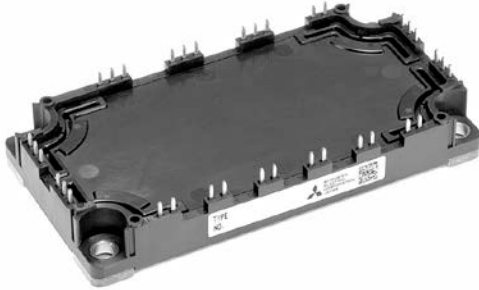


<IGBT Modules>

# CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE



sixpack (3φ Inverter)

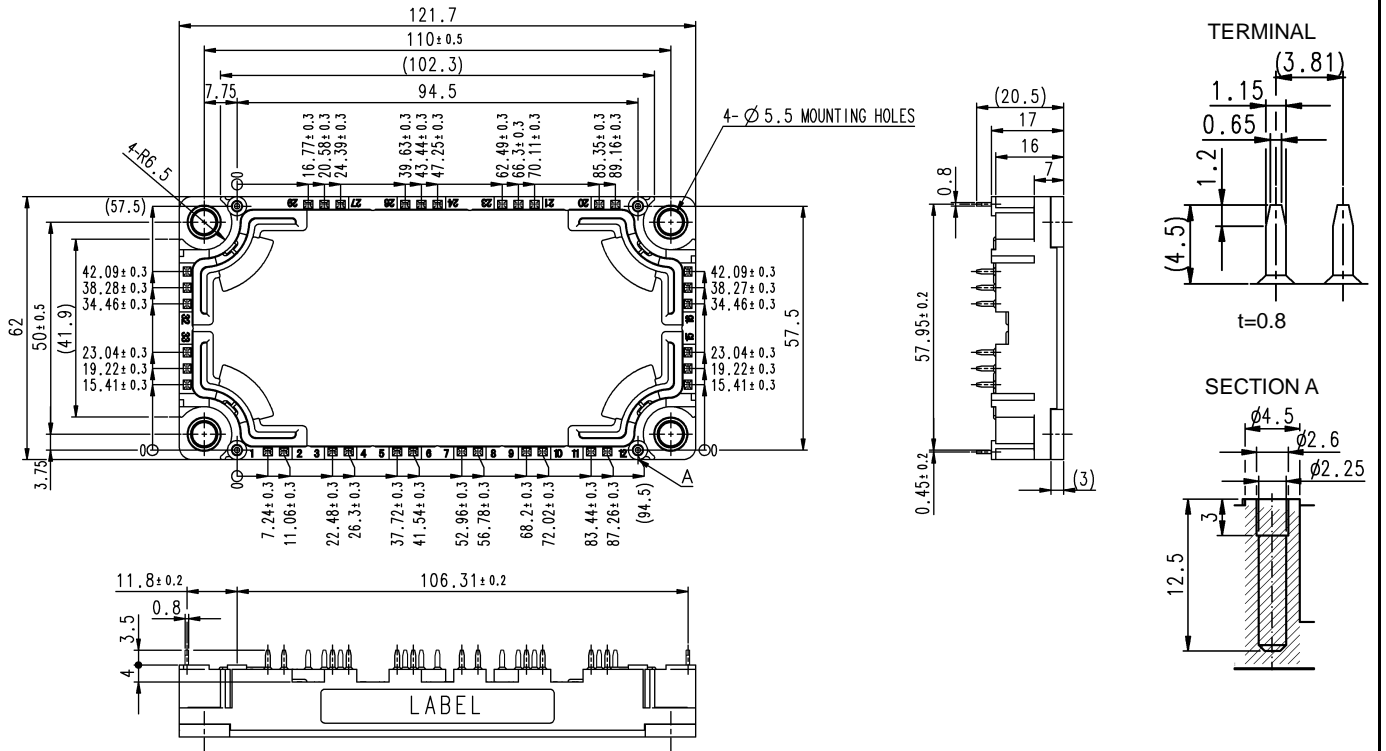
Collector current  $I_c$  ..... 100 A  
 Collector-emitter voltage  $V_{CES}$  ..... 1200 V  
 Maximum junction temperature  $T_{jmax}$  ..... 175 °C

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

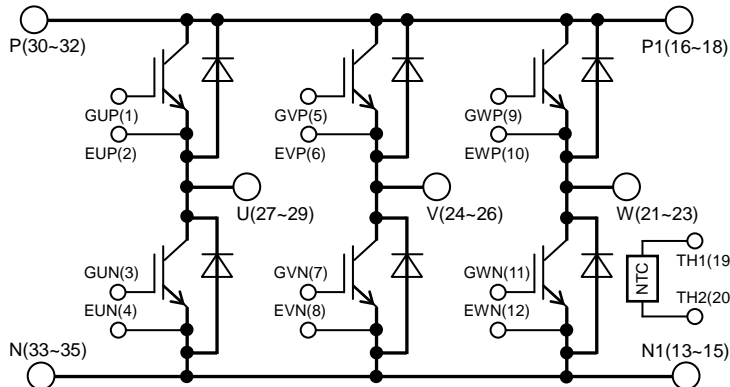
## APPLICATION

AC Motor Control, Motion/Servo Control, etc.

