

< IGBT MODULES >

CM150TX-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



sixpack (3φ Inverter)

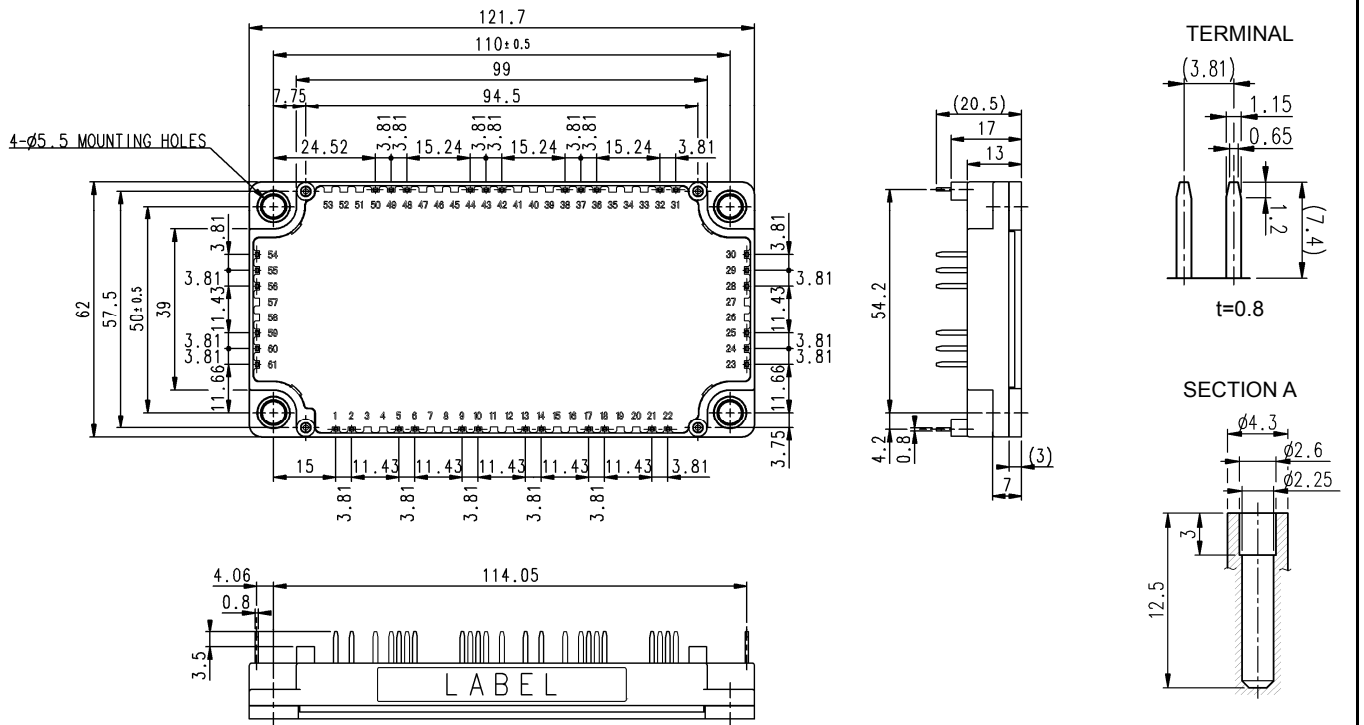
Collector current I_C **150 A**
 Collector-emitter voltage V_{CES} **1200 V**
 Maximum junction temperature T_{jmax} **175 °C**

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

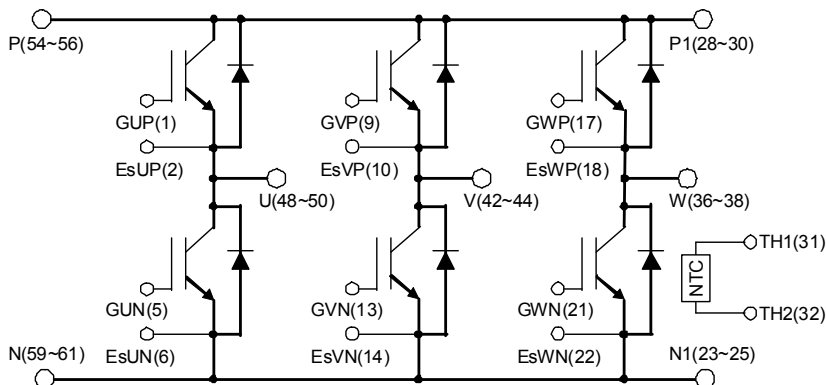
APPLICATION

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

OUTLINE DRAWING & INTERNAL CONNECTION



INTERNAL CONNECTION



Caution: Each (three) pin terminal of P/N/P1/N1/U/V/W is connected in the module, but should use all each three pins for the external wiring.

