

<IGBT Modules>

CM600DX-24T1/CM600DXP-24T1

HIGH POWER SWITCHING USE
INSULATED TYPE

DX		Collector current I_c 600 A Collector-emitter voltage V_{CES} 1200 V Maximum junction temperature T_{vjmax} 175 °C •Flat base type •Copper base plate (Nickel-plating) •RoHS Directive compliant •Tin-plating pin terminals
DXP		Collector current I_c 600 A Collector-emitter voltage V_{CES} 1200 V Maximum junction temperature T_{vjmax} 175 °C •Flat base type •Copper base plate (Nickel-plating) •RoHS Directive compliant •Tin-plating pressfit terminals
dual switch (half-bridge)		•UL Recognized under UL1557, File No. E323585

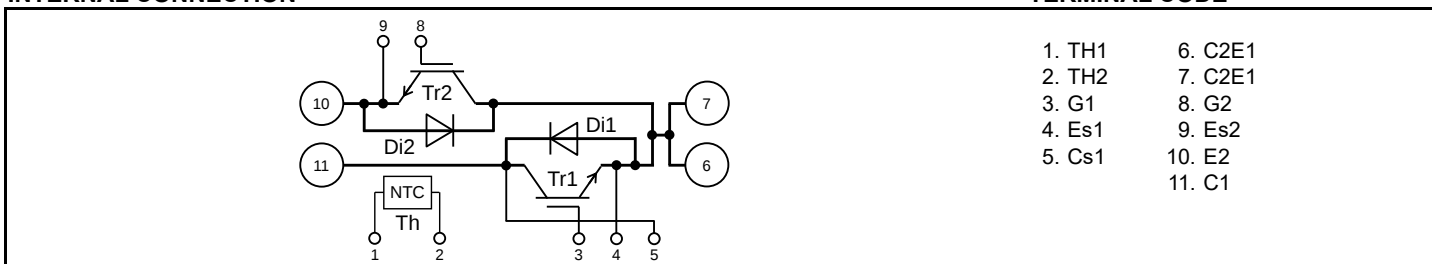
APPLICATION

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

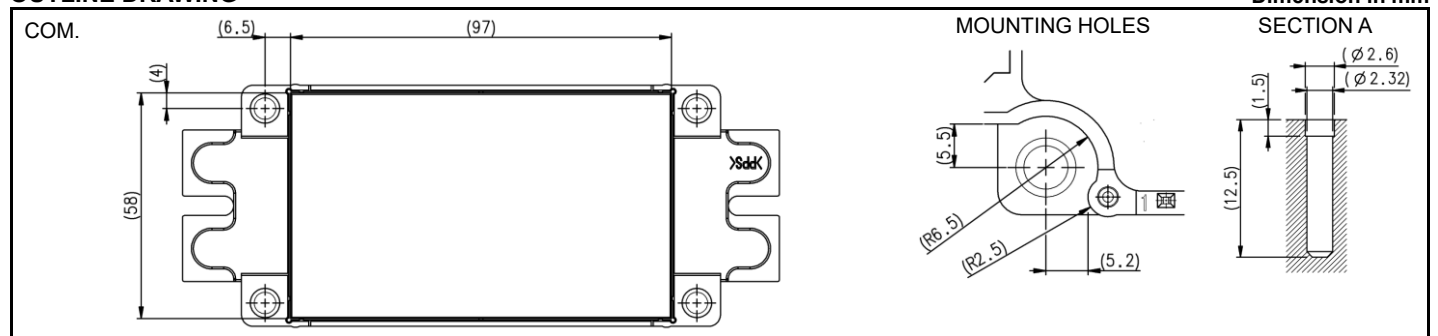
OPTION (Below options are available.)

