

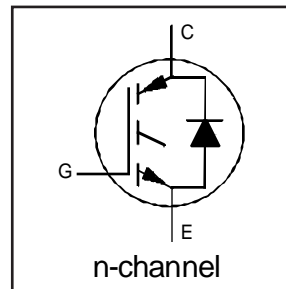
IRGPC50MD2

INSULATED GATE BIPOLAR TRANSISTOR
WITH ULTRAFAST SOFT RECOVERY DIODE

Short Circuit Rated Fast
CoPack IGBT

Features

- Short circuit rated -10 μ s @125°C, $V_{GE} = 15V$
- Switching-loss rating includes all "tail" losses
- HEXFRED™ soft ultrafast diodes
- Optimized for medium operating frequency (1 to 10kHz) See Fig. 1 for Current vs. Frequency curve



$V_{CES} = 600V$

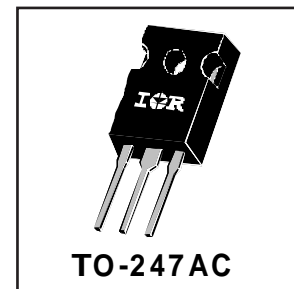
$V_{CE(sat)} \leq 2.0V$

@ $V_{GE} = 15V, I_C = 35A$

Description

Co-packaged IGBTs are a natural extension of International Rectifier's well known IGBT line. They provide the convenience of an IGBT and an ultrafast recovery diode in one package, resulting in substantial benefits to a host of high-voltage, high-current, applications.

These new short circuit rated devices are especially suited for motor control and other applications requiring short circuit withstand capability.



Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	60	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	35	
I_{CM}	Pulsed Collector Current ①	120	
I_{LM}	Clamped Inductive Load Current ②	120	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	25	
I_{FM}	Diode Maximum Forward Current	120	
t_{sc}	Short Circuit Withstand Time	10	μs
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	200	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	78	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.		
	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	-----	-----	0.64	$^\circ C/W$
$R_{\theta JC}$	Junction-to-Case - Diode	-----	-----	0.83	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	-----	0.24	-----	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	-----	-----	40	
Wt	Weight	-----	6 (0.21)	-----	g (oz)

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Electrical Characteristics @ T_J = 25°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 = 250μA
ΔV _{(BR)CES/ΔT_J}	Temperature Coeff. of Breakdown Voltage	----	0.62	----	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	----	1.8	2.0	V	I _C = 35A V _{GE} = 15V I _C = 60A See Fig. 2, 5 I _C = 35A, T _J = 150°C
		----	2.3	----		
		----	2.0	----		
V _{GE(th)}	Gate Threshold Voltage	3.0	----	5.5		V _{CE} = V _{GE} , I _C = 250μA
ΔV _{GE(th)/ΔT_J}	Temperature Coeff. of Threshold Voltage	----	-14	----	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ^④	11	20	----	S	V _{CE} = 100V, I _C = 35A
I _{CES}	Zero Gate Voltage Collector Current	----	----	250	μA	V _{GE} = 0V, V _{CE} = 600V
		----	----	6500		V _{GE} = 0V, V _{CE} = 600V, T _J = 150°C
V _{FM}	Diode Forward Voltage Drop	----	1.3	1.7	V	I _C = 25A See Fig. 13 I _C = 25A, T _J = 150°C
		----	1.2	1.5		
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)	----	120	180	nC	I _C = 35A V _{CC} = 400V See Fig. 8
Q _{ge}	Gate - Emitter Charge (turn-on)	----	25	38		
Q _{gc}	Gate - Collector Charge (turn-on)	----	40	60		
t _{d(on)}	Turn-On Delay Time	----	78	----	ns	T _J = 25°C I _C = 35A, V _{CC} = 480V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery.
t _r	Rise Time	----	110	----		
t _{d(off)}	Turn-Off Delay Time	----	340	510		
t _f	Fall Time	----	265	400	mJ	See Fig. 9, 10, 11, 18
E _{on}	Turn-On Switching Loss	----	2.1	----		
E _{off}	Turn-Off Switching Loss	----	4.0	----		
E _{ts}	Total Switching Loss	----	6.1	9.5	μs	V _{CC} = 360V, T _J = 125°C V _{GE} = 15V, R _G = 5.0Ω, V _{CPK} < 500V
t _{sc}	Short Circuit Withstand Time	10	----	----		
t _{d(on)}	Turn-On Delay Time	----	80	----		
t _r	Rise Time	----	110	----	ns	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 35A, V _{CC} = 480V V _{GE} = 15V, R _G = 5.0Ω Energy losses include "tail" and diode reverse recovery.
t _{d(off)}	Turn-Off Delay Time	----	610	----		
t _f	Fall Time	----	440	----		
E _{ts}	Total Switching Loss	----	9.4	----	mJ	diode reverse recovery.
L _E	Internal Emitter Inductance	----	13	----	nH	Measured 5mm from package
C _{ies}	Input Capacitance	----	2900	----	pF	V _{GE} = 0V V _{CC} = 30V See Fig. 7 f = 1.0MHz
C _{oes}	Output Capacitance	----	230	----		
C _{res}	Reverse Transfer Capacitance	----	30	----		
t _{rr}	Diode Reverse Recovery Time	----	50	75	ns	T _J = 25°C See Fig. 14 T _J = 125°C
		----	105	160		
I _{rr}	Diode Peak Reverse Recovery Current	----	4.5	10	A	T _J = 25°C See Fig. 15 T _J = 125°C
		----	8.0	15		
Q _{rr}	Diode Reverse Recovery Charge	----	112	375	nC	T _J = 25°C See Fig. 16 T _J = 125°C
		----	420	1200		
μs					A/μs	d _(rec) /dt Diode Peak Rate of Fall of Recovery

