

CM225DX-24T/CM225DXP-24T

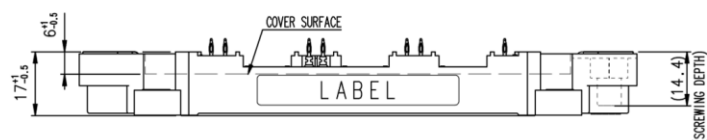
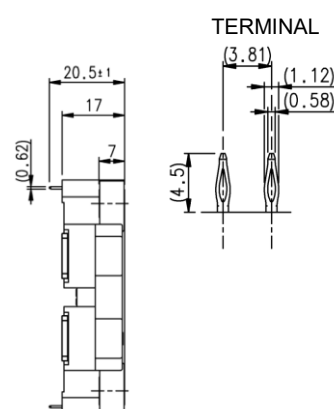
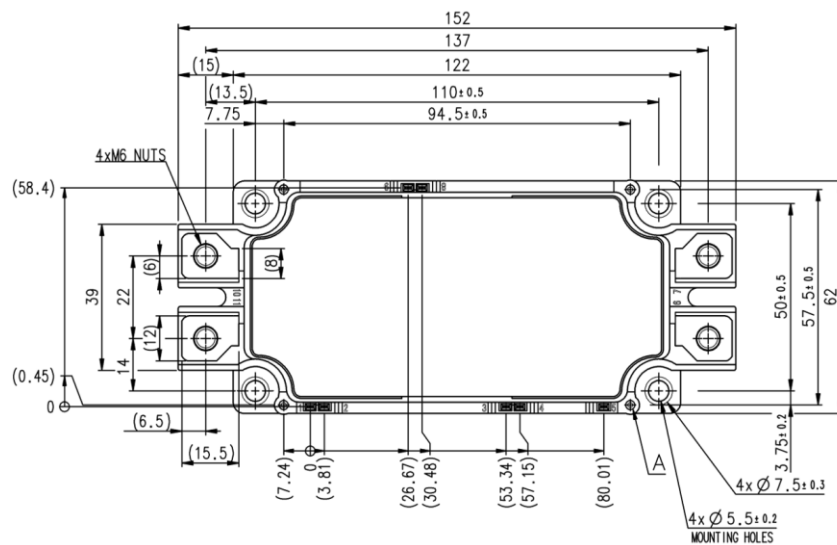
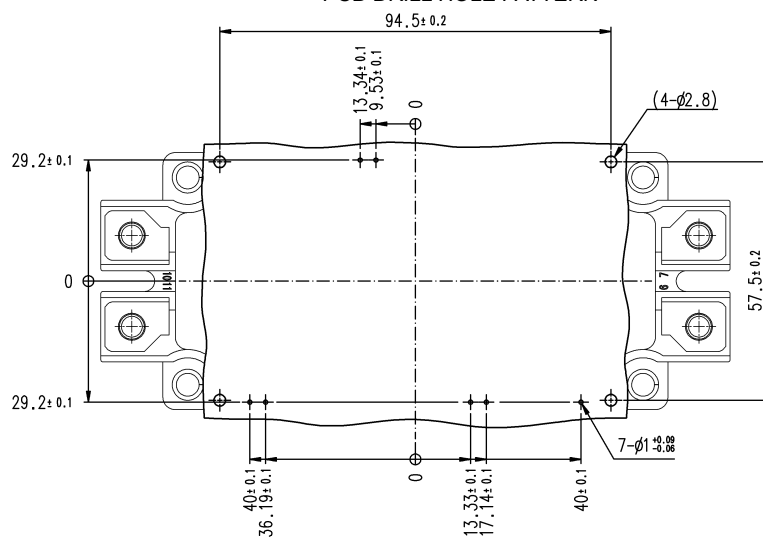
HIGH POWER SWITCHING USE

INSULATED TYPE

OUTLINE DRAWING

Dimension in mm

DXP

**PCB DRILL HOLE PATTERN**

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

CM225DX-24T/CM225DXP-24T

HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM 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, $T_C=125\text{ }^{\circ}\text{C}$ (Note2, 4)	225	A
I_{CRM}		Pulse, Repetitive (Note3)	450	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	1470	W
I_E (Note1)	Emitter current	DC (Note2)	225	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	450	

