

Avalanche-Energy-Rated P-Channel Power MOSFETs

-9 A and -11 A, -150 V and -200 V
 $r_{DS(on)}$ = 0.5 Ω and 0.7 Ω

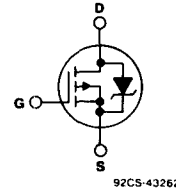
Features:

- Single pulse avalanche energy rated
- SOA is power-dissipation limited
- Nanosecond switching speeds
- Linear transfer characteristics
- High input impedance

The IRF9240, IRF9241, IRF9242, and IRF9243 are advanced power MOSFETs designed, tested, and guaranteed to withstand a specified level of energy in the breakdown avalanche mode of operation. These are p-channel enhancement-mode silicon-gate power field-effect transistors 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.

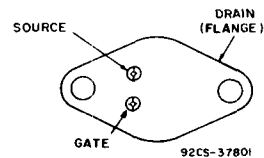
The IRF-types are supplied in the JEDEC TO-204AA steel package.

TERMINAL DIAGRAM



P-CHANNEL ENHANCEMENT MODE

TERMINAL DESIGNATION



JEDEC TO-204AA

ABSOLUTE-MAXIMUM RATINGS

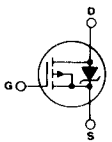
CHARACTERISTIC		IRF9240	IRF9241	IRF9242	IRF9243	UNITS
Drain-Source Voltage ①	V_{DS}	-200	-150	-200	-150	V
Drain-Gate Voltage ($R_{GS} = 20 \text{ k}\Omega$) ①	V_{DGR}	-200	-150	-200	-150	V
Continuous Drain Current	$I_D @ T_C = 25^\circ\text{C}$	-11	-11	-9	-9	A
Continuous Drain Current	$I_D @ T_C = 100^\circ\text{C}$	-7	-7	-6	-6	A
Pulsed Drain Current ③	I_{DM}	-44	-44	-36	-36	A
Gate-Source Voltage	V_{GS}	±20				V
Maximum Power Dissipation	$P_D @ T_C = 25^\circ\text{C}$	125 (See Fig. 14)				W
Linear Derating Factor		1 (See Fig. 14)				W/°C
Single-Pulse Avalanche Energy Rating ④	E_{as}	790				mJ
Operating Junction and Storage Temperature Range	T_J T_{stg}	-55 to +150				°C
Lead Temperature		300 (0.063 in. [1.6 mm] from case for 10 s)				°C

ELECTRICAL CHARACTERISTICS At Case Temperature (T_C) = 25°C Unless Otherwise Specified

