



<IGBT Modules>

CM450DX-34T/CM450DXP-34T

**HIGH POWER SWITCHING USE
INSULATED TYPE**

 <p>DX</p>	<p>Collector current I_C 4 5 0 A Collector-emitter voltage V_{CES} 1 7 0 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>DXP</p>	<p>Collector current I_C 4 5 0 A Collector-emitter voltage V_{CES} 1 7 0 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>dual switch (half-bridge)</p> <ul style="list-style-type: none"> • UL Recognized under UL1557, File No. E323585 	

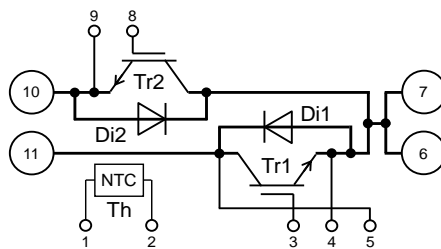
APPLICATION

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

OPTION (Below options are available.)

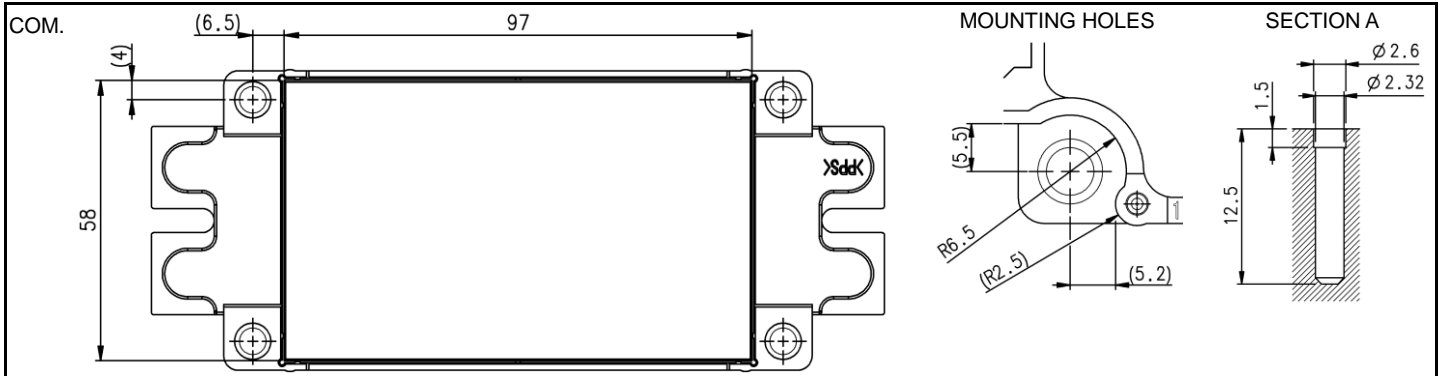
- PC-TIM (Phase Change Thermal Interface Material) pre-apply
- V_{CEsat} selection for parallel connection

