International IƆR Rectifier

## HEXFET® Power MOSFET

- Dynamic dv/dt Rating
- Current Sense
- 175°C Operating Temperature
- Fast Switching
- Ease of Paralleling
- Simple Drive Requirements
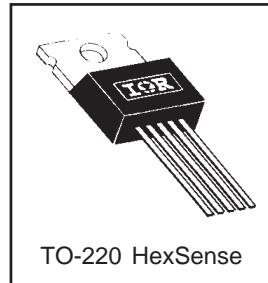
$V_{DSS} = 60V$

$R_{DS(on)} = 0.028\Omega$

$I_D = 50^*A$

Description

Third Generation HEXFETs from International Rectifier provide the designer with the best combination of fast switching, ruggedized device, low on-resistance and cost-effectiveness.

The HEXSense device provides an accurate fraction of the drain current through the additional two leads to be used for control or protection of the device. These devices exhibit similar electrical and thermal characteristics as their IRF-series equivalent part numbers. The provision of a kelvin source connection effectively eliminates problems of common source inductance when the HEXSence is used as a fast, high-current switch in non current-sensing applications.

TO-220 HexSense

Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ $T_C = 25°C$	Continuous Drain Current, V_{GS} @ 10V	50*	A
I_D @ $T_C = 100°C$	Continuous Drain Current, V_{GS} @ 10V	37	
I_{DM}	Pulsed Drain Current ①	210	
P_D @ $T_C = 25°C$	Power Dissipation	150	W
	Linear Derating Factor	1.0	W/°C
V_{GS}	Gate-to-Source Voltage	±20	V
E_{AS}	Single Pulse Avalanche Energy ②	30	mJ
dv/dt	Peak Diode Recovery dv/dt ③	4.5	V/ns
T_J	Operating Junction and	-55 to + 175	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting Torque, 6-32 or M3 screw	10 lbf•in (1.1 N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	—	1.0	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	—	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient —	—	—	62	

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Electrical Characteristics @ T$_J$ = 25°C (unless otherwise specified)

Parameter		Min.	Typ.	Max.	Units	Conditions
V$_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	60	——	——	V	V$_{GS}$ = 0V, I$_D$ = 250μA
ΔV$_{(BR)DSS}$/ΔT$_J$	Breakdown Voltage Temp. Coefficient	——	0.060	——	V/°C	Reference to 25°C, I$_D$ = 1mA
R$_{DS(ON)}$	Static Drain-to-Source On-Resistance	——	——	0.028	Ω	V$_{GS}$ = 10V, I$_D$ = 31A④
V$_{GS(th)}$	Gate Threshold Voltage	2.0	——	4.0	V	V$_{DS}$ = V$_{GS}$, I$_D$ = 250μA
g$_{fs}$	Forward Transconductance	18	——	——	S	V$_{DS}$ = 25V, I$_D$ = 31A
I$_{DSS}$	Drain-to-Source Leakage Current	——	——	25		V$_{DS}$ = 60V, V$_{GS}$ = 0V
		——	——	250		V$_{DS}$ = 48V, V$_{GS}$ = 0V, T$_J$ = 150°C
I$_{GSS}$	Gate-to-Source Forward Leakage	——	——	100		V$_{GS}$ = 20V
	Gate-to-Source Reverse Leakage	——	——	-100		V$_{GS}$ = -20V
Q$_g$	Total Gate Charge	——	——	95		I$_D$ = 52A
Q$_{gs}$	Gate-to-Source Charge	——	——	27	nC	V$_{DS}$ = 48V
Q$_{gd}$	Gate-to-Drain ("Miller") Charge	——	——	46		V$_{GS}$ = 10V, See Fig. 6 and 13 ④
t$_{d(on)}$	Turn-On Delay Time	——	19	——		V$_{DD}$ = 30V
t$_r$	Rise Time	——	120	——		I$_D$ = 52A
t$_{d(off)}$	Turn-Off Delay Time	——	55	——		R$_G$ = 9.1Ω
t$_f$	Fall Time	——	86	——		R$_D$ = 0.54Ω, See Fig. 10 ④
L$_D$	Internal Drain Inductance	——	4.5	——	nH	Between lead, 6 mm (0.25in.) from package and center of die contact
L$_C$	Internal Source Inductance	——	7.5	——		
C$_{iss}$	Input Capacitance	——	2500	——		V$_{GS}$ = 0V
C$_{oss}$	Output Capacitance	——	1200	——	pF	V$_{DS}$ = 25V
C$_{rss}$	Reverse Transfer Capacitance	——	200	——		f = 1.0MHz, See Fig. 5
r	Current Sensing Ratio	2460	——	2720	——	I$_D$ = 52A, V$_{GS}$ = 10V
C$_{oss}$	Output Capacitance of Sensing Cells	——	9.0	——	pF	V$_{GS}$ = 0V, V$_{DS}$ = 25V, f = 1.0MHz

