

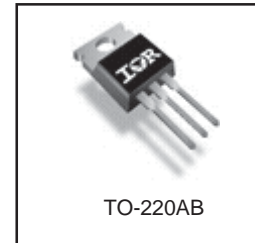
**Applications**

- Zero Voltage Switching SMPS
- Telecom and Server Power Supplies
- Uninterruptible Power Supplies
- Motor Control applications

$V_{DSS}$	$R_{DS(on)}$ typ.	$T_{rr}$ typ.	$I_D$
600V	385mΩ	130ns	16A

**Features and Benefits**

- SuperFast body diode eliminates the need for external diodes in ZVS applications.
- Lower Gate charge results in simpler drive requirements.
- Enhanced dv/dt capabilities offer improved ruggedness.
- Higher Gate voltage threshold offers improved noise immunity.



**Absolute Maximum Ratings**

	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	16	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	10	
$I_{DM}$	Pulsed Drain Current ①	60	
$P_D$ @ $T_C = 25^\circ\text{C}$	Power Dissipation	310	W
	Linear Derating Factor	2.5	W/°C
$V_{GS}$	Gate-to-Source Voltage	±30	V
dv/dt	Peak Diode Recovery dv/dt③	11	V/ns
$T_J$	Operating Junction and	-55 to + 150	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds		
	Mounting torque, 6-32 or M3 screw	1.1(10)	N•m (lbf•in)

**Diode Characteristics**

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	16	A	MOSFET symbol showing the integral reverse p-n junction diode.
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	60		
$V_{SD}$	Diode Forward Voltage	—	—	1.5	V	$T_J = 25^\circ\text{C}$ , $I_S = 16\text{A}$ , $V_{GS} = 0\text{V}$ ④
$t_{rr}$	Reverse Recovery Time	—	130	200	ns	$T_J = 25^\circ\text{C}$ , $I_F = 16\text{A}$
		—	240	360		$T_J = 125^\circ\text{C}$ , $di/dt = 100\text{A}/\mu\text{s}$ ④
$Q_{rr}$	Reverse Recovery Charge	—	450	670	nC	$T_J = 25^\circ\text{C}$ , $I_S = 16\text{A}$ , $V_{GS} = 0\text{V}$ ④
		—	1080	1620		$T_J = 125^\circ\text{C}$ , $di/dt = 100\text{A}/\mu\text{s}$ ④
$I_{RRM}$	Reverse Recovery Current	—	5.8	8.7	A	$T_J = 25^\circ\text{C}$
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by LS+LD)				

# IRFB16N60L

International  
IR Rectifier

## Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	600	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.39	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	385	460	mΩ	$V_{GS} = 10V, I_D = 9.0A$ ④
$V_{GS(th)}$	Gate Threshold Voltage	3.0	—	5.0	V	$V_{DS} = V_{GS}, I_D = 250\mu A$
$I_{DSS}$	Drain-to-Source Leakage Current	—	—	50	μA	$V_{DS} = 600V, V_{GS} = 0V$
		—	—	2.0	mA	$V_{DS} = 480V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100	nA	$V_{GS} = -30V$
$R_G$	Internal Gate Resistance	—	0.79	—	Ω	$f = 1\text{MHz}, \text{open drain}$

## Dynamic @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$g_{fs}$	Forward Transconductance	8.3	—	—	S	$V_{DS} = 50V, I_D = 9.0A$
$Q_g$	Total Gate Charge	—	—	100	nC	$I_D = 16A$
$Q_{gs}$	Gate-to-Source Charge	—	—	30		$V_{DS} = 480V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	—	46		$V_{GS} = 10V, \text{See Fig. 7 \& 15 } \text{④}$
$t_{d(on)}$	Turn-On Delay Time	—	20	—	ns	$V_{DD} = 300V$
$t_r$	Rise Time	—	44	—		$I_D = 16A$
$t_{d(off)}$	Turn-Off Delay Time	—	28	—		$R_G = 1.8\Omega$
$t_f$	Fall Time	—	5.5	—		$V_{GS} = 10V, \text{See Fig. 11a \& 11b } \text{④}$
$C_{iss}$	Input Capacitance	—	2720	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	260	—		$V_{DS} = 25V$
$C_{rss}$	Reverse Transfer Capacitance	—	20	—		$f = 1.0\text{MHz}, \text{See Fig. 5}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	120	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 480V \text{ ⑤}$
$C_{oss \text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related)	—	100	—		

