

<IGBT Modules>

# CM100TX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE



sixpack (3φ Inverter)

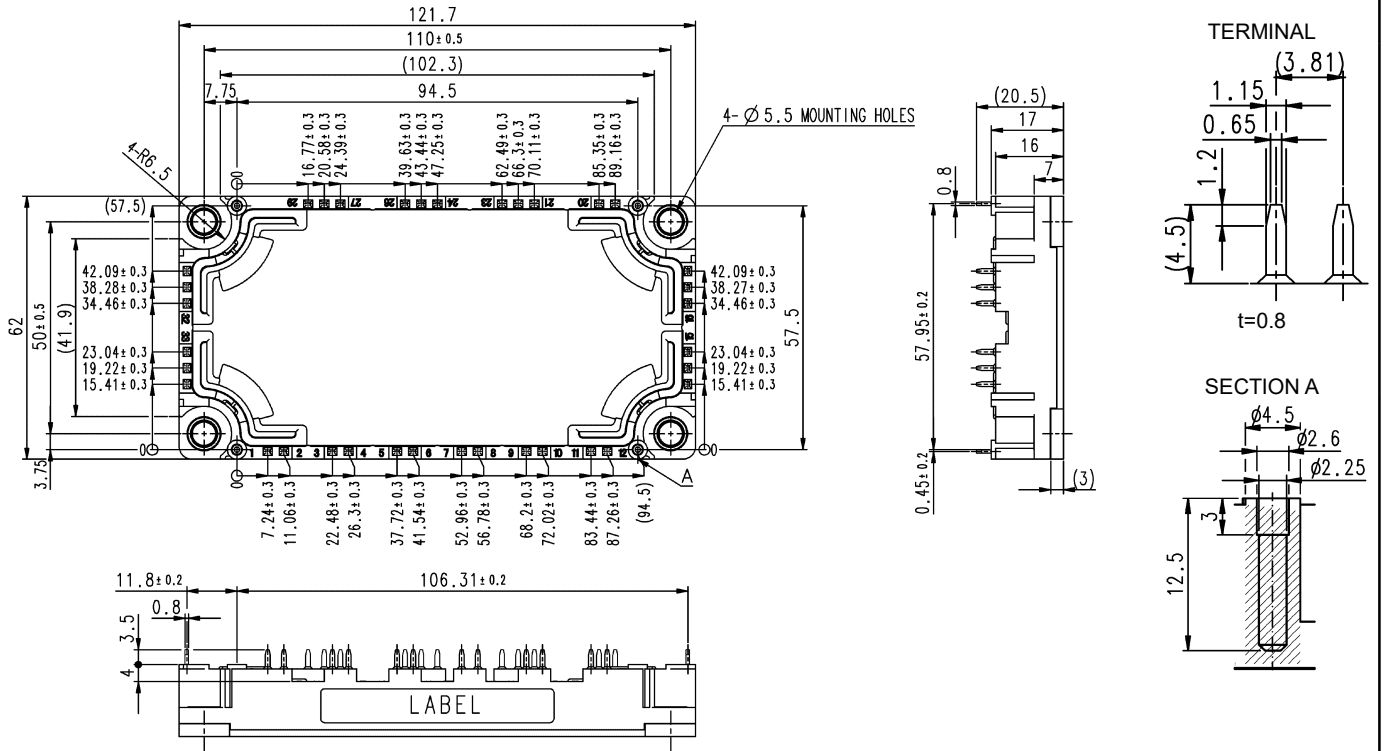
Collector current  $I_c$  ..... 100 A  
 Collector-emitter voltage  $V_{CES}$  ..... 1200 V  
 Maximum junction temperature  $T_{jmax}$  ..... 175 °C

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

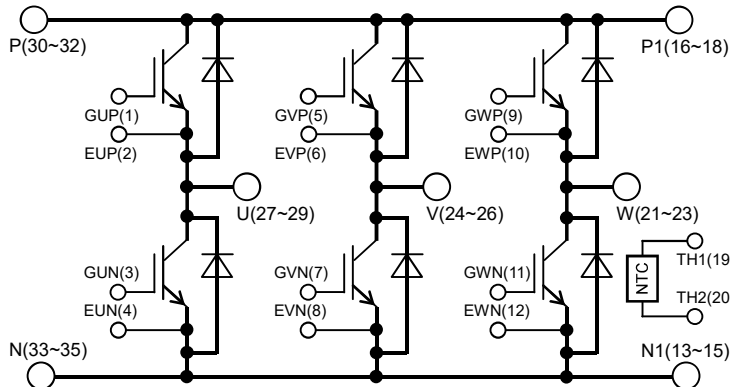
## APPLICATION

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).

