

<IGBT Modules>

CM150RX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE



sevenpack (3φ Inverter + Brake Chopper)

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

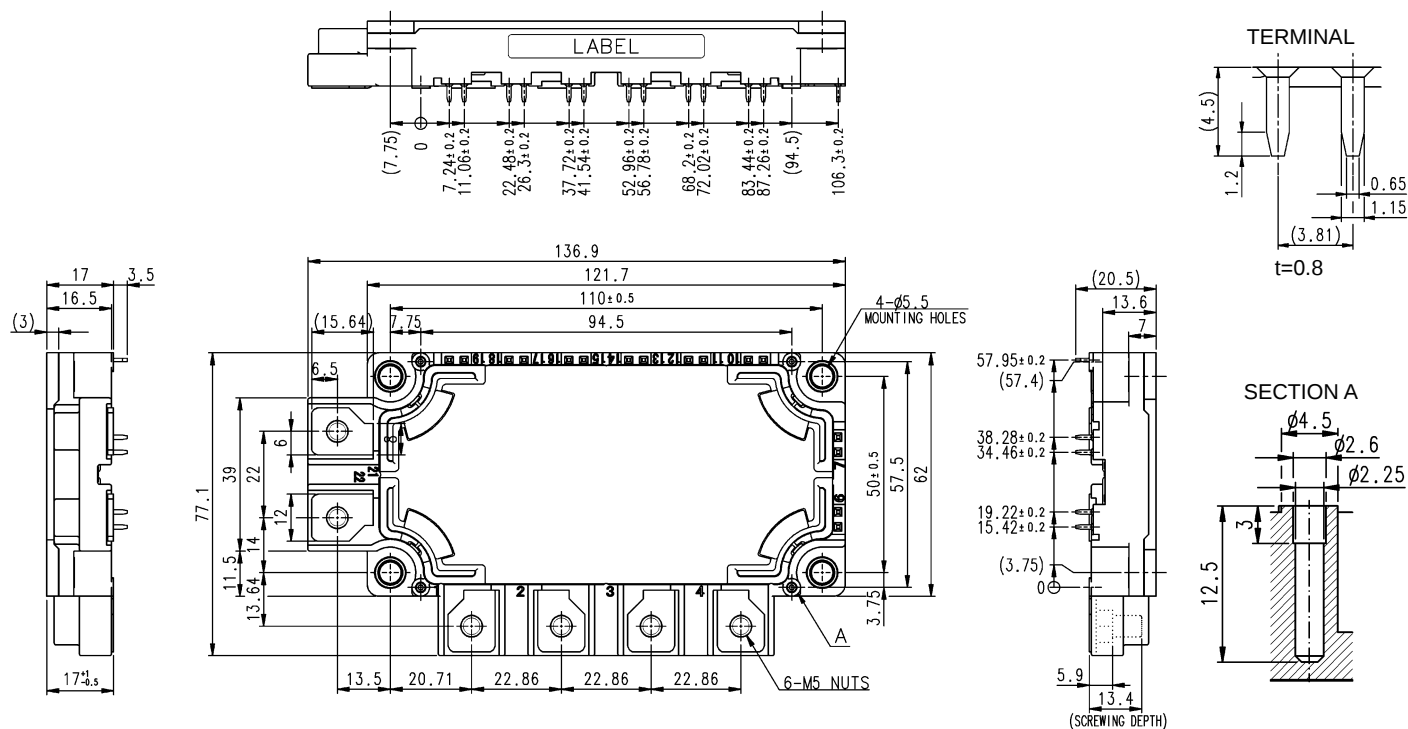
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive* compliant
- Recognized under UL1557, File E323585

APPLICATION

AC Motor Control, Motion/Servo Control, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



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

CM150RX-24S1HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM 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	1200	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =107 °C (Note2, 4)	150	A
I _{CRM}		Pulse, Repetitive (Note3)	300	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	935	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	1200	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =109 °C (Note2, 4)	75	A
I _{CRM}		Pulse, Repetitive (Note3)	150	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	480	W
V _{RRM}	Repetitive peak reverse voltage	G-E short-circuited	1200	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	4000	V
T _{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	°C
T _{Cmax}	Maximum case temperature	(Note4)	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)

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		5.4	6.0	6.6	V
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =150 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	2.00	-	
			T _J =150 °C	-	2.05	-	
V _{CEsat} (Chip)		I _C =150 A, V _{GE} =15 V, (Note5)	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		-	315	-	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	

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HIGH POWER SWITCHING USE
INSULATED TYPE

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) (Terminal)	Emitter-collector voltage	I _E =150 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	2.60	3.40	V
			T _J =125 °C	-	2.16	-	
			T _J =150 °C	-	2.10	-	
V _{EC} (Note1) (Chip)		I _E =150 A, G-E short-circuited, (Note5)	T _J =25 °C	-	2.50	3.30	V
			T _J =125 °C	-	2.06	-	
			T _J =150 °C	-	2.00	-	
t _{rr} (Note1)	Reverse recovery time	V _{CC} =600 V, I _E =150 A, V _{GE} =±15 V,		-	-	300	ns
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load		-	4.0	-	μC
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =150 A,		-	16.6	-	mJ
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _J =150 °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 °C (Note4)		-	-	0.7	mΩ
r _g	Internal gate resistance	Per switch		-	13	-	Ω

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		5.4	6.0	6.6	V
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =75 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	2.00	-	
			T _J =150 °C	-	2.05	-	
V _{CEsat} (Chip)		I _C =75 A, V _{GE} =15 V, (Note5)	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		-	158	-	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		-	-	1.0	mA
V _F (Terminal)	Forward voltage	I _F =75 A, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	2.60	3.40	V
			T _J =125 °C	-	2.16	-	
			T _J =150 °C	-	2.10	-	
V _F (Chip)		I _F =75 A, (Note5)	T _J =25 °C	-	2.50	3.30	V
			T _J =125 °C	-	2.06	-	
			T _J =150 °C	-	2.00	-	
t _{rr}	Reverse recovery time	V _{CC} =600 V, I _E =75 A, V _{GE} =±15 V,		-	-	300	ns
Q _{rr}	Reverse recovery charge	R _G =8.2 Ω, Inductive load		-	2.0	-	μC
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =75 A,		-	3.5	-	mJ
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =8.2 Ω, T _J =150 °C,		-	7.3	-	
E _{rr}	Reverse recovery energy per pulse	Inductive load		-	6.5	-	mJ
r _g	Internal gate resistance	-		-	0	-	Ω

CM150RX-24S1HIGH POWER SWITCHING USE
INSULATED TYPEELECTRICAL 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(j-c)Q}		Junction to case, per Brake IGBT (Note4)	-	-	0.31	K/W
R _{th(j-c)D}		Junction to case, per Brake DIODE (Note4)	-	-	0.47	
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	17	-	-	mm
		Terminal to base plate	20.1	-	-	
d _a	Clearance	Terminal to terminal	10	-	-	mm
		Terminal to base plate	14.8	-	-	
m	mass	-	-	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 (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.

