MITSUBISHI ELECTRIC

< IGBT MODULES >

CM600DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

Dual switch (Half-Bridge)

Collector current I_C ..... **600** A
Collector-emitter voltage V_{CES} ..... **1200** V
Maximum junction temperature T_{jmax} ..... **175** °C

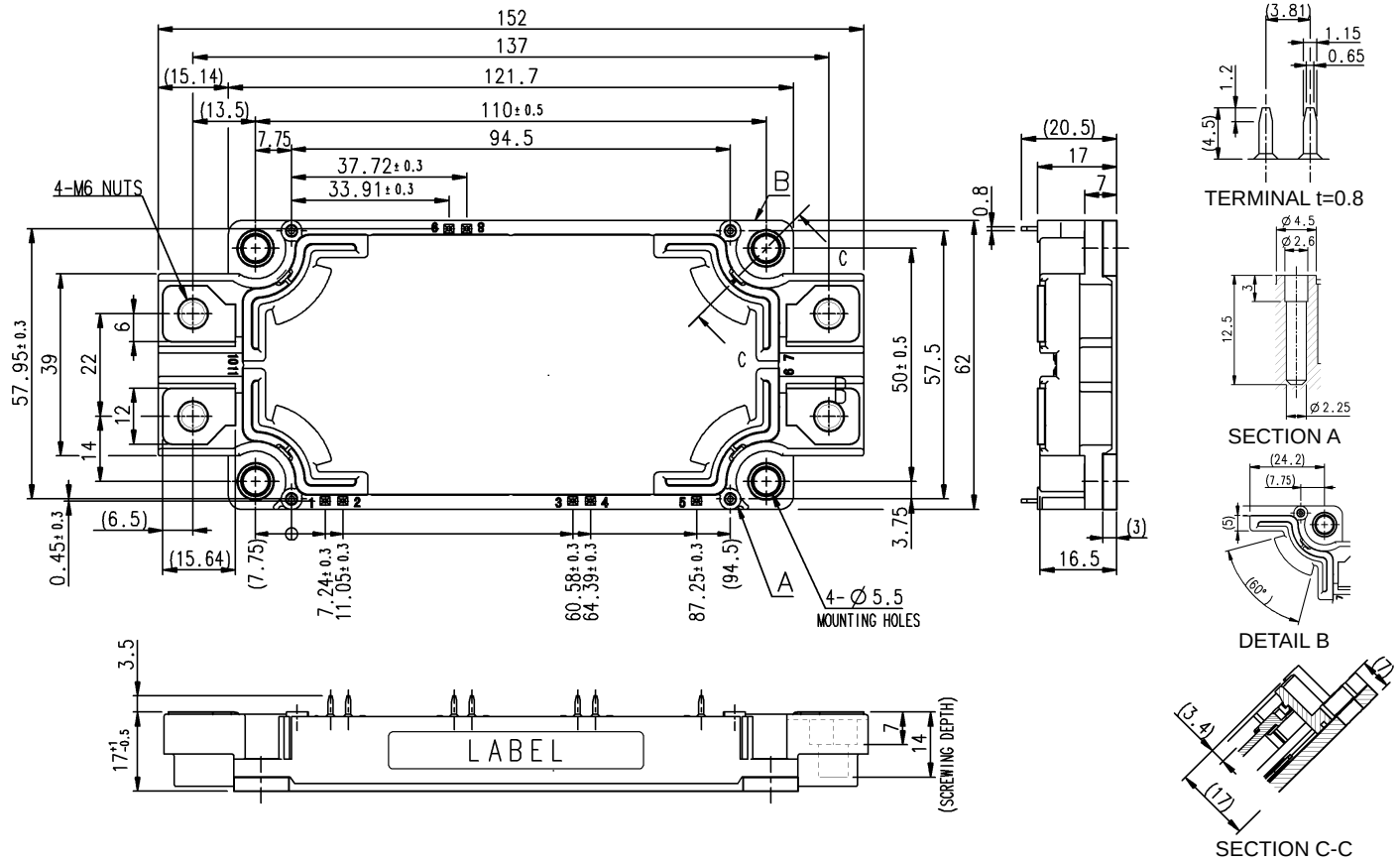
- ●Flat base Type
- ●Copper base plate (non-plating)
- ●Tin plating pin terminals
- ●RoHS Directive compliant
- ●Recognized under UL1557, File E323585

