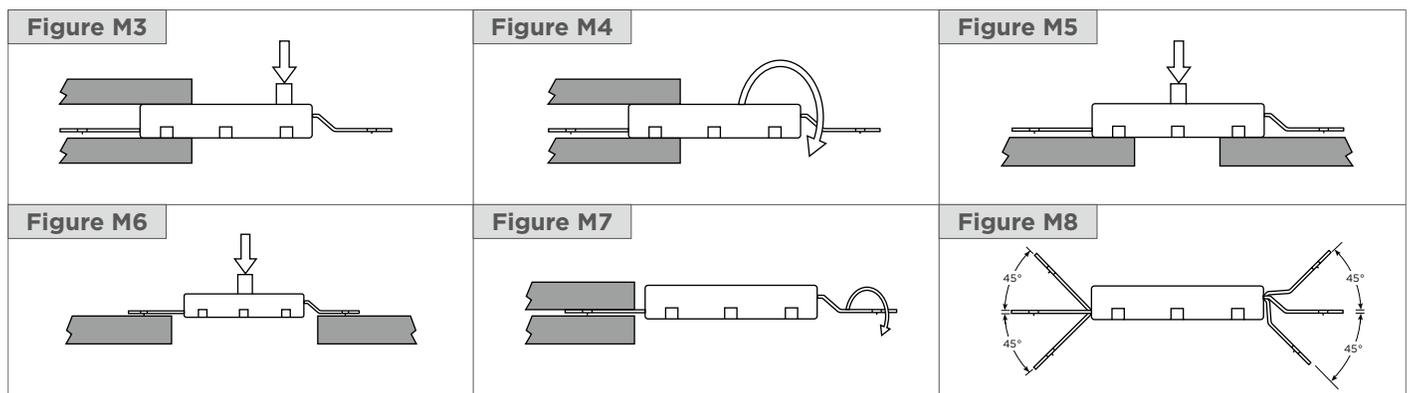
## Precautions for Handling

The device is composed of plastic parts, please do not clamp or dent the housing with a tool as this might cause a resistance increase and product damage.

When welding product terminals or mounting the breaker on a battery (cell), please be careful not to apply excessive bending, twisting or force on the product and terminals. The excessive stress might cause a resistance increase or product damage.

Please refer to following cautions:

1. Do not apply more than 10N bend force to product. (Fig. M3)
2. Do not apply more than 1.5cN/m twist torque to the product. (Fig. M4)
3. Do not apply more than 20N deflection force to product. (Fig. M5)
4. Do not apply more than 2N force to the terminals. (Fig. M6)
5. Do not apply more than 0.6cN/m twisting torque to the terminals. (Fig. M7)
6. Do not bend the terminal base more than  $45^{\circ}$  when the product is mounted in a fixed position. (Fig. M8)



Product terminals can be welded using direct welding and series welding methods. In either case, please use a suitable jig so that the device will not be subjected to the stress conditions listed above.

Pull strength and detach strength of the terminal welds are per user requirements. However, if the welding is controlled by resistance, the measurement should be made as close as possible to the weld point by a "4-point clip method" using milliohm meter to ensure accuracy.

Avoid putting stress on the device, as listed above, when a jig, fitting or additional welding process is used. Please reconfirm the resistance value whenever a new process is added.

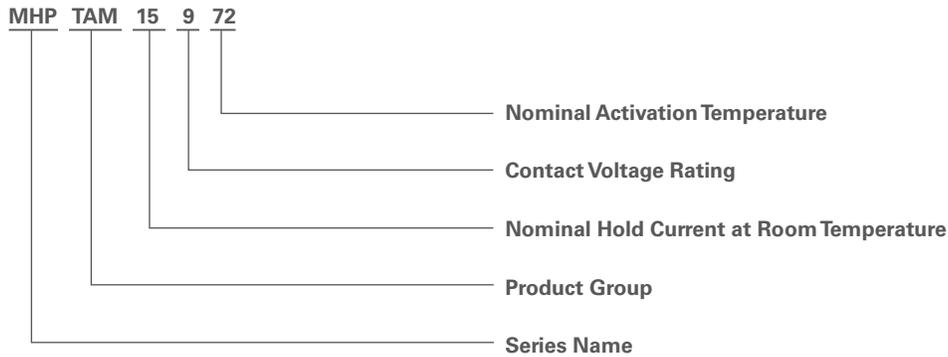
Table M4 — Packaging and Marking Information

| Part Number              | Bag Quantity | T & R Quantity | Standard Package | Part Marketing                          | Agency Recognition                                       |
|--------------------------|--------------|----------------|------------------|---|--|
| <b>MHP-TAM 15 Series</b> |              |                |                  |   |  |
| MHP-TAM15-9-72           | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-24160-UL    |
| MHP-TAM15-9-77           | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-24160-UL    |
| MHP-TAM15-9-82           | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-24160-UL    |
| MHP-TAM15-9-85           | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-24160-UL    |
| MHP-TAM15-9-90           | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-24160-UL    |
| <b>MHP-TAM 6 Series</b>  |              |                |                  |   |  |
| MHP-TAM6-9-72            | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-23966-M1-UL |
| MHP-TAM6-9-77            | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-23966-M1-UL |
| MHP-TAM6-9-82            | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-23966-M1-UL |
| MHP-TAM6-9-85            | 1,000        | —              | 20,000           | Lot ID#, Control# & Co. Logo, Product # | UL & cUL File No. E349829;<br>CB File No. US-23966-M1-UL |

Table M5 — Ordering Information

|     |        |        |
|-----|--------|--------|
| Bag | 1,000  | pieces |
| Box | 20,000 | pieces |

## Part Numbering System

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**Special Recommendations:**

1. The power supply voltage must be less than the rated voltage of the device. Operation above the voltage rating may result in device damage, smoking or flame.
2. Designs must be selected in such a manner that the device hold current is higher than the normal current value in the circuit and that the device trip current is lower than the abnormal current value. Selecting device hold current and trip current values that are too low for the application may interrupt the circuit under normal usage conditions.
3. This product should not be used in an application where the maximum interrupt current can be exceeded in a short circuit condition.
4. The devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
5. The devices may not perform as specified if mechanical pressure is added while the device is in the tripped state or exposed to temperature conditions lower than -30°C or over 100°C.

# HIGH-CURRENT RTP DEVICES

## Reflowable Thermal Protection

### For High-Power Automotive Electronics Design

The Reflowable Thermal Protection (RTP) device is a low-resistance, robust surface mountable thermal protector. The High-Current RTP (HCRTTP) is specifically geared to automotive applications where it can help designers comply with AECQ standards. The HCRTTP has a set open temperature and can be installed using reliable, lead (Pb)-free, Surface Mount Device (SMD) assembly and reflow process. The device's high-current capability of 90A at 23°C helps provide protection against thermal runaway when power FETs and other components fail in applications such as ABS modules, glow plugs and engine cooling fans.

The HCRTTP device can withstand demanding environmental, life and reliability requirements - such as shock, vibration, temperature cycling and humidity exposure - of high-power, high-current automotive applications. In the field, the HCRTTP device opens if its internal junction exceeds the device's specified open temperature of 210°C. Temperature increases can have multiple sources, one of which is component failure of power FETs, capacitors, resistors, triacs, etc. The HCRTTP device's open temperature is selected so that the device does not open within normal component operating windows, but does open in the case of a thermal runaway event, and before the melt temperature of typical lead-free solders.

To simplify installation, improve reliability and optimize thermal coupling with the PCB, the HCRTTP device is surface mountable, which means no special SMD installation is required. After installation, the HCRTTP device utilizes a one-time electronic arming process to become thermally sensitive. Before the arming procedure, the device can go through installation temperatures of up to 260°C without opening. After arming, the device will open when the critical junction exceeds the open temperature. Arming typically occurs at end of line testing after reflow.



### BENEFITS

- Helps prevent failed components from causing damage in case of a thermal event
- Allows the use of standard surface-mount production methods so that no special assembly costs are required
- Low power dissipation and voltage drop
- Supports DC electronic circuits
- Suitable for high-power, high-current automotive applications
- Enables green design

### FEATURES

- Opens at temperature (210°C) below the critical thermal threshold
- Prior to activation, withstands Pb-free solder reflow process with peak temperatures up to 260°C without opening

### APPLICATIONS

- Helps provide protection against thermal runaway for power FETs and other components if failure occurs in applications such as automotive ABS modules, glow plugs and engine cooling fans, etc.
- Other DC thermal protection

Figure HP1 — Typical Application Block Diagram

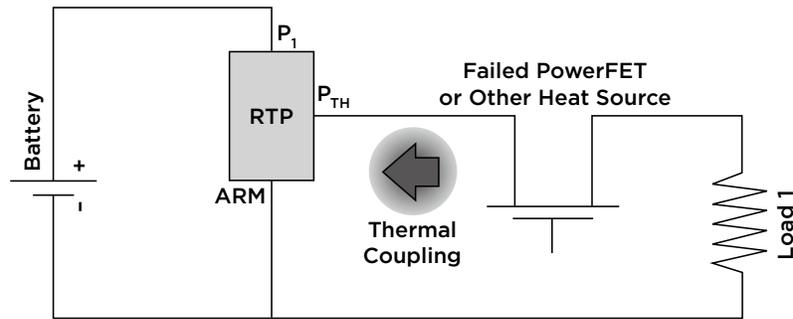
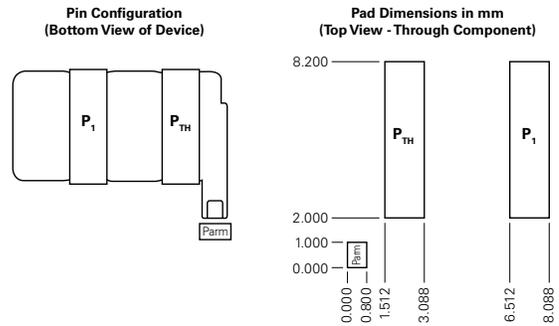


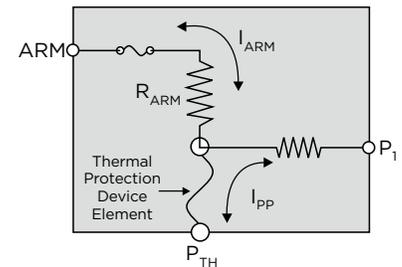
Figure HP2 — Pin Configuration &amp; Description Pad Layout Recommendations

| Pin Number | Pin Name | Pin Function  |
|------------|----------|---|
| 1          | $P_1$    | Power I/O pin<br>(Main power current path)  |
| 2          | $P_{TH}$ | Thermally sensitive power I/O pin -<br>Intended to share protected component<br>heat sink |
| 3          | ARM      | Electronic arming pin   |



## Definition of Terms / Device Block Diagram

| Term                    | Definition   |
|-------------------------|--|
| Junction                | The internal interface which must achieve the "Open Temperature" for the RTP device to open thermally after arming. This interface (thermal element) is located directly above the $P_{TH}$ pad. |
| Open Temp               | The device will open when the junction temperature achieves this value.  |
| $I_{ARM}$ and $R_{ARM}$ | Current and resistance levels measured between the ARM pin and either the $P_1$ or $P_{TH}$ pin. (These values are only relevant during pre-arming.)   |
| $R_{PP}$ and $I_{PP}$   | Current and resistance levels measured between the $P_1$ and $P_{TH}$ pins.  |



## Method of Operation - Electronic Arming

The RTP device is a unique thermal protector. It can be reflowed at temperatures up to 260°C without opening, yet in operation it will open at temperatures well below 260°C. To achieve this functionality, the RTP device uses an electronic arming mechanism.

Electronic arming must be done after reflow, and can be done during final test.

The device is armed by sending a specified arming current through the ARM pin of the device. Arming is a time- and current-dependent event. Arming times vs. current are provided in the "Arming Characteristics" section of this overview. Current can flow in either direction through the ARM pin.

Prior to arming,  $R_{ARM}$  should have typical resistance as specified in the "Arming Characteristics" section. Once armed, the ARM pin will be electrically open relative to the  $P_1$  or  $P_{TH}$  pins.

Arming has been successful once  $R_{ARM}$  exceeds the post-arming minimum resistance specified in the "Arming Characteristics" section. RTP devices must be armed individually and cannot be armed simultaneously in series.

Once "armed," the RTP device will permanently open when the device junction achieves its specified opening temperature.

Although multiple options exist, below is one simple arming option.

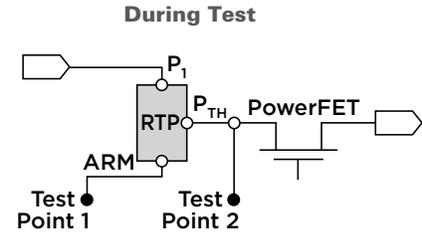
## Sample Arming Options

## ARM pin connected between two test points

In this case, pin  $P_1$  is left "floating," and arming can occur during test, at a user defined time, by connecting to the Test Points and applying sufficient current ( $I_{ARM}$ ) between Test Point 1 and Test Point 2 until the device is armed.

## Current Flow

$P_{TH} \longleftrightarrow ARM =$  Arming



## Table HP1 – Absolute Max Ratings

| Absolute Max Ratings  |               | Max  | Units       |
|---|---------------|------|-------------|
| Max DC Open Voltage <sup>1</sup>  | —             | 16   | $V_{DC}$    |
| Max DC Interrupt Current <sup>1</sup>                                       | @ 16 $V_{DC}$ | 500  | A           |
| ESD Rating (Human Body Model)   | —             | 25   | KV          |
| Max Reflow Temperature (Pre-Arming)   | —             | 260  | $^{\circ}C$ |
| Operating Temperature Limits, Junction ( $P_{TH}$ ) and Storage Temperature | —             | -55  | $^{\circ}C$ |
|   | —             | +150 | $^{\circ}C$ |

(1) Performance capability at these conditions can be influenced by board design. Performance should be verified in the user's system.

## Table HP2 – Performance Characteristics

| Resistance and Open Characteristics $P_1$ to $P_{TH}$                |                       | Min | Typ | Max | Units       |
|--|-----------------------|-----|-----|-----|-------------|
| $R_{PP}$ (Resistance from $P_1$ to $P_{TH}$ )                        | @ 23+/-3 $^{\circ}C$  | —   | 100 | 150 | $\mu\Omega$ |
|  | @ 150+/-3 $^{\circ}C$ | —   | 150 | 260 | m $\Omega$  |
| Operating Voltage  | —                     | —   | 16  | -   | $V_{DC}$    |
| Open Temperature, Post-Arming  | $I_{PP} = 0$          | 202 | 210 | 218 | $^{\circ}C$ |
| Installation Dependent Operating Current, Post-Arming <sup>(2)</sup> | @ 23+/-3 $^{\circ}C$  | 90  | —   | —   | A           |
|  | @ 140+/-3 $^{\circ}C$ | 45  | —   | —   | A           |
| Moisture Sensitivity Level Rating <sup>(3)</sup>                     | —                     | —   | 1   | —   | —           |

## Table HP3 – Arming Characteristics

| Arming Characteristics ARM                            |                      | Min                  | Typ   | Max | Units      |
|---|----------------------|----------------------|-------|-----|------------|
| Arming Type   | —                    | Electronically Armed |       |     | —          |
| $R_{ARM}$ (Resistance from ARM to $P_1$ or $P_{TH}$ ) | Pre-Arming           | —                    | 500   | —   | m $\Omega$ |
|   | Post-Arming          | 10                   | —     | —   | K $\Omega$ |
| Arming Current ( $I_{ARM}$ ) <sup>(4)</sup>           | @ 23+/-3 $^{\circ}C$ | 2                    | —     | 5   | A          |
| Arming Time (@ 23+/-3 $^{\circ}C$ ) <sup>(4)</sup>    | @ 2A                 | —                    | 0.020 | —   | Sec        |
|   | @ 5A                 | —                    | 0.005 | —   | Sec        |

(2) Results obtained on 44.4 mm x 57.2 mm x 1.6 mm of 2-sided FR4 board T4350 with 4.0 oz copper trace.

RTP Device pad connection of:

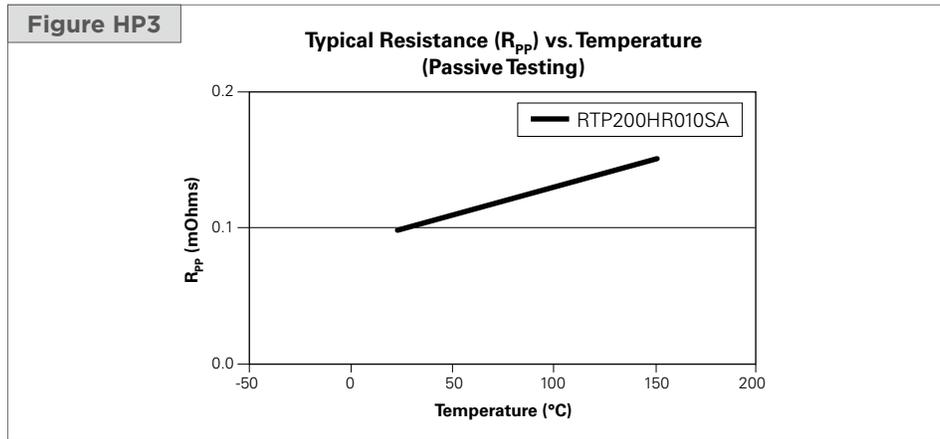
- 283 sq. mm 4.0 oz copper heat spreader connected to  $P_1$  pad.
- 237 sq. mm 4.0 oz copper heat spreader connected to  $P_{TH}$  pad.

(See RTP device test board drawing). Results will vary based on user's configuration and should be validated by the user in the end system.

(3) Operating current is measured on the RTP test boards at the specified temperature. It is a highly installation dependent value.

(4) As per JEDEC J-STD-020C.

Figures HP3-HP6 – Typical Electrical Performance Characteristics



**INSTALLATION DEPENDENT PERFORMANCE CHARACTERISTICS**

Note: Results were obtained on 44.5 x 57.2 x 1.6 (mm) of 2-sided FR4 board T4350 with 4.0 oz Copper trace, RTP device pad connection of 283 sq.mm 4.0 oz copper heat spreader to  $P_1$  pad and 237 sq.mm 4.0 oz copper heat spreader to  $P_{TH}$  pad. Results will vary based on user's configuration and should be validated by the user in the end system.

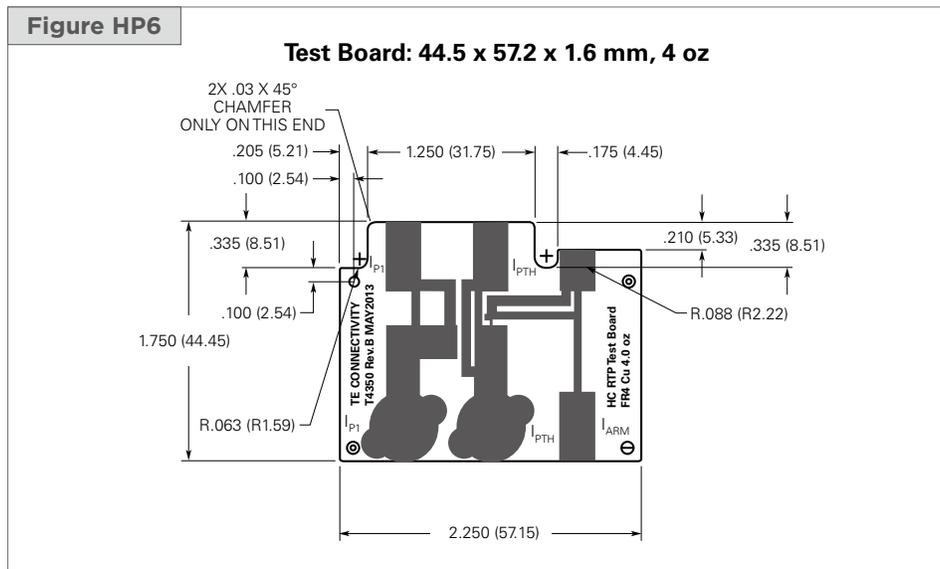
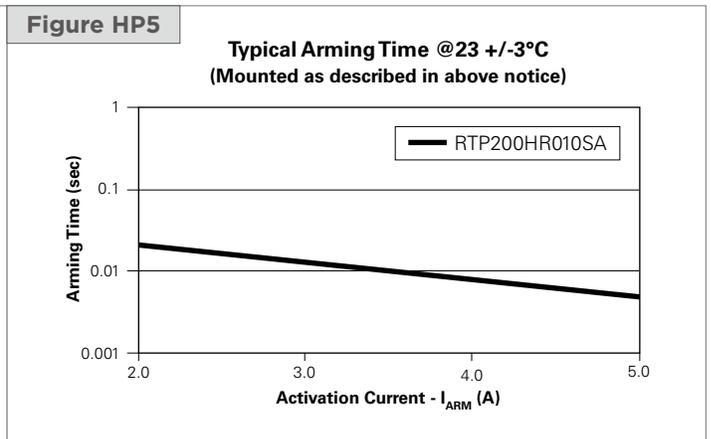
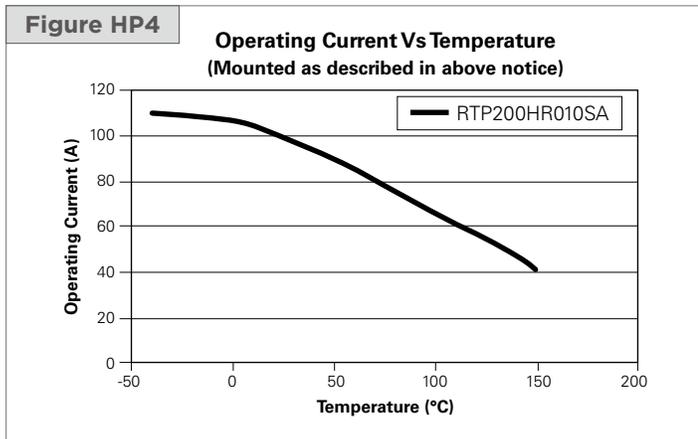
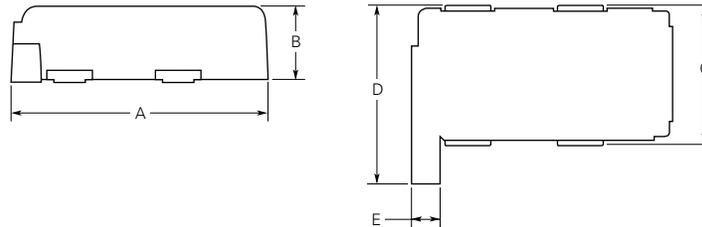


Figure HP7 – Mechanical Dimensions

|      | A      |        | B      |        | C      |        | D      |        | E      |        |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|      | Min    | Max    |
| mm   | 11.60  | 12.0   | 6.0    | 6.35   | 5.25   | 5.5    | 5.25   | 5.5    | 5.25   | 5.5    |
| inch | (0.46) | (0.47) | (0.24) | (0.25) | (0.21) | (0.22) | (0.21) | (0.22) | (0.21) | (0.22) |

**Important Installation Instructions:**

- Note 1 RTP200HR010SA devices are to be board-mounted using only solder pastes referenced in Engineering Report: Q40213
- Note 2 RTP200HR010SA devices are not compatible with conformal coating.  
If selective coatings are used, avoid covering the RTP200HR010SA device

## Material Construction

RoHS Compliant

Directive 2002/95/EC  
Compliant

ELV Compliant

Directive 2000/53/EC  
Compliant

Pb-Free



Halogen Free\*

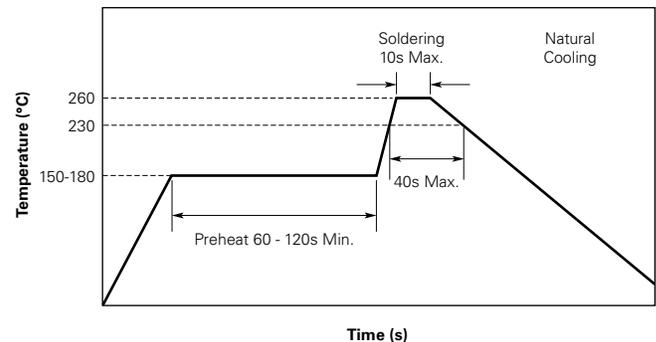


\* Halogen Free refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm.

## Recommended Reflow Profile

## Classification Reflow Profiles

| Profile Feature  | Pb-Free Assembly |
|--|------------------|
| <b>Average Ramp-Up Rate (<math>T_{S_{MAX}}</math> to <math>T_p</math>)</b> | 3°C/ Second Max  |
| <b>Preheat</b>   |                  |
| • Temperature Min ( $T_{S_{MIN}}$ )  | 150°C            |
| • Temperature Max ( $T_{S_{MAX}}$ )  | 200°C            |
| • Time ( $t_{S_{MIN}}$ to $t_{S_{MAX}}$ )                                  | 60-180 Seconds   |
| <b>Time Maintained Above:</b>  |                  |
| • Temperature ( $T_L$ )  | 217°C            |
| • Time ( $t_L$ )   | 60-150 Seconds   |
| <b>Peak/Classification Temperature (<math>T_p</math>)</b>                  | 260°C            |
| <b>Time within 5°C of Actual Peak Temperature</b>                          |                  |
| Time ( $t_p$ )   | 20-40 Seconds    |
| <b>Ramp-Down Rate</b>  | 6°C/ Second Max  |
| <b>Time 25°C to Peak Temperature</b>                                       | 8 Minutes Max    |

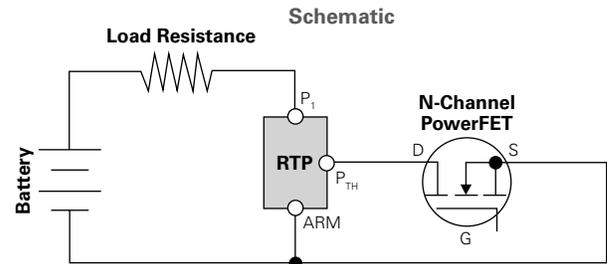


## Alternate & Multi-FET Schematic Implementations

### Low Side, N-Channel Single FET Protection

#### Solution Considerations

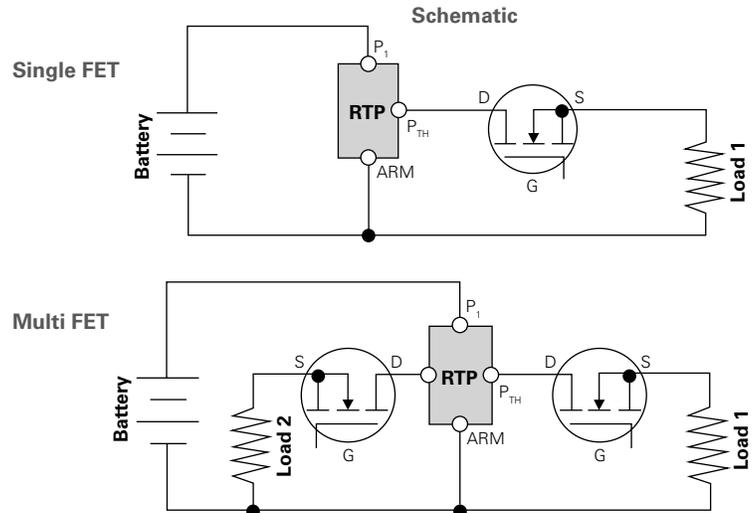
- Low side N-Channel FET architectures allow only one FET to be installed per RTP device.
- Note: Load may limit “arming” current.



### High Side, N-Channel FET Protection

#### Solution Considerations

- High Side FET designs allow multiple FETs to be installed with 1 RTP device while all sharing the same copper mounting pad (heat sink).
- In a multi-FET configuration, care must be taken to assure that the proper thermal response can be achieved with each FET.



**Note:** The degree of thermal connectivity between the heat source and the RTP device is highly dependent on board layouts, PCB material, heat sink structures, and relative placement and design of co-located components. It is the responsibility of the user to verify that the RTP device provides sufficient protection in the user's specific final device implementation.

## Environmental Specifications

| RTP200HR010SA          |  |
|------------------------|--|
| Test                   | Conditions                             |
| Passive thermal aging  | 150°C, 1000 hours                      |
| Active thermal aging   | 150°C, 5A bias, 408hr                  |
| Passive humidity aging | 85°C, 85% RH, 1000 hours               |
| Active humidity aging  | 85°C, 85% RH, 1000 hours               |
| Storage humidity       | Per IPC/JEDEC J-STD020A level 1 (MSL1) |
| Thermal shock          | 150°C, -55°C (500 times)               |

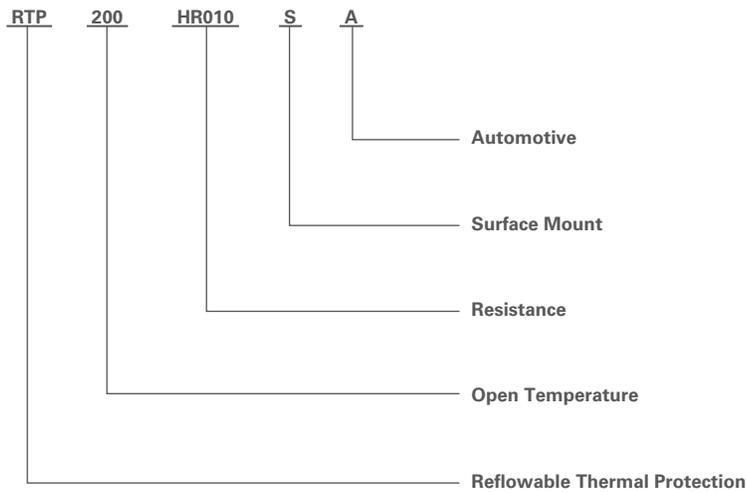
## Qualification Testing

The Qualification Testing plan for this series of RTP devices is built upon AEC automotive grade testing for ICs (AEC-Q100), discrete semiconductors (AEC-Q101) and passive components (AEC-Q200), with the intent to demonstrate survivability to the most stringent of the relevant requirements.\*

Contact TE Circuit Protection for updated qualification status and detailed procedures.

\*A specific list of tests and conditions is available upon request.

## Part Numbering System

**Notice:**

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# PESD PROTECTION DEVICES

TE's Polymer ESD (PESD) line of devices helps protect I/O ports on HDMI 1.3, portable video players, LCD and plasma TVs, USB 2.0, digital visual interface (DVI) and antenna switches. PESD devices shunt electrostatic discharge away from sensitive circuitry in HDTV equipment, printers, laptops, cellular phones and other portable devices.

PESD devices offer many advantages over traditional protection devices, such as multi layer varistors (MLVs), which may degrade or distort the signal in high data rate circuits. Compared to miniature gas discharge tubes (GDTs), PESD devices provide a more compact form factor and an economical solution for the shrinking profiles of today's compact information appliances.

Available in a range of form factors, our PESD protection devices provide low capacitance and meet transmission line pulse (TLP) testing, as well as IEC61000-4-2 testing.



## BENEFITS

- ESD protection for high frequency application (HDMI 1.3)
- Smaller form factor for board space savings
- Helps protect sensitive electronic circuits against damage caused by electrostatic discharge (ESD) events
- Assists equipment to pass IEC 61000-4-2, level 4 testing

## FEATURES

- RoHS compliant
- Lead free
- Halogen free (refers to: Br $\leq$ 900ppm, Cl $\leq$ 900ppm, Br+Cl $\leq$ 1500ppm)
- 0.25 pF (typ) capacitance
- Low-leakage current
- Low-clamping voltage
- Fast response time (< 1ns)
- Capable of withstanding numerous ESD strikes
- Compatible with standard reflow installation procedures
- Thick film technology
- Bi-directional protection

## APPLICATIONS

- HDMI 1.3 interfaces
- LCD & plasma TVs
- Cellular phones
- Antennas
- Portable video players
- Portable devices (PDA, DSC, Bluetooth)
- Printer ports
- Satellite radios
- USB 2.0 and IEEE 1394 interfaces
- DVI
- GPS systems

Table E1 – Electrical Characteristics

|               | Continuous Max Operating Voltage | Typ Trigger Voltage* | Typ Clamping Voltage† | Typ Capacitance @ 1 MHz, 1V <sub>RMS</sub> | Typ Leakage Current | Max Leakage Current @ Max V <sub>DC</sub> |
|---------------|----------------------------------|----------------------|-----------------------|--|---------------------|---|
| Symbol        | V <sub>DC</sub>                  | V <sub>T(TLP)</sub>  | V <sub>C(TLP)</sub>   | C <sub>P</sub>                             | I <sub>L(TYP)</sub> | I <sub>L(MAX)</sub>                       |
| Unit          | V                                | V                    | V                     | pF   | μA                  | μA  |
| PESD0402-140  | 14                               | 250                  | 40                    | 0.25                                       | < 0.01              | 10.0                                      |
| PESD0402-240  | 24                               | 250                  | 40                    | 0.25                                       | < 0.01              | 10.0                                      |
| PESD0603-240  | 24                               | 215                  | 45                    | 0.25                                       | < 0.01              | 10.0                                      |
| PESD1206Q-240 | 24                               | 250                  | 45                    | 0.25                                       | < 0.01              | 10.0                                      |

Notes : \* TLP test method at 1kV.

† Measured 30ns after pulse initiation.

Typical capacitance value is at 0V and max operating voltage bias.

Figure E1 – Capacitance vs. Frequency

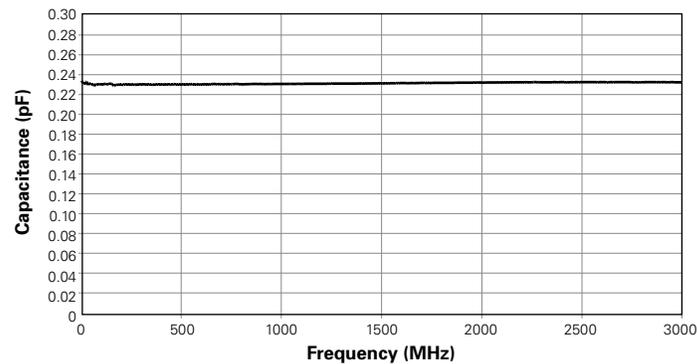


Figure E2 – Eye Diagram Performance at 3.4 GHz

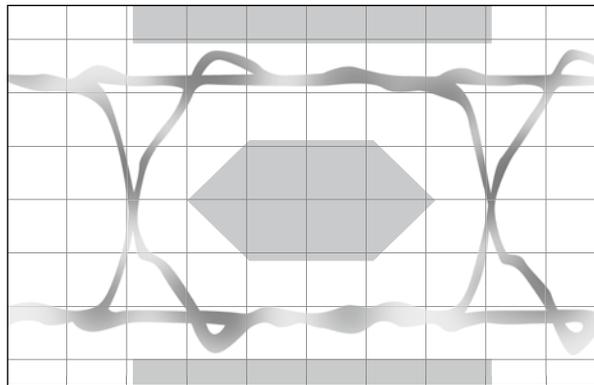
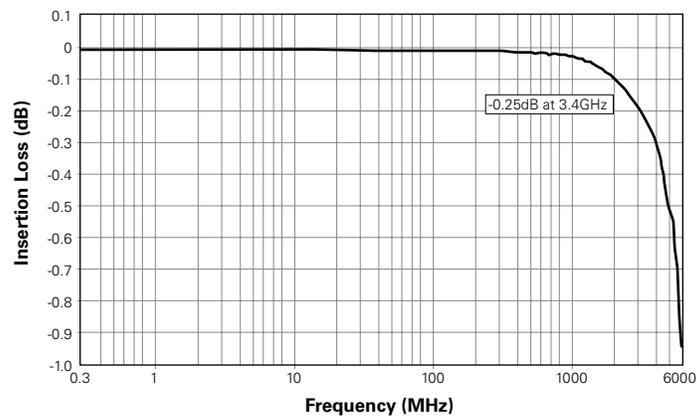


Figure E3 – Insertion Loss Diagram



Figures E4-E5 – PESD Device Protection for HDMI (PESD devices provide electrostatic discharge protection)

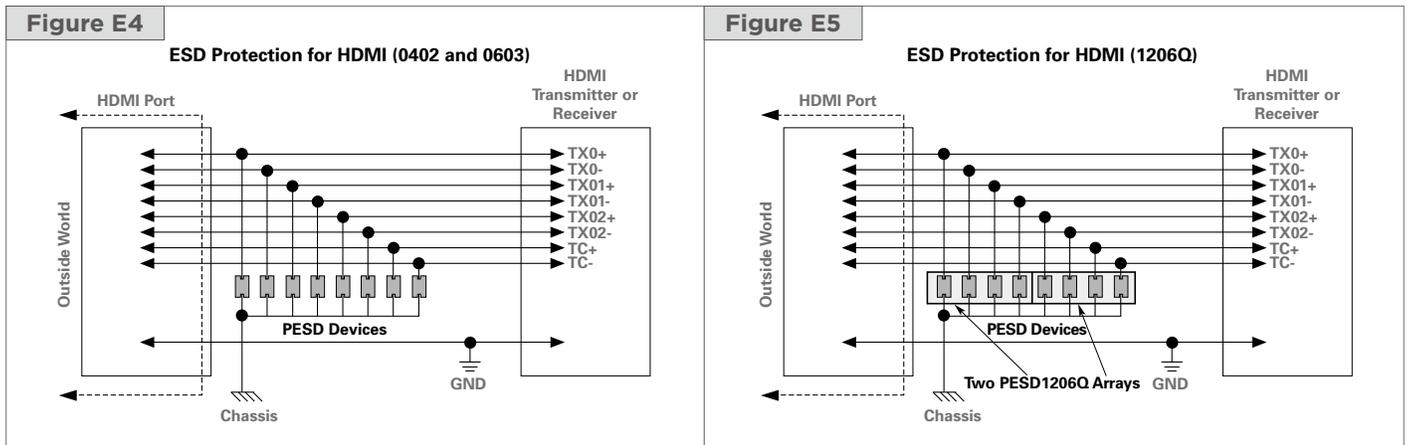


Table E2 – Dimensions in Millimeters (Inches\*)

| Part Number   | A       |         | B       |         | C       |         | D       |         | E       |         | F       |         | Figure |
|---------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|--------|
|               | Min     | Max     |        |
| PESD0402-140  | 0.90    | 1.10    | 0.23    | 0.43    | 0.10    | 0.30    | 0.40    | 0.60    | —       | —       | —       | —       | E6     |
| PESD0402-240  | (0.035) | (0.043) | (0.009) | (0.017) | (0.004) | (0.012) | (0.016) | (0.024) |         |         |         |         |        |
| PESD0603-240  | 1.50    | 1.70    | 0.45    | 0.55    | 0.10    | 0.50    | 0.70    | 0.95    | —       | —       | —       | —       | E6     |
|               | (0.059) | (0.067) | (0.018) | (0.022) | (0.004) | (0.020) | (0.028) | (0.037) |         |         |         |         |        |
| PESD1206Q-240 | 3.10    | 3.30    | 0.40    | 0.60    | 0.10    | 0.30    | 1.50    | 1.70    | 0.20    | 0.60    | 0.20    | 0.60    | E7     |
|               | (0.122) | (0.130) | (0.016) | (0.024) | (0.004) | (0.012) | (0.059) | (0.067) | (0.008) | (0.024) | (0.008) | (0.024) |        |

\*The dimensions in inches are rounded approximations.

Figures E6-E7 – Dimension Figures

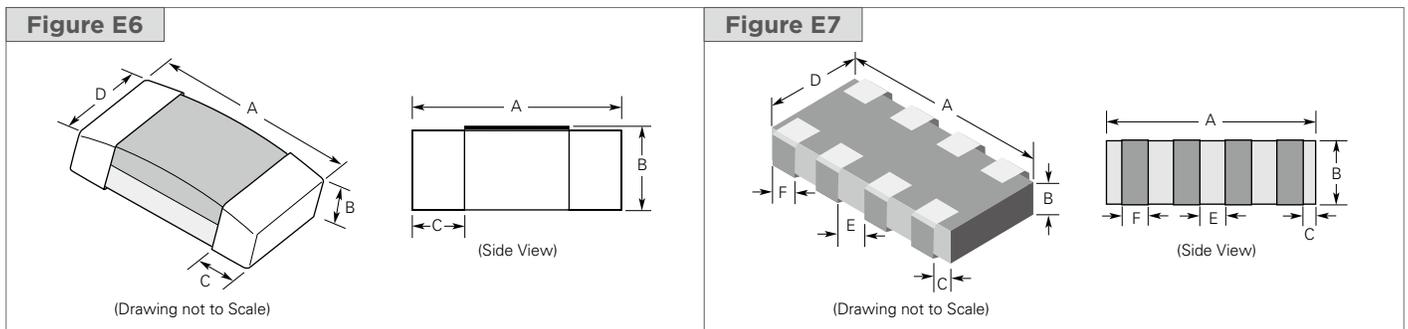


Table E3 – Environmental Specifications

|                    | Test Conditions                                      | Pass / Fail Criteria |
|--------------------|--|----------------------|
| Bias Humidity Test | 85°C, 85% RH, $V_{DC(max)}$ , 1000 hrs               | $I_L \leq 10 \mu A$  |
| Thermal Shock      | -55°C to 125°C, 30 min Dwell, 1000 Cycles            | $I_L \leq 10 \mu A$  |
| Bias Heat Test     | 125°C, $V_{DC(max)}$ , 1000 hrs                      | $I_L \leq 10 \mu A$  |
| Bias Low Temp Test | -55°C, $V_{DC(max)}$ , 1000 hrs                      | $I_L \leq 10 \mu A$  |
| Solderability      | 250°C ± 5°C, 3 ± 1s                                  | 95% Coverage         |
| Solder Heat        | 260°C, 10s   | 90% Coverage         |
| Vibration          | 10 to 50Hz, 60s Cycle, 2 hrs Each in X-Y-Z-Direction | No Physical Damage   |
| Solvent Resistance | IPA Ultrasonic 300s                                  | No Physical Damage   |
| Shock              | 1500G, 0.5ms Each, X-Y-Z Axis 3 Times Each Axis      | No Physical Damage   |

Table E4 – General Characteristics

|  |   |
|--|---|
| Storage Temperature                                  | -40°C to +85°C  |
| Operating Temperature                                | -55°C to +125°C   |
| ESD Voltage Capability<br>(Tested per IEC 61000-4-2) | Contact Discharge Mode: 8kV (Typ), 15kV (max)<br>Air Discharge Mode: 15kV (Typ), 25kV (max) [1 Pulse: per Customer Request] |
| ESD Pulse Withstand                                  | 100 Pulses<br>(Tested per IEC 61000-4-2, Level 4, Contact Method)   |

Table E5 – Materials Information

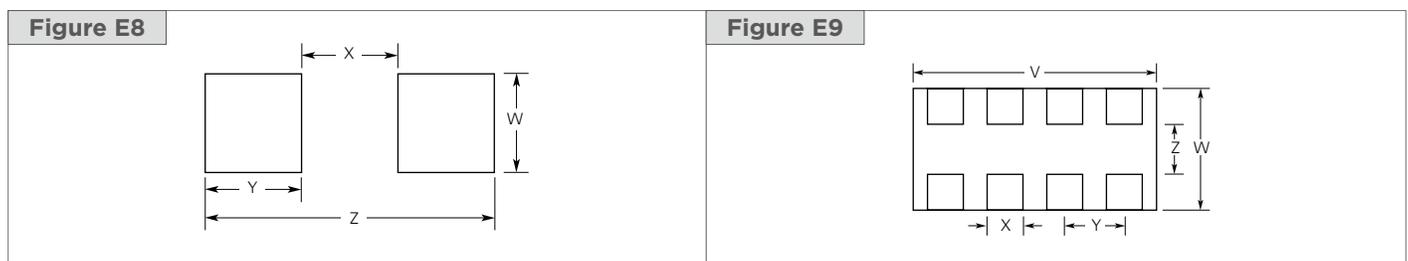
|                |   |
|----------------|---|
| RoHS Compliant | Directive 2002/95/EC Compliant                              |
| RoHS 2.0       | Directive 2011/65/EU Compliant                              |
| ELV Compliant  | Directive 2000/53/EC Compliant                              |
| Halogen Free   | Halogen Free Refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm |

Table E6 – Recommended Pad Layout in Millimeters and (Inches\*)

| Part Number  | V   |     | W       |         | X       |         | Y       |         | Z       |         | Figure |
|--------------|-----|-----|---------|---------|---------|---------|---------|---------|---------|---------|--------|
|              | Min | Max | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |        |
| PESD0402-140 | —   | —   | 0.60    | 0.70    | 0.30    | 0.40    | 0.80    | 0.90    | 2.10    | 2.20    | E8     |
| PESD0402-240 |     |     | (0.024) | (0.028) | (0.012) | (0.016) | (0.031) | (0.035) | (0.083) | (0.087) |        |
| PESD0603-240 | —   | —   | 0.90    | 1.00    | 0.50    | 0.60    | 1.00    | 1.10    | 2.70    | 2.80    | E8     |
|              |     |     | (0.035) | (0.039) | (0.020) | (0.024) | (0.039) | (0.043) | (0.106) | (0.110) |        |

| Part Number   | V       | W       | X       | Y       | Z       | Figure |
|---------------|---------|---------|---------|---------|---------|--------|
|               | Typ     | Typ     | Typ     | Typ     | Typ     |        |
| PESD1206Q-240 | 3.20    | 2.20    | 0.50    | 0.80    | 1.00    | E9     |
|               | (0.126) | (0.087) | (0.020) | (0.031) | (0.039) |        |

\*The dimensions in inches are rounded approximations.



**Note:** Solder thickness 0.15 to 0.2mm.

Table E7 – Solder Reflow Recommendations

|   |                       |   |             |
|---|-----------------------|---|-------------|
| A | Temperature Ramp-up 1 | From Ambient to Preheating Temperature      | 30s to 60s  |
| B | Preheating            | 140°C - 160°C                               | 60s to 120s |
| C | Temperature Ramp-up 2 | From Preheating to Main Heating Temperature | 20s to 40s  |
| D | Main Heating          | at 200°C                                    | 60s to 70s  |
|   |                       | at 220°C                                    | 50s to 60s  |
|   |                       | at 240°C                                    | 30s to 40s  |
|   |                       | at 260°C                                    | 5s to 10s   |
| E | Cooling               | From Main Heating Temperature to 100°C      | 4°C/s (max) |

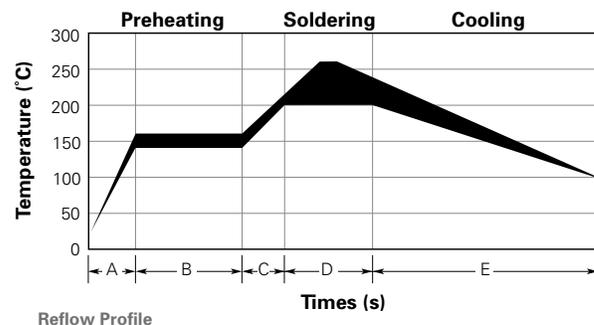


Table E8 — Tape Specifications

| Tape Dimension<br>EIA Mark | 0402           |           | 0603           |           | 1206Q          |           |
|----------------------------|----------------|-----------|----------------|-----------|----------------|-----------|
|                            | Dimension (mm) | Tolerance | Dimension (mm) | Tolerance | Dimension (mm) | Tolerance |
| W                          | 8.00           | ±0.30     | 8.00           | ±0.30     | 8.00           | ±0.30     |
| P <sub>0</sub>             | 4.00           | ±0.10     | 4.00           | ±0.10     | 4.00           | ±0.10     |
| P <sub>1</sub>             | 2.00           | ±0.05     | 4.00           | ±0.05     | 4.00           | ±0.05     |
| P <sub>2</sub>             | 2.00           | ±0.05     | 2.00           | ±0.05     | 2.00           | ±0.05     |
| A <sub>0</sub>             | 0.63           | ±0.03     | 1.27           | ±0.15     | 2.02           | ±0.20     |
| B <sub>0</sub>             | 1.13           | ±0.03     | 2.02           | ±0.20     | 3.62           | ±0.20     |
| D <sub>0</sub>             | 1.50           | ±0.10     | 1.50           | ±0.10     | 1.50           | ±0.10     |
| F                          | 3.50           | ±0.05     | 3.50           | ±0.05     | 3.50           | ±0.05     |
| E <sub>1</sub>             | 1.75           | ±0.10     | 1.75           | ±0.10     | 1.75           | ±0.10     |
| T                          | 0.48           | ±0.03     | 0.60           | ±0.03     | 0.75           | ±0.05     |

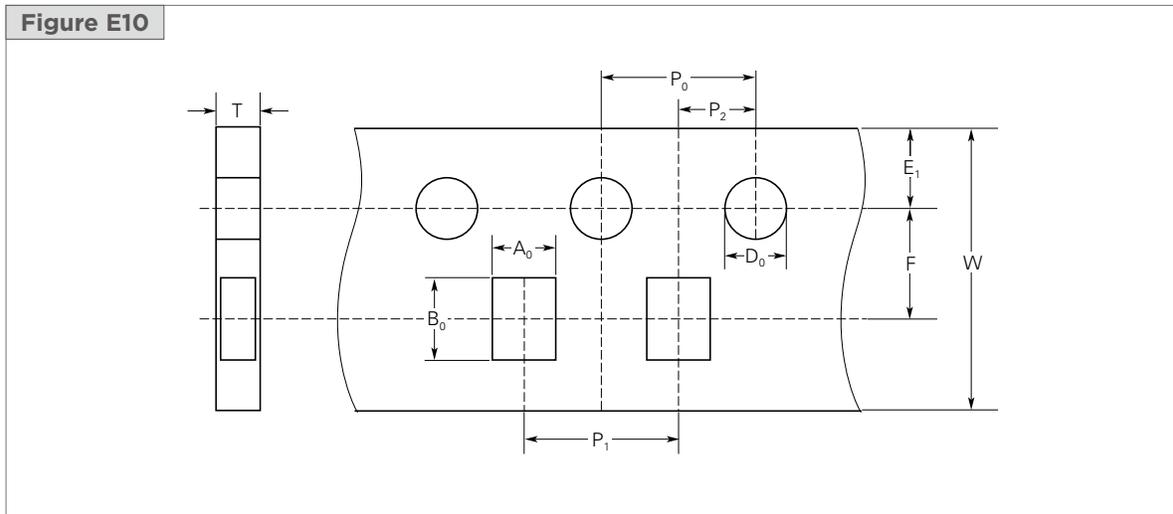
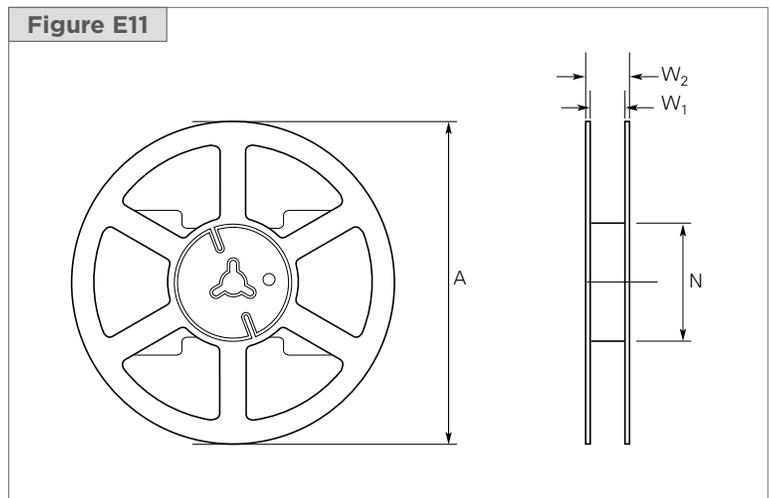


Table E9 — Reel Specifications

| Reel Dimensions (0402, 0603 & 1206Q) |                |
|--------------------------------------|----------------|
| EIA Mark                             | Dimension (mm) |
| A max                                | 180.0          |
| N min                                | 60.5           |
| W <sub>1</sub> max                   | 9.5            |
| W <sub>2</sub> max                   | 14.0           |



## Parameter Definitions

### Operation Voltage ( $V_{DC}$ )

Defined as DC voltage, under which device is in OFF state and leakage current below certain threshold.

### Leakage Current ( $I_L$ )

Current through device under Operation Voltage  $V_{DC}$ .

### Trigger Voltage ( $V_T$ )

Voltage at which the device switches from the OFF to the ON state, during the IEC waveform or the TLP system.

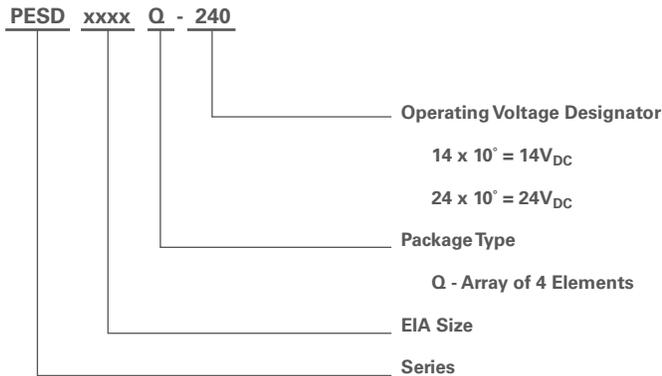
### Clamping Voltage ( $V_C$ )

Voltage across device under 8kV per IEC or measured by TLP system. Typically measured 30ns after initiation of the ESD pulse (for TLP, both 30ns and 60ns are sometimes used).

### Capacitance ( $C_P$ )

Capacitance of the device measured at 1MHz with 0V and max operating voltage bias.

## Part Numbering System



### Warning :

**Application Limitations for PESD0402-140, PESD0402-240, PESD0603-240 and PESD1206Q-240: These parts are not intended to be used on power lines or for power bus applications. Users should independently evaluate the suitability of and test each product selected for their own application.**

### Notice:

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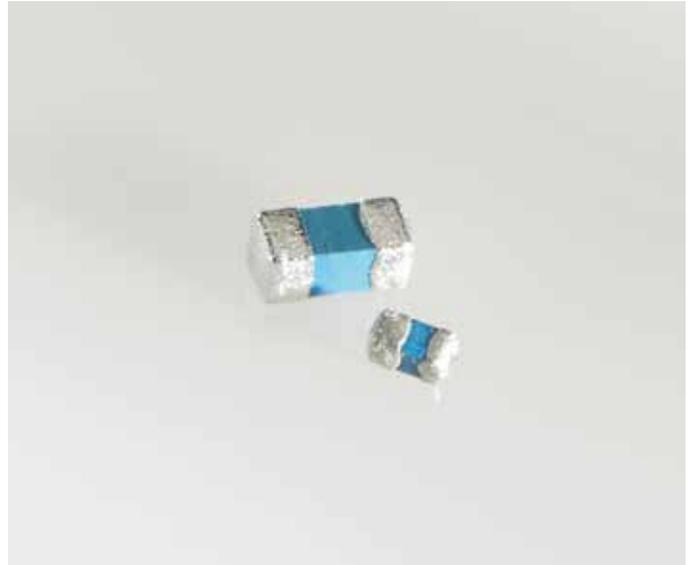
# CHIPSESD DEVICES

TE Circuit Protection's ChipSESD family of Silicon ESD devices, available in EIA-0201 and EIA-0402 sized rectangular SMT passive component packages, can help protect electronic circuits against damage from electrostatic discharge (ESD) events.

The SESD0201P1BN-0400-090, 0201-sized ChipSESD device's miniature footprint (0.6mm x 0.3mm x 0.3mm) is approximately 70% smaller than prior-generation devices. This offers designers flexibility in space constrained applications.

The ChipSESD devices are high-capacitance, bi-directional devices that can be used for low-speed generic interfaces such as keypads, power buttons, speakers and microphone ports in a portable electronics. The bi-directional operation eliminates orientation constraints and the need for polarity inspections. The surface mount technology (SMT) passive component package allows the devices to be easily installed onto the printed circuit board using the standard PCB assembly process. Once soldered onto the boards, the ChipSESD's solder fillets at the end terminals can easily be visually inspected.

The ChipSESD devices offer 10kV contact and 16kV air discharge protection per the IEC61000-4-2, level 4 standard with a surge rating of 2A under 8x20µs pulse.



## BENEFITS

- Silicon ESD devices in an EIA-0201 and EIA-0402 sized rectangular SMT passive component package
- Bi-directional operation eliminates orientation constraints
- Standard PCB assembly and rework process
- ESD protection in space-constrained portable electronics and mobile handsets
- Helps protect electronic circuits against damage from ESD
- Assists equipment to pass IEC61000-4-2, level 4 testing

## FEATURES

- Input capacitance -4.0pF (typ) & 4.5pF (typ)
- Low leakage current - 1.0µA (max)
- Low working reverse voltage - 6.0V (max)
- Capable of withstanding numerous ESD strikes
- RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)

## APPLICATIONS

- Mobile phones and portable electronics
- Digital cameras and camcorders
- Notebooks, set top boxes, motherboards
- USB 2.0 and computer I/O ports
- Applications requiring high ESD performance in a small package

Table CE1 — Maximum Ratings

| Part Number           | IEC61000-4-2, level 4 (ESD Withstand) |          | Temperature    |              |
|-----------------------|---------------------------------------|----------|----------------|--------------|
|                       | Contact (kV)                          | Air (kV) | Operating (°C) | Storage (°C) |
| SESD0201P1BN-0400-090 | ±10*                                  | ±16      | -40 to +125    | -40 to +125  |
| SESD0402P1BN-0450-090 | ±10*                                  | ±16      | -40 to +125    | -40 to +125  |

\*10kV @ 50 ± pulses under IEC61000-4-2; 8kV @ 1,000 pulses under IEC61000-4-2

Table CE2 — Electrical Characteristics @T=25°C

| Part Number           | Input Capacitance* |          | Leakage Current (max)<br>$I_L @ V_{RWM} = 6.0V (\mu A)$ | Breakdown Voltage (min)<br>$V_{br} @ I_T^\dagger = 1mA (V)$ | Working Reverse Voltage<br>$V_{RWM} @ \text{peak} (V)$ | Clamping Voltage (typ)<br>$V_{CL} @ I_{pp}=2A,$<br>$t_p=(8/20\mu s) (V)^*$ |
|-----------------------|--------------------|----------|---|---|--|--|
|                       | Typ (pF)           | Max (pF) |   |   |  |  |
| SESD0201P1BN-0400-090 | 4.0                | 5.0      | 1.0   | 9.0   | 6.0  | +10.0  |
| SESD0402P1BN-0450-090 | 4.5                | 5.5      | 1.0   | 9.0   | 6.0  | +10.0  |

\* @  $V_r=0V$ ,  $f=1MHz$

†  $V_{br}$  is measured at test current  $I_T$

Figure CE1 — ESD Clamping Voltage - 8kV Contact

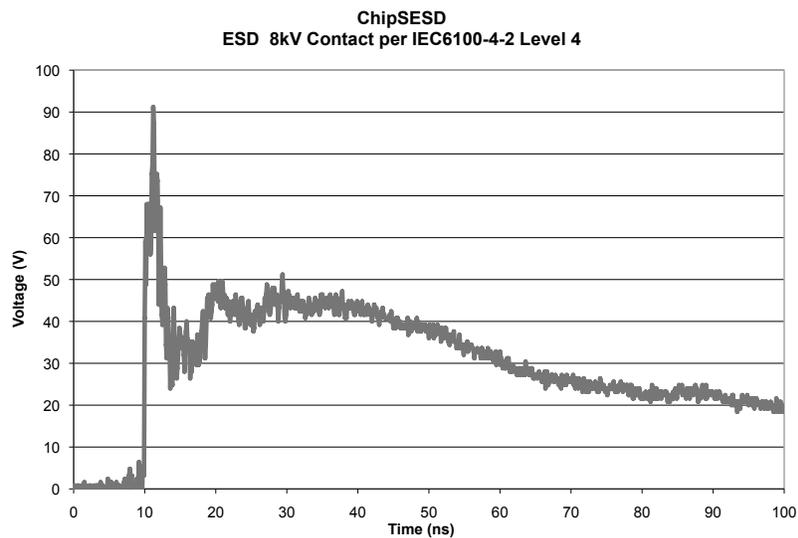


Figure CE2 — ESD Clamping Voltage - 8x20µs, 2A Surge

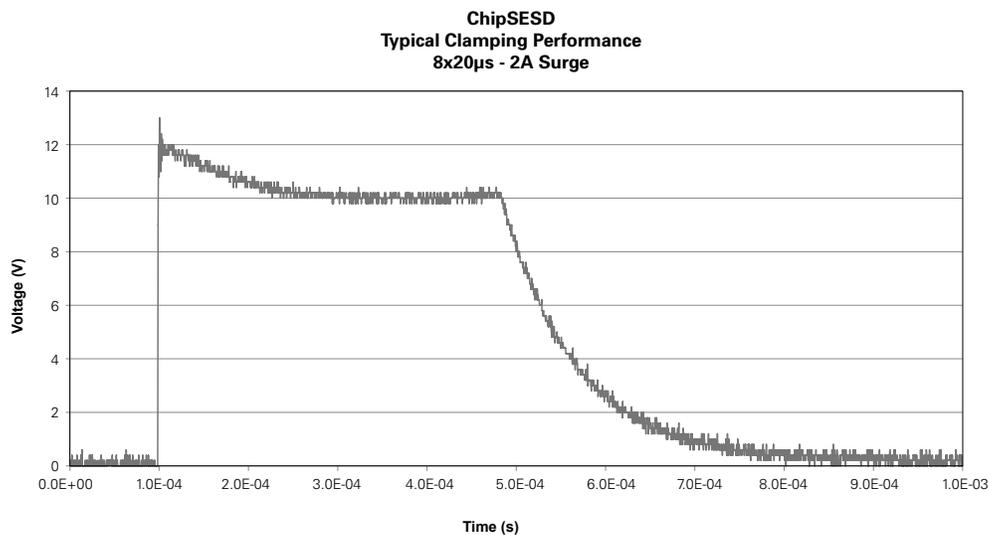


Table CE3 - Dimensions in Millimeters and (Mils)\*

| Part Number | A               | B               | C               | D               | Figure |
|-------------|-----------------|-----------------|-----------------|-----------------|--------|
| SESD0201P   | $0.60 \pm 0.05$ | $0.30 \pm 0.05$ | $0.30 \pm 0.05$ | $0.21 \pm 0.07$ | CE3    |
|             | (23.62 ± 2.00)  | (11.81 ± 2.00)  | (11.81 ± 2.00)  | (8.27 ± 2.80)   |        |
| SESD0402P   | $1.10 \pm 0.10$ | $0.50 \pm 0.10$ | $0.50 \pm 0.10$ | $0.25 \pm 0.15$ | CE3    |
|             | (43.31 ± 0.40)  | (19.69 ± 4.00)  | (19.69 ± 4.00)  | (9.84 ± 6.00)   |        |

\* Round off approximation

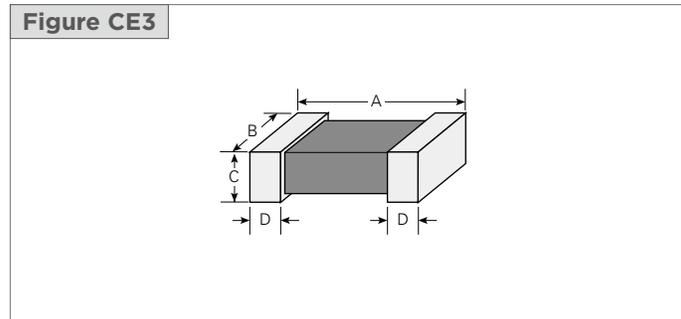


Table CE4 - PCB Pad Layout in Millimeters and (Mils)\*

| Part Number | L               | S               | W               | Figure |
|-------------|-----------------|-----------------|-----------------|--------|
| SESD0201P   | $0.28 \pm 0.01$ | $0.19 \pm 0.01$ | $0.30 \pm 0.01$ | CE4    |
|             | (11.00 ± 0.40)  | (7.50 ± 0.40)   | (11.80 ± 0.40)  |        |
| SESD0402P   | $0.61 \pm 0.05$ | $0.52 \pm 0.05$ | $0.50 \pm 0.05$ | CE4    |
|             | (24.00 ± 2.00)  | (21.00 ± 2.00)  | (20.00 ± 2.00)  |        |

\* Round off approximation

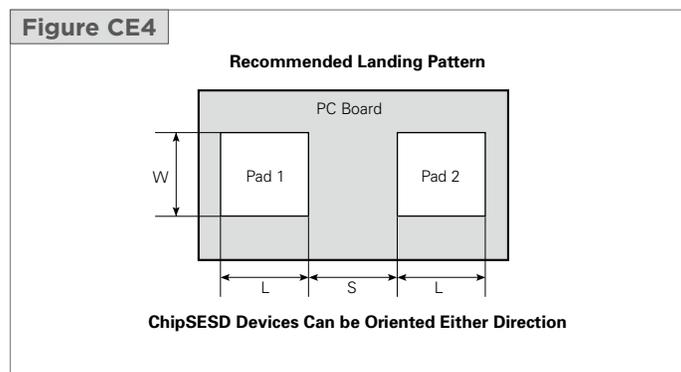


Table CE5 – Tape Specifications

| Tape Dimension<br>EIA Mark | SESD0201P1BN-0400-090 | SESD0402P1BN-0450-090 |
|----------------------------|-----------------------|-----------------------|
|                            | Dimension (mm)        | Dimension (mm)        |
| A                          | $0.35 \pm 0.02$       | $0.58 \pm 0.03$       |
| B                          | $0.67 \pm 0.02$       | $1.20 \pm 0.03$       |
| D                          | $1.55 \pm 0.05$       | $1.55 \pm 0.05$       |
| E                          | $1.75 \pm 0.05$       | $1.75 \pm 0.05$       |
| F                          | $3.50 \pm 0.05$       | $3.50 \pm 0.05$       |
| W                          | $8.00 \pm 0.10$       | $8.00 \pm 0.10$       |
| P <sub>0</sub>             | $4.00 \pm 0.10$       | $4.00 \pm 0.10$       |
| P <sub>1</sub>             | $2.00 \pm 0.05$       | $2.00 \pm 0.05$       |
| P <sub>2</sub>             | $2.00 \pm 0.05$       | $2.00 \pm 0.05$       |
| T                          | $0.42 \pm 0.03$       | $0.60 \pm 0.03$       |

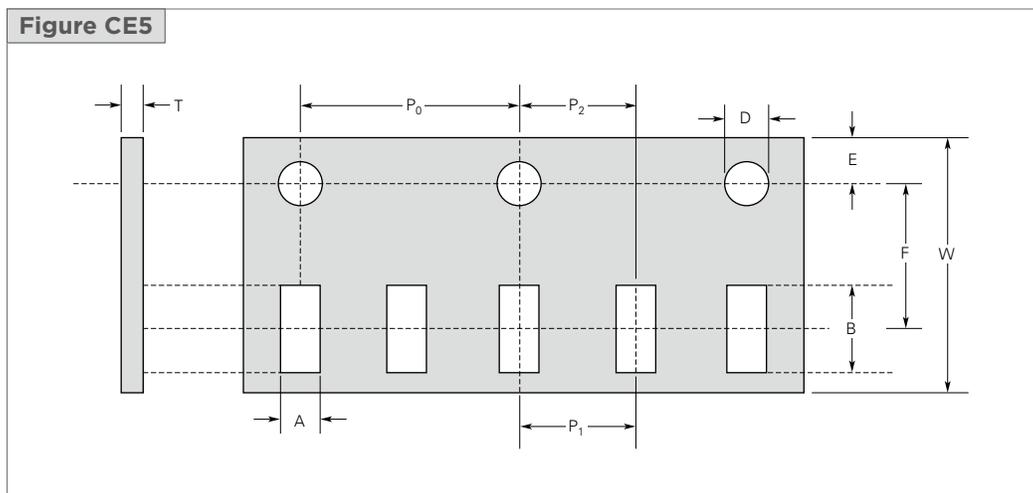
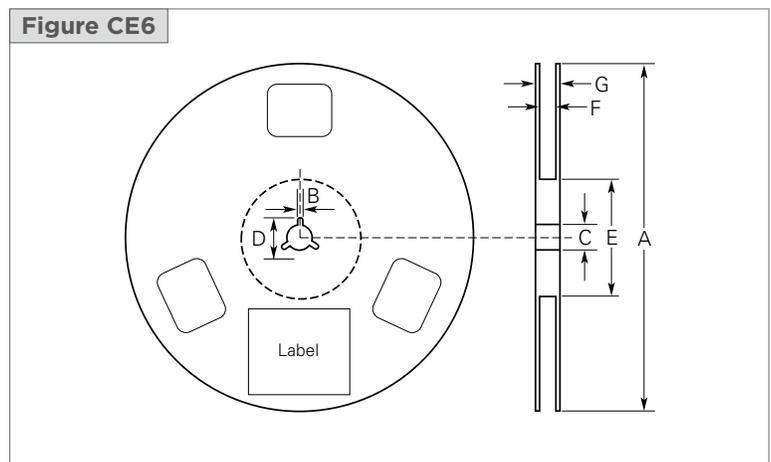


Table CE6 – Reel Specifications

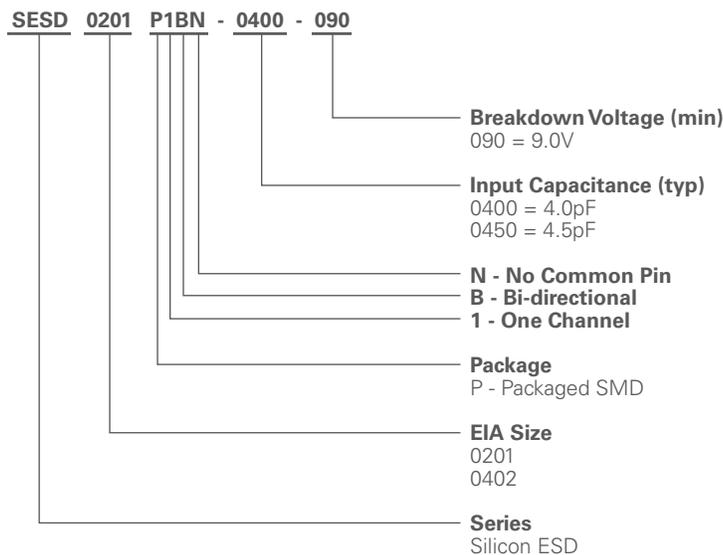
| Reel Dimension<br>EIA Mark | Dimension (mm)  |
|----------------------------|-----------------|
| A                          | $178.0 \pm 2.0$ |
| B                          | $2.0 \pm 0.5$   |
| C                          | $13.0 \pm 0.5$  |
| D                          | $21.0 \pm 0.8$  |
| E                          | $62.0 \pm 1.5$  |
| F                          | $9.0 \pm 0.5$   |
| G                          | $13.0 \pm 1.0$  |



## Definition of Terms

|           |                                     |
|-----------|-------------------------------------|
| $I_L$     | Reverse Leakage Current @ $V_{RWM}$ |
| $V_{RWM}$ | Working Peak Reverse Voltage        |
| $V_{br}$  | Breakdown Voltage @ $I_T$           |
| $I_T$     | Test Current                        |
| $V_{CL}$  | Clamping Voltage                    |

## Part Numbering System



### Notice:

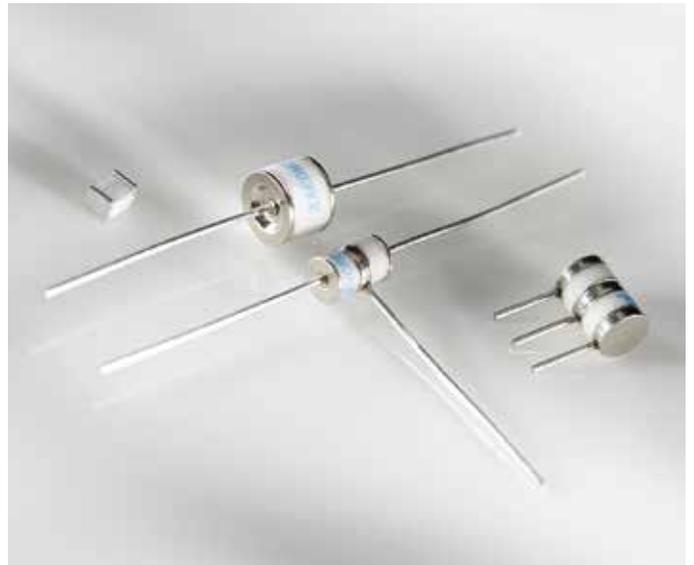
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# GAS DISCHARGE TUBES (GDTs)

TE Circuit Protection's GDTs (Gas Discharge Tubes) are placed in front of, and in parallel with, sensitive telecom equipment such as power lines, communication lines, signal lines and data transmission lines to help protect them from damage caused by transient surge voltages that may result from lightning strikes and equipment switching operations. These devices do not influence the signal in normal operation. However, in the event of an overvoltage surge, such as a lightning strike, the GDT switches to a low impedance state and diverts the energy away from the sensitive equipment.

Our GDTs offer a high level of surge protection, a broad voltage range, low capacitance, and many form factors including new surface mount devices, which makes them suitable for applications such as Main Distribution Frame (MDF) modules, high data-rate telecom applications (e.g. ADSL, VDSL), and surge protection on power lines. Their low capacitance also results in less signal distortion. When used in a coordinated circuit protection solution with PolySwitch devices, they can help equipment manufacturers meet stringent safety regulatory standards.



When used in a coordinated circuit protection solution with PolySwitch devices, they can help equipment manufacturers meet stringent safety regulatory standards.

## BENEFITS

- Helps provide overvoltage fault protection against damage caused by high energy surges
- Suitable for use in sensitive equipment due to impulse sparkover response
- Suitable for high-frequency applications
- Highly reliable performance
- New surface-mount devices for automated manufacturing

## FEATURES

- RoHS compliant
- Halogen free (refers to: Br $\leq$ 900ppm, Cl $\leq$ 900ppm, Br+Cl $\leq$ 1500ppm)
- Wide range of voltages (75V-4000V)
- Wide range of form factors (3mm, 5mm, 6mm, 7mm, 8mm diameter devices)
- Low capacitance and insertion loss
- Crowbar device with low arc voltage
- High accuracy spark-over voltages for high precision designs

## APPLICATIONS

- Telecommunications
  - MDF modules, xDSL equipment, RF systems, antenna, base stations
- Industrial and Consumer Electronics
  - Power supplies, surge protectors, alarm systems, irrigation systems

- Devices tested per ITU K.12 recommendations
- Various lead configurations and surface-mount options
- Optional fail-short mechanism
- Non radioactive materials
- Devices certified to UL497B and UL1449

Figures G1-G2 – Typical Circuits for Gas Discharge Tubes

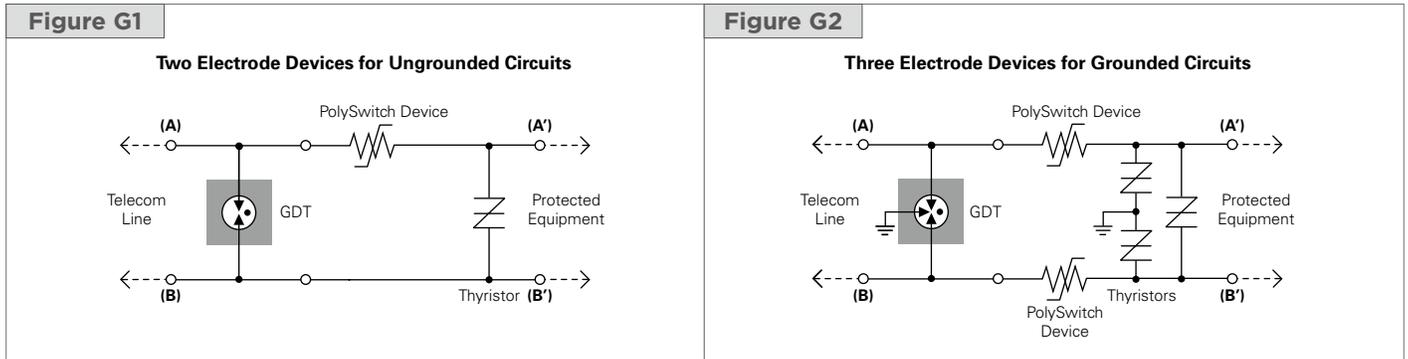


Table G1 – Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance and Agency Approval for Two-Electrode Gas Discharge Tubes

| Part Number       | DC Sparkover Voltage        | Impulse Sparkover Voltage | Impulse Discharge Current                   |  | Impulse Withstanding Voltage                   | Capacitance | Insulation Resistance             | UL Rating   |          |
|-------------------|-----------------------------|---------------------------|---|--|--|-------------|-----------------------------------|-------------|----------|
|                   | @ 100V/s<br>± 20% Tolerance | @ 1kV/μs                  | 8x20μs<br>10 Hits<br>(5 Hits Each Polarity) | 8x20μs<br>300 Hits<br>(150 Hits Each Polarity) | 10/700μs<br>10 Hits<br>(5 Times Each Polarity) | @ 1MHz      | @ 100V <sub>DC</sub> <sup>†</sup> | UL497B      | #E179610 |
| GTCS23-XXXM-R01-2 | 75*                         | 600                       | 1kA   | 100A   | 4kV  | <0.5pF      | 1,000 (MΩ)                        | All Devices |          |
|                   | 90                          | 600                       |   |  |  |             |                                   |             |          |
|                   | 140                         | 600                       |   |  |  |             |                                   |             |          |
|                   | 150                         | 600                       |   |  |  |             |                                   |             |          |
| GTCC23-XXXM-R01-2 | 200                         | 700                       | 1kA   | 100A   | 6kV <sup>‡</sup>                               | <0.5pF      | 1,000 (MΩ)                        | All Devices |          |
|                   | 230                         | 700                       |   |  |  |             |                                   |             |          |
|                   | 300                         | 900                       |   |  |  |             |                                   |             |          |
|                   | 350                         | 1000                      |   |  |  |             |                                   |             |          |
|                   | 400                         | 1000                      |   |  |  |             |                                   |             |          |

\* DCSO 60~105  
<sup>†</sup> Devices <=150V measured @ 50V<sub>DC</sub>  
<sup>‡</sup> Effective output impedance: 40ohms

| Part Number       | DC Sparkover Voltage        | Impulse Sparkover Voltage |          | DC Holdover Voltage | On-State Voltage  | Impulse Discharge Current | Impulse Life          | AC Discharge Current (1s duration; 10 hits) | Capacitance        | Insulation Resistance | UL Rating          |
|-------------------|-----------------------------|---------------------------|----------|---------------------|-------------------|---------------------------|-----------------------|---|--------------------|-----------------------|--------------------|
|                   | @ 100V/s<br>± 20% Tolerance | @ 100V/μs                 | @ 1kV/μs | Per ITU K.12        | Nominal (@1A) (V) | 8x20μs<br>10 Hits         | 10x1000μs<br>300 Hits | @ 50 Hz                                     | @ 1MHz             | @ 100V <sub>DC</sub>  | UL497B<br>#E179610 |
| GTCX25-XXXM-R02   | 75                          | 450                       | 550      | <52                 | 20                | 2.5kA                     | 100A                  | 2.5Arms                                     | <1pF               | 10,000 (MΩ)           | All Devices        |
|                   | 90                          | 450                       | 550      | <52                 | 20                |                           |                       |   |                    |                       |                    |
|                   | 140                         | 500                       | 600      | <80                 | 20                |                           |                       |   |                    |                       |                    |
| GTCX26-XXXM-R05   | 150                         | 500                       | 600      | <80                 | 20                | 5kA                       | 100A                  | 5Arms                                       | <1pF               | 10,000 (MΩ)           | All Devices        |
|                   | 200                         | 600                       | 700      | <135                | 20                |                           |                       |   |                    |                       |                    |
|                   | 230                         | 600                       | 700      | <135                | 20                |                           |                       |   |                    |                       |                    |
| GTCX28-XXXM-R05   | 250                         | 600                       | 700      | <135                | 20                | 5kA                       | 100A                  | 5Arms                                       | <1pF               | 10,000 (MΩ)           | All Devices        |
|                   | 260                         | 700                       | 800      | <135                | 20                |                           |                       |   |                    |                       |                    |
|                   | 300                         | 800                       | 900      | <150                | 20                |                           |                       |   |                    |                       |                    |
| GTCX28-XXXM-R10   | 350                         | 900                       | 1000     | <150                | 20                | 10kA                      | 100A                  | 10Arms                                      | <1pF <sup>††</sup> | 10,000 (MΩ)           | All Devices        |
|                   | 400                         | 900                       | 1000     | <150                | 20                |                           |                       |   |                    |                       |                    |
|                   | 420                         | 900                       | 1000     | <150                | 20                |                           |                       |   |                    |                       |                    |
|                   | 470                         | 1050                      | 1150     | <150                | 20                |                           |                       |   |                    |                       |                    |
|                   | 500                         | 1100                      | 1200     | <150                | 20                |                           |                       |   |                    |                       |                    |
| GTCX28-XXXM-R20** | 550                         | 1300                      | 1400     | <150                | 20                | 20kA                      | 100A                  | 20Arms                                      | <1.5pF             | 10,000 (MΩ)           | All Devices        |
|                   | 600                         | 1300                      | 1400     | <150                | 20                |                           |                       |   |                    |                       |                    |

\*\* GTCX28-XXXM-R20 parts only up to 350V  
<sup>††</sup> <1.2pF for 75V and 90V devices.

Table G2 — Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance and Agency Approval for Two Electrode High-Voltage Gas Discharge Tubes

| Part Number     | DC Sparkover Voltage     | Impulse Sparkover Voltage | Impulse Life | AC Discharge Current, 50Hz           |                      | Impulse Discharge Current 8/20µs |       | Capacitance | UL Rating         |
|-----------------|--------------------------|---------------------------|--------------|--------------------------------------|----------------------|----------------------------------|-------|-------------|-------------------|
|                 | @ 100V/s ± 20% Tolerance | @ 100V/µs                 |              | Multiple Hits (1s Duration: 10 Hits) | Single Hit, 9 Cycles | 10 Hits (5 Hits Each Polarity)   | 1 Hit |             |                   |
| GTCA28-801M-R05 | 800                      | 1400                      | 300 times    | 5A                                   | N/A                  | 5kA                              | N/A   | <1pF        | UL1449 #E332226 ✓ |
| GTCA28-102M-R03 | 1000                     | 1700                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-122M-R03 | 1200                     | 1900                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-152L-R03 | 1500 (± 15%)*            | 2200                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-212M-R03 | 2100                     | 2700                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-242M-R03 | 2400                     | 3300                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-252M-R03 | 2500                     | 3500                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-272L-R03 | 2700 (± 15%)*            | 3700                      | 300Times†    | N/A                                  | N/A                  | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-302M-R03 | 3000                     | 4000                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-312L-R03 | 3100 (± 15%)*            | 3700‡                     | 300Times†    | N/A                                  | N/A                  | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-362M-R03 | 3600                     | 4600                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |
| GTCA28-402M-R03 | 4000                     | 5000                      | N/A          | 1A                                   | 5A                   | 3kA                              | 10kA  | <1pF        | ✓                 |

Note: Insulation resistance: ≥10,000MΩ (all parts measured @ 1000V<sub>DC</sub>, except 800V/1000V/1200V @250V<sub>DC</sub>; 1500V/2100V @ 500V<sub>DC</sub>)

\* DC Sparkover Voltage measured at 5kV/s

† Measured with 8/20µs, 100A impulse

‡ Measured at 1000V/µs

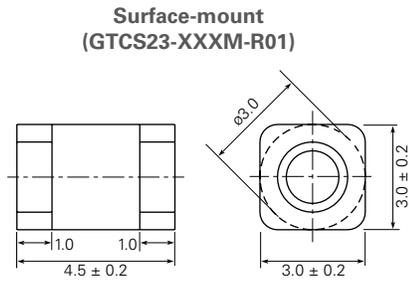
Table G3 — Device Voltage Ratings, Surge Rating, Capacitance, Insulation Resistance and Agency Approval for Three-Electrode Gas Discharge Tubes

| Part Number     | DC Sparkover Voltage (A-E) (B-E) | Impulse Sparkover Voltage (A-E) (B-E) |          | DC Holdover Voltage | On-State Voltage  | Impulse Discharge Current (A+B-E) | Impulse Life (A+B-E) | AC Discharge Current (1s duration; 10 hits) (A+B-E) | Capacitance | Insulation Resistance  | UL Rating       |
|-----------------|----------------------------------|---------------------------------------|----------|---------------------|-------------------|-----------------------------------|----------------------|---|-------------|------------------------|-----------------|
|                 | @ 100V/s ± 20% Tolerance         | @ 100V/µs                             | @ 1kV/µs | Per ITU K.12        | Nominal (@1A) (V) | 8x20µs 10 Hits                    | 10x1000µs 300 Hits   | @ 50 Hz   | @ 1MHz      | @ 100V <sub>DC</sub> * | UL497B #E179610 |
| GTCX35-XXXM-R05 | 75                               | 450                                   | 550      | <52                 | 20                | 5kA                               | 100A                 | 5Arms   | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 90                               | 450                                   | 550      | <52                 | 20                |                                   |                      |   |             |                        |                 |
| GTCX36-XXXM-R05 | 140                              | 500                                   | 600      | <80                 | 20                | 5kA                               | 200A                 | 5Arms   | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 150                              | 500                                   | 600      | <80                 | 20                |                                   |                      |   |             |                        |                 |
| GTCX36-XXXM-R10 | 200                              | 600                                   | 700      | <135                | 20                | 10kA                              | 200A                 | 10Arms  | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 230                              | 600                                   | 700      | <135                | 20                |                                   |                      |   |             |                        |                 |
|                 | 250                              | 600                                   | 700      | <135                | 20                |                                   |                      |   |             |                        |                 |
| GTCX37-XXXM-R10 | 260                              | 700                                   | 800      | <135                | 20                | 10kA                              | 200A                 | 10Arms  | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 300                              | 800                                   | 900      | <150                | 20                |                                   |                      |   |             |                        |                 |
|                 | 350                              | 900                                   | 1000     | <150                | 20                |                                   |                      |   |             |                        |                 |
|                 | 400                              | 900                                   | 1000     | <150                | 20                |                                   |                      |   |             |                        |                 |
| GTCX38-XXXM-R10 | 420                              | 900                                   | 1000     | <150                | 20                | 10kA                              | 200A                 | 10Arms  | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 470                              | 1050                                  | 1150     | <150                | 20                |                                   |                      |   |             |                        |                 |
|                 | 500                              | 1100                                  | 1200     | <150                | 20                |                                   |                      |   |             |                        |                 |
| GTCX38-XXXM-R10 | 550                              | 1300                                  | 1400     | <150                | 20                | 10kA                              | 200A                 | 10Arms  | <1pF        | 10,000 (MΩ)            | All Devices     |
|                 | 600                              | 1300                                  | 1400     | <150                | 20                |                                   |                      |   |             |                        |                 |

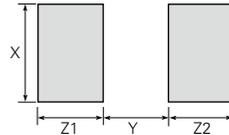
\* Insulation resistance measured at 50V for devices less than 150V.  
Insulation resistance measured at 250V for devices more than 500V.

Figures G3-G11 — Dimensions for Gas Discharge Tubes

Figure G3 — Two Electrode 3mm Product Dimensions



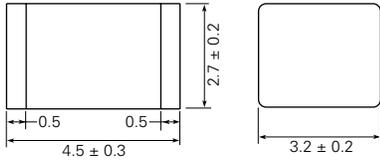
**Pad Layout - Surface-mount Devices  
(GTCS23-XXXM-R01)**



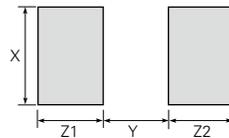
|     | X<br>Nom | Y<br>Nom | Z1<br>Nom | Z2<br>Nom |
|-----|----------|----------|-----------|-----------|
| mm  | 3.0      | 2.0      | 2.0       | 2.0       |
| in* | 0.118    | 0.079    | 0.079     | 0.079     |

\* The dimensions in inches are rounded approximations.

**Chip GDT  
(GTCC23-XXXM-R01)**



**Pad Layout - Chip GDT Devices  
(GTCC23-XXXM-R01)**

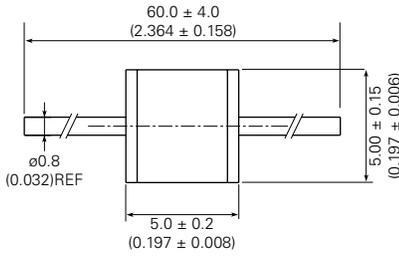


|     | X<br>Nom | Y<br>Nom | Z1<br>Nom | Z2<br>Nom |
|-----|----------|----------|-----------|-----------|
| mm  | 3.5      | 2.7      | 2.0       | 2.0       |
| in* | 0.138    | 0.106    | 0.079     | 0.079     |

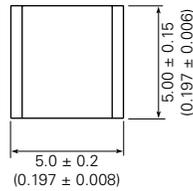
\* The dimensions in inches are rounded approximations.

Figure G4 — Two Electrode 5mm Product Dimensions

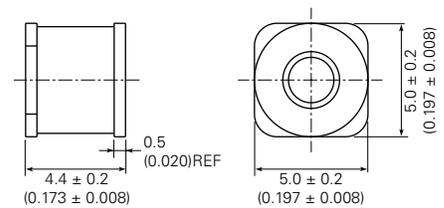
**Axial Leads  
(GTCA25-XXXM-R02)**



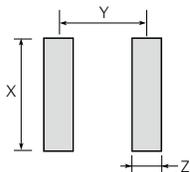
**No Leads  
(GTCN25-XXXM-R02)†**



**Surface-mount  
(GTCS25-XXXM-R02)**



**Pad Layout - Surface-mount Devices  
(GTCS25-XXXM-R02)**



|     | X<br>Nom | Y<br>Nom | Z<br>Nom |
|-----|----------|----------|----------|
| mm  | 6.0      | 3.9      | 1.3      |
| in* | 0.197    | 0.154    | 0.051    |

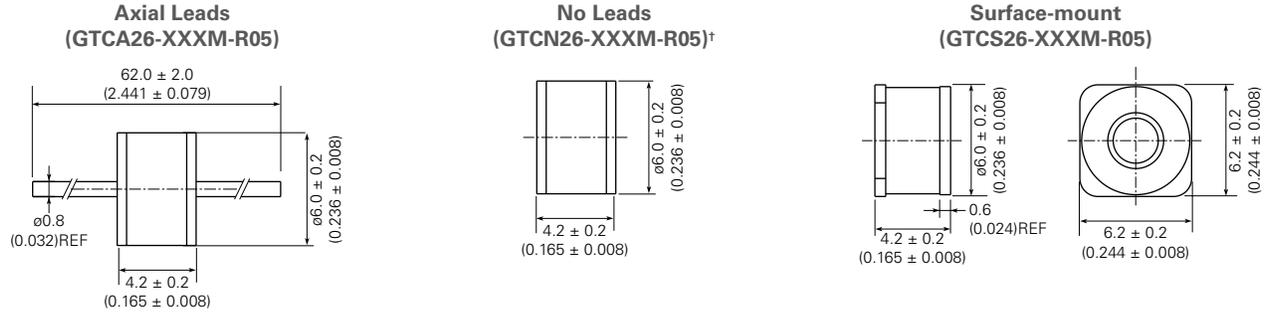
\* The dimensions in inches are rounded approximations.

† Parts with no leads are not solderable and are meant for insertion into magazine clips.

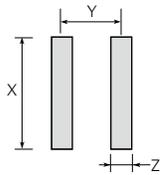
Figures G3-G11 — Dimensions for Gas Discharge Tubes

(Cont'd)

Figure G5 — Two Electrode 6mm Product Dimensions



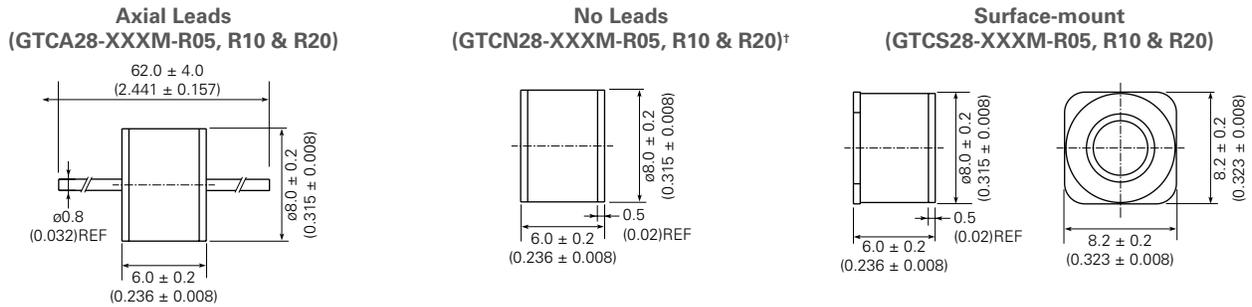
Pad Layout - Surface-mount Devices (GTCS26-XXXM-R05)



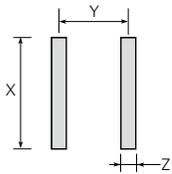
|     | X<br>Nom | Y<br>Nom | Z<br>Nom |
|-----|----------|----------|----------|
| mm  | 7.0      | 3.7      | 1.3      |
| in* | 0.276    | 0.146    | 0.051    |

\* The dimensions in inches are rounded approximations.  
 † Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G6 — Two Electrode 8mm Product Dimensions



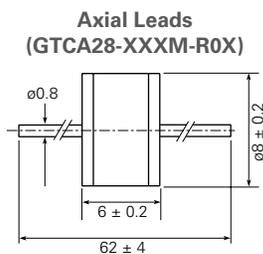
Pad Layout - Surface-mount Devices (GTCS28-XXXM-R05, R10 & R20)



|     | X<br>Nom | Y<br>Nom | Z<br>Nom |
|-----|----------|----------|----------|
| mm  | 9.0      | 5.6      | 1.2      |
| in* | 0.354    | 0.22     | 0.047    |

\* The dimensions in inches are rounded approximations.  
 † Parts with no leads are not solderable and are meant for insertion into magazine clips.

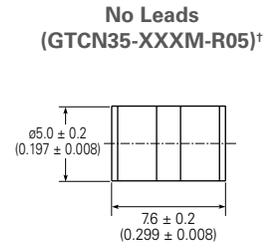
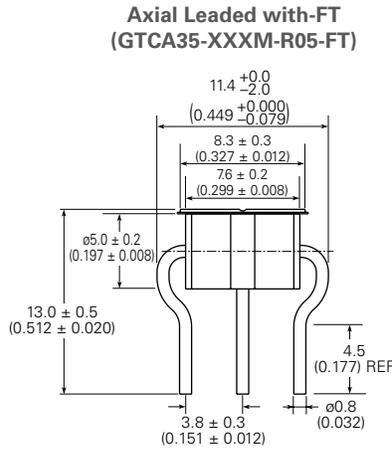
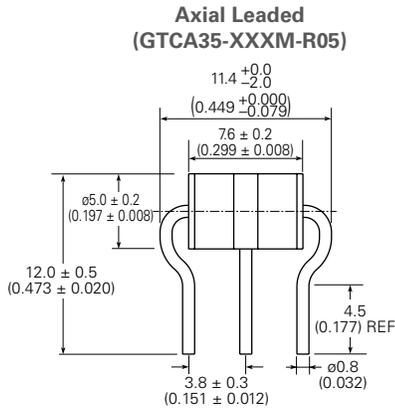
Figure G7 — Two Electrode 8mm High Voltage Product Dimensions



Figures G3-G11 — Dimensions for Gas Discharge Tubes

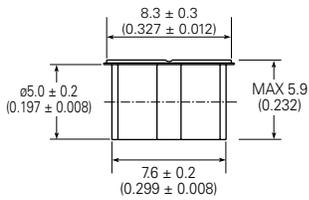
(Cont'd)

Figure G8 — Three Electrode 5mm Product Dimensions

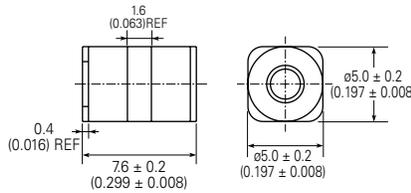


Dimensions in these drawings are in millimeters (inches)

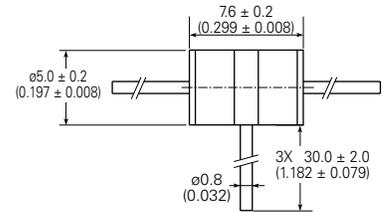
**No Leads with-FT**  
(GTCA35-XXXM-R05-FT)†



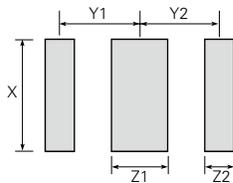
**Surface-mount**  
(GTCS35-XXXM-R05)



**T Leaded**  
(GTCT35-XXXM-R05)



**Pad Layout - Surface-mount Devices**  
(GTCS35-XXXM-R05)



|     | X<br>Nom | Y1<br>Nom | Y2<br>Nom | Z1<br>Nom | Z2<br>Nom |
|-----|----------|-----------|-----------|-----------|-----------|
| mm  | 6.0      | 3.6       | 3.6       | 2.5       | 1.3       |
| in* | 0.236    | 0.142     | 0.142     | 0.098     | 0.051     |

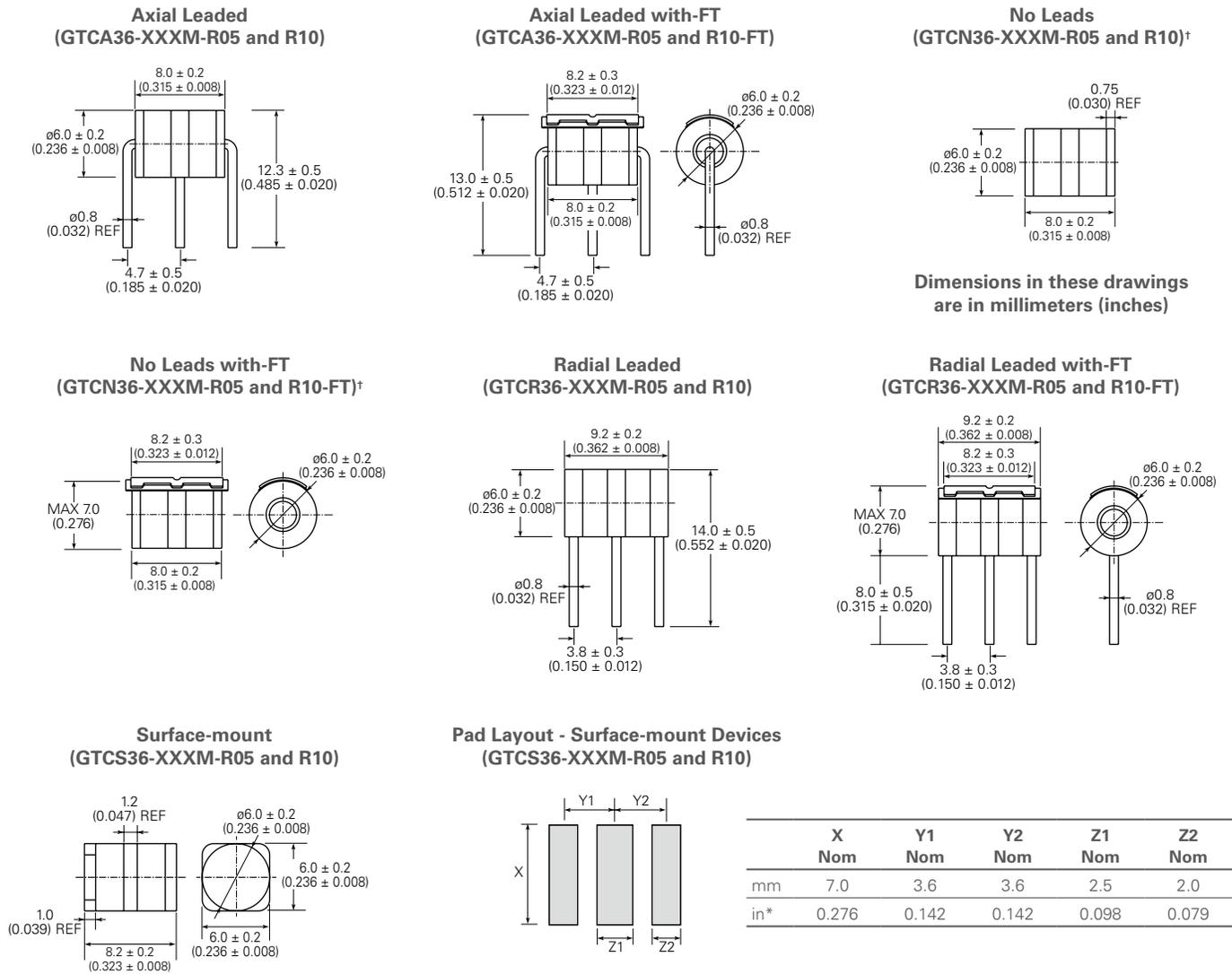
\* The dimensions in inches are rounded approximations.

† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figures G3-G11 — Dimensions for Gas Discharge Tubes

(Cont'd)

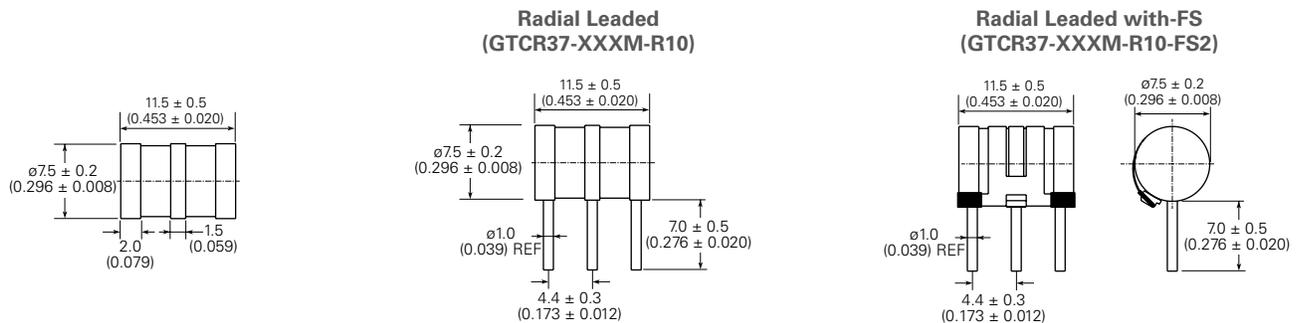
Figure G9 — Three Electrode 6mm Product Dimensions



\* The dimensions in inches are rounded approximations.

† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figure G10 — Three Electrode 7mm Product Dimensions

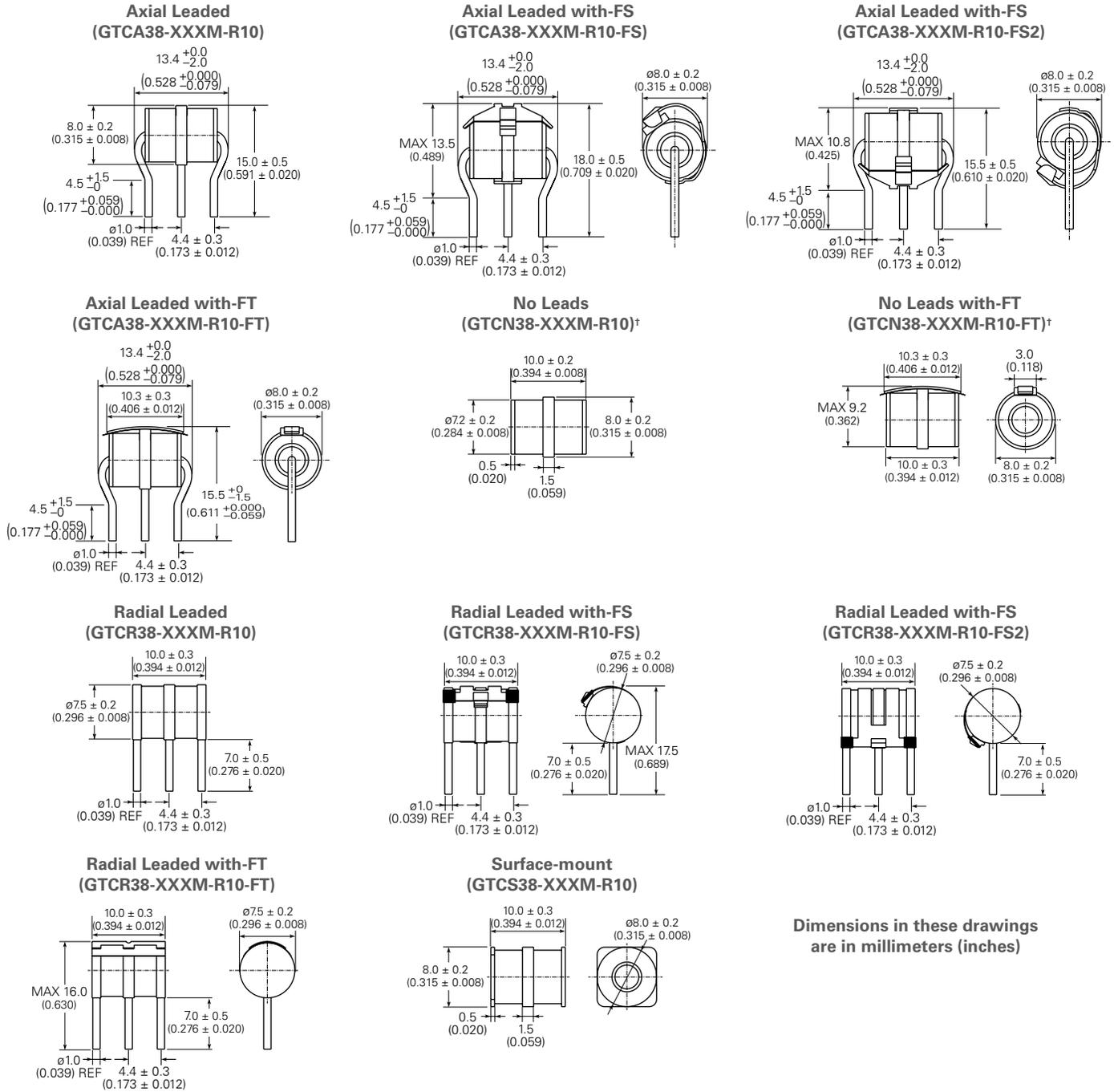


† Parts with no leads are not solderable and are meant for insertion into magazine clips.

Figures G3-G11 — Dimensions for Gas Discharge Tubes

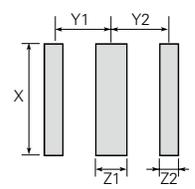
(Cont'd)

Figure G11 — Three Electrode 8mm Product Dimensions



Dimensions in these drawings are in millimeters (inches)

Pad Layout - Surface-mount Devices (GTC38-XXXM-R10)



|     | X<br>Nom | Y1<br>Nom | Y2<br>Nom | Z1<br>Nom | Z2<br>Nom |
|-----|----------|-----------|-----------|-----------|-----------|
| mm  | 9.0      | 4.65      | 4.65      | 2.5       | 1.5       |
| in* | 0.354    | 0.183     | 0.183     | 0.098     | 0.059     |

\* The dimensions in inches are rounded approximations.  
 † Parts with no leads are not solderable and are meant for insertion into magazine clips.

## Fail-Short Mechanism for Gas Discharge Tubes

### Fail-Short Mechanism — FS

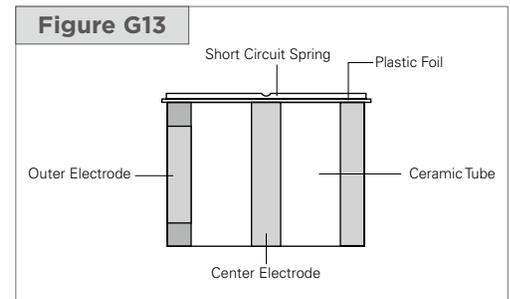
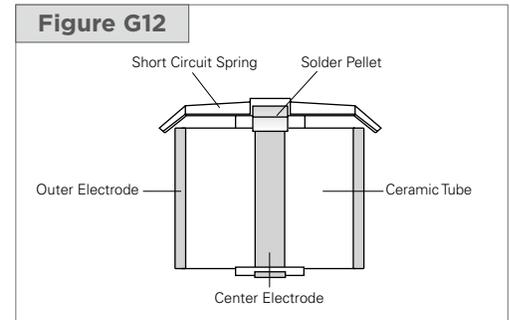
The FS fail-short mechanism is a short circuit spring mounted onto a solder pellet located at the center electrode of the gas tube. Under normal operating conditions, the pellet is positioned to make the spring float above the outer electrodes, as shown in Figure G11 on the previous page.

When a prolonged discharge event causes the gas tube temperature to reach the melting point of the solder, the pellet softens allowing the short circuit spring to contact with both outer electrodes (Figure G12). This process results in a permanent short circuit between all three electrodes creating a low resistance path that conducts the fault current to ground without generating a significant amount of heat.

### Fail-Short Mechanism — FT

The FT fail-short mechanism is a short circuit spring with a piece of plastic foil spot welded onto the center electrode. Under normal operating conditions, the plastic foil makes the spring insulated from the two outer electrodes.

When a prolonged discharge event causes the gas tube temperature to reach the melting point of the plastic foil, the plastic foil melts allowing the short circuit spring to contact both outer electrodes (Figure G13). This process results in a permanent short circuit between all three electrodes creating a low resistance path that conducts the fault current to ground without generating a significant amount of heat.



## Operation and Storage Temperatures for Gas Discharge Tubes

### Operation Temperature Range

Models without Fail-Short Mechanism : -40°C/+90°C  
 Models with Fail-Short Mechanism : -20°C/+65°C

### Storage Temperature Range

Models without Fail-Short Mechanism : -40°C/+90°C  
 Models with Fail-Short Mechanism : -20°C/+65°C

## Packaging Information for Gas Discharge Tubes

| Part Description        | Parts in Bulk      |              | Parts in Tape and Reel           |              |
|-------------------------|--------------------|--------------|----------------------------------|--------------|
|                         | Min Order Quantity | Box Quantity | Tape and Reel Min Order Quantity | Box Quantity |
| 3mm 2Pole Surface-mount | —                  | —            | 2000                             | 16000        |
| 5mm 2Pole No leads      | 5000               | 20000        | —                                | —            |
| 5mm 2Pole Leads         | 1000               | 5000         | —                                | —            |
| 5mm 2Pole Surface-mount | —                  | —            | 1500                             | 12000        |
| 6mm 2Pole No leads      | 2000               | 10000        | —                                | —            |
| 6mm 2Pole Leads         | 1000               | 5000         | —                                | —            |
| 6mm 2Pole Surface-mount | —                  | —            | 750                              | 6000         |
| 8mm 2pole No leads      | 2000               | 10000        | —                                | —            |
| 8mm 2Pole Leads         | 1000               | 5000         | —                                | —            |
| 8mm 2Pole Surface-mount | —                  | —            | 500                              | 4000         |
| 5mm 3Pole No leads      | 2500               | 10000        | —                                | —            |
| 5mm 3Pole Leads         | 1000               | 5000         | —                                | —            |
| 5mm 3Pole Surface-mount | —                  | —            | 1000                             | 8000         |
| 6mm 3Pole No leads      | 2500               | 10000        | —                                | —            |
| 6mm 3Pole Leads         | 1000               | 5000         | —                                | —            |
| 6mm 3Pole Surface-mount | —                  | —            | 750                              | 4500         |
| 7mm 3Pole Leads         | 1000               | 5000         | —                                | —            |
| 8mm 3Pole No leads      | 1000               | 5000         | —                                | —            |
| 8mm 3Pole Leads         | 1000               | 5000         | —                                | —            |
| 8mm 3Pole Surface-mount | —                  | —            | 500                              | 2500         |

## Installation for Gas Discharge Tubes

Care should be taken when installing GDTs equipped with fail-short mechanisms into arrester magazines, printed circuit boards, etc. Too much downward pressure may force the short circuit spring through the thin insulation tube creating a shorted condition.

## Solder Reflow Recommendations for Surface-mount GDT Devices

Surface-mount GDTs can be soldered using standard Pb-free reflow profiles.

