



<IGBT Modules>

CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE
INSULATED TYPE

 <p>TX</p>	<p>Collector current I_c 2 0 0 A Collector-emitter voltage V_{CES} 6 5 0 V Maximum junction temperature T_{vjmax} 1 7 5 °C</p> <ul style="list-style-type: none"> •Flat base type •Copper base plate (Nickel-plating) •RoHS Directive compliant •Tin-plating pin terminals
 <p>TXP</p>	<p>Collector current I_c 2 0 0 A Collector-emitter voltage V_{CES} 6 5 0 V Maximum junction temperature T_{vjmax} 1 7 5 °C</p> <ul style="list-style-type: none"> •Flat base type •Copper base plate (Nickel-plating) •RoHS Directive compliant •Tin-plating pressfit terminals
<p style="text-align: center;">sixpack (three-phase bridge)</p> <ul style="list-style-type: none"> •UL Recognized under UL1557, File No. E323585 	

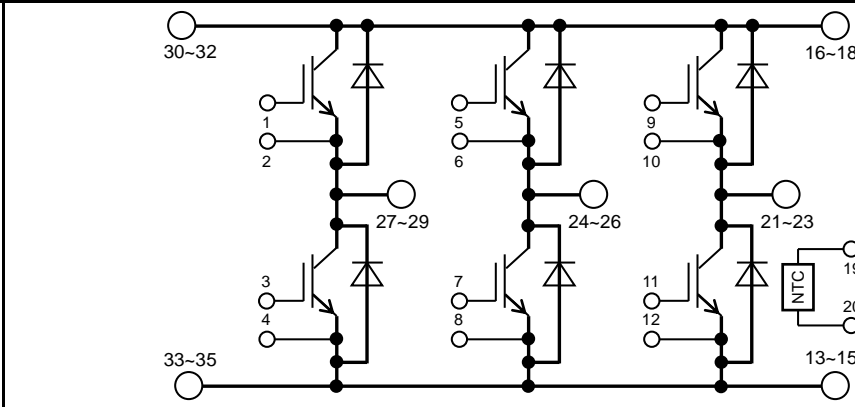
APPLICATION

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

OPTION (Below options are available.)

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

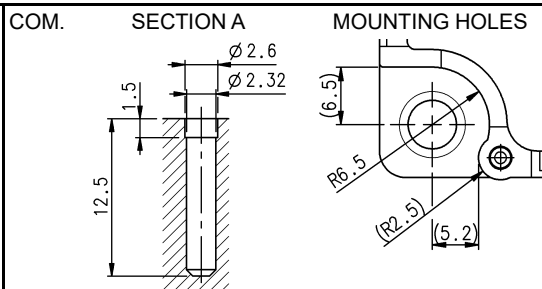
INTERNAL CONNECTION



Terminal code

1 GUP	13 N1	24 V
2 EUP	14 N1	25 V
3 GUN	15 N1	26 V
4 EUN	16 P1	27 U
5 GVP	17 P1	28 U
6 EVP	18 P1	29 U
7 GVN	19 TH1	30 P
8 EVN	20 TH2	31 P
9 GWP	21 W	32 P
10 EWP	22 W	33 N
11 GWN	23 W	34 N
12 EWN		35 N

OUTLINE DRAWING



Dimension in mm

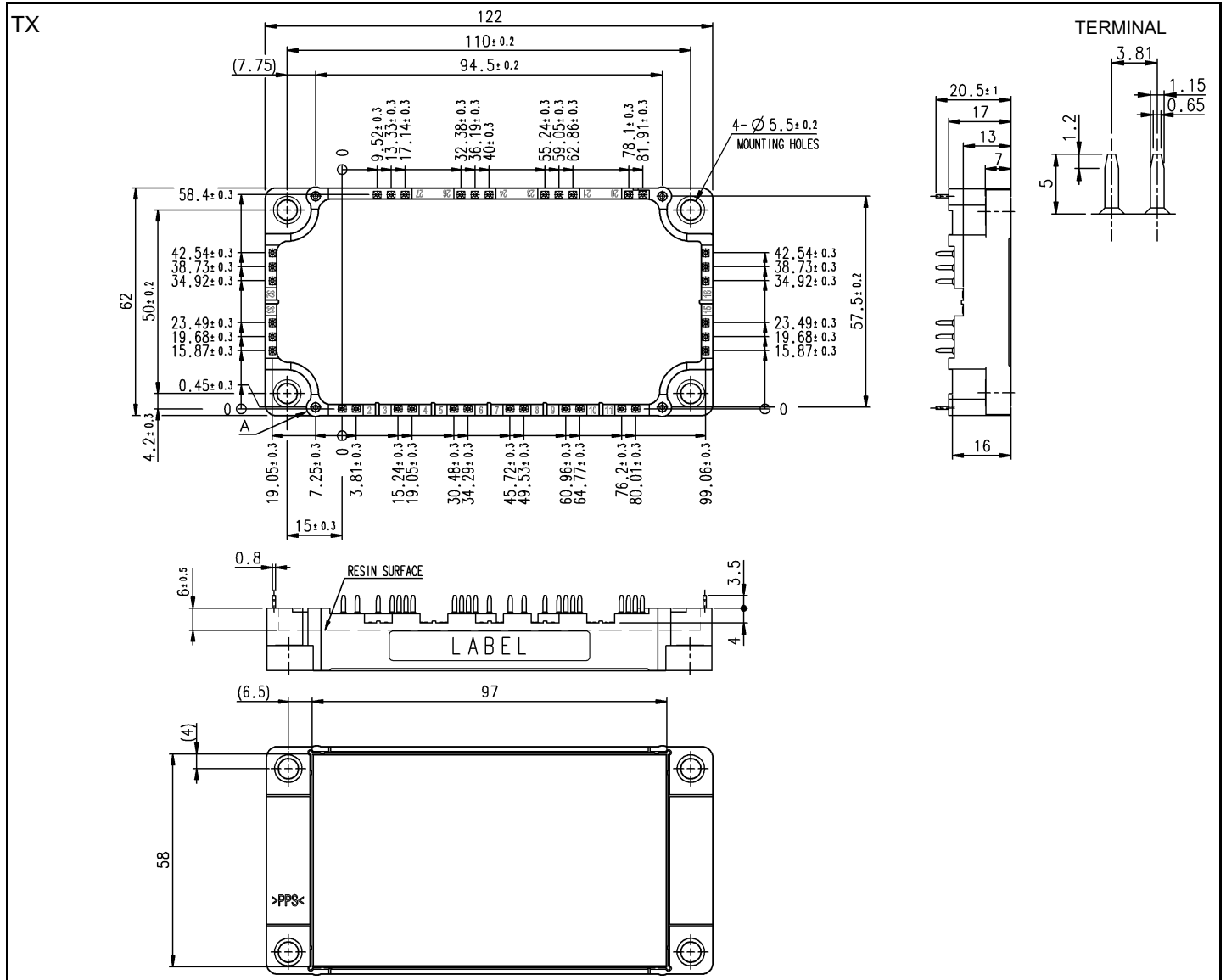
Tolerance otherwise specified	
Division of Dimension	Tolerance
0.5 to 3	±0.2
over 3 to 6	±0.3
over 6 to 30	±0.5
over 30 to 120	±0.8
over 120 to 400	±1.2

