PD -91594C

International
IOR Rectifier

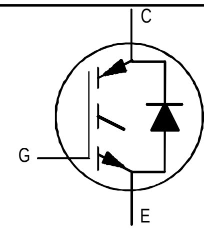
IRG4BC30KD-S

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Short Circuit Rated
UltraFast IGBT

Features

- High short circuit rating optimized for motor control, t_{sc} =10µs, @360V V_{CE} (start), T_J = 125°C, V_{GE} = 15V
- Combines low conduction losses with high switching speed
- tighter parameter distribution and higher efficiency than previous generations
- IGBT co-packaged with HEXFRED™ ultrafast, ultrasoft recovery antiparallel diodes



n-channel

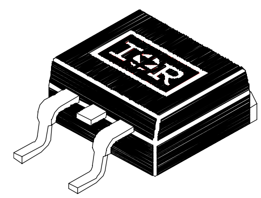
V_{CES} = 600V

$V_{CE(on)\ typ.}$ = 2.21V

@V_{GE} = 15V, I_C = 16A

Benefits

- Latest generation 4 IGBTs offer highest power density motor controls possible
- HEXFRED™ diodes optimized for performance with IGBTs. Minimized recovery characteristic reduce noise, EMI and switching losses
- This part replaces the IRGBC30KD2-S and IRGBC30MD2-S products
- For hints see design tip 97003


D^2Pak

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	28	A
I_C @ T_C = 100°C	Continuous Collector Current	16	
I_{CM}	Pulsed Collector Current ①	58	
I_{LM}	Clamped Inductive Load Current ②	58	
I_F @ T_C = 100°C	Diode Continuous Forward Current	12	
I_{FM}	Diode Maximum Forward Current	58	
t_{sc}	Short Circuit Withstand Time	10	µs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation	100	W
P_D @ T_C = 100°C	Maximum Power Dissipation	42	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to +150	°C
	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	Typ.	Max.	Units
$R_{θJC}$	Junction-to-Case - IGBT	——	1.2	°C/W
$R_{θJC}$	Junction-to-Case - Diode		2.5	
$R_{θCS}$	Case-to-Sink, Flat, Greased Surface	0.5	——	
$R_{θJA}$	Junction-to-Ambient (PCB Mounted,steady-state)⑤	——	40	
Wt	Weight	1.44	——	g

4/24/2000

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage③	600	—	—	V	V_{GE} = 0V, I_C = 250µA	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.54	—	V/°C	V_{GE} = 0V, I_C = 1.0mA	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.21	2.7	V	I_C = 16A	V_{GE} = 15V
		—	2.88	—		I_C = 28A	See Fig. 2, 5
		—	2.36	—		I_C = 16A, T_J = 150°C	
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	6.0		V_{CE} = V_{GE}, I_C = 250µA	
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-12	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA	
g_{fe}	Forward Transconductance ④	5.4	8.1	—	S	V_{CE} = 100V, I_C = 16A	
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°C	
V_{FM}	Diode Forward Voltage Drop	—	1.4	1.7	V	I_C = 12A	See Fig. 13
		—	1.3	1.6		I_C = 12A, T_J = 150°C	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±20V	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	
Q_g	Total Gate Charge (turn-on)	—	67	100	nC	I_C = 16A	
Q_{ge}	Gate - Emitter Charge (turn-on)	—	11	16		V_{CC} = 400V See Fig.8	
Q_{gc}	Gate - Collector Charge (turn-on)	—	25	37		V_{GE} = 15V	
$t_{d(on)}$	Turn-On Delay Time	—	60	—	ns		
t_r	Rise Time	—	42	—		T_J = 25°C	
$t_{d(off)}$	Turn-Off Delay Time	—	160	250		I_C = 16A, V_{CC} = 480V	
t_f	Fall Time	—	80	120		V_{GE} = 15V, R_G = 23Ω	
E_{on}	Turn-On Switching Loss	—	0.60	—	mJ	Energy losses include "tail"	
E_{off}	Turn-Off Switching Loss	—	0.58	—		and diode reverse recovery	
E_{ts}	Total Switching Loss	—	1.18	1.6		See Fig. 9,10,14	
t_{sc}	Short Circuit Withstand Time	10	—	—	µs	V_{CC} = 360V, T_J = 125°C	
						V_{GE} = 15V, R_G = 10Ω , V_{CPK} < 500V	
$t_{d(on)}$	Turn-On Delay Time	—	58	—	ns	T_J = 150°C, See Fig. 11,14	
t_r	Rise Time	—	42	—		I_C = 16A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	—	210	—		V_{GE} = 15V, R_G = 23Ω	
t_f	Fall Time	—	160	—		Energy losses include "tail"	
E_{ts}	Total Switching Loss	—	1.69	—	mJ	and diode reverse recovery	
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	—	920	—	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	—	110	—		V_{CC} = 30V See Fig. 7	
C_{res}	Reverse Transfer Capacitance	—	27	—		ƒ = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	—	42	60	ns	T_J = 25°C See Fig.	
		—	80	120		T_J = 125°C 14	I_F = 12A
I_{rr}	Diode Peak Reverse Recovery Current	—	3.5	6.0	A	T_J = 25°C See Fig.	
		—	5.6	10		T_J = 125°C 15	V_R = 200V
Q_{rr}	Diode Reverse Recovery Charge	—	80	180	nC	T_J = 25°C See Fig.	
		—	220	600		T_J = 125°C 16	di/dt = 200Aµs
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery	—	180	—	A/µs	T_J = 25°C See Fig.	
	During t_b	—	160	—		T_J = 125°C 17	

