MITSUBISHI ELECTRIC

<IGBT Modules>

CM150RX-12A

HIGH POWER SWITCHING USE
INSULATED TYPE

sevenpack (3φ Inverter + Brake Chopper)

Collector current I_C ..... 150 A
Collector-emitter voltage V_{CES} ..... 600 V
Maximum junction temperature T_{jmax} ..... 150 °C

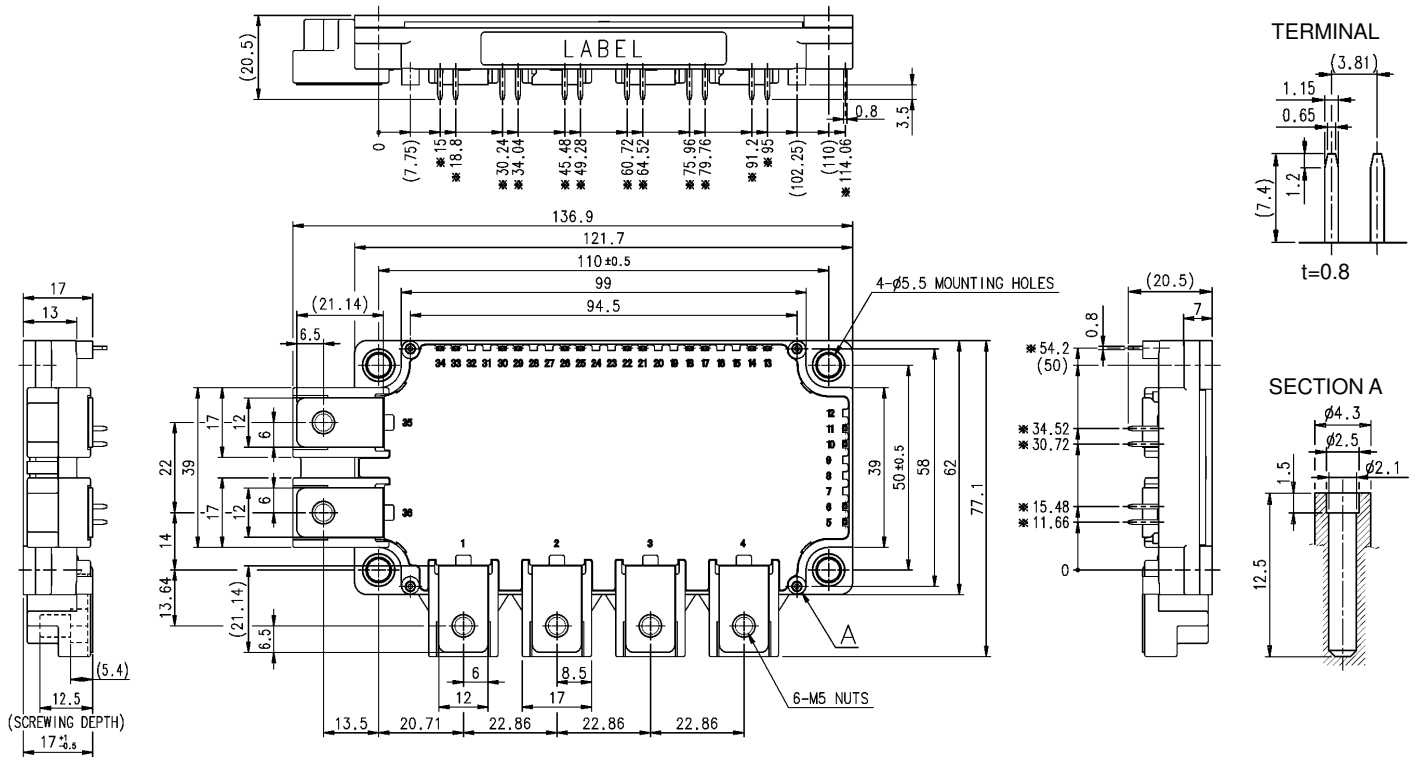
- Flat base Type
- Copper base plate (non-plating)
- RoHS Directive compliant
- Recognized under UL1557, File E323585

