

CM400HA-24A



Single

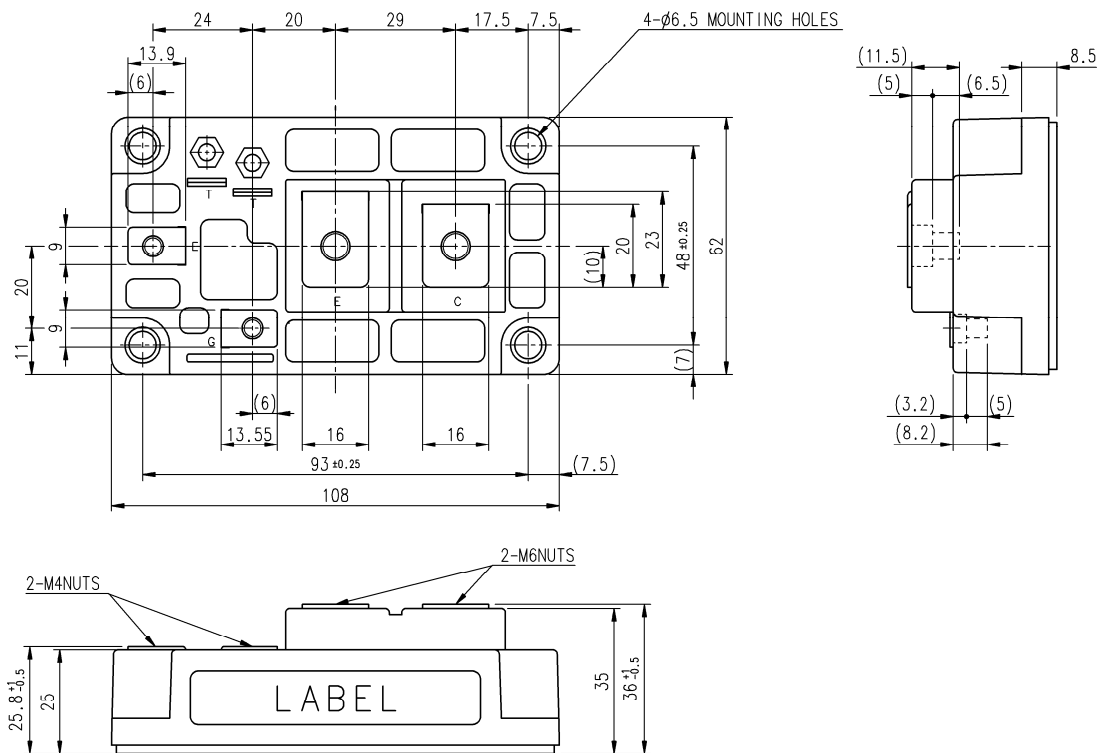
- I_C 400 A
- V_{CES} 1200 V
- Flat base Type
 Copper (non-plating) base plate
 No accessory (terminal screw) attach
- RoHS Directive compliant

APPLICATION

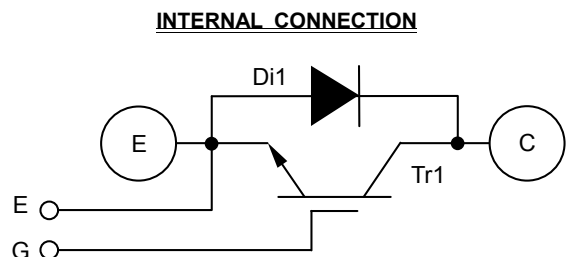
AC Motor Control, Motion/Servo Control, Power supply, etc.

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_j=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E short-circuited	1200	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	±20	V
I _C	Collector current	DC, T _C =87 °C (Note.2)	400	A
I _{CRM}		Pulse, Repetitive (Note.3)	800	
P _{tot}	Total power dissipation	T _C =25 °C (Note.2, 4)	2350	W
I _E (Note.1)	Emitter current (Free wheeling diode forward current)	T _C =25 °C (Note.2, 4)	400	A
I _{ERM} (Note.1)		Pulse, Repetitive (Note.3)	800	
T _j	Junction temperature	-	-40 ~ +150	°C
T _{stg}	Storage temperature	-	-40 ~ +125	
V _{isol}	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 _t	Mounting torque	Main terminals M 6 screw	1.96	2.45	2.94	N·m
M _t		Auxiliary terminals M 4 screw	0.98	1.18	1.47	
M _s		Mounting to heat sink M 6 screw	1.96	2.45	2.94	
m	Weight	-	-	480	-	g
e _c	Flatness of base plate	On the centerline X, Y (Note.5)	±0	-	+100	µm

