

### HEXFET® Power MOSFET

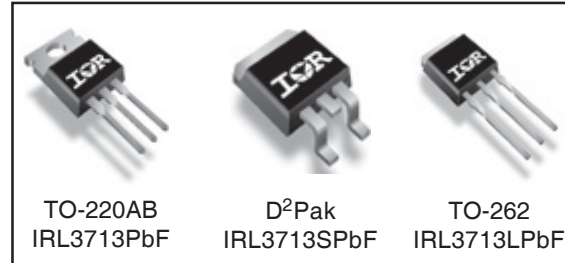
#### Applications

- High Frequency Isolated DC-DC Converters with Synchronous Rectification for Telecom and Industrial Use
- High Frequency Buck Converters for Computer Processor Power
- 100% R<sub>G</sub> Tested

#### Benefits

- Ultra-Low Gate Impedance
- Very Low R<sub>DS(on)</sub> at 4.5V V<sub>GS</sub>
- Fully Characterized Avalanche Voltage and Current
- Lead-Free

V <sub>DSS</sub>	R <sub>DS(on)</sub> max (mΩ)	I <sub>D</sub>
30V	3.0@V <sub>GS</sub> = 10V	260A <sup>Ⓒ</sup>



Base Part Number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRL3713PbF	TO-220	Tube	50	IRL3713PbF
IRL3713SLPbF	TO-262	Tube	50	IRL3713SLPbF
IRL3713SPbF	D²Pak	Tube	50	IRL3713SPbF
		Tape and Reel Left	800	IRL3713STRLPbF
		Tape and Reel Right	800	IRL3713STRRPbF

#### Absolute Maximum Ratings

Symbol	Parameter	Max	Units
V <sub>DS</sub>	Drain-Source Voltage	30	V
V <sub>GS</sub>	Gate-to-Source Voltage	± 20	V
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	260 <sup>Ⓒ</sup>	A
I <sub>D</sub> @ T <sub>C</sub> = 100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	180 <sup>Ⓒ</sup>	
I <sub>DM</sub>	Pulsed Drain Current <sup>①</sup>	1040 <sup>Ⓒ</sup>	
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation	330	W
P <sub>D</sub> @ T <sub>C</sub> = 100°C	Maximum Power Dissipation	170	
	Linear Derating Factor	2.2	W/°C
T <sub>J</sub> , T <sub>STG</sub>	Junction and Storage Temperature Range	-55 to +175	°C

#### Thermal Resistance

Symbol	Parameter	Typ	Max	Units
R <sub>θJC</sub>	Junction-to-Case <sup>②</sup>	—	0.45*	°C/W
R <sub>θCS</sub>	Case-to-Sink, Flat, Greased Surface <sup>④</sup>	0.50	—	
R <sub>θJA</sub>	Junction-to-Ambient <sup>④⑦</sup>	—	62	
R <sub>θJA</sub>	Junction-to-Ambient (PCB Mount) <sup>⑤⑦</sup>	—	40	

\* R<sub>θJC</sub> (end of life) for D²Pak and TO-262 = 0.50°C/W. This is the maximum measured value after 1000 temperature cycles from -55 to 150°C and is accounted for by the physical wearout of the die attach medium.

Notes <sup>①</sup> through <sup>⑦</sup> are on page 11

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

Symbol	Parameter	Min	Typ	Max	Units	Conditions
V <sub>(BR)DSS</sub>	Drain-to-Source Breakdown Voltage	30	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS</sub> /ΔT <sub>J</sub>	Breakdown Voltage Temp. Coefficient	—	0.027	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	2.6	3.0	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 38A ③
		—	3.3	4.0		V <sub>GS</sub> = 4.5V, I <sub>D</sub> = 30A ③
V <sub>GS(th)</sub>	Gate Threshold Voltage	1.0	—	2.5	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	50	μA	V <sub>DS</sub> = 30V, V <sub>GS</sub> = 0V
		—	—	20		V <sub>DS</sub> = 24V, V <sub>GS</sub> = 0V
		—	—	100		V <sub>DS</sub> = 24V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 125°C
I <sub>GSS</sub>	Gate-to-Source Forward Leakage	—	—	200	nA	V <sub>GS</sub> = 20V
	Gate-to-Source Reverse Leakage	—	—	-200		V <sub>GS</sub> = -20V

