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Jameco Part Number 670653

## **11A, 200V, 0.500 Ohm, P-Channel Power MOSFETs**

These are P-Channel enhancement mode silicon-gate power field-effect transistors. They are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. All of these power MOSFETs are designed for applications such as switching regulators, switching converters, motor drivers, relay drivers and as drivers for other high-power switching devices. The high input impedance allows these types to be operated directly from integrated circuits.

Formerly developmental type TA17522.

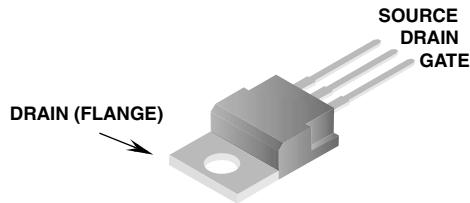
### **Ordering Information**

PART NUMBER	PACKAGE	BRAND
IRF9640	TO-220AB	IRF9640
RF1S9640SM	TO-263AB	RF1S9640

NOTE: When ordering, use the entire part number. Add the suffix 9A to obtain the TO-263AB variant in the tape and reel, i.e., RF1S9640SM9A.

### **Packaging**

JEDEC TO-220AB



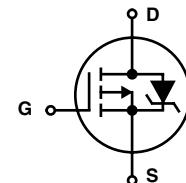
JEDEC TO-263AB



### **Features**

- 11A, 200V
- $r_{DS(ON)} = 0.500\Omega$
- Single Pulse Avalanche Energy Rated
- SOA is Power Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance
- Related Literature
  - TB334, "Guidelines for Soldering Surface Mount Components to PC Boards"

### **Symbol**



# IRF9640, RF1S9640SM

## Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

	IRF9640, RF1S9640SM	UNITS
Drain to Source Breakdown Voltage (Note 1) . . . . .	$V_{DS}$	-200
Drain to Gate Voltage ( $R_{GS} = 20\text{k}\Omega$ ) (Note 1) . . . . .	$V_{DGR}$	-200
Continuous Drain Current . . . . .	$I_D$	-11
$T_C = 100^\circ\text{C}$ . . . . .	$I_D$	-7
Pulsed Drain Current (Note 2) . . . . .	$I_{DM}$	-44
Gate to Source Voltage . . . . .	$V_{GS}$	$\pm 20$
Maximum Power Dissipation . . . . .	$P_D$	125
Linear Derating Factor . . . . .		1
Single Pulse Avalanche Energy Rating (Note 3, 4) . . . . .	$E_{AS}$	790
Operating and Storage Temperature . . . . .	$T_J, T_{STG}$	-55 to 150
Maximum Temperature for Soldering		
Leads at 0.063in (1.6mm) from Case for 10s. . . . .	$T_L$	300
Package Body for 10s, See Techbrief 334 . . . . .	$T_{pkg}$	260

