

**SMPS MOSFET**

**IRFB20N50K**

HEXFET® Power MOSFET

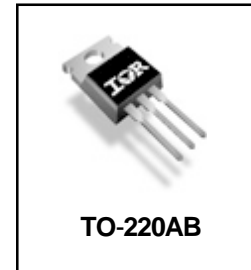
**Applications**

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply
- High Speed Power Switching
- Hard Switched and High Frequency Circuits

$V_{DSS}$	$R_{DS(on)}$ typ.	$I_D$
500V	0.21Ω	20A

**Benefits**

- Low Gate Charge  $Q_g$  results in Simple Drive Requirement
- Improved Gate, Avalanche and Dynamic  $dv/dt$  Ruggedness
- Fully Characterized Capacitance and Avalanche Voltage and Current
- Low  $R_{DS(on)}$



**Absolute Maximum Ratings**

	Parameter	Max.	Units
$I_D$ @ $T_C = 25^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	20	A
$I_D$ @ $T_C = 100^\circ\text{C}$	Continuous Drain Current, $V_{GS}$ @ 10V	12	
$I_{DM}$	Pulsed Drain Current ①	80	
$P_D$ @ $T_C = 25^\circ\text{C}$	Power Dissipation	280	W
	Linear Derating Factor	2.2	W/°C
$V_{GS}$	Gate-to-Source Voltage	± 30	V
$dv/dt$	Peak Diode Recovery $dv/dt$ ③	6.9	V/ns
$T_J$	Operating Junction and	-55 to + 150	°C
$T_{STG}$	Storage Temperature Range		
	Soldering Temperature, for 10 seconds (1.6mm from case )	300	
	Mounting Torque, 6-32 or M3 screw	10	N

**Avalanche Characteristics**

Symbol	Parameter	Typ.	Max.	Units
$E_{AS}$	Single Pulse Avalanche Energy②	—	330	mJ
$I_{AR}$	Avalanche Current④	—	20	A
$E_{AR}$	Repetitive Avalanche Energy④	—	28	mJ

**Thermal Resistance**

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case	—	0.45	°C/W
$R_{\theta CS}$	Case-to-Sink, Flat, Greased Surface	0.50	—	
$R_{\theta JA}$	Junction-to-Ambient	—	58	

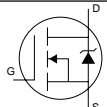
## Static @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	Drain-to-Source Breakdown Voltage	500	—	—	V	$V_{GS} = 0V, I_D = 250\mu A$
$\Delta V_{(BR)DSS}/\Delta T_J$	Breakdown Voltage Temp. Coefficient	—	0.61	—	V/°C	Reference to $25^\circ\text{C}, I_D = 1\text{mA}$
$R_{DS(on)}$	Static Drain-to-Source On-Resistance	—	0.21	0.25	$\Omega$	$V_{GS} = 10V, I_D = 12A$ 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	$\mu A$	$V_{DS} = 500V, V_{GS} = 0V$
		—	—	250	$\mu A$	$V_{DS} = 400V, V_{GS} = 0V, T_J = 125^\circ\text{C}$
$I_{GSS}$	Gate-to-Source Forward Leakage	—	—	100	nA	$V_{GS} = 30V$
	Gate-to-Source Reverse Leakage	—	—	-100	nA	$V_{GS} = -30V$

