

<IGBT Modules>

# CM400DY-40T

HIGH POWER SWITCHING USE  
INSULATED TYPE



Collector Current  $I_c$  ..... **400 A**  
 Collector-emitter voltage  $V_{CES}$  ..... **2000 V**  
 Maximum junction temperature  $T_{vjmax}$  ..... **175 °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

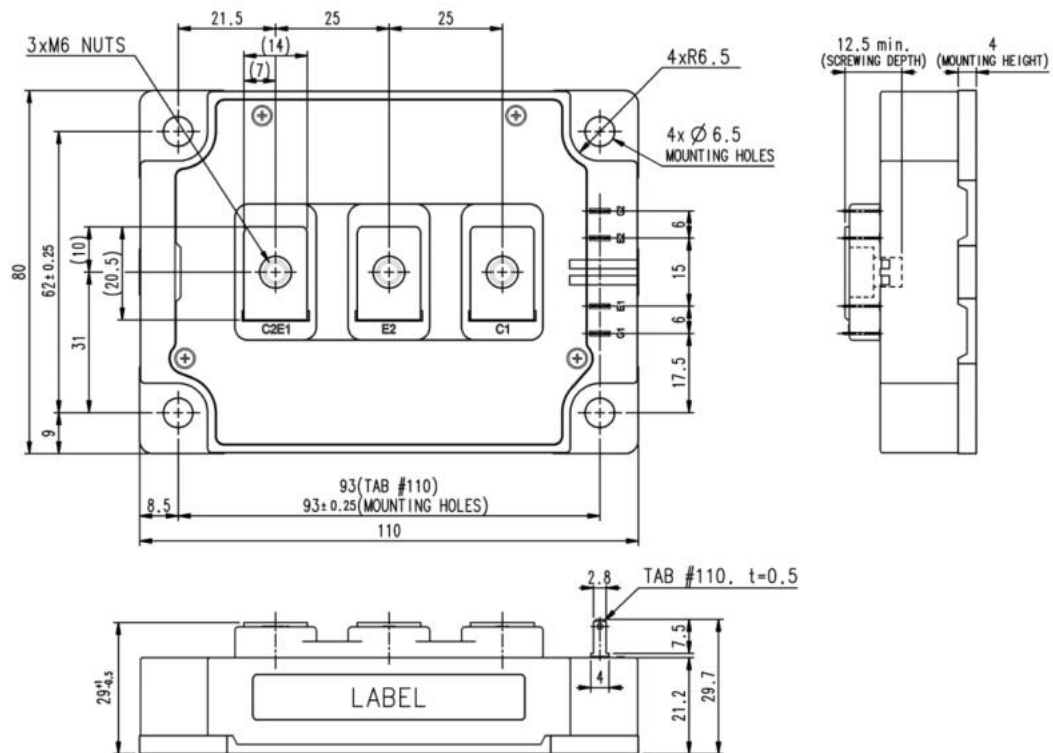
Photo-voltaic , ESS , etc.

## OPTION

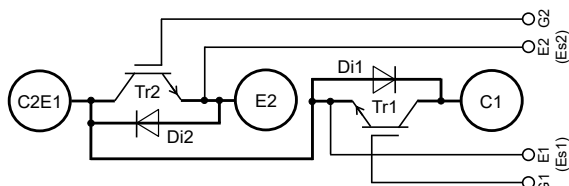
- $V_{CEsat}$  selection for parallel connection

