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<IGBT Modules>

CM400HA-24A

**HIGH POWER SWITCHING USE
INSULATED TYPE**



single switch

Collector current I_C **400 A**
 Collector-emitter voltage V_{CES} **1200 V**
 Maximum junction temperature T_{jmax} **150 °C**

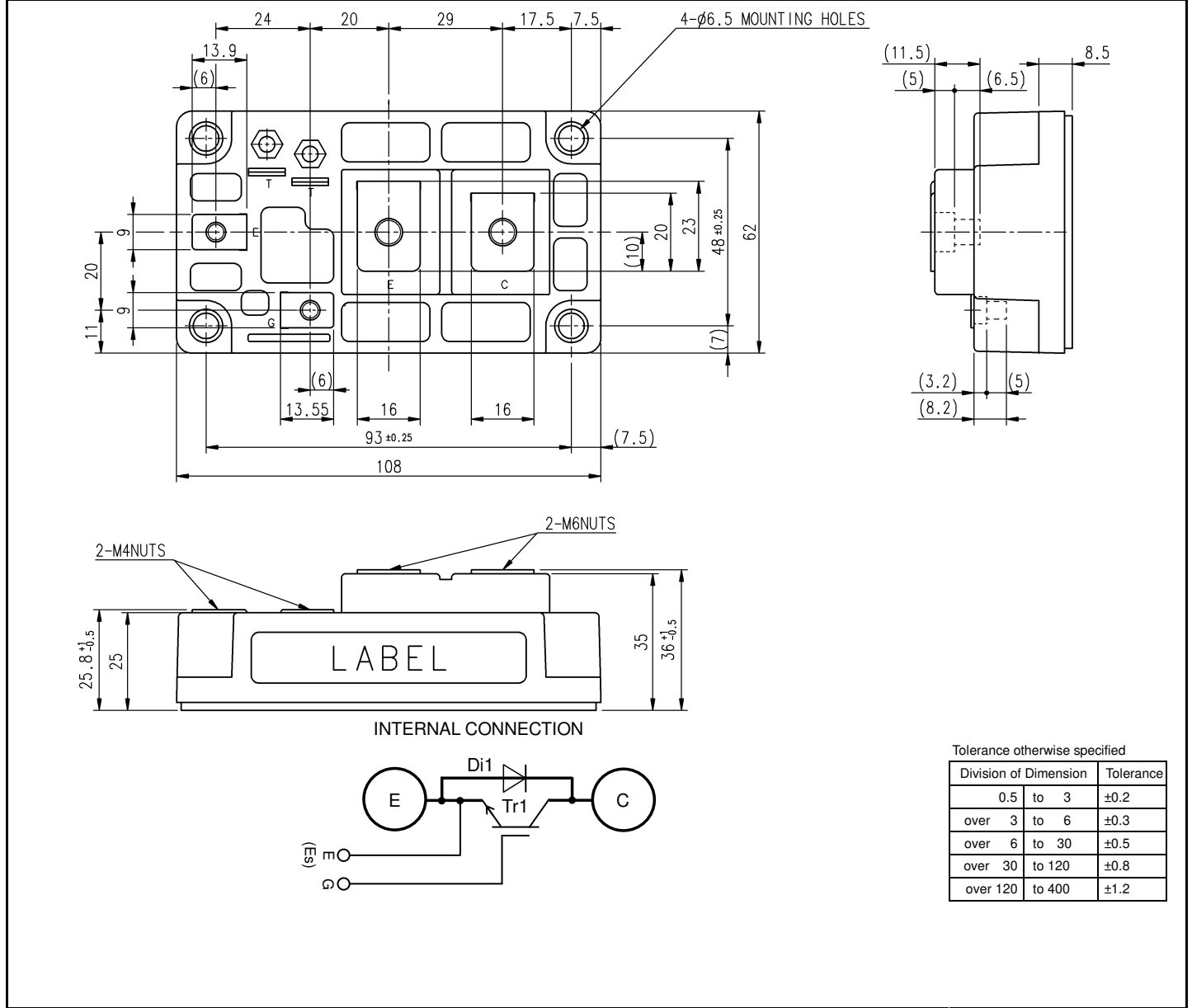
- Flatbase type
- Copper base plate (non-plating)
- Main terminal screws are not attached.
- RoHS Directive compliant
- Recognized under UL1557, File E323585

