HARRIS SEMICONDUCTOR

IRF150, IRF151, IRF152, IRF153

33A and 40A, 60V and 100V, 0.055 and 0.08 Ohm, N-Channel Power MOSFETs

October 1997

Features

- 33A and 40A, 60V and 100V
- $r_{DS(ON)}$ = 0.055Ω and 0.08Ω
- 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"

Description

These are N-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 convertors, motor drivers, relay drivers, and drivers for high power bipolar switching transistors requiring high speed and low gate drive power. These types can be operated directly from integrated circuits.

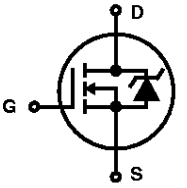
Formerly Developmental Type TA17421.

Ordering Information

PART NUMBER	PACKAGE	BRAND
IRF150	TO-204AE	IRF150
IRF151	TO-204AE	IRF151
IRF152	TO-204AE	IRF152
IRF153	TO-204AE	IRF153

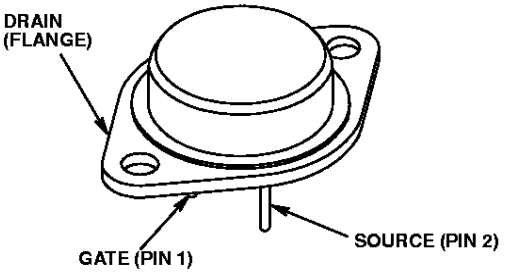
NOTE: When ordering, include the entire part number.

Symbol



Packaging

JEDEC TO-204AE



CAUTION: These devices are sensitive to electrostatic discharge. Users should follow proper ESD Handling Procedures.

File Number **1824.2**

Absolute Maximum Ratings $T_C = 25^oC$, Unless Otherwise Specified

		IRF150	IRF151	IRF152	IRF153	UNITS
Drain to Source Voltage (Note 1)	V_{DS}	100	60	100	60	V
Drain to Gate Voltage (R_{GS} = 20kΩ) (Note 1)	V_{DGR}	100	60	100	60	V
Continuous Drain Current	ID	40	40	33	33	A
$T_C = 100^oC$	I_D	25	25	20	20	A
Pulsed Drain Current (Note 3)	I_{DM}	160	160	132	132	A
Gate to Source Voltage	V_{GS}	±20	±20	±20	±20	V
Maximum Power Dissipation	P_D	150	150	150	150	W
Linear Derating Factor		1.2	1.2	1.2	1.2	W/°C
Single Pulse Avalanche Energy Rating (Note 4)	E_{AS}	150	150	150	150	mJ
Operating and Storage Temperature	T_J, T_{STG}	-55 to 150	-55 to 150	-55 to 150	-55 to 150	°C
Maximum Temperature for Soldering						
Leads at 0.063in (1.6mm) from Case for 10s	T_L	300	300	300	300	°C
Package Body for 10s, See Techbrief 334	T_{pkg}	260	260	260	260	°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.

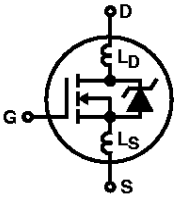
NOTE:

1. $T_J = 25^oC$ to 125^oC.