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 |



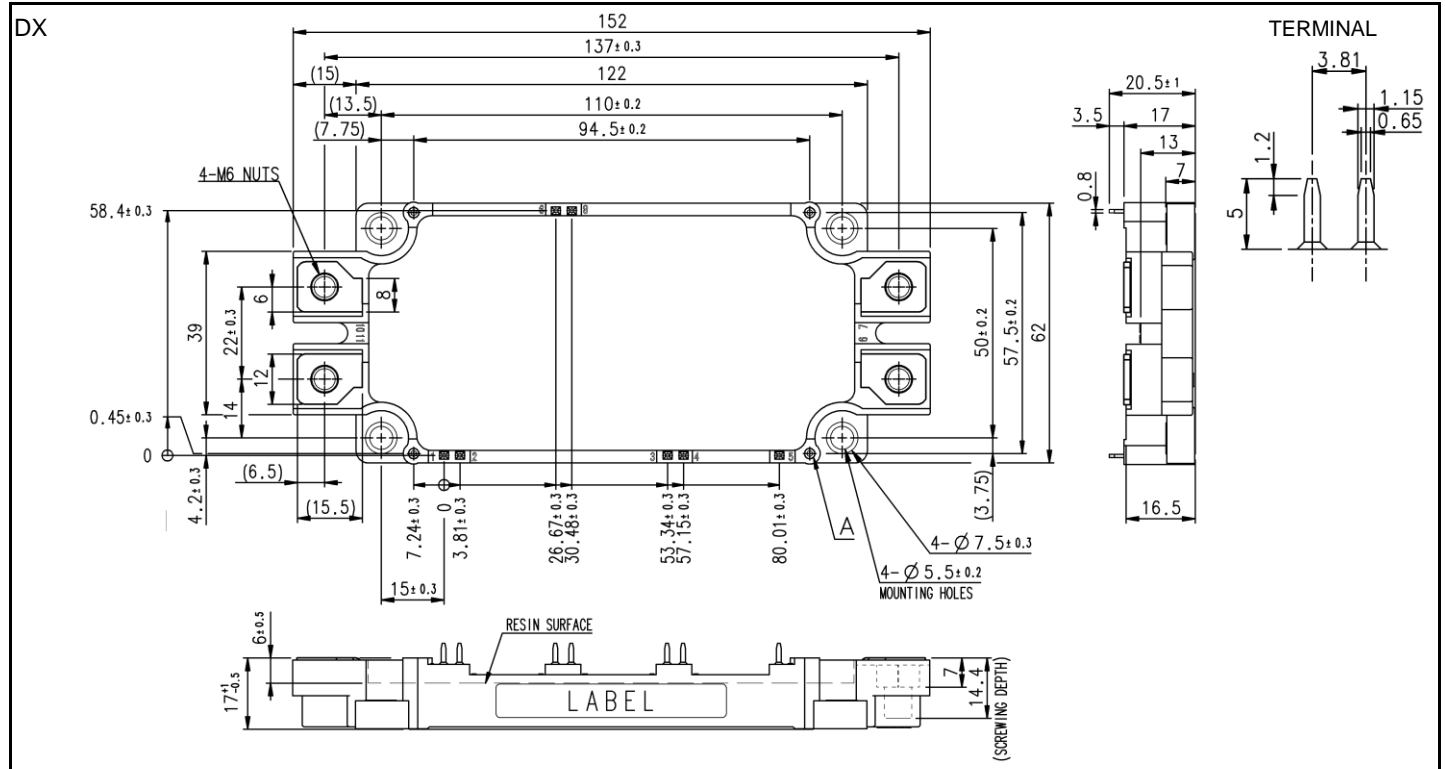
CM450DX-34T/CM450DXP-34T

HIGH POWER SWITCHING USE

INSULATED TYPE

OUTLINE DRAWING

Dimension in mm



Tolerance otherwise specified

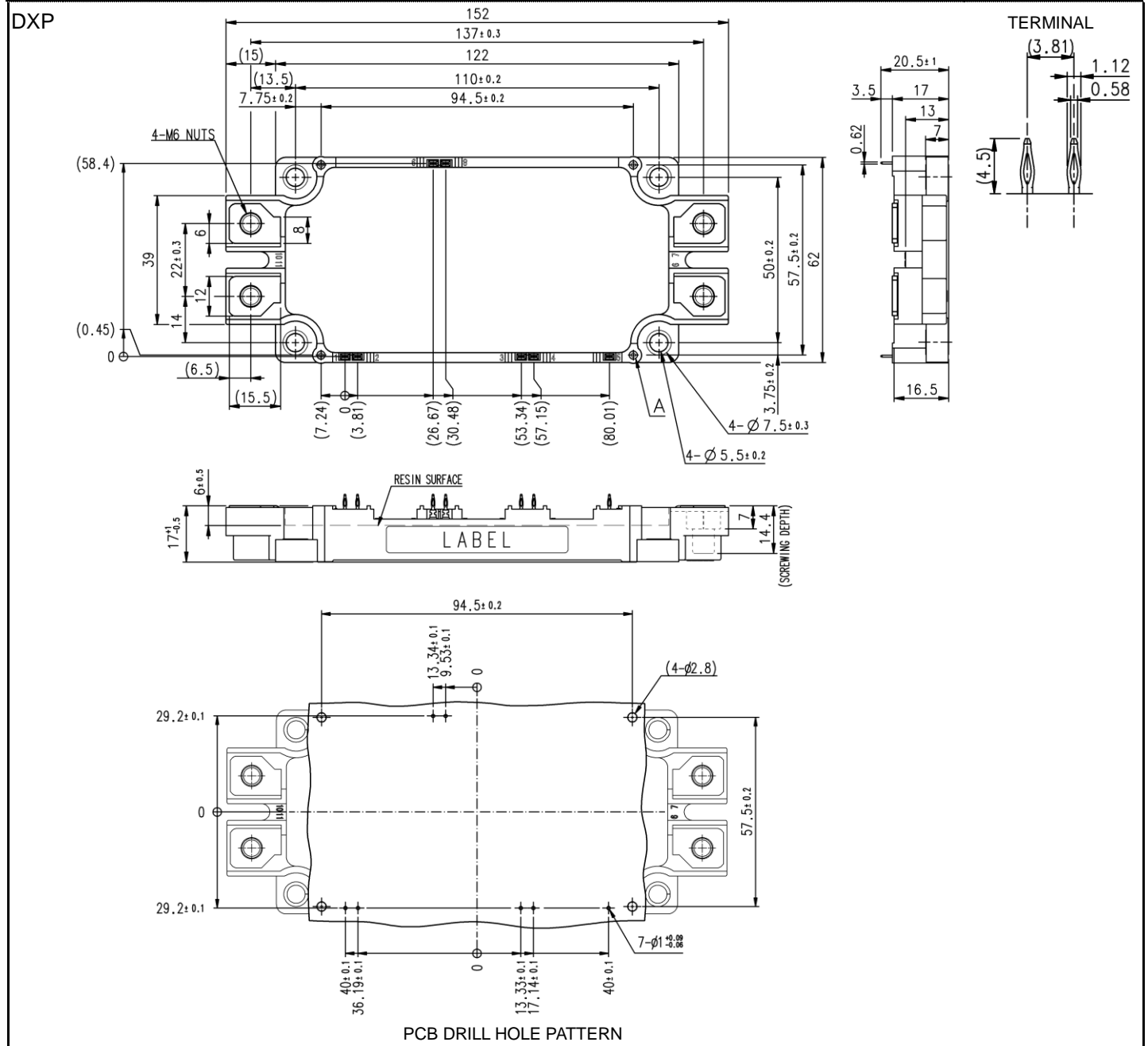
Division of Dimension	Tolerance
0.5 to 3	±0.2
over 3 to 6	±0.3
over 6 to 30	±0.5
over 30 to 120	±0.8
over 120 to 400	±1.2

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HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM450DX-34T/CM450DXP-34T

HIGH POWER SWITCHING USE
INSULATED TYPE

MAXIMUM RATINGS (T_{vj}=25 °C, unless otherwise specified)

INVERTER PART IGBT/FWD

Symbol	Item	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E short-circuited	1700	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =84 °C (Note2, 4)	450	A
I _{CRM}		Pulse, Repetitive (Note3)	900	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	2235	W
I _E (Note1)	Emitter current	DC (Note2)	450	A
I _{ERM} (Note1)		Pulse, Repetitive (Note3)	900	

