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With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



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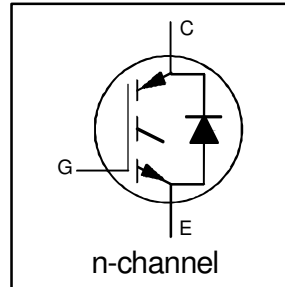


INSULATED GATE BIPOLAR TRANSISTOR  
WITH ULTRAFAST SOFT RECOVERY DIODE

UltraFast CoPack IGBT

**Features**

- Switching-loss rating includes all "tail" losses
- HEXFRED™ soft ultrafast diodes
- Optimized for high operating frequency (over 5kHz)  
See Fig. 1 for Current vs. Frequency curve



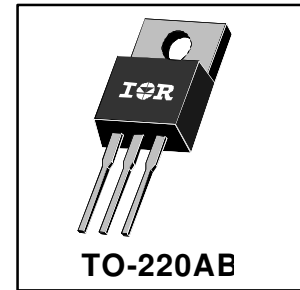
$V_{CES} = 600V$

$V_{CE(sat)} \leq 3.0V$

@  $V_{GE} = 15V, I_C = 6.5A$

**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, motor control, UPS and power supply applications.



**Absolute Maximum Ratings**

	Parameter	Max.	Units
$V_{CES}$	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	13	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	6.5	
$I_{CM}$	Pulsed Collector Current ①	52	
$I_{LM}$	Clamped Inductive Load Current ②	52	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	7.0	
$I_{FM}$	Diode Maximum Forward Current	52	
$V_{GE}$	Gate-to-Emitter Voltage	$\pm 20$	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	60	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	24	
$T_J$	Operating Junction and Storage Temperature Range	-55 to +150	°C
$T_{STG}$			
	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 @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

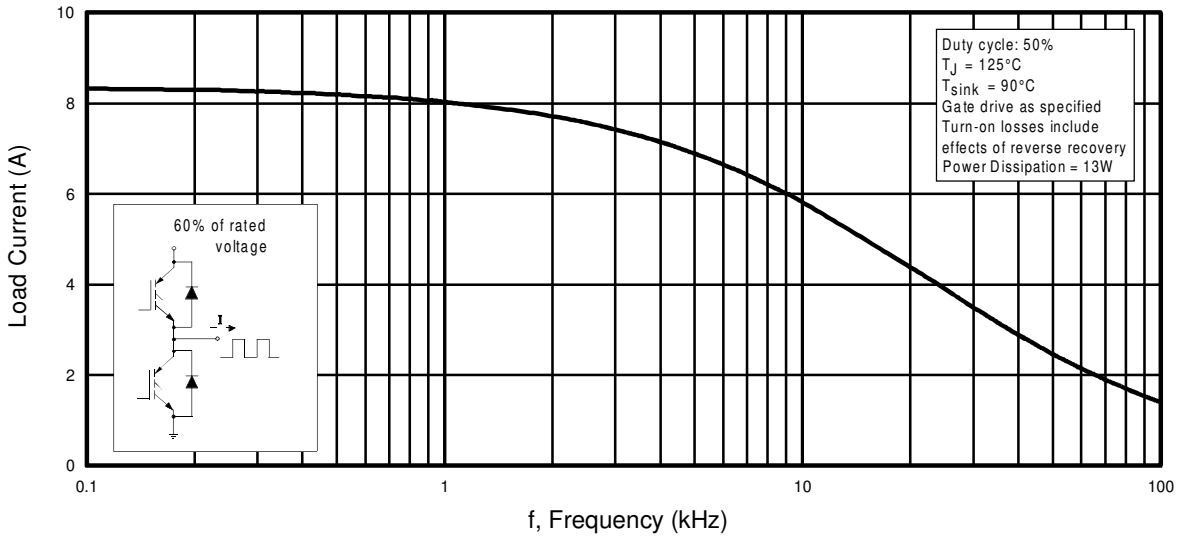
	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage ③	600	—	—	V	$V_{GE} = 0V, I_C = 250\mu\text{A}$
$\Delta V_{(BR)CES}/\Delta T_J$	Temp. Coeff. of Breakdown Voltage	—	0.69	—	V/°C	$V_{GE} = 0V, I_C = 1.0\text{mA}$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	2.2	3.0	V	$I_C = 6.5\text{A}$ $V_{GE} = 15V$
		—	2.8	—		$I_C = 13\text{A}$ See Fig. 2, 5
		—	2.5	—		$I_C = 6.5\text{A}, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	—	5.5		$V_{CE} = V_{GE}, I_C = 250\mu\text{A}$
$\Delta V_{GE(th)}/\Delta T_J$	Temp. Coeff. of Threshold Voltage	—	-11	—	mV/°C	$V_{CE} = V_{GE}, I_C = 250\mu\text{A}$
$g_{fe}$	Forward Transconductance ④	1.4	4.3	—	S	$V_{CE} = 100V, I_C = 6.5\text{A}$
$I_{CES}$	Zero Gate Voltage Collector Current	—	—	250	$\mu\text{A}$	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	1700		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
$V_{FM}$	Diode Forward Voltage Drop	—	1.4	1.7	V	$I_C = 8.0\text{A}$ See Fig. 13
		—	1.3	1.6		$I_C = 8.0\text{A}, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-Emitter Leakage Current	—	—	$\pm 100$	nA	$V_{GE} = \pm 20V$