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	$I_C=22.5\text{ mA}$, $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V
V_{CEsat} (Terminal)	Collector-emitter saturation voltage	$I_C=225\text{ A}$, $V_{GE}=15\text{ V}$, Refer to the figure of test circuit (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.55	2.00	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	1.75	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	1.80	-	
V_{CEsat} (Chip)		$I_C=225\text{ A}$, $V_{GE}=15\text{ V}$, (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.50	17.5	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	1.70	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	1.75	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	55	nF
C_{oes}	Output capacitance		-	-	1.65	
C_{res}	Reverse transfer capacitance		-	-	0.66	
Q_G	Gate charge	$V_{CC}=600\text{ V}$, $I_C=225\text{ A}$, $V_{GE}=15\text{ V}$	-	1.7	-	μC
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=225\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=2.4\text{ }\Omega$, Inductive load	-	-	600	ns
t_r	Rise time		-	-	200	
$t_{d(off)}$	Turn-off delay time		-	-	800	
t_f	Fall time		-	-	400	
V_{EC} (Note1) (Terminal)	Emitter-collector voltage	$I_E=225\text{ A}$, G-E short-circuited, Refer to the figure of test circuit (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.55	2.00	V
			$T_{vj}=125\text{ }^{\circ}\text{C}$	1.70	-	
			$T_{vj}=150\text{ }^{\circ}\text{C}$	1.75	-	
V_{EC} (Note1) (Chip)		$I_E=225\text{ A}$, G-E short-circuited, (Note5)	$T_{vj}=25\text{ }^{\circ}\text{C}$	1.50	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	$V_{CC}=600\text{ V}$, $I_E=225\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=2.4\text{ }\Omega$, Inductive load	-	-	400	ns
Q_{rr} (Note1)	Reverse recovery charge		-	19.3	-	μC
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=225\text{ A}$,	-	25.5	-	mJ
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=2.4\text{ }\Omega$, $T_{vj}=150\text{ }^{\circ}\text{C}$,	-	22.9	-	
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	16.1	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	0.94	-	m Ω
r_g	Internal gate resistance	Per switch	-	1.3	-	Ω

CM225DX-24T/CM225DXP-24T

HIGH POWER SWITCHING USE

INSULATED TYPE

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)	-	-	102	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	150	
$R_{th(c-s)}$	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.

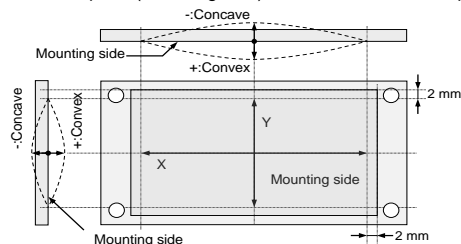
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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.

CM225DX-24T/CM225DXP-24T

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 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	0.75 ± 0.075 N·m	
		φ2.6×12		

