

# CM450DX-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE

## CM450DX-24S



Dual (Half-Bridge)

- 6th Generation NX series -

Collector current  $I_C$  ..... **450 A**

Collector-emitter voltage  $V_{CES}$  ..... **1200 V**

Maximum junction temperature  $T_{jmax}$  ... **175 °C**

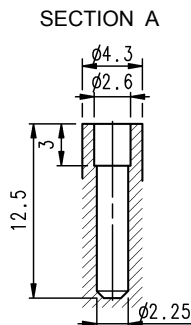
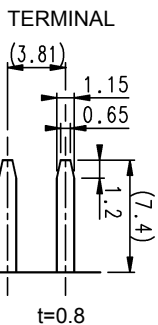
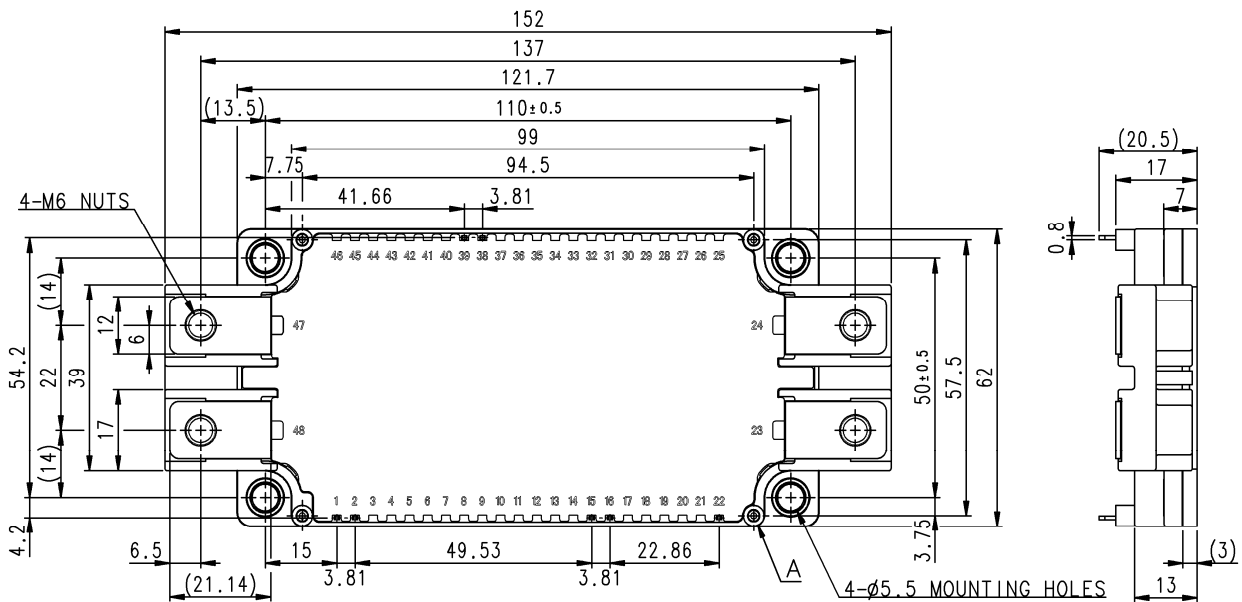
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File E323585

## APPLICATION

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

## OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm

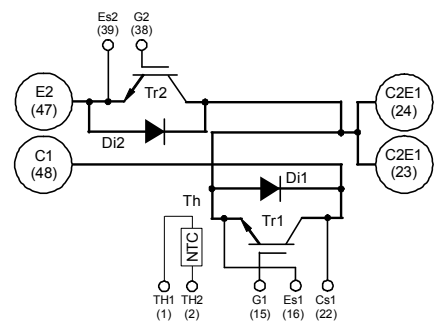


Tolerance otherwise specified

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



**ABSOLUTE MAXIMUM RATINGS ( $T_j=25\text{ }^\circ\text{C}$ , 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	$\pm 20$	V
$I_C$	Collector current	DC, $T_C=119\text{ }^\circ\text{C}$ (Note.2)	450	A
$I_{CRM}$		Pulse, Repetitive (Note.3)	900	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	3405	W
$I_E$ (Note.1)	Emitter current	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	450	A
$I_{ERM}$ (Note.1)		Pulse, Repetitive (Note.3)	900	

