

IRG4IBC10UD

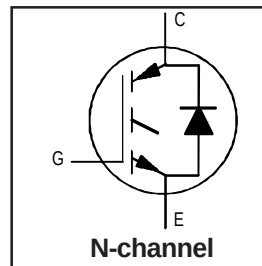
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE UltraFast Co-Pack IGBT

Features

- UltraFast: Optimized for high operating up to 80 kHz in hard switching, > 200 kHz in resonant mode
- Generation 4 IGBT design provides tighter parameter distribution and higher efficiency than previous generation
- IGBT co-packaged with HEXFRED® ultrafast, ultra-soft-recovery anti-parallel diodes for use in bridge configurations
- Industry standard TO-220 Full-Pak

Benefits

- Generation 4 IGBTs offer highest efficiencies available
- IGBTs optimized for specific application conditions
- HEXFRED® diodes optimized for performance with IGBTs
Minimized recovery characteristics require less/no snubbing



$V_{CES} = 600V$
$V_{CE(on)} \text{ typ.} = 2.15V$
@ $V_{GE} = 15V, I_C = 5.0A$
$t_f(\text{typ.}) = 140ns$



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	6.8	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	3.9	
I_{CM}	Pulsed Collector Current ①	27	
I_{LM}	Clamped Inductive Load Current ②	27	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	3.9	
I_{FM}	Diode Maximum Forward Current	27	
V_{ISOL}	RMS Isolated Voltage, Terminal to case, $t=1min$	2500	V
V_{GE}	Gate-to-Emitter Voltage	± 20	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	25	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	10	
T_J	Operating Junction and	-55 to +150	$^\circ C$
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	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	5.0	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	—	9.0	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	65	
Wt	Weight	2.1 (0.075)	—	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	$V_{GE} = 0V, I_C = 250\mu A$
$DV_{(BR)CES}/DT_J$	Temperature Coeff. of Breakdown Voltage	—	0.54	—	V/°C	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.15	2.6	V	$I_C = 5.0A, V_{GE} = 15V$
		—	2.61	—		$I_C = 8.5A, V_{GE} = 15V$
		—	2.30	—		$I_C = 5.0A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage ④	3.0	—	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$
$DV_{GE(th)}/DT_J$	Temperature Coeff. of Threshold Voltage	—	-8.7	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu A$
g_{fe}	Forward Transconductance	2.8	4.2	—	S	$V_{CE} = 100V, I_C = 5.0A$
I_{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	1000		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	—	1.5	1.8	V	$I_C = 4.0A, V_{GE} = 15V$
		—	1.4	1.7		$I_C = 4.0A, T_J = 125^\circ\text{C}$
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)	—	15	22	nC	$I_C = 5.0A, V_{CC} = 400V, V_{GE} = 15V$
Q_{ge}	Gate - Emitter Charge (turn-on)	—	2.6	4.0		See Fig. 8
Q_{gc}	Gate - Collector Charge (turn-on)	—	5.8	8.7		
$t_{d(on)}$	Turn-On Delay Time	—	40	—	ns	$T_J = 25^\circ\text{C}$
t_r	Rise Time	—	16	—		$I_C = 5.0A, V_{CC} = 480V$
$t_{d(off)}$	Turn-Off Delay Time	—	87	130		$V_{GE} = 15V, R_G = 100\Omega$
t_f	Fall Time	—	140	210		Energy losses include "tail" and diode reverse recovery.
E_{on}	Turn-On Switching Loss	—	0.14	—	mJ	See Fig. 9, 10, 18
E_{off}	Turn-Off Switching Loss	—	0.12	—		
E_{ts}	Total Switching Loss	—	0.26	0.33		
$t_{d(on)}$	Turn-On Delay Time	—	38	—	ns	$T_J = 150^\circ\text{C}, I_C = 5.0A, V_{CC} = 480V$
t_r	Rise Time	—	18	—		$V_{GE} = 15V, R_G = 100\Omega$
$t_{d(off)}$	Turn-Off Delay Time	—	95	—		Energy losses include "tail" and diode reverse recovery.
t_f	Fall Time	—	250	—		
E_{ts}	Total Switching Loss	—	0.45	—	mJ	
L_E	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
C_{ies}	Input Capacitance	—	270	—	pF	$V_{GE} = 0V, V_{CC} = 30V, f = 1.0MHz$
C_{oes}	Output Capacitance	—	21	—		See Fig. 7
C_{res}	Reverse Transfer Capacitance	—	3.5	—		
t_{rr}	Diode Reverse Recovery Time	—	28	42	ns	$T_J = 25^\circ\text{C}$ See Fig. 14
		—	38	57		$T_J = 125^\circ\text{C}$
I_{rr}	Diode Peak Reverse Recovery Current	—	2.9	5.2	A	$T_J = 25^\circ\text{C}$ See Fig. 15
		—	3.7	6.7		$T_J = 125^\circ\text{C}$
Q_{rr}	Diode Reverse Recovery Charge	—	40	60	nC	$T_J = 25^\circ\text{C}$ See Fig. 16
		—	70	105		$T_J = 125^\circ\text{C}$
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	—	280	—	A/ μs	$T_J = 25^\circ\text{C}$ See Fig. 17
		—	235	—		$T_J = 125^\circ\text{C}$

