



<IGBT Modules>

# CM150TX-24T/CM150TXP-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

 <p>TX</p>	<p>Collector current <math>I_c</math> ..... <b>1 5 0 A</b>          Collector-emitter voltage <math>V_{CES}</math> ..... <b>1 2 0 0 V</b>          Maximum junction temperature <math>T_{vjmax}</math> ..... <b>1 7 5 °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>1 5 0 A</b>          Collector-emitter voltage <math>V_{CES}</math> ..... <b>1 2 0 0 V</b>          Maximum junction temperature <math>T_{vjmax}</math> ..... <b>1 7 5 °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>sixpack (three-phase bridge)</p> <ul style="list-style-type: none"> <li>•UL Recognized under UL1557, File No. E323585</li> </ul>	

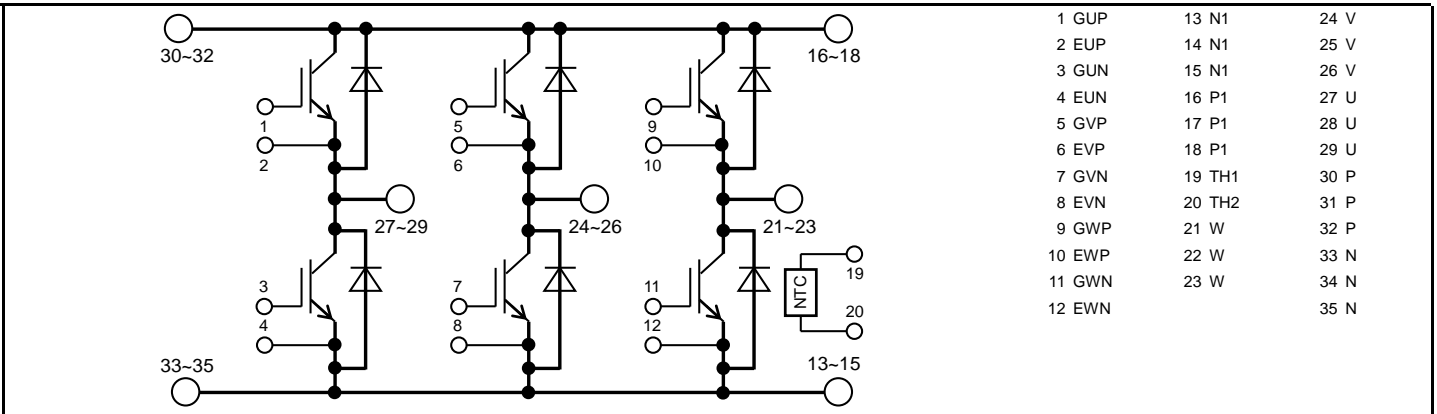
## APPLICATION

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



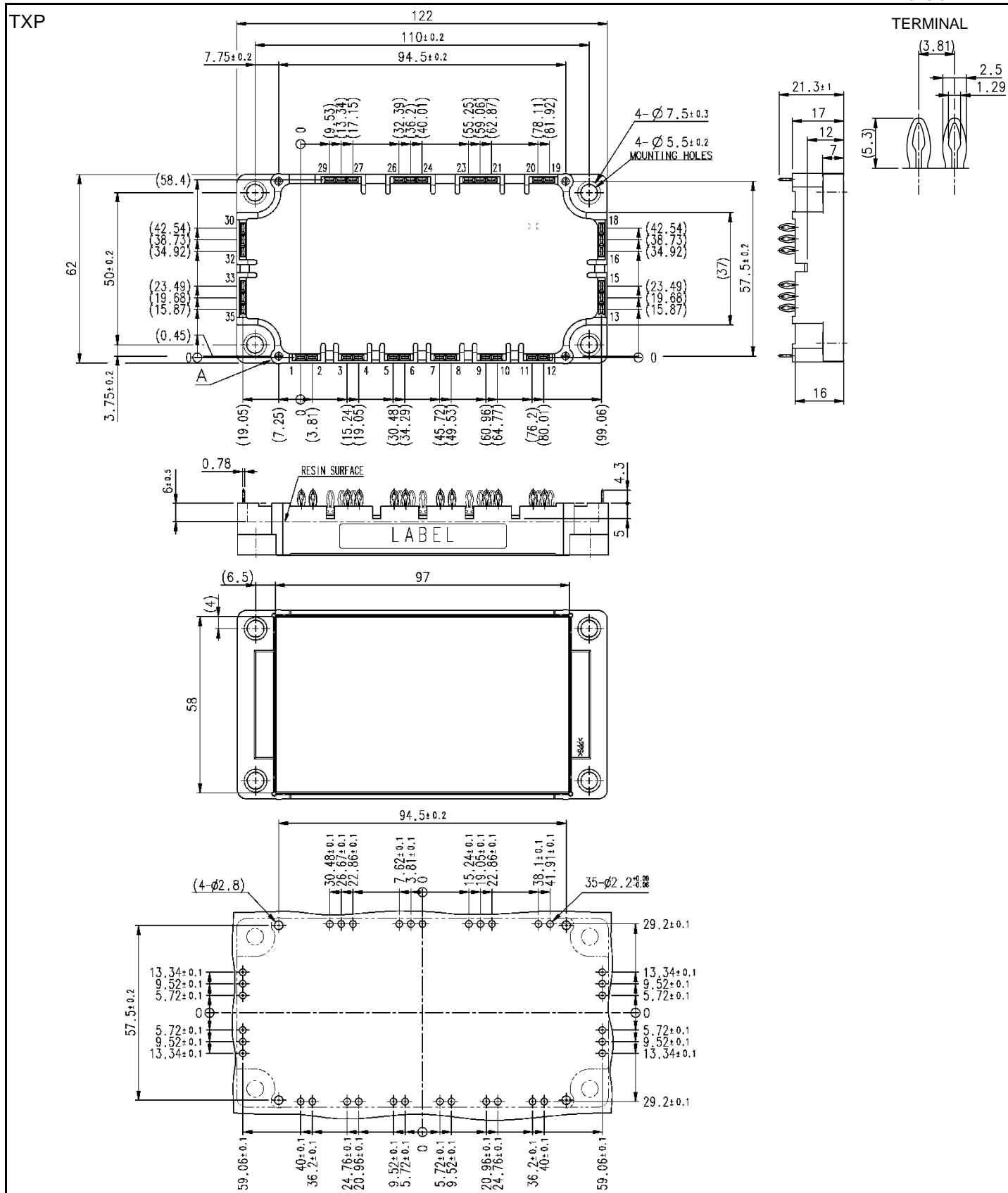


# CM150TX-24T/CM150TXP-24T

HIGH POWER SWITCHING USE  
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## OUTLINE DRAWING

