

<IGBT Modules>

CM400DX-12A

HIGH POWER SWITCHING USE
INSULATED TYPE



dual switch (Half-Bridge)

Collector current I_C 400 A
 Collector-emitter voltage V_{CES} 600 V
 Maximum junction temperature T_{jmax} 150 °C

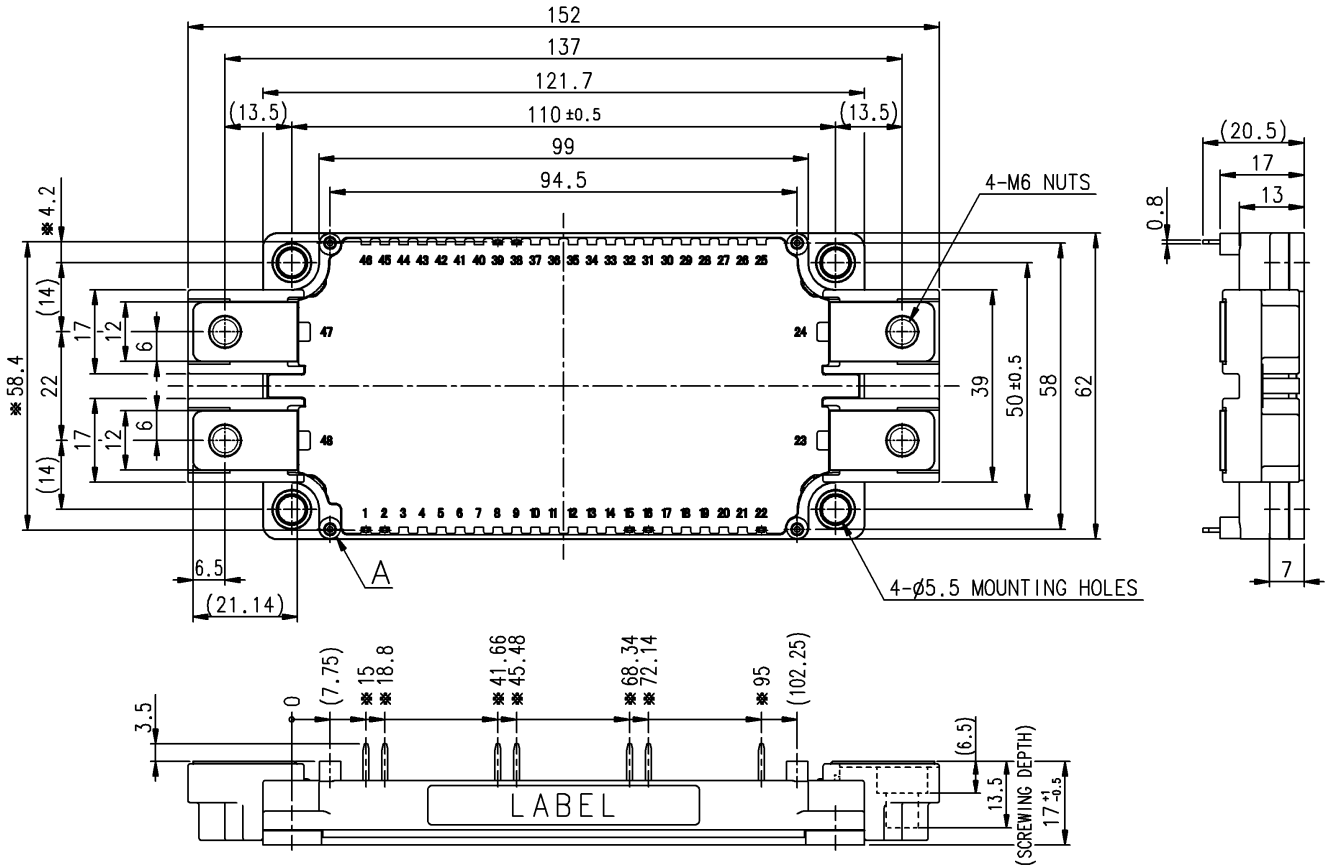
- Flat base Type
- Copper base plate (non-plating)
- RoHS Directive compliant
- Recognized under UL1557, File E323585

