

<IGBT Modules>

# CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE  
INSULATED TYPE

 <p>TX</p>	<p>Collector current <math>I_c</math> ..... <b>200 A</b>          Collector-emitter voltage <math>V_{CES}</math> ..... <b>650 V</b>          Maximum junction temperature <math>T_{vjmax}</math> ..... <b>175 °C</b></p> <ul style="list-style-type: none"> <li>• Flat base type</li> <li>• Copper base plate (Nickel-plating)</li> <li>• RoHS Directive compliant</li> <li>• Tin-plating pin terminals</li> </ul>
 <p>TXP</p>	<p>Collector current <math>I_c</math> ..... <b>200 A</b>          Collector-emitter voltage <math>V_{CES}</math> ..... <b>650 V</b>          Maximum junction temperature <math>T_{vjmax}</math> ..... <b>175 °C</b></p> <ul style="list-style-type: none"> <li>• Flat base type</li> <li>• Copper base plate (Nickel-plating)</li> <li>• RoHS Directive compliant</li> <li>• Tin-plating pressfit terminals</li> </ul>
<p style="text-align: center;"><b>sixpack (three-phase bridge)</b></p> <ul style="list-style-type: none"> <li>• UL Recognized under UL1557, File No. E323585</li> </ul>	

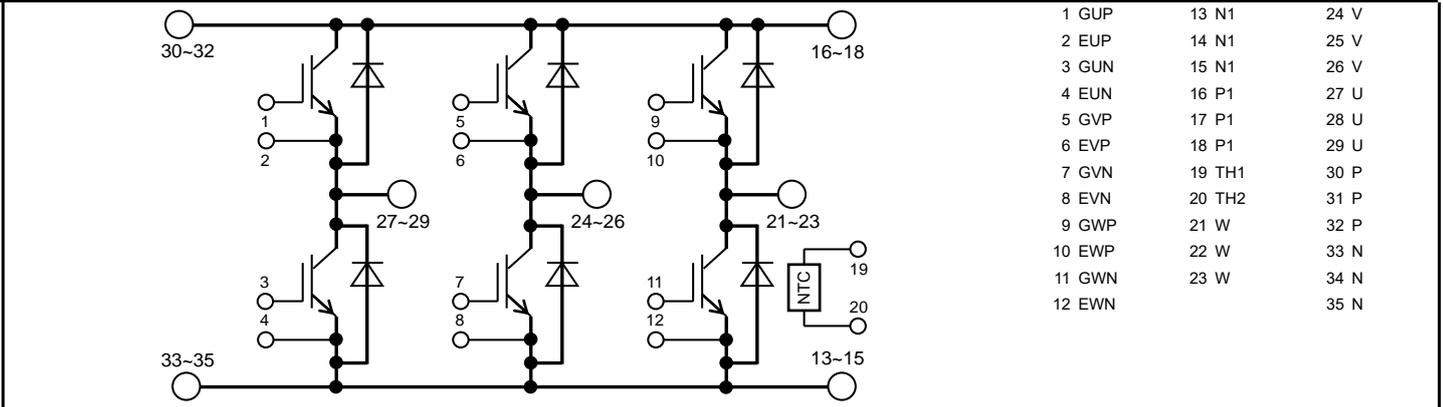
**APPLICATION**

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

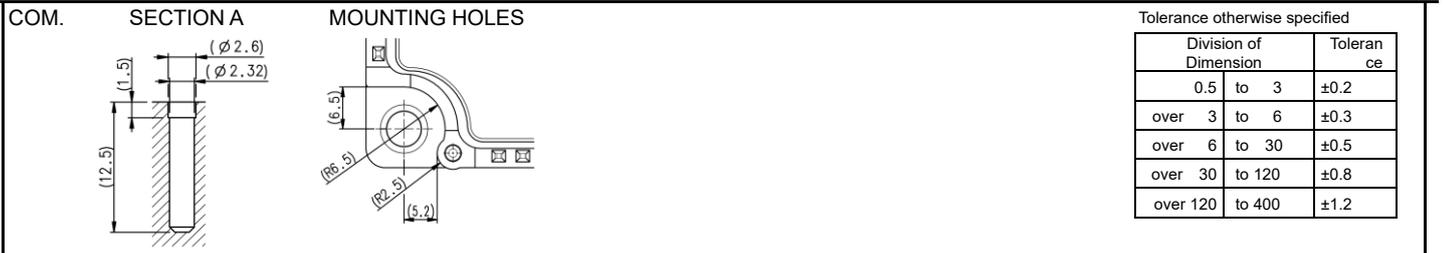
**OPTION (Below options are available.)**

