

< IGBT MODULES >

# CM300DX-24S1

HIGH POWER SWITCHING USE  
INSULATED TYPE



**Dual switch (Half-Bridge)**

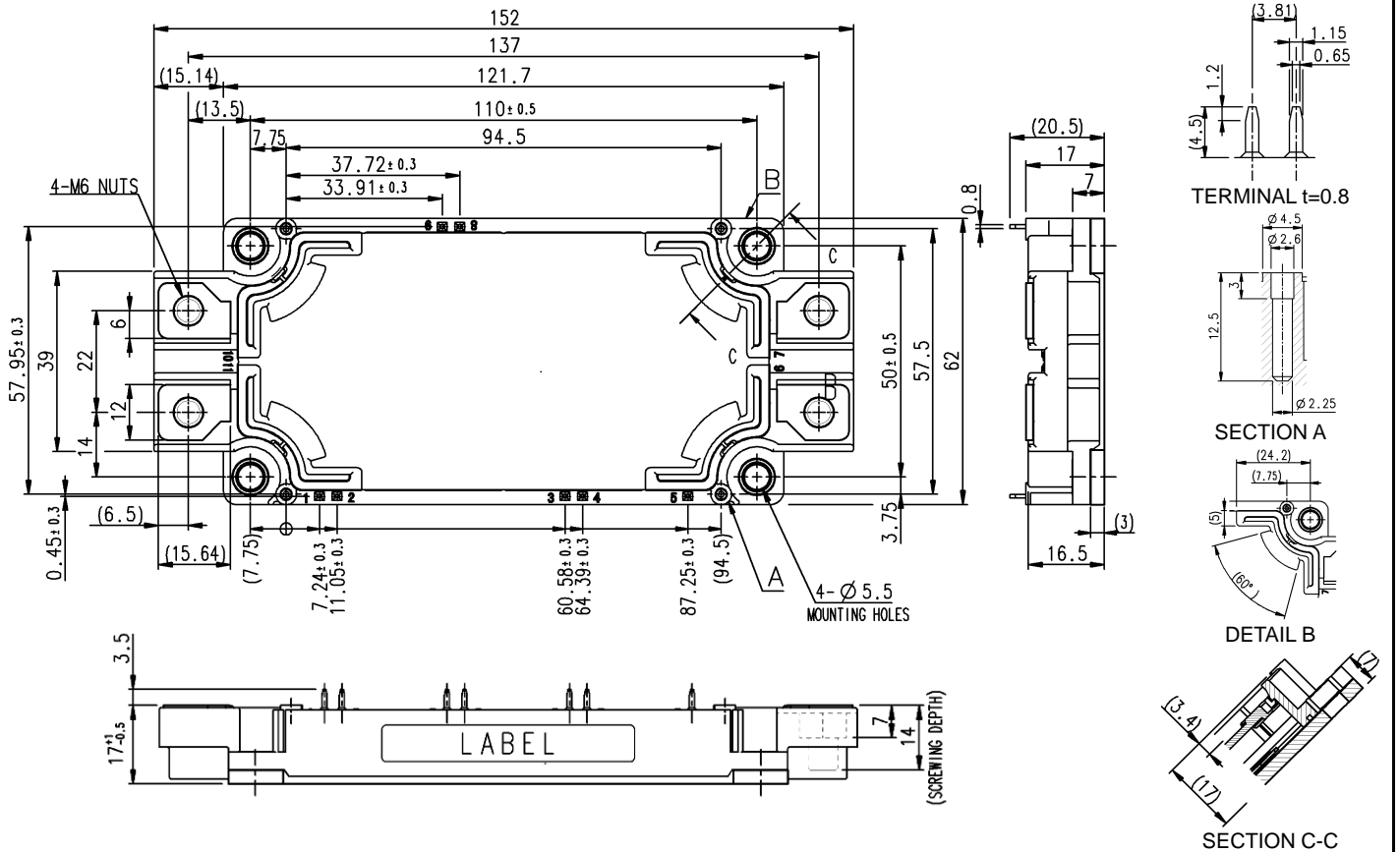
Collector current  $I_C$  ..... **300 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **1200 V**  
 Maximum junction temperature  $T_{jmax}$  ..... **175 °C**

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

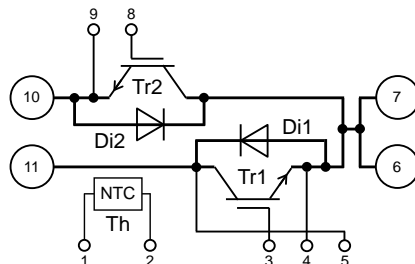
## APPLICATION

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

## OUTLINE DRAWING & INTERNAL CONNECTION



### INTERNAL CONNECTION



#### Terminal code

- 1 TH1
- 2 TH2
- 3 G1
- 4 Es1
- 5 Cs1
- 6 C2E1
- 7 C2E1
- 8 G2
- 9 Es2
- 10 E2
- 11 C1

Tolerance otherwise specified

Division of Dimension	Tolerance
0.5 to 3	$\pm 0.2$
over 3 to 6	$\pm 0.3$
over 6 to 30	$\pm 0.5$
over 30 to 120	$\pm 0.8$
over 120 to 400	$\pm 1.2$

