

# International **IR** Rectifier

## AUTOMOTIVE MOSFET

PD - 95849  
IRLZ44Z  
IRLZ44ZS  
IRLZ44ZL

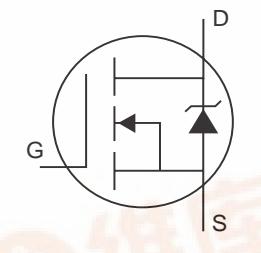
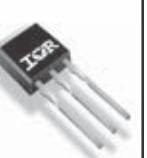
### Features

- Logic Level
- Advanced Process Technology
- Ultra Low On-Resistance
- 175°C Operating Temperature
- Fast Switching
- Repetitive Avalanche Allowed up to Tjmax

### Description

Specifically designed for Automotive applications, this HEXFET® Power MOSFET utilizes the latest processing techniques to achieve extremely low on-resistance per silicon area. Additional features of this design are a 175°C junction operating temperature, fast switching speed and improved repetitive avalanche rating. These features combine to make this design an extremely efficient and reliable device for use in Automotive applications and a wide variety of other applications.

### HEXFET® Power MOSFET

	$V_{DSS} = 55V$ $R_{DS(on)} = 13.5m\Omega$ $I_D = 51A$
 TO-220AB IRLZ44Z	 D²Pak IRLZ44ZS
 TO-262 IRLZ44ZL	

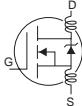
### Absolute Maximum Ratings

	Parameter	Max.	Units
$I_D @ T_C = 25^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$ (Silicon Limited)	51	
$I_D @ T_C = 100^\circ C$	Continuous Drain Current, $V_{GS} @ 10V$	36	A
$I_{DM}$	Pulsed Drain Current ①	204	
$P_D @ T_C = 25^\circ C$	Power Dissipation	80	W
	Linear Derating Factor	0.53	W/ $^\circ C$
$V_{GS}$	Gate-to-Source Voltage	$\pm 16$	V
$E_{AS}$ (Thermally limited)	Single Pulse Avalanche Energy ②	78	mJ
$E_{AS}$ (Tested )	Single Pulse Avalanche Energy Tested Value ③	110	
$I_{AR}$	Avalanche Current ④	See Fig.12a, 12b, 15, 16	A
$E_{AR}$	Repetitive Avalanche Energy ⑤		mJ
$T_J$	Operating Junction and	$-55$ to $+175$	
$T_{STG}$	Storage Temperature Range		$^\circ C$
	Soldering Temperature, for 10 seconds	300 (1.6mm from case )	
	Mounting Torque, 6-32 or M3 screw ⑥	10 lbf $\cdot$ in (1.1N $\cdot$ m)	

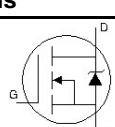
### Thermal Resistance

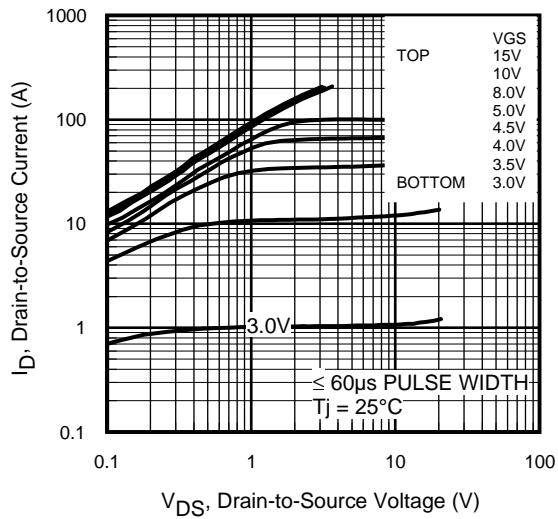
	Parameter	Typ.	Max.	Units
$R_{0JC}$	Junction-to-Case ⑦	—	1.87	$^\circ C/W$
$R_{0CS}$	Case-to-Sink, Flat Greased Surface ⑧⑨	0.50	—	
$R_{0JA}$	Junction-to-Ambient ⑦⑨	—	62	
$R_{0JA}$	Junction-to-Ambient (PCB Mount) ⑧⑨	—	40	

