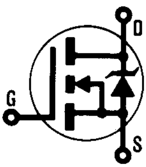
Data Sheet No. PD-9.491C

INTERNATIONAL RECTIFIER

REPETITIVE AVALANCHE RATED AND dv/dt RATED

HEXFET® TRANSISTOR



N-CHANNEL

IRFM350
2N7227
JANTX2N7227
JANTXV2N7227
[REF: MIL-S-19500/592]

400 Volt, 0.315 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.

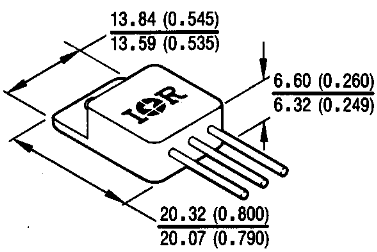
Product Summary

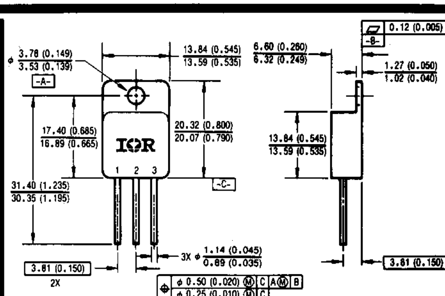
Part Number	BV_{DSS}	$R_{DS(on)}$	I_D
IRFM350	400V	0.315Ω	14A

FEATURES:

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

CASE STYLE AND DIMENSIONS





LEGEND
1 DRAIN
2 SOURCE
3 GATE

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

CAUTION

BERYLLIA WARNING PER MIL-S-19500
SEE PAGE I-340

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

*For leadform configurations see page I-340, fig. 15

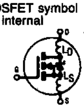
IOR

Absolute Maximum Ratings

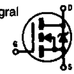
Parameter		IRFM350, JANTXV-, JANTX-, 2N7227	Units
I_D @ V_{GS} = 10V, T_C = 25°C	Continuous Drain Current	14	A
I_D @ V_{GS} = 10V, T_C = 100°C	Continuous Drain Current	9.0	A
I_{DM}	Pulsed Drain Current ①	56	A
P_D @ T_C = 25°C	Max. Power Dissipation	150	W
	Linear Derating Factor	1.2	W/K ⑤
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	700 (See Fig. 12)	mJ
I_{AR}	Avalanche Current ①	14 (See E_{AR})	A
E_{AR}	Repetitive Avalanche Energy ①	15 (See Fig. 13)	mJ
dv/dt	Peak Diode Recovery dv/dt ③	4.0 (See Fig. 13)	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)	°C
	Weight	9.3 (typical)	g

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

Parameter		Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-to-Source Breakdown Voltage	400	—	—	V	V_{GS} = 0V, I_D = 1.0 mA
$\Delta BV_{DSS}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	—	0.46	—	V/°C	Reference to 25°C, I_D = 1.0 mA
$R_{DS(on)}$	Static Drain-to-Source On-State Resistance	—	—	0.315	Ω	V_{GS} = 10V, I_D = 9.0A ④
		—	—	0.415	Ω	V_{GS} = 10V, I_D = 14A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250 μA
g_{fs}	Forward Transconductance	6.0	—	—	S (℧)	V_{DS} ≥ 15V, I_{DS} = 9.0A ④
I_{DSS}	Zero Gate Voltage Drain Current	—	—	25	μA	V_{DS} = 0.8 x Max. Rating, V_{GS} = 0V
		—	—	250	μA	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	nA	V_{GS} = −20V
Q_g	Total Gate Charge	52	—	110	nC	V_{GS} = 10V, I_D = 14A
Q_{gs}	Gate-to-Source Charge	5.0	—	18	nC	V_{DS} = 0.5 x Max. Rating
Q_{gd}	Gate-to-Drain ("Miller") Charge	25	—	65	nC	See Fig. 6 and 14
$t_{d(on)}$	Turn-On Delay Time	—	—	35	ns	V_{DD} = 200V, I_D = 14A, R_G = 2.35Ω
t_r	Rise Time	—	—	190	ns	
$t_{d(off)}$	Turn-Off Delay Time	—	—	170	ns	See Fig. 11
t_f	Fall Time	—	—	130	ns	
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	—	nH	Measured from the source lead, 6 mm (0.25 in.) from package to source bonding pad.
C_{iss}	Input Capacitance	—	2600	—	pF	V_{GS} = 0V, V_{DS} = 25V
C_{oss}	Output Capacitance	—	660	—	pF	f = 1.0 MHz
C_{rss}	Reverse Transfer Capacitance	—	250	—	pF	See Fig. 5
C_{DC}	Drain-to-Case Capacitance	—	12	—	pF	



