

<IGBT Modules>

CM150TX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE



sixpack (3φ Inverter)

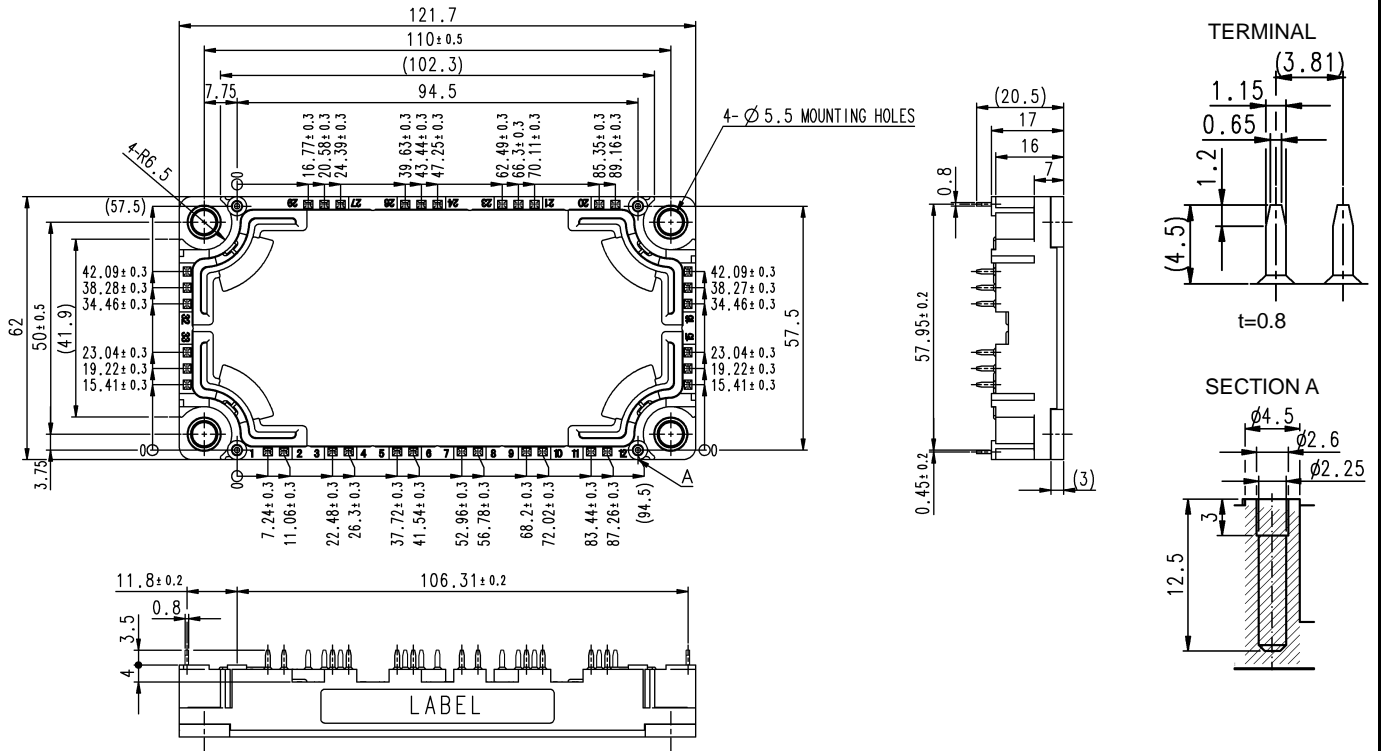
Collector current I_c 150 A
 Collector-emitter voltage V_{CES} 1200 V
 Maximum junction temperature T_{jmax} 175 °C

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

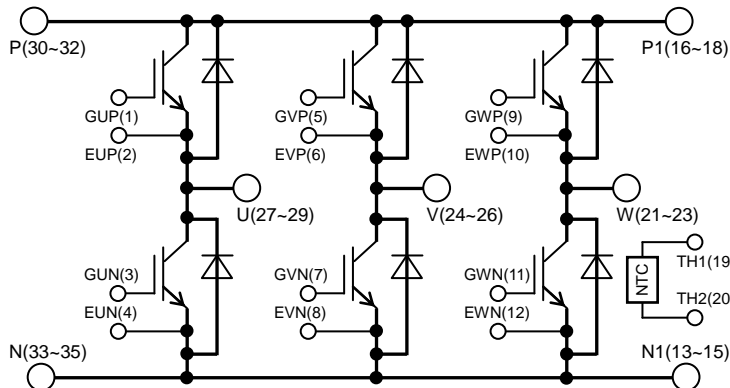
APPLICATION

AC Motor Control, Motion/Servo Control, etc.