Details of note ① through ④ are on the last page

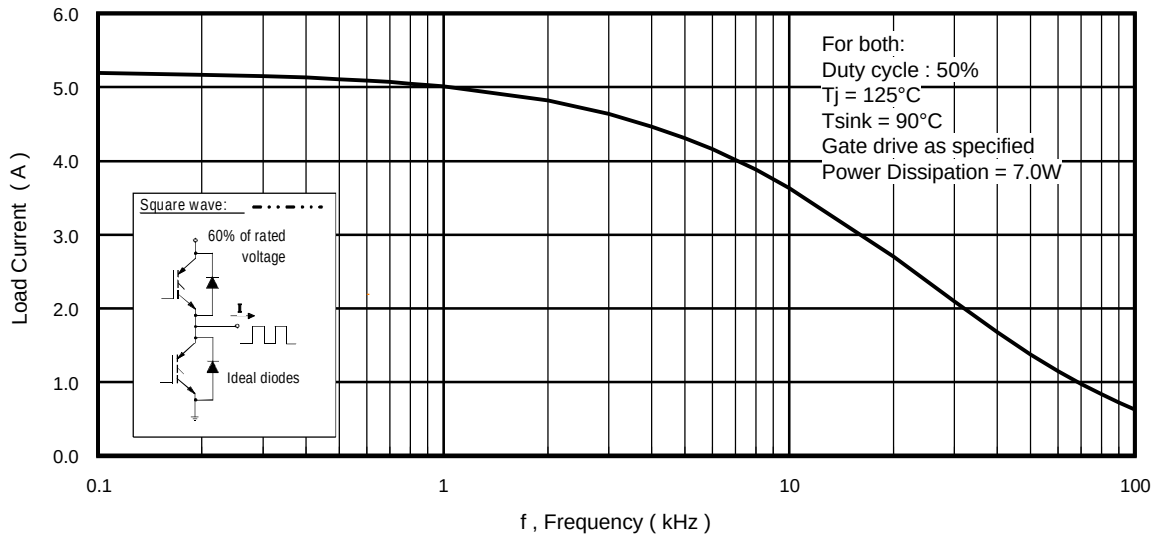


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

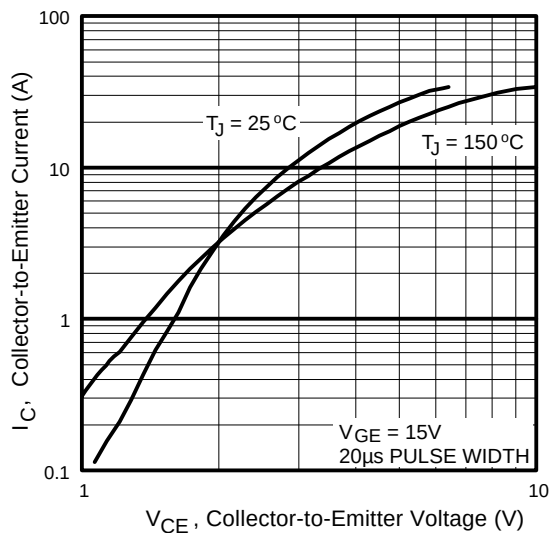


Fig. 2 - Typical Output Characteristics

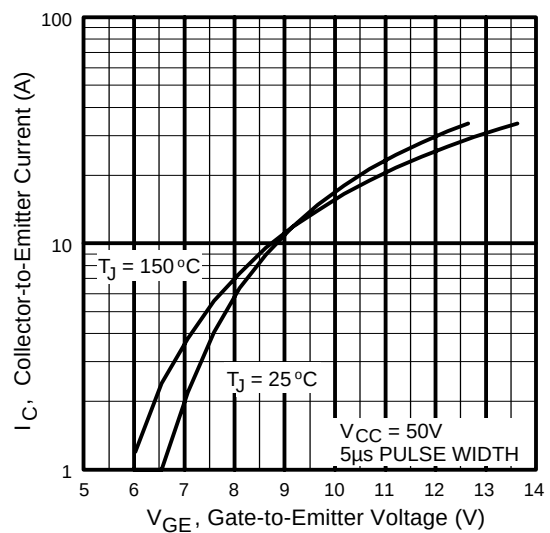


Fig. 3 - Typical Transfer Characteristics

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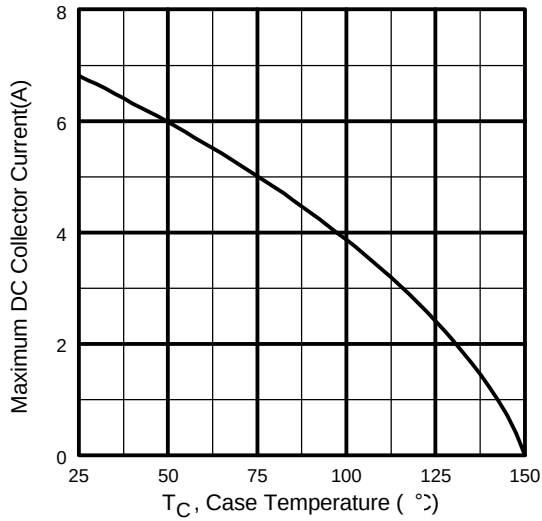


