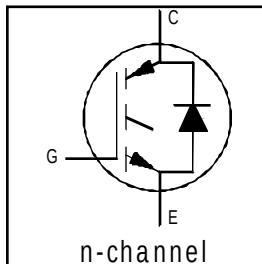


INSULATED GATE BIPOLAR TRANSISTOR WITH Standard Speed CoPack
ULTRAFAST SOFT RECOVERY DIODE**Features**

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

Description

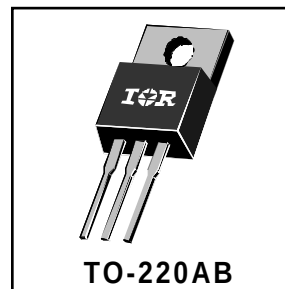
Co-packaged IGBTs are a natural extension of International Rectifier's well-known IGBT line. They provide the convenience of an IGBT and an ultrafast recovery diode in one package, resulting in substantial benefits to a host of high-voltage, high-current, motor control, UPS and power supply applications.



$$V_{CES} = 600V$$

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

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

**Absolute Maximum Ratings**

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	19	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	10	
I_{CM}	Pulsed Collector Current ①	76	
I_{LM}	Clamped Inductive Load Current ②	38	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	7.0	
I_{FM}	Diode Maximum Forward Current	32	V
V_{GE}	Gate-to-Emitter Voltage	± 20	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	60	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	24	
T_J	Operating Junction and	-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	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	-----	-----	2.1	$^\circ C/W$
$R_{\theta JC}$	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	$V_{GE} = 0V, I_C = 250\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	----	0.75	----	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	----	1.8	2.4	V	$I_C = 10A$ $V_{GE} = 15V$
		----	2.4	----		$I_C = 19A$
		----	1.9	----		$I_C = 10A, T_J = 150^\circ\text{C}$
$V_{GE(th)}$	Gate Threshold Voltage	3.0	----	5.5		$V_{CE} = V_{GE}, I_C = 250\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	----	-11	----	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 250\mu A$
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		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
V_{FM}	Diode Forward Voltage Drop	----	1.4	1.7	V	$I_C = 8.0A$
		----	1.3	1.6		$I_C = 8.0A, T_J = 150^\circ\text{C}$
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)	----	1.6	2.6	nC	$I_C = 10A$ $V_{CC} = 400V$	
Q_{ge}	Gate - Emitter Charge (turn-on)	----	2.3	4.0			
Q_{gc}	Gate - Collector Charge (turn-on)	----	7.0	12			
$t_{d(on)}$	Turn-On Delay Time	----	72	----	ns	$T_J = 25^{\circ}C$ $I_C = 10A, V_{CC} = 480V$ $V_{GE} = 15V, R_G = 5.0\Omega$ Energy losses include "tail" and diode reverse recovery.	
t_r	Rise Time	----	69	----			
$t_{d(off)}$	Turn-Off Delay Time	----	820	----			
t_f	Fall Time	----	910	----			
E_{on}	Turn-On Switching Loss	----	0.70	----	mJ		
E_{off}	Turn-Off Switching Loss	----	3.9	----			
E_{ts}	Total Switching Loss	----	4.6	----			
$t_{d(on)}$	Turn-On Delay Time	----	78	----	ns	$T_J = 150^{\circ}C$, $V_{GE} = 15V, R_G = 50\Omega$ Energy losses include "tail" and diode reverse recovery.	
t_r	Rise Time	----	90	----			
$t_{d(off)}$	Turn-Off Delay Time	----	1100	----			
t_f	Fall Time	----	1800	----			
E_{ts}	Total Switching Loss	----	7.0	----	mJ		
L_E	Internal Emitter Inductance	----	7.5	----	nH		
C_{ies}	Input Capacitance	----	360	----	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$	
C_{oes}	Output Capacitance	----	36	----			
C_{res}	Reverse Transfer Capacitance	----	5.2	----			
t_{rr}	Diode Reverse Recovery Time	----	37	55	ns	$T_J = 25^{\circ}C$	$I_F = 8.0A$ $V_R = 200V$ $di/dt\ 200A/\mu s$
		----	55	90		$T_J = 125^{\circ}C$	
I_{rr}	Diode Peak Reverse Recovery Current	----	3.5	5.0	A	$T_J = 25^{\circ}C$	
		----	4.5	8.0		$T_J = 125^{\circ}C$	
Q_{rr}	Diode Reverse Recovery Charge	----	65	138	nC	$T_J = 25^{\circ}C$	
		----	124	360		$T_J = 125^{\circ}C$	
$di_{(rec)M}/dt$	Diode Peak Rate of Fall of Recovery During t_b	----	240	----	A/ μs	$T_J = 25^{\circ}C$	
		----	210	----		$T_J = 125^{\circ}C$	