OUTLINE DRAWING & INTERNAL CONNECTION



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

CM150TX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM RATINGS ($T_j=25\text{ }^\circ\text{C}$, 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, $T_C=107\text{ }^\circ\text{C}$ (Note2, 4)	150	A
I_{CRM}		Pulse, Repetitive (Note3)	300	
P_{tot}	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note2, 4)	935	W
I_E (Note1)	Emitter current	DC (Note2)	150	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	300	

MODULE

Symbol	Item	Conditions	Rating	Unit
V_{isol}	Isolation voltage	Terminals to base plate, RMS, $f=60\text{ Hz}$, AC 1 min	4000	V
T_{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	$^\circ\text{C}$
T_{Cmax}	Maximum case temperature	(Note4)	125	
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/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	$I_C=15\text{ mA}$, $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V		
V_{CESat} (Terminal)	Collector-emitter saturation voltage	$I_C=150\text{ A}$, $V_{GE}=15\text{ V}$, Refer to the figure of test circuit (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	1.80	2.25	V	
			$T_j=125\text{ }^\circ\text{C}$	-	2.00	-		
			$T_j=150\text{ }^\circ\text{C}$	-	2.05	-		
V_{CESat} (Chip)		Collector-emitter saturation voltage	$I_C=150\text{ A}$, $V_{GE}=15\text{ V}$, (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	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	$V_{CC}=600\text{ V}$, $I_C=150\text{ A}$, $V_{GE}=15\text{ V}$	-	315	-	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			
V_{EC} (Note1) (Terminal)	Emitter-collector voltage	$I_E=150\text{ A}$, G-E short-circuited, Refer to the figure of test circuit (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	2.60	3.40	V	
			$T_j=125\text{ }^\circ\text{C}$	-	2.16	-		
			$T_j=150\text{ }^\circ\text{C}$	-	2.10	-		
V_{EC} (Note1) (Chip)		Emitter-collector voltage	$I_E=150\text{ A}$, G-E short-circuited, (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	2.50	3.30	V
				$T_j=125\text{ }^\circ\text{C}$	-	2.06	-	
				$T_j=150\text{ }^\circ\text{C}$	-	2.00	-	
t_{rr} (Note1)	Reverse recovery time		$V_{CC}=600\text{ V}$, $I_E=150\text{ A}$, $V_{GE}=\pm 15\text{ V}$,	-	-	300	ns	
Q_{rr} (Note1)	Reverse recovery charge		$R_G=0\text{ }\Omega$, Inductive load	-	4.0	-	μC	
E_{on}	Turn-on switching energy per pulse		$V_{CC}=600\text{ V}$, $I_C=I_E=150\text{ A}$,	-	16.6	-	mJ	
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, $T_j=150\text{ }^\circ\text{C}$,	-	17.6	-			
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	10.8	-	mJ		
R_{CC+EE}	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note4)	-	-	1.4	m Ω		
r_g	Internal gate resistance	Per switch	-	13	-	Ω		

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HIGH POWER SWITCHING USE
INSULATED TYPE

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)	-	-	0.16	K/W
R _{th(j-c)D}		Junction to case, per Inverter DIODE (Note4)	-	-	0.26	
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 _s	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
m	mass	-	-	330	-	g
d _s	Creepage distance	Terminal to terminal	16.3	-	-	mm
		Terminal to base plate	19.1	-	-	
d _a	Clearance	Terminal to terminal	10.3	-	-	mm
		Terminal to base plate	15.3	-	-	
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).

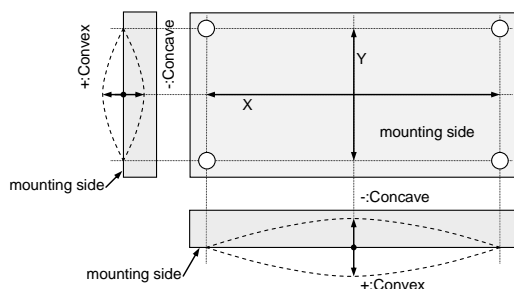
- Junction temperature (T_j) should not increase beyond T_{jmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
- Case temperature (T_C) and heat sink temperature (T_s) are defined on the each surface (mounting side) of base plate and heat sink just under the chips. Refer to the figure of chip location.
- Pulse width and repetition rate should be such as to cause negligible temperature rise.

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

R₂₅: resistance at absolute temperature T₂₅ [K]; T₂₅=25 [°C]+273.15=298.15 [K]

R₅₀: resistance at absolute temperature T₅₀ [K]; T₅₀=50 [°C]+273.15=323.15 [K]

- Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).
- The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



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INSULATED TYPE

- 9 Use the following screws when mounting the printed circuit board (PCB) on the standoffs.

PCB thickness : t=1.6.

Type	Manufacturer	Size	Tightening torque (N·m)	Recommended tightening method
(1) PT®	EJOT	K25×8	0.55 ± 0.055	by handwork (equivalent to 30 rpm by mechanical screw driver) ~ 600 rpm (by mechanical screw driver)
(2) PT®		K25×10	0.75 ± 0.075 N·m	
(3) DELTA PT®		25×8	0.55 ± 0.055 N·m	
(4) DELTA PT®		25×10	0.75 ± 0.075 N·m	
(5) B1 tapping screw	-	φ2.6×10 φ2.6×12	0.75 ± 0.075 N·m	

* This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)

