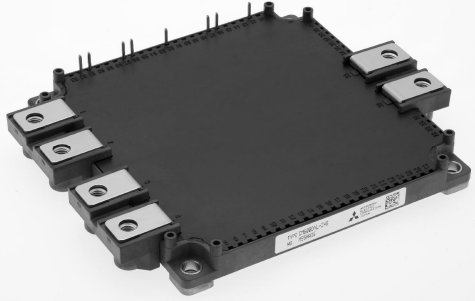


< IGBT MODULES >

# CM600DXL-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE



**Dual (Half-Bridge)**

Collector current  $I_C$  ..... **600 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **1200 V**  
 Maximum junction temperature  $T_{jmax}$  ..... **175 °C**

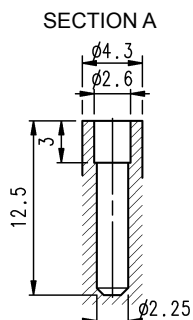
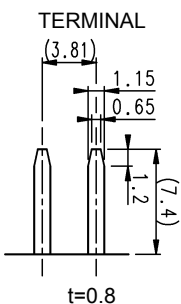
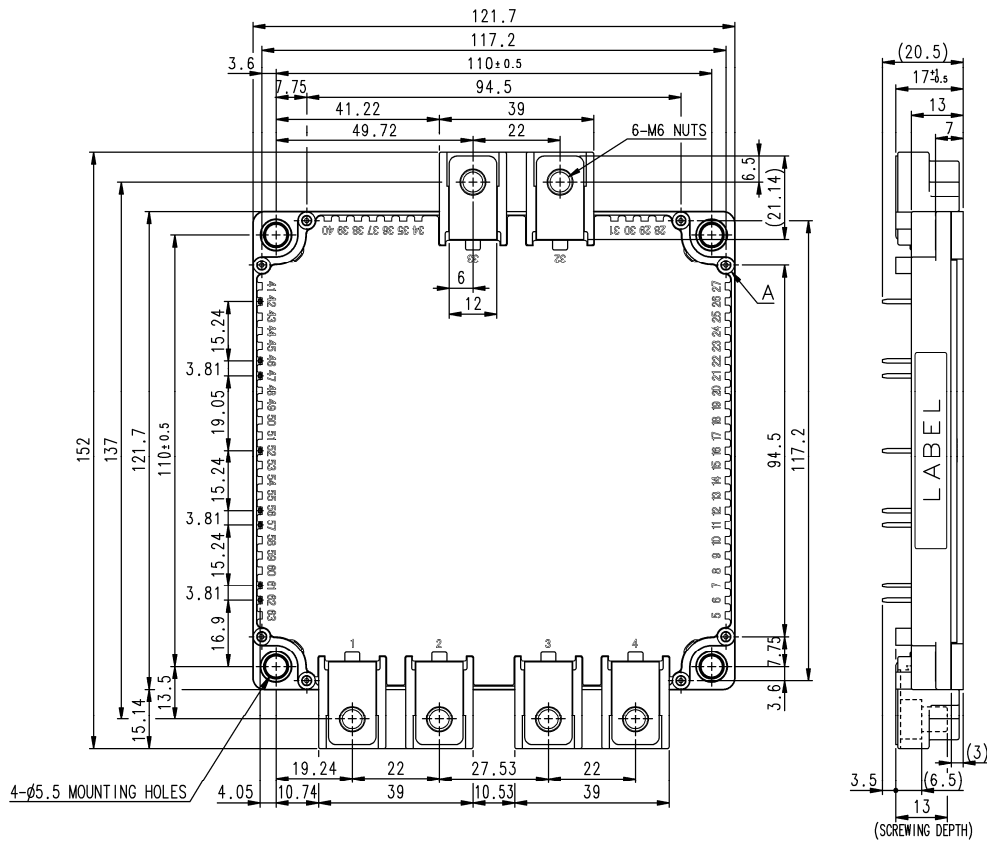
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- Recognized under UL1557, File E323585

## APPLICATION

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

## OUTLINE DRAWING & INTERNAL CONNECTION

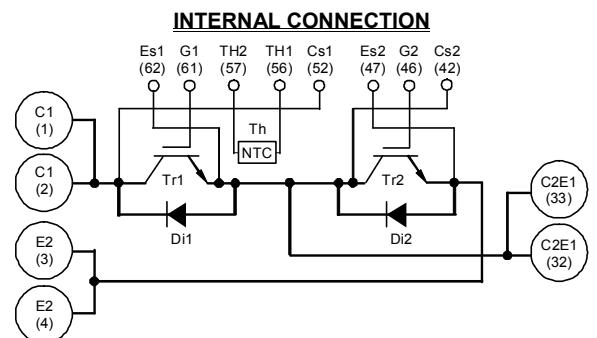
Dimension in mm



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.