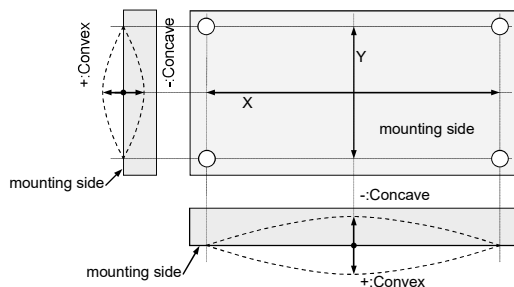
- Junction temperature (T<sub>j</sub>) should not increase beyond T<sub>jmax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>j</sub>) dose not exceed T<sub>jmax</sub> rating.
- Case temperature (T<sub>C</sub>) and heat sink temperature (T<sub>s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



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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

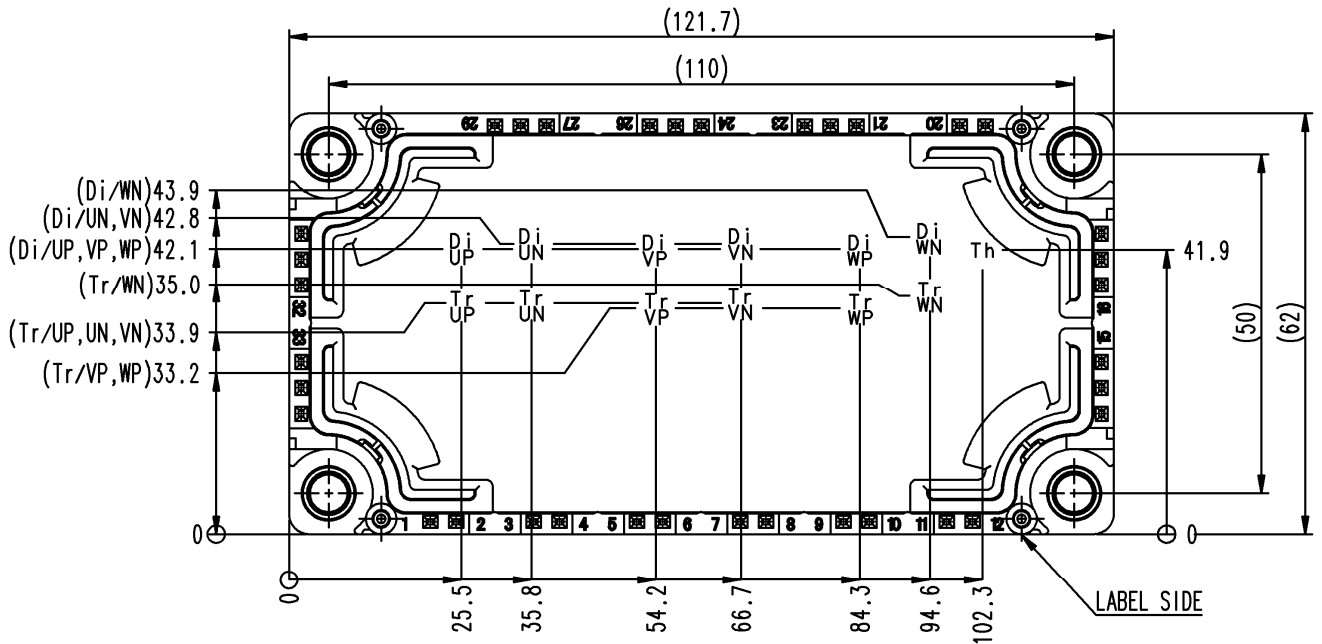
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>CC</sub>	(DC) Supply voltage	Applied across P-N/P1-N1 terminals	-	600	850	V
V <sub>GEon</sub>	Gate (-emitter drive) voltage	Applied across G*P-E*P/G*N-E*N(*=U, V, W) terminals	13.5	15.0	16.5	V
R <sub>G</sub>	External gate resistance	Per switch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