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

CM400HA-24AHIGH POWER SWITCHING USE
INSULATED TYPE**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 (Note2, 4)	400	A
I _{CRM}		Pulse, Repetitive (Note3)	800	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	2350	W
I _E (Note1)	Emitter current	DC (Note2)	400	A
I _{ERM} (Note1)		Pulse, Repetitive (Note3)	800	
V _{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T _j	Operating junction temperature	-	-40 ~ +150	°C
T _{stg}	Storage temperature	-	-40 ~ +125	

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	-	-	1.0	mA
I _{GES}	Gate-emitter leakage current	V _{GE} =V _{GES} , C-E short-circuited	-	-	1.0	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, V _{GE} =15 V (Note5)	-	2.1	3.0	V
		Refer to the figure of test circuit	T _j =25 °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	-	2.0	-	μC
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} (Note1)	Emitter-collector voltage	I _E =400 A, G-E short-circuited (Note5) Refer to the figure of test circuit	-	3.0	3.8	V
t _{rr} (Note1)	Reverse recovery time	V _{CC} =600 V, I _E =400 A, V _{GE} =±15 V,	-	-	250	ns
Q _{rr} (Note1)	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,	-	50.4	-	mJ
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0.78 Ω, T _j =125 °C,	-	41.8	-	
E _{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	20	-	mJ
r _g	Internal gate resistance	T _C =25 °C (Note4)	-	1.5	-	Ω

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance	Junction to case, per IGBT (Note4)	-	-	53	K/kW
R _{th(j-c)D}		Junction to case, per FWD (Note4)	-	-	80	
R _{th(c-s)}	Contact thermal resistance	Case to heat sink, Thermal grease applied (Note4, 6)	-	20	-	K/kW

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
		G/E auxiliary terminals M 4 screw	0.98	1.18	1.47	
M _s	Mounting torque	Mounting to heat sink M 6 screw	1.96	2.45	2.94	N·m
m	mass	-	-	480	-	g
e _c	Flatness of base plate	On the centerline X, Y (Note7)	±0	-	+100	μm

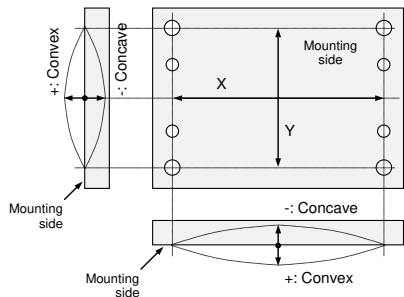
CM400HA-24A

HIGH POWER SWITCHING USE
INSULATED TYPE

*: This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU.

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free-wheeling diode (FWD).

- Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.
- Case temperature (T_C) and heat sink temperature (T_S) are defined on the each surface (mounting side) of base plate and heat sink just under the chips. Refer to the figure of chip location.
- Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.
- Typical value is measured by using thermally conductive grease of $\lambda=0.9\text{ W/(m}\cdot\text{K)}$
- The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.