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

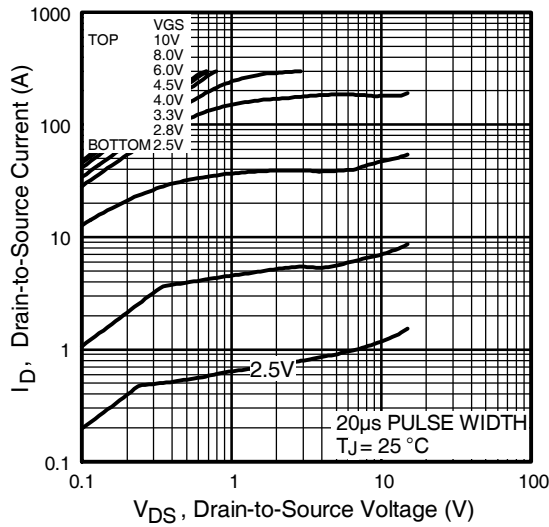
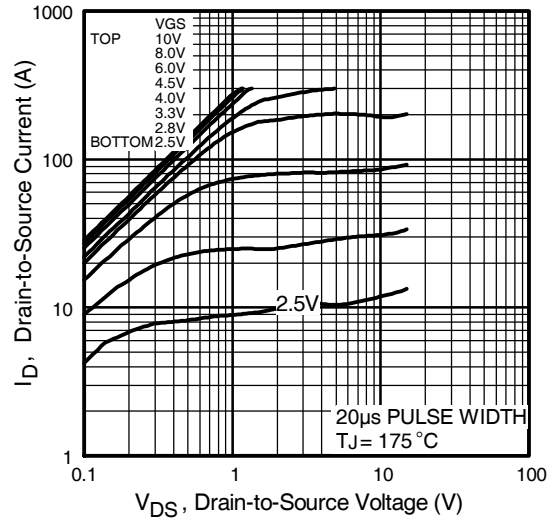
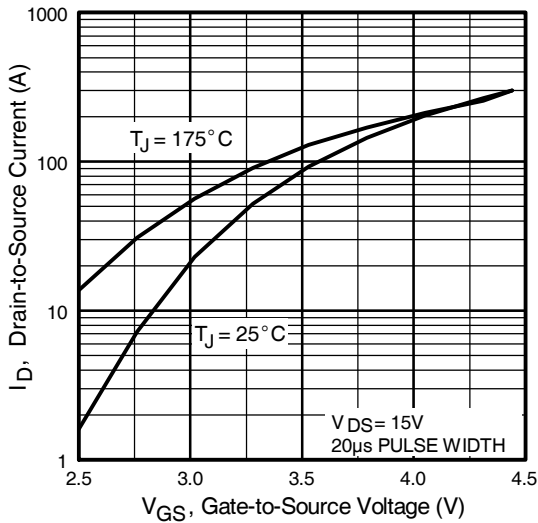
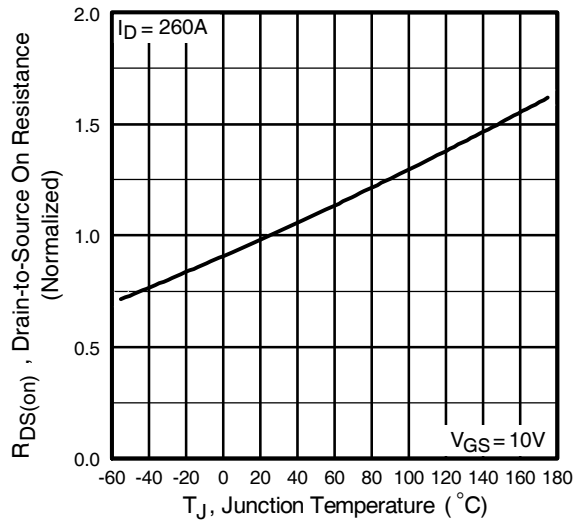
Symbol	Parameter	Min	Typ	Max	Units	Conditions
g <sub>fs</sub>	Forward Transconductance	76	—	—	S	V <sub>DS</sub> = 15V, I <sub>D</sub> = 30A
Q <sub>g</sub>	Total Gate Charge	—	75	110	nC	I <sub>D</sub> = 30A V <sub>DS</sub> = 15V V <sub>GS</sub> = 4.5V ④
Q <sub>gs</sub>	Gate-to-Source Charge	—	24	—		
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	37	—		
Q <sub>OSS</sub>	Output Gate Charge	—	61	92		
R <sub>G</sub>	Gate Resistance	0.5	—	3.4	Ω	
t <sub>d(on)</sub>	Turn-On Delay Time	—	16	—	ns	V <sub>DD</sub> = 15V I <sub>D</sub> = 30A R <sub>G</sub> = 1.8Ω V <sub>GS</sub> = 4.5V ③
t <sub>r</sub>	Rise Time	—	160	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	40	—		
t <sub>f</sub>	Fall Time	—	57	—		
C <sub>iss</sub>	Input Capacitance	—	5890	—	pF	V <sub>GS</sub> = 0V V <sub>DS</sub> = 15V f = 1.0MHz
C <sub>OSS</sub>	Output Capacitance	—	3130	—		
C <sub>rss</sub>	Reverse Transfer Capacitance	—	630	—		

