

<IGBT Modules>

CM300DX-13T/CM300DXP-13T

 HIGH POWER SWITCHING USE
INSULATED TYPE


dual switch (half-bridge)

 Collector current I_c 3 0 0 A

 Collector-emitter voltage V_{CES} 6 5 0 V

 Maximum junction temperature T_{vjmax} 1 7 5 °C

- Flat base type
- Copper base plate (Nickel-plating)
- RoHS Directive compliant
- Tin plating pin terminals

 Collector current I_c 3 0 0 A

 Collector-emitter voltage V_{CES} 6 5 0 V

 Maximum junction temperature T_{vjmax} 1 7 5 °C

- Flat base type
- Copper base plate (Nickel-plating)
- RoHS Directive compliant
- Tin plating pressfit terminals

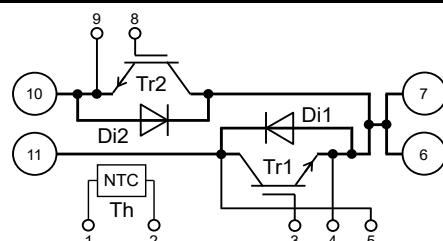
• UL Recognized under UL1557, File No. E323585

APPLICATION

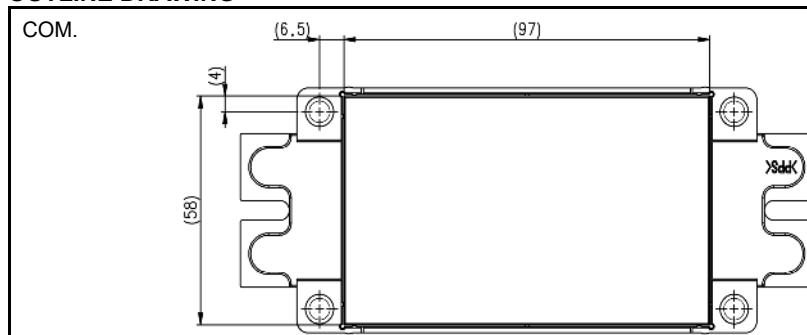
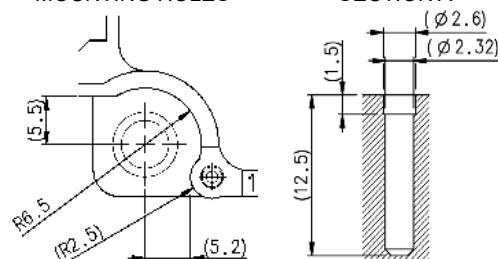
AC Motor Control, Motion/Servo Control, Power supply, etc.

OPTION (Below options are available.)

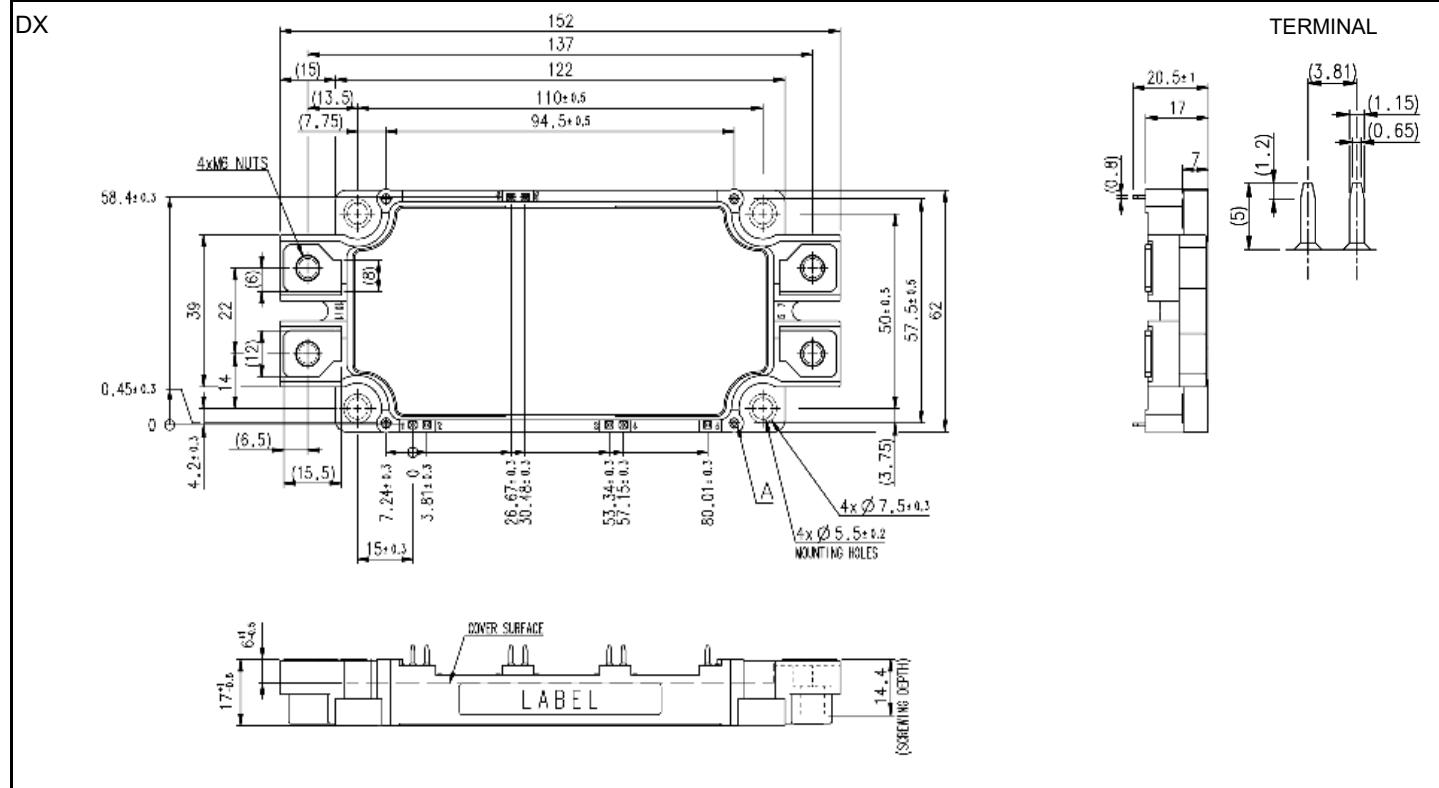
- PC-TIM (Phase Change Thermal Interface Material) pre-apply
- V_{CESat} selection for parallel connection