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

### NOTE:

1.  $T_J = 25^\circ\text{C}$  to  $125^\circ\text{C}$

## Electrical Specifications $T_C = 25^\circ\text{C}$ , Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS	
Drain to Source Breakdown Voltage	$BV_{DSS}$	$I_D = -250\mu\text{A}, V_{GS} = 0\text{V}$ (Figure 10)	-200	-	-	V	
Gate Threshold Voltage	$V_{GS(\text{TH})}$	$V_{GS} = V_{DS}, I_D = -250\mu\text{A}$	-2	-	-4	V	
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS} = \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}$	-	-	25	$\mu\text{A}$	
		$V_{DS} = 0.8 \times \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}, T_C = 125^\circ\text{C}$	-	-	250	$\mu\text{A}$	
On-State Drain Current (Note 2)	$I_{D(\text{ON})}$	$V_{DS} > I_{D(\text{ON})} \times r_{DS(\text{ON})\text{MAX}}, V_{GS} = -10\text{V}$	-11	-	-	A	
Gate to Source Leakage Current	$I_{GSS}$	$V_{GS} = \pm 20\text{V}$	-	-	$\pm 100$	nA	
Drain to Source On Resistance (Note 2)	$r_{DS(\text{ON})}$	$I_D = -6\text{A}, V_{GS} = -10\text{V}$ (Figures 8, 9)	-	0.350	0.500	$\Omega$	
Forward Transconductance (Note 2)	$g_{fs}$	$V_{DS} > I_{D(\text{ON})} \times r_{DS(\text{ON})\text{MAX}}, I_D = -6\text{A}$ (Figure 12)	4	6	-	S	
Turn-On Delay Time	$t_{d(\text{ON})}$	$V_{DD} = 0.5 \times \text{Rated } BV_{DSS}, I_D \approx -11\text{A}, R_G = 9.1\Omega$	-	18	22	ns	
Rise Time	$t_r$	$V_{GS} = -10\text{V}$ (Figures 17, 18)	-	45	68	ns	
Turn-Off Delay Time	$t_{d(\text{OFF})}$	$R_L = 8.4\Omega$ for $V_{DSS} = -100\text{V}$	-	75	90	ns	
Fall Time	$t_f$	$R_L = 6.1\Omega$ for $V_{DSS} = -75\text{V}$	-	29	44	ns	
Total Gate Charge (Gate to Source + Gate to Drain)	$Q_{g(\text{TOT})}$	$V_{GS} = -10\text{V}, I_D = -11\text{A}, V_{DS} = 0.8 \times \text{Rated } BV_{DSS}$ $I_{g(\text{REF})} = -1.5\text{mA}$ (Figures 14, 19, 20)	-	70	90	nC	
Gate to Source Charge	$Q_{gs}$	Gate Charge is Essentially Independent of Operating Temperature	-	55	-	nC	
Gate to Drain "Miller" Charge	$Q_{gd}$		-	15	-	nC	
Input Capacitance	$C_{iss}$	$V_{DS} = -25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ (Figure 11)	-	1100	-	pF	
Output Capacitance	$C_{oss}$		-	375	-	pF	
Reverse Transfer Capacitance	$C_{rss}$		-	150	-	pF	
Internal Drain Inductance	$L_D$	Measured From the Contact Screw on Tab To Center of Die	Modified MOSFET Symbol Showing the Internal Devices Inductances	-	3.5	-	nH
		Measured From the Drain Lead, 6mm (0.25in) from Package to Center of Die		-	4.5	-	nH
Internal Source Inductance	$L_S$	Measured From the Source Lead, 6mm (0.25in) from Header to Source Bonding Pad	oD L <sub>D</sub> G L <sub>S</sub> oS	-	7.5	-	nH
Thermal Resistance Junction to Case	$R_{\theta JC}$		-	-	1.0	$^\circ\text{C}/\text{W}$	
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	Typical Socket Mount	-	-	62.5	$^\circ\text{C}/\text{W}$	

## Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Continuous Source to Drain Current	$I_{SD}$	Modified MOSFET Symbol Showing the Integral Reverse P-N Junction Diode	-	-	-11	A
Pulse Source to Drain Current (Note 3)	$I_{SDM}$		-	-	-44	A
Source to Drain Diode Voltage (Note 2)	$V_{SD}$	$T_J = 25^\circ\text{C}$ , $I_{SD} = -11\text{A}$ , $V_{GS} = 0\text{V}$ (Figure 13)	-	-	-1.5	V
Reverse Recovery Time	$t_{rr}$	$T_J = 150^\circ\text{C}$ , $I_{SD} = -11\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	300	-	ns
Reverse Recovery Charge	$Q_{RR}$	$T_J = 150^\circ\text{C}$ , $I_{SD} = -11\text{A}$ , $dI_{SD}/dt = 100\text{A}/\mu\text{s}$	-	1.9	-	$\mu\text{C}$

## NOTES:

2. Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , duty cycle  $\leq 2\%$ .
3. Repetitive Rating: Pulse width limited by Max junction temperature. See Transient Thermal Impedance curve (Figure 3).
4.  $V_{DD} = 50\text{V}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 9.8\text{mH}$ ,  $R_G = 25\Omega$ , peak  $I_{AS} = 11\text{A}$ . See Figures 15, 16.

