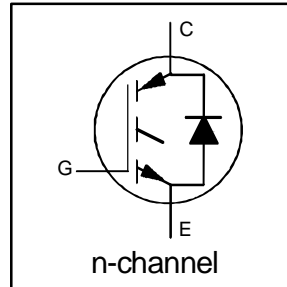


INSULATED GATE BIPOLAR TRANSISTOR
WITH ULTRAFAST SOFT RECOVERY DIODE

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



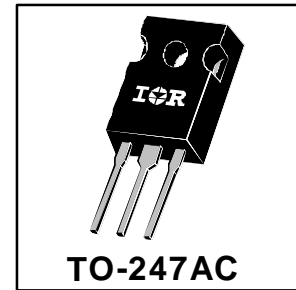
$V_{CES} = 500V$

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

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

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	500	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	25	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	15	
I_{CM}	Pulsed Collector Current ①	50	
I_{LM}	Clamped Inductive Load Current ②	50	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	12	
I_{FM}	Diode Maximum Forward Current	50	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	100	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	42	
T_J	Operating Junction and	-55 to +150	°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	—	—	1.2	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	2.5	
$R_{\theta CS}$	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)

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage ③	500	—	—	V	V _{GE} = 0V, I _C = 250μA
ΔV _{(BR)CES} /ΔT _J	Temp. Coeff. of Breakdown Voltage	—	0.46	—	V/°C	V _{GE} = 0V, I _C = 1.0mA
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	2.3	3.0	V	I _C = 15A V _{GE} = 15V
		—	2.8	—		I _C = 25A See Fig. 2, 5
		—	2.6	—		I _C = 15A, T _J = 150°C
V _{GE(th)}	Gate Threshold Voltage	3.0	—	5.5		V _{CE} = V _{GE} , I _C = 250μA
ΔV _{GE(th)} /ΔT _J	Temp. Coeff. of Threshold Voltage	—	-11	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA
g _{fe}	Forward Transconductance ④	2.3	8.1	—	S	V _{CE} = 100V, I _C = 15A
I _{CES}	Zero Gate Voltage Collector Current	—	—	250	μA	V _{GE} = 0V, V _{CE} = 500V
		—	—	2500		V _{GE} = 0V, V _{CE} = 500V, T _J = 150°C
V _{FM}	Diode Forward Voltage Drop	—	1.4	1.7	V	I _C = 12A See Fig. 13
		—	1.3	1.6		I _C = 12A, 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)	—	31	47	nC	I _C = 15A V _{CC} = 400V See Fig. 8
Q _{ge}	Gate - Emitter Charge (turn-on)	—	6.2	9.2		
Q _{gc}	Gate - Collector Charge (turn-on)	—	12	19		
t _{d(on)}	Turn-On Delay Time	—	73	—	ns	T _J = 25°C I _C = 15A, V _{CC} = 400V V _{GE} = 15V, R _G = 23Ω Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
t _r	Rise Time	—	72	—		
t _{d(off)}	Turn-Off Delay Time	—	120	180		
t _f	Fall Time	—	100	150		
E _{on}	Turn-On Switching Loss	—	0.7	—	mJ	See Fig. 9, 10, 11, 18
E _{off}	Turn-Off Switching Loss	—	0.4	—		
E _{ts}	Total Switching Loss	—	1.1	1.7		
t _{d(on)}	Turn-On Delay Time	—	77	—	ns	T _J = 150°C, See Fig. 9, 10, 11, 18 I _C = 15A, V _{CC} = 400V V _{GE} = 15V, R _G = 23Ω Energy losses include "tail" and diode reverse recovery.
t _r	Rise Time	—	75	—		
t _{d(off)}	Turn-Off Delay Time	—	200	—		
t _f	Fall Time	—	190	—		
E _{ts}	Total Switching Loss	—	1.5	—	mJ	
L _E	Internal Emitter Inductance	—	13	—	nH	Measured 5mm from package
C _{ies}	Input Capacitance	—	660	—	pF	V _{GE} = 0V V _{CC} = 30V See Fig. 7 f = 1.0MHz
C _{oes}	Output Capacitance	—	110	—		
C _{res}	Reverse Transfer Capacitance	—	12	—		
t _{rr}	Diode Reverse Recovery Time	—	42	60	ns	T _J = 25°C See Fig. 14
		—	80	120		T _J = 125°C
I _{rr}	Diode Peak Reverse Recovery Current	—	3.5	6.0	A	T _J = 25°C See Fig. 15
		—	5.6	10		T _J = 125°C
Q _{rr}	Diode Reverse Recovery Charge	—	80	180	nC	T _J = 25°C See Fig. 16
		—	220	600		T _J = 125°C
di _(rec) M/dt	Diode Peak Rate of Fall of Recovery During t _b	—	180	—	A/μs	T _J = 25°C See Fig. 17
		—	116	—		T _J = 125°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=10μH, R_G= 23Ω, (See fig. 19)
- ③ Pulse width ≤ 80μs; duty factor ≤ 0.1%.
- ④ Pulse width 5.0μs, single shot.