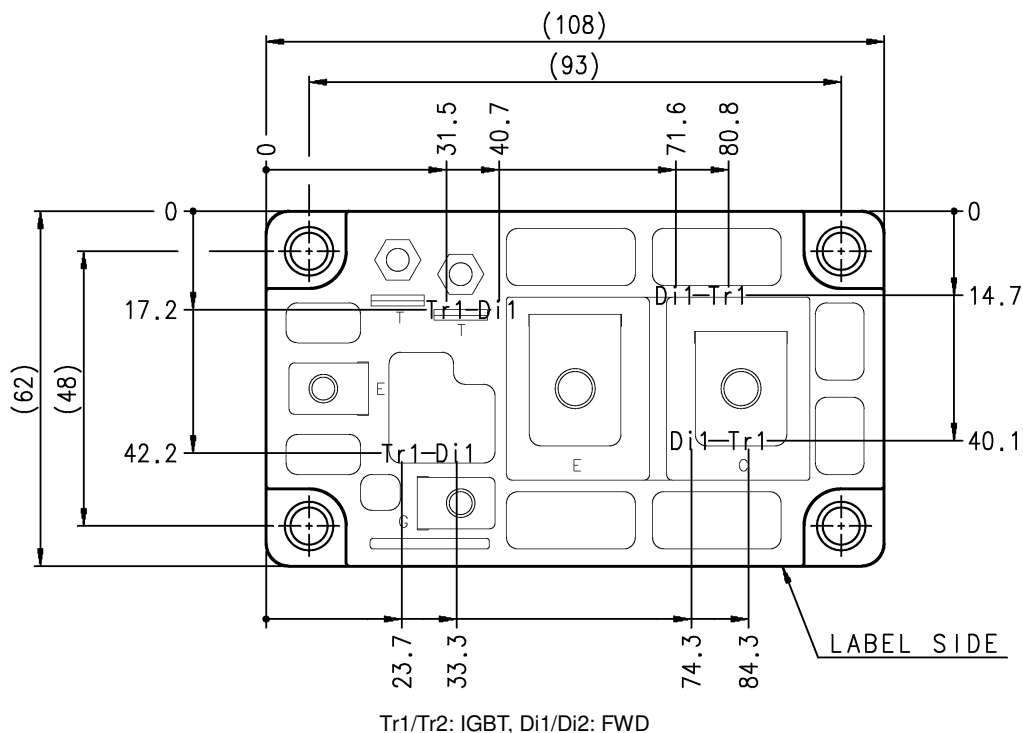


RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C-E terminals	-	600	800	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G-Es terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0.78	-	10	Ω

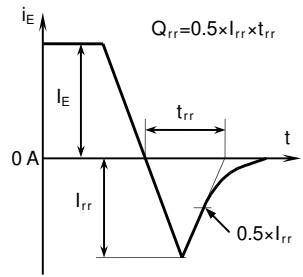
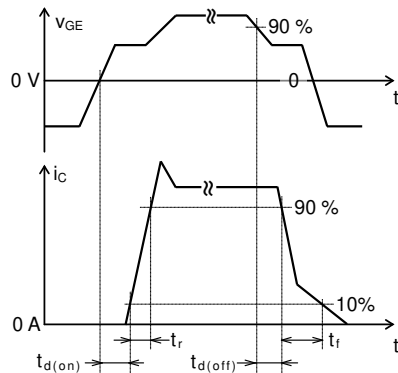
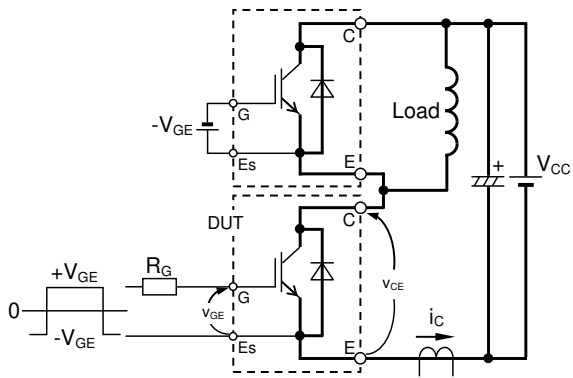
CHIP LOCATION (Top view)

Dimension in mm, tolerance: $\pm 1\text{ mm}$



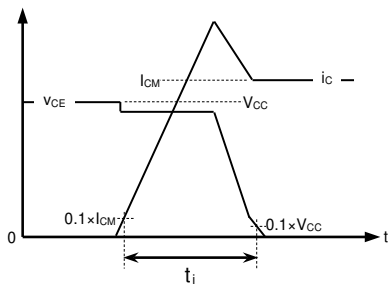
Tr1/Tr2: IGBT, Di1/Di2: FWD

TEST CIRCUIT AND WAVEFORMS

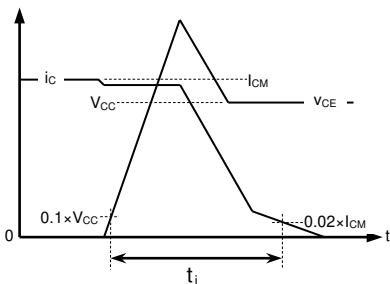


Switching characteristics test circuit and waveforms

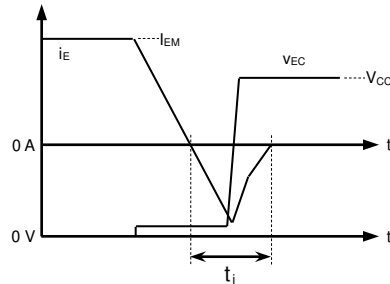
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



