<IGBT Modules>

CM600DX-13T/CM600DXP-13T

HIGH POWER SWITCHING USE
INSULATED TYPE

DX

Collector current I_C .... **600** A
Collector-emitter voltage V_{CES} .... **650** 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} .... **650** 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

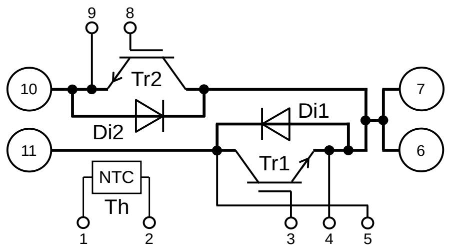
APPLICATION

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



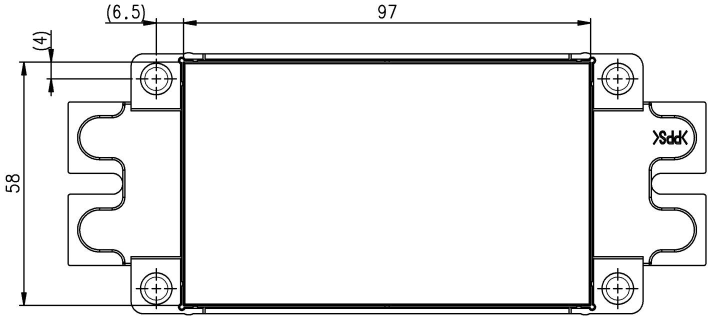
TERMINAL CODE

1. TH1
2. TH2
3. G1
4. Es1
5. Cs1
6. C2E1
7. C2E1
8. G2
9. Es2
10. E2
11. C1

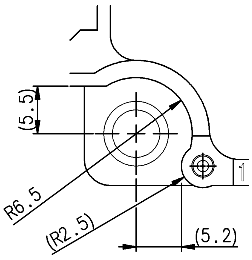
OUTLINE DRAWING

Dimension in mm

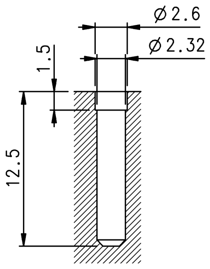
COM.



