

< IGBT MODULES >

CM150RX-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



sevenpack (3φ Inverter+Chopper Brake)

Collector current I_C **1 5 0 A**
 Collector-emitter voltage V_{CES} **1 2 0 0 V**
 Maximum junction temperature T_{jmax} **1 7 5 °C**

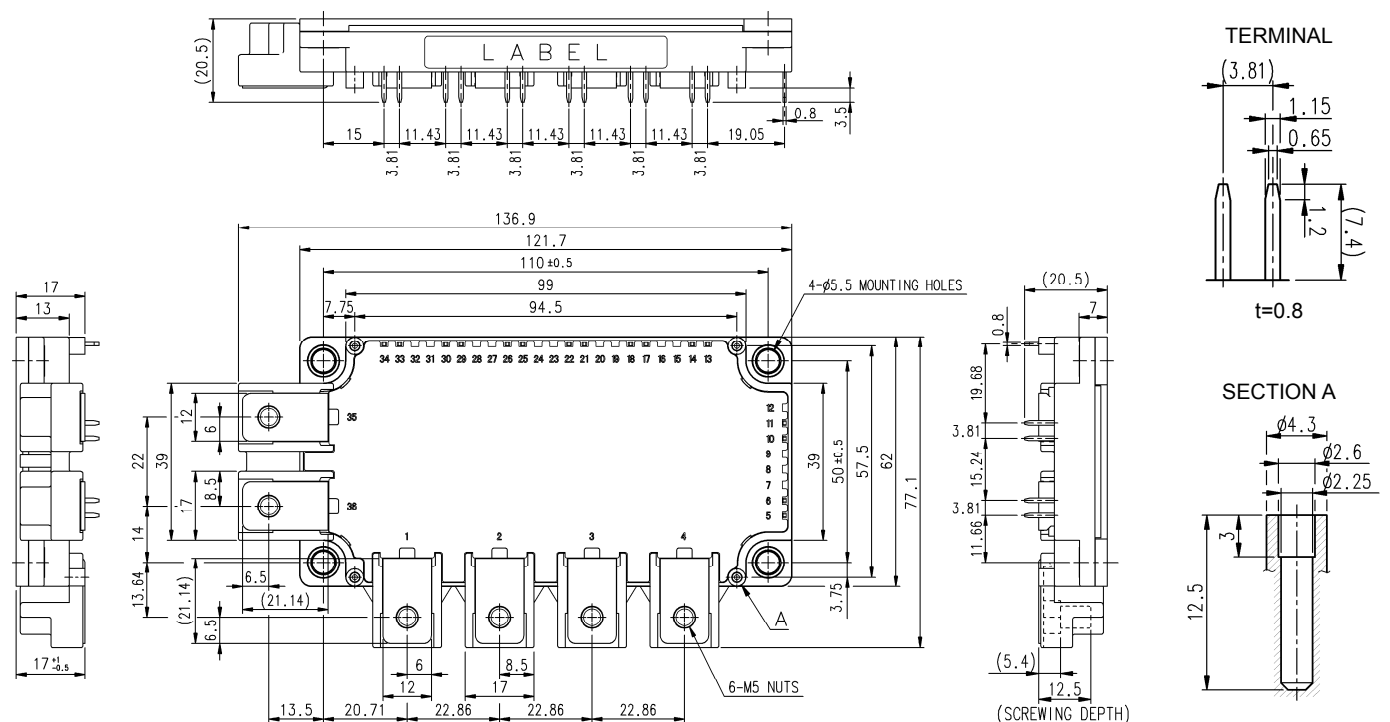
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- Recognized under UL1557, File E323585

APPLICATION

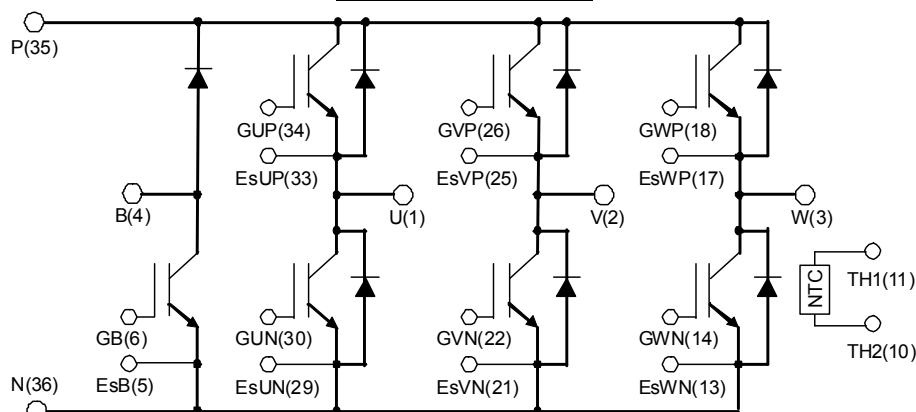
AC Motor Control, Motion/Servo Control, Power supply, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



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

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

< IGBT MODULES >

CM150RX-24S

HIGH POWER SWITCHING USE
INSULATED TYPEABSOLUTE MAXIMUM RATINGS ($T_J=25\text{ }^{\circ}\text{C}$, 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, $T_C=120\text{ }^{\circ}\text{C}$ (Note2, 4)	150	A
I_{CRM}		Pulse, Repetitive (Note3)	300	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	1150	W
I_E (Note1)	Emitter current	(Note2)	150	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	300	

BRAKE PART IGBT/CLAMPDi

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, $T_C=122\text{ }^{\circ}\text{C}$ (Note2, 4)	75	A
I_{CRM}		Pulse, Repetitive (Note3)	150	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note2, 4)	600	W
V_{RRM}	Repetitive peak reverse voltage	G-E short-circuited	1200	V
I_F	Forward current	(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_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^{\circ}\text{C}$
T_{Cmax}	Maximum case temperature	(Note4)	125	$^{\circ}\text{C}$
T_{jop}	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	$^{\circ}\text{C}$
T_{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS ($T_J=25\text{ }^{\circ}\text{C}$, 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	-	-	1.0	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	$I_C=15\text{ mA}$, $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V
V_{CESat}	Collector-emitter saturation voltage	$I_C=150\text{ A}$ (Note5), $V_{GE}=15\text{ V}$, (Terminal)	$T_J=25\text{ }^{\circ}\text{C}$	1.80	2.25	V
			$T_J=125\text{ }^{\circ}\text{C}$	2.00	-	
			$T_J=150\text{ }^{\circ}\text{C}$	2.05	-	
		$I_C=150\text{ A}$ (Note5), $V_{GE}=15\text{ V}$, (Chip)	$T_J=25\text{ }^{\circ}\text{C}$	1.70	2.15	V
			$T_J=125\text{ }^{\circ}\text{C}$	1.90	-	
			$T_J=150\text{ }^{\circ}\text{C}$	1.95	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	15	nF
C_{oes}	Output capacitance		-	-	3.0	
C_{res}	Reverse transfer capacitance		-	-	0.25	
Q_G	Gate charge	$V_{CC}=600\text{ V}$, $I_C=150\text{ A}$, $V_{GE}=15\text{ V}$	-	350	-	nC
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=150\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, Inductive load	-	-	800	ns
t_r	Rise time		-	-	200	
$t_{d(off)}$	Turn-off delay time		-	-	600	
t_f	Fall time		-	-	300	