**MODULE**

Symbol	Item	Conditions	Rating	Unit
$T_{jmax}$	Maximum junction temperature	-	175	$^\circ\text{C}$
$T_{Cmax}$	Maximum case temperature	(Note.2)	125	
$T_{jop}$	Operating junction temperature	-	-40 ~ +150	$^\circ\text{C}$
$T_{stg}$	Storage temperature	-	-40 ~ +125	
$V_{isol}$	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V

**ELECTRICAL CHARACTERISTICS ( $T_j=25\text{ }^\circ\text{C}$ , 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	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	$I_C=45\text{ mA}$ , $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
$V_{CESat}$ (Terminal)	Collector-emitter saturation voltage	$I_C=450\text{ A}$ (Note.5), $V_{GE}=15\text{ V}$	$T_j=25\text{ }^\circ\text{C}$	-	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	$I_C=450\text{ A}$ (Note.5), $V_{GE}=15\text{ V}$	$T_j=25\text{ }^\circ\text{C}$	-	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	-	-	45	nF	
$C_{oes}$	Output capacitance		-	-	9.0		
$C_{res}$	Reverse transfer capacitance		-	-	0.75		
$Q_G$	Gate charge	$V_{CC}=600\text{ V}$ , $I_C=450\text{ A}$ , $V_{GE}=15\text{ V}$	-	1050	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$ , $I_C=450\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=0\ \Omega$ , Inductive load	-	-	800	ns	
$t_r$	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	600		
$t_f$	Fall time		-	-	300		
$V_{EC}$ (Note.1) (Terminal)	Emitter-collector voltage	$I_E=450\text{ A}$ (Note.5), G-E short-circuited	$T_j=25\text{ }^\circ\text{C}$	-	1.8	2.25	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.8	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.8	-	
$V_{EC}$ (Note.1) (Chip)	Emitter-collector voltage	$I_E=450\text{ A}$ (Note.5), G-E short-circuited	$T_j=25\text{ }^\circ\text{C}$	-	1.7	2.15	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.7	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.7	-	
$t_{rr}$ (Note.1)	Reverse recovery time	$V_{CC}=600\text{ V}$ , $I_E=450\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ ,	-	-	300	ns	
$Q_{rr}$ (Note.1)	Reverse recovery charge	$R_G=0\ \Omega$ , Inductive load	-	24	-	$\mu\text{C}$	
$E_{on}$	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$ , $I_C=I_E=450\text{ A}$ ,	-	54.9	-	mJ	
$E_{off}$	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$ , $R_G=0\ \Omega$ , $T_j=150\text{ }^\circ\text{C}$ ,	-	48.0	-		
$E_{rr}$ (Note.1)	Reverse recovery energy per pulse	Inductive load	-	32.4	-	mJ	
$R_{CC+EE}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note.2)	-	-	0.7	m $\Omega$	
$r_g$	Internal gate resistance	Per switch	-	4.3	-	$\Omega$	

**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 (Note.2)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	T <sub>C</sub> =100 °C, R <sub>100</sub> =493 Ω	-7.3	-	+7.8	%
B <sub>(25/50)</sub>	B-constant	Approximate by equation (Note.6)	-	3375	-	K
P <sub>25</sub>	Power dissipation	T <sub>C</sub> =25 °C (Note.2)	-	-	10	mW

**THERMAL RESISTANCE CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Thermal resistance (Note.2)	Junction to case, per Inverter IGBT	-	-	44	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per Inverter FWDi	-	-	78	K/kW
R <sub>th(c-s)</sub>	Contact thermal resistance (Note.2)	Case to heat sink, per 1 module, Thermal grease applied (Note.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 to heat sink M 5 screw	2.5	3.0	3.5	
d <sub>s</sub>	Creepage distance	Terminal to terminal	11.55	-	-	mm
		Terminal to base plate	12.32	-	-	
d <sub>a</sub>	Clearance	Terminal to terminal	10.00	-	-	mm
		Terminal to base plate	10.85	-	-	
m	Weight	-	-	350	-	g
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note.8)	±0	-	+100	μm

Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).

Note.2: 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.  
The heat sink thermal resistance should measure just under the chips.

Note.3: 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.

Note.4: Junction temperature (T<sub>j</sub>) should not increase beyond T<sub>jmax</sub> rating.

