

<IGBT Modules>

# CM400DY-24TH

HIGH POWER SWITCHING USE  
INSULATED TYPE



Collector current  $I_c$  ..... **4 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)
- Tin-plating tab terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File No. E323585

### APPLICATION

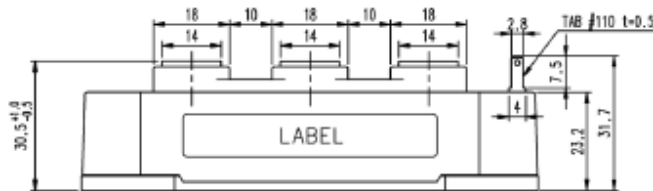
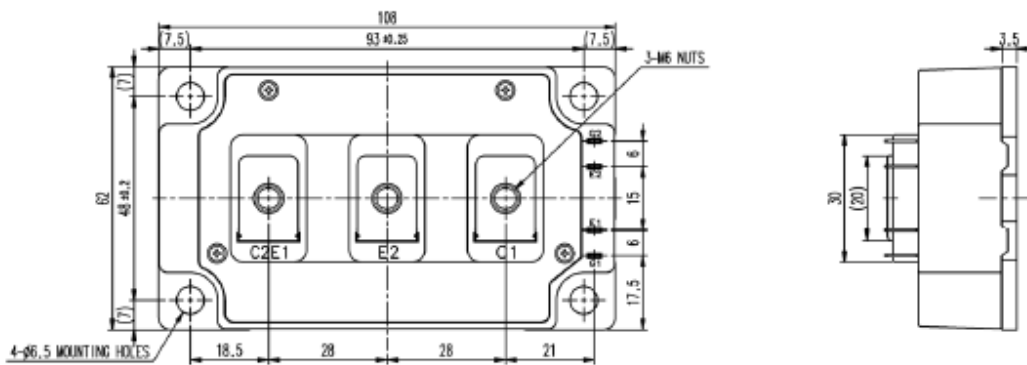
Medical equipment, Welder, Power supply, etc.

### OPTION (Below options are available.)

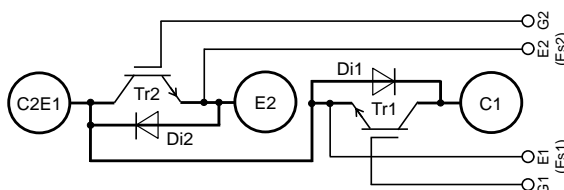
- $V_{CESat}$  selection for parallel connection

### OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



### INTERNAL CONNECTION



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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**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> =25 °C (Note2, 4)	400	A
I <sub>CRM</sub>		Pulse, Repetitive (Note3)	800	
P <sub>tot</sub>	Total power dissipation	T <sub>C</sub> =25 °C (Note2, 4)	2020	W
I <sub>E</sub> (Note1)	Emitter current	DC, T <sub>C</sub> =25 °C (Note2)	400	A
I <sub>ERM</sub> (Note1)		Pulse, Repetitive (Note3)	800	
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) (Note 8)	175	°C
T <sub>Cmax</sub>	Maximum case temperature	(Note4, 8)	125	
T <sub>vjop</sub>	Operating junction temperature	Continuous operation (under switching) (Note 8)	-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	T <sub>vj</sub> =25 °C	-	-	1.0	mA
			T <sub>vj</sub> =150 °C	-	-	75.0	
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> =40 mA, V <sub>CE</sub> =10 V	5.40	6.00	6.60	V	
V <sub>CESat</sub> (Terminal)	Collector-emitter saturation voltage	I <sub>C</sub> =400 A, V <sub>GE</sub> =15 V, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	4.45	5.15	V
			T <sub>vj</sub> =125 °C	-	4.55	-	
			T <sub>vj</sub> =150 °C	-	4.45	-	
V <sub>CESat</sub> (Chip)	Collector-emitter saturation voltage	I <sub>C</sub> =400 A, V <sub>GE</sub> =15 V, (Note5)	T <sub>vj</sub> =25 °C	-	4.35	5.05	V
			T <sub>vj</sub> =125 °C	-	4.45	-	
			T <sub>vj</sub> =150 °C	-	4.35	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited	-	-	60.0	nF	
C <sub>oes</sub>	Output capacitance		-	-	5.0		
C <sub>res</sub>	Reverse transfer capacitance		-	-	1.0		
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =600 V, I <sub>C</sub> =400 A, V <sub>GE</sub> =15 V	-	1.0	-	µC	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =600 V, I <sub>C</sub> =400 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load	-	-	300	ns	
t <sub>r</sub>	Rise time		-	-	100		
t <sub>d(off)</sub>	Turn-off delay time		-	-	500		
t <sub>f</sub>	Fall time		-	-	150		
V <sub>EC</sub> (Note.1) (Terminal)	Emitter-collector voltage	I <sub>E</sub> =400 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T <sub>vj</sub> =25 °C	-	2.45	2.85	V
			T <sub>vj</sub> =125 °C	-	2.60	-	
			T <sub>vj</sub> =150 °C	-	2.55	-	
V <sub>EC</sub> (Note.1) (Chip)	Emitter-collector voltage	I <sub>E</sub> =400 A, G-E short-circuited, (Note5)	T <sub>vj</sub> =25 °C	-	2.35	2.75	V
			T <sub>vj</sub> =125 °C	-	2.50	-	
			T <sub>vj</sub> =150 °C	-	2.45	-	
t <sub>rr</sub> (Note1)	Reverse recovery time	V <sub>CC</sub> =600 V, I <sub>E</sub> =400 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load	-	-	250	ns	
Q <sub>rr</sub> (Note1)	Reverse recovery charge	R <sub>G</sub> =0 Ω, Inductive load	-	26	-	µC	
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =600 V, I <sub>C</sub> =I <sub>E</sub> =400 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, T <sub>vj</sub> =150 °C,	-	10.0	-	mJ	
E <sub>off</sub>	Turn-off switching energy per pulse	Inductive load	-	20.0	-		
E <sub>rr</sub> (Note1)	Reverse recovery energy per pulse	Inductive load	-	25.0	-	mJ	
R <sub>CC+EE'</sub>	Internal lead resistance	Main terminals-chip, per switch, T <sub>C</sub> =25 °C (Note4)	-	0.3	-	mΩ	
r <sub>g</sub>	Internal gate resistance	Per switch	-	0.8	-	Ω	

