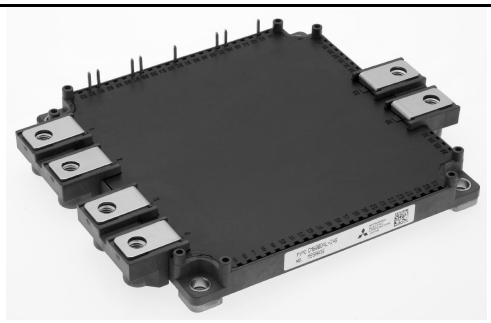
MITSUBISHI ELECTRIC

< IGBT MODULES >

CM600DXL-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



Dual (Half-Bridge)

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

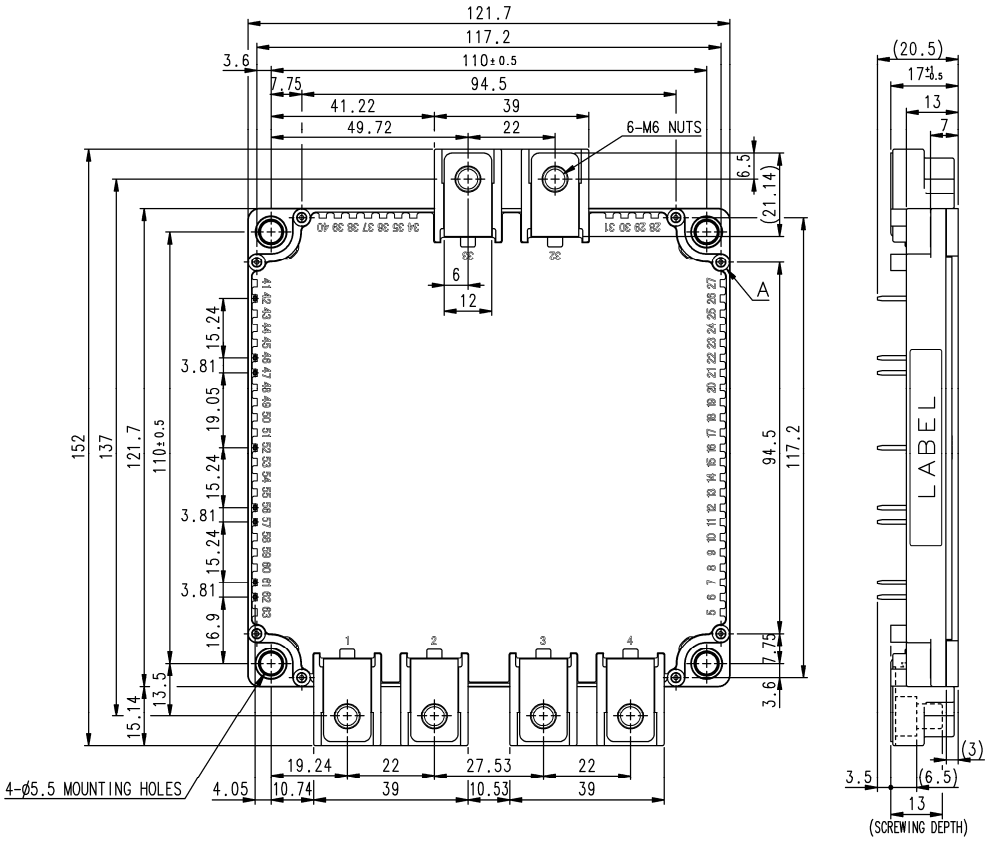
- ●Flat base Type
- ●Copper base plate (non-plating)
- ●Tin plating pin terminals
- ●RoHS Directive compliant
- ●Recognized under UL1557, File E323585

APPLICATION

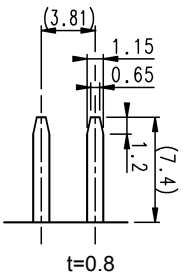
AC Motor Control, Motion/Servo Control, Power supply, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

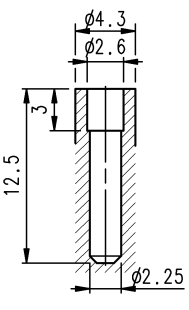
Dimension in mm



TERMINAL



SECTION A

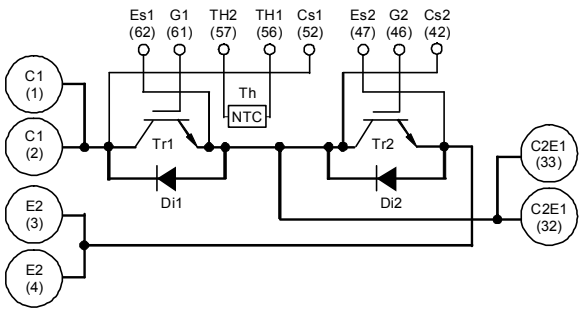


Tolerance otherwise specified

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

The tolerance of size between terminals is assumed to be ±0.4.