APPLICATION

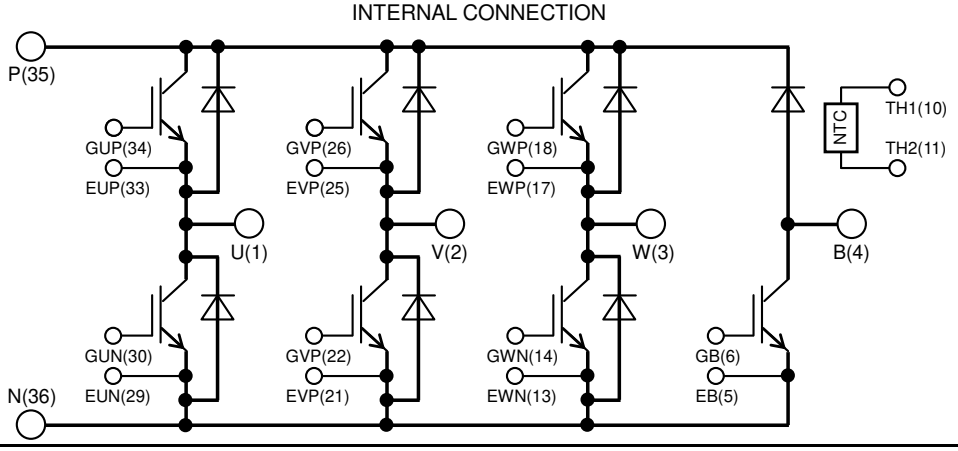
AC Motor Control, Motion/Servo Control, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



INTERNAL CONNECTION



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

※All dimensions with tolerance of ⊕ φ0.5

CM150RX-12A

HIGH POWER SWITCHING USE
INSULATED TYPE

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	600	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I_C	Collector current	DC, T_C=63 °C (Note2, 4)	150	A
I_{CRM}		Pulse, Repetitive (Note3)	300	
P_{tot}	Total power dissipation	T_C=25 °C (Note2, 4)	520	W
I_E (Note1)	Emitter current	DC (Note2)	150	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	300	

BRAKE PART IGBT/DIODE

Symbol	Item	Conditions	Rating	Unit
V_{CES}	Collector-emitter voltage	G-E short-circuited	600	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I_C	Collector current	DC, T_C=70 °C (Note2, 4)	75	A
I_{CRM}		Pulse, Repetitive (Note3)	150	
P_{tot}	Total power dissipation	T_C=25 °C (Note2, 4)	280	W
V_{RRM}	Repetitive peak reverse voltage	G-E short-circuited	600	V
I_F	Forward current	DC (Note2)	75	A
I_{FRM}		Pulse, Repetitive (Note3)	150	

MODULE

Symbol	Item	Conditions	Rating	Unit
V_{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T_j	Junction temperature	-	-40 ~ +150	°C
T_{stg}	Storage temperature	-	-40 ~ +125	
T_{Cmax}	Maximum case temperature	(Note4)	125	°C

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=15 mA, V_{CE}=10 V		5	6	7	V
V_{CEsat}	Collector-emitter saturation voltage	I_C=150 A, V_{GE}=15 V (Note5)	T_j=25 °C	-	1.7	2.1	V
		Refer to the figure of test circuit	T_j=125 °C	-	1.9	-	
		I_C=150 A, V_{GE}=15 V, chip (Note5)		-	1.6	-	
C_{ies}	Input capacitance	V_{CE}=10 V, G-E short-circuited		-	-	18	nF
C_{oes}	Output capacitance			-	-	2.0	
C_{res}	Reverse transfer capacitance			-	-	0.6	
Q_G	Gate charge	V_{CC}=300 V, I_C=150 A, V_{GE}=15 V		-	400	-	nC
$t_{d(on)}$	Turn-on delay time	V_{CC}=300 V, I_C=150 A, V_{GE}=±15 V, R_G=6.2 Ω, Inductive load		-	-	120	ns
t_r	Rise time			-	-	100	
$t_{d(off)}$	Turn-off delay time			-	-	350	
t_f	Fall time			-	-	600	
r_g	Internal gate resistance	Per switch		-	0	-	Ω

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

INVERTER PART IGBT/DIODE

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
V_{EC} (Note1)	Emitter-collector voltage	I_E=150 A, G-E short-circuited (Note5)	T_j=25 °C	-	2.0	2.8	V
		Refer to the figure of test circuit	T_j=125 °C	-	1.95	-	
		I_E=150 A, G-E short-circuited, chip (Note5)		-	1.9	-	
t_{rr} (Note1)	Reverse recovery time	V_{CC}=300 V, I_E=150 A, V_{GE}=±15 V,		-	-	200	ns
Q_{rr} (Note1)	Reverse recovery charge	R_G=6.2 Ω, Inductive load		-	5.0	-	µC
E_{on}	Turn-on switching energy per pulse	V_{CC}=300 V, I_C=I_E=150 A,		-	3.2	-	mJ
E_{off}	Turn-off switching energy per pulse	V_{GE}=±15 V, R_G=6.2 Ω, T_j=125 °C,		-	7.4	-	
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load		-	1.47	-	mJ

