

<IGBT Modules>

CM450DX-24S1

HIGH POWER SWITCHING USE
INSULATED TYPE



dual switch (Half-Bridge)

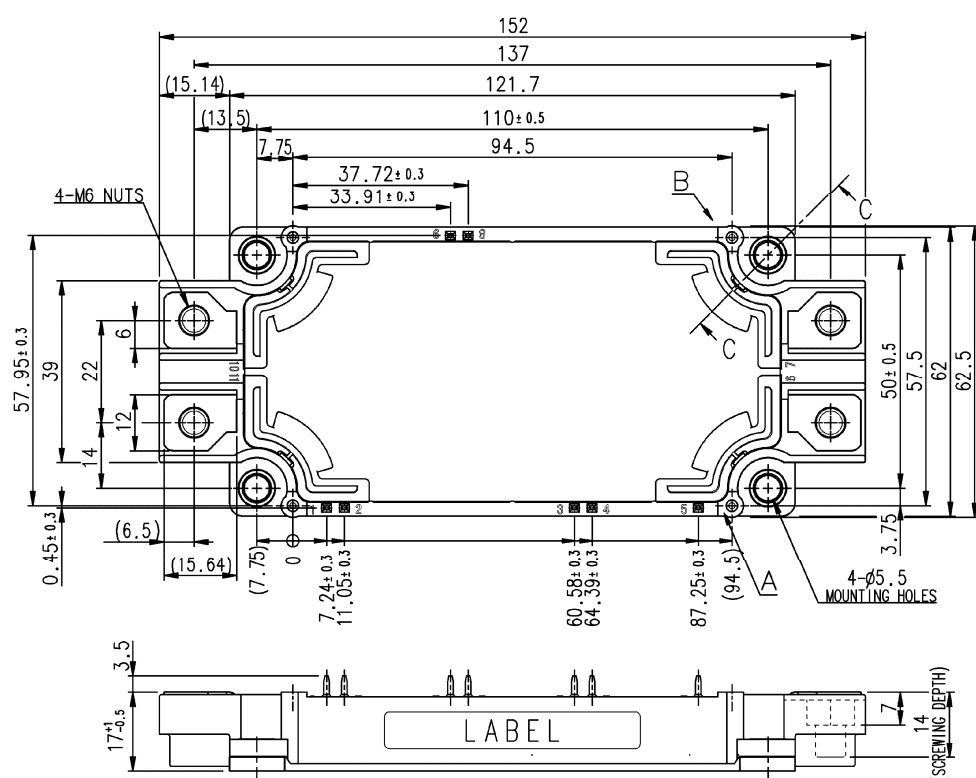
Collector current I_C 450 A
Collector-emitter voltage V_{CES} 1200 V
Maximum junction temperature T_{jmax} 175 °C

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

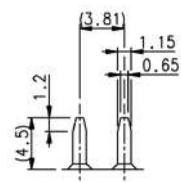
APPLICATION

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

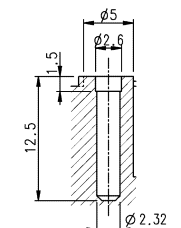
OUTLINE DRAWING & INTERNAL CONNECTION



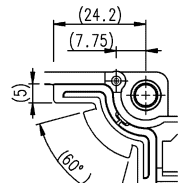
Dimension in mm



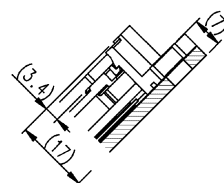
TERMINAL t=0.8



SECTION A

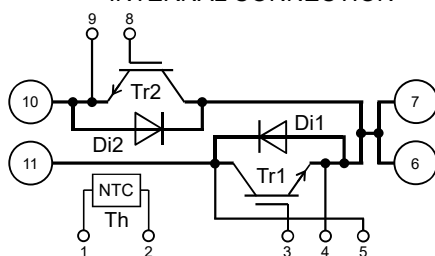


DETAIL B



SECTION C-C

INTERNAL CONNECTION



Terminal code

- 1 TH1
- 2 TH2
- 3 G1
- 4 Es1
- 5 Cs1
- 6 C2E1
- 7 C2E1
- 8 G2
- 9 Es2
- 10 E2
- 11 C1

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

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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)	$-40 \sim +150$	$^{\circ}\text{C}$
T_{stg}	Storage temperature	-	$-40 \sim +125$	