Notes:

① Repetitive rating; V_{GE}=20V, pulse width limited by max. junction temperature. (See fig. 20)

T_J = 125°C, V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 10μH, R_G = 5.0Ω, (See fig. 19)

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

④ Pulse width 5.0μs, single shot.

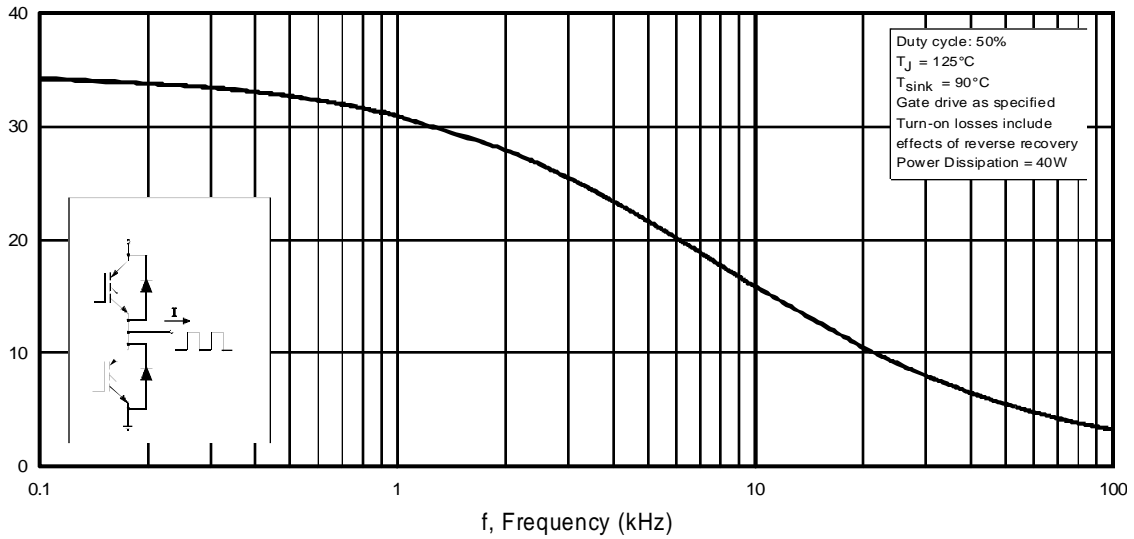


Fig. 1 - Typical Load Current vs. Frequency
 (Load Current = I_{RMS} of fundamental)