Note.5: Pulse width and repetition rate should be such as to cause negligible temperature rise.

Refer to the figure of test circuit for V<sub>CEsat</sub>, V<sub>EC</sub>.

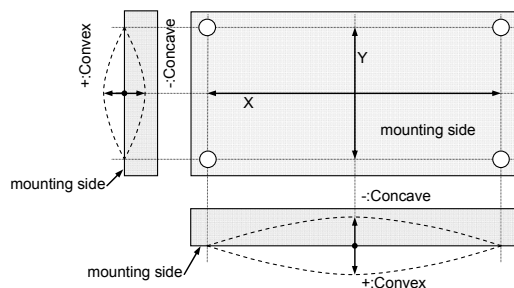
Note.6:  $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

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]

Note.7: Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).

Note.8: The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



Note.9: Japan Electronics and Information Technology Industries Association (JEITA) standards,

"EIAJ ED-4701/300: Environmental and endurance test methods for semiconductor devices (Stress test I)"

Note.10: Use the following screws when mounting the printed circuit board (PCB) on the stand offs.

"M2.6×10 or M2.6×12 self tapping screw"

The length of the screw depends on the thickness of the PCB.

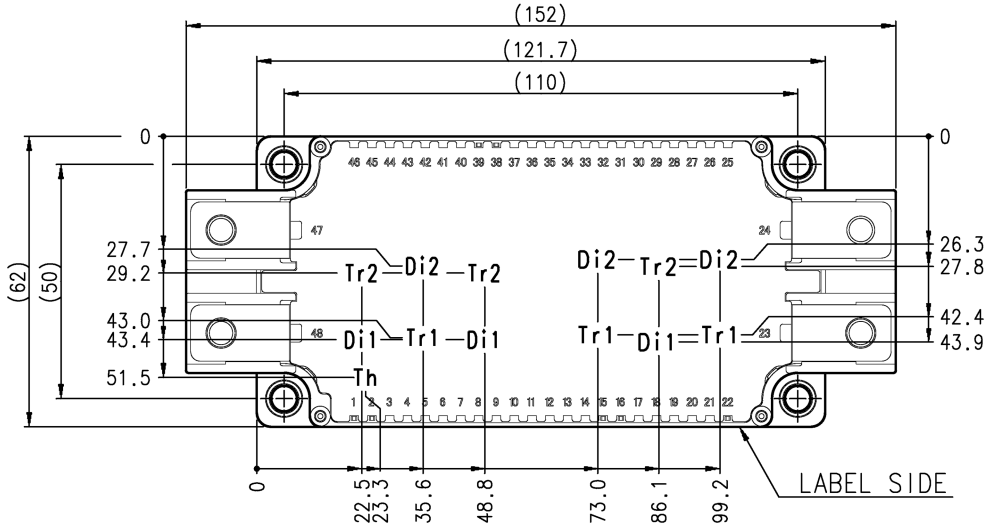
MITSUBISHI IGBT MODULES  
**CM450DX-24S**  
 HIGH POWER SWITCHING USE  
 INSULATED TYPE

**RECOMMENDED OPERATING CONDITIONS (T<sub>a</sub>=25 °C)**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V <sub>CC</sub>	(DC) Supply voltage	Applied across C1-E2	-	600	850	V
V <sub>GEon</sub>	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2	13.5	15.0	16.5	V
R <sub>G</sub>	External gate resistance	Per switch	0	-	10	Ω