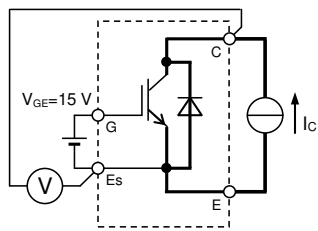
IGBT Turn-off switching energy



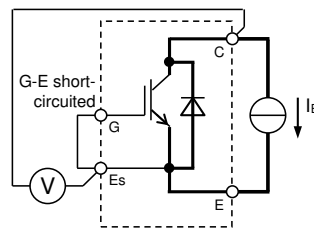
FWD Reverse recovery energy

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

TEST CIRCUIT



V_{CEsat} characteristics test circuit



V_{CE} characteristics test circuit

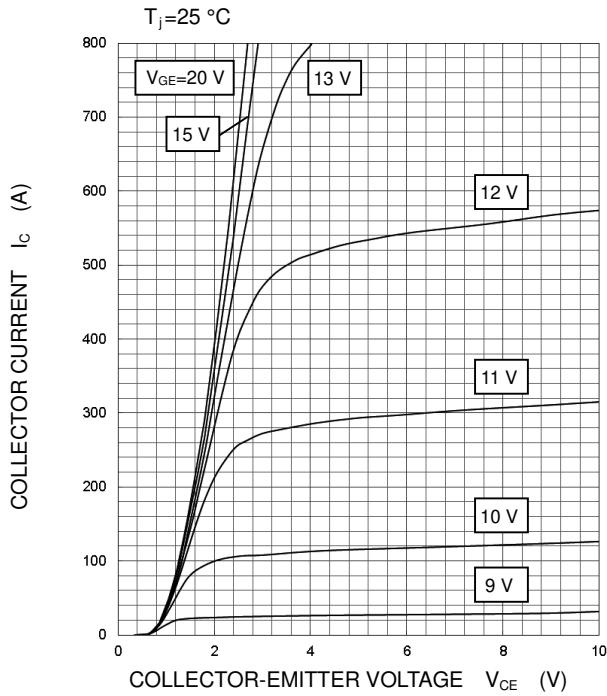
CM400HA-24A

HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

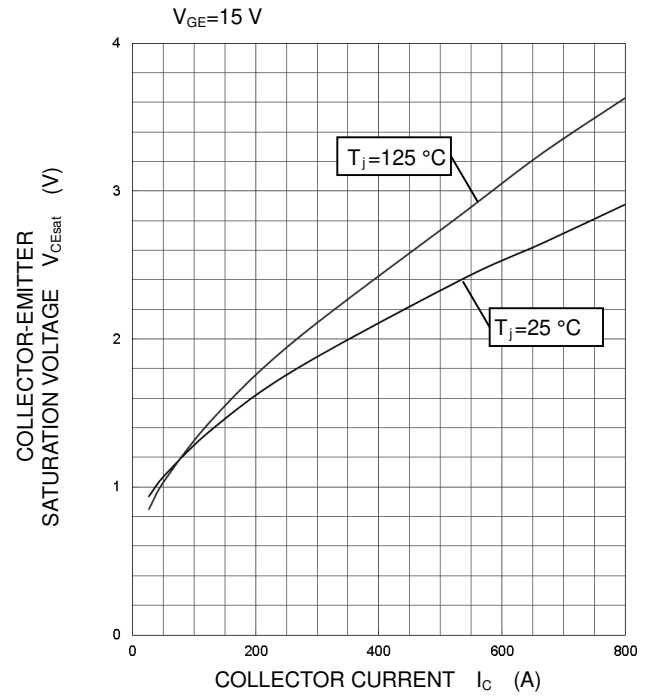
OUTPUT CHARACTERISTICS

(TYPICAL)