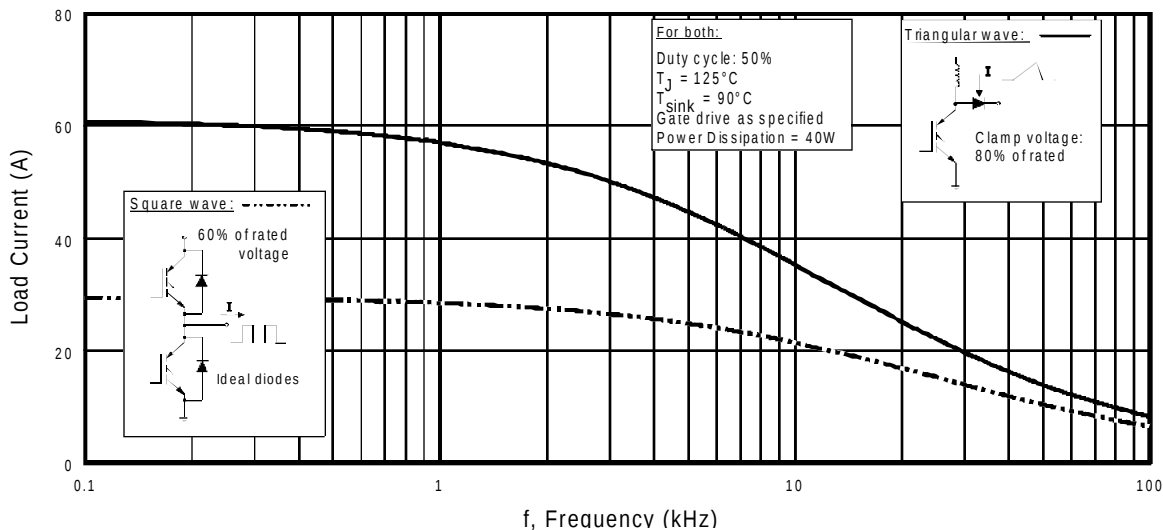


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

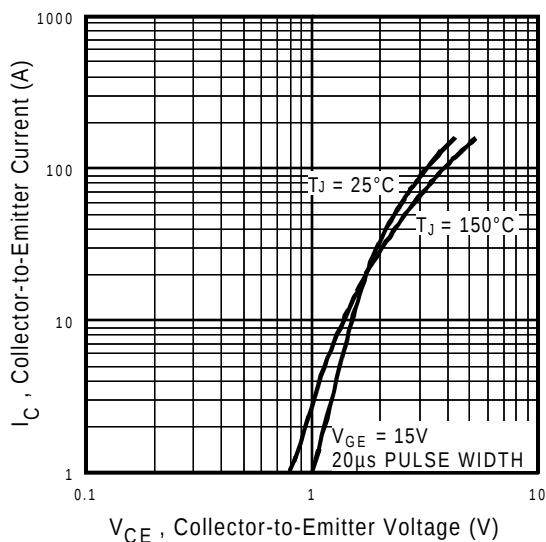


Fig. 2 - Typical Output Characteristics

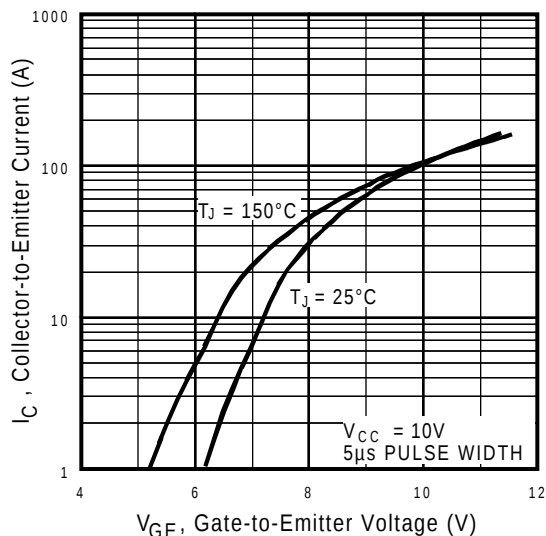


Fig. 3 - Typical Transfer Characteristics

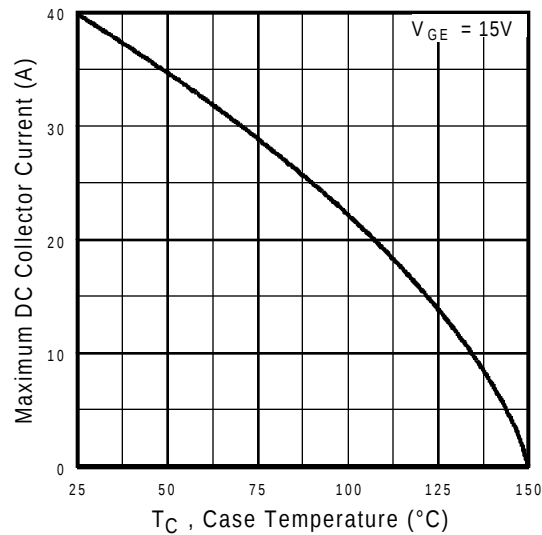


Fig. 4 - Maximum Collector Current vs. Case Temperature