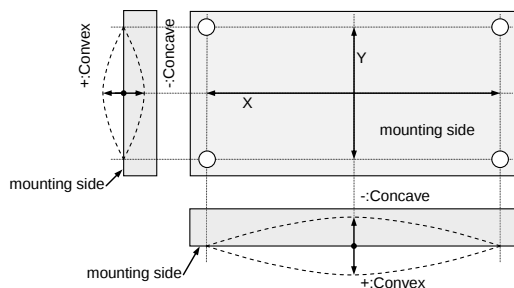
5. Pulse width and repetition rate should be such as to cause negligible temperature rise.

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

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]

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.



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- 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	0.75 ± 0.075 N·m	
		φ2.6×12		

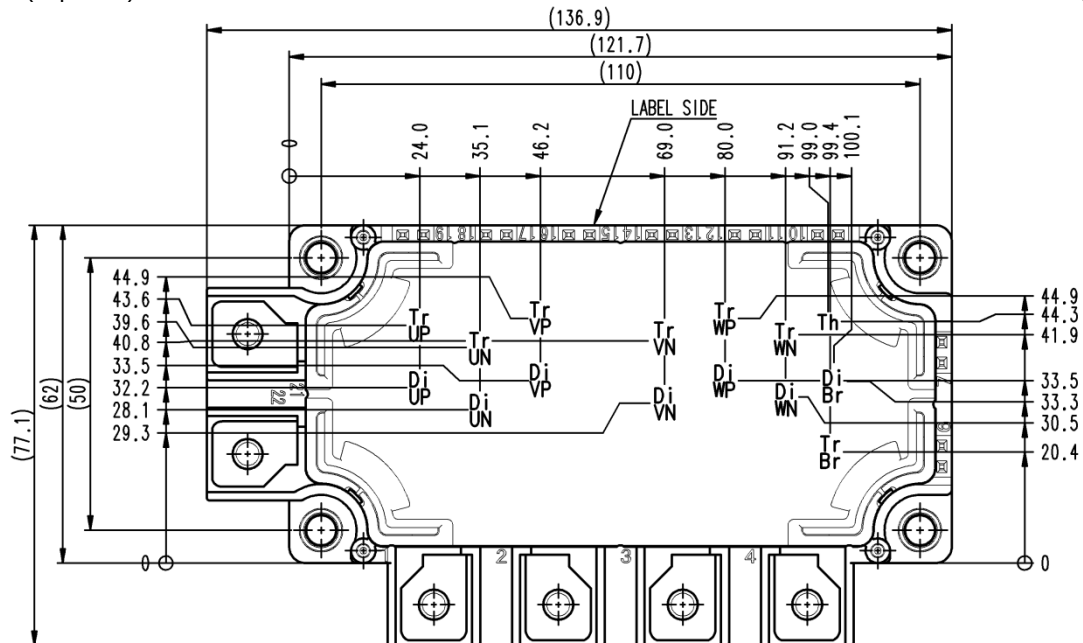
* This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).

RECOMMENDED OPERATING CONDITIONS

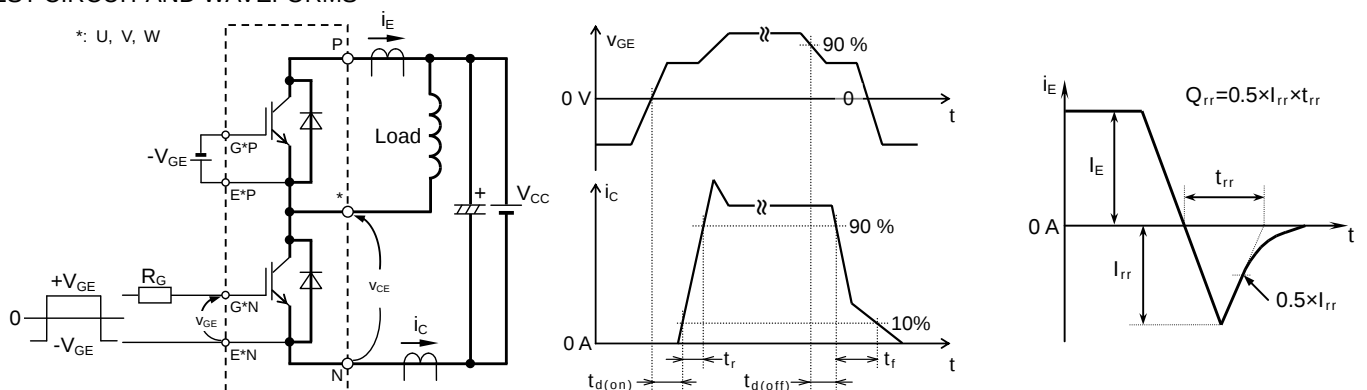
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V _{CC}	(DC) Supply voltage	Applied across P-N terminals	-	600	850	V
V _{GEon}	Gate (-emitter drive) voltage	Applied across GB-EB/ G*P-E*P/G*N-E*N(*=U, V, W) terminals	13.5	15.0	16.5	V
R _G	External gate resistance	Per switch	Inverter IGBT	0	-	30
			Brake IGBT	8.2	-	82

CM150RX-24S1HIGH POWER SWITCHING USE
INSULATED TYPE

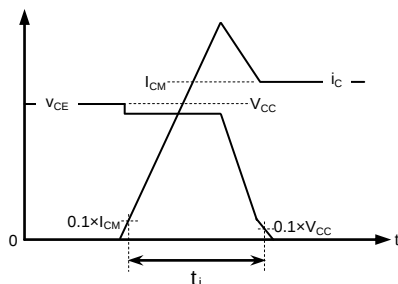
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm