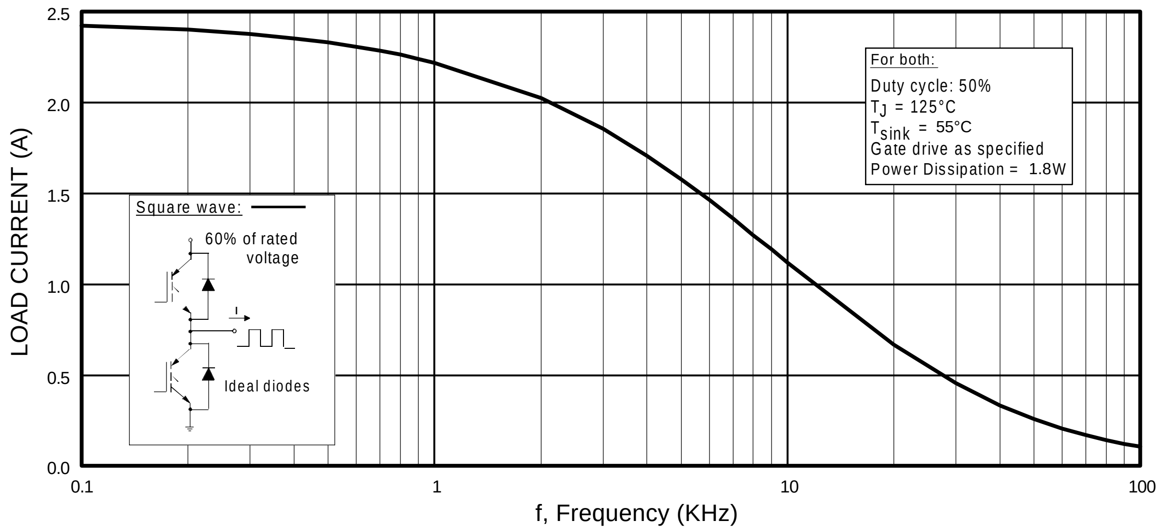


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

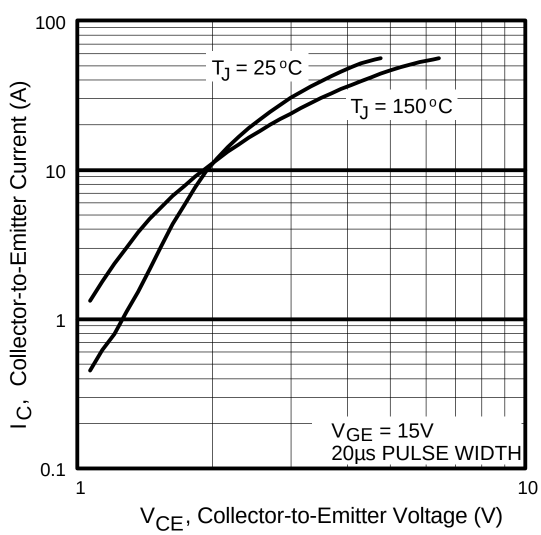


Fig. 2 - Typical Output Characteristics

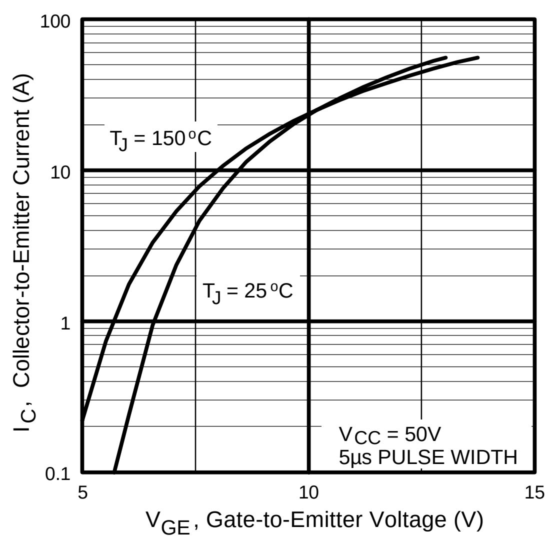


Fig. 3 - Typical Transfer Characteristics

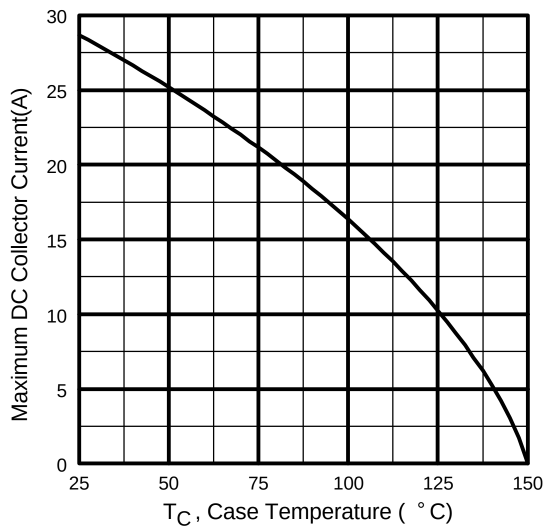


Fig. 4 - Maximum Collector Current vs. Case Temperature

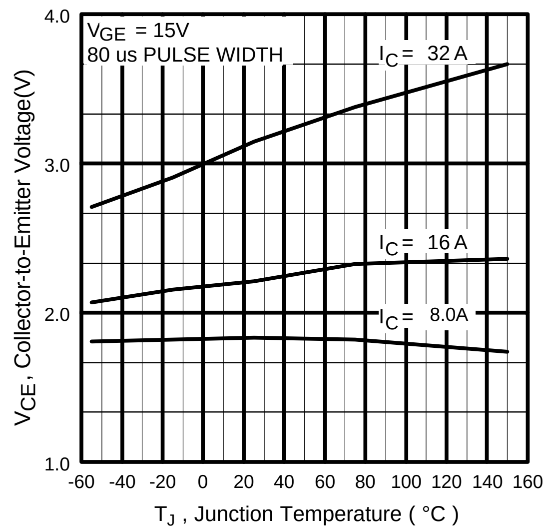


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