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 mA, V _{CE} =10 V		5.4	6.0	6.6	V
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =450 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	1.80	2.25	V
			T _J =125 °C	-	2.00	-	
			T _J =150 °C	-	2.05	-	
V _{CEsat} (Chip)		I _C =450 A, V _{GE} =15 V, (Note5)	T _J =25 °C	-	1.70	2.15	V
			T _J =125 °C	-	1.90	-	
			T _J =150 °C	-	1.95	-	
C _{ies}	Input capacitance	V _{CE} =10 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 V, I _C =450 A, V _{GE} =15 V		-	945	-	nC
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =450 A, V _{GE} =±15 V, R _G =0 Ω, 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 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _J =25 °C	-	2.60	3.40	V
			T _J =125 °C	-	2.16	-	
			T _J =150 °C	-	2.10	-	
V _{EC} (Note1) (Chip)		I _E =450 A, G-E short-circuited, (Note5)	T _J =25 °C	-	2.50	3.30	V
			T _J =125 °C	-	2.06	-	
			T _J =150 °C	-	2.00	-	
t _{rr} (Note1)	Reverse recovery time	V _{CC} =600 V, I _E =450 A, V _{GE} =±15 V,		-	-	300	ns
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load		-	12	-	μC
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =450 A,		-	35.8	-	mJ
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _J =150 °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 °C (Note2)		-	-	0.7	mΩ
r _g	Internal gate resistance	Per switch		-	4.3	-	Ω

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HIGH POWER SWITCHING USE

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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).

2. Junction temperature (T_J) should not increase beyond T_{Jmax} rating.

3. Pulse width and repetition rate should be such that the device junction temperature (T_J) dose not exceed T_{Jmax} rating.

4. 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.

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

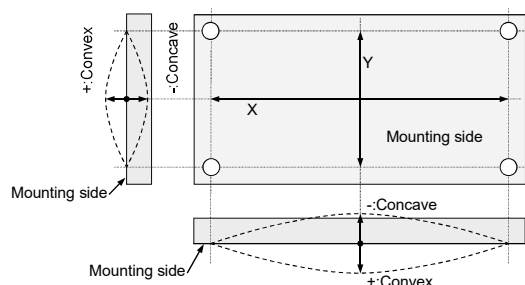
$$6. B(25/50) = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

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.



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

PCB thickness : t=1.6

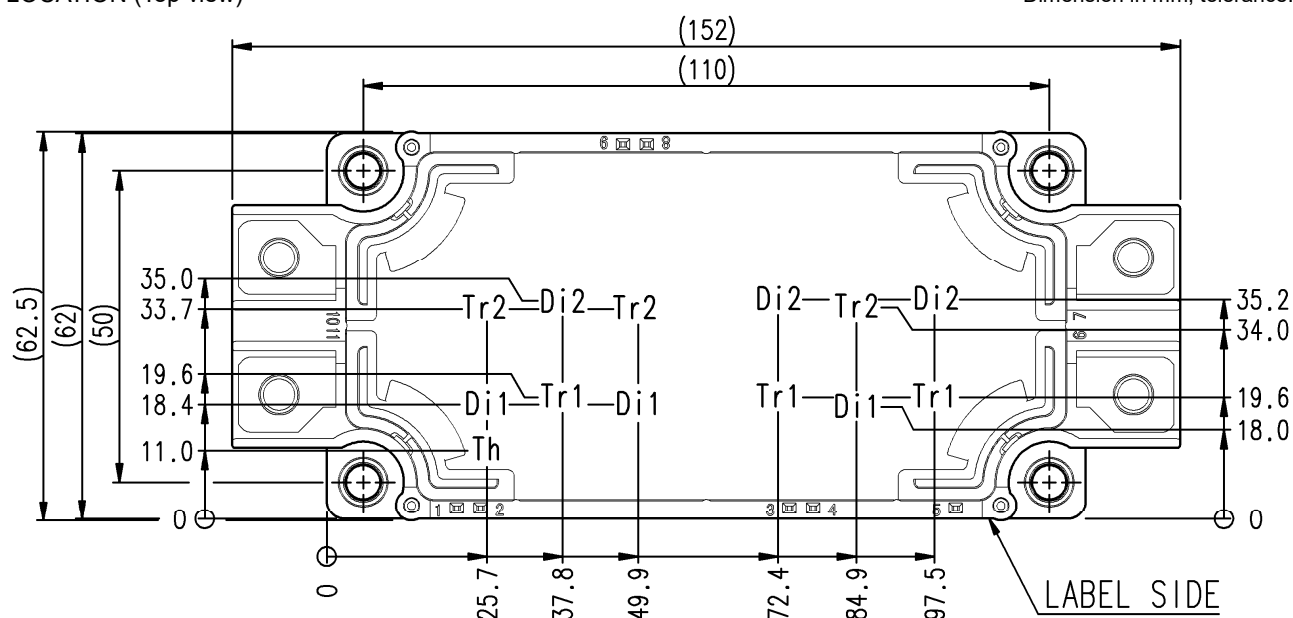
Type	Manufacturer	Size	Tightening torque (N•m)	Recommended tightening method
(1) PT®	EJOT	K25×8	0.55 ± 0.055	by handwork (equivalent to 30 rpm by mechanical screw driver) ~ 600 rpm (by mechanical screw driver)
(2) PT®		K25×10	0.75 ± 0.075	
(3) DELTA PT®		25×8	0.55 ± 0.055	
(4) DELTA PT®		25×10	0.75 ±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

