File Number **2285**

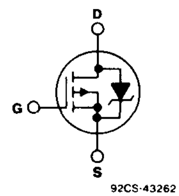
IRFD9120
IRFD9123

Avalanche-Energy-Rated P-Channel Power MOSFETs

-1.0 A and -0.8 A, -60 V and -100 V
$r_{DS(on)}$ = 0.6 Ω and 0.8 Ω

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

TERMINAL DIAGRAM

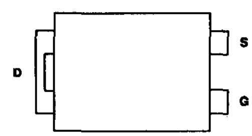


P-CHANNEL ENHANCEMENT MODE

The IRFD9120 and IRFD9123 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 IRFD-types are supplied in the 4-Pin dual-in-line plastic package.

TERMINAL DESIGNATION



TOP VIEW

4-PIN DIP

6

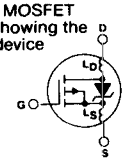
ABSOLUTE-MAXIMUM RATINGS

CHARACTERISTIC		IRFD9120	IRFD9123	UNITS
Drain-Source Voltage ①	V_{DS}	-100	-60	V
Drain-Gate Voltage (R_{GS} = 20 kΩ) ①	V_{DGR}	-100	-60	V
Continuous Drain Current	I_D @ T_C = 25°C	-1	-0.8	A
Pulsed Drain Current ③	I_{DM}	-8	-6.4	A
Gate-Source Voltage	V_{GS}	±20		V
Maximum Power Dissipation	P_D @ T_C = 25°C	1.0 (See Fig. 13)		W
Linear Derating Factor		0.008 (See Fig. 13)		W/°C
Single-Pulse Avalanche Energy Rating ④	E_{as}	370		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}	IRFD9120	-100	—	—	V	V_{GS} = 0 V
		IRFD9123	-60	—	—	V	I_D = -250 μA
Gate Threshold Voltage	$V_{GS(th)}$	ALL	-2.0	—	-4.0	V	V_{DS} = V_{GS}, I_D = -250 μA
Gate-Source Leakage Forward	I_{GSS}	ALL	—	—	-500	nA	V_{GS} = -20 V
Gate-Source Leakage Reverse	I_{GSS}	ALL	—	—	500	nA	V_{GS} = 20 V
Zero-Gate Voltage Drain Current	I_{DSS}	ALL	—	—	-250	μA	V_{DS} = Max. Rating, V_{GS} = 0 V
			—	—	-1000	μA	V_{DS} = Max. Rating x 0.8, V_{GS} = 0 V, T_C = 125°C
On-State Drain Current ②	$I_{D(on)}$	IRFD9120	-1	—	—	A	$V_{DS} > I_{D(on)} \times r_{DS(on)\ max.}$, V_{GS} = -10 V
		IRFD9123	-0.08	—	—	A	
Static Drain-Source On-State Resistance ②	$r_{DS(on)}$	IRFD9120	—	0.5	0.6	Ω	V_{GS} = 10 V, I_D = -0.8A
		IRFD9123	—	0.6	0.8	Ω	
Forward Transconductance ②	g_{fs}	ALL	0.8	1.2	—	S(℧)	$V_{DS} \leq$ 50 V, I_D = -0.8 A
Input Capacitance	C_{iss}	ALL	—	300	—	pF	V_{GS} = 0 V, V_{DS} = -25 V, f = 1.0 MHz See Fig. 9
Output Capacitance	C_{oss}	ALL	—	200	—	pF	
Reverse Transfer Capacitance	C_{rss}	ALL	—	50	—	pF	
Turn-On Delay Time	$t_{d(on)}$	ALL	—	25	50	ns	V_{DD} = 0.5 I_D = -0.8 A, Z_O = 50 Ω See Fig. 16 (MOSFET switching times are essentially independent of operating temperature.)
Rise Time	t_r	ALL	—	50	100	ns	
Turn-Off Delay Time	$t_{d(off)}$	ALL	—	50	100	ns	
Fall Time	t_f	ALL	—	50	100	ns	
Total Gate Charge (Gate-Source Plus Gate-Drain)	Q_g	ALL	—	16	20	nC	V_{GS} = -15 V, I_D = -4 A, V_{DS} = 0.8 Max. Rating. See Fig. 17 for test circuit. (Gate charge is essentially independent of operating temperature.)
Gate-Source Charge	Q_{gs}	ALL	—	9	13.5	nC	
Gate-Drain ("Miller") Charge	Q_{gd}	ALL	—	7	10.5	nC	
Internal Drain Inductance	L_D	ALL	—	4.0	—	nH	Measured from the drain lead, 2.0mm (0.08 in.) from header to center die.
Internal Source Inductance	L_S	ALL	—	6.0	—	nH	Measured from the source lead, 2.0 mm (0.08 in.) from header and source bonding pad.

