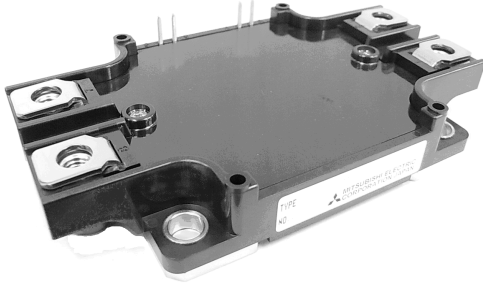


< IGBT MODULES >

# CM200EXS-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE



Single switch

Collector current  $I_C$  ..... **200 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **1200 V**  
 Maximum junction temperature  $T_{jmax}$  ..... **175 °C**

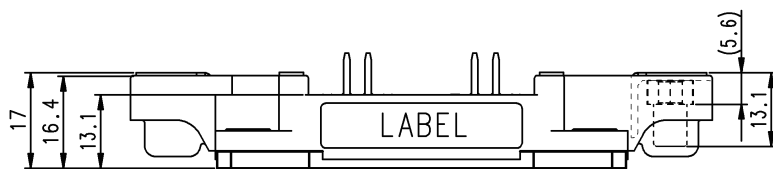
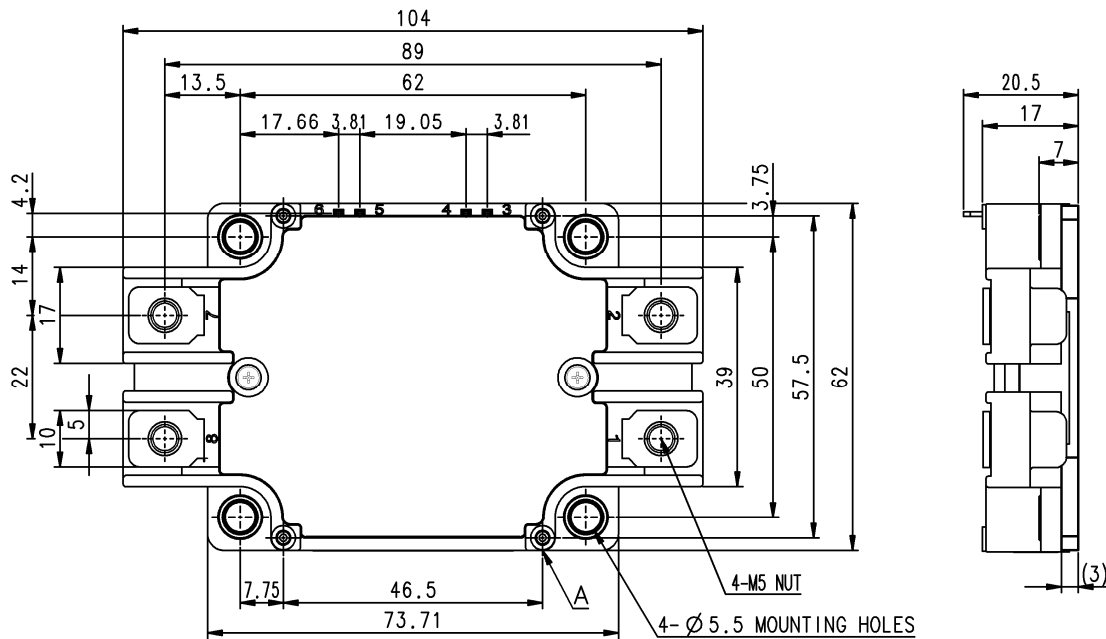
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- Recognized under UL1557, File E323585

## APPLICATION

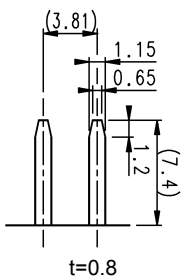
Brake

## OUTLINE DRAWING & INTERNAL CONNECTION

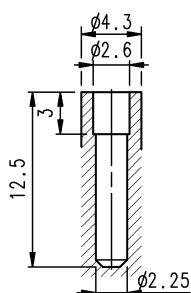
Dimension in mm



TERMINAL



SECTION A

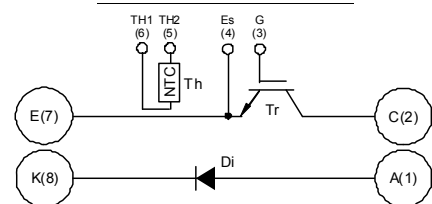


Tolerance otherwise specified

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



< IGBT MODULES >

CM200EXS-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE

**ABSOLUTE MAXIMUM RATINGS (T<sub>J</sub>=25 °C, unless otherwise specified)**

**IGBT**

Symbol	Item	Conditions	Rating	Unit
V <sub>CES</sub>	Collector-emitter voltage	G-E short-circuited	1200	V
V <sub>GES</sub>	Gate-emitter voltage	C-E short-circuited	± 20	V
I <sub>C</sub>	Collector current	DC, T <sub>C</sub> =119 °C (Note1, 3)	200	A
I <sub>CRM</sub>		Pulse, Repetitive (Note2)	400	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note1, 3)	1500	W