- PC-TIM (Phase Change Thermal Interface Material) pre-apply

**INTERNAL CONNECTION**



**OUTLINE DRAWING**

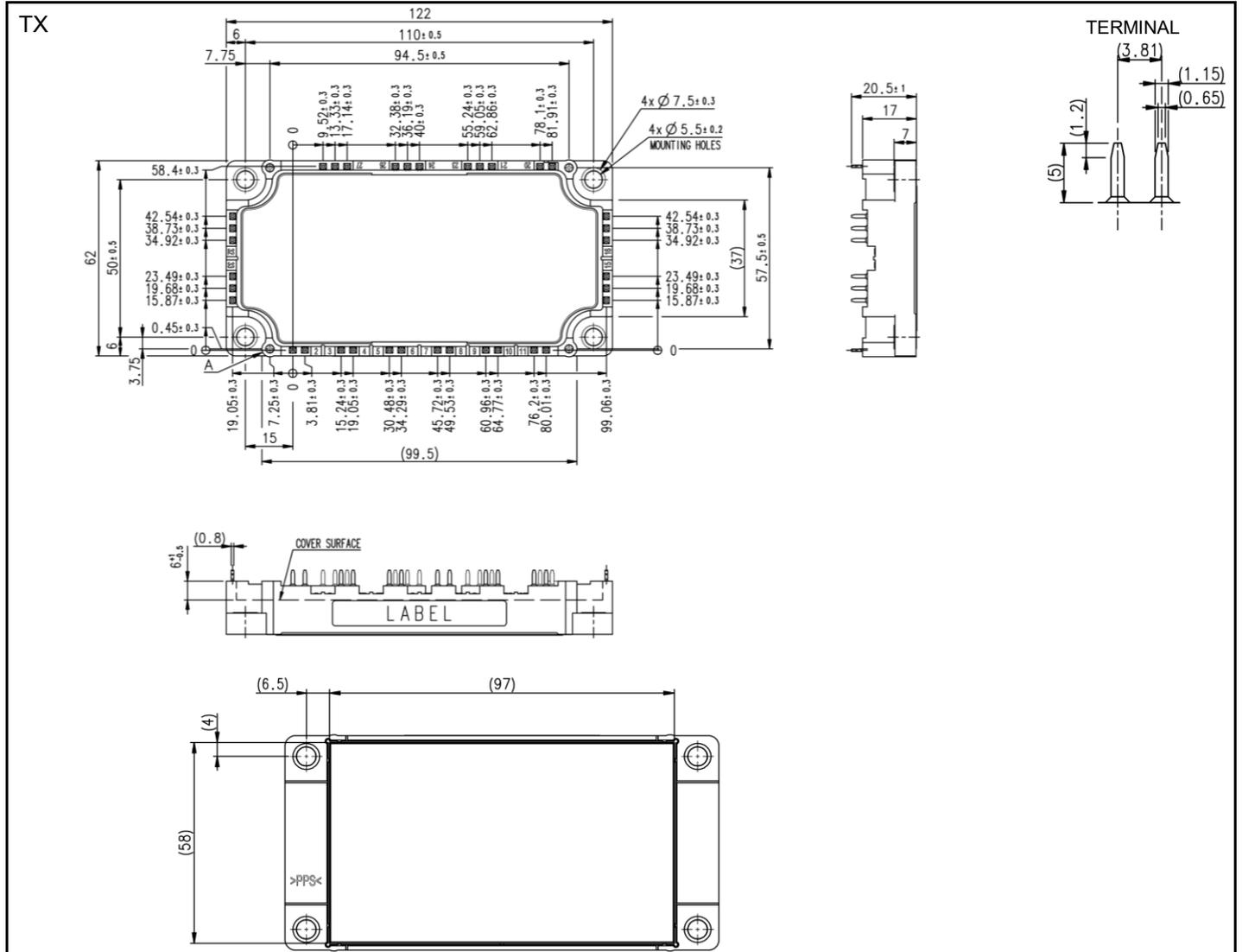


# CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE  
INSULATED TYPE

## OUTLINE DRAWING

Dimension in mm

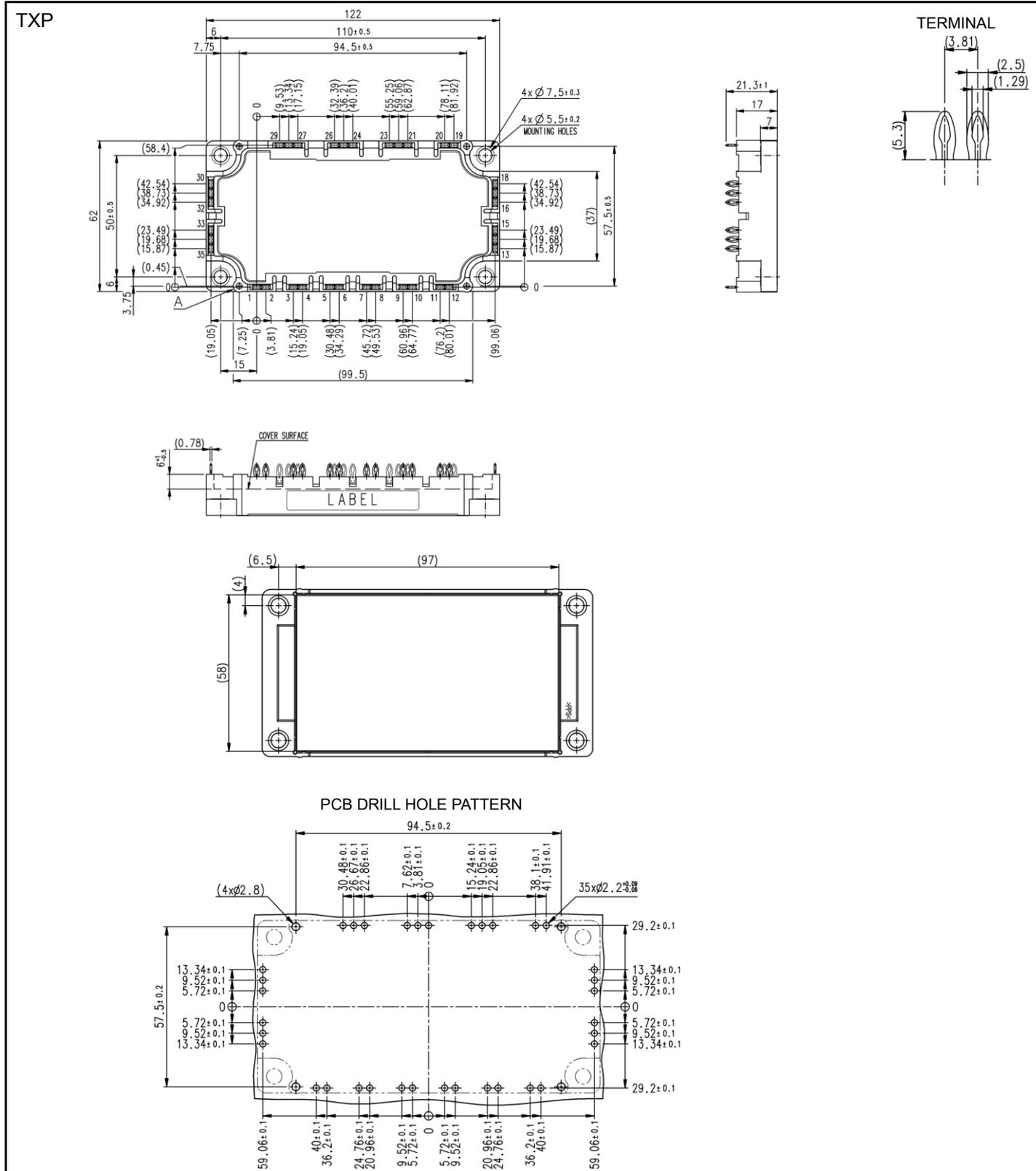


# CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE  
INSULATED TYPE

## OUTLINE DRAWING

Dimension in mm



# CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE  
INSULATED TYPE

## MAXIMUM RATINGS (T<sub>vj</sub>=25 °C, unless otherwise specified)

### INVERTER PART IGBT/FWD

Symbol	Item	Conditions	Rating	Unit
V <sub>CES</sub>	Collector-emitter voltage	G-E short-circuited	650	V
V <sub>GES</sub>	Gate-emitter voltage	C-E short-circuited	± 20	V
I <sub>C</sub>	Collector current	DC, T <sub>C</sub> =101 °C (Note2, 4)	200	A
I <sub>CRM</sub>		Pulse, Repetitive (Note3)	400	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note2, 4)	690	W
I <sub>E</sub> (Note1)	Emitter current	DC (Note2)	200	A
I <sub>ERM</sub> (Note1)		Pulse, Repetitive (Note3)	400	

### MODULE

Symbol	Item	Conditions	Rating	Unit
V <sub>isol</sub>	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T <sub>vjmax</sub>	Maximum junction temperature	Instantaneous event (overload) (Note9)	175	°C
T <sub>Cmax</sub>	Maximum case temperature	(Note4, 9)	125	
T <sub>vjop</sub>	Operating junction temperature	Continuous operation (under switching) (Note9)	-40 ~ +150	°C
T <sub>stg</sub>	Storage temperature	-	-40 ~ +125	