**Electrical Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

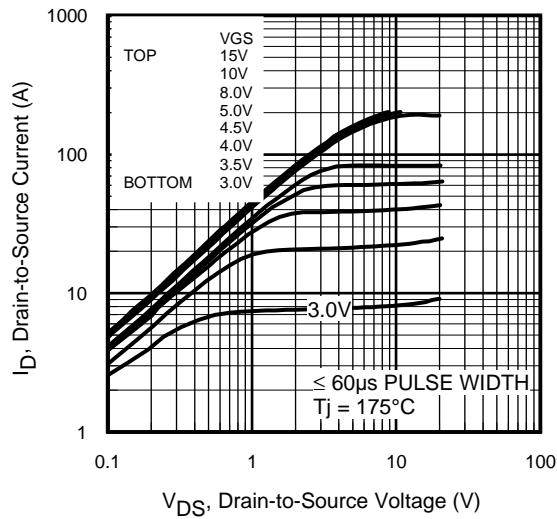
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(\text{BR})\text{DSS}}$	Drain-to-Source Breakdown Voltage	55	—	—	V	$V_{\text{GS}} = 0\text{V}$ , $I_D = 250\mu\text{A}$
$\Delta V_{(\text{BR})\text{DSS}/\Delta T_J}$	Breakdown Voltage Temp. Coefficient	—	0.05	—	$\text{V}/^\circ\text{C}$	Reference to $25^\circ\text{C}$ , $I_D = 1\text{mA}$
$R_{\text{DS}(\text{on})}$	Static Drain-to-Source On-Resistance	—	11	13.5	$\text{m}\Omega$	$V_{\text{GS}} = 10\text{V}$ , $I_D = 31\text{A}$ ③
		—	—	20	$\text{m}\Omega$	$V_{\text{GS}} = 5.0\text{V}$ , $I_D = 30\text{A}$ ③
		—	—	22.5	$\text{m}\Omega$	$V_{\text{GS}} = 4.5\text{V}$ , $I_D = 15\text{A}$ ③
$V_{\text{GS}(\text{th})}$	Gate Threshold Voltage	1.0	—	3.0	V	$V_{\text{DS}} = V_{\text{GS}}$ , $I_D = 250\mu\text{A}$
$g_{\text{fs}}$	Forward Transconductance	27	—	—	V	$V_{\text{DS}} = 25\text{V}$ , $I_D = 31\text{A}$
$I_{\text{DSS}}$	Drain-to-Source Leakage Current	—	—	20	$\mu\text{A}$	$V_{\text{DS}} = 55\text{V}$ , $V_{\text{GS}} = 0\text{V}$
		—	—	250	$\mu\text{A}$	$V_{\text{DS}} = 55\text{V}$ , $V_{\text{GS}} = 0\text{V}$ , $T_J = 125^\circ\text{C}$
$I_{\text{GSS}}$	Gate-to-Source Forward Leakage	—	—	200	nA	$V_{\text{GS}} = 16\text{V}$
	Gate-to-Source Reverse Leakage	—	—	-200	nA	$V_{\text{GS}} = -16\text{V}$
$Q_g$	Total Gate Charge	—	24	36	nC	$I_D = 31\text{A}$
$Q_{\text{gs}}$	Gate-to-Source Charge	—	7.5	—		$V_{\text{DS}} = 44\text{V}$
$Q_{\text{gd}}$	Gate-to-Drain ("Miller") Charge	—	12	—		$V_{\text{GS}} = 5.0\text{V}$ ③
$t_{\text{d}(\text{on})}$	Turn-On Delay Time	—	14	—		$V_{\text{DD}} = 50\text{V}$
$t_r$	Rise Time	—	160	—	ns	$I_D = 31\text{A}$
$t_{\text{d}(\text{off})}$	Turn-Off Delay Time	—	25	—		$R_G = 7.5 \Omega$
$t_f$	Fall Time	—	42	—		$V_{\text{GS}} = 5.0\text{V}$ ③
$L_D$	Internal Drain Inductance	—	4.5	—	nH	Between lead, 6mm (0.25in.) from package and center of die contact
$L_S$	Internal Source Inductance	—	7.5	—		
$C_{\text{iss}}$	Input Capacitance	—	1620	—	pF	$V_{\text{GS}} = 0\text{V}$
$C_{\text{oss}}$	Output Capacitance	—	230	—		$V_{\text{DS}} = 25\text{V}$
$C_{\text{rss}}$	Reverse Transfer Capacitance	—	130	—		$f = 1.0\text{MHz}$
$C_{\text{oss}}$	Output Capacitance	—	860	—		$V_{\text{GS}} = 0\text{V}$ , $V_{\text{DS}} = 1.0\text{V}$ , $f = 1.0\text{MHz}$
$C_{\text{oss}}$	Output Capacitance	—	180	—		$V_{\text{GS}} = 0\text{V}$ , $V_{\text{DS}} = 44\text{V}$ , $f = 1.0\text{MHz}$
$C_{\text{oss eff.}}$	Effective Output Capacitance	—	280	—		$V_{\text{GS}} = 0\text{V}$ , $V_{\text{DS}} = 0\text{V}$ to $44\text{V}$ ④

**Source-Drain Ratings and Characteristics**

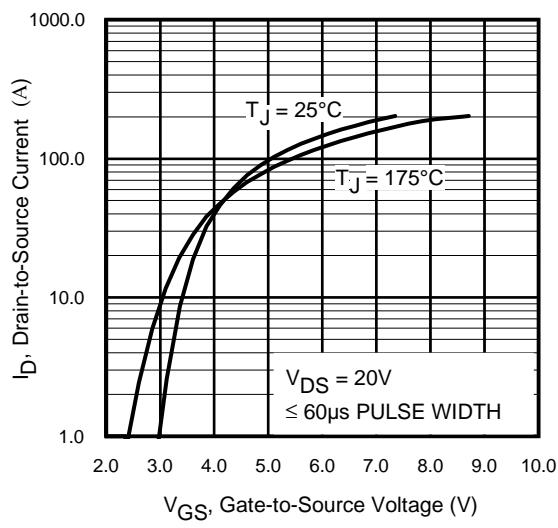
	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	51	A	MOSFET symbol showing the integral reverse p-n junction diode.
	Pulsed Source Current (Body Diode) ①	—	—	204		
$V_{\text{SD}}$	Diode Forward Voltage	—	—	1.3	V	$T_J = 25^\circ\text{C}$ , $I_S = 31\text{A}$ , $V_{\text{GS}} = 0\text{V}$ ③
$t_{\text{rr}}$	Reverse Recovery Time	—	21	32	ns	$T_J = 25^\circ\text{C}$ , $I_F = 31\text{A}$ , $V_{\text{DD}} = 28\text{V}$
$Q_{\text{rr}}$	Reverse Recovery Charge	—	16	24	nC	$\text{di}/\text{dt} = 100\text{A}/\mu\text{s}$ ③
$t_{\text{on}}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $LS+LD$ )				