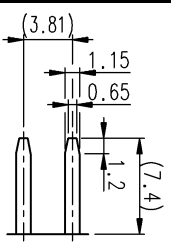
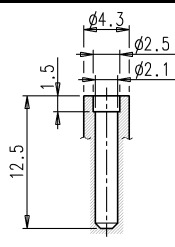
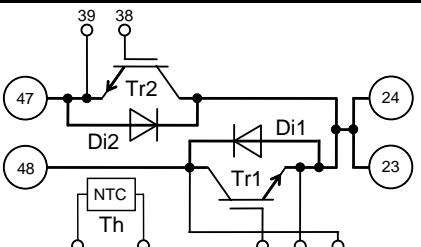
APPLICATION

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

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



TERMINAL t=0.8	SECTION A	INTERNAL CONNECTION
		
		<p>Terminal code</p> <ul style="list-style-type: none"> 1 TH1 2 TH2 15 G1 16 Es1 22 Cs1 23 C2E1 24 C2E1 38 G2 39 Es2 47 E2 48 C1

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

※: Dimensions with a
Tolerance of $\begin{matrix} \square \\ \oplus \end{matrix} \phi 0.5$

CM400DX-12A

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	600	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I_C	Collector current	DC, $T_C=60\text{ }^\circ\text{C}$ (Note2, 4)	400	A
I_{CRM}		Pulse, Repetitive (Note3)	800	
P_{tot}	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note2, 4)	1340	W
I_E (Note1)	Emitter current	DC (Note2)	400	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	800	

MODULE

Symbol	Item	Conditions	Rating	Unit
V_{isol}	Isolation voltage	Terminals to base plate, RMS, $f=60\text{ Hz}$, AC 1 min	2500	V
T_j	Junction temperature	-	-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	$I_C=40\text{ mA}$, $V_{CE}=10\text{ V}$	5	6	7	V
V_{CESat}	Collector-emitter saturation voltage	$I_C=400\text{ A}$, $V_{GE}=15\text{ V}$ (Note5)	-	1.7	2.1	V
		Refer to the figure of test circuit				
		$I_C=400\text{ A}$, $V_{GE}=15\text{ V}$, chip (Note5)	-	1.6	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	50	nF
C_{oes}	Output capacitance		-	-	5.3	
C_{res}	Reverse transfer capacitance		-	-	1.6	
Q_G	Gate charge	$V_{CC}=300\text{ V}$, $I_C=400\text{ A}$, $V_{GE}=15\text{ V}$	-	1100	-	nC
$t_{d(on)}$	Turn-on delay time	$V_{CC}=300\text{ V}$, $I_C=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=3.6\text{ }\Omega$, Inductive load	-	-	200	ns
t_r	Rise time		-	-	200	
$t_{d(off)}$	Turn-off delay time		-	-	400	
t_f	Fall time		-	-	600	
V_{EC} (Note1)	Emitter-collector voltage	$I_E=400\text{ A}$, G-E short-circuited (Note5)	-	2.0	2.8	V
		Refer to the figure of test circuit				
		$I_E=400\text{ A}$, G-E short-circuited, chip (Note5)	-	1.9	-	
t_{rr} (Note1)	Reverse recovery time	$V_{CC}=300\text{ V}$, $I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=3.6\text{ }\Omega$, Inductive load	-	-	200	ns
Q_{rr} (Note1)	Reverse recovery charge	$R_G=3.6\text{ }\Omega$, Inductive load	-	11	-	μC
E_{on}	Turn-on switching energy per pulse	$V_{CC}=300\text{ V}$, $I_C=I_E=400\text{ A}$,	-	13.5	-	mJ
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=3.6\text{ }\Omega$, $T_j=125\text{ }^\circ\text{C}$,	-	23	-	
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	3.8	-	mJ
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note4)	-	1.1	-	$\text{m}\Omega$
r_g	Internal gate resistance	Per switch, $T_C=25\text{ }^\circ\text{C}$ (Note4)	-	0	-	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)	-	-	0.093	K/W
R _{th(j-c)D}		Junction to case, per Inverter DIODE (Note4)	-	-	0.16	
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 6 screw	3.5	4.0	4.5	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	11.55	-	-	mm
		Terminal to base plate	12.32	-	-	
d _a	Clearance	Terminal to terminal	10.00	-	-	mm
		Terminal to base plate	10.85	-	-	
m	mass	-	-	330	-	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).

