

< IGBT MODULES >

# CM600DU-12NFH

HIGH POWER HIGH FREQUENTLY SWITCHING USE  
INSULATED TYPE



Dual (Half-Bridge)

Collector current  $I_C$  ..... **600 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **600 V**  
 Maximum junction temperature  $T_{jmax}$  ... **150 °C**

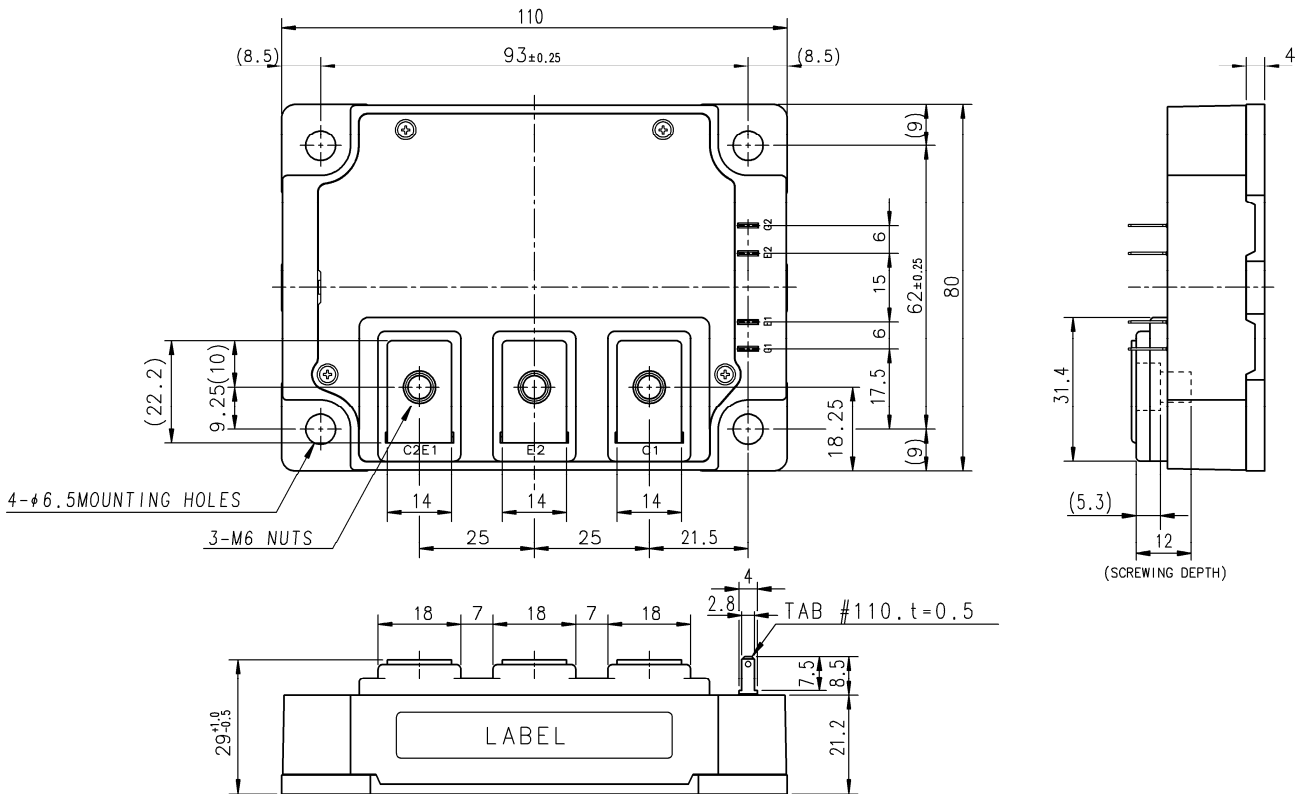
- Flat base Type
- Copper base plate
- RoHS Directive compliant
- UL Recognized under UL1557, File E323585

**APPLICATION**

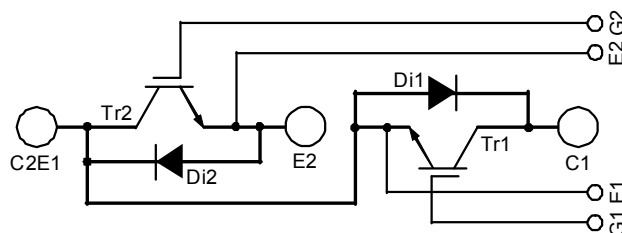
High frequency (30 kHz ~ 60 kHz) switching use:  
 Gradient amplifier, Induction heating, Power supply, etc.

