

< IGBT MODULES >

CM450DX-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



Dual (Half-Bridge)

Collector current I_C **450 A**
 Collector-emitter voltage V_{CES} **1200 V**
 Maximum junction temperature T_{jmax} **175 °C**

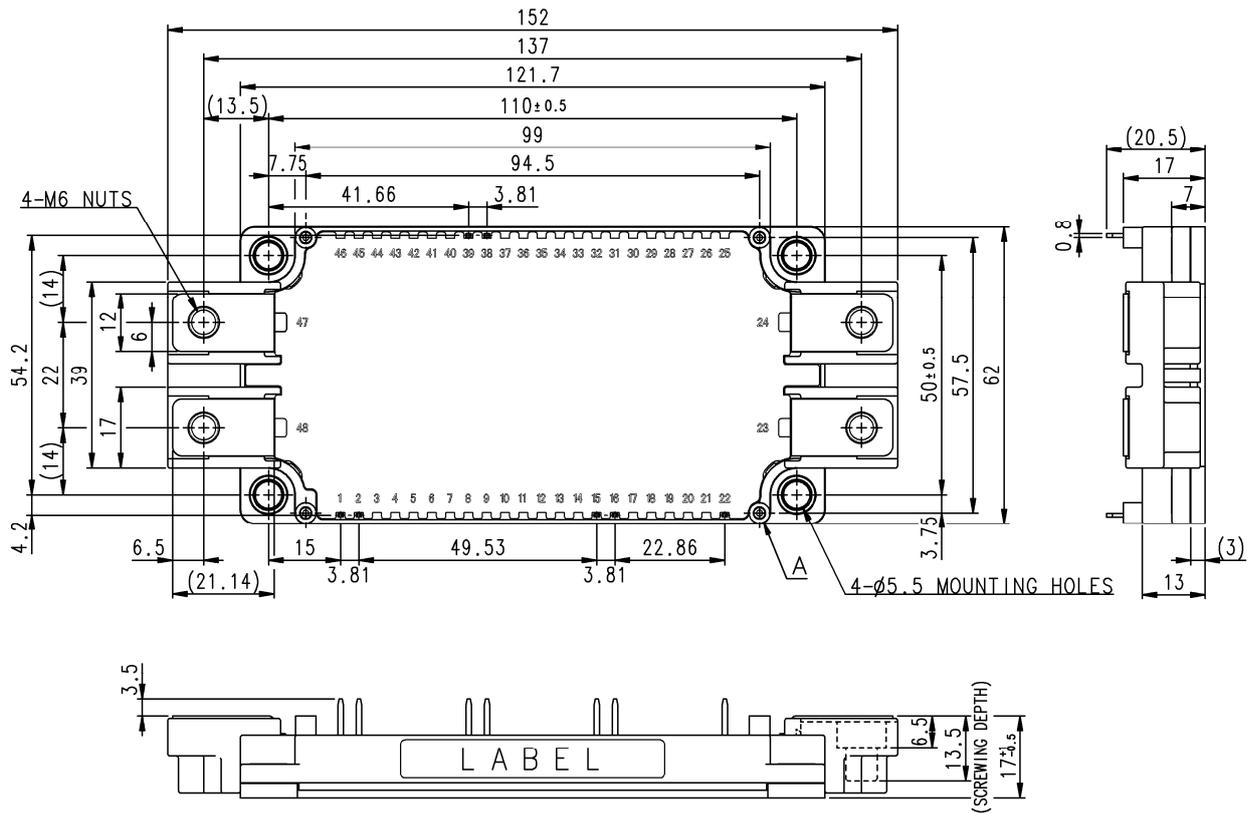
- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File E323585

APPLICATION

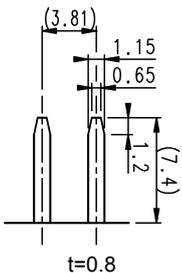
AC Motor Control, Motion/Servo Control, Power supply, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

