

6.5A, 200V, 0.800 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 drivers for other high-power switching devices. The high input impedance allows these types to be operated directly from integrated circuits.

Formerly developmental type TA17512.

Ordering Information

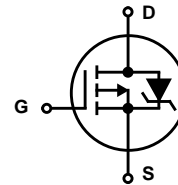
| PART NUMBER | PACKAGE | BRAND |
|-------------|----------|----------|
| IRF9630 | TO-220AB | IRF9630 |
| RF1S9630SM | TO-263AB | RF1S9630 |

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., RF1S9630SM9A.

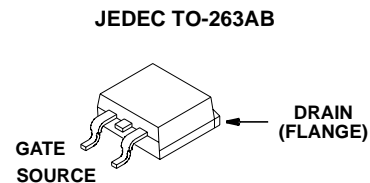
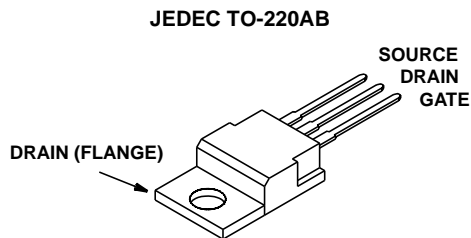
Features

- 6.5A, 200V
- $r_{DS(ON)} = 0.800\Omega$
- 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



Packaging



IRF9630, RF1S9630SM

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

| | IRF9630, RF1S9630SM | UNITS |
|---|------------------------------|---------------------------|
| Drain to Source Voltage (Note 1) | V_{DS} -200 | V |
| Drain to Gate Voltage ($R_{GS} = 20k\Omega$) (Note 1) | V_{DGR} -200 | V |
| Continuous Drain Current | I_D -6.5 | A |
| $T_C = 100^\circ\text{C}$ | I_D -4 | A |
| Pulsed Drain Current (Note 3) | I_{DM} -26 | A |
| Gate to Source Voltage | V_{GS} ± 20 | V |
| Maximum Power Dissipation | P_D 75 | W |
| Dissipation Derating Factor | 0.6 | $\text{W}/^\circ\text{C}$ |
| Single Pulse Avalanche Energy Rating (Note 4) | E_{AS} 500 | mJ |
| Operating and Storage Temperature | T_J, T_{STG} -55 to 150 | $^\circ\text{C}$ |
| Maximum Temperature for Soldering | | |
| Leads at 0.063in (1.6mm) from Case for 10s | T_L 300 | $^\circ\text{C}$ |
| Package Body for 10s, See Techbrief 334 | T_{pkg} 260 | $^\circ\text{C}$ |

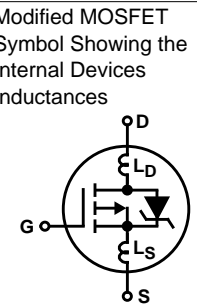
CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