**DIODE**

Symbol	Item	Conditions	Rating	Unit
V <sub>RRM</sub>	Repetitive peak reverse voltage	-	1200	V
I <sub>F</sub>	Forward current	(Note1)	200	A
I <sub>FRM</sub>		Pulse, Repetitive (Note2)	400	

**MODULE**

Symbol	Item	Conditions	Rating	Unit
V <sub>isol</sub>	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	4000	V
T <sub>jmax</sub>	Maximum junction temperature	Instantaneous event (overload)	175	°C
T <sub>Cmax</sub>	Maximum case temperature	(Note3)	125	
T <sub>jop</sub>	Operating junction temperature	Continuous operation (under switching)	-40 ~ +150	°C
T <sub>stg</sub>	Storage temperature	-	-40 ~ +125	

**ELECTRICAL CHARACTERISTICS (T<sub>J</sub>=25 °C, unless otherwise specified)**

**IGBT**

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>CES</sub>	Collector-emitter cut-off current	V <sub>CE</sub> =V <sub>CES</sub> , G-E short-circuited	-	-	1.0	mA	
I <sub>GES</sub>	Gate-emitter leakage current	V <sub>GE</sub> =V <sub>GES</sub> , C-E short-circuited	-	-	0.5	µA	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =20 mA, V <sub>CE</sub> =10 V	5.4	6.0	6.6	V	
V <sub>CESat</sub>	Collector-emitter saturation voltage	I <sub>C</sub> =200 A (Note4), V <sub>GE</sub> =15 V, (Terminal)	T <sub>J</sub> =25 °C	-	1.80	2.25	V
			T <sub>J</sub> =125 °C	-	2.00	-	
			T <sub>J</sub> =150 °C	-	2.05	-	
		I <sub>C</sub> =200 A (Note4), V <sub>GE</sub> =15 V, (Chip)	T <sub>J</sub> =25 °C	-	1.70	2.15	V
			T <sub>J</sub> =125 °C	-	1.90	-	
			T <sub>J</sub> =150 °C	-	1.95	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited	-	-	20	nF	
C <sub>oes</sub>	Output capacitance		-	-	4.0		
C <sub>res</sub>	Reverse transfer capacitance		-	-	0.33		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =600 V, I <sub>C</sub> =200 A, V <sub>GE</sub> =15 V	-	466	-	nC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600 V, I <sub>C</sub> =200 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load	-	-	800	ns	
t <sub>r</sub>	Rise time		-	-	200		
t <sub>d(off)</sub>	Turn-off delay time		-	-	600		
t <sub>f</sub>	Fall time		-	-	300		
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =600 V, I <sub>F</sub> =200 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, T <sub>J</sub> =150 °C, Inductive load	-	30.7	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse	-	-	21.5	-		
R <sub>CC'+EE'</sub>	Internal lead resistance	Main terminals-chip, per element, T <sub>C</sub> =25 °C (Note3)	-	-	2.0	mΩ	
r <sub>g</sub>	Internal gate resistance	-	-	9.8	-	Ω	

< IGBT MODULES >

CM200EXS-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE

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

DIODE

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>	Forward voltage	I <sub>F</sub> =200 A <sup>(Note4)</sup> , (Terminal)	T <sub>j</sub> =25 °C	-	1.8	2.25	V
			T <sub>j</sub> =125 °C	-	1.8	-	
			T <sub>j</sub> =150 °C	-	1.8	-	
		I <sub>F</sub> =200 A <sup>(Note4)</sup> , (Chip)	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> =200 A, V <sub>GE</sub> =±15 V,	-	-	300	ns	
Q <sub>rr</sub>	Reverse recovery charge	R <sub>G</sub> =0 Ω, Inductive load	-	10.7	-	μC	
E <sub>rr</sub>	Reverse recovery energy per pulse	V <sub>CC</sub> =600 V, I <sub>F</sub> =200 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, T <sub>j</sub> =150 °C, Inductive load	-	14.2	-	mJ	