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CM600DXL-24S

HIGH POWER SWITCHING USE  
INSULATED TYPE

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, 4)	600	A
$I_{CRM}$		Pulse, Repetitive (Note.3)	1200	
$P_{tot}$	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	4545	W
$I_E$ (Note.1)	Emitter current	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	600	A
$I_{ERM}$ (Note.1)		Pulse, Repetitive (Note.3)	1200	

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	$I_C=60\text{ mA}$ , $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
$V_{CESat}$	Collector-emitter saturation voltage	$I_C=600\text{ A}$ (Note.5), $V_{GE}=15\text{ V}$ , (Terminal)	$T_j=25\text{ }^\circ\text{C}$	-	1.85	2.30	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.05	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.10	-	
$V_{CESat}$	Collector-emitter saturation voltage	$I_C=600\text{ A}$ (Note.5), $V_{GE}=15\text{ V}$ , (Chip)	$T_j=25\text{ }^\circ\text{C}$	-	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	-	-	60	nF	
$C_{oes}$	Output capacitance		-	-	12		
$C_{res}$	Reverse transfer capacitance		-	-	1.0		
$Q_G$	Gate charge	$V_{CC}=600\text{ V}$ , $I_C=600\text{ A}$ , $V_{GE}=15\text{ V}$	-	1400	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$ , $I_C=600\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=0\text{ }\Omega$ , Inductive load	-	-	800	ns	
$t_r$	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	600		
$t_f$	Fall time		-	-	300		
$V_{EC}$ (Note.1)	Emitter-collector voltage	$I_E=600\text{ A}$ (Note.5), G-E short-circuited, (Terminal)	$T_j=25\text{ }^\circ\text{C}$	-	1.85	2.30	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.85	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.85	-	
$V_{EC}$ (Note.1)	Emitter-collector voltage	$I_E=600\text{ A}$ (Note.5), G-E short-circuited, (Chip)	$T_j=25\text{ }^\circ\text{C}$	-	1.70	2.15	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.70	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.70	-	
$t_{rr}$ (Note.1)	Reverse recovery time	$V_{CC}=600\text{ V}$ , $I_E=600\text{ A}$ , $V_{GE}=\pm 15\text{ V}$ , $R_G=0\text{ }\Omega$ , Inductive load	-	-	300	ns	
$Q_{rr}$ (Note.1)	Reverse recovery charge	$R_G=0\text{ }\Omega$ , Inductive load	-	32	-	$\mu\text{C}$	
$E_{on}$	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$ , $I_C=I_E=600\text{ A}$ ,	-	20.3	-	mJ	
$E_{off}$	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$ , $R_G=0\text{ }\Omega$ , $T_j=150\text{ }^\circ\text{C}$ ,	-	60.1	-		
$E_{rr}$ (Note.1)	Reverse recovery energy per pulse	Inductive load	-	69.2	-	mJ	
$R_{CC+EE}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note.2)	-	-	0.8	m $\Omega$	
$r_g$	Internal gate resistance	Per switch	-	3.3	-	$\Omega$	

**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	-	-	33	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per Inverter FWDi	-	-	63	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)	-	7	-	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	N·m
d <sub>s</sub>	Creepage distance	Terminal to terminal	13.2	-	-	mm
		Terminal to base plate	15.3	-	-	
d <sub>a</sub>	Clearance	Terminal to terminal	13.2	-	-	mm
		Terminal to base plate	14.8	-	-	
m	Weight	-	-	690	-	g
e <sub>c</sub>	Flatness of base plate	On the centerline X, Y (Note.8)	±0	-	+100	μm

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).

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.

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.

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

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

Refer to the figure of test circuit.

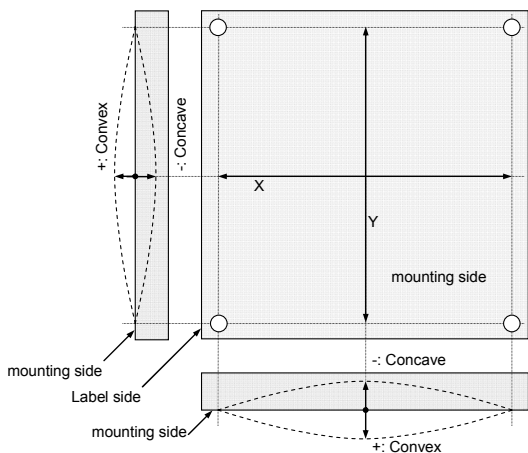
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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



