
<IGBT Modules>

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE INSULATED TYPE



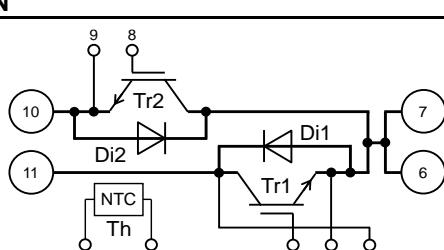
A photograph of a DXP power module, a black rectangular component with metal terminals and a central heat sink.

Allen C. Garrow (from storage)

APPLICATION

OPTION (Below options are available.)

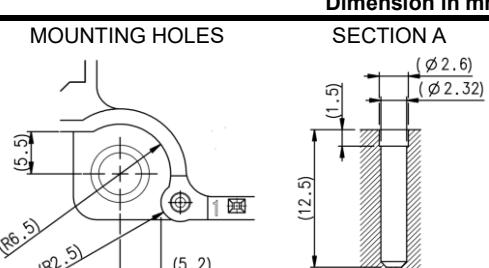
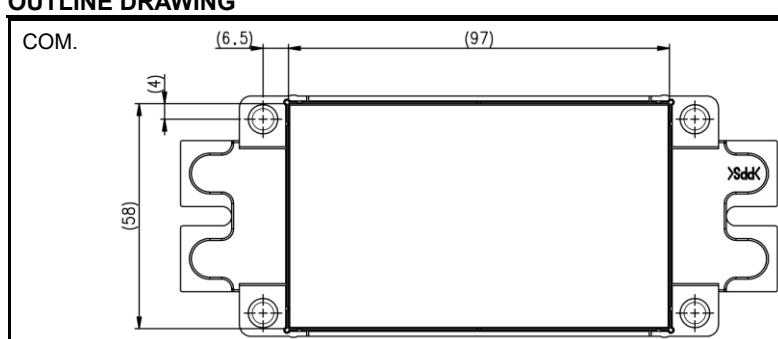
- V_{CEsat} selection for parallel