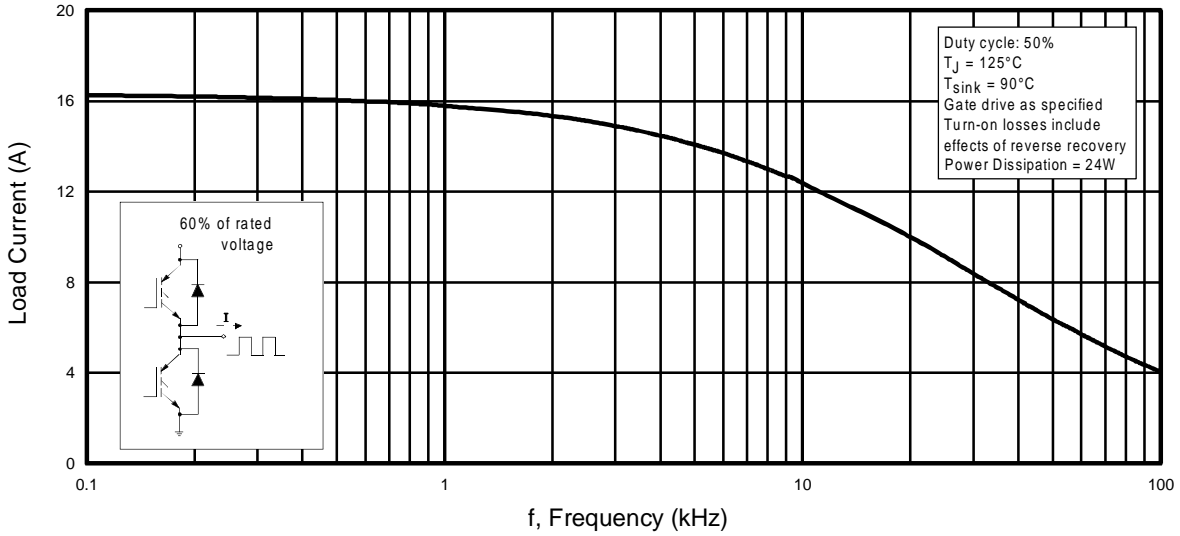


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

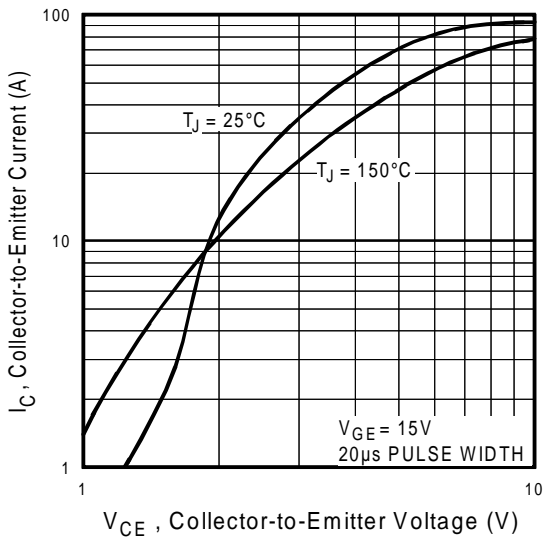


Fig. 2 - Typical Output Characteristics

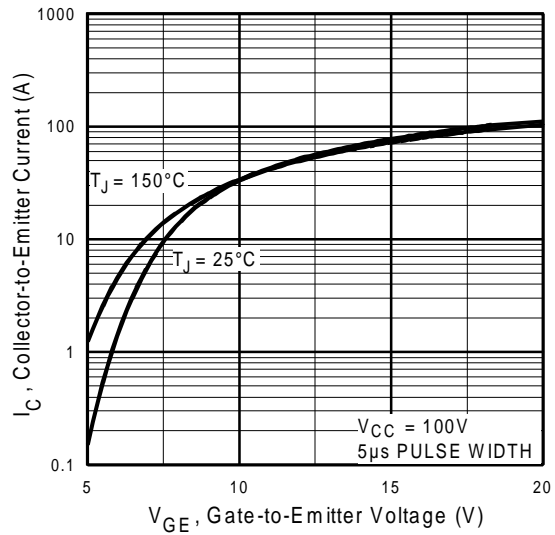


Fig. 3 - Typical Transfer Characteristics

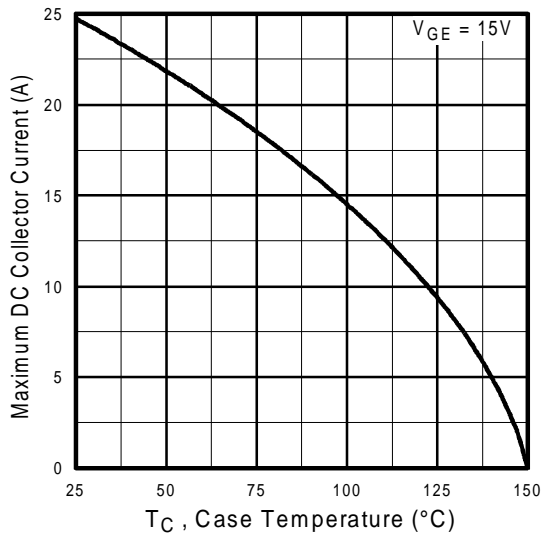


Fig. 4 - Maximum Collector Current vs. Case Temperature

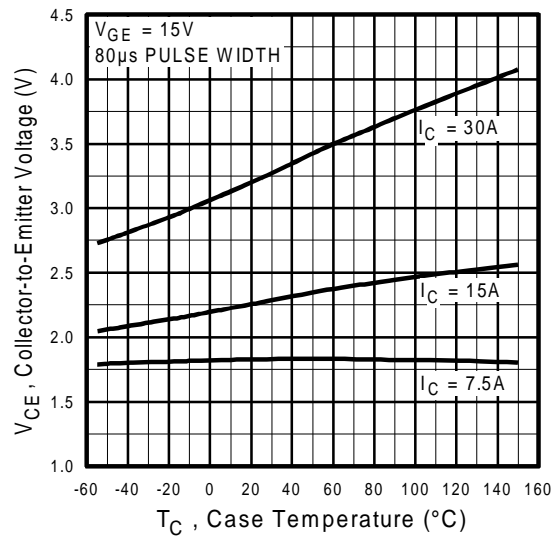