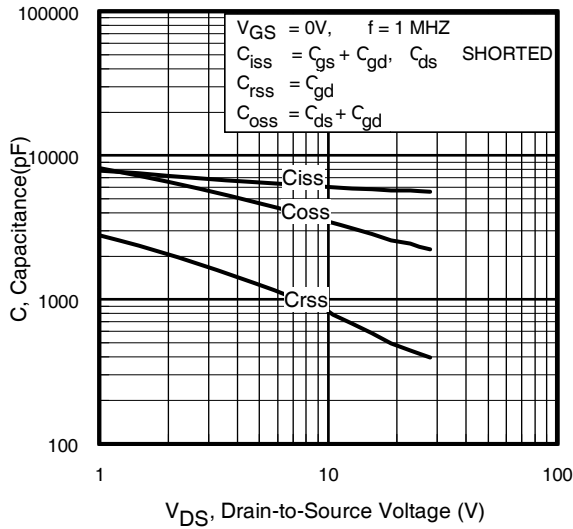
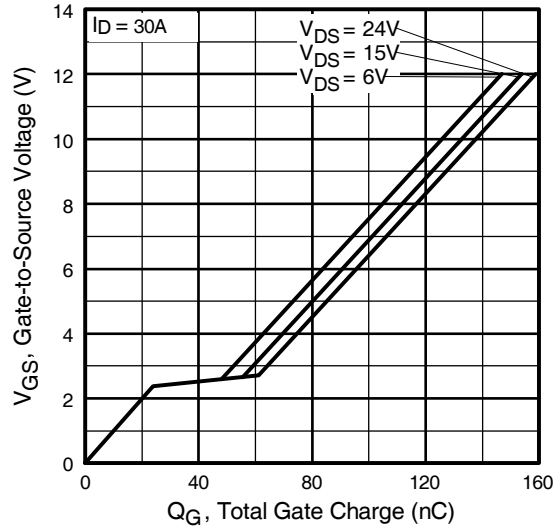
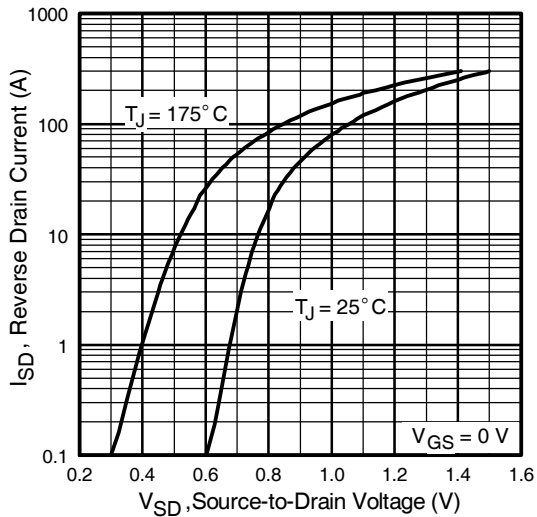
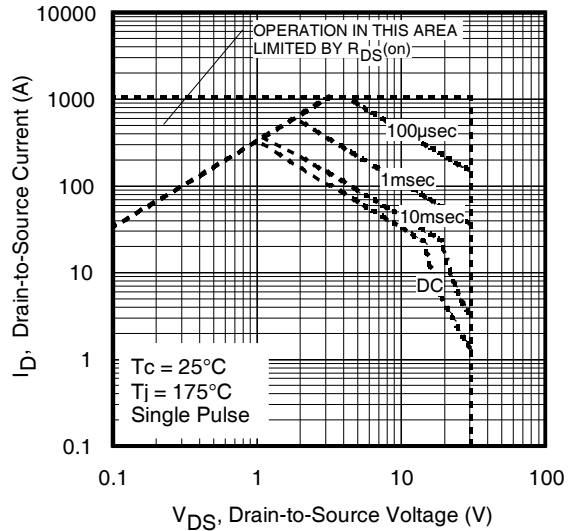
**Avalanche Characteristics**