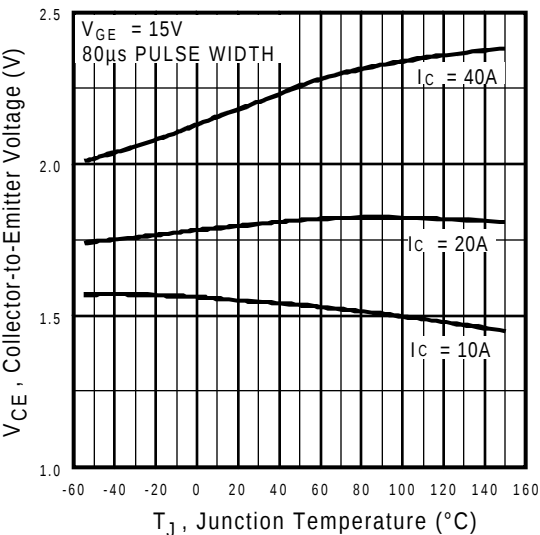


Fig. 5 - Collector-to-Emitter Voltage vs. Junction Temperature

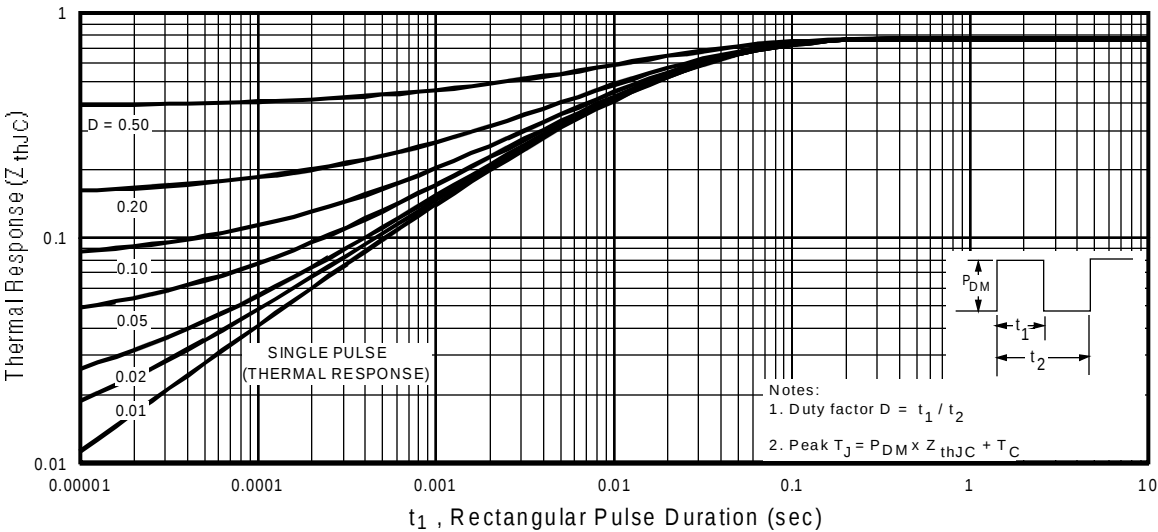


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

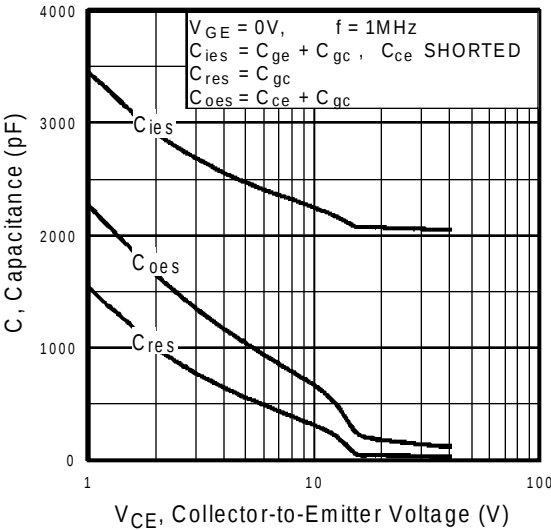


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

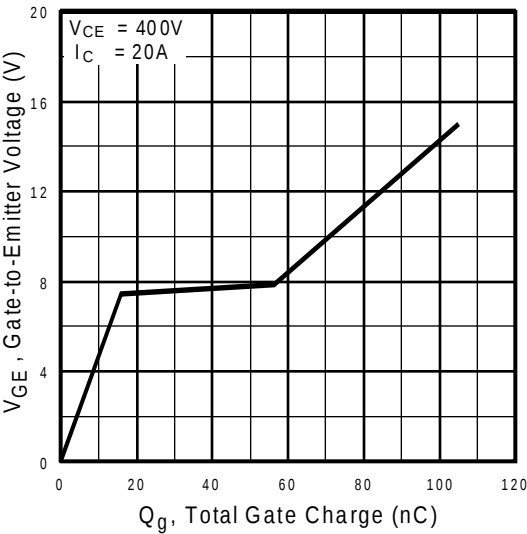


