

<IGBT Modules>

CM450DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE



dual switch (Half-Bridge)

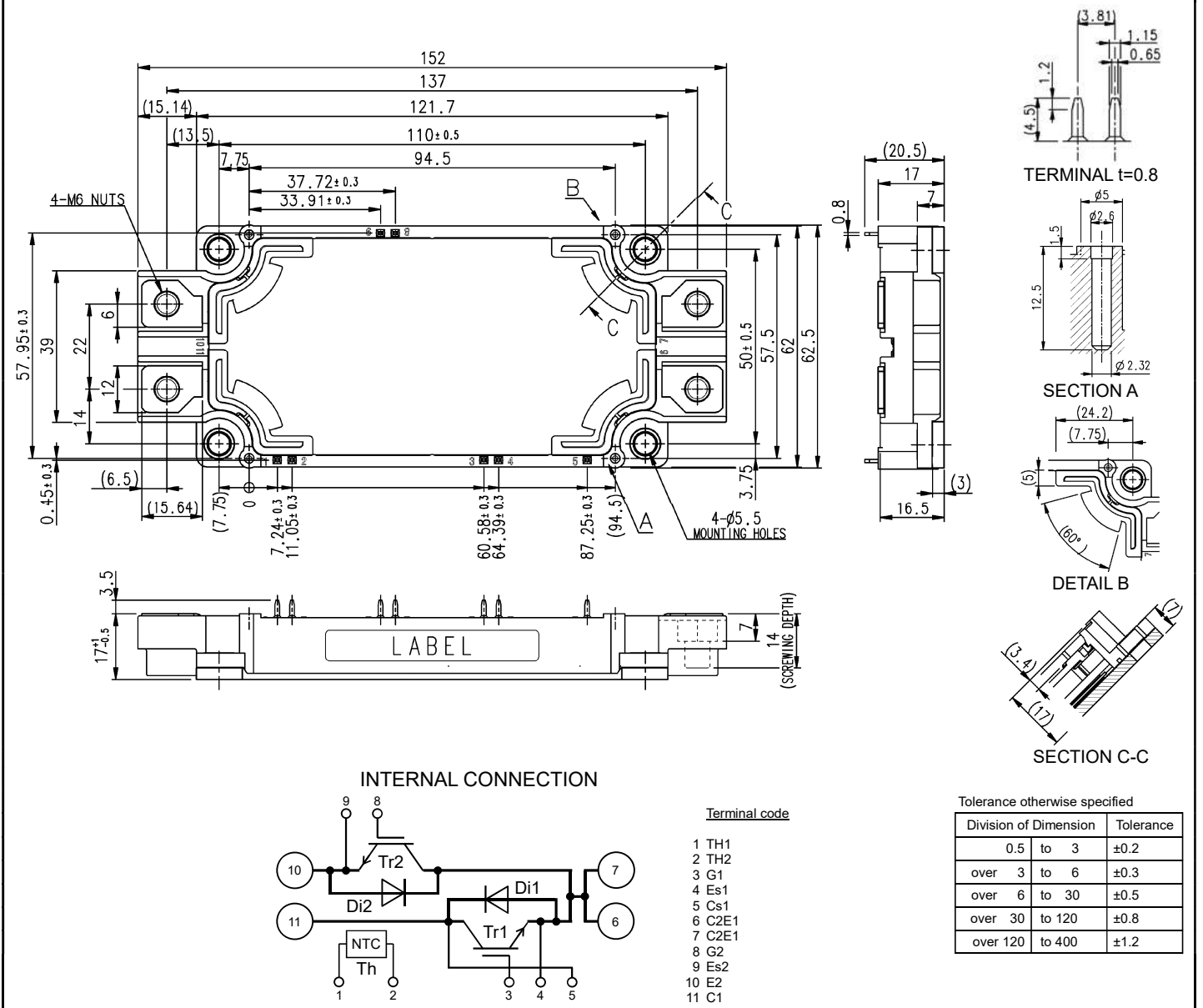
Collector current I_c 450 A
 Collector-emitter voltage V_{CES} 1200 V
 Maximum junction temperature T_{jmax} 175 °C

- Flat base Type
- Copper base plate (non-plating)
- Tin plating pin terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File No. E323585

APPLICATION

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

OUTLINE DRAWING & INTERNAL CONNECTION



CM450DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPEMAXIMUM RATINGS ($T_j=25\text{ }^\circ\text{C}$, unless otherwise specified)