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

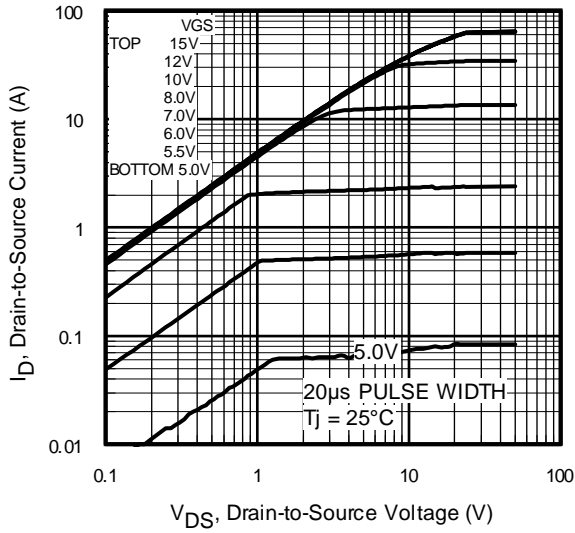
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$g_{fs}$	Forward Transconductance	11	—	—	S	$V_{DS} = 50V, I_D = 12A$
$Q_g$	Total Gate Charge	—	—	110	nC	$I_D = 20A$
$Q_{gs}$	Gate-to-Source Charge	—	—	33		$V_{DS} = 400V$
$Q_{gd}$	Gate-to-Drain ("Miller") Charge	—	—	54		$V_{GS} = 10V, \text{See Fig. 6 and 13}$ ④
$t_{d(on)}$	Turn-On Delay Time	—	22	—	ns	$V_{DD} = 250V$
$t_r$	Rise Time	—	74	—		$I_D = 20A$
$t_{d(off)}$	Turn-Off Delay Time	—	45	—		$R_G = 7.5\Omega$
$t_f$	Fall Time	—	33	—		$V_{GS} = 10V, \text{See Fig. 10}$ ④
$C_{iss}$	Input Capacitance	—	2870	—	pF	$V_{GS} = 0V$
$C_{oss}$	Output Capacitance	—	320	—		$V_{DS} = 25V$
$C_{rss}$	Reverse Transfer Capacitance	—	34	—		$f = 1.0\text{MHz}, \text{See Fig. 5}$
$C_{oss}$	Output Capacitance	—	3480	—		$V_{GS} = 0V, V_{DS} = 1.0V, f = 1.0\text{MHz}$
$C_{oss}$	Output Capacitance	—	85	—		$V_{GS} = 0V, V_{DS} = 400V, f = 1.0\text{MHz}$
$C_{oss \text{ eff.}}$	Effective Output Capacitance	—	160	—		$V_{GS} = 0V, V_{DS} = 0V \text{ to } 400V$ ⑤

## Diode Characteristics

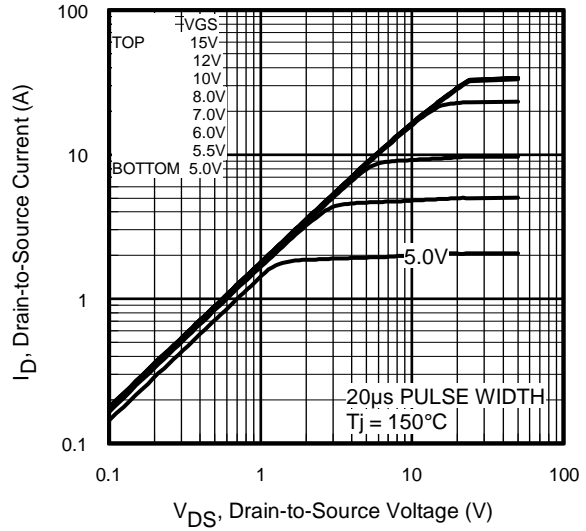
Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
$I_S$	Continuous Source Current (Body Diode)	—	—	20	A	MOSFET symbol showing the integral reverse p-n junction diode. 
$I_{SM}$	Pulsed Source Current (Body Diode) ①	—	—	80		
$V_{SD}$	Diode Forward Voltage	—	—	1.5	V	$T_J = 25^\circ\text{C}, I_S = 20A, V_{GS} = 0V$ ④
$t_{rr}$	Reverse Recovery Time	—	520	780	ns	$T_J = 25^\circ\text{C}, I_F = 20A$
$Q_{rr}$	Reverse Recovery Charge	—	5.3	8.0	$\mu C$	$di/dt = 100A/\mu s$ ④
$t_{on}$	Forward Turn-On Time	Intrinsic turn-on time is negligible (turn-on is dominated by $L_S + L_D$ )				