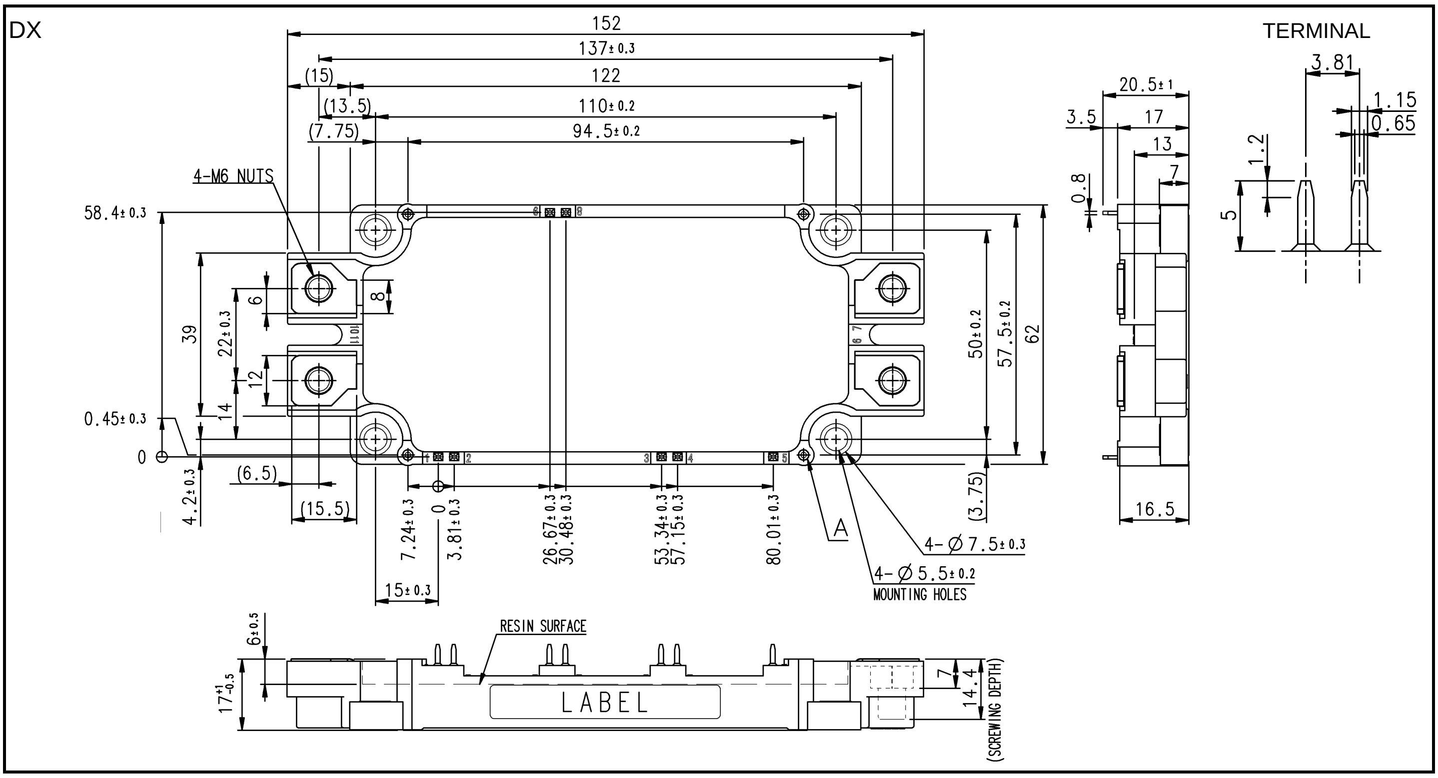
MOUNTING HOLES



SECTION A



OUTLINE DRAWING **Dimension in mm**

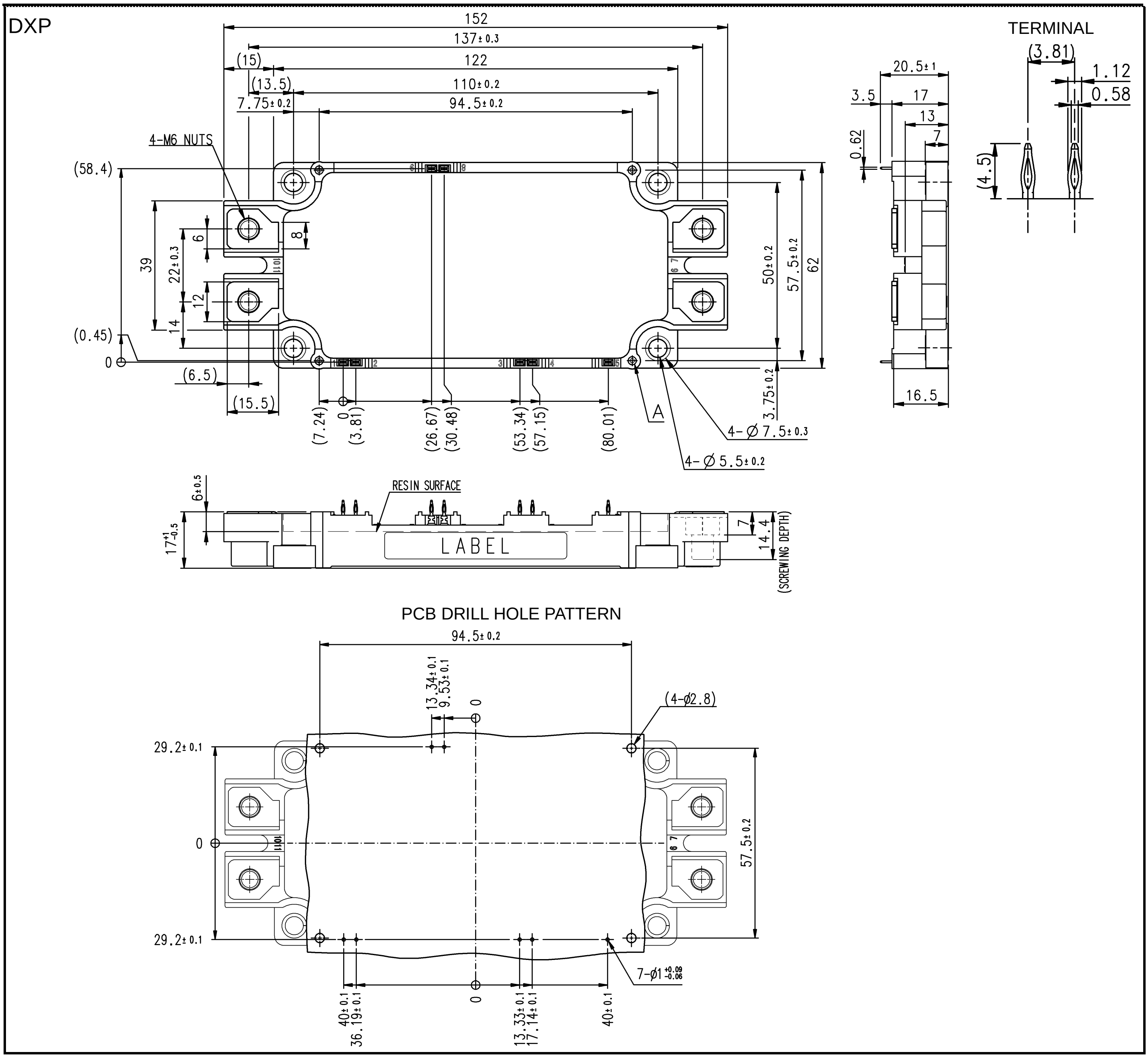


Tolerance otherwise specified

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

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

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=101 °C (Note2, 4)	600	A
I_{CRM}		Pulse, Repetitive (Note3)	1200	
P_{tot}	Total power dissipation	T_C=25 °C (Note2, 4)	2080	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)	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=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	-	1.45	1.80	V
			T_{vj}=125 °C	-	1.55	-	
			T_{vj}=150 °C	-	1.60	-	
V_{CEsat} (Chip)		I_C=600 A, V_{GE}=15 V, (Note5)	T_{vj}=25 °C	-	1.30	1.55	V
			T_{vj}=125 °C	-	1.35	-	
			T_{vj}=150 °C	-	1.35	-	
C_{ies}	Input capacitance	V_{CE}=10 V, G-E short-circuited		-	-	80.2	nF
C_{oes}	Output capacitance			-	-	3.4	
C_{res}	Reverse transfer capacitance			-	-	1.5	
Q_G	Gate charge	V_{CC}=300 V, I_C=600 A, V_{GE}=15 V		-	2.48	-	μC
$t_{d(on)}$	Turn-on delay time	V_{CC}=300 V, I_C=600 A, V_{GE}=±15 V, R_G=1.0 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=600 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T_{vj}=25 °C	-	1.60	2.15	V
			T_{vj}=125 °C	-	1.65	-	
			T_{vj}=150 °C	-	1.65	-	
V_{EC} (Note1) (Chip)		I_E=600 A, G-E short-circuited, (Note5)	T_{vj}=25 °C	-	1.45	1.85	V
			T_{vj}=125 °C	-	1.50	-	
			T_{vj}=150 °C	-	1.50	-	
t_{rr} (Note1)	Reverse recovery time	V_{CC}=300 V, I_E=600 A, V_{GE}=±15 V, R_G=1.0 Ω, Inductive load		-	-	500	ns
Q_{rr} (Note1)	Reverse recovery charge			-	42	-	μC
E_{on}	Turn-on switching energy per pulse	V_{CC}=300 V, I_C=I_E=600 A, V_{GE}=±15 V, R_G=1.0 Ω, T_{vj}=150 °C, Inductive load		-	8.3	-	mJ
E_{off}	Turn-off switching energy per pulse			-	33.2	-	
E_{rr} (Note1)	Reverse recovery energy per pulse			-	23.9	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, T_C=25 °C (Note4)		-	0.71	-	mΩ
r_g	Internal gate resistance	Per switch		-	1.0	-	Ω

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)		-	-	72	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)		-	-	111	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, per 1 module,	Thermal grease applied (Note4, 7)	-	11.5	-	K/kW
			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	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 (Note9)		±0	-	+200	μm
m	mass	-		-	300	-	g

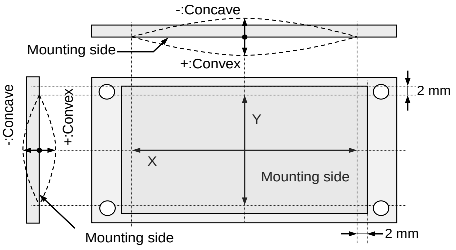
*: This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU.