## OUTLINE DRAWING & INTERNAL CONNECTION



### 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

## CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPEMAXIMUM RATINGS ( $T_j=25\text{ }^\circ\text{C}$ , unless otherwise specified)

## INVERTER PART IGBT/DIODE

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, $T_C=107\text{ }^\circ\text{C}$ (Note2, 4)	100	A
$I_{CRM}$		Pulse, Repetitive (Note3)	200	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note2, 4)	625	W
$I_E$ (Note1)	Emitter current	DC (Note2)	100	A
$I_{ERM}$ (Note1)		Pulse, Repetitive (Note3)	200	

## MODULE

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

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

## INVERTER PART IGBT/DIODE

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	-	-	0.5	$\mu\text{A}$	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=10\text{ mA}$ , $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
$V_{CESat}$ (Terminal)	Collector-emitter saturation voltage	$I_C=100\text{ A}$ , $V_{GE}=15\text{ V}$ , Refer to the figure of test circuit (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	1.80	2.25	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.00	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.05	-	
$V_{CESat}$ (Chip)		$I_C=100\text{ A}$ , $V_{GE}=15\text{ V}$ , (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	1.70	2.15	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.90	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.95	-	
$C_{ies}$	Input capacitance	$V_{CE}=10\text{ V}$ , G-E short-circuited	-	-	10	nF	
$C_{oes}$	Output capacitance		-	-	2.0		
$C_{res}$	Reverse transfer capacitance		-	-	0.17		
$Q_G$	Gate charge	$V_{CC}=600\text{ V}$ , $I_C=100\text{ A}$ , $V_{GE}=15\text{ V}$	-	210	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$ , $I_C=100\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=6.2\text{ }\Omega$ , Inductive load	-	-	300	ns	
$t_r$	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	600		
$t_f$	Fall time		-	-	300		
$V_{EC}$ (Note1) (Terminal)	Emitter-collector voltage	$I_E=100\text{ A}$ , G-E short-circuited, Refer to the figure of test circuit (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	2.60	3.40	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.16	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.10	-	
$V_{EC}$ (Note1) (Chip)		$I_E=100\text{ A}$ , G-E short-circuited, (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	2.50	3.30	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.06	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.00	-	
$t_{rr}$ (Note1)	Reverse recovery time	$V_{CC}=600\text{ V}$ , $I_E=100\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ ,	-	-	300	ns	
$Q_{rr}$ (Note1)	Reverse recovery charge	$R_G=6.2\text{ }\Omega$ , Inductive load	-	2.7	-	$\mu\text{C}$	
$E_{on}$	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$ , $I_C=I_E=100\text{ A}$ ,	-	5.9	-	mJ	
$E_{off}$	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$ , $R_G=6.2\text{ }\Omega$ , $T_j=150\text{ }^\circ\text{C}$ ,	-	9.7	-		
$E_{rr}$ (Note1)	Reverse recovery energy per pulse	Inductive load	-	9.7	-	mJ	
$R_{CC+EE}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note4)	-	-	2.2	m $\Omega$	
$r_g$	Internal gate resistance	Per switch	-	0	-	$\Omega$	

# CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE

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

### 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 Inverter IGBT (Note4)	-	-	0.24	K/W
R <sub>th(j-c)D</sub>		Junction to case, per Inverter DIODE (Note4)	-	-	0.37	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 7)	-	15	-	K/kW

### MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M <sub>s</sub>	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
m	mass	-	-	330	-	g
d <sub>s</sub>	Creepage distance	Terminal to terminal	16.3	-	-	mm
		Terminal to base plate	19.1	-	-	
d <sub>a</sub>	Clearance	Terminal to terminal	10.3	-	-	mm
		Terminal to base plate	15.3	-	-	
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note8)	±0	-	+100	μm

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

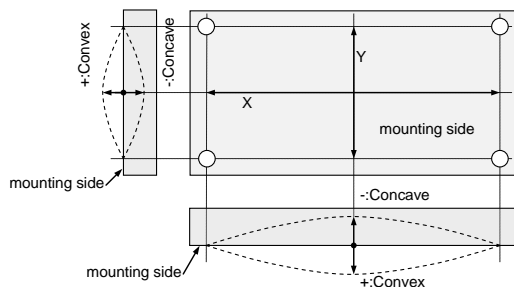
- Junction temperature (T<sub>j</sub>) should not increase beyond T<sub>jmax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>j</sub>) dose not exceed T<sub>jmax</sub> rating.
- Case temperature (T<sub>C</sub>) and heat sink temperature (T<sub>s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

- Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).
- The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



**CM100TX-24S1**

HIGH POWER SWITCHING USE

INSULATED TYPE

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

PCB thickness : t=1.6.

Type	Manufacturer	Size	Tightening torque (N·m)	Recommended tightening method
(1) PT®	EJOT	K25×8	0.55 ± 0.055	by handwork (equivalent to 30 rpm by mechanical screw driver) ~ 600 rpm (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 φ2.6×12	0.75 ± 0.075 N·m	

\* This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).