**OUTLINE DRAWING & INTERNAL CONNECTION**

Dimension in mm



**INTERNAL CONNECTION**



Tolerance otherwise specified

Division of Dimension	Tolerance
0.5 to 3	±0.2
over 3 to 6	±0.3
over 6 to 30	±0.5
over 30 to 120	±0.8
over 120 to 400	±1.2

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ABSOLUTE MAXIMUM RATINGS (T<sub>j</sub>=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Rating	Unit
V <sub>CES</sub>	Collector-emitter voltage	G-E short-circuited	600	V
V <sub>GES</sub>	Gate-emitter voltage	C-E short-circuited	±20	V
I <sub>C</sub>	Collector current	Operation (Note.5)	600	A
		Operation, RMS (Note.5)	400	
		Pulse, Repetitive (Note.4)	1200	
I <sub>CRM</sub>			1200	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note.2, 5)	1130	W
P <sub>tot</sub> '		T <sub>C</sub> '=25 °C, RMS (Note.3, 5)	2350	
I <sub>E</sub> (Note.1)	Emitter current (Free wheeling diode forward current)	Operation (Note.5)	600	A
		Operation, RMS (Note.5)	400	
I <sub>ERM</sub> (Note.1)		Pulse, Repetitive (Note.4)	1200	
T <sub>j</sub>	Junction temperature	-	-40 ~ +150	°C
T <sub>stg</sub>	Storage temperature	-	-40 ~ +125	
V <sub>isol</sub>	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V

ELECTRICAL CHARACTERISTICS (T<sub>j</sub>=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>CES</sub>	Collector-emitter cut-off current	V <sub>CE</sub> =V <sub>CES</sub> , G-E short-circuited	-	-	1	mA	
I <sub>GES</sub>	Gate-emitter leakage current	V <sub>GE</sub> =V <sub>GES</sub> , C-E short-circuited	-	-	0.5	µA	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =60 mA, V <sub>CE</sub> =10 V	5	6	7	V	
V <sub>CESat</sub>	Collector-emitter saturation voltage	I <sub>C</sub> =600 A (Note.6), V <sub>GE</sub> =15 V	T <sub>j</sub> =25 °C	-	2.0	2.7	V
			T <sub>j</sub> =125 °C	-	1.95	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited	-	-	166	nF	
C <sub>oes</sub>	Output capacitance		-	-	11		
C <sub>res</sub>	Reverse transfer capacitance		-	-	6.0		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =300 V, I <sub>C</sub> =600 A, V <sub>GE</sub> =15 V	-	3720	-	nC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =300 V, I <sub>C</sub> =600 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =2.0 Ω, Inductive load	-	-	650	ns	
t <sub>r</sub>	Rise time		-	-	250		
t <sub>d(off)</sub>	Turn-off delay time		-	-	800		
t <sub>f</sub>	Fall time		-	-	150		
V <sub>EC</sub> (Note.1)	Emitter-collector voltage	I <sub>E</sub> =600 A (Note.6), G-E short-circuited	-	2.0	2.6	V	
t <sub>rr</sub> (Note.1)	Reverse recovery time	V <sub>CC</sub> =300 V, I <sub>E</sub> =600 A, V <sub>GE</sub> =±15 V,	-	-	200	ns	
Q <sub>rr</sub> (Note.1)	Reverse recovery charge	R <sub>G</sub> =2.0 Ω, Inductive load	-	11	-	µC	
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =300 V, I <sub>C</sub> =I <sub>E</sub> =600 A,	-	11	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse	V <sub>GE</sub> =±15 V, R <sub>G</sub> =2.0 Ω, T <sub>j</sub> =125 °C,	-	27	-		
E <sub>rr</sub> (Note.1)	Reverse recovery energy per pulse	Inductive load	-	6.3	-	mJ	
r <sub>g</sub>	Internal gate resistance	Per switch, T <sub>C</sub> =25 °C	-	0.8	-	Ω	

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Thermal resistance (Note.2)	Junction to case, per IGBT	-	-	0.11	K/W
R <sub>th(j-c)D</sub>		Junction to case, per FWDi	-	-	0.12	K/W
R <sub>th(c-s)</sub>	Contact thermal resistance (Note.2)	Case to heat sink, per 1/2 module, Thermal grease applied (Note.7)	-	20	-	K/kW
R <sub>th(j-c')Q</sub>	Thermal resistance (Note.3)	Junction to case, per IGBT	-	-	53	K/kW
R <sub>th(j-c')D</sub>		Junction to case, per FWDi	-	-	78	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M <sub>t</sub>	Mounting torque	Main terminals M 6 screw	3.5	4.0	4.5	N·m
M <sub>s</sub>		Mounting to heat sink M 6 screw	3.5	4.0	4.5	
m	Weight	-	-	580	-	g
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note.8)	-100	-	+100	µm

