



<IGBT Modules>

# CM450DX-24T/CM450DXP-24T

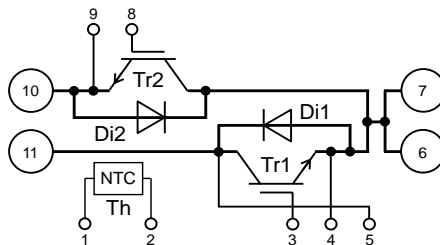
**HIGH POWER SWITCHING USE  
INSULATED TYPE**

 <p>DX</p>	<p>Collector current <math>I_C</math> ..... <b>4 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>•PC-TIM applied optional</li> <li>•Copper base plate (Ni-plating)</li> <li>•RoHS Directive compliant</li> <li>•Tin plating pin terminals</li> </ul>
 <p>DXP</p>	<p>Collector current <math>I_C</math> ..... <b>4 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>•PC-TIM applied optional</li> <li>•Copper base plate (Ni-plating)</li> <li>•RoHS Directive compliant</li> <li>•Tin plating pressfit terminals</li> </ul>
<p><b>dual switch (half-bridge)</b></p> <ul style="list-style-type: none"> <li>•Recognized under UL1557, File E323585</li> </ul>	

**APPLICATION**

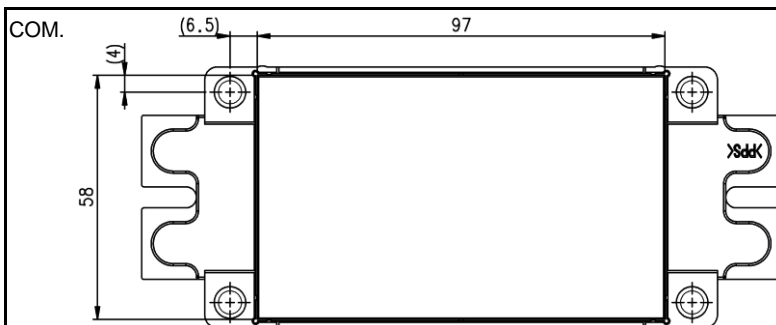
AC Motor Control, Motion/Servo Control, Power supply, etc.

**INTERNAL CONNECTION**

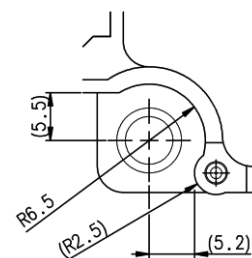


**TERMINAL CODE**

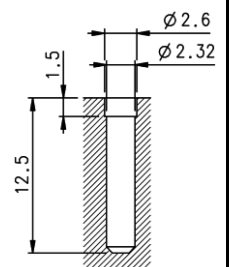
- |        |         |
|--------|---------|
| 1. TH1 | 6. C2E1 |
| 2. TH2 | 7. C2E1 |
| 3. G1  | 8. G2   |
| 4. Es1 | 9. Es2  |
| 5. Cs1 | 10. E2  |
|        | 11. C1  |



**MOUNTING HOLES**



**SECTION A**



Tolerance otherwise specified

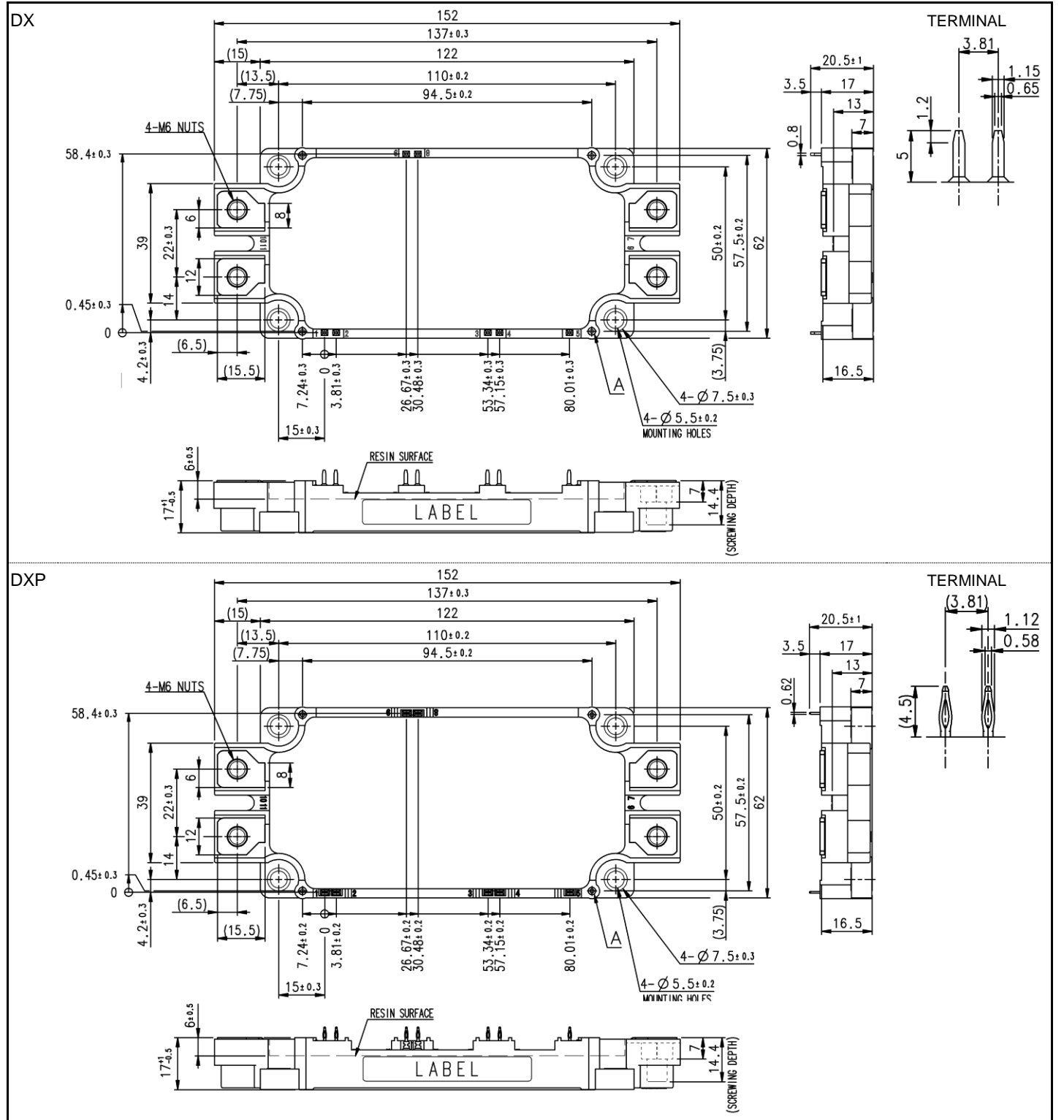
Division of Dimension	Tolerance
0.5 to 3	±0.2
over 3 to 6	±0.3
over 6 to 30	±0.5
over 30 to 120	±0.8
over 120 to 400	±1.2