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

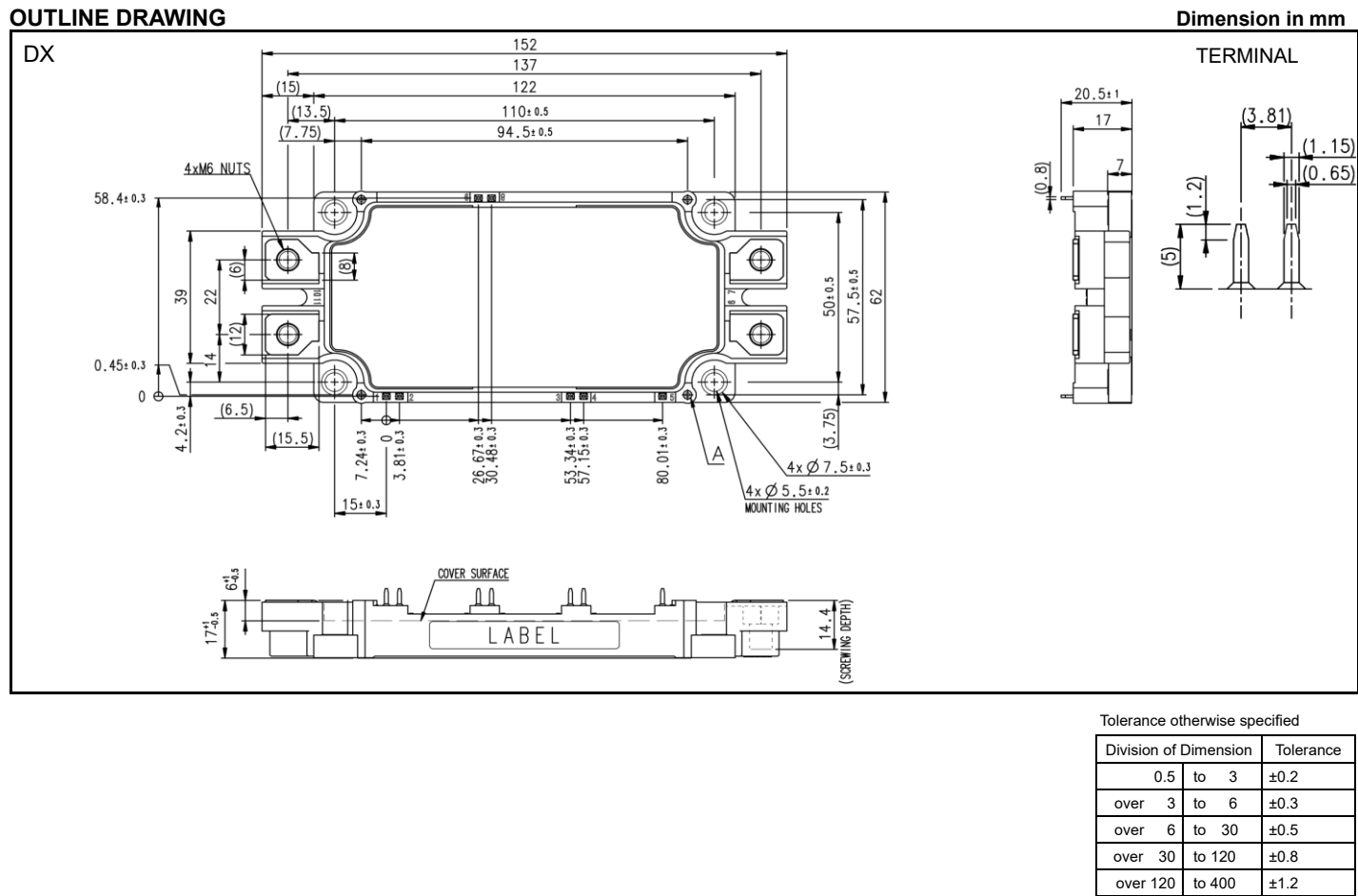
INTERNAL CONNECTION



OUTLINE DRAWING

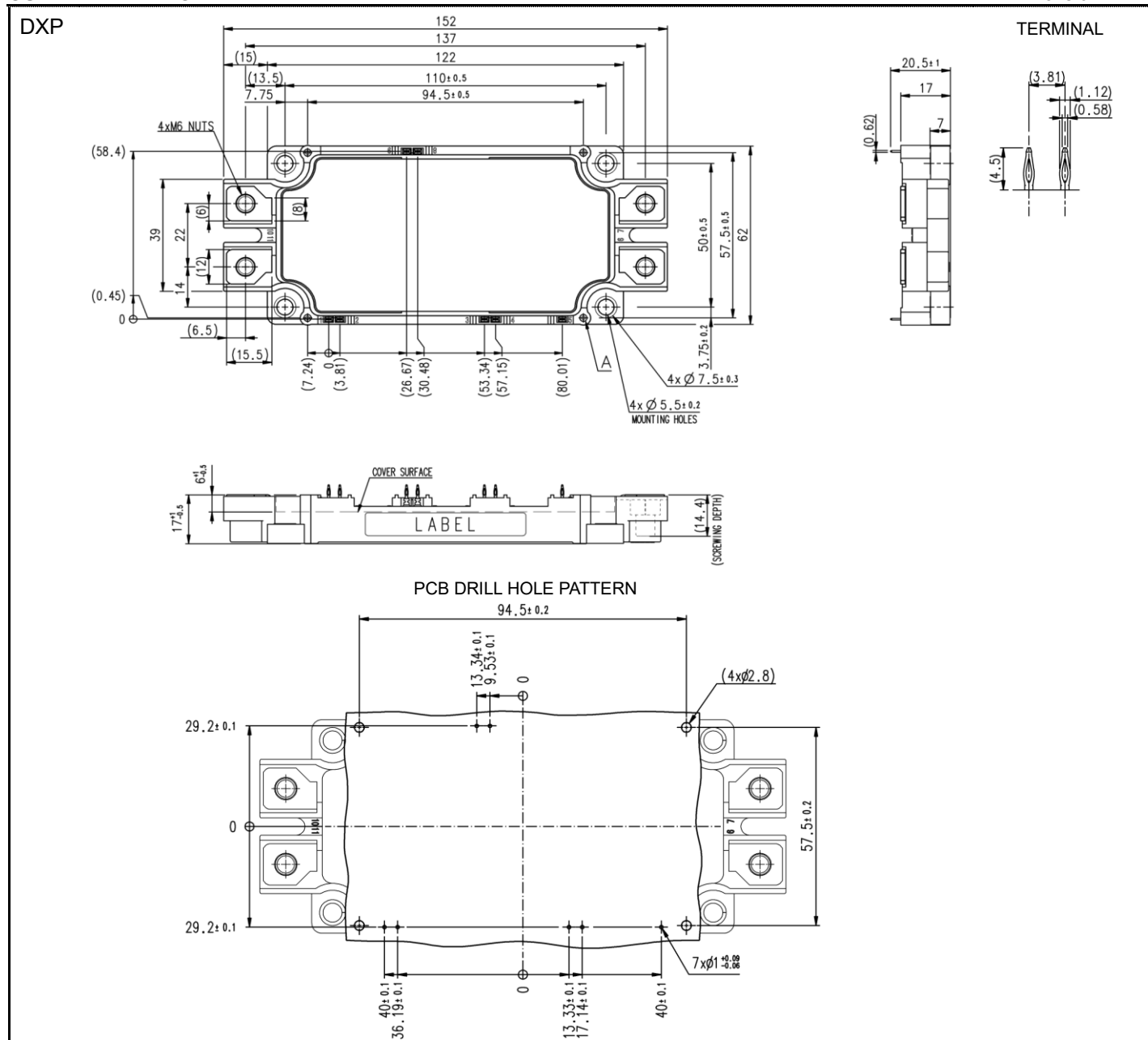


<IGBT Modules>
CM600DX-24T1/CM600DXP-24T1
HIGH POWER SWITCHING USE
INSULATED TYPE



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

CM600DX-24T1/CM600DXP-24T1

HIGH POWER SWITCHING USE

INSULATED TYPE

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	1200	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I_C	Collector current	DC, $T_C=86\text{ }^{\circ}\text{C}$ (Note2, 4)	600	A
I_{CRM}		Pulse, Repetitive (Note3)	1200	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	2500	W
I_E (Note1)	Emitter current	DC (Note2)	600	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	1200	