INVERTER PART IGBT/FWD

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, $T_C=107\text{ }^\circ\text{C}$ (Note2, 4)	450	A
I_{CRM}		Pulse, Repetitive (Note3)	900	
P_{tot}	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note2, 4)	2775	W
I_E (Note1)	Emitter current	DC (Note2)	450	A
I_{ERM} (Note1)		Pulse, Repetitive (Note3)	900	

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	(Note4)	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)

INVERTER PART IGBT/FWD

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} (Terminal)	Collector-emitter saturation voltage	$I_C=450\text{ A}$, $V_{GE}=15\text{ V}$, Refer to the figure of test circuit (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	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)		$I_C=450\text{ A}$, $V_{GE}=15\text{ V}$, (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	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	$V_{CC}=600\text{ V}$, $I_C=450\text{ A}$, $V_{GE}=15\text{ V}$	-	945	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=450\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, Inductive load	-	-	800	ns	
t_r	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	600		
t_f	Fall time		-	-	300		
V_{EC} (Note1) (Terminal)	Emitter-collector voltage	$I_E=450\text{ A}$, G-E short-circuited, Refer to the figure of test circuit (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	2.60	3.40	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.16	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.10	-	
V_{EC} (Note1) (Chip)		$I_E=450\text{ A}$, G-E short-circuited, (Note5)	$T_j=25\text{ }^\circ\text{C}$	-	2.50	3.30	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.06	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.00	-	
t_{rr} (Note1)	Reverse recovery time	$V_{CC}=600\text{ V}$, $I_E=450\text{ A}$, $V_{GE}=\pm 15\text{ V}$,	-	-	300	ns	
Q_{rr} (Note1)	Reverse recovery charge	$R_G=0\text{ }\Omega$, Inductive load	-	12	-	μC	
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=450\text{ A}$,	-	35.8	-	mJ	
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, $T_j=150\text{ }^\circ\text{C}$,	-	52.4	-		
E_{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	27.9	-	mJ	
$R_{CC'+EE'}$	Internal lead resistance	Main terminals-chip, per switch, $T_C=25\text{ }^\circ\text{C}$ (Note2)	-	-	0.7	m Ω	
r_g	Internal gate resistance	Per switch	-	4.3	-	Ω	

CM450DX-24S1

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 (Note4)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R ₁₀₀ =493 Ω, T _C =100 °C (Note4)	-7.3	-	+7.8	%
B _(25/50)	B-constant	Approximate by equation (Note6)	-	3375	-	K
P ₂₅	Power dissipation	T _C =25 °C (Note4)	-	-	10	mW

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	54	K/kW
R _{th(j-c)D}		Junction to case, per Inverter FWD (Note4)	-	-	86	
R _{th(c-s)}	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note4, 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 torque	Mounting to heat sink M 5 screw	2.5	3.0	3.5	N·m
m	mass	-	-	350	-	g
d _s	Creepage distance	Terminal to terminal	17	-	-	mm
		Terminal to base plate	18.5	-	-	
d _a	Clearance	Terminal to terminal	10	-	-	mm
		Terminal to base plate	16.3	-	-	
e _c	Flatness of base plate	On the centerline X, Y (Note8)	±0	-	+100	μm

*. This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU.

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

- Junction temperature (T_j) should not increase beyond T_{jm ax} rating.
- Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jm ax} rating.
- 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.
- Pulse width and repetition rate should be such as to cause negligible temperature rise.

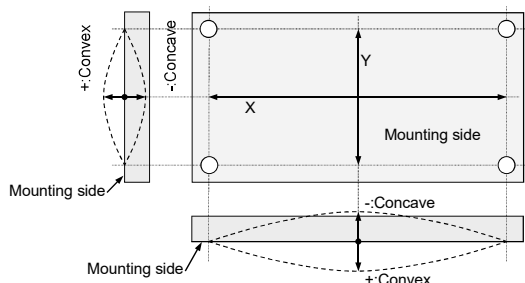
$$6. B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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. The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



CM450DX-24S1

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INSULATED TYPE

Note9. Use the following screws when mounting the printed circuit board (PCB) on the standoffs.

