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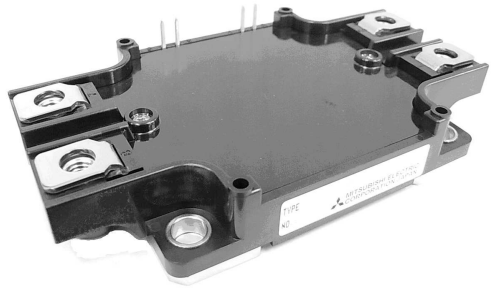
MITSUBISHI ELECTRIC

< IGBT MODULES >

CM150EXS-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



Single switch

Collector current I_C ..... **150** A
Collector-emitter voltage V_{CES} ..... **1200** V
Maximum junction temperature T_{jmax} ..... **175** °C

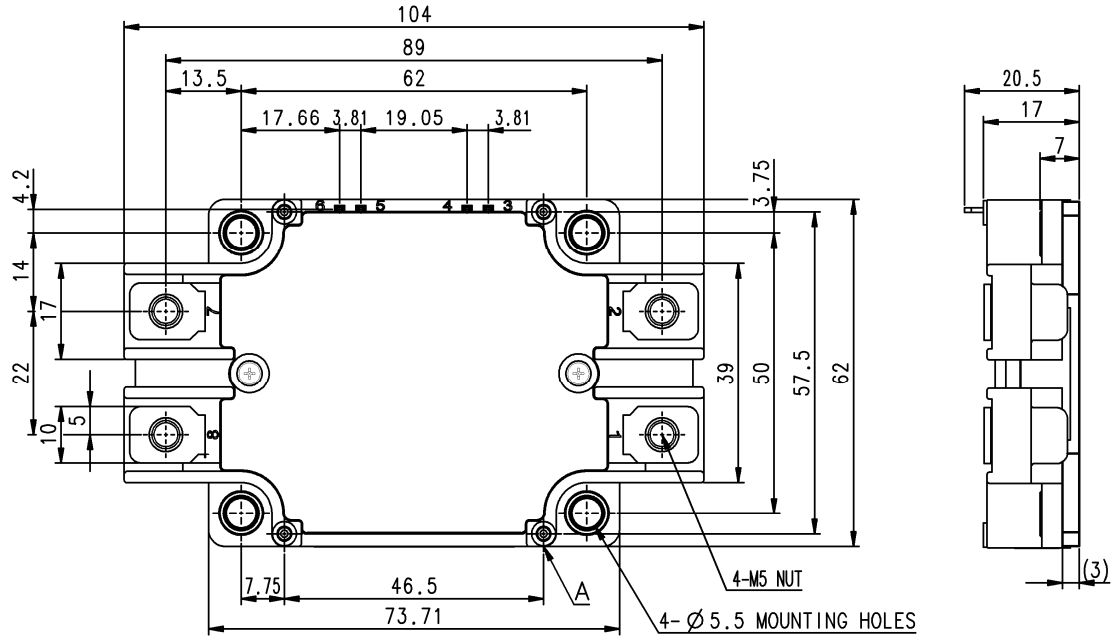
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- Recognized under UL1557, File E323585

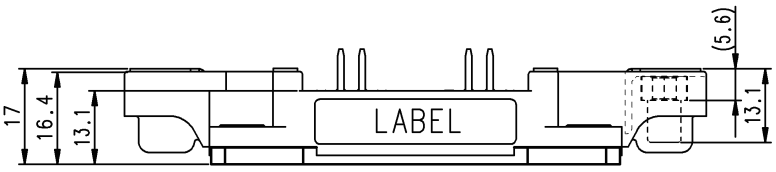
APPLICATION

Brake

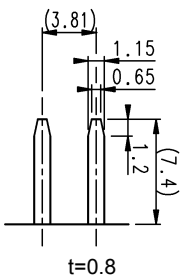
OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm

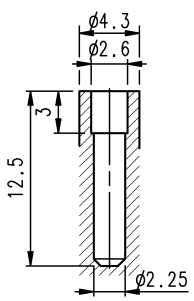




TERMINAL



SECTION A

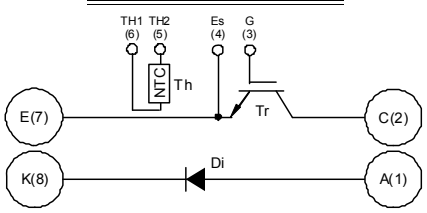


Tolerance otherwise specified

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)