INTERNAL CONNECTION



ABSOLUTE MAXIMUM RATINGS (T_j=25 °C, unless otherwise specified)

INVERTER PART IGBT/FWDi

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=119 °C (Note.2, 4)	600	A
I_{CRM}		Pulse, Repetitive (Note.3)	1200	
P_{tot}	Total power dissipation	T_C=25 °C (Note.2, 4)	4545	W
I_E (Note.1)	Emitter current	T_C=25 °C (Note.2, 4)	600	A
I_{ERM} (Note.1)		Pulse, Repetitive (Note.3)	1200	

MODULE

Symbol	Item	Conditions	Rating	Unit
T_{jmax}	Maximum junction temperature	-	175	°C
T_{Cmax}	Maximum case temperature	(Note.2)	125	
T_{jop}	Operating junction temperature	-	-40 ~ +150	°C
T_{stg}	Storage temperature	-	-40 ~ +125	
V_{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V

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

INVERTER PART IGBT/FWDi

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
I_{CES}	Collector-emitter cut-off current	V_{CE}=V_{CES}, G-E short-circuited		-	-	1	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}	Collector-emitter saturation voltage	I_C=600 A (Note.5), V_{GE}=15 V, (Terminal)	T_j=25 °C	-	1.85	2.30	V
			T_j=125 °C	-	2.05	-	
			T_j=150 °C	-	2.10	-	
		I_C=600 A (Note.5), V_{GE}=15 V, (Chip)	T_j=25 °C	-	1.70	2.15	V
			T_j=125 °C	-	1.90	-	
			T_j=150 °C	-	1.95	-	
C_{ies}	Input capacitance	V_{CE}=10 V, G-E short-circuited		-	-	60	nF
C_{oes}	Output capacitance			-	-	12	
C_{res}	Reverse transfer capacitance			-	-	1.0	
Q_G	Gate charge	V_{CC}=600 V, I_C=600 A, V_{GE}=15 V		-	1400	-	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} (Note.1)	Emitter-collector voltage	I_E=600 A (Note.5), G-E short-circuited, (Terminal)	T_j=25 °C	-	1.85	2.30	V
			T_j=125 °C	-	1.85	-	
			T_j=150 °C	-	1.85	-	
		I_E=600 A (Note.5), G-E short-circuited, (Chip)	T_j=25 °C	-	1.70	2.15	V
			T_j=125 °C	-	1.70	-	
			T_j=150 °C	-	1.70	-	
t_{rr} (Note.1)	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} (Note.1)	Reverse recovery charge			-	32	-	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		-	20.3	-	mJ
E_{off}	Turn-off switching energy per pulse			-	60.1	-	
E_{rr} (Note.1)	Reverse recovery energy per pulse			-	69.2	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, T_C=25 °C (Note.2)		-	-	0.8	mΩ
r_g	Internal gate resistance	Per switch		-	3.3	-	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 (Note.2)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	T_C=100 °C, R_{100}=493 Ω	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note.6)	-	3375	-	K
P_{25}	Power dissipation	T_C=25 °C (Note.2)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

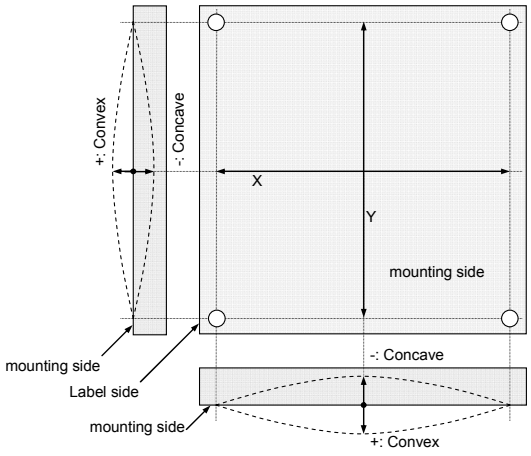
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note.2)	Junction to case, per Inverter IGBT	-	-	33	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWDi	-	-	63	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note.2)	Case to heat sink, per 1 module, Thermal grease applied (Note.7)	-	7	-	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 to heat sink	M 5 screw	2.5	3.0	3.5	N·m
d_s	Creepage distance	Terminal to terminal		13.2	-	-	mm
		Terminal to base plate		15.3	-	-	
d_a	Clearance	Terminal to terminal		13.2	-	-	mm
		Terminal to base plate		14.8	-	-	
m	Weight	-		-	690	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.8)		±0	-	+100	μm