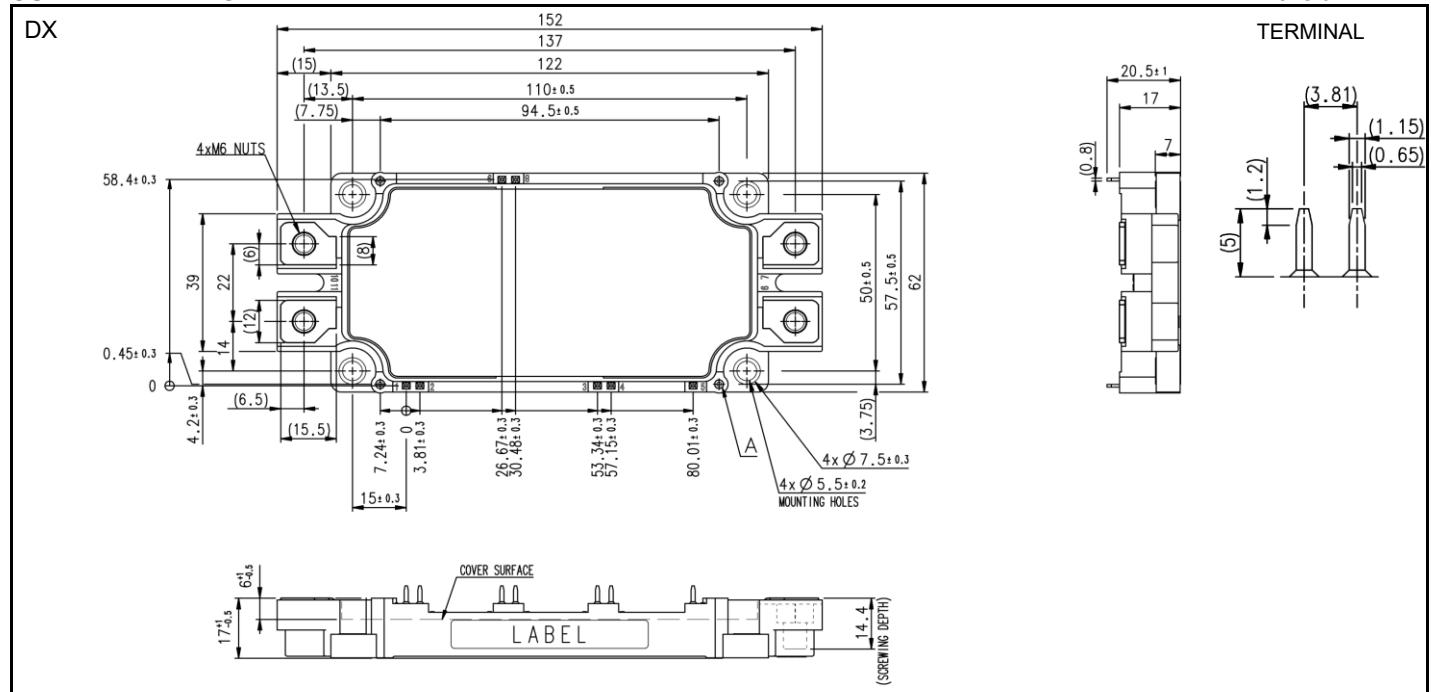
TERMINAL CODE

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

OUTLINE DRAWING



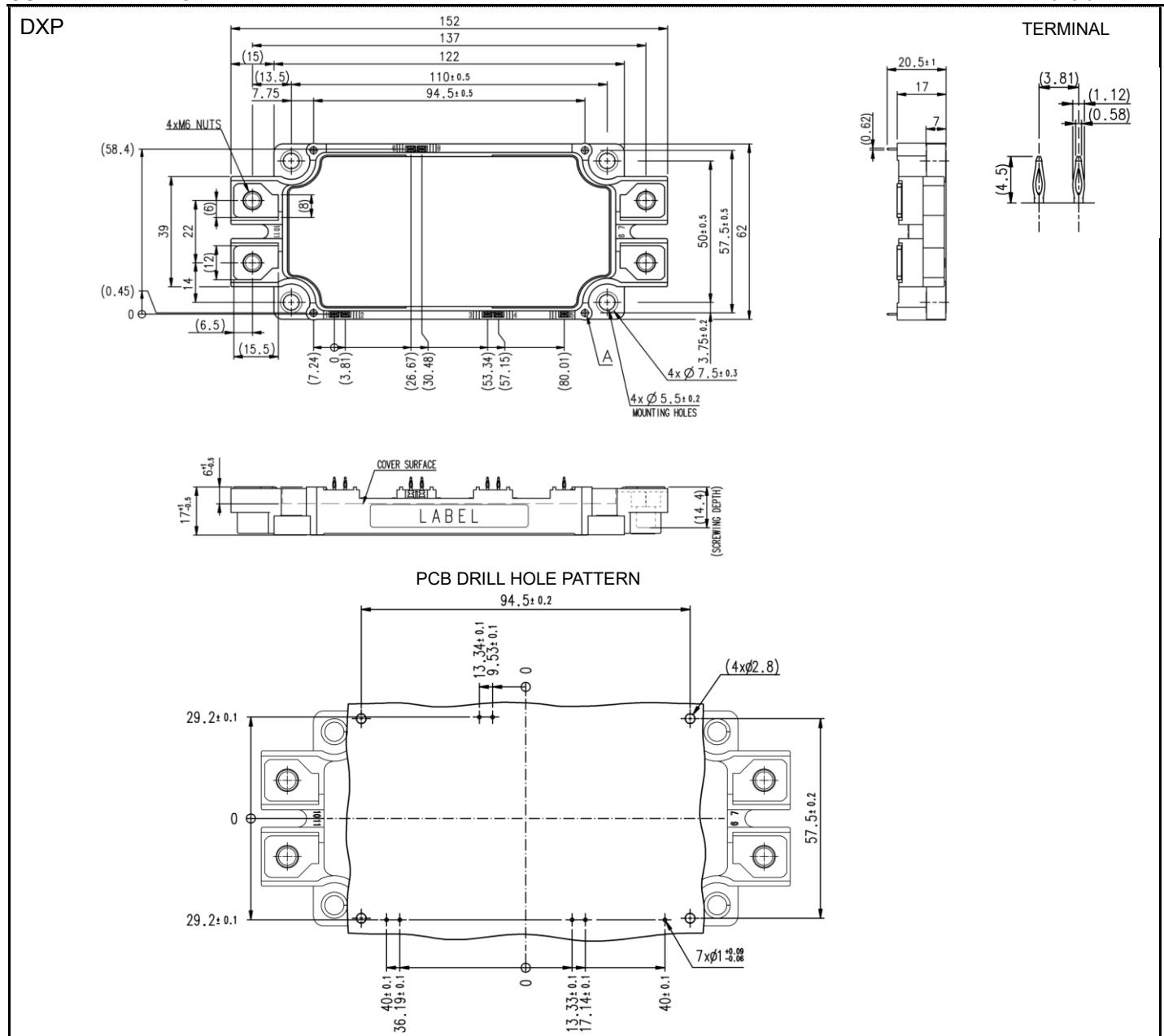
Dimension in mm

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



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-24T/CM600DXP-24T

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	1200	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =114 °C (Note2, 4)	600	A
I _{CRM}		Pulse, Repetitive (Note3)	1200	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	3125	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 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 =60 mA, V _{CE} =10 V	5.4	6.0	6.6	V
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =600 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	1.65	2.05
			T _{vj} =125 °C	-	1.85	-
			T _{vj} =150 °C	-	1.90	-
V _{CEsat} (Chip)	Collector-emitter saturation voltage	I _C =600 A, V _{GE} =15 V, (Note5)	T _{vj} =25 °C	-	1.50	1.75
			T _{vj} =125 °C	-	1.70	-
			T _{vj} =150 °C	-	1.75	-
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	145.5	nF
C _{oes}	Output capacitance		-	-	4.1	
C _{res}	Reverse transfer capacitance		-	-	1.8	
Q _G	Gate charge	V _{CC} =600 V, I _C =600 A, V _{GE} =15 V	-	4.5	-	µC
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =600 A, V _{GE} =±15 V, R _G =1.0 Ω, 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 =600 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	1.75	2.25
			T _{vj} =125 °C	-	1.90	-
			T _{vj} =150 °C	-	1.95	-
V _{EC} (Note1) (Chip)	Emitter-collector voltage	I _E =600 A, G-E short-circuited, (Note5)	T _{vj} =25 °C	-	1.60	1.95
			T _{vj} =125 °C	-	1.60	-
			T _{vj} =150 °C	-	1.60	-
t _{rr} (Note1)	Reverse recovery time	V _{CC} =600 V, I _E =600 A, V _{GE} =±15 V, R _G =1.0 Ω, Inductive load	-	-	400	ns
Q _{rr} (Note1)	Reverse recovery charge		-	46.8	-	µC
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _E =600 A, V _{GE} =±15 V, R _G =1.0 Ω, T _{vj} =150 °C, Inductive load	-	50.6	-	mJ
E _{off}	Turn-off switching energy per pulse		-	61.9	-	
E _{rr} (Note1)	Reverse recovery energy per pulse		-	48.5	-	
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C (Note4)	-	0.71	-	mΩ
r _g	Internal gate resistance	Per switch	-	0.67	-	Ω

CM600DX-24T/CM600DXP-24THIGH 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)	-	-	48	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	76	
$R_{th(c-s)}$	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	-	-	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).