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)	$-40 \sim +150$	$^{\circ}\text{C}$
T_{stg}	Storage temperature	-	$-40 \sim +125$	

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	$I_C=60\text{ mA}$, $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V
V_{CESat} (Terminal)	Collector-emitter saturation voltage	$I_C=600\text{ A}$, $V_{GE}=15\text{ V}$, Refer to the figure of test circuit (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.90	2.25	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	2.15	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	2.25	-	
V_{CESat} (Chip)		$I_C=600\text{ A}$, $V_{GE}=15\text{ V}$, (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.70	2.00	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	1.95	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	2.05	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	109.1	nF
C_{oes}	Output capacitance		-	-	3.1	
C_{res}	Reverse transfer capacitance		-	-	1.4	
Q_G	Gate charge	$V_{CC}=600\text{ V}$, $I_C=600\text{ A}$, $V_{GE}=15\text{ V}$	-	3.4	-	μC
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=600\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.0\text{ }\Omega$, Inductive load	-	-	600	ns
t_r	Rise time		-	-	300	
$t_{d(off)}$	Turn-off delay time		-	-	800	
t_f	Fall time		-	-	400	
V_{EC} (Note1) (Terminal)	Emitter-collector voltage	$I_E=600\text{ A}$, G-E short-circuited, Refer to the figure of test circuit (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.90	2.35	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	1.95	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	2.00	-	
V_{EC} (Note1) (Chip)		$I_E=600\text{ A}$, G-E short-circuited, (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.75	2.10	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	1.80	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	1.80	-	
t_{rr} (Note1)	Reverse recovery time	$V_{CC}=600\text{ V}$, $I_E=600\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.0\text{ }\Omega$, Inductive load	-	-	400	ns
Q_{rr} (Note1)	Reverse recovery charge		-	46.8	-	μC
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=600\text{ A}$,	-	53.0	-	mJ
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=1.0\text{ }\Omega$, $T_{vj}=150\text{ }^{\circ}\text{C}$,	-	56.0	-	
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	40.0	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	0.75	-	m Ω
r_g	Internal gate resistance	Per switch	-	0.67	-	Ω

ELECTRICAL CHARACTERISTICS (cont.: $T_{vj}=25\text{ }^{\circ}\text{C}$, unless otherwise specified)**NTC THERMISTOR PART**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	$T_C=25\text{ }^{\circ}\text{C}$ (Note4)	4.85	5.00	5.15	k Ω
$\Delta R/R$	Deviation of resistance	$R_{100}=493\text{ }\Omega$, $T_C=100\text{ }^{\circ}\text{C}$ (Note4)	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note6)	-	3375	-	K
P_{25}	Power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (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)	-	-	60	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	87	
$R_{th(c-s)}$	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_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	16.4	-	
		Pressfit pin type (DXP)	Terminal to terminal	17	-	mm
			Terminal to base plate	16.8	-	
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 (Note8)	± 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 and (EU) 2015/863.

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

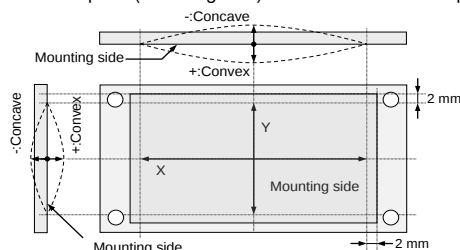
- Junction temperature (T_{vj}) should not increase beyond $T_{vj\max}$ rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed $T_{vj\max}$ rating.
- Case temperature (T_C) and heat sink temperature (T_s) are defined on the each surface (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.

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

R_{25} : resistance at absolute temperature T_{25} [K]; $T_{25}=25\text{ }^{\circ}\text{C}+273.15=298.15$ [K]

R_{50} : resistance at absolute temperature T_{50} [K]; $T_{50}=50\text{ }^{\circ}\text{C}+273.15=323.15$ [K]

- Reference value. Thermally conductive grease of thermal conductivity $\lambda=0.9\text{ W/(m}\cdot\text{K)}$ and thickness $D_{(c-s)}=50\text{ }\mu\text{m}$.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



- 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 ($T_{vj\max}$, $T_{vj\text{op}}$, $T_{C\max}$) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

CM600DX-24T1/CM600DXP-24T1

HIGH POWER SWITCHING USE

INSULATED TYPE

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 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	0.75 ± 0.075 N·m	
		φ2.6×12		