NTC THERMISTOR

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Zero-power resistance	T <sub>C</sub> =25 °C <sup>(Note3)</sup>	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R <sub>100</sub> =493 Ω, T <sub>C</sub> =100 °C <sup>(Note3)</sup>	-7.3	-	+7.8	%
B <sub>(25/50)</sub>	B-constant	Approximate by equation <sup>(Note5)</sup>	-	3375	-	K
P <sub>25</sub>	Power dissipation	T <sub>C</sub> =25 °C <sup>(Note3)</sup>	-	-	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 <sup>(ote3)</sup>	-	-	0.10	K/W
R <sub>th(j-c)D</sub>		Junction to case, DIODE <sup>(Note3)</sup>	-	-	0.19	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied <sup>(Note3, 6)</sup>	-	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	Weight	-	-	210	-	g
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y <sup>(Note7)</sup>	-100	-	+100	μm

< IGBT MODULES >  
**CM200EXS-24S**  
**HIGH POWER SWITCHING USE**  
**INSULATED TYPE**

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

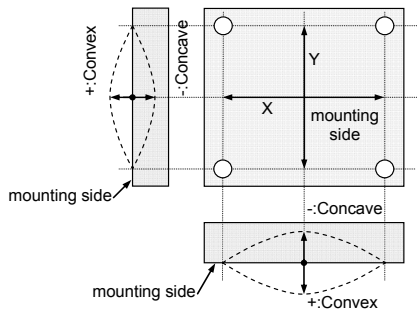
2. Pulse width and repetition rate should be such that the device junction temperature ( $T_j$ ) dose not exceed  $T_{jmax}$  rating.
3. Case temperature ( $T_c$ ) and heat sink temperature ( $T_s$ ) are defined on the each surface (mounting side) of base plate and heat sink just under the chips. Refer 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];  $T_{25}=25 [^{\circ}\text{C}]+273.15=298.15$  [K]

$R_{50}$ : resistance at absolute temperature  $T_{50}$  [K];  $T_{50}=50 [^{\circ}\text{C}]+273.15=323.15$  [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.



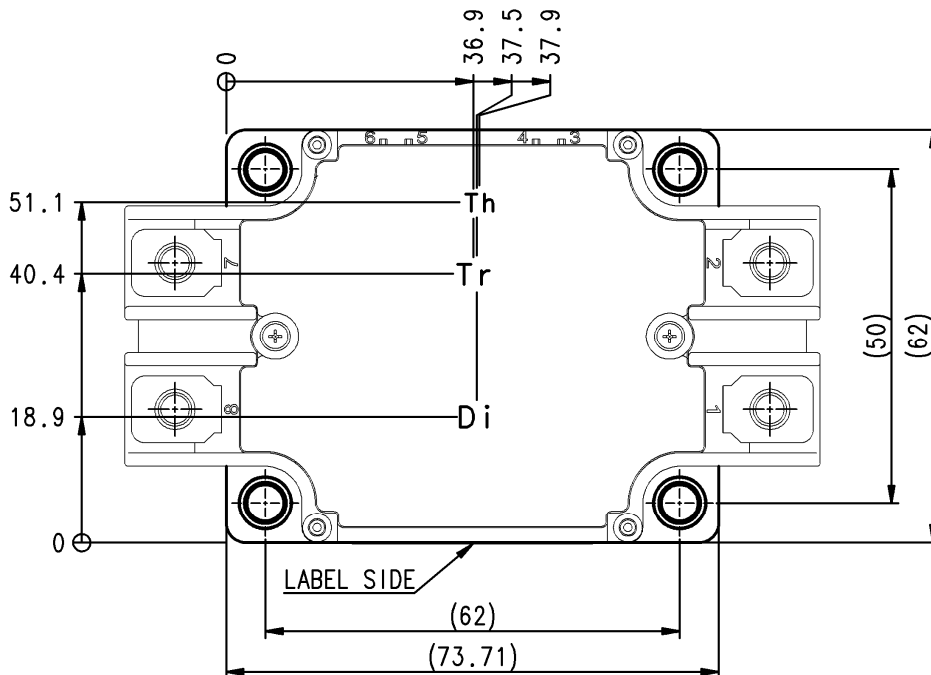
8. Use the following screws when mounting the printed circuit board (PCB) on the stand offs.  
 "φ2.6×10 or φ2.6×12 self tapping screw"  
 The length of the screw depends on thickness (t1.6~t2.0) of the PCB.