Table G4 — Tape and Reel Specifications

| Tape Dimension<br>EIA Mark | 3mm devices (2 pole)<br>Dimension (mm) | 5mm devices (2 pole)<br>Dimension (mm) | 6mm devices (2 pole)<br>Dimension (mm) | 8mm devices (2 pole)<br>Dimension (mm) |
|----------------------------|--|--|--|--|
| A <sub>0</sub>             | 3.40±0.10                              | 4.9±0.10                               | 6.70±0.10                              | 8.60±0.10                              |
| B <sub>0</sub>             | 5.00±0.10                              | 5.5±0.10                               | 4.60±0.10                              | 6.40±0.10                              |
| D <sub>0</sub>             | 1.50+0.10/-0                           | 1.50+0.10/-0                           | 1.50+0.10/-0                           | 1.50+0.10/-0                           |
| D <sub>1</sub>             | —                                      | 1.5 MIN                                | —                                      | —                                      |
| E <sub>1</sub>             | 1.75±0.10                              | 1.75±0.10                              | 1.75±0.10                              | 1.75±0.10                              |
| E <sub>2</sub>             | 14.25±0.30                             | 14.25±0.30                             | 14.25±0.30                             | 14.25±0.30                             |
| F                          | 7.50±0.10                              | 7.50±0.10                              | 7.50±0.10                              | 7.50±0.10                              |
| P <sub>0</sub>             | 4.00±0.10                              | 4.00±0.10                              | 4.00±0.10                              | 4.00±0.10                              |
| P <sub>1</sub>             | 8.00±0.10                              | 8.00±0.10                              | 12.00±0.10                             | 12.00±0.10                             |
| P <sub>2</sub>             | 2.00±0.10                              | 2.00±0.10                              | 2.00±0.10                              | 2.00±0.10                              |
| W                          | 16.00±0.30                             | 16.00±0.30                             | 16.00±0.30                             | 16.00±0.30                             |
| Tape Thickness<br>EIA Mark | Dimension (mm)                         | Dimension (mm)                         | Dimension (mm)                         | Dimension (mm)                         |
| B <sub>1</sub>             | —                                      | —                                      | —                                      | —                                      |
| K <sub>0</sub>             | 3.30±0.10                              | 5.30±0.10                              | 6.50±0.10                              | 8.50±0.10                              |
| T                          | 0.35±0.05                              | 0.40±0.05                              | 0.35±0.05                              | 0.50±0.05                              |
| T <sub>1</sub>             | —                                      | —                                      | —                                      | —                                      |
| T <sub>2</sub>             | —                                      | —                                      | —                                      | —                                      |
| Reel Dimension<br>EIA Mark | Dimension (mm)                         | Dimension (mm)                         | Dimension (mm)                         | Dimension (mm)                         |
| A                          | 330                                    | 330                                    | 330                                    | 330                                    |
| B                          | 2.20±0.50                              | 2.20±0.50                              | 2.20±0.50                              | 2.20±0.50                              |
| C                          | 13.00±0.20                             | 13.00±0.20                             | 13.00±0.20                             | 13.00±0.20                             |
| D                          | 20.20±1.00                             | 20.20±1.00                             | 20.20±1.00                             | 20.20±1.00                             |
| N                          | 100.00±1.00                            | 100.00±1.00                            | 100.00±1.00                            | 100.00±1.00                            |
| W <sub>1</sub>             | 16.50±0.10                             | 16.50±0.10                             | 16.50±0.10                             | 16.50±0.10                             |
| W <sub>2</sub>             | 21.10±02.00                            | 21.10±02.00                            | 21.10±02.00                            | 21.10±02.00                            |

Figure G14 — EIA Referenced Taped Component Dimensions

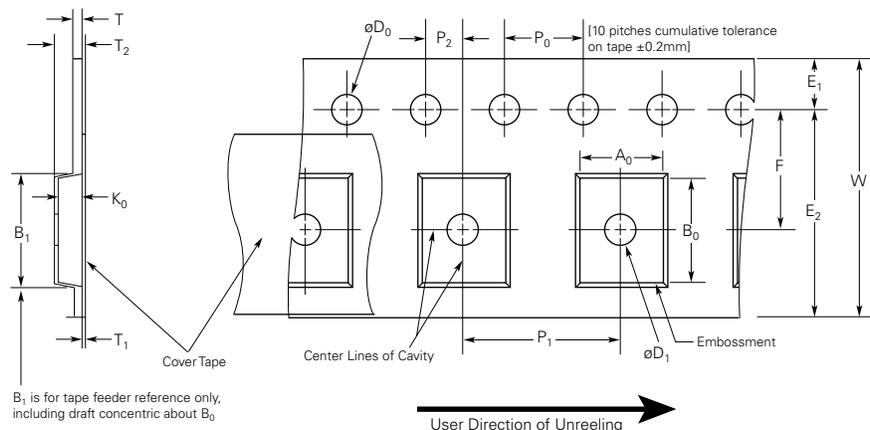
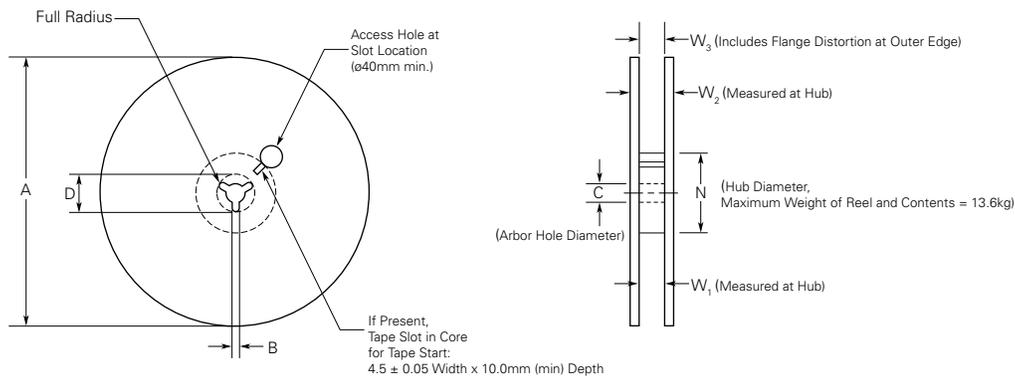


Table G5 — Tape and Reel Specifications

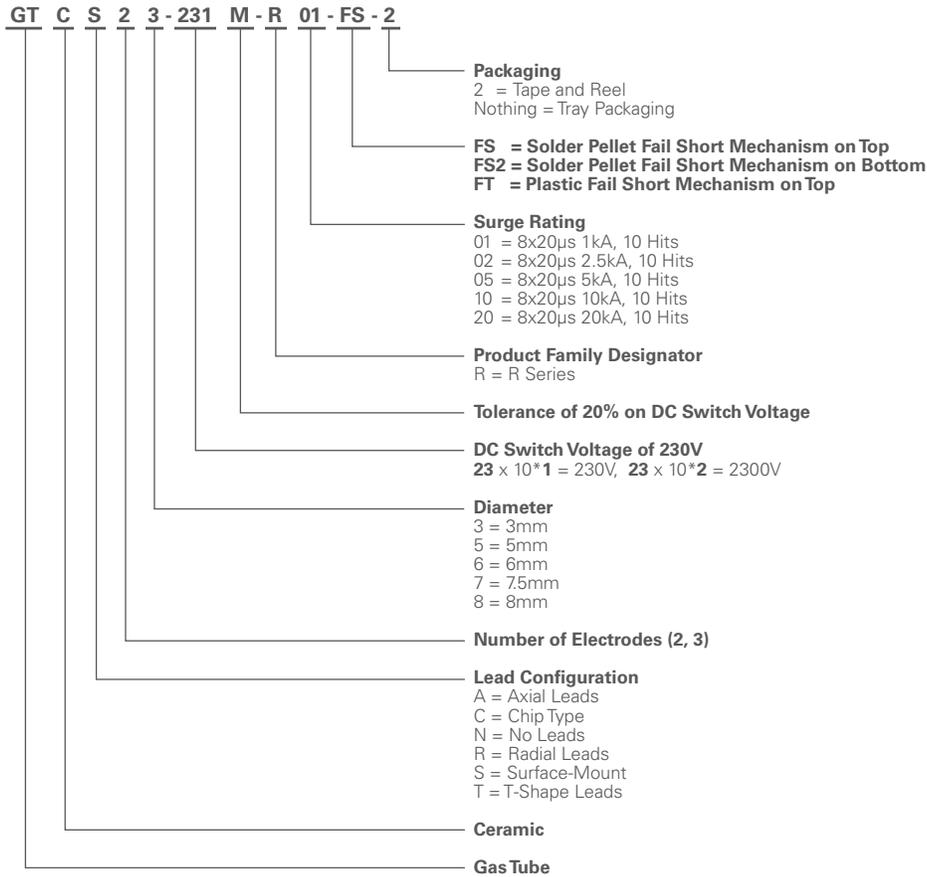
| Tape Dimension<br>EIA Mark | 5mm devices (3 pole)<br>Dimension (mm) | 6mm devices (3 pole)<br>Dimension (mm) | 8mm devices (3 pole)<br>Dimension (mm) |
|----------------------------|--|--|--|
| A <sub>0</sub>             | 5.40±0.10                              | 6.50±0.10                              | 8.50±0.10                              |
| B <sub>0</sub>             | 8.00±0.10                              | 8.60±0.10                              | 10.60±0.10                             |
| D <sub>0</sub>             | 1.50+0.10/-0                           | 1.50+0.10/-0                           | 1.50+0.10/-0                           |
| D <sub>1</sub>             | 1.50(min)                              | 1.50(min)                              | —                                      |
| E <sub>1</sub>             | 1.75±0.10                              | 1.75±0.10                              | 1.75±0.10                              |
| E <sub>2</sub>             | 14.25±0.30                             | 22.25±0.30                             | 22.25±0.30                             |
| F                          | 7.50±0.10                              | 11.50±0.10                             | 11.50±0.10                             |
| P <sub>0</sub>             | 4.00±0.10                              | 4.00±0.10                              | 4.00±0.10                              |
| P <sub>1</sub>             | 8.00±0.10                              | 12.00±0.10                             | 16.00±0.10                             |
| P <sub>2</sub>             | 2.00±0.10                              | 2.00±0.10                              | 2.00±0.10                              |
| W                          | 16.00±0.30                             | 24.00±0.30                             | 24.00±0.30                             |
| Tape Thickness<br>EIA Mark | Dimension (mm)                         | Dimension (mm)                         | Dimension (mm)                         |
| B <sub>1</sub>             | —                                      | —                                      | —                                      |
| K <sub>0</sub>             | 5.70±0.10                              | 6.30±0.10                              | 8.40±0.10                              |
| T                          | 0.50±0.05                              | 0.50±0.05                              | 0.50±0.05                              |
| T <sub>1</sub>             | —                                      | —                                      | —                                      |
| T <sub>2</sub>             | —                                      | —                                      | —                                      |
| Reel Dimension<br>EIA Mark | Dimension (mm)                         | Dimension (mm)                         | Dimension (mm)                         |
| A                          | 330                                    | 330                                    | 330                                    |
| B                          | 2.20±0.50                              | 2.20±0.50                              | 2.20±0.50                              |
| C                          | 13.00±0.20                             | 13.00±0.20                             | 13.00±0.20                             |
| D                          | 20.20±1.00                             | 20.20±1.00                             | 20.20±1.00                             |
| N                          | 100.00±1.00                            | 100.00±1.00                            | 100.00±1.00                            |
| W <sub>1</sub>             | 16.50±0.10                             | 24.50±0.10                             | 24.50±0.10                             |
| W <sub>2</sub>             | 21.10±02.00                            | 29.10±02.00                            | 29.10±02.00                            |
| W <sub>3</sub>             | —                                      | —                                      | —                                      |

Figure G15 — EIA Referenced Reel Dimensions



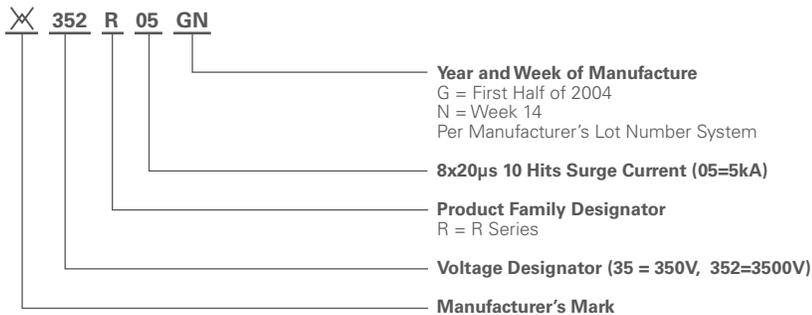
## Part Numbering System for Gas Discharge Tubes

### Example Part Number



**NOTE:** GTCS23-XXXM-R01 and GTCC23-XXXM-R01 parts available only in surface-mount and tape and reel packaging.

### Marking Reference Guide — Example



**NOTES:** GTCS23-XXXM-R01 and GTCC23-XXXM-R01 parts will have no marking. Devices with no leads (GTCNxx-xxxx-xx) are not able to be soldered as their electrodes are nickel plated. They should be installed by insertion into a magazine clip.

### Notice:

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# SURFACE-MOUNT FUSES

## Fundamentals

### Overview

TE Circuit Protection offers the widest selection of surface-mount fuses available for addressing a broad range of overcurrent protection applications. Helping to prevent costly damage and promote a safe environment for electronic and electrical equipment, our single-use chip fuses provide performance stability to support applications with current ratings from .5A up to 30A.



### Multi-layer Design for Chip Fuses

The multi-layer design has the benefit of exposing more fuse element surface area to the glass-ceramic absorption material. When the fuse elements open, there is more material for the vaporizing fuse metals to absorb into, resulting in a very efficient and effective quenching of the fuse arc.

Figure SF1 compares the multi-layer design of our SFF fuses with standard glass coated designs. The glass coated designs rely on the coating on only one side of the fuse element to absorb the vaporizing fuse material when it opens. Therefore, there is much less absorption material available to absorb the fuse metals. The result can be prolonged arcing and possible coating breach.

Figure SF2 shows how the absorption characteristics of the two designs differ. The multi-layer design indicates a clean separation with the fuse element evenly diffusing into the surrounding ceramic substrate. In the glass coated design, the element diffusion takes place in a small portion of the device and is only absorbed by the glass material directly above the area of failure.

### Wire-In-Air Design for 2410SFV, 1206SFV Fuses

The 2410SFV, 1206SFV fuse are Wire-In-Air SMD fuse that is suitable for secondary level overcurrent protection applications.

Figure SF3 compares our straight wire element design 2410SFV, 1206SFV fuses with normal corrugated wire design fuse. The straight wire element in air provides consistent fusing and cutting characteristics together with inrush current withstanding capability.

By introducing PCB assembly technology into the 2410SFV, 1206SFV fuse design and manufacturing process, lead-free compliance has been achieved without the problems associated with end caps on traditional ceramic devices.

Figure SF1

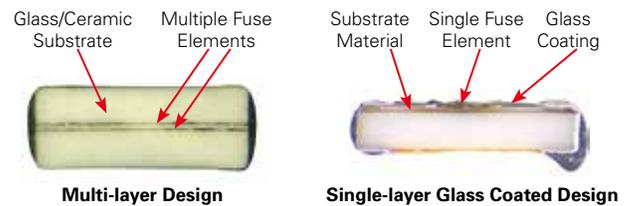


Figure SF2

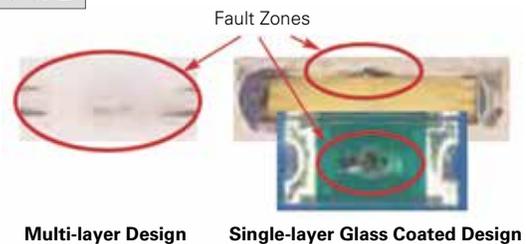
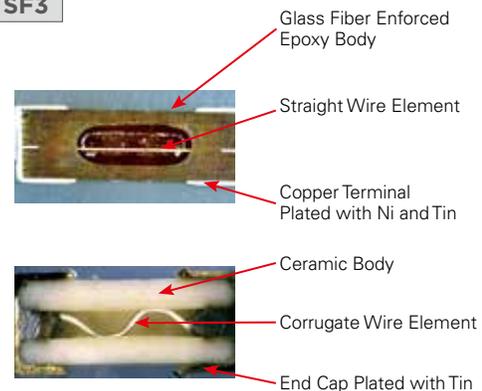


Figure SF3



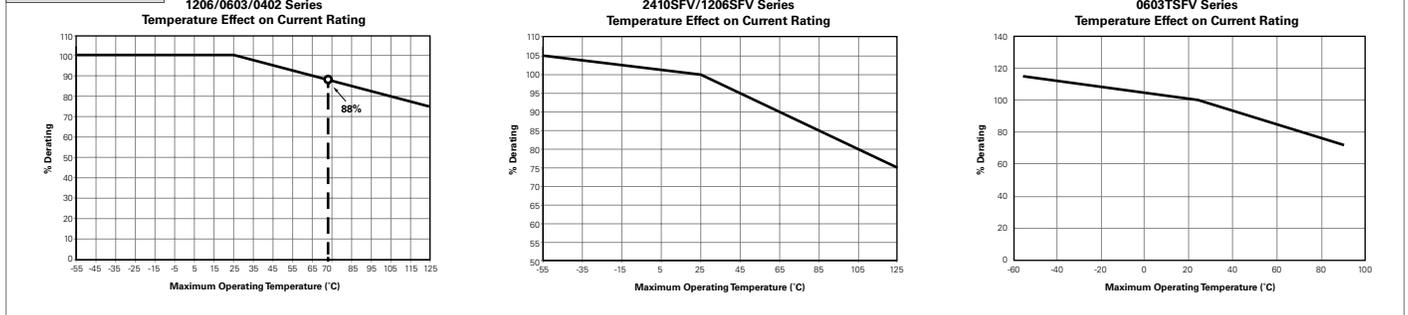
## Thin Film Design for 0603TSFV Fuses

The 0603TSFV fuses are thin film fuses that are suitable for secondary level overcurrent protection applications. The thin film design has the benefit of fast fusing under low overload current and thin thickness.

### Temperature Derating

A fuse is a temperature sensitive device. Therefore, operating temperature will have an effect on fuse performance and lifetime. Operating temperature should be taken into consideration when selecting the fuse current rating. The Thermal Derating Curve for surface-mount fuses is presented in Figure SF4. Use it to determine the derating percentage based on operating temperature and apply it to the derated system current.

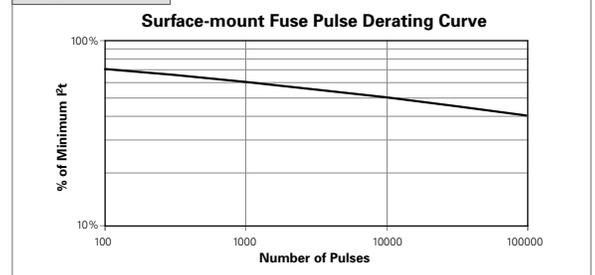
**Figure SF4**



### Pulse Cycle Derating

Once the  $I^2t$  value for the application waveform has been determined, it must be derated based on the number of cycles expected over the system lifetime. Since the stress induced by the current pulse is mechanical in nature, the number of times the stress is applied has significant bearing on how much derating must be applied to the fuse rating. Figure SF5 presents the current pulse derating curve for our surface-mount chip fuses up to 100,000 cycles.

**Figure SF5**



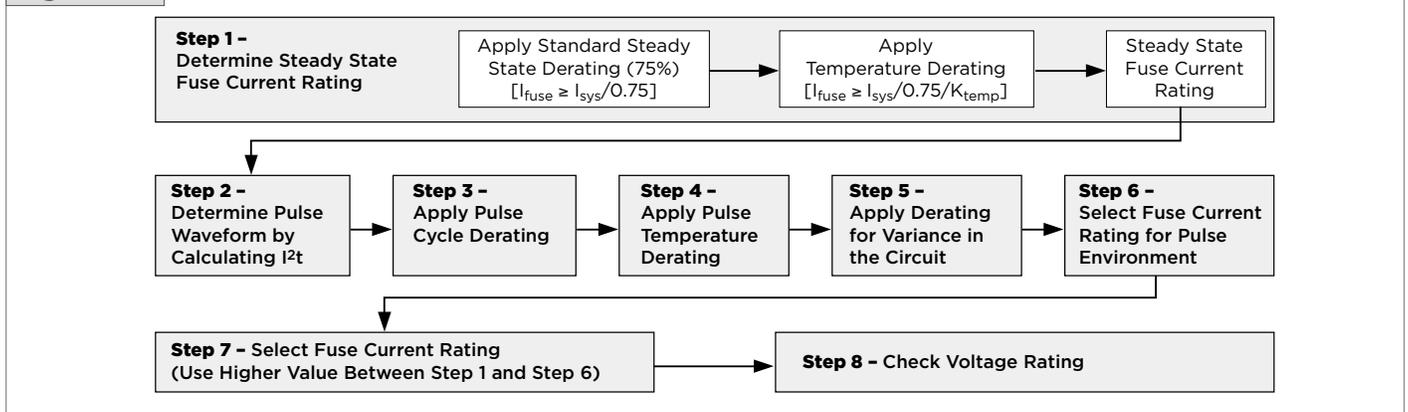
### Selecting Surface-mount Fuses

Fuse selection seems straightforward, in that you pick one which has a current rating just a bit higher than your worst case system operating current. Unfortunately, it is not that simple. There are derating considerations for operating current and application temperature. Turn-on and other system operations (like processor speed changes or motor start up) cause current surges or spikes that also require consideration when selecting a fuse. So selecting the right fuse for your application is not as simple as knowing the nominal current drawn by the system.

### Fuse Selection Flowchart

However, the basic considerations for fuse selection are shown in the flow chart presented in Figure SF6. Following this flow chart will help you select a fuse best suited for your application conditions. For a detailed example of this process you can download our Fuse Selection Guide available on our website.

**Figure SF6**



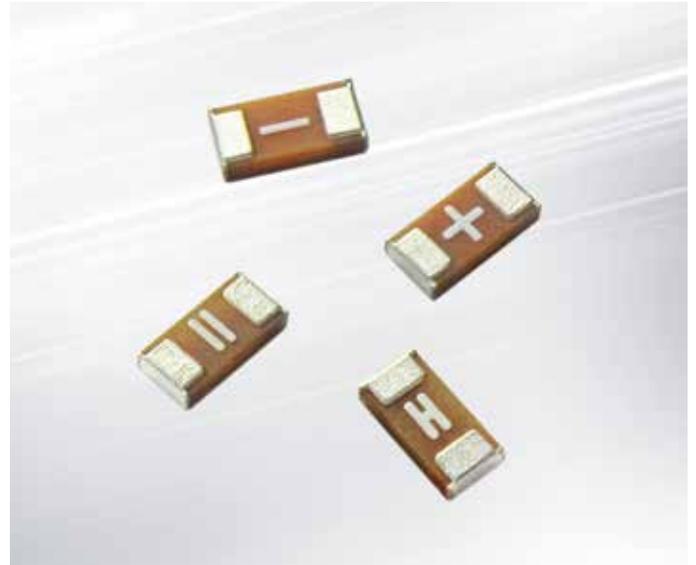
**NEW**

# SURFACE-MOUNT FUSES

## 0603 Thin Film Very Fast-Acting Chip Fuses

Very fast-acting fuses help provide overcurrent protection for systems using DC power sources up to 65V<sub>DC</sub>. The fuses' thin film design helps provide fast fusing under low overload current and low DCR (Direct Current Resistance).

These RoHS-compliant, surface-mount devices offer strong arc suppression characteristics and facilitate the development of more reliable, high-performance consumer electronics, such as notebook computers and tablets, digital cameras, memory cards, toys, Bluetooth earphones and other portable electronics devices.



### BENEFITS

- Very fast acting at 200% and 300% overloads
- Inrush current withstand capability at high overloads
- Thin body for space-limited applications
- Fiberglass enforced epoxy fuse body
- Copper termination with nickel and tin plating
- RoHS compliant and lead-free materials

### FEATURES

- Lead-free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Fiberglass enforces epoxy fuse body design
- Low DCR
- -55°C to +90°C operating temperature range

### APPLICATIONS

- Notebook computers and tablets
- Digital cameras
- Memory cards
- Toys
- Bluetooth earphones
- Portable electronics devices

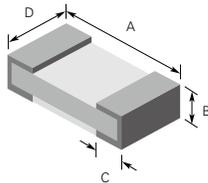
## Table FV1 – Clear Time Characteristics

| % of Rated Current | Clear Time at 25°C |             |
|--------------------|--------------------|-------------|
| 100%               | 4 hrs (min)        | —           |
| 200%               | —                  | 5 s (max)   |
| 300%               | —                  | 0.2 s (max) |

## Table FV2 – Typical Electrical Characteristics and Dimensions

### 0603 (1608 mm) Very Fast-Acting Chip Fuses

Shape and Dimensions  
mm (in)

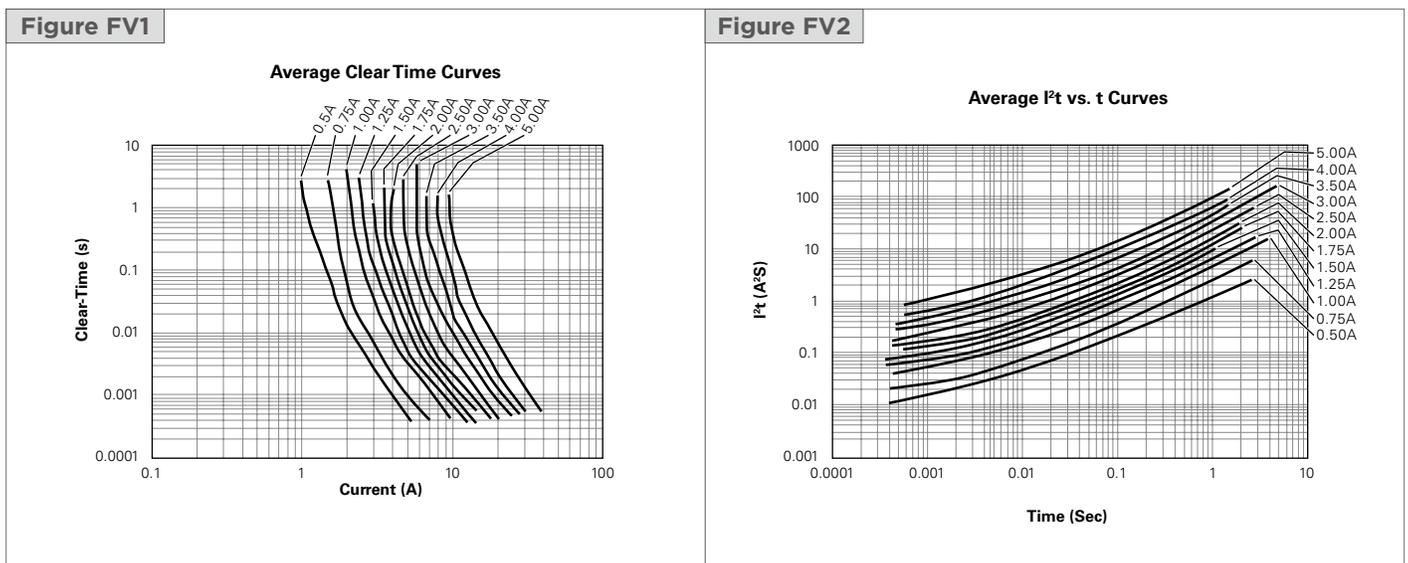


|    | A       |         | B       |         | C      |         | D       |         |
|----|---------|---------|---------|---------|--------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min    | Max     | Min     | Max     |
| mm | 1.500   | 1.700   | 0.200   | 0.400   | 0.260  | 0.460   | 0.710   | 0.910   |
| in | (0.059) | (0.067) | (0.008) | (0.016) | (0.01) | (0.018) | (0.028) | (0.036) |

| Part Number        | Marking Code | Rated Current (A) | Interrupt Rating               | Voltage Rating (V <sub>DC</sub> ) | Nominal Cold DC Resistance (DCR) (Ω) <sup>1</sup> | Nominal I <sup>2</sup> t (A <sup>2</sup> s) <sup>2</sup> |
|--------------------|--------------|-------------------|--------------------------------|-----------------------------------|---|--|
| 0603TSFV050FM/65-2 |              | 0.50              | 50A@35V DC/AC<br>13A@65V DC    | 65                                | 0.185   | 0.0150   |
| 0603TSFV075FM/65-2 | -            | 0.75              |                                | 65                                | 0.112   | 0.0250   |
| 0603TSFV100FM/65-2 | +            | 1.00              | 35A@35V DC/AC<br>13A@65V DC    | 65                                | 0.069   | 0.0300   |
| 0603TSFV125FM/65-2 | x            | 1.25              |                                | 65                                | 0.048   | 0.0520   |
| 0603TSFV150FM/65-2 |              | 1.50              | 35                             | 65                                | 0.037   | 0.0770   |
| 0603TSFV175FM/35-2 | =            | 1.75              |                                | 35                                | 0.031   | 0.1000   |
| 0603TSFV200FM/35-2 | ±            | 2.00              | 35                             | 35                                | 0.0260  | 0.1200   |
| 0603TSFV250FM/35-2 | H            | 2.50              |                                | 35                                | 0.0210  | 0.1500   |
| 0603TSFV300FM/35-2 |              | 3.00              | 35A@35V DC/AC<br>50A@24V DC/AC | 35                                | 0.0176  | 0.3500   |
| 0603TSFV350FM/35-2 | H H          | 3.50              | 35                             | 35                                | 0.0148  | 0.4400   |
| 0603TSFV400FM/35-2 | □            | 4.00              |                                | 35                                | 0.0125  | 1.6000   |
| 0603TSFV500FM/35-2 | □            | 5.00              | 35                             | 0.0095                            | 1.0000  |  |

<sup>1</sup> Measured at ≤10% of rated current and 25°C ambient.  
<sup>2</sup> Melting I<sup>2</sup>t at 1 ms.

## Figures FV1-FV2 – Family Performance Curves



→ Please go to page 111 for more information about 0603 Thin Film Very Fast-Acting Chip Fuses.

# SURFACE-MOUNT FUSES

## Fast-Acting Chip Fuses

Fast-acting chip fuses help provide overcurrent protection for systems using DC power sources up to 63V<sub>DC</sub>. The fuse's monolithic, multilayer design helps provide the highest hold current in the smallest footprint, reduce diffusion-related aging, improve product reliability and resilience, and enhance high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and help facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.



### BENEFITS

- Small size with high current ratings
- Temperature stability
- High reliability and resilience
- Strong arc suppression characteristics

### FEATURES

- Lead-free and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### APPLICATIONS

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

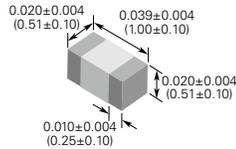
## Table FF1 – Clear Time Characteristics

| % of Rated Current | Clear Time at 25°C |
|--------------------|--------------------|
| 100%               | 4 hrs (min)        |
| 250%               | 5 s (max)          |
| 400%               | 0.05 s (max)       |

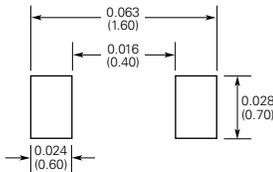
## Table FF2 – Typical Electrical Characteristics, Dimensions and Recommended Pad Layout

### 0402 (1005mm) Fast-Acting Chip Fuses

Shape and Dimensions  
in (mm)

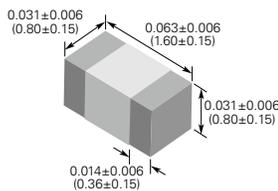


Recommended Pad Layout  
in (mm)

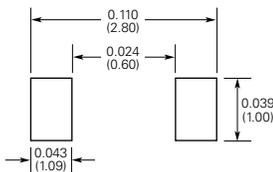


### 0603 (1608mm) Fast-Acting Chip Fuses

Shape and Dimensions  
in (mm)

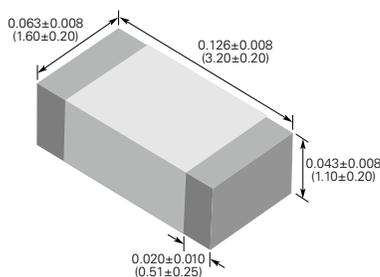


Recommended Pad Layout  
in (mm)

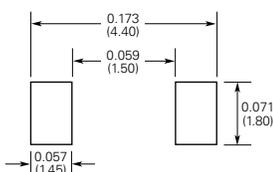


### 1206 (3216mm) Fast-Acting Chip Fuses

Shape and Dimensions  
in (mm)



Recommended Pad Layout  
in (mm)



| Part Number    | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|----------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 0402SFF100F/24 | 1.00                               | 0.120                 | 0.0170   | 24                         | 35          |
| 0402SFF150F/24 | 1.50                               | 0.056                 | 0.0490   | 24                         | 35          |
| 0402SFF200F/24 | 2.00                               | 0.035                 | 0.0700   | 24                         | 35          |
| 0402SFF300F/24 | 3.00                               | 0.021                 | 0.1250   | 24                         | 35          |
| 0402SFF400F/24 | 4.00                               | 0.014                 | 0.2250   | 24                         | 35          |

| Part Number    | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|----------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 0603SFF050F/32 | 0.50                               | 0.485                 | 0.0029   | 63                         | 35          |
| 0603SFF075F/32 | 0.75                               | 0.254                 | 0.0064   | 63                         | 35          |
| 0603SFF100F/32 | 1.00                               | 0.147                 | 0.0160   | 63                         | 35          |
| 0603SFF150F/32 | 1.50                               | 0.059                 | 0.0300   | 63                         | 35          |
| 0603SFF200F/32 | 2.00                               | 0.044                 | 0.0600   | 32                         | 35          |
| 0603SFF250F/32 | 2.50                               | 0.032                 | 0.1150   | 32                         | 35          |
| 0603SFF300F/32 | 3.00                               | 0.025                 | 0.1900   | 32                         | 35          |
| 0603SFF350F/32 | 3.50                               | 0.024                 | 0.2950   | 32                         | 35          |
| 0603SFF400F/32 | 4.00                               | 0.018                 | 0.4000   | 32                         | 35          |
| 0603SFF500F/32 | 5.00                               | 0.013                 | 0.7000   | 32                         | 35          |
| 0603SFF600F/24 | 6.00                               | 0.010                 | 1.1250   | 24                         | 35          |

| Part Number    | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|----------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 1206SFF050F/63 | 0.50                               | 0.730                 | 0.0021   | 63                         | 50          |
| 1206SFF075F/63 | 0.75                               | 0.513                 | 0.0052   | 63                         | 50          |
| 1206SFF100F/63 | 1.00                               | 0.220                 | 0.0120   | 63                         | 50          |
| 1206SFF150F/63 | 1.50                               | 0.120                 | 0.0250   | 63                         | 50          |
| 1206SFF175F/63 | 1.75                               | 0.100                 | 0.0450   | 63                         | 50          |
| 1206SFF200F/63 | 2.00                               | 0.050                 | 0.0700   | 63                         | 50          |
| 1206SFF250F/32 | 2.50                               | 0.035                 | 0.1400   | 32                         | 50          |
| 1206SFF300F/32 | 3.00                               | 0.031                 | 0.2200   | 32                         | 50          |
| 1206SFF400F/32 | 4.00                               | 0.022                 | 0.3800   | 32                         | 45          |
| 1206SFF500F/32 | 5.00                               | 0.015                 | 0.6000   | 32                         | 45          |
| 1206SFF600F/32 | 6.00                               | 0.013                 | 1.0000   | 32                         | 50          |
| 1206SFF700F/32 | 7.00                               | 0.011                 | 1.7500   | 32                         | 50          |
| 1206SFF800F/32 | 8.00                               | 0.008                 | 2.5000   | 32                         | 50          |
| 1206SFF600F/24 | 6.00                               | 0.013                 | 1.0000   | 24                         | 45          |
| 1206SFF700F/24 | 7.00                               | 0.011                 | 1.7500   | 24                         | 45          |
| 1206SFF800F/24 | 8.00                               | 0.008                 | 2.5000   | 24                         | 45          |

\* Measured at ≤10% of rated current and 25°C ambient temperature.

† Melting I<sup>2</sup>t at 0.001 sec clear time.

Figures FF1-FF6 — Family Performance Curves

Figure FF1

0402SFF Average Time Current Curves

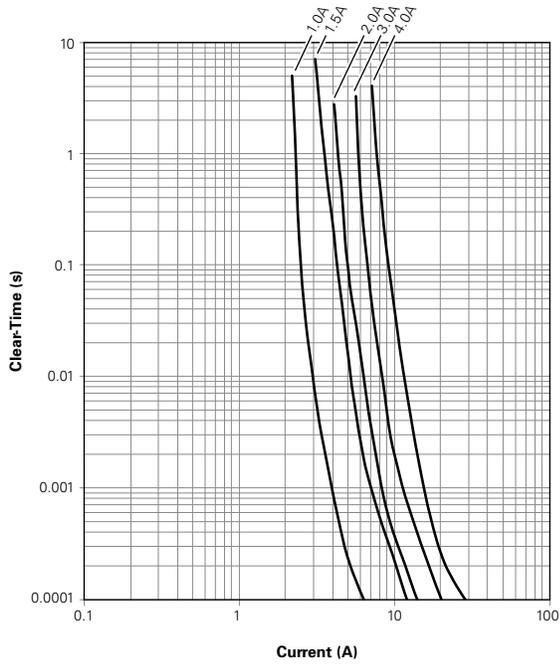
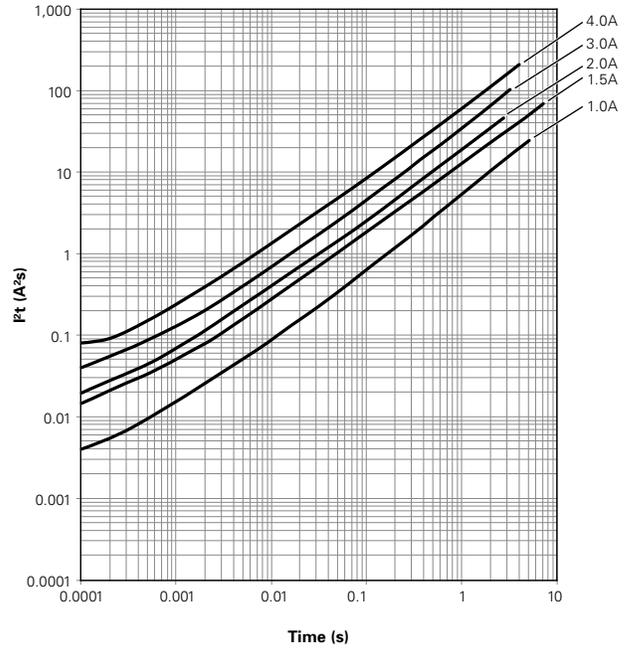


Figure FF2

0402SFF I²t vs. t Curves



Note: Curves are nominal.

Figure FF3

0603SFF Average Time Current Curves

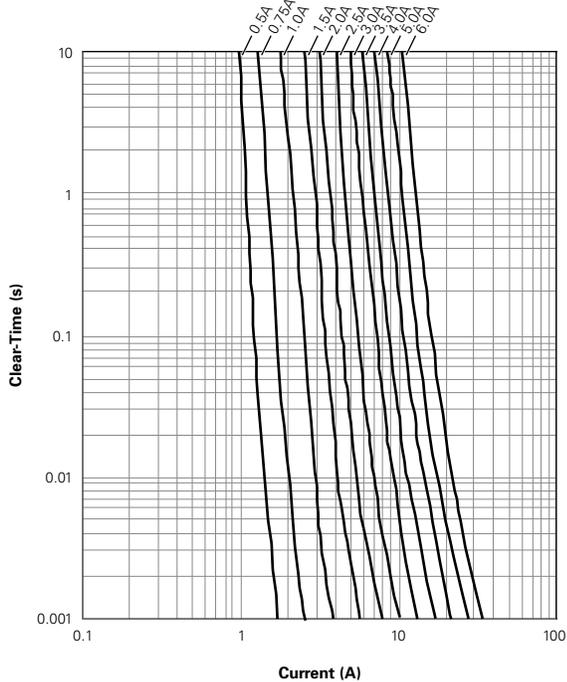
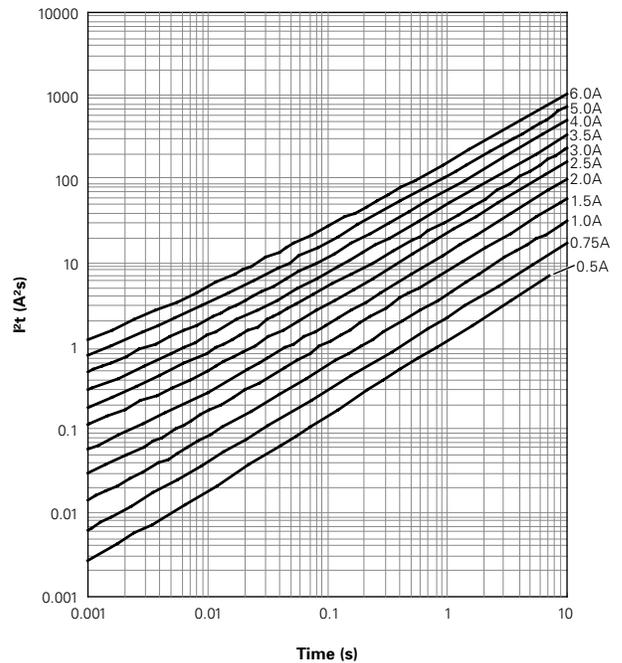


Figure FF4

0603SFF I²t vs. t Curves



Note: Curves are nominal.

Figures FF1-FF6 – Family Performance Curves

(Cont'd)

Figure FF5

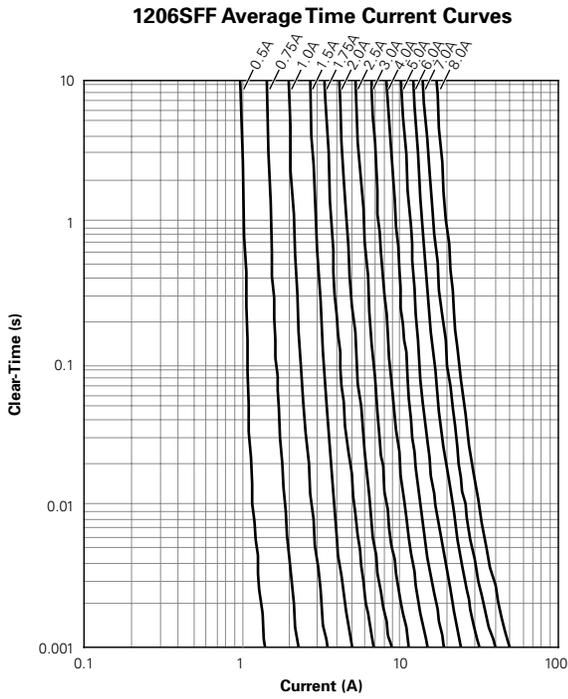
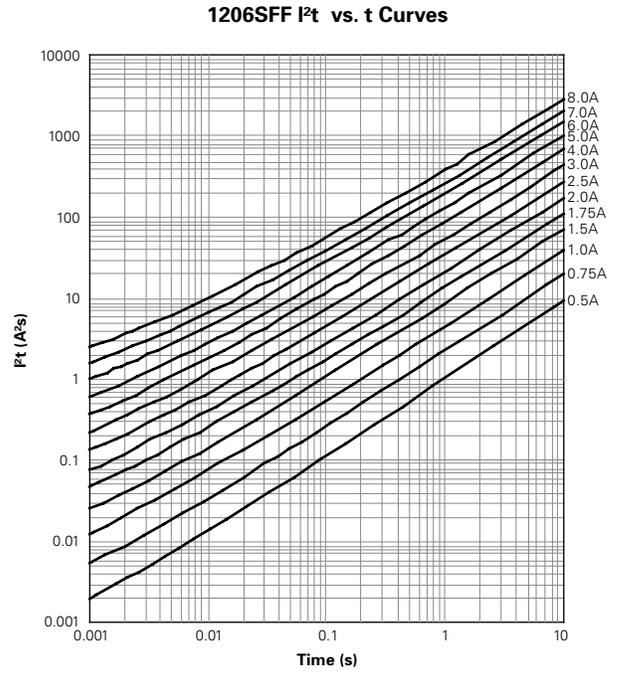


Figure FF6



Note: Curves are nominal.

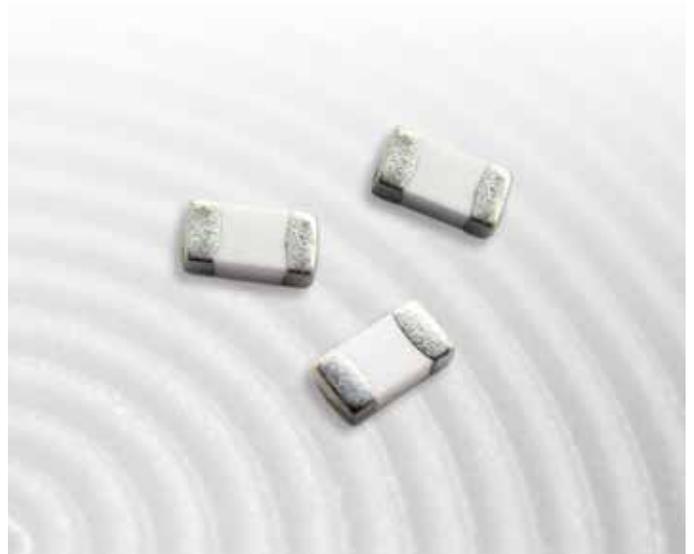
→ Please go to page 111 for more information about Fast-Acting Chip Fuses.

# SURFACE-MOUNT FUSES

## 0603 Very Fast-Acting Chip Fuses

Very fast-acting chip fuses help provide overcurrent protection for systems using DC power sources up to 32V<sub>DC</sub>. The fuse's monolithic, multilayer design helps provide the highest hold current in the smallest footprint, reduce diffusion-related aging, improve product reliability and resilience, and enhance high-temperature performance in a wide range of circuit designs.

These RoHS-compliant surface-mount devices offer strong arc suppression characteristics and facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.



### BENEFITS

- Very fast acting at 200% and 300% overloads
- Inrush current withstand capability at high overloads
- Thin body for space-limited applications
- Glass ceramic monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- RoHS compliant and lead-free materials
- Symmetrical design with marking on both sides (optional)

### FEATURES

- Lead-free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### APPLICATIONS

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

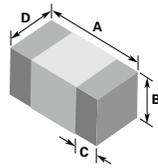
## Table FV1 – Clear Time Characteristics

| % of Rated Current | Clear Time at 25°C |             |
|--------------------|--------------------|-------------|
| 100%               | 4 hrs (min)        | —           |
| 200%               | 0.01 s (min)       | 5 s (max)   |
| 300%               | 0.001 s (min)      | 0.2 s (max) |

## Table FV2 – Typical Electrical Characteristics and Dimensions

### 0603 (1608 mm) Very Fast-Acting Chip Fuses

Shape and Dimensions  
mm (in)

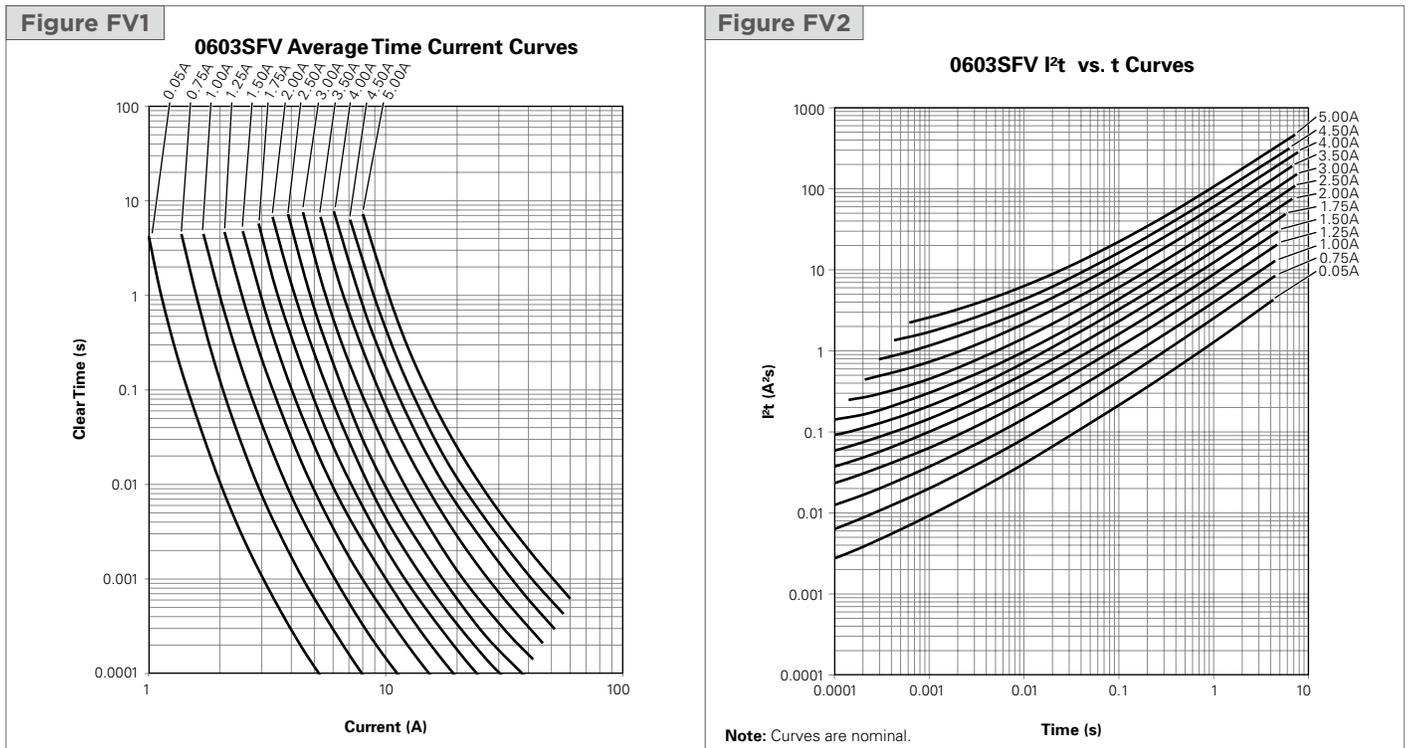


|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 1.45    | 1.75    | 0.22    | 0.48    | 0.21    | 0.51    | 0.65    | 0.95    |
| in | (0.057) | (0.069) | (0.009) | (0.019) | (0.008) | (0.020) | (0.025) | (0.037) |

| Part Number      | Typical Electrical Characteristics |                                |                                    | Max Interrupt Ratings |             |
|------------------|------------------------------------|--------------------------------|------------------------------------|-----------------------|-------------|
|                  | Rated Current (A)                  | Nominal Cold DCR ( $\Omega$ )* | Nominal $I^2t$ ( $A^2\text{sec}$ ) | Voltage ( $V_{DC}$ )  | Current (A) |
| 0603SFV050F/32-2 | 0.5                                | 0.860                          | 0.0093                             | 32                    | 50          |
| 0603SFV075F/32-2 | 0.8                                | 0.450                          | 0.0191                             | 32                    | 50          |
| 0603SFV100F/32-2 | 1.0                                | 0.280                          | 0.0360                             | 32                    | 50          |
| 0603SFV125F/32-2 | 1.3                                | 0.205                          | 0.0630                             | 32                    | 35          |
| 0603SFV150F/32-2 | 1.5                                | 0.143                          | 0.0950                             | 32                    | 35          |
| 0603SFV175F/32-2 | 1.8                                | 0.095                          | 0.1400                             | 32                    | 35          |
| 0603SFV200F/32-2 | 2.0                                | 0.073                          | 0.2100                             | 32                    | 35          |
| 0603SFV250F/32-2 | 2.5                                | 0.046                          | 0.3000                             | 32                    | 35          |
| 0603SFV300F/32-2 | 3.0                                | 0.039                          | 0.4600                             | 32                    | 35          |
| 0603SFV350F/32-2 | 3.5                                | 0.028                          | 0.7300                             | 32                    | 35          |
| 0603SFV400F/32-2 | 4.0                                | 0.023                          | 1.1500                             | 32                    | 35          |
| 0603SFV450F/32-2 | 4.5                                | 0.019                          | 1.6800                             | 32                    | 35          |
| 0603SFV500F/32-2 | 5.0                                | 0.015                          | 2.6200                             | 32                    | 35          |

\* Measured at 10% of rated current and 25°C.

## Figures FV1-FV2 – Family Performance Curves



➔ Please go to page 111 for more information about Very Fast-Acting Chip Fuses.

**NEW**

# SURFACE-MOUNT FUSES

## 1206 Very Fast-Acting Chip Fuses

Very fast-acting chip fuses help provide overcurrent protection for systems using DC power sources up to 65V<sub>DC</sub>. The fuses' wire-in-air design helps provide the highest voltage rating and excellent inrush current withstand capability, reduces diffusion-related aging, improves product reliability and resilience, and enhances high-temperature performance in a wide range of circuit designs.

These RoHS-compliant, surface-mount devices offer strong arc suppression characteristics and facilitate the development of more reliable, high-performance consumer electronics. These include laptop computers and ultra-portable notebooks, backlight drivers, DC/DC converters, low-voltage power for lighting applications and automotive electronics.



### BENEFITS

- Fast acting at 250% overloads
- Inrush current withstand capability at high overloads
- Thin body for space-limited applications
- Fiberglass-enforced epoxy fuse body for reliability
- Symmetrical design with markings on both sides (optional)
- Wire-in-air design increases safety
- Meet environmental standards for greener designs

### FEATURES

- Lead-free materials and RoHS compliant
- Halogen free  
(refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- -55°C to +125°C operating temperature range
- Fast acting at 250% overload current level
- Copper/copper alloy fusing element

### APPLICATIONS

- Laptop computers and ultra-portable notebooks
- Backlight Drivers
- DC/DC Converters
- Low-voltage Power for Lighting Applications
- Automotive Electronics

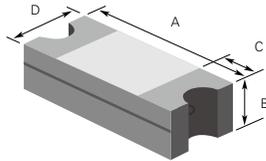
## Table FV1 – Clear Time Characteristics

| % of Rated Current | Clear Time at 25°C |           |
|--------------------|--------------------|-----------|
| 100%               | 4 hrs (min)        | —         |
| 250%               | —                  | 5 s (max) |

## Table FV2 – Typical Electrical Characteristics and Dimensions

### 1206 (3216 mm) Very Fast-Acting Fuses

Shape and Dimensions  
mm (in)

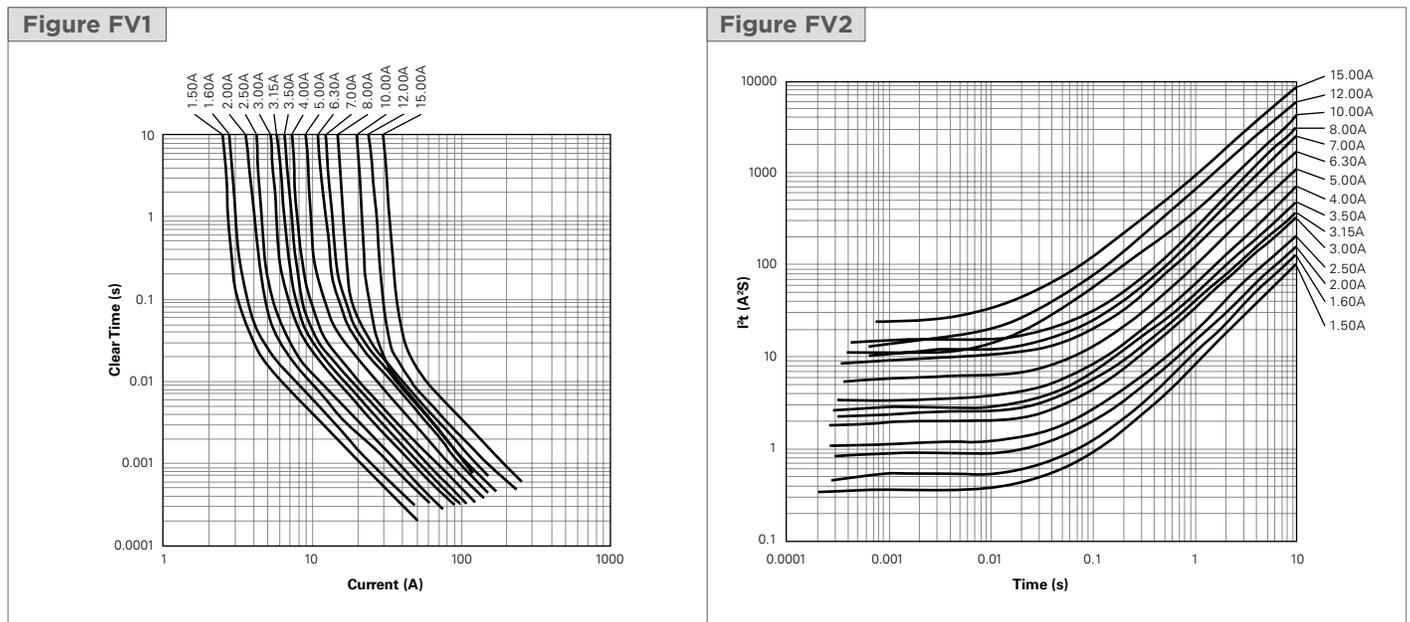


|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 3       | 3.4     | 0.93    | 1.23    | 0.55    | 1.15    | 1.5     | 1.9     |
| in | (0.118) | (0.134) | (0.036) | (0.048) | (0.021) | (0.045) | (0.059) | (0.075) |

| Part Number         | Marking Code | Rated Current (A) | Interrupt Rating          | Voltage Rating (V <sub>DC</sub> ) | Nominal Cold DC Resistance (DCR) (Ω) <sup>1</sup> | Nominal I <sub>t</sub> (A <sup>2</sup> s) |
|---------------------|--------------|-------------------|---------------------------|-----------------------------------|---|---|
| 1206SFV1.50FM/065-2 | G            | 1.50              | 50A@<br>65V <sub>DC</sub> | 65                                | 0.050   | 0.37                                      |
| 1206SFV1.60FM/065-2 | T            | 1.60              |                           | 65                                | 0.043   | 0.52                                      |
| 1206SFV2.00FM/065-2 | I            | 2.00              |                           | 65                                | 0.032   | 0.88                                      |
| 1206SFV2.50FM/065-2 | J            | 2.50              |                           | 65                                | 0.028   | 1.1                                       |
| 1206SFV3.00FM/065-2 | K            | 3.00              |                           | 65                                | 0.022   | 1.9                                       |
| 1206SFV3.15FM/065-2 | V            | 3.15              |                           | 65                                | 0.020   | 2.2                                       |
| 1206SFV3.50FM/065-2 | L            | 3.50              | 50A@<br>32V <sub>DC</sub> | 65                                | 0.018   | 2.6                                       |
| 1206SFV4.00FM/065-2 | M            | 4.00              |                           | 65                                | 0.016   | 3.3                                       |
| 1206SFV5.00FM/032-2 | N            | 5.00              |                           | 32                                | 0.013   | 5.4                                       |
| 1206SFV6.30FM/032-2 | O            | 6.30              |                           | 32                                | 0.010   | 8.9                                       |
| 1206SFV7.00FM/032-2 | P            | 7.00              |                           | 32                                | 0.0092  | 10.4                                      |
| 1206SFV8.00FM/032-2 | R            | 8.00              |                           | 32                                | 0.0084  | 13.5                                      |
| 1206SFV10.0FM/032-2 | Q            | 10.00             |                           | 32                                | 0.0050  | 11.2                                      |
| 1206SFV12.0FM/032-2 | X            | 12.00             |                           | 32                                | 0.0041  | 15.0                                      |
| 1206SFV15.0FM/032-2 | Y            | 15.00             |                           | 32                                | 0.0035  | 24.5                                      |

<sup>1</sup> Measured at ≤10% of rated current and 25°C ambient.

## Figures FV1-FV2 – Family Performance Curves



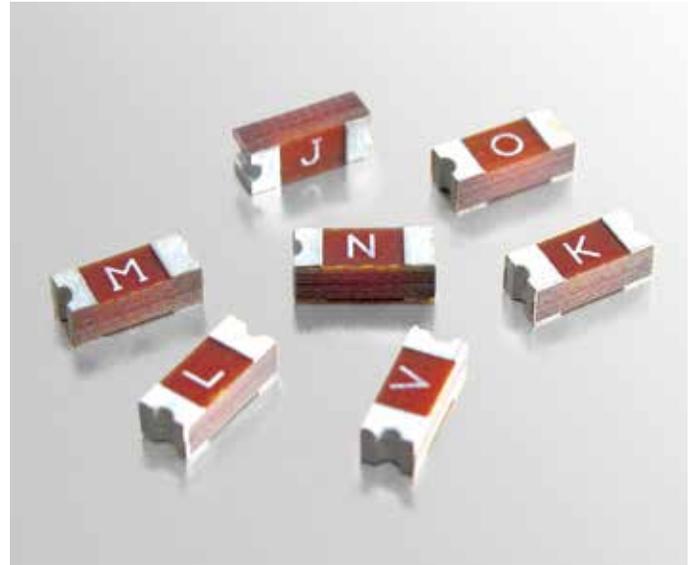
→ Please go to page 111 for more information about Very Fast-Acting Chip Fuses.

# SURFACE-MOUNT FUSES

## 2410 Very Fast-Acting Chip Fuses

The 2410 (6125mm) Wire-in-Air (WIA) SMD Fuse is suitable for secondary-level overcurrent protection applications.

These lead-free surface-mount devices offer increased reliability and avoid the risk of end caps falling off. Their straight wire element in air performs consistent fusing and cutting characteristics.



### BENEFITS

- Very fast acting at 200% overload current level
- Excellent inrush current withstand capability
- High reliability and resilience
- Strong arc suppression characteristics
- Copper terminal with nickel and tin plating

### FEATURES

- Halogen free, RoHS compliant and 100% lead free
- Copper or copper alloy composite fuse link
- Fiberglass enforced epoxy fuse body
- Wide range of current rating
- -55°C to +125°C operating temperature range (With de-rating)

### APPLICATIONS

- Industrial equipment
- LCD/PDP TV
- Backlight inverter
- Power supplier
- Telecom system
- Networking
- Game systems
- White goods
- Automotive

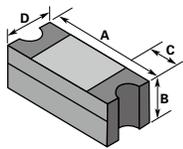
## Table SFV1 – Clear Time Characteristics

| % of Rated Current |  | Clear Time at 25°C |            |
|--------------------|--|--------------------|------------|
| 100%               |  | 4 hrs (min)        | —          |
| 200% (0.5A-10.0A)  |  | 0.01 s (min)       | 5 s (max)  |
| 200% (12.0A-20.0A) |  | 0.01 s (min)       | 20 s (max) |

## Table SFV2 – Typical Electrical Characteristics, Dimensions and Recommended Pad Layout

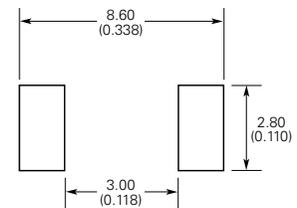
### 2410 (6125 mm) Very Fast-Acting Fuse

**Shape and Dimensions**  
mm (in)



|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 5.95    | 6.25    | 1.96    | 2.36    | 0.97    | 1.73    | 2.34    | 2.64    |
| in | (0.234) | (0.246) | (0.077) | (0.093) | (0.038) | (0.068) | (0.092) | (0.104) |

**Recommended Pad Layout**  
mm (Inch)

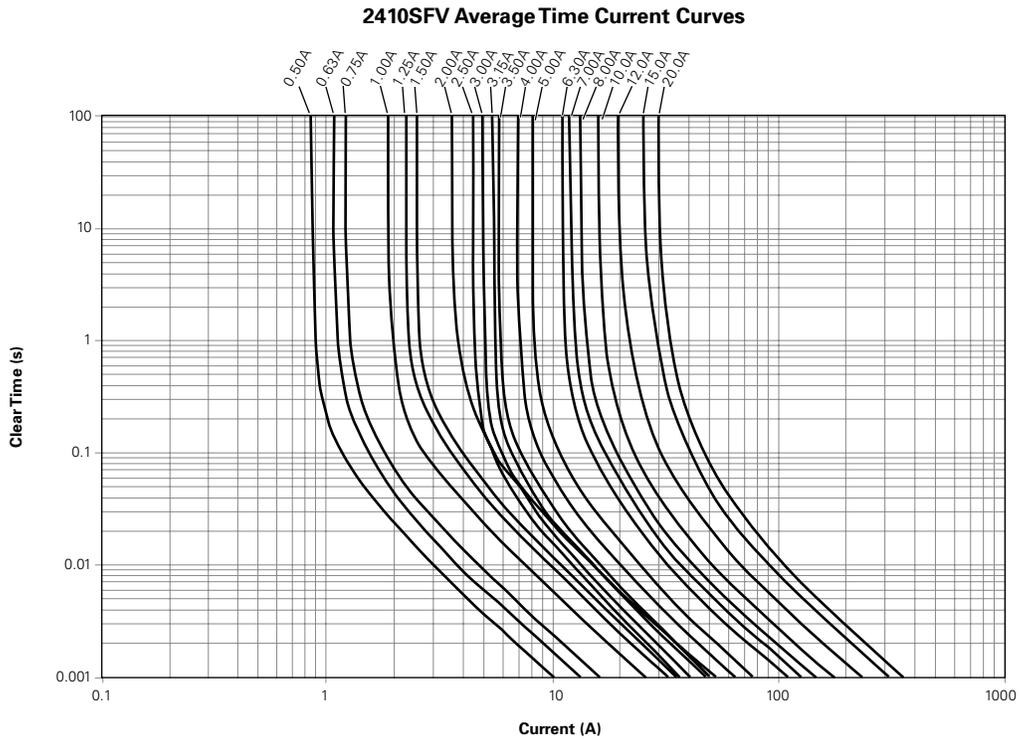


| Part Number       | Marking Code | Rated Current (A) | Interrupt Rating   | Voltage Rating (V) |        | Nominal Cold DC Resistance (DCR) (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> s) |
|-------------------|--------------|-------------------|--|--------------------|--------|---------------------------------------|---|
|                   |              |                   |  | AC                 | DC     |                                       |   |
| 2410SFV0.50FM/125 | C            | 0.5               | <b>UL:</b><br><b>0.5~2A</b><br>100A @ 250V <sub>AC</sub><br><b>2.5~8A</b><br>50A @ 125V <sub>AC</sub><br><b>0.5~8A</b><br>50A @ 125V <sub>DC</sub><br>300A @ 32V <sub>DC</sub> | 250                | 125    | 0.231                                 | 0.1   |
| 2410SFV0.63FM/125 | S            | 0.63              |  | 250                | 125    | 0.174                                 | 0.16  |
| 2410SFV0.75FM/125 | D            | 0.75              |  | 250                | 125    | 0.148                                 | 0.23  |
| 2410SFV1.00FM/125 | E            | 1                 |  | 250                | 125    | 0.093                                 | 0.59  |
| 2410SFV1.25FM/125 | F            | 1.25              |  | 250                | 125    | 0.07                                  | 0.96  |
| 2410SFV1.50FM/125 | G            | 1.5               |  | 250                | 125    | 0.062                                 | 1.19  |
| 2410SFV2.00FM/125 | I            | 2                 |  | 250                | 125    | 0.042                                 | 2.75  |
| 2410SFV2.50FM/125 | J            | 2.5               |  | 125                | 125    | 0.031                                 | 1.21  |
| 2410SFV3.00FM/125 | K            | 3                 |  | 125                | 125    | 0.0249                                | 1.73  |
| 2410SFV3.15FM/125 | V            | 3.15              |  | 125                | 125    | 0.0232                                | 2.2   |
| 2410SFV3.50FM/125 | L            | 3.5               | 125  | 125                | 0.022  | 2.5                                   |   |
| 2410SFV4.00FM/125 | M            | 4                 | 125  | 125                | 0.0172 | 4.1                                   |   |
| 2410SFV5.00FM/125 | N            | 5                 | 125  | 125                | 0.0143 | 5.9                                   |   |
| 2410SFV6.30FM/125 | O            | 6.3               | 125  | 125                | 0.01   | 12.5                                  |   |
| 2410SFV7.00FM/125 | P            | 7                 | 125  | 125                | 0.0094 | 14.2                                  |   |
| 2410SFV8.00FM/125 | R            | 8                 | 125  | 125                | 0.0086 | 20.3                                  |   |
| 2410SFV10.0FM/125 | Q            | 10                | <b>UL:</b><br>35A @ 125V <sub>AC</sub><br>50A @ 125V <sub>DC</sub><br>300A @ 32V <sub>DC</sub>   | 125                | 125    | 0.0066                                | 29.2  |
| 2410SFV12.0FM/065 | X            | 12                | <b>UL:</b><br>50A @ 65V <sub>AC</sub><br>50A @ 65V <sub>DC</sub><br>300A @ 32V <sub>DC</sub>   | 65                 | 65     | 0.0053                                | 49.2  |
| 2410SFV15.0FM/065 | Y            | 15                | <b>UL:</b><br>50A @ 65V <sub>AC</sub><br>50A @ 65V <sub>DC</sub><br>300A @ 32V <sub>DC</sub>   | 65                 | 65     | 0.0038                                | 102.5                                       |
| 2410SFV20.0FM/065 | Z            | 20                | <b>UL:</b><br>50A @ 65V <sub>AC</sub><br>100A @ 65V <sub>DC</sub><br>300A @ 32V <sub>DC</sub>  | 65                 | 65     | 0.0034                                | 126.2                                       |

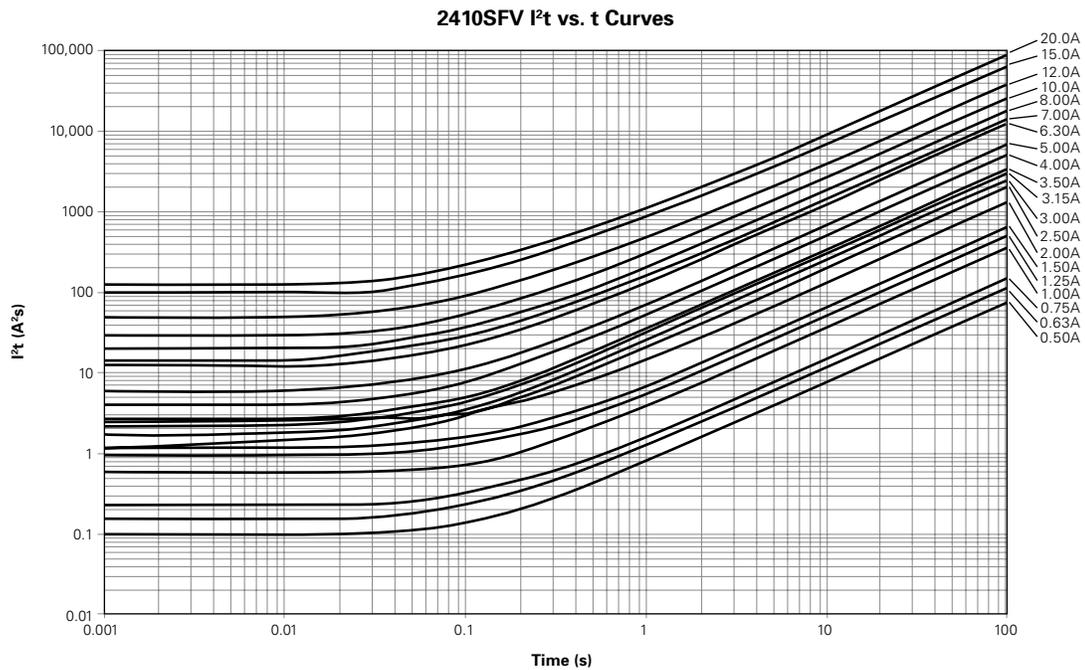
\* Measured at ≤10% of rated current and 25°C ambient

Figures SFV1-SFV2 — Family Performance Curves

**Figure SFV1**



**Figure SFV2**



Note: Curves are nominal.

→ Please go to page 111 for more information about 2410 Very Fast-Acting Chip Fuses.



# SURFACE-MOUNT FUSES

## Pulse Tolerant Chip Fuses

Pulse Tolerant Chip Fuses have high inrush current withstand capability and provide overcurrent protection for DC power systems. These devices combine a silver fusing element and monolithic, multilayer design to provide strong arc suppression characteristics.

These RoHS-compliant surface-mount devices can help facilitate the development of more reliable, high-performance consumer electronics such as laptops, multimedia devices, cell phones and other portable electronics.



### BENEFITS

- High inrush current withstanding capability
- Ceramic monolithic structure
- Silver fusing element and silver termination with nickel and tin plating
- Temperature stability
- Strong arc suppression characteristics

### FEATURES

- Lead free materials and RoHS compliant
- Halogen free  
(refers to: Br $\leq$ 900ppm, Cl $\leq$ 900ppm, Br+Cl $\leq$ 1500ppm)
- Monolithic, multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### APPLICATIONS

- Laptops
- Digital cameras
- Cell phones
- Printers
- DVD players
- Portable electronics
- Game systems
- LCD monitors
- Scanners

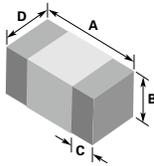
## Table FP1 — Clear Time Characteristics

| % of Rated Current |  | Clear Time at 25°C |              |
|--------------------|--|--------------------|--------------|
| 100%               |  | 4 hrs (min)        | —            |
| 200%               |  | 1 s (min)          | 60 s (max)   |
| 1000%              |  | 0.0002 s (min)     | 0.02 s (max) |

## Table FP2 — Typical Electrical Characteristics and Dimensions

### 0603 (1608 mm) Pulse Tolerant Chip Fuses

Shape and Dimensions  
mm (in)

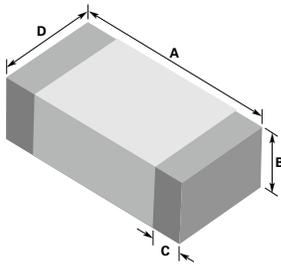


|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 1.45    | 1.75    | 0.65    | 0.95    | 0.21    | 0.51    | 0.65    | 0.95    |
| in | (0.057) | (0.069) | (0.026) | (0.037) | (0.008) | (0.020) | (0.026) | (0.037) |

| Part Number      | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|------------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                  | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 0603SFP100F/32-2 | 1.0                                | 0.210                 | 0.08   | 32                         | 50          |
| 0603SFP150F/32-2 | 1.5                                | 0.101                 | 0.11   | 32                         | 50          |
| 0603SFP200F/32-2 | 2.0                                | 0.057                 | 0.24   | 32                         | 50          |
| 0603SFP250F/32-2 | 2.5                                | 0.042                 | 0.56   | 32                         | 50          |
| 0603SFP300F/32-2 | 3.0                                | 0.030                 | 0.72   | 32                         | 50          |
| 0603SFP350F/32-2 | 3.5                                | 0.022                 | 1.10   | 32                         | 50          |
| 0603SFP400F/32-2 | 4.0                                | 0.018                 | 2.08   | 32                         | 50          |
| 0603SFP450F/32-2 | 4.5                                | 0.014                 | 2.63   | 32                         | 50          |
| 0603SFP500F/32-2 | 5.0                                | 0.013                 | 3.25   | 32                         | 50          |
| 0603SFP600F/32-2 | 6.0                                | 0.010                 | 4.00   | 32                         | 70          |

### 1206 (3216 mm) Pulse Tolerant Chip Fuses

Shape and Dimensions  
mm (in)



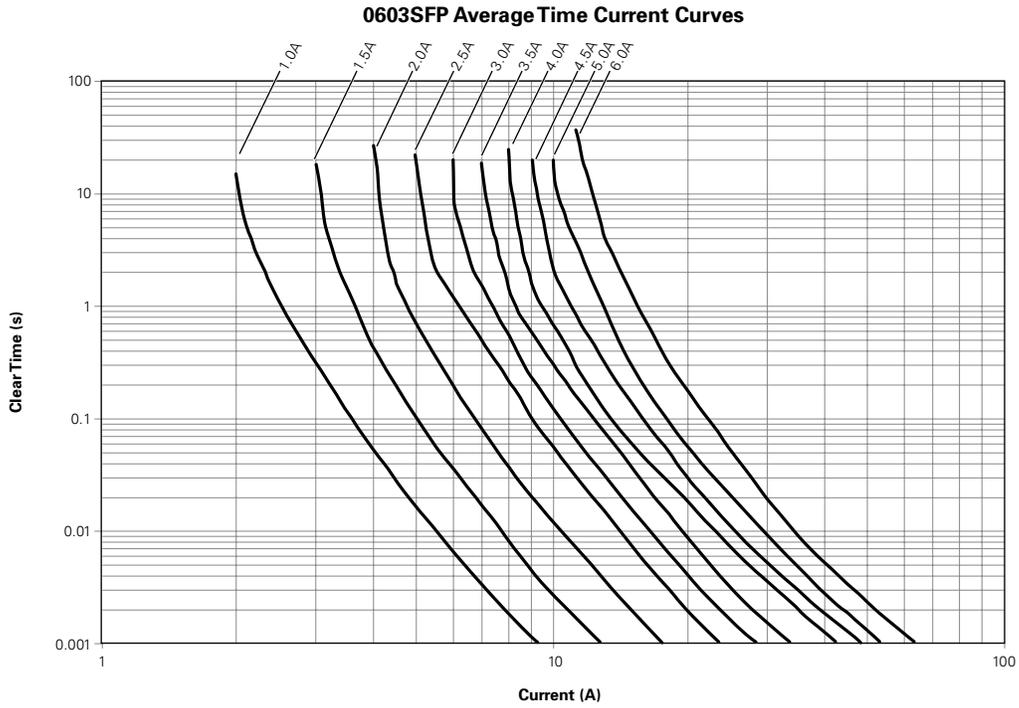
|    | A       |         | B       |         | C       |         | D       |         |
|----|---------|---------|---------|---------|---------|---------|---------|---------|
|    | Min     | Max     | Min     | Max     | Min     | Max     | Min     | Max     |
| mm | 3.00    | 3.40    | 0.77    | 1.17    | 0.26    | 0.76    | 1.40    | 1.80    |
| in | (0.118) | (0.134) | (0.030) | (0.046) | (0.010) | (0.030) | (0.055) | (0.071) |

| Part Number      | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|------------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                  | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 1206SFP100F/63-2 | 1.0                                | 0.340                 | 0.11   | 63                         | 50          |
| 1206SFP150F/63-2 | 1.5                                | 0.150                 | 0.33   | 63                         | 50          |
| 1206SFP200F/63-2 | 2.0                                | 0.090                 | 0.80   | 63                         | 50          |
| 1206SFP250F/32-2 | 2.5                                | 0.070                 | 1.19   | 32                         | 50          |
| 1206SFP300F/32-2 | 3.0                                | 0.035                 | 1.35   | 32                         | 50          |
| 1206SFP350F/32-2 | 3.5                                | 0.029                 | 1.84   | 32                         | 50          |
| 1206SFP400F/32-2 | 4.0                                | 0.023                 | 2.74   | 32                         | 50          |
| 1206SFP450F/32-2 | 4.5                                | 0.021                 | 3.20   | 32                         | 50          |
| 1206SFP500F/32-2 | 5.0                                | 0.017                 | 5.50   | 32                         | 50          |
| 1206SFP600F/24-2 | 6.0                                | 0.013                 | 12.50  | 24                         | 80          |
| 1206SFP700F/24-2 | 7.0                                | 0.010                 | 30.00  | 24                         | 80          |
| 1206SFP800F/24-2 | 8.0                                | 0.009                 | 60.00  | 24                         | 80          |

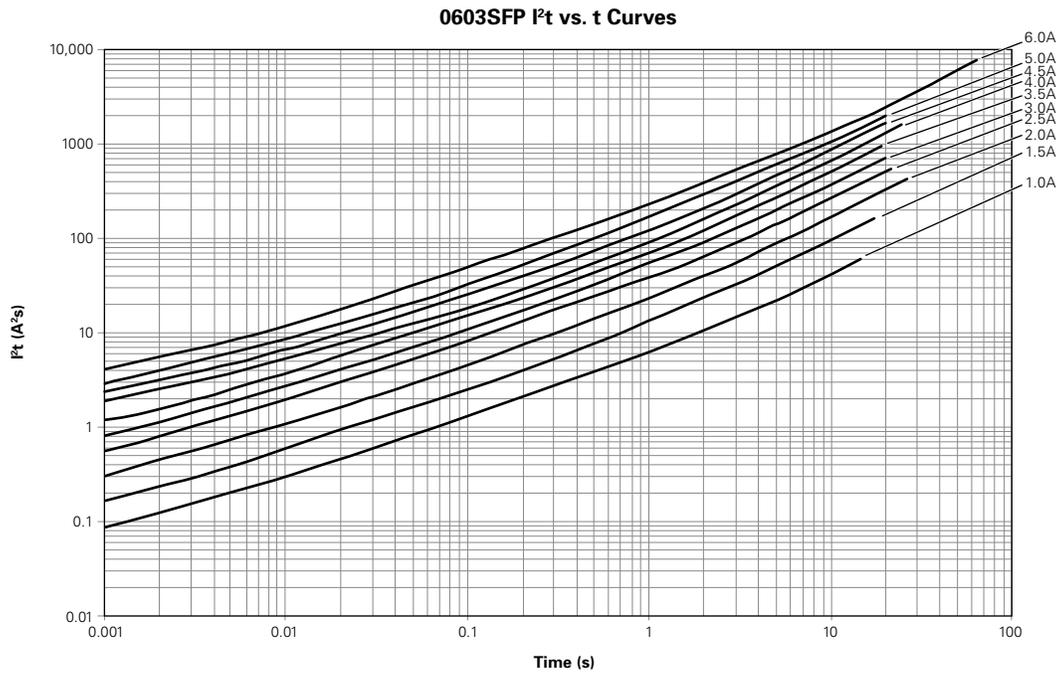
\* Measured at ≤10% of rated current and 25°C ambient temperature.  
† Melting I<sup>2</sup>t at 0.001 sec clear time.

Figures FP1-FP4 — Family Performance Curves

**Figure FP1**



**Figure FP2**



Figures FP1-FP4 – Family Performance Curves

(Cont'd)

Figure FP3

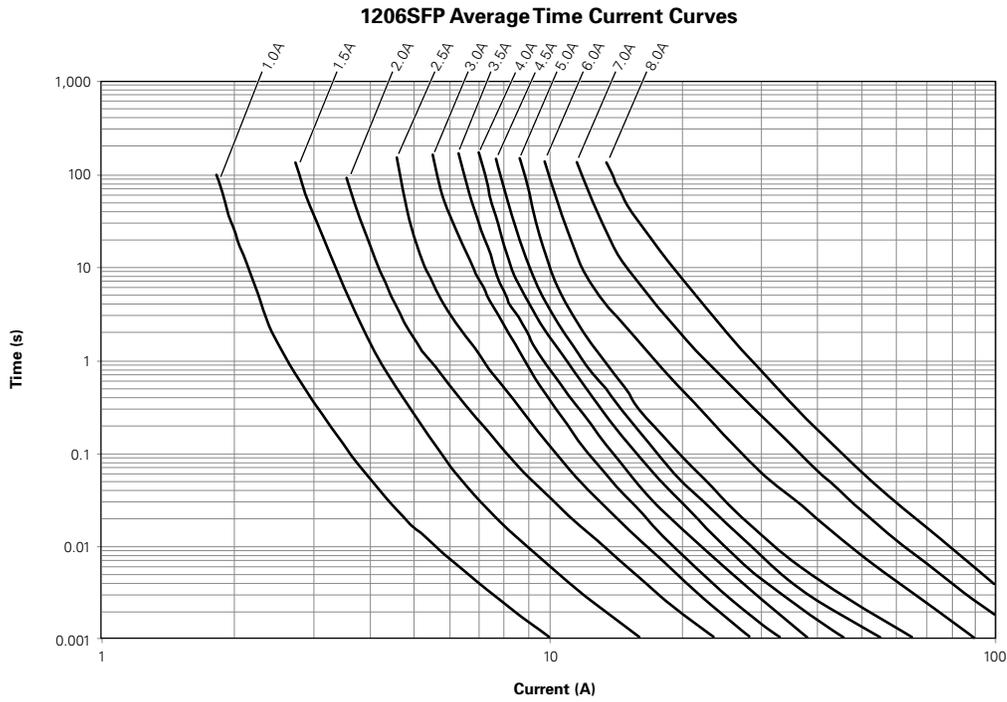
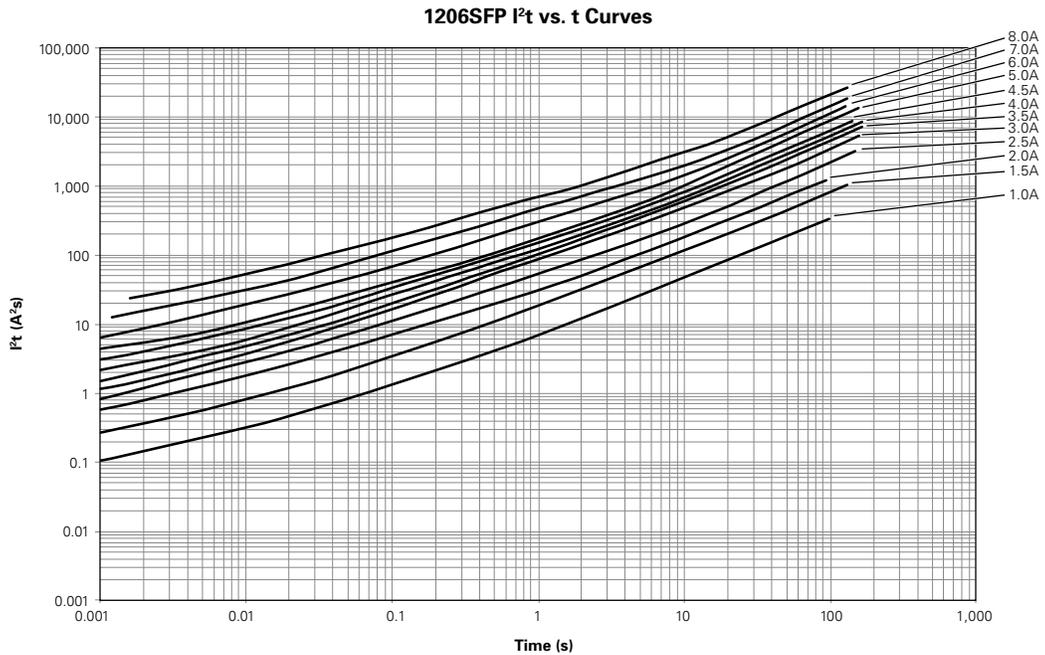


Figure FP4



Note: Curves are nominal.

→ Please go to page 111 for more information about Pulse Tolerant Chip Fuses.

# SURFACE-MOUNT FUSES

## High-Current-Rated Chip Fuses

The monolithic multilayer design of the TE Circuit Protection high-current-rated chip fuses helps to provide some of the highest current ratings available in the 1206 size and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, servers, communications equipment, voltage regulator modules, and other high current, small size applications.



### BENEFITS

- Glass ceramic monolithic structure provides stability in application cycling
- High-current rating in a small package allows more efficient use in system space
- Strong arc suppression in overcurrent conditions

### FEATURES

- Lead-free materials and RoHS compliant
- Halogen free  
(refers to: Br $\leq$ 900ppm, Cl $\leq$ 900ppm, Br+Cl $\leq$ 1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +150°C operating temperature range

### APPLICATIONS

- Communications equipment
- Voltage regulator modules
- Power supplies
- Servers

## Table FH1 – Clear Time Characteristics

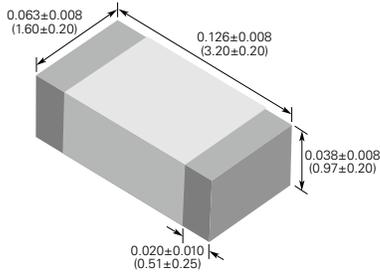
### 1206SFH Series

| % of Rated Current | Clear Time at 25°C |
|--------------------|--------------------|
| 100%               | 4 hrs (min)        |
| 250% (10-20A)      | 5 s (max)          |
| 350% (25-30A)      | 5 s (max)          |

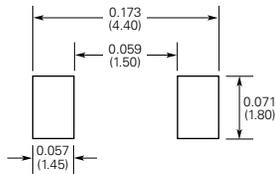
## Table FH2 – Typical Electrical Characteristics, Dimensions and Recommended Pad Layout

### 1206 (3216mm) High-Current-Rated Chip Fuses

Shape and Dimensions  
in (mm)



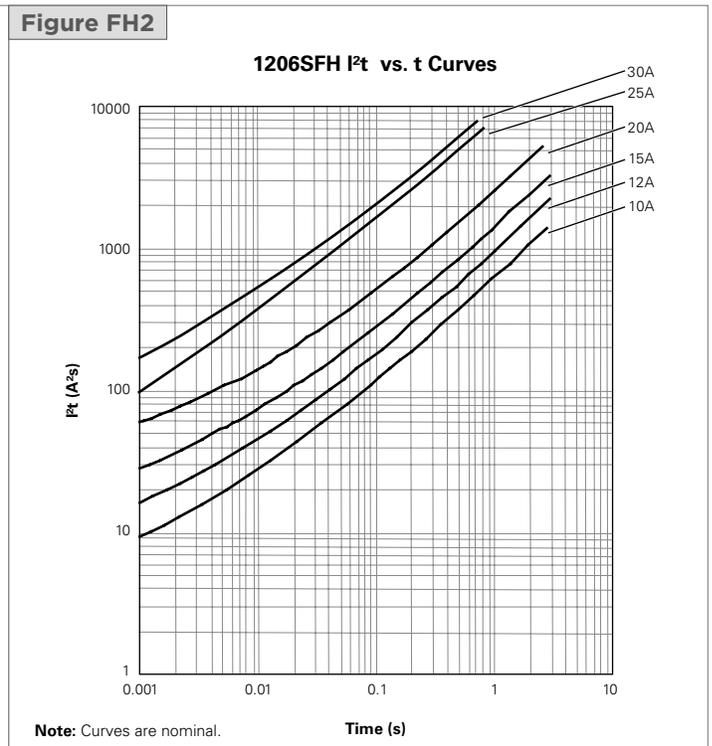
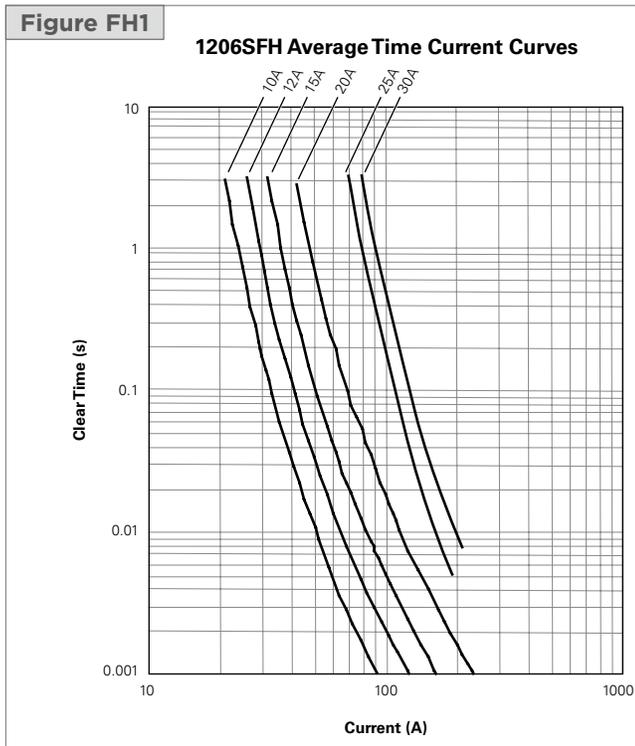
Recommended Pad Layout  
in (mm)



| Part Number    | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|----------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec)† | Voltage (V <sub>DC</sub> ) | Current (A) |
| 1206SFH100F/24 | 10                                 | 0.010                 | 9  | 24                         | 100         |
| 1206SFH120F/24 | 12                                 | 0.008                 | 14   | 24                         | 100         |
| 1206SFH150F/24 | 15                                 | 0.005                 | 26   | 24                         | 100         |
| 1206SFH200F/24 | 20                                 | 0.003                 | 56   | 24                         | 100         |
| 1206SFH250F/24 | 25                                 | 0.0016                | 187  | 24                         | 250         |
| 1206SFH300F/24 | 30                                 | 0.0012                | 270  | 24                         | 300         |

\* Measured at ≤10% of rated current and 25°C ambient temperature.  
† Melting I<sup>2</sup>t at 0.001 sec clear time.

## Figures FH1-FH2 – Family Performance Curves



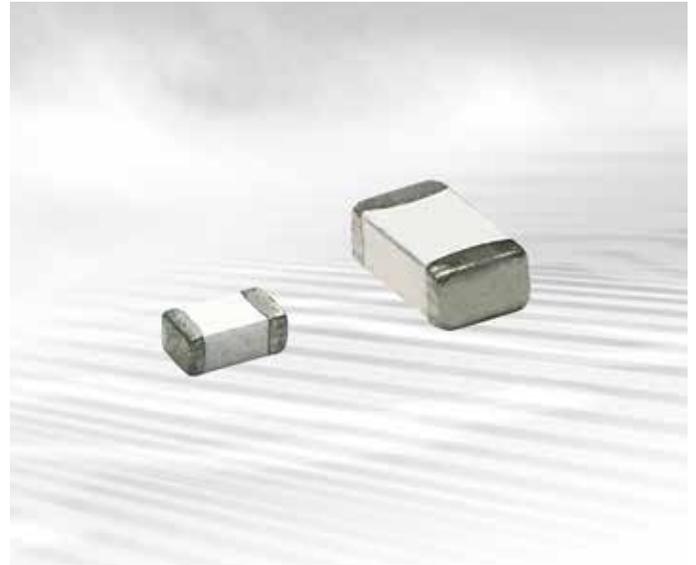
➔ Please go to page 111 for more information about High-Current-Rated Chip Fuses.

# SURFACE-MOUNT FUSES

## Slow-Blow Chip Fuses

Available in industry standard 1206 and 0603 chip sizes, TE Circuit Protection's slow-blow chip fuses help provide overcurrent protection on systems that experience large and frequent current surges as part of their normal operation.

The slow-blow chip fuse's monolithic, multilayer design helps provide some of the highest current ratings available in the 1206 and 0603 footprints and enhances high-temperature performance in a wide range of circuit protection designs. The devices' small size, high reliability and strong arc suppression characteristics make them suitable for overcurrent protection of power supplies, capacitor filter banks, Liquid Crystal Display (LCD) backlight inverters, electric motors and portable electronics.



### BENEFITS

- Time-delayed design prevents nuisance openings in pulsed and high inrush current applications
- Small size with high-current ratings
- Strong arc suppression characteristics

### FEATURES

- Lead-free materials and RoHS compliant
- Halogen free  
(refers to: Br $\leq$ 900ppm, Cl $\leq$ 900ppm, Br+Cl $\leq$ 1500ppm)
- Monolithic multilayer design
- High-temperature performance
- -55°C to +125°C operating temperature range

### APPLICATIONS

- Small motors systems
- Portable electronics
- Input power ports
- Power over Ethernet (PoE)
- Test equipment
- POL converter protection
- Computer drives
- Displays
- Printers

## Table FS1 – Clear Time Characteristics

### 0603SFS Series

| % of Rated Current | Clear Time at 25°C |              |
|--------------------|--------------------|--------------|
| 100%               | 4 hrs (min)        | —            |
| 200%               | 1 s (min)          | 120 s (max)  |
| 300%               | 0.1 s (min)        | 3 s (max)    |
| 800% (1.0A-1.5A)   | 0.0005 s (min)     | 0.05 s (max) |
| 800% (2.0A-5.0A)   | 0.001 s (min)      | 0.05 s (max) |

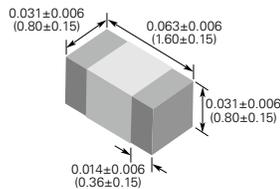
### 1206SFS Series

| % of Rated Current | Clear Time at 25°C |              |
|--------------------|--------------------|--------------|
| 100%               | 4 hrs (min)        | —            |
| 200%               | 1 s (min)          | 120 s (max)  |
| 300%               | 0.1 s (min)        | 3 s (max)    |
| 800% (1.0A-1.5A)   | 0.0016 s (min)     | 0.05 s (max) |
| 800% (2.0A-8.0A)   | 0.002 s (min)      | 0.05 s (max) |

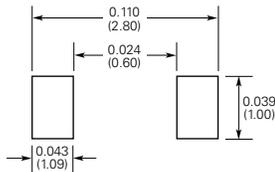
## Table FS2 – Typical Electrical Characteristics, Dimensions and Recommended Pad Layout

### 0603 (1608 mm) Slow-Blow Chip Fuses

**Shape and Dimensions**  
in (mm)

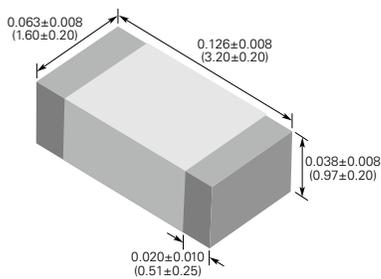


**Recommended Pad Layout**  
in (mm)

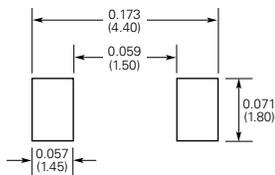


### 1206 (3216 mm) Slow-Blow Chip Fuses

**Shape and Dimensions**  
in (mm)



**Recommended Pad Layout**  
in (mm)



| Part Number    | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|----------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 0603SFS100F/32 | 1.0                                | 0.200                 | 0.093  | 32                         | 50          |
| 0603SFS150F/32 | 1.5                                | 0.100                 | 0.18   | 32                         | 50          |
| 0603SFS200F/32 | 2.0                                | 0.052                 | 0.32   | 32                         | 50          |
| 0603SFS250F/32 | 2.5                                | 0.041                 | 0.63   | 32                         | 50          |
| 0603SFS300F/32 | 3.0                                | 0.031                 | 0.87   | 32                         | 50          |
| 0603SFS350F/32 | 3.5                                | 0.021                 | 1.20   | 32                         | 50          |
| 0603SFS400F/32 | 4.0                                | 0.017                 | 2.30   | 32                         | 50          |
| 0603SFS450F/32 | 4.5                                | 0.015                 | 2.70   | 32                         | 50          |
| 0603SFS500F/32 | 5.0                                | 0.013                 | 3.20   | 32                         | 50          |

| Part Number    | Typical Electrical Characteristics |                       |  | Max Interrupt Ratings      |             |
|----------------|------------------------------------|-----------------------|--|----------------------------|-------------|
|                | Rated Current (A)                  | Nominal Cold DCR (Ω)* | Nominal I <sup>2</sup> t (A <sup>2</sup> sec) <sup>†</sup> | Voltage (V <sub>DC</sub> ) | Current (A) |
| 1206SFS100F/63 | 1.0                                | 0.360                 | 0.11   | 63                         | 50          |
| 1206SFS125F/63 | 1.25                               | 0.200                 | 0.22   | 63                         | 50          |
| 1206SFS150F/63 | 1.5                                | 0.150                 | 0.23   | 63                         | 50          |
| 1206SFS200F/63 | 2.0                                | 0.088                 | 0.63   | 63                         | 50          |
| 1206SFS250F/32 | 2.5                                | 0.065                 | 0.90   | 32                         | 50          |
| 1206SFS300F/32 | 3.0                                | 0.034                 | 1.20   | 32                         | 50          |
| 1206SFS350F/32 | 3.5                                | 0.028                 | 1.60   | 32                         | 50          |
| 1206SFS400F/32 | 4.0                                | 0.024                 | 2.20   | 32                         | 50          |
| 1206SFS450F/32 | 4.5                                | 0.020                 | 3.60   | 32                         | 50          |
| 1206SFS500F/32 | 5.0                                | 0.016                 | 5.30   | 32                         | 50          |
| 1206SFS550F/24 | 5.5                                | 0.014                 | 6.40   | 24                         | 50          |
| 1206SFS600F/24 | 6.0                                | 0.011                 | 8.50   | 24                         | 60          |
| 1206SFS700F/24 | 7.0                                | 0.010                 | 10.00  | 24                         | 60          |
| 1206SFS800F/24 | 8.0                                | 0.009                 | 16.90  | 24                         | 60          |

\* Measured at ≤10% of rated current and 25°C ambient temperature.  
<sup>†</sup> Melting I<sup>2</sup>t at 0.001 sec clear time.

Figures FS1-FS4 – Family Performance Curves

Figure FS1

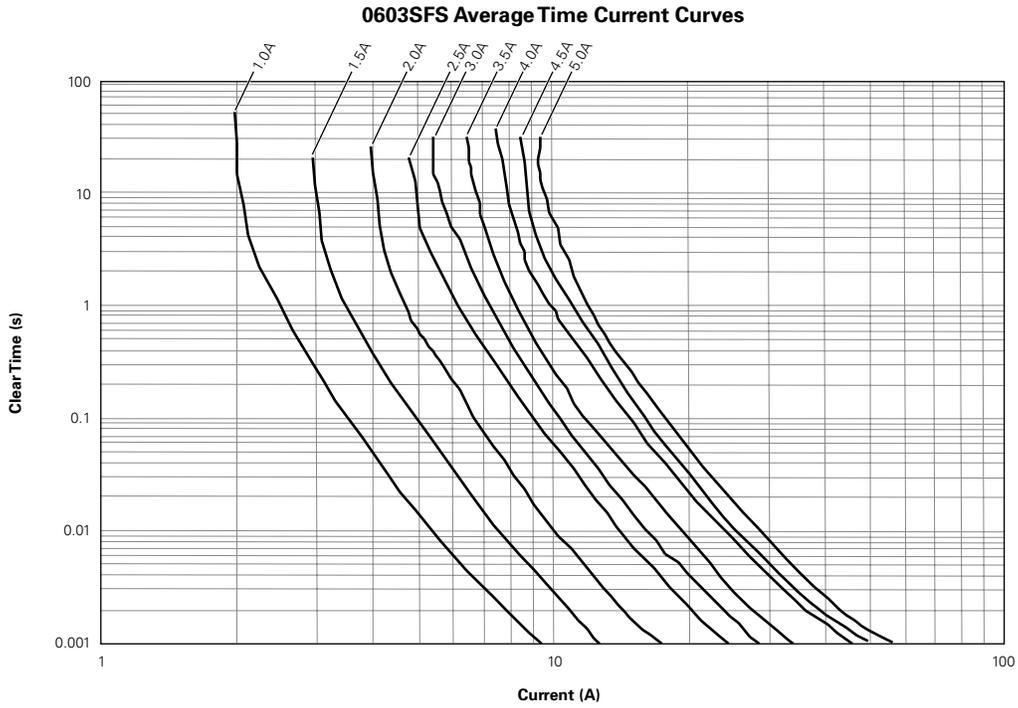
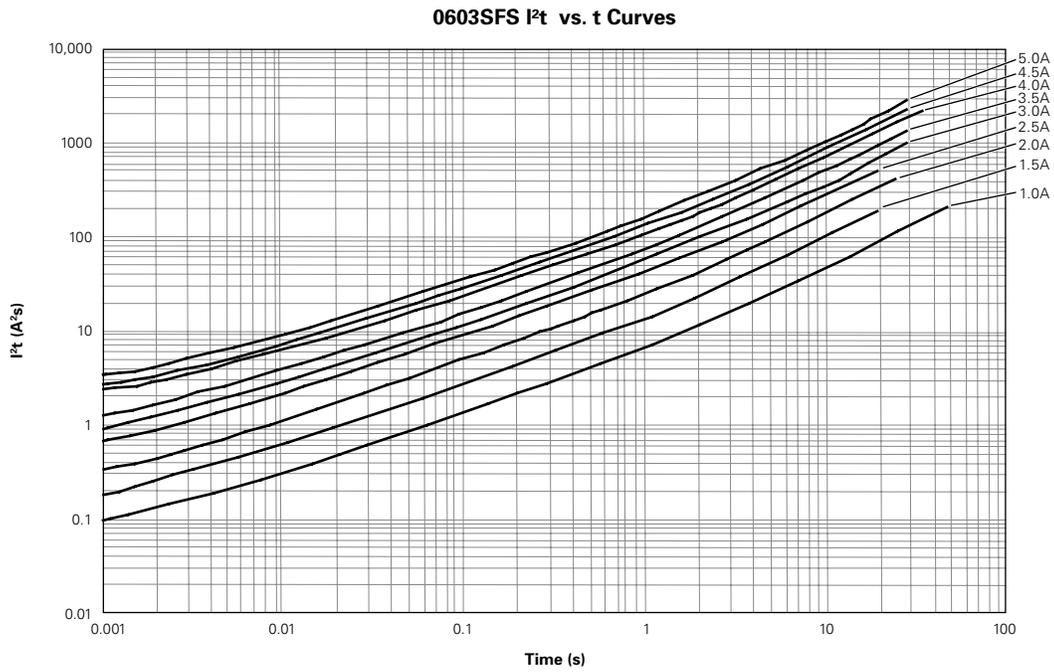


Figure FS2



**Note:** Curves are nominal.

Figures FS1-FS4 – Family Performance Curves

(Cont'd)

Figure FS3

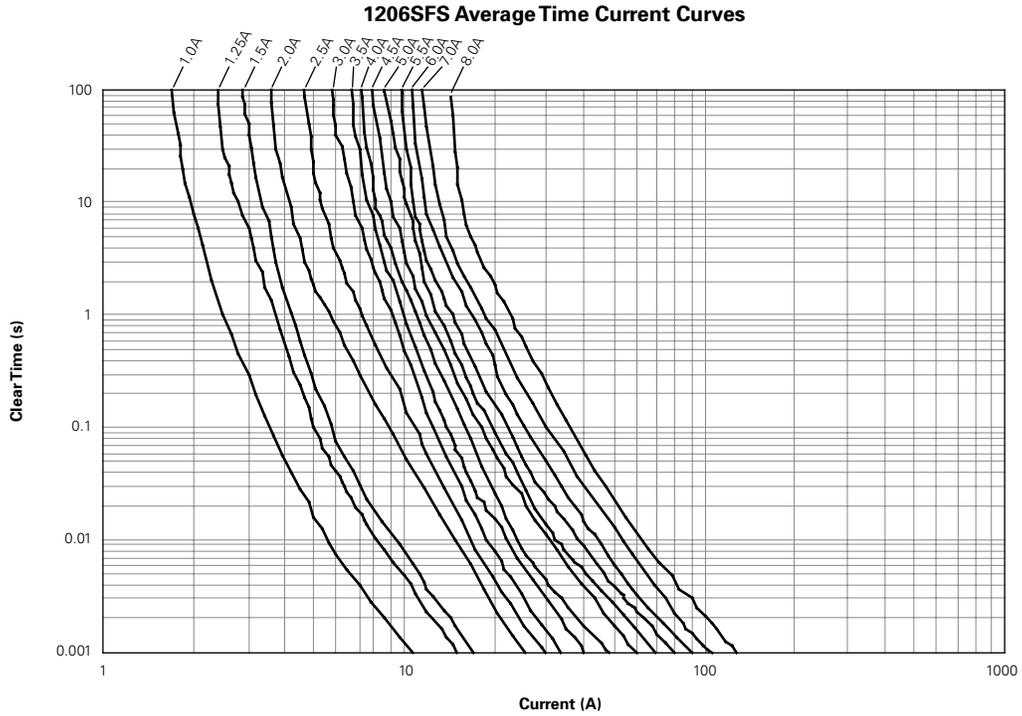
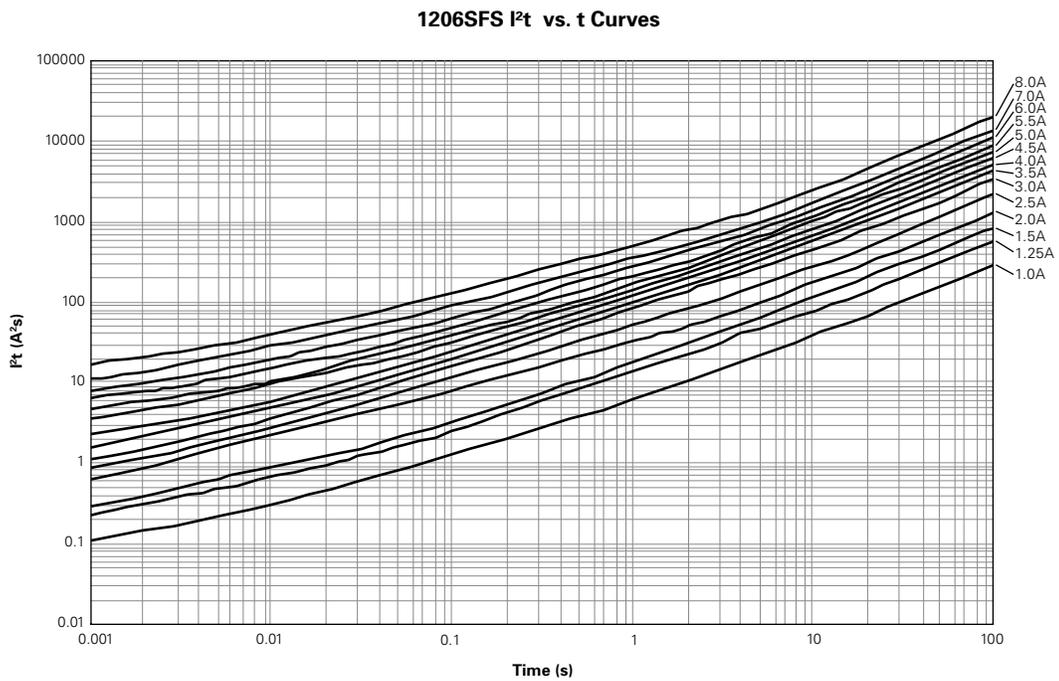


Figure FS4



Note: Curves are nominal.

→ Please go to page 111 for more information about Slow-Blow Chip Fuses.

# SPECIFICATIONS, PACKAGING INFORMATION, AGENCY APPROVALS AND PART NUMBERING SYSTEMS FOR ALL FUSES

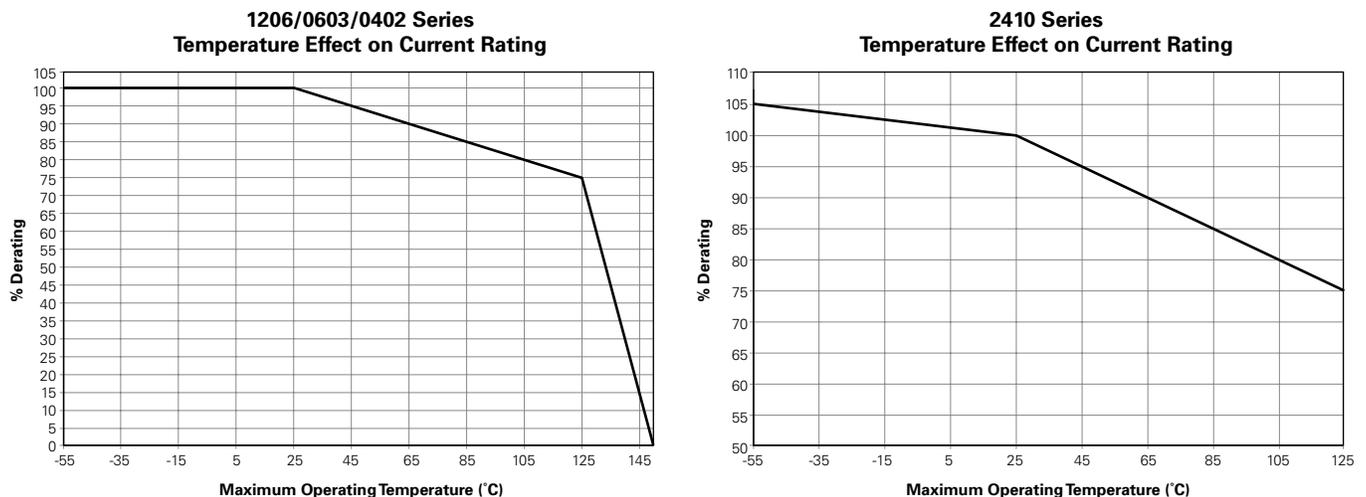
Table F1 – Environmental Specifications for All Fuses

|                              |  |
|------------------------------|--|
| Operating Temperature        | -55°C to +125°C (for the 0603TSFV series the Operating Temperature is -55°C to +90°C)            |
| Mechanical Vibration         | Withstands 5-3000 Hz at 30Gs when evaluated per Method 204 of MIL-STD-202                        |
| Mechanical Shock             | Withstands 1500Gs, 0.5 millisecond half-sine pulses when evaluated per Method 213 of MIL-STD-202 |
| Thermal Shock                | Withstands 100 cycles from -65°C to +125°C when evaluated per Method 107 of MIL-STD-202          |
| Resistance to Soldering Heat | Withstands 60 seconds at +260°C when evaluated per Method 210 of MIL-STD-202                     |
| Solderability                | Meets 95% minimum coverage requirement when evaluated per Method 208 of MIL-STD-202              |
| Moisture Resistance          | Withstands 10 cycles when evaluated per Method 106 of MIL-STD-202                                |
| Salt Spray                   | Withstands 48-hour exposure when evaluated per Method 101 of MIL-STD-202                         |
| Storage Condition            | ≤35°C/ 75% RH  |

Table F2 – Material Specifications for All Fuses

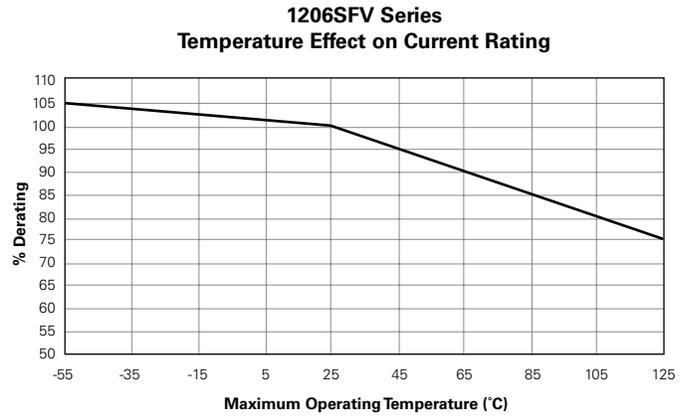
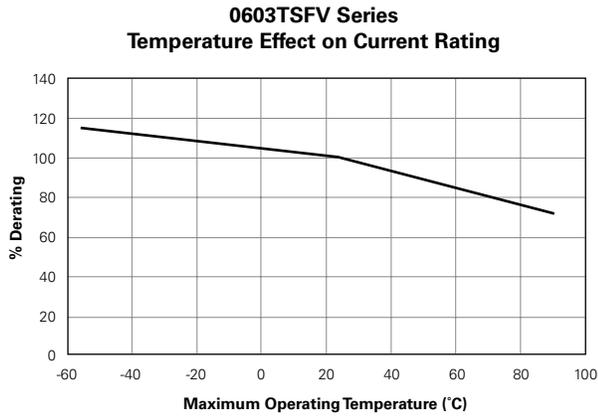
|                            |   |
|----------------------------|---|
| Construction Body Material | Ceramic (1206/0603/0402SFF, 1206/0603SFS, 1206/0603SFP, 1206SFH, 0603SFV)             |
|                            | Fiberglass/Epoxy (2410SFV, 1206SFV, 0603TSFV)   |
| Termination Material       | Silver, Nickel, Tin (1206/0603/0402SFF, 1206/0603SFS, 1206/0603SFP, 1206SFH, 0603SFV) |
|                            | Copper, Nickel, Tin(2410SFV, 1206SFV, 0603TSFV)                                       |
| Fuse Element               | Silver (1206/0603/0402SFF, 1206/0603SFS, 1206/0603SFP, 1206SFH, 0603SFV)              |
|                            | Copper/Copper Alloy (2410SFV, 1206SFV)  |
|                            | Copper/Tin Alloy (0603TSFV)   |

Figure F1 – Thermal Derating Current for All Fuse



## Figures F1 – Thermal Derating Current for All Fuse

(Cont'd)



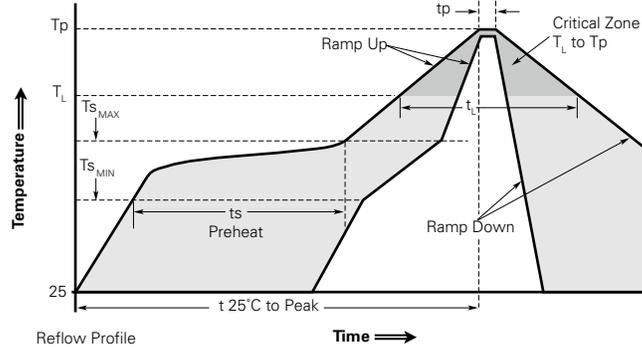
## Table F3 – Electrical Specifications for All Fuses

|                                     |  |
|-------------------------------------|--|
| Insulation Resistance after Opening | 20,000Ω minimum @ rated voltage. Fuse clearing under low-voltage conditions may result in lower post-clearing insulation values. Under normal fault conditions TE Circuit Protection fuses help provide sufficient insulation resistance for circuit protection.<br><b>Notes:</b> for 1206SFV series, the minimum DCR is 10,000Ω; for 0603TSFV, the minimum DCR is 100Ω. |
| Current Carrying Capacity           | Withstands 100% rated current at +25°C ambient for 4 hours when evaluated per MIL-PRF-23419.   |

## Table F4 – Packaging Information for All Fuses

| Size            | Reel Quantity (pcs) | Reel Diameter       | Reel Width   | Carrier Tape Size | Tape Type | Reels per Outside Shipment Box | Outside Shipment Boxes per Overpack |
|-----------------|---------------------|---------------------|--------------|-------------------|-----------|--------------------------------|-------------------------------------|
| 0402 (1005)     | 10,000              | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Paper     | 5                              | 1 to 10                             |
| 0603 (1608)     | 4,000               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Paper     | 5                              | 1 to 10                             |
| 0603SFV (1608)  | 6,000               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Paper     | 5                              | 1 to 10                             |
| 0603TSFV (1608) | 8,000               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Paper     | 5                              | 1 to 10                             |
| 1206 (3216)     | 3,000               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Plastic   | 5                              | 1 to 10                             |
| 1206SFV (3216)  | 3,500               | 178mm white plastic | 9.0 ± 0.5mm  | 8.00 ± 0.10mm     | Plastic   | 5                              | 1 to 10                             |
| 2410SFV (6125)  | 2,000               | 178mm white plastic | 13.4 ± 0.5mm | 12.00 ± 0.10mm    | Plastic   | 4                              | 1 to 10                             |

Figure F2 – Recommended Soldering Temperature Profile for All Fuses

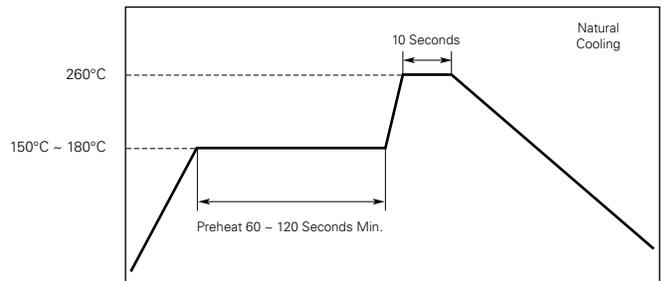


### Classification Reflow Profile

| Profile Feature   | 1206/0603/0402  | 2410            |
|---|-----------------|-----------------|
| <b>Average Ramp Up Rate (T<sub>S</sub>MAX to T<sub>p</sub>)</b> | 3°C/second max  | 3°C/second max  |
| <b>Preheat</b>  |                 |                 |
| • Temperature min (T <sub>S</sub> MIN)                          | 150°C           | 150°C           |
| • Temperature max (T <sub>S</sub> MAX)                          | 200°C           | 200°C           |
| • Time (t <sub>S</sub> MIN to t <sub>S</sub> MAX)               | 60-180 seconds  | 40-100 seconds  |
| <b>Time Maintained Above:</b>                                   |                 |                 |
| • Temperature (T <sub>L</sub> )                                 | 217°C           | 200°C           |
| • Time (t <sub>i</sub> )  | 60-150 seconds  | 30-90 seconds   |
| <b>Peak/Classification Temperature (T<sub>p</sub>)</b>          | 260°C max       | 250°C max       |
| <b>Time Within 5°C of Actual Peak Temperature</b>               |                 |                 |
| Time (t <sub>p</sub> )  | 20-40 seconds   | 30-40 seconds   |
| <b>From 25°C to Preheating (150°C)</b>                          | 8 minutes max   | 40-100 seconds  |
| <b>Ramp Down Rate</b>   | 4°C/seconds max | Natural Cooling |

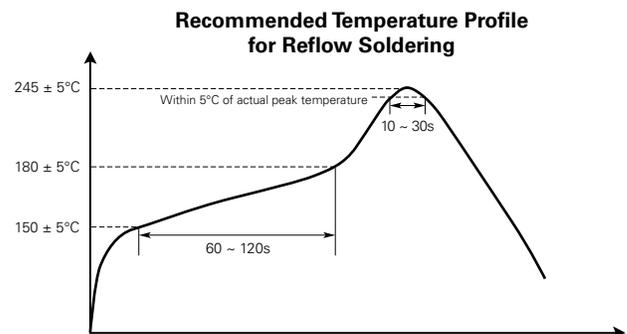
### Classification Reflow Profile

| Profile Feature  | 0603TSFV        |
|--|-----------------|
| <b>Average Ramp Up Rate</b>                            | 3°C/second max  |
| <b>Preheat</b>   |                 |
| • Temperature min                                      | 150°C           |
| • Temperature max                                      | 180°C           |
| • Time   | 60 -120 seconds |
| <b>Peak/Classification temperature (T<sub>p</sub>)</b> | 260°C Max       |
| <b>Time of actual peak temperature</b>                 |                 |
| Time   | 10 seconds      |
| <b>Ramp down rate</b>                                  | Natural Cooling |



### Classification Reflow Profile

| Profile Feature  | 1206SFV         |
|--|-----------------|
| <b>Average Ramp Up Rate</b>                            | 3°C/second max  |
| <b>Preheat</b>   |                 |
| • Temperature min                                      | 150°C           |
| • Temperature max                                      | 180°C           |
| • Time   | 60-120 seconds  |
| <b>Peak/Classification temperature (T<sub>p</sub>)</b> | 245°C Max       |
| <b>Time within 5°C of actual peak temperature</b>      |                 |
| Time   | 10-30 seconds   |
| <b>Ramp down rate</b>                                  | Natural Cooling |



### Recommended Conditions for Hand Soldering:

- Using a hot air rework station that can reflow the solder on both terminations at the same time is strongly recommended; do not directly contact the chip termination with the tip of soldering iron.
- Preheating: 150°C, 60s (min)  
Appropriate temperature (max) of soldering iron tip/soldering time (max): 280°C /10s or 350°C /3s.

