

**CM600HA-24A**



Single

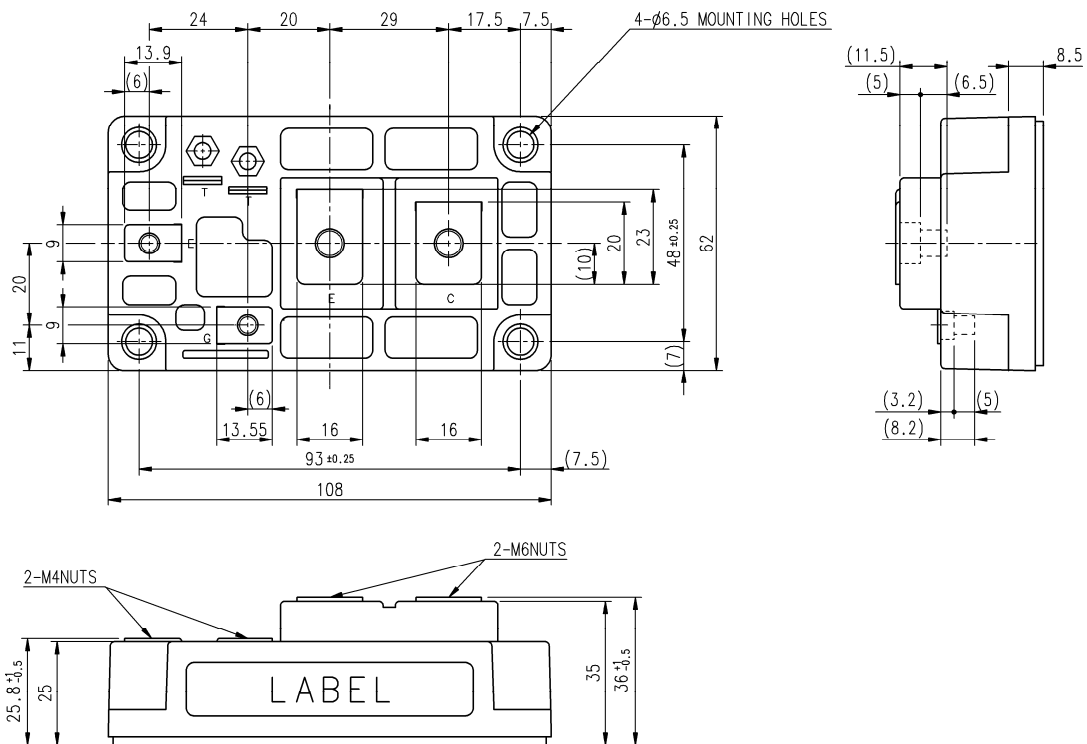
- $I_C$  ..... 600 A
- $V_{CES}$  ..... 1200 V
- Flat base Type  
 Copper (non-plating) base plate  
 No accessory (terminal screw) attach
- RoHS Directive compliant

**APPLICATION**

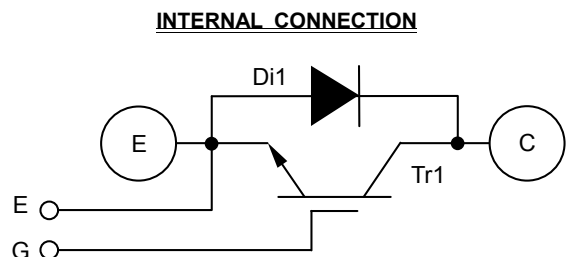
AC Motor Control, Motion/Servo Control, Power supply, etc.

**OUTLINE DRAWING & INTERNAL CONNECTION**

Dimension in mm



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



**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	1200	V
V <sub>GES</sub>	Gate-emitter voltage	C-E short-circuited	±20	V
I <sub>c</sub>	Collector current	DC, T <sub>C</sub> =80 °C (Note.2)	600	A
I <sub>CRM</sub>		Pulse, Repetitive (Note.3)	1200	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note.2, 4)	3670	W
I <sub>E</sub> (Note.1)	Emitter current (Free wheeling diode forward current)	T <sub>C</sub> =25 °C (Note.2, 4)	600	A
I <sub>ERM</sub> (Note.1)		Pulse, Repetitive (Note.3)	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

**MECHANICAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M <sub>t</sub>	Mounting torque	Main terminals M 6 screw	1.96	2.45	2.94	N·m
M <sub>t</sub>		Auxiliary terminals M 4 screw	0.98	1.18	1.47	
M <sub>s</sub>		Mounting to heat sink M 6 screw	1.96	2.45	2.94	
m	Weight	-	-	480	-	g
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note.5)	±0	-	+100	µm

**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>GE</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	-	-	1.5	µA	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =60 mA, V <sub>CE</sub> =10 V	6	7	8	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	-	2.1	3.0	V
			T <sub>j</sub> =125 °C	-	2.4	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited	-	-	105	nF	
C <sub>oes</sub>	Output capacitance		-	-	9.0		
C <sub>res</sub>	Reverse transfer capacitance		-	-	2.0		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =600 V, I <sub>C</sub> =600 A, V <sub>GE</sub> =15 V	-	3000	-	nC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600 V, I <sub>C</sub> =600 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0.52 Ω, Inductive load	-	-	660	ns	
t <sub>r</sub>	Rise time		-	-	190		
t <sub>d(off)</sub>	Turn-off delay time		-	-	700		
t <sub>f</sub>	Fall time		-	-	350		
V <sub>EC</sub> (Note.1)	Emitter-collector voltage	I <sub>E</sub> =600 A (Note.6), G-E short-circuited	-	3.0	3.8	V	
t <sub>rr</sub> (Note.1)	Reverse recovery time	V <sub>CC</sub> =600 V, I <sub>E</sub> =600 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0.52 Ω, Inductive load	-	-	250	ns	
Q <sub>rr</sub> (Note.1)	Reverse recovery charge		-	19	-		µC
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =600 V, I <sub>C</sub> =I <sub>E</sub> =600 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0.52 Ω, T <sub>j</sub> =125 °C, Inductive load	-	100	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse		-	66	-		
E <sub>rr</sub> (Note.1)	Reverse recovery energy per pulse		-	29.5	-		
r <sub>g</sub>	Internal gate resistance	T <sub>C</sub> =25 °C	-	1.0	-	Ω	
R <sub>G</sub>	External gate resistance	-	0.52	-	7.8	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, IGBT part	-	-	34	K/kW
R <sub>th(j-c)D</sub>		Junction to case, FWDi part	-	-	53	
R <sub>th(c-s)</sub>	Contact thermal resistance (Note.2)	Case to heat sink, Thermal grease applied (Note.7)	-	20	-	K/kW

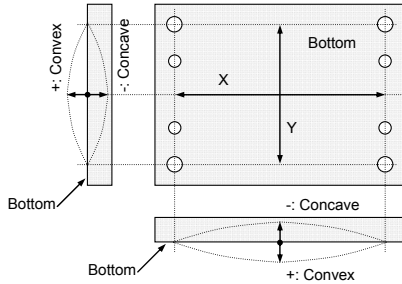
Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).  
 Note.2: Case temperature ( $T_c$ ) and heat sink temperature ( $T_s$ ) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)

The heat sink thermal resistance  $\{R_{th(s-a)}\}$  should measure just under the chips.

Note.3: Pulse width and repetition rate should be such that the device junction temperature ( $T_j$ ) dose not exceed  $T_{jmax}$  rating.

Note.4: Junction temperature ( $T_j$ ) should not increase beyond  $T_{jmax}$  rating.

Note.5: Base plate flatness measurement point is as in the following figure.