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MAXIMUM 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	$\pm 20$	V
$I_C$	Collector current	DC, $T_C=107\text{ }^\circ\text{C}$ (Note2, 4)	300	A
$I_{CRM}$		Pulse, Repetitive (Note3)	600	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note2, 4)	1850	W
$I_E$ (Note1)	Emitter current	DC (Note2)	300	A
$I_{ERM}$ (Note1)		Pulse, Repetitive (Note3)	600	

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	$^\circ\text{C}$
$T_{Cmax}$	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	$\mu\text{A}$	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=30\text{ mA}$ , $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
$V_{CESat}$ (Terminal)	Collector-emitter saturation voltage	$I_C=300\text{ A}$ , $V_{GE}=15\text{ V}$ , 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	$I_C=300\text{ A}$ , $V_{GE}=15\text{ V}$ , (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	-	-	30	nF	
$C_{oes}$	Output capacitance		-	-	6.0		
$C_{res}$	Reverse transfer capacitance		-	-	0.5		
$Q_G$	Gate charge	$V_{CC}=600\text{ V}$ , $I_C=300\text{ A}$ , $V_{GE}=15\text{ V}$	-	630	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$ , $I_C=300\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=0\ \Omega$ , 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	$I_E=300\text{ A}$ , 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	$I_E=300\text{ A}$ , 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	$V_{CC}=600\text{ V}$ , $I_E=300\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ ,	-	-	300	ns	
$Q_{rr}$ (Note1)	Reverse recovery charge	$R_G=0\ \Omega$ , Inductive load	-	8.0	-		$\mu\text{C}$
$E_{on}$	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$ , $I_C=I_E=300\text{ A}$ ,	-	26.7	-	mJ	
$E_{off}$	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$ , $R_G=0\ \Omega$ , $T_j=150\text{ }^\circ\text{C}$ ,	-	35.7	-		
$E_{rr}$ (Note1)	Reverse recovery energy per pulse	Inductive load	-	18.6	-	mJ	
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note2)	-	-	0.9	m $\Omega$	
$r_g$	Internal gate resistance	Per switch	-	6.5	-	$\Omega$	

**ELECTRICAL CHARACTERISTICS (cont.; T<sub>j</sub>=25 °C, unless otherwise specified)**

**NTC THERMISTOR PART**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Zero-power resistance	T <sub>C</sub> =25 °C (Note4)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R <sub>100</sub> =493 Ω, T <sub>C</sub> =100 °C (Note4)	-7.3	-	+7.8	%
B <sub>(25/50)</sub>	B-constant	Approximate by equation (Note6)	-	3375	-	K
P <sub>25</sub>	Power dissipation	T <sub>C</sub> =25 °C (Note4)	-	-	10	mW

**THERMAL RESISTANCE CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	81	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per Inverter DIODE (Note4)	-	-	130	
R <sub>th(c-s)</sub>	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 <sub>t</sub>	Mounting torque	Main terminals M 6 screw	3.5	4.0	4.5	N·m
M <sub>s</sub>	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
m	mass	-	-	350	-	g
d <sub>s</sub>	Creepage distance	Terminal to terminal	17	-	-	mm
		Terminal to base plate	18.5	-	-	
d <sub>a</sub>	Clearance	Terminal to terminal	10	-	-	mm
		Terminal to base plate	16.3	-	-	
e <sub>c</sub>	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<sub>j</sub>) should not increase beyond T<sub>jmax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>j</sub>) dose not exceed T<sub>jmax</sub> rating.
- Case temperature (T<sub>C</sub>) and heat sink temperature (T<sub>s</sub>) 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.

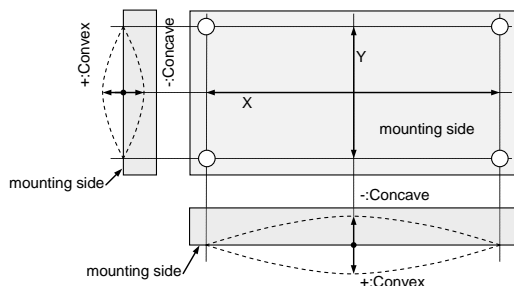
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right),$$

R<sub>25</sub>: resistance at absolute temperature T<sub>25</sub> [K]; T<sub>25</sub>=25 [°C]+273.15=298.15 [K]

R<sub>50</sub>: resistance at absolute temperature T<sub>50</sub> [K]; T<sub>50</sub>=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.