IGBT

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=120 °C (Note1, 3)	150	A
I_{CRM}		Pulse, Repetitive (Note2)	300	
P_{tot}	Total power dissipation	T_C=25 °C (Note1, 3)	1150	W

DIODE

Symbol	Item	Conditions	Rating	Unit
V_{RRM}	Repetitive peak reverse voltage	-	1200	V
I_F	Forward current	(Note1)	150	A
I_{FRM}		Pulse, Repetitive (Note2)	300	

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	(Note3)	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)

IGBT

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=15 mA, V_{CE}=10 V		5.4	6.0	6.6	V
V_{CEsat}	Collector-emitter saturation voltage	I_C=150 A (Note4), V_{GE}=15 V, (Terminal)	T_j=25 °C	-	1.80	2.25	V
			T_j=125 °C	-	2.00	-	
			T_j=150 °C	-	2.05	-	
		I_C=150 A (Note4), 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		-	-	15	nF
C_{oes}	Output capacitance			-	-	3.0	
C_{res}	Reverse transfer capacitance			-	-	0.25	
Q_G	Gate charge	V_{CC}=600 V, I_C=150 A, V_{GE}=15 V		-	350	-	nC
$t_{d(on)}$	Turn-on delay time	V_{CC}=600 V, I_C=150 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	
E_{on}	Turn-on switching energy per pulse	V_{CC}=600 V, I_C=150 A, V_{GE}=±15 V, R_G=0 Ω, T_j=150 °C, Inductive load		-	24.2	-	mJ
E_{off}	Turn-off switching energy per pulse			-	16	-	
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per element, T_C=25 °C (Note3)		-	-	2.0	mΩ
r_g	Internal gate resistance	-		-	13	-	Ω

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

DIODE PART

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
I_{RRM}	Reverse current	V_R=V_{RRM}		-	-	1.0	mA
V_F	Forward voltage	I_F=150 A (Note4), (Terminal)	T_j =25 °C	-	1.8	2.25	V
			T_j =125 °C	-	1.8	-	
			T_j =150 °C	-	1.8	-	
		I_F=150 A (Note4), (Chip)	T_j =25 °C	-	1.7	2.15	V
			T_j =125 °C	-	1.7	-	
			T_j =150 °C	-	1.7	-	
t_{rr}	Reverse recovery time	V_{CC}=600 V, I_F=150 A, V_{GE}=±15 V, R_G=0 Ω, Inductive load		-	-	300	ns
Q_{rr}	Reverse recovery charge			-	8.0	-	μC
E_{rr}	Reverse recovery energy per pulse	V_{CC}=600 V, I_F=150 A, V_{GE}=±15 V, R_G=0 Ω, T_j =150 °C, Inductive load		-	12.2	-	mJ

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	T_C=25 °C (Note3)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R_{100}=493 Ω, T_C=100 °C (Note3)	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note5)	-	3375	-	K
P_{25}	Power dissipation	T_C=25 °C (Note3)	-	-	10	mW

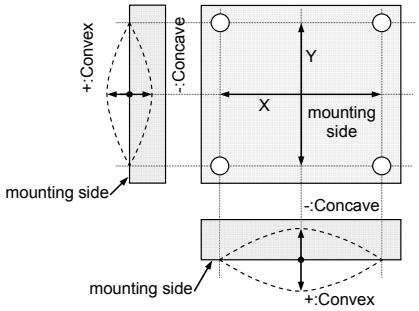
THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, IGBT (Note3)	-	-	0.13	K/W
$R_{th(j-c)D}$		Junction to case, DIODE (Note3)	-	-	0.23	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note3, 6)	-	25	-	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
M_t	Mounting torque	Main terminals	M 5 screw	2.5	3.0	3.5	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		20.6	-	-	mm
		Terminal to base plate		17	-	-	
d_a	Clearance	Terminal to terminal		12	-	-	mm
		Terminal to base plate		10.6	-	-	
m	mass	-		-	210	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note7)		-100	-	+100	μm

