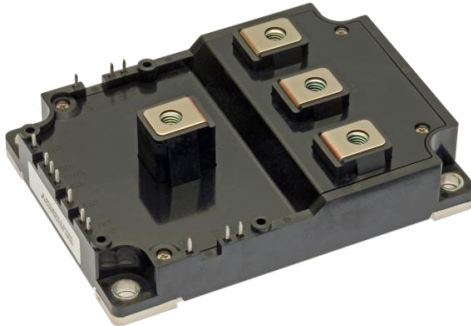


<IGBT Modules>

# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE



fourpack (BRIDGE & AC SWITCH)

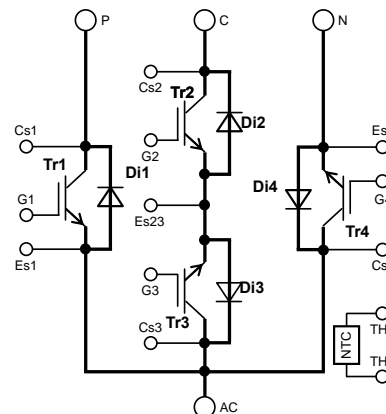
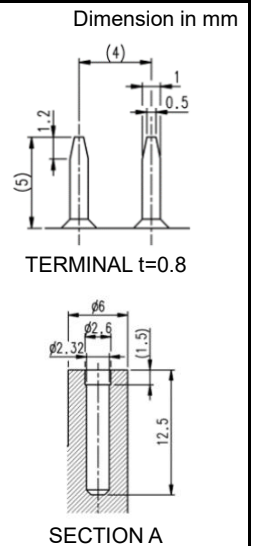
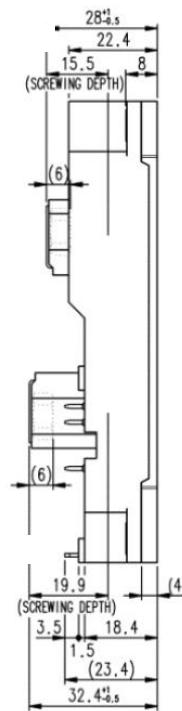
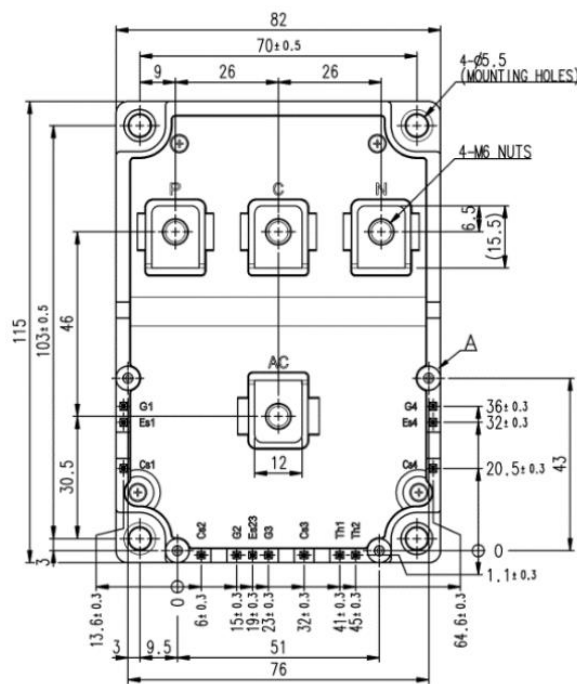
Collector current $I_c$ .....	4 0 0 A
Collector-emitter voltage $V_{CES}$ .....	
	BRIDGE 1 2 0 0 V
	AC SWITCH 6 5 0 V
Maximum junction temperature $T_{vjmax}$ .....	1 7 5 °C

- Flat base Type
- Copper base plate
- Tin plating pin terminals
- RoHS Directive compliant\*
- Recognized under UL1557, File E323585

## APPLICATION

3level inverter, UPS, PV

## OUTLINE DRAWING & 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

- BRIDGE**
- IGBT : Tr1, Tr4
  - DIODE : Di1, Di4
- AC SWITCH**
- IGBT : Tr2, Tr3
  - DIODE : Di2, Di3

# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

MAXIMUM RATINGS ( $T_{vj}=25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

### BRIDGE PART IGBT/DIODE (Tr1, Tr4, Di1, Di4)

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	$\pm 20$	V
$I_C$	Collector current	DC, $T_C=106\text{ }^{\circ}\text{C}$ (Note2, 4)	400	A
$I_{CRM}$		Pulse, Repetitive, $V_{GE}=15\text{ V}$ (Note3)	800	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	1970	W
$I_E$ (Note1)	Emitter current	DC (Note2)	400	A
$I_{ERM}$ (Note1)		Pulse, Repetitive (Note3)	800	

### AC SWITCH PART IGBT/DIODE (Tr2, Tr3, Di2, Di3)

Symbol	Item	Conditions	Rating	Unit
$V_{CES}$	Collector-emitter voltage	G-E short-circuited	650	V
$V_{GES}$	Gate-emitter voltage	C-E short-circuited	$\pm 20$	V
$I_C$	Collector current	DC, $T_C=94\text{ }^{\circ}\text{C}$ (Note2, 4)	400	A
$I_{CRM}$		Pulse, Repetitive, $V_{GE}=15\text{ V}$ (Note3)	800	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	1375	W
$I_E$ (Note1)	Emitter current	DC (Note2)	400	A
$I_{ERM}$ (Note1)		Pulse, Repetitive (Note3)	800	

### MODULE

Symbol	Item	Conditions	Rating	Unit
$V_{isol}$	Isolation voltage	Terminals to base plate, RMS, $f=60\text{ Hz}$ , AC 1 min	4000	V
$T_{vjmax}$	Maximum junction temperature	Instantaneous event (overload) (Note9)	175	$^{\circ}\text{C}$
$T_{Cmax}$	Maximum case temperature	(Note4, 9)	125	
$T_{vjop}$	Operating junction temperature	Continuous operation (under switching) (Note9)	-40 ~ 150	$^{\circ}\text{C}$
$T_{stg}$	Storage temperature	-	-40 ~ 125	

ELECTRICAL CHARACTERISTICS ( $T_{vj}=25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

### BRIDGE PART IGBT/DIODE (Tr1, Tr4, Di1, Di4)

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	-	-	0.5	$\mu\text{A}$	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=40\text{ mA}$ , $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
$V_{CEsat}$ (Terminal)	Collector-emitter saturation voltage	$I_C=400\text{ A}$ , $V_{GE}=15\text{ V}$ , Auxiliary Terminal (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.60	1.95	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.85	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.90	-	
$V_{CEsat}$ (Chip)	Collector-emitter saturation voltage	$I_C=400\text{ A}$ , $V_{GE}=15\text{ V}$ , Chip (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.50	1.75	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.70	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.75	-	
$C_{ies}$	Input capacitance	$V_{CE}=10\text{ V}$ , G-E short-circuited	-	-	97	nF	
$C_{oes}$	Output capacitance		-	-	2.7		
$C_{res}$	Reverse transfer capacitance		-	-	1.2		
$Q_G$	Gate charge	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_C=400\text{ A}$ , $V_{GE}=15\text{ V}$	-	3.0	-	$\mu\text{C}$	
$t_{d(on)}$	Turn-on delay time	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_C=400\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=1.6\text{ }\Omega$ , Inductive load	-	-	750	ns	
$t_r$	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	850		
$t_f$	Fall time		-	-	200		
$V_{EC}$ (Note1) (Terminal)	Emitter-collector voltage	$I_E=400\text{ A}$ , G-E short-circuited, Auxiliary Terminal (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.70	2.15	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.75	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.75	-	
$V_{EC}$ (Note1) (Chip)	Emitter-collector voltage	$I_E=400\text{ A}$ , G-E short-circuited, Chip (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.60	1.95	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.60	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.60	-	

# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

ELECTRICAL CHARACTERISTICS (Cont;  $T_{vj}=25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

## BRIDGE PART IGBT/DIODE (Tr1, Tr4, Di1, Di4)

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$t_{rr}$ (Note1)	Reverse recovery time	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_E=400\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ ,	-	-	350	ns
$Q_{rr}$ (Note1)	Reverse recovery charge	$R_G=0\text{ }\Omega$ (Tr2/Tr3), Inductive load	-	38.0	-	$\mu\text{C}$
$E_{on}$	Turn-on switching energy per pulse	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_C=I_E=400\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $T_{vj}=150\text{ }^{\circ}\text{C}$ ,	-	12.8	-	mJ
$E_{off}$	Turn-off switching energy per pulse			$R_G(\text{Tr1,4})=1.6\text{ }\Omega$		
$E_{rr}$ (Note1)	Reverse recovery energy per pulse	Inductive load	-	15.8	-	mJ
$R_{CC+EE}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	0.25	-	m $\Omega$
$r_g$	Internal gate resistance	Per switch	-	1.0	-	$\Omega$

## RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC(P-C)}$	(DC) Supply voltage	Applied across each of P to C and C to N	-	300	425	V
$V_{CC(C-N)}$						
$V_{GEon}$	Gate (-emitter drive) voltage	Applied across emitter to gate of each IGBT	13.5	15.0	16.5	V
$R_G$	External gate resistance	Per switch	1.6	-	16	$\Omega$