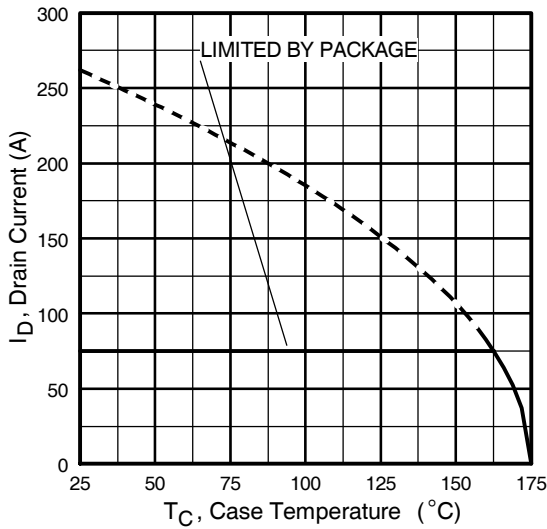
Symbol	Parameter	Typ	Max	Units
E <sub>AS</sub>	Single Pulse Avalanche Energy ②	—	1530	mJ
I <sub>AR</sub>	Avalanche Current ①	—	46	A

**Diode Characteristics**

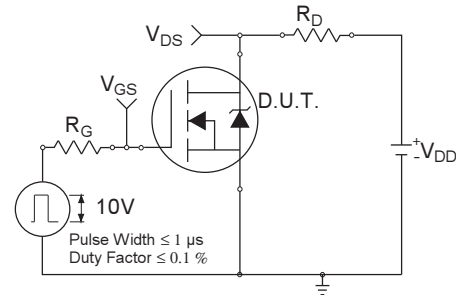
Symbol	Parameter	Min	Typ	Max	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	260 ⑥	A	MOSFET symbol showing the integral reverse p-n junction diode.
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①⑥	—	—	1040 ⑥		
V <sub>SD</sub>	Diode Forward Voltage	—	0.80	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 30A, V <sub>GS</sub> = 0V ③
		—	0.68	—		T <sub>J</sub> = 125°C, I <sub>S</sub> = 30A, V <sub>GS</sub> = 0V ③
t <sub>rr</sub>	Reverse Recovery Time	—	75	110	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 30A, V <sub>R</sub> = 0V
Q <sub>rr</sub>	Reverse Recovery Charge	—	140	210	nC	di/dt = 100A/μs ③
t <sub>rr</sub>	Reverse Recovery Time	—	78	120	ns	T <sub>J</sub> = 125°C, I <sub>F</sub> = 30A, V <sub>R</sub> = 20V
Q <sub>rr</sub>	Reverse Recovery Charge	—	160	240	nC	di/dt = 100A/μs ③


**Fig 1.** Typical Output Characteristics

**Fig 2.** Typical Output Characteristics

**Fig 3.** Typical Transfer Characteristics

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

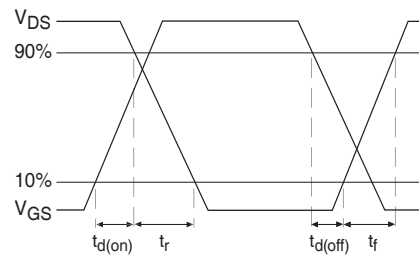

**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage

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

**Fig 7.** Typical Source-Drain Diode Forward Voltage

**Fig 8.** Maximum Safe Operating Area



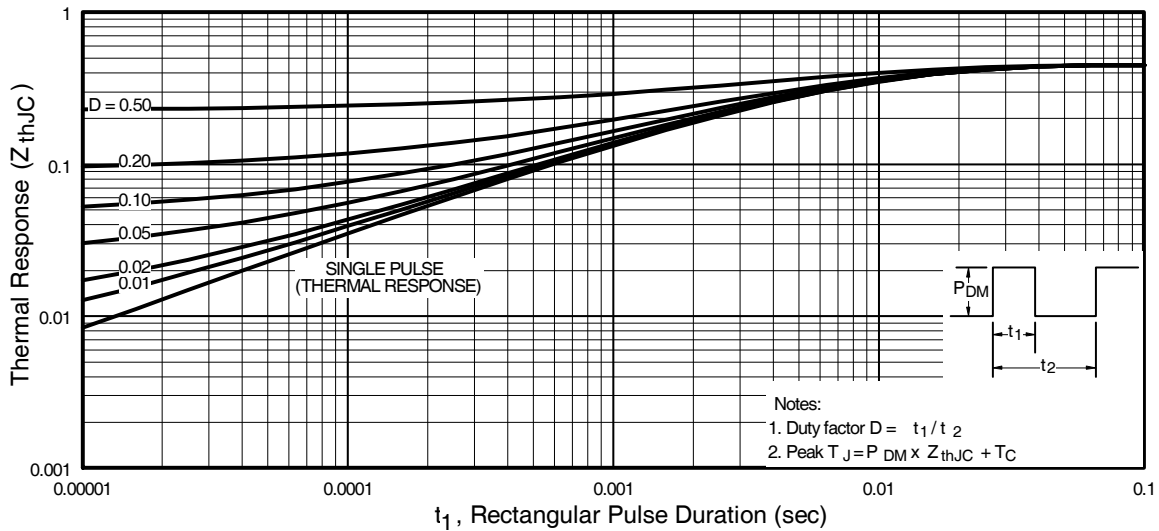
**Fig 9.** Maximum Drain Current Vs. Case Temperature