- $T_J = 25^\circ\text{C}$ to 125°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 | $V_{GS(TH)}$ | $V_{GS} = V_{DS}, I_D = -250\mu\text{A}$ | -2 | - | -4 | V |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}$ | - | - | -25 | μA |
| | | $V_{DS} = 0.8 \times \text{Rated } BV_{DSS}, V_{GS} = 0\text{V}, T_C = 125^\circ\text{C}$ | - | - | -250 | μA |
| On-State Drain Current (Note 2) | $I_{D(ON)}$ | $V_{DS} > I_{D(ON)} \times r_{DS(ON)MAX}, V_{GS} = -10\text{V}$ | -6.5 | - | - | A |
| Gate to Source Leakage Current | I_{GSS} | $V_{GS} = \pm 20\text{V}$ | - | - | ± 100 | nA |
| On Resistance (Note 2) | $r_{DS(ON)}$ | $I_D = -3.5\text{A}, V_{GS} = -10\text{V}$ (Figures 8, 9) | - | 0.500 | 0.800 | Ω |
| Forward Transconductance (Note 2) | g_{fs} | $V_{DS} \geq I_{D(ON)} \times r_{DS(ON)MAX}, I_D = -3.5\text{A}$ (Figure 12) | 2.2 | 3.5 | - | S |
| Turn-On Delay Time | $t_{d(ON)}$ | $V_{DD} = -100\text{V}, I_D \approx -6.5\text{A}, R_G = 50\Omega$ $R_L = 15.4\Omega$ (Figures 17, 18) MOSFET Switching Times are Essentially Independent of Operating Temperature | - | 30 | 50 | ns |
| Rise Time | t_r | | - | 50 | 100 | ns |
| Turn-Off Delay Time | $t_{d(off)}$ | | - | 50 | 100 | ns |
| Fall Time | t_f | | - | 40 | 80 | ns |
| Total Gate Charge (Gate to Source + Gate to Drain) | $Q_{g(TOT)}$ | $V_{GS} = -10\text{V}, I_D = -6.5\text{A}, V_{DS} = 0.8 \times \text{Rated } BV_{DSS}$ $I_{g(REF)} = -1.5\text{mA}$ (Figures 14, 19, 20) | - | 31 | 45 | nC |
| Gate to Source Charge | Q_{gs} | Gate Charge is Essentially Independent of Operating Temperature | - | 18 | - | nC |
| Gate to Drain ("Miller") Charge | Q_{gd} | | - | 13 | - | nC |
| Input Capacitance | C_{ISS} | $V_{DS} = -25\text{V}, V_{GS} = 0\text{V}, f = 1\text{MHz}$ (Figure 11) | - | 550 | - | pF |
| Output Capacitance | C_{OSS} | | - | 170 | - | pF |
| Reverse Transfer Capacitance | C_{RSS} | | - | 50 | - | pF |
| Internal Drain Inductance | L_D | Measured From the Contact Screw On Tab To the Center of Die | - | 3.5 | - | nH |
| | | Measured From the Drain Lead, 6mm (0.25in) From Package to the Center of Die | - | 4.5 | - | nH |
| Internal Source Inductance | L_S | Measured From the Source Lead, 6mm (0.25in) From Package to Source Bonding Pad | - | 7.5 | - | nH |
| Thermal Resistance Junction to Case | $R_{\theta JC}$ | | - | - | 1.67 | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance Junction to Ambient | $R_{\theta JA}$ | Typical Socket Mount | - | - | 80 | $^\circ\text{C}/\text{W}$ |



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 | - | - | -6.5 | A |
| Pulse Source to Drain Current (Note 3) | I_{SDM} | | - | - | -26 | A |
| Source to Drain Diode Voltage (Note 2) | V_{SD} | $T_J = 25^{\circ}\text{C}$, $I_{SD} = -6.5\text{A}$, $V_{GS} = 0\text{V}$ (Figure 13) | - | - | -1.5 | V |
| Reverse Recovery Time | t_{rr} | $T_J = 150^{\circ}\text{C}$, $I_{SD} = -6.5\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$ | - | 400 | - | ns |
| Reverse Recovery Charge | Q_{RR} | $T_J = 150^{\circ}\text{C}$, $I_{SD} = -6.5\text{A}$, $dI_{SD}/dt = 100\text{A}/\mu\text{s}$ | - | 2.6 | - | μC |

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 $T_J = 25^{\circ}\text{C}$, $L = 17.75\text{mH}$, $R_G = 25\Omega$, peak $I_{AS} = 6.5\text{A}$. (Figures 15, 16).