RECOMMENDED OPERATING CONDITIONS

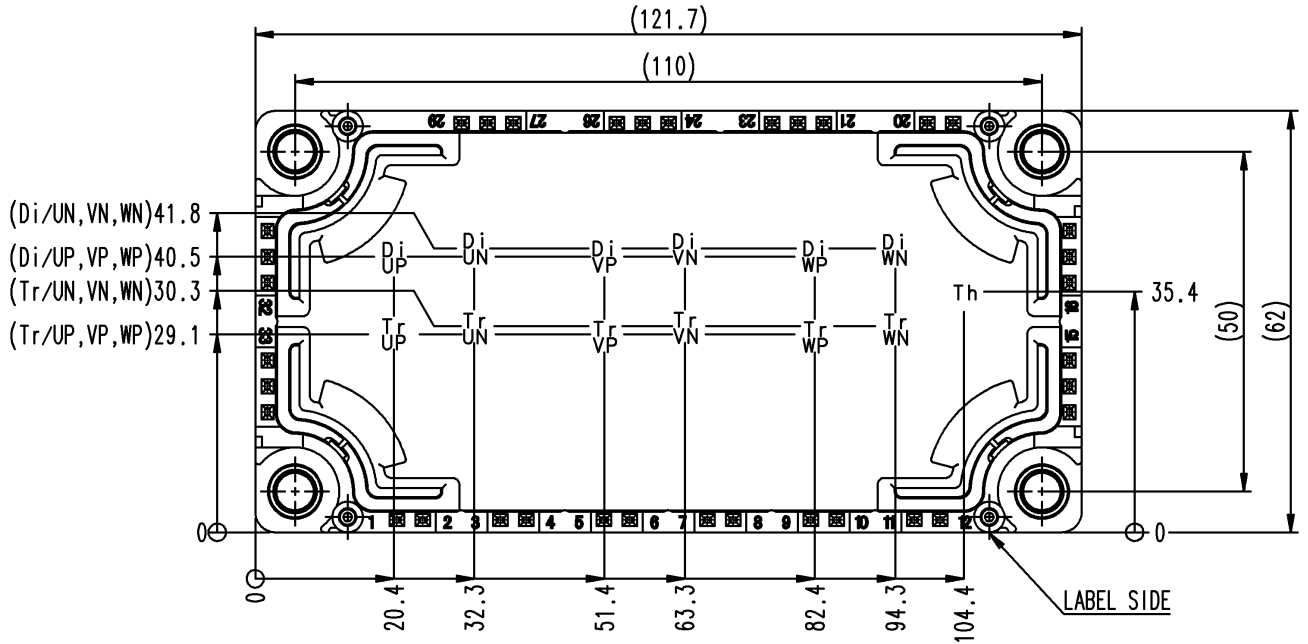
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V _{CC}	(DC) Supply voltage	Applied across P-N/P1-N1 terminals	-	600	850	V
V _{GEon}	Gate (-emitter drive) voltage	Applied across G*P-E*P/G*N-E*N(*=U, V, W) terminals	13.5	15.0	16.5	V
R _G	External gate resistance	Per switch	0	-	30	Ω

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HIGH POWER SWITCHING USE
INSULATED TYPE

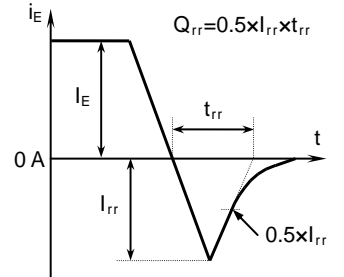
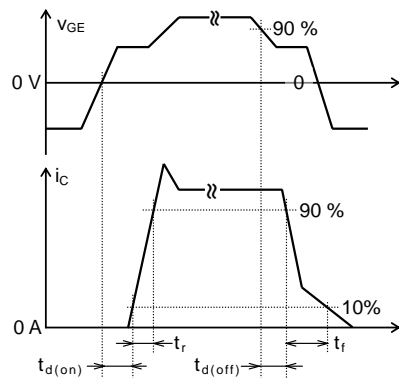
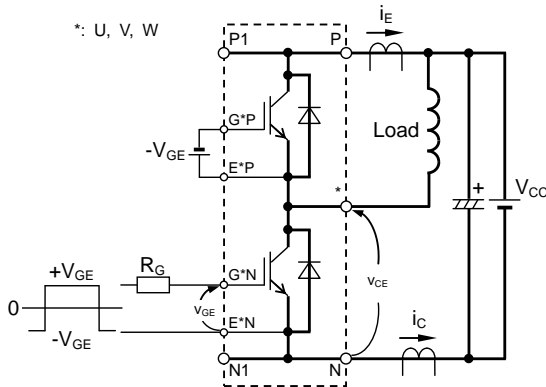
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



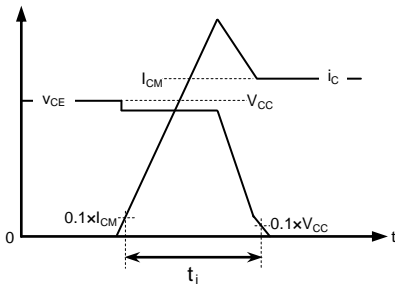
Tr*P/Tr*N: IGBT, Di*P/Di*N: DIODE (*=U/V/W), Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

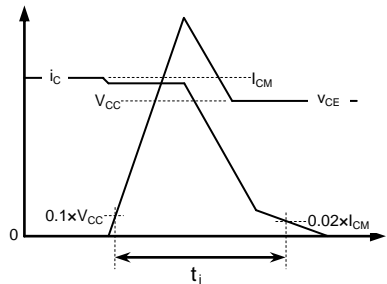


Switching characteristics test circuit and waveforms

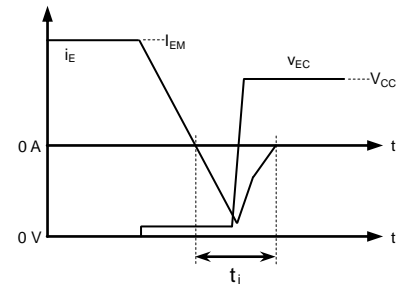
trr, Qrr characteristics test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