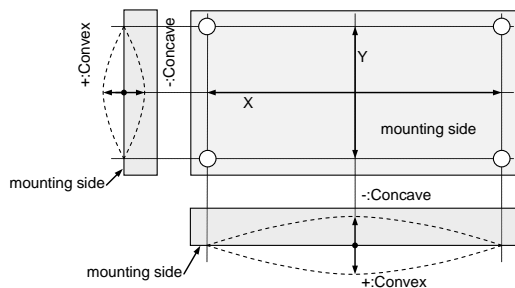
- Junction temperature (T_j) should not increase beyond T_{jmax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) does not exceed T_{jmax} rating.
- Case temperature (T_C) and heat sink temperature (T_s) are defined on the each surface (mounting side) 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.



- 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.

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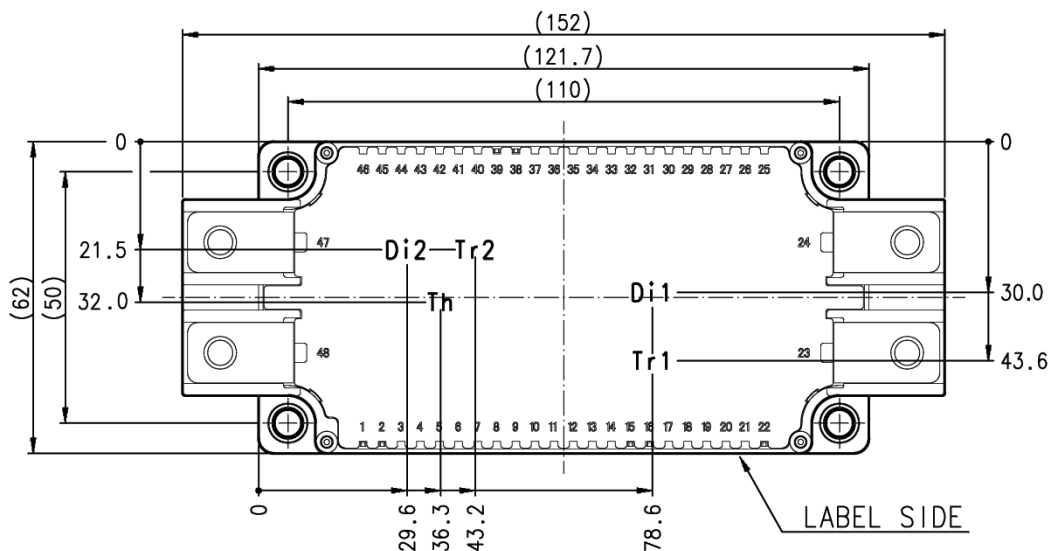
HIGH POWER SWITCHING USE
INSULATED TYPE

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	300	400	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2 terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	1.6	-	16	Ω

CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm

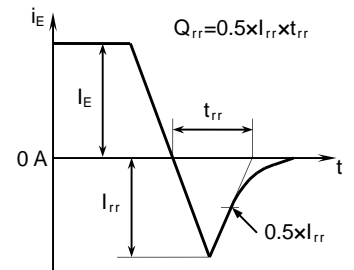
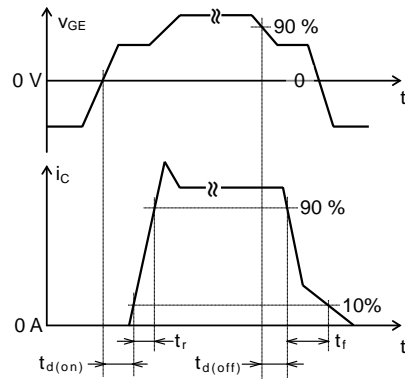
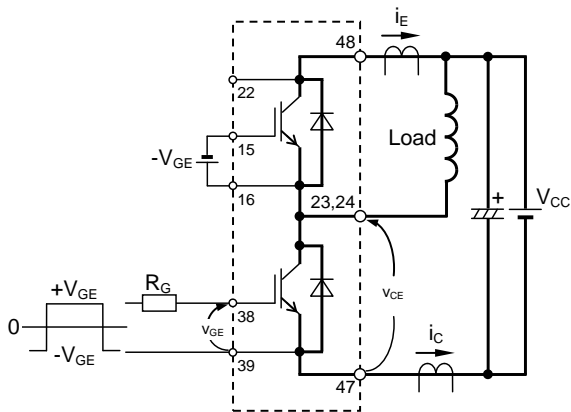


Tr1/Tr2: IGBT, Di1/Di2: DIODE, Th: NTC thermistor

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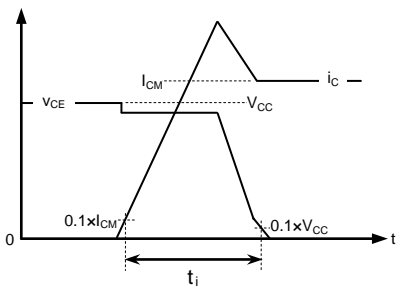
HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