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

### INVERTER PART IGBT/FWD

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>CES</sub>	Collector-emitter cut-off current	V <sub>CE</sub> =V <sub>CES</sub> , G-E short-circuited	-	-	1.0	mA	
I <sub>GES</sub>	Gate-emitter leakage current	V <sub>GE</sub> =V <sub>GES</sub> , C-E short-circuited	-	-	0.5	µA	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =20 mA, V <sub>CE</sub> =10 V	5.4	6.0	6.6	V	
V <sub>CESat</sub> (Terminal)	Collector-emitter saturation voltage	I <sub>C</sub> =200 A, V <sub>GE</sub> =15 V, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.40	1.75	V
V <sub>CESat</sub> (Chip)			T <sub>vj</sub> =125 °C	-	1.50	-	
			T <sub>vj</sub> =150 °C	-	1.55	-	
V <sub>CEsat</sub> (Chip)	Collector-emitter saturation voltage	I <sub>C</sub> =200 A, V <sub>GE</sub> =15 V, (Note5)	T <sub>vj</sub> =25 °C	-	1.30	1.55	V
			T <sub>vj</sub> =125 °C	-	1.35	-	
			T <sub>vj</sub> =150 °C	-	1.35	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited	-	-	26.7	nF	
C <sub>oes</sub>	Output capacitance		-	-	1.1		
C <sub>res</sub>	Reverse transfer capacitance		-	-	0.5		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =300 V, I <sub>C</sub> =200 A, V <sub>GE</sub> =15 V	-	0.83	-	µC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =300 V, I <sub>C</sub> =200 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0.47 Ω, Inductive load	-	-	400	ns	
t <sub>r</sub>	Rise time		-	-	200		
t <sub>d(off)</sub>	Turn-off delay time		-	-	400		
t <sub>f</sub>	Fall time		-	-	600		
V <sub>EC</sub> (Terminal) (Note1)	Emitter-collector voltage	I <sub>E</sub> =200 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.40	1.80	V
V <sub>EC</sub> (Chip) (Note1)			T <sub>vj</sub> =125 °C	-	1.55	-	
			T <sub>vj</sub> =150 °C	-	1.55	-	
V <sub>EC</sub> (Chip) (Note1)	Emitter-collector voltage	I <sub>E</sub> =200 A, G-E short-circuited, (Note5)	T <sub>vj</sub> =25 °C	-	1.35	1.60	V
			T <sub>vj</sub> =125 °C	-	1.50	-	
			T <sub>vj</sub> =150 °C	-	1.50	-	
t <sub>rr</sub> (Note1)	Reverse recovery time	V <sub>CC</sub> =300 V, I <sub>E</sub> =200 A, V <sub>GE</sub> =±15 V,	-	-	400	ns	
Q <sub>rr</sub> (Note1)	Reverse recovery charge	R <sub>G</sub> =0.47 Ω, Inductive load	-	14	-	µC	
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =300 V, I <sub>C</sub> =I <sub>E</sub> =200 A,	-	3.9	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse	V <sub>GE</sub> =±15 V, R <sub>G</sub> =0.47 Ω, T <sub>vj</sub> =150 °C,	-	11.6	-		
E <sub>rr</sub> (Note1)	Reverse recovery energy per pulse	Inductive load	-	10.1	-	mJ	
R <sub>CC'+EE'</sub>	Internal lead resistance	Main terminals-chip, per switch, T <sub>C</sub> =25 °C (Note4)	-	1.4	-	mΩ	
r <sub>g</sub>	Internal gate resistance	Per switch	-	3.0	-	Ω	

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HIGH POWER SWITCHING USE  
INSULATED TYPE

## ELECTRICAL CHARACTERISTICS (cont.; T<sub>vj</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)	-	-	216	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per Inverter FWD (Note4)	-	-	333	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 7, 10)	-	11.5	-	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	Solder pin type (TX)	Terminal to terminal	16.4	-	-	mm
			Terminal to base plate	18.5	-	-	
		Pressfit pin type (TXP)	Terminal to terminal	19	-	-	mm
			Terminal to base plate	18.6	-	-	
d <sub>a</sub>	Clearance	Solder pin type (TX)	Terminal to terminal	10.2	-	-	mm
			Terminal to base plate	9.0	-	-	
		Pressfit pin type (TXP)	Terminal to terminal	8.9	-	-	mm
			Terminal to base plate	9.0	-	-	
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note8)	±0	-	+200	μm	
m	mass	-	-	270	-	g	

\*. 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.

5. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

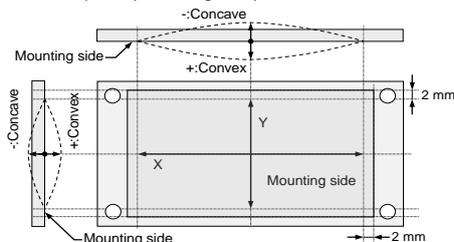
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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. Reference value. Thermally conductive grease of thermal conductivity λ=0.9 W/(m·K) and thickness D<sub>(c-s)</sub>=50 μm.

8. The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



9. 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 user's specific application conditions. Each temperature condition (T<sub>vjmax</sub>, T<sub>vjop</sub>, T<sub>Cmax</sub>) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