# CM450DX-24T/CM450DXP-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

## OUTLINE DRAWING

Dimension in mm



# CM450DX-24T/CM450DXP-24T

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	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> =118 °C (Note2, 4)	450	A
I <sub>CRM</sub>		Pulse, Repetitive (Note3)	900	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note2, 4)	2500	W
I <sub>E</sub> (Note1)	Emitter current	DC (Note2)	450	A
I <sub>ERM</sub> (Note1)		Pulse, Repetitive (Note3)	900	

### 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> =45 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> =450 A, V <sub>GE</sub> =15 V, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.65	2.05	V
V <sub>CEsat</sub> (Chip)			T <sub>vj</sub> =125 °C	-	1.85	-	
			T <sub>vj</sub> =150 °C	-	1.90	-	
V <sub>CEsat</sub> (Chip)	Collector-emitter saturation voltage	I <sub>C</sub> =450 A, V <sub>GE</sub> =15 V, (Note5)	T <sub>vj</sub> =25 °C	-	1.50	1.75	V
			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	-	-	109.1	nF	
C <sub>oes</sub>	Output capacitance		-	-	3.1		
C <sub>res</sub>	Reverse transfer capacitance		-	-	1.4		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =600 V, I <sub>C</sub> =450 A, V <sub>GE</sub> =15 V	-	3.4	-	µC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600 V, I <sub>C</sub> =450 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =1.3 Ω, Inductive load	-	-	600	ns	
t <sub>r</sub>	Rise time		-	-	200		
t <sub>d(off)</sub>	Turn-off delay time		-	-	800		
t <sub>f</sub>	Fall time		-	-	400		
V <sub>EC</sub> (Terminal) (Note1)	Emitter-collector voltage	I <sub>E</sub> =450 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	1.70	2.25	V
V <sub>EC</sub> (Chip) (Note1)			T <sub>vj</sub> =125 °C	-	1.85	-	
			T <sub>vj</sub> =150 °C	-	1.90	-	
V <sub>EC</sub> (Chip) (Note1)	Emitter-collector voltage	I <sub>E</sub> =450 A, G-E short-circuited, (Note5)	T <sub>vj</sub> =25 °C	-	1.50	1.85	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> =600 V, I <sub>E</sub> =450 A, V <sub>GE</sub> =±15 V,	-	-	400	ns	
Q <sub>rr</sub> (Note1)	Reverse recovery charge	R <sub>G</sub> =1.3 Ω, Inductive load	-	35.1	-	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> =450 A,	-	40.8	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse	V <sub>GE</sub> =±15 V, R <sub>G</sub> =1.3 Ω, T <sub>vj</sub> =150 °C,	-	45	-		
E <sub>rr</sub> (Note1)	Reverse recovery energy per pulse	Inductive load	-	32.4	-	mJ	
R <sub>CC'+EE'</sub>	Internal lead resistance	Main terminals-chip, per switch, T <sub>C</sub> =25 °C (Note4)	-	0.75	-	mΩ	
r <sub>g</sub>	Internal gate resistance	Per switch	-	0.67	-	Ω	

# CM450DX-24T/CM450DXP-24T

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)	-	-	60	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per Inverter FWD (Note4)	-	-	87	
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>t</sub>	Mounting torque	Main terminals M 6 screw	3.5	4.0	4.5	N·m	
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 (DX)	Terminal to terminal	17	-	-	mm
			Terminal to base plate	16.4	-	-	
		Pressfit pin type (DXP)	Terminal to terminal	17	-	-	mm
			Terminal to base plate	16.8	-	-	
d <sub>a</sub>	Clearance	Solder pin type (DX)	Terminal to terminal	10	-	-	mm
			Terminal to base plate	16.2	-	-	
		Pressfit pin type (DXP)	Terminal to terminal	10	-	-	mm
			Terminal to base plate	16.2	-	-	
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note9)	±0	-	+200	μm	
m	mass	-	-	300	-	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).

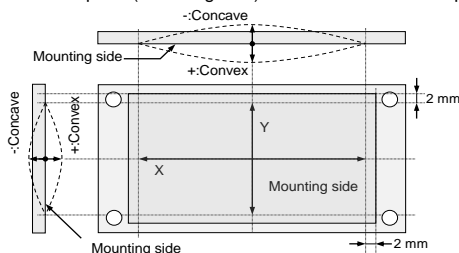
- Junction temperature (T<sub>vj</sub>) should not increase beyond T<sub>vjmax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>vj</sub>) dose not exceed T<sub>vjmax</sub> rating.
- Case temperature (T<sub>C</sub>) and heat sink temperature (T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

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

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)/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.