### Notes:

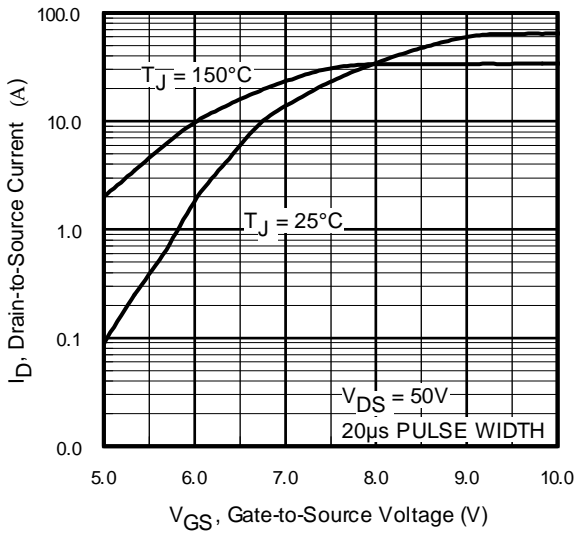
- ① Repetitive rating; pulse width limited by max. junction temperature.
- ② Starting  $T_J = 25^\circ\text{C}, L = 1.6\text{mH}, R_G = 25\Omega, I_{AS} = 20A,$
- ③  $I_{SD} \leq 20A, di/dt \leq 350A/\mu s, V_{DD} \leq V_{(BR)DSS}, T_J \leq 150^\circ\text{C}$
- ④ Pulse width  $\leq 400\mu s;$  duty cycle  $\leq 2\%.$



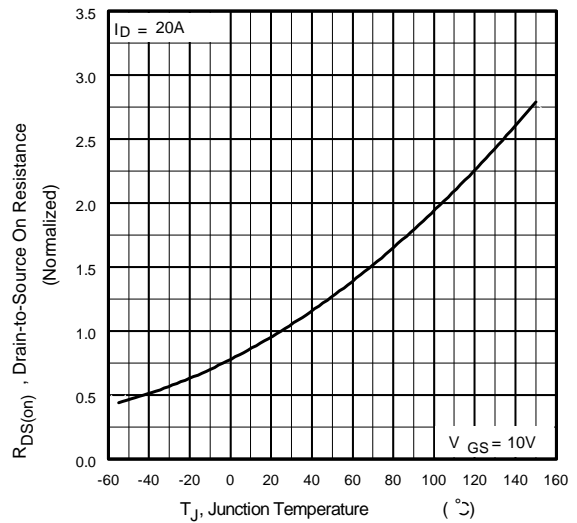
**Fig 1.** Typical Output Characteristics