MODULE

Symbol	Item	Conditions	Rating	Unit
V _{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	4000	V
T _{vjmax}	Maximum junction temperature	Instantaneous event (overload)	175	°C
T _{Cmax}	Maximum case temperature	(Note4)	125	
T _{vjop}	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	°C
T _{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS (T_{vj}=25 °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 =45 mA, V _{CE} =10 V	5.4	6.0	6.6	V	
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =450 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	2.05	2.45	V
			T _{vj} =125 °C	-	2.45	-	
			T _{vj} =150 °C	-	2.55	-	
V _{CEsat} (Chip)		I _C =450 A, V _{GE} =15 V, (Note5)	T _{vj} =25 °C	-	1.95	2.35	V
			T _{vj} =125 °C	-	2.35	-	
			T _{vj} =150 °C	-	2.45	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	120	nF	
C _{oes}	Output capacitance		-	-	3.3		
C _{res}	Reverse transfer capacitance		-	-	1.1		
Q _G	Gate charge	V _{CC} =1000 V, I _C =450 A, V _{GE} =15 V	-	3.53	-	µC	
t _{d(on)}	Turn-on delay time	V _{CC} =1000 V, I _C =450 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	800	ns	
t _r	Rise time		-	-	200		
t _{d(off)}	Turn-off delay time		-	-	800		
t _f	Fall time		-	-	600		
V _{EC} (Note1) (Terminal)	Emitter-collector voltage	I _E =450 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	2.75	3.35	V
			T _{vj} =125 °C	-	2.95	-	
			T _{vj} =150 °C	-	2.95	-	
V _{EC} (Note1) (Chip)		I _E =450 A, G-E short-circuited, (Note5)	T _{vj} =25 °C	-	2.65	3.25	V
			T _{vj} =125 °C	-	2.75	-	
			T _{vj} =150 °C	-	2.75	-	
t _{rr} (Note1)	Reverse recovery time	V _{CC} =1000 V, I _E =450 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	300	ns	
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load	-	21.5	-	µC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =1000 V, I _C =I _E =450 A,	-	113.4	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _{vj} =150 °C,	-	116.4	-		
E _{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	56.3	-	mJ	
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C (Note4)	-	0.75	-	mΩ	
r _g	Internal gate resistance	Per switch	-	1.7	-	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)	-	-	67	K/kW
R _{th(j-c)D}		Junction to case, per Inverter FWD (Note4)	-	-	101	
R _{th(c-s)}	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 _t	Mounting torque	Main terminals M 6 screw	3.5	4.0	4.5	N·m	
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 (DX)	Terminal to terminal	17	-	-	mm
			Terminal to base plate	18.1	-	-	
		Pressfit pin type (DXP)	Terminal to terminal	17	-	-	mm
			Terminal to base plate	18.6	-	-	
d _a	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 _c	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).

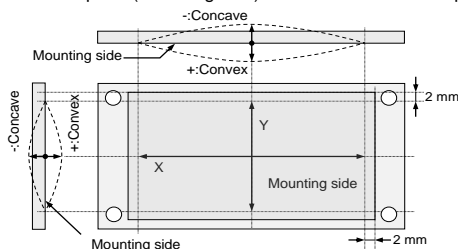
- Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.
- Case temperature (T_C) and heat sink temperature (T_S) are defined on the each surface (mounting side) of base plate and heat sink just under the chips.
Refer to the figure of chip location.
- 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]

- Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K)/D_(c-s)=50 μm.
- Typical value is measured by using PC-TIM of λ=3.4 W/(m·K)/D_(c-s)=50 μm.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



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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 : t1.6

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

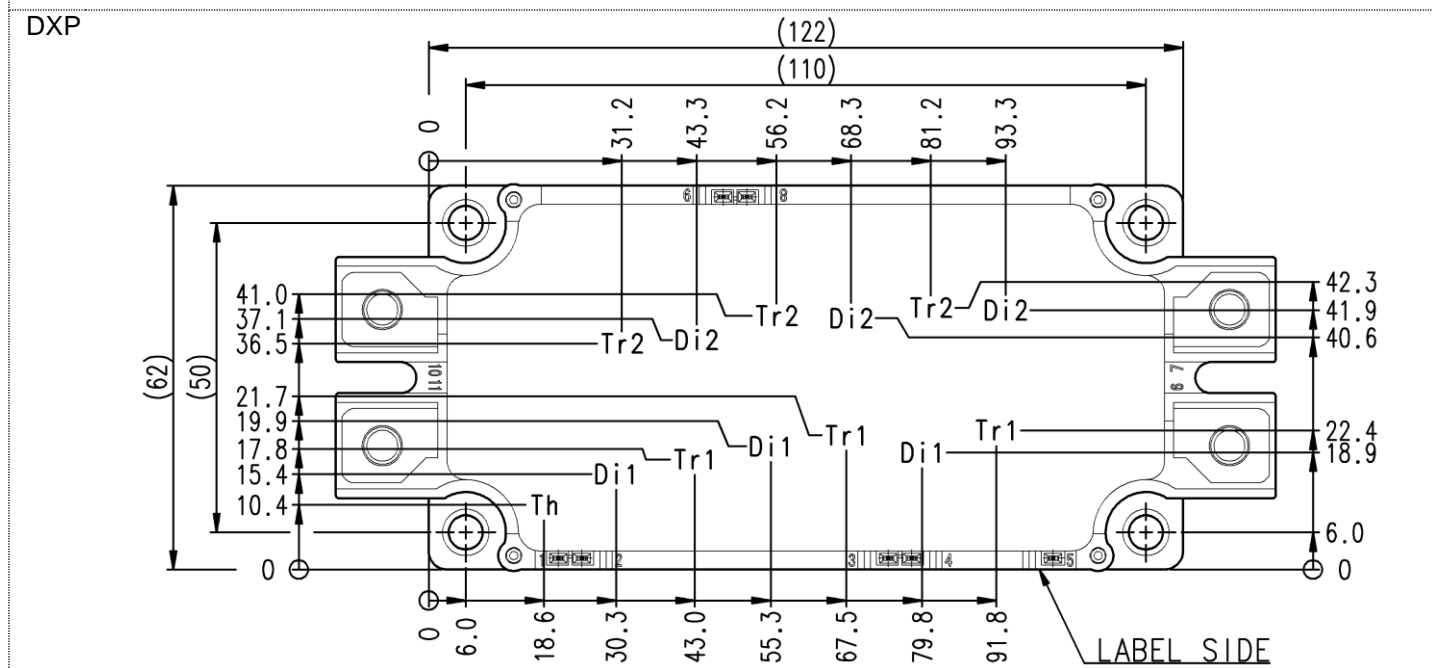
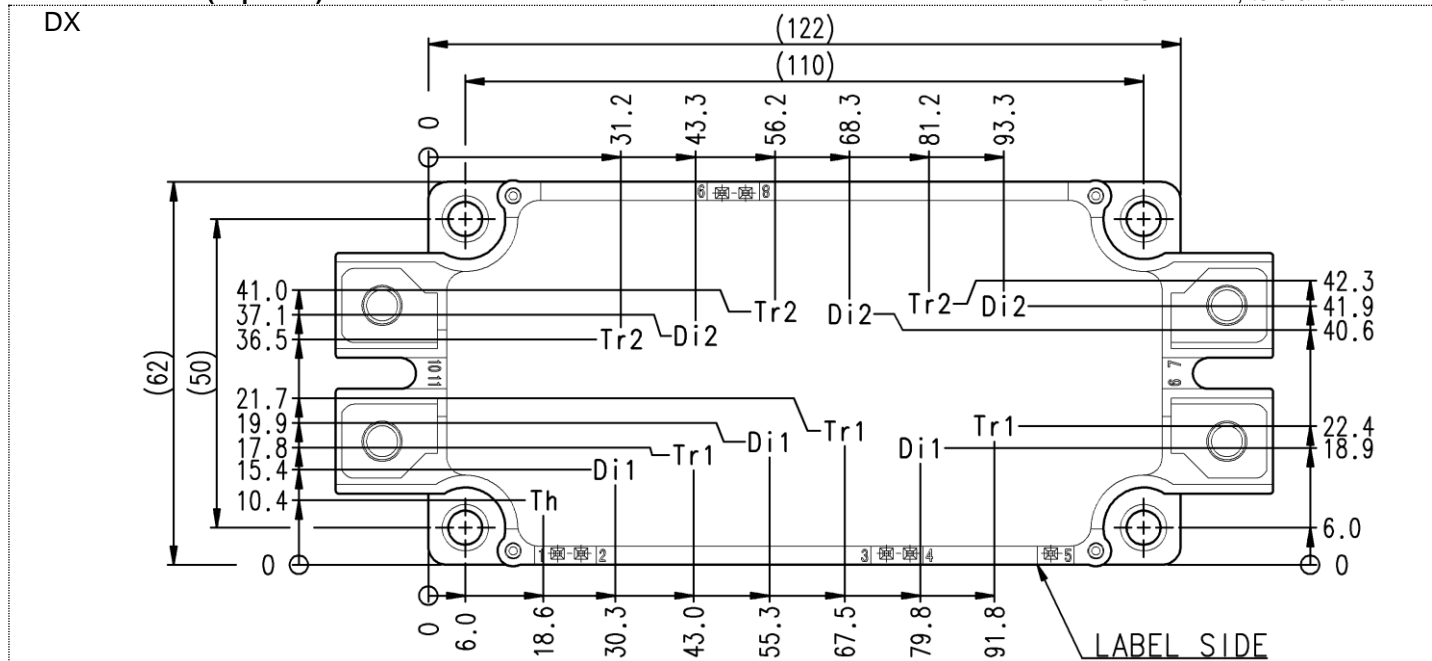
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	1000	1200	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2 terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0	-	16	Ω