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

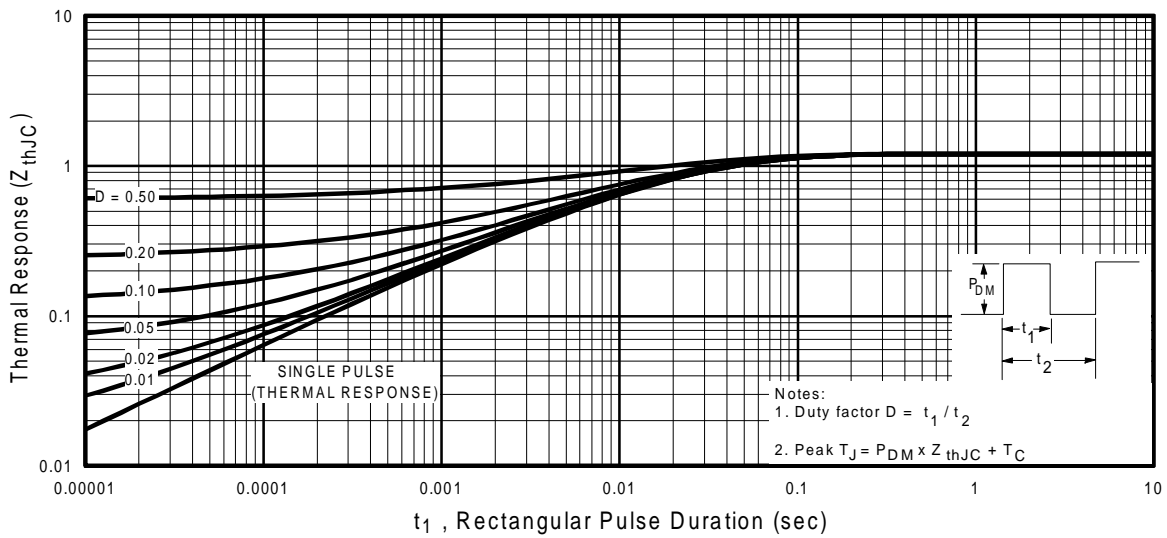


Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case

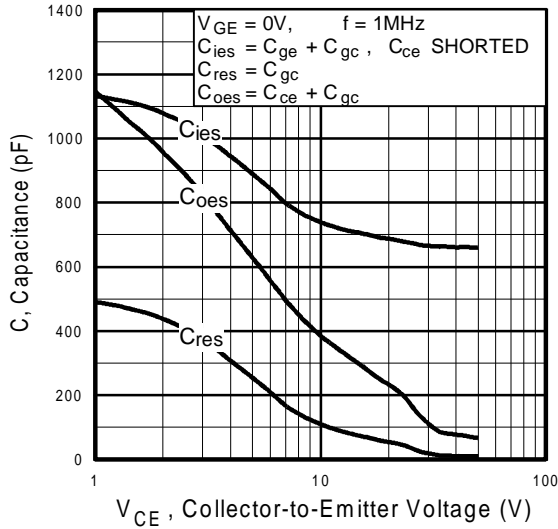


Fig. 7 - Typical Capacitance vs. Collector-to-Emitter Voltage

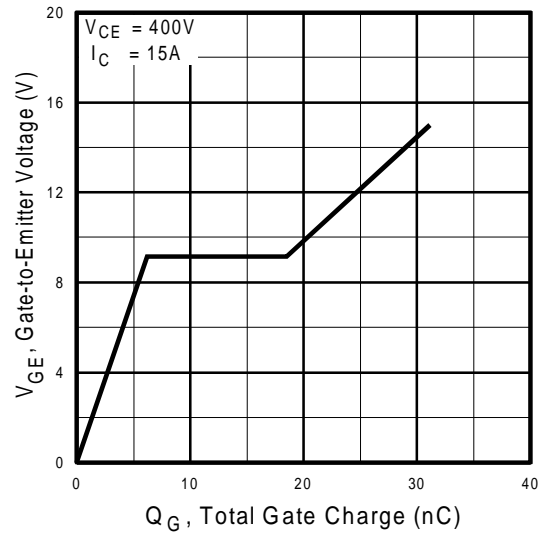


Fig. 8 - Typical Gate Charge vs. Gate-to-Emitter Voltage

