

< IGBT MODULES >

# CM300EXS-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE



Brake-chopper

Collector current  $I_C$  ..... **3 0 0 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **1 2 0 0 V**  
 Maximum junction temperature  $T_{jmax}$  ..... **1 7 5 °C**

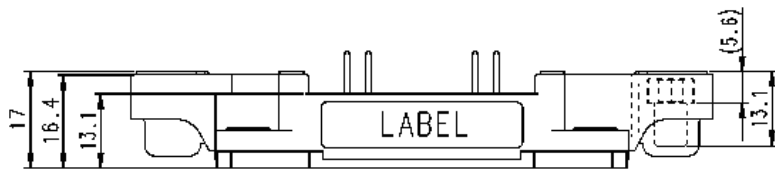
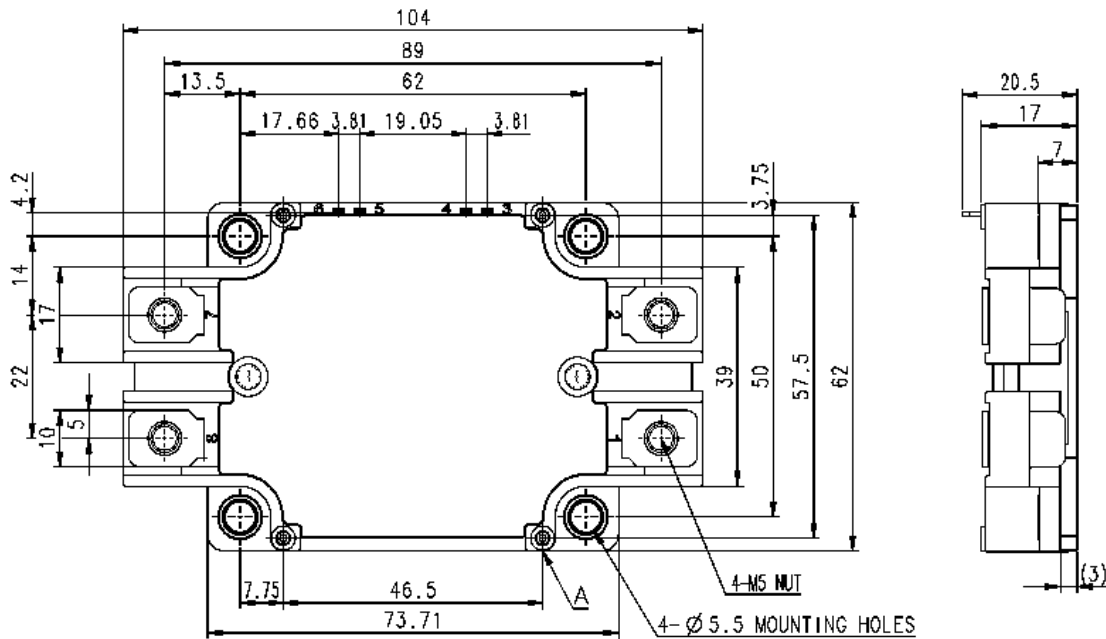
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- Recognized under UL1557, File E323585

## APPLICATION

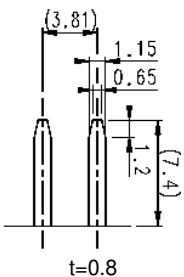
Brake

## OUTLINE DRAWING & INTERNAL CONNECTION

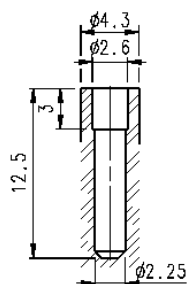
Dimension in mm



### TERMINAL



### SECTION A

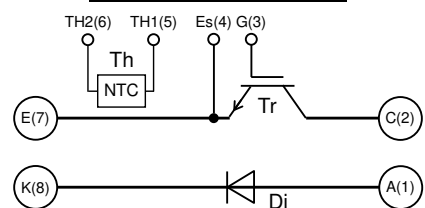


Tolerance otherwise specified

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.

