

International
IR Rectifier

IRG4BC20MD-SPbF

INSULATED GATE BIPOLAR TRANSISTOR WITH
ULTRAFAST SOFT RECOVERY DIODE

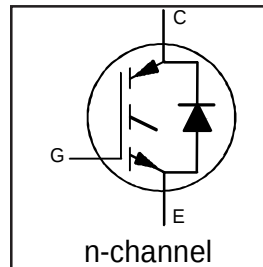
Short Circuit Rated
Fast IGBT

Features

- Rugged: 10μsec short circuit capable at $V_{GS}=15V$
- Low $V_{CE(on)}$ for 4 to 10kHz applications
- IGBT Co-packaged with ultra-soft-recovery antiparallel diode
- Industry standard D²Pak package
- Lead-Free

Benefits

- Offers highest efficiency and short circuit capability for intermediate applications
- Provides best efficiency for the mid range frequency (4 to 10kHz)
- Optimized for Appliance Motor Drives, Industrial (Short Circuit Proof) Drives and Intermediate Frequency Range Drives
- High noise immune "Positive Only" gate drive- Negative bias gate drive not necessary
- For Low EMI designs- requires little or no snubbing
- Single Package switch for bridge circuit applications
- Compatible with high voltage Gate Driver IC's
- Allows simpler gate drive



$$V_{CES} = 600V$$

$$V_{CE(on)} \text{ typ.} = 1.85V$$

$$@V_{GE} = 15V, I_C = 11A$$



D²Pak

Absolute Maximum Ratings

	Parameter	Max.	Units
V _{CES}	Collector-to-Emitter Voltage	600	V
I _C @ T _C = 25°C	Continuous Collector Current	18	A
I _C @ T _C = 100°C	Continuous Collector Current	11	
I _{CM}	Pulsed Collector Current ①	36	
I _{LM}	Clamped Inductive Load Current ②	36	
I _F @ T _C = 100°C	Diode Continuous Forward Current	7.0	
t _{SC}	Short Circuit Withstand Time	10	μs
I _{FM}	Diode Maximum Forward Current	36	A
V _{GE}	Gate-to-Emitter Voltage	± 20	V
P _D @ T _C = 25°C	Maximum Power Dissipation	60	W
P _D @ T _C = 100°C	Maximum Power Dissipation	24	
T _J	Operating Junction and	-55 to +150	°C
T _{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting Torque, 6-32 or M3 Screw.	10 lbf•in (1.1 N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	-----	-----	2.1	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	-----	-----	2.5	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	-----	0.50	-----	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	-----	-----	80	
Wt	Weight	-----	2 (0.07)	-----	g (oz)

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage ^③	600	----	----	V	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.67	----	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.85	2.1	V	$I_C = 11A, V_{GE} = 15V$
		----	2.46	----		$I_C = 18A$
		----	2.07	----		$I_C = 11A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	4.0	----	6.5		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	----	-11	----	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance ^④	3.0	3.6	----	S	$V_{CE} = 100V, I_C = 11A$
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		----	----	2500		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	----	1.4	1.7	V	$I_C = 8.0A$
		----	1.3	1.6		$I_C = 8.0A, T_J = 150^\circ\text{C}$
I_{GES}	Gate-to-Emitter Leakage Current	----	----	± 100	nA	$V_{GE} = \pm 20V$

