

<IGBT Modules>

# CM800DW-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE



Collector current  $I_c$  ..... **8 0 0 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **1 2 0 0 V**  
 Maximum junction temperature  $T_{vjmax}$  ..... **1 7 5 °C**

- Dual switch (Half-bridge)
- Copper base plate (Nickel-plating)
- Ni-plating signal terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File No. E323585

## APPLICATION

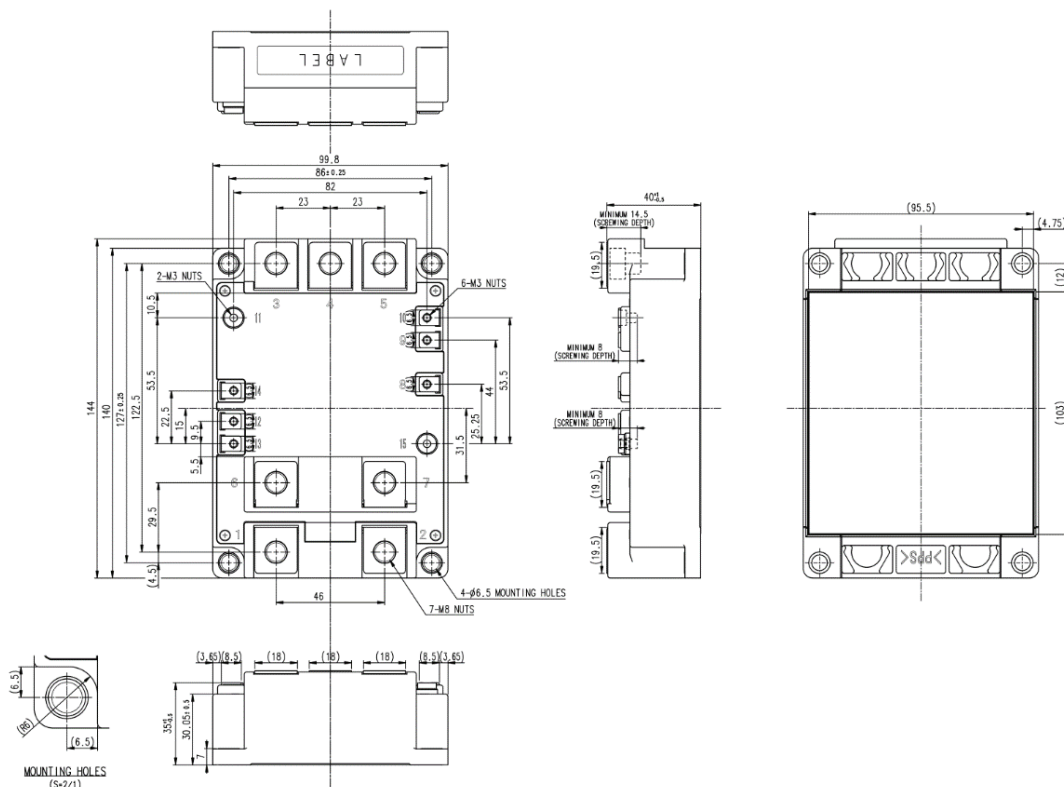
AC motor control, Photovoltaic (PV) inverter, Power supply etc,

## OPTION (Below options are available.)

- PC-TIM (Phase Change Thermal Interface Material) pre-apply
- $V_{CEsat}$  selection for parallel connection

## 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

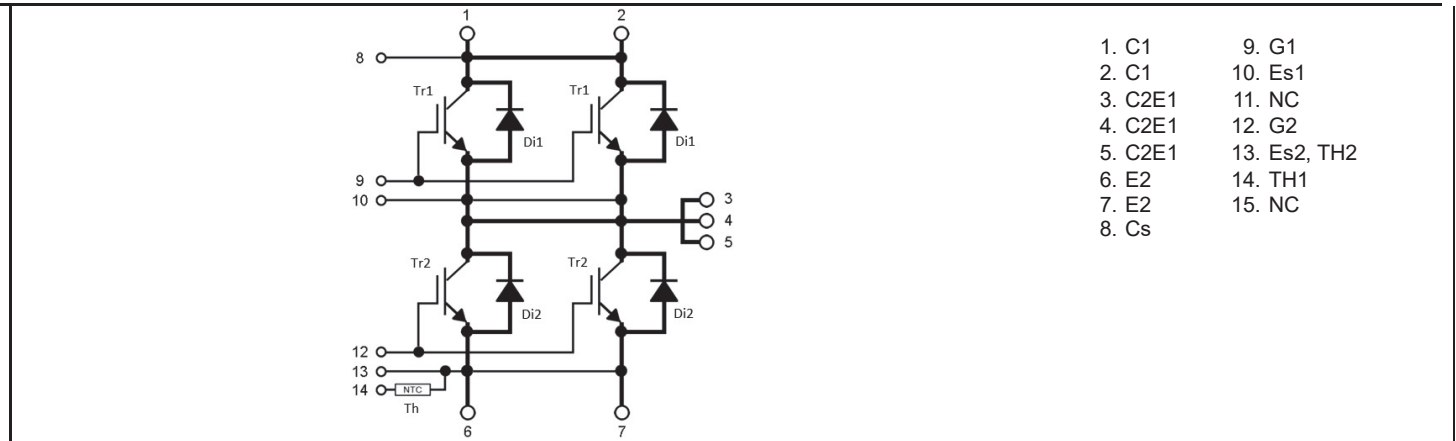
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# CM800DW-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

## INTERNAL CONNECTION

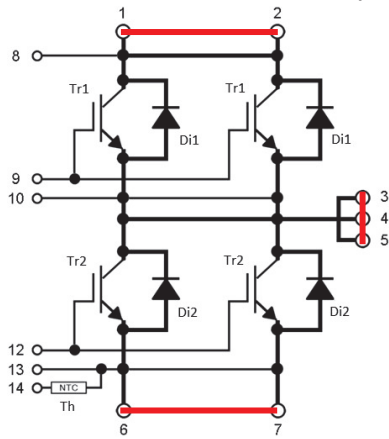
## TERMINAL CODE



1. C1	9. G1
2. C1	10. Es1
3. C2E1	11. NC
4. C2E1	12. G2
5. C2E1	13. Es2, TH2
6. E2	14. TH1
7. E2	15. NC
8. Cs	

## NOTE

Terminal 1 and 2, Terminal 3,4 and 5, Terminal 6 and 7,  
These terminals should be connected respectively when it is used.