Note1. Junction temperature (T_j) should not increase beyond T_{jmax} rating.
2. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
3. 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.
4. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.
5. $B_{(25/50)} = \ln(\frac{R_{25}}{R_{50}})/(\frac{1}{T_{25}} - \frac{1}{T_{50}})$,
   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]
6. Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).
7. The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



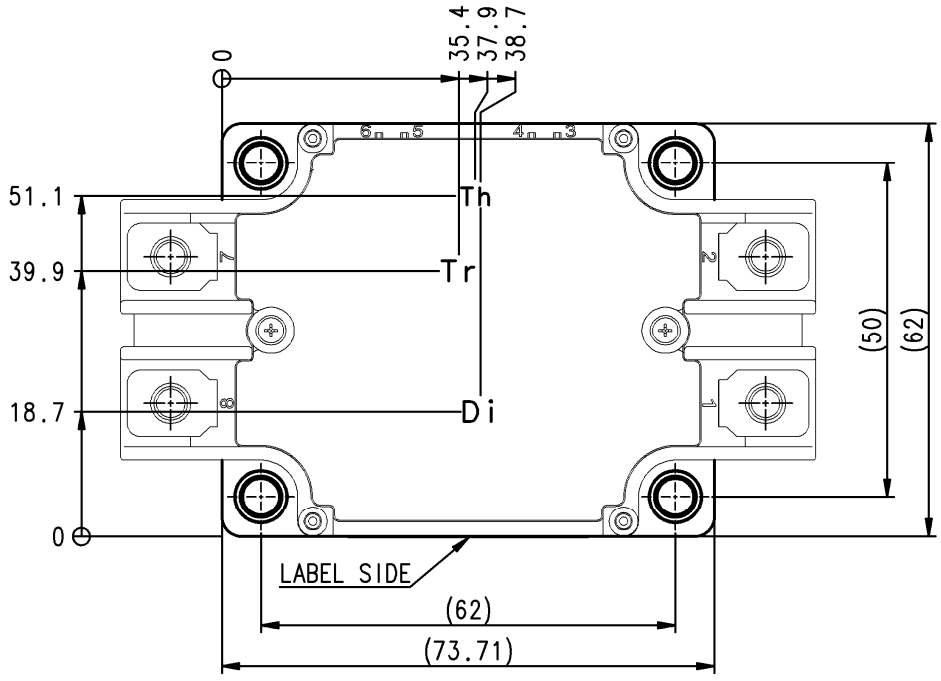
8. Use the following screws when mounting the printed circuit board (PCB) on the stand offs.
   "φ2.6×10 or φ2.6×12 self tapping screw"
   The length of the screw depends on thickness (t1.6~t2.0) of the PCB.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C-E/A-K terminals	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G-Es terminals	13.5	15.0	16.5	V
R_G	External gate resistance	-	0	-	30	Ω

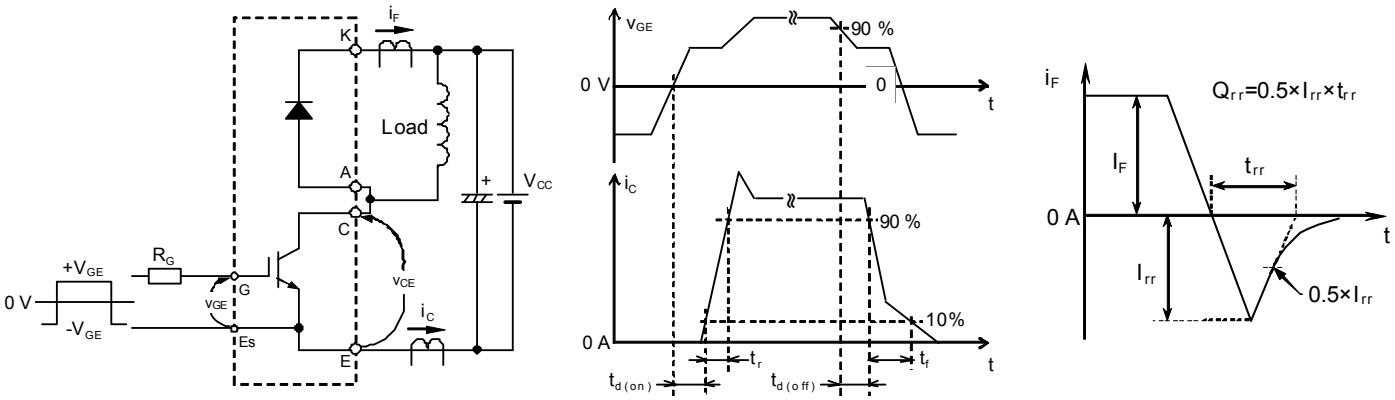
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm

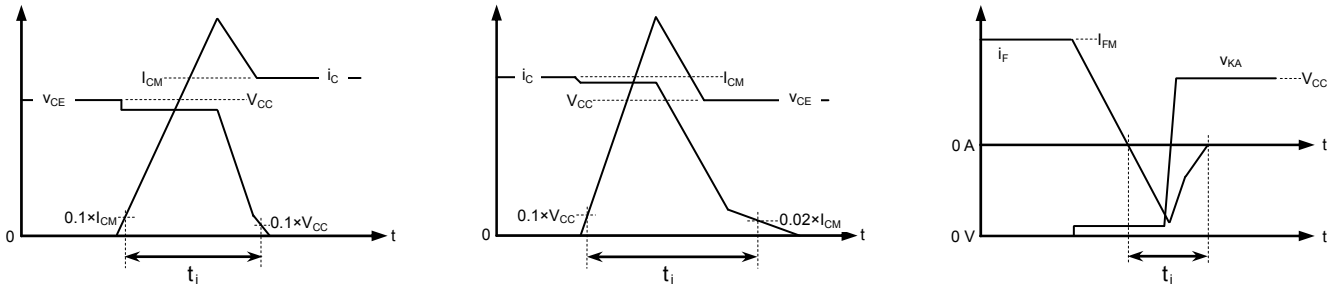


Tr: IGBT, Di: DIODE, Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS



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



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

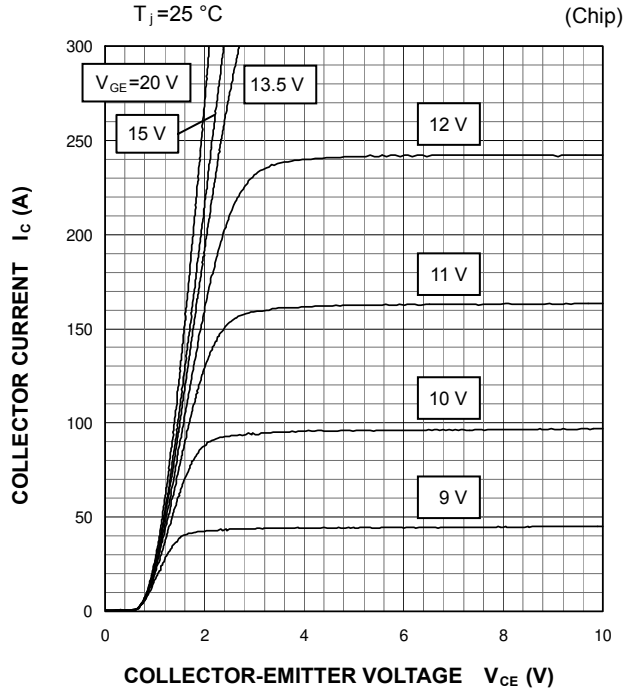
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