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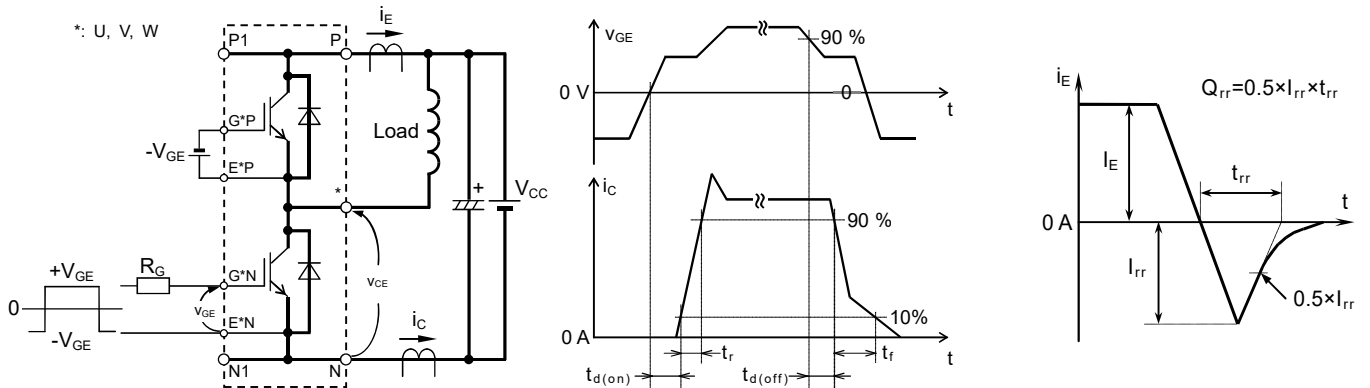
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



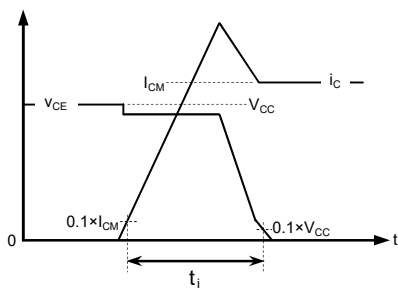
Tr\*P/Tr\*N: IGBT, Di\*P/Di\*N: DIODE (\*=U/V/W), Th: NTC thermistor

## TEST CIRCUIT AND WAVEFORMS

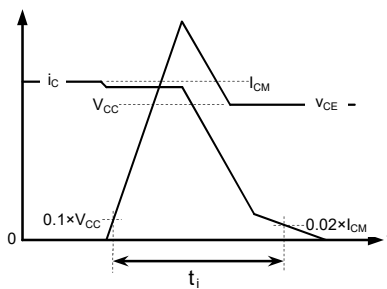


Switching characteristics test circuit and waveforms

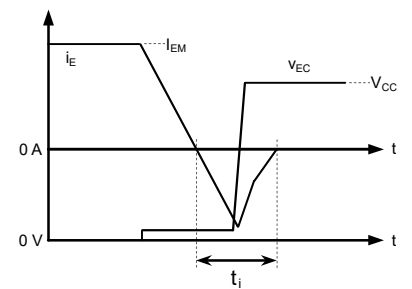
trr, Qrr characteristics test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



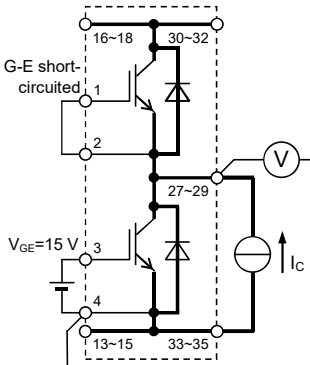
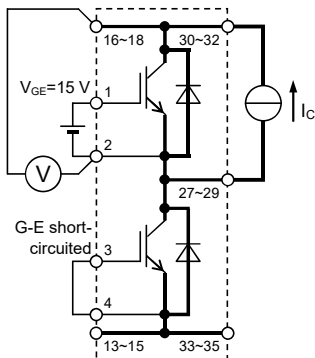
DIODE Reverse recovery energy

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

# CM100TX-24S1

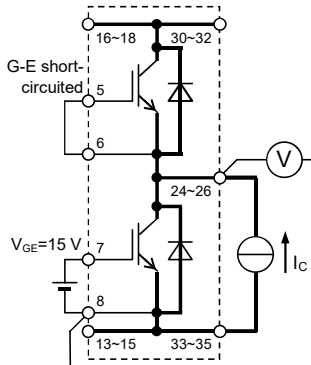
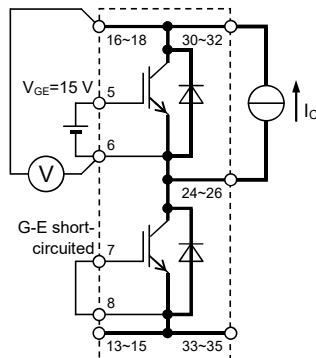
HIGH POWER SWITCHING USE  
INSULATED TYPE

## TEST CIRCUIT



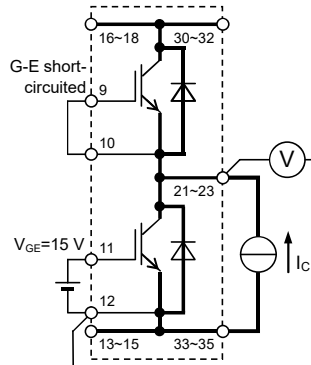
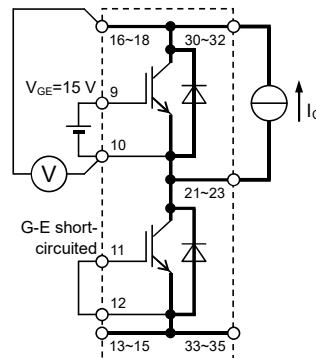
Gate-emitter GVP-EVP, GVN-EVN,  
short-circuited GWP-EWP, GWN-EWN