**Fig 2.** Typical Output Characteristics

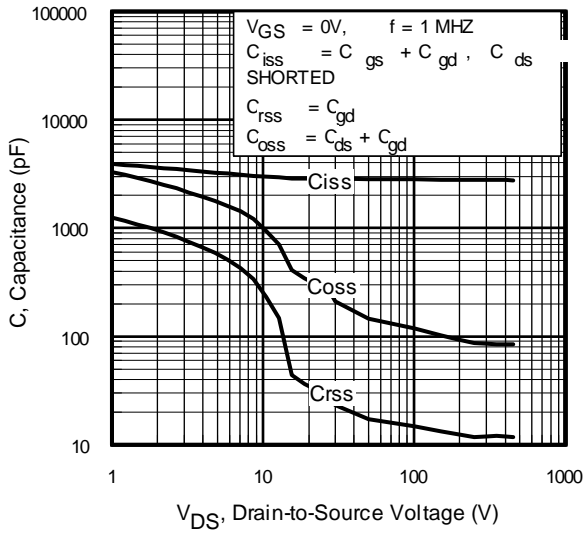


**Fig 3.** Typical Transfer Characteristics

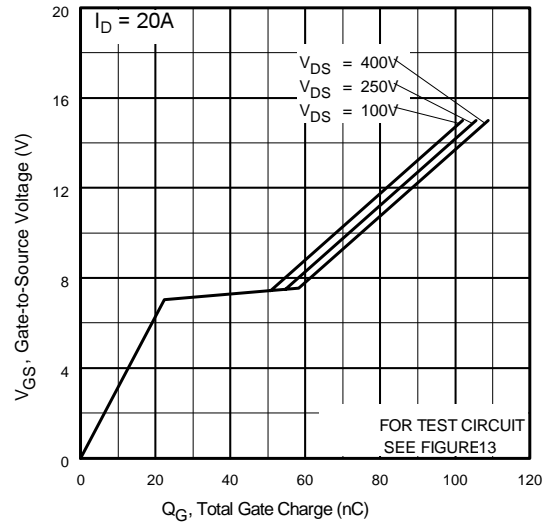


**Fig 4.** Normalized On-Resistance Vs. Temperature

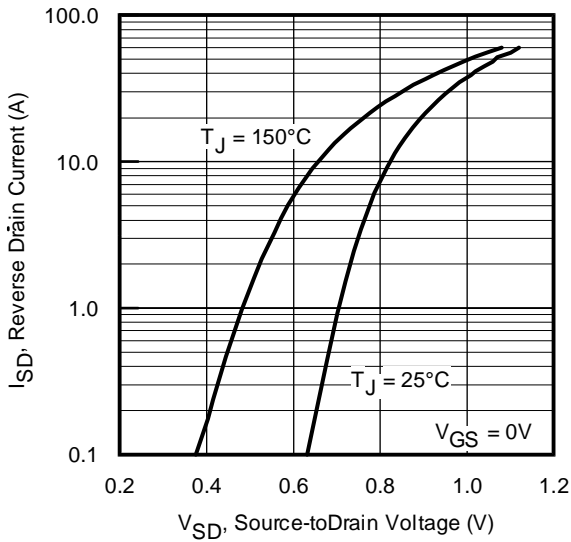
# IRFB20N50K



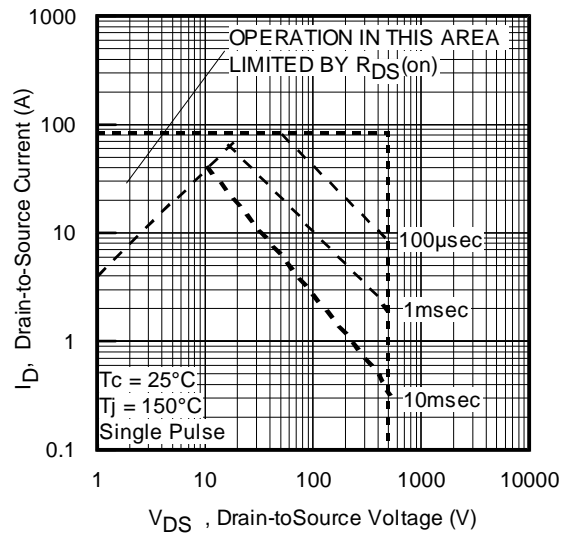
**Fig 5.** Typical Capacitance Vs. Drain-to-Source Voltage



