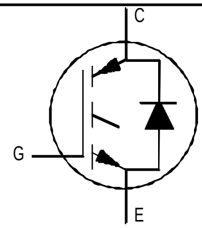
International
IOR Rectifier

PROVISIONAL

IRGBC20SD2

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Standard Speed CoPack



n-channel

$V_{CES} = 600V$

$V_{CE(SAT)} \leq 2.4V$

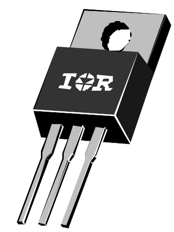
$@V_{GE} = 15V, I_C = 10A$

Features

- Switching-loss rating includes all 'tail' losses
- HEXFRED^{TM} soft ultrafast diodes
- Optimized for line frequency operation (to 400HZ)

Description

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



TO-220AB

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
I_C @ T_C = 25°C	Continuous Collector Current	19	A
I_C @ T_C = 100°C	Continuous Collector Current	10	
I_{CM}	Pulsed Collector Current ①	76	
I_{LM}	Clamped Inductive Load Current ②	38	
I_F @ T_C = 100°C	Diode Continuous Forward Current	7.0	
I_{FM}	Diode Maximum Forward Current	32	
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 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	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	------	------	2.1	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	------	------	3.5	
$R_{\theta CS}$	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°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	----	0.75	----	V/°C	V_{GE} = 0V, I_C = 1.0mA
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.8	2.4	V	I_C = 10A, V_{GE} = 15V
		----	2.4	----		I_C = 19A
		----	1.9	----		I_C = 10A, T_J = 150°C
$V_{GE(th)}$	Gate Threshold Voltage	3.0	----	5.5		V_{CE} = V_{GE}, I_C = 250µA
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	----	-11	----	mV/°C	V_{CE} = V_{GE}, I_C = 250µA
g_{fe}	Forward Transconductance ④	2.0	5.8	----	S	V_{CE} = 100V, I_C = 10A
I_{CES}	Zero Gate Voltage Collector Current	----	----	250	µA	V_{GE} = 0V, V_{CE} = 600V
		----	----	1700		V_{GE} = 0V, V_{CE} = 600V, T_J = 150°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°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)	----	1.6	2.6	nC	I_C = 10A	
Qge	Gate - Emitter Charge (turn-on)	----	2.3	4.0		V_{CC} = 400V	
Q_{gc}	Gate - Collector Charge (turn-on)	----	7.0	12			
$t_{d(on)}$	Turn-On Delay Time	----	72	----	ns	T_J = 25°C	
t_r	Rise Time	----	69	----		I_C = 10A, V_{CC} = 480V	
$t_{d(off)}$	Turn-Off Delay Time	----	820	----		V_{GE} = 15V, R_G = 5.0Ω	
t_f	Fall Time	----	910	----		Energy losses include "tail" and	
E_{on}	Turn-On Switching Loss	----	0.70	----	mJ	diode reverse recovery.	
E_{off}	Turn-Off Switching Loss	----	3.9	----			
E_{ts}	Total Switching Loss	----	4.6	----			
$t_{d(on)}$	Turn-On Delay Time	----	78	----	ns	T_J = 150°C,	
t_r	Rise Time	----	90	----			
$t_{d(off)}$	Turn-Off Delay Time	----	1100	----		V_{GE} = 15V, R_G = 50Ω	
t_f	Fall Time	----	1800	----		Energy losses include "tail" and	
E_{ts}	Total Switching Loss	----	7.0	----	mJ	diode reverse recovery.	
L_E	Internal Emitter Inductance	----	7.5	----	nH	Measured 5mm from package	
C_{ies}	Input Capacitance	----	360	----	pF	V_{GE} = 0V	
C_{oes}	Output Capacitance	----	36	----		V_{CC} = 30V	
C_{res}	Reverse Transfer Capacitance	----	5.2	----		f = 1.0MHz	
t_{rr}	Diode Reverse Recovery Time	----	37	55	ns	T_J = 25°C	I_F = 8.0A
		----	55	90		T_J = 125°C	
I_{rr}	Diode Peak Reverse Recovery Current	----	3.5	5.0	A	T_J = 25°C	V_R = 200V
		----	4.5	8.0		T_J = 125°C	
Q_{rr}	Diode Reverse Recovery Charge	----	65	138	nC	T_J = 25°C	di/dt 200A/µs
		----	124	360		T_J = 125°C	
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	----	240	----	A/µs	T_J = 25°C	
		----	210	----		T_J = 125°C	