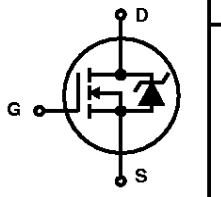
Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Drain to Source Breakdown Voltage	BV_{DSS}	V_{GS} = 0V, I_D = 250μA, (Figure 10)				
IRF150, IRF152			100	-	-	V
IRF151, IRF153			60	-	-	V
Gate to Threshold Voltage	$V_{GS(TH)}$	V_{GS} = V_{DS}, I_D = 250μA	2.0	-	4.0	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = Rated BV_{DSS}, V_{GS} = 0V	-	-	25	μA
		V_{DS} = 0.8 x Rated BV_{DSS}, V_{GS} = 0V, $T_J = 125^oC$	-	-	250	μA
On-State Drain Current (Note 2)	$I_{D(ON)}$	$V_{DS} > I_{D(ON)} \times r_{DS(ON)MAX}$, V_{GS} = 10V				
IRF150, IRF151			40	-	-	A
IRF152, IRF153			33	-	-	A
Gate to Source Leakage Current	I_{GSS}	V_{GS} = ±20V	-	-	±100	nA
Drain to Source On Resistance (Note 2)	$r_{DS(ON)}$	V_{GS} = 10V, I_D = 20A, (Figure 8, 9)				
IRF150, IRF151			-	0.045	0.055	Ω
IRF152, IRF153			-	0.06	0.08	Ω
Forward Transconductance (Note 2)	g_{fs}	$V_{DS} > I_{D(ON)} \times r_{DS(ON)MAX}$, I_D = 20A (Figure 12)	9.0	11	-	S
Turn-On Delay Time	$t_{d(ON)}$	V_{DD} = 24V, $I_D \approx$ 20A, R_G = 4.7Ω, R_L = 1.2Ω (Figure 17, 18) MOSFET Switching Times are Essentially Independent of Operating Temperature	-	-	35	ns
Rise Time	t_r		-	-	100	ns
Turn-Off Delay Time	$t_{d(OFF)}$		-	-	125	ns
Fall Time	t_f		-	-	100	ns
Total Gate Charge (Gate to Source + Gate to Drain)	$Q_{g(TOT)}$	V_{GS} = 10V, I_D = 50A, V_{DS} = 0.8 x Rated BV_{DSS}, $I_{g(REF)}$ = -1.5mA (Figures 14, 19, 20) Gate Charge is Essentially Independent of Operating Temperature	-	63	120	nC
Gate to Source Charge	Q_{gs}		-	27	-	nC
Gate to Drain "Miller" Charge	Q_{gd}		-	36	-	nC

Electrical Specifications $T_C = 25^oC$, Unless Otherwise Specified **(Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Input Capacitance	C_{ISS}	V_{GS} = 0V, V_{DS} = 25V, f = 1.0MHz (Figure 11)		-	2000	-	pF
Output Capacitance	C_{OSS}			-	1000	-	pF
Reverse Transfer Capacitance	C_{RSS}			-	350	-	pF
Internal Drain Inductance	L_D	Measured Between the Contact Screw on the Flange that is Closer to Source and Gate Pins and the Center of Die	Modified MOSFET Symbol Showing the Internal Devices Inductances 	-	5.0	-	nH
Internal Source Inductance	L_S	Measured From The Source Lead, 6mm (0.25in) From the Flange and the Source Bonding Pad		-	12.5	-	nH
Thermal Impedance Junction to Case	$R_{\theta JC}$			-	-	0.8	$^oC/W$
Thermal Impedance Junction to Ambient	$R_{\theta JA}$	Free Air Operation		-	-	30	$^oC/W$

Source to Drain Diode Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Continuous Source to DrainCurrent	I_{SD}	Modified MOSFET Symbol Showing the Integral Reverse P-N Junction Diode		-	-	40	A
Pulse Source to Drain Current (Note 3)	I_{SDM}			-	-	160	A
Diode Source to Drain Voltage (Note 2)	V_{SD}	$T_J = 25^oC$, I_{SD} = 40A, V_{GS} = 0V, (Figure 13)		-	-	2.5	V
Reverse Recovery Time	t_{rr}	$T_J = 150^oC$, I_{SD} = 40A, dI_{SD}/dt = 100A/µs		-	600	-	ns
Reverse Recovery Charge	Q_{RR}	$T_J = 25^oC$, I_{SD} = 5.5A, dI_{SD}/dt = 100A/µs		-	3.3	-	µC

NOTES:

2. Pulse test: pulse width ≤ 300µs, duty cycle ≤ 2%.
3. Repetitive rating: pulse width limited by Max junction temperature. See Transient Thermal Impedance curve (Figure 3).
4. V_{DD} = 10V, starting $T_J = 25^oC$, L = 170µH, R_G = 50Ω, Peak I_{AS} = 40A. See Figures 15, 16.