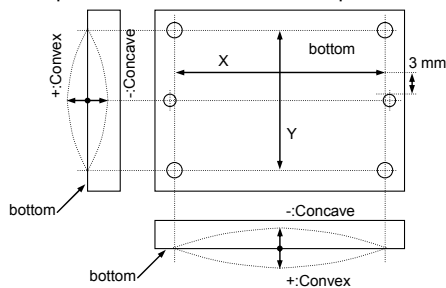
# CM600DU-12NFH

HIGH POWER HIGH FREQUENTLY SWITCHING USE  
INSULATED TYPE

## RECOMMENDED OPERATING CONDITIONS (T<sub>a</sub>=25 °C)

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>CC</sub>	(DC) Supply voltage	Applied across C1-E2	-	300	400	V
V <sub>GEon</sub>	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2	13.5	15.0	16.5	
R <sub>G</sub>	External gate resistance	Per switch	1.0	-	10	Ω

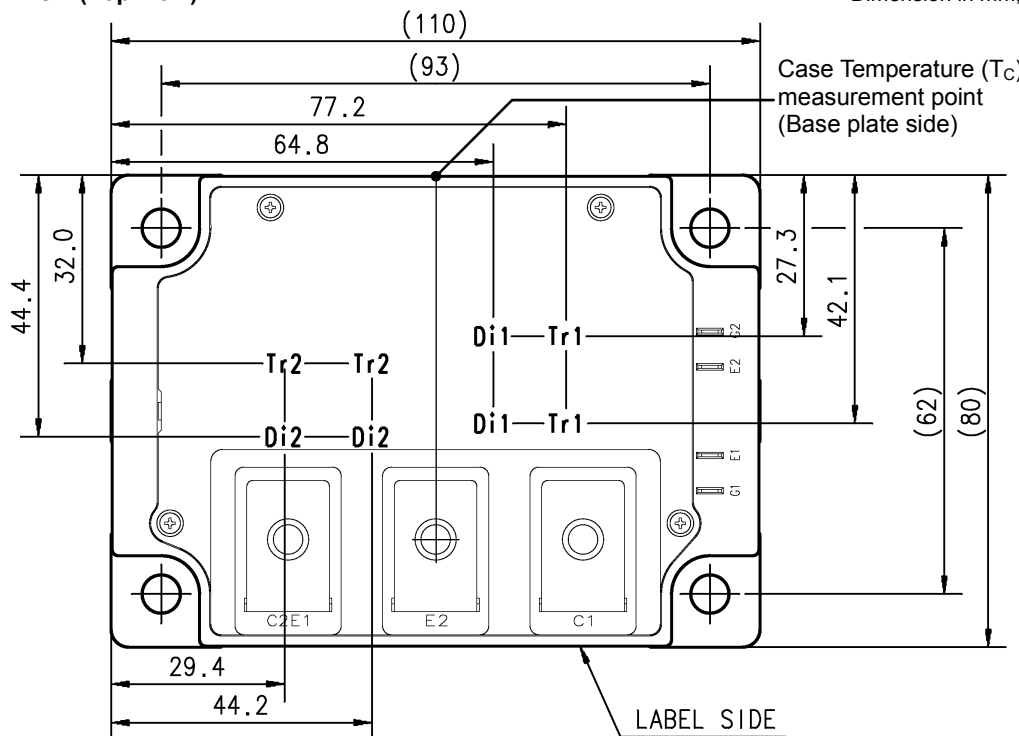
- Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).  
 2: Case temperature (T<sub>C</sub>) measured point is base plate side. (Refer to the figure of chip location)  
 3: Case temperature (T<sub>C</sub>') and heat sink temperature (T<sub>s</sub>') are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)  
 4: Pulse width and repetition rate should be such that the device junction temperature (T<sub>j</sub>) dose not exceed T<sub>jmax</sub> rating.  
 5: Junction temperature (T<sub>j</sub>) should not increase beyond T<sub>jmax</sub> rating.  
 6: Pulse width and repetition rate should be such as to cause negligible temperature rise. (Refer to the figure of test circuit)  
 7: Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).  
 8: Base plate flatness measurement points are as in the following figure.



9: No short circuit capability is designed.