RECOMMENDED OPERATING CONDITIONS

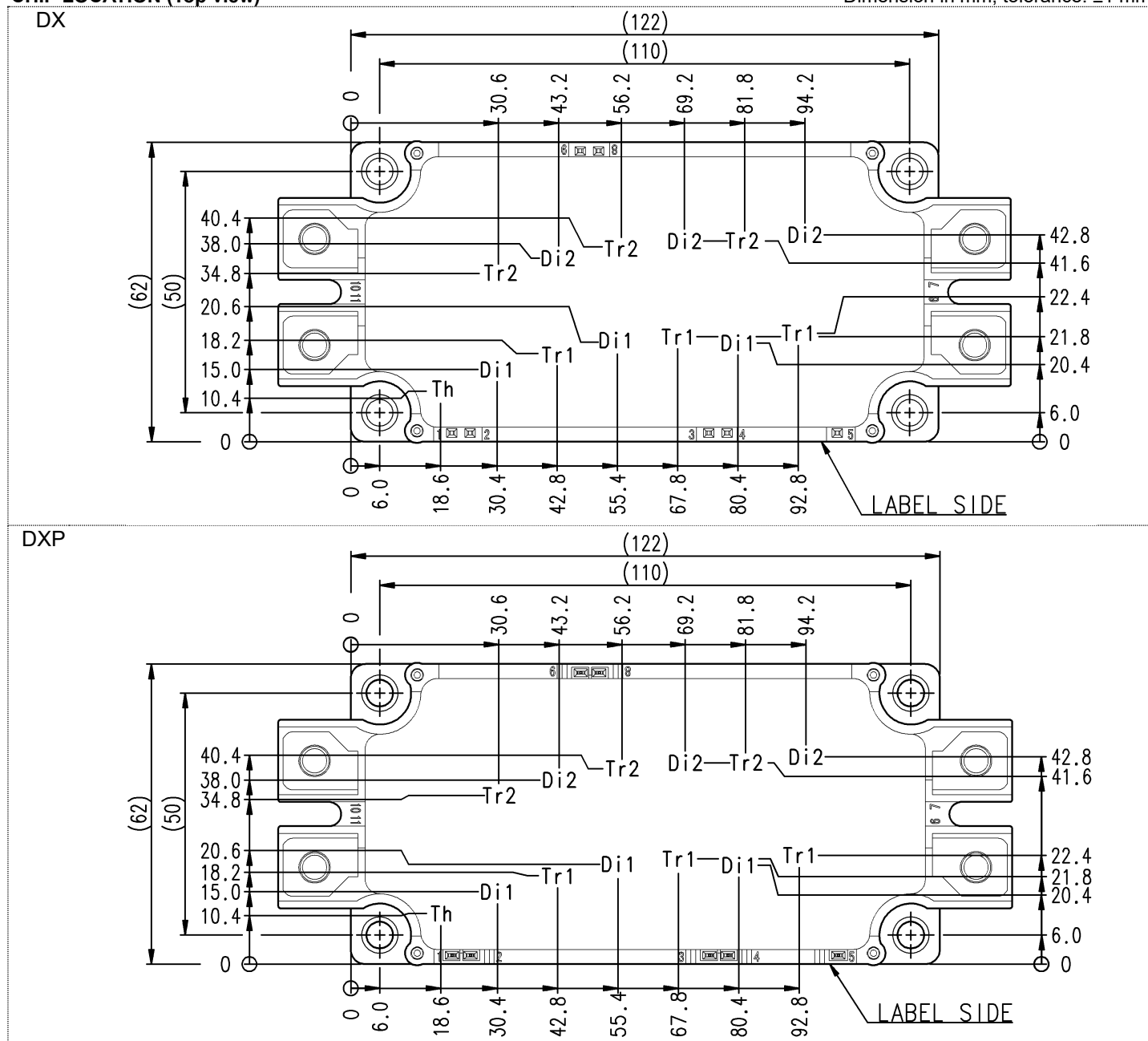
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-E1s/G2-E2s terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	1.0	-	6.8	Ω

CM600DX-24T1/CM600DXP-24T1

HIGH POWER SWITCHING USE

INSULATED TYPE

CHIP LOCATION (Top view)

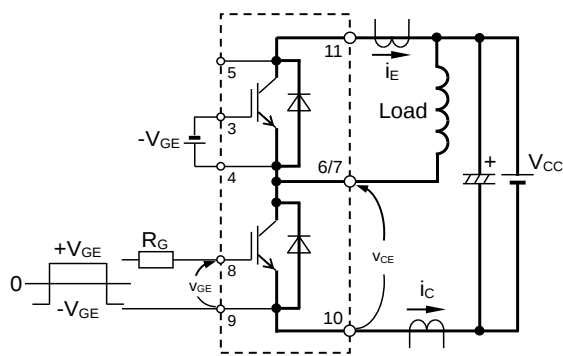
Dimension in mm, tolerance: ± 1 mm

CM600DX-24T1/CM600DXP-24T1

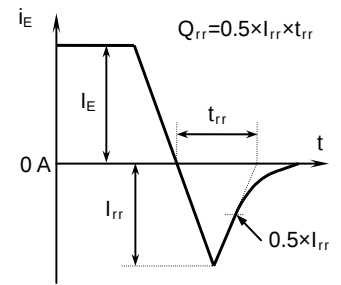
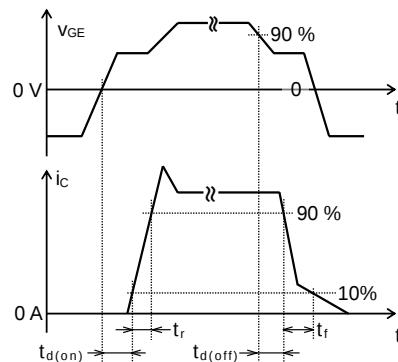
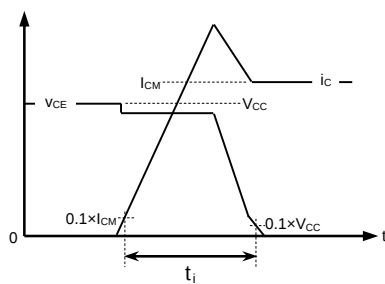
HIGH POWER SWITCHING USE

INSULATED TYPE

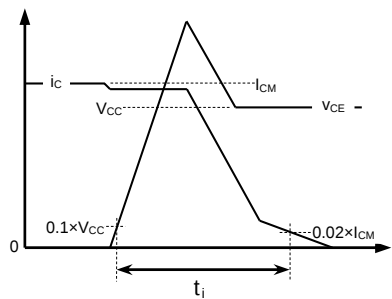
TEST CIRCUIT AND WAVEFORMS



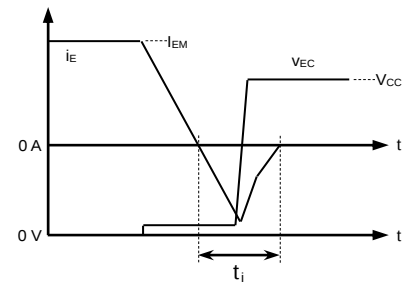
Switching characteristics test circuit and waveforms

