

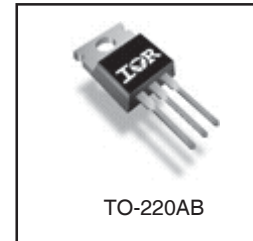
IRFB16N60LPbF

Applications

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

HEXFET® Power MOSFET

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/dt ②	10	V/ns
T_J	Operating Junction and	-55 to + 150	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 seconds	300 (1.6mm from case)	
	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)				

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°C , $I_D = 1mA$
$R_{DS(on)}$	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	$f = 1MHz$, 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	nC	$V_{DS} = 480V$
Q_{gd}	Gate-to-Drain ("Miller") Charge	—	—	46	nC	$V_{GS} = 10V$, See Fig. 7 & 15 ④
$t_{d(on)}$	Turn-On Delay Time	—	20	—	ns	$V_{DD} = 300V$
t_r	Rise Time	—	44	—	ns	$I_D = 16A$
$t_{d(off)}$	Turn-Off Delay Time	—	28	—	ns	$R_G = 1.8\Omega$
t_f	Fall Time	—	5.5	—	ns	$V_{GS} = 10V$, See Fig. 11a & 11b ④
C_{iss}	Input Capacitance	—	2720	—	pF	$V_{GS} = 0V$
C_{oss}	Output Capacitance	—	260	—	pF	$V_{DS} = 25V$
C_{rss}	Reverse Transfer Capacitance	—	20	—	pF	$f = 1.0MHz$, See Fig. 5
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	120	—	pF	$V_{GS} = 0V, V_{DS} = 0V \text{ to } 480V$ ⑤
$C_{oss \text{ eff. (ER)}}$	Effective Output Capacitance (Energy Related)	—	100	—	pF	

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	—	0.4	°C/W
$R_{\theta JA}$	Junction-to-Ambient	—	62	°C/W

Notes:

- ① Repetitive rating; pulse width limited by max. junction temperature. (See Fig. 11)
- ② Starting $T_J = 25^\circ\text{C}$, $L = 2.5mH$, $R_G = 25\Omega$, $I_{AS} = 16A$, $dv/dt = 10V/ns$. (See Figure 12a)
- ③ $I_{SD} \leq 16A$, $di/dt \leq 340A/\mu s$, $V_{DD} \leq V_{(BR)DSS}$, $T_J \leq 150^\circ\text{C}$.

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} .