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

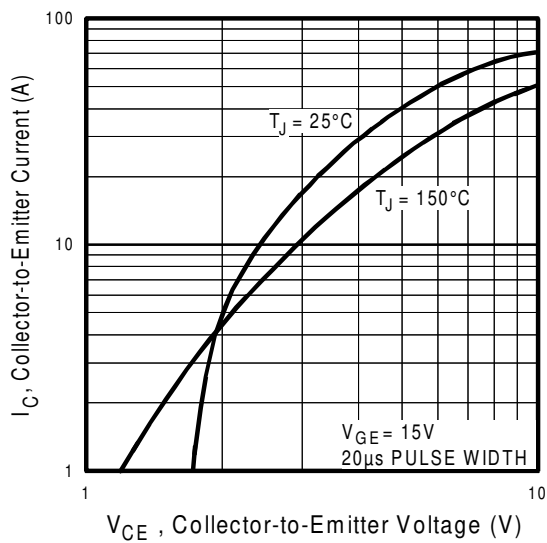
	Parameter	Min.	Typ.	Max.	Units	Conditions
$Q_g$	Total Gate Charge (turn-on)	—	16	22	nC	$I_C = 6.5\text{A}$ $V_{CC} = 400V$ See Fig. 8
$Q_{ge}$	Gate - Emitter Charge (turn-on)	—	2.5	3.8		
$Q_{gc}$	Gate - Collector Charge (turn-on)	—	7.8	13		
$t_{d(on)}$	Turn-On Delay Time	—	60	—	ns	$T_J = 25^\circ\text{C}$ $I_C = 6.5\text{A}, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
$t_r$	Rise Time	—	29	—		
$t_{d(off)}$	Turn-Off Delay Time	—	130	200		
$t_f$	Fall Time	—	65	120		
$E_{on}$	Turn-On Switching Loss	—	0.21	—	mJ	$T_J = 150^\circ\text{C}$ , See Fig. 9, 10, 11, 18 $I_C = 6.5\text{A}, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" and diode reverse recovery.
$E_{off}$	Turn-Off Switching Loss	—	0.22	—		
$E_{ts}$	Total Switching Loss	—	0.43	0.65		
$t_{d(on)}$	Turn-On Delay Time	—	60	—	ns	$T_J = 150^\circ\text{C}$ , See Fig. 9, 10, 11, 18 $I_C = 6.5\text{A}, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" and diode reverse recovery.
$t_r$	Rise Time	—	30	—		
$t_{d(off)}$	Turn-Off Delay Time	—	210	—		
$t_f$	Fall Time	—	180	—		
$E_{ts}$	Total Switching Loss	—	0.71	—	mJ	
$L_E$	Internal Emitter Inductance	—	7.5	—	nH	Measured 5mm from package
$C_{ies}$	Input Capacitance	—	330	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ See Fig. 7 $f = 1.0\text{MHz}$
$C_{oes}$	Output Capacitance	—	65	—		
$C_{res}$	Reverse Transfer Capacitance	—	6.0	—		
$t_{rr}$	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/ $\mu\text{s}$	$T_J = 25^\circ\text{C}$ See Fig. 17
		—	210	—		$T_J = 125^\circ\text{C}$