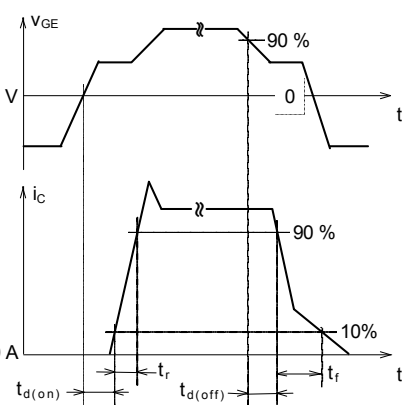
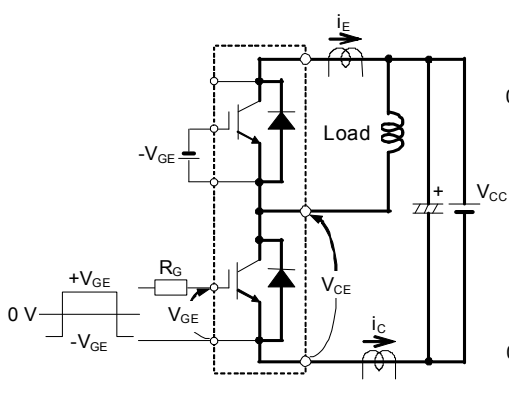
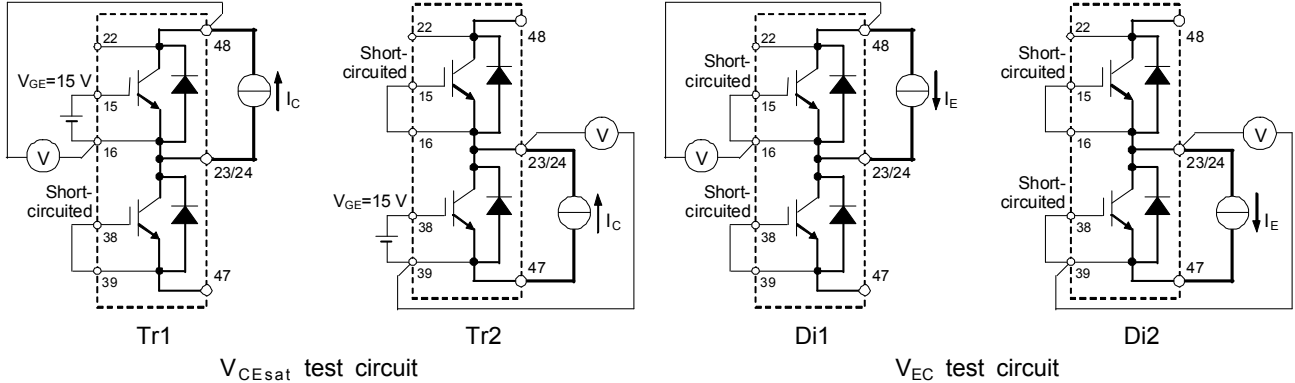
**CHIP LOCATION (top view)**

Dimension in mm, tolerance: ±1 mm



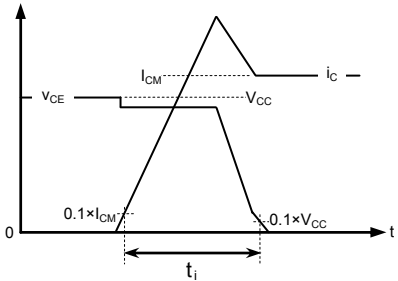
Tr1/Tr2: IGBT, Di1/Di2: FWDi, Th: NTC thermistor, Each mark points the center position of each chip.

**TEST CIRCUIT AND WAVEFORMS**

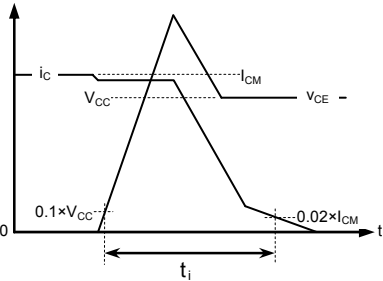


Switching characteristics test circuit and waveforms

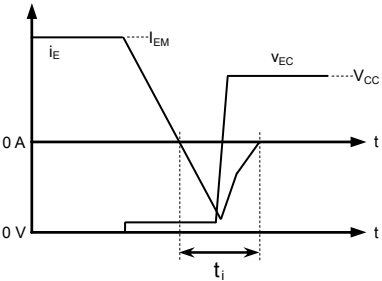
$t_{rr}$ ,  $Q_{rr}$  test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