PCB thickness : t=1.6

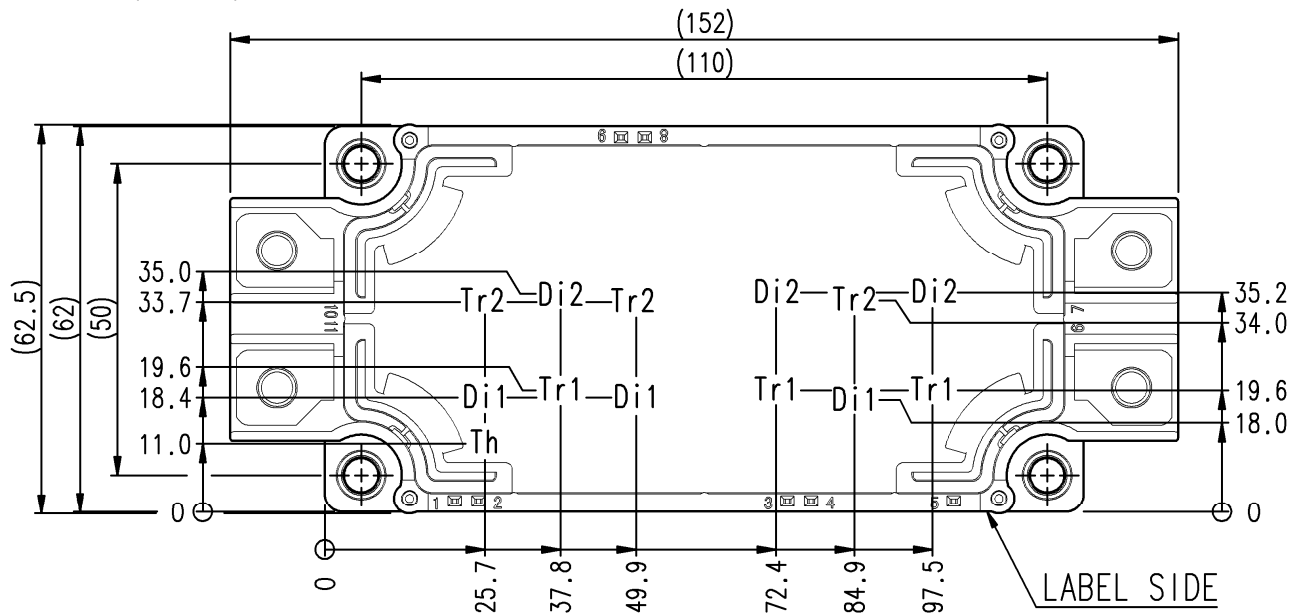
Type	Manufacturer	Size	Tightening torque (N·m)	Recommended tightening method
(1) PT®	EJOT	K25×8	0.55 ± 0.055	by handwork (equivalent to 30 rpm by mechanical screw driver) ~ 600 rpm (by mechanical screw driver)
(2) PT®		K25×10	0.75 ± 0.075	
(3) DELTA PT®		25×8	0.55 ± 0.055	
(4) DELTA PT®		25×10	0.75 ± 0.075	
(5) B1 tapping screw	-	φ2.6×10	0.75 ± 0.075	
		φ2.6×12		

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V _{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	V
V _{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2 terminals	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

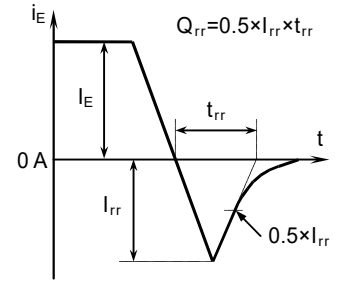
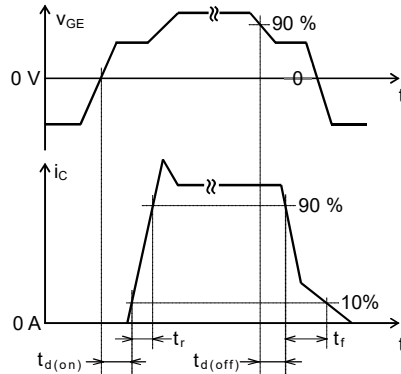
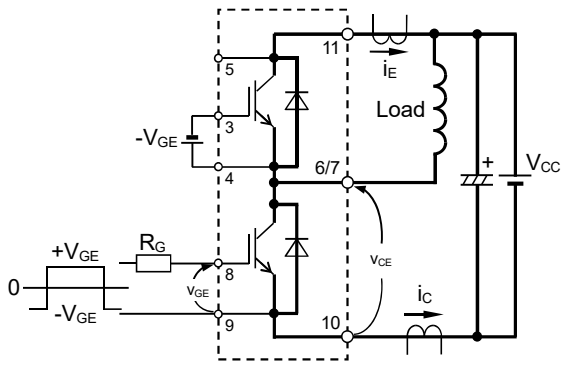


Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

CM450DX-24S1

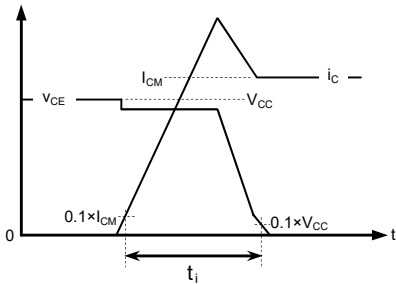
HIGH POWER SWITCHING USE
INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

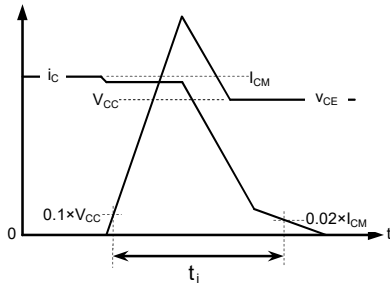


Switching characteristics test circuit and waveforms

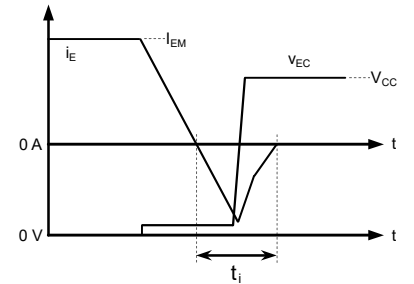
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



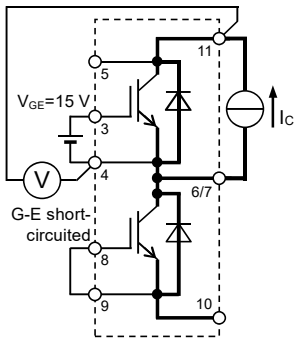
IGBT Turn-off switching energy



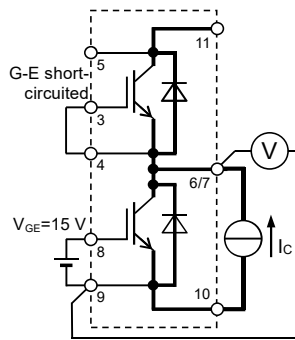
FWD Reverse recovery energy

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

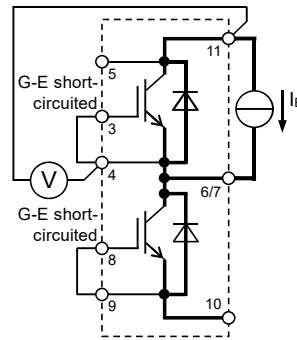
TEST CIRCUIT



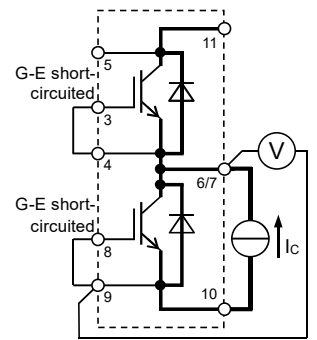
Tr1 V_{CEsat} characteristics test circuit



Tr2



Di1



Di2

V_{EC} characteristics test circuit

CM450DX-24S1

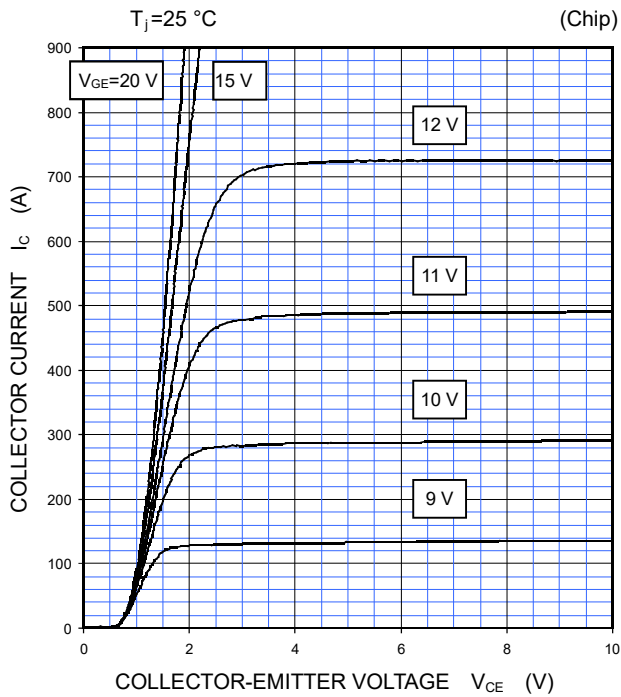
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