IRFB16N60LPbF

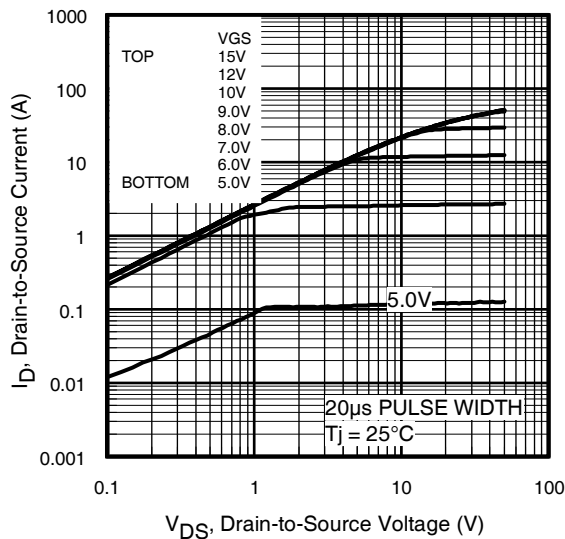


Fig 1. Typical Output Characteristics

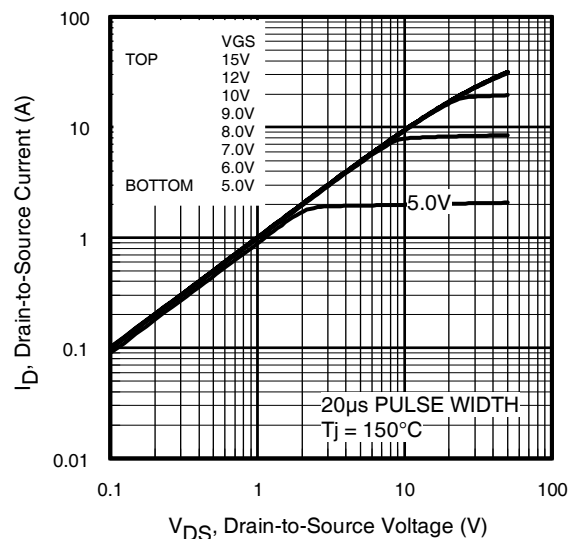


Fig 2. Typical Output Characteristics

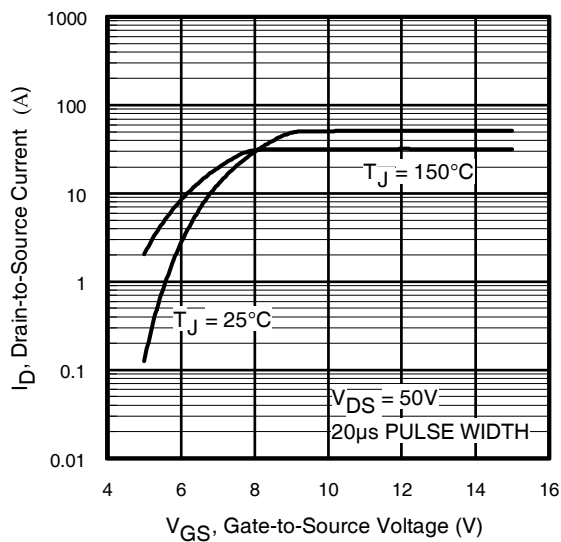


Fig 3. Typical Transfer Characteristics

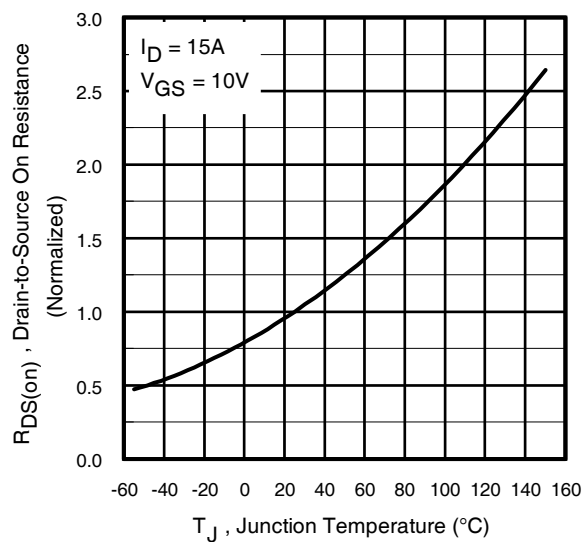


Fig 4. Normalized On-Resistance vs. Temperature

IRFB16N60LPbF

International
IR Rectifier

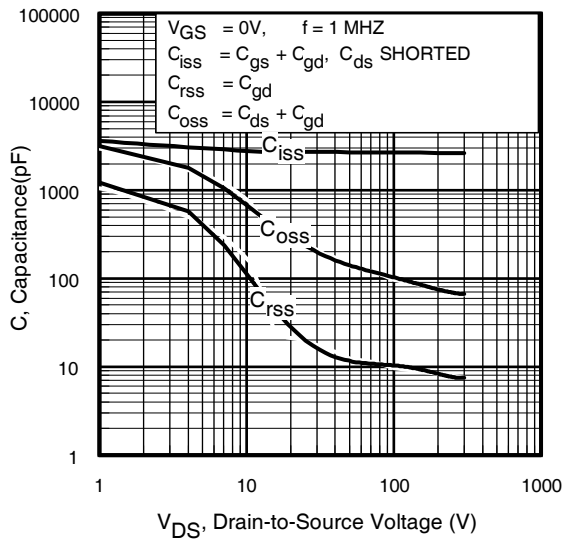