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OUTLINE DRAWING

Dimension in mm



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

INVERTER PART IGBT/FWD

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	± 20	V
I_C	Collector current	DC, $T_C=101\text{ }^{\circ}\text{C}$ (Note2, 4)	200	A
I_{CRM}		Pulse, Repetitive (Note3)	400	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	690	W
I_E (Note1)	Emitter current	DC (Note2)	200	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	400	

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_{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)

INVERTER PART IGBT/FWD

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	μA	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=20\text{ mA}$, $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
V_{CESat} (Terminal)	Collector-emitter saturation voltage	$I_C=200\text{ A}$, $V_{GE}=15\text{ V}$, Refer to the figure of test circuit (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.40	1.75	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.50	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.55	-	
V_{CESat} (Chip)		$I_C=200\text{ A}$, $V_{GE}=15\text{ V}$, (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	-	-	26.7	nF	
C_{oes}	Output capacitance		-	-	1.1		
C_{res}	Reverse transfer capacitance		-	-	0.5		
Q_G	Gate charge	$V_{CC}=300\text{ V}$, $I_C=200\text{ A}$, $V_{GE}=15\text{ V}$	-	0.83	-	μC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=300\text{ V}$, $I_C=200\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.47\text{ }\Omega$, Inductive load	-	-	400	ns	
t_r	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	400		
t_f	Fall time		-	-	600		
V_{EC} (Terminal) (Note1)	Emitter-collector voltage	$I_E=200\text{ A}$, G-E short-circuited, Refer to the figure of test circuit (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.50	2.05	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.55	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.55	-	
V_{EC} (Chip) (Note1)		$I_E=200\text{ A}$, G-E short-circuited, (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	-	1.45	1.85	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	-	1.50	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	-	1.50	-	
t_{rr} (Note1)	Reverse recovery time	$V_{CC}=300\text{ V}$, $I_E=200\text{ A}$, $V_{GE}=\pm 15\text{ V}$,	-	-	400	ns	
Q_{rr} (Note1)	Reverse recovery charge	$R_G=0.47\text{ }\Omega$, Inductive load	-	14	-	μC	
E_{on}	Turn-on switching energy per pulse	$V_{CC}=300\text{ V}$, $I_C=I_E=200\text{ A}$,	-	3.9	-	mJ	
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=0.47\text{ }\Omega$, $T_{vj}=150\text{ }^{\circ}\text{C}$,	-	11.6	-		
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	10.1	-	mJ	
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	1.4	-	m Ω	
r_g	Internal gate resistance	Per switch	-	3.0	-	Ω	

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HIGH POWER SWITCHING USE
INSULATED TYPE

ELECTRICAL CHARACTERISTICS (cont.; T_{vj}=25 °C, unless otherwise specified)

NTC THERMISTOR PART

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

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	216	K/kW
R _{th(j-c)D}		Junction to case, per Inverter FWD (Note4)	-	-	333	
R _{th(c-s)}	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 7, 9)	-	11.5	-	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
M _s	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m	
d _s	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 _a	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 _c	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_{vj}) should not increase beyond T_{vjmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.
- Case temperature (T_C) and heat sink temperature (T_S) 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.

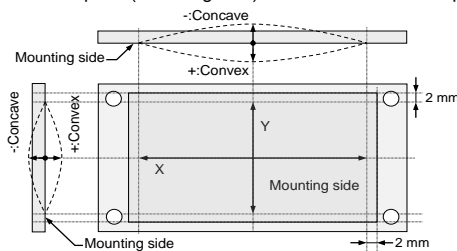
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

R₂₅: resistance at absolute temperature T₂₅ [K]; T₂₅=25 [°C]+273.15=298.15 [K]

R₅₀: resistance at absolute temperature T₅₀ [K]; T₅₀=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_(c-s)=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_{vjmax}, T_{vjop}, T_{Cmax}) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

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HIGH POWER SWITCHING USE

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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