Typical Performance Curves Unless Otherwise Specified

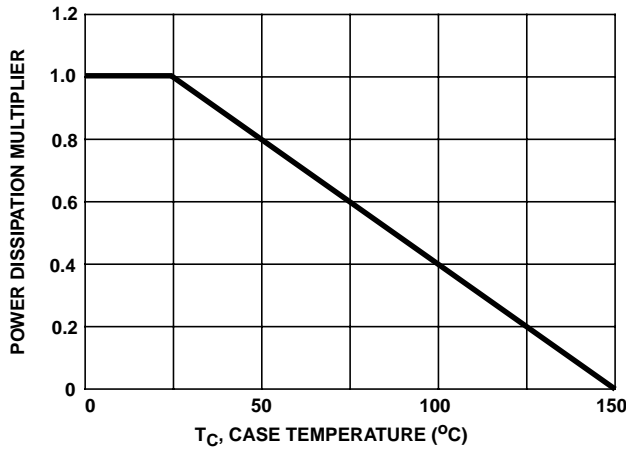


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

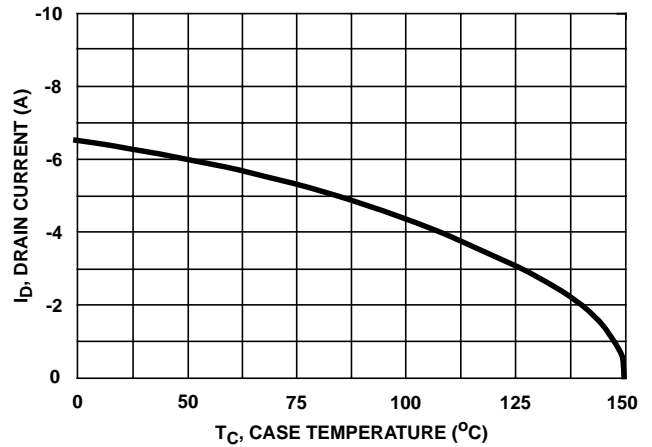


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

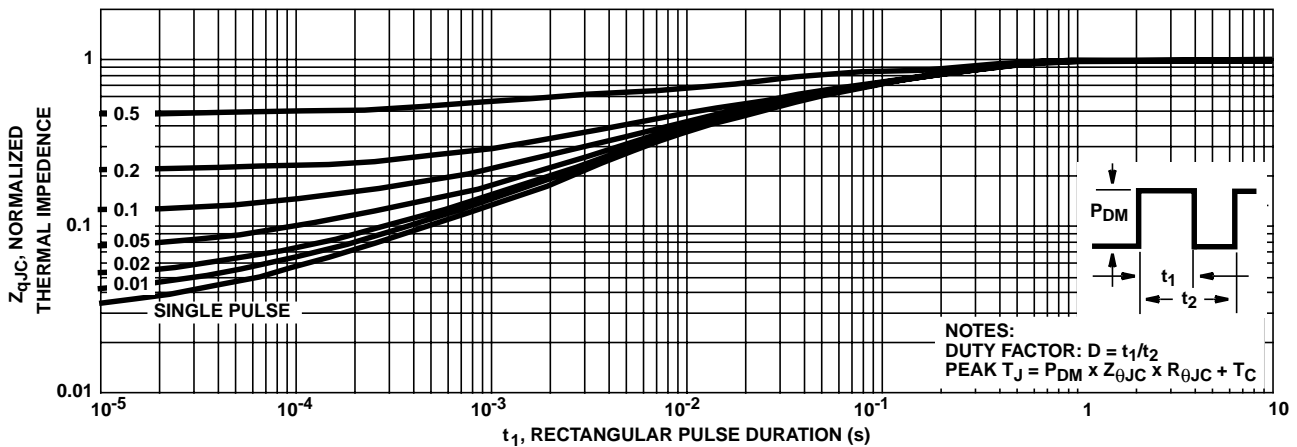


FIGURE 3. NORMALIZED MAXIMUM TRANSIENT THERMAL IMPEDANCE

Typical Performance Curves Unless Otherwise Specified (Continued)