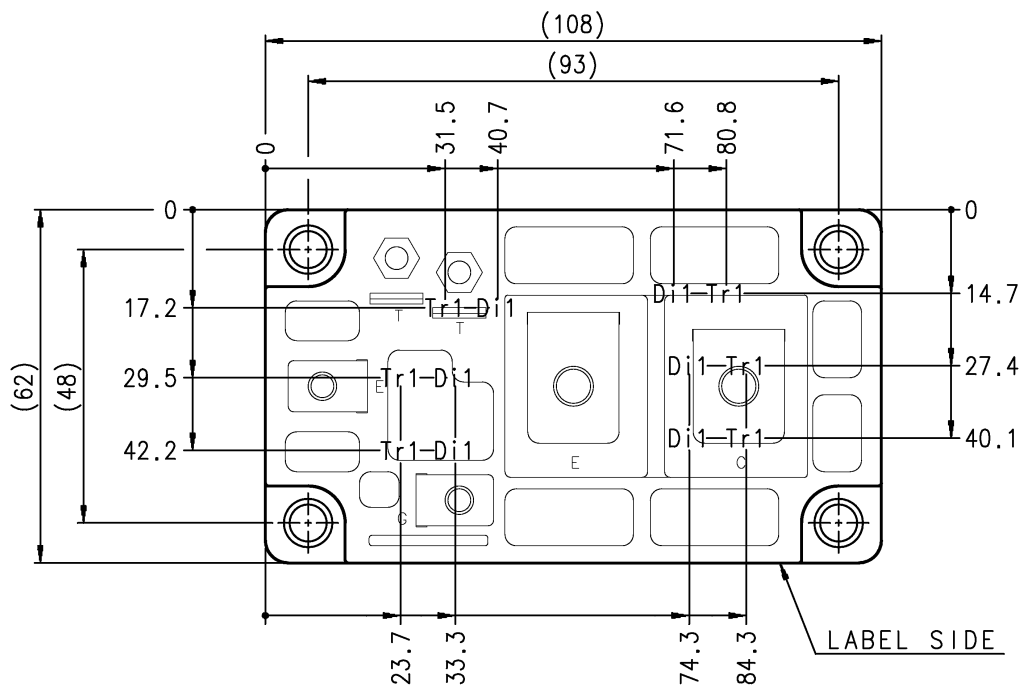


Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise. (Refer to the figure of test circuit)

Note.7: Typical value is measured by using thermally conductive grease of  $\lambda=0.9$  W/(m·K).

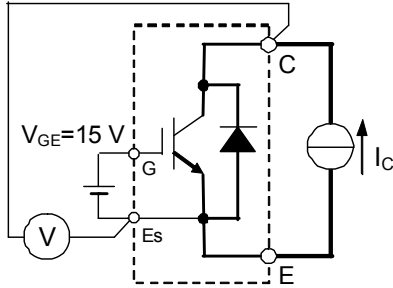
### CHIP LOCATION (Top view)

Dimension in mm, tolerance:  $\pm 1$  mm

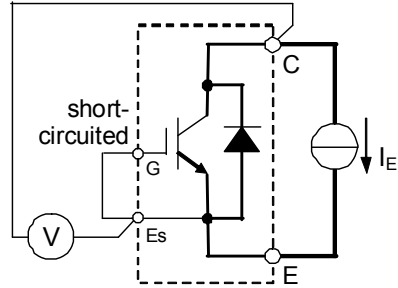


Tr1: IGBT, Di1: FWDi. Each mark points the center position of each chip.

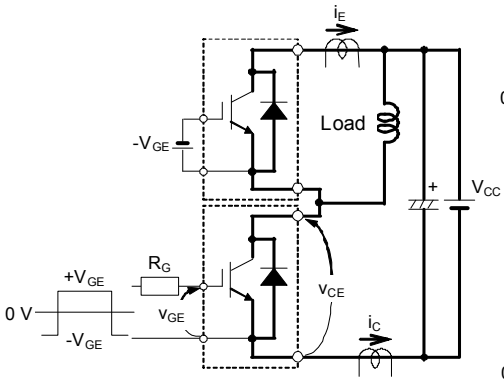
**TEST CIRCUIT AND WAVEFORMS**



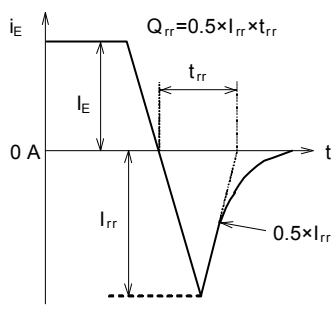
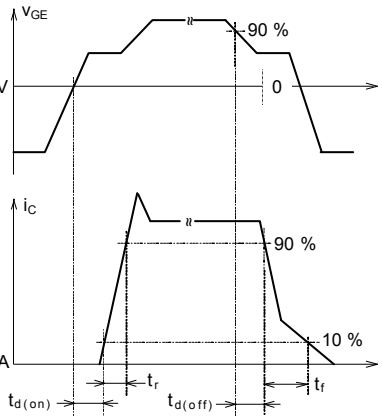
$V_{CEsat}$  test circuit