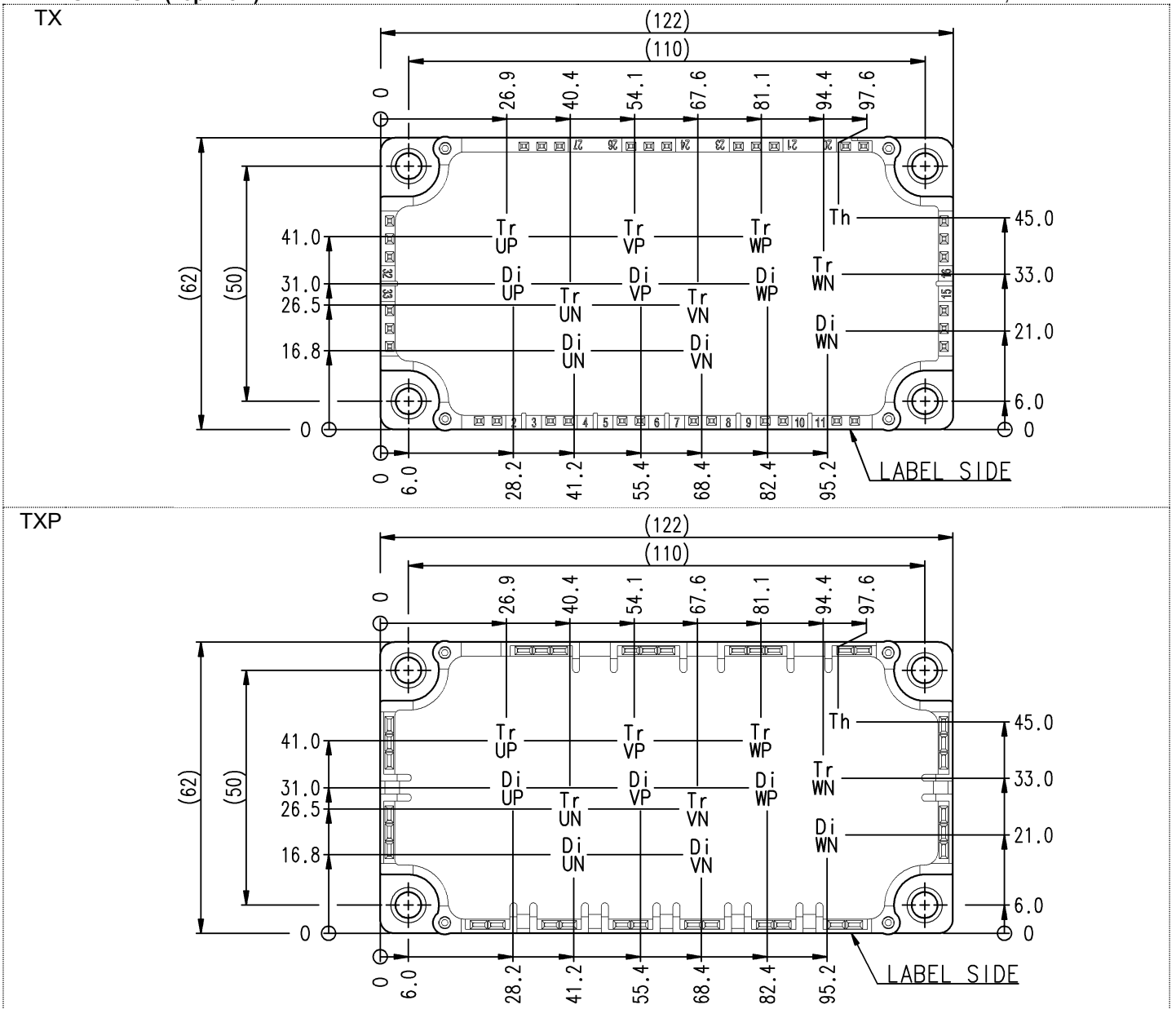
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across P-N terminals	-	300	450	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G*P-E*P/G*N-E*N terminals (*=U,V,W)	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0.47	-	30	Ω

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HIGH POWER SWITCHING USE
INSULATED TYPE

CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm

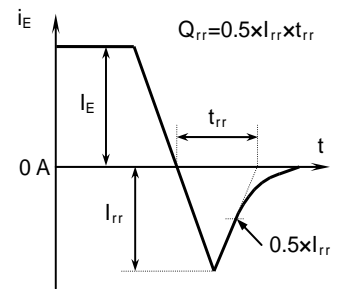
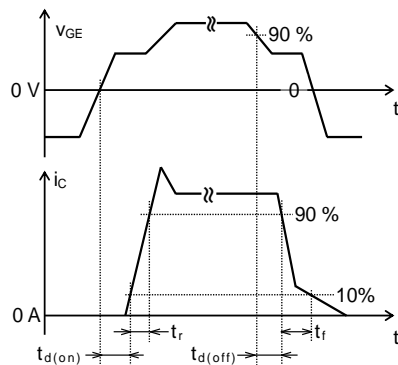
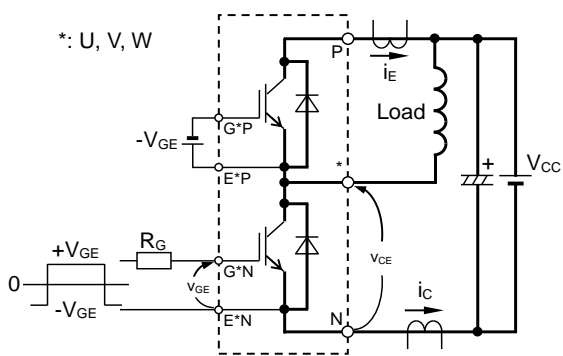


Tr*P/Tr*N: IGBT, Di*P/Di*N: FWD (*=U,V,W), Th: NTC thermistor

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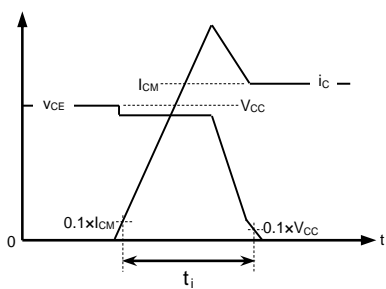
HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