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

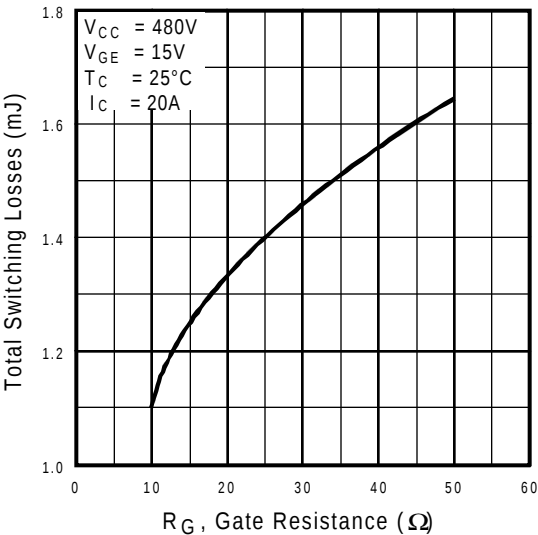


Fig. 9 - Typical Switching Losses vs. Gate Resistance

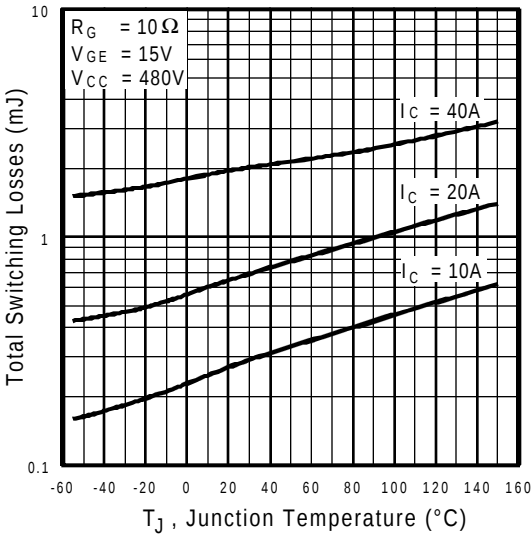


Fig. 10 - Typical Switching Losses vs. Junction Temperature

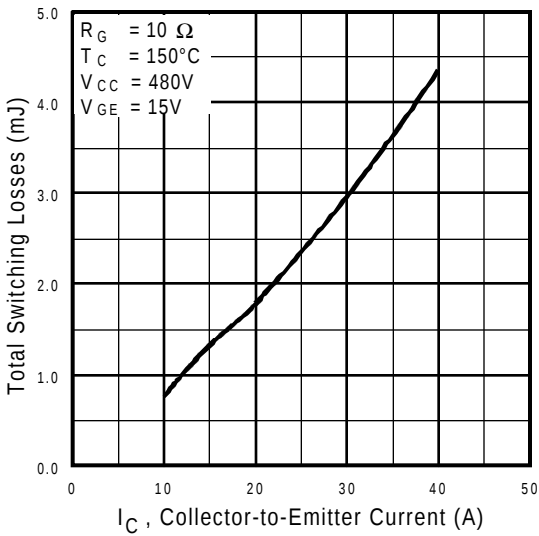


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