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

2. 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.
   The heat sink thermal resistance should measure just under the chips.
3. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
4. Junction temperature (T_j) should not increase beyond T_{jmax} rating.
5. Pulse width and repetition rate should be such as to cause negligible temperature rise.
   Refer to the figure of test circuit.
6. $B_{(25/50)} = \ln(\frac{R_{25}}{R_{50}})/(\frac{1}{T_{25}} - \frac{1}{T_{50}})$
   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. Base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



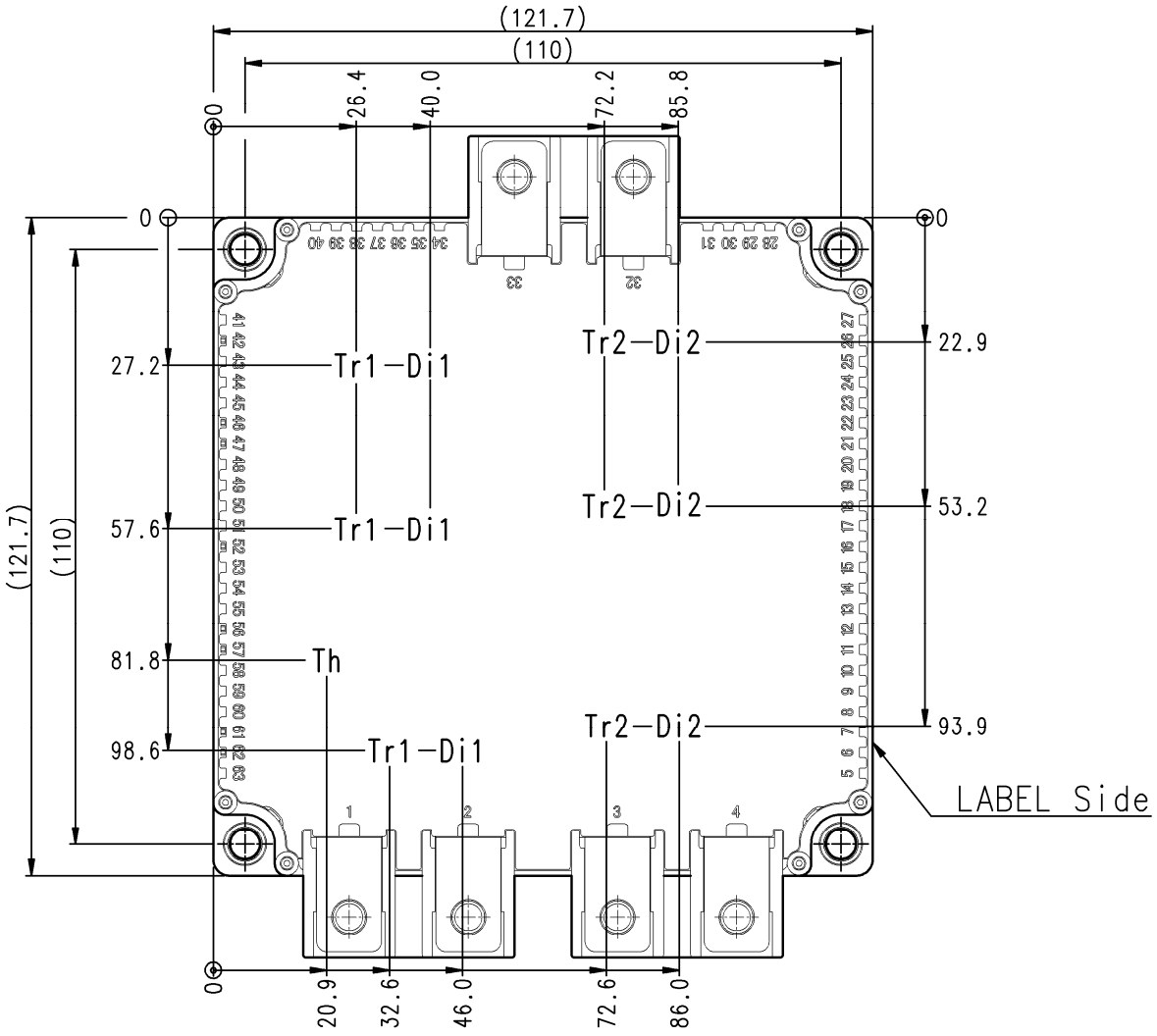
Note9. Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
"M2.6×10 or M2.6×12 self tapping screw"
The length of the screw depends on the thickness of the PCB.