Modified MOSFET symbol showing the internal device

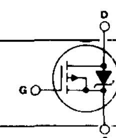


THERMAL RESISTANCE

Junction-to-Ambient	$R_{\theta JA}$	ALL	—	—	120	°C/W	Typical socket mount

SOURCE-DRAIN DIODE RATINGS AND CHARACTERISTICS

Continuous Source Current (Body Diode)	I_S	IRFD9120	—	—	-1	A	Modified MOSFET symbol showing the integral reverse P-N junction rectifier.
		IRFD9123	—	—	-0.8	A	
Pulse Source Current (Body Diode)	I_{SM}	IRFD9120	—	—	-8	A	
		IRFD9123	—	—	-6.4	A	
Diode Forward Voltage ②	V_{SD}	IRFD9120	—	—	-1.5	V	T_C = 25°C, I_S = -1 A, V_{GS} = 0 V
		IRFD9123	—	—	-1.5	V	T_C = 25°C, I_S = -0.8 A, V_{GS} = 0 V
Reverse Recovery Time	t_{rr}	ALL	—	150	—	ns	T_J = 150°C, I_F = -4 A, dI_F/dt = 100 A/μs
Reverse Recovered Charge	Q_{RR}	ALL	—	0.9	—	μC	T_J = 150°C, I_F = -4 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°C to 150°C.

② Pulse Test: Pulse width ≤ 300 μs, Duty Cycle ≤ 2%.

④ V_{DD} = 25 V, Starting T_J = 25°C, L = 555 mH, R_G = 25 Ω, Peak I_L = 1 A (See Figs. 14 & 15).

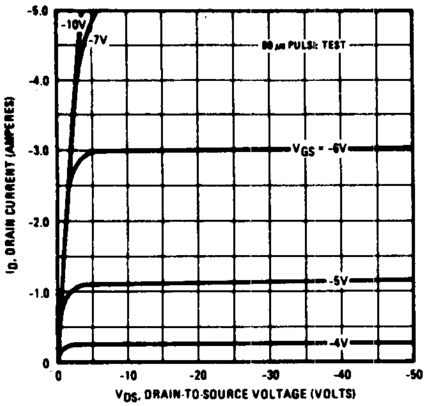


Fig. 1 - Typical output characteristics.

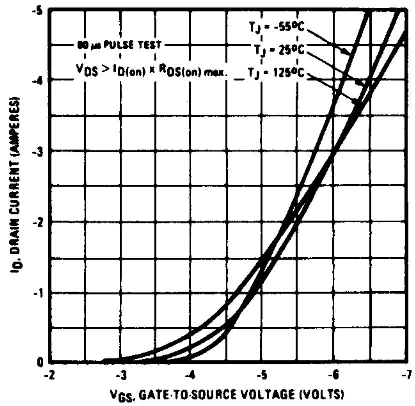


Fig. 2 - Typical transfer characteristics.

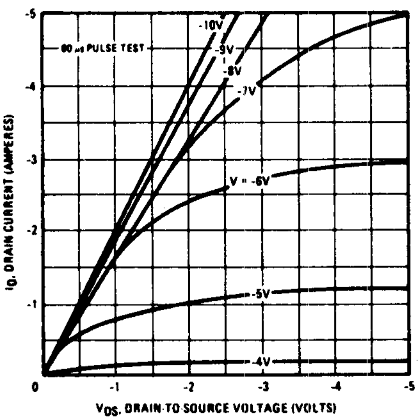
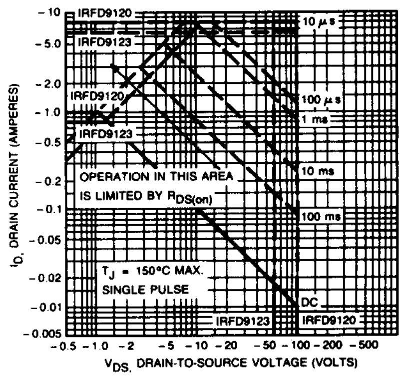


Fig. 3 - Typical saturation characteristics.