- Use the following screws when mounting the printed circuit board (PCB) on the stand offs.  
"φ2.6×10 or φ2.6×12 B1 tapping screw"  
The length of the screw depends on thickness (t1.6~t2.0) of the PCB.

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CM300DX-24S1

HIGH POWER SWITCHING USE

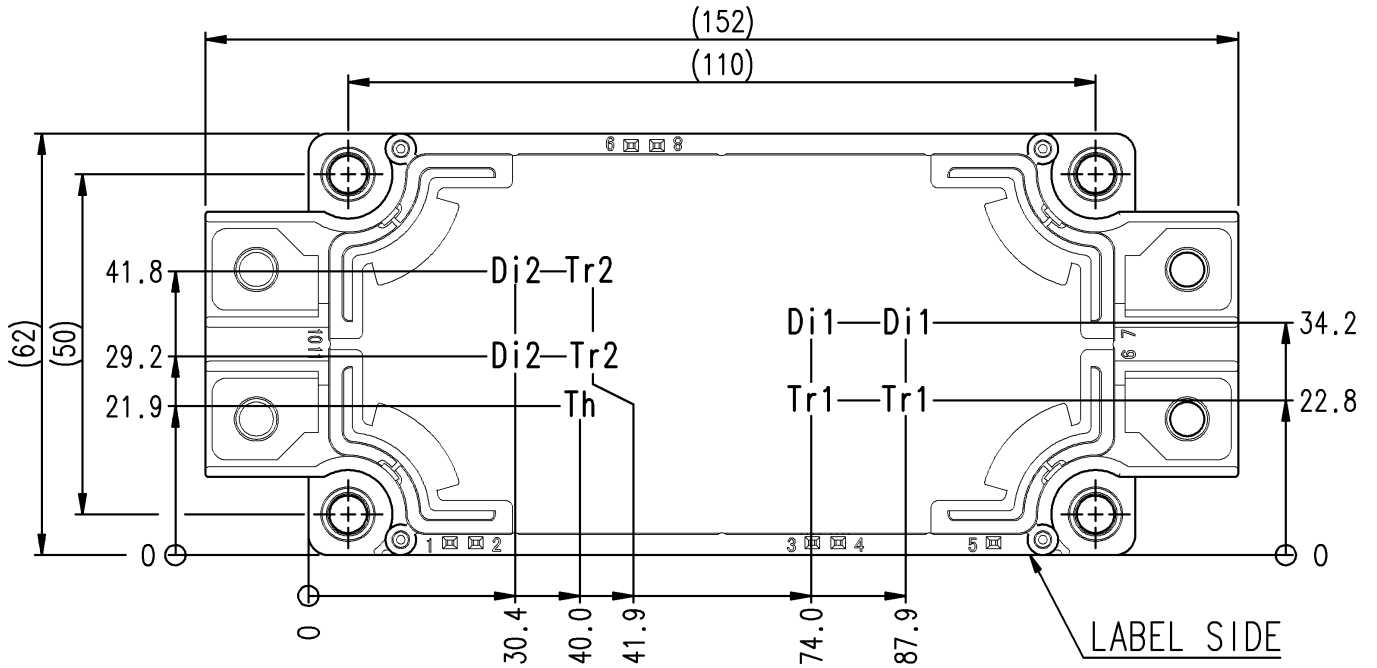
INSULATED TYPE

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC}$	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	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	0	-	15	$\Omega$

CHIP LOCATION (Top view)

Dimension in mm, tolerance:  $\pm 1$  mm

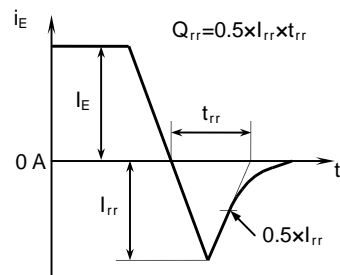
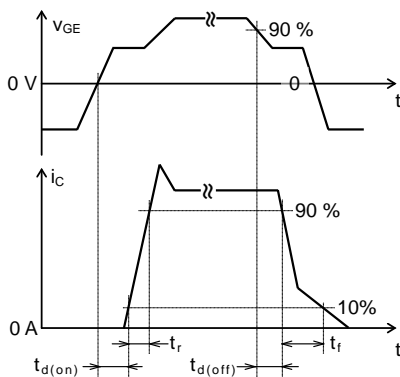
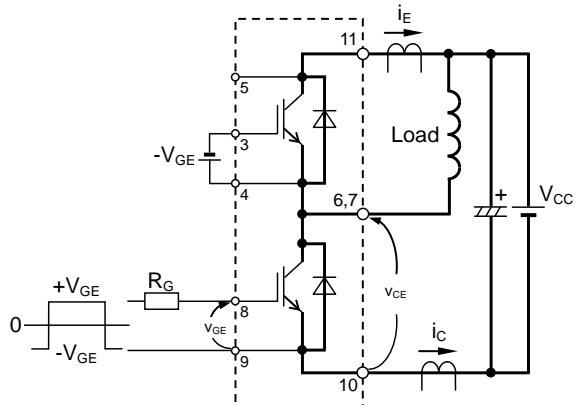