**CM800DW-24T**HIGH POWER SWITCHING USE  
INSULATED TYPE**MAXIMUM RATINGS (T<sub>vj</sub>=25 °C, unless otherwise specified)**

Symbol	Item	Conditions	Rating	Unit
V <sub>CEs</sub>	Collector-emitter voltage	G-E short-circuited	1200	V
V <sub>GES</sub>	Gate-emitter voltage	C-E short-circuited	±20	V
I <sub>C</sub>	Collector current	DC, T <sub>C</sub> =(102) °C (Note.2, 4)	800	A
I <sub>CRM</sub>		Pulse, Repetitive (Note.3)	1600	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note.2,4)	3485	W
I <sub>E</sub> (Note.4)	Emitter current	DC (Note.2)	800	A
I <sub>ERM</sub> (Note.4)		Pulse, Repetitive (Note.3)	1600	
V <sub>isol</sub>	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	4000	V
T <sub>vjmax</sub>	Maximum junction temperature	Instantaneous event (overload) (Note9)	175	°C
T <sub>Cmax</sub>	Maximum case temperature	(Note.4,9)	125	°C
T <sub>vjop</sub>	Operating junction temperature	Continuous operation (Note9)	-40 ~ +150	°C
T <sub>stg</sub>	Storage temperature	-	-40 ~ +125	

**ELECTRICAL CHARACTERISTICS (T<sub>vj</sub>=25 °C, unless otherwise specified)**

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I <sub>CEs</sub>	Collector-emitter cut-off current	V <sub>CE</sub> =V <sub>CEs</sub> , G-E short-circuited	-	-	1.0	mA	
I <sub>GES</sub>	Gate-emitter leakage current	V <sub>GE</sub> =V <sub>GES</sub> , C-E short-circuited	-	-	0.5	µA	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	I <sub>C</sub> =80 mA, V <sub>CE</sub> =10 V	5.4	6	6.6	V	
V <sub>CEsat</sub>	Collector-emitter saturation voltage	I <sub>C</sub> =800 A (Note.5), V <sub>GE</sub> =15 V, (Terminal)	T <sub>vj</sub> = 25 °C	-	1.55	1.90	V
			T <sub>vj</sub> =125 °C	-	1.75	-	
			T <sub>vj</sub> =150 °C	-	1.80	-	
		I <sub>C</sub> =800 A (Note.5), V <sub>GE</sub> =15 V, (Chip)	T <sub>vj</sub> = 25 °C	-	1.50	1.75	V
			T <sub>vj</sub> =125 °C	-	1.70	-	
			T <sub>vj</sub> =150 °C	-	1.75	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, V <sub>GE</sub> =0V	-	-	194	nF	
C <sub>oes</sub>	Output capacitance		-	-	5.5		
C <sub>res</sub>	Reverse transfer capacitance		-	-	2.4		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =600 V, I <sub>C</sub> =800 A, V <sub>GE</sub> =15 V	-	6.0	-	µC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600 V, I <sub>E</sub> =800 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =1.6 Ω, Inductive load	-	-	800	ns	
t <sub>r</sub>	Rise time		-	-	200		
t <sub>d(off)</sub>	Turn-off delay time		-	-	1200		
t <sub>f</sub>	Fall time		-	-	400		
V <sub>EC</sub> (Note.4)	Emitter-collector voltage	I <sub>E</sub> =800 A (Note.5), G-E short-circuited, (Terminal)	T <sub>vj</sub> = 25 °C	-	1.65	2.00	V
			T <sub>vj</sub> =125 °C	-	1.65	-	
			T <sub>vj</sub> =150 °C	-	1.65	-	
		I <sub>E</sub> =800 A (Note.5), G-E short-circuited, (Chip)	T <sub>vj</sub> = 25 °C	-	1.60	1.95	V
			T <sub>vj</sub> =125 °C	-	1.60	-	
			T <sub>vj</sub> =150 °C	-	1.60	-	
t <sub>rr</sub> (Note.4)	Reverse recovery time	V <sub>CC</sub> =600 V, I <sub>E</sub> =800 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =1.6 Ω, Inductive load	-	-	400	ns	
Q <sub>rr</sub> (Note.4)	Reverse recovery charge		-	62.4	-		µC
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =600V, I <sub>C</sub> =I <sub>E</sub> =800A, V <sub>GE</sub> =±15V, R <sub>G</sub> =1.6Ω, T <sub>vj</sub> =150°C, Inductive load	-	72	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse		-	94	-		
E <sub>rr</sub> (Note.4)	Reverse recovery energy per pulse		-	57	-		
R <sub>CC'+EE'</sub>	Internal lead resistance	Main terminals-chip T <sub>C</sub> =25 °C (Note.4)	-	0.25	-	mΩ	
r <sub>g</sub>	Internal gate resistance	Per switch	-	0.50	-	Ω	

# CM800DW-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

## NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>25</sub>	Zero-power resistance	T <sub>C</sub> =25 °C (Note4)	4.85	5.00	5.15	kΩ
ΔR/R	Deviation of resistance	R <sub>100</sub> =493 Ω, T <sub>C</sub> =100 °C (Note4)	-7.3	-	+7.8	%
B <sub>(25/50)</sub>	B-constant	Approximate by equation (Note6)	-	3375	-	K
P <sub>25</sub>	Power dissipation	T <sub>C</sub> =25 °C (Note4)	-	-	10	mW

## THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Thermal resistance	Junction to case, per IGBT switch (Note.4)	-	-	43	K/kW
R <sub>th(j-c)D</sub>		Junction to case, per FWDi switch (Note.4)	-	-	68	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, per 1 module, Thermal grease applied (Note 4,7,9)	-	10	-	K/kW

