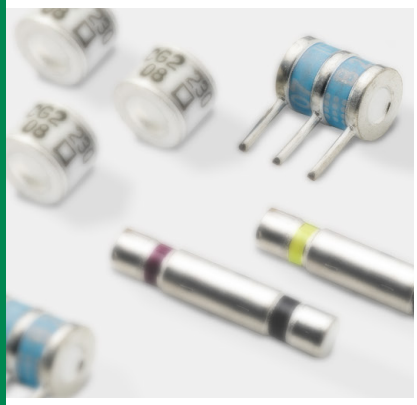
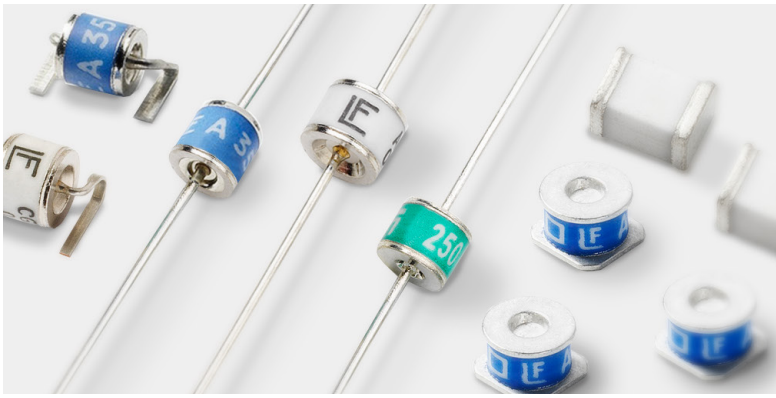
Littelfuse®

Expertise Applied | Answers Delivered



PRODUCT CATALOG & DESIGN GUIDE



GDT

Gas Discharge Tube (GDT) Products

TABLE OF CONTENTS

Series Name[1]		DC Breakover Voltage Range (Nom V_{BO})	Max AC Surge Rating	Peak Pulse Current (8x20µs)	Max Capacitance	Operating Temperature Range	# Terminals	Mounting Options: Mini Tube	Surface	Axial Lead	Radial Lead	Cartridge Clip	RoHS Compliant	Lead Free
High Voltage GDTs														
AC		285 - 600	NA	5000A	1.5pF	-40°C to +90°C	2			•			•	
CG3		1000 - 7500		5000A	1.5pF		2			•			•	
Low to Medium Surge GDTs														
CG5		90 - 600	5A	5000A	1.5pF	-40°C to +90°C	2	•	•	•			•	
SL0902A		90 - 600	5A	5000A	1.5pF		2	•	•				•	•
SL1002A		75 - 600	5A	5000A	1.2pF		2	•	•				•	•
SL1003A		90 - 500	10A*	10,000A	1.5pF		3	•	•		•		•	•
SL1010A		75 to 470		5000A	1.5pF		3		•				•	•
SL1011A		75 - 600	5A	5000A	1.5pF		2		•	•			•	•
Medium to High Surge GDTs														
SL1122A		90 - 260	10A*	10000A*	100-270pF	-40°C to +90°C	3				•		•	
SL1021A		75 - 600	10A*	20000A*	1.5pF		3		•		•		•	•
SL1411A		75 - 600	10A	10000A	1.5pF		2		•	•			•	•
CG/CG2		75 - 1000	20A	20000A	1.5pF		2	•	•	•			•	
Very High Surge GDTs														
SL1021B		75 - 600	10A*	20000A*	1.5pF	-40°C to +90°C	3		•		•		•	•
SL1026		275 - 700	10A*	40000A*			3					•	•	•
Squared GDTs														
SE		140 to 500		0.5KA	0.5pF	-40°C to +90°C	2						•	•
SG		75 to 600		1KA / 2KA	1pF		2						•	•

(1) Please refer to product data in our datasheets for detailed information by part number.
* Total current through center (ground) terminal

GDT Characteristics, Terms and Consideration Factors

Surge Arresters

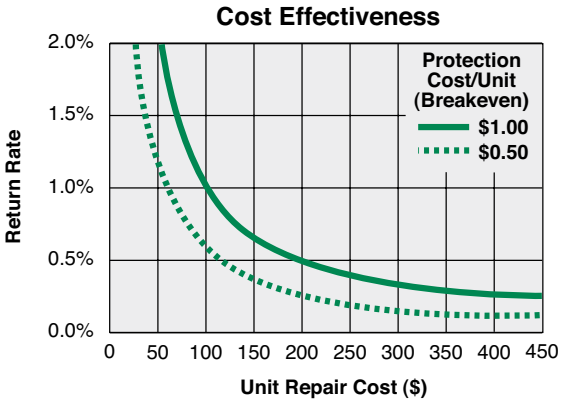
Littelfuse gas discharge tube (GDT) surge arrester devices protect personnel and electrical equipment from damaging high voltage transients induced by lightning, inductive switching, or electrostatic discharge. Depending upon the application, Littelfuse offers a variety of two and three electrode GDTs for protecting telecommunication, test, computer, power supply, medical, and cable television equipment. Along with protecting circuits, GDTs can also be used as switches to create a discharge voltage in circuits used for medical, gas ignition, and HID lighting applications.

Why Use Surge Protection?

Surge protectors protect personnel and equipment from damaging high-voltage surges from lightning, inductive switching, nuclear electromagnetic pulse, electrostatic discharge, or interference from power supply lines. From a design point of view, protection circuits only cost money and, if customer requirements or regulatory agencies do not require them, they will easily be forgotten. Yet, appropriate surge protection is beneficial. Protected equipment will not be affected by the highvoltage surges listed above. This will result in:

- Reduced field failures
- Improved product quality and reliability
- Reduced cost of quality

The figure below illustrates the cost effectiveness of adding surge protection by demonstrating the unit repair cost to break even over a range of return rates for added protection costs of $0.50/unit and $1.00/unit.



Through ongoing research and engineering improvements, Littelfuse has developed a family of Surge Protection Products that offer impressive characteristics for a variety of applications. Four differentiating characteristics are found in every Littelfuse Surge Protection Product:

- High surge current rating
- Long life
- Fast response
- Rugged construction

A Comparison of Surge Arrester Technologies

In today's world of sensitive electronics, an increasingly important topic has become the protection of electronic components from overvoltage surges. There is a multitude of devices on the market for this purpose but what are the differences between them and which is best for what application? The following describes, analyzes, and compares these devices in detail.

Basically there are two types of surge protection classifications with each consisting of its own group of devices:

CROWBAR
- Air Gap
- Carbon Block
- Gas Discharge Tube (GDT)
- Silicon Controlled Rectifier (SCR)

CLAMP
- Zener (Avalanche) Diode
- Metal Oxide Varistor (MOV)

CROWBAR PROTECTION: A crowbar device limits the energy delivered to the protected circuit by abruptly changing from a high impedance state to a low impedance state in response to an elevated voltage level. Having been subjected to a sufficient voltage level the crowbar begins to conduct. While conducting, the voltage across the crowbar remains quite low (typically less than 15 volts for gas discharge tubes usually higher for the air gap and carbon block protectors) and thus, the majority of the transient's power is dissipated in the circuit's resistive elements and not in the protected circuit nor the crowbar itself. This allows the crowbar to be able to withstand and protect loads from higher voltage and/or higher current levels for a greater duration of time than clamping devices.

AIR GAP PROTECTOR: An air gap protector consists of two conductive surfaces with a spacing between them that will permit an arc when a specified potential is placed across the surfaces. The air gap is not a sealed device and therefore it must operate at atmospheric pressure and under the effects of the environment. Since the electrodes are exposed to the environment, they will often experience oxidation and corrosion which is not a problem common to a gas tube such as Littelfuse's GDT. These factors contribute to the air gap's high nominal breakdown voltage, wide breakdown voltage tolerance, and poor impulse response. Often an air gap is placed in parallel with a gas discharge tube or carbon block protector to provide back up protection in the event that the primary protection fails.

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GDT Characteristics, Terms and Consideration Factors (continued)

CARBON BLOCK PROTECTOR: A carbon block protector consists of a pair of carbon elements separated by a 0.003-0.004 inch air gap. When a specified potential is placed across the carbon surfaces an arc will be initiated. Like the air gap protector, the carbon block is an unsealed device and its performance suffers in the same manner as the air gap. Carbon block protectors are used mainly for telephone line protection but are being replaced, in most installations, with the more reliable and consistent gas discharge tubes.

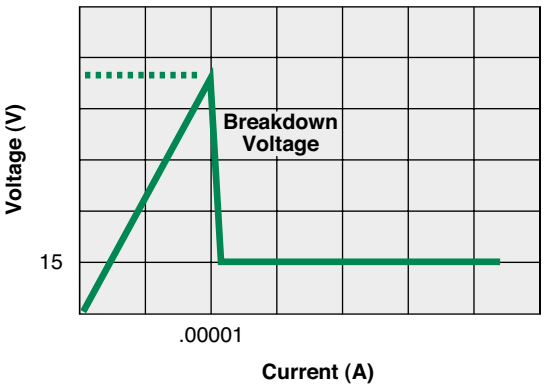
GDT GAS DISCHARGE TUBE:

Littelfuse's GDT, a hermetically sealed gas filled ceramic tube with metal electrodes, is recognized for:

- Stable electrical parameters
- High insulation resistance
- Low capacitance
- High current capability
- Low leakage current
- Low arc voltages

For a gas tube to begin conduction, an electron within the sealed device must gain sufficient energy to initiate the ionization of the gas. Complete ionization of the gas takes place through electron collision. The events leading up to this phenomenon occur when a gas tube is subjected to a rising voltage potential. Once the gas is ionized, breakdown occurs and the gas tube changes from a high impedance state to a virtual short circuit and thus, any transient will be diverted from and will not reach the protected circuit. The arc voltage (the voltage across the gas tube while the gas tube is conducting) will typically be 15 volts. After the transient has passed, the GDT will extinguish and again appear as an open circuit. In order to insure gas tube turn off at the zero crossing in AC applications, the current through the GDT once the transient has passed, must be less than the follow-on current rating of the gas tube. The follow-on current requirement can easily be met by placing a resistor in series with the gas tube. Littelfuse's AC series gas discharge tube surge arresters were developed specifically to protect AC power lines and normally will not require additional components to limit follow-on current. In DC applications, the gas discharge tube will extinguish as long as the device is operated within the specified holdover conditions. Holdover conditions involve the maximum bias voltage that can appear across a gas discharge tube under specified current conditions and still allow the gas discharge tube to turn off. Under normal operating conditions, the GDT shunted across a circuit, will act like an open switch with a high insulation resistance.

Comgap Gas Discharge Tube
Voltage vs. Current Characteristics



The GDT's breakdown voltage is determined by electrode spacing, gas type (usually neon and/or argon), gas pressure (less than atmospheric), and the rate of rise of the transient. Breakdown voltage is defined as that voltage at which a crowbar type of surge arrester changes from a high impedance state to a low impedance state. The GDT series is categorized by the breakdown voltage of each gas tube when a slowly rising transient is applied. For example: Littelfuse's CG2-230L gas tube will breakdown at 230V (+/- 15% to 20%) when subjected to a ramp with a rate of rise of 100V/second. The breakdown voltage response of a crowbar to transients with ramp rates of 1V/microsecond or less is referred to as the DC breakdown voltage level. Due to the nature of gas discharge tubes, the same gas tube will experience breakdown at a higher voltage as a transient's ramp rate increases. For example: At 100V/microsecond, the CG2-230L gas tube will breakdown at 600V maximum. The breakdown voltage response of a crowbar to transients with ramp rates greater than 1V/microsecond is referred to as the impulse breakdown voltage level.

Due to the GDT's rugged construction, it can handle currents that far surpass other transient suppressors' capabilities - greater than 10 pulses of a 20,000 peak amperes pulse having a rise time of 8 microseconds decaying to half value in 20 microseconds (also referred to as an 8/20 wave form). The surge life of the GDT is at least 1000 shots of a 500 amperes peak 10/1000 pulse. GDT is the practical device for the protection of telephone circuits, AC power lines, modems, power supplies, CATV and almost any application where protection from large and/or unpredictable transients is desired.

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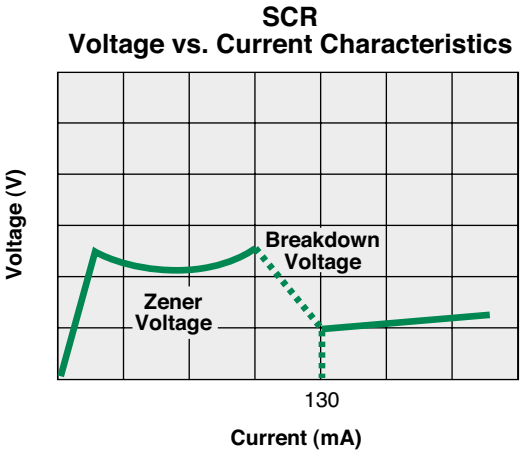
GDT Characteristics, Terms and Consideration Factors (continued)

SILICON CONTROLLED RECTIFIER (SCR): Unlike the crowbar devices discussed above, the SCR is a semiconductor. Like the GDT, the SCR will have a very low voltage drop across it while conducting. The SCR does require a trigger signal when a surge is present before it can begin to conduct. This trigger signal is usually supplied through the use of a zener diode. Packages that combine the SCR and zener diode are now available. These packages are monolithic devices and often contain an SCR-type thyristor with a gate region that acts like the avalanche diode. Once triggered, the SCR begins to conduct, dropping the voltage across the zener diode to a value below the zener's operating voltage and thus causing the zener to stop conducting. The SCR will conduct until the applied voltage drops to zero (zero crossing of AC) or until the current falls below a specified value (sometimes referred to as a holding current).



Although typically having a faster response time than a GDT, the SCR package is subject to higher leakage current and capacitance. The SCR package can handle currents of several hundred amperes of an 8/20 wave form and packages are available that offer bi-directional protection.

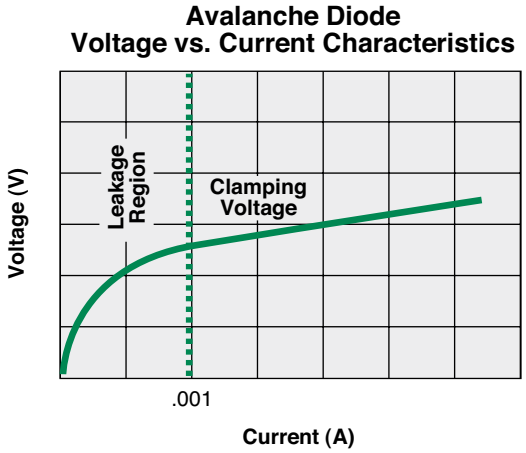
CLAMPING PROTECTION: A clamping device actually limits the voltage transient to a specified level by varying its internal resistance in response to the applied voltage. A clamping device must absorb the transient's energy and therefore, cannot withstand very high current levels. Although these devices have quick response times, they are subject to leakage currents and their capacitance values are higher than those found in the GDT.

ZENER (AVALANCHE) DIODE: The zener diode comes closest to modeling the ideal constant voltage clamp. It responds quickly to a fast rising voltage potential and is available for a fairly wide range of clamping voltages (from less than 10 volts up

to several hundred volts). The zener is placed in parallel with the circuit to be protected and will not operate until a surge exceeds the zener's breakdown voltage. The surge, causing the zener to conduct will be clamped to the zener's rated voltage. The zener is a good protector for circuits operating at low voltages. Caution is advised when designing the device into RF circuits due to the diode's high capacitance.

Also available are silcon avalanche suppressers which are referred to as transient voltage suppressers (TVS) diodes. These diodes consist of fairly large junction zeners which have been designed specifically for surge protection. The TVS diodes are rated for higher current surges than zener diodes and they can carry these currents for periods of 2-10 microseconds.

For use in AC signal lines, two zeners are required. These are available as packaged devices. Avalanche diodes are often used to protect IC's from static discharge and other forms of transients in power supplies computer buses, and data lines.



MOV (METAL OXIDE VARISTOR): As its name suggests, the MOV is a voltage variable resistor made from sintered metal oxides. The grains produced in the sintered metal oxide material of the MOV can be thought of as a network of series and parallel diodes. As the voltage potential across the MOV increases, some of the diodes experience avalanche breakdown and begin to conduct and as a result, reduce the net resistance of the MOV.

The MOV can handle current pulses of higher peak values and for a longer duration than a diode, but the MOV can experience cumulative degradation and performance changes after it is exposed to large current pulses when not properly selected. The high peak current surges tend to fuse the oxide grains and thus alter the MOV's performance. Some engineers recommend that a fuse be used with an MOV as a large current surge could damage the grain structure, fuse the grains together and result in the protected circuit being shorted out.

The MOV is available in a wide range of voltages and experiences a quick turn on time when subjected to a fast rising surge. The MOV is subject to leakage current and high capacitance (10's to 1000's of picofarads). When designing with a MOV it is necessary to remember that as the current

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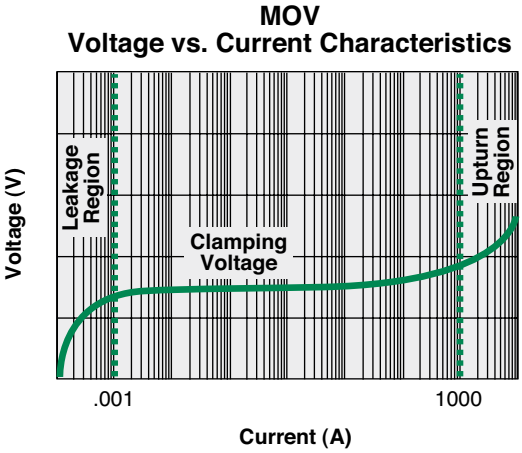
GDT Characteristics, Terms and Consideration Factors (continued)

through the device increases, the voltage which the MOV clamps at is greatly increased.



GDT and MOV PROTECTION: In summary, there is no one ideal surge arrester device type that meets all of the key performance parameters for every application. Due to their complementary performance characteristics, however, a GDT and MOV can be combined in a circuit to provide the ultimate in surge suppression performance. The MOV quickly clamps a fast rising voltage surge while the GDT crowbars to safely dissipate the large peak current to ground. (See Application Note entitled "Surge Protection of AC Power Lines".)

SUMMARIZED COMPARISON OF TECHNOLOGIES

	GAS TUBE CG2-230L	SCR	MOV	DIODE
Type of Device	CROWBAR	CROWBAR	CLAMP	CLAMP
Response Speed	<1 uSEC.	<100nSEC.	<100nSEC.	<100nSEC.
Capacitance	1pF MAX.	50pF	45pF	50pF
Leakage Current	<1 pAMP	50 nAMPS	10,000 nAMPS	10,000 nAMPS
Maximum Surge Current (8/20 µsec wave form)	20,000 AMPS	500 AMPS	200 AMPS	50 AMPS
Relative Cost	$1.00	$1.50	$0.50	$1.50

The CLARE product engineering department provides objective technical expertise and application assistance to designer's of switching surge protection systems. Our mission is to assist you in designing the best solution to your specific application problem, regardless manufacturer. To access our team of engineering professionals call toll free 1-800 CPCLARE.

CONSTRUCTION: Gas Discharge Tube (GDT) surge arresters commonly employ hermetically-sealed enclosures utilizing either ceramic-to-metal or glass-to-metal seals. The many advantages of ceramic-to-metal units have made them the norm for gas discharge tube surge arresters such as Littelfuse's GDTs. Along with being low cost, they offer high product uniformity capable of handling extreme levels of shock, vibration, and temperature.

The ceramic for GDTs is alumina ranging from 94- 98% Al2O3. The ceramic-to-metal seals are prepared by moly-manganese or tungsten metallizing processes with nickel plating and the final seal is made in a gasfilled vacuum furnace using braze preforms made of copper-silver eutectic. The electrodes used for GDTs are either copper or a nickel-iron alloy, often with a coating to lower the work function and/or add gettering capability. Stripes or bands of semi-conductive material are applied to the inner surfaces of the ceramic to improve stability and high-speed response.

In contrast, most devices in Littelfuse's High Energy Devices product line are glass-to-metal units. This allows greater flexibility in configuration and is ideal for the production of standard and custom parts in more limited quantities. The electrodes of High Energy Devices are usually made of refractory metals such as tungsten or molybdenum to meet more extreme life and surge capacity requirements.

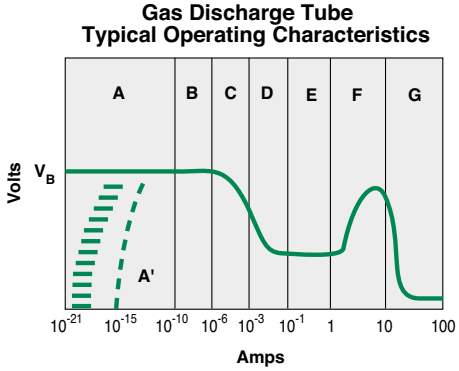


Figure 1. A generic V-I characteristic of a plasma device.