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
Q_g	Total Gate Charge (turn-on)	----	39	59	nC	$I_C = 11A$
Q_{ge}	Gate - Emitter Charge (turn-on)	----	5.3	8.0		$V_{CC} = 400V$
Q_{gc}	Gate - Collector Charge (turn-on)	----	20	30		$V_{GE} = 15V$
$t_{d(on)}$	Turn-On Delay Time	----	21	----	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	----	37	----		$I_C = 11A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	----	463	690		$V_{GE} = 15V, R_G = 50\Omega$
t_f	Fall Time	----	340	510		Energy losses include "tail" and diode reverse recovery.
E_{on}	Turn-On Switching Loss	----	0.41	----	mJ	See Fig. 9, 10, 11, 18
E_{off}	Turn-Off Switching Loss	----	2.03	----		
E_{ts}	Total Switching Loss	----	2.44	3.7		
$t_{d(on)}$	Turn-On Delay Time	----	19	----	ns	$T_J = 150^\circ\text{C}$, See Fig. 9, 10, 11, 18
t_r	Rise Time	----	41	----		$I_C = 6.5A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	----	590	----		$V_{GE} = 15V, R_G = 50\Omega$
t_f	Fall Time	----	600	----		Energy losses include "tail" and diode reverse recovery.
E_{ts}	Total Switching Loss	----	3.49	----	mJ	
L_E	Internal Emitter Inductance	----	7.5	----	nH	Measured 5mm from package
C_{ies}	Input Capacitance	----	460	----	pF	$V_{GE} = 0V$
C_{oes}	Output Capacitance	----	54	----		$V_{CC} = 30V$
C_{res}	Reverse Transfer Capacitance	----	14	----		$f = 1.0MHz$
t_{rr}	Diode Reverse Recovery Time	----	37	55	ns	$T_J = 25^\circ\text{C}$ See Fig. 14
		----	55	90		$T_J = 125^\circ\text{C}$
I_{rr}	Diode Peak Reverse Recovery Current	----	3.5	5.0	A	$T_J = 25^\circ\text{C}$ See Fig. 15
		----	4.5	8.0		$T_J = 125^\circ\text{C}$
Q_{rr}	Diode Reverse Recovery Charge	----	65	138	nC	$T_J = 25^\circ\text{C}$ See Fig. 16
		----	124	360		$T_J = 125^\circ\text{C}$
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	----	240	----	A/ μs	$T_J = 25^\circ\text{C}$ See Fig. 17
		----	210	----		$T_J = 125^\circ\text{C}$