## 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

JIS B 0405 c

**CM400DY-40T**

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	2000	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> =94 °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)	2235	W
I <sub>E</sub> (Note1)	Emitter current	DC (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) (Note8)	175	°C
T <sub>Cmax</sub>	Maximum case temperature	(Note4, 8)	125	
T <sub>vjop</sub>	Operating junction temperature	Continuous operation (Note8)	-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	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> =40 mA, V <sub>CE</sub> =10 V		5.5	6.0	6.6	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	-	2.20	2.55	V
			T <sub>vj</sub> =125 °C	-	2.60	-	
			T <sub>vj</sub> =150 °C	-	2.70	-	
V <sub>CEsat</sub> (Chip)		I <sub>C</sub> =400 A, V <sub>GE</sub> =15 V, (Note5)	T <sub>vj</sub> =25 °C	-	2.10	2.35	V
			T <sub>vj</sub> =125 °C	-	2.50	-	
			T <sub>vj</sub> =150 °C	-	2.60	-	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> =10 V, G-E short-circuited		-	-	110	nF
C <sub>oes</sub>	Output capacitance			-	-	1.9	
C <sub>res</sub>	Reverse transfer capacitance			-	-	0.8	
Q <sub>G</sub>	Gate charge	V <sub>CC</sub> =1300 V, I <sub>C</sub> =400 A, V <sub>GE</sub> =15 V		-	3.2	-	μC
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> =1300 V, I <sub>C</sub> =400 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load		-	-	800	ns
t <sub>r</sub>	Rise time			-	-	200	
t <sub>d(off)</sub>	Turn-off delay time			-	-	800	
t <sub>f</sub>	Fall time			-	-	900	
V <sub>EC</sub> (Note1) (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	-	3.45	4.30	V
			T <sub>vj</sub> =125 °C	-	3.80	-	
			T <sub>vj</sub> =150 °C	-	3.70	-	
V <sub>EC</sub> (Note1) (Chip)		I <sub>E</sub> =400 A, G-E short-circuited, (Note5)	T <sub>vj</sub> =25 °C	-	3.35	4.10	V
			T <sub>vj</sub> =125 °C	-	3.70	-	
			T <sub>vj</sub> =150 °C	-	3.60	-	
t <sub>rr</sub> (Note1)	Reverse recovery time	V <sub>CC</sub> =1300 V, I <sub>E</sub> =400 A, V <sub>GE</sub> =±15 V, R <sub>G</sub> =0 Ω, Inductive load		-	-	300	ns
Q <sub>rr</sub> (Note1)	Reverse recovery charge			-	45	-	μC
E <sub>on</sub>	Turn-on switching energy per pulse	V <sub>CC</sub> =1300 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, Inductive load		-	100	-	mJ
E <sub>off</sub>	Turn-off switching energy per pulse			-	175	-	
E <sub>rr</sub> (Note1)	Reverse recovery energy per pulse			-	78	-	
R <sub>CC'+EE'</sub>	Internal lead resistance	Main terminals-chip, per switch, T <sub>C</sub> =25 °C (Note4)		-	0.65	-	mΩ
r <sub>g</sub>	Internal gate resistance	Per switch		-	1.9	-	Ω

## 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)	-	-	67	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	125	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, per 1 module.	-	9	-	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 6 screw	3.5	4.0	4.5	
$d_s$	Creepage distance	Terminal to terminal	16	-	-	mm
		Terminal to base plate	16	-	-	
$d_a$	Clearance	Terminal to terminal	8	-	-	mm
		Terminal to base plate	8	-	-	
$e_c$	Flatness of base plate	On the centerline X, Y (Note7)	-50	-	+100	μm
m	mass	—	-	530	-	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.

※Restriction of the use of certain Hazardous Substances in electrical and electronic equipment.

Note 1. Represent ratings and characteristics of the anti-parallel, emitter-collector free-wheeling diode (FWD).

2. Junction temperature ( $T_{vj}$ ) should not increase beyond  $T_{vjmax}$  rating.

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

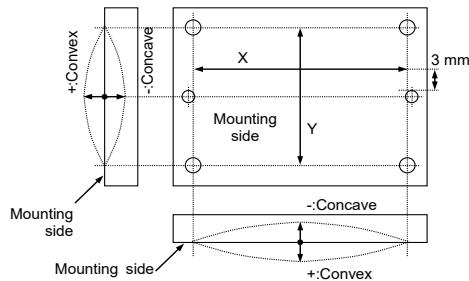
4. Case temperature ( $T_c$ ) and heat sink temperature ( $T_s$ ) are defined on the each surface (mounting side) of base plate and heat sink just under the chips.

Refer to the figure of chip location.

5. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.

6. Reference value. Thermally conductive grease of thermal conductivity  $\lambda=0.9$  W/(m·K) and thickness  $D_{(c-s)}=50$  μm.

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



8. 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 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.