## Typical Performance Curves Unless Otherwise Specified

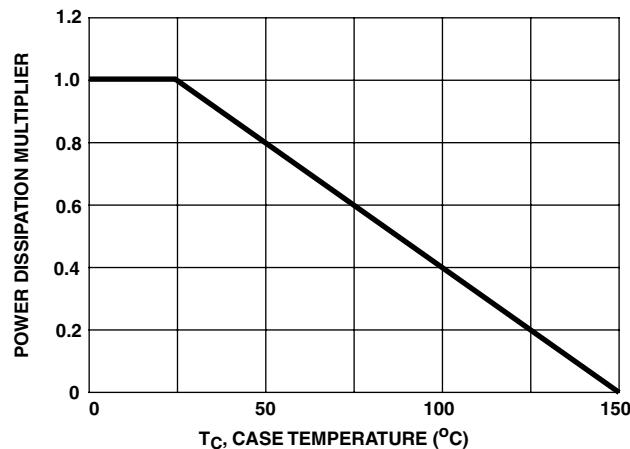


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

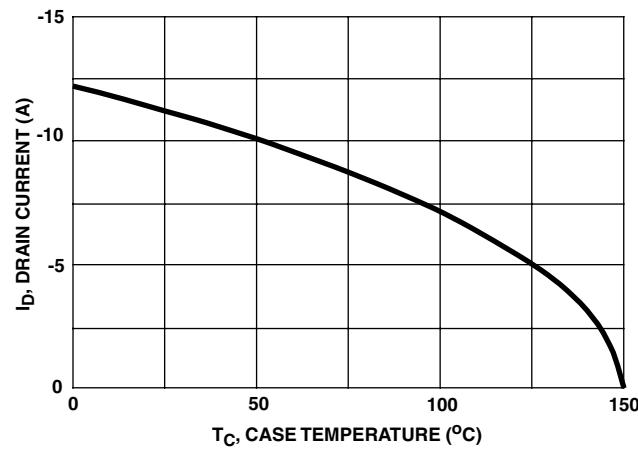


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

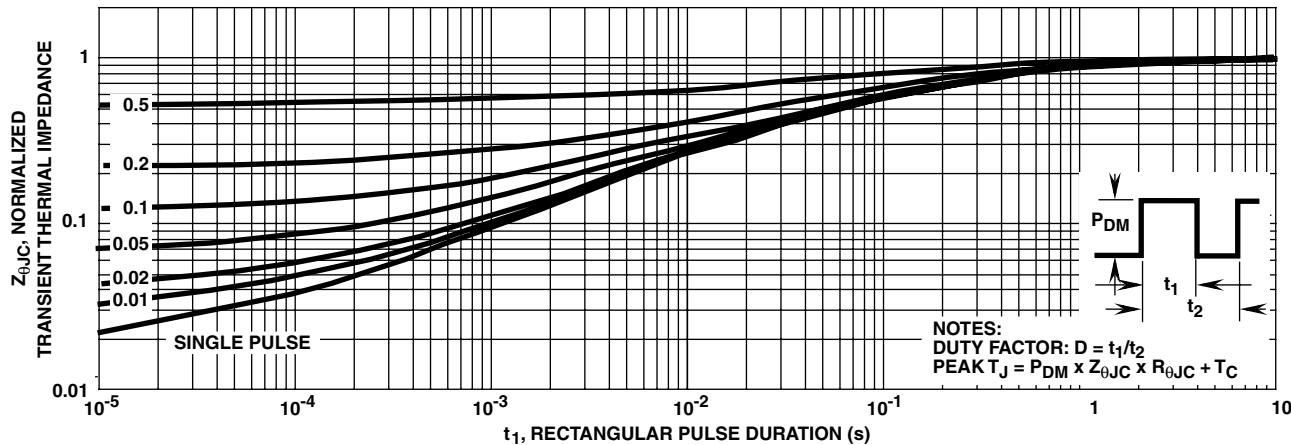


FIGURE 3. MAXIMUM TRANSIENT THERMAL IMPEDANCE

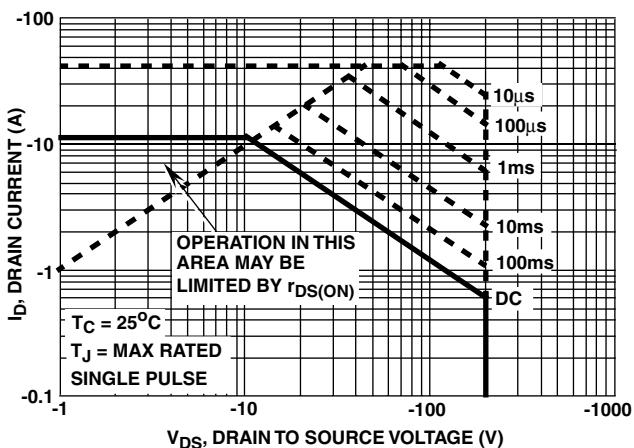
**Typical Performance Curves** Unless Otherwise Specified (Continued)

FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

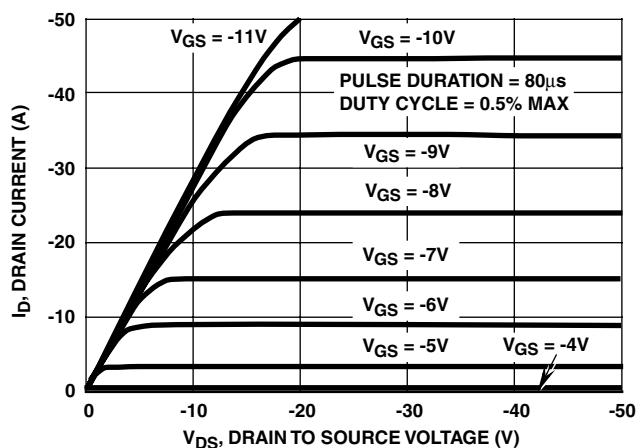


FIGURE 5. OUTPUT CHARACTERISTICS

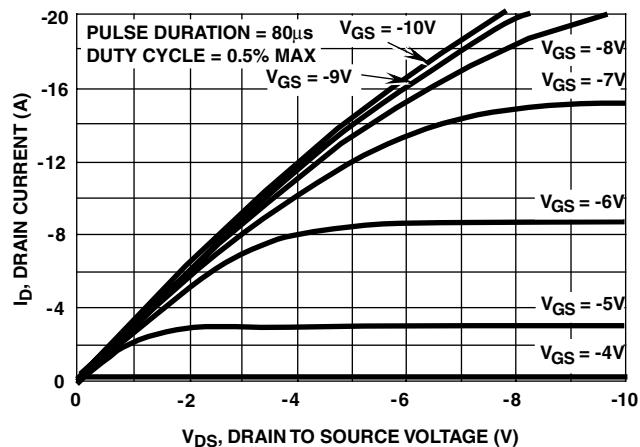


FIGURE 6. SATURATION CHARACTERISTICS

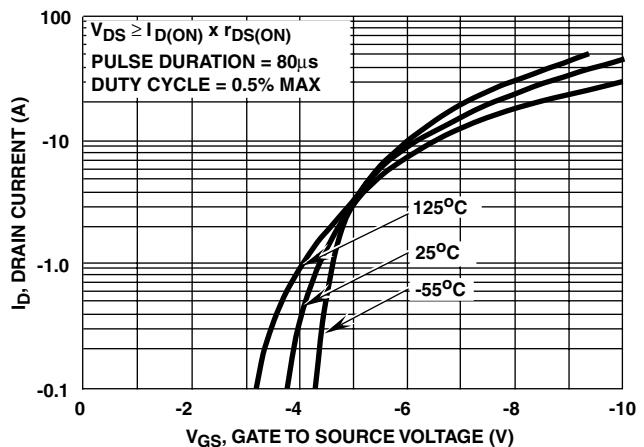
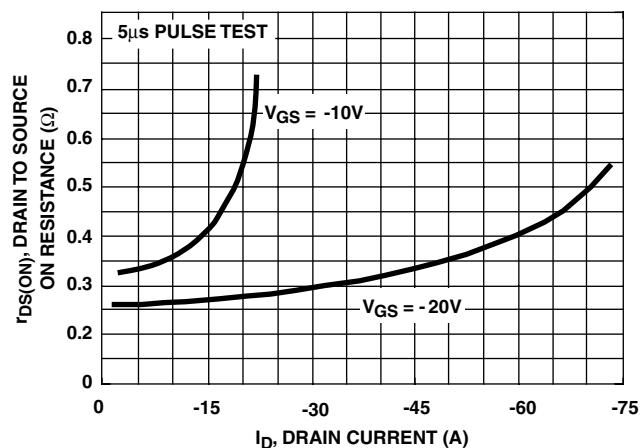


FIGURE 7. TRANSFER CHARACTERISTICS



NOTE: Heating effect of 5 μs pulse is minimal.