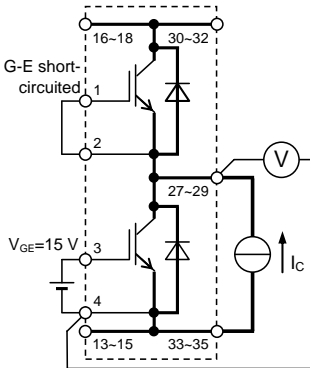
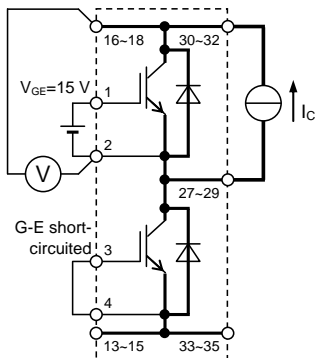
DIODE Reverse recovery energy

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

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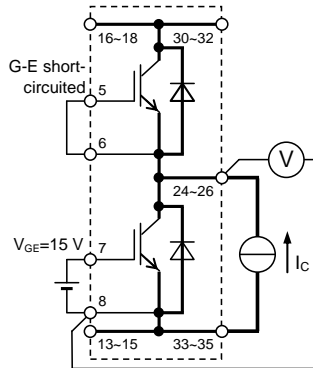
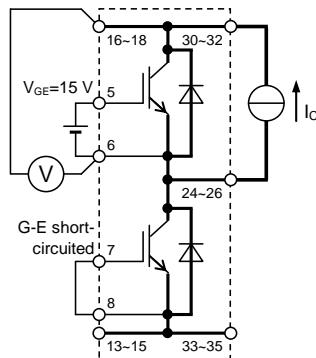
HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT



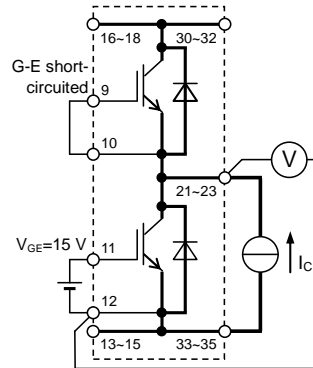
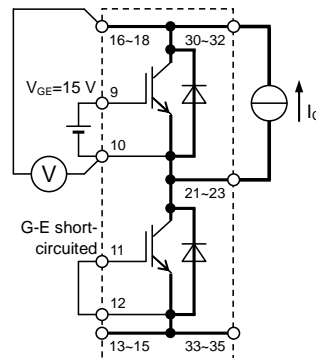
Gate-emitter GVP-EVP, GVN-EVN,
short-circuited GWP-EWP, GWN-EWN

UP / UN IGBT



Gate-emitter GUP-EUP, GUN-EUN,
short-circuited GWP-EWP, GWN-EWN

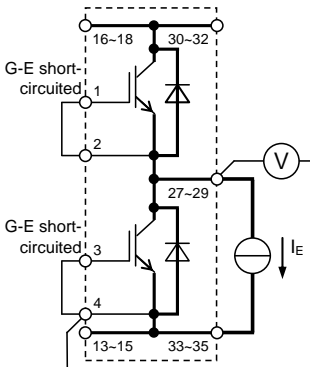
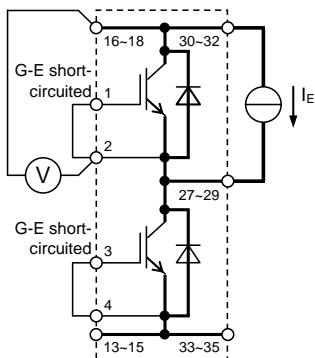
VP / VN IGBT



Gate-emitter GUP-EUP, GUN-EUN,
short-circuited GVP-EVP, GVN-EVN

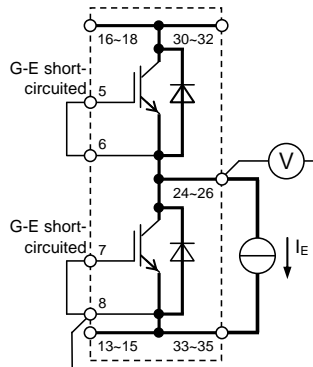
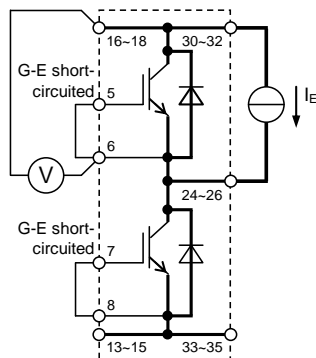
WP / WN IGBT