Source-Drain Diode Ratings and Characteristics

Parameter		Min.	Typ.	Max.	Units	Test Conditions
I_S	Continuous Source Current (Body Diode)	—	—	14	A	Modified MOSFET symbol showing the integral Reverse p-n junction rectifier. 
I_{SM}	Pulsed Source Current (Body Diode) ①	—	—	56		
V_{SD}	Diode Forward Voltage	—	—	1.7	V	T_J = 25°C, I_S = 14A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	—	1200	nS	T_J = 25°C, I_F = 14A, di/dt ≤ 100 A/μs ④
Q_{RR}	Reverse Recovery Charge	—	—	11	μC	V_{DD} ≤ 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	—	—	0.83	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 ≥ 6.3 mH, R_G = 25Ω, Peak I_L = 14A

③ I_{SD} ≤ 14A, di/dt ≤ 145 A/μs, V_{DD} ≤ BV_{DSS}, T_J ≤ 150°C Suggested R_G = 2.35Ω

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

⑤ K/W = °C/W W/K = W/°C

I

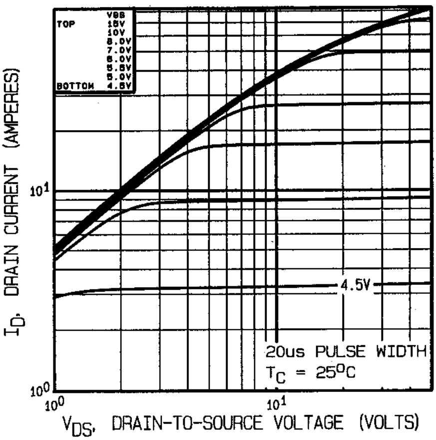


