

# International Rectifier

PD - 5.024A

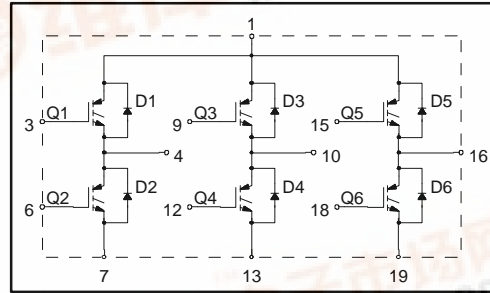
## CPV363MU

IGBT SIP MODULE

Ultra-Fast IGBT

### Features

- Fully isolated printed circuit board mount package
- 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



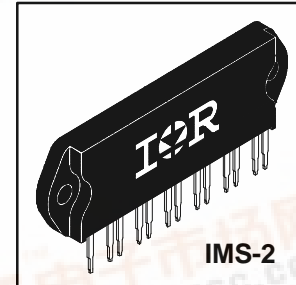
### Product Summary

#### Output Current in a Typical 20 kHz Motor Drive

5.4 A<sub>RMS</sub> per phase (1.7 kW total) with T<sub>C</sub> = 90°C, T<sub>J</sub> = 125°C, Supply Voltage 360Vdc, Power Factor 0.8, Modulation Depth 80% (See Figure 1)

### Description

The IGBT technology is the key to International Rectifier's advanced line of IMS (Insulated Metal Substrate) Power Modules. These modules are more efficient than comparable bipolar transistor modules, while at the same time having the simpler gate-drive requirements of the familiar power MOSFET. This superior technology has now been coupled to a state of the art materials system that maximizes power throughput with low thermal resistance. This package is highly suited to motor drive applications and where space is at a premium.



### Absolute Maximum Ratings

	Parameter	Max.	Units
V <sub>CES</sub>	Collector-to-Emitter Voltage	600	V
I <sub>C</sub> @ T <sub>C</sub> = 25°C	Continuous Collector Current, each IGBT	13	A
I <sub>C</sub> @ T <sub>C</sub> = 100°C	Continuous Collector Current, each IGBT	6.8	
I <sub>CM</sub>	Pulsed Collector Current ①	40	
I <sub>LM</sub>	Clamped Inductive Load Current ②	40	
I <sub>F</sub> @ T <sub>C</sub> = 100°C	Diode Continuous Forward Current	6.1	
I <sub>FM</sub>	Diode Maximum Forward Current	40	
V <sub>GE</sub>	Gate-to-Emitter Voltage	±20	V
V <sub>ISOL</sub>	Isolation Voltage, any terminal to case, 1 min.	2500	V <sub>RMS</sub>
P <sub>D</sub> @ T <sub>C</sub> = 25°C	Maximum Power Dissipation, each IGBT	36	W
P <sub>D</sub> @ T <sub>C</sub> = 100°C	Maximum Power Dissipation, each IGBT	14	
T <sub>J</sub>	Operating Junction and Storage Temperature Range	-40 to +150	°C
T <sub>STG</sub>			
	Mounting torque, 6-32 or M3 screw.	5-7 lbf•in (0.55-0.8 N•m)	

### Thermal Resistance

	Parameter	Typ.	Max.	Units
R <sub>θJC</sub> (IGBT)	Junction-to-Case, each IGBT, one IGBT in conduction	—	3.5	°C/W
R <sub>θJC</sub> (DIODE)	Junction-to-Case, each diode, one diode in conduction	—	5.5	
R <sub>θCS</sub> (MODULE)	Case-to-Sink, flat, greased surface	0.1	—	
Wt	Weight of module	20 (0.7)	—	g (oz)