## Avalanche Characteristics

Symbol	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy ②	—	310	mJ
$I_{AR}$	Avalanche Current ①	—	16	A
$E_{AR}$	Repetitive Avalanche Energy ①	—	31	mJ

## Thermal Resistance

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case ⑥	—	0.4	°C/W
$R_{\theta JA}$	Junction-to-Ambient ⑥	—	62	

### Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See Fig. 12)
- ② Starting  $T_J = 25^\circ\text{C}$ ,  $L = 2.5\text{mH}$ ,  $R_G = 25\Omega$ ,  $I_{AS} = 16A$ . (See Figure 14a)
- ③  $I_{SD} \leq 16A$ ,  $di/dt \leq 650A/\mu s$ ,  $V_{DD} \leq V_{(BR)DSS}$ ,  $T_J \leq 150^\circ\text{C}$ .

④ Pulse width  $\leq 300\mu s$ ; duty cycle  $\leq 2\%$ .

⑤  $C_{oss \text{ eff.}}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

$C_{oss \text{ eff. (ER)}}$  is a fixed capacitance that stores the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

⑥  $R_{\theta}$  is measured at  $T_J$  approximately  $90^\circ\text{C}$

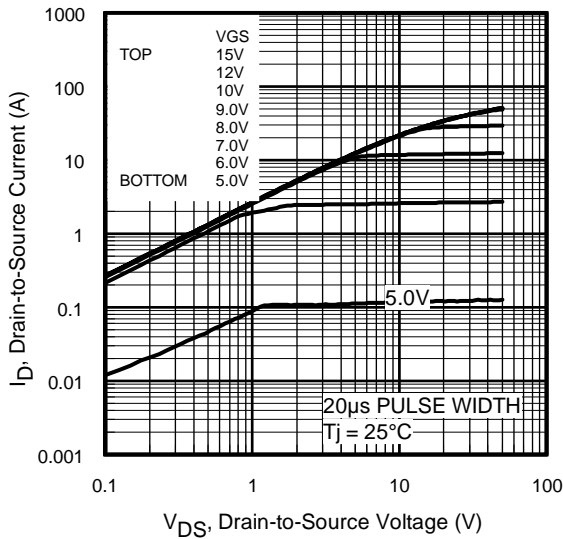


Fig 1. Typical Output Characteristics

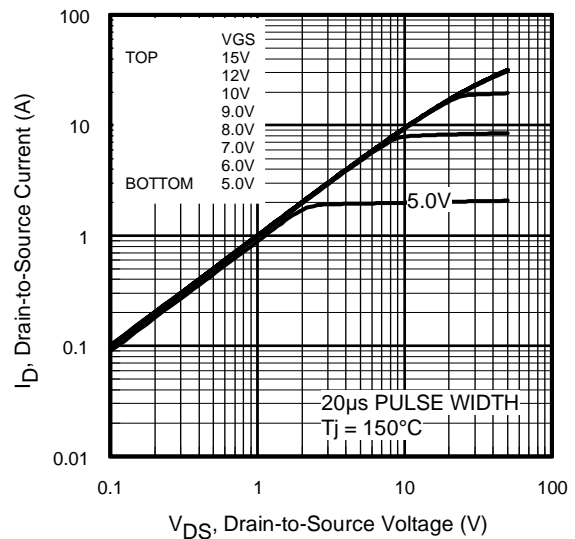


Fig 2. Typical Output Characteristics

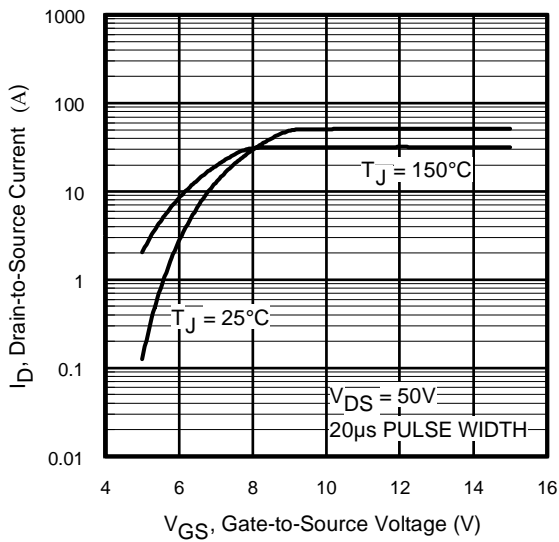


Fig 3. Typical Transfer Characteristics

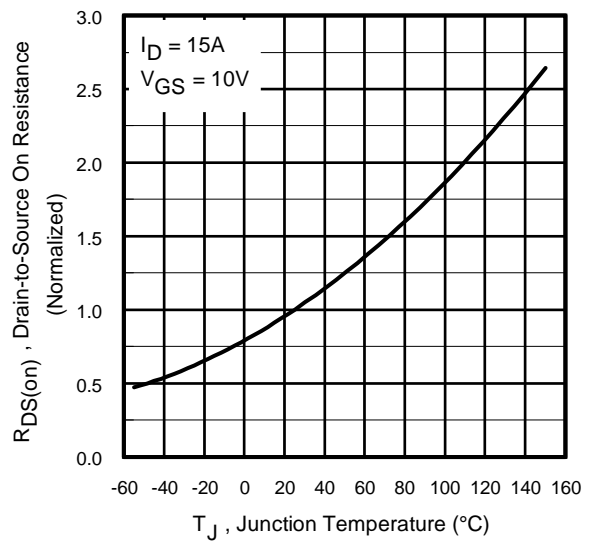
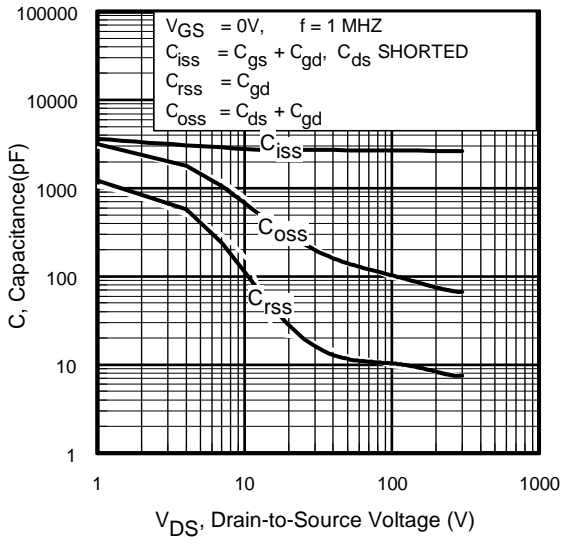
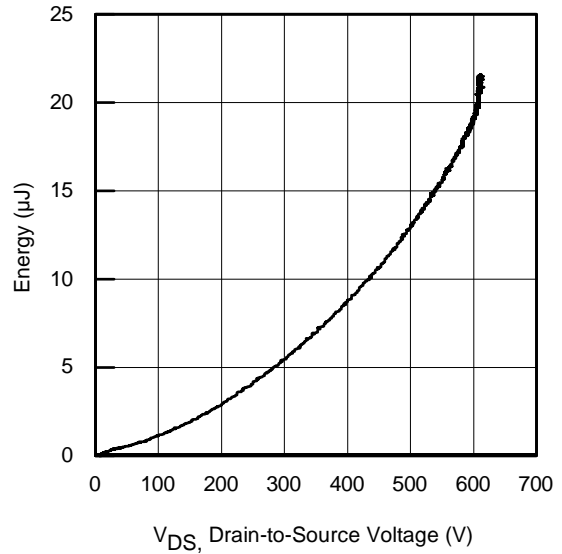