UP / UN IGBT



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

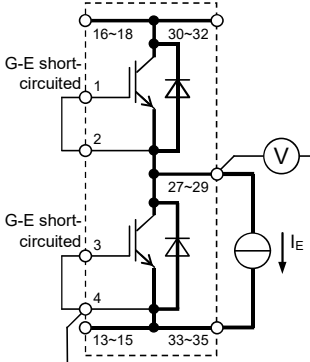
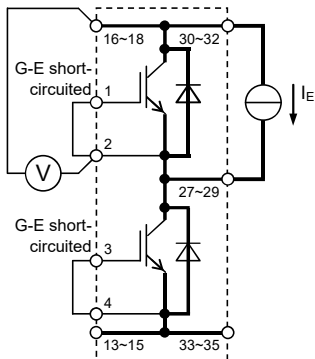
VP / VN IGBT



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

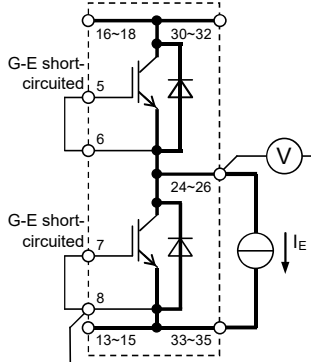
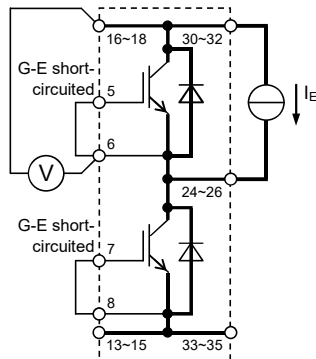
WP / WN IGBT

## $V_{CEsat}$ characteristics test circuit



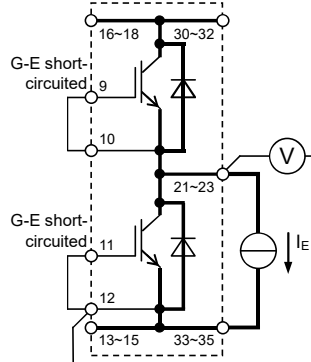
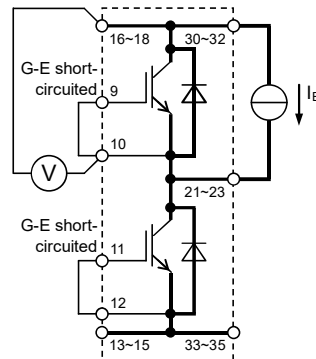
Gate-emitter GVP-EVP, GVN-EVN,  
short-circuited GWP-EWP, GWN-EWN