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

Note9. 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"

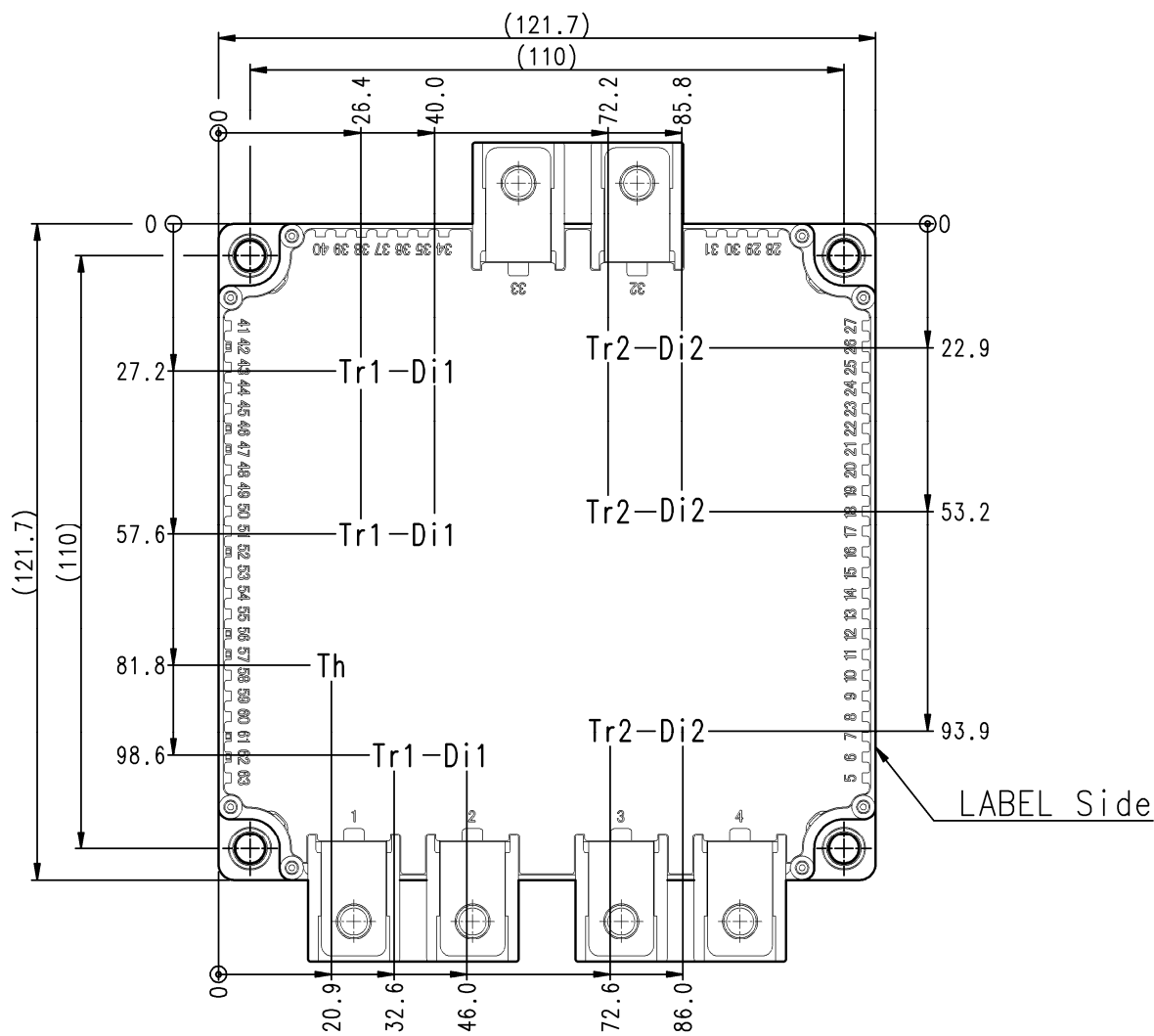
The length of the screw depends on the thickness of the PCB.