V_{CEsat} test circuit **V_F test circuit**

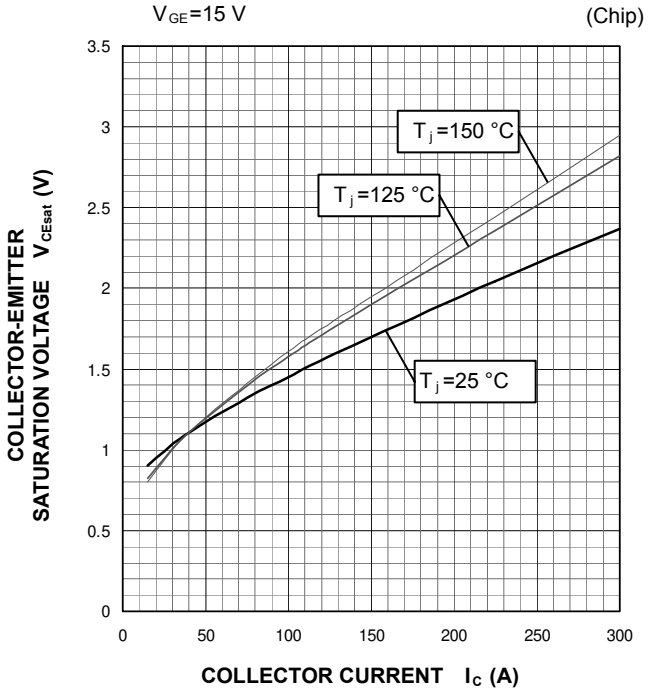
PERFORMANCE CURVES

IGBT/DIODE PART

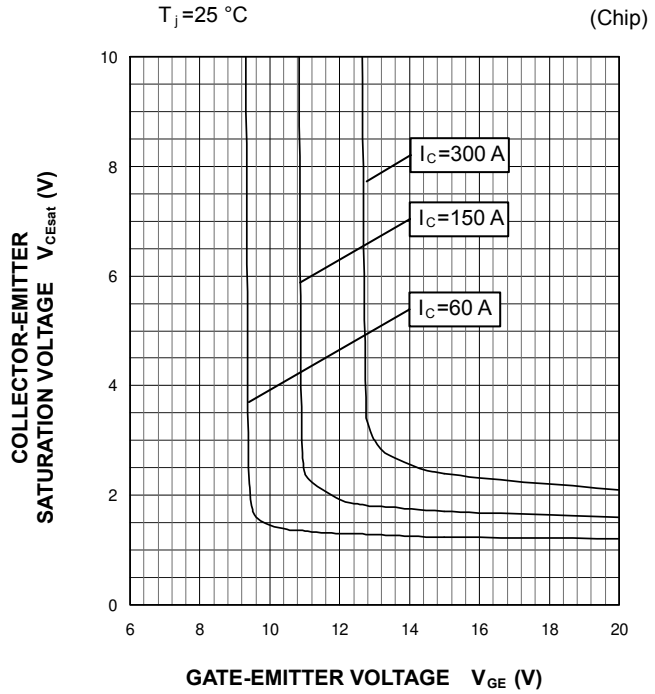
OUTPUT CHARACTERISTICS (TYPICAL)



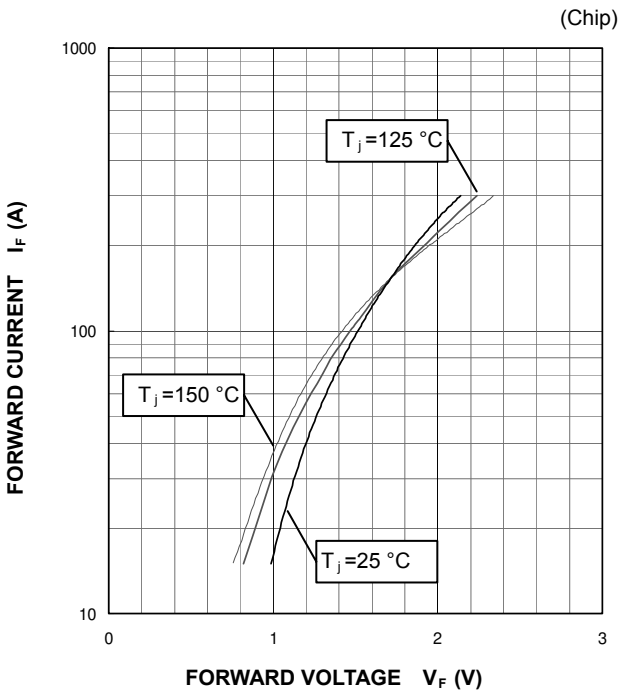
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



CLAMP DIODE FORWARD CHARACTERISTICS (TYPICAL)