Fig 4. Normalized On-Resistance vs. Temperature

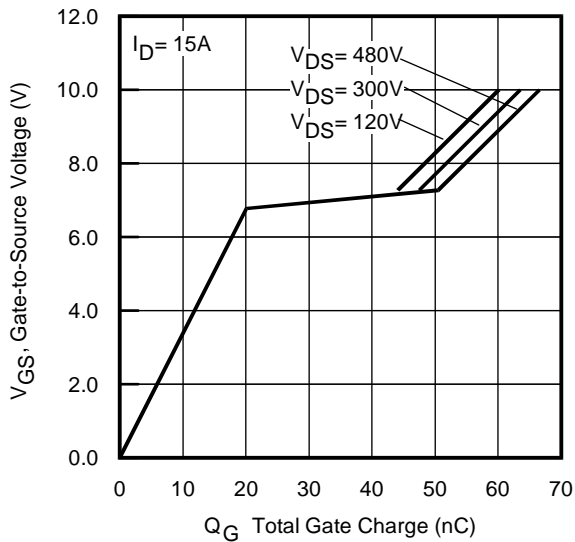
# IRFB16N60L



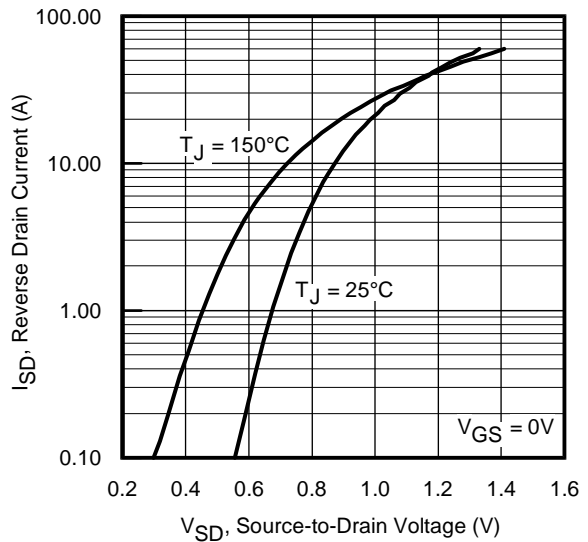
**Fig 5.** Typical Capacitance vs. Drain-to-Source Voltage



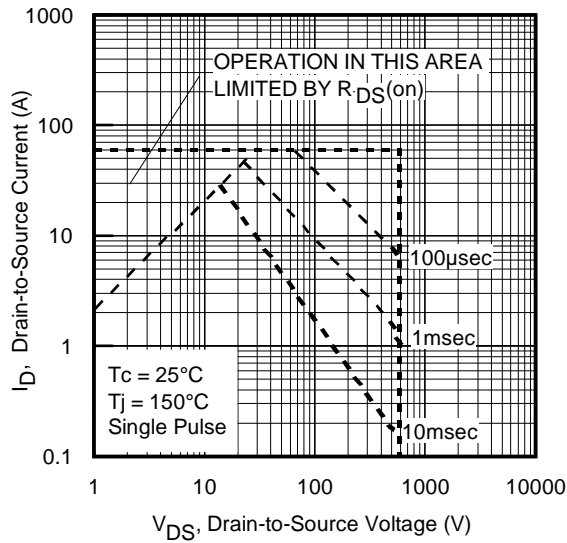
**Fig 6.** Typ. Output Capacitance Stored Energy vs.  $V_{DS}$



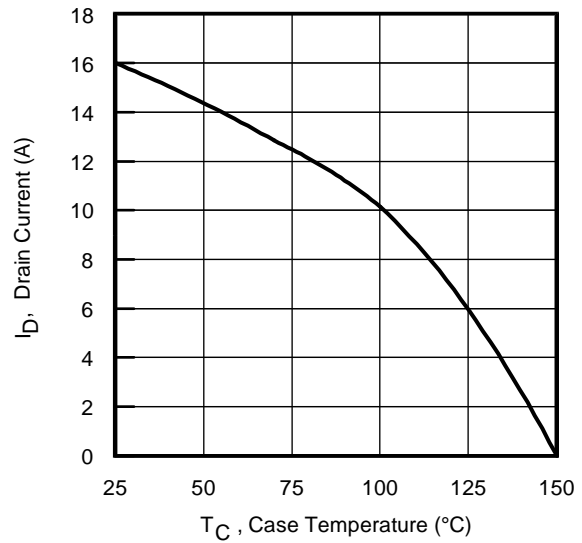
**Fig 7.** Typical Gate Charge vs. Gate-to-Source Voltage