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	

OUTLINE DRAWING

MOUNTING HOLES


Dimension in mm

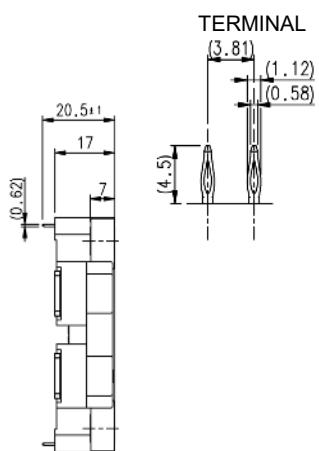
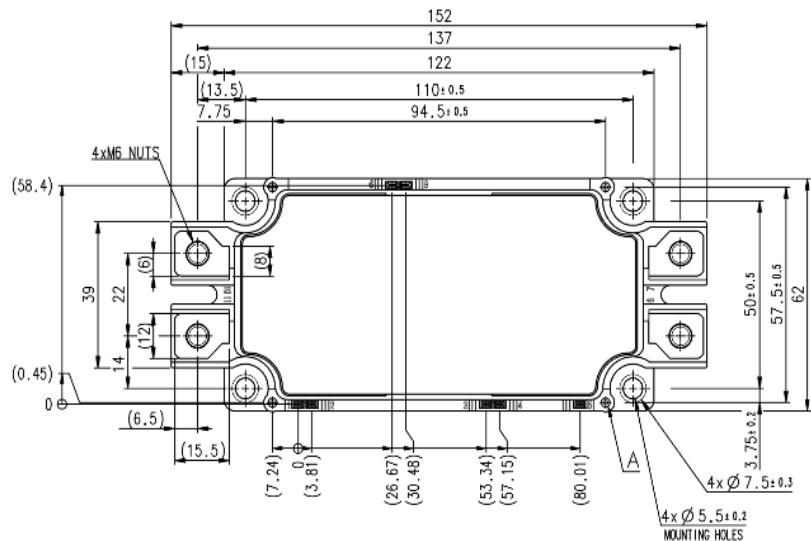
OUTLINE DRAWING

Tolerance otherwise specified

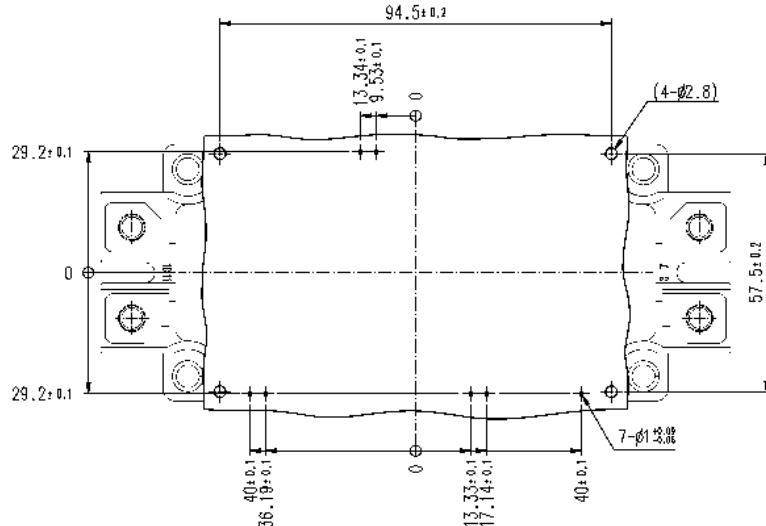
Division of Dimension	Tolerance
0.5 to 3	± 0.2
over 3 to 6	± 0.3
over 6 to 30	± 0.5
over 30 to 120	± 0.8
over 120 to 400	± 1.2

OUTLINE DRAWING

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

CM300DX-13T/CM300DXP-13T

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	650	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =108 °C (Note2, 4)	300	A
I _{CRM}		Pulse, Repetitive (Note3)	600	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	1145	W
I _E (Note1)	Emitter current	DC (Note2)	300	A
I _{ERM} (Note1)		Pulse, Repetitive (Note3)	600	

MODULE

Symbol	Item	Conditions	Rating	Unit
V _{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T _{vjmax}	Maximum junction temperature	Instantaneous event (overload) (Note9)	175	°C
T _{Cmax}	Maximum case temperature	(Note4,9)	125	
T _{vjop}	Operating junction temperature	Continuous operation (under switching) (Note9)	-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 =30 mA, V _{CE} =10 V	5.4	6.0	6.6	V
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =300 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	1.40	1.75
			T _{vj} =125 °C	-	1.50	-
			T _{vj} =150 °C	-	1.55	-
V _{CEsat} (Chip)	Collector-emitter saturation voltage	I _C =300 A, V _{GE} =15 V, (Note5)	T _{vj} =25 °C	-	1.30	1.55
			T _{vj} =125 °C	-	1.35	-
			T _{vj} =150 °C	-	1.35	-
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	40.1	nF
C _{oes}	Output capacitance		-	-	1.7	
C _{res}	Reverse transfer capacitance		-	-	0.8	
Q _G	Gate charge	V _{CC} =300 V, I _C =300 A, V _{GE} =15 V	-	1.24	-	µC
t _{d(on)}	Turn-on delay time	V _{CC} =300 V, I _C =300 A, V _{GE} =±15 V, R _G =1.6 Ω, Inductive load	-	-	400	ns
t _r	Rise time		-	-	200	
t _{d(off)}	Turn-off delay time		-	-	400	
t _f	Fall time		-	-	400	
V _{EC} (Note1) (Terminal)	Emitter-collector voltage	I _E =300 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	1.60	2.15
			T _{vj} =125 °C	-	1.65	-
			T _{vj} =150 °C	-	1.65	-
V _{EC} (Note1) (Chip)	Emitter-collector voltage	I _E =300 A, G-E short-circuited, (Note5)	T _{vj} =25 °C	-	1.45	1.85
			T _{vj} =125 °C	-	1.50	-
			T _{vj} =150 °C	-	1.50	-
t _{rr} (Note1)	Reverse recovery time	V _{CC} =300 V, I _E =300 A, V _{GE} =±15 V, R _G =1.6 Ω, Inductive load	-	-	400	ns
Q _{rr} (Note1)	Reverse recovery charge		-	21	-	µC
E _{on}	Turn-on switching energy per pulse	V _{CC} =300 V, I _C =I _E =300 A, V _{GE} =±15 V, R _G =1.6 Ω, T _{vj} =150 °C, Inductive load	-	5.8	-	mJ
E _{off}	Turn-off switching energy per pulse		-	14.0	-	
E _{rr} (Note1)	Reverse recovery energy per pulse		-	12.4	-	
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C (Note4)	-	1.13	-	mΩ
r _g	Internal gate resistance	Per switch	-	2.0	-	Ω

