

# International IR Rectifier

PD- 94504

IRF1312

IRF1312S

IRF1312L

HEXFET® Power MOSFET

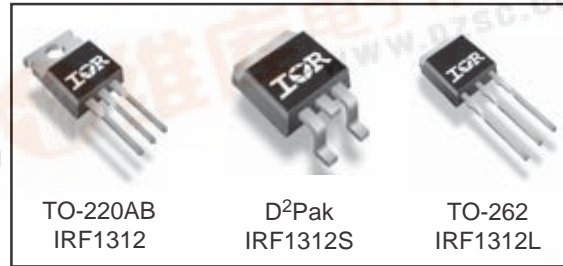
## Applications

- High frequency DC-DC converters
- Motor Control
- Uninterruptible Power Supplies

V <sub>DSS</sub>	R <sub>DS(on)</sub> max	I <sub>D</sub>
80V	10mΩ	95A <sup>Ⓞ</sup>

## Benefits

- Low Gate-to-Drain Charge to Reduce Switching Losses
- Fully Characterized Capacitance Including Effective C<sub>OSS</sub> to Simplify Design, (See App. Note AN1001)
- Fully Characterized Avalanche Voltage and Current



## Absolute Maximum Ratings

	Parameter	Max.	Units
I <sub>D</sub> @ T <sub>C</sub> = 25°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	95 <sup>Ⓞ</sup>	A
I <sub>D</sub> @ T <sub>C</sub> = 100°C	Continuous Drain Current, V <sub>GS</sub> @ 10V	67 <sup>Ⓞ</sup>	
I <sub>DM</sub>	Pulsed Drain Current <sup>Ⓛ</sup>	380	
P <sub>D</sub> @ T <sub>A</sub> = 25°C	Power Dissipation <sup>Ⓞ</sup>	3.8	W
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Power Dissipation	210	
	Linear Derating Factor	1.4	W/°C
V <sub>GS</sub>	Gate-to-Source Voltage	± 20	V
dv/dt	Peak Diode Recovery dv/dt <sup>Ⓜ</sup>	5.1	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	300 (1.6mm from case )	
	Mounting torque, 6-32 or M3 screw	10 lbf•in (1.1N•m)	

## Thermal Resistance

	Parameter	Typ.	Max.	Units
R <sub>θJC</sub>	Junction-to-Case	—	0.73	°C/W
R <sub>θCS</sub>	Case-to-Sink, Flat, Greased Surface <sup>Ⓡ</sup>	0.50	—	
R <sub>θJA</sub>	Junction-to-Ambient <sup>Ⓢ</sup>	—	62	
R <sub>θJA</sub>	Junction-to-Ambient (PCB mount) <sup>Ⓢ</sup>	—	40	

Notes <sup>Ⓛ</sup> through <sup>Ⓢ</sup> are on page 11

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7/01/02



# IRF1312/S/L

International  
**IR** Rectifier

## Static @ 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	80	—	—	V	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA
ΔV <sub>(BR)DSS/ΔT<sub>J</sub></sub>	Breakdown Voltage Temp. Coefficient	—	0.078	—	V/°C	Reference to 25°C, I <sub>D</sub> = 1mA
R <sub>DS(on)</sub>	Static Drain-to-Source On-Resistance	—	6.6	10	mΩ	V <sub>GS</sub> = 10V, I <sub>D</sub> = 57A ④
V <sub>GS(th)</sub>	Gate Threshold Voltage	3.5	—	5.5	V	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA
I <sub>DSS</sub>	Drain-to-Source Leakage Current	—	—	1.0	μA	V <sub>DS</sub> = 76V, V <sub>GS</sub> = 0V
		—	—	250		V <sub>DS</sub> = 64V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 150°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

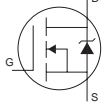
## Dynamic @ T<sub>J</sub> = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
g <sub>fs</sub>	Forward Transconductance	92	—	—	S	V <sub>DS</sub> = 25V, I <sub>D</sub> = 57A
Q <sub>g</sub>	Total Gate Charge	—	93	140	nC	I <sub>D</sub> = 57A
Q <sub>gs</sub>	Gate-to-Source Charge	—	36	—		V <sub>DS</sub> = 40V
Q <sub>gd</sub>	Gate-to-Drain ("Miller") Charge	—	34	—		V <sub>GS</sub> = 10V, ④
t <sub>d(on)</sub>	Turn-On Delay Time	—	25	—	ns	V <sub>DD</sub> = 40V
t <sub>r</sub>	Rise Time	—	130	—		I <sub>D</sub> = 57A
t <sub>d(off)</sub>	Turn-Off Delay Time	—	47	—		R <sub>G</sub> = 4.5Ω
t <sub>f</sub>	Fall Time	—	51	—		V <sub>GS</sub> = 10V ④
C <sub>iss</sub>	Input Capacitance	—	5450	—	pF	V <sub>GS</sub> = 0V
C <sub>oss</sub>	Output Capacitance	—	550	—		V <sub>DS</sub> = 25V
C <sub>rss</sub>	Reverse Transfer Capacitance	—	340	—		f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	1910	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 1.0V, f = 1.0MHz
C <sub>oss</sub>	Output Capacitance	—	380	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 64V, f = 1.0MHz
C <sub>oss eff.</sub>	Effective Output Capacitance	—	620	—		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 0V to 64V ⑤