Table F4 – Packaging Information for All Fuses

| Mark           | Dimension in in (mm)               |                                    |                                    |                                    |                                    |                                      |
|----------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|
|                | 0402 (1005)                        | 0603 (1608)                        | 1206 (3216)                        | 0603SFV(1608)                      | 2410SFV(6125)                      | 1206SFV (3216)                       |
| E <sub>1</sub> | 0.069 ± 0.004<br>(1.75 ± 0.10)     | 0.069±0.004<br>(1.75 ± 0.10)         |
| F              | 0.138 ± 0.002<br>(3.50 ± 0.05)     | 0.217 ± 0.004<br>(5.50 ± 0.10)     | 0.138 ± 0.002<br>(3.50 ± 0.05)       |
| W              | 0.315 ± 0.004<br>(8.00 ± 0.10)     | 0.472 ± 0.004<br>(12.00 ± 0.10)    | 0.315 ± 0.004<br>(8.00 ± 0.10)       |
| P <sub>1</sub> | 0.079 ± 0.004<br>(2.00 ± 0.10)     | 0.157 ± 0.004<br>(4.00 ± 0.10)       |
| P <sub>0</sub> | 0.157 ± 0.004<br>(4.00 ± 0.10)       |
| P <sub>2</sub> | 0.079 ± 0.002<br>(2.00 ± 0.05)     | 0.079 ± 0.004<br>(2.00 ± 0.10)     | 0.079 ± 0.002<br>(2.00 ± 0.05)       |
| D <sub>0</sub> | 0.059 ± 0.004<br>(1.50±0.10/-0.00) | 0.059±0.004/-0.00<br>1.50±0.10/-0.00 |
| D <sub>1</sub> | —                                  | —                                  | 0.039 max<br>(1.00 max)            | —                                  | 0.61 ± 0.004<br>(1.55 ± 0.10)      | 0.039 ± 0.002<br>1.00 ± 0.05         |
| t              | —                                  | —                                  | 0.009 ± 0.001<br>(0.23 ± 0.02)     | —                                  | 0.010 ± 0.002<br>(0.25 ± 0.05)     | 0.009 ± 0.002<br>0.22±0.05           |
| A <sub>0</sub> | 0.026 ± 0.004<br>(0.67 ± 0.10)     | 0.039 ± 0.004<br>(0.98 ± 0.10)     | 0.071 ± 0.004<br>(1.80 ± 0.10)     | 0.039 ± 0.004<br>(0.98 ± 0.10)     | 0.112 ± 0.004<br>(2.85 ± 0.10)     | 0.081±0.004<br>(2.05 ± 0.10)         |
| B <sub>0</sub> | 0.046 ± 0.004<br>(1.17 ± 0.10)     | 0.071 ± 0.004<br>(1.80 ± 0.10)     | 0.138 ± 0.004<br>(3.50 ± 0.10)     | 0.071 ± 0.004<br>(1.80 ± 0.10)     | 0.252 ± 0.004<br>(6.40 ± 0.10)     | 0.138 ± 0.004<br>(3.50 ± 0.10)       |
| K <sub>0</sub> | 0.025 ± 0.004<br>(0.63 ± 0.10)     | 0.037 ± 0.003<br>(0.95 ± 0.08)     | 0.050 ± 0.004<br>(1.27 ± 0.10)     | 0.024 ± 0.003<br>(0.60 ± 0.08)     | 0.093 ± 0.004<br>(2.35 ± 0.10)     | 0.051 ± 0.004<br>(1.30 ± 0.10)       |

Figure F3 – Component Tape Dimensions for All Fuses

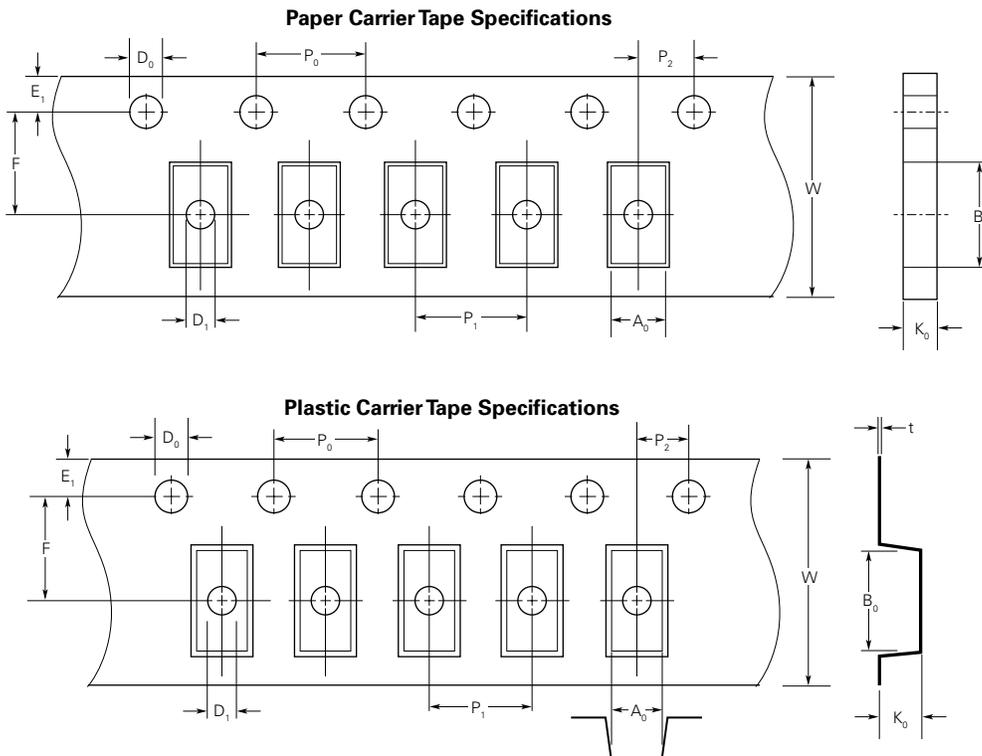
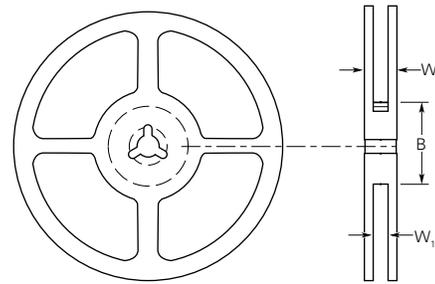


Figure F4 – Reel Dimensions for All Fuses

| Dimension Description | Mark           | Dimension (mm) |      |
|-----------------------|----------------|----------------|------|
|                       |                | 1206/0603/0402 | 2410 |
| Hub Outer Diameter    | B              | 60             | 60.2 |
| Reel Inside Width     | W <sub>1</sub> | 9              | 13.4 |
| Reel Outside Width    | W <sub>2</sub> | 11.4           | 16   |
| Tape Width            |                | 8              |      |



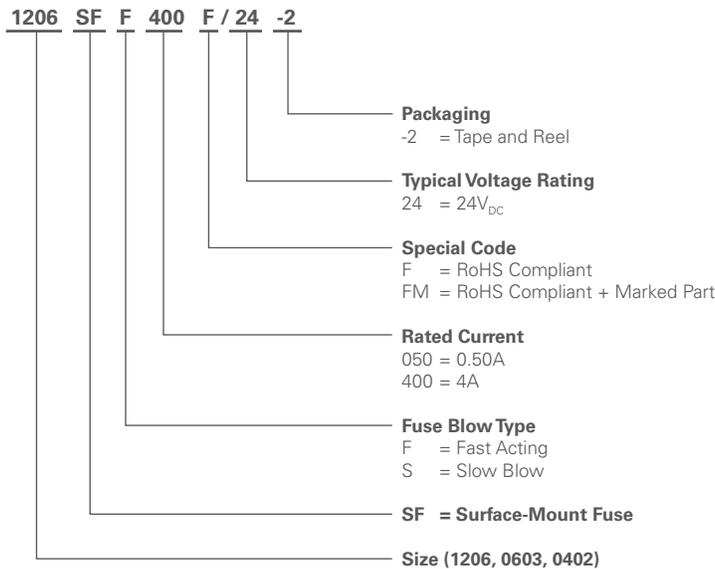
Agency Approvals for All Fuses

UL: All fuses

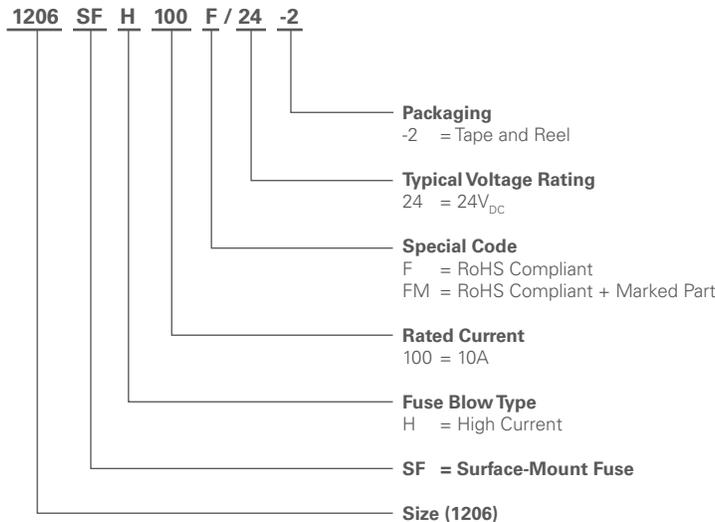
CQC: File # 12012078873 (for 2410SFV 0.5A, 1A, 2A)

TUV: File # 50236400 (for 2410SFV 0.5A, 0.63A, 1A, 1.25A, 2A)

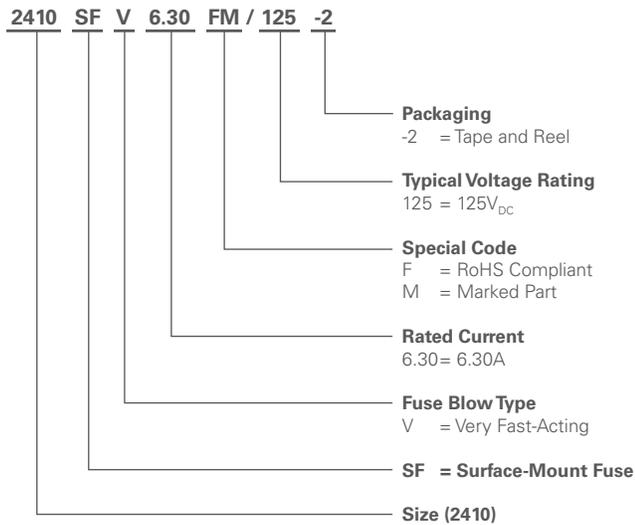
Part Numbering System for Fast-Acting, Slow-Blow And 0603 Very Fast-Acting Chip Fuses



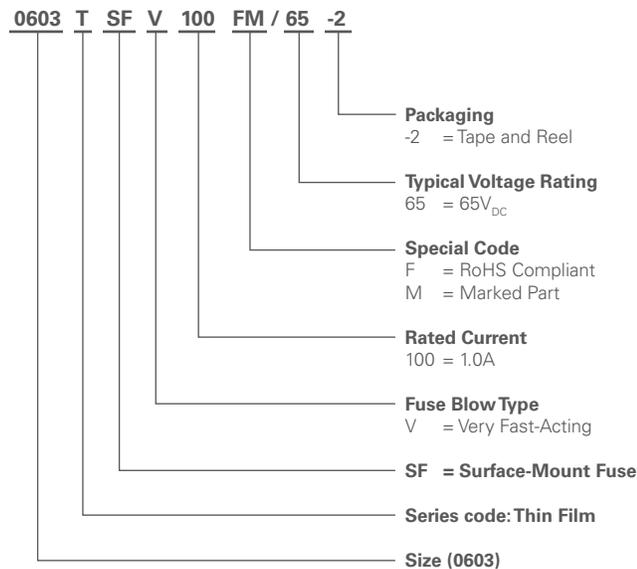
Part Numbering System for High-Current-Rated Chip Fuses



## Part Numbering System for 1206/2410 Very Fast-Acting Fuses



## Part Numbering System for 0603 Thin Film Very Fast-Acting Chip Fuses

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# POLYSWITCH RESETTABLE DEVICES

## Fundamentals

### Overview

PolySwitch polymeric positive temperature coefficient (PPTC) devices help protect against damage caused by harmful overcurrent surges and overtemperature faults. Like traditional fuses, these devices limit the flow of dangerously high current during fault conditions. The PolySwitch device, however, resets after the fault is cleared and power to the circuit is removed, thereby helping to reduce warranty, service and repair costs.

PolySwitch circuit protection devices are made from a composite of semi-crystalline polymer and conductive particles. At normal temperature, the conductive particles form low-resistance networks in the polymer (Figure 1.a). However, if the temperature rises, either from high current through the part or from an increase in the ambient temperature, the crystallites in the polymer melt and become amorphous. The increase in volume during melting of the crystalline phase separates the conductive particles, resulting in a large non-linear increase in the resistance of the device.

### Overcurrent Protection Using a PPTC Device

The PPTC device is a series element in a circuit. The PPTC device helps protect the circuit by going from a low-resistance to a high-resistance state in response to an overcurrent condition, as shown in Figure 2. This is referred to as “tripping” the device.

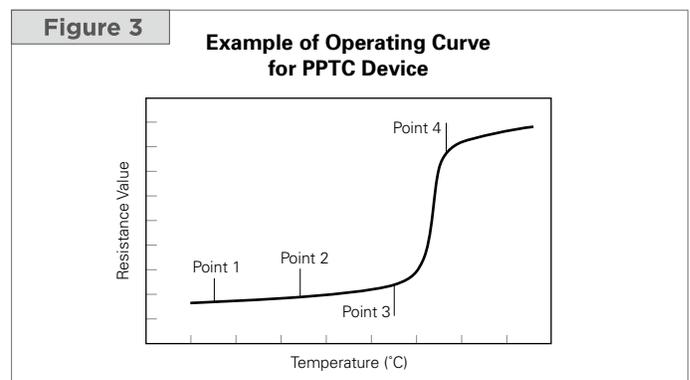
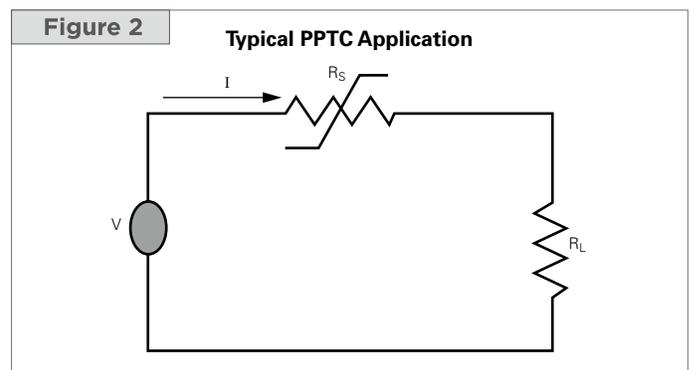
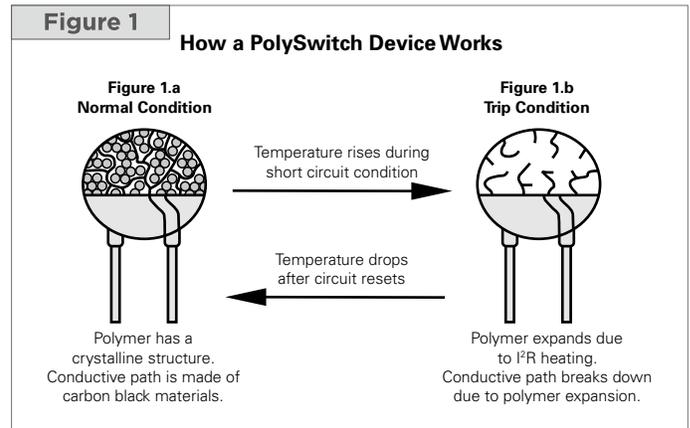
In normal operation the device has a resistance that is much lower than that of the circuit. In response to an overcurrent condition, the device increases in resistance (trips), reducing the current in the circuit to a value that can be safely carried by any of the circuit elements. This change is the result of a rapid increase in the temperature of the device caused by  $I^2R$  heating.

### Principles of Operation

PolySwitch PPTC device's operation is based on an overall energy balance, as shown in Figure 3. Under normal operating conditions, the heat generated by the device and the heat lost by the device to the environment are in balance at a relatively low temperature, as shown between Points 1 and 2.

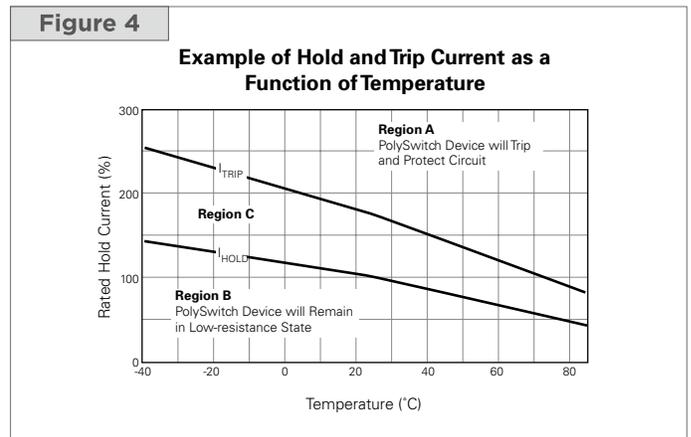
If the current through the device is increased while the ambient temperature is kept constant, the temperature of the device increases. Further increases in either current, ambient temperature, or both, will cause the device to reach a temperature where the resistance rapidly increases, as shown in Point 3.

Any further increase in current or ambient temperature will cause the device to generate heat at a rate greater than the rate at which heat can be dissipated, thus causing the device to heat up rapidly. At this stage, a very large increase in resistance occurs for a very small change in temperature, between Points 3 and 4. This is the normal operating region for a device in the tripped state. This large change in resistance causes a corresponding decrease in the current flowing to the circuit. This relation holds until the device resistance reaches the upper knee of the curve (Point 4). As long as the applied voltage remains at this level, the device will remain in the tripped state (that is, the device will remain latched in its protective state). Once the voltage decreases, the power is removed and the device cools, the device will reset.



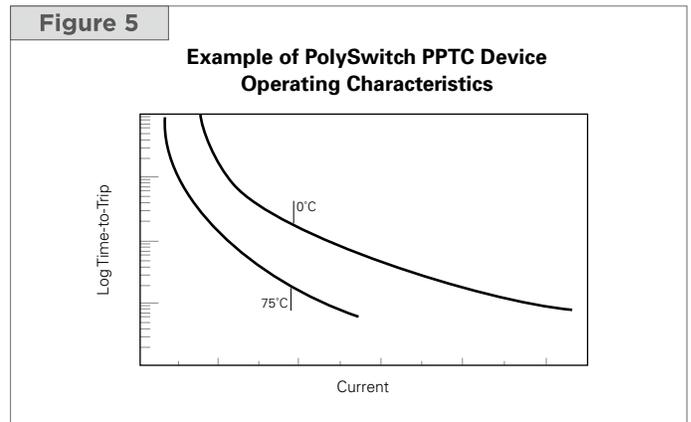
## Example of Hold and Trip Current as a Function of Temperature

Figure 4 illustrates the hold- and trip-current behavior of a PolySwitch PPTC device as a function of temperature. One such curve can be defined for each available device. Region A describes the combinations of current and temperature at which the PolySwitch device will trip (go into the high-resistance state) and protect the circuit. Region B describes the combinations of current and temperature at which the PolySwitch device will allow for normal operation of the circuit. In Region C, it is possible for the device to either trip or remain in the low-resistance state (depending on individual device resistance).



## Operating Characteristics of a PolySwitch PPTC Device

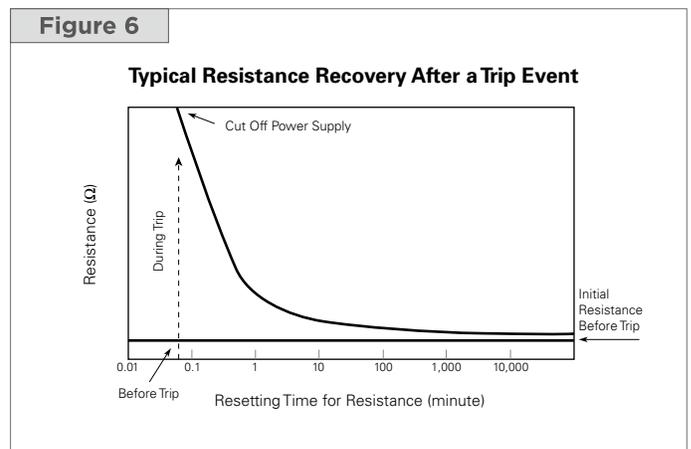
Figure 5 shows a typical pair of operating curves for a PolySwitch device in still air at 0°C and 75°C. The curves are different because the heat required to trip the device comes both from electrical I<sup>2</sup>R heating and from the device environment. At 75°C the heat input from the environment is substantially greater than it is at 0°C, so the additional I<sup>2</sup>R needed to trip the device is correspondingly less. This results in a lower trip current at a given trip time (or a faster trip at given trip current).



## Typical Resistance Recovery After a Trip Event

Figure 6 shows typical behavior of a PolySwitch device that is tripped and then allowed to cool. This figure illustrates how, even after a number of hours, the device resistance is still greater than the initial resistance. Over an extended period of time, device resistance will continue to fall and will eventually approach initial resistance.

However, since this time can be measured in days, months, or years, it is not practical to expect that the device resistance will reach the original value for operational purposes. Therefore, when PolySwitch devices are chosen, R<sub>1MAX</sub> should be taken into consideration when determining hold current. R<sub>1MAX</sub> is the resistance of the device one hour after the thermal event.



# POLYSWITCH RESETTABLE DEVICES

## Product Selection Guide

Table 1 – PolySwitch Device Characteristics

| PolySwitch Device Family | V <sub>MAX</sub> Operating (V <sub>DC</sub> ) | V <sub>MAX</sub> Interrupt (V <sub>RMS</sub> ) | I <sub>H</sub>  | Temp. Range  | Form Factor   | Agency Spec.      | Application                  |
|--------------------------|---|--|-----------------|--------------|---------------|-------------------|------------------------------|
| LVR                      | 120V/240V                                     | 135V/265V                                      | 0.05 to 2A      | -20 to 85°C  | Radial-leaded | UL, CSA, TÜV      | Line Voltage                 |
| LVB                      | 240V  | 265V   | 1.25A           | -40 to 85°C  | Radial-leaded | UL                | Line Voltage                 |
| RGEF                     | 16V   | —  | 2.5 to 14.0A    | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV      | General Electronics          |
| RHEF                     | 16 to 30V                                     | —  | 0.5 to 15A      | -40 to 125°C | Radial-leaded | UL, CSA, TÜV      | General Electronics          |
| RUEF                     | 30V   | —  | 0.9 to 9.0A     | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV, CQC | General Electronics          |
| RKEF                     | 60V   | —  | 0.50 to 5A      | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV      | General Electronics          |
| RXEF                     | 60 to 72V                                     | —  | 0.05 to 3.75A   | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV, CQC | General Electronics          |
| RUSBF                    | 6 to 16V                                      | —  | 0.75 to 2.5A    | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV      | Computer/General Electronics |
| femtoSMDC                | 6 to 15V                                      | —  | 0.05 to 0.35A   | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| High Temperature SMD     | 6 to 30V                                      | —  | 0.10 to 0.75A   | -40 to 125°C | Surface-mount | —                 | Computer/General Electronics |
| microSMD                 | 6 to 30V                                      | —  | 0.05 to 2.0A    | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| midSMD                   | 6 to 60V                                      | —  | 0.3 to 2.0A     | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| miniSMDC                 | 6 to 60V                                      | —  | 0.10 to 3A      | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| nanoSMDC                 | 6 to 60V                                      | —  | 0.10 to 2.0A    | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| picoSMDC                 | 6 to 15V                                      | —  | 0.10 to 1.1A    | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| SMD                      | 6 to 60V                                      | —  | 0.3 to 3.0A     | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| SMD2                     | 15 to 33V                                     | —  | 1.5 to 2.5A     | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| SMDC                     | 18 to 33V                                     | —  | 1.25 to 3.1A    | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Computer/General Electronics |
| BD                       | 16V   | —  | 8 to 21A        | -40 to 125°C | Plug-in       | —                 | Automotive                   |
| AGRF                     | 16V   | —  | 4.0 to 14.0A    | -40 to 85°C  | Radial-leaded | —                 | Automotive                   |
| AHRF                     | 16 to 30V                                     | —  | 0.50 to 15A     | -40 to 125°C | Radial-leaded | —                 | Automotive                   |
| AHS                      | 16V   | —  | 0.80 to 3.0A    | -40 to 125°C | Surface-mount | —                 | Automotive                   |
| ASMD                     | 16 to 60V                                     | —  | 0.23 to 1.97A   | -40 to 85°C  | Surface-mount | —                 | Automotive                   |
| AHEF                     | 32V   | —  | 0.50 to 10A     | -40 to 125°C | Radial-leaded | —                 | Automotive                   |
| nanoASMD                 | 16 to 48V                                     | —  | 0.12 to 0.35A   | -40 to 85°C  | Surface-mount | —                 | Automotive                   |
| microASMD                | 30V   | —  | 0.05 to 0.1A    | -40 to 85°C  | Surface-mount | —                 | Automotive                   |
| miniASMD                 | 16 to 60V                                     | —  | 0.1 to 2.6A     | -40 to 85°C  | Surface-mount | —                 | Automotive                   |
| TCF                      | 60V   | 250V   | 0.09 to 0.18A   | -40 to 85°C  | Chip          | —                 | Telecom & Networking         |
| TRF250                   | 60 to 100V                                    | 250V   | 0.055 to 0.184A | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV      | Telecom & Networking         |
| TRF600                   | 60 to 250V                                    | 600V   | 0.15 to 0.40A   | -40 to 85°C  | Radial-leaded | UL, CSA, TÜV      | Telecom & Networking         |
| TS250/TSV250             | 60V   | 250V   | 0.13 to 0.184A  | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Telecom & Networking         |
| TSL250                   | 80V   | 250V   | 0.08A           | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Telecom & Networking         |
| TS600/TSM600             | 60 to 250V                                    | 600V   | 0.17 to 0.40A   | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Telecom & Networking         |
| MXP                      | 6V  | —  | 1.9 to 3.7A     | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV      | Battery                      |
| MGP                      | 6V  | —  | 4.5 to 5.0A     | -40 to 85°C  | Axial-leaded  | UL, TÜV           | Battery                      |
| LR4                      | 15 to 20V                                     | —  | 1.9 to 13.0A    | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV      | Battery                      |
| SRP                      | 15 to 30V                                     | —  | 1.2 to 4.2A     | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV      | Battery                      |
| VLP                      | 16V   | —  | 1.2 to 2.7A     | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV      | Battery                      |
| VLR                      | 12V   | —  | 1.7 to 2.3A     | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV      | Battery                      |
| VTP                      | 16V   | —  | 1.1 to 2.1A     | -40 to 85°C  | Axial-leaded  | UL, CSA, TÜV      | Battery                      |
| low resistivity SMD      | 6V  | —  | 1.75 to 5.0A    | -40 to 85°C  | Surface-mount | UL, CSA, TÜV      | Battery                      |

Table 2 — Thermal Derating PPTC

| PolySwitch Device Family | -40°C | -20°C | 0°C  | 20°C | 25°C | 30°C | 40°C | 50°C | 60°C | 70°C | 85°C | 125°C |
|--------------------------|-------|-------|------|------|------|------|------|------|------|------|------|-------|
| LVR005-055               | —     | 1.48  | 1.24 | 1.00 | 0.99 | 0.93 | 0.82 | 0.72 | 0.60 | 0.51 | 0.35 | —     |
| LVR075-200               | —     | 1.69  | 1.34 | 1.00 | 0.99 | 0.95 | 0.88 | 0.80 | 0.73 | 0.66 | 0.55 | —     |
| LVB                      | 1.67  | 1.45  | 1.22 | 1.00 | 0.98 | 0.88 | 0.79 | 0.69 | 0.59 | 0.48 | 0.33 | —     |
| RGEF                     | 1.47  | 1.33  | 1.20 | 1.04 | 1.00 | 0.95 | 0.87 | 0.80 | 0.71 | 0.63 | 0.47 | —     |
| RHEF                     | 1.36  | 1.25  | 1.15 | 1.03 | 1.00 | 0.96 | 0.88 | 0.81 | 0.75 | 0.67 | 0.55 | 0.25  |
| RUEF                     | 1.48  | 1.32  | 1.16 | 1.00 | 0.96 | 0.92 | 0.84 | 0.76 | 0.68 | 0.60 | 0.48 | —     |
| RKEF                     | 1.45  | 1.30  | 1.15 | 1.00 | 0.97 | 0.92 | 0.83 | 0.77 | 0.68 | 0.61 | 0.52 | —     |
| RXEF                     | 1.56  | 1.37  | 1.19 | 1.00 | 0.95 | 0.91 | 0.82 | 0.72 | 0.63 | 0.54 | 0.40 | —     |
| RUSBF                    | 1.41  | 1.27  | 1.14 | 1.00 | 0.97 | 0.93 | 0.87 | 0.80 | 0.73 | 0.66 | 0.56 | —     |
| femtoSMDC                | 1.59  | 1.39  | 1.18 | 1.05 | 1.00 | 0.86 | 0.78 | 0.66 | 0.61 | 0.47 | 0.41 | —     |
| High Temperature SMD     | 0.18  | 0.16  | 0.15 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.07 | 0.06 | 0.06 | 0.03  |
| microSMD                 | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | —     |
| midSMD                   | 1.41  | 1.27  | 1.14 | 1.00 | 0.97 | 0.93 | 0.87 | 0.80 | 0.73 | 0.66 | 0.56 | —     |
| miniSMDC                 | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | —     |
| nanoSMDC                 | 1.56  | 1.39  | 1.15 | 1.04 | 1.00 | 0.96 | 0.87 | 0.79 | 0.70 | 0.61 | 0.49 | —     |
| picoSMDC                 | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | —     |
| SMD                      | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | —     |
| SMDC                     | 2.02  | 1.78  | 1.55 | 1.31 | 1.25 | 1.08 | 0.96 | 0.84 | 0.72 | 0.60 | 0.54 | —     |
| BD                       | 1.50  | 1.35  | 1.19 | 1.04 | 1.00 | 0.96 | 0.88 | 0.81 | 0.73 | 0.65 | 0.54 | 0.23  |
| AGRF                     | 1.47  | 1.33  | 1.20 | 1.04 | 1.00 | 0.95 | 0.87 | 0.80 | 0.71 | 0.63 | 0.47 | —     |
| AHRF                     | 1.36  | 1.25  | 1.15 | 1.03 | 1.00 | 0.96 | 0.88 | 0.81 | 0.75 | 0.67 | 0.55 | 0.25  |
| AHS                      | 1.41  | 1.28  | 1.16 | 1.03 | 1.00 | 0.97 | 0.91 | 0.84 | 0.78 | 0.72 | 0.62 | 0.37  |
| ASMD                     | 1.59  | 1.41  | 1.23 | 1.05 | 1.00 | 0.95 | 0.86 | 0.77 | 0.68 | 0.59 | 0.45 | —     |
| AHEF                     | 1.36  | 1.25  | 1.14 | 1.03 | 1.00 | 0.96 | 0.89 | 0.81 | 0.74 | 0.66 | 0.55 | 0.20  |
| nanoASMD                 | 1.56  | 1.39  | 1.15 | 1.04 | 1.00 | 0.96 | 0.87 | 0.79 | 0.70 | 0.61 | 0.49 | —     |
| microASMD                | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | —     |
| miniASMD                 | 1.45  | 1.30  | 1.15 | 1.00 | 0.96 | 0.93 | 0.85 | 0.78 | 0.70 | 0.63 | 0.51 | —     |
| TCF                      | 1.54  | 1.36  | 1.18 | 1.00 | 0.96 | 0.91 | 0.82 | 0.73 | 0.64 | 0.55 | 0.42 | —     |
| TRF                      | 1.54  | 1.36  | 1.18 | 1.00 | 0.96 | 0.91 | 0.82 | 0.73 | 0.64 | 0.55 | 0.42 | —     |
| TS                       | 1.54  | 1.36  | 1.18 | 1.00 | 0.96 | 0.91 | 0.82 | 0.73 | 0.64 | 0.55 | 0.42 | —     |
| MXP                      | 1.99  | 1.68  | 1.37 | 1.07 | 1.00 | 0.91 | 0.76 | 0.61 | 0.45 | 0.30 | 0.07 | —     |
| MGP                      | 1.90  | 1.65  | 1.35 | 1.08 | 1.00 | 0.93 | 0.80 | 0.65 | 0.50 | 0.35 | 0.13 | —     |
| LR4                      | 1.41  | 1.27  | 1.14 | 1.00 | 0.97 | 0.93 | 0.87 | 0.80 | 0.73 | 0.66 | 0.56 | —     |
| SRP                      | 1.47  | 1.31  | 1.16 | 1.00 | 0.96 | 0.92 | 0.85 | 0.77 | 0.69 | 0.61 | 0.50 | —     |
| VLP                      | 1.88  | 1.67  | 1.43 | 1.05 | 1.00 | 0.95 | 0.76 | 0.62 | 0.48 | 0.33 | 0.04 | —     |
| VLR                      | 2.05  | 1.70  | 1.41 | 1.08 | 1.00 | 0.92 | 0.74 | 0.59 | 0.41 | 0.18 | —    | —     |
| VTP                      | 1.88  | 1.67  | 1.43 | 1.05 | 1.00 | 0.95 | 0.76 | 0.62 | 0.48 | 0.33 | 0.04 | —     |
| low resistivity SMD      | 5.80  | 5.20  | 4.60 | 4.00 | 3.90 | 3.40 | 3.10 | 2.82 | 2.52 | 2.23 | 2.10 | —     |

## PolySwitch Device Selection Guide

### Step 1. Determine your circuit's parameters

You will need to determine the following parameters of your circuit:

- Maximum ambient operating temperature
- Normal operating current
- Maximum operating voltage
- Maximum interrupt current

### Step 2. Select a PolySwitch device that will accommodate the circuit's maximum ambient temperature and normal operating current

Use the Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] table on page 112 and choose the column with the temperature that most closely matches the circuit's maximum ambient temperature. Look down that column to find the value equal to or greater than the circuit's normal operating current. Now look to the far left of that row to find the part number that will best accommodate that current.

### Step 3. Compare the selected device's maximum electrical ratings with the circuit's maximum operating voltage and interrupt current

Use the Electrical Characteristics table on page 111 to verify that the part you selected in Step 2 will handle your circuit's maximum operating voltage and interrupt current. Find the device's maximum operating voltage ( $V_{MAX}$ ) and maximum interrupt current ( $I_{MAX}$ ). Ensure that  $V_{MAX}$  and  $I_{MAX}$  are greater than or equal to the circuit's maximum operating voltage and maximum fault current.

### Step 4. Determine time-to-trip

Time-to-trip is the amount of time it takes for a device to switch to a high-resistance state once a fault current has been applied through the device. Identifying the PolySwitch device's time-to-trip is important in order to provide the desired protection capabilities. If the chosen device trips too fast, undesired or nuisance tripping may occur. If the device trips too slowly, the components being protected may be damaged before the device can trip and limit the current.

Use the Typical Time-to-trip Curves at 20°C on page 110 Figure 5 to determine if the PolySwitch device's time-to-trip characteristics are acceptable at expected fault levels. If not, go back to Step 2 and choose an alternate device.

### Step 5. Verify ambient operating temperature

Ensure that your application's minimum and maximum ambient temperatures are within the operating temperature of the PolySwitch device. Most PolySwitch devices have an operating temperature range from -40°C to 85°C with some exceptions to 125°C.

### Step 6. Verify the PolySwitch device dimensions

Use the Dimensions table on pages 122-125 to compare the dimensions of the PolySwitch device you selected with the application's space considerations.

### Definitions of terms

|                   |  |
|-------------------|--|
| $I_H$             | the maximum steady state current at 20°C that can be passed through a PolySwitch device without causing the device to trip   |
| $I_T$             | the minimum current that will cause the PolySwitch device to trip at 20°C  |
| $V_{MAX}$         | the maximum voltage that can safely be dropped across a PolySwitch device in its tripped state also called: Maximum Device Voltage, Maximum Voltage, $V_{max}$ , Max Interrupt Voltage |
| $I_{MAX}$         | the maximum fault current that can safely be used to trip a PolySwitch device  |
| $P_D$             | the power (in Watts) dissipated by a PolySwitch device in its tripped state  |
| $R_{MAX}$         | the maximum resistance prior to the trip of a PolySwitch device  |
| $R_{MIN}$         | the minimum resistance prior to the trip of a PolySwitch device  |
| $R_{1MAX}$        | the maximum resistance of a PolySwitch device at 20°C 1 hour after being tripped and reset or after reflow soldering   |
| $R_{Tripped Typ}$ | the typical resistance of a PolySwitch device 1 hour after the initial trip and reset  |



# POLYSWITCH RESETTABLE DEVICES

## Surface-Mount Devices

PolySwitch surface-mount devices are an effective circuit protection method for computer, consumer, multimedia, portable and automotive electronics applications.

In an effort to reduce the size and cost of surface-mount devices, TE Circuit Protection introduced the miniSMD product series in 1995. Subsequently, we developed the microSMD, nanoSMD, picoSMD and femtoSMD family of products. The femtoSMD series reduced the device size to a 1608mm (0603 mils) footprint, which is one-twelfth the size of the popular miniSMD series.

Recent additions to the PolySwitch surface-mount series include 1.1A picoSMD 1210mm (0805 mils) and 0.35A femtoSMD 1608mm (0603 mils) devices.



### BENEFITS

- Smaller size helps save board space and cost
- Many product choices optimizes design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

### FEATURES

- RoHS compliant
- Halogen free (refers to: Br $\leq$ 900ppm, Cl $\leq$ 900ppm, Br+Cl $\leq$ 1500ppm)
- Broadest range of resettable devices available in the industry
- Current ratings from 0.05 to 3.1A
- Voltage ratings from 6V computer and electronic applications to 60V telecom applications
- Agency recognition: UL, CSA, TÜV
- Small footprint
- Fast time-to-trip
- Low resistance

### APPLICATIONS

- Computer
- Portable electronics
- Multimedia
- Game machines
- Telephony and broadband
- Mobile phones
- Automotive
- Industrial controls
- Battery

## Application Selection Table

- The table below lists PolySwitch surface-mount devices recommended for use in typical applications
- Specifications for the suggested PolySwitch surface-mount device part numbers can be found in this table
- Once a part has been selected, the user should evaluate and test each product for the intended application

|                             |                      |                         | PolySwitch Resettable Devices - Key Selection Criteria |                   |  |
|-----------------------------|----------------------|-------------------------|--|-------------------|--|
| Protection Application      | Additional Comments  | Overcurrent Overvoltage | Small Size   | Low Resistance    | Fast Time-to-trip (Temperature Protection) |
| AC Adapter Input Power      | Use w/ Zener & Triac |                         | SMD250F  | SMD250F           | SMD200F                                    |
| Battery Pack Protection     |                      |                         | nanoSMDC150F   | miniSMDC260F      | miniSMDE200F/16                            |
| Charger Protection          |                      |                         | nanoSMDC050F   | miniSMDC110F/16   | nanoSMDC075F                               |
| CPU/IC Protection           |                      |                         | nanoSMDC110F   | nanoSMDC150F      | nanoSMDC075F                               |
| Data Acquisition/Sensor     |                      |                         | microSMD005F   | —                 | microSMD005F                               |
| DC Input/Output Power       | ≤6V                  |                         | nanoSMDC075F   | nanoSMDC150F      | nanoSMDC050F/13.2                          |
|                             | ≤12V                 |                         | miniSMDC075F   | miniSMDC110F/16   | miniSMDC075F                               |
| DDC                         |                      |                         | nanoSMDC075F   | nanoSMDC110F      | nanoSMDC050F/13.2                          |
| Device Bay System           | DB12, DB20           |                         | miniSMDC200F   | miniSMDC260F      | miniSMDC200F                               |
|                             | DB32                 |                         | miniSMDC260F   | SMD300F           | miniSMDC200F                               |
| Ethernet/LAN                |                      |                         | nanoSMDC050F/13.2                                      | miniSMDC110F/16   | nanoSMDC075F                               |
| Fan                         |                      |                         | microSMD035F   | microSMD050F      | microSMD035F                               |
| HDMI                        |                      |                         | picoSMDC035S   | picoSMDC035S      | picoSMDC035S                               |
| IEEE 802.3af                | VoIP                 |                         | decaSMDC050F/60  | decaSMDC050F/60   | decaSMDC050F/60                            |
| IEEE-1394                   | Power Provider       |                         | SMD100F/33   | SMD185F           | SMD100F/33                                 |
|                             | Alt. Power Provider  |                         | SMD185F  | SMD185F           | SMD150F/33                                 |
|                             | Self-Powered         |                         | SMD185F  | SMD185F           | SMD150F/33                                 |
| LCD Inverter                |                      |                         | nanoSMDC050F/13.2                                      | miniSMDC110F/16   | nanoSMDC075F                               |
| LCD Screen Power            |                      |                         | nanoSMDC050F/13.2                                      | nanoSMDC050F/13.2 | microSMD035F                               |
| LNB (Low Noise Block)       |                      |                         | SMD075F  | SMD075F           | SMD050F                                    |
| Motor                       | ≤6V                  |                         | nanoSMDC110F   | nanoSMDC150F      | microSMD075F                               |
|                             | ≤13.2V               |                         | miniSMDC075F   | miniSMDC110F/16   | miniSMDC075F                               |
| PS/2 Mouse/Keyboard         |                      |                         | nanoSMDC075F   | nanoSMDC110F      | nanoSMDC050F/13.2                          |
| Signal - Data Communication | ≤6V                  |                         | nanoSMDC075F   | nanoSMDC075F      | nanoSMDC075F                               |
|                             | ≤13.2V               |                         | miniSMDC050F   | miniSMDC075F      | miniSMDC020F                               |
|                             | ≤30V                 |                         | SMD030F-2018   | SMD075F           | SMD050F                                    |
| SCSI                        |                      |                         | nanoSMDC110F   | nanoSMDC150F      | nanoSMDC075F                               |
| SIM/Smart Card Reader       |                      |                         | femtoSMDC010F  | femtoSMDC010F     | femtoSMDC005F                              |
| Telecom - Modem             | Digital Line         | OC                      | miniSMDC014F   | miniSMDC014F      | miniSMDC014F                               |
| Telecom - PBX               | Subscriber           | OC                      | miniSMDC014F   | miniSMDC014F      | miniSMDC014F                               |
| Temperature Sensor          | CPU                  |                         | nanoSMDC050F/13.2                                      | nanoSMDC075F      | nanoSMDC050F/13.2                          |
| USB                         | Individual Port      |                         | nanoSMDC075F   | nanoSMDC110F      | nanoSMDC050F/13.2                          |
|                             | 2 Port Ganged        |                         | nanoSMDC150F   | miniSMDC150F      | miniSMDC125F                               |
|                             | 3 Port Ganged        |                         | miniSMDC200F   | miniSMDC200F      | miniSMDC200F                               |

**Note:** This list is not exhaustive. TE Circuit Protection welcomes our customers' input for additional application ideas for PolySwitch resettable devices.

Table S1 — Product Series: Size, Current Rating, Voltage Rating/Maximum Resistance

|                         | femtoSMD                  | picoSMD                   | nanoSMD                    | microSMD                   | miniSMD                     | midSMD                   |
|-------------------------|---------------------------|---------------------------|----------------------------|----------------------------|-----------------------------|--------------------------|
| <b>Size mm</b>          | 1608                      | 2012                      | 3216                       | 3225                       | 4532                        | 5050                     |
| <b>(mils)</b>           | (0603)                    | (0805)                    | (1206)                     | (1210)                     | (1812)                      | (2018)                   |
| <b>Hold Current (A)</b> |                           |                           |                            |                            |                             |                          |
| 0.050                   | 15V <sub>DC</sub> /30.00Ω | —                         | —                          | 30V <sub>DC</sub> /50Ω     | —                           | —                        |
| 0.080                   | 12V <sub>DC</sub> /14.00Ω | —                         | —                          | —                          | —                           | —                        |
| 0.100                   | 12V <sub>DC</sub> /8.00Ω  | 15V <sub>DC</sub> /11.00Ω | 60V <sub>DC</sub> /15.00Ω  | 30V <sub>DC</sub> /15Ω     | 60V <sub>DC</sub> /12.70Ω   | —                        |
|                         | —                         | —                         | —                          | —                          | —                           | —                        |
| 0.120                   | 9V <sub>DC</sub> /5.80Ω   | 15V <sub>DC</sub> /9.00Ω  | 48V <sub>DC</sub> /6.50Ω   | —                          | —                           | —                        |
| 0.140                   | —                         | —                         | —                          | —                          | 60V <sub>DC</sub> /6.00Ω    | —                        |
| 0.160                   | 9V <sub>DC</sub> /4.20Ω   | —                         | 48V <sub>DC</sub> /5.00Ω   | —                          | —                           | —                        |
| 0.200                   | 9V <sub>DC</sub> /3.00Ω   | 9V <sub>DC</sub> /3.20Ω   | 24V <sub>DC</sub> /3.10Ω   | —                          | 30V <sub>DC</sub> /3.30Ω    | —                        |
| 0.250                   | —                         | —                         | 16V <sub>DC</sub> /2.10Ω   | —                          | —                           | —                        |
| 0.300                   | —                         | —                         | —                          | —                          | 30V <sub>DC</sub> /1.75Ω    | 60V <sub>DC</sub> /2.30Ω |
| 0.350                   | 6V <sub>DC</sub> /1.00Ω   | 6V <sub>DC</sub> /1.40Ω   | 16V <sub>DC</sub> /1.35Ω   | 6V <sub>DC</sub> /1.30Ω    | —                           | —                        |
| 0.500                   | —                         | 6V <sub>DC</sub> /0.80Ω   | 13.2V <sub>DC</sub> /0.75Ω | 13.2V <sub>DC</sub> /0.90Ω | 24V <sub>DC</sub> /1.00Ω    | —                        |
| 0.750                   | —                         | 6V <sub>DC</sub> /0.35Ω*  | 6V <sub>DC</sub> /0.30Ω    | 6V <sub>DC</sub> /0.40Ω    | 13.2V <sub>DC</sub> /0.45Ω  | —                        |
|                         | —                         | —                         | —                          | —                          | 24V <sub>DC</sub> /0.29Ω    | —                        |
|                         | —                         | —                         | —                          | —                          | 33V <sub>DC</sub> /0.39Ω    | —                        |
| 1.000                   | —                         | —                         | —                          | —                          | —                           | 15V <sub>DC</sub> /0.40Ω |
|                         | —                         | —                         | —                          | —                          | —                           | —                        |
| 1.100                   | —                         | 6V <sub>DC</sub> /0.17Ω*  | 6V <sub>DC</sub> /0.20Ω    | 6V <sub>DC</sub> /0.21Ω    | 8V <sub>DC</sub> /0.21Ω     | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.18Ω    | —                        |
|                         | —                         | —                         | —                          | —                          | 24V <sub>DC</sub> /0.18Ω    | —                        |
| 1.200                   | —                         | —                         | —                          | —                          | —                           | —                        |
| 1.250                   | —                         | —                         | —                          | —                          | 6V <sub>DC</sub> /0.14Ω     | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.14Ω    | —                        |
| 1.500                   | —                         | —                         | 6V <sub>DC</sub> /0.11Ω    | 6V <sub>DC</sub> /0.11Ω    | 6V <sub>DC</sub> /0.11Ω     | 15V <sub>DC</sub> /0.18Ω |
|                         | —                         | —                         | —                          | —                          | 12V <sub>DC</sub> /0.11Ω    | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.11Ω    | —                        |
|                         | —                         | —                         | —                          | —                          | 24V <sub>DC</sub> /0.12Ω    | —                        |
| 1.600                   | —                         | —                         | —                          | —                          | 9V <sub>DC</sub> /0.10Ω     | —                        |
| 1.750                   | —                         | —                         | —                          | 6V <sub>DC</sub> /0.08Ω    | —                           | —                        |
| 1.850                   | —                         | —                         | —                          | —                          | —                           | —                        |
| 2.000                   | —                         | —                         | 6V <sub>DC</sub> /0.072Ω   | 6V <sub>DC</sub> /0.06Ω    | 8V <sub>DC</sub> /0.07Ω     | 6V <sub>DC</sub> /0.10Ω  |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.085Ω   | —                        |
| 2.500                   | —                         | —                         | —                          | —                          | —                           | —                        |
| 2.600                   | —                         | —                         | —                          | —                          | 6V <sub>DC</sub> /0.043Ω    | —                        |
|                         | —                         | —                         | —                          | —                          | 12V <sub>DC</sub> /0.047Ω   | —                        |
|                         | —                         | —                         | —                          | —                          | 13.2V <sub>DC</sub> /0.050Ω | —                        |
|                         | —                         | —                         | —                          | —                          | 16V <sub>DC</sub> /0.050Ω   | —                        |
| 3.000                   | —                         | —                         | —                          | —                          | 6V <sub>DC</sub> /0.036Ω    | —                        |
|                         | —                         | —                         | —                          | —                          | —                           | —                        |
| 3.100                   | —                         | —                         | —                          | —                          | —                           | —                        |

Table S1 — Product Series: Size, Current Rating, Voltage Rating/Maximum Resistance (Cont'd)

|                         | SMDC                      | SMD                       | SMD2                      | decaSMD                  | High Temperature SMD     |
|-------------------------|---------------------------|---------------------------|---------------------------|--------------------------|--------------------------|
| <b>Size mm</b>          | 7555                      | 7555                      | 8763                      | 5050                     | 3216 & 3225              |
| <b>(mils)</b>           | (2920)                    | (2920)                    | (3425)                    | (2018)                   | (1206) & (1210)          |
| <b>Hold Current (A)</b> |                           |                           |                           |                          |                          |
| 0.050                   | —                         | —                         | —                         | —                        | —                        |
| 0.080                   | —                         | —                         | —                         | —                        | —                        |
| 0.100                   | —                         | —                         | —                         | —                        | 30V <sub>DC</sub> /10.0Ω |
|                         | —                         | —                         | —                         | —                        | 30V <sub>DC</sub> /11.0Ω |
| 0.120                   | —                         | —                         | —                         | —                        | —                        |
| 0.140                   | —                         | —                         | —                         | —                        | —                        |
| 0.160                   | —                         | —                         | —                         | —                        | —                        |
| 0.200                   | —                         | —                         | —                         | —                        | —                        |
| 0.250                   | —                         | —                         | —                         | —                        | —                        |
| 0.300                   | —                         | 60V <sub>DC</sub> /4.80Ω  | —                         | —                        | —                        |
| 0.350                   | —                         | —                         | —                         | —                        | —                        |
| 0.500                   | —                         | 60V <sub>DC</sub> /1.40Ω  | —                         | 60V <sub>DC</sub> /1.10Ω | 6V <sub>DC</sub> /0.90Ω  |
| 0.750                   | —                         | 30V <sub>DC</sub> /1.00Ω  | —                         | —                        | 6V <sub>DC</sub> /0.36Ω  |
|                         | —                         | 60V <sub>DC</sub> /1.00Ω  | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
| 1.000                   | —                         | 30V <sub>DC</sub> /0.48Ω  | —                         | —                        | —                        |
|                         | —                         | 33V <sub>DC</sub> /0.41Ω  | —                         | —                        | —                        |
| 1.100                   | —                         | —                         | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
| 1.200                   | —                         | 16V <sub>DC</sub> /0.34Ω  | —                         | —                        | —                        |
| 1.250                   | 33V <sub>DC</sub> /0.25Ω  | 15V <sub>DC</sub> /0.25Ω  | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
| 1.500                   | —                         | 33V <sub>DC</sub> /0.23Ω  | 15V <sub>DC</sub> /0.25Ω  | —                        | —                        |
|                         | —                         | —                         | 33V <sub>DC</sub> /0.23Ω  | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
| 1.600                   | —                         | —                         | 16V <sub>DC</sub> /0.15Ω  | —                        | —                        |
| 1.750                   | —                         | —                         | —                         | —                        | —                        |
| 1.850                   | 33V <sub>DC</sub> /0.15Ω  | —                         | 33V <sub>DC</sub> /0.165Ω | —                        | —                        |
| 2.000                   | —                         | 24V <sub>DC</sub> /0.125Ω | 15V <sub>DC</sub> /0.125Ω | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
| 2.500                   | —                         | 15V <sub>DC</sub> /0.085Ω | 15V <sub>DC</sub> /0.85Ω  | —                        | —                        |
| 2.600                   | —                         | 6V <sub>DC</sub> /0.075Ω  | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
|                         | —                         | —                         | —                         | —                        | —                        |
| 3.000                   | 24V <sub>DC</sub> /0.072Ω | 6V <sub>DC</sub> /0.048Ω  | —                         | —                        | —                        |
|                         | —                         | 15V <sub>DC</sub> /0.05Ω  | —                         | —                        | —                        |
| 3.100                   | 18V <sub>DC</sub> /0.036Ω | —                         | —                         | —                        | —                        |

Table S2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

| Part Number                                     | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |      |       |
|---|-----------------------------|-------|------|------|------|------|------|------|------|------|------|-------|
|   | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C | 125°C |
| <b>femtoSMDC Series</b><br>Size 1608mm/0603mils |                             |       |      |      |      |      |      |      |      |      |      |       |
| femtoSMDC005F                                   | 0.08                        | 0.07  | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | —     |
| femtoSMDC008F                                   | 0.13                        | 0.11  | 0.10 | 0.08 | 0.08 | 0.07 | 0.06 | 0.06 | 0.05 | 0.04 | 0.04 | —     |
| femtoSMDC010F                                   | 0.16                        | 0.14  | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.04 | —     |
| femtoSMDC012F                                   | 0.18                        | 0.16  | 0.14 | 0.12 | 0.12 | 0.11 | 0.10 | 0.08 | 0.08 | 0.07 | 0.06 | —     |
| femtoSMDC016F                                   | 0.25                        | 0.22  | 0.18 | 0.17 | 0.16 | 0.14 | 0.12 | 0.11 | 0.10 | 0.08 | 0.07 | —     |
| femtoSMDC020F                                   | 0.30                        | 0.27  | 0.24 | 0.20 | 0.20 | 0.17 | 0.16 | 0.14 | 0.12 | 0.11 | 0.10 | —     |
| femtoSMDC035F                                   | 0.53                        | 0.47  | 0.41 | 0.36 | 0.35 | 0.30 | 0.27 | 0.25 | 0.22 | 0.19 | 0.17 | —     |
| <b>picoSMDC Series</b><br>Size 2012mm/0805mils  |                             |       |      |      |      |      |      |      |      |      |      |       |
| picoSMDC010S                                    | 0.17                        | 0.15  | 0.13 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.05 | —     |
| picoSMDC012S                                    | 0.20                        | 0.17  | 0.15 | 0.13 | 0.12 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | —     |
| picoSMDC020S                                    | 0.30                        | 0.27  | 0.24 | 0.21 | 0.20 | 0.18 | 0.16 | 0.15 | 0.13 | 0.12 | 0.11 | —     |
| picoSMDC035S                                    | 0.55                        | 0.49  | 0.44 | 0.37 | 0.35 | 0.31 | 0.28 | 0.26 | 0.23 | 0.20 | 0.18 | —     |
| picoSMDC050S                                    | 0.70                        | 0.62  | 0.55 | 0.55 | 0.50 | 0.43 | 0.38 | 0.33 | 0.30 | 0.28 | 0.26 | —     |
| picoSMDC075S                                    | 1.13                        | 1.01  | 0.90 | 0.78 | 0.75 | 0.67 | 0.61 | 0.55 | 0.49 | 0.43 | 0.40 | —     |
| picoSMDC110S                                    | 1.64                        | 1.47  | 1.30 | 1.14 | 1.10 | 0.97 | 0.89 | 0.80 | 0.72 | 0.64 | 0.59 | —     |
| <b>nanoSMDC Series</b><br>Size 3216mm/1206mils  |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>NEW</b> nanoSMDC010F                         | 0.15                        | 0.14  | 0.12 | 0.10 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.05 | —     |
| nanoSMDC012F                                    | 0.20                        | 0.17  | 0.15 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.07 | —     |
| nanoSMDC016F                                    | 0.21                        | 0.20  | 0.18 | 0.16 | 0.16 | 0.14 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | —     |
| nanoSMDC020F                                    | 0.34                        | 0.30  | 0.26 | 0.22 | 0.20 | 0.17 | 0.15 | 0.13 | 0.11 | 0.09 | 0.08 | —     |
| nanoSMDC025F                                    | 0.38                        | 0.33  | 0.30 | 0.26 | 0.25 | 0.22 | 0.20 | 0.19 | 0.16 | 0.13 | 0.11 | —     |
| nanoSMDC035F                                    | 0.58                        | 0.51  | 0.44 | 0.38 | 0.35 | 0.31 | 0.28 | 0.24 | 0.21 | 0.18 | 0.16 | —     |
| nanoSMDC050F/13.2                               | 0.78                        | 0.69  | 0.61 | 0.52 | 0.50 | 0.44 | 0.39 | 0.35 | 0.30 | 0.25 | 0.24 | —     |
| nanoSMDC075F                                    | 1.15                        | 1.04  | 0.92 | 0.78 | 0.75 | 0.69 | 0.63 | 0.58 | 0.51 | 0.46 | 0.43 | —     |
| nanoSMDC110F                                    | 1.64                        | 1.46  | 1.30 | 1.10 | 1.06 | 0.92 | 0.83 | 0.80 | 0.65 | 0.56 | 0.52 | —     |
| nanoSMDC150F                                    | 2.20                        | 1.99  | 1.77 | 1.55 | 1.50 | 1.34 | 1.23 | 1.10 | 1.01 | 0.90 | 0.84 | —     |
| nanoSMDC200F                                    | 2.92                        | 2.64  | 2.35 | 2.07 | 2.00 | 1.79 | 1.64 | 1.50 | 1.36 | 1.22 | 1.15 | —     |
| <b>microSMD Series</b><br>Size 3225mm/1210mils  |                             |       |      |      |      |      |      |      |      |      |      |       |
| microSMD005F                                    | 0.08                        | 0.07  | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | —     |
| microSMD010F                                    | 0.15                        | 0.13  | 0.12 | 0.10 | 0.10 | 0.09 | 0.08 | 0.06 | 0.06 | 0.05 | 0.05 | —     |
| microSMD035F                                    | 0.51                        | 0.46  | 0.40 | 0.35 | 0.34 | 0.30 | 0.27 | 0.24 | 0.22 | 0.19 | 0.18 | —     |
| microSMD050F                                    | 0.76                        | 0.66  | 0.58 | 0.50 | 0.48 | 0.42 | 0.38 | 0.35 | 0.29 | 0.25 | 0.23 | —     |
| microSMD075F                                    | 1.10                        | 0.97  | 0.86 | 0.75 | 0.72 | 0.64 | 0.58 | 0.55 | 0.47 | 0.42 | 0.39 | —     |
| microSMD110F                                    | 1.60                        | 1.42  | 1.26 | 1.10 | 1.06 | 0.94 | 0.86 | 0.80 | 0.70 | 0.62 | 0.58 | —     |
| microSMD150F                                    | 2.30                        | 2.02  | 1.76 | 1.50 | 1.43 | 1.24 | 1.11 | 1.00 | 0.85 | 0.72 | 0.65 | —     |
| microSMD175F                                    | 2.80                        | 2.45  | 2.10 | 1.75 | 1.70 | 1.55 | 1.45 | 1.35 | 1.25 | 1.15 | 1.10 | —     |
| microSMD200F                                    | 2.60                        | 2.44  | 2.35 | 2.00 | 1.96 | 1.78 | 1.67 | 1.50 | 1.45 | 1.15 | 1.10 | —     |
| <b>miniSMDC Series</b><br>Size 4532mm/1812mils  |                             |       |      |      |      |      |      |      |      |      |      |       |
| miniSMDC010F                                    | 0.17                        | 0.15  | 0.13 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.04 | —     |
| miniSMDC014F                                    | 0.23                        | 0.20  | 0.17 | 0.14 | 0.13 | 0.11 | 0.10 | 0.09 | 0.07 | 0.06 | 0.05 | —     |
| miniSMDC020F                                    | 0.30                        | 0.27  | 0.23 | 0.20 | 0.19 | 0.17 | 0.15 | 0.13 | 0.12 | 0.10 | 0.09 | —     |
| miniSMDC030F                                    | 0.49                        | 0.44  | 0.39 | 0.32 | 0.30 | 0.27 | 0.24 | 0.22 | 0.18 | 0.16 | 0.14 | —     |
| miniSMDC050F                                    | 0.59                        | 0.57  | 0.55 | 0.50 | 0.48 | 0.45 | 0.43 | 0.35 | 0.30 | 0.25 | 0.23 | —     |
| miniSMDC075F                                    | 1.10                        | 0.99  | 0.87 | 0.75 | 0.72 | 0.63 | 0.57 | 0.49 | 0.45 | 0.39 | 0.35 | —     |
| miniSMDC075F/24                                 | 1.50                        | 1.25  | 1.00 | 0.75 | 0.73 | 0.65 | 0.60 | 0.55 | 0.50 | 0.45 | 0.43 | —     |

Table S2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] (Cont'd)

| Part Number                                    | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |      |       |
|--|-----------------------------|-------|------|------|------|------|------|------|------|------|------|-------|
|  | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C | 125°C |
| <b>miniSMDC Series</b><br>Size 4532mm/1812mils |                             |       |      |      |      |      |      |      |      |      |      |       |
| miniSMDC075F/33                                | 1.09                        | 0.98  | 0.87 | 0.77 | 0.75 | 0.66 | 0.61 | 0.55 | 0.50 | 0.45 | 0.42 | —     |
| miniSMDC100F                                   | 1.60                        | 1.45  | 1.28 | 1.10 | 1.07 | 0.92 | 0.83 | 0.71 | 0.66 | 0.57 | 0.52 | —     |
| miniSMDC110F                                   | 1.60                        | 1.45  | 1.28 | 1.10 | 1.07 | 0.92 | 0.83 | 0.71 | 0.66 | 0.57 | 0.52 | —     |
| miniSMDC110F/16                                | 1.68                        | 1.49  | 1.30 | 1.10 | 1.05 | 0.92 | 0.83 | 0.75 | 0.64 | 0.55 | 0.50 | —     |
| miniSMDC110F/24                                | 2.00                        | 1.70  | 1.40 | 1.10 | 1.06 | 0.95 | 0.88 | 0.80 | 0.73 | 0.65 | 0.61 | —     |
| miniSMDC125F                                   | 2.00                        | 1.69  | 1.47 | 1.25 | 1.17 | 1.03 | 0.92 | 0.90 | 0.69 | 0.58 | 0.53 | —     |
| miniSMDC125F/16                                | 2.00                        | 1.69  | 1.47 | 1.25 | 1.17 | 1.03 | 0.92 | 0.90 | 0.69 | 0.58 | 0.53 | —     |
| miniSMDC150F                                   | 2.30                        | 2.05  | 1.77 | 1.50 | 1.44 | 1.23 | 1.09 | 0.95 | 0.82 | 0.68 | 0.61 | —     |
| miniSMDC150F/12                                | 2.40                        | 2.10  | 1.80 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.75 | 0.69 | —     |
| miniSMDC150F/16                                | 2.40                        | 2.10  | 1.80 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.75 | 0.69 | —     |
| miniSMDC150F/24                                | 2.10                        | 1.90  | 1.70 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.75 | 0.69 | —     |
| miniSMDC160F                                   | 2.50                        | 2.19  | 1.89 | 1.60 | 1.53 | 1.31 | 1.16 | 1.10 | 0.95 | 0.79 | 0.71 | —     |
| miniSMDC200F                                   | 2.60                        | 2.44  | 2.22 | 2.00 | 1.96 | 1.78 | 1.67 | 1.50 | 1.45 | 1.34 | 1.29 | —     |
| miniSMDC200F/16                                | 3.07                        | 2.74  | 2.40 | 2.07 | 2.00 | 1.74 | 1.57 | 1.40 | 1.24 | 1.07 | 0.99 | —     |
| miniSMDC260F                                   | 3.40                        | 3.16  | 2.80 | 2.60 | 2.54 | 2.32 | 2.18 | 2.00 | 1.90 | 1.76 | 1.69 | —     |
| miniSMDC260F/12                                | 3.40                        | 3.16  | 3.00 | 2.60 | 2.54 | 2.32 | 2.18 | 2.00 | 1.90 | 1.76 | 1.69 | —     |
| miniSMDC260F/13.2                              | 3.40                        | 3.16  | 3.00 | 2.60 | 2.54 | 2.32 | 2.18 | 2.00 | 1.90 | 1.76 | 1.69 | —     |
| miniSMDC260F/16                                | 3.50                        | 3.20  | 3.00 | 2.60 | 2.53 | 2.30 | 2.15 | 2.00 | 1.85 | 1.70 | 1.63 | —     |
| miniSMDC300F                                   | 4.13                        | 3.75  | 3.33 | 3.02 | 3.00 | 2.70 | 2.54 | 2.35 | 2.22 | 2.06 | 1.98 | —     |
| <b>midSMD Series</b><br>Size 5050mm/2018mils   |                             |       |      |      |      |      |      |      |      |      |      |       |
| SMD030F-2018                                   | 0.48                        | 0.42  | 0.35 | 0.30 | 0.28 | 0.24 | 0.21 | 0.17 | 0.15 | 0.12 | 0.10 | —     |
| decaSMDC050F/60                                | 1.00                        | 0.85  | 0.70 | 0.55 | 0.53 | 0.45 | 0.40 | 0.35 | 0.30 | 0.25 | 0.23 | —     |
| SMD100F-2018                                   | 1.59                        | 1.43  | 1.20 | 1.10 | 1.03 | 0.94 | 0.85 | 0.72 | 0.69 | 0.61 | 0.57 | —     |
| SMD150F-2018                                   | 2.21                        | 1.97  | 1.70 | 1.50 | 1.43 | 1.26 | 1.15 | 1.00 | 0.91 | 0.79 | 0.73 | —     |
| SMD200F-2018                                   | 2.81                        | 2.54  | 2.27 | 2.00 | 1.93 | 1.73 | 1.59 | 1.46 | 1.32 | 1.19 | 1.12 | —     |
| <b>SMDC Series</b><br>Size 7555mm/2920mils     |                             |       |      |      |      |      |      |      |      |      |      |       |
| <b>NEW</b> SMDC125F/33                         | 2.02                        | 1.78  | 1.55 | 1.31 | 1.25 | 1.08 | 0.96 | 0.84 | 0.72 | 0.60 | 0.54 | —     |
| <b>NEW</b> SMDC185F/33                         | 2.83                        | 2.50  | 2.20 | 1.85 | 1.74 | 1.53 | 1.37 | 1.22 | 1.04 | 0.88 | 0.80 | —     |
| <b>NEW</b> SMDC300F/24                         | 4.70                        | 4.19  | 3.70 | 3.17 | 3.00 | 2.66 | 2.41 | 2.20 | 1.90 | 1.65 | 1.50 | —     |
| <b>NEW</b> SMDC310F/18                         | 4.50                        | 4.06  | 3.78 | 3.19 | 3.10 | 2.75 | 2.54 | 2.32 | 2.10 | 1.88 | 1.76 | —     |
| <b>SMD Series</b><br>Size 7555mm/2920mils      |                             |       |      |      |      |      |      |      |      |      |      |       |
| SMD030F  | 0.44                        | 0.39  | 0.32 | 0.30 | 0.28 | 0.26 | 0.23 | 0.19 | 0.18 | 0.17 | 0.15 | —     |
| SMD050F  | 0.73                        | 0.65  | 0.55 | 0.50 | 0.47 | 0.43 | 0.39 | 0.33 | 0.31 | 0.28 | 0.26 | —     |
| SMD075F  | 1.11                        | 0.99  | 0.84 | 0.75 | 0.71 | 0.63 | 0.57 | 0.49 | 0.45 | 0.39 | 0.36 | —     |
| SMD075F/60                                     | 1.11                        | 0.99  | 0.84 | 0.75 | 0.71 | 0.63 | 0.57 | 0.49 | 0.45 | 0.39 | 0.36 | —     |
| SMD100F  | 1.59                        | 1.43  | 1.20 | 1.10 | 1.03 | 0.94 | 0.85 | 0.72 | 0.69 | 0.61 | 0.57 | —     |
| SMD100F/33                                     | 1.48                        | 1.35  | 1.20 | 1.10 | 1.06 | 0.98 | 0.91 | 0.83 | 0.79 | 0.73 | 0.69 | —     |
| SMDH120  | 2.34                        | 1.96  | 1.58 | 1.20 | 1.15 | 1.02 | 0.92 | 0.83 | 0.74 | 0.65 | 0.60 | 0.26  |
| SMD125F  | 1.89                        | 1.68  | 1.50 | 1.25 | 1.21 | 1.04 | 0.93 | 0.85 | 0.71 | 0.61 | 0.55 | —     |
| SMD150F/33-2920                                | 2.27                        | 2.01  | 1.76 | 1.50 | 1.44 | 1.25 | 1.12 | 0.99 | 0.86 | 0.74 | 0.67 | —     |
| SMD200F/24-2920                                | 2.90                        | 2.60  | 2.30 | 2.00 | 1.93 | 1.70 | 1.55 | 1.40 | 1.25 | 1.10 | 1.03 | —     |
| SMD250F/15-2920                                | 3.65                        | 3.25  | 2.80 | 2.50 | 2.33 | 2.02 | 1.82 | 1.60 | 1.41 | 1.20 | 1.11 | —     |
| SMD260F  | 3.82                        | 3.41  | 2.90 | 2.60 | 2.45 | 2.19 | 1.99 | 1.70 | 1.58 | 1.38 | 1.28 | —     |
| SMD300F  | 4.13                        | 3.75  | 3.30 | 3.00 | 2.87 | 2.62 | 2.43 | 2.25 | 2.00 | 1.87 | 1.78 | —     |
| SMD300F/15                                     | 4.20                        | 3.80  | 3.30 | 3.00 | 2.90 | 2.62 | 2.43 | 2.25 | 2.00 | 1.87 | 1.78 | —     |

Table S2 – Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] (Cont'd)

| Part Number   | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |      |       |
|---|-----------------------------|-------|------|------|------|------|------|------|------|------|------|-------|
|   | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C | 125°C |
| <b>SMD2 Series<br/>Size 8763mm/3425mils</b>                                       |                             |       |      |      |      |      |      |      |      |      |      |       |
| SMD150F   | 2.30                        | 2.04  | 1.80 | 1.50 | 1.45 | 1.23 | 1.10 | 0.99 | 0.83 | 0.70 | 0.63 | —     |
| SMD150F/33  | 2.30                        | 2.04  | 1.80 | 1.50 | 1.45 | 1.23 | 1.10 | 0.99 | 0.83 | 0.70 | 0.63 | —     |
| SMDH160   | 2.14                        | 1.96  | 1.78 | 1.60 | 1.56 | 1.42 | 1.33 | 1.24 | 1.15 | 1.06 | 1.02 | 0.44  |
| SMD185F   | 2.54                        | 2.29  | 2.20 | 1.85 | 1.80 | 1.55 | 1.43 | 1.31 | 1.19 | 1.06 | 1.00 | —     |
| SMD200F   | 3.01                        | 2.67  | 2.30 | 2.00 | 1.90 | 1.66 | 1.50 | 1.30 | 1.16 | 0.99 | 0.91 | —     |
| SMD250F   | 3.72                        | 3.31  | 2.80 | 2.50 | 2.35 | 2.09 | 1.89 | 1.60 | 1.48 | 1.28 | 1.18 | —     |
| <b>High Temperature SMD Series<br/>Size 3216mm/1206mils &amp; 3225mm/1210mils</b> |                             |       |      |      |      |      |      |      |      |      |      |       |
| NEW nanoSMDCH010F   | 0.18                        | 0.16  | 0.15 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.07 | 0.06 | 0.06 | 0.03  |
| NEW nanoSMDH075F  | 1.07                        | 0.98  | 0.90 | 0.78 | 0.75 | 0.70 | 0.66 | 0.61 | 0.56 | 0.52 | 0.50 | 0.30  |
| NEW microSMDCH010F  | 0.18                        | 0.16  | 0.15 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 | 0.05 | 0.02  |
| NEW microSMDCH050F  | 0.85                        | 0.78  | 0.75 | 0.54 | 0.50 | 0.48 | 0.45 | 0.42 | 0.38 | 0.35 | 0.35 | 0.18  |

Figure S1 – Thermal Derating Curve

- A = femtoSMD / picoSMD / nanoSMD / microSMD / miniSMD decaSMD / SMDC and SMD
- B = SMDH120 / SMDH160 and High Temperature SMD

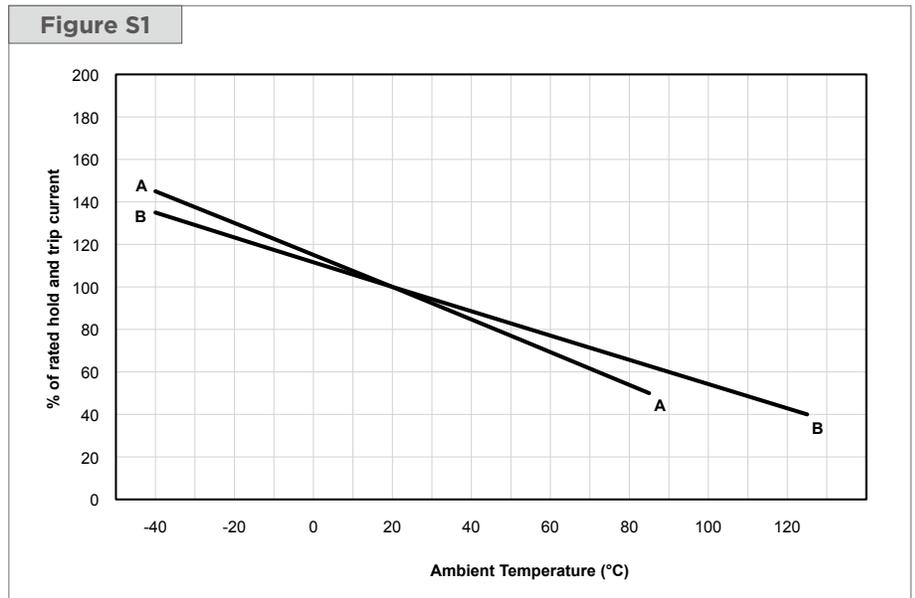


Table S3 — Electrical Characteristics for Surface-Mount Devices  
at Room Temperature

| Part Number                                     | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D MAX</sub><br>(W) | Max Time-to-Trip |       | R <sub>MIN</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Figure for Dimensions |
|---|-----------------------|-----------------------|--|-------------------------|---------------------------|------------------|-------|-------------------------|--------------------------|-----------------------|
|   |                       |                       |  |                         |                           | (A)              | (S)   |                         |                          |                       |
| <b>femtoSMDC Series</b><br>Size 1608mm/0603mils |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| femtoSMDC005F                                   | 0.05                  | 0.15                  | 15                                     | 40                      | 0.50                      | 0.50             | 0.10  | 3.80                    | 30.00                    | S2                    |
| femtoSMDC008F                                   | 0.08                  | 0.20                  | 12                                     | 40                      | 0.50                      | 0.60             | 0.10  | 2.80                    | 14.00                    | S2                    |
| femtoSMDC010F                                   | 0.10                  | 0.25                  | 12                                     | 40                      | 0.50                      | 0.70             | 0.10  | 1.70                    | 8.00                     | S2                    |
| femtoSMDC012F                                   | 0.12                  | 0.30                  | 9                                      | 40                      | 0.50                      | 0.80             | 0.10  | 1.10                    | 5.80                     | S2                    |
| femtoSMDC016F                                   | 0.16                  | 0.40                  | 9                                      | 40                      | 0.50                      | 1.00             | 0.10  | 1.00                    | 4.20                     | S2                    |
| femtoSMDC020F                                   | 0.20                  | 0.45                  | 9                                      | 40                      | 0.50                      | 2.00             | 0.10  | 0.70                    | 3.00                     | S2                    |
| femtoSMDC035F                                   | 0.35                  | 0.70                  | 6                                      | 40                      | 0.50                      | 3.50             | 0.10  | 0.28                    | 1.00                     | S2                    |
| <b>picoSMDC Series</b><br>Size 2012mm/0805mils  |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| picoSMDC010S                                    | 0.10                  | 0.30                  | 15                                     | 100                     | 0.50                      | 0.50             | 0.60  | 1.50                    | 11.00                    | S2                    |
| picoSMDC012S                                    | 0.12                  | 0.30                  | 15                                     | 100                     | 0.50                      | 1.00             | 0.10  | 1.50                    | 9.00                     | S2                    |
| picoSMDC020S                                    | 0.20                  | 0.47                  | 9                                      | 100                     | 0.50                      | 2.00             | 0.10  | 0.75                    | 3.20                     | S2                    |
| picoSMDC035S                                    | 0.35                  | 0.75                  | 6                                      | 100                     | 0.50                      | 1.75             | 0.20  | 0.35                    | 1.40                     | S2                    |
| picoSMDC050S                                    | 0.50                  | 1.00                  | 6                                      | 100                     | 0.50                      | 8.00             | 0.10  | 0.15                    | 0.80                     | S2                    |
| picoSMDC075S                                    | 0.75                  | 1.50                  | 6                                      | 40                      | 0.70                      | 8.00             | 0.20  | 0.10                    | 0.35                     | S2                    |
| picoSMDC110S                                    | 1.10                  | 2.20                  | 6                                      | 40                      | 0.80                      | 8.00             | 0.20  | 0.05                    | 0.17                     | S2                    |
| <b>nanoSMDC Series</b><br>Size 3216mm/1206mils  |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| <b>NEW</b> nanoSMDC010F                         | 0.10                  | 0.25                  | 60                                     | 10                      | 0.80                      | 0.50             | 1.00  | 1.60                    | 15.00                    | S2                    |
| nanoSMDC012F                                    | 0.12                  | 0.39                  | 48                                     | 10                      | 0.50                      | 1.00             | 0.20  | 1.40                    | 6.50                     | S2                    |
| nanoSMDC016F                                    | 0.16                  | 0.45                  | 48                                     | 10                      | 0.50                      | 1.00             | 0.30  | 1.10                    | 5.00                     | S2                    |
| nanoSMDC020F                                    | 0.20                  | 0.42                  | 24                                     | 100                     | 0.60                      | 8.00             | 0.10  | 0.65                    | 3.10                     | S2                    |
| nanoSMDC025F                                    | 0.25                  | 0.58                  | 16                                     | 100                     | 0.60                      | 8.00             | 0.10  | 0.40                    | 2.10                     | S2                    |
| nanoSMDC035F                                    | 0.35                  | 0.75                  | 16                                     | 20                      | 0.60                      | 3.50             | 0.10  | 0.45                    | 1.35                     | S2                    |
| nanoSMDC050F/13.2                               | 0.50                  | 1.10                  | 13.2                                   | 100                     | 0.80                      | 8.00             | 0.10  | 0.20                    | 0.75                     | S2                    |
| nanoSMDC075F                                    | 0.75                  | 1.50                  | 6                                      | 100                     | 0.80                      | 8.00             | 0.10  | 0.09                    | 0.30                     | S2                    |
| nanoSMDC110F                                    | 1.10                  | 2.20                  | 6                                      | 100                     | 0.80                      | 8.00             | 0.10  | 0.07                    | 0.20                     | S2                    |
| nanoSMDC150F                                    | 1.50                  | 3.00                  | 6                                      | 100                     | 0.80                      | 8.00             | 0.30  | 0.04                    | 0.11                     | S2                    |
| nanoSMDC200F                                    | 2.00                  | 4.00                  | 6                                      | 100                     | 1.00                      | 8.00             | 1.50  | 0.02                    | 0.072                    | S2                    |
| <b>microSMD Series</b><br>Size 3225mm/1210mils  |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| microSMD005F                                    | 0.05                  | 0.15                  | 30                                     | 10                      | 1.00                      | 0.25             | 1.50  | 3.60                    | 50.00                    | S2                    |
| microSMD010F                                    | 0.10                  | 0.25                  | 30                                     | 10                      | 0.80                      | 0.50             | 1.00  | 2.10                    | 15.00                    | S2                    |
| microSMD035F                                    | 0.35                  | 0.75                  | 6                                      | 40                      | 0.80                      | 8.00             | 0.20  | 0.32                    | 1.30                     | S2                    |
| microSMD050F                                    | 0.50                  | 1.00                  | 13.2                                   | 40                      | 0.80                      | 8.00             | 0.05  | 0.25                    | 0.90                     | S2                    |
| microSMD075F                                    | 0.75                  | 1.50                  | 6                                      | 40                      | 0.80                      | 8.00             | 0.10  | 0.11                    | 0.40                     | S2                    |
| microSMD110F                                    | 1.10                  | 2.20                  | 6                                      | 40                      | 0.80                      | 8.00             | 0.20  | 0.07                    | 0.21                     | S2                    |
| microSMD150F                                    | 1.50                  | 3.00                  | 6                                      | 40                      | 0.80                      | 8.00             | 1.00  | 0.04                    | 0.11                     | S2                    |
| microSMD175F                                    | 1.75                  | 3.50                  | 6                                      | 40                      | 0.80                      | 8.00             | 0.80  | 0.025                   | 0.08                     | S2                    |
| microSMD200F                                    | 2.00                  | 4.00                  | 6                                      | 100                     | 0.80                      | 8.00             | 2.50  | 0.020                   | 0.06                     | S2                    |
| <b>miniSMDC Series</b><br>Size 4532mm/1812mils  |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| miniSMDC010F                                    | 0.10                  | 0.30                  | 60                                     | 40                      | 0.75                      | 0.50             | 5.00  | 0.70                    | 12.70                    | S2                    |
| miniSMDC014F                                    | 0.14                  | 0.28                  | 60                                     | 10                      | 0.75                      | 8.00             | 0.008 | 1.50                    | 6.00                     | S2                    |
| miniSMDC020F                                    | 0.20                  | 0.40                  | 30                                     | 10                      | 0.80                      | 8.00             | 0.02  | 0.60                    | 3.30                     | S2                    |
| miniSMDC030F                                    | 0.30                  | 0.60                  | 30                                     | 40                      | 0.80                      | 8.00             | 0.10  | 0.20                    | 1.75                     | S2                    |
| miniSMDC050F                                    | 0.50                  | 1.00                  | 24                                     | 100                     | 0.80                      | 8.00             | 0.15  | 0.15                    | 1.00                     | S2                    |
| miniSMDC075F                                    | 0.75                  | 1.50                  | 13.2                                   | 100                     | 1.00                      | 8.00             | 0.20  | 0.11                    | 0.45                     | S2                    |
| miniSMDC075F/24                                 | 0.75                  | 1.50                  | 24                                     | 40                      | 0.80                      | 8.00             | 0.30  | 0.09                    | 0.29                     | S2                    |

Table S3 — Electrical Characteristics for Surface-Mount Devices  
at Room Temperature

(Cont'd)

| Part Number                                    | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub><br>(V <sub>DC</sub> ) | I <sub>MAX</sub><br>(A) | P <sub>D MAX</sub><br>(W) | Max Time-to-Trip |       | R <sub>MIN</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Figure for Dimensions |
|--|-----------------------|-----------------------|--|-------------------------|---------------------------|------------------|-------|-------------------------|--------------------------|-----------------------|
|  |                       |                       |  |                         |                           | (A)              | (S)   |                         |                          |                       |
| <b>miniSMDC Series</b><br>Size 4532mm/1812mils |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| miniSMDC075F/33                                | 0.75                  | 1.60                  | 33                                     | 100                     | 1.00                      | 8.00             | 1.00  | 0.11                    | 0.39                     | S2                    |
| miniSMDC100F                                   | 1.10                  | 2.20                  | 8                                      | 100                     | 1.20                      | 8.00             | 0.30  | 0.04                    | 0.21                     | S2                    |
| miniSMDC110F                                   | 1.10                  | 2.20                  | 8                                      | 100                     | 1.20                      | 8.00             | 0.30  | 0.04                    | 0.21                     | S2                    |
| miniSMDC110F/16                                | 1.10                  | 2.20                  | 16                                     | 100                     | 0.80                      | 8.00             | 0.30  | 0.06                    | 0.18                     | S2                    |
| miniSMDC110F/24                                | 1.10                  | 2.20                  | 24                                     | 20                      | 0.80                      | 8.00             | 0.50  | 0.06                    | 0.18                     | S2                    |
| miniSMDC125F                                   | 1.25                  | 2.50                  | 6                                      | 100                     | 0.80                      | 8.00             | 0.40  | 0.05                    | 0.14                     | S2                    |
| miniSMDC125F/16                                | 1.25                  | 2.50                  | 16                                     | 100                     | 0.80                      | 8.00             | 0.40  | 0.05                    | 0.14                     | S2                    |
| miniSMDC150F                                   | 1.50                  | 3.00                  | 6                                      | 100                     | 0.80                      | 8.00             | 0.50  | 0.04                    | 0.11                     | S2                    |
| miniSMDC150F/12                                | 1.50                  | 2.80                  | 12                                     | 100                     | 0.80                      | 8.00             | 0.50  | 0.04                    | 0.11                     | S2                    |
| miniSMDC150F/16                                | 1.50                  | 2.80                  | 16                                     | 100                     | 0.80                      | 8.00             | 0.50  | 0.04                    | 0.11                     | S2                    |
| miniSMDC150F/24                                | 1.50                  | 3.00                  | 24                                     | 20                      | 1.00                      | 8.00             | 1.50  | 0.04                    | 0.12                     | S2                    |
| miniSMDC160F                                   | 1.60                  | 3.20                  | 9                                      | 100                     | 0.80                      | 8.00             | 1.00  | 0.03                    | 0.10                     | S2                    |
| miniSMDC200F                                   | 2.00                  | 4.00                  | 8                                      | 100                     | 1.00                      | 8.00             | 5.00  | 0.020                   | 0.070                    | S2                    |
| miniSMDC200F/16                                | 2.00                  | 4.00                  | 16                                     | 40                      | 1.20                      | 8.00             | 5.00  | 0.020                   | 0.085                    | S2                    |
| miniSMDC260F                                   | 2.60                  | 5.00                  | 6                                      | 100                     | 1.00                      | 8.00             | 5.00  | 0.015                   | 0.043                    | S2                    |
| miniSMDC260F/12                                | 2.60                  | 5.00                  | 12                                     | 100                     | 1.00                      | 8.00             | 5.00  | 0.015                   | 0.047                    | S2                    |
| miniSMDC260F/13.2                              | 2.60                  | 5.00                  | 13.2                                   | 100                     | 1.20                      | 8.00             | 5.00  | 0.015                   | 0.050                    | S2                    |
| miniSMDC260F/16                                | 2.60                  | 5.00                  | 16                                     | 100                     | 1.20                      | 8.00             | 5.00  | 0.015                   | 0.050                    | S2                    |
| miniSMDC300F                                   | 3.00                  | 6.00                  | 6                                      | 100                     | 1.00                      | 8.00             | 5.00  | 0.011                   | 0.036                    | S2                    |
| <b>midSMD Series</b><br>Size 5050mm/2018mils   |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| SMD030F-2018                                   | 0.30                  | 0.80                  | 60                                     | 20                      | 1.50                      | 1.50             | 1.50  | 0.500                   | 2.30                     | S3                    |
| decaSMDC050F/60                                | 0.55                  | 1.10                  | 60                                     | 10                      | 1.00                      | 8.00             | 0.10  | 0.200                   | 1.10                     | S2                    |
| SMD100F-2018                                   | 1.10                  | 2.20                  | 15                                     | 40                      | 1.40                      | 8.00             | 0.50  | 0.100                   | 0.40                     | S3                    |
| SMD150F-2018                                   | 1.50                  | 3.00                  | 15                                     | 40                      | 1.80                      | 8.00             | 1.00  | 0.070                   | 0.18                     | S3                    |
| SMD200F-2018                                   | 2.00                  | 4.20                  | 6                                      | 40                      | 1.50                      | 8.00             | 3.00  | 0.048                   | 0.10                     | S3                    |
| <b>SMDC Series</b><br>Size 7555mm/2920mils     |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| <b>NEW</b> SMDC125F/33                         | 1.25                  | 2.50                  | 33                                     | 40                      | 1.50                      | 8.00             | 2.00  | 0.040                   | 0.250                    | S2                    |
| <b>NEW</b> SMDC185F/33                         | 1.85                  | 3.70                  | 33                                     | 40                      | 1.70                      | 8.00             | 2.50  | 0.050                   | 0.150                    | S2                    |
| <b>NEW</b> SMDC300F/24                         | 3.00                  | 6.00                  | 24                                     | 40                      | 1.70                      | 8.00             | 5.00  | 0.015                   | 0.072                    | S2                    |
| <b>NEW</b> SMDC310F/18                         | 3.10                  | 6.00                  | 18                                     | 50                      | 1.50                      | 8.00             | 25.00 | 0.013                   | 0.036                    | S2                    |
| <b>SMD Series</b><br>Size 7555mm/2920mils      |                       |                       |  |                         |                           |                  |       |                         |                          |                       |
| SMD030F  | 0.30                  | 0.60                  | 60                                     | 10                      | 1.70                      | 1.50             | 3.00  | 1.200                   | 4.800                    | S4                    |
| SMD050F  | 0.50                  | 1.00                  | 60                                     | 10                      | 1.70                      | 2.50             | 4.00  | 0.350                   | 1.400                    | S4                    |
| SMD075F  | 0.75                  | 1.50                  | 30                                     | 40                      | 1.70                      | 8.00             | 0.30  | 0.350                   | 1.000                    | S4                    |
| SMD075F/60                                     | 0.75                  | 1.50                  | 60                                     | 10                      | 1.70                      | 8.00             | 0.30  | 0.350                   | 1.000                    | S4                    |
| SMD100F  | 1.10                  | 2.20                  | 30                                     | 40                      | 1.70                      | 8.00             | 0.50  | 0.120                   | 0.480                    | S4                    |
| SMD100F/33                                     | 1.10                  | 2.20                  | 33                                     | 40                      | 1.70                      | 8.00             | 0.50  | 0.120                   | 0.410                    | S4                    |
| SMDH120  | 1.20                  | 2.30                  | 16                                     | 50                      | 2.00                      | 8.00             | 2.00  | 0.150                   | 0.340                    | S4                    |
| SMD125F  | 1.25                  | 2.50                  | 15                                     | 40                      | 1.70                      | 8.00             | 2.00  | 0.070                   | 0.250                    | S4                    |
| SMD150F/33-2920                                | 1.50                  | 3.00                  | 33                                     | 40                      | 1.50                      | 8.00             | 5.00  | 0.080                   | 0.230                    | S4                    |
| SMD200F/24-2920                                | 2.00                  | 4.00                  | 24                                     | 40                      | 1.50                      | 8.00             | 5.00  | 0.050                   | 0.125                    | S4                    |
| SMD250F/15-2920                                | 2.50                  | 5.00                  | 15                                     | 40                      | 1.50                      | 8.00             | 10.00 | 0.035                   | 0.085                    | S4                    |
| SMD260F  | 2.60                  | 5.20                  | 6                                      | 40                      | 1.70                      | 8.00             | 20.00 | 0.025                   | 0.075                    | S4                    |
| SMD300F  | 3.00                  | 6.00                  | 6                                      | 40                      | 1.50                      | 8.00             | 35.00 | 0.015                   | 0.048                    | S4                    |
| SMD300F/15                                     | 3.00                  | 6.00                  | 15                                     | 40                      | 1.50                      | 8.00             | 35.00 | 0.015                   | 0.050                    | S4                    |

Table S3 – Electrical Characteristics for Surface-Mount Devices  
at Room Temperature

(Cont'd)

| Part Number  | $I_H$<br>(A) | $I_T$<br>(A) | $V_{MAX}$<br>(V <sub>DC</sub> ) | $I_{MAX}$<br>(A) | $P_{D MAX}$<br>(W) | Max Time-to-Trip |       | $R_{MIN}$<br>(Ω) | $R_{1MAX}$<br>(Ω) | Figure for Dimensions |
|--|--------------|--------------|---------------------------------|------------------|--------------------|------------------|-------|------------------|-------------------|-----------------------|
|  |              |              |                                 |                  |                    | (A)              | (S)   |                  |                   |                       |
| <b>SMD2 Devices</b><br>Size 8763mm/3425mils                                  |              |              |                                 |                  |                    |                  |       |                  |                   |                       |
| SMD150F  | 1.50         | 3.00         | 15                              | 40               | 1.90               | 8.00             | 5.00  | 0.060            | 0.250             | S4                    |
| SMD150F/33   | 1.50         | 3.00         | 33                              | 40               | 1.90               | 8.00             | 5.00  | 0.080            | 0.230             | S4                    |
| SMDH160  | 1.60         | 3.20         | 16                              | 70               | 2.20               | 8.00             | 15.00 | 0.050            | 0.150             | S4                    |
| SMD185F  | 1.85         | 3.60         | 33                              | 40               | 1.50               | 8.00             | 5.00  | 0.065            | 0.165             | S4                    |
| SMD200F  | 2.00         | 4.00         | 15                              | 40               | 1.90               | 8.00             | 12.00 | 0.050            | 0.125             | S4                    |
| SMD250F  | 2.50         | 5.00         | 15                              | 40               | 1.90               | 8.00             | 25.00 | 0.035            | 0.085             | S4                    |
| <b>High Temperature SMD Series</b><br>Size 3216mm/1206mils & 3225mm/1210mils |              |              |                                 |                  |                    |                  |       |                  |                   |                       |
| <b>NEW</b> nanoSMDCH010F   | 0.10         | 0.35         | 30                              | 10               | 0.80               | 1.00             | 0.10  | 1.10             | 10.00             | S2                    |
| <b>NEW</b> nanoSMDH075F  | 0.75         | 2.00         | 6                               | 10               | 1.10               | 8.00             | 0.10  | 0.10             | 0.36              | S5                    |
| <b>NEW</b> microSMDCH010F  | 0.10         | 0.35         | 30                              | 10               | 0.90               | 1.00             | 0.10  | 1.20             | 11.00             | S2                    |
| <b>NEW</b> microSMDCH050F  | 0.50         | 1.50         | 6                               | 10               | 1.10               | 8.00             | 0.05  | 0.19             | 0.90              | S2                    |

Figures S2-S5 – Dimension Figures

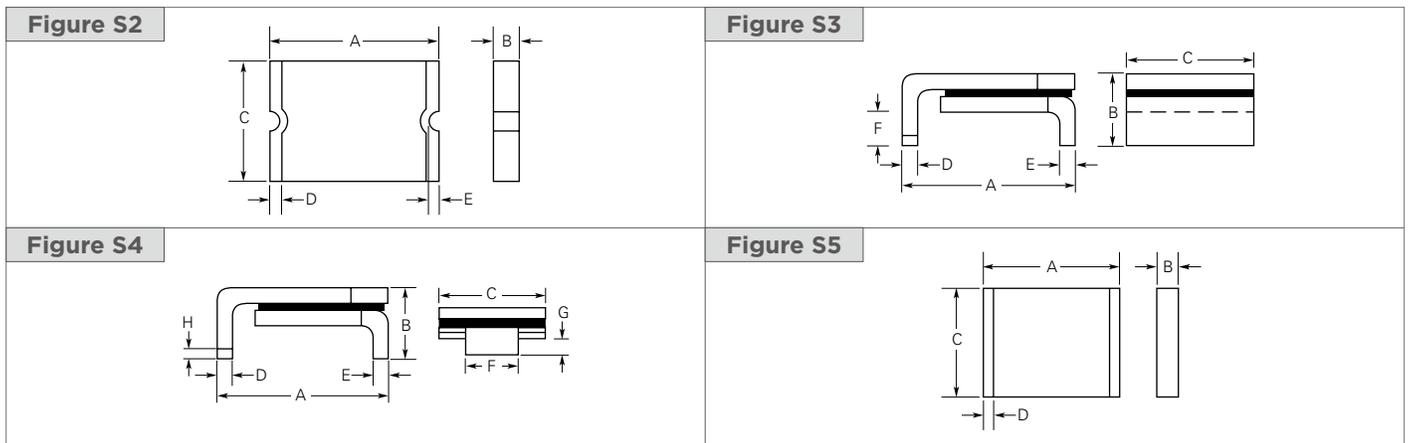


Table S4 – Dimensions in Millimeters (Inches)

| Part Number                                     | A               |                 | B               |                 | C               |                 | D               |                 | E                |     | F   |     | G   |     | H   | Figure |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|-----|-----|-----|-----|-----|-----|--------|
|   | Min             | Max             | Min             | Max             | Min             | Max             | Min             | Max             | Min              | Max | Min | Max | Min | Max | Min |        |
| <b>femtoSMDC Series</b><br>Size 1608mm/0603mils |                 |                 |                 |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| femtoSMDC005F                                   | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.45<br>(0.017) | 0.85<br>(0.033) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| femtoSMDC008F                                   | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.45<br>(0.017) | 0.85<br>(0.033) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| femtoSMDC010F                                   | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.45<br>(0.017) | 0.85<br>(0.033) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| femtoSMDC012F                                   | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.35<br>(0.013) | 0.75<br>(0.030) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |

Table S4 – Dimensions in Millimeters (Inches)

(Cont'd)

| Part Number                 | A               |                 | B               |                 | C               |                 | D               |                 | E                |     | F   |     | G   |     | H   | Figure |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|-----|-----|-----|-----|-----|-----|--------|
|                             | Min             | Max             | Min             | Max             | Min             | Max             | Min             | Max             | Min              | Max | Min | Max | Min | Max | Min |        |
| <b>femtoSMDC Series</b>     |                 |                 |                 |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| <b>Size 1608mm/0603mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| femtoSMDC016F               | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.35<br>(0.013) | 0.75<br>(0.030) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| femtoSMDC020F               | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.35<br>(0.013) | 0.75<br>(0.030) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| femtoSMDC035F               | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.55<br>(0.021) | 0.95<br>(0.037) | 0.60<br>(0.023) | 1.00<br>(0.039) | 0.10<br>(0.004) | 0.50<br>(0.020) | 0.075<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| <b>picoSMDC Series</b>      |                 |                 |                 |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| <b>Size 2012mm/0805mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| picoSMDC010S                | 2.00<br>(0.079) | 2.20<br>(0.087) | 0.60<br>(0.023) | 1.00<br>(0.040) | 1.30<br>(0.051) | 1.50<br>(0.059) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| picoSMDC012S                | 2.00<br>(0.079) | 2.20<br>(0.087) | 0.44<br>(0.017) | 0.68<br>(0.027) | 1.30<br>(0.051) | 1.50<br>(0.059) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| picoSMDC020S                | 2.00<br>(0.079) | 2.20<br>(0.087) | 0.44<br>(0.017) | 0.68<br>(0.027) | 1.30<br>(0.051) | 1.50<br>(0.059) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| picoSMDC035S                | 2.00<br>(0.079) | 2.20<br>(0.087) | 0.44<br>(0.017) | 0.68<br>(0.027) | 1.30<br>(0.051) | 1.50<br>(0.059) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| picoSMDC050S                | 2.00<br>(0.079) | 2.20<br>(0.087) | 0.63<br>(0.025) | 0.93<br>(0.036) | 1.30<br>(0.051) | 1.50<br>(0.059) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| picoSMDC075S                | 2.00<br>(0.079) | 2.20<br>(0.087) | 0.63<br>(0.025) | 0.93<br>(0.036) | 1.30<br>(0.051) | 1.50<br>(0.059) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| picoSMDC110S                | 2.00<br>(0.079) | 2.20<br>(0.087) | 0.80<br>(0.031) | 1.20<br>(0.047) | 1.30<br>(0.051) | 1.50<br>(0.059) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| <b>nanoSMDC Series</b>      |                 |                 |                 |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| <b>Size 3216mm/1206mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| <b>NEW</b> nanoSMDC010F     | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.62<br>(0.024) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC012F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.62<br>(0.024) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC016F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.62<br>(0.024) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC020F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.58<br>(0.023) | 0.82<br>(0.032) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC025F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.58<br>(0.023) | 0.82<br>(0.032) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC035F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.58<br>(0.023) | 0.82<br>(0.032) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC050F/13.2           | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.50<br>(0.019) | 0.74<br>(0.029) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC075F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.44<br>(0.017) | 0.68<br>(0.027) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC110F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.28<br>(0.011) | 0.67<br>(0.026) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC150F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.55<br>(0.022) | 0.89<br>(0.035) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| nanoSMDC200F                | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.83<br>(0.033) | 1.10<br>(0.043) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |

Table S4 – Dimensions in Millimeters (Inches)

(Cont'd)

| Part Number                 | A               |                 | B                |                 | C               |                 | D               |                 | E                |     | F   |     | G   |     | H   | Figure |
|-----------------------------|-----------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|-----|-----|-----|-----|-----|-----|--------|
|                             | Min             | Max             | Min              | Max             | Min             | Max             | Min             | Max             | Min              | Max | Min | Max | Min | Max | Min |        |
| <b>microSMD Series</b>      |                 |                 |                  |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| <b>Size 3225mm/1210mils</b> |                 |                 |                  |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| microSMD005F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.50<br>(0.019)  | 0.85<br>(0.034) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD010F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.50<br>(0.019)  | 0.85<br>(0.034) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD035F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD050F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD075F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD110F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.28<br>(0.011)  | 0.48<br>(0.019) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD150F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.51<br>(0.020)  | 1.22<br>(0.048) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD175F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.40<br>(0.016)  | 0.76<br>(0.030) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| microSMD200F                | 3.0<br>(0.118)  | 3.43<br>(0.135) | 0.79<br>(0.031)  | 1.17<br>(0.046) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —   | —   | —   | —   | —   | —   | S2     |
| <b>miniSMDC Series</b>      |                 |                 |                  |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| <b>Size 4532mm/1812mils</b> |                 |                 |                  |                 |                 |                 |                 |                 |                  |     |     |     |     |     |     |        |
| miniSMDC010F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC014F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC020F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC030F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC050F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC075F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC075F/24             | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.81<br>(0.032)  | 1.46<br>(0.057) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC075F/33             | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.94<br>(0.037)  | 1.46<br>(0.057) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC100F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC110F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC110F/16             | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC110F/24             | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.81<br>(0.032)  | 1.46<br>(0.057) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC125F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |
| miniSMDC125F/16             | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008)  | —   | —   | —   | —   | —   | —   | S2     |

Table S4 – Dimensions in Millimeters (Inches)

(Cont'd)

| Part Number                 | A               |                 | B               |                 | C               |                 | D               |                 | E               |                 | F               |                 | G   |     | H   | Figure |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|-----|-----|--------|
|                             | Min             | Max             | Min | Max | Min |        |
| <b>miniSMDC Series</b>      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |     |     |     |        |
| <b>Size 4532mm/1812mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |     |     |     |        |
| miniSMDC150F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.28<br>(0.011) | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC150F/12             | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.28<br>(0.011) | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC150F/16             | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.28<br>(0.011) | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC150F/24             | 4.37<br>(0.172) | 4.83<br>(0.190) | 1.00<br>(0.040) | 1.94<br>(0.077) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC160F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.28<br>(0.011) | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC200F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.51<br>(0.020) | 1.22<br>(0.048) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC200F/16             | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.51<br>(0.020) | 1.22<br>(0.048) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC260F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.48<br>(0.019) | 0.78<br>(0.031) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC260F/12             | 4.37<br>(0.172) | 4.83<br>(0.190) | 1.02<br>(0.042) | 1.52<br>(0.060) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC260F/13.2           | 4.37<br>(0.172) | 4.83<br>(0.190) | 1.02<br>(0.042) | 1.52<br>(0.060) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC260F/16             | 4.37<br>(0.172) | 4.83<br>(0.190) | 1.02<br>(0.042) | 1.52<br>(0.060) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| miniSMDC300F                | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.45<br>(0.018) | 0.76<br>(0.030) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| <b>midSMD Series</b>        |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |     |     |     |        |
| <b>Size 5050mm/2018mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |     |     |     |        |
| SMD030F-2018                | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.78<br>(0.070) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —   | —   | —   | S3     |
| decaSMDC050F/60             | 4.70<br>(0.185) | 5.31<br>(0.209) | 0.63<br>(0.025) | 0.89<br>(0.035) | 4.19<br>(0.165) | 4.81<br>(0.189) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.25<br>(0.010) | —               | —               | —               | —   | —   | —   | S2     |
| SMD100F-2018                | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —   | —   | —   | S3     |
| SMD150F-2018                | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —   | —   | —   | S3     |
| SMD200F-2018                | 4.72<br>(0.186) | 5.44<br>(0.214) | —               | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —   | —   | —   | S3     |
| <b>SMDC Series</b>          |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |     |     |     |        |
| <b>Size 7555mm/2920mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |     |     |     |        |
| <b>NEW</b> SMDC125F/33      | 7.30<br>(0.287) | 7.70<br>(0.303) | 0.45<br>(0.018) | 0.71<br>(0.028) | 4.90<br>(0.193) | 5.30<br>(0.209) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| <b>NEW</b> SMDC185F/33      | 7.30<br>(0.287) | 7.70<br>(0.303) | 0.90<br>(0.035) | 1.20<br>(0.047) | 4.90<br>(0.193) | 5.30<br>(0.209) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| <b>NEW</b> SMDC300F/24      | 7.30<br>(0.287) | 7.70<br>(0.303) | 0.80<br>(0.031) | 1.10<br>(0.043) | 4.90<br>(0.193) | 5.30<br>(0.209) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —               | —               | —               | —   | —   | —   | S2     |
| <b>NEW</b> SMDC310F/18      | 7.30<br>(0.287) | 7.70<br>(0.303) | 1.10<br>(0.043) | 1.70<br>(0.067) | 4.90<br>(0.193) | 5.30<br>(0.209) | 0.95<br>(0.037) | 1.45<br>(0.057) | 0.35<br>(0.014) | —               | —               | —               | —   | —   | —   | S2     |

Table S4 – Dimensions in Millimeters (Inches)

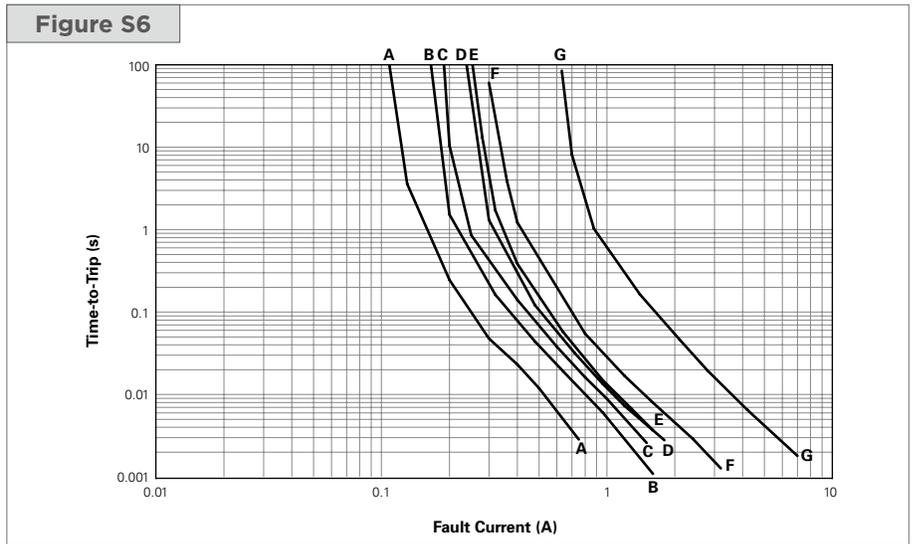
(Cont'd)

| Part Number                                       | A               |                 | B               |                 | C               |                 | D               |                 | E               |                  | F               |                 | G               |                 | H               | Figure |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------|
|   | Min             | Max              | Min             | Max             | Min             | Max             | Min             |        |
| <b>SMD Series</b>                                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |                 |                 |                 |        |
| <b>Size 7555mm/2920mils</b>                       |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |                 |                 |                 |        |
| SMD030F   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD050F   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD075F   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD075F/60  | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.18<br>(0.125) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD100F   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD100F/33  | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMDH120   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD125F   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD150F/33-2920                                   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD200F/24-2920                                   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD250F/15-2920                                   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD260F   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD300F   | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD300F/15  | 6.73<br>(0.265) | 7.98<br>(0.314) | —               | 3.00<br>(0.118) | 4.80<br>(0.19)  | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| <b>SMD2 Devices</b>                               |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |                 |                 |                 |        |
| <b>Size 8763mm/3425mils</b>                       |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |                 |                 |                 |        |
| SMD150F   | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD150F/33  | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMDH160   | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD185F   | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD200F   | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| SMD250F   | 8.00<br>(0.315) | 9.40<br>(0.370) | —               | 3.00<br>(0.118) | 6.00<br>(0.236) | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028)  | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026) | 1.37<br>(0.054) | 0.43<br>(0.017) | S4     |
| <b>High Temperature SMD Series</b>                |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |                 |                 |                 |        |
| <b>Size 3216mm/1206mils &amp; 3225mm/1210mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |                 |                 |                 |        |
| <b>NEW</b>  | nanoSMDCH010F   | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.30<br>(0.012) | 0.70<br>(0.028) | 1.37<br>(0.054) | 1.80<br>(0.071) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —               | —               | —               | —               | —               | S2     |
| <b>NEW</b>  | nanoSMDH075F    | 3.00<br>(0.118) | 3.40<br>(0.134) | 0.60<br>(0.023) | 1.00<br>(0.039) | 1.40<br>(0.055) | 1.80<br>(0.071) | 0.20<br>(0.008) | 0.80<br>(0.032) | —                | —               | —               | —               | —               | —               | S5     |
| <b>NEW</b>  | microSMDCH010F  | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.57<br>(0.022) | 0.97<br>(0.038) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —               | —               | —               | —               | —               | S2     |
| <b>NEW</b>  | microSMDCH050F  | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.24<br>(0.009) | 0.64<br>(0.025) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | —               | —               | —               | —               | —               | S2     |

### Figures S6-S15 — Typical Time-to-Trip Curves at 20°C

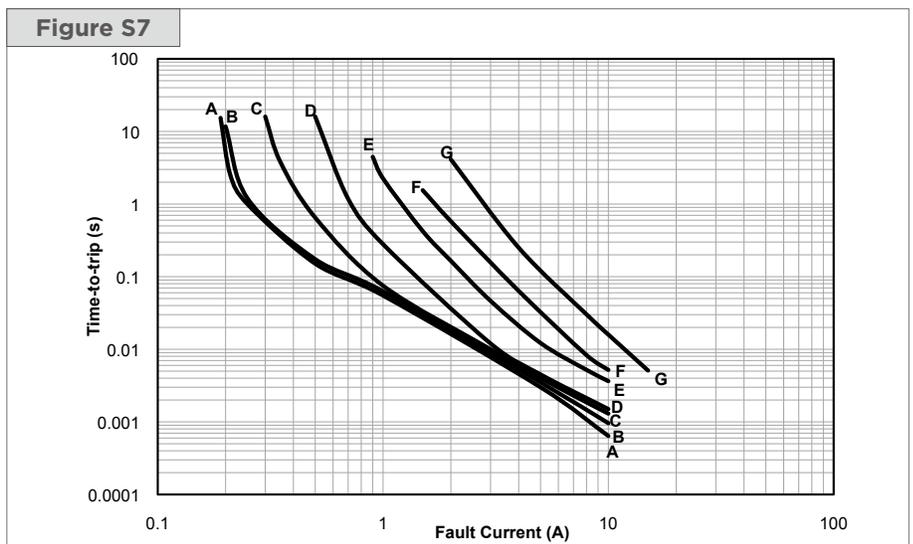
#### femtoSMDCxxxF

- A = femtoSMDC005F
- B = femtoSMDC008F
- C = femtoSMDC010F
- D = femtoSMDC012F
- E = femtoSMDC016F
- F = femtoSMDC020F
- G = femtoSMDC035F



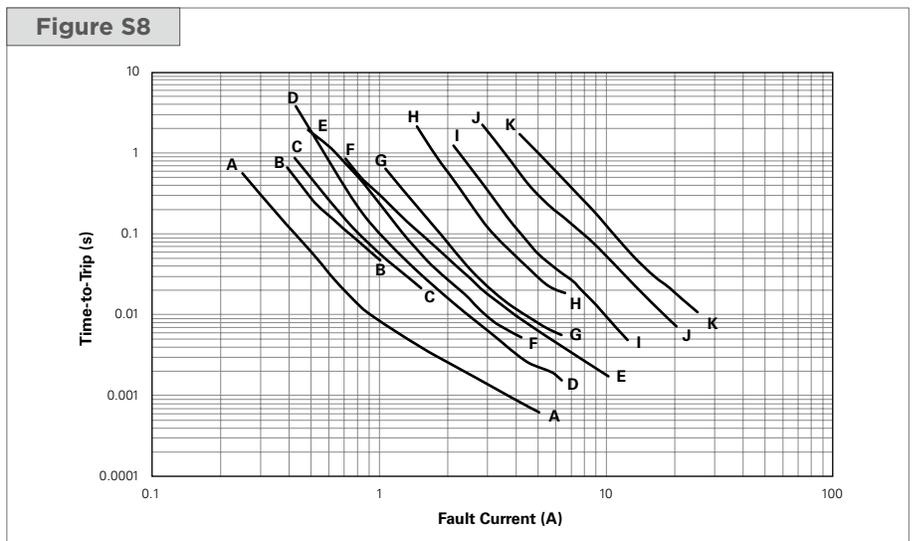
#### picoSMDCxxxS

- A = picoSMDC010S
- B = picoSMDC012S
- C = picoSMDC020S
- D = picoSMDC035S
- E = picoSMDC050S
- F = picoSMDC075S
- G = picoSMDC110S



#### nanoSMDCxxxF

- A = nanoSMDC010F
- B = nanoSMDC012F
- C = nanoSMDC016F
- D = nanoSMDC020F
- E = nanoSMDC025F
- F = nanoSMDC035F
- G = nanoSMDC050F/13.2
- H = nanoSMDC075F
- I = nanoSMDC110F
- J = nanoSMDC150F
- K = nanoSMDC200F



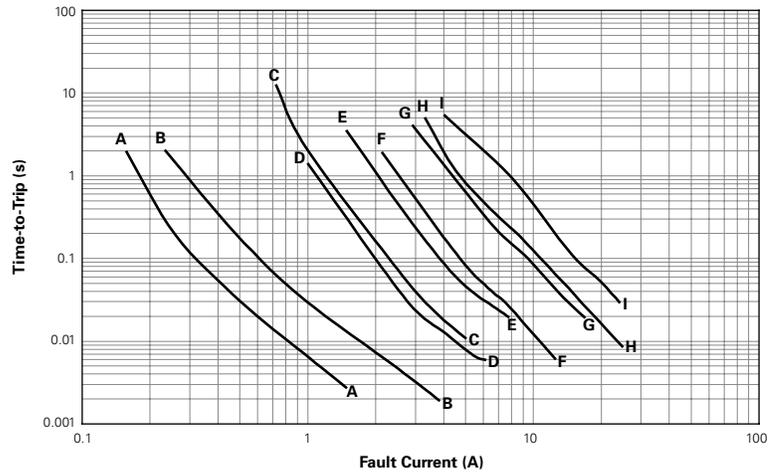
Figures S6-S15 — Typical Time-to-Trip Curves at 20°C

(Cont'd)

microSMDxxxF

- A = microSMD005F
- B = microSMD010F
- C = microSMD035F
- D = microSMD050F
- E = microSMD075F
- F = microSMD110F
- G = microSMD150F
- H = microSMD175F
- I = microSMD200F