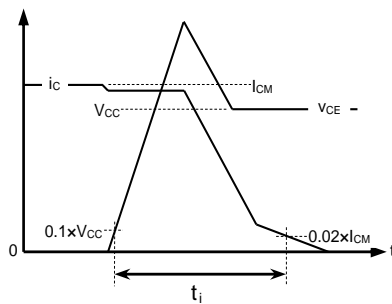


Switching characteristics test circuit and waveforms

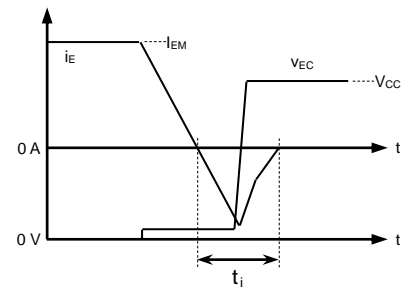
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



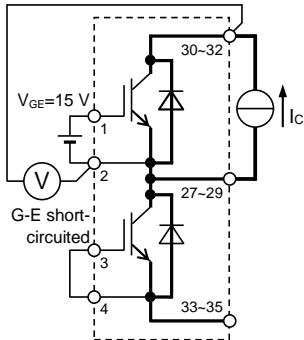
FWD Reverse recovery energy

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

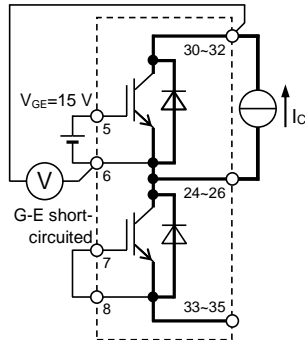
CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE
INSULATED TYPE

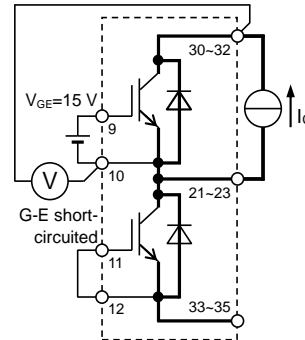
TEST CIRCUIT



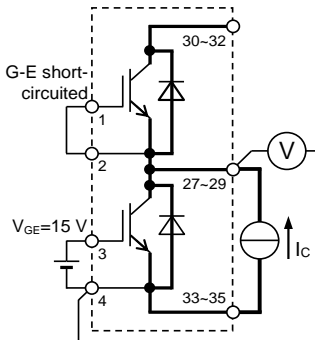
TrUP



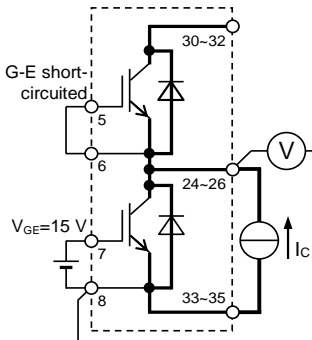
TrVP



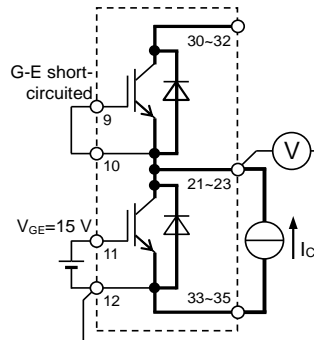
TrWP



TrUN



TrVN



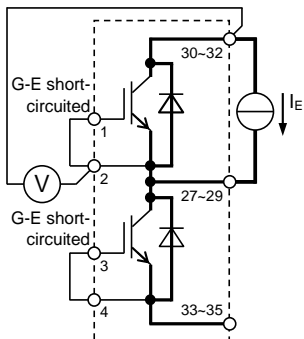
TrWN

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

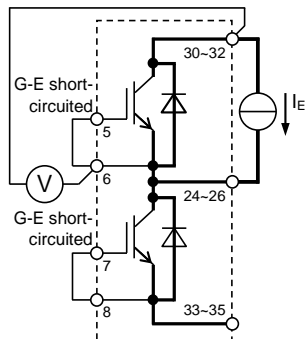
Gate-emitter GUP-EUP, GUN-EUN,
short-circuited GWP-EWP, GWN-EWN