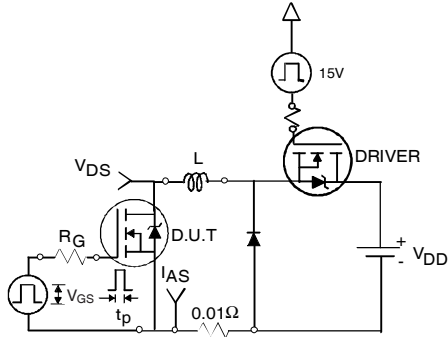
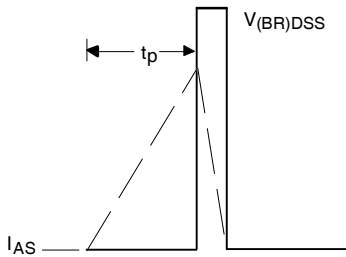
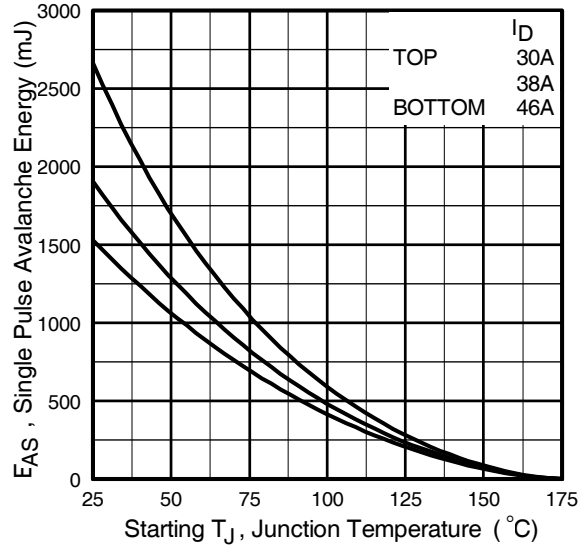
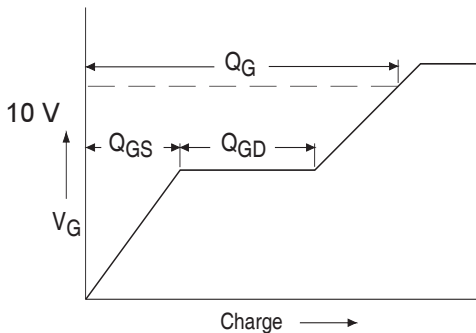
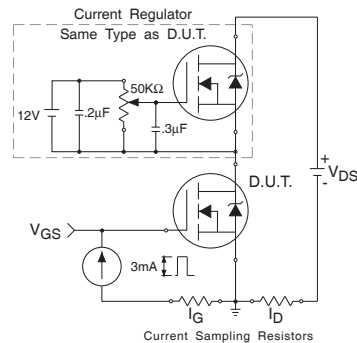
**Fig 10a.** Switching Time Test Circuit