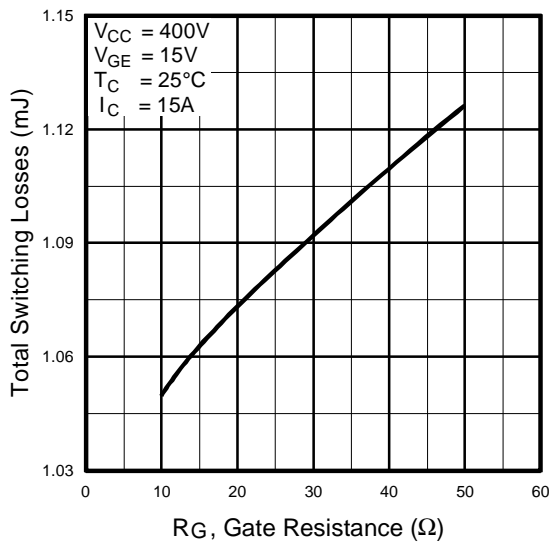


Fig. 9 - Typical Switching Losses vs. Gate Resistance

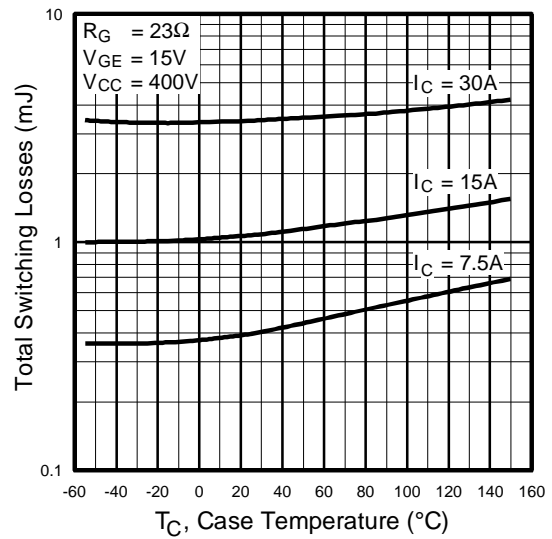


Fig. 10 - Typical Switching Losses vs. Case Temperature

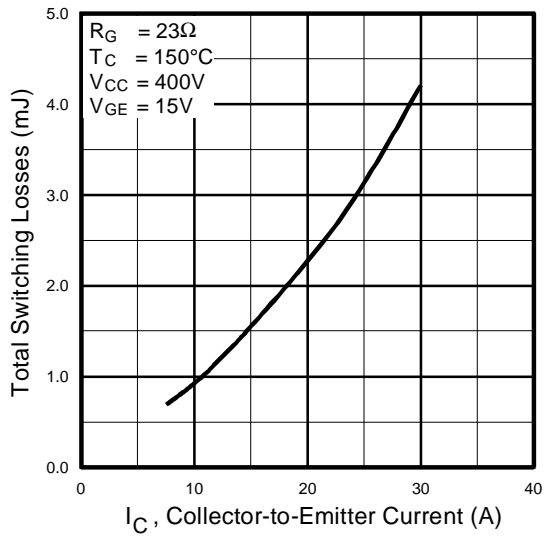


Fig. 11 - Typical Switching Losses vs. Collector-to-Emitter Current

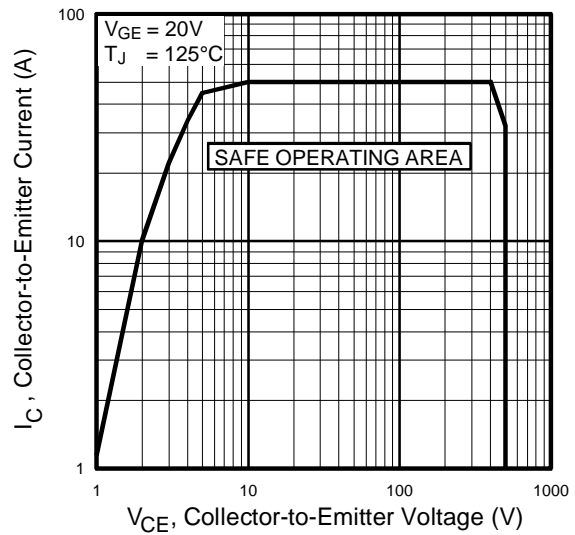


Fig. 12 - Turn-Off SOA