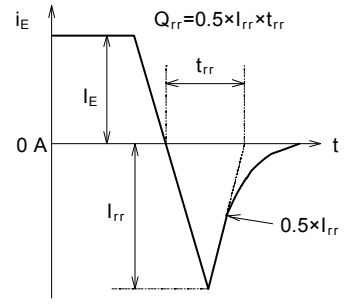
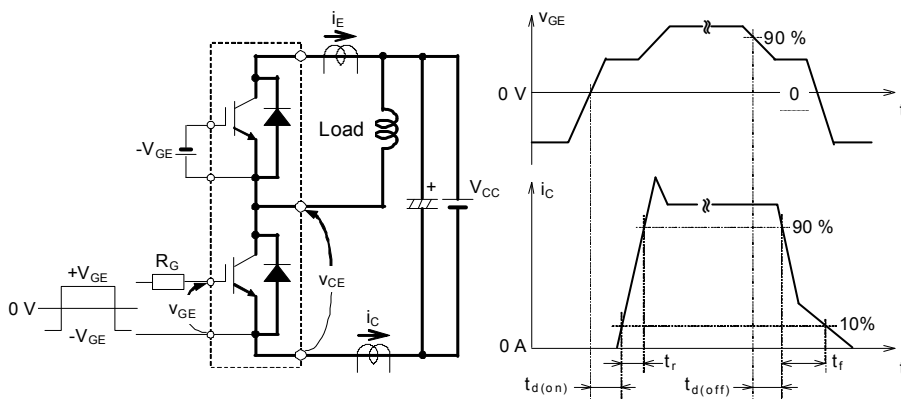
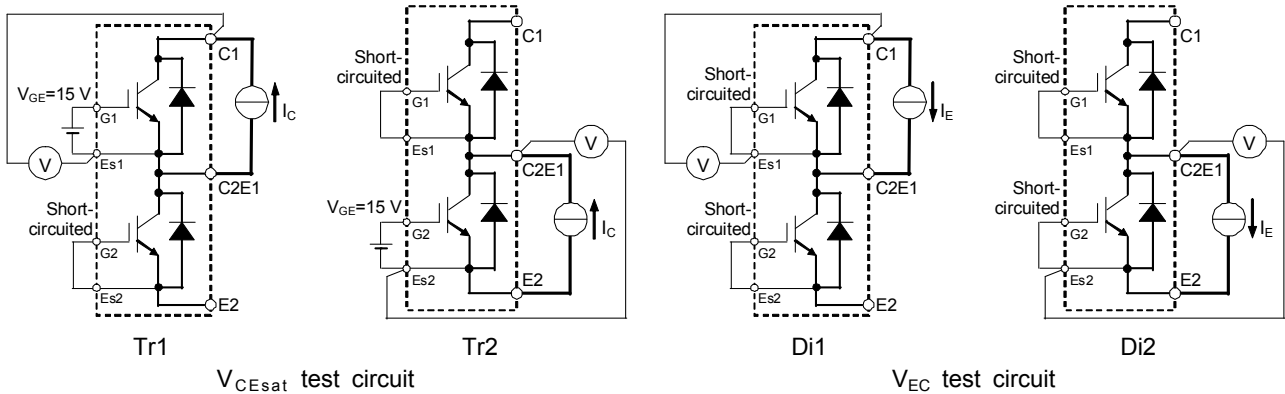
## CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



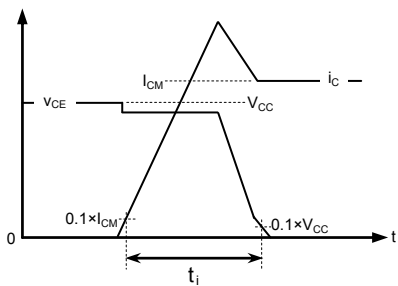
Tr1/Tr2: IGBT, Di1/Di2: FWDi

TEST CIRCUIT AND WAVEFORMS

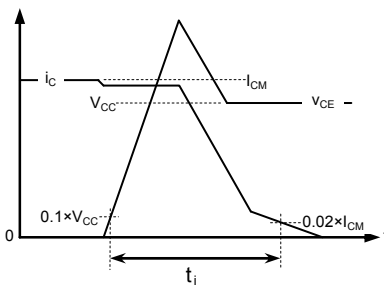


Switching characteristics test circuit and waveforms

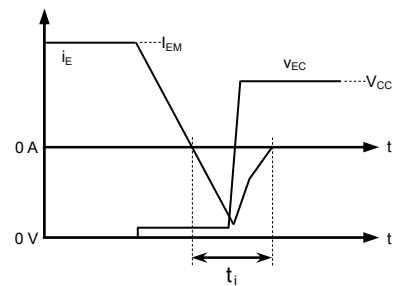
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy

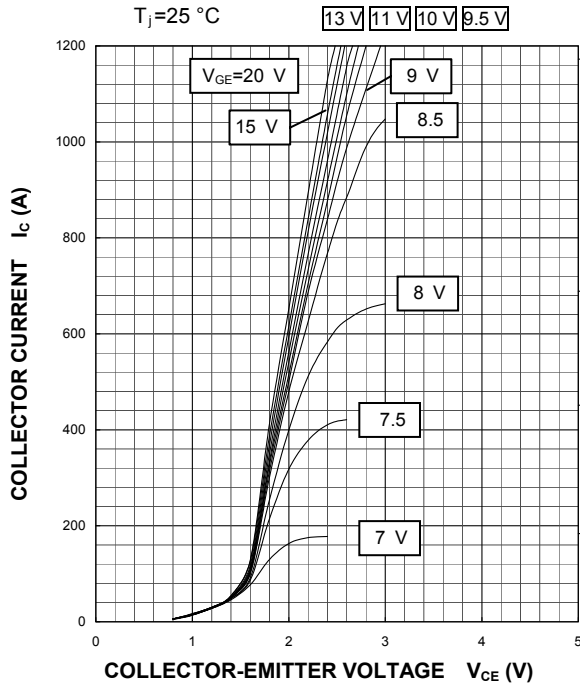


FWDi Reverse recovery energy

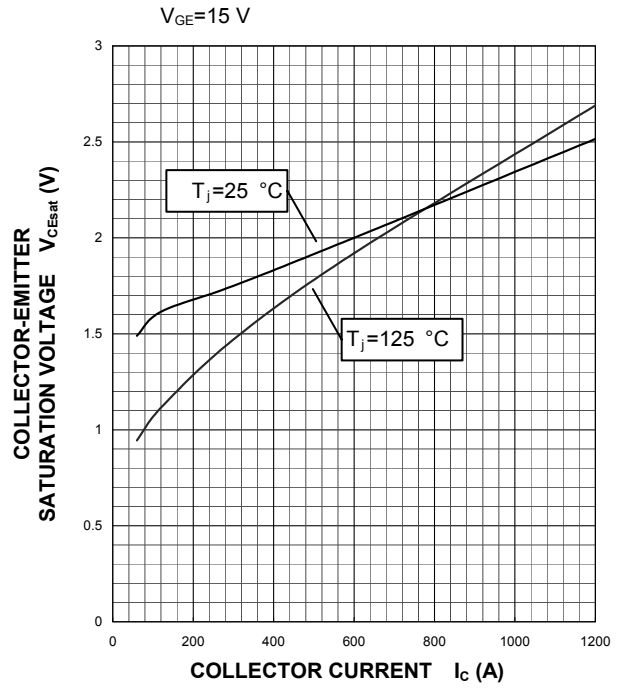
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

PERFORMANCE CURVES

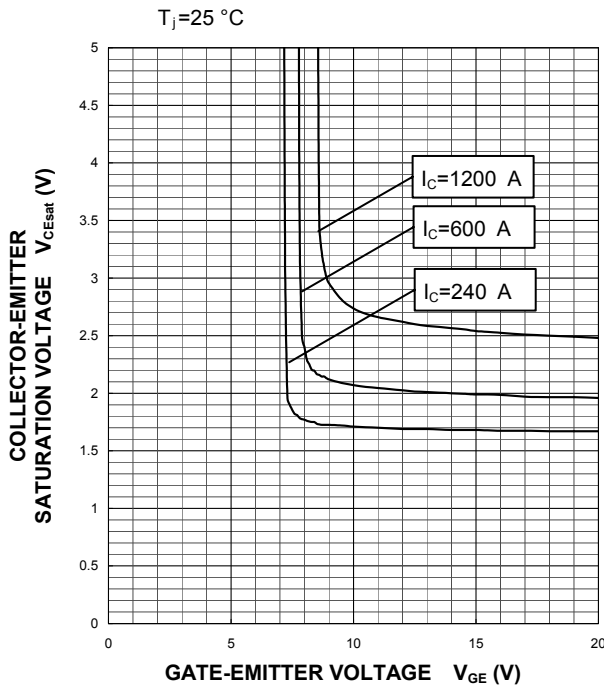
OUTPUT CHARACTERISTICS  
(TYPICAL)