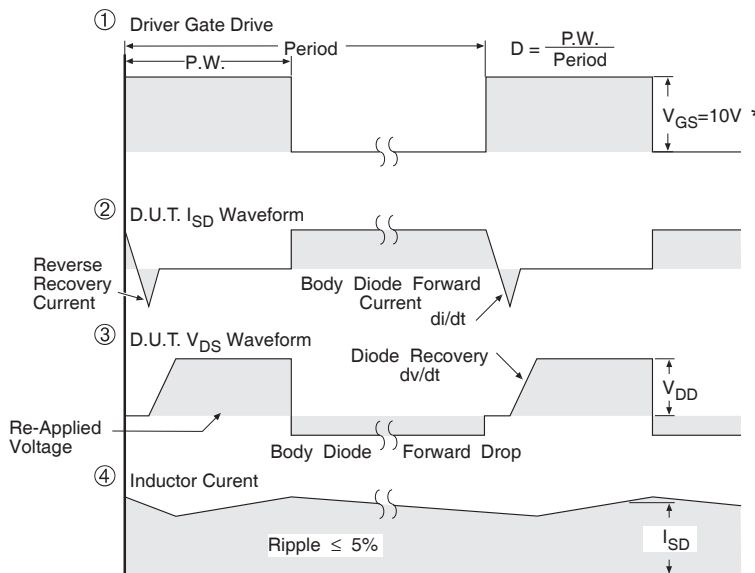
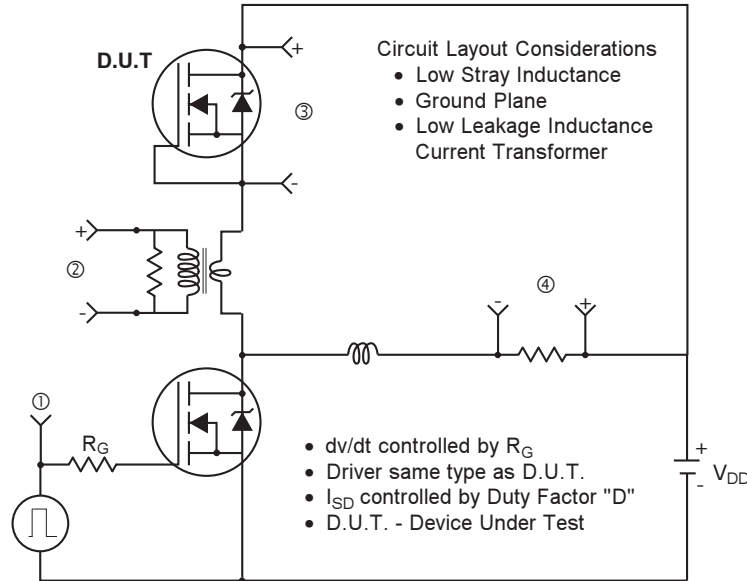


**Fig 10b.** Switching Time Waveforms



**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case


**Fig 12a.** Unclamped Inductive Test Circuit

**Fig 12b.** Unclamped Inductive Waveforms

**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

**Fig 13a.** Basic Gate Charge Waveform

**Fig 13b.** Gate Charge Test Circuit

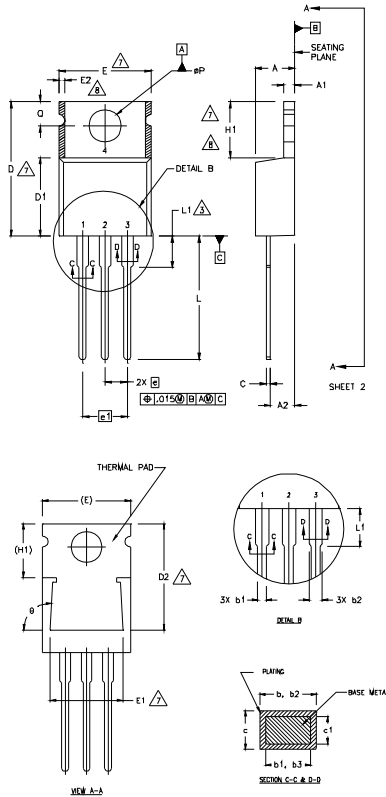
**Peak Diode Recovery dv/dt Test Circuit**


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

**Fig 14.** For N-Channel HEXFET® Power MOSFETs

## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



- NOTES:
- 1 DIMENSIONING AND TOLERANCING PER ASME Y14.5 M- 1994.
  - 2 DIMENSIONS ARE SHOWN IN INCHES (MILLIMETERS).
  - 3 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
  - 4 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
  - 5 DIMENSION b1 & c1 APPLY TO BASE METAL ONLY.
  - 6 CONTROLLING DIMENSION : INCHES.
  - 7 THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
  - 8 DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.