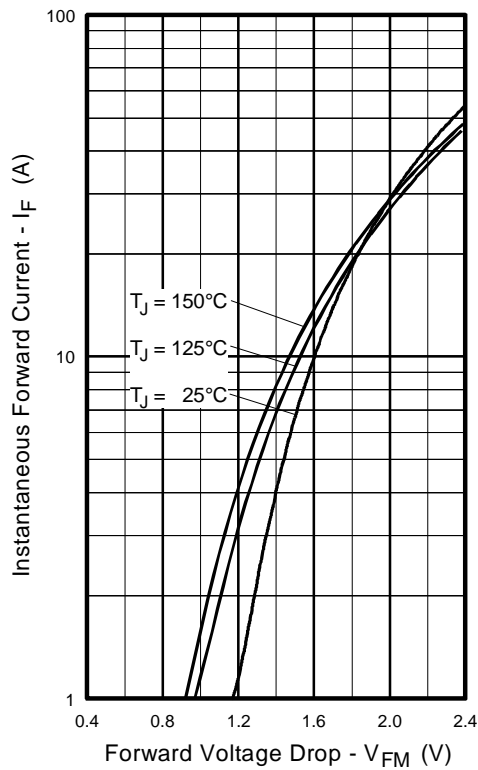


Fig. 13 - Maximum Forward Voltage Drop vs. Instantaneous Forward Current

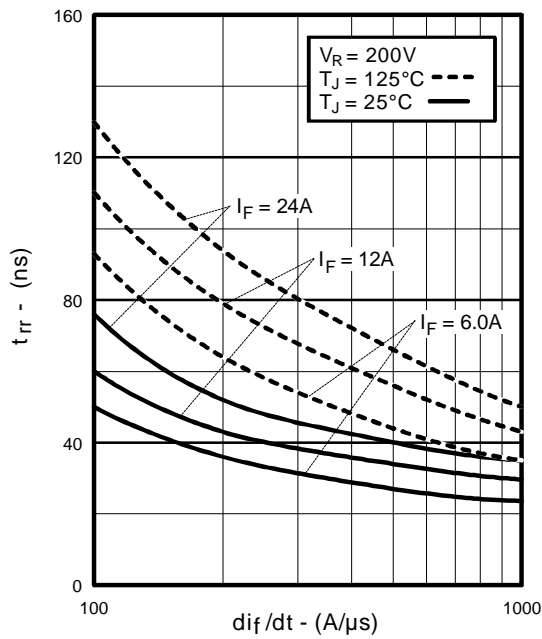


Fig. 14 - Typical Reverse Recovery vs. di_f/dt

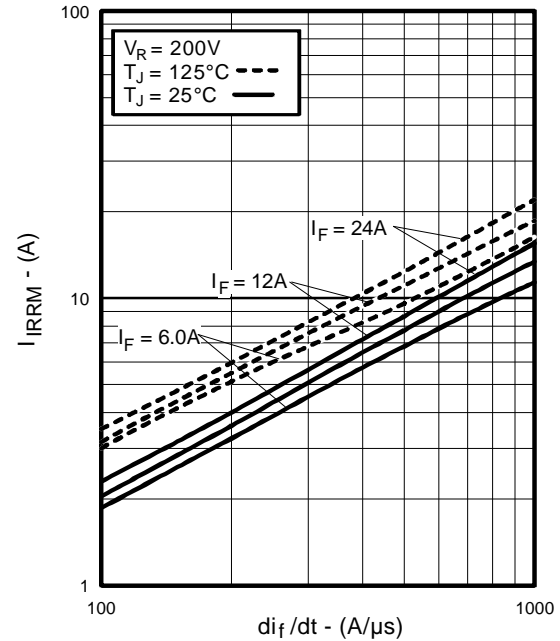


Fig. 15 - Typical Recovery Current vs. di_f/dt

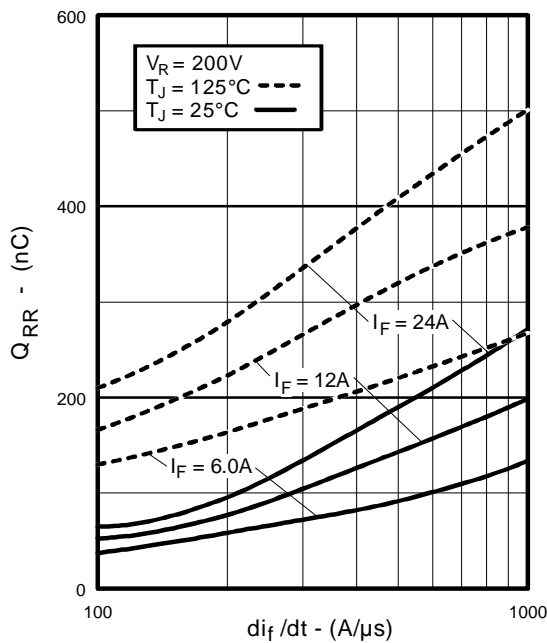


Fig. 16 - Typical Stored Charge vs. di_f/dt

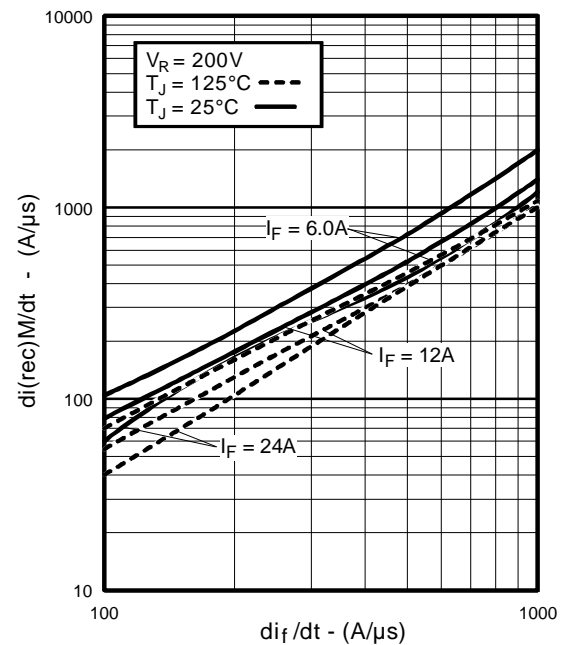