Fig. 4 - Maximum Collector Current vs. Case Temperature

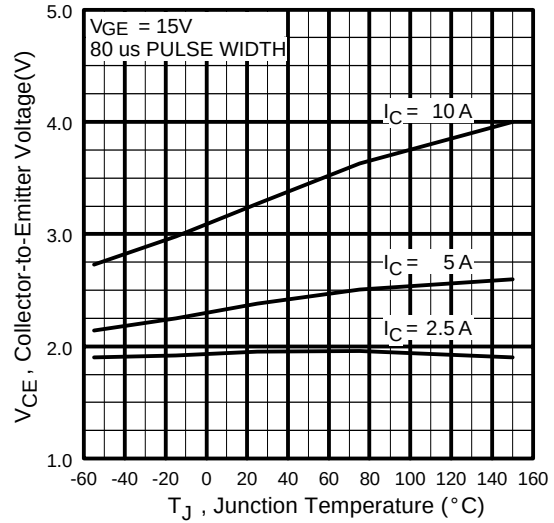


Fig. 5 - Typical Collector-to-Emitter Voltage vs. Junction Temperature

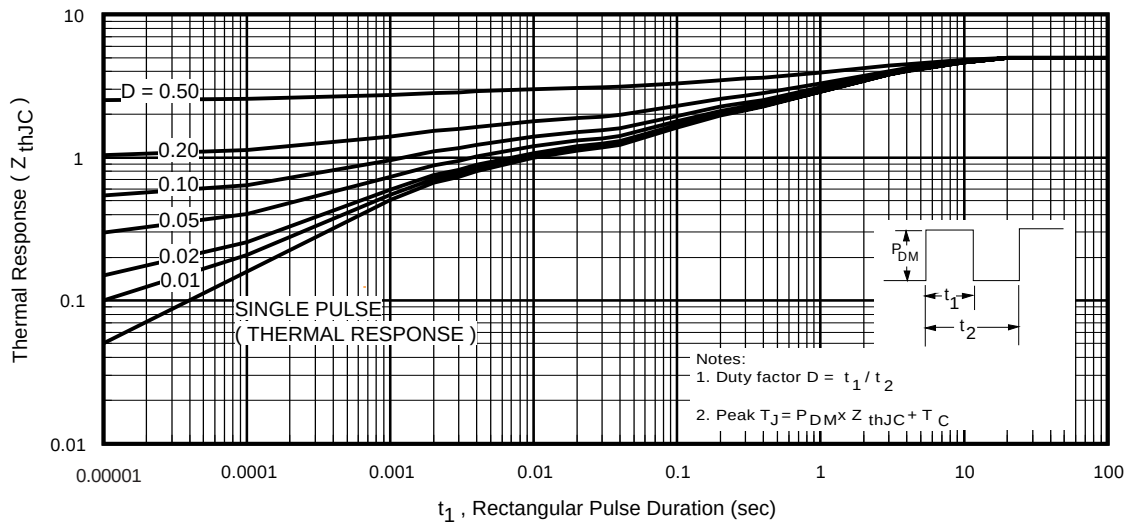