V_{CEsat} characteristics test circuit



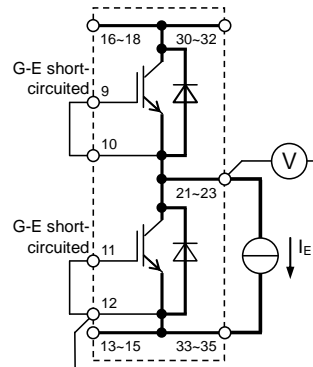
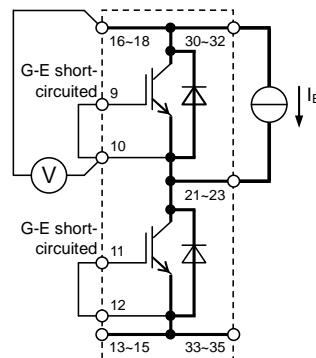
Gate-emitter GVP-EVP, GVN-EVN,
short-circuited GWP-EWP, GWN-EWN

UP / UN DIODE



Gate-emitter GUP-EUP, GUN-EUN,
short-circuited GWP-EWP, GWN-EWN

VP / VN DIODE



Gate-emitter GUP-EUP, GUN-EUN,
short-circuited GVP-EVP, GVN-EVN

WP / WN DIODE

V_{EC} characteristics test circuit

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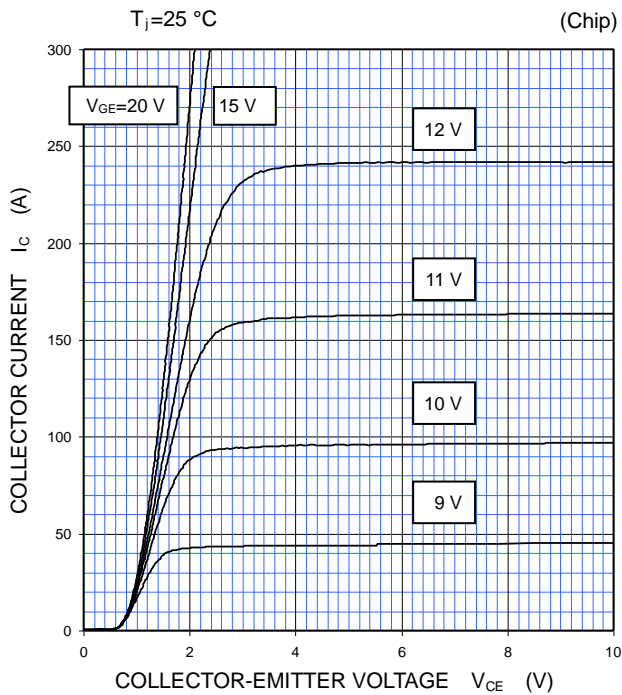
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

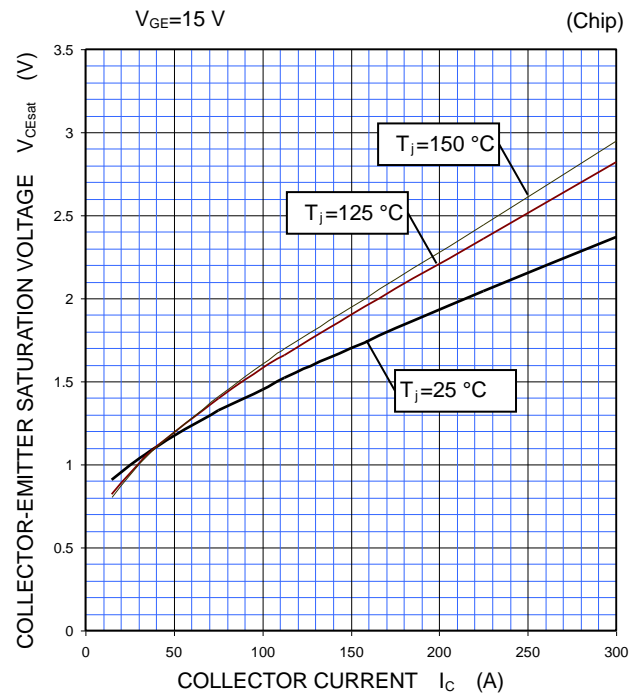
OUTPUT CHARACTERISTICS

(TYPICAL)



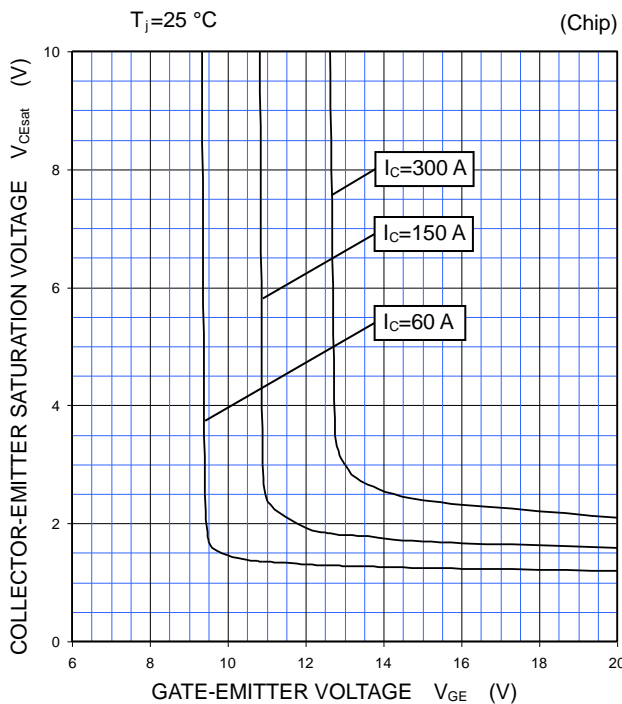
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