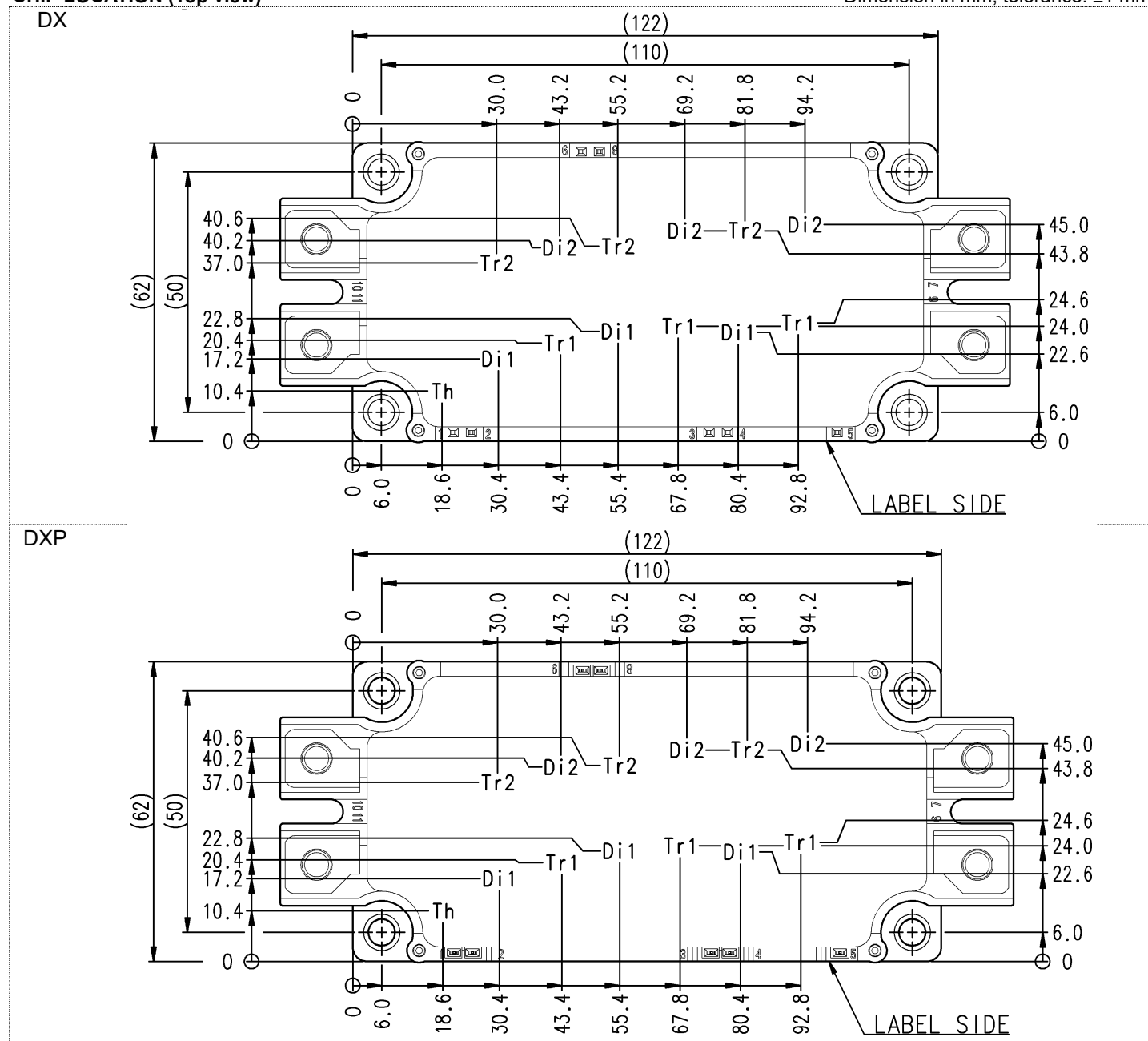
RECOMMENDED OPERATING CONDITIONS

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	2.4	-	24	Ω

CM225DX-24T/CM225DXP-24T

HIGH POWER SWITCHING USE

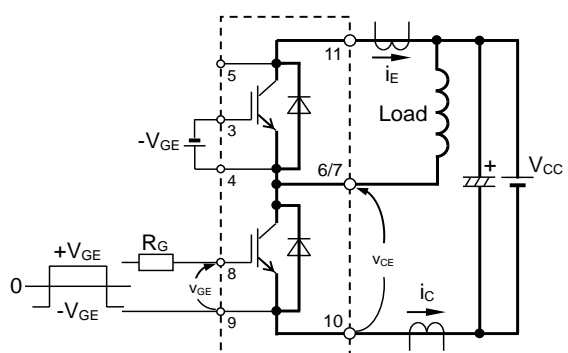
INSULATED TYPE

CHIP LOCATION (Top view)Dimension in mm, tolerance: ± 1 mm

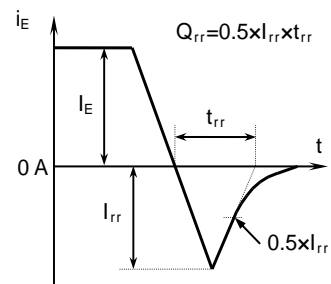
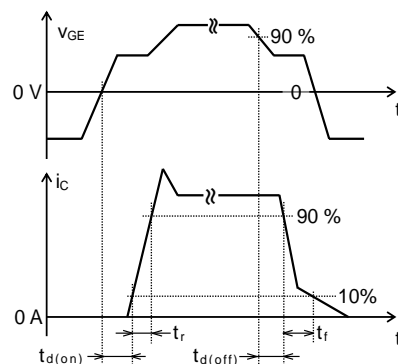
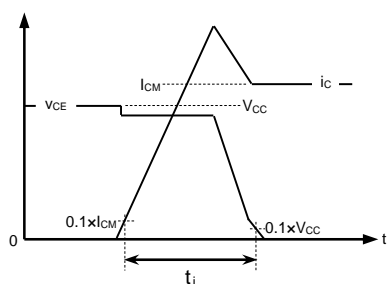
CM225DX-24T/CM225DXP-24T

HIGH POWER SWITCHING USE

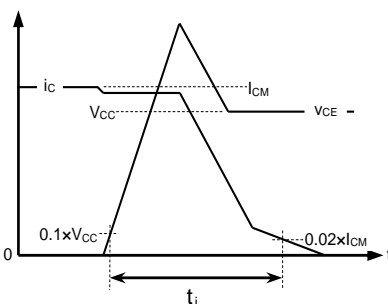
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

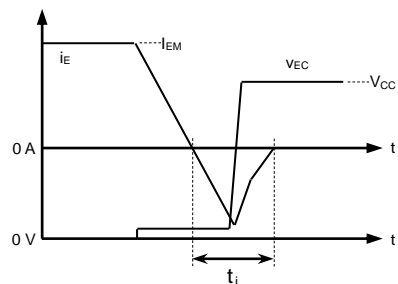
Switching characteristics test circuit and waveforms

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

IGBT Turn-on switching energy

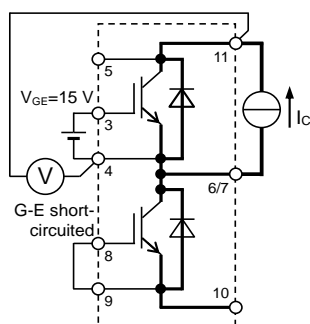


IGBT Turn-off switching energy

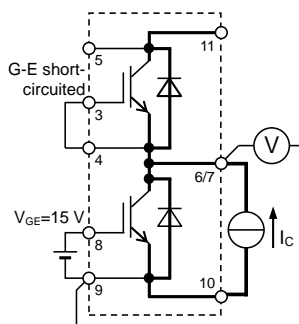


FWD Reverse recovery energy

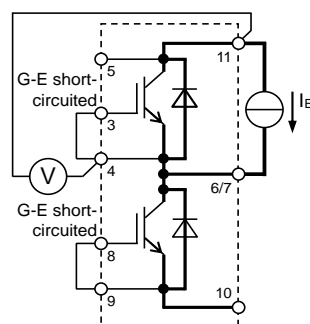
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