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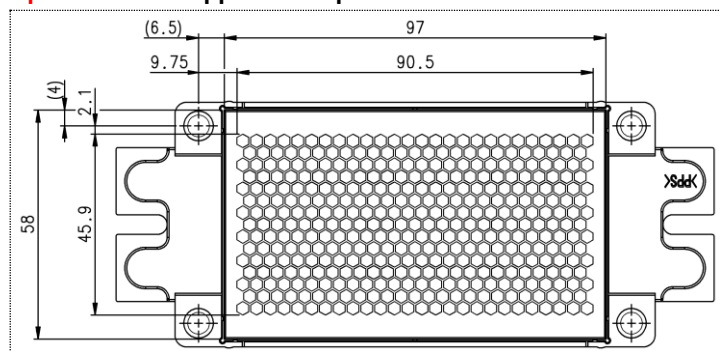
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



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

Option: PC-TIM applied baseplate outline

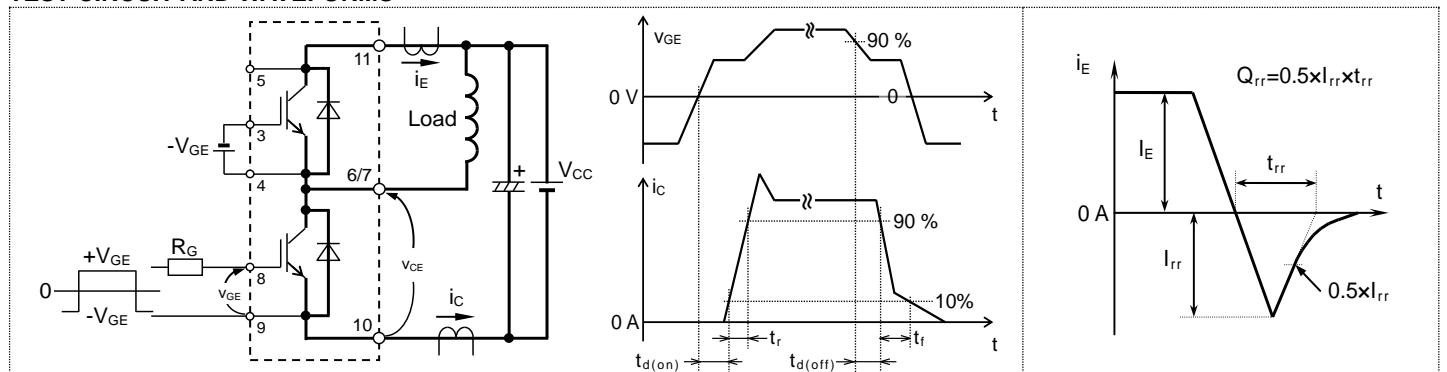


CM450DX-34T/CM450DXP-34T

HIGH POWER SWITCHING USE

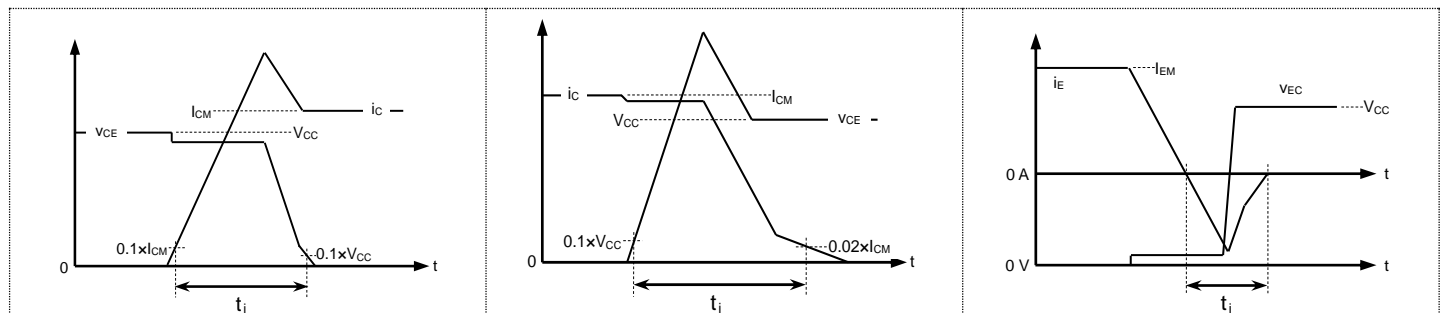
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS



Switching characteristics test circuit and waveforms

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



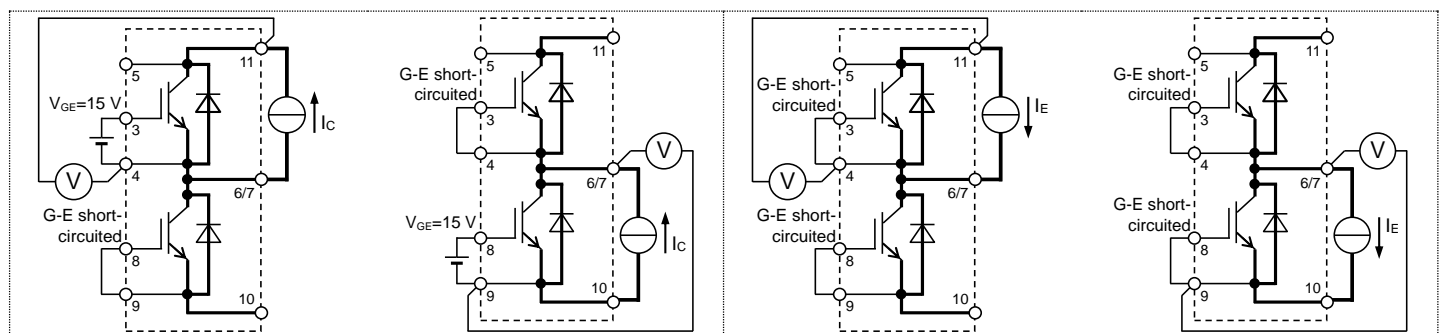
IGBT Turn-on switching energy

IGBT Turn-off switching energy

FWD Reverse recovery energy

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

TEST CIRCUIT



Tr1

Tr2

Di1

Di2

V_{CEsat} characteristics test circuit

V_{EC} characteristics test circuit

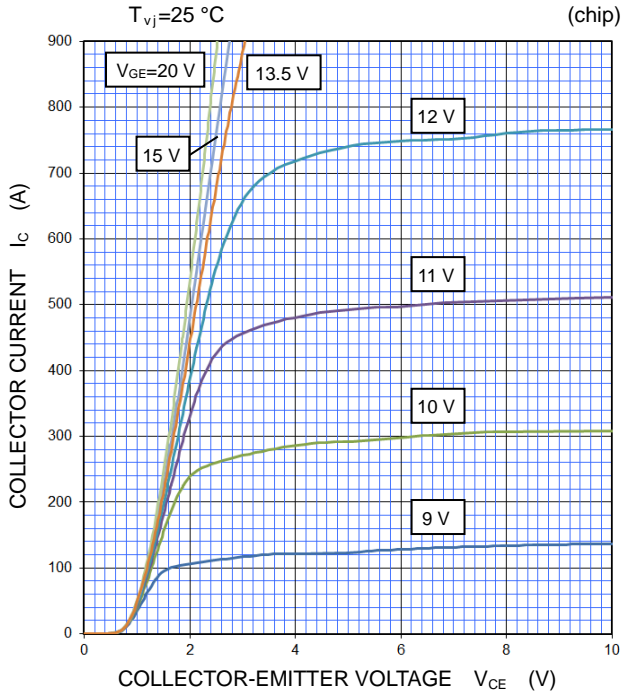
CM450DX-34T/CM450DXP-34T

HIGH POWER SWITCHING USE
INSULATED TYPE

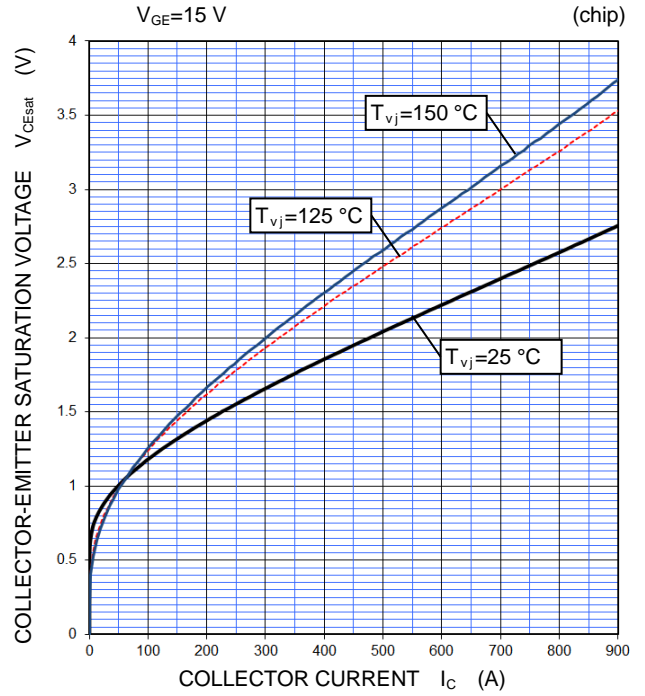
PERFORMANCE CURVES

INVERTER PART

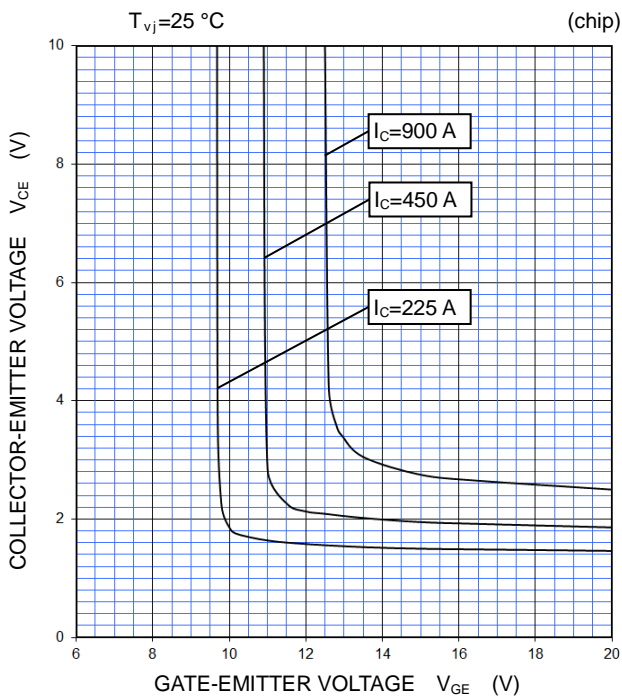
OUTPUT CHARACTERISTICS
(TYPICAL)