ELECTRICAL CHARACTERISTICS (T_j=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
I _{CES}	Collector-emitter cut-off current	V _{CE} =V _{CES} , G-E short-circuited	-	-	1	mA
I _{GES}	Gate-emitter leakage current	±V _{GE} =V _{GES} , C-E short-circuited	-	-	1	µA
V _{GE(th)}	Gate-emitter threshold voltage	I _C =40 mA, V _{CE} =10 V	6	7	8	V
V _{CEsat}	Collector-emitter saturation voltage	I _C =400 A (Note.6), V _{GE} =15 V	T _j =25 °C	2.1	3.0	V
			T _j =125 °C	2.4	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	70	nF
C _{oes}	Output capacitance		-	-	6.0	
C _{res}	Reverse transfer capacitance		-	-	1.4	
Q _G	Gate charge	V _{CC} =600 V, I _C =400 A, V _{GE} =15 V	-	2000	-	nC
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =400 A, V _{GE} =±15 V, R _G =0.78 Ω, Inductive load	-	-	550	ns
t _r	Rise time		-	-	180	
t _{d(off)}	Turn-off delay time		-	-	600	
t _f	Fall time		-	-	350	
V _{EC} (Note.1)	Emitter-collector voltage	I _E =400 A (Note.6), G-E short-circuited	-	3.0	3.8	V
t _{rr} (Note.1)	Reverse recovery time	V _{CC} =600 V, I _E =400 A, V _{GE} =±15 V, R _G =0.78 Ω, Inductive load	-	-	250	ns
Q _{rr} (Note.1)	Reverse recovery charge	R _G =0.78 Ω, Inductive load	-	14.7	-	µC
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =400 A, V _{GE} =±15 V, R _G =0.78 Ω,	-	50.4	-	mJ
E _{off}	Turn-off switching energy per pulse	T _j =125 °C, Inductive load	-	41.8	-	
E _{rr} (Note.1)	Reverse recovery energy per pulse	T _j =125 °C, Inductive load	-	20	-	
r _g	Internal gate resistance	T _C =25 °C	-	1.5	-	Ω
R _G	External gate resistance	-	0.78	-	10	Ω

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance (Note.2)	Junction to case, IGBT part	-	-	53	K/kW
R _{th(j-c)D}		Junction to case, FWDi part	-	-	80	
R _{th(c-s)}	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).

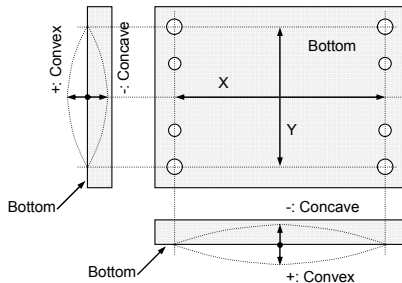
Note.2: Case temperature (T_c) and heat sink temperature (T_s) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)

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.