**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	-	6.8	Ω

**CHIP LOCATION (Top view)**

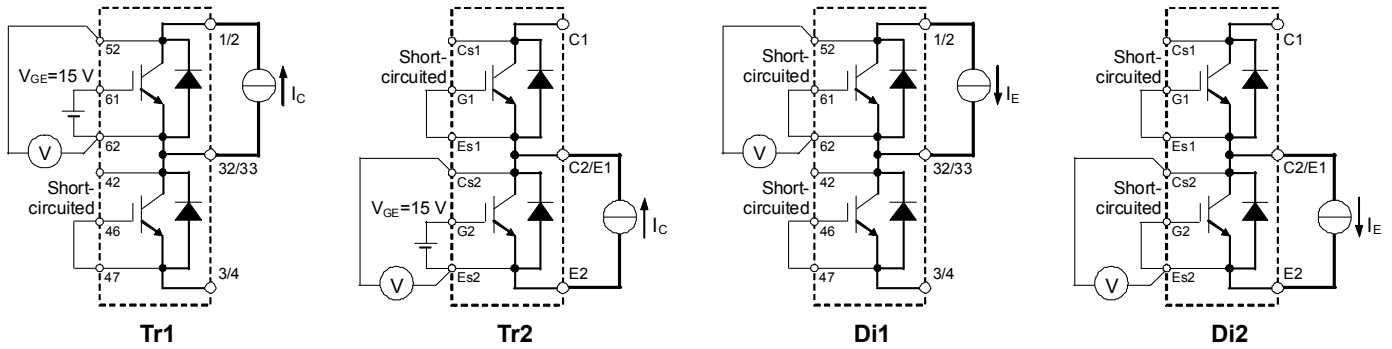
Dimension in mm, tolerance: ±1 mm



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

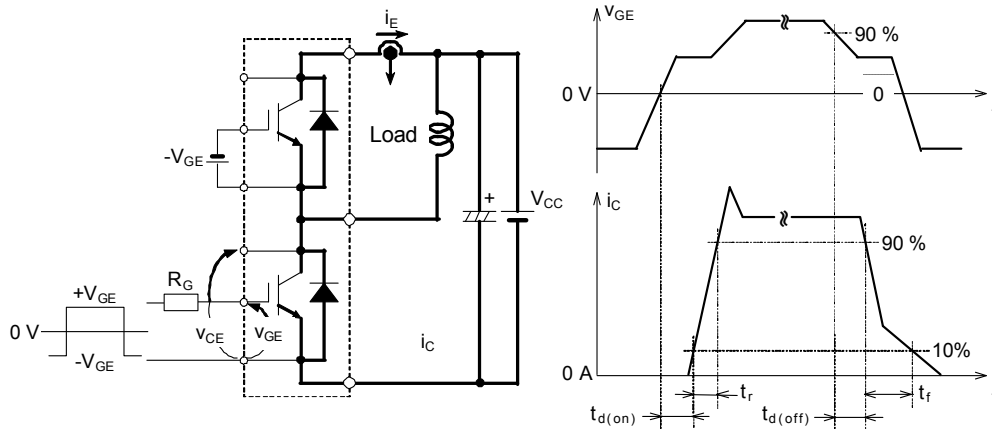
< IGBT MODULES >  
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**TEST CIRCUIT AND WAVEFORMS**

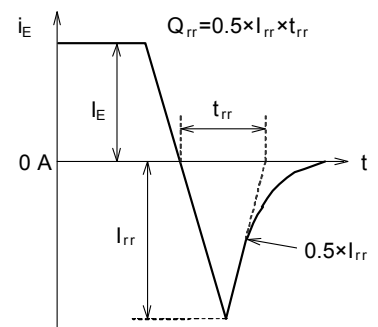


**$V_{CESat}$  test circuit**

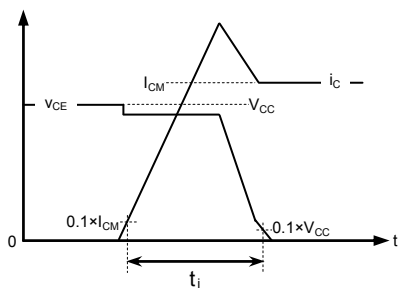
**$V_{EC}$  test circuit**



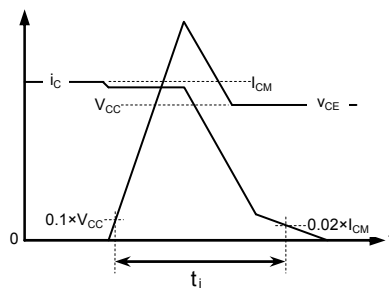
**Switching characteristics test circuit and waveforms**