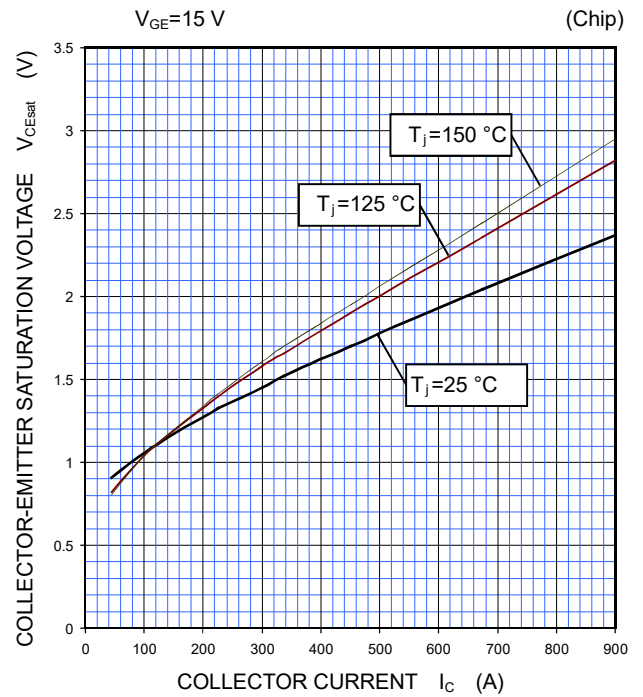
OUTPUT CHARACTERISTICS

(TYPICAL)



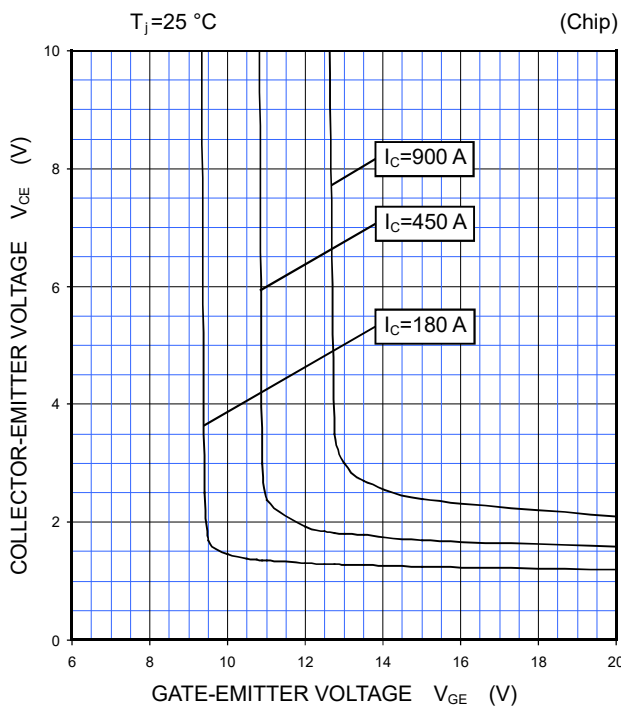
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



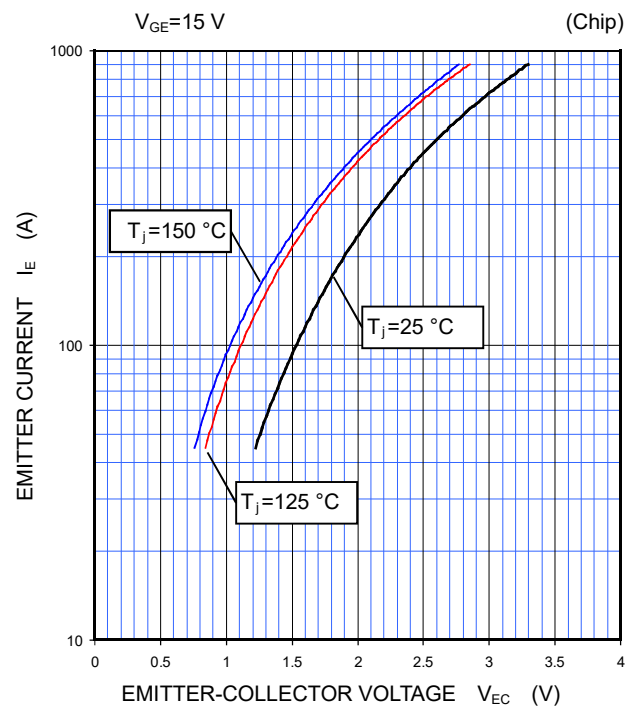
COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)