APPLICATION

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

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



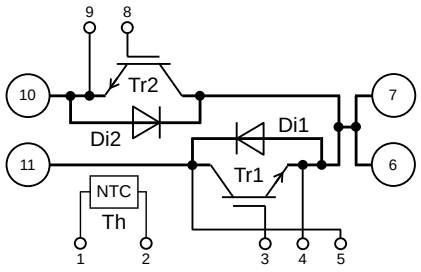
TERMINAL t=0.8

SECTION A

DETAIL B

SECTION C-C

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

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_j=25 °C, unless otherwise specified)

INVERTER PART IGBT/DIODE

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=94 °C (Note2, 4)	600	A
I_{CRM}		Pulse, Repetitive, V_{GE}=15 V (Note3)	1200	
P_{tot}	Total power dissipation	T_C=25 °C (Note2, 4)	3330	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	4000	V
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	°C
T_{Cmax}	Maximum case temperature	(Note4)	125	
T_{jop}	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	°C
T_{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS (T_j=25 °C, unless otherwise specified)

INVERTER PART IGBT/DIODE

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_j=25 °C	-	2.00	2.45	V
			T_j=125 °C	-	2.30	-	
			T_j=150 °C	-	2.40	-	
V_{CEsat} (Chip)		I_C=600 A, V_{GE}=15 V, (Note5)	T_j=25 °C	-	1.85	2.35	V
			T_j=125 °C	-	2.10	-	
			T_j=150 °C	-	2.15	-	
C_{ies}	Input capacitance	V_{CE}=10 V, G-E short-circuited		-	-	50	nF
C_{oes}	Output capacitance			-	-	10	
C_{res}	Reverse transfer capacitance			-	-	0.83	
Q_G	Gate charge	V_{CC}=600 V, I_C=600 A, V_{GE}=15 V		-	1050	-	nC
$t_{d(on)}$	Turn-on delay time	V_{CC}=600 V, I_C=600 A, V_{GE}=±15 V, R_G=0 Ω, Inductive load		-	-	800	ns
t_r	Rise time			-	-	200	
$t_{d(off)}$	Turn-off delay time			-	-	600	
t_f	Fall time			-	-	300	
V_{EC} (Note1) (Terminal)	Emitter-collector voltage	I_E=600 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T_j=25 °C	-	2.8	3.60	V
			T_j=125 °C	-	2.4	-	
			T_j=150 °C	-	2.3	-	
V_{EC} (Note1) (Chip)		I_E=600 A, G-E short-circuited, (Note5)	T_j=25 °C	-	2.7	3.50	V
			T_j=125 °C	-	2.3	-	
			T_j=150 °C	-	2.2	-	
t_{rr} (Note1)	Reverse recovery time	V_{CC}=600 V, I_E=600 A, V_{GE}=±15 V, R_G=0 Ω, Inductive load		-	-	300	ns
Q_{rr} (Note1)	Reverse recovery charge			-	16	-	μC
E_{on}	Turn-on switching energy per pulse	V_{CC}=600 V, I_C=I_E=600 A, V_{GE}=±15 V, R_G=0 Ω, T_j=150 °C, Inductive load		-	91.5	-	mJ
E_{off}	Turn-off switching energy per pulse			-	63.1	-	
E_{rr} (Note1)	Reverse recovery energy per pulse			-	36.1	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, T_C=25 °C (Note4)		-	-	0.4	mΩ
r_g	Internal gate resistance	Per switch		-	5.0	-	Ω

ELECTRICAL CHARACTERISTICS (cont.; T_j=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)	-	-	45	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter DIODE (Note4)	-	-	72	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 7)	-	15	-	K/kW

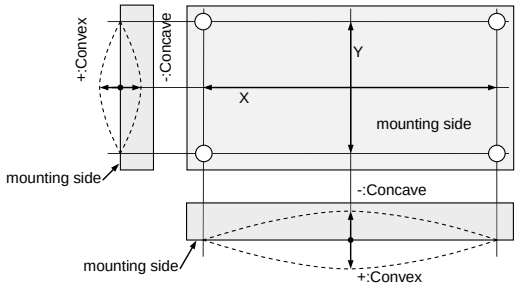
MECHANICAL CHARACTERISTICS

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	Terminal to terminal	17	-	-	mm
		Terminal to base plate	18.5	-	-	
d_a	Clearance	Terminal to terminal	10	-	-	mm
		Terminal to base plate	16.3	-	-	
m	mass	-	-	350	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note8)	±0	-	+100	μm

