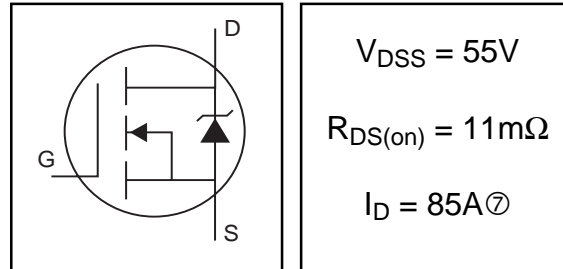# International IΩR Rectifier

# IRF1010N

HEXFET® Power MOSFET

- Advanced Process Technology
- Ultra Low On-Resistance
- Dynamic dv/dt Rating
- 175°C Operating Temperature
- Fast Switching
- Fully Avalanche Rated

$V_{DSS} = 55V$

$R_{DS(on)} = 11m\Omega$

$I_D = 85A\text{⑦}$

Description

Advanced HEXFET® Power MOSFETs from International Rectifier utilize advanced processing techniques to achieve extremely low on-resistance per silicon area. This benefit, combined with the fast switching speed and ruggedized device design that HEXFET power MOSFETs are well known for, provides the designer with an extremely efficient and reliable device for use in a wide variety of applications.

The TO-220 package is universally preferred for all commercial-industrial applications at power dissipation levels to approximately 50 watts. The low thermal resistance and low package cost of the TO-220 contribute to its wide acceptance throughout the industry.
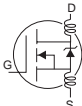
TO-220AB
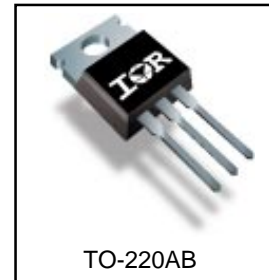
Absolute Maximum Ratings

	Parameter	Max.	Units
I_D @ T_C = 25°C	Continuous Drain Current, V_{GS} @ 10V	85⑦	
I_D @ T_C = 100°C	Continuous Drain Current, V_{GS} @ 10V	60	A
I_{DM}	Pulsed Drain Current ①	290	
P_D @T_C = 25°C	Power Dissipation	180	W
	Linear Derating Factor	1.2	W/°C
V_{GS}	Gate-to-Source Voltage	± 20	V
I_{AR}	Avalanche Current①	43	A
E_{AR}	Repetitive Avalanche Energy①	18	mJ
dv/dt	Peak Diode Recovery dv/dt ③	3.6	V/ns
T_J	Operating Junction and	-55 to + 175	
T_{STG}	Storage Temperature Range		°C
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	Mounting torque, 6-32 or M3 srew	10 lbf•in (1.1N•m)	
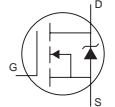
Thermal Resistance

	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	——	0.85	
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	——	°C/W
$R_{\theta JA}$	Junction-to-Ambient	——	62	

3/16/01

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Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	55	—	—	V	V_{GS} = 0V, I_D = 250µA
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.058	—	V/°C	Reference to 25°C, I_D = 1mA
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	—	11	mΩ	V_{GS} = 10V, I_D = 43A ④
$V_{GS(th)}$	Gate Threshold Voltage	2.0	—	4.0	V	V_{DS} = V_{GS}, I_D = 250µA
g_{fs}	Forward Transconductance	32	—	—	S	V_{DS} = 25V, I_D = 43A④
I_{DSS}	Drain-to-Source Leakage Current	—	—	25	µA	V_{DS} = 55V, V_{GS} = 0V
		—	—	250		V_{DS} = 44V, V_{GS} = 0V, T_J = 150°C
I_{GSS}	Gate-to-Source Forward Leakage	—	—	100	nA	V_{GS} = 20V
	Gate-to-Source Reverse Leakage	—	—	-100		V_{GS} = -20V
Q_g	Total Gate Charge	—	—	120		I_D = 43A
Q_{gs}	Gate-to-Source Charge	—	—	19	nC	V_{DS} = 44V
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	41		V_{GS} = 10V, See Fig. 6 and 13
$t_{d(on)}$	Turn-On Delay Time	—	13	—		V_{DD} = 28V
t_r	Rise Time	—	76	—	ns	I_D = 43A
$t_{d(off)}$	Turn-Off Delay Time	—	39	—		R_G = 3.6Ω
t_f	Fall Time	—	48	—		V_{GS} = 10V, See Fig. 10 ④
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_{iss}	Input Capacitance	—	3210	—		V_{GS} = 0V
C_{oss}	Output Capacitance	—	690	—	pF	V_{DS} = 25V
C_{rss}	Reverse Transfer Capacitance	—	140	—		f = 1.0MHz, See Fig. 5
E_{AS}	Single Pulse Avalanche Energy②	—	1030⑤	250⑥	mJ	I_{AS} = 4.3A, L = 270µH

