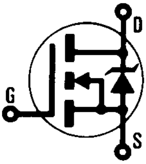
Data Sheet No. PD-9.727A

INTERNATIONAL RECTIFIER IOR

REPETITIVE AVALANCHE RATED AND dv/dt RATED

HEXFET® TRANSISTOR IRFM460



N-CHANNEL

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500 Volt, 0.27 Ohm HEXFET

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

The HEXFET transistors also feature all of the well established advantages of MOSFETs such as voltage control, very fast switching, ease of paralleling and temperature stability of the electrical parameters.

They are well suited for applications such as switching power supplies and virtually any application where military and/or high reliability is required.

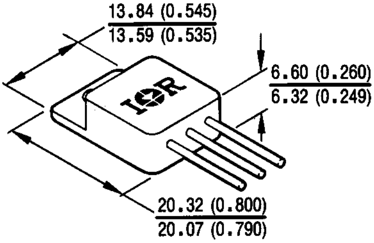
Product Summary

Part Number	BV_{DSS}	$R_{DS(on)}$	I_D
IRFM460	500V	0.27Ω	19A

FEATURES:

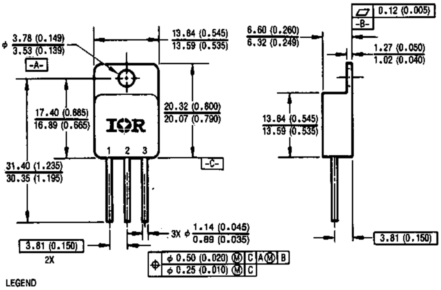
- Repetitive Avalanche Rating
- Isolated and Hermetically Sealed
- Alternative to TO-3 Package
- Simple Drive Requirements
- Ease of Paralleling
- Ceramic Eyelet

CASE STYLE AND DIMENSIONS



CAUTION

BERYLLIA WARNING PER MIL-S-19500
SEE PAGE I-372



LEGEND
1 DRAIN
2 SOURCE
3 GATE

NOTES:
1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M - 1982.
2 ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).

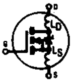
Conforms to JEDEC Outline TO-254AA*
Dimensions in Millimeters and (Inches)

*For leadform configurations see page I-372, fig. 15

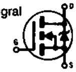
Absolute Maximum Ratings

Parameter		IRFM460	Units
I_D @ V_{GS} = 0V, T_C = 25°C	Continuous Drain Current	19	A
I_D @ V_{GS} = 0V, T_C = 100°C	Continuous Drain Current	12	
I_{DM}	Pulsed Drain Current ①	76	
P_D @ T_C = 25°C	Max. Power Dissipation	250	W
	Linear Derating Factor	2.0	W/K ⑤
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	1200	mJ
I_{AR}	Avalanche Current ①	19	A
E_{AR}	Repetitive Avalanche Energy ①	25	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
	Lead Temperature	300 (0.063 in. (1.6 mm) from case for 10s)	

Electrical Characteristics @ T_J = 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 = 1.0 mA
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	0.68	—	V/°C	Reference to 25°C, I_D = 1.0 mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.27	Ω	V_{GS} = 10V, I_D = 12A ④
		—	—	0.31		V_{GS} = 10V, I_D = 19A
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250 μA
g_{fs}	Forward Transconductance	13	—	—	S (℧)	V_{DS} ≥ 15V, I_{DS} = 12A 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	—	—	190	nC	V_{GS} = 10V, I_D = 19A
Q_{gs}	Gate-to-Source Charge	—	—	27		V_{DS} = 0.5 x Max. Rating
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	135		See Fig. 6 and 14
$t_{d(on)}$	Turn-On Delay Time	—	—	35	ns	V_{DD} = 250V, I_D = 19A, R_G = 2.35Ω
t_r	Rise Time	—	—	120		
$t_{d(off)}$	Turn-Off Delay Time	—	—	130		See Fig. 11
t_f	Fall Time	—	—	98		
L_D	Internal Drain Inductance	—	8.7	—	nH	Measured from the drain lead, 6 mm (0.25 in.) from package to center of die. Modified MOSFET symbol showing the internal inductances. 
L_S	Internal Source Inductance	—	8.7	—		Measured from the source lead, 6 mm (0.25 in.) from package to source bonding pad.
C_{iss}	Input Capacitance	—	4300	—	pF	V_{GS} = 0V, V_{DS} = 25V
C_{oss}	Output Capacitance	—	1000	—		f = 1.0 MHz
C_{rss}	Reverse Transfer Capacitance	—	250	—		See Fig. 5