### Notes:

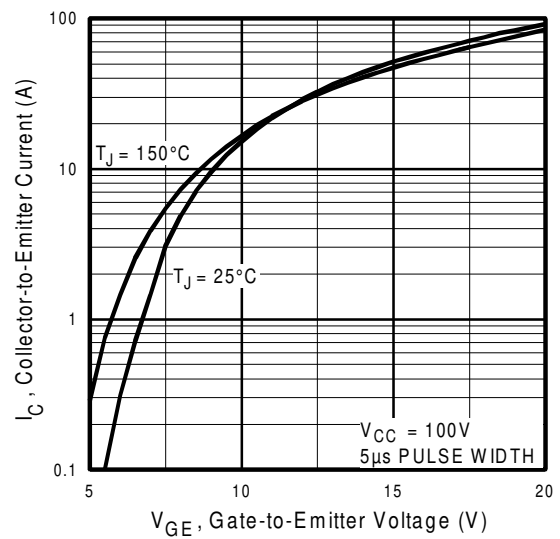
- ① Repetitive rating;  $V_{GE}=20V$ , pulse width limited by max. junction temperature. ( See fig. 20 )
- ②  $V_{CC}=80\%(V_{CES}), V_{GE}=20V, L=10\mu\text{H}, R_G=50\Omega$ , ( See fig. 19 )
- ③ Pulse width  $\leq 80\mu\text{s}$ ; duty factor  $\leq 0.1\%$ .
- ④ Pulse width 5.0 $\mu\text{s}$ , single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



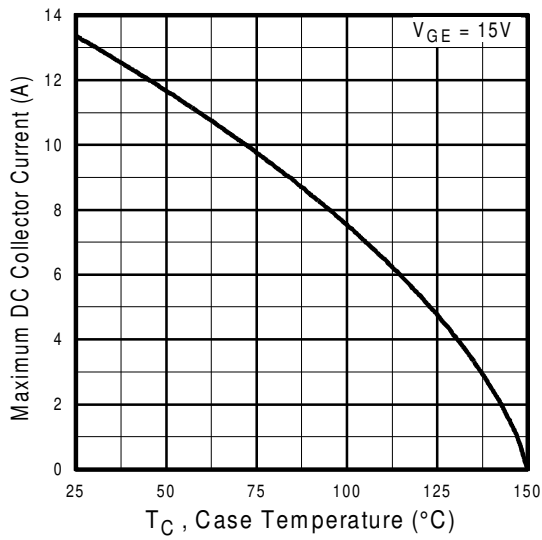
**Fig. 1 - Typical Load Current vs. Frequency**  
(Load Current =  $I_{RMS}$  of fundamental)



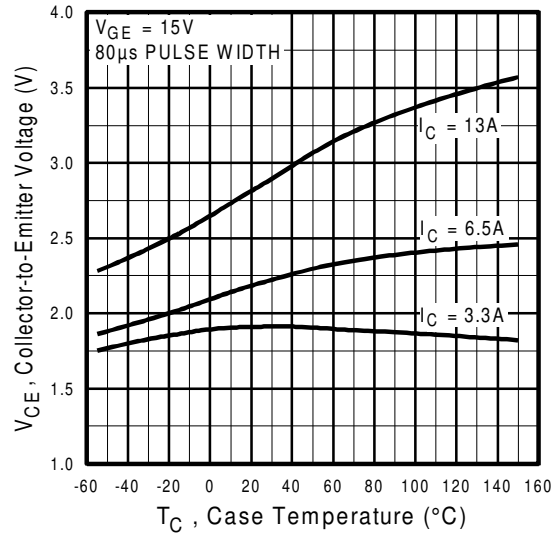
**Fig. 2 - Typical Output Characteristics**