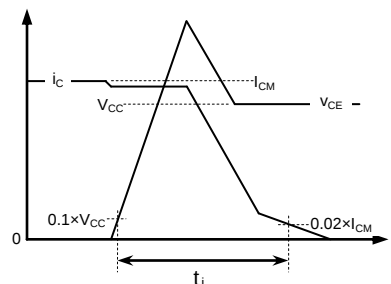
Tr*P/Tr*N/TrBr: IGBT, Di*P/Di*N: DIODE (*=U/V/W), DiBr: Brake DIODE, Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

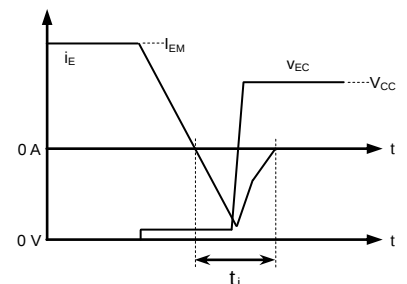
Switching test circuit and waveforms

 t_{rr} , Q_{rr} test waveform

IGBT Turn-on switching energy



IGBT Turn-off switching energy



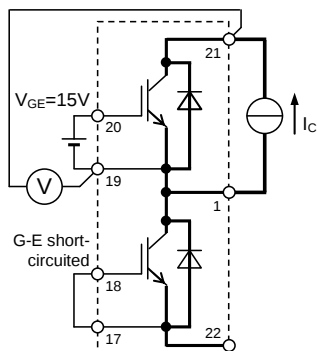
DIODE Reverse recovery energy

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

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HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT



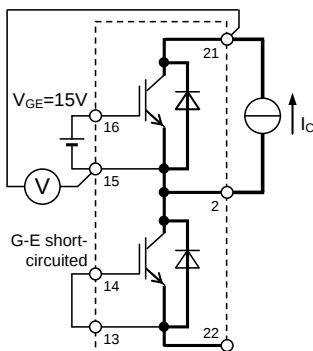
G-E short-circuited

G-E short-circuited

$V_{GE}=15V$

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

UP / UN IGBT



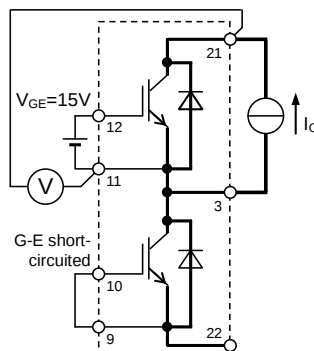
G-E short-circuited

G-E short-circuited

$V_{GE}=15V$

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

VP / VN IGBT



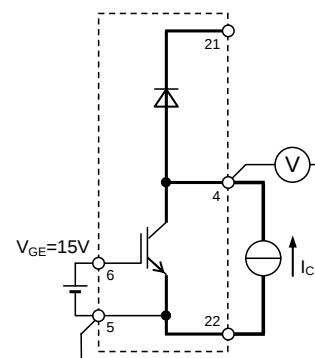
G-E short-circuited

G-E short-circuited

$V_{GE}=15V$

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

WP / WN IGBT

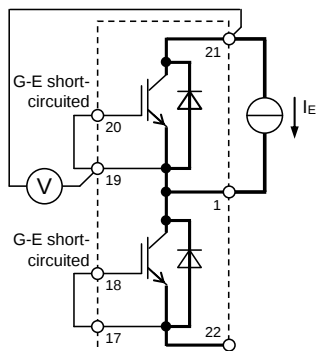


$V_{GE}=15V$

Gate-emitter GUP-EUP, GUN-EUN,
short-circuited GVP-EVP, GVN-EVN,
GWP-EWP, GWN-EWN

Brake IGBT

V_{CEsat} characteristics test circuit



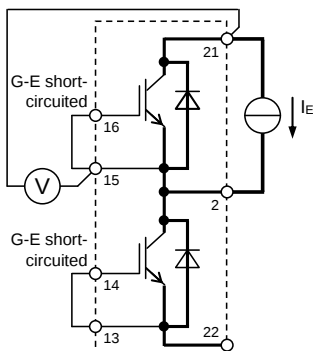
G-E short-circuited

G-E short-circuited

G-E short-circuited

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

UP / UN DIODE



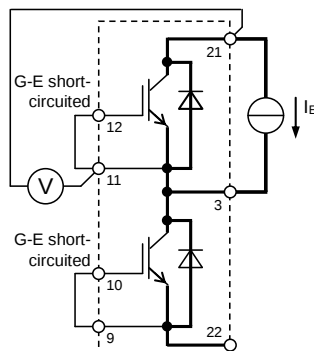
G-E short-circuited

G-E short-circuited

G-E short-circuited

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

VP / VN DIODE



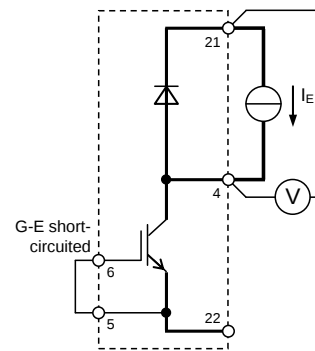
G-E short-circuited

G-E short-circuited

G-E short-circuited

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

WP / WN DIODE



G-E short-circuited

Gate-emitter GUP-EUP, GUN-EUN,
short-circuited GVP-EVP, GVN-EVN,
GWP-EWP, GWN-EWN

