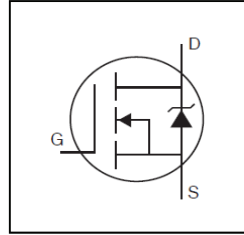


HEXFET® Power MOSFET

**Applications**

- High Efficiency Synchronous Rectification in SMPS
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits



<b>V<sub>DSS</sub></b>	<b>100V</b>
<b>R<sub>DS(on)</sub> typ.</b>	<b>3.7mΩ</b>
<b>R<sub>DS(on)</sub> max.</b>	<b>4.5mΩ</b>
<b>I<sub>D</sub></b>	<b>72A</b>

**Benefits**

- Improved Gate, Avalanche and Dynamic dV/dt Ruggedness
- Fully Characterized Capacitance and Avalanche SOA
- Enhanced body diode dV/dt and dI/dt Capability
- Lead-Free
- Halogen-Free



<b>G</b>	<b>D</b>	<b>S</b>
Gate	Drain	Source

Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRFI4110GPbF	TO-220 Full-Pak	Tube	50	IRFI4110GPbF

**Absolute Maximum Ratings**

Symbol	Parameter	Max.	Units
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	72	A
I <sub>D</sub> @ T <sub>C</sub> = 100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	51	
I <sub>DM</sub>	Pulsed Drain Current ①	290	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation	61	W
	Linear Derating Factor	0.41	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	± 20	V
dv/dt	Peak Diode Recovery dv/dt③	27	V/ns
T <sub>J</sub>	Operating Junction and	-55 to + 175	°C
T <sub>STG</sub>	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case)		
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

**Avalanche Characteristics**

E <sub>AS</sub>	Single Pulse Avalanche Energy (Thermally Limited) ②	71	mJ
I <sub>AR</sub>	Avalanche Current ①	43	A
E <sub>AR</sub>	Repetitive Avalanche Energy ①	6.1	mJ

**Thermal Resistance**

Symbol	Parameter	Typ.	Max.	Units
R <sub>θJC</sub>	Junction-to-Case ③	—	2.46	°C/W
R <sub>θJA</sub>	Junction-to-Ambient (PCB Mount)②	—	65	


**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	100	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.11	—	V/°C	Reference to 25°C, I <sub>D</sub> = 5mA ①
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	3.7	4.5	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 43A
V <sub>GS(th)</sub>	Gate Threshold Voltage	2.0	—	4.0	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	20	μA	V <sub>DS</sub> = 100V, V <sub>GS</sub> = 0V
		—	—	250		V <sub>DS</sub> = 100V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	100	nA	V <sub>GS</sub> = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V <sub>GS</sub> = -20V