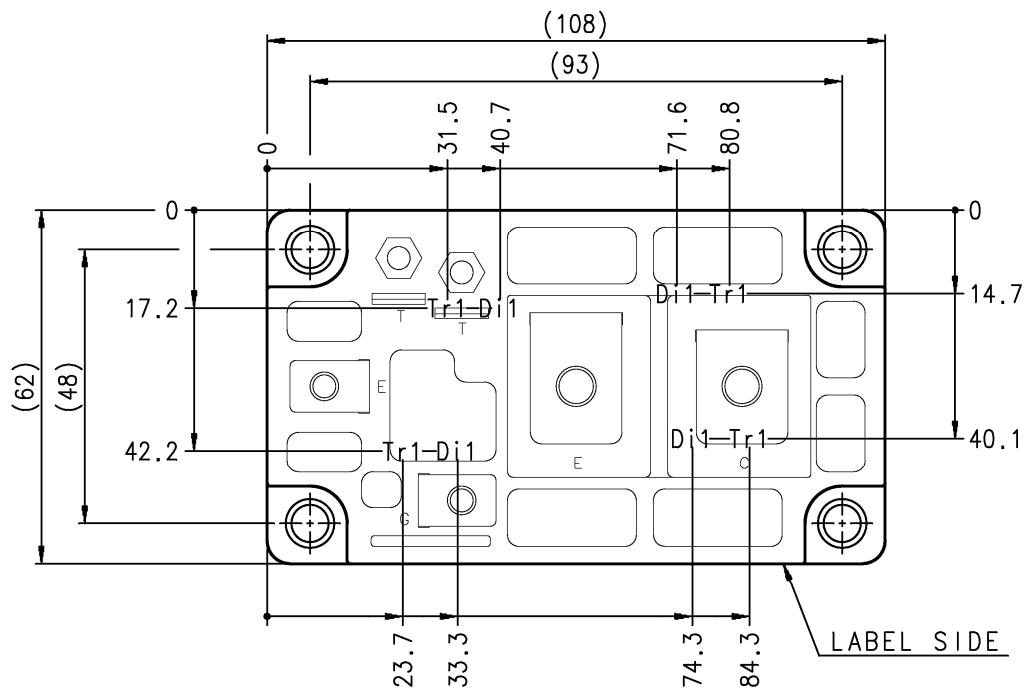
Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise.

(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).

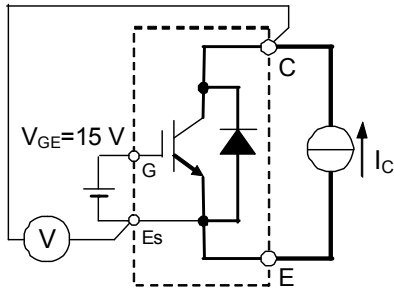
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm

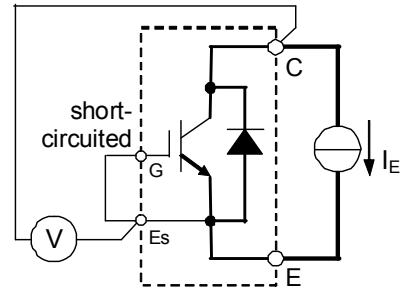


Tr1: IGBT, Di1: FWDi. Each mark points the center position of each chip.

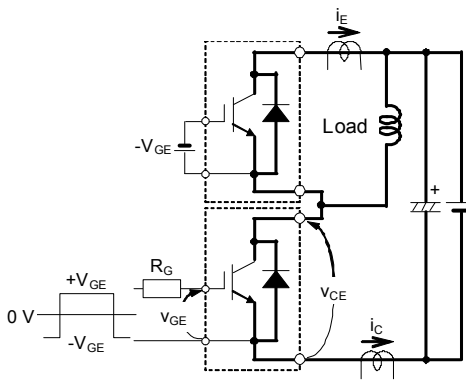
TEST CIRCUIT AND WAVEFORMS



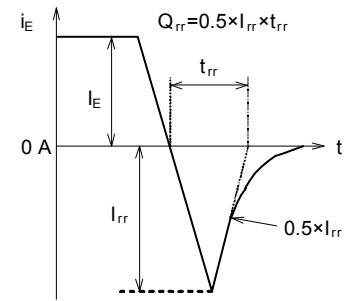
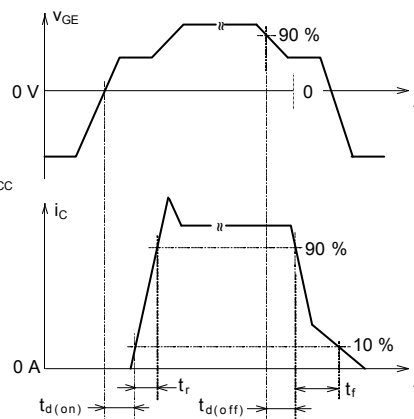
V_{CEsat} test circuit



