

<IGBT Modules>

# CM100TX-24S

**HIGH POWER SWITCHING USE  
INSULATED TYPE**



**sixpack (3φ Inverter)**

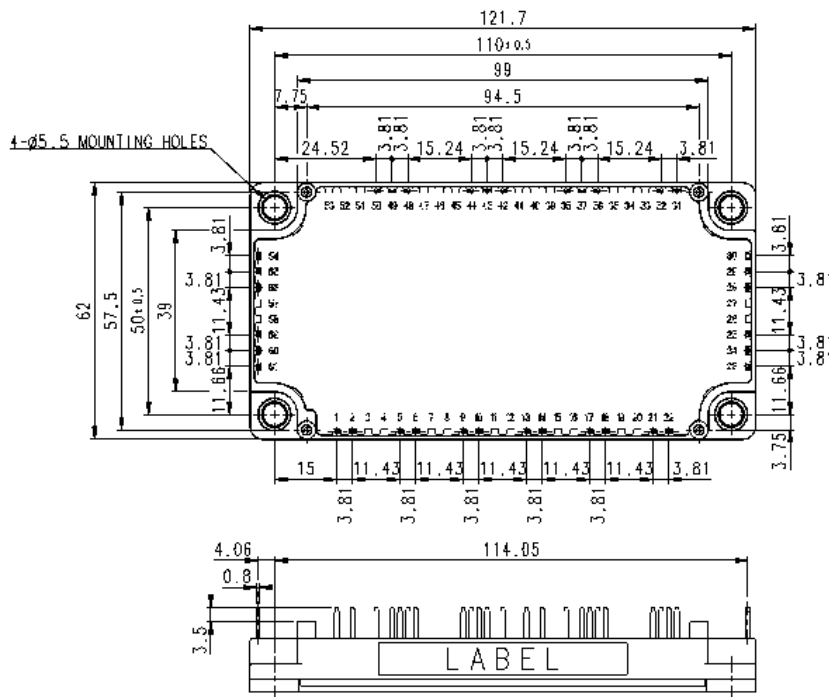
Collector current  $I_C$  ..... **1 0 0 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **1 2 0 0 V**  
 Maximum junction temperature  $T_{jmax}$  ..... **1 7 5 °C**

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

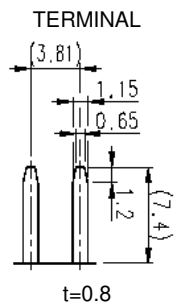
## APPLICATION

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

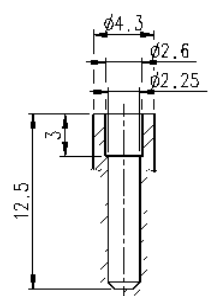
## OUTLINE DRAWING & INTERNAL CONNECTION



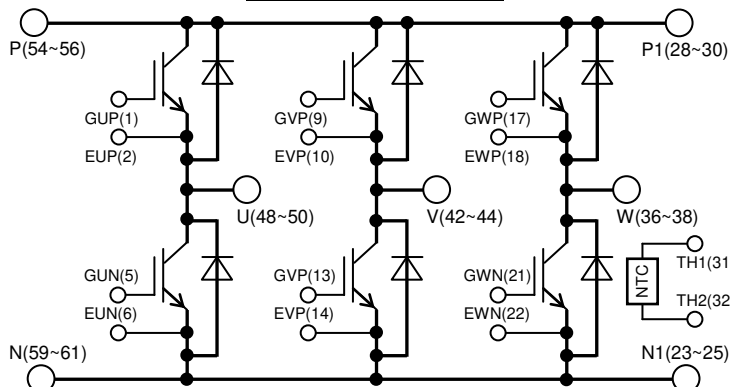
Dimension in mm



SECTION A



### INTERNAL CONNECTION



Caution: Each (three) pin terminal of P/N/P1/N1/U/V/W is connected in the module, but should use all each three pins for the external wiring.

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

The tolerance of size between terminals is assumed to be ±0.4.