**Dynamic @ T<sub>J</sub> = 25°C (unless otherwise specified)**

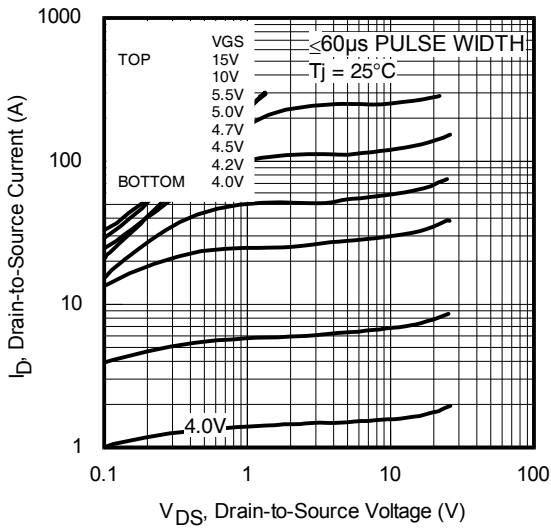
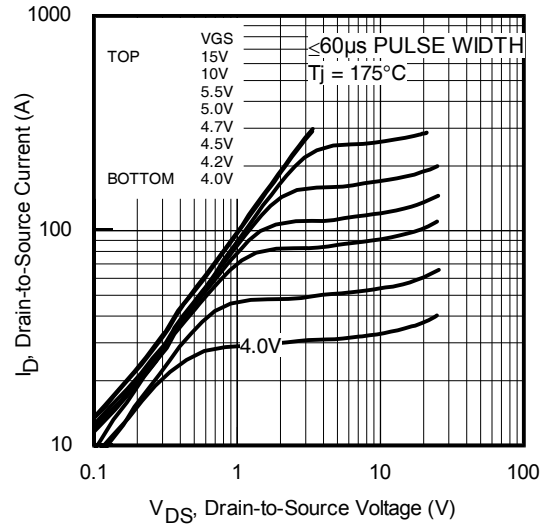
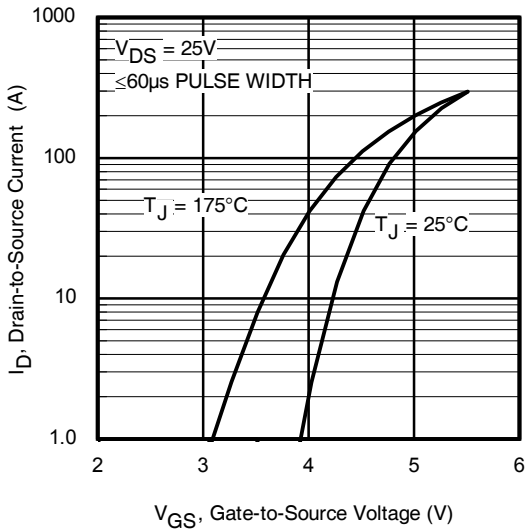
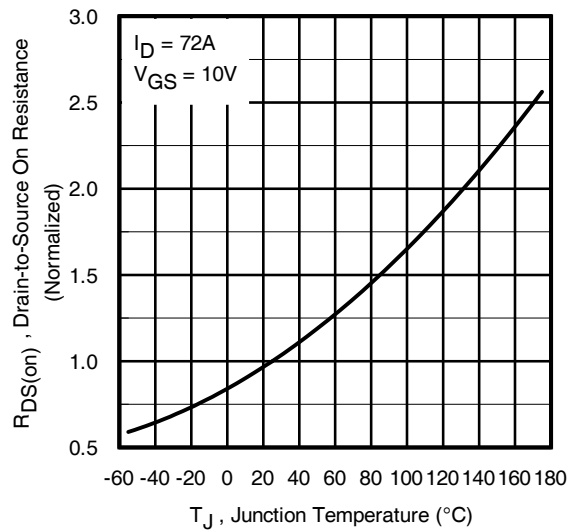
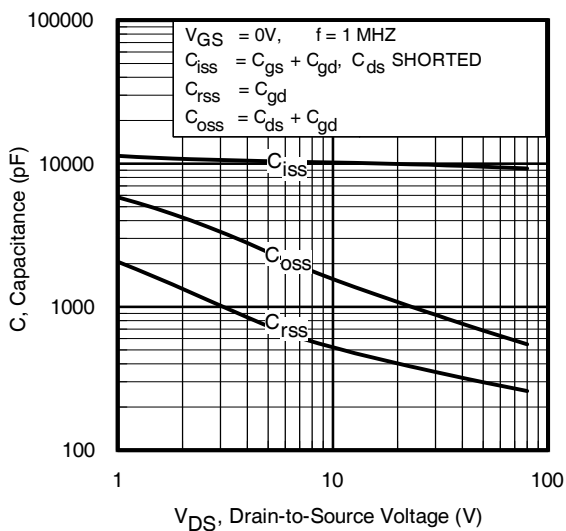
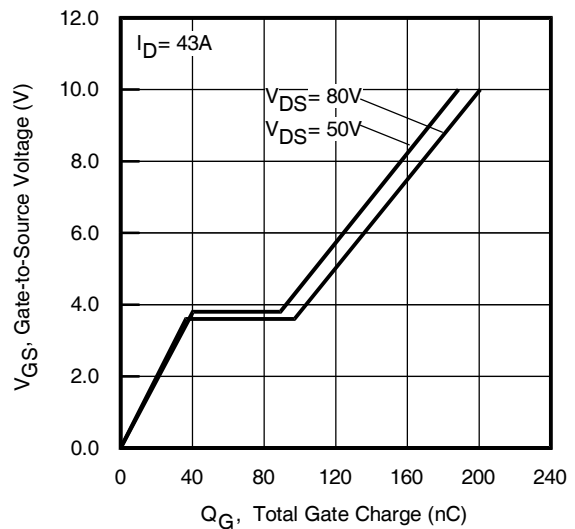
g <sub>fs</sub>	Forward Trans conductance	260	—	—	S	V <sub>DS</sub> = 50V, I <sub>D</sub> = 43A
Q <sub>g</sub>	Total Gate Charge	—	190	290	nC	I <sub>D</sub> = 43A
Q <sub>gs</sub>	Gate-to-Source Charge	—	40	—		V <sub>DS</sub> = 50V
Q <sub>gd</sub>	Gate-to-Drain Charge	—	49	—		V <sub>GS</sub> = 10V ④
R <sub>G</sub>	Internal Gate Resistance	—	1.3	—	Ω	
t <sub>d(on)</sub>	Turn-On Delay Time	—	24	—	ns	V <sub>DD</sub> = 65V
t <sub>r</sub>	Rise Time	—	58	—		I <sub>D</sub> = 43A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	81	—		R <sub>G</sub> = 2.6Ω
t <sub>f</sub>	Fall Time	—	71	—		V <sub>GS</sub> = 10V ④
C <sub>iss</sub>	Input Capacitance	—	9540	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	680	—		V <sub>DS</sub> = 50V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	300	—		f = 1.0MHz
C <sub>oss eff. (ER)</sub>	Effective Output Capacitance (Energy Related)	—	760	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 80V ⑥
C <sub>oss eff. (TR)</sub>	Effective Output Capacitance (Time Related)	—	1120	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 80V ⑤