# CPV363MU



## Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

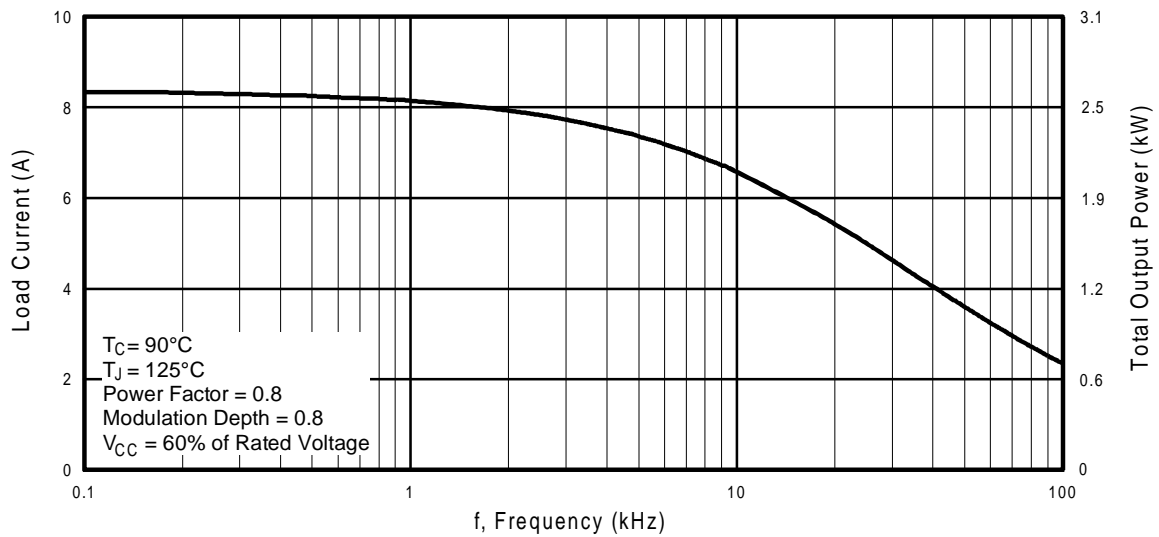
	Parameter	Min.	Typ.	Max.	Units	Conditions
V <sub>(BR)CES</sub>	Collector-to-Emitter Breakdown Voltage ③	600	—	—	V	V <sub>GE</sub> = 0V, I <sub>C</sub> = 250μA
ΔV <sub>(BR)CES/ΔT<sub>J</sub></sub>	Temperature Coeff. of Breakdown Voltage	—	0.63	—	V/°C	V <sub>GE</sub> = 0V, I <sub>C</sub> = 1.0mA
V <sub>CE(on)</sub>	Collector-to-Emitter Saturation Voltage	—	1.9	2.4	V	I <sub>C</sub> = 6.8A I <sub>C</sub> = 13A I <sub>C</sub> = 6.8A, T <sub>J</sub> = 150°C V <sub>GE</sub> = 15V See Fig. 2, 5
		—	2.3	—		
		—	1.8	—		
V <sub>GE(th)</sub>	Gate Threshold Voltage	3.0	—	5.5		V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>	Temperature Coeff. of Threshold Voltage	—	-11	—	mV/°C	V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA
g <sub>re</sub>	Forward Transconductance ④	4.0	6.0	—	S	V <sub>CE</sub> = 100V, I <sub>C</sub> = 6.8A
I <sub>CES</sub>	Zero Gate Voltage Collector Current	—	—	250	μA	V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V
		—	—	2500		V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 150°C
V <sub>FM</sub>	Diode Forward Voltage Drop	—	1.4	1.7	V	I <sub>C</sub> = 12A I <sub>C</sub> = 12A, T <sub>J</sub> = 150°C See Fig. 13
		—	1.3	1.6		
I <sub>GES</sub>	Gate-to-Emitter Leakage Current	—	—	±500	nA	V <sub>GE</sub> = ±20V