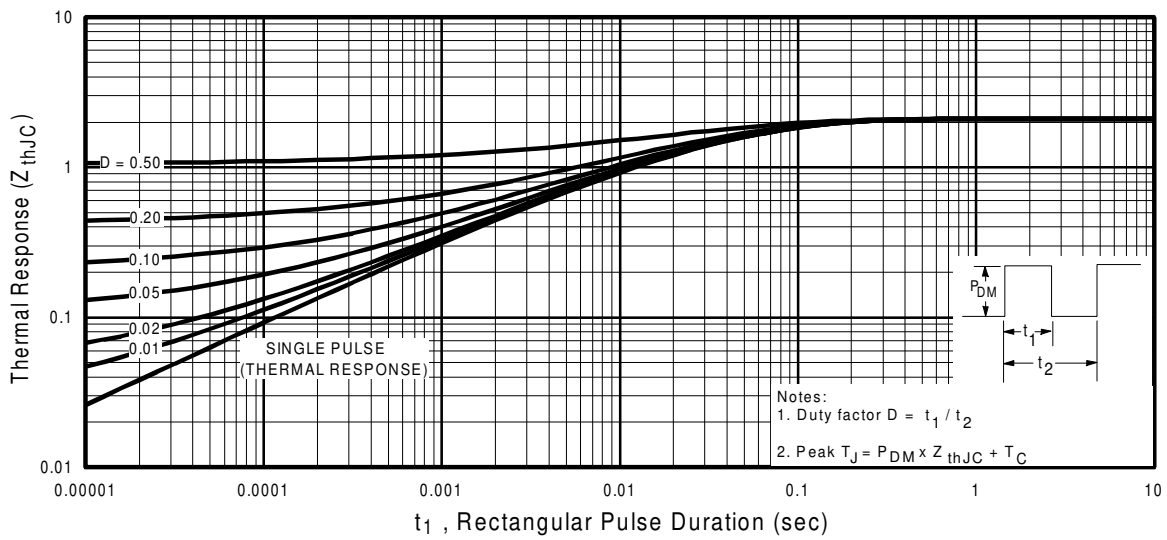
**Fig. 3 - Typical Transfer Characteristics**



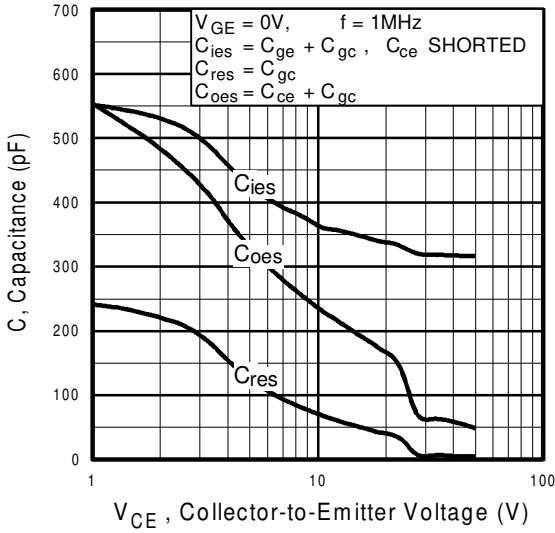
**Fig. 4 - Maximum Collector Current vs. Case Temperature**



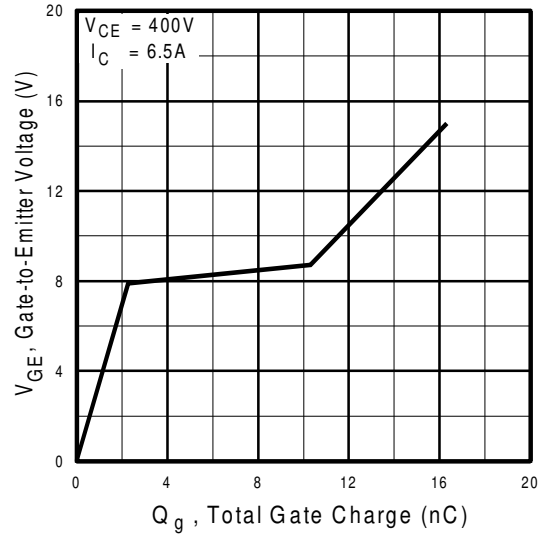
**Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature**



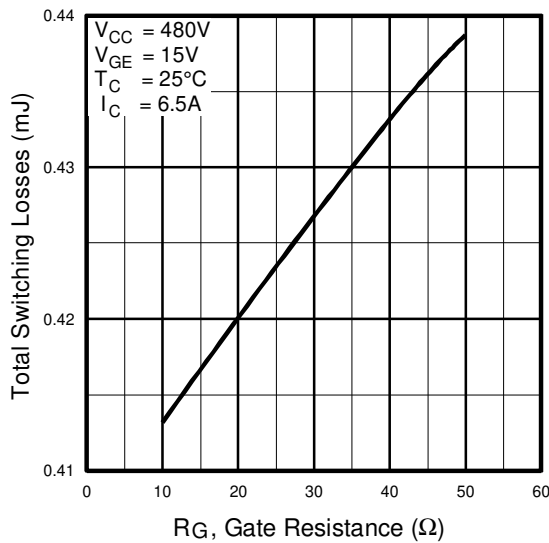
**Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case**