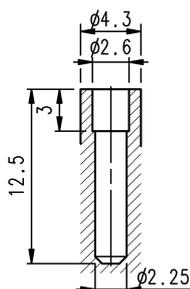
Dimension in mm



TERMINAL



SECTION A

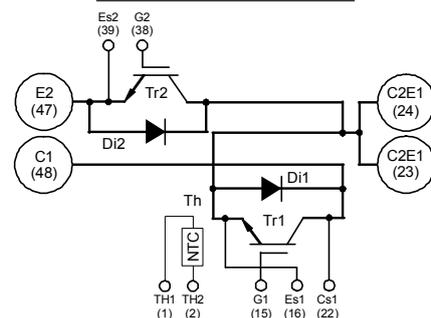


Tolerance otherwise specified

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



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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	± 20	V
I_C	Collector current	DC, $T_C=119\text{ }^\circ\text{C}$ (Note.2, 4)	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	-	-	1.0	mA	
I_{GES}	Gate-emitter leakage current	$V_{GE}=V_{GES}$, C-E short-circuited	-	-	0.5	μA	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=45\text{ mA}$, $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
V_{CESat}	Collector-emitter saturation voltage	$I_C=450\text{ A}$ (Note.5), $V_{GE}=15\text{ V}$, (Terminal)	$T_j=25\text{ }^\circ\text{C}$	-	1.80	2.25	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.00	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.05	-	
		$I_C=450\text{ A}$ (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	-	-	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)	Emitter-collector voltage	$I_E=450\text{ A}$ (Note.5), G-E short-circuited, (Terminal)	$T_j=25\text{ }^\circ\text{C}$	-	1.80	2.25	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.80	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.80	-	
		$I_E=450\text{ A}$ (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	$V_{CC}=600\text{ V}$, $I_E=450\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, Inductive load	-	-	300	ns	
Q_{rr} (Note.1)	Reverse recovery charge	$R_G=0\ \Omega$, Inductive load	-	24	-	μC	
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 Ω	
r_g	Internal gate resistance	Per switch	-	4.3	-	Ω	

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HIGH POWER SWITCHING USE INSULATED TYPE

ELECTRICAL CHARACTERISTICS (cont.; T_j=25 °C, unless otherwise specified)

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R ₂₅	Zero-power resistance	T _c =25 °C (Note.2)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	T _c =100 °C, R ₁₀₀ =493 Ω	-7.3	-	+7.8	%
B _(25/50)	B-constant	Approximate by equation (Note.6)	-	3375	-	K
P ₂₅	Power dissipation	T _c =25 °C (Note.2)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance (Note.2)	Junction to case, per Inverter IGBT	-	-	44	K/kW
R _{th(j-c)D}		Junction to case, per Inverter FWDi	-	-	78	K/kW
R _{th(c-s)}	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 _t	Mounting torque	Main terminals M 6 screw	3.5	4.0	4.5	N·m
M _s		Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
d _s	Creepage distance	Terminal to terminal	11.55	-	-	mm
		Terminal to base plate	12.32	-	-	
d _a	Clearance	Terminal to terminal	10.00	-	-	mm
		Terminal to base plate	10.85	-	-	
m	Weight	-	-	350	-	g
e _c	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_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.

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_j) dose not exceed T_{jmax} rating.

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

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

Refer to the figure of test circuit.

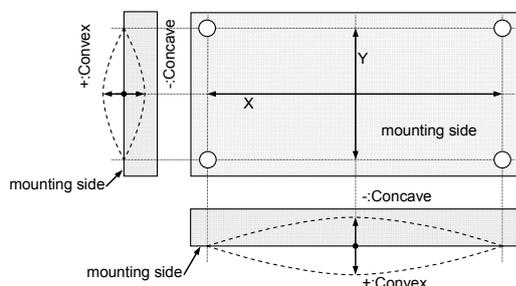
$$6. B_{(25/50)} = \ln \left(\frac{R_{25}}{R_{50}} \right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}} \right)$$

R₂₅: resistance at absolute temperature T₂₅ [K]; T₂₅=25 [°C]+273.15=298.15 [K]

R₅₀: resistance at absolute temperature T₅₀ [K]; T₅₀=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.