**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	-	22	Ω

**CHIP LOCATION (Top view)**

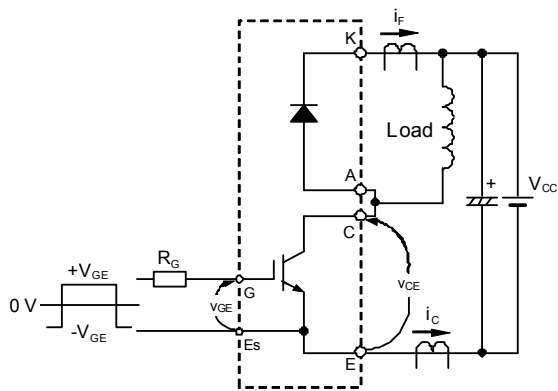
Dimension in mm, tolerance: ±1 mm



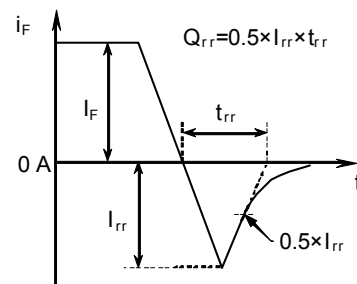
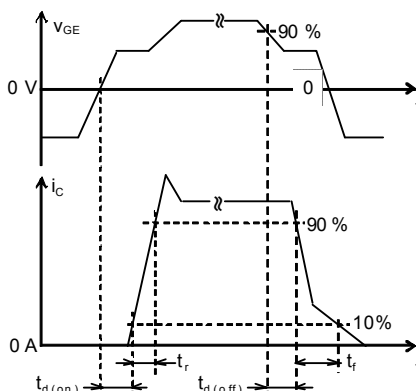
Tr: IGBT, Di: CLAMP DIODE, Th: NTC thermistor

< IGBT MODULES >  
**CM200EXS-24S**  
 HIGH POWER SWITCHING USE  
 INSULATED TYPE

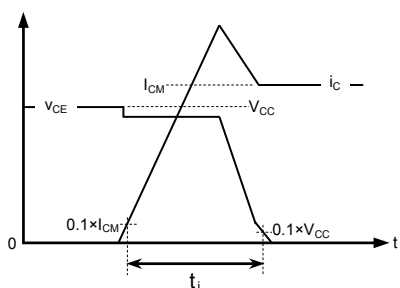
**TEST CIRCUIT AND WAVEFORMS**



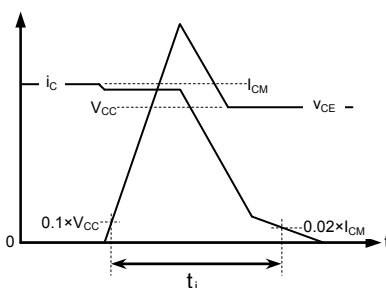
**Switching characteristics test circuit and waveforms**