Source-Drain Ratings and Characteristics

| Parameter		Min.	Typ.	Max.	Units	Conditions
I$_S$	Continuous Source Current (Body Diode)	——	——	50*	A	MOSFET symbol showing the integral reverse p-n junction diode.
I$_{SM}$	Pulsed Source Current (Body Diode) ①	——	——	210		
V$_{SD}$	Diode Forward Voltage	——	——	2.5	V	T$_J$ = 25°C, I$_S$ = 52A, V$_{GS}$ = 0V ④
t$_{rr}$	Reverse Recovery Time	——	140	300	ns	T$_J$ = 25°C, I$_F$ = 52A
Q$_{rr}$	Reverse Recovery Charge	——	1.2	2.8	nC	di/dt = 100A/μs ④
t$_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L$_S$+L$_D$)				
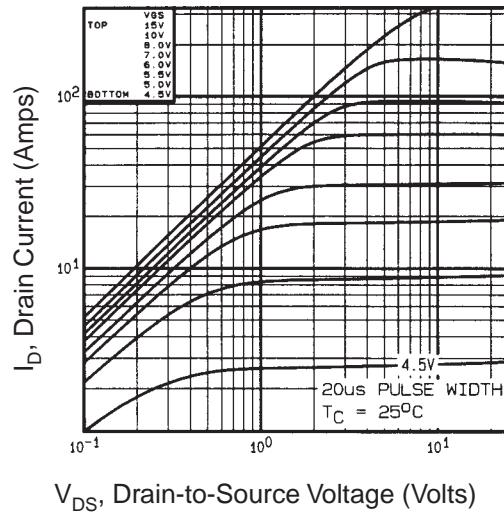
Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
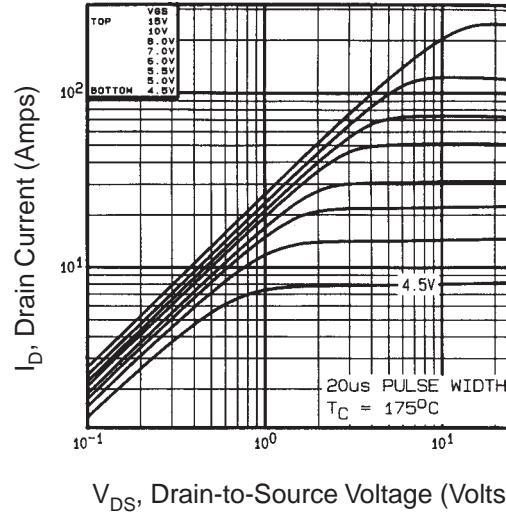
② V$_{DD}$ = 25V, starting T$_J$ = 25°C, L = 0.013mH R$_G$ = 25Ω, I$_{AS}$ = 52A. (See Figure 12)

③ I$_{SD}$ ≤ 52A, di/dt ≤ 250A/μs, V$_{DD}$ ≤ V$_{(BR)DSS}$, T$_J$ ≤ 175°C

④ Pulse width ≤ 300μs; duty cycle ≤ 2%.