Tr1/Tr2: IGBT, Di1/Di2: DIODE, Th: NTC thermistor

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**CM300DX-24S1**

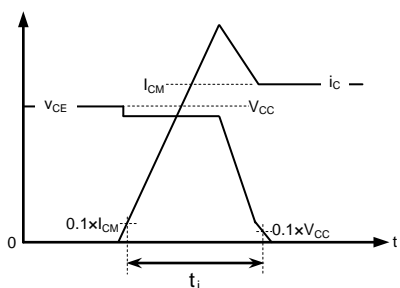
**HIGH POWER SWITCHING USE**  
**INSULATED TYPE**

**TEST CIRCUIT AND WAVEFORMS**

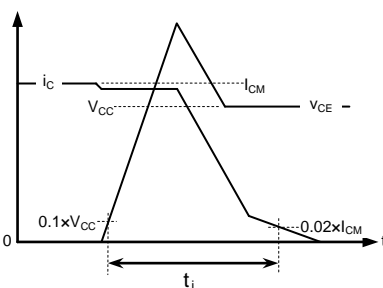


**Switching characteristics test circuit and waveforms**

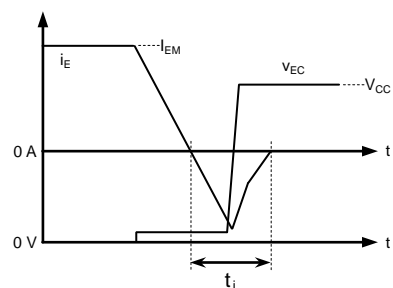
**t<sub>rr</sub>, Q<sub>rr</sub> characteristics test waveform**



**IGBT Turn-on switching energy**



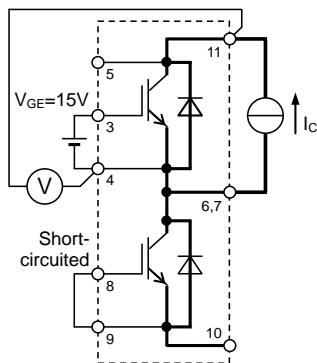
**IGBT Turn-off switching energy**



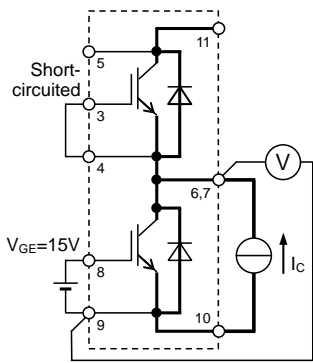
**DIODE Reverse recovery energy**

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

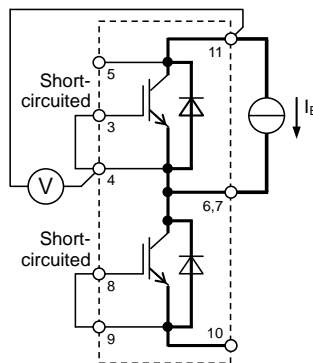
**TEST CIRCUIT**



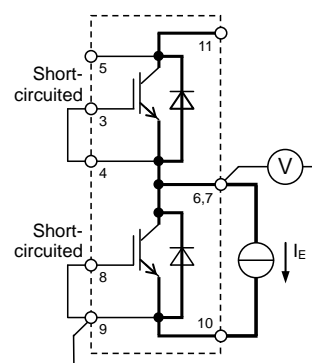
**Tr1**  
**V<sub>CEsat</sub> characteristics test circuit**