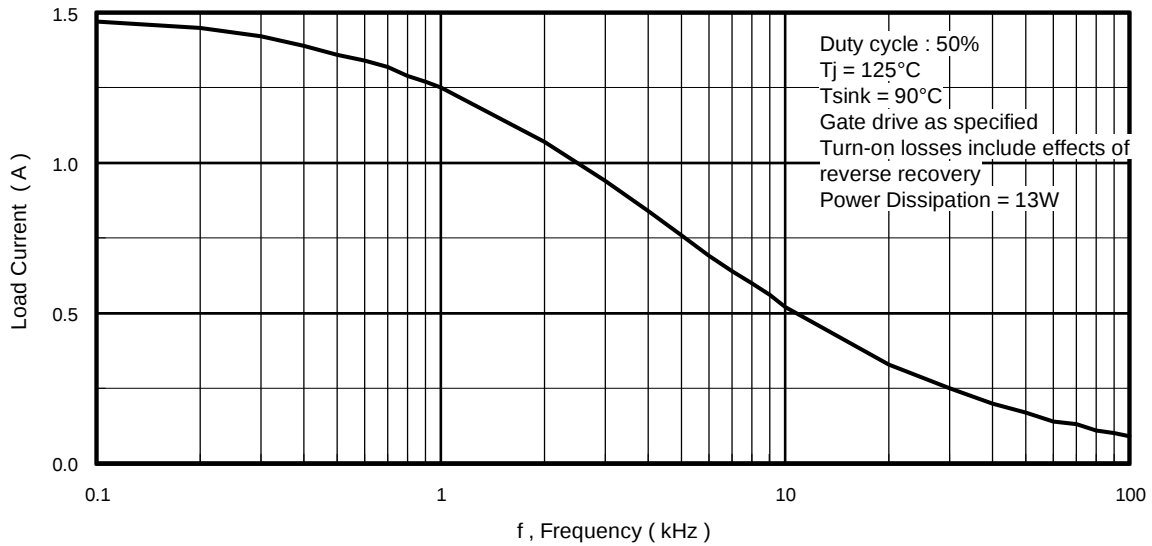


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

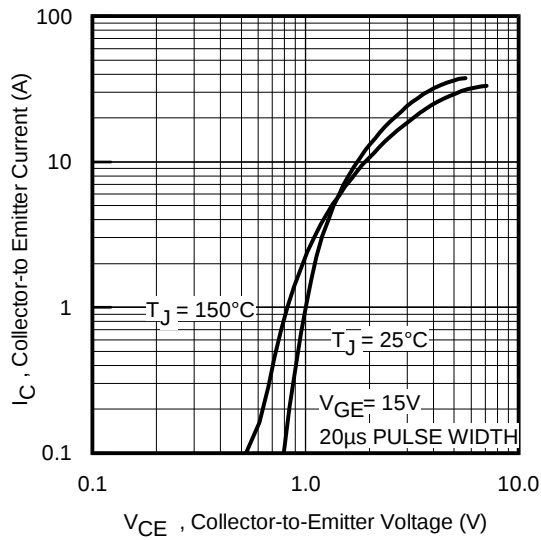


Fig. 2 - Typical Output Characteristics

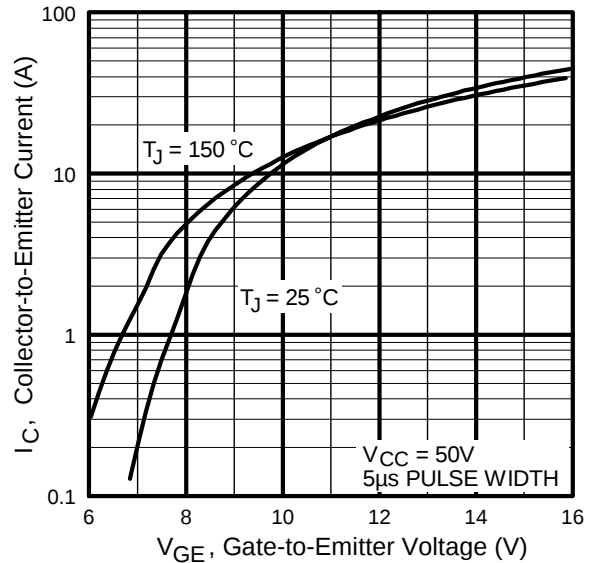


Fig. 3 - Typical Transfer Characteristics

IRG4BC20MD-SPbF

International
IRF Rectifier

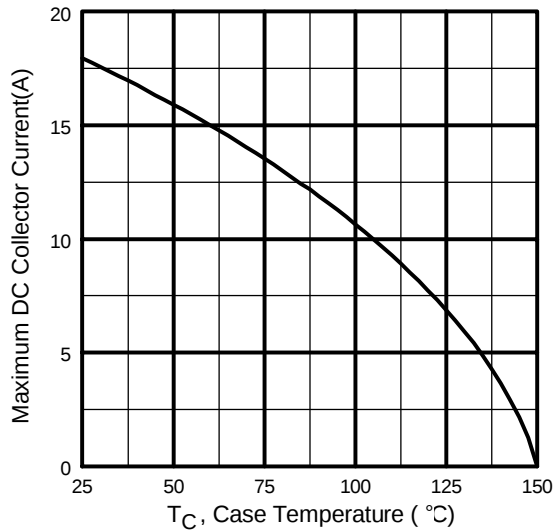