Fig. 6 - Maximum Effective Transient Thermal Impedance, Junction-to-Case

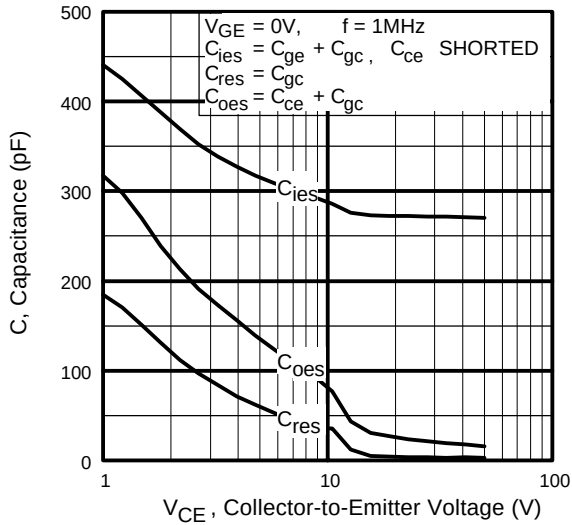


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

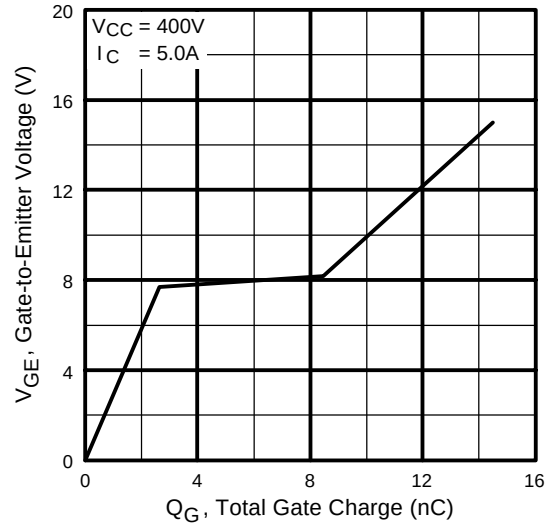


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