**Tr2**



**Di1**  
**V<sub>EC</sub> characteristics test circuit**



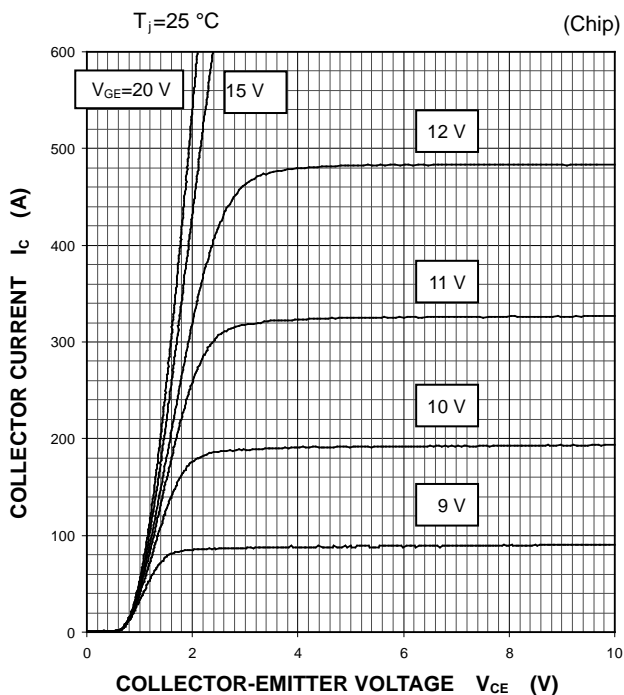
**Di2**

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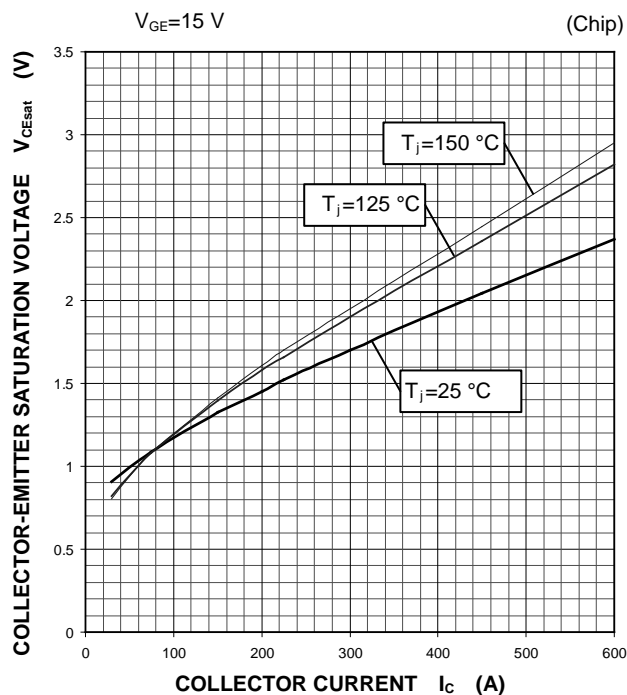
PERFORMANCE CURVES

INVERTER PART

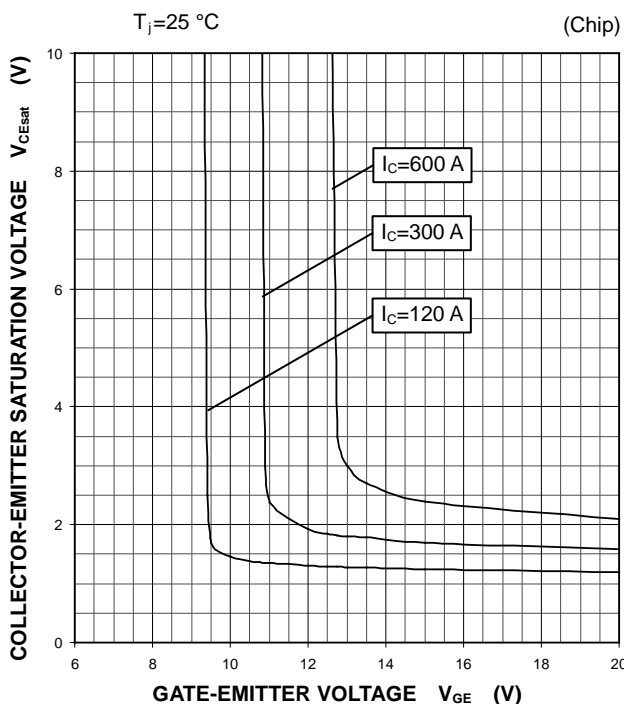
OUTPUT CHARACTERISTICS  
 (TYPICAL)



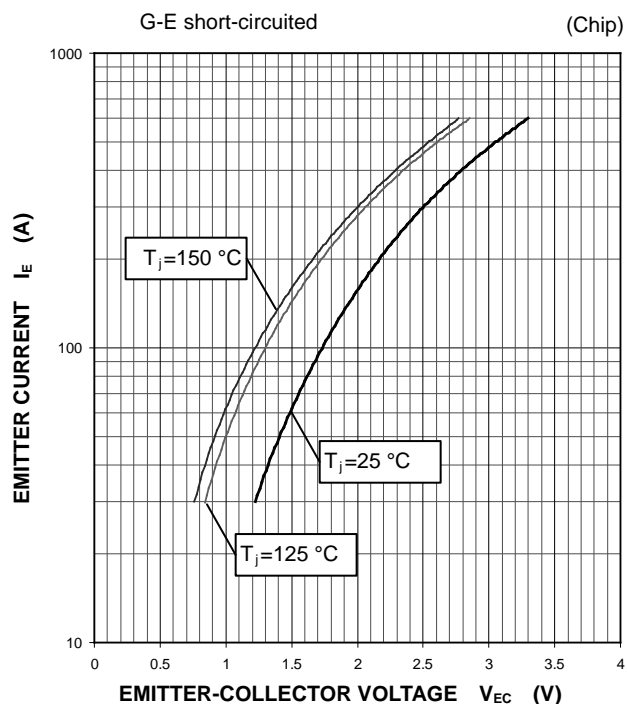
COLLECTOR-EMITTER SATURATION VOLTAGE  
 CHARACTERISTICS  
 (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE  
 CHARACTERISTICS  
 (TYPICAL)