BRAKE 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=7.5 mA, V_{CE}=10 V		5	6	7	V
V_{CEsat}	Collector-emitter saturation voltage	I_C=75 A, V_{GE}=15 V (Note5)	T_j=25 °C	-	1.7	2.1	V
		Refer to the figure of test circuit	T_j=125 °C	-	1.9	-	
		I_C=75 A, V_{GE}=15 V, chip (Note5)		-	1.6	-	
C_{ies}	Input capacitance	V_{CE}=10 V, G-E short-circuited		-	-	9.3	nF
C_{oes}	Output capacitance			-	-	1.0	
C_{res}	Reverse transfer capacitance			-	-	0.3	
Q_G	Gate charge	V_{CC}=300 V, I_C=75 A, V_{GE}=15 V		-	200	-	nC
I_{RRM}	Repetitive peak reverse current	V_R=V_{RRM}, G-E short-circuited		-	-	1.0	mA
V_F	Forward voltage	I_F=75 A, G-E short-circuited (Note5)	T_j=25 °C	-	2.0	2.8	V
		Refer to the figure of test circuit	T_j=125 °C	-	1.95	-	
		I_F=75 A, G-E short-circuited, chip (Note5)		-	1.9	-	
r_g	Internal gate resistance	-		-	0	-	Ω

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

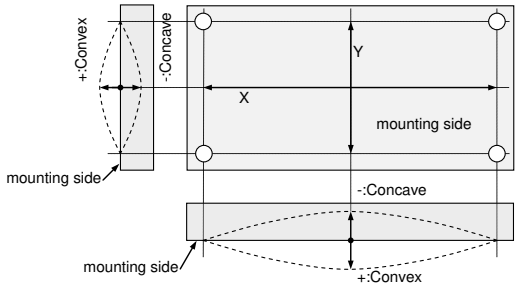
THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	0.24	K/W
$R_{th(j-c)D}$		Junction to case, per Inverter DIODE (Note4)	-	-	0.46	
$R_{th(j-c)Q}$		Junction to case, Brake IGBT (Note4)	-	-	0.44	K/W
$R_{th(j-c)D}$		Junction to case, Brake DIODE (Note4)	-	-	0.85	
$R_{th(c-s)}$	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 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		10.28	-	-	mm
		Terminal to base plate		12.46	-	-	
d_a	Clearance	Terminal to terminal		9.88	-	-	mm
		Terminal to base plate		10.12	-	-	
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.



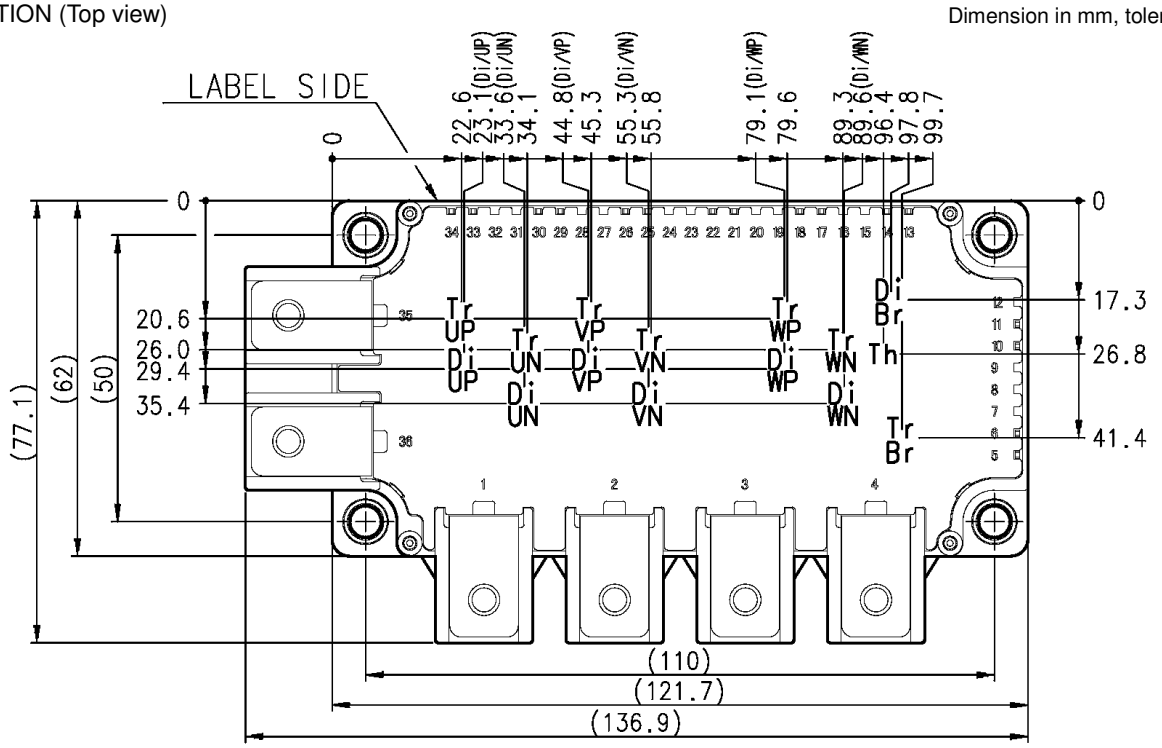
9. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.
   "φ2.3×10 or φ2.3×12, B1 tapping screw"
   The length of the screw depends on the thickness (t1.6~t2.0) of the PCB.