## Avalanche Characteristics

	Parameter	Typ.	Max.	Units
E <sub>AS</sub>	Single Pulse Avalanche Energy②⑥	—	250	mJ
I <sub>AR</sub>	Avalanche Current①	—	57	A
E <sub>AR</sub>	Repetitive Avalanche Energy①	—	21	mJ

## Diode Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I <sub>S</sub>	Continuous Source Current (Body Diode)	—	—	95⑥	A	MOSFET symbol showing the integral reverse p-n junction diode. 
I <sub>SM</sub>	Pulsed Source Current (Body Diode) ①⑥	—	—	380		
V <sub>SD</sub>	Diode Forward Voltage	—	—	1.3	V	T <sub>J</sub> = 25°C, I <sub>S</sub> = 57A, V <sub>GS</sub> = 0V ④
t <sub>rr</sub>	Reverse Recovery Time	—	64	96	ns	T <sub>J</sub> = 25°C, I <sub>F</sub> = 57A
Q <sub>rr</sub>	Reverse Recovery Charge	—	150	230	nC	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> )				

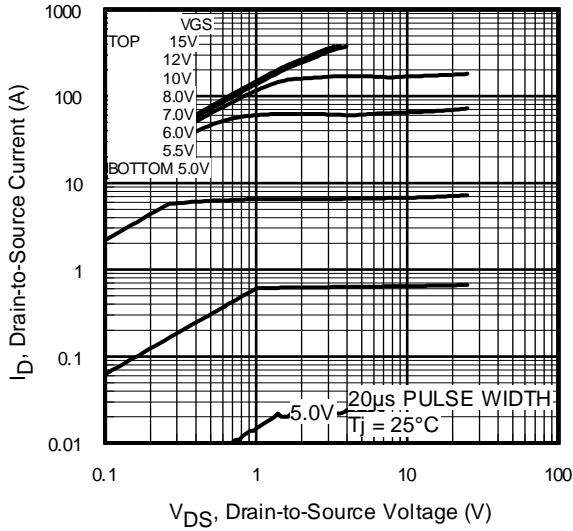


Fig 1. Typical Output Characteristics

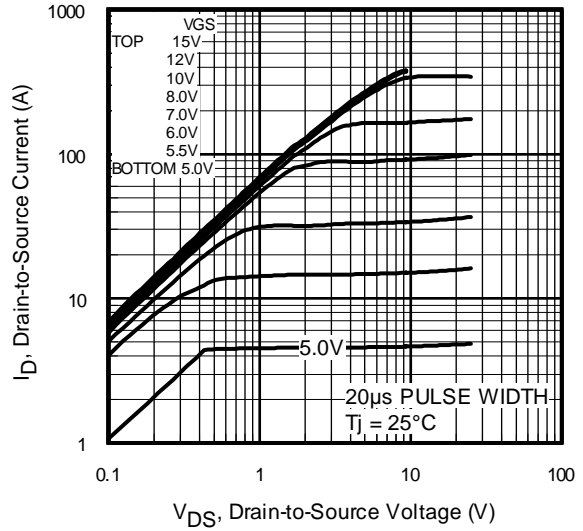


Fig 2. Typical Output Characteristics

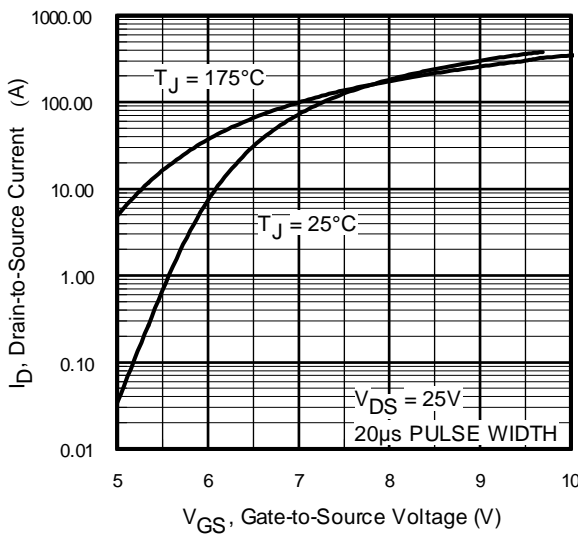


Fig 3. Typical Transfer Characteristics

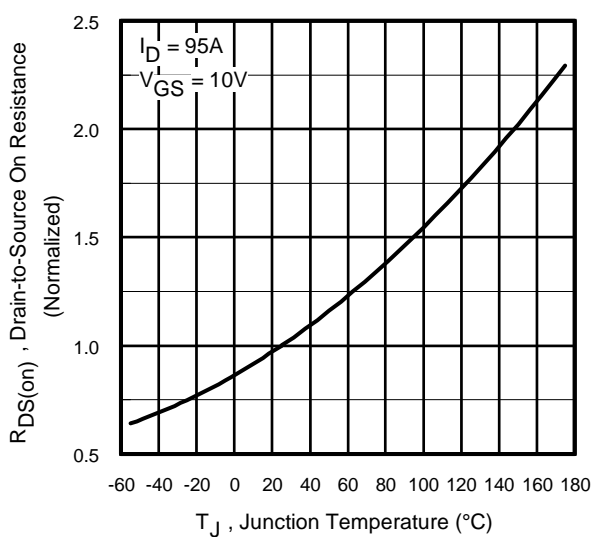
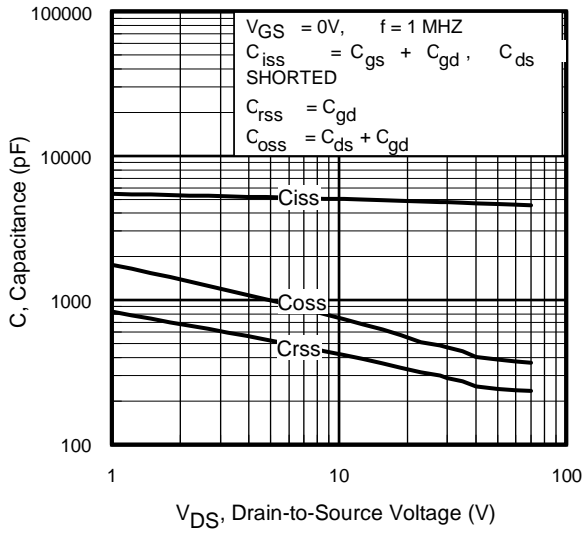
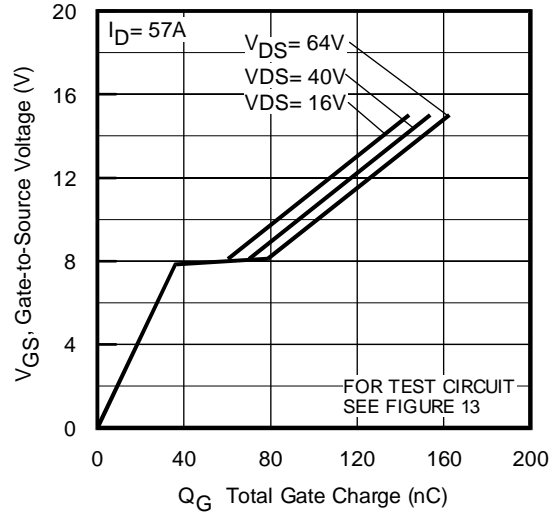