## Switching Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)

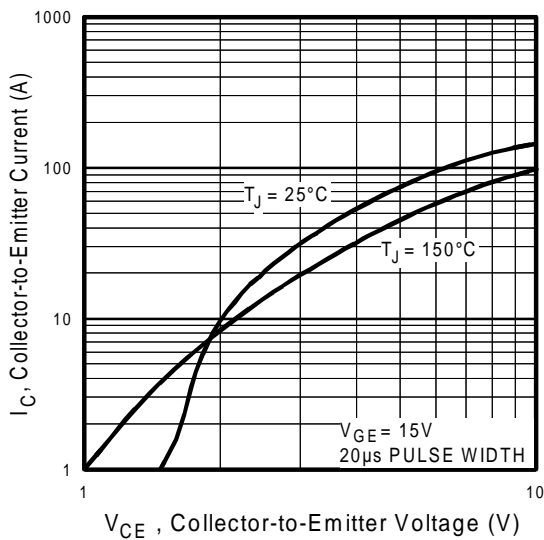
	Parameter	Min.	Typ.	Max.	Units	Conditions
Q <sub>g</sub>	Total Gate Charge (turn-on)	—	29	36	nC	I <sub>C</sub> = 6.8A V <sub>CC</sub> = 400V See Fig. 8
Q <sub>ge</sub>	Gate - Emitter Charge (turn-on)	—	4.8	6.8		
Q <sub>gc</sub>	Gate - Collector Charge (turn-on)	—	12	17		
t <sub>d(on)</sub>	Turn-On Delay Time	—	25	—	ns	T <sub>J</sub> = 25°C I <sub>C</sub> = 6.8A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω Energy losses include "tail" and diode reverse recovery. See Fig. 9, 10, 11, 18
t <sub>r</sub>	Rise Time	—	15	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	92	200		
t <sub>f</sub>	Fall Time	—	93	190	mJ	T <sub>J</sub> = 150°C, See Fig. 9, 10, 11, 18 I <sub>C</sub> = 6.8A, V <sub>CC</sub> = 480V V <sub>GE</sub> = 15V, R <sub>G</sub> = 23Ω Energy losses include "tail" and diode reverse recovery.
E <sub>on</sub>	Turn-On Switching Loss	—	0.23	—		
E <sub>off</sub>	Turn-Off Switching Loss	—	0.13	—		
E <sub>ts</sub>	Total Switching Loss	—	0.36	0.62	pF	V <sub>GE</sub> = 0V V <sub>CC</sub> = 30V f = 1.0MHz See Fig. 7
t <sub>d(on)</sub>	Turn-On Delay Time	—	25	—		
t <sub>r</sub>	Rise Time	—	15	—		
t <sub>d(off)</sub>	Turn-Off Delay Time	—	160	—	ns	T <sub>J</sub> = 25°C See Fig. 14 T <sub>J</sub> = 125°C 15 T <sub>J</sub> = 125°C 16
t <sub>f</sub>	Fall Time	—	200	—		
E <sub>ts</sub>	Total Switching Loss	—	0.71	—		
C <sub>ies</sub>	Input Capacitance	—	660	—	pF	See Fig. 17
C <sub>oes</sub>	Output Capacitance	—	100	—		
C <sub>res</sub>	Reverse Transfer Capacitance	—	11	—		
t <sub>rr</sub>	Diode Reverse Recovery Time	—	42	60	ns	I <sub>F</sub> = 12A V <sub>R</sub> = 200V di/dt = 200A/μs
		—	80	120		
I <sub>rr</sub>	Diode Peak Reverse Recovery Current	—	3.5	6.0		
		—	5.6	10	A	See Fig. 15 See Fig. 16
Q <sub>rr</sub>	Diode Reverse Recovery Charge	—	80	180		
		—	220	600		
di <sub>(rec)</sub> /dt	Diode Peak Rate of Fall of Recovery During t <sub>b</sub>	—	180	—	A/μs	See Fig. 17
		—	116	—		

### Notes:

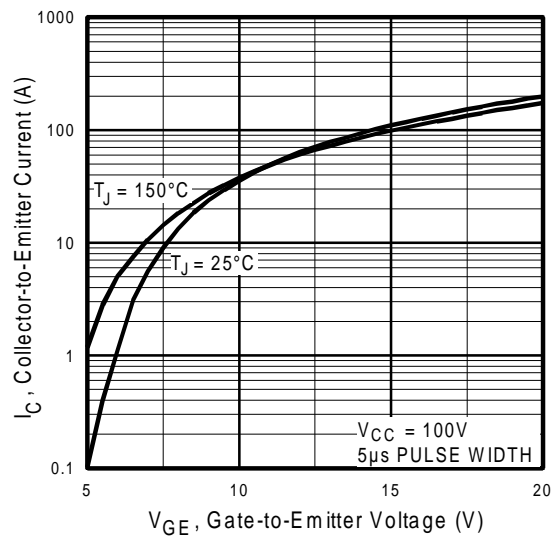
- ① Repetitive rating; V<sub>GE</sub>=20V, pulse width limited by max. junction temperature. ( See fig. 20 )
- ② V<sub>CC</sub>=80%(V<sub>CES</sub>), V<sub>GE</sub>=20V, L=10μH, R<sub>G</sub>= 23Ω, ( See fig. 19 )
- ③ Pulse width ≤ 80μs; duty factor ≤ 0.1%.
- ④ Pulse width 5.0μs, single shot.