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.

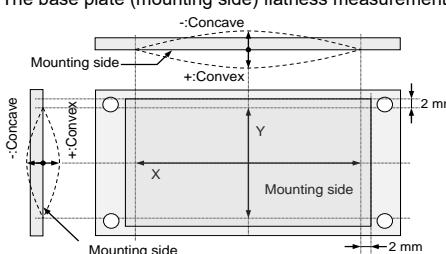
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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 $\lambda=0.9\text{ W/(m}\cdot\text{K)}$ 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.

CM600DX-24T/CM600DXP-24T

HIGH POWER SWITCHING USE

INSULATED TYPE

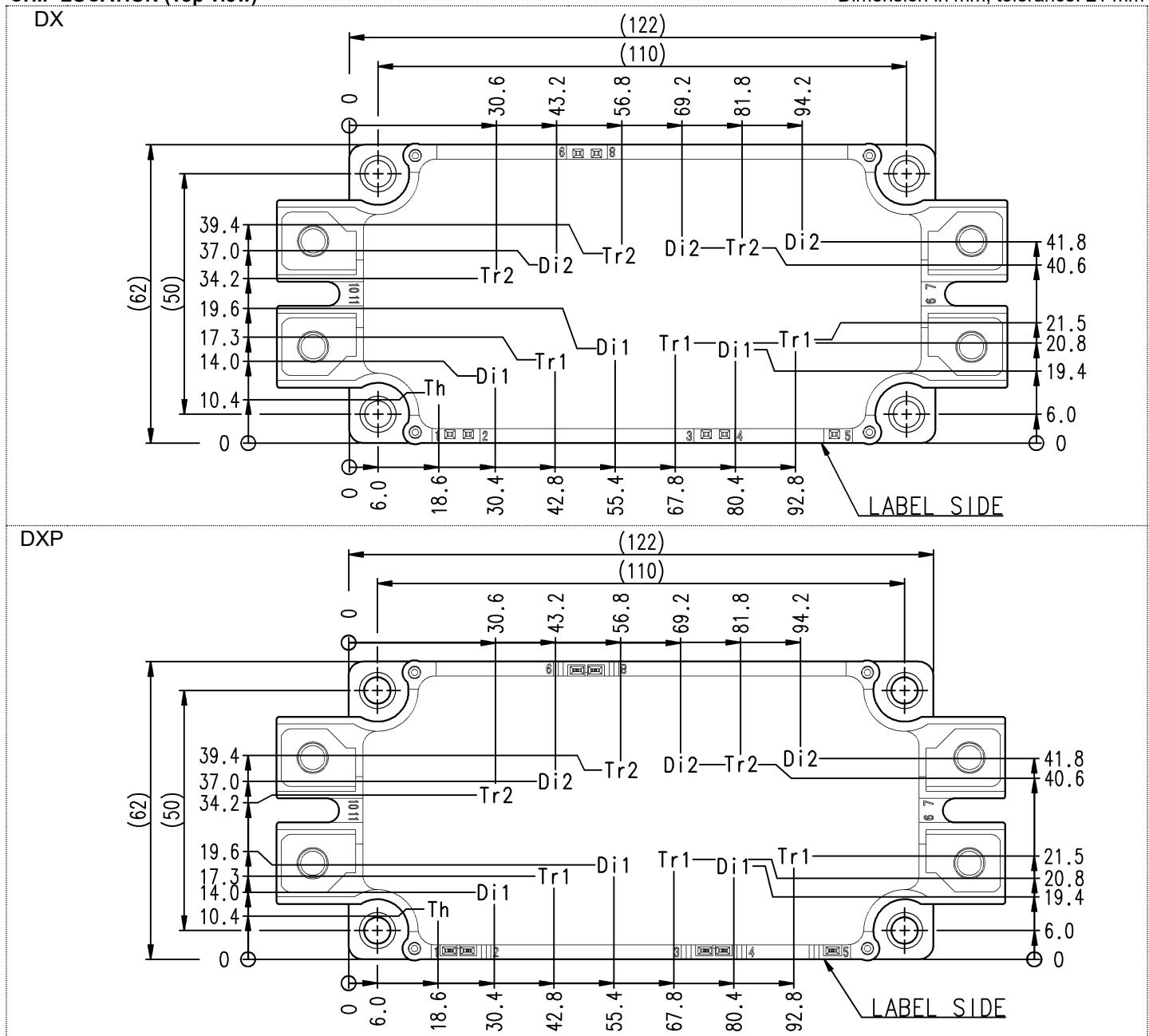
Note10. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.