Fig 5. Typical Capacitance vs. Drain-to-Source Voltage

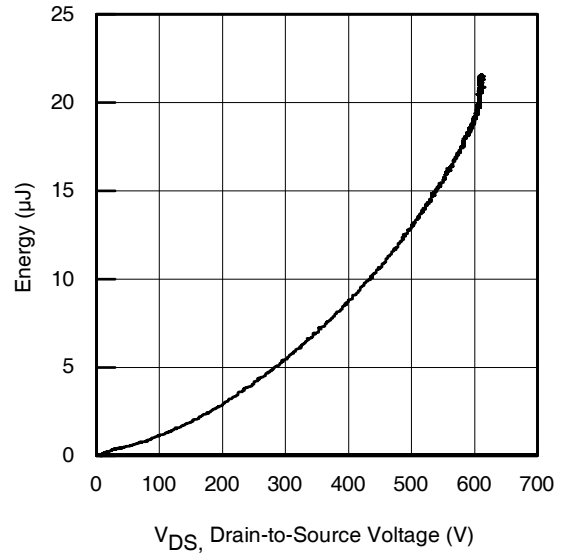


Fig 6. Typ. Output Capacitance Stored Energy vs. V_{DS}

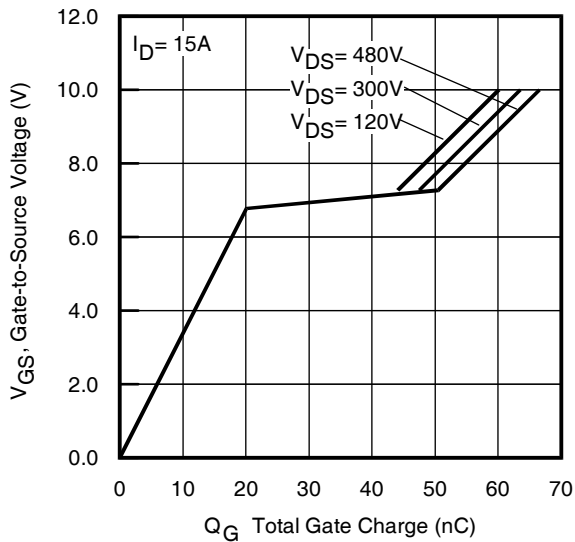


Fig 7. Typical Gate Charge vs. Gate-to-Source Voltage

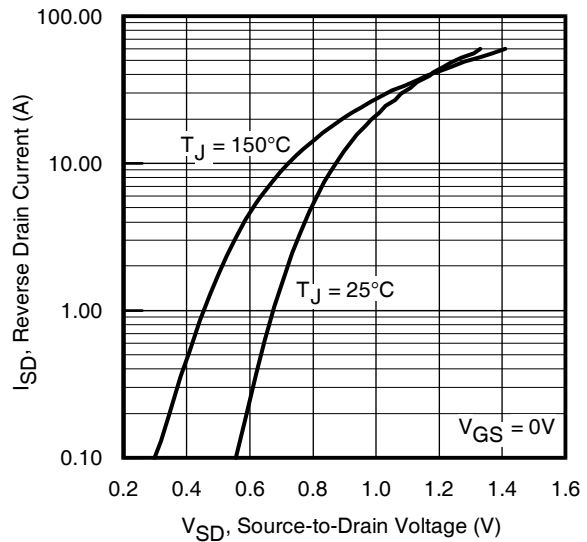


Fig 8. Typical Source-Drain Diode Forward Voltage

IRFB16N60LPbF

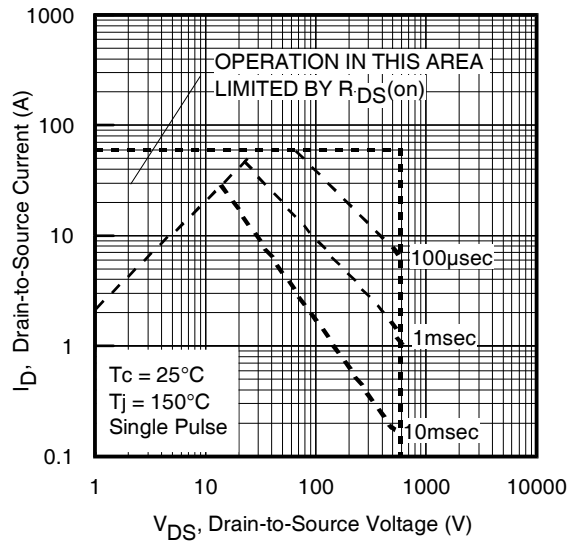


Fig 9. Maximum Safe Operating Area

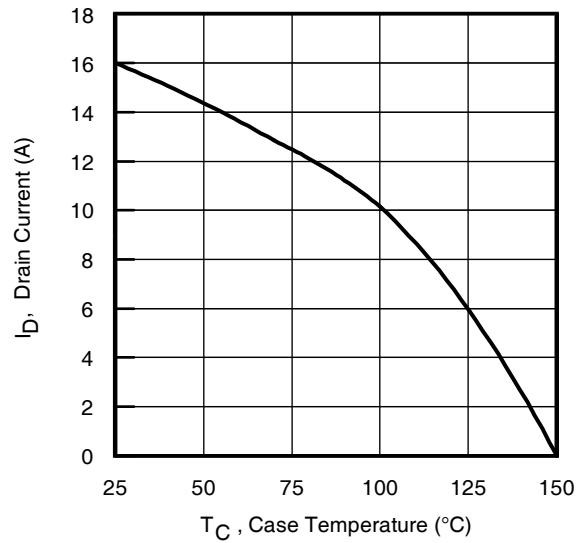