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GDT Characteristics, Terms and Consideration Factors (continued)

THEORY

The basic operation of gas tube surge arrestors such as Littelfuse's GDTs is best understood by referring to the schematic form of the voltage-current (V-i) relationship of a generic gas discharge device such as the one depicted in Figure 1.

A For voltages below the breakdown voltage, the gas provides a good insulator. Very low leakage currents (10-12A) occasionally encountered result from ionization by cosmic rays, high energy photons, etc; and is, therefore, subject to statistical fluctuations. A1 The current is higher due to supplementary electron sources such as photoemission.

B The discharge is self-sustaining due to gas ionization –if external agents such as those mentioned for regions A and A1 are removed, the current will not change (Townsend discharge). This occurs at the breakdown voltage of the device.

C The transition region. As the electric field increases, more secondary electrons are generated,decreasing the voltage drop until the glow voltage (region D) is reached. Stable operation can only be maintained with active current regulation because of the negative slope of the V-i characteristic.

D The glow region (or normal glow region). In this region, the glow voltage is roughly constant with respect to small changes in current.

E The abnormal glow region. In contrast to the normal glow region, the glow voltage begins to increase as the current is increased.

F The glow-to-arc transition region.

G The arc region. In this region, the arc voltage will quickly drop and the arc current will quickly increase within the limitations of the drive energy and impedance.

If the current through the gas discharge device is adjusted over the range of values of 10-18 to 102 amps, the voltage across the device will also vary. When a gas discharge device is operated as a transient voltage protector, the modes of operation of greatest significance are in regions A, F, and G. The applied voltage is normally less than the breakdown voltage of the device, VBD, at which time the current through the device is in the A region. The charged carriers of electric current in this mode originate from the cathode by photon emission and within the fill gas by collisions of gas particles with cosmic rays (or radioactive decay particles if an isotope is used in the device).

As soon as the applied voltage across the device exceeds the breakdown voltage, the current through the device increases rapidly to values of several amps or greater. The rate of current rise and the level reached is limited by the source capacity and the series impedance of the circuit. The voltage across the device at this time is very low with typical values of 20V or less.

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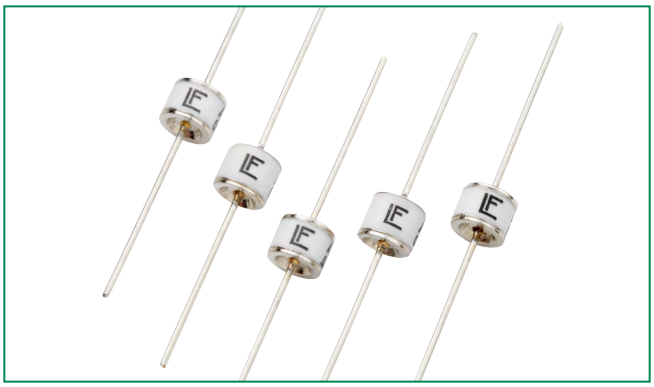
AC and CG3 Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E320116*

*NOTE: CG3 7.5 product UL approval is currently pending

2 Electrode GDT Graphical Symbol

Additional Information

Datasheet AC Series

Resources AC Series

Samples AC Series

Datasheet CG3 Series

Resources CG3 Series

Samples CG3 Series

Description

Littelfuse AC series two-electrode line protectors provide a high degree of surge protection in AC line applications. The two models, AC120 and AC240 are designed for use with 120VAC and 240VAC lines respectively. They are able to extinguish AC follow-on currents of at least 200A.

Littelfuse CG3 two electrode high voltage (1.0 - 7.5 KV) devices are designed for surge protection and high isolation applications, and for applications for which bias voltages or signal levels of several hundred volts are normally present.

Features

- Rugged ceramic-metal construction
- Low capacitance (<1.5 pF)
- Available in tape-and-reel packaging
- Available with or without leads

Applications

AC Series:

- Long branch circuits (AC wall outlet)
- Short branch circuits (at breaker box, computer, etc)
- Power supplies
- Test equipment
- Submersible pumps
- Medical electronics

CG3 Series:

- CRT terminals
- CATV equipment
- Antennas
- Power supplies
- Medical electronics

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Electrical Characteristics

Part Number	Device Dimension Type	Device Specifications (at 25°C)								Life Ratings				
		DC Breakdown in Volts (@100V/s)			Impulse Breakdown in Volts (@100V/µs)	Impulse Breakdown In Volts (@1 Kv/µsec)	Insulation Resistance	Capacitance (@1MHz)	Arc Voltage (on state Voltage) @1Amp Min	Max Follow On Current[3]	Nominal AC Discharge Current (10x1sec @50-60Hz)	AC Discharge Current (1 x 50Hz 9 cycles)	Nominal Impulse Discharge Current[4] (@8/20µs)	Max Surge Current[5] (@8/20µs)
		MIN	TYP	MAX	MAX		MIN	MAX	TYP					
AC120[1]	A	230	285	340	500	550	10 GΩ (at 100V)	<1.5 pf	~ 25 V	200 Amps	5 A	65 A	10 shots 5kA	1 shot 10kA
AC240[1]	A	480	600	720	1100	1200								
CG3 1.0[1]	A	800	1000	1200	1400	1500	10 GΩ (at 100V)	<1.5 pf	~ 25 V	200 Amps	N/A	N/A	10 shots 5kA	1 shot 10kA
CG3 1.1[1]	A	880	1100	1320	1600	1700								
CG3 1.2[1]	A	960	1200	1440	1700	1800								
CG3 1.3[1]	A	1040	1300	1560	1800	1900								
CG3 1.5[1]	A	1200	1500	1800	1800	2000								
CG3 2.0[1]	A	1600	2000	2400	2500	2750								
CG3 2.5[1]	A	2000	2500	3000	3200	3500								
CG3 2.7[1]	A	2160	2700	3240	3600	4000								
CG3 3.0[1]	A	2400	3000	3600	4000	4200								
CG3 3.3[1]	A	2640	3300	3960	4600	4700								
CG3 4.0[2]	B	3200	4000	4800	5800	6000								
CG3 4.5[2]	B	3600	4500	5400	6150	6500								
CG3 5.0[2]	B	4000	5000	6000	7500	8000								
CG3 6.2[2,7]	B	4960	6200	7440	8100	9500								
CG3 6.5[2,7]	B	5200	6500	7800	9500	10000								
CG3 7.5[2,6,7]	B	6000	7500	9000	10000	10600								

NOTES:
1. Refer to Production Dimensions section, outline A devices
2. Refer to Production Dimensions section, outline B devices
3. Tested to UL1449 – 120V r.ms. for AC120, 230V r.m.s. all others.
   Conducted with suitable MOV connected in series.
4. 10 x [5(+) and 5(-)] applications 5kA @ 8/20µs
5. 1 x [1(+) and 1(-)] application 10kA @ 8/20µs
6. CG3 7.5 product UL approval is currently pending
7. When ordering this item, use suffix code D004 when entering the part number.
   The older product version without D004 suffix code has been discontinued.
   Refer to Part Numbering System section for additional information.

Product Characteristics

Materials	**Core Outline A & B items:** Device: Tin Plated 17.5±12.5 Microns **Axial Outline A & B items:** Device & Wire: Tin Plated 17.5±12.5 Microns
Product Marking	LF Logo, Voltage and date code; Black ink positive print
Glow to arc transition current	< 0.5Amps
Glow Voltage	~ 140 Volts
Storage and Operational Temperature	-40 to +90

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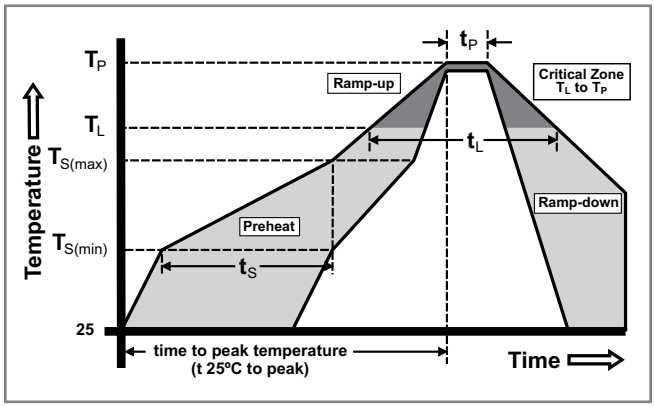
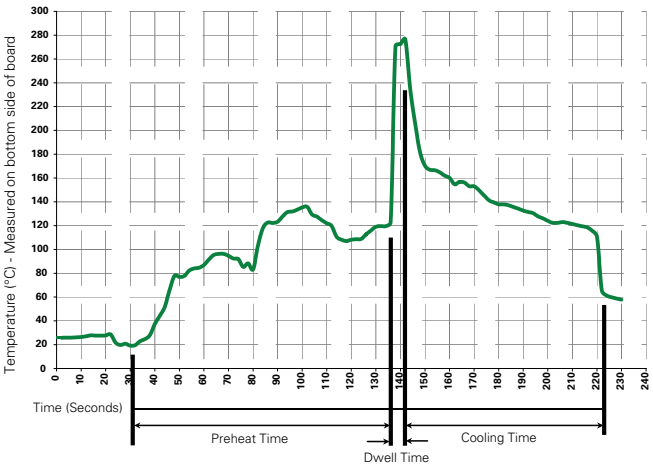
Soldering Parameters - Reflow Soldering (Surface Mount Devices)

Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C



Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

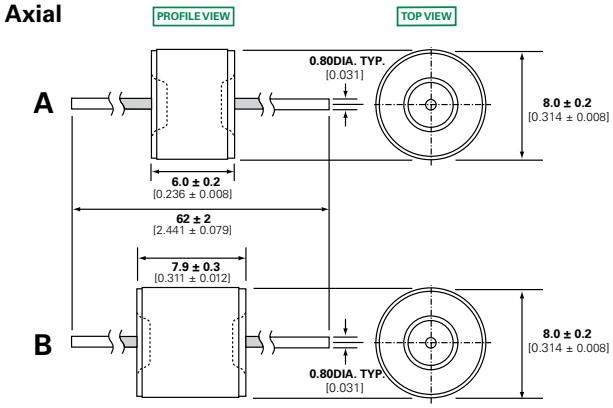
Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

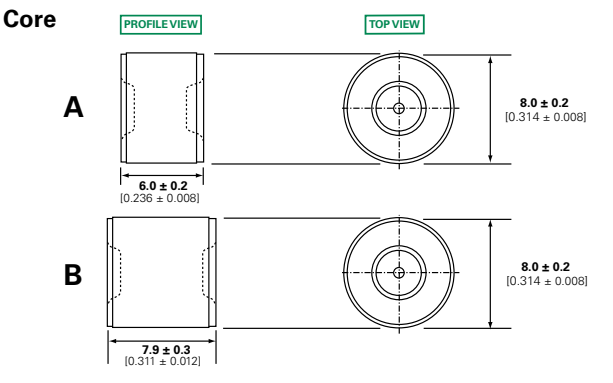
Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Revised: 11/06/15

Device Dimensions





Part Numbering System and Ordering Information

AC XXX XXX

Series

AC Line Voltage
- **120** = 120V
- **240** = 240V

Lead / Packaging Option
- = Core (no leads) / Bulk pack, 400 pcs per bag
- **L** = Leaded / Bulk pack, 50 pcs per tray
- **LTR** = Leaded / Tape & Reel, 500 pcs per reel

CG3 X.X XXX D004

Series
- **CG3**

Breakdown Voltage
- **1.0** = 1000V
- **1.1** = 1100V
- **1.2** = 1200V
- **1.3** = 1300V
- **1.5** = 1500V
- **2.0** = 2000V
- **2.5** = 2500V
- **2.7** = 2700V
- **3.0** = 3000V
- **3.3** = 3300V
- **4.0** = 4000V
- **4.5** = 4500V
- **5.0** = 5000V
- **6.2** = 6200V
- **6.5** = 6500V
- **7.5** = 7500V

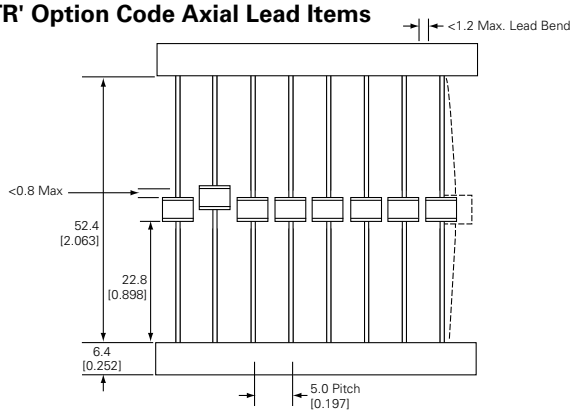
Lead / Packaging Option
- = Core (no leads) / Bulk pack, 400 pcs per bag
- **L** = Leaded / Bulk pack, 50 pcs per tray
- **LTR** = Leaded / Tape & Reel, 500 pcs per reel

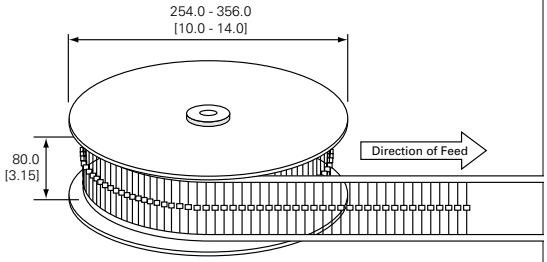
Special Suffix Code

Enter this D004 special suffix code when placing orders for CG36.2, CG36.5 and CG37.5 only

Packaging Dimensions

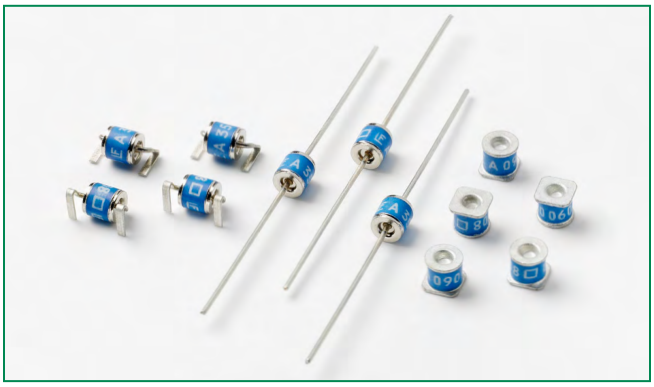
For 'LTR' Option Code Axial Lead Items





Revised: 11/06/15

CG5 and SL0902A Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
UL	E128662 (exception: CG550)

2 Electrode GDT Graphical Symbol

Additional Information

Datasheet CG5 Series

Resources CG5 Series

Samples CG5 Series

Datasheet SL0902A

Resources SL0902A

Samples SL0902A

Description

Littelfuse Broadband Optimized™ SL0902A Series offers high surge ratings in a miniature package. Special design features provide high levels of protection against fast rising transients in the 100V/µs to 1kV/µs range usually caused by lightning disturbances. Low insertion loss is perfectly suited to broadband equipment applications. The capacitance does not vary with voltage, and will not cause operational problems with ADSL2+, where capacitance variation across Tip and Ring is undesirable. These devices are extremely robust and are able to divert a 2500A pulse without destruction. For AC Power Cross of long duration, overcurrent protection is recommended.

Littelfuse CG5 MS mini surge arresters are specifically designed for protection of electrical and communication equipment against over voltage transients in surface mount assembly applications. This series offers the most cutting edge protection using non-radioactive elements.

Features

- RoHS compliant and Lead-free
- GHz working frequency
- Excellent stability on multiple pulse duty cycle
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss
- 5KA surge capability tested with 8/20µS pulse as defined by IEC 61000-4-5
- Ultra small devices offered in a variety of mounting lead forms
- Non-Radioactive
- Low capacitance (<1pF)
- Voltage Ranges 90V to 600V
- UL recognized
- Conforms to ITU-T K12, IEC 1000-4-5

Applications

- Communication equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Telecom SLIC protection
- Broadband equipment
- ADSL equipment, including ADSL2+
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

Revised: 11/06/15

Electrical Characteristics

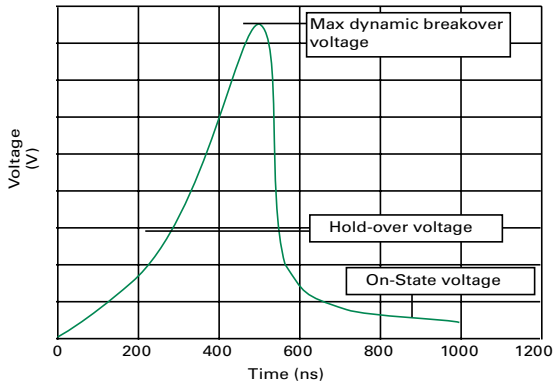
Part Number	Device Specifications (at 25°C)							Life Ratings				
	DC Breakdown in Volts (@100V/s)			Impulse Breakdown in Volts (@100V/µs)	Impulse Breakdown In Volts (@1 Kv/µsec)	Insulation Resistance	Capacitance (@1MHz)	Surge Life (10/1000µs)	Nominal Impulse Discharge Current (8/20µs)	Nominal AC Discharge Current (10x1sec @50-60Hz)	AC Dischage Current (9 cycle @50Hz)	Max Impulse Discharge Current (1 Application @ 10/350µs)
	MIN	TYP	MAX	MAX		MIN	MAX					
SL0902A090 CG590	72	90	108	550	700	10^{10} Ω (at 50V)	1.5 pf	300 shots (@100A)	10 shots (@5kA)	5 A	10 A	0.5kA
CG5145	116	145	174	550	650	10^{10} Ω (at 100V)						
CG5150	120	150	180	550								
SL0902A230 CG5230	184	230	276	550	650							
CG5250	200	250	300	600								
CG5270	216	270	324	650								
SL0902A350 CG5350	280	350	420	800	900							
CG5400	320	400	480	900								
SL0902A420	336	420	504	900	1000							
CG5470	376	470	564	1000	1200							
SL0902A600 CG5600	480	600	720	1350	1500							

Product Characteristics

Materials	**CG5xxxLS (Outline 500), CG5xxxxLTR & CG5350L-03TR (Outline 502), and CG5xxxL-02 (Outline 503):** Device Nickel Plated 2–5 Microns Wire Tin Plated 17.5±12.5 Microns Construction Ceramic Insulator. **CG5xxx (Outline 501), and CG5xxxMS & SL0902AxxxSM (Outline 505):** Device Tin Plated 17.5±12.5 Microns Construction Ceramic Insulator.