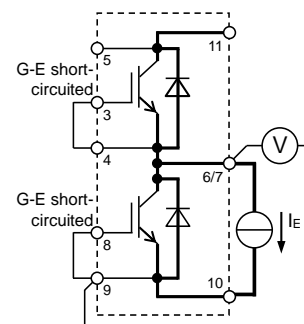
Tr1

 V_{CEsat} characteristics test circuit

Tr2



Di1

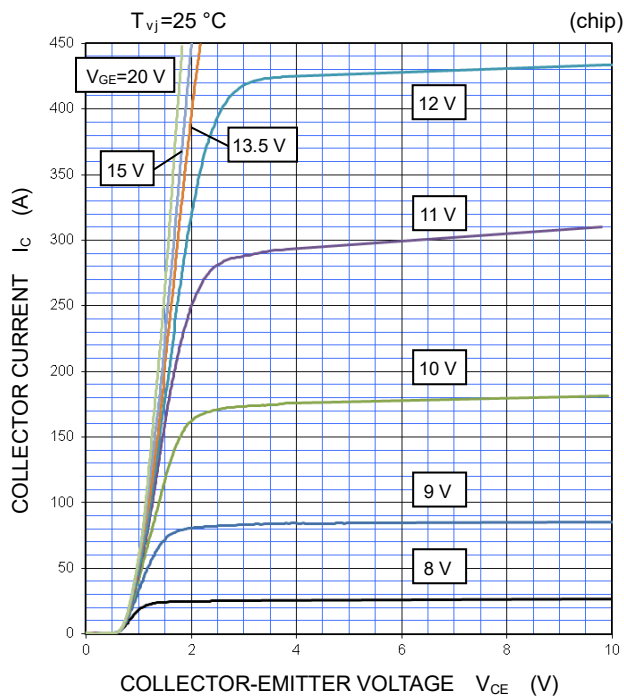
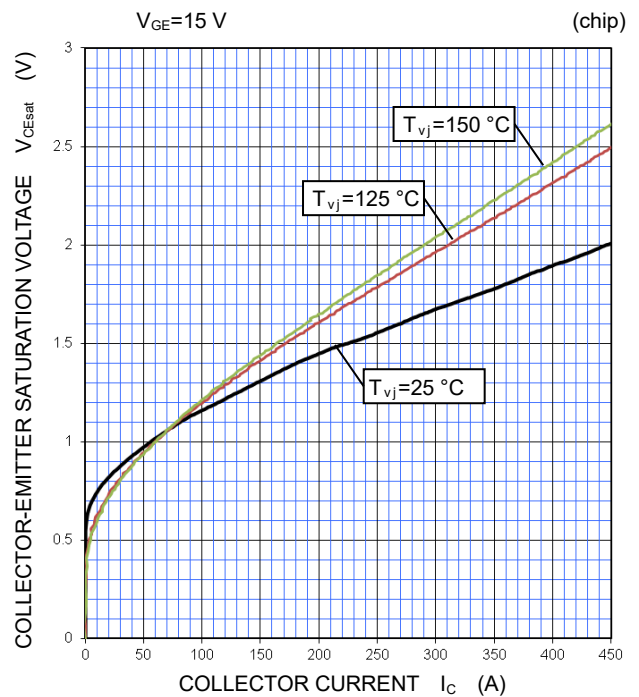
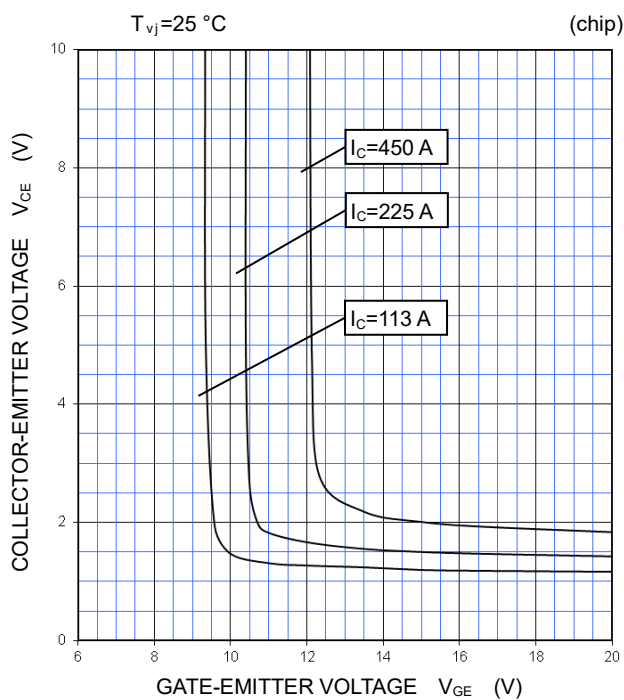
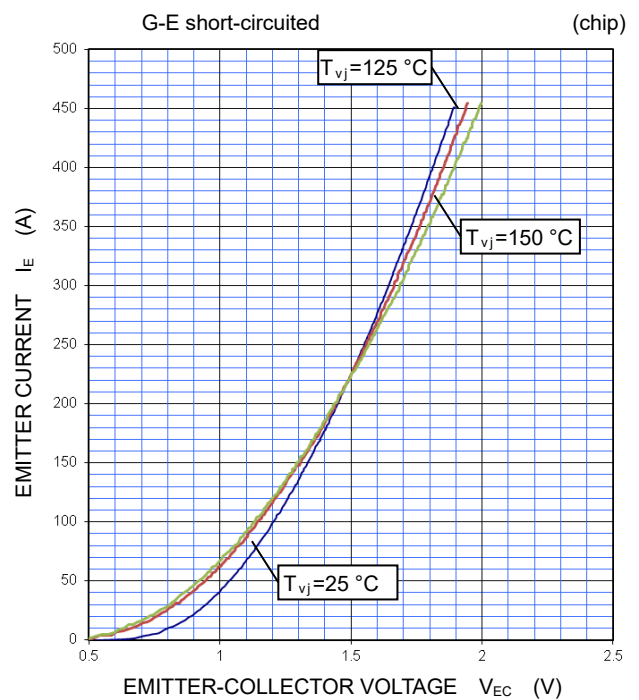
 V_{CE} characteristics test circuit