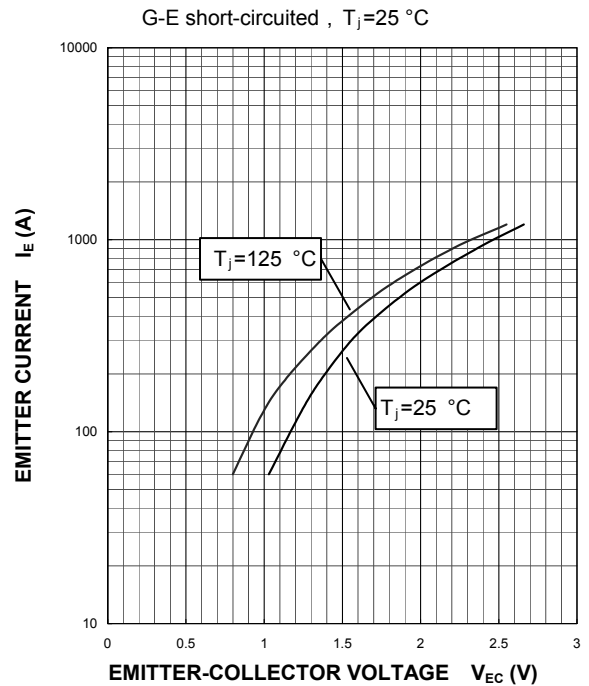
COLLECTOR-EMITTER SATURATION  
VOLTAGE CHARACTERISTICS  
(TYPICAL)



COLLECTOR-EMITTER SATURATION  
VOLTAGE CHARACTERISTICS  
(TYPICAL)



FREE WHEELING DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL)

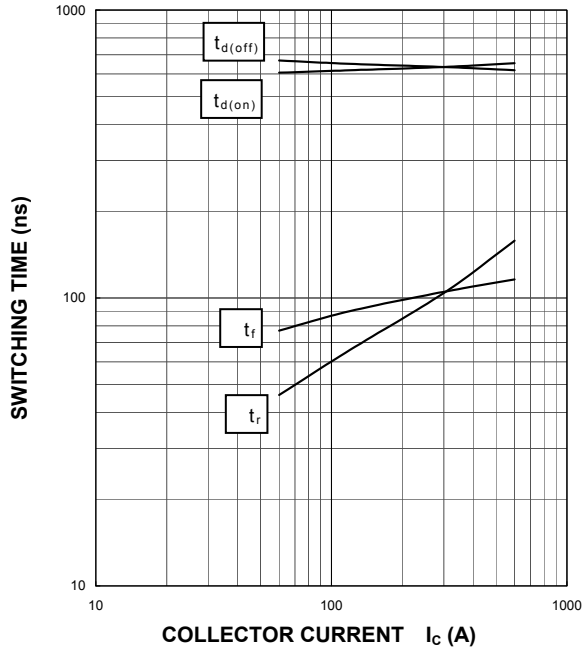


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HIGH POWER HIGH FREQUENTLY SWITCHING USE  
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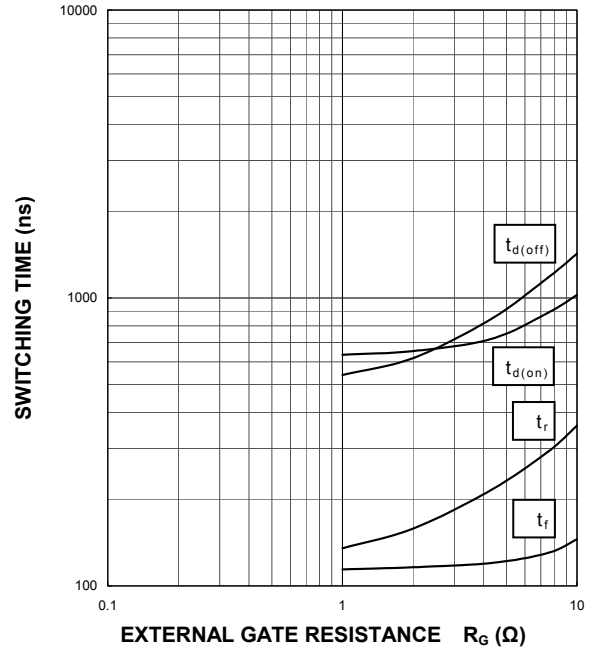
**HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=2.0\ \Omega$ ,  
 $T_j=125\text{ }^\circ\text{C}$ , INDUCTIVE LOAD