Product Marking	LF Logo, Voltage and date code
Glow to arc transition current	< 0.5Amps
Glow Voltage	140 Volts
Storage and Operational Temperature	-40 to +90

Voltage vs. Time Characteristic



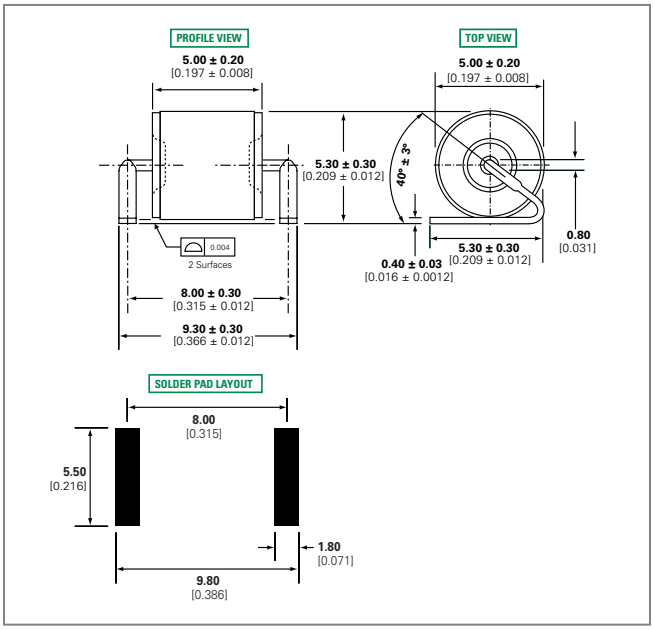
Typical Insertion Loss

@ 1.0 GHz = 0.01 dB
@ 1.4GHz = 0.1 dB
@ 1.8 GHz = 0.53 dB
@ 2.1 GHz = 0.81 dB
@ 2.45 GHz= 1 dB
@ 2.8 GHz = 1.2 dB
@ 3.1 GHz = 1.5 dB
@ 3.5 GHz = 2.1 dB

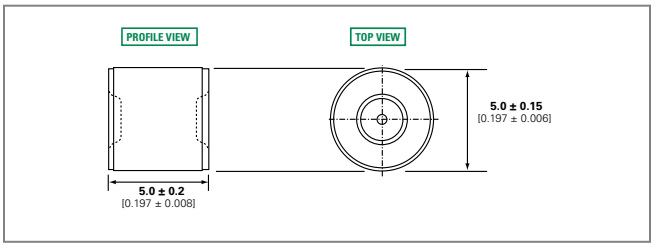
Revised: 11/06/15

Device Dimensions

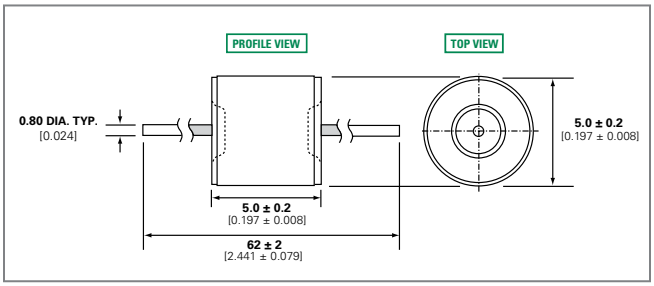
Outline 500 - CG5xxxLS



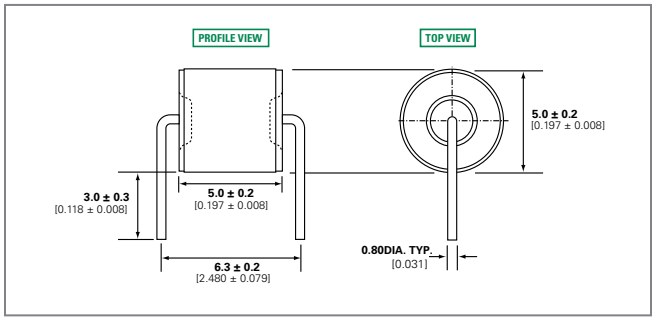
Outline 501 - CG5xxx



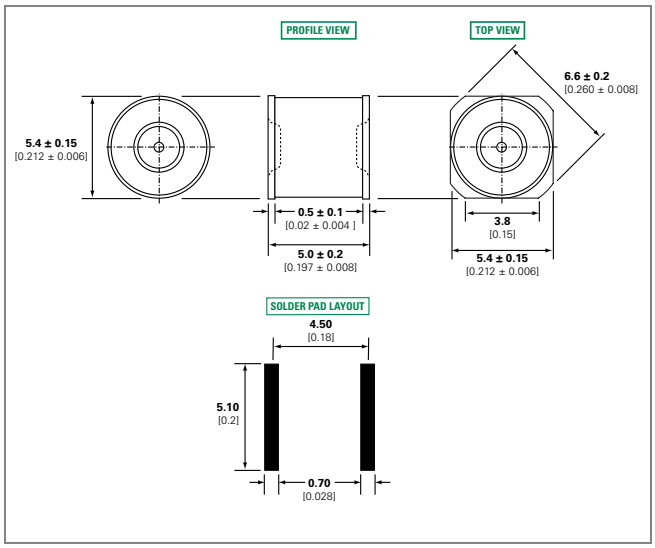
Outline 502 - CG5xxxLTR (also CG5350L-03TR, CG5600L-02)



Outline 503 - CG5xxxL-02 (except CG5600L-02, see Outline 502)



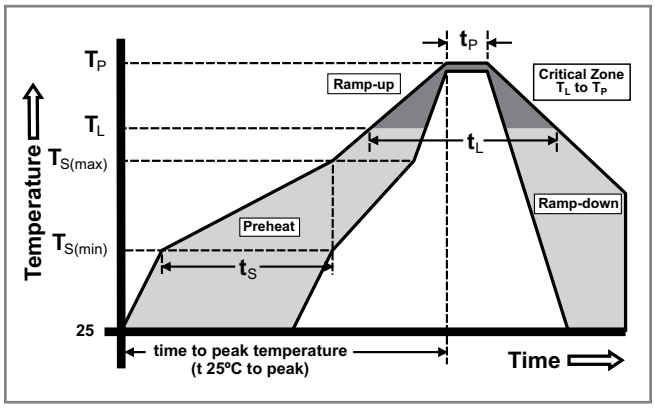
Outline 505 - CG5xxxMS and SL0902AxxxSM



Revised: 11/06/15

Soldering Parameters - Reflow Soldering (Surface Mount Devices)

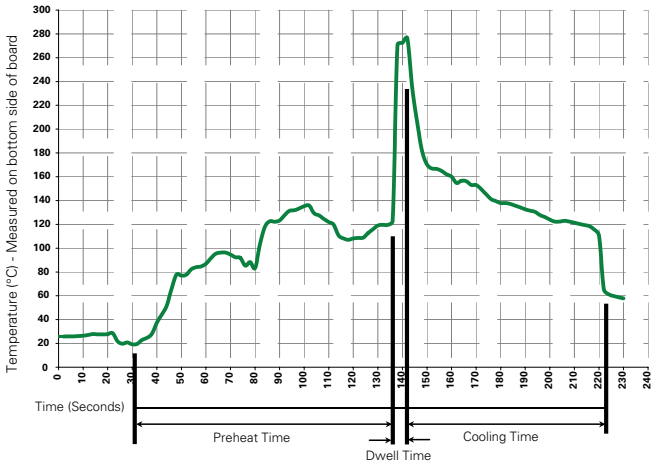
Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C



Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

Note: These devices are not recommended for IR or Convection Reflow process.

Revised: 11/06/15

Gas Discharge Tubes
CG5 and SL0902A Series

Part Numbering System and Ordering Information

CG5 xxx L TR

Series
CG5

Breakdown Voltage
90 = 90V
230 = 230V
350 = 350V
600 = 600V

Lead Option Code
(Blank) = Core Device (No Leads)
L = Straight Leads
LS = Shaped Leads
MS = Surface Mount

Packaging Option Code
(Blank) = Bulk (Applies to Core Devices Only)
TR = Tape & Reel

SL0902A xxx SM

Series
SL0902A

Breakdown Voltage
090 = 90V
230 = 230V
350 = 350V
420 = 420V

Lead Option Code
SM = Surface Mount

(Packaging Option Code is not applicable for SL0902A)

Packaging

Part Number and Device Type		Device Dimensions Reference	Quantity and Packaging Description
CG5xxx	Core	Outline 501	1000pcs/bag in bulk packaging
CG5xxxLS	Shaped Leads	Outline 500	900pcs/reel in carrier and tape*
CG5xxxLTR CG5xxxL-03TR**	Straight Axial Leads	Outline 502	1000pcs/reel in tape and reel*
CG5xxxL-02**	Bent Radial Leads	Outline 503	50pcs/tray in tray and cover
CG5xxxMS SL0902AxxxSM	Surface mount	Outline 505	900pcs/reel in carrier and tape*

* For tape specifications and dimensions, please contact factory.
** Special order items not available for general sale. Please contact Littelfuse for details.

Revised: 11/06/15

SL1002A Series

Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662

2 Electrode GDT Graphical Symbol

Additional Information

Datasheet | Resources | Samples

Description

The Broadband Optimized™ SL1002A series has been especially developed for use in broadband equipment. Special design features provide high levels of protection against fast rising transients in the 100V/µs to 1kV/µs range usually caused by lightning disturbances. These devices have ultra low capacitance (typically 1.2pF or less) and present insignificant signal losses up to 1.5GHz. These devices are extremely robust and are able to divert a 5000A pulse without destruction. For AC Power Cross of long duration, overcurrent protection is recommended.

Features

- RoHS compliant/Lead-free
- Ultra low insertion loss
- Surface mountable
- 5kA surge capability tested with 8/20µS–Pulse as defined by IEC 61000-4-5
- Excellent response to fast rising transients
- Can be used to meet Telcordia GR1089 without series resistance
- 10/700 6kV capability, as per ITU-T Rec. K.21, enhanced test level
- 2000 A 2/10µs surge rating
- Meet FCC part 68 10/160µs waveform, 200A test and 10/560µs waveform 100A test
- Halogen-free

Applications

- Broadband equipment
- ADSL equipment
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

Revised: 11/06/15

Electrical Characteristics

Part Number	Device Specifications (at 25°C)								Life Ratings					
	DC Breakdown in Volts[1,2] (@100V/s)			Impulse Breakdown in Volts[3,4] (@100V/µs)	Impulse Breakdown in Volts[3,4] (@1kV/µs)	Insulation Resistance	Capacitance (@1MHz 0V Bias)	Arc Voltage (on state voltage) @1Amp Min	Surge Life (@100A 10/1000µs)	Nominal Impulse Discharge Current (8/20µs)	Nominal AC Discharge Current (10x1s @50-60Hz)	DC Holdover Voltage[5]	Max Impulse Discharge Current (1 Application)	
	MIN	TYP	MAX	MAX		MIN	MAX	TYP				TYP	@ 2/10 µs	@ 10/350 µs
SL1002A075	60	75	90	400	650	10^9 Ω (at 50V)	1.2 pF	~15 V	300 shots[6]	10 shots[7] (@ 5kA)	5 A	50 V	2 kA	1.5 kA
SL1002A090	72	90	108											
SL1002A230	184	230	276	600	700	10^9 Ω (at 100V)						135 V		
SL1002A250	200	250	300											
SL1002A260	210	260	310											
SL1002A350	280	350	420	800	900									
SL1002A470	376	470	564	900	1000									
SL1002A600	480	600	720	1100	1200									
SL1002A600SP	570	600	780	1200	1300	10^9 Ω (at 500V)								

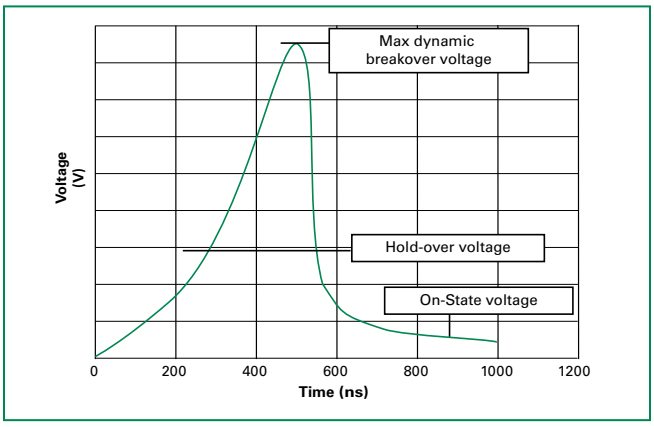
Notes:
1. At delivery AQL 0.65 level II, DIN ISO 2859
2. In ionized mode
3. In ionized mode, tested according to ITU-T Rec. K.12
4. Comparable to the silicon measurement Switching Voltage (Vs)
5. Reference REA PE-80, 0.2A. Tested to ITU-T Rec. K.12 and REA PE-80 < 150 msecs.
6. 300 Applications [150(+) & 150(-)]
7. 10x[5x (+) & 5x (-)] Applications

Product Characteristics

Materials	**Construction** = Ceramic Insulator **Device Finish** = Dull Tin-plated 17.5 +/-12.5 microns
Product Marking	Littelfuse 'LF' Mark, voltage and date code

Glow to Arc Transition Current	< 0.5 Amps
Glow Voltage	~60 - 140 Volts
Storage and Operational Temperature	-40 to +90°C

Voltage vs. Time Characteristics

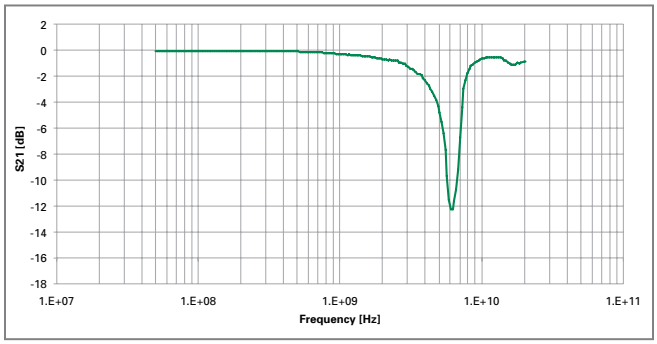


Revised: 11/06/15

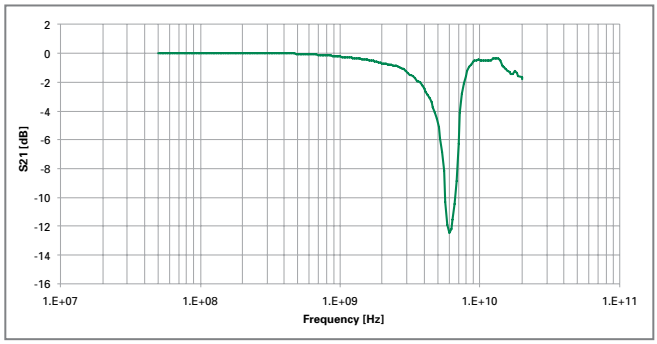
Gas Discharge Tubes
SL1002A Series

Insertion Loss Characteristics

Typical Insertion Loss Characteristics (90V)

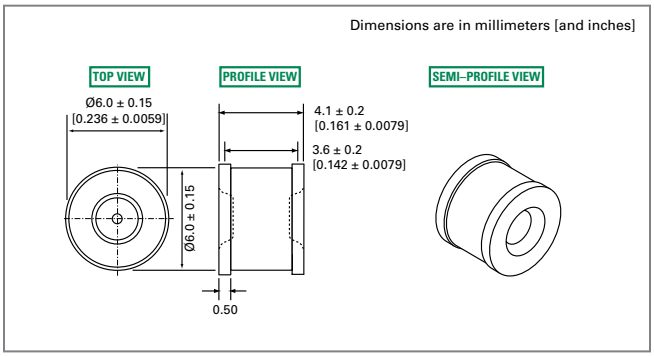


Typical Insertion Loss Characteristics (600V)

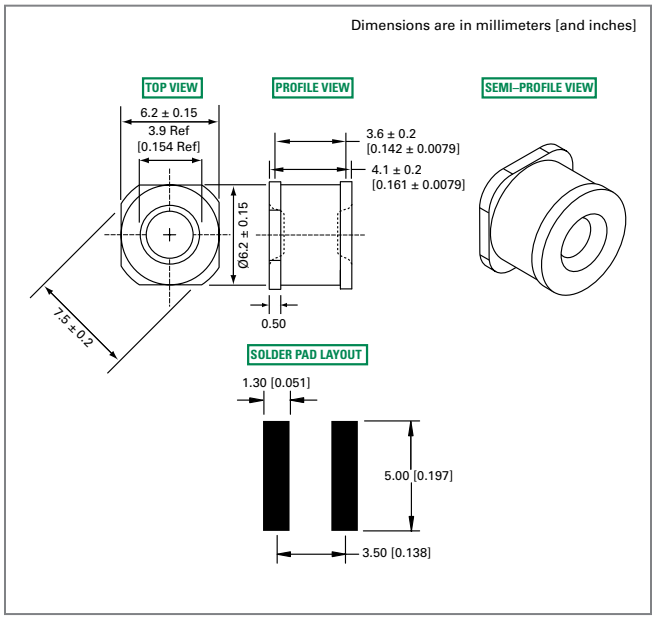


Device Dimensions

'C' Type Core Devices



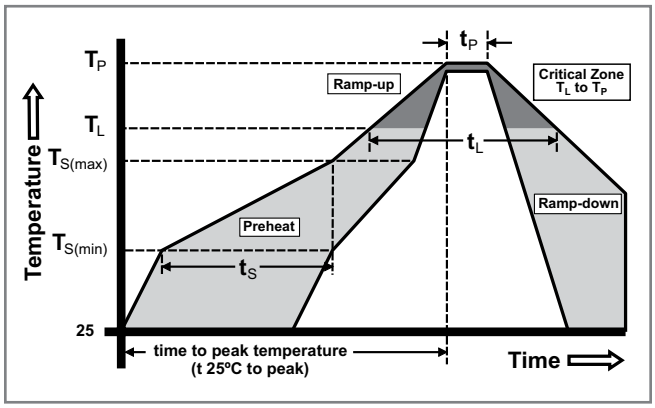
'SM' Type Surface Mount Devices



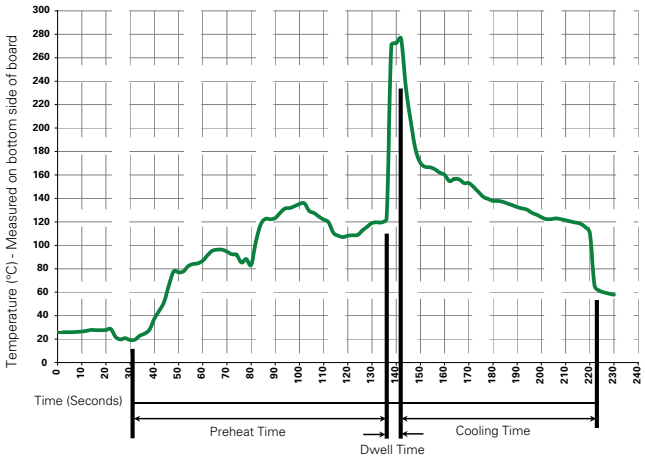
Revised: 11/06/15

Soldering Parameters - Reflow Soldering (Surface Mount Devices)

Reflow Condition		Pb-free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 seconds
Average Ramp-up Rate (Liquidus Temp (T_L) to peak)		3°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of Actual Peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max.
Time 25°C to Peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C



Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

Soldering Parameters - Hand Soldering

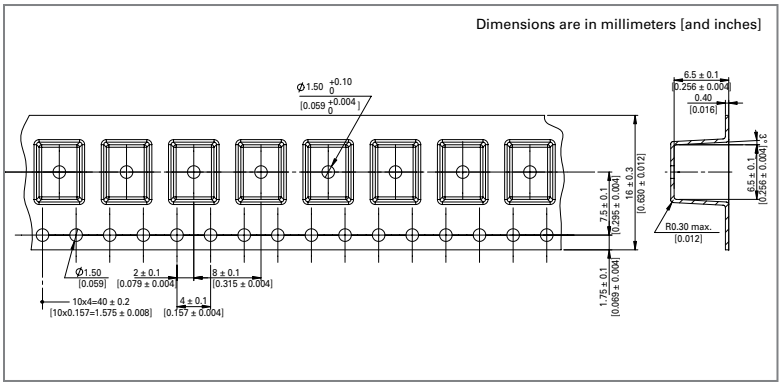
Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

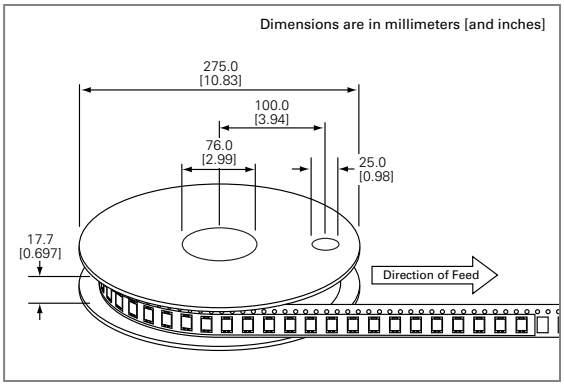
Revised: 11/06/15

Packaging

'C' Type Core Items: Package bulk pack in polybag, 1000 pcs/bag

'SM' Type Surface Mount Items: Packaged tape and reel carrier, 1000 pcs/reel (specifications below)





Part Numbering System and Ordering Information

SL1002 A XXX XX

Surge Capability

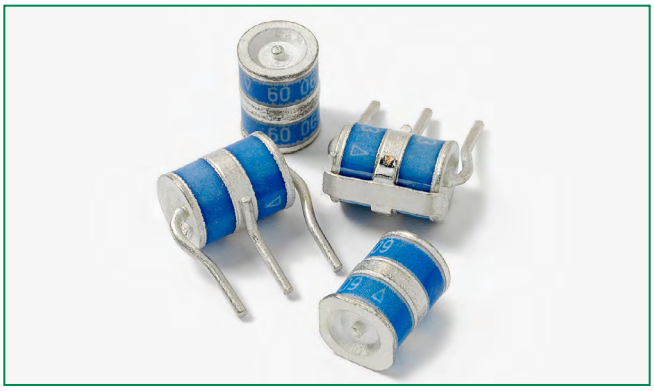
Voltage

Pin Configuration

C = Core (Packed in polybag, 1000pcs/bag)
SM = Surface Mount (Packed in carrier and tape, 1000pcs/reel)

Revised: 11/06/15

SL1003A Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
UL	E128662

3 Electrode GDT Graphical Symbol

Additional Information

Datasheet | Resources | Samples

Description

The SL1003A series has been especially developed for Broadband equipment. Special design features provide high levels of protection against fast rising transients in the 100V/µs to 1kV/µs range usually caused by lightning disturbances.