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I_D, Drain Current (Amps)
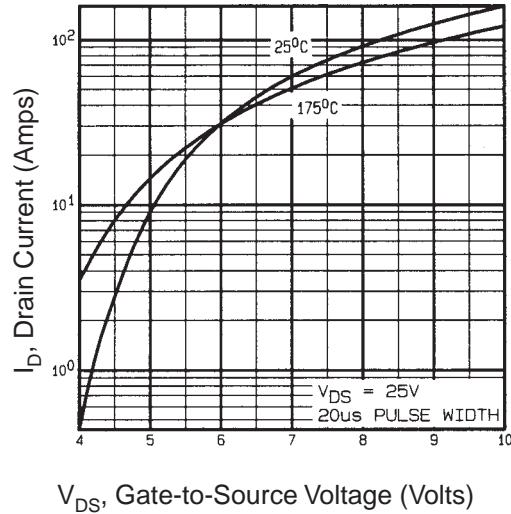
V_{DS}, Drain-to-Source Voltage (Volts)

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

I_D, Drain Current (Amps)
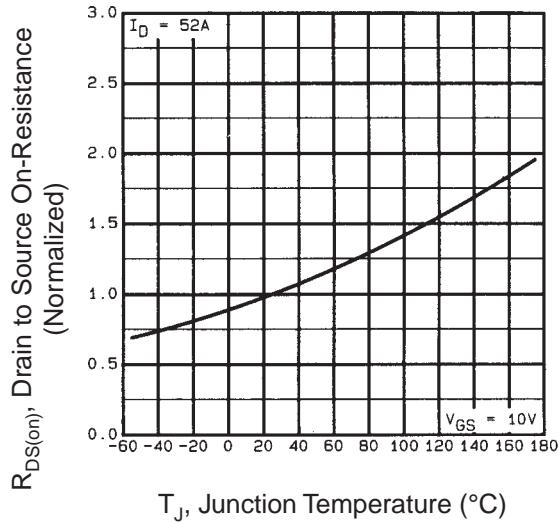
V_{DS}, Drain-to-Source Voltage (Volts)

**Fig. 2 Typical Output Characteristics,
T_C=175°C**

I_D, Drain Current (Amps)

V_{DS}, Gate-to-Source Voltage (Volts)

Fig. 3 Typical Transfer Characteristics

$R_{DS(on)}$, Drain to Source On-Resistance (Normalized)

T_J, Junction Temperature (°C)

**Fig. 4 Normalized On-Resistance vs.
Temperature**

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V$_{DS}$, Drain-to-Source Voltage (Volts)
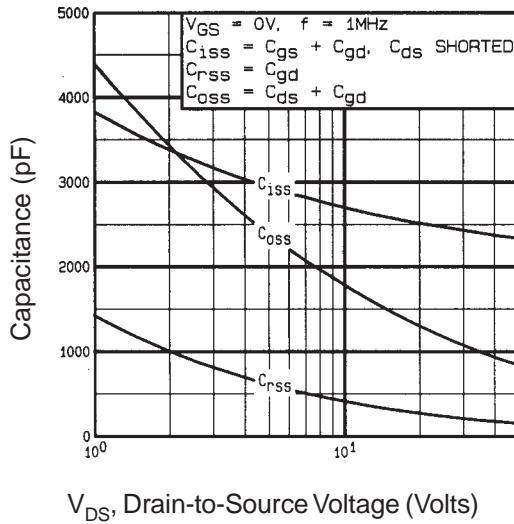
Fig. 5 Typical Capacitance vs. Drain-to-Source Voltage