## AC SWITCH PART IGBT/DIODE (Tr2, Tr3, Di2, Di3)

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	-	-	0.5	$\mu\text{A}$	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=40\text{ mA}$ , $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
$V_{CEsat}$ (Terminal)	Collector-emitter saturation voltage	$I_C=400\text{ A}$ , $V_{GE}=15\text{ V}$ , Auxiliary Terminal (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.40	1.75	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.50	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.50	-	
$V_{CEsat}$ (Chip)	Collector-emitter saturation voltage	$I_C=400\text{ A}$ , $V_{GE}=15\text{ V}$ , Chip (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.30	1.55	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.35	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.35	-	
$C_{ies}$	Input capacitance	$V_{CE}=10\text{ V}$ , G-E short-circuited	-	-	53.5	nF	
$C_{oes}$	Output capacitance		-	-	2.3		
$C_{res}$	Reverse transfer capacitance		-	-	1.0		
$Q_G$	Gate charge	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_C=400\text{ A}$ , $V_{GE}=15\text{ V}$	-	1.65	-	$\mu\text{C}$	
$t_{d(on)}$	Turn-on delay time	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_C=400\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=0\text{ }\Omega$ , Inductive load	-	-	400	ns	
$t_r$	Rise time		-	-	150		
$t_{d(off)}$	Turn-off delay time		-	-	500		
$t_f$	Fall time		-	-	400		
$V_{EC}$ (Terminal)	Emitter-collector voltage	$I_E=400\text{ A}$ , G-E short-circuited, Auxiliary Terminal (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.50	1.95	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.60	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.60	-	
$V_{EC}$ (Chip)	Emitter-collector voltage	$I_E=400\text{ A}$ , G-E short-circuited, Chip (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.40	1.74	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.45	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.45	-	
$t_{rr}$ (Note1)	Reverse recovery time	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_E=400\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ ,	-	-	450	ns	
$Q_{rr}$ (Note1)	Reverse recovery charge	$R_G=1.6\text{ }\Omega$ (Tr1/Tr4), Inductive load	-	38.0	-	$\mu\text{C}$	
$E_{on}$	Turn-on switching energy per pulse	$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ , $I_C=I_E=400\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $T_{vj}=150\text{ }^{\circ}\text{C}$ ,	-	0.28	-	mJ	
$E_{off}$	Turn-off switching energy per pulse			$R_G(\text{Tr2,3})=0\text{ }\Omega$			
$E_{rr}$ (Note1)	Reverse recovery energy per pulse	Inductive load	-	10.0	-	mJ	
$R_{CC+EE}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	0.25	-	m $\Omega$	
$r_g$	Internal gate resistance	Per switch	-	1.5	-	$\Omega$	

# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

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

## RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>CC(P-C)</sub> V <sub>CC(C-N)</sub>	(DC) Supply voltage	Applied across each of P to C and C to N	-	300	425	V
V <sub>GEon</sub>	Gate (-emitter drive) voltage	Applied across emitter to gate of each IGBT	13.5	15.0	16.5	V
R <sub>G</sub>	External gate resistance	Per switch Tr2, Tr3	0	-	16	Ω

## NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Zero-power resistance	T <sub>C</sub> =25 °C (Note4)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R <sub>100</sub> =493 Ω, T <sub>C</sub> =100 °C (Note4)	-7.3	-	+7.8	%
B <sub>(25/50)</sub>	B-constant	Approximate by equation (Note6)	-	3375	-	K
P <sub>25</sub>	Power dissipation	T <sub>C</sub> =25 °C (Note4)	-	-	10	mW

## THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Thermal resistance	Junction to case, per BRIDGE PART IGBT (Note4)	-	-	76	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per BRIDGE PART FWD (Note4)	-	-	118	
R <sub>th(j-c)Q</sub>		Junction to case, per AC SWITCH PART IGBT (Note4)	-	-	109	
R <sub>th(j-c)D</sub>		Junction to case, per AC SWITCH PART FWD (Note4)	-	-	167	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 7, 9)	-	11	-	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 torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
m	mass	-	-	560	-	g
d <sub>s</sub>	Creepage distance	Terminal to terminal	14.4	-	-	mm
		Terminal to base plate	16.7	-	-	
d <sub>a</sub>	Clearance	Terminal to terminal	8.0	-	-	mm
		Terminal to base plate	16.7	-	-	
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note8)	-50	-	100	μm

\*: This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU and (EU)2015/863.

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

- Junction temperature (T<sub>vj</sub>) should not increase beyond T<sub>vjmax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>vj</sub>) dose not exceed T<sub>vjmax</sub> rating.
- Case temperature (T<sub>C</sub>) and heat sink temperature (T<sub>s</sub>) 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.

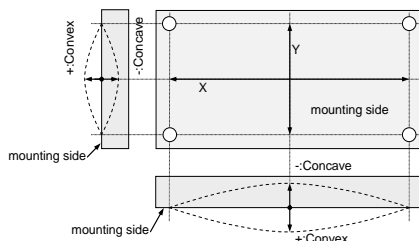
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

R<sub>25</sub>: resistance at absolute temperature T<sub>25</sub> [K]; T<sub>25</sub>=25 [°C]+273.15=298.15 [K]

R<sub>50</sub>: resistance at absolute temperature T<sub>50</sub> [K]; T<sub>50</sub>=50 [°C]+273.15=323.15 [K]

7. Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).

8. The base plate (mounting side) flatness measurement points (X, Y) are as follows of the next figure.



# CM400ST-24T

HIGH POWER SWITCHING USE  
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Note9. Long term performance related to thermal conductive grease (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under your specific application conditions. Each temperature condition ( $T_{vj\ max}$ ,  $T_{vj\ op}$ ,  $T_{C\ max}$ ) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

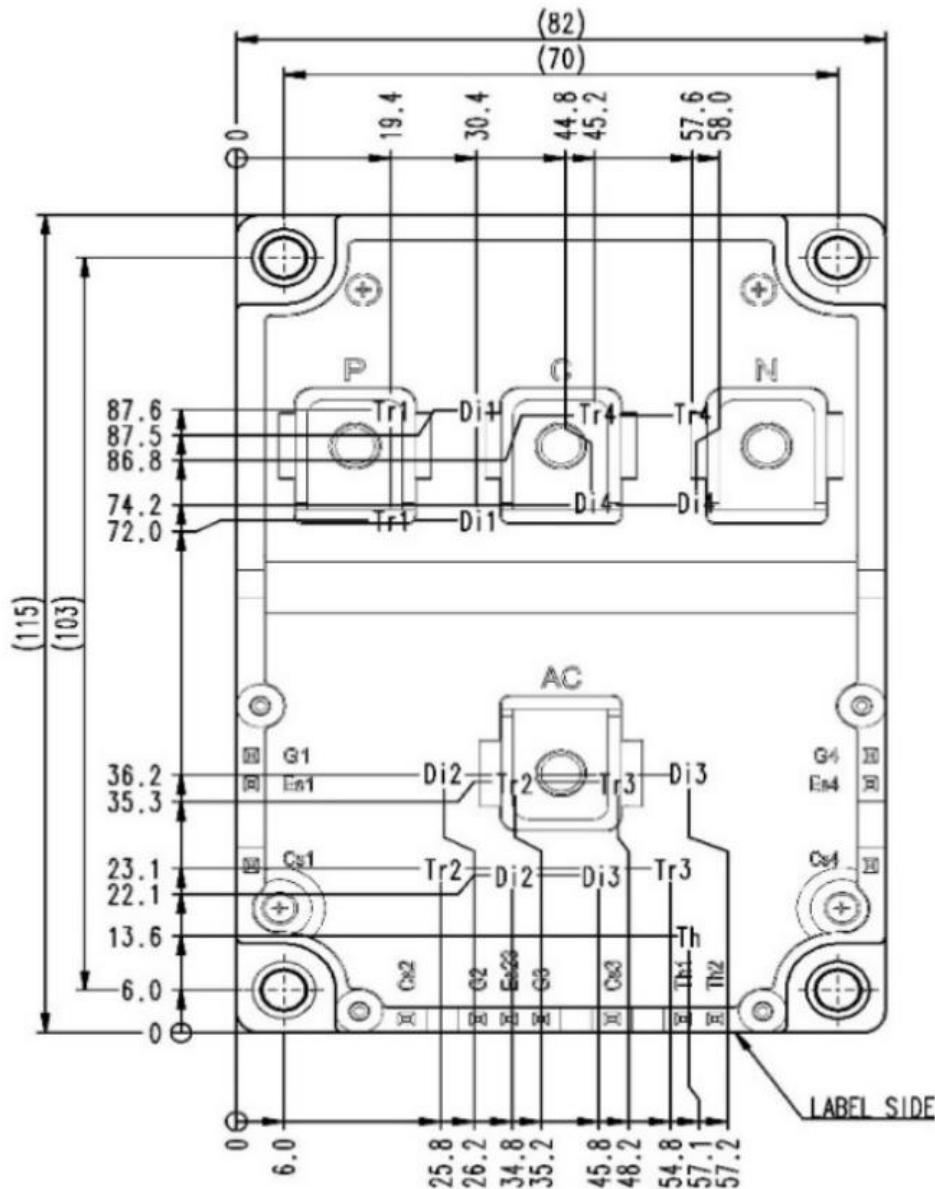
10. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.

The length of the screw depends on thickness (t1.0~t1.6) of the PCB.