These devices have ultra low capacitance 1.5pF and present insignificant signal losses up to 1.5GHz. These devices are extremely robust and are able to divert a 5000A pulse without destruction. For AC Power Cross of long duration, over-current protection is recommended.

Features

- RoHS compliant
- Low insertion loss
- Surface mountable
- 5kA surge capability tested with 8/20/µs pulse as defined by IEC 61000-4-5
- GHz working frequency
- Excellent response to fast rising transients
- Can be used to meet Telcordia GR1089 without series resistance
- 10/700 6kV capability, as per ITU-Tk.21, enhanced test level
- 2000 Amp 2/10µs surge rating

Applications

- Broadband equipment
- ADSL equipment
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

Revised: 11/06/15

Electrical Characteristics

Part Number	Device Specifications (at 25°C)								Life Ratings					
	DC Breakdown in Volts[1,2,3] (@100V/s)			Impulse Breakdown in Volts[2,3] (@100V/µs)	Impulse Breakdown In Volts[2,3] (@1kV/µs)	Insulation Resistance	Capacitance (@1MHz 0V Bias)	Arc Voltage (on state Voltage) @1Amp Min	Surge Life (@200A 10/1000µs)	Nominal Impulse Discharge Current (8/20µs)	Nominal AC Discharge Current (10x1s @50Hz)	AC Discharge Current (9 Cycles @ 50Hz)	DC Holdover Voltage[4]	Max Impulse Discharge Current (1 Application)
	MIN	TYP	MAX	MAX		MIN	MAX	TYP					TYP	@ 10/350µs
SL1003A090	72	90	108	600	700	$10^9\Omega$ (at 50V)	1.5 pF	~10 to 35 V	300 shots	10 shots (@10kA)	10 A	30 A	50 V	2 kA
SL1003A230	184	230	276			$10^9\Omega$ (at 100V)								
SL1003A250	200	250	300		750								135 V	
SL1003A260	210	260	310											
SL1003A300	240	300	360	750	850									
SL1003A350	280	350	420	800	900									
SL1003A400	320	400	480	850	950									
SL1003A450	360	450	540	900	1000									
SL1003A500	400	500	600	1100	1400									

Notes:
1. At delivery AQL 0.65 level II, DIN ISO 2859
2. In ionized mode, tested according to ITU-T Rec. K.12
3. Comparable to the silicon measurement Switching Voltage (Vs)
4. Reference REA PE-80, 0.2A. Tested to ITU-T Rec. K.12 and REA PE-80 < 150 msecs.

Product Characteristics

Materials	**Leaded Device:** Tin-plated copper wire **Core and Surface Mount:** Dull Tin-plated
Product Marking	Littelfuse 'LF' Mark, voltage and date code

Glow to Arc Transition Current	~1 Amp
Glow Voltage	~60 to 200 Volts
Storage and Operational Temperature	-40 to +90°C

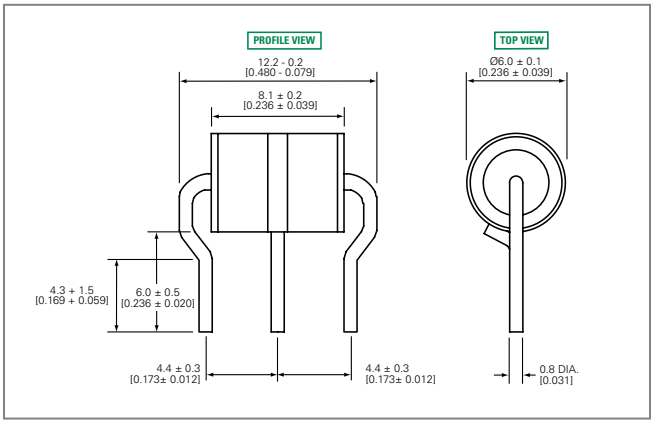
Revised: 11/06/15

Device Dimensions

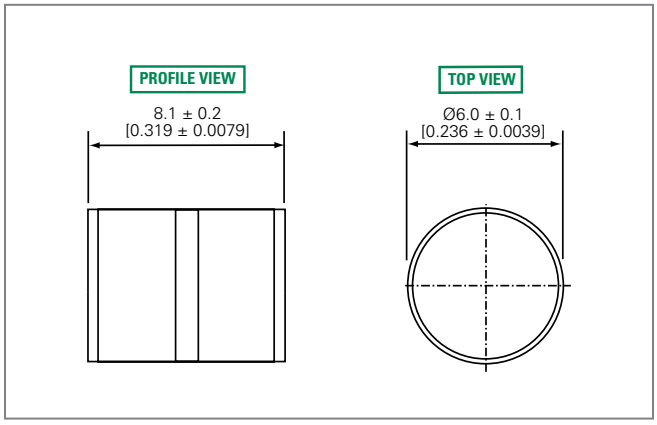
For SL1003A series:

Dimensions are in millimeters [and inches]

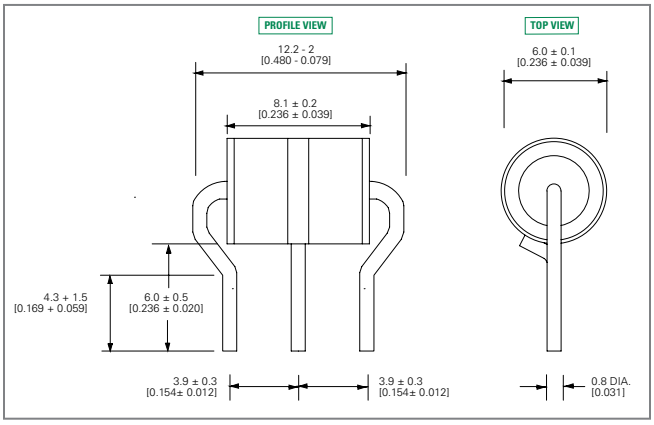
'R' Type Radial Lead Devices (SL1003AxxxR-001)

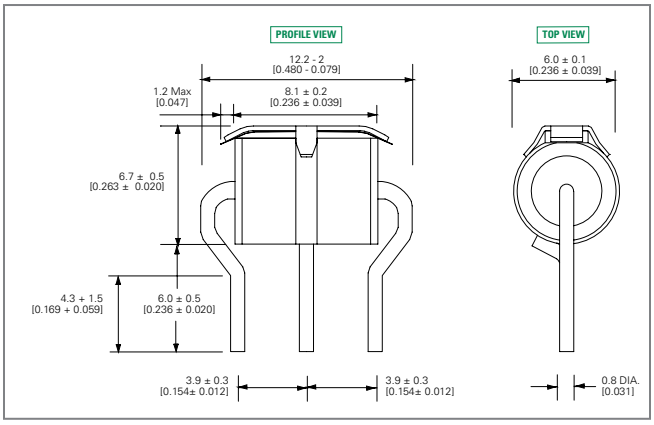


'C' Type Core Devices

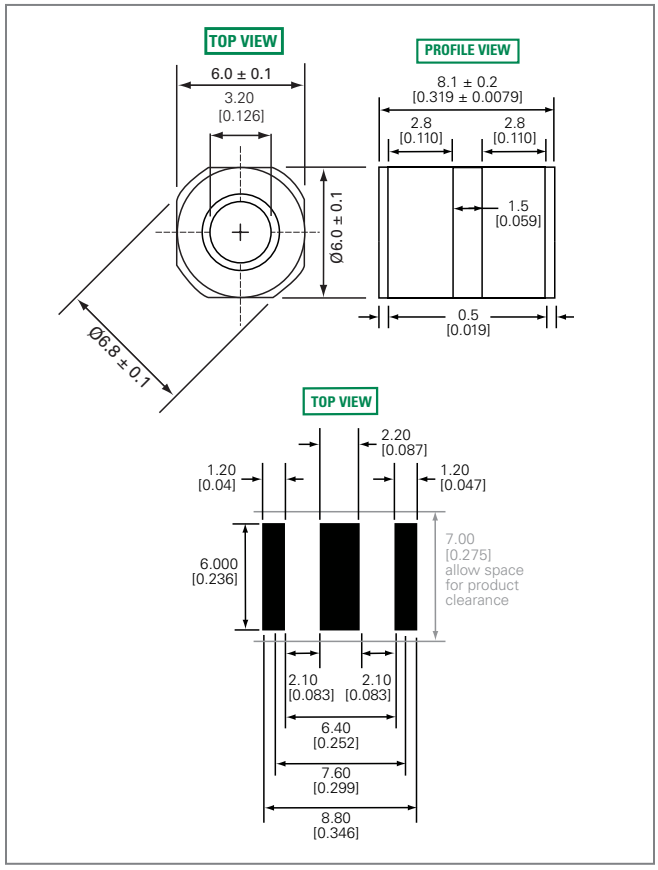


'R' Type Radial Lead Devices (SL1003AxxxR and SL1003AxxxRF)





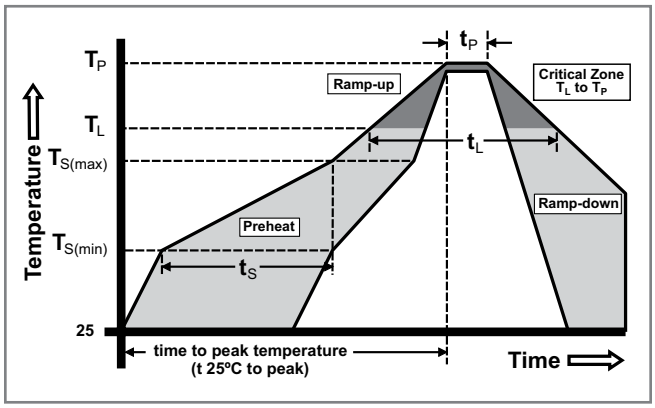
'SM' Type Surface Mount Devices



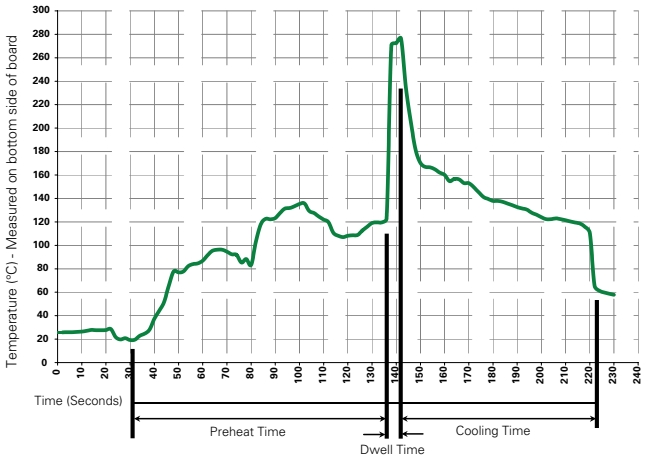
Revised: 11/06/15

Soldering Parameters - Reflow Soldering (Surface Mount Devices)

Reflow Condition		Pb-free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 seconds
Average Ramp-up Rate (Liquidus Temp (T_L) to peak)		3°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of Actual Peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max.
Time 25°C to Peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C



Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Revised: 11/06/15

Gas Discharge Tubes
SL1003A Series

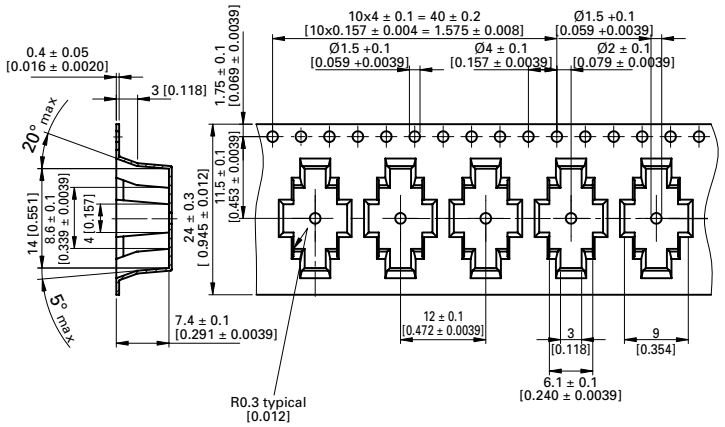
Packaging

'C' Type Core Items: Package bulk pack in polybag, 500 pcs/bag

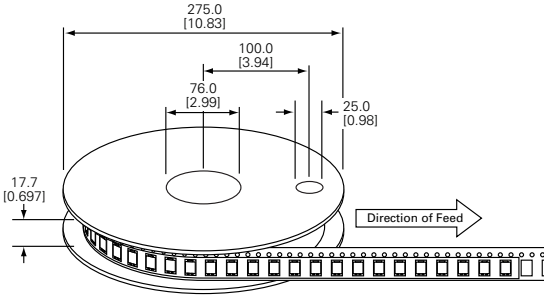
'R' and 'RF' Type Radial Lead Items: Packed in tray, 100 pcs/tray

'SM' Type Surface Mount Items: Packaged tape and reel carrier, 700 pcs/reel (specifications below)

Dimensions are in millimeters [and inches]



Dimensions are in millimeters [and inches]



SMD-tape according to IEC 60286-3

Part Numbering System and Ordering Information

SL1003 A XXX XX

Type 3 Pole Arrestor

Voltage

Pin Configuration

C = Core type (Packed in polybag, 500pcs/bag)
R = Radial Lead without Failsafe (Packed in tray, 100pcs/tray)
RF = Radial Lead with Failsafe (Packed in tray, 100pcs/tray)
SM = Surface Mount (Packed in carrier and tape, 700pcs/reel)

Revised: 11/06/15

SL1010A Series

Description

The SL1010A Series Gas Discharge Tube (GDT) offers a compact, three-terminal, surface mount component that's just 5mm in diameter. It is rated for 10 hits (±5 repetitions) of a 5kA 8/20µs surge event with a low off-state capacitance of 1.5pF. Its low arc voltage parameter of 10V reduces thermal accumulation during long-term power fault events.

Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662

3 Electrode GDT Graphical Symbol

Additional Information

Datasheet | Resources | Samples

Features

- 5mm diameter size
- Low insertion loss
- Fast response time
- Single component balanced protector (T-grd & R-grd)
- High current rating
- Stable performance over lifetime
- Lead-free and RoHS compliant
- UL Recognized

Applications

- Data lines
- Broadband interfaces such as ADSL2/VDSL2
- xDSL equipment
- Satellite and CATV equipment
- General telecom equipment
- Industrial automation
- Home gateway

Revised: 11/06/15

Gas Discharge Tubes
SL1010A Series

Littelfuse
Expertise Applied | Answers Delivered

Electrical Characteristics

Part Number	Device Specifications (at 25°C)									
	DC Breakdown in Volts[1,2,3] (@100V/s)			Impulse Breakdown in Volts[2,3] (@100V/µs)	Impulse Breakdown In Volts[2,3] (@1kV/µs)	Insulation Resistance	Capacitance (@1MHz 0V Bias)	Arc Voltage (on state Voltage) @1Amp Min	Nominal Impulse Discharge Current (x10@8/20µs)	Nominal Impulse Discharge Current (x1@10/350µs)
	MIN	TYP	MAX	MAX		MIN	MAX			
SL1010A075	60	75	90	450	600	>1GΩ (at 50VDC)	<1.5 pF	~10 V	5kA	1kA
SL1010A090	72	90	108	550	700					
SL1010A170	136	170	204							
SL1010A230	184	230	276	580	750					
SL1010A350	280	350	420	850	1000					
SL1010A470	376	470	564	800	950					

Notes:
1. At delivery AQL 0.65 level II, DIN ISO 2859
2. In ionized mode, tested according to ITU-T Rec. K.12
3. Comparable to the silicon measurement Switching Voltage (Vs)
4. Total current through center electrode at 10kA, through side electrode respectively at 5kA

Product Characteristics

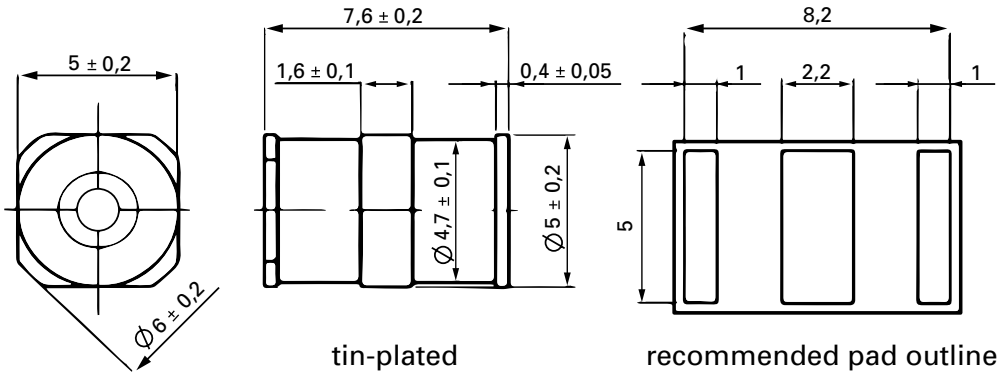
Materials	**Construction:** Ceramic Insulator **Device Finish:** Dull Tin-plated 17.5 +/- 12.5 microns
Product Marking	Littelfuse 'LF' Mark, voltage and date code

Glow to Arc Transition Current	~1 Amp
Glow Voltage	~60 Volts
Storage and Operational Temperature	-40 to +90°C

Device Dimensions

For SL1010A series:

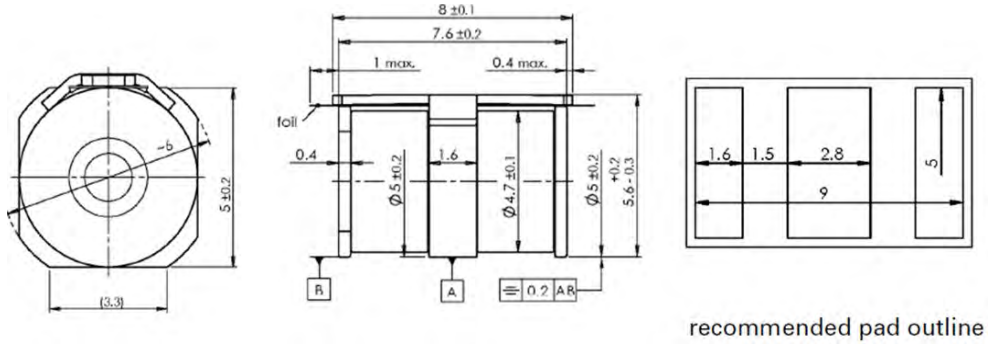
Dimensions are in millimeters [and inches]



tin-plated

recommended pad outline

For SL1010A series failsafe version:

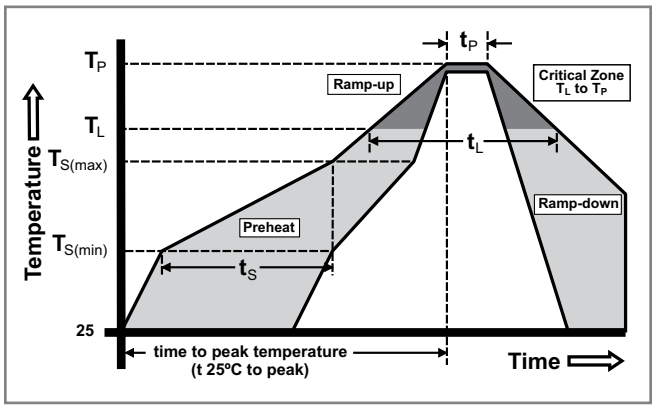


recommended pad outline

Revised: 11/06/15

Soldering Parameters - Reflow Soldering (Surface Mount Devices)

Reflow Condition		Pb-free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 seconds
Average Ramp-up Rate (Liquidus Temp (T_L) to peak)		3°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of Actual Peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max.
Time 25°C to Peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C

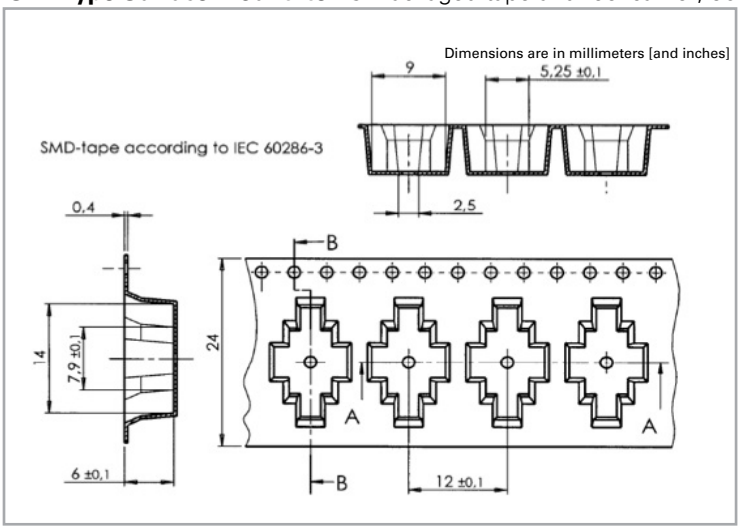


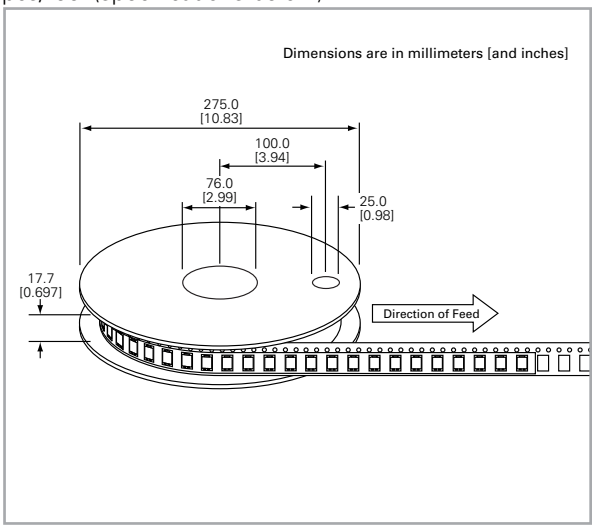
Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Packaging

'SM' Type Surface Mount Items: Packaged tape and reel carrier, 900 pcs/reel (specifications below)





Part Numbering System and Ordering Information

SL1010A XXX XX

SL1010A Series

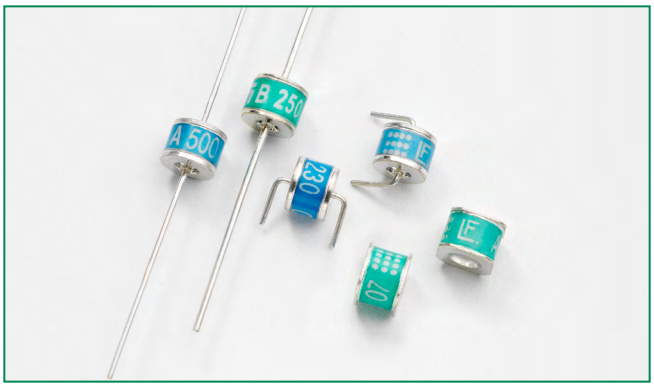
Voltage

Pin Configuration

F = with Failsafe (Packed in carrier and tape, 900pcs/reel)
SM = Surface Mount (Packed in carrier and tape, 900pcs/reel)
SMF = Surface Mount with Failsafe (Packed in carrier and tape, 900pcs,

Revised: 11/06/15

SL1011A and SL1411A Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662

2 Electrode GDT Graphical Symbol

Additional Information

Datasheet SL1011A

Resources SL1011A

Samples SL1011A

Datasheet SL1411A

Resources SL1411A

Samples SL1411A

Description

The SL1011A and SL1411A series provides high levels of protection against fast rising transients in the 100V/µs to 1kV/µs range usually caused by lightning disturbances.