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

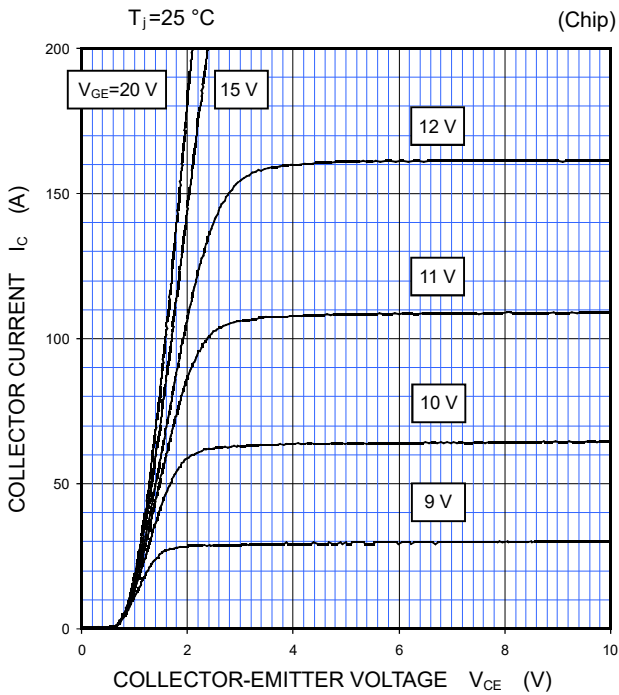
# CM100TX-24S1

HIGH POWER SWITCHING USE  
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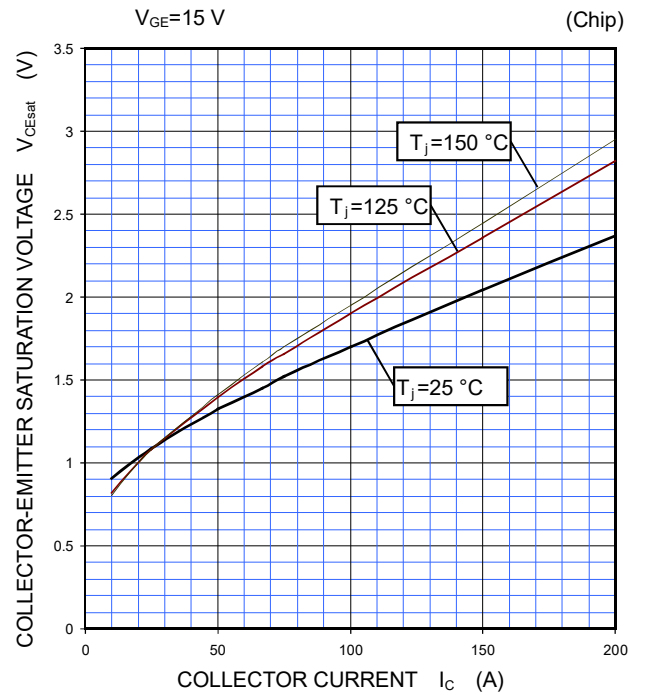
## PERFORMANCE CURVES

### INVERTER PART

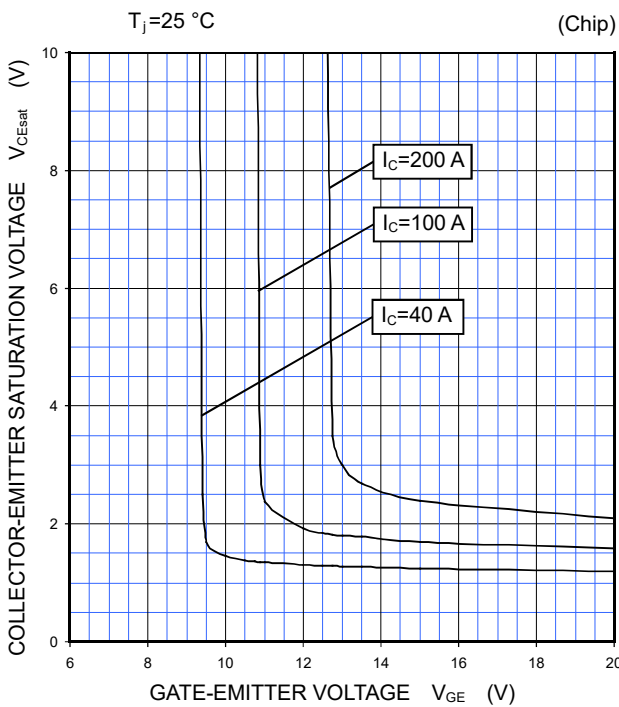
OUTPUT CHARACTERISTICS  
(TYPICAL)



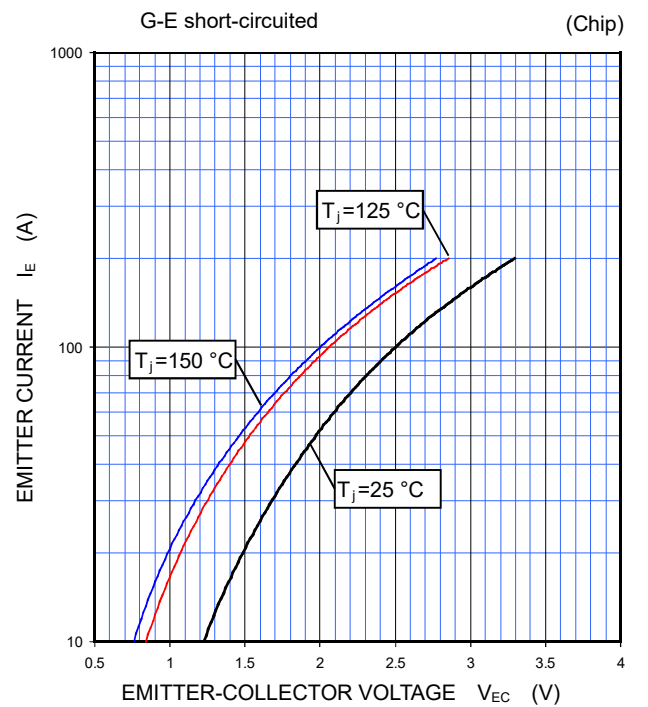
COLLECTOR-EMITTER SATURATION VOLTAGE  
CHARACTERISTICS  
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE  
CHARACTERISTICS  
(TYPICAL)