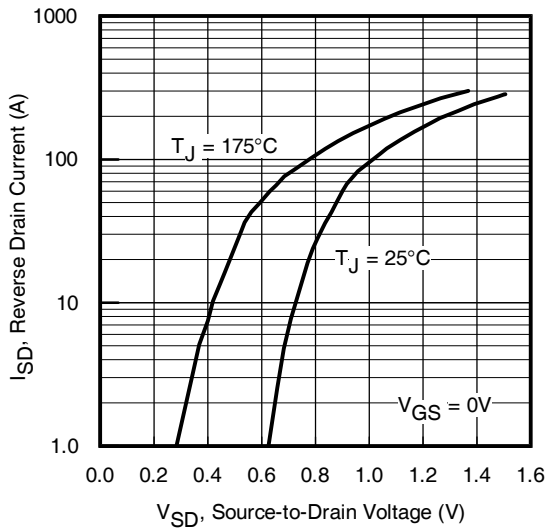
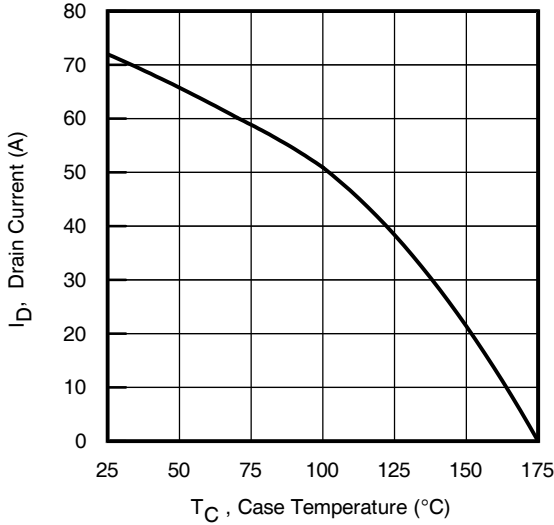
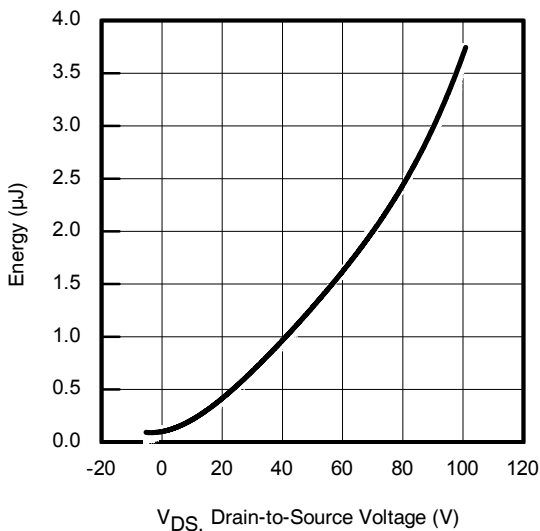
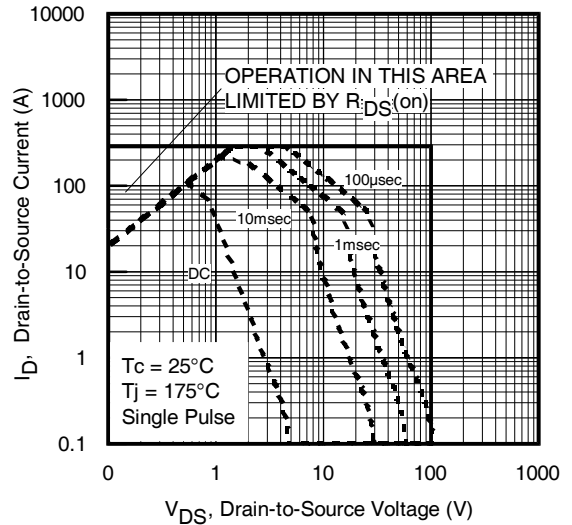
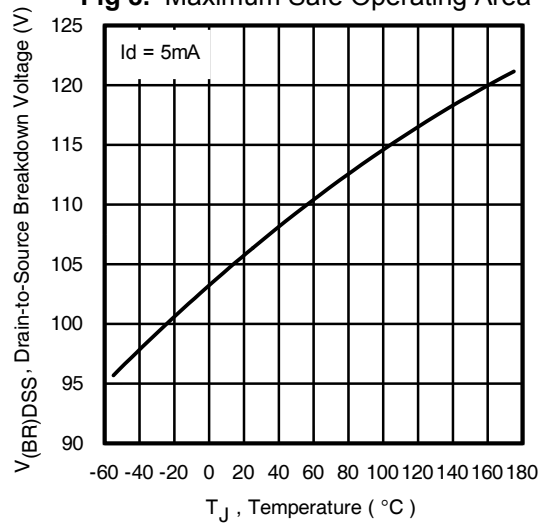
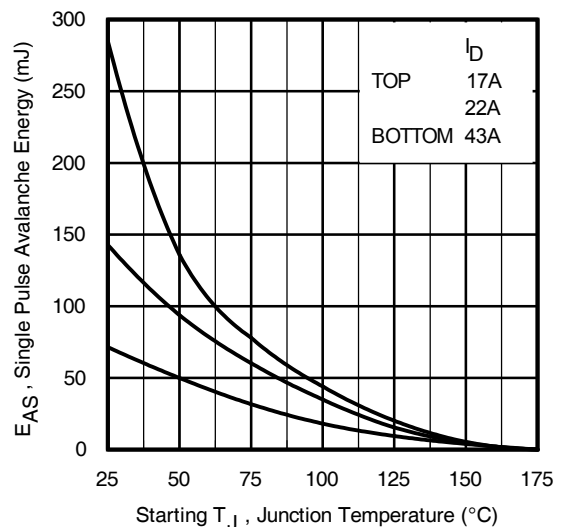
**Source-Drain Ratings and Characteristics**