CHARACTERISTIC	TYPE	MIN.	TYP.	MAX.	UNITS	TEST CONDITIONS
Drain-Source Breakdown Voltage BV_{DSS}	IRF9240 IRF9242	-200	—	—	V	$V_{GS} = 0$ V $I_D = -250 \mu A$
	IRF9241 IRF9243	-150	—	—	V	
Gate Threshold Voltage $V_{GS(th)}$	ALL	-2.0	—	-4.0	V	$V_{DS} = V_{GS}$, $I_D = -250 \mu A$
Gate-Source Leakage Forward I_{GSS}	ALL	—	—	-100	nA	$V_{GS} = -20$ V
Gate-Source Leakage Reverse I_{GSS}	ALL	—	—	100	nA	$V_{GS} = 20$ V
Zero-Gate Voltage Drain Current I_{DSS}	ALL	—	—	-250	μA	$V_{DS} = \text{Max. Rating}$, $V_{GS} = 0$ V
		—	—	-1000	μA	$V_{DS} = \text{Max. Rating} \times 0.8$, $V_{GS} = 0$ V, $T_C = 125^\circ C$
On-State Drain Current $I_{D(on)}$	IRF9240 IRF9241	-11	—	—	A	$V_{DS} > I_{D(on)} \times r_{DS(on)max}$, $V_{GS} = -10$ V
	IRF9242 IRF9243	-9	—	—	A	
Static Drain-Source On-State Resistance $r_{DS(on)}$	IRF9240 IRF9241	—	0.35	0.5	Ω	$V_{GS} = 10$ V, $I_D = -6$ A
	IRF9242 IRF9243	—	0.55	0.7	Ω	
Forward Transconductance g_{fs}	ALL	4	6	—	S(Ω)	$V_{DS} > I_{D(on)} \times r_{DS(on)max}$, $I_D = -6$ A
Input Capacitance C_{iss}	ALL	—	1100	—	pF	$V_{GS} = 0$ V, $V_{DS} = -25$ V, $f = 1.0$ MHz See Fig. 10
Output Capacitance C_{oss}	ALL	—	375	—	pF	
Reverse Transfer Capacitance C_{rss}	ALL	—	150	—	pF	
Turn-On Delay Time $t_{d(on)}$	ALL	—	18	22	ns	$V_{DD} = 100$ V, $I_D = -11$ A, $Z_o = 9.1 \Omega$ See Fig. 17 (MOSFET switching times are essentially independent of operating temperature.)
Rise Time t_r	ALL	—	45	68	ns	
Turn-Off Delay Time $t_{d(off)}$	ALL	—	75	90	ns	
Fall Time t_f	ALL	—	29	44	ns	
Total Gate Charge (Gate-Source Plus Gate-Drain) Q_g	ALL	—	70	90	nC	$V_{GS} = -15$ V, $I_D = -11$ A, $V_{DS} = 0.8$ Max. Rating. See Fig. 18 for test circuit. (Gate charge is essentially independent of operating temperature.)
Gate-Source Charge Q_{gs}	ALL	—	55	83	nC	
Gate-Drain ("Miller") Charge Q_{gd}	ALL	—	15	23	nC	
Internal Drain Inductance L_D	ALL	—	5.0	—	nH	Measured between the contact screw on header that is closer to source and gate pins and center of die.
Internal Source Inductance L_S	ALL	—	12.5	—	nH	Measured from the source pin, 6 mm (0.25 in.) from header and source bonding pad.
Junction-to-Case $R_{\theta JC}$	ALL	—	—	1	$^\circ C/W$	
Case-to-Sink $R_{\theta CS}$	ALL	—	0.1	—	$^\circ C/W$	Mounting surface flat, smooth, and greased.
Junction-to-Ambient $R_{\theta JA}$	ALL	—	—	30	$^\circ C/W$	Typical socket mount.

6

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

Continuous Source Current (Body Diode) I_S	IRF9240 IRF9241	—	—	-11	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.
	IRF9242 IRF9243	—	—	-9	A	
Pulse Source Current (Body Diode) I_{SM}	IRF9240 IRF9241	—	—	-44	A	
	IRF9242 IRF9243	—	—	-36	A	
Diode Forward Voltage V_{SD}	IRF9240 IRF9241	—	—	-1.5	V	$T_C = 25^\circ C$, $I_S = -11$ A, $V_{GS} = 0$ V
	IRF9242 IRF9243	—	—	-1.5	V	$T_C = 25^\circ C$, $I_S = -9$ A, $V_{GS} = 0$ V
Reverse Recovery Time t_{rr}	ALL	—	270	—	ns	$T_J = 150^\circ C$, $I_F = -11$ A, $di_F/dt = 100$ A/ μs
Reverse Recovered Charge Q_{RR}	ALL	—	2	—	μC	$T_J = 150^\circ C$, $I_F = -11$ A, $di_F/dt = 100$ A/ μs
Forward Turn-on Time t_{on}	ALL	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by $L_S + L_D$.				

① $T_J = 25^\circ C$ to $150^\circ C$.② Pulse Test: Pulse width $\leq 300 \mu s$,
Duty Cycle $\leq 2\%$.③ Repetitive Rating: Pulse width limited by
max. junction temperature. See Transient
Thermal Impedance Curve (Fig. 5).④ $V_{DD} = 50$ V, Starting $T_J = 25^\circ C$, $L = 9.8$ mH,
 $R_G = 25 \Omega$, Peak $I_L = 11$ A (See Figs. 15 & 16).