**CM200TX-13T/CM200TXP-13T**

HIGH POWER SWITCHING USE

INSULATED TYPE

Note10. 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	

**RECOMMENDED OPERATING CONDITIONS**

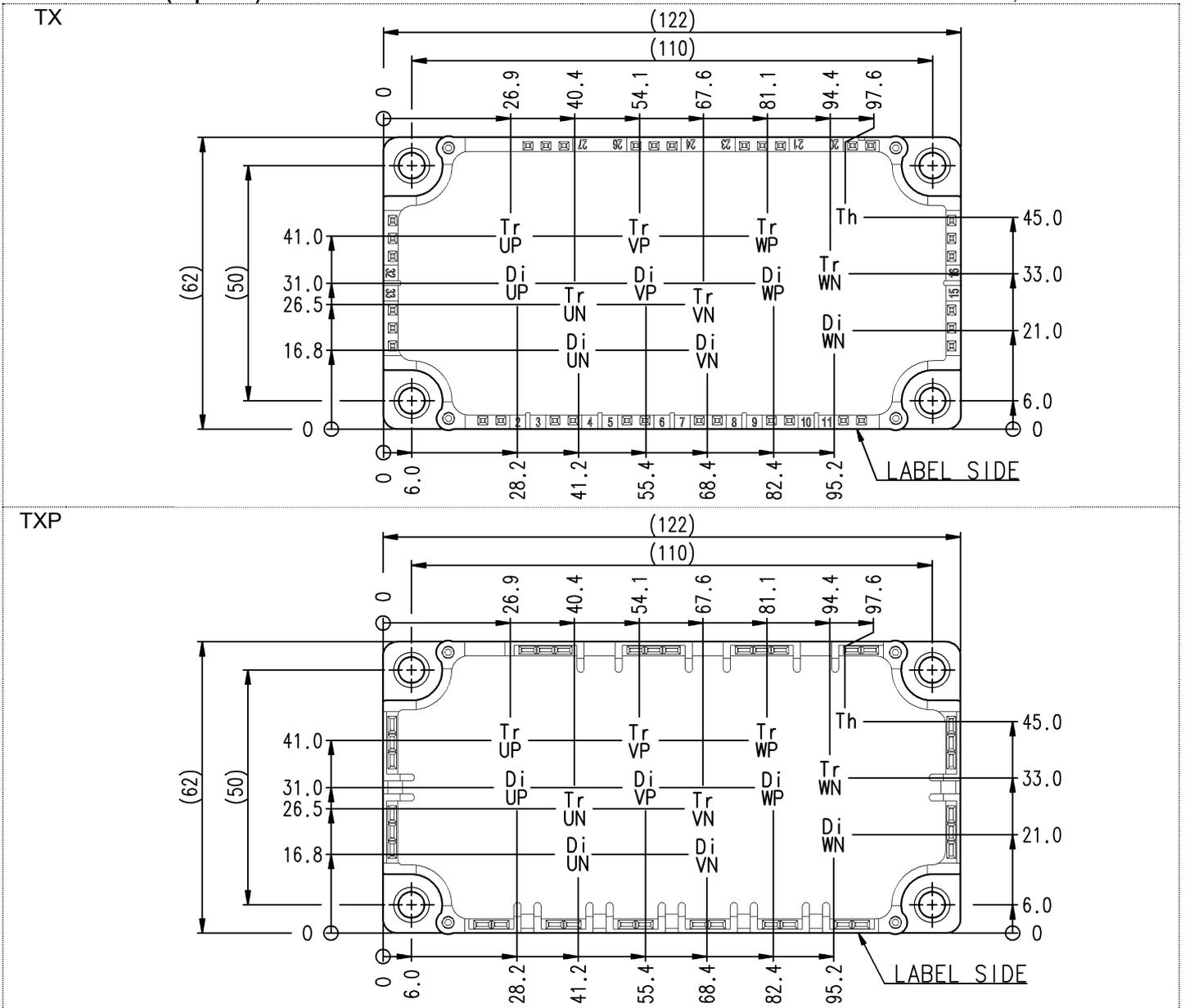
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC}$	(DC) Supply voltage	Applied across P-N terminals	-	300	450	V
$V_{GEon}$	Gate (-emitter drive) voltage	Applied across G*P-E*P/G*N-E*N terminals (*=U,V,W)	13.5	15.0	16.5	V
$R_G$	External gate resistance	Per switch	0.47	-	30	Ω

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HIGH POWER SWITCHING USE  
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## CHIP LOCATION (Top view)

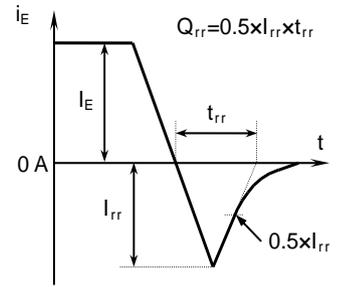
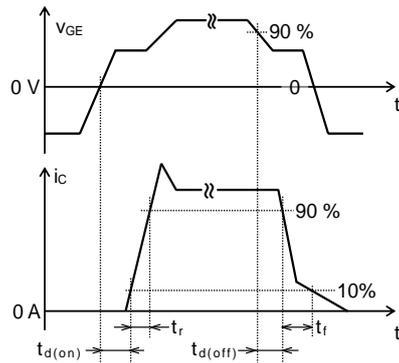
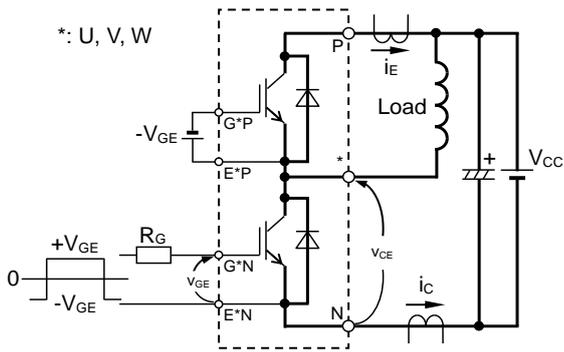
Dimension in mm, tolerance:  $\pm 1$  mm



# CM200TX-13T/CM200TXP-13T

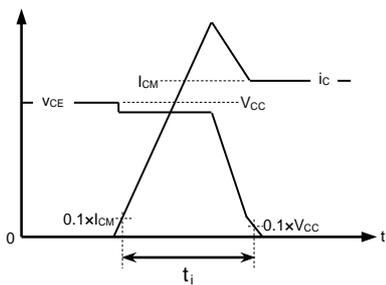
HIGH POWER SWITCHING USE  
INSULATED TYPE

## TEST CIRCUIT AND WAVEFORMS

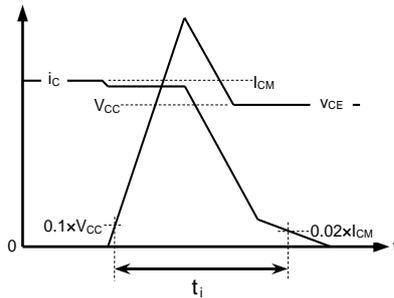


Switching characteristics test circuit and waveforms

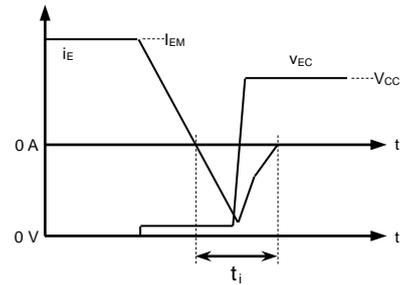
$t_{rr}$ ,  $Q_{rr}$  characteristics test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



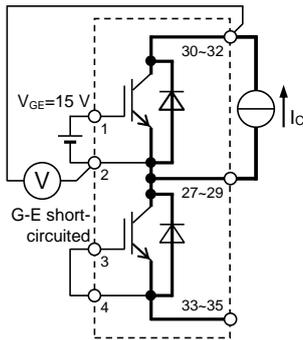
FWD Reverse recovery energy

Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

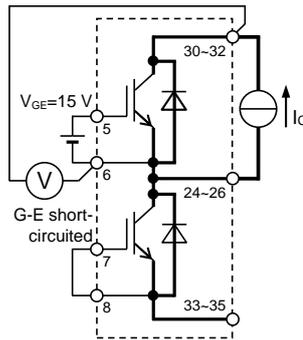
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HIGH POWER SWITCHING USE  
INSULATED TYPE