Type	Size	Tightening torque	Recommended tightening method
(1) PT®	K25×8	0.55 ± 0.055 N·m	by handwork (equivalent to 30 r/min by mechanical screw driver) ~ 600 r/min (by mechanical screw driver)
(2) PT®	K25×10	0.75 ± 0.075 N·m	
(3) DELTA PT®	25×8	0.55 ± 0.055 N·m	
(4) DELTA PT®	25×10	0.75 ± 0.075 N·m	
(5) B1 tapping screw	φ2.6×10 or φ2.6×12	0.75 ± 0.075 N·m	

CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm

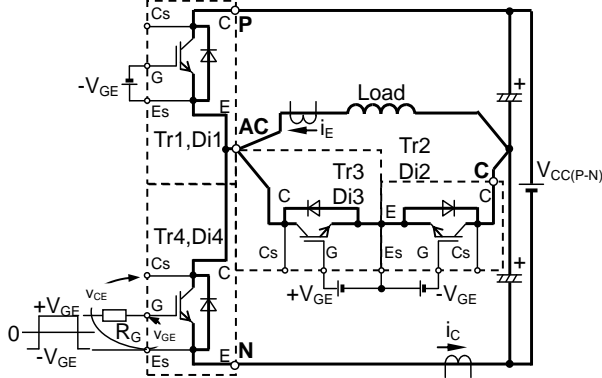


Tr1/Tr4: BRIDGE IGBT, Tr2/Tr3: AC SWITCH IGBT,  
Di1/Di4: BRIDGE FWD, Di2/Di3: AC SWITCH FWD,  
Th: NTC thermistor.

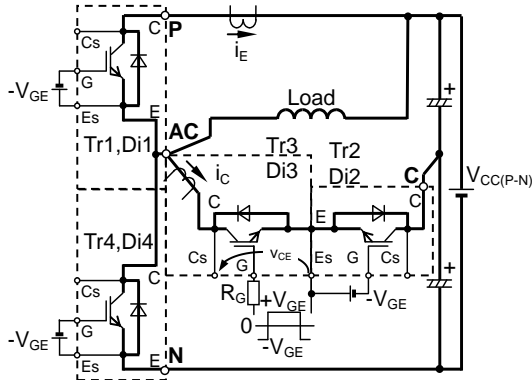
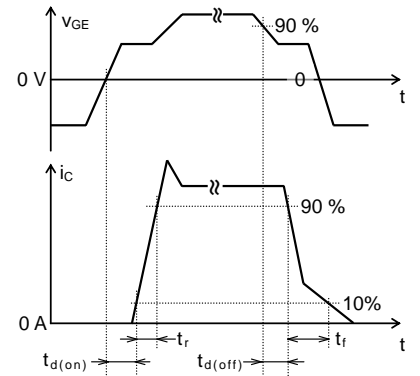
# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

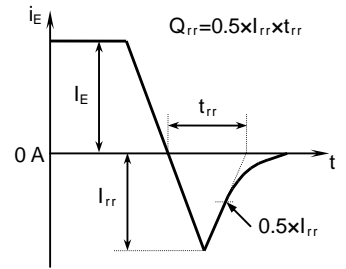
## TEST CIRCUIT AND WAVEFORMS



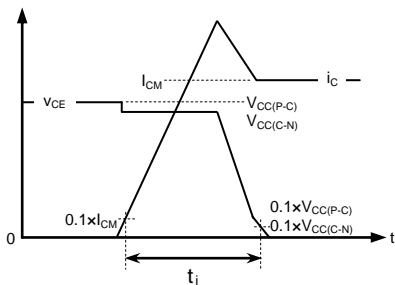
Switching test circuit and waveforms (BRIDGE PART switching)



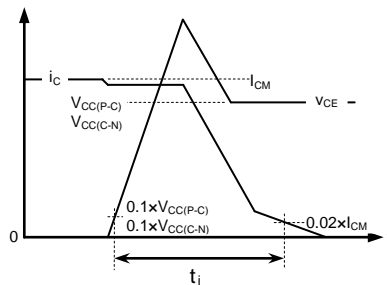
Switching test circuit and waveforms (AC SWITCH PART switching)



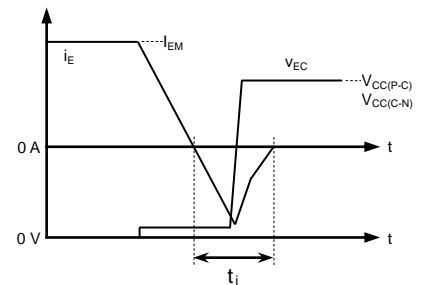
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



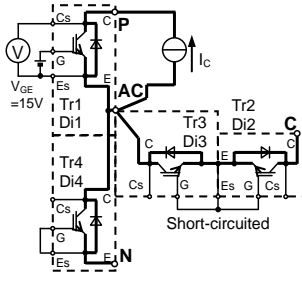
FWD Reverse recovery energy

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

# CM400ST-24T

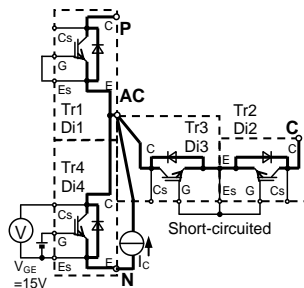
HIGH POWER SWITCHING USE  
INSULATED TYPE

## TEST CIRCUIT

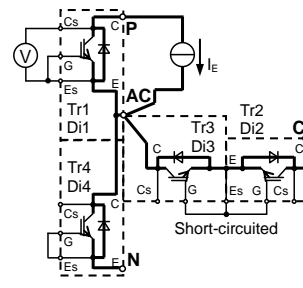


Tr1

$V_{CESat}$  characteristics test circuit (BRIDGE PART)

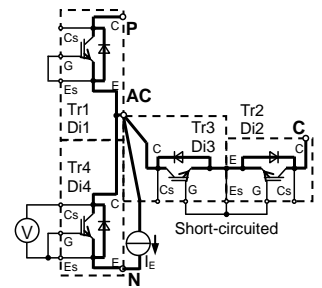


Tr4

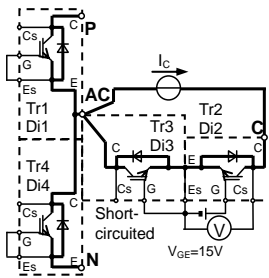


Di1

$V_{EC}$  characteristics test circuit (BRIDGE PART)

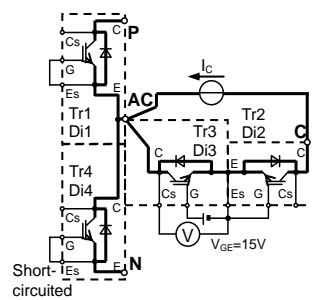


Di4

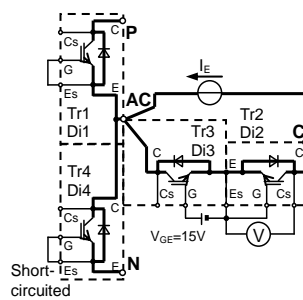


Tr2

$V_{CESat}$  characteristics test circuit (AC SWITCH PART)

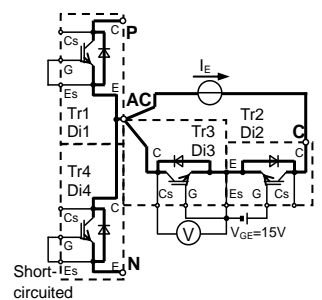


Tr3



Di2

$V_{EC}$  characteristics test circuit (AC SWITCH PART)



Di3

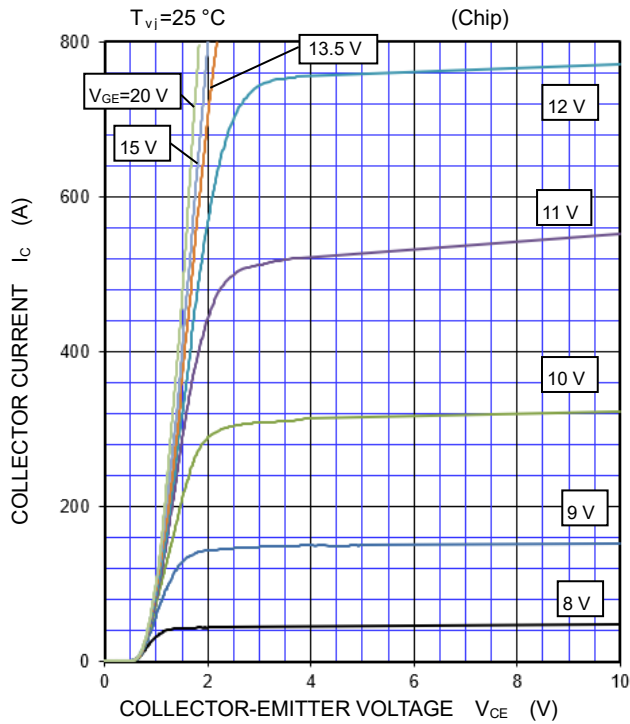
# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