Fig. 17 - Typical $di_{(rec)M}/dt$ vs. di_f/dt

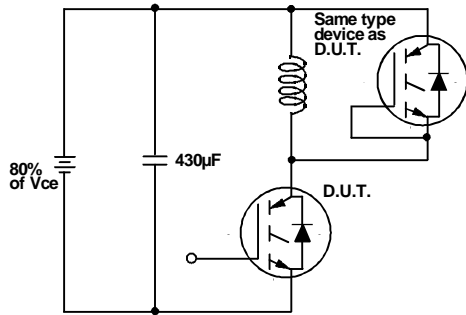


Fig. 18a - Test Circuit for Measurement of I_{LM} , E_{on} , $E_{off(diode)}$, t_{rr} , Q_{rr} , I_{rr} , $t_{d(on)}$, t_r , $t_{d(off)}$, t_f

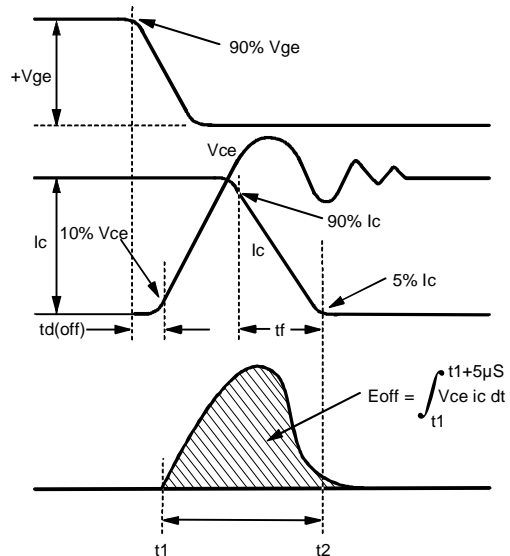


Fig. 18b - Test Waveforms for Circuit of Fig. 18a, Defining E_{off} , $t_{d(off)}$, t_f