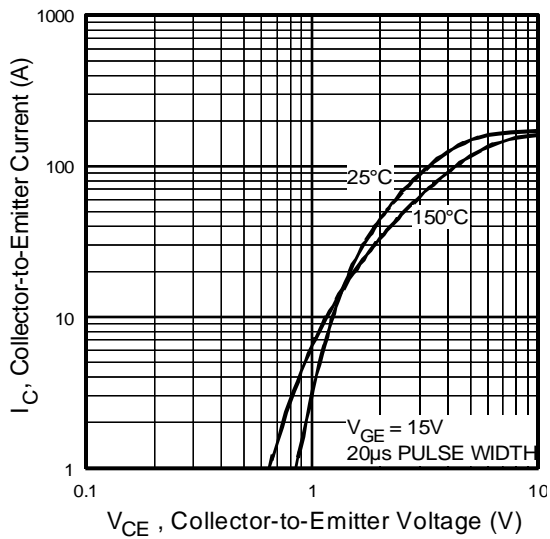


Fig. 2 - Typical Output Characteristics

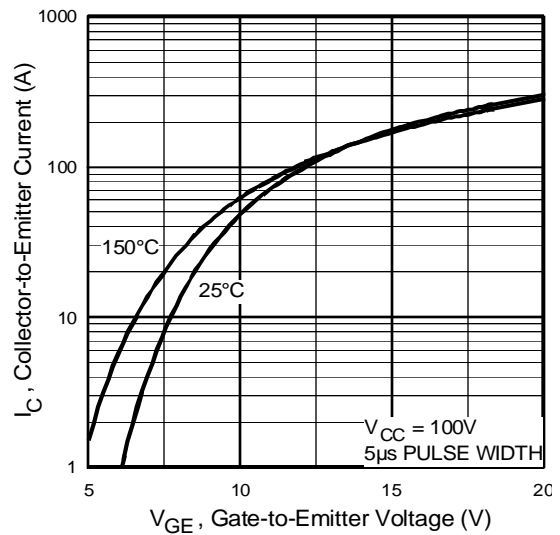


Fig. 3 - Typical Transfer Characteristics

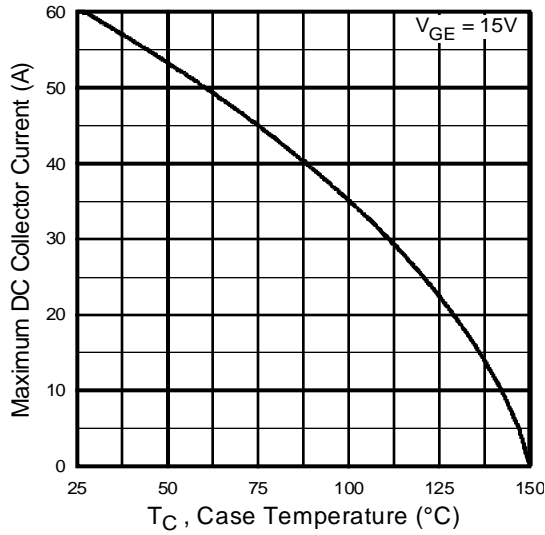


Fig. 4 - Maximum Collector Current vs. Case Temperature