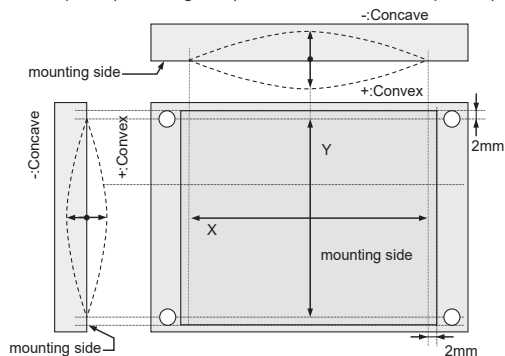
## MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M <sub>t</sub>	Mounting torque	Main terminals M 8 screw	7.0	10.5	14.0	N·m
M <sub>s</sub>		Mounting to heat sink M 6 screw	3.5	4.0	4.5	
M <sub>t</sub>		Auxiliary terminals M 3 screw	0.4	0.5	0.6	
d <sub>s</sub>	Creepage distance	Terminal to terminal	17	-	-	mm
		Terminal to base plate	30	-	-	mm
d <sub>a</sub>	Clearance	Terminal to terminal	8.5	-	-	mm
		Terminal to base plate	28	-	-	mm
e <sub>c</sub>	Flatness of base plate	On the centerline of X, Y (Note.8)	0	-	+200	μm
m	Mass	-	-	860	-	g

\*: This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU and (EU)2015/863.

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

- Junction temperature (T<sub>vj</sub>) should not increase beyond T<sub>vjmax</sub> rating.
- Pulse width and repetition rate should be such that the device junction temperature (T<sub>vj</sub>) dose not exceed T<sub>vjmax</sub> rating.
- 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.
- Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.
- $B(25/50) - \ln \left( \frac{R_{25}}{R_{50}} \right) / \left( \frac{1}{T_{25}} - \frac{1}{T_{50}} \right)$   
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]
- Reference value. Thermally conductive grease of thermal conductivity λ=0.9 W/(m·K) and thickness D(C-S)=50 μm.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



- Long term performance related to thermal conductive grease (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under user's specific application conditions. Each temperature condition (T<sub>vjmax</sub>, T<sub>vjop</sub>, T<sub>Cmax</sub>) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

## RECOMMENDED OPERATING CONDITIONS

# CM800DW-24T

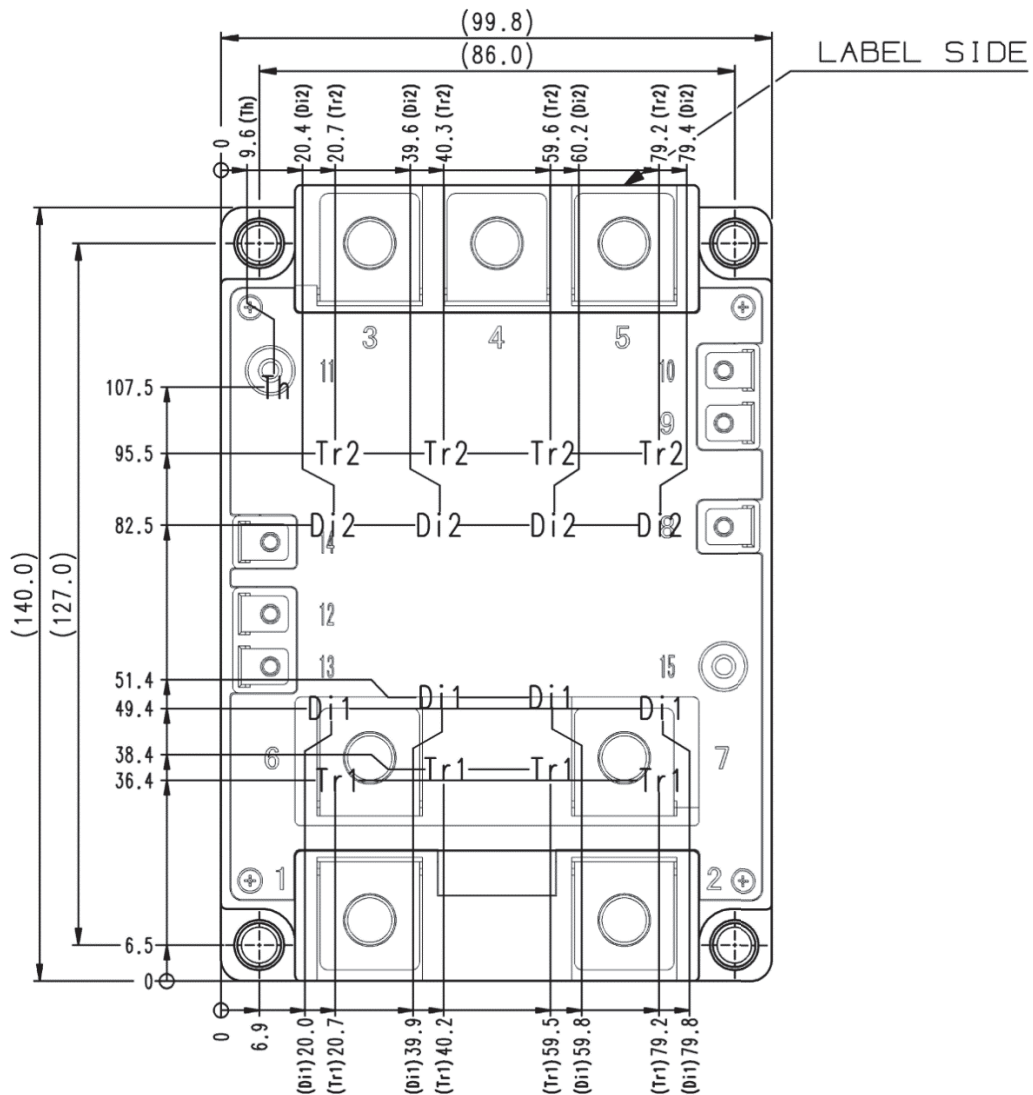
HIGH POWER SWITCHING USE  
INSULATED TYPE

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	1.6	-	10	$\Omega$

Optimum operating conditions should be selected with careful confirmation for no occurrence of any maximum rating violation ( $T_{vj}$ ,  $V_{CES}$ , etc.) or any unexpected malfunction (arm-short-through, oscillation, etc.) at the actual application conditions.