PCB thickness : t1.6

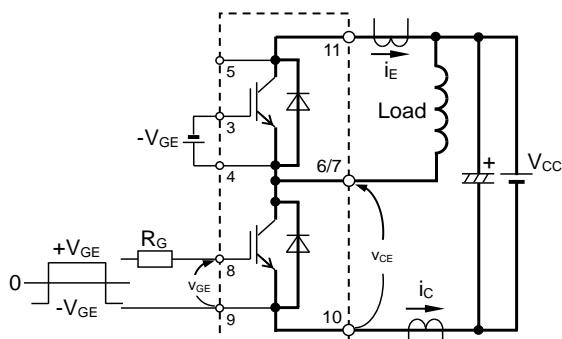
Type	Manufacturer	Size	Tightening torque (N·m)	Recommended tightening method
(1) PT®	EJOT	K25×8	0.55 ± 0.055	by handwork (equivalent to 30 rpm by mechanical screw driver) ~ 600 rpm (by mechanical screw driver)
(2) PT®		K25×10	0.75 ± 0.075 N·m	
(3) DELTA PT®		25×8	0.55 ± 0.055 N·m	
(4) DELTA PT®		25×10	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

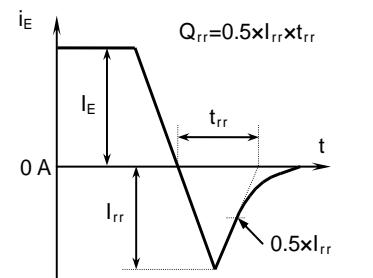
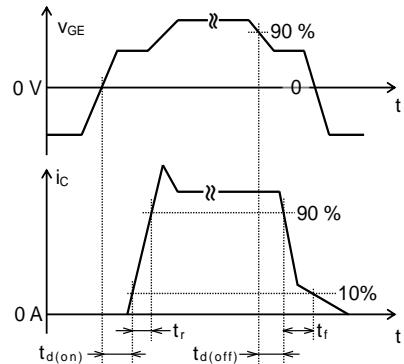
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-E1s/G2-E2s terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	1.0	-	6.8	Ω

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

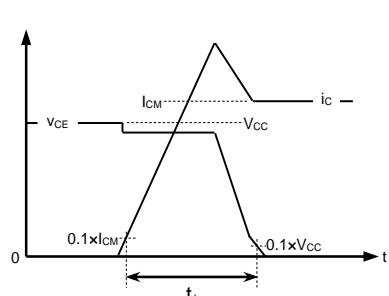
Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

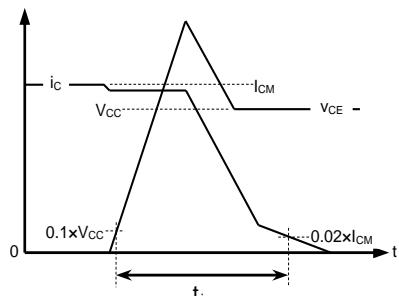
Switching characteristics test circuit and waveforms



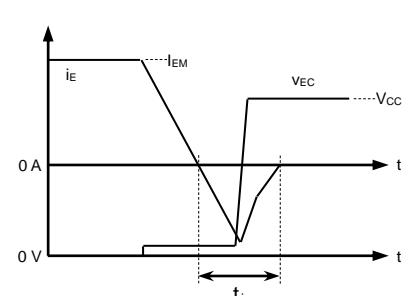
trr, Qrr characteristics test waveform



IGBT Turn-on switching energy

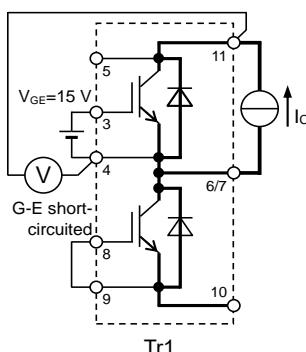


IGBT Turn-off switching energy

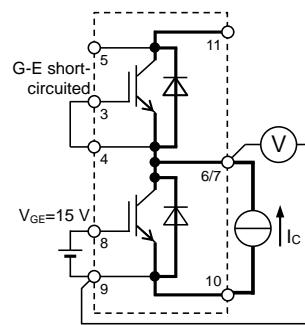


FWD Reverse recovery energy

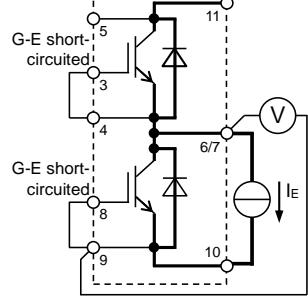
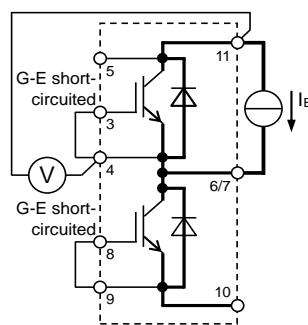
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