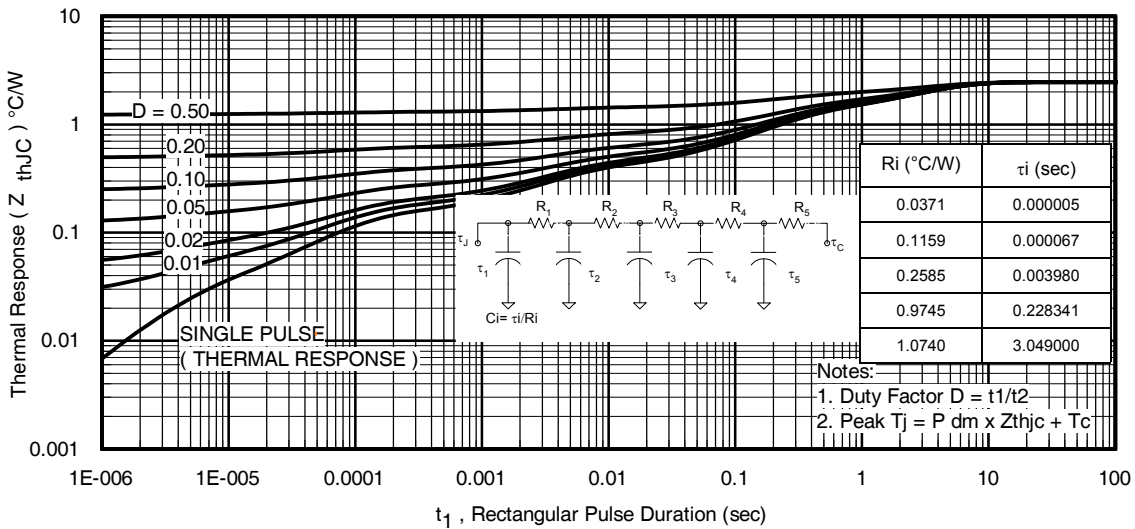
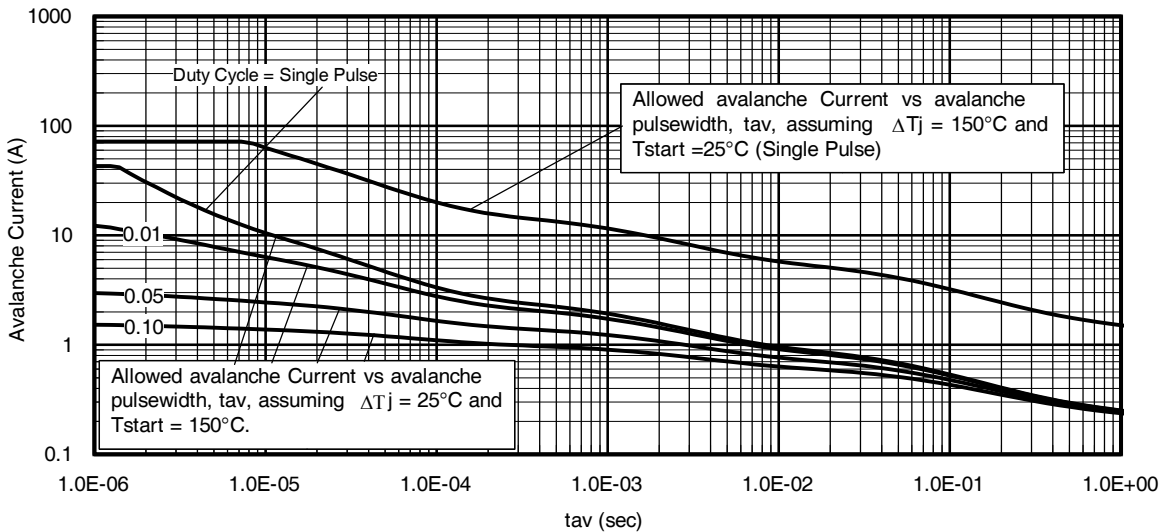
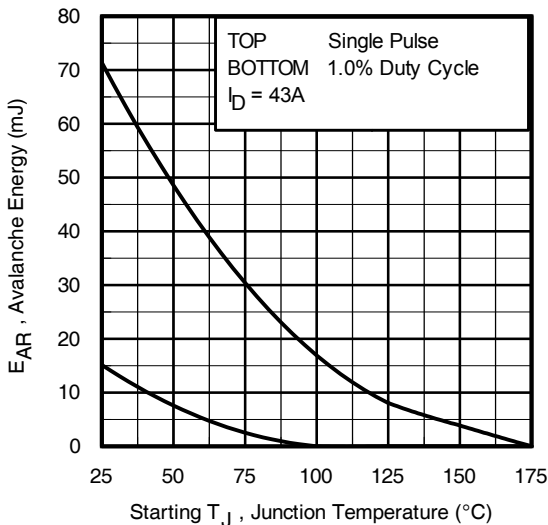
	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	72	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①	—	—	290		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 43A, V <sub>GS</sub> = 0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	50	75	ns	T <sub>J</sub> = 25°C
		—	60	90		T <sub>J</sub> = 125°C
Q <sub>rr</sub>	Reverse Recovery Charge	—	100	150	nC	T <sub>J</sub> = 25°C — V <sub>R</sub> = 85V
		—	140	210		T <sub>J</sub> = 125°C — I <sub>F</sub> = 43A
I <sub>RRM</sub>	Reverse Recovery Current	—	3.5	—	A	T <sub>J</sub> = 25°C — di/dt = 100A/μs ④
t <sub>on</sub>	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L <sub>S</sub> +L <sub>D</sub> )				