## RECOMMENDED OPERATING CONDITIONS

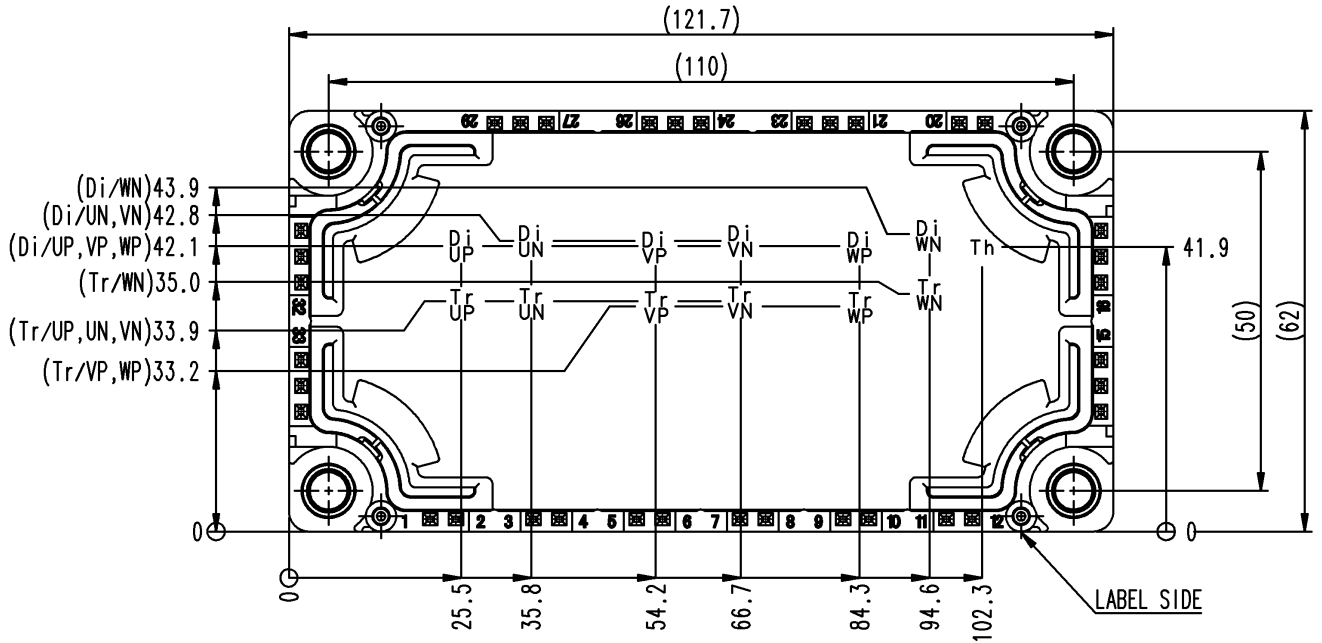
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>CC</sub>	(DC) Supply voltage	Applied across P-N/P1-N1 terminals	-	600	850	V
V <sub>GEon</sub>	Gate (-emitter drive) voltage	Applied across G*P-E*P/G*N-E*N(*=U, V, W) terminals	13.5	15.0	16.5	V
R <sub>G</sub>	External gate resistance	Per switch	6.2	-	62	Ω

# CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE

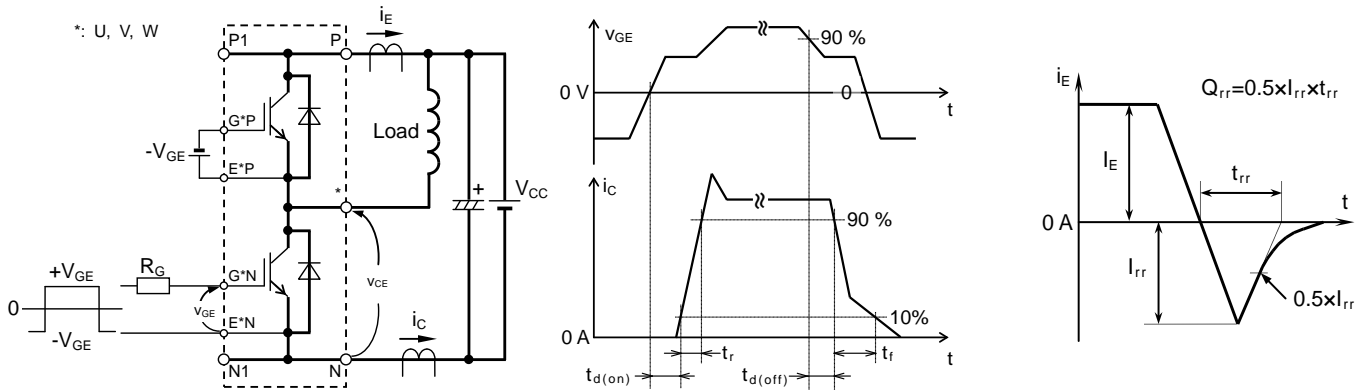
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



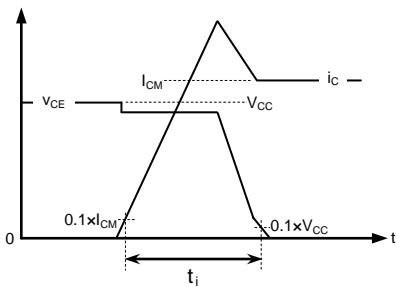
Tr\*P/Tr\*N: IGBT, Di\*P/Di\*N: DIODE (\*=U/V/W), Th: NTC thermistor

## TEST CIRCUIT AND WAVEFORMS

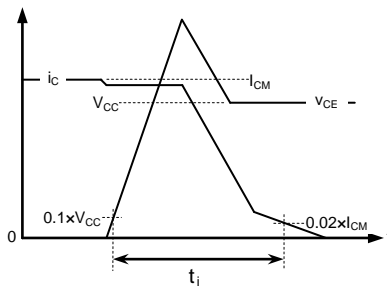


Switching characteristics test circuit and waveforms

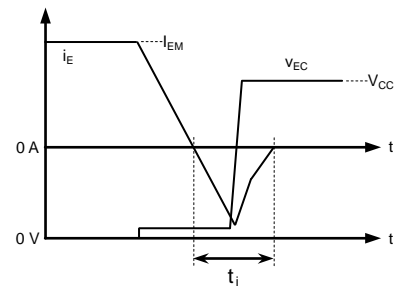
trr, Qrr characteristics test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