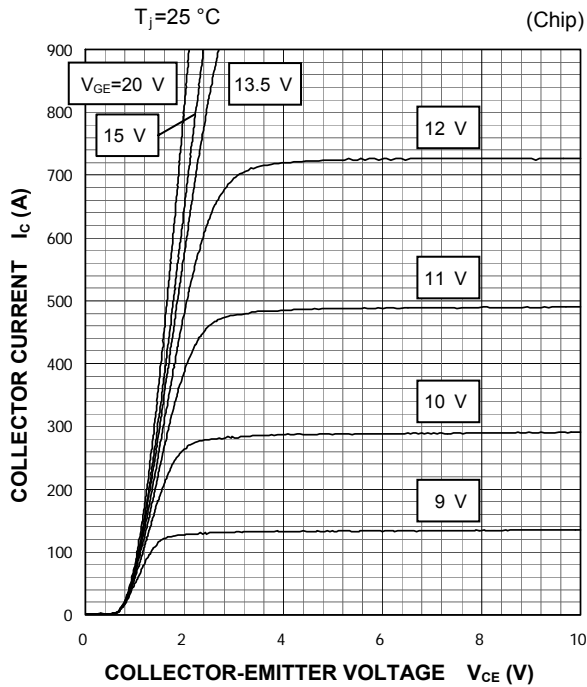
FWDi Reverse recovery energy

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

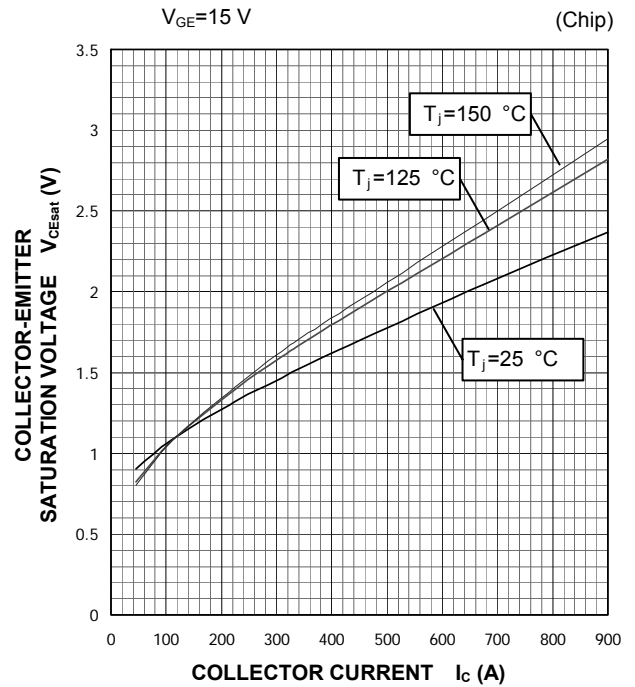
PERFORMANCE CURVES

INVERTER PART

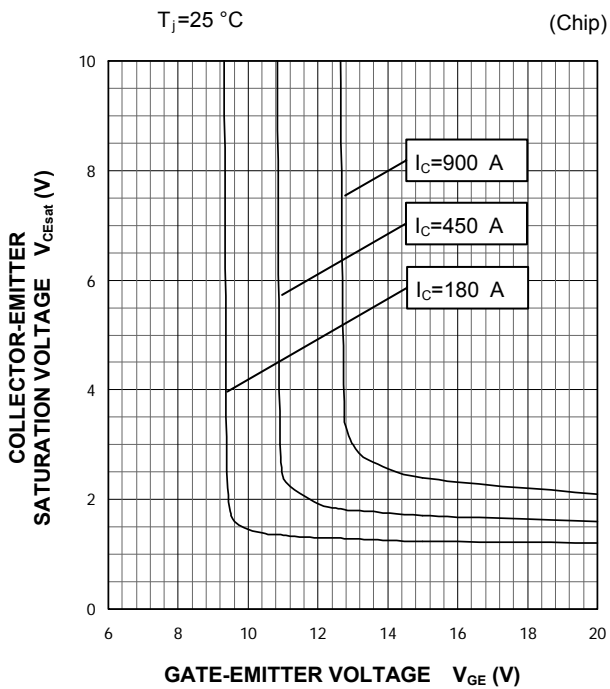
OUTPUT CHARACTERISTICS  
(TYPICAL)