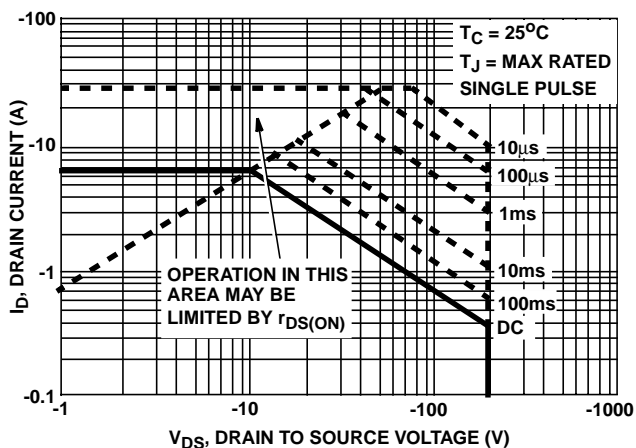


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

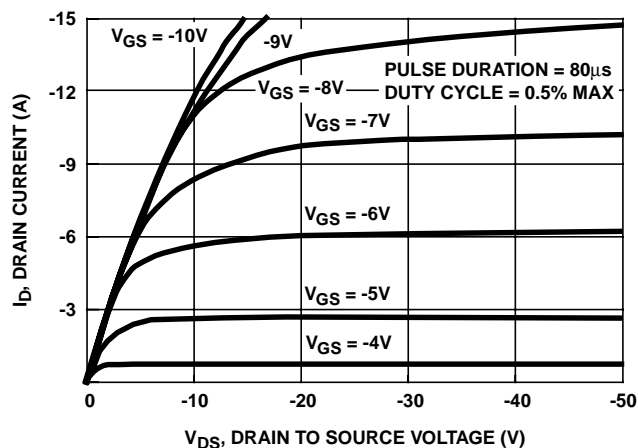


FIGURE 5. OUTPUT CHARACTERISTICS

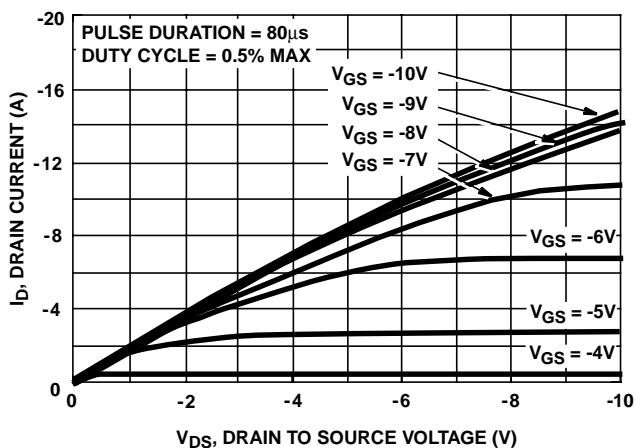


FIGURE 6. SATURATION CHARACTERISTICS

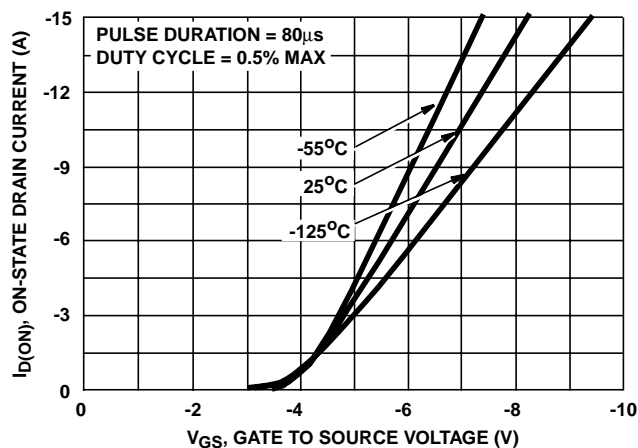
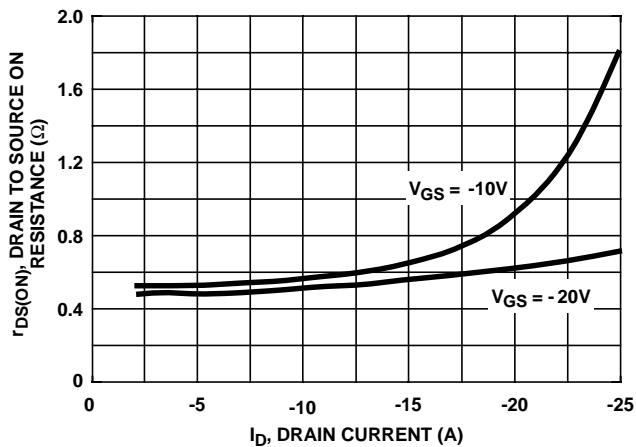


FIGURE 7. TRANSFER CHARACTERISTICS



NOTE: Heating effect of 2µs pulse is minimal.