## CHIP LOCATION (Top view)

Dimension in mm, tolerance:  $\pm 1$  mm

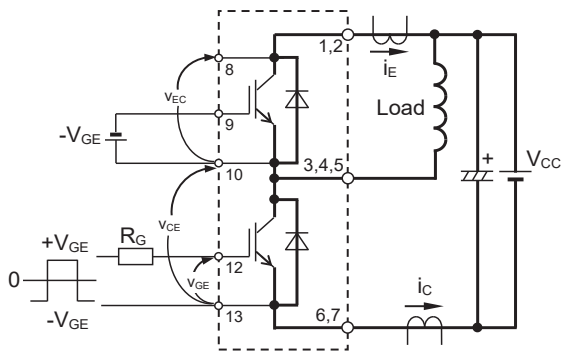


Tr1/Tr2: IGBT, Di1/Di2: FWD, Th: NTC thermistor

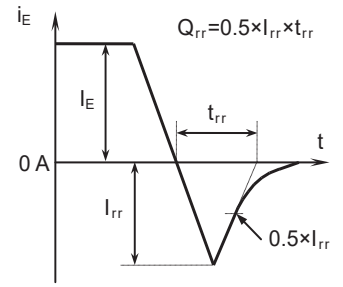
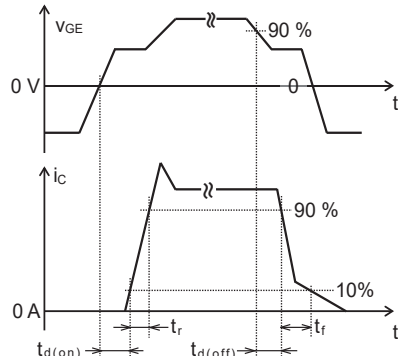
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HIGH POWER SWITCHING USE  
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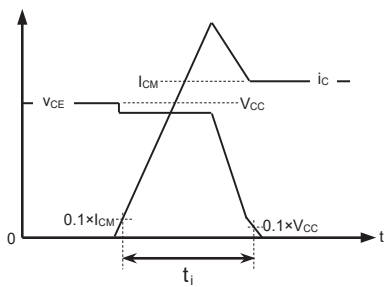
## TEST CIRCUIT AND WAVEFORMS



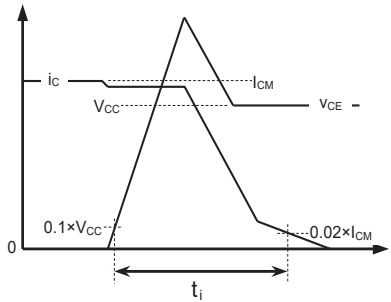
Switching characteristics test circuit and waveforms



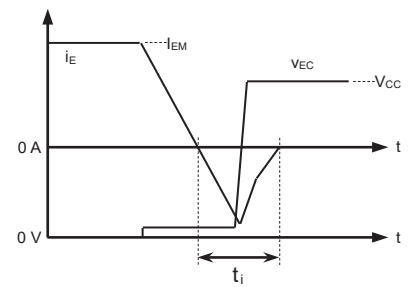
$t_{rr}$ ,  $Q_{rr}$  characteristics test waveform



IGBT Turn-on switching energy



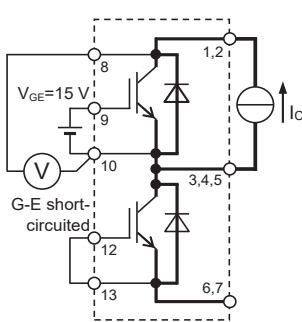
IGBT Turn-off switching energy



FWD Reverse recovery energy

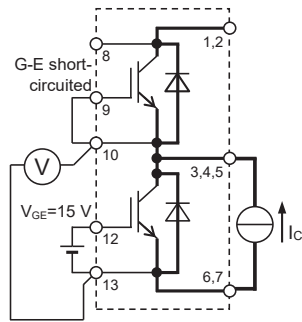
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

## TEST CIRCUIT

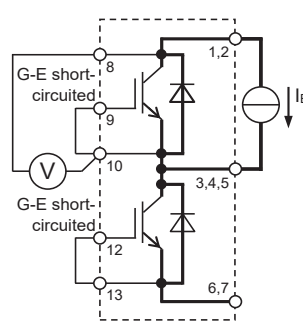


Tr1

$V_{CEsat}$  characteristics test circuit

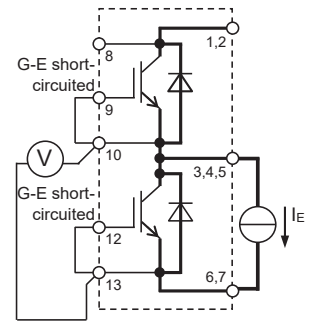


Tr2



Di1

$V_{CE}$  characteristics test circuit



Di2

# CM800DW-24T

HIGH POWER SWITCHING USE  
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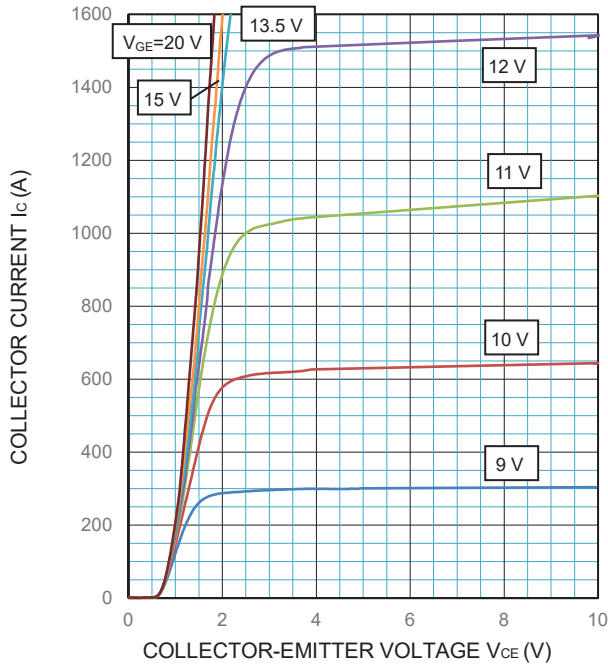
## PERFORMANCE CURVES