Q$_G$, Total Gate Charge (nC)
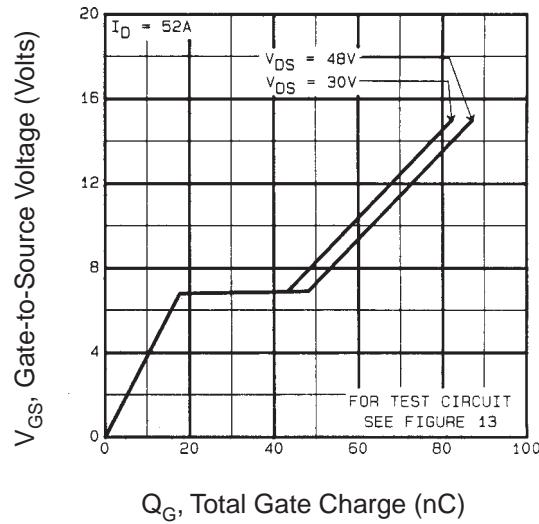
Fig. 6 Typical Gate Charge vs. Gate-to-Source Voltage

V$_{SD}$, Source-to-Drain Voltage (Volts)
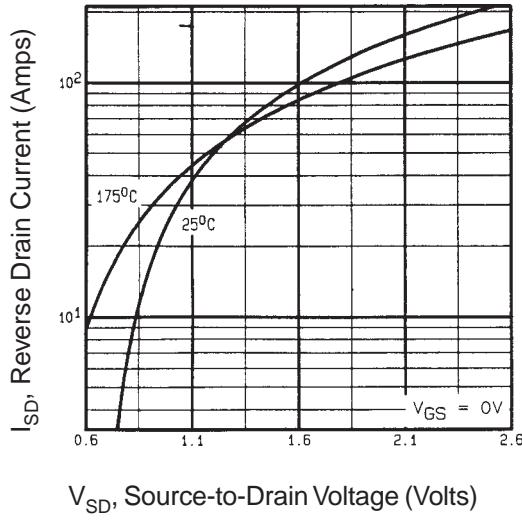
Fig. 7 Typical Source-Drain Diode Forward Voltage

V$_{DS}$, Drain-to-Source Voltage (Volts)
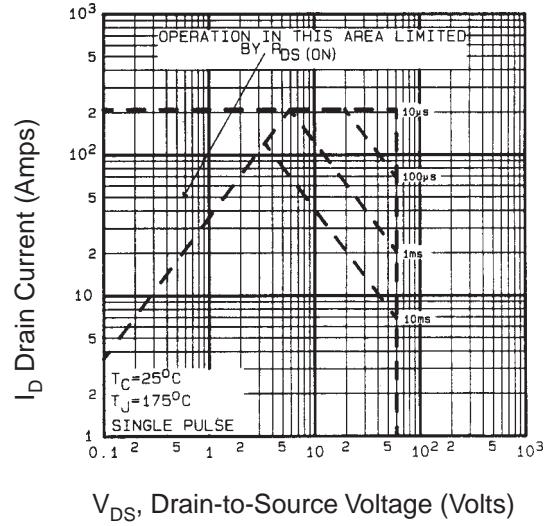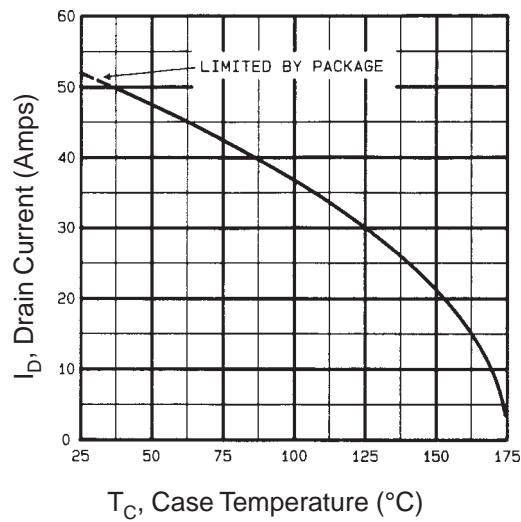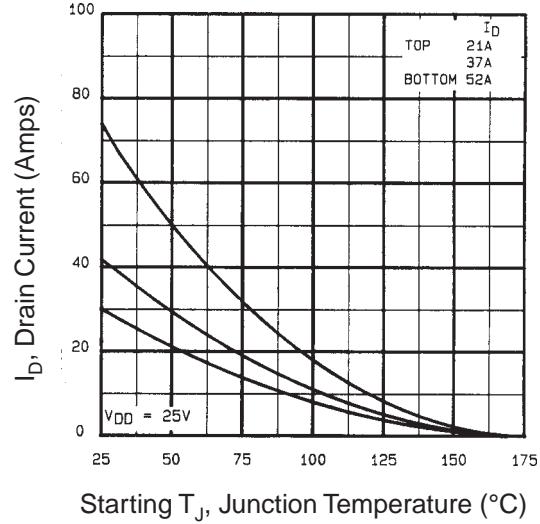
Fig. 8 Maximum Safe Operating Area