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

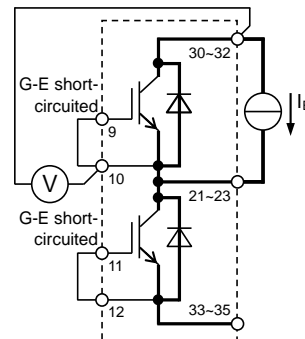
V_{CEsat} characteristics test circuit



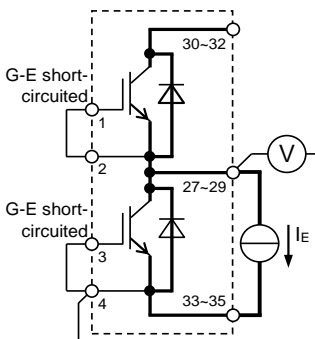
DiUP



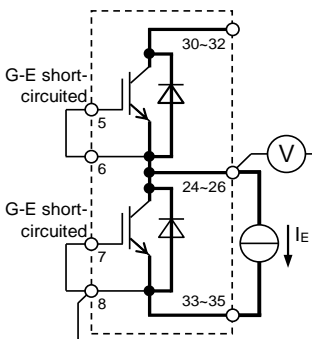
DiVP



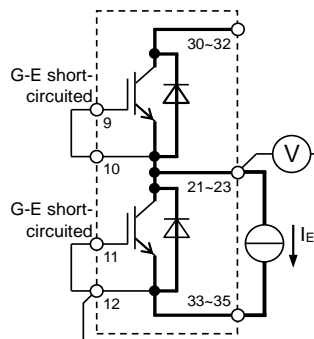
DiWP



DiUN



DiVN



DiWN

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

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

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

V_{EC} characteristics test circuit

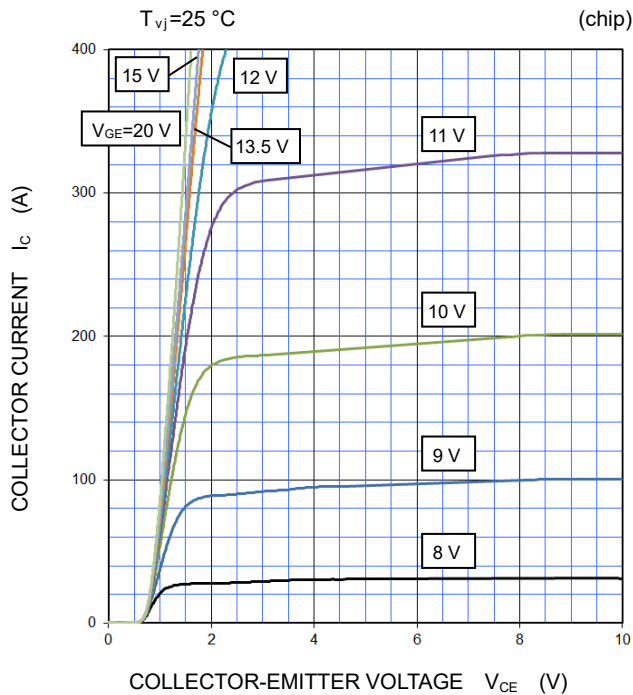
CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE
INSULATED TYPE

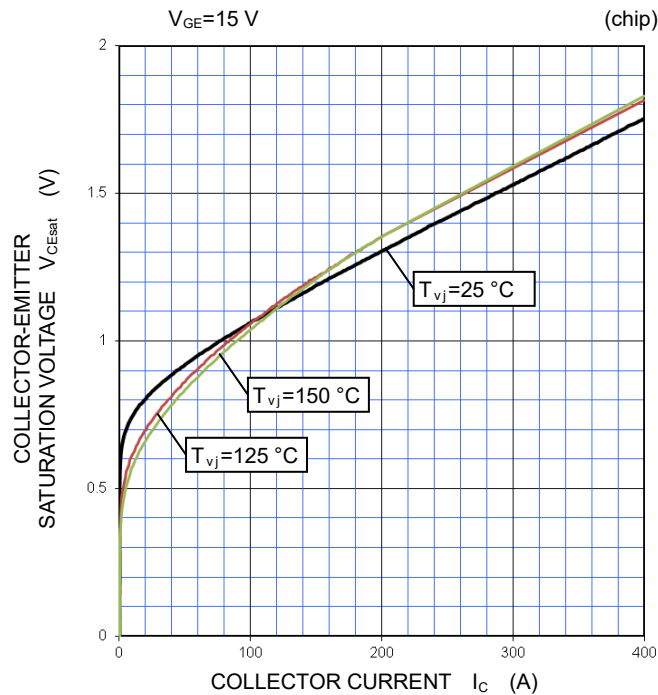
PERFORMANCE CURVES

INVERTER PART

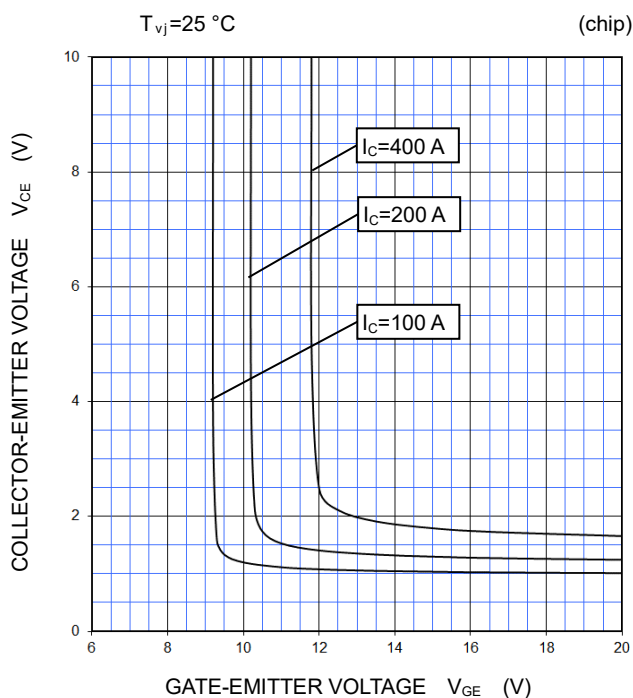
OUTPUT CHARACTERISTICS
(TYPICAL)



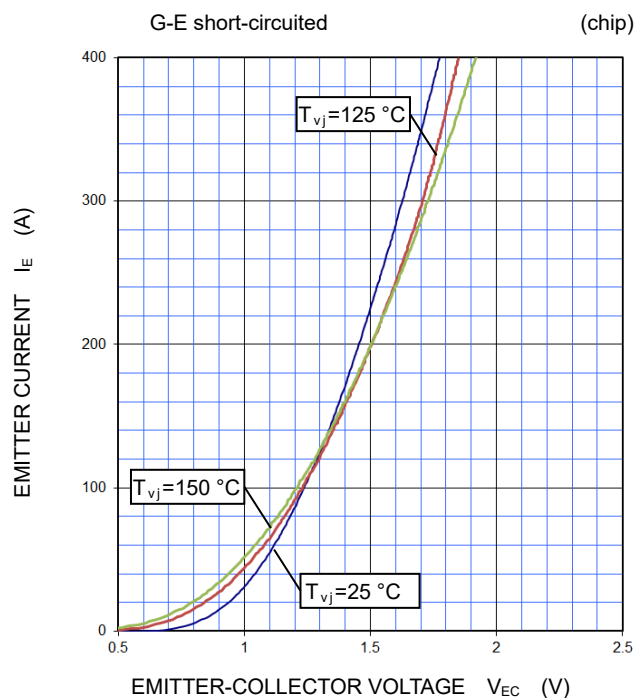
COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