Typical Performance Curves Unless Otherwise Specified

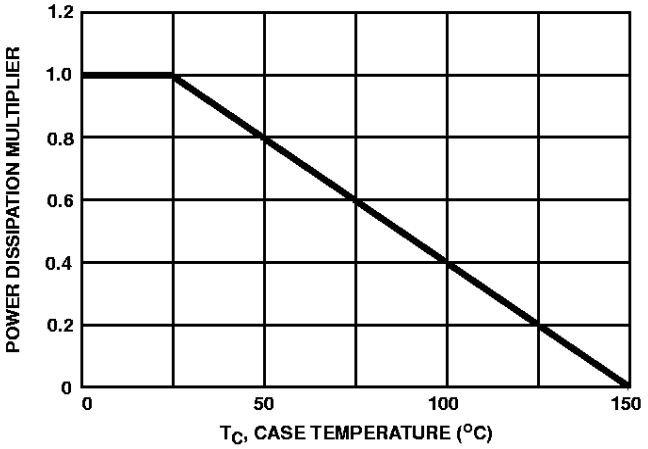


FIGURE 1. NORMALIZED POWER DISSIPATION vs CASE TEMPERATURE

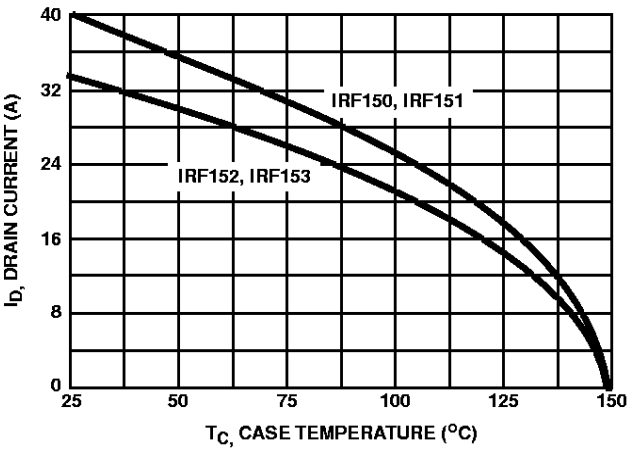


FIGURE 2. MAXIMUM CONTINUOUS DRAIN CURRENT vs CASE TEMPERATURE

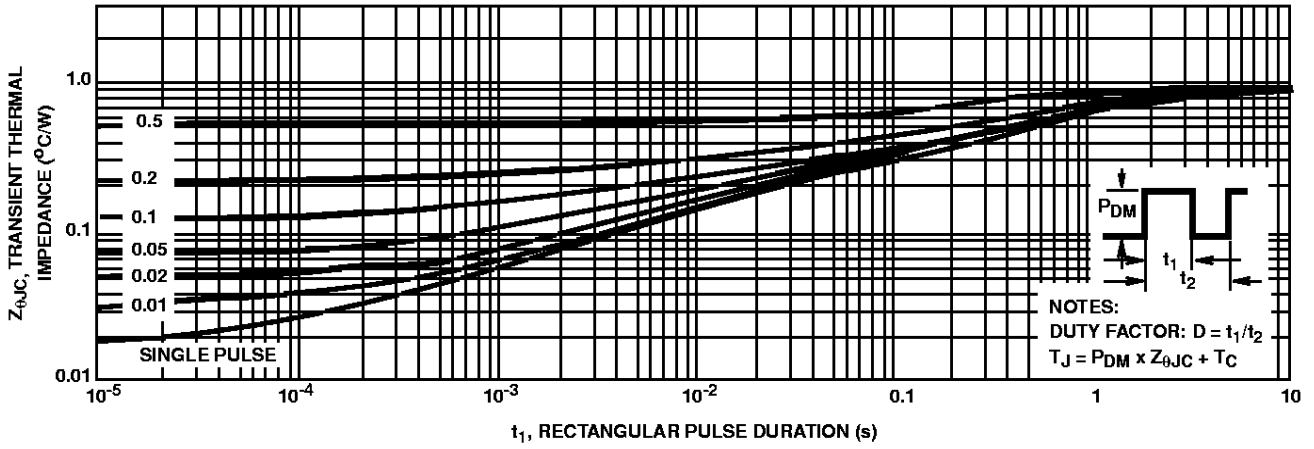


FIGURE 3. MAXIMUM TRANSIENT THERMAL IMPEDANCE

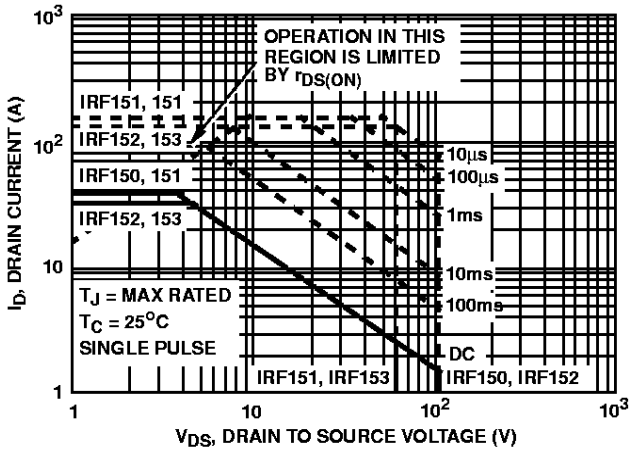