Di2

CM225DX-24T/CM225DXP-24T

HIGH POWER SWITCHING USE

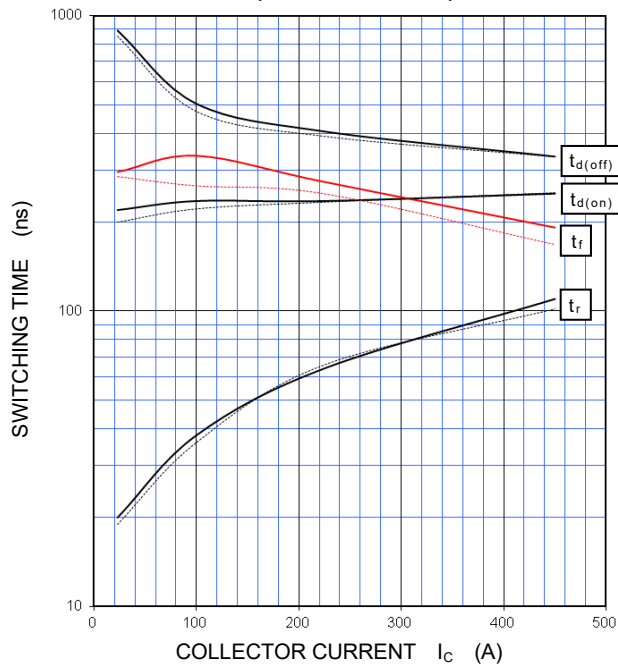
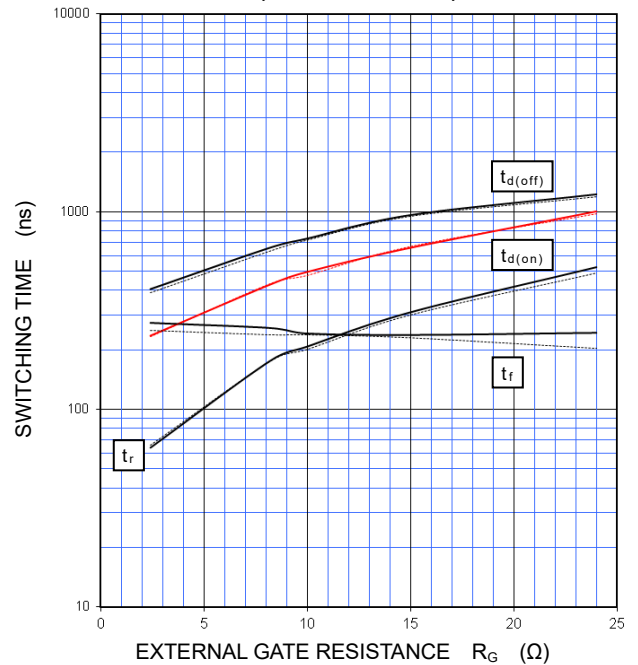
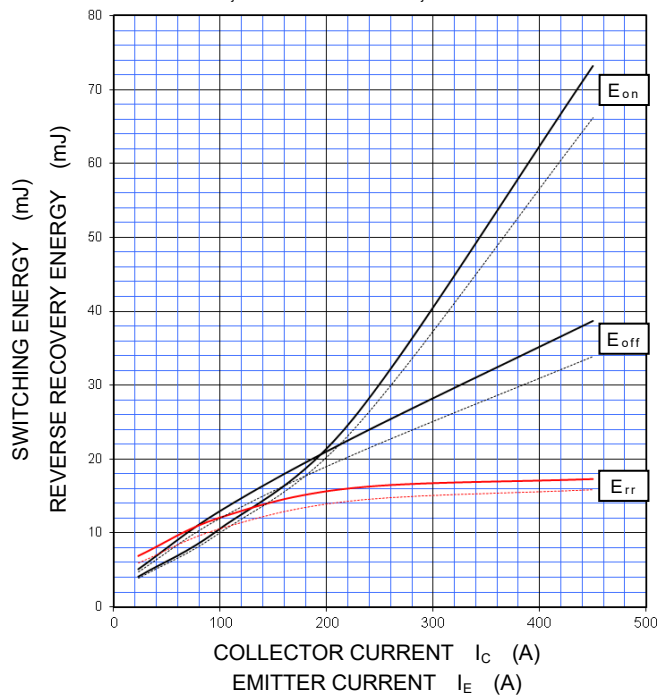
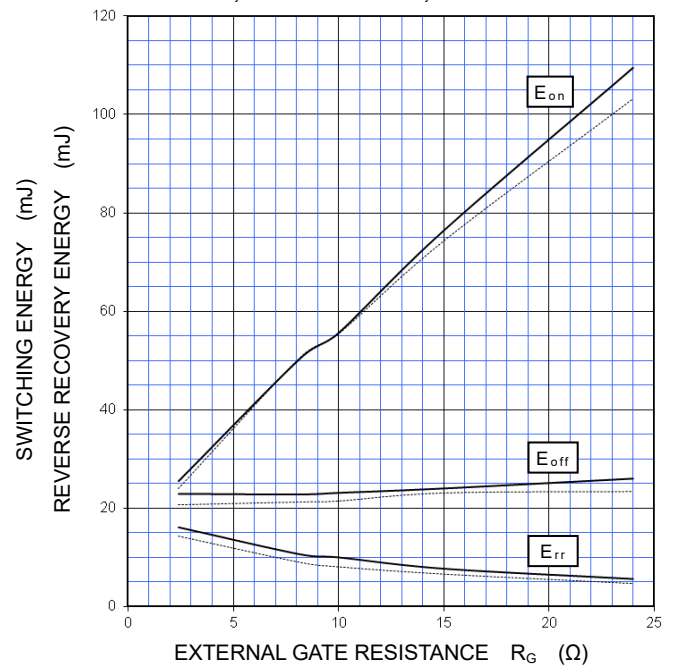
INSULATED TYPE