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

2. Junction temperature (T_j) should not increase beyond T_{jmax} rating.
3. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} 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.
6. $B_{(25/50)} = \ln(\frac{R_{25}}{R_{50}}) / (\frac{1}{T_{25}} - \frac{1}{T_{50}})$,

   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).
8. The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



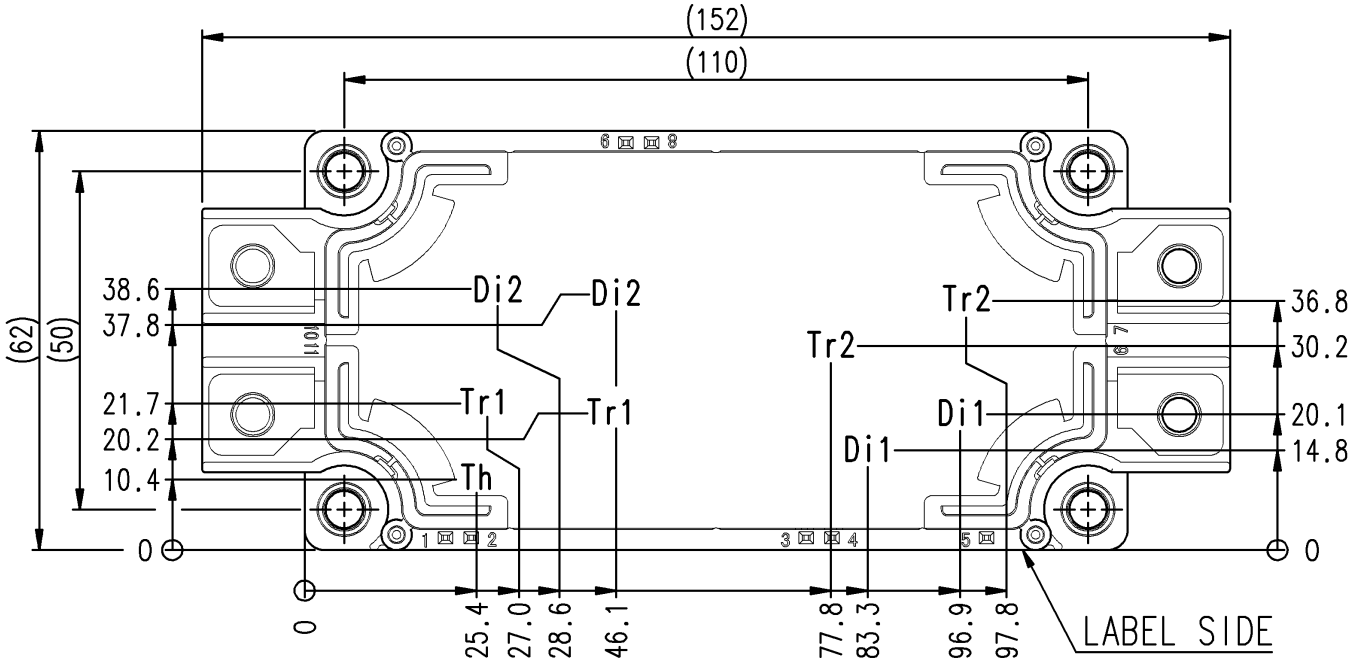
9. Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
   "φ2.6×10 or φ2.6×12 B1 tapping screw"
   The length of the screw depends on thickness (t1.6~t2.0) of the PCB.

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-Es1/G2-Es2 terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0	-	6.8	Ω

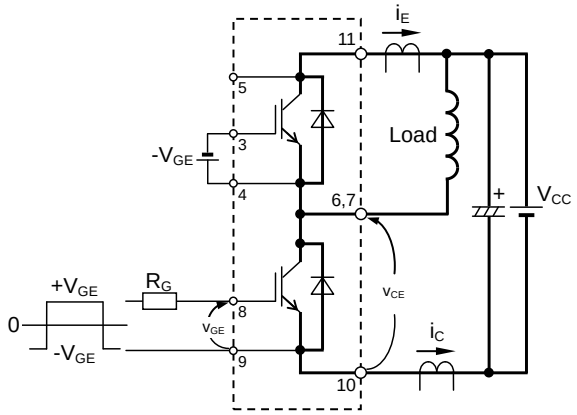
CHIP LOCATION (Top view)