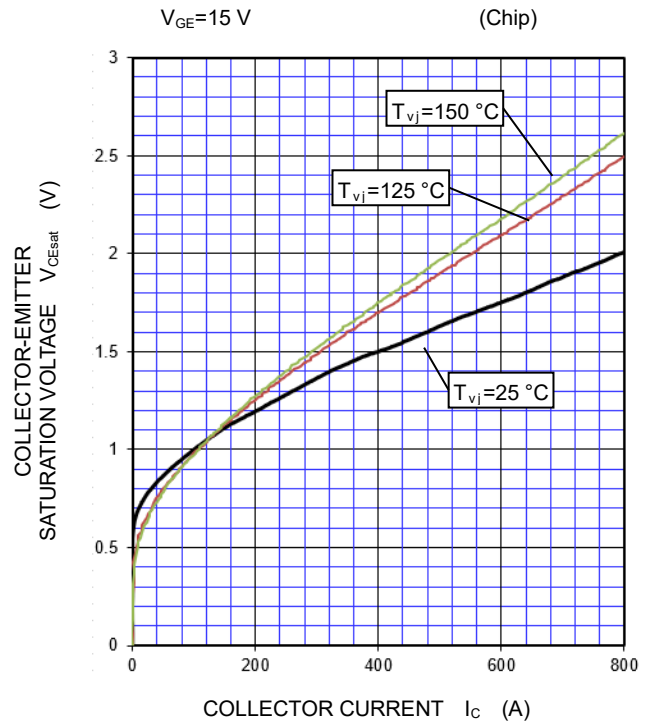
## PERFORMANCE CURVES

### BRIDGE PART

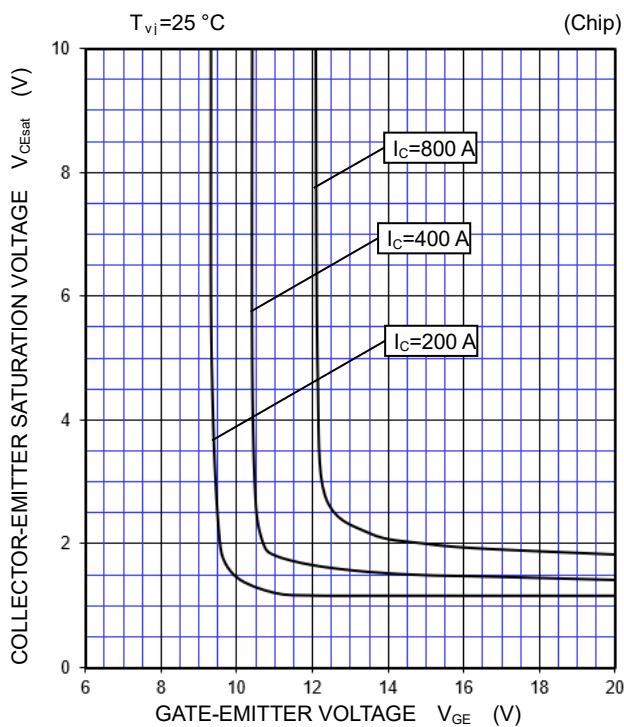
OUTPUT CHARACTERISTICS (TYPICAL)



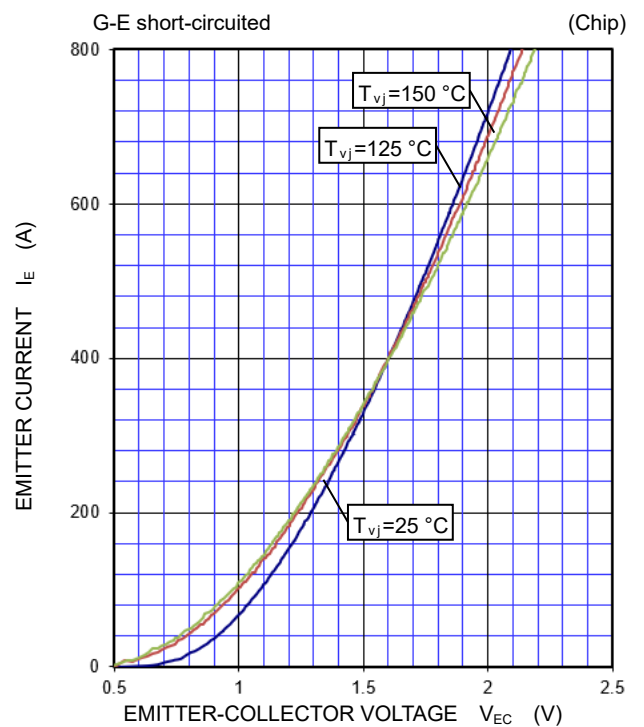
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



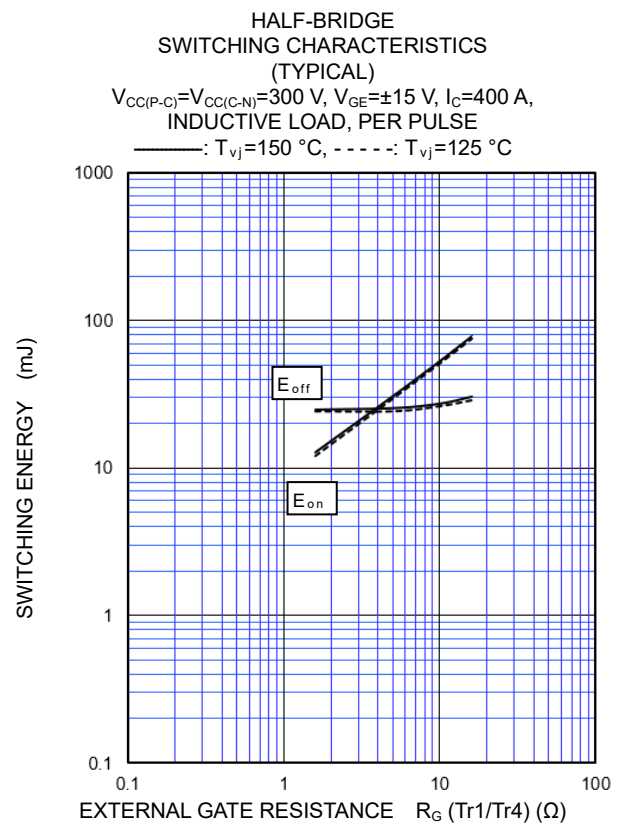
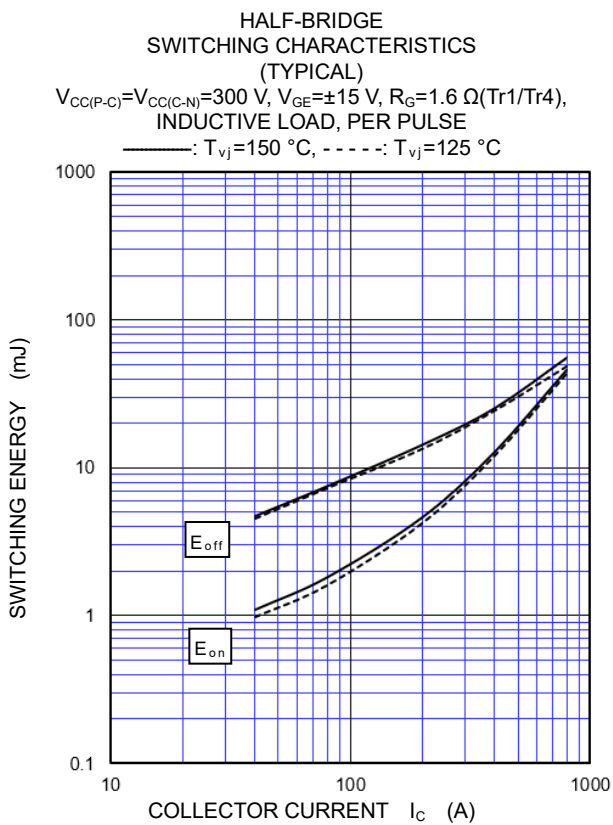
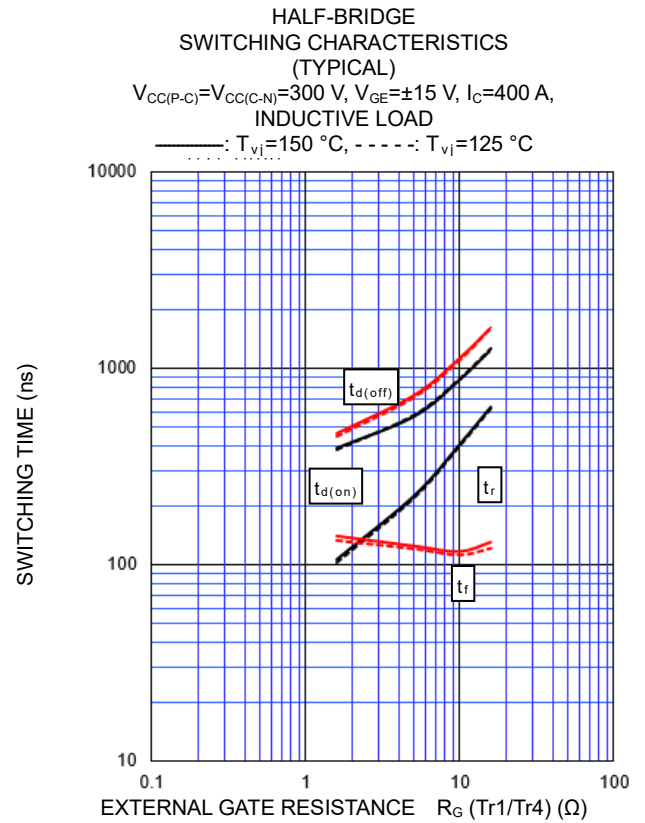
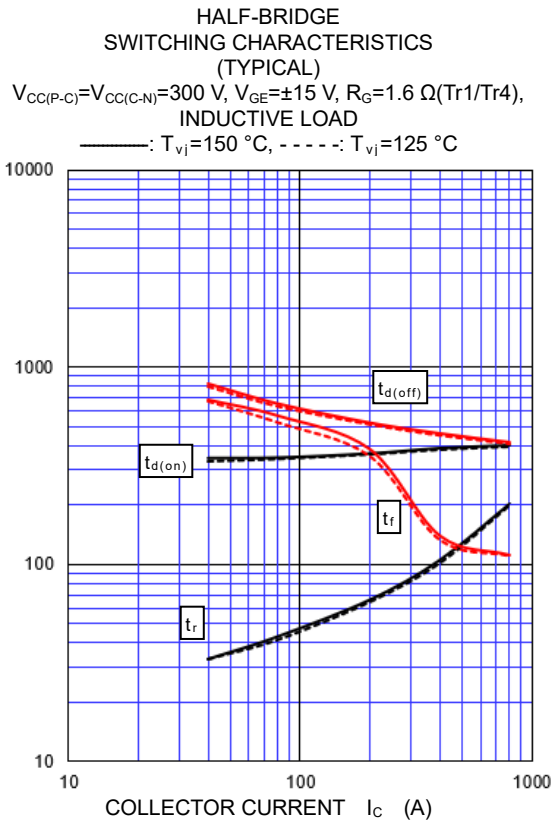


# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### BRIDGE PART



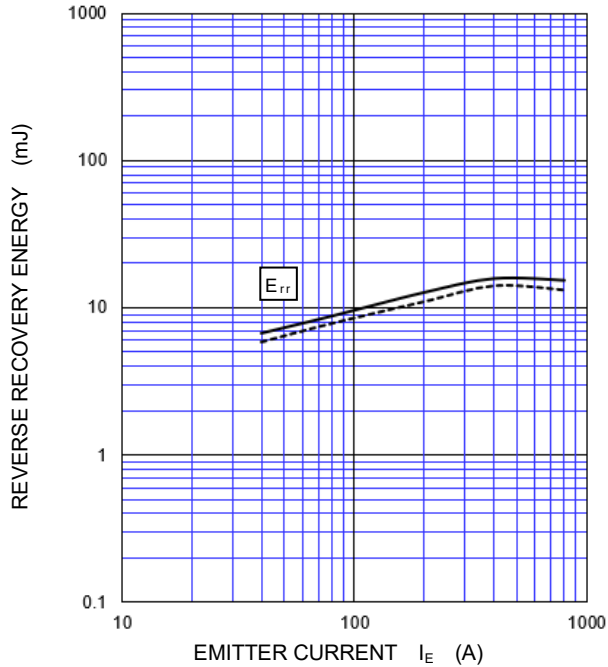
# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

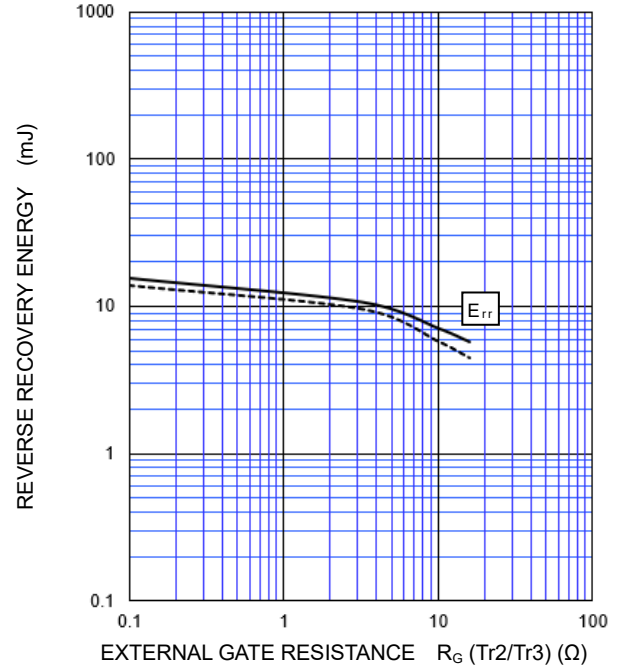
## PERFORMANCE CURVES

### BRIDGE PART

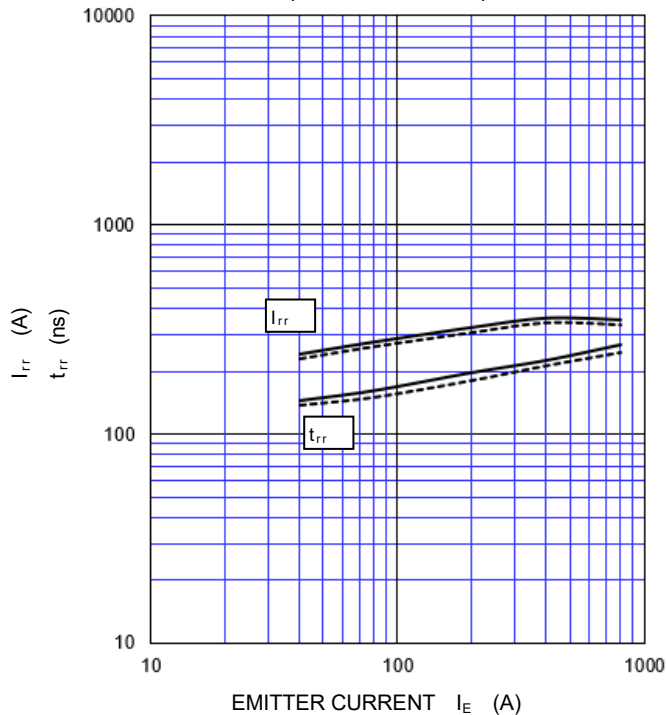
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)  
 $V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega$  (Tr2/Tr3),  
INDUCTIVE LOAD, PER PULSE  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)  
 $V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_E=400\text{ A}$ ,  
INDUCTIVE LOAD, PER PULSE  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)  
 $V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega$  (Tr2/Tr3),  
INDUCTIVE LOAD  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



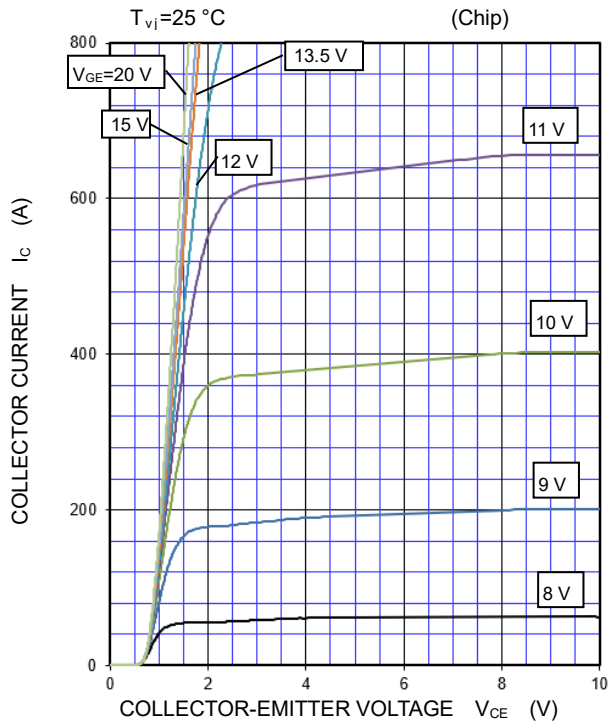
# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

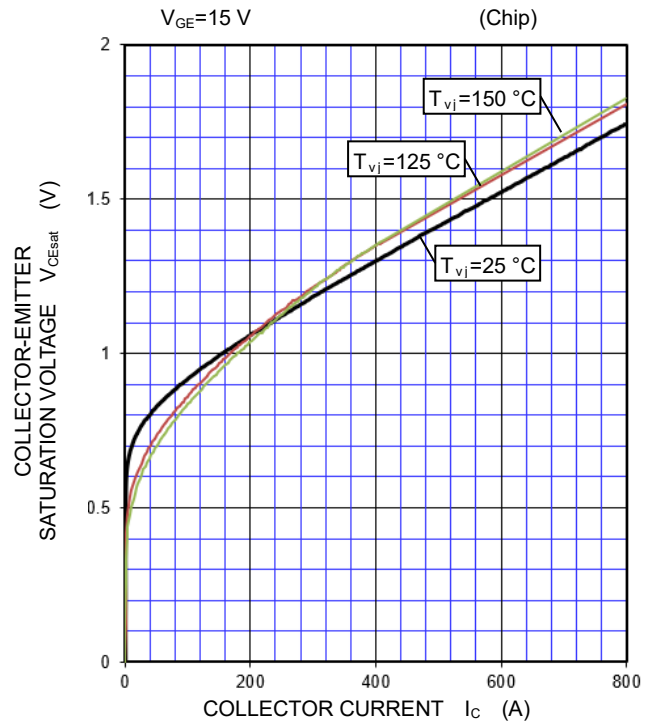
## PERFORMANCE CURVES

### AC SWITCH PART

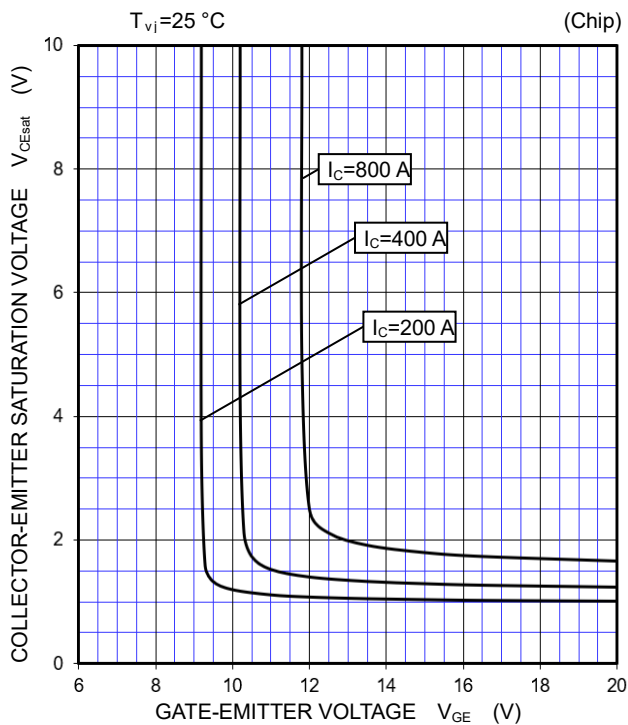
OUTPUT CHARACTERISTICS (TYPICAL)