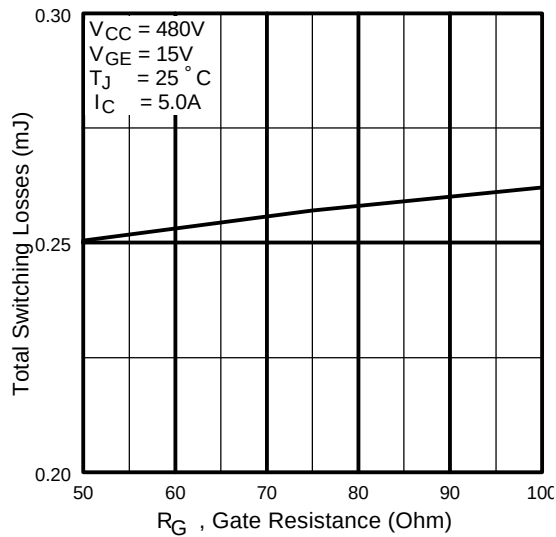


Fig. 9 - Typical Switching Losses vs. Gate Resistance

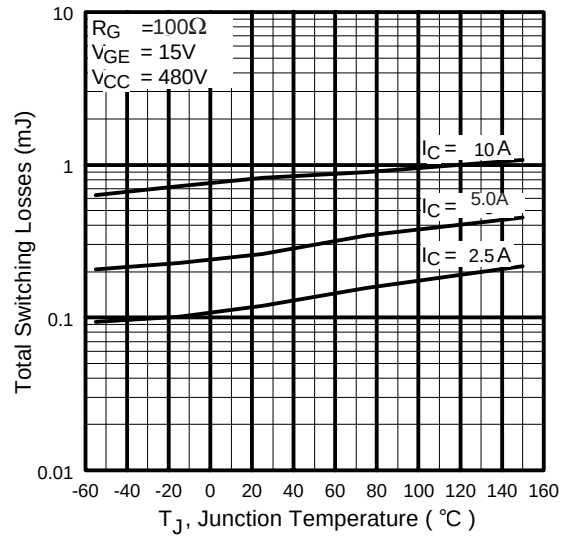
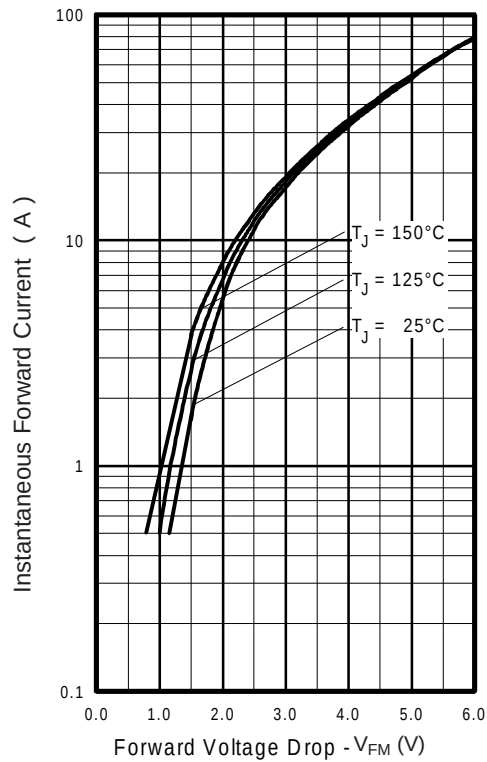
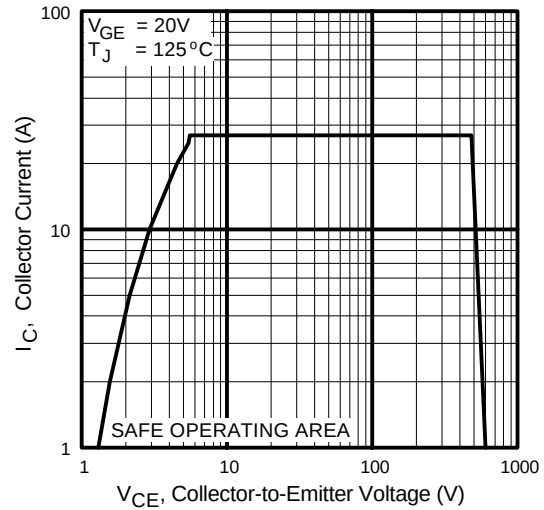
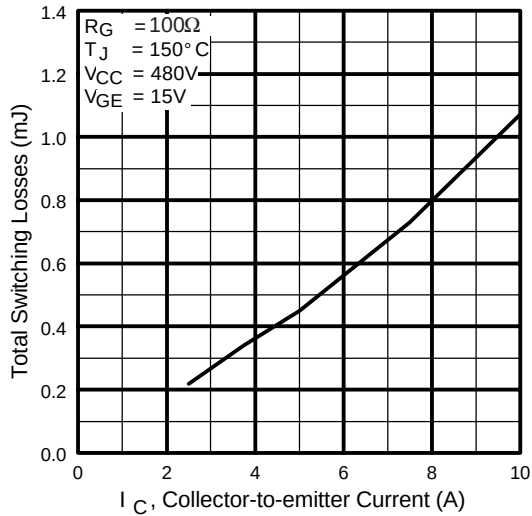