Fig. 4 - Maximum Collector Current vs. Case Temperature

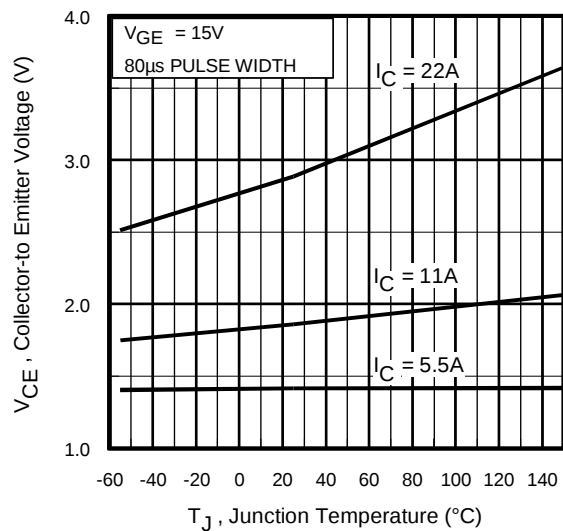


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

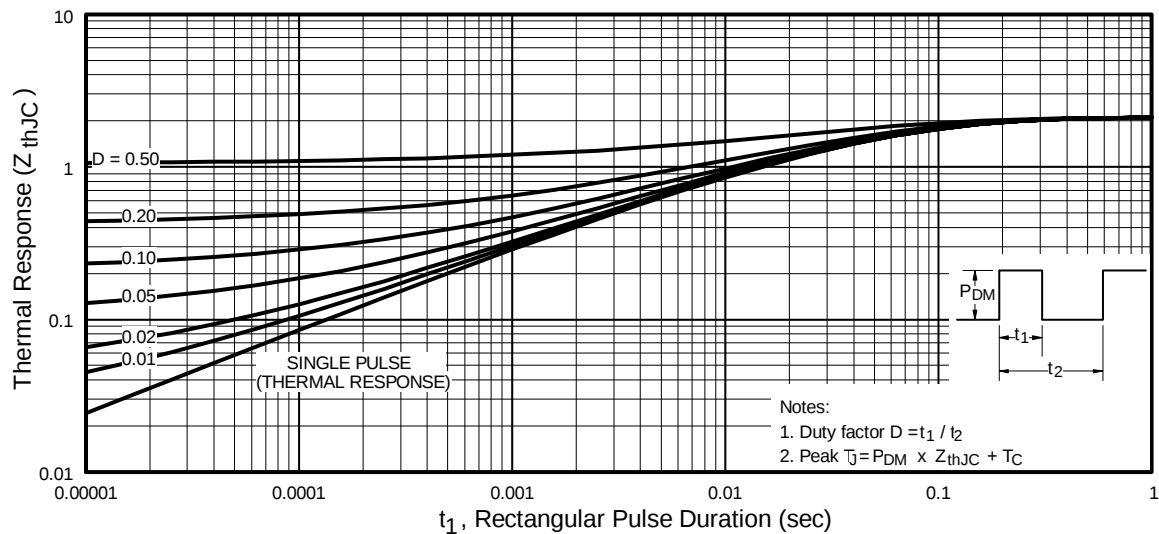


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

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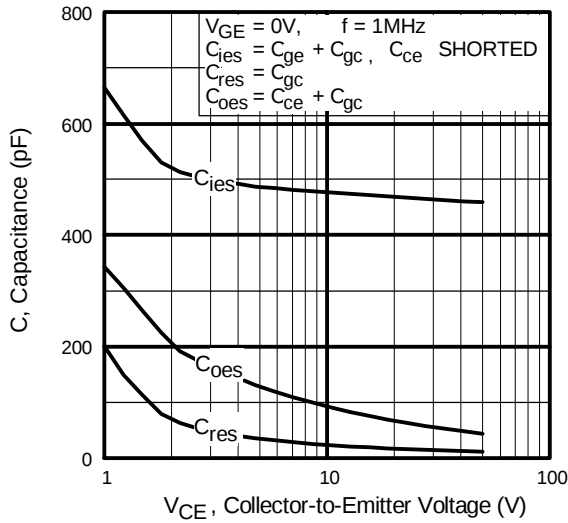