RECOMMENDED OPERATING CONDITIONS

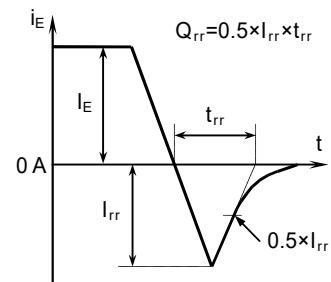
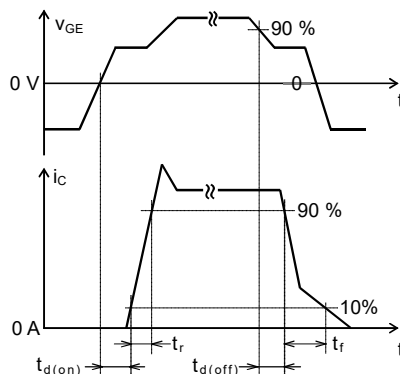
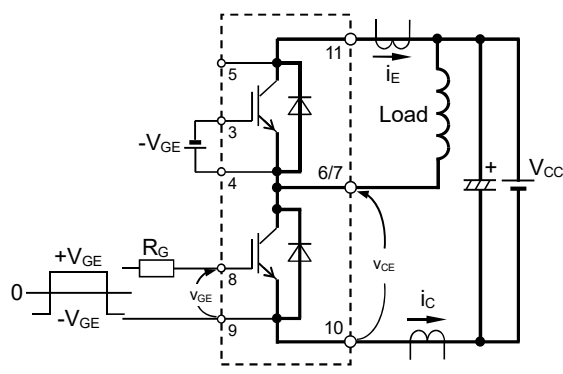
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V _{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	600	850	V
V _{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2 terminals	13.5	15.0	16.5	V
R _G	External gate resistance	Per switch	0	-	10	Ω

CHIP LOCATION (Top view)

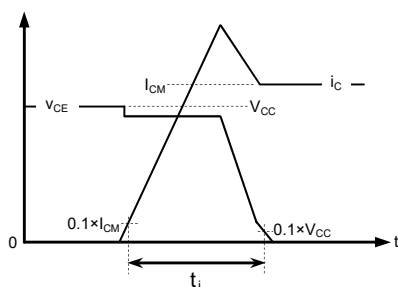
Dimension in mm, tolerance: ±1 mm



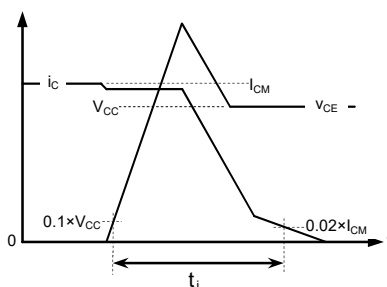
Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

CM450DX-24S1HIGH POWER SWITCHING USE
INSULATED TYPE**TEST CIRCUIT AND WAVEFORMS**

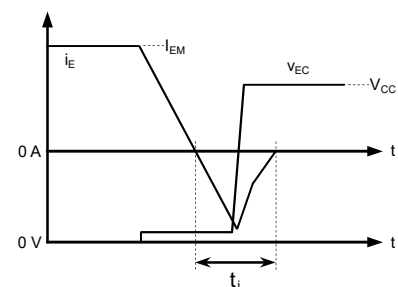
Switching characteristics test circuit and waveforms