FREE WHEELING DIODE  
 FORWARD CHARACTERISTICS  
 (TYPICAL)



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**CM300DX-24S1**

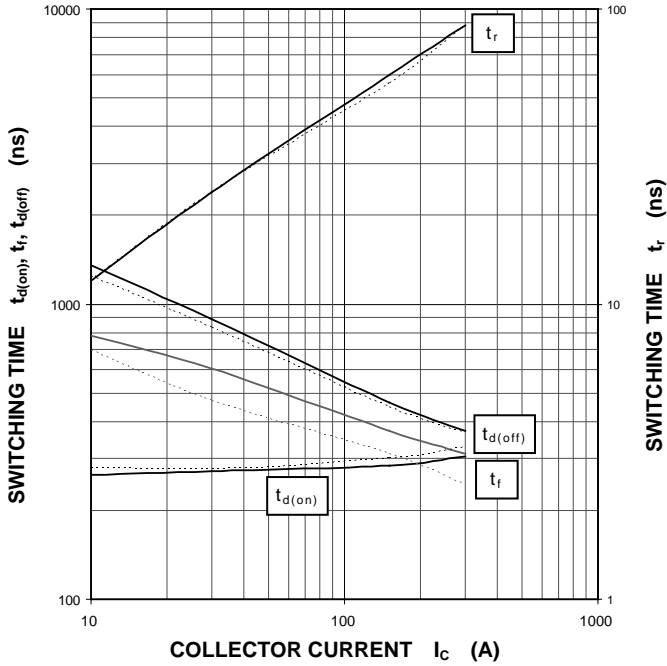
HIGH POWER SWITCHING USE  
 INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

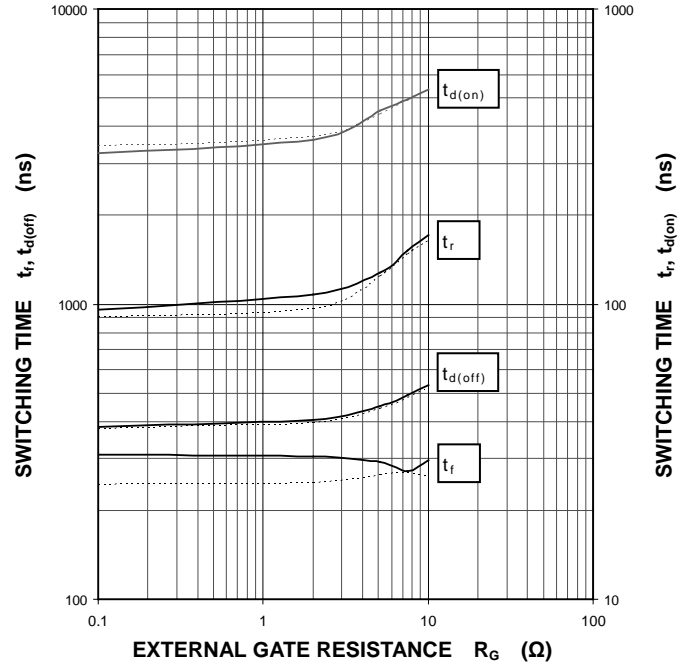
HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)

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



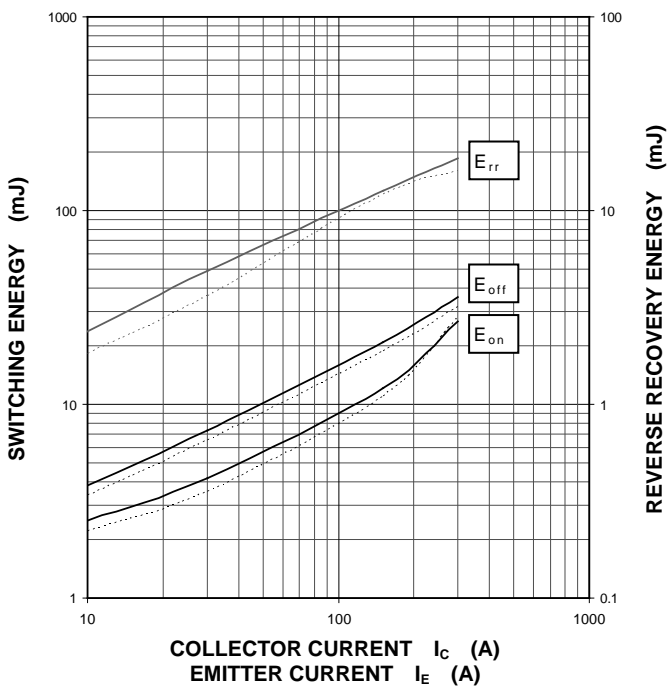
HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C=300\text{ A}$ , INDUCTIVE LOAD  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - - -:  $T_j=125\text{ }^\circ\text{C}$