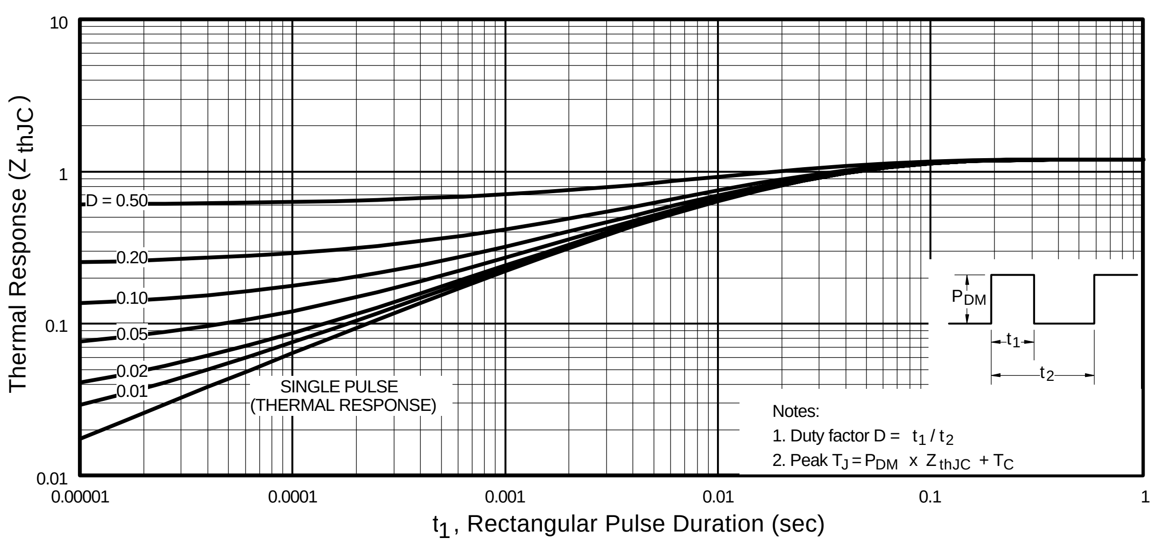


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

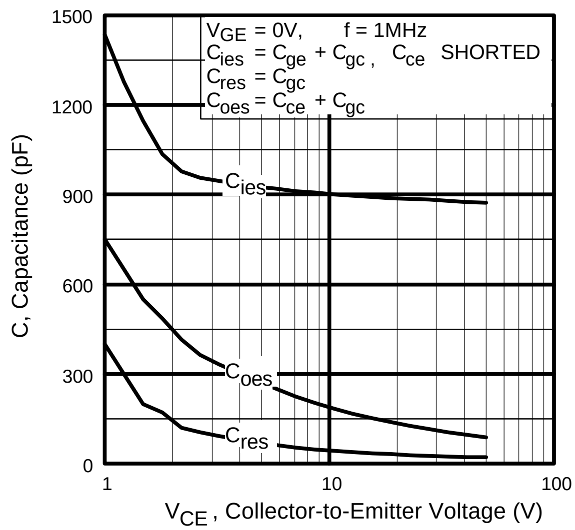


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

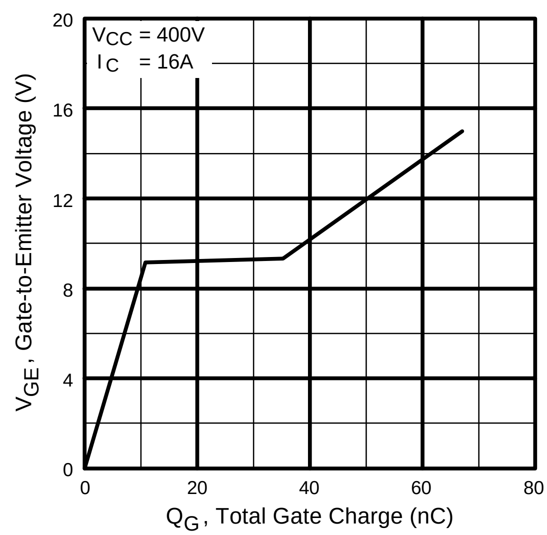


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

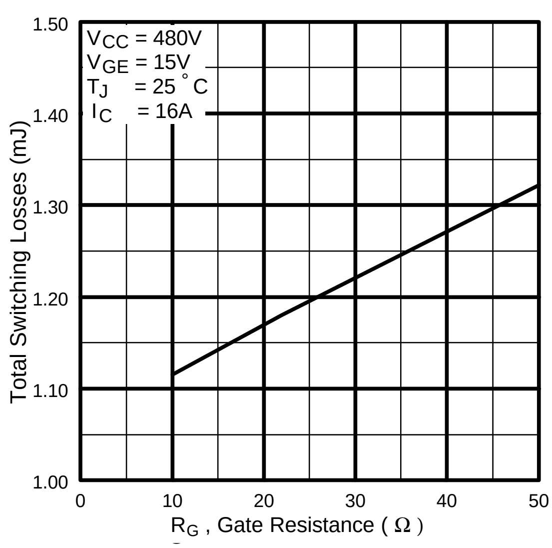


Fig. 9 - Typical Switching Losses vs. Gate Resistance

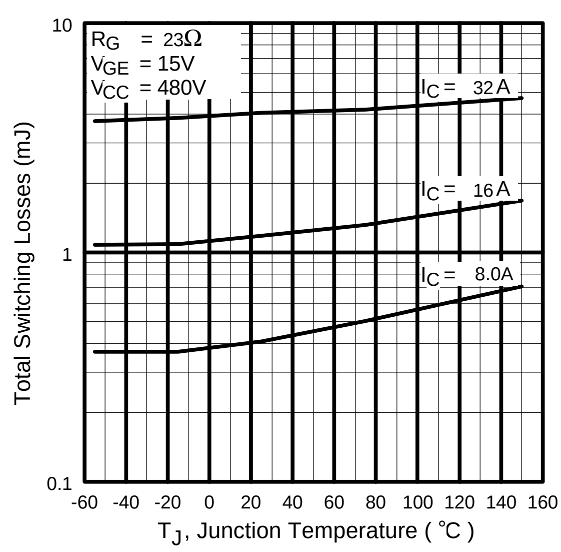


Fig. 10 - Typical Switching Losses vs. Junction Temperature