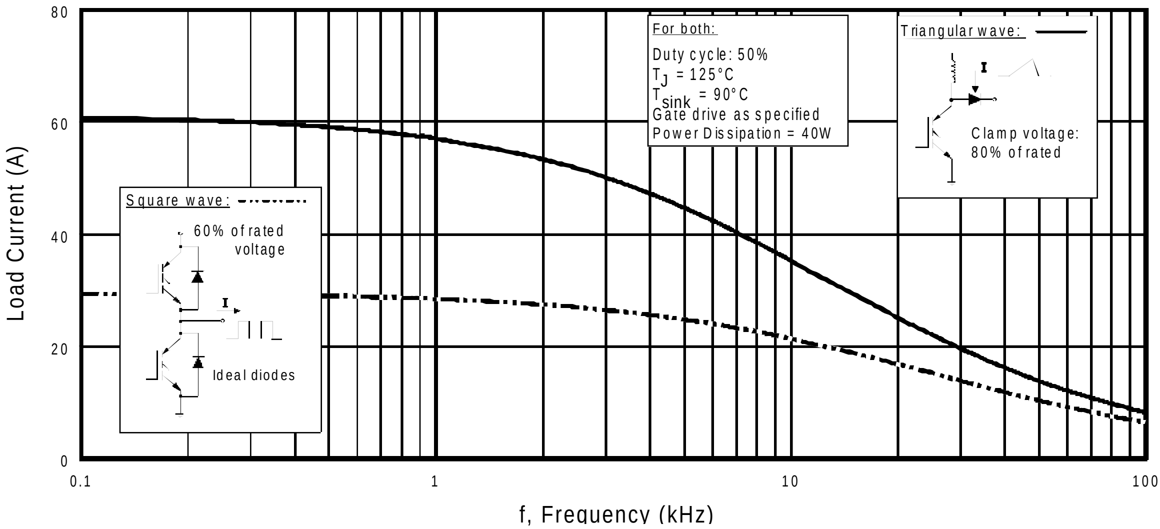


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

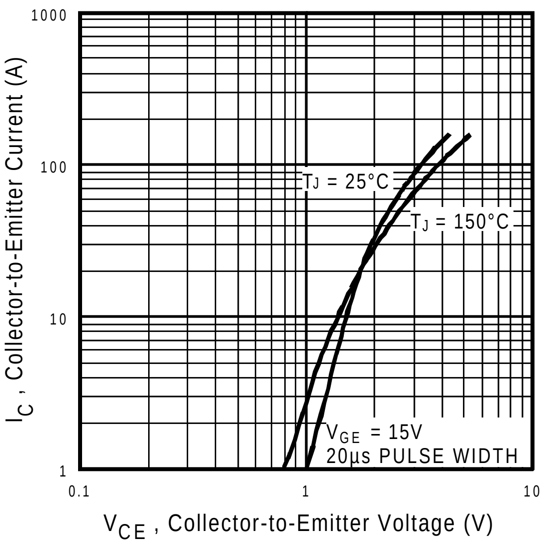


Fig. 2 - Typical Output Characteristics

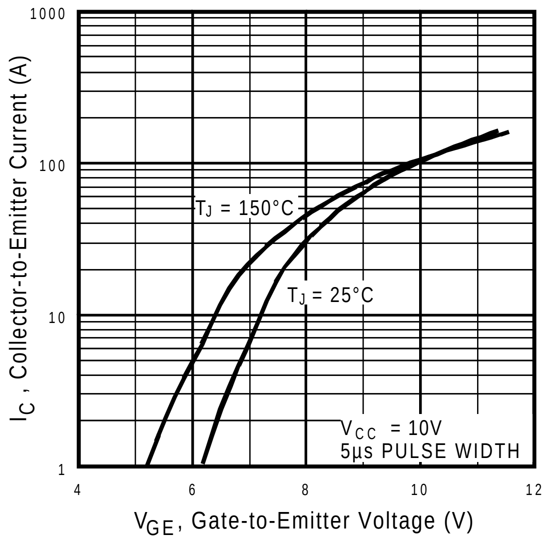


Fig. 3 - Typical Transfer Characteristics

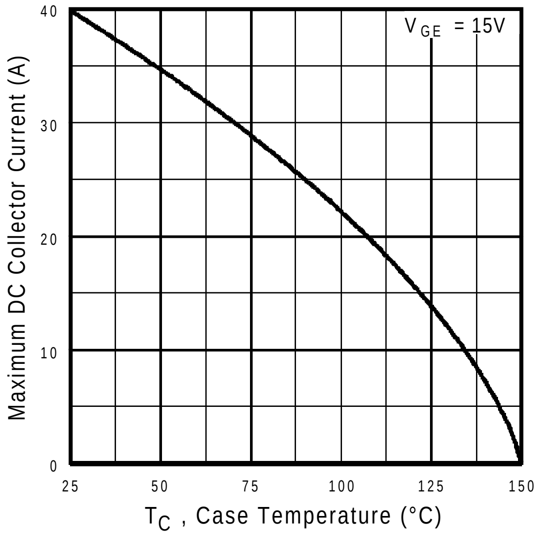


Fig. 4 - Maximum Collector Current vs. Case Temperature