### INTERNAL CONNECTION



## &lt; IGBT MODULES &gt;

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MAXIMUM RATINGS ( $T_j=25\text{ }^\circ\text{C}$ , unless otherwise specified)

## IGBT PART

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, $T_C=119\text{ }^\circ\text{C}$ (Note1, 3)	300	A
$I_{CRM}$		Pulse, Repetitive (Note2)	600	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note1, 3)	2270	W

## DIODE PART

Symbol	Item	Conditions	Rating	Unit
$V_{RRM}$	Repetitive peak reverse voltage	-	1200	V
$I_F$	Forward current	DC (Note1)	300	A
$I_{FRM}$		Pulse, Repetitive (Note2)	600	

## 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	(Note3)	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)

## IGBT PART

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 (Note4)	$T_j=25\text{ }^\circ\text{C}$	-	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)		$I_C=300\text{ A}$ , $V_{GE}=15\text{ V}$ , (Note4)	$T_j=25\text{ }^\circ\text{C}$	-	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	$V_{CC}=600\text{ V}$ , $I_C=300\text{ A}$ , $V_{GE}=15\text{ V}$	-	700	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$ , $I_C=300\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=0\text{ }\Omega$ , Inductive load	-	-	800	ns	
$t_r$	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	600		
$t_f$	Fall time		-	-	300		
$E_{on}$	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$ , $I_C=300\text{ A}$ ,	-	41	-	mJ	
$E_{off}$	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$ , $R_G=0\text{ }\Omega$ , $T_j=150\text{ }^\circ\text{C}$ ,	-	32	-		
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note3)	-	-	2.0	m $\Omega$	
$r_g$	Internal gate resistance	-	-	6.5	-	$\Omega$	

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

**DIODE PART**

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>RRM</sub>	Reverse current	V <sub>R</sub> =V <sub>RRM</sub>	-	-	1.0	mA	
V <sub>F</sub> (Terminal)	Forward voltage	I <sub>F</sub> =300 A, Refer to the figure of test circuit (Note4)	T <sub>j</sub> =25 °C	-	1.8	2.25	V
V <sub>F</sub> (Chip)			T <sub>j</sub> =125 °C	-	1.8	-	
			T <sub>j</sub> =150 °C	-	1.8	-	
		I <sub>F</sub> =300 A, (Note4)	T <sub>j</sub> =25 °C	-	1.7	2.15	V
			T <sub>j</sub> =125 °C	-	1.7	-	
			T <sub>j</sub> =150 °C	-	1.7	-	
t <sub>rr</sub>	Reverse recovery time	V <sub>CC</sub> =600 V, I <sub>F</sub> =300 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load	-	-	300	ns	
Q <sub>rr</sub>	Reverse recovery charge		-	16	-	μC	
E <sub>rr</sub>	Reverse recovery energy per pulse	V <sub>CC</sub> =600 V, I <sub>F</sub> =300 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, T <sub>j</sub> =150 °C, Inductive load	-	22	-	mJ	

**NTC THERMISTOR PART**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Zero-power resistance	T <sub>C</sub> =25 °C (Note3)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R <sub>100</sub> =493 Ω, T <sub>C</sub> =100 °C (Note3)	-7.3	-	+7.8	%
B <sub>(25/50)</sub>	B-constant	Approximate by equation (Note5)	-	3375	-	K
P <sub>25</sub>	Power dissipation	T <sub>C</sub> =25 °C (Note3)	-	-	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, IGBT (Note3)	-	-	0.066	K/W
R <sub>th(j-c)D</sub>		Junction to case, DIODE (Note3)	-	-	0.12	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note3, 6)	-	25	-	K/kW

**MECHANICAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M <sub>t</sub>	Mounting torque	Main terminals M 5 screw	2.5	3.0	3.5	N·m
M <sub>s</sub>	Mounting torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
d <sub>s</sub>	Creepage distance	Terminal to terminal	20.6	-	-	mm
		Terminal to base plate	17	-	-	
d <sub>a</sub>	Clearance	Terminal to terminal	12	-	-	mm
		Terminal to base plate	10.6	-	-	
m	mass	-	-	210	-	g
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note7)	-100	-	+100	μm

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Note1. Junction temperature ( $T_j$ ) should not increase beyond  $T_{jmax}$  rating.

2. Pulse width and repetition rate should be such that the device junction temperature ( $T_j$ ) dose not exceed  $T_{jmax}$  rating.
3. 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.

4. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

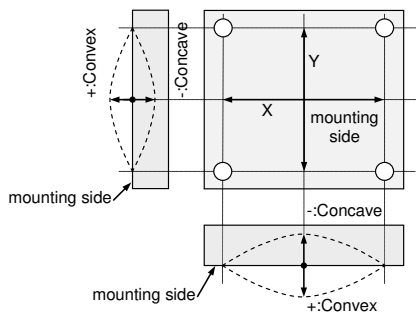
5.  $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$ ,

$R_{25}$ : resistance at absolute temperature  $T_{25}$  [K];  $T_{25}=25$  [°C]+273.15=298.15 [K]

$R_{50}$ : resistance at absolute temperature  $T_{50}$  [K];  $T_{50}=50$  [°C]+273.15=323.15 [K]

6. Typical value is measured by using thermally conductive grease of  $\lambda=0.9$  W/(m·K).

7. The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



8. Use the following screws when mounting the printed circuit board (PCB) on the stand offs.

" $\phi 2.6 \times 10$  or  $\phi 2.6 \times 12$  self tapping screw"

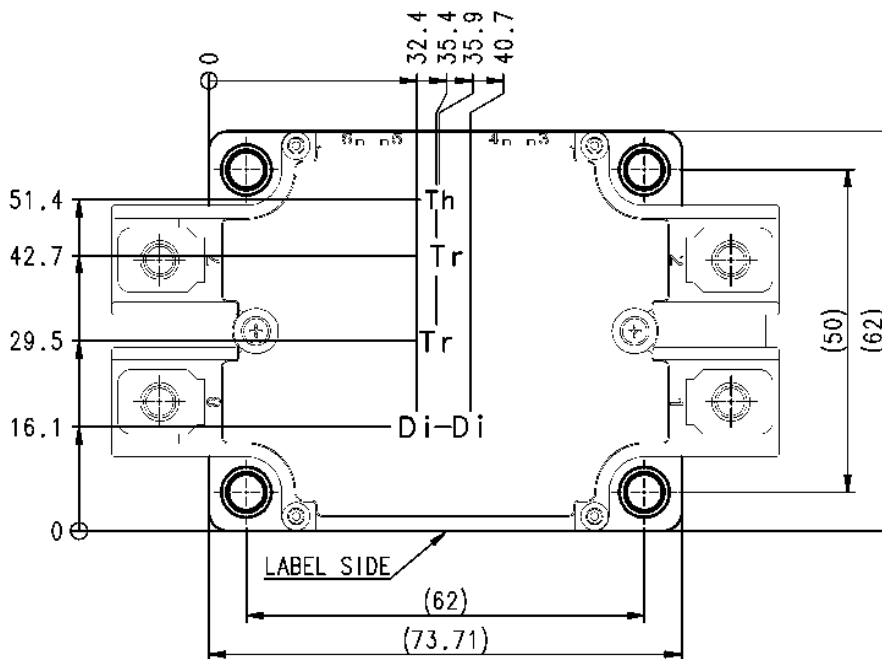
The length of the screw depends on thickness ( $t_{1.6} \sim t_{2.0}$ ) of the PCB.

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC}$	(DC) Supply voltage	Applied across C-E/A-K terminals	-	600	850	V
$V_{GEon}$	Gate (-emitter drive) voltage	Applied across G-Es terminals	13.5	15.0	16.5	V
$R_G$	External gate resistance	-	0	-	15	$\Omega$

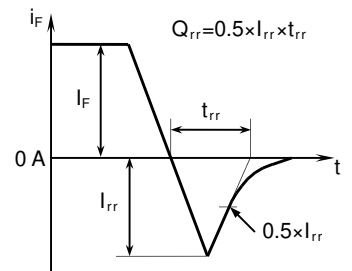
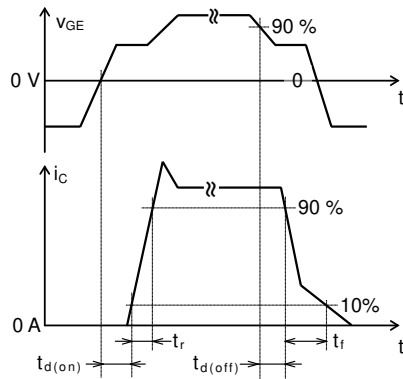
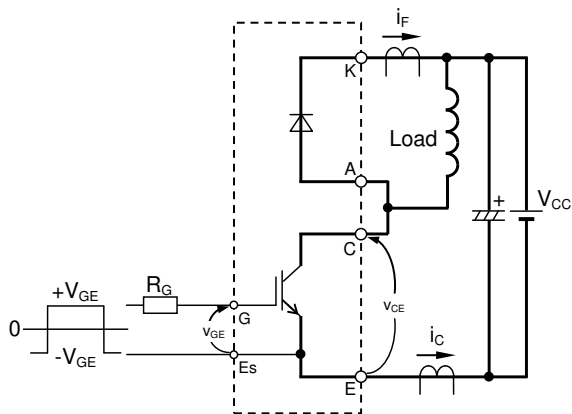
**CHIP LOCATION (Top view)**