Source-Drain Ratings and Characteristics

	Parameter	Min.	Typ.	Max.	Units	Conditions
I_S	Continuous Source Current (Body Diode)	—	—	85⑦	A	MOSFET symbol showing the integral reverse p-n junction diode.
I_{SM}	Pulsed Source Current (Body Diode)①	—	—	290		
V_{SD}	Diode Forward Voltage	—	—	1.3	V	T_J = 25°C, I_S = 43A, V_{GS} = 0V ④
t_{rr}	Reverse Recovery Time	—	69	100	ns	T_J = 25°C, I_F = 43A
Q_{rr}	Reverse Recovery Charge	—	220	230	nC	di/dt = 100A/µs ④
t_{on}	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by L_S+L_D)				

Notes:

① Repetitive rating; pulse width limited by max. junction temperature. (See fig. 11)

② Starting T_J = 25°C, L = 270µH
   R_G = 25Ω, I_{AS} = 43A, V_{GS}=10V (See Figure 12)

③ $I_{SD} \leq$ 43A, di/dt $\leq$ 210A/µs, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq$ 175°C

④ Pulse width $\leq$ 400µs; duty cycle $\leq$ 2%.

⑤ This is a typical value at device destruction and represents operation outside rated limits.

⑥ This is a calculated value limited to T_J = 175°C .

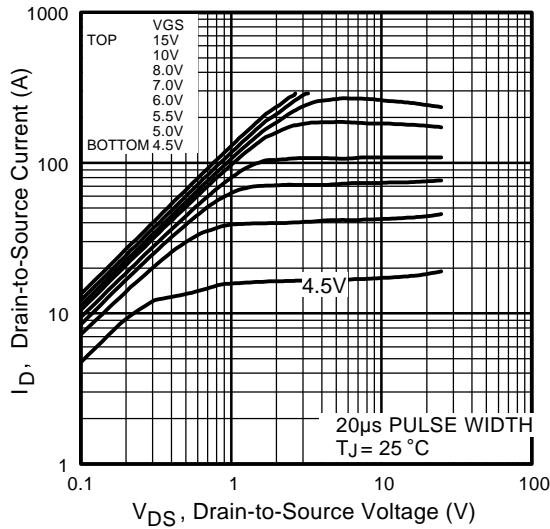⑦ Calculated continuous current based on maximum allowable junction temperature. Package limitation current is 75A.

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Fig 1. Typical Output Characteristics