Source-Drain Diode Ratings and Characteristics

Parameter	Min.	Typ.	Max.	Units	Test Conditions
I_S Continuous Source Current (Body Diode)	—	—	19		Modified MOSFET symbol showing the integral Reverse p-n junction rectifier. 
I_{SM} Pulsed Source Current (Body Diode) ①	—	—	76		
V_{SD} Diode Forward Voltage	—	—	1.8		$T_J = 25°C$, $I_S = 19A$, $V_{GS} = 0V$ ④
t_{rr} Reverse Recovery Time	—	—	580		$T_J = 25°C$, $I_F = 19A$, $di/dt \leq 100\ A/\mu s$ ④
Q_{RR} Reverse Recovery Charge	—	—	8.1		$V_{DD} \leq 50V$
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	—	—	0.5	K/W ⑤	
R_{thCS} Case-to-Sink	—	0.21	—		Mounting surface flat, smooth, and greased
R_{thJA} Junction-to-Ambient	—	—	48		Typical socket mount

① Repetitive Rating; Pulse width limited by maximum junction temperature (see figure 9) Refer to current HEXFET reliability report

② @ $V_{DD} = 50V$, Starting $T_J = 25°C$, $L \geq 6.0\ mH$, $R_G = 25\Omega$, Peak $I_L = 19A$

③ $I_{SD} \leq 19A$, $di/dt \leq 160\ A/\mu s$, $V_{DD} \leq BV_{DSS}$, $T_J \leq 150°C$ Suggested $R_G = 2.35\ \Omega$