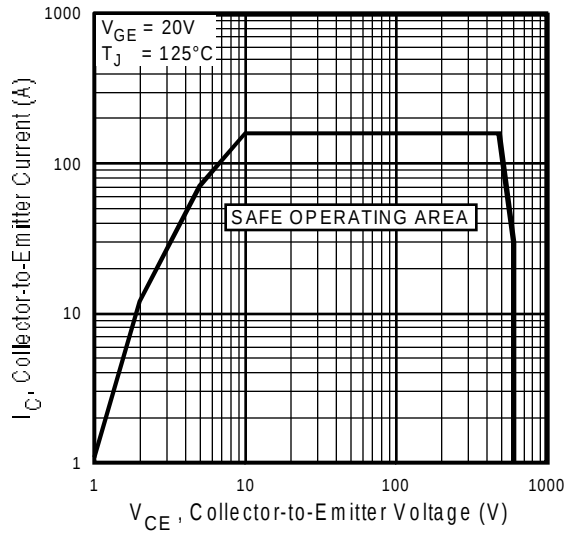


Fig. 12 - Turn-Off SOA

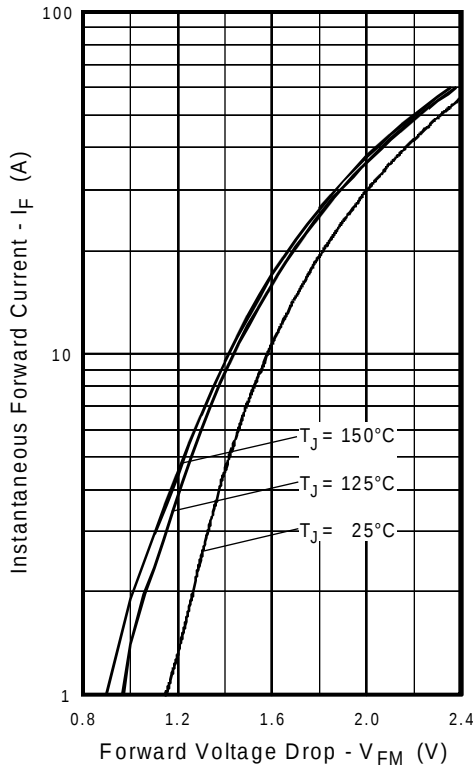


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

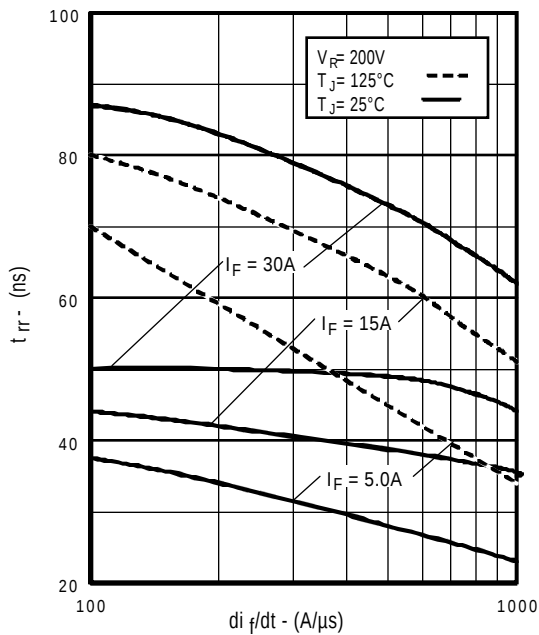


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

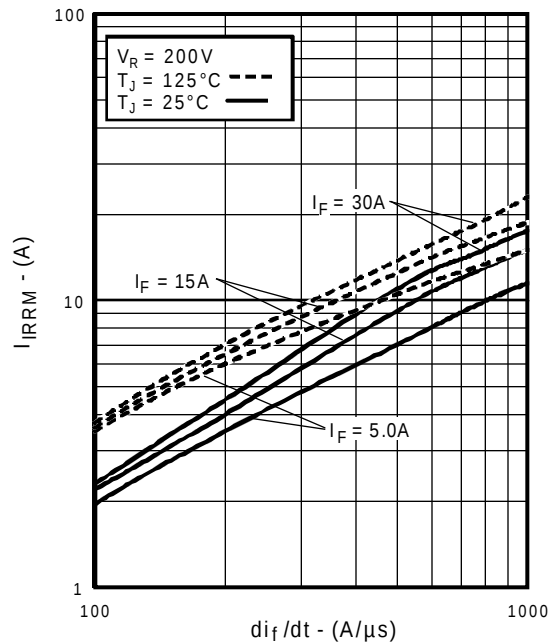


Fig. 15 - Typical Recovery Current vs. di_f/dt