RECOMMENDED OPERATING CONDITIONS (T_a=25 °C)

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0	-	6.8	Ω

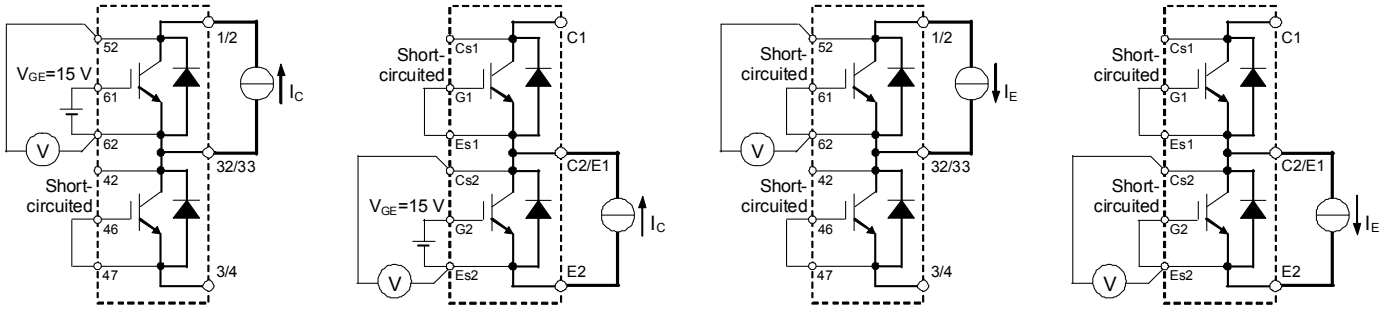
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



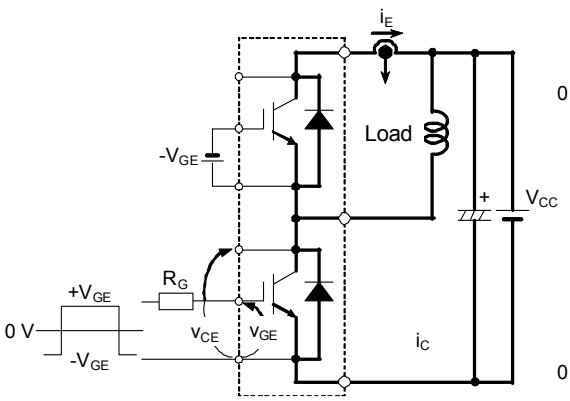
Tr1/Tr2: IGBT, Di1/Di2: FWDi, Th: NTC thermistor

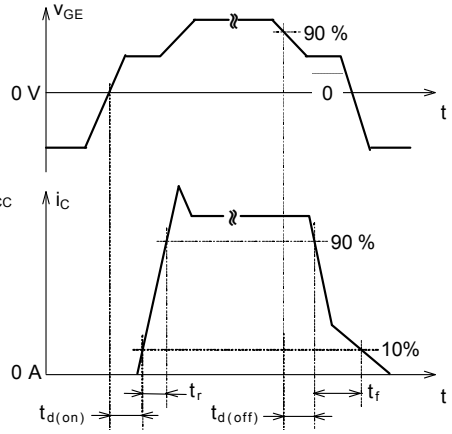
TEST CIRCUIT AND WAVEFORMS

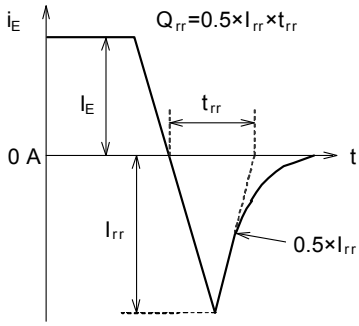


Tr1 **Tr2** **Di1** **Di2**

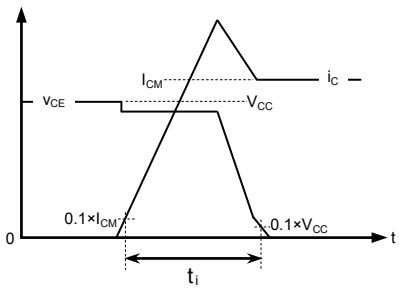
V_{CEsat} test circuit **V_{EC} test circuit**

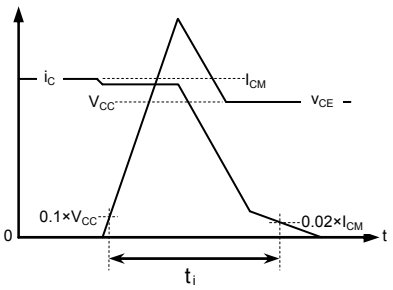


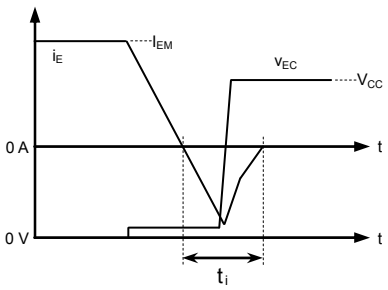




Switching characteristics test circuit and waveforms **t_{rr}, Q_{rr} test waveform**