FIGURE 4. FORWARD BIAS SAFE OPERATING AREA

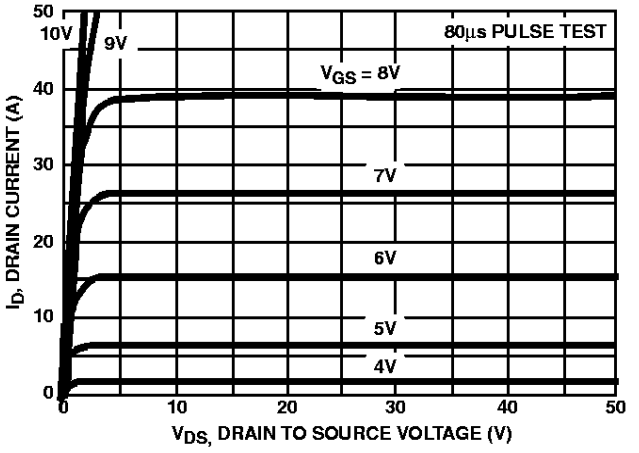


FIGURE 5. OUTPUT CHARACTERISTICS

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

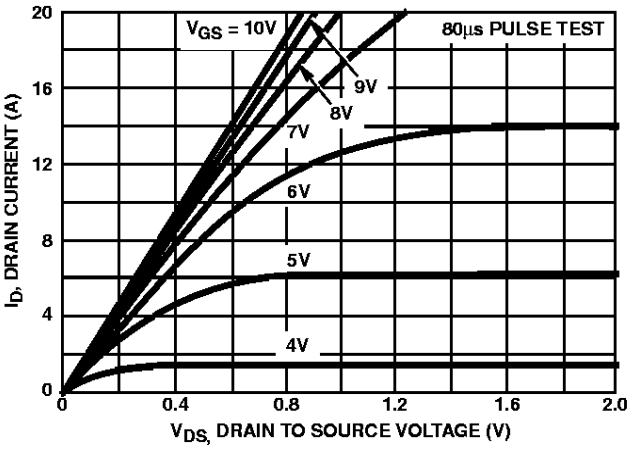


FIGURE 6. SATURATION CHARACTERISTICS

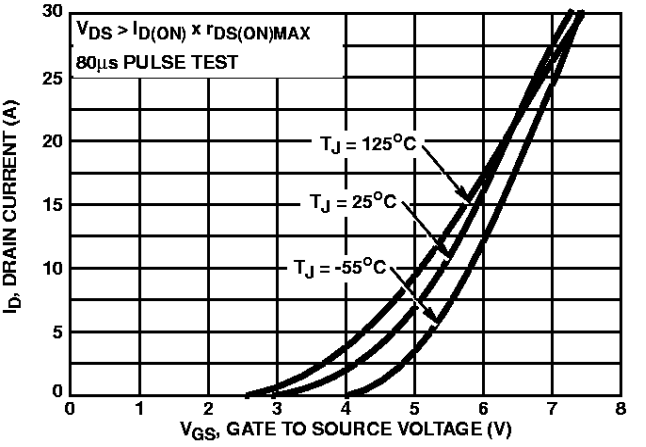
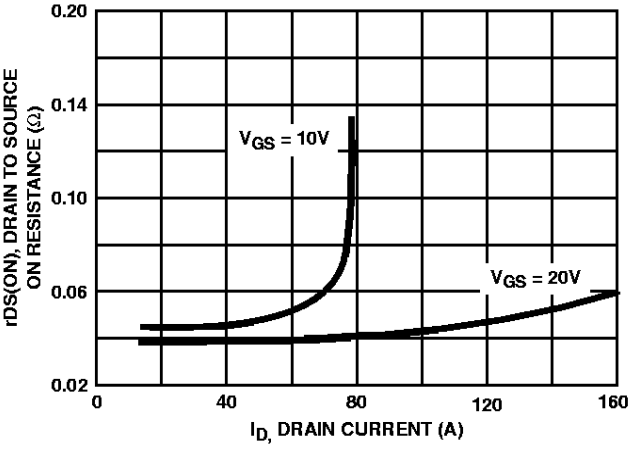


FIGURE 7. TRANSFER CHARACTERISTICS



NOTE: Heating effect of 2µs is minimal.