### INVERTER PART

#### OUTPUT CHARACTERISTICS

(TYPICAL)

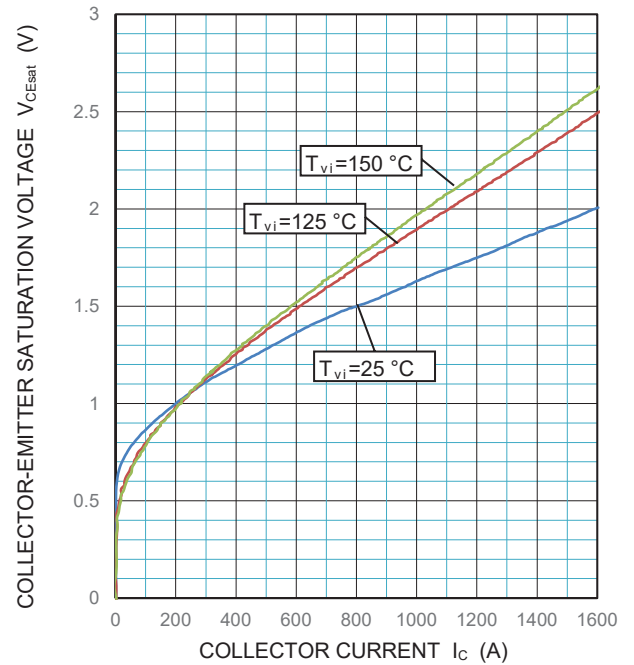
$T_{vj}=25^{\circ}\text{C}$  (chip)



#### COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)

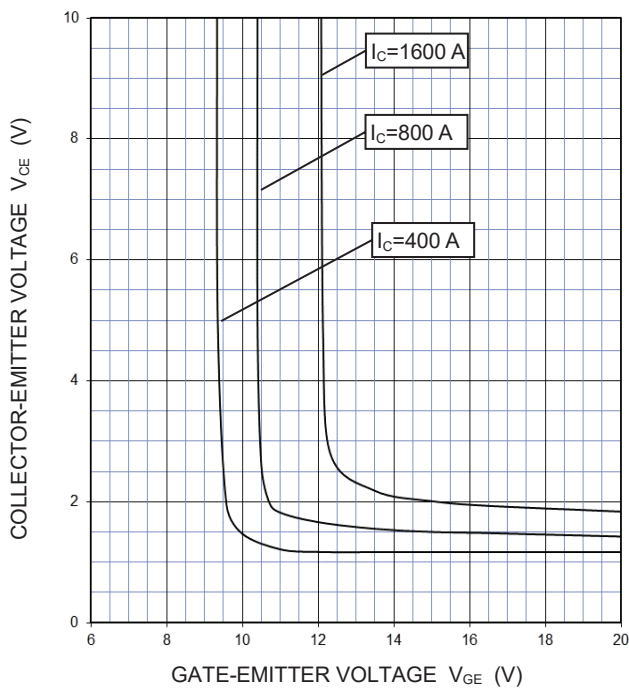
$V_{ge}=15\text{V}$  (chip)



#### COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS

(TYPICAL)

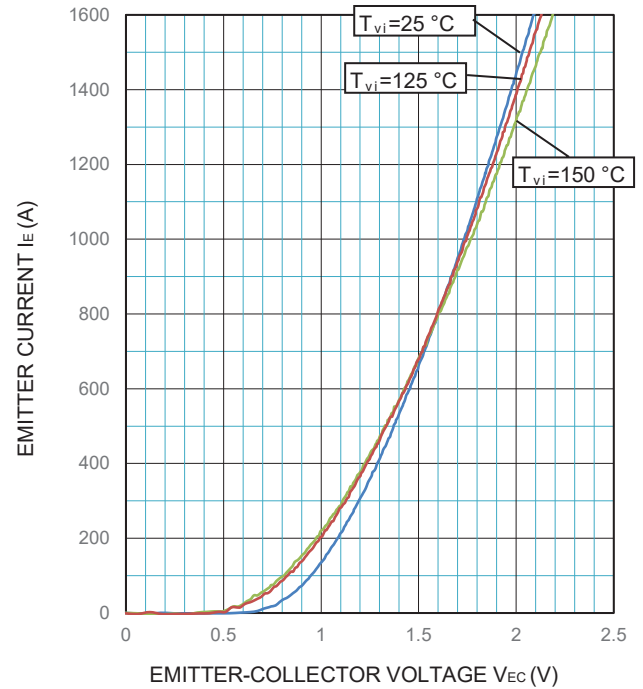
$T_{vj}=25^{\circ}\text{C}$  (chip)



#### FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)

G-E short-circuited (chip)



# CM800DW-24T

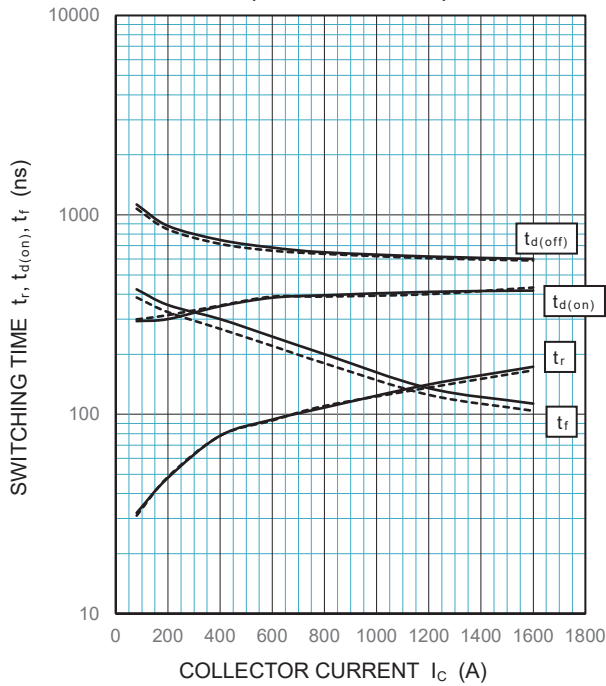
HIGH POWER SWITCHING USE  
INSULATED TYPE