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CM150RX-24S

HIGH POWER SWITCHING USE
INSULATED TYPEELECTRICAL CHARACTERISTICS (cont; $T_J=25\text{ }^{\circ}\text{C}$, unless otherwise specified)

INVERTER PART IGBT/FWDi

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
V_{EC} ^(Note1)	Emitter-collector voltage	$I_E=150\text{ A}$ ^(Note5) , G-E short-circuited, (Terminal)	$T_J=25\text{ }^{\circ}\text{C}$	-	1.80	2.25	V
			$T_J=125\text{ }^{\circ}\text{C}$	-	1.80	-	
			$T_J=150\text{ }^{\circ}\text{C}$	-	1.80	-	
		$I_E=150\text{ A}$ ^(Note5) , G-E short-circuited, (Chip)	$T_J=25\text{ }^{\circ}\text{C}$	-	1.70	2.15	V
			$T_J=125\text{ }^{\circ}\text{C}$	-	1.70	-	
			$T_J=150\text{ }^{\circ}\text{C}$	-	1.70	-	
t_{rr} ^(Note1)	Reverse recovery time	$V_{CC}=600\text{ V}$, $I_E=150\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, Inductive load		-	-	300	ns
Q_{rr} ^(Note1)	Reverse recovery charge			-	8.0	-	μC
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=150\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, $T_J=150\text{ }^{\circ}\text{C}$, Inductive load		-	24.2	-	mJ
E_{off}	Turn-off switching energy per pulse			-	16	-	
E_{rr} ^(Note1)	Reverse recovery energy per pulse			-	12.2	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^{\circ}\text{C}$ ^(Note4)		-	-	1.8	m Ω
r_g	Internal gate resistance	Per switch		-	13	-	Ω

BRAKE PART IGBT/CLAMPDi

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 =7.5 mA, V _{CE} =10 V		5.4	6.0	6.6	V
V _{CESat}	Collector-emitter saturation voltage	I _C =75 A (Note5), 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 =75 A (Note5), 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		-	-	7.5	nF
C _{oes}	Output capacitance			-	-	1.5	
C _{res}	Reverse transfer capacitance			-	-	0.13	
Q _G	Gate charge	V _{CC} =600 V, I _C =75 A, V _{GE} =15 V		-	175	-	nC
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =75 A, V _{GE} =±15 V, R _G =8.2 Ω, Inductive load		-	-	300	ns
t _r	Rise time			-	-	200	
t _{d(off)}	Turn-off delay time			-	-	600	
t _f	Fall time			-	-	300	
I _{RRM}	Repetitive peak reverse current	V _R =V _{RRM} , G-E short-circuited		-	-	1	mA
V _F	Forward voltage	I _E =75 A (Note5), G-E short-circuited, (Terminal)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	1.80	-	
			T _J =150 °C	-	1.80	-	
		I _E =75 A (Note5), 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}	Reverse recovery time	V _{CC} =600 V, I _E =75 A, V _{GE} =±15 V, R _G =8.2 Ω, Inductive load		-	-	300	ns
Q _{rr}	Reverse recovery charge			-	4.0	-	μC
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =75 A,		-	7.3	-	mJ
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =8.2 Ω, T _J =150 °C,		-	8.0	-	
E _{rr}	Reverse recovery energy per pulse	Inductive load		-	6.9	-	mJ
r _g	Internal gate resistance	-		-	0	-	Ω

ELECTRICAL CHARACTERISTICS (cont; $T_J=25\text{ }^{\circ}\text{C}$, unless otherwise specified)

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	$T_C=25\text{ }^{\circ}\text{C}$ (Note4)	4.85	5.00	5.15	k Ω
$\Delta R/R$	Deviation of resistance	$R_{100}=493\text{ }\Omega$, $T_C=100\text{ }^{\circ}\text{C}$ (Note4)	-7.3	-	+7.8	%
$B_{(25/50)}$	B-constant	Approximate by equation (Note7)	-	3375	-	K
P_{25}	Power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note4)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note4)	Junction to case, per Inverter IGBT	-	-	0.13	K/W
$R_{th(j-c)D}$		Junction to case, per Inverter FWDi	-	-	0.23	
$R_{th(j-c)Q}$		Junction to case, per Brake IGBT	-	-	0.25	K/W
$R_{th(j-c)D}$		Junction to case, per Brake ClampDi	-	-	0.40	
$R_{th(c-s)}$	Contact thermal resistance (Note4)	Case to heat sink, per 1 module, Thermal grease applied (Note7)	-	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	10.25	-	-	mm
		Terminal to base plate	12.32	-	-	
d_a	Clearance	Terminal to terminal	10.28	-	-	mm
		Terminal to base plate	10.85	-	-	
m	Weight	-	-	370	-	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 (FWDi).

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.

Refer to the figure of test circuit.

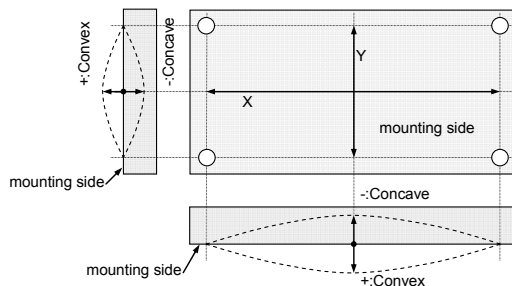
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right),$$

R_{25} : resistance at absolute temperature T_{25} [K]; $T_{25}=25\text{ }^{\circ}\text{C}+273.15=298.15$ [K]

R_{50} : resistance at absolute temperature T_{50} [K]; $T_{50}=50\text{ }^{\circ}\text{C}+273.15=323.15$ [K]

7. Typical value is measured by using thermally conductive grease of $\lambda=0.9\text{ W/(m}\cdot\text{K)}$.

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.

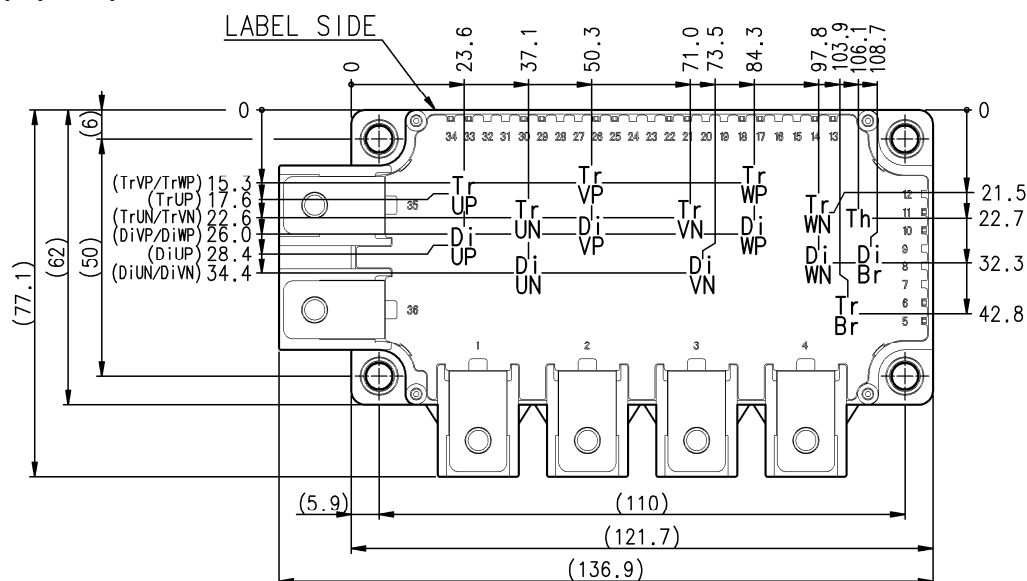
"ST2.6×10 or ST2.6×12 self tapping screw"

The length of the screw depends on the thickness of the PCB.