Fig. 10 - Typical Switching Losses vs. Junction Temperature

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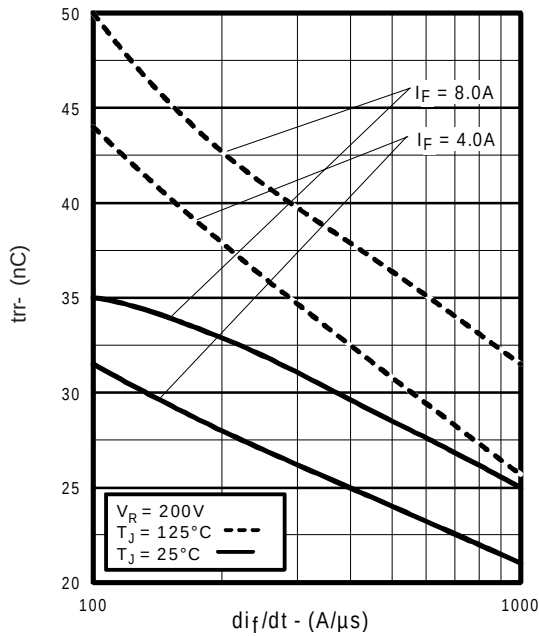


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

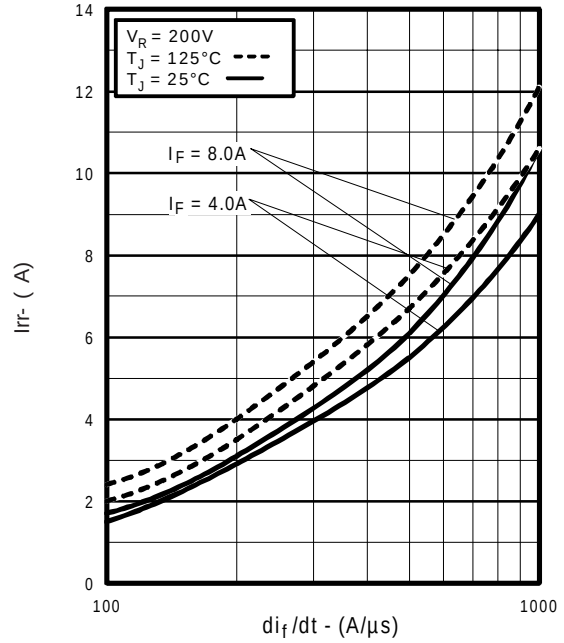


Fig. 15 - Typical Recovery Current vs. di_f/dt

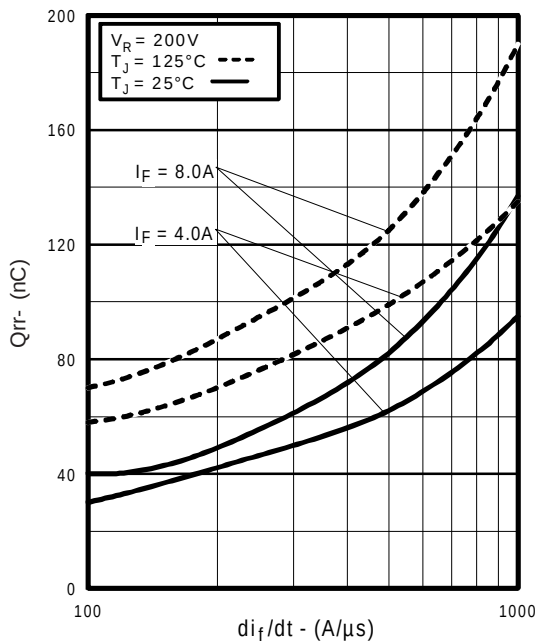


Fig. 16 - Typical Stored Charge vs. di_f/dt

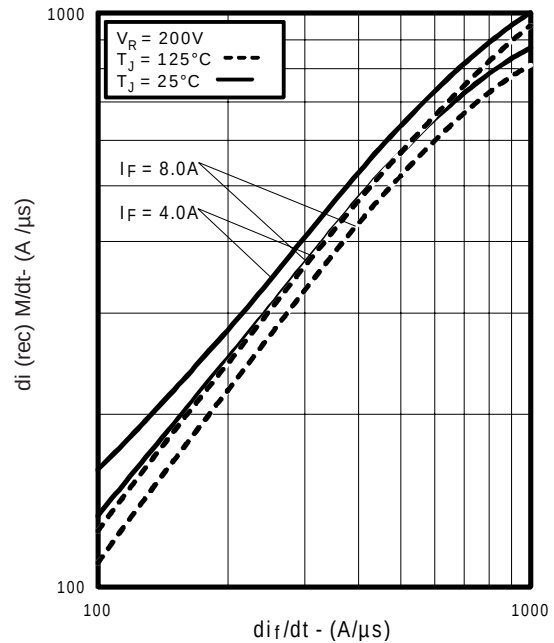


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

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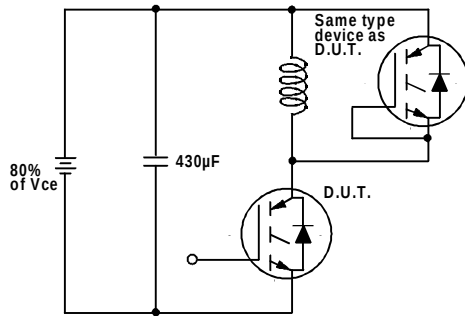