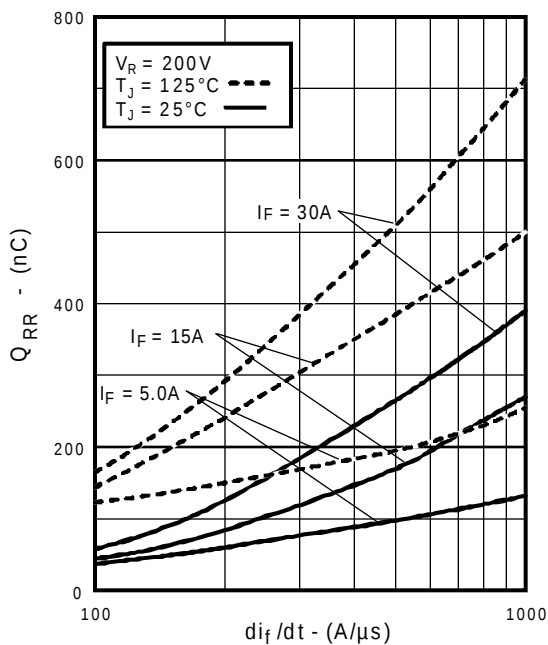


Fig. 16 - Typical Stored Charge vs. di_f/dt

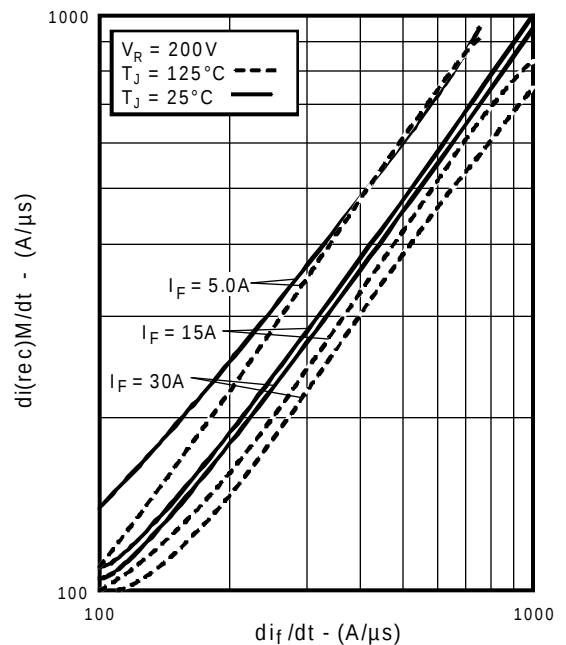


Fig. 17 - Typical $di(rec)M/dt$ vs. di_f/dt

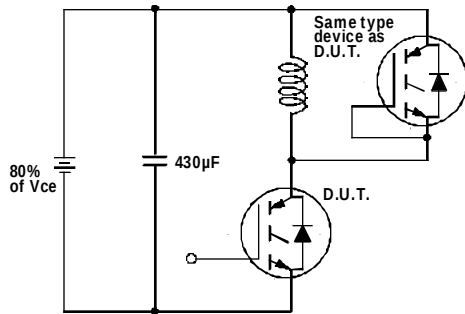


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off}(\text{diode})$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

