

August 1991

Features

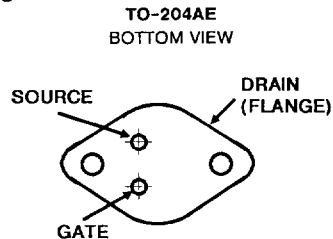
- 25A and 30A, 150V - 200V
- $r_{DS(on)} = 0.085\Omega$ and 0.120Ω
- Single Pulse Avalanche Energy Rated*
- SOA is Power-Dissipation Limited
- Nanosecond Switching Speeds
- Linear Transfer Characteristics
- High Input Impedance

Description

The IRF250, IRF251, IRF252, and IRF253 are n-channel enhancement-mode silicon-gate power field-effect transistors. IRF250R, IRF251R, IRF252R, and IRF253R types 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 high-power bipolar switching transistors requiring high speed and low gate-drive power. These types can be operated directly from integrated circuits.

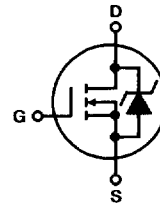
The IRF types are supplied in the JEDEC TO-204AE steel package.

Package



Terminal Diagram

N-CHANNEL ENHANCEMENT MODE



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

	IRF250 IRF250R	IRF251 IRF251R	IRF252 IRF252R	IRF253 IRF253R	UNITS	
Drain-Source Voltage (1)	V_{DS}	200	150	200	150	V
Drain-Gate Voltage ($R_{GS} = 20k\Omega$) (1)	V_{DGR}	200	150	200	150	V
Continuous Drain Current						
$T_C = +25^\circ\text{C}$	I_D	30	30	25	25	A
$T_C = +100^\circ\text{C}$	I_D	19	19	16	16	A
Pulsed Drain Current (3)	I_{DM}	120	120	100	100	A
Gate-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
Inductive Current, Clamped	I_{LM}	120	120	100	100	A
(See Figure 14, $L = 100\mu\text{H}$)						
Single Pulse Avalanche Energy Rating (4)	E_{as}^*	910	910	910	910	mJ
Operating and Storage Junction	T_J, T_{STG}	-55 to +150	-55 to +150	-55 to +150	-55 to +150	°C
Temperature Range						
Maximum Lead Temperature for Soldering	T_L	300	300	300	300	°C
(0.063" (1.6mm) from case for 10s)						

NOTES:

1. $T_J = +25^\circ\text{C}$ to $+150^\circ\text{C}$.

2. Pulse Test: Pulse width $\leq 300\mu\text{s}$, Duty Cycle $\leq 2\%$.

3. Repetitive Rating: Pulse width limited by max junction temp. See Transient Thermal Impedance Curve (Figure 5).

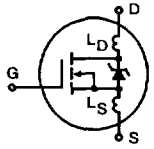
4. $V_{DD} = 50\text{V}$, starting $T_J = +25^\circ\text{C}$, $L = 1.5\text{mH}$, $R_{GS} = 25\Omega$, $I_{PEAK} = 30\text{A}$. See Figure 15.

* R Suffix Types Only

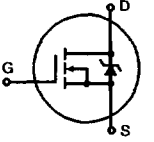
IRF250, IRF251, IRF252, IRF253 IRF250R, IRF251R, IRF252R, IRF253R