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HIGH POWER SWITCHING USE  
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**THERMAL RESISTANCE CHARACTERISTICS**

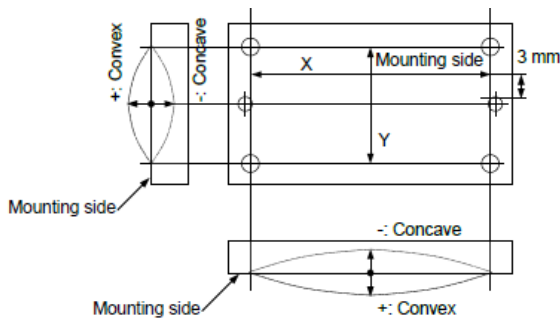
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	74	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	141	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, Thermal grease applied (Note4, 6, 8) per 1 module,	-	10	-	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 6 screw	3.5	4.0	4.5	N·m
$d_s$	Creepage distance	Terminal to terminal	20.0	-	-	mm
		Terminal to base plate	37.3	-	-	
$d_a$	Clearance	Terminal to terminal	11.0	-	-	mm
		Terminal to base plate	29.4	-	-	
$e_c$	Flatness of base plate	On the centerline X,Y (Note7)	-50	-	+100	$\mu\text{m}$
$m$	mass	-	-	400	-	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 ( $T_{vj}$ ) should not increase beyond  $T_{vjmax}$  rating.
  - Pulse width and repetition rate should be such that the device junction temperature ( $T_{vj}$ ) dose not exceed  $T_{vjmax}$  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. Refer to the figure of test circuit.
  - Typical value is measured by using thermally conductive grease of  $\lambda=0.9 \text{ W/(m}\cdot\text{K)}/D_{(C-S)}=50 \mu\text{m}$ .
  - The base plate (mounting side) flatness measurement point (X,Y) is as follows of the following figure.



Long term performance related to thermal conductive grease and PC-TIM (including but not limited to aspects such as the increase of thermal resistance due to pumping out, etc.) should be verified under your specific application conditions. Each temperature condition ( $T_{vjmax}$ ,  $T_{vjop}$ ,  $T_{Cmax}$ ) must be maintained below the maximum rated temperature throughout consideration of the temperature rise even for long term usage.

※ No short circuit capability is designed.

# CM400DY-24TH

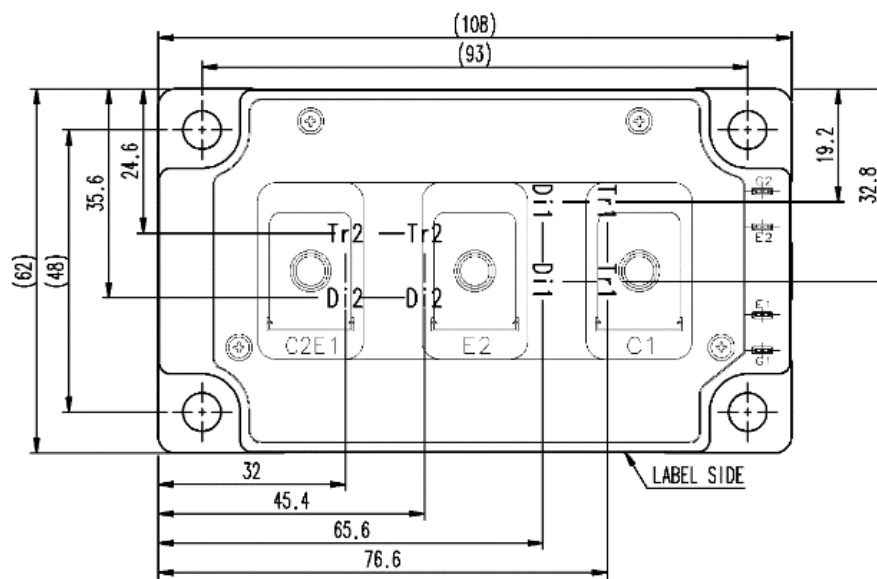
HIGH POWER SWITCHING USE  
INSULATED TYPE