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across P-N terminals		-	300	400	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across GB-EB / G*P-E*P / G*N-E*N (*=U, V, W) terminals		13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	Inverter IGBT	4.1	-	41	Ω
			Brake IGBT	8.0	-	83	

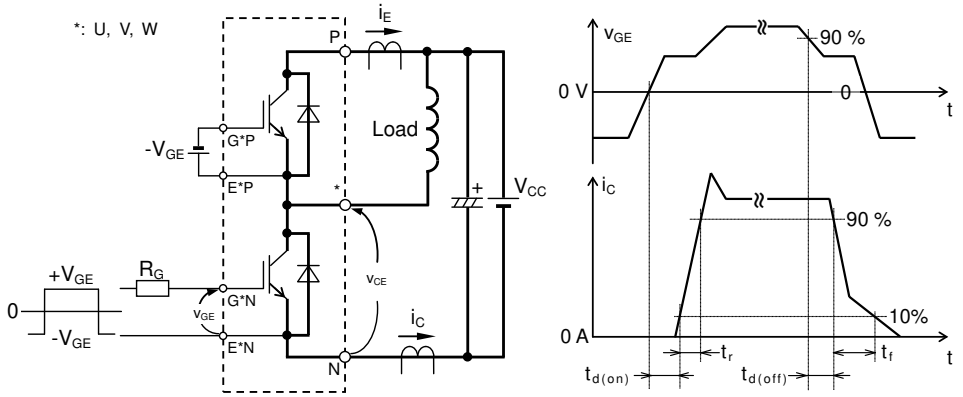
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm

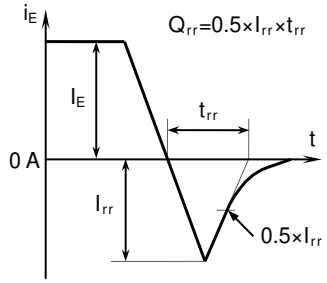


Tr*P/Tr*N/TrBr: IGBT, Di*P/Di*N: DIODE (*=U/V/W), DiBr: BRAKE DIODE, Th: NTC thermistor

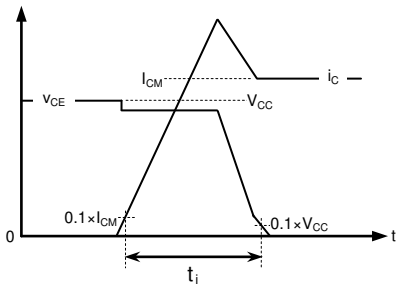
TEST CIRCUIT AND WAVEFORMS



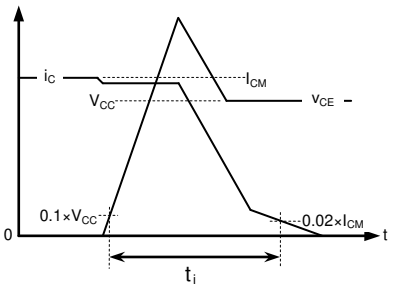
Switching test circuit and waveforms (ex. lower arm switching)



