International
IOR Rectifier

Provisional Data Sheet No. PD-9.1552

HEXFET® POWER MOSFET

IRFN440

N-CHANNEL

500 Volt, 0.85Ω HEXFET

HEXFET technology is the key to International Rectifier's advanced line of power MOSFET transistors. The efficient geometry achieves very low on-state resistance combined with high transconductance.

HEXFET transistors also feature all of the well-establish advantages of MOSFETs, such as voltage control, very fast switching, ease of paralleling and electrical parameter temperature stability. They are well-suited for applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers, and high energy pulse circuits.

The Surface Mount Device (SMD-1) package represents another step in the continual evolution of surface mount technology. The SMD-1 will give designers the extra flexibility they need to increase circuit board density. International Rectifier has engineered the SMD-1 package to meet the specific needs of the power market by increasing the size of the termination pads, thereby enhancing thermal and electrical performance.

Product Summary

Part Number	BV_{DSS}	$R_{DS(on)}$	I_D
IRFN440	500V	0.85Ω	8.0A

Features:

- Avalanche Energy Rating
- Dynamic dv/dt Rating
- Simple Drive Requirements
- Ease of Paralleling
- Hermetically Sealed
- Surface Mount
- Light-weight

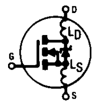
Absolute Maximum Ratings

	Parameter	IRFN440	Units
I_D @ V_{GS} = 10V, T_C = 25°C	Continuous Drain Current	8.0	A
I_D @ V_{GS} = 10V, T_C = 100°C	Continuous Drain Current	5.0	
I_{DM}	Pulsed Drain Current ①	32	
P_D @ T_C = 25°C	Max. Power Dissipation	125	W
	Linear Derating Factor	1.0	W/K ⑤
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	700	mJ
I_{AR}	Avalanche Current ①	8.0	A
E_{AR}	Repetitive Avalanche Energy ①	12.5	mJ
dv/dt	Peak Diode Recovery dv/dt ③	3.5	V/ns
T_J T_{STG}	Operating Junction Storage Temperature Range	-55 to 150	°C
	Package Mounting Surface Temperature	300 (for 5 seconds)	
	Weight	2.6 (typical)	g

IRFN440 Device

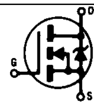
Electrical Characteristics @ Tj = 25°C (Unless Otherwise Specified)

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	500	—	—	V	V_{GS} = 0V, I_D = 1.0mA
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	0.78	—	V/°C	Reference to 25°C, I_D = 1.0mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.85	Ω	V_{GS} = 10V, I_D = 5.0A ④
		—	—	0.95		V_{GS} = 10V, I_D = 8.0A
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250µA
g_{fs}	Forward Transconductance	4.7	—	—	S (℧)	V_{DS} > 15V, I_{DS} = 5.0A ④
I_{DSS}	Zero Gate Voltage Drain Current	—	—	25	µA	V_{DS} = 0.8 x Max Rating, V_{GS} = 0V
		—	—	250		V_{DS} = 0.8 x Max Rating V_{GS} = 0V, T_J = 125°C
I_{GSS}	Gate-to-Source Leakage Forward	—	—	100	nA	V_{GS} = 20V
I_{GSS}	Gate-to-Source Leakage Reverse	—	—	-100		V_{GS} = -20V
Q_g	Total Gate Charge	27.3	—	68.5	nC	V_{GS} = 10V, I_D = 8.0A
Q_{gs}	Gate-to-Source Charge	2.0	—	12.5		V_{DS} = Max. Rating x 0.5
Q_{gd}	Gate-to-Drain (“Miller”) Charge	11.1	—	42.4		see figures 6 and 13
$t_{d(on)}$	Turn-On Delay Time	—	—	21	ns	V_{DD} = 250V, I_D = 8.0A,
t_r	Rise Time	—	—	73		R_G = 9.1Ω, VGS = 10V
$t_{d(off)}$	Turn-Off Delay Time	—	—	72		
t_f	Fall Time	—	—	51		see figure 10
L_D	Internal Drain Inductance	—	2.0	—	nH	Measured from the drain lead, 6mm (0.25 in.) from package to center of die. / Modified MOSFET symbol showing the internal inductances.
L_S	Internal Source Inductance	—	6.5	—		Measured from the source lead, 6mm (0.25 in.) from package to source bonding pad.
C_{iss}	Input Capacitance	—	1300	—	pF	V_{GS} = 0V, V_{DS} = 25V
C_{oss}	Output Capacitance	—	310	—		f = 1.0 MHz
C_{rss}	Reverse Transfer Capacitance	—	120	—		see figure 5



Source-Drain Diode Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	8.0	A	Modified MOSFET symbol showing the integral reverse p-n junction rectifier.
I_{SM}	Pulse Source Current (Body Diode) ①	—	—	32		
V_{SD}	Diode Forward Voltage	—	—	1.5	V	T_j = 25°C, I_S = 8.0A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	—	700	ns	T_j = 25°C, I_F = 8.0A, di/dt ≤ 100A/µs
Q_{RR}	Reverse Recovery Charge	—	—	8.9	µC	V_{DD} ≤ 50V ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible. Turn-on speed is substantially controlled by L_S + L_D.				



Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units	Test Conditions
R_{thJC}	Junction-to-Case	—	—	1.0	K/W	
$R_{thJ-PCB}$	Junction-to-PC Board	—	TBD	—		Soldered to a copper clad PC board

IRFN440 Device

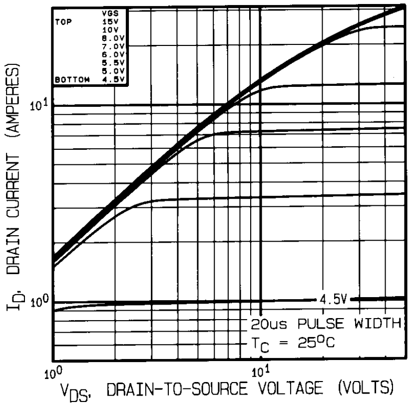


Fig. 1 — Typical Output Characteristics
T_C = 25°C

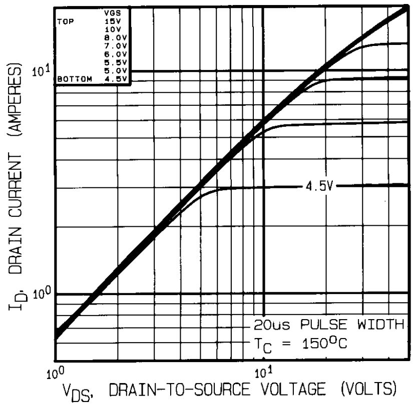


Fig. 2 — Typical Output Characteristics
T_C = 150°C

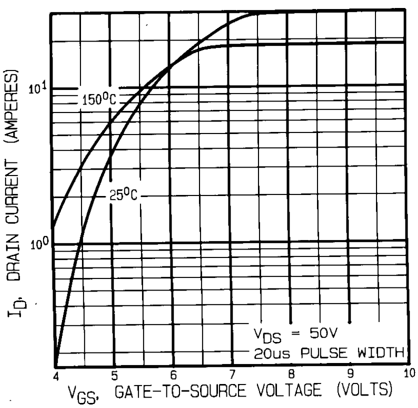


Fig. 3 — Typical Transfer Characteristics

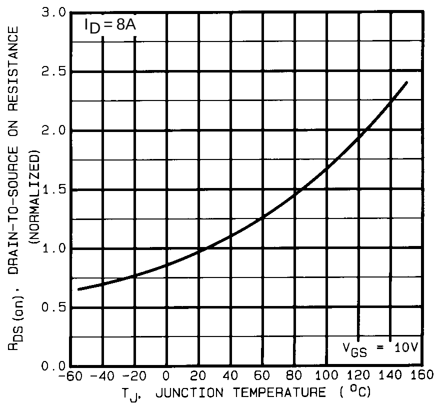


Fig. 4 — Normalized On-Resistance Vs.Temperature

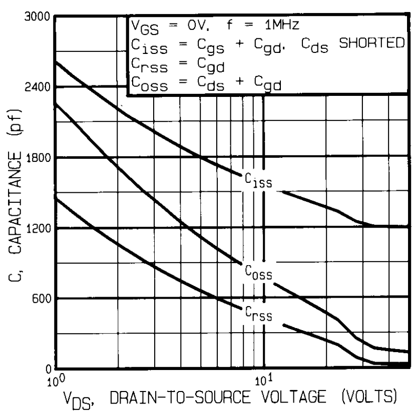


Fig. 5 — Typical Capacitance Vs. Drain-to-Source Voltage

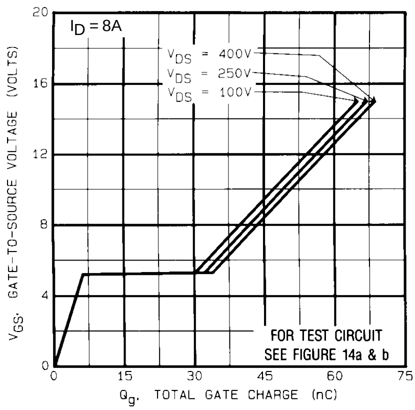


Fig. 6 — Typical Gate Charge Vs. Gate-to-Source Voltage