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

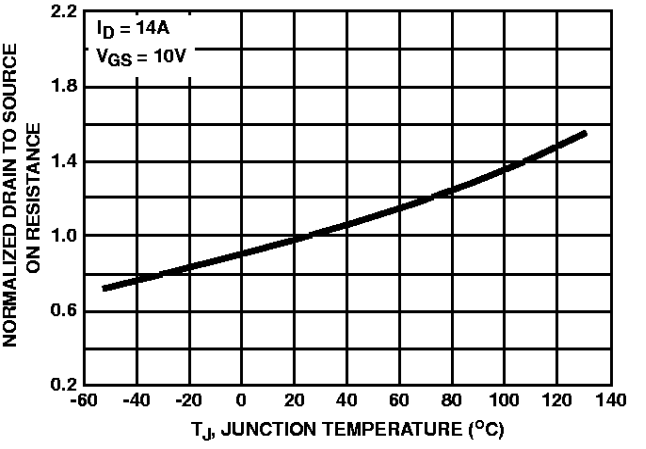


FIGURE 9. NORMALIZED DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMPERATURE

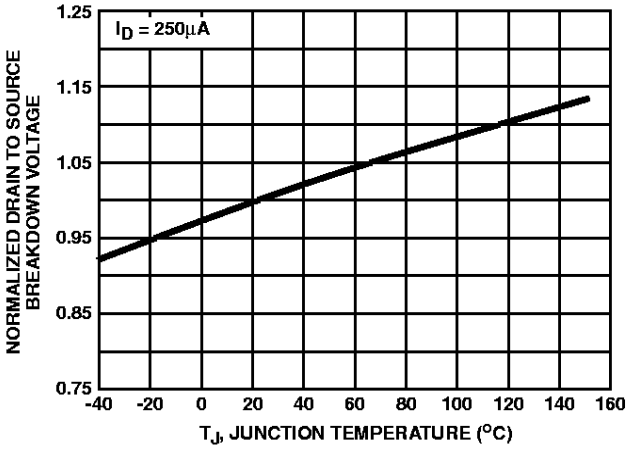


FIGURE 10. NORMALIZED DRAIN TO SOURCE BREAKDOWN VOLTAGE vs JUNCTION TEMPERATURE

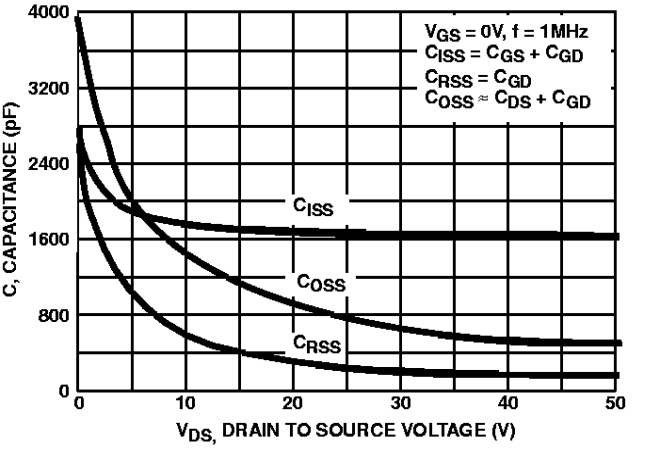


FIGURE 11. CAPACITANCE vs DRAIN TO SOURCE VOLTAGE

Typical Performance Curves Unless Otherwise Specified (Continued)