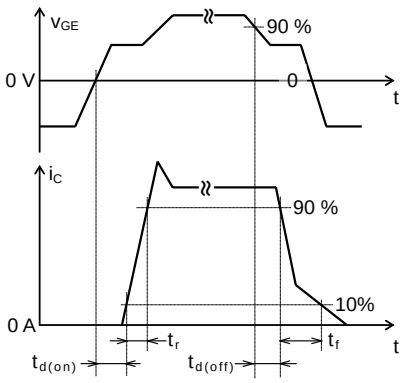
Dimension in mm, tolerance: ±1 mm



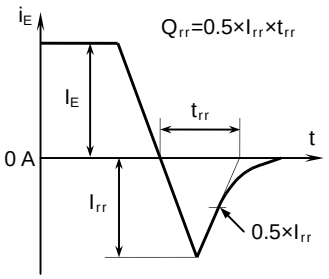
Tr1/Tr2: IGBT, Di1/Di2: DIODE, Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

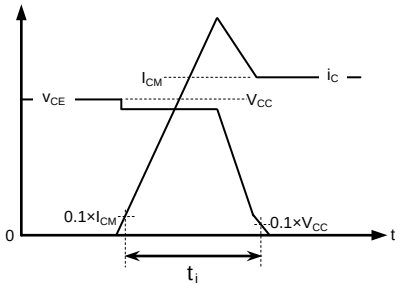




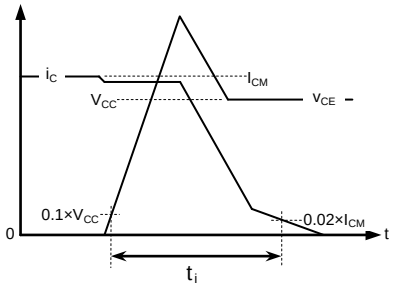
Switching characteristics test circuit and waveforms



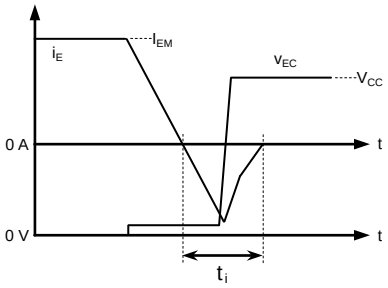
t_{rr}, Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