## CM100TX-24S

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, $T_C=119\text{ }^\circ\text{C}$ (Note2, 4)	100	A
$I_{CRM}$		Pulse, Repetitive (Note3)	200	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note2, 4)	750	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	2500	V
$T_{jmax}$	Maximum junction temperature	Instantaneous event (overload)	175	$^\circ\text{C}$
$T_{Cmax}$	Maximum case temperature	(Note4)	125	$^\circ\text{C}$
$T_{jop}$	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. (Note6)	$T_j=25\text{ }^\circ\text{C}$	-	1.80	2.25	V
$V_{Cesat}$ (Chip)			$T_j=125\text{ }^\circ\text{C}$	-	2.00	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.05	-	
		$V_{Cesat}$ (Chip)	$I_C=100\text{ A}$ , $V_{GE}=15\text{ V}$ , (Note6)	$T_j=25\text{ }^\circ\text{C}$	-	1.70	2.15
$T_j=125\text{ }^\circ\text{C}$				-	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	$V_{CC}=600\text{ V}$ , $I_C=100\text{ A}$ , $V_{GE}=15\text{ V}$	-	233	-	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. (Note6)	$T_j=25\text{ }^\circ\text{C}$	-	1.80	2.25	V
$V_{EC}$ (Note1) (Chip)			$T_j=125\text{ }^\circ\text{C}$	-	1.80	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.80	-	
		$V_{EC}$ (Note1) (Chip)	$I_E=100\text{ A}$ , G-E short-circuited, (Note6)	$T_j=25\text{ }^\circ\text{C}$	-	1.70	2.15
$T_j=125\text{ }^\circ\text{C}$				-	1.70	-	
$T_j=150\text{ }^\circ\text{C}$				-	1.70	-	
$t_{rr}$ (Note1)	Reverse recovery time	$V_{CC}=600\text{ V}$ , $I_E=100\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=6.2\text{ }\Omega$ , Inductive load	-	-	300	ns	
$Q_{rr}$ (Note1)	Reverse recovery charge	$R_G=6.2\text{ }\Omega$ , Inductive load	-	5.3	-	$\mu\text{C}$	
$E_{on}$	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$ , $I_C=I_E=100\text{ A}$ ,	-	8.6	-	mJ	
$E_{off}$	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$ , $R_G=6.2\text{ }\Omega$ , $T_j=150\text{ }^\circ\text{C}$ ,	-	10.7	-		
$E_{rr}$ (Note1)	Reverse recovery energy per pulse	Inductive load	-	10.2	-	mJ	
$R_{CC+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note4)	-	-	3.5	m $\Omega$	
$r_g$	Internal gate resistance	Per switch	-	0	-	$\Omega$	

# CM100TX-24S

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)	-	-	0.20	K/W
R <sub>th(j-c)D</sub>		Junction to case, per Inverter DIODE (Note4)	-	-	0.29	
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
d <sub>s</sub>	Creepage distance	Terminal to terminal	10.28	-	-	mm
		Terminal to base plate	12.41	-	-	
d <sub>a</sub>	Clearance	Terminal to terminal	9.88	-	-	mm
		Terminal to base plate	12.41	-	-	
m	mass	-	-	300	-	g
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).

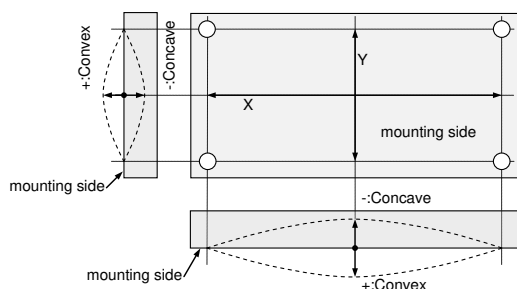
- Junction temperature (T<sub>j</sub>) should not increase beyond T<sub>jm ax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>j</sub>) dose not exceed T<sub>jm ax</sub> rating.
- Case temperature (T<sub>C</sub>) and heat sink temperature (T<sub>s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



- Use the following screws when mounting the printed circuit board (PCB) on the stand offs.  
"φ2.6×10 or φ2.6×12 self tapping screw"  
The length of the screw depends on the thickness (t1.6~t2.0) of the PCB.

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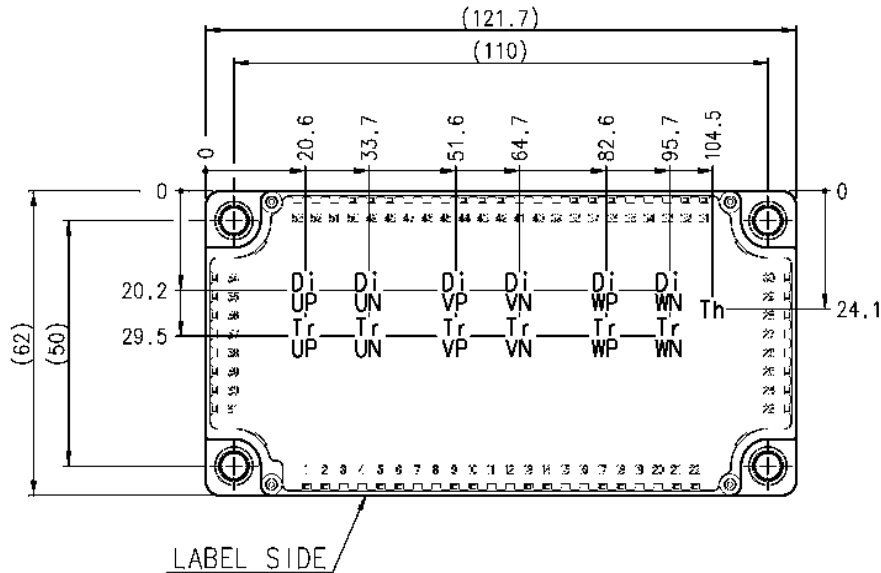
HIGH POWER SWITCHING USE  
INSULATED TYPE

## RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC}$	(DC) Supply voltage	Applied across P-N/P1-N1 terminals	-	600	850	V
$V_{GEon}$	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
$R_G$	External gate resistance	Per switch	6.2	-	62	$\Omega$

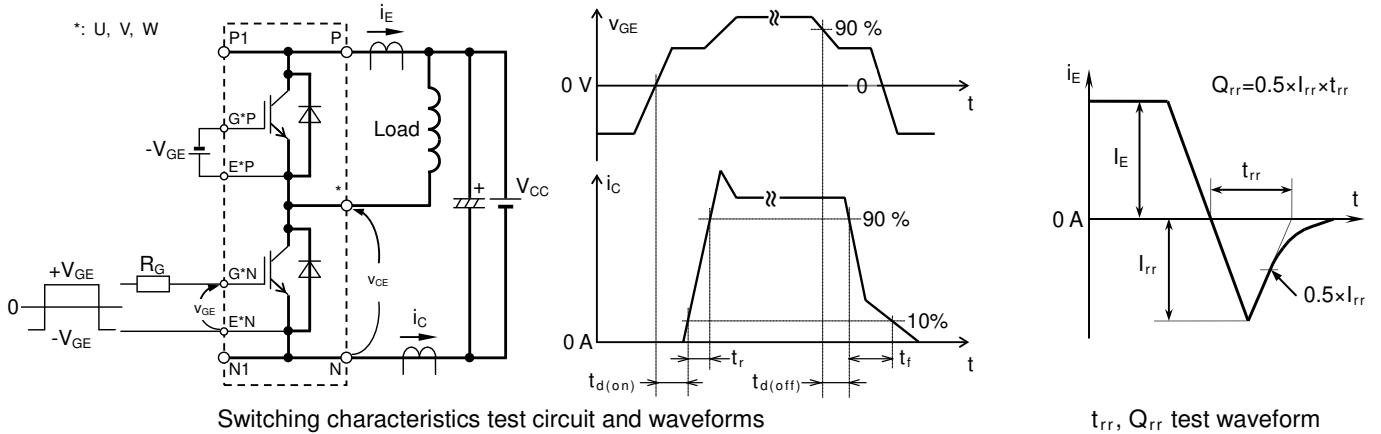
## CHIP LOCATION (Top view)

Dimension in mm, tolerance:  $\pm 1$  mm



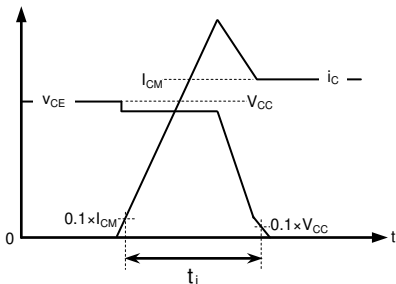
Tr\*P/Tr\*N/TrBr: IGBT, Di\*P/Di\*N: DIODE (\*=U/V/W), Th: NTC thermistor

## TEST CIRCUIT AND WAVEFORMS

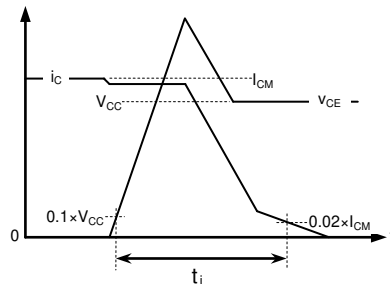


Switching characteristics test circuit and waveforms

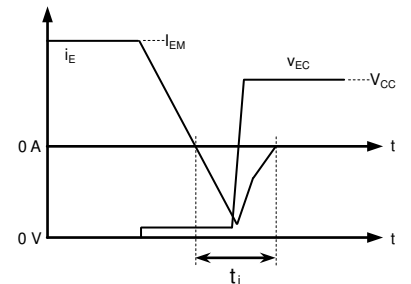
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