9. 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.

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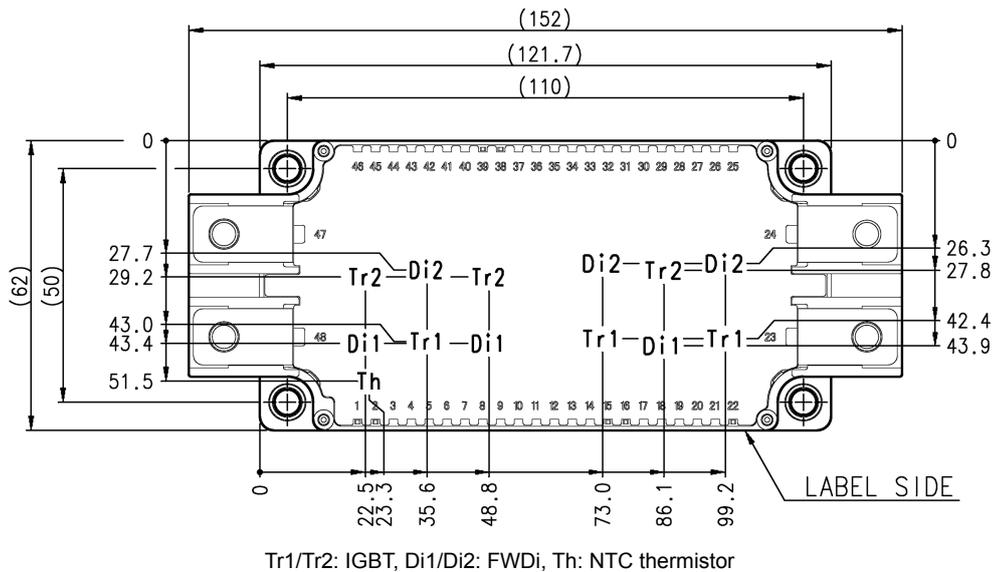
HIGH POWER SWITCHING USE
INSULATED TYPE

RECOMMENDED OPERATING CONDITIONS (T_a=25 °C)

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

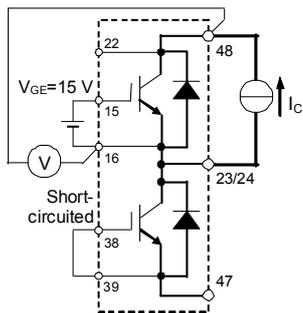
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



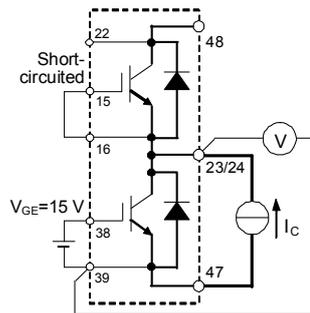
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TEST CIRCUIT AND WAVEFORMS