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.

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ABSOLUTE MAXIMUM RATINGS (T_j=25 °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 °C (Note2, 4)	150	A
I _{CRM}		Pulse, Repetitive (Note3)	300	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	1150	W
I _E (Note1)	Emitter current	(Note2)	150	A
I _{ERM} (Note1)		Pulse, Repetitive (Note3)	300	

MODULE

Symbol	Item	Conditions	Rating	Unit
V _{iso1}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T _{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	°C
T _{Cmax}	Maximum case temperature	(Note4)	125	°C
T _{top}	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/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 mA, V _{CE} =10 V	5.4	6.0	6.6	V	
V _{CESat}	Collector-emitter saturation voltage	I _C =150 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 =150 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	-	-	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		
V _{EC} (Note1)	Emitter-collector voltage	I _E =150 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 =150 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} (Note1)	Reverse recovery time	V _{CC} =600 V, I _E =150 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	300	ns	
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load	-	8.0	-	µC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =150 A,	-	24.2	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _j =150 °C,	-	16	-		
E _{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	12.2	-	mJ	
R _{CC'+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C (Note4)	-	-	1.8	mΩ	
r _g	Internal gate resistance	Per switch	-	13	-	Ω	

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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 (Note7)	-	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 (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(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 _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	14.27	-	-	
d _a	Clearance	Terminal to terminal	10.28	-	-	mm
		Terminal to base plate	12.33	-	-	
m	Weight	-	-	300	-	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).

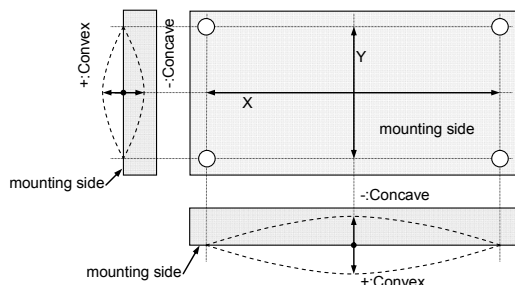
- Junction temperature (T_j) should not increase beyond T_{jmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
- Case temperature (T_c) and heat sink temperature (T_s) are defined on the each surface (mounting side) 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. Refer to the figure of test circuit.

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

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.



- 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.

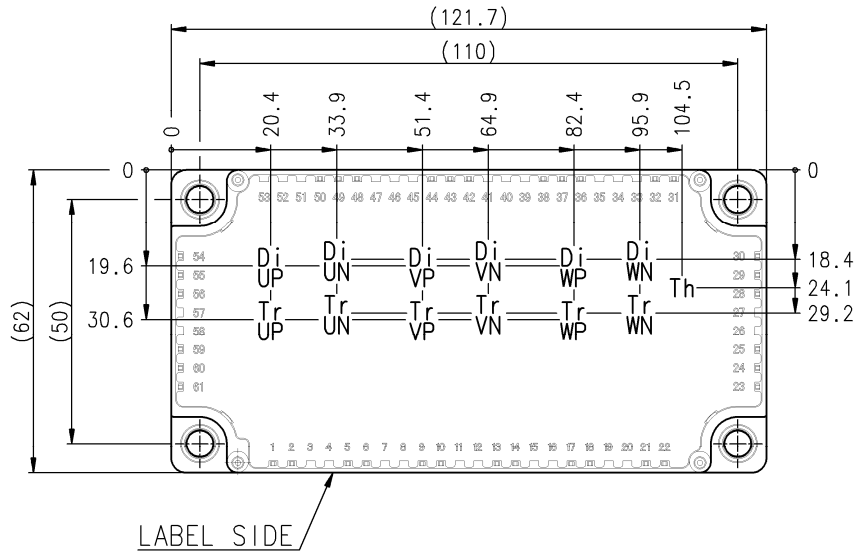
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RECOMMENDED OPERATING CONDITIONS

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 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	0	-	30	Ω