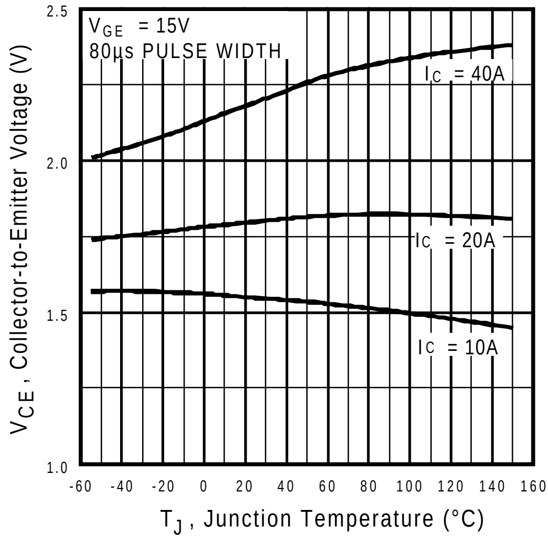


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

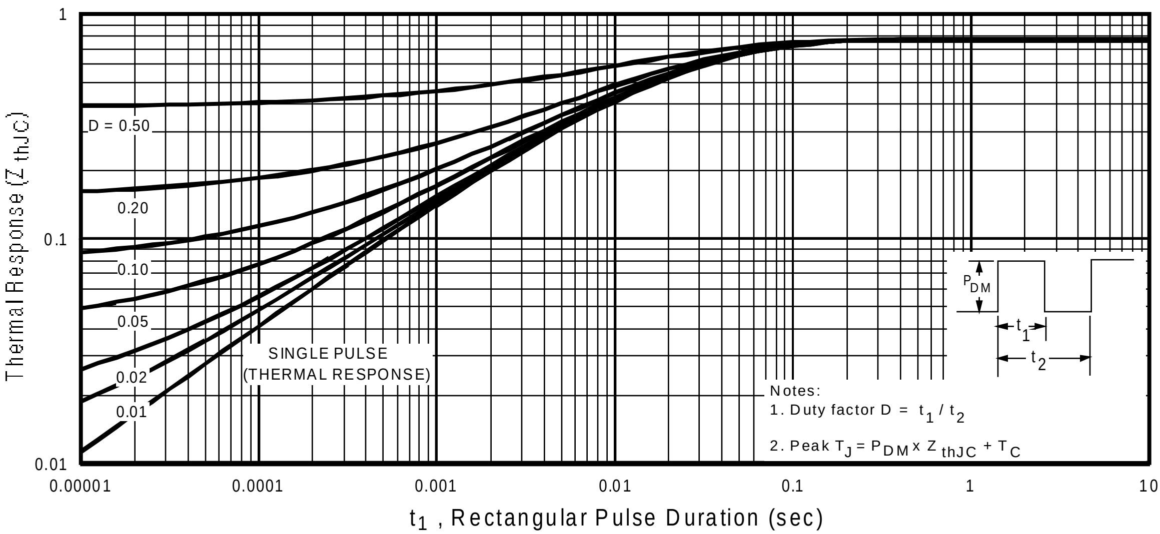


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

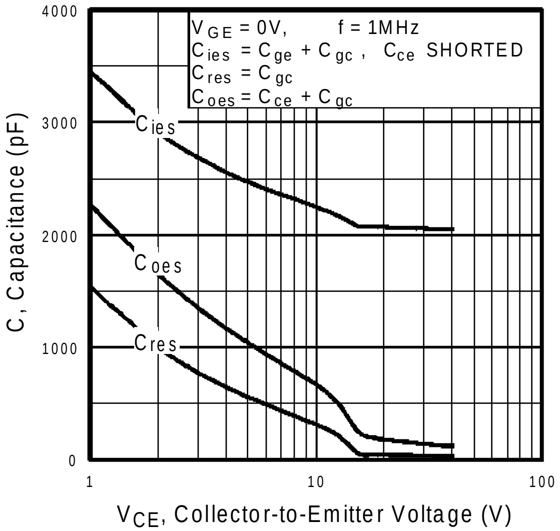


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

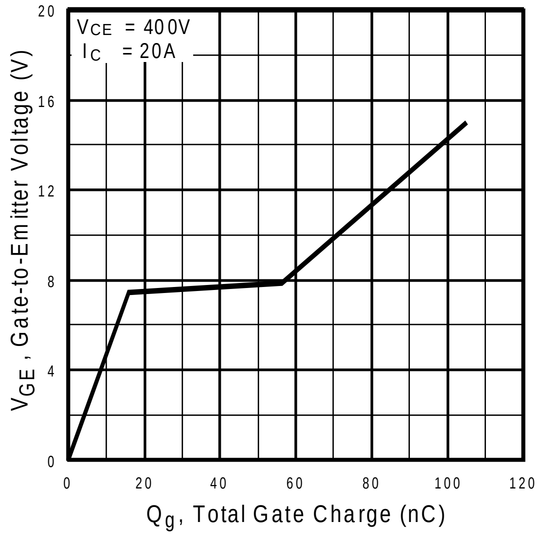