Figure S9



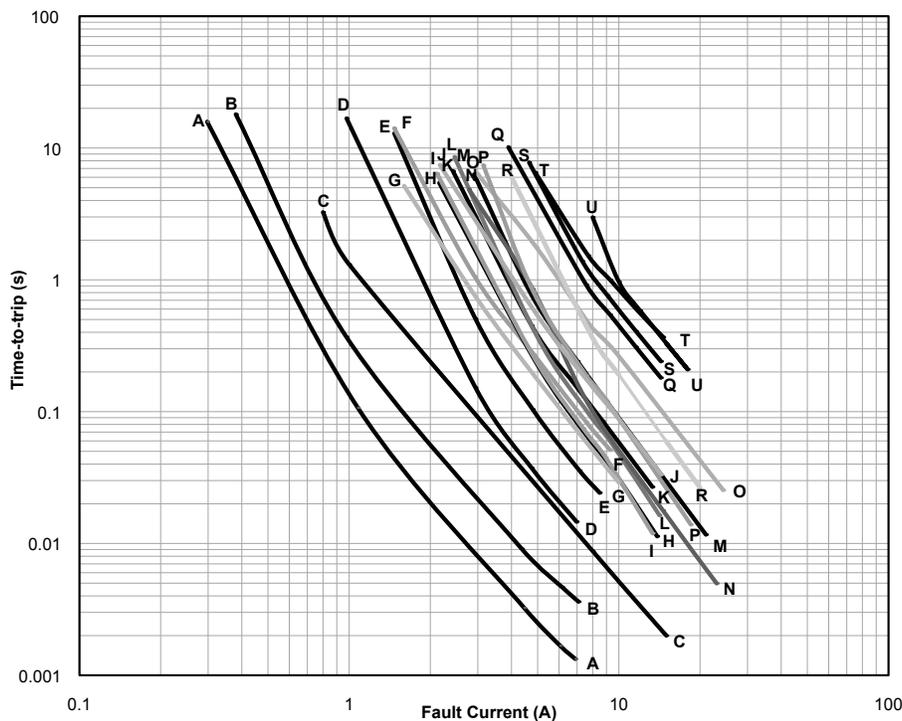
miniSMDCxxxF

- A = miniSMDC010F, miniSMDC014F
- B = miniSMDC020F
- C = miniSMDC030F
- D = miniSMDC050F
- E = miniSMDC075F
- F = miniSMDC075F/24

- G = miniSMDC075F/33
- H = miniSMDC100F, miniSMDC110F
- I = miniSMDC110F/16
- J = miniSMDC110F/24
- K = miniSMDC125F
- L = miniSMDC125F/16
- M = miniSMDC150F, miniSMDC150F/12
- N = miniSMDC150F/16

- O = miniSMDC150F/24
- P = miniSMDC160F
- Q = miniSMDC200F
- R = miniSMDC200F/16
- S = miniSMDC260F
- T = miniSMDC260F/12, miniSMDC260F/13.2, miniSMDC260F/16
- U = miniSMDC300F

Figure S10

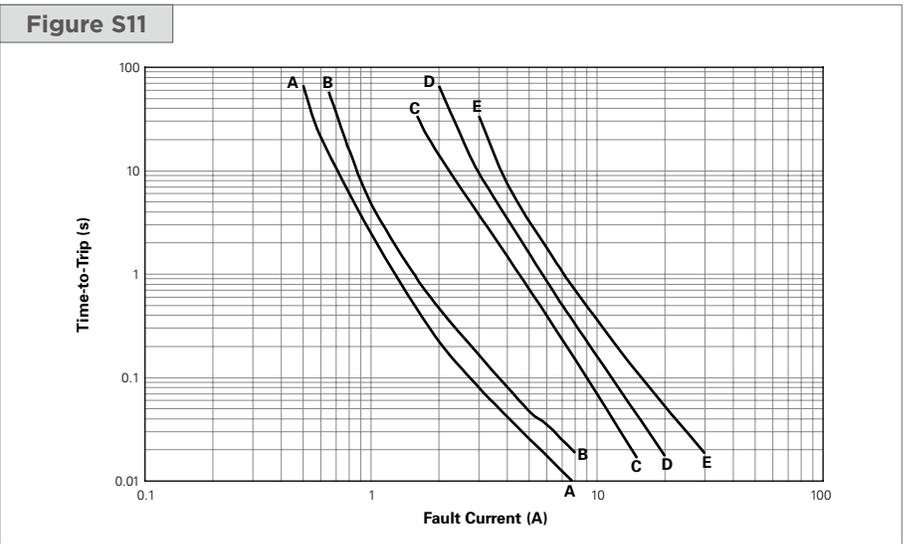


Figures S6-S15 — Typical Time-to-Trip Curves at 20°C

(Cont'd)

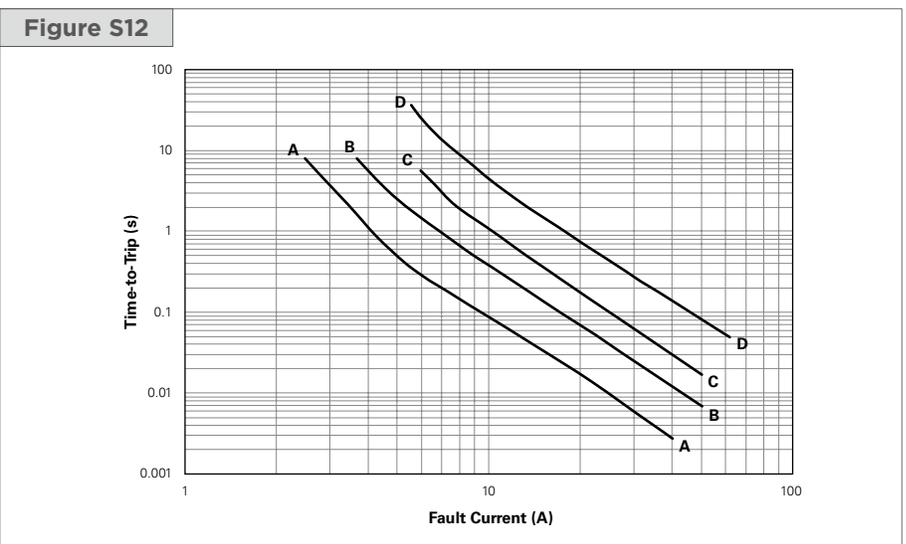
midSMD

- A = SMD030F-2018
- B = decaSMDC050F/60
- C = SMD100F-2018
- D = SMD150F-2018
- E = SMD200F-2018



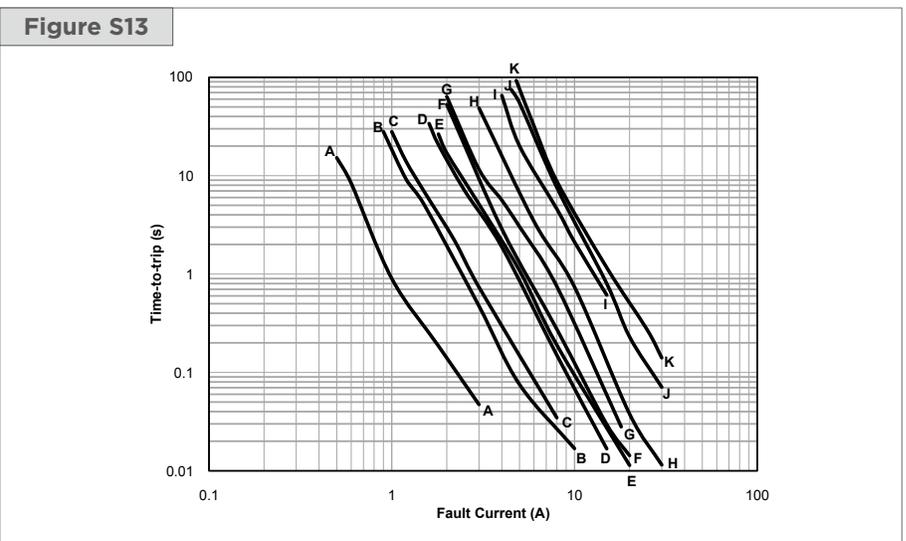
SMDCxxxF

- A = SMDC125F/33
- B = SMDC185F/33
- C = SMDC300F/24
- D = SMDC310F/18



SMDxxxF

- A = SMD030F
- B = SMD050F
- C = SMD075F, SMD075F/60
- D = SMD100F, SMD100F/33
- E = SMDH120
- F = SMD150F/33-2920
- G = SMD125F
- H = SMD200F/24-2920
- I = SMD250F/15-2920
- J = SMD260F
- K = SMD300F, SMD300F/15

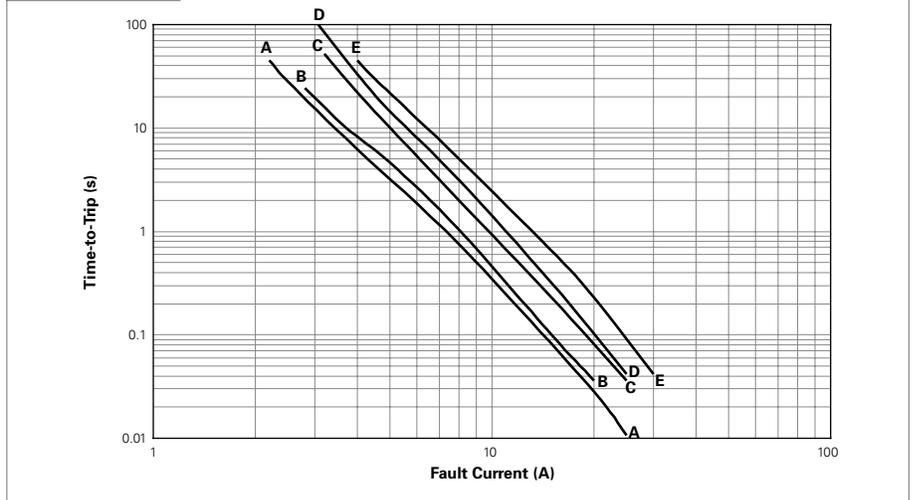


## Figures S6-S15 — Typical Time-to-Trip Curves at 20°C

(Cont'd)

**SMD2xxxF**

- A = SMD150F, SMD150F/33
- B = SMDH160
- C = SMD185F
- D = SMD200F
- E = SMD250F

**Figure S14****High Temperature SMD**

- A = nanoSMDCH010F
- B = microSMDCH010F
- C = microSMDCH050F
- D = nanoSMDH075F

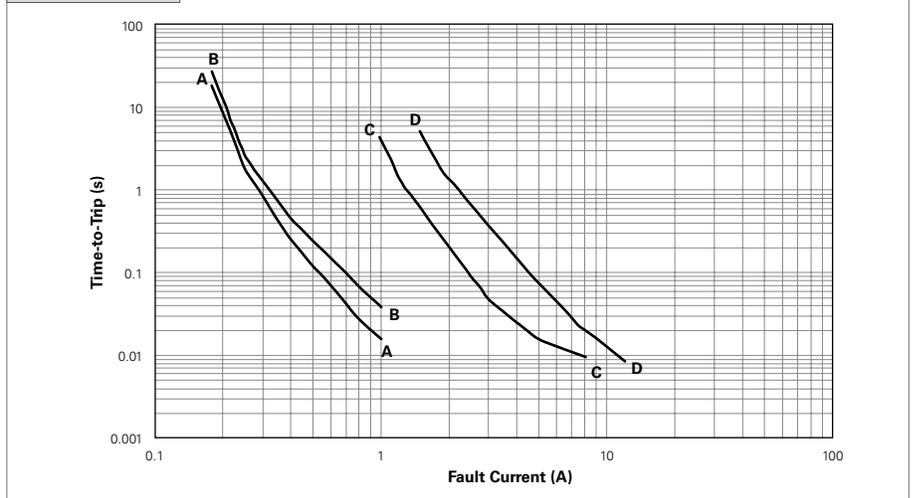
**Figure S15**

Table S5 — Physical Characteristics and Environmental Specifications

Operating temperature range -40°C to 85°C, -40°C to 125°C for SMDH120, SMDH160 and High Temperature SMD

| Physical Characteristics       |   |                         |                   |
|--------------------------------|---|-------------------------|-------------------|
| Terminal Pad Material          | 100% Matte Tin with Nickel Underplate   |                         |                   |
| Soldering Characteristics      | ANSI/J-STD-002 Category 3 for femtoSMD, picoSMD, nanoSMD, microSMD, miniSMD and SMDC Series<br>ANSI/J-STD-002 Category 1 for SMD Series |                         |                   |
| Solder Heat Withstand          | per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A  |                         |                   |
| Flammability Resistance        | per IEC 695-2-2 Needle Flame Test for 20 seconds  |                         |                   |
| Recommended Storage Conditions | 40°C max, 70% R.H. max; Devices May Not Meet Specified Ratings if Storage Conditions Are Exceeded                                       |                         |                   |
| Environmental Specifications   |   |                         |                   |
| Test                           | Test Method   | Conditions              | Resistance Change |
| Storage Life                   | PS300, Section 5.3.2  | 60°C, 1000 hrs          | ±3% typ           |
|                                |   | 85°C, 1000 hrs          | ±5% typ           |
| Humidity Aging                 | PS300, Section 5.3.1  | 85°C, 85% RH, 100 hrs   | ±1.2% typ         |
| Thermal Shock                  | MIL-STD-202, Method 107G  | 85°C, -40°C (20 Times)  | -33% typ          |
|                                |   | 125°C, -55°C (10 Times) | -33% typ          |
| Vibration                      | MIL-STD-883C  | per MIL-STD-883C        | No Change         |
| Solvent Resistance             | PS300, Section 5.2.2  | Freon                   | No Change         |
|                                |   | Trichloroethane         | No Change         |
|                                |   | Hydrocarbons            | No Change         |

Table S6 — Packaging and Marking Information

| Part Number                                     | Tape and Reel Quantity | Standard Package | Part Marking | Recommended Pad Layout Figures [mm (in)] |                   |                   | Agency Recognition |
|---|------------------------|------------------|--------------|--|-------------------|-------------------|--------------------|
|   |                        |                  |              | Dimension A (Nom)                        | Dimension B (Nom) | Dimension C (Nom) |                    |
| <b>femtoSMDC Series</b><br>Size 1608mm/0603mils |                        |                  |              |  |                   |                   |                    |
| femtoSMDC005F                                   | 4,000                  | 20,000           | A            | 0.80 (0.032)                             | 0.60 (0.024)      | 0.80 (0.032)      | UL, CSA            |
| femtoSMDC008F                                   | 4,000                  | 20,000           | T            | 0.80 (0.032)                             | 0.60 (0.024)      | 0.80 (0.032)      | UL, CSA            |
| femtoSMDC010F                                   | 4,000                  | 20,000           | B            | 0.80 (0.032)                             | 0.60 (0.024)      | 0.80 (0.032)      | UL, CSA, TÜV       |
| femtoSMDC012F                                   | 5,000                  | 25,000           | C            | 0.80 (0.032)                             | 0.60 (0.024)      | 0.80 (0.032)      | UL, CSA            |
| femtoSMDC016F                                   | 5,000                  | 25,000           | E            | 0.80 (0.032)                             | 0.60 (0.024)      | 0.80 (0.032)      | UL, CSA            |
| femtoSMDC020F                                   | 5,000                  | 25,000           | F            | 0.80 (0.032)                             | 0.60 (0.024)      | 0.80 (0.032)      | UL, CSA, TÜV       |
| femtoSMDC035F                                   | 4,000                  | 20,000           | K            | 0.80 (0.032)                             | 0.60 (0.024)      | 0.80 (0.032)      | UL, CSA            |
| <b>picoSMDC Series</b><br>Size 2012mm/0805mils  |                        |                  |              |  |                   |                   |                    |
| picoSMDC010S                                    | 3,000                  | 15,000           | C            | 1.50 (0.060)                             | 1.00 (0.039)      | 1.20 (0.047)      | UL, CSA, TÜV       |
| picoSMDC012S                                    | 4,000                  | 20,000           | F            | 1.50 (0.060)                             | 1.00 (0.039)      | 1.20 (0.047)      | UL, CSA, TÜV       |
| picoSMDC020S                                    | 4,000                  | 20,000           | H            | 1.50 (0.060)                             | 1.00 (0.039)      | 1.20 (0.047)      | UL, CSA, TÜV       |
| picoSMDC035S                                    | 4,000                  | 20,000           | I            | 1.50 (0.060)                             | 1.00 (0.039)      | 1.20 (0.047)      | UL, CSA, TÜV       |
| picoSMDC050S                                    | 3,000                  | 15,000           | K            | 1.50 (0.060)                             | 1.00 (0.039)      | 1.20 (0.047)      | UL, CSA, TÜV       |
| picoSMDC075S                                    | 3,000                  | 15,000           | M            | 1.50 (0.060)                             | 1.00 (0.039)      | 1.20 (0.047)      | UL, CSA, TÜV       |
| picoSMDC110S                                    | 3,000                  | 15,000           | S            | 1.50 (0.060)                             | 1.00 (0.039)      | 1.20 (0.047)      | UL, TÜV            |
| <b>nanoSMDC Series</b><br>Size 3216mm/1206mils  |                        |                  |              |  |                   |                   |                    |
| <b>NEW</b> nanoSMDC010F                         | 3,000                  | 15,000           | A            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, TÜV            |
| nanoSMDC012F                                    | 3,000                  | 15,000           | P            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC016F                                    | 3,000                  | 15,000           | N            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |

Table S6 — Packaging and Marking Information

(Cont'd)

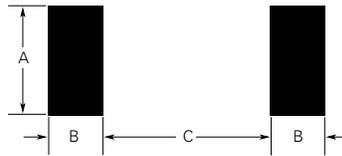
| Part Number                 | Tape and Reel Quantity | Standard Package | Part Marking | Recommended Pad Layout Figures [mm (in)] |                   |                   | Agency Recognition |
|-----------------------------|------------------------|------------------|--------------|--|-------------------|-------------------|--------------------|
|                             |                        |                  |              | Dimension A (Nom)                        | Dimension B (Nom) | Dimension C (Nom) |                    |
| <b>nanoSMDC Series</b>      |                        |                  |              |  |                   |                   |                    |
| <b>Size 3216mm/1206mils</b> |                        |                  |              |  |                   |                   |                    |
| nanoSMDC020F                | 3,000                  | 15,000           | 02           | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC025F                | 3,000                  | 15,000           | C            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC035F                | 3,000                  | 15,000           | 03           | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC050F/13.2           | 3,000                  | 15,000           | M            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC075F                | 3,000                  | 15,000           | L            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC110F                | 3,000                  | 15,000           | K            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC150F                | 3,000                  | 15,000           | 15           | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMDC200F                | 3,000                  | 15,000           | T            | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| <b>microSMD Series</b>      |                        |                  |              |  |                   |                   |                    |
| <b>Size 3225mm/1210mils</b> |                        |                  |              |  |                   |                   |                    |
| microSMD005F                | 4,000                  | 20,000           | 05           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD010F                | 4,000                  | 20,000           | 10           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD035F                | 4,000                  | 20,000           | 3            | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD050F                | 4,000                  | 20,000           | 50           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD075F                | 4,000                  | 20,000           | 75           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD110F                | 4,000                  | 20,000           | 11           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD150F                | 4,000                  | 20,000           | 15           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD175F                | 4,000                  | 20,000           | 17           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| microSMD200F                | 3,000                  | 15,000           | 20           | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| <b>miniSMDC Series</b>      |                        |                  |              |  |                   |                   |                    |
| <b>Size 4532mm/1812mils</b> |                        |                  |              |  |                   |                   |                    |
| miniSMDC010F                | 2,000                  | 10,000           | 10           | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC014F                | 2,000                  | 10,000           | 14           | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC020F                | 2,000                  | 10,000           | 2            | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC030F                | 2,000                  | 10,000           | 3            | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC050F                | 2,000                  | 10,000           | 5            | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC075F                | 2,000                  | 10,000           | 7            | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC075F/24             | 1,500                  | 7,500            | 075F 24V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC075F/33             | 1,500                  | 7,500            | 075F 33V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC100F                | 2,000                  | 10,000           | 1            | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC110F                | 2,000                  | 10,000           | 1            | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC110F/16             | 2,000                  | 10,000           | 110F 16V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC110F/24             | 1,500                  | 7,500            | 110F 24V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC125F                | 2,000                  | 10,000           | 12           | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC125F/16             | 2,000                  | 10,000           | 125F 16V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC150F                | 2,000                  | 10,000           | 15           | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC150F/12             | 2,000                  | 10,000           | 150F 12V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC150F/16             | 2,000                  | 10,000           | 150 16V      | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC150F/24             | 1,000                  | 5,000            | 150F 24V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC160F                | 2,000                  | 10,000           | 16           | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC200F                | 2,000                  | 10,000           | 20           | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC200F/16             | 2,000                  | 10,000           | 200F 16V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, TÜV            |
| miniSMDC260F                | 2,000                  | 10,000           | 260F         | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC260F/12             | 1,500                  | 7,500            | 260F 12V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC260F/13.2           | 1,500                  | 7,500            | 260F 13V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC260F/16             | 1,500                  | 7,500            | 260F 16V     | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |
| miniSMDC300F                | 2,000                  | 10,000           | 30           | 3.15 (0.124)                             | 1.68 (0.066)      | 3.10 (0.122)      | UL, CSA, TÜV       |

Table S6 — Packaging and Marking Information

(Cont'd)

| Part Number                                       | Tape and Reel Quantity | Standard Package | Part Marking | Recommended Pad Layout Figures [mm (in)] |                   |                   | Agency Recognition |
|---|------------------------|------------------|--------------|--|-------------------|-------------------|--------------------|
|   |                        |                  |              | Dimension A (Nom)                        | Dimension B (Nom) | Dimension C (Nom) |                    |
| <b>midSMD Series</b>                              |                        |                  |              |  |                   |                   |                    |
| <b>Size 5050mm/2018mils</b>                       |                        |                  |              |  |                   |                   |                    |
| SMD030F-2018                                      | 4,000                  | 20,000           | A03F         | 4.60 (0.18)                              | 1.50 (0.059)      | 3.40 (0.134)      | UL, CSA, TÜV       |
| decaSMDC050F/60                                   | 1,000                  | 5,000            | 050F 60V     | 4.32 (0.17)                              | 1.40 (0.055)      | 3.61 (0.142)      | UL, CSA, TÜV       |
| SMD100F-2018                                      | 4,000                  | 20,000           | A10F         | 4.60 (0.18)                              | 1.50 (0.059)      | 3.40 (0.134)      | UL, CSA, TÜV       |
| SMD150F-2018                                      | 4,000                  | 20,000           | A15F         | 4.60 (0.18)                              | 1.50 (0.059)      | 3.40 (0.134)      | UL, CSA, TÜV       |
| SMD200F-2018                                      | 4,000                  | 20,000           | A20F         | 4.60 (0.18)                              | 1.50 (0.059)      | 3.40 (0.134)      | UL, CSA, TÜV       |
| <b>SMDC Series</b>                                |                        |                  |              |  |                   |                   |                    |
| <b>Size 7555mm/2920mils</b>                       |                        |                  |              |  |                   |                   |                    |
| <b>NEW</b> SMDC125F/33                            | 4,000                  | 20,000           | 125F         | 5.30 (0.209)                             | 2.00 (0.079)      | 4.60 (0.18)       | UL                 |
| <b>NEW</b> SMDC185F/33                            | 4,000                  | 20,000           | 185F 33V     | 5.30 (0.209)                             | 2.00 (0.079)      | 4.60 (0.18)       | UL, CSA, TÜV       |
| <b>NEW</b> SMDC300F/24                            | 4,000                  | 20,000           | 300F 24V     | 5.30 (0.209)                             | 2.00 (0.079)      | 4.60 (0.18)       | UL, CSA, TÜV       |
| <b>NEW</b> SMDC310F/18                            | 3,000                  | 15,000           | 310F 18V     | 5.30 (0.209)                             | 2.00 (0.079)      | 4.60 (0.18)       | UL, CSA            |
| <b>SMD Series</b>                                 |                        |                  |              |  |                   |                   |                    |
| <b>Size 7555mm/2920mils</b>                       |                        |                  |              |  |                   |                   |                    |
| SMD030F   | 2,000                  | 10,000           | 030F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD050F   | 2,000                  | 10,000           | 050F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD075F   | 2,000                  | 10,000           | 075F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD075F/60  | 2,000                  | 10,000           | 756F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD100F   | 2,000                  | 10,000           | 100F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD100F/33  | 2,000                  | 10,000           | 103F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMDH120   | 2,000                  | 10,000           | H12          | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD125F   | 2,000                  | 10,000           | 125F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD150F/33-2920                                   | 2,000                  | 10,000           | S15F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD200F/24-2920                                   | 2,000                  | 10,000           | S20F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD250F/15-2920                                   | 2,000                  | 10,000           | S25F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD260F   | 2,000                  | 10,000           | 260F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD300F   | 2,000                  | 10,000           | 300F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| SMD300F/15  | 2,000                  | 10,000           | 315F         | 3.10 (0.12)                              | 2.30 (0.09)       | 5.10 (0.201)      | UL, CSA, TÜV       |
| <b>SMD2 Devices</b>                               |                        |                  |              |  |                   |                   |                    |
| <b>Size 8763mm/3425mils</b>                       |                        |                  |              |  |                   |                   |                    |
| SMD150F   | 1,500                  | 7,500            | 150F         | 4.60 (0.18)                              | 2.30 (0.09)       | 6.10 (0.240)      | UL, CSA, TÜV       |
| SMD150F/33  | 1,500                  | 7,500            | 153F         | 4.60 (0.18)                              | 2.30 (0.09)       | 6.10 (0.240)      | UL, CSA, TÜV       |
| SMDH160   | 1,500                  | 7,500            | 160F         | 4.60 (0.18)                              | 2.30 (0.09)       | 6.10 (0.240)      | UL, CSA, TÜV       |
| SMD185F   | 1,500                  | 7,500            | 185F         | 4.60 (0.18)                              | 2.30 (0.09)       | 6.10 (0.240)      | UL, CSA, TÜV       |
| SMD200F   | 1,500                  | 7,500            | 200F         | 4.60 (0.18)                              | 2.30 (0.09)       | 6.10 (0.240)      | UL, CSA, TÜV       |
| SMD250F   | 1,500                  | 7,500            | 250F         | 4.60 (0.18)                              | 2.30 (0.09)       | 6.10 (0.240)      | UL, CSA, TÜV       |
| <b>High Temperature SMD Series</b>                |                        |                  |              |  |                   |                   |                    |
| <b>Size 3216mm/1206mils &amp; 3225mm/1210mils</b> |                        |                  |              |  |                   |                   |                    |
| <b>NEW</b> nanoSMDCH010F                          | 4,000                  | 20,000           | H01          | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | —                  |
| <b>NEW</b> nanoSMDH075F                           | 3,000                  | 15,000           | H75          | 1.60 (0.063)                             | 1.00 (0.039)      | 2.00 (0.079)      | —                  |
| <b>NEW</b> microSMDCH010F                         | 3,000                  | 15,000           | H01          | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | —                  |
| <b>NEW</b> microSMDCH050F                         | 4,000                  | 20,000           | H05          | 2.50 (0.098)                             | 1.00 (0.039)      | 2.00 (0.079)      | —                  |

Figure S16 — Recommended Pad Layout



## Agency Recognition

|     |  |
|-----|--|
| UL  | File # E74889 for all Surface-mount Devices                          |
| CSA | File # CA78165 for all Surface-mount Devices                         |
| TÜV | Certificate Number Available Upon Request (Certified to IEC 60730-1) |

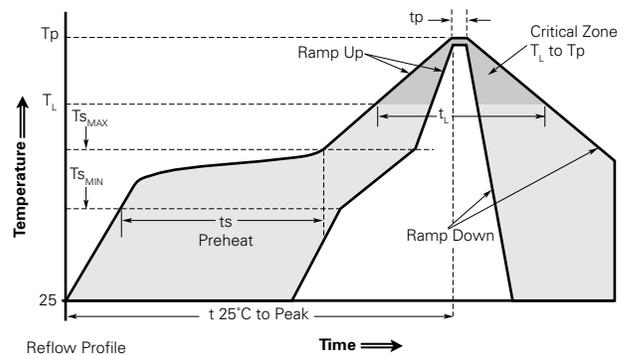
## Solder Reflow and Rework Recommendation

### Classification Reflow Profiles

| Profile Feature  | Pb-Free Assembly |
|--|------------------|
| <b>Average Ramp-up Rate (<math>T_{s_{MAX}}</math> to <math>T_p</math>)</b> | 3°C/s max        |
| <b>Preheat</b>   |                  |
| • Temperature min ( $T_{s_{MIN}}$ )  | 150°C            |
| • Temperature max ( $T_{s_{MAX}}$ )  | 200°C            |
| • Time ( $t_{s_{MIN}}$ to $t_{s_{MAX}}$ )                                  | 60-120s          |
| <b>Time Maintained Above:</b>  |                  |
| • Temperature ( $T_L$ )  | 217°C            |
| • Time ( $t_L$ )   | 60-150s          |
| <b>Peak/Classification Temperature (<math>T_p</math>)</b>                  | 260°C            |
| <b>Time within 5°C of Actual Peak Temperature</b>                          |                  |
| Time ( $t_p$ )   | 30s max          |
| <b>Ramp-down Rate</b>  | 3°C/s max        |
| <b>Time 25°C to Peak Temperature</b>                                       | 8 mins max       |

**Note:** All temperatures refer to topside of the package, measured on the package body surface.

Figure S17



## Solder Reflow

- Recommended reflow methods:
  - IR
  - Hot air
  - Nitrogen
- Recommended maximum paste thickness: 0.25mm (0.010in)
- Devices can be cleaned using standard methods and aqueous solvents.
- Experience has shown the optimum conditions for forming acceptable solder fillets occur when a reasonable amount of solder paste is placed underneath each device's termination. As such, we request that customers comply with our recommended solder pad layouts.
- Customer should validate that the solder paste amount and reflow recommendations meet its application.
- We request that customer board layouts refrain from placing raised features (e.g. vias, nomenclature, traces, etc.) underneath PolySwitch devices. It is possible that raised features could negatively impact solderability performance of our devices.

## Rework

- femtoSMD, picoSMD, nanoSMD, microSMD, miniSMD and SMDC series: standard industry practices. (Please also avoid direct contact to the device.)
- SMD series: Rework should be confined to removal of the installed product and replacement with a fresh device.

Table S7 — Tape and Reel Specifications (Millimeters)

| Description        | nanoSMDC               |                       | microSMD  |  | miniSMDC                     |                              | midSMD           |                  | SMD               |                 |
|--------------------|------------------------|-----------------------|---|--|------------------------------|------------------------------|------------------|------------------|-------------------|-----------------|
|                    | femtoSMDC<br>EIA 481-1 | picoSMDC<br>EIA 481-1 | nanoSMDC<br>nanoSMDCH010F<br>and<br>nanoSMDH075F<br>EIA 481-1 | microSMD<br>microSMDCH010F<br>and<br>microSMDCH050F<br>EIA 481-1 | decaSMDC050F/60<br>EIA 481-1 | decaSMDC050F/60<br>EIA 481-2 | SMD<br>EIA 481-1 | SMD<br>EIA 481-2 | SMD2<br>EIA 481-2 |                 |
| W                  | 8.0 ± 0.30             | 8.0 ± 0.30            | 8.0 ± 0.30  | 8.0 ± 0.30   | 12.0 ± 0.30                  | 16.0 ± 0.30                  | 16.0 ± 0.30      | 16.0 ± 0.30      | 16.0 ± 0.30       | 16.0 ± 0.30     |
| P <sub>0</sub>     | 4.0 ± 0.10             | 4.0 ± 0.10            | 4.0 ± 0.10  | 4.0 ± 0.10   | 4.0 ± 0.10                   | 4.0 ± 0.10                   | 4.0 ± 0.10       | 4.0 ± 0.10       | 4.0 ± 0.10        | 4.0 ± 0.10      |
| P <sub>1</sub>     | 4.0 ± 0.10             | 4.0 ± 0.10            | 4.0 ± 0.10  | 4.0 ± 0.10   | 8.0 ± 0.10                   | 8.0 ± 0.10                   | 8.0 ± 0.10       | 8.0 ± 0.10       | 8.0 ± 0.10        | 12.0 ± 0.10     |
| P <sub>2</sub>     | 2.0 ± 0.05             | 2.0 ± 0.10            | 2.0 ± 0.05  | 2.0 ± 0.05   | 2.0 ± 0.05                   | 2.0 ± 0.10                   | 2.0 ± 0.10       | 2.0 ± 0.10       | 2.0 ± 0.10        | 2.0 ± 0.10      |
| A <sub>0</sub>     | 0.95 ± 0.05            | 1.70 ± 0.10           | 1.95 ± 0.10   | 2.9 ± 0.10   | Table S8                     | 5.11 ± 0.15                  | Table S8         | 5.6 ± 0.23       | 6.9 ± 0.23        | 6.9 ± 0.23      |
| B <sub>0</sub>     | 1.85 ± 0.05            | 2.45 ± 0.10           | Table S8  | Table S8   | Table S8                     | 5.6 ± 0.23                   | Table S8         | 8.1 ± 0.15       | 9.6 ± 0.15        | 9.6 ± 0.15      |
| B <sub>1</sub> max | 4.35                   | 4.35                  | 4.35  | 4.35   | 6.15                         | 6.4                          | 12.1             | 12.1             | 12.1              | 12.1            |
| D <sub>0</sub>     | 1.55 ± 0.05            | 1.55 ± 0.05           | 1.55 ± 0.05   | 1.55 ± 0.05  | 1.55 ± 0.05                  | 1.5 ± 0.10/-.00              | 1.5 ± 0.10/-.00  | 1.5 ± 0.10/-.00  | 1.5 ± 0.10/-.00   | 1.5 ± 0.10/-.00 |
| F                  | 3.50 ± 0.05            | 3.50 ± 0.05           | 3.50 ± 0.05   | 3.50 ± 0.05  | 5.50 ± 0.10                  | 7.50 ± 0.10                  | 7.50 ± 0.10      | 7.50 ± 0.10      | 7.50 ± 0.10       | 7.50 ± 0.10     |
| E <sub>1</sub>     | 1.75 ± 0.10            | 1.75 ± 0.10           | 1.75 ± 0.10   | 1.75 ± 0.10  | 1.75 ± 0.10                  | 1.75 ± 0.10                  | 1.75 ± 0.10      | 1.75 ± 0.10      | 1.75 ± 0.10       | 1.75 ± 0.10     |
| E <sub>2</sub> min | 6.25                   | 6.25                  | 6.25  | 6.25   | 10.25                        | 14.25                        | 14.25            | 14.25            | 14.25             | 14.25           |
| T max              | 0.3                    | 0.3                   | 0.3   | 0.3  | 0.35                         | 0.4                          | 0.35             | 0.4              | 0.4               | 0.4             |
| T <sub>1</sub> max | 0.1                    | 0.1                   | 0.1   | 0.1  | 0.1                          | 0.1                          | 0.1              | 0.1              | 0.1               | 0.1             |
| K <sub>0</sub>     | Table S8               | Table S8              | Table S8  | Table S8   | Table S8                     | 1.8 ± 0.15                   | Table S8         | 3.2 ± 0.15       | 3.4 ± 0.15        | 3.4 ± 0.15      |

Table S8 — Tape and Reel Specifications (Millimeters)

| Description    | femtoSMDC005F<br>femtoSMDC008F<br>femtoSMDC010F<br>femtoSMDC035F |  | femtoSMDC012F<br>femtoSMDC016F<br>femtoSMDC020F  |                 | picoSMDC012S<br>picoSMDC020S<br>picoSMDC035S |                  | picoSMDC010S<br>picoSMDC050S<br>picoSMDC075S |             | picoSMDC110S |  | nanoSMDCH010F<br>and<br>All nanoSMDC<br>series except<br>nanoSMDC010F<br>nanoSMDC012F<br>nanoSMDC016F<br>nanoSMDC200F |  | nanoSMDH075F<br>nanoSMDC010F<br>nanoSMDC016F<br>nanoSMDC200F |  | microSMDCH050F<br>and<br>All microSMD<br>series except<br>microSMD200F |  |
|----------------|--|--|--|-----------------|--|------------------|--|-------------|--------------|--|---|--|--|--|--|--|
|                | microSMDCH010F<br>microSMD200F                                   | miniSMDC010F<br>miniSMDC014F~075F<br>miniSMDC100F~110F/16<br>miniSMDC125F~150F/16<br>miniSMDC160F~260F<br>miniSMDC300F | miniSMDC075F/24<br>miniSMDC075F/33<br>miniSMDC110F/24<br>miniSMDC260F/12<br>miniSMDC260F/13.2<br>miniSMDC260F/16 | miniSMDC150F/24 | decaSMDC050F/60                              | SMDC125F/33      | SMDC185F/33<br>SMDC300F/24                   | SMDC310F/18 |              |  |   |  |  |  |  |  |
| A <sub>0</sub> | 0.95 ± 0.05  | 0.95 ± 0.05  | 1.70 ± 0.1   | 1.70 ± 0.1      | 1.70 ± 0.1                                   | 1.95 ± 0.1       | 1.95 ± 0.1                                   | 2.9 ± 0.1   |              |  |   |  |  |  |  |  |
| B <sub>0</sub> | 1.85 ± 0.05  | 1.85 ± 0.05  | 2.45 ± 0.1   | 2.45 ± 0.1      | 2.45 ± 0.1                                   | 3.50 ± 0.1/-0.08 | 3.5 ± 0.1                                    | 3.5 ± 0.1   |              |  |   |  |  |  |  |  |
| K <sub>0</sub> | 0.90 ± 0.1   | 0.55 ± 0.05  | 0.86 ± 0.1   | 1.12 ± 0.1      | 1.35 ± 0.1                                   | 0.89 ± 0.1       | 1.27 ± 0.1                                   | 0.9 ± 0.1   |              |  |   |  |  |  |  |  |
| A <sub>0</sub> | 2.9 ± 0.1  | 3.5 ± 0.1  | 3.7 ± 0.1  | 3.7 ± 0.1       | 5.0 ± 0.1                                    | 5.5 ± 0.1        | 5.35 ± 0.1                                   | 5.5 ± 0.1   |              |  |   |  |  |  |  |  |
| B <sub>0</sub> | 3.55 ± 0.1   | 4.95 ± 0.1   | 4.9 ± 0.1  | 4.9 ± 0.1       | 5.4 ± 0.1                                    | 7.9 ± 0.1        | 7.85 ± 0.1                                   | 8.0 ± 0.1   |              |  |   |  |  |  |  |  |
| K <sub>0</sub> | 1.27 ± 0.1   | 0.9 ± 0.1  | 1.4 ± 0.1  | 1.78 ± 0.1      | 1.7 ± 0.1                                    | 0.9 ± 0.1        | 1.45 ± 0.1                                   | 2.0 ± 0.1   |              |  |   |  |  |  |  |  |

Table S9 — Reel Dimensions (Millimeters)

|                    | femto/pico/nano/microSMD/<br>High Temperature SMD | miniSMDC        | midSMD          | SMD/SMDC        | SMD2            |
|--------------------|---|-----------------|-----------------|-----------------|-----------------|
| A max              | 185   | 185             | 330             | 330             | 330             |
| N min              | 50  | 50              | 50              | 50              | 50              |
| W <sub>1</sub>     | 8.4 + 1.5/-0.0                                    | 12.4 + 2.0/-0.0 | 16.4 + 2.0/-0.0 | 16.4 + 2.0/-0.0 | 16.4 + 2.0/-0.0 |
| W <sub>2</sub> max | 14.4  | 18.4            | 22.4            | 22.4            | 22.4            |

Figure S18 — EIA Referenced Taped Component Dimensions

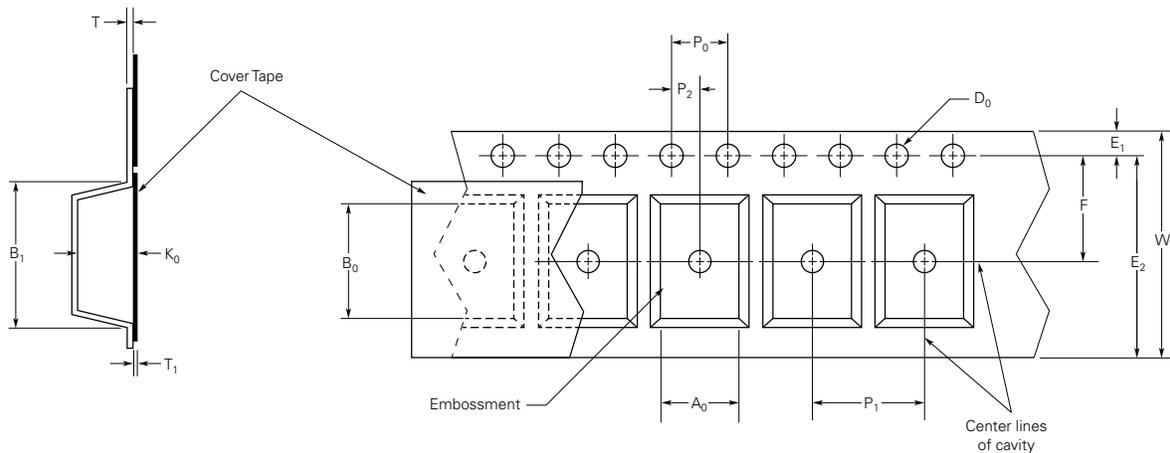
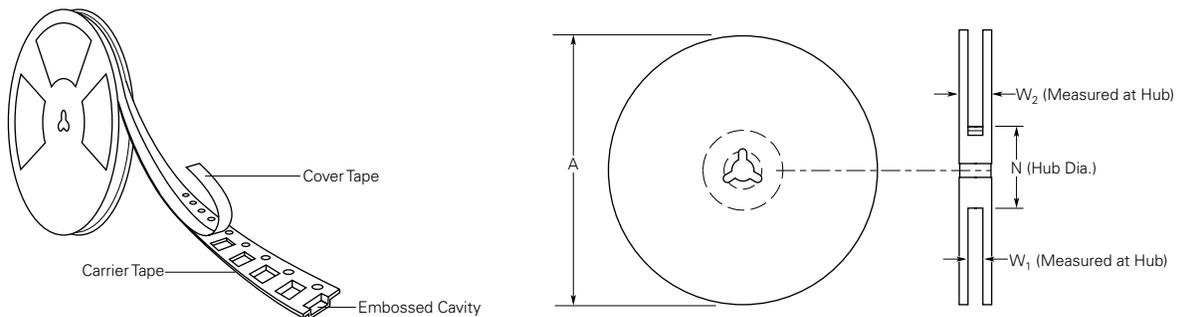
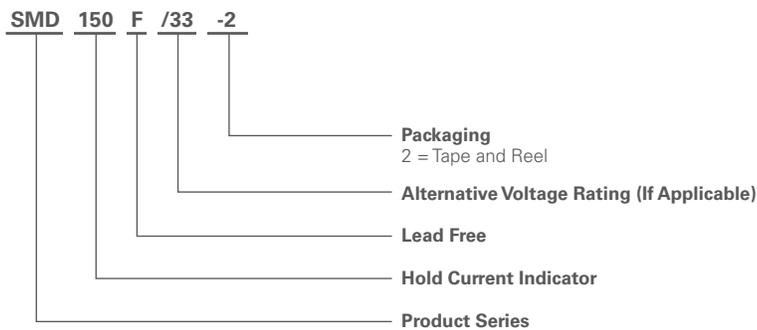


Figure S19 — EIA Referenced Reel Dimensions



## Part Numbering System

**Warning :**

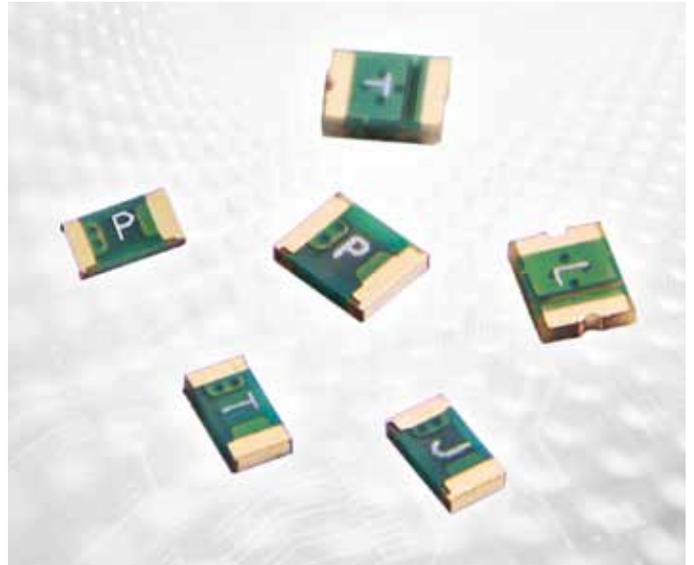
- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.

# POLYSWITCH RESETTABLE DEVICES

## Low Resistivity SMD Devices

The low resistivity SMD (surface-mount device) series is well suited to space-constrained mobile applications. The devices can help provide both overcurrent and overtemperature protection for battery pack PCMs (protection circuit modules) used in compact consumer devices such as smartphones and MP3/MP4 media players. In particular, the low resistivity SMD series helps battery pack suppliers achieve their design goals and simplify their installation methods.

The low resistivity SMD series comprises eleven devices. In the model number descriptions, the “micro” prefix refers to the 1210 form factor and the “nano” prefix refers to the 1206 form factor.



### BENEFITS

- Helps save board space and power consumption, and therefore costs, in space-constrained mobile electronics
- Are more compact in comparison with similar offerings and are available in an industry-standard form factor
- Can be assembled with a reflowable soldering technique, as opposed to the spot welding process required by many other components
- Maximum electrical rating: Voltage  $6V_{DC}$  and short circuit current 50A
- Industry-standard form factor of 1210 (3.0mmx2.54mm; or 0.12inx0.10in), or 1206 (3.0mmx1.52mm; or 0.12inx0.060in)
- Useful for an operating current of 2A and above
- Useful for and packaged for surface mounting on the PCB

### FEATURES

- RoHS compliant
- Halogen free (refers to:  $Br \leq 900ppm$ ,  $Cl \leq 900ppm$ ,  $Br+Cl \leq 1500ppm$ )
- Current ratings from 1.75 to 5.0A

### APPLICATIONS

- Mobile and smart phones
- Media players (MP3/MP4)
- Digital still and video cameras
- Mini notebooks
- Tablets

- Agency recognition: UL, CSA, TÜV
- Small footprint
- Fast time-to-trip

Table LR1 – Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

| Part Number                                      | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |      |
|--|-----------------------------|-------|------|------|------|------|------|------|------|------|------|
|  | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C |
| <b>nanoSMDLR Series</b><br>Size 3216mm/1206mils  |                             |       |      |      |      |      |      |      |      |      |      |
| nanoSMD175LR                                     | 3.00                        | 2.60  | 2.20 | 1.75 | 1.70 | 1.40 | 1.20 | 1.00 | 0.80 | 0.60 | 0.50 |
| nanoSMD200LR                                     | 3.60                        | 3.20  | 2.80 | 2.00 | 1.90 | 1.80 | 1.60 | 1.40 | 1.20 | 1.00 | 0.80 |
| nanoSMD270LR                                     | 4.00                        | 3.50  | 3.00 | 2.70 | 2.60 | 2.20 | 2.00 | 1.60 | 1.40 | 1.20 | 1.10 |
| nanoSMD350LR                                     | 5.50                        | 4.80  | 4.00 | 3.50 | 3.30 | 2.70 | 2.30 | 1.90 | 1.60 | 1.40 | 1.30 |
| nanoSMD500LR                                     | 7.40                        | 6.60  | 6.00 | 5.00 | 4.90 | 4.60 | 4.20 | 3.70 | 3.30 | 3.00 | 2.80 |
| <b>microSMDLR Series</b><br>Size 3225mm/1210mils |                             |       |      |      |      |      |      |      |      |      |      |
| microSMD190LR                                    | 3.40                        | 2.90  | 2.40 | 1.90 | 1.80 | 1.40 | 1.15 | 0.90 | 0.65 | 0.40 | 0.28 |
| microSMD200LR                                    | 3.50                        | 3.00  | 2.50 | 2.00 | 1.90 | 1.50 | 1.25 | 1.00 | 0.75 | 0.50 | 0.38 |
| microSMD250LR                                    | 4.40                        | 3.80  | 3.20 | 2.50 | 2.40 | 1.90 | 1.60 | 1.30 | 1.00 | 0.65 | 0.50 |
| microSMD350LR                                    | 5.40                        | 4.75  | 4.00 | 3.50 | 3.20 | 2.70 | 2.40 | 2.00 | 1.70 | 1.35 | 1.20 |
| microSMD450LR                                    | 7.00                        | 6.20  | 5.50 | 4.50 | 4.40 | 3.80 | 3.50 | 3.20 | 2.75 | 2.35 | 2.16 |

Figure LR1 – Thermal Derating Curve

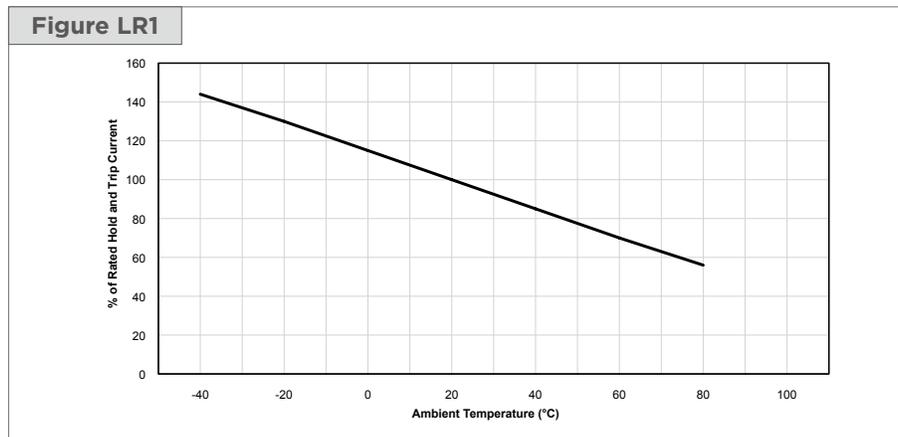
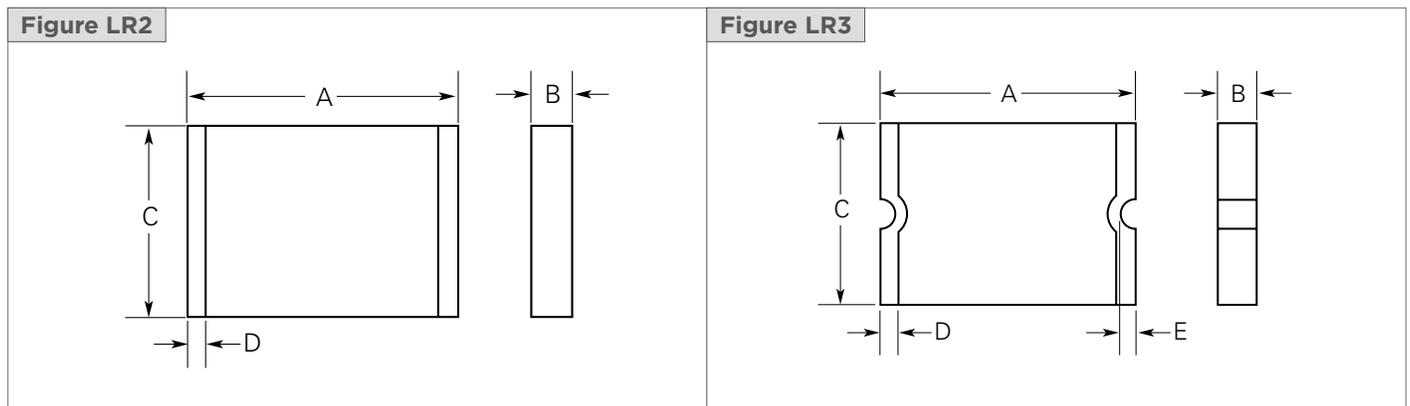


Table LR2 – Electrical Characteristics for low resistivity SMD Devices at Room Temperature

| Part Number                                      | $I_H$<br>(A) | $I_T$<br>(A) | $V_{MAX}$<br>(V <sub>DC</sub> ) | $I_{MAX}$<br>(A) | $P_{D MAX}$<br>(W) | Max Time-to-Trip |       | $R_{MIN}$<br>(Ω) | $R_{1MAX}$<br>(Ω) | Figure for Dimensions |
|--|--------------|--------------|---------------------------------|------------------|--------------------|------------------|-------|------------------|-------------------|-----------------------|
|  |              |              |                                 |                  |                    | (A)              | (S)   |                  |                   |                       |
| <b>nanoSMDLR Series</b><br>Size 3216mm/1206mils  |              |              |                                 |                  |                    |                  |       |                  |                   |                       |
| nanoSMD175LR                                     | 1.75         | 5.00         | 6                               | 50               | 1.00               | 9.50             | 1.00  | 0.008            | 0.034             | LR2                   |
| nanoSMD200LR                                     | 2.00         | 6.00         | 6                               | 50               | 1.00               | 9.50             | 3.00  | 0.006            | 0.024             | LR2                   |
| nanoSMD270LR                                     | 2.70         | 6.30         | 6                               | 50               | 1.00               | 8.00             | 5.00  | 0.005            | 0.018             | LR2                   |
| nanoSMD350LR                                     | 3.50         | 6.30         | 6                               | 50               | 1.00               | 8.00             | 5.00  | 0.004            | 0.018             | LR2                   |
| nanoSMD500LR                                     | 5.00         | 10.00        | 6                               | 50               | 1.00               | 25.00            | 2.00  | 0.002            | 0.008             | LR2                   |
| <b>microSMDLR Series</b><br>Size 3225mm/1210mils |              |              |                                 |                  |                    |                  |       |                  |                   |                       |
| microSMD190LR                                    | 1.90         | 4.90         | 6                               | 50               | 1.00               | 9.50             | 4.00  | 0.006            | 0.021             | LR3                   |
| microSMD200LR                                    | 2.00         | 5.00         | 6                               | 50               | 1.00               | 9.50             | 4.00  | 0.006            | 0.021             | LR3                   |
| microSMD250LR                                    | 2.50         | 5.20         | 6                               | 50               | 1.00               | 9.50             | 5.00  | 0.005            | 0.018             | LR3                   |
| microSMD350LR                                    | 3.50         | 9.00         | 6                               | 50               | 1.00               | 9.50             | 10.00 | 0.0025           | 0.011             | LR2                   |
| microSMD450LR                                    | 4.50         | 9.00         | 5                               | 50               | 1.00               | 25.00            | 2.00  | 0.002            | 0.008             | LR3                   |

## Figures LR2-LR3 – Dimensions Figures



### Table LR3 – Dimensions in Millimeters (Inches)

| Part Number                                       | A               |                 | B               |                 | C               |                 | D               |                 | E                | Figure |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|--------|
|   | Min             | Max             | Min             | Max             | Min             | Max             | Min             | Max             | Min              |        |
| <b>nanoSMDLR Series<br/>Size 3216mm/1206mils</b>  |                 |                 |                 |                 |                 |                 |                 |                 |                  |        |
| nanoSMD175LR                                      | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.85<br>(0.073) | 0.25<br>(0.010) | 0.75<br>(0.030) | —                | LR2    |
| nanoSMD200LR                                      | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.85<br>(0.073) | 0.25<br>(0.010) | 0.75<br>(0.030) | —                | LR2    |
| nanoSMD270LR                                      | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.85<br>(0.073) | 0.25<br>(0.010) | 0.75<br>(0.030) | —                | LR2    |
| nanoSMD350LR                                      | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 1.37<br>(0.054) | 1.85<br>(0.073) | 0.25<br>(0.010) | 0.75<br>(0.030) | —                | LR2    |
| nanoSMD500LR                                      | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 0.80<br>(0.031) | 1.37<br>(0.054) | 1.85<br>(0.073) | 0.25<br>(0.010) | 0.75<br>(0.030) | —                | LR2    |
| <b>microSMDLR Series<br/>Size 3225mm/1210mils</b> |                 |                 |                 |                 |                 |                 |                 |                 |                  |        |
| microSMD190LR                                     | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | LR3    |
| microSMD200LR                                     | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | LR3    |
| microSMD250LR                                     | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | LR3    |
| microSMD350LR                                     | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | —                | LR2    |
| microSMD450LR                                     | 3.00<br>(0.118) | 3.43<br>(0.135) | 0.50<br>(0.019) | 1.00<br>(0.039) | 2.35<br>(0.092) | 2.80<br>(0.110) | 0.25<br>(0.010) | 0.75<br>(0.030) | 0.076<br>(0.003) | LR3    |

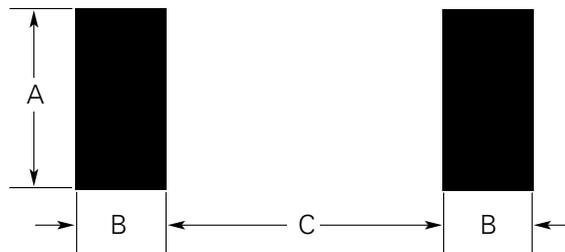
### Table LR4 – Physical Characteristics Operating Temperature Range -40°C to 85°C

| Physical Characteristics       |  |
|--------------------------------|--|
| Terminal Pad Material          | Gold with Nickel Underplate  |
| Soldering Characteristics      | ANSI/J-STD-002 Category 3  |
| Solder Heat Withstand          | per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A   |
| Flammability Resistance        | per IEC 695-2-2 Needle Flame Test for 20 sec.  |
| Recommended Storage Conditions | 40°C max, 70% R.H. max; Devices May Not Meet Specified Ratings if Storage Conditions Are Exceeded. |

Table LR5 — Packaging and Marking Information

| Part Number                                      | Tape & Reel Quantity | Standard Package | Part Marking | Recommended Pad Layout Figures [mm (in)] |                   |                   | Agency Recognition |
|--|----------------------|------------------|--------------|--|-------------------|-------------------|--------------------|
|  |                      |                  |              | Dimension A (Nom)                        | Dimension B (Nom) | Dimension C (Nom) |                    |
| <b>nanoSMDLR Series</b><br>Size 3216mm/1206mils  |                      |                  |              |  |                   |                   |                    |
| nanoSMD175LR                                     | 3,000                | 15,000           | J            | 1.75 (0.069)                             | 1.10 (0.043)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMD200LR                                     | 3,000                | 15,000           | T            | 1.75 (0.069)                             | 1.10 (0.043)      | 2.00 (0.079)      | UL, CSA            |
| nanoSMD270LR                                     | 3,000                | 15,000           | L            | 1.75 (0.069)                             | 1.10 (0.043)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMD350LR                                     | 3,000                | 15,000           | P            | 1.75 (0.069)                             | 1.10 (0.043)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| nanoSMD500LR                                     | 3,000                | 15,000           | H            | 1.75 (0.069)                             | 1.10 (0.043)      | 2.00 (0.079)      | UL, CSA, TÜV       |
| <b>microSMDLR Series</b><br>Size 3225mm/1210mils |                      |                  |              |  |                   |                   |                    |
| microSMD190LR                                    | 3,000                | 15,000           | None         | 2.65 (0.104)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA            |
| microSMD200LR                                    | 3,000                | 15,000           | T            | 2.65 (0.104)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA            |
| microSMD250LR                                    | 3,000                | 15,000           | L            | 2.65 (0.104)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL, CSA            |
| microSMD350LR                                    | 3,000                | 15,000           | P            | 2.65 (0.104)                             | 1.10 (0.043)      | 2.00 (0.079)      | UL, CSA            |
| microSMD450LR                                    | 3,000                | 15,000           | H            | 2.65 (0.104)                             | 1.00 (0.039)      | 2.00 (0.079)      | UL                 |

Figure LR4 — Recommended Pad Layout



## Agency Recognition

|     |  |
|-----|--|
| UL  | File # E74889 for all low resistivity SMD Devices                    |
| CSA | File # CA78165 for all low resistivity SMD Devices                   |
| TÜV | Certificate Number Available Upon Request (Certified to IEC 60730-1) |

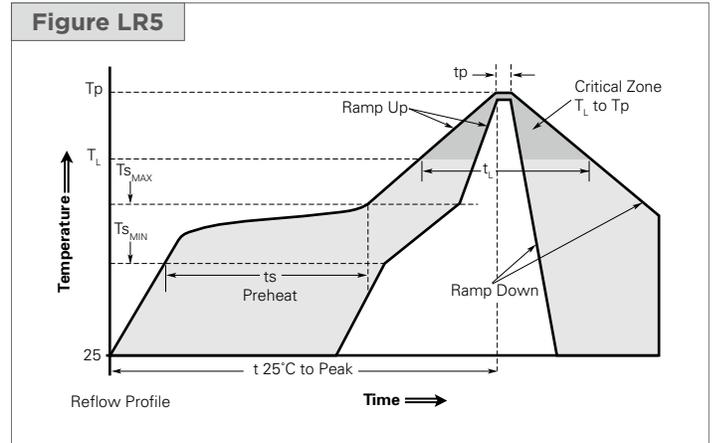
## Solder Reflow Recommendation

## Classification Reflow Profiles

| Profile Feature  | Pb-Free Assembly |
|--|------------------|
| <b>Average Ramp-up Rate (<math>T_{S_{MAX}}</math> to <math>T_p</math>)</b> | 3°C/s max        |
| <b>Preheat</b>   |                  |
| • Temperature min ( $T_{S_{MIN}}$ )  | 150°C            |
| • Temperature max ( $T_{S_{MAX}}$ )  | 200°C            |
| • Time ( $t_{S_{MIN}}$ to $t_{S_{MAX}}$ )                                  | 60-120s          |
| <b>Time Maintained Above:</b>  |                  |
| • Temperature ( $T_L$ )  | 217°C            |
| • Time ( $t_l$ )   | 60-150s          |
| <b>Peak/Classification Temperature (<math>T_p</math>)</b>                  | 260°C            |
| <b>Time within 5°C of Actual Peak Temperature</b>                          |                  |
| Time ( $t_p$ )   | 30s max          |
| <b>Ramp-down Rate</b>  | 2°C/s max        |
| <b>Time 25°C to Peak Temperature</b>                                       | 8 mins max       |

**Note:** All temperatures refer to topside of the package measured on the package body surface.

Figure LR5



## Solder Reflow

- Recommended reflow methods:
  - IR
  - Hot air
  - Nitrogen
- Recommended maximum paste thickness: 0.25mm (0.010 inch)
- Devices can be cleaned using standard methods and aqueous solvents.
- Experience has shown the optimum conditions for forming acceptable solder fillets occur when a reasonable amount of solder paste is placed underneath each device's termination. As such, we request that customers comply with our recommended solder pad layouts.
- Customer should validate that the solder paste amount and reflow recommendations meet its application.
- We request that customer board layouts refrain from placing raised features (e.g. vias, nomenclature, traces, etc.) underneath PolySwitch devices. It is possible that raised features could negatively impact solderability performance of our devices.

## Table LR6 — Tape and Reel Specifications in Millimeters

| Description        | nanoSMDLR Series<br>EIA 481-1 | microSMDLR Series<br>EIA 481-1 |
|--------------------|-------------------------------|--------------------------------|
| W                  | 8.0 ± 0.30                    | 8.0 ± 0.30                     |
| P <sub>0</sub>     | 4.0 ± 0.10                    | 4.0 ± 0.10                     |
| P <sub>1</sub>     | 4.0 ± 0.10                    | 4.0 ± 0.10                     |
| P <sub>2</sub>     | 2.0 ± 0.05                    | 2.0 ± 0.05                     |
| A <sub>0</sub>     | 1.95 ± 0.10                   | 2.9 ± 0.10                     |
| B <sub>0</sub>     | 3.50 +0.1/-0.08               | 3.55 ± 0.10                    |
| B <sub>1 MAX</sub> | 4.35                          | 4.35                           |
| D <sub>0</sub>     | 1.55 ± 0.05                   | 1.55 ± 0.05                    |
| F                  | 3.50 ± 0.05                   | 3.50 ± 0.05                    |
| E <sub>1</sub>     | 1.75 ± 0.10                   | 1.75 ± 0.10                    |
| E <sub>2 MIN</sub> | 6.25                          | 6.25                           |
| T MAX              | 0.3                           | 0.3                            |
| T <sub>1 MAX</sub> | 0.1                           | 0.1                            |
| K <sub>0</sub>     | 0.89 ± 0.10                   | 1.27 ± 0.10                    |
| A MAX              | 185                           | 185                            |
| N MIN              | 50                            | 50                             |
| W <sub>1</sub>     | 12.4 + 2.0/-0.00              | 12.4 + 2.0/-0.00               |
| W <sub>2 MAX</sub> | 14.4                          | 14.4                           |

Figure LR6 — EIA Referenced Taped Component Dimensions

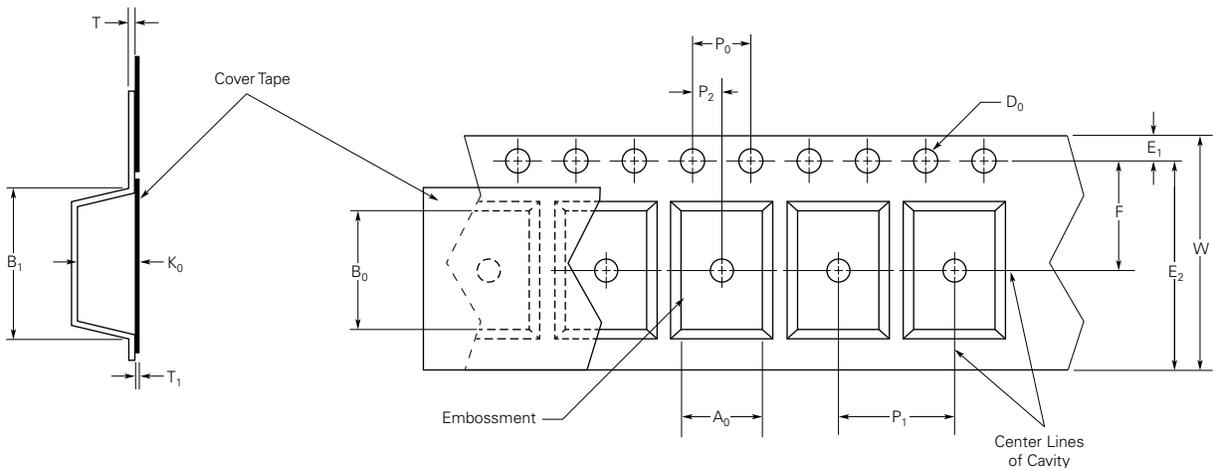
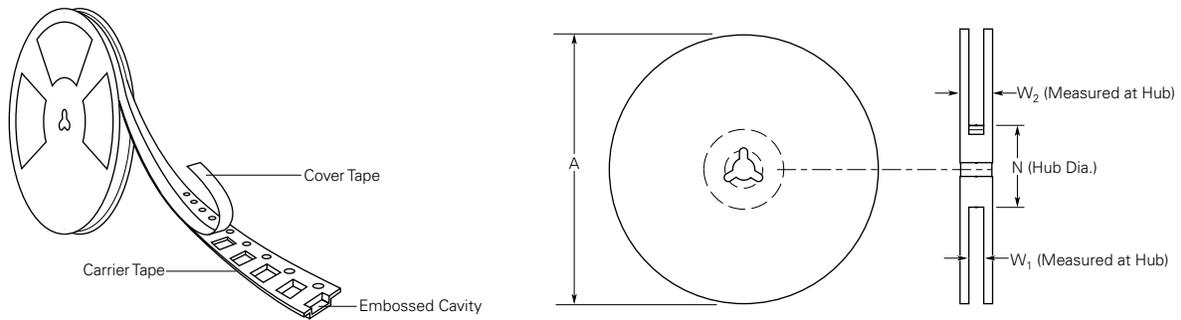
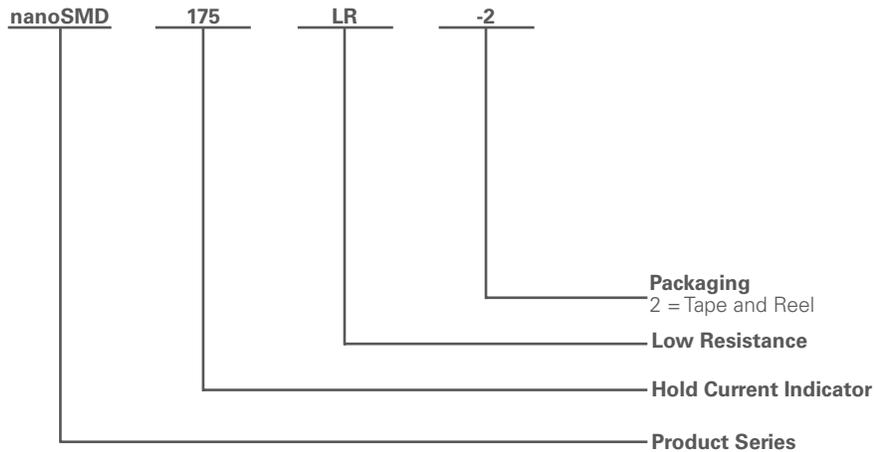


Figure LR7 — EIA Referenced Reel Dimensions



## Part Numbering System

**Warning :**

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.

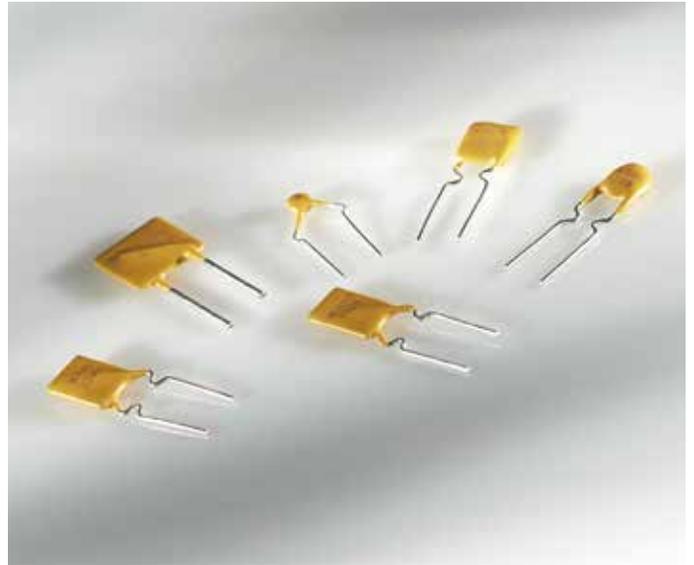


# POLYSWITCH RESETTABLE DEVICES

## Radial-Leaded Devices

TE Circuit Protection's PolySwitch radial-leaded products represent the most comprehensive and complete set of PPTC products available in the industry today.

- RGEF series for hold currents up to 14A
- RHEF series for flatter thermal derating and operating temperatures up to 125°C
- RUEF series for balance of voltage rating (30V) and hold current (up to 9A)
- RUSBF series for fast time-to-trip and low-resistance computer applications
- RXEF series for low hold currents (down to 50mA) and high voltage rating (up to 72V)
- RKEF series for balance of voltage rating (60V) and hold current (up to 5A)
- Now offering halogen free versions of all products



### BENEFITS

- Many product choices help provide engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

### FEATURES

- RoHS compliant
- Halogen free (refers to: Br≤900ppm, Cl≤900ppm, Br+Cl≤1500ppm)
- Broadest range of radial-leaded resettable devices available in the industry
- Current ratings from 50mA to 15A
- Voltage ratings from 6V (computer and electronic applications) to 72V
- Agency recognition : UL, CSA, TÜV, CQC\*\*
- Fast time-to-trip
- Low resistance

\*\*CQC only applies to RXEF, RUEF family parts

### APPLICATIONS

- Satellite video receivers
- Industrial controls
- Transformers
- Modems
- CD-ROMs
- Game machines
- Phones
- Fax machines
- Analog and digital line cards
- Printers
- Intelligent appliance
- Robotic machine
- Power supply
- Security
- Lighting
- Medical application

## Application Selection Guide

The guide below lists PolySwitch radial-leaded devices that are typically used in each of the applications described.

Specifications for the suggested device part numbers can be found in this section.

Once a part number has been selected, the user should evaluate and test each product for its intended application.

| Protection Application                      | PolySwitch Resettable Devices – Key Selection Criteria |                  |                              |
|---|--|------------------|------------------------------|
|   | Small Size   | Flatter Derating | Lower Current Higher Voltage |
| Electromagnetic Loads                       | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Halogen Lighting                            | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Lighting Ballast                            | RXEF (<72V)  |                  |                              |
| Loudspeakers                                | RXEF (<72V)  |                  | RXEF (<72V), RKEF (<60V)     |
| Medical Equipment                           | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| MOSFET Devices                              | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Motors, Fans and Blowers                    | RXEF (<72V), RGEF (<16V)                               | RHEF (<16V)      |                              |
| POS Equipment                               | RXEF (<72V), RUEF (<30V)                               |                  |                              |
| Process and Industrial Controls             | RXEF (<72V), RUEF (<30V)                               |                  |                              |
| Satellite Video Receivers                   | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Security and Fire Alarm Systems             | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Test and Measurement Equipment              | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| Transformers                                | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |
| DDC Computer and Consumer Electronics       | RUEF (<30V)  |                  |                              |
| Mouse and Keyboard                          | RUEF (<30V)  |                  |                              |
| SCSI  | RUEF (<30V)  |                  |                              |
| USB   | RUSBF (<16V)   |                  |                              |
| Traces and Printed Circuit Board Protection | RGEF (<16V), RUEF (<30V)                               | RHEF (<16V)      | RXEF (<72V), RKEF (<60V)     |

**Note** : This list is not exhaustive. TE Circuit Protection welcomes customer input for additional application ideas for PolySwitch resettable devices.

## Table R1 – Product Series - Current Rating, Voltage Rating/Typical Resistance

| Voltage Rating          | RXEF<br>72V | RKEF<br>60V | RXEF<br>60V | RUEF<br>30V | RGEF<br>16V | RHEF<br>16V | RHEF<br>30V | RUSBF<br>16V | RUSBF<br>6V |
|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|
| <b>Hold Current (A)</b> |             |             |             |             |             |             |             |              |             |
| 0.050                   | —           | —           | 9.20Ω       | —           | —           | —           | —           | —            | —           |
| 0.100                   | —           | —           | 3.50Ω       | —           | —           | —           | —           | —            | —           |
| 0.170                   | —           | —           | 4.30Ω       | —           | —           | —           | —           | —            | —           |
| 0.200                   | 2.290Ω      | —           | —           | —           | —           | —           | —           | —            | —           |
| 0.250                   | 1.600Ω      | —           | —           | —           | —           | —           | —           | —            | —           |
| 0.300                   | 1.110Ω      | —           | —           | —           | —           | —           | —           | —            | —           |
| 0.400                   | 0.710Ω      | —           | —           | —           | —           | —           | —           | —            | —           |
| 0.500                   | 0.640Ω      | 0.425Ω      | —           | —           | —           | —           | 0.68Ω       | —            | —           |
| 0.550                   | —           | —           | —           | —           | —           | —           | —           | —            | —           |
| 0.650                   | 0.400Ω      | 0.350Ω      | —           | —           | —           | —           | —           | —            | —           |
| 0.700                   | —           | —           | —           | —           | —           | —           | 0.42Ω       | —            | —           |
| 0.750                   | 0.325Ω      | 0.295Ω      | —           | —           | —           | —           | —           | —            | 0.140Ω      |
| 0.900                   | 0.255Ω      | 0.255Ω      | —           | 0.095Ω      | —           | —           | —           | 0.100Ω       | —           |
| 1.000                   | —           | —           | —           | —           | —           | —           | 0.24Ω       | —            | —           |
| 1.100                   | 0.200Ω      | 0.225Ω      | —           | 0.075Ω      | —           | —           | —           | 0.075Ω       | —           |
| 1.200                   | —           | —           | —           | —           | —           | —           | —           | —            | 0.080Ω      |
| 1.350                   | 0.155Ω      | 0.165Ω      | —           | 0.060Ω      | —           | —           | —           | 0.060Ω       | —           |
| 1.550                   | —           | —           | —           | —           | —           | —           | —           | —            | 0.058Ω      |
| 1.600                   | 0.115Ω      | 0.150Ω      | —           | 0.050Ω      | —           | —           | —           | 0.050Ω       | —           |
| 1.850                   | 0.100Ω      | 0.106Ω      | —           | 0.045Ω      | —           | —           | —           | 0.045Ω       | —           |
| 1.900                   | —           | —           | —           | —           | —           | —           | —           | —            | —           |

Table R1 — Product Series - Current Rating, Voltage Rating/Typical Resistance (Cont'd)

| Voltage Rating          | RXEF<br>72V | RKEF<br>60V | RXEF<br>60V | RUEF<br>30V | RGEF<br>16V | RHEF<br>16V | RHEF<br>30V | RUSBF<br>16V | RUSBF<br>6V |
|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|
| <b>Hold Current (A)</b> |             |             |             |             |             |             |             |              |             |
| 2.000                   | —           | —           | —           | —           | —           | 0.0610Ω     | —           | —            | —           |
| 2.500                   | 0.065Ω      | 0.063Ω      | —           | 0.030Ω      | 0.0380Ω     | —           | —           | 0.030Ω       | —           |
| 3.000                   | 0.050Ω      | 0.040Ω      | —           | 0.035Ω      | 0.0514Ω     | 0.0430Ω     | —           | —            | —           |
| 3.750                   | 0.040Ω      | 0.029Ω      | —           | —           | —           | —           | —           | —            | —           |
| 4.000                   | —           | 0.026Ω      | —           | 0.020Ω      | 0.0300Ω     | 0.0320Ω     | —           | —            | —           |
| 4.500                   | —           | —           | —           | —           | —           | 0.0290Ω     | —           | —            | —           |
| 5.000                   | —           | 0.021Ω      | —           | 0.020Ω      | 0.0192Ω     | —           | —           | —            | —           |
| 5.500                   | —           | —           | —           | —           | —           | 0.0200Ω     | —           | —            | —           |
| 6.000                   | —           | —           | —           | 0.013Ω      | 0.0145Ω     | 0.0175Ω     | —           | —            | —           |
| 6.500                   | —           | —           | —           | —           | —           | 0.0144Ω     | —           | —            | —           |
| 7.000                   | —           | —           | —           | 0.013Ω      | 0.0105Ω     | 0.0132Ω     | —           | —            | —           |
| 7.500                   | —           | —           | —           | —           | —           | 0.0120Ω     | —           | —            | —           |
| 8.000                   | —           | —           | —           | 0.013Ω      | 0.0086Ω     | 0.0110Ω     | —           | —            | —           |
| 9.000                   | —           | —           | —           | 0.008Ω      | 0.0070Ω     | 0.0100Ω     | —           | —            | —           |
| 10.00                   | —           | —           | —           | —           | 0.0056Ω     | 0.0083Ω     | —           | —            | —           |
| 11.00                   | —           | —           | —           | —           | 0.0050Ω     | 0.0073Ω     | —           | —            | —           |
| 12.00                   | —           | —           | —           | —           | 0.0046Ω     | —           | —           | —            | —           |
| 13.00                   | —           | —           | —           | —           | —           | 0.0055Ω     | —           | —            | —           |
| 14.00                   | —           | —           | —           | —           | 0.0040Ω     | 0.0050Ω     | —           | —            | —           |
| 15.00                   | —           | —           | —           | —           | —           | 0.0050Ω     | —           | —            | —           |

HF Halogen Free

Table R2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

| Part Number     | Maximum Ambient Temperature |       |      |      |       |      |       |       |       |      |       |
|-----------------|-----------------------------|-------|------|------|-------|------|-------|-------|-------|------|-------|
|                 | -40°C                       | -20°C | 0°C  | 20°C | 25°C  | 40°C | 50°C  | 60°C  | 70°C  | 85°C | 125°C |
| <b>RXEF 60V</b> |                             |       |      |      |       |      |       |       |       |      |       |
| RXEF005         | 0.078                       | 0.068 | 0.06 | 0.05 | 0.048 | 0.04 | 0.035 | 0.032 | 0.027 | 0.02 | —     |
| RXEF010         | 0.160                       | 0.140 | 0.11 | 0.10 | 0.096 | 0.08 | 0.072 | 0.067 | 0.050 | 0.04 | —     |
| RXEF017         | 0.260                       | 0.230 | 0.21 | 0.17 | 0.160 | 0.14 | 0.120 | 0.110 | 0.090 | 0.07 | —     |
| <b>RXEF 72V</b> |                             |       |      |      |       |      |       |       |       |      |       |
| RXEF020         | 0.31                        | 0.27  | 0.24 | 0.20 | 0.19  | 0.16 | 0.14  | 0.13  | 0.11  | 0.08 | —     |
| RXEF025         | 0.39                        | 0.34  | 0.30 | 0.25 | 0.24  | 0.20 | 0.18  | 0.16  | 0.14  | 0.10 | —     |
| RXEF030         | 0.47                        | 0.41  | 0.36 | 0.30 | 0.29  | 0.24 | 0.22  | 0.20  | 0.16  | 0.12 | —     |
| RXEF040         | 0.62                        | 0.54  | 0.48 | 0.40 | 0.38  | 0.32 | 0.29  | 0.25  | 0.22  | 0.16 | —     |
| RXEF050         | 0.78                        | 0.68  | 0.60 | 0.50 | 0.48  | 0.41 | 0.36  | 0.32  | 0.27  | 0.20 | —     |
| RXEF065         | 1.01                        | 0.88  | 0.77 | 0.65 | 0.62  | 0.53 | 0.47  | 0.41  | 0.35  | 0.26 | —     |
| RXEF075         | 1.16                        | 1.02  | 0.89 | 0.75 | 0.72  | 0.61 | 0.54  | 0.47  | 0.41  | 0.30 | —     |
| RXEF090         | 1.40                        | 1.22  | 1.07 | 0.90 | 0.86  | 0.73 | 0.65  | 0.57  | 0.49  | 0.36 | —     |
| RXEF110         | 1.71                        | 1.50  | 1.31 | 1.10 | 1.06  | 0.89 | 0.79  | 0.69  | 0.59  | 0.44 | —     |
| RXEF135         | 2.09                        | 1.84  | 1.61 | 1.35 | 1.30  | 1.09 | 0.97  | 0.85  | 0.73  | 0.54 | —     |
| RXEF160         | 2.48                        | 2.18  | 1.90 | 1.60 | 1.54  | 1.30 | 1.15  | 1.01  | 0.86  | 0.64 | —     |
| RXEF185         | 2.87                        | 2.52  | 2.20 | 1.85 | 1.78  | 1.50 | 1.33  | 1.17  | 1.00  | 0.74 | —     |
| RXEF250         | 3.88                        | 3.40  | 2.98 | 2.50 | 2.40  | 2.03 | 1.80  | 1.58  | 1.35  | 1.00 | —     |
| RXEF300         | 4.65                        | 4.08  | 3.57 | 3.00 | 2.88  | 2.43 | 2.16  | 1.89  | 1.62  | 1.20 | —     |
| RXEF375         | 5.81                        | 5.10  | 4.46 | 3.75 | 3.60  | 3.04 | 2.70  | 2.36  | 2.03  | 1.50 | —     |

Table R2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] (Cont'd)

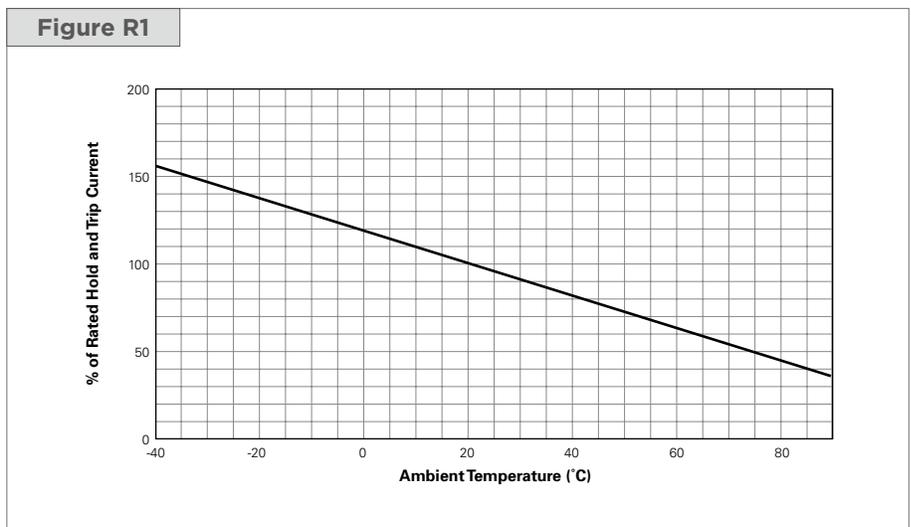
| Part Number                            | Maximum Ambient Temperature |       |       |      |      |      |      |      |      |      |       |
|--|-----------------------------|-------|-------|------|------|------|------|------|------|------|-------|
|  | -40°C                       | -20°C | 0°C   | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 85°C | 125°C |
| <b>RKEF<br/>60V</b>                    |                             |       |       |      |      |      |      |      |      |      |       |
| RKEF050                                | 0.73                        | 0.65  | 0.58  | 0.50 | 0.48 | 0.42 | 0.38 | 0.34 | 0.31 | 0.26 | —     |
| RKEF065                                | 0.94                        | 0.85  | 0.75  | 0.65 | 0.63 | 0.54 | 0.50 | 0.44 | 0.40 | 0.34 | —     |
| RKEF075                                | 1.09                        | 0.98  | 0.86  | 0.75 | 0.73 | 0.62 | 0.58 | 0.51 | 0.46 | 0.39 | —     |
| RKEF090                                | 1.30                        | 1.17  | 1.04  | 0.90 | 0.87 | 0.75 | 0.69 | 0.61 | 0.55 | 0.47 | —     |
| RKEF110                                | 1.60                        | 1.43  | 1.27  | 1.10 | 1.06 | 0.92 | 0.85 | 0.75 | 0.67 | 0.57 | —     |
| RKEF135                                | 1.96                        | 1.76  | 1.55  | 1.35 | 1.31 | 1.12 | 1.04 | 0.92 | 0.83 | 0.71 | —     |
| RKEF160                                | 2.32                        | 2.08  | 1.84  | 1.60 | 1.55 | 1.33 | 1.23 | 1.08 | 0.98 | 0.83 | —     |
| RKEF185                                | 2.68                        | 2.41  | 2.13  | 1.85 | 1.79 | 1.54 | 1.43 | 1.26 | 1.13 | 0.96 | —     |
| RKEF250                                | 3.63                        | 3.25  | 2.88  | 2.50 | 2.43 | 2.08 | 1.93 | 1.70 | 1.52 | 1.31 | —     |
| RKEF300                                | 4.35                        | 3.90  | 3.45  | 3.00 | 2.91 | 2.50 | 2.30 | 2.04 | 1.84 | 1.55 | —     |
| RKEF375                                | 5.44                        | 4.88  | 4.31  | 3.75 | 3.64 | 3.11 | 2.90 | 2.54 | 2.29 | 1.94 | —     |
| RKEF400                                | 5.80                        | 5.20  | 4.60  | 4.00 | 3.88 | 3.32 | 3.08 | 2.73 | 2.45 | 2.08 | —     |
| RKEF500                                | 7.25                        | 6.50  | 5.75  | 5.00 | 4.85 | 4.15 | 3.85 | 3.41 | 3.06 | 2.59 | —     |
| <b>RUEF<br/>30V</b>                    |                             |       |       |      |      |      |      |      |      |      |       |
| RUEF090                                | 1.31                        | 1.17  | 1.04  | 0.90 | 0.87 | 0.75 | 0.69 | 0.61 | 0.55 | 0.47 | —     |
| RUEF110                                | 1.60                        | 1.43  | 1.27  | 1.10 | 1.07 | 0.91 | 0.85 | 0.75 | 0.67 | 0.57 | —     |
| RUEF135                                | 1.96                        | 1.76  | 1.55  | 1.35 | 1.31 | 1.12 | 1.04 | 0.92 | 0.82 | 0.70 | —     |
| RUEF160                                | 2.32                        | 2.08  | 1.84  | 1.60 | 1.55 | 1.33 | 1.23 | 1.09 | 0.98 | 0.83 | —     |
| RUEF185                                | 2.68                        | 2.41  | 2.13  | 1.85 | 1.79 | 1.54 | 1.42 | 1.26 | 1.13 | 0.96 | —     |
| RUEF250                                | 3.63                        | 3.25  | 2.88  | 2.50 | 2.43 | 2.08 | 1.93 | 1.70 | 1.53 | 1.30 | —     |
| RUEF300                                | 4.35                        | 3.90  | 3.45  | 3.00 | 2.91 | 2.49 | 2.31 | 2.04 | 1.83 | 1.56 | —     |
| RUEF400                                | 5.80                        | 5.20  | 4.60  | 4.00 | 3.88 | 3.32 | 3.08 | 2.72 | 2.44 | 2.08 | —     |
| RUEF500                                | 7.25                        | 6.50  | 5.75  | 5.00 | 4.85 | 4.15 | 3.85 | 3.40 | 3.05 | 2.60 | —     |
| RUEF600                                | 8.70                        | 7.80  | 6.90  | 6.00 | 5.82 | 4.98 | 4.62 | 4.08 | 3.66 | 3.12 | —     |
| RUEF700                                | 10.15                       | 9.10  | 8.05  | 7.00 | 6.79 | 5.81 | 5.39 | 4.76 | 4.27 | 3.64 | —     |
| RUEF800                                | 11.60                       | 10.40 | 9.20  | 8.00 | 7.76 | 6.64 | 6.16 | 5.44 | 4.88 | 4.16 | —     |
| RUEF900                                | 13.05                       | 11.70 | 10.35 | 9.00 | 8.73 | 7.47 | 6.93 | 6.12 | 5.49 | 4.68 | —     |
| <b>RHEF<br/>30V - High Temperature</b> |                             |       |       |      |      |      |      |      |      |      |       |
| RHEF050                                | 0.68                        | 0.62  | 0.56  | 0.51 | 0.50 | 0.44 | 0.40 | 0.36 | 0.34 | 0.28 | 0.12  |
| RHEF070                                | 0.95                        | 0.87  | 0.79  | 0.72 | 0.70 | 0.62 | 0.56 | 0.51 | 0.47 | 0.39 | 0.17  |
| RHEF100                                | 1.36                        | 1.24  | 1.13  | 1.03 | 1.00 | 0.89 | 0.80 | 0.73 | 0.67 | 0.56 | 0.24  |
| <b>RUSBF<br/>16V</b>                   |                             |       |       |      |      |      |      |      |      |      |       |
| RUSBF090                               | 1.31                        | 1.17  | 1.04  | 0.90 | 0.87 | 0.75 | 0.69 | 0.61 | 0.55 | 0.47 | —     |
| RUSBF110                               | 1.60                        | 1.43  | 1.27  | 1.10 | 1.07 | 1.00 | 0.92 | 0.75 | 0.67 | 0.57 | —     |
| RUSBF135                               | 1.96                        | 1.76  | 1.55  | 1.35 | 1.31 | 1.12 | 1.04 | 0.92 | 0.82 | 0.70 | —     |
| RUSBF160                               | 2.32                        | 2.08  | 1.84  | 1.60 | 1.55 | 1.33 | 1.23 | 1.09 | 0.98 | 0.83 | —     |
| RUSBF185                               | 2.68                        | 2.41  | 2.13  | 1.85 | 1.79 | 1.54 | 1.42 | 1.26 | 1.13 | 0.96 | —     |
| RUSBF250                               | 3.63                        | 3.25  | 2.88  | 2.50 | 2.43 | 2.08 | 1.93 | 1.70 | 1.53 | 1.30 | —     |
| <b>RGEF<br/>16V</b>                    |                             |       |       |      |      |      |      |      |      |      |       |
| RGEF250                                | 3.7                         | 3.3   | 3.0   | 2.6  | 2.50 | 2.2  | 2.0  | 1.8  | 1.6  | 1.2  | —     |
| RGEF300                                | 4.4                         | 4.0   | 3.6   | 3.1  | 3.00 | 2.6  | 2.4  | 2.1  | 1.9  | 1.4  | —     |
| RGEF400                                | 5.9                         | 5.3   | 4.8   | 4.1  | 4.00 | 3.5  | 3.2  | 2.8  | 2.5  | 1.9  | —     |
| RGEF500                                | 7.3                         | 6.6   | 6.0   | 5.2  | 5.00 | 4.4  | 4.0  | 3.6  | 3.1  | 2.4  | —     |
| RGEF600                                | 8.8                         | 8.0   | 7.2   | 6.2  | 6.00 | 5.2  | 4.8  | 4.2  | 3.8  | 2.8  | —     |
| RGEF700                                | 10.3                        | 9.3   | 8.4   | 7.3  | 7.00 | 6.2  | 5.6  | 5.0  | 4.4  | 3.3  | —     |
| RGEF800                                | 11.7                        | 10.7  | 9.6   | 8.3  | 8.00 | 6.9  | 6.4  | 5.6  | 5.1  | 3.7  | —     |

Table R2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] (Cont'd)

| Part Number                            | Maximum Ambient Temperature |       |       |       |       |       |       |       |      |      |       |
|--|-----------------------------|-------|-------|-------|-------|-------|-------|-------|------|------|-------|
|  | -40°C                       | -20°C | 0°C   | 20°C  | 25°C  | 40°C  | 50°C  | 60°C  | 70°C | 85°C | 125°C |
| <b>RGEF<br/>16V</b>                    |                             |       |       |       |       |       |       |       |      |      |       |
| RGEF900                                | 13.2                        | 11.9  | 10.7  | 9.4   | 9.00  | 7.9   | 7.2   | 6.4   | 5.6  | 4.2  | —     |
| RGEF1000                               | 14.7                        | 13.3  | 12.0  | 10.3  | 10.00 | 8.7   | 8.0   | 7.0   | 6.3  | 4.7  | —     |
| RGEF1100                               | 16.1                        | 14.6  | 13.1  | 11.5  | 11.00 | 9.7   | 8.8   | 7.8   | 6.9  | 5.2  | —     |
| RGEF1200                               | 17.6                        | 16.0  | 14.4  | 12.4  | 12.00 | 10.4  | 9.6   | 8.4   | 7.6  | 5.6  | —     |
| RGEF1400                               | 20.5                        | 18.7  | 16.8  | 14.5  | 14.00 | 12.1  | 11.2  | 9.8   | 8.9  | 6.5  | —     |
| <b>RHEF<br/>16V - High Temperature</b> |                             |       |       |       |       |       |       |       |      |      |       |
| RHEF200                                | 2.71                        | 2.49  | 2.26  | 2.06  | 2.00  | 1.77  | 1.60  | 1.46  | 1.34 | 1.11 | 0.49  |
| RHEF300                                | 4.07                        | 3.74  | 3.41  | 3.09  | 3.00  | 2.65  | 2.40  | 2.21  | 2.00 | 1.66 | 0.74  |
| RHEF400                                | 5.57                        | 5.11  | 4.65  | 4.22  | 4.00  | 3.62  | 3.29  | 3.01  | 2.73 | 2.27 | 1.01  |
| RHEF450                                | 6.10                        | 5.60  | 5.10  | 4.60  | 4.50  | 4.00  | 3.60  | 3.30  | 3.00 | 2.50 | 1.10  |
| RHEF550                                | 7.47                        | 6.86  | 6.24  | 5.66  | 5.50  | 4.85  | 4.41  | 4.04  | 3.66 | 3.05 | 1.36  |
| RHEF600                                | 8.20                        | 7.50  | 6.80  | 6.20  | 6.00  | 5.30  | 4.90  | 4.40  | 4.00 | 3.30 | 1.50  |
| RHEF650                                | 8.80                        | 8.10  | 7.40  | 6.70  | 6.50  | 5.70  | 5.30  | 4.80  | 4.30 | 3.60 | 1.60  |
| RHEF700                                | 9.51                        | 8.73  | 7.95  | 7.20  | 7.00  | 6.17  | 5.61  | 5.15  | 4.66 | 3.88 | 1.73  |
| RHEF750                                | 10.20                       | 9.40  | 8.60  | 7.70  | 7.50  | 6.60  | 6.10  | 5.60  | 5.00 | 4.10 | 1.90  |
| RHEF800                                | 10.87                       | 9.98  | 9.08  | 8.23  | 8.00  | 7.06  | 6.41  | 5.88  | 5.33 | 4.43 | 1.97  |
| RHEF900                                | 12.21                       | 11.19 | 10.16 | 9.26  | 9.00  | 7.97  | 7.20  | 6.56  | 6.04 | 5.01 | 2.19  |
| RHEF1000                               | 13.60                       | 12.50 | 11.40 | 10.30 | 10.00 | 8.80  | 8.10  | 7.40  | 6.60 | 5.50 | 2.50  |
| RHEF1100                               | 14.94                       | 13.72 | 12.49 | 11.31 | 11.00 | 9.70  | 8.82  | 8.09  | 7.32 | 6.09 | 2.71  |
| RHEF1300                               | 17.70                       | 16.30 | 14.80 | 13.40 | 13.00 | 11.40 | 10.50 | 9.60  | 8.60 | 7.20 | 3.30  |
| RHEF1400                               | 19.01                       | 17.46 | 15.89 | 14.40 | 14.00 | 12.35 | 11.22 | 10.29 | 9.32 | 7.76 | 3.45  |
| RHEF1500                               | 20.40                       | 18.80 | 17.10 | 15.50 | 15.00 | 13.20 | 12.10 | 11.10 | 9.90 | 8.30 | 3.80  |
| <b>RUSBF<br/>6V</b>                    |                             |       |       |       |       |       |       |       |      |      |       |
| RUSBF075                               | 1.05                        | 0.95  | 0.85  | 0.75  | 0.73  | 0.65  | 0.60  | 0.55  | 0.50 | 0.43 | —     |
| RUSBF120                               | 1.69                        | 1.52  | 1.36  | 1.20  | 1.16  | 1.04  | 0.96  | 0.88  | 0.80 | 0.68 | —     |
| RUSBF155                               | 2.17                        | 1.96  | 1.75  | 1.55  | 1.50  | 1.34  | 1.24  | 1.14  | 1.03 | 0.88 | —     |

Figures R1-R5 — Thermal Derating Curve

RXEF

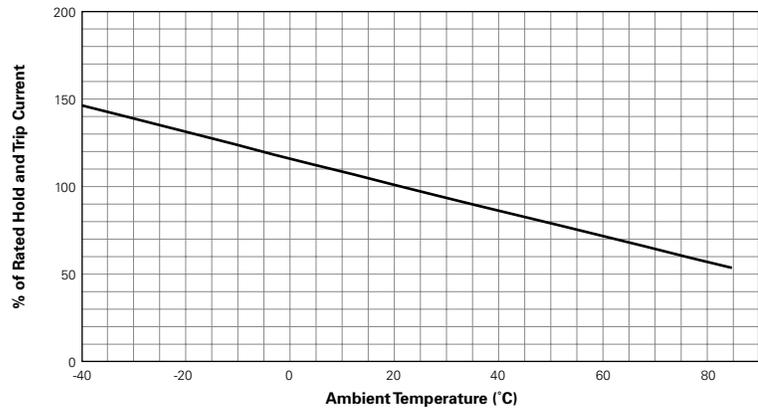


Figures R1-R5 — Thermal Derating Curve

(Cont'd)

RKEF

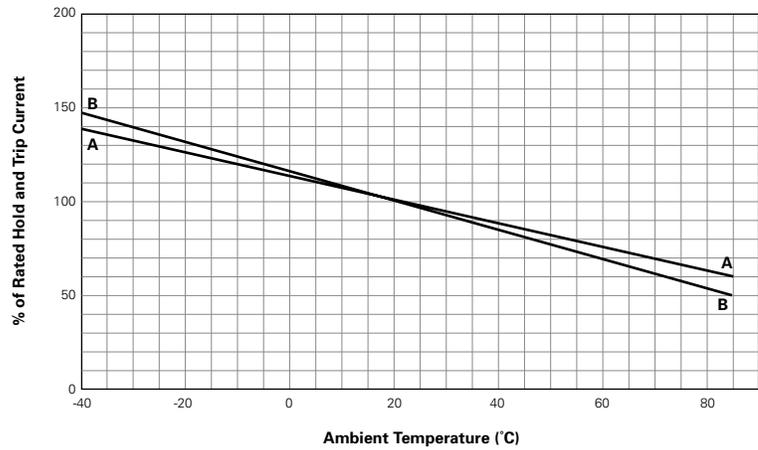
Figure R2



A = RUSBF075,  
RUSBF120,  
RUSBF155

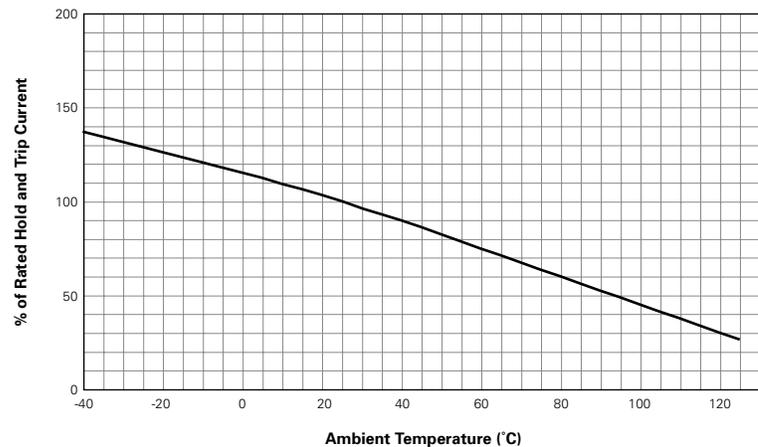
B = RUEF,  
and all other RUSBF

Figure R3



RHEF

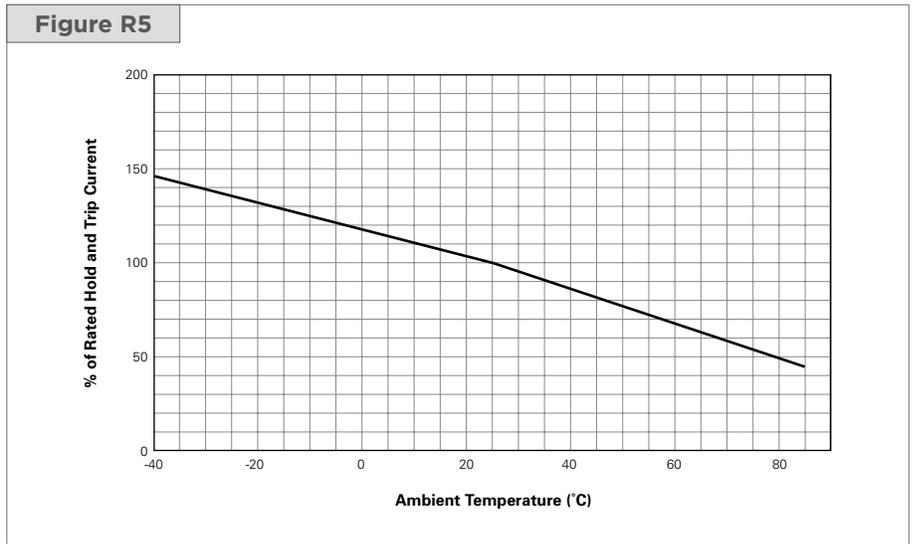
Figure R4



## Figures R1-R5 — Thermal Derating Curve

(Cont'd)

RGEF



## Table R3 — Electrical Characteristics

| Part Number         | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub>   |                        | I <sub>MAX</sub>     |                       | P <sub>D</sub> Typ<br>(W) | Max Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Lead Size<br>[mm <sup>2</sup> (AWG)] |
|---------------------|-----------------------|-----------------------|--------------------|------------------------|----------------------|-----------------------|---------------------------|------------------|------|-------------------------|-------------------------|--------------------------|--------------------------------------|
|                     |                       |                       | (V <sub>DC</sub> ) | (V <sub>AC RMS</sub> ) | (DC <sub>ADC</sub> ) | (AC <sub>ARMS</sub> ) |                           | (A)              | (s)  |                         |                         |                          |                                      |
| <b>RXEF<br/>60V</b> |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RXEF005             | 0.05                  | 0.10                  | 60                 | —                      | 40                   | —                     | 0.22                      | 0.25             | 5.0  | 7.3                     | 11.10                   | 20.00                    | [0.128mm <sup>2</sup> (26)]          |
| RXEF010             | 0.10                  | 0.20                  | 60                 | —                      | 40                   | —                     | 0.38                      | 0.50             | 4.0  | 2.5                     | 4.50                    | 7.50                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF017             | 0.17                  | 0.34                  | 60                 | —                      | 40                   | —                     | 0.48                      | 0.85             | 3.0  | 3.3                     | 5.21                    | 8.00                     | [0.205mm <sup>2</sup> (24)]          |
| <b>RXEF<br/>72V</b> |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RXEF020             | 0.20                  | 0.40                  | 72                 | 72                     | 40                   | 40                    | 0.41                      | 1.00             | 2.2  | 1.83                    | 2.75                    | 4.40                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF025             | 0.25                  | 0.50                  | 72                 | 72                     | 40                   | 40                    | 0.45                      | 1.25             | 2.5  | 1.25                    | 1.95                    | 3.00                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF030             | 0.30                  | 0.60                  | 72                 | 72                     | 40                   | 40                    | 0.49                      | 1.50             | 3.0  | 0.88                    | 1.33                    | 2.10                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF040             | 0.40                  | 0.80                  | 72                 | 72                     | 40                   | 40                    | 0.56                      | 2.00             | 3.8  | 0.55                    | 0.86                    | 1.29                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF050             | 0.50                  | 1.00                  | 72                 | 72                     | 40                   | 40                    | 0.77                      | 2.50             | 4.0  | 0.50                    | 0.77                    | 1.17                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF065             | 0.65                  | 1.30                  | 72                 | 72                     | 40                   | 40                    | 0.88                      | 3.25             | 5.3  | 0.31                    | 0.48                    | 0.72                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF075             | 0.75                  | 1.50                  | 72                 | 72                     | 40                   | 40                    | 0.92                      | 3.75             | 6.3  | 0.25                    | 0.40                    | 0.60                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF090             | 0.90                  | 1.80                  | 72                 | 72                     | 40                   | 40                    | 0.99                      | 4.50             | 7.2  | 0.20                    | 0.31                    | 0.47                     | [0.205mm <sup>2</sup> (24)]          |
| RXEF110             | 1.10                  | 2.20                  | 72                 | 72                     | 40                   | 40                    | 1.50                      | 5.50             | 8.2  | 0.15                    | 0.25                    | 0.38                     | [0.520mm <sup>2</sup> (20)]          |
| RXEF135             | 1.35                  | 2.70                  | 72                 | 72                     | 40                   | 40                    | 1.70                      | 6.75             | 9.6  | 0.12                    | 0.19                    | 0.30                     | [0.520mm <sup>2</sup> (20)]          |
| RXEF160             | 1.60                  | 3.20                  | 72                 | 72                     | 40                   | 40                    | 1.90                      | 8.00             | 11.4 | 0.09                    | 0.14                    | 0.22                     | [0.520mm <sup>2</sup> (20)]          |
| RXEF185             | 1.85                  | 3.70                  | 72                 | 72                     | 40                   | 40                    | 2.10                      | 9.25             | 12.6 | 0.08                    | 0.12                    | 0.19                     | [0.520mm <sup>2</sup> (20)]          |
| RXEF250             | 2.50                  | 5.00                  | 72                 | 72                     | 40                   | 40                    | 2.50                      | 12.50            | 15.6 | 0.05                    | 0.08                    | 0.13                     | [0.520mm <sup>2</sup> (20)]          |
| RXEF300             | 3.00                  | 6.00                  | 72                 | 72                     | 40                   | 40                    | 2.80                      | 15.00            | 19.8 | 0.04                    | 0.06                    | 0.10                     | [0.520mm <sup>2</sup> (20)]          |
| RXEF375             | 3.75                  | 7.50                  | 72                 | 72                     | 40                   | 40                    | 3.20                      | 18.75            | 24.0 | 0.03                    | 0.05                    | 0.08                     | [0.520mm <sup>2</sup> (20)]          |

Table R3 – Electrical Characteristics

(Cont'd)

| Part Number                   | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub>   |                        | I <sub>MAX</sub>     |                       | P <sub>D Typ</sub><br>(W) | Max Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Lead Size<br>[mm <sup>2</sup> (AWG)] |
|-------------------------------|-----------------------|-----------------------|--------------------|------------------------|----------------------|-----------------------|---------------------------|------------------|------|-------------------------|-------------------------|--------------------------|--------------------------------------|
|                               |                       |                       | (V <sub>DC</sub> ) | (V <sub>AC RMS</sub> ) | (DC <sub>ADC</sub> ) | (AC <sub>ARMS</sub> ) |                           | (A)              | (s)  |                         |                         |                          |                                      |
| <b>RKEF</b>                   |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| <b>60V</b>                    |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RKEF050                       | 0.50                  | 1.00                  | 60                 | —                      | 40                   | —                     | 1.00                      | 8.00             | 0.8  | 0.320                   | 0.529                   | 0.900                    | [0.205mm <sup>2</sup> (24)]          |
| RKEF065                       | 0.65                  | 1.30                  | 60                 | —                      | 40                   | —                     | 1.25                      | 8.00             | 1.0  | 0.250                   | 0.450                   | 0.720                    | [0.205mm <sup>2</sup> (24)]          |
| RKEF075                       | 0.75                  | 1.50                  | 60                 | —                      | 40                   | —                     | 1.40                      | 8.00             | 1.5  | 0.200                   | 0.390                   | 0.640                    | [0.205mm <sup>2</sup> (24)]          |
| RKEF090                       | 0.90                  | 1.80                  | 60                 | —                      | 40                   | —                     | 1.50                      | 8.00             | 2.0  | 0.190                   | 0.320                   | 0.520                    | [0.205mm <sup>2</sup> (24)]          |
| RKEF110                       | 1.10                  | 2.20                  | 60                 | —                      | 40                   | —                     | 2.20                      | 8.00             | 3.0  | 0.170                   | 0.280                   | 0.470                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF135                       | 1.35                  | 2.70                  | 60                 | —                      | 40                   | —                     | 2.30                      | 8.00             | 4.5  | 0.110                   | 0.220                   | 0.370                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF160                       | 1.60                  | 3.20                  | 60                 | —                      | 40                   | —                     | 2.40                      | 8.20             | 9.0  | 0.100                   | 0.200                   | 0.320                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF185                       | 1.85                  | 3.70                  | 60                 | —                      | 40                   | —                     | 2.60                      | 9.25             | 12.6 | 0.060                   | 0.152                   | 0.250                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF250                       | 2.50                  | 5.00                  | 60                 | —                      | 40                   | —                     | 2.80                      | 12.50            | 15.6 | 0.040                   | 0.085                   | 0.140                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF300                       | 3.00                  | 6.00                  | 60                 | —                      | 40                   | —                     | 3.20                      | 15.00            | 19.8 | 0.030                   | 0.050                   | 0.080                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF375                       | 3.75                  | 7.50                  | 60                 | —                      | 40                   | —                     | 3.40                      | 18.75            | 22.0 | 0.017                   | 0.040                   | 0.060                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF400                       | 4.00                  | 8.00                  | 60                 | —                      | 40                   | —                     | 3.70                      | 20.00            | 24.0 | 0.014                   | 0.038                   | 0.060                    | [0.520mm <sup>2</sup> (20)]          |
| RKEF500                       | 5.00                  | 10.00                 | 60                 | —                      | 40                   | —                     | 5.00                      | 25.00            | 28.0 | 0.012                   | 0.030                   | 0.050                    | [0.520mm <sup>2</sup> (20)]          |
| <b>RUEF</b>                   |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| <b>30V</b>                    |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RUEF090                       | 0.90                  | 1.80                  | 30                 | 30                     | 100                  | 70                    | 0.60                      | 4.50             | 5.9  | 0.070                   | 0.120                   | 0.22                     | [0.205mm <sup>2</sup> (24)]          |
| RUEF110                       | 1.10                  | 2.20                  | 30                 | 30                     | 100                  | 70                    | 0.70                      | 5.50             | 6.6  | 0.070                   | 0.100                   | 0.17                     | [0.205mm <sup>2</sup> (24)]          |
| RUEF135                       | 1.35                  | 2.70                  | 30                 | 30                     | 100                  | 70                    | 0.80                      | 6.75             | 7.3  | 0.040                   | 0.080                   | 0.13                     | [0.205mm <sup>2</sup> (24)]          |
| RUEF160                       | 1.60                  | 3.20                  | 30                 | 30                     | 100                  | 70                    | 0.90                      | 8.00             | 8.0  | 0.030                   | 0.070                   | 0.11                     | [0.205mm <sup>2</sup> (24)]          |
| RUEF185                       | 1.85                  | 3.70                  | 30                 | 30                     | 100                  | 70                    | 1.00                      | 9.25             | 8.7  | 0.030                   | 0.060                   | 0.09                     | [0.205mm <sup>2</sup> (24)]          |
| RUEF250                       | 2.50                  | 5.00                  | 30                 | 30                     | 100                  | 70                    | 1.20                      | 12.50            | 10.3 | 0.020                   | 0.040                   | 0.07                     | [0.205mm <sup>2</sup> (24)]          |
| RUEF300                       | 3.00                  | 6.00                  | 30                 | 30                     | 100                  | 70                    | 2.00                      | 15.00            | 10.8 | 0.020                   | 0.050                   | 0.08                     | [0.520mm <sup>2</sup> (20)]          |
| RUEF400                       | 4.00                  | 8.00                  | 30                 | 30                     | 100                  | 70                    | 2.50                      | 20.00            | 12.7 | 0.010                   | 0.030                   | 0.05                     | [0.520mm <sup>2</sup> (20)]          |
| RUEF500                       | 5.00                  | 10.00                 | 30                 | 30                     | 100                  | 70                    | 3.00                      | 25.00            | 14.5 | 0.010                   | 0.030                   | 0.05                     | [0.520mm <sup>2</sup> (20)]          |
| RUEF600                       | 6.00                  | 12.00                 | 30                 | 30                     | 100                  | 70                    | 3.50                      | 30.00            | 16.0 | 0.005                   | 0.020                   | 0.04                     | [0.520mm <sup>2</sup> (20)]          |
| RUEF700                       | 7.00                  | 14.00                 | 30                 | 30                     | 100                  | 70                    | 3.80                      | 35.00            | 17.5 | 0.005                   | 0.020                   | 0.03                     | [0.520mm <sup>2</sup> (20)]          |
| RUEF800                       | 8.00                  | 16.00                 | 30                 | 30                     | 100                  | 70                    | 4.00                      | 40.00            | 18.8 | 0.005                   | 0.013                   | 0.02                     | [0.520mm <sup>2</sup> (20)]          |
| RUEF900                       | 9.00                  | 18.00                 | 30                 | 30                     | 100                  | 70                    | 4.20                      | 45.00            | 20.0 | 0.005                   | 0.010                   | 0.02                     | [0.520mm <sup>2</sup> (20)]          |
| <b>RHEF*</b>                  |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| <b>30V - High Temperature</b> |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RHEF050                       | 0.5                   | 0.9                   | 30                 | —                      | 40                   | —                     | 0.9                       | 2.5              | 2.5  | 0.480                   | 0.780                   | 1.10                     | [0.205mm <sup>2</sup> (24)]          |
| RHEF070                       | 0.7                   | 1.4                   | 30                 | —                      | 40                   | —                     | 1.4                       | 3.5              | 3.2  | 0.300                   | 0.540                   | 0.80                     | [0.205mm <sup>2</sup> (24)]          |
| RHEF100                       | 1.0                   | 1.8                   | 30                 | —                      | 40                   | —                     | 1.4                       | 5.0              | 5.2  | 0.180                   | 0.300                   | 0.43                     | [0.205mm <sup>2</sup> (24)]          |
| <b>RUSBF</b>                  |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| <b>16V</b>                    |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RUSBF090                      | 0.90                  | 1.8                   | 16                 | —                      | 40                   | —                     | 0.6                       | 8.0              | 1.2  | 0.070                   | 0.120                   | 0.180                    | [0.205mm <sup>2</sup> (24)]          |
| RUSBF110                      | 1.10                  | 2.2                   | 16                 | —                      | 40                   | —                     | 0.7                       | 8.0              | 2.3  | 0.050                   | 0.095                   | 0.140                    | [0.205mm <sup>2</sup> (24)]          |
| RUSBF135                      | 1.35                  | 2.7                   | 16                 | —                      | 40                   | —                     | 0.8                       | 8.0              | 4.5  | 0.040                   | 0.074                   | 0.112                    | [0.205mm <sup>2</sup> (24)]          |
| RUSBF160                      | 1.60                  | 3.2                   | 16                 | —                      | 40                   | —                     | 0.9                       | 8.0              | 9.0  | 0.030                   | 0.061                   | 0.110                    | [0.205mm <sup>2</sup> (24)]          |
| RUSBF185                      | 1.85                  | 3.7                   | 16                 | —                      | 40                   | —                     | 1.0                       | 8.0              | 10.0 | 0.030                   | 0.051                   | 0.090                    | [0.205mm <sup>2</sup> (24)]          |
| RUSBF250                      | 2.50                  | 5.0                   | 16                 | —                      | 40                   | —                     | 1.2                       | 8.0              | 40.0 | 0.020                   | 0.036                   | 0.060                    | [0.205mm <sup>2</sup> (24)]          |
| <b>RGEF*</b>                  |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| <b>16V</b>                    |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RGEF250                       | 2.5                   | 4.7                   | 16                 | —                      | 100                  | —                     | 1.0                       | 12.5             | 5.0  | 0.0220                  | 0.0350                  | 0.0530                   | [0.205mm <sup>2</sup> (24)]          |
| RGEF300                       | 3.0                   | 5.1                   | 16                 | —                      | 100                  | —                     | 2.3                       | 15.0             | 1.0  | 0.0380                  | 0.0645                  | 0.0975                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF400                       | 4.0                   | 6.8                   | 16                 | —                      | 100                  | —                     | 2.4                       | 20.0             | 1.7  | 0.0210                  | 0.0390                  | 0.0600                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF500                       | 5.0                   | 8.5                   | 16                 | —                      | 100                  | —                     | 2.6                       | 25.0             | 2.0  | 0.0150                  | 0.0240                  | 0.0340                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF600                       | 6.0                   | 10.2                  | 16                 | —                      | 100                  | —                     | 2.8                       | 30.0             | 3.3  | 0.0100                  | 0.0190                  | 0.0280                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF700                       | 7.0                   | 11.9                  | 16                 | —                      | 100                  | —                     | 3.0                       | 35.0             | 3.5  | 0.0077                  | 0.0131                  | 0.0200                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF800                       | 8.0                   | 13.6                  | 16                 | —                      | 100                  | —                     | 3.0                       | 40.0             | 5.0  | 0.0056                  | 0.0110                  | 0.0175                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF900                       | 9.0                   | 15.3                  | 16                 | —                      | 100                  | —                     | 3.3                       | 45.0             | 5.5  | 0.0047                  | 0.0091                  | 0.0135                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF1000                      | 10.0                  | 17.0                  | 16                 | —                      | 100                  | —                     | 3.6                       | 50.0             | 6.0  | 0.0040                  | 0.0070                  | 0.0102                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF1100                      | 11.0                  | 18.7                  | 16                 | —                      | 100                  | —                     | 3.7                       | 55.0             | 7.0  | 0.0037                  | 0.0060                  | 0.0089                   | [0.520mm <sup>2</sup> (20)]          |
| RGEF1200                      | 12.0                  | 20.4                  | 16                 | —                      | 100                  | —                     | 4.2                       | 60.0             | 7.5  | 0.0033                  | 0.0057                  | 0.0086                   | [0.823mm <sup>2</sup> (18)]          |
| RGEF1400                      | 14.0                  | 23.8                  | 16                 | —                      | 100                  | —                     | 4.6                       | 70.0             | 9.0  | 0.0026                  | 0.0043                  | 0.0064                   | [0.823mm <sup>2</sup> (18)]          |

### Table R3 – Electrical Characteristics

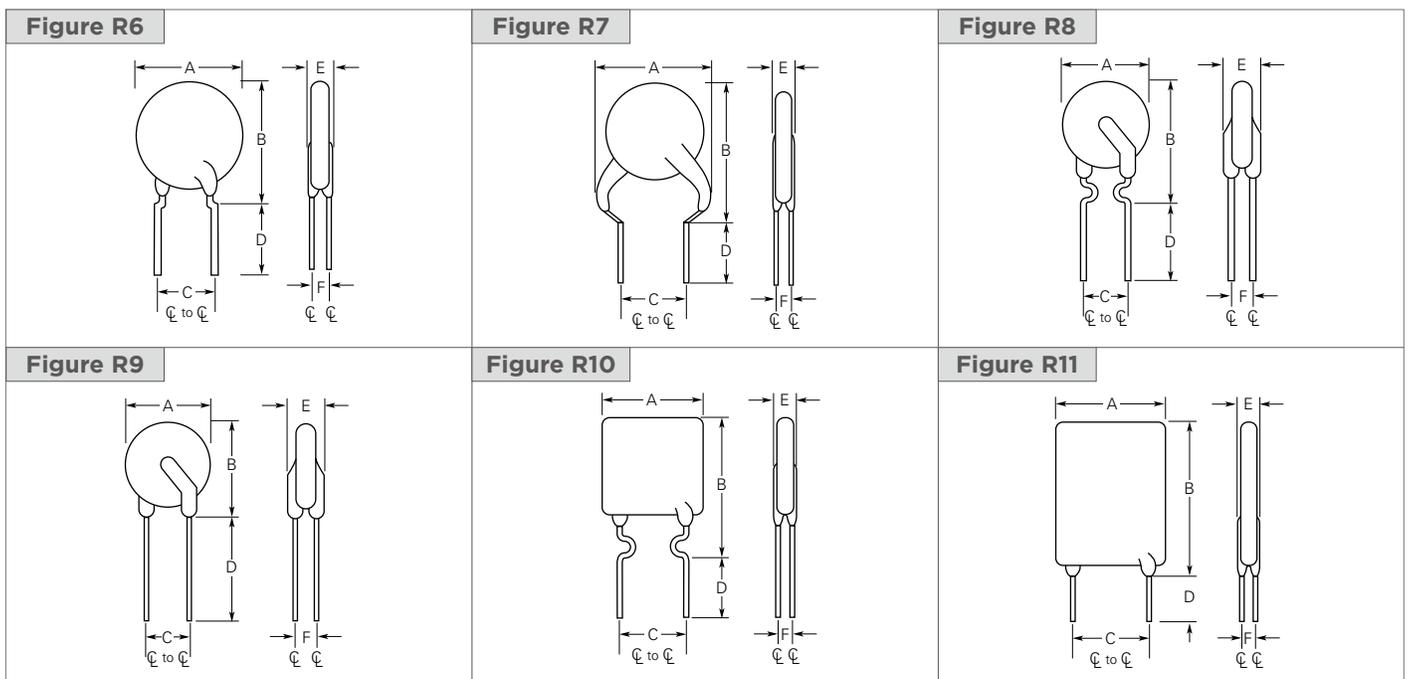
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| Part Number                   | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub>   |                        | I <sub>MAX</sub>     |                       | P <sub>D</sub> Typ<br>(W) | Max Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Lead Size<br>[mm <sup>2</sup> (AWG)] |
|-------------------------------|-----------------------|-----------------------|--------------------|------------------------|----------------------|-----------------------|---------------------------|------------------|------|-------------------------|-------------------------|--------------------------|--------------------------------------|
|                               |                       |                       | (V <sub>DC</sub> ) | (V <sub>AC RMS</sub> ) | (DC <sub>ADC</sub> ) | (AC <sub>ARMS</sub> ) |                           | (A)              | (s)  |                         |                         |                          |                                      |
| <b>RHEF*</b>                  |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| <b>16V - High Temperature</b> |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RHEF200                       | 2.0                   | 3.8                   | 16                 | —                      | 100                  | —                     | 1.4                       | 10.0             | 4.3  | 0.0450                  | 0.07400                 | 0.1100                   | [0.205mm <sup>2</sup> (24)]          |
| RHEF300                       | 3.0                   | 6.0                   | 16                 | —                      | 100                  | —                     | 3.0                       | 15.0             | 5.0  | 0.0330                  | 0.05300                 | 0.0790                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF400                       | 4.0                   | 7.5                   | 16                 | —                      | 100                  | —                     | 3.3                       | 20.0             | 5.0  | 0.0240                  | 0.04000                 | 0.0600                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF450                       | 4.5                   | 7.8                   | 16                 | —                      | 100                  | —                     | 3.6                       | 22.5             | 3.0  | 0.0220                  | 0.03600                 | 0.0540                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF550                       | 5.5                   | 10.0                  | 16                 | —                      | 100                  | —                     | 3.5                       | 27.5             | 6.0  | 0.0150                  | 0.02500                 | 0.0370                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF600                       | 6.0                   | 10.8                  | 16                 | —                      | 100                  | —                     | 4.1                       | 30.0             | 5.0  | 0.0130                  | 0.02150                 | 0.0320                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF650                       | 6.5                   | 12.0                  | 16                 | —                      | 100                  | —                     | 4.1                       | 32.5             | 5.5  | 0.0110                  | 0.01750                 | 0.0260                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF700                       | 7.0                   | 13.0                  | 16                 | —                      | 100                  | —                     | 4.0                       | 35.0             | 7.0  | 0.0100                  | 0.01640                 | 0.0250                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF750                       | 7.5                   | 13.1                  | 16                 | —                      | 100                  | —                     | 4.5                       | 37.5             | 7.0  | 0.0094                  | 0.01530                 | 0.0220                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF800                       | 8.0                   | 15.0                  | 16                 | —                      | 100                  | —                     | 4.2                       | 40.0             | 8.0  | 0.0080                  | 0.01350                 | 0.0200                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF900                       | 9.0                   | 16.5                  | 16                 | —                      | 100                  | —                     | 5.0                       | 45.0             | 10.0 | 0.0074                  | 0.01200                 | 0.0170                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF1000                      | 10.0                  | 18.5                  | 16                 | —                      | 100                  | —                     | 5.3                       | 50.0             | 9.0  | 0.0062                  | 0.01050                 | 0.0150                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF1100                      | 11.0                  | 20.0                  | 16                 | —                      | 100                  | —                     | 5.5                       | 55.0             | 11.0 | 0.0055                  | 0.00900                 | 0.0130                   | [0.520mm <sup>2</sup> (20)]          |
| RHEF1300                      | 13.0                  | 24.0                  | 16                 | —                      | 100                  | —                     | 6.9                       | 65.0             | 13.0 | 0.0041                  | 0.00690                 | 0.0100                   | [0.823mm <sup>2</sup> (18)]          |
| RHEF1400                      | 14.0                  | 27.0                  | 16                 | —                      | 100                  | —                     | 6.9                       | 70.0             | 13.0 | 0.0030                  | 0.00600                 | 0.0090                   | [0.823mm <sup>2</sup> (18)]          |
| RHEF1500                      | 15.0                  | 28.0                  | 16                 | —                      | 100                  | —                     | 7.0                       | 75.0             | 20.0 | 0.0032                  | 0.00613                 | 0.0092                   | [0.823mm <sup>2</sup> (18)]          |
| <b>RUSBF</b>                  |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| <b>6V</b>                     |                       |                       |                    |                        |                      |                       |                           |                  |      |                         |                         |                          |                                      |
| RUSBF075                      | 0.75                  | 1.30                  | 6                  | —                      | 40                   | —                     | 0.3                       | 8.0              | 0.4  | 0.110                   | 0.1750                  | 0.23                     | [0.205mm <sup>2</sup> (24)]          |
| RUSBF120                      | 1.20                  | 2.00                  | 6                  | —                      | 40                   | —                     | 0.6                       | 8.0              | 0.5  | 0.070                   | 0.0975                  | 0.14                     | [0.205mm <sup>2</sup> (24)]          |
| RUSBF155                      | 1.55                  | 2.65                  | 6                  | —                      | 40                   | —                     | 0.6                       | 7.8              | 2.2  | 0.040                   | 0.0705                  | 0.10                     | [0.205mm <sup>2</sup> (24)]          |

**Notes:**

- I<sub>H</sub> : Hold current: maximum current device will pass without interruption in 20°C still air.
  - I<sub>T</sub> : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.
  - V<sub>MAX</sub> : Maximum continuous voltage device can withstand without damage at rated current.
  - I<sub>MAX</sub> : Maximum fault current device can withstand without damage at rated voltage.
  - P<sub>D</sub> : Power dissipated from device when in the tripped state in 20°C still air.
  - R<sub>MIN</sub> : Minimum resistance of device as supplied at 20°C unless otherwise specified.
  - R<sub>MAX</sub> : Maximum resistance of device as supplied at 20°C unless otherwise specified.
  - R<sub>1MAX</sub> : Maximum resistance of device when measured one hour post reflow (surface-mount device) or one hour post trip (radial-leaded device) at 20°C unless otherwise specified.
- \* Electrical characteristics determined at 25°C.