RECOMMENDED OPERATING CONDITIONS

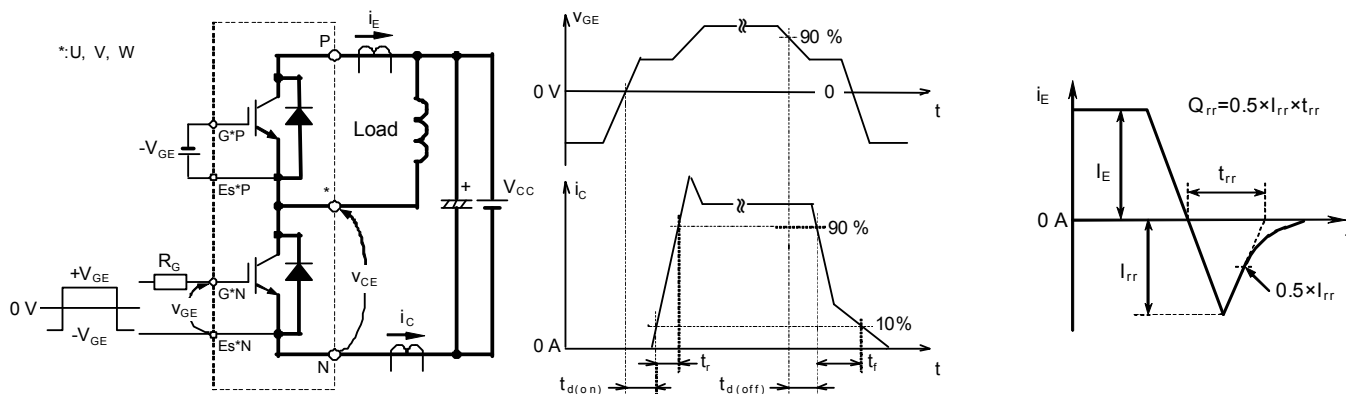
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across P-N terminals	-	600	850	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across GB-EsB/ G*P-Es*P/G*N-Es*N (*=U, V, W) terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	Inverter IGBT	0	-	Ω
			Brake IGBT	8.2	-	

CHIP LOCATION (Top view)

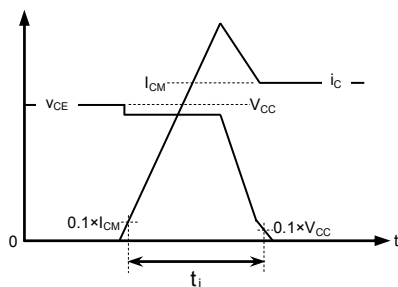
Dimension in mm, tolerance: ± 1 mm

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

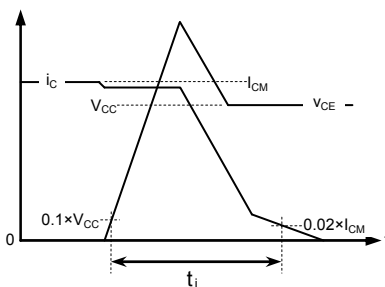
TEST CIRCUIT AND WAVEFORMS



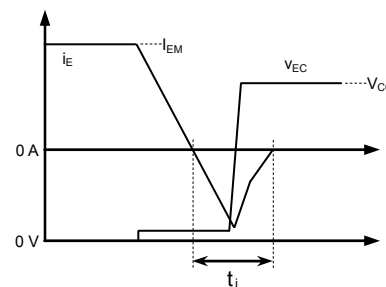
Switching characteristics test circuit and waveforms

 t_{rr} , Q_{rr} test waveform

IGBT Turn-on switching energy



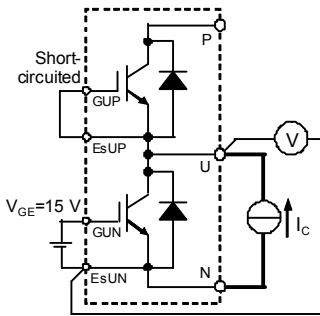
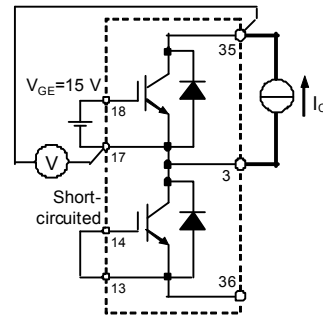
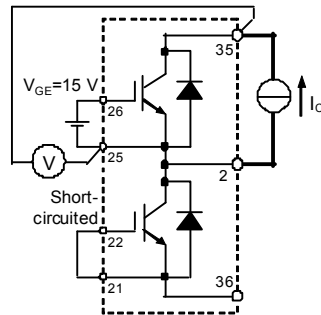
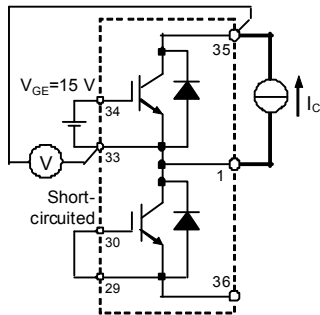
IGBT Turn-off switching energy



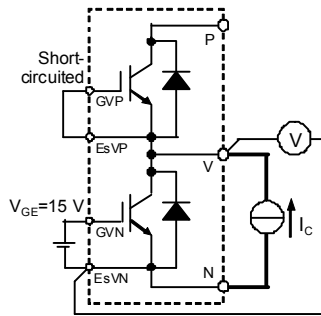
FWDi Reverse recovery energy

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

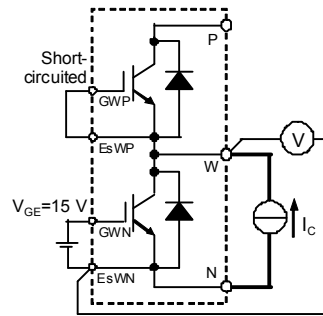
TEST CIRCUIT

Gate-emitter GVP-EsVP GVN-EsVN,
short-circuited GWP-EsWP, GWN-EsWN,
GB-EsB

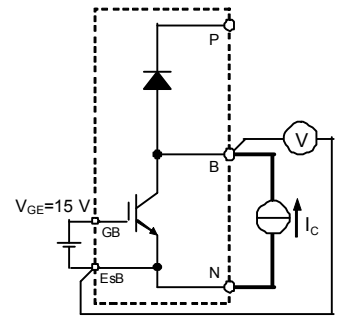
UP / UN IGBT

Gate-emitter GUP-EsUP GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN,
GB-EsB