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T_C, Case Temperature (°C)

Fig. 9 Maximum Drain Current vs. Case Temperature

Starting T_J, Junction Temperature (°C)

Fig. 12c Maximum Avalanche Energy vs. Drain Current

t_1, Rectiangular Pulse Duration (seconds)
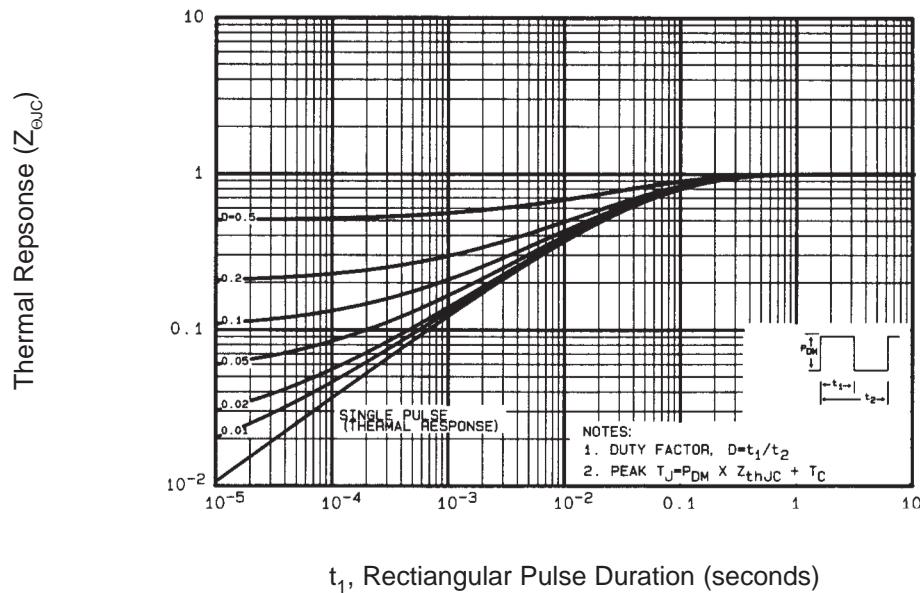
Fig. 11 Maximum Effective Transient Thermal Impedance, Junction-to-Case