**Notes:**

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)
- ② Limited by T<sub>Jmax</sub>, starting T<sub>J</sub> = 25°C, L = 0.077mH, R<sub>G</sub> = 50Ω, I<sub>AS</sub> = 43A, V<sub>GS</sub> = 10V. Part not recommended for use above this value.
- ③ I<sub>SD</sub> ≤ 43A, di/dt ≤ 1600A/μs, V<sub>DD</sub> ≤ V<sub>(BR)DSS</sub>, T<sub>J</sub> ≤ 175°C.
- ④ Pulse width ≤ 400μs; duty cycle ≤ 2%.
- ⑤ C<sub>oss eff. (TR)</sub> is a fixed capacitance that gives the same charging time as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>.
- ⑥ C<sub>oss eff. (ER)</sub> is a fixed capacitance that gives the same energy as C<sub>oss</sub> while V<sub>DS</sub> is rising from 0 to 80% V<sub>DSS</sub>.
- ⑦ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
- ⑧ R<sub>θ</sub> is measured at T<sub>J</sub> approximately 90°C.


**Fig. 1** Typical Output Characteristics

**Fig. 2** Typical Output Characteristics

**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-to-Drain Diode Forward Voltage

**Fig. 9.** Maximum Drain Current vs. Case Temperature

**Fig. 11.** Typical  $C_{OSS}$  Stored Energy

**Fig 8.** Maximum Safe Operating Area

**Fig 10.** Drain-to-Source Breakdown Voltage

**Fig 12.** Maximum Avalanche Energy vs. Drain Current

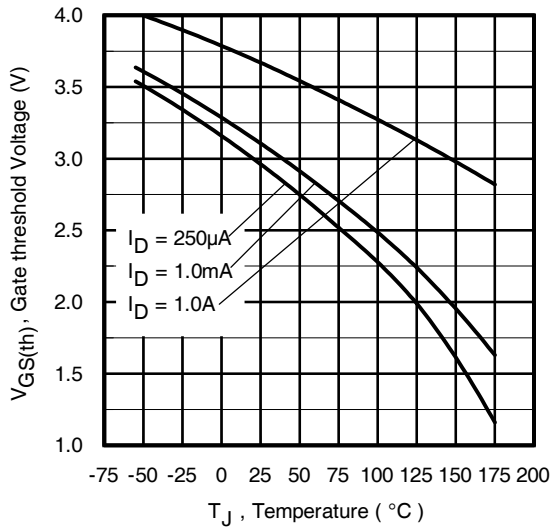
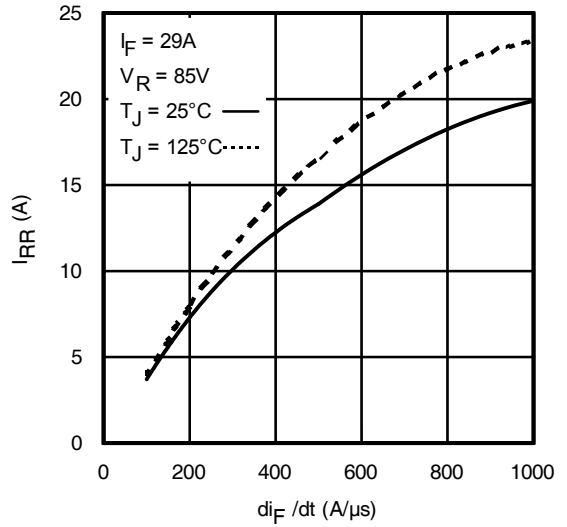
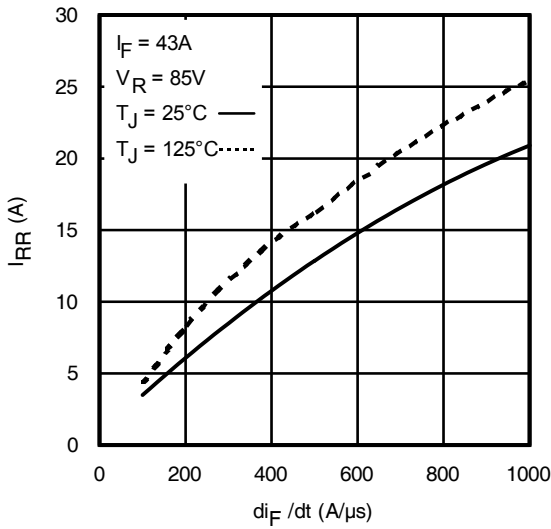
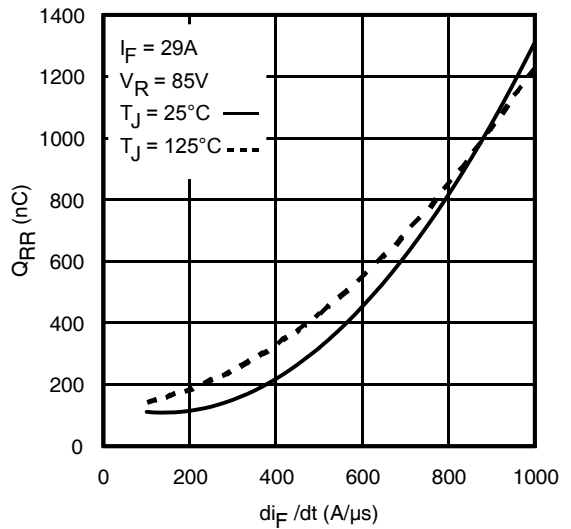
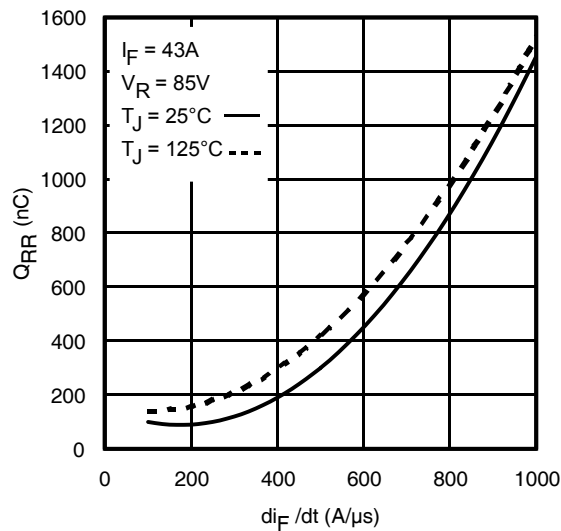