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

2. Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.
3. Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} 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 [°C]+273.15=298.15 [K]

   R_{50}: resistance at absolute temperature T_{50} [K]; T_{50}=50 [°C]+273.15=323.15 [K]
7. Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K)/$D_{(C-S)}$=50 μm.
8. Typical value is measured by using PC-TIM of λ=3.4 W/(m·K)/$D_{(C-S)}$=50 μm.
9. The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



Note10. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.
PCB thickness : t=1.6.

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		

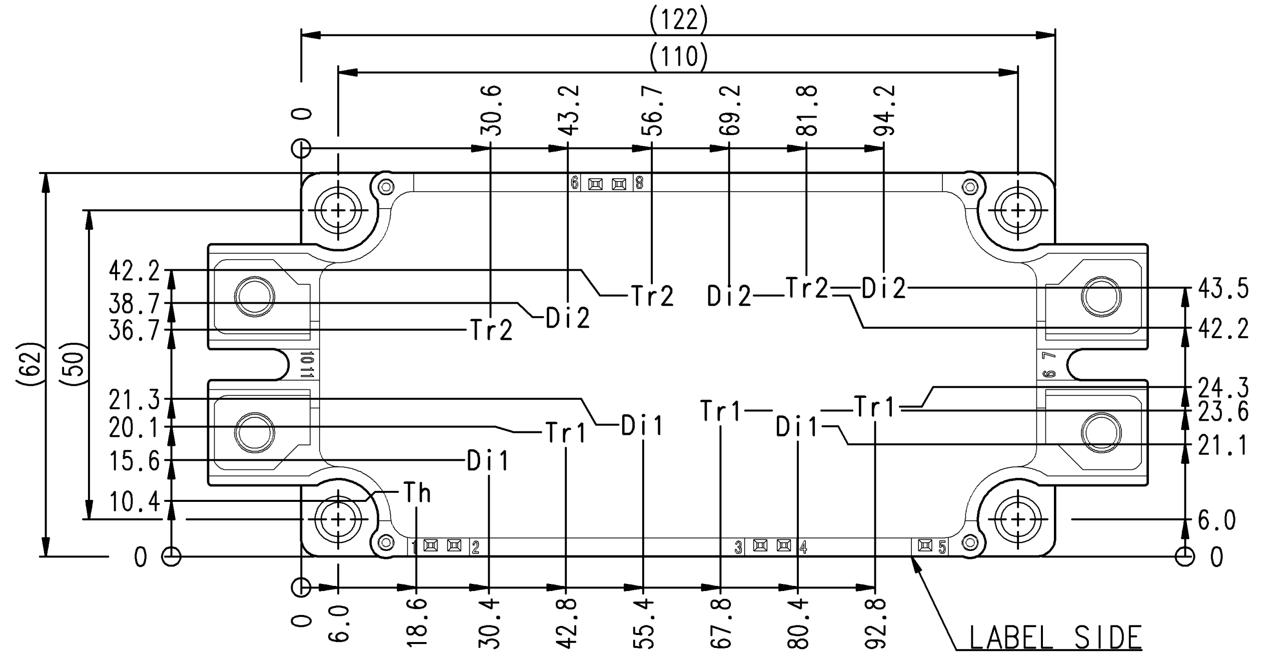
RECOMMENDED OPERATING CONDITIONS

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	1.0	-	10	Ω

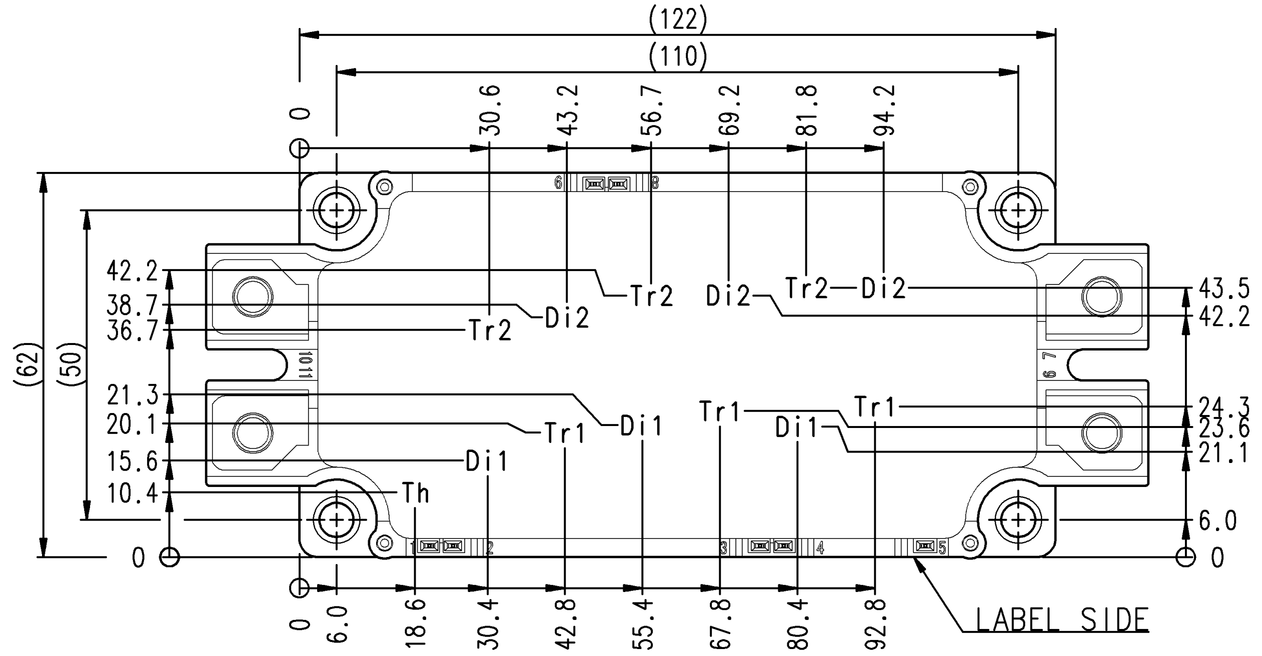
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm