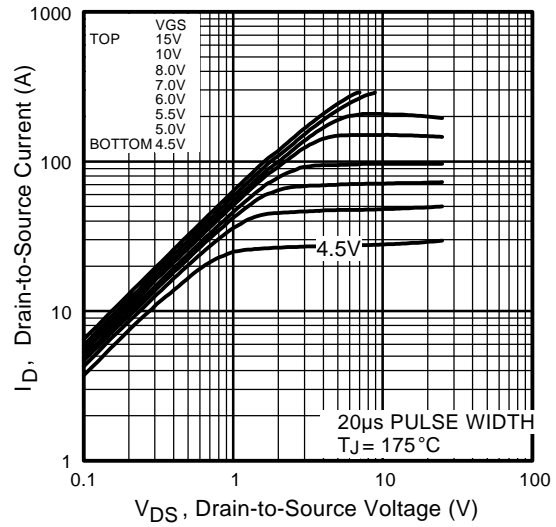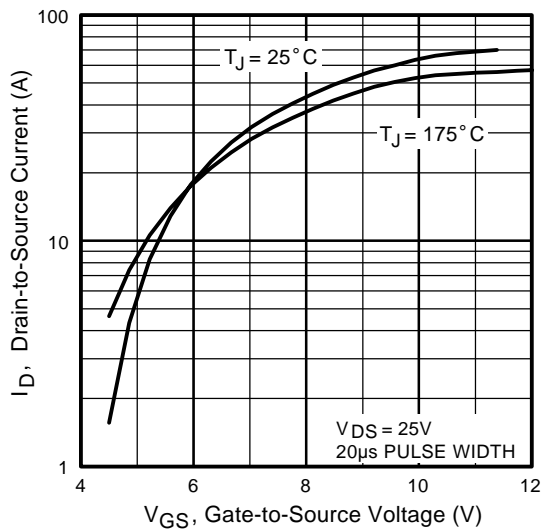**Fig 2.** Typical Output Characteristics

Fig 3. Typical Transfer Characteristics

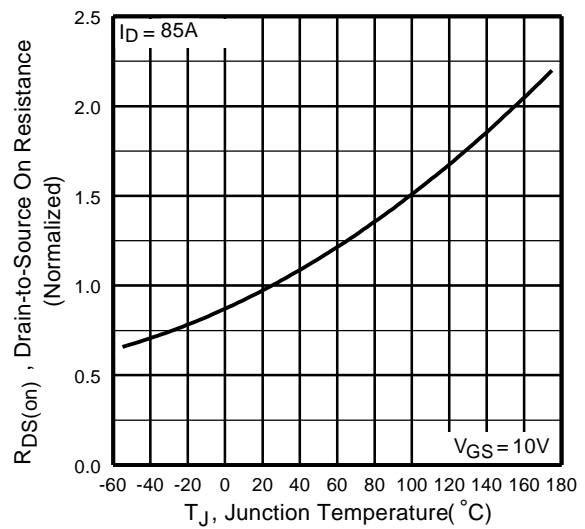**Fig 4.** Normalized On-Resistance
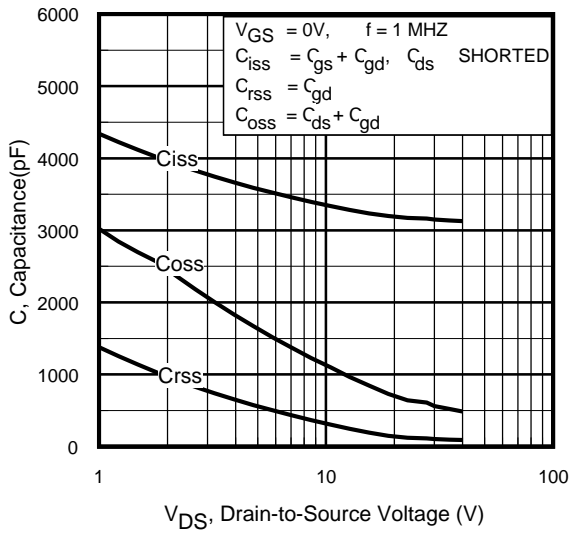Vs. Temperature

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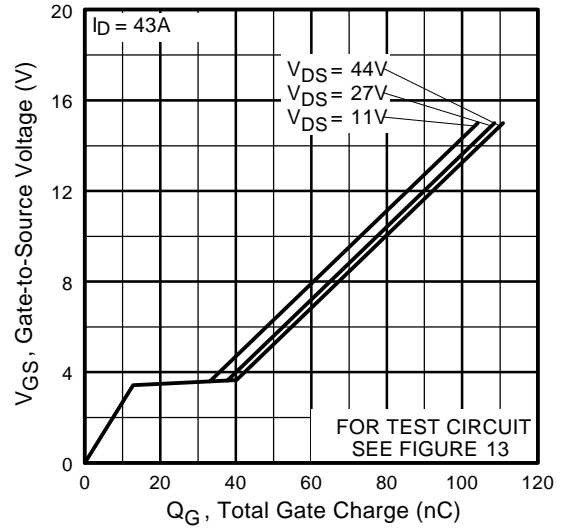Drain-to-Source Voltage