CM300DX-13T/CM300DXP-13THIGH POWER SWITCHING USE
INSULATED TYPE**ELECTRICAL CHARACTERISTICS (cont.; $T_{vj}=25^{\circ}\text{C}$, unless otherwise specified)****NTC THERMISTOR PART**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	$T_c=25^{\circ}\text{C}$ (Note4)	4.85	5.00	5.15	$\text{k}\Omega$
$\Delta R/R$	Deviation of resistance	$R_{100}=493\ \Omega$, $T_c=100^{\circ}\text{C}$ (Note4)	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note6)	-	3375	-	K
P_{25}	Power dissipation	$T_c=25^{\circ}\text{C}$ (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)	-	-	131	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	169	
$R_{th(c-s)}$	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	$\text{N}\cdot\text{m}$
M_s	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	$\text{N}\cdot\text{m}$
d_s	Creepage distance	Solder pin type (DX)	Terminal to terminal	17	-	-
			Terminal to base plate	16.4	-	-
		Pressfit pin type (DXP)	Terminal to terminal	17	-	-
			Terminal to base plate	16.8	-	-
d_a	Clearance	Solder pin type (DX)	Terminal to terminal	10	-	-
			Terminal to base plate	16.2	-	-
		Pressfit pin type (DXP)	Terminal to terminal	10	-	-
			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).

2. Junction temperature (T_{vj}) should not increase beyond $T_{vj\max}$ rating.

3. Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed $T_{vj\max}$ rating.

4. 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.

5. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

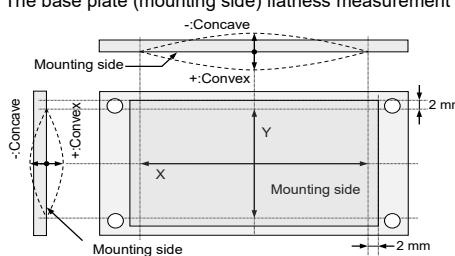
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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

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

7. Reference value. Thermally conductive grease of thermal conductivity $\lambda=0.9\text{ W}/(\text{m}\cdot\text{K})$ and thickness $D_{(c-s)}=50\text{ }\mu\text{m}$.

8. The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



9. 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.

CM300DX-13T/CM300DXP-13T

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	-	300	450	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	1.6	-	16	Ω

CM300DX-13T/CM300DXP-13T

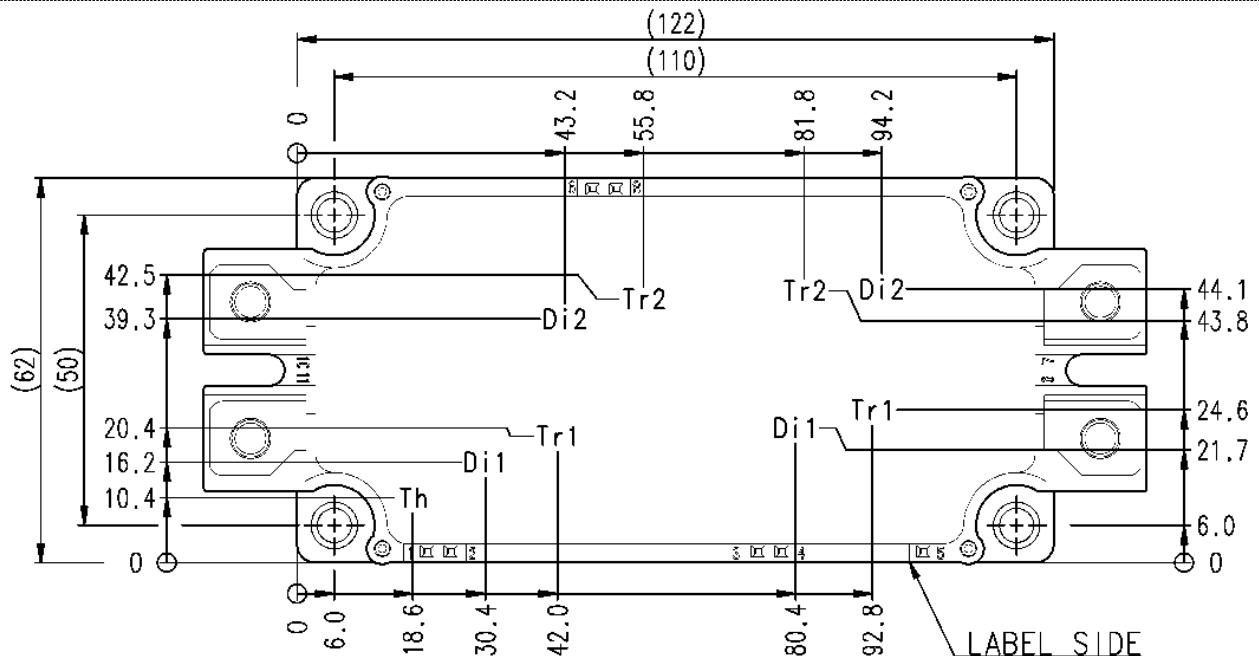
HIGH POWER SWITCHING USE

INSULATED TYPE

CHIP LOCATION (Top view)