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

IGBT Turn-on switching energy



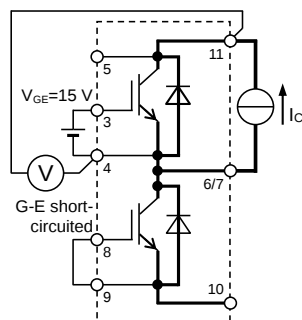
IGBT Turn-off switching energy



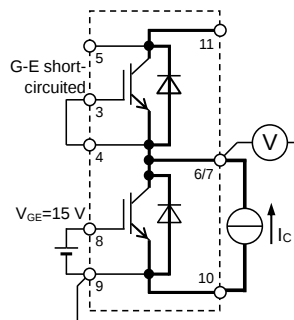
FWD Reverse recovery energy

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

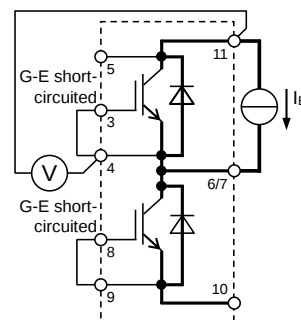
TEST CIRCUIT



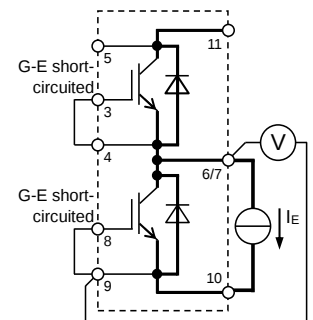
Tr1

 V_{CEsat} characteristics test circuit

Tr2



Di1

 V_{CE} characteristics test circuit

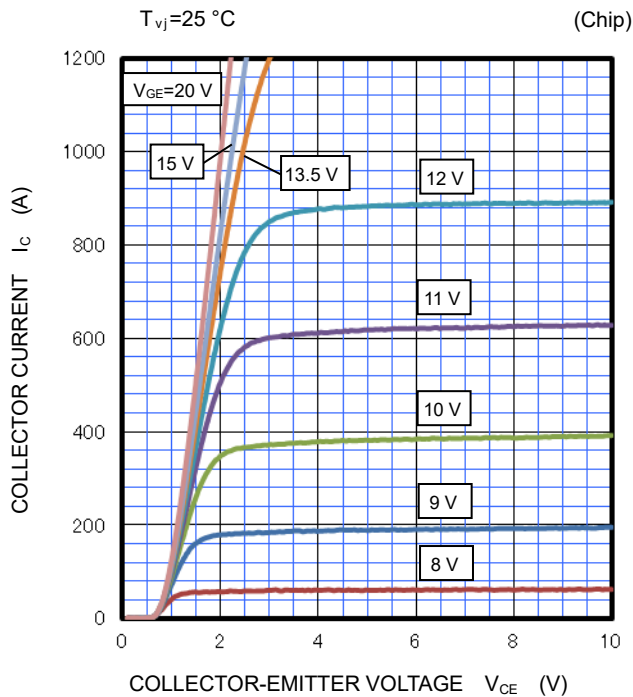
Di2

PERFORMANCE CURVES

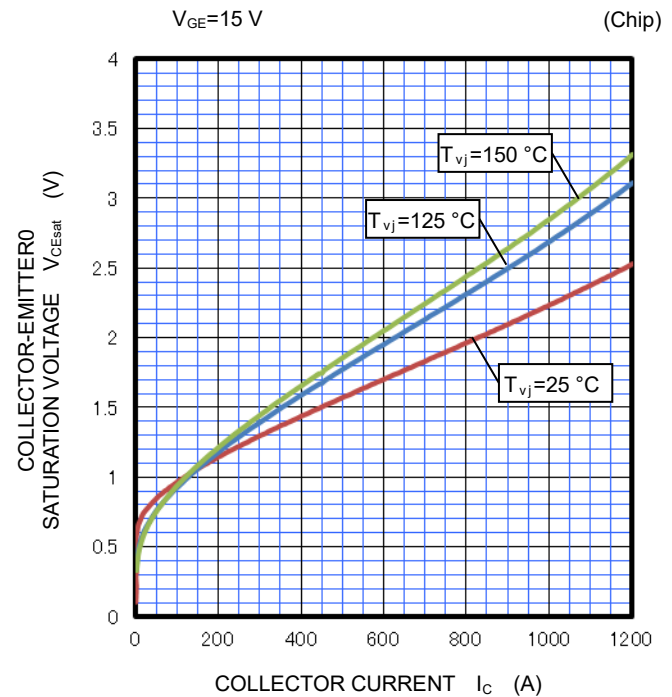
INVERTER PART

OUTPUT CHARACTERISTICS

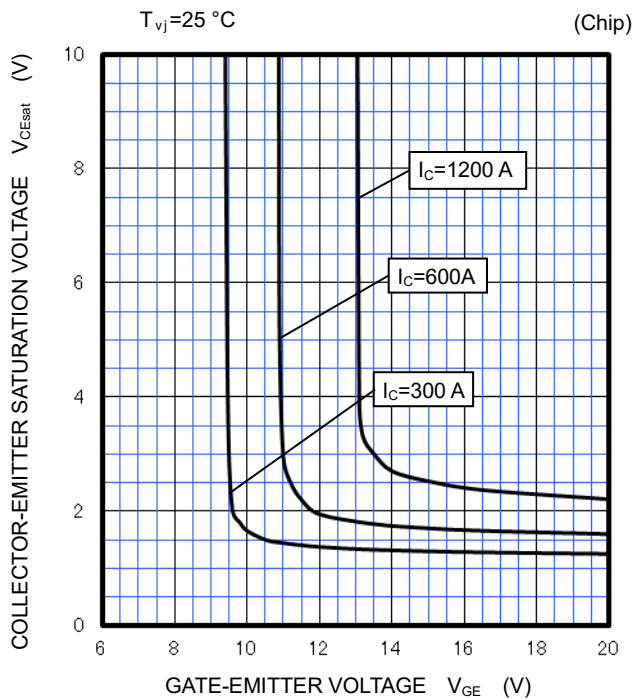
(TYPICAL)