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

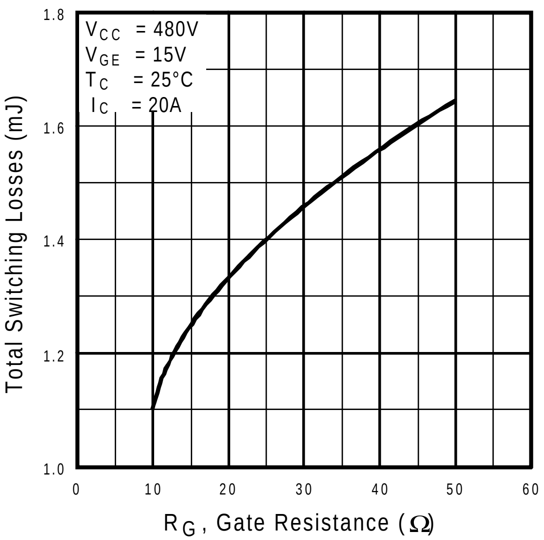


Fig. 9 - Typical Switching Losses vs. Gate Resistance

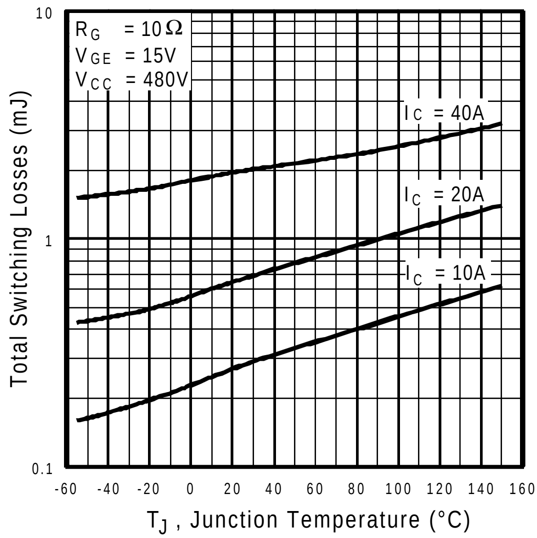


Fig. 10 - Typical Switching Losses vs. Junction Temperature

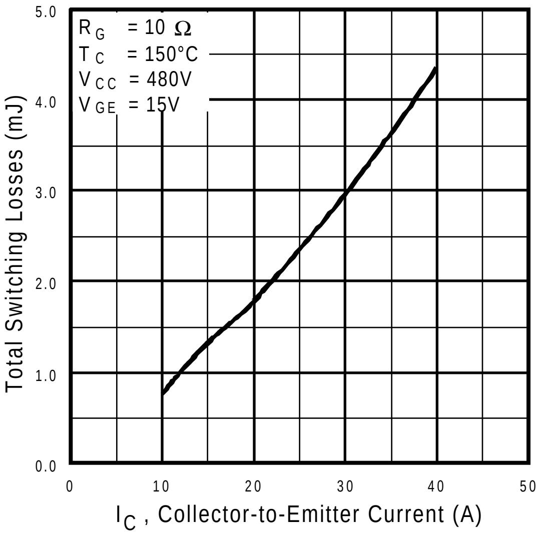


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