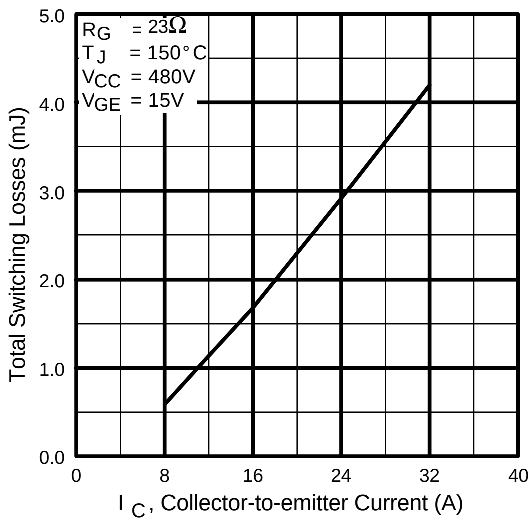


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

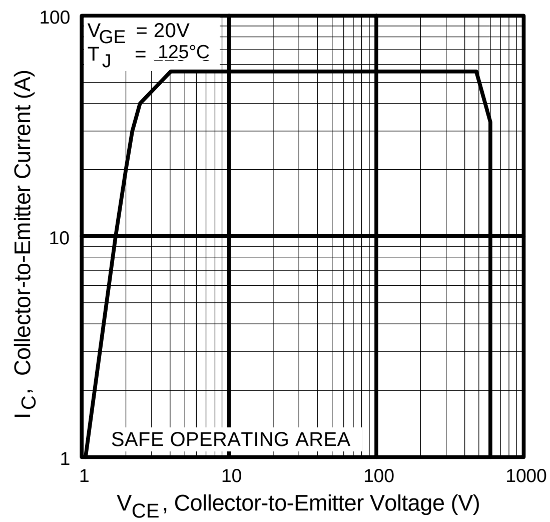


Fig. 12 - Turn-Off SOA

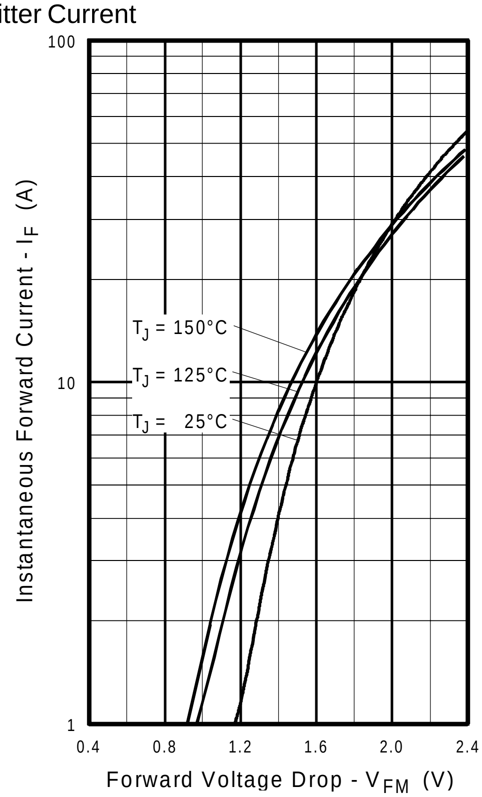


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

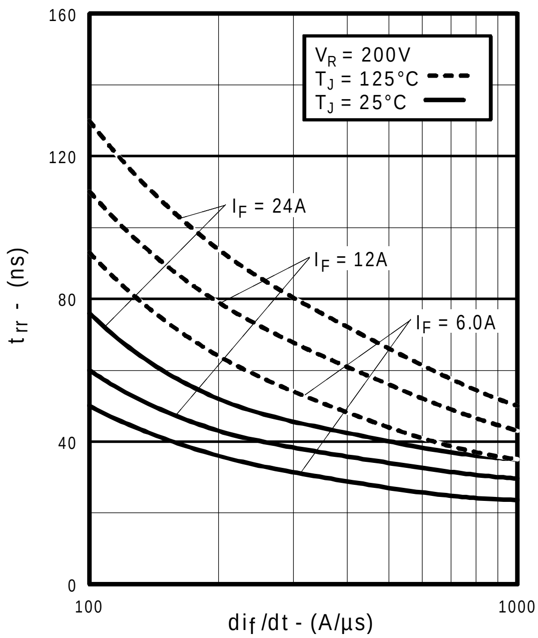


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

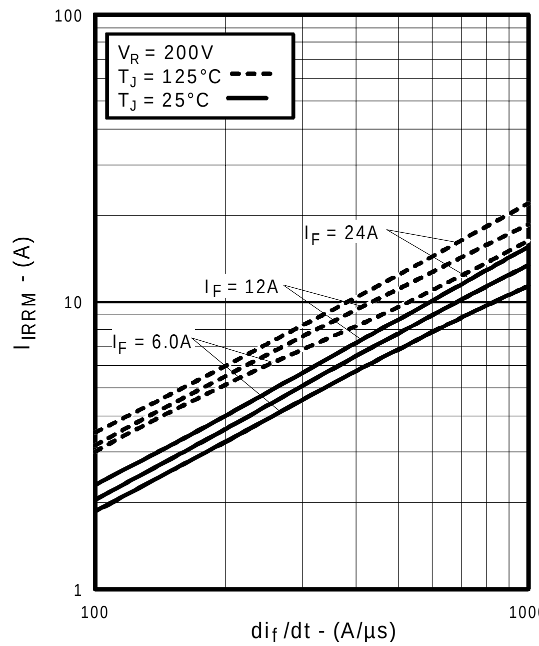


Fig. 15 - Typical Recovery Current vs. di_f/dt