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N-CHANNEL
POWER MOSFETs

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

CHARACTERISTIC	SYMBOL	TEST CONDITIONS	LIMITS			UNITS
			MIN	TYP	MAX	
Drain-Source Breakdown Voltage IRF250/252, IRF250R/252R IRF251/253, IRF251R/253R	BV _{DSS}	V _{GS} = 0V, I _D = 250μA	200	-	-	V
			150	-	-	V
Gate Threshold Voltage	V _{GS(TH)}	V _{DS} = V _{GS} , I _D = 250μA	2.0	-	4.0	V
Gate-Source Leakage Forward	I _{GSS}	V _{GS} = 20V	-	-	100	nA
Gate-Source Leakage Reverse	I _{GSS}	V _{GS} = -20V	-	-	-100	nA
Zero Gate Voltage Drain Current	I _{DSS}	V _{DS} = Max Rating, V _{GS} = 0V	-	-	250	μA
		V _{DS} = Max Rating x 0.8, V _{GS} = 0V, T _J = +125°C	-	-	1000	μA
On-State Drain Current (Note 2) IRF250/251, IRF250R/251R IRF252/253, IRF252R/253R	I _{D(ON)}	V _{DS} > I _{D(ON)} × r _{DS(ON)} Max, V _{GS} = 10V	30	-	-	A
			25	-	-	A
Static Drain-Source On-State Resistance (Note 2) IRF250/251, IRF250R/251R IRF252/253, IRF252R/253R	r _{DS(ON)}	V _{GS} = 10V, I _D = 16A	-	0.07	0.085	Ω
			-	0.09	0.120	Ω
			-	-	-	-
Forward Transconductance (Note 2)	g _{fs}	V _{DS} ≥ 50V, I _D = 16A	13	19	-	S(Ω)
Input Capacitance	C _{ISS}	V _{GS} = 0V, V _{DS} = 25V, f = 1.0MHz	-	2000	-	pF
Output Capacitance	C _{OSS}	See Figure 10	-	800	-	pF
Reverse Transfer Capacitance	C _{RSS}		-	300	-	pF
Turn-On Delay Time	t _{d(ON)}	V _{DD} = 100V, I _D ≈ 30A, R _G = 6.2Ω	-	20	30	ns
Rise Time	t _r	See Figure 16. (MOSFET switching times are essentially independent of operating temperature)	-	120	180	ns
Turn-Off Delay Time	t _{d(OFF)}		-	70	100	ns
Fall Time	t _f		-	80	120	ns
Total Gate Charge (Gate-Source + Gate-Drain)	Q _g	V _{GS} = 10V, I _D = 30A, V _{DS} = 0.8 Max Rating. See Figure 17 for test circuit.	-	79	120	nC
Gate-Source Charge	Q _{gs}	(Gate charge is essentially independent of operating temperature.)	-	13	-	nC
Gate-Drain ("Miller") Charge	Q _{gd}		-	42	-	nC
Internal Drain Inductance	L _D	Measured between the contact screw on header that is closer to source and gate pins and center of center of die.	-	5.0	-	nH
Internal Source Inductance	L _S	Measured from the source lead, 6mm (0.25") from header and source bonding pad.	-	12.5	-	nH
						
Junction-to-Case	R _{θJC}		-	-	0.83	°C/W
Case-to-Sink	R _{θCS}	Mounting surface flat, smooth and greased	-	0.1	-	°C/W
Junction-to-Ambient	R _{θJA}	Free air operation	-	-	30	°C/W

Source Drain Diode Ratings and Characteristics

Continuous Source Current (Body Diode)	I _S	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.	-	-	30	A
Pulse Source Current (Body Diode) (Note 3)	I _{SM}		-	-	120	A
						
Diode Forward Voltage (Note 2)	V _{SD}	T _J = +25°C, I _S = 30A, V _{GS} = 0V	-	-	2.0	V
Reverse Recovery Time	t _{rr}	T _J = +25°C, I _F = 30A, dI _F /dt = 100A/μs	140	350	630	ns
Reverse Recovered Charge	Q _{RR}	T _J = +25°C, I _F = 30A, dI _F /dt = 100A/μs	1.8	4.7	8.1	μC
Forward Turn-on Time	t _{ON}	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L _S + L _D .	-	-	-	-

NOTES: 1. T_J = +25°C to +150°C

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 5)