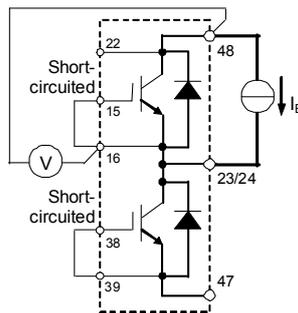


Tr1

V_{CEsat} test circuit

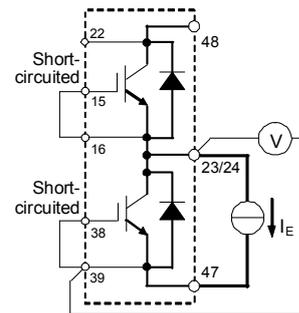


Tr2

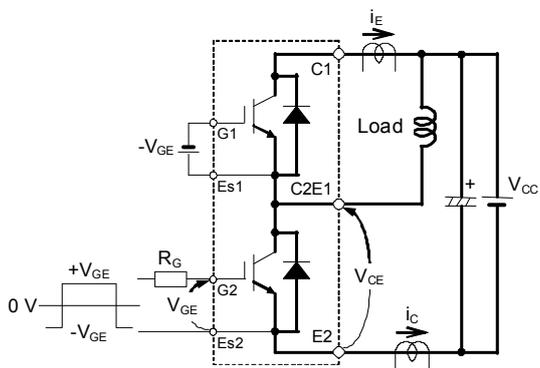


Di1

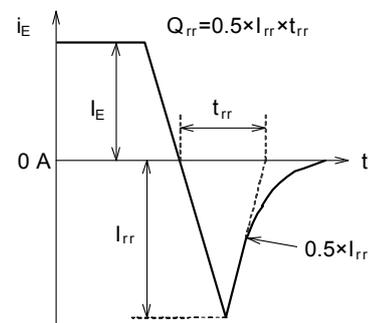
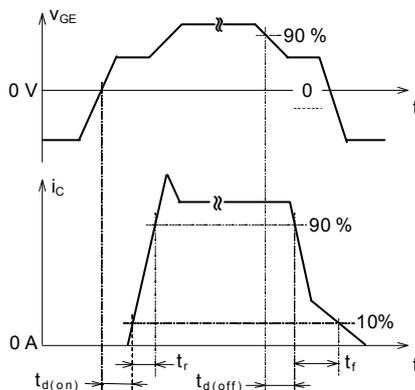
V_{EC} test circuit



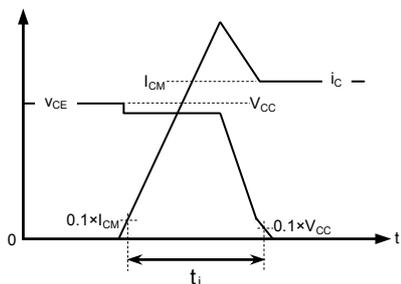
Di2



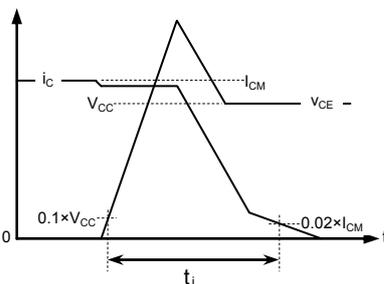
Switching characteristics test circuit and waveforms



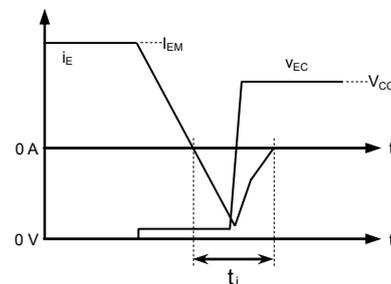
t_{rr}, Q_{rr} test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



FWDi Reverse recovery energy

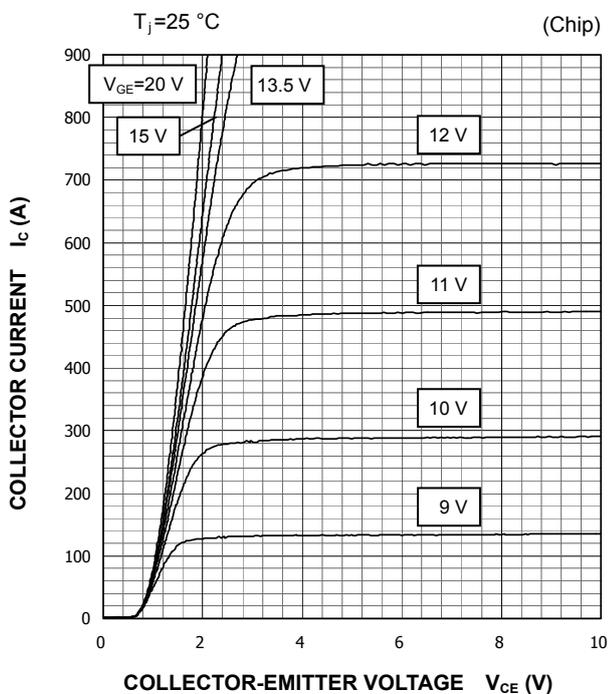
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