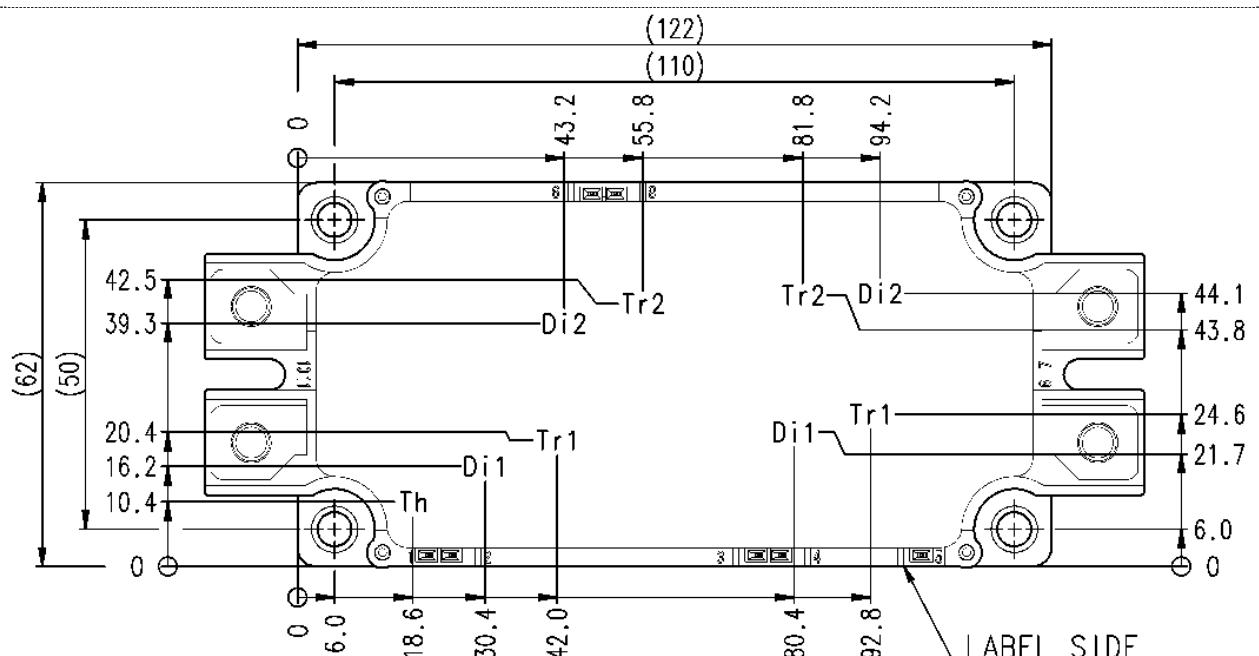
Dimension in mm, tolerance: ± 1 mm

DX



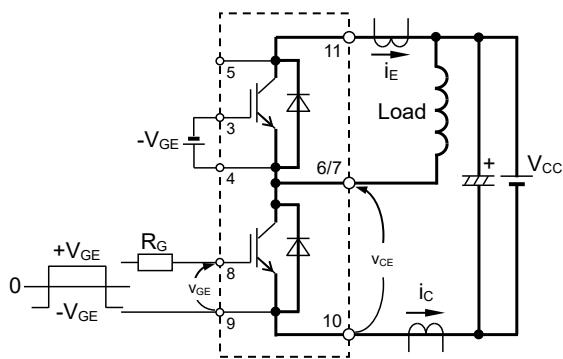
LABEL SIDE

DXP

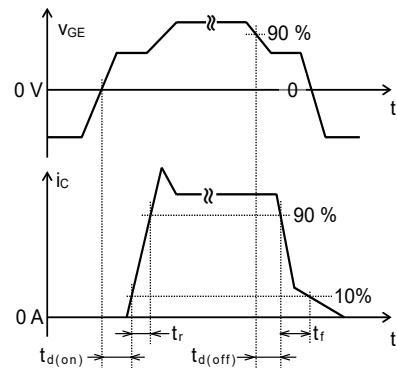


LABEL SIDE

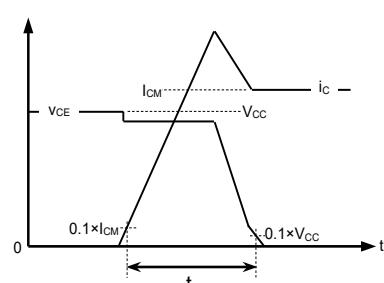
Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

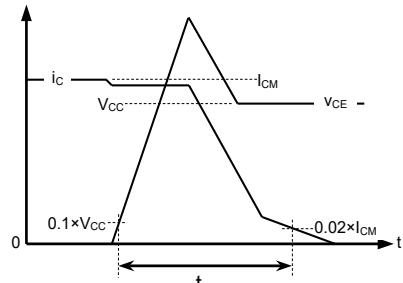
Switching characteristics test circuit and waveforms