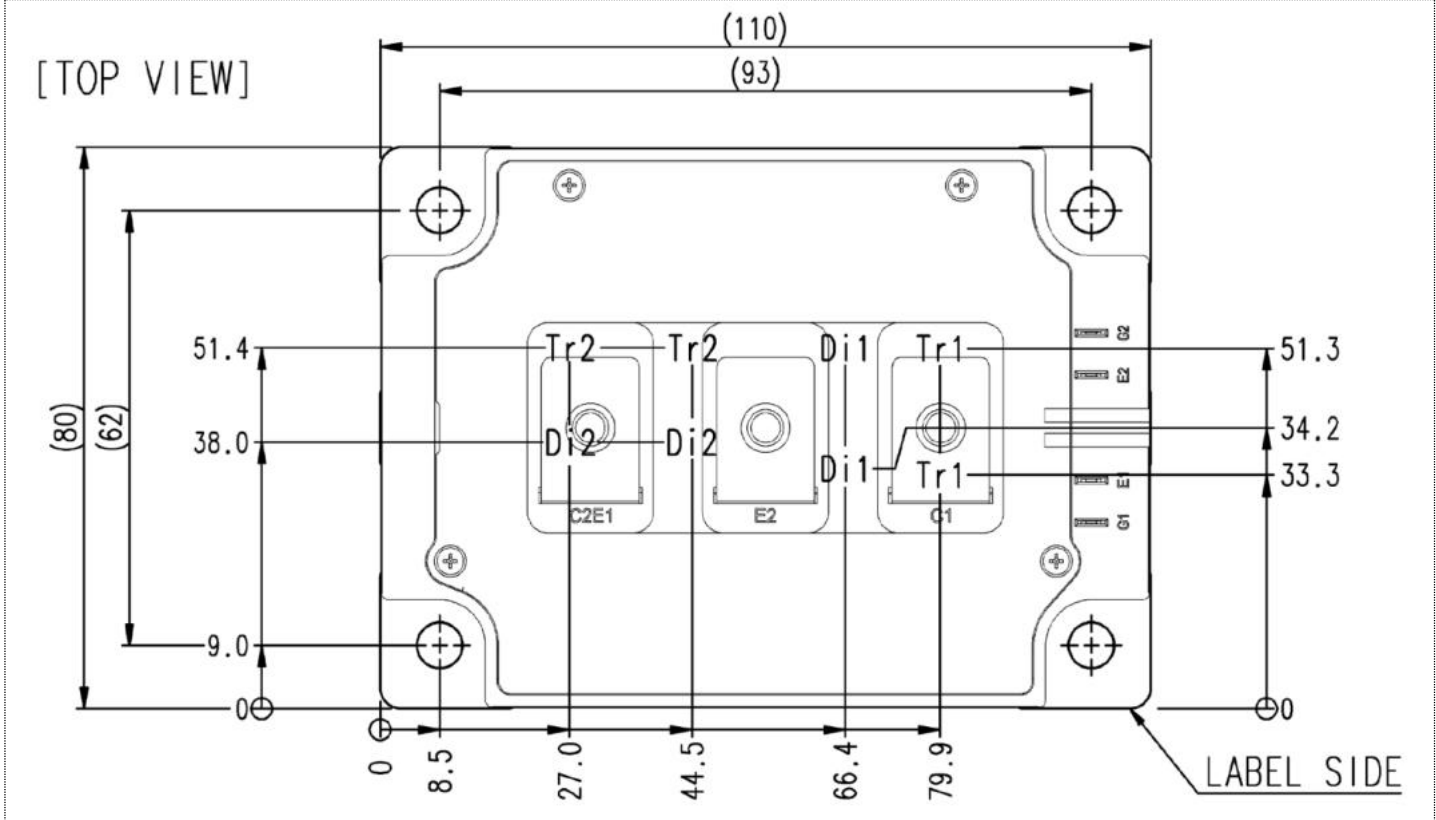
<IGBT Modules>  
**CM400DY-40T**  
HIGH POWER SWITCHING USE  
INSULATED TYPE

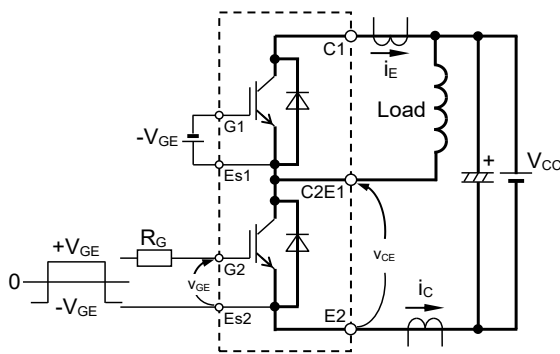
RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{CC}$	(DC) Supply voltage	Applied across C1-E2 terminals	-	1300	1500	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	$\Omega$