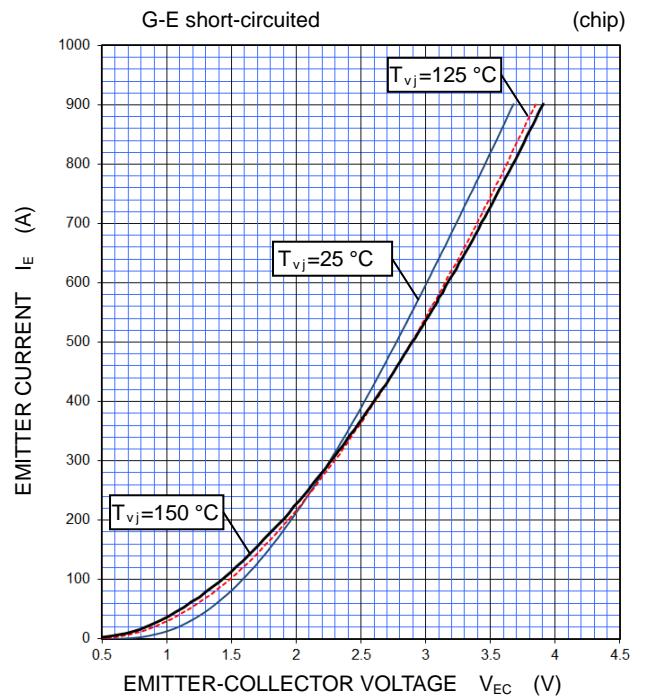
COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



CM450DX-34T/CM450DXP-34T

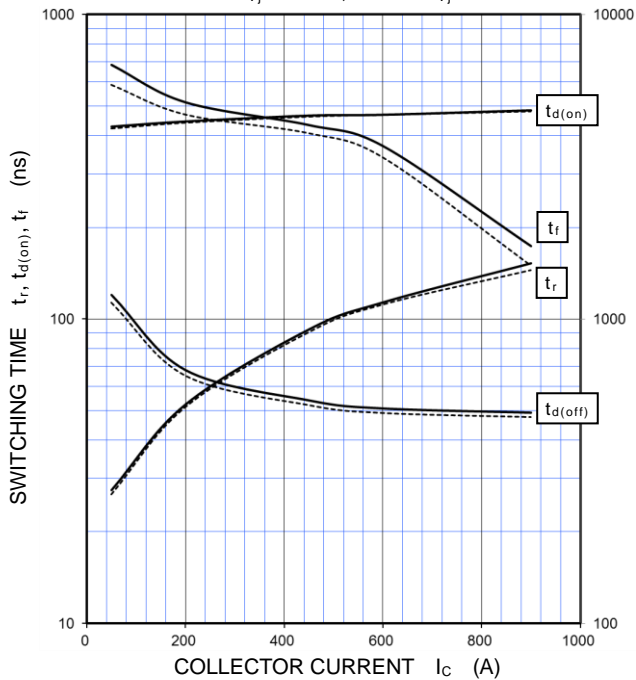
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

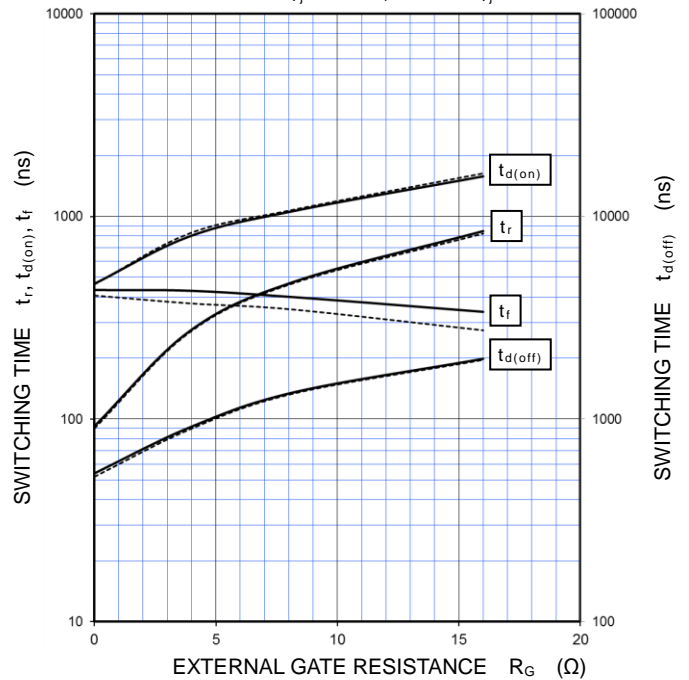
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $R_G=0\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



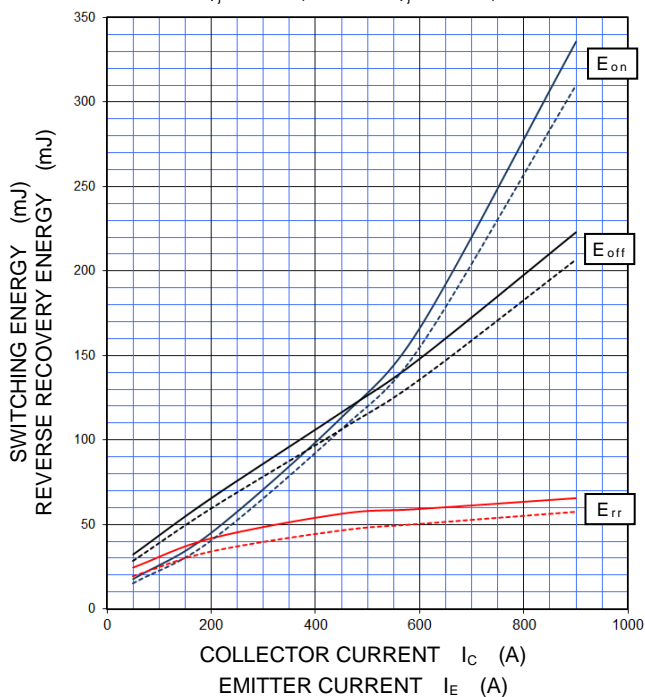
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $I_c=450\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