## 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	$\Omega$
$f_c$	Switching frequency	$V_{CC}=600\text{ V}$ , $R_G=0\ \Omega$ , $V_{GE}=\pm 15\text{ V}$ , $T_{vj}=150^\circ\text{C}$	-	-	60	kHz

## CHIP LOCATION (Top view)

Dimension in mm, tolerance:  $\pm 1\text{ mm}$

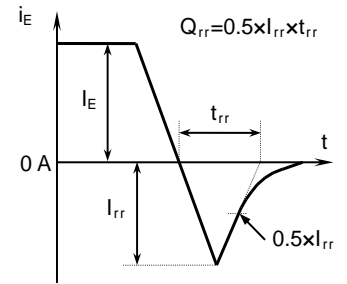
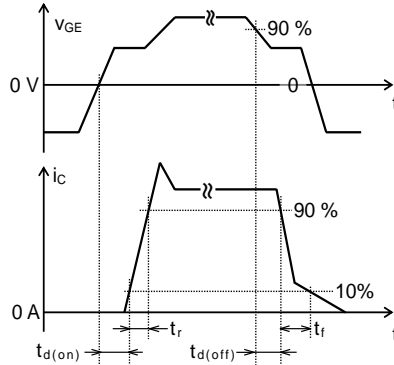
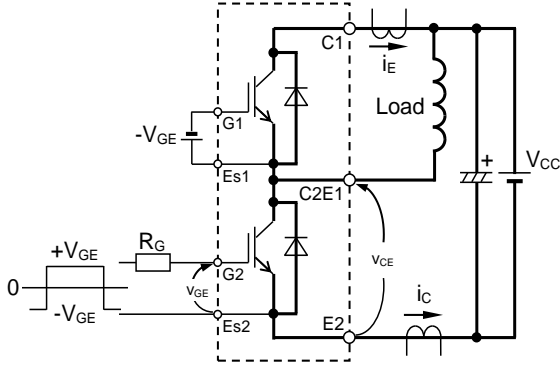


Tr1/Tr2: IGBT, Di1/Di2: FWD

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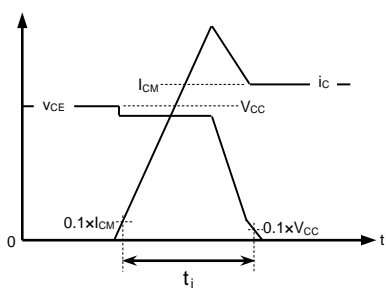
HIGH POWER SWITCHING USE  
 INSULATED TYPE

**TEST CIRCUIT AND WAVEFORMS**

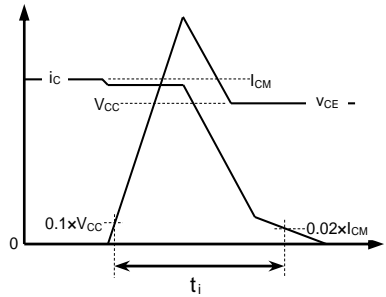


Switching characteristics test circuit and waveforms

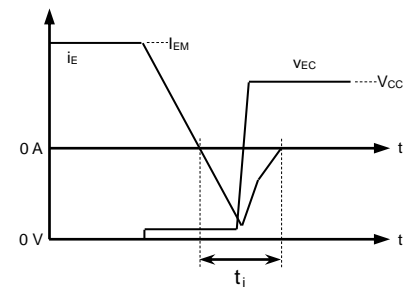
$t_{rr}$ ,  $Q_{rr}$  characteristics test waveform