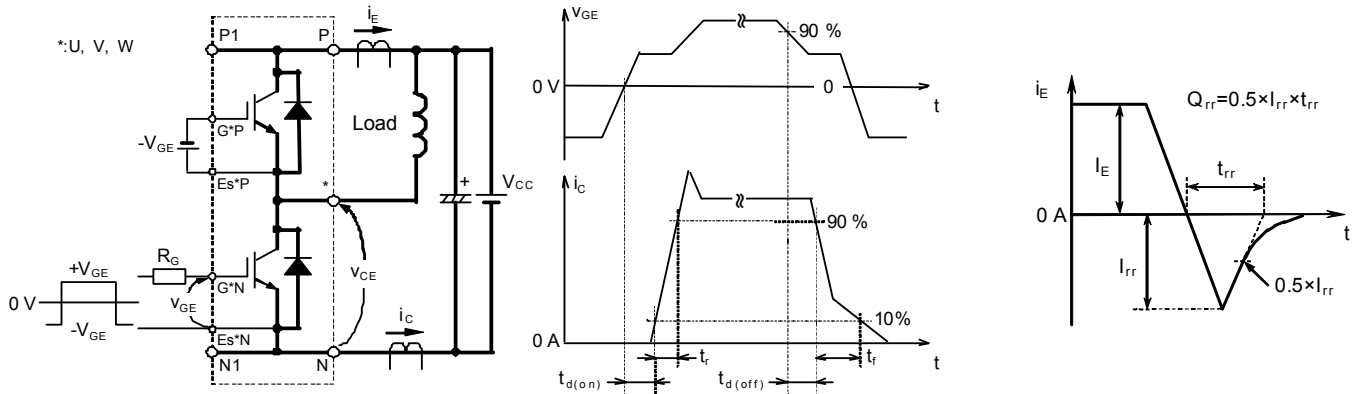
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



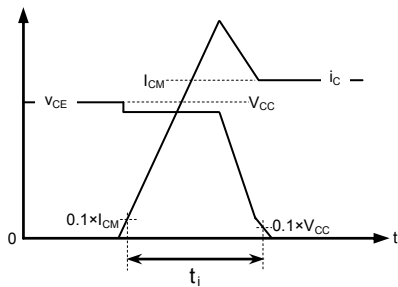
Tr*P/Tr*N: IGBT, Di*P/Di*N: FWDi (*=U/V/W), Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

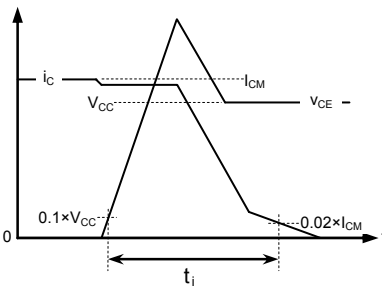


Switching characteristics test circuit and waveforms

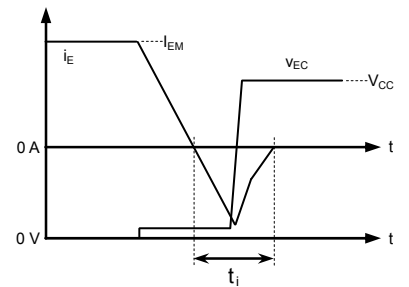
t_{rr} , Q_{rr} test waveform



IGBT Turn-on switching energy



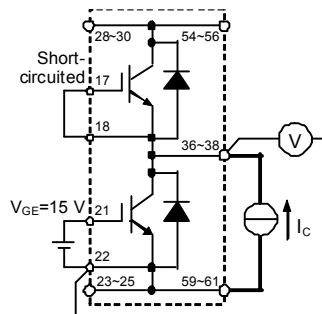
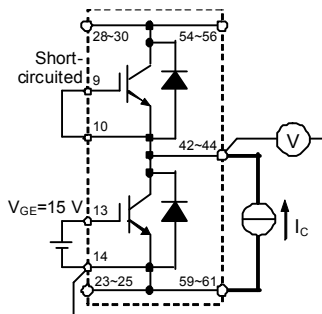
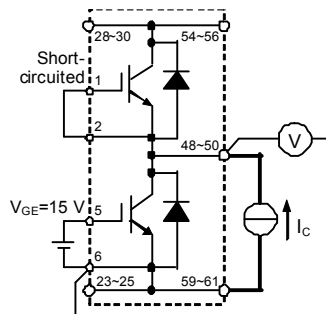
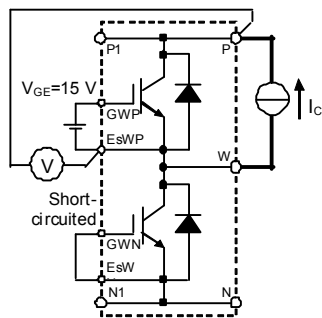
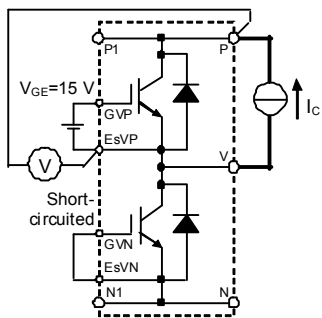
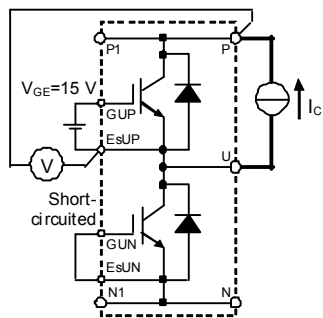
IGBT Turn-off switching energy