**Fig. 1 - RMS Current and Output Power, Synthesized Sine Wave**



**Fig. 2 - Typical Output Characteristics**



**Fig. 3 - Typical Transfer Characteristics**

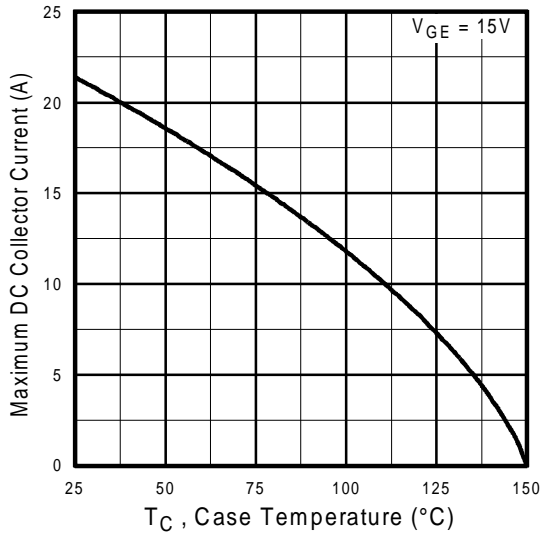


Fig. 4 - Maximum Collector Current vs. Case Temperature

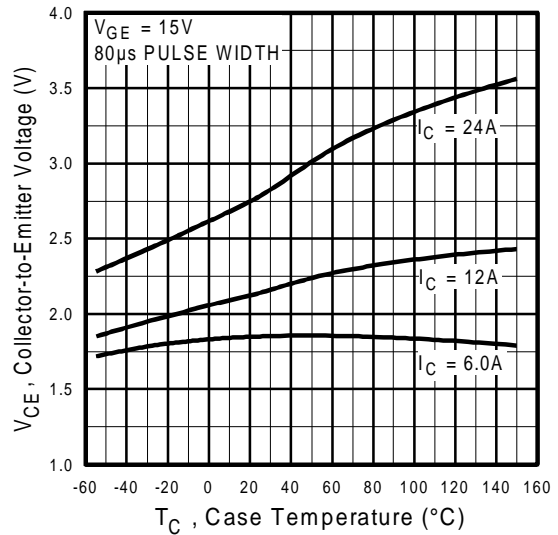


Fig. 5 - Collector-to-Emitter Voltage vs. Case Temperature