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

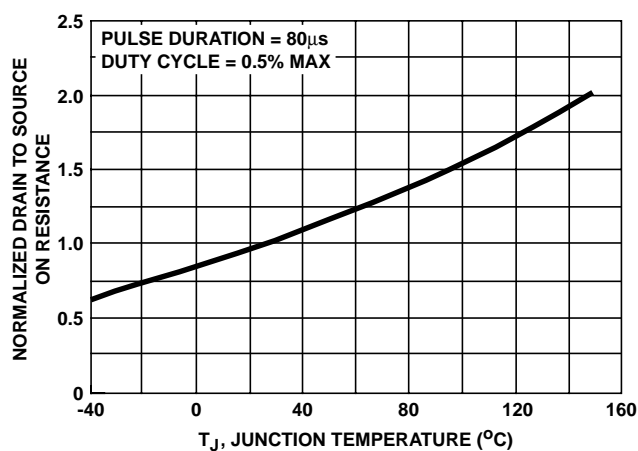


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

Typical Performance Curves Unless Otherwise Specified (Continued)

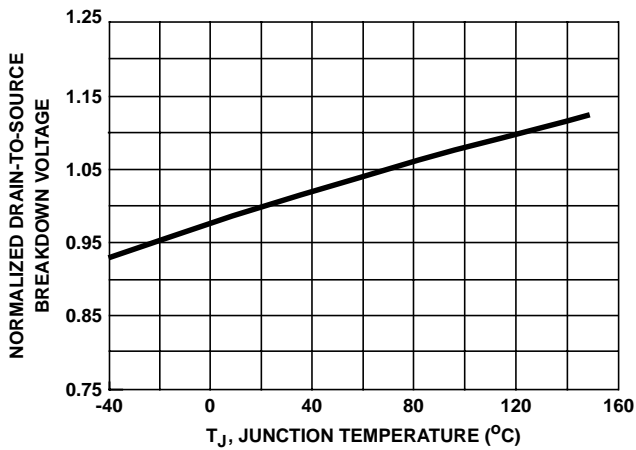


FIGURE 10. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

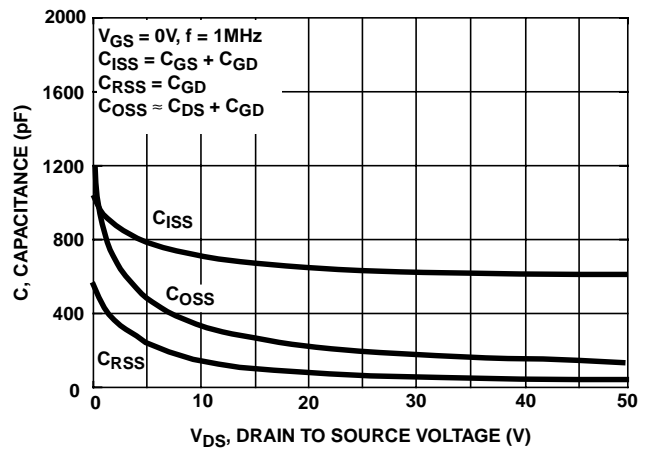


FIGURE 11. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

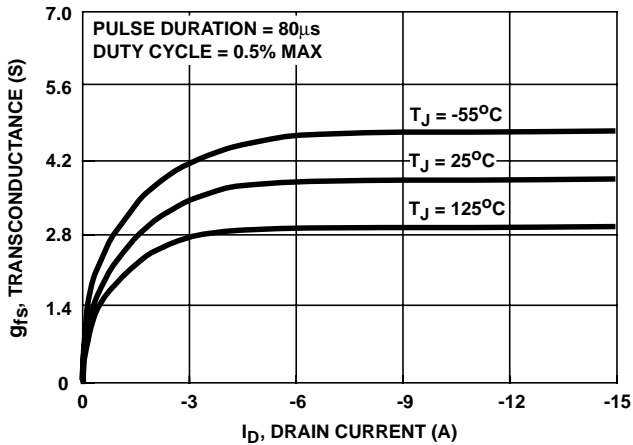


FIGURE 12. TRANSCONDUCTANCE vs DRAIN CURRENT

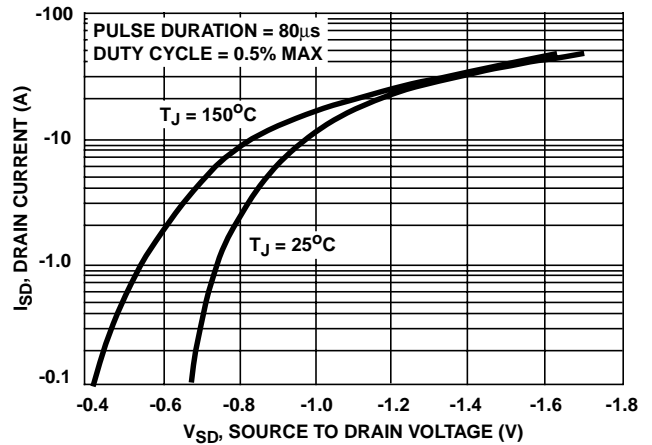