IGBT Turn-on switching energy



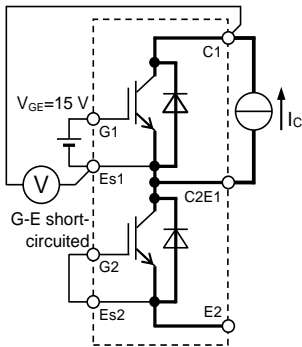
IGBT Turn-off switching energy



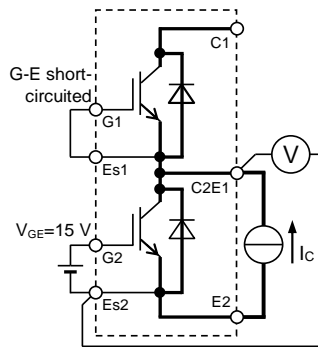
FWD Reverse recovery energy

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

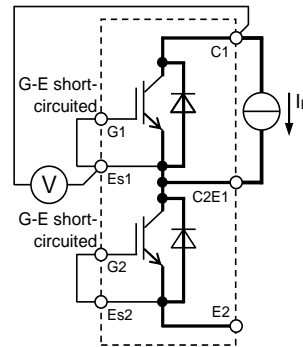
**TEST CIRCUIT**



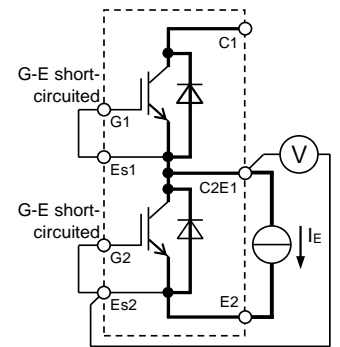
$V_{CEsat}$  characteristics test circuit



$Tr_2$



$Di_1$

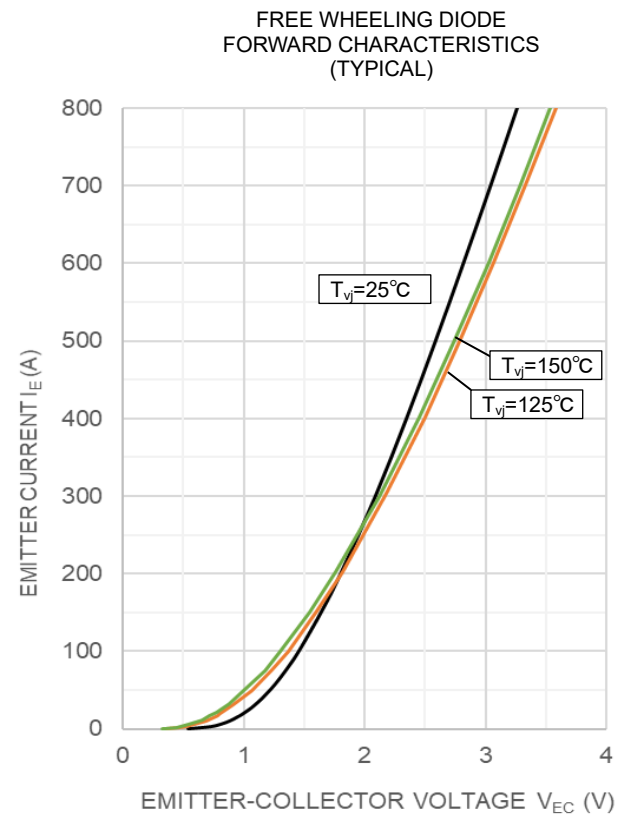
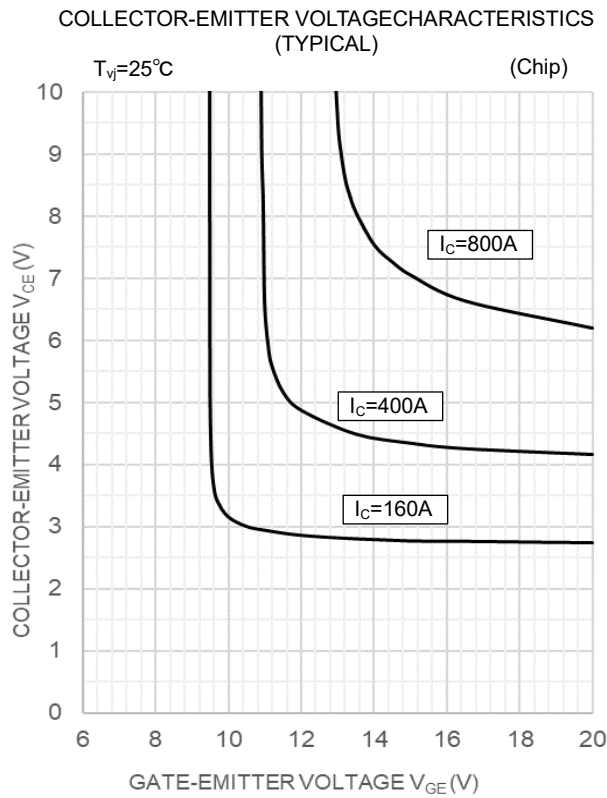
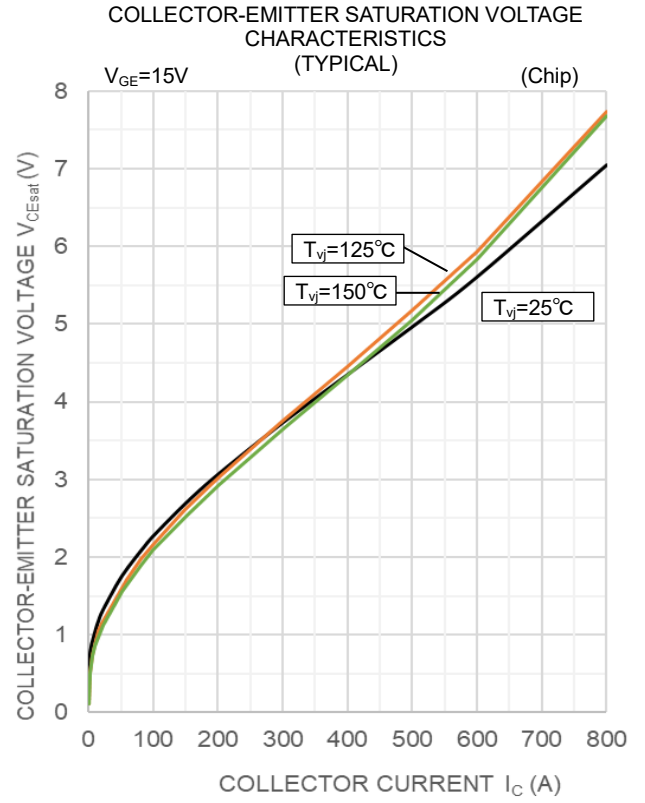
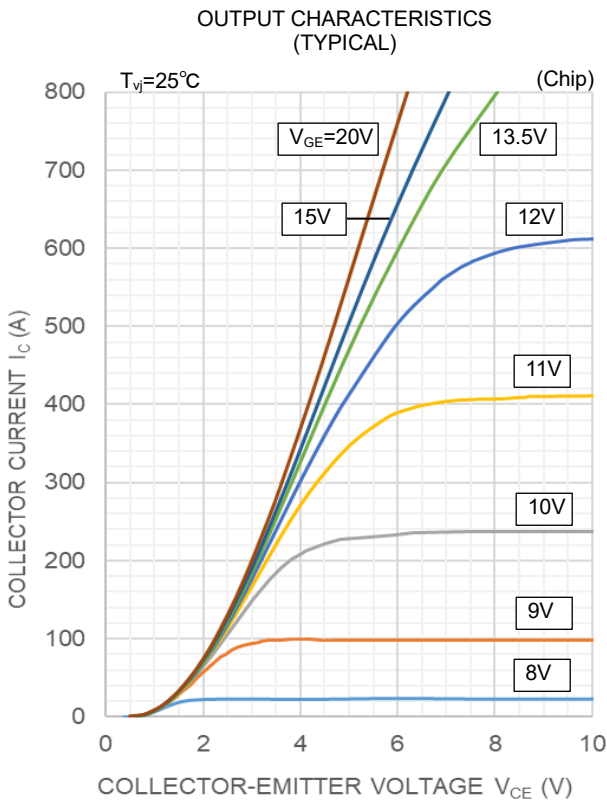