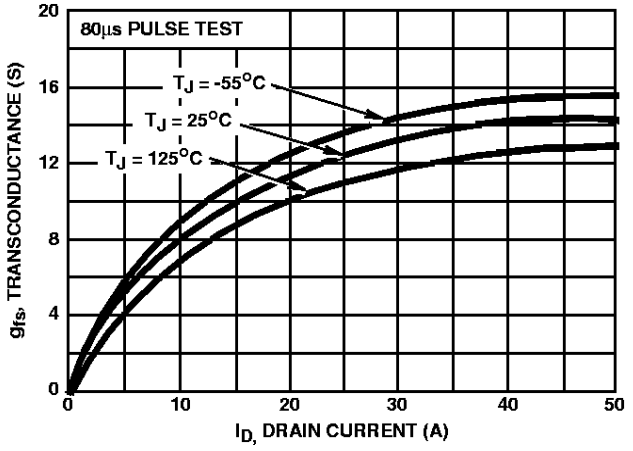


FIGURE 12. TRANSCONDUCTANCE vs DRAIN CURRENT

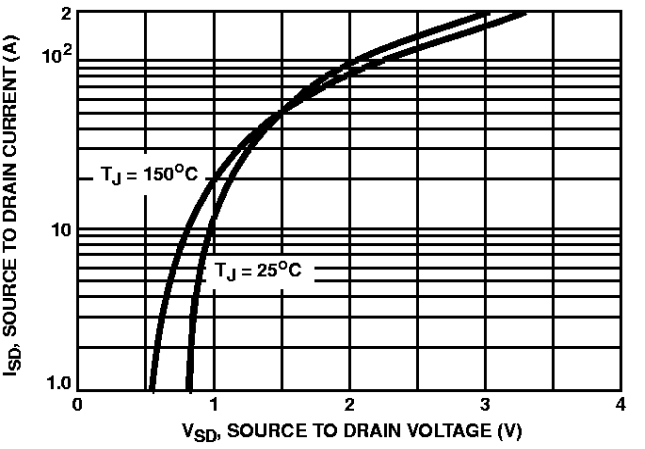


FIGURE 13. SOURCE TO DRAIN DIODE VOLTAGE

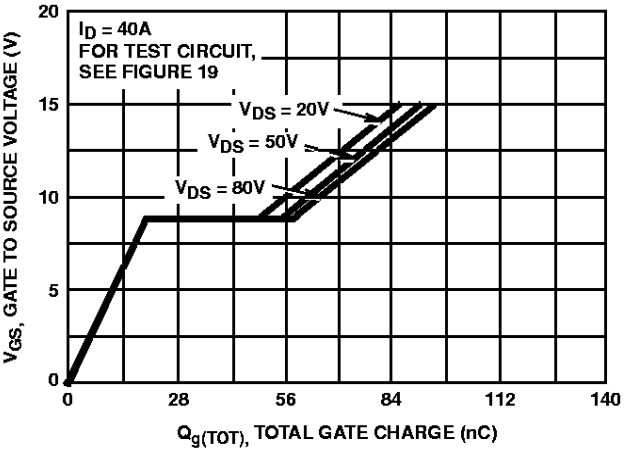


FIGURE 14. GATE TO SOURCE VOLTAGE vs GATE CHARGE

Test Circuits and Waveforms

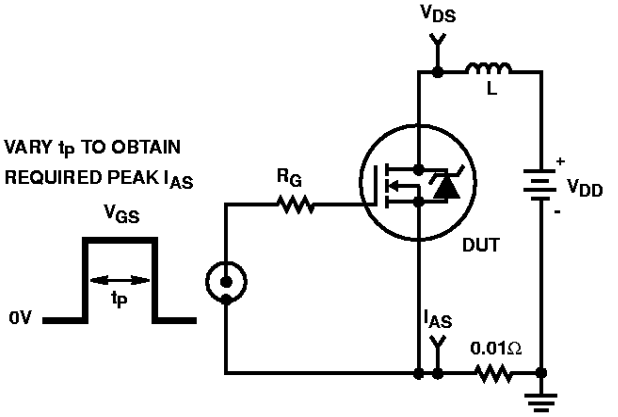


FIGURE 15. UNCLAMPED ENERGY TEST CIRCUIT