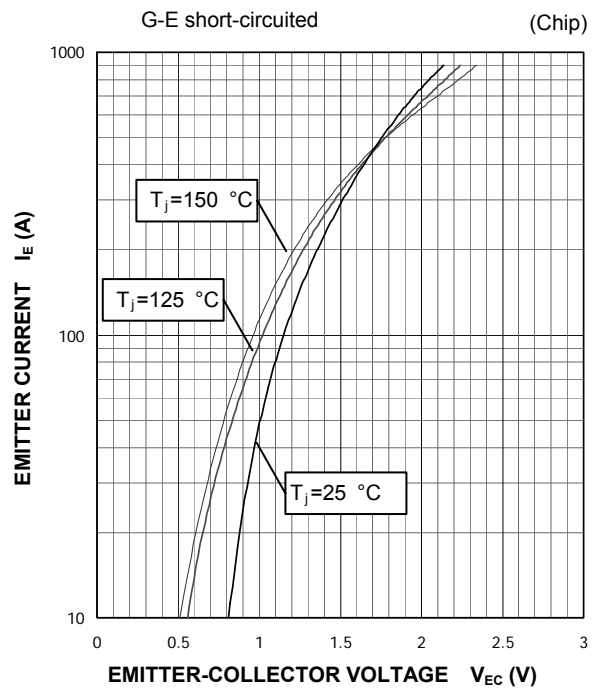
COLLECTOR-EMITTER SATURATION  
VOLTAGE CHARACTERISTICS  
(TYPICAL)



COLLECTOR-EMITTER SATURATION  
VOLTAGE CHARACTERISTICS  
(TYPICAL)



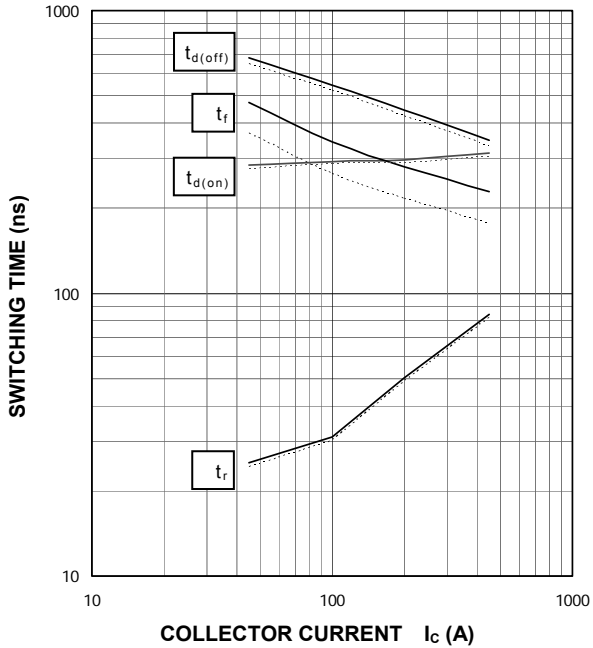
FREE WHEELING DIODE  
FORWARD CHARACTERISTICS  
(TYPICAL)



MITSUBISHI IGBT MODULES  
**CM450DX-24S**  
 HIGH POWER SWITCHING USE  
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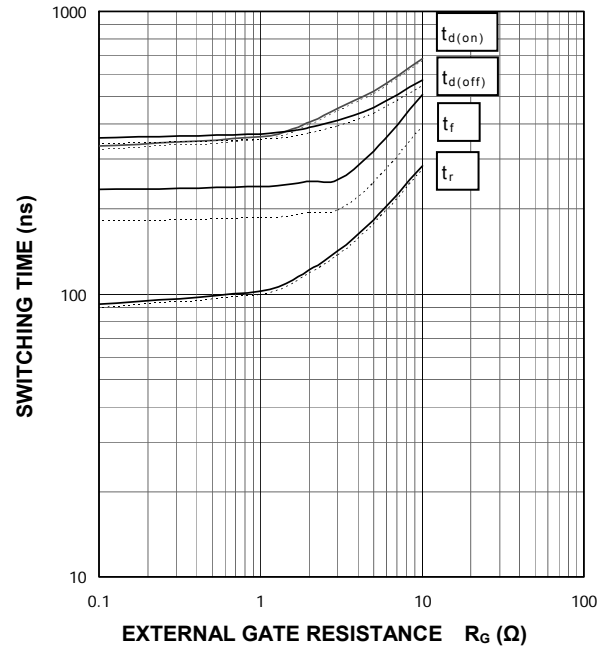
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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