Fig 10. Maximum Drain Current vs. Case Temperature

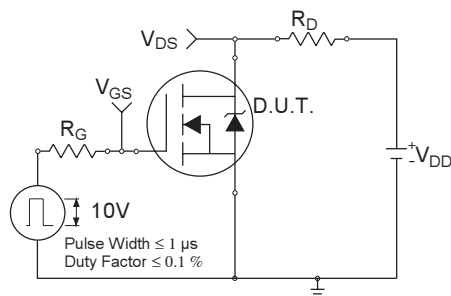


Fig 11a. Switching Time Test Circuit

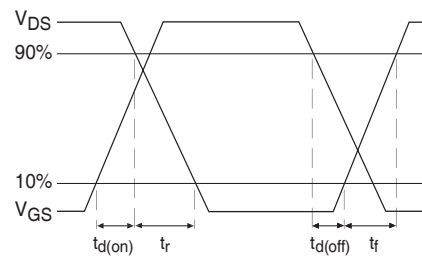


Fig 11b. Switching Time Waveforms

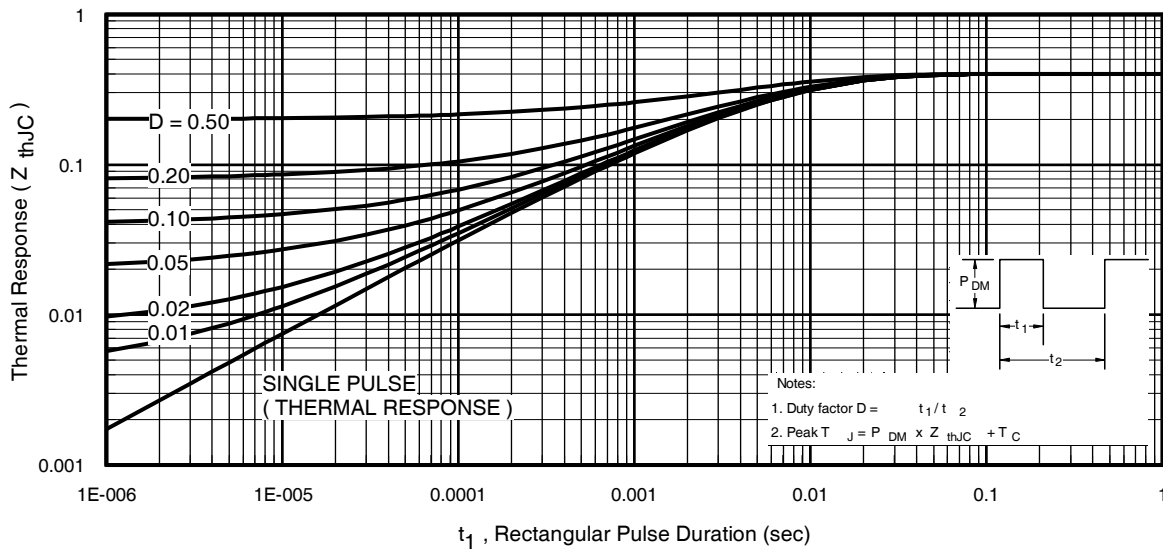


Fig 12. Maximum Effective Transient Thermal Impedance, Junction-to-Case

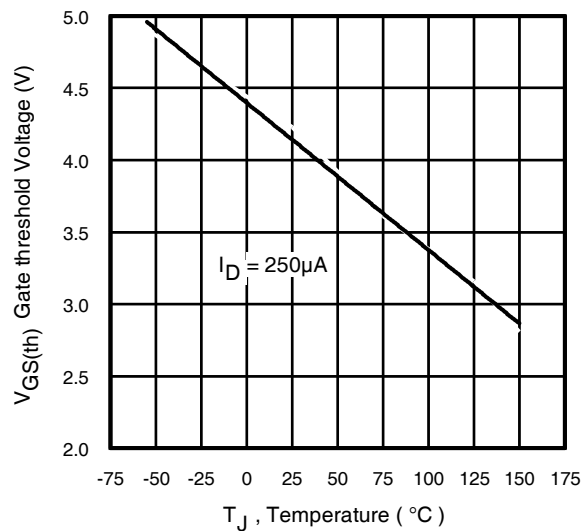


Fig 13. Threshold Voltage vs. Temperature

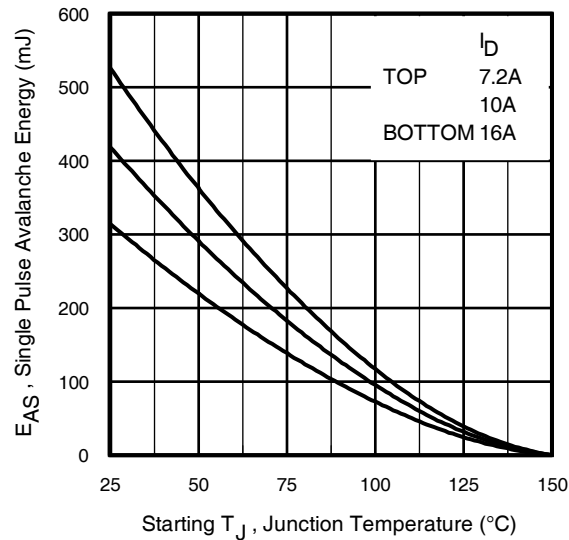