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

IGBT Turn-on switching energy

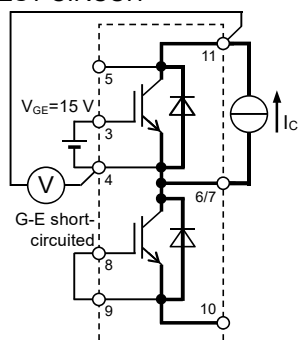


IGBT Turn-off switching energy

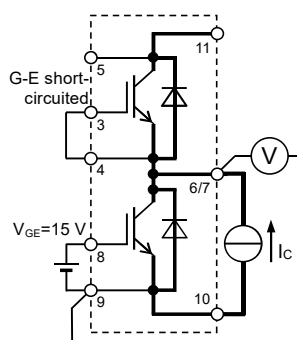


FWD Reverse recovery energy

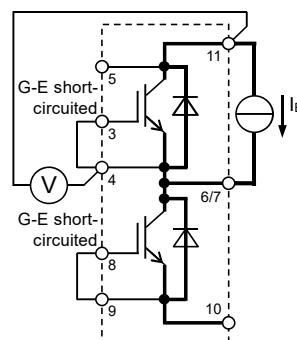
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

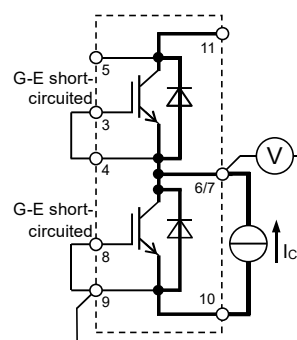
Tr1

 V_{CEsat} characteristics test circuit

Tr2



Di1

 V_{EC} characteristics test circuit

Di2

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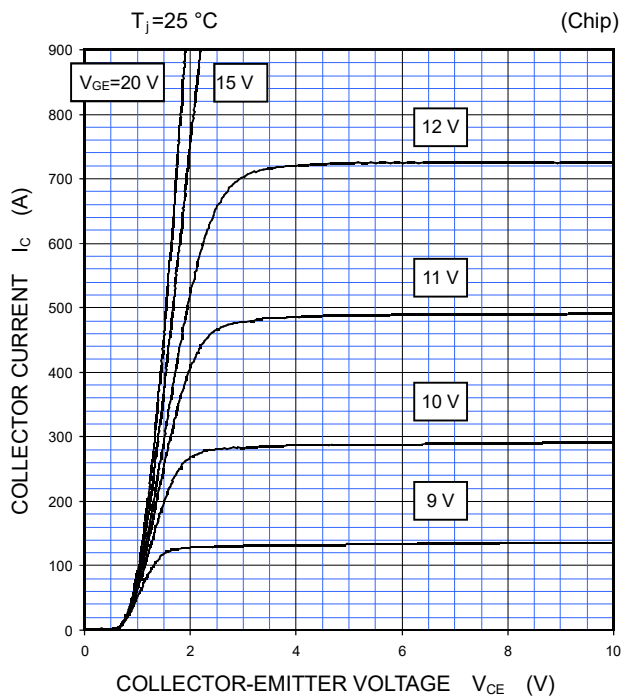
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

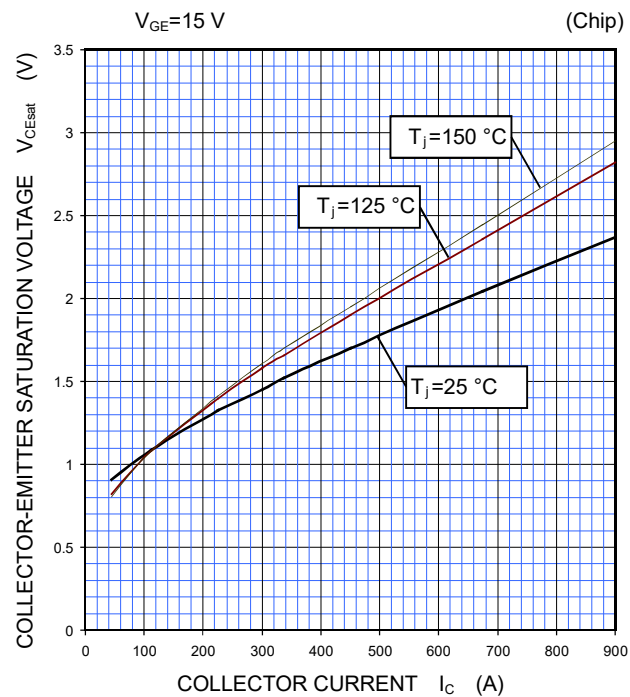
OUTPUT CHARACTERISTICS

(TYPICAL)