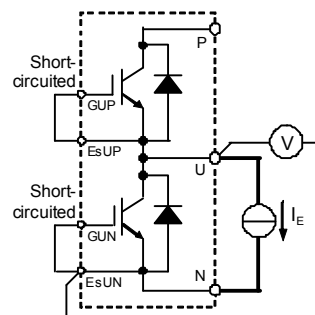
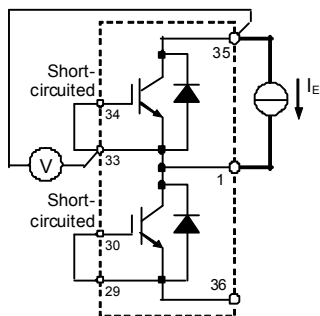
VP / VN IGBT

Gate-emitter GUP-EsUP GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN,
GB-EsB

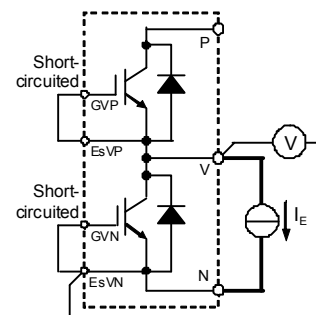
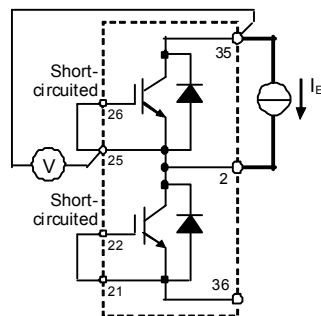
WP / WN IGBT

Gate-emitter GUP-EsUP, GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN,
GWP-EsWP, GWN-EsWN

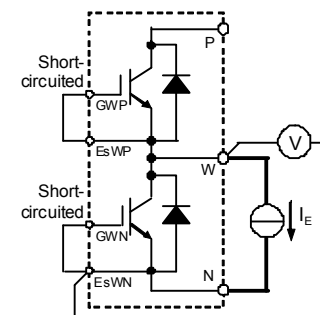
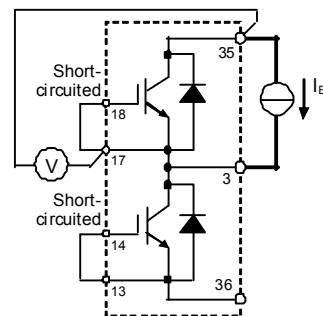
Brake IGBT

 V_{CEsat} test circuitGate-emitter GVP-EsVP GVN-EsVN,
short-circuited GWP-EsWP, GWN-EsWN,
GB-EsB

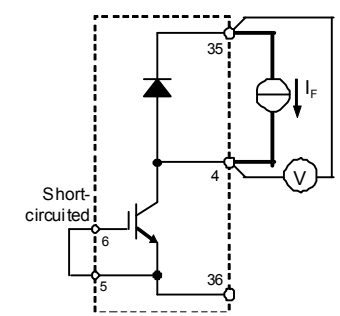
UP / UN FWDi

Gate-emitter GUP-EsUP GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN,
GB-EsB

VP / VN FWDi

Gate-emitter GUP-EsUP GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN,
GB-EsB

WP / WN FWDi

Gate-emitter GUP-EsUP, GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN,
GWP-EsWP, GWN-EsWN

Brake ClampDi

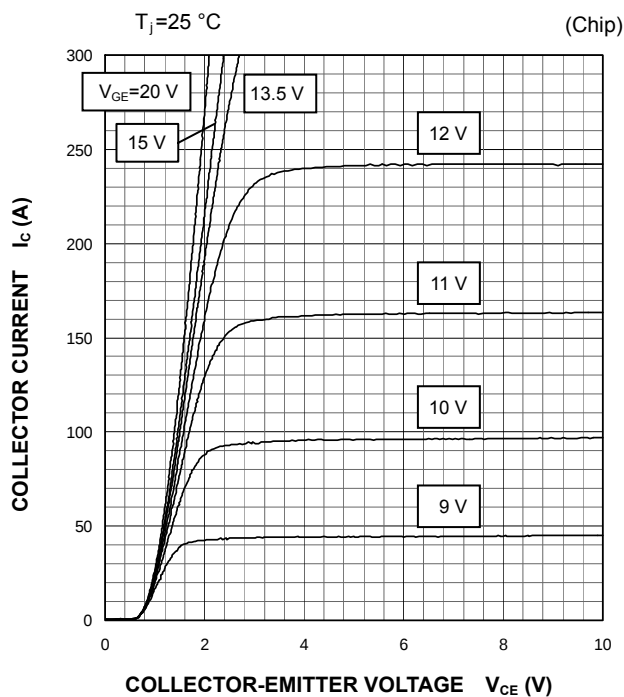
 V_{EC} / V_F test circuit

< IGBT MODULES >
CM150RX-24S
 HIGH POWER SWITCHING USE
 INSULATED TYPE

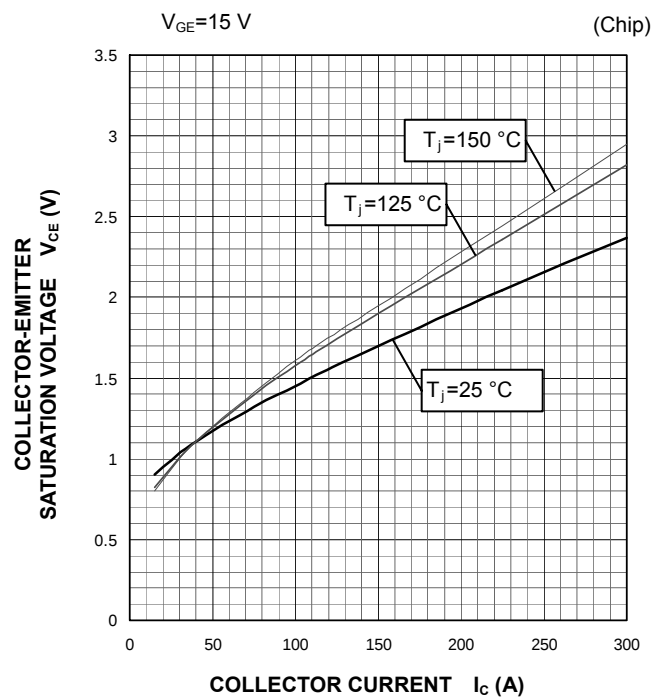
PERFORMANCE CURVES

INVERTER PART

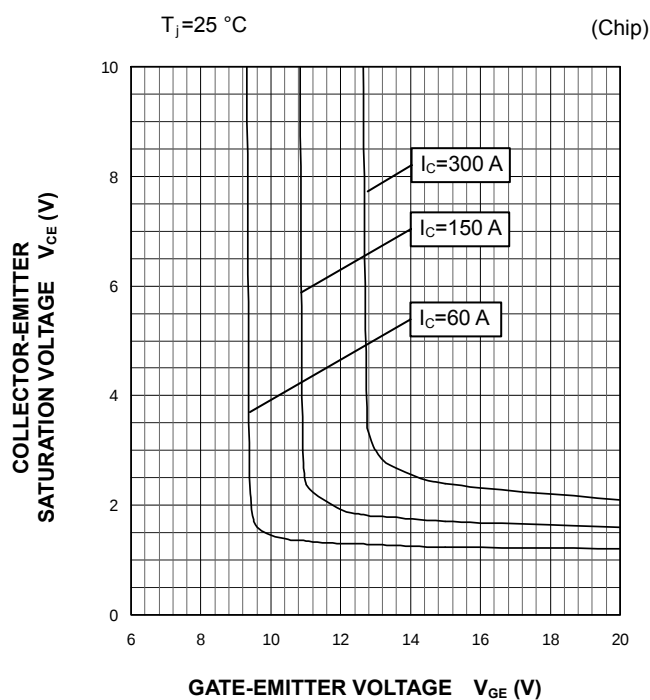
OUTPUT CHARACTERISTICS
(TYPICAL)