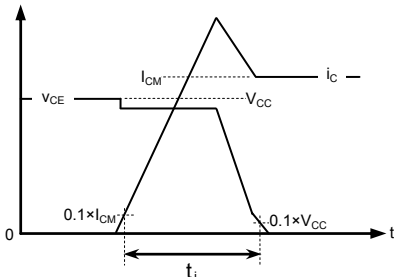
$V_{EC}$  test circuit



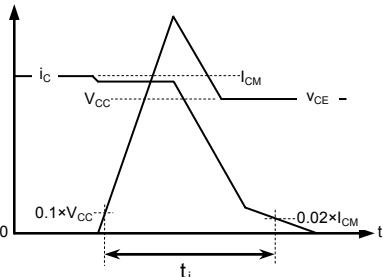
Switching characteristics test circuit and waveforms



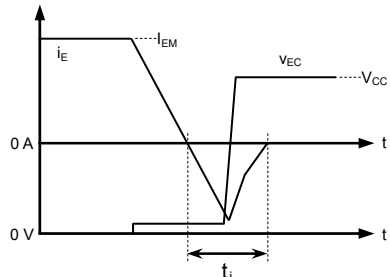
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy

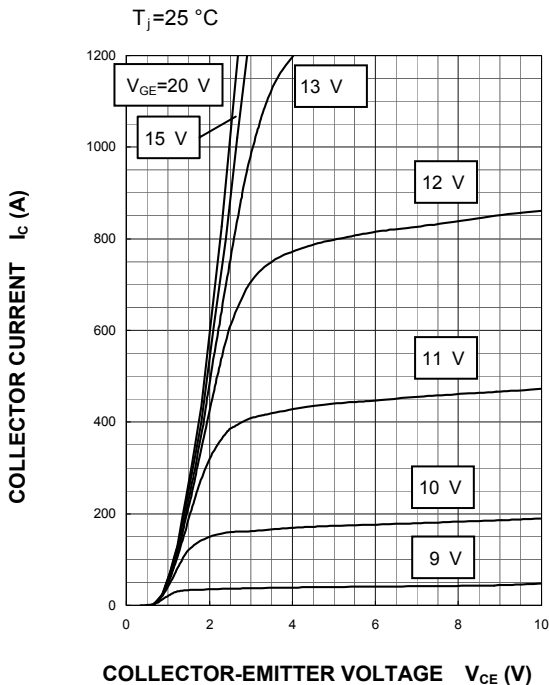


FWDi Reverse recovery energy

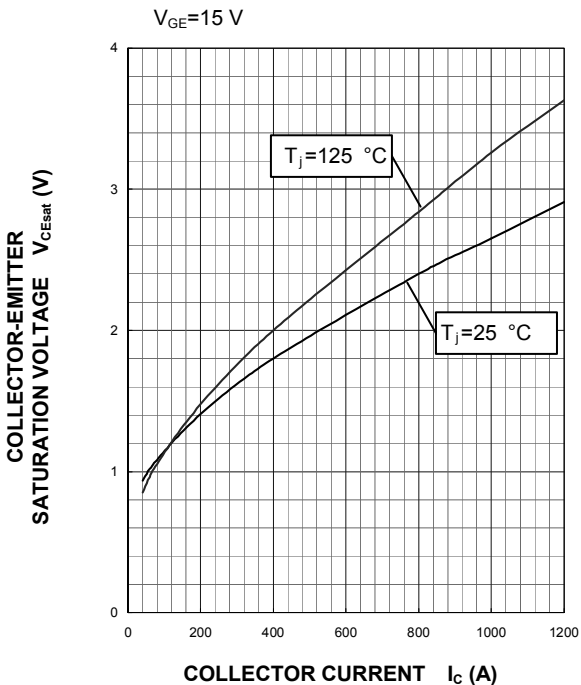
Turn-on, Turn-off switching and Reverse recovery energy test waveforms (integral range)