4. V_{DD} = 50V, Start T_J = +25°C, L = 1.5mH, R_{GS} = 25Ω, I_{PEAK} = 30A (See Figure 15)

IRF250, IRF251, IRF252, IRF253 IRF250R, IRF251R, IRF252R, IRF253R

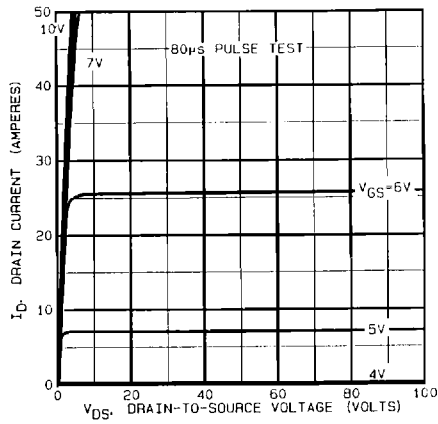


FIGURE 1. TYPICAL OUTPUT CHARACTERISTICS

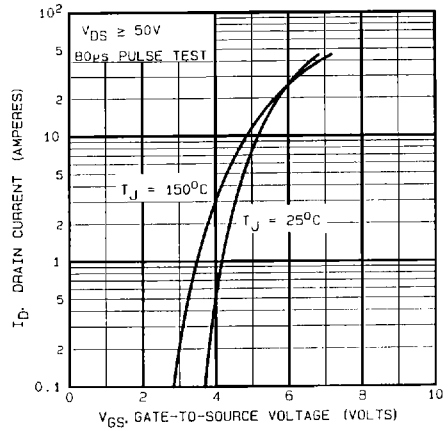


FIGURE 2. TYPICAL TRANSFER CHARACTERISTICS

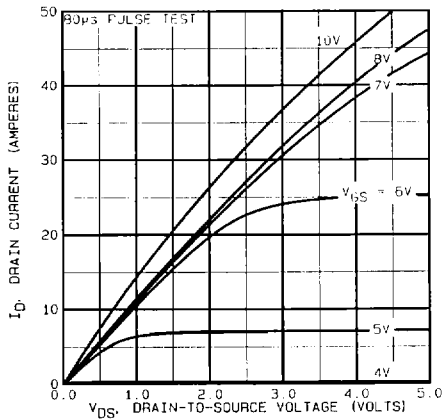


FIGURE 3. TYPICAL SATURATION CHARACTERISTICS

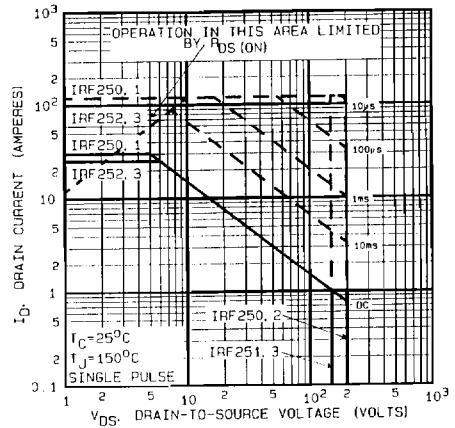


FIGURE 4. MAXIMUM SAFE OPERATING AREA

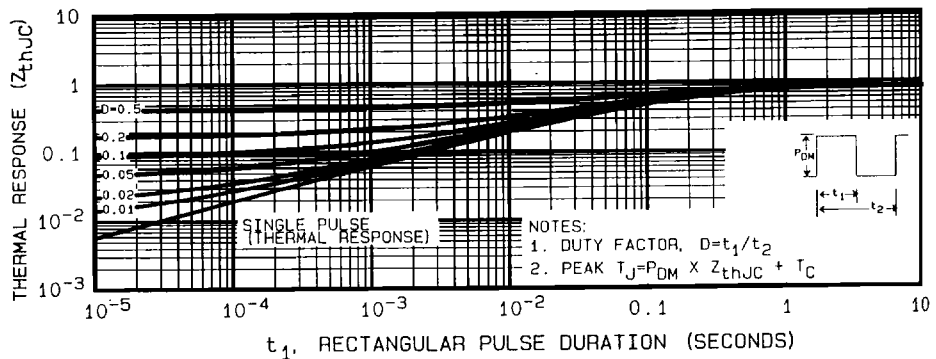


FIGURE 5. MAXIMUM EFFECTIVE TRANSIENT THERMAL IMPEDANCE, JUNCTION-TO-CASE vs PULSE DURATION

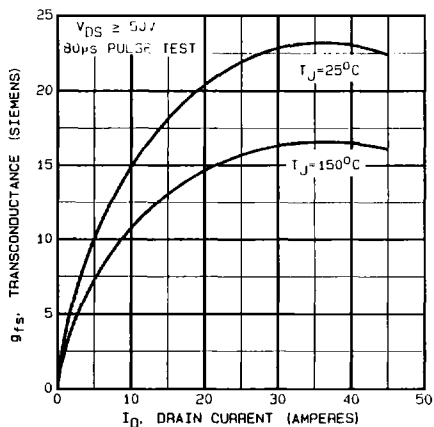