## PERFORMANCE CURVES

### INVERTER PART

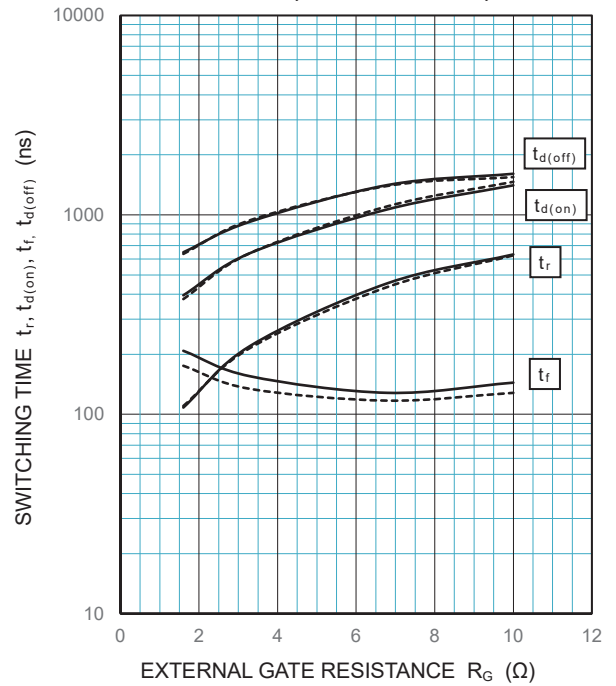
#### HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$ ,  $R_G=1.6\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



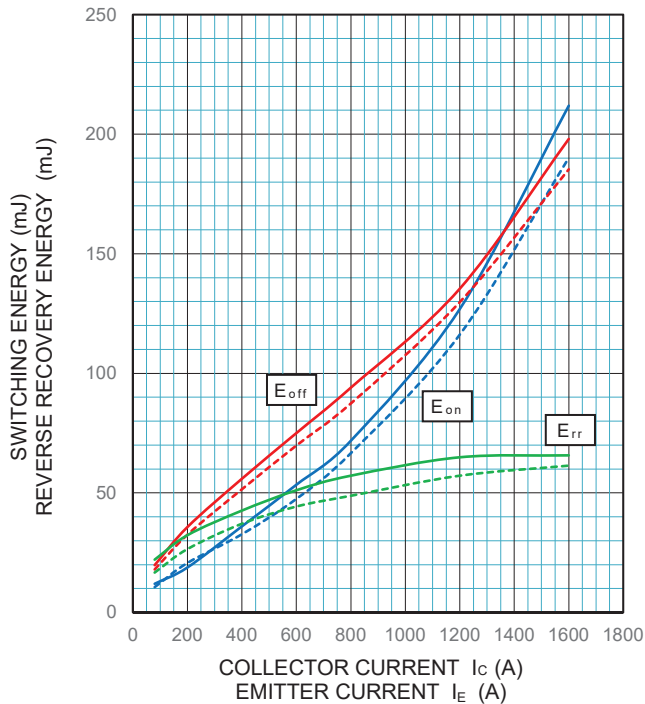
#### HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$ ,  $I_c=800\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - -:  $T_{vj}=125\text{ }^\circ\text{C}$



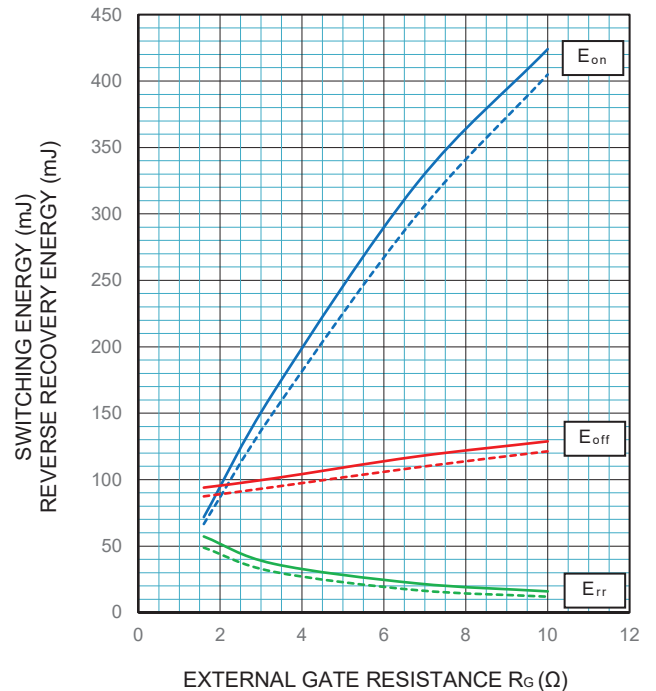
#### HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$ ,  $R_G=1.6\ \Omega$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - -:  $T_{vj}=125\text{ }^\circ\text{C}$ ,  
 PER PULSE



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

$V_{CC}=600\text{ V}$ ,  $I_c/I_E=800\text{ A}$ ,  $V_{GE}=\pm 15\text{ V}$ , INDUCTIVE LOAD,  
 —:  $T_{vj}=150\text{ }^\circ\text{C}$ , - - -:  $T_{vj}=125\text{ }^\circ\text{C}$ ,  
 PER PULSE