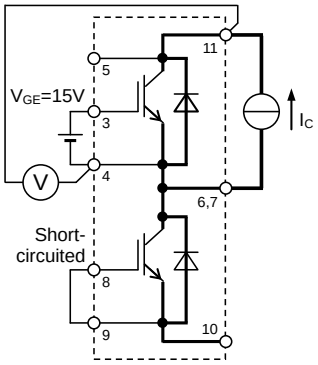
IGBT Turn-off switching energy



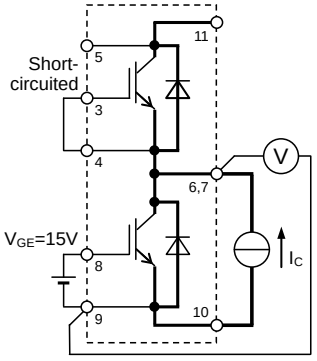
DIODE Reverse recovery energy

Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

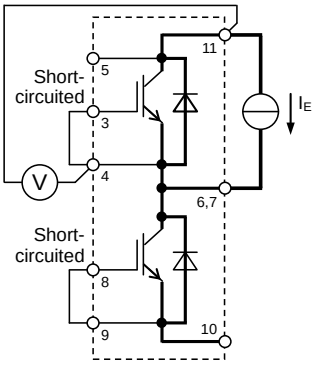


Tr1

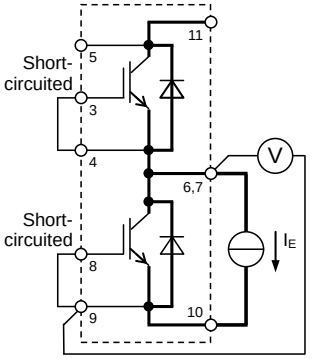


Tr2

V_{CEsat} characteristics test circuit



Di1



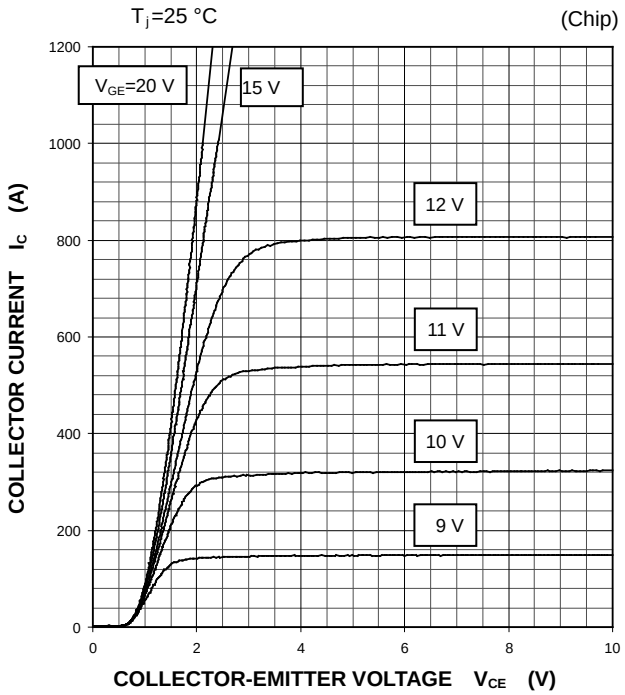
Di2

V_{EC} characteristics test circuit

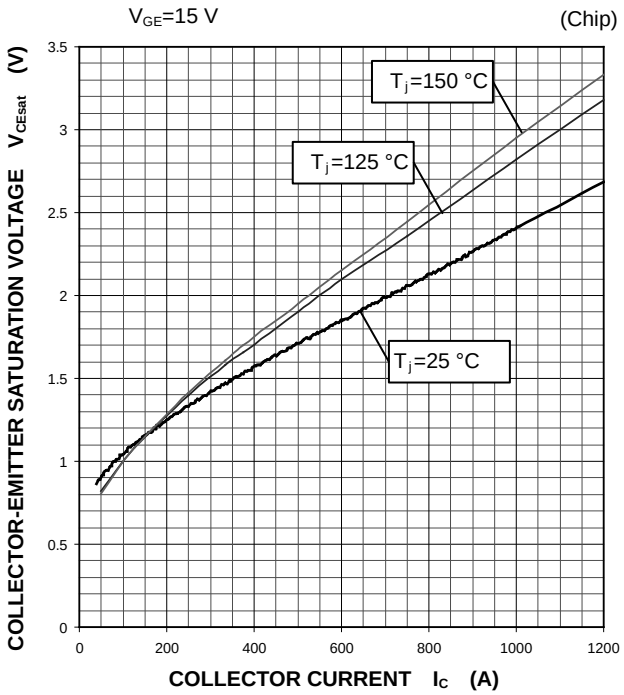
PERFORMANCE CURVES

INVERTER PART

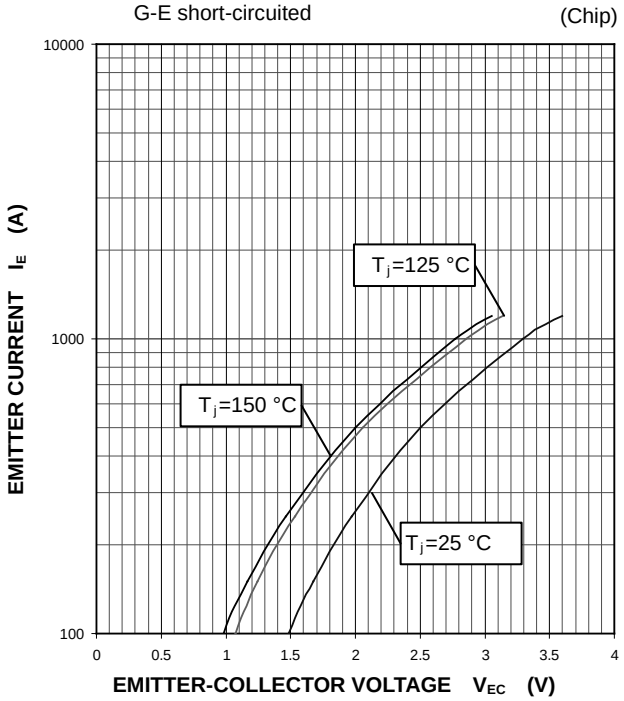
OUTPUT CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)