Dimension in mm



# CM150TX-24T/CM150TXP-24T

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## 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	1200	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> =119 °C (Note2, 4)	150	A
I <sub>CRM</sub>		Pulse, Repetitive (Note3)	300	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note2, 4)	850	W
I <sub>E</sub> (Note1)	Emitter current	DC (Note2)	150	A
I <sub>ERM</sub> (Note1)		Pulse, Repetitive (Note3)	300	

### 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)	175	°C
T <sub>Cmax</sub>	Maximum case temperature	(Note4)	125	
T <sub>vjop</sub>	Operating junction temperature	Continuous operation (under switching)	-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> =15 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> =150 A, V <sub>GE</sub> =15 V, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.55	1.95	V
V <sub>CESat</sub> (Chip)			T <sub>vj</sub> =125 °C	-	1.75	-	
			T <sub>vj</sub> =150 °C	-	1.80	-	
V <sub>CEsat</sub> (Chip)	Collector-emitter saturation voltage	I <sub>C</sub> =150 A, V <sub>GE</sub> =15 V, (Note5)	T <sub>vj</sub> =25 °C	-	1.50	1.75	V
V <sub>CEsat</sub> (Terminal)			T <sub>vj</sub> =125 °C	-	1.70	-	
			T <sub>vj</sub> =150 °C	-	1.75	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited	-	-	36.4	nF	
C <sub>oes</sub>	Output capacitance		-	-	1.0		
C <sub>res</sub>	Reverse transfer capacitance		-	-	0.5		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =600 V, I <sub>C</sub> =150 A, V <sub>GE</sub> =15 V	-	1.13	-	µC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600 V, I <sub>C</sub> =150 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load	-	-	400	ns	
t <sub>r</sub>	Rise time		-	-	200		
t <sub>d(off)</sub>	Turn-off delay time		-	-	500		
t <sub>f</sub>	Fall time		-	-	500		
V <sub>EC</sub> (Terminal)	Emitter-collector voltage	I <sub>E</sub> =150 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.65	2.15	V
V <sub>EC</sub> (Chip)			T <sub>vj</sub> =125 °C	-	1.80	-	
			T <sub>vj</sub> =150 °C	-	1.85	-	
V <sub>EC</sub> (Terminal)	Emitter-collector voltage	I <sub>E</sub> =150 A, G-E short-circuited, (Note5)	T <sub>vj</sub> =25 °C	-	1.60	1.95	V
V <sub>EC</sub> (Chip)			T <sub>vj</sub> =125 °C	-	1.60	-	
			T <sub>vj</sub> =150 °C	-	1.60	-	
t <sub>rr</sub> (Note1)	Reverse recovery time	V <sub>CC</sub> =600 V, I <sub>E</sub> =150 A, V <sub>GE</sub> =±15 V,	-	-	300	ns	
Q <sub>rr</sub> (Note1)	Reverse recovery charge	R <sub>G</sub> =0 Ω, Inductive load	-	11.7	-	µC	
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =600 V, I <sub>C</sub> =I <sub>E</sub> =150 A,	-	12.1	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse	V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, T <sub>vj</sub> =150 °C,	-	18.1	-		
E <sub>rr</sub> (Note1)	Reverse recovery energy per pulse	Inductive load	-	12.8	-	mJ	
R <sub>CC'+EE'</sub>	Internal lead resistance	Main terminals-chip, per switch, T <sub>C</sub> =25 °C (Note4)	-	1.8	-	mΩ	
r <sub>g</sub>	Internal gate resistance	Per switch	-	2.0	-	Ω	

# CM150TX-24T/CM150TXP-24T

HIGH POWER SWITCHING USE  
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## 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)	-	-	176	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per Inverter FWD (Note4)	-	-	261	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, Thermal grease applied (Note4, 7)	-	11.5	-	K/kW
		per 1 module, PC-TIM applied (Note4, 8)	-	3.1	-	

## 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 (Note9)	±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.

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

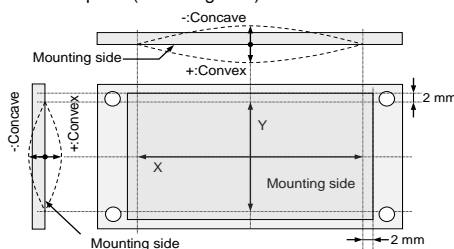
- Junction temperature (T<sub>vj</sub>) should not increase beyond T<sub>vjmax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>vj</sub>) dose not exceed T<sub>vjmax</sub> rating.
- Case temperature (T<sub>C</sub>) and heat sink temperature (T<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.
- Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

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

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)/D<sub>(C-S)</sub>=50 μm.
- Typical value is measured by using PC-TIM of λ=3.4 W/(m·K)/D<sub>(C-S)</sub>=50 μm.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



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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**