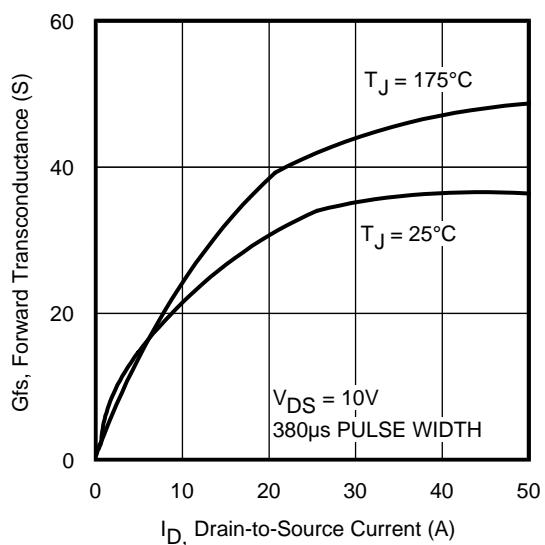
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics



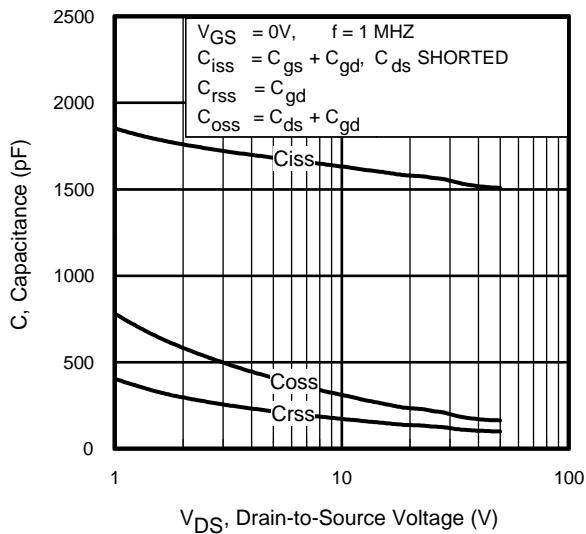
**Fig 3.** Typical Transfer Characteristics



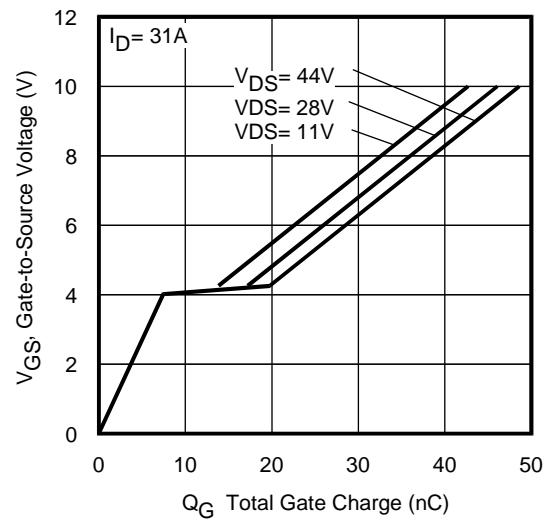
**Fig 4.** Typical Forward Transconductance Vs. Drain Current

# IRLZ44Z/S/L

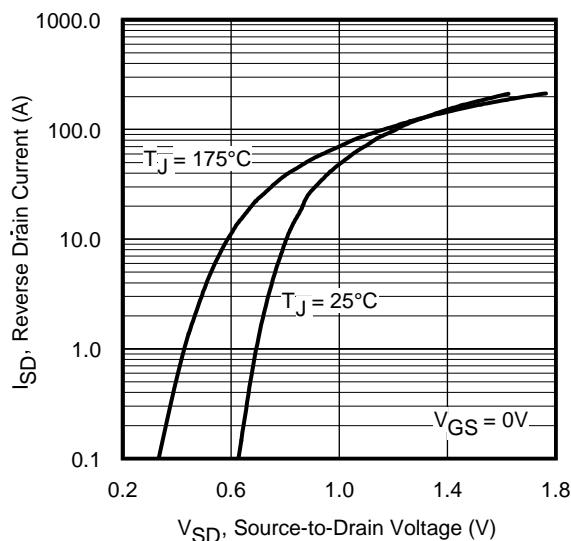
International  
**IR** Rectifier



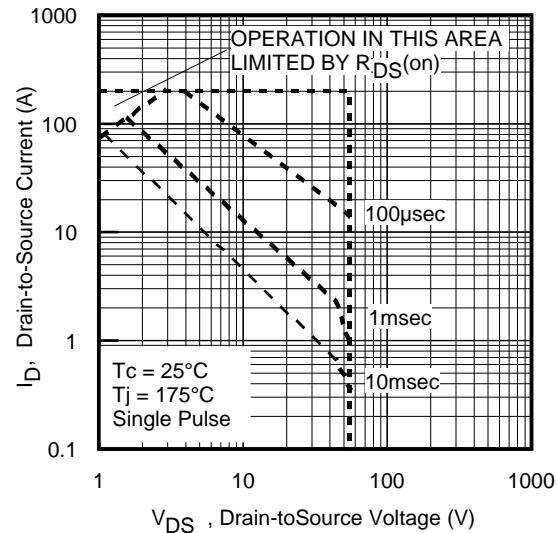
**Fig 5.** Typical Capacitance Vs.  
Drain-to-Source Voltage