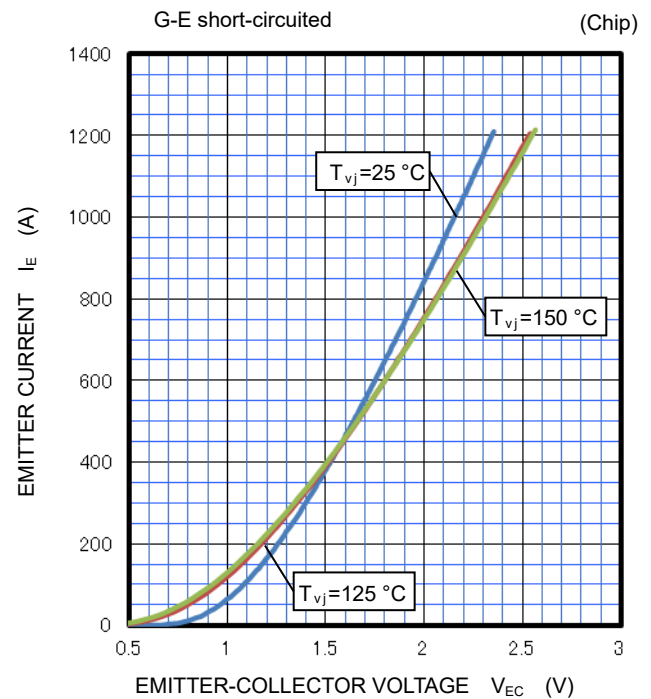
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



CM600DX-24T1/CM600DXP-24T1

HIGH POWER SWITCHING USE

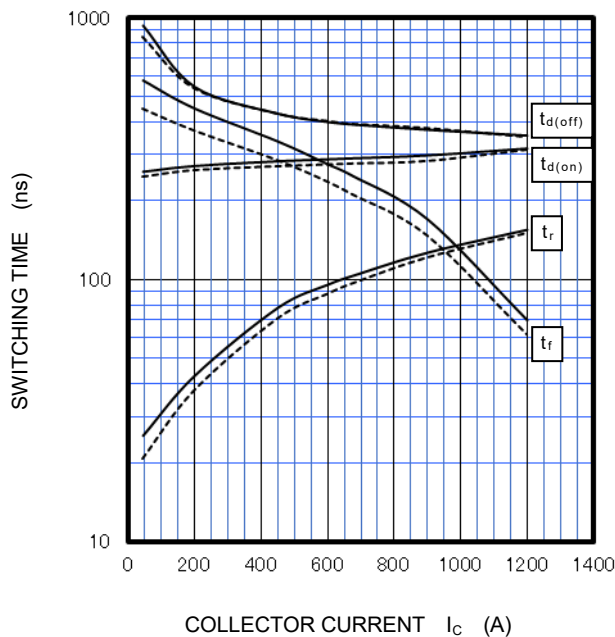
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

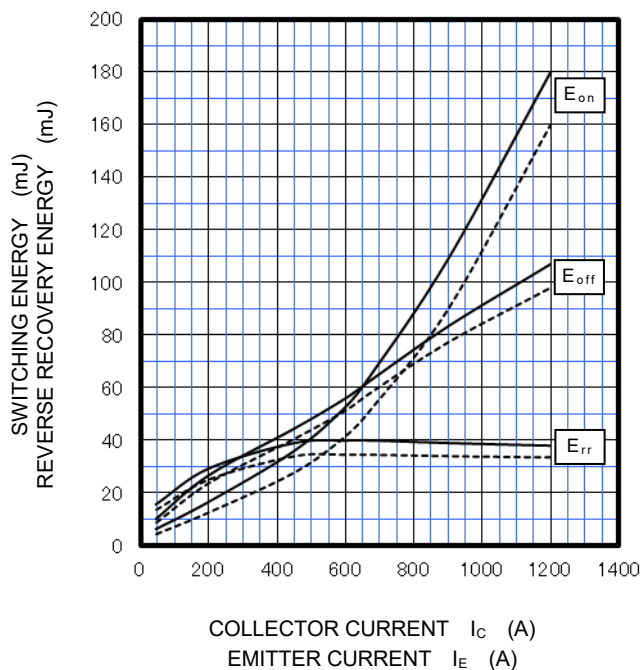
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.0\ \Omega$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



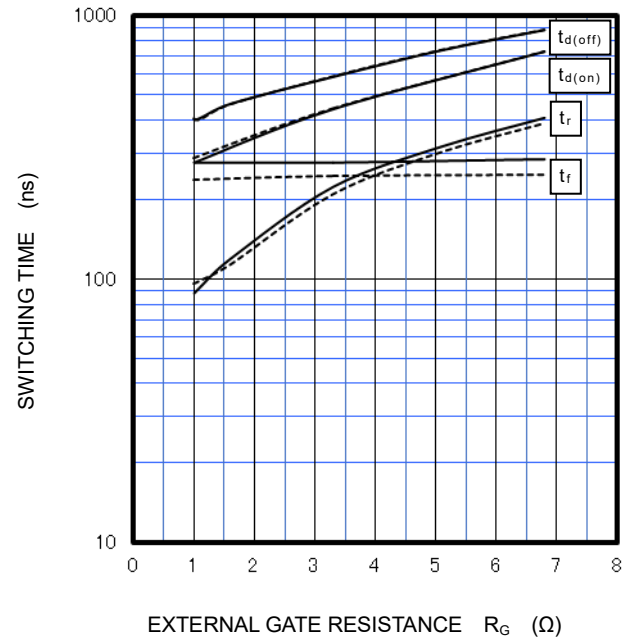
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.0\ \Omega$,
 INDUCTIVE LOAD, PER PULSE
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