$V_{EC}$  characteristics test circuit

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PERFORMANCE CURVES



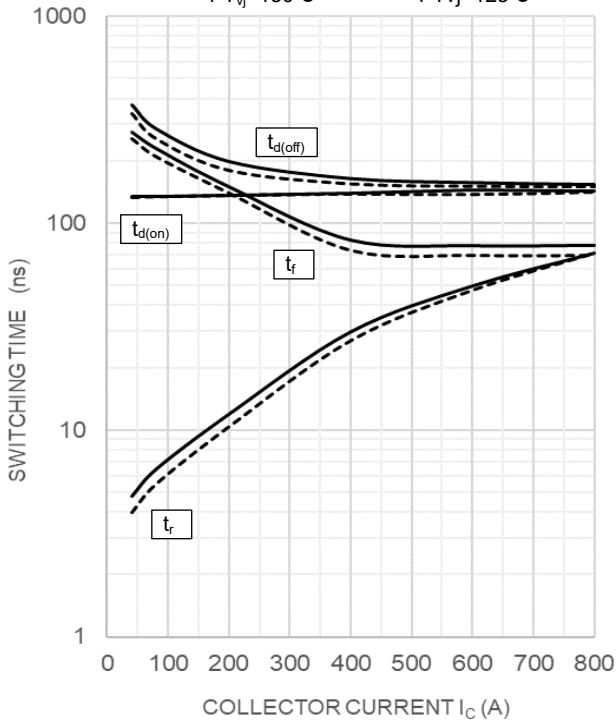
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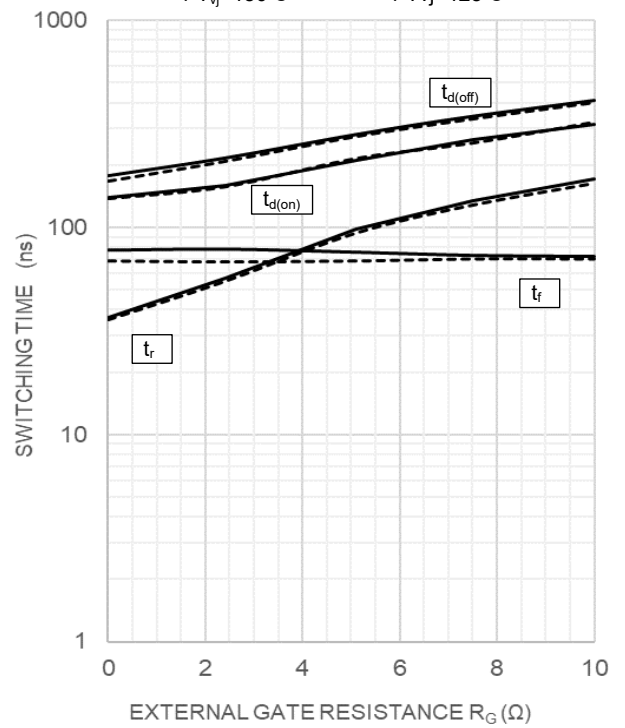
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