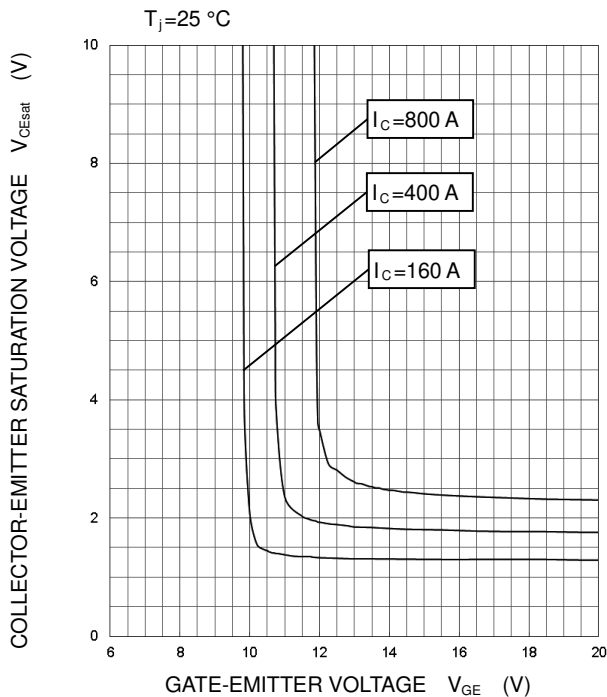
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



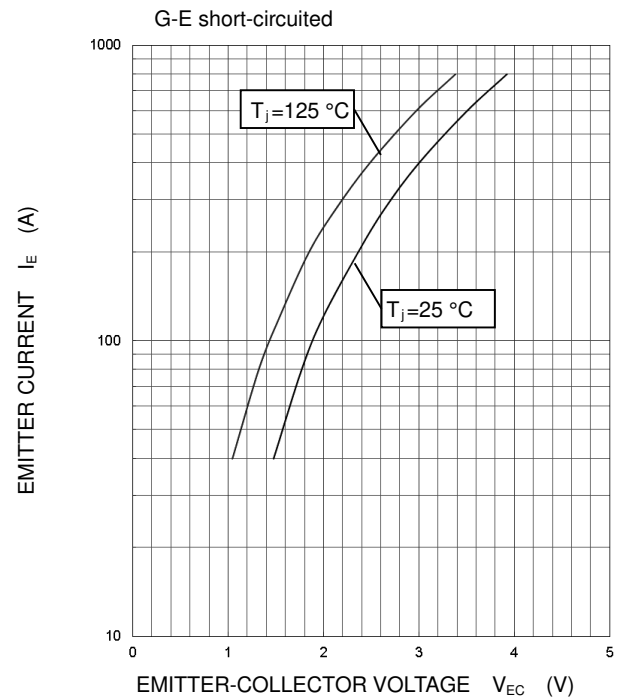
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)