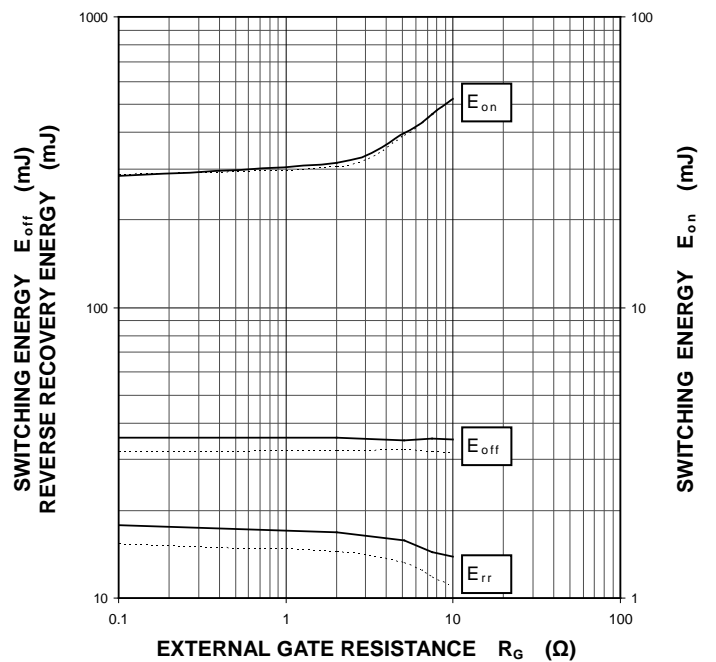
HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)

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



HALF-BRIDGE  
 SWITCHING CHARACTERISTICS  
 (TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C/I_E=300\text{ A}$ ,  
 INDUCTIVE LOAD, PER PULSE  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - - -:  $T_j=125\text{ }^\circ\text{C}$



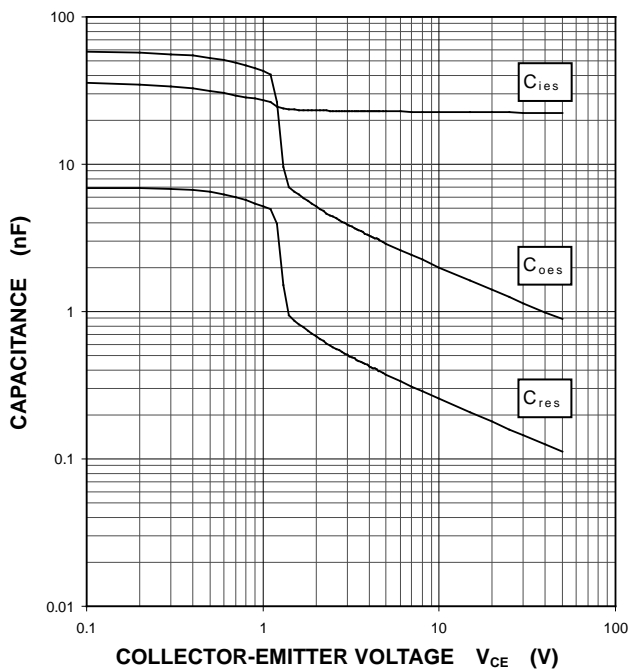
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 HIGH POWER SWITCHING USE  
 INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

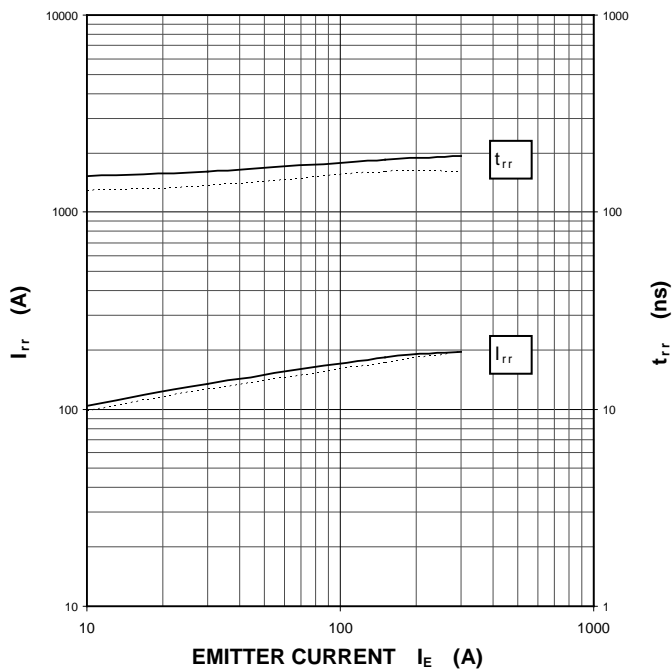
**CAPACITANCE CHARACTERISTICS (TYPICAL)**