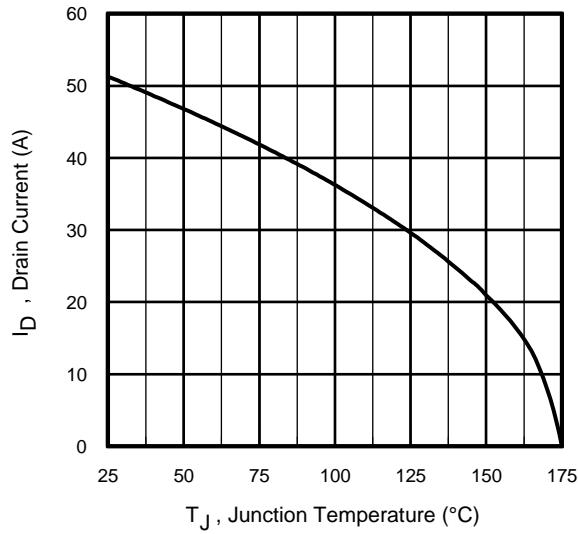
**Fig 6.** Typical Gate Charge Vs.  
Gate-to-Source Voltage



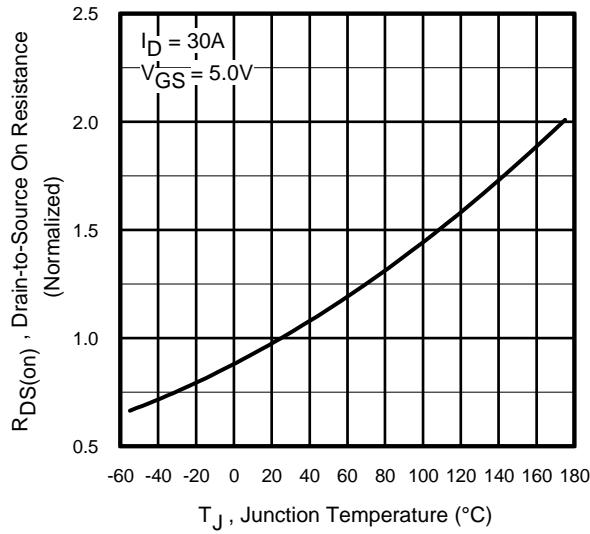
**Fig 7.** Typical Source-Drain Diode  
Forward Voltage



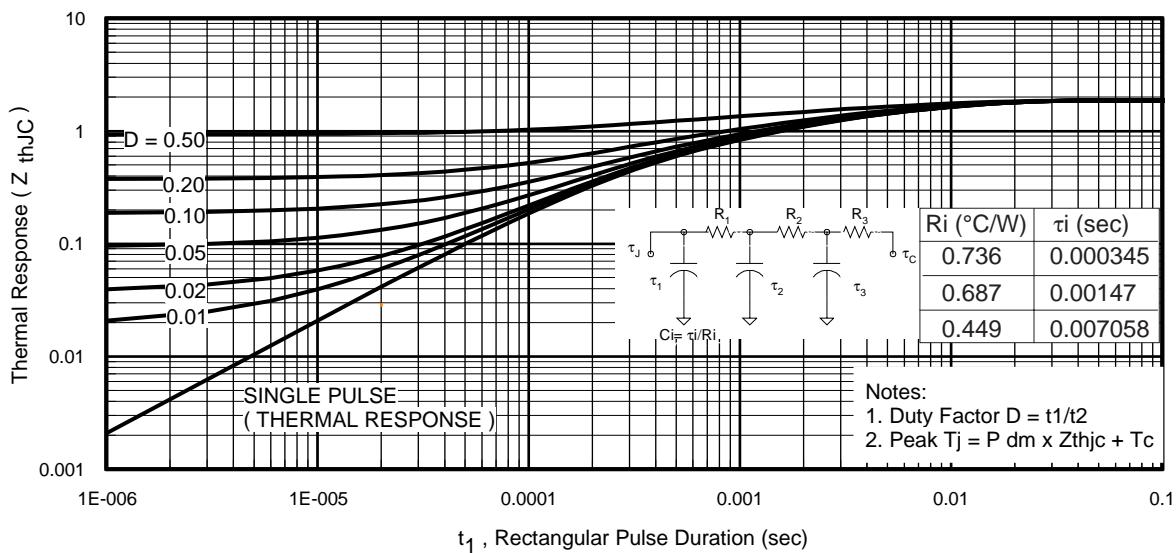
**Fig 8.** Maximum Safe Operating Area



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



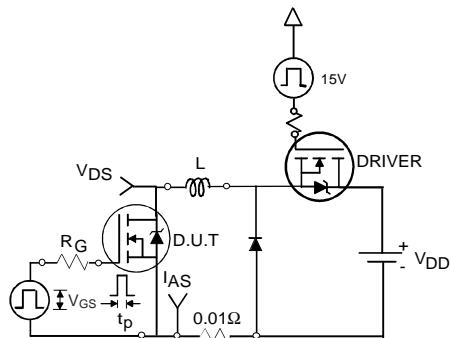
**Fig 10.** Normalized On-Resistance  
Vs. Temperature



