



**THE DATASHEET OF
BAT15-099R**



HEXFET® Power MOSFET

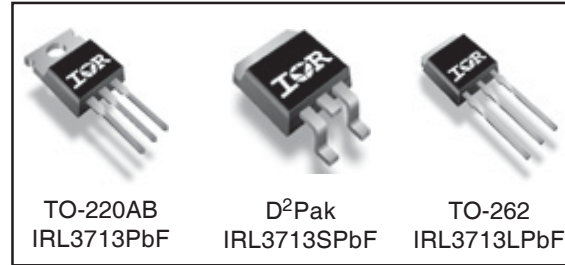
Applications

- High Frequency Isolated DC-DC Converters with Synchronous Rectification for Telecom and Industrial Use
- High Frequency Buck Converters for Computer Processor Power
- 100% R_G Tested

Benefits

- Ultra-Low Gate Impedance
- Very Low R_{DS(on)} at 4.5V V_{GS}
- Fully Characterized Avalanche Voltage and Current
- Lead-Free

V _{DSS}	R _{DS(on)} max (mΩ)	I _D
30V	3.0@V _{GS} = 10V	260A [Ⓒ]



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 _{DS}	Drain-Source Voltage	30	V
V _{GS}	Gate-to-Source Voltage	± 20	V
I _D @ T _C = 25°C	Continuous Drain Current, V _{GS} @ 10V	260 [Ⓒ]	A
I _D @ T _C = 100°C	Continuous Drain Current, V _{GS} @ 10V	180 [Ⓒ]	
I _{DM}	Pulsed Drain Current [Ⓐ]	1040 [Ⓒ]	
P _D @ T _C = 25°C	Maximum Power Dissipation	330	W
P _D @ T _C = 100°C	Maximum Power Dissipation	170	
	Linear Derating Factor	2.2	W/°C
T _J , T _{STG}	Junction and Storage Temperature Range	-55 to +175	°C

Thermal Resistance

Symbol	Parameter	Typ	Max	Units
R _{θJC}	Junction-to-Case [Ⓓ]	—	0.45*	°C/W
R _{θCS}	Case-to-Sink, Flat, Greased Surface [Ⓓ]	0.50	—	
R _{θJA}	Junction-to-Ambient [Ⓓ] [Ⓔ]	—	62	
R _{θJA}	Junction-to-Ambient (PCB Mount) [Ⓓ] [Ⓔ]	—	40	

* R_{θJC} (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 [Ⓐ] through [Ⓔ] are on page 11

Static @ T_J = 25°C (unless otherwise specified)

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

Dynamic @ T_J = 25°C (unless otherwise specified)