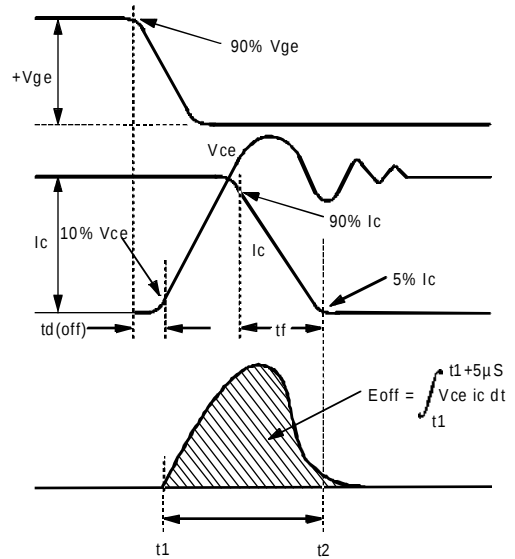


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

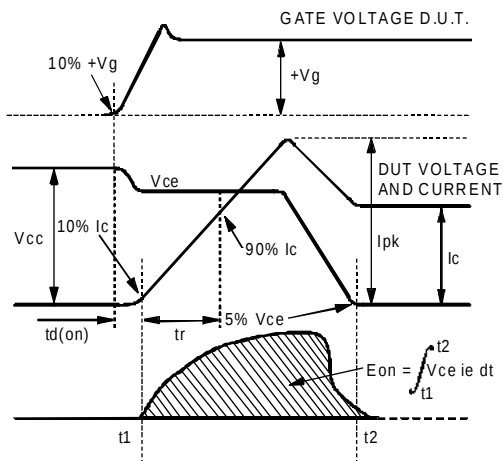


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

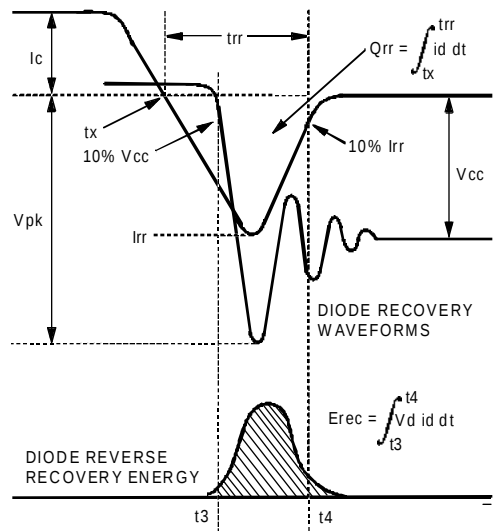


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

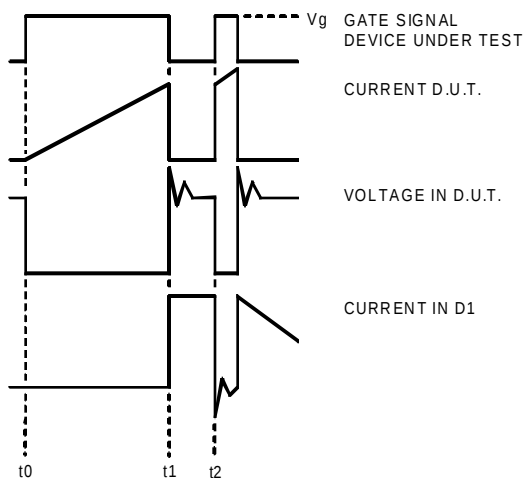


Figure 18e. Macro Waveforms for Figure 18a's Test Circuit

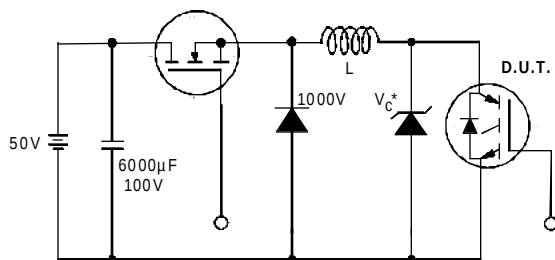


Figure 19. Clamped Inductive Load Test Circuit

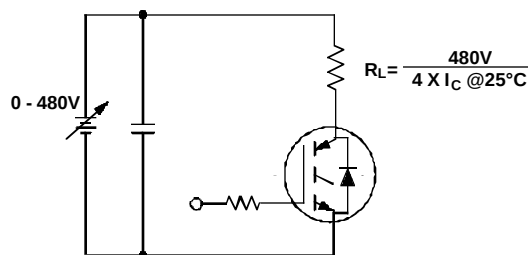


Figure 20. Pulsed Collector Current Test Circuit

Notes:

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

Case Outline — TO-247AC