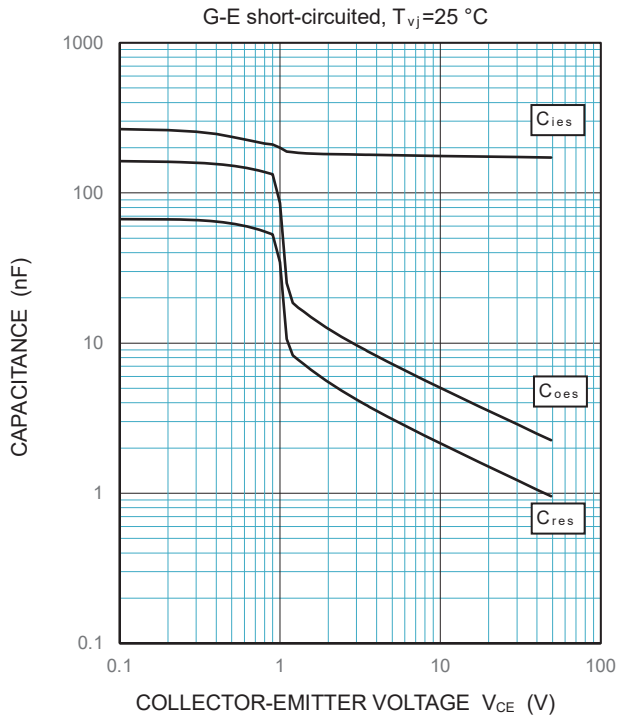
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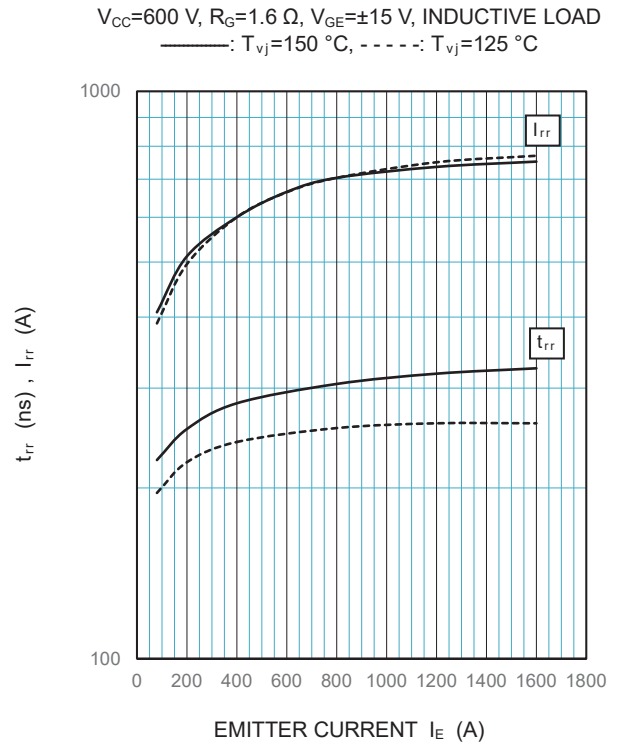
## PERFORMANCE CURVES

### INVERTER PART

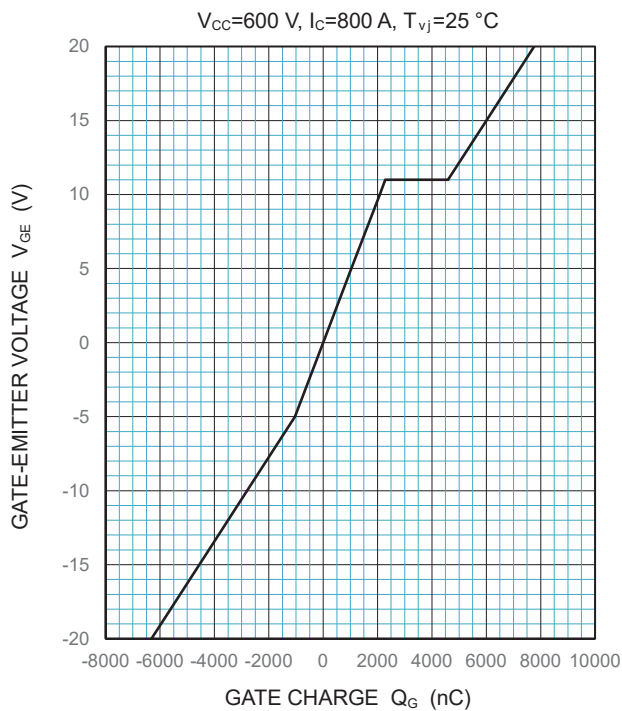
**CAPACITANCE CHARACTERISTICS (TYPICAL)**



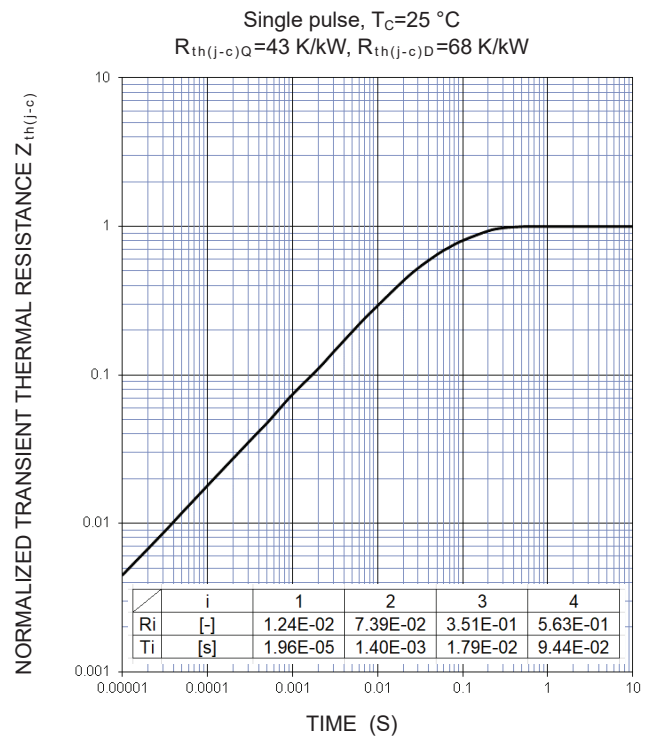
**FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