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

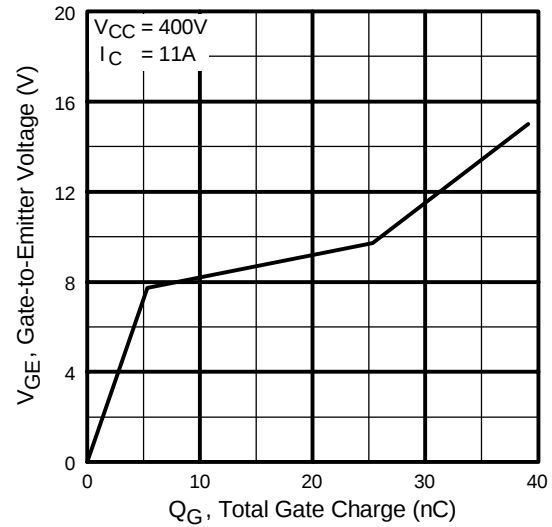


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

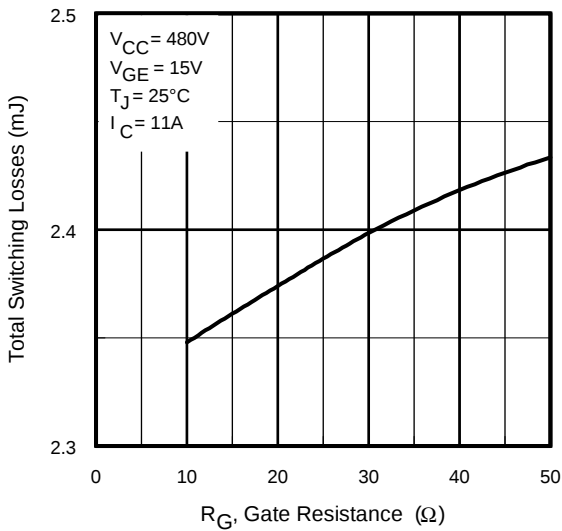


Fig. 9 - Typical Switching Losses vs. Gate Resistance

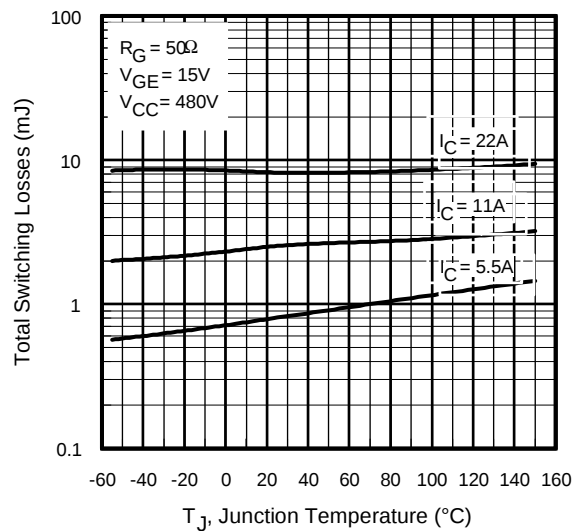


Fig. 10 - Typical Switching Losses vs. Junction Temperature

IRG4BC20MD-SPbF

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IR Rectifier

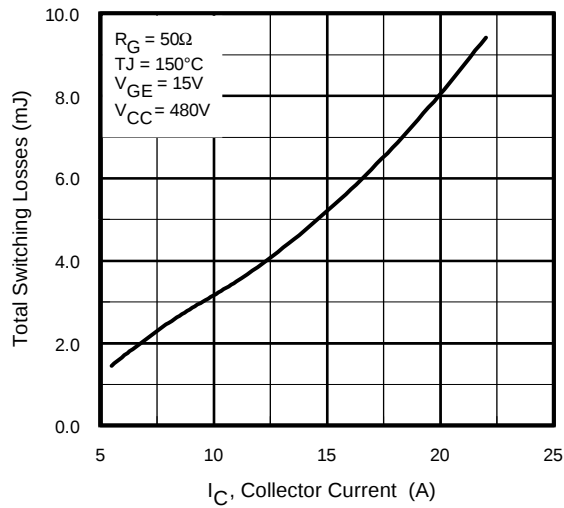


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

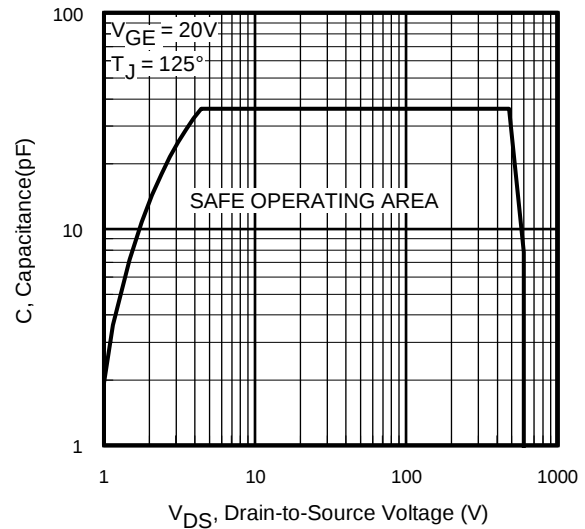


Fig. 12 - Turn-Off SOA