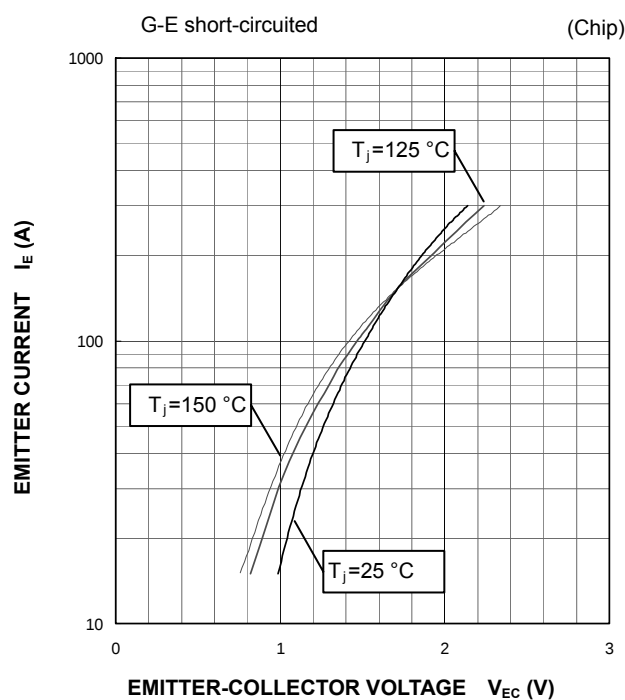
COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)

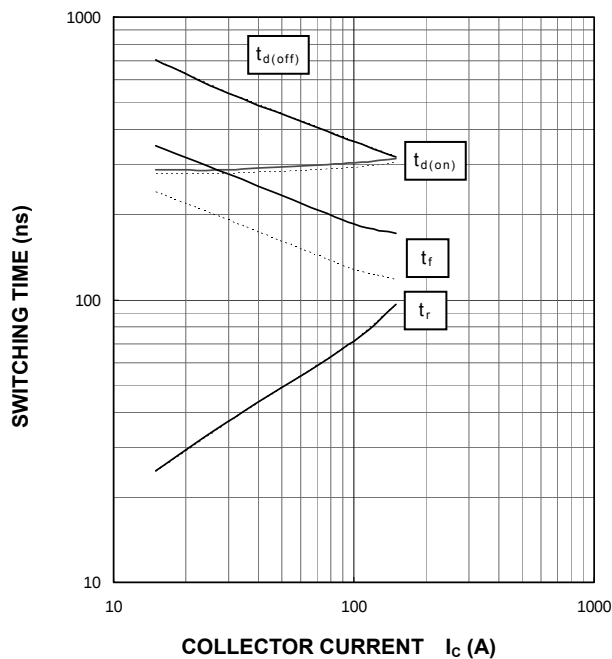


PERFORMANCE CURVES

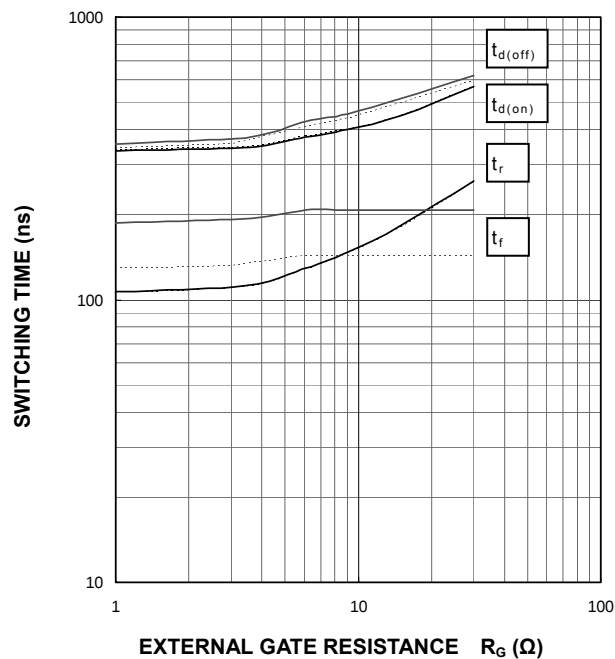
INVERTER PART

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

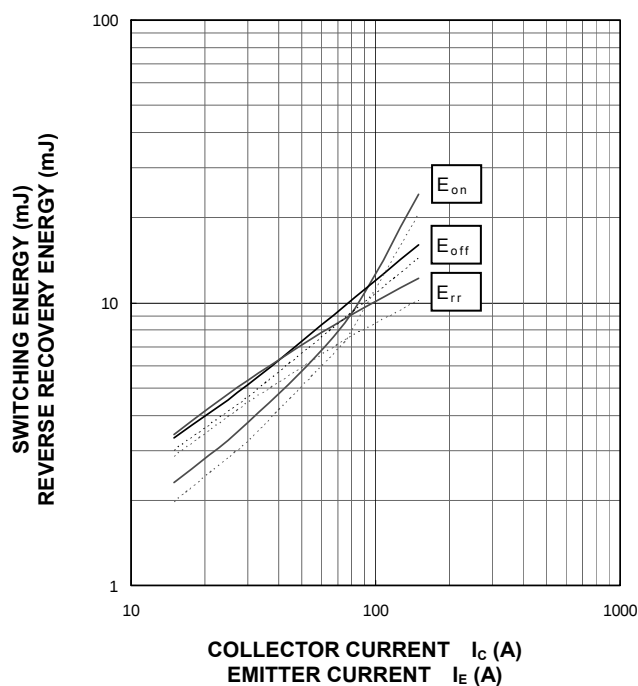
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
 —: $T_J=150\text{ }^\circ\text{C}$, - - - - -: $T_J=125\text{ }^\circ\text{C}$