FWDi Reverse recovery energy

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

TEST CIRCUIT

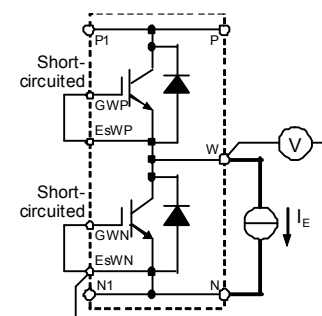
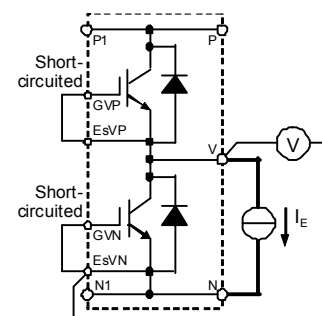
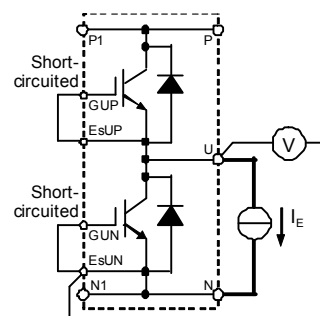
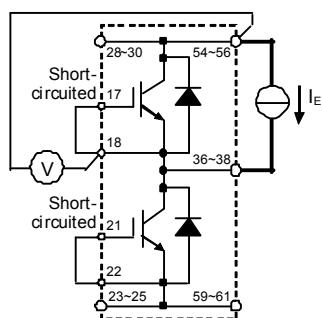
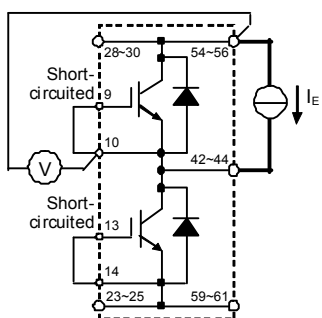
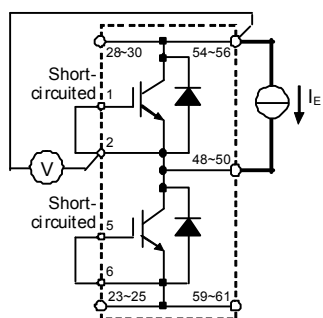


Gate-emitter GVP-EsVP, GVN-EsVP,
short-circuited GWP-EsWN, GWN-EsWN
UP / UN IGBT

Gate-emitter GUP-EsUP, GUN-EsUN,
short-circuited GWP-EsWP, GWN-EsWN
VP / VN IGBT

Gate-emitter GUP-EsUP, GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN
WP / WN IGBT