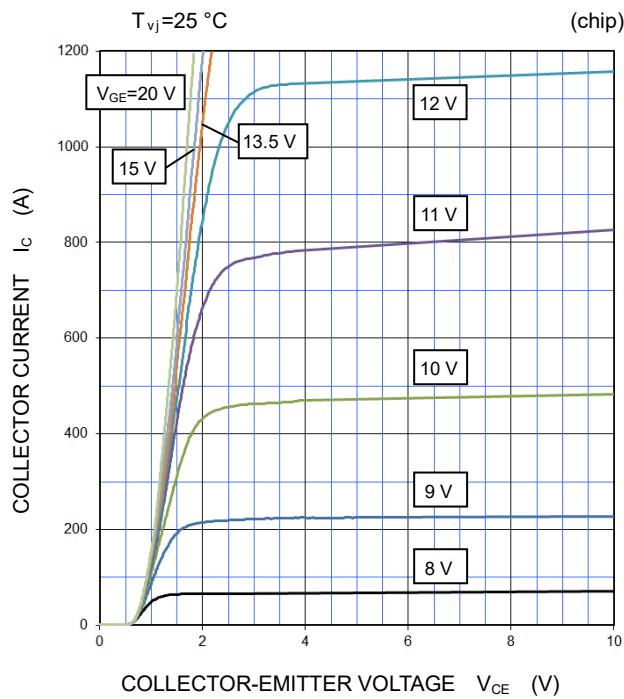
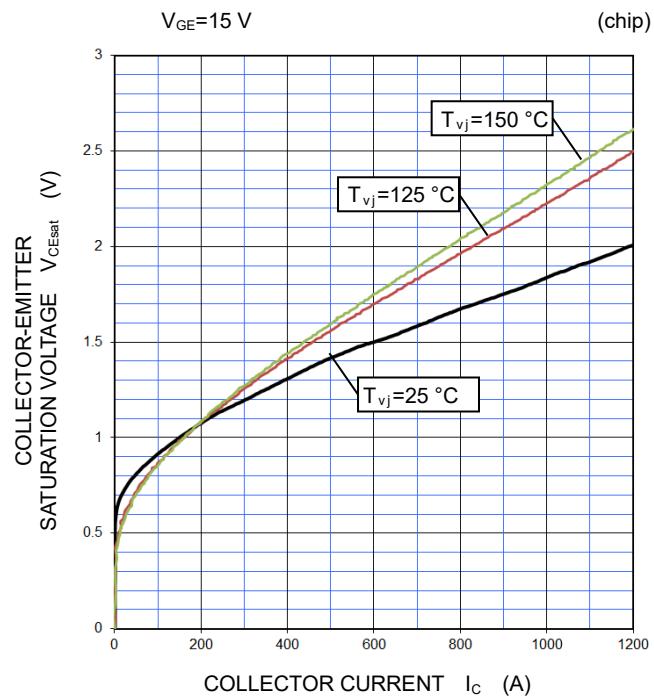
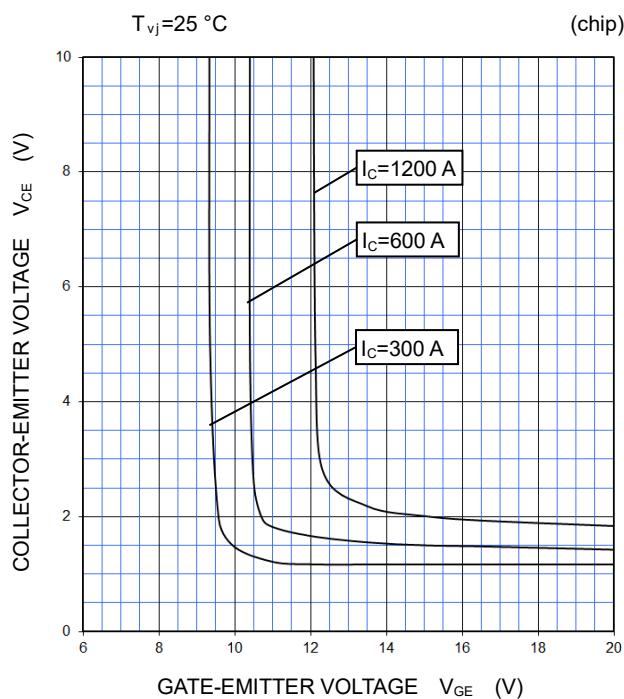
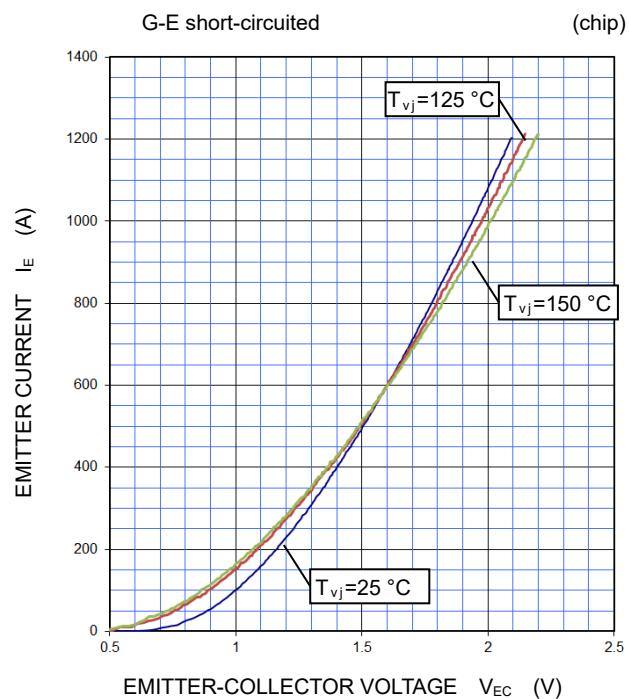
TEST CIRCUIT