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 HIGH POWER SWITCHING USE
 INSULATED TYPE

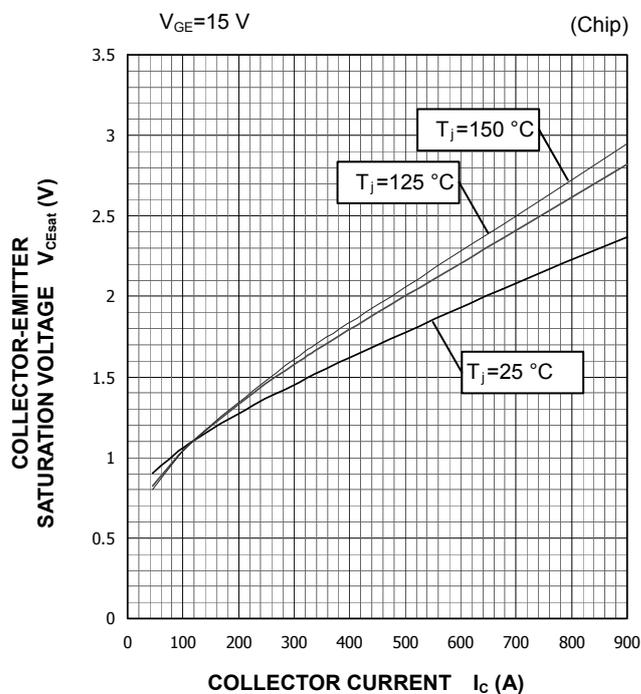
PERFORMANCE CURVES

INVERTER PART

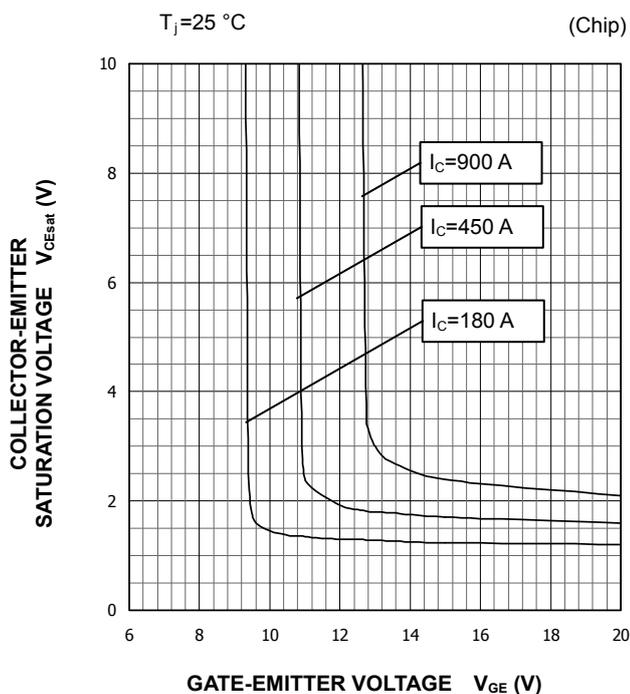
OUTPUT CHARACTERISTICS (TYPICAL)



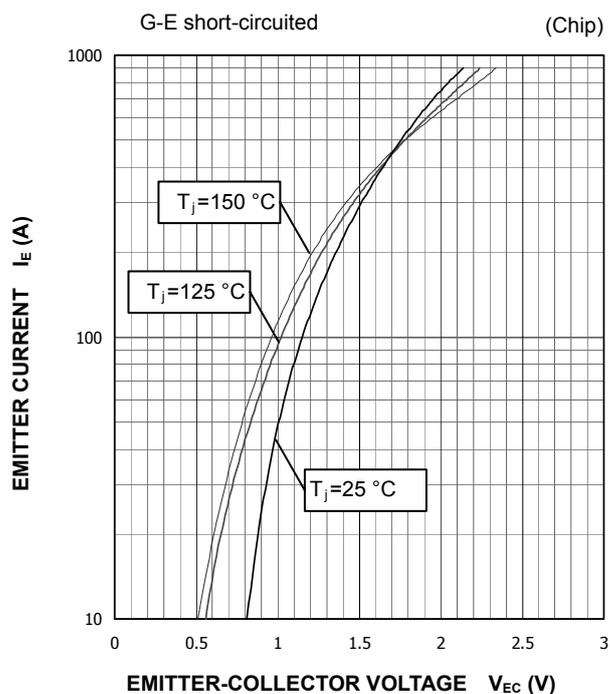
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS (TYPICAL)