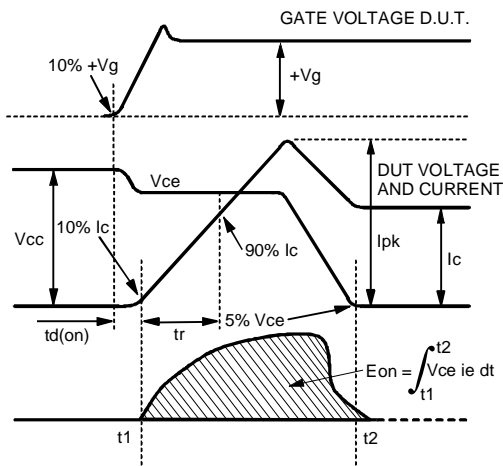


Fig. 18c - Test Waveforms for Circuit of Fig. 18a, Defining E_{on} , $t_{d(on)}$, t_r

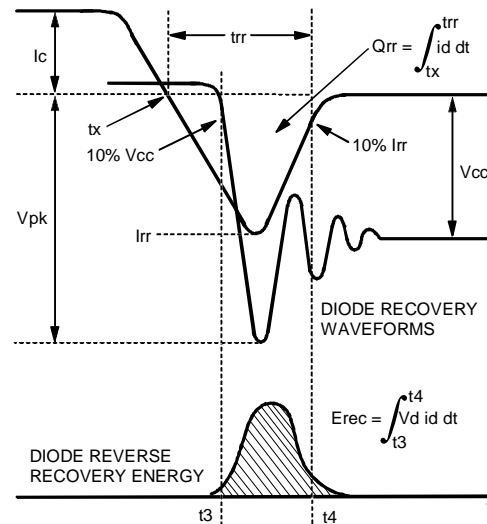


Fig. 18d - Test Waveforms for Circuit of Fig. 18a, Defining E_{rec} , t_{rr} , Q_{rr} , I_{rr}

**Refer to Section D for the following:
Appendix B: Section D - page D-4**

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