CM450DX-24S1

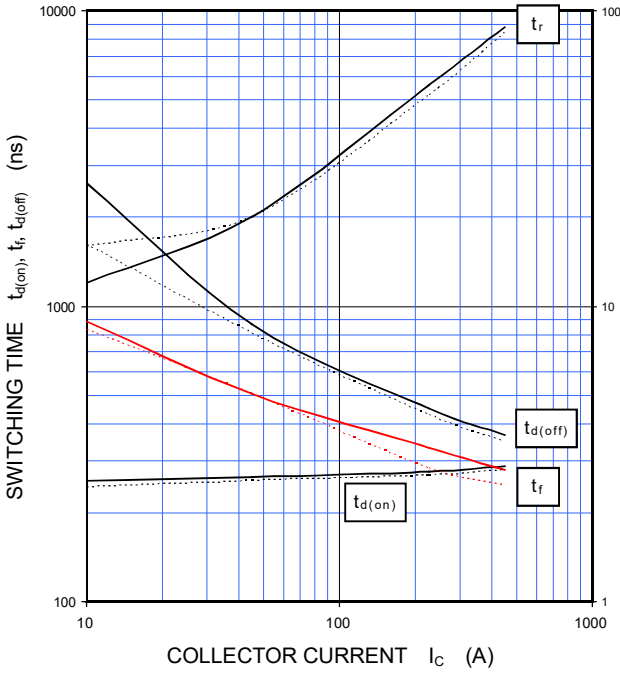
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

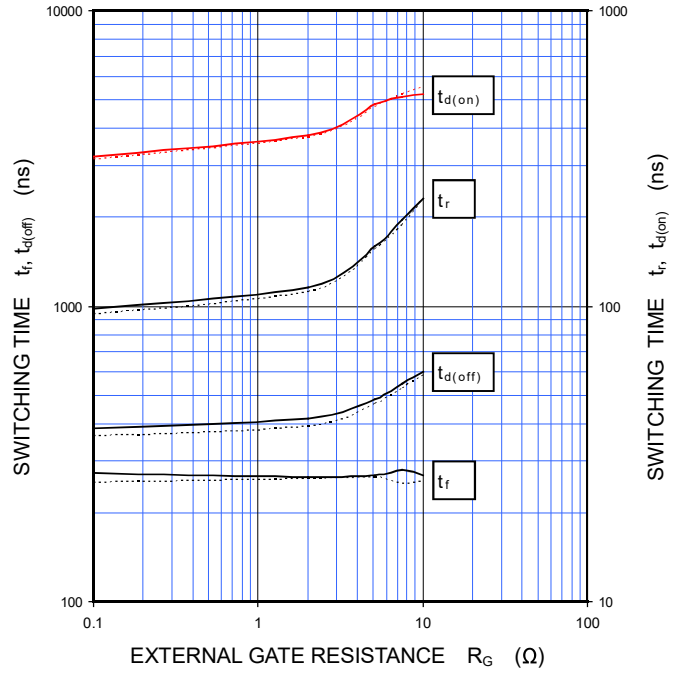
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



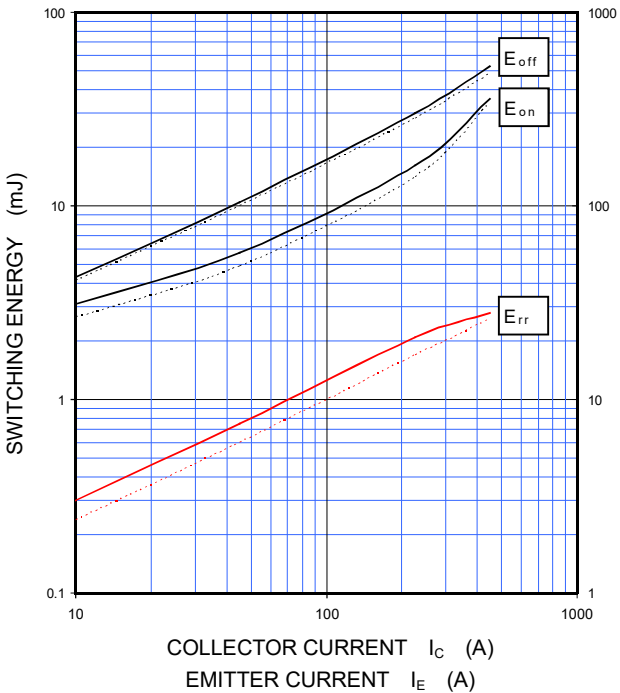
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