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

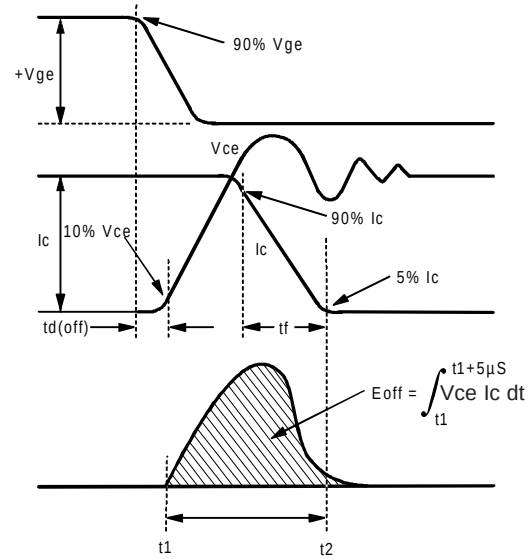


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

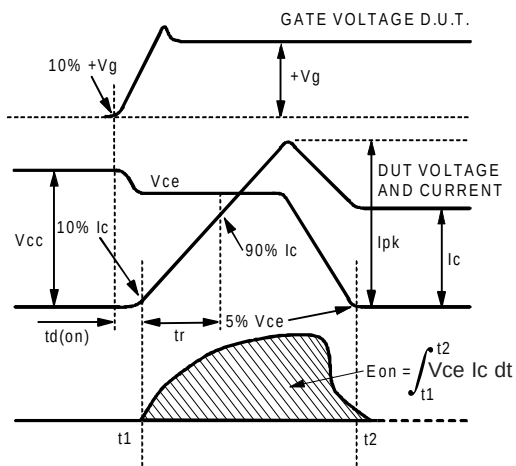


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

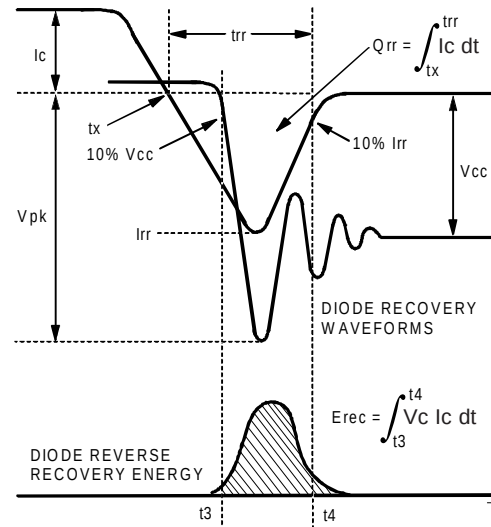


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

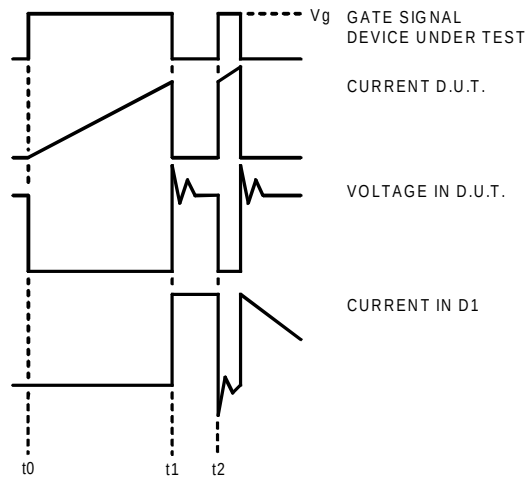


Fig. 18e - Macro Waveforms for Figure 18a's Test Circuit

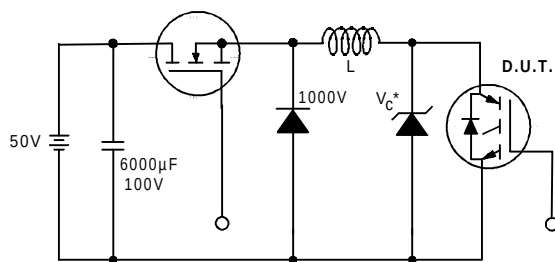


Fig. 19 - Clamped Inductive Load Test Circuit