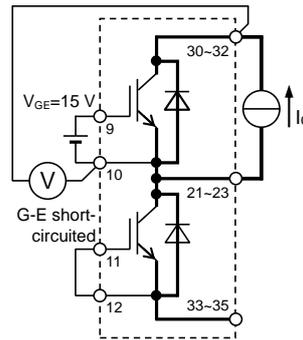
## TEST CIRCUIT



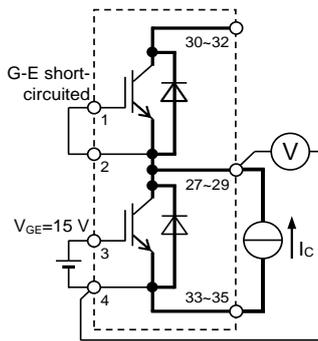
TrUP



TrVP

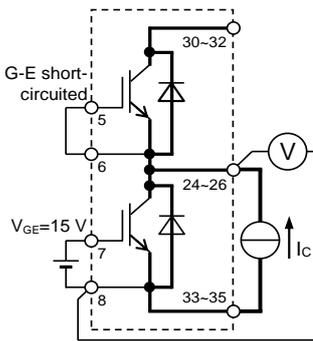


TrWP



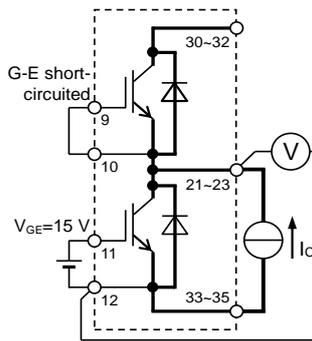
TrUN

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



TrVN

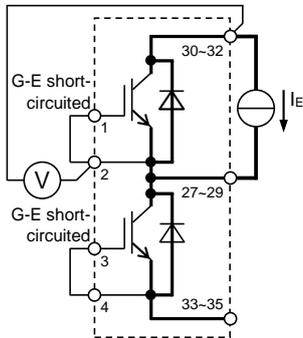
Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GWP-EWP, GWN-EWN



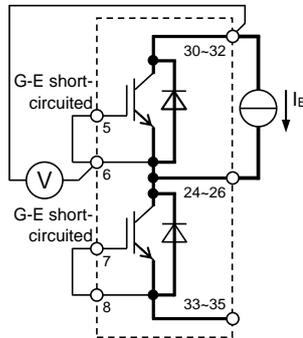
TrWN

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

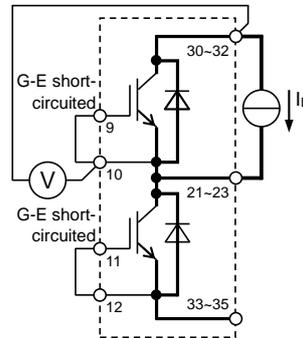
## VCesat characteristics test circuit



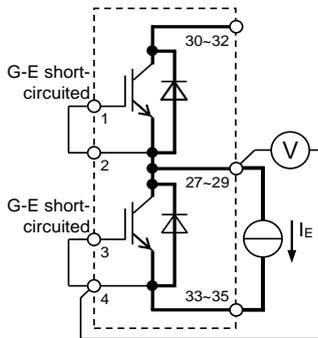
DiUP



DiVP

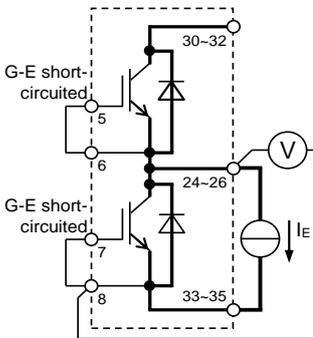


DiWP



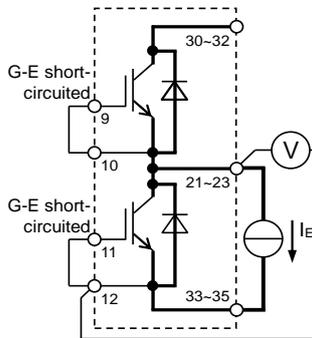
DiUN

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



DiVN

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



DiWN

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

## VEC characteristics test circuit

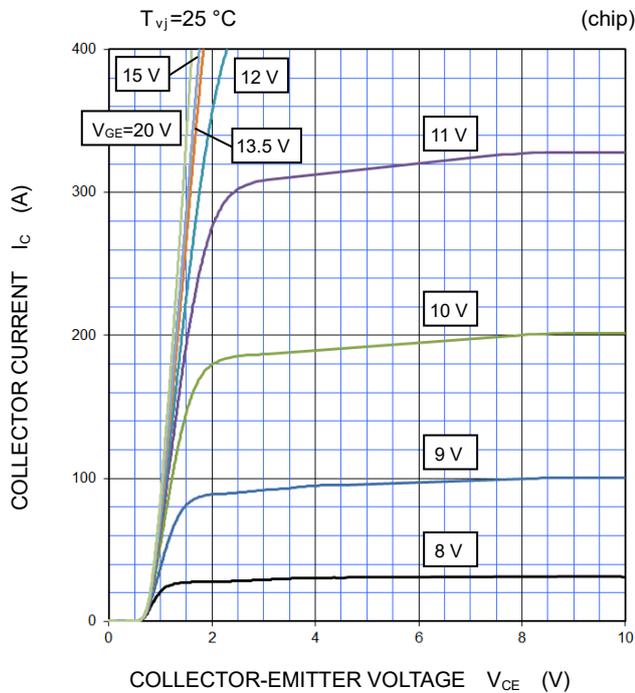
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HIGH POWER SWITCHING USE  
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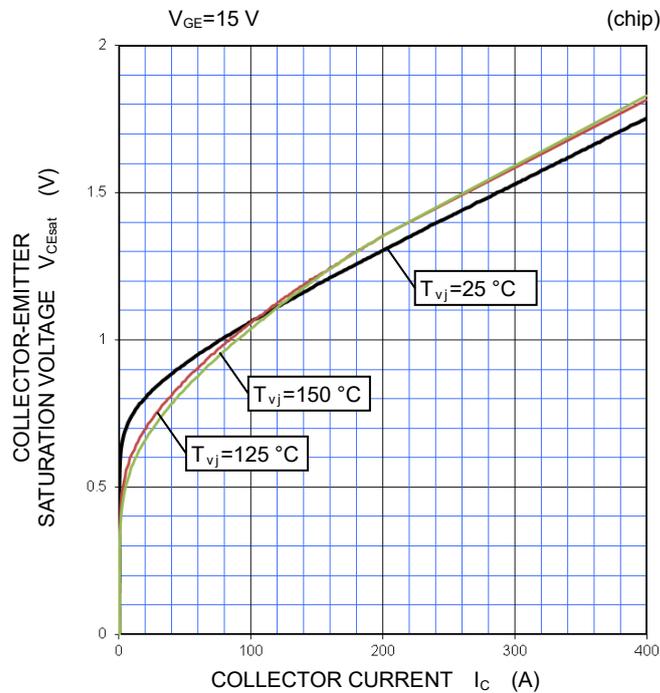
## PERFORMANCE CURVES