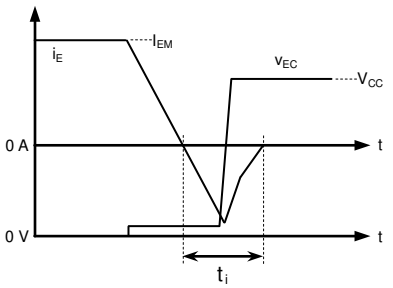
t_{rr}, Q_{rr} test waveform



IGBT Turn-on switching energy



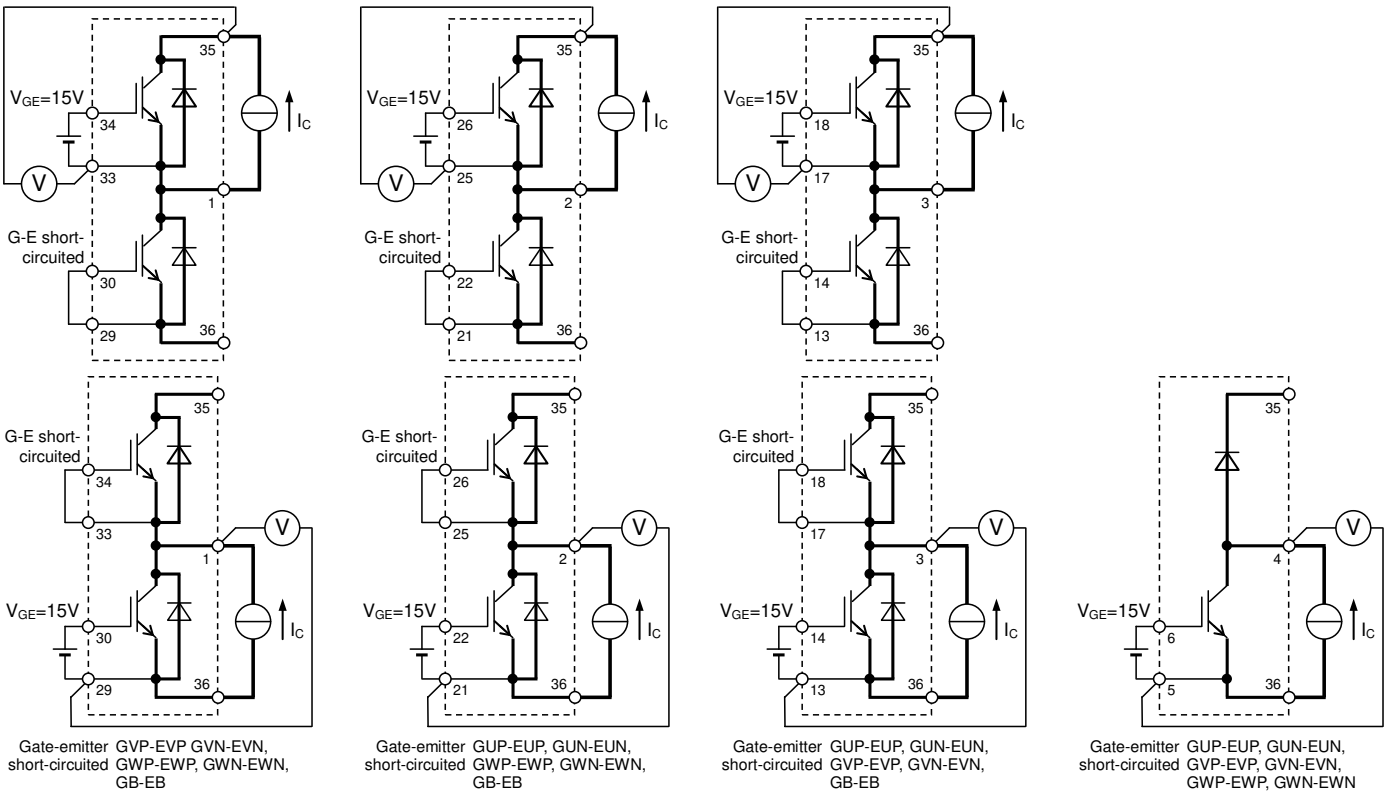
IGBT Turn-off switching energy



DIODE Reverse recovery energy

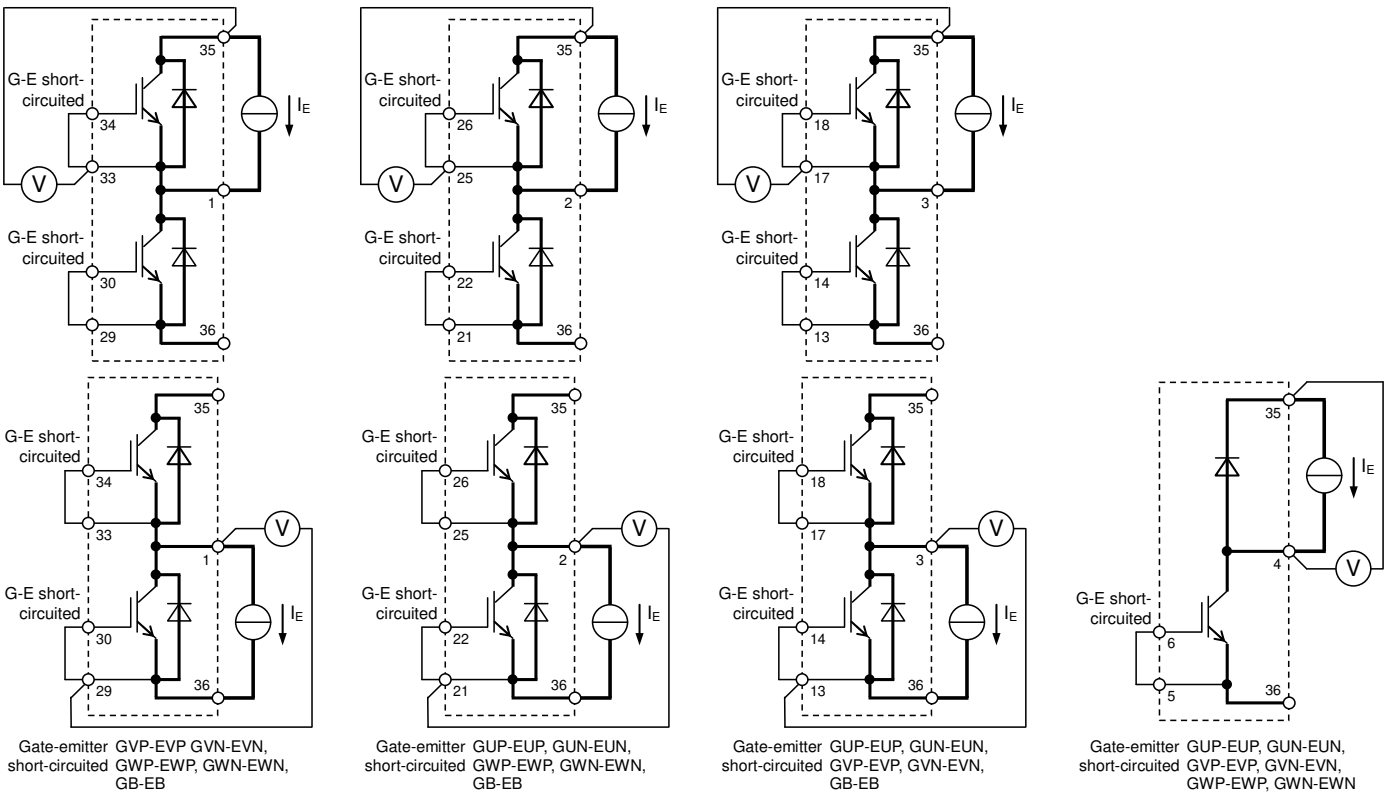
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT



UP / UN IGBT | VP / VN IGBT | WP / WN IGBT | Brake IGBT

V_{CEsat} characteristics test circuit



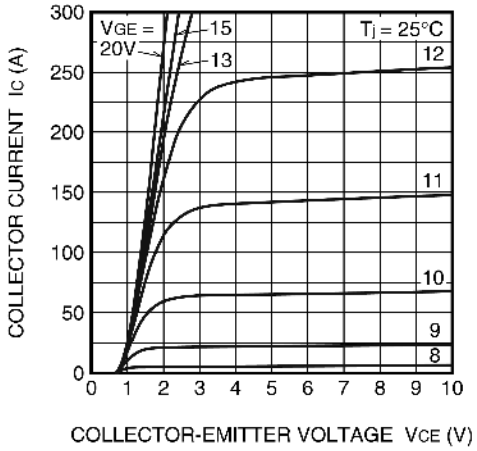
UP / UN DIODE | VP / VN DIODE | WP / WN DIODE | Brake DIODE

V_{EC} / Brake diode V_F characteristics test circuit

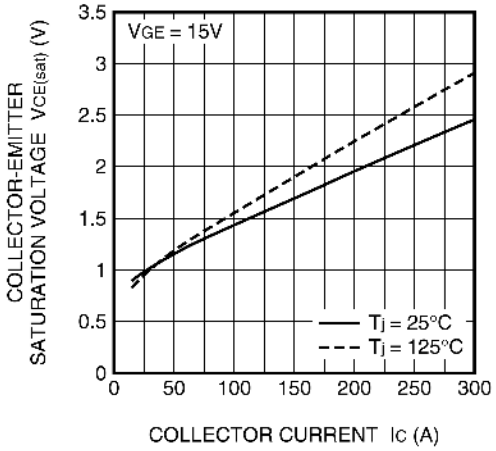
PERFORMANCE CURVES

INVERTER PART

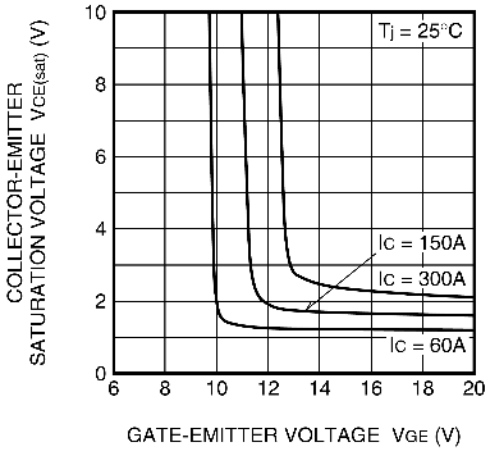
OUTPUT CHARACTERISTICS (TYPICAL) Inverter part



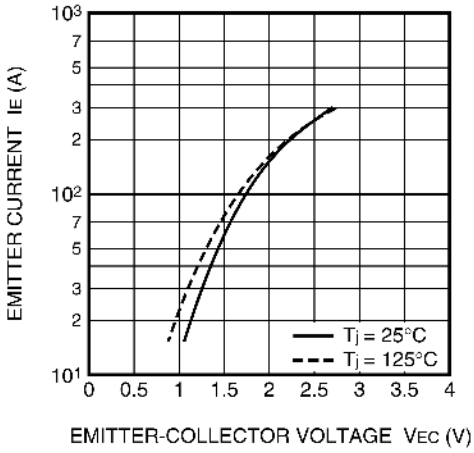
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL) Inverter part