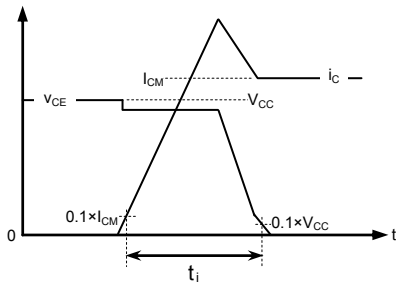
V_{EC} test circuit



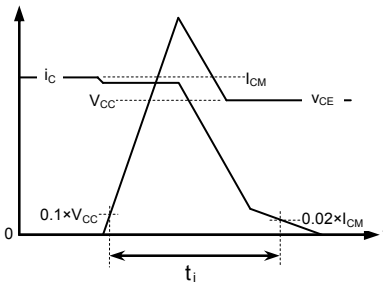
Switching characteristics test circuit and waveforms



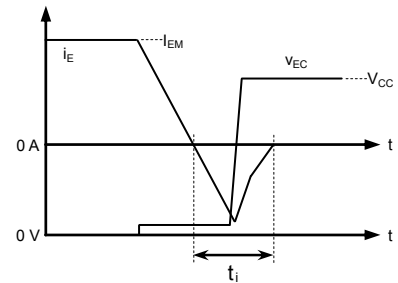
t_{rr} , Q_{rr} test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy

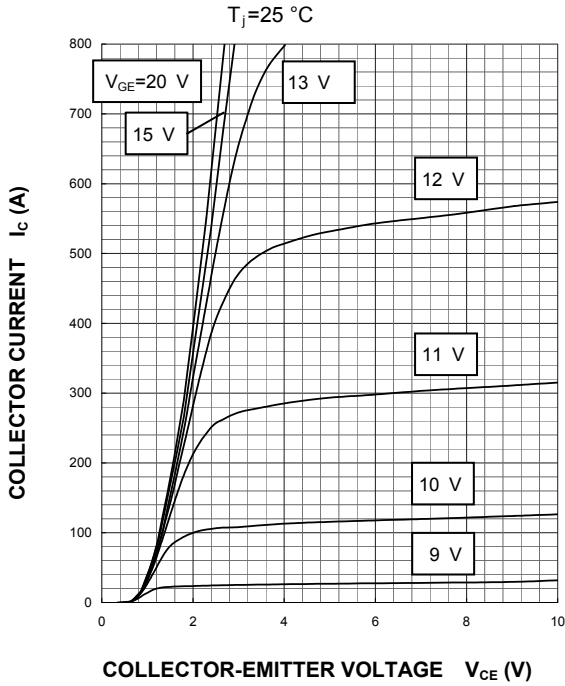


FWDi Reverse recovery energy

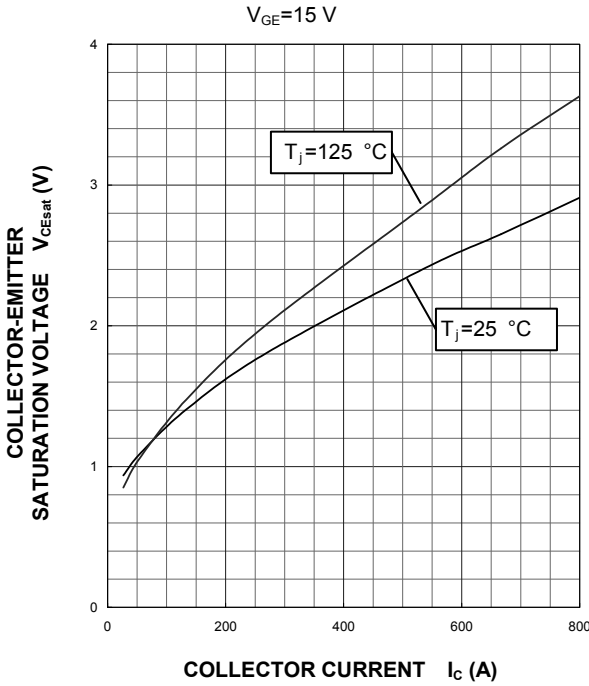
Turn-on, Turn-off switching and Reverse recovery energy test waveforms (integral range)