FIGURE 6. TYPICAL TRANSCONDUCTANCE vs DRAIN CURRENT

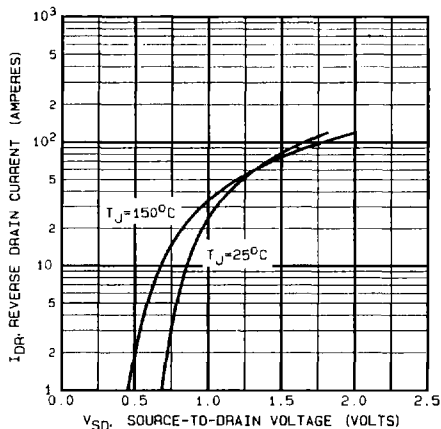


FIGURE 7. TYPICAL SOURCE-DRAIN DIODE FORWARD VOLTAGE

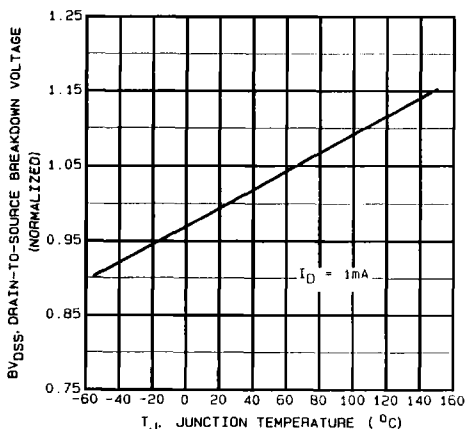


FIGURE 8. BREAKDOWN VOLTAGE vs TEMPERATURE

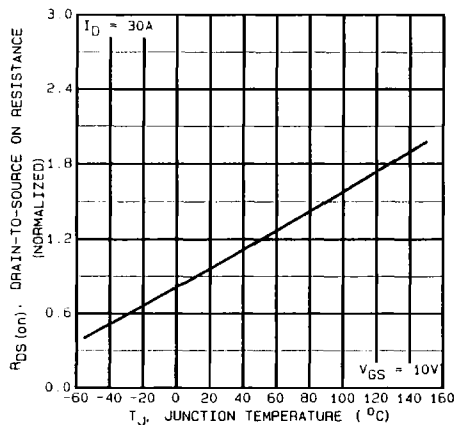


FIGURE 9. NORMALIZED ON-RESISTANCE vs TEMPERATURE

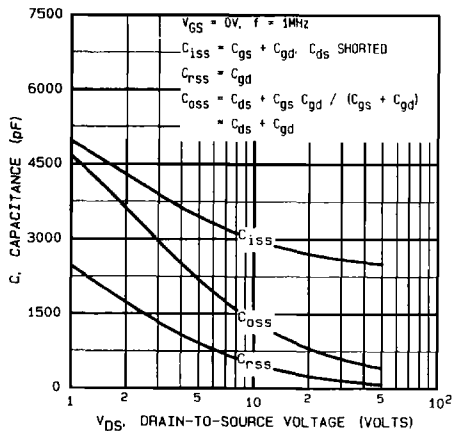


FIGURE 10. TYPICAL CAPACITANCE vs DRAIN-TO-SOURCE VOLTAGE

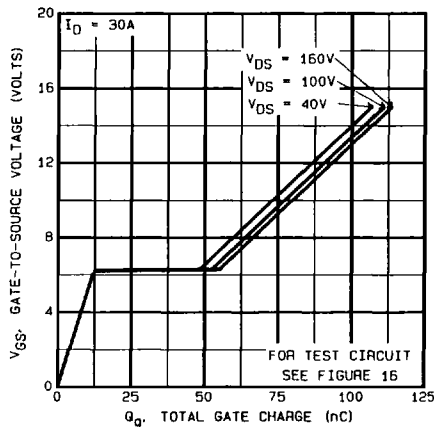


FIGURE 11. TYPICAL GATE CHARGE vs GATE-TO-SOURCE VOLTAGE

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N-CHANNEL
POWER MOSFETs

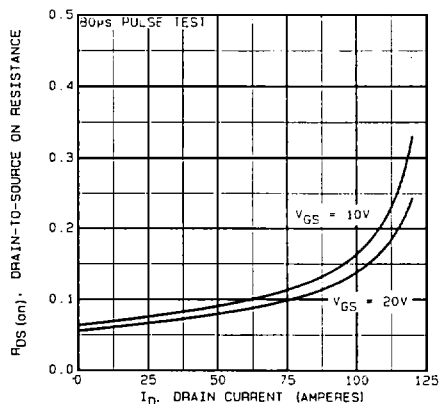