**CM450DX-24T/CM450DXP-24T**

HIGH POWER SWITCHING USE

INSULATED TYPE

Note10. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.

The length of the screw depends on thickness (t1.0~t1.6) of the PCB.

Type	Size	Tightening torque	Recommended tightening method
(1) PT®	K25×8	0.55 ± 0.055 N·m	by handwork (equivalent to 30 r/min by mechanical screw driver) ~ 600 r/min (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 or φ2.6×12	0.75 ± 0.075 N·m	

**RECOMMENDED OPERATING CONDITIONS**

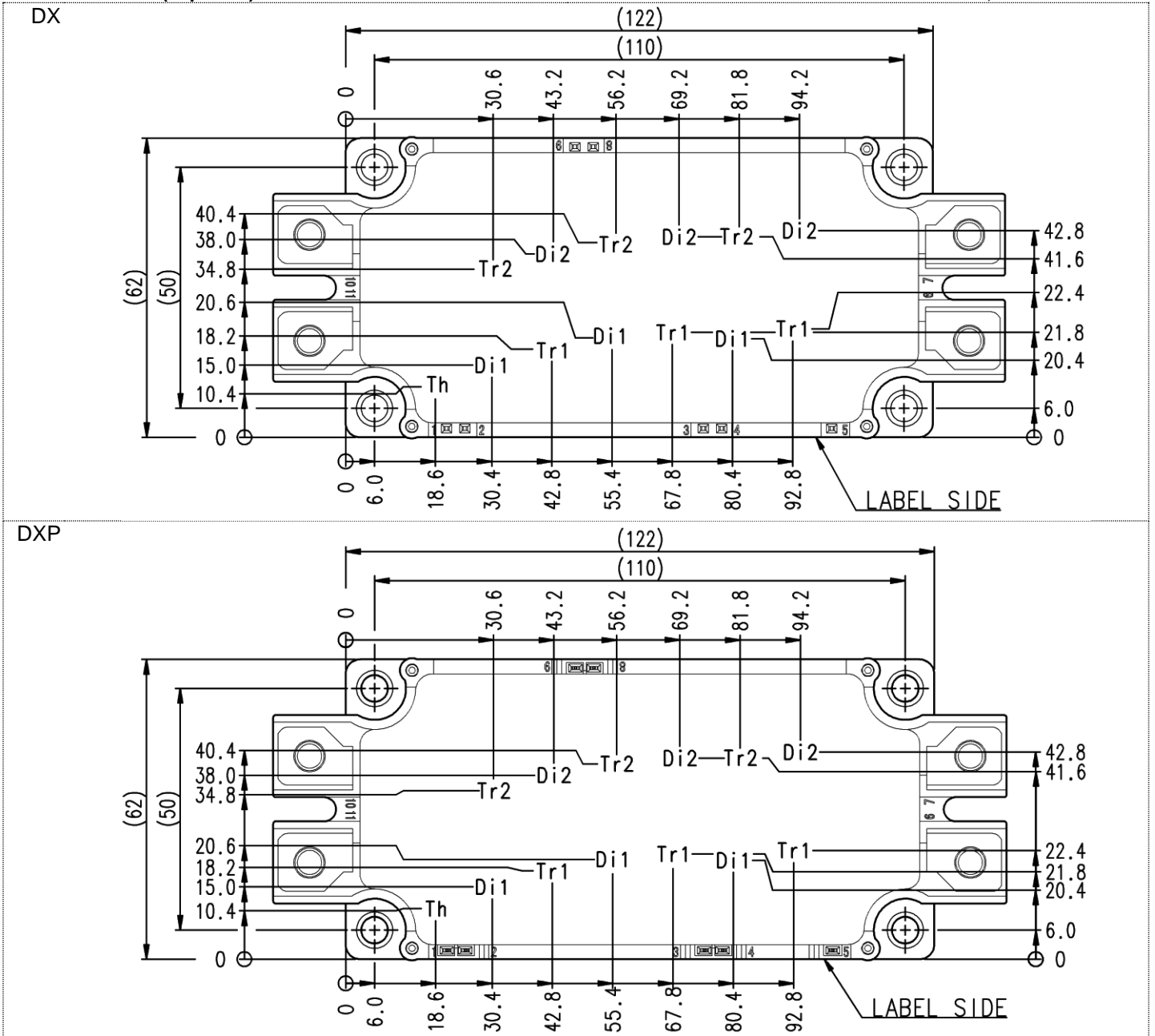
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC}$	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	V
$V_{GEon}$	Gate (-emitter drive) voltage	Applied across G1-E1s/G2-E2s terminals	13.5	15.0	16.5	V
$R_G$	External gate resistance	Per switch	1.3	-	10	Ω

# CM450DX-24T/CM450DXP-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

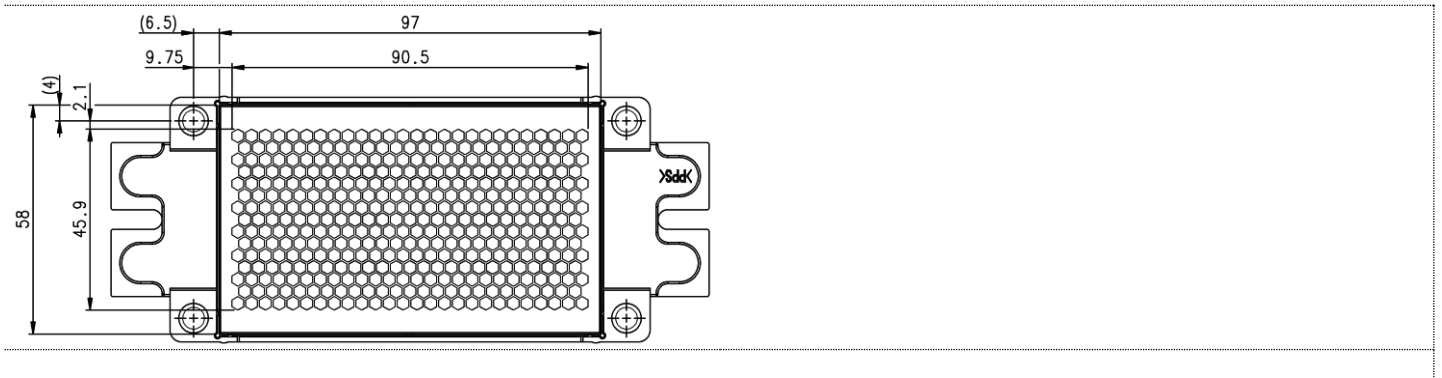
## CHIP LOCATION (Top view)