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



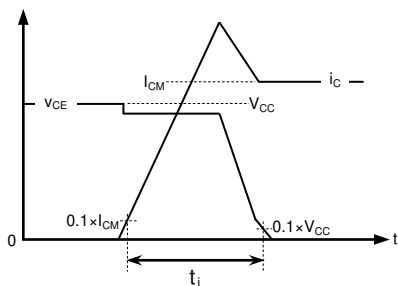
Tr: IGBT, Di: DIODE, Th: NTC thermistor

TEST CIRCUIT AND WAVEFORMS

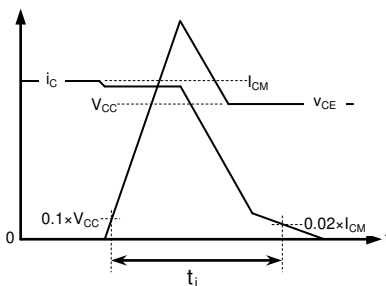


Switching test circuit and waveforms

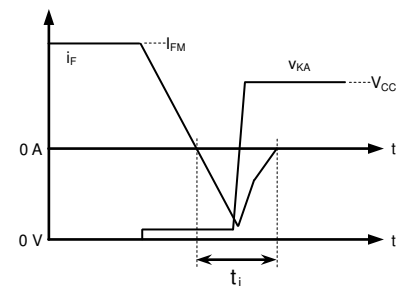
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