Rugged Power MOSFETs

IRF9240, IRF9241
IRF9242, IRF9243

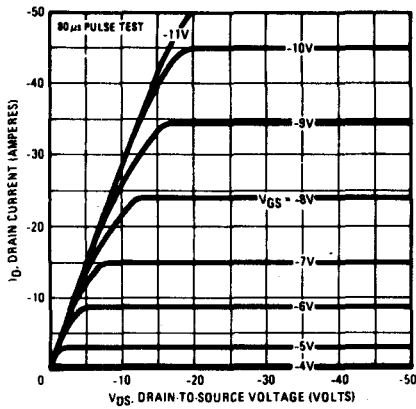


Fig. 1 - Typical output characteristics.

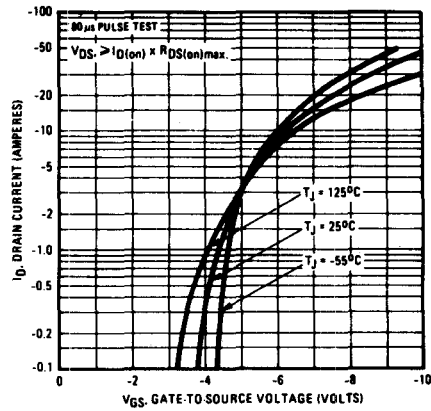


Fig. 2 - Typical transfer characteristics.

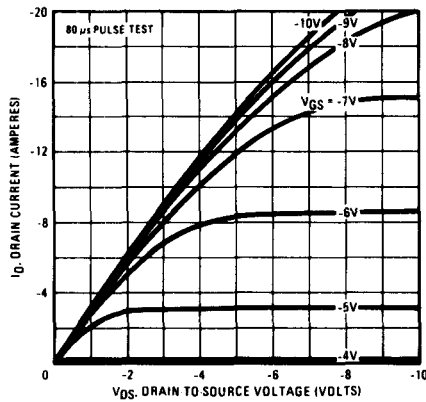


Fig. 3 - Typical saturation characteristics.

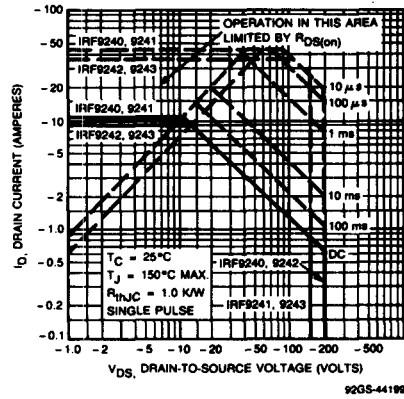


Fig. 4 - Maximum safe operating area.

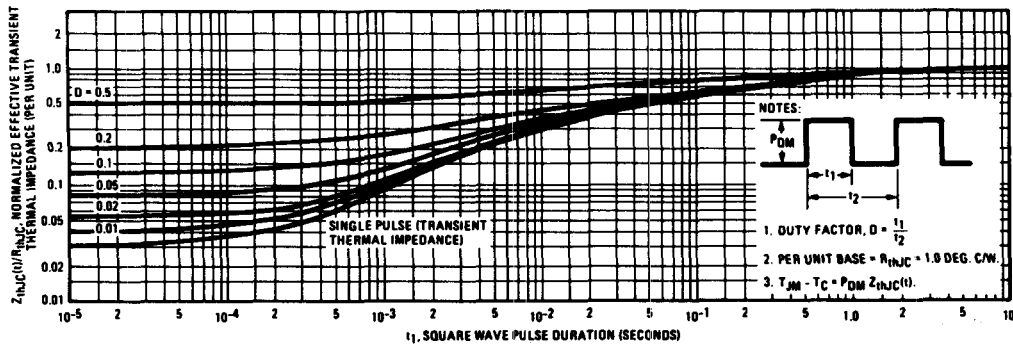


Fig. 5 - Maximum effective transient thermal impedance, junction-to-case vs. pulse duration.