Brake DIODE

V_{EC} / V_F characteristics test circuit

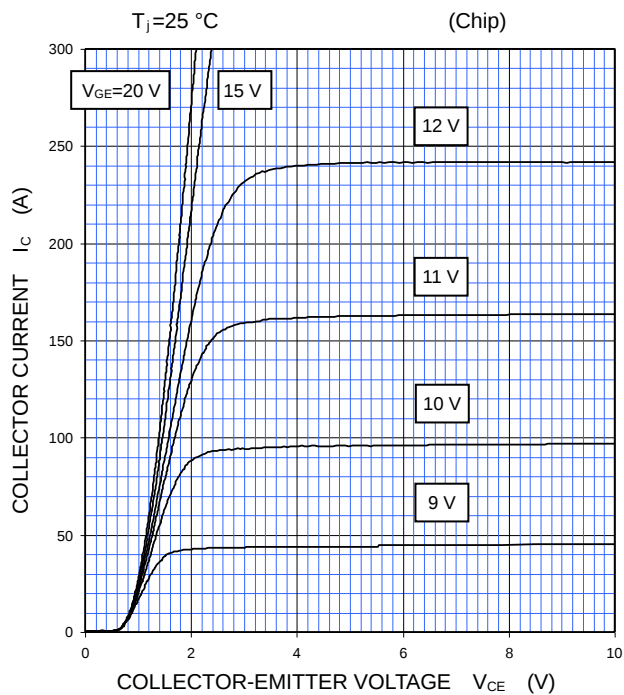
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HIGH POWER SWITCHING USE
INSULATED TYPE

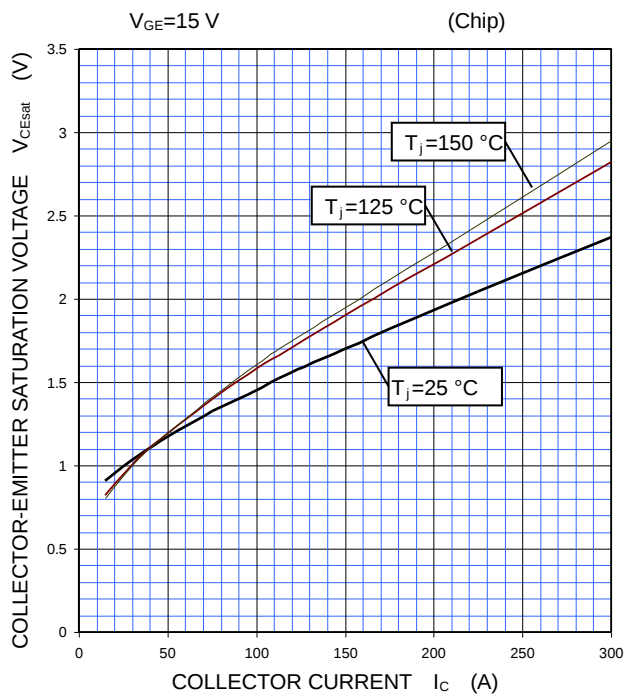
PERFORMANCE CURVES

INVERTER PART

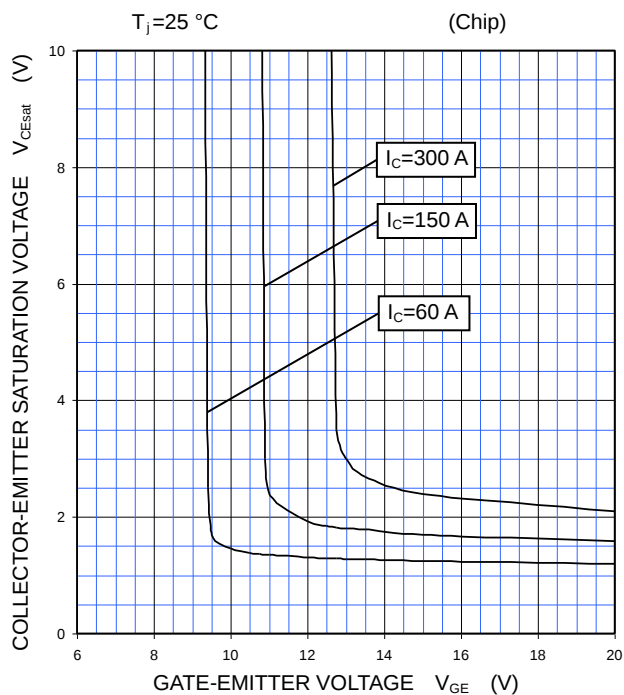
OUTPUT
CHARACTERISTICS
(TYPICAL)



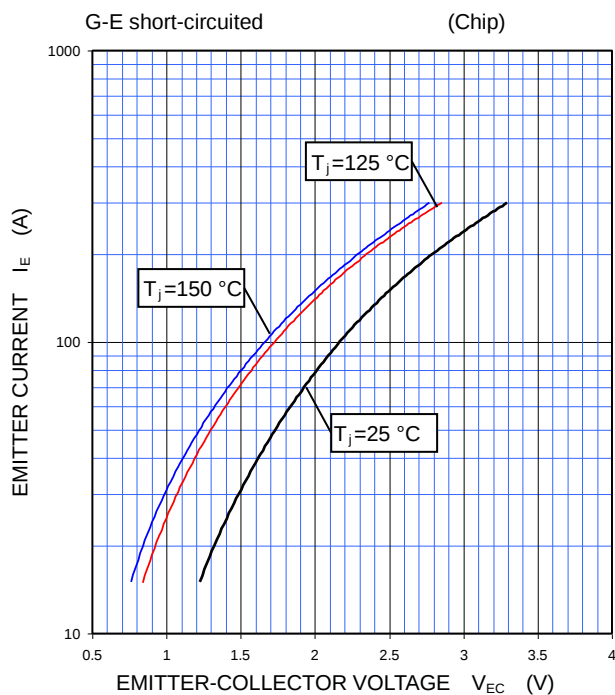
COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)



FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



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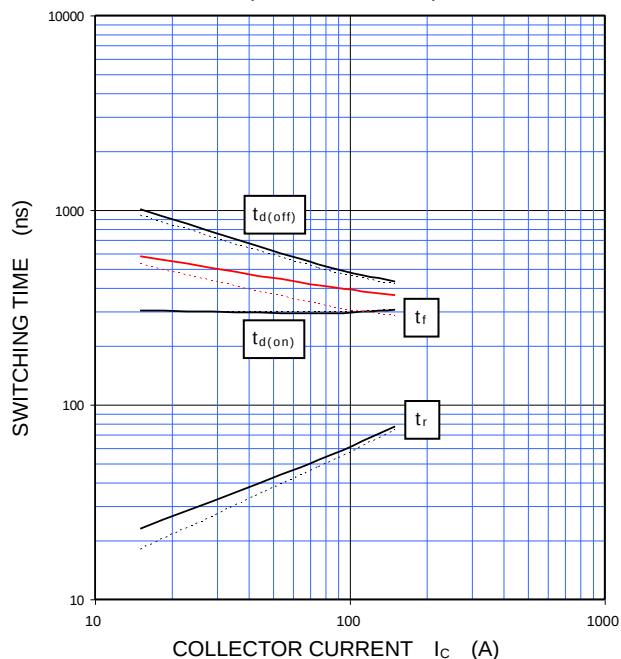
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