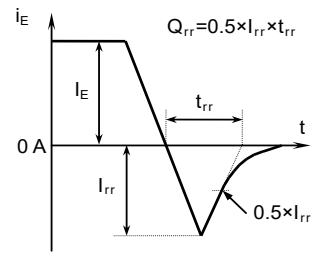
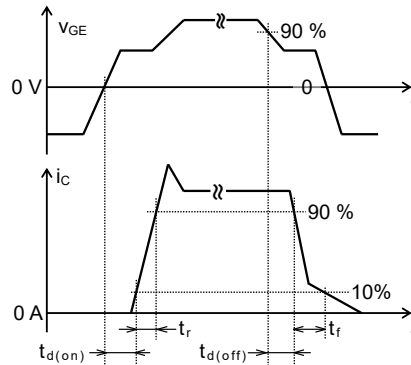
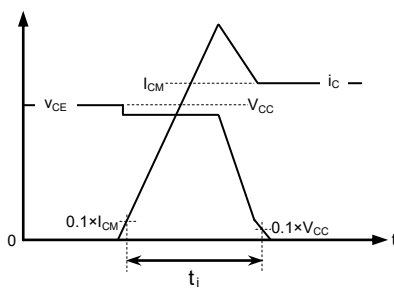
CHIP LOCATION (Top view)

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

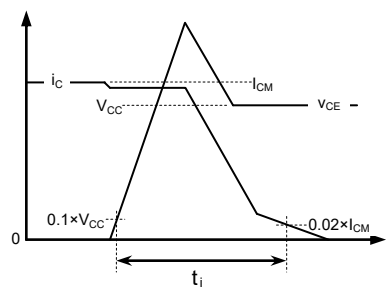


**TEST CIRCUIT AND WAVEFORMS**

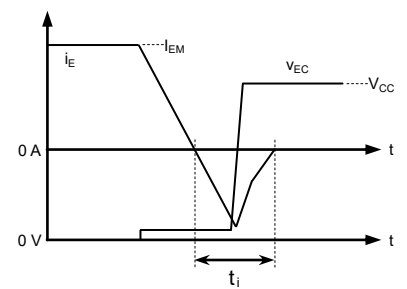
Switching characteristics test circuit and waveforms

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

IGBT Turn-on switching energy

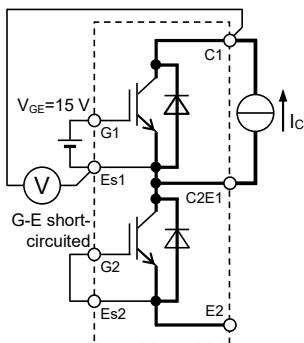


IGBT Turn-off switching energy

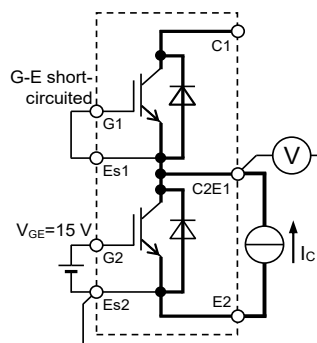


FWD Reverse recovery energy

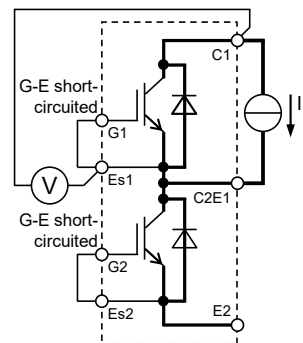
Switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)