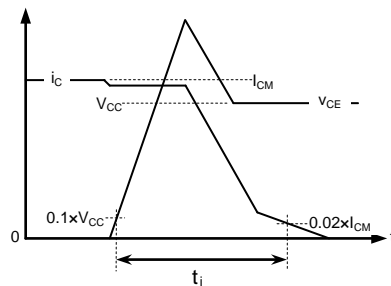


Switching test circuit and waveforms

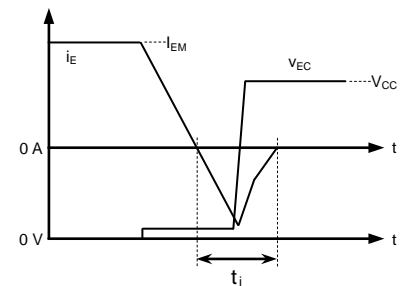
t_{rr} , Q_{rr} test waveform



IGBT Turn-on switching energy



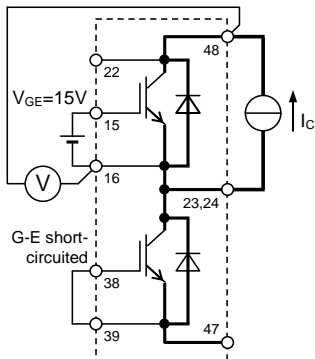
IGBT Turn-off switching energy



DIODE Reverse recovery energy

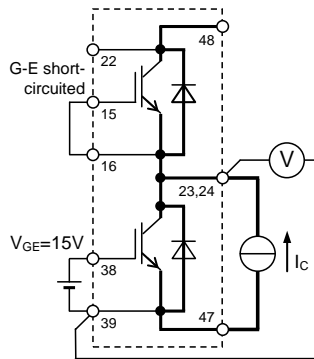
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