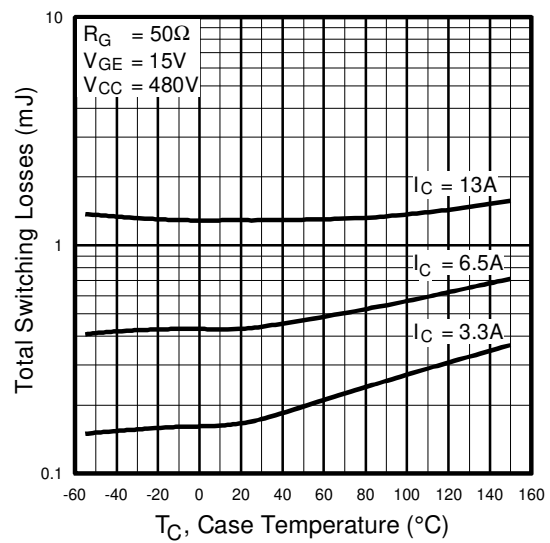
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



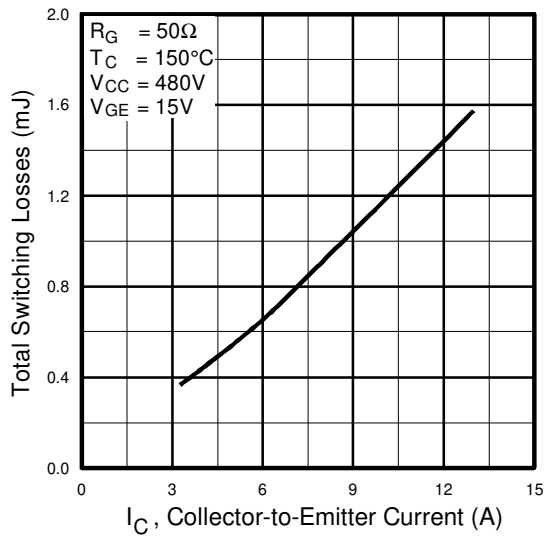
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



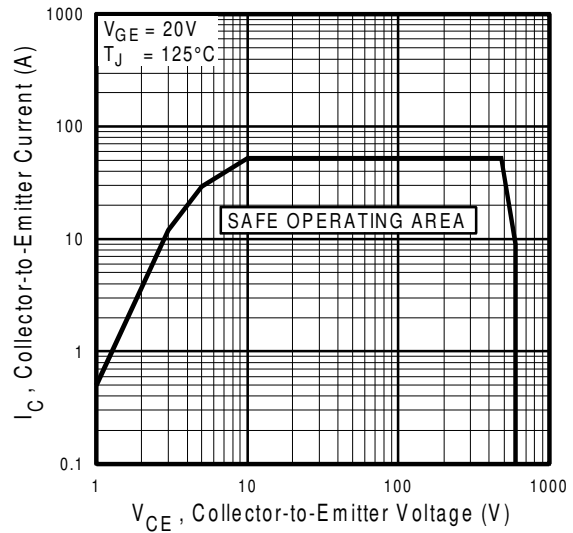
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



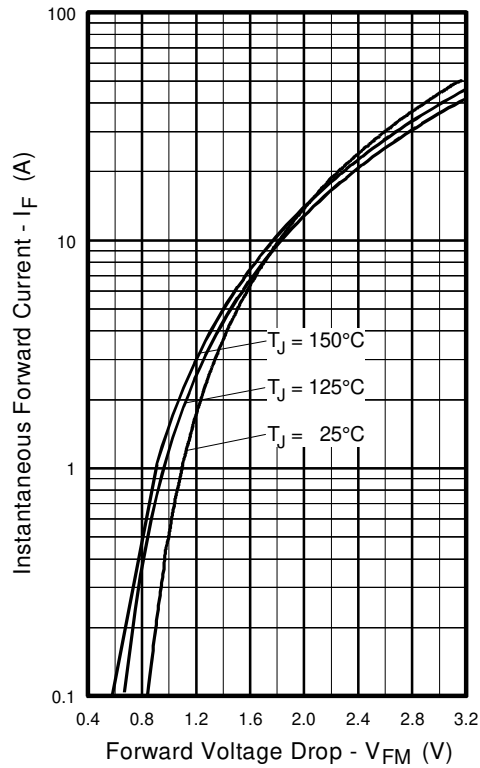
**Fig. 10** - Typical Switching Losses vs. Case Temperature