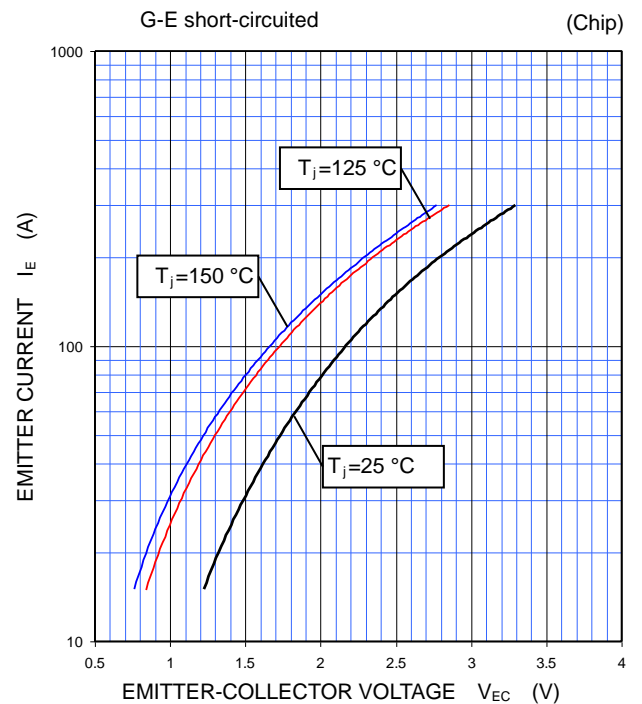
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)



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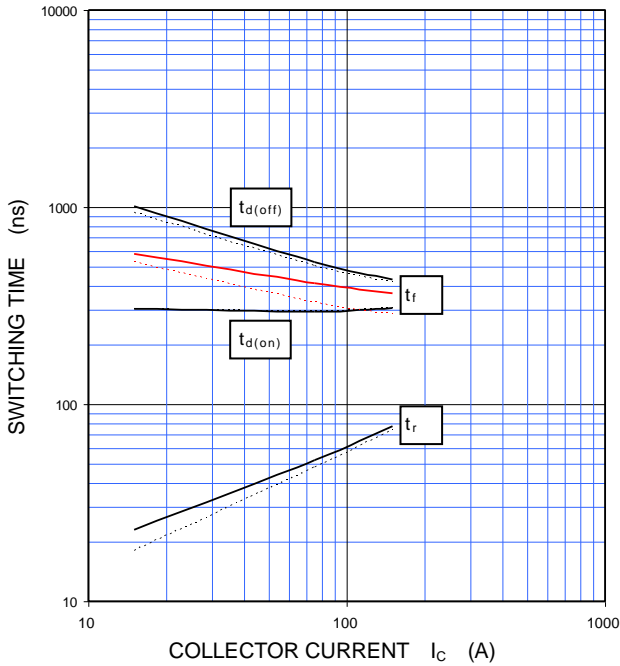
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

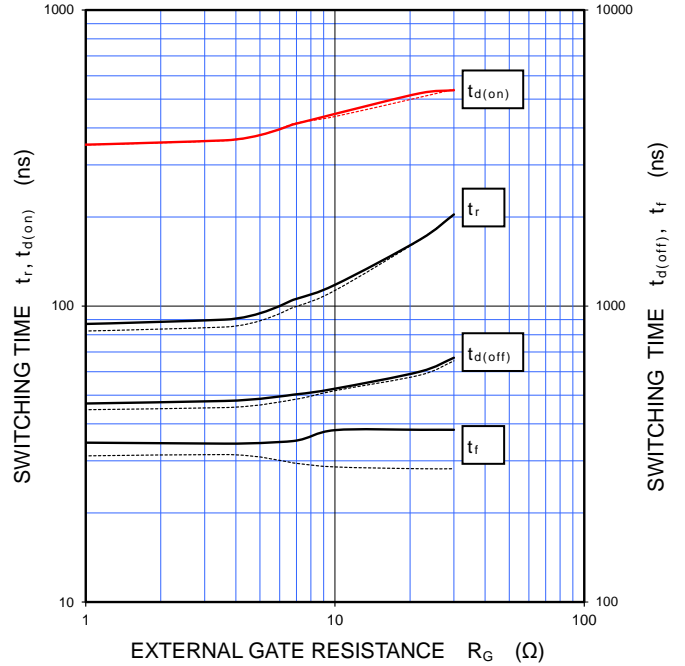
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



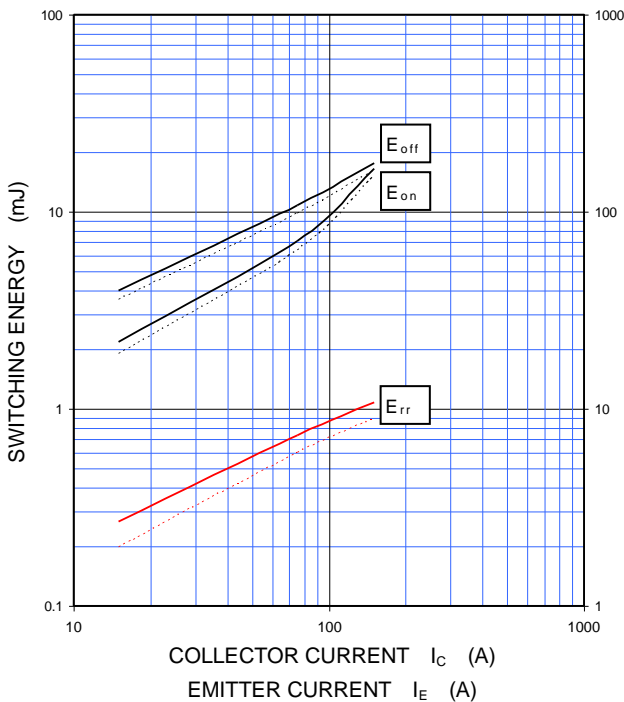
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