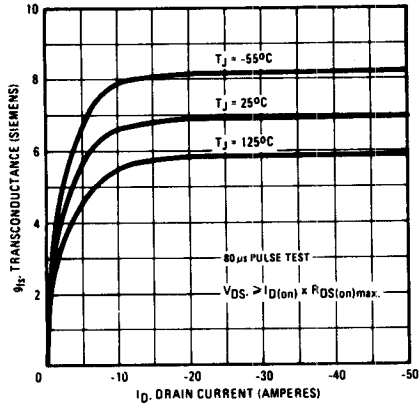


Fig. 6 - Typical transconductance vs. drain current.

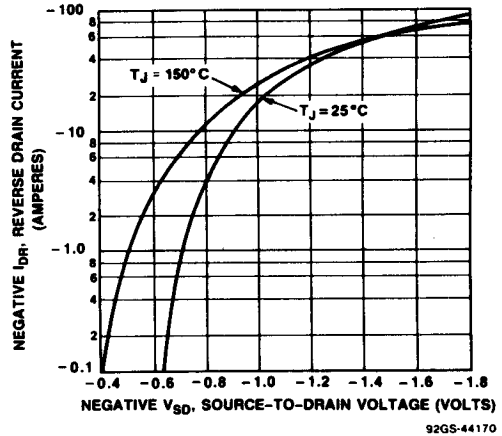


Fig. 7 - Typical source-drain diode forward voltage.

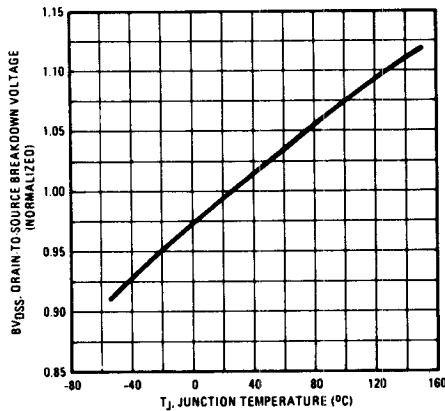


Fig. 8 - Breakdown voltage vs. temperature.

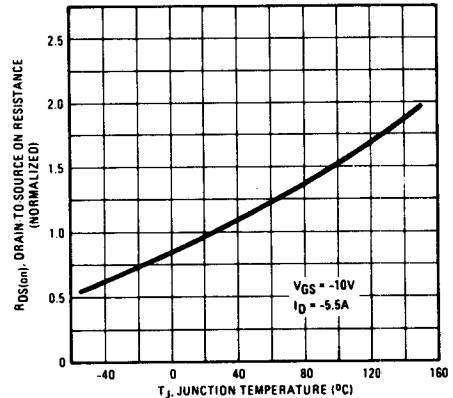


Fig. 9 - Normalized on-resistance vs. temperature.

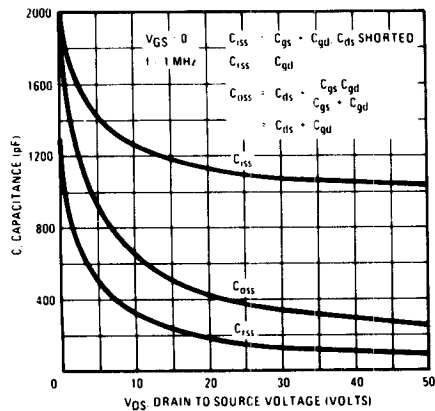


Fig. 10 - Typical capacitance vs. drain-to-source voltage.

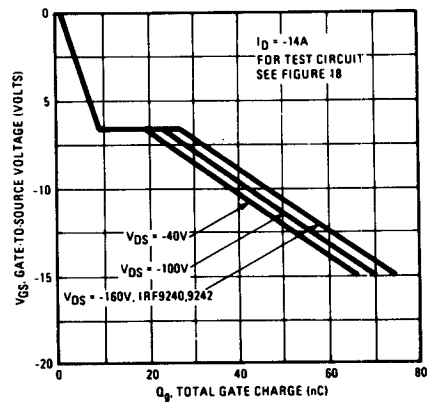


Fig. 11 - Typical gate charge vs. gate-to-source voltage.