**Fig 13. Maximum Effective Transient Thermal Impedance, Junction-to-Case**

**Fig 14. Single Avalanche Event: Pulse Current vs. Pulse Width**

**Fig 15. Maximum Avalanche Energy vs. Temperature**
**Notes on Repetitive Avalanche Curves , Figures 14, 15:**  
**(For further info, see AN-1005 at www.infineon.com)**

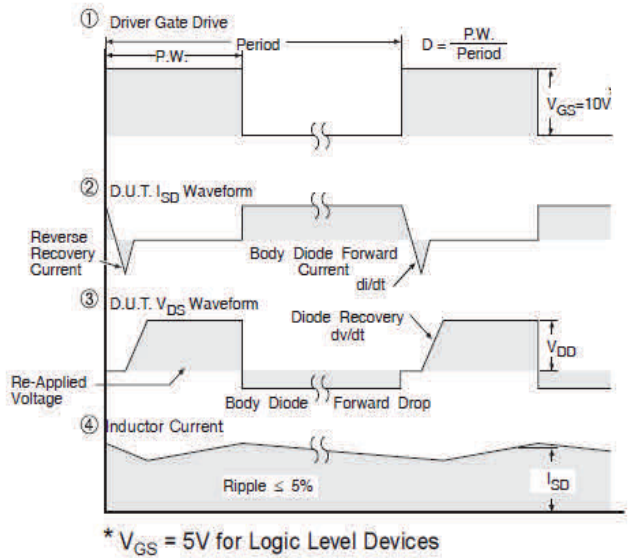
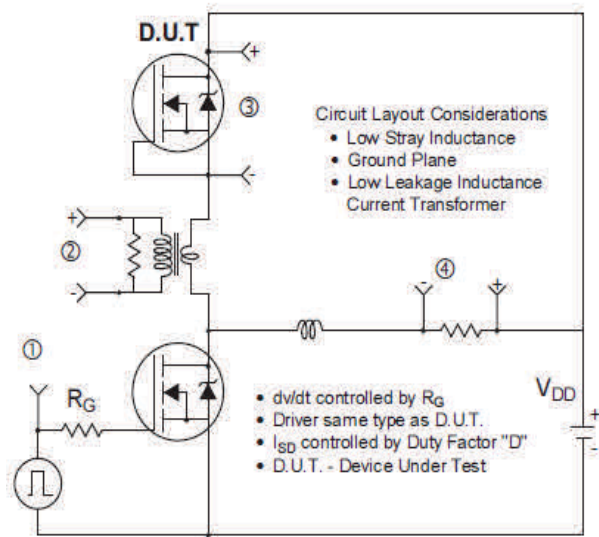
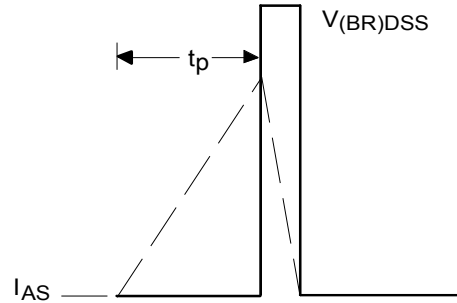
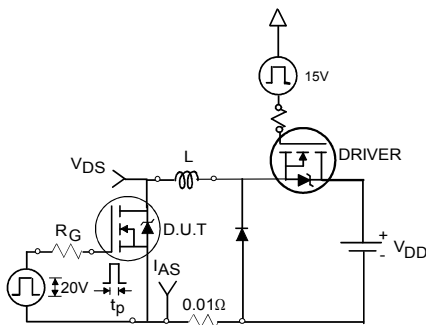
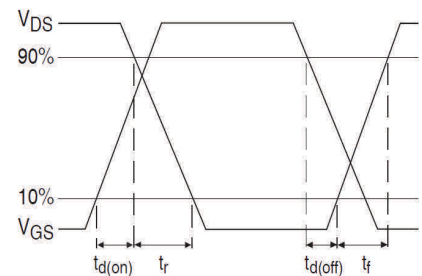
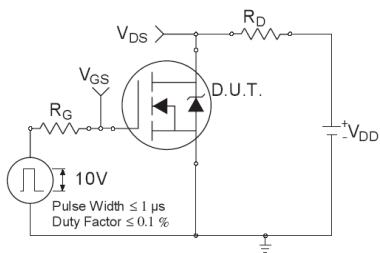
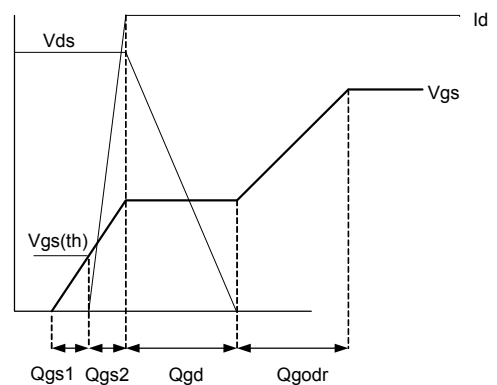
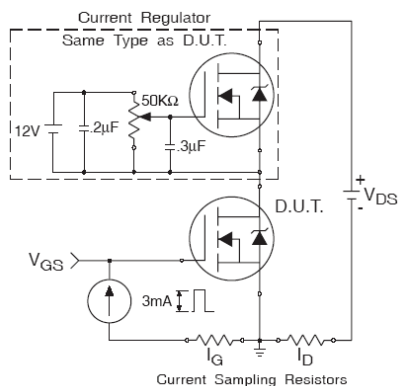
1. Avalanche failures assumption:  
Purely a thermal phenomenon and failure occurs at a temperature far in excess of  $T_{jmax}$ . This is validated for every part type.