FIGURE 13. SOURCE TO DRAIN DIODE VOLTAGE

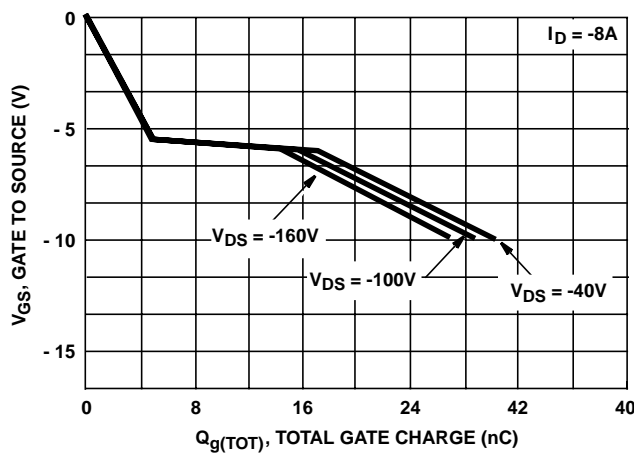


FIGURE 14. GATE TO SOURCE VOLTAGE vs GATE CHARGE

Test Circuits and Waveforms

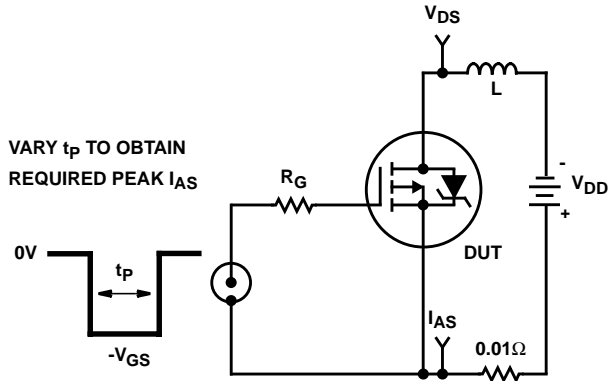


FIGURE 15. UNCLAMPED INDUCTIVE ENERGY TEST CIRCUIT

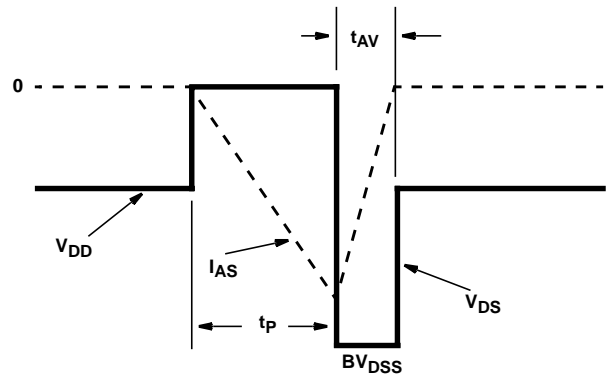


FIGURE 16. UNCLAMPED ENERGY WAVEFORMS

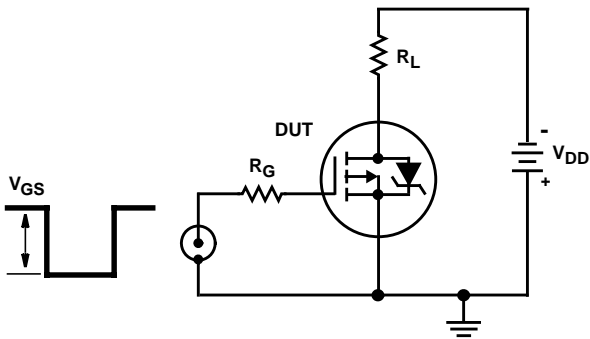


FIGURE 17. SWITCHING TIME TEST CIRCUIT

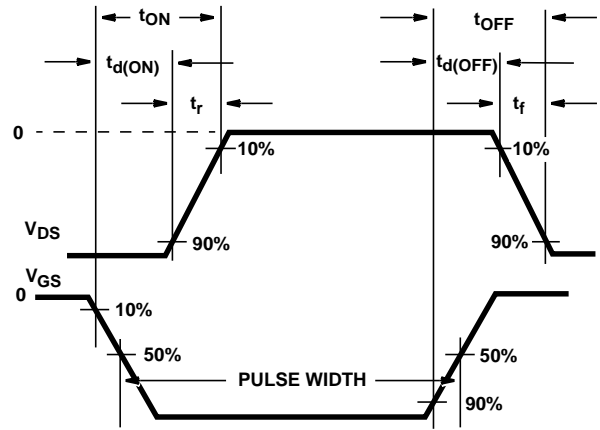


FIGURE 18. RESISTIVE SWITCHING WAVEFORMS

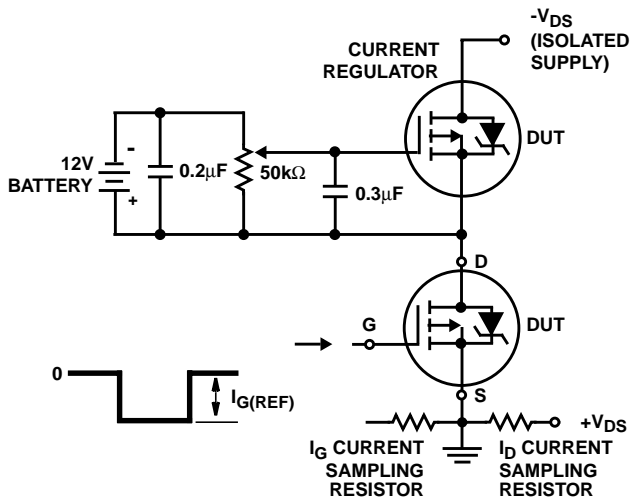