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

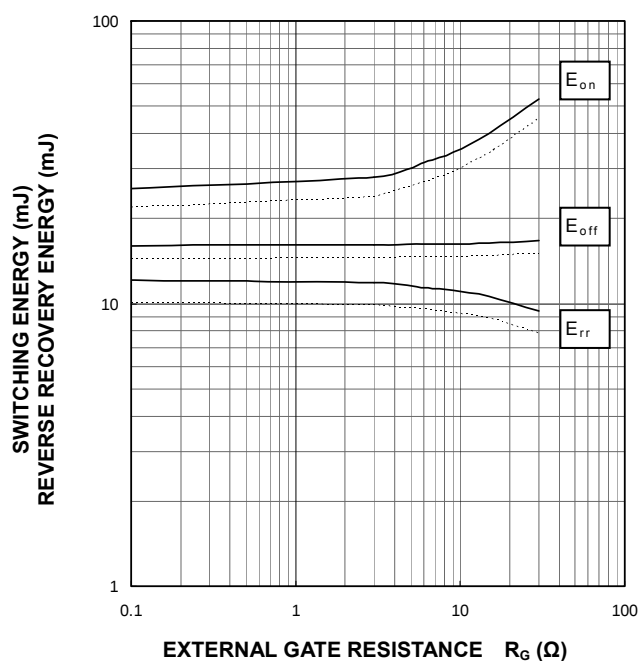
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=150\text{ A}$, INDUCTIVE LOAD
 —: $T_J=150\text{ }^\circ\text{C}$, - - - - -: $T_J=125\text{ }^\circ\text{C}$

HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$,
INDUCTIVE LOAD, PER PULSE
 —: $T_J=150\text{ }^\circ\text{C}$, - - - - -: $T_J=125\text{ }^\circ\text{C}$

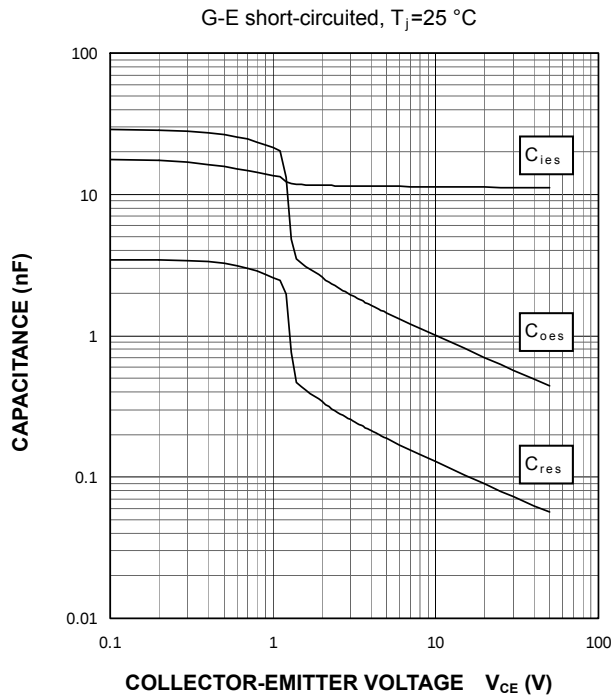
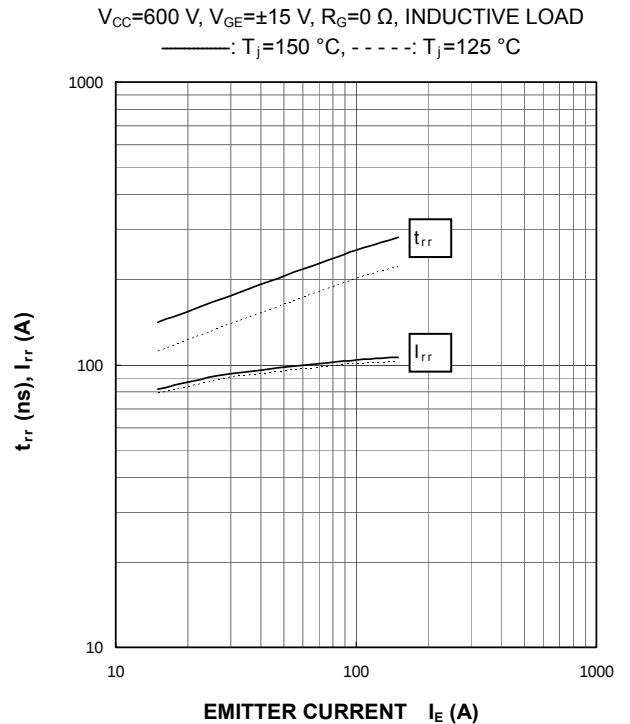
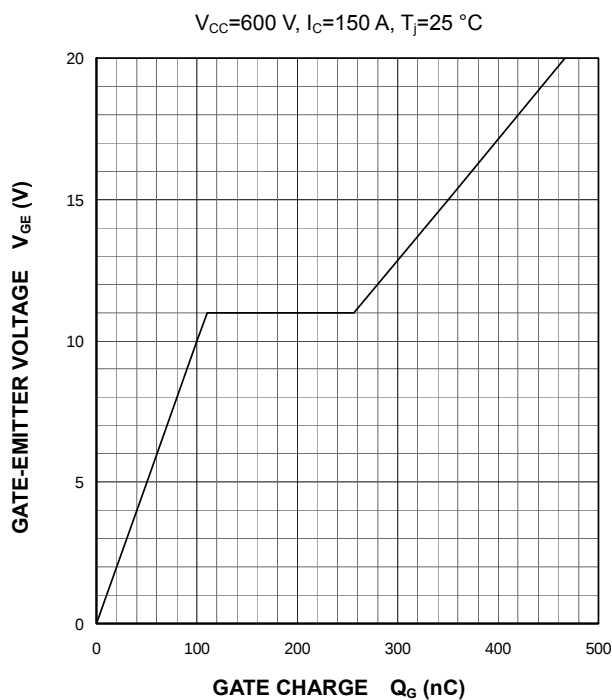
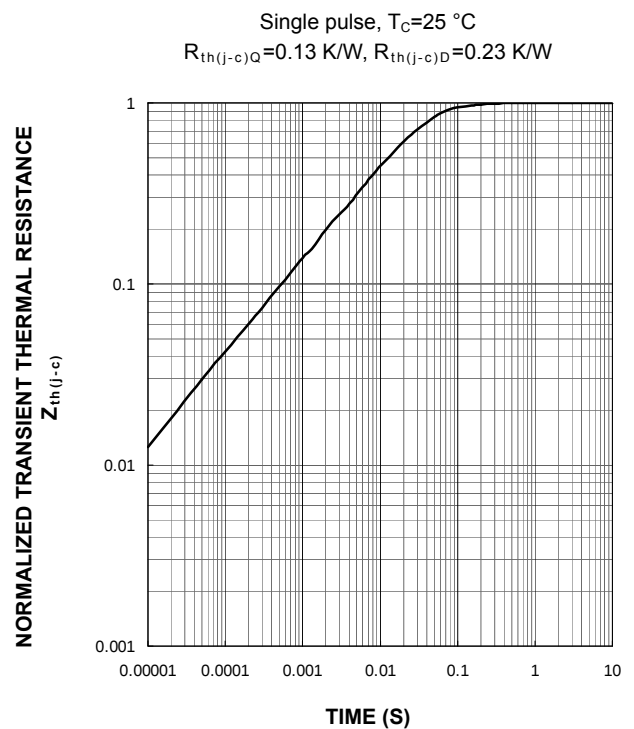
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C/I_E=150\text{ A}$,
INDUCTIVE LOAD, PER PULSE
 —: $T_J=150\text{ }^\circ\text{C}$, - - - - -: $T_J=125\text{ }^\circ\text{C}$