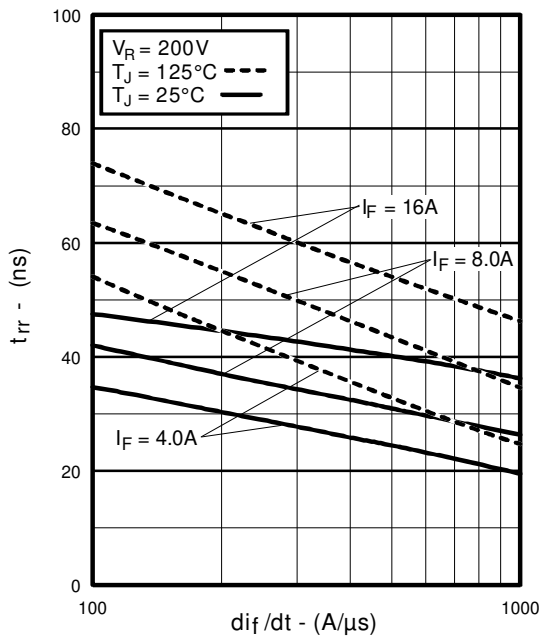
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



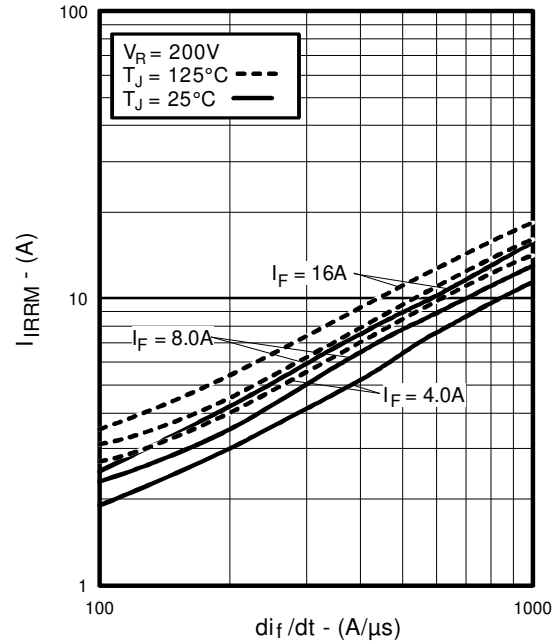
**Fig. 12** - Turn-Off SOA



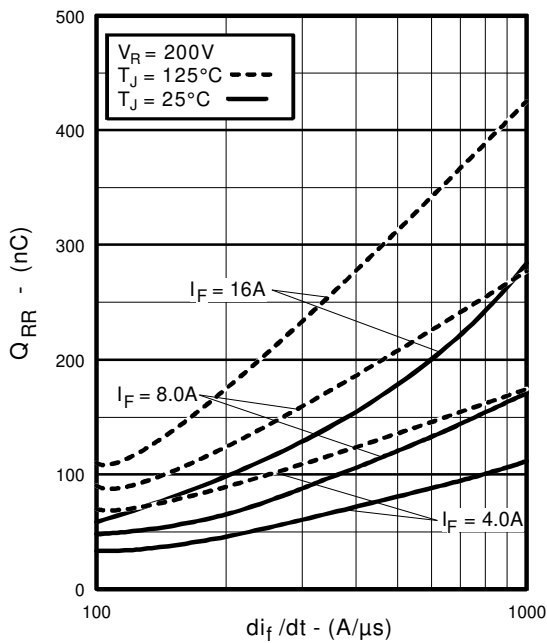
**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