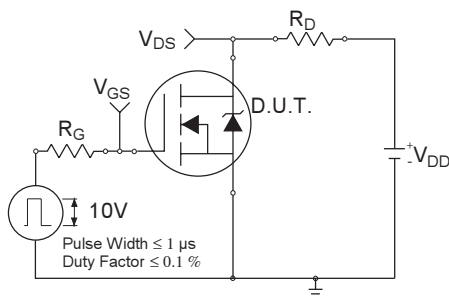
**Fig 8.** Typical Source-Drain Diode Forward Voltage



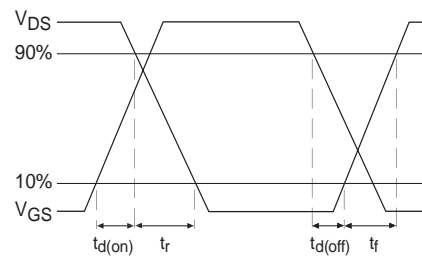
**Fig 9.** Maximum Safe Operating Area



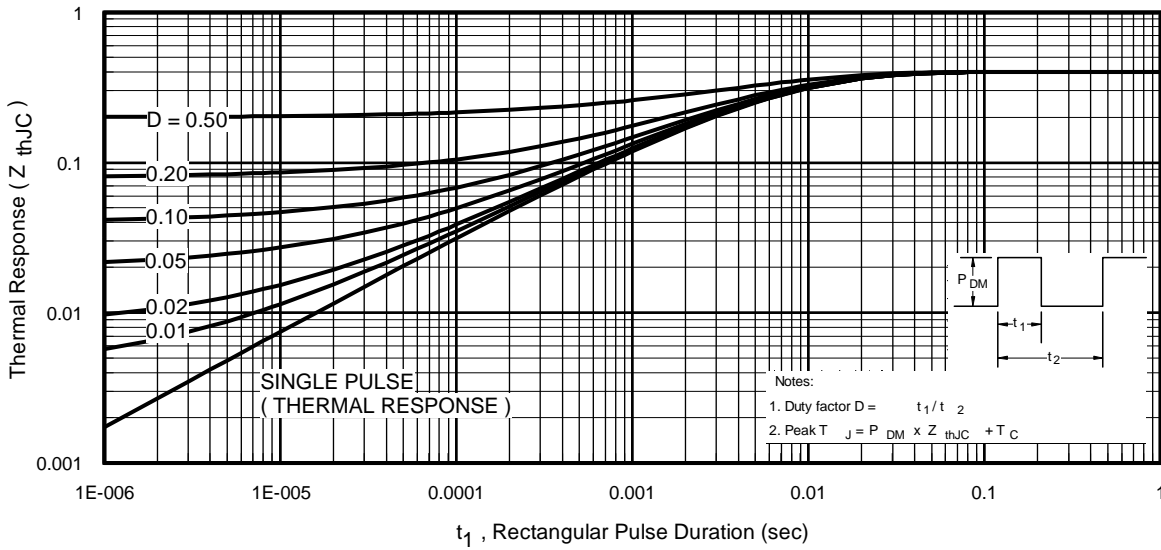
**Fig 10.** Maximum Drain Current vs. Case Temperature



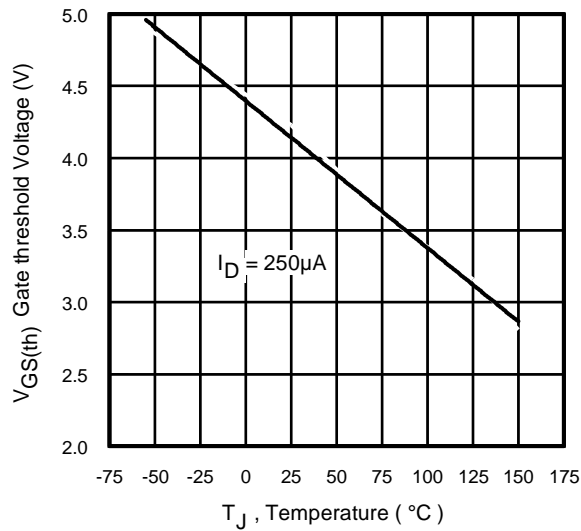
**Fig 11a.** Switching Time Test Circuit