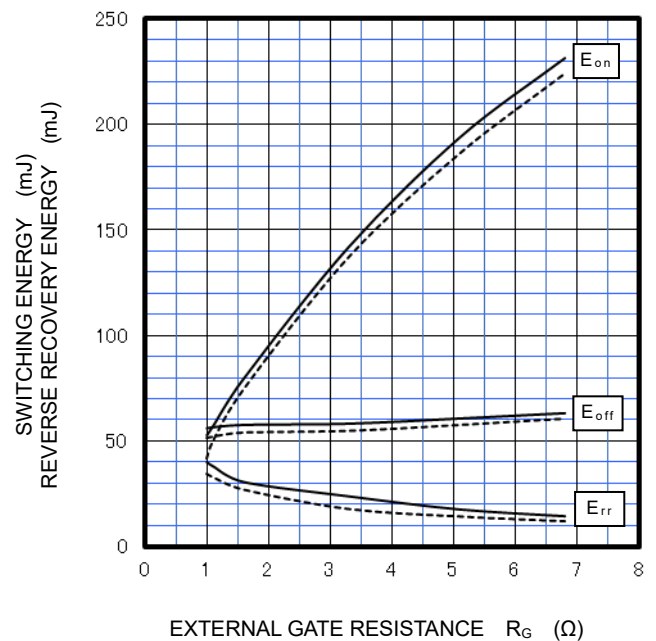
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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

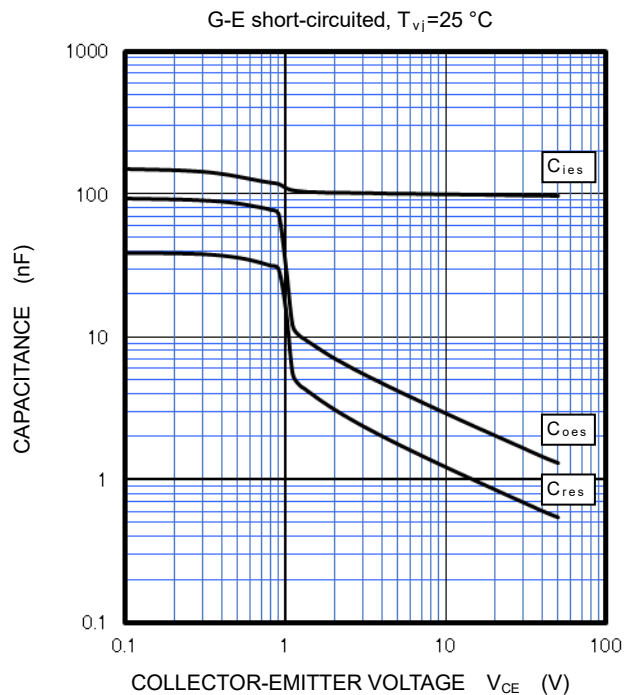
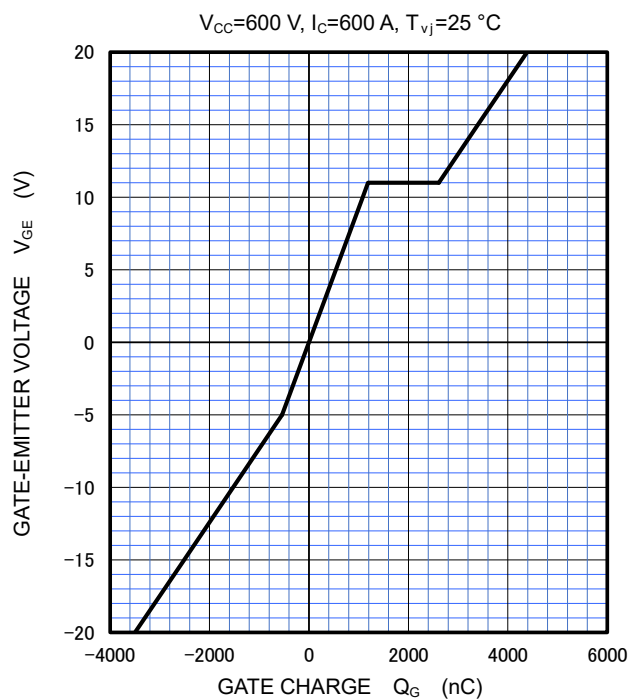


PERFORMANCE CURVES

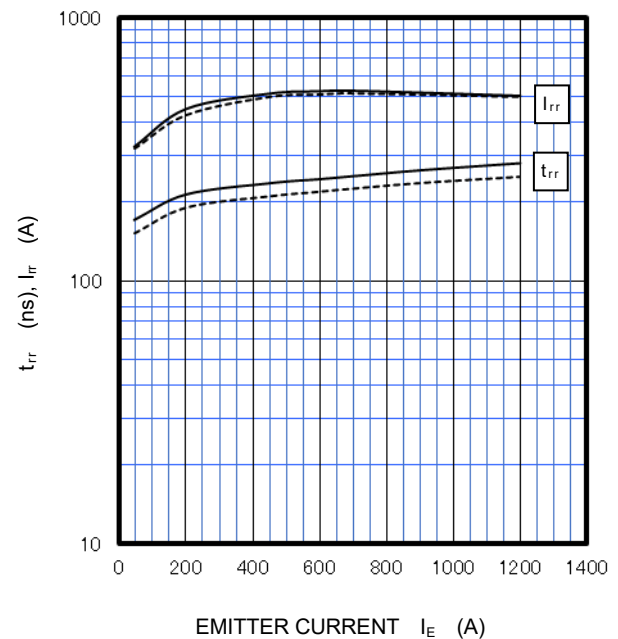
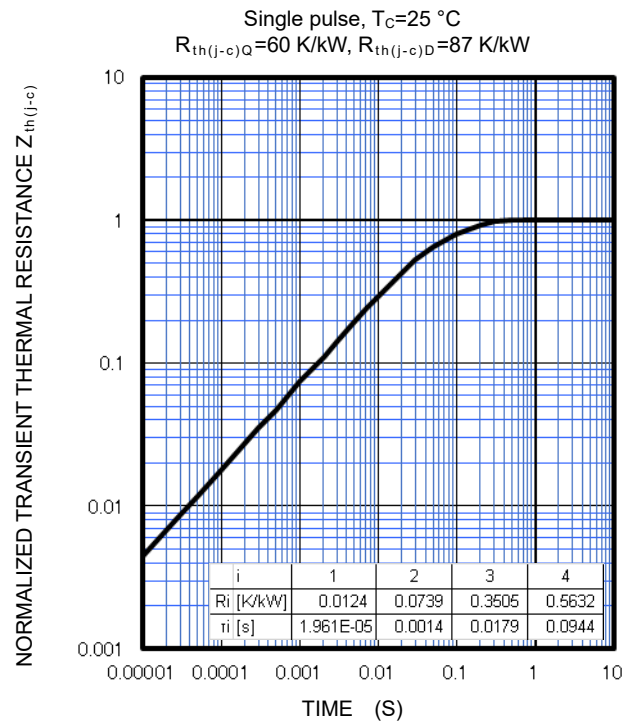
INVERTER PART