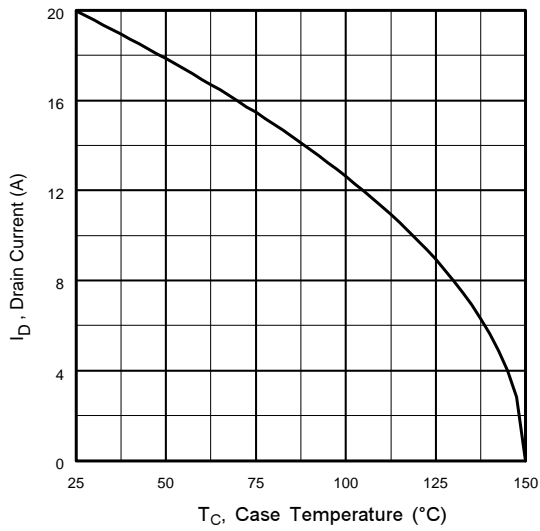
**Fig 6.** Typical Gate Charge Vs. Gate-to-Source Voltage



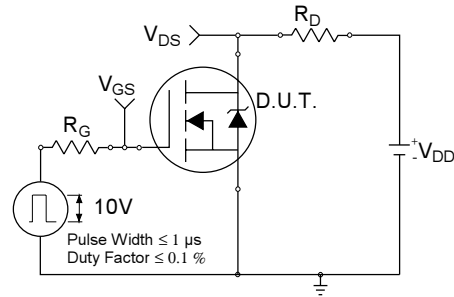
**Fig 7.** Typical Source-Drain Diode Forward Voltage



**Fig 8.** Maximum Safe Operating Area



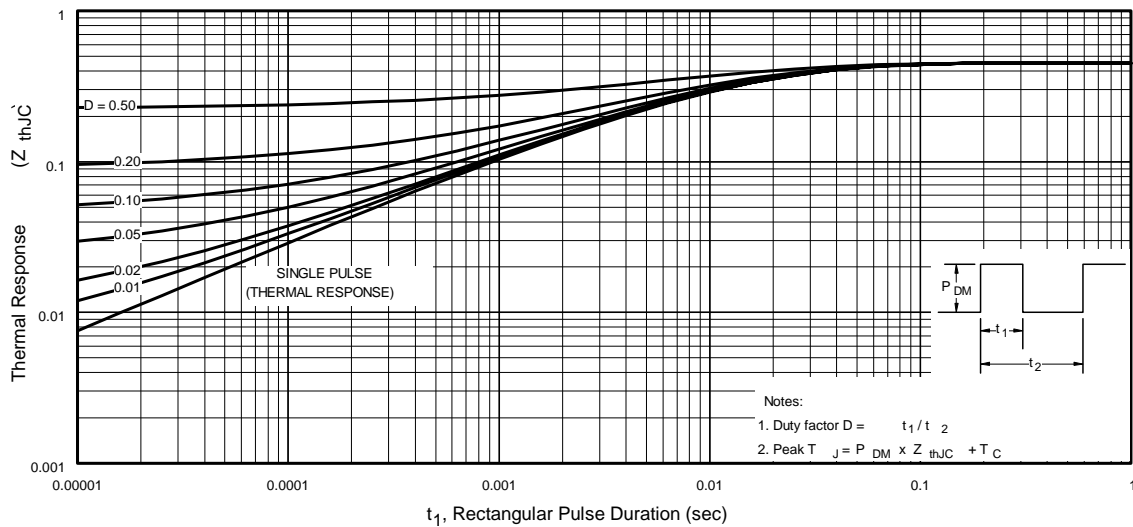
**Fig 9.** Maximum Drain Current Vs. Case Temperature