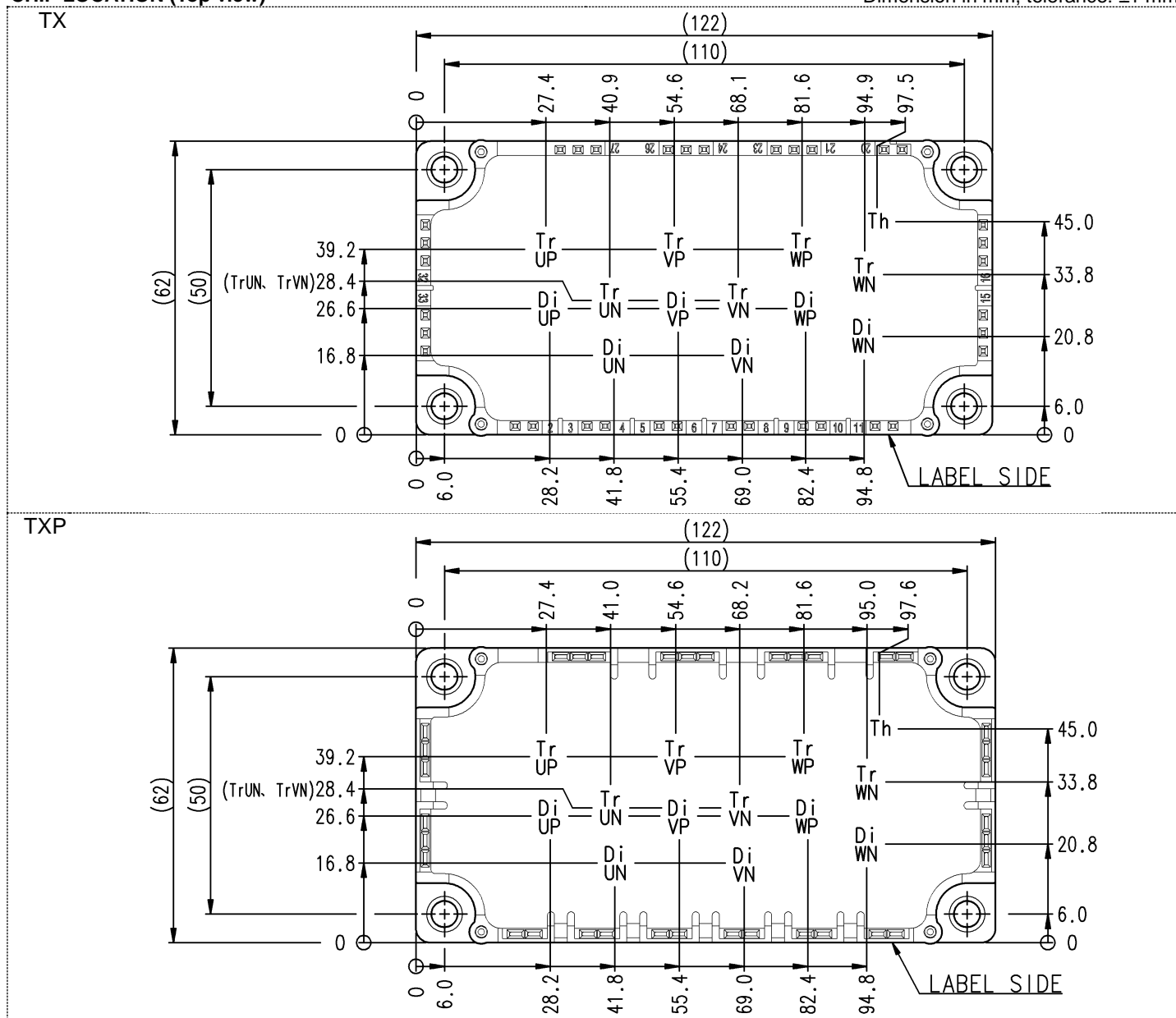
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>CC</sub>	(DC) Supply voltage	Applied across P-N terminals	-	600	850	V
V <sub>GEon</sub>	Gate (-emitter drive) voltage	Applied across G*P-E*P/G*N-E*N terminals (*=U,V,W)	13.5	15.0	16.5	V
R <sub>G</sub>	External gate resistance	Per switch	0	-	20	Ω

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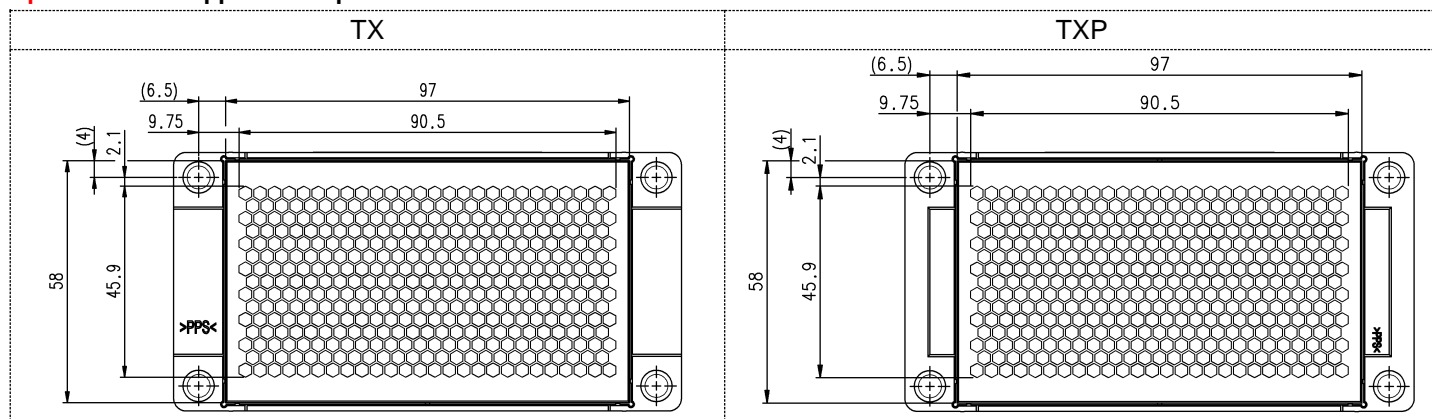
HIGH POWER SWITCHING USE  
INSULATED TYPE