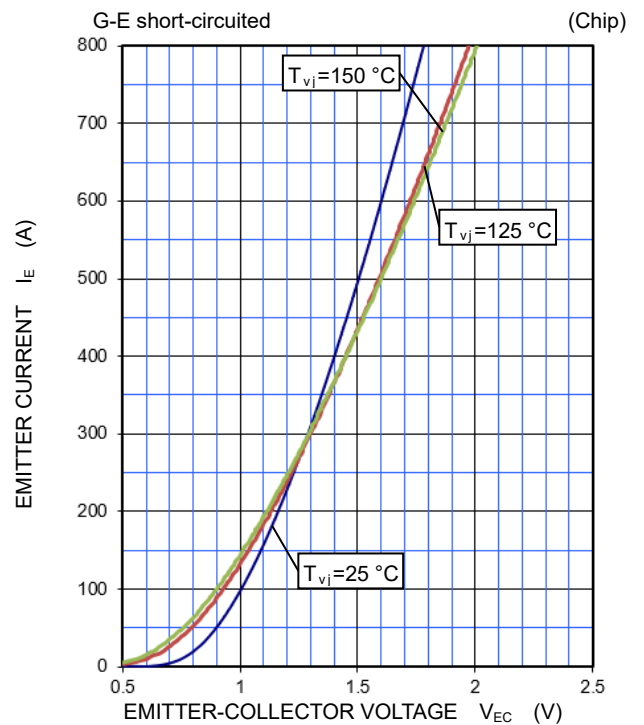
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



# CM400ST-24T

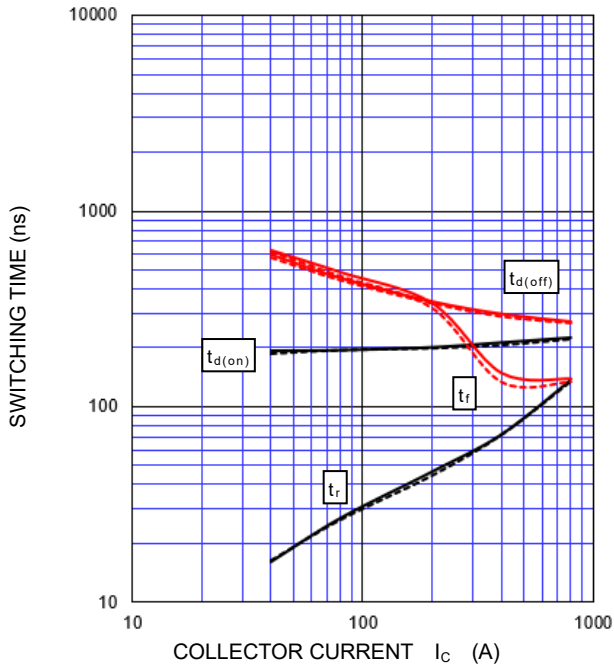
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### AC SWITCH PART

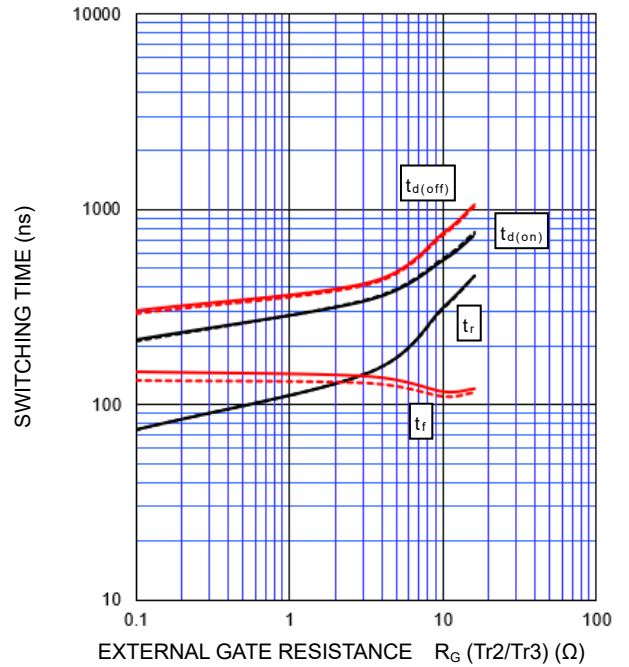
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega(\text{Tr2/Tr3})$ ,  
INDUCTIVE LOAD  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



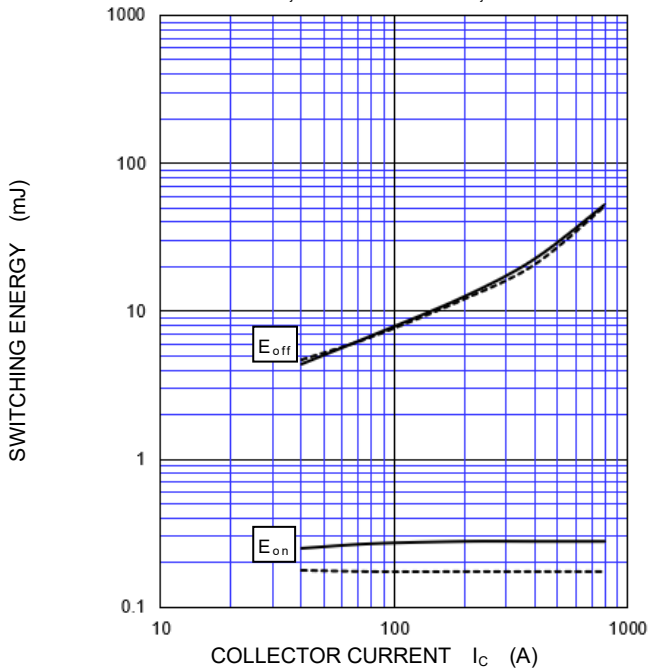
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_c=400\text{ A}$ ,  
INDUCTIVE LOAD  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



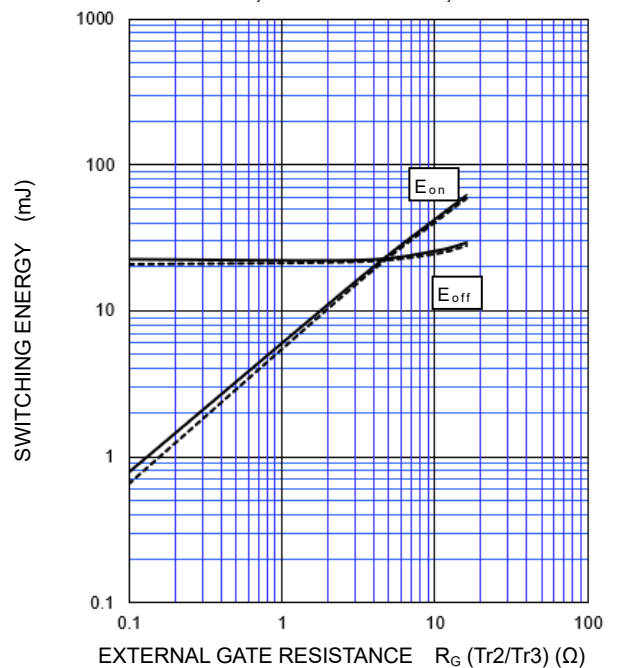
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega(\text{Tr2/Tr3})$ ,  
INDUCTIVE LOAD, PER PULSE  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_c=400\text{ A}$ ,  
INDUCTIVE LOAD, PER PULSE  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



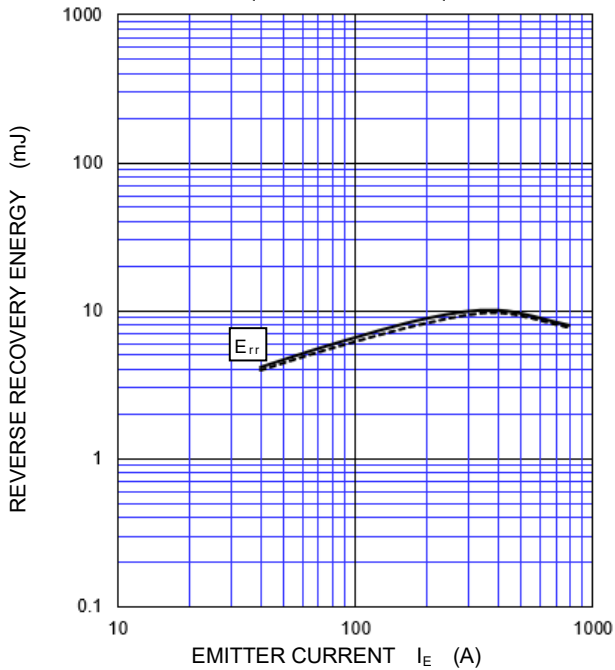
# CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