The SL1011A and SL1411A series offers low capacitance (< 1.5pf) which provides low insertion loss at high frequencies.

SL1011A offers 5kA protection without destruction whereas the SL1411A offer 10kA surge protection without destruction (maximum single surge of 12kA @ 8/20µs).

Features

- RoHS compliant
- Low insertion loss
- Excellent response to fast rising transients
- Ultra low capacitance
- 5kA (SL1011A) or 10kA (SL1411A) surge capability tested with 8/20µs pulse as defined by IEC 61000-4-5

Applications

- Broadband equipment
- ADSL equipment
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

Revised: 11/06/15

Electrical Characteristics

Part Number	Device Specifications (at 25°C)								Life Ratings						
	DC Breakdown in Volts[1,2] (@100V/s)			Impulse Breakdown in Volts[3] (@100V/µs)	Impulse Breakdown In Volts (@1kV/µs)	Insulation Resistance	Capacitance (@1MHz)	Arc Voltage (on state Voltage) @1Amp Min	Surge Life (@100A 10/1000µs)	Nominal Impulse Discharge Current (8/20µs)	Nominal AC Discharge Current (10x1s @50-60Hz)	AC Dischage Current (9 Cycles @ 50Hz)	DC Holdover Voltage[4]	Max Impulse Discharge Current (1 Application)	
	MIN	TYP	MAX	MAX		MIN	MAX	TYP					TYP	@ 8/20µs	@ 10/350µs
SL1011A075	60	75	90	500	700	10^{10} Ω (at 50V)	1.5 pF	~20 V	300 shots	SL1011A: 10 shots (@5kA) SL1411A: 10 shots (@10kA)	SL1011A: 5 A SL1411A: 10 A	SL1011A: 20 A SL1411A: 65 A	50 V	SL1411A: 12 kA	1 kA
SL1411A075															
SL1011A090	72	90	108	500	600										
SL1411A090															
SL1011A145	116	145	174	500	650	10^{10} Ω (at 100V)									
SL1011A150	120	150	180	500	650										
SL1411A150															
SL1011A230	184	230	276	550	700								135 V		
SL1411A230															
SL1011A250	200	250	300	600	800										
SL1411A250															
SL1011A260	210	260	310	600	800										
SL1011A350	280	350	420	800	900										
SL1411A350															
SL1011A470	376	470	564	1000	1100										
SL1411A470															
SL1011A500	400	500	600	1100	1200										
SL1011A600	480	600	720	1200	1400										
SL1411A600															

Notes:
1. At delivery AQL 0.65 level II, DIN ISO 2859
2. In ionized mode
3. Comparable to the silicon measurement Switching Voltage (Vs)
4. Tested according to ITU-T Rec. K.12 < 150 msecs.

Product Characteristics

Materials	**Leaded Device:** Nickel-plated with Tin-plated wires **Core and Surface Mount:** Dull Tin-plated
Product Marking	Littelfuse 'LF' Mark, voltage and date code

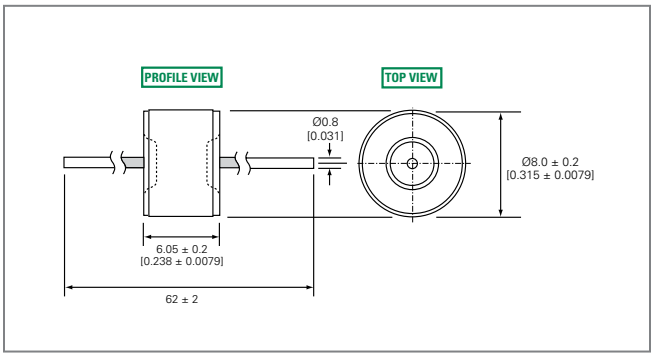
Glow to Arc Transition Current	< 0.5 Amps
Glow Voltage	~60 Volts
Storage and Operational Temperature	-40 to +90°C

Revised: 11/06/15

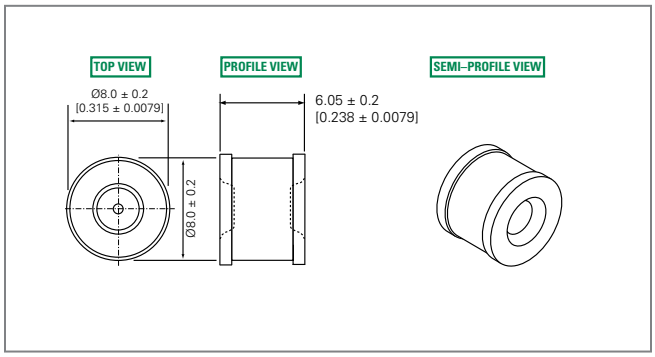
Device Dimensions

For SL1011A Series:

'A' Type Axial Lead Devices

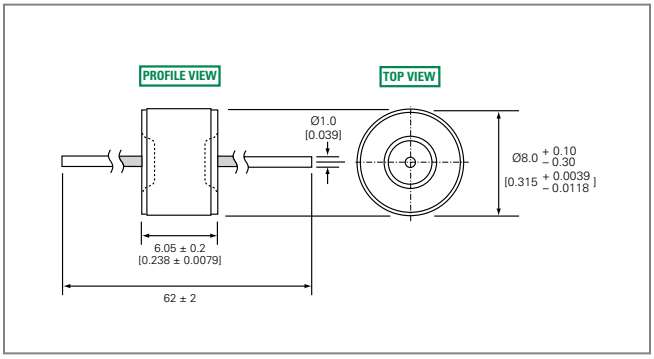


'C' Type Core Devices

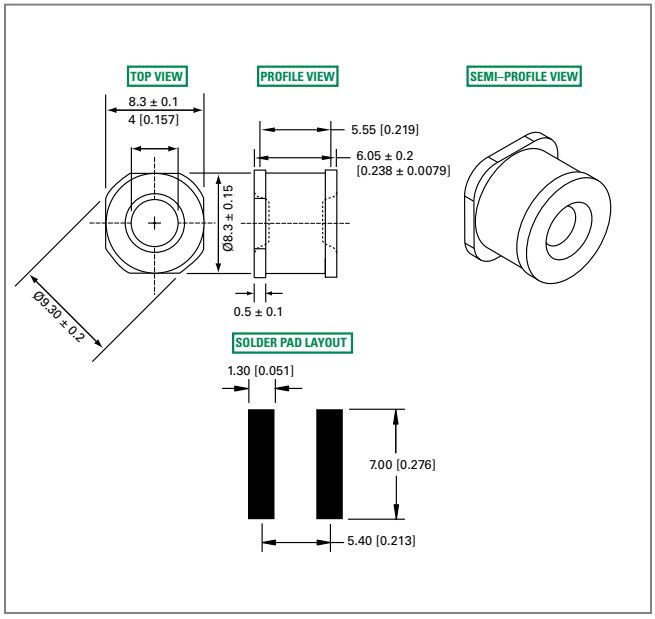


For SL1411A series:

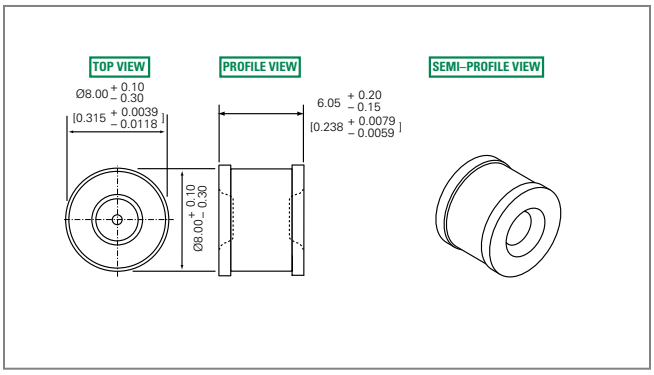
'A' Type Axial Lead Devices



'SM' Type Surface Mount Devices



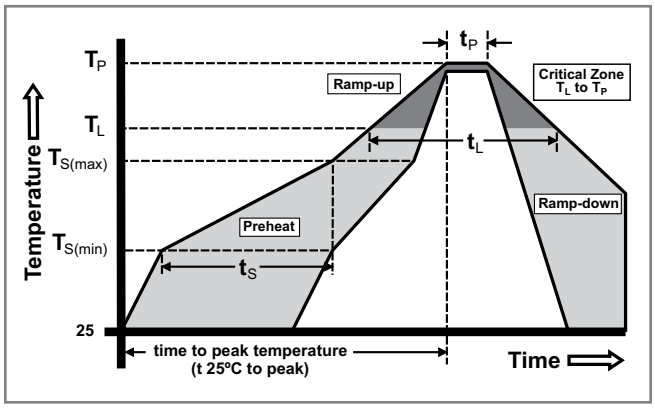
'C' Type Core Devices



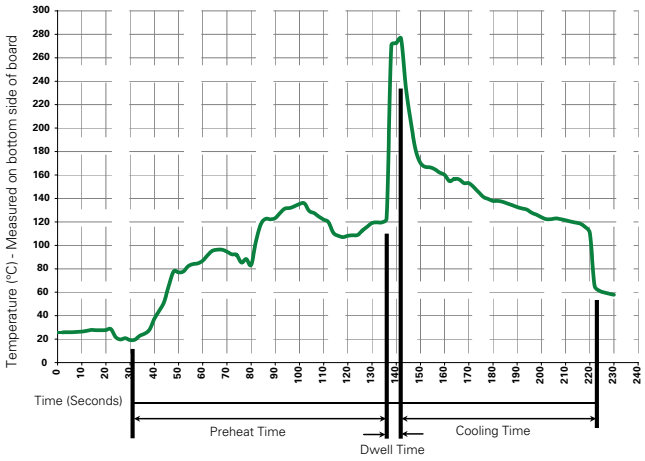
Revised: 11/06/15

Soldering Parameters - Reflow Soldering (Surface Mount Devices)

Reflow Condition		Pb-free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 seconds
Average Ramp-up Rate (Liquidus Temp (T_L) to peak)		3°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of Actual Peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max.
Time 25°C to Peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C



Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

Soldering Parameters - Hand Soldering

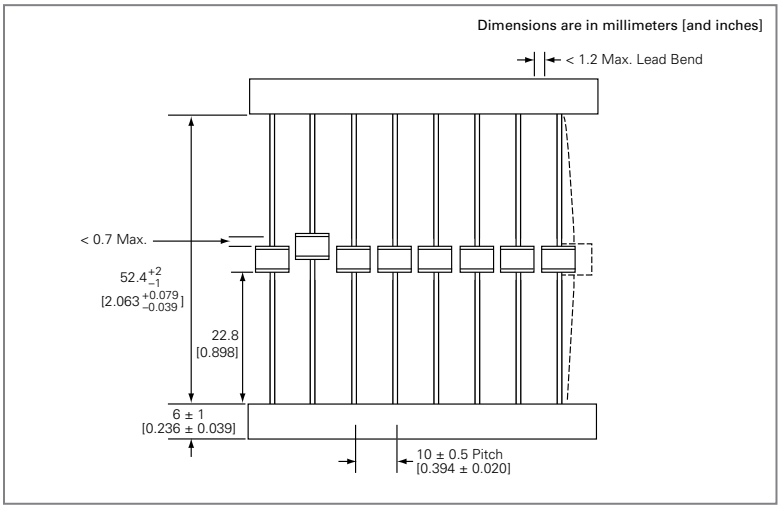
Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Revised: 11/06/15

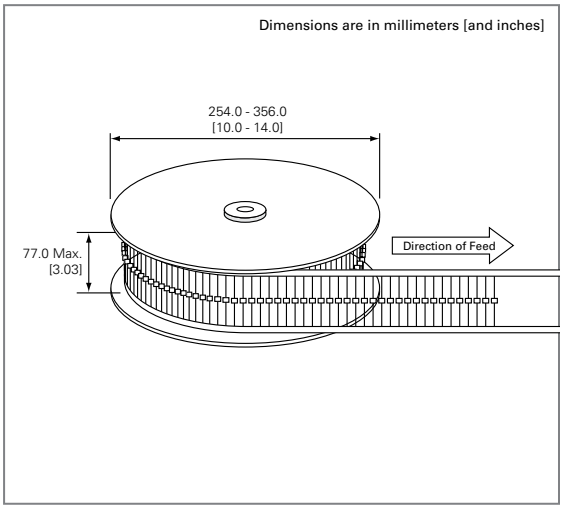
Packaging Dimensions

For Axial Lead Items

Dimensions are in millimeters [and inches]

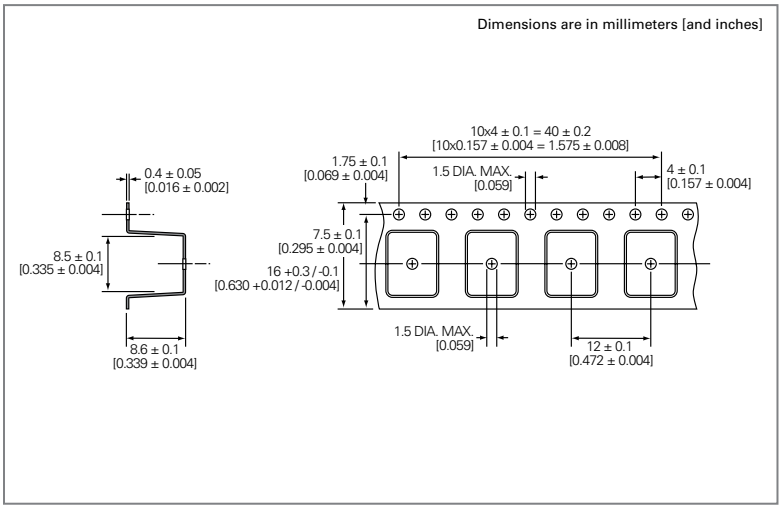


Dimensions are in millimeters [and inches]

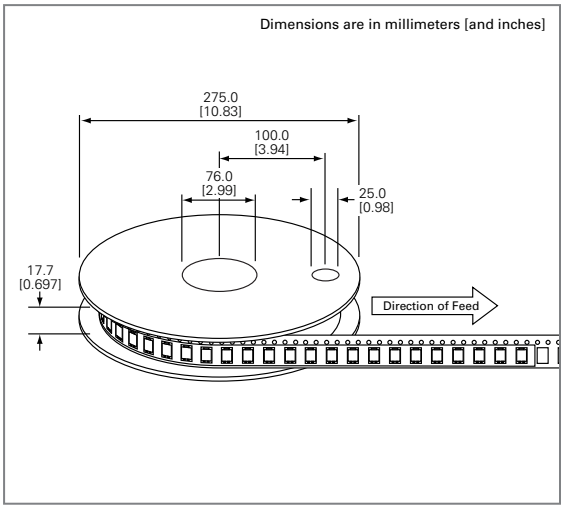


For 'SM' Type Surface Mount Items (SL1411A series only)

Dimensions are in millimeters [and inches]



Dimensions are in millimeters [and inches]



For 'C' Type Core Items: Packed in plastic bag (500 pcs)

Revised: 11/06/15

Part Numbering System and Ordering Information

For SL1011A series:

SL1011A XXX X

Voltage

Pin Configuration

A = Axial Lead
C = Core

Remarks: Formed leads are available on request

For SL1411A series:

SL1411 A XXX XX

Surge Capability

Voltage

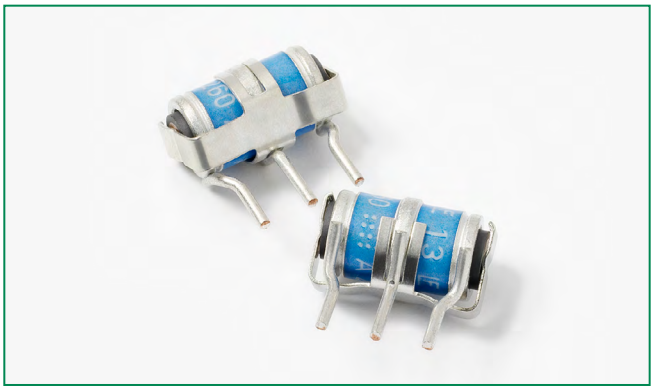
Pin Configuration

A = Axial Lead
C = Core
SM = Surface Mount

Revised: 11/06/15

SL1122A Series Hybrid

RoHS



Description

The SL1122A series Hybrid features a high performance Alpha Gas Plasma Tube in conjunction with a MOV. These devices are matched so that high speed pulses are initially clamped by the MOV, then as the current rises, the transient energy is switched through the gas tube. The Hybrid offers high levels of performance on fast rising transients in the domain of 100V/µs to 10 kV/µs, so eliminates the dv/dt switching delay normally exhibited by standard GDTs. These devices are extremely robust and are able to divert a 10,000 Amp pulse without destruction.