Fig 4. Normalized On-Resistance Vs. Temperature

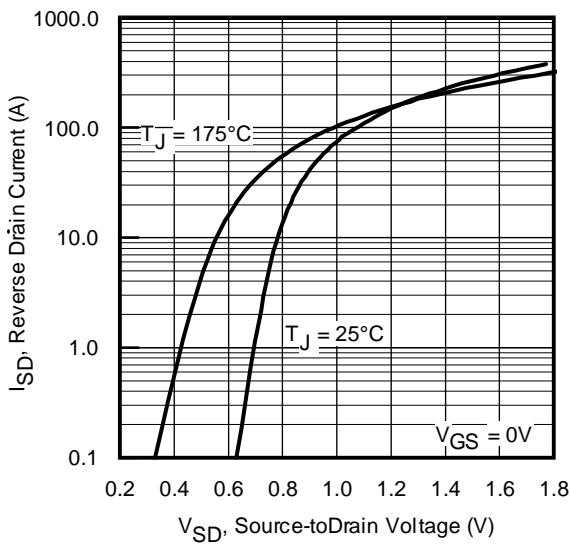
# IRF1312/S/L



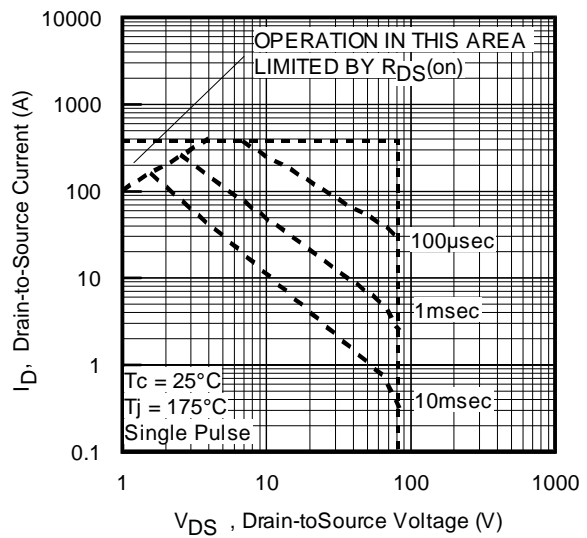
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



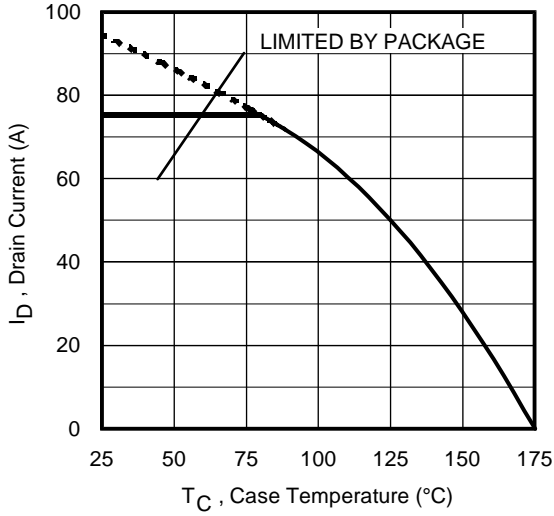
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



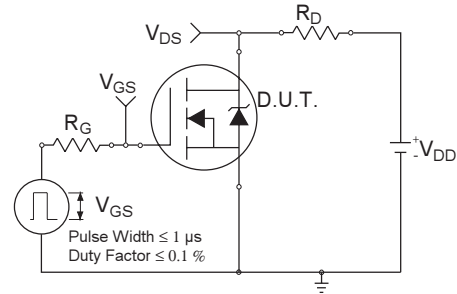
**Fig 7.** Typical Source-Drain Diode Forward Voltage



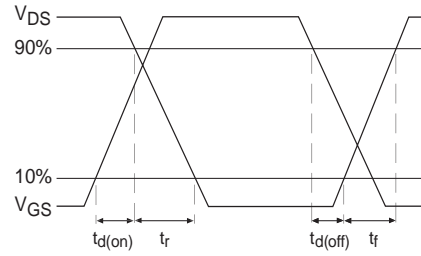
**Fig 8.** Maximum Safe Operating Area



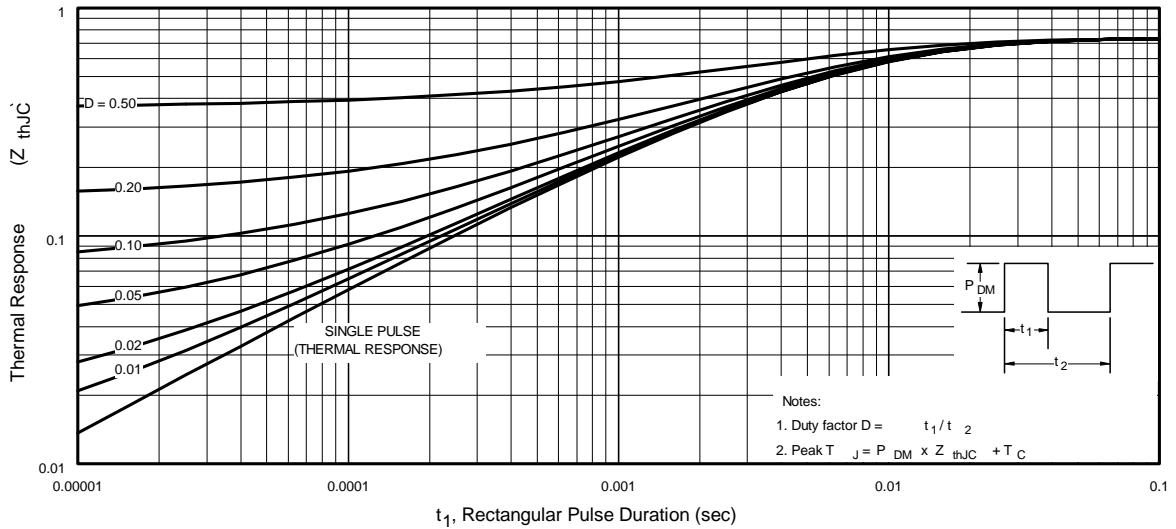
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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