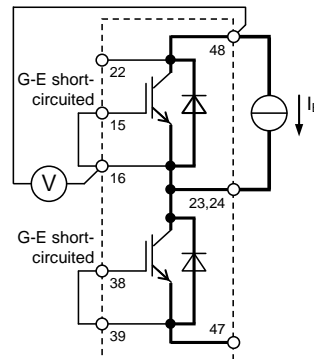


Tr1

V_{CEsat} characteristics test circuit

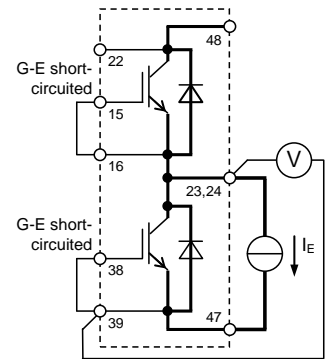


Tr2



Di1

V_{EC} characteristics test circuit



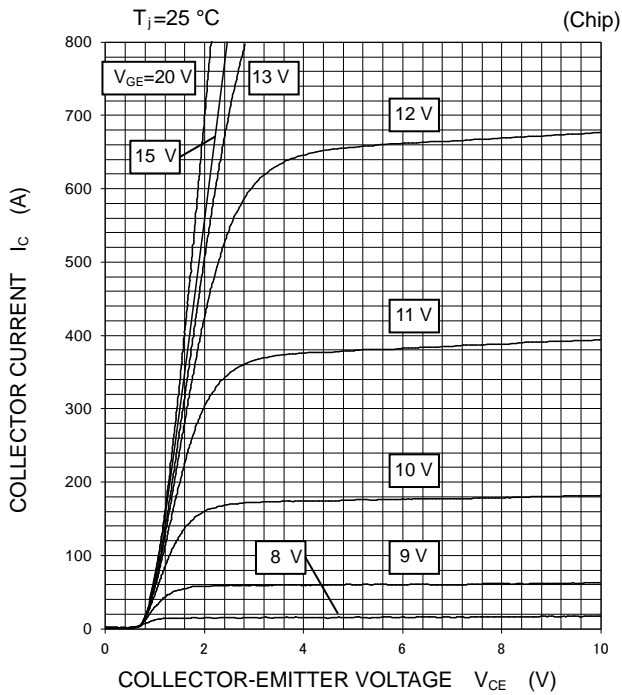
Di2

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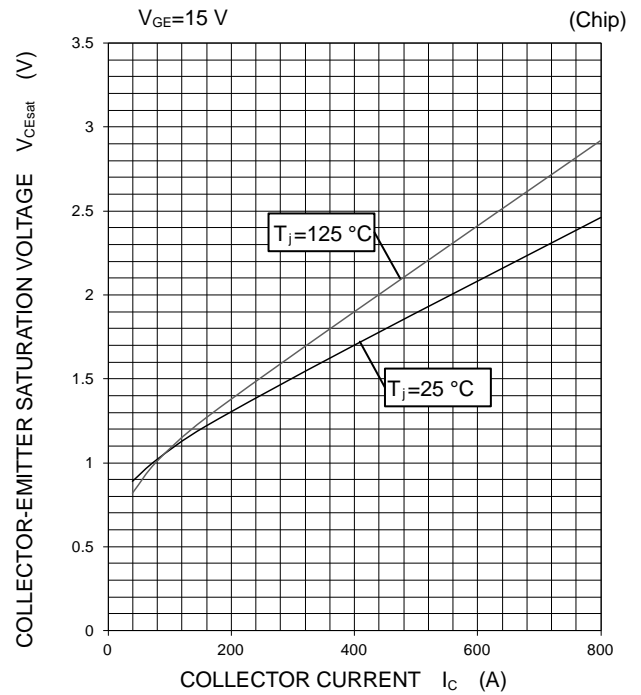
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES INVERTER PART

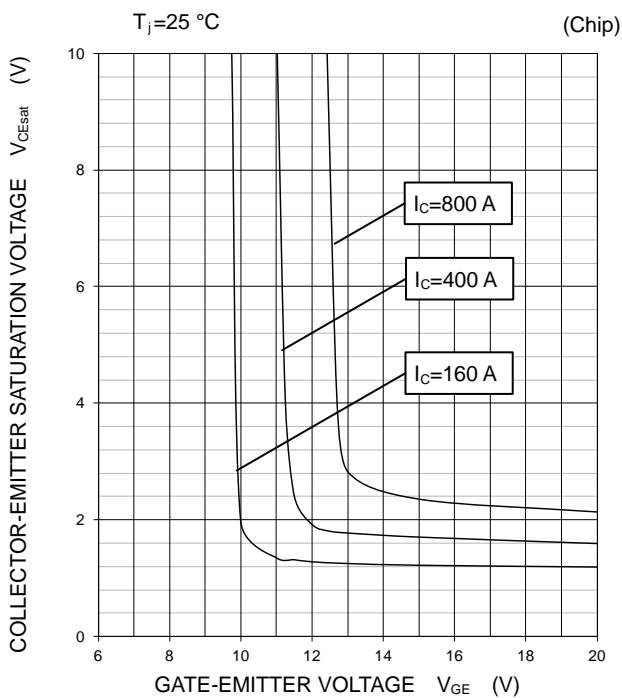
OUTPUT CHARACTERISTICS (TYPICAL)



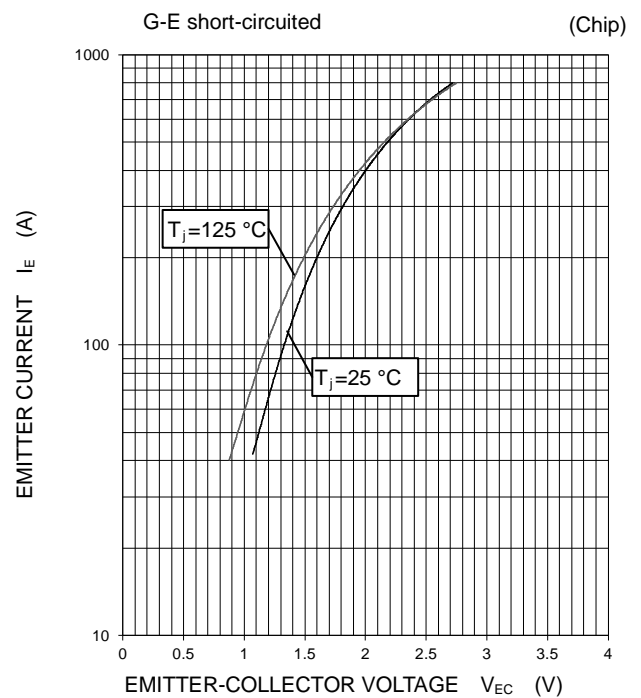
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