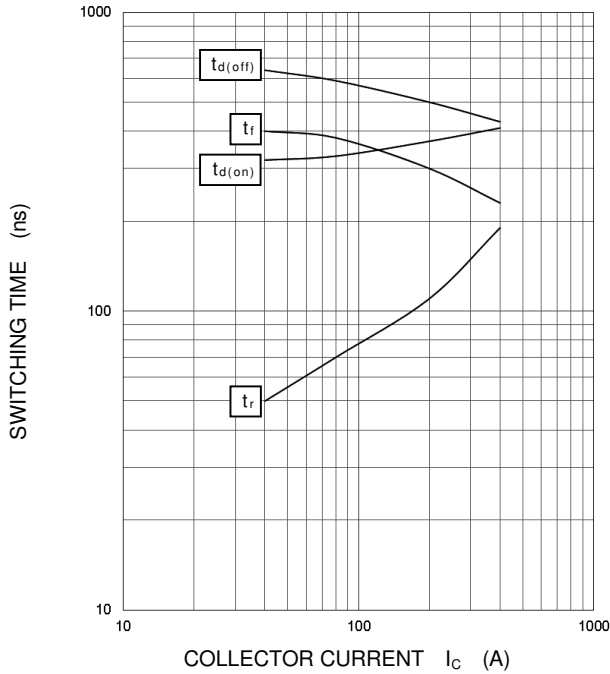
CM400HA-24A

HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

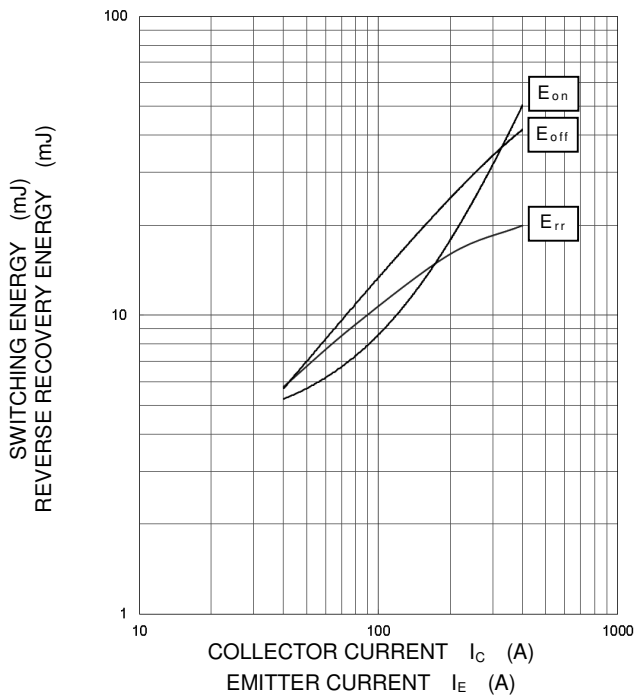
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



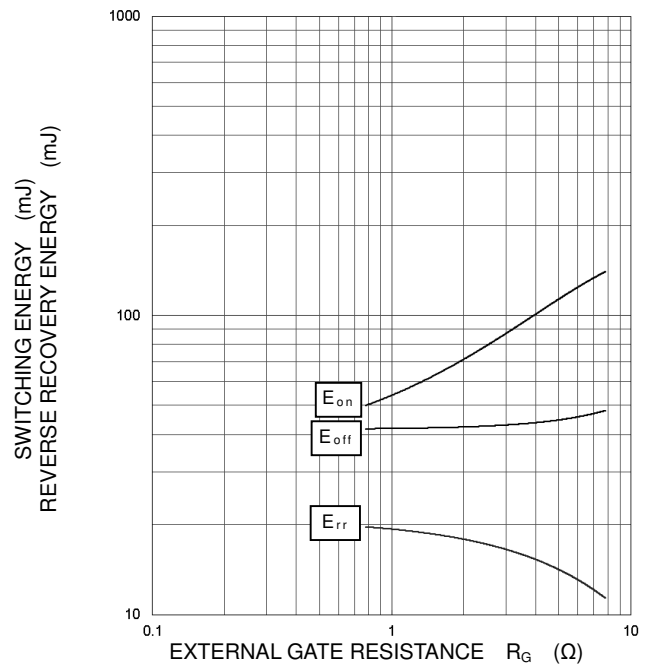
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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