2. Safe operation in Avalanche is allowed as long as  $T_{jmax}$  is not exceeded.
3. Equation below based on circuit and waveforms shown in Figures 16a, 16b.
4.  $P_{D(ave)}$  = Average power dissipation per single avalanche pulse.
5. BV = Rated breakdown voltage (1.3 factor accounts for voltage increase during avalanche).
6.  $I_{av}$  = Allowable avalanche current.
7.  $\Delta T$  = Allowable rise in junction temperature, not to exceed  $T_{jmax}$  (assumed as 25°C in Figure 14, 15).  
 $t_{av}$  = Average time in avalanche.  
 $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see Figures 13)

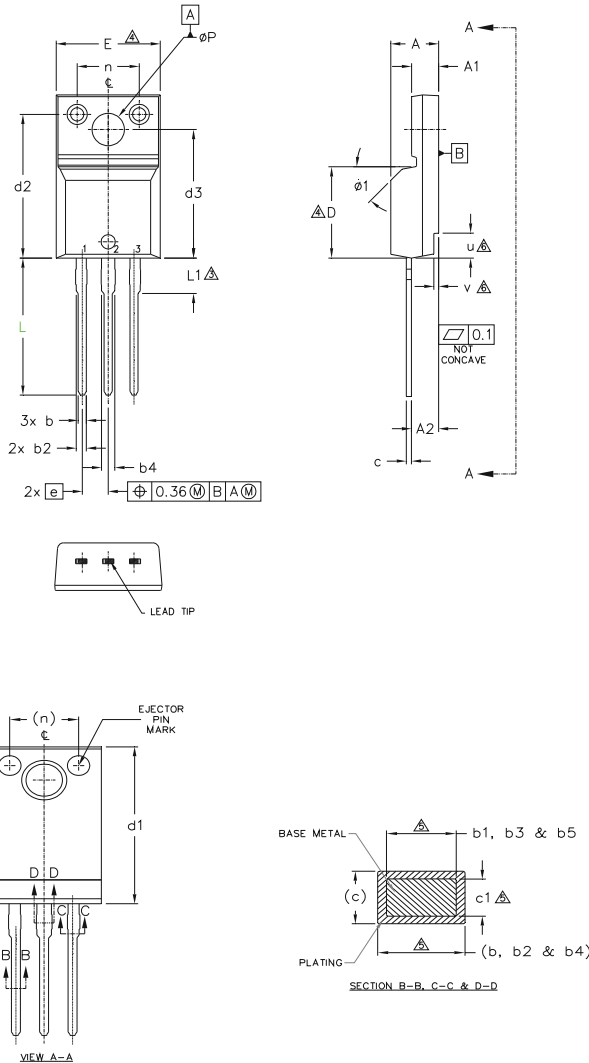
$$P_{D(ave)} = 1/2 ( 1.3 \cdot BV \cdot I_{av} ) = \Delta T / Z_{thJC}$$