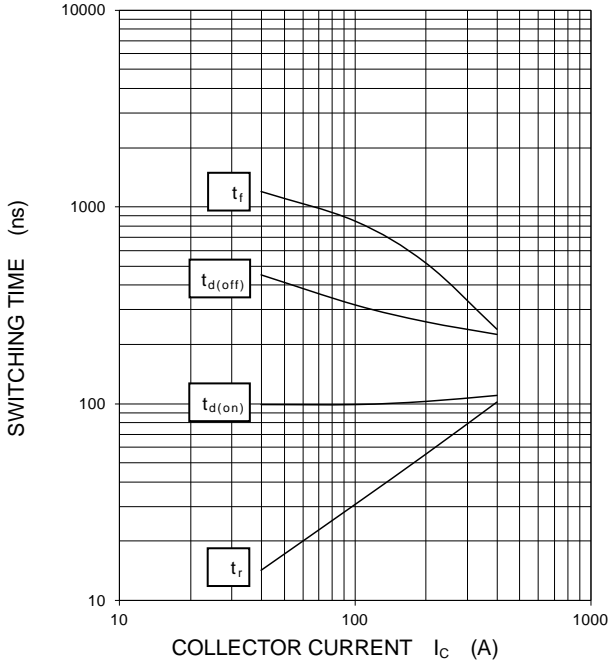
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HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES
INVERTER PART

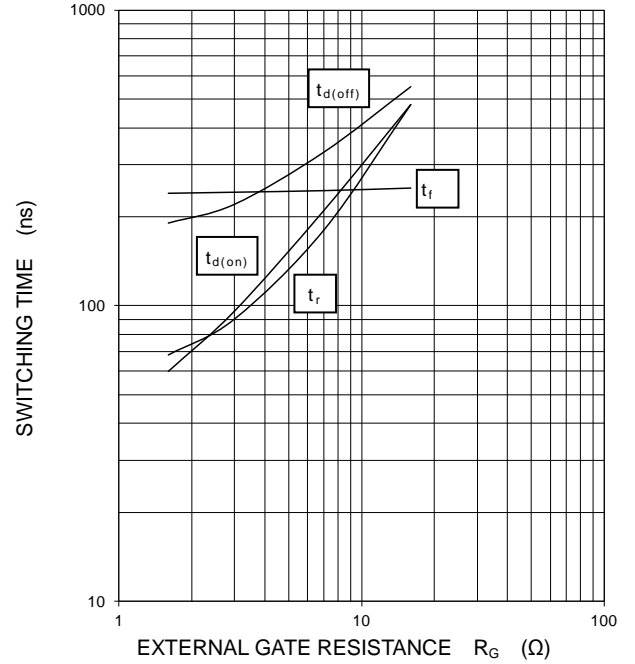
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=3.6\ \Omega$,
 $T_j=125\text{ }^\circ\text{C}$, INDUCTIVE LOAD



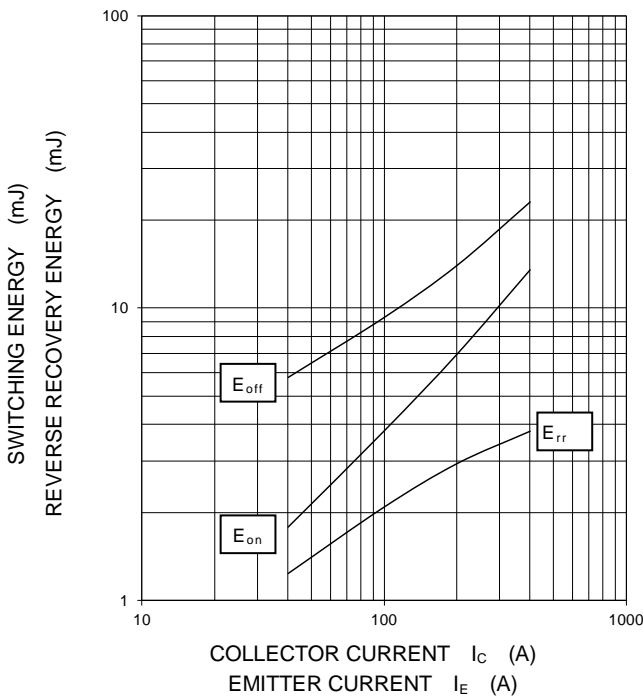
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=400\text{ A}$,
 $T_j=125\text{ }^\circ\text{C}$, INDUCTIVE LOAD