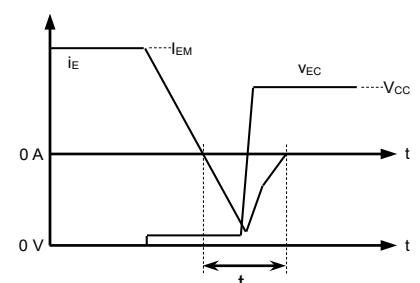
tr, Qrr characteristics test waveform



IGBT Turn-on switching energy

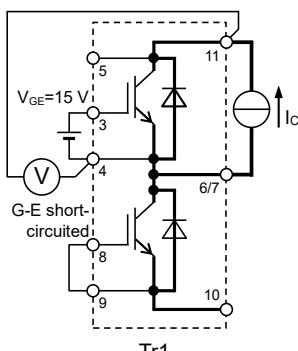


IGBT Turn-off switching energy

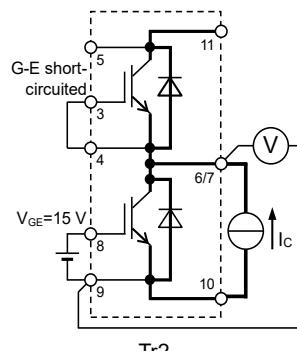


FWD Reverse recovery energy

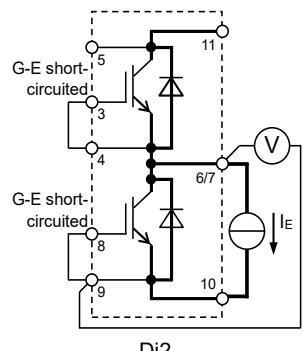
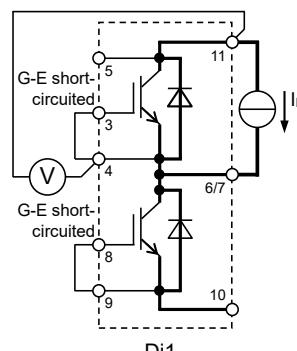
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

VCEsat characteristics test circuit

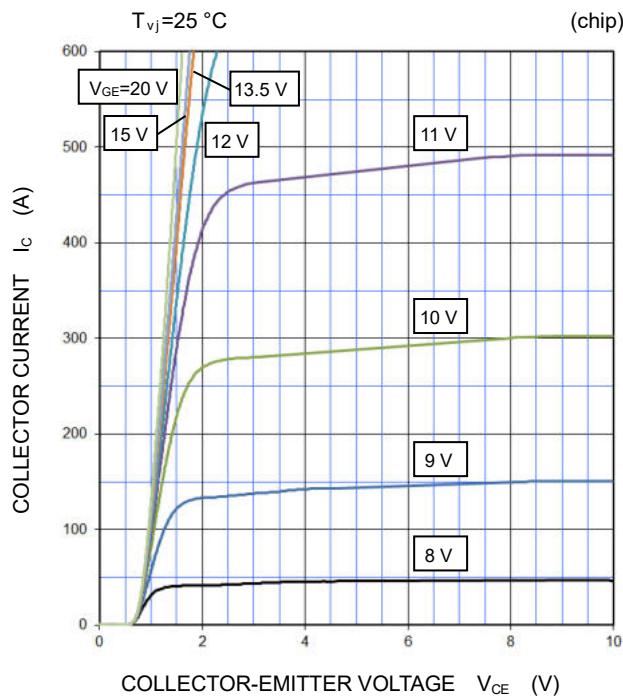
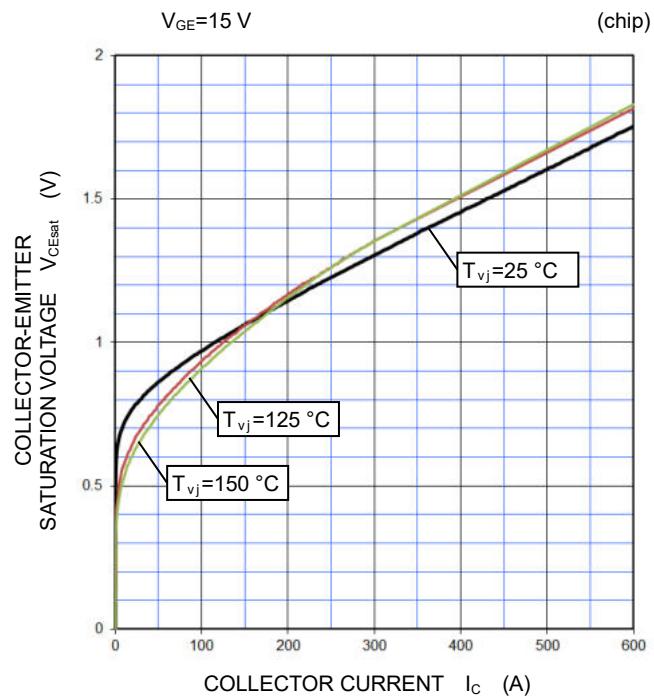
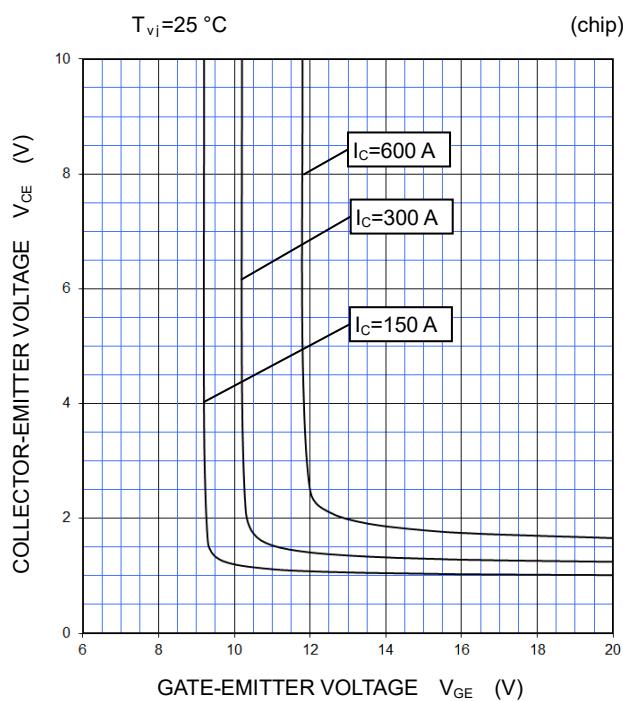
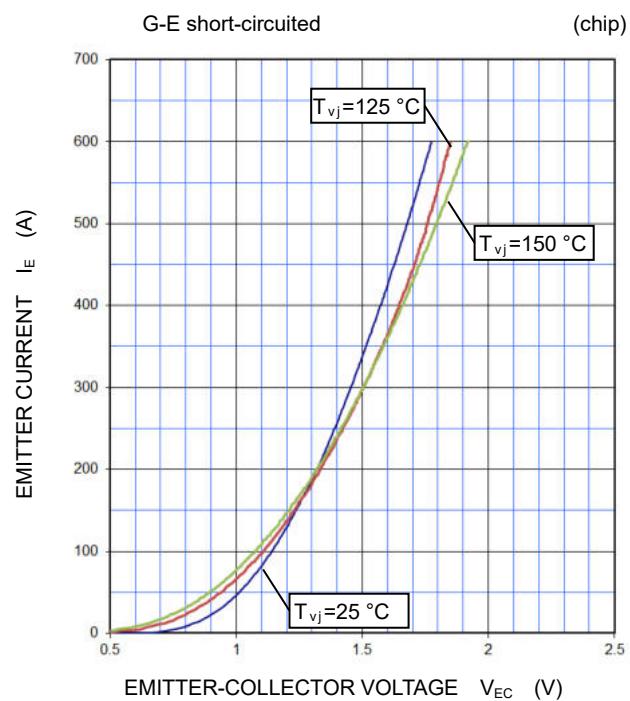