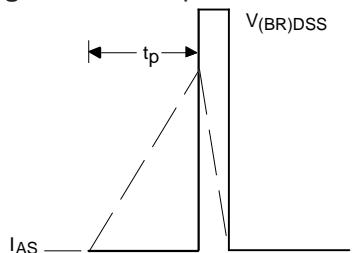
**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

# IRLZ44Z/S/L

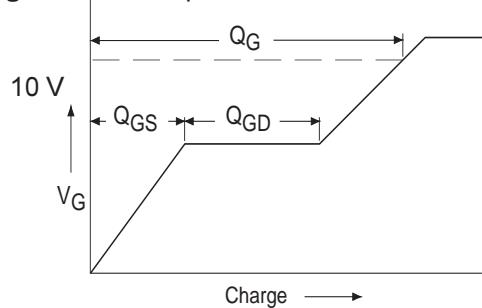
International  
**IR** Rectifier



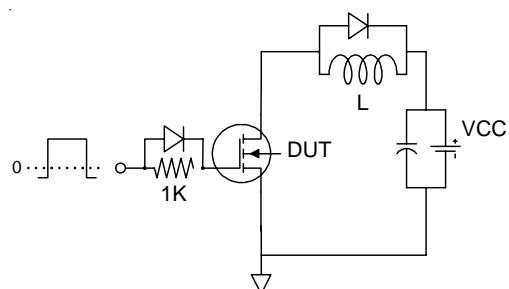
**Fig 12a.** Unclamped Inductive Test Circuit