## CHIP LOCATION (Top view)

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



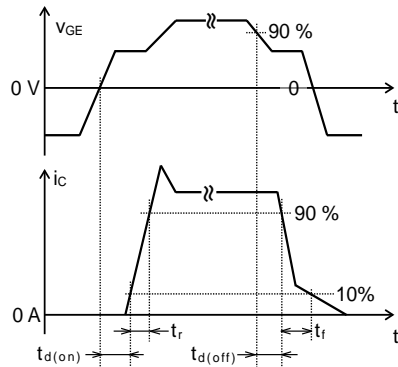
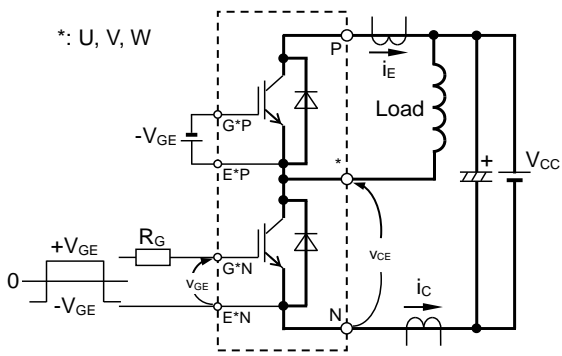
### Option: PC-TIM applied baseplate outline



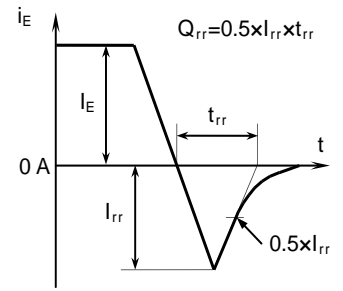
# CM150TX-24T/CM150TXP-24T

HIGH POWER SWITCHING USE  
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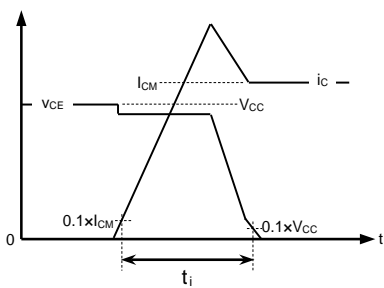
## TEST CIRCUIT AND WAVEFORMS



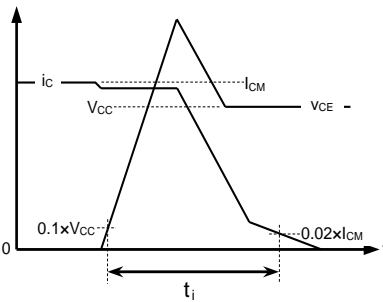
Switching characteristics test circuit and waveforms



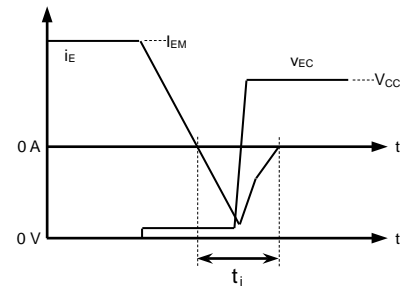
$t_{rr}$ ,  $Q_{rr}$  characteristics test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



FWD Reverse recovery energy

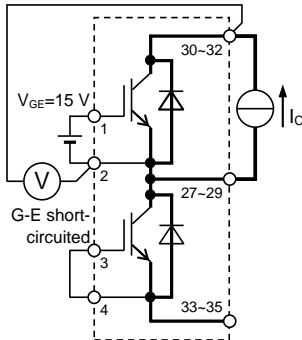
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)



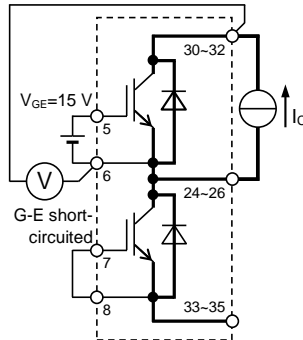
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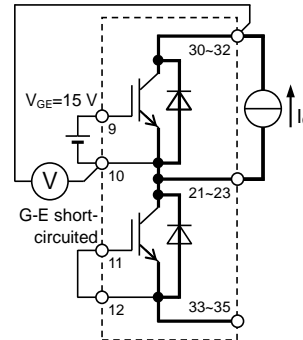
## TEST CIRCUIT



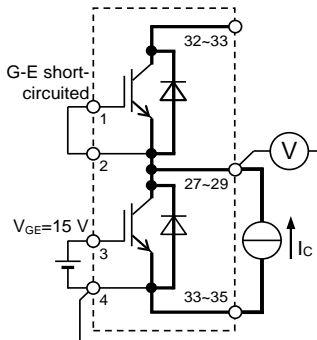
TrUP



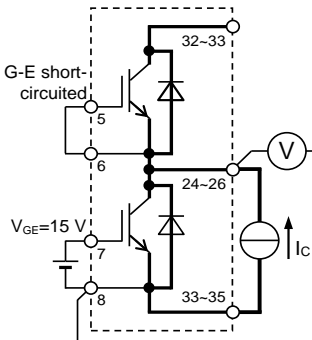
TrVP



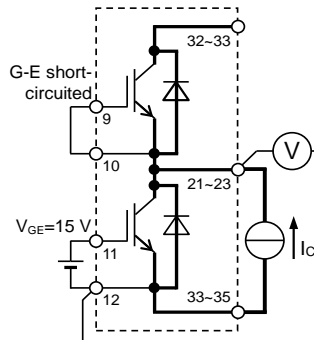
TrWP



TrUN



TrVN



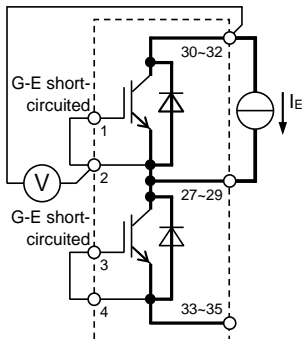
TrWN

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

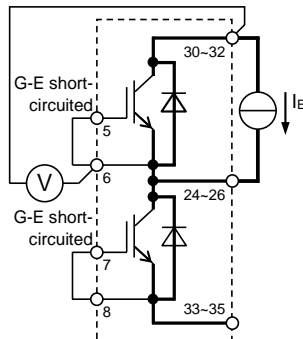
Gate-emitter GUP-EUP, GUN-EUN,  
short-circuited GWP-EWP, GWN-EWN