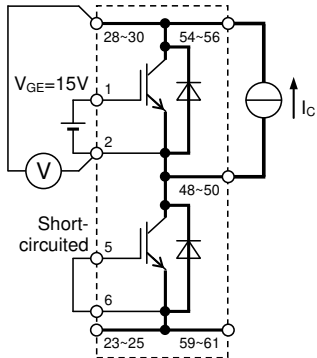
DIODE Reverse recovery energy

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

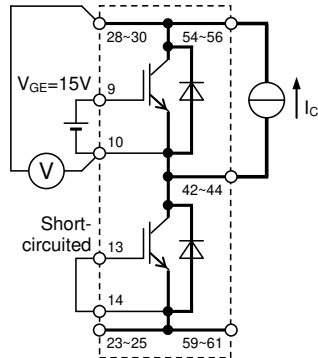
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HIGH POWER SWITCHING USE  
INSULATED TYPE

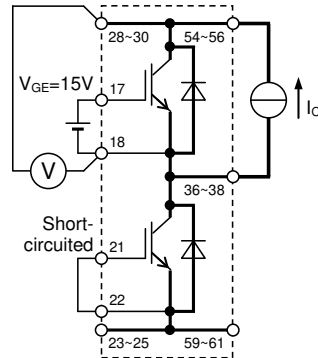
## TEST CIRCUIT



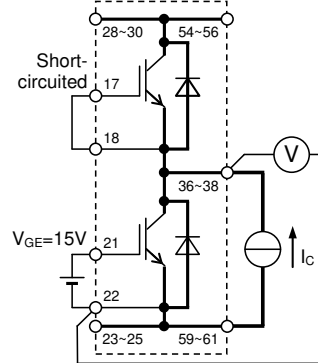
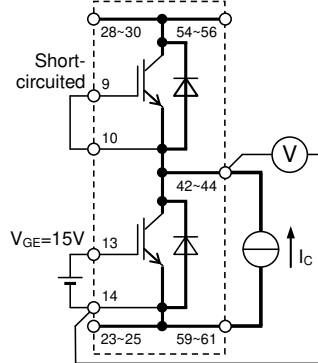
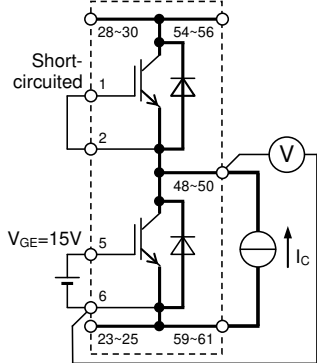
Gate-emitter GVP-EVP, GVN-EVP,  
short-circuited GWP-EWN, GWN-EWN  
UP / UN IGBT



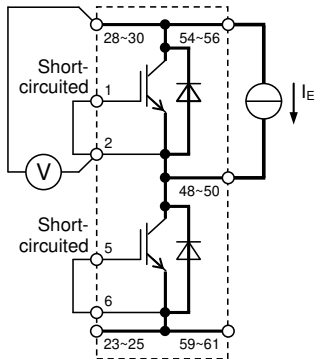
Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GWP-EWP, GWN-EWN  
VP / VN IGBT



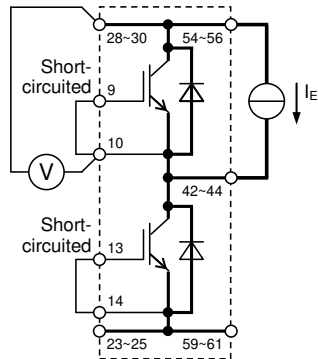
Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GVP-EVP, GVN-EVN  
WP / WN IGBT



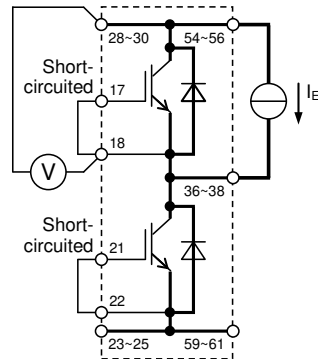
## V<sub>CEsat</sub> test circuit



Gate-emitter GVP-EVP, GVN-EVP,  
short-circuited GWP-EWN, GWN-EWN  
UP / UN DIODE



Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GWP-EWP, GWN-EsWN  
VP / VN DIODE



Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GVP-EVP, GVN-EVN  
WP / WN DIODE