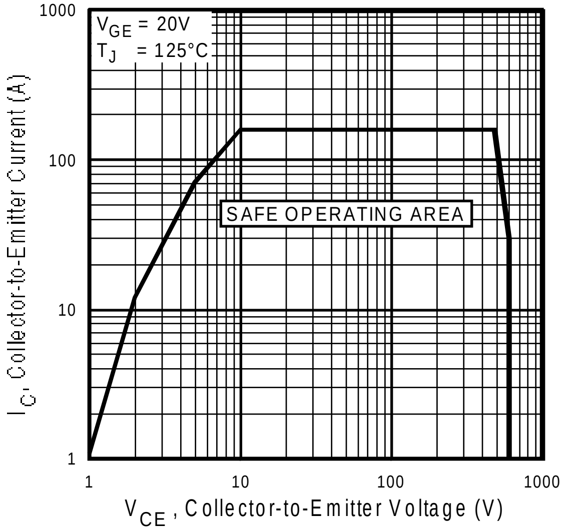


Fig. 12 - Turn-Off SOA

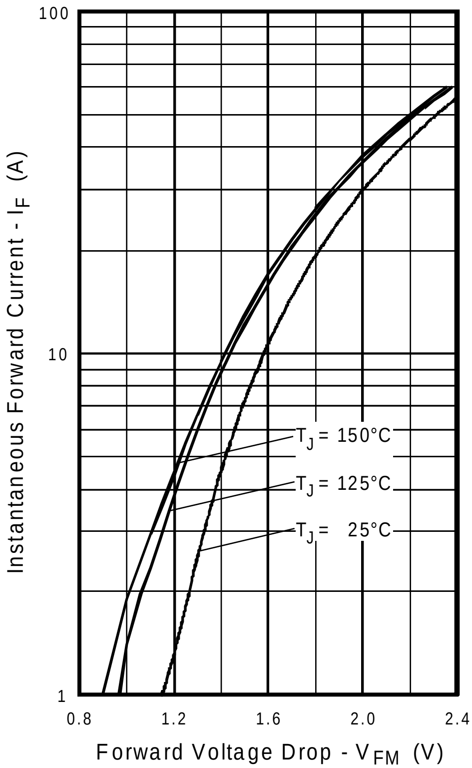


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

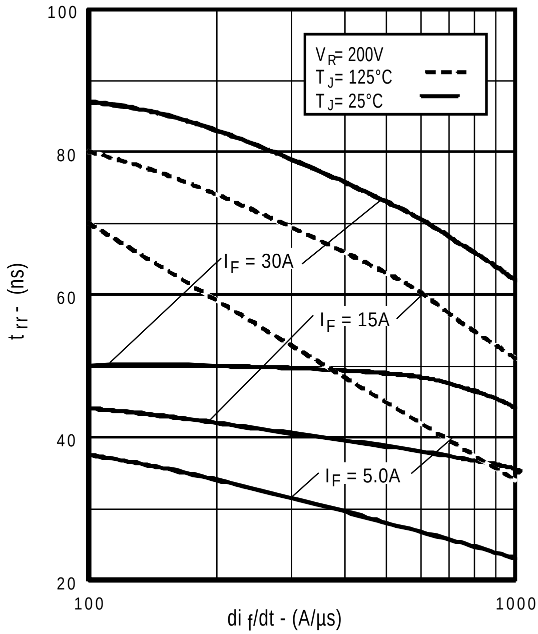


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

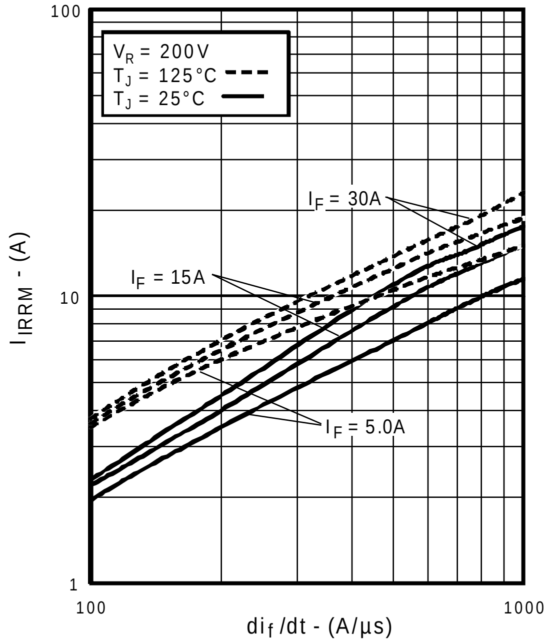


Fig. 15 - Typical Recovery Current vs. di_f/dt