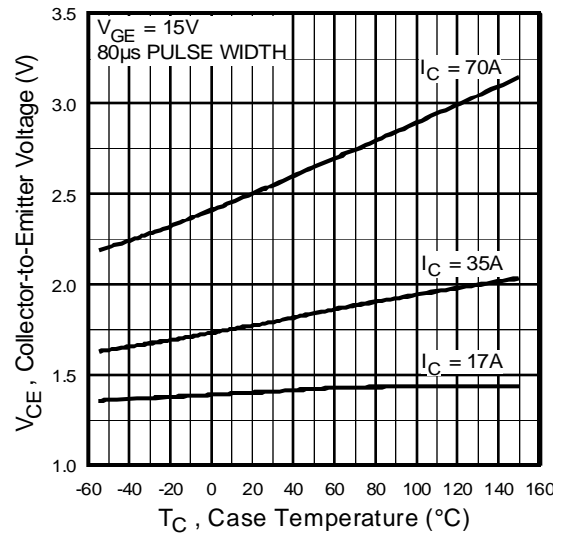


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

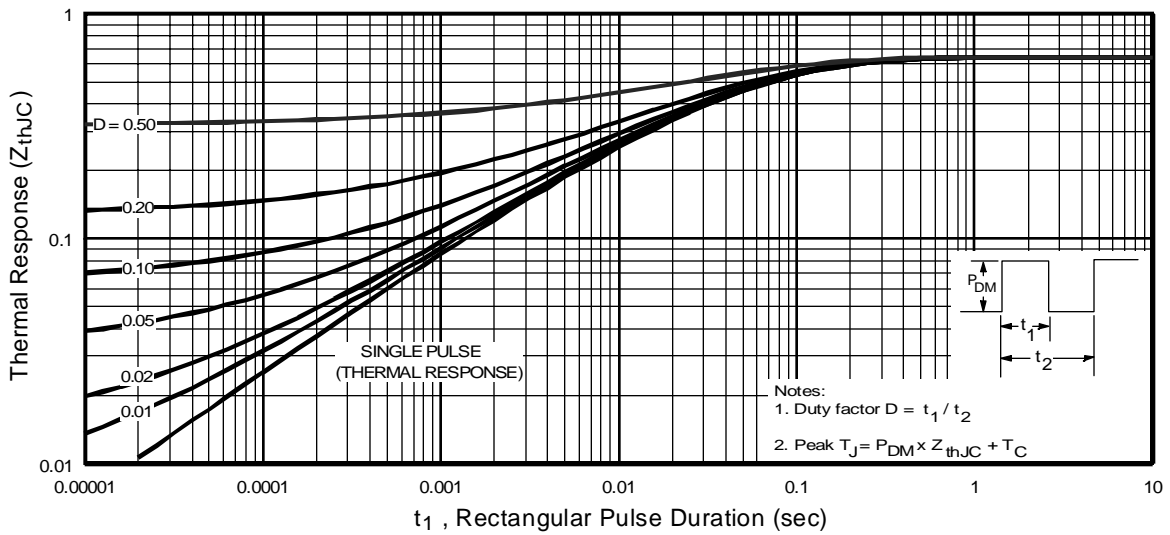


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case



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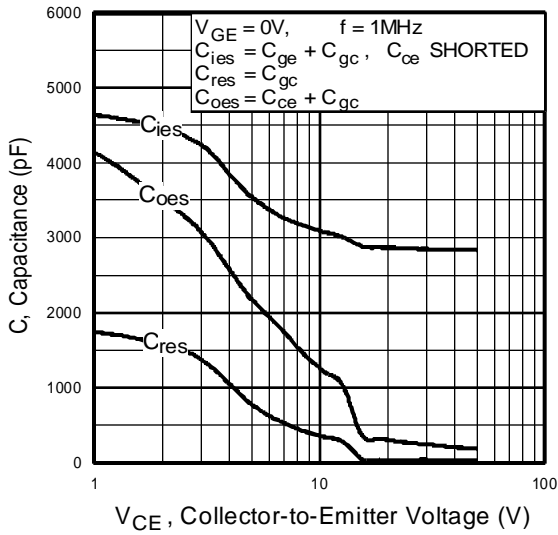