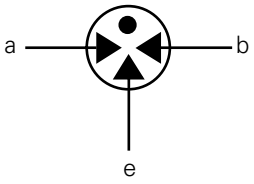
Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662

Features

- RoHs Compliant
- Excellent response to fast rising transients
- Flat response up to 10kV/µs
- 10kA surge capability tested with 8/20µs pulse as defined by IEC 61000-4-5
- Thermal failsafe

2 Electrode GDT Graphical Symbol



a = TIP
b = RING
e = GROUND
(centre electrode)

Applications

- MDF protection
- ADSL equipment
- XDSL equipment
- Alarm panels
- General telecom equipment

Additional Information

Datasheet | Resources | Samples

Electrical Characteristics

Part Number	Device Specifications (at 25°C)							Life Ratings			
	DC Breakdown in Volts[1, 2] (@100V/s)			DC Voltage[2] (1kV/µs Ignition Time)	Insulation Resistance	Capacitance (@1MHz, 0V bias, 1V oscillation)	Arc Voltage (on state voltage) @1Amp Min	Surge Life[1] (10/1000µs 300x +/-)	Surge Current[1] (8/20µs x 10)	Nominal AC Discharge Current[1] (10x1s@50Hz)	DC Holdover Voltage (<150msecs.)
	MIN	TYP	MAX		MIN	MAX	TYP				TYP
SL1122A090	72	90	108	200 (< 10µs)	> 10^8 Ω (at 50V)	270 pF	~10 to 35 Volts	200 A	10 kA	10 A	50 V
SL1122A230	184	230	276	350 (< 10µs)	> 10^8 Ω (at 100V)	100 pF					135 V
SL1122A260	210	260	310	400 (< 10µs)							

Tested in accordance with ITU-T Rec K.12

Notes:
1. Total current through centre electrode
2. Maximum Peak Break Over Voltage

Revised: 11/06/15

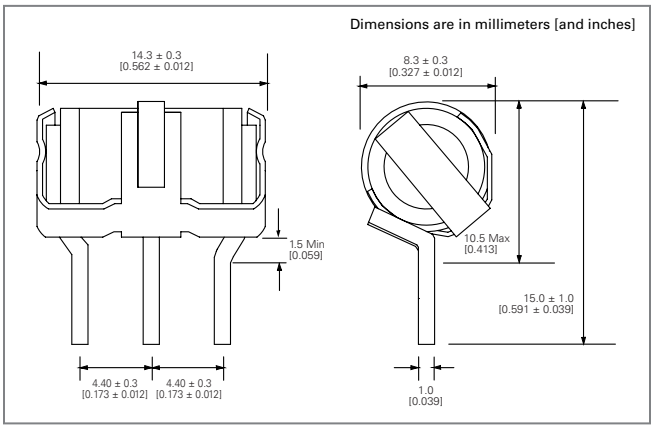
Product Characteristics

Materials	**Electrode Base:** Copper **Electrode Plating:** Bright Tin **Body:** Ceramic
Product Marking	Littelfuse 'LF' Mark, voltage and date code. Red.

Glow to Arc Transition Current	~1 Amp
Glow Voltage	~60 to 200 Volts
Storage and Operational Temperature	-40 to +90°C
Transverse Voltage (Delay Time)	< 0.2 µSec. (Tested to ITU-T Rec.K.12)

Device Dimensions

Radial Lead Devices



Packaging Dimensions

For Radial Lead Items: Packed in tray (100 pcs)

Part Numbering System and Ordering Information

SL1122A XXX X

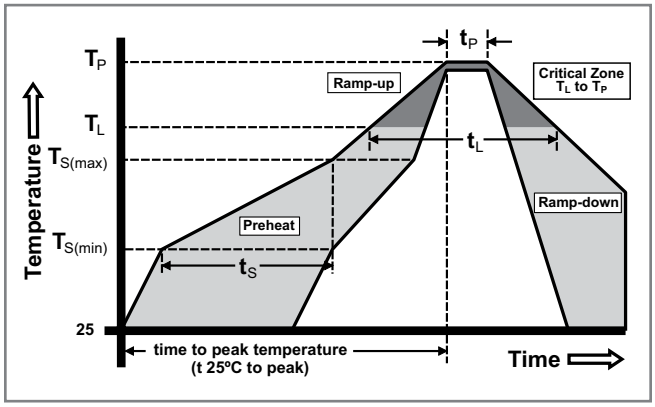
Voltage

Pin Configuration

Revised: 11/06/15

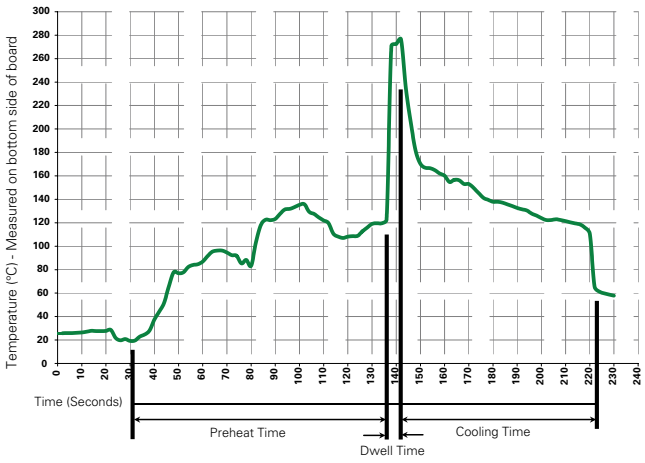
Soldering Parameters - Reflow Soldering

Reflow Condition		Pb-free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 seconds
Average Ramp-up Rate (Liquidus Temp (T_L) to peak)		3°C/second max.
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max.
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of Actual Peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max.
Time 25°C to Peak Temperature (T_P)		8 minutes max.
Do not exceed		260°C



* Devices that are soldered require inspection before use.

Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

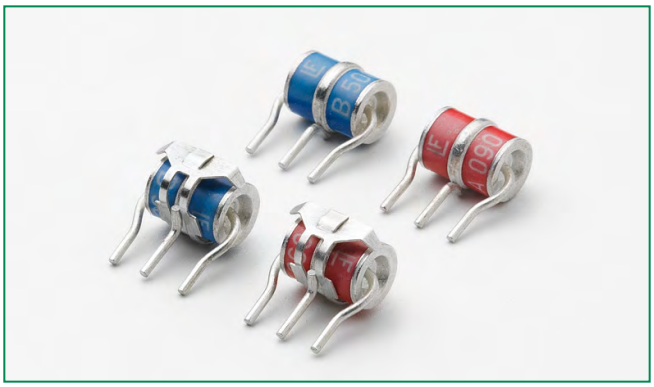
Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Revised: 11/06/15

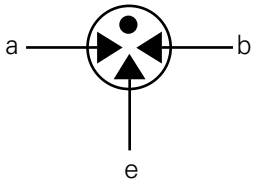
SL1021A/B Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662

3 Electrode GDT Graphical Symbol



a = TIP
b = RING
e = GROUND
(center electrode)

Features

- RoHS compliant
- Low insertion loss
- Excellent response to fast rising transients
- Ultra low capacitance
- 10KA (A suffix devices) / 20KA (B suffix devices) surge capability tested with 8/20µs pulse as defined by IEC 61000-4-5
- Available with thermal failsafe option (add 'F' suffix to part number)

Applications

SL1021:

- Broadband equipment
- ADSL equipment
- XDSL equipment
- Satellite and CATV equipment
- Splitters
- General telecom equipment
- Telecom network interfaces
- Telephone line cards
- Repeaters
- Modems
- Line test equipment

Description

GDT circuit protection devices dissipate electrical surge energy safely within a contained plasma gas. Commonly used to help protect sensitive telecom and networking equipment and lines, GDTs protect from damage that may result from lightning strikes and equipment switching operations.

The Littelfuse GDT series described in this document are available in a variety of leaded and surface mount forms and offered with and without optional fail-safe clip. Please refer to the electrical specifications, dimension and packaging options section of this document for additional information.

SL1021A/B Series:

SL1021A/B series GDTs are designed to offer high levels of performance on fast rising transients in the range of 100V/µS to 1KV/µS, which are those most likely created by induced lightning disturbances.

These devices feature ultra low capacitance (typically 1.5pF or less) and are extremely robust with SL1021A devices able to divert a 10,000 Amp pulse without destruction, and SL1021B suffix devices able to divert a 20,000 Amp pulse without destruction.

These series offer optimized internal geometry which provide low insertion loss at high frequencies, ideal for the protection of broadband and other high speed transmission equipment.

Product Characteristics

Materials	Dull Tin Plate 17.5 ± 12.5 Microns. with ceramic insulator
Product Marking	'LF' mark, voltage& date code: SL1021A - **Red**/White text SL1021B - **Blue**/White text
Glow to arc transition current	~ 1Amp
Glow Voltage	~60-200 Volts
Storage and Operation Temperature	-40 to +90°C
Transverse Voltage (Delay Time)	< 0.2µSec (Tested to ITU-T Rec. K.12)
Arc Voltage	~10 to 35 Volts
Holdover Voltage	<150mS (Tested to ITU-T Rec. K.12)

Revised: 11/06/15

Electrical Characteristics

Device Specifications (at 25°C)								Life Ratings				
Part Number	DC Voltage 100V/Sec.			DC Voltage 100 V/ µSec.	DC Voltage 1kV/ µSec.	Capacitance (@1Mhz)	Insulation Resistance	AC Current 50Hz 1Sec.x10[1]	Surge Current 8/20µSec x10[1]	Max Single Surge 8/20µSec[1]	Max Single Surge 10/350µSec[1]	Surge Life 10/1000 µSecx300[1]
	MIN	TYP	MAX				MIN					
SL1021B075	60	75	90	500	650	<1.5pF	>10^{10} Ω (at 50V)	10Amps	10kA[2] 20kA[3]	15kA[2] 25kA[3]	4kA[2] 5kA[3]	200Amps
SL1021A090 SL1021B090	72	90	108									
SL1021A145 SL1021B145	116	145	174		600		>10^{10} Ω (at 100V)				2.5kA[2] 5kA[3]	
SL1021A150 SL1021B150	120	150	180									
SL1021A200	150	200	250									
SL1021A230 SL1021B230	184	230	276	450	650							
SL1021A250 SL1021B250	200	250	300	500								
SL1021A260 SL1021B260	210	260	310	550	700							
SL1021A300 SL1021B300	240	300	360	650	850							
SL1021A350 SL1021B350	280	350	420	700	900							
SL1021A400 SL1021B400	320	400	480	850	950							
SL1021A420 SL1021B420	345	420	500									
SL1021A450 SL1021B450	360	450	540	900	1000							
SL1021A500 SL1021B500	400	500	600	950	1100							
SL1021A600	480	600	720	1000	1200							

NOTES:
1. Total current through centre electrode, tested in accordance with ITU-T Rec K.12
2. SL1021A series
3. SL1021B series

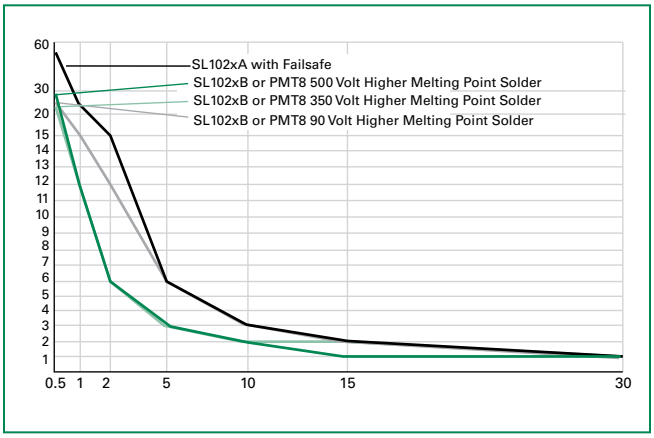
Additional Information

Datasheet SL1021A
Resources SL1021A
Samples SL1021A
Datasheet SL1021B
Resources SL1021B
Samples SL1021B

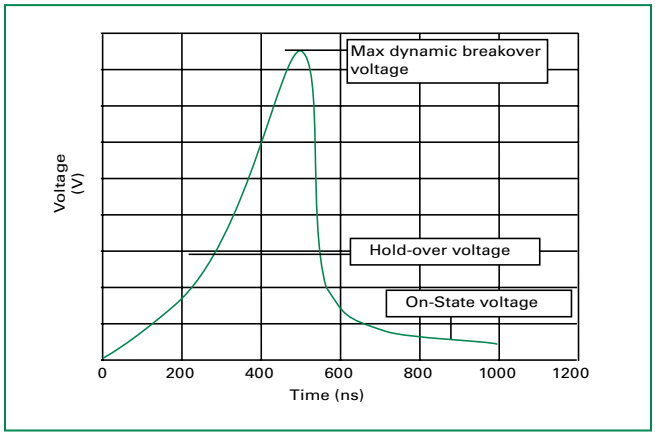
Revised: 11/06/15

Gas Discharge Tubes
SL1021A/B Series

Time vs. Current for Failsafe

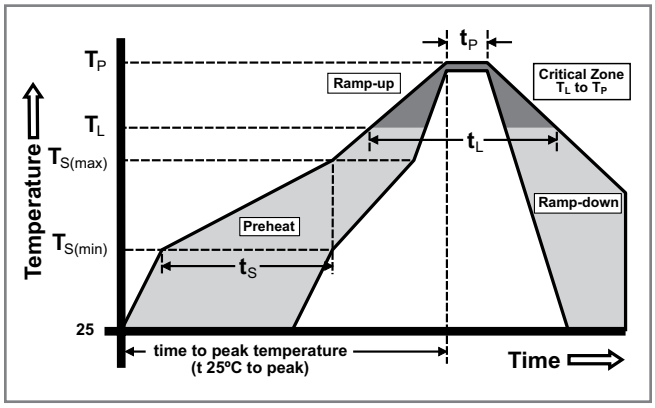


Voltage vs. Time Characteristic



Soldering Parameters - Reflow Soldering (Surface Mount Devices)

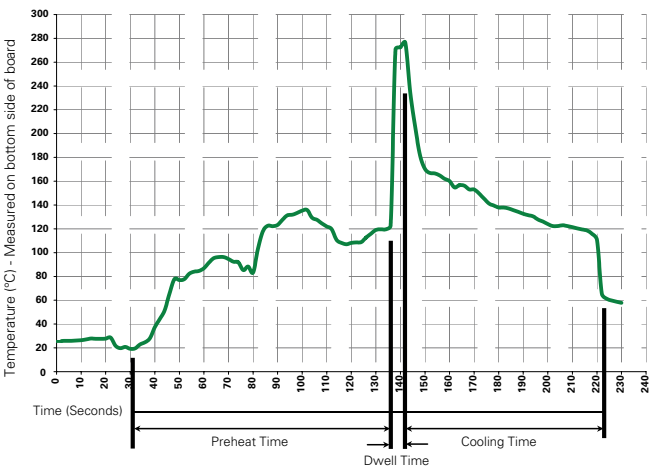
Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C



Soldering Parameters - Hand Soldering

Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

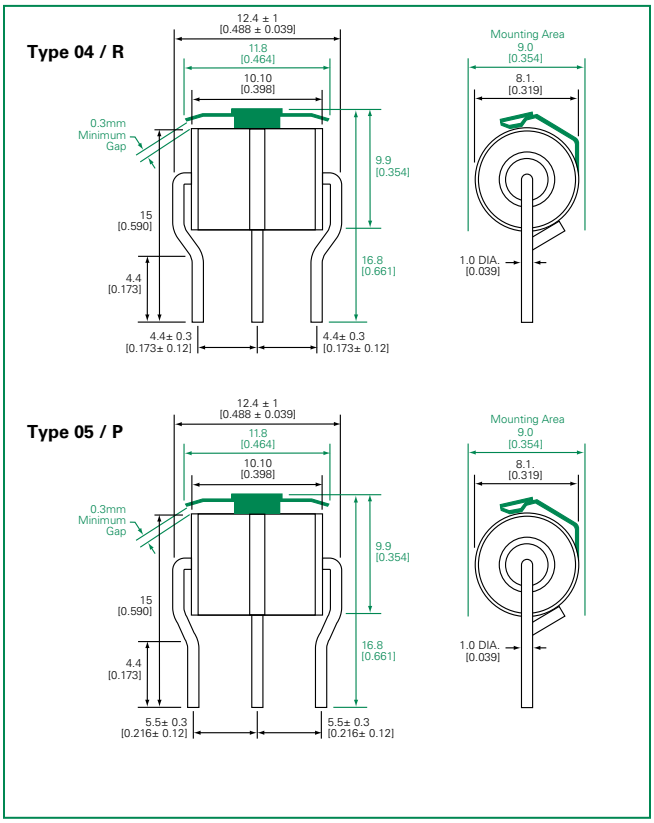
Note: Surge Arrestors with a Failsafe mechanism should be individually examined after soldering

Revised: 11/06/15

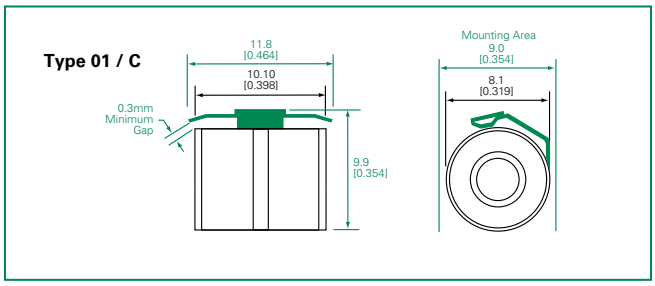
Device Dimensions

NOTE: Failsafe option dimensions shown in green.

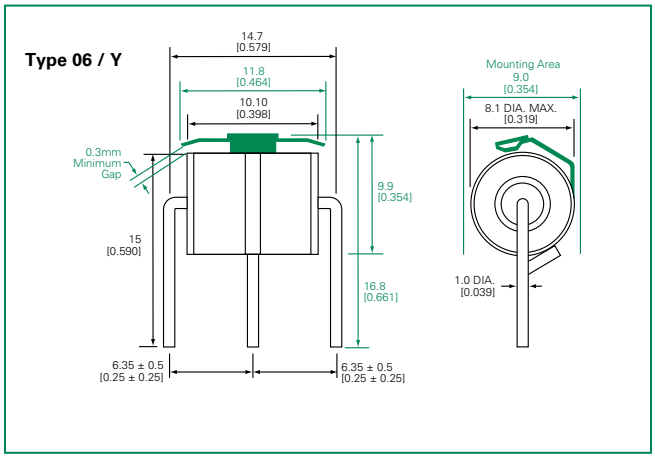
Shaped Radial Leaded Devices:



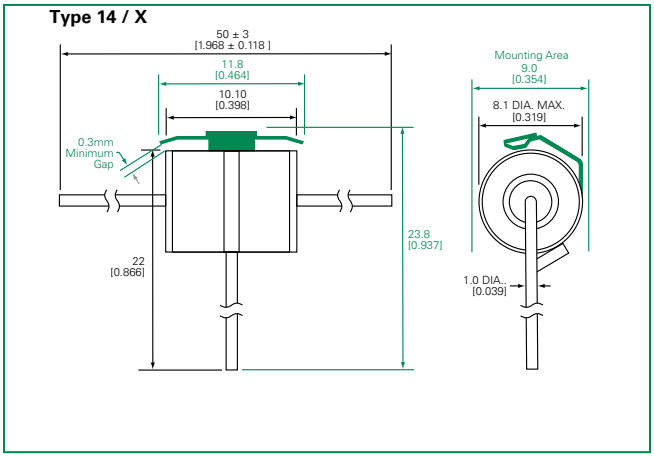
Core Devices:



Straight Radial Leaded Devices:



Straight "T" Leaded Devices:



Type “R” is available for SL1021B075 device only.

Revised: 11/06/15

Gas Discharge Tubes
SL1021A/B Series

Part Numbering System and Ordering Information

SL102x x xxx x x

Series
SL1021
SL1024

Surge Capability
A = 10kA
B = 20kA

Breakdown Voltage

090 = 90V	300 = 300V
145 = 145V	350 = 350V
150 = 150V	400 = 400V
200 = 200V	420 = 420V
230 = 230V	450 = 450V
250 = 250V	500 = 500V
260 = 260V	600 = 600V

Configuration Code
(See Device Dimensions section)

C	Y
R	X
P	

Option Code
Blank = No failsafe
F or G = With Failsafe

PMT8 xxx x x

Series
PMT8

Breakdown Voltage
090 = 90V
230 = 230V
250 = 250V
350 = 350V
400 = 400V

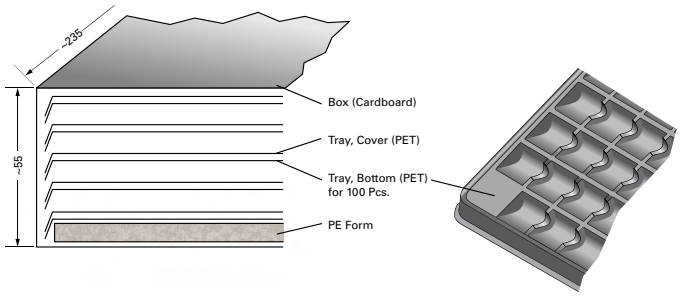
Configuration Code
(See Device Dimensions section)

01	10
04	14
05	60
06	

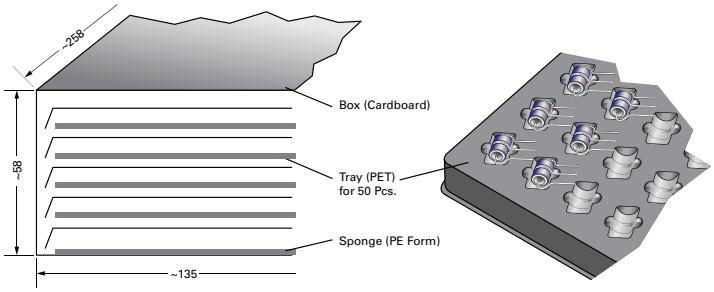
Option Code
Blank = No Failsafe
F = With Failsafe

Packaging

For 'SL1021A/B' device type C, R, P, Y packing



For 'SL1021A/B' device type X packing

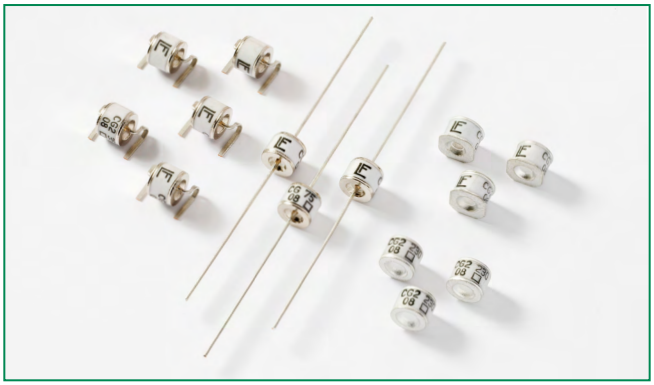


Device Type	Description	Quantity
Type C	100pcs/tray x 5 trays per carton	500
Type R	100pcs/tray x 5 trays per carton	500
Type P	100pcs/tray x 5 trays per carton	500
Type Y	100pcs/tray x 5 trays per carton	500
Type X	50pcs/tray x 5 trays per carton	250

* Please contact the factory for further packaging information.