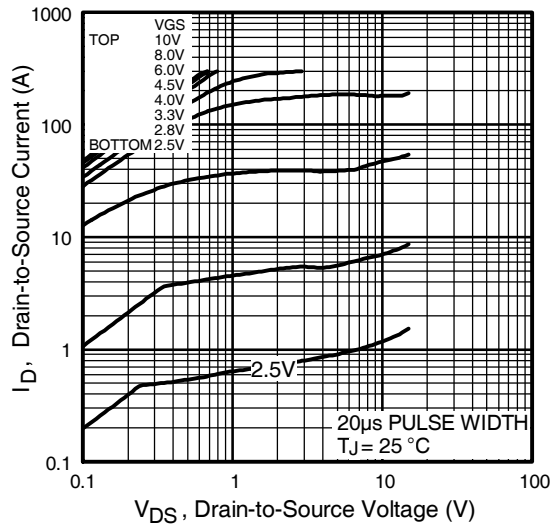
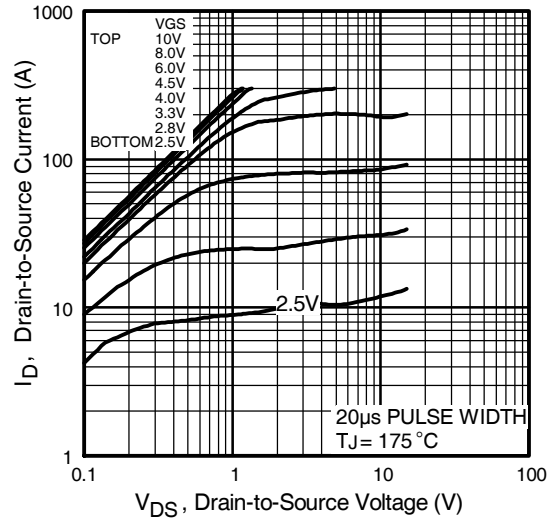
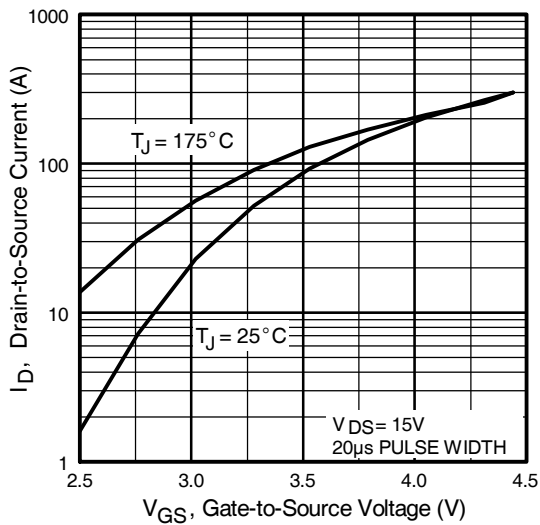
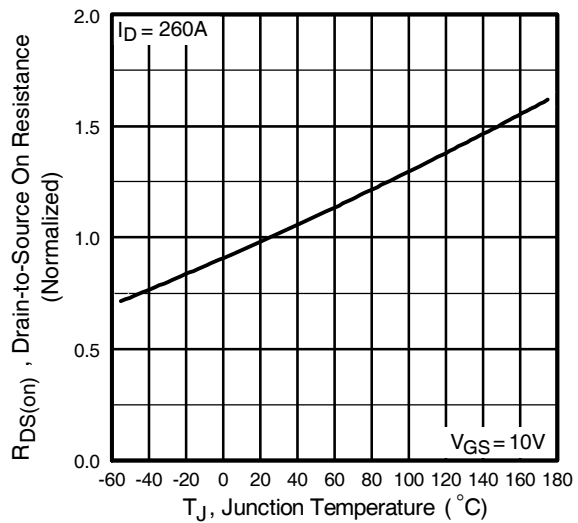
Symbol	Parameter	Min	Typ	Max	Units	Conditions
g _{fs}	Forward Transconductance	76	—	—	S	V _{DS} = 15V, I _D = 30A
Q _g	Total Gate Charge	—	75	110	nC	I _D = 30A V _{DS} = 15V V _{GS} = 4.5V ④
Q _{gs}	Gate-to-Source Charge	—	24	—		
Q _{gd}	Gate-to-Drain ("Miller") Charge	—	37	—		
Q _{OSS}	Output Gate Charge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