DX

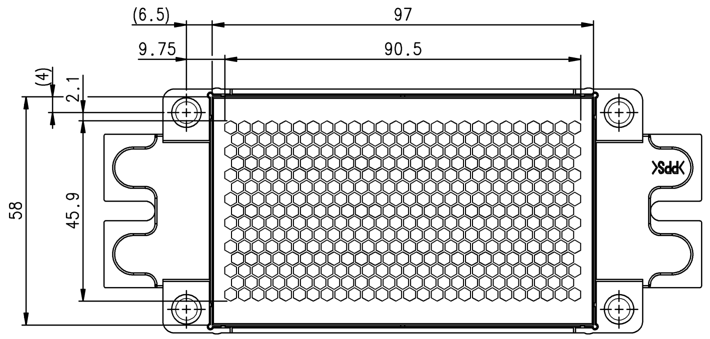


DXP

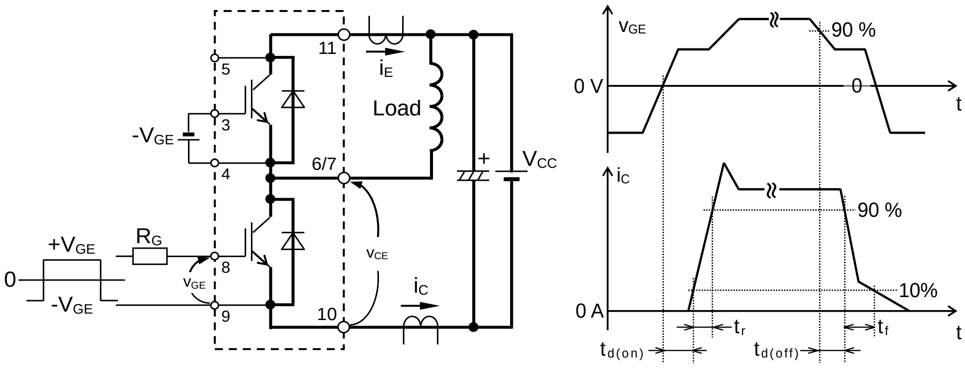


Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

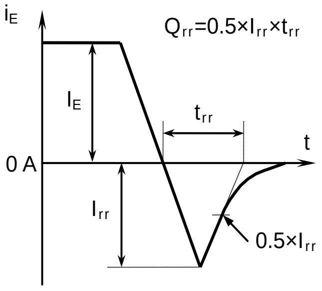
Option: PC-TIM applied baseplate outline