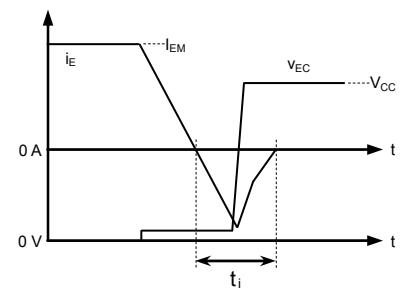
**$t_{rr}$ ,  $Q_{rr}$  test waveform**



**IGBT Turn-on switching energy**



**IGBT Turn-off switching energy**



**FWDi Reverse recovery energy**

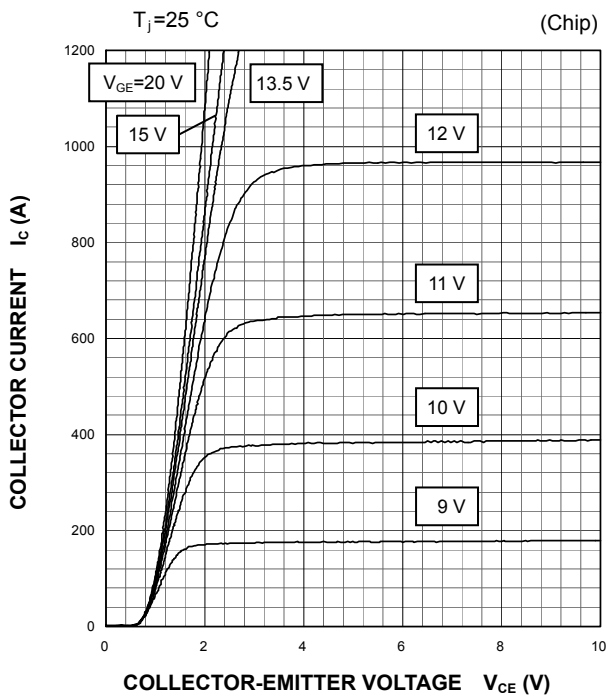
**Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)**

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**CM600DXL-24S**  
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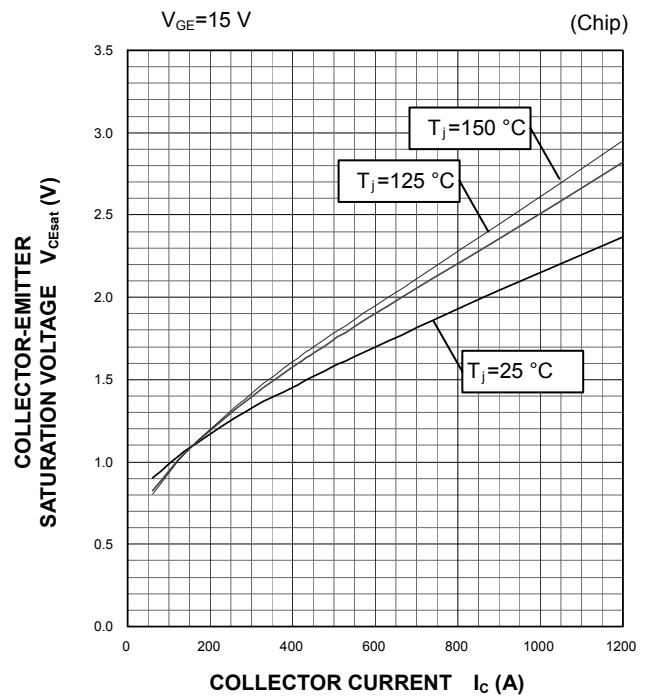
PERFORMANCE CURVES

INVERTER PART

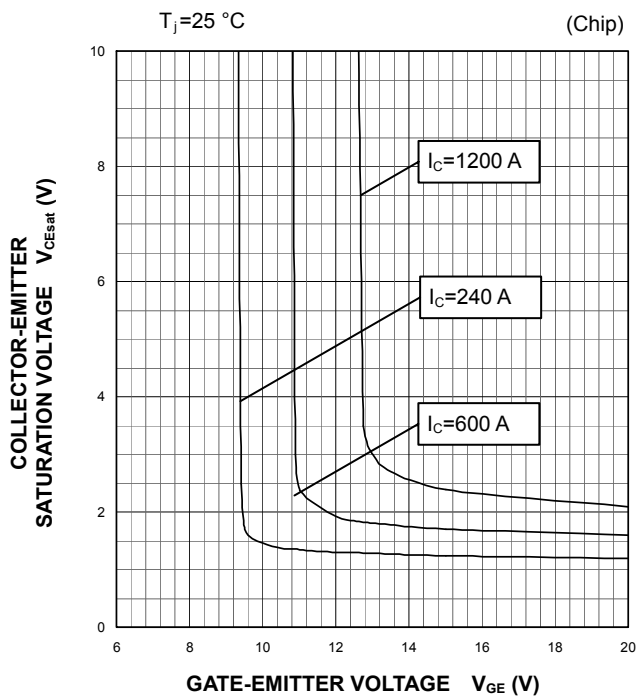
OUTPUT CHARACTERISTICS  
 (TYPICAL)