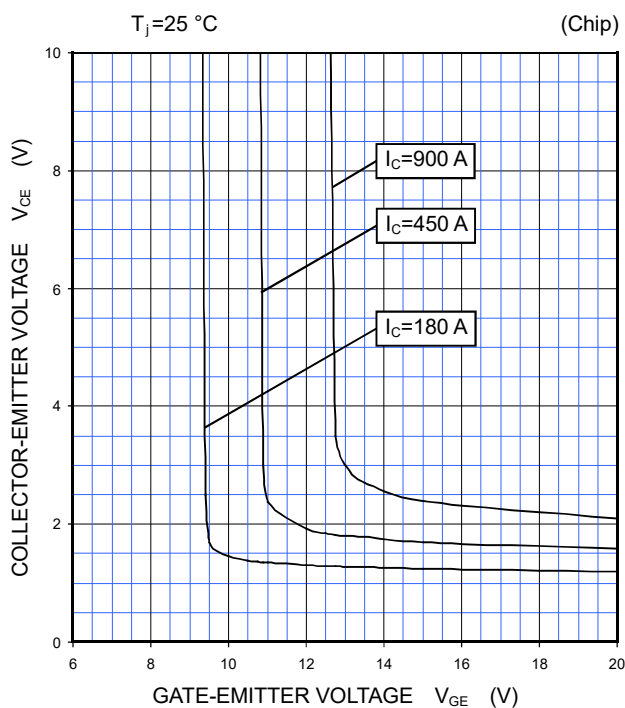
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



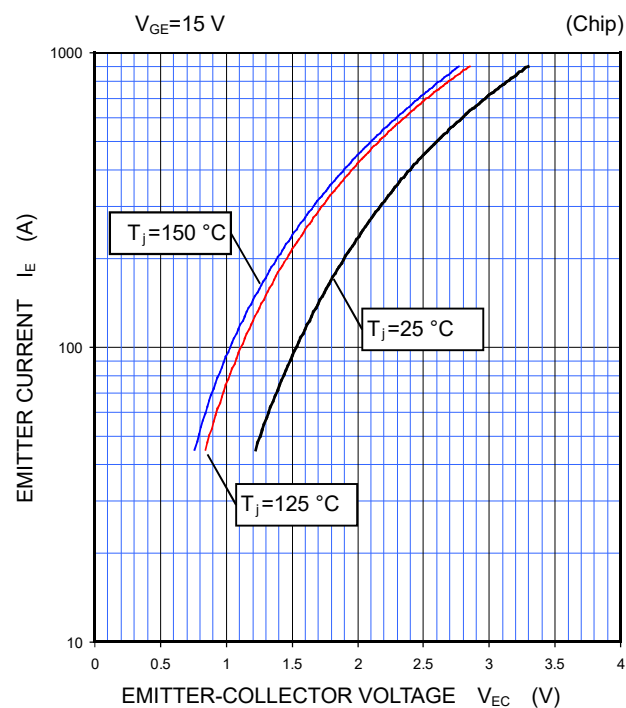
COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)