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



Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

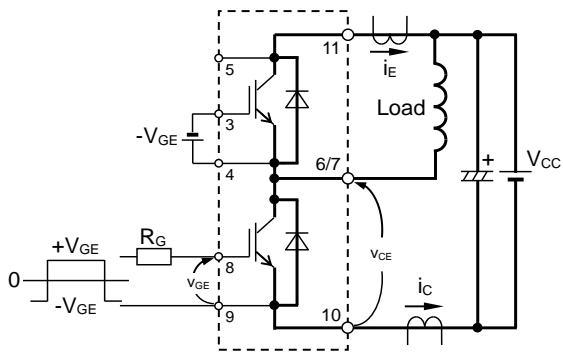
## PC-TIM applied (option) baseplate outline



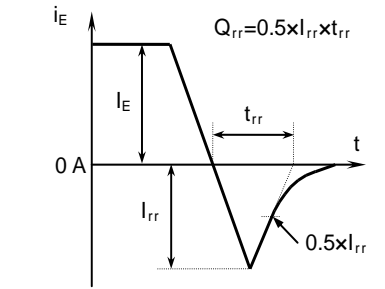
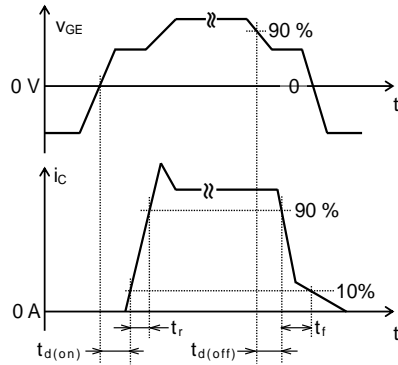
# CM450DX-24T/CM450DXP-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

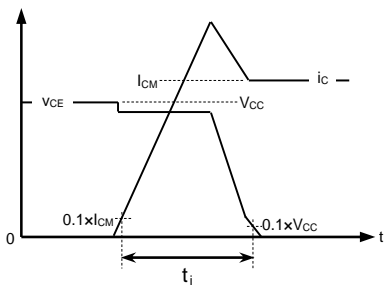
## TEST CIRCUIT AND WAVEFORMS



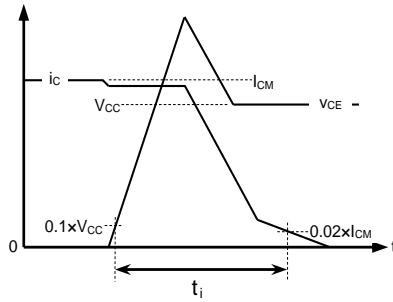
Switching characteristics test circuit and waveforms



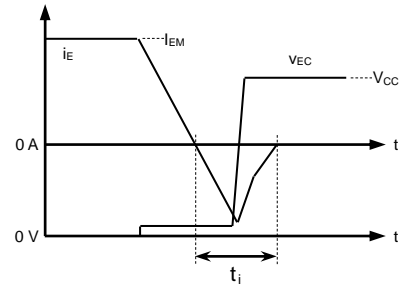
$t_{rr}$ ,  $Q_{rr}$  characteristics test waveform



IGBT Turn-on switching energy



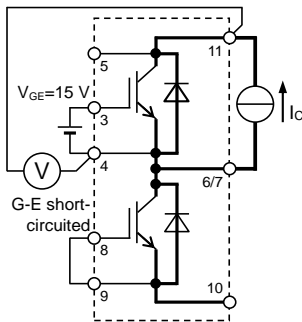
IGBT Turn-off switching energy



FWD Reverse recovery energy

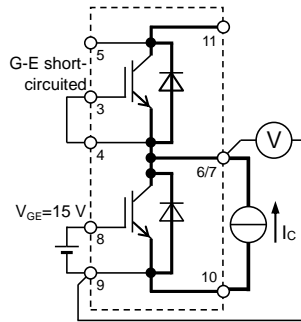
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