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

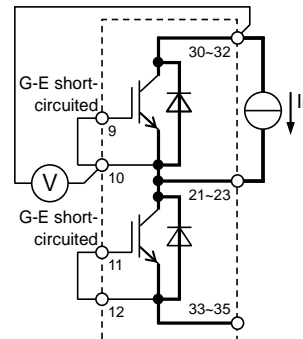
## $V_{CEsat}$ characteristics test circuit



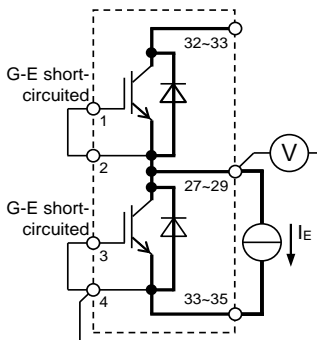
DiUP



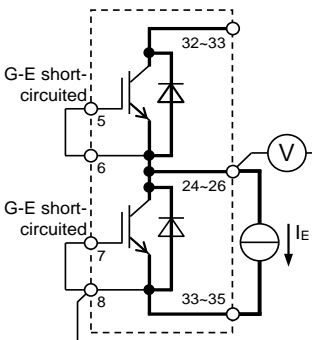
DiVP



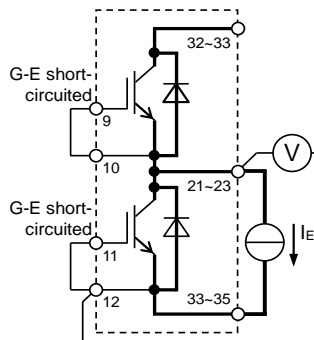
DiWP



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

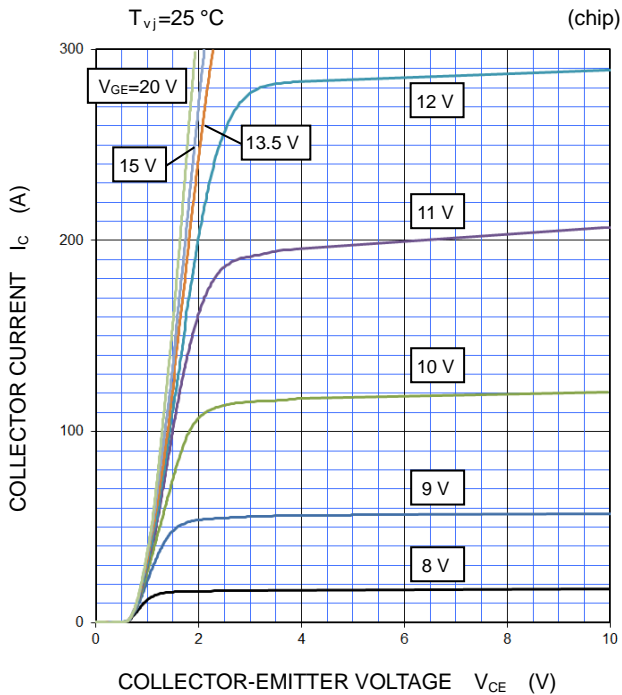
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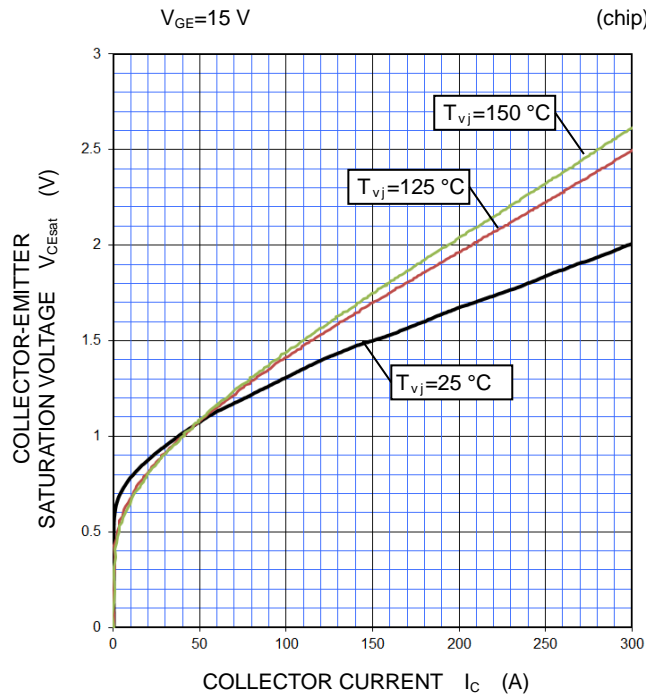
## PERFORMANCE CURVES