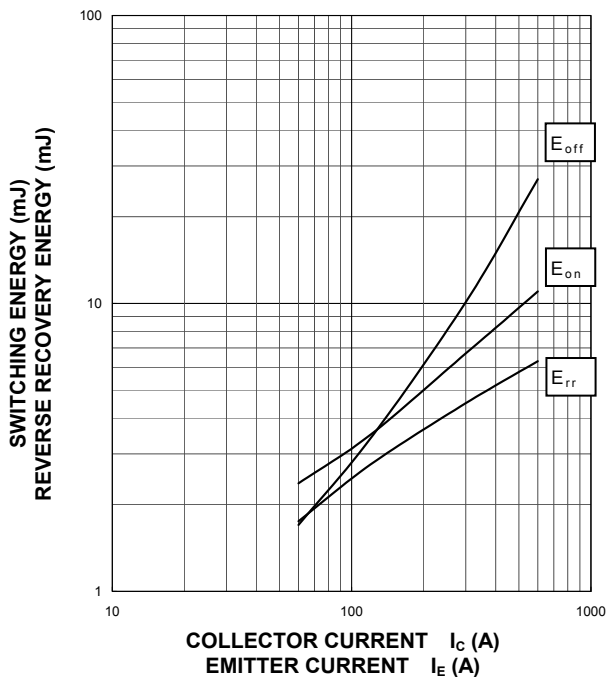
**HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $I_C=600\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  
 $T_j=125\text{ }^\circ\text{C}$ , INDUCTIVE LOAD



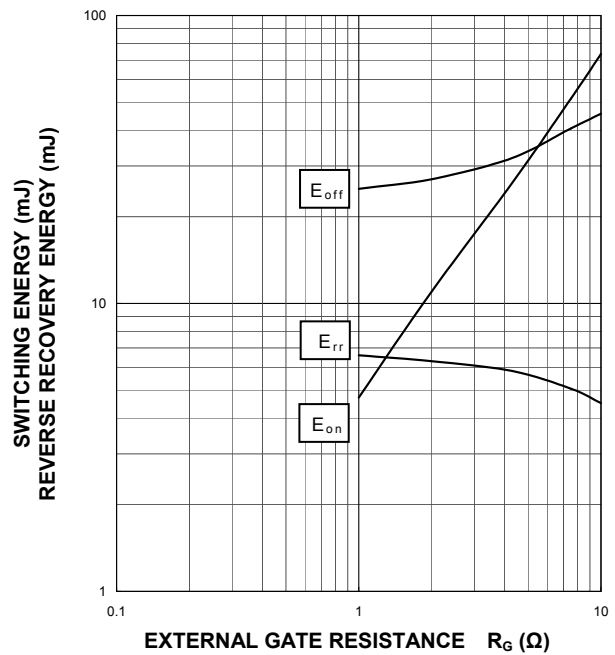
**HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=2.0\ \Omega$ ,  $T_j=125\text{ }^\circ\text{C}$ ,  
INDUCTIVE LOAD, PER PULSE



**HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $I_C/I_E=600\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $T_j=125\text{ }^\circ\text{C}$ ,  
INDUCTIVE LOAD, PER PULSE