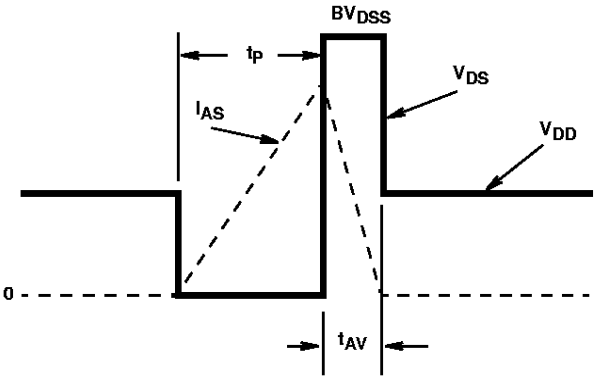


FIGURE 16. UNCLAMPED ENERGY WAVEFORMS

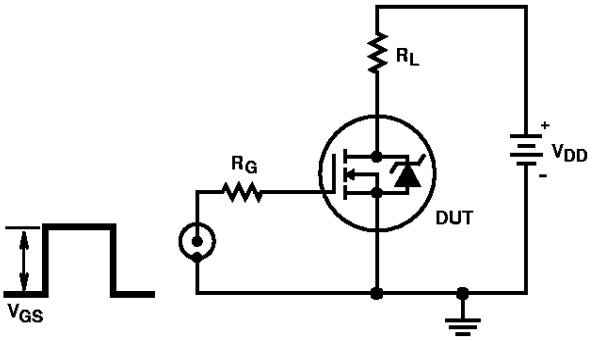


FIGURE 17. SWITCHING TIME TEST CIRCUIT

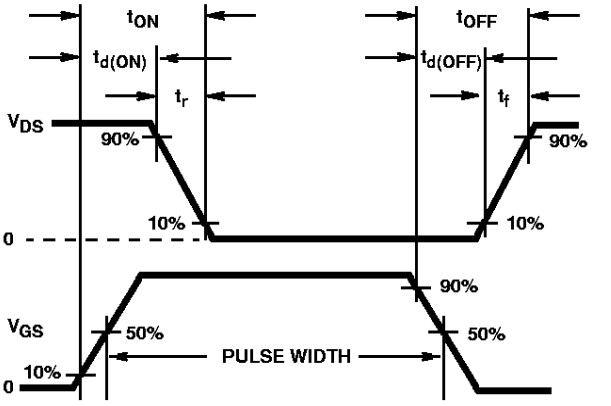


FIGURE 18. RESISTIVE SWITCHING WAVEFORMS

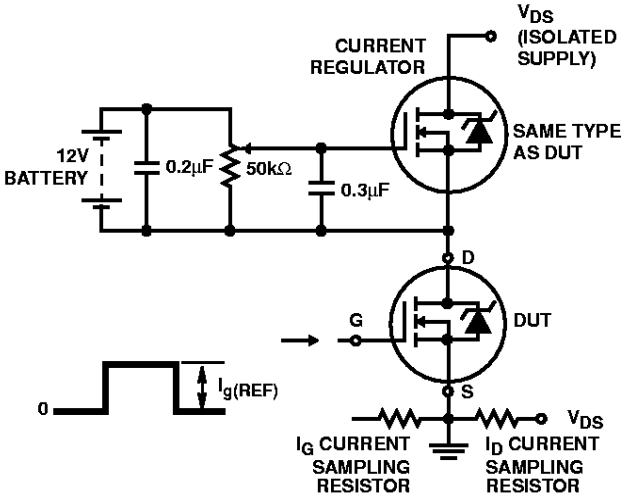


FIGURE 19. GATE CHARGE TEST CIRCUIT

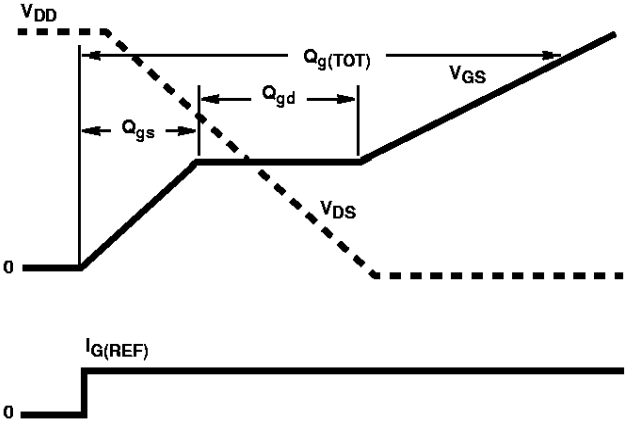


FIGURE 20. GATE CHARGE WAVEFORMS