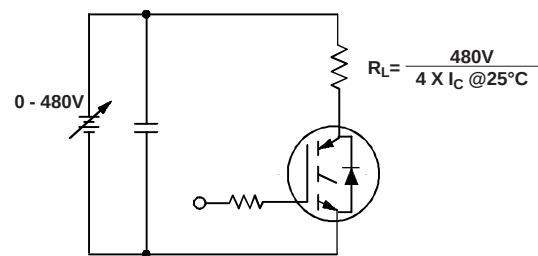
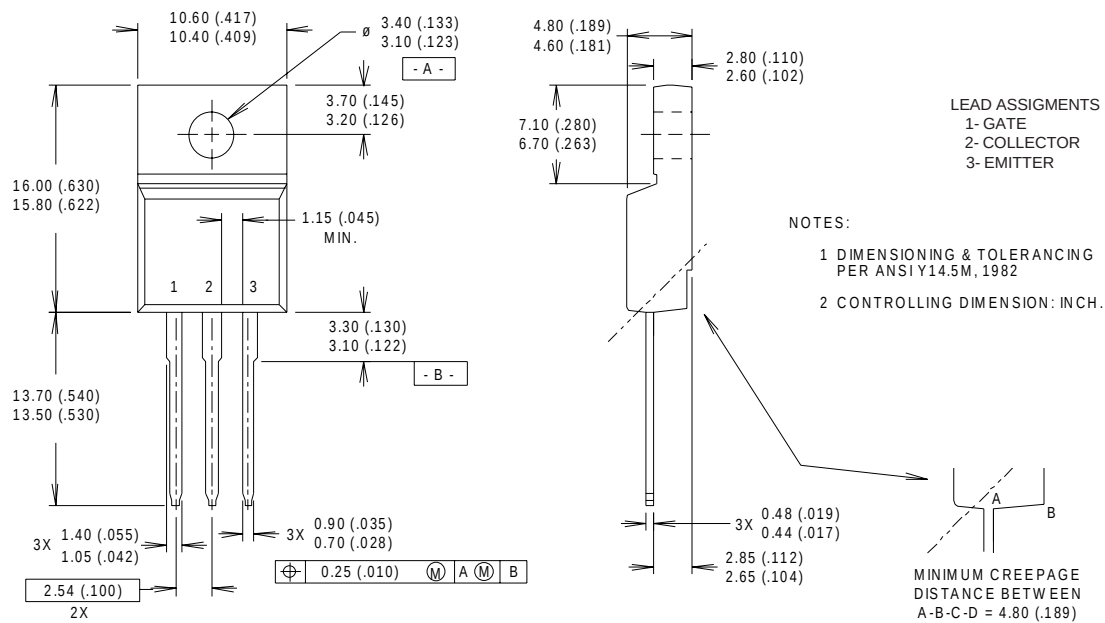


Fig. 20 - Pulsed Collector Current Test Circuit

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TO-220 Full-Pak Package Outline



Notes

- ① Repetitive rating: $V_{GE}=20V$; Pulse width limited by maximum junction temperature (figure 20)
- ② $V_{CC}=80\%(V_{CES})$, $V_{GE}=20V$, $L=10\mu H$, $R_G=100\Omega$ (figure 19)
- ③ Pulse width $\leq 80\mu s$, duty factor $\leq 0.1\%$.
- ④ Pulse width $5.0\mu s$, single shot.

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