**Fig 12b.** Unclamped Inductive Waveforms

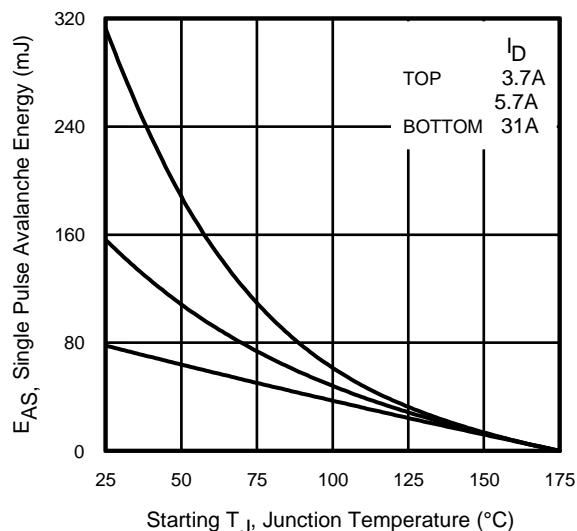


**Fig 13a.** Basic Gate Charge Waveform

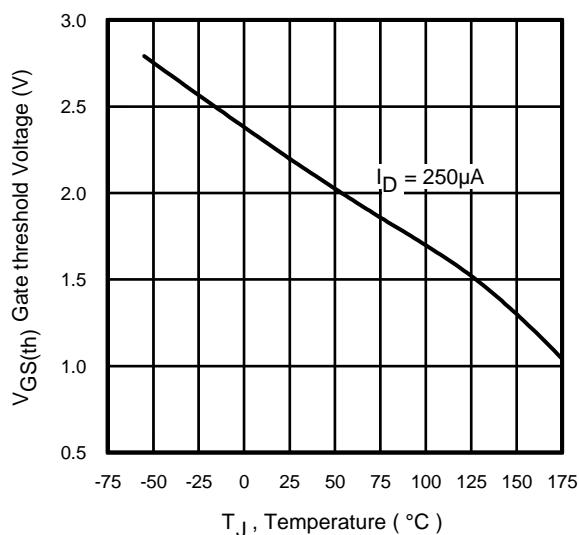


**Fig 13b.** Gate Charge Test Circuit

6

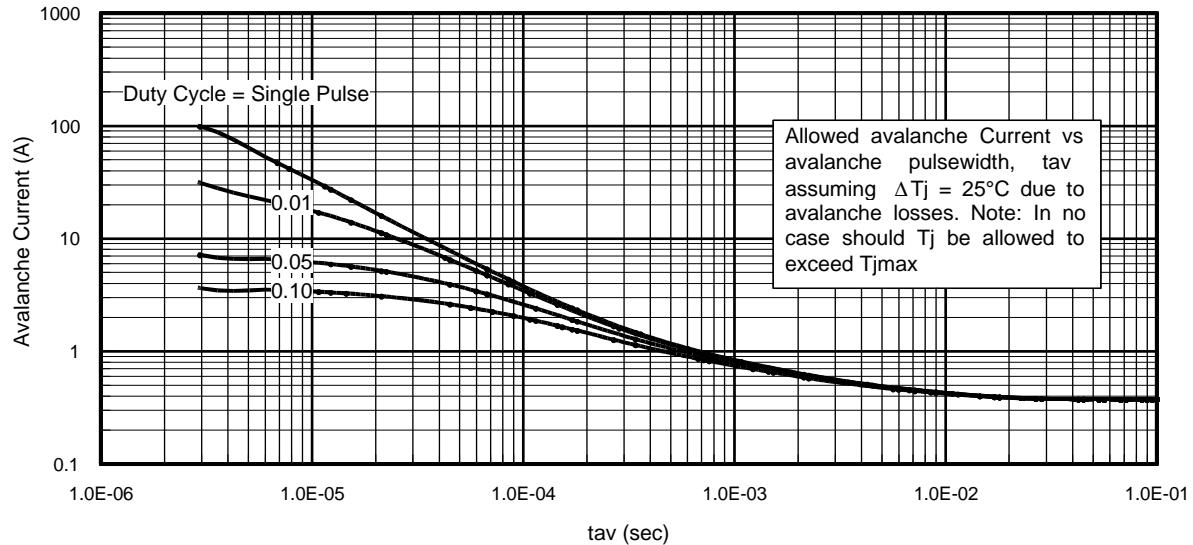


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current

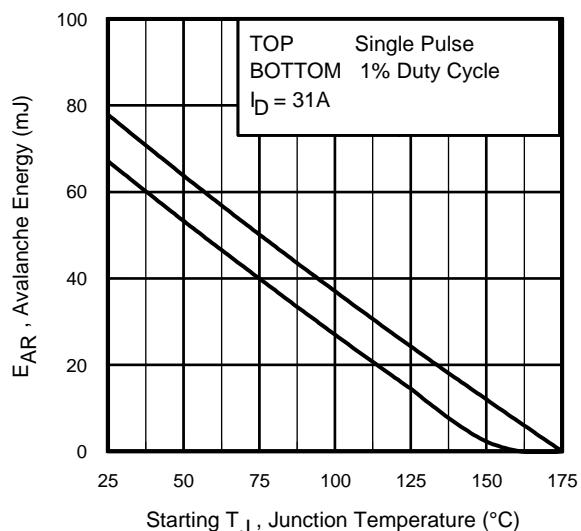


**Fig 14.** Threshold Voltage Vs. Temperature

[www.irf.com](http://www.irf.com)



**Fig 15.** Typical Avalanche Current Vs.Pulsewidth



**Fig 16.** Maximum Avalanche Energy Vs. Temperature

**Notes on Repetitive Avalanche Curves , Figures 15, 16:  
 (For further info, see AN-1005 at [www.irf.com](http://www.irf.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 12a, 12b.
  4.  $P_D(\text{ave})$  = 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  $25^\circ\text{C}$  in Figure 15, 16).
- $t_{av}$  = Average time in avalanche.  
 $D$  = Duty cycle in avalanche =  $t_{av} \cdot f$   
 $Z_{thJC}(D, t_{av})$  = Transient thermal resistance, see figure 11)

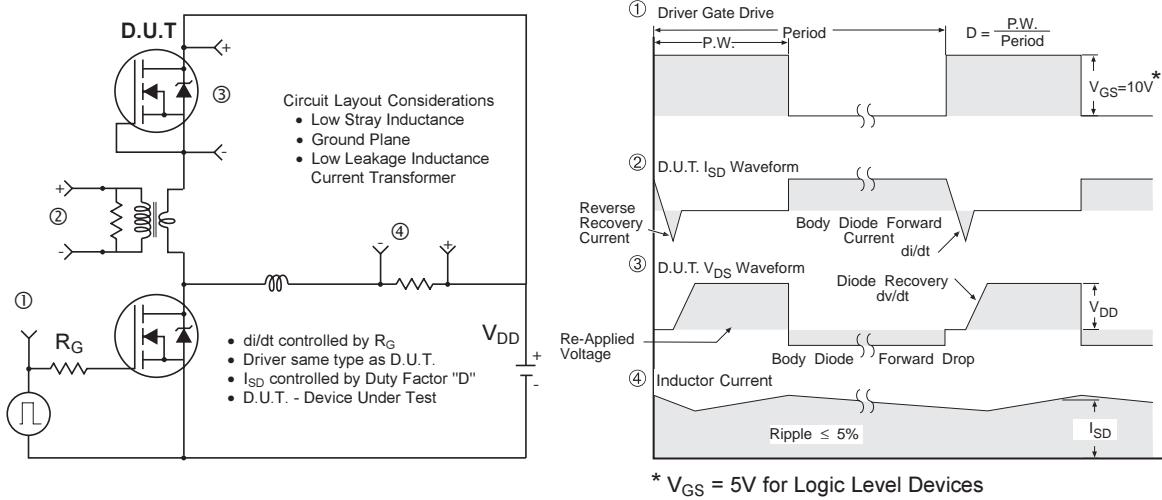
$$P_D(\text{ave}) = 1/2 (1.3 \cdot BV \cdot I_{av}) = \Delta T / Z_{thJC}$$

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

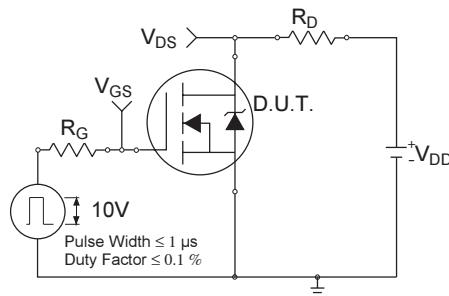
$$E_{AS(AR)} = P_D(\text{ave}) \cdot t_{av}$$