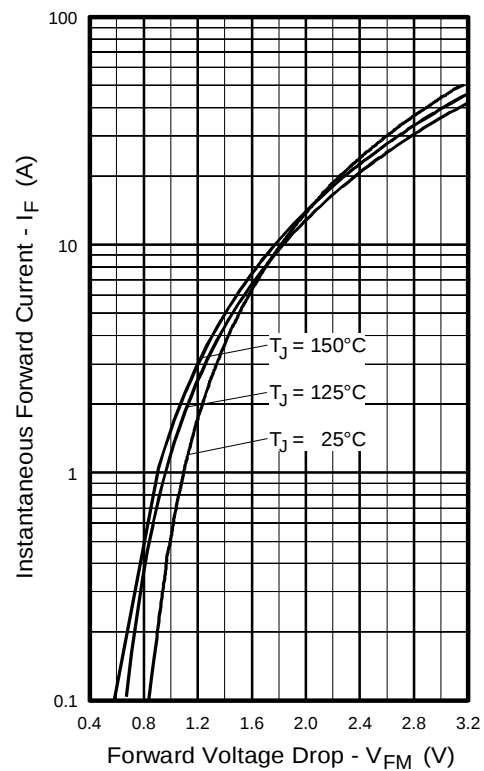


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

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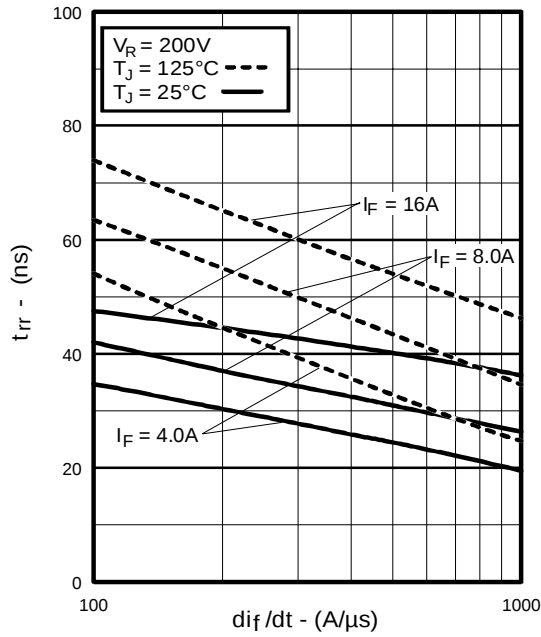


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

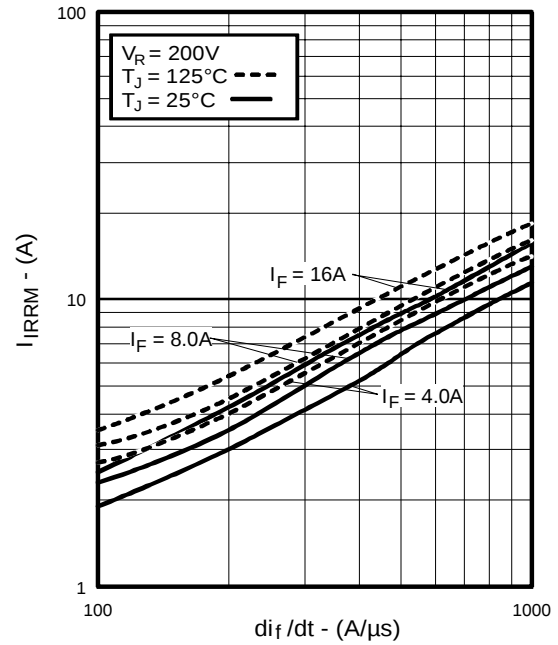


Fig. 15 - Typical Recovery Current vs. di_f/dt

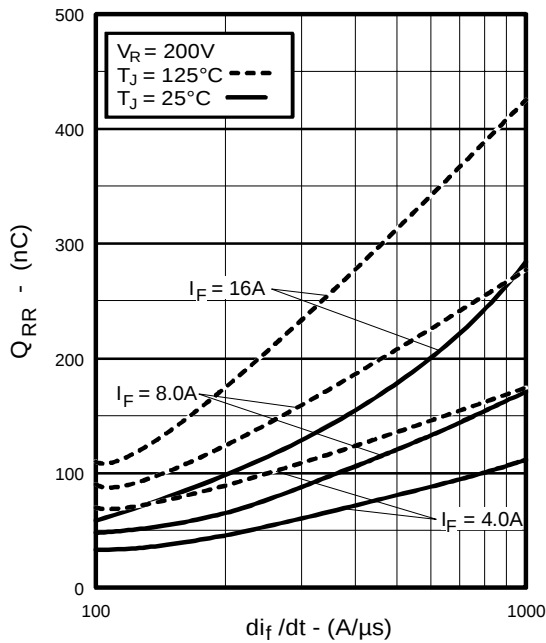


Fig. 16 - Typical Stored Charge vs. di_f/dt

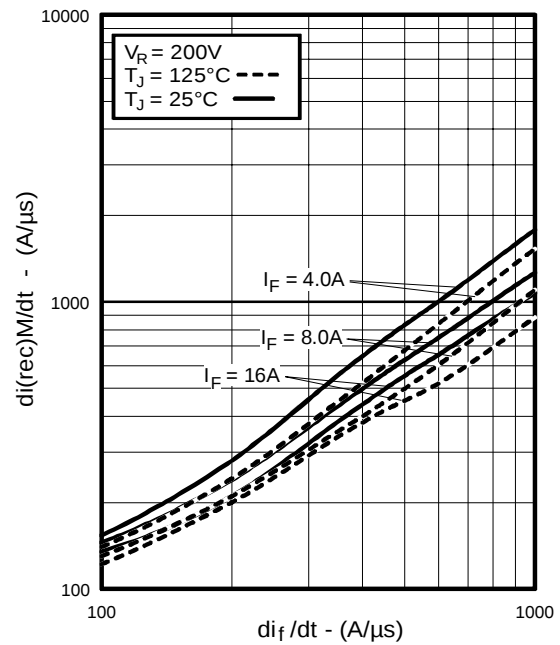


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

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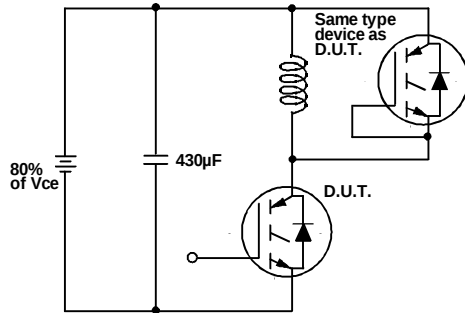