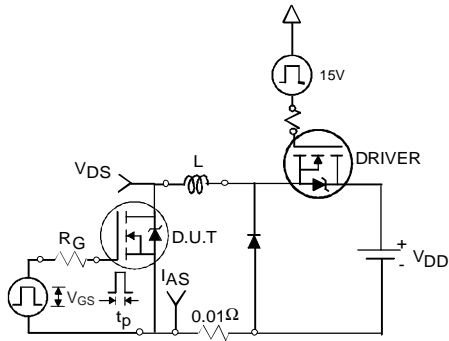


**Fig 10b.** Switching Time Waveforms

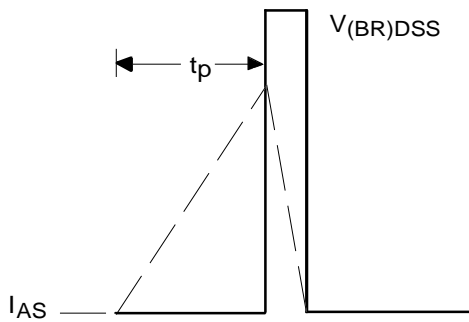


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

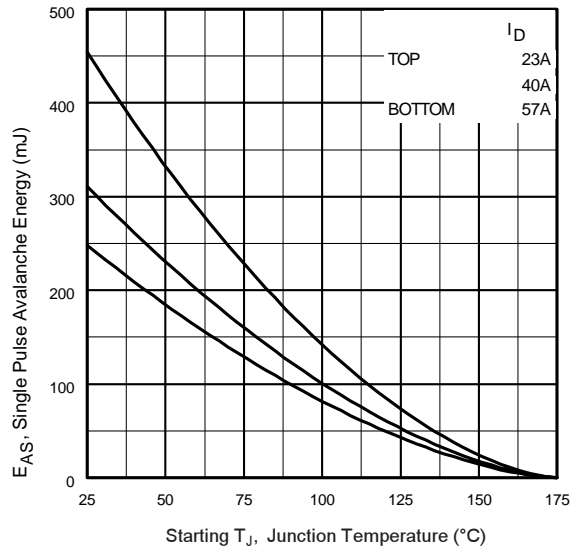
# IRF1312/S/L



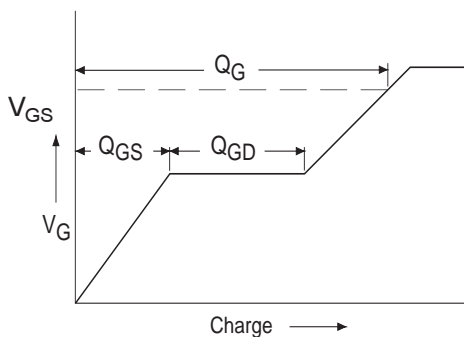
**Fig 12a.** Unclamped Inductive Test Circuit



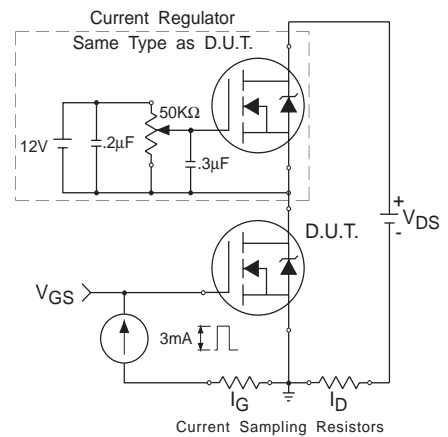
**Fig 12b.** Unclamped Inductive Waveforms