# IRLZ44Z/S/L

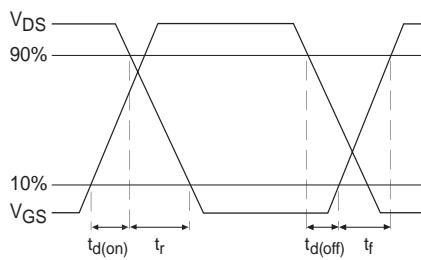
International  
**IR** Rectifier



**Fig 17.** Diode Reverse Recovery Test Circuit for N-Channel HEXFET® Power MOSFETs



**Fig 18a.** Switching Time Test Circuit



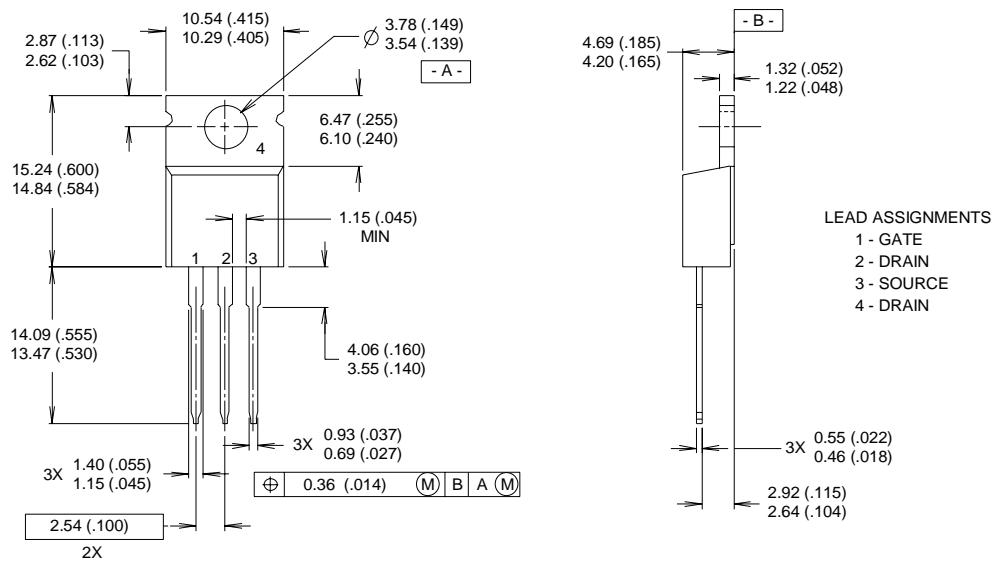
**Fig 18b.** Switching Time Waveforms

International  
**IR** Rectifier

**IRLZ44Z/S/L**

## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



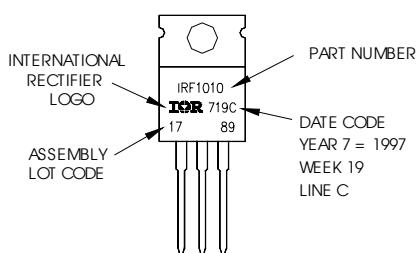
NOTES:

- 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.

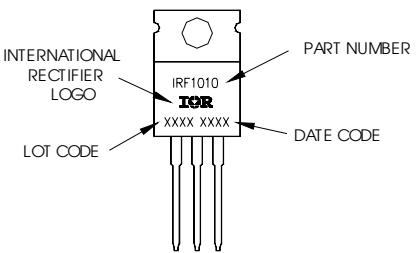
## TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010  
LOT CODE 1789  
ASSEMBLED ON WW19, 1997  
IN THE ASSEMBLY LINE "C"



### For GB Production

EXAMPLE: THIS IS AN IRF1010  
LOT CODE 1789  
ASSEMBLED ON WW19, 1997  
IN THE ASSEMBLY LINE "C"

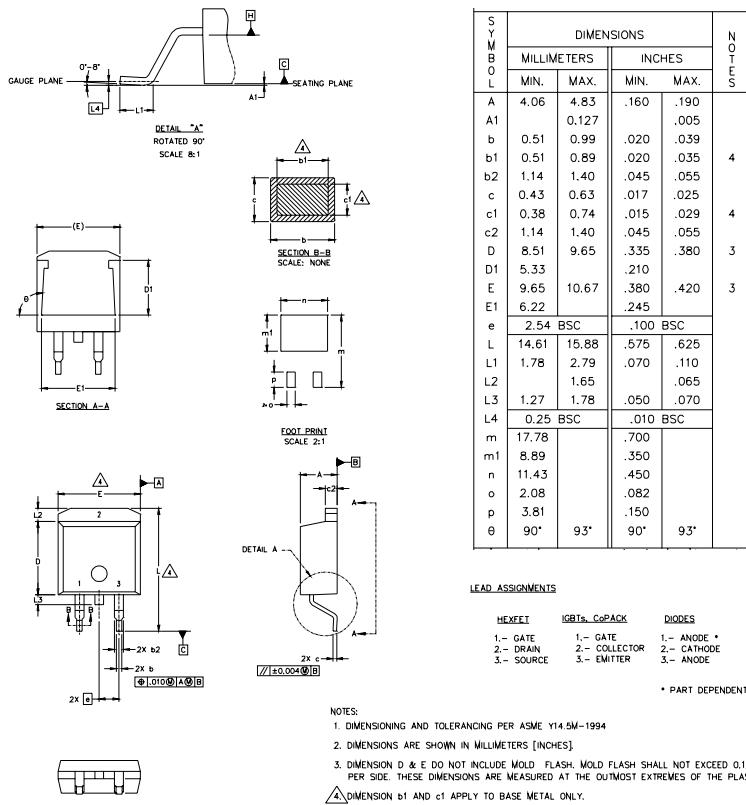


# IRLZ44Z/S/L

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

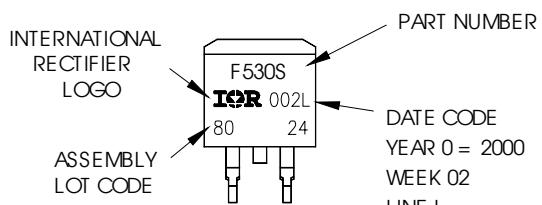
Dimensions are shown in millimeters (inches)