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

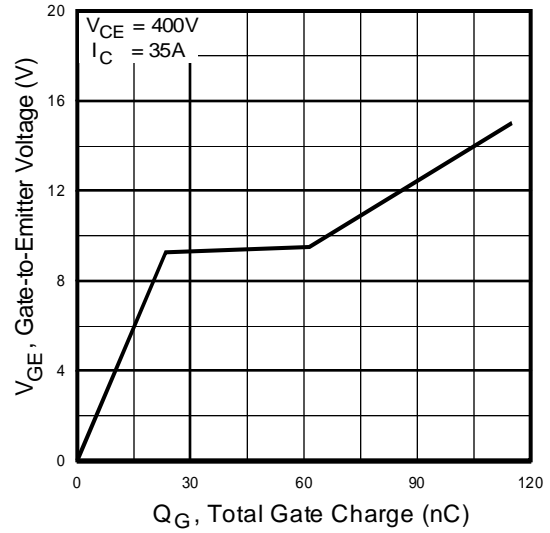


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

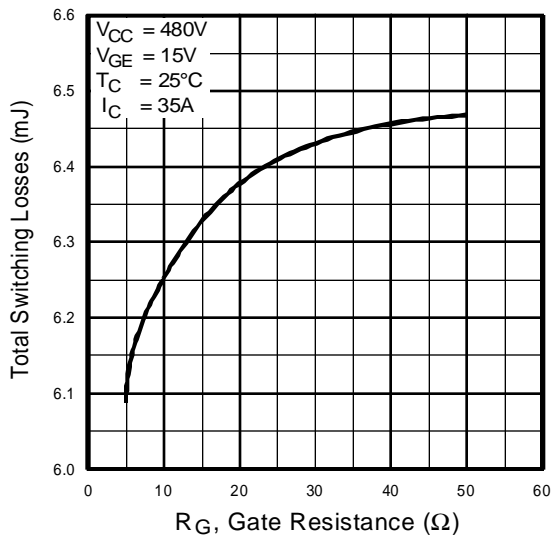


Fig. 9 - Typical Switching Losses vs. Gate Resistance

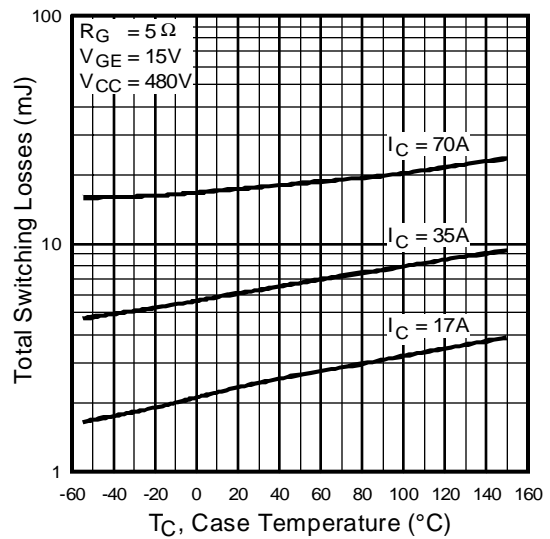


Fig. 10 - Typical Switching Losses vs. Case Temperature

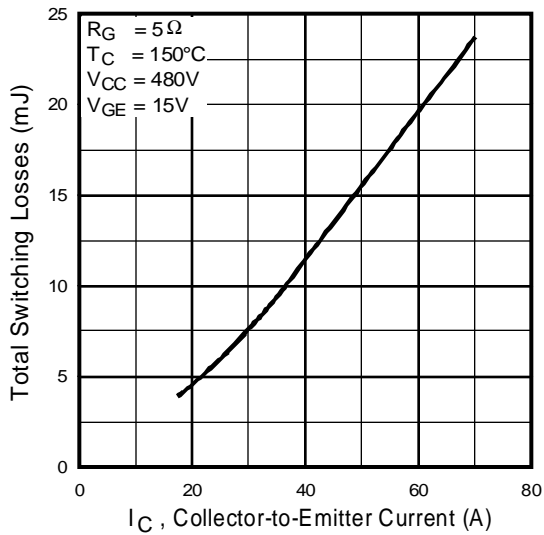


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

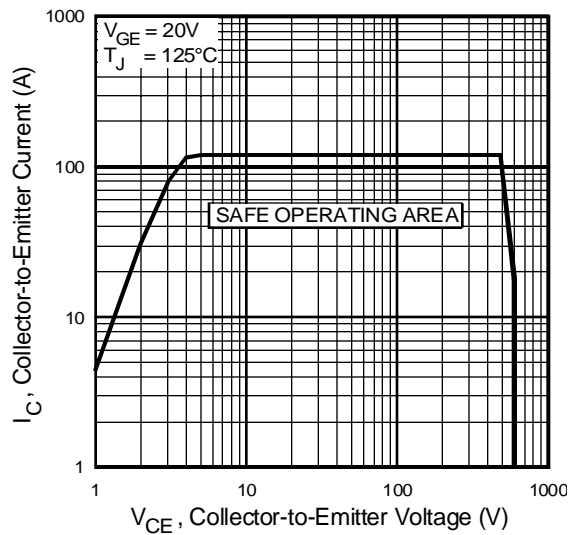


Fig. 12 - Turn-Off SOA

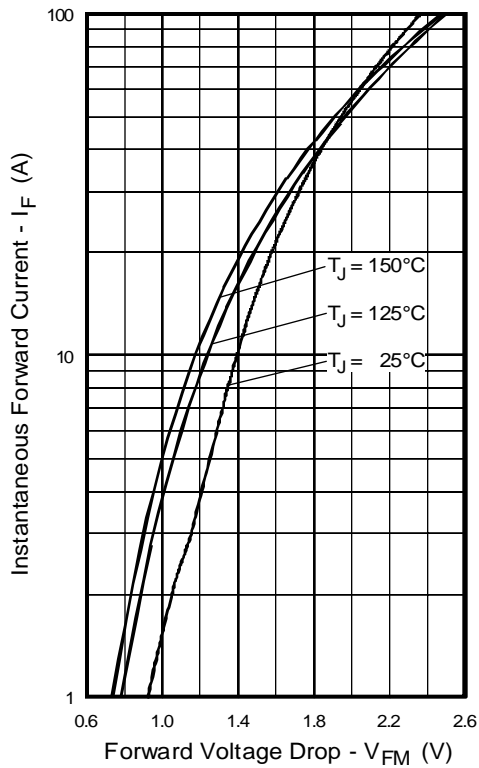