Revised: 11/06/15

CG/CG2 Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662[1]
	E320116[2]

NOTES:
1. Certified to UL 497B.
2. Only CG2300, CG2470, CG2600, CG2800 and CG221000. Certified to UL 1449.

2 Electrode GDT Graphical Symbol

Additional Information

Datasheet CG/CG2

Resources CG/CG2

Samples CG/CG2

Description

Littelfuse highly reliable CG/CG2 Series GDTs provide a high degree of surge protection in a small size ideal for board level circuit protection.

GDTs function as switches which dissipate a minimum amount of energy and therefore handle currents that far surpass other types of transient voltage protection. Their gas-filled, rugged ceramic metal construction make them well suited to adverse environments.

The CG/CG2 series comes in a variety of forms including surface mount, core, straight and shaped leads, to serve a variety of mounting methods.

The CG Series (75V-110V) is ideal for protection of test and communication equipment and other devices in which low voltage limits and extremely low arc voltages are required.

The CG2 Series (145V-1000V) is ideal for protecting equipment where higher voltage limits and holdover voltages are necessary.

Features

- RoHS and Lead-free compliant
- Rugged Ceramic-Metal construction
- Low Capacitance (<1.5pf)
- Meets REA PE-80
- Available in surface mount, and a variety of lead options options

Applications

- Communication lines and equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Instrumentation circuits
- Medical electronics
- ADSL equipment
- Telecom SLIC protection

Revised: 11/06/15

Electrical Characteristics

Part Number	Device Specifications (at 25°C)								Life Ratings					
	DC Breakdown in Volts (@100V/s)			Impulse Breakdown in Volts (@100V/µs)	Impulse Breakdown In Volts (@1 Kv/µsec)	Insulation Resistance	Capacitance (@1MHz)	Arc Voltage (on state Voltage) @1Amp Min	Surge Life (@500A 10/1000µs)	Nominal Impulse Discharge Current (8/20µs)	Nominal AC Discharge Current (10x1sec @50-60Hz)	AC Dischage Current (9 cycle @50Hz)	DC Holdover Voltage[2]	Max Impulse Discharge Current (1 Application @ 10/350µs)
	MIN	TYP	MAX	MAX		MIN	MAX	TYP					TYP	
CG75	60	75	90	400	650	10^{10} Ω (at 50V)	1.5 pf	15 V	400 shots	10 shots (@20kA)[3]	20 A	100 A	52 V	4kA
CG90	72	90	108	400	600									
CG90 SN	72	90	108	400	600									
CG110	88	110	132	450	600								80 V	2.5kA
CG2145	116	145	174	500	600	10^{10} Ω (at 100V)								
CG2145 SN	120	145	174	500	600									
CG2230[1]	195	230	265	600	700								135 V	
CG2230 SN[1]	184	230	276	600	700									
CG2250	213	250	288	625	725									
CG2250 SN	200	250	300	625	725									
CG2300	255	300	345	700	800									
CG2300 SN	240	300	360	700	800									
CG2350	297	350	403	750	900									
CG2350 SN	280	350	420	750	900									
CG2420	357	420	483	800	1000									
CG2470[1]	400	470	540	850	1200									
CG2470 SN[1]	376	470	564	850	1200									
CG2600[1]	510	600	690	1000	1400									
CG2600 SN[1]	480	600	720	1000	1400									
CG2800[1]	680	800	920	1200	1500					10 shots (@10kA)	10 A	65 A		
CG21000[1]	850	1000	1150	1500	1600									

NOTES:
1. Certified to UL 1449.
2. Reference REA PE-80, 0.2A. Tested to ITU-T Rec K.12 and REA PE 80 < 150 mSec.
3. 5 x [5 (+) or 5 (-)] applications 20kA 8/20µSec. (75 to 600 volt devices.)
   10 x [5 (+) and 5 (-)] applications 10kA 8/20µSec. (800 and 100 volt devices.)

Product Characteristics

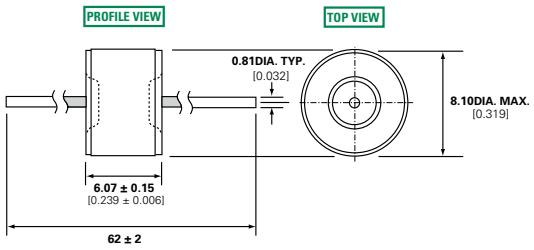
Materials	**LS, Axial:** Device: Tin Plated 2–5 Microns Lead Wires: Tin Plated 17.5 ± 12.5 Microns Construction: Ceramic Insulator **Core:** Device: Tin Plated 17.5 ± 12.5 Microns. Construction: Ceramic Insulator **MS:** Device: Dull Tin Plated 7–9 Microns Construction: Ceramic Insulator
Product Marking	LF Logo, Voltage and date code; Black in positive print

Glow to arc transition current	< 0.5Amps
Glow Voltage	60-160 Volts
Storage and Operational Temperature	-40 to +90
Maximum Follow On Current[1]	230 Volts r.m.s, 200 Amps. (800V and 1000V devices tested to UL1449 3rd edition)

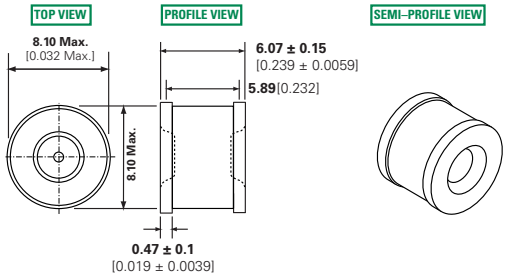
Revised: 11/06/15

Device Dimensions

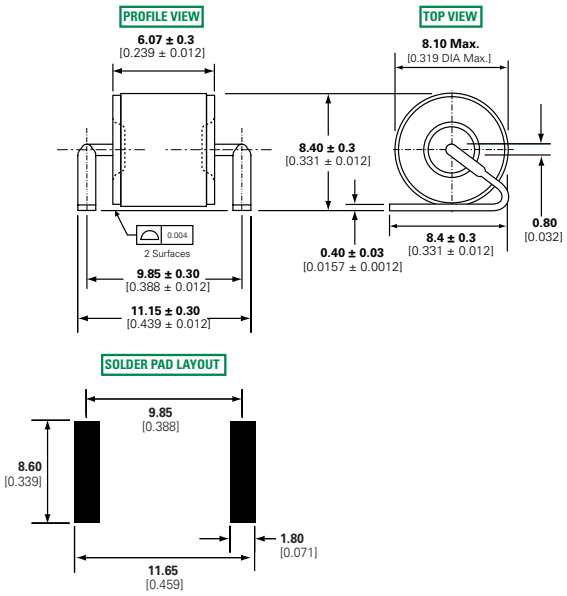
Leaded 'L' Type Straight Axial Devices



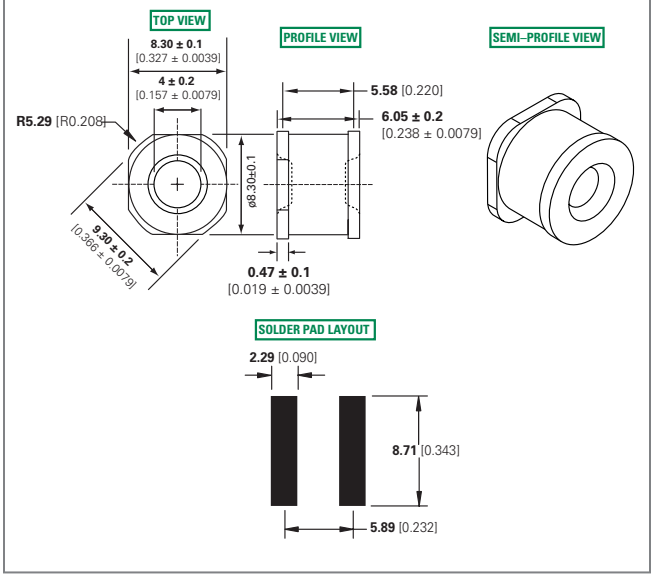
Core Devices



Leaded 'LS' Type Shaped Lead Devices



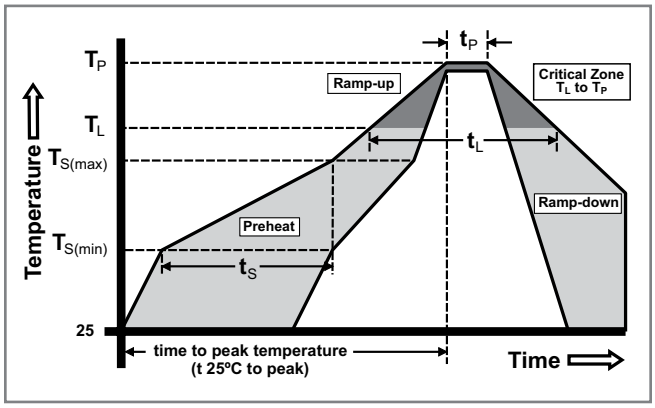
'MS' Type Devices



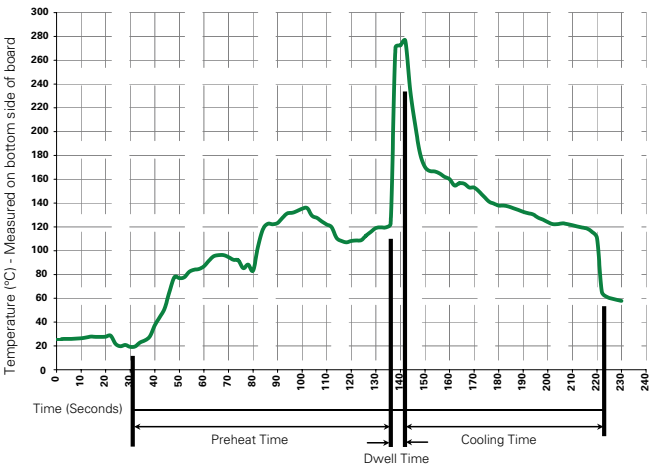
Revised: 11/06/15

Soldering Parameters - Reflow Soldering (Surface Mount Devices)

Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C



Soldering Parameters - Wave Soldering (Thru-Hole Devices)



Recommended Process Parameters:

Wave Parameter	Lead-Free Recommendation
Preheat: (Depends on Flux Activation Temperature)	(Typical Industry Recommendation)
Temperature Minimum:	100° C
Temperature Maximum:	150° C
Preheat Time:	60-180 seconds
Solder Pot Temperature:	280° C Maximum
Solder Dwell Time:	2-5 seconds

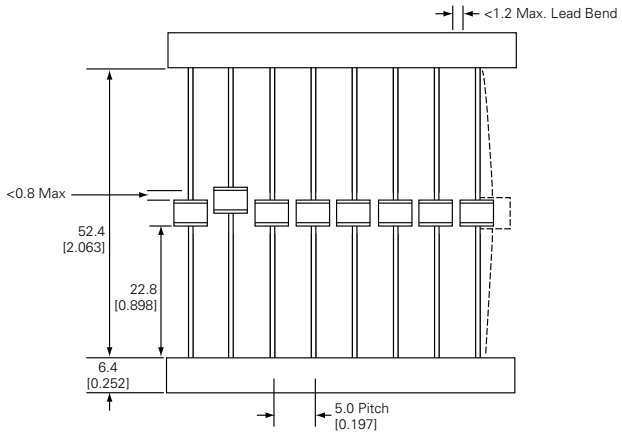
Soldering Parameters - Hand Soldering

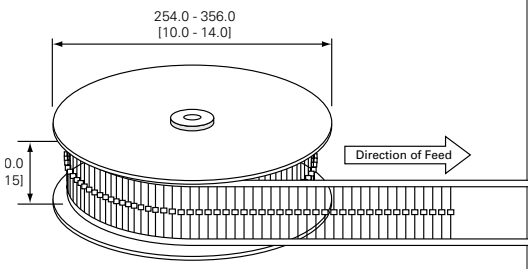
Solder Iron Temperature: 350° C +/- 5°C
Heating Time: 5 seconds max.

Revised: 11/06/15

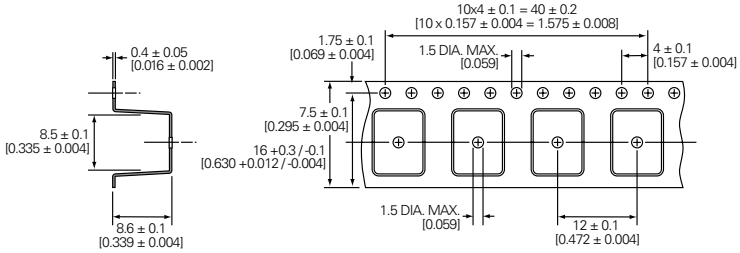
Packaging Dimensions

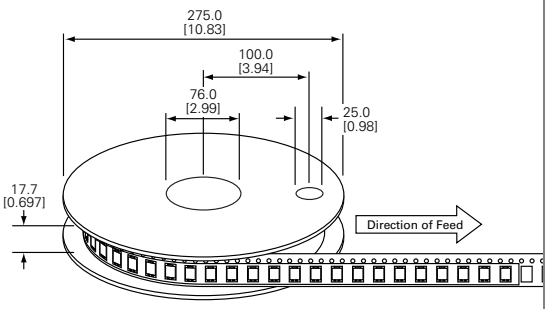
For 'L' Type Axial Lead Items



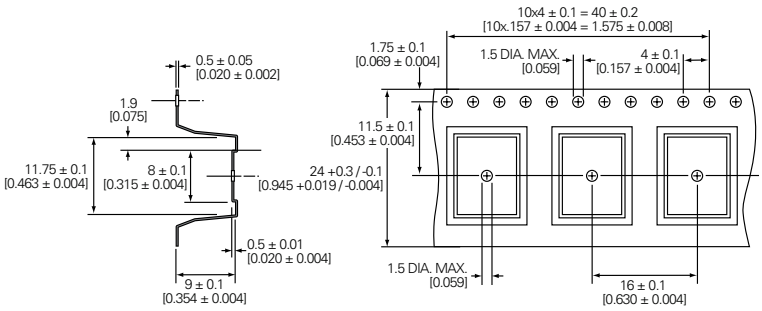


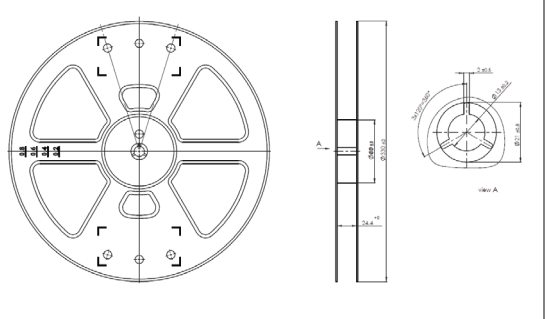
Core and 'MS' Type Items





For 'LS' Type Shaped Lead Items





Revised: 11/06/15

Part Numbering System and Ordering Information

CG2 XXX XX * XX

Series
CG – for 75, 90, or 110V
CG2 – for 145V to 1000V

Breakdown Voltage

75	**300**
90	**350**
110	**470**
145	**600**
230	**800**
250	**1000**

Lead Option Code
(Blank) = No Leads / Core
L = Straight Leads
LS = Shaped Leads
MS = Surface Mount

Option Code*
SN = may have different DC Breakover Voltage Limit. Please refer to Electrical Characteristics table for additional information.

Packaging Option Code
(Blank) = No Leads / Core, Bulk Bag - 400 pcs
L(Blank) = Straight Lead, Tray - 50 pcs
LTR = Straight Lead, Tape & Reel per EIA RS-296-E - 500 per reel
LS(Blank) = Shaped Lead (see LS dimensions), Tape & Reel - 500 per reel

Examples:

CG75 – A non-leaded 75V device

CG2230L – A leaded 230V device

CG2800LTR – A leaded 800V device, tape-and-reel (per EIA standard RS-296-D)

Notes:

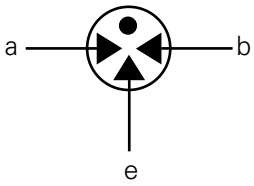
CG/CG2 devices with other breakdown voltages in the 75-1000 V range are available upon request.

Revised: 11/06/15

SL1026 Series

RoHS

3 Electrode GDT Graphical Symbol



a = TIP
b = RING
e = GROUND
(centre electrode)

Additional Information

Datasheet | **Resources** | **Samples**

Description

The SL1026 Series is a heavy-duty transient suppresser using Gas Plasma technology. In response to transients that exceed the device's breakover voltage, the device changes from a very high impedance state to a low impedance state to conduct harmful current away from the protected system. The SL1026 is designed to protect electrical and electronic equipment such as communications, control and railway systems. Carefully designed geometry ensures against short circuiting if a failure occurs due to conditions and events beyond the design criteria. Optional electrical mounting clip (part SL1053) is available to aid mounting and connection.

Features

- RoHS compliant
- 55 kA surge capability (single shot) tested with 8/20µS pulse as defined by IEC 61000-4-5
- 40 kA surge capability (repetitive)
- Will protect against Trapezoidal waveforms as specified in RIA 12.
- Will protect against capacitor discharge voltage transient waveforms as specified in RIA 12.
- Will protect against double exponential voltage transient waveforms as specified in IEC 571.

Applications

- Signaling equipment.
- Communication equipment
- Control gear.
- Trackside cabinets.
- Cell phone base stations

Electrical Characteristics

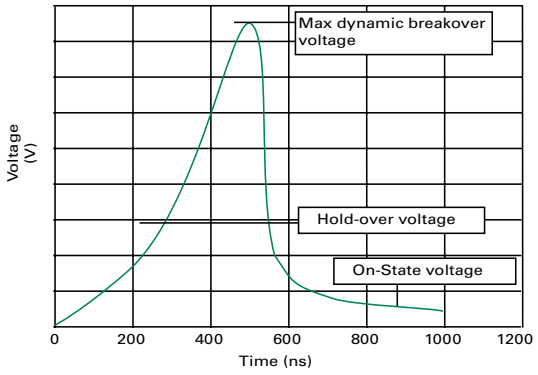
Part Number*	DC Voltage 100 V/sec		DC Voltage 1kV/µs	[1]AC Current 9 cycles @50-60Hz (Amps)	[1]AC Current 50Hz 1 sec x10 (Amps)	[1]Surge Current 8/20µSec x 10 (kAmps)	[1,2] Max Single Surge 8/20µSec (kAmps)	[1]Max Single Surge 10/350µSec (kAmps)	[1]150(+) and 150(-) 10/1000µSec (Amps)
	MIN	MAX							
SL1026-275	200	350	800	200	10	20	40	8	200
SL1026-400	300	500	900	200	10	20	40	8	200
SL1026-700	560	840	1300	200	10	20	40	8	200

NOTES:
End of life limits
– DC: 50% of minimum initial DC breakdown voltage limit to 150% of maximum initial DC breakdown voltage limit.
– Impulse: less that 150% of initial impulse breakdown voltage limit.
1. Total current through center electrode, tested using SL1053B-NL holder
2. Exceeds capability of SL1053B-NL holder

Revised: 11/06/15

Littelfuse
Expertise Applied | Answers Delivered

Voltage vs. Time Characteristic



Electrical Specifications

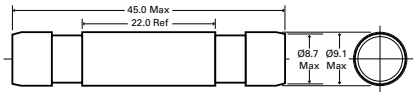
Insulation Resistance	> 10GΩ at 100 Volts
Capacitance:	<=2.5pf, 1MHz 0 Volts Bias
Holdover Voltage:	<150mS, tested at 130 volts according to ITU-T Rec. K.12 & REA PE 80
Arc Voltage:	~35 Volts, On State Voltage at 1 Amp (Depending on Voltage Type)
Glow to Arc Transition Current:	~1 Amp
Glow Voltage:	> 150 Volts, depending on Voltage Type

Physical Specifications

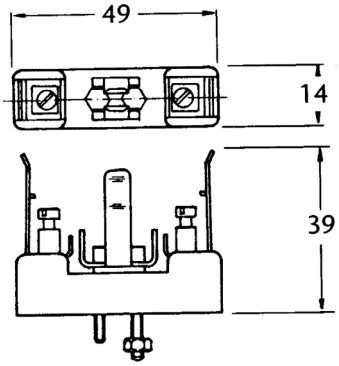
Weight:	11g (0.388 oz.)
Materials:	Electrode Base: Nickel Iron Alloy Electrode Plating: Nickel Body: Ceramic
Part Marking:	Color coded body SL1026-275: Black/Black SL1026-400: Black/Yellow SL1026-700: Black/Red
Storage and Operating Temperature:	-40°C to +90°C

Product Dimensions

SL1026 GDT Series Profile



Type 1053 Holder Profile



All dimensions in mm

Part Numbering System

SL 1026 – _ _ _

Voltage

Packaging

GDT devices are provided as bulk pack in poly bag -- 20 pieces per bag and 5 bags per carton.