### Figures R6-R14 – Dimension Figures



## Figures R6-R14 – Dimension Figures

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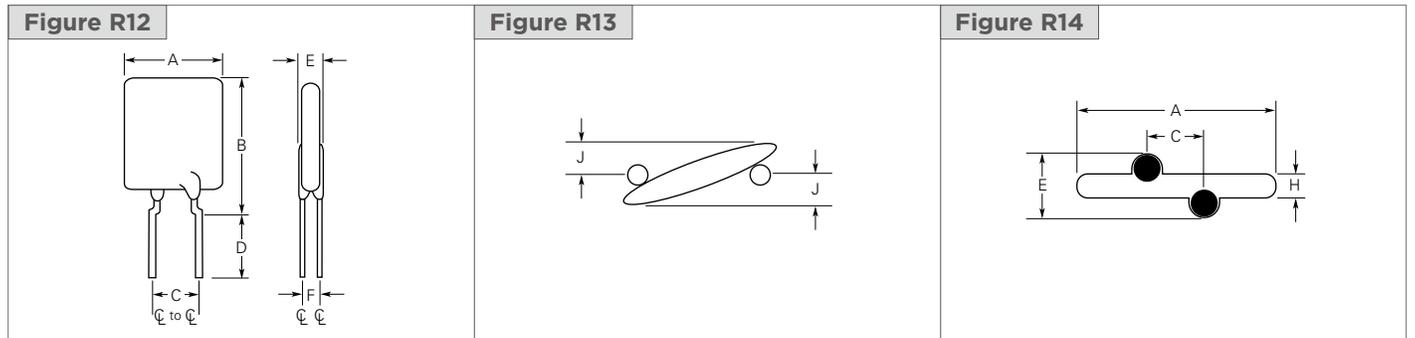


Table R4 – Dimensions and Weights

| Part Number     | Dimensions in Millimeters (Inches) |                |     |                |               |                |               |     |     |               |     |                 |               | Figure          | Device Mass (g)<br>(Only for Reference) |
|-----------------|------------------------------------|----------------|-----|----------------|---------------|----------------|---------------|-----|-----|---------------|-----|-----------------|---------------|-----------------|---|
|                 | A                                  |                | B   |                | C             |                | D             |     | E   |               | F   | H               | J             |                 |   |
|                 | Min                                | Max            | Min | Max            | Min           | Max            | Min           | Max | Min | Max           | Typ | Typ             | Typ           |                 |   |
| <b>RXEF 60V</b> |                                    |                |     |                |               |                |               |     |     |               |     |                 |               |                 |   |
| RXEF005         | —                                  | 8.0<br>(0.32)  | —   | 8.3<br>(0.33)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.07<br>(0.042) | 1.0<br>(0.04) | R7, R13,<br>R14 | 0.069                                   |
| RXEF010         | —                                  | 7.4<br>(0.29)  | —   | 11.6<br>(0.46) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.07<br>(0.042) | 1.0<br>(0.04) | R8, R13,<br>R14 | 0.128                                   |
| RXEF017         | —                                  | 7.4<br>(0.29)  | —   | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.68<br>(0.066) | 1.7<br>(0.07) | R8, R13,<br>R14 | 0.174                                   |
| <b>RXEF 72V</b> |                                    |                |     |                |               |                |               |     |     |               |     |                 |               |                 |   |
| RXEF020         | —                                  | 7.4<br>(0.29)  | —   | 11.7<br>(0.46) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.0<br>(0.04) | R8, R13,<br>R14 | 0.119                                   |
| RXEF025         | —                                  | 7.4<br>(0.29)  | —   | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.0<br>(0.04) | R8, R13,<br>R14 | 0.130                                   |
| RXEF030         | —                                  | 7.4<br>(0.29)  | —   | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.0<br>(0.04) | R8, R13,<br>R14 | 0.143                                   |
| RXEF040         | —                                  | 7.6<br>(0.30)  | —   | 13.5<br>(0.53) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.2<br>(0.05) | R8, R13,<br>R14 | 0.202                                   |
| RXEF050         | —                                  | 7.9<br>(0.31)  | —   | 13.7<br>(0.54) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.2<br>(0.05) | R8, R13,<br>R14 | 0.210                                   |
| RXEF065         | —                                  | 9.4<br>(0.37)  | —   | 14.5<br>(0.57) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.5<br>(0.06) | R8, R13,<br>R14 | 0.277                                   |
| RXEF075         | —                                  | 10.2<br>(0.40) | —   | 15.2<br>(0.60) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.5<br>(0.06) | R8, R13,<br>R14 | 0.310                                   |
| RXEF090         | —                                  | 11.2<br>(0.44) | —   | 15.8<br>(0.62) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.17<br>(0.046) | 1.5<br>(0.06) | R8, R13,<br>R14 | 0.365                                   |
| RXEF110         | —                                  | 12.8<br>(0.50) | —   | 17.5<br>(0.69) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.37<br>(0.054) | 1.2<br>(0.05) | R9, R13,<br>R14 | 0.546                                   |
| RXEF135         | —                                  | 14.5<br>(0.57) | —   | 19.1<br>(0.75) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.37<br>(0.054) | 1.2<br>(0.05) | R9, R13,<br>R14 | 0.653                                   |
| RXEF160         | —                                  | 16.3<br>(0.64) | —   | 20.8<br>(0.82) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.37<br>(0.054) | 1.5<br>(0.06) | R9, R13,<br>R14 | 0.684                                   |
| RXEF185         | —                                  | 17.5<br>(0.69) | —   | 22.4<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.37<br>(0.054) | 1.5<br>(0.06) | R9, R13,<br>R14 | 0.808                                   |
| RXEF250         | —                                  | 20.8<br>(0.82) | —   | 25.4<br>(1.00) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.37<br>(0.054) | 1.7<br>(0.07) | R9, R13,<br>R14 | 1.139                                   |
| RXEF300         | —                                  | 23.9<br>(0.94) | —   | 28.6<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.37<br>(0.054) | 1.7<br>(0.07) | R9, R13,<br>R14 | 1.379                                   |
| RXEF375         | —                                  | 27.2<br>(1.07) | —   | 31.8<br>(1.25) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | —   | 1.37<br>(0.054) | 1.7<br>(0.07) | R9, R13,<br>R14 | 1.708                                   |

Table R4 – Dimensions and Weights

(Cont'd)

| Part Number         | Dimensions in Millimeters (Inches) |                 |     |                 |                |                 |                |     |     |                |     |                 | Figure        | Device Mass (g)<br>(Only for Reference) |       |
|---------------------|------------------------------------|-----------------|-----|-----------------|----------------|-----------------|----------------|-----|-----|----------------|-----|-----------------|---------------|---|-------|
|                     | A                                  |                 | B   |                 | C              |                 | D              |     | E   |                | F   | H               |               |   | J     |
|                     | Min                                | Max             | Min | Max             | Min            | Max             | Min            | Max | Min | Max            | Typ | Typ             |               |   | Typ   |
| <b>RKEF<br/>60V</b> |                                    |                 |     |                 |                |                 |                |     |     |                |     |                 |               |   |       |
| RKEF050             | —                                  | 7.10<br>(0.28)  | —   | 11.43<br>(0.45) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.56<br>(0.14) | —   | —               | —             | R10, R13,<br>R14                        | 0.166 |
| RKEF065             | —                                  | 7.11<br>(0.28)  | —   | 12.20<br>(0.48) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.56<br>(0.14) | —   | —               | —             | R10, R13,<br>R14                        | 0.182 |
| RKEF075             | —                                  | 7.87<br>(0.31)  | —   | 12.20<br>(0.48) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.56<br>(0.14) | —   | —               | —             | R10, R13,<br>R14                        | 0.201 |
| RKEF090             | —                                  | 7.87<br>(0.31)  | —   | 13.97<br>(0.55) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.56<br>(0.14) | —   | —               | —             | R10, R13,<br>R14                        | 0.235 |
| RKEF110             | —                                  | 7.60<br>(0.30)  | —   | 15.00<br>(0.59) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 4.10<br>(0.16) | —   | —               | —             | R10, R13,<br>R14                        | 0.353 |
| RKEF135             | —                                  | 10.20<br>(0.40) | —   | 17.00<br>(0.67) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.81<br>(0.15) | —   | —               | —             | R11, R13,<br>R14                        | 0.438 |
| RKEF160             | —                                  | 12.20<br>(0.48) | —   | 18.30<br>(0.72) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.81<br>(0.15) | —   | —               | —             | R11, R13,<br>R14                        | 0.546 |
| RKEF185             | —                                  | 13.00<br>(0.51) | —   | 18.80<br>(0.74) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.81<br>(0.15) | —   | —               | —             | R11, R13,<br>R14                        | 0.538 |
| RKEF250             | —                                  | 14.00<br>(0.55) | —   | 20.60<br>(0.81) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.00<br>(0.12) | —   | —               | —             | R11, R13,<br>R14                        | 0.775 |
| RKEF300             | —                                  | 16.50<br>(0.65) | —   | 21.20<br>(0.83) | 4.32<br>(0.17) | 5.84<br>(0.23)  | 7.60<br>(0.30) | —   | —   | 3.00<br>(0.12) | —   | —               | —             | R11, R13,<br>R14                        | 0.971 |
| RKEF375             | —                                  | 16.50<br>(0.65) | —   | 25.20<br>(0.99) | 9.40<br>(0.37) | 10.90<br>(0.43) | 7.60<br>(0.30) | —   | —   | 3.00<br>(0.12) | —   | —               | —             | R11, R13,<br>R14                        | 1.142 |
| RKEF400             | —                                  | 21.00<br>(0.83) | —   | 24.90<br>(0.98) | 9.40<br>(0.37) | 10.90<br>(0.43) | 7.60<br>(0.30) | —   | —   | 3.00<br>(0.12) | —   | —               | —             | R11, R13,<br>R14                        | 1.391 |
| RKEF500             | —                                  | 24.10<br>(0.95) | —   | 29.00<br>(1.14) | 9.40<br>(0.37) | 10.90<br>(0.43) | 7.60<br>(0.30) | —   | —   | 3.00<br>(0.12) | —   | —               | —             | R11, R13,<br>R14                        | 1.783 |
| <b>RUEF<br/>30V</b> |                                    |                 |     |                 |                |                 |                |     |     |                |     |                 |               |   |       |
| RUEF090             | —                                  | 7.4<br>(0.29)   | —   | 12.2<br>(0.48)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 0.89<br>(0.035) | 0.8<br>(0.03) | R10, R13,<br>R14                        | 0.183 |
| RUEF110             | —                                  | 7.4<br>(0.29)   | —   | 14.2<br>(0.56)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 0.89<br>(0.035) | 0.8<br>(0.03) | R10, R13,<br>R14                        | 0.204 |
| RUEF135             | —                                  | 8.9<br>(0.35)   | —   | 13.5<br>(0.53)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14                        | 0.255 |
| RUEF160             | —                                  | 8.9<br>(0.35)   | —   | 15.2<br>(0.60)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14                        | 0.289 |
| RUEF185             | —                                  | 10.2<br>(0.40)  | —   | 15.7<br>(0.62)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14                        | 0.379 |
| RUEF250             | —                                  | 11.4<br>(0.45)  | —   | 18.3<br>(0.72)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 0.89<br>(0.035) | 1.2<br>(0.05) | R10, R13,<br>R14                        | 0.493 |
| RUEF300             | —                                  | 11.4<br>(0.45)  | —   | 16.5<br>(0.65)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 1.19<br>(0.047) | 1.5<br>(0.06) | R11, R13,<br>R14                        | 0.516 |
| RUEF400             | —                                  | 14.0<br>(0.55)  | —   | 19.3<br>(0.76)  | 4.3<br>(0.17)  | 5.8<br>(0.23)   | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 1.19<br>(0.047) | 1.7<br>(0.07) | R11, R13,<br>R14                        | 0.670 |
| RUEF500             | —                                  | 14.0<br>(0.55)  | —   | 24.1<br>(0.95)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 1.19<br>(0.047) | 1.0<br>(0.04) | R11, R13,<br>R14                        | 0.926 |
| RUEF600             | —                                  | 16.5<br>(0.65)  | —   | 24.1<br>(0.95)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 1.19<br>(0.047) | 1.0<br>(0.04) | R11, R13,<br>R14                        | 1.352 |
| RUEF700             | —                                  | 19.1<br>(0.75)  | —   | 25.9<br>(1.02)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 1.19<br>(0.047) | 1.2<br>(0.05) | R11, R13,<br>R14                        | 1.543 |
| RUEF800             | —                                  | 21.6<br>(0.85)  | —   | 28.4<br>(1.12)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 1.19<br>(0.047) | 1.5<br>(0.06) | R11, R13,<br>R14                        | 1.852 |
| RUEF900             | —                                  | 24.1<br>(0.95)  | —   | 29.0<br>(1.14)  | 9.4<br>(0.37)  | 10.9<br>(0.43)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12)  | —   | 1.19<br>(0.047) | 1.5<br>(0.06) | R11, R13,<br>R14                        | 2.104 |

Table R4 — Dimensions and Weights

(Cont'd)

| Part Number                   | Dimensions in Millimeters (Inches) |                 |                |                |               |                |                |                |               |               |               |                 |               | Figure           | Device Mass (g)<br>(Only for Reference) |
|-------------------------------|------------------------------------|-----------------|----------------|----------------|---------------|----------------|----------------|----------------|---------------|---------------|---------------|-----------------|---------------|------------------|---|
|                               | A                                  |                 | B              |                | C             |                | D              |                | E             |               | F             | H               | J             |                  |   |
|                               | Min                                | Max             | Min            | Max            | Min           | Max            | Min            | Max            | Min           | Max           | Typ           | Typ             | Typ           |                  |   |
| <b>RHEF</b>                   |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| <b>30V - High Temperature</b> |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| RHEF050                       | —                                  | 7.4<br>(0.29)   | —              | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —             | R8, R13,<br>R14  | 0.177                                   |
| RHEF070                       | —                                  | 6.9<br>(0.27)   | —              | 10.8<br>(0.43) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.2<br>(0.05) | R10, R13,<br>R14 | 0.259                                   |
| RHEF100                       | —                                  | 9.7<br>(0.38)   | —              | 13.6<br>(0.54) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | —               | —             | R8, R13,<br>R14  | 0.312                                   |
| <b>RUSBF</b>                  |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| <b>16V</b>                    |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| RUSBF090                      | —                                  | 7.4<br>(0.29)   | —              | 12.2<br>(0.48) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.1<br>(0.12) | —             | 0.89<br>(0.035) | 0.8<br>(0.03) | R10, R13,<br>R14 | 0.183                                   |
| RUSBF110                      | —                                  | 7.4<br>(0.29)   | —              | 14.2<br>(0.56) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 0.8<br>(0.03) | R10, R13,<br>R14 | 0.204                                   |
| RUSBF135                      | —                                  | 8.9<br>(0.35)   | —              | 13.5<br>(0.53) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14 | 0.240                                   |
| RUSBF160                      | —                                  | 8.9<br>(0.35)   | —              | 15.2<br>(0.60) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14 | 0.300                                   |
| RUSBF185                      | —                                  | 10.2<br>(0.40)  | —              | 15.7<br>(0.62) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.0<br>(0.04) | R10, R13,<br>R14 | 0.368                                   |
| RUSBF250                      | —                                  | 11.4<br>(0.45)  | —              | 18.3<br>(0.72) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | —             | 0.89<br>(0.035) | 1.2<br>(0.05) | R10, R13,<br>R14 | 0.467                                   |
| <b>RGEF</b>                   |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| <b>16V</b>                    |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| RGEF250                       | —                                  | 8.9<br>(0.35)   | —              | 12.8<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 3.18<br>(0.13) | 6.18<br>(0.24) | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.2<br>(0.05) | R10, R13,<br>R14 | 0.277                                   |
| RGEF300                       | 6.1<br>(0.24)                      | 7.1<br>(0.28)   | 6.1<br>(0.24)  | 11.0<br>(0.43) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.2<br>(0.05) | R11, R13,<br>R14 | 0.323                                   |
| RGEF400                       | 7.9<br>(0.31)                      | 8.9<br>(0.35)   | 7.9<br>(0.31)  | 12.8<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.4<br>(0.06) | R11, R13,<br>R14 | 0.417                                   |
| RGEF500                       | 9.4<br>(0.37)                      | 10.4<br>(0.41)  | 9.4<br>(0.37)  | 14.3<br>(0.56) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06) | R11, R13,<br>R14 | 0.540                                   |
| RGEF600                       | 9.7<br>(0.38)                      | 10.7<br>(0.42)  | 12.2<br>(0.48) | 17.1<br>(0.67) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06) | R11, R13,<br>R14 | 0.604                                   |
| RGEF700                       | 10.2<br>(0.40)                     | 11.2<br>(0.44)  | 14.7<br>(0.58) | 19.7<br>(0.78) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.7<br>(0.07) | R11, R13,<br>R14 | 0.701                                   |
| RGEF800                       | 11.7<br>(0.46)                     | 12.7<br>(0.50)  | 16.0<br>(0.63) | 20.9<br>(0.82) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.8<br>(0.07) | R11, R13,<br>R14 | 0.829                                   |
| RGEF900                       | 13.0<br>(0.51)                     | 14.0<br>(0.55)  | 16.8<br>(0.66) | 21.7<br>(0.85) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.0<br>(0.08) | R11, R13,<br>R14 | 0.887                                   |
| RGEF1000                      | —                                  | 16.5<br>(0.65)  | 21.1<br>(0.83) | 25.2<br>(0.99) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.0<br>(0.08) | R11, R13,<br>R14 | 1.219                                   |
| RGEF1100                      | 16.5<br>(0.65)                     | 17.5<br>(0.69)  | 21.1<br>(0.83) | 26.0<br>(1.02) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | 2.0<br>(0.08) | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.4<br>(0.09) | R11, R13,<br>R14 | 1.408                                   |
| RGEF1200                      | 16.4<br>(0.65)                     | 17.5<br>(0.69)  | 22.6<br>(0.89) | 28.0<br>(1.10) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30)  | —              | 2.3<br>(0.09) | 3.5<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.5<br>(0.06) | R11, R13,<br>R14 | 1.650                                   |
| RGEF1400                      | —                                  | 23.5<br>(0.925) | 22.6<br>(0.89) | 27.9<br>(1.10) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30)  | —              | 2.3<br>(0.09) | 3.5<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.9<br>(0.08) | R11, R13,<br>R14 | 2.146                                   |
| <b>RHEF</b>                   |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| <b>16V - High Temperature</b> |                                    |                 |                |                |               |                |                |                |               |               |               |                 |               |                  |   |
| RHEF200                       | —                                  | 9.4<br>(0.37)   | —              | 14.4<br>(0.57) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.1<br>(0.12) | —             | —               | —             | R8, R13,<br>R14  | 0.278                                   |
| RHEF300                       | —                                  | 8.8<br>(0.35)   | —              | 13.8<br>(0.55) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —             | R12, R13,<br>R14 | 0.433                                   |
| RHEF400                       | —                                  | 10.0<br>(0.39)  | —              | 15.0<br>(0.59) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —              | —             | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06) | R12, R13,<br>R14 | 0.509                                   |

Table R4 – Dimensions and Weights

(Cont'd)

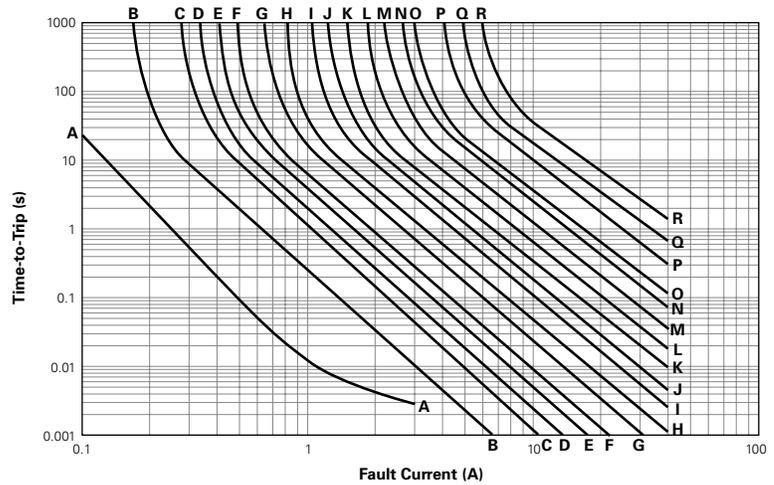
| Part Number                   | Dimensions in Millimeters (Inches) |                 |     |                |               |                |               |     |     |               |               |                 |                | Figure           | Device Mass (g)<br>(Only for Reference) |
|-------------------------------|------------------------------------|-----------------|-----|----------------|---------------|----------------|---------------|-----|-----|---------------|---------------|-----------------|----------------|------------------|---|
|                               | A                                  |                 | B   |                | C             |                | D             |     | E   |               | F             | H               | J              |                  |   |
|                               | Min                                | Max             | Min | Max            | Min           | Max            | Min           | Max | Min | Max           | Typ           | Typ             | Typ            |                  |   |
| <b>RHEF</b>                   |                                    |                 |     |                |               |                |               |     |     |               |               |                 |                |                  |   |
| <b>16V - High Temperature</b> |                                    |                 |     |                |               |                |               |     |     |               |               |                 |                |                  |   |
| RHEF450                       | —                                  | 10.4<br>(0.41)  | —   | 15.6<br>(0.61) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.6<br>(0.06)  | R12, R13,<br>R14 | 0.605                                   |
| RHEF550                       | —                                  | 11.2<br>(0.44)  | —   | 18.9<br>(0.74) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 0.704                                   |
| RHEF600                       | —                                  | 11.2<br>(0.44)  | —   | 21.0<br>(0.83) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.7<br>(0.067) | R12, R13,<br>R14 | 0.792                                   |
| RHEF650                       | —                                  | 12.7<br>(0.50)  | —   | 22.2<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.8<br>(0.07)  | R12, R13,<br>R14 | 0.952                                   |
| RHEF700                       | —                                  | 14.0<br>(0.55)  | —   | 21.9<br>(0.86) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 0.850                                   |
| RHEF750                       | —                                  | 14.0<br>(0.55)  | —   | 23.5<br>(0.93) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 2.0<br>(0.08)  | R12, R13,<br>R14 | 1.054                                   |
| RHEF800                       | —                                  | 16.5<br>(0.65)  | —   | 22.5<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 1.073                                   |
| RHEF900                       | —                                  | 16.5<br>(0.65)  | —   | 25.7<br>(1.01) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 1.516                                   |
| RHEF1000                      | —                                  | 17.5<br>(0.69)  | —   | 26.5<br>(1.04) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | 1.24<br>(0.049) | 1.5<br>(0.06)  | R12, R13,<br>R14 | 1.791                                   |
| RHEF1100                      | —                                  | 21.0<br>(0.83)  | —   | 26.1<br>(1.03) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —               | —              | R12, R13,<br>R14 | 1.570                                   |
| RHEF1300                      | —                                  | 23.5<br>(0.925) | —   | 28.7<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.6<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.9<br>(0.084) | R12, R13,<br>R14 | 2.257                                   |
| RHEF1400                      | —                                  | 23.5<br>(0.925) | —   | 28.6<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.6<br>(0.14) | 1.4<br>(0.06) | —               | —              | R12, R13,<br>R14 | 2.051                                   |
| RHEF1500                      | —                                  | 23.5<br>(0.925) | —   | 28.7<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.30) | —   | —   | 3.6<br>(0.14) | 1.4<br>(0.06) | 1.45<br>(0.057) | 1.9<br>(0.084) | R12, R13,<br>R14 | 2.257                                   |
| <b>RUSBF</b>                  |                                    |                 |     |                |               |                |               |     |     |               |               |                 |                |                  |   |
| <b>6V</b>                     |                                    |                 |     |                |               |                |               |     |     |               |               |                 |                |                  |   |
| RUSBF075                      | —                                  | 6.9<br>(0.27)   | —   | 11.4<br>(0.45) | 4.3<br>(0.17) | 5.9<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.1<br>(0.12) | —             | 0.91<br>(0.036) | 1.0<br>(0.04)  | R8, R13,<br>R14  | 0.123                                   |
| RUSBF120                      | —                                  | 6.9<br>(0.27)   | —   | 11.7<br>(0.46) | 4.3<br>(0.17) | 5.9<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.1<br>(0.12) | —             | 0.91<br>(0.036) | 1.0<br>(0.04)  | R8, R13,<br>R14  | 0.111                                   |
| RUSBF155                      | —                                  | 6.9<br>(0.27)   | —   | 11.7<br>(0.46) | 4.3<br>(0.17) | 5.9<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.1<br>(0.12) | —             | 0.91<br>(0.036) | 1.0<br>(0.04)  | R8, R13,<br>R14  | 0.135                                   |

### Figures R15-R20 — Typical Time-to-Trip Curves at 20°C

#### RXEF

|             |             |
|-------------|-------------|
| A = RXEF005 | J = RXEF075 |
| B = RXEF010 | K = RXEF090 |
| C = RXEF017 | L = RXEF110 |
| D = RXEF020 | M = RXEF135 |
| E = RXEF025 | N = RXEF160 |
| F = RXEF030 | O = RXEF185 |
| G = RXEF040 | P = RXEF250 |
| H = RXEF050 | Q = RXEF300 |
| I = RXEF065 | R = RXEF375 |

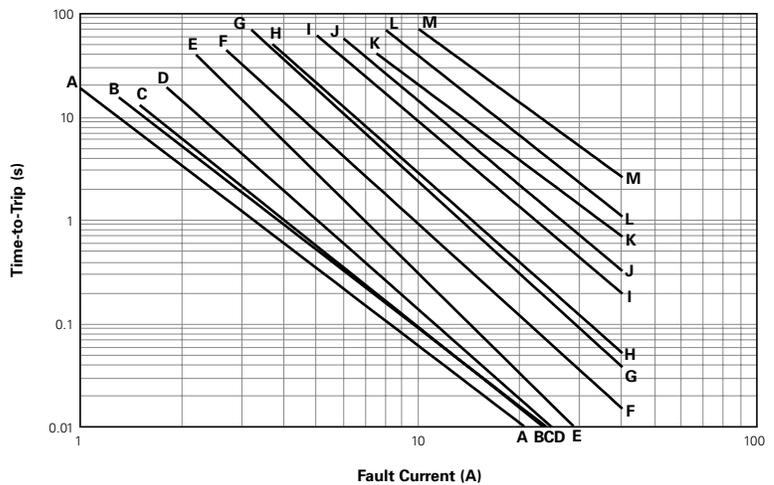
**Figure R15**



#### RKEF

|             |             |
|-------------|-------------|
| A = RKEF050 | J = RKEF300 |
| B = RKEF065 | K = RKEF375 |
| C = RKEF075 | L = RKEF400 |
| D = RKEF090 | M = RKEF500 |
| E = RKEF110 |             |
| F = RKEF135 |             |
| G = RKEF160 |             |
| H = RKEF185 |             |
| I = RKEF250 |             |

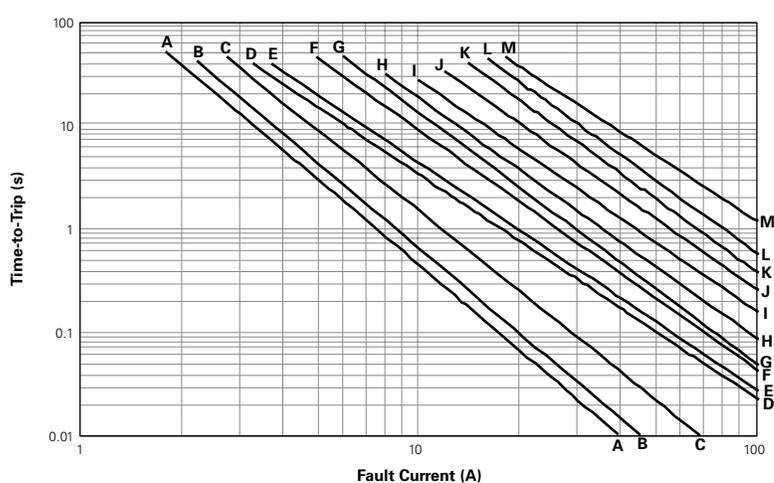
**Figure R16**



#### RUEF

|             |             |
|-------------|-------------|
| A = RUEF090 | H = RUEF400 |
| B = RUEF110 | I = RUEF500 |
| C = RUEF135 | J = RUEF600 |
| D = RUEF160 | K = RUEF700 |
| E = RUEF185 | L = RUEF800 |
| F = RUEF250 | M = RUEF900 |
| G = RUEF300 |             |

**Figure R17**

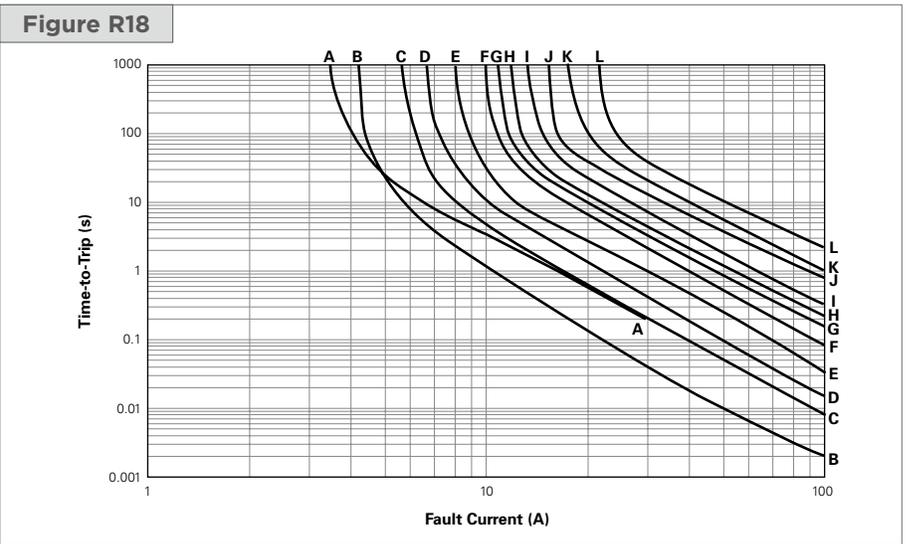


Figures R15-R20 — Typical Time-to-Trip Curves at 20°C

(Cont'd)

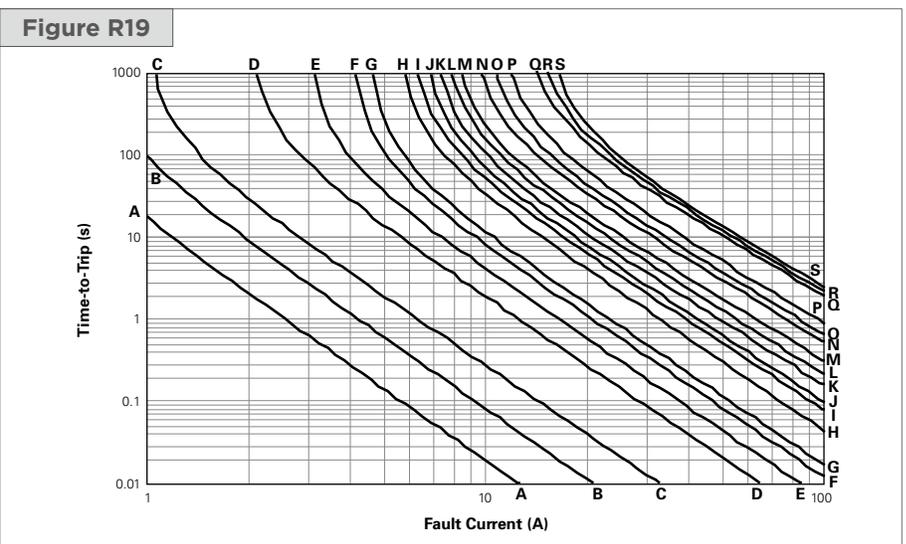
RGEF (data at 25°C)

- A = RGEF250
- B = RGEF300
- C = RGEF400
- D = RGEF500
- E = RGEF600
- F = RGEF700
- G = RGEF800
- H = RGEF900
- I = RGEF1000
- J = RGEF1100
- K = RGEF1200
- L = RGEF1400



RHEF (data at 25°C)

- A = RHEF050
- B = RHEF070
- C = RHEF100
- D = RHEF200
- E = RHEF300
- F = RHEF400
- G = RHEF450
- H = RHEF550
- I = RHEF600
- J = RHEF650
- K = RHEF700
- L = RHEF750
- M = RHEF800
- N = RHEF900
- O = RHEF1000
- P = RHEF1100
- Q = RHEF1300
- R = RHEF1400
- S = RHEF1500



RUSBF

- A = RUSBF075
- B = RUSBF090
- C = RUSBF110
- D = RUSBF120
- E = RUSBF135
- F = RUSBF155
- G = RUSBF160
- H = RUSBF185
- I = RUSBF250

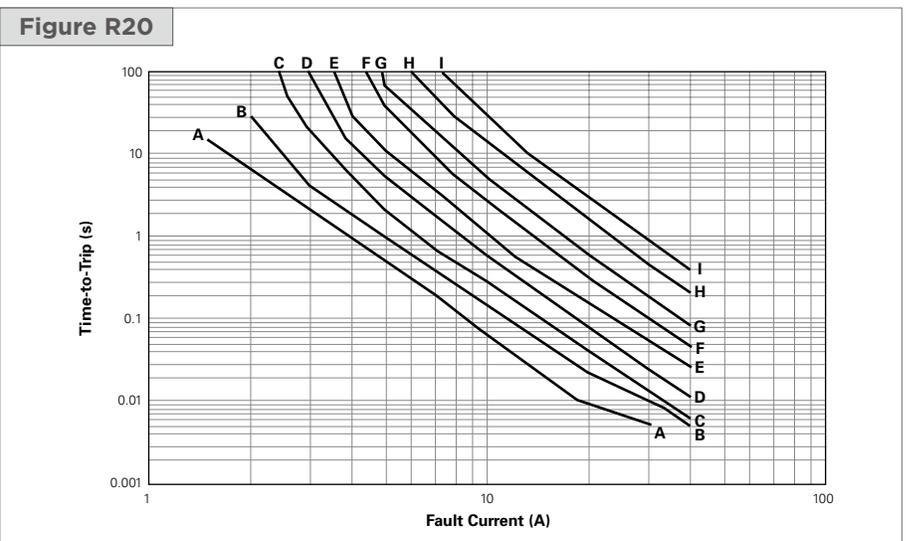


Table R5 — Physical Characteristics and Environmental Specifications

| RXEF   |   |   |
|--|---|---|
| Physical Characteristics   |   |   |
| Lead Material  | RXEF005   | : Tin-plated Nickel-copper Alloy, 0.128mm <sup>2</sup> (26AWG), ø0.40mm (0.016in) |
|  | RXEF010   | : Tin-plated Nickel-copper Alloy, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in) |
|  | RXEF017 to 040  | : Tin-plated Copper-clad Steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in)   |
|  | RXEF050 to 090  | : Tin-plated Copper, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in)              |
|  | RXEF110 to 375  | : Tin-plated Copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm (0.032in)               |
| Soldering Characteristics  | Solderability per ANSI/J-STD-002 Category 3   |   |
|  | RXEF005, RXEF010 Meet ANSI/J-STD-002 Category 1   |   |
| Solder Heat Withstand  | RXEF005- RXEF025: per IEC-STD 68-2-20, Test Tb, Method 1a, Condition a;<br>Can Withstand 5s at 260°C ±5°C       |   |
|  | All Other Sizes : per IEC-STD 68-2-20, Test Tb, Method 1a, Condition b;<br>Can Withstand 10s at 260°C ±5°C      |   |
| Insulating Material  | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0  |   |
| Operation Temperature  | -40°C~85°C  |   |
| <b>Note:</b> Devices are not designed to be placed through a reflow process. |   |   |
| Environmental Specifications   |   |   |
| Test   | Conditions  | Resistance Change   |
| Passive Aging  | -40°C, 1000 hrs   | ±5%   |
|  | 85°C, 1000 hrs  | ±5%   |
| Humidity Aging   | 85°C, 85%RH, 1000 hrs   | ±10%  |
| Thermal Shock  | 85°C, -40°C (10 Times)  | ±10%  |
| Solvent Resistance   | MIL-STD-202, Method 215F  | No Change   |
| RKEF   |   |   |
| Physical Characteristics   |   |   |
| Lead Material  | RKEF050 to 090  | : Tin-plated Copper, 0.205mm <sup>2</sup> (24AWG), ø0.51mm (0.020in)              |
|  | RKEF110 to 500  | : Tin-plated Copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm (0.032in)               |
| Soldering Characteristics  | Solderability per ANSI/J-STD-002 Category 3   |   |
| Solder Heat Withstand  | RKEF050-RKEF185: per IEC-STD 68-2-20, Test Tb, Method 1a, Condition a;<br>Can Withstand 5s at 260°C ±5°C        |   |
|  | All Other Sizes : per IEC-STD 68-2-20, Test Tb, Method 1a, Condition b;<br>RKEF Can Withstand 10s at 260°C ±5°C |   |
| Insulating Material  | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0  |   |
| Operation Temperature  | -40°C~85°C  |   |
| <b>Note:</b> Devices are not designed to be placed through a reflow process. |   |   |
| Environmental Specifications   |   |   |
| Test   | Conditions  | Resistance Change   |
| Passive Aging  | -40°C, 1000 hrs   | ±5%   |
|  | 85°C, 1000 hrs  | ±5%   |
| Humidity Aging   | 85°C, 85%RH, 1000 hrs   | ±10%  |
| Thermal Shock  | 85°C, -40°C (10 Times)  | ±10%  |
| Solvent Resistance   | MIL-STD-202, Method 215F  | No Change   |

Table R5 — Physical Characteristics and Environmental Specifications

(Cont'd)

| RUEF   |  |                   |
|--|--|-------------------|
| Physical Characteristics   |  |                   |
| Lead Material  | RUEF090 to RUEF250: Tin-plated Copper-clad Steel, 0.205mm <sup>2</sup> (24AWG)                     |                   |
|  | RUEF300 to RUEF900: Tin-plated Copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm (0.032in)              |                   |
| Soldering Characteristics  | Solderability per ANSI/J-STD-002 Category 3  |                   |
| Solder Heat Withstand  | per IEC-STD 68-2-20, Test Tb, Method1A, Condition B, Can Withstand 10s at 260°C ±5°C               |                   |
| Insulating Material  | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0   |                   |
| Operation Temperature  | -40°C~85°C   |                   |
| <b>Note:</b> Devices are not designed to be placed through a reflow process. |  |                   |
| Environmental Specifications   |  |                   |
| Test   | Conditions   | Resistance Change |
| Passive Aging  | 70°C, 1000 hrs   | ±5%               |
|  | 85°C, 1000 hrs   | ±5%               |
| Humidity Aging   | 85°C, 85%RH, 1000 hrs  | ±5%               |
| Thermal Shock  | 85°C, -40°C (10 times)   | ±5%               |
| Solvent Resistance   | MIL-STD-202, Method 215F   | No Change         |
| RUSBF  |  |                   |
| Physical Characteristics   |  |                   |
| Lead Material  | RUSBF075 : Tin-plated Nickel-copper Alloy, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in           |                   |
|  | RUSBF090 to RUSBF250: Tin-plated Copper-clad Steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in  |                   |
| Soldering Characteristics  | Solderability per ANSI/J-STD-002 Category 3 Except   |                   |
|  | RUSBF075 Meet ANSI/J-STD-002 Category 1  |                   |
| Solder Heat Withstand  | RUSBF120: per IEC-STD 68-2-20, Test Tb, Method 1A, Condition A; Can Withstand 5s at 260°C ±5°C     |                   |
|  | All Others : per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B; Can Withstand 10s at 260°C ±5°C |                   |
| Insulating Material  | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0   |                   |
| Operation Temperature  | -40°C~85°C   |                   |
| <b>Note:</b> Devices are not designed to be placed through a reflow process. |  |                   |
| Environmental Specifications   |  |                   |
| Test   | Conditions   | Resistance Change |
| Passive Aging  | 70°C, 1000 hrs   | ±5%               |
|  | 85°C, 1000 hrs   | ±5%               |
| Humidity Aging   | 85°C, 85%RH, 1000 hrs  | ±5%               |
| Thermal Shock  | 85°C, -40°C (10 Times)   | ±5%               |
| Solvent Resistance   | MIL-STD-202, Method 215F   | No change         |

Table R5 — Physical Characteristics and Environmental Specifications

(Cont'd)

| RGEF                      |   |
|---------------------------|---|
| Physical Characteristics  |   |
| Lead Material             | RGEF250 : Tin-plated Copper-clad Steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in<br>RGEF300 to RGEF1100 : Tin-plated Copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm/0.032in<br>RGEF1200 to RGEF1400: Tin-plated Copper, 0.82mm <sup>2</sup> (18AWG), ø1.0mm/0.04in |
| Soldering Characteristics | Solderability per ANSI/J-STD-002 Category 3   |
| Solder Heat Withstand     | RGEF250 and RGEF400 : per IEC 68-2-20, Test Tb, Method 1a, Condition a;<br>can withstand 5s at 260°C ±5°C<br>RGEF500 to RGEF1400 : per IEC 68-2-20, Test Tb, Method 1a, Condition b;<br>can withstand 10s at 260°C ±5°C   |
| Insulating Material       | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0  |
| Operation Temperature     | -40°C~85°C  |

**Note:** Devices are not designed to be placed through a reflow process.

| Environmental Specifications |                          |                   |
|------------------------------|--------------------------|-------------------|
| Test                         | Conditions               | Resistance Change |
| Passive Aging                | -40°C, 1000 hrs          | ±5%               |
|                              | 85°C, 1000 hrs           | ±5%               |
| Humidity Aging               | 85°C, 85%RH, 1000 hrs    | ±5%               |
| Thermal Shock                | 85°C, -40°C (10 Times)   | ±5%               |
| Solvent Resistance           | MIL-STD-202, Method 215F | No Change         |

| RHEF                      |  |
|---------------------------|--|
| Physical Characteristics  |  |
| Lead Material             | RHEF050 to RHEF200 : Tin-plated Copper-clad Steel, 0.205mm <sup>2</sup> (24AWG), ø0.51mm/0.020in<br>RHEF300 to RHEF1100 : Tin-plated Copper, 0.52mm <sup>2</sup> (20AWG), ø0.81mm/0.032in<br>RHEF1300 to RHEF1500: Tin-plated Copper, 0.82mm <sup>2</sup> (18AWG), ø1.0mm/0.04in |
| Soldering Characteristics | Solderability per ANSI/J-STD-002 Category 3  |
| Solder Heat Withstand     | per IEC 68-2-20, Test Tb, Method 1A, Condition B; Can Withstand 10s at 260°C ±5°C  |
| Insulating Material       | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0   |
| Operation Temperature     | -40°C~125°C  |

**Note:** Devices are not designed to be placed through a reflow process.

| Environmental Specifications |                          |                   |
|------------------------------|--------------------------|-------------------|
| Test                         | Conditions               | Resistance Change |
| Passive Aging                | 70°C, 1000 hrs           | ±5%               |
|                              | 85°C, 1000 hrs           | ±5%               |
| Humidity Aging               | 85°C, 85%RH, 1000 hrs    | ±5%               |
| Thermal Shock                | 125°C, -40°C (10 Times)  | ±5%               |
| Solvent Resistance           | MIL-STD-202, Method 215F | No Change         |

## Storage Conditions

|                    |  |
|--------------------|--|
| Storage Conditions | 40°C max, 70% RH max; devices should remain in original sealed bags prior to use.<br>Devices may not meet specified values if these storage conditions are exceeded. |
|--------------------|--|

**Note:** For the TR devices series, see the telecommunications and networking devices section.

Table R6 — Packaging and Marking Information

| Part Number     | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-----------------|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RXEF 60V</b> |              |                        |                    |                           |              |                    |
| RXEF005         | 500          | —                      | —                  | 10,000                    | —            | UL, CSA, TÜV, CQC  |
| RXEF005-2       | —            | 3,000                  | —                  | 15,000                    | —            | UL, CSA, TÜV, CQC  |
| RXEF005-AP      | —            | —                      | 2,000              | 10,000                    | —            | UL, CSA, TÜV, CQC  |
| RXEF010         | 500          | —                      | —                  | 10,000                    | X10          | UL, CSA, TÜV, CQC  |
| RXEF010-2       | —            | 3,000                  | —                  | 15,000                    | X10          | UL, CSA, TÜV, CQC  |
| RXEF010-AP      | —            | —                      | 2,000              | 10,000                    | X10          | UL, CSA, TÜV, CQC  |
| RXEF017         | 500          | —                      | —                  | 10,000                    | X17          | UL, CSA, TÜV, CQC  |
| RXEF017-2       | —            | 2,500                  | —                  | 12,500                    | X17          | UL, CSA, TÜV, CQC  |
| RXEF017-AP      | —            | —                      | 2,000              | 10,000                    | X17          | UL, CSA, TÜV, CQC  |
| <b>RXEF 72V</b> |              |                        |                    |                           |              |                    |
| RXEF020         | 500          | —                      | —                  | 10,000                    | X20          | UL, CSA, TÜV, CQC  |
| RXEF020-2       | —            | 3,000                  | —                  | 15,000                    | X20          | UL, CSA, TÜV, CQC  |
| RXEF020-AP      | —            | —                      | 2,000              | 10,000                    | X20          | UL, CSA, TÜV, CQC  |
| RXEF025         | 500          | —                      | —                  | 10,000                    | X25          | UL, CSA, TÜV, CQC  |
| RXEF025-2       | —            | 3,000                  | —                  | 15,000                    | X25          | UL, CSA, TÜV, CQC  |
| RXEF025-AP      | —            | —                      | 2,000              | 10,000                    | X25          | UL, CSA, TÜV, CQC  |
| RXEF030         | 500          | —                      | —                  | 10,000                    | X30          | UL, CSA, TÜV, CQC  |
| RXEF030-2       | —            | 3,000                  | —                  | 15,000                    | X30          | UL, CSA, TÜV, CQC  |
| RXEF030-AP      | —            | —                      | 2,000              | 10,000                    | X30          | UL, CSA, TÜV, CQC  |
| RXEF040         | 500          | —                      | —                  | 10,000                    | X40          | UL, CSA, TÜV, CQC  |
| RXEF040-2       | —            | 3,000                  | —                  | 15,000                    | X40          | UL, CSA, TÜV, CQC  |
| RXEF040-AP      | —            | —                      | 2,000              | 10,000                    | X40          | UL, CSA, TÜV, CQC  |
| RXEF050         | 500          | —                      | —                  | 10,000                    | X50          | UL, CSA, TÜV, CQC  |
| RXEF050-2       | —            | 3,000                  | —                  | 15,000                    | X50          | UL, CSA, TÜV, CQC  |
| RXEF050-AP      | —            | —                      | 2,000              | 10,000                    | X50          | UL, CSA, TÜV, CQC  |
| RXEF065         | 500          | —                      | —                  | 10,000                    | X65          | UL, CSA, TÜV, CQC  |
| RXEF065-2       | —            | 3,000                  | —                  | 15,000                    | X65          | UL, CSA, TÜV, CQC  |
| RXEF065-AP      | —            | —                      | 2,000              | 10,000                    | X65          | UL, CSA, TÜV, CQC  |
| RXEF075         | 500          | —                      | —                  | 10,000                    | X75          | UL, CSA, TÜV, CQC  |
| RXEF075-2       | —            | 3,000                  | —                  | 15,000                    | X75          | UL, CSA, TÜV, CQC  |
| RXEF075-AP      | —            | —                      | 2,000              | 10,000                    | X75          | UL, CSA, TÜV, CQC  |
| RXEF090         | 500          | —                      | —                  | 10,000                    | X90          | UL, CSA, TÜV, CQC  |
| RXEF090-2       | —            | 3,000                  | —                  | 15,000                    | X90          | UL, CSA, TÜV, CQC  |
| RXEF090-AP      | —            | —                      | 2,000              | 10,000                    | X90          | UL, CSA, TÜV, CQC  |
| RXEF110         | 500          | —                      | —                  | 10,000                    | X110         | UL, CSA, TÜV, CQC  |
| RXEF110-2       | —            | 1,500                  | —                  | 7,500                     | X110         | UL, CSA, TÜV, CQC  |
| RXEF110-AP      | —            | —                      | 1,000              | 5,000                     | X110         | UL, CSA, TÜV, CQC  |
| RXEF135         | 500          | —                      | —                  | 10,000                    | X135         | UL, CSA, TÜV, CQC  |
| RXEF135-2       | —            | 1,500                  | —                  | 7,500                     | X135         | UL, CSA, TÜV, CQC  |
| RXEF135-AP      | —            | —                      | 1,000              | 5,000                     | X135         | UL, CSA, TÜV, CQC  |
| RXEF160         | 500          | —                      | —                  | 10,000                    | X160         | UL, CSA, TÜV, CQC  |
| RXEF160-2       | —            | 1,500                  | —                  | 7,500                     | X160         | UL, CSA, TÜV, CQC  |
| RXEF160-AP      | —            | —                      | 1,000              | 5,000                     | X160         | UL, CSA, TÜV, CQC  |
| RXEF185         | 500          | —                      | —                  | 10,000                    | X185         | UL, CSA, TÜV, CQC  |
| RXEF185-2       | —            | 1,500                  | —                  | 7,500                     | X185         | UL, CSA, TÜV, CQC  |
| RXEF185-AP      | —            | —                      | 1,000              | 5,000                     | X185         | UL, CSA, TÜV, CQC  |
| RXEF250         | 250          | —                      | —                  | 5,000                     | X250         | UL, CSA, TÜV, CQC  |
| RXEF250-2       | —            | 1,000                  | —                  | 5,000                     | X250         | UL, CSA, TÜV, CQC  |
| RXEF250-AP      | —            | —                      | 1,000              | 5,000                     | X250         | UL, CSA, TÜV, CQC  |

Table R6 — Packaging and Marking Information

(Cont'd)

| Part Number | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RXEF</b> |              |                        |                    |                           |              |                    |
| <b>72V</b>  |              |                        |                    |                           |              |                    |
| RXEF300     | 250          | —                      | —                  | 5,000                     | X300         | UL, CSA, TÜV, CQC  |
| RXEF300-2   | —            | 1,000                  | —                  | 5,000                     | X300         | UL, CSA, TÜV, CQC  |
| RXEF300-AP  | —            | —                      | 1,000              | 5,000                     | X300         | UL, CSA, TÜV, CQC  |
| RXEF375     | 250          | —                      | —                  | 5,000                     | X375         | UL, CSA, TÜV, CQC  |
| <b>RKEF</b> |              |                        |                    |                           |              |                    |
| <b>60V</b>  |              |                        |                    |                           |              |                    |
| RKEF050     | 500          | —                      | —                  | 10,000                    | K50          | UL, CSA, TÜV       |
| RKEF065     | 500          | —                      | —                  | 10,000                    | K65          | UL, CSA, TÜV       |
| RKEF075     | 500          | —                      | —                  | 10,000                    | K75          | UL, CSA, TÜV       |
| RKEF090     | 500          | —                      | —                  | 10,000                    | K90          | UL, CSA, TÜV       |
| RKEF110     | 500          | —                      | —                  | 10,000                    | K110         | UL, CSA, TÜV       |
| RKEF135     | 500          | —                      | —                  | 10,000                    | K135         | UL, CSA, TÜV       |
| RKEF160     | 500          | —                      | —                  | 10,000                    | K160         | UL, CSA, TÜV       |
| RKEF185     | 500          | —                      | —                  | 10,000                    | K185         | UL, CSA, TÜV       |
| RKEF250     | 500          | —                      | —                  | 10,000                    | K250         | UL, CSA, TÜV       |
| RKEF300     | 250          | —                      | —                  | 5,000                     | K300         | UL, CSA, TÜV       |
| RKEF375     | 250          | —                      | —                  | 5,000                     | K375         | UL, CSA, TÜV       |
| RKEF400     | 250          | —                      | —                  | 5,000                     | K400         | UL, CSA, TÜV       |
| RKEF500     | 250          | —                      | —                  | 5,000                     | K500         | UL, CSA, TÜV       |
| <b>RUEF</b> |              |                        |                    |                           |              |                    |
| <b>30V</b>  |              |                        |                    |                           |              |                    |
| RUEF090     | 500          | —                      | —                  | 10,000                    | U90          | UL, CSA, TÜV, CQC  |
| RUEF090-2   | —            | 3,000                  | —                  | 15,000                    | U90          | UL, CSA, TÜV, CQC  |
| RUEF090-AP  | —            | —                      | 2,000              | 10,000                    | U90          | UL, CSA, TÜV, CQC  |
| RUEF110     | 500          | —                      | —                  | 10,000                    | U110         | UL, CSA, TÜV, CQC  |
| RUEF110-2   | —            | 3,000                  | —                  | 15,000                    | U110         | UL, CSA, TÜV, CQC  |
| RUEF110-AP  | —            | —                      | 2,000              | 10,000                    | U110         | UL, CSA, TÜV, CQC  |
| RUEF135     | 500          | —                      | —                  | 10,000                    | U135         | UL, CSA, TÜV, CQC  |
| RUEF135-2   | —            | 3,000                  | —                  | 15,000                    | U135         | UL, CSA, TÜV, CQC  |
| RUEF135-AP  | —            | —                      | 2,000              | 10,000                    | U135         | UL, CSA, TÜV, CQC  |
| RUEF160     | 500          | —                      | —                  | 10,000                    | U160         | UL, CSA, TÜV, CQC  |
| RUEF160-2   | —            | 3,000                  | —                  | 15,000                    | U160         | UL, CSA, TÜV, CQC  |
| RUEF160-AP  | —            | —                      | 2,000              | 10,000                    | U160         | UL, CSA, TÜV, CQC  |
| RUEF185     | 500          | —                      | —                  | 10,000                    | U185         | UL, CSA, TÜV, CQC  |
| RUEF185-2   | —            | 3,000                  | —                  | 15,000                    | U185         | UL, CSA, TÜV, CQC  |
| RUEF185-AP  | —            | —                      | 2,000              | 10,000                    | U185         | UL, CSA, TÜV, CQC  |
| RUEF250     | 500          | —                      | —                  | 10,000                    | U250         | UL, CSA, TÜV, CQC  |
| RUEF250-2   | —            | 3,000                  | —                  | 15,000                    | U250         | UL, CSA, TÜV, CQC  |
| RUEF250-AP  | —            | —                      | 2,000              | 10,000                    | U250         | UL, CSA, TÜV, CQC  |
| RUEF300     | 500          | —                      | —                  | 10,000                    | U300         | UL, CSA, TÜV, CQC  |
| RUEF300-2   | —            | 2,500                  | —                  | 12,500                    | U300         | UL, CSA, TÜV, CQC  |
| RUEF300-AP  | —            | —                      | 1,000              | 5,000                     | U300         | UL, CSA, TÜV, CQC  |
| RUEF400     | 500          | —                      | —                  | 10,000                    | U400         | UL, CSA, TÜV, CQC  |
| RUEF400-2   | —            | 1,500                  | —                  | 7,500                     | U400         | UL, CSA, TÜV, CQC  |
| RUEF400-AP  | —            | —                      | 1,000              | 5,000                     | U400         | UL, CSA, TÜV, CQC  |
| RUEF500     | 250          | —                      | —                  | 5,000                     | U500         | UL, CSA, TÜV, CQC  |
| RUEF500-2   | —            | 1,500                  | —                  | 7,500                     | U500         | UL, CSA, TÜV, CQC  |
| RUEF500-AP  | —            | —                      | 1,000              | 5,000                     | U500         | UL, CSA, TÜV, CQC  |
| RUEF600     | 250          | —                      | —                  | 5,000                     | U600         | UL, CSA, TÜV, CQC  |
| RUEF600-2   | —            | 1,000                  | —                  | 5,000                     | U600         | UL, CSA, TÜV, CQC  |

Table R6 — Packaging and Marking Information

(Cont'd)

| Part Number                   | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------------------------|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RUEF</b>                   |              |                        |                    |                           |              |                    |
| <b>30V</b>                    |              |                        |                    |                           |              |                    |
| RUEF600-AP                    | —            | —                      | 1,000              | 5,000                     | U600         | UL, CSA, TÜV, CQC  |
| RUEF700                       | 250          | —                      | —                  | 5,000                     | U700         | UL, CSA, TÜV, CQC  |
| RUEF700-2                     | —            | 1,000                  | —                  | 5,000                     | U700         | UL, CSA, TÜV, CQC  |
| RUEF700-AP                    | —            | —                      | 1,000              | 5,000                     | U700         | UL, CSA, TÜV, CQC  |
| RUEF800                       | 250          | —                      | —                  | 5,000                     | U800         | UL, CSA, TÜV, CQC  |
| RUEF800-2                     | —            | 1,000                  | —                  | 5,000                     | U800         | UL, CSA, TÜV, CQC  |
| RUEF800-AP                    | —            | —                      | 1,000              | 5,000                     | U800         | UL, CSA, TÜV, CQC  |
| RUEF900                       | 250          | —                      | —                  | 5,000                     | U900         | UL, CSA, TÜV, CQC  |
| RUEF900-2                     | —            | 1,000                  | —                  | 4,000                     | U900         | UL, CSA, TÜV, CQC  |
| RUEF900-AP                    | —            | —                      | 1,000              | 4,000                     | U900         | UL, CSA, TÜV, CQC  |
| <b>RHEF</b>                   |              |                        |                    |                           |              |                    |
| <b>30V - High Temperature</b> |              |                        |                    |                           |              |                    |
| RHEF050                       | 500          | —                      | —                  | 10,000                    | H0.5         | UL, CSA, TÜV       |
| RHEF050-2                     | —            | 2,500                  | —                  | 12,500                    | H0.5         | UL, CSA, TÜV       |
| RHEF070                       | 500          | —                      | —                  | 10,000                    | H0.7         | UL, CSA, TÜV       |
| RHEF070-2                     | —            | 2,500                  | —                  | 12,500                    | H0.7         | UL, CSA, TÜV       |
| RHEF100                       | 500          | —                      | —                  | 10,000                    | H1           | UL, CSA, TÜV       |
| RHEF100-2                     | —            | 2,500                  | —                  | 12,500                    | H1           | UL, CSA, TÜV       |
| <b>RUSBF</b>                  |              |                        |                    |                           |              |                    |
| <b>16V</b>                    |              |                        |                    |                           |              |                    |
| RUSBF090                      | 500          | —                      | —                  | 10,000                    | R90          | UL, CSA, TÜV       |
| RUSBF090-2                    | —            | 3,000                  | —                  | 15,000                    | R90          | UL, CSA, TÜV       |
| RUSBF090-AP                   | —            | —                      | 2,000              | 10,000                    | R90          | UL, CSA, TÜV       |
| RUSBF110                      | 500          | —                      | —                  | 10,000                    | R110         | UL, CSA, TÜV       |
| RUSBF110-2                    | —            | 3,000                  | —                  | 15,000                    | R110         | UL, CSA, TÜV       |
| RUSBF110-AP                   | —            | —                      | 2,000              | 10,000                    | R110         | UL, CSA, TÜV       |
| RUSBF135                      | 500          | —                      | —                  | 10,000                    | R135         | UL, CSA, TÜV       |
| RUSBF135-2                    | —            | 3,000                  | —                  | 15,000                    | R135         | UL, CSA, TÜV       |
| RUSBF135-AP                   | —            | —                      | 2,000              | 10,000                    | R135         | UL, CSA, TÜV       |
| RUSBF160                      | 500          | —                      | —                  | 10,000                    | R160         | UL, CSA, TÜV       |
| RUSBF160-2                    | —            | 3,000                  | —                  | 15,000                    | R160         | UL, CSA, TÜV       |
| RUSBF160-AP                   | —            | —                      | 2,000              | 10,000                    | R160         | UL, CSA, TÜV       |
| RUSBF185                      | 500          | —                      | —                  | 10,000                    | R185         | UL, CSA, TÜV       |
| RUSBF185-2                    | —            | 3,000                  | —                  | 15,000                    | R185         | UL, CSA, TÜV       |
| RUSBF185-AP                   | —            | —                      | 2,000              | 10,000                    | R185         | UL, CSA, TÜV       |
| RUSBF250                      | 500          | —                      | —                  | 10,000                    | R250         | UL, CSA, TÜV       |
| RUSBF250-2                    | —            | 3,000                  | —                  | 15,000                    | R250         | UL, CSA, TÜV       |
| RUSBF250-AP                   | —            | —                      | 2,000              | 10,000                    | R250         | UL, CSA, TÜV       |
| <b>RGEF</b>                   |              |                        |                    |                           |              |                    |
| <b>16V</b>                    |              |                        |                    |                           |              |                    |
| RGEF250                       | 500          | —                      | —                  | 10,000                    | G2.5         | UL, CSA, TÜV       |
| RGEF250-2                     | —            | 3,000                  | —                  | 15,000                    | G2.5         | UL, CSA, TÜV       |
| RGEF250-AP                    | —            | —                      | 2,000              | 10,000                    | G2.5         | UL, CSA, TÜV       |
| RGEF300                       | 500          | —                      | —                  | 10,000                    | G3           | UL, CSA, TÜV       |
| RGEF300-2                     | —            | 2,500                  | —                  | 12,500                    | G3           | UL, CSA, TÜV       |
| RGEF300-AP                    | —            | —                      | 2,000              | 10,000                    | G3           | UL, CSA, TÜV       |
| RGEF400                       | 500          | —                      | —                  | 10,000                    | G4           | UL, CSA, TÜV       |
| RGEF400-2                     | —            | 2,500                  | —                  | 12,500                    | G4           | UL, CSA, TÜV       |
| RGEF400-AP                    | —            | —                      | 2,000              | 10,000                    | G4           | UL, CSA, TÜV       |
| RGEF500                       | 500          | —                      | —                  | 10,000                    | G5           | UL, CSA, TÜV       |

Table R6 – Packaging and Marking Information

(Cont'd)

| Part Number                   | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------------------------|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RGEF</b>                   |              |                        |                    |                           |              |                    |
| <b>16V</b>                    |              |                        |                    |                           |              |                    |
| RGEF500-2                     | —            | 2,000                  | —                  | 10,000                    | G5           | UL, CSA, TÜV       |
| RGEF500-AP                    | —            | —                      | 2,000              | 10,000                    | G5           | UL, CSA, TÜV       |
| RGEF600                       | 500          | —                      | —                  | 10,000                    | G6           | UL, CSA, TÜV       |
| RGEF600-2                     | —            | 2,000                  | —                  | 10,000                    | G6           | UL, CSA, TÜV       |
| RGEF600-AP                    | —            | —                      | 2,000              | 10,000                    | G6           | UL, CSA, TÜV       |
| RGEF700                       | 500          | —                      | —                  | 10,000                    | G7           | UL, CSA, TÜV       |
| RGEF700-2                     | —            | 1,500                  | —                  | 7,500                     | G7           | UL, CSA, TÜV       |
| RGEF700-AP                    | —            | —                      | 1,500              | 7,500                     | G7           | UL, CSA, TÜV       |
| RGEF800                       | 500          | —                      | —                  | 10,000                    | G8           | UL, CSA, TÜV       |
| RGEF800-2                     | —            | 1,500                  | —                  | 7,500                     | G8           | UL, CSA, TÜV       |
| RGEF800-AP                    | —            | —                      | 1,500              | 7,500                     | G8           | UL, CSA, TÜV       |
| RGEF900                       | 500          | —                      | —                  | 10,000                    | G9           | UL, CSA, TÜV       |
| RGEF900-2                     | —            | 1,000                  | —                  | 5,000                     | G9           | UL, CSA, TÜV       |
| RGEF900-AP                    | —            | —                      | 1,000              | 5,000                     | G9           | UL, CSA, TÜV       |
| RGEF1000                      | 250          | —                      | —                  | 5,000                     | G10          | UL, CSA, TÜV       |
| RGEF1000-2                    | —            | 1,000                  | —                  | 5,000                     | G10          | UL, CSA, TÜV       |
| RGEF1000-AP                   | —            | —                      | 1,000              | 5,000                     | G10          | UL, CSA, TÜV       |
| RGEF1100                      | 250          | —                      | —                  | 5,000                     | G11          | UL, CSA, TÜV       |
| RGEF1100-2                    | —            | 1,000                  | —                  | 5,000                     | G11          | UL, CSA, TÜV       |
| RGEF1100-AP                   | —            | —                      | 1,000              | 5,000                     | G11          | UL, CSA, TÜV       |
| RGEF1200                      | 250          | —                      | —                  | 5,000                     | G12          | UL, CSA, TÜV       |
| RGEF1200-2                    | —            | 1,000                  | —                  | 5,000                     | G12          | UL, CSA, TÜV       |
| RGEF1200-AP                   | —            | —                      | 1,000              | 5,000                     | G12          | UL, CSA, TÜV       |
| RGEF1400                      | 250          | —                      | —                  | 5,000                     | G14          | UL, CSA, TÜV       |
| RGEF1400-2                    | —            | 1,000                  | —                  | 5,000                     | G14          | UL, CSA, TÜV       |
| RGEF1400-AP                   | —            | —                      | 1,000              | 5,000                     | G14          | UL, CSA, TÜV       |
| <b>RHEF</b>                   |              |                        |                    |                           |              |                    |
| <b>16V - High Temperature</b> |              |                        |                    |                           |              |                    |
| RHEF200                       | 500          | —                      | —                  | 10,000                    | H2           | UL, CSA, TÜV       |
| RHEF200-2                     | —            | 2,500                  | —                  | 12,500                    | H2           | UL, CSA, TÜV       |
| RHEF200-AP                    | —            | —                      | 2,500              | 12,500                    | H2           | UL, CSA, TÜV       |
| RHEF300                       | 500          | —                      | —                  | 10,000                    | H3           | UL, CSA, TÜV       |
| RHEF300-2                     | —            | 2,000                  | —                  | 10,000                    | H3           | UL, CSA, TÜV       |
| RHEF300-AP                    | —            | —                      | 2,000              | 10,000                    | H3           | UL, CSA, TÜV       |
| RHEF400                       | 500          | —                      | —                  | 10,000                    | H4           | UL, CSA, TÜV       |
| RHEF400-2                     | —            | 1,500                  | —                  | 7,500                     | H4           | UL, CSA, TÜV       |
| RHEF400-AP                    | —            | —                      | 1,500              | 7,500                     | H4           | UL, CSA, TÜV       |
| RHEF450                       | 500          | —                      | —                  | 10,000                    | H4.5         | UL, CSA, TÜV       |
| RHEF450-2                     | —            | 1,500                  | —                  | 7,500                     | H4.5         | UL, CSA, TÜV       |
| RHEF450-AP                    | —            | —                      | 1,500              | 7,500                     | H4.5         | UL, CSA, TÜV       |
| RHEF550                       | 500          | —                      | —                  | 10,000                    | H5.5         | UL, CSA, TÜV       |
| RHEF550-2                     | —            | 2,000                  | —                  | 10,000                    | H5.5         | UL, CSA, TÜV       |
| RHEF550-AP                    | —            | —                      | 2,000              | 10,000                    | H5.5         | UL, CSA, TÜV       |
| RHEF600                       | 500          | —                      | —                  | 10,000                    | H6           | UL, CSA, TÜV       |
| RHEF600-2                     | —            | 2,000                  | —                  | 10,000                    | H6           | UL, CSA, TÜV       |
| RHEF600-AP                    | —            | —                      | 2,000              | 10,000                    | H6           | UL, CSA, TÜV       |
| RHEF650                       | 500          | —                      | —                  | 10,000                    | H6.5         | UL, CSA, TÜV       |
| RHEF650-2                     | —            | 1,500                  | —                  | 7,500                     | H6.5         | UL, CSA, TÜV       |
| RHEF650-AP                    | —            | —                      | 1,500              | 7,500                     | H6.5         | UL, CSA, TÜV       |
| RHEF700                       | 500          | —                      | —                  | 10,000                    | H7           | UL, CSA, TÜV       |

Table R6 — Packaging and Marking Information

(Cont'd)

| Part Number                   | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|-------------------------------|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>RHEF</b>                   |              |                        |                    |                           |              |                    |
| <b>16V - High Temperature</b> |              |                        |                    |                           |              |                    |
| RHEF700-2                     | —            | 1,500                  | —                  | 7,500                     | H7           | UL, CSA, TÜV       |
| RHEF700-AP                    | —            | —                      | 1,500              | 7,500                     | H7           | UL, CSA, TÜV       |
| RHEF750                       | 500          | —                      | —                  | 10,000                    | H7.5         | UL, CSA, TÜV       |
| RHEF750-2                     | —            | 1,000                  | —                  | 5,000                     | H7.5         | UL, CSA, TÜV       |
| RHEF750-AP                    | —            | —                      | 1,000              | 5,000                     | H7.5         | UL, CSA, TÜV       |
| RHEF800                       | 500          | —                      | —                  | 10,000                    | H8           | UL, CSA, TÜV       |
| RHEF800-2                     | —            | 1,000                  | —                  | 5,000                     | H8           | UL, CSA, TÜV       |
| RHEF800-AP                    | —            | —                      | 1,000              | 5,000                     | H8           | UL, CSA, TÜV       |
| RHEF900                       | 250          | —                      | —                  | 5,000                     | H9           | UL, CSA, TÜV       |
| RHEF900-2                     | —            | 1,000                  | —                  | 5,000                     | H9           | UL, CSA, TÜV       |
| RHEF900-AP                    | —            | —                      | 1,000              | 5,000                     | H9           | UL, CSA, TÜV       |
| RHEF1000                      | 250          | —                      | —                  | 5,000                     | H10          | UL, CSA, TÜV       |
| RHEF1000-2                    | —            | 1,000                  | —                  | 5,000                     | H10          | UL, CSA, TÜV       |
| RHEF1000-AP                   | —            | —                      | 1,000              | 5,000                     | H10          | UL, CSA, TÜV       |
| RHEF1100                      | 250          | —                      | —                  | 5,000                     | H11          | UL, CSA, TÜV       |
| RHEF1100-2                    | —            | 1,000                  | —                  | 5,000                     | H11          | UL, CSA, TÜV       |
| RHEF1100-AP                   | —            | —                      | 1,000              | 5,000                     | H11          | UL, CSA, TÜV       |
| RHEF1300                      | 250          | —                      | —                  | 5,000                     | H13          | UL, CSA, TÜV       |
| RHEF1300-2                    | —            | 1,000                  | —                  | 5,000                     | H13          | UL, CSA, TÜV       |
| RHEF1300-AP                   | —            | —                      | 1,000              | 5,000                     | H13          | UL, CSA, TÜV       |
| RHEF1400                      | 250          | —                      | —                  | 5,000                     | H14          | UL, CSA, TÜV       |
| RHEF1400-2                    | —            | 1,000                  | —                  | 5,000                     | H14          | UL, CSA, TÜV       |
| RHEF1400-AP                   | —            | —                      | 1,000              | 5,000                     | H14          | UL, CSA, TÜV       |
| RHEF1500                      | 250          | —                      | —                  | 5,000                     | H15          | UL, CSA, TÜV       |
| RHEF1500-2                    | —            | 1,000                  | —                  | 5,000                     | H15          | UL, CSA, TÜV       |
| RHEF1500-AP                   | —            | —                      | 1,000              | 5,000                     | H15          | UL, CSA, TÜV       |
| <b>RUSBF</b>                  |              |                        |                    |                           |              |                    |
| <b>6V</b>                     |              |                        |                    |                           |              |                    |
| RUSBF075                      | 500          | —                      | —                  | 10,000                    | R75          | UL, CSA, TÜV       |
| RUSBF075-2                    | —            | 3,000                  | —                  | 15,000                    | R75          | UL, CSA, TÜV       |
| RUSBF075-AP                   | —            | —                      | 2,000              | 10,000                    | R75          | UL, CSA, TÜV       |
| RUSBF120                      | 500          | —                      | —                  | 10,000                    | R120         | UL, CSA, TÜV       |
| RUSBF120-2                    | —            | 3,000                  | —                  | 15,000                    | R120         | UL, CSA, TÜV       |
| RUSBF120-AP                   | —            | —                      | 2,000              | 10,000                    | R120         | UL, CSA, TÜV       |
| RUSBF155                      | 500          | —                      | —                  | 10,000                    | R155         | UL, CSA, TÜV       |
| RUSBF155-2                    | —            | 3,000                  | —                  | 15,000                    | R155         | UL, CSA, TÜV       |
| RUSBF155-AP                   | —            | —                      | 2,000              | 10,000                    | R155         | UL, CSA, TÜV       |

## Agency Recognitions

|     |  |
|-----|--|
| UL  | File # E74889  |
| CSA | File # CA78165   |
| TÜV | Certificate number available on request (per IEC 60730-1). |

## Table R7 — Tape and Reel Specifications

RXEF and RKEF devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards. See Figures R21 and R22 for details.

| Description   | EIA Mark       | Dimension (mm) | Tolerance  |
|---|----------------|----------------|------------|
| Carrier Tape Width  | W              | 18             | -0.5/+1.0  |
| Hold-Down Tape Width  | W <sub>4</sub> | 11             | Minimum    |
| Top Distance between Tape Edges   | W <sub>6</sub> | 3              | Maximum    |
| Sprocket Hole Position  | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket Hole Diameter  | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to Plane (Straight Lead) (RXEF110 To RXEF300, RKEF135 To RKEF500)      | H              | 18.5           | ± 2.5      |
| Abscissa to Plane (Kinked Lead) (RXEF010 To RXEF090, RKEF050 To RKEF110)        | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to Top (RXEF010 To RXEF090, RKEF050 To RKEF185)                        | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to Top* (RXEF110 To RXEF300, RKEF250 To RKEF500)                       | H <sub>1</sub> | 47.5           | Maximum    |
| Overall Width with Lead Protrusion (RXEF010 To RXEF090, RKEF050 To RKEF185)     | C <sub>1</sub> | 43.2           | Maximum    |
| Overall Width with Lead Protrusion* (RXEF110 To RXEF300, RKEF250 To RKEF500)    | C <sub>1</sub> | 58             | Maximum    |
| Overall Width without Lead Protrusion (RXEF010 To RXEF090, RKEF050 To RKEF185)  | C <sub>2</sub> | 42.5           | Maximum    |
| Overall Width without Lead Protrusion* (RXEF110 To RXEF300, RKEF250 To RKEF500) | C <sub>2</sub> | 57             | Maximum    |
| Lead Protrusion   | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of Cut-Out   | L              | 11.0           | Maximum    |
| Protrusion beyond Hold-down Tape  | l <sub>2</sub> | Not Specified  | —          |
| Sprocket Hole Pitch   | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device Pitch (RXEF010 To RXEF090, RKEF050 To RKEF185)                           | —              | 12.7           | ± 0.3      |
| Device Pitch (RXEF110 To RXEF300, RKEF250 To RKEF500)                           | —              | 25.4           | ± 0.61     |
| Pitch Tolerance   | —              | 20 Consecutive | ± 1        |
| Tape Thickness  | T              | 0.9            | Maximum    |
| Overall Tape and Lead Thickness (RXEF010 To RXEF090, RKEF050 To RKEF185)        | T <sub>1</sub> | 1.5            | Maximum    |
| Overall Tape and Lead Thickness (RXEF110 To RXEF300, RKEF250 To RKEF500)        | T <sub>1</sub> | 2.3            | Maximum    |
| Splice Sprocket Hole Alignment  | —              | 0              | ± 0.3      |
| Body Lateral Deviation  | Δh             | 0              | ± 1.0      |
| Body Tape Plane Deviation   | Δp             | 0              | ± 1.3      |
| Ordinate to Adjacent Component Lead (RXEF010 To RXEF185, RKEF050 To RKEF300)    | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to Adjacent Component Lead (RXEF250 To RXEF300, RKEF375 To RKEF500)    | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead Spacing* (RXEF010 To RXEF185, RKEF050 To RKEF300)                          | F              | 5.05           | ± 0.75     |
| Lead Spacing* (RXEF250 To RXEF300, RKEF375 To RKEF500)                          | F              | 10.15          | ± 0.75     |
| Reel Width (RXEF010 To RXEF090, RKEF050 To RKEF185)                             | W <sub>2</sub> | 56.0           | Maximum    |
| Reel Width* (RXEF110 To RXEF300, RKEF250 To RKEF500)                            | W <sub>2</sub> | 63.5           | Maximum    |
| Reel Diameter   | A              | 370.0          | Maximum    |
| Space between Flanges* (RXEF010 To RXEF090, RKEF050 To RKEF185)                 | W <sub>1</sub> | 48.00          | Maximum    |
| Space between Flanges* (RXEF110 To RXEF300, RKEF250 To RKEF500)                 | W <sub>1</sub> | 55.00          | Maximum    |
| Arbor Hold Diameter   | C              | 26.0           | ± 12.0     |
| Core Diameter*  | N              | 91.0           | Maximum    |
| Box   | —              | 64/372/362     | Maximum    |
| Consecutive Missing Places  | —              | None           | —          |
| Empty Places per Reel   | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

Table R7 — Tape and Reel Specifications

(Cont'd)

RUEF and RUSBF devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards.  
See Figures R21 and R22 for details.

| Description  | EIA Mark       | Dimension (mm) | Tolerance  |
|--|----------------|----------------|------------|
| Carrier Tape Width   | W              | 18             | -0.5/+1.0  |
| Hold-down Tape Width   | W <sub>4</sub> | 11             | Minimum    |
| Top Distance between Tape Edges  | W <sub>6</sub> | 3              | Maximum    |
| Sprocket Hole Position   | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket Hole Diameter   | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to Plane (Straight Lead)* (RUEF300 to RUEF900)                          | H              | 18.5           | ± 2.5      |
| Abscissa to Plane (Kinked Lead) (RUSBF075 to RUSBF250, RUEF090 to RUEF250)       | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to Top (RUSBF075 to RUSBF250, RUEF090 to RUEF300)                       | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to Top* (RUEF400 to RUEF900)  | H <sub>1</sub> | 45.0           | Maximum    |
| Overall Width with Lead Protrusion (RUSBF075 to RUSBF250, RUEF090 to RUEF300)    | C <sub>1</sub> | 43.2           | Maximum    |
| Overall Width with Lead Protrusion (RUEF400 To RUEF900)                          | C <sub>1</sub> | 56             | Maximum    |
| Overall Width without Lead Protrusion (RUSBF075 to RUSBF250, RUEF090 to RUEF300) | C <sub>2</sub> | 42.5           | Maximum    |
| Overall Width without Lead Protrusion (RUEF400 to RUEF900)                       | C <sub>2</sub> | 56             | Maximum    |
| Lead Protrusion  | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of Cut-out  | L              | 11             | Maximum    |
| Protrusion beyond Hold-down Tape   | l <sub>2</sub> | Not Specified  | —          |
| Sprocket Hole Pitch  | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device Pitch (RUSBF075 to RUSBF250, RUEF090 to RUEF300)                          | —              | 12.7           | ± 0.3      |
| Device Pitch (RUEF400 to RUEF900)  | —              | 25.4           | ± 0.6      |
| Pitch Tolerance  | —              | 20 Consecutive | ± 1        |
| Tape Thickness   | T              | 0.9            | Maximum    |
| Overall Tape and Lead Thickness (RUSBF075 to RUSBF250, RUEF090 to RUEF50)        | T <sub>1</sub> | 1.5            | Maximum    |
| Overall Tape and Lead Thickness* (RUEF300 to RUEF900)                            | T <sub>1</sub> | 2.3            | Maximum    |
| Splice Sprocket Hole Alignment   | —              | 0              | ± 0.3      |
| Body Lateral Deviation   | Δh             | 0              | ± 1.0      |
| Body Tape Plane Deviation  | Δp             | 0              | ± 1.3      |
| Ordinate to Adjacent Component Lead (RUSBF075 to RUSBF250, RUEF090 to RUEF300)   | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to Adjacent Component Lead (RUEF400 to RUEF900)                         | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead Spacing* (RUSBF075 to RUSBF250, RUEF090 to RUEF400)                         | F              | 5.05           | ± 0.75     |
| Lead Spacing* (RUEF500 to RUEF900)   | F              | 10.15          | ± 0.75     |
| Reel Width (RUEF090 to RUEF400, Rusbf075 to Rusbf250)                            | W <sub>2</sub> | 56.0           | Maximum    |
| Reel Width (RUEF500* to RUEF900)   | W <sub>2</sub> | 63.5           | Maximum    |
| Reel Diameter  | A              | 370.0          | Maximum    |
| Space between Flanges* (RUEF090 to RUEF400, RUSBF075 to RUSBF250)                | W <sub>1</sub> | 48.0           | Maximum    |
| Space between Flanges* (RUEF500 to RUEF900)                                      | W <sub>1</sub> | 55.0           | Maximum    |
| Arbor Hold Diameter  | C              | 26.0           | ± 12.0     |
| Core Diameter*   | N              | 91.0           | Maximum    |
| Box  | —              | 64/372/362     | Maximum    |
| Consecutive Missing Places   | —              | None           | —          |
| Empty Places per Reel  | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

Table R7 — Tape and Reel Specifications

(Cont'd)

RGEF and RHEF devices are available in tape and reel packaging per EIA468–B/IEC60286–2 standards.  
See Figures R21 and R22 for details.

| Description  | EIA Mark       | Dimension (mm) | Tolerance  |
|--|----------------|----------------|------------|
| Carrier Tape Width   | W              | 18             | -0.5/+1.0  |
| Hold-Down Tape Width   | W <sub>4</sub> | 11             | Minimum    |
| Top Distance between Tape Edges  | W <sub>6</sub> | 3              | Maximum    |
| Sprocket Hole Position   | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket Hole Diameter   | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to Plane (Straight Lead) (RGEF250 to RGEF1400)                          | H              | 18.5           | ± 2.5      |
| Abscissa to Plane (Kinked Lead) (RHEF050 to RGEF1500)                            | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to Top (RGEF250 to RGEF500, RGEF050 to RGEF450)                         | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to Top* (RGEF600 to RGEF1400, RHEF550 to RHEF1500)                      | H <sub>1</sub> | 45.0           | Maximum    |
| Overall Width with Lead Protrusion (RGEF250 to RGEF600, RHEF050 to RHEF450)      | C <sub>1</sub> | 43.2           | Maximum    |
| Overall Width with Lead Protrusion (RGEF700 to RGEF1400, RHEF550 to RHEF1500)    | C <sub>1</sub> | 55             | Maximum    |
| Overall Width without Lead Protrusion (RGEF250 to RGEF600, RHEF050 to RHEF450)   | C <sub>2</sub> | 42.5           | Maximum    |
| Overall Width without Lead Protrusion (RGEF700 to RGEF1400, RHEF550 to RHEF1500) | C <sub>2</sub> | 54             | Maximum    |
| Lead Protrusion  | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of Cut-out  | L              | 11             | Maximum    |
| Protrusion beyond Hold-down Tape   | l <sub>2</sub> | Not Specified  | —          |
| Sprocket Hole Pitch  | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device Pitch (RGEF250 to RGEF700, RHEF050 to RHEF600)                            | —              | 25.4           | ± 0.61     |
| Device Pitch (RGEF800 to RGEF1400, RHEF650 to RHEF1500)                          | —              | 25.4           | ± 0.6      |
| Pitch Tolerance  | —              | 20 Consecutive | ± 1        |
| Tape Thickness   | T              | 0.9            | Maximum    |
| Overall Tape and Lead Thickness* (RGEF250 to RGEF1100, RHEF050 to RHEF1100)      | T <sub>1</sub> | 2.0            | Maximum    |
| Overall Tape and Lead Thickness* (RGEF1200 to RGEF1400, RHEF1300 to RHEF1500)    | T <sub>1</sub> | 2.3            | Maximum    |
| Splice Sprocket Hole Alignment   | —              | 0              | ± 0.3      |
| Body Lateral Deviation   | Δh             | 0              | ± 1.0      |
| Body Tape Plane Deviation  | Δp             | 0              | ± 1.3      |
| Ordinate to Adjacent Component Lead (RGEF250 to RGEF1100, RHEF050 to RHEF900)    | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to Adjacent Component Lead (RGEF1200 to RGEF1400, RHEF1000 to RHEF1500) | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead Spacing* (RGEF250 to RGEF1100, RHEF050 to RHEF900)                          | F              | 5.05           | ± 0.75     |
| Lead Spacing* (RGEF1200 to RGEF1400, RHEF1000 to RHEF1500)                       | F              | 10.15          | ± 0.75     |
| Reel Width (RGEF250 to RGEF600, RHEF050 to RHEF450)                              | W <sub>2</sub> | 56.0           | Maximum    |
| Reel Width* (RGEF700 to RGEF1400 & RHEF550 to RHEF1500)                          | W <sub>2</sub> | 63.5           | Maximum    |
| Reel Diameter  | A              | 370.0          | Maximum    |
| Space between Flanges* (RGEF250 to RGEF600, RHEF050 to RHEF450)                  | W <sub>1</sub> | 48.0           | Maximum    |
| Space between Flanges* (RGEF700 to RGEF400, RHEF550 to RHEF1500)                 | W <sub>1</sub> | 55.0           | Maximum    |
| Arbor Hold Diameter  | C              | 26.0           | ± 12.0     |
| Core Diameter*   | N              | 91.0           | Maximum    |
| Box  | —              | 64/372/362     | Maximum    |
| Consecutive Missing Places   | —              | None           | —          |
| Empty Places per Reel  | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

Figure R21 – EIA Referenced Taped Component Dimensions

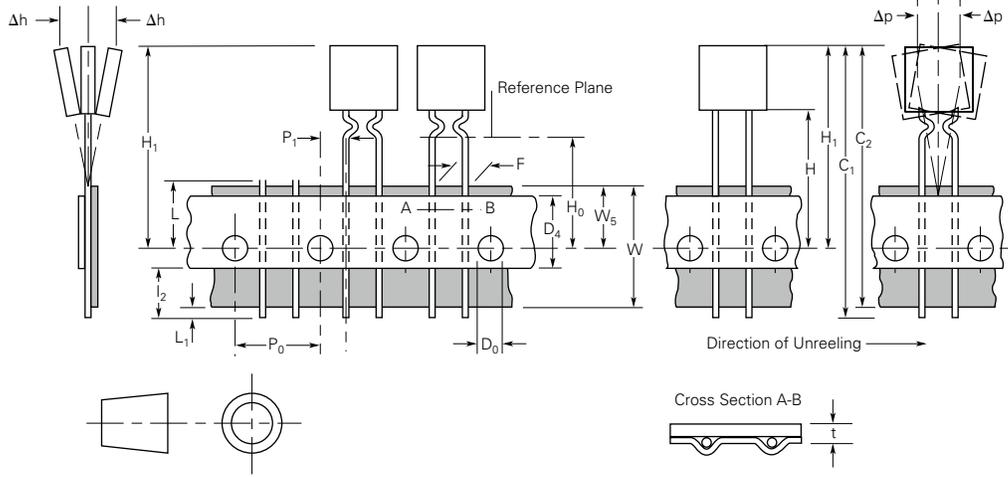
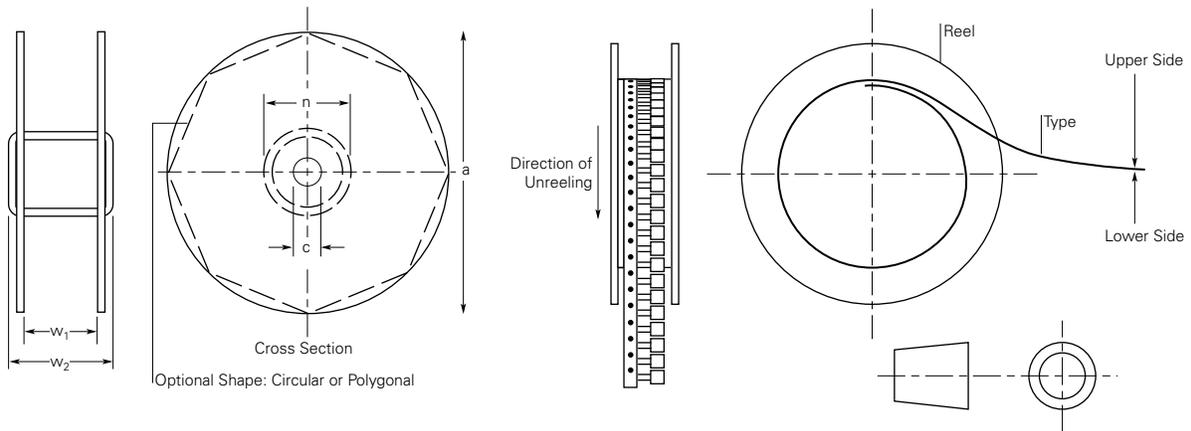


Figure R22 – EIA Referenced Reel Dimensions



## Part Numbering System

RUEF 250 U 2

**Packaging**

Blank = Packaged in Bags  
 -1 = 25.4mm (1.0 in) Minimum Lead Length  
 -2 = Tape and Reel  
 -AP = Ammo Pack  
 -X.X = Special Lead Cut Length (in)

**Modifier**

K = Standard Kinked Lead  
 B = Special Kinked Lead  
 S = Straight Lead  
 U = Uncoated Device

**Hold Current Indicator****Product Series**

An "F" at the end of product series indicates Pb-free version of product.

**Note:** Kinked parts are recommended to control the height of the part on the PCB in non-auto PCB applications.

**Warning :**

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.

# POLYSWITCH RESETTABLE DEVICES

## Line-Voltage-Rated Devices

PolySwitch line-voltage-rated (LVR) devices help protect electric motors and transformers used in commercial and home appliances from damage caused by mechanical overloads, overheating, stall, lost neutral and other potentially harmful conditions.

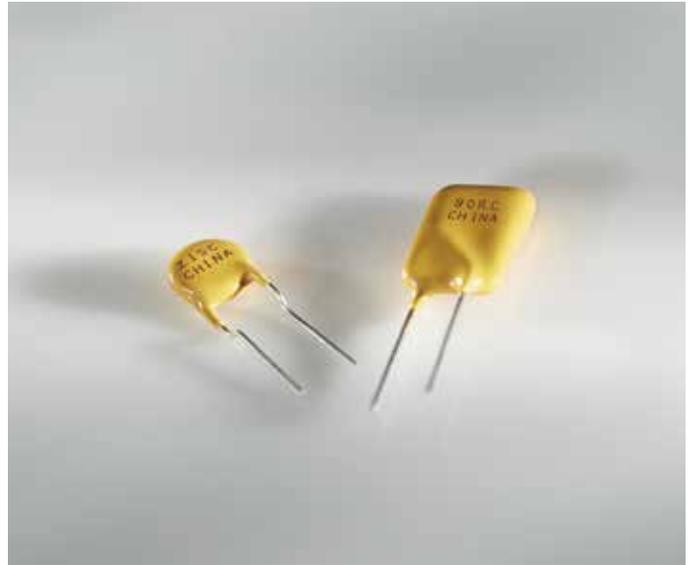
The LVR line-voltage product line of polymeric positive temperature coefficient (PPTC) devices includes components that are rated for line voltages of 120V<sub>AC</sub> and 240V<sub>AC</sub>, for up to 2A of operating current at 20°C. They help protect against damage caused by both overcurrent surges and overtemperature faults. They also offer low resistance and are compatibly sized with fuse solutions.

Unlike traditional fuses, PolySwitch devices do not require replacement after a fault event. After power has been removed and the overcurrent condition eliminated, the circuit is restored to normal operating condition. Compared to bimetal breakers, they offer greater flexibility, longer lifespan and lower electromagnetic interference (EMI).

The PolySwitch LVR devices' resettable functionality and latching attributes make them a reliable, cost-effective circuit protection solution for both intermittent- and continuous-operation motor applications. Their low resistance, fast time-to-trip, and low profile help circuit designers provide a safe and dependable product, comply with regulatory agency requirements and reduce warranty repair costs.

LVR/LVB series are suitable for line-voltage applications up to a continuous operating voltage of 240V<sub>AC</sub>/120V<sub>AC</sub>.

RoHS versions of all products are available.



### BENEFITS

- Choice of many devices helps provide engineers with design flexibility
- Compatible with high-volume electronics assembly
- Assist in meeting regulatory requirements
- Higher voltage ratings allow use in new applications

### FEATURES

- RoHS compliant
- Broadest range of radial-leaded resettable devices available in the industry
- Current ratings from 50mA to 2A
- Line voltage rating of 120V<sub>AC</sub> and 240V<sub>AC</sub>
- Agency recognition : UL, CSA, TÜV, CQC
- Fast time-to-trip
- Low resistance

### APPLICATIONS

- Electromagnetic loads
- Game machines
- Industrial controls
- Lighting ballasts
- Loudspeakers
- Medical equipment
- Motors, fans and blowers
- POS equipment
- Satellite video receivers
- Security and fire alarm systems
- Test and measurement equipment
- Transformers
- USB hubs, ports and peripherals
- Intelligent appliance
- Robotic machine

Table L1 — Product Series - Current Rating, Voltage Rating/Typical Resistance

| Voltage Rating          | LVR 240V <sub>AC</sub> / 120V <sub>AC</sub> | LVB 240V <sub>AC</sub> |
|-------------------------|---|------------------------|
| <b>Hold Current (A)</b> |   |                        |
| 0.050                   | 25.00Ω                                      | —                      |
| 0.080                   | 9.800Ω                                      | —                      |
| 0.120                   | 4.800Ω                                      | —                      |
| 0.160                   | 3.400Ω                                      | —                      |
| 0.250                   | 1.700Ω                                      | —                      |
| 0.330                   | 1.000Ω                                      | —                      |
| 0.400                   | 0.800Ω                                      | —                      |
| 0.550                   | 0.590Ω                                      | —                      |
| 0.750                   | 0.400Ω                                      | —                      |
| 1.000                   | 0.276Ω                                      | —                      |
| 1.250                   | 0.209Ω                                      | 0.209Ω                 |
| 1.350                   | —   | —                      |
| 2.000                   | 0.110Ω                                      | —                      |

Table L2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

| Part Number | Maximum Ambient Temperature |      |      |      |      |      |      |      |      |
|-------------|-----------------------------|------|------|------|------|------|------|------|------|
|             | -20°C                       | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 85°C |
| <b>LVR</b>  |                             |      |      |      |      |      |      |      |      |
| LVR005N     | 0.08                        | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 |
| LVR008N     | 0.12                        | 0.10 | 0.08 | 0.08 | 0.07 | 0.06 | 0.05 | 0.04 | 0.03 |
| LVR012      | 0.18                        | 0.15 | 0.12 | 0.12 | 0.10 | 0.09 | 0.07 | 0.06 | 0.04 |
| LVR016      | 0.24                        | 0.20 | 0.16 | 0.16 | 0.13 | 0.11 | 0.10 | 0.08 | 0.05 |
| LVR025      | 0.38                        | 0.32 | 0.25 | 0.25 | 0.21 | 0.18 | 0.15 | 0.13 | 0.09 |
| LVR033      | 0.50                        | 0.42 | 0.33 | 0.33 | 0.27 | 0.23 | 0.20 | 0.17 | 0.11 |
| LVR040      | 0.61                        | 0.51 | 0.40 | 0.40 | 0.33 | 0.28 | 0.24 | 0.20 | 0.14 |
| LVR055      | 0.80                        | 0.68 | 0.55 | 0.54 | 0.46 | 0.40 | 0.35 | 0.29 | 0.22 |
| LVR075      | 1.23                        | 0.98 | 0.75 | 0.74 | 0.60 | 0.56 | 0.49 | 0.45 | 0.41 |
| LVR100      | 1.65                        | 1.30 | 1.00 | 0.94 | 0.80 | 0.75 | 0.65 | 0.60 | 0.55 |
| LVR125      | 2.06                        | 1.63 | 1.25 | 1.20 | 1.00 | 0.94 | 0.81 | 0.75 | 0.69 |
| LVR200      | 3.30                        | 2.60 | 2.00 | 1.97 | 1.60 | 1.50 | 1.30 | 1.20 | 1.10 |
| LVR075-240  | 1.23                        | 0.98 | 0.75 | 0.74 | 0.60 | 0.56 | 0.49 | 0.45 | 0.41 |
| LVR100-240  | 1.65                        | 1.30 | 1.00 | 0.94 | 0.80 | 0.75 | 0.65 | 0.60 | 0.55 |
| LVR125-240  | 2.06                        | 1.63 | 1.25 | 1.20 | 1.00 | 0.94 | 0.81 | 0.75 | 0.69 |
| LVR200-240  | 3.30                        | 2.60 | 2.00 | 1.97 | 1.60 | 1.50 | 1.30 | 1.20 | 1.10 |
| <b>LVB</b>  |                             |      |      |      |      |      |      |      |      |
| LVB125      | 2.09                        | 1.81 | 1.53 | 1.25 | 1.19 | 0.99 | 0.86 | 0.73 | 0.60 |

Figure L1 — Thermal Derating Curve

- A = LVR075-LVR200  
 B = LVB125  
 C = LVR005N-LVR055

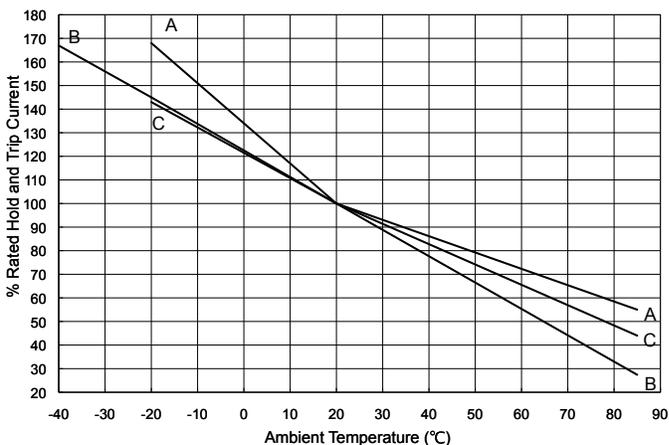


Table L3 – Electrical Characteristics\*

| Part Number | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub> <sup>†</sup>   |                                 | I <sub>MAX</sub> <sup>†</sup><br>Interrupt<br>(A) | P <sub>D</sub> TYP<br>(W) | Max. Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) | Lead Size<br>[mm (AWG)] |
|-------------|-----------------------|-----------------------|---------------------------------|---------------------------------|---|---------------------------|-------------------|------|-------------------------|-------------------------|--------------------------|-------------------------|
|             |                       |                       | Operating<br>(V <sub>AC</sub> ) | Interrupt<br>(V <sub>AC</sub> ) |   |                           | (A)               | (s)  |                         |                         |                          |                         |
| <b>LVR</b>  |                       |                       |                                 |                                 |   |                           |                   |      |                         |                         |                          |                         |
| LVR005NK    | 0.05                  | 0.12                  | 240<br>120                      | 265<br>135                      | 1.0<br>20.0                                       | 0.9                       | 0.25              | 10.0 | 18.500                  | 31.000                  | 65.000                   | [0.51mm (24)]           |
| LVR005NS    | 0.05                  | 0.12                  | 240<br>120                      | 265<br>135                      | 1.0<br>20.0                                       | 0.9                       | 0.25              | 10.0 | 18.500                  | 31.000                  | 65.000                   | [0.51mm (24)]           |
| LVR008NK    | 0.08                  | 0.19                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 0.9                       | 0.40              | 10.0 | 7.400                   | 12.000                  | 26.000                   | [0.51mm (24)]           |
| LVR008NS    | 0.08                  | 0.19                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 0.9                       | 0.40              | 10.0 | 7.400                   | 12.000                  | 26.000                   | [0.51mm (24)]           |
| LVR012K     | 0.12                  | 0.30                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 1.0                       | 0.60              | 15.0 | 3.000                   | 6.500                   | 12.000                   | [0.51mm (24)]           |
| LVR012S     | 0.12                  | 0.30                  | 240<br>120                      | 265<br>135                      | 1.2<br>20.0                                       | 1.0                       | 0.60              | 15.0 | 3.000                   | 6.500                   | 12.000                   | [0.51mm (24)]           |
| LVR016K     | 0.16                  | 0.37                  | 240<br>120                      | 265<br>135                      | 2.0<br>20.0                                       | 1.4                       | 0.80              | 15.0 | 2.500                   | 4.100                   | 7.800                    | [0.51mm (24)]           |
| LVR016S     | 0.16                  | 0.37                  | 240<br>120                      | 265<br>135                      | 2.0<br>20.0                                       | 1.4                       | 0.80              | 15.0 | 2.500                   | 4.100                   | 7.800                    | [0.51mm (24)]           |
| LVR025K     | 0.25                  | 0.56                  | 240<br>120                      | 265<br>135                      | 3.5<br>20.0                                       | 1.5                       | 1.25              | 18.5 | 1.300                   | 2.100                   | 3.800                    | [0.64mm (22)]           |
| LVR025S     | 0.25                  | 0.56                  | 240<br>120                      | 265<br>135                      | 3.5<br>20.0                                       | 1.5                       | 1.25              | 18.5 | 1.300                   | 2.100                   | 3.800                    | [0.64mm (22)]           |
| LVR033K     | 0.33                  | 0.74                  | 240<br>120                      | 265<br>135                      | 4.5<br>20.0                                       | 1.7                       | 1.65              | 21.0 | 0.770                   | 1.240                   | 2.600                    | [0.64mm (22)]           |
| LVR033S     | 0.33                  | 0.74                  | 240<br>120                      | 265<br>135                      | 4.5<br>20.0                                       | 1.7                       | 1.65              | 21.0 | 0.770                   | 1.240                   | 2.600                    | [0.64mm (22)]           |
| LVR040K     | 0.40                  | 0.90                  | 240<br>120                      | 265<br>135                      | 5.5<br>20.0                                       | 2.0                       | 2.00              | 24.0 | 0.600                   | 0.970                   | 1.900                    | [0.64mm (22)]           |
| LVR040S     | 0.40                  | 0.90                  | 240<br>120                      | 265<br>135                      | 5.5<br>20.0                                       | 2.0                       | 2.00              | 24.0 | 0.600                   | 0.970                   | 1.900                    | [0.64mm (22)]           |
| LVR055K     | 0.55                  | 1.25                  | 240<br>120                      | 265<br>135                      | 7.0<br>20.0                                       | 3.4                       | 2.75              | 26.0 | 0.450                   | 0.730                   | 1.450                    | [0.81mm (20)]           |
| LVR055S     | 0.55                  | 1.25                  | 240<br>120                      | 265<br>135                      | 7.0<br>20.0                                       | 3.4                       | 2.75              | 26.0 | 0.450                   | 0.730                   | 1.450                    | [0.81mm (20)]           |
| LVR075S     | 0.75                  | 1.50                  | 240                             | 265                             | 7.5   | 2.6                       | 3.75              | 18.0 | 0.316                   | 0.483                   | 0.839                    | [0.81mm (20)]           |
| LVR100S     | 1.00                  | 2.00                  | 240                             | 265                             | 10.0  | 2.9                       | 5.00              | 21.0 | 0.218                   | 0.334                   | 0.580                    | [0.81mm (20)]           |
| LVR125S     | 1.25                  | 2.50                  | 240                             | 265                             | 12.5  | 3.3                       | 6.25              | 23.0 | 0.165                   | 0.253                   | 0.440                    | [0.81mm (20)]           |
| LVR200S     | 2.00                  | 4.00                  | 240                             | 265                             | 20.0  | 4.5                       | 10.00             | 28.0 | 0.089                   | 0.131                   | 0.221                    | [0.81mm (20)]           |
| LVR075S-240 | 0.75                  | 1.50                  | 240                             | 265                             | 7.5   | 2.6                       | 3.75              | 18.0 | 0.316                   | 0.483                   | 0.839                    | [0.81mm (20)]           |
| LVR100S-240 | 1.00                  | 2.00                  | 240                             | 265                             | 10.0  | 2.9                       | 5.00              | 21.0 | 0.218                   | 0.334                   | 0.580                    | [0.81mm (20)]           |
| LVR125S-240 | 1.25                  | 2.50                  | 240                             | 265                             | 12.5  | 3.3                       | 6.25              | 23.0 | 0.165                   | 0.253                   | 0.440                    | [0.81mm (20)]           |
| LVR200S-240 | 2.00                  | 4.00                  | 240                             | 265                             | 20.0  | 4.5                       | 10.00             | 28.0 | 0.089                   | 0.131                   | 0.221                    | [0.81mm (20)]           |
| LVR075K-240 | 0.75                  | 1.50                  | 240                             | 265                             | 7.5   | 2.6                       | 3.75              | 18.0 | 0.316                   | 0.483                   | 0.839                    | [0.81mm (20)]           |
| LVR100K-240 | 1.00                  | 2.00                  | 240                             | 265                             | 10.0  | 2.9                       | 5.00              | 21.0 | 0.218                   | 0.334                   | 0.580                    | [0.81mm (20)]           |
| LVR125K-240 | 1.25                  | 2.50                  | 240                             | 265                             | 12.5  | 3.3                       | 6.25              | 23.0 | 0.165                   | 0.253                   | 0.440                    | [0.81mm (20)]           |
| LVR200K-240 | 2.00                  | 4.00                  | 240                             | 265                             | 20.0  | 4.5                       | 10.00             | 28.0 | 0.089                   | 0.131                   | 0.221                    | [0.81mm (20)]           |
| <b>LVB</b>  |                       |                       |                                 |                                 |   |                           |                   |      |                         |                         |                          |                         |
| LVB125      | 1.25                  | 2.50                  | 240                             | 265                             | 12.5  | 4.0                       | 8.00              | 5.0  | 0.152                   | 0.292                   | 0.482                    | [0.81mm (20)]           |

**Notes:**

- I<sub>H</sub> : Hold current: maximum current device will pass without interruption in 20°C still air.  
I<sub>T</sub> : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.  
V<sub>MAX</sub> Operating: Maximum continuous voltage device can withstand without damage at rated current.  
V<sub>MAX</sub> Interrupt : Under specified conditions this is the highest voltage that can be applied to the device at the maximum interrupt current.  
I<sub>MAX</sub> Interrupt : Maximum fault current device can withstand without damage at rated voltage.  
P<sub>D</sub> : Power dissipated from device when in the tripped state in 20°C still air.  
R<sub>MIN</sub> : Minimum resistance of device as supplied at 20°C unless otherwise specified.  
R<sub>MAX</sub> : Maximum resistance of device as supplied at 20°C unless otherwise specified.  
R<sub>1MAX</sub> : Maximum resistance of device when measured one hour post trip at 20°C unless otherwise specified.