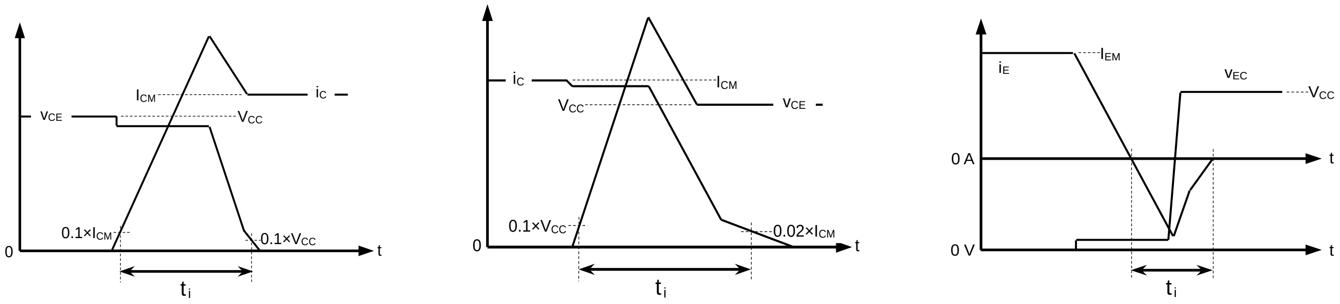
TEST CIRCUIT AND WAVEFORMS



Switching characteristics test circuit and waveforms



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



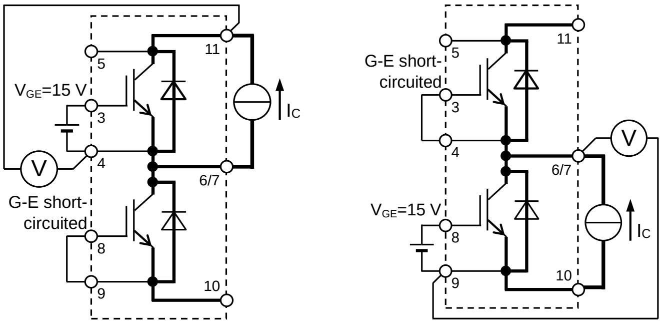
IGBT Turn-on switching energy

IGBT Turn-off switching energy

FWD Reverse recovery energy

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

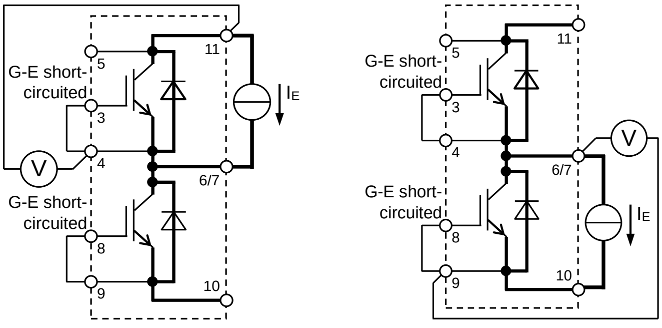
TEST CIRCUIT



Tr1

Tr2

V_{CEsat} characteristics test circuit



Di1

Di2

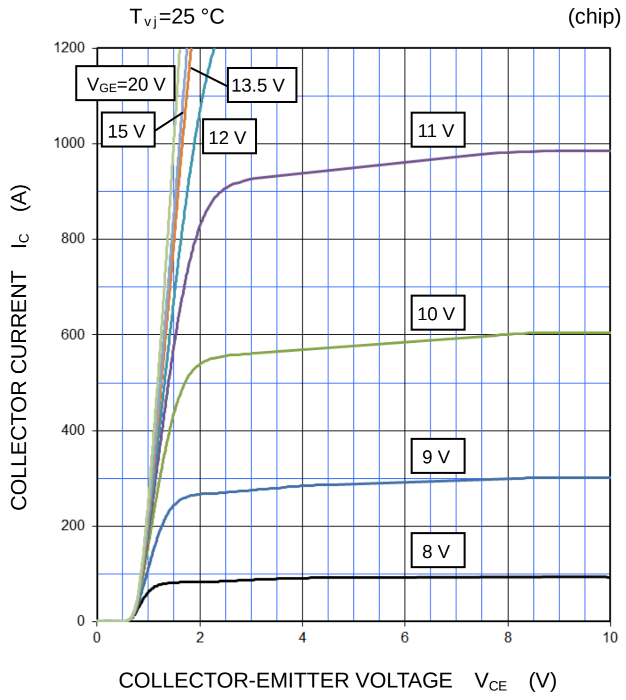
V_{EC} characteristics test circuit

PERFORMANCE CURVES

INVERTER PART

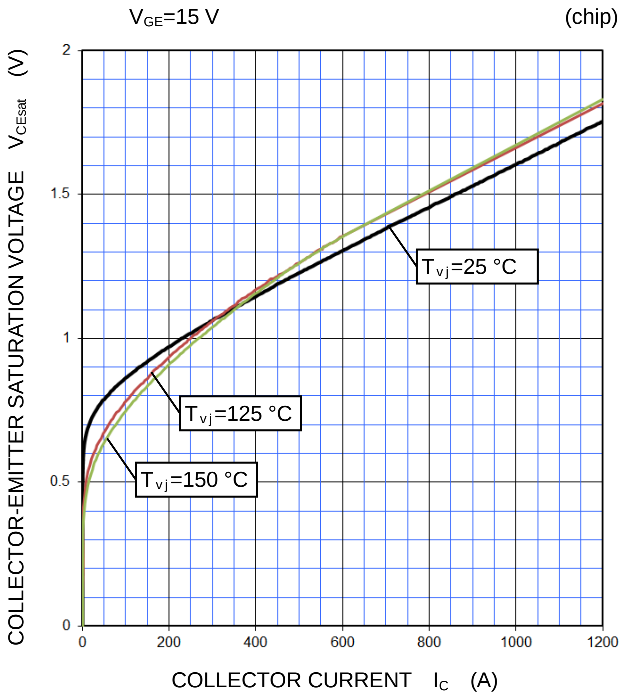
OUTPUT CHARACTERISTICS

(TYPICAL)



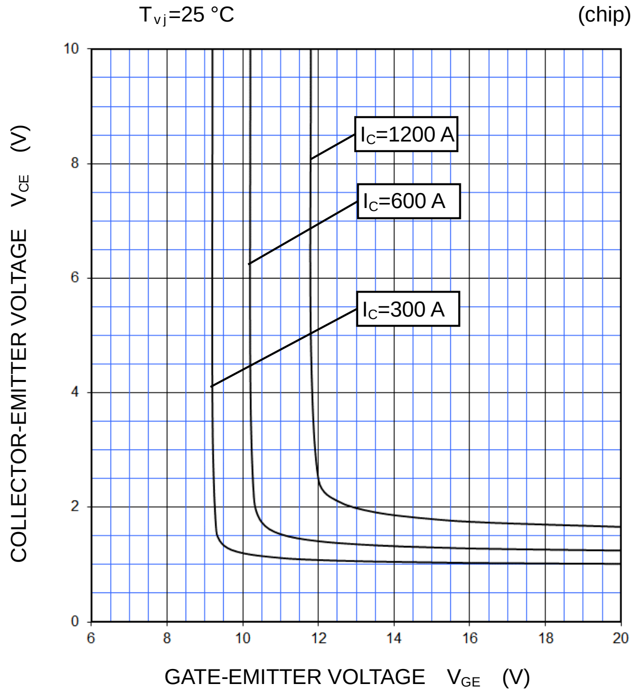
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



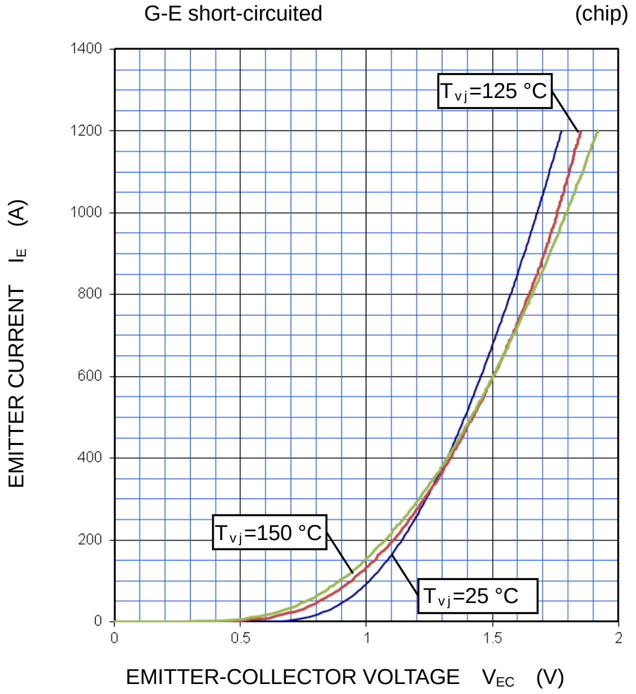
COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)