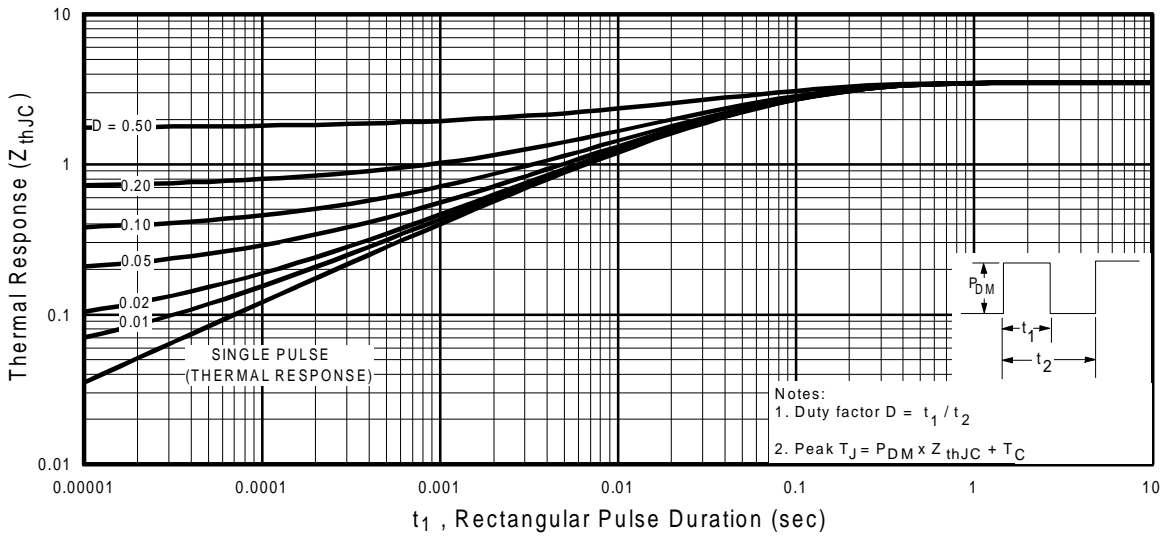
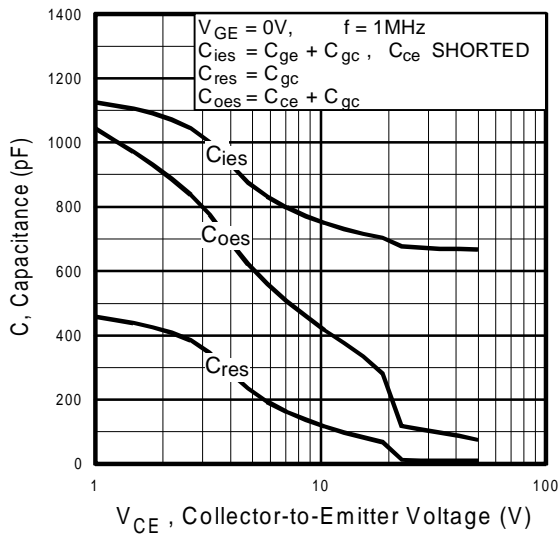
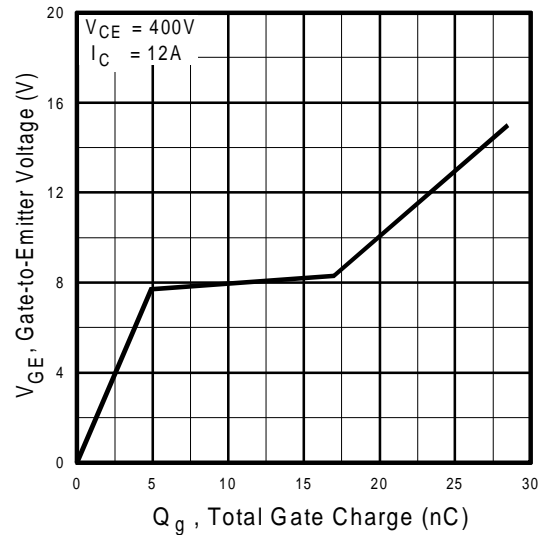


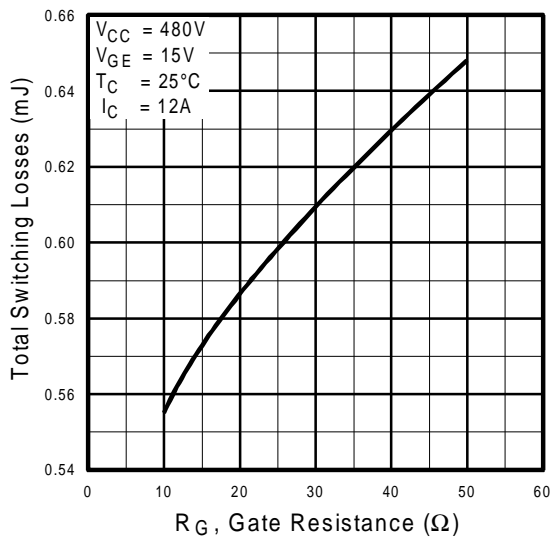
Fig. 6 - Maximum IGBT Effective Transient Thermal Impedance, Junction-to-Case



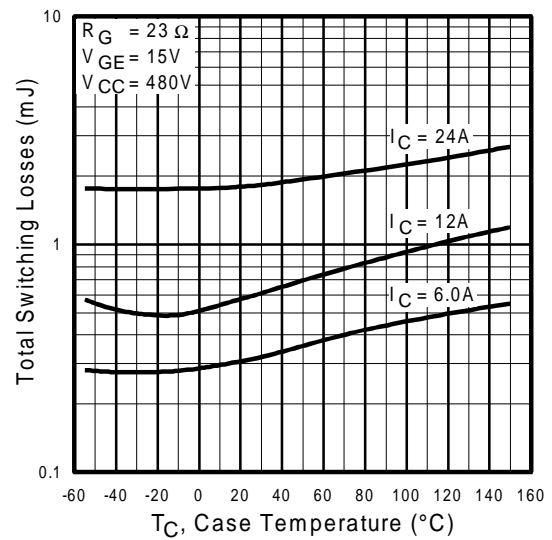
**Fig. 7** - Typical Capacitance vs. Collector-to-Emitter Voltage