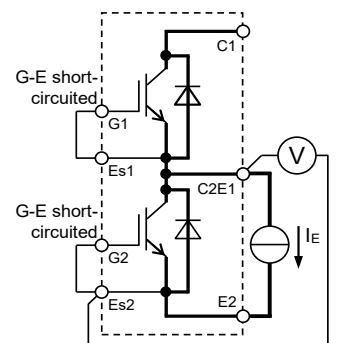
Tr1

 $V_{CEsat}$  characteristics test circuit

Tr2



Di1

 $V_{EC}$  characteristics test circuit

Di2

**CM400DY-40T**

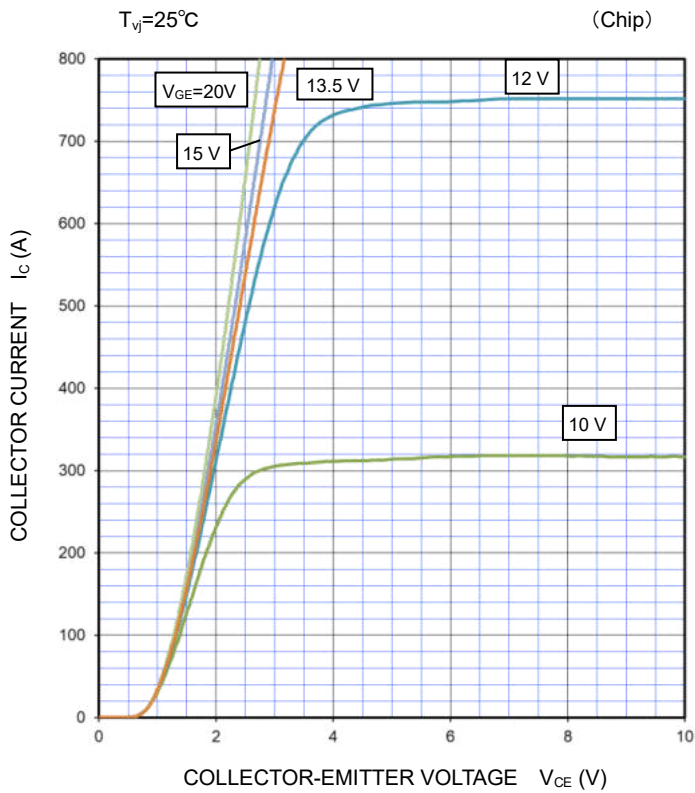
HIGH POWER SWITCHING USE

INSULATED TYPE

**PERFORMANCE CURVES****OUTPUT CHARACTERISTICS**

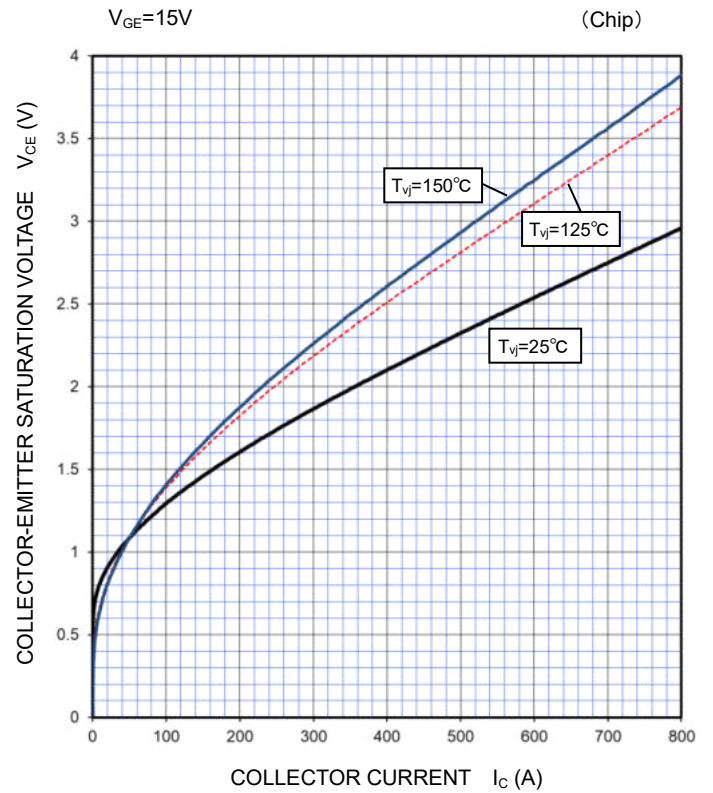
(TYPICAL)

(Chip)

**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS**

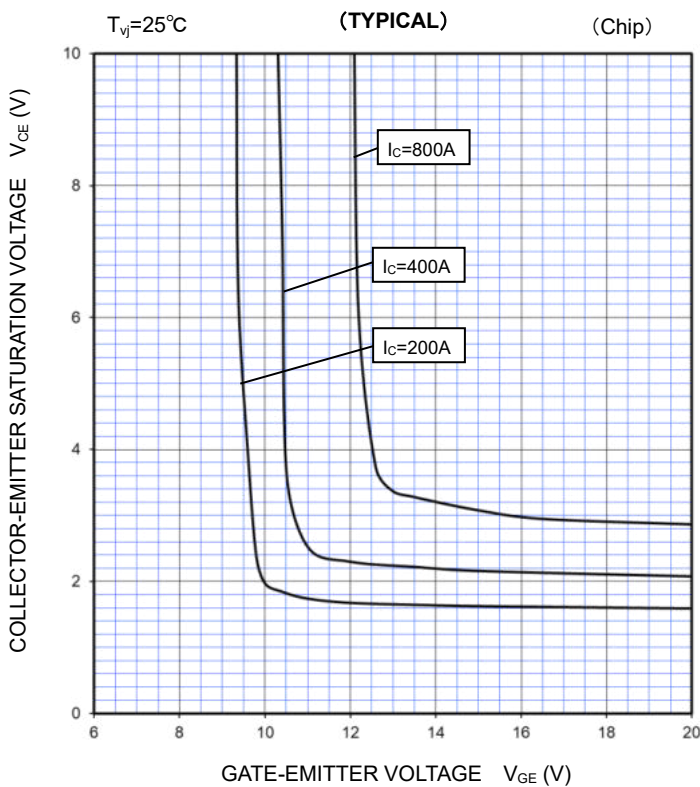
(TYPICAL)