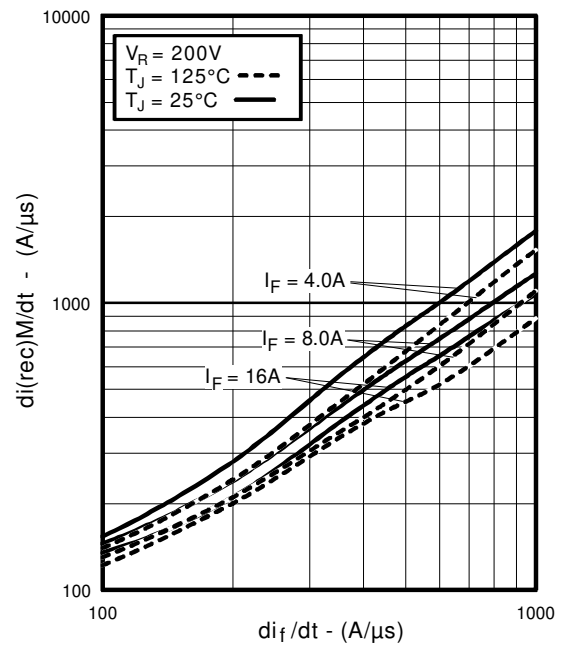
**Fig. 14** - Typical Reverse Recovery vs.  $di_f/dt$



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

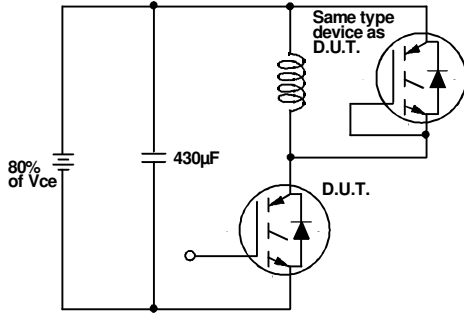


**Fig. 16** - Typical Stored Charge vs.  $di_f/dt$

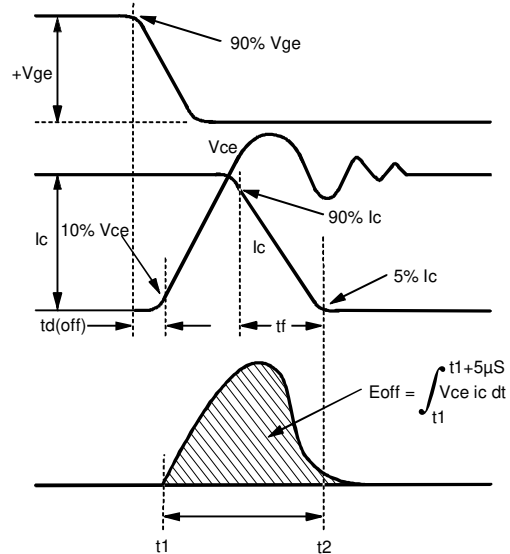


**Fig. 17** - Typical  $di_{(rec)M}/dt$  vs.  $di_f/dt$

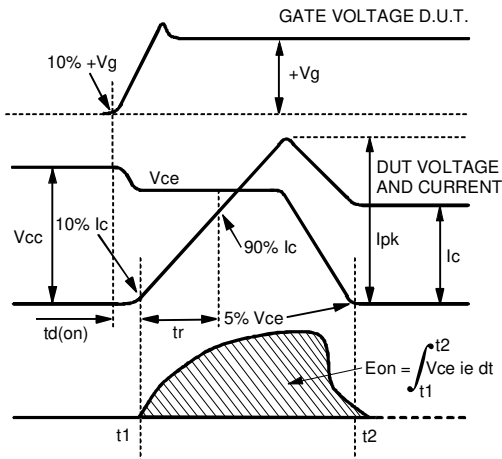




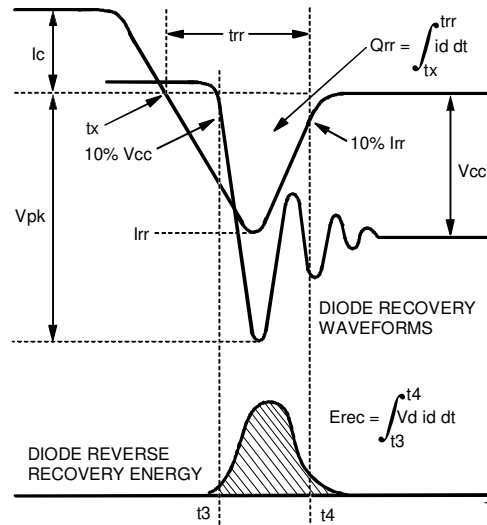
**Fig. 18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off}(\text{diode})$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**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  $E_{rec}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$

Refer to Section D for the following:  
**Appendix D: Section D - page D-6**

- Fig. 18e - Macro Waveforms for Test Circuit Fig. 18a
- Fig. 19 - Clamped Inductive Load Test Circuit
- Fig. 20 - Pulsed Collector Current Test Circuit