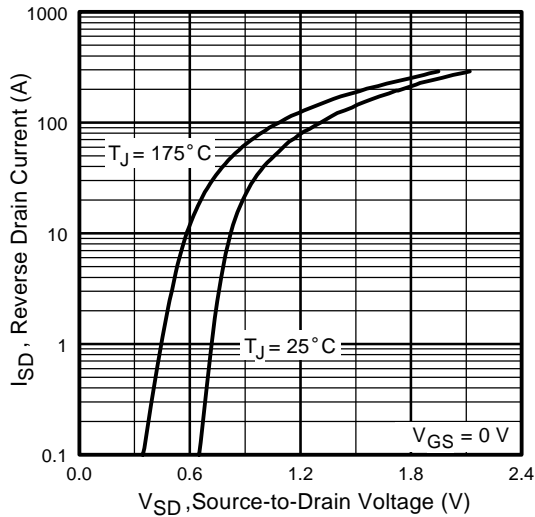

Fig 6. Typical Gate Charge Vs.
Gate-to-Source Voltage
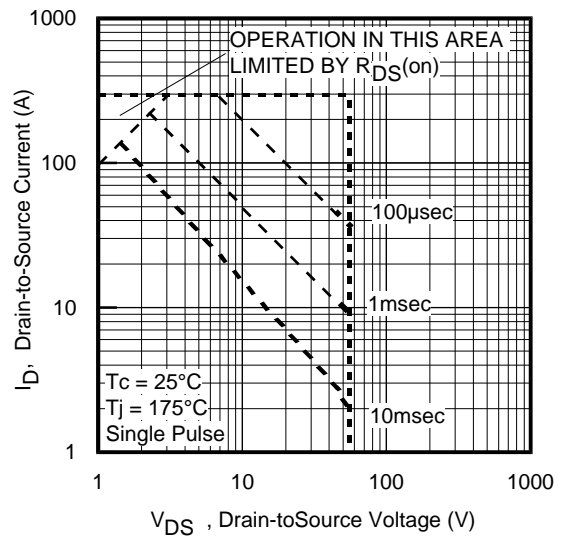

Fig 7. Typical Source-Drain Diode
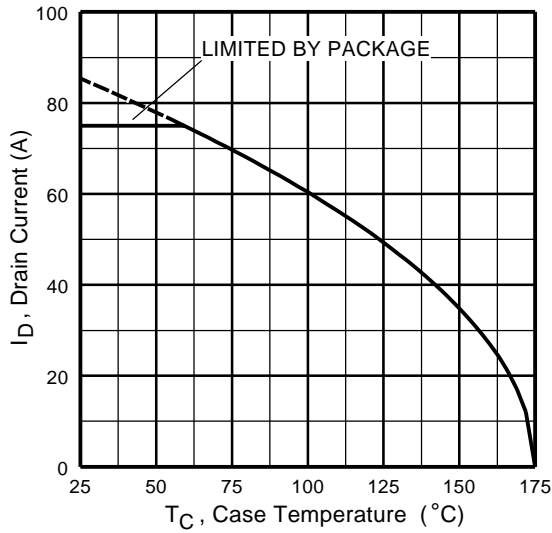Forward Voltage

Fig 8. Maximum Safe Operating Area
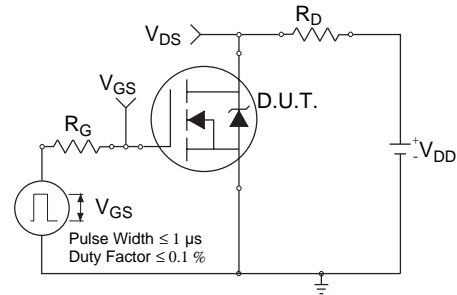
4

Fig 9. Maximum Drain Current Vs.
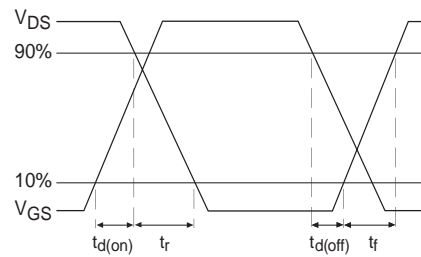Case Temperature