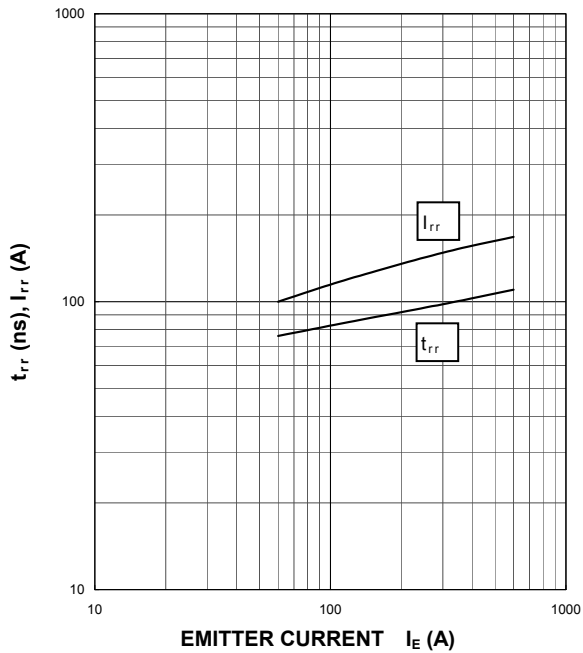


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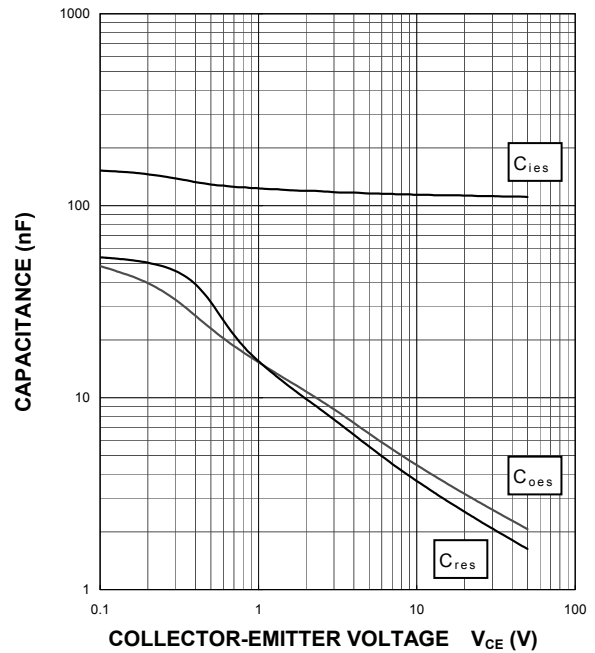
**FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=2.0\ \Omega$ ,  
 $T_j=25\text{ }^\circ\text{C}$ , INDUCTIVE LOAD



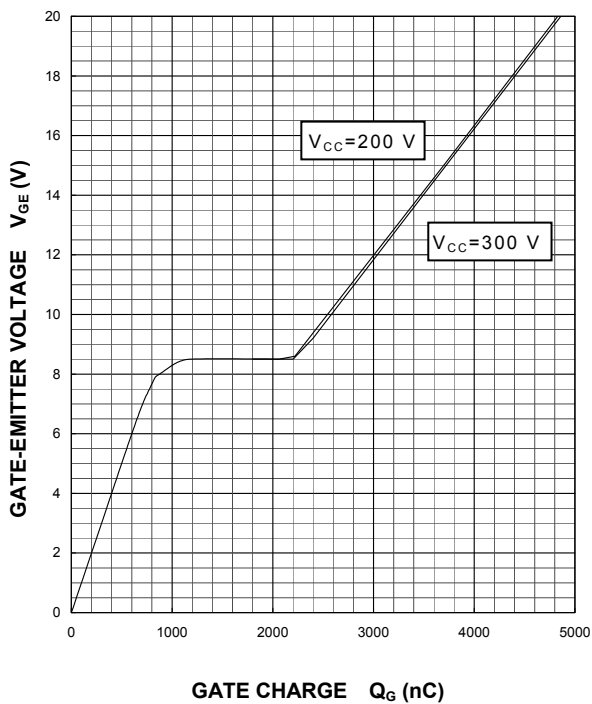
**CAPACITANCE CHARACTERISTICS  
(TYPICAL)**

G-E short-circuited,  $T_j=25\text{ }^\circ\text{C}$



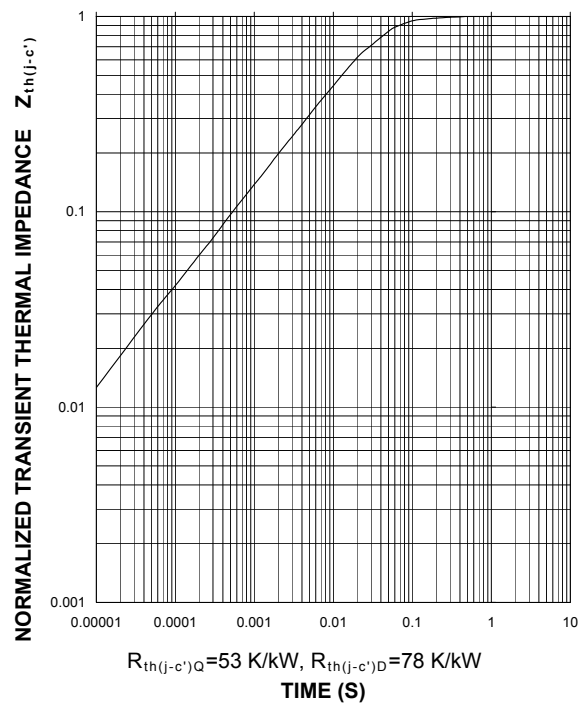
**GATE CHARGE CHARACTERISTICS  
(TYPICAL)**

$I_C=600\text{ A}$ ,  $T_j=25\text{ }^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE  
CHARACTERISTICS  
(MAXIMUM)**

Single pulse,  $T_c'=25\text{ }^\circ\text{C}$



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