92GS-44202

Fig. 4 - Maximum safe operating area.

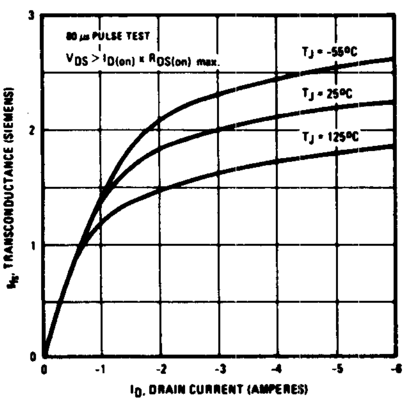
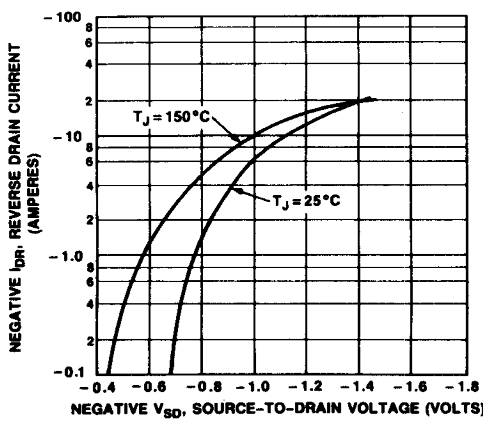


Fig. 5 - Typical transconductance vs. drain current.



92GS-44168

Fig. 6 - Typical source-drain diode forward voltage.

6

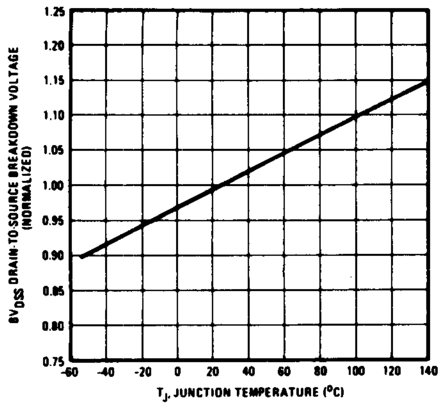


Fig. 7 - Breakdown voltage vs. temperature.

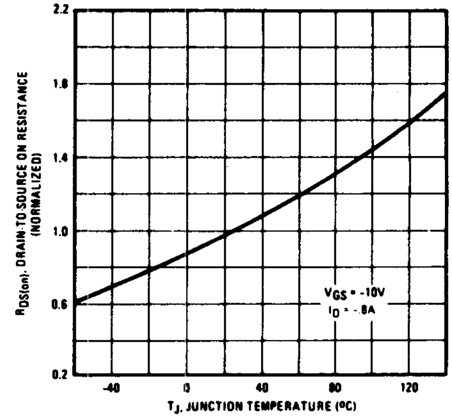


Fig. 8 - Normalized on-resistance vs. temperature.

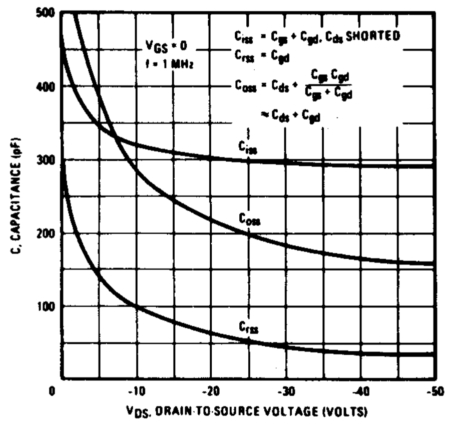


Fig. 9 - Typical capacitance vs. drain-to-source voltage.