PERFORMANCE CURVES**INVERTER PART****OUTPUT CHARACTERISTICS
(TYPICAL)****COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)****COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS
(TYPICAL)****FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)**

CM225DX-24T/CM225DXP-24T

HIGH POWER SWITCHING USE

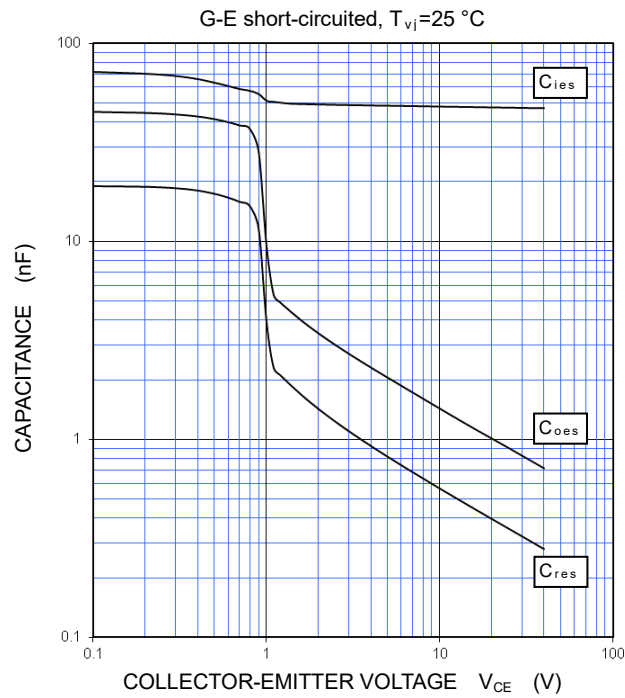
INSULATED TYPE

PERFORMANCE CURVES**INVERTER PART****HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)** $V_{CC}=600\text{ V}$, $R_G=2.4\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - - -: $T_{vj}=125\text{ }^\circ\text{C}$ **HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)** $V_{CC}=600\text{ V}$, $I_C=225\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - - -: $T_{vj}=125\text{ }^\circ\text{C}$ **HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)** $V_{CC}=600\text{ V}$, $R_G=2.4\ \Omega$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD,
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - - -: $T_{vj}=125\text{ }^\circ\text{C}$, PER PULSE**HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)** $V_{CC}=600\text{ V}$, $I_C/I_E=225\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD,
—: $T_{vj}=150\text{ }^\circ\text{C}$, - - - - -: $T_{vj}=125\text{ }^\circ\text{C}$, PER PULSE