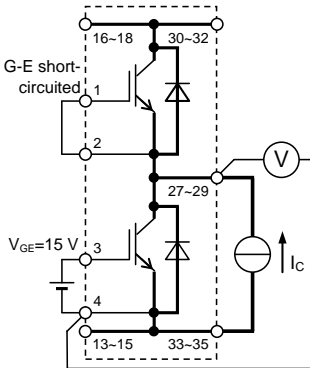
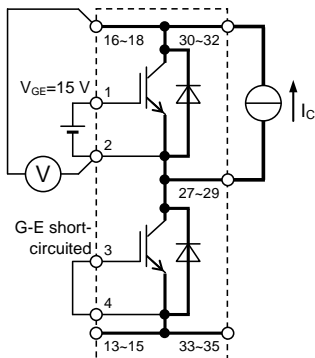
DIODE Reverse recovery energy

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

# CM100TX-24S1

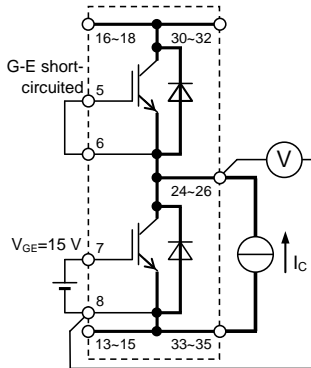
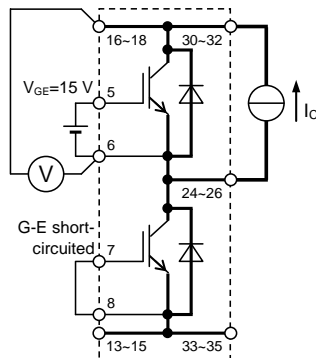
HIGH POWER SWITCHING USE  
INSULATED TYPE

## TEST CIRCUIT



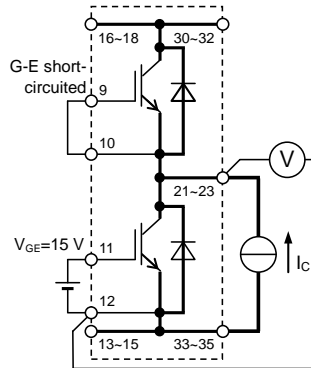
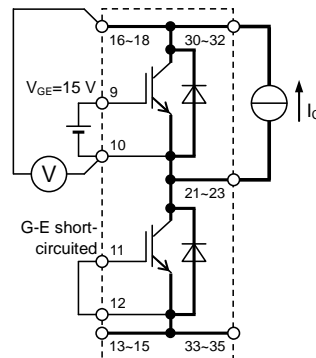
Gate-emitter GVP-EVP, GVN-EVN,  
short-circuited GWP-EWP, GWN-EWN

UP / UN IGBT



Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GWP-EWP, GWN-EWN

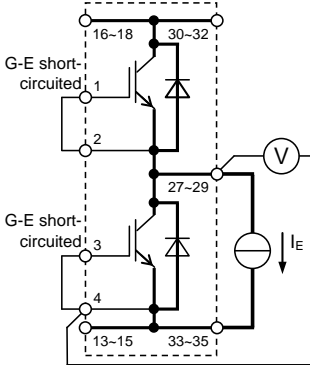
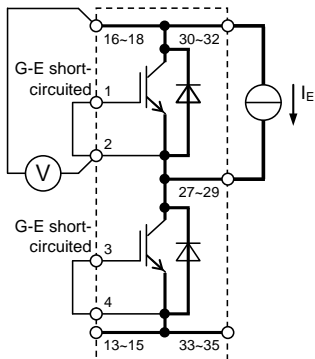
VP / VN IGBT



Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GVP-EVP, GVN-EVN

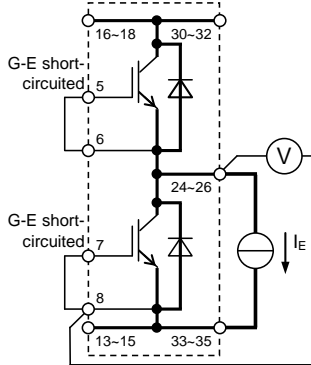
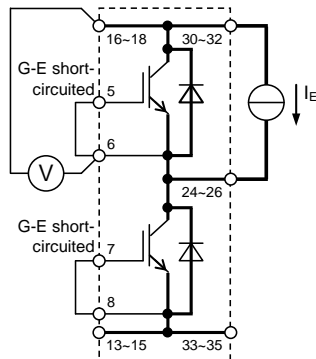
WP / WN IGBT

## $V_{CEsat}$ characteristics test circuit



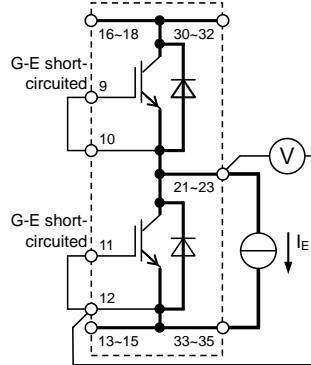
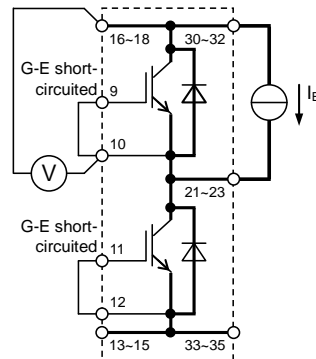
Gate-emitter GVP-EVP, GVN-EVN,  
short-circuited GWP-EWP, GWN-EWN