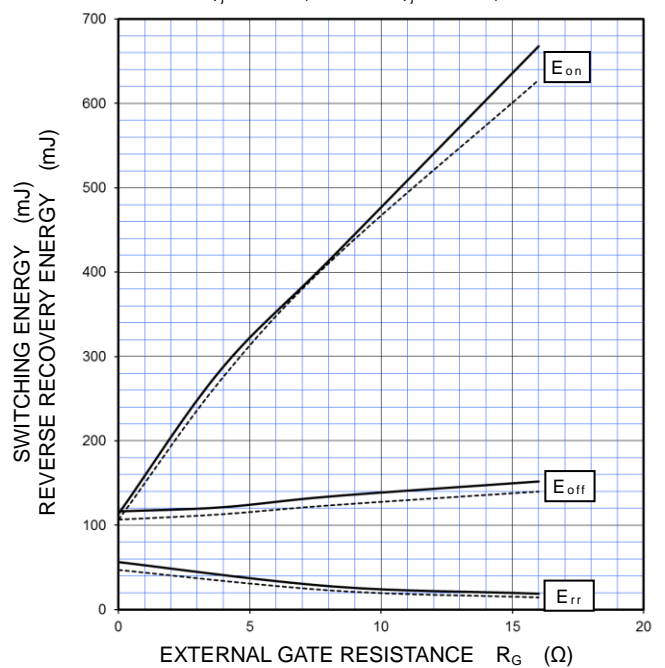
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $R_G=0\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD, PER PULSE
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $I_c/I_E=450\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD, PER PULSE
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



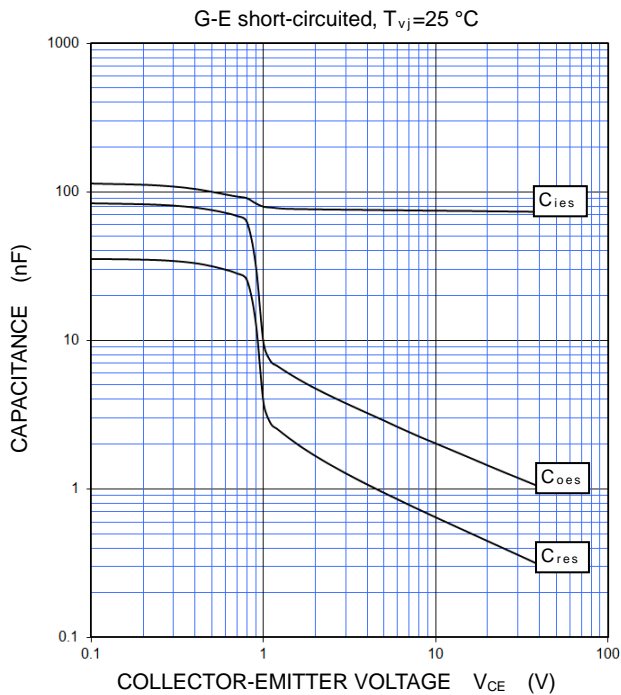
CM450DX-34T/CM450DXP-34T

HIGH POWER SWITCHING USE
INSULATED TYPE

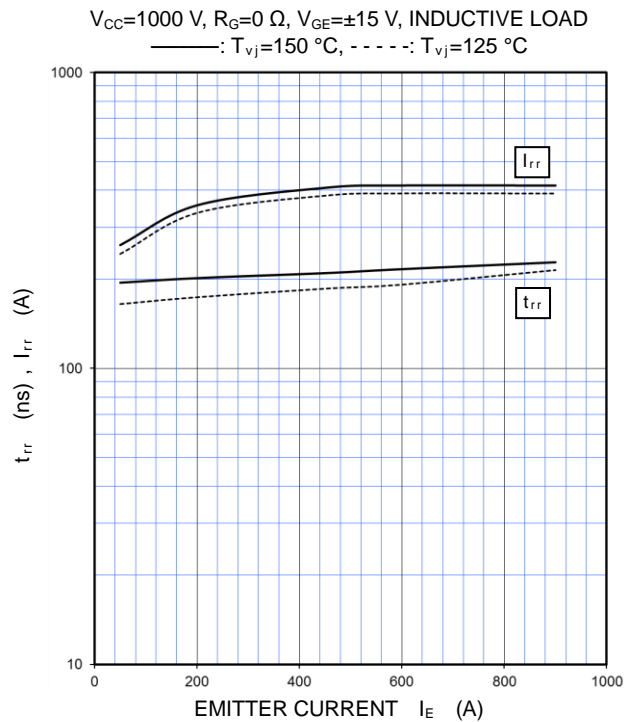
PERFORMANCE CURVES

INVERTER PART

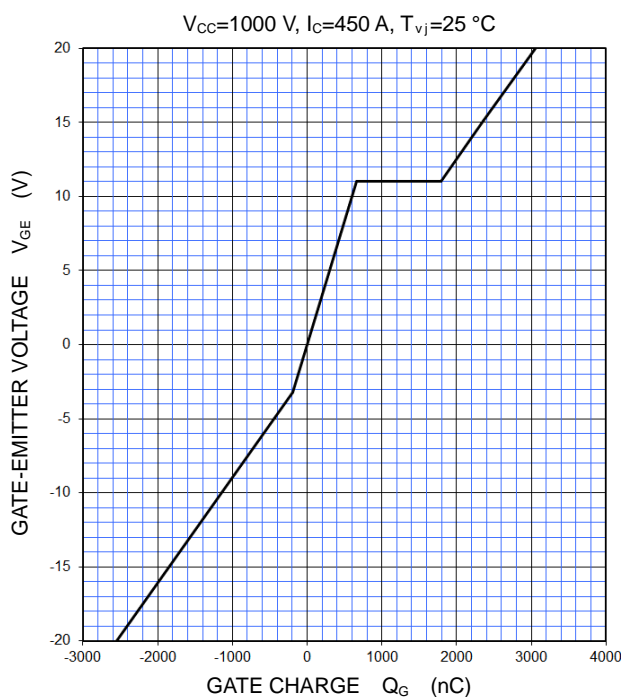
CAPACITANCE CHARACTERISTICS (TYPICAL)