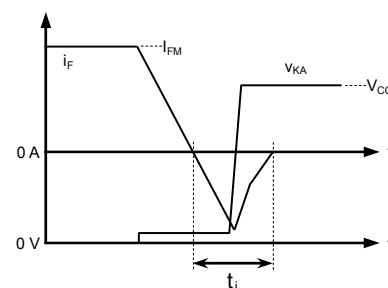
**$t_{rr}$ ,  $Q_{rr}$  test waveform**



**IGBT Turn-on switching energy**

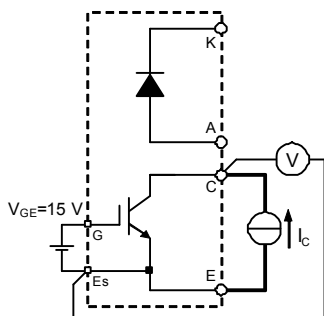


**IGBT Turn-off switching energy**

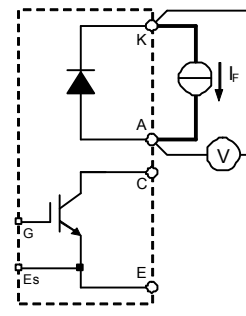


**DIODE Reverse recovery energy**

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



**$V_{CEsat}$  test circuit**



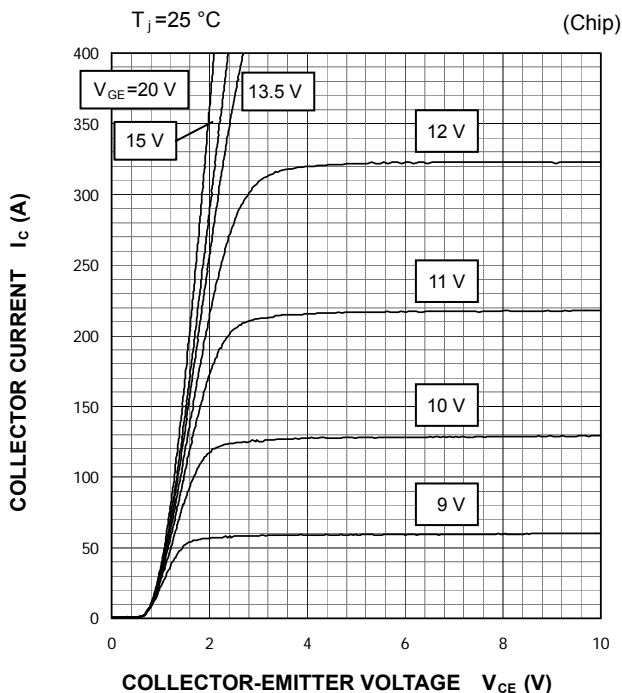
**$V_F$  test circuit**

< IGBT MODULES >  
**CM200EXS-24S**  
 HIGH POWER SWITCHING USE  
 INSULATED TYPE

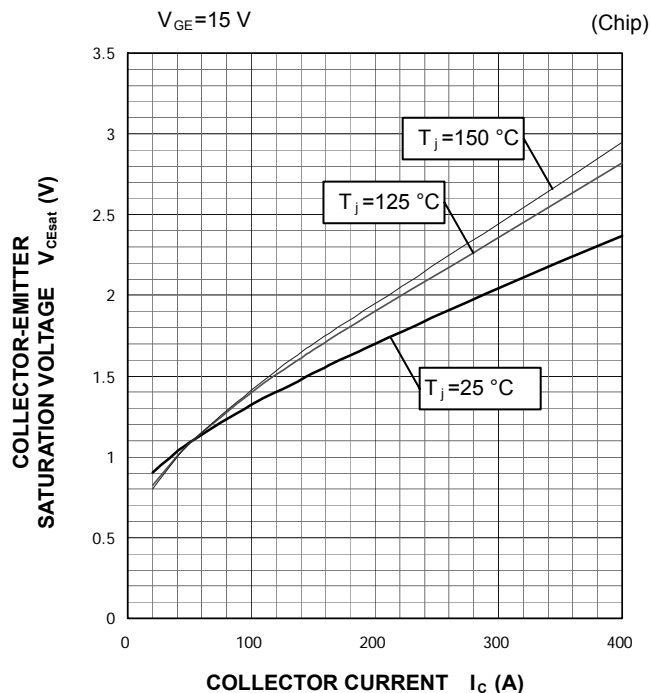
PERFORMANCE CURVES

IGBT/DIODE

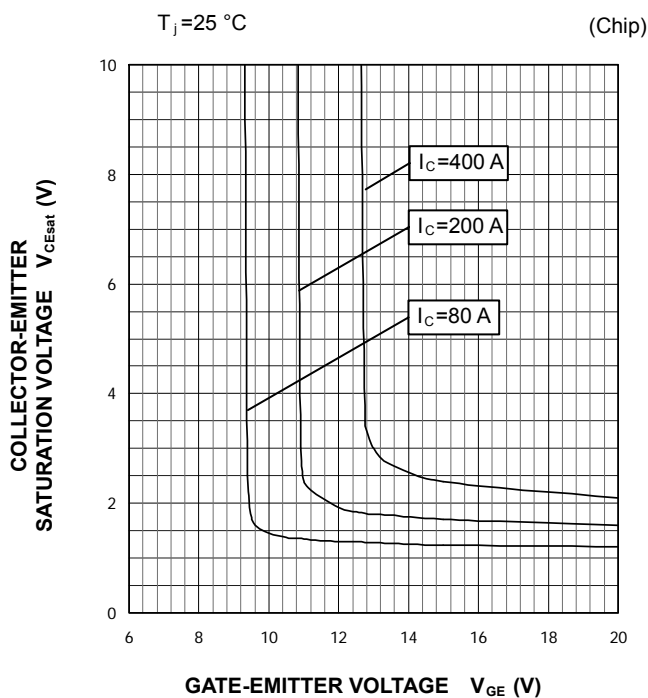
OUTPUT CHARACTERISTICS  
 (TYPICAL)



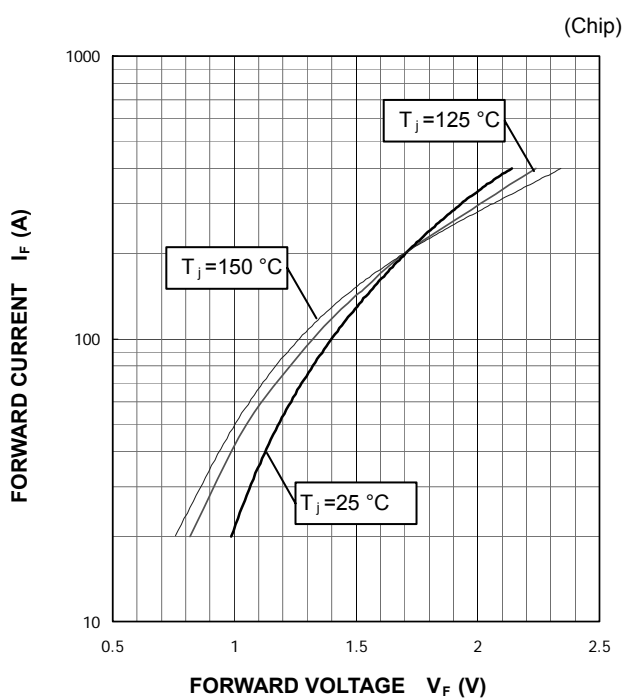
COLLECTOR-EMITTER SATURATION VOLTAGE  
 CHARACTERISTICS  
 (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE  
 CHARACTERISTICS  
 (TYPICAL)