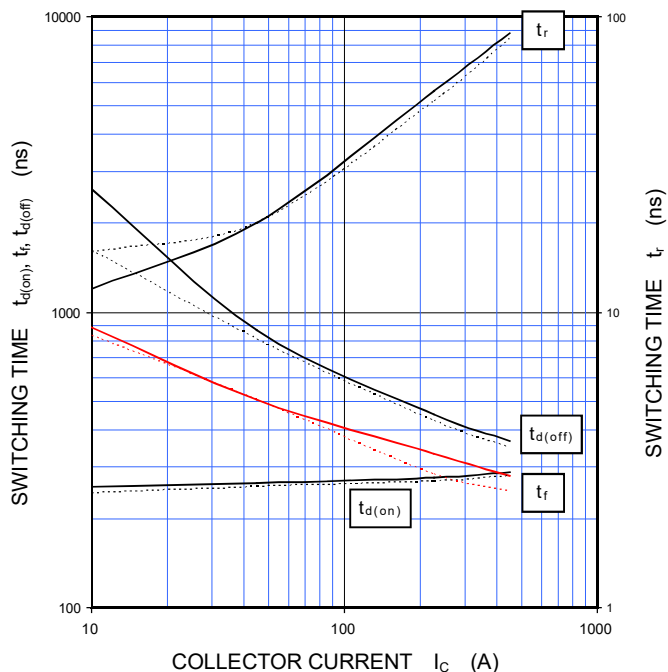
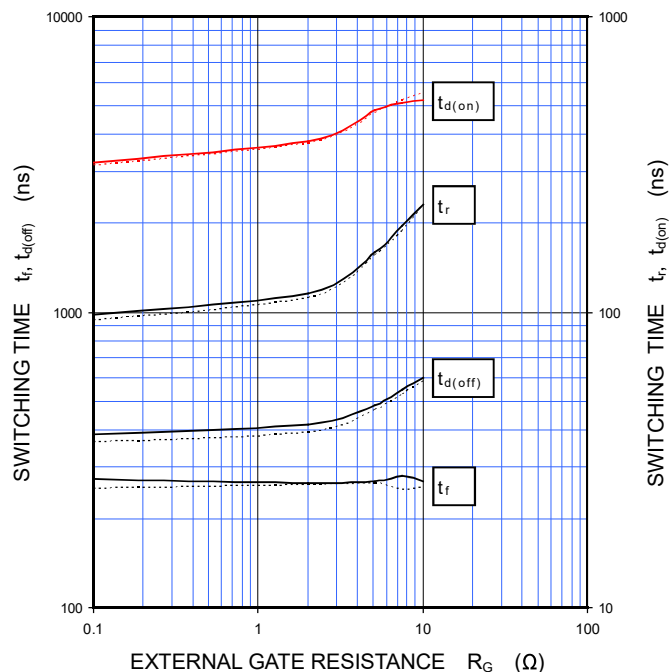
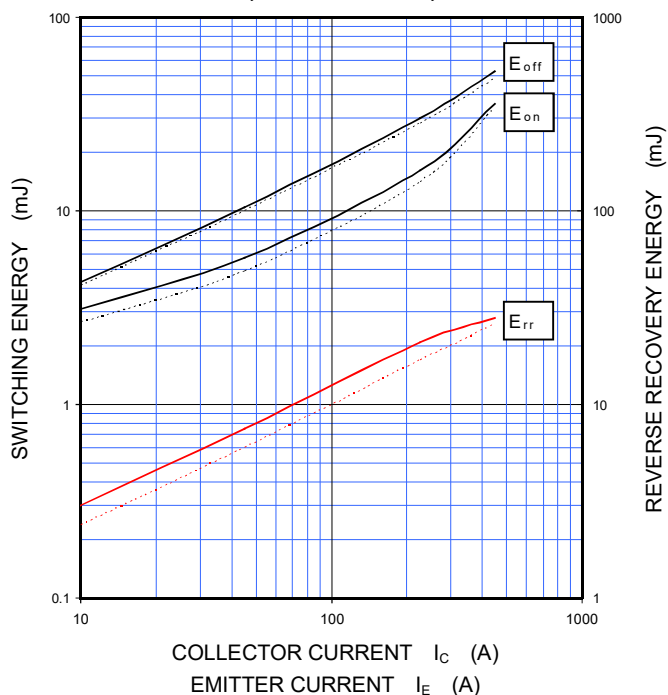
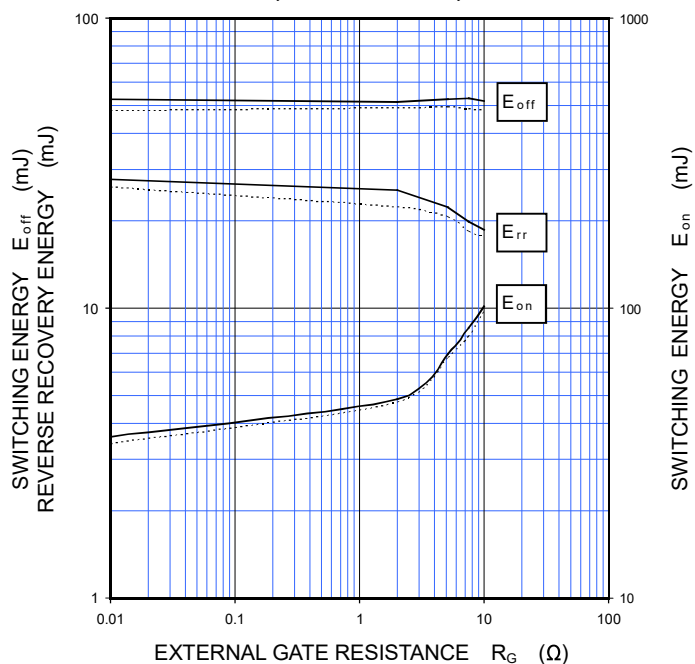