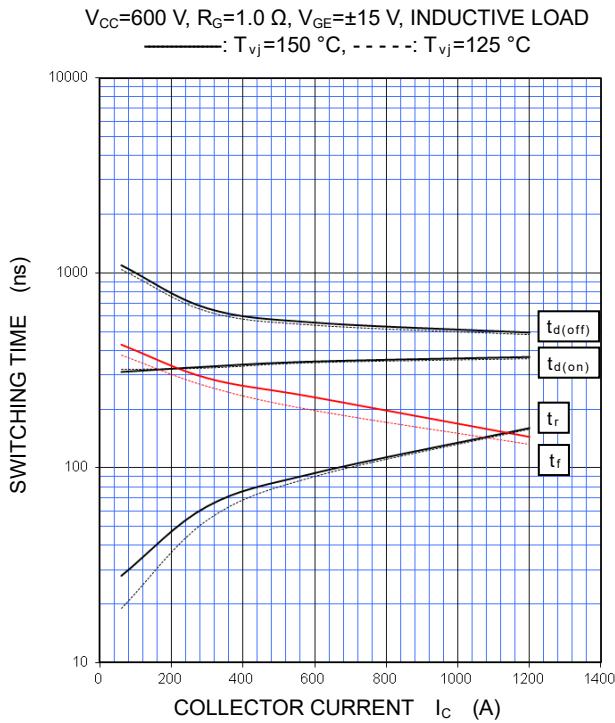
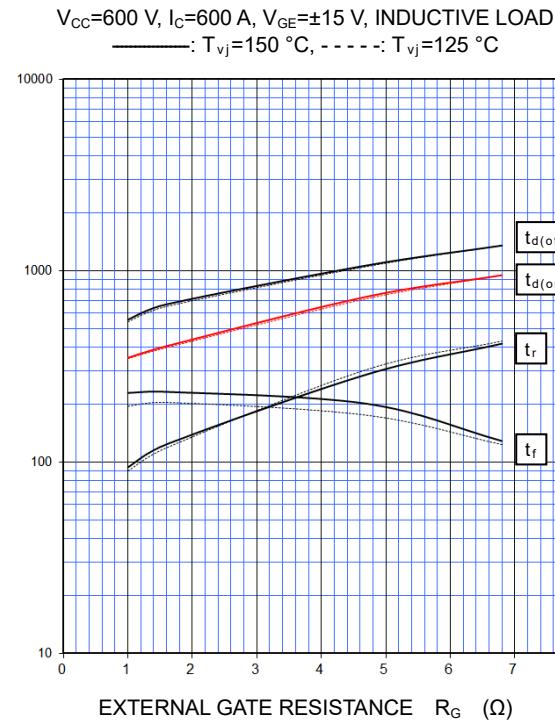
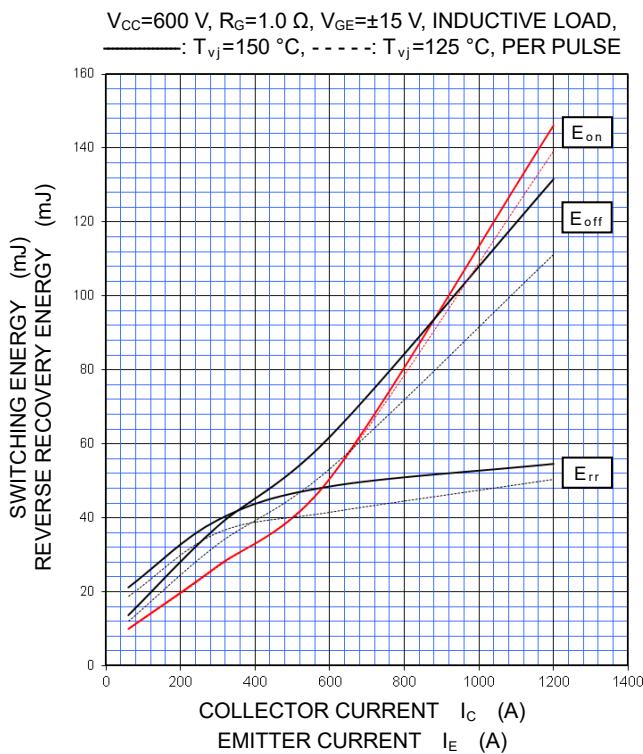
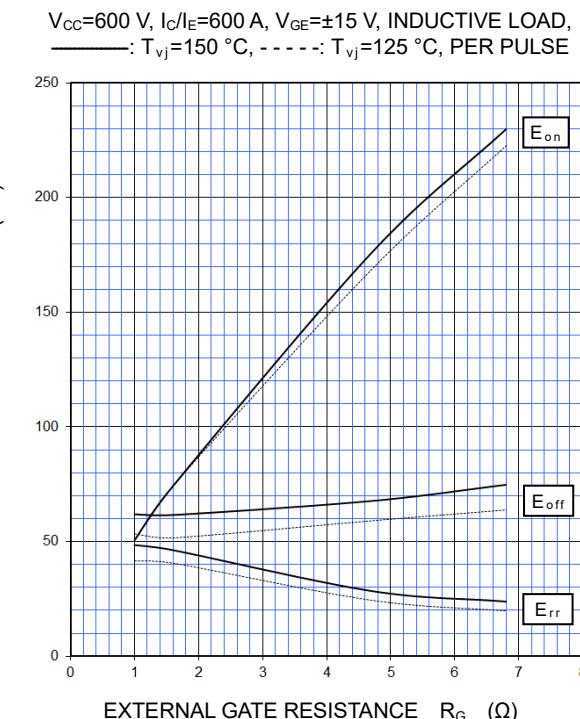
VCEsat characteristics test circuit