\* Electrical characteristics determined at 20°C.

† See Application Limitations on next page.

Figures L2-L7 – Dimension Figures

Figure L2

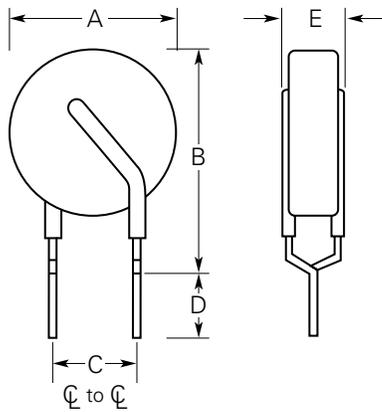


Figure L3

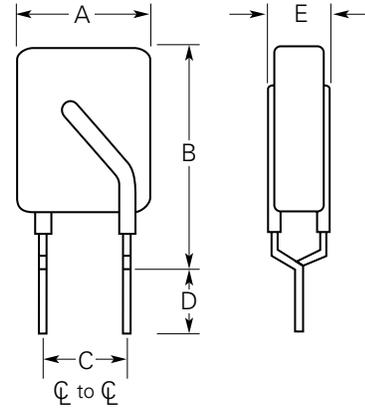


Figure L4

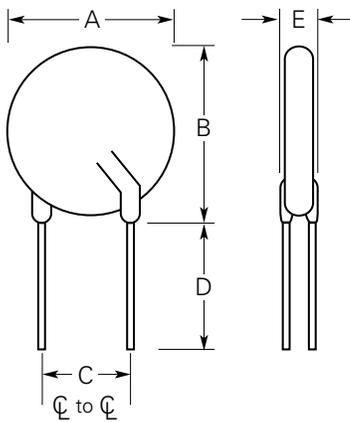


Figure L5

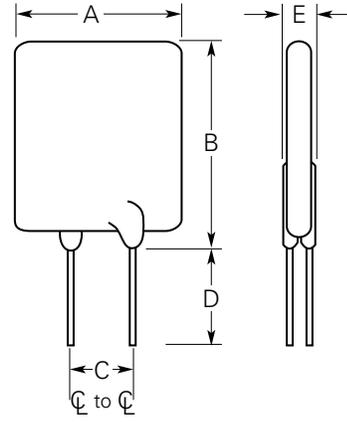


Figure L6

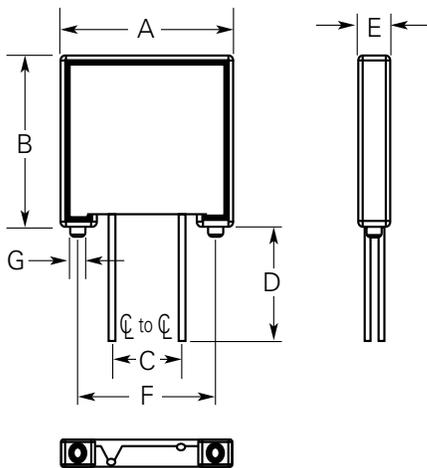
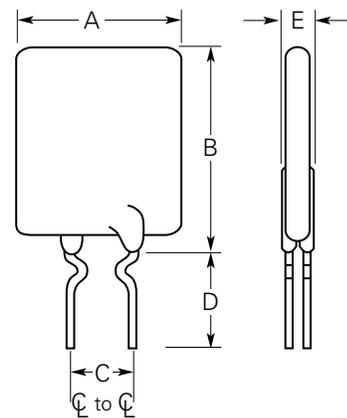


Figure L7



# 11 PolySwitch Resettable Devices Line-Voltage-Rated Devices

Table L4 – Dimensions and Weights - Millimeters (Inches)

| Part Number | A              |                 | B              |                 | C             |                | D             |     | E             |               | Figure         | Device Mass(g)<br>(Only for Reference) |   |               |    |       |
|-------------|----------------|-----------------|----------------|-----------------|---------------|----------------|---------------|-----|---------------|---------------|----------------|--|---|---------------|----|-------|
|             | Min            | Max             | Min            | Max             | Min           | Max            | Min           | Max | Min           | Max           |                |  |   |               |    |       |
| <b>LVR</b>  |                |                 |                |                 |               |                |               |     |               |               |                |  |   |               |    |       |
| LVR005NK    | —              | 6.9<br>(0.27)   | —              | 12.1<br>(0.48)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 4.6<br>(0.18) | L2             | 0.177                                  |   |               |    |       |
| LVR005NS    | —              | 6.9<br>(0.27)   | —              | 9.9<br>(0.39)   | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 4.6<br>(0.18) | L4             | 0.211                                  |   |               |    |       |
| LVR008NK    | —              | 7.2<br>(0.28)   | —              | 12.4<br>(0.49)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 4.6<br>(0.18) | L2             | 0.233                                  |   |               |    |       |
| LVR008NS    | —              | 7.2<br>(0.28)   | —              | 10.2<br>(0.40)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 4.6<br>(0.18) | L4             | 0.211                                  |   |               |    |       |
| LVR012K     | —              | 8.3<br>(0.33)   | —              | 12.9<br>(0.51)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L2             | 0.231                                  |   |               |    |       |
| LVR012S     | —              | 8.3<br>(0.33)   | —              | 10.7<br>(0.43)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L4             | 0.235                                  |   |               |    |       |
| LVR016K     | —              | 9.9<br>(0.39)   | —              | 13.8<br>(0.54)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L2             | 0.253                                  |   |               |    |       |
| LVR016S     | —              | 9.9<br>(0.39)   | —              | 12.5<br>(0.50)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L4             | 0.291                                  |   |               |    |       |
| LVR025K     | —              | 9.6<br>(0.38)   | —              | 18.8<br>(0.74)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L3             | 0.508                                  |   |               |    |       |
| LVR025S     | —              | 9.6<br>(0.38)   | —              | 17.4<br>(0.69)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L5             | 0.472                                  |   |               |    |       |
| LVR033K     | —              | 11.4<br>(0.45)  | —              | 19.0<br>(0.75)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L3             | 0.628                                  |   |               |    |       |
| LVR033S     | —              | 11.4<br>(0.45)  | —              | 16.5<br>(0.65)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L5             | 0.600                                  |   |               |    |       |
| LVR040K     | —              | 11.5<br>(0.46)  | —              | 20.9<br>(0.82)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L3             | 0.698                                  |   |               |    |       |
| LVR040S     | —              | 11.5<br>(0.46)  | —              | 19.5<br>(0.77)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 3.8<br>(0.15) | L5             | 0.688                                  |   |               |    |       |
| LVR055K     | —              | 14.0<br>(0.55)  | —              | 22.4<br>(0.88)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 4.1<br>(0.16) | L3             | 1.100                                  |   |               |    |       |
| LVR055S     | —              | 14.0<br>(0.55)  | —              | 21.7<br>(0.85)  | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —             | 4.1<br>(0.16) | L5             | 1.060                                  |   |               |    |       |
| LVR075S     | —              | 11.5<br>(0.45)  | —              | 23.4<br>(0.92)  | 4.1<br>(0.16) | 6.1<br>(0.24)  | 5.1<br>(0.20) | —   | —             | 4.8<br>(0.19) | L5             | 1.088                                  |   |               |    |       |
| LVR100S     | —              | 18.7<br>(0.74)  | —              | 24.4<br>(0.96)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —   | —             | 5.1<br>(0.20) | L4             | 1.345                                  |   |               |    |       |
| LVR125S     | —              | 21.2<br>(0.84)  | —              | 27.4<br>(1.08)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —   | —             | 5.3<br>(0.21) | L4             | 1.800                                  |   |               |    |       |
| LVR200S     | —              | 24.9<br>(0.98)  | —              | 33.8<br>(1.33)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —   | —             | 6.1<br>(0.24) | L5             | 2.777                                  |   |               |    |       |
| LVR075S-240 | —              | 11.5<br>(0.45)  | —              | 23.4<br>(0.92)  | 4.1<br>(0.16) | 6.1<br>(0.24)  | 5.1<br>(0.20) | —   | —             | 4.8<br>(0.19) | L5             | 1.088                                  |   |               |    |       |
| LVR100S-240 | —              | 18.7<br>(0.74)  | —              | 24.4<br>(0.96)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —   | —             | 5.1<br>(0.20) | L4             | 1.345                                  |   |               |    |       |
| LVR125S-240 | —              | 21.2<br>(0.84)  | —              | 27.4<br>(1.08)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —   | —             | 5.3<br>(0.21) | L4             | 1.800                                  |   |               |    |       |
| LVR200S-240 | —              | 24.9<br>(0.98)  | —              | 33.8<br>(1.33)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —   | —             | 6.1<br>(0.24) | L5             | 2.777                                  |   |               |    |       |
| LVR075K-240 | —              | 11.5<br>(0.45)  | —              | 25.4<br>(1.00)  | 4.1<br>(0.16) | 6.1<br>(0.24)  | 7.6<br>(0.30) | —   | —             | 4.1<br>(0.16) | L3             | 1.088                                  |   |               |    |       |
| LVR100K-240 | —              | 18.7<br>(0.74)  | —              | 28.8<br>(1.13)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 7.6<br>(0.30) | —   | —             | 4.1<br>(0.16) | L2             | 1.345                                  |   |               |    |       |
| LVR125K-240 | —              | 21.2<br>(0.84)  | —              | 31.8<br>(1.25)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 7.6<br>(0.30) | —   | —             | 4.1<br>(0.16) | L2             | 1.800                                  |   |               |    |       |
| LVR200K-240 | —              | 24.9<br>(0.98)  | —              | 34.80<br>(1.37) | 8.9<br>(0.35) | 11.4<br>(0.45) | 7.6<br>(0.30) | —   | —             | 4.1<br>(0.16) | L7             | 2.777                                  |   |               |    |       |
| <b>LVB</b>  |                |                 |                |                 |               |                |               |     |               |               |                |  |   |               |    |       |
| LVB125      | 24.8<br>(0.98) | 25.2<br>(0.999) | 26.8<br>(1.06) | 27.2<br>(1.07)  | 8.9<br>(0.35) | 11.4<br>(0.45) | 5.1<br>(0.20) | —   | 4.2<br>(0.17) | 4.6<br>(0.18) | 20.0<br>(0.79) | 20.3<br>(0.80)                         | — | 2.5<br>(0.80) | L6 | 1.653 |

Figure L8 — Typical Time-to-Trip Curves at 20°C

**LVR/LVB**

|   |   |                   |
|---|---|-------------------|
| A | = | LVR005N           |
| B | = | LVR008N           |
| C | = | LVR012            |
| D | = | LVR016            |
| E | = | LVR025            |
| F | = | LVR033            |
| G | = | LVR040            |
| H | = | LVR055            |
| I | = | LVR075/LVR075-240 |
| J | = | LVR100/LVR100-240 |
| K | = | LVR125/LVR125-240 |
| L | = | LVB125            |
| M | = | LVR200/LVR200-240 |

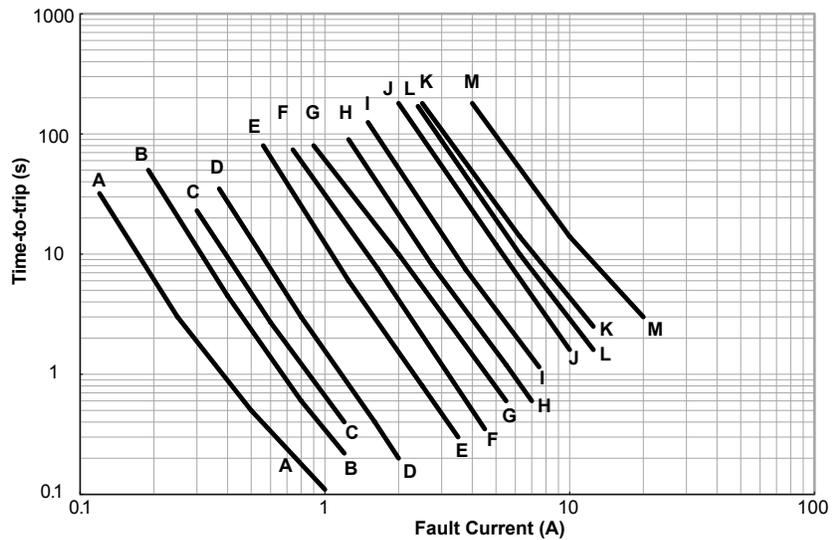


Table L5 — Physical Characteristics and Environmental Specifications

| LVR/LVB                   |   |  |
|---------------------------|---|--|
| Physical Characteristics  |   |  |
| Lead Material             | LVR005N to LVR016   | : Tin-plated Copper, (24AWG), $\phi$ 0.51mm (0.020in)      |
|                           | LVR025 to LVR040  | : Tin-plated Copper, (22AWG), $\phi$ 0.64mm (0.025in)      |
|                           | LVR055 to LVR200  | : Tin-plated Copper, (20AWG), $\phi$ 0.81mm (0.032in)      |
|                           | LVR075-240 to LVR200-240  | : Tin-plated Copper, (20AWG), $\phi$ 0.81mm (0.032in)      |
|                           | LVB125  | : Tin-plated Copper, (20AWG), $\phi$ 0.81mm (0.032in)      |
| Soldering Characteristics | Solderability per ANSI/J-STD-002 Category 3   |  |
| Solder Heat Withstand     | Per IEC-STD 68-2-20, Test Tb, Method 1A, Condition B, Can Withstand 10 s at 260°C $\pm$ 5°C |  |
| Insulating Material       | LVR005N to LVR055   | : Cured, Flame-retardant Epoxy Polymer, Meets UL 94V-0     |
|                           | LVR075 to LVR200  | : Cured, Flame-retardant Modified Silicone, Meets UL 94V-0 |
|                           | LVR075-240 to LVR200-240  | : Cured, Flame-retardant Epoxy Polymer, Meets UL 94V-0     |
|                           | LVB125  | : Glass Reinforced PBT, Meets UL 94V-0                     |

**Note:** Devices are not intended to be placed through a reflow process.

| Environmental Specifications |                          |                   |
|------------------------------|--------------------------|-------------------|
| Test                         | Conditions               | Resistance Change |
| Passive Aging                | 70°C, 1000 hrs           | $\pm$ 10%         |
|                              | 85°C, 1000 hrs           | $\pm$ 10%         |
| Humidity Aging               | 85°C, 85% RH, 1000 hrs   | $\pm$ 20%         |
| Thermal Shock                | 85°C, -40°C (10 Times)   | $\pm$ 15%         |
| Solvent Resistance           | MIL-STD-202, Method 215F | No Change         |

## Agency Recognitions

|     |  |
|-----|--|
| UL  | File # E74889  |
| CSA | File # CA78165   |
| TÜV | Certificate Number Available on Request (per IEC 60730-1). |

Table L6 — Packaging and Marking Information

| Part Number    | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|----------------|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>LVR/LVB</b> |              |                        |                    |                           |              |                    |
| LVR005NK       | 500          | —                      | —                  | 10,000                    | L005         | UL, CSA, TÜV, CQC  |
| LVR005NK-2     | —            | 1,500                  | —                  | 7,500                     | L005         | UL, CSA, TÜV, CQC  |
| LVR005NS       | 500          | —                      | —                  | 10,000                    | L005         | UL, CSA, TÜV, CQC  |
| LVR005NS-2     | —            | 1,500                  | —                  | 7,500                     | L005         | UL, CSA, TÜV, CQC  |
| LVR008NK       | 500          | —                      | —                  | 10,000                    | L008         | UL, CSA, TÜV, CQC  |
| LVR008NK-2     | —            | 1,500                  | —                  | 7,500                     | L008         | UL, CSA, TÜV, CQC  |
| LVR008NS       | 500          | —                      | —                  | 10,000                    | L008         | UL, CSA, TÜV, CQC  |
| LVR008NS-2     | —            | 1,500                  | —                  | 7,500                     | L008         | UL, CSA, TÜV, CQC  |
| LVR012K        | 500          | —                      | —                  | 10,000                    | L012         | UL, CSA, TÜV, CQC  |
| LVR012K-2      | —            | 2,000                  | —                  | 10,000                    | L012         | UL, CSA, TÜV, CQC  |
| LVR012S        | 500          | —                      | —                  | 10,000                    | L012         | UL, CSA, TÜV, CQC  |
| LVR012S-2      | —            | 2,000                  | —                  | 10,000                    | L012         | UL, CSA, TÜV, CQC  |
| LVR016K        | 500          | —                      | —                  | 10,000                    | L016         | UL, CSA, TÜV, CQC  |
| LVR016K-2      | —            | 2,000                  | —                  | 10,000                    | L016         | UL, CSA, TÜV, CQC  |
| LVR016S        | 500          | —                      | —                  | 10,000                    | L016         | UL, CSA, TÜV, CQC  |
| LVR016S-2      | —            | 2,000                  | —                  | 10,000                    | L016         | UL, CSA, TÜV, CQC  |
| LVR025K        | 500          | —                      | —                  | 10,000                    | L025         | UL, CSA, TÜV, CQC  |
| LVR025K-2      | —            | 2,000                  | —                  | 10,000                    | L025         | UL, CSA, TÜV, CQC  |
| LVR025S        | 500          | —                      | —                  | 10,000                    | L025         | UL, CSA, TÜV, CQC  |
| LVR025S-2      | —            | 2,000                  | —                  | 10,000                    | L025         | UL, CSA, TÜV, CQC  |
| LVR033K        | 500          | —                      | —                  | 10,000                    | L033         | UL, CSA, TÜV, CQC  |
| LVR033K-2      | —            | 2,000                  | —                  | 10,000                    | L033         | UL, CSA, TÜV, CQC  |
| LVR033S        | 500          | —                      | —                  | 10,000                    | L033         | UL, CSA, TÜV, CQC  |
| LVR033S-2      | —            | 2,000                  | —                  | 10,000                    | L033         | UL, CSA, TÜV, CQC  |
| LVR040K        | 500          | —                      | —                  | 10,000                    | L040         | UL, CSA, TÜV, CQC  |
| LVR040K-2      | —            | 2,000                  | —                  | 10,000                    | L040         | UL, CSA, TÜV, CQC  |
| LVR040S        | 500          | —                      | —                  | 10,000                    | L040         | UL, CSA, TÜV, CQC  |
| LVR040S-2      | —            | 2,000                  | —                  | 10,000                    | L040         | UL, CSA, TÜV, CQC  |
| LVR055K        | 500          | —                      | —                  | 10,000                    | L055         | UL, CSA, TÜV, CQC  |
| LVR055S        | 500          | —                      | —                  | 10,000                    | L055         | UL, CSA, TÜV, CQC  |
| LVR055S-2      | —            | 1,000                  | —                  | 5,000                     | L055         | UL, CSA, TÜV, CQC  |
| LVR075S        | 500          | —                      | —                  | 10,000                    | L075         | UL, CSA, TÜV, CQC  |
| LVR100S        | 250          | —                      | —                  | 5,000                     | L100         | UL, CSA, TÜV, CQC  |
| LVR125S        | 250          | —                      | —                  | 5,000                     | L125         | UL, CSA, TÜV, CQC  |
| LVR200S        | 250          | —                      | —                  | 5,000                     | L200         | UL, CSA, TÜV, CQC  |
| LVR075S-240    | 500          | —                      | —                  | 10,000                    | L075         | UL, CSA, TÜV, CQC  |
| LVR075S-240-2  | —            | 1,000                  | —                  | 5,000                     | L075         | UL, CSA, TÜV, CQC  |
| LVR075S-240-AP | —            | —                      | 1,000              | 5,000                     | L075         | UL, CSA, TÜV, CQC  |
| LVR100S-240    | 250          | —                      | —                  | 5,000                     | L100         | UL, CSA, TÜV, CQC  |
| LVR100S-240-2  | —            | 1,000                  | —                  | 5,000                     | L100         | UL, CSA, TÜV, CQC  |
| LVR100S-240-AP | —            | —                      | 1,000              | 5,000                     | L100         | UL, CSA, TÜV, CQC  |
| LVR125S-240    | 250          | —                      | —                  | 5,000                     | L125         | UL, CSA, TÜV, CQC  |
| LVR125S-240-2  | —            | 1,000                  | —                  | 5,000                     | L125         | UL, CSA, TÜV, CQC  |
| LVR125S-240-AP | —            | —                      | 1,000              | 5,000                     | L125         | UL, CSA, TÜV, CQC  |
| LVR200S-240    | 250          | —                      | —                  | 5,000                     | L200         | UL, CSA, TÜV, CQC  |
| LVR200S-240-2  | —            | 1,000                  | —                  | 5,000                     | L200         | UL, CSA, TÜV, CQC  |
| LVR200S-240-AP | —            | —                      | 1,000              | 5,000                     | L200         | UL, CSA, TÜV, CQC  |
| LVR075K-240    | 500          | —                      | —                  | 10,000                    | L075         | UL, CSA, TÜV, CQC  |
| LVR075K-240-2  | —            | 1,000                  | —                  | 5,000                     | L075         | UL, CSA, TÜV, CQC  |
| LVR075K-240-AP | —            | —                      | 1,000              | 5,000                     | L075         | UL, CSA, TÜV, CQC  |
| LVR100K-240    | 250          | —                      | —                  | 5,000                     | L100         | UL, CSA, TÜV, CQC  |
| LVR100K-240-2  | —            | 1,000                  | —                  | 5,000                     | L100         | UL, CSA, TÜV, CQC  |
| LVR100K-240-AP | —            | —                      | 1,000              | 5,000                     | L100         | UL, CSA, TÜV, CQC  |
| LVR125K-240    | 250          | —                      | —                  | 5,000                     | L125         | UL, CSA, TÜV, CQC  |
| LVR125K-240-2  | —            | 1,000                  | —                  | 5,000                     | L125         | UL, CSA, TÜV, CQC  |
| LVR125K-240-AP | —            | —                      | 1,000              | 5,000                     | L125         | UL, CSA, TÜV, CQC  |
| LVR200K-240    | 250          | —                      | —                  | 5,000                     | L200         | UL, CSA, TÜV, CQC  |
| LVR200K-240-2  | —            | 1,000                  | —                  | 5,000                     | L200         | UL, CSA, TÜV, CQC  |
| LVR200K-240-AP | —            | —                      | 1,000              | 5,000                     | L200         | UL, CSA, TÜV, CQC  |
| LVB125         | 250          | —                      | —                  | 5,000                     | B125         | UL                 |

Table L7 — Tape and Reel Specifications

LVR devices are available in tape and reel packaging per EIA468-B/IEC60286-2 standards.  
See Figures L9 and L10 for details.

| Description   | EIA Mark       | Dimension (mm) | Tolerance  |
|---|----------------|----------------|------------|
| Carrier Tape Width  | W              | 18             | -0.5/+1.0  |
| Hold-down Tape Width                                      | W <sub>4</sub> | 11             | Minimum    |
| Top Distance between Tape Edges                           | W <sub>6</sub> | 3              | Maximum    |
| Sprocket Hole Position                                    | W <sub>5</sub> | 9              | -0.5/+0.75 |
| Sprocket Hole Diameter                                    | D <sub>0</sub> | 4              | ± 0.2      |
| Abscissa to Plane (Straight Lead) (LVR005N to LVR200)     | H              | 18.5           | ± 2.5      |
| Abscissa to Plane (Kinked Lead) (LVR005N to LVR055)       | H <sub>0</sub> | 16.0           | ± 0.5      |
| Abscissa to Top (LVR005N to LVR016)                       | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to Top* (LVR025 to LVR200)                       | H <sub>1</sub> | 45.0           | Maximum    |
| Overall Width with Lead Protrusion (LVR005N to LVR016)    | C <sub>1</sub> | 43.2           | Maximum    |
| Overall Width with Lead Protrusion (LVR025 to LVR200)     | C <sub>1</sub> | 56.0           | Maximum    |
| Overall Width without Lead Protrusion (LVR005N to LVR016) | C <sub>2</sub> | 42.5           | Maximum    |
| Overall Width without Lead Protrusion (LVR025 to LVR200)  | C <sub>2</sub> | 56.0           | Maximum    |
| Lead Protrusion   | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of Cut-out                                     | L              | 11.0           | Maximum    |
| Protrusion beyond Hold-down Tape                          | l <sub>2</sub> | Not Specified  | —          |
| Sprocket Hole Pitch                                       | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device Pitch (LVR005N to LVR040)                          | —              | 12.7           | ± 0.3      |
| Device Pitch (LVR055 to LVR200)                           | —              | 25.4           | ± 0.6      |
| Pitch Tolerance   | —              | 20 Consecutive | ± 1        |
| Tape Thickness  | t              | 0.9            | Maximum    |
| Overall Tape and Lead Thickness (LVR005N to LVR040)       | t <sub>1</sub> | 1.5            | Maximum    |
| Overall Tape and Lead Thickness (LVR055 to LVR200)        | t <sub>1</sub> | 2.3            | Maximum    |
| Splice Sprocket Hole Alignment                            | —              | 0              | ± 0.3      |
| Body Lateral Deviation                                    | Δh             | 0              | ± 1.0      |
| Body Tape Plane Deviation                                 | Δp             | 0              | ± 1.3      |
| Ordinate to Adjacent Component Lead                       | P <sub>1</sub> | 3.81           | ± 0.7      |
| Lead Spacing*   | F              | 5.08           | +0.75/-0.5 |
| Reel Width (LVR005N to LVR040)                            | W <sub>2</sub> | 56.0           | Maximum    |
| Reel Width* (LVR055 to LVR200)                            | W <sub>2</sub> | 63.5           | Maximum    |
| Reel Diameter   | a              | 370.0          | Maximum    |
| Space between Flanges* (LVR005N to LVR040)                | W <sub>1</sub> | 48.0           | Maximum    |
| Space between Flanges* (LVR055 to LVR200)                 | W <sub>1</sub> | 55.0           | Maximum    |
| Arbor Hold Diameter                                       | c              | 26.0           | ± 12.0     |
| Core Diameter*  | n              | 91.0           | Maximum    |
| Box   | —              | 64/372/362     | Maximum    |
| Consecutive Missing Places                                | —              | None           | —          |
| Empty Places per Reel                                     | —              | 0.1%           | Maximum    |

\*Differs from EIA specification.

Figure L9 – EIA Referenced Taped Component Dimensions

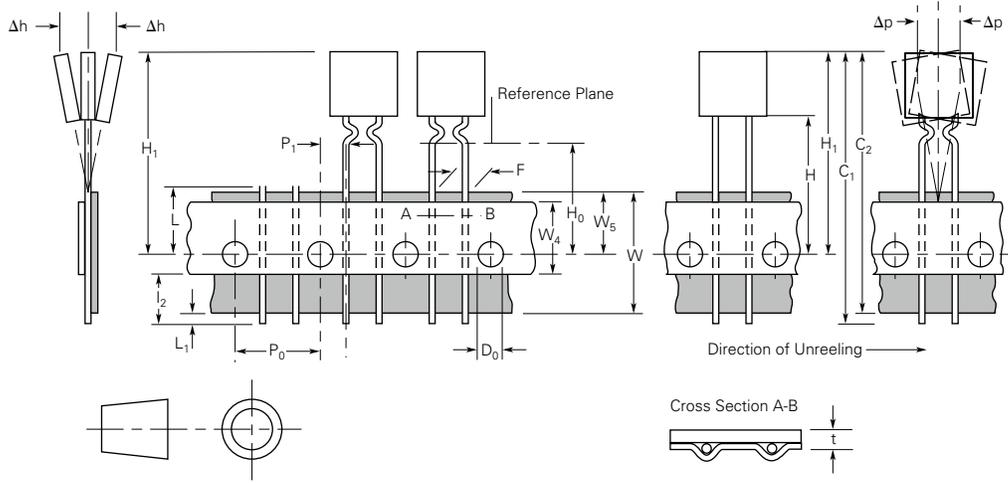
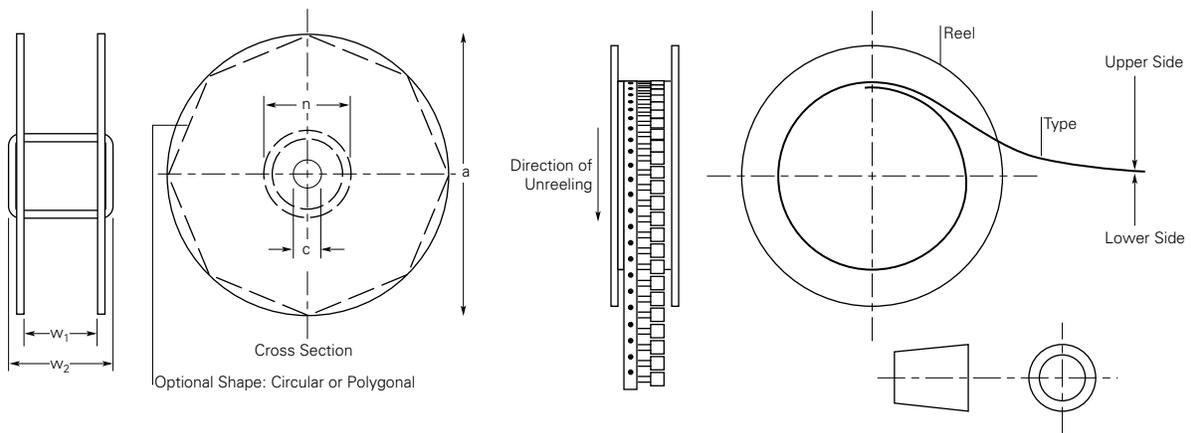


Figure L10 – EIA Referenced Reel Dimensions

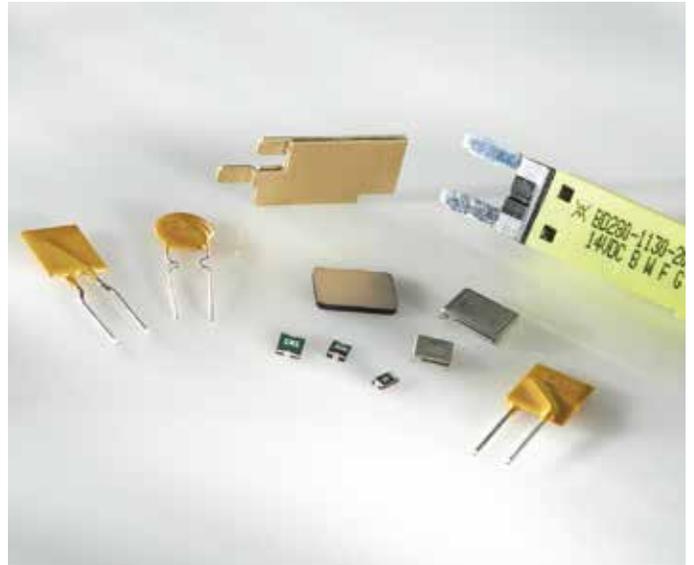




# POLYSWITCH RESETTABLE DEVICES

## Automotive Devices

We have provided PPTC resettable devices for the automotive industry for over 25 years. With the advent of TS16949 and our continued involvement in the automotive industry, TE Circuit Protection developed automotive-specific versions of our PolySwitch PPTC devices (the nanoASMD, microASMD, miniASMD, AHS, ASMD, AHRF, AHEF, AGRF and BD families). These products are qualified and sold under the PS400 specification which is derived from AEC-Q200, the standard for electronic components used in the automotive industry. The key difference between these product families and other protection devices in our circuit protection product portfolio is the qualification process that is followed that includes a series of rigorous tests related to the automotive environment. As a result, they are characterized by specific additional values determined following automotive-related testing.



### BENEFITS

- Expertise from the world's leading resettable overcurrent protection manufacturer
- High-quality products from the world's largest passive component manufacturer
- Worldwide team dedicated to support automotive applications
- Wide range of dedicated automotive surface-mount and radial-leaded resettable overcurrent devices
- High-performance transient voltage protection devices

### FEATURES

- RoHS compliant
- Overcurrent and overvoltage circuit protection devices
- Resettable and single-use overcurrent devices
- Wide range of form factor and termination methods
- Products meet applicable automotive industry standards
- Devices compatible with high-volume electronics assembly

### APPLICATIONS

- Motor and motor circuit protection including power door-locks, mirrors, lumbar pumps, seats, sunroofs and windows
- Electronic Control Unit (ECU) I/O protection
- Heating, Ventilation and Cooling (HVAC) motor and I/O protection
- Telematics, infotainment and navigations systems
- Liquid Crystal Display (LCD) back-light heaters
- Power and cigarette lighter outlets, plugs and adapter/chargers
- Powered networks and buses
- Air-flow detection and overcurrent protection in HVAC and cooling fan systems
- Stall detection in express window and sunroof circuits
- Resettable overcurrent protection for power distribution, electrical centers and junction boxes
- Wire downsizing
- Motor electromagnetic interference (EMI) suppression
- Electrostatic discharge (ESD) damage protection
- Load dump and other transient voltage protection

Table A1 – Product Series - Current Rating, Voltage Rating/Typical Resistance

| Voltage Rating          | AGRF 16V | AHRF 16V | AHRF 30V | AHEF 32V | AHS 16V | ASMD 16V | ASMD 30V | ASMD 33V | ASMD 60V | BD 14V   | BD 16V  |
|-------------------------|----------|----------|----------|----------|---------|----------|----------|----------|----------|----------|---------|
| <b>Hold Current (A)</b> |          |          |          |          |         |          |          |          |          |          |         |
| 0.30                    | —        | —        | —        | —        | —       | —        | —        | —        | 2.90Ω    | —        | —       |
| 0.50                    | —        | —        | 0.565Ω   | 0.5650Ω  | —       | —        | —        | —        | 0.90Ω    | —        | —       |
| 0.70                    | —        | —        | 0.385Ω   | 0.3850Ω  | —       | —        | —        | —        | —        | —        | —       |
| 0.75                    | —        | —        | —        | —        | —       | —        | 0.60Ω    | —        | —        | —        | —       |
| 0.80                    | —        | —        | —        | —        | 0.250Ω  | —        | —        | —        | —        | —        | —       |
| 1.00                    | —        | —        | 0.225Ω   | 0.2250Ω  | —       | —        | 0.30Ω    | —        | —        | —        | —       |
| 1.20                    | —        | —        | —        | —        | 0.245Ω  | —        | —        | —        | —        | —        | —       |
| 1.25                    | —        | —        | —        | —        | —       | 0.160Ω   | —        | —        | —        | —        | —       |
| 1.50                    | —        | —        | —        | —        | —       | 0.140Ω   | —        | 0.149Ω   | —        | —        | —       |
| 1.60                    | —        | —        | —        | —        | 0.100Ω  | —        | —        | —        | —        | —        | —       |
| 1.85                    | —        | —        | —        | —        | —       | 0.079Ω   | —        | —        | —        | —        | —       |
| 2.00                    | —        | 0.0565Ω  | —        | —        | 0.070Ω  | 0.090Ω   | —        | —        | —        | —        | —       |
| 2.50                    | —        | —        | —        | —        | —       | 0.060Ω   | —        | —        | —        | —        | —       |
| 3.00                    | —        | 0.0410Ω  | —        | 0.0520Ω  | 0.050Ω  | —        | —        | —        | —        | —        | —       |
| 4.00                    | 0.0300Ω  | 0.0305Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 4.50                    | —        | 0.0290Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 5.00                    | 0.0192Ω  | —        | —        | 0.0200Ω  | —       | —        | —        | —        | —        | —        | —       |
| 5.50                    | —        | 0.0190Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 6.00                    | 0.0145Ω  | 0.0180Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 6.50                    | —        | 0.0140Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 7.00                    | 0.0105Ω  | 0.0126Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 7.50                    | —        | 0.0120Ω  | —        | 0.0120Ω  | —       | —        | —        | —        | —        | —        | —       |
| 8.00                    | 0.0086Ω  | 0.0104Ω  | —        | —        | —       | —        | —        | —        | —        | 0.01150Ω | —       |
| 9.00                    | 0.0070Ω  | 0.0100Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 10.00                   | 0.0056Ω  | 0.0083Ω  | —        | 0.0083Ω  | —       | —        | —        | —        | —        | —        | —       |
| 11.00                   | 0.0050Ω  | 0.0069Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 12.00                   | 0.0046Ω  | —        | —        | —        | —       | —        | —        | —        | —        | 0.00600Ω | —       |
| 13.00                   | —        | 0.0055Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 14.00                   | 0.0040Ω  | 0.0050Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 15.00                   | —        | 0.0050Ω  | —        | —        | —       | —        | —        | —        | —        | —        | —       |
| 16.00                   | —        | —        | —        | —        | —       | —        | —        | —        | —        | 0.00365Ω | —       |
| 20.00                   | —        | —        | —        | —        | —       | —        | —        | —        | —        | 0.00285Ω | —       |
| 21.00                   | —        | —        | —        | —        | —       | —        | —        | —        | —        | 0.00260Ω | 0.0030Ω |

| Voltage Rating          | nanoASMD 48V | nanoASMD 24V | nanoASMD 16V | microASMD 30V | miniASMD 60V | miniASMD 30V | miniASMD 24V | miniASMD 16V |
|-------------------------|--------------|--------------|--------------|---------------|--------------|--------------|--------------|--------------|
| <b>Hold Current (A)</b> |              |              |              |               |              |              |              |              |
| 0.05                    | —            | —            | —            | 26.80Ω        | —            | —            | —            | —            |
| 0.10                    | —            | —            | —            | 8.55Ω         | 6.70Ω        | —            | —            | —            |
| 0.12                    | 3.95Ω        | —            | —            | —             | —            | —            | —            | —            |
| 0.14                    | —            | —            | —            | —             | 3.75Ω        | —            | —            | —            |
| 0.16                    | 3.05Ω        | —            | —            | —             | —            | —            | —            | —            |
| 0.20                    | —            | 1.875Ω       | —            | —             | —            | 1.950Ω       | —            | —            |
| 0.30                    | —            | —            | —            | —             | —            | 0.975Ω       | —            | —            |
| 0.35                    | —            | —            | 0.90Ω        | —             | —            | —            | —            | —            |
| 0.50                    | —            | —            | —            | —             | —            | —            | 0.575Ω       | —            |
| 0.75                    | —            | —            | —            | —             | —            | —            | 0.190Ω       | —            |
| 1.10                    | —            | —            | —            | —             | —            | —            | 0.120Ω       | 0.1200Ω      |
| 1.25                    | —            | —            | —            | —             | —            | —            | —            | 0.0950Ω      |
| 1.50                    | —            | —            | —            | —             | —            | —            | 0.080Ω       | 0.0750Ω      |
| 2.60                    | —            | —            | —            | —             | —            | —            | —            | 0.0325Ω      |

Table A2 – Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

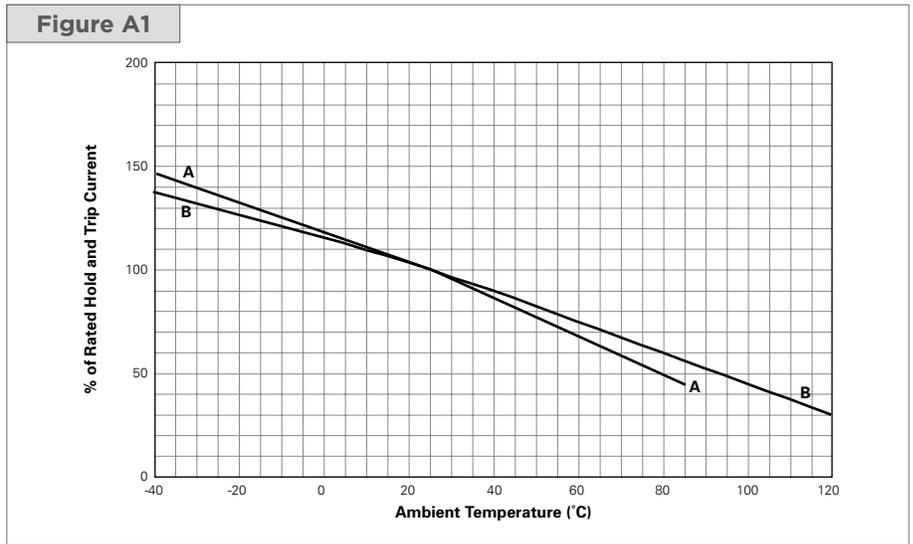
| Part Number  | Maximum Ambient Temperature |       |       |      |      |      |       |      |      |       |       |
|--|-----------------------------|-------|-------|------|------|------|-------|------|------|-------|-------|
|  | -40°C                       | -20°C | 0°C   | 20°C | 25°C | 40°C | 50°C  | 60°C | 70°C | 85°C  | 125°C |
| <b>AGRF (High Temperature)<br/>16V – Radial-leaded</b> |                             |       |       |      |      |      |       |      |      |       |       |
| AGRF400  | 5.9                         | 5.3   | 4.8   | 4.1  | 4.0  | 3.5  | 3.2   | 2.8  | 2.5  | 1.9   | —     |
| AGRF500  | 7.3                         | 6.6   | 6.0   | 5.2  | 5.0  | 4.4  | 4.0   | 3.6  | 3.1  | 2.4   | —     |
| AGRF600  | 8.8                         | 8.0   | 7.2   | 6.2  | 6.0  | 5.2  | 4.8   | 4.2  | 3.8  | 2.8   | —     |
| AGRF700  | 10.3                        | 9.3   | 8.4   | 7.3  | 7.0  | 6.2  | 5.6   | 5.0  | 4.4  | 3.3   | —     |
| AGRF800  | 11.7                        | 10.7  | 9.6   | 8.3  | 8.0  | 6.9  | 6.4   | 5.6  | 5.1  | 3.7   | —     |
| AGRF900  | 13.2                        | 11.9  | 10.7  | 9.4  | 9.0  | 7.9  | 7.2   | 6.4  | 5.6  | 4.2   | —     |
| AGRF1000   | 14.7                        | 13.3  | 12.0  | 10.3 | 10.0 | 8.7  | 8.0   | 7.0  | 6.3  | 4.7   | —     |
| AGRF1100   | 16.1                        | 14.6  | 13.1  | 11.5 | 11.0 | 9.7  | 8.8   | 7.8  | 6.9  | 5.2   | —     |
| AGRF1200   | 17.6                        | 16.0  | 14.4  | 12.4 | 12.0 | 10.4 | 9.6   | 8.4  | 7.6  | 5.6   | —     |
| AGRF1400   | 20.5                        | 18.7  | 16.8  | 14.5 | 14.0 | 12.1 | 11.2  | 9.8  | 8.9  | 6.5   | —     |
| <b>AHRF (High Temperature)<br/>30V – Radial-leaded</b> |                             |       |       |      |      |      |       |      |      |       |       |
| AHRF050  | 0.7                         | 0.6   | 0.6   | 0.5  | 0.5  | 0.4  | 0.4   | 0.4  | 0.3  | 0.3   | 0.1   |
| AHRF070  | 1.0                         | 0.9   | 0.8   | 0.7  | 0.7  | 0.6  | 0.6   | 0.5  | 0.5  | 0.4   | 0.2   |
| AHRF100  | 1.4                         | 1.2   | 1.1   | 1.0  | 1.0  | 0.9  | 0.8   | 0.7  | 0.7  | 0.6   | 0.2   |
| <b>AHRF (High Temperature)<br/>16V – Radial-leaded</b> |                             |       |       |      |      |      |       |      |      |       |       |
| AHRF200  | 2.7                         | 2.5   | 2.3   | 2.1  | 2.0  | 1.8  | 1.6   | 1.5  | 1.3  | 1.1   | 0.5   |
| AHRF300  | 4.1                         | 3.7   | 3.4   | 3.1  | 3.0  | 2.7  | 2.4   | 2.2  | 2.0  | 1.7   | 0.7   |
| AHRF400  | 5.6                         | 5.1   | 4.7   | 4.2  | 4.0  | 3.6  | 3.3   | 3.0  | 2.7  | 2.3   | 1.0   |
| AHRF450  | 6.1                         | 5.6   | 5.1   | 4.6  | 4.5  | 4.0  | 3.6   | 3.3  | 3.0  | 2.5   | 1.1   |
| AHRF550  | 7.5                         | 6.9   | 6.2   | 5.7  | 5.5  | 4.9  | 4.4   | 4.0  | 3.7  | 3.1   | 1.4   |
| AHRF600  | 8.2                         | 7.5   | 6.8   | 6.2  | 6.0  | 5.3  | 4.9   | 4.4  | 4.0  | 3.3   | 1.5   |
| AHRF650  | 8.8                         | 8.1   | 7.4   | 6.7  | 6.5  | 5.7  | 5.3   | 4.8  | 4.3  | 3.6   | 1.6   |
| AHRF700  | 9.5                         | 8.7   | 8.0   | 7.2  | 7.0  | 6.2  | 5.6   | 5.2  | 4.7  | 3.9   | 1.7   |
| AHRF750  | 10.2                        | 9.4   | 8.6   | 7.7  | 7.5  | 6.6  | 6.1   | 5.6  | 5.0  | 4.1   | 1.9   |
| AHRF800  | 10.9                        | 10.0  | 9.1   | 8.2  | 8.0  | 7.1  | 6.4   | 5.9  | 5.3  | 4.4   | 2.0   |
| AHRF900  | 12.2                        | 11.2  | 10.2  | 9.3  | 9.0  | 8.0  | 7.2   | 6.6  | 6.0  | 5.0   | 2.2   |
| AHRF1000   | 13.6                        | 12.5  | 11.4  | 10.3 | 10.0 | 8.8  | 8.1   | 7.4  | 6.6  | 5.5   | 2.5   |
| AHRF1100   | 14.9                        | 13.7  | 12.5  | 11.3 | 11.0 | 9.7  | 8.8   | 8.1  | 7.3  | 6.1   | 2.7   |
| AHRF1300   | 17.7                        | 16.3  | 14.8  | 13.4 | 13.0 | 11.4 | 10.5  | 9.6  | 8.6  | 7.2   | 3.3   |
| AHRF1400   | 19.0                        | 17.5  | 15.9  | 14.4 | 14.0 | 12.4 | 11.2  | 10.3 | 9.3  | 7.8   | 3.5   |
| AHRF1500   | 20.4                        | 18.8  | 17.1  | 15.5 | 15.0 | 13.2 | 12.1  | 11.1 | 9.9  | 8.3   | 3.8   |
| <b>AHEF (High Temperature)<br/>32V – Radial-leaded</b> |                             |       |       |      |      |      |       |      |      |       |       |
| AHEF050  | 0.7                         | 0.6   | 0.60  | 0.5  | 0.5  | 0.4  | 0.400 | 0.40 | 0.30 | 0.300 | 0.1   |
| AHEF070  | 1.0                         | 0.9   | 0.80  | 0.7  | 0.7  | 0.6  | 0.600 | 0.50 | 0.50 | 0.400 | 0.2   |
| AHEF100  | 1.4                         | 1.2   | 1.10  | 1.0  | 1.0  | 0.9  | 0.800 | 0.70 | 0.70 | 0.600 | 0.2   |
| AHEF300  | 4.1                         | 3.8   | 3.42  | 3.1  | 3.0  | 2.7  | 2.430 | 2.22 | 1.98 | 1.650 | 0.6   |
| AHEF500  | 6.8                         | 6.3   | 5.70  | 5.2  | 5.0  | 4.5  | 4.050 | 3.70 | 3.30 | 2.750 | 1.0   |
| AHEF750  | 10.2                        | 9.4   | 8.55  | 7.7  | 7.5  | 6.7  | 6.075 | 5.55 | 4.95 | 4.125 | 1.5   |
| AHEF1000   | 13.6                        | 12.5  | 11.40 | 10.3 | 10.0 | 8.9  | 8.100 | 7.40 | 6.60 | 5.500 | 2.0   |
| <b>AHS (High Temperature)<br/>16V – Surface-mount</b>  |                             |       |       |      |      |      |       |      |      |       |       |
| AHS080-2018  | 1.20                        | 1.04  | 0.90  | 0.8  | 0.77 | 0.68 | 0.62  | 0.60 | 0.53 | 0.46  | 0.26  |
| AHS120   | 1.72                        | 1.54  | 1.36  | 1.2  | 1.14 | 1.01 | 0.92  | 0.83 | 0.74 | 0.61  | 0.25  |
| AHS160   | 2.15                        | 1.96  | 1.78  | 1.6  | 1.55 | 1.42 | 1.33  | 1.24 | 1.15 | 1.01  | 0.64  |
| AHS200   | 2.90                        | 2.50  | 2.20  | 2.0  | 1.94 | 1.80 | 1.75  | 1.70 | 1.40 | 1.18  | 0.67  |
| AHS300   | 4.20                        | 3.80  | 3.70  | 3.0  | 2.92 | 2.63 | 2.44  | 2.10 | 2.00 | 1.76  | 1.00  |

Table A2 – Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] (Cont'd)

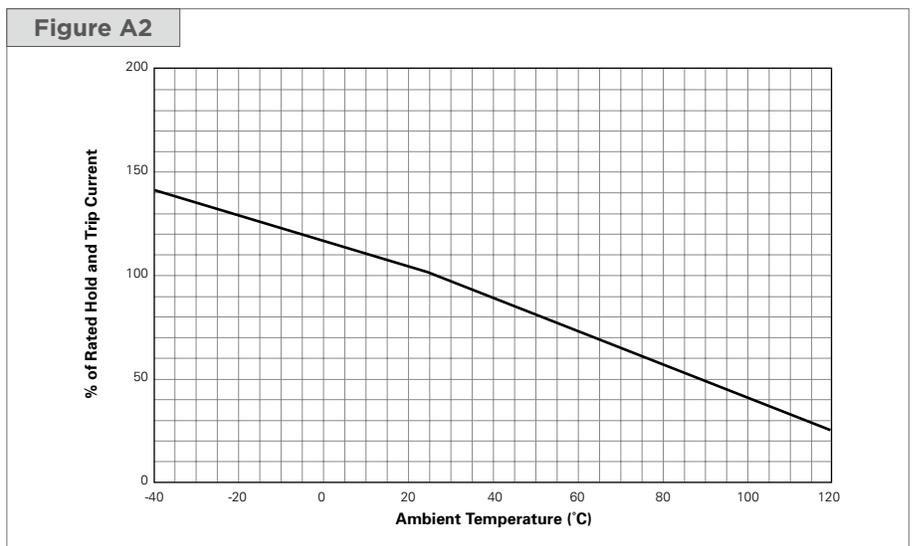
| Part Number                   | Maximum Ambient Temperature |       |      |      |      |      |      |      |      |      |       |
|-------------------------------|-----------------------------|-------|------|------|------|------|------|------|------|------|-------|
|                               | -40°C                       | -20°C | 0°C  | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 85°C | 125°C |
| <b>ASMD</b>                   |                             |       |      |      |      |      |      |      |      |      |       |
| <b>16-60V – Surface-mount</b> |                             |       |      |      |      |      |      |      |      |      |       |
| ASMD030F                      | 0.35                        | 0.31  | 0.27 | 0.23 | 0.22 | 0.19 | 0.17 | 0.15 | 0.13 | 0.11 | —     |
| ASMD050F                      | 0.59                        | 0.53  | 0.46 | 0.39 | 0.37 | 0.33 | 0.29 | 0.26 | 0.23 | 0.18 | —     |
| ASMD075F                      | 0.91                        | 0.81  | 0.71 | 0.60 | 0.58 | 0.50 | 0.45 | 0.40 | 0.35 | 0.28 | —     |
| ASMD100F                      | 1.37                        | 1.22  | 1.06 | 0.90 | 0.86 | 0.76 | 0.68 | 0.60 | 0.52 | 0.41 | —     |
| ASMD125F                      | 1.58                        | 1.40  | 1.23 | 1.04 | 1.00 | 0.87 | 0.78 | 0.70 | 0.60 | 0.48 | —     |
| ASMD150F                      | 1.93                        | 1.70  | 1.50 | 1.27 | 1.22 | 1.07 | 0.95 | 0.85 | 0.74 | 0.58 | —     |
| <b>NEW</b> ASMD150F/33        | 1.96                        | 1.73  | 1.50 | 1.26 | 1.20 | 1.03 | 0.91 | 0.80 | 0.68 | 0.51 | —     |
| ASMD185F                      | 2.93                        | 2.58  | 2.30 | 1.93 | 1.85 | 1.62 | 1.44 | 1.30 | 1.12 | 0.88 | —     |
| ASMD200F                      | 2.63                        | 2.34  | 2.04 | 1.73 | 1.66 | 1.45 | 1.30 | 1.16 | 1.00 | 0.80 | —     |
| ASMD250F                      | 3.00                        | 2.66  | 2.32 | 1.97 | 1.89 | 1.65 | 1.48 | 1.32 | 1.14 | 0.91 | —     |
| <b>nanoASMD</b>               |                             |       |      |      |      |      |      |      |      |      |       |
| <b>16-48V – Surface-mount</b> |                             |       |      |      |      |      |      |      |      |      |       |
| nanoASMD012F                  | 0.20                        | 0.17  | 0.15 | 0.13 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | —     |
| nanoASMD016F                  | 0.21                        | 0.20  | 0.18 | 0.16 | 0.16 | 0.14 | 0.13 | 0.12 | 0.11 | 0.09 | —     |
| nanoASMD020F                  | 0.34                        | 0.30  | 0.26 | 0.22 | 0.20 | 0.17 | 0.15 | 0.13 | 0.11 | 0.08 | —     |
| nanoASMD035F                  | 0.58                        | 0.51  | 0.44 | 0.38 | 0.35 | 0.31 | 0.28 | 0.24 | 0.21 | 0.16 | —     |
| <b>microASMD</b>              |                             |       |      |      |      |      |      |      |      |      |       |
| <b>30V – Surface-mount</b>    |                             |       |      |      |      |      |      |      |      |      |       |
| microASMD005F                 | 0.08                        | 0.07  | 0.06 | 0.05 | 0.05 | 0.04 | 0.04 | 0.03 | 0.03 | 0.02 | —     |
| microASMD010F                 | 0.15                        | 0.13  | 0.12 | 0.10 | 0.10 | 0.09 | 0.08 | 0.06 | 0.06 | 0.05 | —     |
| <b>miniASMD</b>               |                             |       |      |      |      |      |      |      |      |      |       |
| <b>16-60V – Surface-mount</b> |                             |       |      |      |      |      |      |      |      |      |       |
| miniASMD010F                  | 0.17                        | 0.15  | 0.13 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.06 | 0.04 | —     |
| miniASMD014F                  | 0.23                        | 0.20  | 0.17 | 0.14 | 0.13 | 0.11 | 0.10 | 0.09 | 0.07 | 0.05 | —     |
| miniASMD020F                  | 0.30                        | 0.27  | 0.23 | 0.20 | 0.19 | 0.17 | 0.15 | 0.13 | 0.12 | 0.09 | —     |
| miniASMD030F                  | 0.49                        | 0.44  | 0.39 | 0.32 | 0.30 | 0.27 | 0.24 | 0.22 | 0.18 | 0.14 | —     |
| miniASMD050F                  | 0.59                        | 0.57  | 0.55 | 0.50 | 0.48 | 0.45 | 0.43 | 0.35 | 0.30 | 0.23 | —     |
| miniASMD075F/24               | 1.50                        | 1.25  | 1.00 | 0.75 | 0.73 | 0.65 | 0.60 | 0.55 | 0.50 | 0.43 | —     |
| miniASMD0110F/16              | 1.68                        | 1.49  | 1.30 | 1.10 | 1.05 | 0.92 | 0.83 | 0.75 | 0.64 | 0.50 | —     |
| miniASMD0110F/24              | 2.00                        | 1.70  | 1.40 | 1.10 | 1.06 | 0.95 | 0.88 | 0.80 | 0.73 | 0.61 | —     |
| miniASMD0125F/16              | 2.00                        | 1.69  | 1.47 | 1.25 | 1.17 | 1.03 | 0.92 | 0.90 | 0.69 | 0.53 | —     |
| miniASMD0150F/16              | 2.40                        | 2.10  | 1.80 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.69 | —     |
| miniASMD0150F/24              | 2.10                        | 1.90  | 1.70 | 1.50 | 1.44 | 1.25 | 1.13 | 1.00 | 0.88 | 0.69 | —     |
| miniASMD0260F/16              | 3.50                        | 3.20  | 3.00 | 2.60 | 2.53 | 2.30 | 2.15 | 2.00 | 1.85 | 1.63 | —     |
| <b>BD</b>                     |                             |       |      |      |      |      |      |      |      |      |       |
| <b>14-16V – Bladed Device</b> |                             |       |      |      |      |      |      |      |      |      |       |
| BD280-1130-10/16              | 12.4                        | 11.0  | 9.7  | 8.3  | 8.0  | 7.0  | 6.3  | 5.6  | 5.0  | 4.0  | 1.8   |
| BD280-1130-15/16              | 17.4                        | 15.7  | 14.1 | 12.4 | 12.0 | 10.8 | 9.9  | 9.1  | 8.3  | 7.0  | 2.6   |
| BD280-1130-20/16              | 24.0                        | 21.6  | 19.1 | 16.6 | 16.0 | 14.1 | 12.9 | 11.7 | 10.4 | 8.6  | 3.5   |
| BD280-1927-25/16-W            | 32.0                        | 28.3  | 24.6 | 20.9 | 20.0 | 17.2 | 15.4 | 13.5 | 11.7 | 8.9  | 4.4   |
| BD280-1927-30/16-W            | 34.1                        | 30.1  | 26.0 | 22.0 | 21.0 | 18.0 | 16.0 | 14.0 | 11.9 | 9.1  | 4.6   |
| BD540-30                      | 34.1                        | 30.1  | 26.0 | 22.0 | 21.0 | 18.0 | 16.0 | 14.0 | 11.9 | 9.1  | 4.6   |

Figures A1-A4 – Thermal Derating Curves

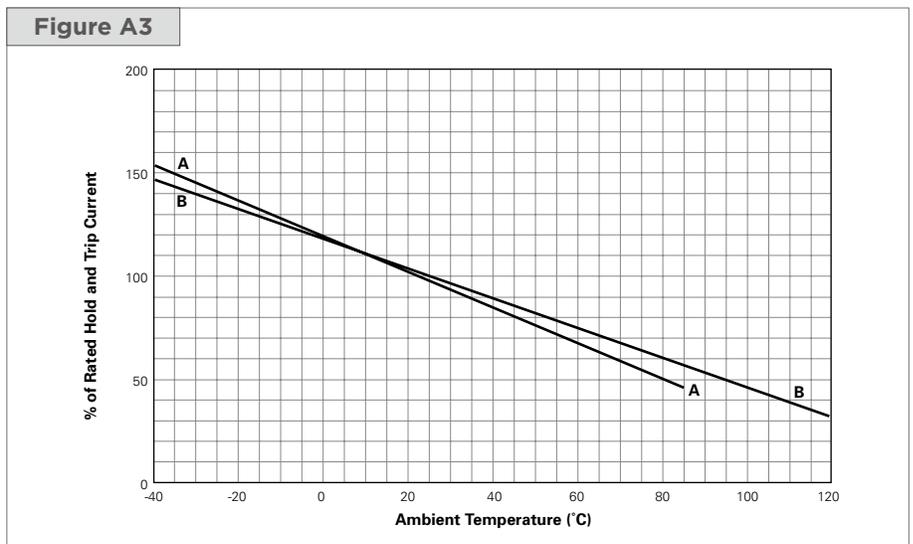
A = AGRF  
B = AHRF



AHEF



A = ASMD, nanoASMD, microASMD, miniASMD  
B = AHS



## Figures A1-A4 – Thermal Derating Curves

(Cont'd)

BD

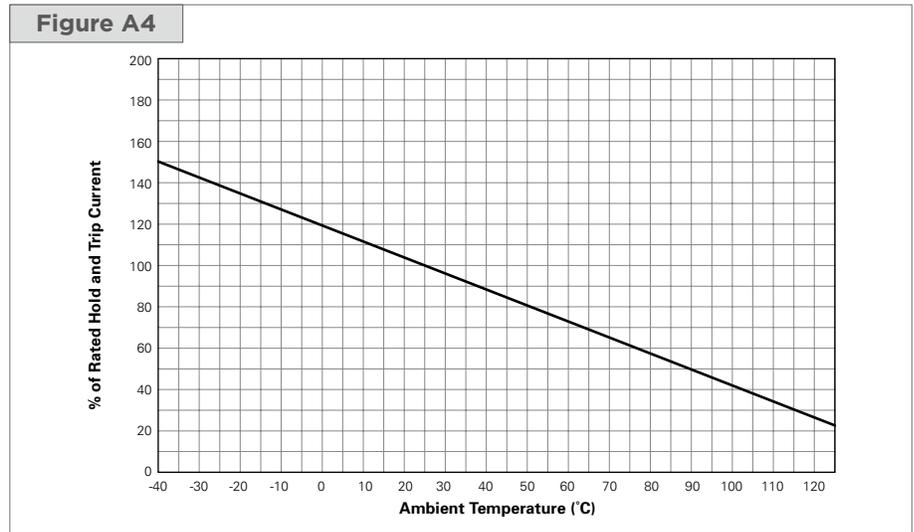


Table A3 – Electrical Characteristics

| Part Number                    | $I_H(A)@$  | $I_H(A)@$  | $I_T$<br>(A) | $V_{MAX}$<br>( $V_{DC}$ ) | $I_{MAX}$<br>(A) | $P_{D(TYP)}$<br>(W) | Max. Time-to-trip |      | $R_{MIN}$<br>( $\Omega$ ) | $R_{1MAX}$<br>( $\Omega$ ) | $R_{BMAX}$<br>( $\Omega$ ) | Figure for Dimensions |
|--------------------------------|------------|------------|--------------|---------------------------|------------------|---------------------|-------------------|------|---------------------------|----------------------------|----------------------------|-----------------------|
|                                | $R_{1MAX}$ | $R_{BMAX}$ |              |                           |                  |                     | (A)               | (s)  |                           |                            |                            |                       |
| <b>AGRF</b>                    |            |            |              |                           |                  |                     |                   |      |                           |                            |                            |                       |
| <b>16V – Radial-leaded</b>     |            |            |              |                           |                  |                     |                   |      |                           |                            |                            |                       |
| AGRF400                        | 4.0        | 3.0        | 7.6          | 16                        | 100              | 2.5                 | 20.0              | 2.0  | 0.0186                    | 0.0610                     | 0.0850                     | A5, A8, A9            |
| AGRF500                        | 5.0        | 4.3        | 9.4          | 16                        | 100              | 2.7                 | 25.0              | 2.5  | 0.0140                    | 0.0340                     | 0.0480                     | A5, A8, A9            |
| AGRF600                        | 6.0        | 5.3        | 10.7         | 16                        | 100              | 2.8                 | 30.0              | 3.5  | 0.0095                    | 0.0280                     | 0.0320                     | A5, A8, A9            |
| AGRF700                        | 7.0        | 6.5        | 13.2         | 16                        | 100              | 3.0                 | 35.0              | 4.0  | 0.0066                    | 0.0200                     | 0.0220                     | A5, A8, A9            |
| AGRF800                        | 8.0        | 7.6        | 15.0         | 16                        | 100              | 3.2                 | 40.0              | 5.5  | 0.0049                    | 0.0175                     | 0.0181                     | A5, A8, A9            |
| AGRF900                        | 9.0        | 8.6        | 16.5         | 16                        | 100              | 3.4                 | 45.0              | 6.0  | 0.0041                    | 0.0135                     | 0.0140                     | A5, A8, A9            |
| AGRF1000                       | 10.0       | 9.6        | 18.5         | 16                        | 100              | 3.6                 | 50.0              | 7.0  | 0.0034                    | 0.0102                     | 0.0106                     | A5, A8, A9            |
| AGRF1100                       | 11.0       | 10.5       | 20.3         | 16                        | 100              | 3.7                 | 55.0              | 7.5  | 0.0033                    | 0.0089                     | 0.0093                     | A5, A8, A9            |
| AGRF1200                       | 12.0       | 11.5       | 22.1         | 16                        | 100              | 4.2                 | 60.0              | 8.0  | 0.0030                    | 0.0086                     | 0.0091                     | A5, A8, A9            |
| AGRF1400                       | 14.0       | 13.0       | 27.3         | 16                        | 100              | 4.6                 | 70.0              | 9.0  | 0.0022                    | 0.0064                     | 0.0067                     | A5, A8, A9            |
| <b>AHRF (High Temperature)</b> |            |            |              |                           |                  |                     |                   |      |                           |                            |                            |                       |
| <b>30V – Radial-leaded</b>     |            |            |              |                           |                  |                     |                   |      |                           |                            |                            |                       |
| AHRF050                        | 0.5        | 0.5        | 1.0          | 30                        | 40               | 0.9                 | 2.5               | 3.0  | 0.3500                    | 1.100                      | 1.100                      | A8, A9, A11           |
| AHRF070                        | 0.7        | 0.7        | 1.4          | 30                        | 40               | 1.4                 | 3.5               | 3.2  | 0.2300                    | 0.800                      | 0.800                      | A5, A8, A9            |
| AHRF100                        | 1.0        | 1.0        | 1.9          | 30                        | 40               | 1.4                 | 5.0               | 6.2  | 0.1500                    | 0.430                      | 0.430                      | A8, A9, A10           |
| <b>AHRF (High Temperature)</b> |            |            |              |                           |                  |                     |                   |      |                           |                            |                            |                       |
| <b>16V – Radial-leaded</b>     |            |            |              |                           |                  |                     |                   |      |                           |                            |                            |                       |
| AHRF200                        | 2.0        | 2.0        | 3.8          | 16                        | 100              | 1.4                 | 10.0              | 4.8  | 0.0390                    | 0.1100                     | 0.1100                     | A8, A9, A10           |
| AHRF300                        | 3.0        | 3.0        | 6.5          | 16                        | 100              | 3.0                 | 15.0              | 5.0  | 0.0290                    | 0.0790                     | 0.0790                     | A5, A8, A9            |
| AHRF400                        | 4.0        | 4.0        | 7.4          | 16                        | 100              | 3.3                 | 20.0              | 5.0  | 0.0210                    | 0.0600                     | 0.0600                     | A5, A8, A9            |
| AHRF450                        | 4.5        | 4.5        | 8.7          | 16                        | 100              | 3.6                 | 22.5              | 4.0  | 0.0170                    | 0.0540                     | 0.0540                     | A5, A8, A9            |
| AHRF550                        | 5.5        | 5.5        | 10.0         | 16                        | 100              | 3.5                 | 27.5              | 6.0  | 0.0130                    | 0.0370                     | 0.0370                     | A5, A8, A9            |
| AHRF600                        | 6.0        | 6.0        | 12.0         | 16                        | 100              | 4.1                 | 30.0              | 6.5  | 0.0100                    | 0.0320                     | 0.0320                     | A5, A8, A9            |
| AHRF650                        | 6.5        | 6.5        | 13.7         | 16                        | 100              | 4.3                 | 32.5              | 7.0  | 0.0090                    | 0.0260                     | 0.0260                     | A5, A8, A9            |
| AHRF700                        | 7.0        | 7.0        | 13.1         | 16                        | 100              | 4.0                 | 35.0              | 7.0  | 0.0087                    | 0.0250                     | 0.0250                     | A5, A8, A9            |
| AHRF750                        | 7.5        | 7.5        | 14.8         | 16                        | 100              | 4.5                 | 37.5              | 8.0  | 0.0074                    | 0.0220                     | 0.0220                     | A5, A8, A9            |
| AHRF800                        | 8.0        | 8.0        | 15.0         | 16                        | 100              | 4.2                 | 40.0              | 8.0  | 0.0072                    | 0.0200                     | 0.0200                     | A5, A8, A9            |
| AHRF900                        | 9.0        | 9.0        | 18.5         | 16                        | 100              | 5.0                 | 45.0              | 11.5 | 0.0061                    | 0.0170                     | 0.0170                     | A5, A8, A9            |
| AHRF1000                       | 10.0       | 10.0       | 20.5         | 16                        | 100              | 5.3                 | 50.0              | 10.5 | 0.0051                    | 0.0150                     | 0.0150                     | A5, A8, A9            |
| AHRF1100                       | 11.0       | 11.0       | 21.2         | 16                        | 100              | 5.5                 | 55.0              | 11.0 | 0.0048                    | 0.0130                     | 0.0130                     | A5, A8, A9            |
| AHRF1300                       | 13.0       | 13.0       | 27.0         | 16                        | 100              | 6.9                 | 65.0              | 15.0 | 0.0034                    | 0.0100                     | 0.0100                     | A5, A8, A9            |
| AHRF1400                       | 14.0       | 14.0       | 28.3         | 16                        | 100              | 6.9                 | 70.0              | 15.5 | 0.0029                    | 0.0090                     | 0.0090                     | A5, A8, A9            |
| AHRF1500                       | 15.0       | 15.0       | 33.0         | 16                        | 100              | 7.0                 | 75.0              | 20.0 | 0.0027                    | 0.0092                     | 0.0092                     | A5, A8, A9            |

Table A3 – Electrical Characteristics

(Cont'd)

| Part Number                    | $I_H(A)@$  | $I_H(A)@$  | $I_T$ | $V_{MAX}$ | $I_{MAX}$ | $P_{D\ TYP}$ | Max. Time-to-trip |       | $R_{MIN}$ | $R_{1MAX}$ | $R_{aMAX}$ | Figure for Dimensions |
|--------------------------------|------------|------------|-------|-----------|-----------|--------------|-------------------|-------|-----------|------------|------------|-----------------------|
|                                | $R_{1MAX}$ | $R_{aMAX}$ |       |           |           |              | (A)               | (s)   |           |            |            |                       |
| <b>AHEF (High Temperature)</b> |            |            |       |           |           |              |                   |       |           |            |            |                       |
| <b>32V – Radial-leaded</b>     |            |            |       |           |           |              |                   |       |           |            |            |                       |
| AHEF050                        | 0.5        | 0.5        | 1.0   | 32        | 100       | 0.9          | 2.5               | 3.0   | 0.3500    | 1.100      | 1.100      | A8, A9, A10           |
| AHEF070                        | 0.7        | 0.7        | 1.4   | 32        | 100       | 1.4          | 3.5               | 3.2   | 0.2300    | 0.800      | 0.800      | A8, A9, A11           |
| AHEF100                        | 1.0        | 1.0        | 1.9   | 32        | 100       | 1.4          | 5.0               | 6.2   | 0.1500    | 0.430      | 0.430      | A8, A9, A10           |
| AHEF300                        | 3.0        | 3.0        | 6.0   | 32        | 100       | 3.2          | 15.0              | 5.0   | 0.0350    | 0.110      | 0.110      | A8, A9, A12           |
| AHEF500                        | 5.0        | 5.0        | 10.0  | 32        | 100       | 5.3          | 25.0              | 9.0   | 0.0150    | 0.040      | 0.040      | A8, A9, A12           |
| AHEF750                        | 7.5        | 7.5        | 15.0  | 32        | 100       | 6.5          | 37.5              | 13.0  | 0.0074    | 0.023      | 0.023      | A8, A9, A12           |
| AHEF1000                       | 10.0       | 10.0       | 20.0  | 32        | 100       | 7.0          | 50.0              | 15.0  | 0.0060    | 0.016      | 0.016      | A8, A9, A12           |
| <b>AHS (High Temperature)</b>  |            |            |       |           |           |              |                   |       |           |            |            |                       |
| <b>16V – Surface-mount</b>     |            |            |       |           |           |              |                   |       |           |            |            |                       |
| AHS080-2018                    | 0.80       | 0.80       | 2.00  | 16        | 70        | 1.5          | 8.0               | 9.0   | 0.130     | 0.550      | 0.550      | A6                    |
| AHS120                         | 1.20       | 1.20       | 2.30  | 16        | 50        | 2.2          | 8.0               | 2.0   | 0.150     | 0.340      | 0.340      | A7                    |
| AHS160                         | 1.60       | 1.60       | 3.20  | 16        | 70        | 2.2          | 8.0               | 15.0  | 0.050     | 0.150      | 0.150      | A7                    |
| AHS200                         | 2.00       | 2.00       | 4.00  | 16        | 70        | 2.3          | 8.0               | 13.4  | 0.050     | 0.140      | 0.140      | A7                    |
| AHS300                         | 3.00       | 3.00       | 6.00  | 16        | 70        | 3.0          | 15.0              | 8.0   | 0.024     | 0.083      | 0.083      | A7                    |
| <b>ASMD</b>                    |            |            |       |           |           |              |                   |       |           |            |            |                       |
| <b>16-60V – Surface-mount</b>  |            |            |       |           |           |              |                   |       |           |            |            |                       |
| ASMD030F                       | 0.23       | 0.23       | 0.59  | 60        | 10        | 1.1          | 1.15              | 12.0  | 0.980     | 4.800      | 4.800      | A7                    |
| ASMD050F                       | 0.37       | 0.37       | 0.98  | 60        | 10        | 1.7          | 1.95              | 20.0  | 0.290     | 1.400      | 1.400      | A7                    |
| ASMD075F                       | 0.60       | 0.60       | 1.48  | 30        | 40        | 1.1          | 3.00              | 20.0  | 0.290     | 1.000      | 1.000      | A7                    |
| ASMD100F                       | 0.90       | 0.90       | 2.16  | 30        | 40        | 1.1          | 4.50              | 20.0  | 0.098     | 0.480      | 0.480      | A7                    |
| ASMD125F                       | 1.04       | 1.04       | 2.46  | 16        | 40        | 1.1          | 5.20              | 20.0  | 0.057     | 0.250      | 0.250      | A7                    |
| ASMD150F                       | 1.27       | 1.27       | 2.95  | 16        | 40        | 1.2          | 6.35              | 25.0  | 0.049     | 0.250      | 0.250      | A7                    |
| <b>NEW</b> ASMD150F/33         | 1.20       | 1.20       | 2.88  | 33        | 40        | 1.9          | 6.00              | 14.0  | 0.068     | 0.230      | 0.230      | A7                    |
| ASMD185F                       | 1.85       | 1.85       | 3.70  | 16        | 40        | 1.5          | 9.25              | 11.3  | 0.032     | 0.126      | 0.126      | A7                    |
| ASMD200F                       | 1.73       | 1.73       | 3.93  | 16        | 40        | 1.2          | 8.65              | 30.0  | 0.050     | 0.120      | 0.120      | A7                    |
| ASMD250F                       | 1.97       | 1.97       | 5.00  | 16        | 40        | 1.2          | 9.85              | 30.0  | 0.035     | 0.085      | 0.085      | A7                    |
| <b>nanoASMD</b>                |            |            |       |           |           |              |                   |       |           |            |            |                       |
| <b>16-48V – Surface-mount</b>  |            |            |       |           |           |              |                   |       |           |            |            |                       |
| nanoASMD012F                   | 0.12       | 0.12       | 0.39  | 48        | 10        | 0.5          | 1.0               | 0.2   | 1.40      | 6.50       | 6.50       | A15                   |
| nanoASMD016F                   | 0.16       | 0.16       | 0.45  | 48        | 10        | 0.5          | 1.0               | 0.3   | 1.10      | 5.00       | 5.00       | A15                   |
| nanoASMD020F                   | 0.20       | 0.20       | 0.42  | 24        | 100       | 0.6          | 8.0               | 0.1   | 0.65      | 3.10       | 3.10       | A15                   |
| nanoASMD035F                   | 0.35       | 0.75       | 0.75  | 16        | 20        | 0.6          | 3.5               | 0.1   | 0.45      | 1.35       | 1.35       | A15                   |
| <b>microASMD</b>               |            |            |       |           |           |              |                   |       |           |            |            |                       |
| <b>30V – Surface-mount</b>     |            |            |       |           |           |              |                   |       |           |            |            |                       |
| microASMD005F                  | 0.05       | 0.05       | 0.15  | 30        | 10        | 1.0          | 0.25              | 1.5   | 3.6       | 50.0       | 50.0       | A15                   |
| microASMD010F                  | 0.10       | 0.10       | 0.25  | 30        | 10        | 0.8          | 0.50              | 1.0   | 2.1       | 15.0       | 15.0       | A15                   |
| <b>miniASMD</b>                |            |            |       |           |           |              |                   |       |           |            |            |                       |
| <b>16-60V – Surface-mount</b>  |            |            |       |           |           |              |                   |       |           |            |            |                       |
| miniASMD010F                   | 0.10       | 0.10       | 0.30  | 60        | 40        | 0.75         | 0.5               | 5.000 | 0.700     | 12.70      | 12.70      | A15                   |
| miniASMD014F                   | 0.14       | 0.14       | 0.28  | 60        | 10        | 0.75         | 8.0               | 0.008 | 1.500     | 6.00       | 6.00       | A15                   |
| miniASMD020F                   | 0.20       | 0.20       | 0.40  | 30        | 10        | 0.80         | 8.0               | 0.020 | 0.600     | 3.30       | 3.30       | A15                   |
| miniASMD030F                   | 0.30       | 0.30       | 0.60  | 30        | 40        | 0.80         | 8.0               | 0.100 | 0.200     | 1.75       | 1.75       | A15                   |
| miniASMD050F                   | 0.50       | 0.50       | 1.00  | 24        | 100       | 0.80         | 8.0               | 0.150 | 0.150     | 1.00       | 1.00       | A15                   |
| miniASMD075F/24                | 0.75       | 0.75       | 1.50  | 24        | 40        | 0.80         | 8.0               | 0.300 | 0.090     | 0.29       | 0.29       | A15                   |
| miniASMD110F/16                | 1.10       | 1.10       | 2.20  | 16        | 100       | 0.80         | 8.0               | 0.300 | 0.060     | 0.18       | 0.18       | A15                   |
| miniASMD110F/24                | 1.10       | 1.10       | 2.20  | 24        | 20        | 0.80         | 8.0               | 0.500 | 0.060     | 0.18       | 0.18       | A15                   |
| miniASMD125F/16                | 1.25       | 1.25       | 2.50  | 16        | 100       | 0.80         | 8.0               | 0.400 | 0.050     | 0.14       | 0.14       | A15                   |
| miniASMD150F/16                | 1.50       | 1.50       | 2.80  | 16        | 100       | 0.80         | 8.0               | 0.500 | 0.040     | 0.11       | 0.11       | A15                   |
| miniASMD150F/24                | 1.50       | 1.50       | 3.00  | 24        | 20        | 1.00         | 8.0               | 1.500 | 0.040     | 0.12       | 0.12       | A15                   |
| miniASMD260F/16                | 2.60       | 2.60       | 5.00  | 16        | 100       | 1.20         | 8.0               | 5.000 | 0.015     | 0.05       | 0.05       | A15                   |

## Table A3 – Electrical Characteristics

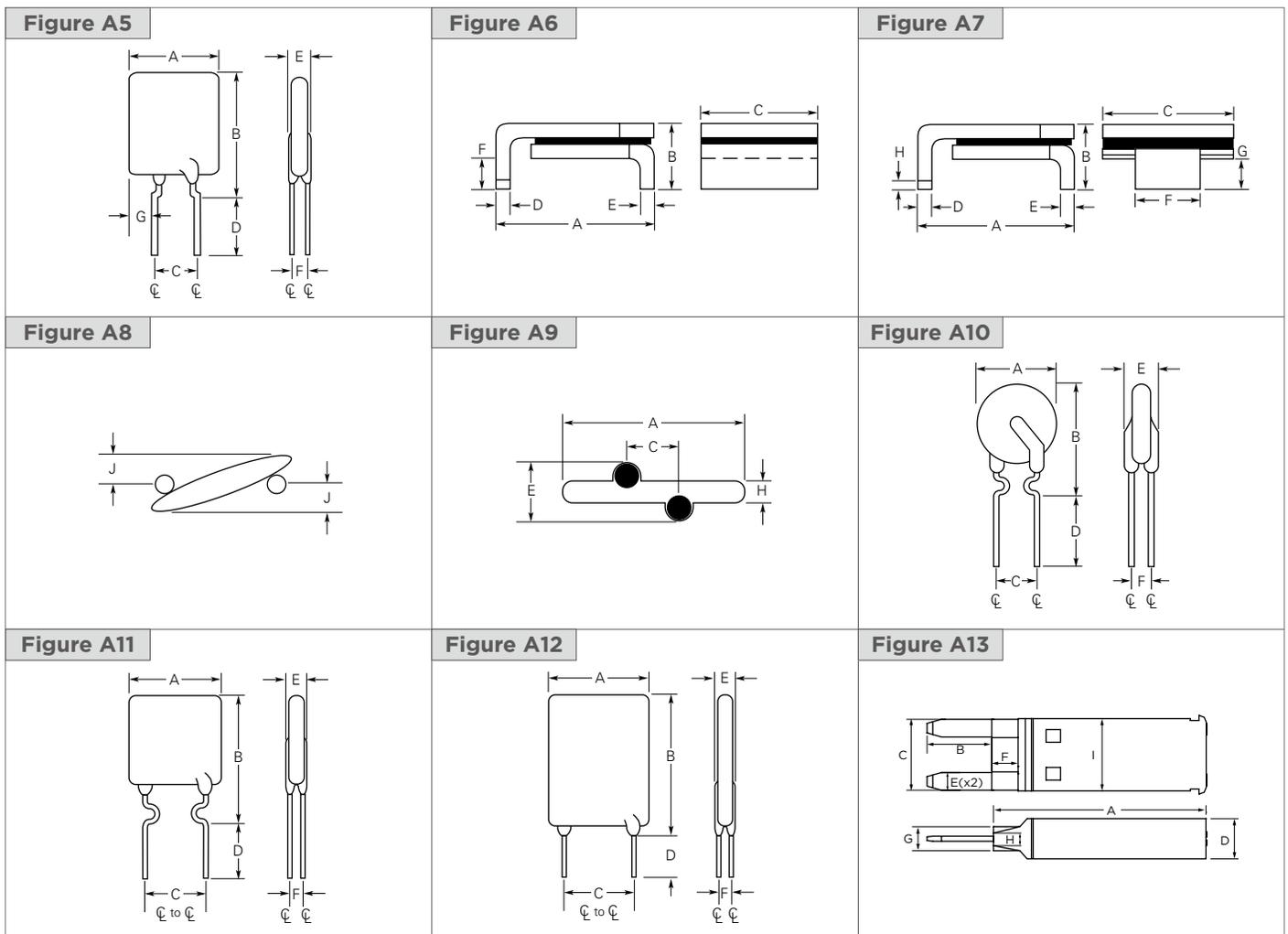
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| Part Number                   | $I_H(A)@$  | $I_H(A)@$  | $I_T$<br>(A) | $V_{MAX}$<br>(V <sub>DC</sub> ) | $I_{MAX}$<br>(A) | $P_{D\ TYP}$<br>(W) | Max. Time-to-trip |     | $R_{MIN}$<br>(Ω) | $R_{1MAX}$<br>(Ω) | $R_{aMAX}$<br>(Ω) | Figure for Dimensions |
|-------------------------------|------------|------------|--------------|---------------------------------|------------------|---------------------|-------------------|-----|------------------|-------------------|-------------------|-----------------------|
|                               | $R_{1MAX}$ | $R_{aMAX}$ |              |                                 |                  |                     | (A)               | (s) |                  |                   |                   |                       |
| <b>BD 14V – Bladed Device</b> |            |            |              |                                 |                  |                     |                   |     |                  |                   |                   |                       |
| BD280-1130-10/16              | 8          | 8          | 13           | 14                              | 100              | 4.4                 | 40                | 8   | 0.0095           | 0.0185            | 0.0185            | A13                   |
| BD280-1130-15/16              | 12         | 12         | 20           | 14                              | 100              | 4.5                 | 60                | 8   | 0.0050           | 0.0070            | 0.0070            | A13                   |
| BD280-1130-20/16              | 16         | 16         | 26           | 14                              | 100              | 5.2                 | 80                | 10  | 0.0028           | 0.0064            | 0.0064            | A13                   |
| BD280-1927-25/16-W            | 20         | 20         | 32           | 14                              | 100              | 6.0                 | 100               | 13  | 0.0024           | 0.0042            | 0.0042            | A14                   |
| BD280-1927-30/16-W            | 21         | 21         | 38           | 14                              | 100              | 6.2                 | 120               | 13  | 0.0021           | 0.0043            | 0.0043            | A14                   |
| <b>BD 16V – Bladed Device</b> |            |            |              |                                 |                  |                     |                   |     |                  |                   |                   |                       |
| BD540-30                      | 21         | 21         | 40           | 16                              | 100              | 6                   | 120               | 13  | 0.0016           | 0.0044            | 0.0044            | A16                   |

**Notes:**

- $I_H$  : Hold current: maximum current device will pass without interruption in 25°C, unless otherwise specified (20°C for ASMD).
- $I_T$  : Trip current: minimum current that will switch the device from low-resistance to high-resistance in 25°C still air, unless otherwise specified.
- $V_{MAX}$  : Maximum voltage device can withstand without damage at rated current.
- $I_{MAX}$  : Maximum fault current device can withstand without damage at rated voltage.
- $P_D$  : Power dissipated from device when in the tripped state in 25°C still air, unless otherwise specified.
- $R_{MIN}$  : Minimum resistance of device as supplied at 25°C, unless otherwise specified.
- $R_{1MAX}$  : Maximum resistance of device when measured one hour post reflow (surface-mount device) or one hour post trip (radial-leaded device) at 25°C unless otherwise specified.
- $R_{aMAX}$  : Maximum functional resistance of device after being subjected to the stresses described in PS400 at 25°C, unless otherwise specified.
- $R_{aMIN}$  : Minimum functional resistance of device after being subjected to the stresses described in PS400 at 25°C, unless otherwise specified.

## Figures A5-A16 – Dimension Figures



### Figures A5-A16 — Dimension Figures

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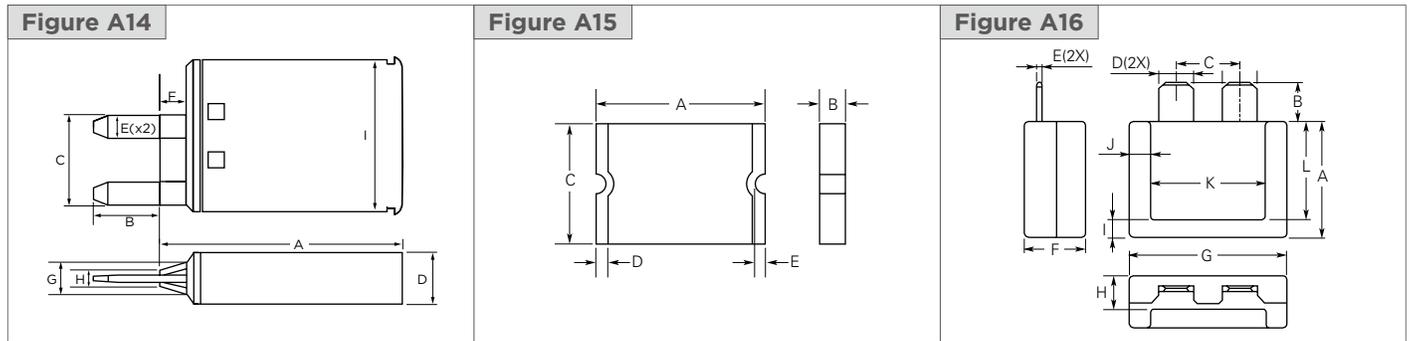


Table A4 — Dimensions in Millimeters and (Inches)

| Part Number                    | A   |                  | B   |                | C             |                | D             |     | E   |               | F             |     | G   |                 | H               | J             | Figure         |
|--------------------------------|-----|------------------|-----|----------------|---------------|----------------|---------------|-----|-----|---------------|---------------|-----|-----|-----------------|-----------------|---------------|----------------|
|                                | Min | Max              | Min | Max            | Min           | Max            | Min           | Max | Min | Max           | Min           | Max | Min | Max             | Typ             | Max           |                |
| <b>AGRF</b>                    |     |                  |     |                |               |                |               |     |     |               |               |     |     |                 |                 |               |                |
| <b>16V — Radial-leaded</b>     |     |                  |     |                |               |                |               |     |     |               |               |     |     |                 |                 |               |                |
| AGRF400                        | —   | 8.9<br>(0.350)   | —   | 14.1<br>(0.56) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.15) | —   | —   | 3.10<br>(0.120) | 1.24<br>(0.049) | 1.4<br>(0.06) | A5, A8,<br>A9  |
| AGRF500                        | —   | 10.4<br>(0.410)  | —   | 15.6<br>(0.61) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 3.94<br>(0.155) | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AGRF600                        | —   | 10.7<br>(0.420)  | —   | 18.4<br>(0.73) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 4.07<br>(0.160) | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AGRF700                        | —   | 11.2<br>(0.440)  | —   | 21.0<br>(0.73) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 4.49<br>(0.177) | 1.24<br>(0.049) | 1.7<br>(0.07) | A5, A8,<br>A9  |
| AGRF800                        | —   | 12.7<br>(0.500)  | —   | 22.2<br>(0.88) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 5.08<br>(0.200) | 1.24<br>(0.049) | 1.8<br>(0.07) | A5, A8,<br>A9  |
| AGRF900                        | —   | 14.0<br>(0.550)  | —   | 23.0<br>(0.91) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 5.69<br>(0.224) | 1.24<br>(0.049) | 2.0<br>(0.08) | A5, A8,<br>A9  |
| AGRF1000                       | —   | 16.51<br>(0.650) | —   | 25.7<br>(1.01) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 6.96<br>(0.274) | 1.24<br>(0.049) | 2.0<br>(0.08) | A5, A8,<br>A9  |
| AGRF1100                       | —   | 17.5<br>(0.690)  | —   | 26.5<br>(1.04) | 4.3<br>(0.17) | 5.8<br>(0.20)  | 7.6<br>(0.3)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 7.47<br>(0.294) | 1.24<br>(0.049) | 2.4<br>(0.09) | A5, A8,<br>A9  |
| AGRF1200                       | —   | 17.5<br>(0.690)  | —   | 28.8<br>(1.14) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.3)  | —   | —   | 3.5<br>(0.14) | 1.4<br>(0.06) | —   | —   | 4.83<br>(0.190) | 1.45<br>(0.057) | 1.5<br>(0.06) | A5, A8,<br>A9  |
| AGRF1400                       | —   | 23.5<br>(0.925)  | —   | 28.7<br>(1.13) | 9.4<br>(0.37) | 10.9<br>(0.43) | 7.6<br>(0.3)  | —   | —   | 3.5<br>(0.14) | 1.4<br>(0.06) | —   | —   | 7.82<br>(0.308) | 1.45<br>(0.057) | 1.9<br>(0.07) | A5, A8,<br>A9  |
| <b>AHRF (High Temperature)</b> |     |                  |     |                |               |                |               |     |     |               |               |     |     |                 |                 |               |                |
| <b>30V — Radial-leaded</b>     |     |                  |     |                |               |                |               |     |     |               |               |     |     |                 |                 |               |                |
| AHRF050                        | —   | 7.4<br>(0.29)    | —   | 12.7<br>(0.50) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.3<br>(0.13) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A8, A9,<br>A10 |
| AHRF070                        | —   | 6.9<br>(0.27)    | —   | 10.8<br>(0.43) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.3<br>(0.13) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A8, A9,<br>A11 |
| AHRF100                        | —   | 9.7<br>(0.38)    | —   | 13.6<br>(0.54) | 4.3<br>(0.17) | 5.8<br>(0.23)  | 7.6<br>(0.30) | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A8, A9,<br>A10 |

Table A4 – Dimensions in Millimeters and (Inches)

(Cont'd)

| Part Number  | A   |                 | B   |                | C              |                | D              |     | E   |               | F             |     | G   |                 | H               | J             | Figure         |
|--|-----|-----------------|-----|----------------|----------------|----------------|----------------|-----|-----|---------------|---------------|-----|-----|-----------------|-----------------|---------------|----------------|
|  | Min | Max             | Min | Max            | Min            | Max            | Min            | Max | Min | Max           | Min           | Max | Min | Max             | Typ             | Max           |                |
| <b>AHRF (High Temperature)<br/>16V – Radial-leaded</b> |     |                 |     |                |                |                |                |     |     |               |               |     |     |                 |                 |               |                |
| AHRF200  | —   | 9.4<br>(0.37)   | —   | 14.4<br>(0.57) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A8, A9,<br>A10 |
| AHRF300  | —   | 8.8<br>(0.35)   | —   | 13.8<br>(0.55) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF400  | —   | 10.0<br>(0.39)  | —   | 15.0<br>(0.59) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF450  | —   | 10.4<br>(0.41)  | —   | 15.6<br>(0.61) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 3.94<br>(0.155) | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF550  | —   | 11.2<br>(0.44)  | —   | 18.9<br>(0.74) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF600  | —   | 11.2<br>(0.44)  | —   | 21.0<br>(0.73) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 4.49<br>(0.177) | 1.24<br>(0.049) | 1.7<br>(0.07) | A5, A8,<br>A9  |
| AHRF650  | —   | 12.7<br>(0.50)  | —   | 22.2<br>(0.88) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 5.08<br>(0.200) | 1.24<br>(0.049) | 1.8<br>(0.07) | A5, A8,<br>A9  |
| AHRF700  | —   | 14.0<br>(0.55)  | —   | 21.9<br>(0.86) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF750  | —   | 14.0<br>(0.55)  | —   | 23.5<br>(0.93) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 5.69<br>(0.224) | 1.24<br>(0.049) | 2.0<br>(0.08) | A5, A8,<br>A9  |
| AHRF800  | —   | 16.5<br>(0.65)  | —   | 22.5<br>(0.88) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF900  | —   | 16.5<br>(0.65)  | —   | 25.7<br>(1.01) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | —               | —             | A5, A8,<br>A9  |
| AHRF1000   | —   | 17.5<br>(0.69)  | —   | 26.5<br>(1.04) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | 7.47<br>(0.294) | 1.24<br>(0.049) | 1.5<br>(0.06) | A5, A8,<br>A9  |
| AHRF1100   | —   | 21.0<br>(0.83)  | —   | 26.1<br>(1.03) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | 1.2<br>(0.05) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF1300   | —   | 23.5<br>(0.925) | —   | 28.7<br>(1.13) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —   | —   | 3.5<br>(0.14) | 1.4<br>(0.06) | —   | —   | 7.82<br>(0.308) | 1.45<br>(0.057) | 1.9<br>(0.08) | A5, A8,<br>A9  |
| AHRF1400   | —   | 23.5<br>(0.93)  | —   | 28.7<br>(1.13) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —   | —   | 3.6<br>(0.14) | 1.4<br>(0.06) | —   | —   | —               | 1.24<br>(0.049) | 1.6<br>(0.06) | A5, A8,<br>A9  |
| AHRF1500   | —   | 23.5<br>(0.93)  | —   | 28.7<br>(1.13) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —   | —   | 3.5<br>(0.14) | 1.4<br>(0.06) | —   | —   | 7.82<br>(0.308) | —               | —             | A5, A8,<br>A9  |
| <b>AHEF (High Temperature)<br/>32V – Radial-leaded</b> |     |                 |     |                |                |                |                |     |     |               |               |     |     |                 |                 |               |                |
| AHEF050  | —   | 7.4<br>(0.29)   | —   | 12.7<br>(0.50) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.3<br>(0.13) | —             | —   | —   | —               | —               | —             | A8, A9,<br>A10 |
| AHEF070  | —   | 6.9<br>(0.27)   | —   | 10.8<br>(0.43) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | —             | —   | —   | —               | —               | —             | A8, A9,<br>A11 |
| AHEF100  | —   | 9.7<br>(0.38)   | —   | 13.6<br>(0.54) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 7.6<br>(0.30)  | —   | —   | 3.0<br>(0.12) | —             | —   | —   | —               | —               | —             | A8, A9,<br>A10 |
| AHEF300  | —   | 10.2<br>(0.40)  | —   | 15.5<br>(0.61) | 4.32<br>(0.17) | 5.84<br>(0.23) | 7.6<br>(0.30)  | —   | —   | 3.8<br>(0.15) | —             | —   | —   | —               | —               | —             | A8, A9,<br>A12 |
| AHEF500  | —   | 14.0<br>(0.55)  | —   | 24.1<br>(0.95) | 4.3<br>(0.17)  | 5.8<br>(0.23)  | 11.5<br>(0.45) | —   | —   | 3.8<br>(0.15) | —             | —   | —   | —               | —               | —             | A8, A9,<br>A12 |
| AHEF750  | —   | 21.1<br>(0.83)  | —   | 24.9<br>(0.98) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —   | —   | 3.8<br>(0.15) | —             | —   | —   | —               | —               | —             | A8, A9,<br>A12 |
| AHEF1000   | —   | 23.5<br>(0.93)  | —   | 27.9<br>(1.10) | 9.4<br>(0.37)  | 10.9<br>(0.43) | 7.6<br>(0.30)  | —   | —   | 4.0<br>(0.16) | —             | —   | —   | —               | —               | —             | A8, A9,<br>A12 |

Table A4 — Dimensions in Millimeters and (Inches)

(Cont'd)

| Part Number                   | A               |                 | B   |                 | C               |                 | D               |                 | E               |                 | F               |                 | G                |                 | H               |     | Figure |
|-------------------------------|-----------------|-----------------|-----|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|-----|--------|
|                               | Min             | Max             | Min | Max             | Min             | Max             | Min             | Max             | Min             | Max             | Min             | Max             | Min              | Max             | Min             | Max |        |
| <b>AHS (High Temperature)</b> |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| <b>16V — Surface-mount</b>    |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| AHS080-2018                   | 4.72<br>(0.186) | 5.44<br>(0.214) | —   | 1.52<br>(0.060) | 4.22<br>(0.166) | 4.93<br>(0.194) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.25<br>(0.010) | 0.36<br>(0.014) | 0.30<br>(0.012) | 0.46<br>(0.018) | —                | —               | —               | —   | A6     |
| AHS120                        | 6.73<br>(0.265) | 7.98<br>(0.314) | —   | 3.00<br>(0.118) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| AHS160                        | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| AHS200                        | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.240)  | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| AHS300                        | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.240)  | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| <b>ASMD</b>                   |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| <b>16-60V — Surface-mount</b> |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| ASMD030F                      | 6.73<br>(0.265) | 7.98<br>(0.314) | —   | 3.18<br>(0.125) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD050F                      | 6.73<br>(0.265) | 7.98<br>(0.314) | —   | 3.18<br>(0.125) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD075F                      | 6.73<br>(0.265) | 7.98<br>(0.314) | —   | 3.18<br>(0.125) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD100F                      | 6.73<br>(0.265) | 7.98<br>(0.314) | —   | 3.00<br>(0.118) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD125F                      | 6.73<br>(0.265) | 7.98<br>(0.314) | —   | 3.00<br>(0.118) | 4.8<br>(0.19)   | 5.44<br>(0.214) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 2.16<br>(0.085) | 2.41<br>(0.095) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD150F                      | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| <b>NEW</b> ASMD150F/33        | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD185F                      | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD200F                      | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| ASMD250F                      | 8.00<br>(0.315) | 9.40<br>(0.370) | —   | 3.00<br>(0.118) | 6.0<br>(0.24)   | 6.71<br>(0.264) | 0.56<br>(0.022) | 0.71<br>(0.028) | 0.56<br>(0.022) | 0.71<br>(0.028) | 3.68<br>(0.145) | 3.94<br>(0.155) | 0.66<br>(0.026)  | 1.37<br>(0.054) | 0.43<br>(0.017) | —   | A7     |
| <b>nanoASMD</b>               |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| <b>16-48V — Surface-mount</b> |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| nanoASMD012F                  | 3.00<br>(0.118) | 3.40<br>(0.134) | —   | 0.62<br>(0.024) | 1.00<br>(0.039) | —               | 1.37<br>(0.054) | 1.80<br>(0.071) | —               | 0.25<br>(0.010) | 0.75<br>(0.030) | —               | 0.076<br>(0.003) | —               | —               | —   | A15    |
| nanoASMD016F                  | 3.00<br>(0.118) | 3.40<br>(0.134) | —   | 0.62<br>(0.024) | 1.00<br>(0.039) | —               | 1.37<br>(0.054) | 1.80<br>(0.071) | —               | 0.25<br>(0.010) | 0.75<br>(0.030) | —               | 0.076<br>(0.003) | —               | —               | —   | A15    |
| nanoASMD020F                  | 3.00<br>(0.118) | 3.40<br>(0.134) | —   | 0.58<br>(0.023) | 0.82<br>(0.032) | —               | 1.37<br>(0.054) | 1.80<br>(0.071) | —               | 0.25<br>(0.010) | 0.75<br>(0.030) | —               | 0.076<br>(0.003) | —               | —               | —   | A15    |
| nanoASMD035F                  | 3.00<br>(0.118) | 3.40<br>(0.134) | —   | 0.58<br>(0.023) | 0.82<br>(0.032) | —               | 1.37<br>(0.054) | 1.80<br>(0.071) | —               | 0.25<br>(0.010) | 0.75<br>(0.030) | —               | 0.076<br>(0.003) | —               | —               | —   | A15    |
| <b>microASMD</b>              |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| <b>30V — Surface-mount</b>    |                 |                 |     |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                 |                 |     |        |
| microASMD005F                 | 3.0<br>(0.118)  | 3.43<br>(0.135) | —   | 0.50<br>(0.019) | 0.85<br>(0.034) | —               | 2.35<br>(0.092) | 2.80<br>(0.110) | —               | 0.25<br>(0.010) | 0.75<br>(0.030) | —               | 0.076<br>(0.003) | —               | —               | —   | A15    |
| microASMD010F                 | 3.0<br>(0.118)  | 3.43<br>(0.135) | —   | 0.50<br>(0.019) | 0.85<br>(0.034) | —               | 2.35<br>(0.092) | 2.80<br>(0.110) | —               | 0.25<br>(0.010) | 0.75<br>(0.030) | —               | 0.076<br>(0.003) | —               | —               | —   | A15    |

Table A4 – Dimensions in Millimeters and (Inches)

(Cont'd)

| Part Number                   | A               |                 | B                |                 | C               |                 | D               |                 | E               |     | Figure |
|-------------------------------|-----------------|-----------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|--------|
|                               | Min             | Max             | Min              | Max             | Min             | Max             | Min             | Max             | Min             | Max |        |
| <b>miniASMDC</b>              |                 |                 |                  |                 |                 |                 |                 |                 |                 |     |        |
| <b>16-60V – Surface-mount</b> |                 |                 |                  |                 |                 |                 |                 |                 |                 |     |        |
| miniASMDC010F                 | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC014F                 | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC020F                 | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC030F                 | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.635<br>(0.025) | 0.89<br>(0.035) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC050F                 | 4.37<br>(0.172) | 4.73<br>(0.186) | 0.38<br>(0.015)  | 0.62<br>(0.025) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC075F/24              | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.81<br>(0.032)  | 1.46<br>(0.057) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC110F/16              | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC110F/24              | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.81<br>(0.032)  | 1.46<br>(0.057) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC125F/16              | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC150F/16              | 4.37<br>(0.172) | 4.83<br>(0.190) | 0.28<br>(0.011)  | 0.48<br>(0.019) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC150F/24              | 4.37<br>(0.172) | 4.83<br>(0.190) | 1.00<br>(0.040)  | 1.94<br>(0.077) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |
| miniASMDC260F/16              | 4.37<br>(0.172) | 4.83<br>(0.190) | 1.02<br>(0.042)  | 1.52<br>(0.060) | 3.07<br>(0.121) | 3.41<br>(0.134) | 0.25<br>(0.010) | 0.95<br>(0.040) | 0.20<br>(0.008) | —   | A15    |

| Part Number                | A                |                  | B               |                 | C                |                  | D               |                 | E(x2)           |                 | F               |                 | G               |                 | H               |                 | I                |                  | Figure |
|----------------------------|------------------|------------------|-----------------|-----------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|--------|
|                            | Min              | Max              | Min             | Max             | Min              | Max              | Min             | Max             | Min             | Max             | Min             | Max             | Min             | Max             | Min             | Max             | Min              | Max              |        |
| <b>BD</b>                  |                  |                  |                 |                 |                  |                  |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                  |        |
| <b>14V – Bladed Device</b> |                  |                  |                 |                 |                  |                  |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                  |                  |        |
| BD280-1130-10/16           | 29.50<br>(1.173) | 30.10<br>(1.185) | 8.70<br>(0.343) | 9.30<br>(0.366) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 3.30<br>(0.130) | 3.90<br>(0.154) | 3.40<br>(0.134) | 4.00<br>(0.157) | 1.70<br>(0.067) | 2.30<br>(0.091) | 10.90<br>(0.429) | 11.50<br>(0.453) | A13    |
| BD280-1130-15/16           | 29.50<br>(1.173) | 30.10<br>(1.185) | 8.70<br>(0.343) | 9.30<br>(0.366) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 3.30<br>(0.130) | 3.90<br>(0.154) | 3.40<br>(0.134) | 4.00<br>(0.157) | 1.70<br>(0.067) | 2.30<br>(0.091) | 10.90<br>(0.429) | 11.50<br>(0.453) | A13    |
| BD280-1130-20/16           | 29.50<br>(1.173) | 30.10<br>(1.185) | 8.70<br>(0.343) | 9.30<br>(0.366) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 3.30<br>(0.130) | 3.90<br>(0.154) | 3.40<br>(0.134) | 4.00<br>(0.157) | 1.70<br>(0.067) | 2.30<br>(0.091) | 10.90<br>(0.429) | 11.50<br>(0.453) | A13    |
| BD280-1927-25/16-W         | 26.65<br>(1.049) | 27.35<br>(1.077) | 8.60<br>(0.339) | 9.20<br>(0.362) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 1.80<br>(0.071) | 2.20<br>(0.087) | 3.50<br>(0.138) | 3.90<br>(0.154) | 1.70<br>(0.067) | 2.30<br>(0.091) | 19.00<br>(0.748) | 19.40<br>(0.764) | A14    |
| BD280-1927-30/16-W         | 26.65<br>(1.049) | 27.35<br>(1.077) | 8.60<br>(0.339) | 9.20<br>(0.362) | 10.75<br>(0.423) | 11.25<br>(0.443) | 6.05<br>(0.238) | 6.65<br>(0.262) | 2.55<br>(0.100) | 3.05<br>(0.120) | 1.80<br>(0.071) | 2.20<br>(0.087) | 3.50<br>(0.138) | 3.90<br>(0.154) | 1.70<br>(0.067) | 2.30<br>(0.091) | 19.00<br>(0.748) | 19.40<br>(0.764) | A14    |

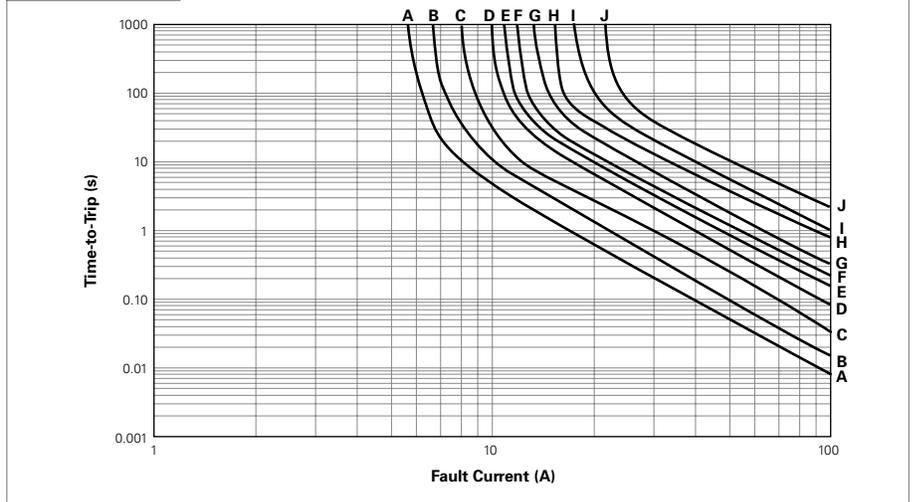
| Part Number                | A                |                  | B               |                 | C               |                  | D               |                 | E(x2)          |                 | F               |                 | Figure |
|----------------------------|------------------|------------------|-----------------|-----------------|-----------------|------------------|-----------------|-----------------|----------------|-----------------|-----------------|-----------------|--------|
|                            | Min              | Max              | Min             | Max             | Min             | Max              | Min             | Max             | Min            | Max             | Min             | Max             |        |
| <b>BD</b>                  |                  |                  |                 |                 |                 |                  |                 |                 |                |                 |                 |                 |        |
| <b>16V – Bladed Device</b> |                  |                  |                 |                 |                 |                  |                 |                 |                |                 |                 |                 |        |
| BD540-30                   | 21.65<br>(0.852) | 22.36<br>(0.880) | 7.06<br>(0.277) | 7.74<br>(0.304) | 9.35<br>(0.368) | 10.55<br>(0.415) | 5.28<br>(0.207) | 5.72<br>(0.225) | 0.7<br>(0.027) | 0.83<br>(0.032) | 9.5<br>(0.374)  | 10<br>(0.393)   | A16    |
|                            | <b>G</b>         |                  | <b>H</b>        |                 | <b>I</b>        |                  | <b>J</b>        |                 | <b>K</b>       |                 | <b>L</b>        |                 |        |
|                            | Min              | Max              | Min             | Max             | Min             | Max              | Min             | Max             | Min            | Max             | Min             | Max             |        |
|                            | 24.75<br>(0.974) | 25.4<br>(1.000)  | 6.05<br>(0.238) | 6.65<br>(0.261) | 3.4<br>(0.133)  | 3.6<br>(0.141)   | 3.4<br>(0.133)  | 3.6<br>(0.141)  | 18<br>(0.708)  | 18.2<br>(0.716) | 18.4<br>(0.724) | 18.6<br>(0.732) |        |

Figures A17-A26 — Typical Time-to-Trip at 25°C

**AGRF**

- A = AGRF400
- B = AGRF500
- C = AGRF600
- D = AGRF700
- E = AGRF800
- F = AGRF900
- G = AGRF1000
- H = AGRF1100
- I = AGRF1200
- J = AGRF1400

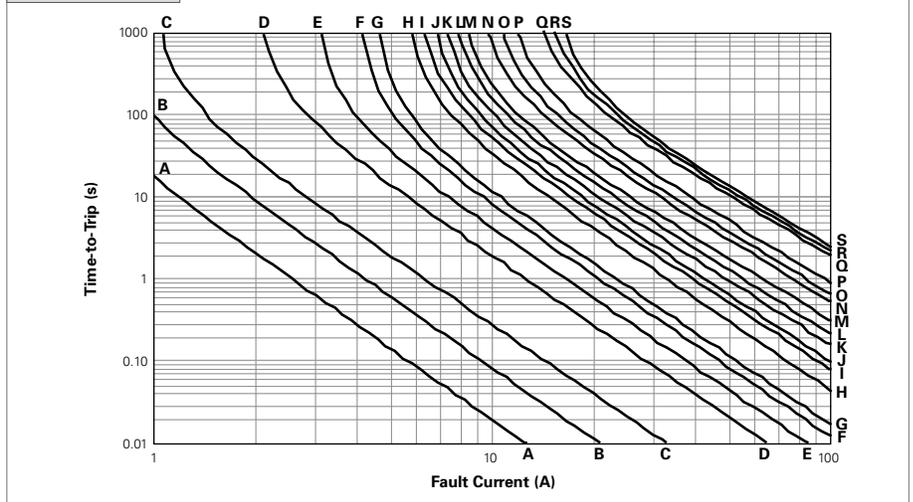
**Figure A17**



**AHRF**

- A = AHRF050
- B = AHRF070
- C = AHRF100
- D = AHRF200
- E = AHRF300
- F = AHRF400
- G = AHRF450
- H = AHRF550
- I = AHRF600
- J = AHRF650
- K = AHRF700
- L = AHRF750
- M = AHRF800
- N = AHRF900
- O = AHRF1000
- P = AHRF1100
- Q = AHRF1300
- R = AHRF1400
- S = AHRF1500

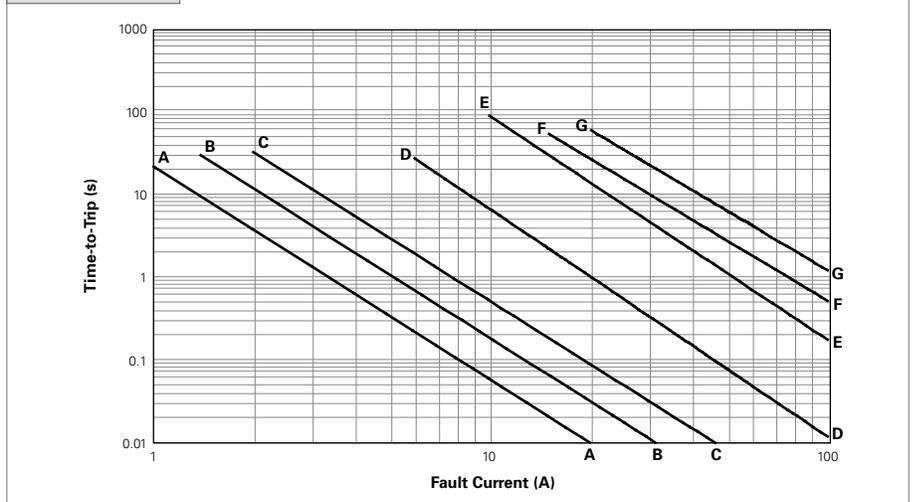
**Figure A18**



**AHEF**

- A = AHEF050
- B = AHEF070
- C = AHEF100
- D = AHEF300
- E = AHEF500
- F = AHEF750
- G = AHEF1000

**Figure A19**

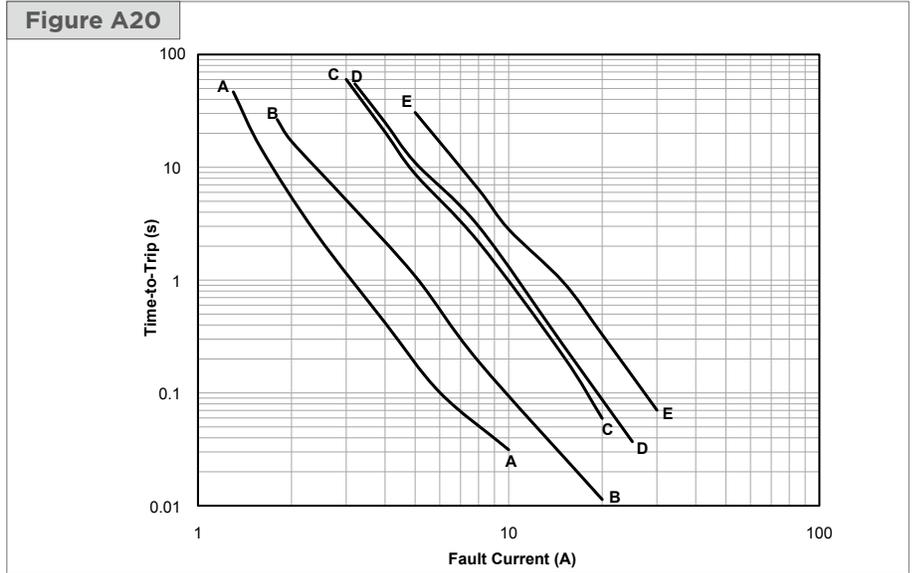


Figures A17-A26 — Typical Time-to-Trip at 25°C

(Cont'd)

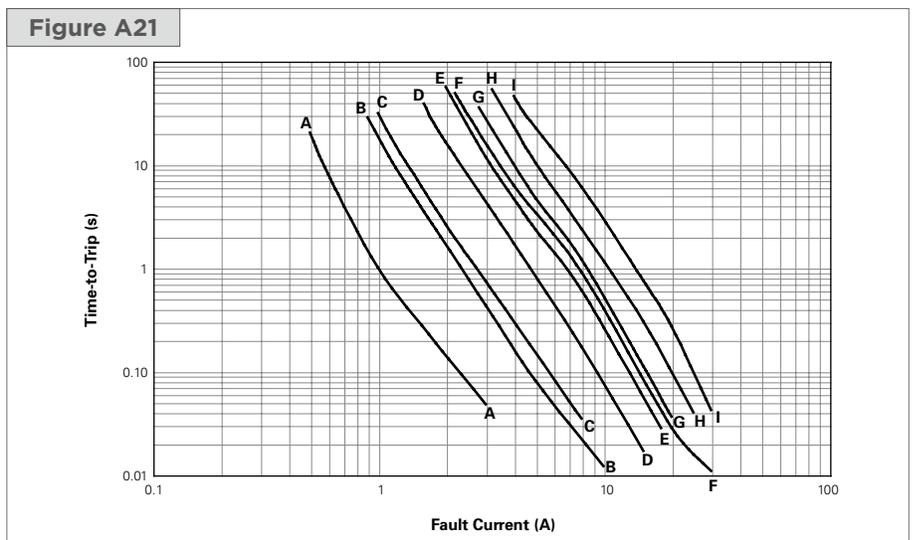
**AHS**

- A = AHS080-2018
- B = AHS120
- C = AHS160
- D = AHS200
- E = AHS300



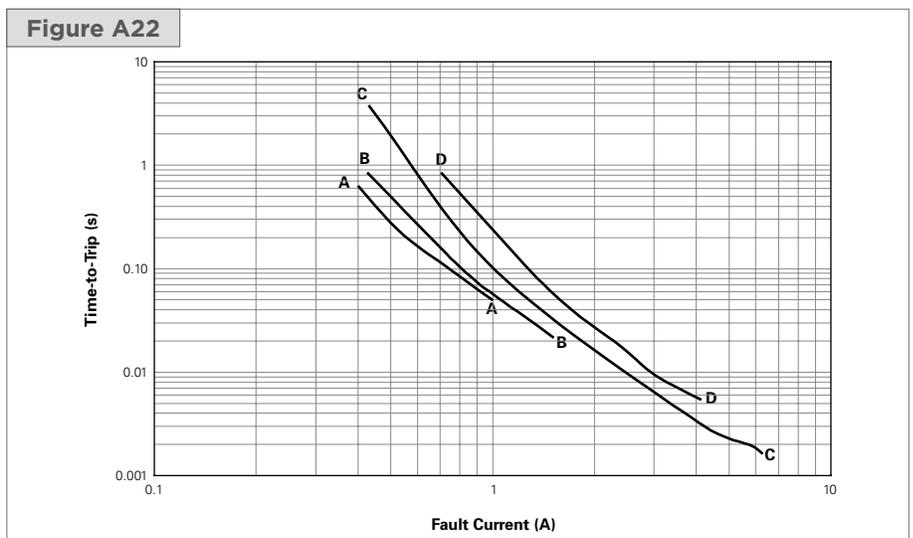
**ASMD**

- A = ASMD030F
- B = ASMD050F
- C = ASMD075F
- D = ASMD100F
- E = ASMD125F
- F = ASMD150F, ASMD150F/33
- G = ASMD185F
- H = ASMD200F
- I = ASMD250F