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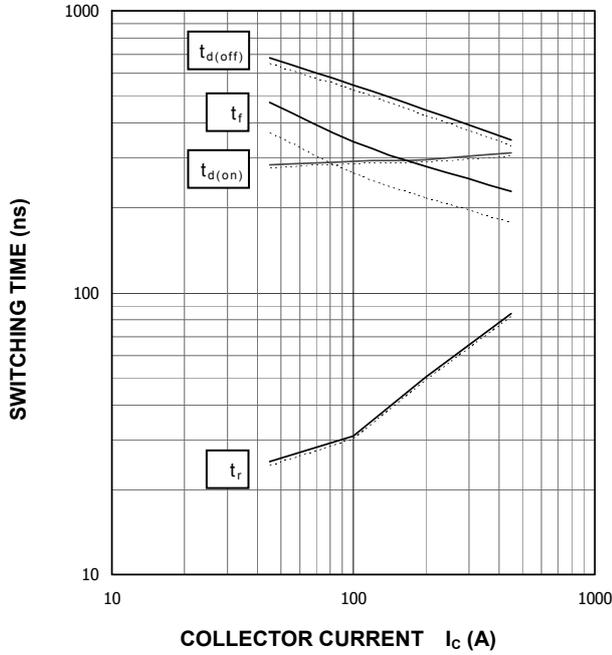
HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

INVERTER PART

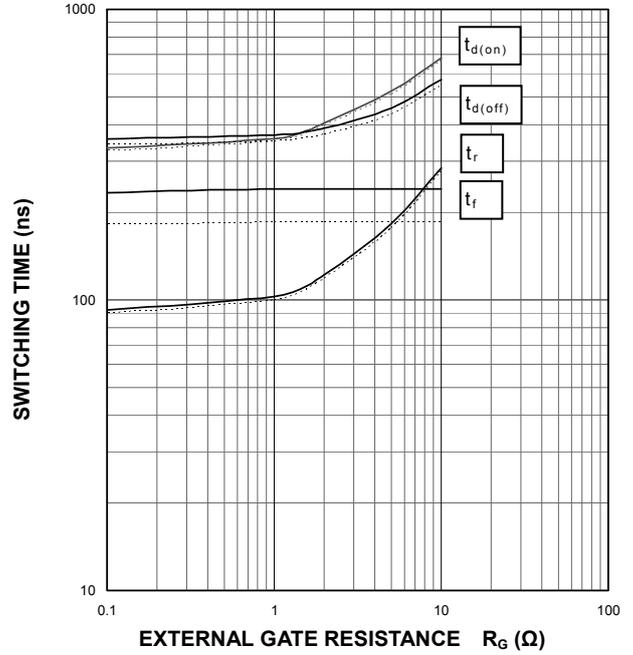
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



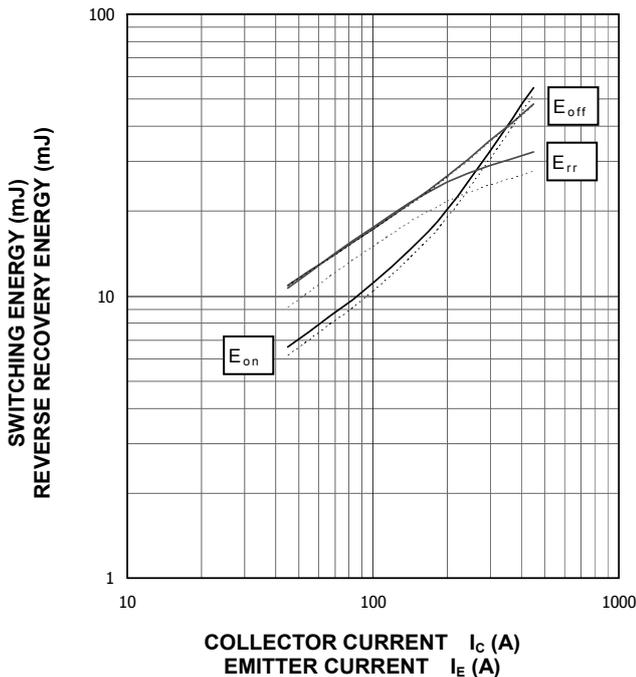
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