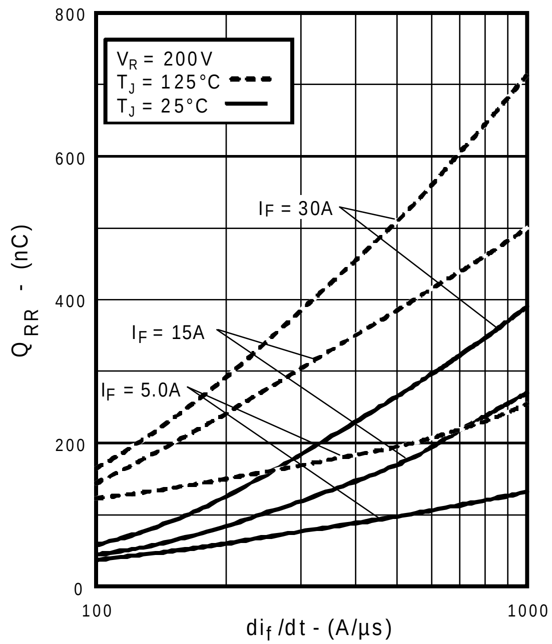


Fig. 16 - Typical Stored Charge vs. di_f/dt

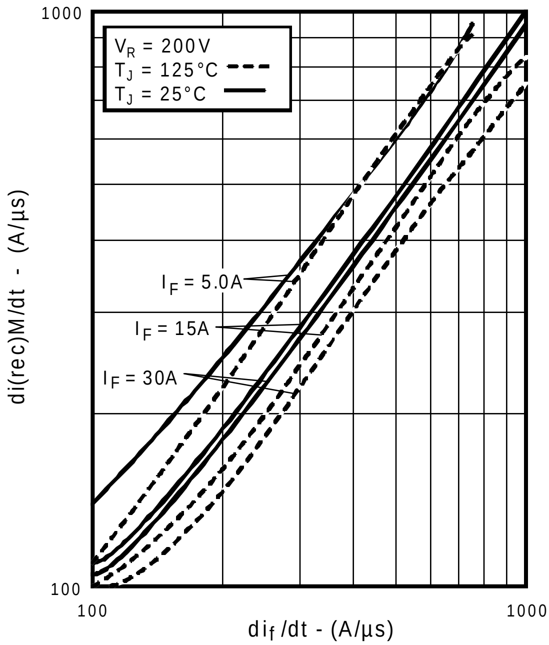


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

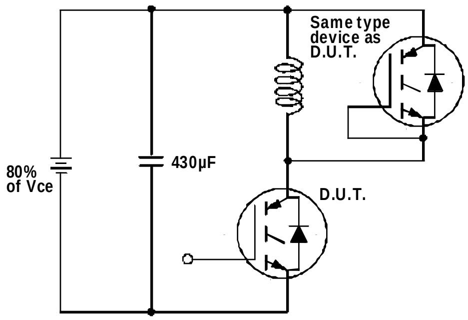


Fig. 18a - Test Circuit for Measurement of I_{LM}, E_{on}, $E_{off(diode)}$, t_{rr}, Q_{rr}, I_{rr}, $t_{d(on)}$, t_r, $t_{d(off)}$, t_f