CM200TX-13T/CM200TXP-13T

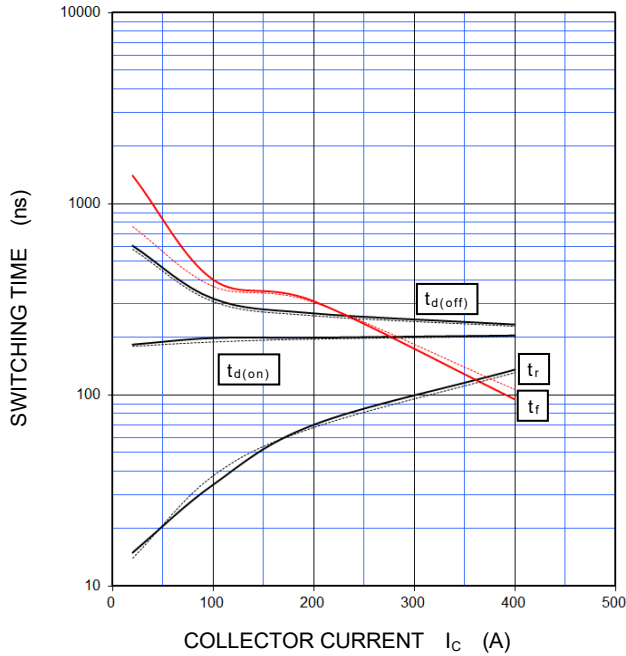
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

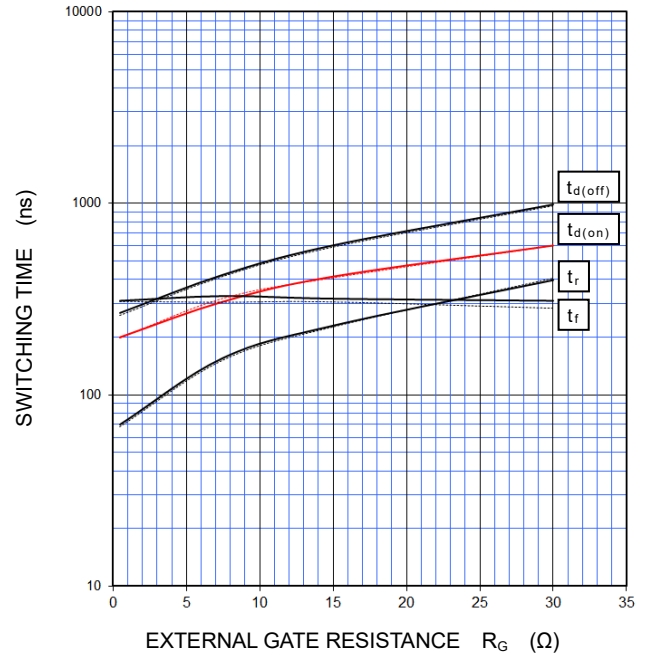
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



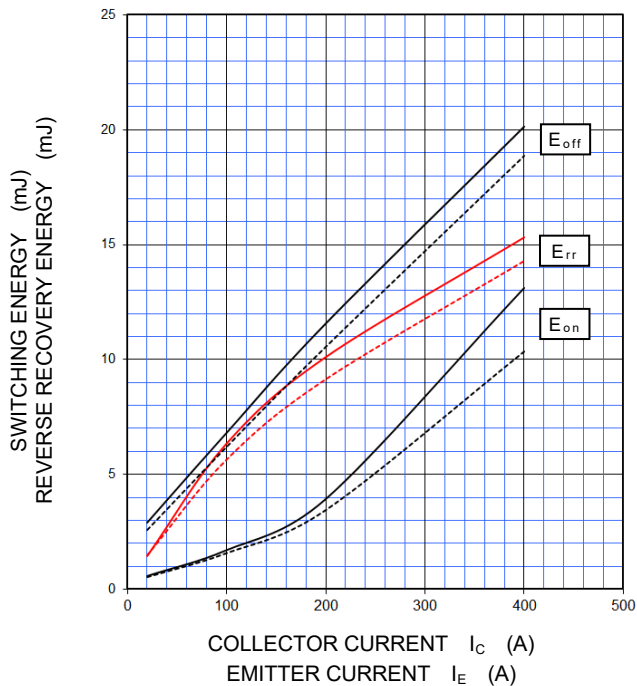
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



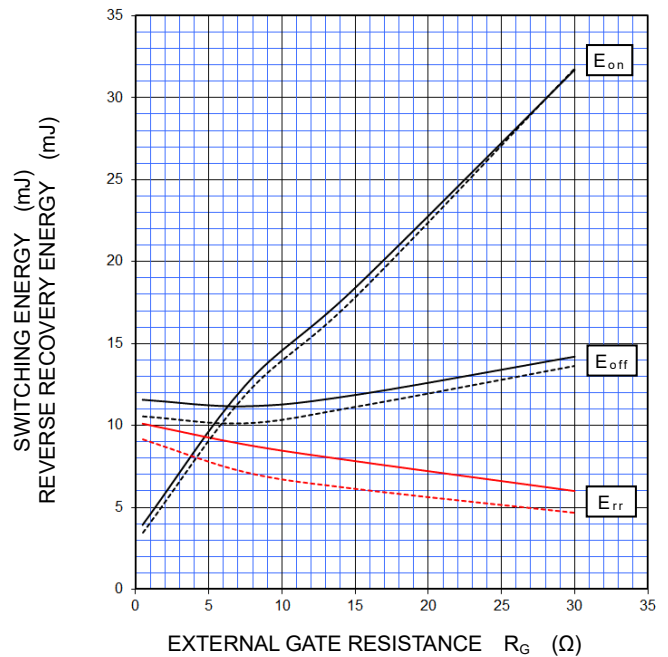
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