International  
**IR** Rectifier



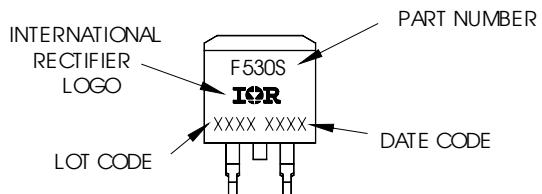
## D<sup>2</sup>Pak Part Marking Information

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



For GB Production

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

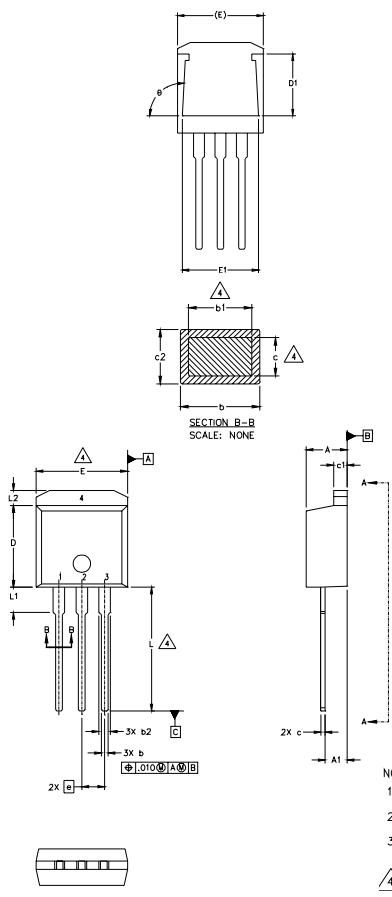


International  
**IRF** Rectifier

**IRLZ44Z/S/L**

## 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	4	
c	0.38	0.63	.015	.025		
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- GATE
4.- DRAIN	4- DRAIN

NOTES:

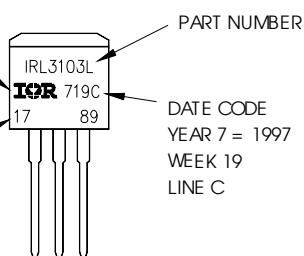
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. DIMENSION b1 AND c1 APPLY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

INTERNATIONAL  
RECTIFIER  
LOGO

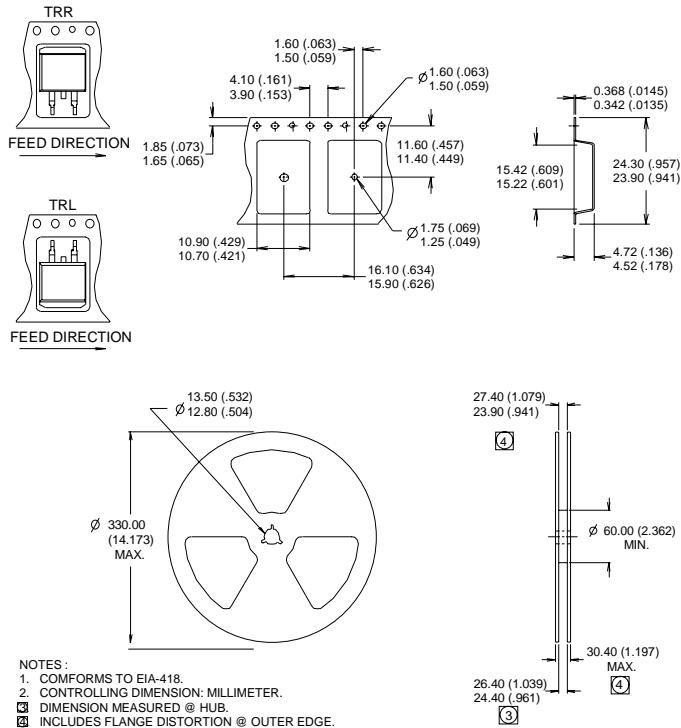
ASSEMBLY  
LOT CODE



# IRLZ44Z/S/L

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

International  
**IR** Rectifier



### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11).
- ② Limited by  $T_{Jmax}$ , starting  $T_J = 25^\circ\text{C}$ ,  $L = 0.166\text{mH}$   $R_G = 25\Omega$ ,  $I_{AS} = 31\text{A}$ ,  $V_{GS} = 10\text{V}$ . Part not recommended for use above this value.
- ③ Pulse width  $\leq 1.0\text{ms}$ ; duty cycle  $\leq 2\%$ .
- ④  $C_{oss}$  eff. is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .
- ⑤ Limited by  $T_{Jmax}$ , see Fig.12a, 12b, 15, 16 for typical repetitive avalanche performance.
- ⑥ This value determined from sample failure population. 100% tested to this value in production.
- 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.
- ⑨  $R_\theta$  is measured at  $T_J$  approximately  $90^\circ\text{C}$

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 Automotive [Q101]market.  
Qualification Standards can be found on IR's Web site.

International  
**IR** Rectifier

**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105  
TAC Fax: (310) 252-7903  
Visit us at [www.irf.com](http://www.irf.com) for sales contact information. 3/04