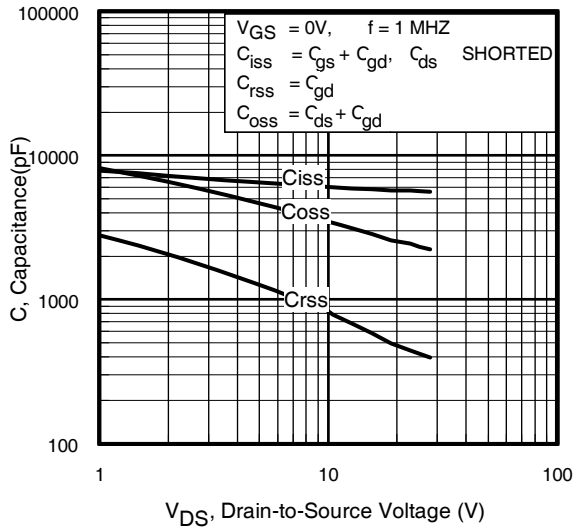
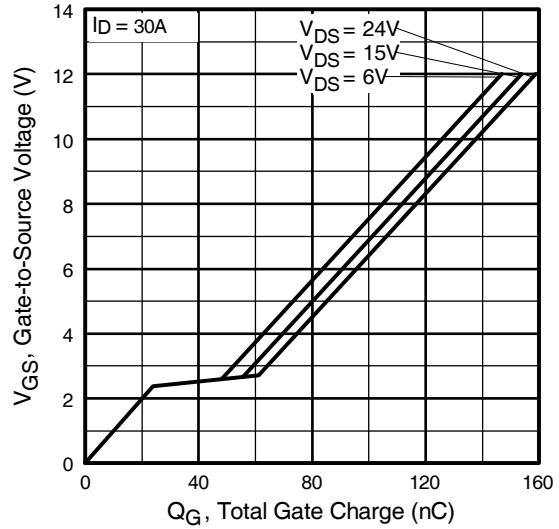
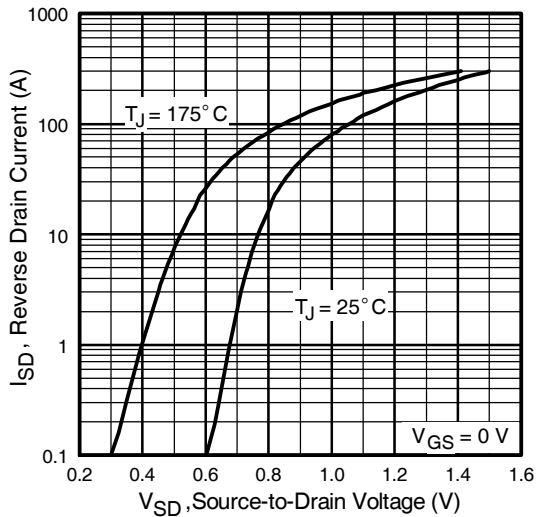
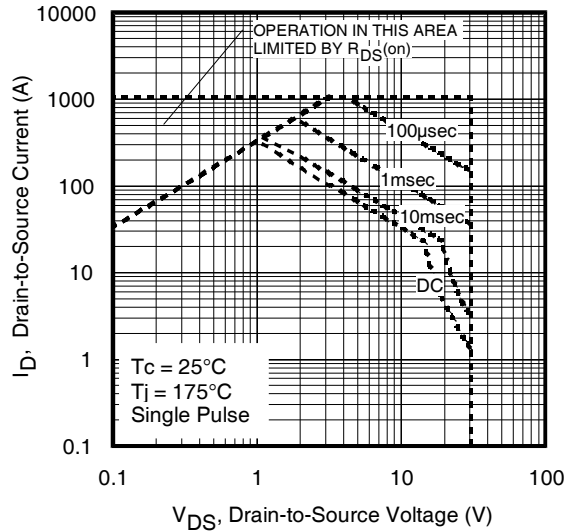
Avalanche Characteristics

Symbol	Parameter	Typ	Max	Units
E _{AS}	Single Pulse Avalanche Energy ②	—	1530	mJ
I _{AR}	Avalanche Current ①	—	46	A