IRFN440 Device

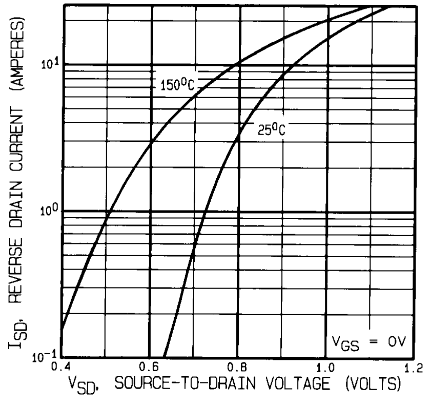


Fig. 7 — Typical Source-to-Drain Diode Forward Voltage

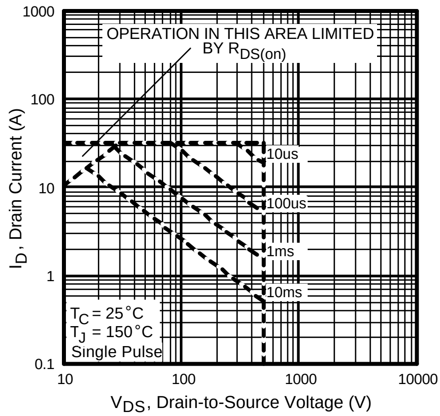


Fig. 8 — Maximum Safe Operating Area

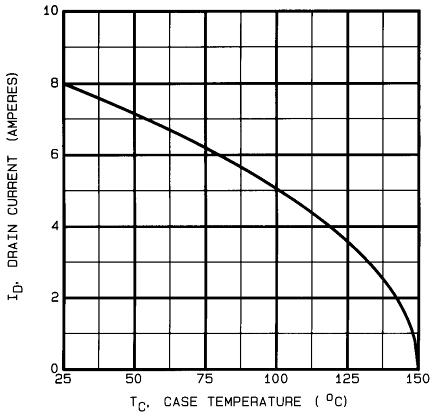


Fig. 9 — Maximum Drain Current Vs. Case Temperature

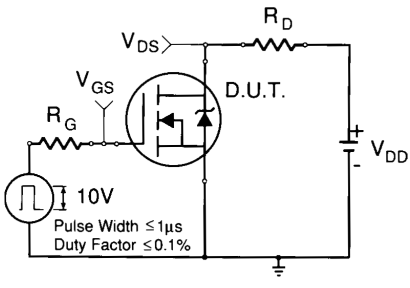


Fig. 10a — Switching Time Test Circuit

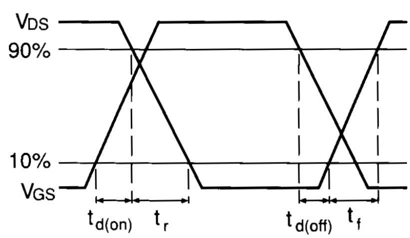


Fig. 10b — Switching Time Waveforms

IRFN440 Device

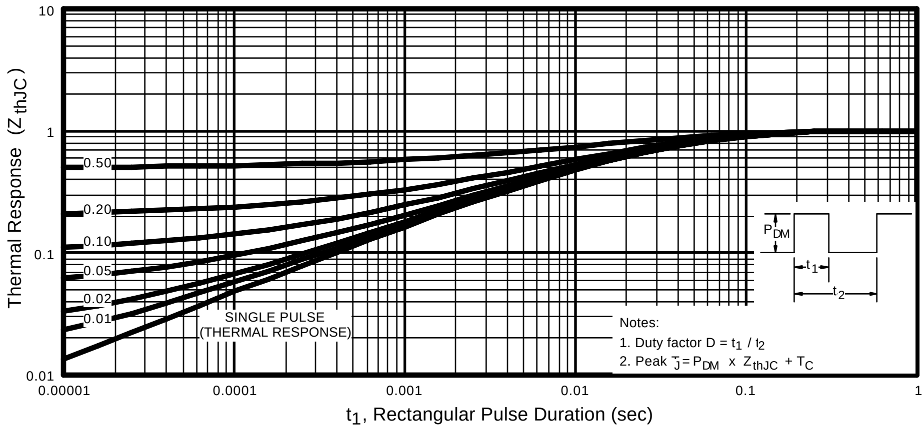


Fig. 11 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

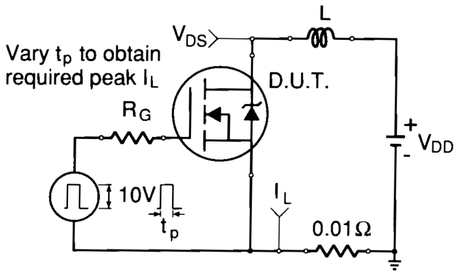


Fig. 12a — Unclamped Inductive Test Circuit

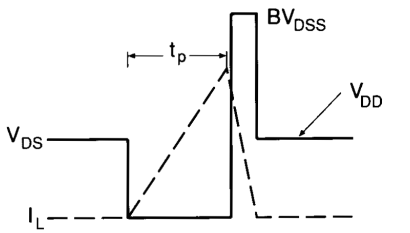


Fig. 12b — Unclamped Inductive Waveforms