V_{CEsat} test circuit



Gate-emitter GVP-EsVP, GVN-EsVP,
short-circuited GWP-EsWN, GWN-EsWN
UP / UN FWDi

Gate-emitter GUP-EsUP, GUN-EsUN,
short-circuited GWP-EsWP, GWN-EsWN
VP / VN FWDi

Gate-emitter GUP-EsUP, GUN-EsUN,
short-circuited GVP-EsVP, GVN-EsVN
WP / WN FWDi

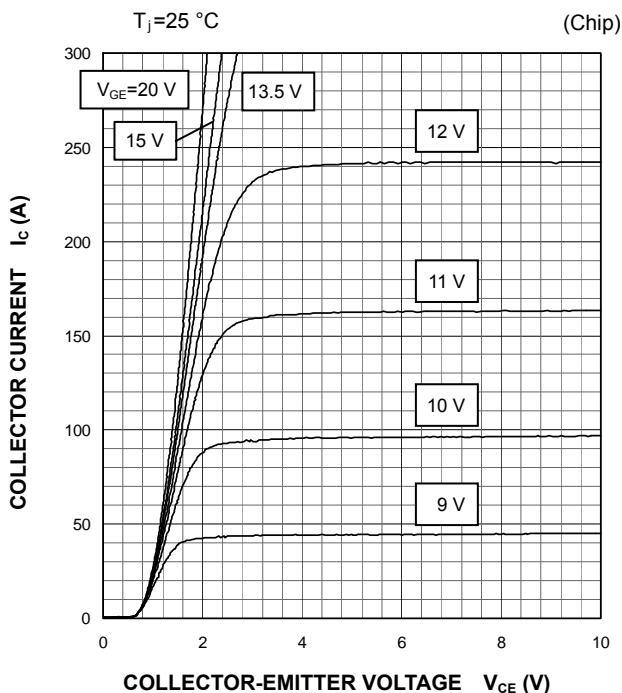
V_{EC} test circuit

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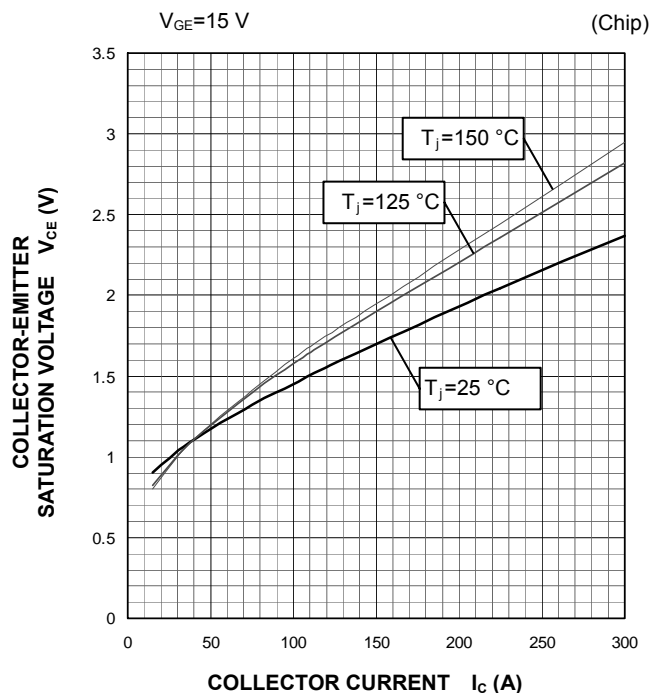
PERFORMANCE CURVES

INVERTER PART

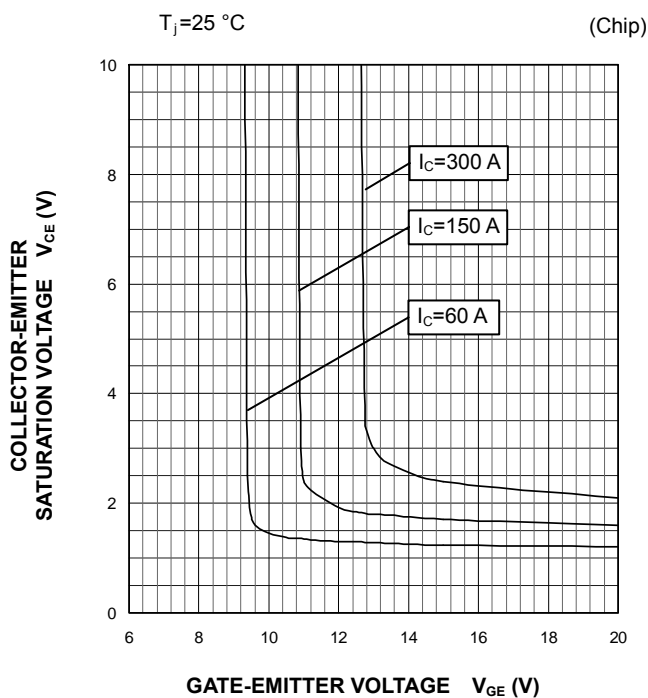
OUTPUT CHARACTERISTICS
 (TYPICAL)



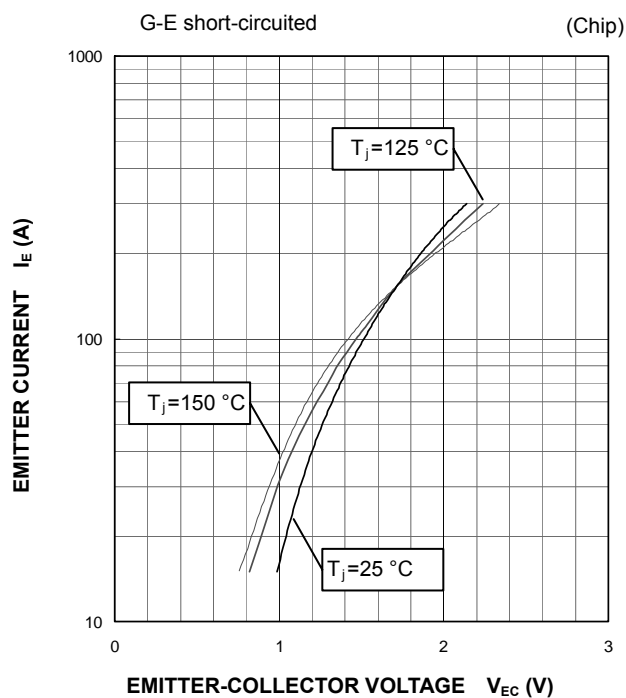
COLLECTOR-EMITTER SATURATION VOLTAGE
 CHARACTERISTICS
 (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
 CHARACTERISTICS
 (TYPICAL)