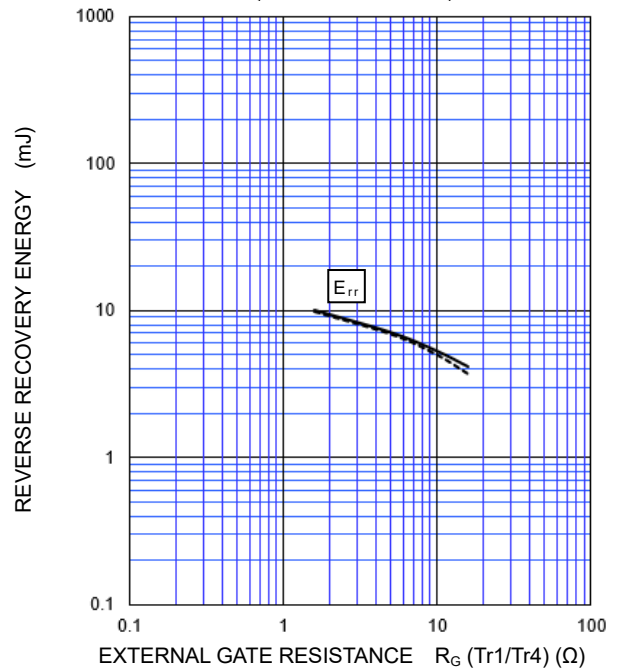
## PERFORMANCE CURVES

### AC SWITCH PART

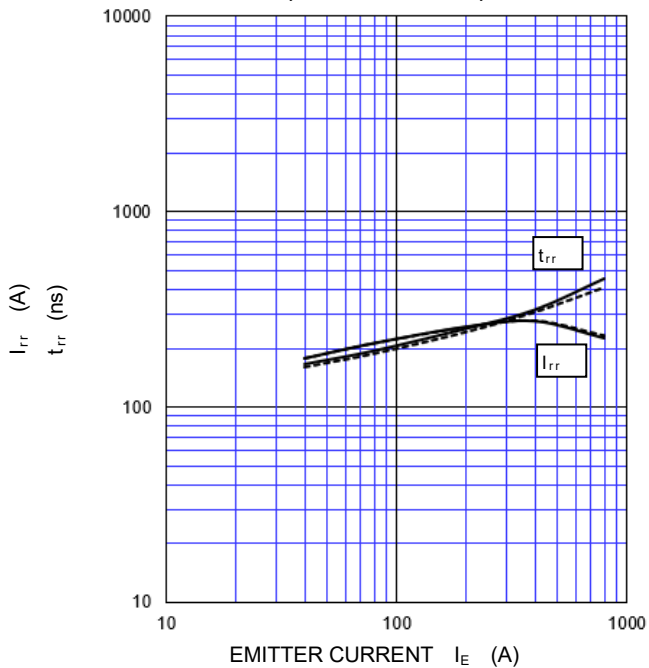
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)  
 $V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=1.6\ \Omega$  (Tr1/Tr4),  
INDUCTIVE LOAD, PER PULSE  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)  
 $V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_E=400\text{ A}$ ,  
INDUCTIVE LOAD, PER PULSE  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)  
 $V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=1.6\ \Omega$  (Tr1/Tr4),  
INDUCTIVE LOAD  
——:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



# CM400ST-24T

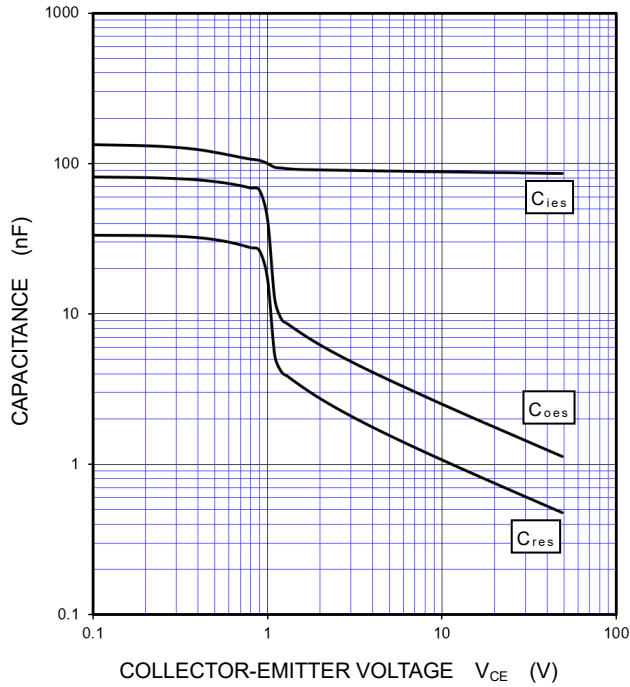
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### BRIDGE PART

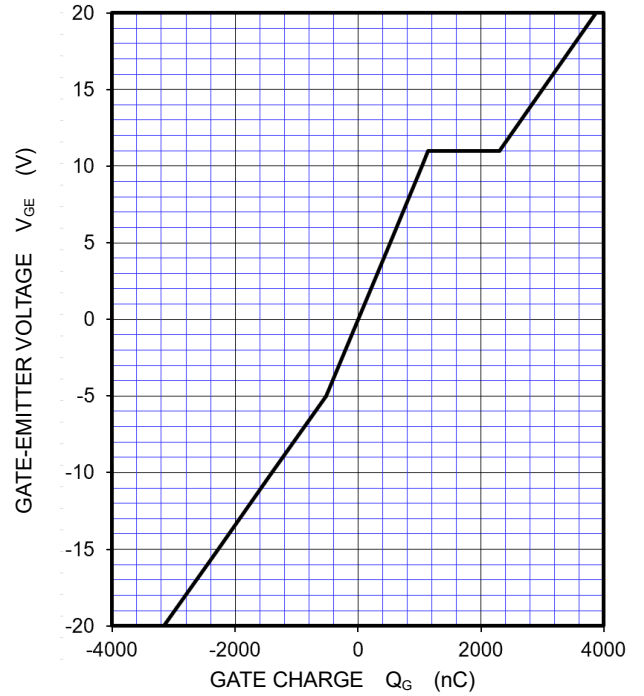
CAPACITANCE CHARACTERISTICS (TYPICAL)

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



GATE CHARGE CHARACTERISTICS (TYPICAL)

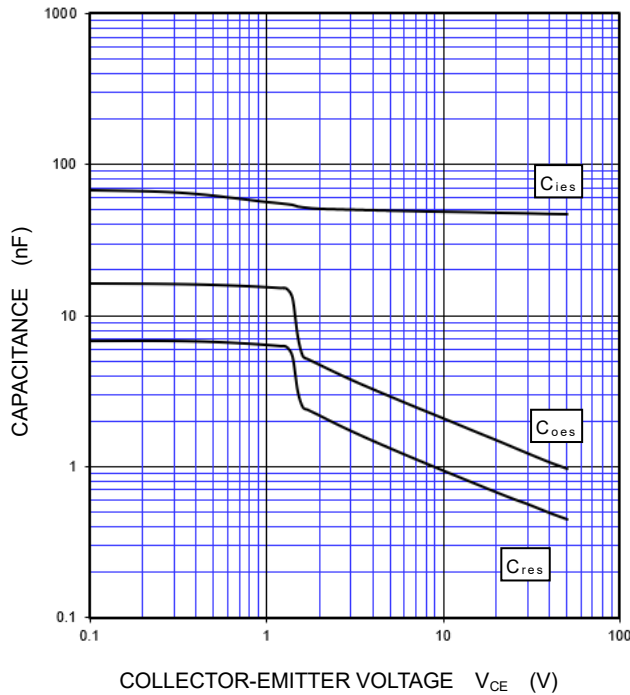
$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $I_C=400\text{ A}$ ,  $T_{vj}=25\text{ }^{\circ}\text{C}$



### AC SWITCH PART

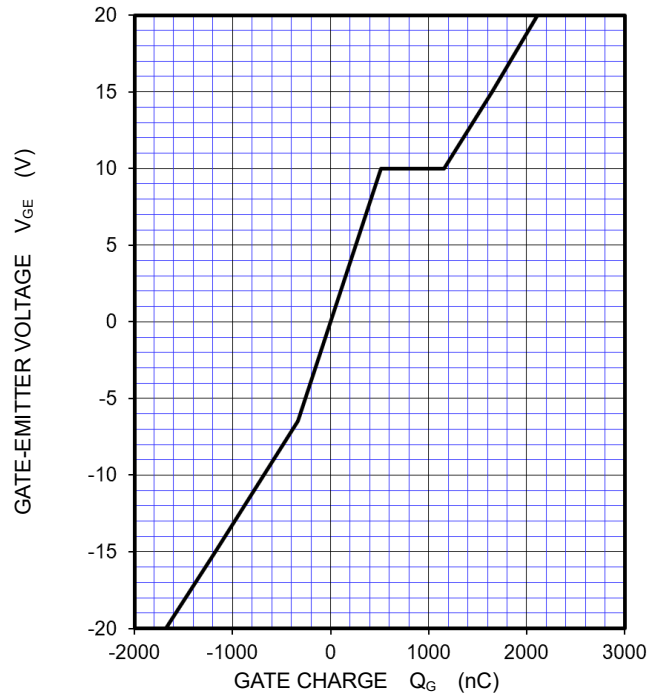
CAPACITANCE CHARACTERISTICS (TYPICAL)

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



GATE CHARGE CHARACTERISTICS (TYPICAL)

$V_{CC(P-C)}=V_{CC(C-N)}=300\text{ V}$ ,  $I_C=400\text{ A}$ ,  $T_{vj}=25\text{ }^{\circ}\text{C}$