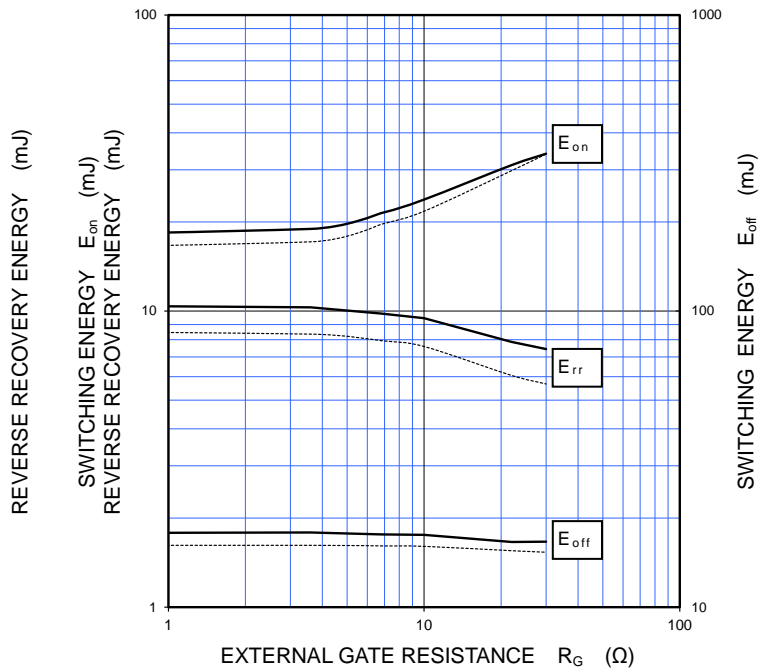
HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)

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



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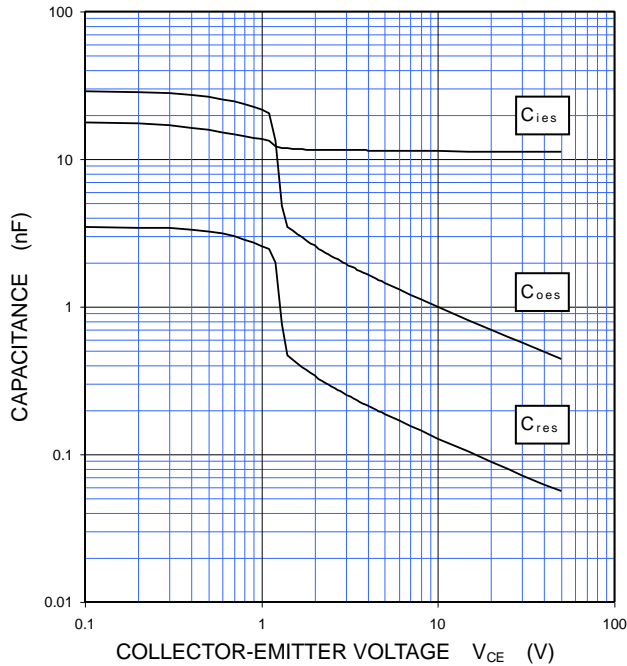
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

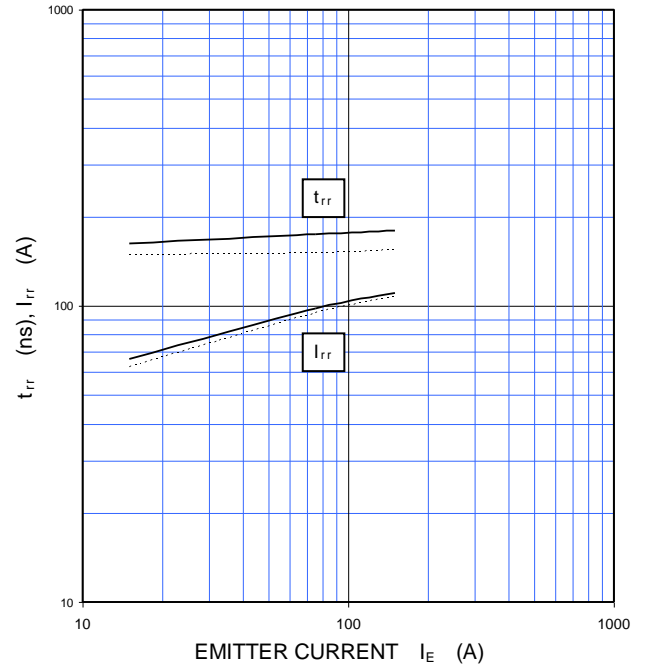
CAPACITANCE CHARACTERISTICS
(TYPICAL)