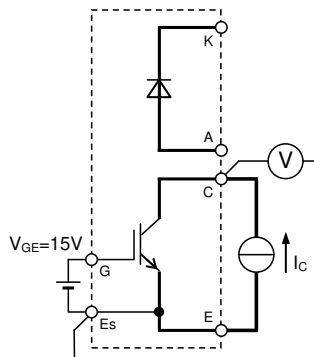
IGBT Turn-off switching energy



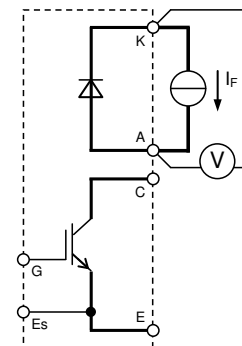
DIODE Reverse recovery energy

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

TEST CIRCUIT



$V_{CEsat}$  characteristics test circuit

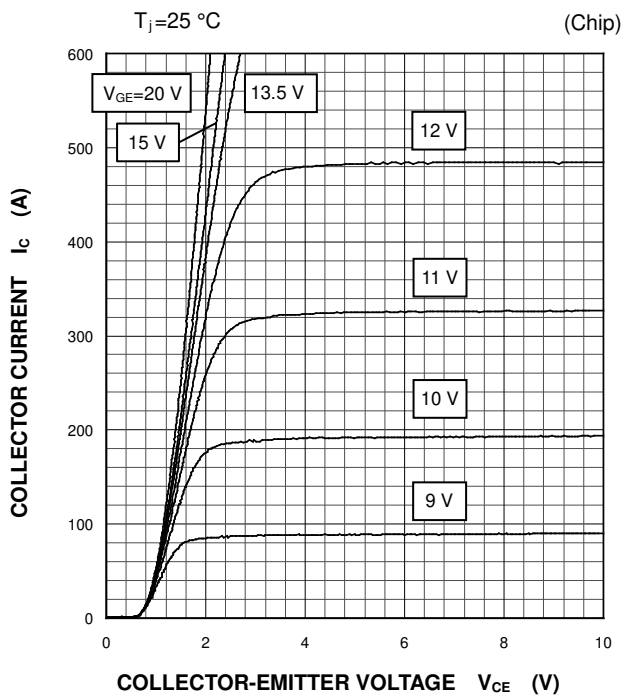


$V_F$  characteristics test circuit

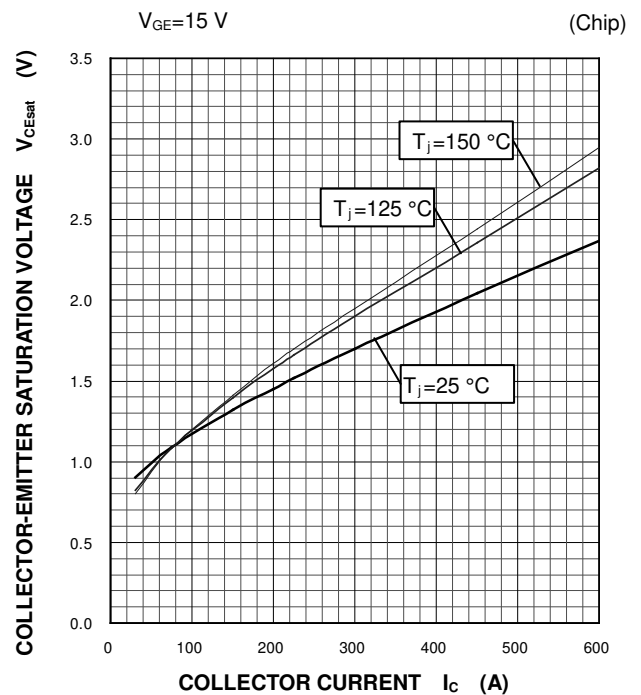
PERFORMANCE CURVES

IGBT/DIODE part

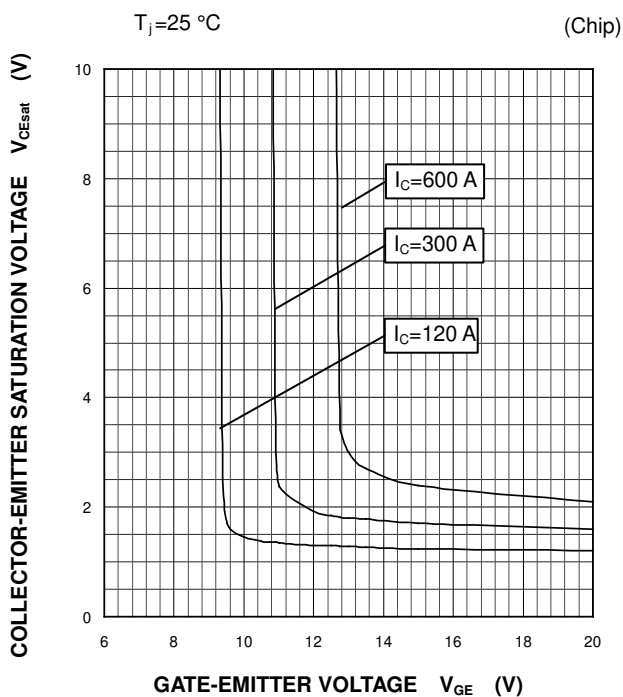
OUTPUT CHARACTERISTICS  
(TYPICAL)



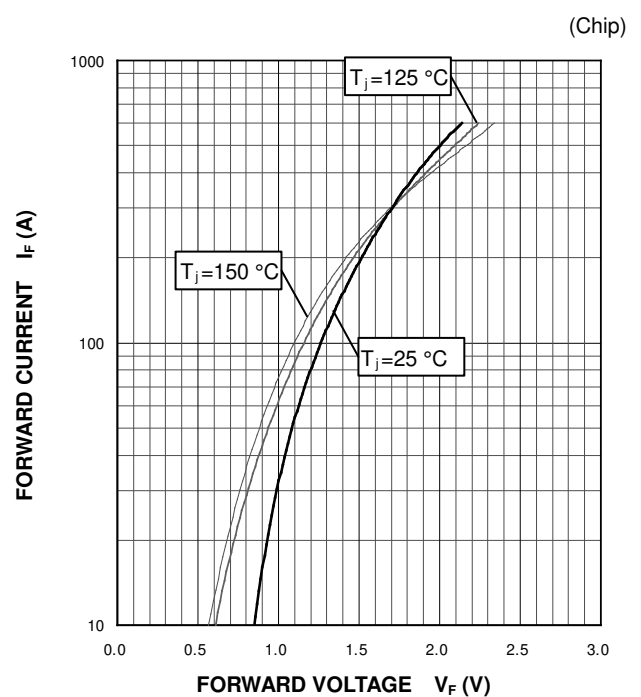
COLLECTOR-EMITTER SATURATION VOLTAGE  
CHARACTERISTICS  
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE  
CHARACTERISTICS  
(TYPICAL)



DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL)