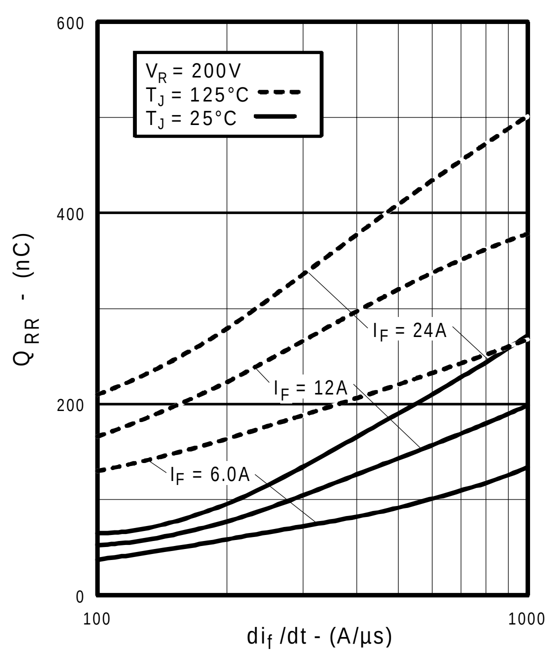


Fig. 16 - Typical Stored Charge vs. di_f/dt

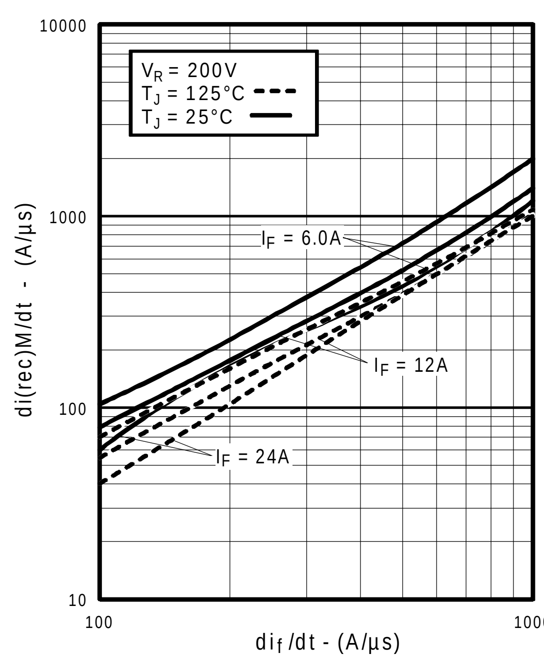


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

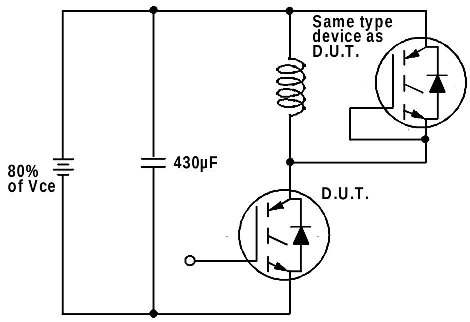


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

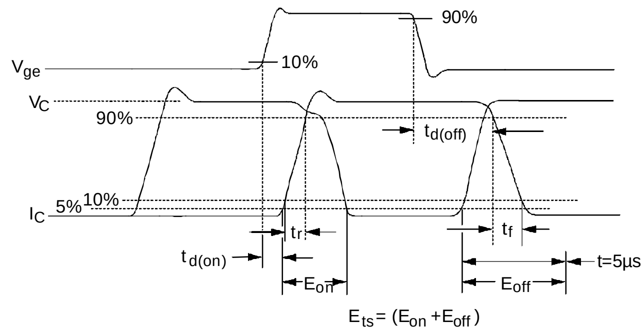


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

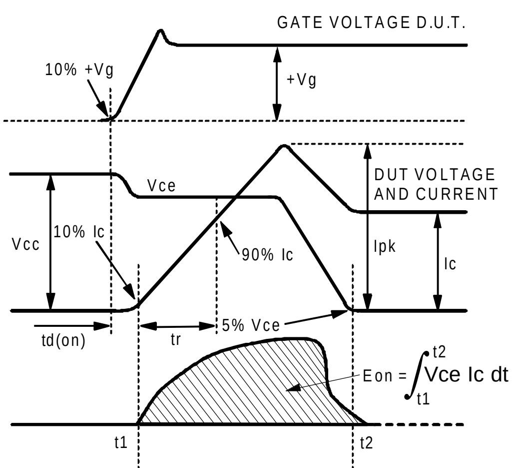


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