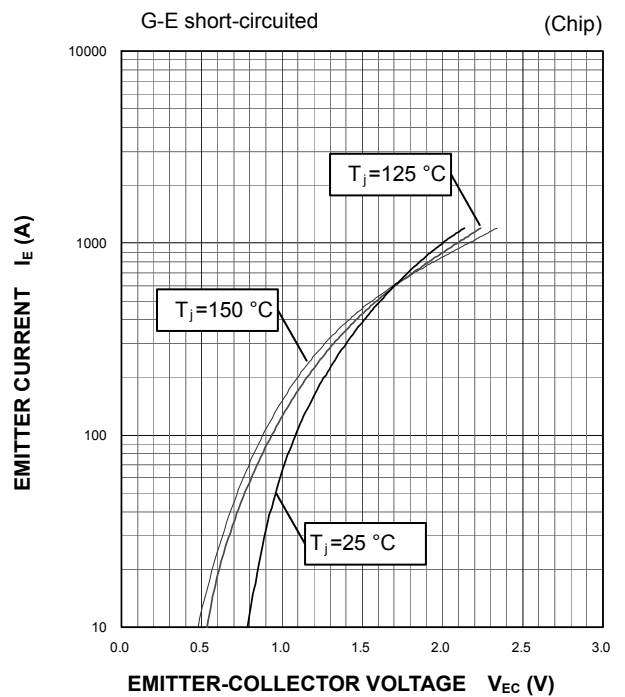
COLLECTOR-EMITTER SATURATION  
 VOLTAGE CHARACTERISTICS  
 (TYPICAL)



COLLECTOR-EMITTER SATURATION  
 VOLTAGE CHARACTERISTICS  
 (TYPICAL)



FREE WHEELING DIODE  
 FORWARD CHARACTERISTICS  
 (TYPICAL)

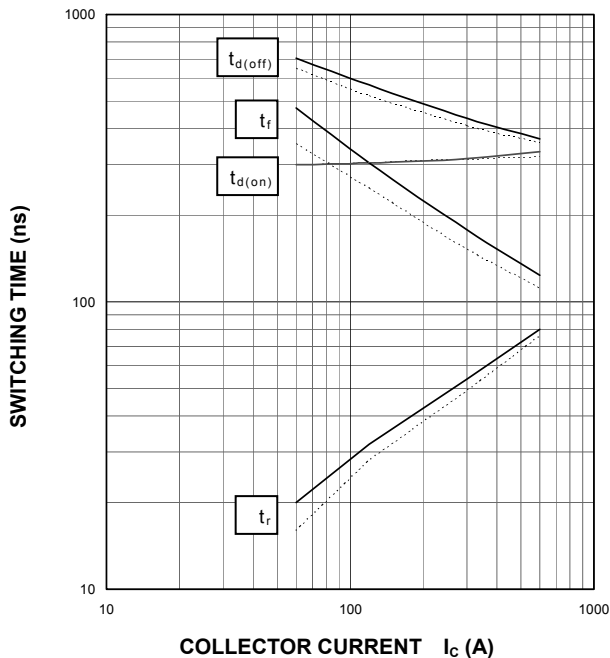


PERFORMANCE CURVES

INVERTER PART

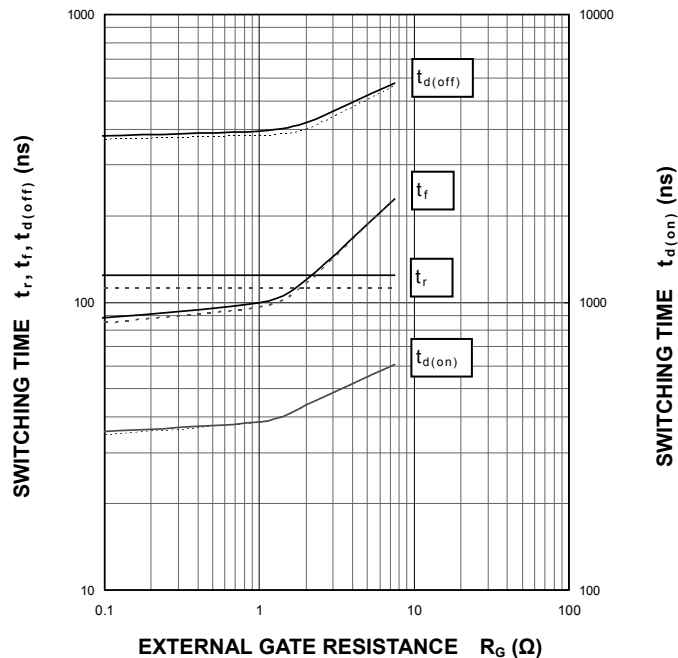
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