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

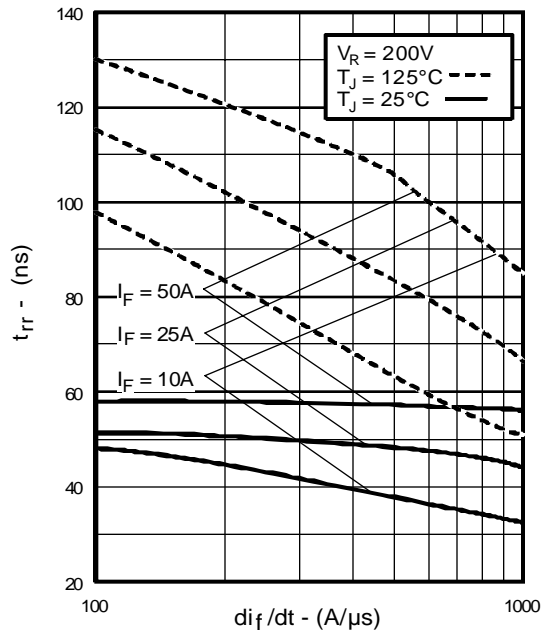


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

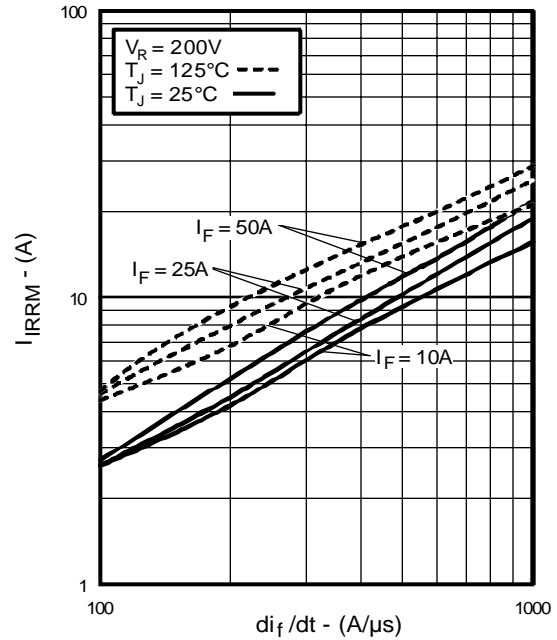


Fig. 15 - Typical Recovery Current vs. di_f/dt

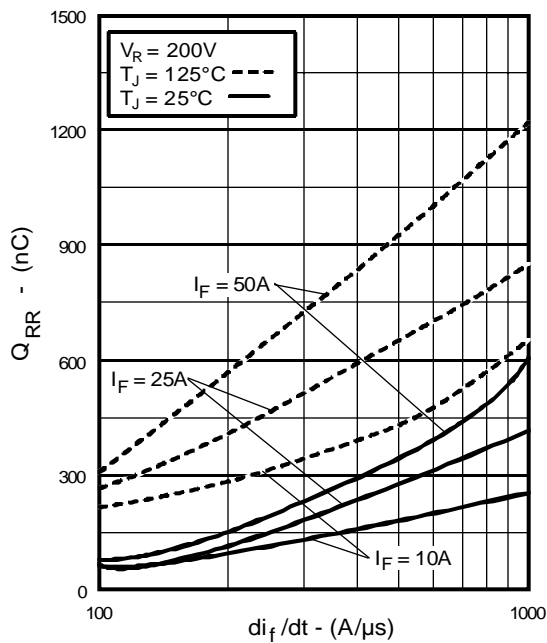


Fig. 16 - Typical Stored Charge vs. di_f/dt

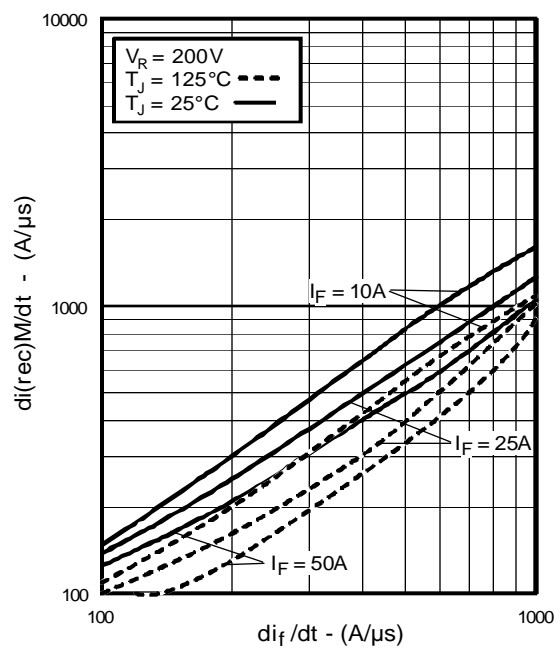


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

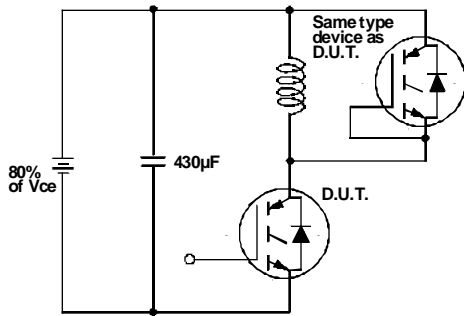


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