FREE WHEELING DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)



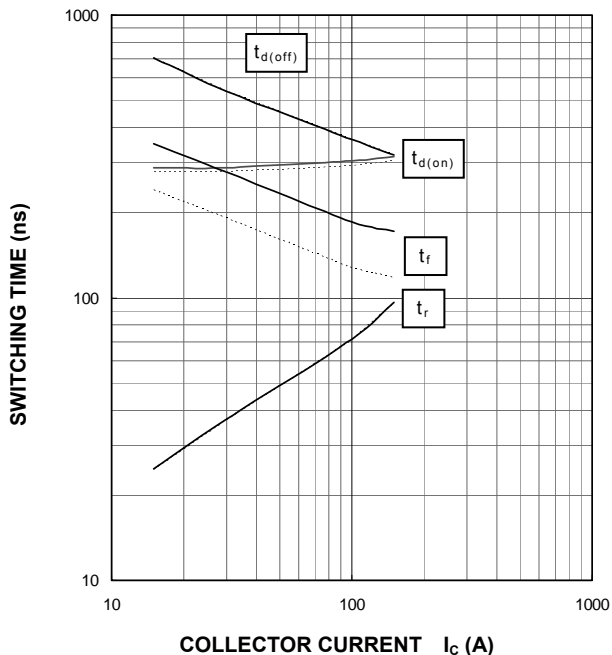
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PERFORMANCE CURVES

INVERTER PART

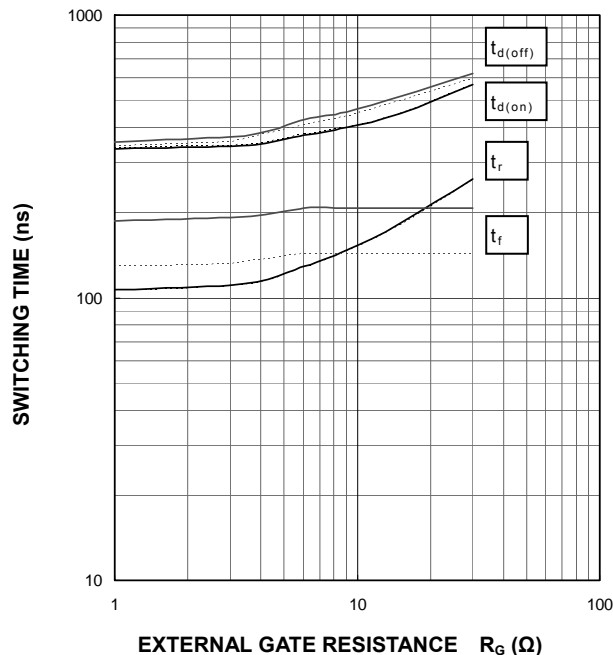
HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)

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



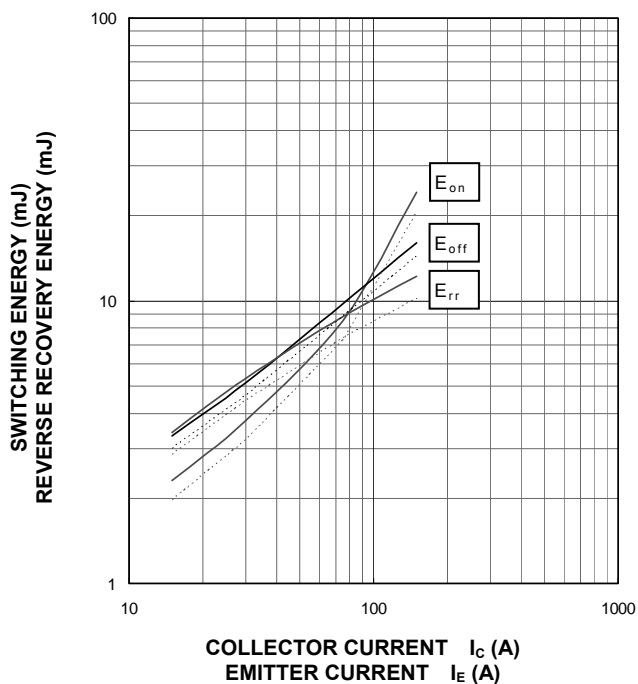
HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)