### INVERTER PART

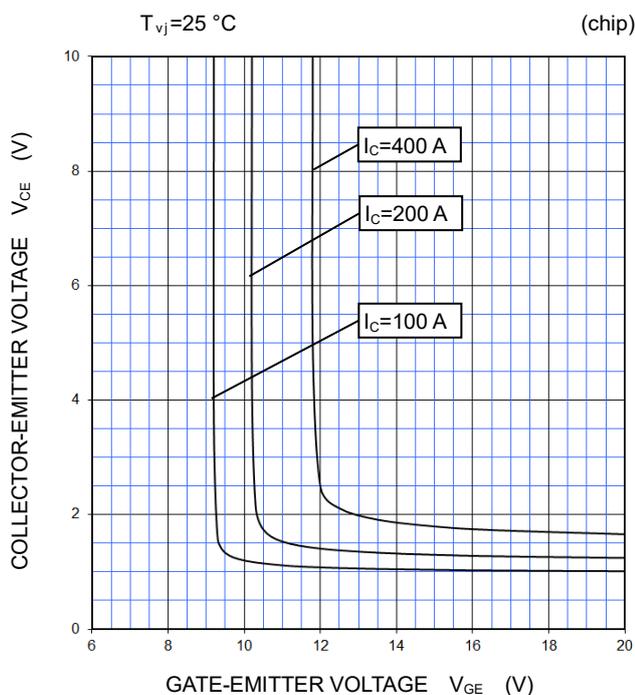
**OUTPUT CHARACTERISTICS (TYPICAL)**



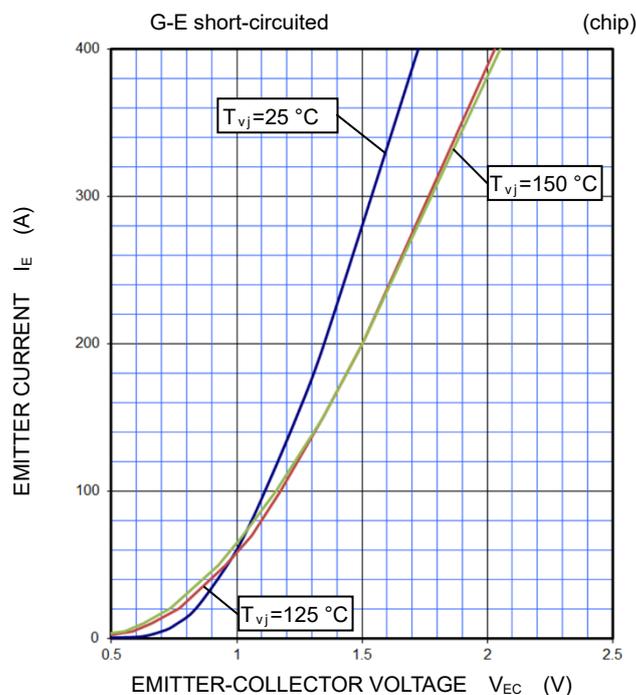
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



**COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS (TYPICAL)**



**FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)**



# CM200TX-13T/CM200TXP-13T

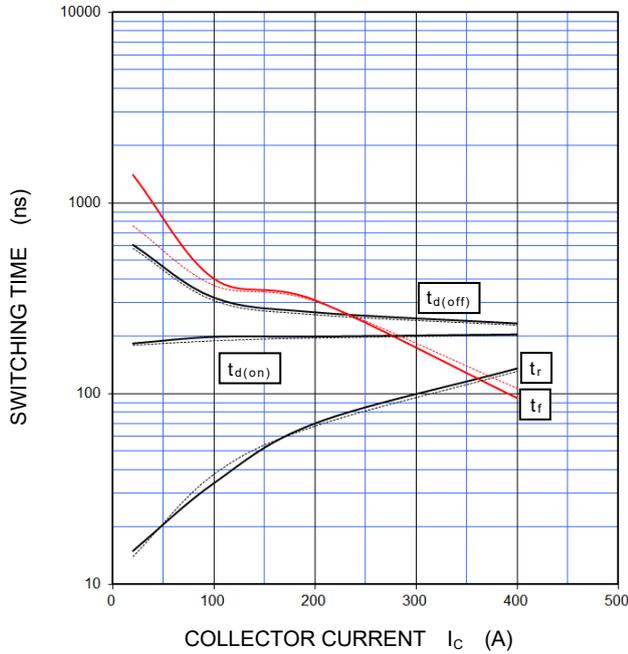
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

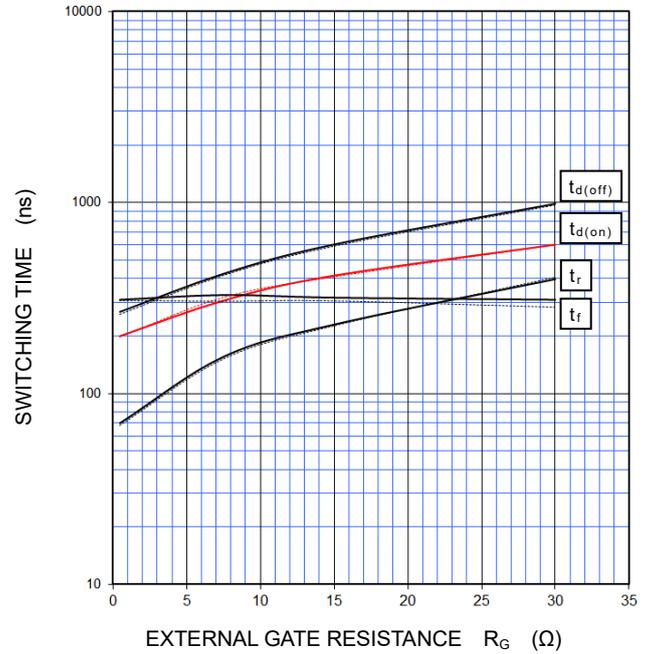
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $R_G=0.47\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