UP / UN DIODE



Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GWP-EWP, GWN-EWN

VP / VN DIODE



Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GVP-EVP, GVN-EVN

WP / WN DIODE

## $V_{EC}$ characteristics test circuit

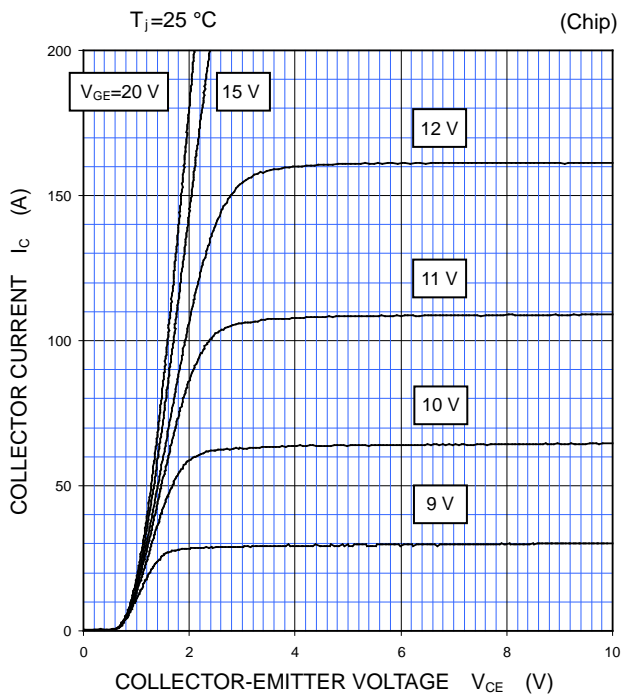
# CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE

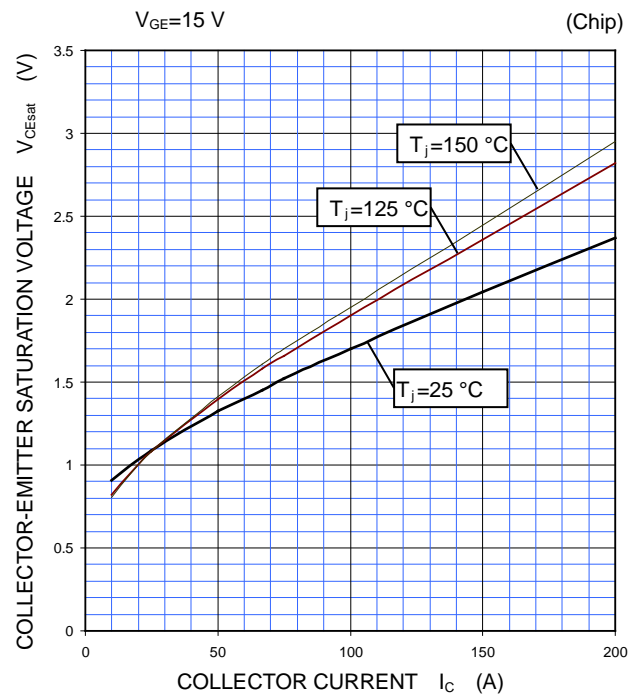
## PERFORMANCE CURVES

### INVERTER PART

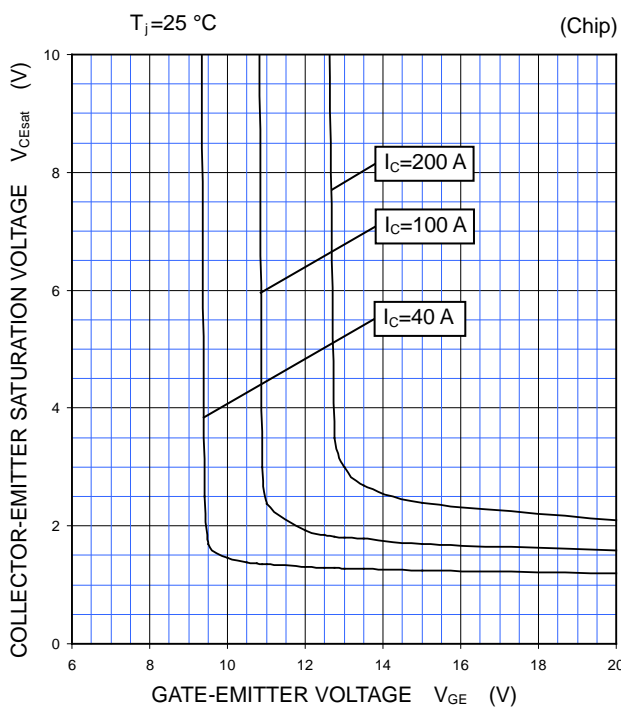
OUTPUT CHARACTERISTICS  
(TYPICAL)