## V<sub>EC</sub> / V<sub>F</sub> test circuit

# CM100TX-24S

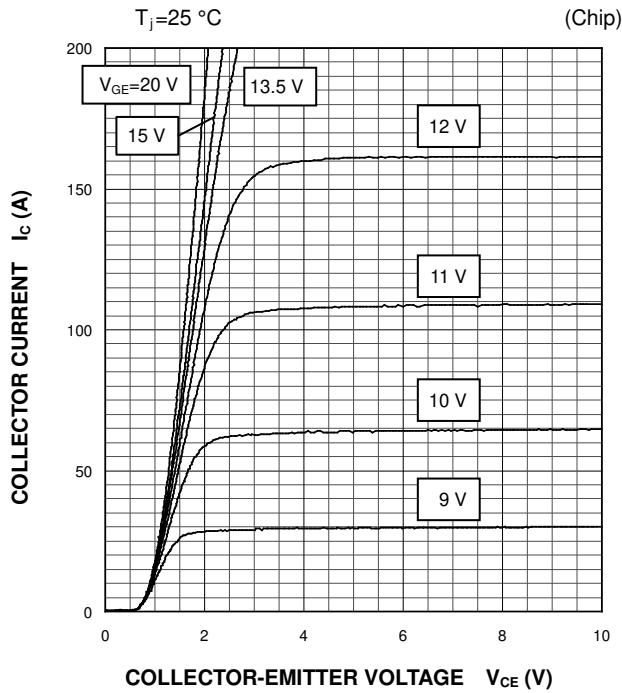
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

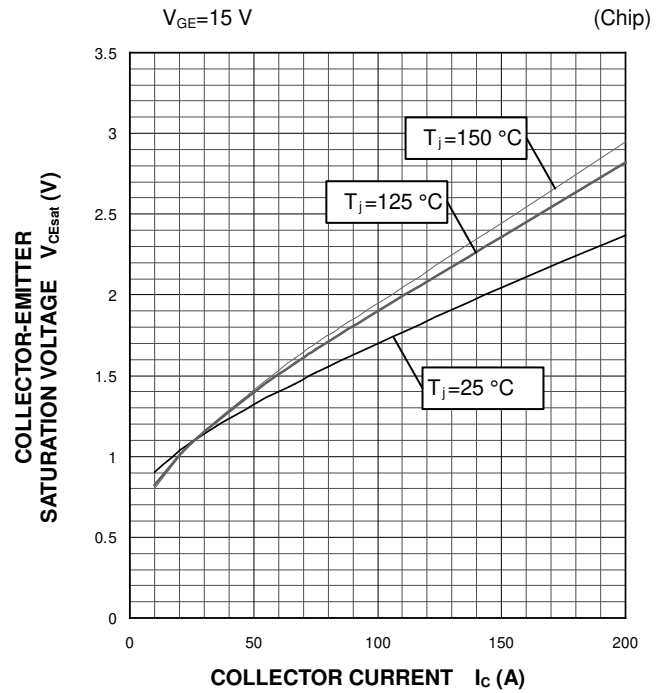
#### OUTPUT CHARACTERISTICS

(TYPICAL)



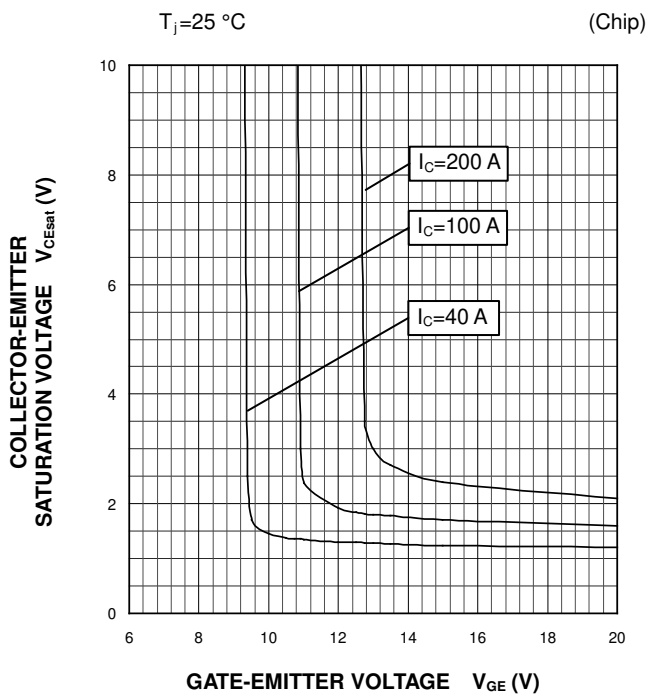
#### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



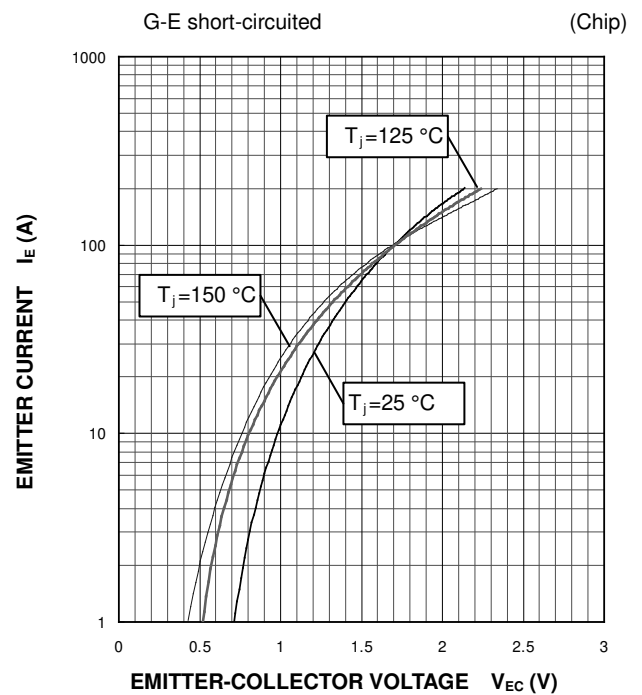
#### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



#### FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)



# CM100TX-24S

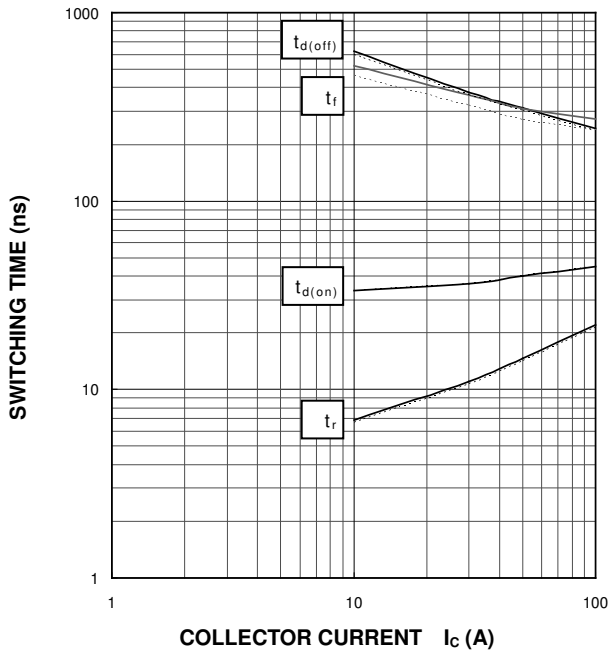
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

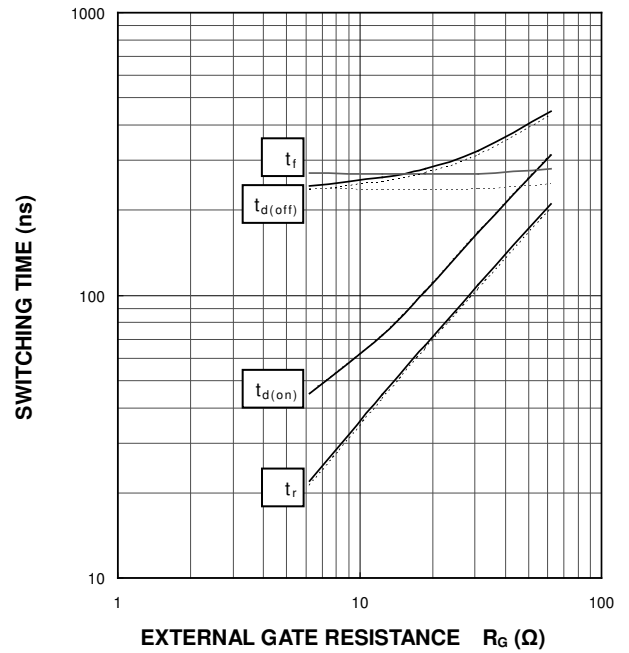
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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



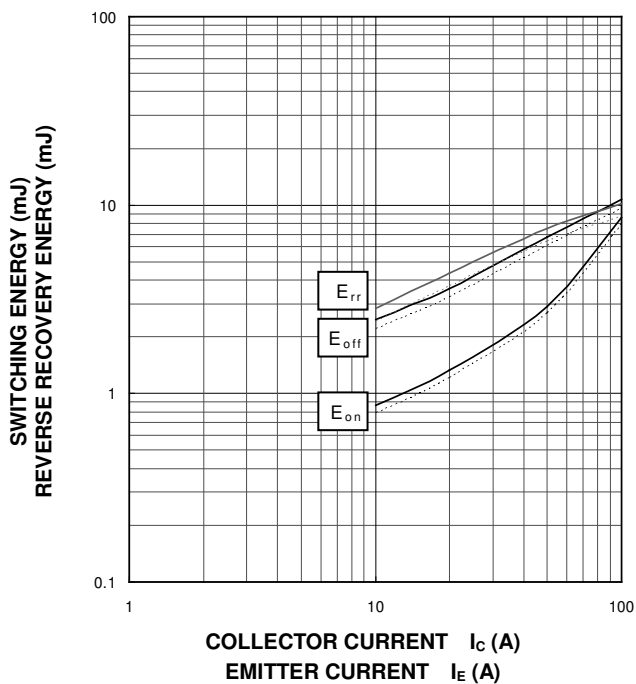
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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