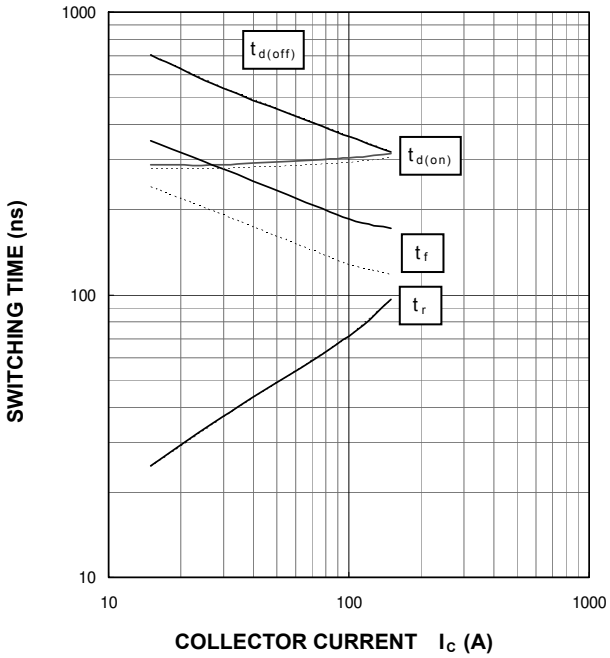


PERFORMANCE CURVES

IGBT/DIODE PART

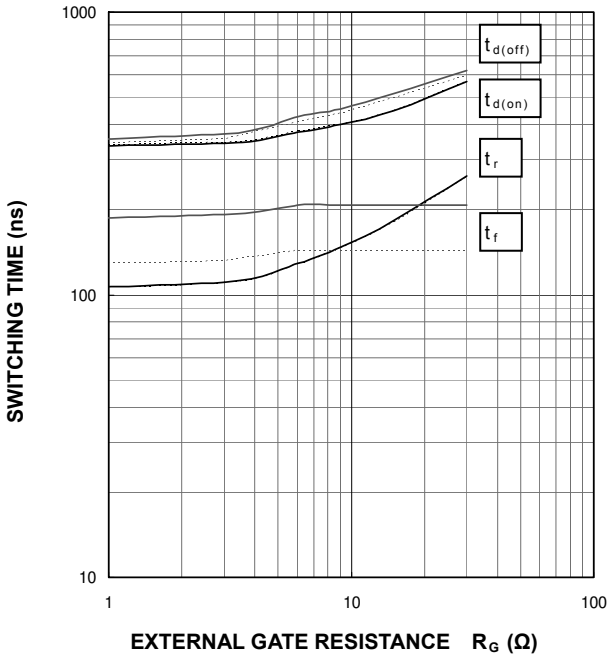
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



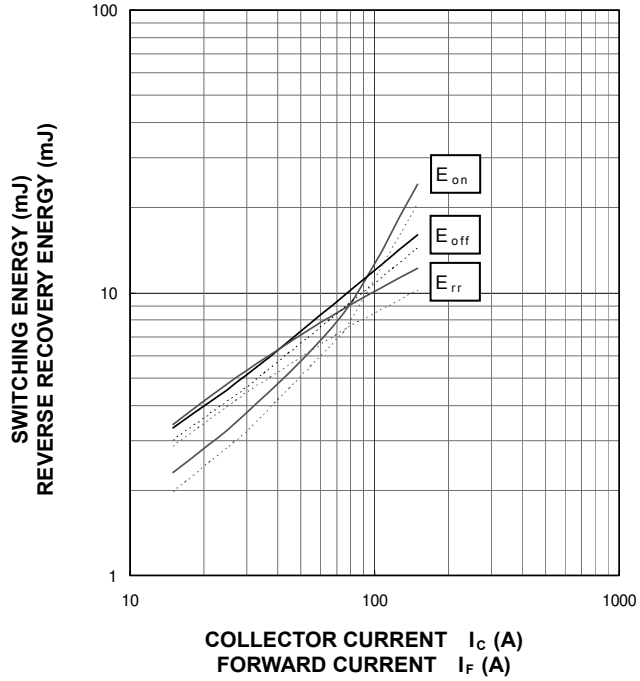
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