PERFORMANCE CURVES

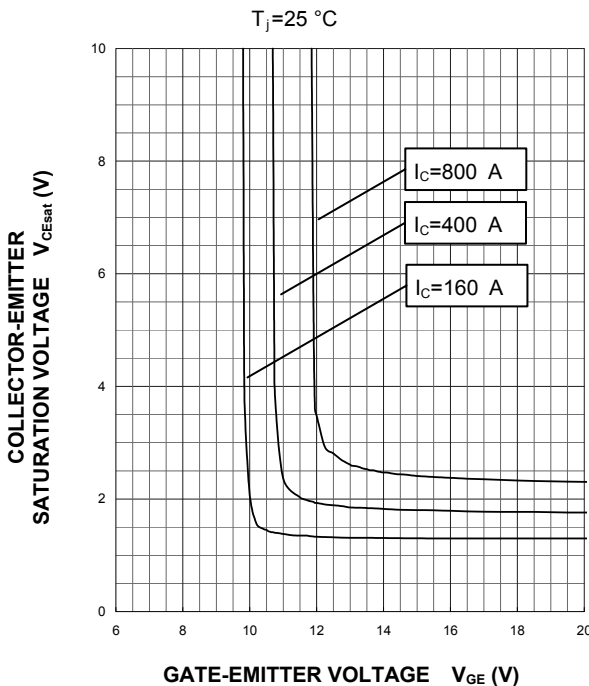
OUTPUT CHARACTERISTICS
 (TYPICAL)



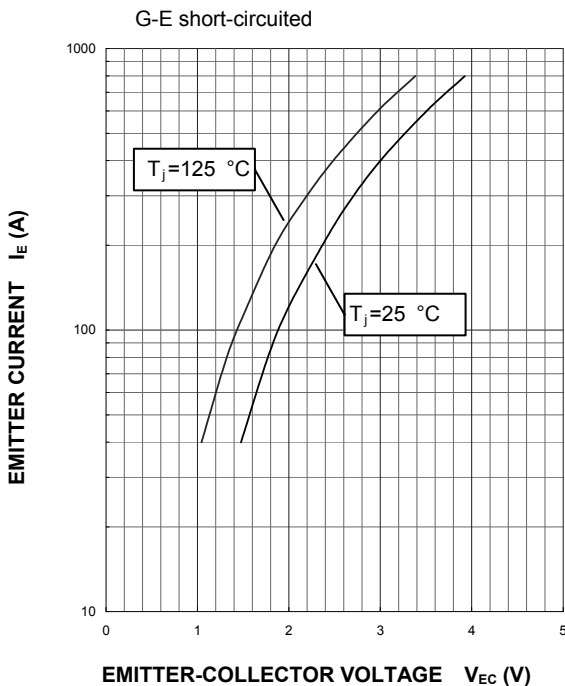
COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)



COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)

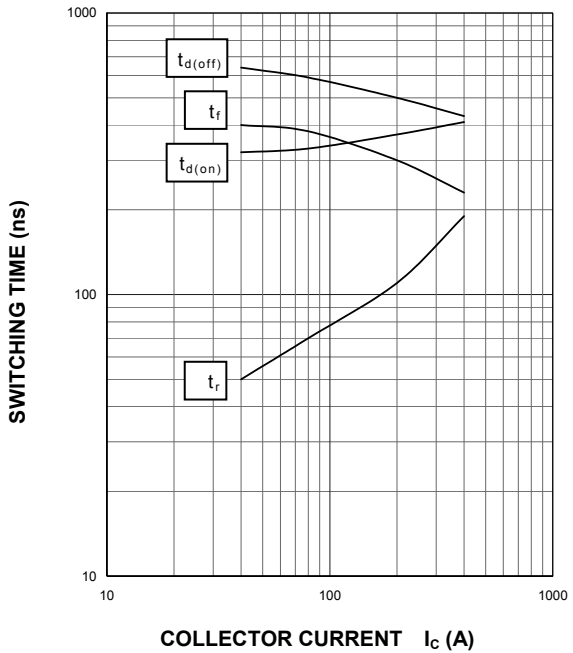


FREE WHEELING DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)