Fig. 1 — Typical Output Characteristics, T_C = 25°C

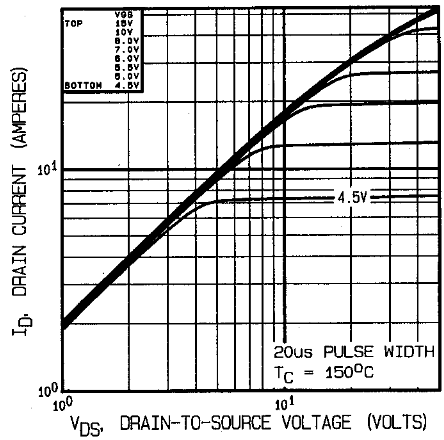


Fig. 2 — Typical Output Characteristics, T_C = 150°C

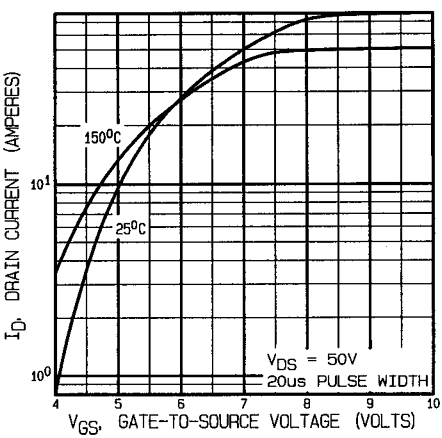


Fig. 3 — Typical Transfer Characteristics

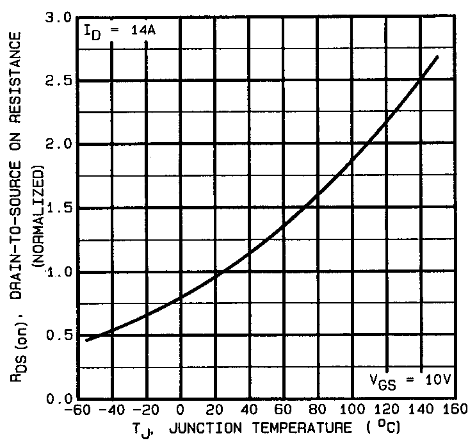


Fig. 4 — Normalized On-Resistance Vs. Temperature

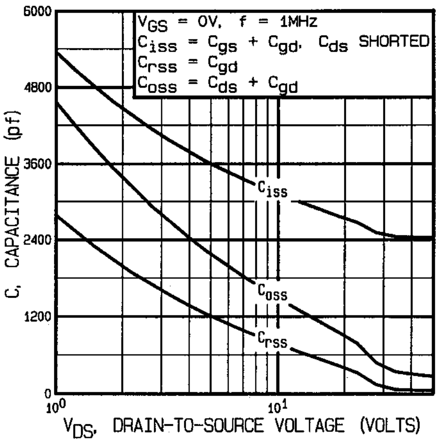


Fig. 5 — Typical Capacitance Vs. Drain-to-Source Voltage

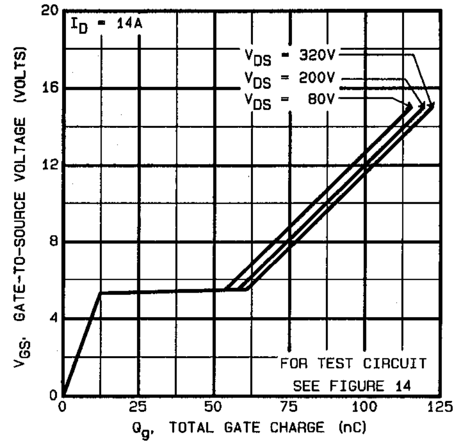


Fig. 6 — Typical Gate Charge Vs. Gate-to-Source Voltage

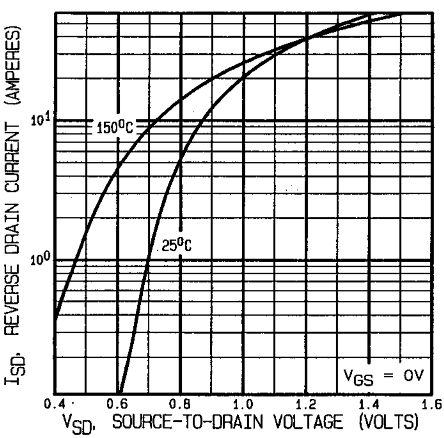


Fig. 7 — Typical Source-Drain Diode Forward Voltage

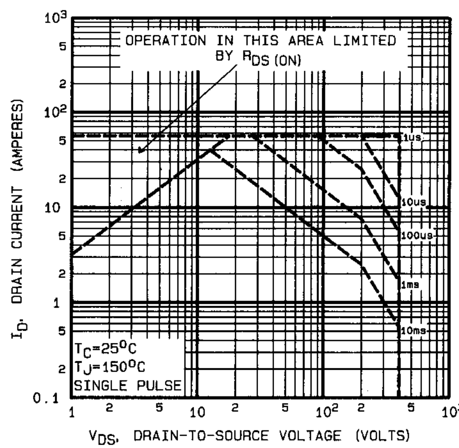


Fig. 8 — Maximum Safe Operating Area

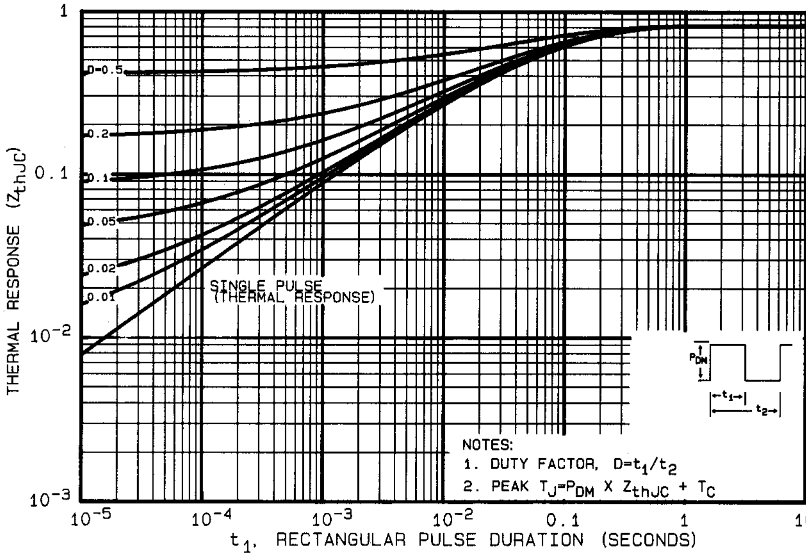


Fig. 9 — Maximum Effective Transient Thermal Impedance, Junction-to-Case Vs. Pulse Duration