FREE WHEELING DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL)



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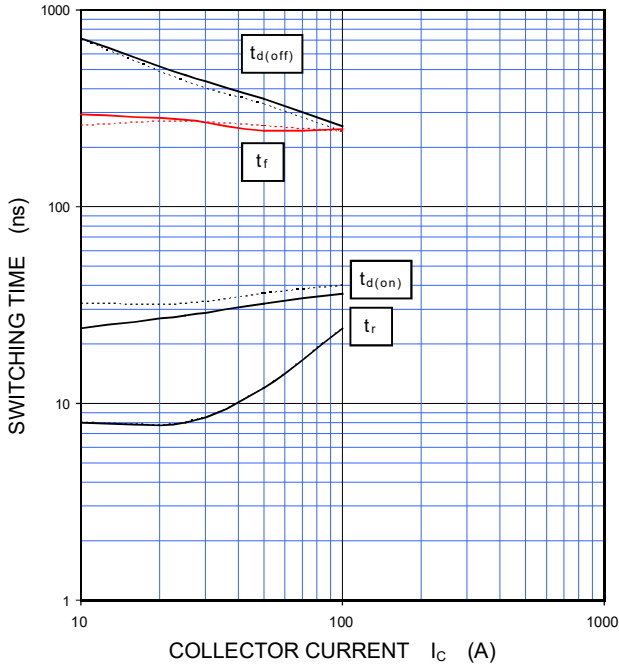
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

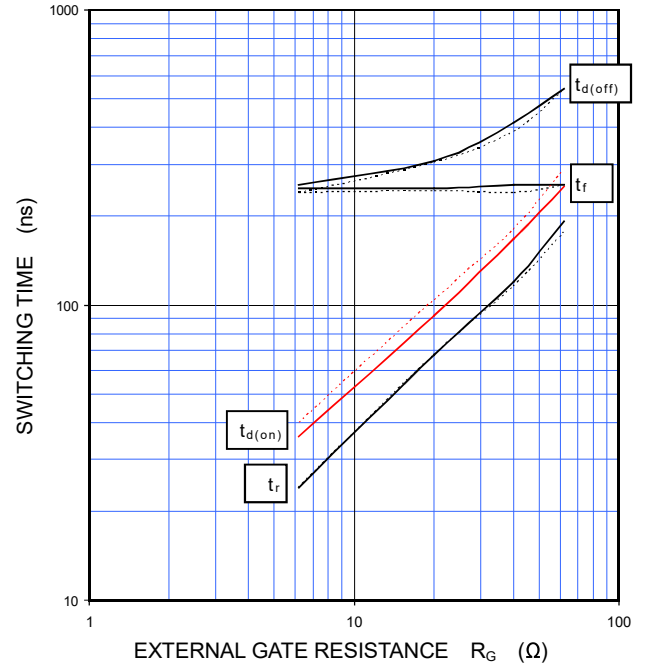
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



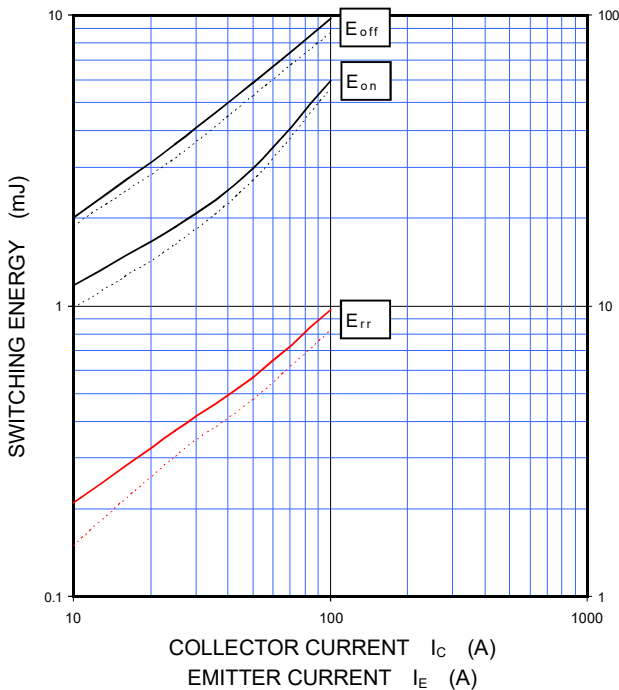
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