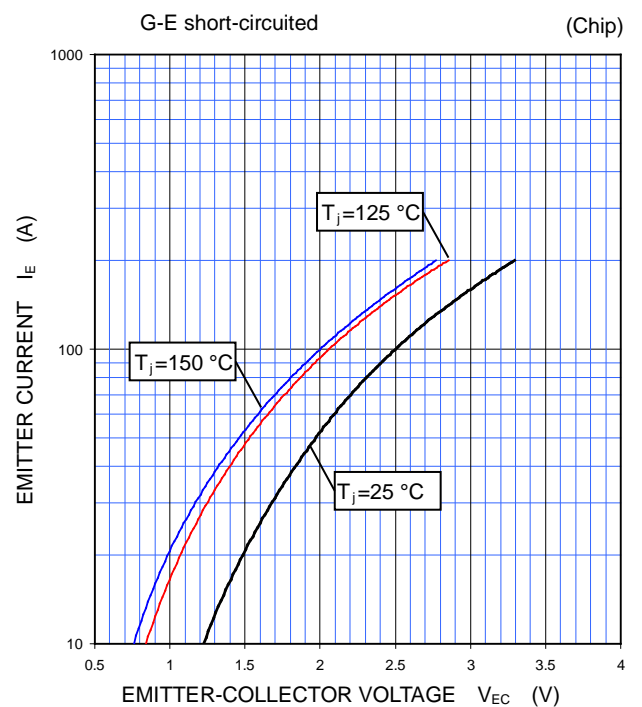
COLLECTOR-EMITTER SATURATION VOLTAGE  
CHARACTERISTICS  
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE  
CHARACTERISTICS  
(TYPICAL)



FREE WHEELING DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL)



# CM100TX-24S1

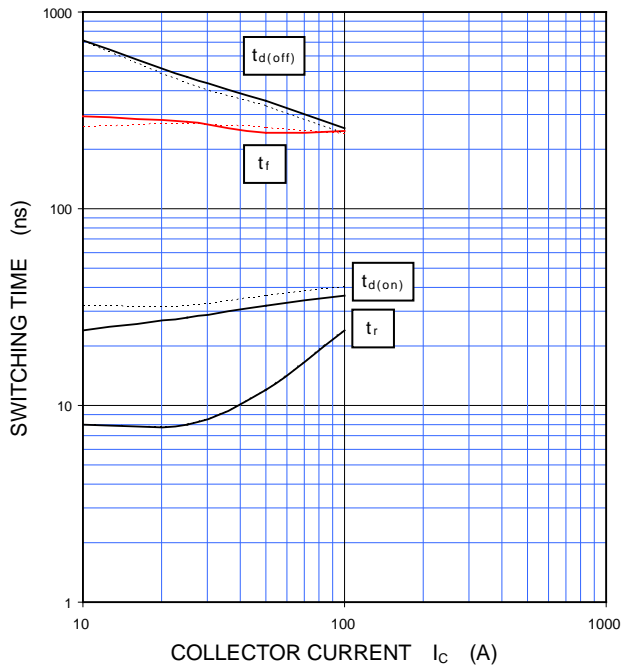
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

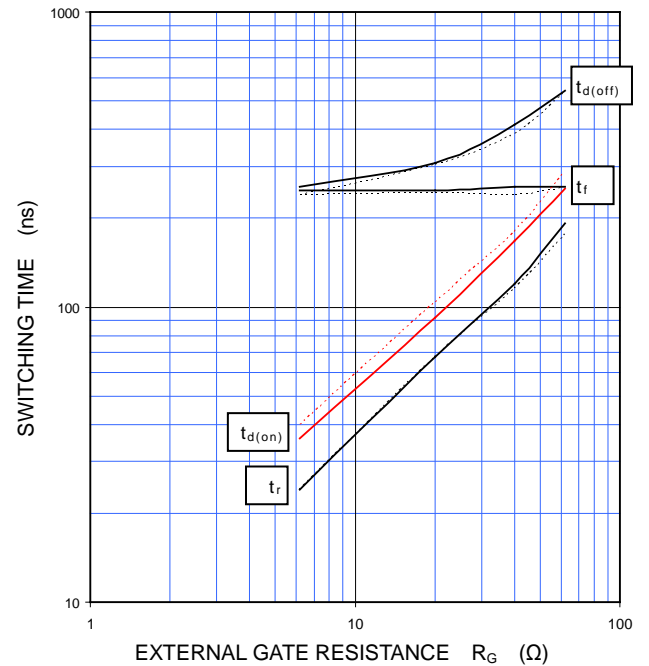
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=6.2\ \Omega$ , INDUCTIVE LOAD  
——:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



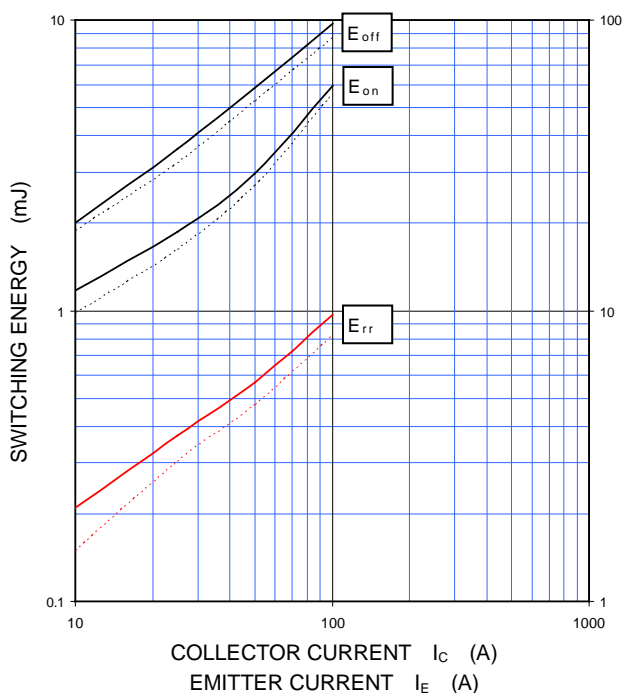
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C=100\text{ A}$ , INDUCTIVE LOAD  
——:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