**PERFORMANCE CURVES**

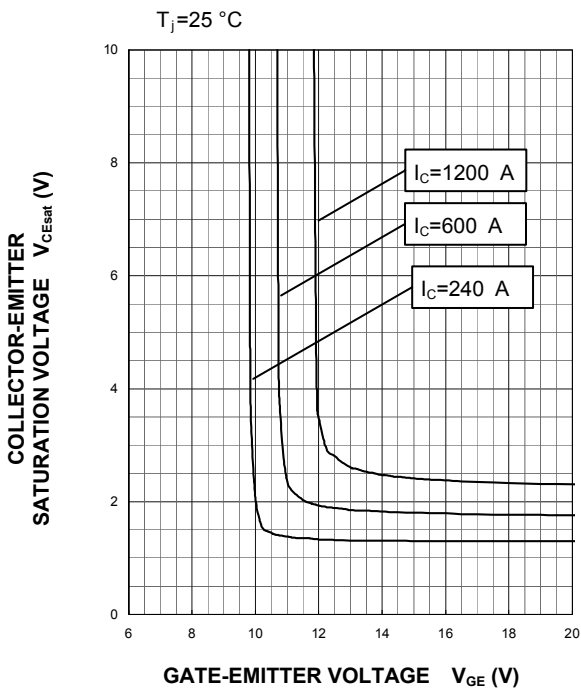
**OUTPUT CHARACTERISTICS (TYPICAL)**



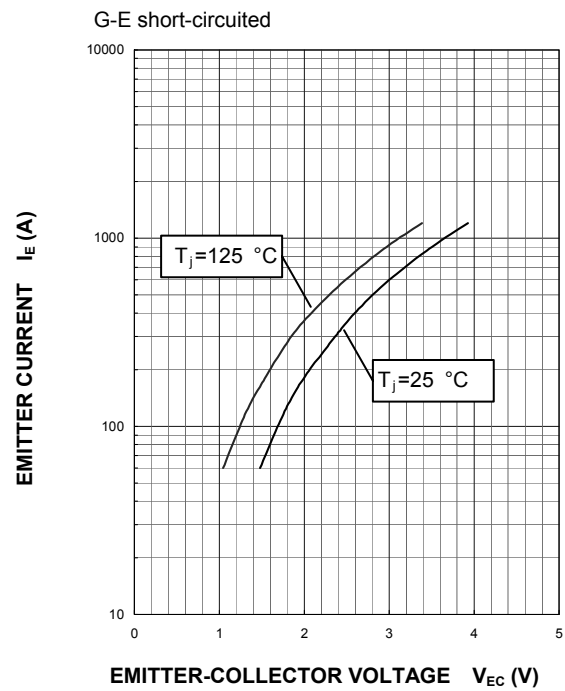
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



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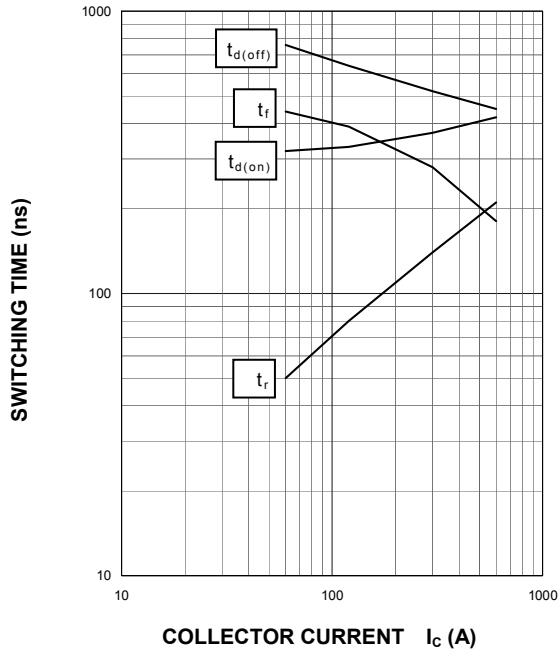


**FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)**



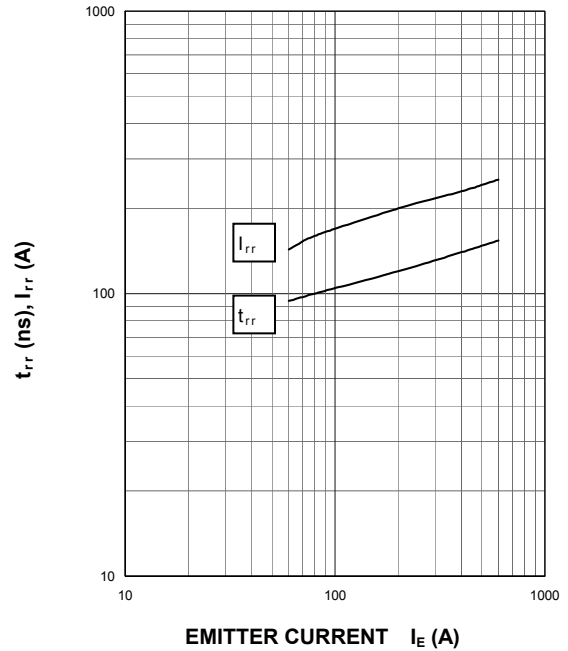
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0.52\ \Omega$ ,  $T_j=125\text{ }^\circ\text{C}$   
 INDUCTIVE LOAD



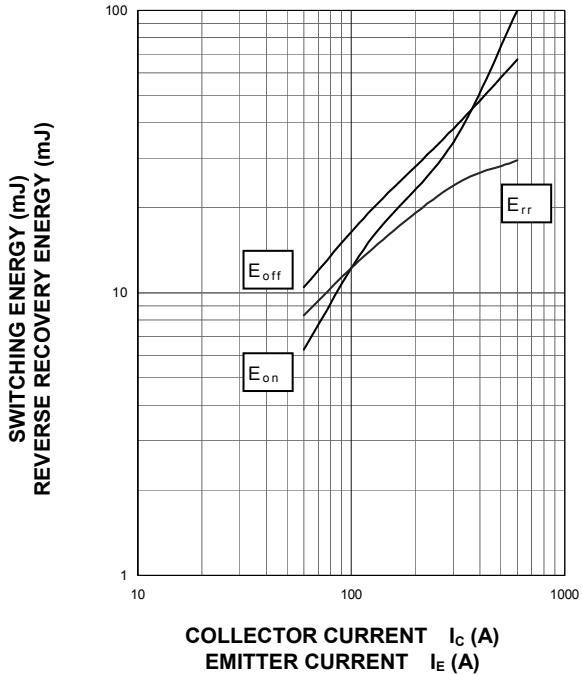
**FREE WHEELING DIODE  
 REVERSE RECOVERY CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0.52\ \Omega$ ,  $T_j=125\text{ }^\circ\text{C}$   
 INDUCTIVE LOAD



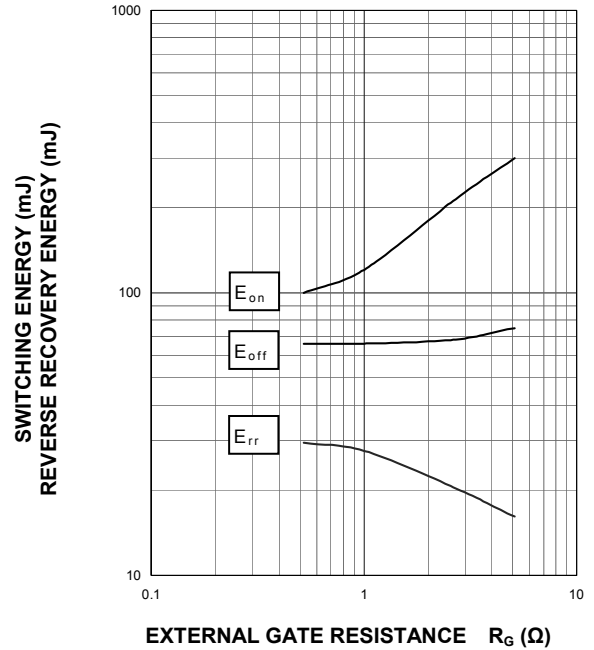
**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0.52\ \Omega$ ,  $T_j=125\text{ }^\circ\text{C}$   
 INDUCTIVE LOAD, PER PULSE