DIODE  
 FORWARD CHARACTERISTICS  
 (TYPICAL)

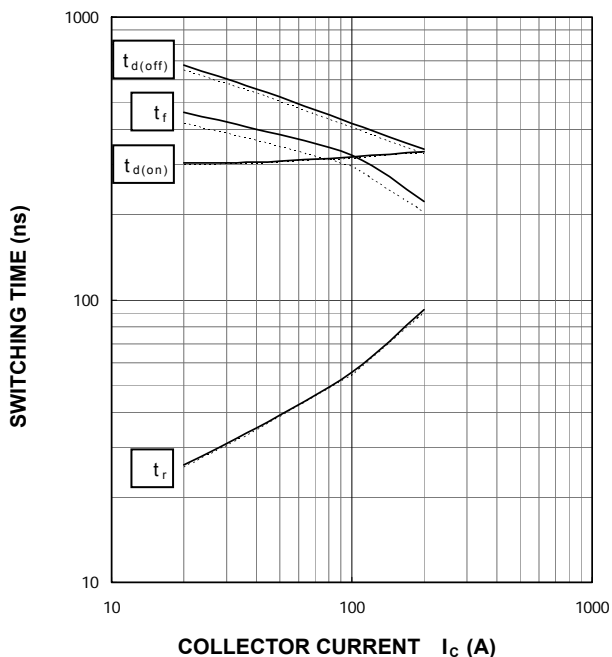


PERFORMANCE CURVES

IGBT/DIODE

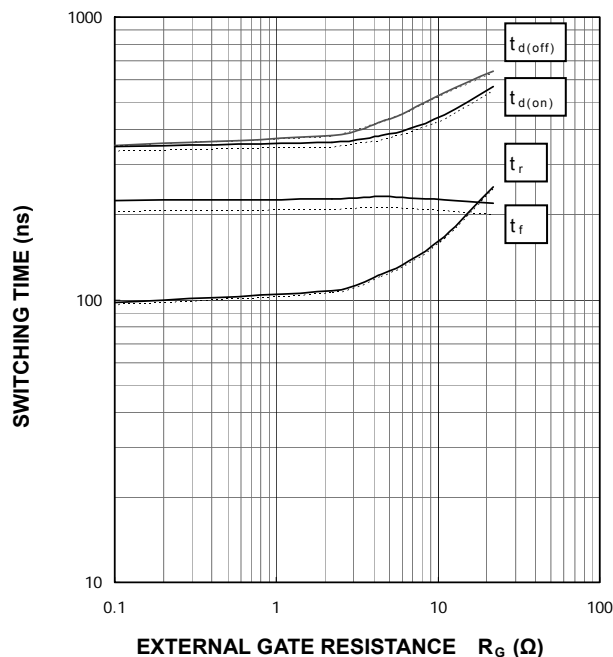
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



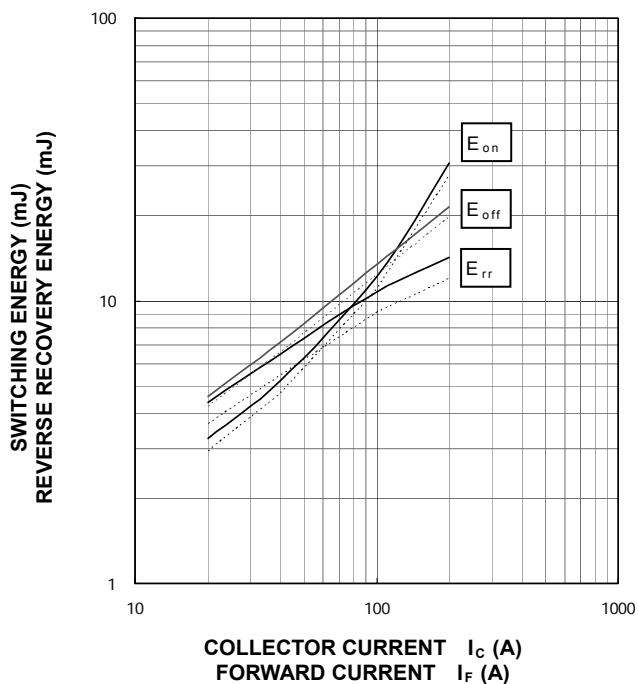
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C=200\text{ A}$ , INDUCTIVE LOAD  
——:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