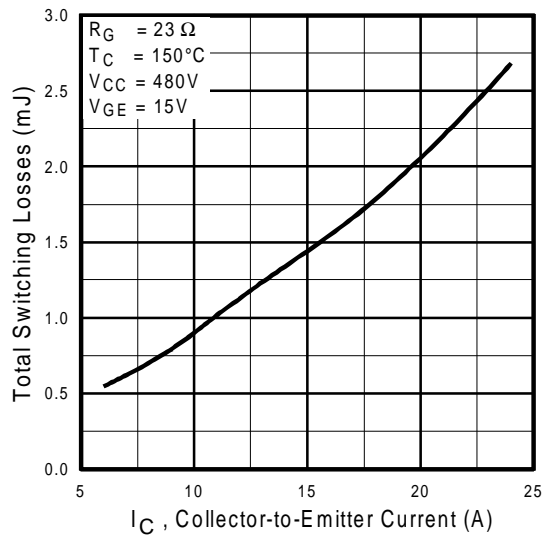
**Fig. 8** - Typical Gate Charge vs. Gate-to-Emitter Voltage



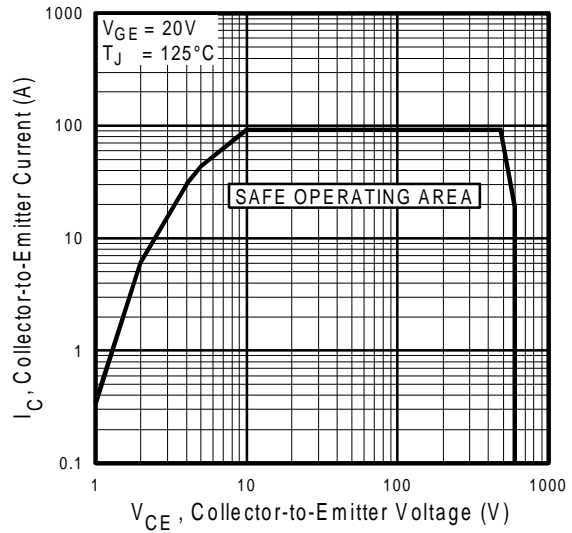
**Fig. 9** - Typical Switching Losses vs. Gate Resistance



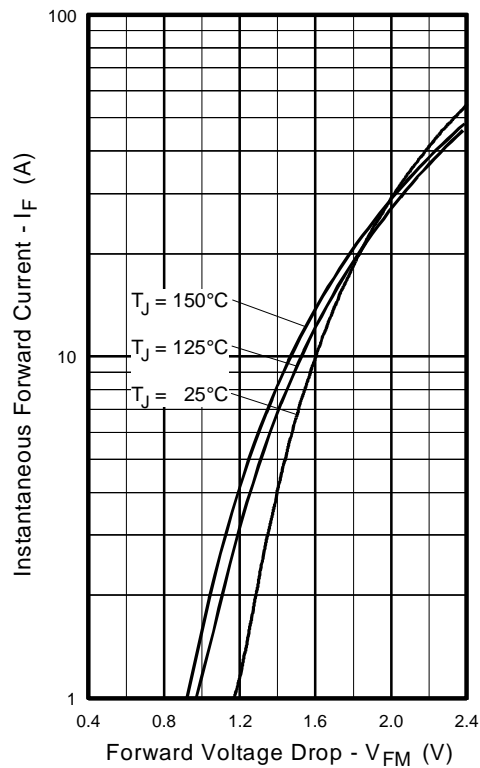
**Fig. 10** - Typical Switching Losses vs. Case Temperature