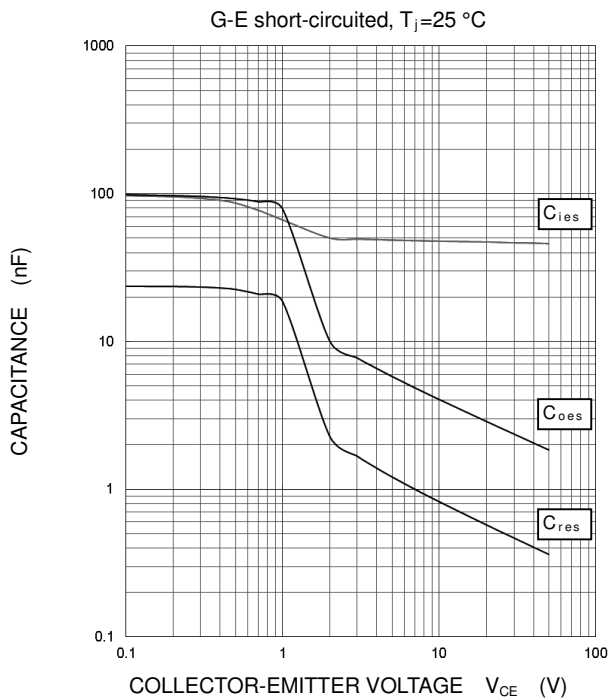


CM400HA-24A

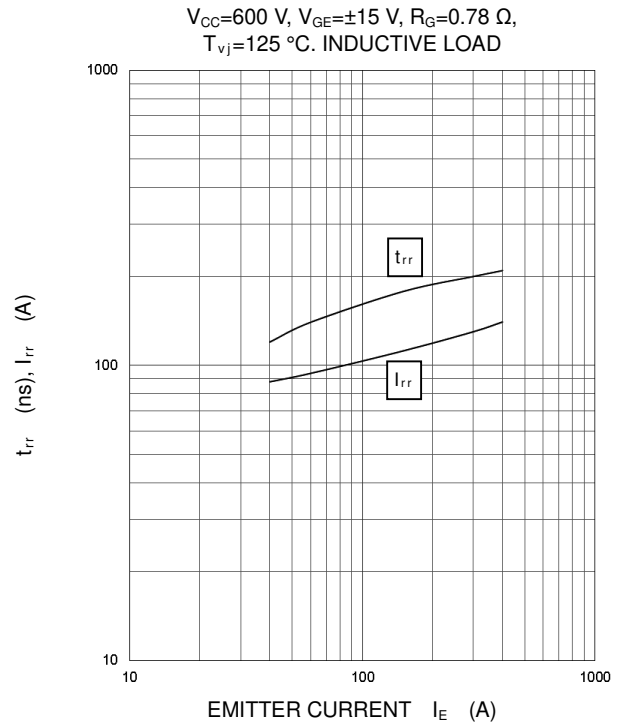
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

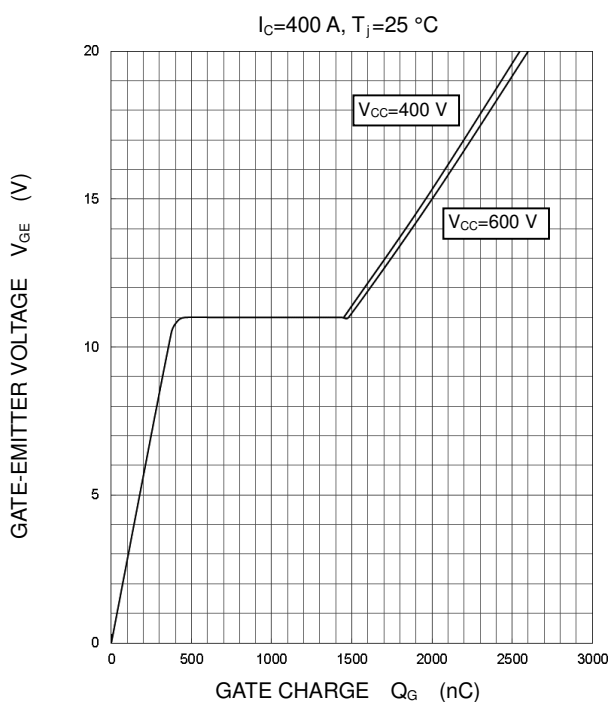
CAPACITANCE CHARACTERISTICS
(TYPICAL)