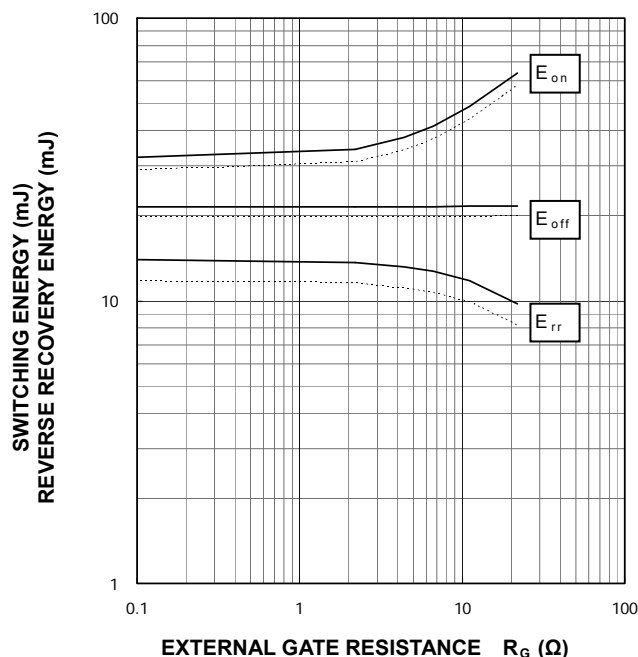
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $I_C/I_F=200\text{ A}$ ,  
INDUCTIVE LOAD, PER PULSE  
——:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



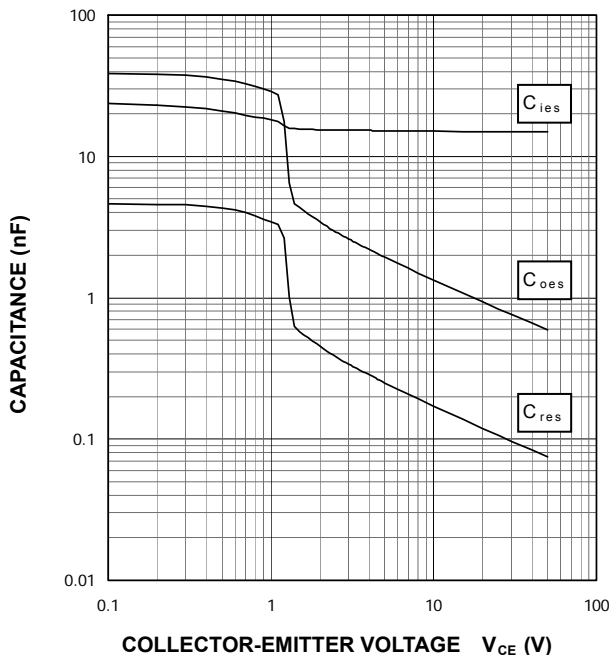
< IGBT MODULES >  
**CM200EXS-24S**  
 HIGH POWER SWITCHING USE  
 INSULATED TYPE

PERFORMANCE CURVES

IGBT/DIODE

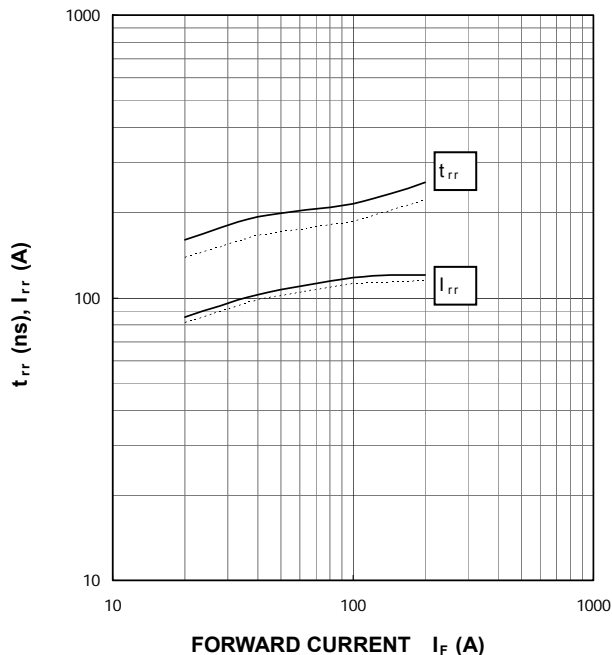
**CAPACITANCE CHARACTERISTICS (TYPICAL)**