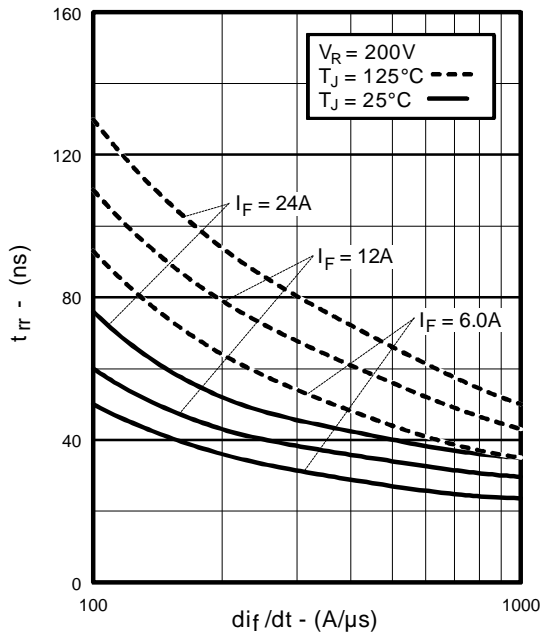
**Fig. 11** - Typical Switching Losses vs. Collector-to-Emitter Current



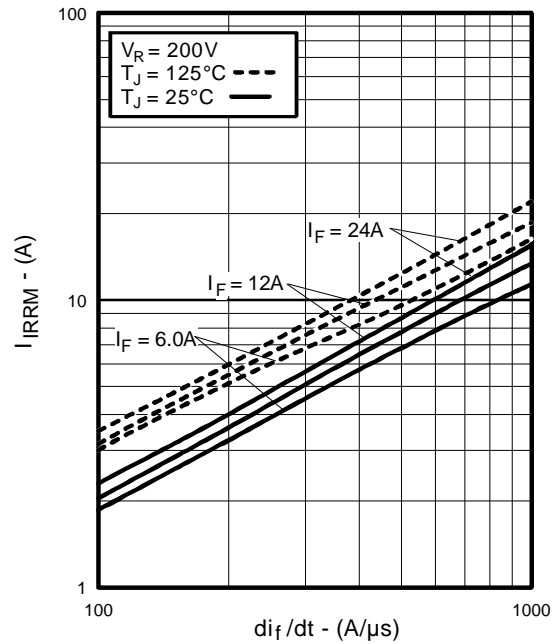
**Fig. 12** - Turn-Off SOA



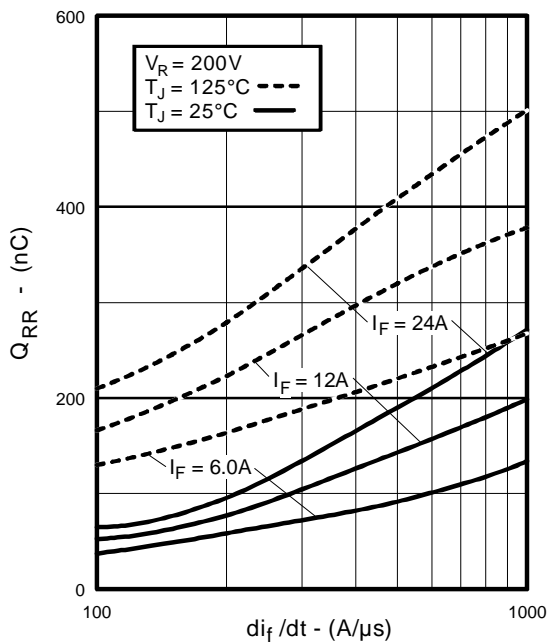
**Fig. 13** - Maximum Forward Voltage Drop vs. Instantaneous Forward Current



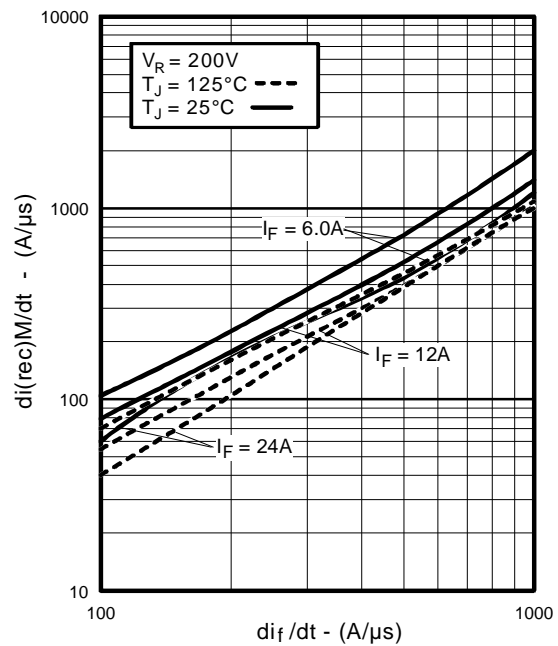
**Fig. 14** - Typical Reverse Recovery vs.  $di_f/dt$