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, E_{off}(diode), t_{rr}, Q_{rr}, I_{rr}, t_d(on), t_r, t_d(off), t_f

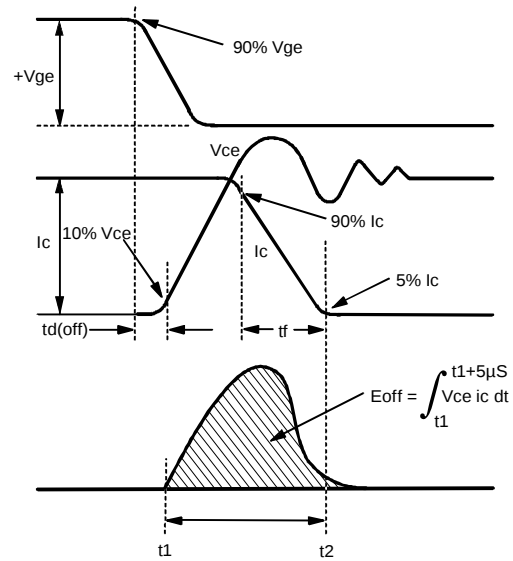


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, t_d(off), t_f

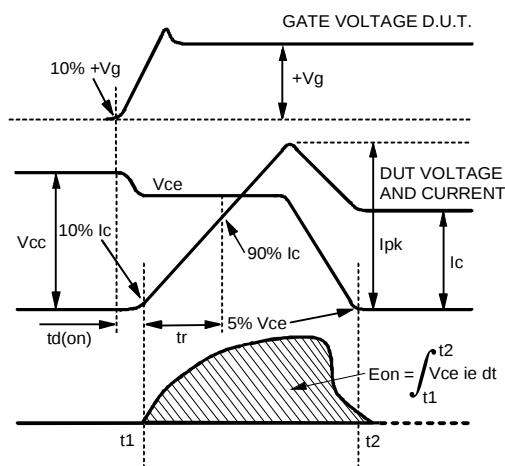


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, t_d(on), t_r

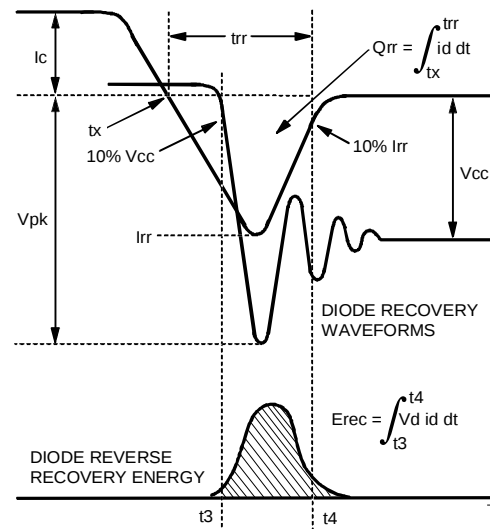


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

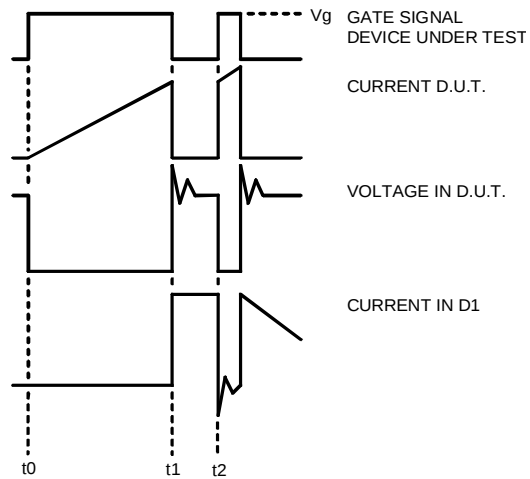


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

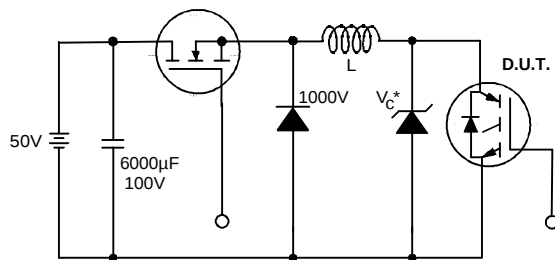


Figure 19. Clamped Inductive Load Test Circuit

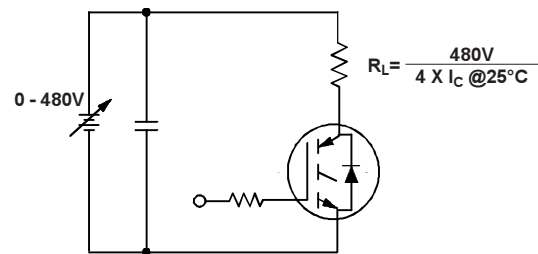
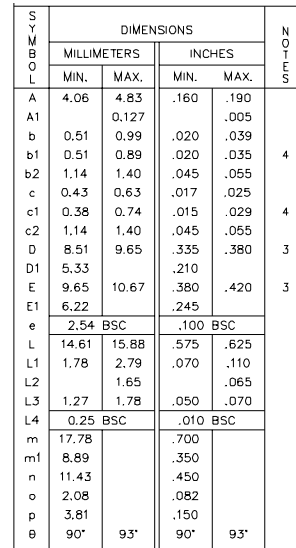


Figure 20. Pulsed Collector Current Test Circuit

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Dimensions are shown in millimeters (inches)



HEXFET	IGBTs, CoPACK	DIODES
1.- GATE	1.- GATE	1.- ANODE *