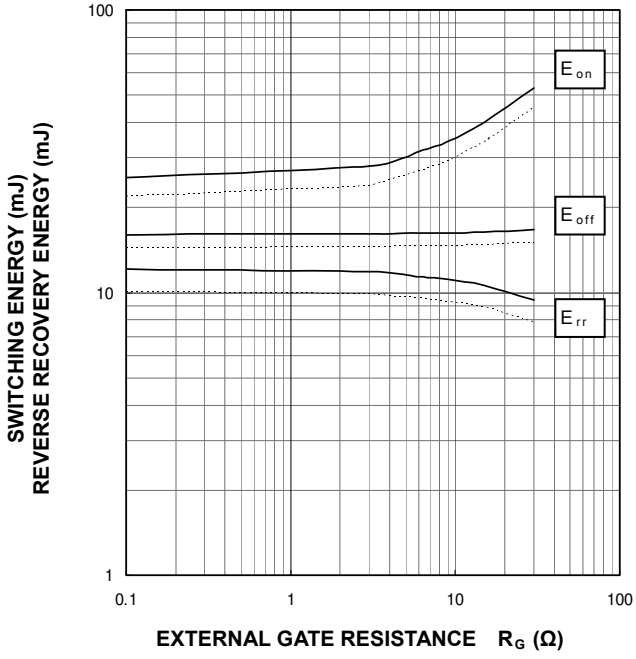
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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_F=150 A,
INDUCTIVE LOAD, PER PULSE
————: T_j=150 °C, - - - - -: T_j=125 °C

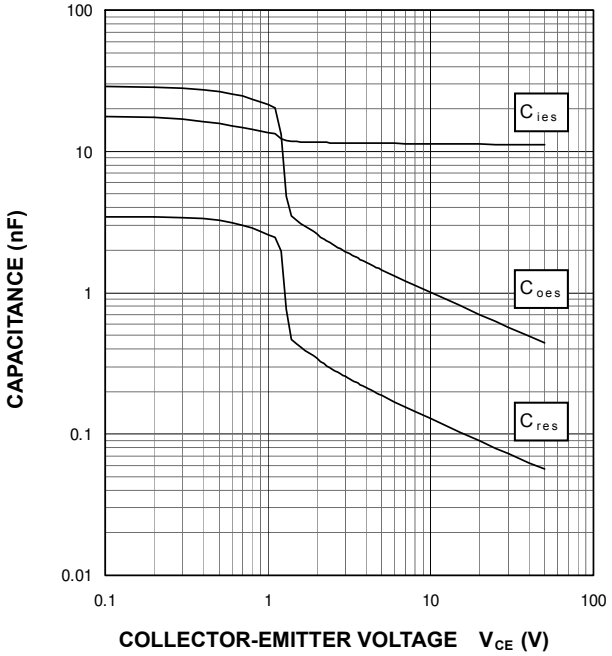


PERFORMANCE CURVES

IGBT/DIODE PART

CAPACITANCE CHARACTERISTICS (TYPICAL)