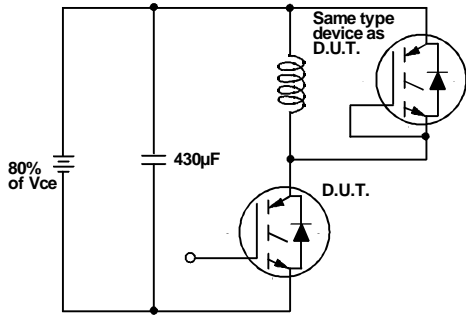
**Fig. 15** - Typical Recovery Current vs.  $di_f/dt$



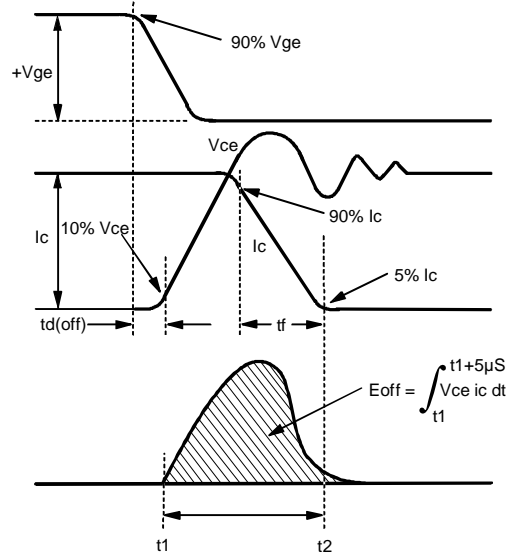
**Fig. 16** - Typical Stored Charge vs.  $di_f/dt$



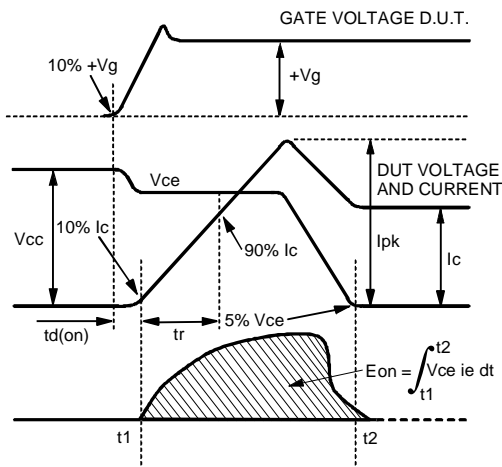
**Fig. 17** - Typical  $di_{(rec)M}/dt$  vs.  $di_f/dt$



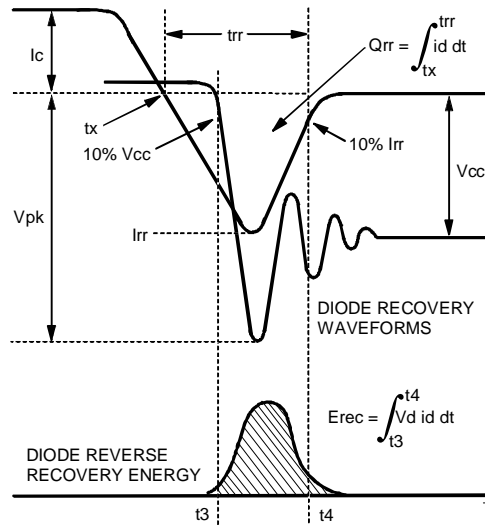
**Fig.18a** - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{on}$ ,  $E_{off(diode)}$ ,  $t_{rr}$ ,  $Q_{rr}$ ,  $I_{rr}$ ,  $t_{d(on)}$ ,  $t_r$ ,  $t_{d(off)}$ ,  $t_f$



**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 D: Section D - page D-6**

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

Fig. 19 - Clamped Inductive Load Test Circuit

Fig. 20 - Pulsed Collector Current Test Circuit