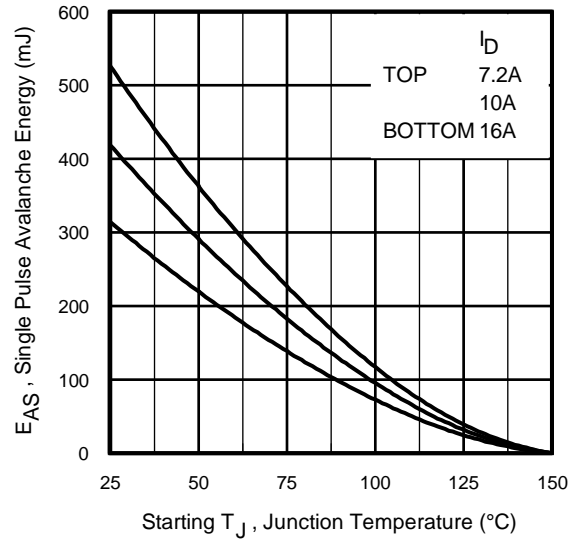
**Fig 11b.** Switching Time Waveforms



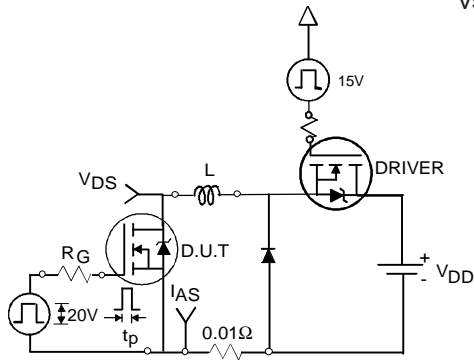
**Fig 12.** Maximum Effective Transient Thermal Impedance, Junction-to-Case



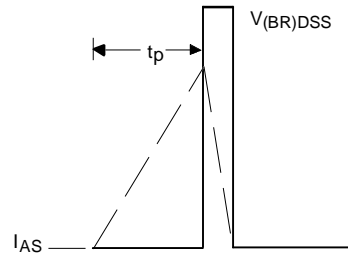
**Fig 13.** Threshold Voltage vs. Temperature



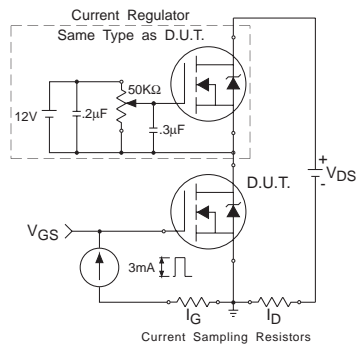
**Fig 14a.** Maximum Avalanche Energy vs. Drain Current



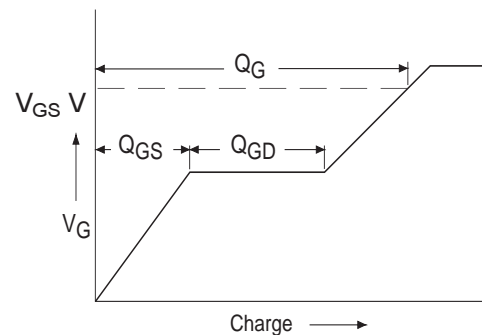
**Fig 14b.** Unclamped Inductive Test Circuit