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

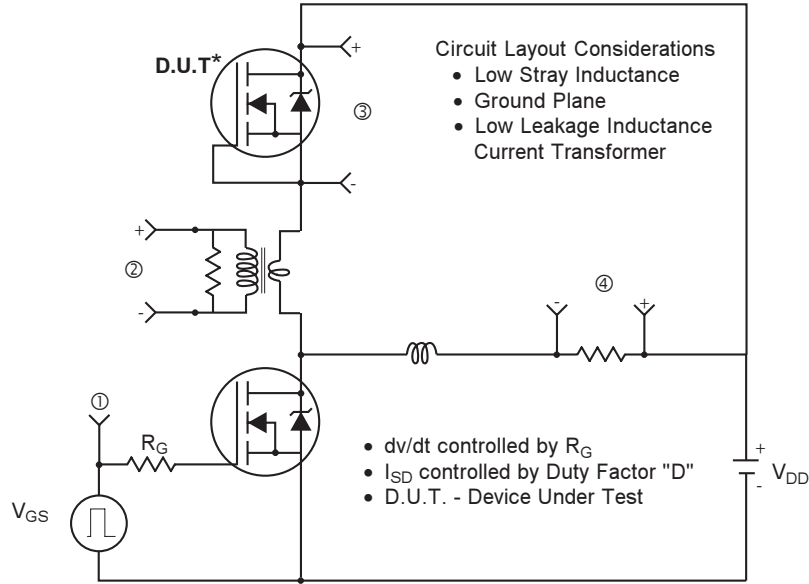


**Fig 13a.** Basic Gate Charge Waveform

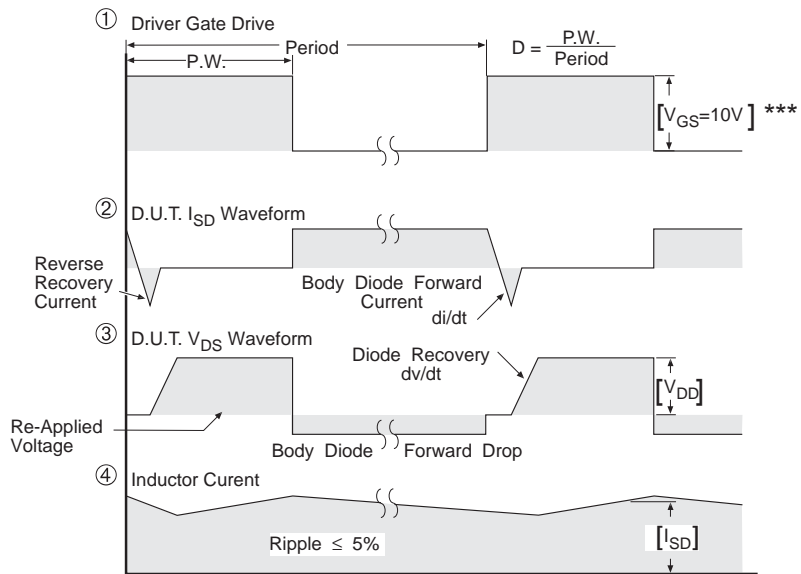


**Fig 13b.** Gate Charge Test Circuit

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



\* Reverse Polarity of D.U.T for P-Channel



\*\*\*  $V_{GS} = 5.0V$  for Logic Level and 3V Drive Devices

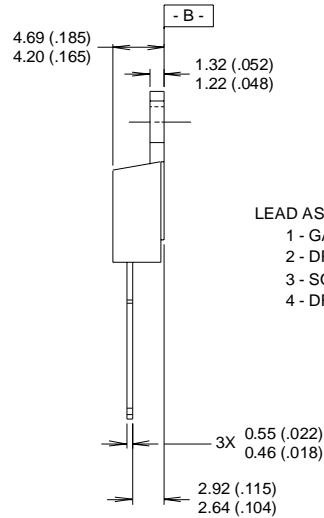
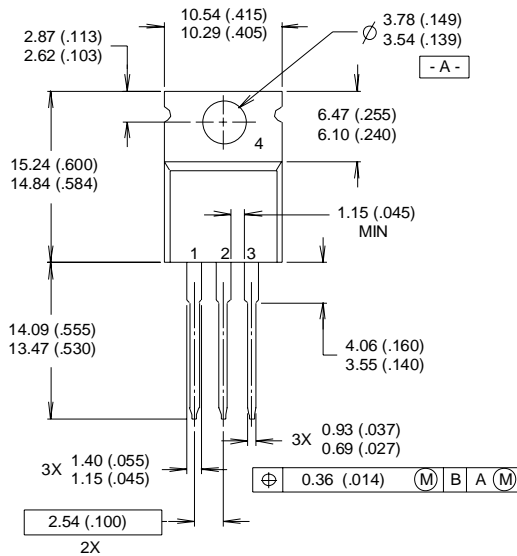
**Fig 14.** For N-channel HEXFET® power MOSFETs