Revised: 11/06/15

SE Series

Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662

2 Electrode GDT Graphical Symbol

Additional Information

Datasheet | Resources | Samples

Description

Littelfuse SE series GDT offers high surge ratings in a miniature package. It's designed for surface mounting on PCB with small size 3.2x1.6x1.6mm. Low insertion loss is perfectly suited to broadband equipment applications. The capacitance does not vary with voltage, and will not cause operational problems with ADSL2+, where capacitance variation across Tip and Ring is undesirable. These devices are extremely robust and are able to divert a 500A-600A pulse in a miniature package 1206 without destruction.

Features

- RoHS compliant and Lead-free
- GHz working frequency
- Excellent stability on multiple pulse duty cycle
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss
- 0.5-0.6KA surge capability tested with 8/20μS pulse as defined by IEC 61000-4-5
- Ultra small devices offered in a variety of mounting lead forms
- Non-Radioactive
- Low capacitance (<0.5pF)
- Voltage Ranges 140V to 500V
- UL recognized
- Conforms to ITU-T K12, IEC 1000-4-5
- Square Outline

Applications

- Communication equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Telecom SLIC protection
- Broadband equipment
- ADSL equipment, including ADSL2+
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

Revised: 11/06/15

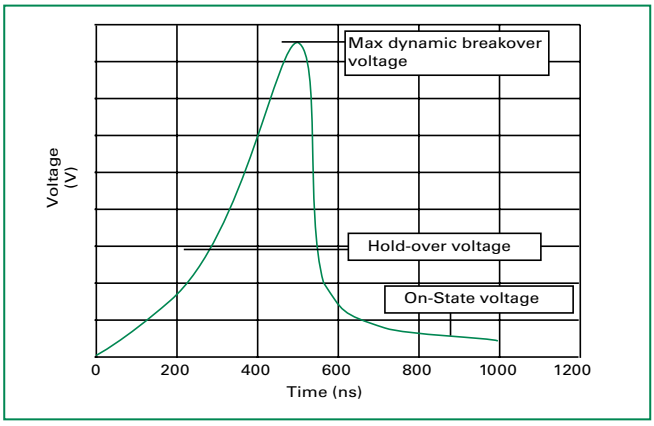
Electrical Characteristics

Part Number	Device Specifications (at 25°C)										Life Ratings	
	DC Breakdown in Volts (@100V/s)			Impulse Breakdown in Volts (@100V/µs)	Impulse Breakdown In Volts (@1 Kv/µsec)	Insulation Resistance	Capacitance (@1MHz)	Arc Voltage (@1A)	Glow to Arc Transition Current	Glow Voltage	Nominal Impulse Discharge Current (x10 @8/20µs)	Nominal Impulse Discharge Current (x10 @5/320µs)
	MIN	TYP	MAX	MAX		MIN	MAX					
SE140	98	140	182	800	900	>1GΩ (at 100VDC)	<0.5 pf	~10 V	<1.0 A	~60 V	0.5 kA	150 A
SE200	140	200	260	700	1100		<0.3 pf		<1.0 A			
SE230	172	230	276	600	800		<0.5 pf		<1.0 A			
SE350	265	350	495	900	1150		<0.5 pf		<1.0 A			
SE470	329	470	611	1050	1200		<0.3 pf		<1.0 A		0.5 kA	
SE500	400	500	600	1050	1200		<0.3 pf		<1.0 A		0.5 kA	

Product Characteristics

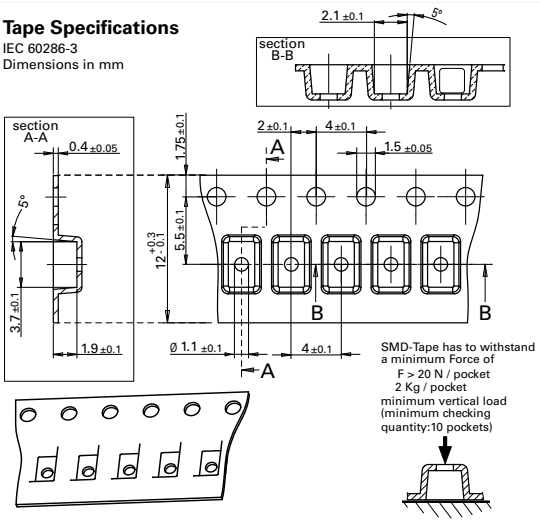
Materials	Device Tin Plated 17.5±12.5 Microns Construction Ceramic Insulator.
Storage and Operational Temperature	-40 to +90 °C

Voltage vs. Time Characteristic

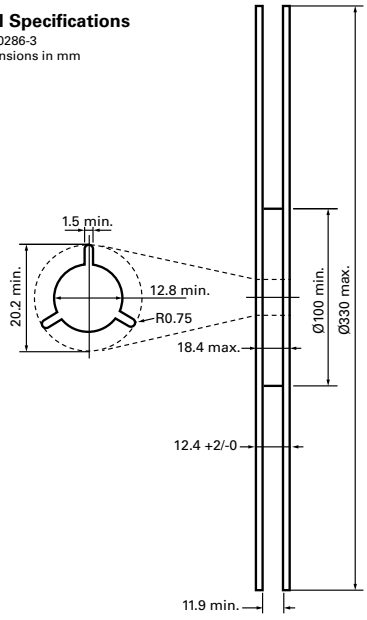


Tape and Reel Dimensions (IEC 60286-3, dimension in mm)

Tape Specifications
IEC 60286-3
Dimensions in mm



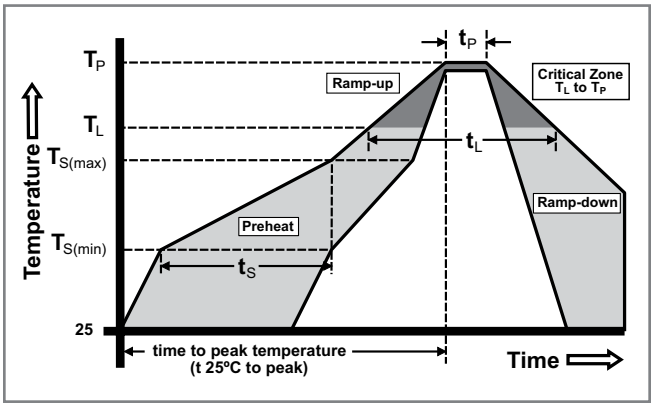
Reel Specifications
IEC 60286-3
Dimensions in mm



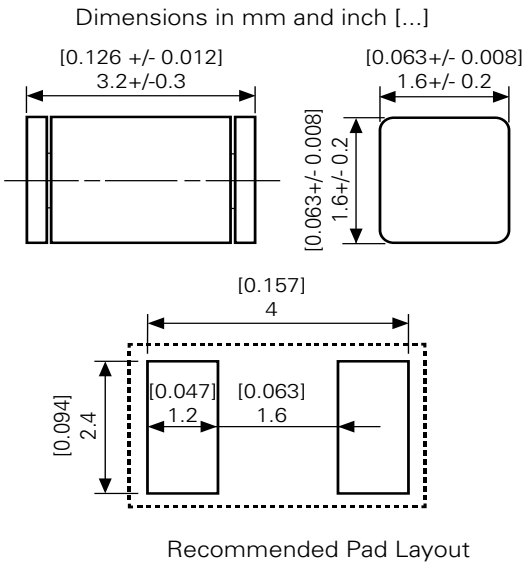
Revised: 11/06/15

Soldering Parameters - Reflow Soldering (Surface Mount Devices)

Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C



Device Dimensions



Recommended Pad Layout

Part Numbering System and Ordering Information

SE xxx

Series
1206 Square GDT

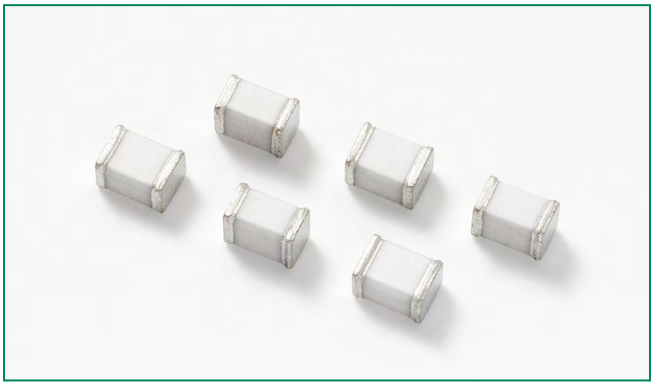
Breakdown Voltage
140 = 140V
200 = 200V
230 = 230V
350 = 350V
470 = 470V
500 = 500V

Packaging

Part Number	Packaging Option	Quantity
SE140	Tape and Reel	3,000
SE200	Tape and Reel	3,000
SE230	Tape and Reel	3,000
SE350	Tape and Reel	3,000
SE470	Tape and Reel	3,000
SE500	Tape and Reel	3,000

Revised: 11/06/15

SG Series



Agency Approvals

AGENCY	AGENCY FILE NUMBER
	E128662

2 Electrode GDT Graphical Symbol

Additional Information

Datasheet | Resources | Samples

Description

Littelfuse SG series GDT offers high surge ratings in a miniature package. It's designed for surface mounting on PCB with small size 4.5x3.2x2.7mm. Low insertion loss is perfectly suited to broadband equipment applications. The capacitance does not vary with voltage, and will not cause operational problems with ADSL2+, where capacitance variation across Tip and Ring is undesirable. These devices are extremely robust and are able to divert a 1000A pulse without destruction.

Features

- RoHS compliant and Lead-free
- GHz working frequency
- Excellent stability on multiple pulse duty cycle
- Excellent response to fast rising transients.
- Ultra Low Insertion Loss
- 1-2KA surge capability tested with 8/20µS pulse as defined by IEC 61000-4-5
- Ultra small devices offered in a variety of mounting lead forms
- Non-Radioactive
- Low capacitance (<1pF)
- Voltage Ranges 75V to 600V
- UL recognized
- Conforms to ITU-T K12, IEC 1000-4-5
- Square Outline

Applications

- Communication equipment
- CATV equipment
- Test equipment
- Data lines
- Power supplies
- Telecom SLIC protection
- Broadband equipment
- ADSL equipment, including ADSL2+
- XDSL equipment
- Satellite and CATV equipment
- General telecom equipment

Revised: 11/06/15

Gas Discharge Tubes
SG Series

Electrical Characteristics

Part Number	Device Specifications (at 25°C)										Life Ratings		
	DC Breakdown in Volts (@100V/s)			Impulse Breakdown in Volts (@100V/µs)	Impulse Breakdown In Volts (@1 Kv/µsec)	Insulation Resistance	Capacitance (@1MHz)	Arc Voltage (@1A)	Glow to Arc Transition Current	Glow Voltage	Nominal AC Discharge Current (x10 @50Hz)	Nominal Impulse Discharge Current (x10 @8/20µs)	Nominal Impulse Discharge Current (10/1000µs 100 cycles)
	MIN	TYP	MAX	MAX		MIN	MAX						
SG75	52	75	98	500	650	>1GΩ (at 50VDC)	<1 pf	~10 V	~1.0 A	~60 V	2 A	2kA	10 A
SG90	63	90	117	500	600								
SG150	105	150	195	500	600								
SG200	140	200	260	550	700	>1GΩ (at 100VDC)					2.5 A	1kA	
SG230	172	230	288	650	800	>1GΩ (at 50VDC)					2 A		
SG300	225	300	375	700	850			~12 V	~0.5 A	~90 V			
SG300Q	210	300	390	580	650			~20 V	~0.8 A	~140 V	NA*		
SG350	263	350	437	750	900		<0.8 pf	~12 V	~0.5 A	~90 V	2 A		
SG350Q	263	350	437	600	700					~140 V	NA*		
SG400	300	400	500	800	950					~90 V	2 A		
SG420	315	420	525	800	1000		<1 pf	~10 V	<1.0 A	~60 V	2 A		
SG420Q	315	420	525	650	750			~20 V		~140 V	NA*		
SG450Q	370	450	500	680	750	>1GΩ (at 100VDC)		~20 V			1 A		
SG500Q	400	500	600	950	1050		<0.5 pf	~16 V	~0.1 A		2 A		
SG600Q	450	600	750	1100	1200		<1 pf	~20 V	<0.5 A				

* Specification is not applicable for quick response (SGxxx**Q**) version of product

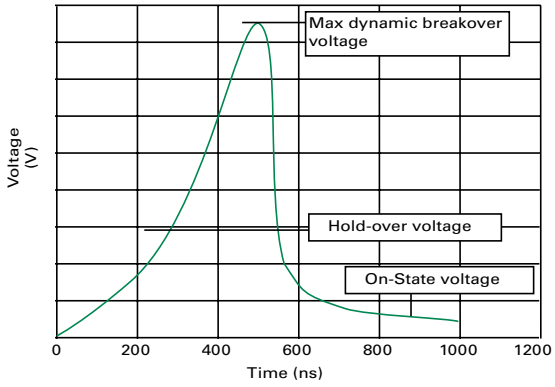
Product Characteristics

Materials	Device Tin Plated 17.5±12.5 Microns Construction Ceramic Insulator.
Storage and Operational Temperature	-40 to +90 °C

Typical Insertion Loss

@ 1.0 GHz = 0.01 dB
@ 1.4GHz = 0.1 dB
@ 1.8 GHz = 0.53 dB
@ 2.1 GHz = 0.81 dB
@ 2.45 GHz= 1 dB
@ 2.8 GHz = 1.2 dB
@ 3.1 GHz = 1.5 dB
@ 3.5 GHz = 2.1 dB

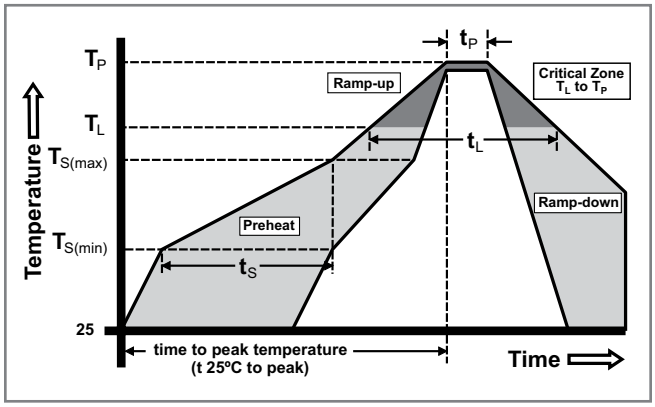
Voltage vs. Time Characteristic



Revised: 11/06/15

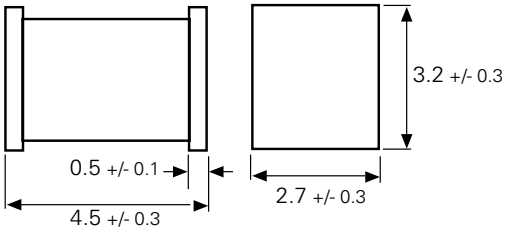
Soldering Parameters - Reflow Soldering (Surface Mount Devices)

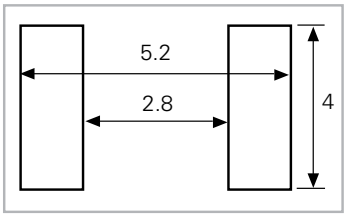
Reflow Condition		Pb – Free assembly
Pre Heat	-Temperature Min ($T_{s(min)}$)	150°C
	-Temperature Max ($T_{s(max)}$)	200°C
	-Time (Min to Max) (t_s)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
$T_{S(max)}$ to T_L - Ramp-up Rate		5°C/second max
Reflow	-Temperature (T_L) (Liquidus)	217°C
	-Temperature (t_L)	60 – 150 seconds
Peak Temperature (T_P)		$260^{+0/-5}$ °C
Time within 5°C of actual peak Temperature (t_p)		10 – 30 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C



Device Dimensions

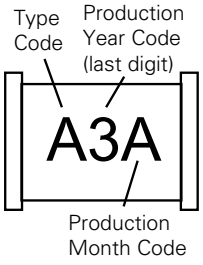
Dimensions in Millimeters.





Recommended Soldering Pad Layout

Device Marking



Type Code	
A	SG75
B	SG90
C	SG150
D	SG230
E	SG300
F	SG300Q
G	SG350
H	SG350Q
I	SG400
J	SG420
K	SG420Q
L	SG450Q
M	SG500Q
N	SG600Q
O	SG200

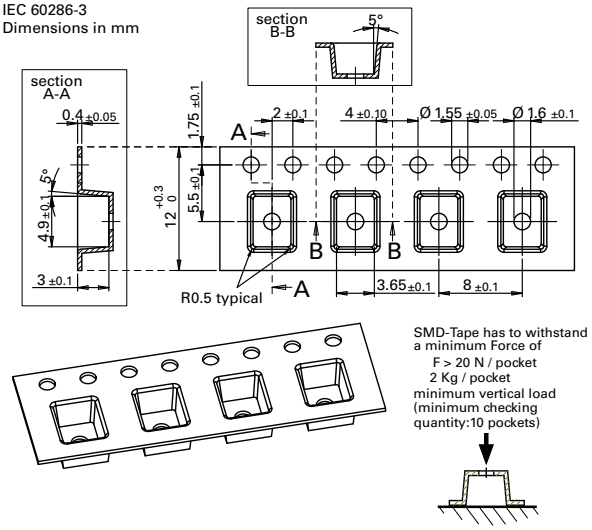
Month Code	
A	January
B	February
C	March
D	April
E	May
F	June
G	July
H	August
I	September
J	October
K	November
L	December

Revised: 11/06/15

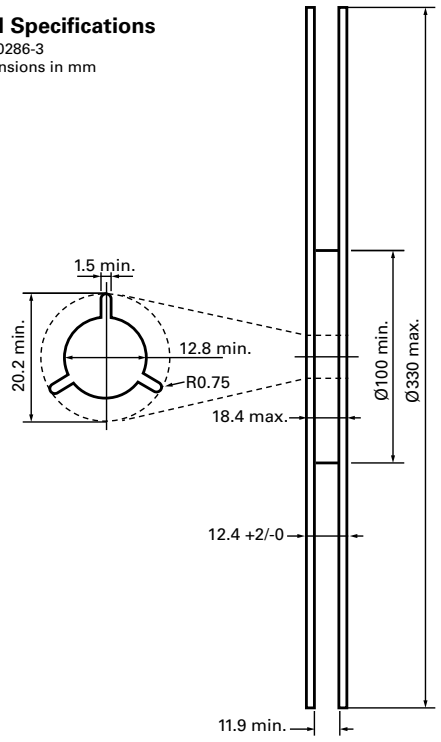
Gas Discharge Tubes
SG Series

Tape and Reel Dimensions (IEC 60286-3, dimension in mm)

Tape Specifications
IEC 60286-3
Dimensions in mm



Reel Specifications
IEC 60286-3
Dimensions in mm



Part Numbering System and Ordering Information

SG xxx Q

Series
Square GDT

Breakdown Voltage
75 = 75V
90 = 90V
150 = 150V
200 = 200V
230 = 230V
300 = 300V
350 = 350V
400 = 400V
420 = 420V
450 = 450V (Not available without "Q" suffix)
500 = 500V (Not available without "Q" suffix)
600 = 600V (Not available without "Q" suffix)

Device Option Code
(Blank) = Standard device
Q = Quick Response Version (300V, 350V, 420V, 450V, 500V, 600V only)

Packaging

Part Number and Device Type		Quantity and Packaging Description
SGxxx	Surface mount	2000pcs/reel in tape and reel

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