VCE characteristics test circuit

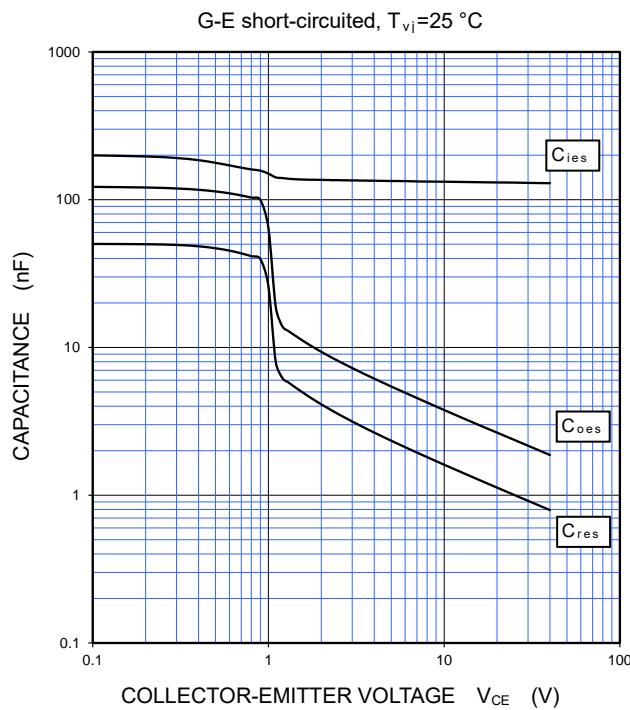
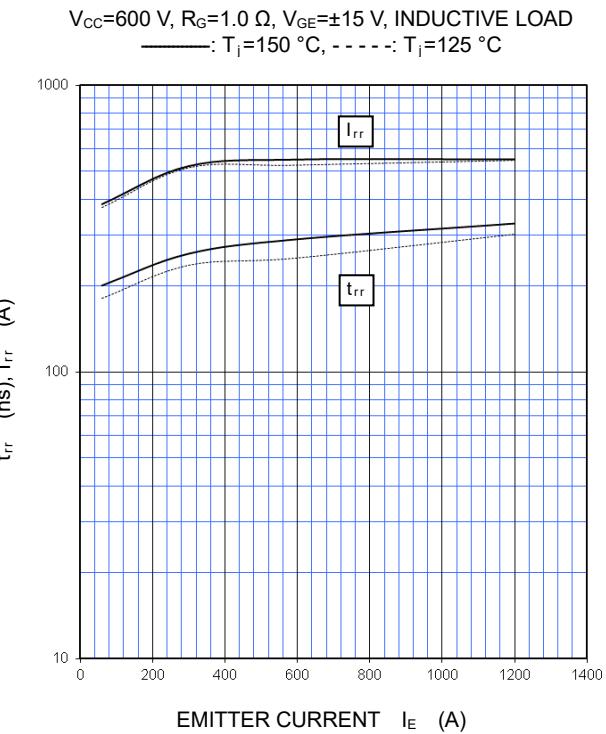
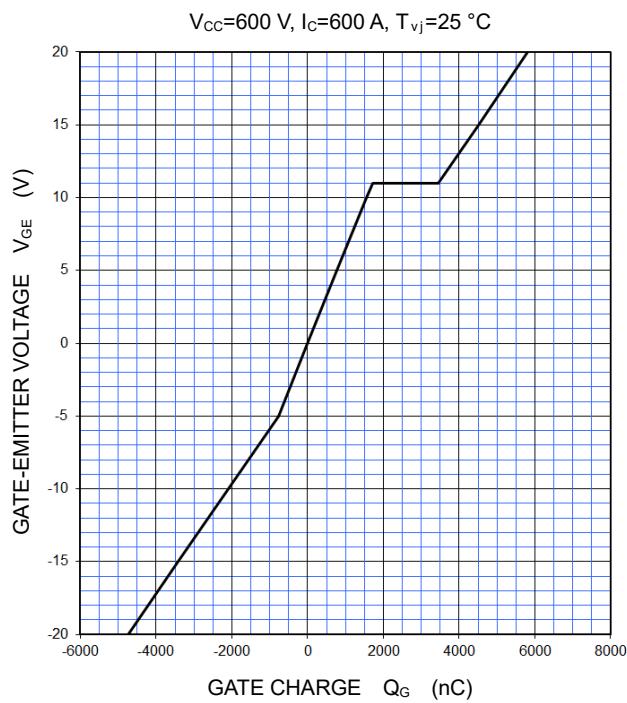
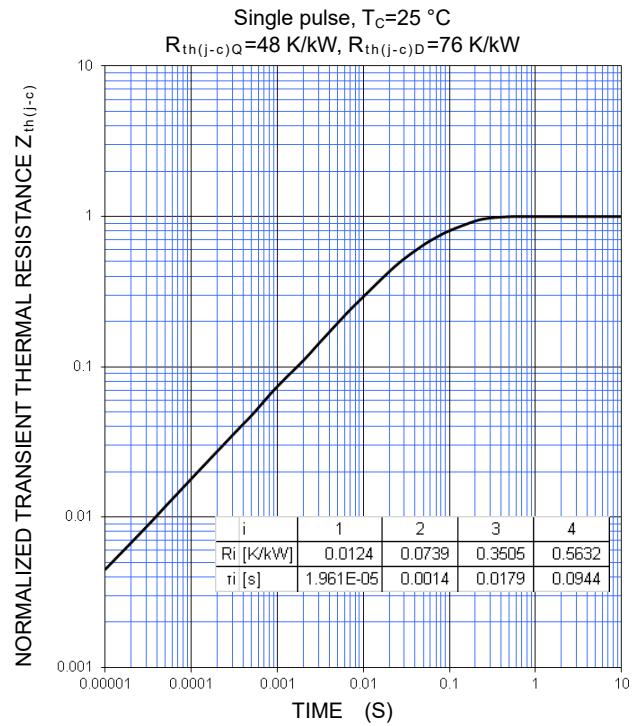