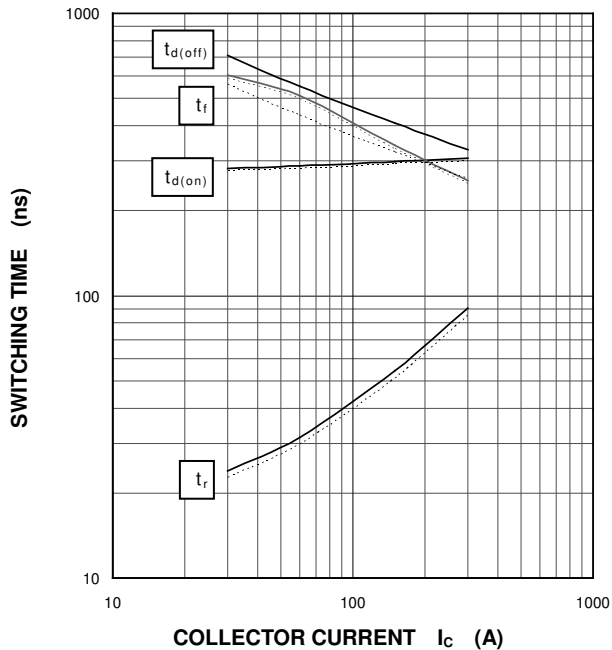


PERFORMANCE CURVES

IGBT/DIODE part

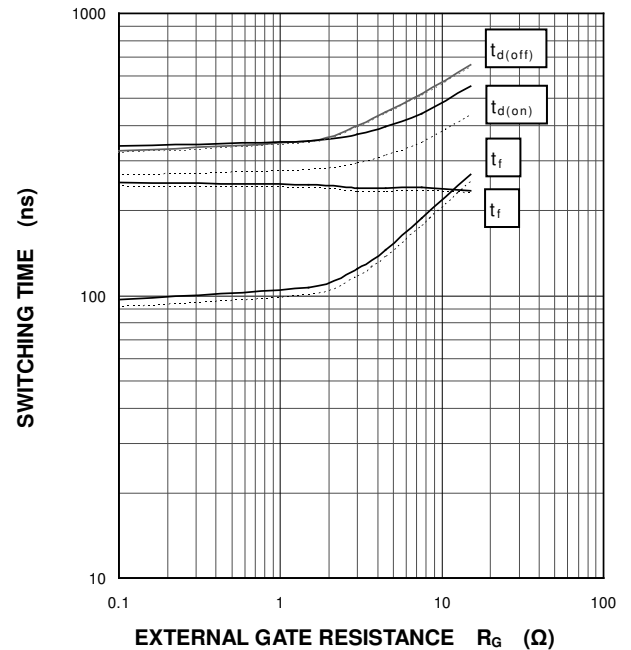
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



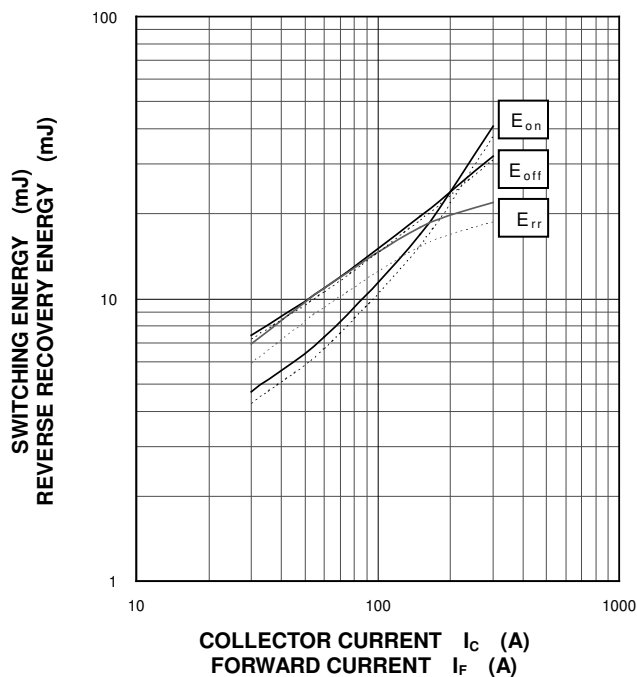
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