2.- DRAIN	2.- COLLECTOR	2.- CATHODE
3.- SOURCE	3.- EMITTER	3.- ANODE

- PART DEPENDENT

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994

2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]

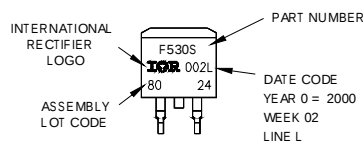
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.

4. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.

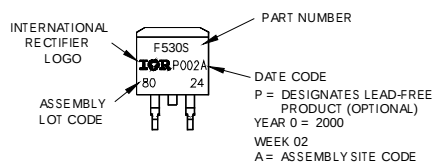
5. CONTROLLING DIMENSION: INCH.

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

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



OR

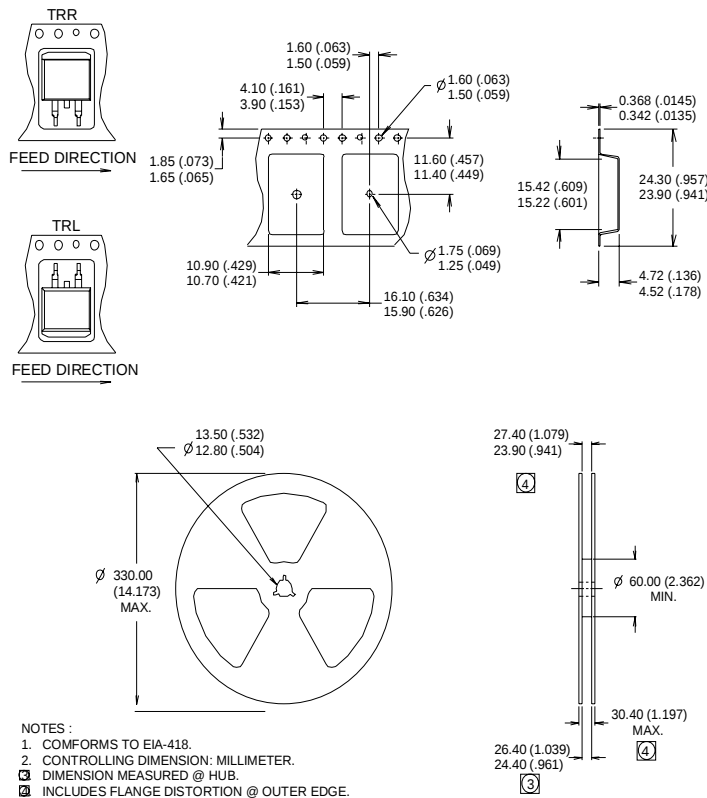


Notes:

- ① Repetitive rating: $V_{GE}=20V$; pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G = 50\Omega$ (figure 19)
- ③ Pulse width $\leq 80\mu s$; duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

D²Pak Tape & Reel Information

Dimensions are shown in millimeters (inches)



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.