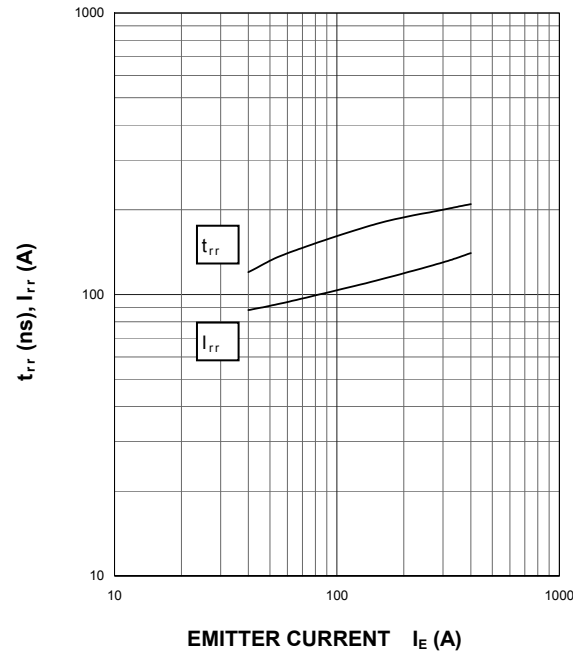
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.78\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
 INDUCTIVE LOAD



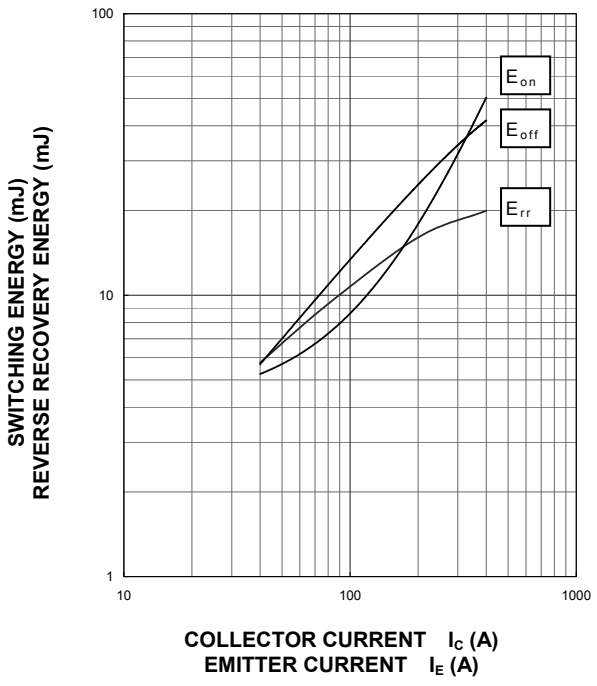
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.78\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
 INDUCTIVE LOAD



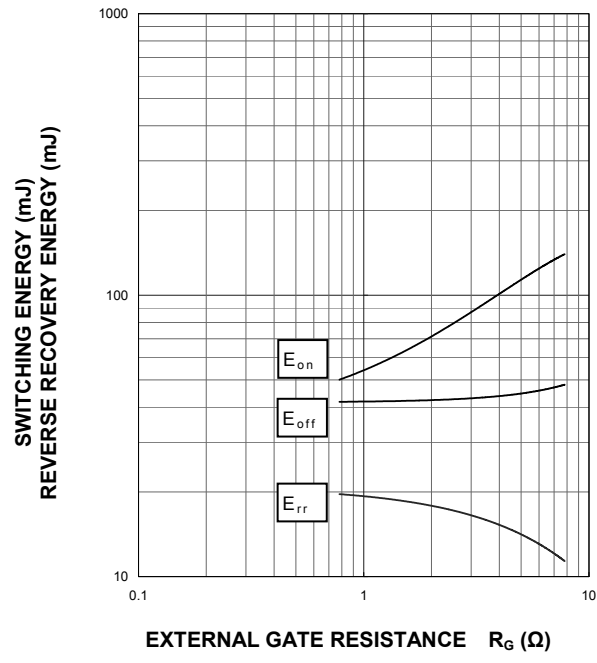
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.78\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
 INDUCTIVE LOAD, PER PULSE