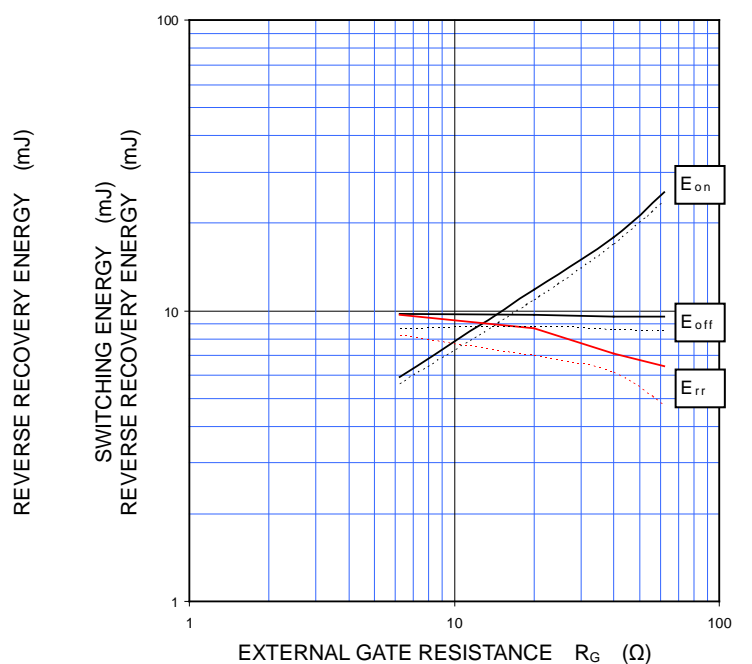
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=6.2\ \Omega$ ,  
INDUCTIVE LOAD, PER PULSE  
——:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C/I_E=100\text{ A}$ ,  
INDUCTIVE LOAD, PER PULSE  
——:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$





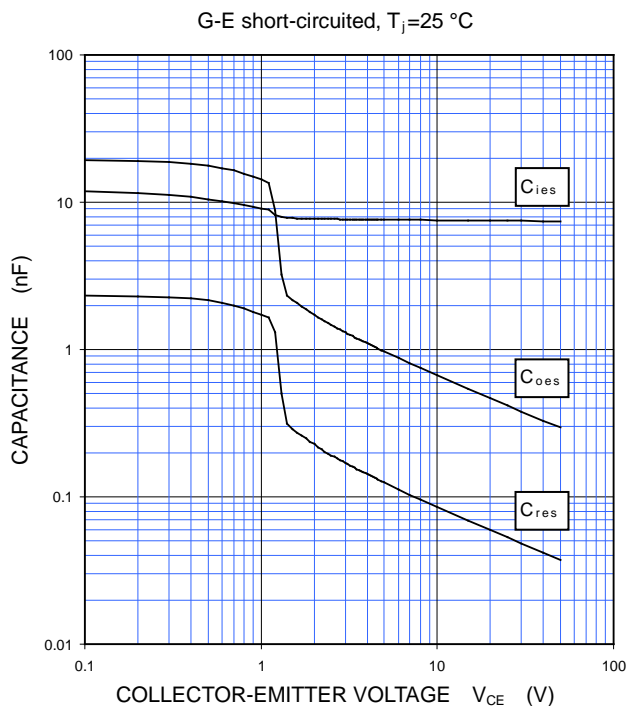
# CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE

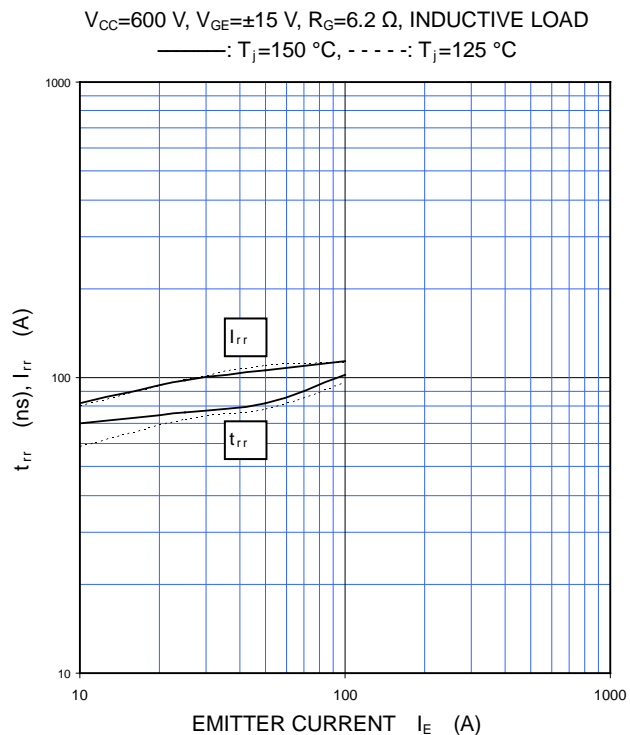
## PERFORMANCE CURVES

### INVERTER PART

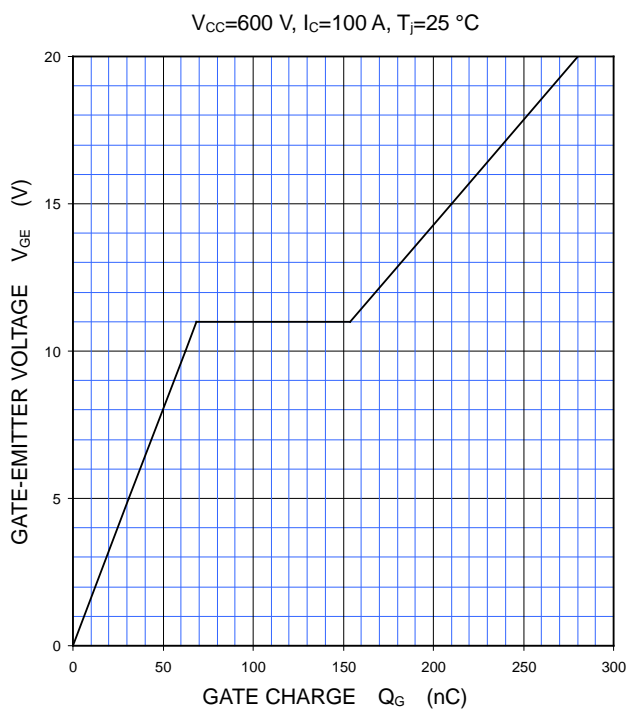
CAPACITANCE CHARACTERISTICS  
(TYPICAL)



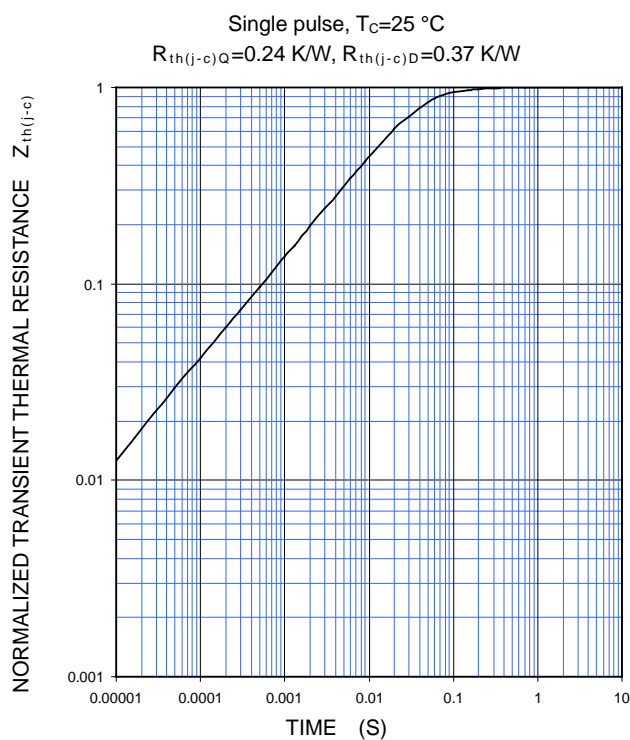
FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)



GATE CHARGE CHARACTERISTICS  
(TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS  
(MAXIMUM)



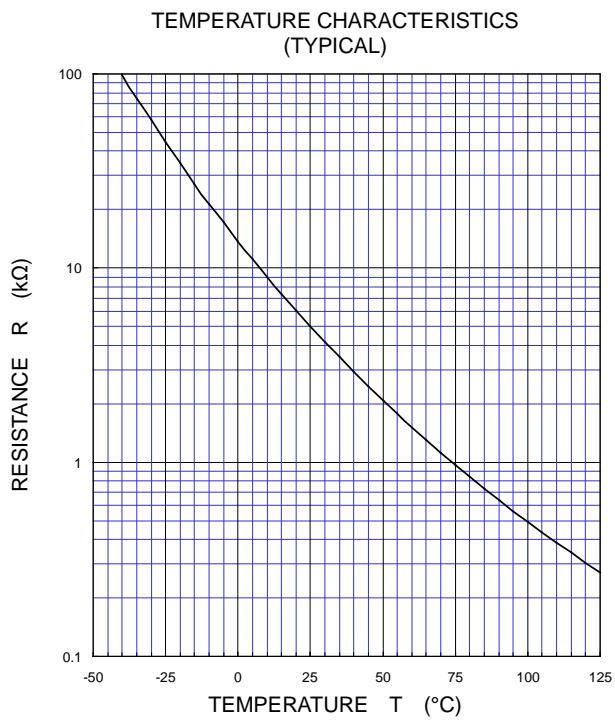
# CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE

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## PERFORMANCE CURVES

NTC thermistor part



## **Keep safety first in your circuit designs!**

This product is designed for industrial application purpose. The performance, the quality and support level of the product is guaranteed by "Customer's Std. Spec."

Mitsubishi Electric Corporation puts its reasonable effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them by the reliability lifetime such as Power Cycle, Thermal Cycle or others, or to be used under special circumstances (e.g. high humidity, dusty, salty, highlands, environment with lots of organic matter / corrosive gas / explosive gas, or situation which terminal of semiconductor products is received strong mechanical stress).

In the customer's research and development, please evaluate it not only with a single semiconductor product but also in the entire system, and judge whether it's applicable. Furthermore, trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits (e.g. appropriate fuse or circuit breaker between a power supply and semiconductor products), (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

## **Notes regarding these materials**

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