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



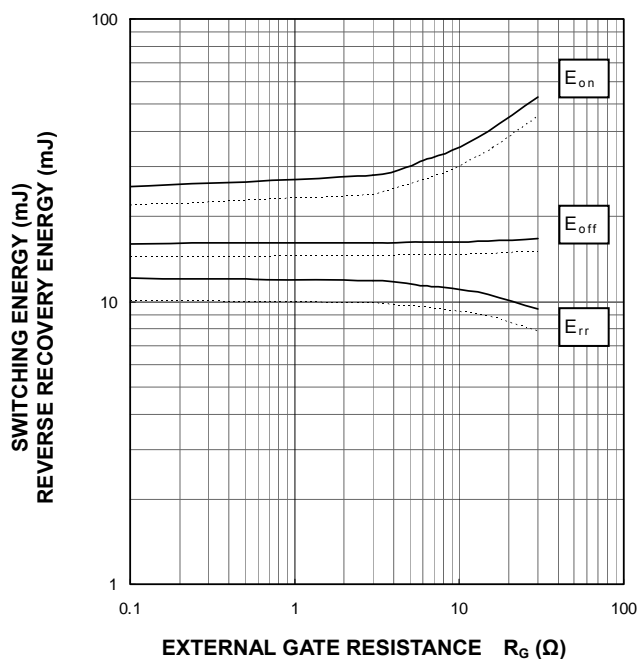
HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)

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



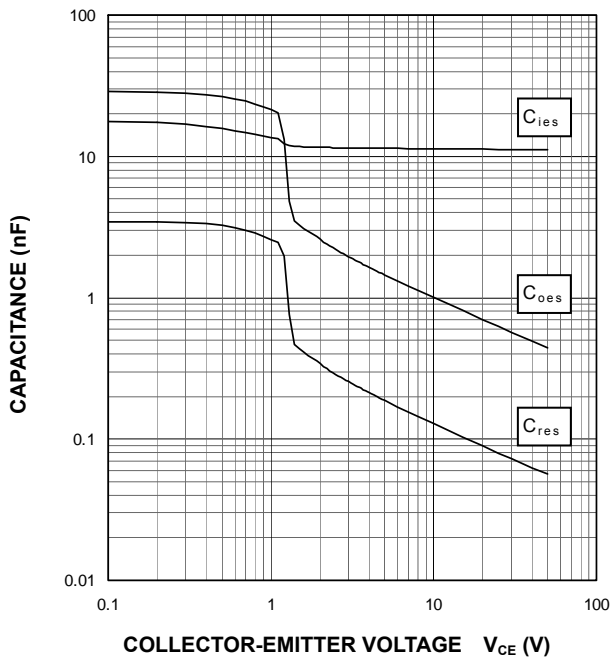
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PERFORMANCE CURVES

INVERTER PART

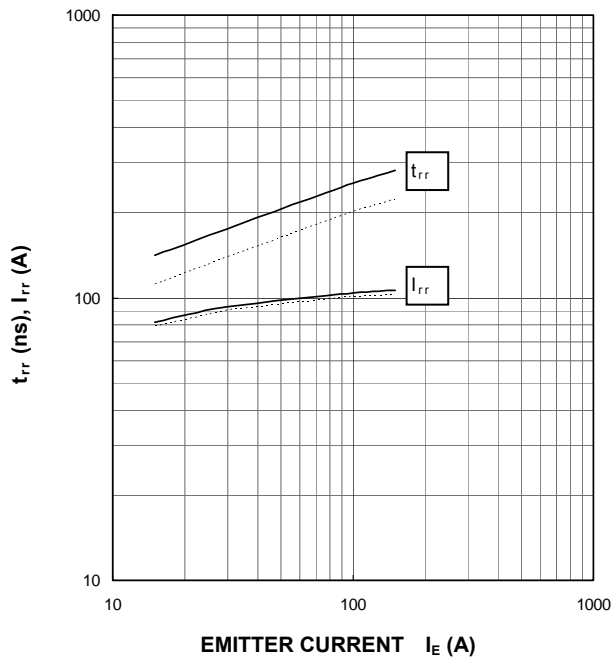
CAPACITANCE CHARACTERISTICS (TYPICAL)