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

⑤ K/W = °C/W
W/K = W/°C

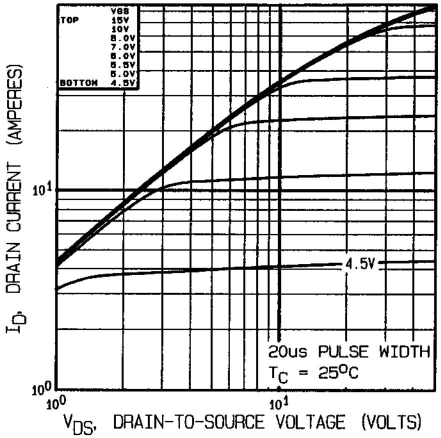


Fig. 1 — Typical Output Characteristics, T_C = 25°C

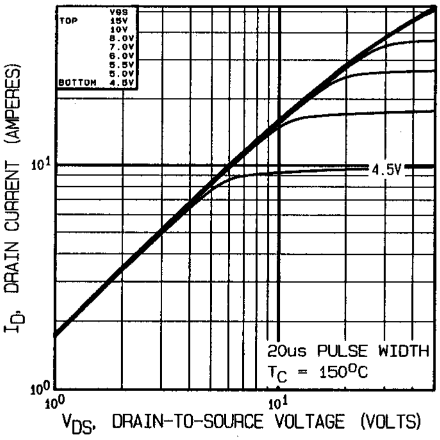


Fig. 2 — Typical Output Characteristics, T_C = 150°C

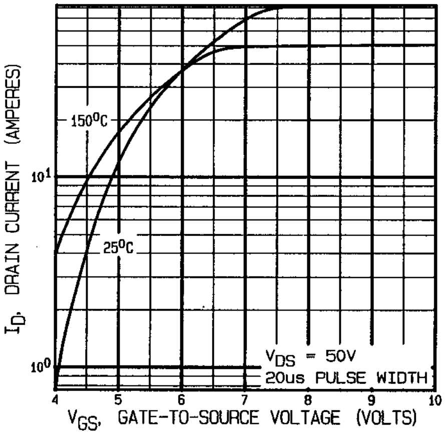


Fig. 3 — Typical Transfer Characteristics

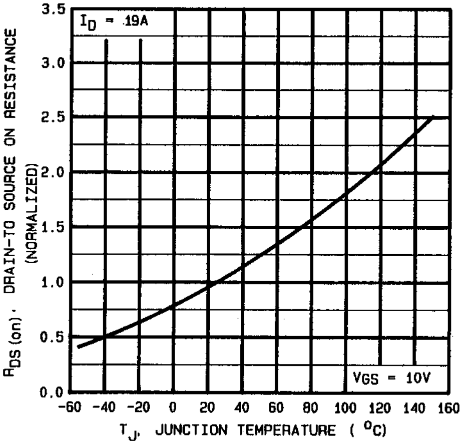


Fig. 4 — Normalized On-Resistance Vs. Temperature

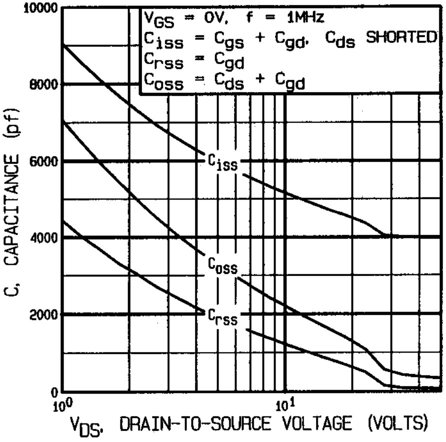


Fig. 5 — Typical Capacitance Vs. Drain-to-Source Voltage

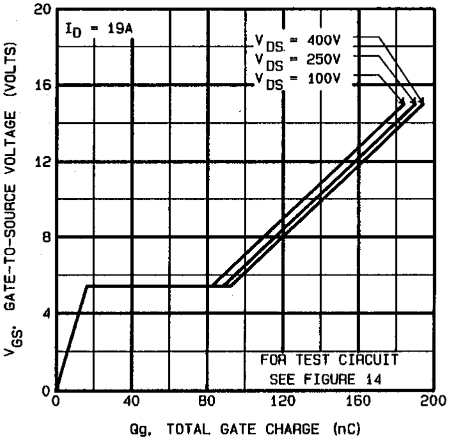


Fig. 6 — Typical Gate Charge Vs. Gate-to-Source Voltage

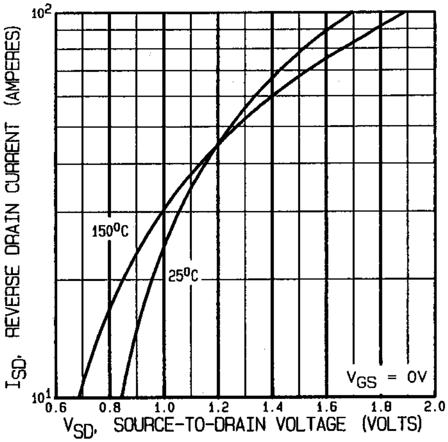


Fig. 7 — Typical Source-Drain Diode Forward Voltage