FIGURE 8. DRAIN TO SOURCE ON RESISTANCE vs GATE VOLTAGE AND DRAIN CURRENT

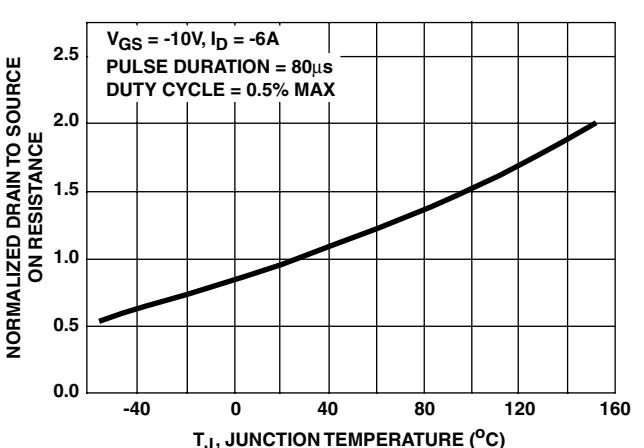


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

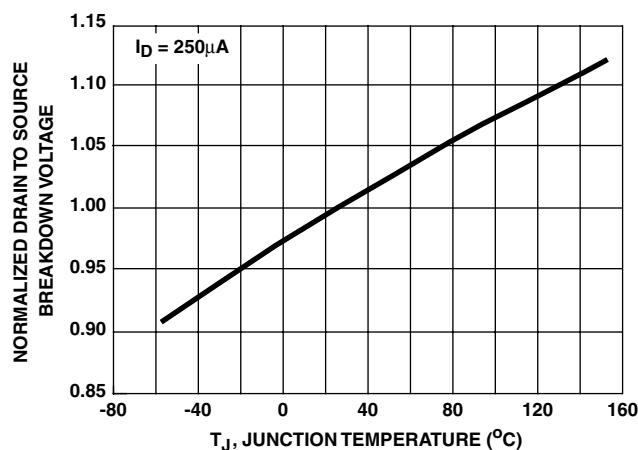
**Typical Performance Curves** Unless Otherwise Specified (Continued)