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



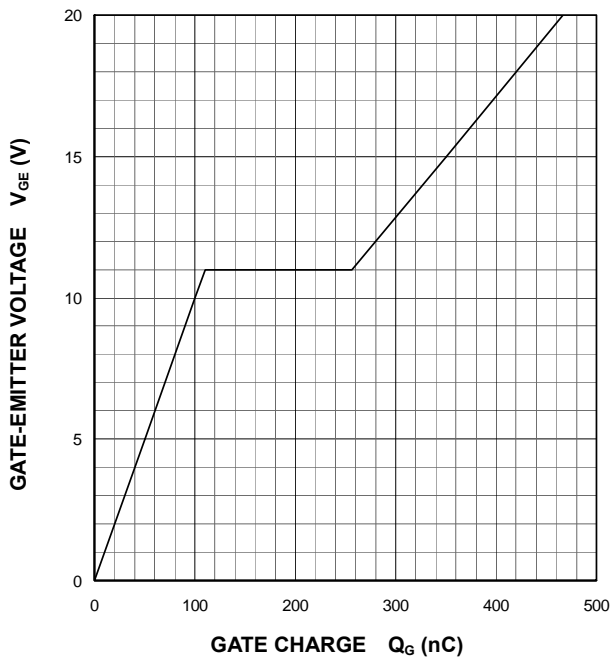
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

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



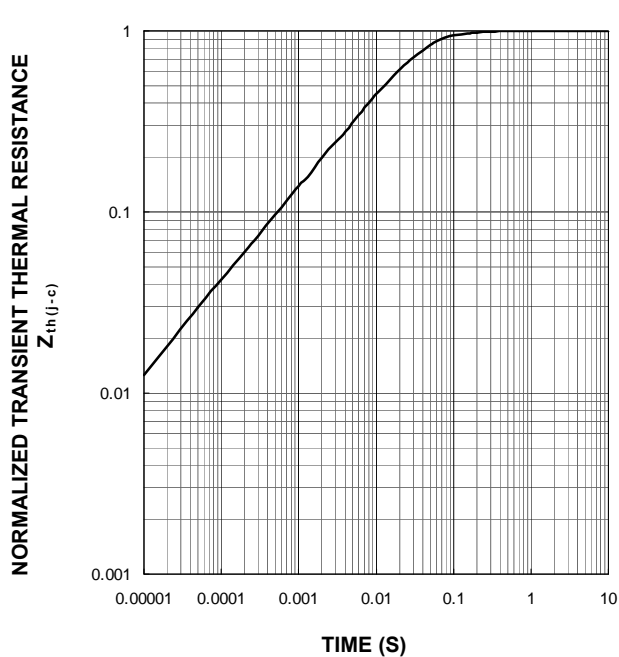
GATE CHARGE CHARACTERISTICS (TYPICAL)

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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

Single pulse, $T_C=25\text{ }^\circ\text{C}$
 $R_{th(j-c)Q}=0.13\text{ K/W}$, $R_{th(j-c)D}=0.23\text{ K/W}$

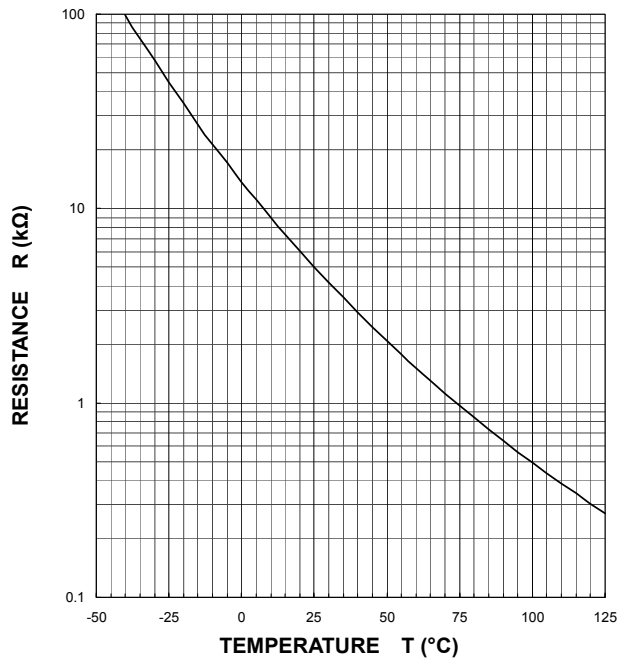


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HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



Keep safety first in your circuit designs!

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