Fig 14a. Maximum Avalanche Energy vs. Drain Current

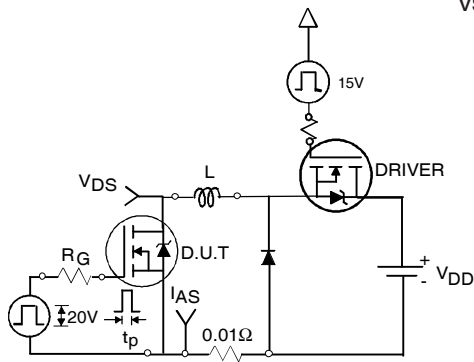


Fig 14b. Unclamped Inductive Test Circuit

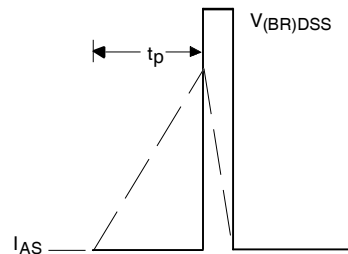


Fig 14c. Unclamped Inductive Waveforms

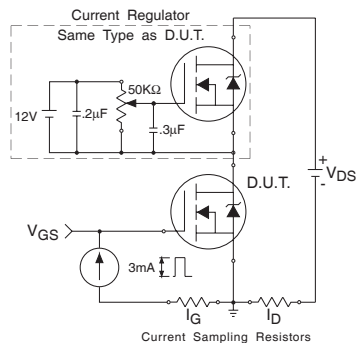


Fig 15a. Gate Charge Test Circuit

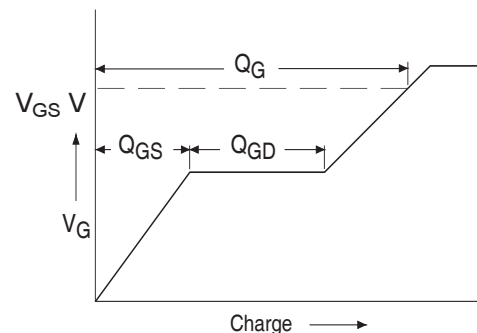
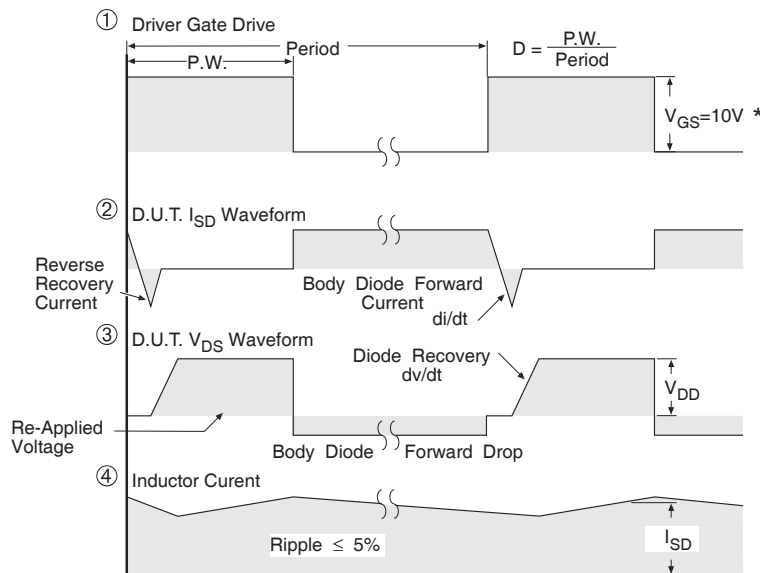
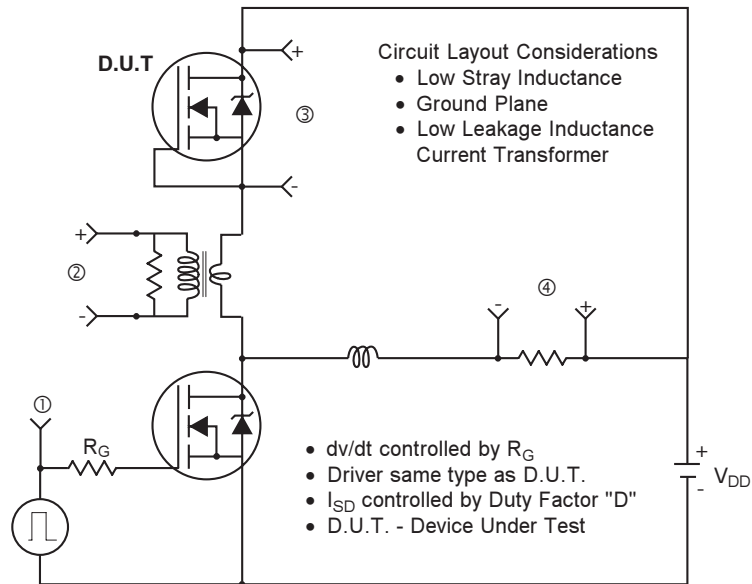