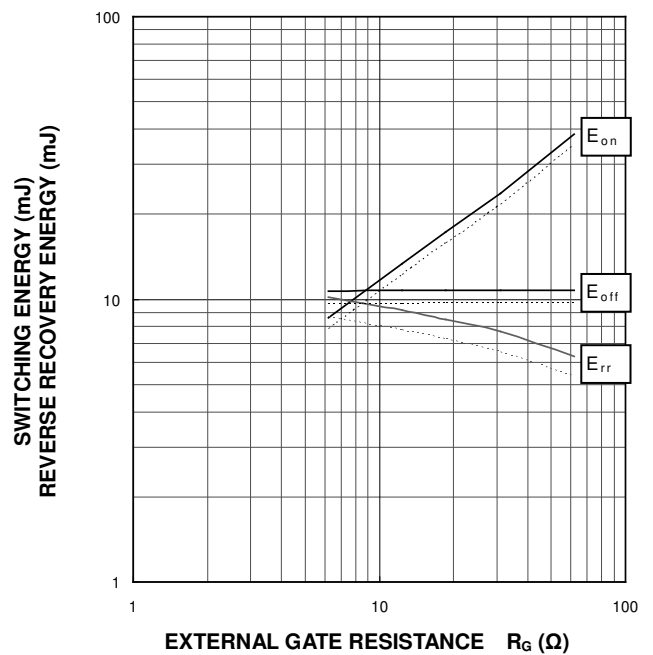
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=6.2\ \Omega$ ,  
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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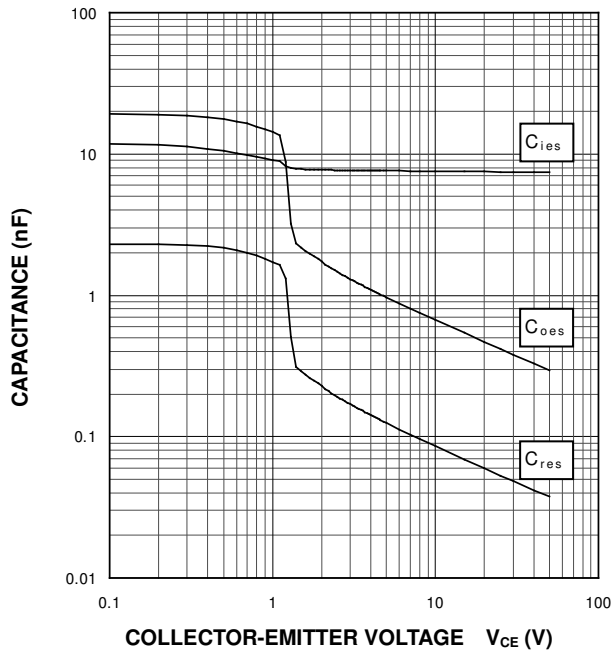
## PERFORMANCE CURVES

### INVERTER PART

#### CAPACITANCE CHARACTERISTICS

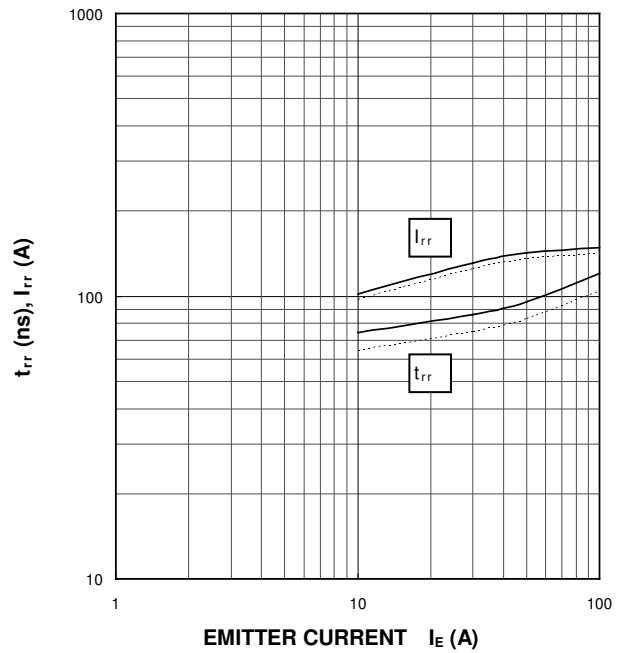
(TYPICAL)