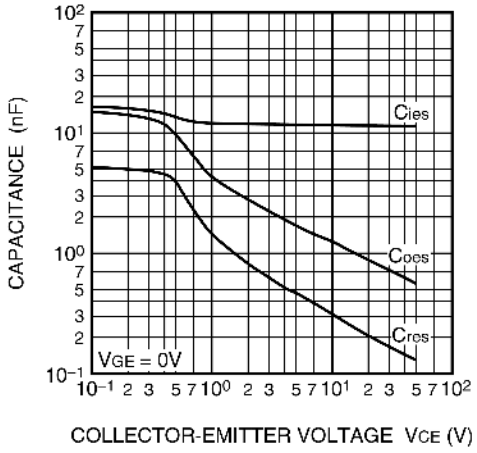
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL) Inverter part



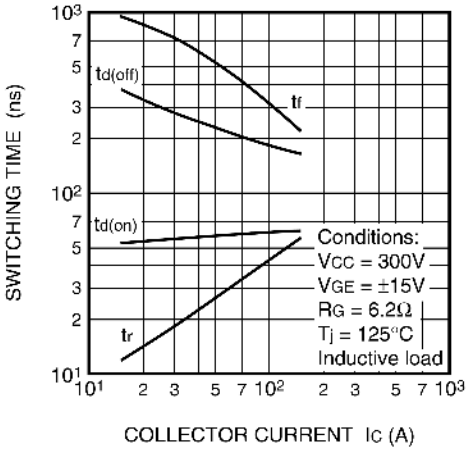
FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL) Inverter part



CAPACITANCE CHARACTERISTICS (TYPICAL) Inverter part



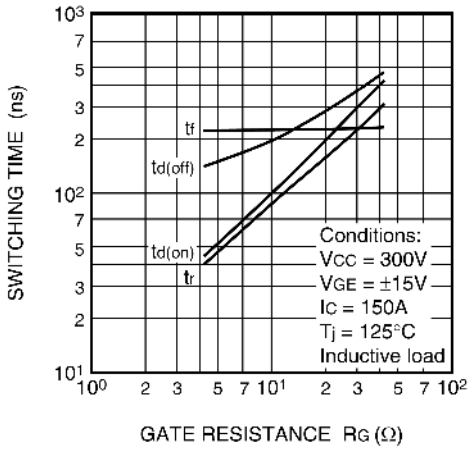
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



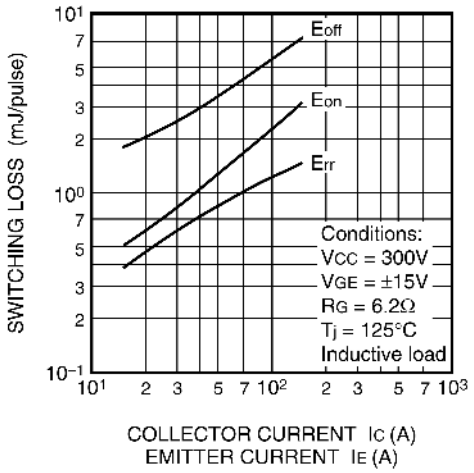
PERFORMANCE CURVES

INVERTER PART

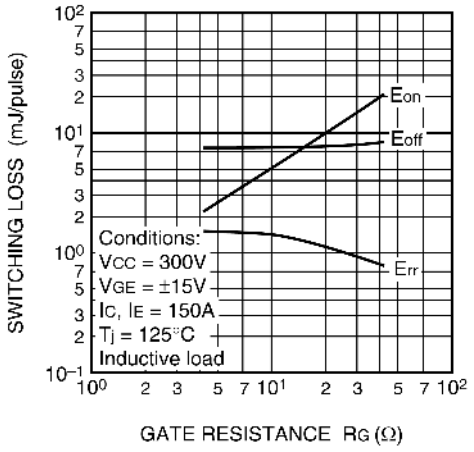
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



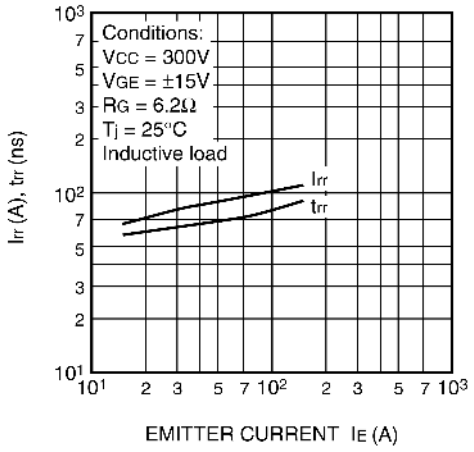
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