## TEST CIRCUIT

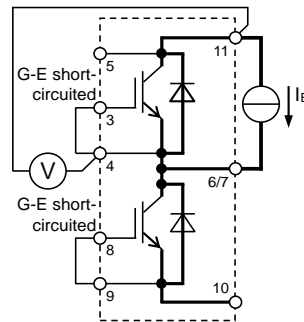


Tr1

$V_{CEsat}$  characteristics test circuit

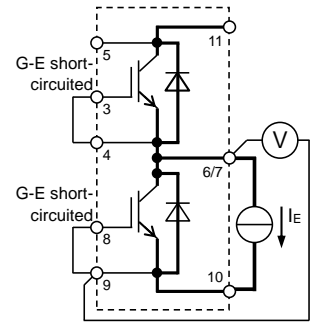


Tr2



Di1

$V_{EC}$  characteristics test circuit



Di2

# CM450DX-24T/CM450DXP-24T

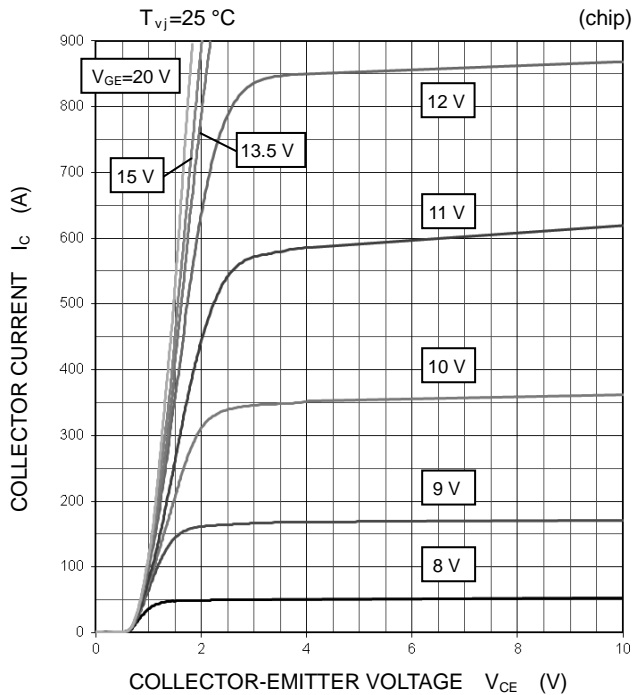
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

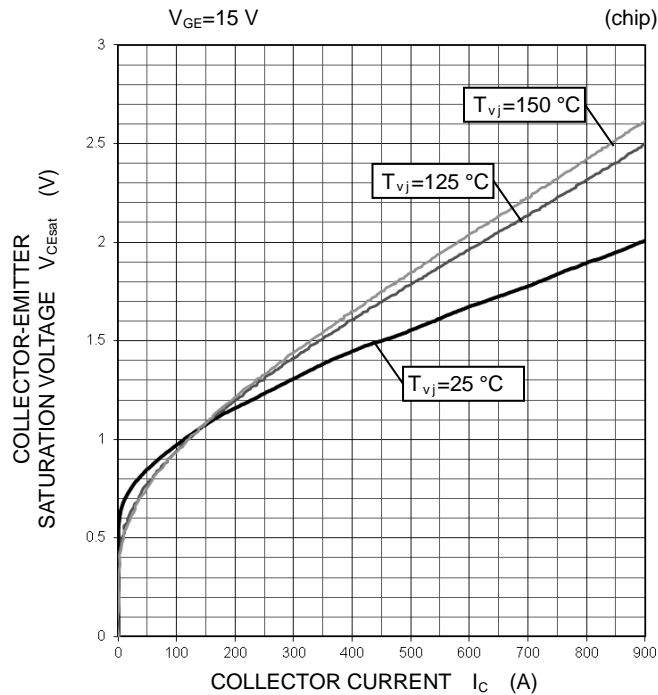
#### OUTPUT CHARACTERISTICS

(TYPICAL)



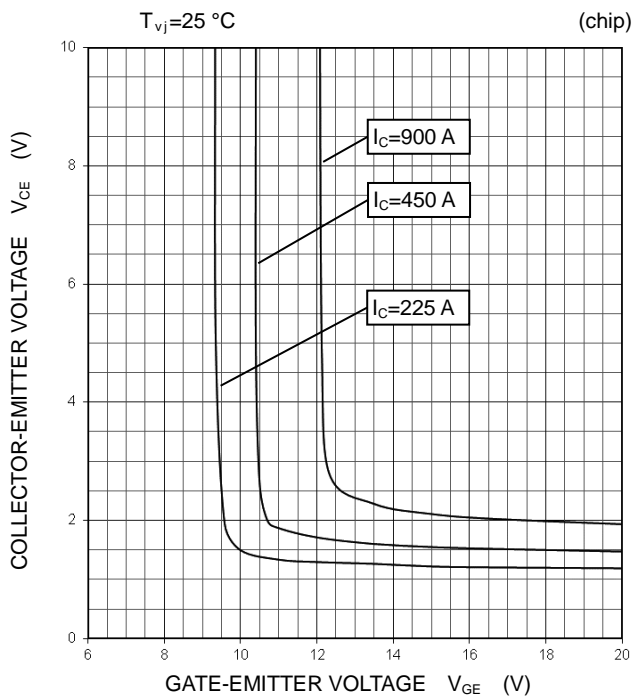
#### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



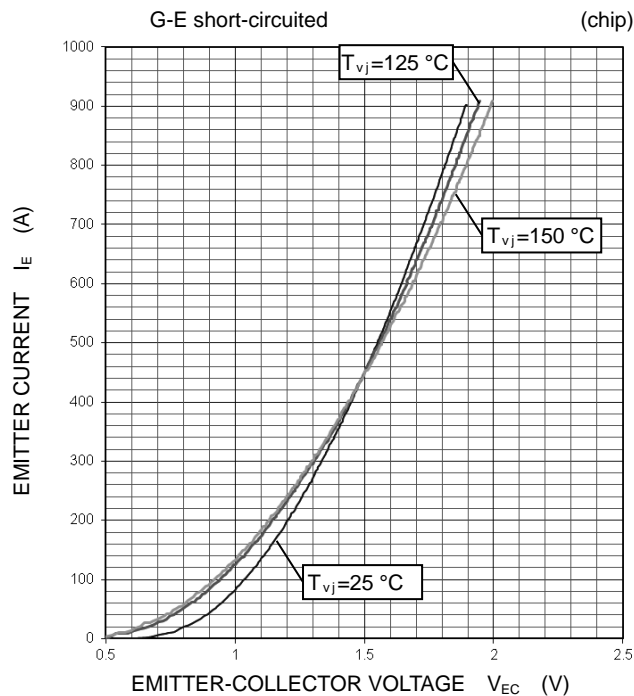
#### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



#### FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)





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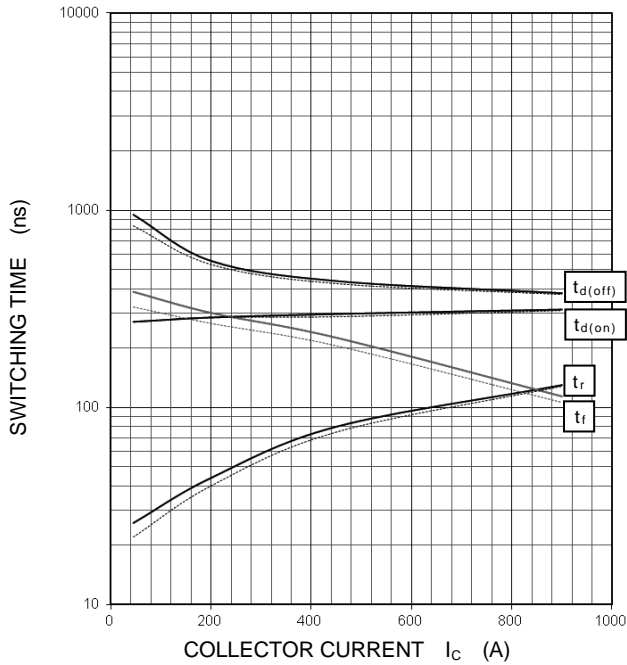
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

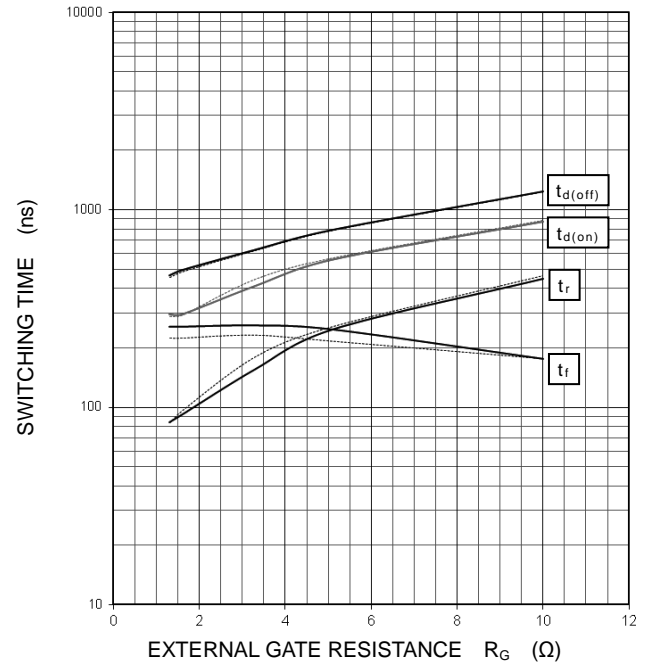
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $R_G=1.3\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



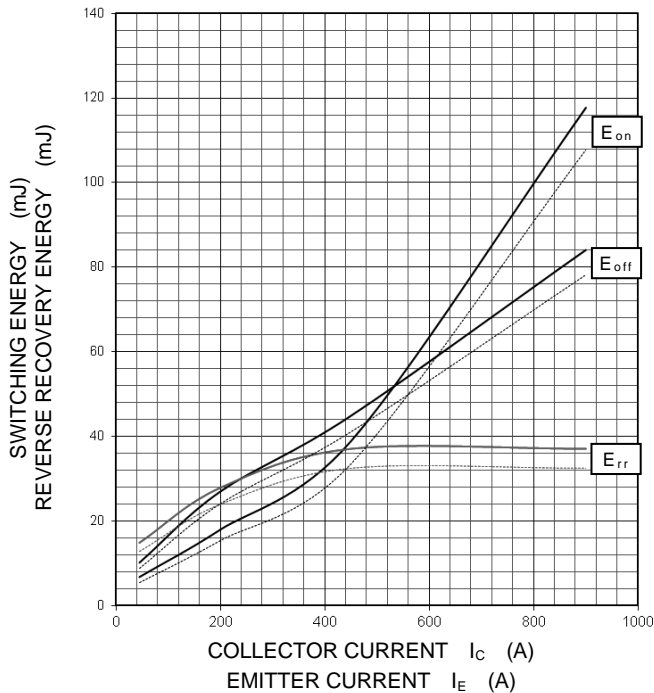
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C=450\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



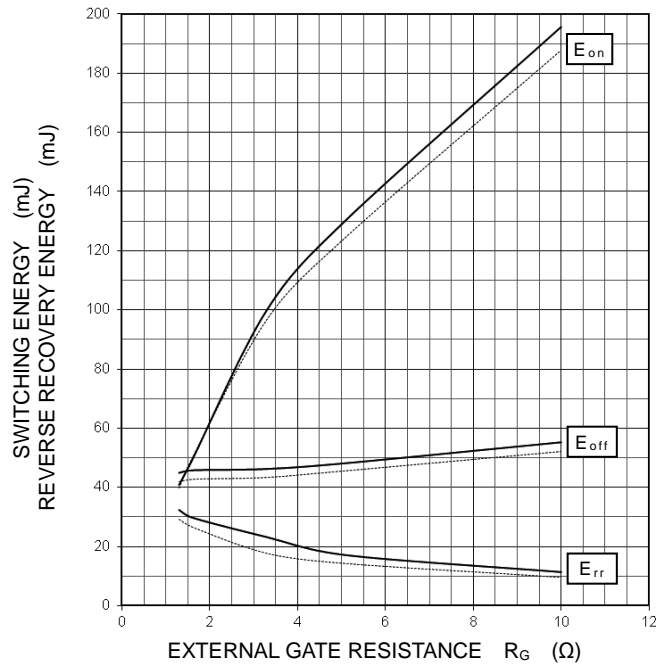
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $R_G=1.3\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD,  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$ , PER PULSE



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

$V_{CC}=600\text{ V}$ ,  $I_C/I_E=450\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD,  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - - -:  $T_{vj}=125\text{ }^\circ\text{C}$ , PER PULSE