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## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS  
1 - GATE  
2 - DRAIN  
3 - SOURCE  
4 - DRAIN

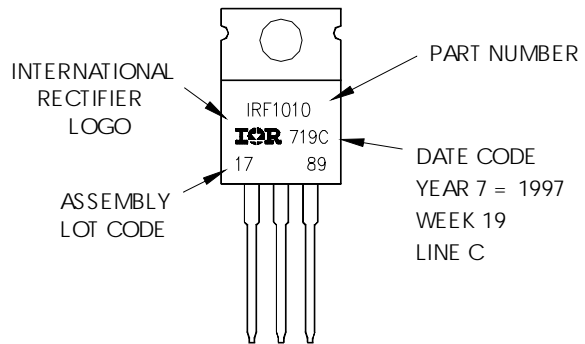
**NOTES:**

- 1 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION : INCH

- 3 OUTLINE CONFORMS TO JEDEC OUTLINE TO-220AB.
- 4 HEATSINK & LEAD MEASUREMENTS DO NOT INCLUDE BURRS.

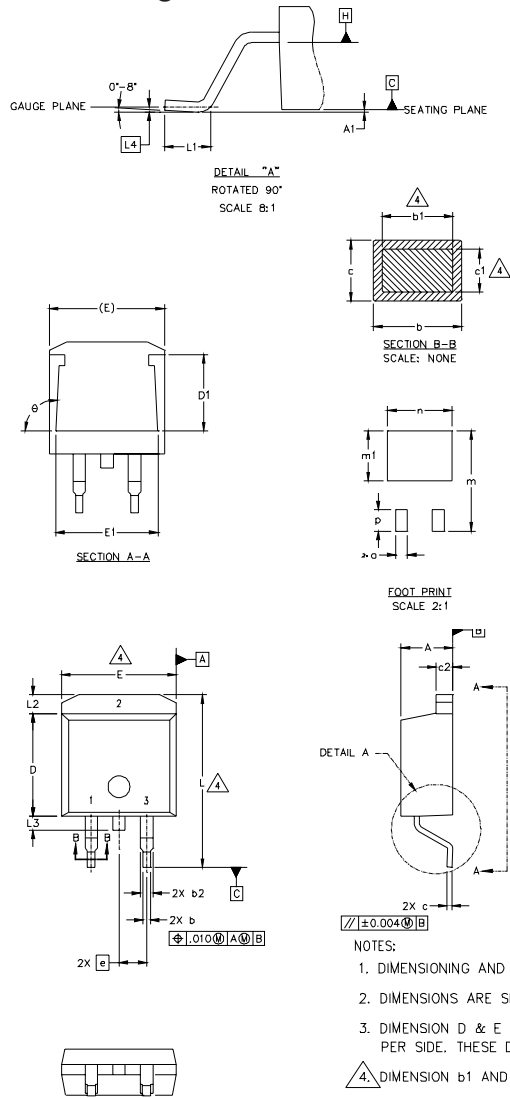
## TO-220AB Part Marking Information

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





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



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1		0.127		.005	
b	0.51	0.99	.020	.039	4
b1	0.51	0.89	.020	.035	
b2	1.14	1.40	.045	.055	
c	0.38	0.74	.015	.029	
c1	0.43	0.63	.017	.025	4
c2	1.14	1.40	.045	.055	
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	14.61	15.88	.575	.625	
L1	1.78	2.79	.070	.110	
L2		1.65		.065	
L3	1.27	1.78	.050	.070	
L4	0.25 BSC		.010 BSC		
m	17.78		.700		
m1	8.89		.350		
n	11.43		.450		
o	2.08		.082		
p	3.81		.150		
θ	90°	93°	90°	93°	

**LEAD ASSIGNMENTS**

HEXFET	IGBTs, CoPACK	DIODES
1.- GATE	1.- GATE	1.- ANODE *
2.- DRAIN	2.- COLLECTOR	2.- CATHODE
3.- SOURCE	3.- EMITTER	3.- ANODE

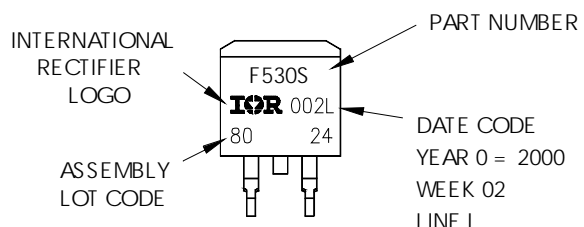
\* PART DEPENDENT.