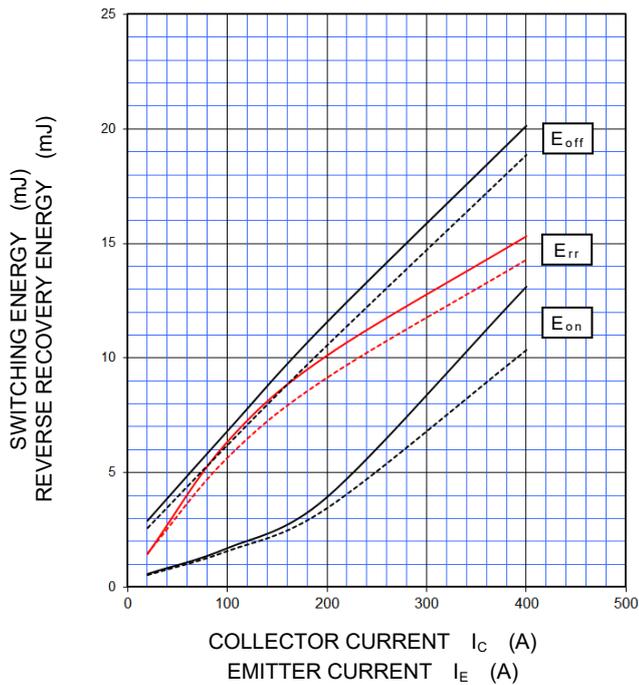
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $I_C=200\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



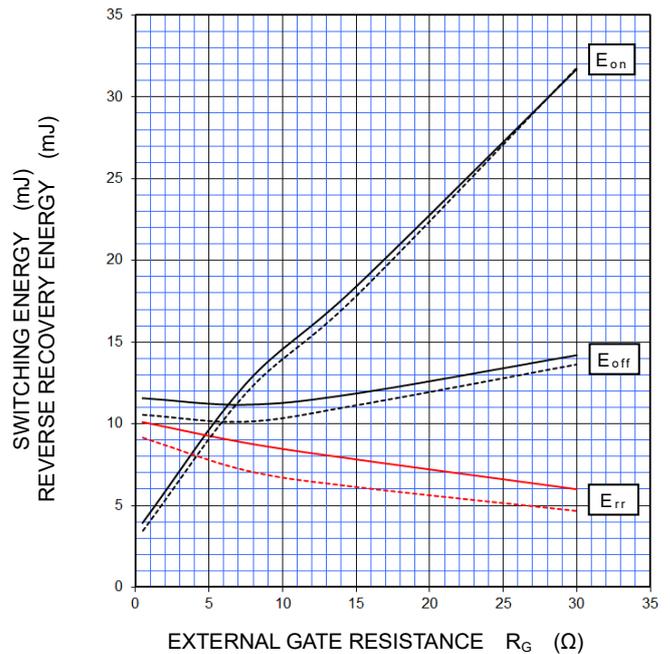
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=300\text{ V}$ ,  $R_G=0.47\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD,  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$ , PER PULSE



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

$V_{CC}=300\text{ V}$ ,  $I_C/I_E=200\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD,  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$ , PER PULSE



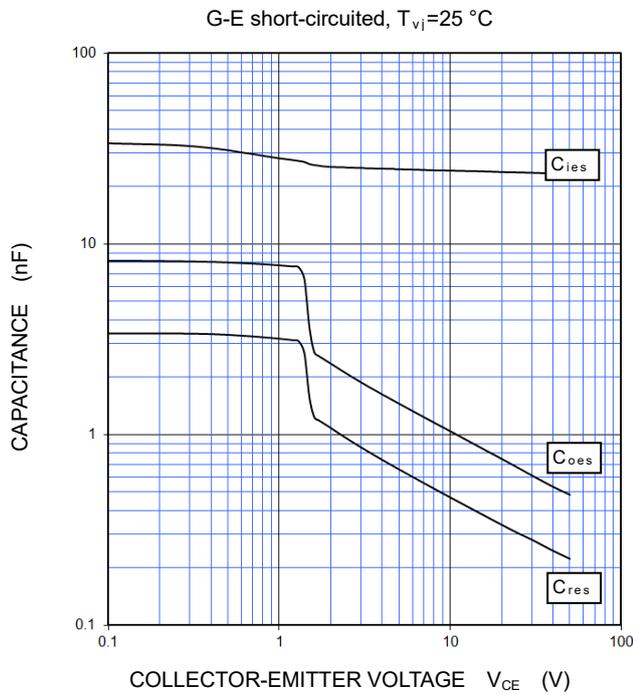
# CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE  
INSULATED TYPE

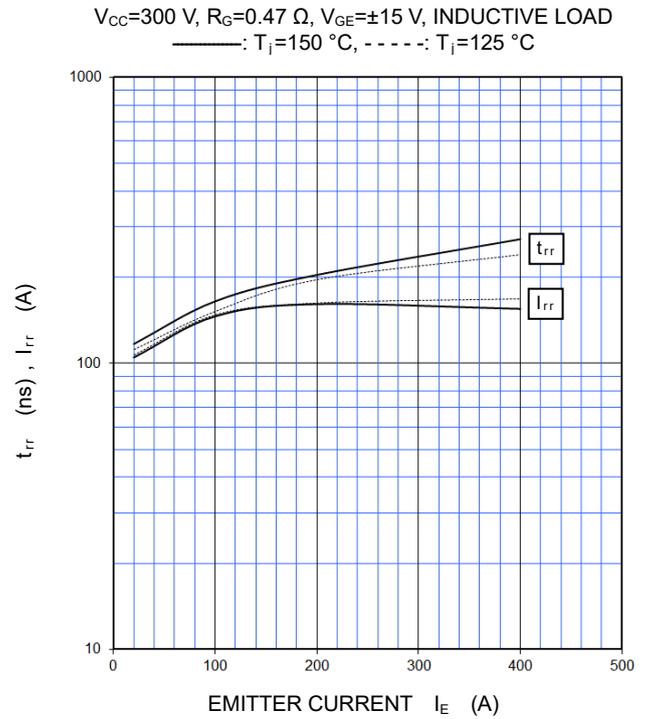
## PERFORMANCE CURVES

### INVERTER PART

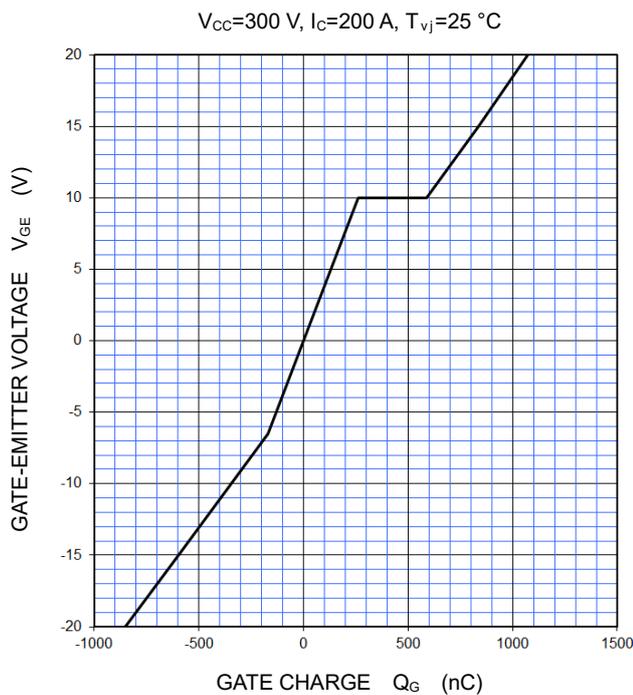
**CAPACITANCE CHARACTERISTICS  
(TYPICAL)**