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



#### FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

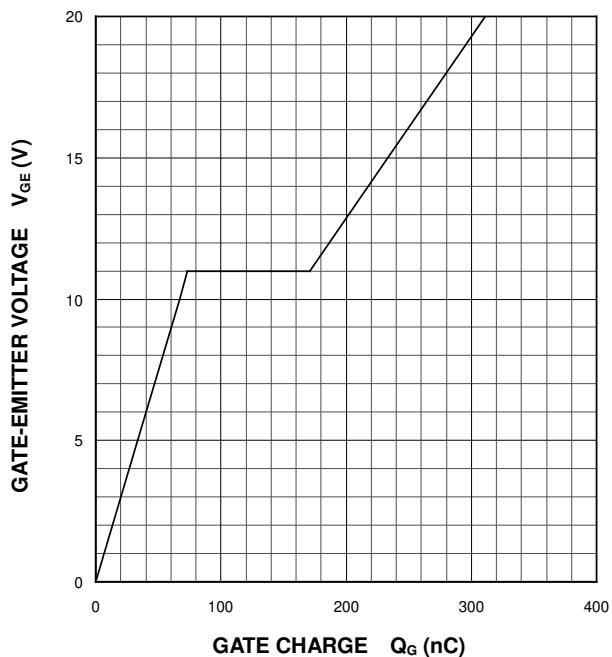
$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=6.2\ \Omega$ , INDUCTIVE LOAD  
—:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



#### GATE CHARGE CHARACTERISTICS

(TYPICAL)

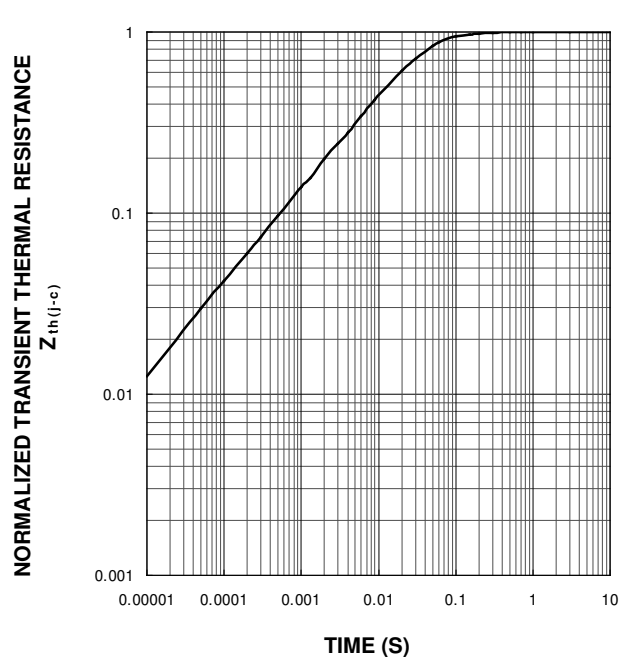
$V_{CC}=600\text{ V}$ ,  $I_C=100\text{ A}$ ,  $T_j=25\text{ }^\circ\text{C}$



#### TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

(MAXIMUM)

Single pulse,  $T_C=25\text{ }^\circ\text{C}$   
 $R_{th(j-c)Q}=0.20\text{ K/W}$ ,  $R_{th(j-c)D}=0.29\text{ K/W}$





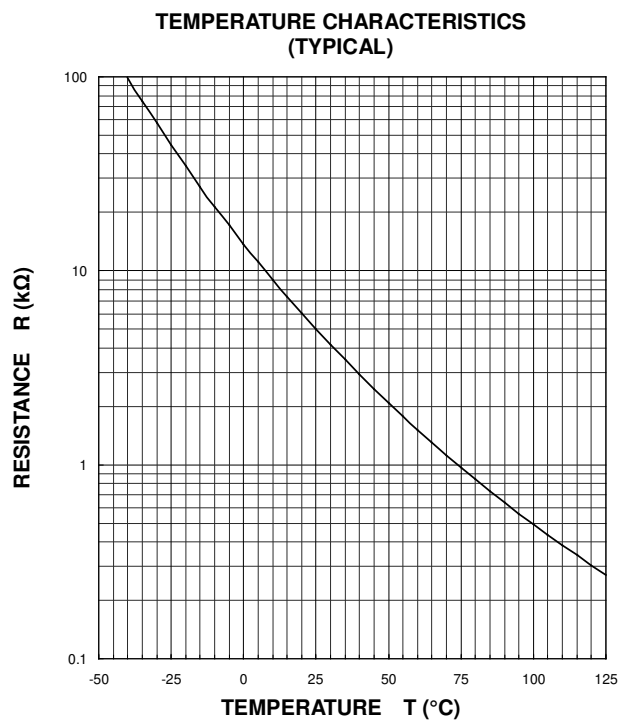
# CM100TX-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE

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## PERFORMANCE CURVES

NTC thermistor part



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

Mitsubishi Electric Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. 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, (ii) use of non-flammable material or (iii) prevention against any malfunction or mishap.

## **Notes regarding these materials**

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