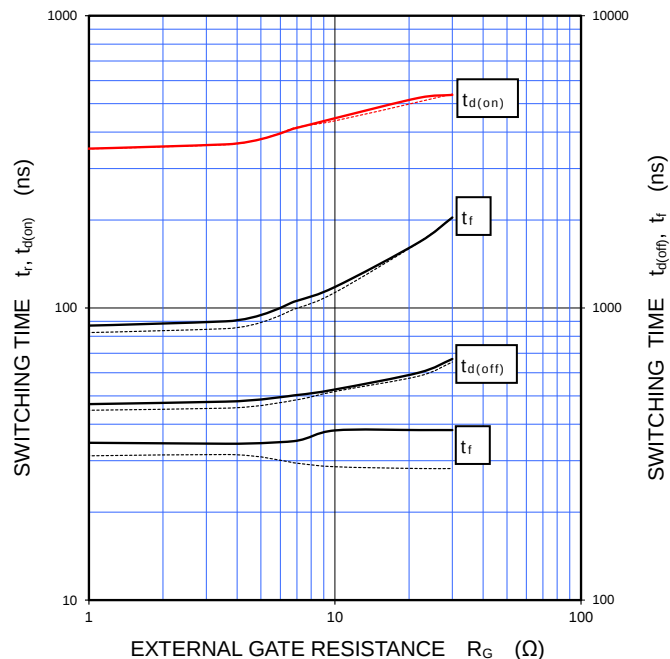
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



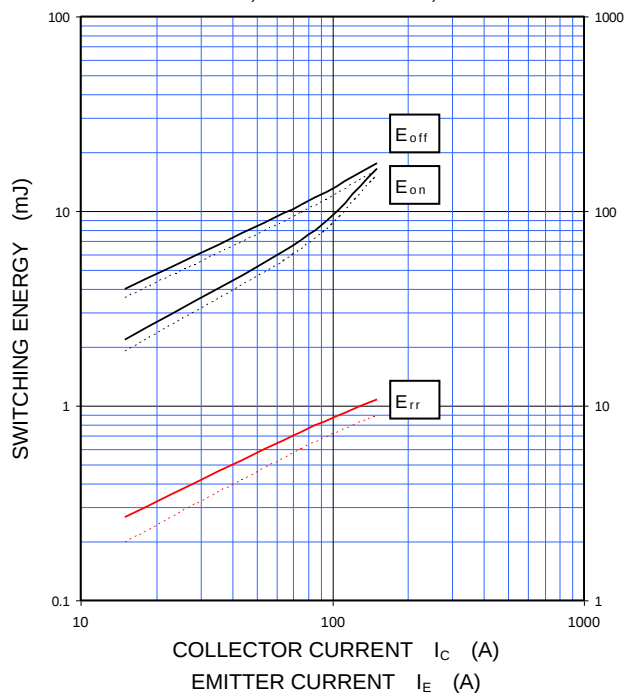
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



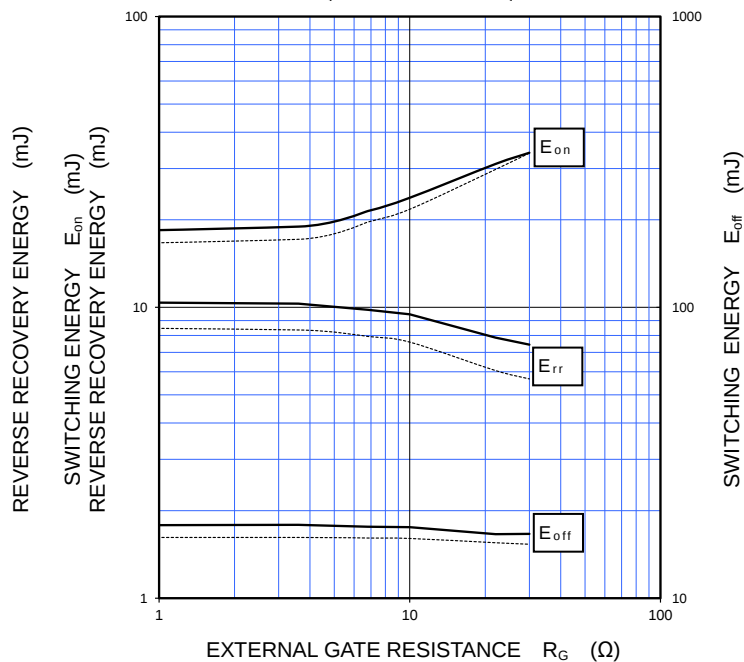
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



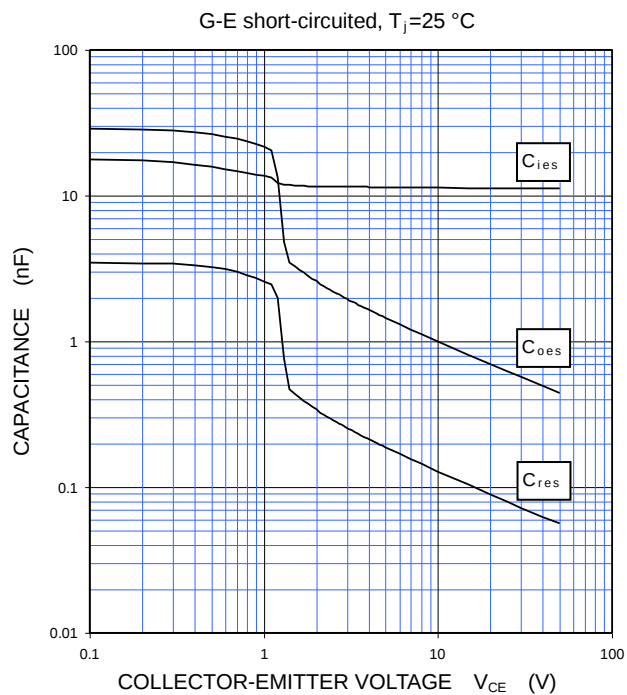
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HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