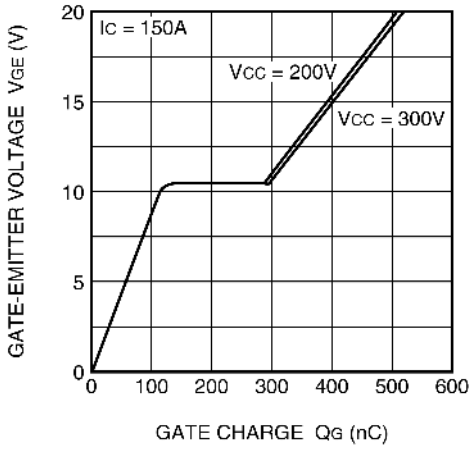
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL) Inverter part



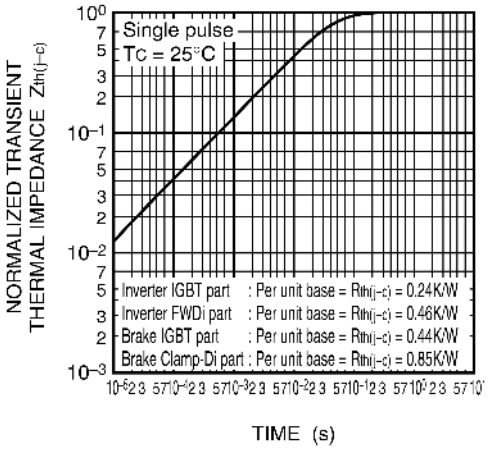
REVERSE RECOVERY CHARACTERISTICS OF FREE WHEELING DIODE (TYPICAL) Inverter part



GATE CHARGE CHARACTERISTICS (TYPICAL) Inverter part



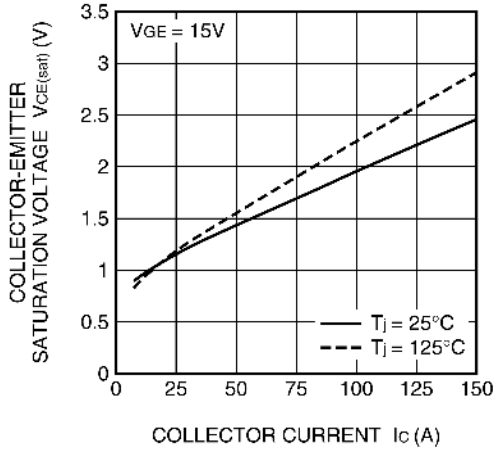
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



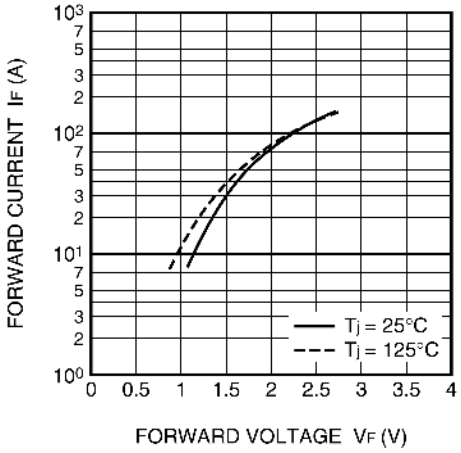
PERFORMANCE CURVES

BRAKE PART

COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL) Brake part

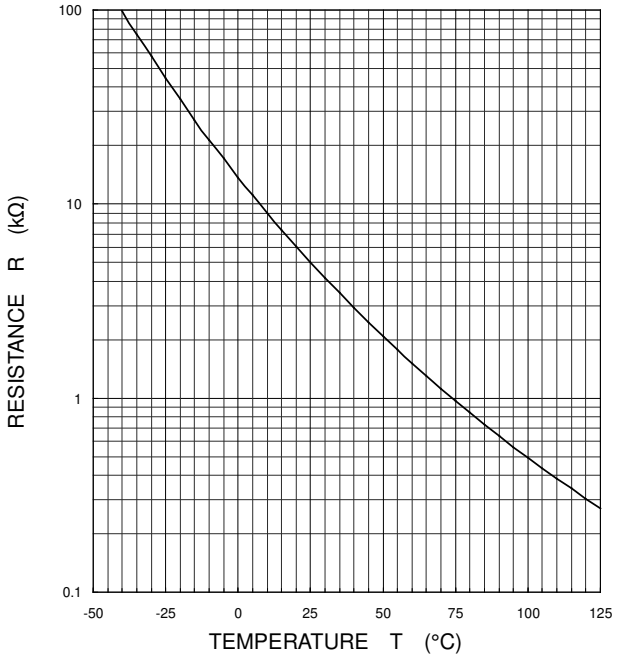


CLAMP DIODE FORWARD CHARACTERISTICS (TYPICAL) Brake part



NTC thermistor part

TEMPERATURE CHARACTERISTICS (TYPICAL)



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