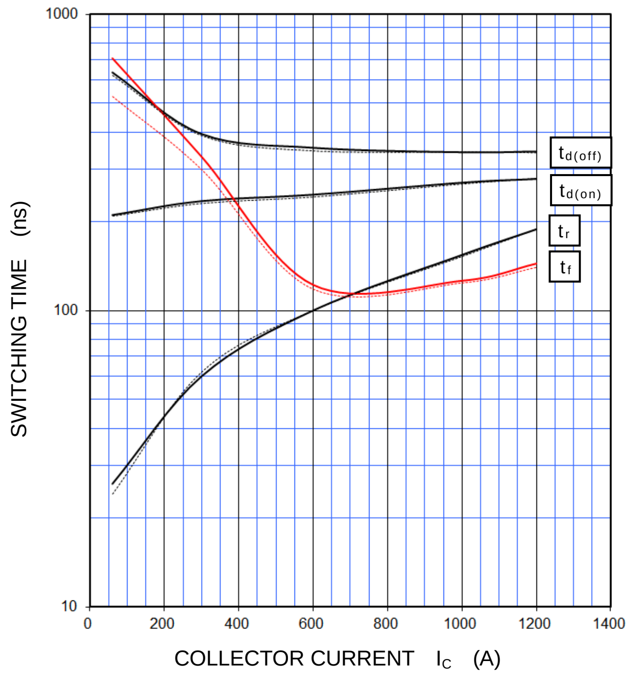


PERFORMANCE CURVES

INVERTER PART

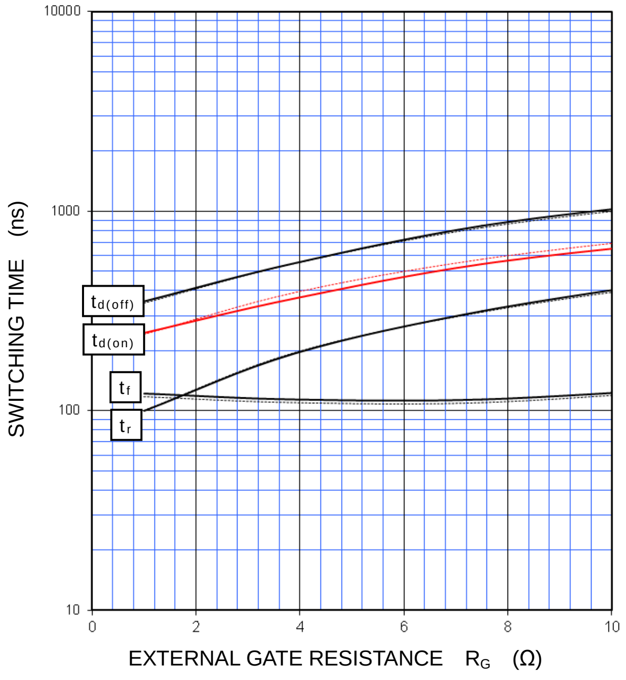
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=300 V, R_G=1.0 Ω, V_{GE}=±15 V, INDUCTIVE LOAD
———: T_{vj}=150 °C, - - - - -: T_{vj}=125 °C



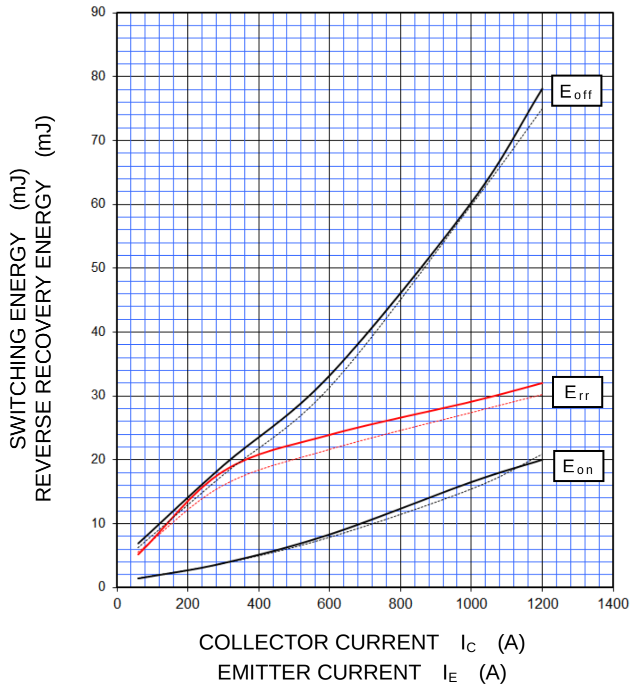
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=300 V, I_C=600 A, V_{GE}=±15 V, INDUCTIVE LOAD
———: T_{vj}=150 °C, - - - - -: T_{vj}=125 °C



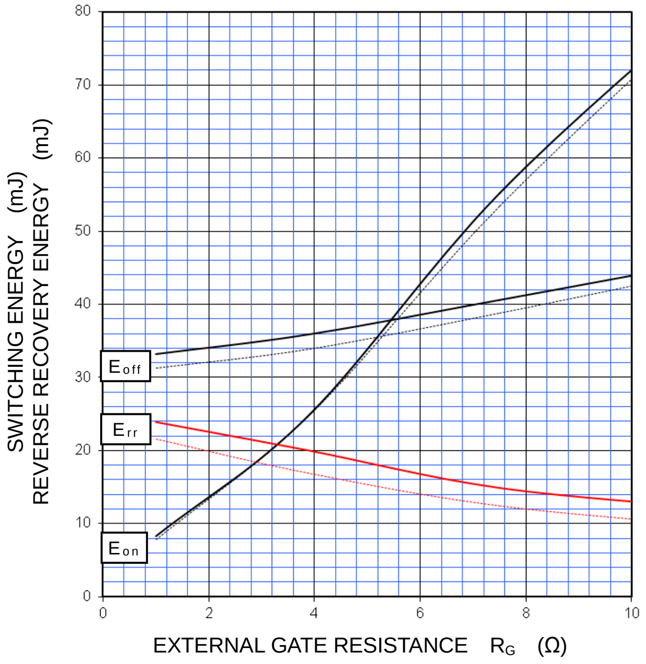
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=300 V, R_G=1.0 Ω, V_{GE}=±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=600 A, V_{GE}=±15 V, INDUCTIVE LOAD,
———: T_{vj}=150 °C, - - - - -: T_{vj}=125 °C, PER PULSE