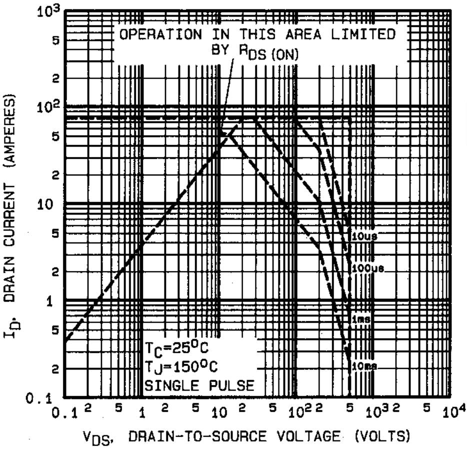


Fig. 8 — Maximum Safe Operating Area

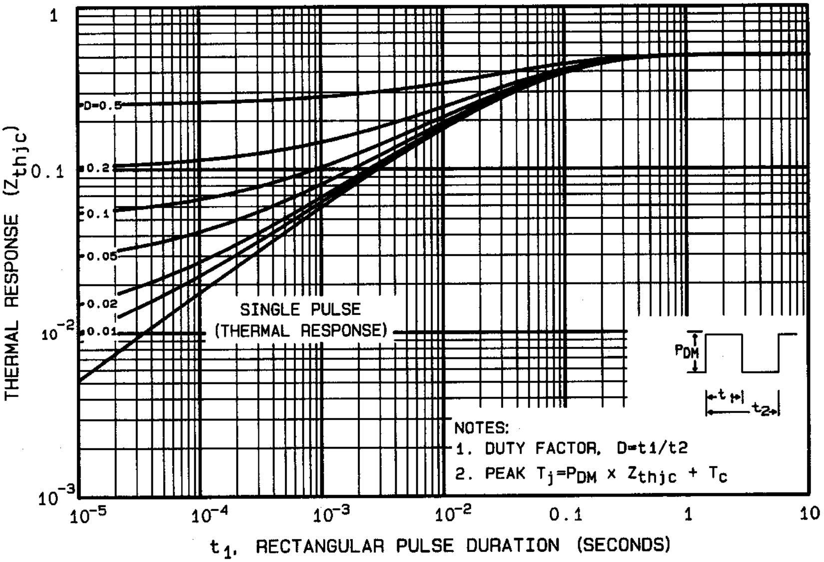


Fig. 9 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

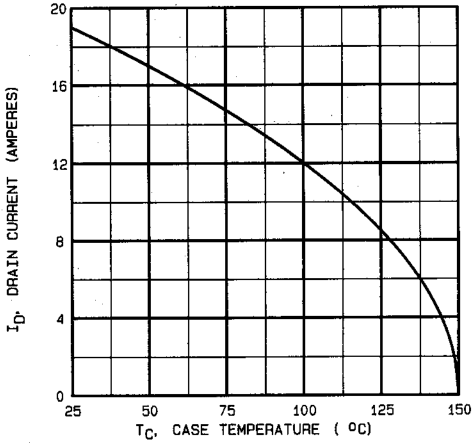


Fig. 10 — Maximum Drain Current Vs. Case Temperature

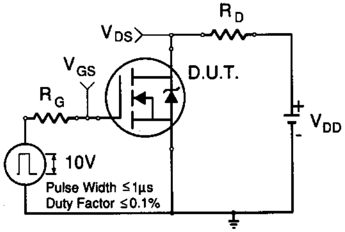


Fig. 11a — Switching Time Test Circuit

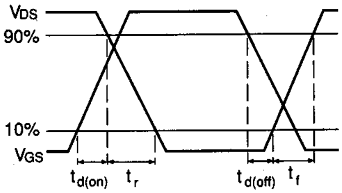


Fig. 11b — Switching Time Waveforms

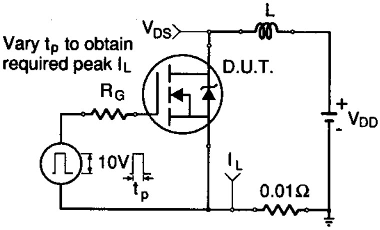


Fig. 12a — Unclamped Inductive Test Circuit

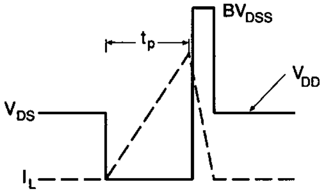


Fig. 12b — Unclamped Inductive Waveforms

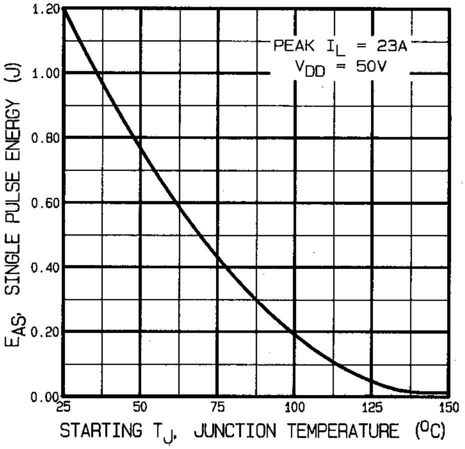
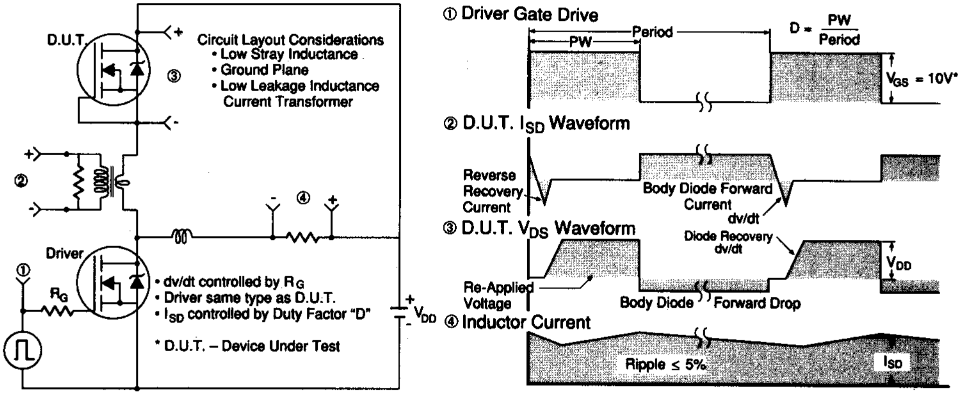