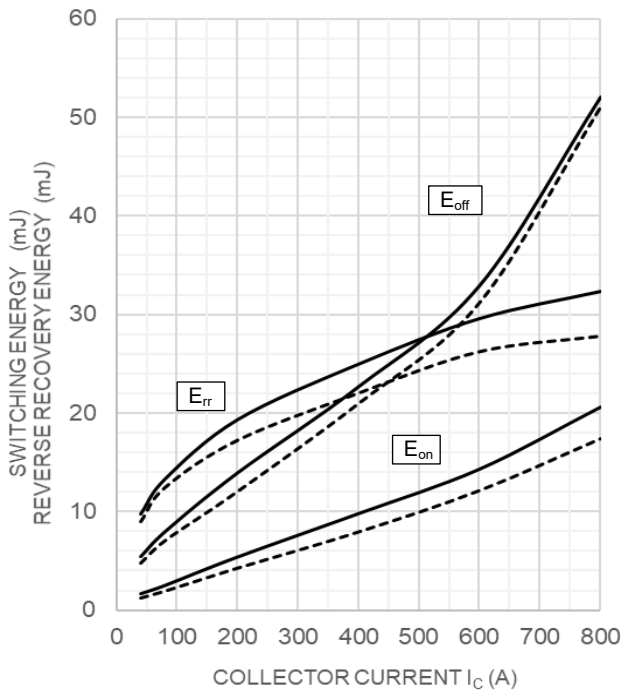
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600V, V_{GE}=\pm 15V, I_C=400A$ , INDUCTIVE LOAD  
 — :  $T_{vj}=150^\circ C$  - - - - :  $T_{vj}=125^\circ C$



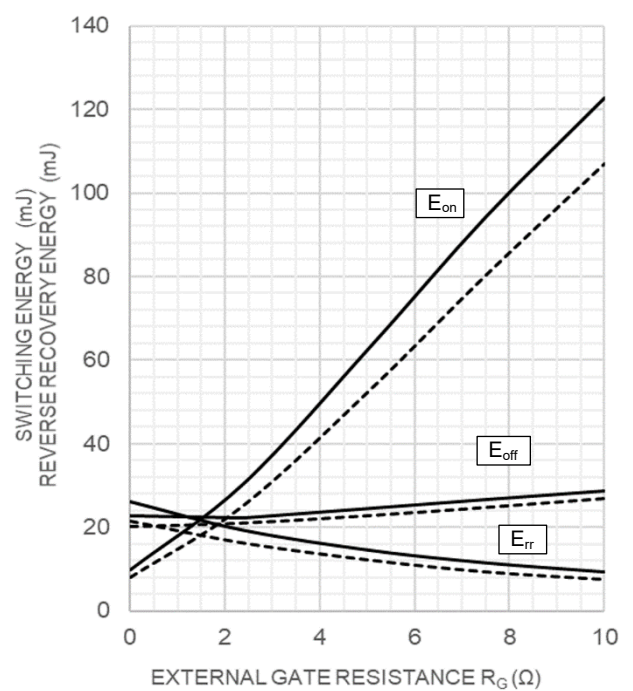
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

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



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600V, V_{GE}=\pm 15V, I_C=400A$ , INDUCTIVE LOAD  
 — :  $T_{vj}=150^\circ C$  - - - - :  $T_{vj}=125^\circ C$