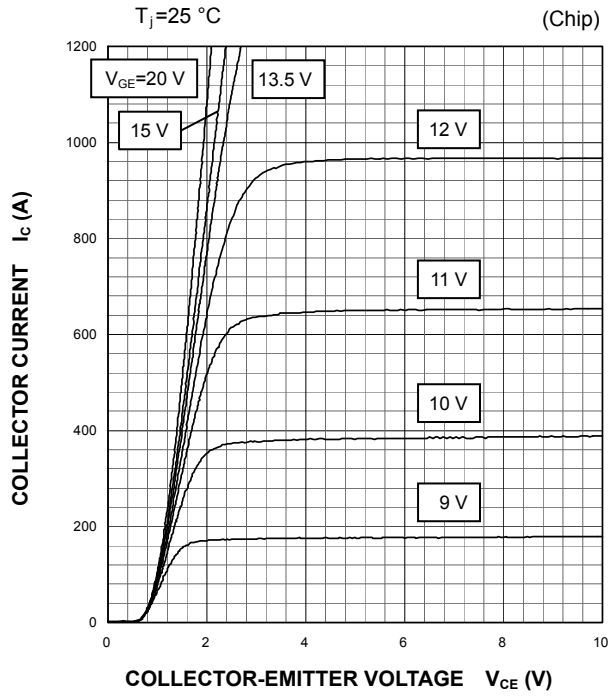
IGBT Turn-on switching energy **IGBT Turn-off switching energy** **FWDi Reverse recovery energy**

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

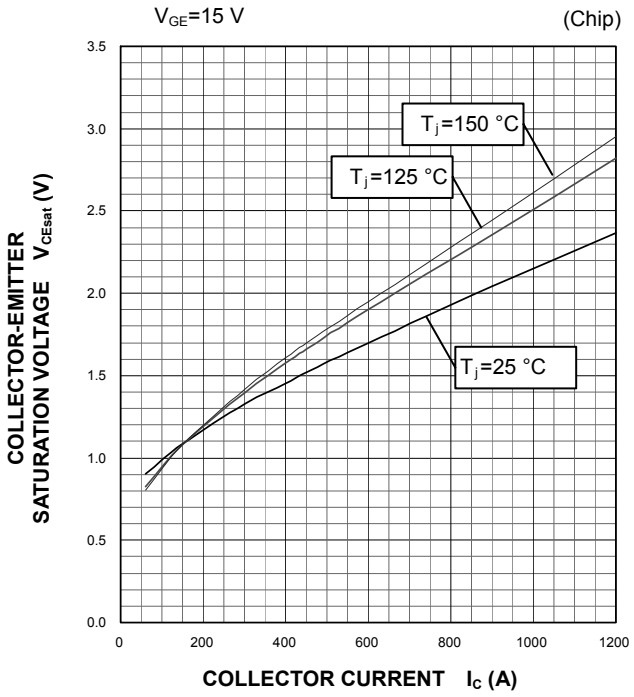
PERFORMANCE CURVES

INVERTER PART

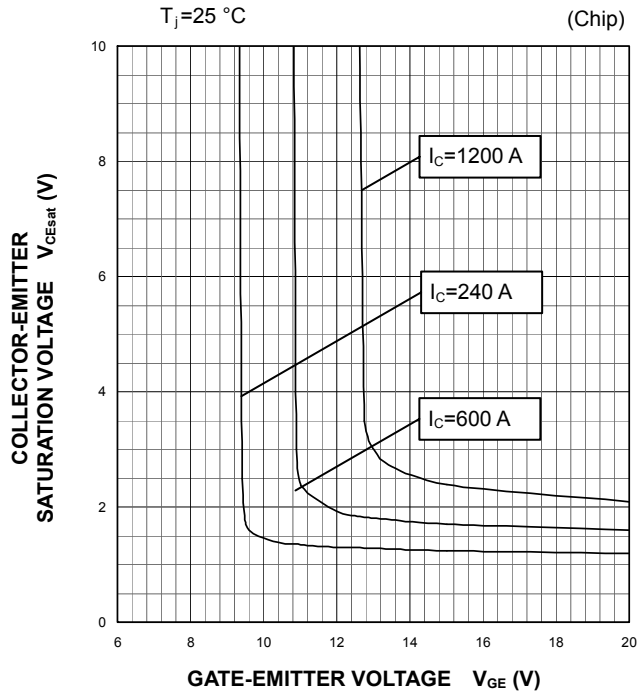
OUTPUT CHARACTERISTICS (TYPICAL)