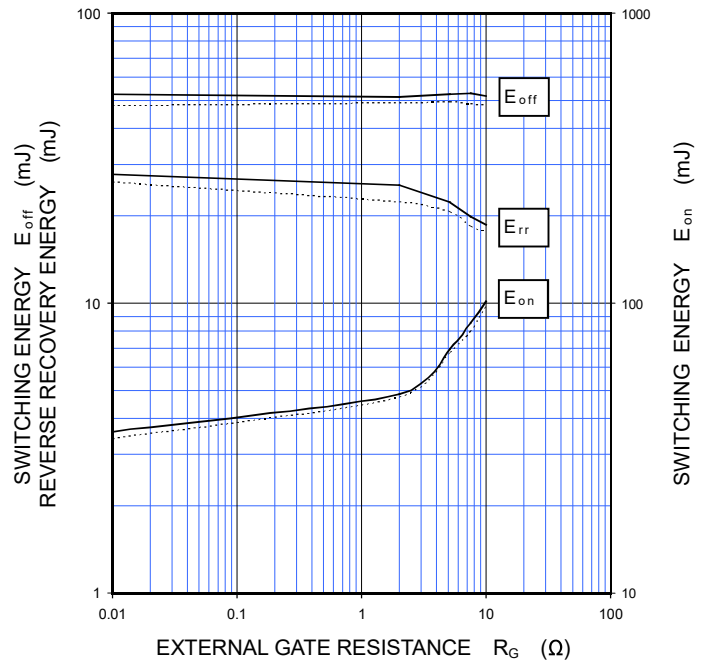
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



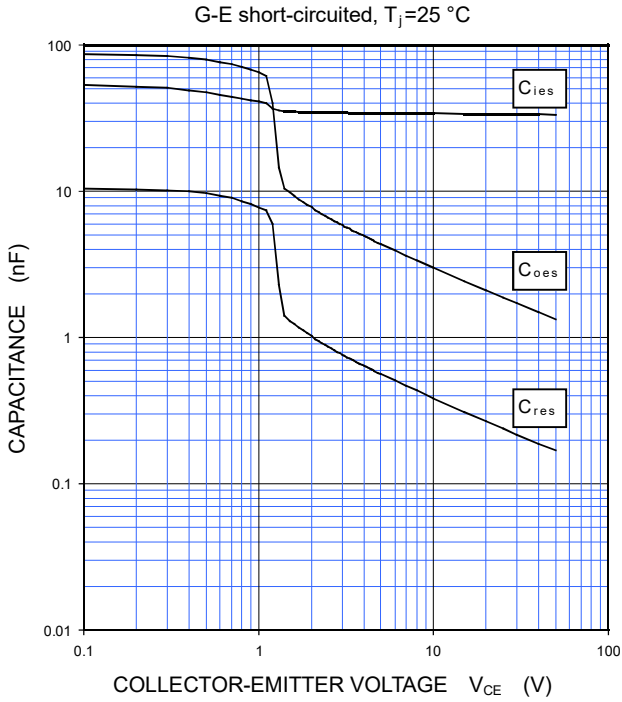
CM450DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