VCE characteristics test circuit



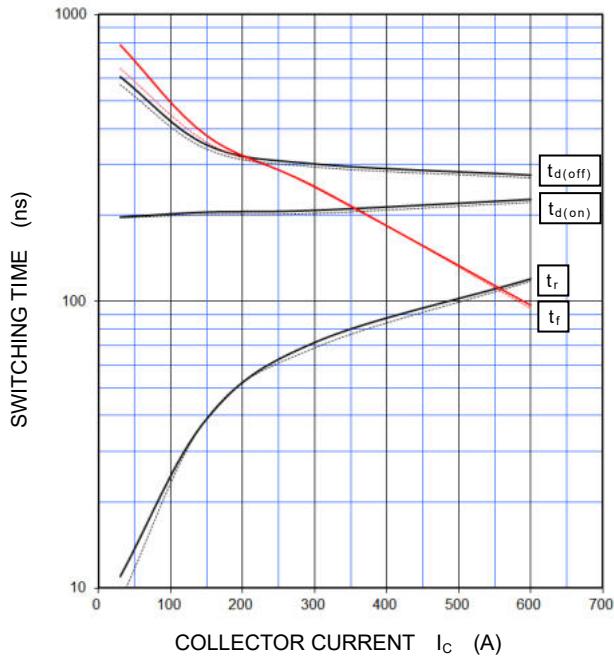
PERFORMANCE CURVES

INVERTER PART

OUTPUT CHARACTERISTICS
(TYPICAL)COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)

PERFORMANCE CURVES**INVERTER PART****HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)**

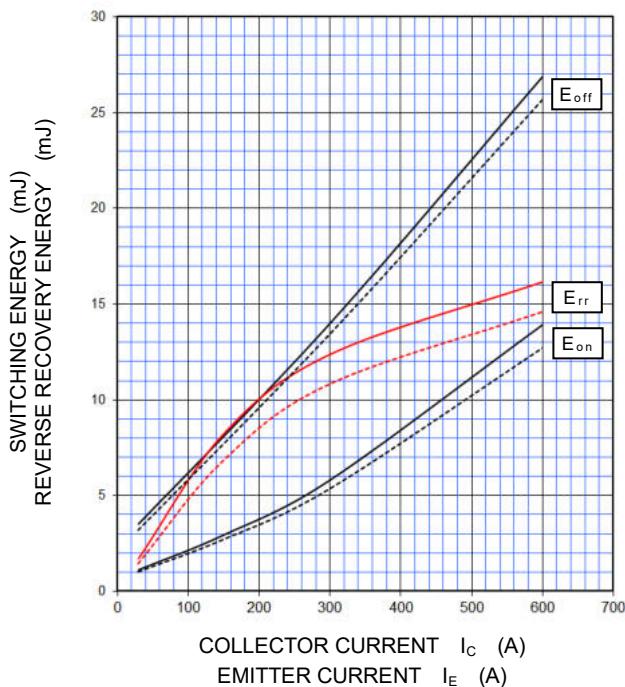
$V_{CC}=300$ V, $R_G=1.6$ Ω, $V_{GE}=\pm 15$ V, INDUCTIVE LOAD
—: $T_{vj}=150$ °C, - - -: $T_{vj}=125$ °C

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

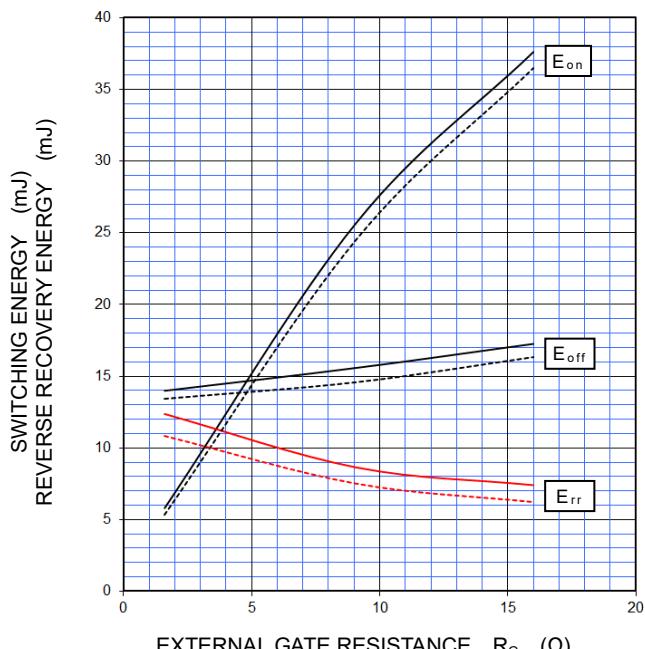
$V_{CC}=300$ V, $I_C=300$ A, $V_{GE}=\pm 15$ V, INDUCTIVE LOAD
—: $T_{vj}=150$ °C, - - -: $T_{vj}=125$ °C