Fig 10a. Switching Time Test Circuit

Fig 10b. Switching Time Waveforms

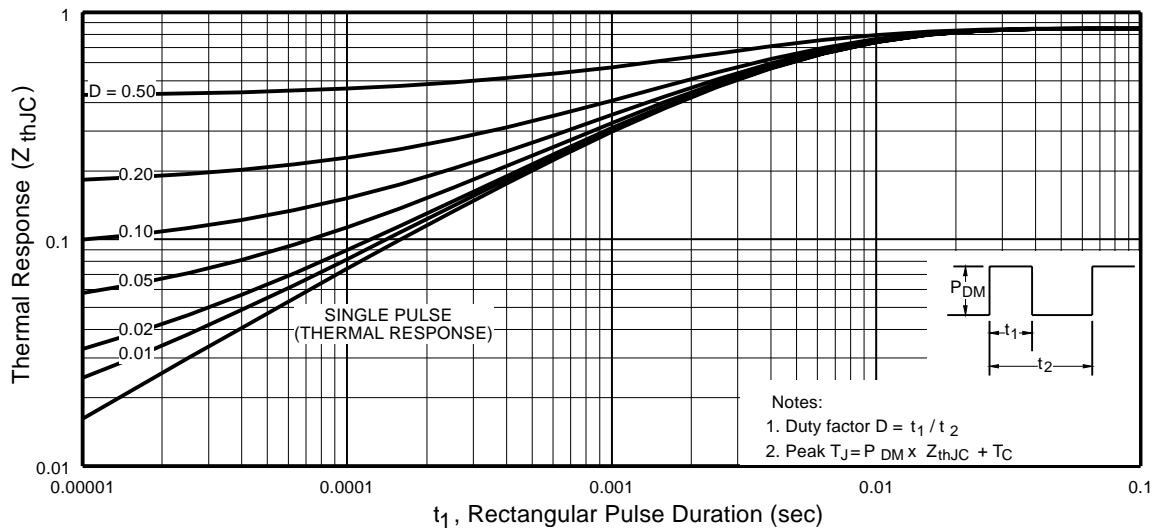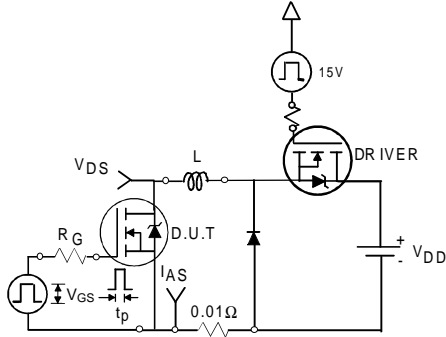**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

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IⓇR Rectifier

Fig 12a. Unclamped Inductive Test Circuit
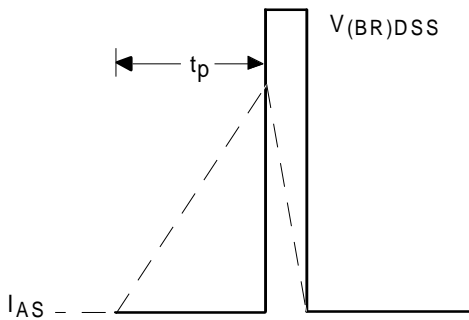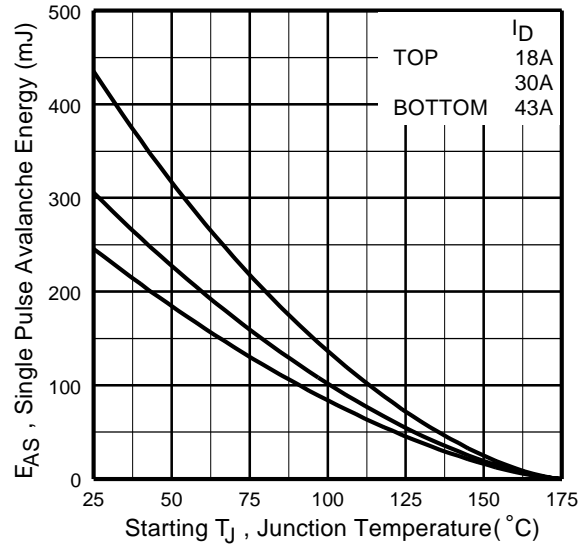