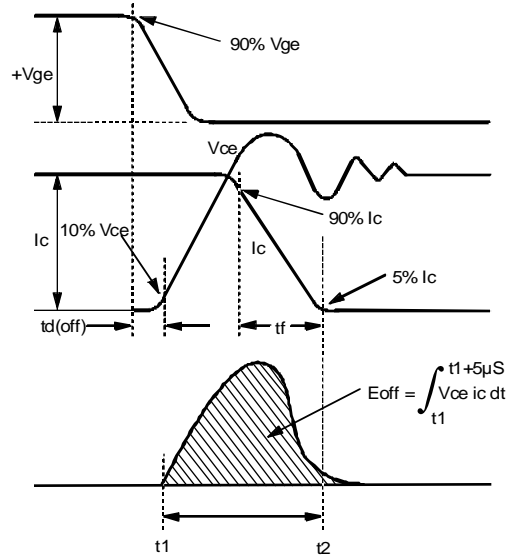


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

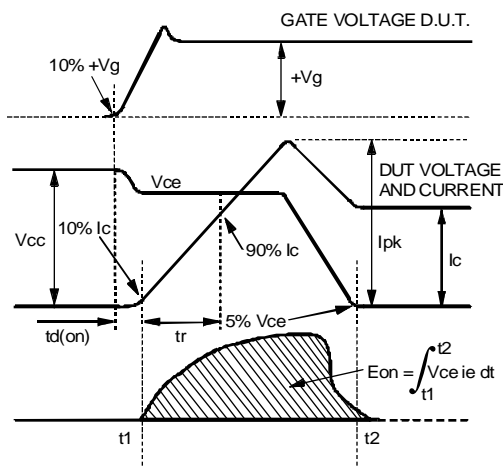


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

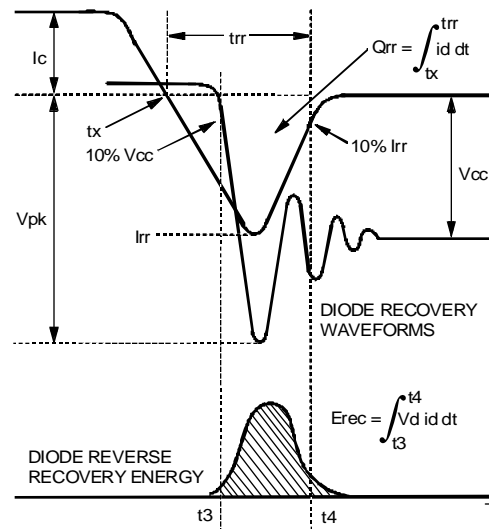


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}



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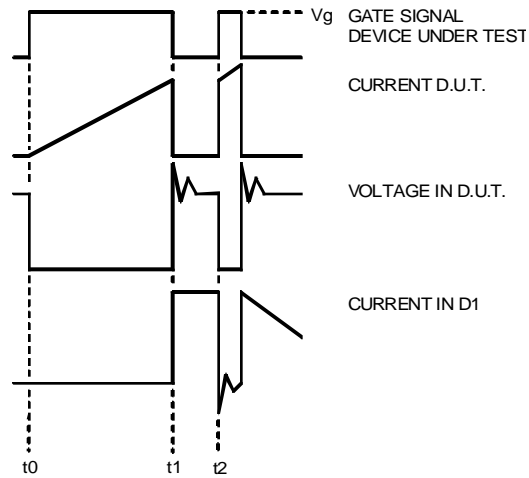


Fig. 18e - Macro Waveforms for Test Circuit of Fig. 18a

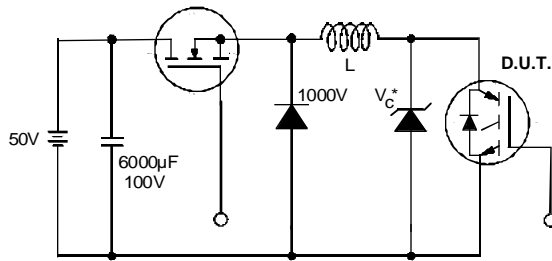


Fig. 19 - Clamped Inductive Load Test Circuit

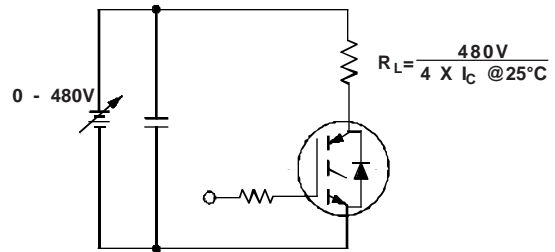