CAPACITANCE CHARACTERISTICS

(TYPICAL)

GATE CHARGE CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

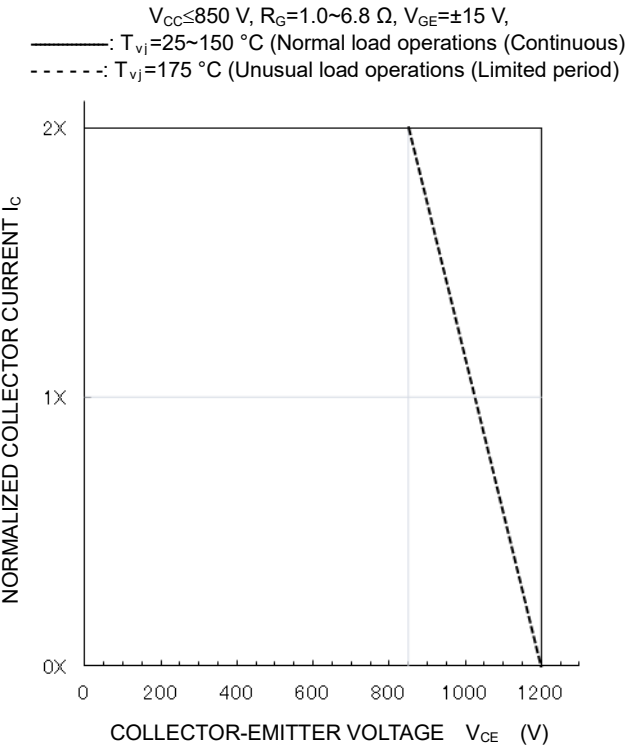
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.0\text{ }\Omega$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^{\circ}\text{C}$, - - - - : $T_{vj}=125\text{ }^{\circ}\text{C}$

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

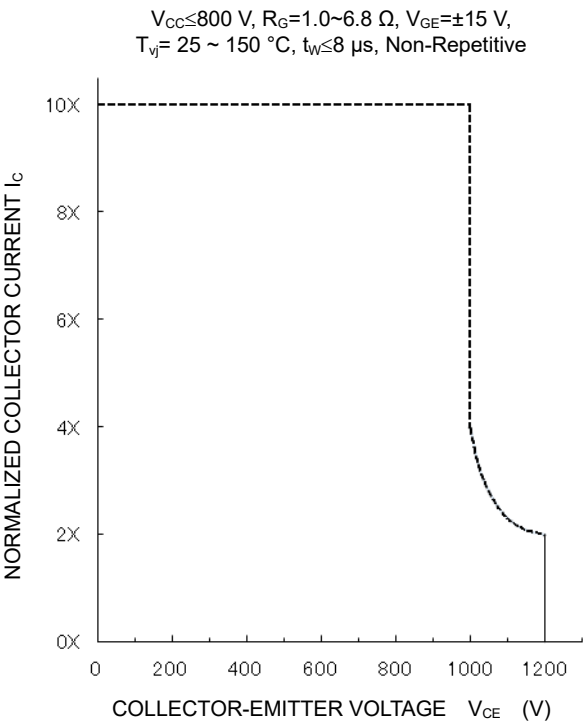
PERFORMANCE CURVES

INVERTER PART

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

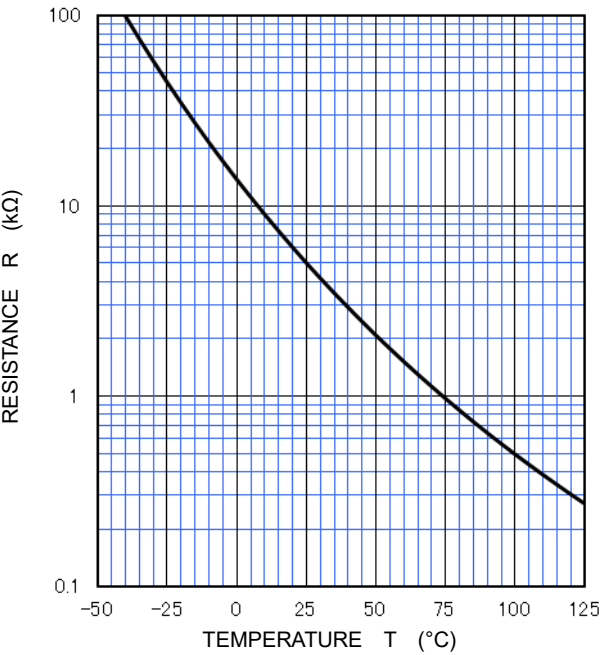


SHORT-CIRCUIT SAFE OPERATING AREA
(MAXIMUM)



NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



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

CM600DX-24T1/CM600DXP-24T1

HIGH POWER SWITCHING USE

INSULATED TYPE

Important Notice

The information contained in this datasheet shall in no event be regarded as a guarantee of conditions or characteristics. This product has to be used within its specified maximum ratings, and is subject to customer's compliance with any applicable legal requirement, norms and standards.

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In usage of power semiconductor, there is always the possibility that trouble may occur with them by the reliability lifetime such as Power Cycle, Thermal Cycle or others, or when used under special circumstances (e.g. condensation, high humidity, dusty, salty, highlands, environment with lots of organic matter / corrosive gas / explosive gas, or situations which terminals of semiconductor products receive strong mechanical stress). Therefore, please pay sufficient attention to such circumstances. Further, depending on the technical requirements, our semiconductor products may contain environmental regulation substances, etc. If there is necessity of detailed confirmation, please contact our nearest sales branch or distributor.

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Keep safety first in your circuit designs!

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