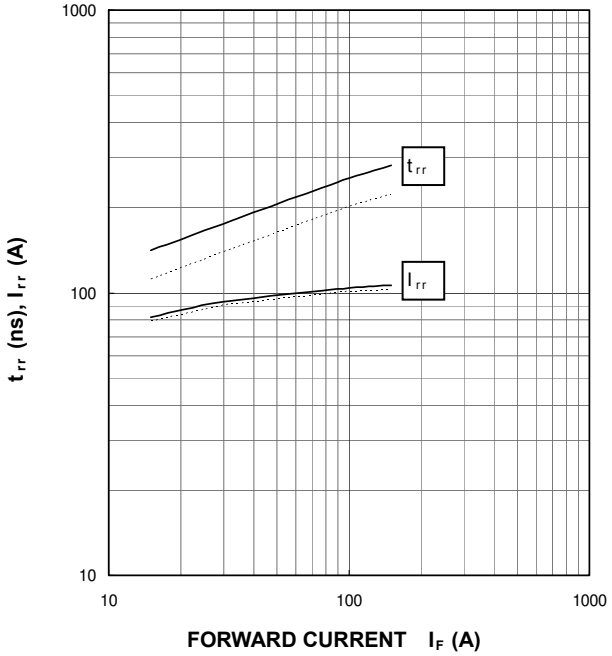
G-E short-circuited, T_j =25 °C



CLAMP DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

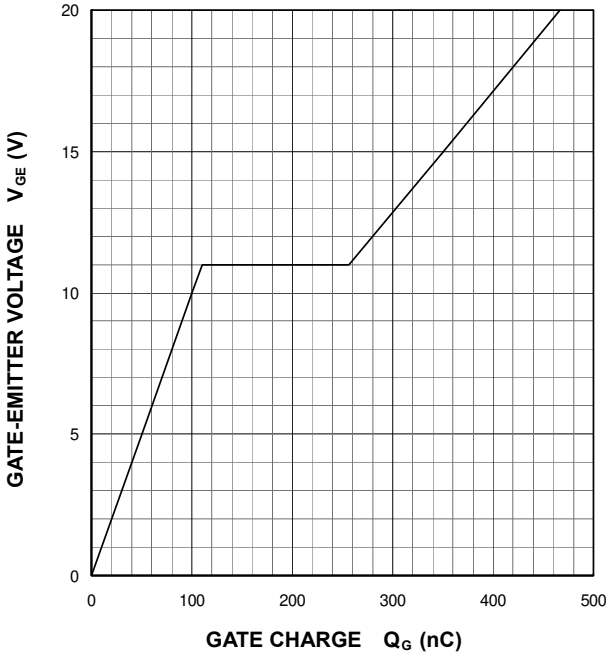
V_{CC}=600 V, V_{GE}=±15 V, R_G=0 Ω, INDUCTIVE LOAD

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



GATE CHARGE CHARACTERISTICS (TYPICAL)

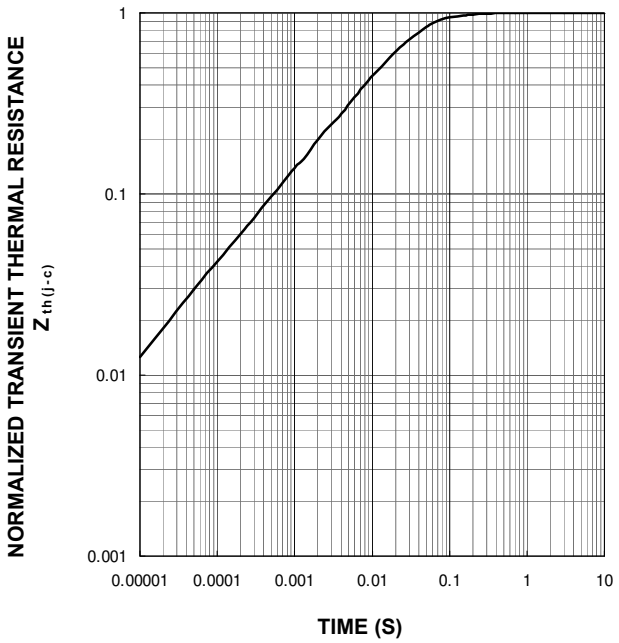
V_{CC}=600 V, I_C=150 A, T_j=25 °C



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

Single pulse, T_C=25 °C

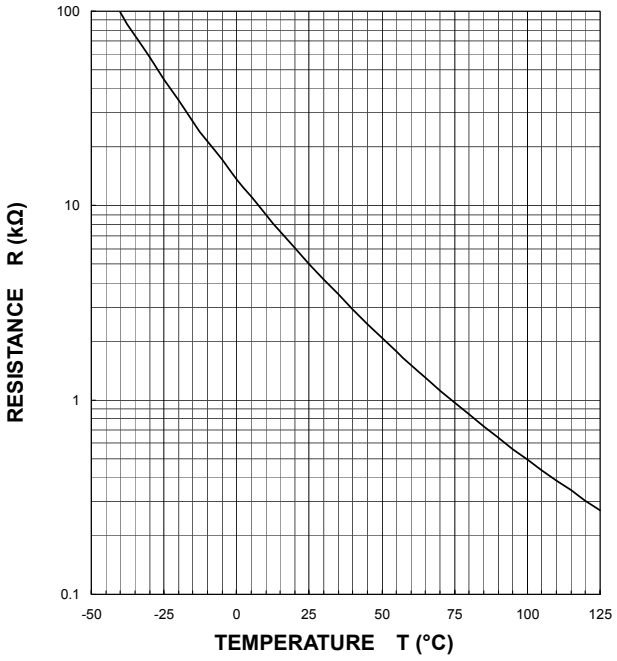
$R_{th(j-c)Q}$ =0.13 K/W, $R_{th(j-c)D}$ =0.23 K/W



PERFORMANCE CURVES

NTC THERMISTOR PART

TEMPERATURE CHARACTERISTICS (TYPICAL)



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