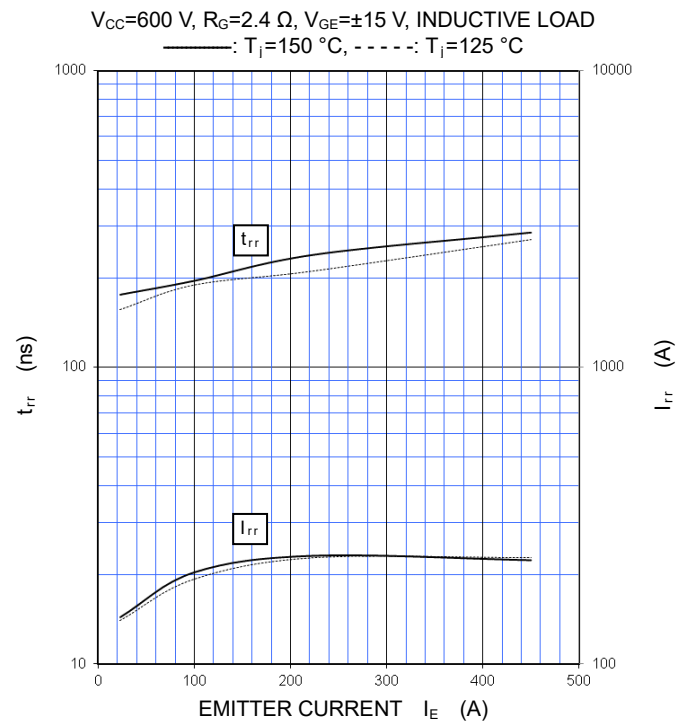
PERFORMANCE CURVES

INVERTER PART

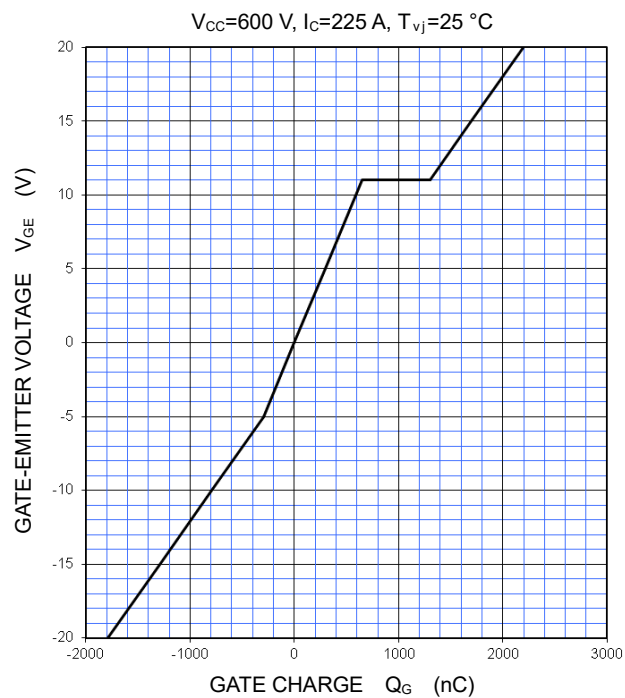
CAPACITANCE CHARACTERISTICS
(TYPICAL)



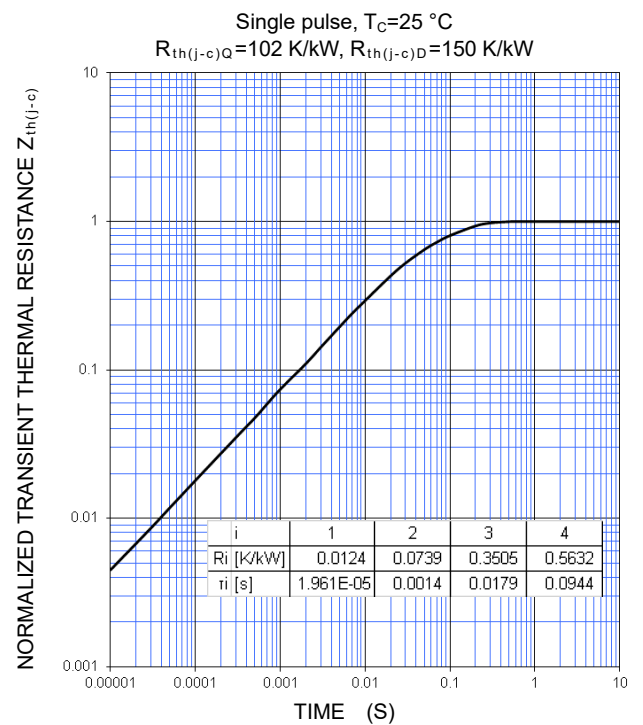
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)