Diode Characteristics

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

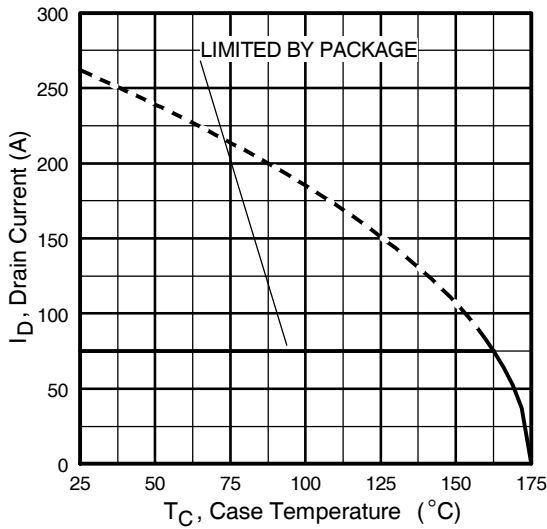


Fig 9. Maximum Drain Current Vs. Case Temperature

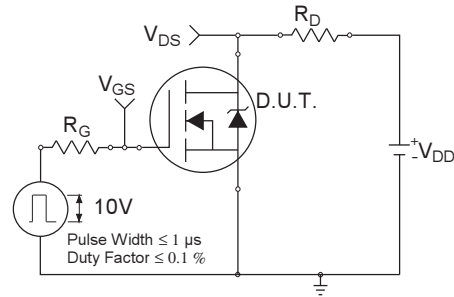


Fig 10a. Switching Time Test Circuit

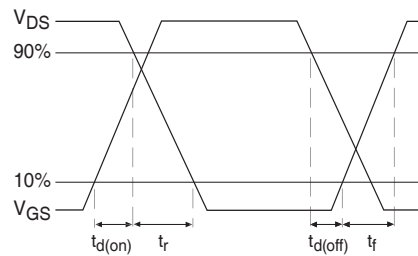


Fig 10b. Switching Time Waveforms