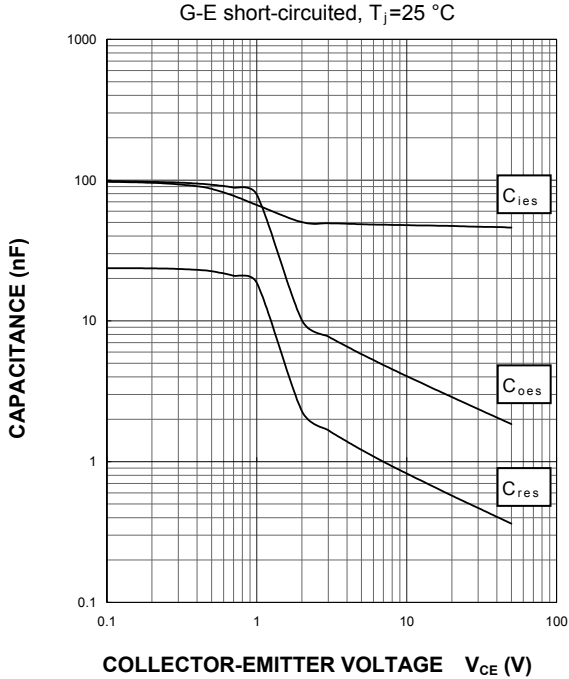


HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

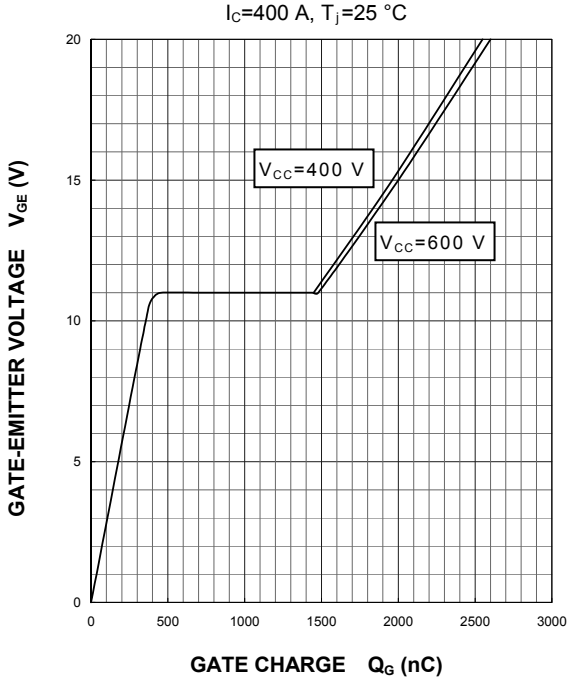
$V_{CC}=600\text{ V}$, $I_C/I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $T_j=125\text{ }^\circ\text{C}$
 INDUCTIVE LOAD, PER PULSE



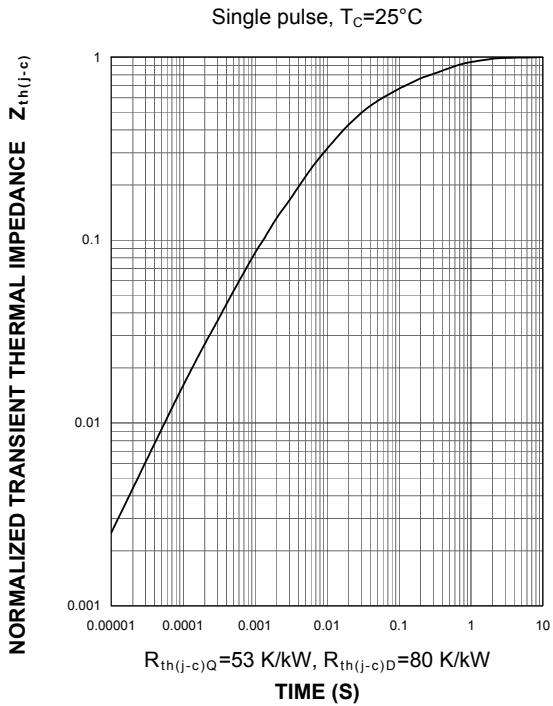
**CAPACITANCE CHARACTERISTICS
 (TYPICAL)**



**GATE CHARGE CHARACTERISTICS
 (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE
 CHARACTERISTICS
 (MAXIMUM)**



Keep safety first in your circuit designs!

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