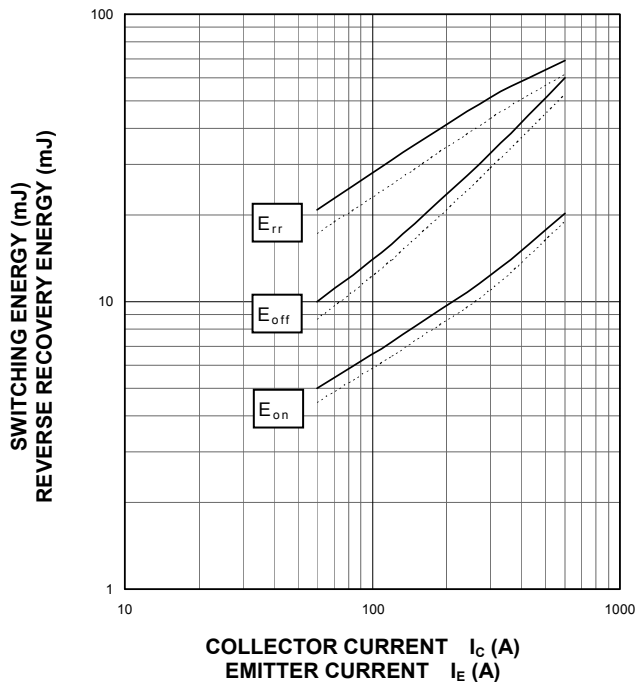
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



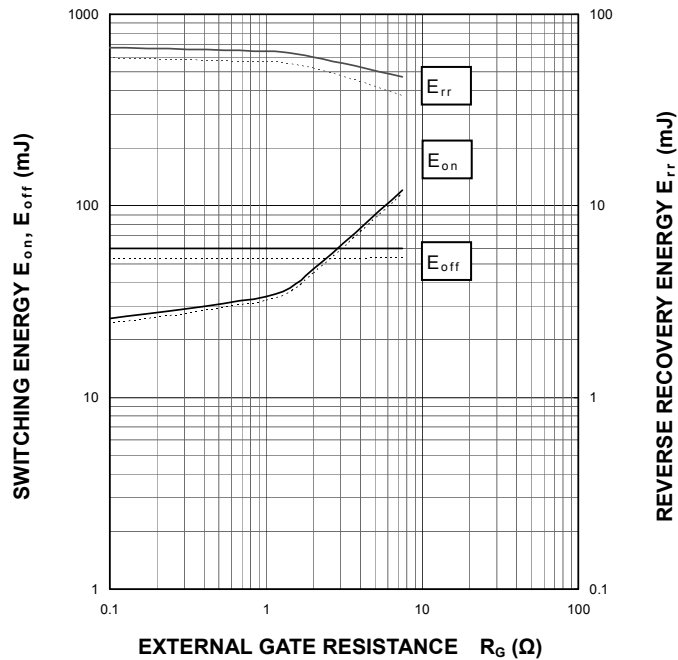
HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



HALF-BRIDGE  
SWITCHING CHARACTERISTICS  
(TYPICAL)

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



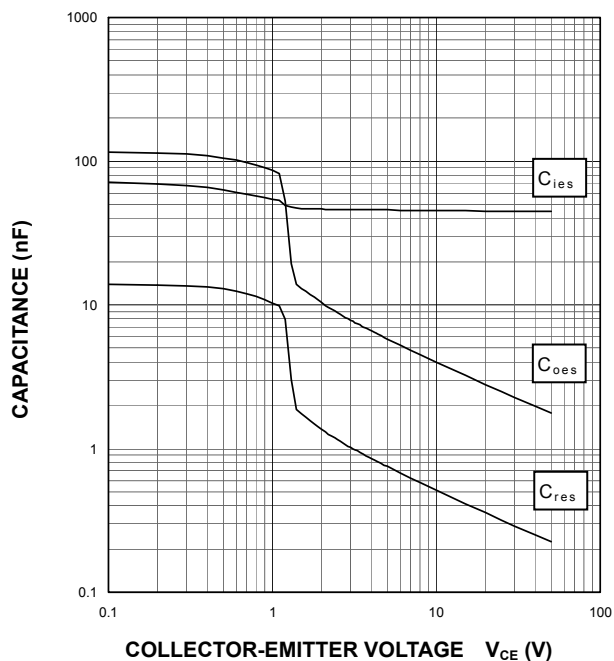
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**PERFORMANCE CURVES**