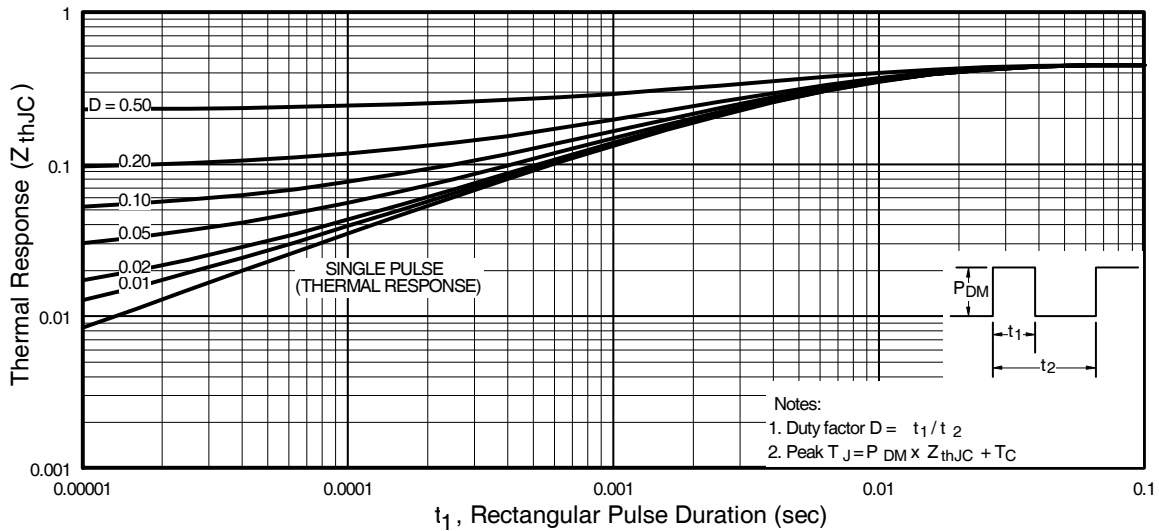
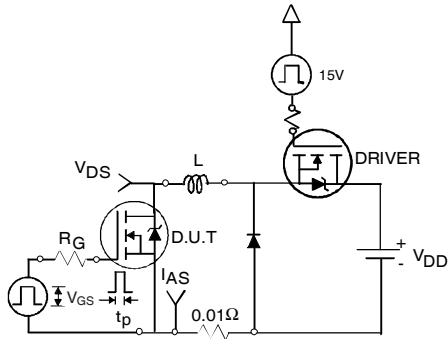
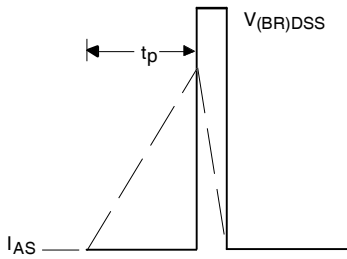
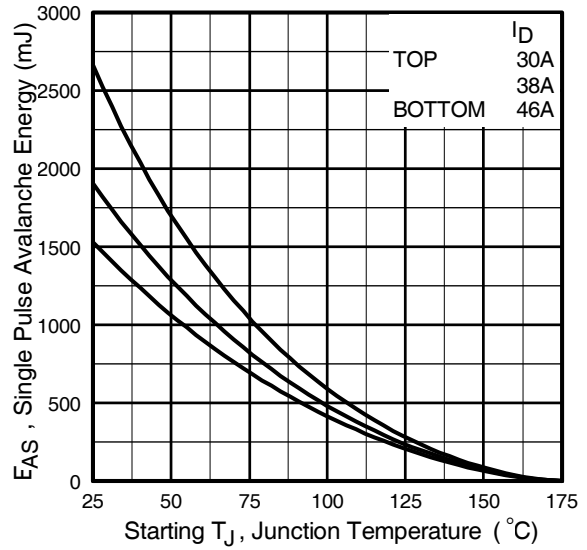
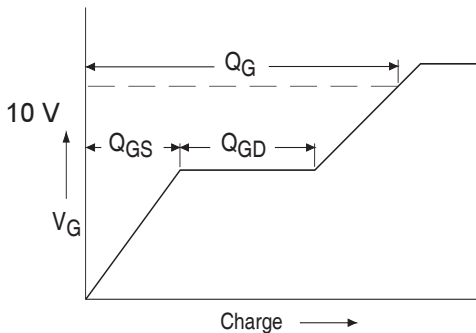
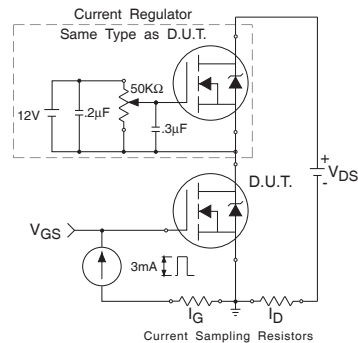
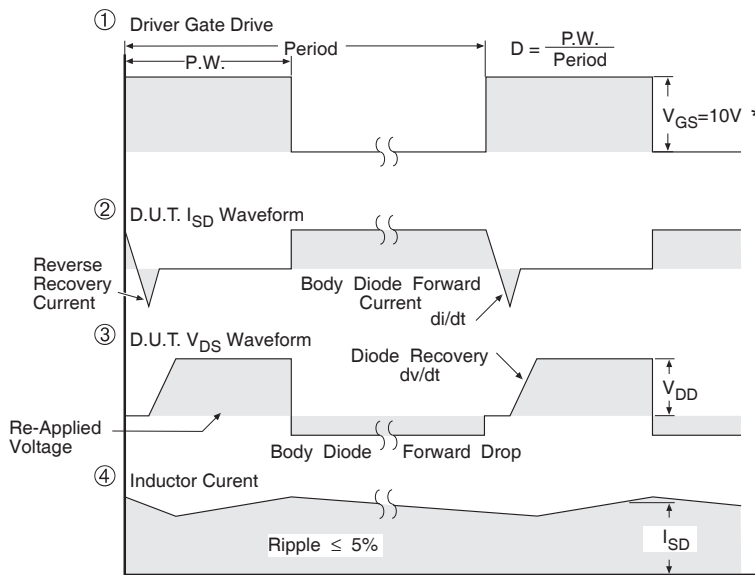
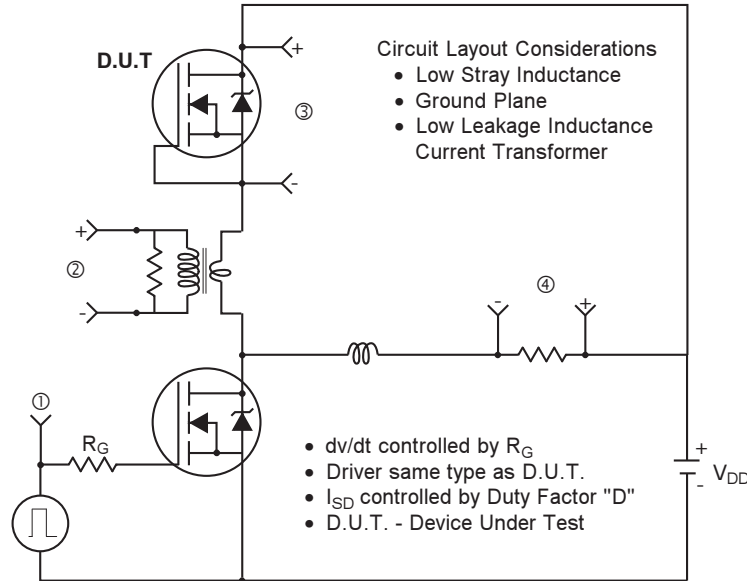