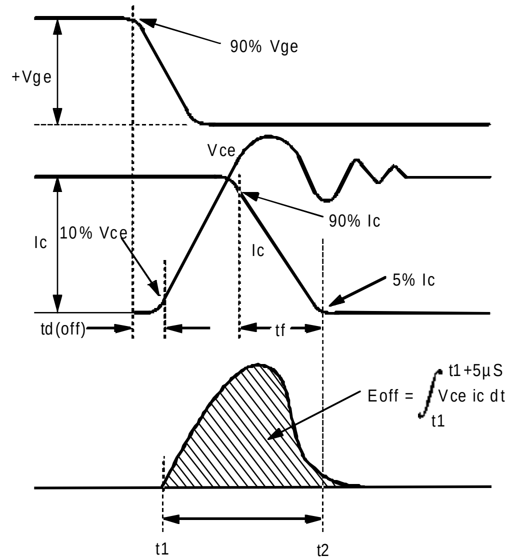


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off}, $t_{d(off)}$, t_f

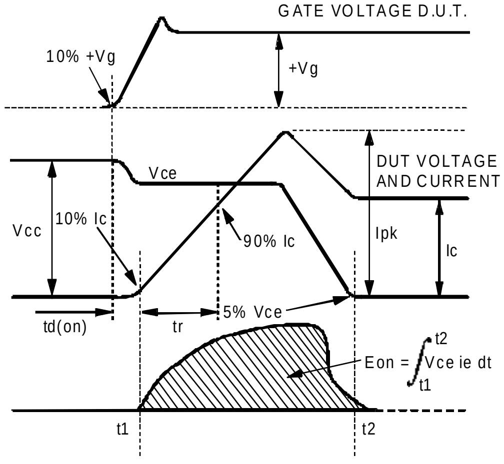


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on}, $t_{d(on)}$, t_r

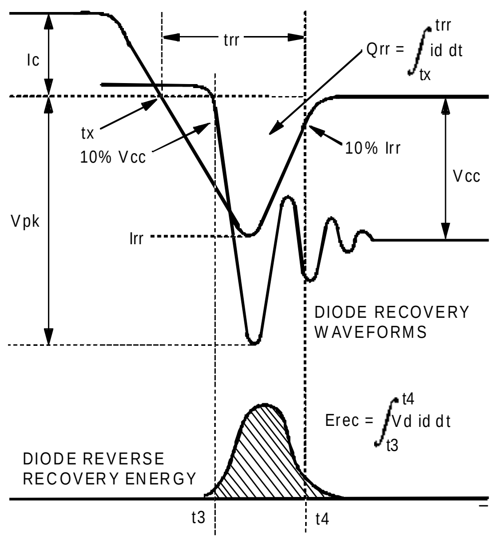


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec}, t_{rr}, Q_{rr}, I_{rr}

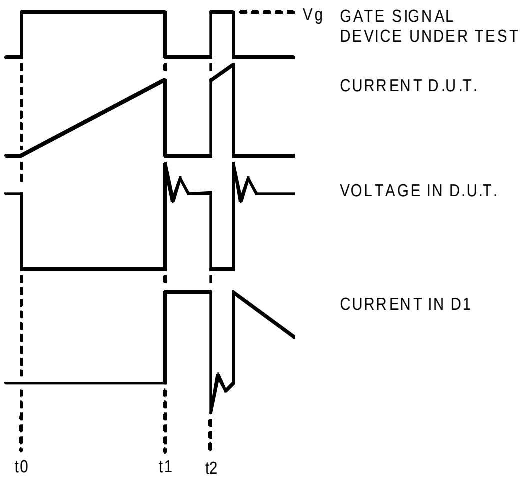


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

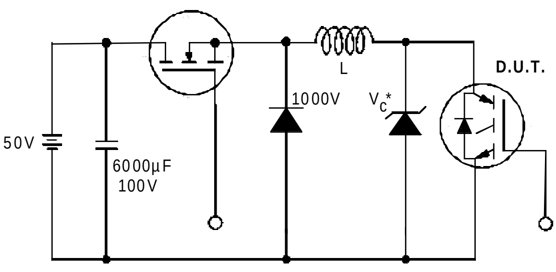


Figure 19. Clamped Inductive Load Test Circuit

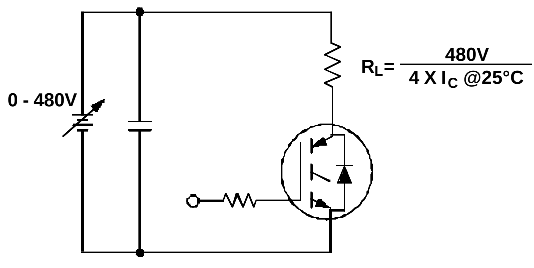


Figure 20. Pulsed Collector Current Test Circuit

Notes:

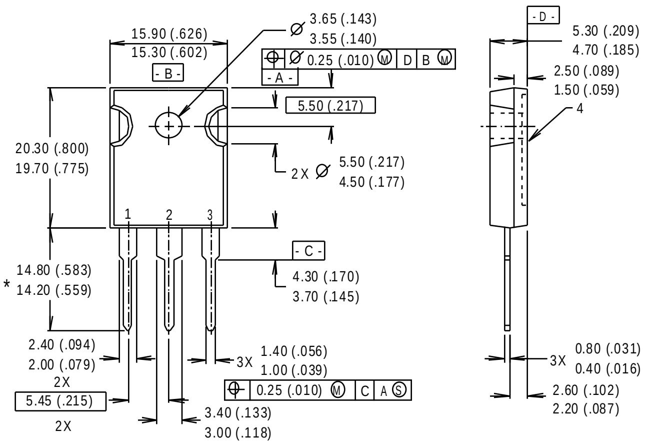
① Repetitive rating: V_{GE}=20V; pulse width limited by maximum junction temperature

② V_{CC}=80%(V_{CES}), V_{GE}=20V, L=10μH, R_G= 50Ω

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

④ Pulse width 5.0μs, single shot.

Case Outline — TO-247AC



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)

International
IOR Rectifier

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IR GERMANY: Saalburgstrasse 157, 61350 Bad Homburg Tel: ++ 49 6172 96590
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IR FAR EAST: K&H Bldg., 2F, 3-30-4 Nishi-Ikeburo 3-Chome, Toshima-Ki, Tokyo Japan 171 Tel: 81 3 3983 0086
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