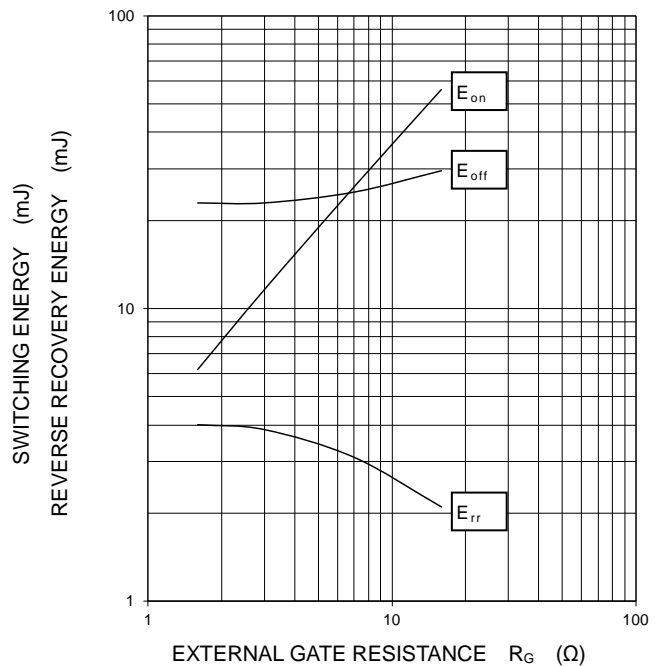
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=3.6\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
INDUCTIVE LOAD, PER PULSE



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C/I_E=400\text{ A}$, $T_j=125\text{ }^\circ\text{C}$
INDUCTIVE LOAD, PER PULSE

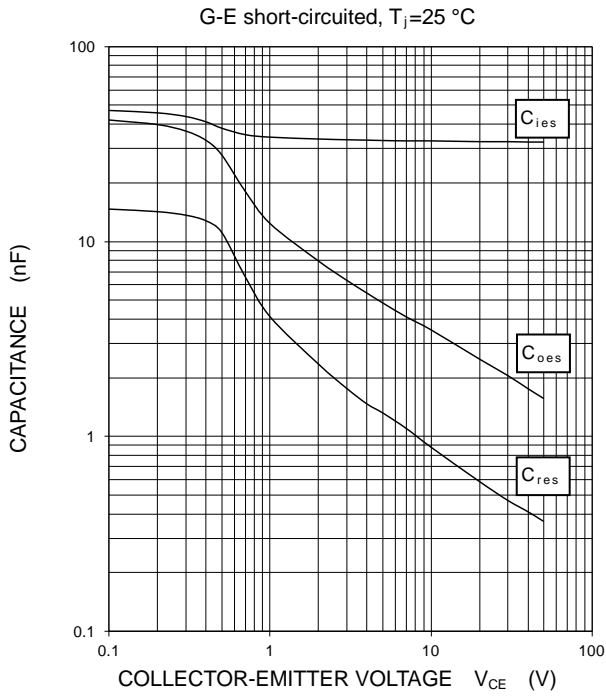


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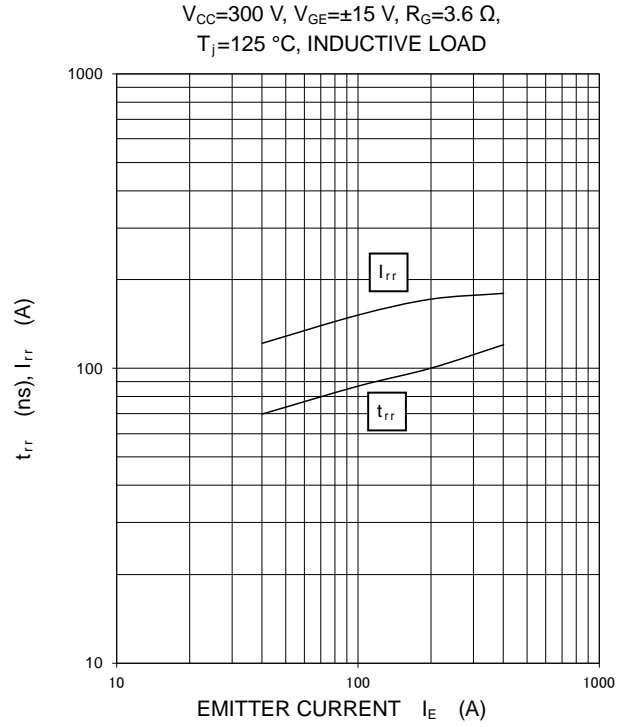
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES INVERTER PART