Fig 11. Maximum Effective Transient Thermal Impedance, Junction-to-Case


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

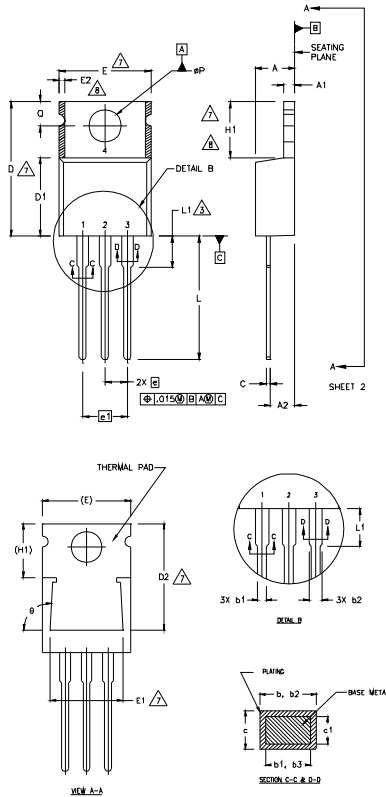
Peak Diode Recovery dv/dt Test Circuit


* $V_{GS} = 5V$ 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

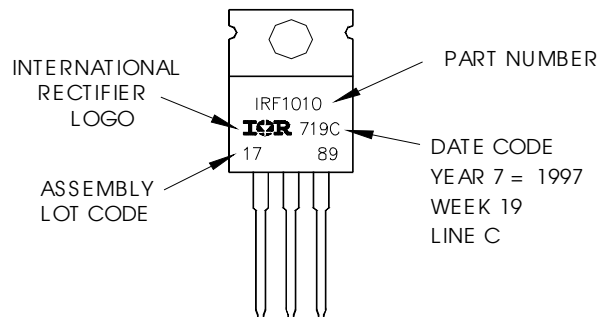
DIODES

- 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"

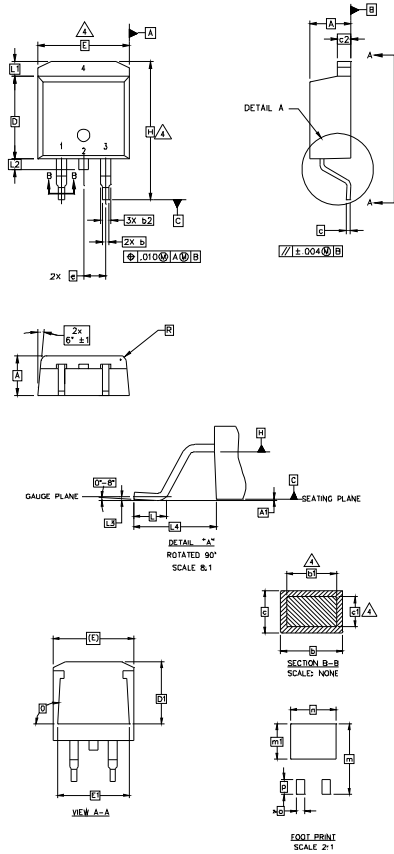


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>



D²Pak 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

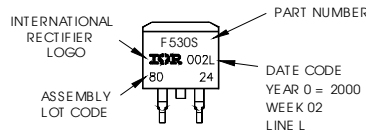
- 1.- ANODE *
 2, 4.- CATHODE
 3.- ANODE

* PART DEPENDENT.