### INVERTER PART

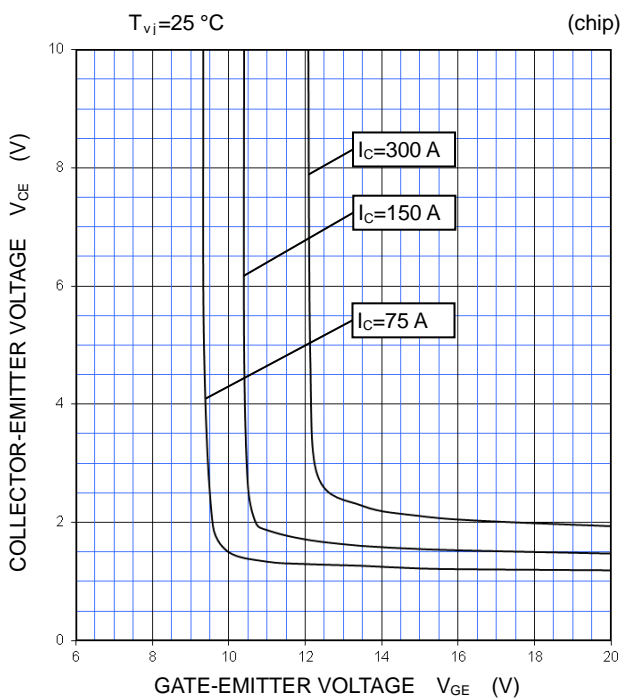
**OUTPUT CHARACTERISTICS (TYPICAL)**



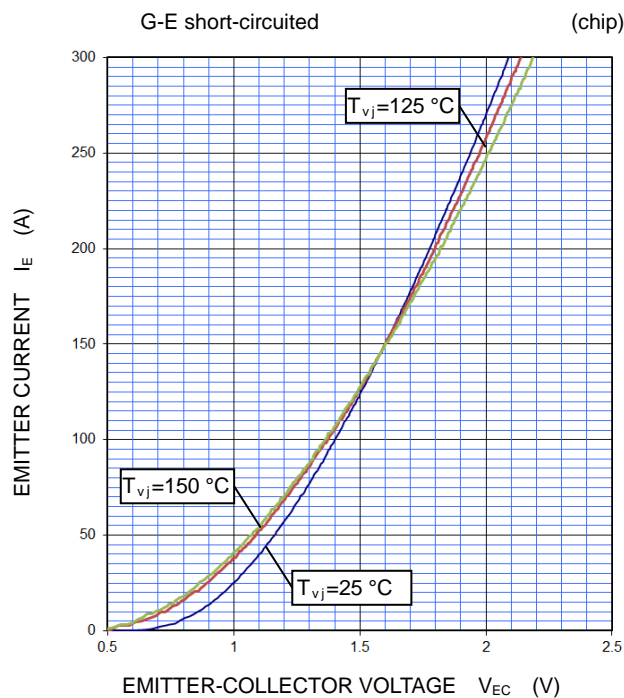
**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**



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



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



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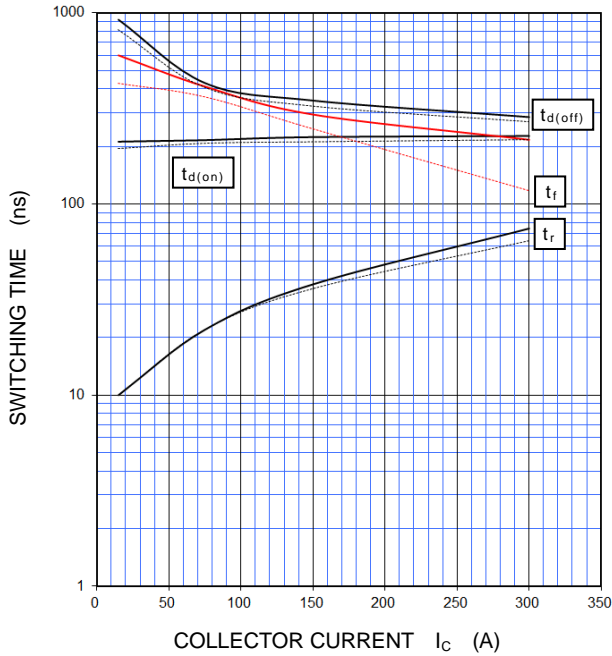
HIGH POWER SWITCHING USE  
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## PERFORMANCE CURVES

### INVERTER PART

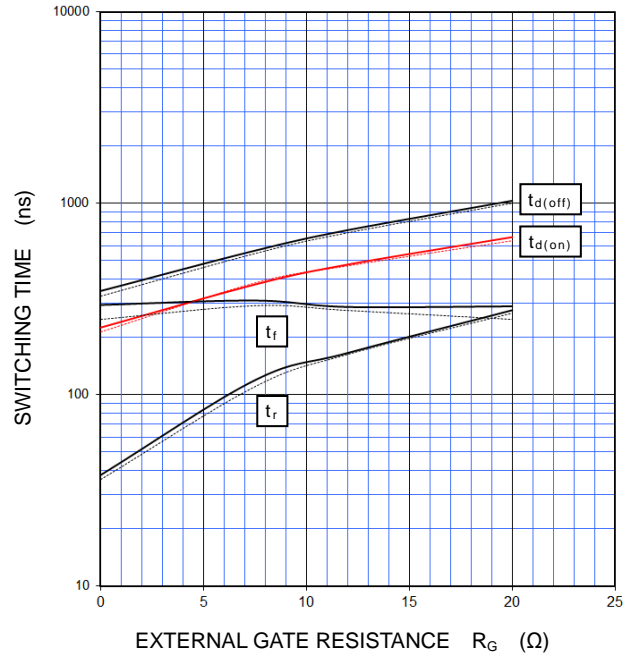
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $R_G=0\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



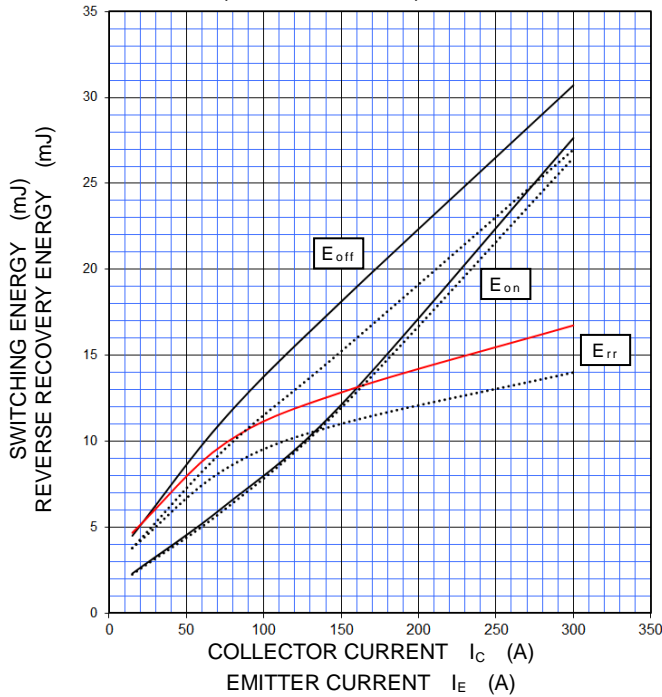
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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