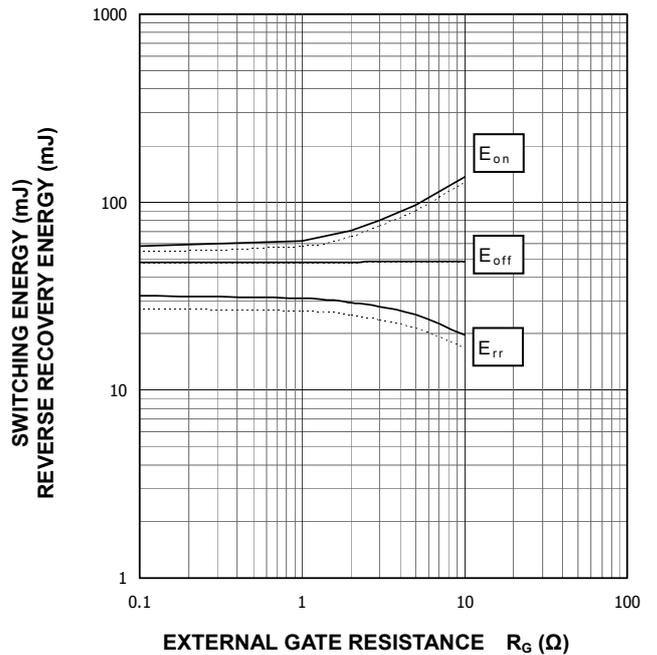
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



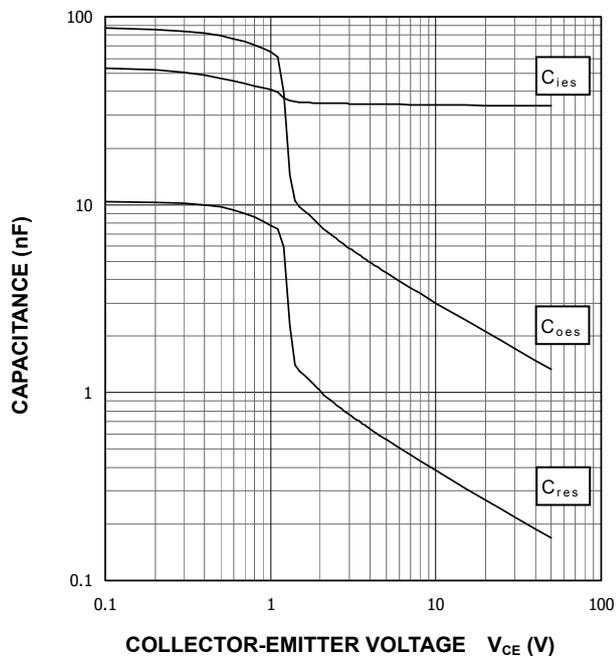
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CM450DX-24S
 HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

INVERTER PART

CAPACITANCE CHARACTERISTICS (TYPICAL)