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HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

INVERTER PART

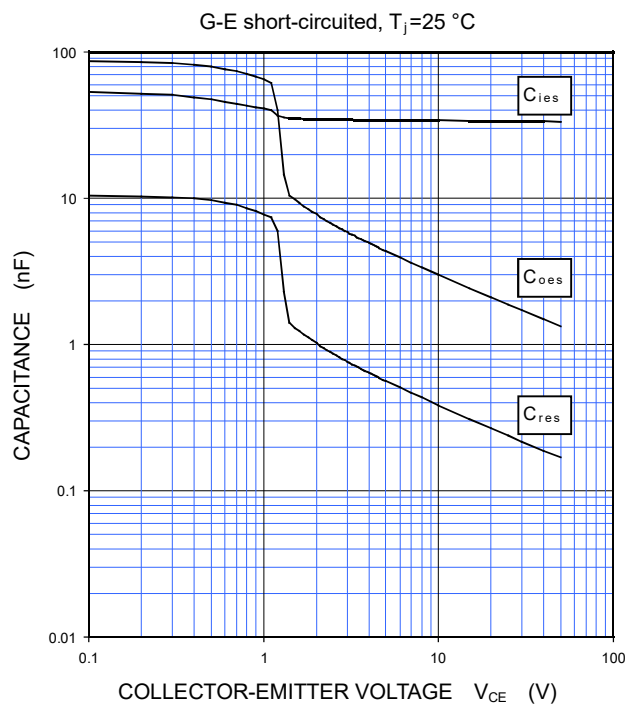
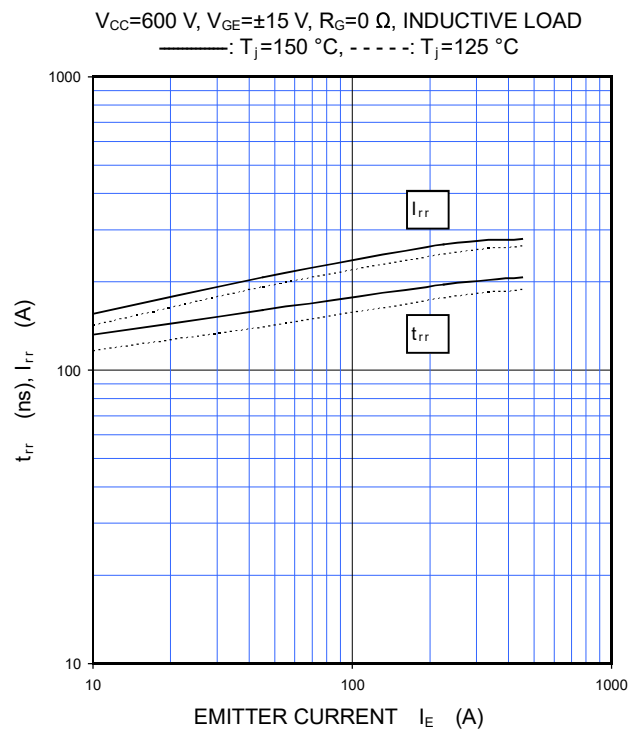
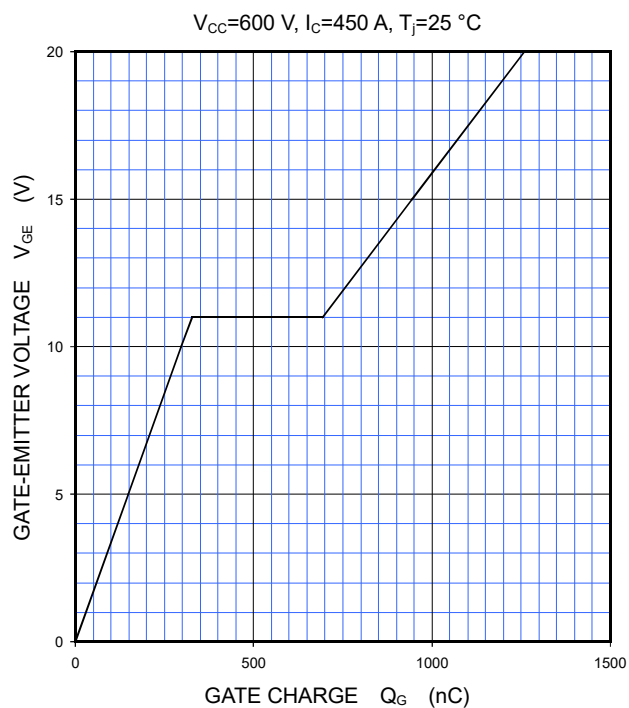
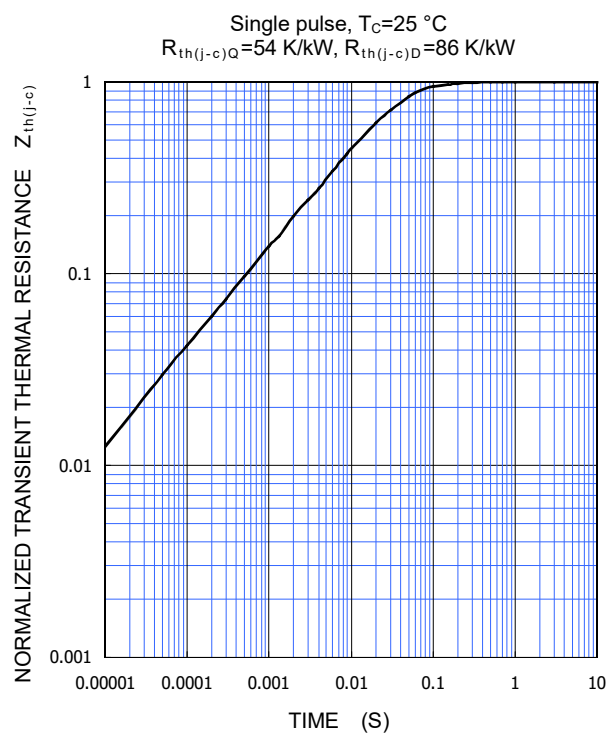
HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD——: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$ HALF-BRIDGE SWITCHING CHARACTERISTICS
(TYPICAL) $V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=450\text{ A}$, 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——: $T_J=150\text{ }^\circ\text{C}$, - - - -: $T_J=125\text{ }^\circ\text{C}$ 