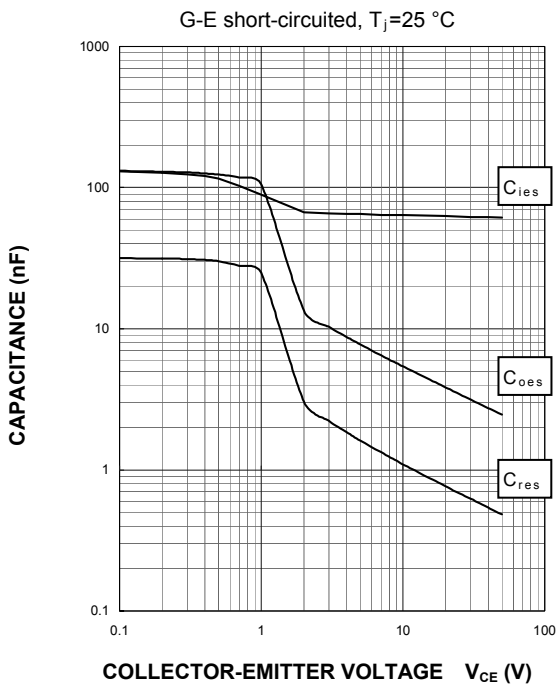


**HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)**

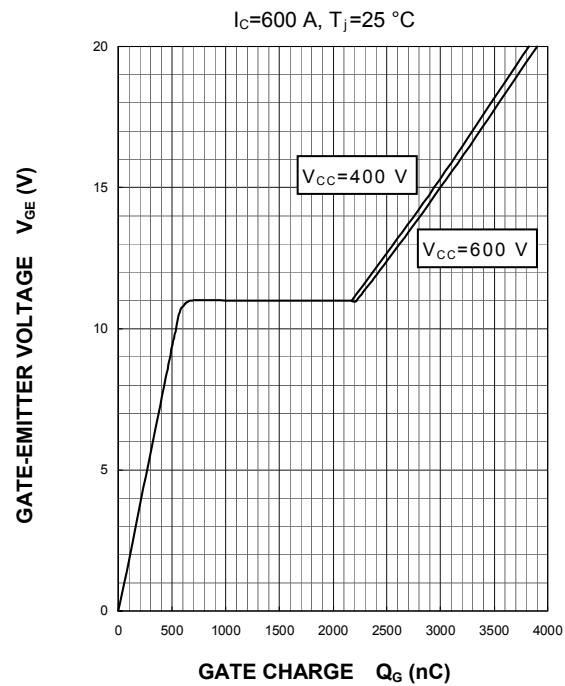
$V_{CC}=600\text{ V}$ ,  $I_C/I_E=600\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $T_j=125\text{ }^\circ\text{C}$   
 INDUCTIVE LOAD, PER PULSE



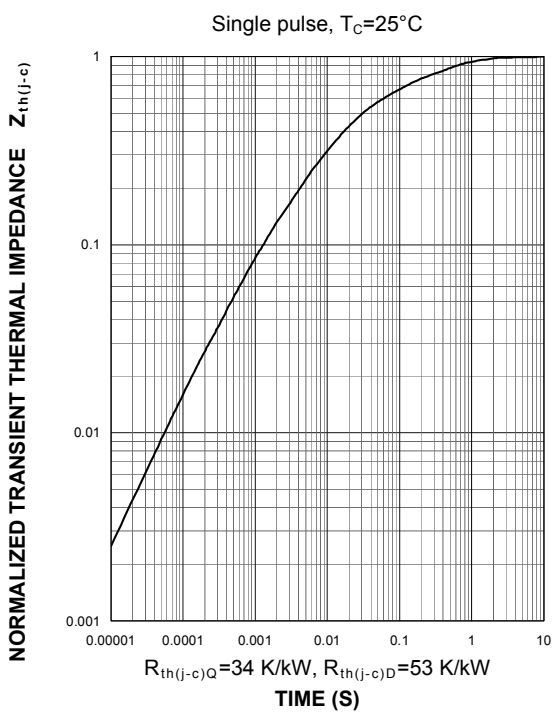
**CAPACITANCE CHARACTERISTICS  
 (TYPICAL)**



**GATE CHARGE CHARACTERISTICS  
 (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE  
 CHARACTERISTICS  
 (MAXIMUM)**



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