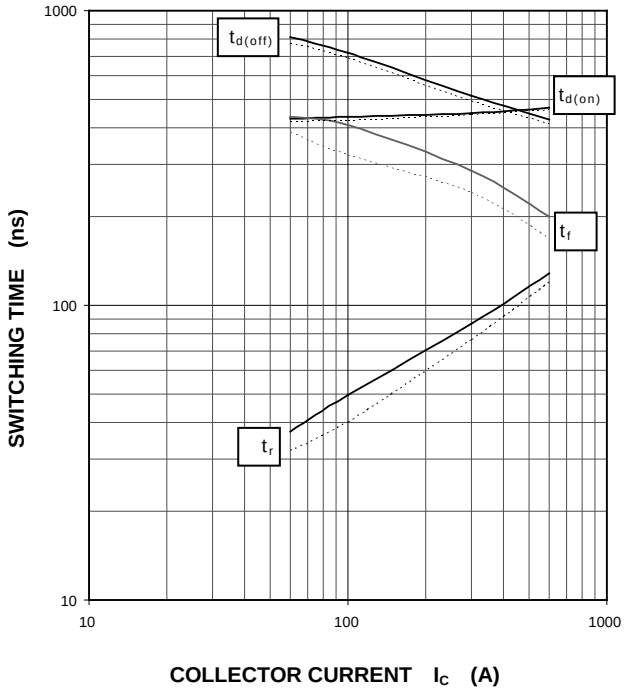


PERFORMANCE CURVES

INVERTER PART

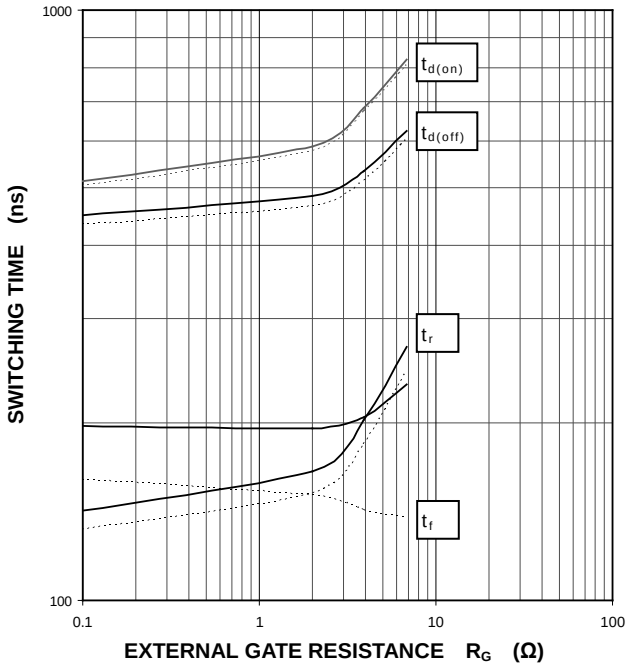
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω, INDUCTIVE LOAD
———: T_j=150 °C, - - - - -: T_j=125 °C