Fig. 12c — Maximum Avalanche Energy Vs. Starting Junction Temperature



*V_{GS} = 5V for Logic Level Devices

Fig. 13 — Peak Diode Recovery dv/dt Test Circuit

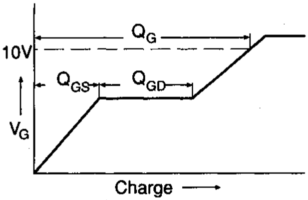


Fig. 14a — Basic Gate Charge Waveform

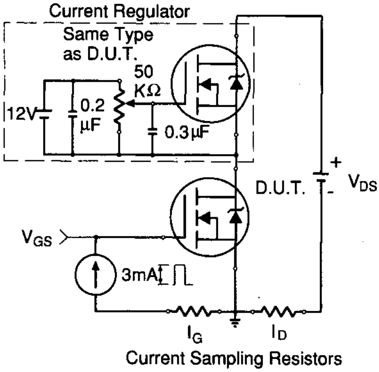
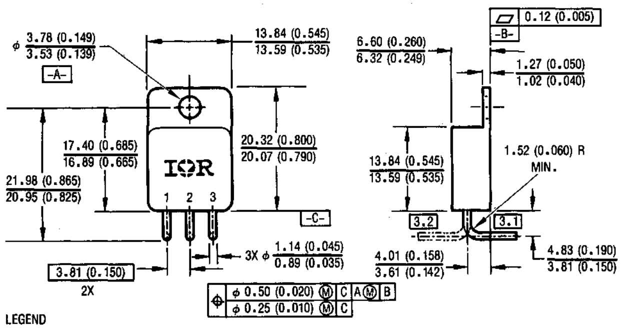


Fig. 14b — Gate Charge Test Circuit



LEGEND
1 DRAIN
2 SOURCE
3 GATE

NOTES:
1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M - 1982.
2 ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
3 LEADFORM IS AVAILABLE IN EITHER ORIENTATION:
  3.1 EXAMPLE: IRFM460D
  3.2 EXAMPLE: IRFM460U

Fig. 15 – Optional Leadforms for Outline TO-254

BERYLLIA WARNING PER MIL-S-19500

Packages containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.