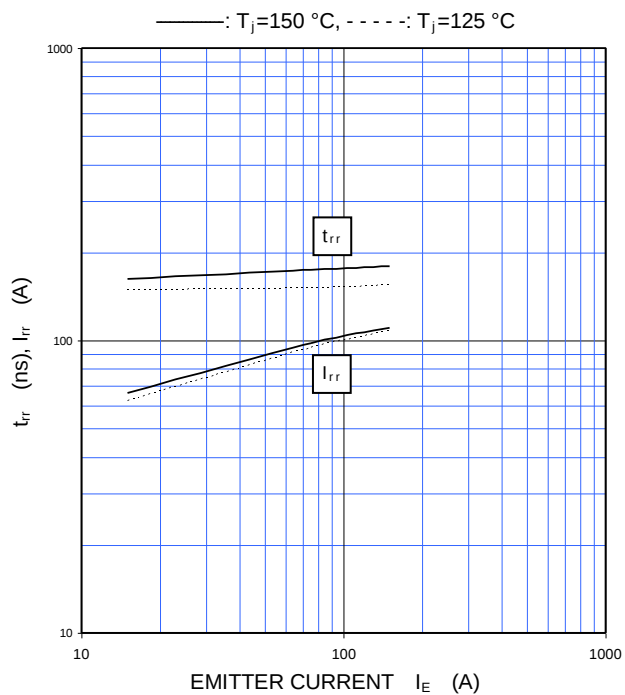
INVERTER PART

CAPACITANCE CHARACTERISTICS (TYPICAL)

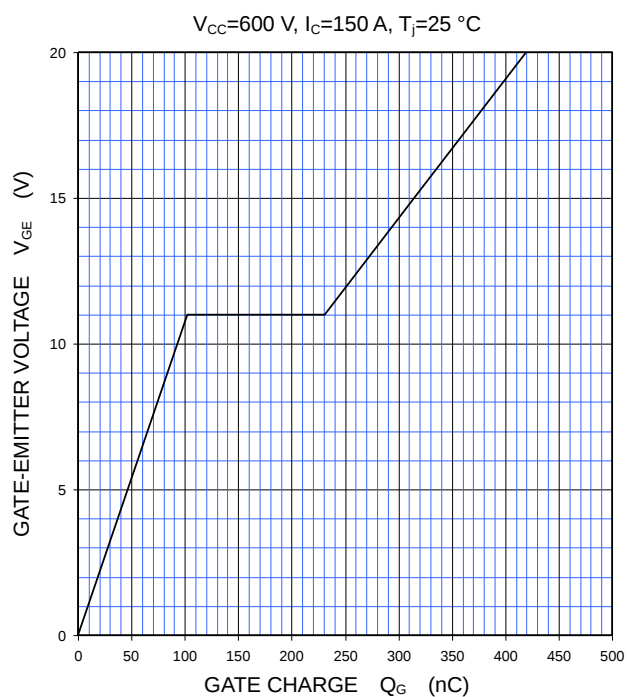


FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

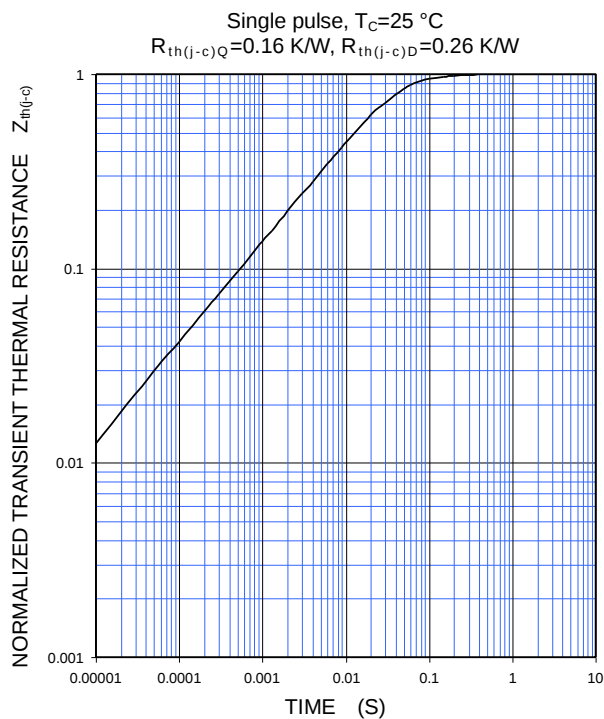
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, INDUCTIVE LOAD



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



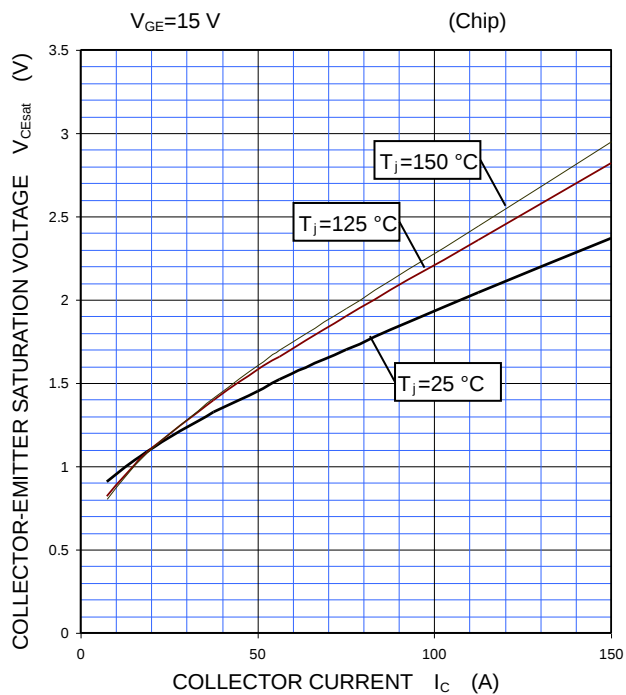
CM150RX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