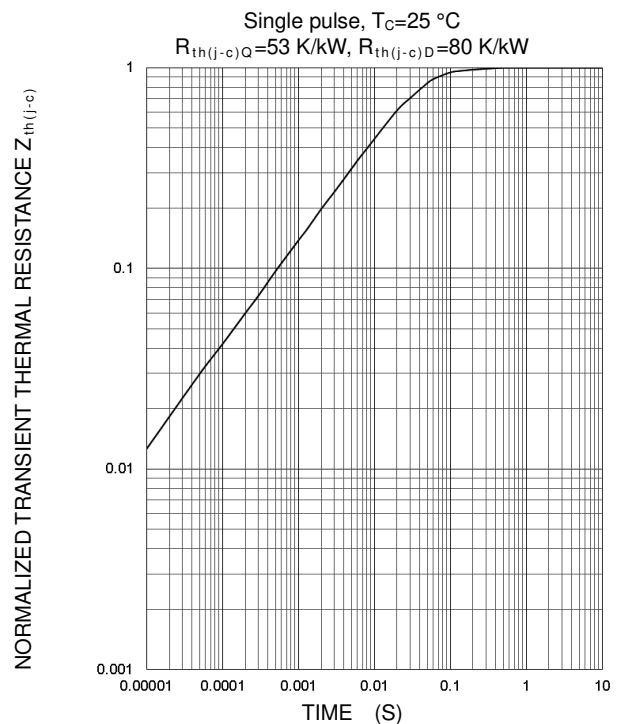
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)



GATE CHARGE CHARACTERISTICS
(TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)



Note: The characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

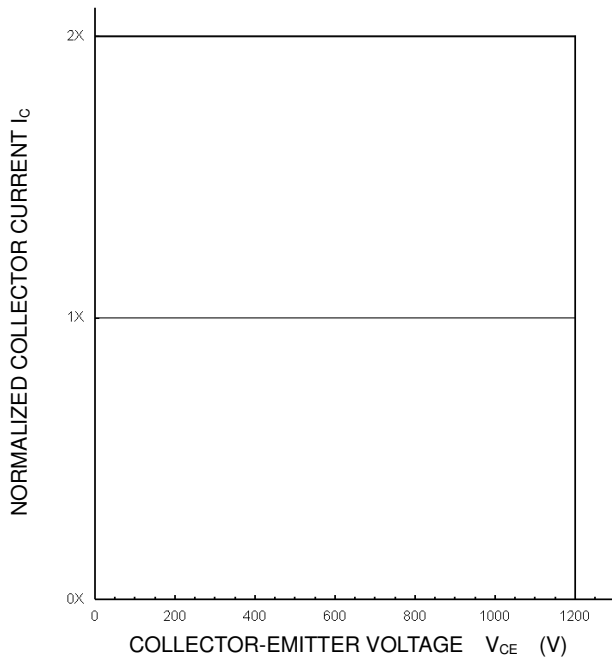
CM400HA-24A

HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

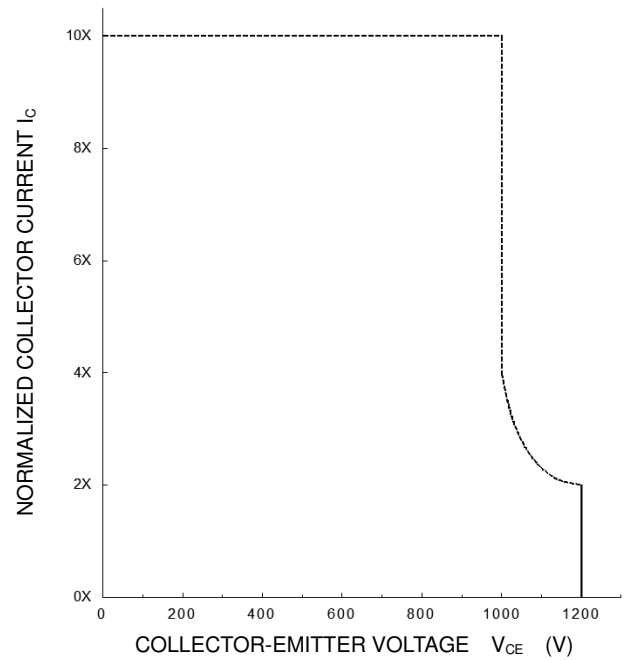
**TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)**

$V_{CC} \leq 800 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.78 \sim 10 \ \Omega$, $T_j = 25 \sim 125 \text{ }^\circ\text{C}$



**SHORT-CIRCUIT SAFE OPERATING AREA
(MAXIMUM)**

$V_{CC} \leq 800 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0.78 \sim 10 \ \Omega$,
 $T_j = 25 \sim 125 \text{ }^\circ\text{C}$, $t_w \leq 10 \ \mu\text{s}$, Non-Repetitive



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