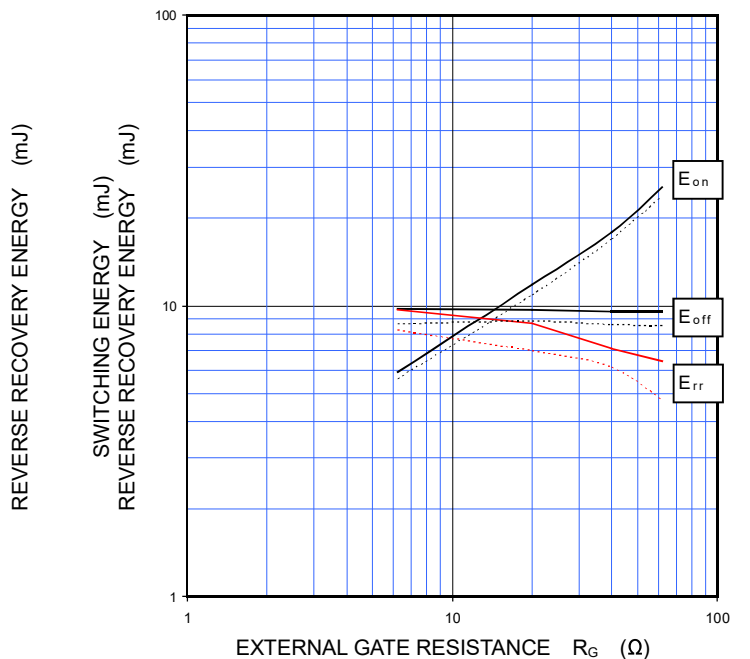
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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





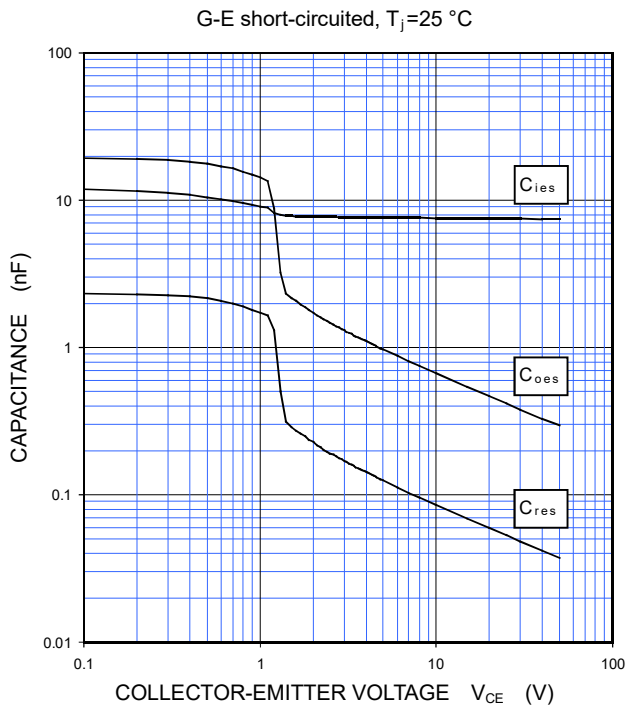
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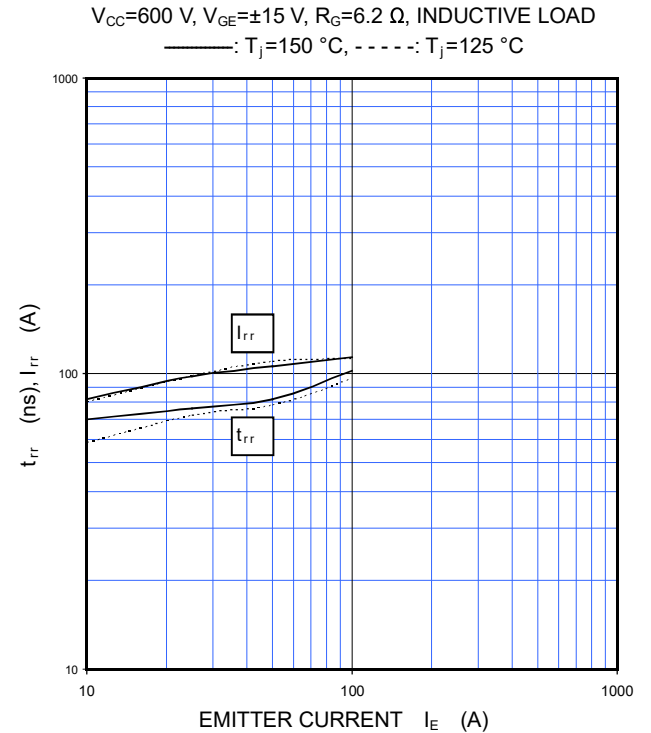
## PERFORMANCE CURVES