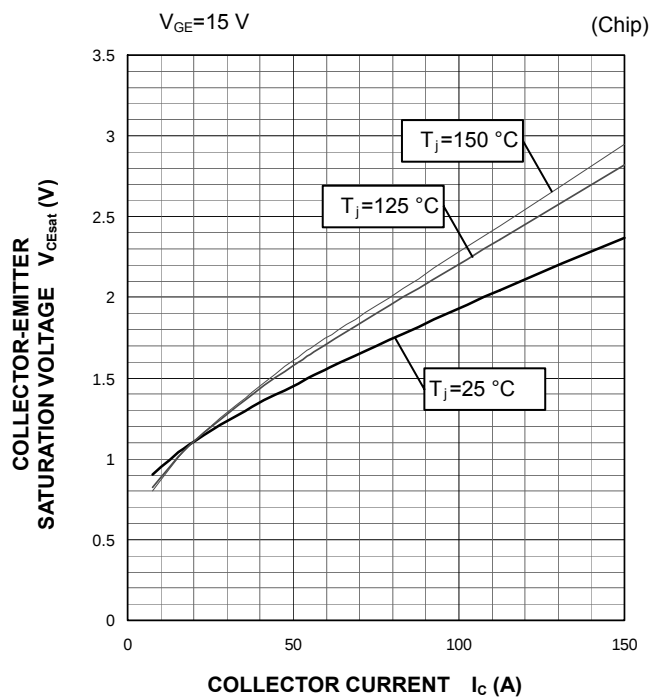
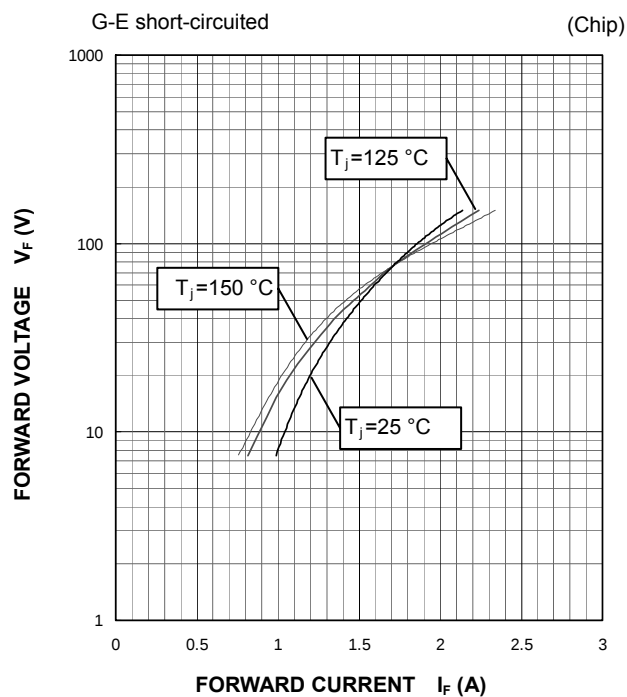
PERFORMANCE CURVES

INVERTER PART

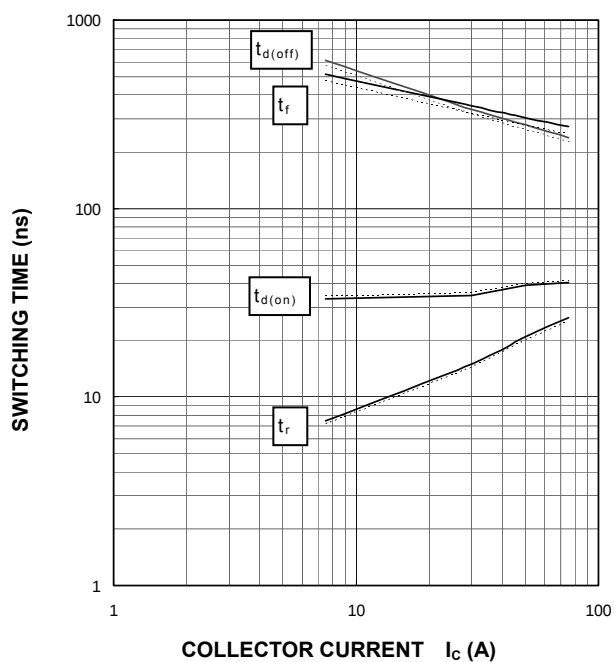
CAPACITANCE CHARACTERISTICS
(TYPICAL)FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)GATE CHARGE CHARACTERISTICS
(TYPICAL)TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

PERFORMANCE CURVES

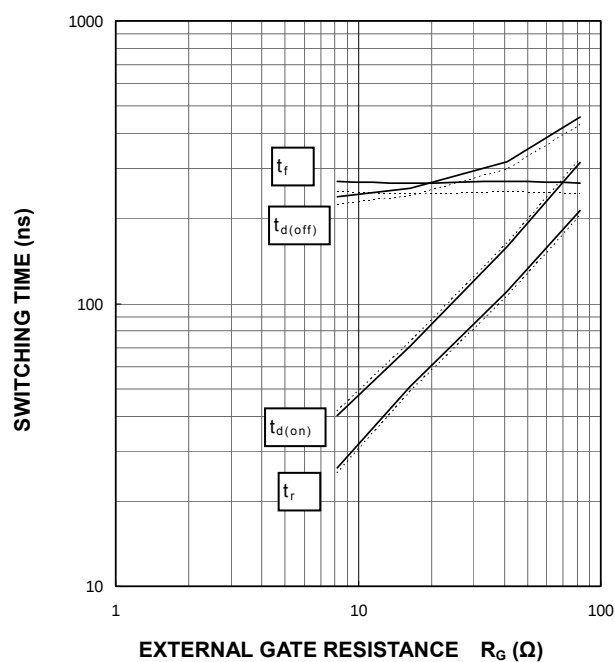
BRAKE PART

COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)CLAMP DIODE
FORWARD CHARACTERISTICS
(TYPICAL)HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=8.2\ \Omega$, INDUCTIVE LOAD
——: $T_j=150^\circ\text{C}$, - - - - : $T_j=125^\circ\text{C}$