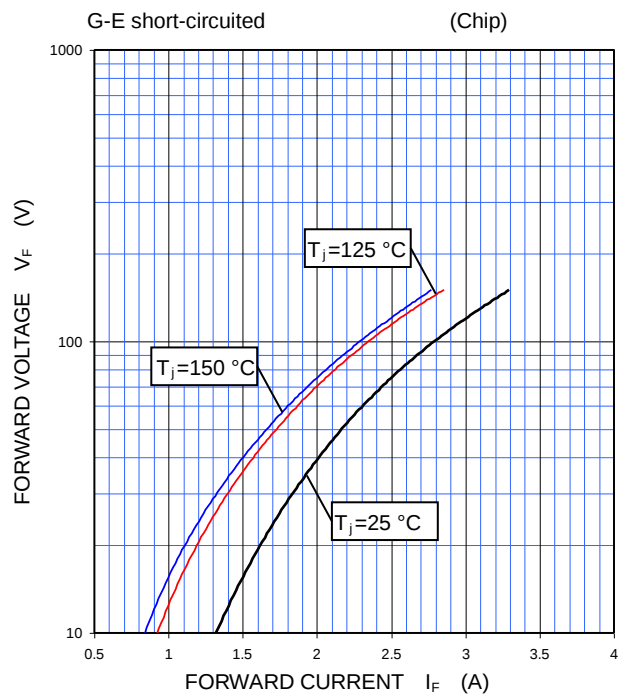
PERFORMANCE CURVES

BRAKE PART

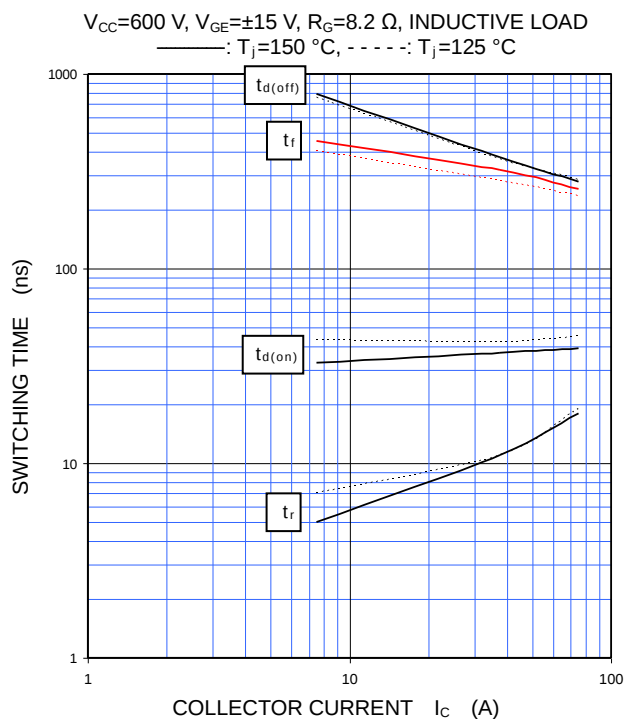
COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)



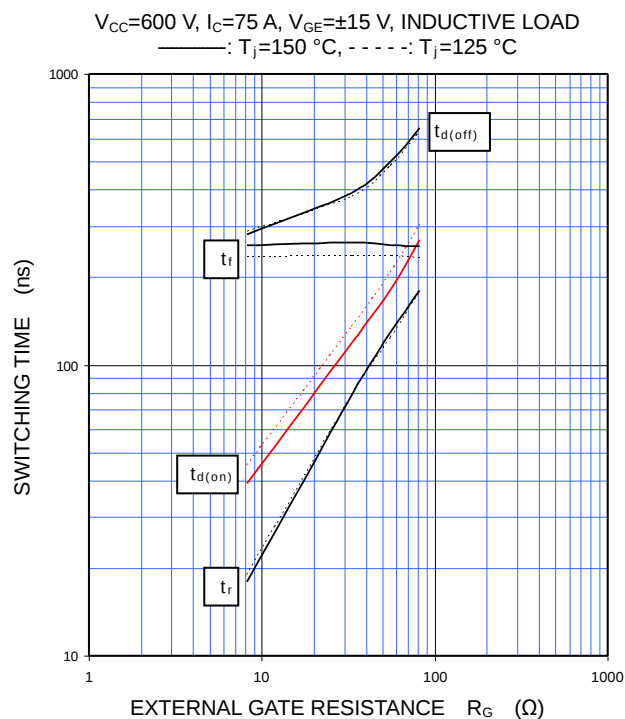
CLAMP DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)



HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)



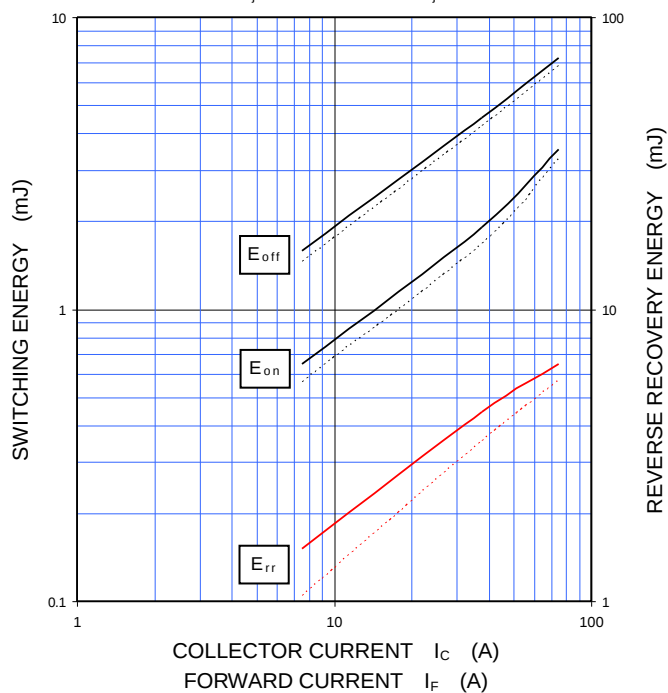
CM150RX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