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

$V_{CC}=300$ V, $R_G=1.6$ Ω, $V_{GE}=\pm 15$ V, INDUCTIVE LOAD,
—: $T_{vj}=150$ °C, - - -: $T_{vj}=125$ °C, PER PULSE

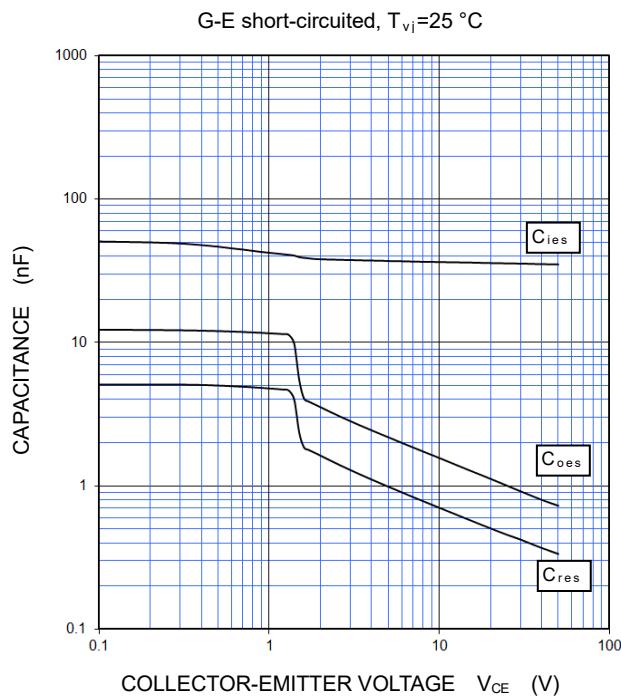
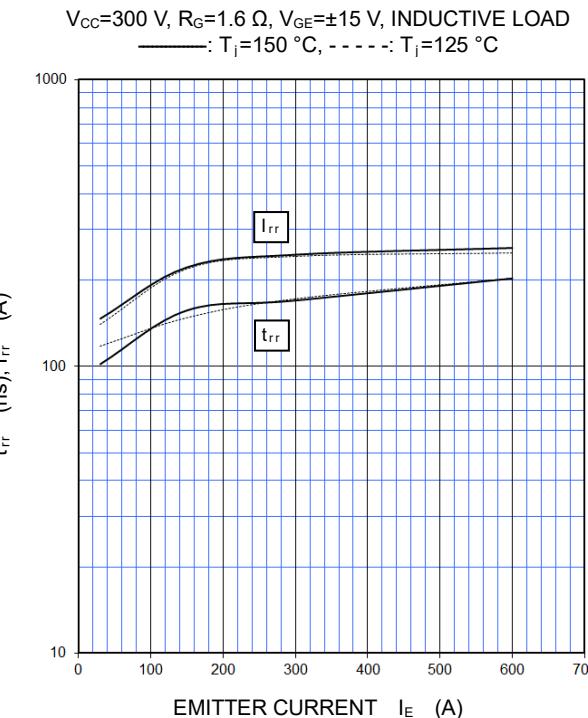
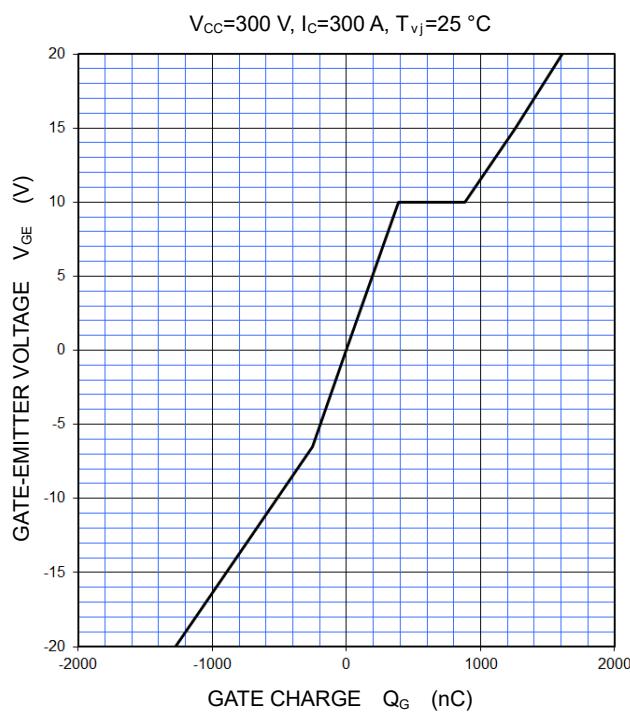
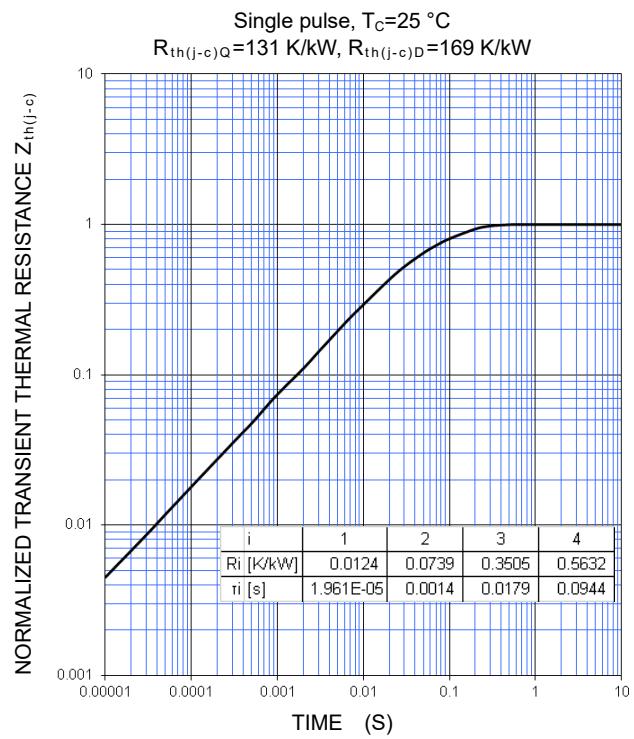
**HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL)**