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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)

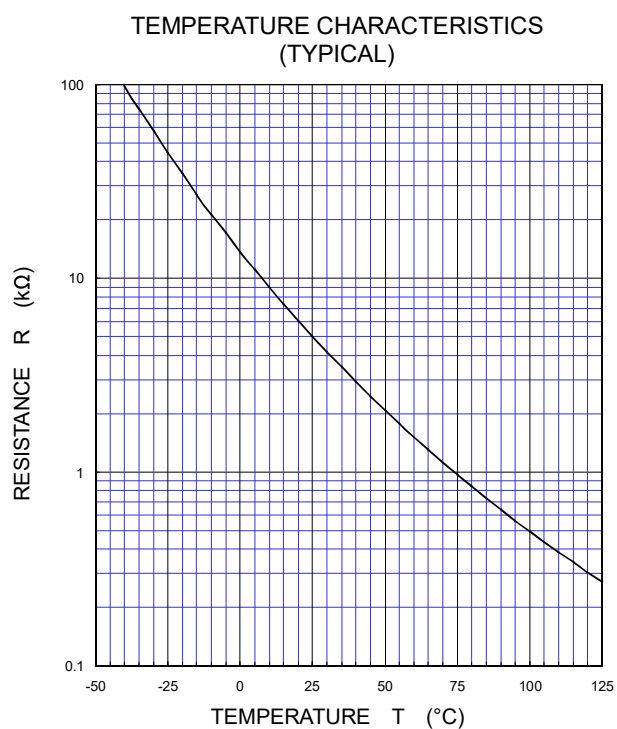
CM450DX-24S1

HIGH POWER SWITCHING USE

INSULATED TYPE

PERFORMANCE CURVES

NTC thermistor part



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