**LEAD ASSIGNMENTS**

**HEXLEET**

- 1- GATE
- 2- DRAIN
- 3- SOURCE

**IGBTs - CoPACK**

- 1- GATE
- 2- COLLECTOR
- 3- EMITTER

**DIODES**

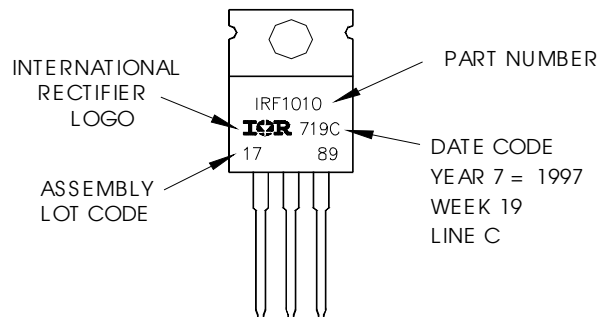
- 1- ANODE/OPEN
- 2- CATHODE
- 3- ANODE

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.82	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.04	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.96	.015	.038	5
b2	1.15	1.77	.045	.070	
b3	1.15	1.73	.045	.068	
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	12.19	12.88	.480	.507	7
E	9.66	10.66	.380	.420	4,7
E1	8.38	8.89	.330	.350	7
e	2.54 BSC		.100 BSC		
e1	5.08		.200 BSC		
H1	5.85	6.55	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	-	6.35	-	.250	3
øP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	
ø	90°-93°		90°-93°		

## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"

**Note:** "P" in assembly line position indicates "Lead-Free"



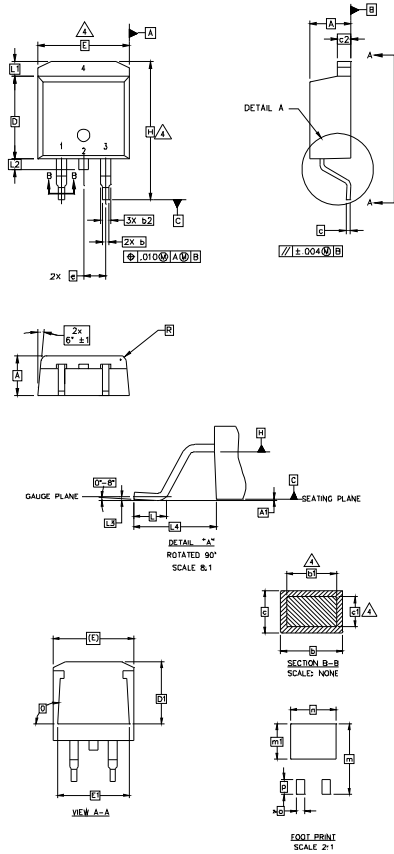
Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>





## D<sup>2</sup>Pak Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
5. CONTROLLING DIMENSION: INCH.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.78	.045	.070	
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	4
c2	1.14	1.65	.045	.065	
D	8.51	9.65	.335	.380	3
D1	6.86		.270		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54	BSC	.100	BSC	
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1		1.65		.065	
L2	1.27	1.78	.050	.070	
L3	0.25	BSC	.010	BSC	
L4	4.78	5.28	.188	.208	
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
R	0.51	0.71	.020	.028	
θ	90°	93°	90°	93°	

LEAD ASSIGNMENTS

- HEXFET  
 1.- GATE  
 2, 4.- DRAIN  
 3.- SOURCE

IGBTs, CoPACK

- 1.- GATE  
 2, 4.- COLLECTOR  
 3.- EMITTER

DIODES

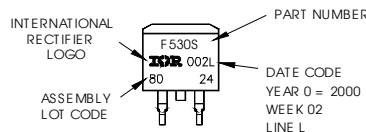
- 1.- ANODE \*  
 2, 4.- CATHODE  
 3.- ANODE

\* PART DEPENDENT.

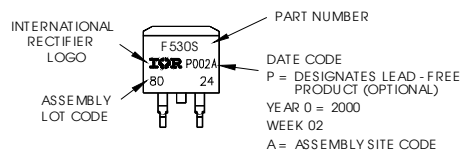
## D<sup>2</sup>Pak Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH  
 LOT CODE 8024  
 ASSEMBLED ON WW 02, 2000  
 IN THE ASSEMBLY LINE "L"

Note: "P" in assembly line position  
 indicates "Lead - Free"



OR

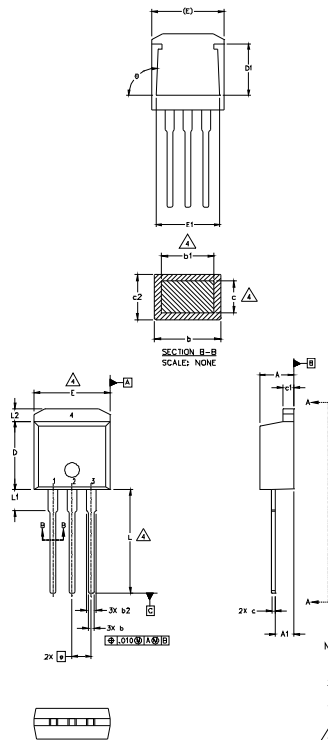


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>



### TO-262 Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	2.03	2.92	.080	.115	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	4
b2	1.14	1.40	.045	.055	
c	0.38	0.63	.015	.025	4
c1	1.14	1.40	.045	.055	
c2	0.43	.063	.017	.029	
D	8.51	9.65	.335	.380	3
D1	5.33		.210		
E	9.65	10.67	.380	.420	3
E1	6.22		.245		
e	2.54 BSC		.100 BSC		
L	13.46	14.09	.530	.555	
L1	3.56	3.71	.140	.146	
L2		1.65		.065	