Fig 12b. Unclamped Inductive Waveforms

Fig 12c. Maximum Avalanche Energy
Vs. Drain Current

Fig 13a. Basic Gate Charge Waveform
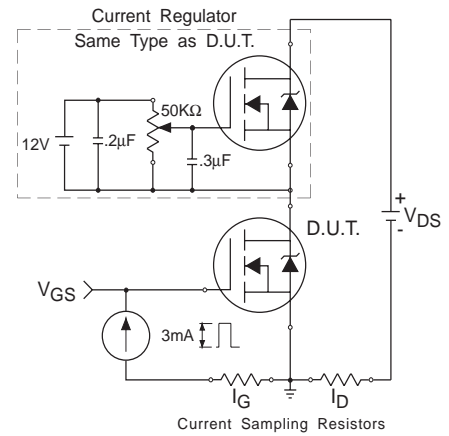
Fig 13b. Gate Charge Test Circuit

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Peak Diode Recovery dv/dt Test Circuit

D.U.T*

Circuit Layout Considerations
- Low Stray Inductance
- Ground Plane
- Low Leakage Inductance
  Current Transformer

③

②

④

- dv/dt controlled by R_G
- I_{SD} controlled by Duty Factor "D"
- D.U.T. - Device Under Test

R_G

V_{DD}

V_{GS}

①
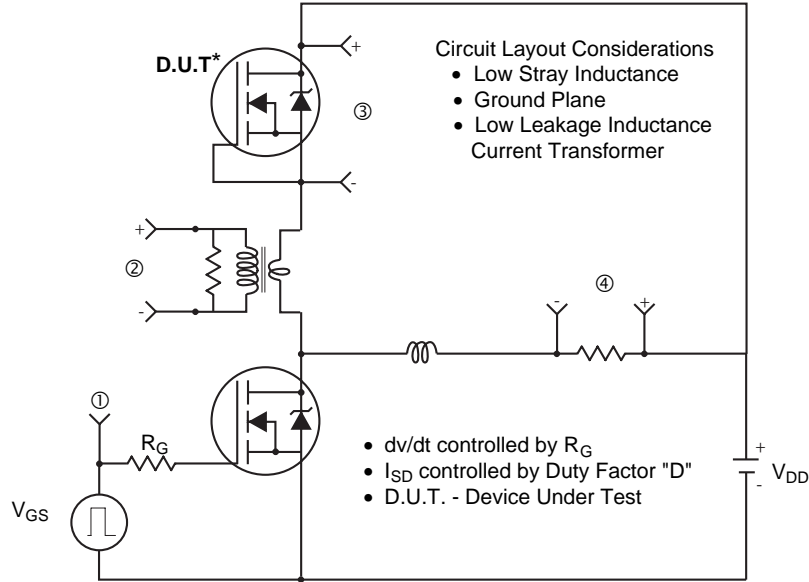
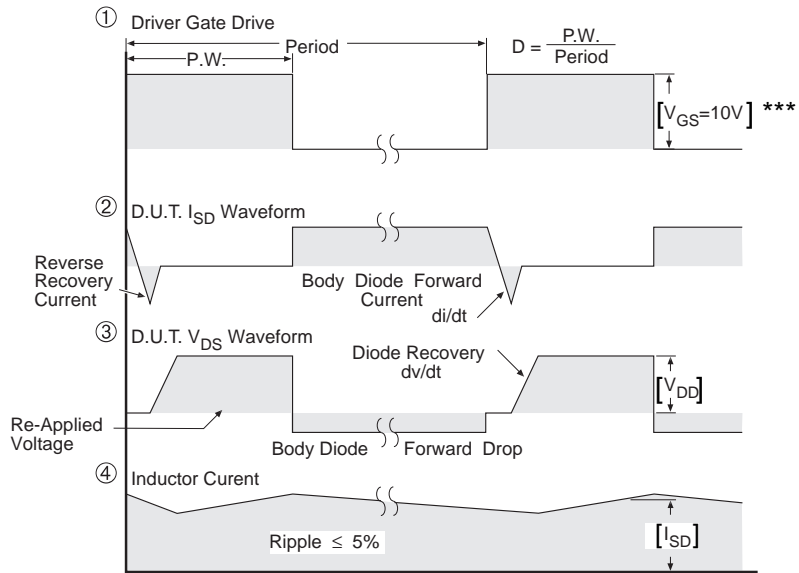* Reverse Polarity of D.U.T for P-Channel