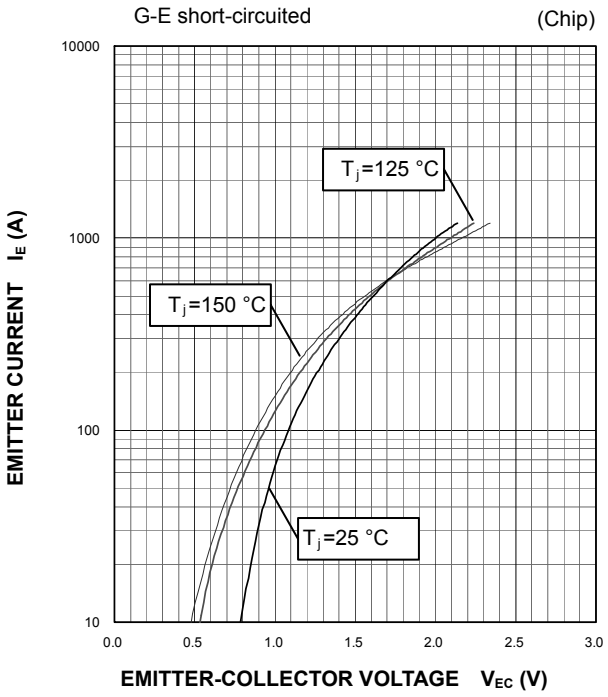
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