$V_{CC}=300$ V, $I_C/I_E=300$ A, $V_{GE}=\pm 15$ V, INDUCTIVE LOAD,
—: $T_{vj}=150$ °C, - - -: $T_{vj}=125$ °C, PER PULSE



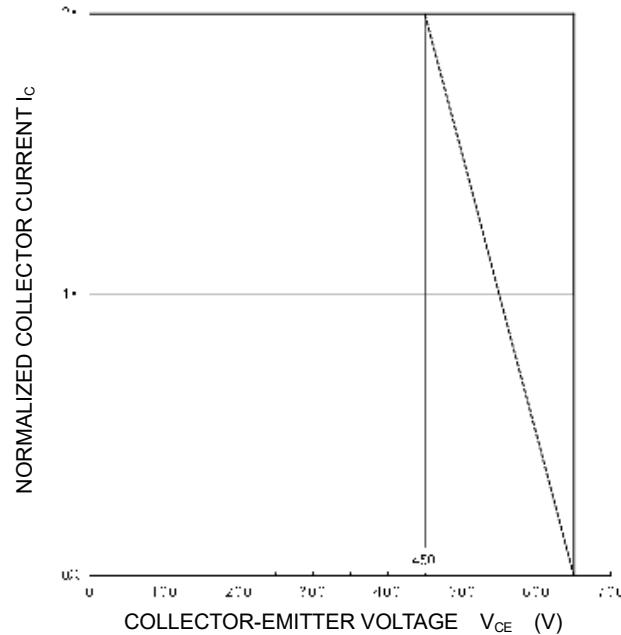
PERFORMANCE CURVES

INVERTER PART

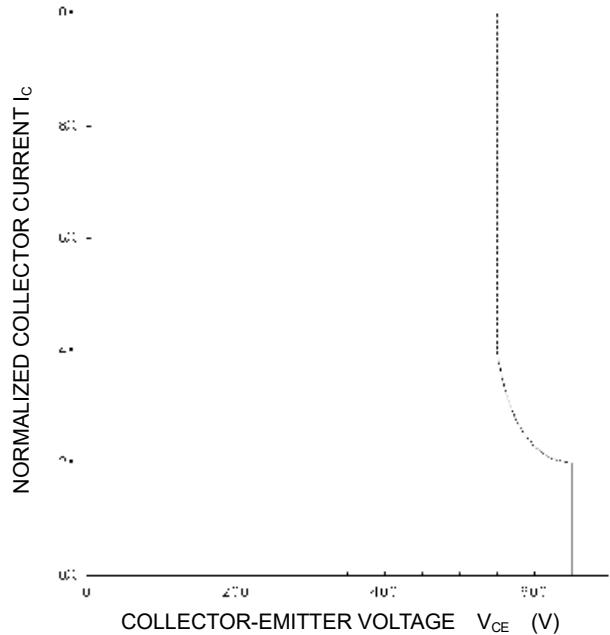
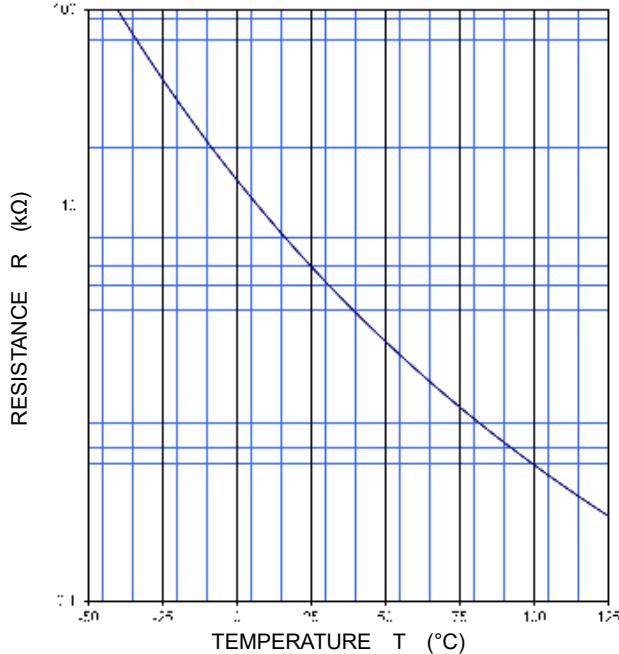
CAPACITANCE CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)GATE CHARGE CHARACTERISTICS
(TYPICAL)TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

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

$V_{CC} \leq 450$ V, $R_G = 1.6 \sim 16$ Ω , $V_{GE} = \pm 15$ V,
 —: $T_{vj} = 25 \sim 150$ $^{\circ}\text{C}$ (Normal load operations (Continuous))
 - - -: $T_{vj} = 175$ $^{\circ}\text{C}$ (Unusual load operations (Limited period))

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

$V_{CC} \leq 400$ V, $R_G = 1.6 \sim 16$ Ω , $V_{GE} = \pm 15$ V,
 $T_{vj} = 25 \sim 150$ $^{\circ}\text{C}$, $t_W \leq 8$ μs , 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.

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.

Except as otherwise explicitly approved by Mitsubishi Electric Corporation in a written document signed by authorized representatives of Mitsubishi Electric Corporation, our products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

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.

The contents or data contained in this datasheet are exclusively intended for technically trained staff. Customer's technical departments should take responsibility to evaluate the suitability of Mitsubishi Electric Corporation product for the intended application and the completeness of the product data with respect to such application. In the customer's research and development, please evaluate it not only with a single semiconductor product but also in the entire system, and judge whether it's applicable. As required, pay close attention to the safety design by installing appropriate fuse or circuit breaker between a power supply and semiconductor products to prevent secondary damage. Please also pay attention to the application note and the related technical information.

Keep safety first in your circuit designs!

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