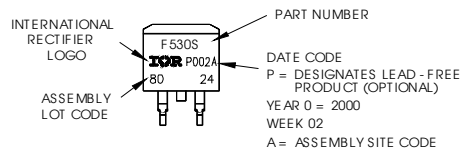
D²Pak Part Marking Information

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

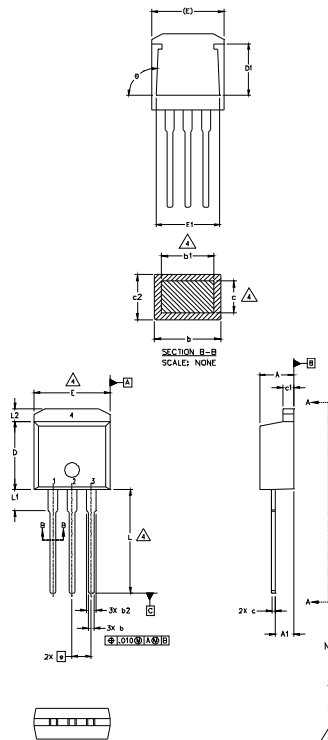


Note: For the most current drawing please refer to IR website at <http://www.irf.com/package/>



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	

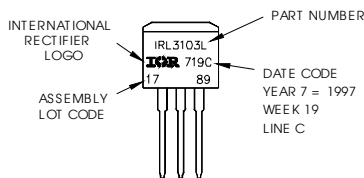
LEAD ASSIGNMENTS

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

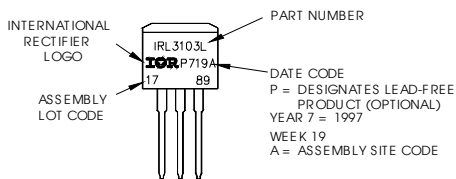
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
 2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
 3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
 4. DIMENSION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



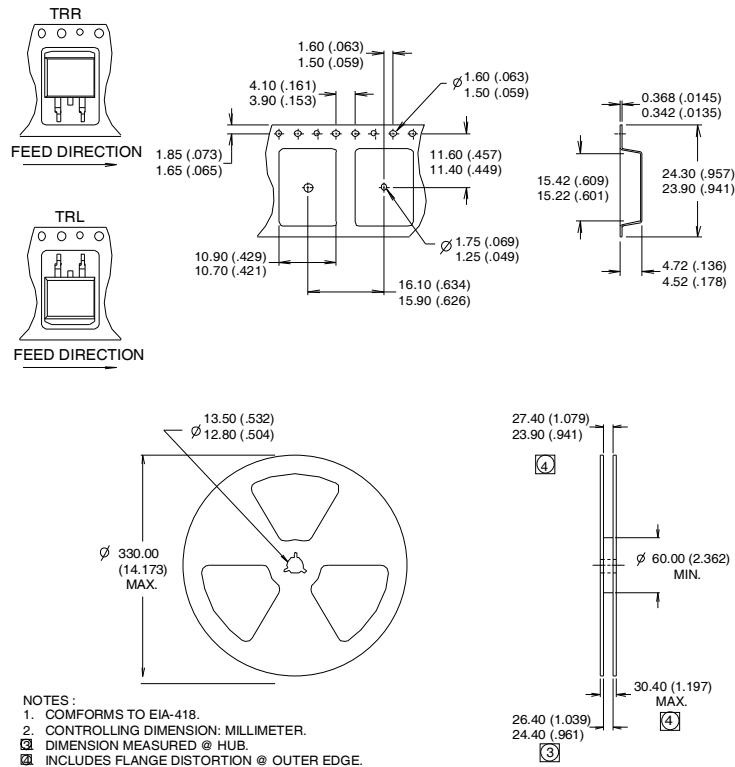
OR



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

D²Pak 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 D²Pak, 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_{θ} is measured at T_J approximately 90°C .

Qualification information[†]

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

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

^{††} Applicable version of JEDEC standard at the time of product release

Revision History

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

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-  Excess Inventory Management