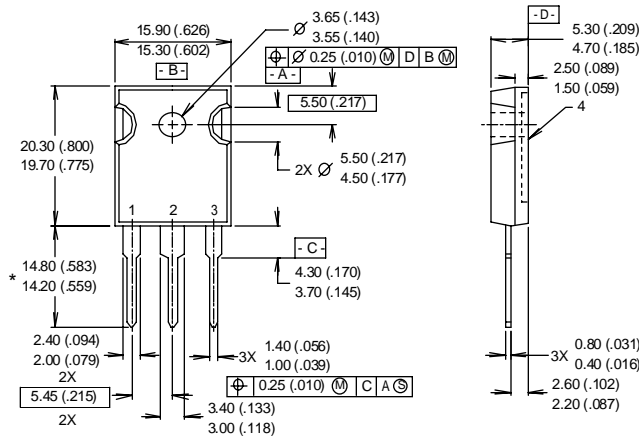


Fig. 20 - Pulsed Collector Current Test Circuit



- NOTES:
- 1 DIMENSIONS & TOLERANCING PER ANSI Y14.5M, 1982.
 - 2 CONTROLLING DIMENSION : INCH.
 - 3 DIMENSIONS ARE SHOWN MILLIMETERS (INCHES).
 - 4 CONFORMS TO JEDEC OUTLINE TO-247AC.

- LEAD ASSIGNMENTS
- 1 - GATE
 - 2 - COLLECTOR
 - 3 - EMITTER
 - 4 - COLLECTOR

* LONGER LEADED (20mm) VERSION AVAILABLE (TO-247AD) TO ORDER ADD "E" SUFFIX TO PART NUMBER

CONFORMS TO JEDEC OUTLINE TO-247AC (TO-3P)
Dimensions in Millimeters and (Inches)