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HIGH POWER SWITCHING USE  
INSULATED TYPE

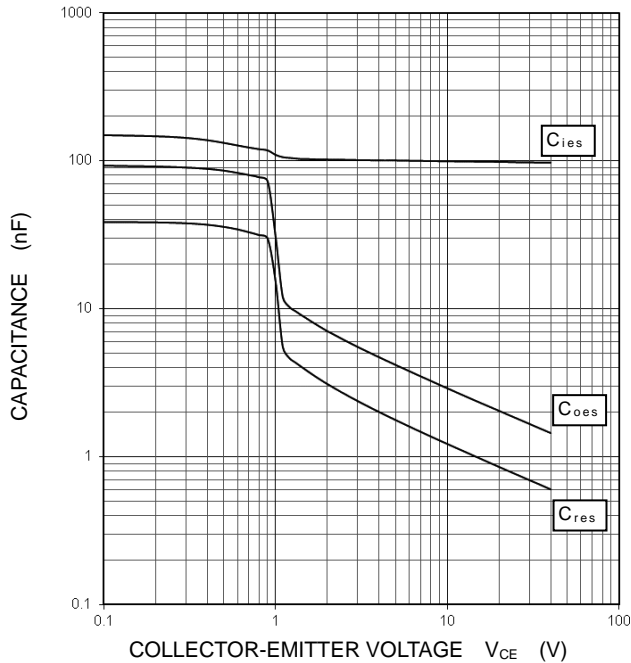
## PERFORMANCE CURVES

### INVERTER PART

#### CAPACITANCE CHARACTERISTICS

(TYPICAL)

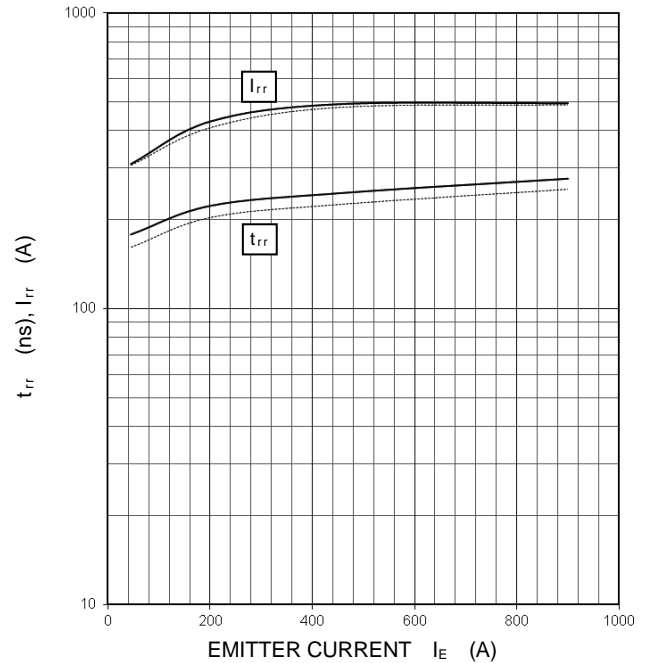
G-E short-circuited,  $T_{vj}=25\text{ }^{\circ}\text{C}$



#### FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS

(TYPICAL)

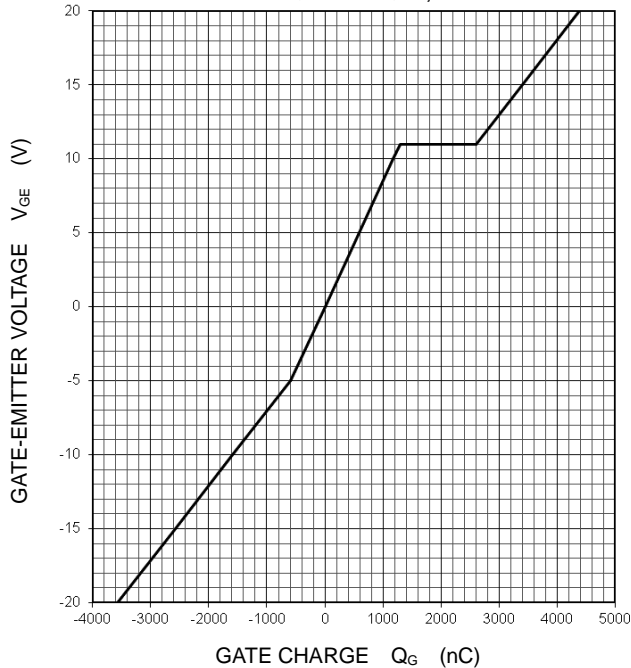
$V_{CC}=600\text{ V}$ ,  $R_G=1.3\text{ }\Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
—:  $T_j=150\text{ }^{\circ}\text{C}$ , - - - -:  $T_j=125\text{ }^{\circ}\text{C}$



#### GATE CHARGE CHARACTERISTICS

(TYPICAL)

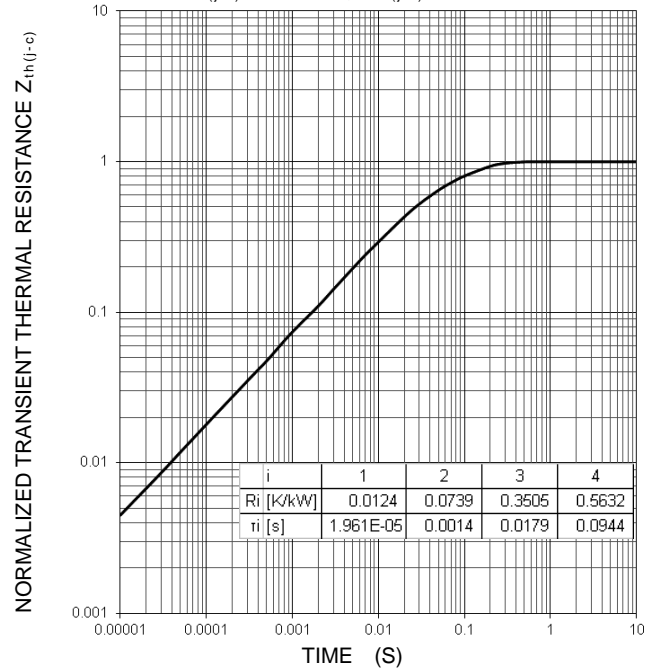
$V_{CC}=600\text{ V}$ ,  $I_C=450\text{ A}$ ,  $T_{vj}=25\text{ }^{\circ}\text{C}$



#### TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

(MAXIMUM)

Single pulse,  $T_C=25\text{ }^{\circ}\text{C}$   
 $R_{th(j-c)Q}=60\text{ K/kW}$ ,  $R_{th(j-c)D}=87\text{ K/kW}$



# CM450DX-24T/CM450DXP-24T

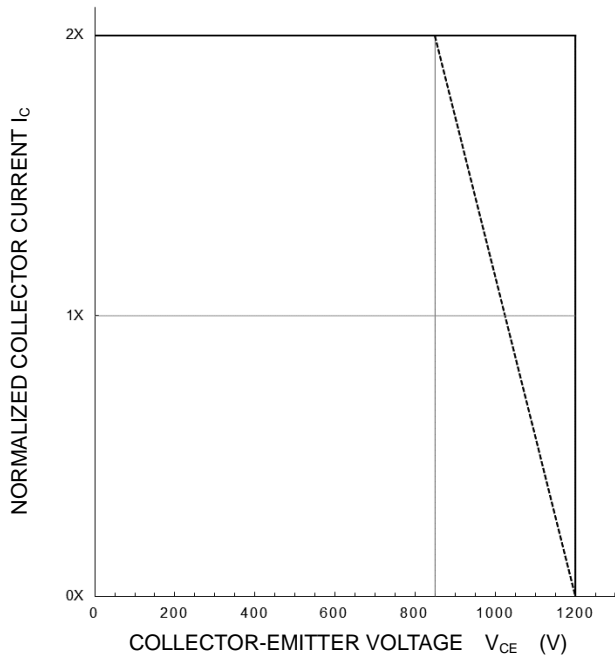
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

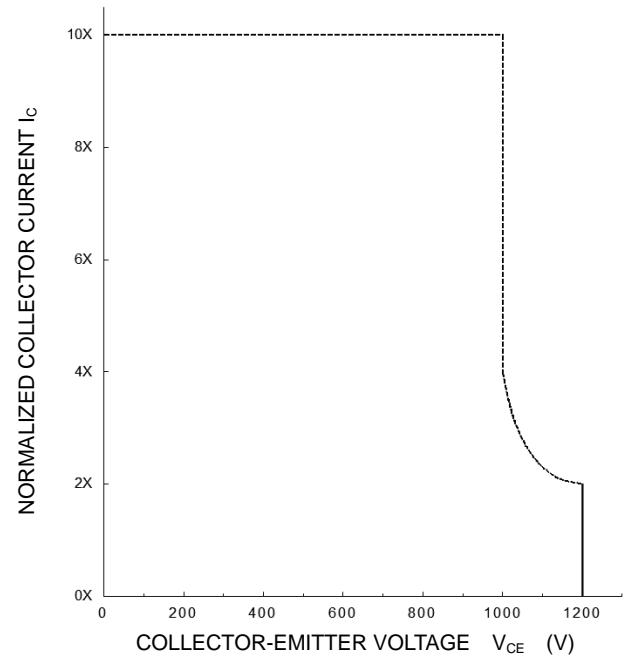
**TURN-OFF SWITCHING SAFE OPERATING AREA  
(REVERSE BIAS SAFE OPERATING AREA)  
(MAXIMUM)**

$V_{CC} \leq 850 \text{ V}$ ,  $R_G = 1.3 \sim 10 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 ———:  $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$  (Normal load operations (Continuous))  
 - - - - -:  $T_{vj} = 175 \text{ }^\circ\text{C}$  (Unusual load operations (Limited period))



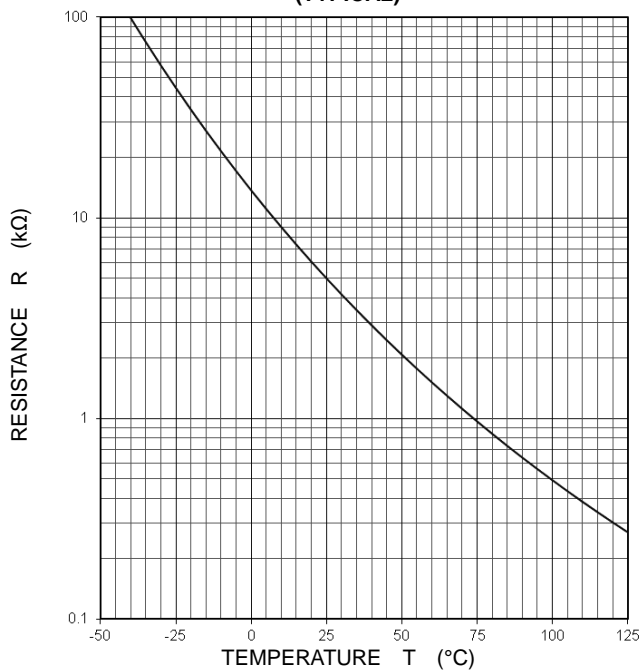
**SHORT-CIRCUIT SAFE OPERATING AREA  
(MAXIMUM)**

$V_{CC} \leq 800 \text{ V}$ ,  $R_G = 1.3 \sim 10 \ \Omega$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ ,  $t_W \leq 8 \ \mu\text{s}$ , 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.

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

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