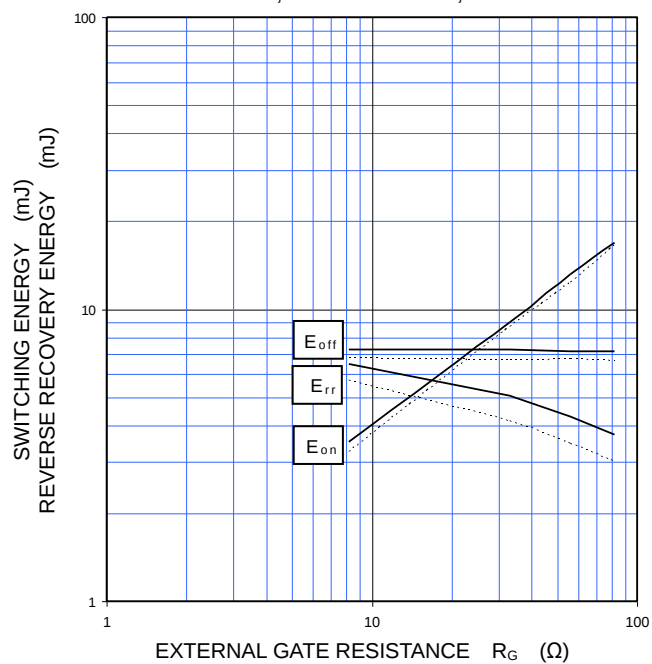
PERFORMANCE CURVES

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
—: $T_J=150\text{ }^\circ\text{C}$, - - - - : $T_J=125\text{ }^\circ\text{C}$

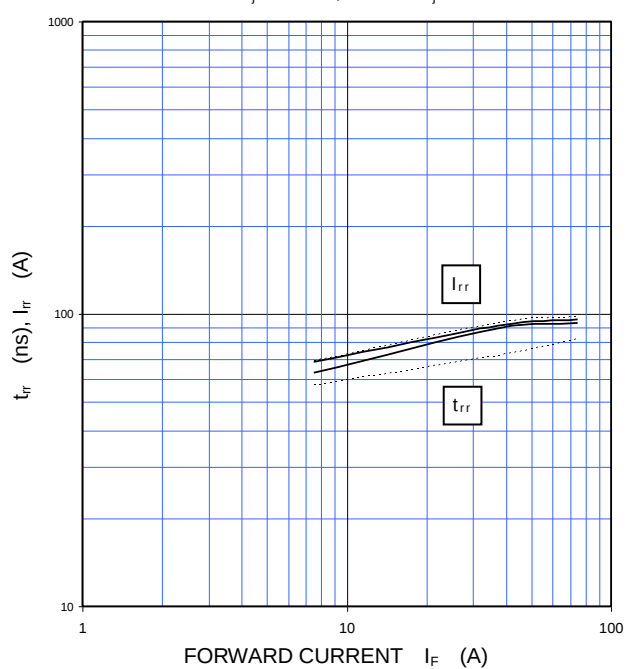


HALF-BRIDGE
SWITCHING CHARACTERISTICS
(TYPICAL)
 $V_{CC}=600\text{ V}$, $I_C/I_F=75\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
INDUCTIVE LOAD, PER PULSE
—: $T_J=150\text{ }^\circ\text{C}$, - - - - : $T_J=125\text{ }^\circ\text{C}$



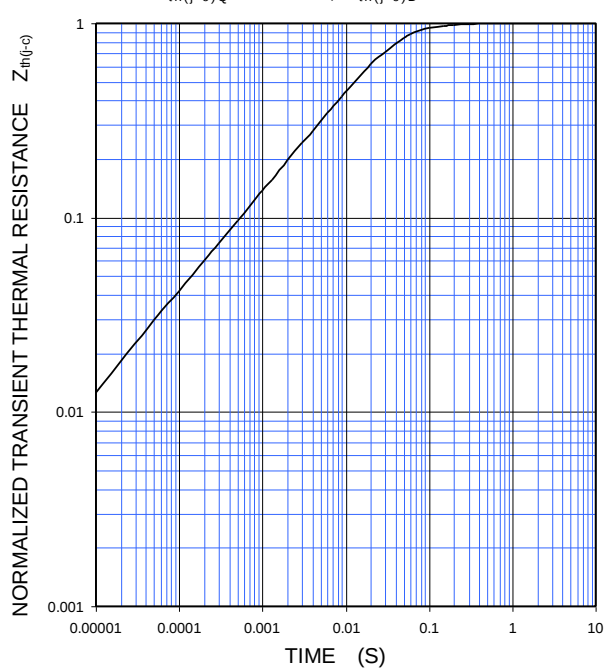
BRAKE DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

Single pulse, $T_C=25\text{ }^\circ\text{C}$
 $R_{th(j-c)Q}=0.31\text{ K/W}$, $R_{th(j-c)D}=0.47\text{ K/W}$



CM150RX-24S1

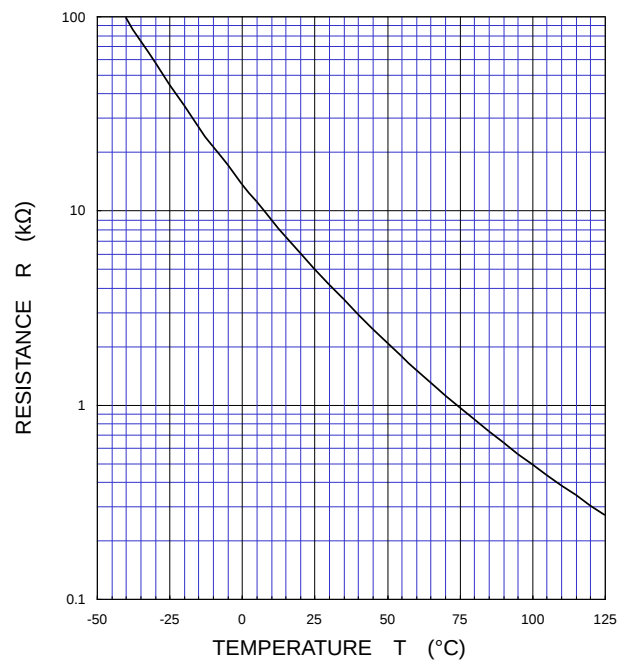
HIGH POWER SWITCHING USE

INSULATED TYPE

PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE
CHARACTERISTICS
(TYPICAL)



CM150RX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

Keep safety first in your circuit designs!

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