PERFORMANCE CURVES**INVERTER PART****OUTPUT CHARACTERISTICS
(TYPICAL)****COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)****COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS
(TYPICAL)****FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)**

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

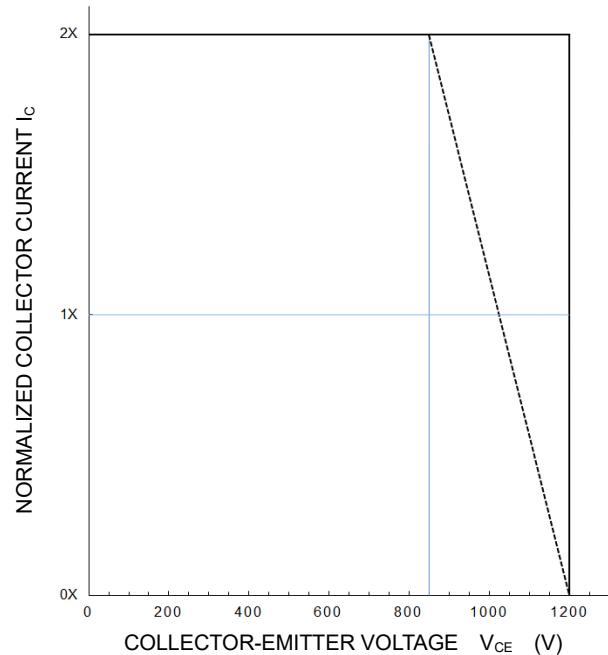
PERFORMANCE CURVES

INVERTER PART

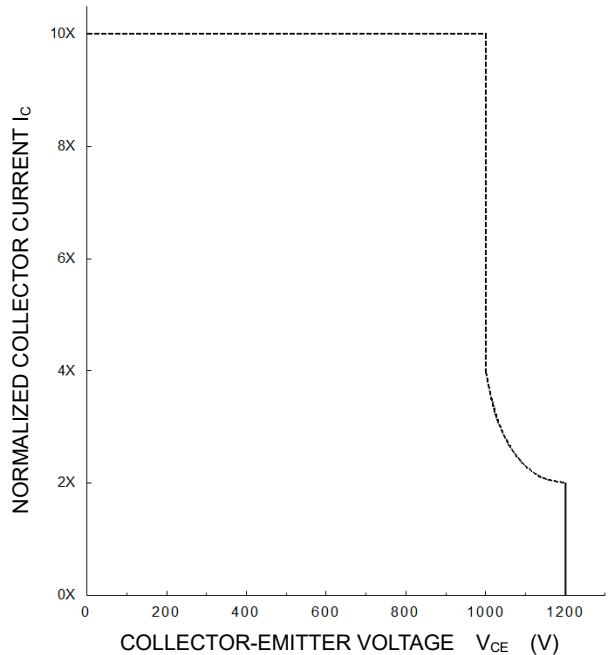
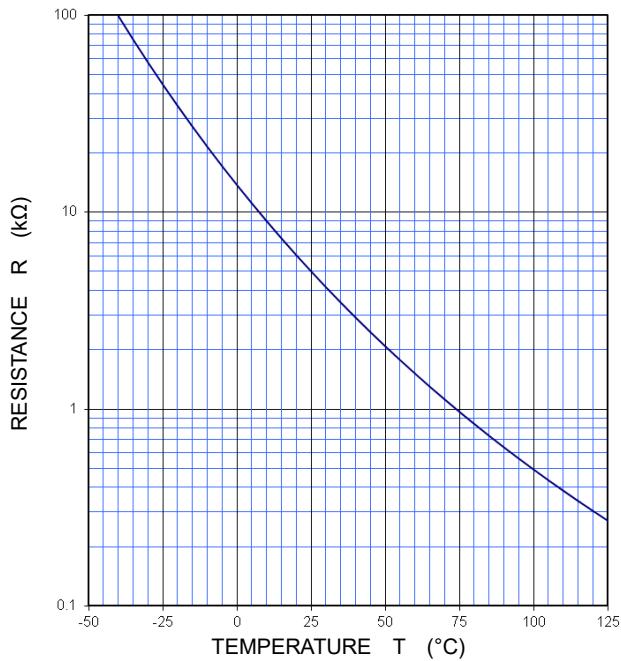
CAPACITANCE CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)GATE CHARGE CHARACTERISTICS
(TYPICAL)TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

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

$V_{CC} \leq 850$ V, $R_G = 1.0 \sim 6.8$ 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)**

$V_{CC} \leq 800$ V, $R_G = 1.0 \sim 6.8$ 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.

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