G-E short-circuited, $T_j=25\text{ }^\circ\text{C}$



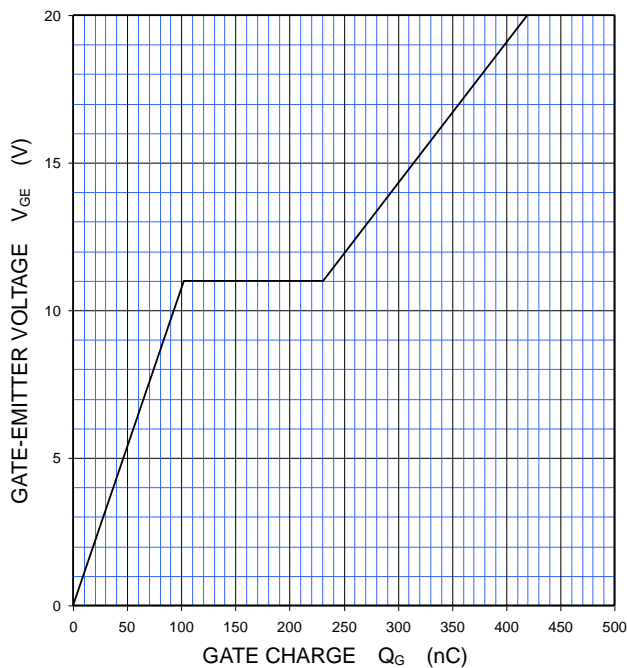
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

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



GATE CHARGE CHARACTERISTICS
(TYPICAL)

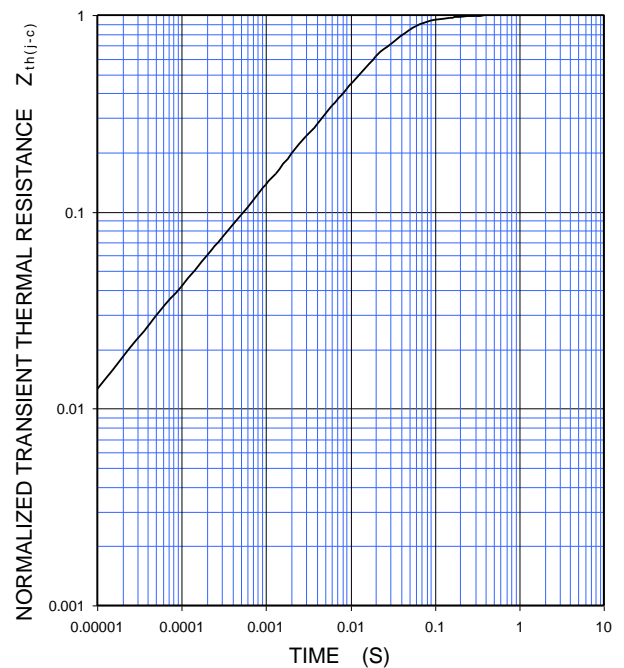
$V_{CC}=600\text{ V}$, $I_C=150\text{ A}$, $T_j=25\text{ }^\circ\text{C}$



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

Single pulse, $T_C=25\text{ }^\circ\text{C}$

$R_{th(j-c)Q}=0.16\text{ K/W}$, $R_{th(j-e)D}=0.26\text{ K/W}$



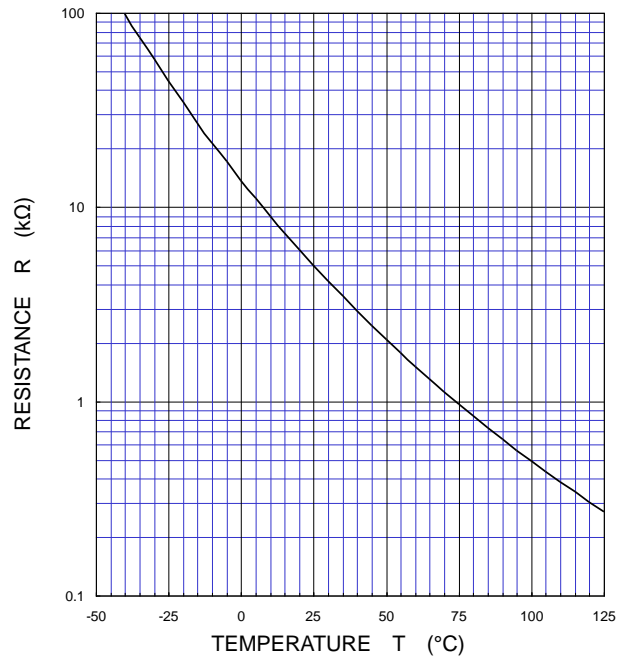
CM150TX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



Keep safety first in your circuit designs!

This product is designed for industrial application purpose. The performance, the quality and support level of the product is guaranteed by "Customer's Std. Spec."

Mitsubishi Electric Corporation puts its reasonable effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them by the reliability lifetime such as Power Cycle, Thermal Cycle or others, or to be used under special circumstances (e.g. high humidity, dusty, salty, highlands, environment with lots of organic matter / corrosive gas / explosive gas, or situation which terminal of semiconductor products is received strong mechanical stress).

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Notes regarding these materials

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