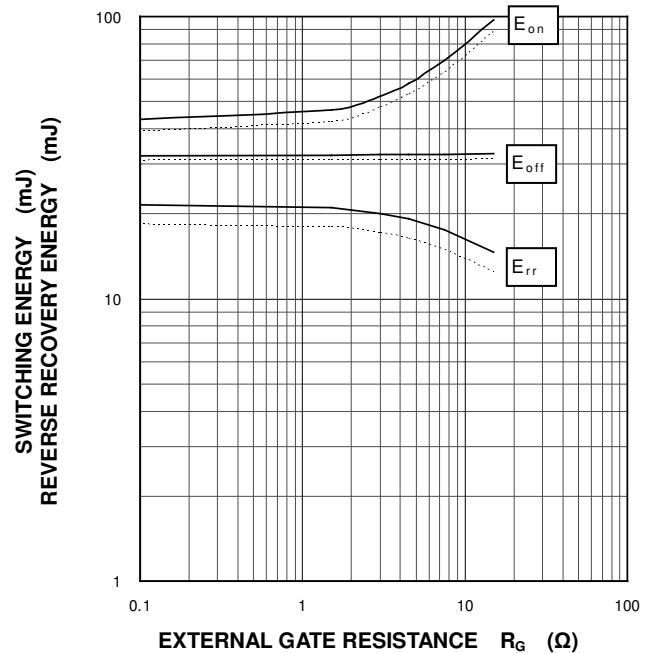
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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

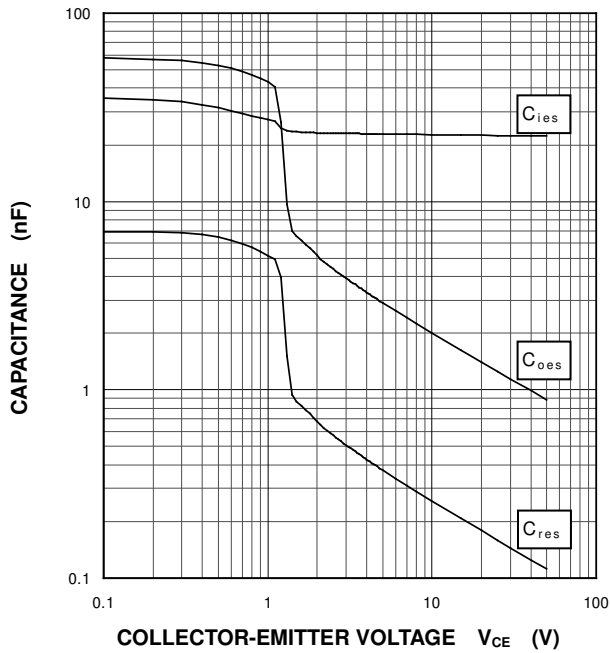


PERFORMANCE CURVES

IGBT/DIODE part

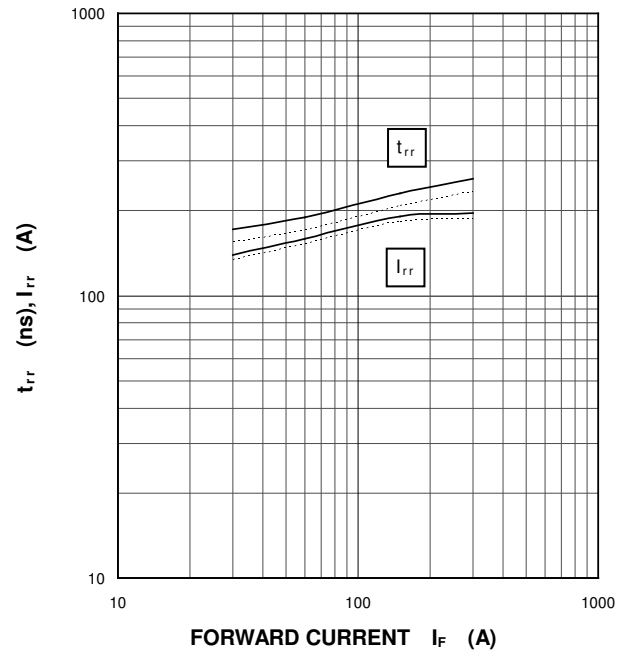
CAPACITANCE CHARACTERISTICS  
(TYPICAL)