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

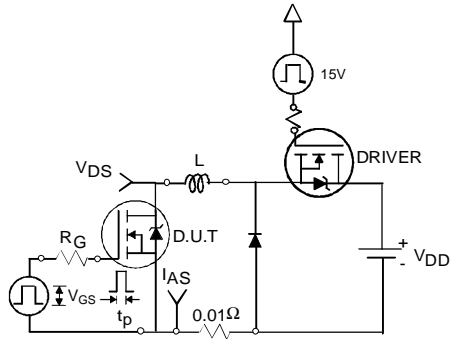


**Fig 10b.** Switching Time Waveforms

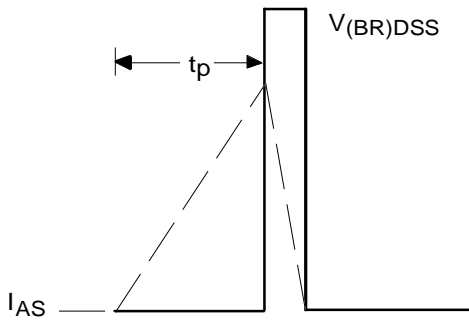


**Fig 11.** Maximum Effective Transient Thermal Impedance, Junction-to-Case

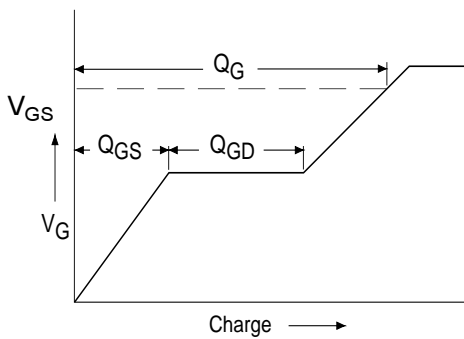
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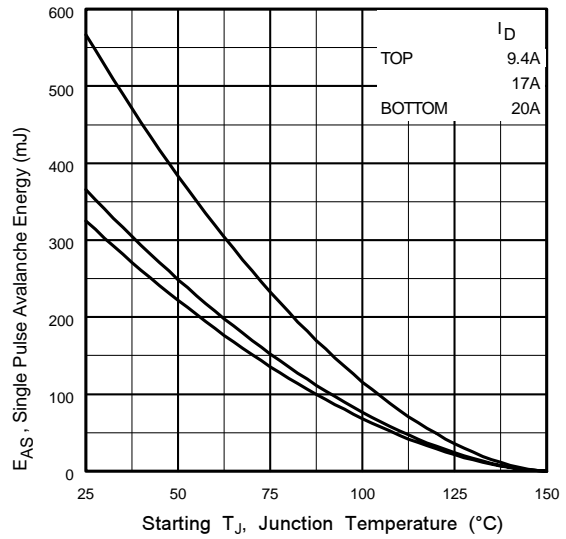
**Fig 12a.** Unclamped Inductive Test Circuit



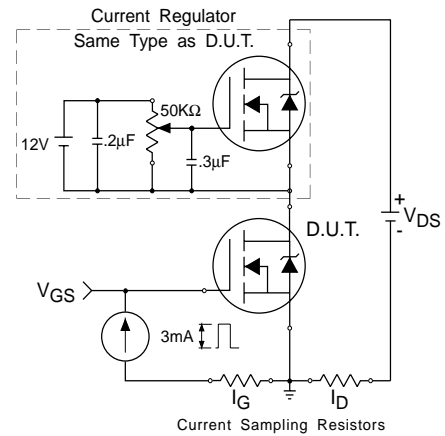
**Fig 12b.** Unclamped Inductive Waveforms