GATE CHARGE CHARACTERISTICS
(TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)



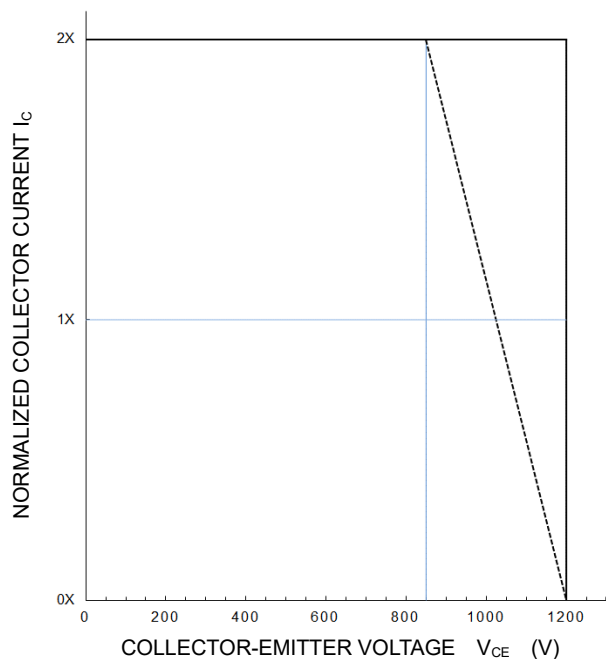
CM225DX-24T/CM225DXP-24T

HIGH POWER SWITCHING USE

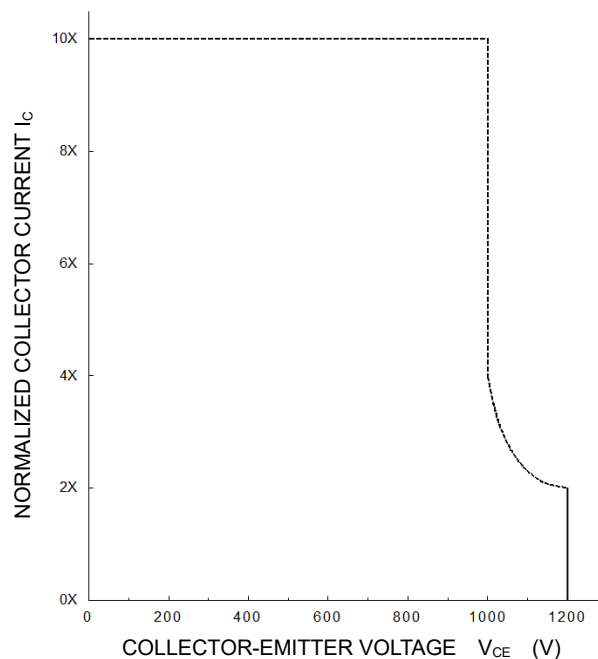
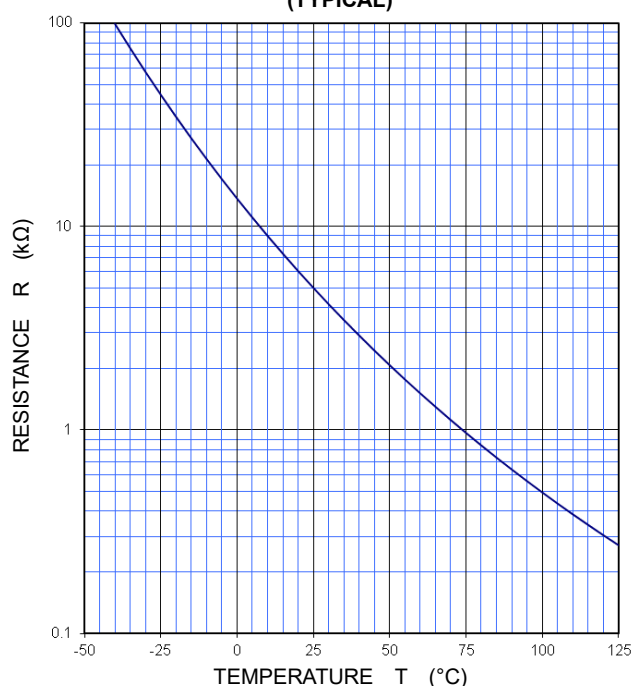
INSULATED TYPE

PERFORMANCE CURVES**INVERTER PART****TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)**

$V_{CC} \leq 850 \text{ V}$, $R_G = 2.4 \sim 24 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 ———: $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ (Normal load operations (Continuous))
 - - - - -: $T_{vj} = 175 \text{ }^\circ\text{C}$ (Unusual load operations (Limited period))

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

$V_{CC} \leq 800 \text{ V}$, $R_G = 2.4 \sim 24 \ \Omega$, $V_{GE} = \pm 15 \text{ V}$,
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$, $t_W \leq 8 \ \mu\text{s}$, 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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