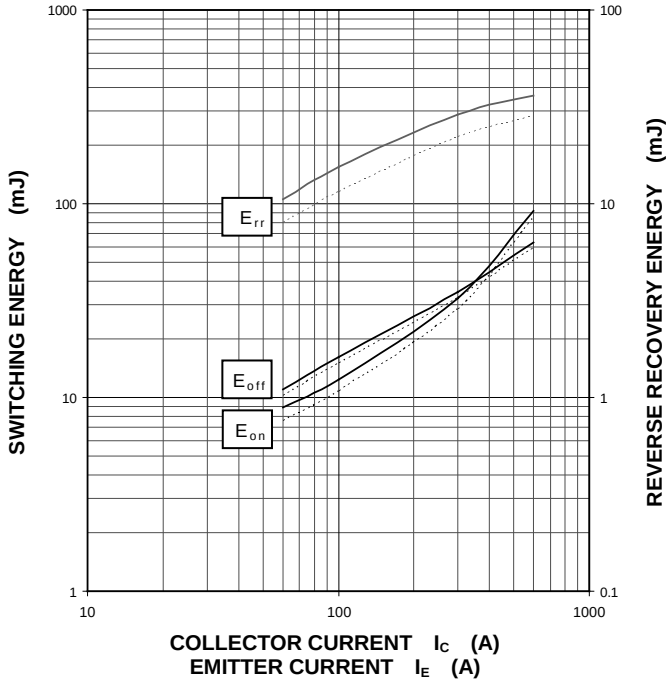


HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

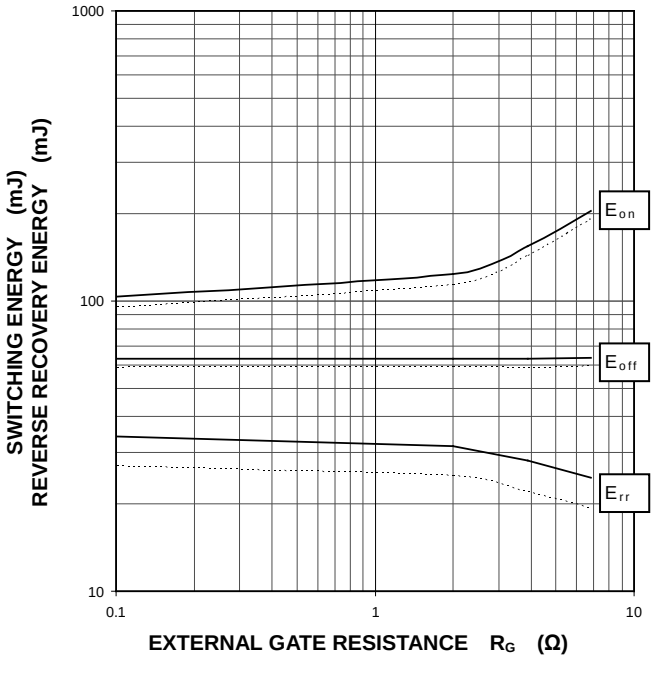
V_{CC}=600 V, V_{GE}=±15 V, I_C=600 A, INDUCTIVE LOAD
———: T_j=150 °C, - - - - -: T_j=125 °C



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω,
INDUCTIVE LOAD, PER PULSE
———: T_j=150 °C, - - - - -: T_j=125 °C



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
V_{CC}=600 V, V_{GE}=±15 V, I_C/I_E=600 A,
INDUCTIVE LOAD, PER PULSE
———: T_j=150 °C, - - - - -: T_j=125 °C

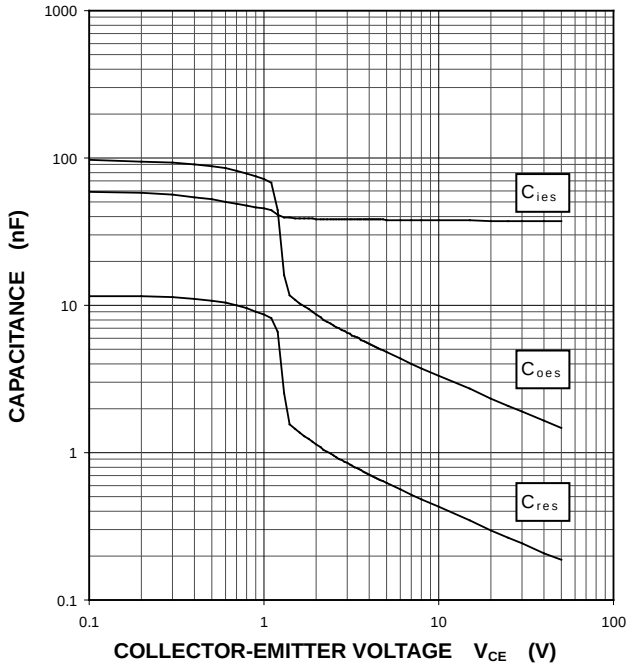


PERFORMANCE CURVES

INVERTER PART

CAPACITANCE CHARACTERISTICS (TYPICAL)