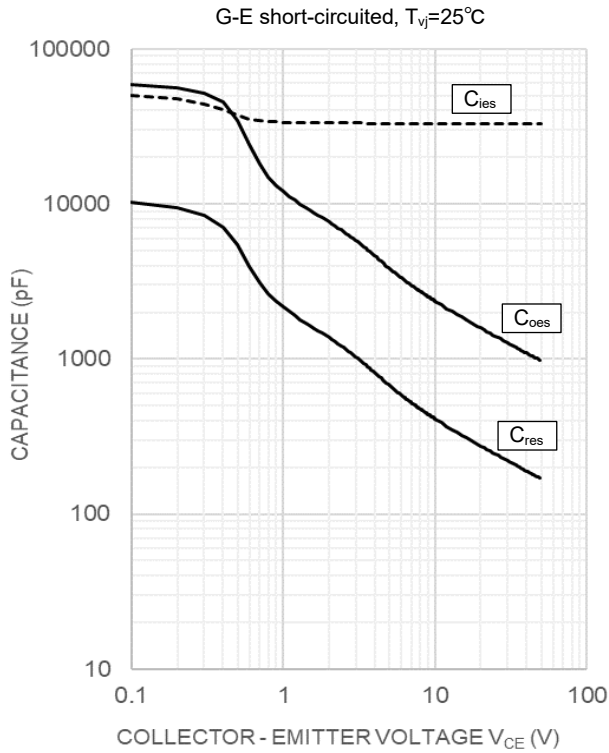


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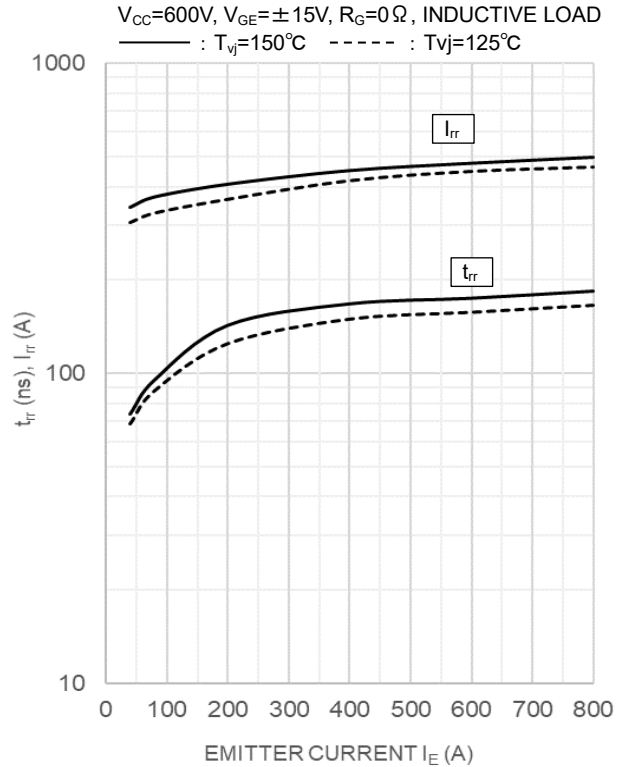
HIGH POWER SWITCHING USE  
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PERFORMANCE CURVES

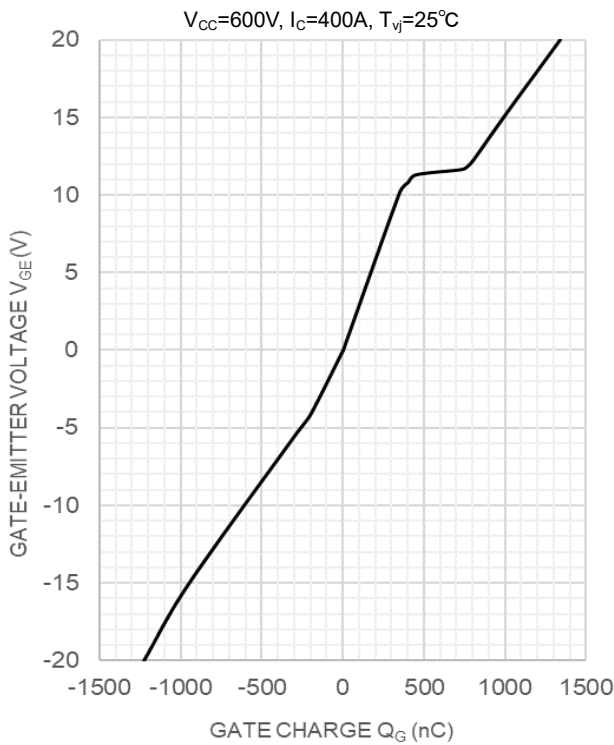
CAPACITANCE CHARACTERISTICS  
 (TYPICAL)