① Driver Gate Drive

$D = \dfrac{P.W.}{Period}$

P.W.

Period

P.W.

$\left[V_{GS}=10V\right]$ ***

② D.U.T. I_{SD} Waveform

Reverse
Recovery
Current

Body Diode Forward
Current

di/dt

③ D.U.T. V_{DS} Waveform

Diode Recovery
dv/dt

$\left[V_{DD}\right]$

Re-Applied
Voltage

Body Diode Forward Drop

④ Inductor Curent

Ripple $\leq$ 5%

$\left[I_{SD}\right]$

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

Fig 14. For N-channel HEXFET® power MOSFETs

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Package Outline
TO-220AB
Dimensions are shown in millimeters (inches)

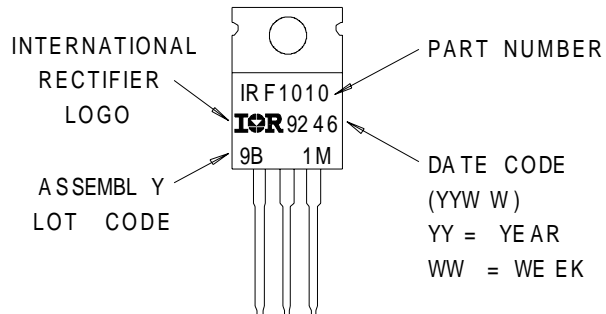LEAD ASSIGNMENTS
1 - GATE
2 - DRAIN
3 - SOURCE
4 - DRAIN
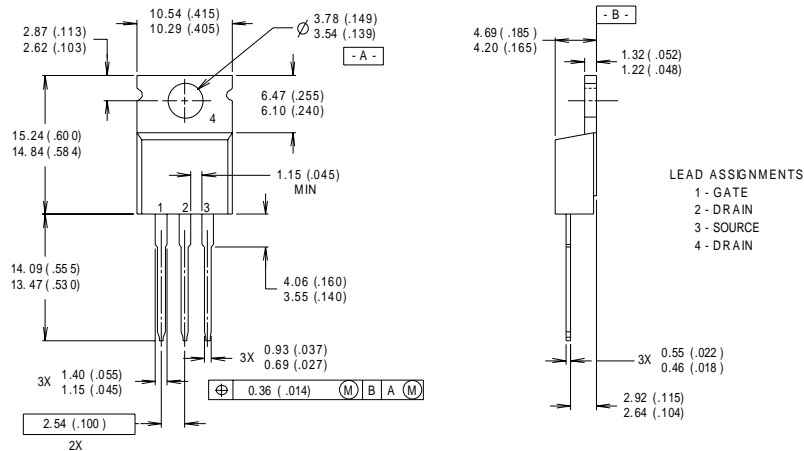
NOTES:

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.

Part Marking Information
TO-220AB

EXAMPLE : THIS IS AN IRF1010
WITH ASSEMBLY
LOT CODE 9B1M

INTERNATIONAL
RECTIFIER
LOGO

PART NUMBER

IRF1010

IOR 92 46

9B   1M

DATE CODE
(YYWW)
YY = YEAR
WW = WEEK

ASSEMBLY
LOT CODE

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.