### INVERTER PART

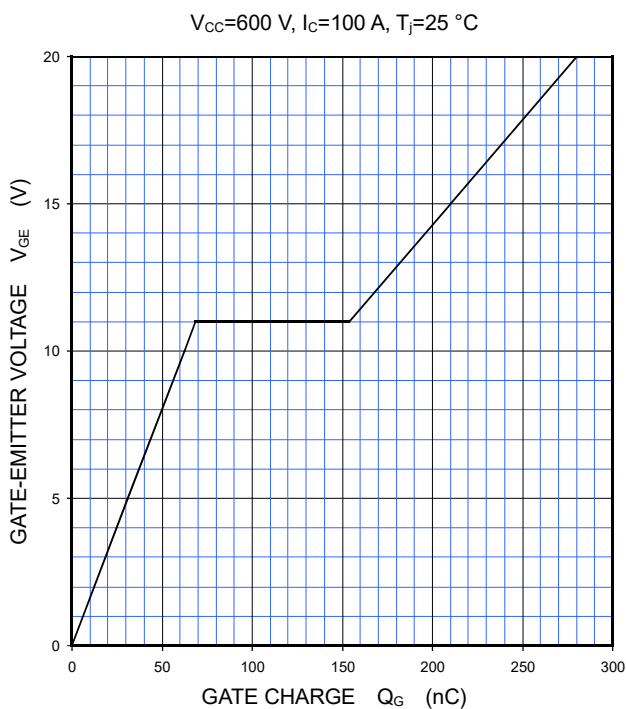
CAPACITANCE CHARACTERISTICS  
(TYPICAL)



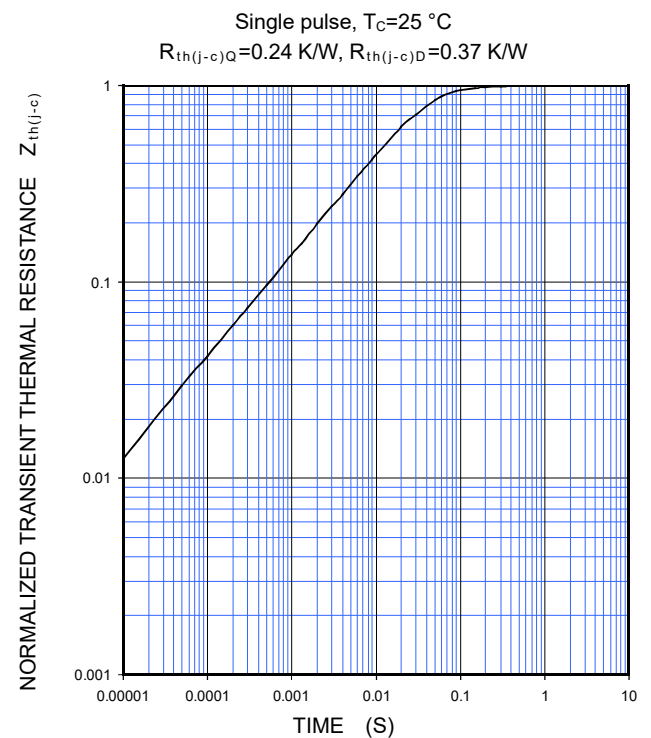
FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)



GATE CHARGE CHARACTERISTICS  
(TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS  
(MAXIMUM)



# CM100TX-24S1

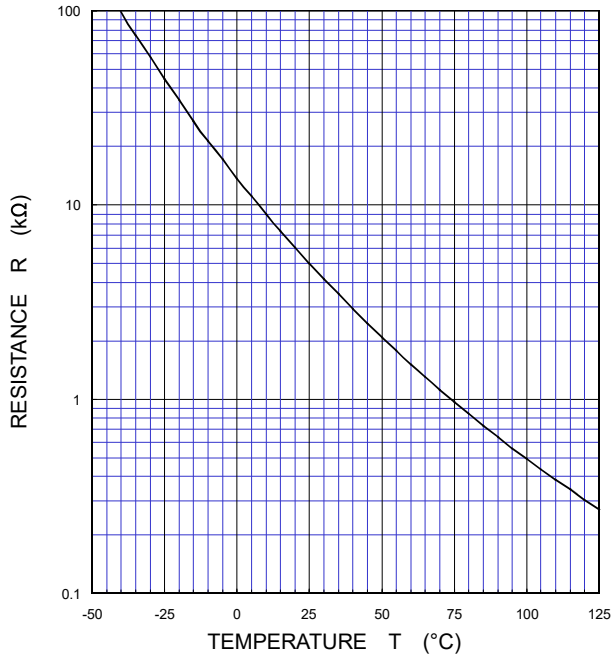
HIGH POWER SWITCHING USE  
INSULATED TYPE

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## PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS  
(TYPICAL)



## **Important Notice**

The information contained in this datasheet shall in no event be regarded as a guarantee of conditions or characteristics. This product has to be used within its specified maximum ratings, and is subject to customer's compliance with any applicable legal requirement, norms and standards.

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