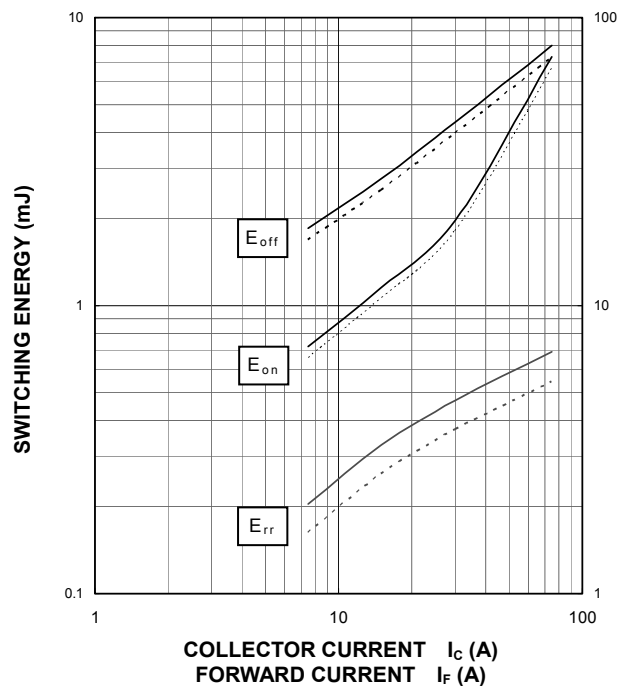
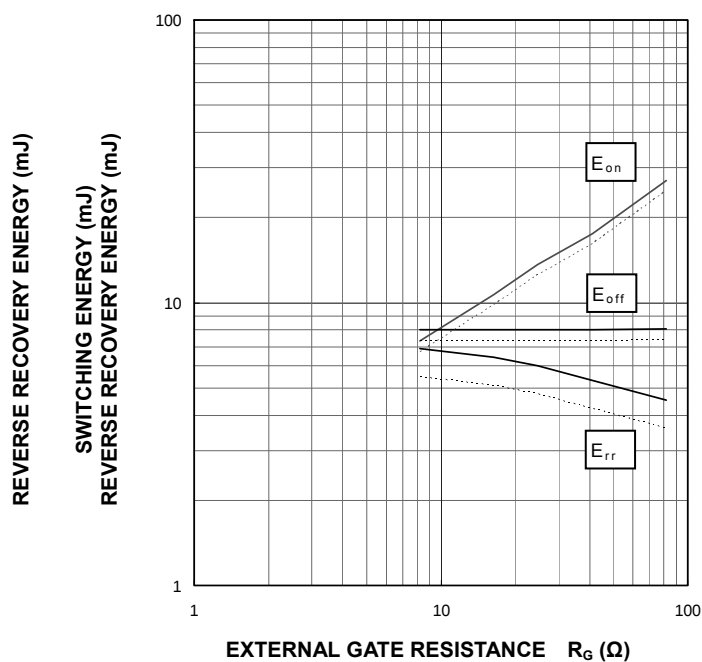
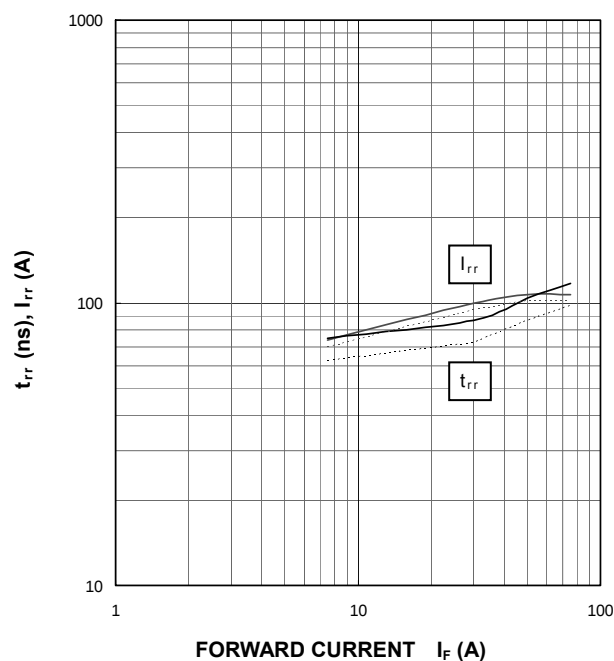
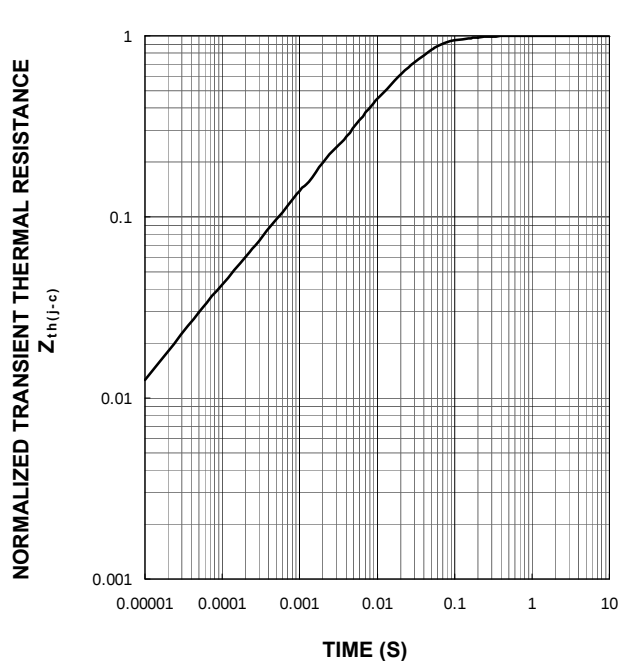
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

$V_{CC}=600\text{ V}$, $I_C=75\text{ A}$, $V_{GE}=\pm 15\text{ V}$, INDUCTIVE LOAD
——: $T_j=150^\circ\text{C}$, - - - - : $T_j=125^\circ\text{C}$



PERFORMANCE CURVES

BRAKE PART

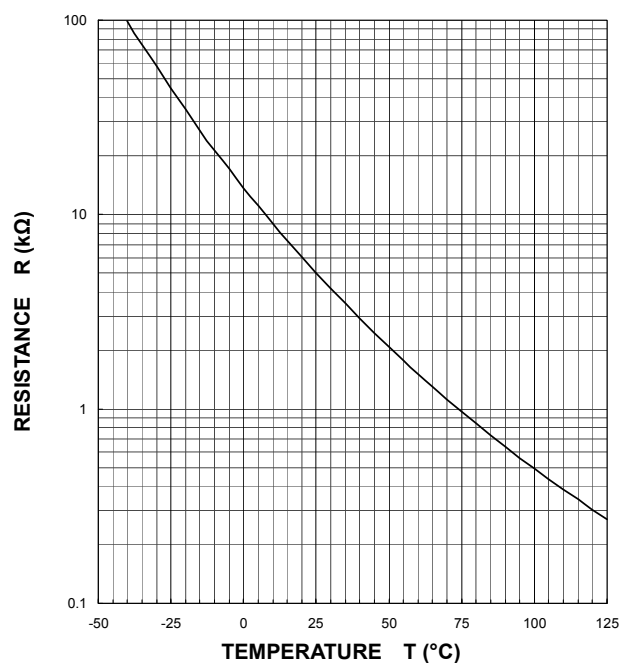
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=8.2\ \Omega$,
INDUCTIVE LOAD, PER PULSE—: $T_J=150\text{ }^\circ\text{C}$, - - - - : $T_J=125\text{ }^\circ\text{C}$ HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $I_C/I_F=75\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
INDUCTIVE LOAD, PER PULSE—: $T_J=150\text{ }^\circ\text{C}$, - - - - : $T_J=125\text{ }^\circ\text{C}$ CLAMP DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=8.2\ \Omega$, INDUCTIVE LOAD—: $T_J=150\text{ }^\circ\text{C}$, - - - - : $T_J=125\text{ }^\circ\text{C}$ TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)Single pulse, $T_C=25\text{ }^\circ\text{C}$ $R_{th(j-c)Q}=0.25\text{ K/W}$, $R_{th(j-c)D}=0.40\text{ K/W}$ 

< IGBT MODULES >
CM150RX-24S
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



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