FIGURE 12. TYPICAL ON RESISTANCE vs DRAIN CURRENT

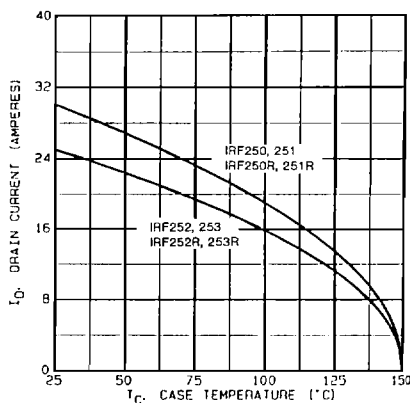


FIGURE 13. MAXIMUM DRAIN CURRENT vs CASE TEMPERATURE

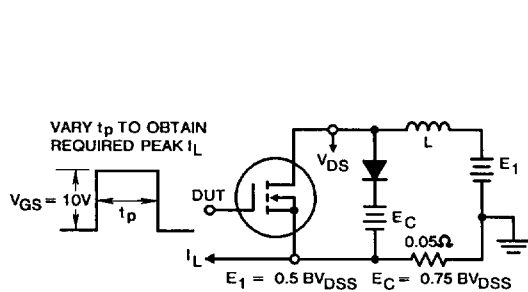


FIGURE 14a. CLAMPED INDUCTIVE TEST CIRCUIT

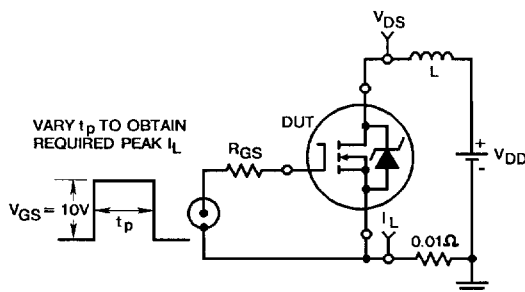


FIGURE 15a. UNCLAMPED ENERGY TEST CIRCUIT

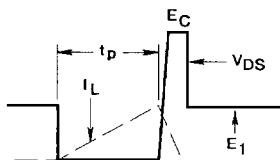


FIGURE 14b. CLAMPED INDUCTIVE WAVEFORMS

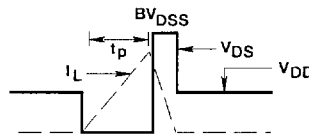


FIGURE 15b. UNCLAMPED ENERGY WAVEFORMS

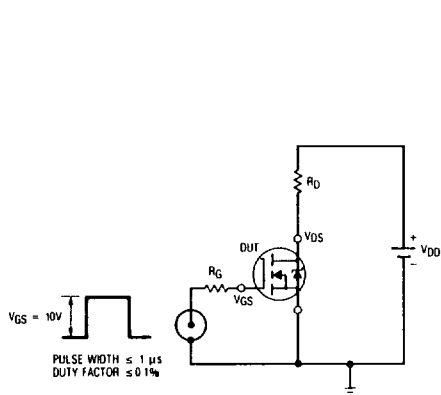


FIGURE 16. SWITCHING TIME TEST CIRCUIT

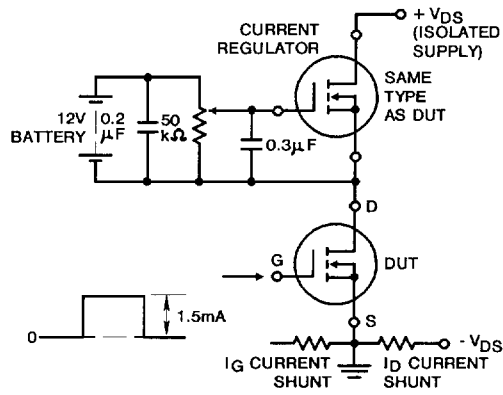


FIGURE 17. GATE CHARGE TEST CIRCUIT