FIGURE 19. GATE CHARGE TEST CIRCUIT

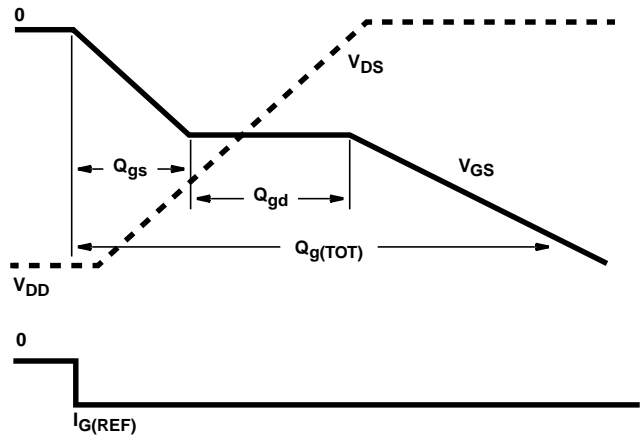


FIGURE 20. GATE CHARGE WAVEFORMS

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Sales Office Headquarters

NORTH AMERICA

Intersil Corporation
P. O. Box 883, Mail Stop 53-204
Melbourne, FL 32902
TEL: (407) 724-7000
FAX: (407) 724-7240

EUROPE

Intersil SA
Mercure Center
100, Rue de la Fusee
1130 Brussels, Belgium
TEL: (32) 2.724.2111
FAX: (32) 2.724.22.05

ASIA

Intersil (Taiwan) Ltd.
7F-6, No. 101 Fu Hsing North Road
Taipei, Taiwan
Republic of China
TEL: (886) 2 2716 9310
FAX: (886) 2 2715 3029