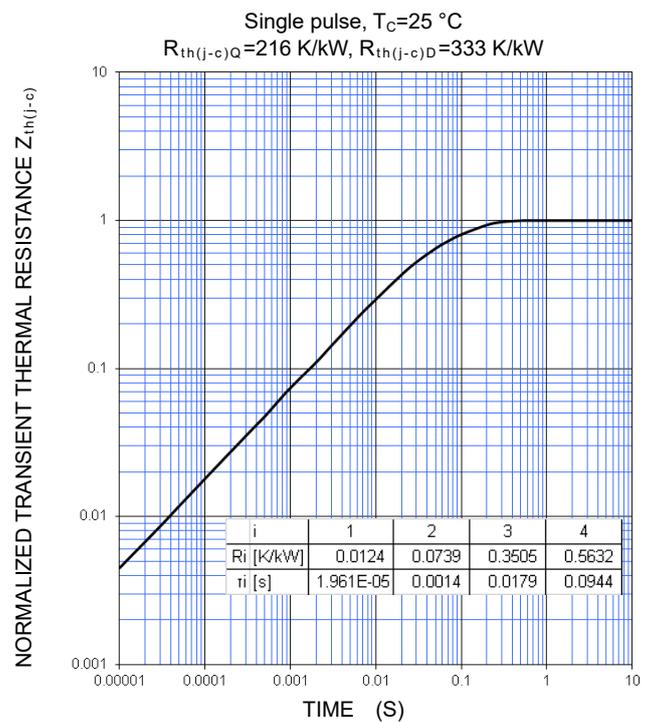
**FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)**



**GATE CHARGE CHARACTERISTICS  
(TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS  
(MAXIMUM)**



# CM200TX-13T/CM200TXP-13T

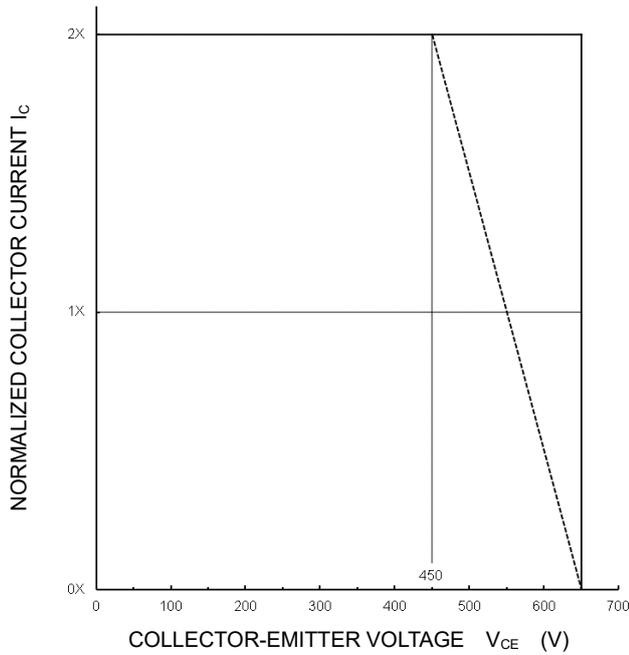
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

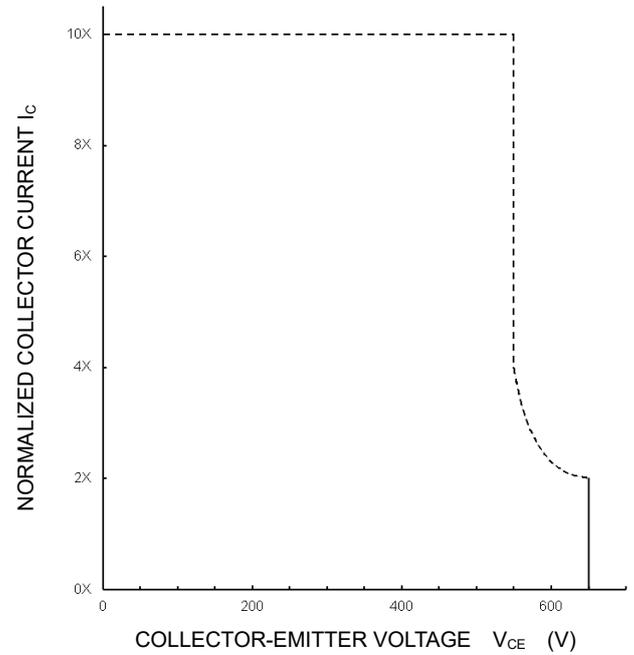
**TURN-OFF SWITCHING SAFE OPERATING AREA  
(REVERSE BIAS SAFE OPERATING AREA)  
(MAXIMUM)**

$V_{CC} \leq 450 \text{ V}$ ,  $R_G = 0.47 \sim 30 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 ———:  $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$  (Normal load operations (Continuous))  
 - - - - -:  $T_{vj} = 175 \text{ }^\circ\text{C}$  (Unusual load operations (Limited period))



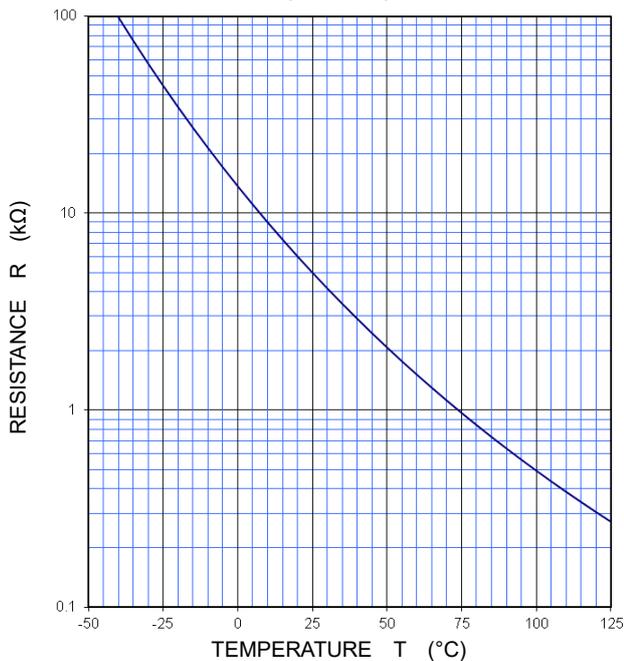
**SHORT-CIRCUIT SAFE OPERATING AREA  
(MAXIMUM)**

$V_{CC} \leq 400 \text{ V}$ ,  $R_G = 0.47 \sim 30 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ ,  $t_W \leq 8 \ \mu\text{s}$ , Non-Repetitive



### NTC thermistor part

**TEMPERATURE CHARACTERISTICS  
(TYPICAL)**



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

# CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE  
INSULATED TYPE

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