**Fig 14c.** Unclamped Inductive Waveforms

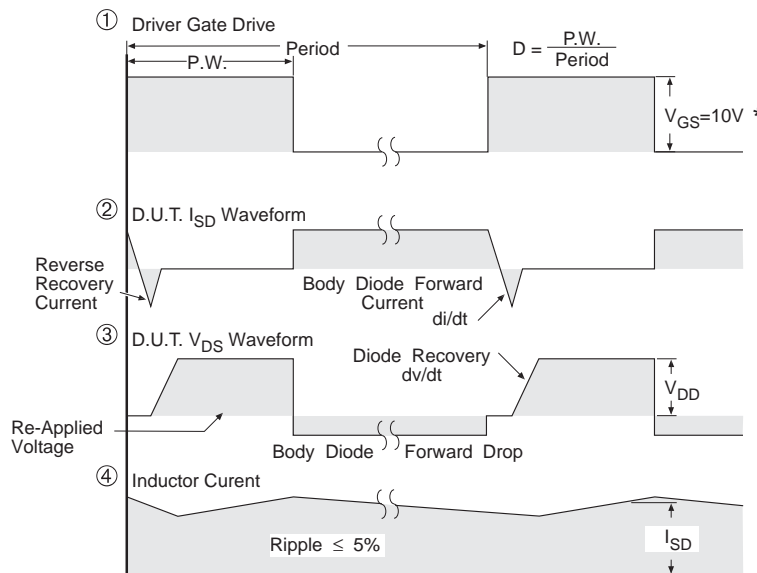
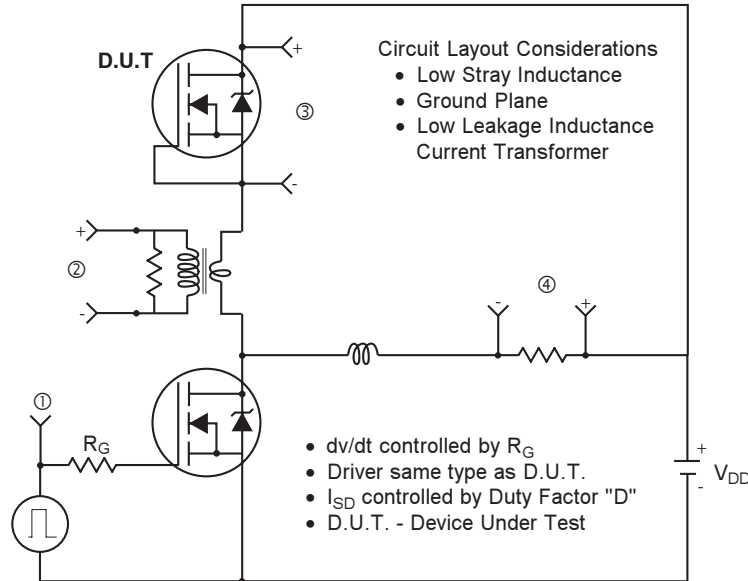


**Fig 15a.** Gate Charge Test Circuit



**Fig 15b.** Basic Gate Charge Waveform

## Peak Diode Recovery dv/dt Test Circuit



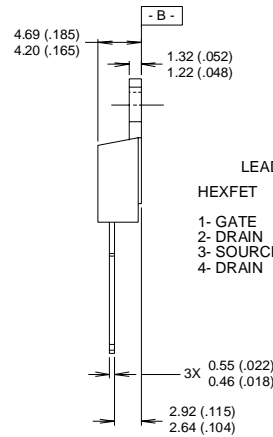
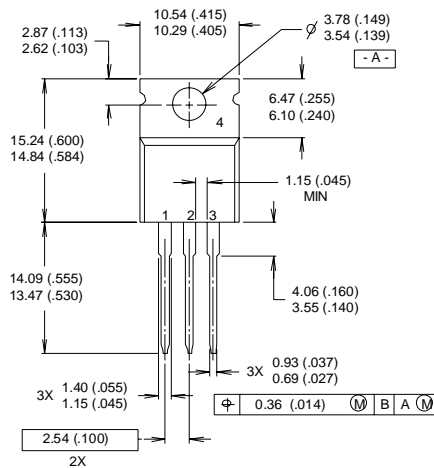
\*  $V_{GS} = 5V$  for Logic Level Devices

**Fig 16.** For N-Channel HEXFET® Power MOSFETs



## TO-220AB Package Outline

Dimensions are shown in millimeters (inches)



LEAD ASSIGNMENTS

HEXFET	IGBTs, CoPACK
1- GATE	1- GATE
2- DRAIN	2- COLLECTOR
3- SOURCE	3- EMITTER
4- DRAIN	4- COLLECTOR

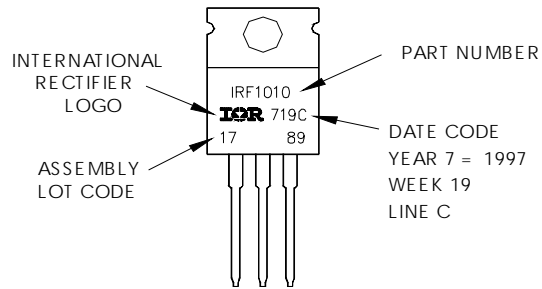
**NOTES:**

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



**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.