$$I_{av} = 2\Delta T / [1.3 \cdot BV \cdot Z_{th}]$$

$$E_{AS(AR)} = P_{D(ave)} \cdot t_{av}$$


**Fig 16.** Threshold Voltage vs. Temperature

**Fig 17.** Typical Recovery Current vs.  $di_F/dt$ 

**Fig 18.** Typical Recovery Current vs.  $di_F/dt$ 

**Fig 19.** Typical Stored Charge vs.  $di_F/dt$ 

**Fig 20.** Typical Stored Charge vs.  $di_F/dt$


**Fig 21. Peak Diode Recovery dv/dt Test Circuit for N-Channel HEXFET® Power MOSFETs**

**Fig 22a. Unclamped Inductive Test Circuit**
**Fig 22b. Unclamped Inductive Waveforms**

**Fig 23a. Switching Time Test Circuit**
**Fig 23b. Switching Time Waveforms**

**Fig 24a. Gate Charge Test Circuit**
**Fig 24b. Gate Charge Waveform**

**TO-220 Full-Pak Package Outline (Dimensions are shown in millimeters (inches))**

**NOTES:**

- 1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
- 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
- 5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
- 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
- 7.0 CONTROLLING DIMENSION : INCHES.

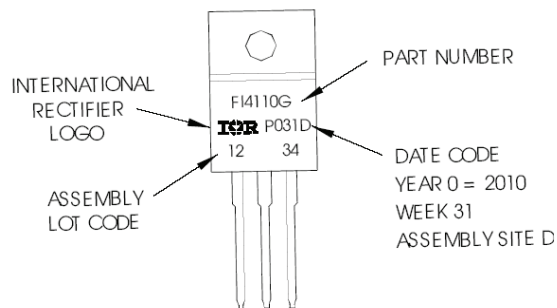
SYMBOL	DIMENSIONS				NOTES	
	MILLIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.		
A	4.57	4.83	.180	.190	LEAD ASSIGNMENTS  HEXFET 1.- GATE 2.- DRAIN 3.- SOURCE	
A1	2.57	2.82	.101	.111		
A2	2.51	2.92	.099	.115		
b	0.61	0.94	.024	.037		
b1	0.61	0.89	.024	.035		5
b2	0.76	1.27	.030	.050		5
b3	0.76	1.22	.030	.048		
b4	1.02	1.52	.040	.060		5
b5	1.02	1.47	.040	.058		
c	0.33	0.63	.013	.025		4
c1	0.33	0.58	.013	.023		
D	8.66	9.80	.341	.386	4	
d1	15.80	16.13	.622	.635		
d2	13.97	14.22	.550	.560	4	
d3	12.29	12.93	.484	.509		
E	9.63	10.74	.379	.423	4	
e	2.54 BSC		.100 BSC			
L	13.21	13.72	.520	.540	3	
L1	3.10	3.68	.122	.145		
n	6.05	6.60	.238	.260	6	
phiP	3.05	3.45	.120	.136		
u	2.39	2.49	.094	.098	6	
v	0.41	0.51	.016	.020		
phi1	-	45°	-	45°		

IGBTs, CoPACK  
1.- GATE  
2.- COLLECTOR  
3.- EMITTER

**TO-220 Full-Pak Part Marking Information**

EXAMPLE: THIS IS AN IRFI4110G  
WITH ASSEMBLY  
LOT CODE 1234  
ASSEMBLED ON WW31, 2010

Notes: - "P" in assembly line position indicates "Lead-Free"  
- "G" suffix in part number indicates "Halogen-Free"



TO-220AB Full-Pak packages are not recommended for Surface Mount Application.

Note: For the most current drawing please refer to website at <http://www.irf.com/package/>



**Qualification Information**

<b>Qualification Level</b>	Industrial (per JEDEC JESD47F) †	
<b>Moisture Sensitivity Level</b>	TO-220 Full-Pak	N/A
<b>RoHS Compliant</b>	Yes	

† Applicable version of JEDEC standard at the time of product release.

**Revision History**

Date	Comments
04/27/2017	<ul style="list-style-type: none"> <li>Changed datasheet with Infineon logo - all pages.</li> <li>Corrected Package Outline on page 8.</li> <li>Corrected fig 19 &amp; 20 –Y axis title from “A” to “nC” on page 6.</li> <li>Added disclaimer on last page.</li> </ul>

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