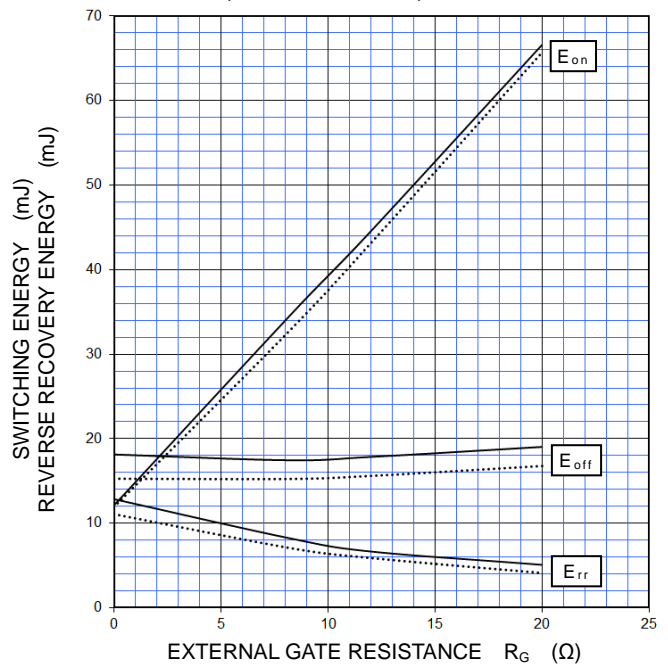
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $R_G=0\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD, PER PULSE  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



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

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



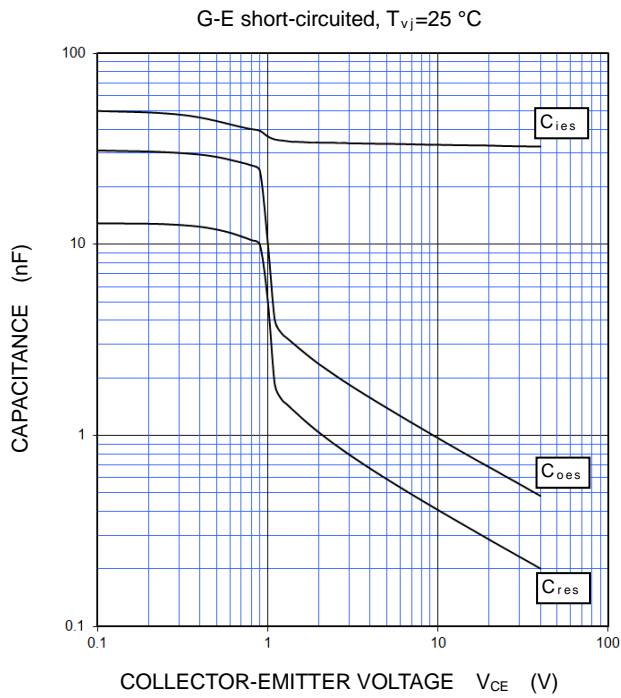
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INSULATED TYPE

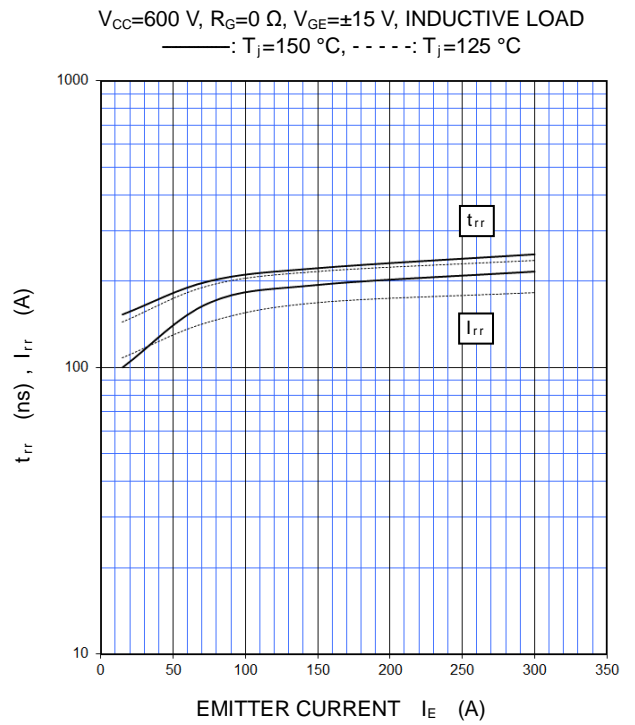
## PERFORMANCE CURVES

### INVERTER PART

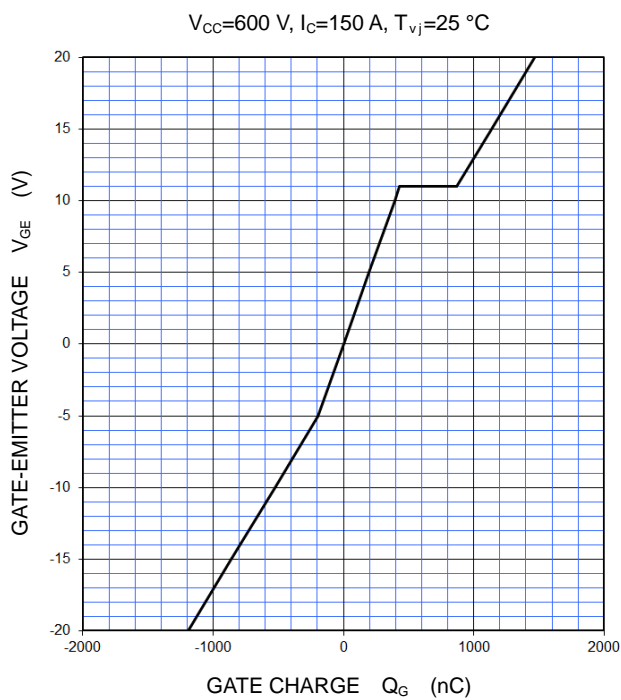
**CAPACITANCE CHARACTERISTICS (TYPICAL)**