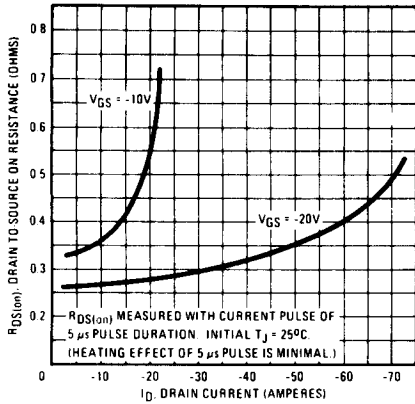


Fig. 12 - Typical on-resistance vs. drain current.

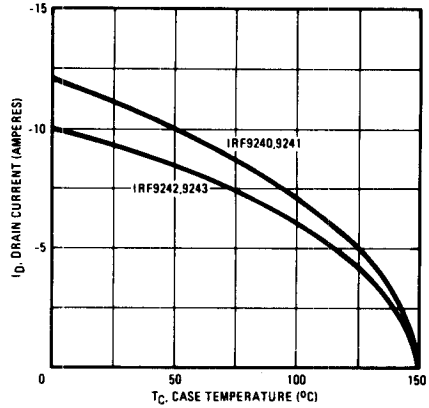


Fig. 13 - Maximum drain current vs. case temperature.

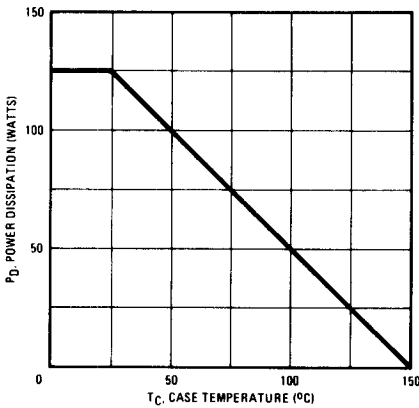


Fig. 14 - Power vs. temperature derating curve.

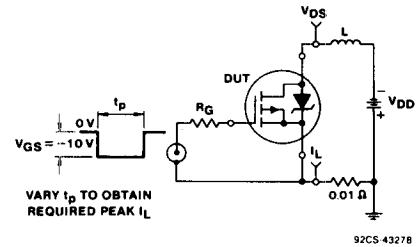


Fig. 15 - Unclamped inductive test circuit.

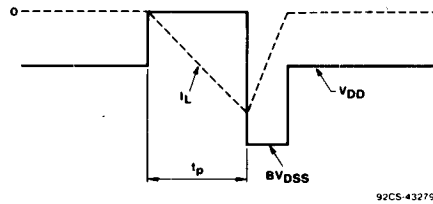


Fig. 16 - Unclamped inductive waveforms.

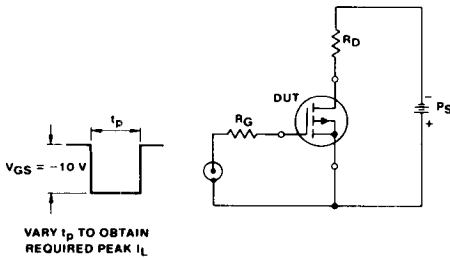


Fig. 17 - Switching time test circuit.

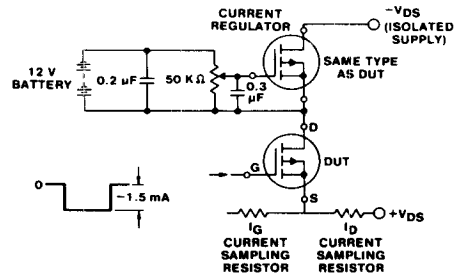


Fig. 18 - Gate charge test circuit.