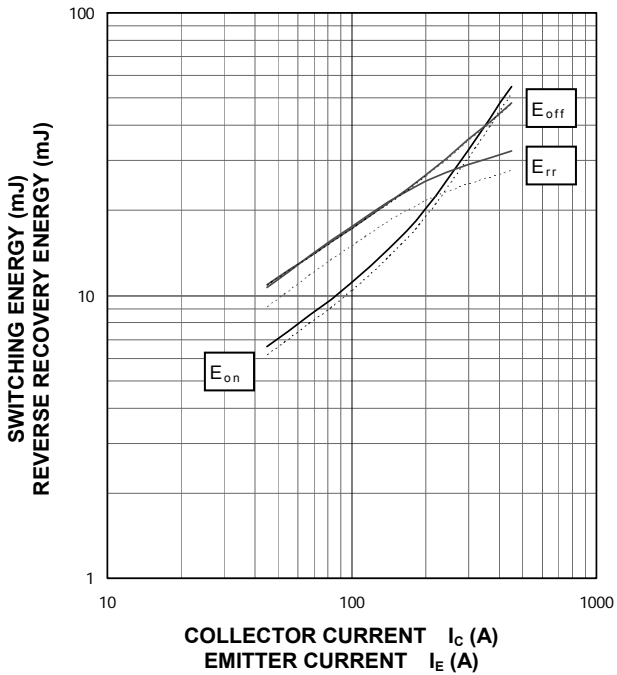
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C=450\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



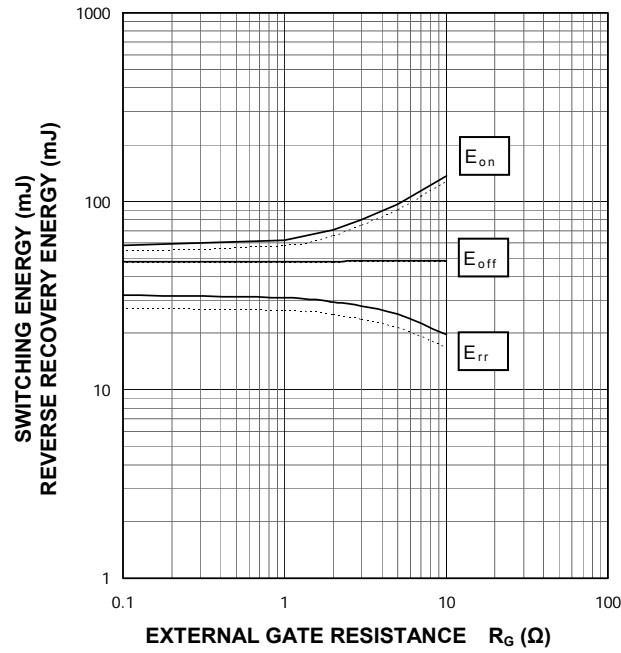
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

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



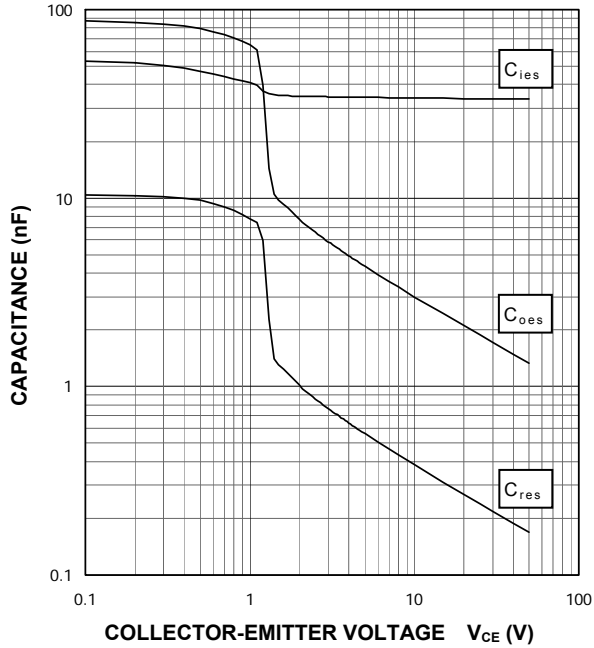
**HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C/I_E=450\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD, PER PULSE  
 —:  $T_j=150\text{ }^\circ\text{C}$ , - - - -:  $T_j=125\text{ }^\circ\text{C}$