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



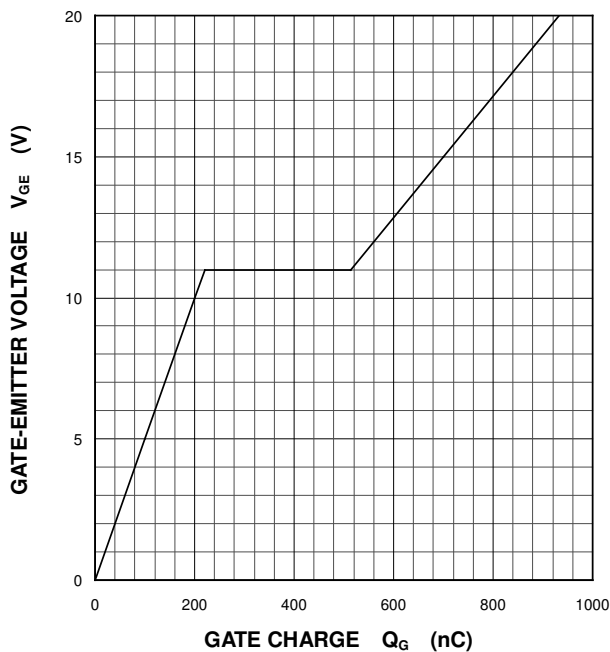
DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)

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



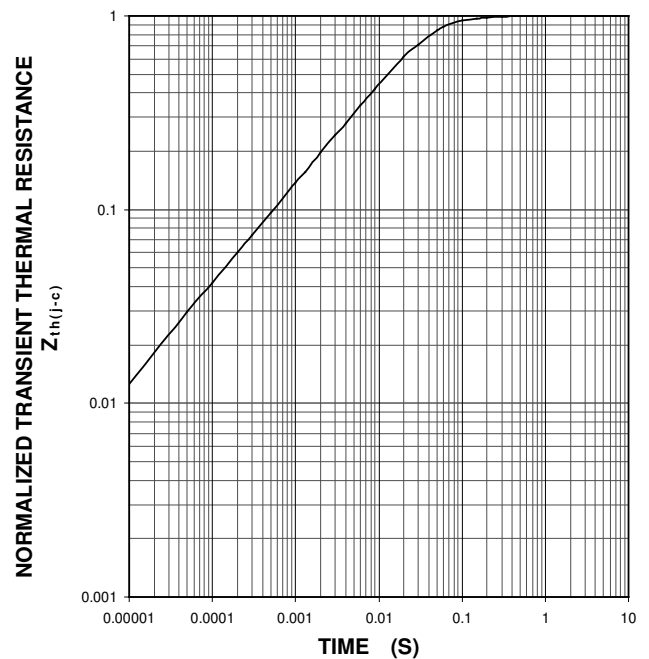
GATE CHARGE CHARACTERISTICS  
(TYPICAL)

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



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS  
(MAXIMUM)

Single pulse,  $T_C=25\text{ }^\circ\text{C}$   
 $R_{th(j-c)Q}=0.066\text{ K/W}$ ,  $R_{th(j-c)D}=0.12\text{ K/W}$





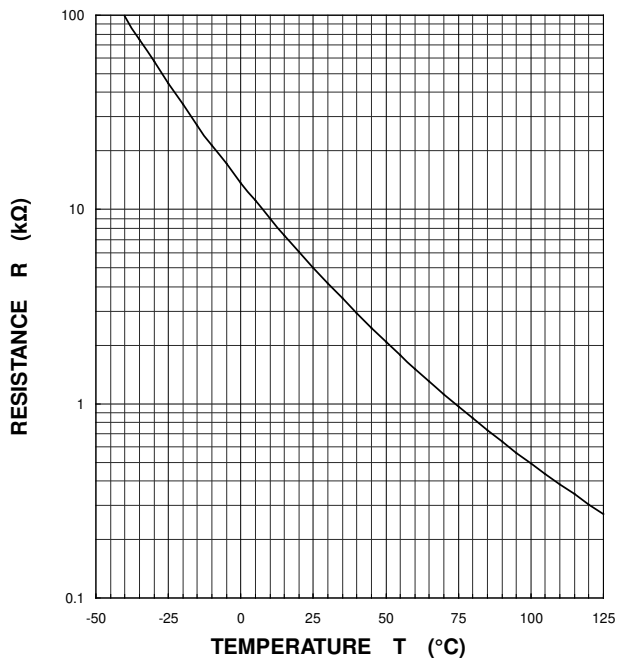
< IGBT MODULES >  
CM300EXS-24S  
HIGH POWER SWITCHING USE  
INSULATED TYPE

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PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS  
(TYPICAL)



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

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