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



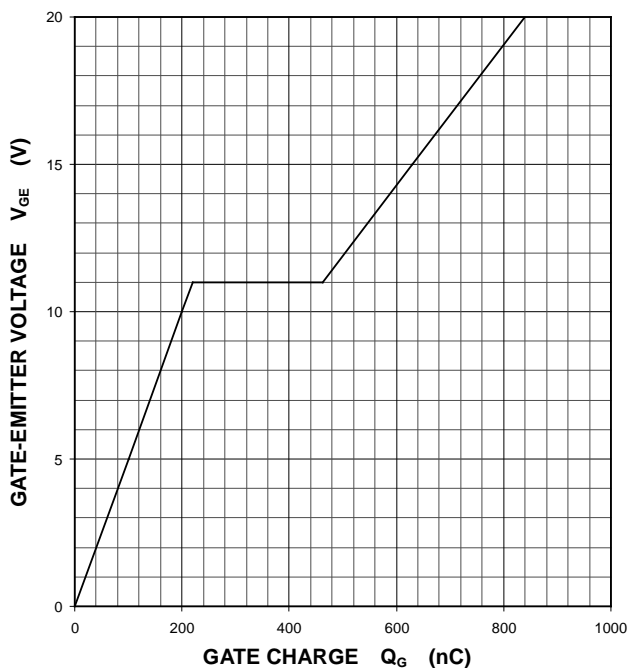
**FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**

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



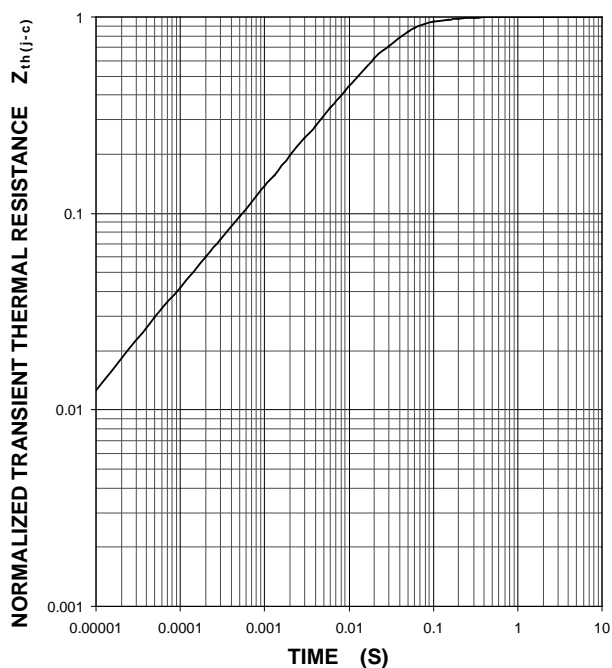
**GATE CHARGE CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C=300\text{ A}$ ,  $T_j=25\text{ }^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**

Single pulse,  $T_C=25\text{ }^\circ\text{C}$   
 $R_{th(j-c)Q}=81\text{ K/kW}$ ,  $R_{th(j-c)D}=130\text{ K/kW}$





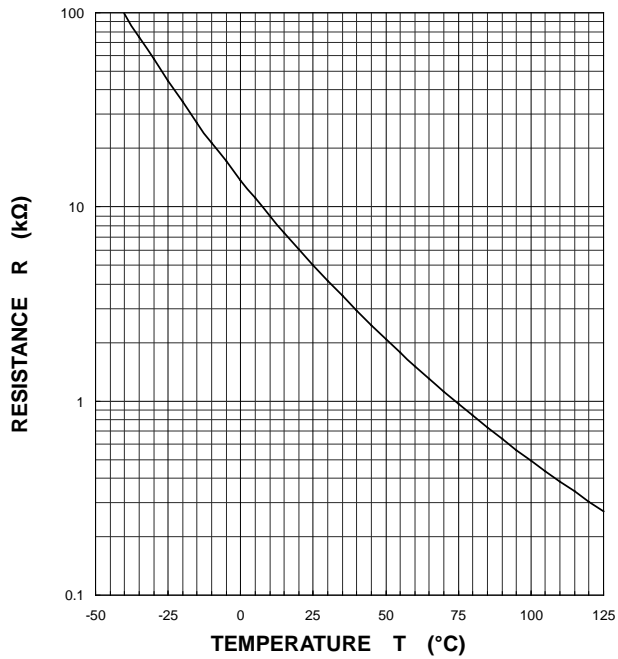
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CM300DX-24S1  
HIGH POWER SWITCHING USE  
INSULATED TYPE

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PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS  
(TYPICAL)



### **Keep safety first in your circuit designs!**

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