**nanoASMD**

- A = nanoASMD012F
- B = nanoASMD016F
- C = nanoASMD020F
- D = nanoASMD035F



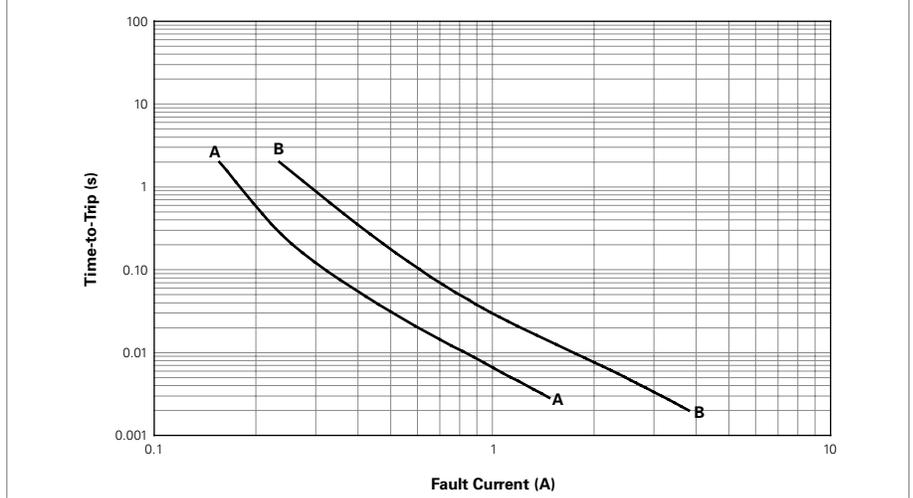
Figures A17-A26 — Typical Time-to-Trip at 25°C

(Cont'd)

**microASMD**

- A = microASMD005F
- B = microASMD010F

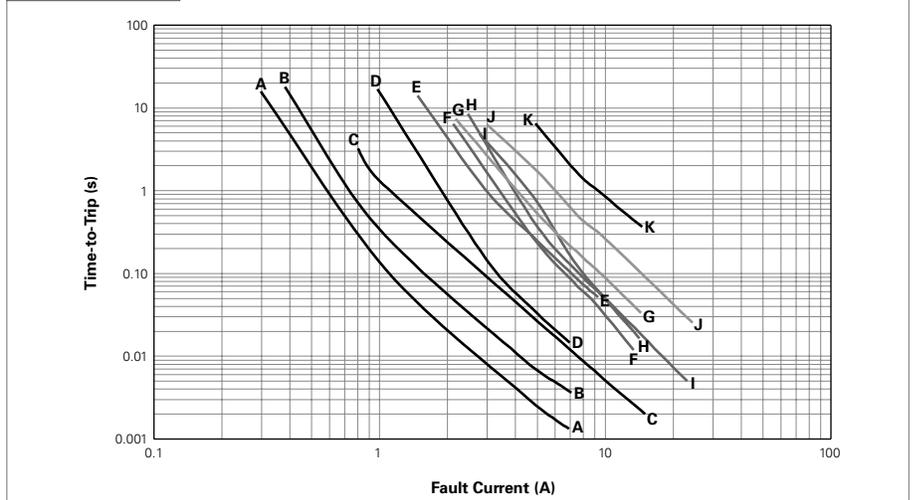
**Figure A23**



**miniASMD**

- A = miniASMD010F, miniASMD014F
- B = miniASMD020F
- C = miniASMD030F
- D = miniASMD050F
- E = miniASMD075F/24
- F = miniASMD110F/16
- G = miniASMD110F/24
- H = miniASMD125F/16
- I = miniASMD150F/16
- J = miniASMD150F/24
- K = miniASMD260F/16

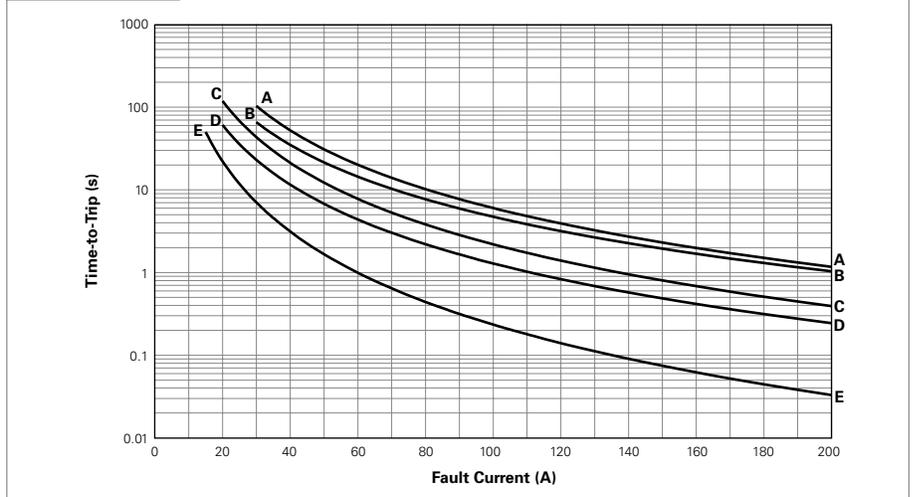
**Figure A24**



**BD**

- A = BD30A
- B = BD25A
- C = BD20A
- D = BD15A
- E = BD10A

**Figure A25**

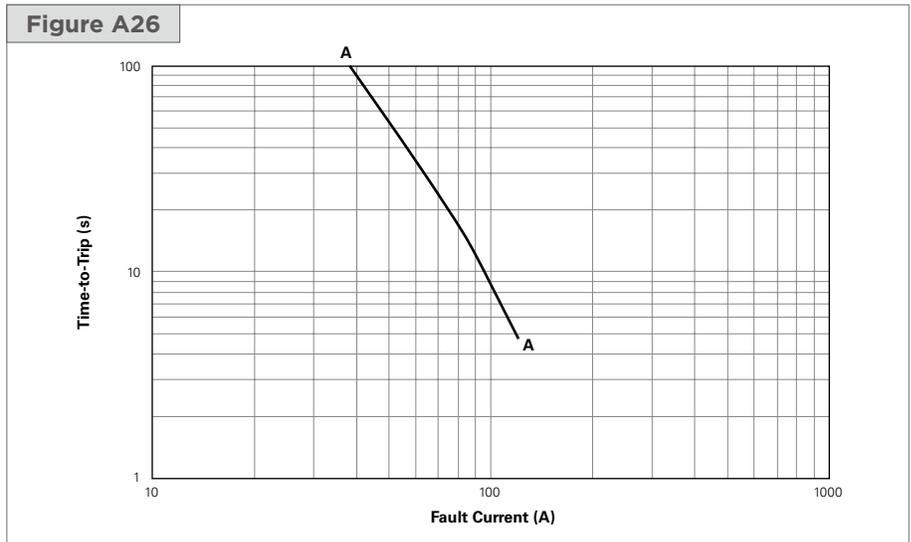


## Figures A17-A26 — Typical Time-to-Trip at 25°C

(Cont'd)

BD

A = BD540-30



## Table A5 — Physical Characteristics and Environmental Specifications

| AGRF  |  |                   |
|---|--|-------------------|
| Physical Characteristics  |  |                   |
| Lead Material   | AGRF400 to AGRF1100 : Tin-plated Copper, 0.52mm <sup>2</sup> (20AWG) $\varnothing$ 0.8 mm/0.032in        |                   |
|   | AGRF1200 to AGRF1400: Tin-plated Copper, 0.82mm <sup>2</sup> (18AWG) $\varnothing$ 1.0mm/0.040in         |                   |
| Soldering Characteristics   | Solderability per ANSI/J-STD-002 Category 3  |                   |
| Solder Heat Withstand   | AGRF400 : per IEC68-2-20 Test Tb, Method 1A, Condition A: Can Withstand 5 s at 260°C $\pm$ 5°C           |                   |
|   | AGRF500-AGRF1400 : per IEC68-2-20 Test Tb, Method 1A, Condition B: Can Withstand 10 s at 260°C $\pm$ 5°C |                   |
| Insulating Material   | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0   |                   |
| Operation Temperature   | -40°C~85°C   |                   |
| <b>Note:</b> See PS400 for other physical characteristics.<br>Devices are not intended to be placed through a reflow process. |  |                   |
| Environmental Specifications  |  |                   |
| Test  | Conditions   | Resistance Change |
| Passive Aging   | 70°C, 1000 hrs   | $\pm$ 5%          |
|   | 85°C, 1000 hrs   | $\pm$ 5%          |
| Humidity Aging  | 85°C, 85% RH, 1000 hrs   | $\pm$ 5%          |
| Thermal Shock   | 85°C, -40°C (10 Times)   | $\pm$ 5%          |
| Solvent Resistance  | MIL-STD-202, Method 215F   | No Change         |
| <b>Note:</b> See PS400 for other environmental specifications.  |  |                   |

## Table A5 – Physical Characteristics and Environmental Specifications

(Cont'd)

| AHRF                      |  |
|---------------------------|--|
| Physical Characteristics  |  |
| Lead material             | AHRF050 to AHRF200 : Tin-plated Copper-clad Steel, 0.205mm <sup>2</sup> (24 AWG), ø 0.51mm/0.020in<br>AHRF300 to AHRF1100 : Tin-plated Copper 0.52mm <sup>2</sup> (20 AWG), ø 0.81mm/0.032in<br>AHRF1300 to AHRF1500: Tin-plated Copper 0.82mm <sup>2</sup> (18 AWG), ø 1.0mm/0.04in |
| Soldering Characteristics | Solderability per ANSI/J-STD 002 Category 3  |
| Solder Heat Withstand     | Per IEC 68-2-20, Test Tb, Method 1A, Condition B; Can Withstand 10 s at 260°C ± 5°C  |
| Insulating Material       | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0 Requirements  |
| Operation Temperature     | -40°C~125°C  |

**Note:** See PS400 for other physical characteristics.  
Devices are not intended to be placed through a reflow process.

| Environmental Specifications |                          |                   |
|------------------------------|--------------------------|-------------------|
| Test                         | Conditions               | Resistance Change |
| Passive Aging                | 70°C, 1000 hrs           | ±5%               |
|                              | 85°C, 1000 hrs           | ±5%               |
| Humidity Aging               | 85°C, 85% RH, 1000 hrs   | ±5%               |
| Thermal Shock                | 125°C, -40°C (10 Times)  | ±5%               |
| Solvent Resistance           | MIL-STD-202, Method 215F | No Change         |

**Note:** See PS400 for other environmental specifications.

| AHEF                      |  |
|---------------------------|--|
| Physical Characteristics  |  |
| Lead Material             | AHEF050 to AHEF100: Tin-plated Copper-clad Steel, 0.205mm <sup>2</sup> (24 AWG), ø 0.51mm/0.020in.<br>AHEF300 to AHEF750: Tin-plated Copper 0.52mm <sup>2</sup> (20 AWG), ø 0.81mm/0.032in<br>AHEF1000: Tin-plated Copper 0.82mm <sup>2</sup> (18 AWG), ø 1.0mm/0.04in |
| Soldering Characteristics | Solderability per ANSI/J-STD 002 Category 3  |
| Solder Heat Withstand     | Per IEC 68-2-20, Test Tb, Method 1A, Condition B; Can Withstand 10 s at 260°C ± 5°C  |
| Insulating Material       | Cured, Flame-retardant Epoxy Polymer; Meets UL 94V-0 Requirements  |
| Operation Temperature     | -40°C~125°C  |

**Note:** See PS400 for other physical characteristics.  
Devices are not intended to be placed through a reflow process.

| Environmental Specifications |                          |                   |
|------------------------------|--------------------------|-------------------|
| Test                         | Conditions               | Resistance Change |
| Passive Aging                | 70°C, 1000 hrs           | ±5%               |
|                              | 85°C, 1000 hrs           | ±5%               |
| Humidity Aging               | 85°C, 85% RH, 1000 hrs   | ±5%               |
| Thermal Shock                | 125°C, -40°C (10 Times)  | ±5%               |
| Solvent Resistance           | MIL-STD-202, Method 215F | No Change         |

**Note:** See PS400 for other environmental specifications.

Table A5 — Physical Characteristics and Environmental Specifications

(Cont'd)

| AHS  |   |                   |
|--|---|-------------------|
| Physical Characteristics                                       |   |                   |
| Lead Material  | Tin-plated Brass to MIL-T-10727B  |                   |
| Soldering Characteristics                                      | Solderability per ANSI-J-STD-002 Category 1   |                   |
| Solder Heat Withstand  | Per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A  |                   |
| Flammability   | Per IEC 695-2-2 Needle Flame Test for 20 s  |                   |
| Operation Temperature  | -40°C~125°C   |                   |
| <b>Note:</b> See PS400 for other physical characteristics.     |   |                   |
| Environmental Specifications                                   |   |                   |
| Test   | Conditions  | Resistance Change |
| Passive Aging  | 70°C, 1000 hrs  | ±3% Typical       |
|  | 85°C, 1000 hrs  | ±5% Typical       |
| Humidity Aging   | 85°C, 85% RH, 1000 hrs  | ±1.2% Typical     |
| Thermal Shock  | 125°C, -40°C (20 Times)   | -33% Typical      |
| Solvent Resistance   | Freon   | No Change         |
|  | Trichloroethane   | No Change         |
|  | Hydrocarbons  | No Change         |
| <b>Note:</b> See PS400 for other environmental specifications. |   |                   |
| ASMD   |   |                   |
| Physical Characteristics                                       |   |                   |
| Terminal Pad Material  | 98%+ Tin-plated Brass   |                   |
| Soldering Characteristics                                      | Solderability per ANSI-J-STD-002 Category 1   |                   |
| Solder Heat Withstand  | Per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A  |                   |
| Flammability Resistance  | Per IEC 695-2-2 Needle Flame Test for 20 s  |                   |
| Recommended Storage Conditions                                 | 40°C max, 70% RH max; Devices May Not Meet Specified Ratings if Storage Conditions are Exceeded |                   |
| Operation Temperature  | -40°C~85°C  |                   |
| <b>Note:</b> See PS400 for other physical characteristics.     |   |                   |
| Environmental Specifications                                   |   |                   |
| Test   | Conditions  | Resistance Change |
| Passive Aging  | 60°C, 1000 hrs  | ±3% Typical       |
|  | 85°C, 1000 hrs  | ±5% Typical       |
| Humidity Aging   | 85°C, 85% RH, 100 hrs   | ±1.2% Typical     |
| Thermal Shock  | 85°C, -40°C (20 Times)  | -33% Typical      |
|  | 125°C, -55°C (10 Times)   | -33% Typical      |
| Solvent Resistance   | Freon   | No Change         |
|  | Trichloroethane   | No Change         |
|  | Hydrocarbons  | No Change         |
| <b>Note:</b> See PS400 for other environmental specifications. |   |                   |

Table A5 – Physical Characteristics and Environmental Specifications

(Cont'd)

| nanoASMD/microASMD/miniASMD    |   |
|--------------------------------|---|
| Physical Characteristics       |   |
| Terminal Pad Material          | 100% Matte Tin with Nickel Underplate   |
| Soldering Characteristics      | Solderability per ANSI-J-STD-002 Category 3   |
| Solder Heat Withstand          | Per IEC-STD 68-2-20, Test Tb, Section 5, Method 1A  |
| Flammability Resistance        | Per IEC 695-2-2 Needle Flame Test for 20 s  |
| Recommended Storage Conditions | 40°C max, 70% RH max; Devices May Not Meet Specified Ratings if Storage Conditions are Exceeded |
| Operation Temperature          | -40°C~85°C  |

**Note:** See PS400 for other physical characteristics.

| Environmental Specifications |                         |                   |
|------------------------------|-------------------------|-------------------|
| Test                         | Conditions              | Resistance Change |
| Passive Aging                | 60°C, 1000 hrs          | ±3% Typical       |
|                              | 85°C, 1000 hrs          | ±5% Typical       |
| Humidity Aging               | 85°C, 85% RH, 100 hrs   | ±1.2% Typical     |
| Thermal Shock                | 85°C, -40°C (20 Times)  | -33% Typical      |
|                              | 125°C, -55°C (10 Times) | -33% Typical      |
| Solvent Resistance           | Freon                   | No Change         |
|                              | Trichloroethane         | No Change         |
|                              | Hydrocarbons            | No Change         |

**Note:** See PS400 for other environmental specifications.

| BD                        |   |
|---------------------------|---|
| Physical Characteristics  |   |
| Lead Material             | Brass H65, Thickness: 0.8mm, Tin Plating Thickness: 5µm |
| Soldering Characteristics | NA  |
| Solder Heat Withstand     | NA  |
| Insulating Material       | Colored PBT, Meets UL94V-0 Requirements                 |
| Operation Temperature     | -40°C~125°C   |

**Note:** See PS400 for other physical characteristics.

| Environmental Specifications |   |                   |
|------------------------------|---|-------------------|
| Test                         | Conditions  | Resistance Change |
| Passive Aging                | 85°C, 1000 hrs                                      | ±5%               |
| Humidity Aging               | 85°C, 85% RH, 1000 hrs                              | ±5%               |
|                              | 85°C, 85% RH (with 10% I <sub>HOLD</sub> ), 500 hrs | ±5%               |
| Thermal Shock                | 85°C to -40°C (5 Times)                             | Meet SCD          |
| Solvent Resistance           | MIL-STD-202, Method 215F                            | No Change         |

**Note:** See PS400 for other environmental specifications.

## Table A6 – Packaging and Marking Information

| Part Number                    | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|--------------------------------|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>AGRF</b>                    |              |                        |                    |                           |              |                    |
| <b>Radial-leaded</b>           |              |                        |                    |                           |              |                    |
| AGRF400                        | 500          | —                      | —                  | 10,000                    | G4           | *                  |
| AGRF400-2                      | —            | 2,500                  | —                  | 12,500                    | G4           | *                  |
| AGRF400-AP                     | —            | —                      | 2,000              | 10,000                    | G4           | *                  |
| AGRF500                        | 500          | —                      | —                  | 10,000                    | G5           | *                  |
| AGRF500-2                      | —            | 2,000                  | —                  | 10,000                    | G5           | *                  |
| AGRF500-AP                     | —            | —                      | 2,000              | 10,000                    | G5           | *                  |
| AGRF600                        | 500          | —                      | —                  | 10,000                    | G6           | *                  |
| AGRF600-2                      | —            | 2,000                  | —                  | 10,000                    | G6           | *                  |
| AGRF600-AP                     | —            | —                      | 2,000              | 10,000                    | G6           | *                  |
| AGRF700                        | 500          | —                      | —                  | 10,000                    | G7           | *                  |
| AGRF700-2                      | —            | 1,500                  | —                  | 7,500                     | G7           | *                  |
| AGRF700-AP                     | —            | —                      | 1,500              | 7,500                     | G7           | *                  |
| AGRF800                        | 500          | —                      | —                  | 10,000                    | G8           | *                  |
| AGRF800-2                      | —            | 1,500                  | —                  | 7,500                     | G8           | *                  |
| AGRF800-AP                     | —            | —                      | 1,500              | 7,500                     | G8           | *                  |
| AGRF900                        | 500          | —                      | —                  | 10,000                    | G9           | *                  |
| AGRF900-2                      | —            | 1,000                  | —                  | 5,000                     | G9           | *                  |
| AGRF900-AP                     | —            | —                      | 1,000              | 5,000                     | G9           | *                  |
| AGRF1000                       | 250          | —                      | —                  | 5,000                     | G10          | *                  |
| AGRF1000-2                     | —            | 1,000                  | —                  | 5,000                     | G10          | *                  |
| AGRF1000-AP                    | —            | —                      | 1,000              | 5,000                     | G10          | *                  |
| AGRF1100                       | 250          | —                      | —                  | 5,000                     | G11          | *                  |
| AGRF1100-2                     | —            | 1,000                  | —                  | 5,000                     | G11          | *                  |
| AGRF1100-AP                    | —            | —                      | 1,000              | 5,000                     | G11          | *                  |
| AGRF1200                       | 250          | —                      | —                  | 5,000                     | G12          | *                  |
| AGRF1200-2                     | —            | 1,000                  | —                  | 5,000                     | G12          | *                  |
| AGRF1200-AP                    | —            | —                      | 1,000              | 5,000                     | G12          | *                  |
| AGRF1400                       | 250          | —                      | —                  | 5,000                     | G14          | *                  |
| AGRF1400-2                     | —            | 1,000                  | —                  | 5,000                     | G14          | *                  |
| AGRF1400-AP                    | —            | —                      | 1,000              | 5,000                     | G14          | *                  |
| <b>AHRF (High Temperature)</b> |              |                        |                    |                           |              |                    |
| <b>Radial-leaded</b>           |              |                        |                    |                           |              |                    |
| AHRF050                        | 500          | —                      | —                  | 10,000                    | H0.5         | *                  |
| AHRF050-2                      | —            | 2,500                  | —                  | 12,500                    | H0.5         | *                  |
| AHRF050-AP                     | —            | —                      | 2,500              | 12,500                    | H0.5         | *                  |
| AHRF070                        | 500          | —                      | —                  | 10,000                    | H0.7         | *                  |
| AHRF070-2                      | —            | 2,500                  | —                  | 12,500                    | H0.7         | *                  |
| AHRF070-AP                     | —            | —                      | 2,500              | 12,500                    | H0.7         | *                  |
| AHRF100                        | 500          | —                      | —                  | 10,000                    | H1           | *                  |
| AHRF100-2                      | —            | 2,500                  | —                  | 12,500                    | H1           | *                  |
| AHRF100-AP                     | —            | —                      | 2,500              | 12,500                    | H1           | *                  |
| AHRF200                        | 500          | —                      | —                  | 10,000                    | H2           | *                  |
| AHRF200-2                      | —            | 2,500                  | —                  | 12,500                    | H2           | *                  |
| AHRF200-AP                     | —            | —                      | 2,500              | 12,500                    | H2           | *                  |
| AHRF300                        | 500          | —                      | —                  | 10,000                    | H3           | *                  |
| AHRF300-2                      | —            | 2,000                  | —                  | 10,000                    | H3           | *                  |
| AHRF300-AP                     | —            | —                      | 2,000              | 10,000                    | H3           | *                  |
| AHRF400                        | 500          | —                      | —                  | 10,000                    | H4           | *                  |
| AHRF400-2                      | —            | 1,500                  | —                  | 7,500                     | H4           | *                  |
| AHRF400-AP                     | —            | —                      | 1,500              | 7,500                     | H4           | *                  |

\* These devices are intended for use in automotive applications.  
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

Table A6 – Packaging and Marking Information

(Cont'd)

| Part Number                                      | Bag Quantity | Tape and Reel Quantity | Ammo Pack Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|--|--------------|------------------------|--------------------|---------------------------|--------------|--------------------|
| <b>AHRF (High Temperature)<br/>Radial-leaded</b> |              |                        |                    |                           |              |                    |
| AHRF450  | 500          | —                      | —                  | 10,000                    | H4.5         | *                  |
| AHRF450-2  | —            | 1,500                  | —                  | 7,500                     | H4.5         | *                  |
| AHRF450-AP                                       | —            | —                      | 1,500              | 7,500                     | H4.5         | *                  |
| AHRF550  | 500          | —                      | —                  | 10,000                    | H5.5         | *                  |
| AHRF550-2  | —            | 2,000                  | —                  | 10,000                    | H5.5         | *                  |
| AHRF550-AP                                       | —            | —                      | 2,000              | 10,000                    | H5.5         | *                  |
| AHRF600  | 500          | —                      | —                  | 10,000                    | H6           | *                  |
| AHRF600-2  | —            | 2,000                  | —                  | 10,000                    | H6           | *                  |
| AHRF600-AP                                       | —            | —                      | 2,000              | 10,000                    | H6           | *                  |
| AHRF650  | 500          | —                      | —                  | 10,000                    | H6.5         | *                  |
| AHRF650-2  | —            | 1,500                  | —                  | 7,500                     | H6.5         | *                  |
| AHRF650-AP                                       | —            | —                      | 1,500              | 7,500                     | H6.5         | *                  |
| AHRF700  | 500          | —                      | —                  | 10,000                    | H7           | *                  |
| AHRF700-2  | —            | 1,500                  | —                  | 7,500                     | H7           | *                  |
| AHRF700-AP                                       | —            | —                      | 1,500              | 7,500                     | H7           | *                  |
| AHRF750  | 500          | —                      | —                  | 10,000                    | H7.5         | *                  |
| AHRF750-2  | —            | 1,000                  | —                  | 5,000                     | H7.5         | *                  |
| AHRF750-AP                                       | —            | —                      | 1,000              | 5,000                     | H7.5         | *                  |
| AHRF800  | 500          | —                      | —                  | 10,000                    | H8           | *                  |
| AHRF800-2  | —            | 1,000                  | —                  | 5,000                     | H8           | *                  |
| AHRF800-AP                                       | —            | —                      | 1,000              | 5,000                     | H8           | *                  |
| AHRF900  | 250          | —                      | —                  | 5,000                     | H9           | *                  |
| AHRF900-2  | —            | 1,000                  | —                  | 5,000                     | H9           | *                  |
| AHRF900-AP                                       | —            | —                      | 1,000              | 5,000                     | H9           | *                  |
| AHRF1000   | 250          | —                      | —                  | 5,000                     | H10          | *                  |
| AHRF1000-2                                       | —            | 1,000                  | —                  | 5,000                     | H10          | *                  |
| AHRF1000-AP                                      | —            | —                      | 1,000              | 5,000                     | H10          | *                  |
| AHRF1100   | 250          | —                      | —                  | 5,000                     | H11          | *                  |
| AHRF1100-2                                       | —            | 1,000                  | —                  | 5,000                     | H11          | *                  |
| AHRF1100-AP                                      | —            | —                      | 1,000              | 5,000                     | H11          | *                  |
| AHRF1300   | 250          | —                      | —                  | 5,000                     | H13          | *                  |
| AHRF1300-2                                       | —            | 1,000                  | —                  | 5,000                     | H13          | *                  |
| AHRF1300-AP                                      | —            | —                      | 1,000              | 5,000                     | H13          | *                  |
| AHRF1400   | 250          | —                      | —                  | 5,000                     | H14          | *                  |
| AHRF1400-2                                       | —            | 1,000                  | —                  | 5,000                     | H14          | *                  |
| AHRF1400-AP                                      | —            | —                      | 1,000              | 5,000                     | H14          | *                  |
| AHRF1500   | 250          | —                      | —                  | 5,000                     | H15          | *                  |
| AHRF1500-2                                       | —            | 1,000                  | —                  | 5,000                     | H15          | *                  |
| AHRF1500-AP                                      | —            | —                      | 1,000              | 5,000                     | H15          | *                  |
| <b>AHEF (High Temperature)<br/>Radial-leaded</b> |              |                        |                    |                           |              |                    |
| AHEF050  | 500          | —                      | —                  | 10,000                    | E0.5         | *                  |
| AHEF070  | 500          | —                      | —                  | 10,000                    | E0.7         | *                  |
| AHEF100  | 500          | —                      | —                  | 10,000                    | E1           | *                  |
| AHEF300  | 500          | —                      | —                  | 10,000                    | E3           | *                  |
| AHEF500  | 250          | —                      | —                  | 5,000                     | E5           | *                  |
| AHEF750  | 250          | —                      | —                  | 5,000                     | E7.5         | *                  |
| AHEF1000   | 250          | —                      | —                  | 5,000                     | E10          | *                  |

\* These devices are intended for use in automotive applications.  
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

Table A6 – Packaging and Marking Information

(Cont'd)

| Part Number                   | Tape and Reel Quantity | Standard Package Quantity | Part Marking | Recommended Pad Layouts [mm(in) See Figure A27] |                   |                   | Agency Recognition |
|-------------------------------|------------------------|---------------------------|--------------|---|-------------------|-------------------|--------------------|
|                               |                        |                           |              | Dimension A (Min*/Nom)                          | Dimension B (Nom) | Dimension C (Nom) |                    |
| <b>AHS (High Temperature)</b> |                        |                           |              |   |                   |                   |                    |
| <b>Surface-mount</b>          |                        |                           |              |   |                   |                   |                    |
| AHS080-2018                   | 4,000                  | 20,000                    | H08          | 4.6 (0.18)                                      | 1.5 (0.06)        | 3.4 (0.134)       | *                  |
| AHS120                        | 2,000                  | 10,000                    | H12          | 3.1 (0.12)                                      | 2.3 (0.09)        | 5.1 (0.201)       | *                  |
| AHS160                        | 1,500                  | 7,500                     | 160          | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| AHS200                        | 1,500                  | 7,500                     | H200         | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| AHS300                        | 1,500                  | 7,500                     | H300         | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| <b>ASMD</b>                   |                        |                           |              |   |                   |                   |                    |
| <b>Surface-mount</b>          |                        |                           |              |   |                   |                   |                    |
| ASMD030F                      | 2,000                  | 10,000                    | 030F         | 3.1 (0.12)                                      | 2.3 (0.09)        | 5.1 (0.201)       | *                  |
| ASMD050F                      | 2,000                  | 10,000                    | 050F         | 3.1 (0.12)                                      | 2.3 (0.09)        | 5.1 (0.201)       | *                  |
| ASMD075F                      | 2,000                  | 10,000                    | 075F         | 3.1 (0.12)                                      | 2.3 (0.09)        | 5.1 (0.201)       | *                  |
| ASMD100F                      | 2,000                  | 10,000                    | 100F         | 3.1 (0.12)                                      | 2.3 (0.09)        | 5.1 (0.201)       | *                  |
| ASMD125F                      | 2,000                  | 10,000                    | 125F         | 3.1 (0.12)                                      | 2.3 (0.09)        | 5.1 (0.201)       | *                  |
| ASMD150F                      | 1,500                  | 7,500                     | 150F         | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| <b>NEW</b> ASMD150F/33        | 1,500                  | 7,500                     | 153F         | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| ASMD185F                      | 1,500                  | 7,500                     | 185A         | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| ASMD200F                      | 1,500                  | 7,500                     | 200F         | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| ASMD250F                      | 1,500                  | 7,500                     | 250F         | 4.6 (0.18)                                      | 2.3 (0.09)        | 6.1 (0.240)       | *                  |
| <b>nanoASMD</b>               |                        |                           |              |   |                   |                   |                    |
| <b>Surface-mount</b>          |                        |                           |              |   |                   |                   |                    |
| nanoASMD012F                  | 3,000                  | 15,000                    | P            | 1.60 (0.063)                                    | 1.00 (0.039)      | 2.00 (0.079)      | *                  |
| nanoASMD016F                  | 3,000                  | 15,000                    | N            | 1.60 (0.063)                                    | 1.00 (0.039)      | 2.00 (0.079)      | *                  |
| nanoASMD020F                  | 3,000                  | 15,000                    | 02           | 1.60 (0.063)                                    | 1.00 (0.039)      | 2.00 (0.079)      | *                  |
| nanoASMD035F                  | 3,000                  | 15,000                    | 03           | 1.60 (0.063)                                    | 1.00 (0.039)      | 2.00 (0.079)      | *                  |
| <b>microASMD</b>              |                        |                           |              |   |                   |                   |                    |
| <b>Surface-mount</b>          |                        |                           |              |   |                   |                   |                    |
| microASMD005F                 | 4,000                  | 20,000                    | 05           | 2.50 (0.098)                                    | 1.00 (0.039)      | 2.00 (0.079)      | *                  |
| microASMD010F                 | 4,000                  | 20,000                    | 10           | 2.50 (0.098)                                    | 1.00 (0.039)      | 2.00 (0.079)      | *                  |
| <b>miniASMD</b>               |                        |                           |              |   |                   |                   |                    |
| <b>Surface-mount</b>          |                        |                           |              |   |                   |                   |                    |
| miniASMD010F                  | 2,000                  | 10,000                    | 10           | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD014F                  | 2,000                  | 10,000                    | 14           | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD020F                  | 2,000                  | 10,000                    | 2            | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD030F                  | 2,000                  | 10,000                    | 3            | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD050F                  | 2,000                  | 10,000                    | 5            | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD075F/24               | 1,500                  | 7,500                     | 075F 24V     | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD110F/16               | 2,000                  | 10,000                    | 110F 16V     | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD110F/24               | 1,500                  | 7,500                     | 110F 24V     | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD125F/16               | 2,000                  | 10,000                    | 125F 16V     | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD150F/16               | 2,000                  | 10,000                    | 150 16V      | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD150F/24               | 1,000                  | 5,000                     | 150F 24V     | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |
| miniASMD260F/16               | 1,500                  | 7,500                     | 260F 16V     | 3.15 (0.124)                                    | 1.68 (0.066)      | 3.10 (0.122)      | *                  |

\* These devices are intended for use in automotive applications.  
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

| Part Number          | Bag Quantity | Standard Package Quantity | Part Marking  | Agency Recognition |
|----------------------|--------------|---------------------------|---------------|--------------------|
| <b>BD</b>            |              |                           |               |                    |
| <b>Bladed Device</b> |              |                           |               |                    |
| BD280-1130-10/16     | 200          | 1600                      | BD280-1130-10 | *                  |
| BD280-1130-15/16     | 200          | 1600                      | BD280-1130-15 | *                  |
| BD280-1130-20/16     | 200          | 1600                      | BD280-1130-20 | *                  |
| BD280-1927-25/16-W   | 200          | 1600                      | BD280-1927-25 | *                  |
| BD280-1927-30/16-W   | 200          | 1600                      | BD280-1927-30 | *                  |
| BD540-30             | 200          | 1600                      | BD540-30      | *                  |

\* These devices are intended for use in automotive applications.  
For commercial alternatives to these products please see the radial-leaded devices section or surface-mount devices section.

Figure A27 — Recommended Pad Layout

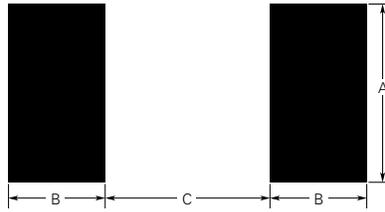


Table A7 — Tape and Reel Specifications for AGRF/AHRF/AHEF Devices

AGRF, AHRF and AHEF devices are available in tape and reel packaging per EIA468-B/IEC286-2 and EIA 481-2 standards. See Figures A28 and A29 for details.

| Description   | EIA Mark       | Dimension (mm) | Tolerance  |
|---|----------------|----------------|------------|
| Carrier Tape Width  | W              | 18.0           | -0.5/+1.0  |
| Hold Down Tape Width  | W <sub>4</sub> | 11.0           | Minimum    |
| Top Distance between Tape Edges   | W <sub>6</sub> | 3.0            | Maximum    |
| Sprocket Hole Position  | W <sub>5</sub> | 9.0            | -0.5/+0.75 |
| Sprocket Hole Diameter  | D <sub>0</sub> | 4.0            | ±0.2       |
| Abscissa to Plane (Straight Lead) (AHEF300 to AHEF1000)   | H              | 20.3           | ±0.5       |
| Abscissa to Plane (Kinked Lead) (AGRF400 to AGRF1400, AHRF050 to AHRF1500, AHEF050 to AHEF100)        | H <sub>0</sub> | 16.0           | ±0.5       |
| Abscissa to Top (AGRF400 to AGRF600, AHRF050 to AHRF450, AHEF050 to AHEF300)                          | H <sub>1</sub> | 32.2           | Maximum    |
| Abscissa to Top (AGRF700 to AGRF1400, AHRF550 to AHRF1500*, AHEF500 to AHEF1000)                      | H <sub>1</sub> | 45.0           | Maximum    |
| Overall Width with Lead Protrusion (AGRF400 to AGRF600 & AHRF050 to AHRF450, AHEF050 to AHEF300)      | C <sub>1</sub> | 43.2           | Maximum    |
| Overall Width with Lead Protrusion (AGRF700 to AGRF1400, AHRF550 to AHRF1500, AHEF500 to AHEF1000)    | C <sub>1</sub> | 55.0           | Maximum    |
| Overall Width without Lead Protrusion (AGRF400 to AGRF600, AHRF050 to AHRF450, AHEF050 to AHEF300)    | C <sub>2</sub> | 42.5           | Maximum    |
| Overall Width without Lead Protrusion (AGRF700 to AGRF1400, AHRF550 to AHRF1500, AHEF500 to AHEF1000) | C <sub>2</sub> | 54.0           | Maximum    |
| Lead Protrusion   | L <sub>1</sub> | 1.0            | Maximum    |
| Protrusion of Cut-out   | L              | 11.0           | Maximum    |
| Protrusion Beyond Hold-Down Tape  | I <sub>2</sub> | Not specified  | —          |
| Sprocket Hole Pitch   | P <sub>0</sub> | 12.7           | ± 0.3      |
| Device Pitch (AGRF400 to AGRF700, AHRF050 to AHRF600, AHEF050 to AHEF300)                             | —              | 12.7           | ± 0.3      |
| Device Pitch (AGRF800 to AGRF1400, AHRF650 to AHRF1500, AHEF500 to AHEF1000)                          | —              | 25.4           | ± 0.6      |
| Pitch Tolerance   | —              | 20 consec.     | ± 0.1      |
| Tape Thickness  | t              | 0.9            | Maximum    |
| Overall Tape and Lead Thickness (AGRF400 to AGRF1100, AHRF050 to AHRF1100*, AHEF050 to AHEF750)       | t <sub>1</sub> | 2.0            | Maximum    |
| Overall Tape and Lead Thickness (AGRF1200 to AGRF1400, AHRF1300 to AHRF1500*, AHEF1000)               | t <sub>1</sub> | 2.3            | Maximum    |
| Splice Sprocket Hole Alignment  | —              | 0              | ± 0.3      |
| Body Lateral Deviation  | Δh             | 0              | ± 1.0      |
| Body Tape Plane Deviation   | Δp             | 0              | ± 1.3      |
| Ordinate to Adjacent Component Lead (AGRF400 to AGRF1100, AHRF050 to AHRF900, AHEF050 to AHEF500)     | P <sub>1</sub> | 3.81           | ± 0.7      |
| Ordinate to Adjacent Component Lead (AGRF1200 to AGRF1400, AHRF1000 to AHRF1500, AHEF750 to AHEF1000) | P <sub>1</sub> | 7.62           | ± 0.7      |
| Lead Spacing (AGRF400 to AGRF1100, AHRF050 to AHRF900*, AHEF050 to AHEF500)                           | F              | 5.05           | ± 0.75     |
| Lead Spacing (AGRF1200 to AGRF1400, AHRF1000 to AHRF1500*, AHEF750 to AHEF1000)                       | F              | 10.15          | ± 0.75     |
| Reel Width (AGRF400 to AGRF600 & AHRF050 to AHRF450, AHEF050 to AHEF300)                              | w <sub>2</sub> | 56.0           | Maximum    |
| Reel Width (AGRF700 to AGRF1400, AHRF550 to AHRF1500*, AHEF500 to AHEF1000)                           | w <sub>2</sub> | 63.5           | Maximum    |
| Reel Diameter   | a              | 370.0          | Maximum    |
| Space between Flanges* (AHEF050 to AHEF300)   | w <sub>1</sub> | 48.0           | Maximum    |
| Space between Flanges* (AHEF500 to AHEF1000)  | w <sub>1</sub> | 55.0           | Maximum    |
| Arbor Hold Diameter   | c              | 26.0           | ±12.0      |
| Core Diameter*  | n              | 91.0           | Maximum    |
| Box   | —              | 64/372/362     | Maximum    |
| Consecutive Missing Places  | —              | None           | —          |
| Empty Places per Reel   | —              | 0.1%           | Maximum    |

\* Differs from EIA specification.

Figure A28 – EIA Referenced Taped Component Dimensions for AGRF/AHRF/AHEF Devices

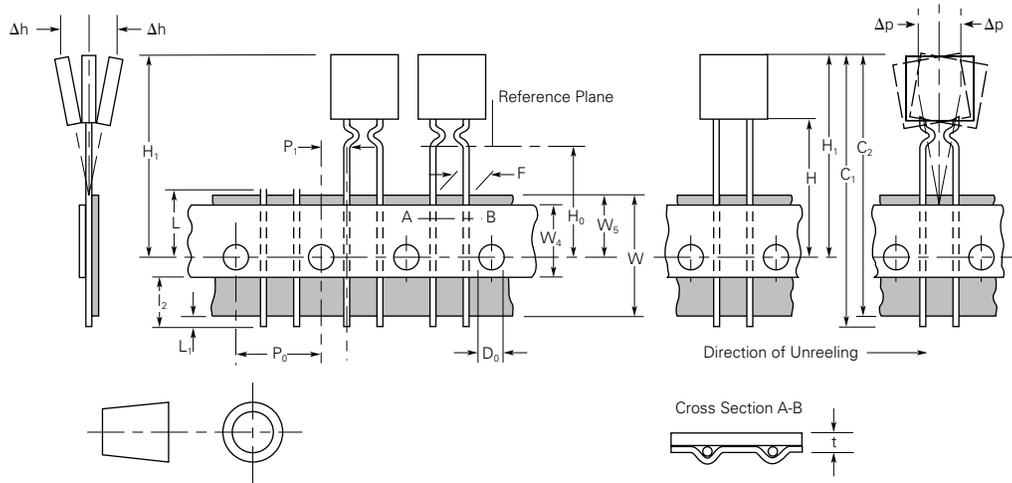


Figure A29 – EIA Referenced Reel Dimensions for AGRF/AHRF/AHEF Devices

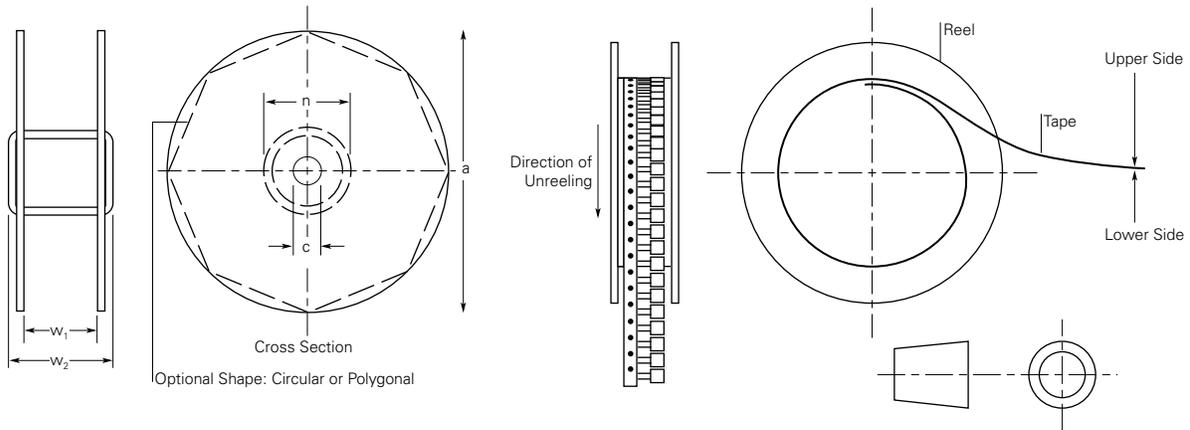


Table A8 – Tape and Reel Specifications for AHS/ASMD/nanoASMD/microASMD/miniASMD Devices (in Millimeters)

| Description        | nanoASMD<br>EIA 481-1 | microASMD<br>EIA 481-1 | miniASMD<br>EIA 481-1 | AHS080-2018<br>EIA 481-2 | AHS120<br>ASMD030F~ASMD125F<br>EIA 481-2 | AHS160~AHS300<br>ASMD150F~ASMD250F<br>EIA 481-2 |
|--------------------|-----------------------|------------------------|-----------------------|--------------------------|--|---|
| W                  | 8.0 ± 0.30            | 8.0 ± 0.30             | 12.0 ± 0.30           | 16.0 ± 0.30              | 16.0 ± 0.30                              | 16.0 ± 0.30                                     |
| P <sub>0</sub>     | 4.0 ± 0.10            | 4.0 ± 0.10             | 4.0 ± 0.10            | 4.0 ± 0.10               | 4.0 ± 0.10                               | 4.0 ± 0.10                                      |
| P <sub>1</sub>     | 4.0 ± 0.10            | 4.0 ± 0.10             | 8.0 ± 0.10            | 8.0 ± 0.10               | 8.0 ± 0.10                               | 12.0 ± 0.10                                     |
| P <sub>2</sub>     | 2.0 ± 0.05            | 2.0 ± 0.05             | 2.0 ± 0.05            | 2.0 ± 0.10               | 2.0 ± 0.10                               | 2.0 ± 0.10                                      |
| A <sub>0</sub>     | 1.95 ± 0.10           | 2.9 ± 0.10             | Table A9              | 5.11 ± 0.15              | 5.6 ± 0.23                               | 6.9 ± 0.23                                      |
| B <sub>0</sub>     | Table A9              | 3.50 ± 0.10            | Table A9              | 5.6 ± 0.23               | 8.1 ± 0.15                               | 9.6 ± 0.15                                      |
| B <sub>1</sub> max | 4.35                  | 4.35                   | 6.15                  | 12.1                     | 12.1                                     | 12.1  |
| D <sub>0</sub>     | 1.55 ± .05            | 1.55 ± .05             | 1.5 + 0.10/ -.00      | 1.5 + 0.10/ -.00         | 1.5 + 0.10/ -.00                         | 1.5 + 0.10/ -.00                                |
| F                  | 3.50 ± 0.05           | 3.50 ± 0.05            | 5.50 ± 0.05           | 7.50 ± 0.10              | 7.50 ± 0.10                              | 7.50 ± 0.10                                     |
| E <sub>1</sub>     | 1.75 ± 0.10           | 1.75 ± 0.10            | 1.75 ± 0.10           | 1.75 ± 0.10              | 1.75 ± 0.10                              | 1.75 ± 0.10                                     |
| E <sub>2</sub> min | 6.25                  | 6.25                   | 10.25                 | 14.25                    | 14.25                                    | 14.25   |
| T max              | 0.3                   | 0.3                    | 0.35                  | 0.4                      | 0.4                                      | 0.4   |
| T <sub>1</sub> max | 0.1                   | 0.1                    | 0.1                   | 0.1                      | 0.1                                      | 0.1   |
| K <sub>0</sub>     | Table A9              | 0.9 ± 0.1              | Table A9              | 1.8 ± 0.15               | 3.2 ± 0.15                               | 3.4 ± 0.15                                      |
| Leader min         | 390                   | 390                    | 390                   | 400                      | 400                                      | 400   |
| Trailer min        | 160                   | 160                    | 160                   | 160                      | 160                                      | 160   |

Table A9 – Tape and Reel Specifications for nanoASMDc/miniASMDc Devices (in Millimeters)

| Description    | nanoASMDc020F<br>nanoASMDc035F | nanoASMDc012F<br>nanoASMDc016F | miniASMDc010F~050F<br>miniASMDc110F/16<br>miniASMDc125F/16<br>miniASMDc150F/16 | miniASMDc075F/24<br>miniASMDc110F/24<br>miniASMDc260F/16 | miniASMDc150F/24 |
|----------------|--------------------------------|--------------------------------|--|--|------------------|
| A <sub>0</sub> | 1.95 ± 0.1                     | 1.95 ± 0.1                     | 3.5 ± 0.1  | 3.7 ± 0.1  | 3.7 ± 0.1        |
| B <sub>0</sub> | 3.50 +0.1/-0.08                | 3.5 ± 0.1                      | 4.95 ± 0.1   | 4.9 ± 0.1  | 4.9 ± 0.1        |
| K <sub>0</sub> | 0.89 ± 0.1                     | 1.27 ± 0.1                     | 0.9 ± 0.1  | 1.4 ± 0.1  | 1.78 ± 0.1       |

Table A10 – Reel Dimensions for AHS/ASMD/nanoASMDc/microASMD/miniASMDc Devices (in Millimeters)

| Description        | nanoASMDc<br>microASMD | miniASMDc        | AHS<br>ASMD      |
|--------------------|------------------------|------------------|------------------|
| A max              | 185                    | 185              | 330              |
| N min              | 50                     | 50               | 50               |
| W <sub>1</sub>     | 8.4 + 1.5/-0.00        | 12.4 + 2.0/-0.00 | 16.4 + 2.0/-0.00 |
| W <sub>2</sub> max | 14.4                   | 18.4             | 22.4             |

Figure A30 – EIA Referenced Taped Component Dimensions for AHS/ASMD/nanoASMDc/microASMD/miniASMDc Devices

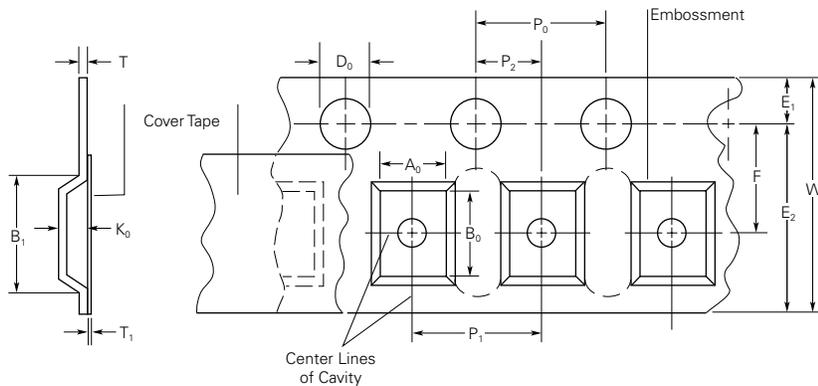
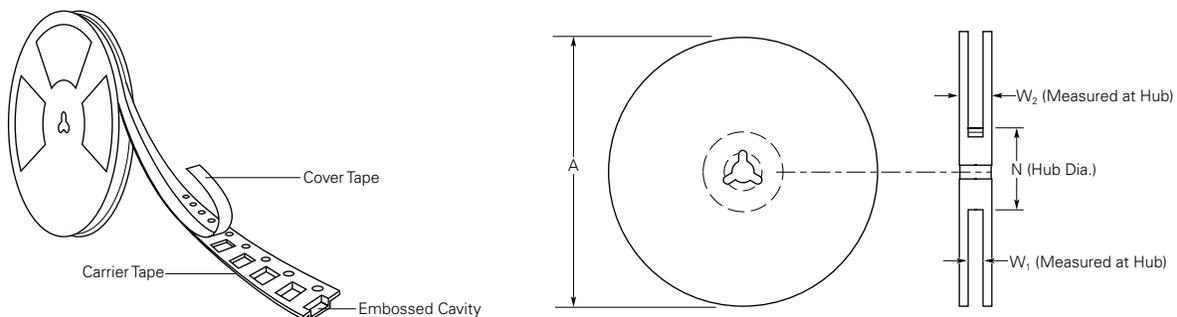


Figure A31 – EIA Referenced Reel Dimensions for AHS/ASMD/nanoASMDc/microASMD/miniASMDc Devices



## Part Numbering System

**AGRF 800 -2****Packaging Option**

(Blank) = Bulk  
 2 = Tape and Reel Packaging  
 AP = Ammo Pack

**Hold Current Indicator****Product Series**

An "F" at the End of the Series  
 Indicates Pb-free Version of Product

**AHS 080 -2****Packaging**

2 = Tape and Reel

**Hold Current Indicator****Product Series****BD280 -1130 -10/16****Rating Current / Maximum Operating Voltage**

10 = Rating Current (Hold Current of BD Device is 70%~80% of Rating Current)  
 16 = Max Operating Voltage is 16V (Nominal Operating Voltage of BD Device is 14V)

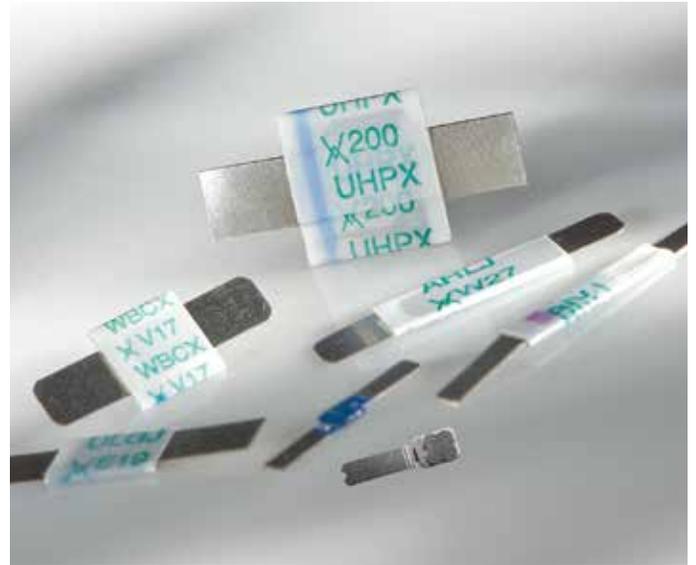
**Typical Cap Size****Product Series****Warning :**

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.

# POLYSWITCH RESETTABLE DEVICES

## Strap Battery Devices

TE Circuit Protection, a pioneer of polymeric positive temperature coefficient (PPTC) resettable devices, offers several material platforms to help protect battery applications. Each of these material platforms offers different performance characteristics that allow the engineer greater design flexibility. PolySwitch devices for battery protection include SRP, LR4, VTP, VLP, VLR, MXP, MGP and RSD series, disc and special application strap devices.



### BENEFITS

- Many material platforms and device form factors help provide engineers more design flexibility
- Compatible with high-volume electronics assembly
- Assists in meeting regulatory requirements
- Low-resistance devices increase battery operating time

### FEATURES

- RoHS compliant
- Lead-free versions of all devices are available
- Broad range of resettable devices available
- Current ratings from 1.1A to 13A
- Voltage ratings from 6V to 30V
- Agency recognition: UL, CSA, TÜV
- Fast time-to-trip
- Low resistance

### APPLICATIONS

- Mobile phone and smart phone battery packs
- Tablet PC battery packs
- Mobile radio battery packs
- Computer battery packs
- Digital camera battery packs
- Portable media player battery packs
- Power tools (charge line)

## Application Selection Guide

The guide below lists PolySwitch strap battery devices which are typically used in applications. The following pages contain the specifications for the part numbers recommended below. Once a device is selected, the user should evaluate and test each product for its intended application.

| Protection Application       | Additional Comments  | PolySwitch Resettable Devices — Key Device Selection Criteria |  |                        |
|------------------------------|----------------------|---|--|------------------------|
|                              |                      | Installation Method   | Lowest Resistance                              | Lowest Thermal Cut-off |
| Mobile Phone Battery Packs   | Li-ion               | Surface-mount   | Refer to Surface-mount Section of this Catalog |                        |
|                              |                      | Prismatic   | MXP370BD, RSD310                               | VLR175F                |
| Cordless Phone Battery Packs | NiMH                 | Cylindrical   | VLP210F  | —                      |
|                              |                      |   | SRP175F  | —                      |
| Mobile Radio Battery Packs   | NiMH                 | Cylindrical   | LR4-380F<br>SRP350F                            | —                      |
| Computer Battery Packs       | NiMH                 | Cylindrical   | LR4-900F                                       | —                      |
|                              | Li-ion               | Cylindrical   | LR4-1300SSF                                    | —                      |
| Camcorder Battery Packs      | NiMH or Li-ion       | Prismatic   | Consult Local Rep                              | Consult Local Rep      |
|                              |                      |   | VLP270F  | VTP210GF               |
| PDA Battery Packs            | Li-ion               | Prismatic   | LR4-380F                                       | —                      |
|                              |                      |   | VLP220F  | VLR175F                |
| Power Tools (Charge Line)    | NiCd, NiMH or Li-ion | Cylindrical   | Custom LR4                                     | Custom VTP             |

Table B1 — Product Series - Current Rating, Voltage Rating / Typical Resistance

| Hold Current (A) | Typical Activation Temperature |             | VTP<br>90°C | MXP<br>120°C | RSD<br>125°C | SRP<br>125°C | LR4<br>125°C |
|------------------|--------------------------------|-------------|-------------|--------------|--------------|--------------|--------------|
|                  | VLR<br>85°C                    | VLP<br>90°C |             |              |              |              |              |
| 1.10             | —                              | —           | 16V/0.054Ω  | —            | —            | —            | —            |
| 1.20             | —                              | 16V/0.053Ω  | —           | —            | —            | 15V/0.123Ω   | —            |
| 1.70             | 12V/0.025Ω                     | —           | 16V/0.041Ω  | —            | —            | —            | —            |
| 1.75             | 12V/0.024Ω                     | 16V/0.032Ω  | 16V/0.040Ω  | —            | —            | 15V/0.070Ω   | —            |
| 1.80             | —                              | —           | —           | 6V/0.0105Ω   | —            | —            | —            |
| 1.90             | —                              | —           | —           | 6V/0.011Ω    | —            | —            | 15V/0.056Ω   |
| 2.00             | —                              | —           | —           | —            | —            | 30V/0.045Ω   | —            |
| 2.10             | —                              | 16V/0.024Ω  | 16V/0.024Ω  | —            | —            | —            | —            |
| 2.20             | —                              | 16V/0.023Ω  | —           | —            | —            | —            | —            |
| 2.30             | 12V/0.015Ω                     | —           | —           | —            | —            | —            | —            |
| 2.50             | —                              | —           | —           | 6V/0.011Ω    | —            | —            | —            |
| 2.60             | —                              | —           | —           | —            | —            | —            | 15V/0.031Ω   |
| 2.70             | —                              | 16V/0.015Ω  | —           | 6V/0.0105Ω   | —            | —            | —            |
| 3.10             | —                              | —           | —           | 6V/0.0075Ω   | 6V/0.010Ω    | —            | —            |
| 3.50             | —                              | —           | —           | —            | —            | 30V/0.024Ω   | —            |
| 3.70             | —                              | —           | —           | 6V/0.007Ω    | 6V/0.007Ω    | —            | —            |
| 3.80             | —                              | —           | —           | —            | —            | —            | 15V/0.020Ω   |
| 4.20             | —                              | —           | —           | —            | 6V/0.0065Ω   | 30V/0.018Ω   | —            |
| 4.50             | —                              | —           | —           | —            | —            | —            | 20V/0.016Ω   |
| 5.50             | —                              | —           | —           | —            | —            | —            | 20V/0.013Ω   |
| 6.00             | —                              | —           | —           | —            | —            | —            | 20V/0.011Ω   |
| 7.30             | —                              | —           | —           | —            | —            | —            | 20V/0.009Ω   |
| 9.00             | —                              | —           | —           | —            | —            | —            | 20V/0.008Ω   |
| 13.00            | —                              | —           | —           | —            | —            | —            | 20V/0.006Ω   |

Table B2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

| Part Number                         | Maximum Ambient Temperature |       |     |      |      |      |      |      |      |      |      |
|-------------------------------------|-----------------------------|-------|-----|------|------|------|------|------|------|------|------|
|                                     | -40°C<br>A                  | -20°C | 0°C | 20°C | 25°C | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C |
| <b>85°C Typical Activation VLR*</b> |                             |       |     |      |      |      |      |      |      |      |      |
| VLR170F                             | 3.5                         | 2.9   | 2.4 | 1.84 | 1.70 | 1.2  | 1.0  | 0.7  | 0.3  | —    | —    |
| VLR175F                             | 3.5                         | 2.9   | 2.4 | 1.87 | 1.75 | 1.3  | 1.0  | 0.8  | 0.3  | —    | —    |
| VLR175LF                            | 3.5                         | 2.9   | 2.4 | 1.87 | 1.75 | 1.3  | 1.0  | 0.8  | 0.3  | —    | —    |
| VLR230F                             | 5.0                         | 4.2   | 3.4 | 2.52 | 2.30 | 1.7  | 1.3  | 0.9  | 0.4  | —    | —    |

Table B2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)] (Cont'd)

| Part Number                     | Maximum Ambient Temperature |       |      |      |       |      |      |      |      |      |      |      |      |
|---------------------------------|-----------------------------|-------|------|------|-------|------|------|------|------|------|------|------|------|
|                                 | -40°C<br>A                  | -20°C | 0°C  | 20°C | 25°C  | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C |      |      |
| <b>90°C Typical Activation</b>  |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| <b>VLP*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| VLP120UF                        | 2.4                         | 2.1   | 1.8  | 1.30 | 1.20  | 1.0  | 0.7  | 0.6  | 0.3  | 0.2  | 0.1  |      |      |
| VLP175UAF                       | 3.2                         | 2.7   | 2.3  | 1.70 | 1.75  | 1.2  | 1.0  | 0.9  | 0.5  | 0.2  | 0.1  |      |      |
| VLP210F                         | 4.3                         | 3.6   | 2.9  | 2.31 | 2.10  | 1.6  | 1.3  | 1.0  | 0.6  | 0.3  | 0.1  |      |      |
| VLP220F                         | 4.5                         | 3.8   | 3.0  | 2.45 | 2.20  | 1.7  | 1.4  | 1.1  | 0.7  | 0.3  | 0.1  |      |      |
| VLP270F                         | 5.6                         | 4.7   | 4.0  | 3.05 | 2.70  | 2.2  | 1.7  | 1.4  | 0.9  | 0.4  | 0.1  |      |      |
| <b>VTP*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| VTP110F                         | 2.0                         | 1.7   | 1.4  | 1.12 | 1.10  | 0.85 | 0.75 | 0.7  | 0.4  | 0.2  | 0.1  |      |      |
| VTP170F                         | 3.2                         | 2.7   | 2.2  | 1.80 | 1.70  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |      |      |
| VTP170XSF                       | 3.2                         | 2.7   | 2.2  | 1.80 | 1.70  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |      |      |
| VTP175F                         | 3.2                         | 2.7   | 2.2  | 1.84 | 1.75  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |      |      |
| VTP175LF                        | 3.2                         | 2.7   | 2.2  | 1.84 | 1.75  | 1.3  | 1.0  | 0.8  | 0.5  | 0.3  | 0.1  |      |      |
| VTP210GF                        | 4.1                         | 3.5   | 2.9  | 2.26 | 2.10  | 1.6  | 1.3  | 1.0  | 0.7  | 0.4  | 0.1  |      |      |
| VTP210SF                        | 4.1                         | 3.5   | 2.9  | 2.26 | 2.10  | 1.6  | 1.3  | 1.0  | 0.7  | 0.4  | 0.1  |      |      |
| Part Number                     | Maximum Ambient Temperature |       |      |      |       |      |      |      |      |      |      |      |      |
|                                 | -40°C<br>A                  | -20°C | 0°C  | 20°C | 25°C  | 40°C | 50°C | 60°C | 70°C | 75°C | 80°C | 85°C | 90°C |
| <b>120°C Typical Activation</b> |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| <b>MXP*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| MXP180                          | —                           | —     | 2.45 | —    | 1.8   | —    | —    | 0.80 | —    | —    | —    | —    | —    |
| MXP190BB                        | —                           | —     | 2.6  | —    | 1.9   | —    | —    | 0.85 | —    | —    | —    | —    | —    |
| MXP250K                         | —                           | —     | 3.6  | —    | 2.5   | —    | —    | 1.3  | —    | —    | —    | —    | —    |
| MXP270                          | —                           | —     | 3.8  | —    | 2.7   | —    | —    | 1.4  | —    | —    | —    | —    | 0.3  |
| MXP310                          | —                           | —     | 5.0  | —    | 3.1   | —    | —    | 1.9  | —    | 1.0  | —    | —    | —    |
| MXP370BD                        | —                           | —     | 5.0  | —    | 3.7   | —    | —    | 1.9  | —    | —    | —    | —    | —    |
| <b>120°C Typical Activation</b> |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| <b>MGP</b>                      |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| MGP450                          | —                           | —     | —    | —    | 4.5   | —    | —    | 2.6  | —    | —    | —    | —    | —    |
| MGP500                          | —                           | —     | —    | —    | 5.0   | —    | —    | 3.0  | 2.0  | —    | —    | —    | —    |
| <b>125°C Typical Activation</b> |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| <b>RSD*</b>                     |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| RSD310                          | —                           | —     | —    | —    | 3.1   | —    | —    | —    | —    | —    | —    | —    | —    |
| RSD370                          | —                           | —     | —    | —    | 3.7   | —    | —    | —    | —    | —    | —    | —    | —    |
| RSD420                          | —                           | —     | —    | —    | 4.2   | —    | —    | —    | —    | —    | —    | —    | —    |
| Part Number                     | Maximum Ambient Temperature |       |      |      |       |      |      |      |      |      |      |      |      |
|                                 | -40°C<br>A                  | -20°C | 0°C  | 20°C | 25°C  | 40°C | 50°C | 60°C | 70°C | 80°C | 85°C |      |      |
| <b>125°C Typical Activation</b> |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| <b>SRP</b>                      |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| SRP120F                         | 1.9                         | 1.7   | 1.5  | 1.20 | 1.17  | 1.0  | 0.9  | 0.8  | 0.6  | 0.5  | 0.4  |      |      |
| SRP175F                         | 2.5                         | 2.2   | 2.0  | 1.75 | 1.68  | 1.4  | 1.3  | 1.2  | 1.0  | 0.9  | 0.8  |      |      |
| SRP200F                         | 3.1                         | 2.8   | 2.5  | 2.00 | 1.97  | 1.7  | 1.5  | 1.4  | 1.2  | 1.0  | 0.9  |      |      |
| SRP350F                         | 5.3                         | 4.8   | 4.3  | 3.50 | 3.44  | 3.0  | 2.7  | 2.5  | 2.1  | 1.8  | 1.7  |      |      |
| SRP420F                         | 6.3                         | 5.7   | 5.1  | 4.20 | 4.11  | 3.6  | 3.3  | 3.0  | 2.6  | 2.2  | 2.1  |      |      |
| <b>LR4</b>                      |                             |       |      |      |       |      |      |      |      |      |      |      |      |
| LR4-190F                        | 2.8                         | 2.5   | 2.3  | 1.9  | 1.86  | 1.6  | 1.5  | 1.4  | 1.2  | 1.1  | 1.0  |      |      |
| LR4-260F                        | 3.8                         | 3.4   | 3.1  | 2.6  | 2.54  | 2.2  | 2.0  | 1.9  | 1.7  | 1.4  | 1.3  |      |      |
| LR4-380F                        | 5.4                         | 4.9   | 4.4  | 3.8  | 3.64  | 3.3  | 3.0  | 2.8  | 2.5  | 2.3  | 2.1  |      |      |
| LR4-380XF                       | 5.4                         | 4.9   | 4.4  | 3.8  | 3.64  | 3.3  | 3.0  | 2.8  | 2.5  | 2.3  | 2.1  |      |      |
| LR4-450F                        | 6.5                         | 5.8   | 5.3  | 4.5  | 4.38  | 3.9  | 3.6  | 3.3  | 2.9  | 2.6  | 2.4  |      |      |
| LR4-550F                        | 7.6                         | 6.9   | 6.2  | 5.5  | 5.32  | 4.7  | 4.3  | 4.0  | 3.6  | 3.2  | 3.0  |      |      |
| LR4-600F                        | 8.7                         | 7.8   | 7.1  | 6.0  | 5.86  | 5.2  | 4.7  | 4.4  | 3.9  | 3.4  | 3.2  |      |      |
| LR4-600XF                       | 8.7                         | 7.8   | 7.1  | 6.0  | 5.86  | 5.2  | 4.7  | 4.4  | 3.9  | 3.4  | 3.2  |      |      |
| LR4-730F                        | 10.5                        | 9.5   | 8.6  | 7.3  | 7.13  | 6.3  | 5.7  | 5.4  | 4.7  | 4.2  | 4.0  |      |      |
| LR4-900F                        | 12.7                        | 11.4  | 10.0 | 9.0  | 8.50  | 7.5  | 6.8  | 6.2  | 5.5  | 4.9  | 4.5  |      |      |
| LR4-1300SSF                     | 17.9                        | 16.2  | 14.5 | 13.0 | 12.40 | 11.1 | 10.3 | 9.5  | 8.6  | 7.7  | 7.2  |      |      |

\* Product electrical characteristics determined at 25°C.

Figure B1 — Thermal Derating Curve

- A = LR4  
B = SRP  
C = VTP, VLP, MXP  
D = MGP  
E = VLR

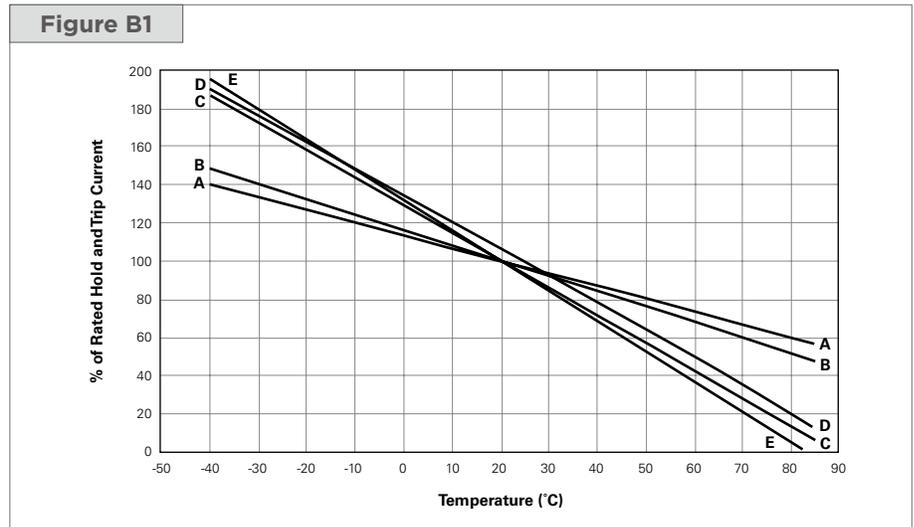


Table B3 — Electrical Characteristics

| Part Number                     | $I_H$<br>(A) | $I_T$<br>(A) | $V_{MAX}$<br>(V <sub>DC</sub> ) | $I_{MAX}$<br>(A) | $P_{D MAX}$<br>(W) | Max Time-to-trip |     | $R_{MIN}$<br>( $\Omega$ ) | $R_{MAX}$<br>( $\Omega$ ) | $R_{1MAX}$<br>( $\Omega$ ) | Figure for Dimension |
|---------------------------------|--------------|--------------|---------------------------------|------------------|--------------------|------------------|-----|---------------------------|---------------------------|----------------------------|----------------------|
|                                 |              |              |                                 |                  |                    | (A)              | (s) |                           |                           |                            |                      |
| <b>85°C Typical Activation</b>  |              |              |                                 |                  |                    |                  |     |                           |                           |                            |                      |
| <b>VLR*</b>                     |              |              |                                 |                  |                    |                  |     |                           |                           |                            |                      |
| VLR170F                         | 1.70         | 4.1          | 12                              | 100              | 1.4                | 8.50             | 5.0 | 0.018                     | 0.032                     | 0.064                      | B3                   |
| VLR175F                         | 1.75         | 4.2          | 12                              | 100              | 1.4                | 8.75             | 5.0 | 0.017                     | 0.031                     | 0.062                      | B3                   |
| VLR175LF                        | 1.75         | 4.2          | 12                              | 100              | 1.4                | 8.75             | 5.0 | 0.017                     | 0.031                     | 0.062                      | B3                   |
| VLR230F                         | 2.30         | 5.0          | 12                              | 100              | 2.5                | 10.00            | 5.0 | 0.012                     | 0.018                     | 0.036                      | B3                   |
| <b>90°C Typical Activation</b>  |              |              |                                 |                  |                    |                  |     |                           |                           |                            |                      |
| <b>VLP*</b>                     |              |              |                                 |                  |                    |                  |     |                           |                           |                            |                      |
| VLP120UF                        | 1.20         | 3.6          | 16                              | 60               | 1.6                | 7.00             | 5.0 | 0.039                     | 0.067                     | 0.134                      | B5                   |
| VLP175UAF                       | 1.75         | 3.9          | 16                              | 60               | 1.8                | 8.75             | 5.0 | 0.023                     | 0.041                     | 0.082                      | B5                   |
| VLP210F                         | 2.10         | 5.0          | 16                              | 60               | 1.8                | 10.50            | 5.0 | 0.018                     | 0.030                     | 0.060                      | B2                   |
| VLP220F                         | 2.20         | 5.3          | 16                              | 60               | 1.8                | 11.00            | 5.0 | 0.017                     | 0.029                     | 0.058                      | B3                   |
| VLP270F                         | 2.70         | 6.5          | 16                              | 60               | 2.5                | 13.50            | 5.0 | 0.012                     | 0.018                     | 0.036                      | B3                   |
| <b>VTP*</b>                     |              |              |                                 |                  |                    |                  |     |                           |                           |                            |                      |
| VTP110F                         | 1.10         | 2.7          | 16                              | 100              | 1.3                | 5.50             | 5.0 | 0.038                     | 0.070                     | 0.140                      | B5                   |
| VTP170F                         | 1.70         | 3.4          | 16                              | 100              | 1.4                | 8.50             | 5.0 | 0.030                     | 0.052                     | 0.105                      | B2                   |
| VTP170XSF                       | 1.70         | 3.4          | 16                              | 100              | 1.4                | 8.50             | 5.0 | 0.030                     | 0.052                     | 0.105                      | B4                   |
| VTP175F                         | 1.75         | 3.6          | 16                              | 100              | 1.4                | 8.75             | 5.0 | 0.029                     | 0.051                     | 0.102                      | B3                   |
| VTP175LF                        | 1.75         | 3.6          | 16                              | 100              | 1.4                | 8.75             | 5.0 | 0.029                     | 0.051                     | 0.102                      | B3                   |
| VTP210GF                        | 2.10         | 4.7          | 16                              | 100              | 1.5                | 10.00            | 5.0 | 0.018                     | 0.030                     | 0.060                      | B3                   |
| VTP210SF                        | 2.10         | 4.7          | 16                              | 100              | 1.5                | 10.00            | 5.0 | 0.018                     | 0.030                     | 0.060                      | B4                   |
| <b>120°C Typical Activation</b> |              |              |                                 |                  |                    |                  |     |                           |                           |                            |                      |
| <b>MXP*</b>                     |              |              |                                 |                  |                    |                  |     |                           |                           |                            |                      |
| MXP180                          | 1.80         | 5.2          | 6                               | 50               | 1.0                | 9.00             | 5.0 | 0.007                     | 0.014                     | 0.024                      | B10                  |
| MXP190BB                        | 1.90         | 4.9          | 6                               | 50               | 1.0                | 9.50             | 2.0 | 0.007                     | 0.015                     | 0.024                      | B9                   |
| MXP250K                         | 2.50         | 6.2          | 6                               | 50               | 1.0                | 13.50            | 2.0 | 0.006                     | 0.016                     | 0.028                      | B10                  |
| MXP270                          | 2.70         | 6.2          | 6                               | 50               | 1.0                | 13.50            | 2.0 | 0.006                     | 0.015                     | 0.026                      | B10                  |
| MXP310                          | 3.10         | 9.0          | 6                               | 50               | 1.3                | 17.50            | 5.0 | 0.003                     | 0.012                     | 0.018                      | B10                  |
| MXP370BD                        | 3.70         | 9.0          | 6                               | 50               | 1.3                | 18.50            | 5.0 | 0.004                     | 0.010                     | 0.016                      | B10                  |

\* Product electrical characteristics determined at 25°C.

Table B3 – Electrical Characteristics

(Cont'd)

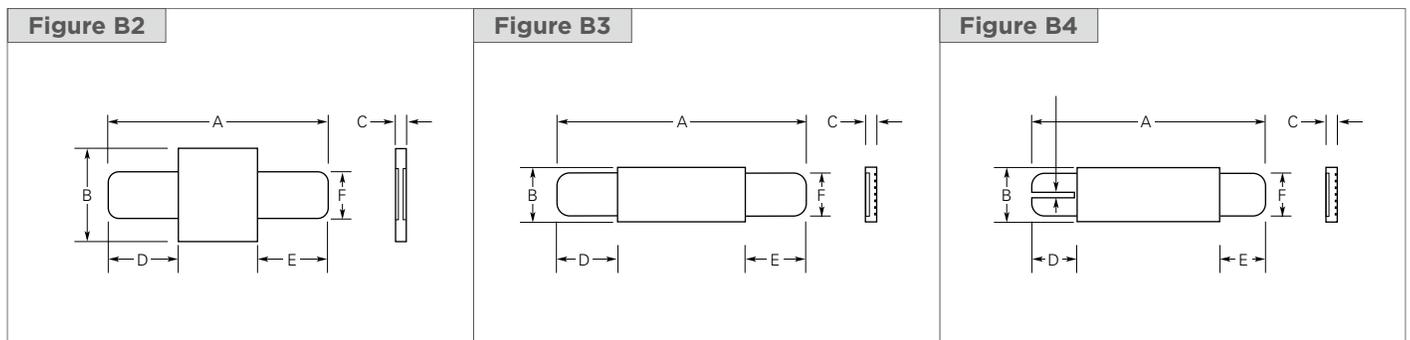
| Part Number                          | $I_H$<br>(A) | $I_T$<br>(A) | $V_{MAX}$<br>(V <sub>DC</sub> ) | $I_{MAX}$<br>(A) | $P_{D MAX}$<br>(W) | Max Time-to-trip |      | $R_{MIN}$<br>(Ω) | $R_{MAX}$<br>(Ω) | $R_{1MAX}$<br>(Ω) | Figure for Dimension |
|--------------------------------------|--------------|--------------|---------------------------------|------------------|--------------------|------------------|------|------------------|------------------|-------------------|----------------------|
|                                      |              |              |                                 |                  |                    | (A)              | (s)  |                  |                  |                   |                      |
| <b>120°C Typical Activation MGP</b>  |              |              |                                 |                  |                    |                  |      |                  |                  |                   |                      |
| MGP450                               | 4.50         | 9.2          | 6                               | 50               | 1.5                | 25.00            | 5.0  | 0.0025           | 0.007            | 0.013             | B11                  |
| MGP500                               | 5.00         | 9.2          | 6                               | 50               | 1.5                | 25.00            | 5.0  | 0.0025           | 0.0065           | 0.013             | B12                  |
| <b>125°C Typical Activation RSD*</b> |              |              |                                 |                  |                    |                  |      |                  |                  |                   |                      |
| RSD310                               | 3.1          | 11           | 6                               | 50               | 1.5                | 15.5             | 5.0  | 0.0040           | 0.015            | 0.022             | B13                  |
| RSD370                               | 3.7          | 12           | 6                               | 50               | 1.5                | 18.5             | 5.0  | 0.0035           | 0.012            | 0.018             | B13                  |
| RSD420                               | 4.2          | 13           | 6                               | 50               | 1.5                | 21.0             | 5.0  | 0.0030           | 0.010            | 0.016             | B13                  |
| <b>125°C Typical Activation SRP</b>  |              |              |                                 |                  |                    |                  |      |                  |                  |                   |                      |
| SRP120F                              | 1.20         | 2.7          | 15                              | 100              | 1.2                | 6.00             | 5.0  | 0.085            | 0.160            | 0.220             | B6                   |
| SRP175F                              | 1.75         | 3.8          | 15                              | 100              | 1.5                | 8.75             | 5.0  | 0.050            | 0.090            | 0.120             | B6                   |
| SRP200F                              | 2.00         | 4.4          | 30                              | 100              | 1.9                | 10.00            | 4.0  | 0.030            | 0.060            | 0.100             | B6                   |
| SRP350F                              | 3.50         | 6.3          | 30                              | 100              | 2.5                | 20.00            | 3.0  | 0.017            | 0.031            | 0.050             | B6                   |
| SRP420F                              | 4.20         | 7.6          | 30                              | 100              | 2.9                | 20.00            | 6.0  | 0.012            | 0.024            | 0.040             | B6                   |
| <b>LR4</b>                           |              |              |                                 |                  |                    |                  |      |                  |                  |                   |                      |
| LR4-190F                             | 1.90         | 3.9          | 15                              | 100              | 1.2                | 9.5              | 5.0  | 0.0390           | 0.0720           | 0.102             | B7                   |
| LR4-260F                             | 2.60         | 5.8          | 15                              | 100              | 2.5                | 13.0             | 5.0  | 0.0200           | 0.0420           | 0.063             | B7                   |
| LR4-380F                             | 3.80         | 8.3          | 15                              | 100              | 2.5                | 19.0             | 5.0  | 0.0130           | 0.0260           | 0.037             | B7                   |
| LR4-380XF                            | 3.80         | 8.3          | 15                              | 100              | 2.5                | 19.0             | 5.0  | 0.0130           | 0.0260           | 0.037             | B7                   |
| LR4-450F                             | 4.50         | 8.9          | 20                              | 100              | 2.3                | 22.5             | 5.0  | 0.0110           | 0.0200           | 0.028             | B7                   |
| LR4-550F                             | 5.50         | 10.5         | 20                              | 100              | 2.8                | 27.5             | 5.0  | 0.0090           | 0.0160           | 0.022             | B7                   |
| LR4-600F                             | 6.00         | 11.7         | 20                              | 100              | 2.8                | 30.0             | 5.0  | 0.0070           | 0.0140           | 0.019             | B7                   |
| LR4-600XF                            | 6.00         | 11.7         | 20                              | 100              | 2.8                | 30.0             | 5.0  | 0.0075           | 0.0140           | 0.019             | B7                   |
| LR4-730F                             | 7.30         | 14.1         | 20                              | 100              | 3.3                | 30.0             | 5.0  | 0.0060           | 0.0120           | 0.015             | B7                   |
| LR4-900F                             | 9.00         | 16.7         | 20                              | 100              | 3.8                | 45.0             | 5.0  | 0.0060           | 0.0100           | 0.014             | B7                   |
| LR4-1300SSF                          | 13.00        | 21.2         | 20                              | 100              | 4.5                | 50.0             | 10.0 | 0.0035           | 0.0065           | 0.009             | B8                   |

\* Product electrical characteristics determined at 25°C.

**Notes**

- $I_H$  : Hold current: maximum current device will pass without interruption in 20°C still air unless otherwise specified.  
 $I_T$  : Trip current: minimum current that will switch the device from low-resistance to high-resistance in 20°C still air unless otherwise specified.  
 $V_{MAX}$  : Maximum voltage device can withstand without damage at rated current.  
 $I_{MAX}$  : Maximum fault current device can withstand without damage at rated voltage.  
 $P_D$  : Power dissipated from device when in the tripped state in 20°C still air unless otherwise specified.  
 $R_{MIN}$  : Minimum resistance of device as supplied at 20°C unless otherwise specified.  
 $R_{MAX}$  : Maximum resistance of device as supplied at 20°C unless otherwise specified.  
 $R_{1MAX}$  : Maximum resistance, measured at 20°C unless otherwise specified, of device one hour after being tripped the first time.

## Figures B2-B13 – Dimension Figures



### Figures B2-B13 — Dimension Figures

(Cont'd)

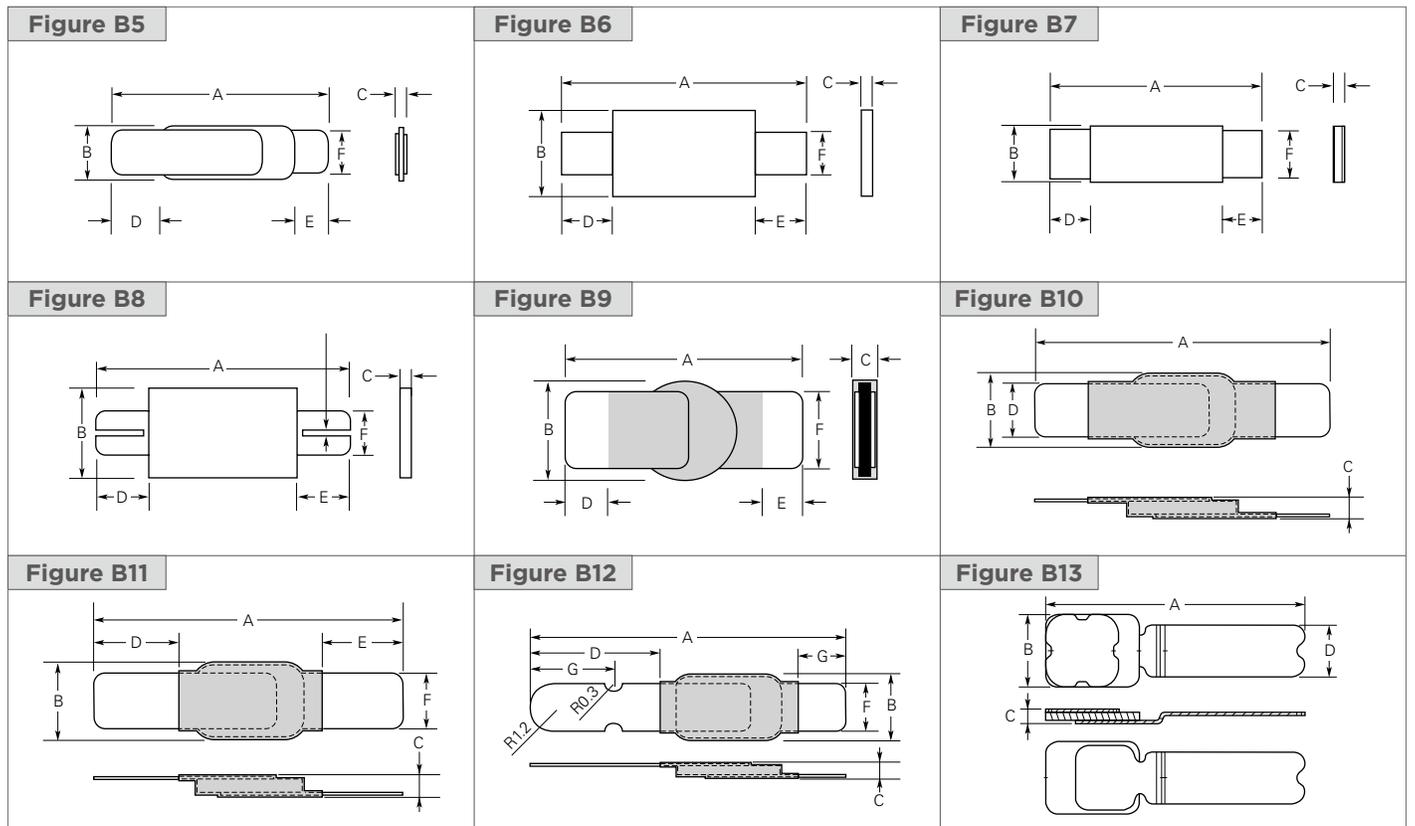


Table B4 — Dimensions in Millimeters (Inches)

| Part Number                    | A               |                 | B              |                | C              |                | D              |                | E               |                 | F              |                | G   |     | Figure |
|--------------------------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|----------------|----------------|-----|-----|--------|
|                                | Min             | Max             | Min            | Max            | Min            | Max            | Min            | Max            | Min             | Max             | Min            | Max            | Min | Max |        |
| <b>85°C Typical Activation</b> |                 |                 |                |                |                |                |                |                |                 |                 |                |                |     |     |        |
| <b>VLR</b>                     |                 |                 |                |                |                |                |                |                |                 |                 |                |                |     |     |        |
| VLR170F                        | 20.8<br>(0.832) | 23.2<br>(0.928) | 3.5<br>(0.140) | 3.9<br>(0.156) | —              | 0.8<br>(0.032) | 4.5<br>(0.180) | 6.5<br>(0.260) | 4.5<br>(0.180)  | 6.5<br>(0.260)  | 2.4<br>(0.096) | 2.6<br>(0.104) | —   | —   | B3     |
| VLR175F                        | 23.0<br>(0.920) | 24.5<br>(0.980) | 2.9<br>(0.116) | 3.3<br>(0.132) | 0.5<br>(0.020) | 0.8<br>(0.032) | 4.7<br>(0.188) | 7.2<br>(0.288) | 3.8<br>(0.152)  | 5.4<br>(0.216)  | 2.4<br>(0.096) | 2.6<br>(0.104) | —   | —   | B3     |
| VLR175LF                       | 29.3<br>(1.172) | 31.7<br>(1.268) | 2.9<br>(0.116) | 3.3<br>(0.132) | —              | 0.8<br>(0.032) | 5.2<br>(0.208) | 6.8<br>(0.272) | 10<br>(0.400)   | 12.5<br>(0.500) | 2.4<br>(0.096) | 2.6<br>(0.104) | —   | —   | B3     |
| VLR230F                        | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196) | 5.3<br>(0.212) | —              | 0.8<br>(0.032) | 4.1<br>(0.164) | 5.8<br>(0.232) | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —   | —   | B3     |
| <b>90°C Typical Activation</b> |                 |                 |                |                |                |                |                |                |                 |                 |                |                |     |     |        |
| <b>VLP</b>                     |                 |                 |                |                |                |                |                |                |                 |                 |                |                |     |     |        |
| VLP120UF                       | 10.9<br>(0.430) | 11.8<br>(0.460) | 4.4<br>(0.170) | 4.6<br>(0.180) | —              | 0.7<br>(0.028) | 5.5<br>(0.220) | 6.5<br>(0.260) | 1.65<br>(0.065) | 1.9<br>(0.075)  | 2.3<br>(0.091) | 2.5<br>(0.098) | —   | —   | B5     |
| VLP175UAF                      | 23.6<br>(0.944) | 25.6<br>(1.024) | 2.7<br>(0.108) | 2.9<br>(0.116) | —              | 0.7<br>(0.028) | 7.0<br>(0.280) | 8.0<br>(0.320) | 7.0<br>(0.280)  | 8.0<br>(0.320)  | 2.3<br>(0.092) | 2.5<br>(0.100) | —   | —   | B5     |
| VLP210F                        | 15.4<br>(0.616) | 17.5<br>(0.700) | 6.9<br>(0.276) | 7.3<br>(0.292) | 0.6<br>(0.024) | 0.8<br>(0.032) | 4.0<br>(0.160) | 6.2<br>(0.248) | 4.0<br>(0.160)  | 6.2<br>(0.248)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —   | —   | B2     |
| VLP220F                        | 21.1<br>(0.844) | 23.3<br>(0.932) | 3.5<br>(0.140) | 3.9<br>(0.156) | 0.6<br>(0.024) | 0.8<br>(0.032) | 5.1<br>(0.204) | 6.8<br>(0.272) | 5.1<br>(0.204)  | 6.8<br>(0.272)  | 2.9<br>(0.116) | 3.1<br>(0.124) | —   | —   | B3     |
| VLP270F                        | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196) | 5.3<br>(0.212) | 0.6<br>(0.024) | 0.8<br>(0.032) | 4.1<br>(0.164) | 5.8<br>(0.232) | 4.1<br>(0.164)  | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —   | —   | B3     |

Table B4 — Dimensions in Millimeters (Inches)

(Cont'd)

| Part Number                     | A               |                 | B               |                 | C              |                 | D              |                | E              |                 | F              |                | G              |                | Figure |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|----------------|-----------------|----------------|----------------|----------------|-----------------|----------------|----------------|----------------|----------------|--------|
|                                 | Min             | Max             | Min             | Max             | Min            | Max             | Min            | Max            | Min            | Max             | Min            | Max            | Min            | Max            |        |
| <b>VTP</b>                      |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| VTP110F                         | 23.6<br>(0.944) | 25.6<br>(1.024) | 2.7<br>(0.108)  | 2.9<br>(0.116)  | —<br>(0.028)   | 0.7<br>(0.028)  | 7.0<br>(0.280) | 8.0<br>(0.320) | 7.0<br>(0.280) | 8.0<br>(0.320)  | 2.3<br>(0.092) | 2.5<br>(0.100) | —              | —              | B5     |
| VTP170F                         | 15.4<br>(0.616) | 17.5<br>(0.700) | 7.0<br>(0.280)  | 7.4<br>(0.296)  | 0.5<br>(0.020) | 0.8<br>(0.032)  | 4.0<br>(0.160) | 6.2<br>(0.248) | 4.0<br>(0.160) | 6.2<br>(0.248)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —              | —              | B2     |
| VTP170XSF                       | 20.9<br>(0.836) | 22.9<br>(0.916) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | 0.5<br>(0.020) | 0.8<br>(0.032)  | 6.0<br>(0.240) | 8.6<br>(0.344) | 6.0<br>(0.240) | 8.6<br>(0.344)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —              | —              | B4     |
| VTP175F                         | 21.2<br>(0.848) | 23.2<br>(0.928) | 3.5<br>(0.140)  | 3.9<br>(0.156)  | —<br>(0.032)   | 0.8<br>(0.032)  | 4.6<br>(0.184) | 6.6<br>(0.264) | 4.6<br>(0.184) | 6.6<br>(0.264)  | 2.9<br>(0.116) | 3.1<br>(0.124) | —              | —              | B3     |
| VTP175LF                        | 25.8<br>(1.032) | 28.2<br>(1.128) | 3.5<br>(0.140)  | 3.9<br>(0.156)  | —<br>(0.032)   | 0.8<br>(0.032)  | 5.7<br>(0.228) | 7.3<br>(0.292) | 8.7<br>(0.348) | 10.3<br>(0.412) | 2.4<br>(0.096) | 2.6<br>(0.104) | —              | —              | B3     |
| VTP210GF                        | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | —<br>(0.032)   | 0.8<br>(0.032)  | 4.1<br>(0.164) | 5.8<br>(0.232) | 4.1<br>(0.164) | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —              | —              | B3     |
| VTP210SF                        | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.3<br>(0.212)  | 0.6<br>(0.024) | 0.8<br>(0.032)  | 4.1<br>(0.164) | 5.8<br>(0.232) | 4.1<br>(0.164) | 5.8<br>(0.232)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —              | —              | B4     |
| <b>120°C Typical Activation</b> |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| <b>MXP</b>                      |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| MXP180                          | 9.4<br>(0.37)   | 10.0<br>(0.39)  | 2.3<br>(0.09)   | 2.6<br>(0.10)   | 0.7<br>(0.02)  | 1.1<br>(0.04)   | 1.9<br>(0.07)  | 2.1<br>(0.08)  | —              | —               | —              | —              | —              | —              | B10    |
| MXP190BB                        | 9.2<br>(0.36)   | 10.8<br>(0.43)  | 2.96<br>(0.12)  | 3.26<br>(0.13)  | 0.7<br>(0.03)  | 1.1<br>(0.04)   | 1.6<br>(0.06)  | 3.1<br>(0.12)  | 1.6<br>(0.06)  | 3.1<br>(0.12)   | 2.2<br>(0.09)  | 2.4<br>(0.10)  | —              | —              | B9     |
| MXP250K                         | 11.75<br>(0.46) | 12.35<br>(0.49) | 2.3<br>(0.09)   | 2.7<br>(0.11)   | 0.7<br>(0.03)  | 1.1<br>(0.04)   | 2.4<br>(0.09)  | 2.6<br>(0.10)  | —              | —               | —              | —              | —              | —              | B10    |
| MXP270                          | 10.3<br>(0.40)  | 11.5<br>(0.45)  | 2.3<br>(0.09)   | 2.7<br>(0.10)   | 0.7<br>(0.02)  | 1.1<br>(0.04)   | 2.1<br>(0.08)  | —              | 2.1<br>(0.08)  | —               | 1.9<br>(0.07)  | 2.1<br>(0.08)  | —              | —              | B9     |
| MXP310                          | 14.5<br>(0.57)  | 16.5<br>(0.65)  | 2.96<br>(0.11)  | 3.26<br>(0.13)  | 0.65<br>(0.03) | 0.95<br>(0.04)  | 4.6<br>(0.18)  | —              | 4.6<br>(0.18)  | —               | 2.2<br>(0.09)  | 2.4<br>(0.10)  | —              | —              | B9     |
| MXP370BD                        | 10.5<br>(0.41)  | 11.3<br>(0.44)  | 2.96<br>(0.11)  | 3.26<br>(0.12)  | 0.7<br>(0.02)  | 1.1<br>(0.04)   | 2.0<br>(0.07)  | —              | 2.0<br>(0.07)  | —               | 2.2<br>(0.08)  | 2.4<br>(0.09)  | —              | —              | B9     |
| <b>120°C Typical Activation</b> |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| <b>MGP</b>                      |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| MGP450                          | 13.0<br>(0.51)  | 14.0<br>(0.55)  | 2.96<br>(0.12)  | 3.26<br>(0.13)  | —<br>(0.04)    | 0.95<br>(0.04)  | 3.0<br>(0.12)  | —              | 3.0<br>(0.12)  | —               | 2.2<br>(0.09)  | 2.4<br>(0.09)  | —              | —              | B11    |
| MGP500                          | 14.5<br>(0.57)  | 15.5<br>(0.61)  | 2.96<br>(0.12)  | 3.26<br>(0.13)  | —<br>(0.04)    | 0.95<br>(0.04)  | 5.5<br>(0.22)  | 7.0<br>(0.28)  | 2.0<br>(0.08)  | —               | 2.3<br>(0.09)  | 2.5<br>(0.10)  | 3.95<br>(0.16) | 4.05<br>(0.16) | B12    |
| <b>125°C Typical Activation</b> |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| <b>RSD</b>                      |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| RSD310                          | 9.7<br>(0.382)  | 10.3<br>(0.406) | 2.65<br>(0.106) | 2.95<br>(0.114) | —<br>(0.024)   | 0.65<br>(0.024) | 1.9<br>(0.075) | 2.1<br>(0.083) | —              | —               | —              | —              | —              | —              | B13    |
| RSD370                          | 9.7<br>(0.382)  | 10.3<br>(0.406) | 2.65<br>(0.106) | 2.95<br>(0.114) | —<br>(0.024)   | 0.65<br>(0.024) | 1.9<br>(0.075) | 2.1<br>(0.083) | —              | —               | —              | —              | —              | —              | B13    |
| RSD420                          | 9.7<br>(0.382)  | 10.3<br>(0.406) | 2.65<br>(0.106) | 2.95<br>(0.114) | —<br>(0.024)   | 0.65<br>(0.024) | 1.9<br>(0.075) | 2.1<br>(0.083) | —              | —               | —              | —              | —              | —              | B13    |
| <b>125°C Typical Activation</b> |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| <b>SRP</b>                      |                 |                 |                 |                 |                |                 |                |                |                |                 |                |                |                |                |        |
| SRP120F                         | 19.9<br>(0.796) | 22.1<br>(0.884) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040)  | 5.5<br>(0.220) | 7.5<br>(0.300) | 5.5<br>(0.220) | 7.5<br>(0.300)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —              | —              | B6     |
| SRP175F                         | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.2<br>(0.208)  | 0.6<br>(0.024) | 1.0<br>(0.040)  | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220)  | 3.9<br>(0.156) | 4.1<br>(0.164) | —              | —              | B6     |
| SRP200F                         | 21.3<br>(0.852) | 23.4<br>(0.936) | 10.2<br>(0.408) | 11.0<br>(0.440) | 0.5<br>(0.020) | 1.1<br>(0.044)  | 5.0<br>(0.200) | 7.6<br>(0.304) | 5.0<br>(0.200) | 7.6<br>(0.304)  | 4.8<br>(0.192) | 5.4<br>(0.216) | —              | —              | B6     |
| SRP350F                         | 28.4<br>(1.136) | 31.8<br>(1.272) | 13.0<br>(0.520) | 13.5<br>(0.540) | 0.5<br>(0.020) | 1.1<br>(0.044)  | 6.3<br>(0.252) | 8.9<br>(0.356) | 6.3<br>(0.252) | 8.9<br>(0.356)  | 6.0<br>(0.240) | 6.6<br>(0.264) | —              | —              | B6     |
| SRP420F                         | 30.6<br>(1.224) | 32.4<br>(1.296) | 12.9<br>(0.516) | 13.6<br>(0.544) | 0.5<br>(0.020) | 1.1<br>(0.044)  | 5.0<br>(0.200) | 7.5<br>(0.300) | 5.0<br>(0.200) | 7.5<br>(0.300)  | 6.0<br>(0.240) | 6.7<br>(0.268) | —              | —              | B6     |

Table B4 – Dimensions in Millimeters (Inches)

(Cont'd)

| Part Number | A               |                 | B               |                 | C              |                | D              |                | E              |                | F              |                | G   |     | Figure |
|-------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----|-----|--------|
|             | Min             | Max             | Min             | Max             | Min            | Max            | Min            | Max            | Min            | Max            | Min            | Max            | Min | Max |        |
| <b>LR4</b>  |                 |                 |                 |                 |                |                |                |                |                |                |                |                |     |     |        |
| LR4-190F    | 19.9<br>(0.796) | 22.1<br>(0.884) | 4.9<br>(0.196)  | 5.5<br>(0.220)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.5<br>(0.220) | 7.5<br>(0.300) | 5.5<br>(0.220) | 7.5<br>(0.300) | 3.9<br>(0.156) | 4.1<br>(0.164) | —   | —   | B7     |
| LR4-260F    | 20.9<br>(0.836) | 23.1<br>(0.924) | 4.9<br>(0.196)  | 5.5<br>(0.220)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 3.9<br>(0.156) | 4.1<br>(0.164) | —   | —   | B7     |
| LR4-380F    | 24.0<br>(0.960) | 26.0<br>(1.040) | 6.9<br>(0.276)  | 7.5<br>(0.300)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.9<br>(0.196) | 5.1<br>(0.204) | —   | —   | B7     |
| LR4-380XF   | 32.2<br>(1.288) | 35.8<br>(1.432) | 4.9<br>(0.196)  | 5.5<br>(0.220)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.5<br>(0.220) | 7.5<br>(0.300) | 5.5<br>(0.220) | 7.5<br>(0.300) | 3.9<br>(0.156) | 4.1<br>(0.164) | —   | —   | B7     |
| LR4-450F    | 24.0<br>(0.960) | 26<br>(1.040)   | 9.9<br>(0.396)  | 10.5<br>(0.420) | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.3<br>(0.212) | 6.7<br>(0.268) | 5.3<br>(0.212) | 6.7<br>(0.268) | 5.9<br>(0.236) | 6.1<br>(0.244) | —   | —   | B7     |
| LR4-550F    | 35.0<br>(1.400) | 37.0<br>(1.480) | 6.9<br>(0.276)  | 7.5<br>(0.300)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.3<br>(0.212) | 6.7<br>(0.268) | 5.3<br>(0.212) | 6.7<br>(0.268) | 4.9<br>(0.196) | 5.1<br>(0.204) | —   | —   | B7     |
| LR4-600F    | 24.0<br>(0.960) | 26.0<br>(1.040) | 13.9<br>(0.556) | 14.5<br>(0.580) | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 5.9<br>(0.236) | 6.1<br>(0.244) | —   | —   | B7     |
| LR4-600XF   | 40.5<br>(1.620) | 42.7<br>(1.708) | 6.9<br>(0.276)  | 7.5<br>(0.300)  | 0.6<br>(0.024) | 1.0<br>(0.040) | 5.2<br>(0.208) | 6.8<br>(0.272) | 5.2<br>(0.208) | 6.8<br>(0.272) | 4.9<br>(0.196) | 5.1<br>(0.204) | —   | —   | B7     |
| LR4-730F    | 27.1<br>(1.084) | 29.1<br>(1.164) | 13.9<br>(0.556) | 14.5<br>(0.580) | 0.6<br>(0.024) | 1.0<br>(0.040) | 4.1<br>(0.164) | 5.5<br>(0.220) | 4.1<br>(0.164) | 5.5<br>(0.220) | 5.9<br>(0.236) | 6.1<br>(0.244) | —   | —   | B7     |
| LR4-900F    | 45.4<br>(1.816) | 47.6<br>(1.904) | 7.9<br>(0.316)  | 8.5<br>(0.340)  | 0.9<br>(0.036) | 1.3<br>(0.052) | 4.6<br>(0.184) | 6.2<br>(0.248) | 4.6<br>(0.184) | 6.2<br>(0.248) | 5.9<br>(0.236) | 6.1<br>(0.244) | —   | —   | B7     |
| LR4-1300SSF | 61.5<br>(2.460) | 66.5<br>(2.660) | 9.4<br>(0.376)  | 10.0<br>(0.400) | 0.9<br>(0.036) | 1.3<br>(0.052) | 5.0<br>(0.200) | 7.5<br>(0.300) | 5.0<br>(0.200) | 7.5<br>(0.300) | 5.9<br>(0.236) | 6.1<br>(0.244) | —   | —   | B8     |

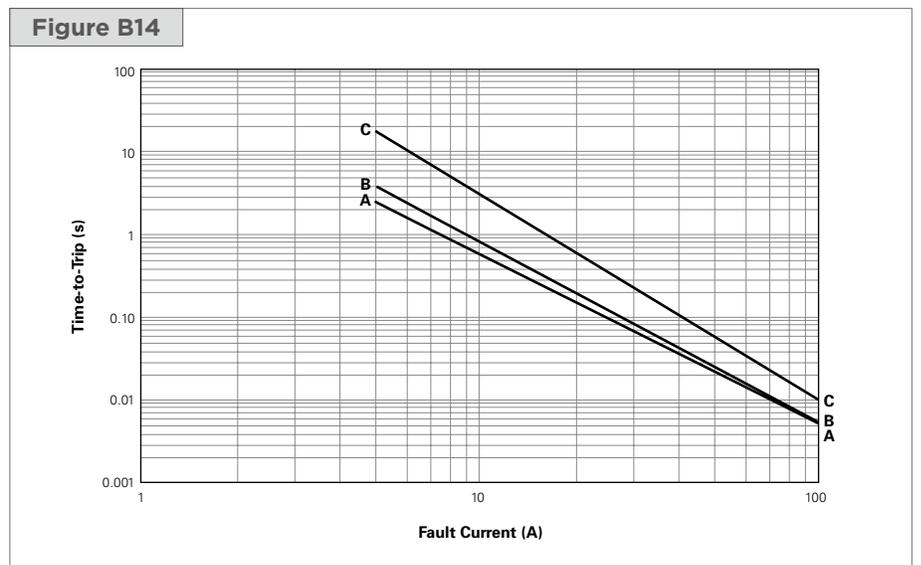
Figures B14-B20 – Typical Time-to-Trip Curve at 20°C

## VLR (data at 25°C)

A = VLR170F

B = VLR175F

C = VLR230F



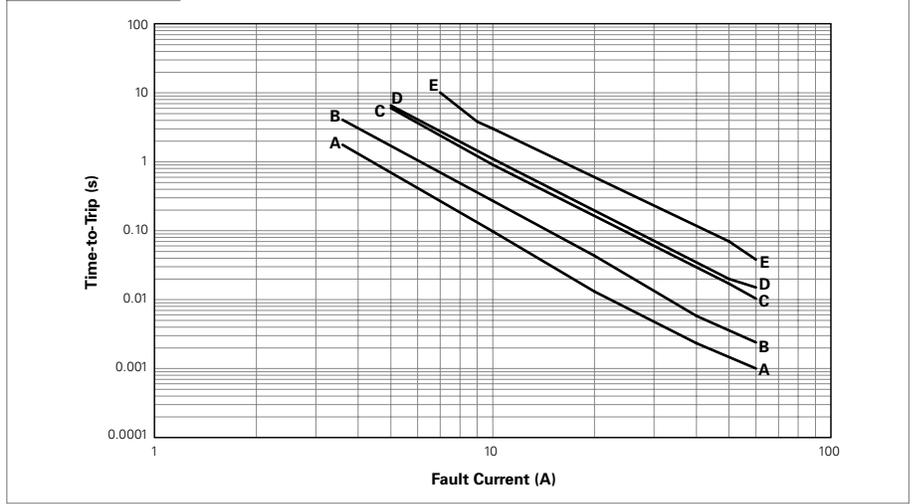
Figures B14-B20 — Typical Time-to-Trip Curve at 20°C

(Cont'd)

VLP (data at 25°C)

- A = VLP120UF
- B = VLP175UAF
- C = VLP210F
- D = VLP220F
- E = VLP270F

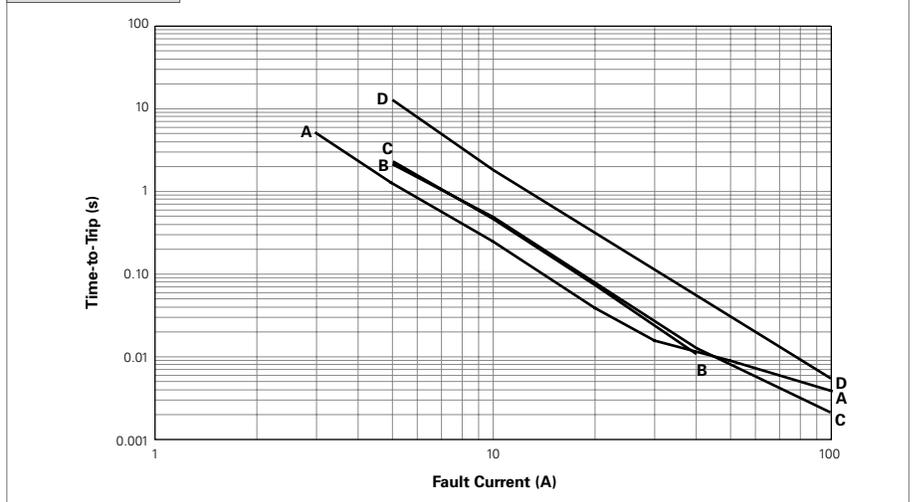
Figure B15



VTP (data at 25°C)

- A = VTP110F
- B = VTP170F
- C = VTP175F
- D = VTP210GF

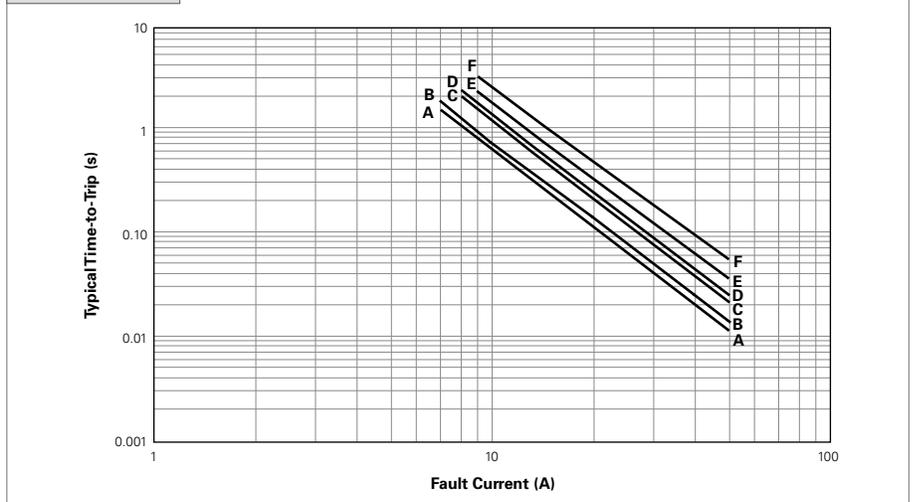
Figure B16



MXP (data at 25°C)

- A = MXP180
- B = MXP190BB
- C = MXP250K
- D = MXP270
- E = MXP310
- F = MXP370BD

Figure B17

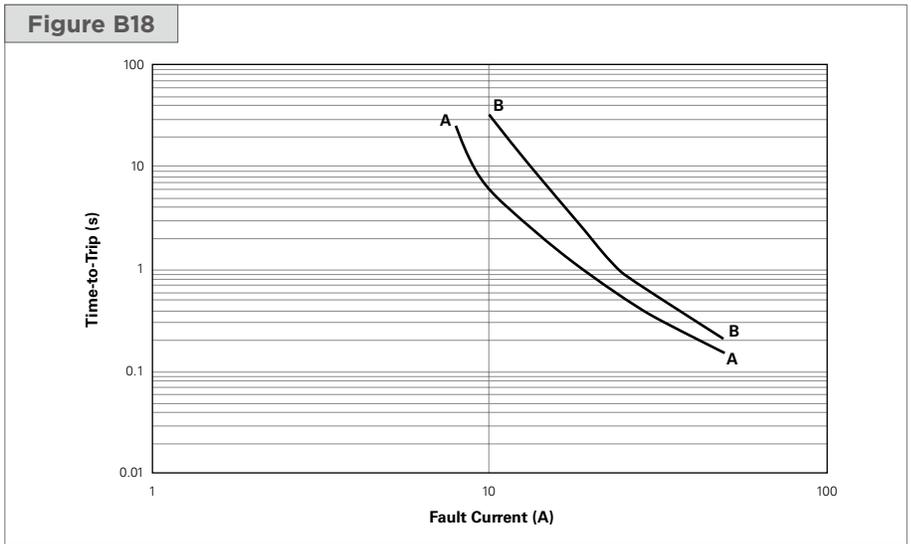


Figures B14-B20 — Typical Time-to-Trip Curve at 20°C

(Cont'd)

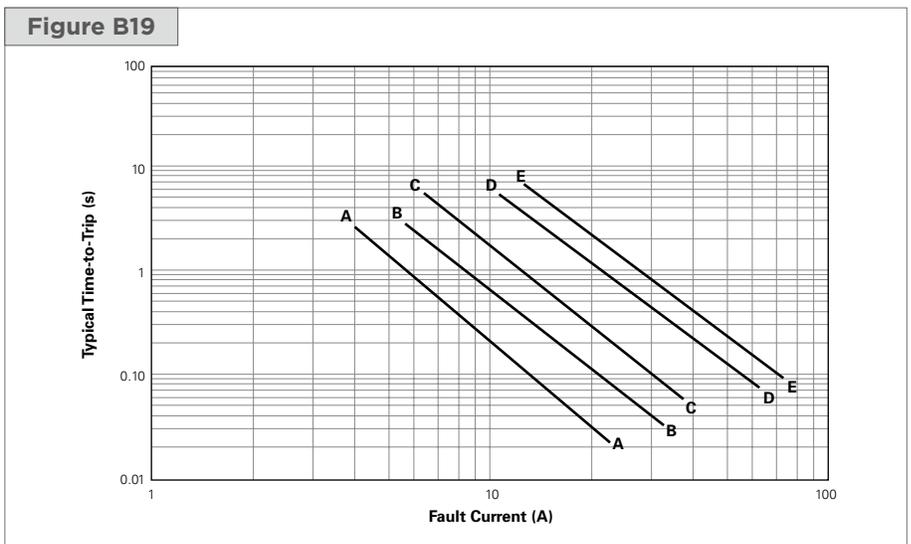
**MGP**

- A = MGP450
- B = MGP500



**SRP**

- A = SRP120F
- B = SRP175F
- C = SRP200F
- D = SRP350F
- E = SRP420F

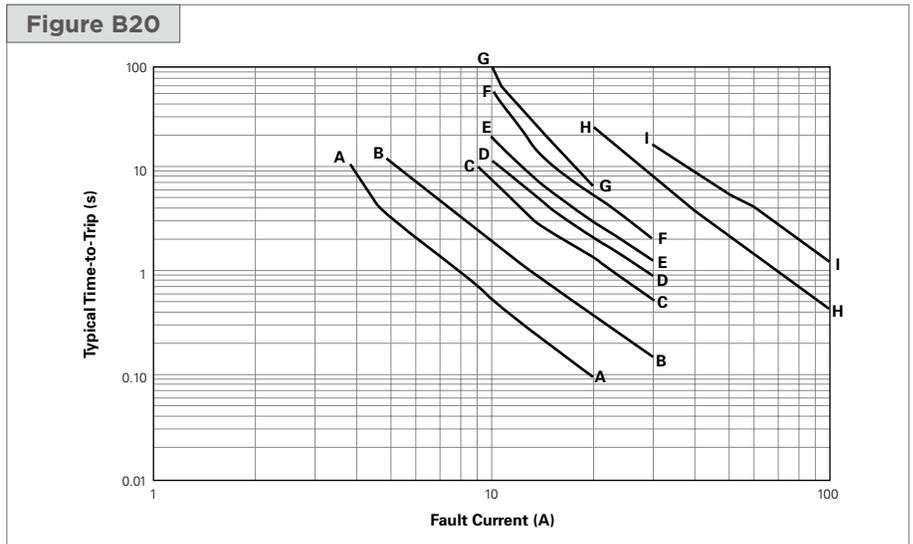


## Figures B14-B20 — Typical Time-to-Trip Curve at 20°C

(Cont'd)

## LR4

- A = LR4-190F
- B = LR4-260F
- C = LR4-380F
- D = LR4-450F
- E = LR4-550F
- F = LR4-600F
- G = LR4-730F
- H = LR4-900F
- I = LR4-1300SSF



## Table B5 — Physical Characteristics and Environmental Specifications

| VLR                          |  |                   |
|------------------------------|--|-------------------|
| Physical Characteristics     |  |                   |
| Lead Material                | 0.125mm Nominal Thickness, Quarter-hard Nickel |                   |
| Tape Material                | Polyester                                      |                   |
| Environmental Specifications |  |                   |
| Test                         | Conditions                                     | Resistance Change |
| Passive Aging                | -40°C, 1000 hrs                                | ±5% typ           |
|                              | 60°C, 1000 hrs                                 | ±20% typ          |
| Humidity Aging               | 60°C/95% RH, 1000 hrs                          | ±30% typ          |
| Thermal Shock                | 85°C, -40°C (10 Times)                         | ±5% typ           |
| Vibration                    | MIL-STD-883D, Method 2026                      | No Change         |
| VLP and VTP                  |  |                   |
| Physical Characteristics     |  |                   |
| Lead Material                | 0.125mm Nominal Thickness, Quarter-hard Nickel |                   |
| Tape Material                | Polyester                                      |                   |
| Environmental Specifications |  |                   |
| Test                         | Conditions                                     | Resistance Change |
| Passive Aging                | -40°C, 1000 hrs                                | ±5% typ           |
|                              | 60°C, 1000 hrs                                 | ±10% typ          |
| Humidity Aging               | 60°C/95% RH, 1000 hrs                          | ±10% typ          |
| Thermal Shock                | 85°C, -40°C (10 Times)                         | ±5% typ           |
| Vibration                    | MIL-STD-883D, Method 2026                      | No Change         |

**Note:** Storage conditions: 40°C max., 70% RH max.; devices should remain in original sealed bags prior to use. Devices may not meet specified values if these storage conditions are exceeded.