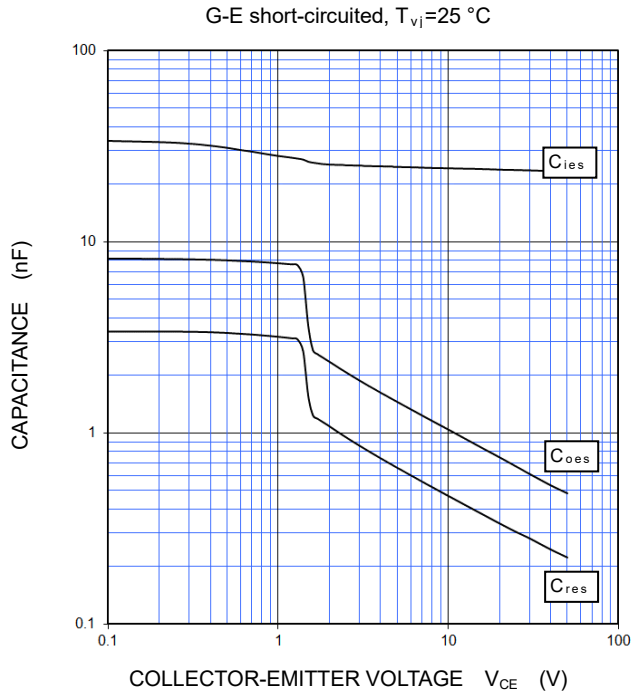
CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE
INSULATED TYPE

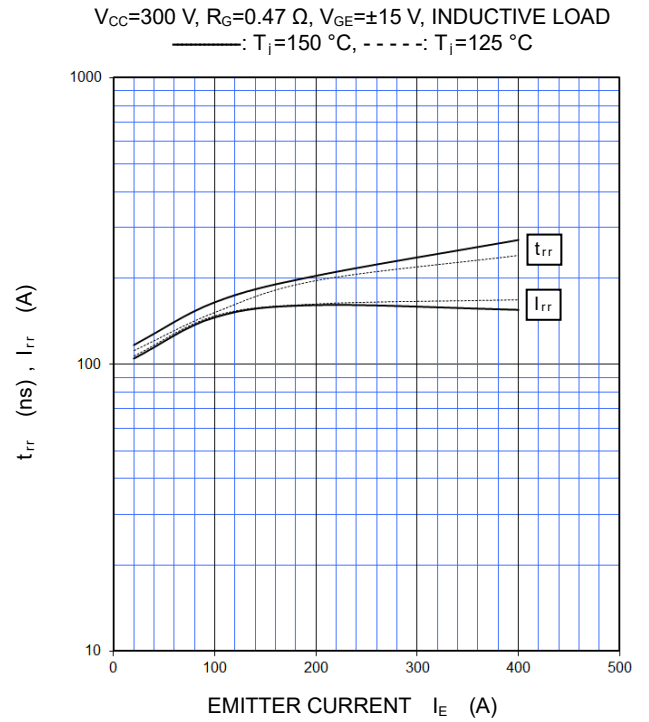
PERFORMANCE CURVES

INVERTER PART

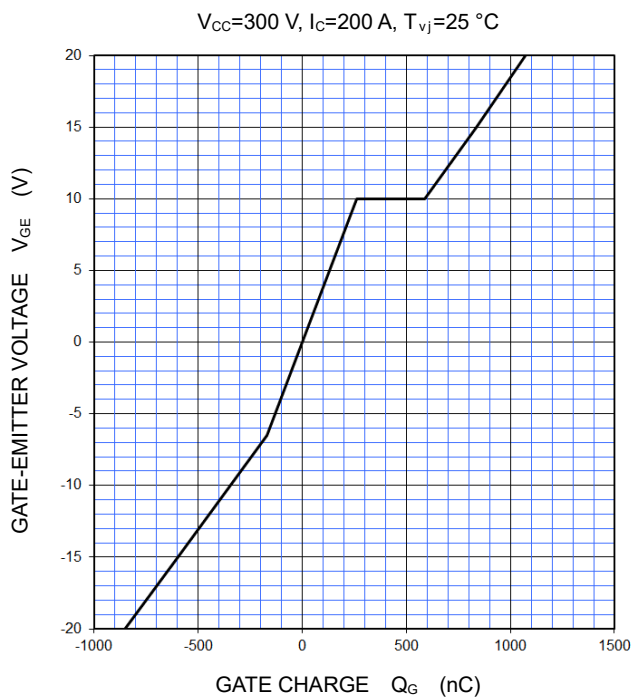
**CAPACITANCE CHARACTERISTICS
(TYPICAL)**