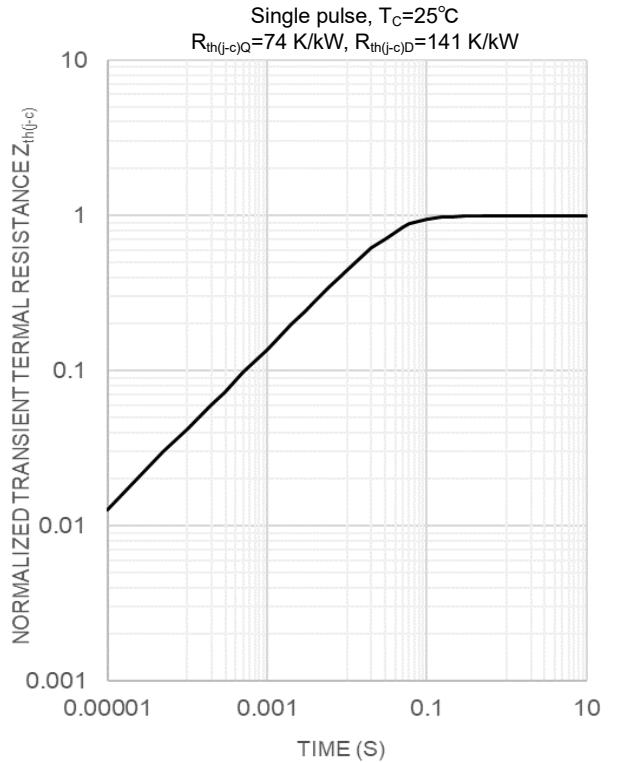
FREE WHEELING DIODE  
 REVERSE RECOVERY CHARACTERISTICS  
 (TYPICAL)



GATE CHARGE CHARACTERISTICS  
 (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS  
 (MAXIMUM)





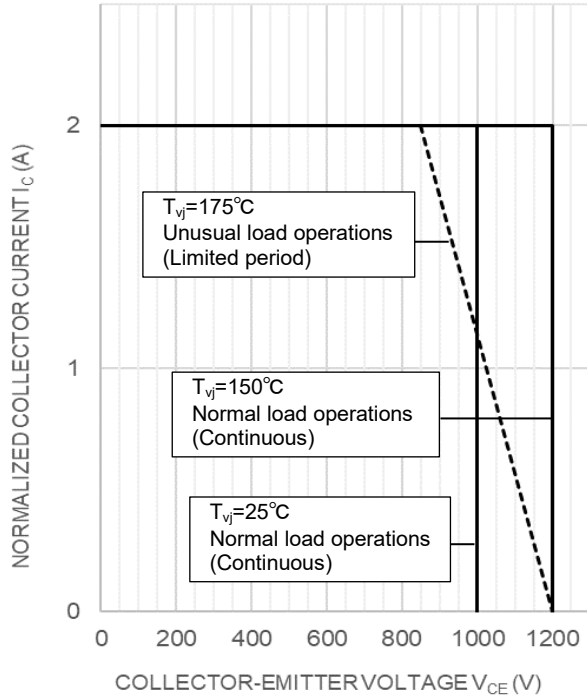
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HIGH POWER SWITCHING USE  
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## PERFORMANCE CURVES

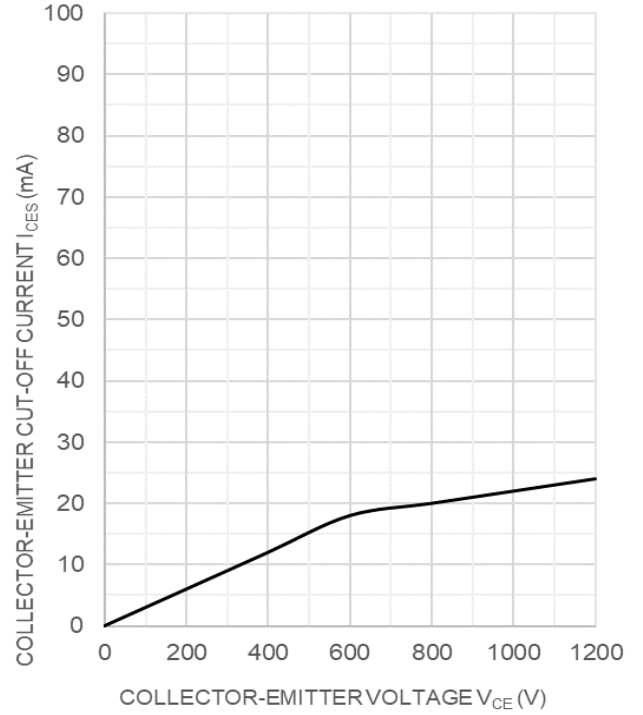
TURN-OFF SWITCHING SAFE OPERATING AREA  
(REVERSE BIAS SAFE OPERATING AREA)  
(MAXIMUM)

$V_{CC}=600V, I_C=400A, T_{vj}=25^\circ C$



COLLECTOR-EMITTER CUT-OFF CURRENT  
CHARACTERISTICS  
(TYPICAL)

$T_{vj}=150^\circ C, G-E$  short-circuited



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

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## **Important Notice**

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