FIGURE 10. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

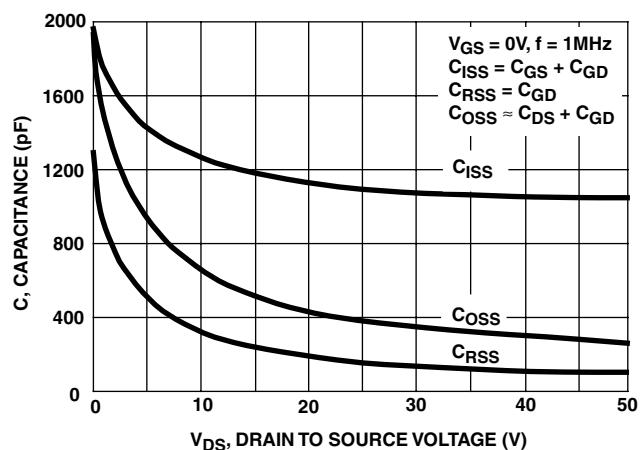


FIGURE 11. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

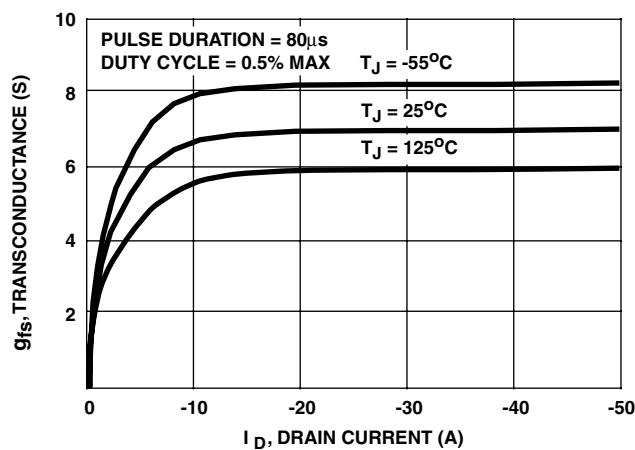


FIGURE 12. TRANSCONDUCTANCE vs DRAIN CURRENT

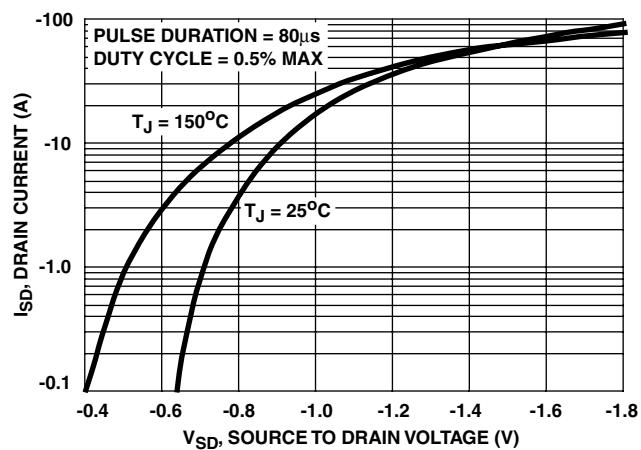


FIGURE 13. SOURCE TO DRAIN DIODE VOLTAGE

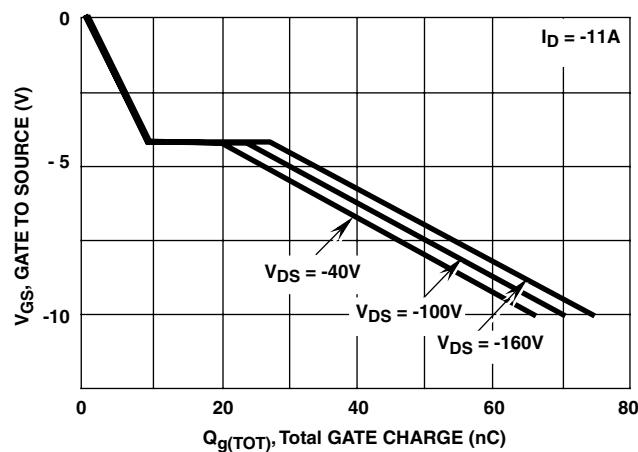


FIGURE 14. GATE TO SOURCE VOLTAGE vs GATE CHARGE

## Test Circuits and Waveforms

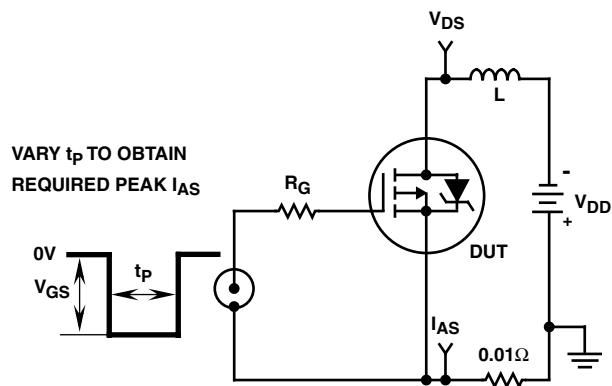


FIGURE 15. UNCLAMPED ENERGY TEST CIRCUIT

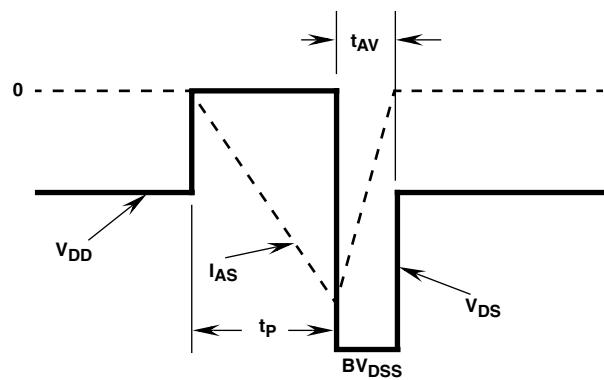


FIGURE 16. UNCLAMPED ENERGY WAVEFORMS

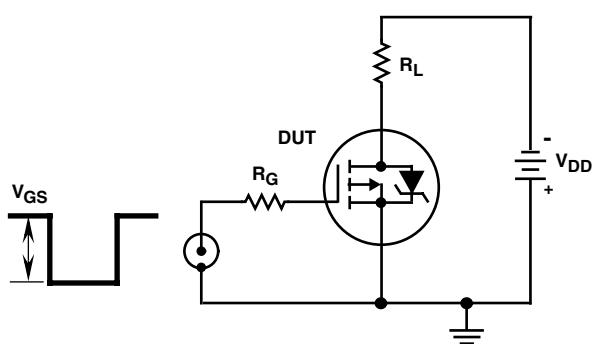


FIGURE 17. SWITCHING TIME TEST CIRCUIT

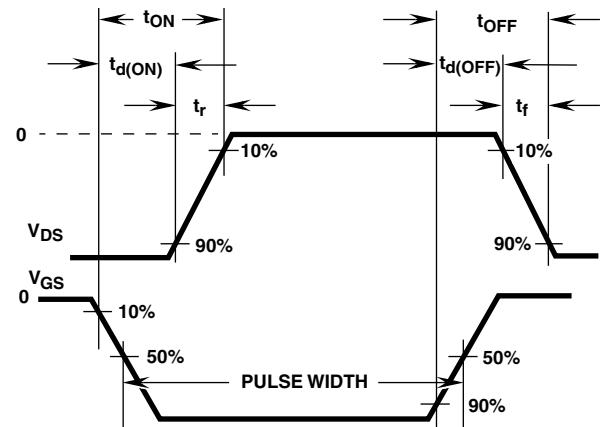


FIGURE 18. RESISTIVE SWITCHING WAVEFORMS

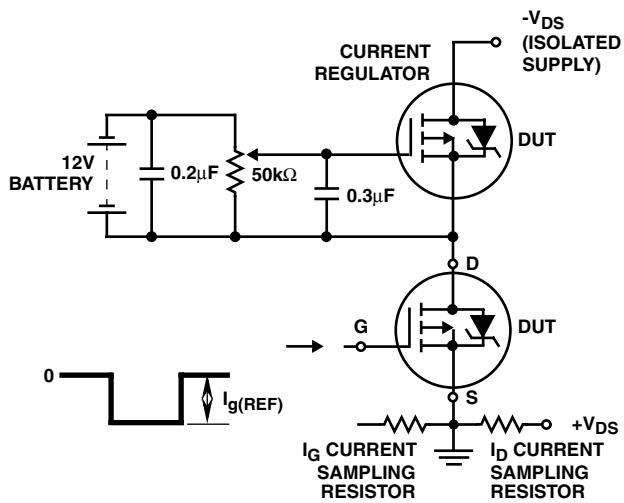


FIGURE 19. GATE CHARGE TEST CIRCUIT

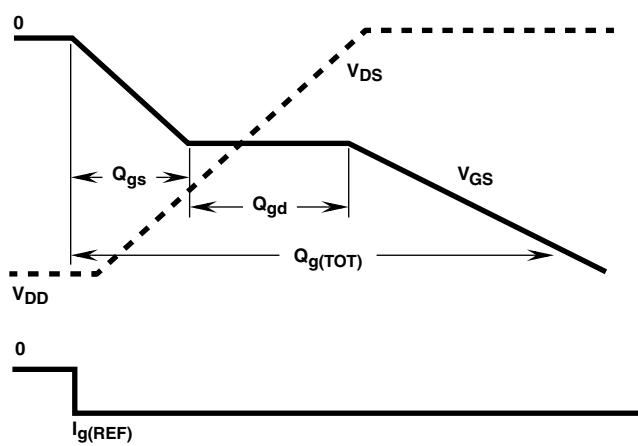


FIGURE 20. GATE CHARGE WAVEFORMS