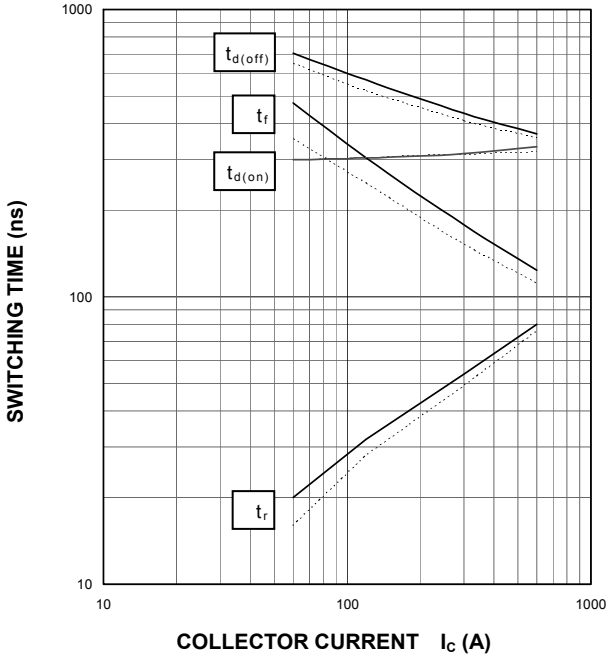
PERFORMANCE CURVES

INVERTER PART

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

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

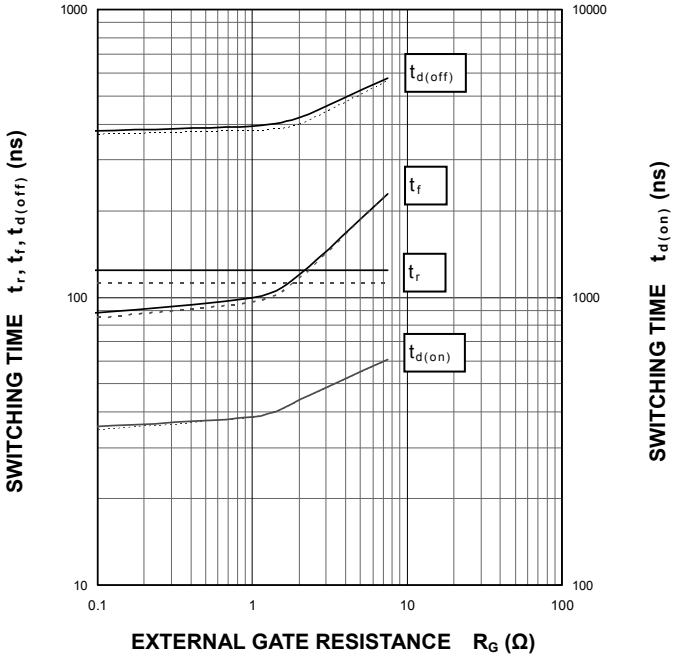
——: T_j=150 °C, - - - - -: T_j=125 °C



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

V_{CC}=600 V, I_C=600 A, V_{GE}=±15 V, INDUCTIVE LOAD

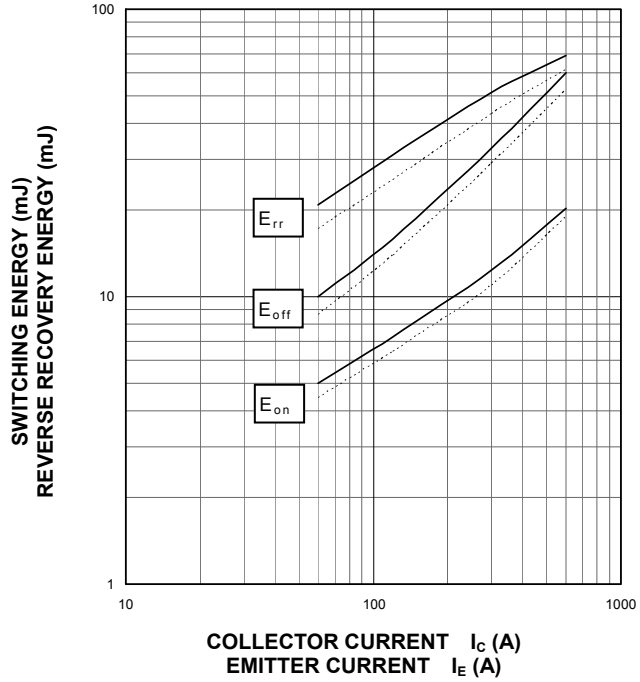
——: T_j=150 °C, - - - - -: T_j=125 °C



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

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

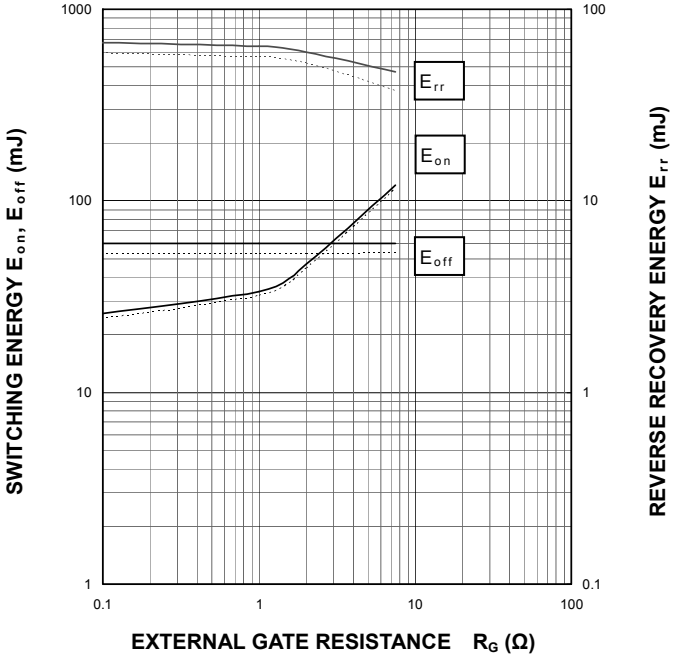
——: T_j=150 °C, - - - - -: T_j=125 °C



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

V_{CC}=600 V, I_C/I_E=600 A, V_{GE}=±15 V,
INDUCTIVE LOAD, PER PULSE

——: T_j=150 °C, - - - - -: T_j=125 °C

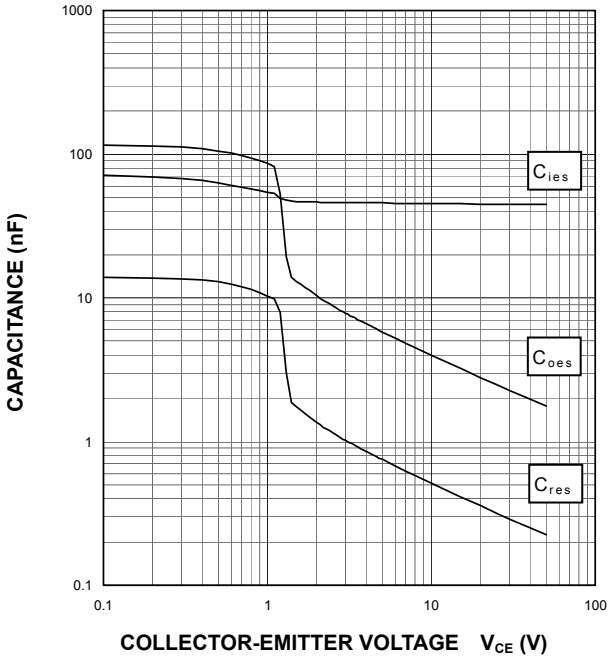


PERFORMANCE CURVES

INVERTER PART

CAPACITANCE CHARACTERISTICS (TYPICAL)