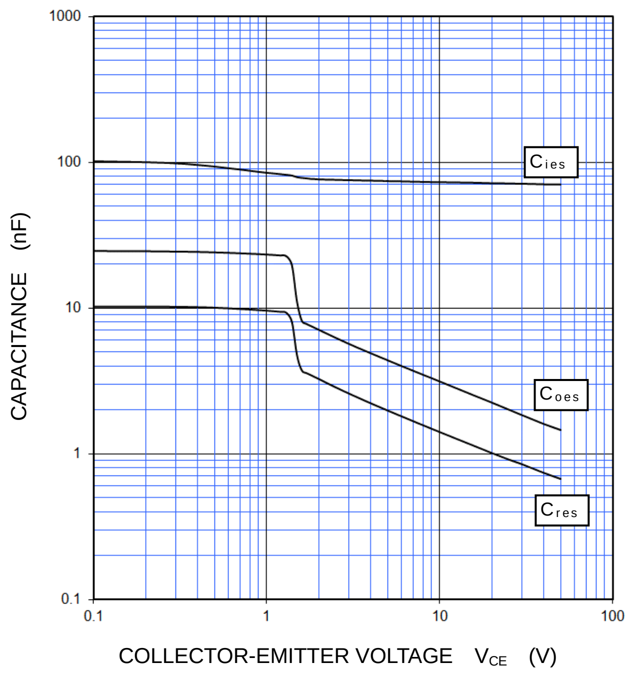


PERFORMANCE CURVES

INVERTER PART

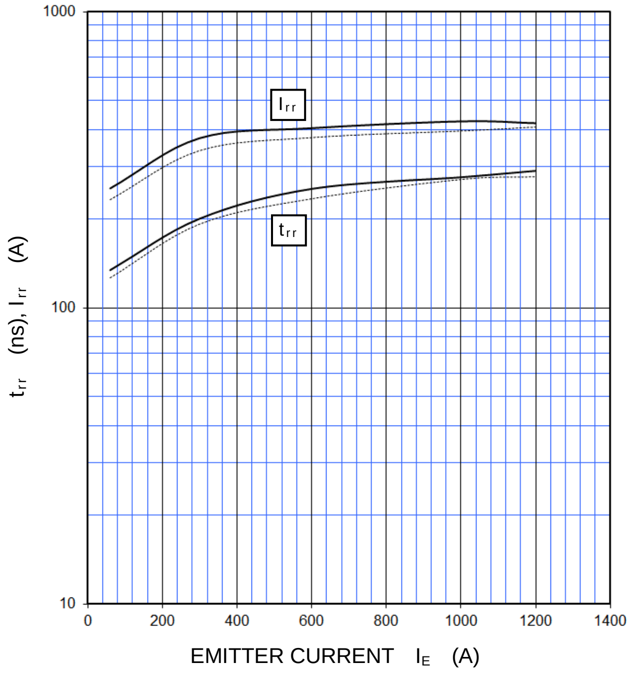
CAPACITANCE CHARACTERISTICS (TYPICAL)

G-E short-circuited, T_{vj}=25 °C



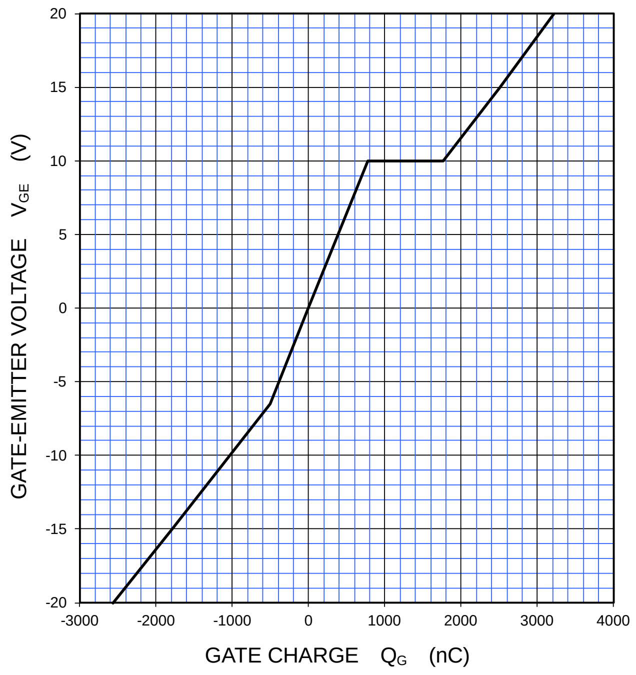
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

V_{CC}=300 V, R_G=1.0 Ω, V_{GE}=±15 V, INDUCTIVE LOAD
———: T_j=150 °C, - - - - -: T_j=125 °C



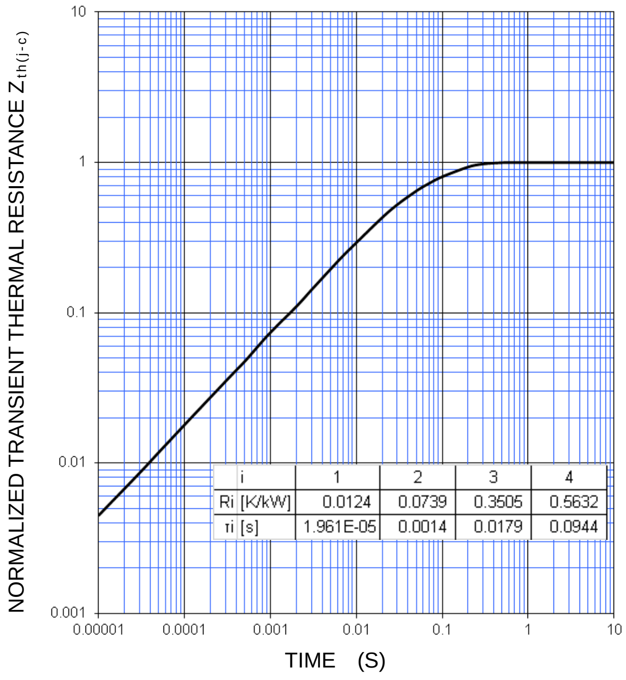
GATE CHARGE CHARACTERISTICS (TYPICAL)