Table B5 — Physical Characteristics and Environmental Specifications

(Cont'd)

| MXP and MGP                  |  |                   |
|------------------------------|--|-------------------|
| Physical Characteristics     |  |                   |
| Lead Material                | 0.1mm Nominal Thickness, Half-hard Nickel      |                   |
| Coating Material             | Epoxy  |                   |
| Environmental Specifications |  |                   |
| Test                         | Conditions                                     | Resistance Change |
| Passive Aging                | -40°C, 1000 hrs                                | ±5% typ           |
|                              | 60°C, 1000 hrs                                 | ±20% typ          |
| Humidity Aging               | 60°C/95% RH, 1000 hrs                          | ±30% typ          |
| Thermal Shock                | 85°C, -40°C (10 Times)                         | ±5% typ           |
| Vibration                    | MIL-STD-883D, Method 2026                      | No Change         |
| RSD                          |  |                   |
| Physical Characteristics     |  |                   |
| Lead Material                | 0.1mm nominal thickness, half-hard nickel      |                   |
| Environmental Specifications |  |                   |
| Test                         | Conditions                                     | Resistance Change |
| Passive Aging                | -40°C, 1000 hrs                                | ±5% typ           |
|                              | 60°C, 1000 hrs                                 | ±10% typ          |
| Humidity Aging               | 60°C/95% RH, 1000 hrs                          | ±10% typ          |
| Thermal Shock                | 85°C, -40°C (10 Times)                         | ±5% typ           |
| Vibration                    | MIL-STD-883D, Method 2026                      | No Change         |
| SRP                          |  |                   |
| Physical Characteristics     |  |                   |
| Lead Material                | 0.125mm Nominal Thickness, Quarter-hard Nickel |                   |
| Tape Material                | Polyester                                      |                   |
| Environmental Specifications |  |                   |
| Test                         | Conditions                                     | Resistance Change |
| Passive Aging                | 70°C, 1000 hrs                                 | ±10% typ          |
| Humidity Aging               | 85°C/85% RH, 7 Days                            | ±5% typ           |
| Vibration                    | MIL-STD-883C, Test Condition A                 | No Change         |
| LR4                          |  |                   |
| Physical Characteristics     |  |                   |
| Lead Material                | 0.125mm Nominal Thickness, Quarter-hard Nickel |                   |
| Tape Material                | Polyester                                      |                   |
| Environmental Specifications |  |                   |
| Test                         | Conditions                                     | Resistance Change |
| Passive Aging                | 70°C, 1000 hrs                                 | ±10% typ          |
| Humidity Aging               | 85°C/85% RH, 7 Days                            | ±5% typ           |
| Vibration                    | MIL-STD-883D, Method 2026                      | No Change         |

**Note:** Storage conditions: 40°C max., 70% RH max.; devices should remain in original sealed bags prior to use.  
Devices may not meet specified values if these storage conditions are exceeded.

## Table B6 — Packaging and Marking Information/Agency Recognition

| Part Number                     | Bag Quantity | Tape and Reel Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|---------------------------------|--------------|------------------------|---------------------------|--------------|--------------------|
| <b>85°C Typical Activation</b>  |              |                        |                           |              |                    |
| <b>VLR</b>                      |              |                        |                           |              |                    |
| VLR170F                         | 1,000        | —                      | 10,000                    | R17          | UL, CSA, TÜV       |
| VLR175F                         | 1,000        | —                      | 10,000                    | R1X          | UL, CSA, TÜV       |
| VLR175LF                        | 1,000        | —                      | 10,000                    | R1X          | UL, CSA, TÜV       |
| VLR230F                         | 1,000        | —                      | 10,000                    | R23          | UL, CSA, TÜV       |
| <b>90°C Typical Activation</b>  |              |                        |                           |              |                    |
| <b>VLP</b>                      |              |                        |                           |              |                    |
| VLP120UF                        | 1,000        | —                      | 10,000                    | —            | UL, CSA, TÜV       |
| VLP175UAF                       | 1,000        | —                      | 10,000                    | —            | UL, CSA, TÜV       |
| VLP210F                         | 1,000        | —                      | 10,000                    | W21          | UL, CSA, TÜV       |
| VLP220F                         | 1,000        | —                      | 10,000                    | W22          | UL, CSA, TÜV       |
| VLP270F                         | 1,000        | —                      | 10,000                    | W27          | UL, CSA, TÜV       |
| <b>VTP</b>                      |              |                        |                           |              |                    |
| VTP110F                         | 1,000        | —                      | 10,000                    | —            | UL, CSA, TÜV       |
| VTP170F                         | 1,000        | —                      | 10,000                    | V17          | UL, CSA, TÜV       |
| VTP170XSF                       | 1,000        | —                      | 10,000                    | V17          | UL, CSA, TÜV       |
| VTP175F                         | 1,000        | —                      | 10,000                    | V1X          | UL, CSA, TÜV       |
| VTP175LF                        | 1,000        | —                      | 10,000                    | V1X          | UL, CSA, TÜV       |
| VTP210GF                        | 1,000        | —                      | 10,000                    | V21          | UL, CSA, TÜV       |
| VTP210SF                        | 1,000        | —                      | 10,000                    | V21          | UL, CSA, TÜV       |
| <b>120°C Typical Activation</b> |              |                        |                           |              |                    |
| <b>MXP</b>                      |              |                        |                           |              |                    |
| MXP180                          | 2,000        | —                      | 48,000                    | —            | UL, CSA, TÜV       |
| MXP190BB                        | 2,000        | —                      | 48,000                    | —            | UL, CSA, TÜV       |
| MXP250K                         | 2,000        | —                      | 48,000                    | —            | UL, CSA, TÜV       |
| MXP270                          | 2,000        | —                      | 48,000                    | —            | UL                 |
| MXP310                          | 2,000        | —                      | 48,000                    | —            | UL                 |
| MXP370BD                        | 2,000        | —                      | 48,000                    | —            | UL, CSA, TÜV       |
| <b>120°C Typical Activation</b> |              |                        |                           |              |                    |
| <b>MGP</b>                      |              |                        |                           |              |                    |
| MGP450                          | 2,000        | —                      | 48,000                    | —            | —                  |
| MGP500                          | 2,000        | —                      | 48,000                    | —            | UL, TÜV            |
| <b>125°C Typical Activation</b> |              |                        |                           |              |                    |
| <b>RSD</b>                      |              |                        |                           |              |                    |
| RSD310                          | —            | 6,000                  | 30,000                    | —            | UL                 |
| RSD370                          | —            | 6,000                  | 30,000                    | —            | UL                 |
| RSD420                          | —            | 6,000                  | 30,000                    | —            | UL                 |
| <b>125°C Typical Activation</b> |              |                        |                           |              |                    |
| <b>SRP</b>                      |              |                        |                           |              |                    |
| SRP120F                         | 1,000        | —                      | 10,000                    | 120          | UL, CSA, TÜV       |
| SRP175F                         | 2,000        | —                      | 10,000                    | 175          | UL, CSA, TÜV       |
| SRP200F                         | 1,000        | —                      | 10,000                    | 200          | UL, CSA, TÜV       |
| SRP350F                         | 500          | —                      | 10,000                    | 350          | UL, CSA, TÜV       |
| SRP420F                         | 500          | —                      | 10,000                    | 420          | UL, CSA, TÜV       |
| <b>LR4</b>                      |              |                        |                           |              |                    |
| LR4-190F                        | 2,000        | —                      | 10,000                    | E19          | UL, CSA, TÜV       |
| LR4-260F                        | 1,000        | —                      | 10,000                    | E26          | UL, CSA, TÜV       |
| LR4-380F                        | 1,000        | —                      | 10,000                    | E38          | UL, CSA, TÜV       |
| LR4-380XF                       | 1,000        | —                      | 10,000                    | E38          | UL, CSA, TÜV       |
| LR4-450F                        | 1,000        | —                      | 10,000                    | E45          | UL, CSA, TÜV       |
| LR4-550F                        | 1,000        | —                      | 10,000                    | E55          | UL, CSA, TÜV       |
| LR4-600F                        | 1,000        | —                      | 10,000                    | E60          | UL, CSA, TÜV       |
| LR4-600XF                       | 1,000        | —                      | 10,000                    | E60          | UL, CSA, TÜV       |
| LR4-730F                        | 1,000        | —                      | 10,000                    | E73          | UL, CSA, TÜV       |
| LR4-900F                        | 500          | —                      | 10,000                    | E90          | UL, CSA, TÜV       |
| LR4-1300SSF                     | 250          | —                      | 10,000                    | EX3          | UL, CSA, TÜV       |

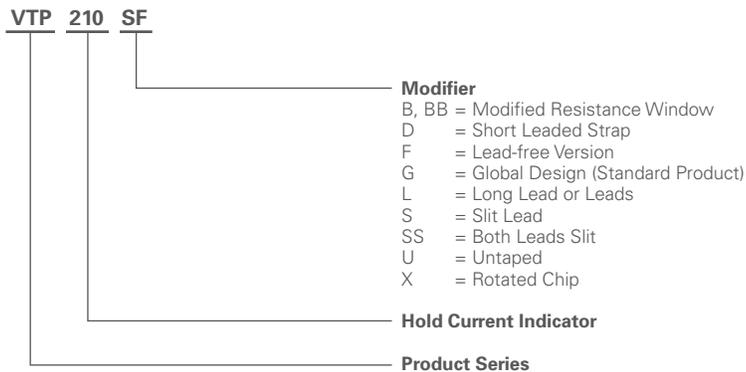
## Agency Recognition

|     |   |
|-----|---|
| UL  | File # E74889                           |
| CSA | File # 78165C                           |
| TÜV | Certificate Number Available on Request |

## Installation Guidelines for the Strap Family

- PPTC devices operate by thermal expansion of the conductive polymer. If devices are placed under pressure or installed in spaces that would prevent thermal expansion, they may not properly protect against damage caused by fault conditions. Designs must be selected in such a manner that adequate space is maintained over the life of the product.
- Twisting, bending, or placing the PPTC device in tension will decrease the ability of the device to protect against damage caused by electrical faults. No residual force should remain on device after installation. Mechanical damage to the PPTC device may affect device performance and should be avoided.
- Chemical contamination of PPTC devices should be avoided. Certain greases, solvents, hydraulic fluids, fuels, industrial cleaning agents, volatile components of adhesives, silicones, and electrolytes can have an adverse effect on device performance.
- PPTC strap devices are intended to be resistance welded to battery cells or to pack interconnect straps, yet some precautions must be taken when doing so. In order for the PPTC device to exhibit its specified performance, weld placement should be a minimum of 2mm from the edge of the PPTC device, weld splatter must not touch the PPTC device, and welding conditions must not heat the PPTC device above its maximum operating temperature.
- PPTC strap devices are not intended for applications where reflow onto flex circuits or rigid circuit boards is required.
- The polyester tape on PPTC strap devices is intended for marking and identification purposes only, not for electrical insulation.
- The coating on MXP and MGP devices is intended to prevent oxidization/aging of the devices. Damaging the coating or causing the coating to delaminate can have negative effects on device performance and should be avoided.
- MXP and MGP devices have a small PPTC chip size and therefore have weaker peel strength between the polymer and Ni-foil of the chip. Excessive mechanical force to the device may cause delamination of Ni-foil from the polymer.

## Part Numbering System



### Warning :

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal, and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.

# POLYSWITCH RESETTABLE DEVICES

## Telecommunications and Networking Devices

The PolySwitch families of telecommunications and networking devices help meet the growing demand for resettable overcurrent protection. These product families help provide protection against damage caused by power cross and power induction surges as defined in ITU, Telcordia GR1089 and UL60950. Available in chip, surface-mount and radial-leaded configurations, TE's PolySwitch devices help improve the reliability of customer premise and network equipment worldwide.



### BENEFITS

- Choice of many product options helps engineers by improving design flexibility
- Compatible with high-volume electronics assembly
- Assist in meeting regulatory equipment requirements
- Help improve line balance
- Applicable for legacy POTS and modern digital communications equipment

### FEATURES

- RoHS compliant
- Resettable overcurrent protection
- Surface-mount, radial-leaded and chip form factors
- Fast time-to-trip
- Agency recognition: UL, CSA, TÜV
- Resistance-sorted and matched devices available
- Low parasitic capacitance/flat impedance with frequency

### APPLICATIONS

- Modems
- Phone sets
- Fax machines
- Phone wall outlets
- Alarm systems
- PBX systems
- MDF modules
- Analog and digital line cards
- T1/E1 equipment
- xDSL modems and splitters
- Powered ethernet systems
- VoIP (Voice over Internet Protocol) equipment
- LAN, WAN equipment
- Customer premise equipment
- Access network hardware

## Application Guide for Telecommunications and Networking Devices\*

To use this guide, follow the steps below:

1. Select your equipment type from the guide below.
2. Select the type of protection depending on the agency and regional specifications in the second column.
3. Select the form factor for your application.
4. Use the Agency Specification/ PolySwitch Device Selection Guide on the next page to select a specific part number for each application based on the agency requirements.
5. Parts with fast time-to-trip or low resistance are available. Please consult a TE Circuit Protection representative.

| Application   | Region/<br>Specification   | Overcurrent Protection |               |             |
|---|--|------------------------|---------------|-------------|
|   |  | Form Factor            |               |             |
|   |  | Radial-leaded          | Surface-mount | Chip        |
| <b>Customer Premise equipment<br/>IT equipment</b><br>Analog Modems, V.90 Modems,<br>ISDN Modems, xDSL Modems,<br>ADSL Splitters, Phone Sets, Fax Machines,<br>Answering Machines, Caller ID, Internet<br>Appliances, PBX Systems, POS Terminals,<br>Wall Plugs | <b>North America</b><br>TIA-968-A,<br>UL 60950,<br>GR1089 Port Type 3 <sup>+</sup> | TRF600-150             | TS600-170F    |             |
|   |  | TR600-150F-EX          | TS600-200F    |             |
|   |  | TRF600-160             | TSM600-250F   |             |
|   |  | TRF600-250             | TSM600-400F   |             |
|   |  | TRF600-400             |               |             |
|   | <b>Europe/Asia/<br/>South America</b><br>ITU K.21                                  | TRF250-120             | TS250-130F    | TCF250-120  |
|   |  | TRF250-120T            | TSV250-130F   | TCF250-145  |
|   |  | TRF250-120U            | TSV250-184F   | TCF250-180T |
|   |  | TRF250-120UT           | TSL250-130F   |             |
|   |  | TRF250-145             |               |             |
|   |  | TRF250-145T            |               |             |
|   |  | TRF250-145U            |               |             |
|   |  | TRF250-183             |               |             |
|   |  | TRF250-183U            |               |             |
|   |  | TRF250-184             |               |             |
| <b>Access network equipment (†)</b><br>Remote Terminals, Line Repeaters,<br>Multiplexers, Cross-Connects,<br>WAN Equipment  | <b>North America</b><br>GR1089 Port Type 5 <sup>+</sup>                            | TRF600-160             | TS600-170F    |             |
|   |  | TRF600-250             | TS600-200F    |             |
|   |  | TRF600-400             | TS600-400F    |             |
|   |  |                        | TSM600-250F   |             |
|   |  |                        | TSM600-400F   |             |
|   | <b>Europe/Asia/<br/>South America</b><br>ITU K.45                                  | TRF250-120             | TS250-130F    | TCF250-120  |
|   |  | TRF250-120T            | TSV250-130F   | TCF250-145  |
|   |  | TRF250-120U            | TSV250-184F   | TCF250-180T |
|   |  | TRF250-120UT           | TSL250-130F   |             |
|   |  | TRF250-145             |               |             |
|   |  | TRF250-145T            |               |             |
|   |  | TRF250-145U            |               |             |
|   |  | TRF250-183             |               |             |
|   |  | TRF250-183U            |               |             |
|   |  | TRF250-184             |               |             |
| <b>Central office switching equipment (†)</b><br>Analog/POTS Linecards, ISDN Linecards,<br>xDSL Modems, ADSL/VDSL Splitters,<br>T1/E1 Linecards, Multiplexers,<br>CSU/DSU, Servers  | <b>North America</b><br>GR1089 Port Type 1 <sup>+</sup>                            | TRF600-160             | TS600-170F    |             |
|   |  | TRF600-250             | TS600-200F    |             |
|   |  | TRF600-400             | TS600-400F    |             |
|   |  |                        | TSM600-250F   |             |
|   |  |                        | TSM600-400F   |             |
|   | <b>Europe/Asia/<br/>South America</b><br>ITU K.20                                  | TRF250-120             | TS250-130F    | TCF250-120  |
|   |  | TRF250-120T            | TSV250-130F   | TCF250-145  |
|   |  | TRF250-120U            | TSV250-184F   | TCF250-180T |
|   |  | TRF250-120UT           | TSL250-130F   |             |
|   |  | TRF250-145             |               |             |
|   |  | TRF250-145T            |               |             |
|   |  | TRF250-145U            |               |             |
|   |  | TRF250-183             |               |             |
|   |  | TRF250-183U            |               |             |
|   |  | TRF250-184             |               |             |

## Application Guide for Telecommunications and Networking Devices\*

(Cont'd)

| Application  | Region/<br>Specification   | Overcurrent Protection |                     |             |
|--|--|------------------------|---------------------|-------------|
|  |  | Form Factor            |                     |             |
|  |  | Radial-leaded          | Surface-mount       | Chip        |
| <b>Primary protection modules (†)</b><br>MDF modules, Network Interface Devices (NID)  | <b>North America</b><br>Telcordia GR-974   | TRF250-183             | TSV250-184F         |             |
|  |  | TRF250-184             |                     |             |
|  | <b>Europe/Asia/<br/>South America</b><br>ITU K.20  | TRF250-055T            | TSL250-080F         | TCF250-100T |
|  |  | TRF250-055UT           | TS250-130F          | TCF250-120  |
|  |  | TRF250-080T            | TSV250-130F         | TCF250-120T |
|  |  | TRF250-080U            | TSV250-184F         | TCF250-145  |
|  |  | TRF250-110U            | TSL250-130F         | TCF250-145T |
|  |  | TRF250-120             |                     | TCF250-180T |
|  |  | TRF250-120T            |                     |             |
|  |  | TRF250-120U            |                     |             |
|  |  | TRF250-120UT           |                     |             |
|  |  | TRF250-145             |                     |             |
|  |  | TRF250-145T            |                     |             |
|  |  | TRF250-145U            |                     |             |
|  |  | TRF250-183             |                     |             |
|  |  | TRF250-183U            |                     |             |
|  |  | TRF250-184             |                     |             |
| <b>Short-haul/intrabuilding communications equipment (†)</b><br>LAN Equipment, VoIP Cards, Cable Telephony NIUs, Wireless Local Loop Handsets  | <b>North America</b><br>GR1089 Port Type 2 <sup>‡</sup><br>GR1089 Port Type 4 <sup>‡</sup> | TRF250-080T            | TSL250-080F         | TCF250-120  |
|  |  | TRF250-080U            | TS250-130F          | TCF250-145  |
|  |  | TRF250-120             | TSV250-130F         | TCF250-180T |
|  |  | TRF250-120T            | TSV250-184F         |             |
|  |  | TRF250-120U            | TSL250-130F         |             |
|  |  | TRF250-120UT           |                     |             |
|  |  | TRF250-145             |                     |             |
|  |  | TRF250-145T            |                     |             |
|  |  | TRF250-145U            |                     |             |
|  |  | TRF250-183             |                     |             |
|  | TRF250-183U  |                        |                     |             |
|  | TRF250-184   |                        |                     |             |
|  | <b>Europe/Asia/<br/>South America</b><br>ITU K.21  | TRF250-120             | TS250-130F          | TCF250-120  |
|  |  | TRF250-120T            | TSV250-130F         | TCF250-145  |
|  |  | TRF250-120U            | TSV250-184F         | TCF250-180T |
|  |  | TRF250-120UT           | TSL250-130F         |             |
|  |  | TRF250-145             |                     |             |
| TRF250-145T  |  |                        |                     |             |
| TRF250-145U  |  |                        |                     |             |
| <b>LAN Intrabuilding Power Cross Protection</b><br>LAN Equipment, VoIP Cards, IP Phones  | <b>North America</b><br>GR1089 Port Type 4 <sup>‡</sup>                                    | TRF250-080T            | TSL250-080F         | TCF250-120  |
|  |  | TRF250-080U            | TS250-130F          | TCF250-145  |
|  |  | TRF250-120             | TSV250-130F         | TCF250-180T |
|  |  | TRF250-120T            | TSV250-184F         |             |
|  |  | TRF250-120U            | TSL250-130F         |             |
|  |  | TRF250-120UT           |                     |             |
|  |  | TRF250-145             |                     |             |
|  |  | TRF250-145T            |                     |             |
|  |  | TRF250-145U            |                     |             |
|  |  | TRF250-183             |                     |             |
| TRF250-183U  |  |                        |                     |             |
| TRF250-184   |  |                        |                     |             |
| <b>IEEE 802.3AF/AT Power over Ethernet protection</b><br>Powered Ethernet Switches and Terminals,<br>IP phones, Wireless LAN Base Stations,<br>Microcellular Base Stations, VoIP Cards |  |                        | decaSMDC050F/60-2** |             |

\* This list is not exhaustive. TE Circuit Protection welcomes our customers' input for additional application ideas for PolySwitch resettable devices.

† For improved line balance in these applications, resistance-matched parts are recommended.

‡ May require additional impedance or coordination with primary protector.

\*\* For details on decaSMDC050F/60-2, see surface-mount devices section.

## Agency Specification/Selection Guide

Use the guide below to select the PolySwitch devices which are typically used in your application. The following pages contain the specifications for the part numbers recommended below. PolySwitch devices assist telecommunication equipment in meeting the applicable protection requirements of these industry specifications. Refer to individual agency specifications for test procedures and circuit schematics. Users should independently evaluate the suitability of and test each product for their application.

| Family         | Product*                                     | Lightning  | Power Cross/Contact/Induction                    |
|----------------|--|--|--|
| TCF250         | TCF250-100T                                  | ITU K.20 – 1.0kV 10/700µs                        | PRC YD/T694                                      |
|                |  | GR-1089 Port Types 2 and 4 – 1st Level           | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                |  |  | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |
|                |  |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
|                |  |  | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω        |
|                |  |  | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                | TCF250-120                                   | ITU K.20/21/45 – 1.5kV 10/700µs                  | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                | TCF250-120T                                  | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup>     | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                | TCF250-145                                   | GR-1089 Port Types 2 and 4 – 1st Level           | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |
|                | TCF250-145T                                  |  | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |
|                | TCF250-180T                                  |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
| TRF250         | TRF250-055T                                  | ITU K.20 – 1.0kV 10/700µs                        | ITU K.20 – 230V <sub>AC</sub> , 10Ω              |
|                |  | GR-1089 Port Types 2 and 4 – 1st Level           | ITU K.20 – 0.2A <sup>2</sup> s                   |
|                |  |  | ITU K.20 – 1A <sup>2</sup> s <sup>†</sup>        |
|                | TRF250-080T                                  |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
|                |  |  | ITU K.20/21/45 – 1.5kV 10/700µs                  |
|                | TRF250-110U                                  | ITU K.20/21/45 – 1.5kV 10/700µs                  | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω        |
|                |  | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup>     | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                | TRF250-120T                                  | GR-1089 Port Types 2 and 4 – 1st Level           | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |
|                |  |  | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |
|                | TRF250-120U                                  |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
|                |  |  | ITU K.20/21/45 – 1.5kV 10/700µs                  |
|                | TRF250-145T                                  | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup>     | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                |  | GR-1089 Port Types 2 and 4 – 1st Level           | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |
|                | TRF250-145U                                  |  | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |
|                |  |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
| TRF250-183U    |  | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω**      |  |
|                |  | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |  |
| TRF250-184     | ITU K.20/21/45 – 1.5kV 10/700µs              | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |  |
|                | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup> | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |  |
|                | GR-1089 Port Types 2 and 4 – 1st Level       | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |  |
|                |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |  |
| TS250/TSV250   | TSV250-130F                                  | ITU K.20/21/45 – 1.5kV 10/700µs                  | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω        |
|                |  | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup>     | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                |  | GR-1089 Port Types 2 and 4 – 1st Level           | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |
|                | TSL250-130F                                  |  | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |
|                |  |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
|                |  |  | ITU K.20/21/45 – 1.5kV 10/700µs                  |
| TSV250-130F-RB | ITU K.20/21/45 – 1.5kV 10/700µs              | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω        |  |
|                | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup> | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |  |
|                | GR-1089 Port Types 2 and 4 – 1st Level       | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |  |
|                |  | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |  |
|                |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |  |
| TSV250-184F    | ITU K.20/21/45 – 1.5kV 10/700µs              | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω**      |  |
|                | ITU K.20/21/45 – 4.0kV 10/700µs <sup>†</sup> | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |  |
|                | GR-1089 Port Types 2 and 4 – 1st Level       | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |  |
|                |  | ITU K.20/21/45 – 10A <sup>2</sup> s <sup>†</sup> |  |
|                |  | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |  |
| TSL250         | TSL250-080F                                  | GR-1089 Port Types 2 and 4 – 1st Level           | GR-1089 Port Type 4 – 120V <sub>AC</sub> , 25Asc |
|                |  | ITU K.20 – 1.0kV 10/700µs                        | ITU K.20/21/45 – 230V <sub>AC</sub> , 10Ω        |
|                |  |  | ITU K.20/21/45 – 0.2A <sup>2</sup> s             |
|                |  | ITU K.20/21/45 – 1A <sup>2</sup> s <sup>†</sup>  |  |

## Agency Specification/Selection Guide

(Cont'd)

| Family | Product*      | Lightning   | Power Cross/Contact/Induction                  |
|--------|---------------|---|--|
| TRF600 | TRF600-150    | TIA-968-A Types A & B                               | UL60950 – 600V <sub>AC</sub> , 40Asc           |
|        | TR600-150F-EX | GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† | UL60950 – 600V <sub>AC</sub> , 40Asc           |
|        | TRF600-160    | GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc |
|        | TRF600-250    | GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc |
|        | TRF600-400    | GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level   | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc |
| TS600  | TS600-170F    | TIA-968-A Types A & B                               | UL60950 – 600V <sub>AC</sub> , 40Asc           |
|        | TS600-200F    | GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc |
|        | TS600-400F    |   |  |
| TSM600 | TSM600-250F   | TIA-968-A Types A & B                               | UL60950 – 600V <sub>AC</sub> , 40Asc           |
|        |               | GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level†† | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc |
|        | TSM600-400F   | TIA-968-A Types A & B                               | UL60950 – 600V <sub>AC</sub> , 40Asc           |
|        |               | GR-1089 Port Types 1, 3 and 5 – 1st and 2nd Level   | Telcordia GR-1089 – 600V <sub>AC</sub> , 60Asc |

**Notes:**

\* Applies to all products that share the same prefix.

† Tested with 230V gas discharge tube primary protector.

‡ Tested with 350V gas discharge tube primary protector.

\*\* See SCD for additional application fault ratings.

†† May require additional series resistor to help telecommunication equipment pass Surge 3 (1kV, 10/1000µs).

Table T1 – Product Series: Size, Current Rating, Voltage Rating, Typical Resistance

|  | TCF250                          | TRF250                          | TS250                           | TSV250                          | TSL250                   | TS600<br>TSM600                        | TRF600                                 |
|--|---------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------------------|--|--|
| V <sub>MAX</sub> Interrupt (V <sub>AC</sub> )* | 250                             | 250                             | 250                             | 250                             | 250                      | 600                                    | 600                                    |
| Specification                                  | ITU<br>GR-1089<br>Ports 2 and 4 | GR-1089<br>Ports 2 and 4 | UL60950<br>GR-1089<br>Ports 1, 3 and 5 | UL60950<br>GR-1089<br>Ports 1, 3 and 5 |
| <b>Hold Current (A)</b>                        |                                 |                                 |                                 |                                 |                          |  |  |
| 0.055  | —                               | 20.0Ω                           | —                               | —                               | —                        | —                                      | —                                      |
| 0.080  | —                               | 17.0Ω                           | —                               | —                               | 8.0Ω                     | —                                      | —                                      |
| 0.100  | 11.0Ω                           | —                               | —                               | —                               | —                        | —                                      | —                                      |
| 0.110  | —                               | 7.0Ω                            | —                               | —                               | —                        | —                                      | —                                      |
| 0.120  | 10.5Ω                           | 8.0Ω                            | —                               | —                               | —                        | —                                      | —                                      |
| 0.130  | —                               | —                               | 9.0Ω                            | 5.5Ω                            | 5.5Ω                     | —                                      | —                                      |
| 0.145  | 7.0Ω                            | 4.5Ω                            | —                               | —                               | —                        | —                                      | —                                      |
| 0.150  | —                               | —                               | —                               | —                               | —                        | —                                      | 8.0Ω                                   |
| 0.160  | —                               | —                               | —                               | —                               | —                        | —                                      | 6.0Ω                                   |
| 0.170  | —                               | —                               | —                               | —                               | —                        | 11.0Ω                                  | —                                      |
| 0.183  | —                               | 1.3Ω                            | —                               | —                               | —                        | —                                      | —                                      |
| 0.184  | —                               | 1.9Ω                            | —                               | 1.6Ω                            | —                        | —                                      | —                                      |
| 0.200  | —                               | —                               | —                               | —                               | —                        | 8.5Ω                                   | —                                      |
| 0.250  | —                               | —                               | —                               | —                               | —                        | 3.5Ω                                   | 3.0Ω                                   |
| 0.400  | —                               | —                               | —                               | —                               | —                        | 1.2Ω                                   | 1.2Ω                                   |

**Voltage Ratings for Telecommunications and Networking Devices**

For circuit protection telecommunications devices there are two applicable voltage ratings. These are V<sub>MAX</sub> Operating and V<sub>MAX</sub> Interrupt. To help understand the nature of these two different voltage ratings, the following definitions are provided:

**V<sub>MAX</sub> Operating:** For telecommunications devices, this is the voltage used to obtain component recognition under UL1434. Most circuit protection devices are certified at 60V but can withstand higher V<sub>MAX</sub> Interrupt conditions. See Table T3 for its V<sub>MAX</sub> Operating.

**\*V<sub>MAX</sub> Interrupt:** Under specified conditions, this is the highest voltage that can be applied to the device at the maximum current. Devices may trip safely under higher power level cross conditions, as listed above, to assist equipment in meeting the appropriate industry conditions.

Table T2 — Thermal Derating [Hold Current (A) at Ambient Temperature (°C)]

| Part Number**                             | Maximum Ambient Temperature |       |       |       |       |       |       |       |       |
|---|-----------------------------|-------|-------|-------|-------|-------|-------|-------|-------|
|   | -40°C                       | -20°C | 0°C   | 20°C  | 40°C  | 50°C  | 60°C  | 70°C  | 85°C  |
| <b>Chip* — 250V<sub>AC</sub></b>          |                             |       |       |       |       |       |       |       |       |
| <b>TCF250</b>                             |                             |       |       |       |       |       |       |       |       |
| TCF250-100T                               | 0.155                       | 0.138 | 0.119 | 0.100 | 0.083 | 0.073 | 0.064 | 0.055 | 0.042 |
| TCF250-120                                | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TCF250-120T                               | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TCF250-145                                | 0.225                       | 0.199 | 0.172 | 0.145 | 0.119 | 0.106 | 0.093 | 0.080 | 0.060 |
| TCF250-145T                               | 0.225                       | 0.199 | 0.172 | 0.145 | 0.119 | 0.106 | 0.093 | 0.080 | 0.060 |
| TCF250-180T                               | 0.269                       | 0.240 | 0.211 | 0.180 | 0.153 | 0.138 | 0.123 | 0.109 | 0.087 |
| <b>Radial-leaded* — 250V<sub>AC</sub></b> |                             |       |       |       |       |       |       |       |       |
| <b>TRF250</b>                             |                             |       |       |       |       |       |       |       |       |
| TRF250-055T                               | 0.085                       | 0.076 | 0.065 | 0.055 | 0.045 | 0.041 | 0.035 | 0.030 | 0.023 |
| TRF250-055UT                              | 0.085                       | 0.076 | 0.065 | 0.055 | 0.045 | 0.041 | 0.035 | 0.030 | 0.023 |
| TRF250-080T                               | 0.124                       | 0.110 | 0.095 | 0.080 | 0.066 | 0.059 | 0.051 | 0.044 | 0.033 |
| TRF250-080U                               | 0.124                       | 0.110 | 0.095 | 0.080 | 0.066 | 0.059 | 0.051 | 0.044 | 0.033 |
| TRF250-110U                               | 0.171                       | 0.151 | 0.131 | 0.110 | 0.091 | 0.081 | 0.071 | 0.061 | 0.046 |
| TRF250-120                                | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TRF250-120T                               | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TRF250-120U                               | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TRF250-120UT                              | 0.186                       | 0.165 | 0.143 | 0.120 | 0.099 | 0.088 | 0.077 | 0.066 | 0.050 |
| TRF250-145                                | 0.225                       | 0.199 | 0.172 | 0.145 | 0.119 | 0.106 | 0.093 | 0.080 | 0.060 |
| TRF250-145T                               | 0.225                       | 0.199 | 0.172 | 0.145 | 0.119 | 0.106 | 0.093 | 0.080 | 0.060 |
| TRF250-145U                               | 0.225                       | 0.199 | 0.172 | 0.145 | 0.119 | 0.106 | 0.093 | 0.080 | 0.060 |
| TRF250-183†                               | 0.284                       | 0.251 | 0.217 | 0.183 | 0.149 | 0.133 | 0.117 | 0.101 | 0.075 |
| TRF250-183U†                              | 0.284                       | 0.251 | 0.217 | 0.183 | 0.149 | 0.133 | 0.117 | 0.101 | 0.075 |
| TRF250-184‡                               | 0.286                       | 0.252 | 0.218 | 0.184 | 0.150 | 0.134 | 0.118 | 0.102 | 0.075 |
| <b>Surface-mount* — 250V<sub>AC</sub></b> |                             |       |       |       |       |       |       |       |       |
| <b>TS250/TSL250/TSV250</b>                |                             |       |       |       |       |       |       |       |       |
| TSL250-080F                               | 0.124                       | 0.110 | 0.095 | 0.080 | 0.066 | 0.059 | 0.051 | 0.044 | 0.033 |
| TSL250-130F                               | 0.208                       | 0.182 | 0.156 | 0.130 | 0.104 | 0.091 | 0.078 | 0.065 | 0.045 |
| TS250-130F                                | 0.208                       | 0.182 | 0.156 | 0.130 | 0.104 | 0.091 | 0.078 | 0.065 | 0.045 |
| TSV250-130F                               | 0.208                       | 0.182 | 0.156 | 0.130 | 0.104 | 0.091 | 0.078 | 0.065 | 0.045 |
| TSV250-184F                               | 0.286                       | 0.252 | 0.218 | 0.184 | 0.150 | 0.134 | 0.118 | 0.102 | 0.075 |
| <b>Radial-leaded† — 600V<sub>AC</sub></b> |                             |       |       |       |       |       |       |       |       |
| <b>TRF600</b>                             |                             |       |       |       |       |       |       |       |       |
| TRF600-150                                | 0.239                       | 0.209 | 0.180 | 0.150 | 0.121 | 0.107 | 0.093 | 0.079 | 0.057 |
| TR600-150F-EX                             | 0.239                       | 0.209 | 0.180 | 0.150 | 0.121 | 0.107 | 0.093 | 0.079 | 0.057 |
| TRF600-160                                | 0.255                       | 0.223 | 0.192 | 0.160 | 0.129 | 0.114 | 0.099 | 0.084 | 0.061 |
| TRF600-250                                | 0.400                       | 0.350 | 0.300 | 0.250 | 0.198 | 0.170 | 0.140 | 0.117 | 0.083 |
| TRF600-400                                | 0.640                       | 0.560 | 0.480 | 0.400 | 0.320 | 0.270 | 0.230 | 0.190 | 0.130 |
| <b>Surface-mount† — 600V<sub>AC</sub></b> |                             |       |       |       |       |       |       |       |       |
| <b>TSM600/TSM600</b>                      |                             |       |       |       |       |       |       |       |       |
| TS600-170F                                | 0.264                       | 0.230 | 0.200 | 0.170 | 0.140 | 0.125 | 0.109 | 0.094 | 0.070 |
| TS600-200F                                | 0.310                       | 0.275 | 0.238 | 0.200 | 0.165 | 0.147 | 0.128 | 0.110 | 0.083 |
| TS600-400F                                | 0.640                       | 0.560 | 0.480 | 0.400 | 0.320 | 0.270 | 0.230 | 0.190 | 0.130 |
| TSM600-250F                               | 0.400                       | 0.350 | 0.300 | 0.250 | 0.198 | 0.170 | 0.140 | 0.117 | 0.083 |
| TSM600-400F                               | 0.640                       | 0.560 | 0.480 | 0.400 | 0.320 | 0.270 | 0.230 | 0.190 | 0.130 |

\* 250V<sub>AC</sub> interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.

\*\* Applies to all products which share the same prefix.

† 600V<sub>AC</sub> interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

‡ Product is not currently available in a resistance matched or sorted option.

Figure T1 – Thermal Derating Curve

A = TCF250-180T  
B = All other TCF, TRF,  
TSM Series Devices

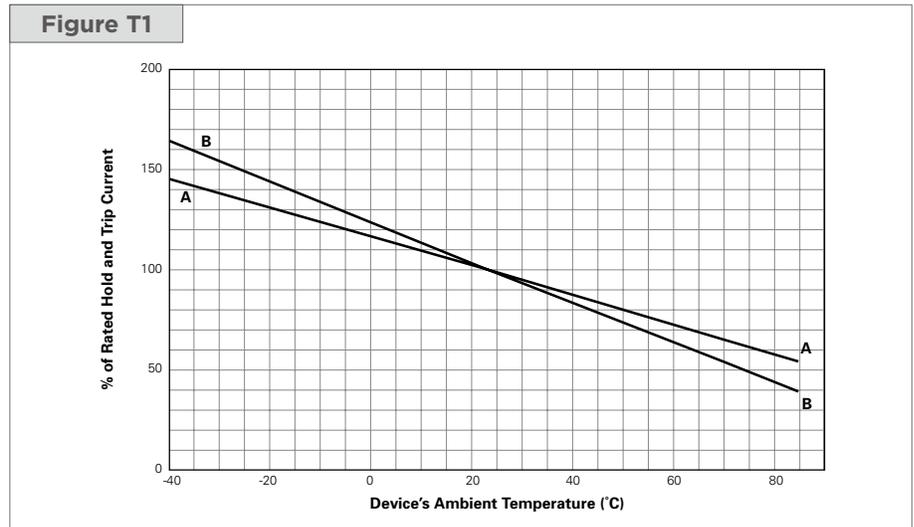


Table T3 – Electrical Characteristics

| Part Number                               | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub>                |                                  | I <sub>MAX</sub> *†<br>(A) | P <sub>D</sub> Typ<br>(W) | Typical Time-to-trip |     | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) |
|---|-----------------------|-----------------------|---------------------------------|----------------------------------|----------------------------|---------------------------|----------------------|-----|-------------------------|-------------------------|--------------------------|
|   |                       |                       | Operating<br>(V <sub>DC</sub> ) | Interrupt<br>(V <sub>RMS</sub> ) |                            |                           | (A)                  | (s) |                         |                         |                          |
| <b>Chip* – 250V<sub>AC</sub></b>          |                       |                       |                                 |                                  |                            |                           |                      |     |                         |                         |                          |
| <b>TCF250</b>                             |                       |                       |                                 |                                  |                            |                           |                      |     |                         |                         |                          |
| TCF250-100T-RB                            | 0.090                 | 0.150                 | 60                              | 250                              | 3.0                        | 0.6                       | 1.0                  | 0.2 | 15.4                    | 18.0                    | 24.0                     |
| TCF250-120                                | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.0                  | 0.9 | 5.0                     | 9.0                     | 14.0                     |
| TCF250-120T                               | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.0                  | 0.6 | 6.3                     | 12.0                    | 18.0                     |
| TCF250-145                                | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                        | 1.0                       | 1.0                  | 2.5 | 3.0                     | 6.0                     | 14.0                     |
| TCF250-145T                               | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                        | 1.0                       | 1.0                  | 1.0 | 5.0                     | 9.0                     | 14.0                     |
| TCF250-180T‡                              | 0.180                 | 0.380                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.0                  | 3.4 | 1.9                     | 3.0                     | 4.2                      |
| <b>Radial-leaded* – 250V<sub>AC</sub></b> |                       |                       |                                 |                                  |                            |                           |                      |     |                         |                         |                          |
| <b>TRF250</b>                             |                       |                       |                                 |                                  |                            |                           |                      |     |                         |                         |                          |
| TRF250-055T                               | 0.055                 | 0.170                 | 60                              | 250                              | 3.0                        | 0.6                       | 0.28                 | 3.5 | 15.0                    | 25.0                    | 35.0                     |
| TRF250-055UT                              | 0.055                 | 0.170                 | 60                              | 250                              | 3.0                        | 0.6                       | 0.28                 | 3.0 | 15.0                    | 25.0                    | 35.0                     |
| TRF250-080T                               | 0.080                 | 0.160                 | 60                              | 250                              | 3.0                        | 0.6                       | 0.35                 | 4.0 | 15.0                    | 22.0                    | 33.0                     |
| TRF250-080U                               | 0.080                 | 0.160                 | 60                              | 250                              | 3.0                        | 0.6                       | 0.35                 | 2.5 | 14.0                    | 20.0                    | 33.0                     |
| TRF250-110U                               | 0.110                 | 0.220                 | 60                              | 250                              | 3.0                        | 0.6                       | 1.00                 | 0.8 | 5.0                     | 9.0                     | 16.0                     |
| TRF250-120                                | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 1.5 | 4.0                     | 8.0                     | 16.0                     |
| TRF250-120T                               | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 0.7 | 7.0                     | 12.0                    | 16.0                     |
| TRF250-120T-RA                            | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 1.2 | 7.0                     | 9.0                     | 16.0                     |
| TRF250-120T-RC                            | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 3.0 | 5.4                     | 7.5                     | 14.0                     |
| TRF250-120T-RF                            | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 0.9 | 6.0                     | 10.5                    | 16.0                     |
| TRF250-120T-RH                            | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 0.7 | 9.0                     | 11.0                    | 16.0                     |
| TRF250-120T-R1                            | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 0.7 | 6.0                     | 9.0                     | 16.0                     |
| TRF250-120T-R2                            | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 0.8 | 8.0                     | 10.5                    | 16.0                     |
| TRF250-120U                               | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.7                       | 1.00                 | 1.0 | 6.0                     | 10.0                    | 16.0                     |
| TRF250-120UT                              | 0.120                 | 0.240                 | 60                              | 250                              | 3.0                        | 0.7                       | 1.00                 | 0.7 | 7.0                     | 12.0                    | 16.0                     |
| TRF250-145                                | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 2.5 | 3.0                     | 6.0                     | 14.0                     |

\* 250V<sub>AC</sub> interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.

† 600V<sub>AC</sub> interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

‡ Product is not currently available in a resistance matched or sorted option.

Table T3 – Electrical Characteristics

(Cont'd)

| Part Number                               | I <sub>H</sub><br>(A) | I <sub>T</sub><br>(A) | V <sub>MAX</sub>                |                                  | I <sub>MAX</sub> *†<br>(A) | P <sub>D</sub> Typ<br>(W) | Typical Time-to-trip |      | R <sub>MIN</sub><br>(Ω) | R <sub>MAX</sub><br>(Ω) | R <sub>1MAX</sub><br>(Ω) |
|---|-----------------------|-----------------------|---------------------------------|----------------------------------|----------------------------|---------------------------|----------------------|------|-------------------------|-------------------------|--------------------------|
|   |                       |                       | Operating<br>(V <sub>DC</sub> ) | Interrupt<br>(V <sub>RMS</sub> ) |                            |                           | (A)                  | (s)  |                         |                         |                          |
| <b>Radial-leaded* – 250V<sub>AC</sub></b> |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| <b>TRF250</b>                             |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| TRF250-145-RA                             | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 2.5  | 3.0                     | 6.0                     | 12.0                     |
| TRF250-145T                               | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                        | 0.8                       | 1.00                 | 1.5  | 5.4                     | 7.5                     | 14.0                     |
| TRF250-145U                               | 0.145                 | 0.290                 | 60                              | 250                              | 3.0                        | 0.7                       | 1.00                 | 2.0  | 3.5                     | 6.5                     | 14.0                     |
| TRF250-183†                               | 0.183                 | 0.685                 | 100                             | 250                              | 10.0                       | 0.9                       | 3.00                 | 0.6  | 0.8                     | 2.0                     | 3.4                      |
| TRF250-183U†                              | 0.183                 | 0.685                 | 100                             | 250                              | 10.0                       | 0.9                       | 3.00                 | 0.6  | 0.8                     | 2.0                     | 3.4                      |
| TRF250-184†                               | 0.184                 | 1.000                 | 100                             | 250                              | 10.0                       | 0.9                       | 3.00                 | 0.5  | 1.2                     | 2.4                     | 3.1                      |
| <b>Surface-mount* – 250V<sub>AC</sub></b> |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| <b>TS250/TSL250/TSV250</b>                |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| TSL250-080F                               | 0.080                 | 0.240                 | 80                              | 250                              | 3.0                        | 1.2                       | 1.0                  | 0.8  | 5.0                     | 11.0                    | 20.0**                   |
| TSL250-130F                               | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                        | 1.5                       | 1.0                  | 2.0  | 4.0                     | 8.0                     | 12.0**                   |
| TS250-130F                                | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                        | 1.1                       | 1.0                  | 0.9  | 6.5                     | 12.0                    | 20.0**                   |
|   | —                     | —                     | 60                              | 600                              | 1.0                        | —                         | —                    | —    | —                       | —                       | —                        |
| TS250-130F-RA                             | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                        | 1.1                       | 1.0                  | 1.4  | 6.5                     | 9.0                     | 15.0**                   |
|   | —                     | —                     | 60                              | 600                              | 1.0                        | —                         | —                    | —    | —                       | —                       | —                        |
| TS250-130F-RB                             | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                        | 1.1                       | 1.0                  | 0.7  | 9.0                     | 12.0                    | 20.0**                   |
|   | —                     | —                     | 60                              | 600                              | 1.0                        | —                         | —                    | —    | —                       | —                       | —                        |
| TS250-130F-RC                             | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                        | 1.1                       | 1.0                  | 1.1  | 7.0                     | 10.0                    | 17.0**                   |
|   | —                     | —                     | 60                              | 600                              | 1.0                        | —                         | —                    | —    | —                       | —                       | —                        |
| TSV250-130F                               | 0.130                 | 0.260                 | 60                              | 250                              | 3.0                        | 1.5                       | 1.0                  | 2.0  | 4.0                     | 7.0                     | 12.0**                   |
| TSV250-184F                               | 0.184                 | 0.690                 | 100                             | 250                              | 10.0                       | 0.9                       | 3.0                  | 0.5  | 1.2                     | 3.0                     | 4.0**                    |
| <b>Radial-leaded† – 600V<sub>AC</sub></b> |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| <b>TRF600</b>                             |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| TRF600-150                                | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                        | 1.4                       | 1.0                  | 1.4  | 6.0                     | 10.0                    | 17.0                     |
| TRF600-150-RB                             | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                        | 1.4                       | 1.0                  | 1.0  | 9.0                     | 12.0                    | 22.0                     |
| TRF600-150-R2                             | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                        | 1.4                       | 1.0                  | 1.3  | 7.0                     | 10.0                    | 17.0                     |
| TR600-150F-EX                             | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                        | 1.4                       | 1.0                  | 5.0  | 6.0                     | 12.0                    | 22.0                     |
| TR600-150F-EX-RB                          | 0.150                 | 0.300                 | 250                             | 600                              | 3.0                        | 1.4                       | 1.0                  | 5.0  | 9.0                     | 12.0                    | 22.0                     |
| TRF600-160                                | 0.160                 | 0.320                 | 250                             | 600                              | 3.0                        | 1.7                       | 1.0                  | 7.5  | 4.0                     | 10.0                    | 18.0                     |
| TRF600-160-RA                             | 0.160                 | 0.320                 | 250                             | 600                              | 3.0                        | 1.7                       | 1.0                  | 9.5  | 4.0                     | 7.0                     | 16.0                     |
| TRF600-250                                | 0.250                 | 0.850                 | 250                             | 600                              | 3.0                        | 2.0                       | 3.0                  | 1.0  | 1.0                     | 4.3                     | 7.0                      |
| TRF600-400                                | 0.400                 | 1.000                 | 60                              | 600                              | 3.0                        | 2.4                       | 3.0                  | 4.0  | 0.95                    | 1.45                    | 1.90                     |
| <b>Surface-mount† – 600V<sub>AC</sub></b> |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| <b>TS600/TSM600</b>                       |                       |                       |                                 |                                  |                            |                           |                      |      |                         |                         |                          |
| TS600-170F                                | 0.170                 | 0.400                 | 60                              | 600                              | 3.0                        | 2.5                       | 1.0                  | 10.0 | 4.0                     | 9.0                     | 18.0                     |
| TS600-200F-RA-B-0.5                       | 0.200                 | 0.400                 | 60                              | 600                              | 3.0                        | 2.5                       | 1.0                  | 12.0 | 4.0                     | 7.5                     | 13.5                     |
| TS600-400F                                | 0.400                 | 1.000                 | 60                              | 600                              | 3.0                        | 2.0                       | 3.0                  | 5.0  | 0.5                     | 1.1                     | 2.0                      |
| TSM600-250F                               | 0.250                 | 0.860                 | 250                             | 600                              | 3.0                        | 2.0                       | 3.0                  | 0.8  | 1.0                     | 3.5                     | 7.0                      |
| TSM600-250F-RA                            | 0.250                 | 0.860                 | 250                             | 600                              | 3.0                        | 2.0                       | 3.0                  | 1.0  | 1.0                     | 3.0                     | 5.0                      |
| TSM600-400F                               | 0.400                 | 1.000                 | 250                             | 600                              | 3.0                        | 2.0                       | 3.0                  | 5.0  | 0.5                     | 1.1                     | 2.0                      |

**Notes:**I<sub>H</sub> : Hold current: maximum current device will pass without interruption in 20°C still air.I<sub>T</sub> : Trip current: minimum current that will switch the device from low resistance to high resistance in 20°C still air.V<sub>MAX</sub> Operating: Maximum continuous voltage device can withstand without damage at rated current. This voltage is used for component recognition under UL1434.V<sub>MAX</sub> Interrupt : Maximum voltage that can be safely placed across a device in its tripped state. Devices may trip safely under higher level power cross conditions to assist equipment in meeting the appropriate ITU, UL60950 or GR1089 industry requirements.I<sub>MAX</sub> Interrupt : Maximum fault current device can withstand without damage at rated operating voltage. This current is used for component recognition under UL1434.

Devices may trip safely under higher level power cross conditions to assist equipment in meeting the appropriate ITU, UL60950 or GR1089 industry requirements.

P<sub>D</sub> : Power dissipated from device when in the tripped state in 20°C still air.R<sub>MIN</sub> : Minimum resistance of device as supplied at 20°C unless otherwise specified.R<sub>MAX</sub> : Maximum resistance of device as supplied at 20°C unless otherwise specified.R<sub>1MAX</sub> : Maximum resistance measured one hour post-trip or post-reflow at 20°C.\* 250V<sub>AC</sub> interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.† 600V<sub>AC</sub> interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

‡ Product is not currently available in a resistance matched or sorted option.

\*\* R<sub>1MAX</sub> measured 1 hour post-trip or 24 hours post-reflow at 20°C.

Figures T2-T12 – Dimension Figures

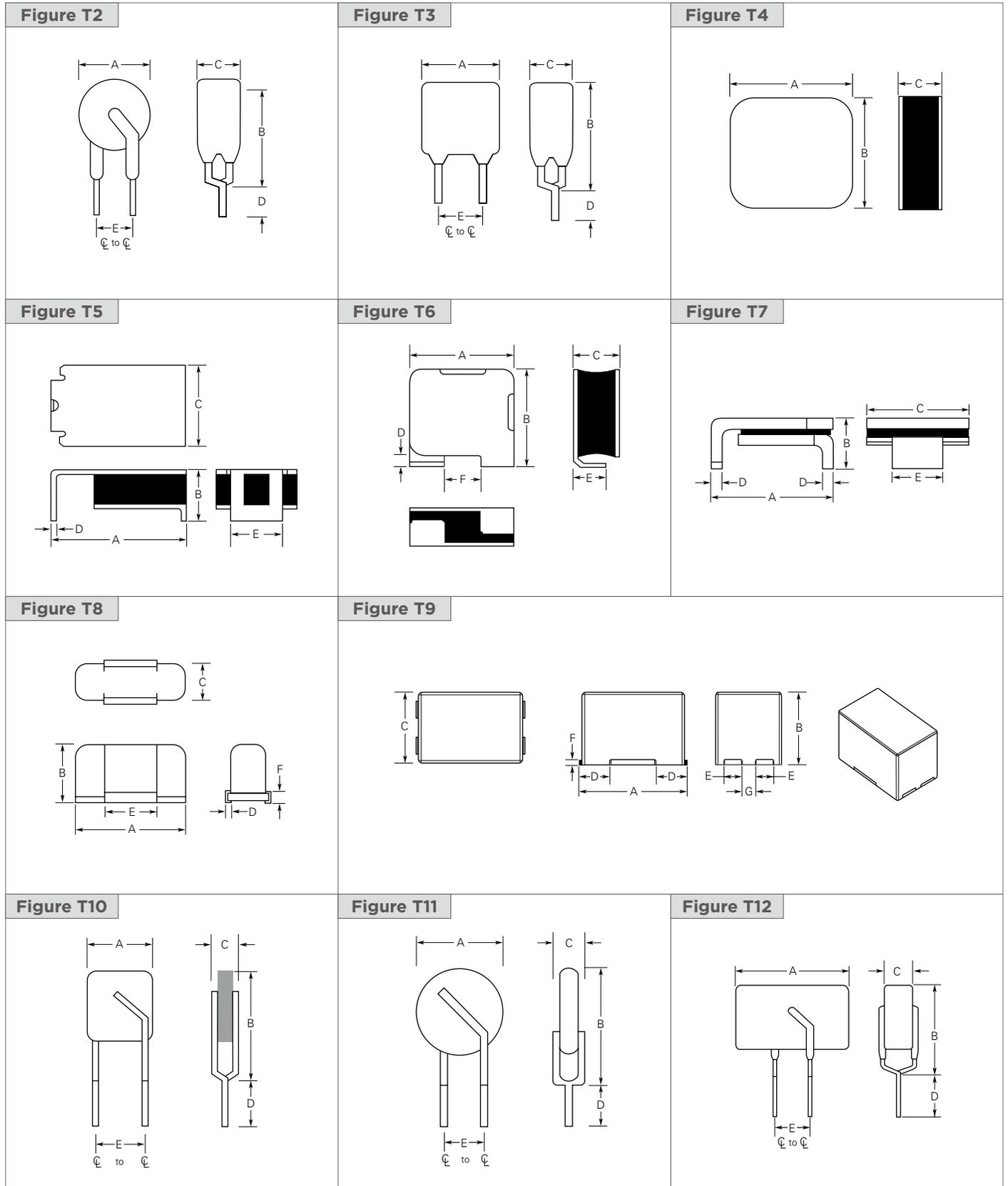


Table T4 – Dimensions &amp; Weights

| Part Number**                    | Dimensions in Millimeters (Inches) |               |               |                |               |               |                            |               |                            |               |     |               |     |     | Figure | Device Mass (g)<br>(Only for Reference) |
|----------------------------------|------------------------------------|---------------|---------------|----------------|---------------|---------------|----------------------------|---------------|----------------------------|---------------|-----|---------------|-----|-----|--------|---|
|                                  | A                                  |               | B             |                | C             |               | D                          |               | E                          |               | F   |               | G   |     |        |   |
|                                  | Min                                | Max           | Min           | Max            | Min           | Max           | Min                        | Max           | Min                        | Max           | Min | Max           | Min | Max |        |   |
| <b>TCF-250V*</b>                 |                                    |               |               |                |               |               |                            |               |                            |               |     |               |     |     |        |   |
| TCF250-100T                      | 4.6<br>(0.18)                      | 4.9<br>(0.19) | 4.6<br>(0.18) | 4.9<br>(0.19)  | 2.0<br>(0.08) | 2.3<br>(0.09) | —                          | —             | —                          | —             | —   | —             | —   | —   | T4     | 0.24                                    |
| TCF250-120                       | 5.4<br>(0.21)                      | 5.6<br>(0.22) | 5.4<br>(0.21) | 5.6<br>(0.22)  | 2.0<br>(0.08) | 2.3<br>(0.09) | —                          | —             | —                          | —             | —   | —             | —   | —   | T4     | 0.28                                    |
| TCF250-120T                      | 5.4<br>(0.21)                      | 5.6<br>(0.22) | 5.4<br>(0.21) | 5.6<br>(0.22)  | 2.0<br>(0.08) | 2.3<br>(0.09) | —                          | —             | —                          | —             | —   | —             | —   | —   | T4     | 0.28                                    |
| TCF250-145                       | 5.4<br>(0.21)                      | 5.6<br>(0.22) | 5.4<br>(0.21) | 5.6<br>(0.22)  | 2.0<br>(0.08) | 2.5<br>(0.10) | —                          | —             | —                          | —             | —   | —             | —   | —   | T4     | 0.28                                    |
| TCF250-145T                      | 5.4<br>(0.21)                      | 5.6<br>(0.22) | 5.4<br>(0.21) | 5.6<br>(0.22)  | 2.0<br>(0.08) | 2.5<br>(0.10) | —                          | —             | —                          | —             | —   | —             | —   | —   | T4     | 0.28                                    |
| TCF250-180T                      | 6.9<br>(0.27)                      | 7.1<br>(0.28) | 6.9<br>(0.27) | 7.1<br>(0.28)  | 1.3<br>(0.05) | 1.6<br>(0.06) | —                          | —             | —                          | —             | —   | —             | —   | —   | T4     | 0.35                                    |
| <b>TRF250-250V*</b>              |                                    |               |               |                |               |               |                            |               |                            |               |     |               |     |     |        |   |
| TRF250-055T                      | —                                  | 5.8<br>(0.23) | —             | 9.9<br>(0.39)  | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T2     | 0.28                                    |
| TRF250-055UT                     | —                                  | 4.8<br>(0.19) | —             | 9.3<br>(0.37)  | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T11    | 0.13                                    |
| TRF250-080T                      | —                                  | 5.8<br>(0.23) | —             | 9.9<br>(0.39)  | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T2     | 0.28                                    |
| TRF250-080U                      | —                                  | 4.8<br>(0.19) | —             | 9.3<br>(0.37)  | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T11    | 0.13                                    |
| TRF250-110U                      | —                                  | 5.3<br>(0.21) | —             | 9.4<br>(0.37)  | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T11    | 0.13                                    |
| TRF250-120                       | —                                  | 6.5<br>(0.26) | —             | 11.0<br>(0.43) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T3     | 0.38                                    |
| TRF250-120T                      | —                                  | 6.5<br>(0.26) | —             | 11.0<br>(0.43) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | 7.0<br>(0.28) | —   | —   | T3     | 0.38                                    |
| TRF250-120U                      | —                                  | 6.0<br>(0.24) | —             | 10.0<br>(0.39) | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | 6.0<br>(0.24) | —   | —   | T10    | 0.19                                    |
| TRF250-120UT                     | —                                  | 6.0<br>(0.24) | —             | 10.0<br>(0.39) | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | 6.0<br>(0.24) | —   | —   | T10    | 0.19                                    |
| TRF250-145                       | —                                  | 6.5<br>(0.26) | —             | 11.0<br>(0.43) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | 7.0<br>(0.28) | —   | —   | T3     | 0.38                                    |
| TRF250-145T                      | —                                  | 6.5<br>(0.26) | —             | 11.0<br>(0.43) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | 7.0<br>(0.28) | —   | —   | T3     | 0.38                                    |
| TRF250-145U                      | —                                  | 6.0<br>(0.24) | —             | 10.0<br>(0.39) | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | 6.0<br>(0.24) | —   | —   | T10    | 0.19                                    |
| TRF250-183                       | —                                  | 7.5<br>(0.29) | —             | 10.5<br>(0.41) | —             | 3.8<br>(0.15) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T2     | 0.30                                    |
| TRF250-183U                      | —                                  | 6.5<br>(0.26) | —             | 10.0<br>(0.39) | —             | 3.0<br>(0.12) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T11    | 0.16                                    |
| TRF250-184                       | —                                  | 7.7<br>(0.30) | —             | 10.5<br>(0.41) | —             | 4.6<br>(0.18) | 4.7<br>(0.19)              | —             | 5.0 <sup>‡</sup><br>(0.20) | —             | —   | —             | —   | —   | T2     | 0.32                                    |
| <b>TS250/TSL250/TSV250-250V*</b> |                                    |               |               |                |               |               |                            |               |                            |               |     |               |     |     |        |   |
| TSL250-080F                      | 6.7<br>(0.27)                      | 7.9<br>(0.31) | 2.7<br>(0.11) | 3.7<br>(0.15)  | 4.8<br>(0.19) | 5.3<br>(0.21) | 0.2<br>(0.01)              | 0.4<br>(0.02) | 2.5<br>(0.10)              | 3.1<br>(0.12) | —   | —             | —   | —   | T7     | 2.80                                    |
| TSL250-130F                      | 6.7<br>(0.27)                      | 7.9<br>(0.31) | 2.7<br>(0.11) | 3.7<br>(0.15)  | 4.8<br>(0.19) | 5.3<br>(0.21) | 0.2<br>(0.01)              | 0.4<br>(0.02) | 2.5<br>(0.10)              | 3.1<br>(0.12) | —   | —             | —   | —   | T7     | 2.80                                    |
| TS250-130F                       | 8.5<br>(0.34)                      | 9.4<br>(0.37) | —             | 3.4<br>(0.14)  | —             | 7.4<br>(0.29) | 0.3 <sup>‡</sup><br>(0.01) | —             | 3.8 <sup>‡</sup><br>(0.15) | —             | —   | —             | —   | —   | T5     | 3.60                                    |

Table T4 – Dimensions &amp; Weights

(Cont'd)

| Part Number**                    | Dimensions in Millimeters (Inches) |                 |                 |                 |                 |                 |                |                |                            |                |                |                |               |               | Figure | Device Mass (g)<br>(Only for Reference) |
|----------------------------------|------------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|----------------------------|----------------|----------------|----------------|---------------|---------------|--------|---|
|                                  | A                                  |                 | B               |                 | C               |                 | D              |                | E                          |                | F              |                | G             |               |        |   |
|                                  | Min                                | Max             | Min             | Max             | Min             | Max             | Min            | Max            | Min                        | Max            | Min            | Max            | Min           | Max           |        |   |
| <b>TS250/TSL250/TSV250-250V*</b> |                                    |                 |                 |                 |                 |                 |                |                |                            |                |                |                |               |               |        |   |
| TSV250-130F                      | —                                  | 6.10<br>(0.24)  | —               | 6.90<br>(0.27)  | —               | 3.20<br>(0.13)  | 0.56<br>(0.02) | —              | —                          | 1.90<br>(0.08) | 1.60<br>(0.07) | 2.30<br>(0.09) | —             | —             | T6     | 2.80                                    |
| TSV250-184F                      | —                                  | 6.10<br>(0.24)  | —               | 6.90<br>(0.27)  | —               | 3.20<br>(0.13)  | 0.56<br>(0.02) | —              | —                          | 1.90<br>(0.08) | 1.60<br>(0.07) | 2.30<br>(0.09) | —             | —             | T6     | 2.80                                    |
| <b>TRF600-600V†</b>              |                                    |                 |                 |                 |                 |                 |                |                |                            |                |                |                |               |               |        |   |
| TRF600-150                       | —                                  | 9.0<br>(0.35)   | —               | 12.5<br>(0.49)  | —               | 4.6<br>(0.18)   | 4.7<br>(0.19)  | —              | 5.0<br>(0.20)              | —              | —              | 9.0<br>(0.35)  | —             | —             | T3     | 0.37                                    |
| TR600-150F-EX                    | —                                  | 13.5<br>(0.53)  | —               | 12.6<br>(0.50)  | —               | 6.0<br>(0.18)   | 4.7<br>(0.19)  | —              | 5.0<br>(0.20)              | —              | —              | —              | —             | —             | T12    | 0.80                                    |
| TRF600-160                       | —                                  | 16.0<br>(0.63)  | —               | 12.6<br>(0.50)  | —               | 6.0<br>(0.24)   | 4.7<br>(0.19)  | —              | 5.0 <sup>‡</sup><br>(0.20) | —              | —              | 10.0<br>(0.39) | —             | —             | T13    | 0.90                                    |
| TRF600-250                       | —                                  | 15.0<br>(0.59)  | —               | 14.5<br>(0.57)  | —               | 4.6<br>(0.18)   | 4.7<br>(0.19)  | —              | 5.0 <sup>‡</sup><br>(0.20) | —              | —              | 10.0<br>(0.39) | —             | —             | T3     | 0.87                                    |
| TRF600-400                       | —                                  | 14.8<br>(0.58)  | —               | 13.1<br>(0.52)  | —               | 4.6<br>(0.18)   | 6.0<br>(0.27)  | —              | 5.0 <sup>‡</sup><br>(0.20) | —              | —              | —              | —             | —             | T12    | 0.85                                    |
| <b>TS600/TSM600-600V†</b>        |                                    |                 |                 |                 |                 |                 |                |                |                            |                |                |                |               |               |        |   |
| TS600-170F                       | 18.3<br>(0.72)                     | 19.4<br>(0.77)  | 11.6<br>(0.46)  | 12.3<br>(0.49)  | 7.2<br>(0.29)   | 8.3<br>(0.33)   | 1.7<br>(0.07)  | 2.4<br>(0.10)  | 9.9<br>(0.39)              | 10.4<br>(0.41) | 1.5<br>(0.06)  | 2.3<br>(0.09)  | —             | —             | T8     | 23.6                                    |
| TS600-200F                       | 18.3<br>(0.72)                     | 19.4<br>(0.77)  | 11.6<br>(0.46)  | 12.3<br>(0.49)  | 7.2<br>(0.29)   | 8.3<br>(0.33)   | 1.7<br>(0.07)  | 2.4<br>(0.10)  | 9.9<br>(0.39)              | 10.4<br>(0.41) | 1.5<br>(0.06)  | 2.3<br>(0.09)  | —             | —             | T8     | 23.6                                    |
| TS600-400F                       | 18.3<br>(0.72)                     | 19.4<br>(0.77)  | 11.6<br>(0.46)  | 12.3<br>(0.49)  | 7.2<br>(0.29)   | 8.3<br>(0.33)   | 1.7<br>(0.07)  | 2.4<br>(0.10)  | 9.9<br>(0.39)              | 10.4<br>(0.41) | 1.5<br>(0.06)  | 2.3<br>(0.09)  | —             | —             | T8     | 19.8                                    |
| TSM600-250F                      | 17.0<br>(0.67)                     | 17.60<br>(0.69) | 11.20<br>(0.44) | 11.70<br>(0.46) | 10.40<br>(0.41) | 11.20<br>(0.44) | 4.80<br>(0.19) | 5.20<br>(0.20) | 2.50<br>(0.10)             | 2.80<br>(0.11) | 0.60<br>(0.02) | 1.0<br>(0.04)  | 2.2<br>(0.09) | 3.1<br>(0.12) | T9     | 31.2                                    |
| TSM600-400F                      | 17.0<br>(0.67)                     | 17.60<br>(0.69) | 11.20<br>(0.44) | 11.70<br>(0.46) | 10.40<br>(0.41) | 11.20<br>(0.44) | 4.80<br>(0.19) | 5.20<br>(0.20) | 2.50<br>(0.10)             | 2.80<br>(0.11) | 0.60<br>(0.02) | 1.0<br>(0.04)  | 2.2<br>(0.09) | 3.1<br>(0.12) | T9     | 31.2                                    |

\* 250V<sub>AC</sub> interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.

\*\* Applies to all products which share the same prefix.

† 600V<sub>AC</sub> interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

‡ Indicates dimension is typical, not minimum.

## Figures T13-T16 — Typical Time-to-Trip Curves at 20°C

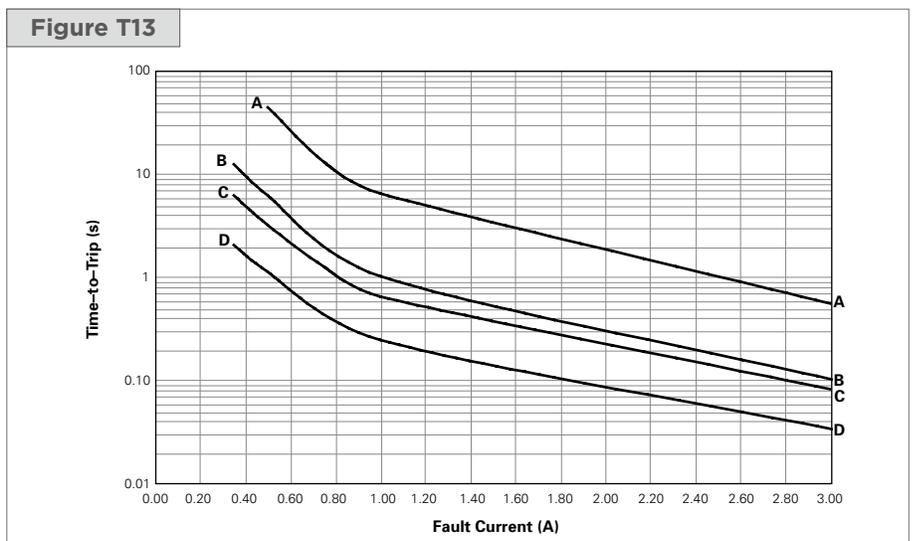
## TCF250

A = TCF250-180T

B = TCF250-145/145T

C = TCF250-120/120T

D = TCF250-100T

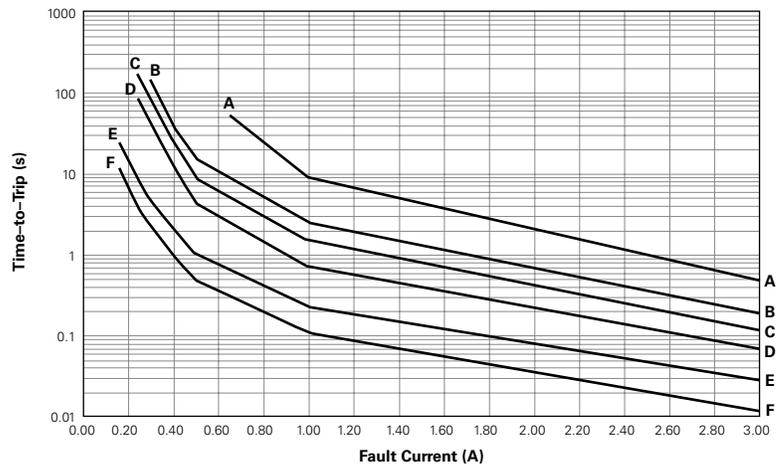


## Figures T13-T16 — Typical Time-to-Trip Curves at 20°C

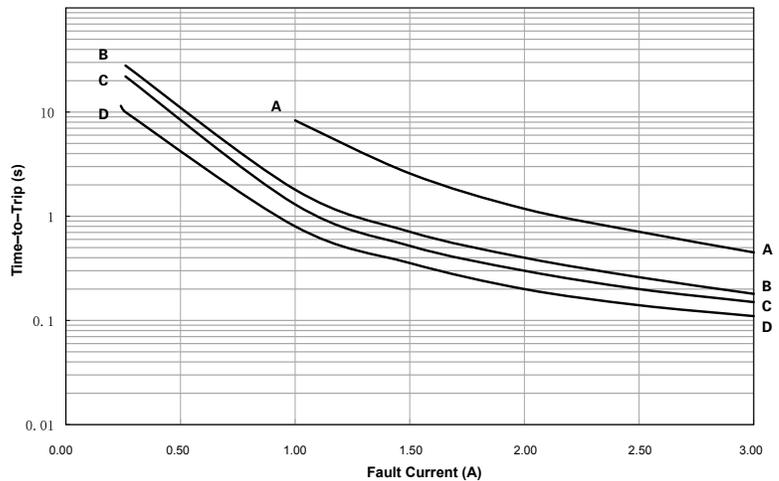
(Cont'd)

**TRF250**

- A = TRF250-183/183U/184
- B = TRF250-145/145U/145T
- C = TRF250-120/120U
- D = TRF250-110U/120UT/120T
- E = TRF250-080T/080U
- F = TRF250-055T/055UT

**Figure T14****TS250/TSV250/TSL250**

- A = TSV250-184F
- B = TSV250-130F/TSL250-130F
- C = TS250-130F
- D = TSL250-080F

**Figure T15****TRF600/TS600/TSM600**

- A = TRF600-400/TS600-400/  
TSM600-400F
- B = TRF600-250/TSM600-250F/  
TS600-170F/200F
- C = TRF600-160
- D = TR600-150F-EX
- E = TRF600-150

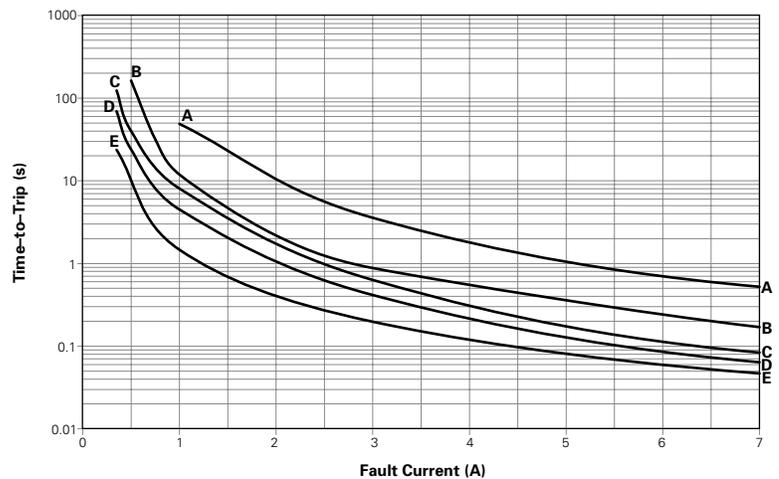
**Figure T16**

Table T5 — Physical Characteristics and Environmental Specifications

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

| TCF250*                      |                           |
|------------------------------|---------------------------|
| Physical Characteristics     |                           |
| Terminal Material            | Nickel-plated Copper Foil |
| Environmental Specifications |                           |
| Test                         | Conditions                |
| Passive Aging                | 60°C, 1000 hrs            |
|                              | 85°C, 1000 hrs            |
| Humidity Aging               | 85°C, 85% RH, 1000 hrs    |
| Thermal Shock                | 125°C, -55°C (10 Times)   |
| Solvent Resistance           | MIL-STD-202, Method 215F  |

**Note:** Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use.  
Devices may not meet specified values if these storage conditions are exceeded.

| TRF250*                   |  |
|---------------------------|--|
| Physical Characteristics  |  |
| Lead Material             | Tin-plated Copper, 22AWG   |
| Insulating Material       | Cured Epoxy Polymer  |
| Flammability              | Per IEC 695-2-2 Needle Flame Test for 20 s   |
| Soldering Characteristics | ANSI/J-STD-002, Category 3   |
| Solder Heat Withstand     | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: Can Withstand 10s at 260°C±5°C |

**Note:** Devices are not intended to be placed through a reflow process.

| Environmental Specifications |                          |
|------------------------------|--------------------------|
| Test                         | Conditions               |
| Passive Aging                | 60°C, 1000 hrs           |
|                              | 85°C, 1000 hrs           |
| Humidity Aging               | 85°C, 85% RH, 1000 hrs   |
| Thermal Shock                | 125°C, -55°C (10 Times)  |
| Solvent Resistance           | MIL-STD-202, Method 215F |

**Note:** Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use.  
Devices may not meet specified values if these storage conditions are exceeded.

| TS250/TSV250/TSL250*         |  |
|------------------------------|--|
| Physical Characteristics     |  |
| Terminal Material            | Tin-plated Brass, Nickel Under-plating |
| Soldering Characteristics    | EIC 60068-2-58                         |
| Environmental Specifications |  |
| Test                         | Conditions                             |
| Passive Aging                | 60°C, 1000 hrs                         |
|                              | 85°C, 1000 hrs                         |
| Humidity Aging               | 85°C, 85% RH, 500 hrs                  |
| Thermal Shock                | 125°C, -55°C (10 Times)                |
| Solvent Resistance           | MIL-STD-202, Method 215F               |

**Note:** Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use.  
Devices may not meet specified values if these storage conditions are exceeded.

Table T5 — Physical Characteristics and Environmental Specifications

(Cont'd)

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

**TRF600<sup>†</sup>****Physical Characteristics**

|                           |   |
|---------------------------|---|
| Lead Material             | Tin-plated Copper, 22AWG  |
| Insulating Material       | Cured Epoxy Polymer <sup>‡</sup>  |
| Flammability              | Per IEC 695-2-2 Needle Flame Test for 20s   |
| Soldering Characteristics | ANSI/J-STD-002, Category 3  |
| Solder Heat Withstand     | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A, Condition B: Can Withstand 10 s at 260°C±5°C |

**Note:** Devices are not intended to be placed through a reflow process.

**Environmental Specifications**

| Test               | Conditions                          |
|--------------------|-------------------------------------|
| Passive Aging      | 60°C, 1000 hrs                      |
|                    | 85°C, 1000 hrs                      |
| Humidity Aging     | 85°C, 85% RH, 1000 hrs <sup>‡</sup> |
| Thermal Shock      | 125°C, -55°C (10 Times)             |
| Solvent Resistance | MIL-STD-202, Method 215F            |

**Note:** Storage conditions: 40°C (max), 70% RH (max) devices should remain in original sealed bag prior to use.  
Devices may not meet specified values if these storage conditions are exceeded.

**TS600<sup>†</sup>****Physical Characteristics**

|                           |  |
|---------------------------|--|
| Terminal Material         | Tin-plated Brass                               |
| Insulating Material       | Nylon Resin (UL94V-0), 1000V Dielectric Rating |
| Flammability              | IEC 695-2-2 Needle Flame Test for 20 s         |
| Soldering Characteristics | ANSI/J-STD-002, Category 3                     |
| Solder Heat Withstand     | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A  |

**Environmental Specifications**

| Test               | Conditions               |
|--------------------|--------------------------|
| Passive Aging      | 60°C, 1000 hrs           |
|                    | 85°C, 1000 hrs           |
| Humidity Aging     | 85°C, 85% RH, 1000 hrs   |
| Thermal Shock      | 125°C, -55°C (10 Times)  |
| Solvent Resistance | MIL-STD-202, Method 215F |

**Note:** Storage conditions: 40°C (max), 70% RH (max), devices should remain in original sealed bag prior to use.  
Devices may not meet specified values if these storage conditions are exceeded.

\* 250V<sub>AC</sub> interrupt products may help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.

† 600V<sub>AC</sub> interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

‡ Excluding TRF600-150 and TRF600-400, which have a coating that is not rated for dielectric withstand and can withstand 500h at 85°C/85% RH or 1000h at 60°C/90% RH.

Table T5 — Physical Characteristics and Environmental Specifications

(Cont'd)

Operating temperature range for all listed products is -40°C to 85°C, except for TRF250-080T and TRF250-184 (0°C to 85°C)

| <b>TSM600<sup>†</sup></b>           |  |
|-------------------------------------|--|
| <b>Physical Characteristics</b>     |  |
| Terminal Material                   | Tin-plated Brass                               |
| Insulating Material                 | Nylon Resin (UL94V-0), 1000V Dielectric Rating |
| Flammability                        | IEC 695-2-2 Needle Flame Test for 20 s         |
| Soldering Characteristics           | EIC60068-2-58, Method 7                        |
| Solder Heat Withstand               | IEC-STD 68-2-20, Test Tb, Section 5 Method 1A  |
| <b>Environmental Specifications</b> |  |
| <b>Test</b>                         | <b>Conditions</b>                              |
| Passive Aging                       | 60°C, 1000 hrs                                 |
|                                     | 85°C, 1000 hrs                                 |
| Humidity Aging                      | 85°C, 85% RH, 1000 hrs                         |
| Storage Humidity                    | Per IPC/JEDEC J-STD-020A Level 2a              |
| Thermal Shock                       | 125°C, -55°C (10 Times)                        |
| Solvent Resistance                  | MIL-STD-202, Method 215J                       |

**Note:** Storage conditions: 40°C (max), 70% RH (max) devices should remain in original sealed bag prior to use. Devices may not meet specified values if these storage conditions are exceeded.

<sup>†</sup> 600V<sub>AC</sub> interrupt products may help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

Table T6 — Packaging and Marking Information

| <b>Part Number**</b>                      | <b>Bag Quantity</b> | <b>Tape and Reel Quantity</b> | <b>Standard Package Quantity</b> | <b>Part Marking</b> | <b>Agency Recognition</b> |
|---|---------------------|-------------------------------|----------------------------------|---------------------|---------------------------|
| <b>Chip* — 250V<sub>AC</sub></b>          |                     |                               |                                  |                     |                           |
| <b>TCF250</b>                             |                     |                               |                                  |                     |                           |
| TCF250-100T                               | 2,500               | —                             | 10,000                           | —                   | —                         |
| TCF250-120                                | 2,500               | —                             | 10,000                           | —                   | —                         |
| TCF250-120T                               | 2,500               | —                             | 10,000                           | —                   | —                         |
| TCF250-145                                | 2,500               | —                             | 10,000                           | —                   | UL                        |
| TCF250-145T                               | 2,500               | —                             | 10,000                           | —                   | UL                        |
| TCF250-180T                               | 2,500               | —                             | 10,000                           | —                   | UL                        |
| <b>Radial-leaded* — 250V<sub>AC</sub></b> |                     |                               |                                  |                     |                           |
| <b>TRF250</b>                             |                     |                               |                                  |                     |                           |
| TRF250-055T                               | 500                 | —                             | 10,000                           | —                   | —                         |
| TRF250-055UT                              | 500                 | —                             | 10,000                           | —                   | —                         |
| TRF250-080U                               | 500                 | —                             | 10,000                           | —                   | UL, CSA, TÜV              |
| TRF250-080T                               | 500                 | —                             | 10,000                           | 08F                 | UL, CSA, TÜV              |
| TRF250-110U                               | 500                 | —                             | 10,000                           | —                   | UL, CSA, TÜV              |
| TRF250-120                                | 500                 | —                             | 10,000                           | 20F                 | UL, CSA, TÜV              |
| TRF250-120-2                              | —                   | 1,500                         | 7,500                            | 20F                 | UL, CSA, TÜV              |
| TRF250-120T                               | 500                 | —                             | 10,000                           | 20F                 | UL, CSA, TÜV              |
| TRF250-120T-2                             | —                   | 1,500                         | 7,500                            | 20F                 | UL, CSA, TÜV              |
| TRF250-120U                               | 500                 | —                             | 10,000                           | 20F                 | UL, CSA, TÜV              |
| TRF250-120U-2                             | —                   | 1,500                         | 7,500                            | 20F                 | UL, CSA, TÜV              |
| TRF250-120UT                              | 500                 | —                             | 10,000                           | 20F                 | UL, CSA, TÜV              |

Table T6 — Packaging and Marking Information

(Cont'd)

| Part Number**                             | Bag Quantity | Tape and Reel Quantity | Standard Package Quantity | Part Marking | Agency Recognition |
|---|--------------|------------------------|---------------------------|--------------|--------------------|
| <b>Radial-leaded* — 250V<sub>AC</sub></b> |              |                        |                           |              |                    |
| <b>TRF250</b>                             |              |                        |                           |              |                    |
| TRF250-145                                | 500          | —                      | 10,000                    | 45F          | UL, CSA, TÜV       |
| TRF250-145-2                              | —            | 1,500                  | 7,500                     | 45F          | UL, CSA, TÜV       |
| TRF250-145T                               | 500          | —                      | 10,000                    | 45F          | UL, CSA, TÜV       |
| TRF250-145T-2                             | —            | 1,500                  | 7,500                     | 45F          | UL, CSA, TÜV       |
| TRF250-145U                               | 500          | —                      | 10,000                    | 45F          | UL, CSA, TÜV       |
| TRF250-145U-2                             | —            | 1,500                  | 7,500                     | 45F          | UL, CSA, TÜV       |
| TRF250-183                                | 500          | —                      | 10,000                    | 83F          | UL, CSA, TÜV       |
| TRF250-183-2                              | —            | 1,500                  | 7,500                     | 83F          | UL, CSA, TÜV       |
| TRF250-183U                               | 500          | —                      | 10,000                    | —            | UL, CSA, TÜV       |
| TRF250-184                                | 500          | —                      | 10,000                    | 84F          | UL, CSA, TÜV       |
| <b>Surface-mount* — 250V<sub>AC</sub></b> |              |                        |                           |              |                    |
| <b>TS250/TSL250/TSV250</b>                |              |                        |                           |              |                    |
| TSL250-080F-2                             | —            | 1,500                  | 7,500                     | T08          | UL, CSA, TÜV       |
| TSL250-130F-2                             | —            | 1,500                  | 7,500                     | T13          | —                  |
| TS250-130F-2                              | —            | 1,500                  | 7,500                     | T13          | UL, CSA, TÜV       |
| TSV250-130F                               | 2500         | —                      | 10,000                    | T13V         | UL, CSA, TÜV       |
| TSV250-130F-2                             | —            | 1,200                  | 6,000                     | T13V         | UL, CSA, TÜV       |
| TSV250-184F                               | 2500         | —                      | 10,000                    | T18V         | UL                 |
| <b>Radial-leaded† — 600V<sub>AC</sub></b> |              |                        |                           |              |                    |
| <b>TRF600</b>                             |              |                        |                           |              |                    |
| TRF600-150                                | 500          | —                      | 10,000                    | 150F         | UL, CSA, TÜV       |
| TRF600-150-2                              | —            | 1,500                  | 7,500                     | 150F         | UL, CSA, TÜV       |
| TR600-150F-EX                             | 500          | —                      | 10,000                    | 150F         | UL, CSA            |
| TR600-150F-EX-2                           | —            | 600                    | 3,000                     | 150F         | UL, CSA            |
| TRF600-160                                | 500          | —                      | 10,000                    | 160F         | UL, CSA, TÜV       |
| TRF600-160-2                              | —            | 600                    | 3,000                     | 160F         | UL, CSA, TÜV       |
| TRF600-250                                | 500          | —                      | 10,000                    | 250F         | UL, CSA, TÜV       |
| TRF600-400                                | 500          | —                      | 10,000                    | 400F         | UL, CSA, TÜV       |
| <b>Surface-mount† — 600V<sub>AC</sub></b> |              |                        |                           |              |                    |
| <b>TSM600/TSM600</b>                      |              |                        |                           |              |                    |
| TS600-170F-2                              | —            | 300                    | 900                       | T20          | UL, CSA            |
| TS600-200F-RA-2                           | —            | 300                    | 900                       | T20          | UL, CSA            |
| TS600-400F-2                              | —            | 300                    | 900                       | T40          | UL, CSA            |
| TSM600-250F-2                             | —            | 200                    | 600                       | TSM600       | UL, CSA            |
| TSM600-250F-RA-2                          | —            | 200                    | 600                       | TSM600       | UL, CSA            |
| TSM600-400F-2                             | —            | 200                    | 600                       | TSM600-4     | UL                 |

**Notes:**\* 250V<sub>AC</sub> interrupt products are designed to help equipment pass ITU K.20, K.21 and K.45 recommendations and Telcordia GR-1089 Port Type 2 and 4 requirements.

\*\* Applies to all products which share the same prefix.

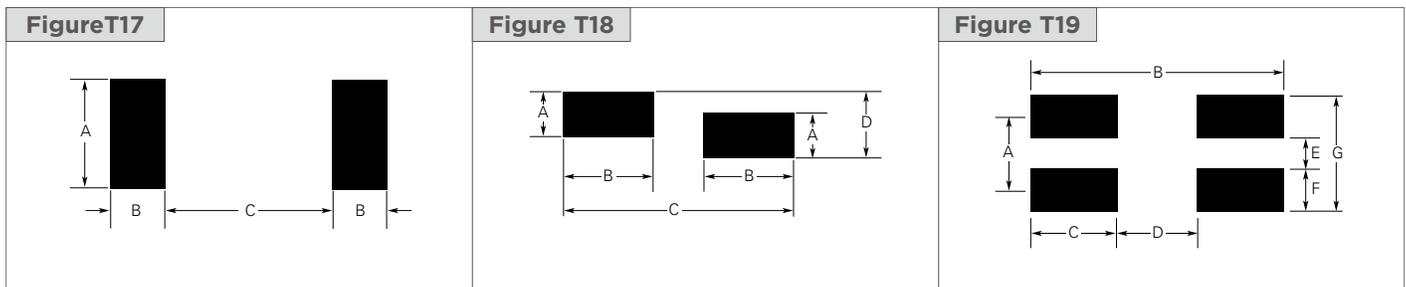
† 600V<sub>AC</sub> interrupt products are designed to help equipment pass UL60950, TIA-968-A and GR1089 Port Type 1, 3 and 5 requirements.

## Agency Recognition

|     |                |   |
|-----|----------------|---|
| UL  | File # E74889  |   |
| CSA | File # 78165C  |   |
| TÜV | Per IEC60730-1 | Certificate # for individual products available upon request. |

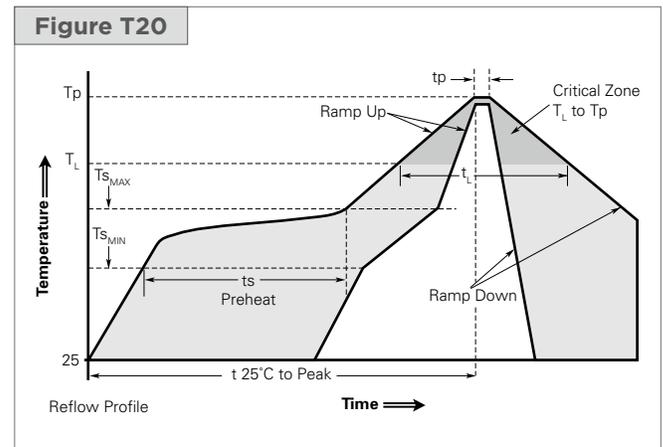
Table T7 — Recommended Pad Layouts for Surface-mount PolySwitch Telecommunications and Networking Devices in Millimeters (Inches) Nominal

| Device       | A                | B                | C               | D               | E               | F               | G               | Figure |
|--------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|--------|
| TS250 (All)  | 4.60<br>(0.180)  | 1.80<br>(0.070)  | 6.10<br>(0.240) | —<br>—          | —<br>—          | —<br>—          | —<br>—          | T17    |
| TSV250 (All) | 2.29<br>(0.090)  | 2.41<br>(0.095)  | 6.35<br>(0.250) | 3.43<br>(0.135) | —<br>—          | —<br>—          | —<br>—          | T18    |
| TSL250 (All) | 3.60<br>(0.140)  | 1.80<br>(0.070)  | 5.50<br>(0.220) | —<br>—          | —<br>—          | —<br>—          | —<br>—          | T17    |
| TS600 (All)  | 10.42<br>(0.410) | 3.30<br>(0.130)  | 3.35<br>(0.132) | —<br>—          | —<br>—          | —<br>—          | —<br>—          | T17    |
| TSM600 (All) | 5.20<br>(0.205)  | 17.80<br>(0.701) | 5.54<br>(0.218) | 6.75<br>(0.266) | 2.08<br>(0.082) | 3.12<br>(0.123) | 8.39<br>(0.331) | T19    |



## Solder Reflow and Rework Recommendations for PolySwitch Telecommunications Surface-Mount Devices

| Profile Feature   | Pb-Free Assembly |
|---|------------------|
| Average ramp up rate ( $T_{s_{MAX}}$ to $T_p$ )           | 3°C/s max        |
| <b>Preheat</b>  |                  |
| • Temperature min ( $T_{s_{MIN}}$ )                       | 150°C            |
| • Temperature max ( $T_{s_{MAX}}$ )                       | 200°C            |
| • Time ( $t_{s_{MIN}}$ to $t_{s_{MAX}}$ )                 | 60-180 s         |
| <b>Time maintained above:</b>                             |                  |
| • Temperature ( $T_L$ )                                   | 217°C            |
| • Time ( $t_L$ )  | 60-150 s         |
| <b>Peak/Classification temperature (<math>T_p</math>)</b> | 260°C            |
| <b>Time within 5°C of actual peak temperature</b>         |                  |
| Time ( $t_p$ )  | 20-40 s          |
| <b>Ramp down rate</b>                                     | 6°C/s max        |
| <b>Time 25°C to peak temperature</b>                      | 8min max         |



**Note:** All temperatures refer to topside of the package, measured on the package body surface.

### Solder Reflow

- Recommended reflow method: IR, vapor phase oven, hot air oven.
- Surface-mount devices are not intended to be wave soldered to the bottom side of the board.
- Recommended maximum paste thickness of 0.25mm (0.010in).
- Devices can be cleaned using standard industry methods and solvents.

### Rework

- If a device is removed from the board, it should be discarded and replaced with a new device.

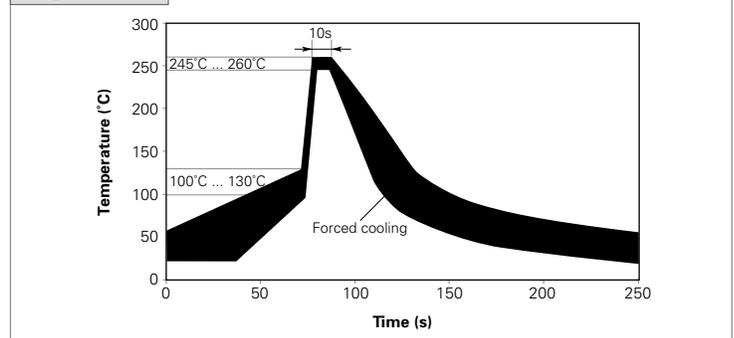
## Wave Soldering and Rework Recommendations for PolySwitch Telecommunications Radial-Leaded Devices

**Recommended Wave Soldering**

- Soldering temperature profile  
Temperature characteristic at component terminal with dual wave soldering

**Rework**

- If a device is removed from the board, it should be discarded and replaced with a new device

**Figure T21****Table T8 – TRF250/TRF600 Tape and Reel Specifications**

TRF250/TRF600 devices are available in tape and reel packaging per EIA 468-B standard. See Figures T22 and T23 for details.

| Dimension Description                  | EIA Mark        | IEC Mark       | Dimension (mm) | Tolerance  |
|--|-----------------|----------------|----------------|------------|
| Carrier Tape Width                     | W               | W              | 18             | -0.5/+1.0  |
| Hold Down Tape Width                   | W <sub>4</sub>  | W <sub>0</sub> | 5              | Min        |
| Top Distance between Tape Edges        | W <sub>6</sub>  | W <sub>2</sub> | 3              | Max        |
| Sprocket Hole Position                 | W <sub>5</sub>  | W <sub>1</sub> | 9              | -0.5/+0.75 |
| Sprocket Hole Diameter                 | D <sub>0</sub>  | D <sub>0</sub> | 4              | ±0.2       |
| Abcissa to Plane (Straight Lead)       | H               | H              | 18.5           | ±3.0       |
| Abcissa to Plane (Kinked Lead)*        | H <sub>0</sub>  | H <sub>0</sub> | 16             | -0.5/+0.6  |
| Abcissa to Top                         | H <sub>1</sub>  | H <sub>1</sub> | 32.2           | Max        |
| Overall Width with Lead Protrusion     | —               | C <sub>1</sub> | 43.2           | Max        |
| Overall Width without Lead Protrusion  | —               | C <sub>2</sub> | 42.5           | Max        |
| Lead Protrusion                        | L <sub>1</sub>  | I <sub>1</sub> | 1.0            | Max        |
| Protrusion of Cut-out                  | L               | L              | 11             | Max        |
| Protrusion beyond Hold Down Tape       | I <sub>2</sub>  | I <sub>2</sub> | Not Specified  | —          |
| Sprocket Hole Pitch                    | P <sub>0</sub>  | P <sub>0</sub> | 12.7           | ±0.3       |
| Device Pitch (TRF250 and TRF600-150)   | —               | —              | 12.7           | —          |
| Device Pitch (TRF600-160 - TRF600-400) | —               | —              | 25.4           | —          |
| Pitch Tolerance                        | —               | —              | 20 Consecutive | ±1         |
| Tape Thickness                         | t               | t              | 0.9            | Max        |
| Tape Thickness with Splice*            | t <sub>1</sub>  | —              | 2.0            | Max        |
| Splice Sprocket Hole Alignment         | —               | —              | 0              | ±0.3       |
| Body Lateral Deviation                 | Δh              | Δh             | 0              | ±1.0       |
| Body Tape Plane Deviation              | Δp              | Δp             | 0              | ±1.3       |
| Lead Spacing Plane Deviation           | ΔP <sub>1</sub> | P <sub>1</sub> | 0              | ±0.7       |
| Lead Spacing*                          | F               | F              | 5.08           | ±0.6       |
| Reel Width                             | w <sub>2</sub>  | w              | 56             | Max        |
| Reel Diameter                          | a               | d              | 370            | Max        |
| Space between Flanges Less Device      | w <sub>1</sub>  | —              | 4.75           | ±3.25      |
| Arbor Hole Diameter                    | c               | f              | 26             | ±12.0      |
| Core Diameter                          | n               | h              | 80             | Max        |
| Box                                    | —               | —              | 56/372/372     | Max        |
| Consecutive Missing Pieces*            | —               | —              | 3 Max          | —          |
| Empty Places per Reel*                 | —               | —              | Not Specified  | —          |

\* Differs from EIA specification.

Figure T22 — EIA Referenced Taped Component Dimensions for PolySwitch Telecommunications Radial-Leaded Devices

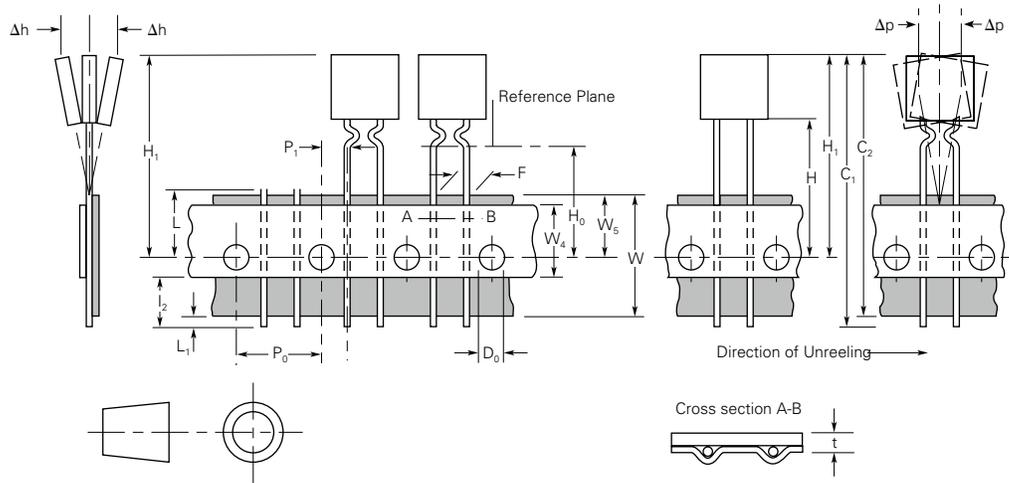


Figure T23 — Reel Dimensions for PolySwitch Telecommunications Radial-Leaded Devices

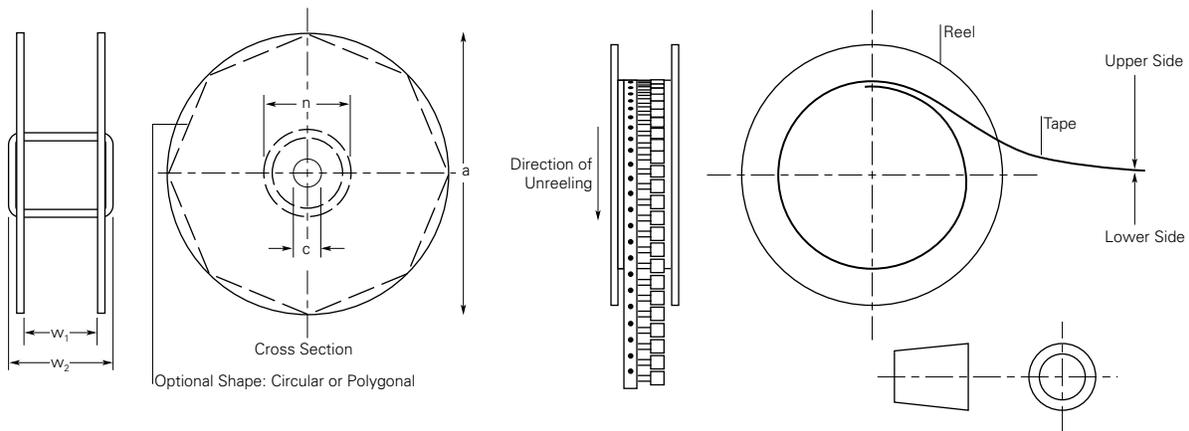


Table T9 — TS Tape and Reel Specifications

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T24 and T25 for details.

| TS250/TSL250/TSV250                             |                    |                |                |                |                |                |                |
|---|--------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Dimension Description                           | EIA Mark           | TS250          |                | TSV250         |                | TSL250         |                |
|   |                    | Dimension (mm) | Tolerance (mm) | Dimension (mm) | Tolerance (mm) | Dimension (mm) | Tolerance (mm) |
| Carrier Tape Width                              | W                  | 16             | ±0.30          | 16.0           | ±0.30          | 16             | ±0.30          |
| Sprocket Hole Pitch                             | P <sub>0</sub>     | 4.0            | ±0.10          | 4.0            | ±0.10          | 4.0            | ±0.10          |
|   | P <sub>1</sub>     | 12.0           | ±0.10          | 8.0            | ±0.10          | 8.0            | ±0.10          |
|   | P <sub>2</sub>     | 2.0            | ±0.10          | 2.0            | ±0.10          | 2.0            | ±0.10          |
|   | A <sub>0</sub>     | 6.9            | ±0.23          | 5.5            | ±0.10          | 5.5            | ±0.10          |
|   | B <sub>0</sub>     | 9.6            | ±0.15          | 6.2            | ±0.10          | 7.9            | ±0.10          |
|   | B <sub>1</sub> max | 12.1           | —              | 8.0            | —              | 9.2            | —              |
| Sprocket Hole Diameter                          | D <sub>0</sub>     | 1.5            | -0/+0.1        | 1.55           | ±0.05          | 1.55           | ±0.05          |
|   | F                  | 7.5            | ±0.10          | 7.5            | ±0.10          | 7.5            | ±0.10          |
|   | E <sub>1</sub>     | 1.75           | ±0.10          | 1.75           | ±0.10          | 1.75           | ±0.10          |
|   | E <sub>2</sub> min | 14.25          | —              | —              | —              | —              | —              |
| Tape Thickness                                  | T max              | 0.4            | —              | 0.45           | —              | 0.35           | —              |
| Tape Thickness With Splice Cover Tape Thickness | T <sub>1</sub> max | 0.1            | —              | 0.1            | —              | 0.1            | —              |
|   | K <sub>0</sub>     | 3.4            | ±0.15          | 7.0            | ±0.10          | 3.70           | ±0.10          |
|   | Leader min         | 300            | —              | 390            | —              | 390            | —              |
|   | Trailer min        | 300            | —              | 160            | —              | 160            | —              |
| <b>Reel Dimensions</b>                          |                    |                |                |                |                |                |                |
| Reel Diameter                                   | A max              | 340            | —              | 340            | —              | 340            | —              |
| Core Diameter                                   | N min              | 50             | —              | 50             | —              | 50             | —              |
| Space between Flanges-less Device               | W <sub>1</sub>     | 16.4           | -0/+2.0        | 16.4           | -0/+2.0        | 16.4           | -0/+2.0        |
| Reel Width                                      | W <sub>2</sub> max | 22.4           | —              | 22.4           | —              | 22.4           | —              |

| TS600                             |                    |                |                |
|-----------------------------------|--------------------|----------------|----------------|
| Dimension Description             | EIA Mark           | Dimension (mm) | Tolerance (mm) |
| Carrier Tape Width                | W                  | 32             | ±0.3           |
| Sprocket Hole Pitch               | P <sub>0</sub>     | 4.0            | ±0.1           |
|                                   | P <sub>1</sub>     | 16             | ±0.1           |
|                                   | P <sub>2</sub>     | 2.0            | ±0.1           |
|                                   | A <sub>0</sub>     | 10             | ±0.1           |
|                                   | B <sub>0</sub>     | 19.2           | ±0.1           |
|                                   | B <sub>1</sub> max | 21.6           |                |
| Sprocket Hole Diameter            | D <sub>0</sub>     | 1.5            | -0/+1.0        |
|                                   | F                  | 14.2           | ±0.1           |
|                                   | E <sub>1</sub>     | 1.75           | ±0.1           |
|                                   | E <sub>2</sub> min | 28.4           | ±0.1           |
| Tape Thickness                    | T max              | 0.50           | ±0.5           |
| Tape Thickness with Splice        | T <sub>1</sub> max | 0.1            |                |
|                                   | K <sub>0</sub>     | 13.2           | ±0.1           |
|                                   | Leader min         | 390            |                |
|                                   | Trailer min        | 160            |                |
| <b>Reel Dimensions</b>            |                    |                |                |
| Reel Diameter                     | A max              | 360            |                |
| Core Diameter                     | N min              | 50             |                |
| Space between Flanges-less Device | W <sub>1</sub>     | 32.4           | -0/+2.0        |
| Reel Width                        | W <sub>2</sub> max | 40             |                |

Table T9 — TS Tape and Reel Specifications

(Cont'd)

TS devices are packaged per EIA 481 and EIA 481-2 standards. See Figures T24 and T25 for details.

| TSM600                            |             |                |                |
|-----------------------------------|-------------|----------------|----------------|
| Dimension Description             | EIA Mark    | Dimension (mm) | Tolerance (mm) |
| Carrier Tape Width                | W           | 32             | ±0.3           |
| Sprocket Hole Pitch               | $P_0$       | 4.0            | ±0.1           |
|                                   | $P_1$       | 24             | ±0.1           |
|                                   | $P_2$       | 2.0            | ±0.1           |
|                                   | $A_0$       | 11.2           | ±0.1           |
|                                   | $B_0$       | 17.8           | ±0.1           |
|                                   | $B_1$ max   | 23.45          |                |
| Sprocket Hole Diameter            | D           | 1.5            | -0/+1.0        |
|                                   | F           | 14.2           | ±0.1           |
|                                   | $E_1$       | 1.74           | ±0.1           |
|                                   | $E_2$ max   | 28.4           | ±0.1           |
| Tape Thickness                    | T max       | 0.5            | ±0.5           |
| Tape Thickness with Splice        | $T_1$ max   | 0.1            |                |
|                                   | $K_0$       | 11.9           | ±0.1           |
|                                   | Leader min  | 390            |                |
|                                   | Trailer min | 160            |                |
| Reel Dimensions                   |             |                |                |
| Reel Diameter                     | A max       | 360            |                |
| Core Diameter                     | N min       | 50             |                |
| Space between Flanges-less Device | $W_1$       | 32.4           | -0/+2.0        |
| Reel Width                        | $W_2$ max   | 40             |                |

Figure T24 — EIA Referenced Taped Component Dimensions for PolySwitch Telecommunications and Networking Devices

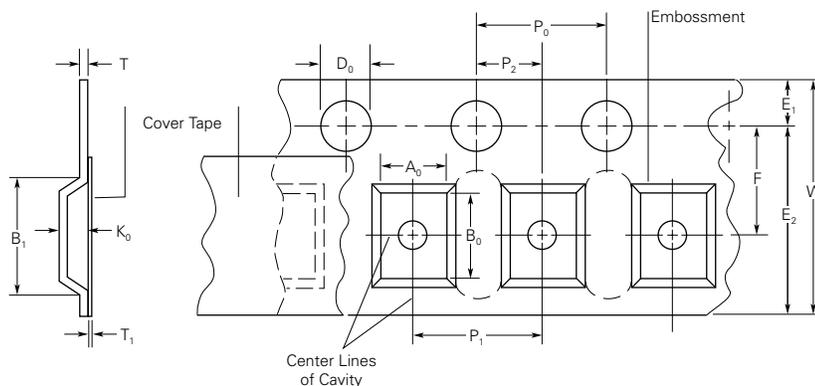
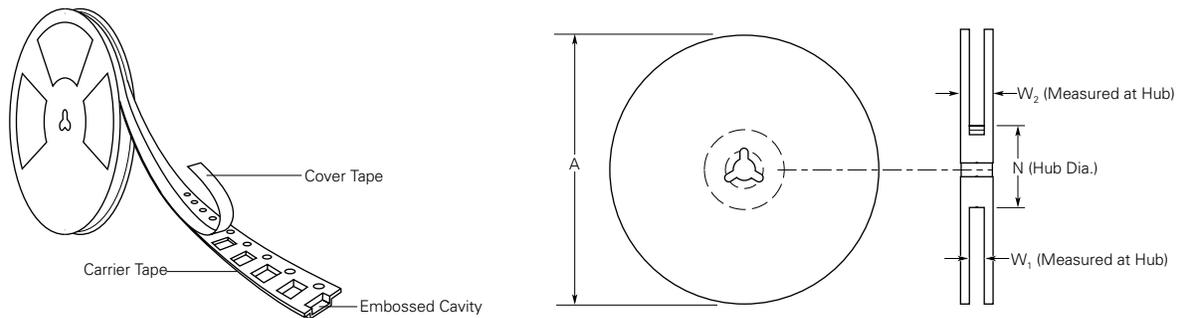


Figure T25 — EIA Referenced Reel Dimensions for PolySwitch Telecommunications and Networking Devices



## PolySwitch Telecommunications and Networking Resistance-Sorted and Resistance-Matched Devices

Most TCF, TRF and TS devices are available in resistance-sorted and/or resistance-matched versions.

### Resistance-sorted Devices

Resistance-sorted devices (part number suffix "Rx"; where x = 1, 2, A, B, C, F, etc.) are supplied with resistance values that are within specified segments of the device's full range of resistance.

#### Feature

- Narrow resistance range.

#### Benefits

- Can help provide greater flexibility for design engineers.
- Lower resistance devices can help provide increased loop length on line card designs.
- Higher resistance devices may help provide greater protection by offering faster time-to-trip.

### Resistance-matched Devices

Resistance-matched devices are supplied such that all parts in one particular package (or reel) are within  $0.5\Omega$  of each other ( $1.0\Omega$  for TRF250-080T devices). Individual matched packages are supplied from the full resistance range of the specified device.

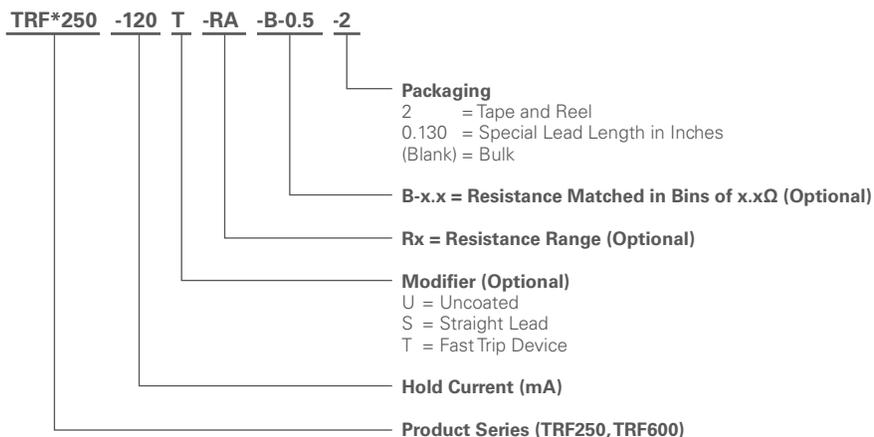
#### Feature

- Tighter resistance balance between any two parts in a package.

#### Benefits

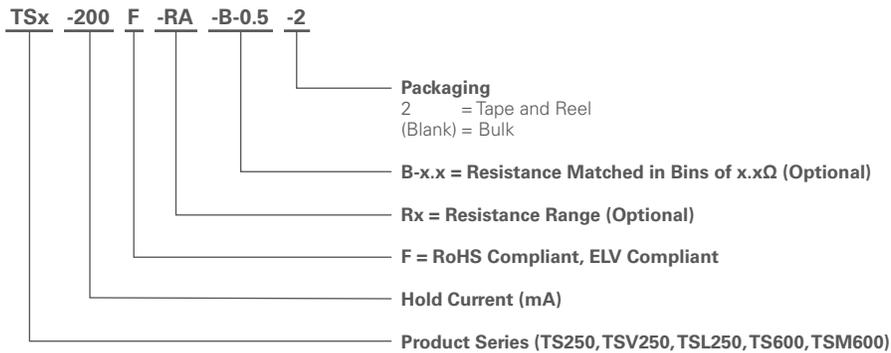
- Resistance-matched devices may help reduce the tip-ring resistance differential, reducing the possibility of line imbalance.

## Part Numbering System for PolySwitch Radial-Leaded Telecommunications and Networking Devices

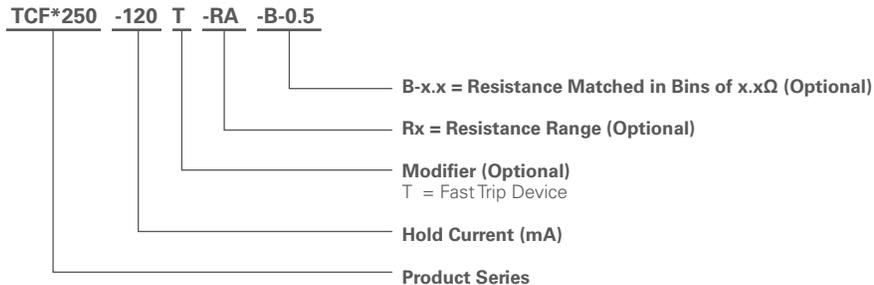


\* F = RoHS compliant, ELV compliant

## Part Numbering System for PolySwitch Surface-mount Telecommunications and Networking Devices



## Part Numbering System for Chip PolySwitch Telecommunications and Networking Devices



\* F = RoHS compliant, ELV compliant

**Warning :**

- Users should independently evaluate the suitability of and test each product selected for their own application.
- Operation beyond the maximum ratings or improper use may result in device damage and possible electrical arcing and flame.
- These devices are intended for protection against damage caused by occasional overcurrent or overtemperature fault conditions and should not be used when repeated fault conditions or prolonged trip events are anticipated.
- Contamination of the PPTC material with certain silicone-based oils or some aggressive solvents can adversely impact the performance of the devices.
- Device performance can be impacted negatively if devices are handled in a manner inconsistent with recommended electronic, thermal and mechanical procedures for electronic components.
- PPTC devices are not recommended for installation in applications where the device is constrained such that its PTC properties are inhibited, for example in rigid potting materials or in rigid housings, which lack adequate clearance to accommodate device expansion.
- Operation in circuits with a large inductance can generate a circuit voltage ( $Ldi/dt$ ) above the rated voltage of the device.



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