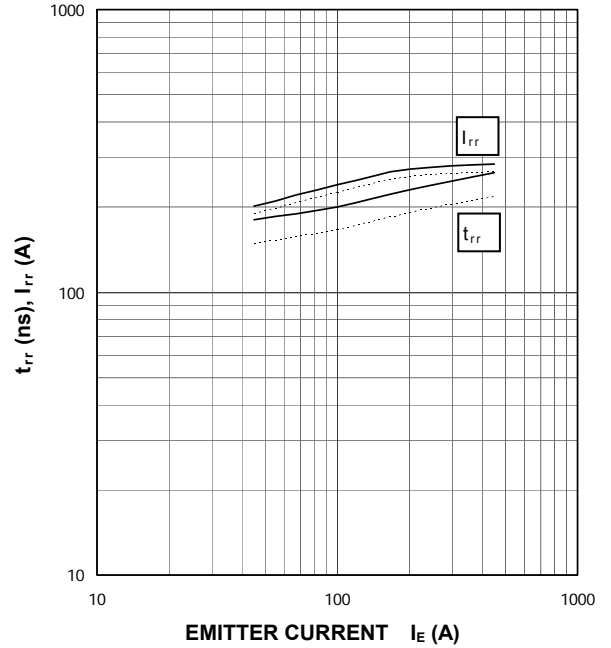
**CAPACITANCE CHARACTERISTICS  
 (TYPICAL)**

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



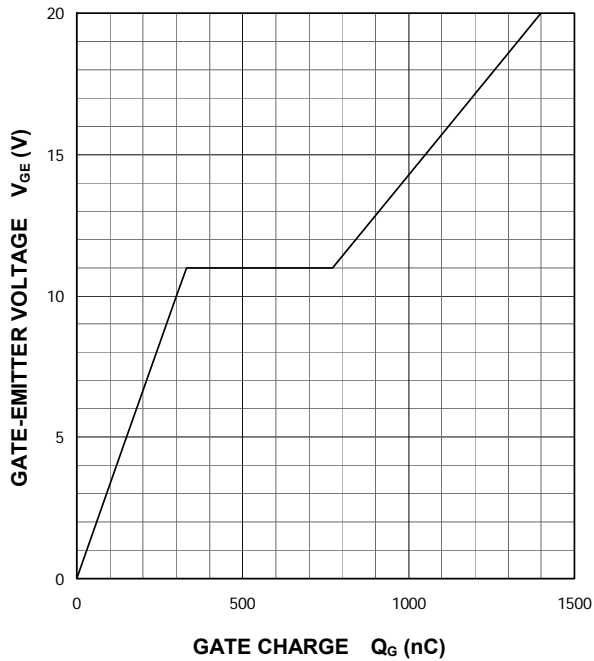
**FREE WHEELING DIODE  
 REVERSE RECOVERY CHARACTERISTICS  
 (TYPICAL)**

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



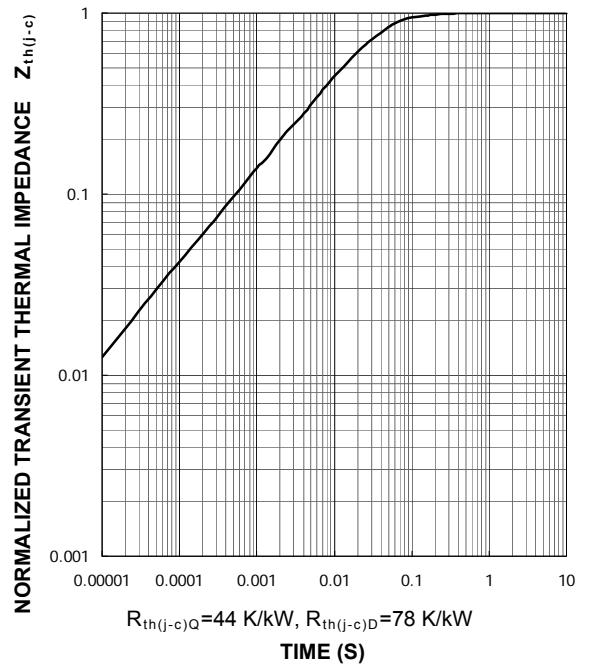
**GATE CHARGE CHARACTERISTICS  
 (TYPICAL)**

$V_{CC}=600\text{ V}$ ,  $I_C=450\text{ A}$ ,  $T_j=25\text{ }^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE  
 CHARACTERISTICS  
 (MAXIMUM)**

Single pulse,  $T_c=25\text{ }^\circ\text{C}$





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

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