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

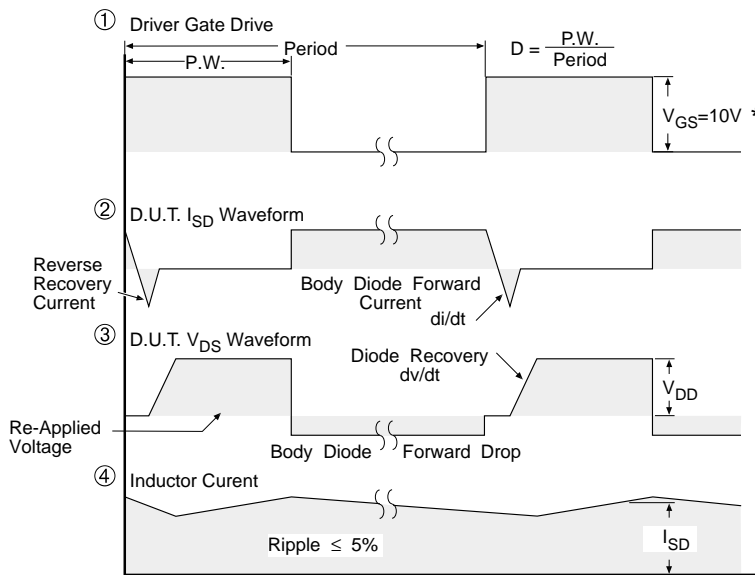
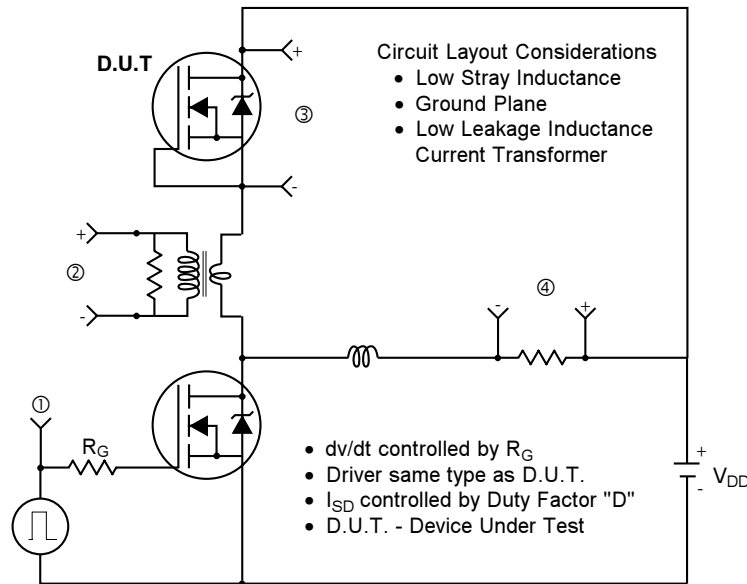


**Fig 12c.** Maximum Avalanche Energy Vs. Drain Current



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

## Peak Diode Recovery dv/dt Test Circuit



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

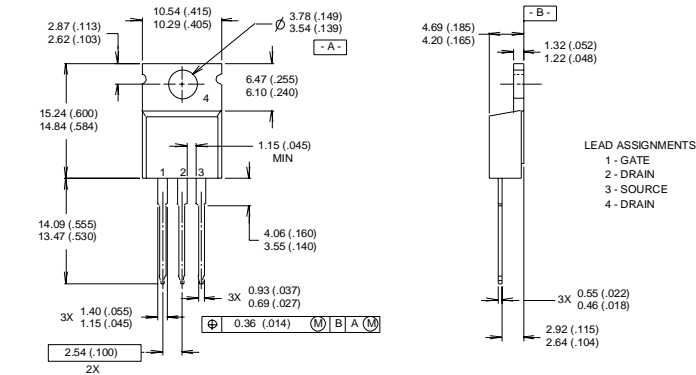
**Fig 14.** For N-Channel HEXFETS

# IRFB20N50K

International  
**IR** Rectifier

## TO-220 Package Outline

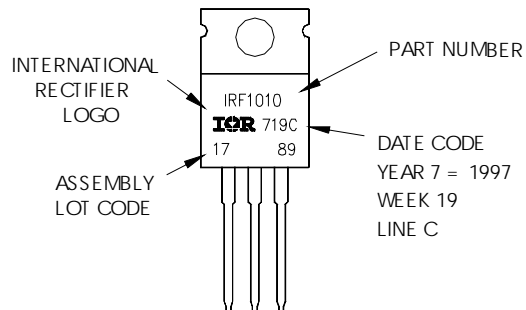
Dimensions are shown in millimeters (inches)



- 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-220 Part Marking Information

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



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.

International  
**IR** Rectifier

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