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CROSSVOLT <sup>TM</sup>	GlobalOptoisolator <sup>TM</sup>	POP <sup>TM</sup>	SuperSOT <sup>TM</sup> -3	
DenseTrench <sup>TM</sup>	GTOT <sup>TM</sup>	Power247 <sup>TM</sup>	SuperSOT <sup>TM</sup> -6	
DOME <sup>TM</sup>	HiSeC <sup>TM</sup>	PowerTrench <sup>®</sup>	SuperSOT <sup>TM</sup> -8	
EcoSPARK <sup>TM</sup>	ISOPLANAR <sup>TM</sup>	QFET <sup>TM</sup>	SyncFET <sup>TM</sup>	
E <sup>2</sup> CMOS <sup>TM</sup>	LittleFET <sup>TM</sup>	QS <sup>TM</sup>	TinyLogic <sup>TM</sup>	
EnSigna <sup>TM</sup>	MicroFET <sup>TM</sup>	QT Optoelectronics <sup>TM</sup>	TruTranslation <sup>TM</sup>	
FACT <sup>TM</sup>	MicroPak <sup>TM</sup>	Quiet Series <sup>TM</sup>	UHC <sup>TM</sup>	
FACT Quiet Series <sup>TM</sup>	MICROWIRE <sup>TM</sup>	SILENT SWITCHER <sup>®</sup>	UltraFET <sup>®</sup>	

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## PRODUCT STATUS DEFINITIONS

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Datasheet Identification	Product Status	Definition
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