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$V_{GS} = 10V$
$I_D = 52A$

T_J, Junction Temperature (°C)
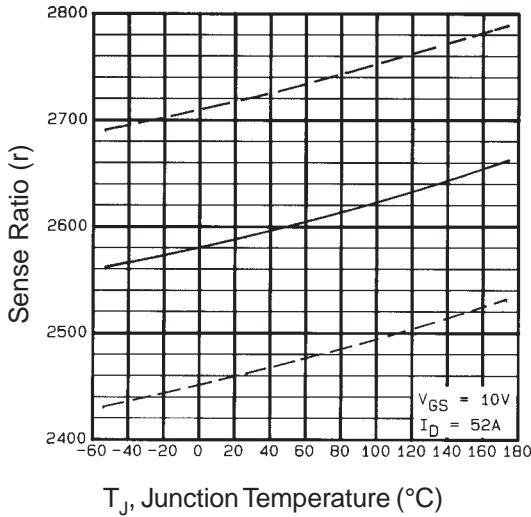
Fig. 15 Typical HEXSense Ratio vs. Junction Temperature

$V_{GS} = 10V$
$T_J = 25^oC$

I_D, Drain Current (Amps)
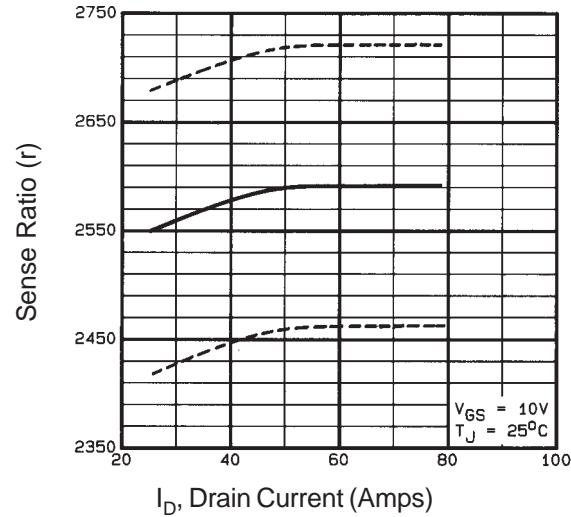
Fig. 16 Typical HEXSense Ratio vs. Drain Current

$T_J = 25^oC$
$I_D = 52A$

V_{GS}, Gate-to-Source Voltage (Volts)
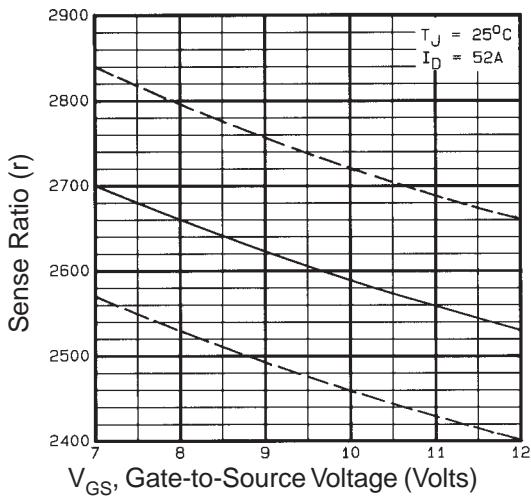
Fig. 17 Typical HEXSense Ratio vs. Gate Voltage

Mechanical drawings, Appendix A
Part marking information, Appendix B
Test Circuit diagrams, Appendix C

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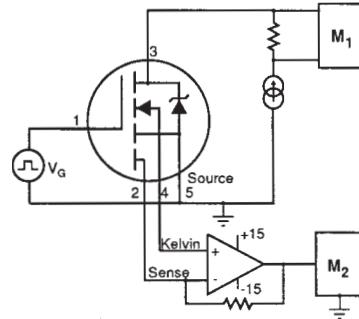
Fig. 18 HEXSense Ratio Test Circuit
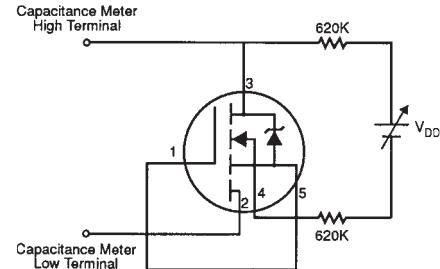
Fig. 19 HEXSense Sensing Cell Output Capacitance Test Circuit