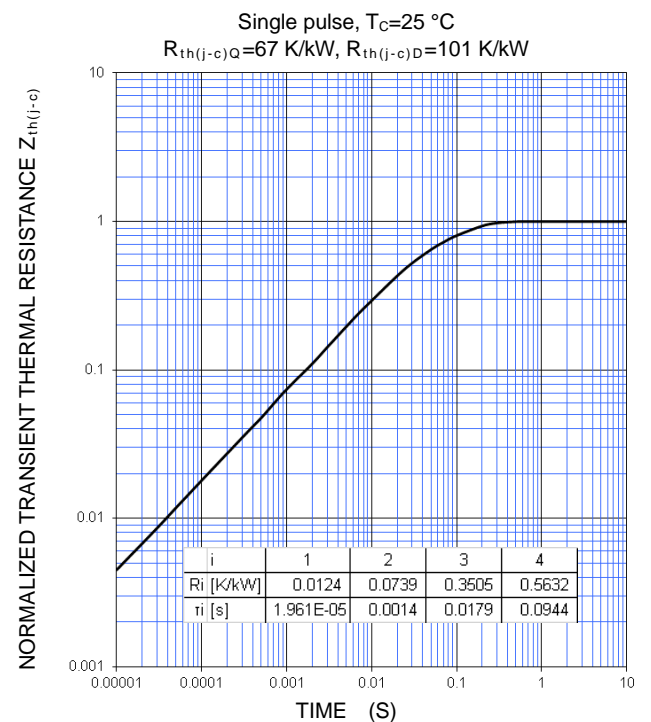
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



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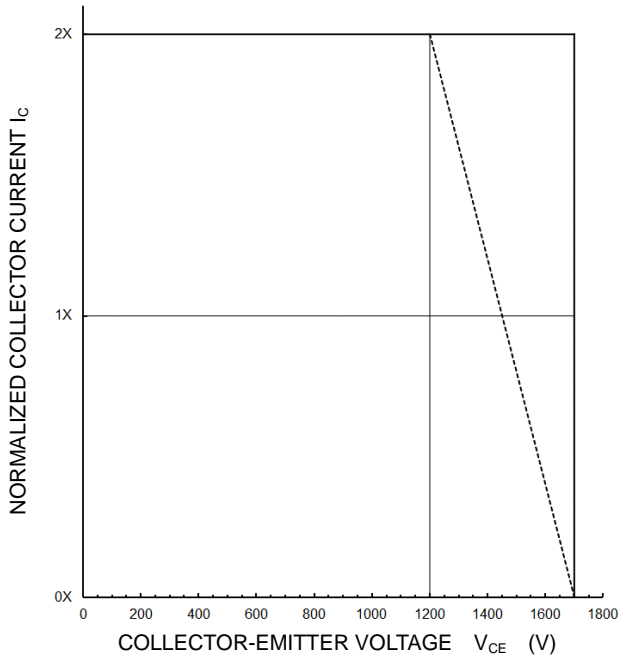
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

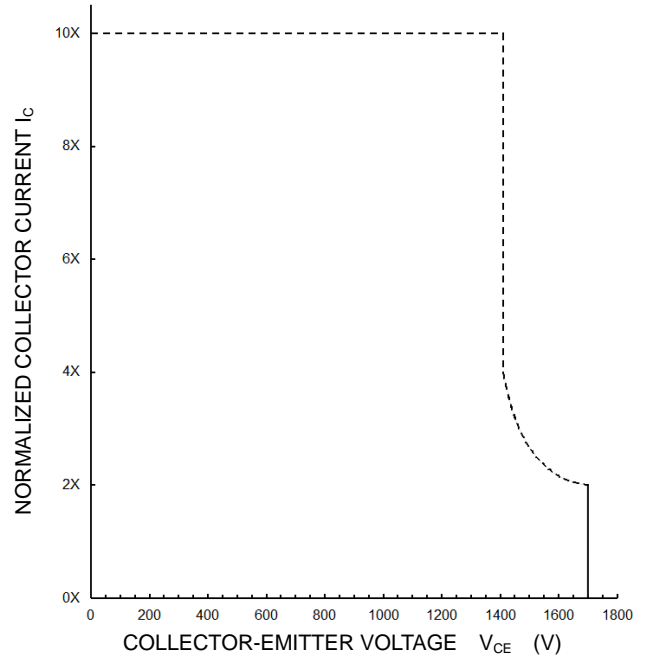
**TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)**

$V_{CC} \leq 1200 \text{ V}$, $R_G = 0 \sim 16 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 ———: $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ (Normal load operations (Continuous))
 - - - - -: $T_{vj} = 175 \text{ }^\circ\text{C}$ (Unusual load operations (Limited period))



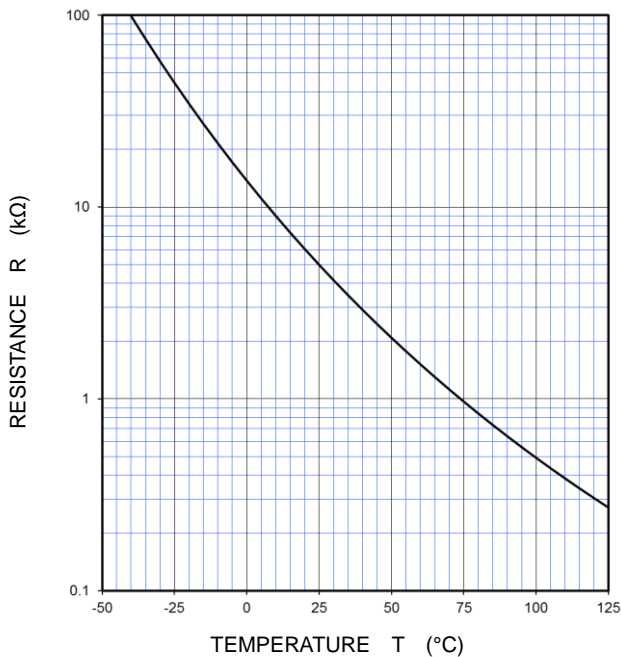
**SHORT-CIRCUIT SAFE OPERATING AREA
(MAXIMUM)**

$V_{CC} \leq 1200 \text{ V}$, $R_G = 0 \sim 16 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$, $t_w \leq 8 \ \mu\text{s}$, Non-Repetitive



NTC thermistor part

**TEMPERATURE CHARACTERISTICS
(TYPICAL)**



CM450DX-34T/CM450DXP-34T

HIGH POWER SWITCHING USE

INSULATED TYPE

Keep safety first in your circuit designs!

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