V_{CC}=300 V, I_C=600 A, T_{vj}=25 °C



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

Single pulse, T_C=25 °C
$R_{th(j-c)Q}$=72 K/kW, $R_{th(j-c)D}$=111 K/kW



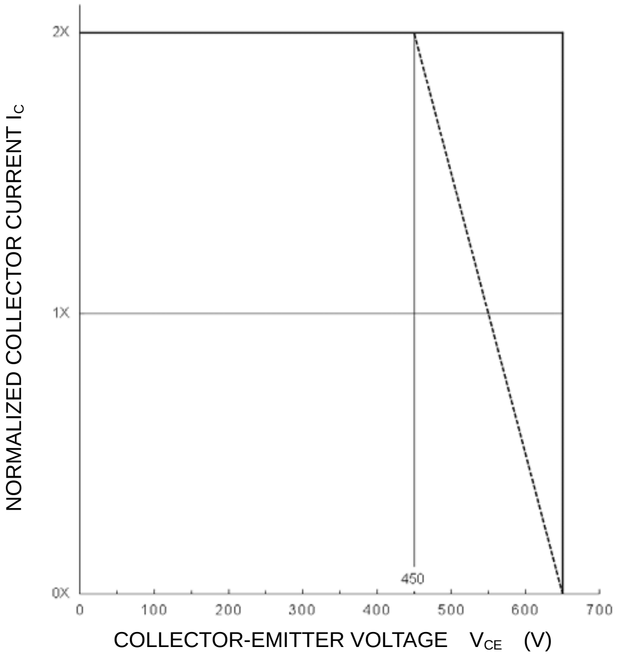
i	1	2	3	4
Ri [K/kW]	0.0124	0.0739	0.3505	0.5632
τi [s]	1.961E-05	0.0014	0.0179	0.0944

PERFORMANCE CURVES

INVERTER PART

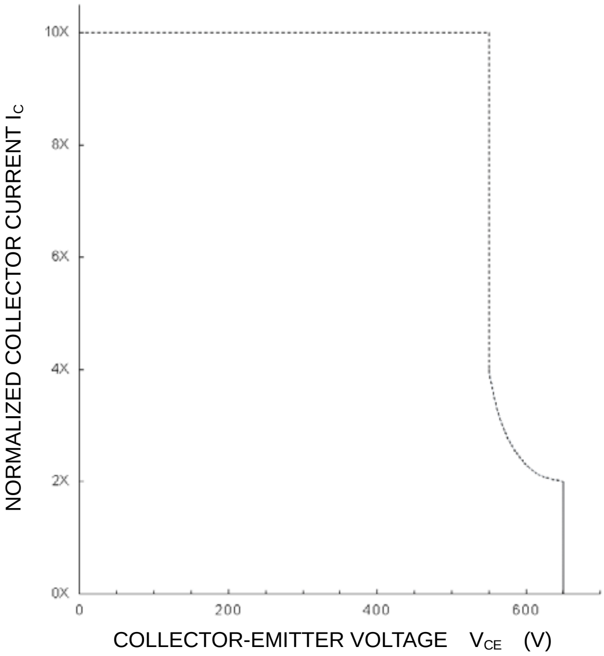
TURN-OFF SWITCHING SAFE OPERATIONG AREA (REVERSE BIAS SAFE OPERATING AREA) (MAXIMUM)

V_{CC}≤450 V, R_G=1.0~10 Ω, V_{GE}=±15 V,
———: T_{vj}=25~150 °C (Normal load operations (Continuous)
- - - - - -: T_{vj}=175 °C (Unusual load operations (Limited period)



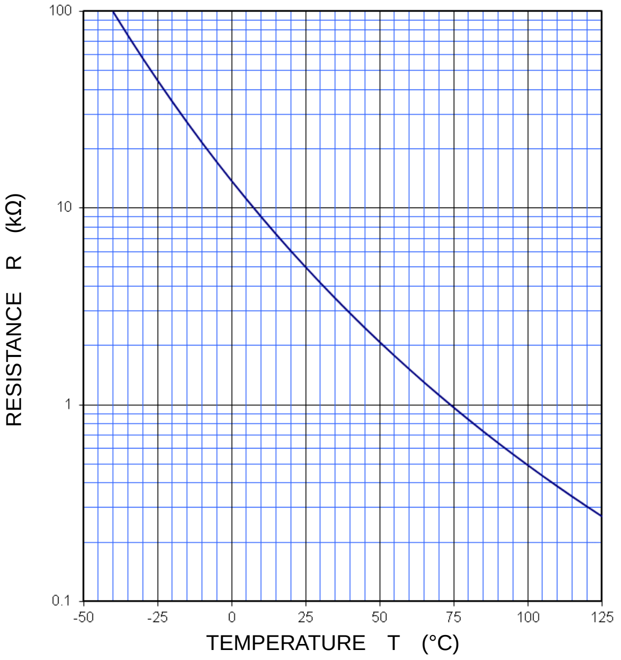
SHORT-CIRCUIT SAFE OPERATING AREA (MAXIMUM)

V_{CC}≤400 V, R_G=1.0~10 Ω, V_{GE}=±15 V,
T_{vj}= 25 ~ 150 °C, t_W≤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.

Keep safety first in your circuit designs!

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