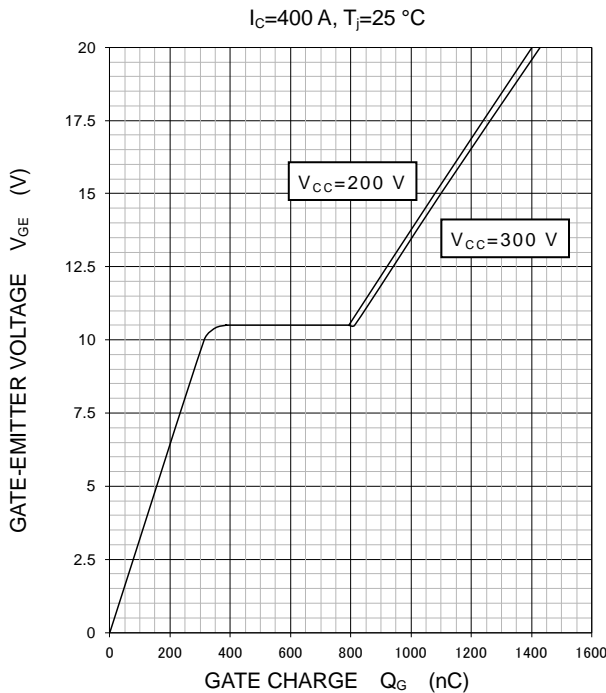
CAPACITANCE CHARACTERISTICS (TYPICAL)



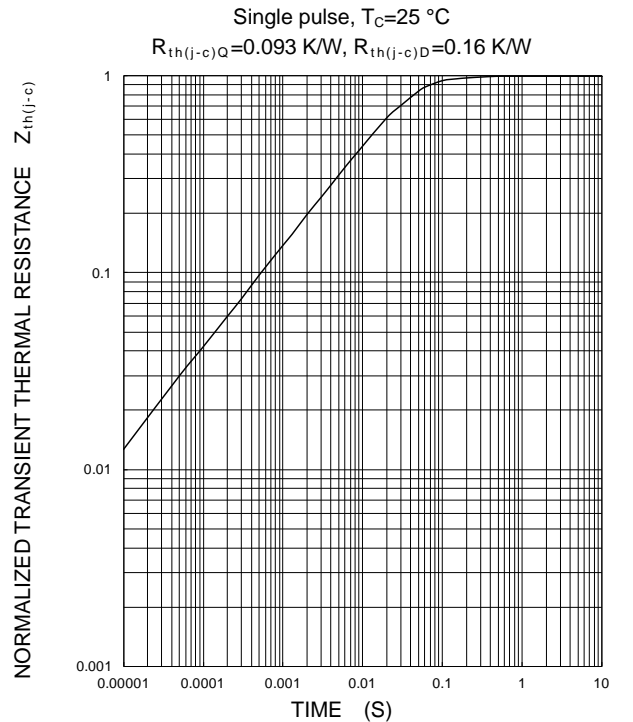
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



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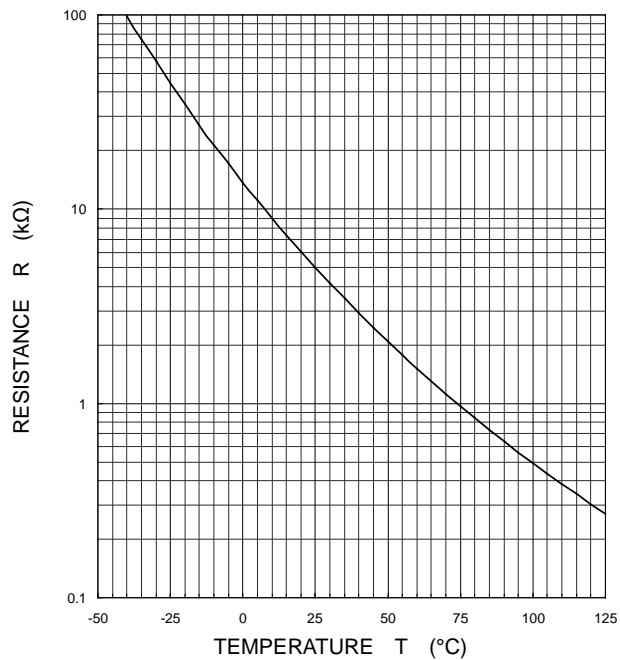
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS

(TYPICAL)



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