# CM400ST-24T

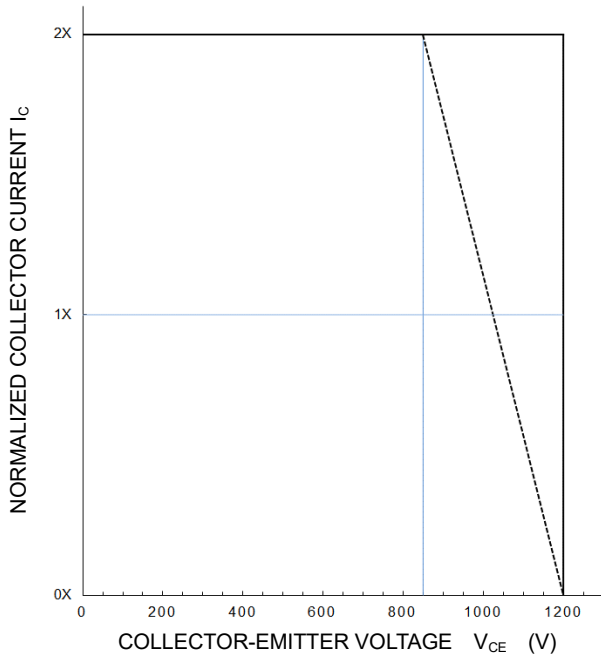
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### BRIDGE PART

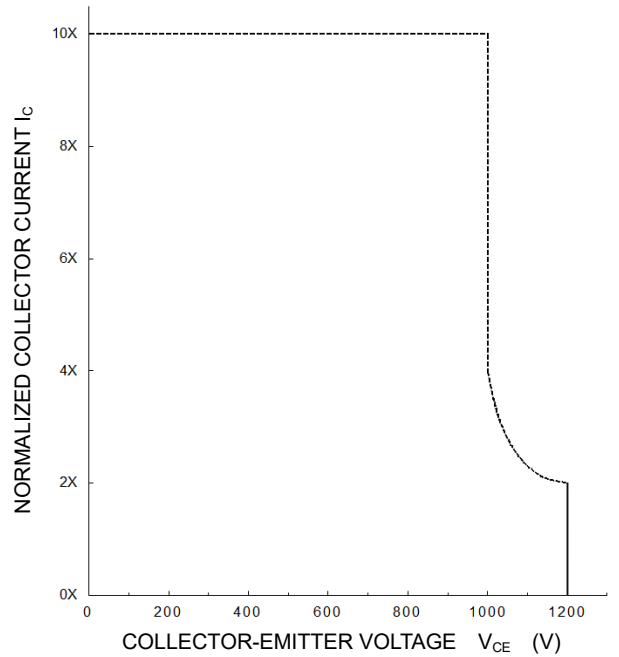
**TURN-OFF SWITCHING SAFE OPERATING AREA  
(REVERSE BIAS SAFE OPERATING AREA)  
(MAXIMUM)**

$V_{CC} \leq 850 \text{ V}$ ,  $R_G = 1.6 \sim 16 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 —:  $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$  (Normal load operations (Continuous))  
 - - - -:  $T_{vj} = 175 \text{ }^\circ\text{C}$  (Unusual load operations (Limited period))



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

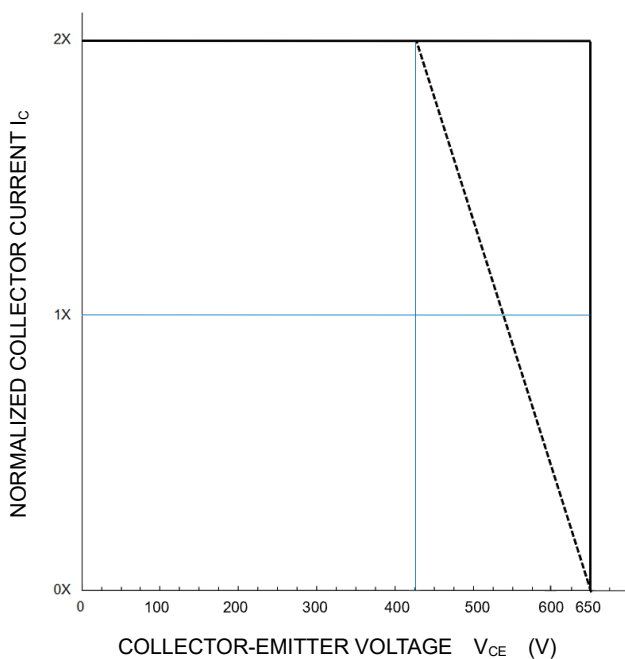
$V_{CC} \leq 800 \text{ V}$ ,  $R_G = 1.6 \sim 16 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ ,  $t_W \leq 6 \ \mu\text{s}$ , Non-Repetitive



### AC SWITCH PART

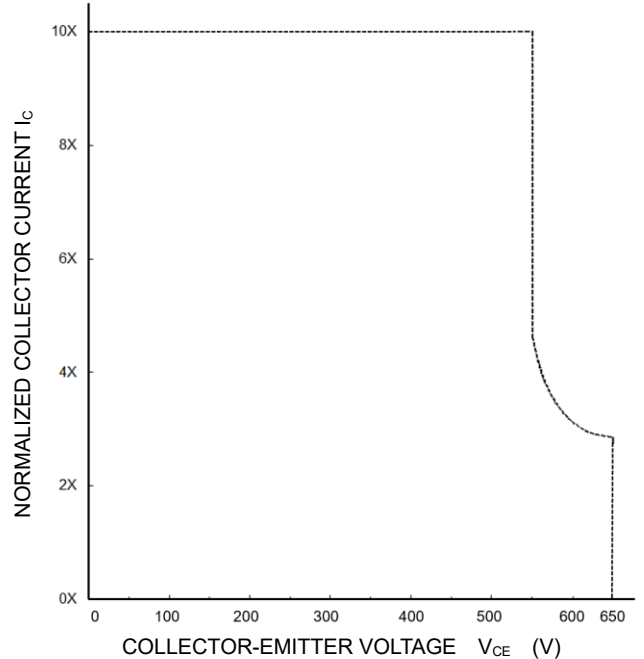
**TURN-OFF SWITCHING SAFE OPERATING AREA  
(REVERSE BIAS SAFE OPERATING AREA)  
(MAXIMUM)**

$V_{CC} \leq 425 \text{ V}$ ,  $R_G = 0 \sim 16 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 —:  $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$  (Normal load operations (Continuous))  
 - - - -:  $T_{vj} = 175 \text{ }^\circ\text{C}$  (Unusual load operations (Limited period))



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

$V_{CC} \leq 400 \text{ V}$ ,  $R_G = 0 \sim 16 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ ,  $t_W \leq 6 \ \mu\text{s}$ , Non-Repetitive



# CM400ST-24T

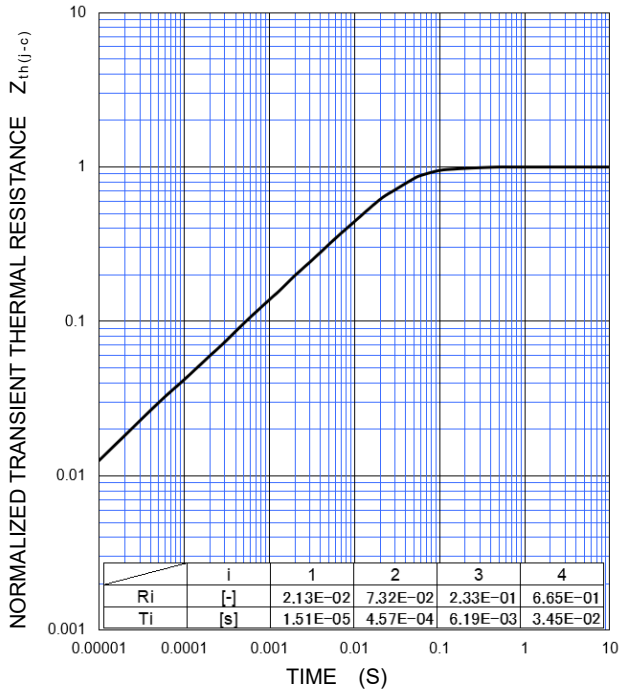
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### COMMON PART

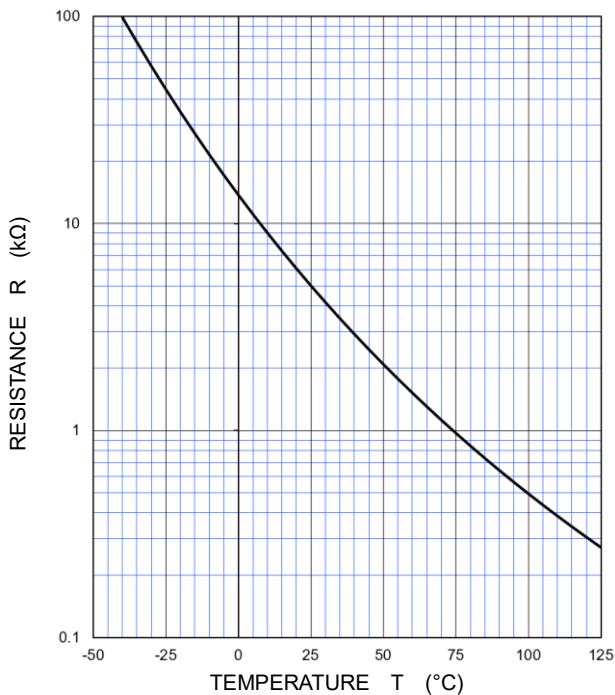
TRANSIENT THERMAL IMPEDANCE  
CHARACTERISTICS  
(MAXIMUM)  
Single pulse,  $T_c=25\text{ }^\circ\text{C}$

BRIDGE PART:  $R_{th(j-c)Q}=76\text{ K/kW}$ ,  $R_{th(j-c)D}=118\text{ K/kW}$   
AC SWITCH PART:  $R_{th(j-c)Q}=109\text{ K/kW}$ ,  $R_{th(j-c)D}=167\text{ K/kW}$



### NTC THERMISTOR PART

TEMPERATURE  
CHARACTERISTICS  
(TYPICAL)



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



## CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

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## CM400ST-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

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