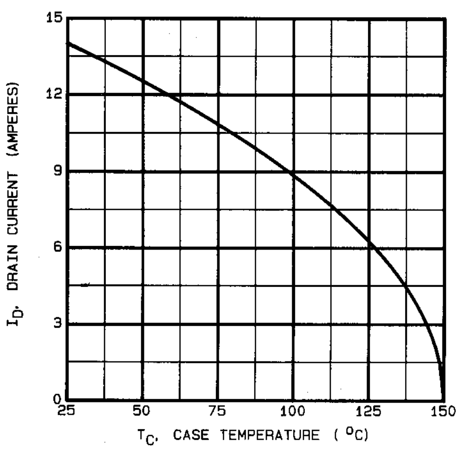


Fig. 10 — Maximum Drain Current Vs. Case Temperature

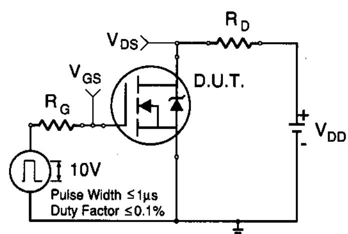


Fig. 11a — Switching Time Test Circuit

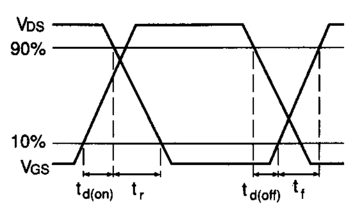


Fig. 11b — Switching Time Waveforms

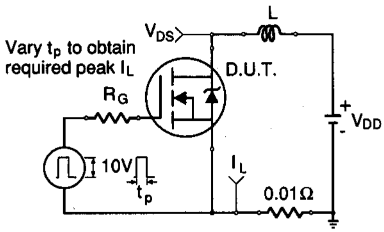


Fig. 12a — Unclamped Inductive Test Circuit

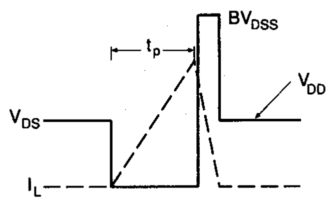


Fig. 12b — Unclamped Inductive Waveforms

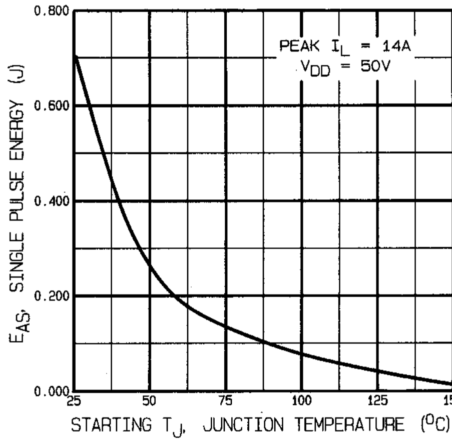


Fig. 12c — Maximum Avalanche Energy Vs. Starting Junction Temperature

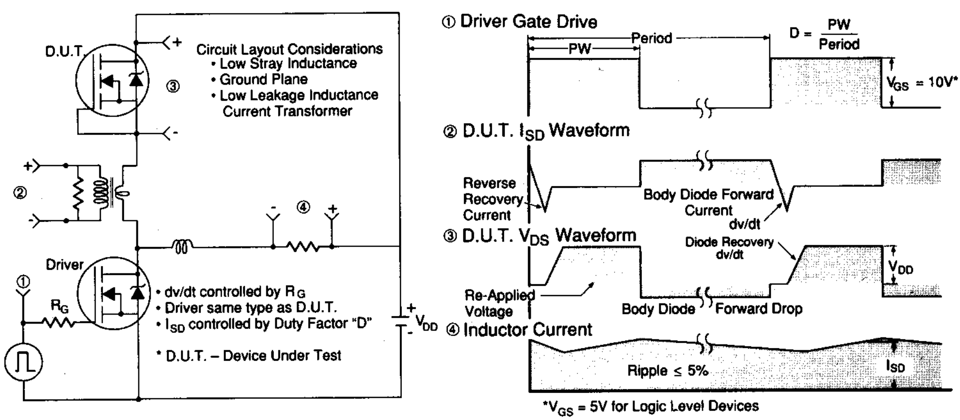


Fig. 13 — Peak Diode Recovery dv/dt Test Circuit

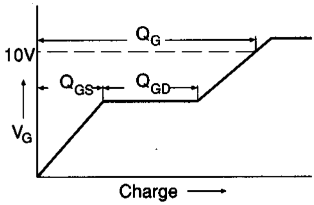


Fig. 14a — Basic Gate Charge Waveform

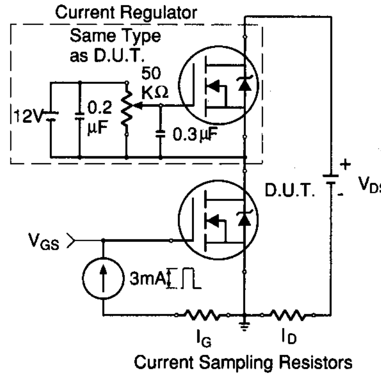
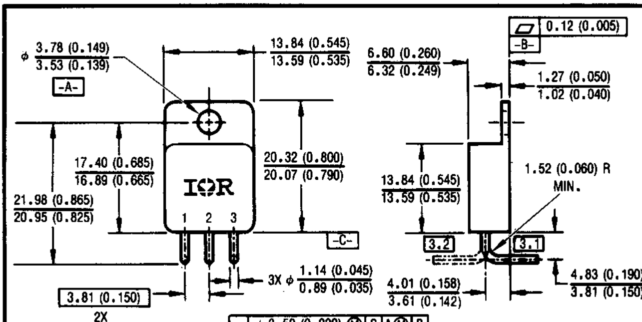


Fig. 14b — Gate Charge Test Circuit



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: IRFM350D
   3.2 EXAMPLE: IRFM350U

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.