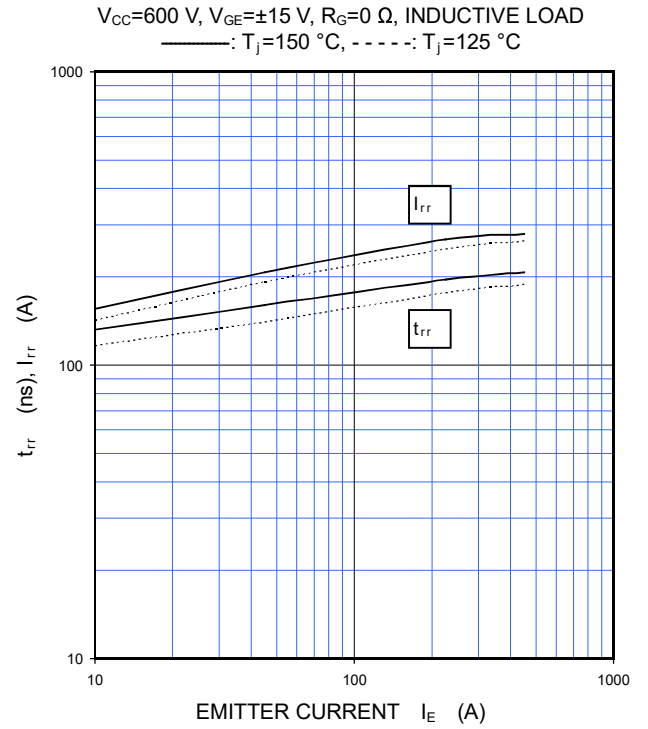
PERFORMANCE CURVES

INVERTER PART

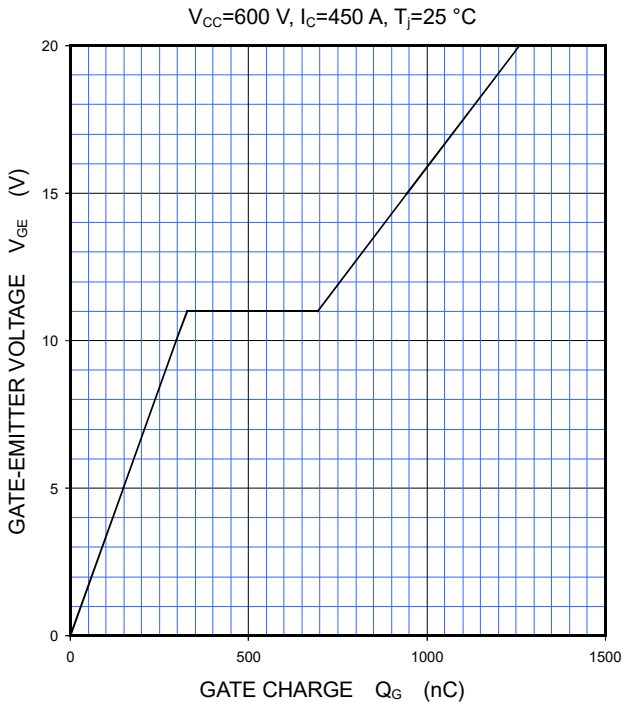
CAPACITANCE CHARACTERISTICS
(TYPICAL)



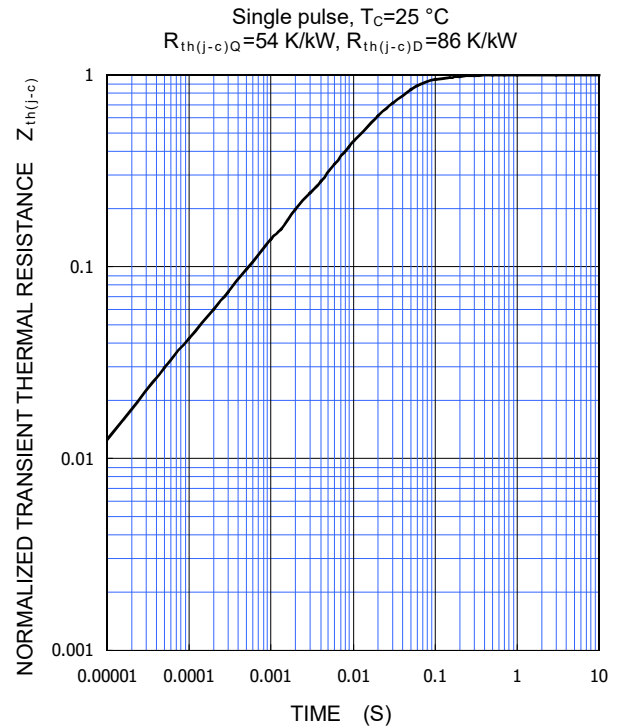
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)



GATE CHARGE CHARACTERISTICS
(TYPICAL)



TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS
(MAXIMUM)



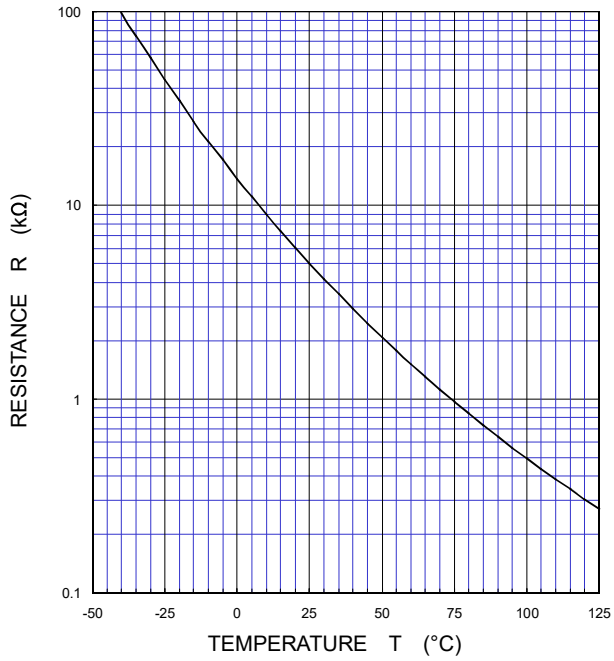
CM450DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

NTC thermistor part

TEMPERATURE CHARACTERISTICS
(TYPICAL)



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