**GATE CHARGE CHARACTERISTICS (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)**



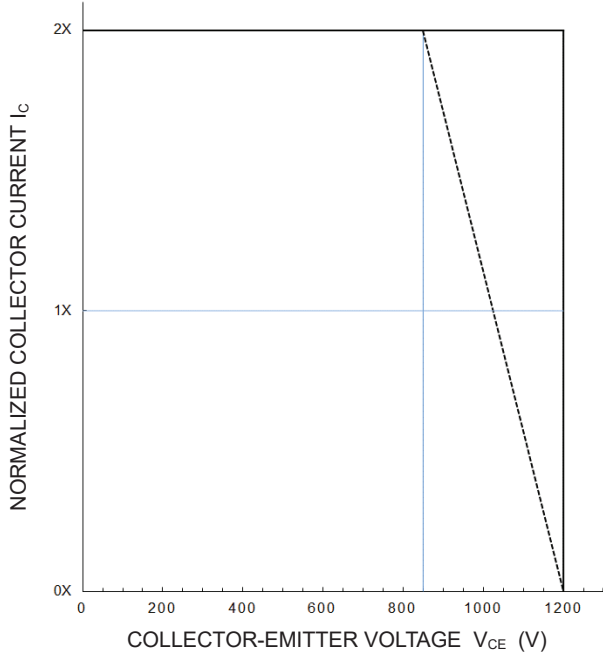
# CM800DW-24T

HIGH POWER SWITCHING USE  
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## PERFORMANCE CURVES

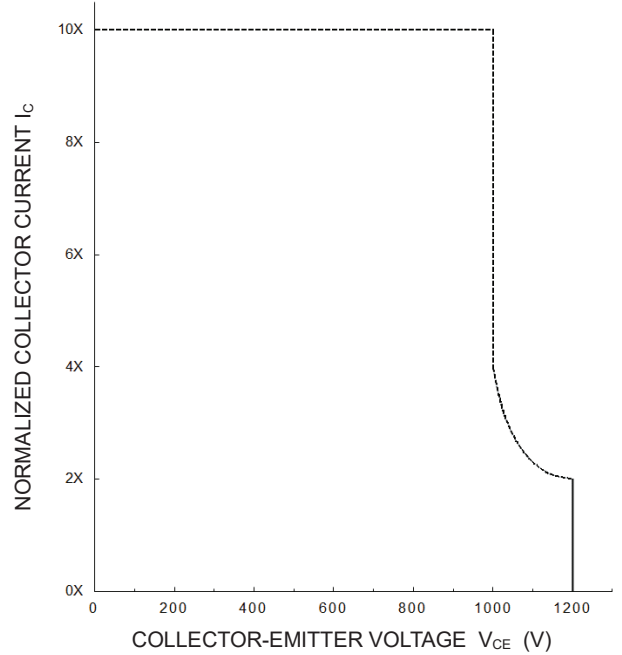
**TURN-OFF SWITCHING SAFE OPERATING AREA  
(REVERSE BIAS SAFE OPERATING AREA)  
(MAXIMUM)**

$V_{CC} \leq 850 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  $R_{G(off)} = 1.6 \sim 10 \ \Omega$ ,  
 ———:  $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$  (Normal load operations (Continuous))  
 - - - - -:  $T_{vj} = 175 \text{ }^\circ\text{C}$  (Unusual load operations (Limited period))



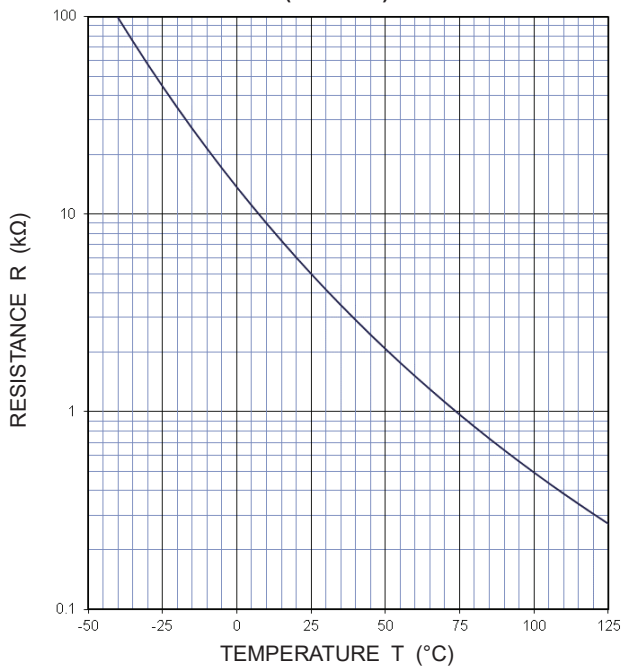
**SHORT-CIRCUIT SAFE OPERATING AREA  
(MAXIMUM)**

$V_{CC} \leq 800 \text{ V}$ ,  $V_{GE} = \pm 15 \text{ V}$ ,  
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ ,  $t_{sc} \leq 8 \ \mu\text{s}$ , Non-Repetitive



## NTC thermistor part

**TEMPERATURE CHARACTERISTICS  
(TYPICAL)**



Note: The characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

## CM800DW-24T

HIGH POWER SWITCHING USE  
INSULATED TYPE

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### **Important Notice**

The information contained in this datasheet shall in no event be regarded as a guarantee of conditions or characteristics. This product has to be used within its specified maximum ratings, and is subject to customer's compliance with any applicable legal requirement, norms and standards.

Except as otherwise explicitly approved by Mitsubishi Electric Corporation in a written document signed by authorized representatives of Mitsubishi Electric Corporation, our products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.

In usage of power semiconductor, there is always the possibility that trouble may occur with them by the reliability lifetime such as Power Cycle, Thermal Cycle or others, or when used under special circumstances (e.g. condensation, high humidity, dusty, salty, highlands, environment with lots of organic matter / corrosive gas / explosive gas, or situations which terminals of semiconductor products receive strong mechanical stress). Therefore, please pay sufficient attention to such circumstances. Further, depending on the technical requirements, our semiconductor products may contain environmental regulation substances, etc. If there is necessity of detailed confirmation, please contact our nearest sales branch or distributor.

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

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