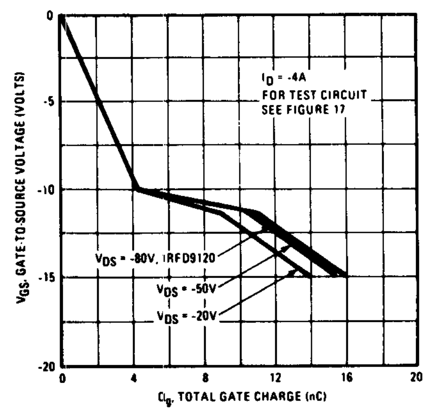


Fig. 10 - Typical gate charge vs. gate-to-source voltage.

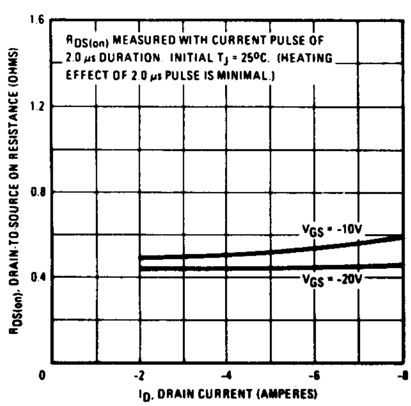


Fig. 11 - Typical on-resistance vs. drain current.

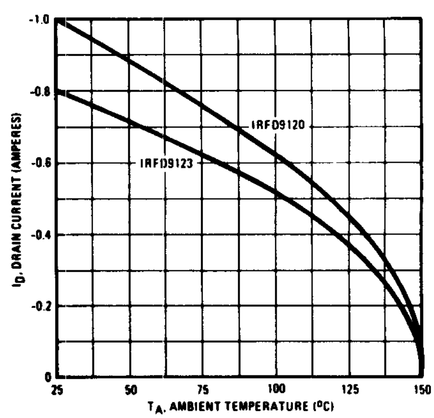


Fig. 12 - Maximum drain current vs. case temperature.

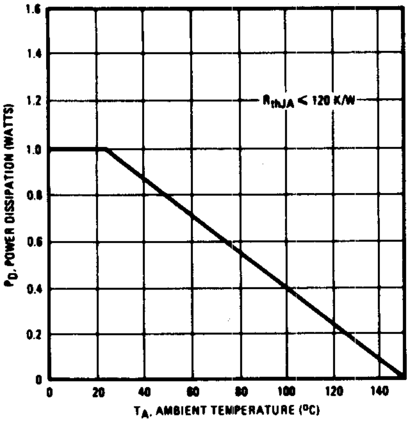


Fig. 13 - Power vs. temperature derating curve.

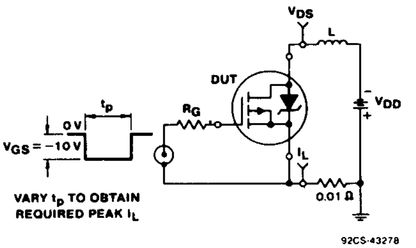


Fig. 14 - Unclamped inductive test circuit.

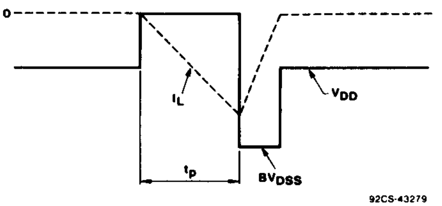


Fig. 15 - Unclamped inductive waveforms.

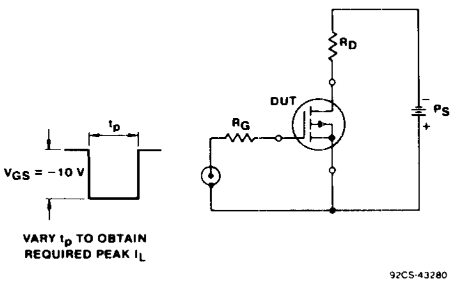


Fig. 16 - Switching time test circuit.

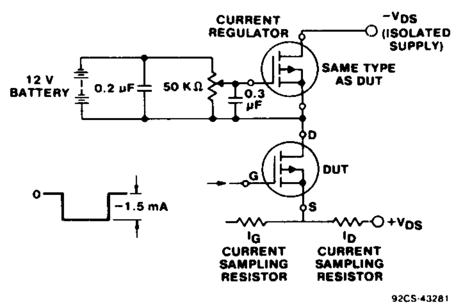


Fig. 17 - Gate charge test circuit.

6