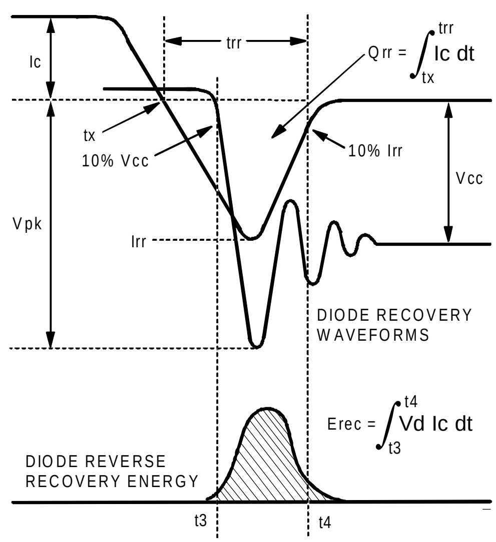


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

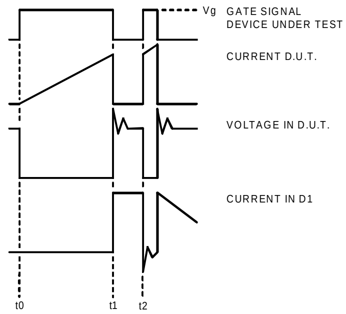


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

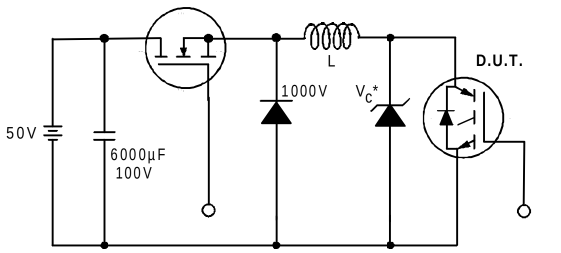


Figure 19. Clamped Inductive Load Test Circuit

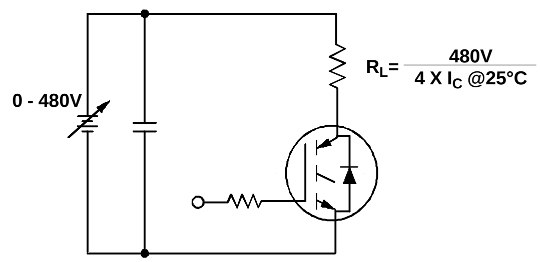
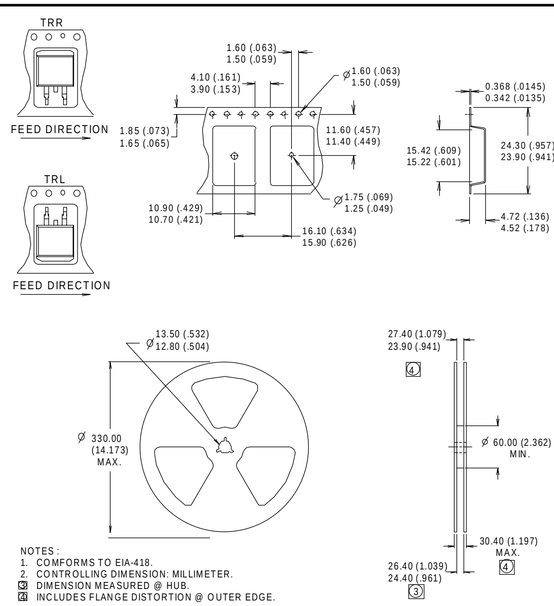


Figure 20. Pulsed Collector Current Test Circuit

Tape & Reel Information

D^{2}Pak



Notes:

① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature (figure 20)

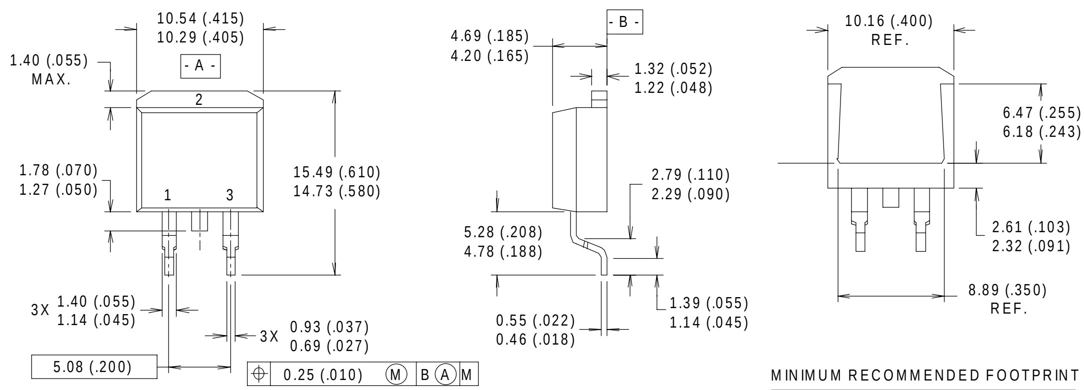
② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10µH, R_G= 23Ω (figure 19)

③ Pulse width ≤ 80µs; duty factor ≤ 0.1%.

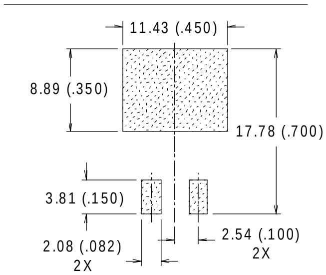
④ Pulse width 5.0µs, single shot.

⑤ When mounted on 1" square PCB (FR-4 or G-10 Material).
For recommended footprint and soldering techniques refer to application note #AN-994.

D^{2}Pak Package Outline



MINIMUM RECOMMENDED FOOTPRINT



NOTES:
1 DIMENSIONS AFTER SOLDER DIP.
2 DIMENSIONING & TOLERANCING PER ANSI Y14.5M, 1982.
3 CONTROLLING DIMENSION : INCH.
4 HEATSINK & LEAD DIMENSIONS DO NOT INCLUDE BURRS.

LEAD ASSIGNMENTS
1 - GATE
2 - DRAIN
3 - SOURCE

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Data and specifications subject to change without notice. 10/00

Note: For the most current drawings please refer to the IR website at:
http://www.irf.com/package/