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



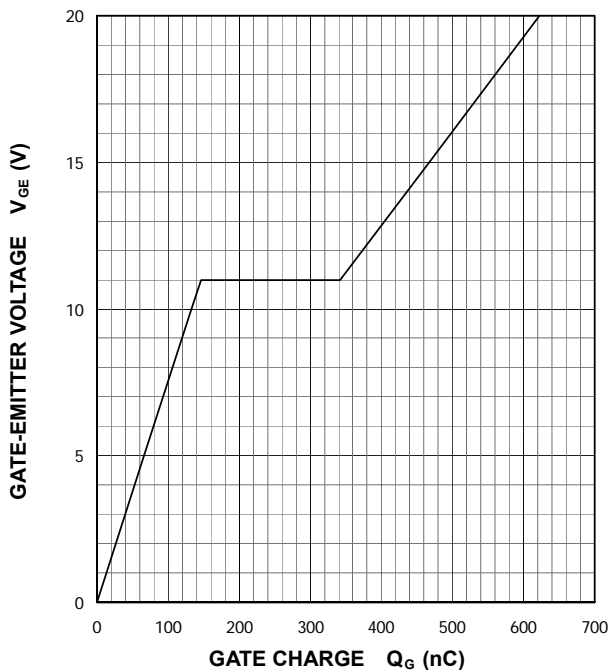
**DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**

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



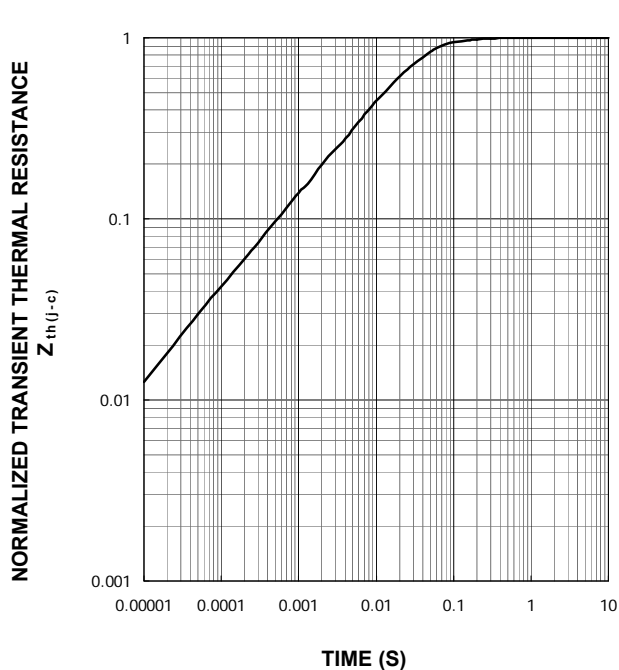
**GATE CHARGE CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C=200\text{ A}$ ,  $T_j=25\text{ }^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**

Single pulse,  $T_C=25\text{ }^\circ\text{C}$   
 $R_{th(j-c)Q}=0.10\text{ K/W}$ ,  $R_{th(j-c)D}=0.19\text{ K/W}$





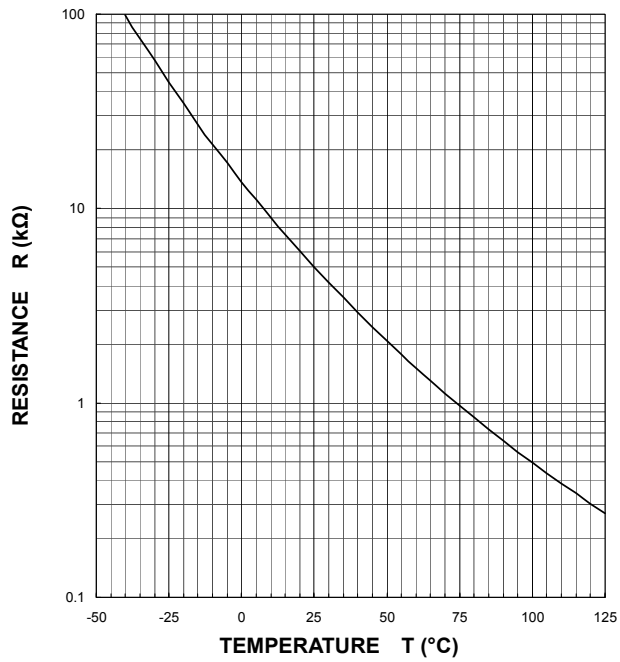
< IGBT MODULES >  
CM200EXS-24S  
HIGH POWER SWITCHING USE  
INSULATED TYPE

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PERFORMANCE CURVES

NTC THERMISTOR

TEMPERATURE CHARACTERISTICS  
(TYPICAL)



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