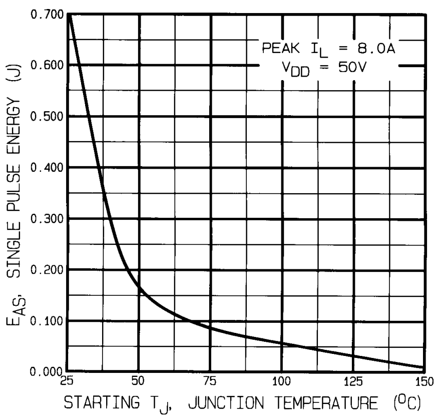


Fig. 12c — Max. Avalanche Energy vs. Current

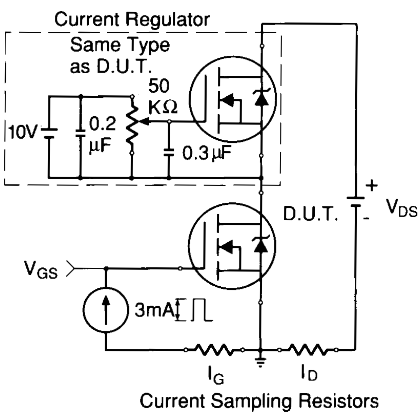


Fig. 13a — Gate Charge Test Circuit

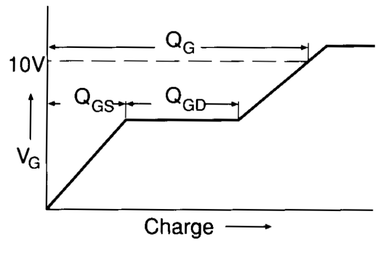


Fig. 13b — Basic Gate Charge Waveform

① Repetitive Rating; Pulse width limited by maximum junction temperature. (see figure 11)

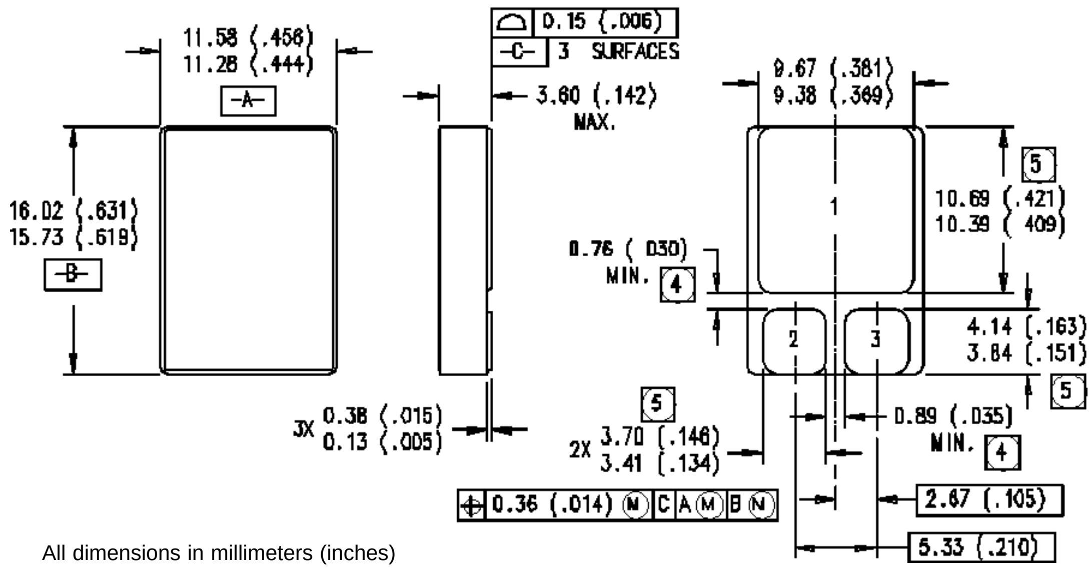
② @ V_{DD} = 50V, Starting T_J = 25°C, $E_{AS} = [0.5 * L * (I_L^2) * [BV_{DSS}/(BV_{DSS}-V_{DD})]$ Peak I_L = 8.0A, V_{GS} = 10V, 25 ≤ R_G ≤ 200Ω

③ I_{SD} ≤ 8.0A, di/dt ≤ 100A/µs, V_{DD} ≤ BV_{DSS}, T_J ≤ 150°C

④ Pulse width ≤ 300 µs; Duty Cycle ≤ 2%

⑤ K/W = °C/W
W/K = W/°C

Case Outline and Dimensions — SMD-1



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