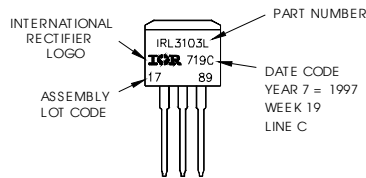
LEAD ASSIGNMENTS

HEXFET	IGBT
1.- GATE	1 - GATE
2.- DRAIN	2 - COLLECTOR
3.- SOURCE	3 - EMITTER
4.- DRAIN	

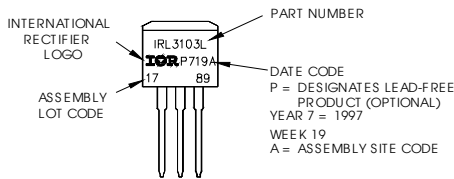
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
  3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
  5. CONTROLLING DIMENSION: INCH.

### TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L  
 LOT CODE 1789  
 ASSEMBLED ON WW 19, 1997  
 IN THE ASSEMBLY LINE "C"  
 Note: "P" in assembly line position indicates "Lead-Free"



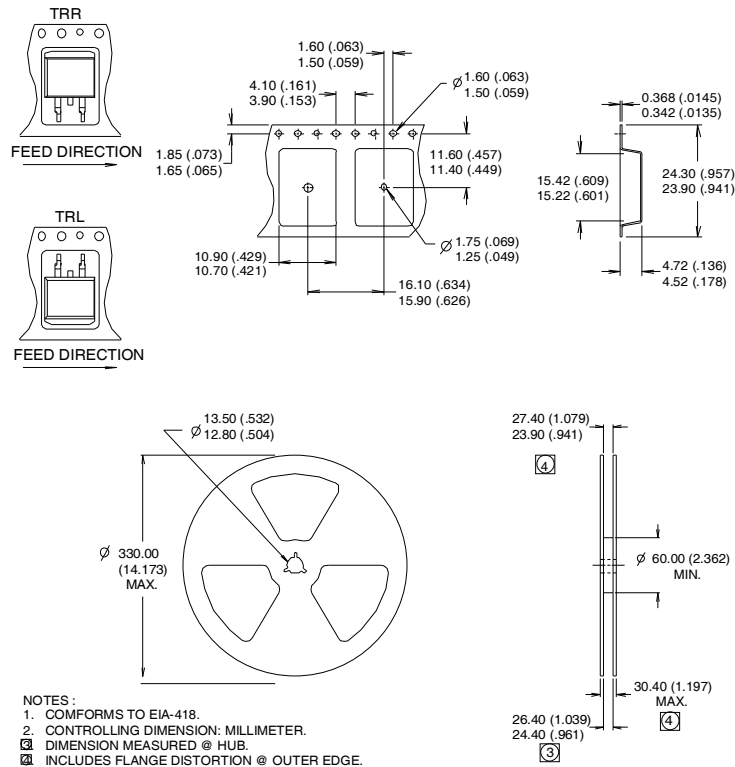
OR



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

## D<sup>2</sup>Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



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

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 1.4\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 46\text{A}$ ,  $V_{GS} = 10\text{V}$ .
- ③ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ④ This is only applied to TO-220A package.
- ⑤ This is applied to D<sup>2</sup>Pak, when mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.
- ⑦  $R_{\theta}$  is measured at  $T_J$  approximately  $90^\circ\text{C}$ .

**Qualification information<sup>†</sup>**

Qualification level	Industrial (per JEDEC JESD47F <sup>††</sup> guidelines)	
Moisture Sensitivity Level	TO-220 PAK	N/A
	TO-262 PAK	
	D2-PAK	MSL1 (per JEDEC J-STD-020D <sup>††</sup> )
RoHS compliant	Yes	

<sup>†</sup> Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/product-info/reliability>

<sup>††</sup> Applicable version of JEDEC standard at the time of product release

**Revision History**

Date	Comments
6/17/2013	<ul style="list-style-type: none"> <li>• Updated ds with New IR Corporate Template</li> <li>• Updated Fig8-SOA curve with Spirito effect on page 4</li> </ul>

International  
 Rectifier

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