**INVERTER PART**

**CAPACITANCE CHARACTERISTICS (TYPICAL)**

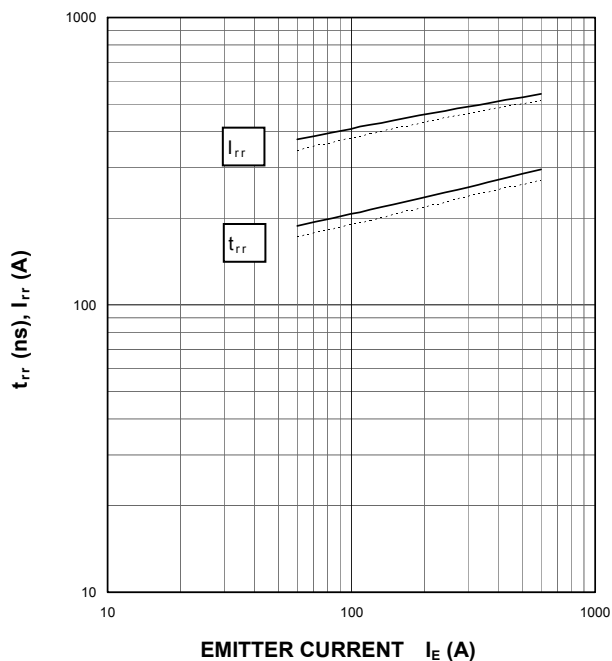
G-E short-circuited,  $T_j=25^\circ\text{C}$



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

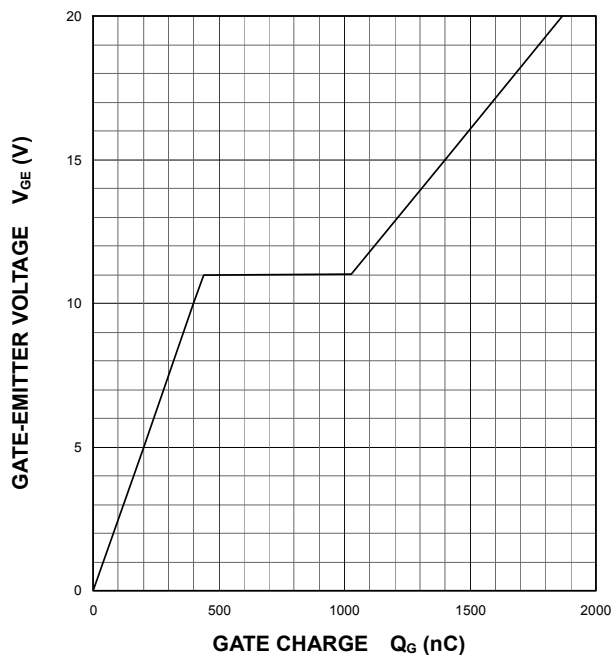
$V_{CC}=600\text{ V}$ ,  $V_{GE}=\pm 15\text{ V}$ ,  $R_G=0\ \Omega$ , INDUCTIVE LOAD

—:  $T_j=150^\circ\text{C}$ , - - - -:  $T_j=125^\circ\text{C}$



**GATE CHARGE CHARACTERISTICS (TYPICAL)**

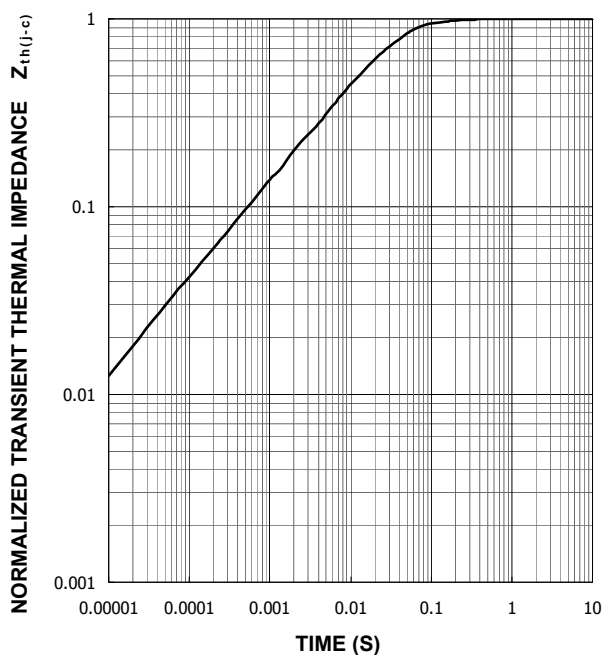
$V_{CC}=600\text{ V}$ ,  $I_C=600\text{ A}$ ,  $T_j=25^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**

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

$R_{th(j-c)Q}=33\text{ K/kW}$ ,  $R_{th(j-c)D}=63\text{ K/kW}$





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