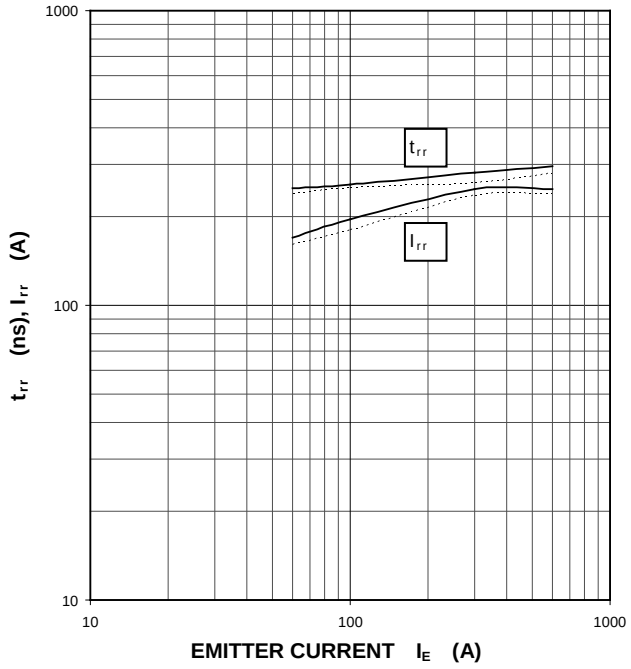
G-E short-circuited, T_j=25 °C



FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

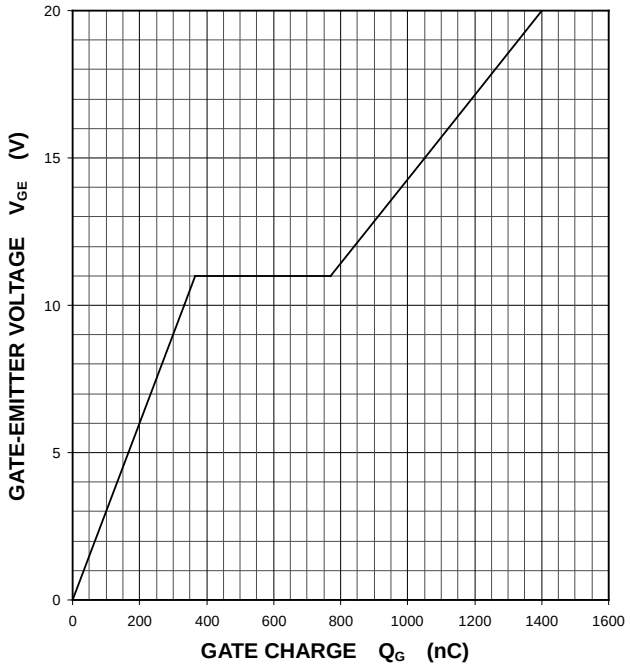
V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω, INDUCTIVE LOAD

———: T_j=150 °C, - - - - -: T_j=125 °C



GATE CHARGE CHARACTERISTICS (TYPICAL)

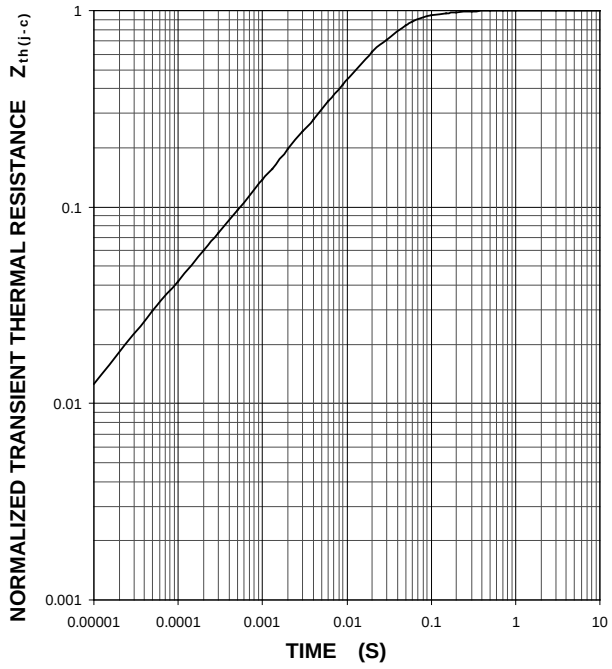
V_{CC}=600 V, I_C=600 A, T_j=25 °C



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

Single pulse, T_C=25 °C

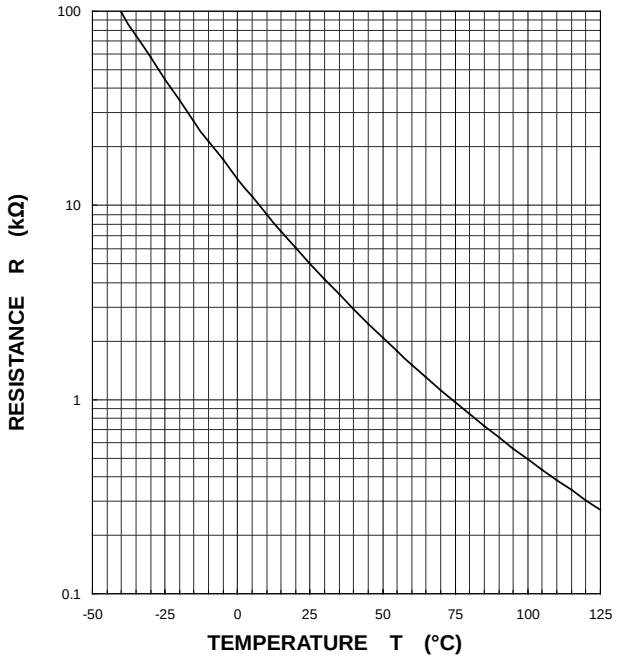
$R_{th(j-c)Q}$=45 K/kW, $R_{th(j-c)D}$=72 K/kW



PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS (TYPICAL)



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