**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.

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

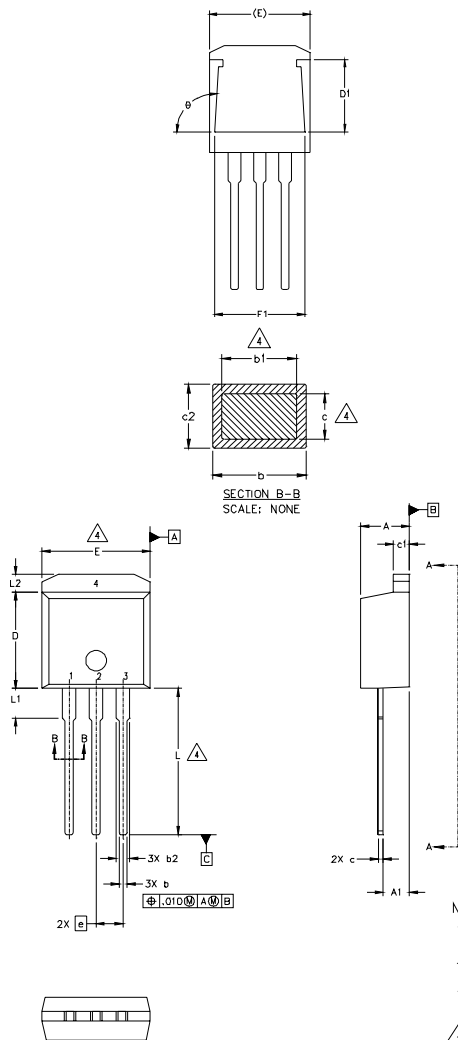
EXAMPLE: THIS IS AN IRF530S WITH  
LOT CODE 8024  
ASSEMBLED ON WW 02, 2000  
IN THE ASSEMBLY LINE "L"



# IRF1312/S/L

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## TO-262 Package Outline



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	

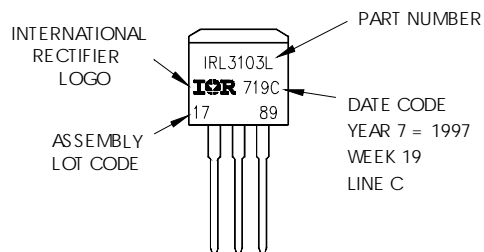
### LEAD ASSIGNMENTS

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

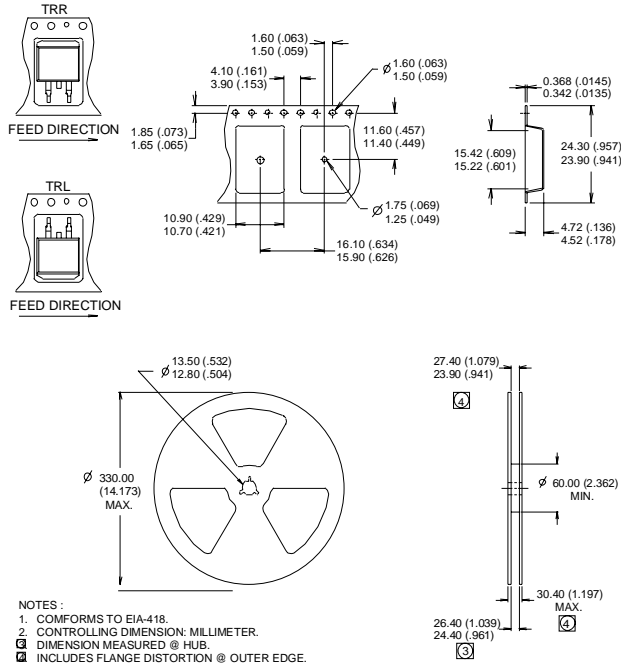
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
  2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
  3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
  4. DIMENSION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



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



Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. ( See fig. 11 )
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.15\text{mH}$   
 $R_G = 25\Omega$ ,  $I_{AS} = 57\text{A}$ . (See Figure 12)
- ③  $I_{SD} \leq 57\text{A}$ ,  $di/dt \leq 410\text{A}/\mu\text{s}$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  
 $T_J \leq 175^\circ\text{C}$
- ④ Pulse width  $\leq 400\mu\text{s}$ ; duty cycle  $\leq 2\%$ .
- ⑤  $C_{OSS}$  eff. is a fixed capacitance that gives the same charging time as  $C_{OSS}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$
- ⑥ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.
- ⑦ This is only applied to TO-220AB package
- ⑧ 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.

TO-220AB package is not recommended for Surface Mount Application

Data and specifications subject to change without notice.  
 This product has been designed and qualified for the Industrial market.  
 Qualification Standards can be found on IR's Web site.