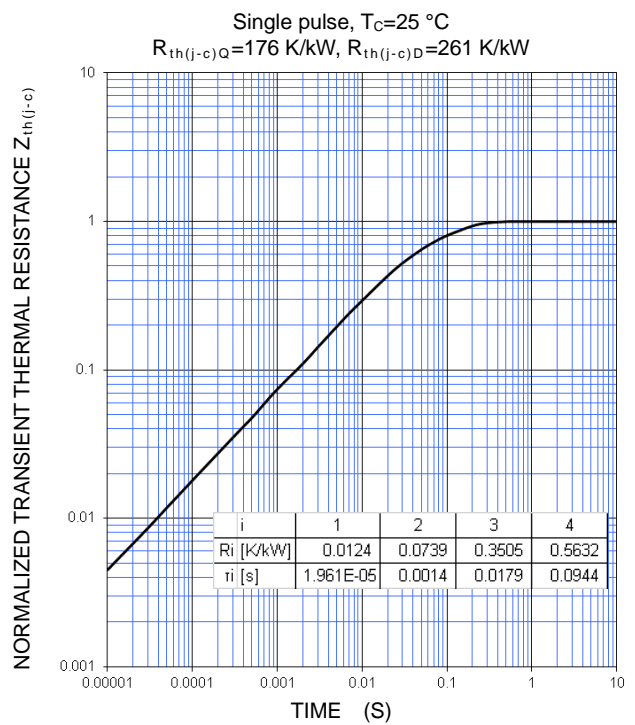
**FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



**GATE CHARGE CHARACTERISTICS (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**



# CM150TX-24T/CM150TXP-24T

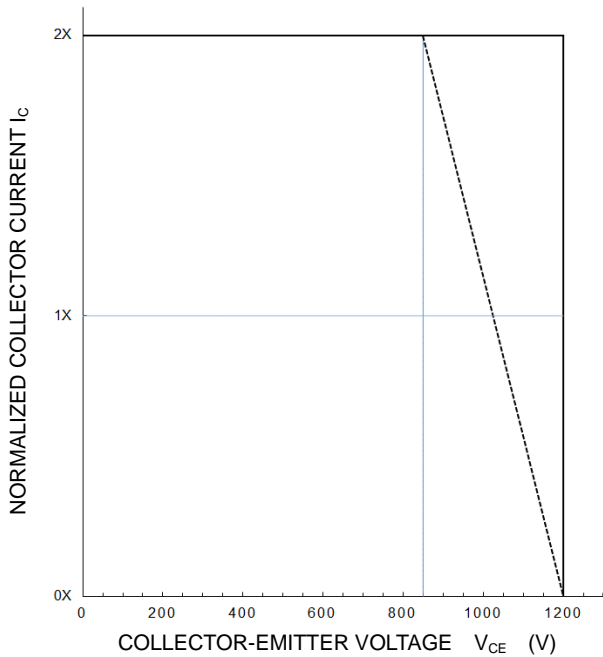
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

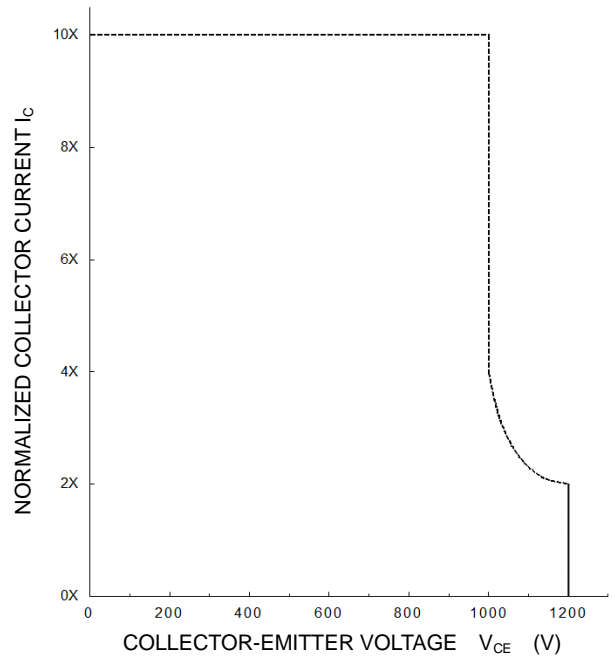
**TURN-OFF SWITCHING SAFE OPERATING AREA  
(REVERSE BIAS SAFE OPERATING AREA)  
(MAXIMUM)**

$V_{CC} \leq 850 \text{ V}$ ,  $R_G = 0 \sim 20 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 ———:  $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$  (Normal load operations (Continuous))  
 - - - - -:  $T_{vj} = 175 \text{ }^\circ\text{C}$  (Unusual load operations (Limited period))



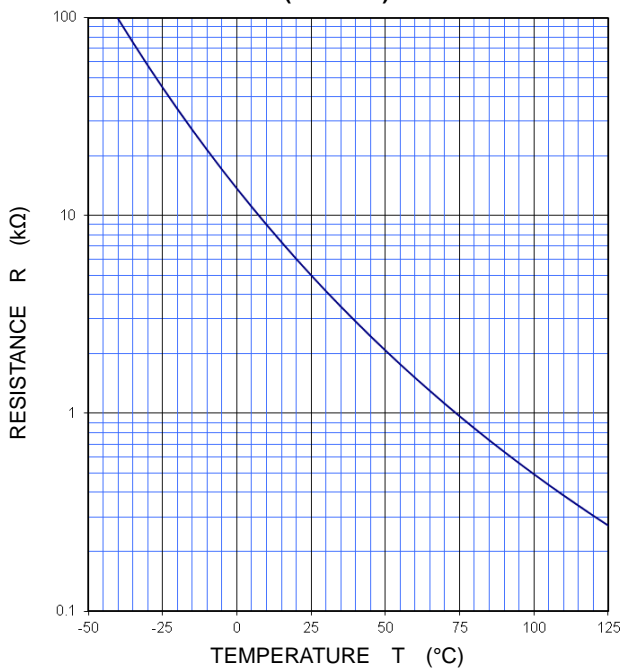
**SHORT-CIRCUIT SAFE OPERATING AREA  
(MAXIMUM)**

$V_{CC} \leq 800 \text{ V}$ ,  $R_G = 0 \sim 20 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ ,  $t_W \leq 8 \ \mu\text{s}$ , 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.

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