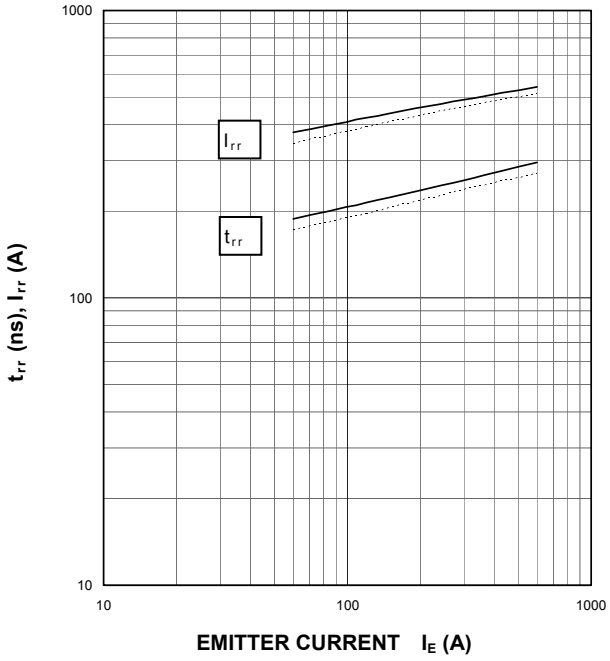
G-E short-circuited, T_j=25 °C



FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

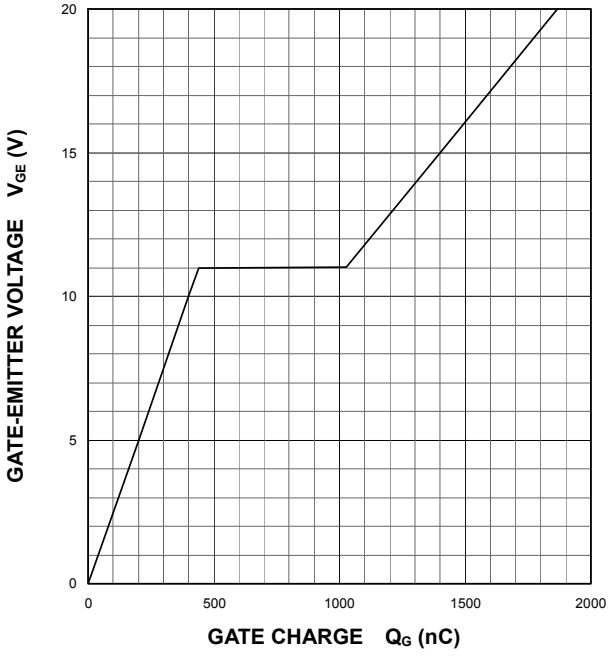
V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω, INDUCTIVE LOAD

——: T_j=150 °C, - - - - -: T_j=125 °C



GATE CHARGE CHARACTERISTICS (TYPICAL)

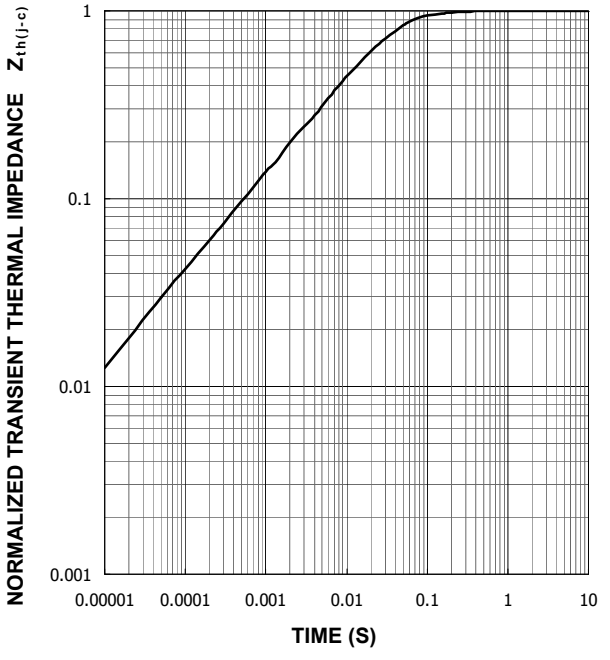
V_{CC}=600 V, I_C=600 A, T_j=25 °C



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

Single pulse, T_C=25°C

$R_{th(j-c)Q}$=33 K/kW, $R_{th(j-c)D}$=63 K/kW



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