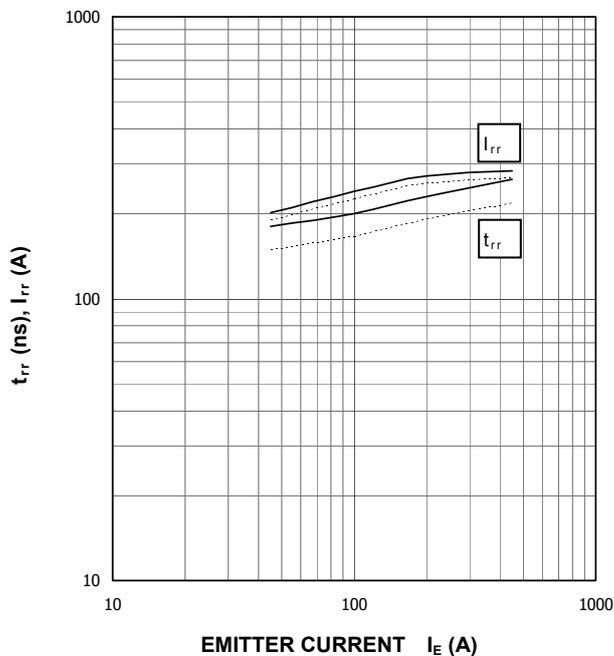
G-E short-circuited, $T_j=25\text{ }^\circ\text{C}$



FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

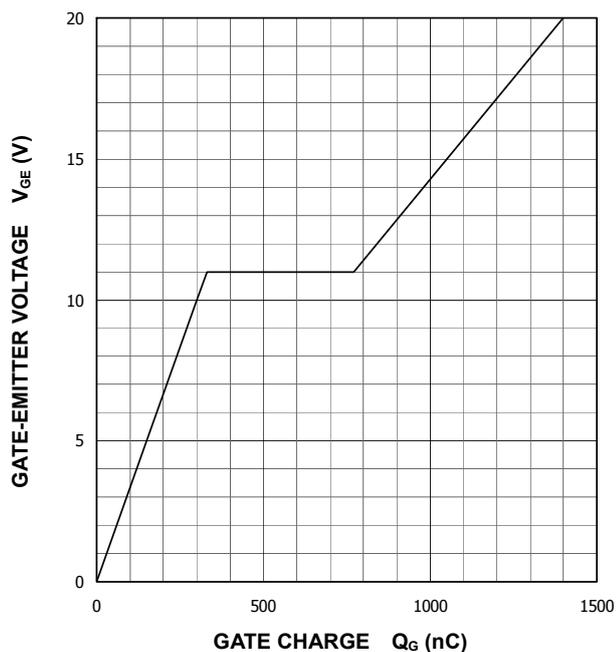
$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD

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



GATE CHARGE CHARACTERISTICS (TYPICAL)

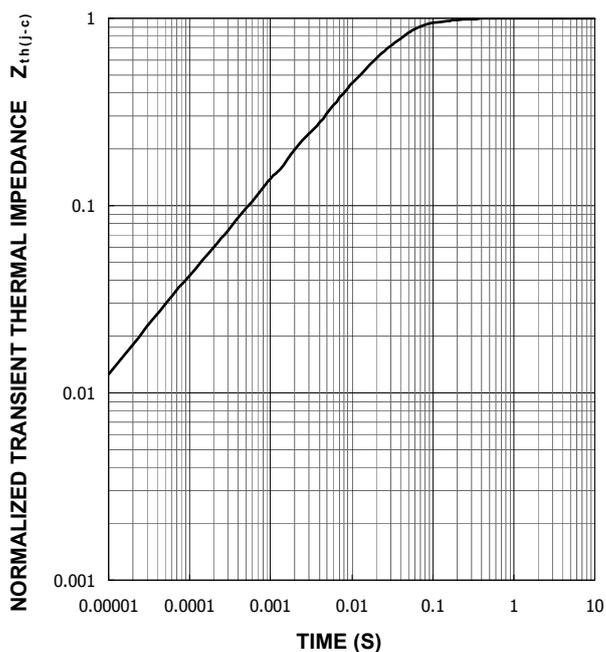
$V_{CC}=600\text{ V}$, $I_C=450\text{ A}$, $T_j=25\text{ }^\circ\text{C}$



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)

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

$R_{th(j-c)Q}=44\text{ K/kW}$, $R_{th(j-c)D}=78\text{ K/kW}$



Keep safety first in your circuit designs!

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