Fig 15b. Basic Gate Charge Waveform

Peak Diode Recovery dv/dt Test Circuit

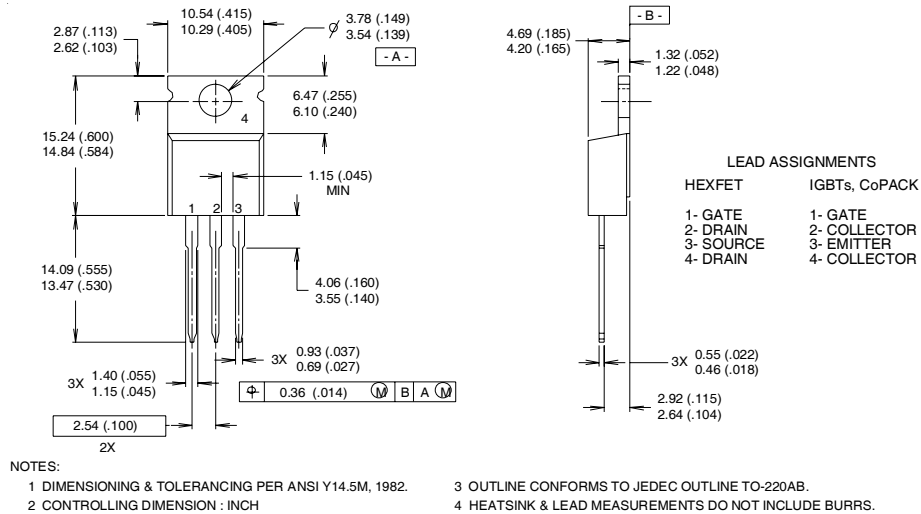


* $V_{GS} = 5V$ for Logic Level Devices

Fig 16. For N-Channel HEXFET® Power MOSFETs

TO-220AB Package Outline

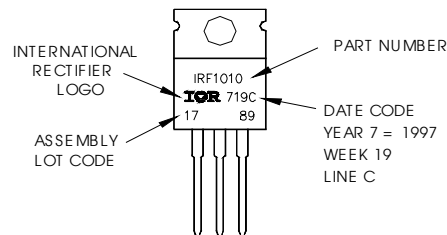
Dimensions are shown in millimeters (inches)



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.

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 for sales contact information.7/04