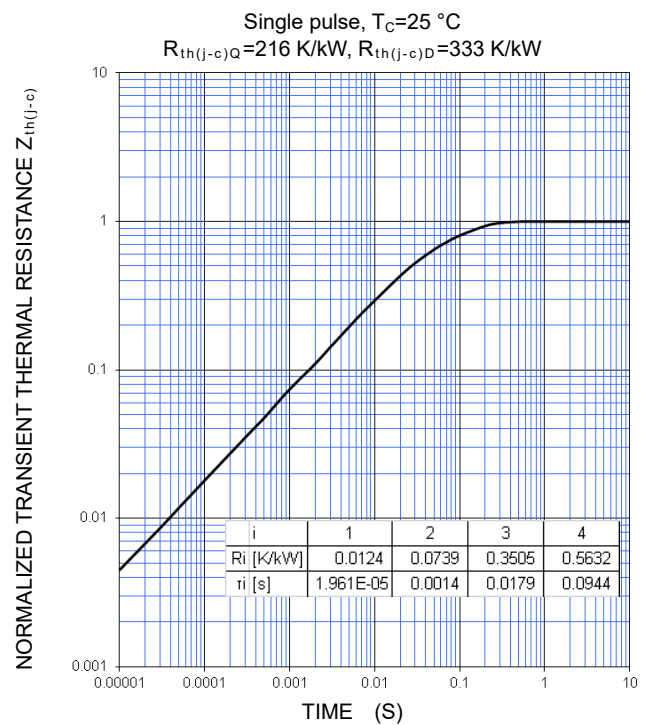
**FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)**



**GATE CHARGE CHARACTERISTICS
(TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)**



CM200TX-13T/CM200TXP-13T

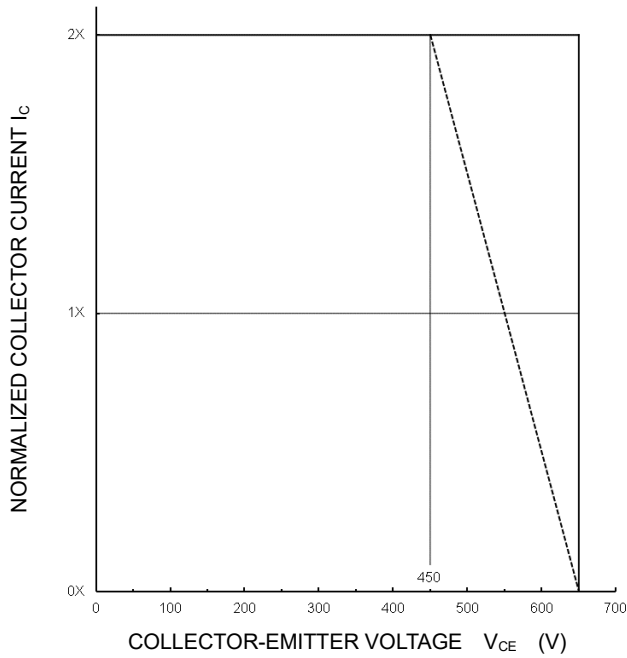
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

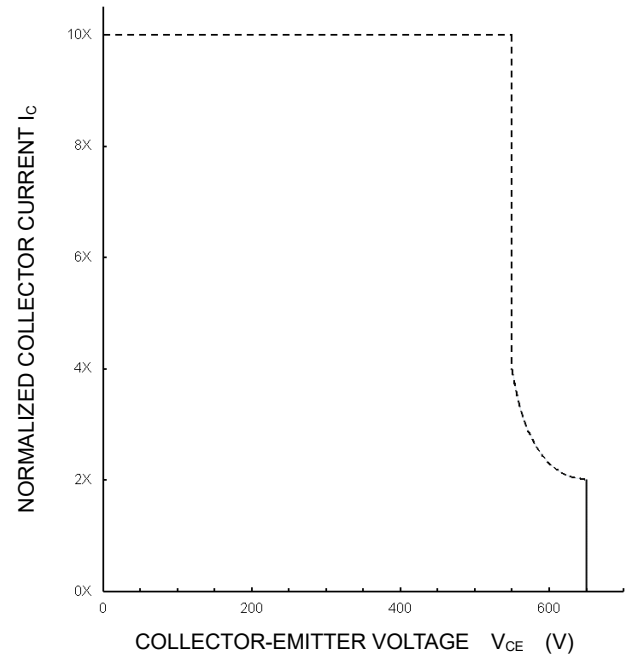
**TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)**

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



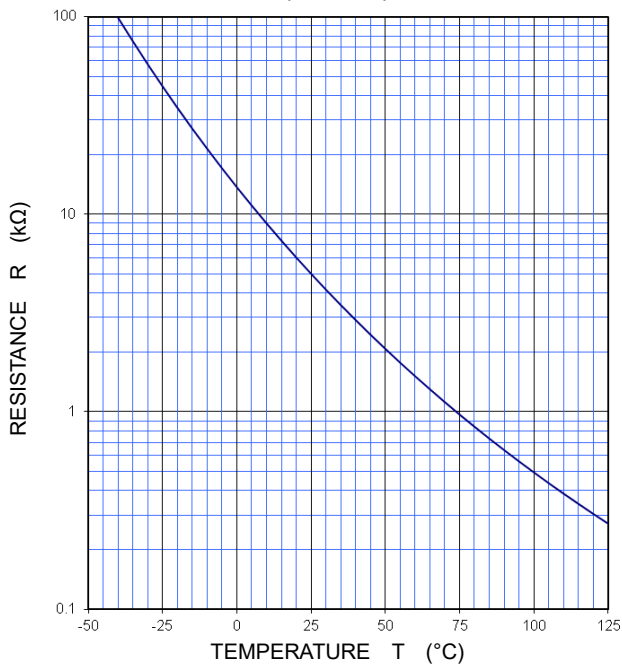
**SHORT-CIRCUIT SAFE OPERATING AREA
(MAXIMUM)**

$V_{CC} \leq 400 \text{ V}$, $R_G = 0.47 \sim 30 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$, $t_W \leq 8 \ \mu\text{s}$, 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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CM200TX-13T/CM200TXP-13T

HIGH POWER SWITCHING USE
INSULATED TYPE

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