(Chip)

**COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS**

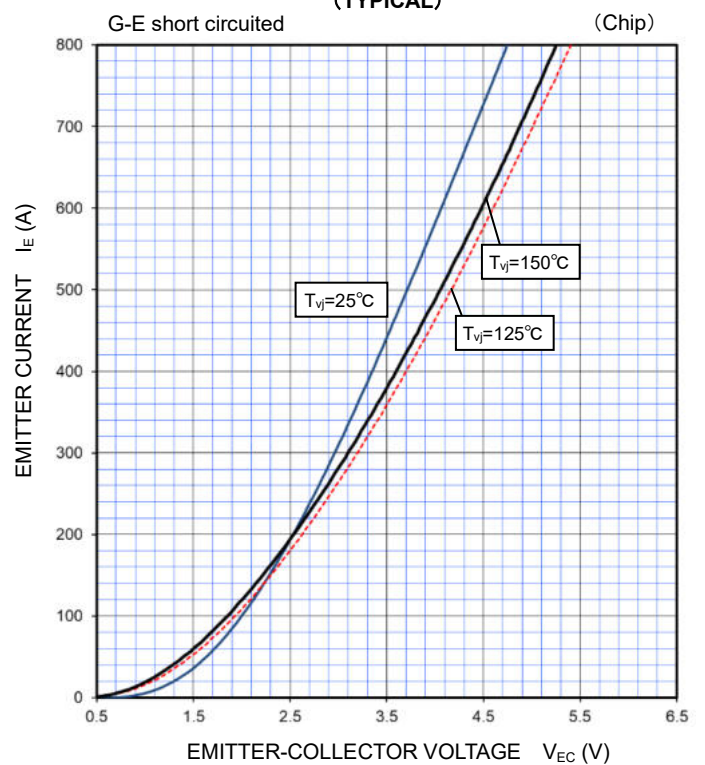
(TYPICAL)

(Chip)

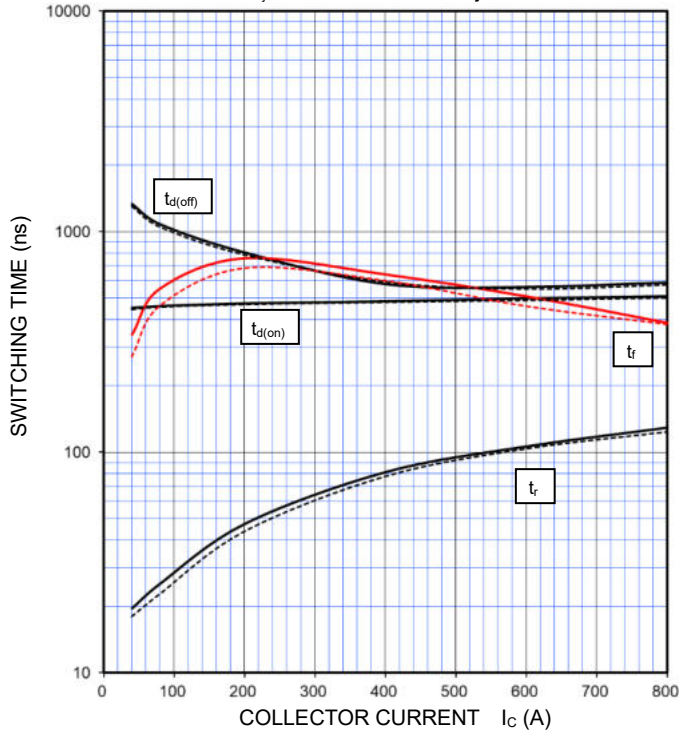
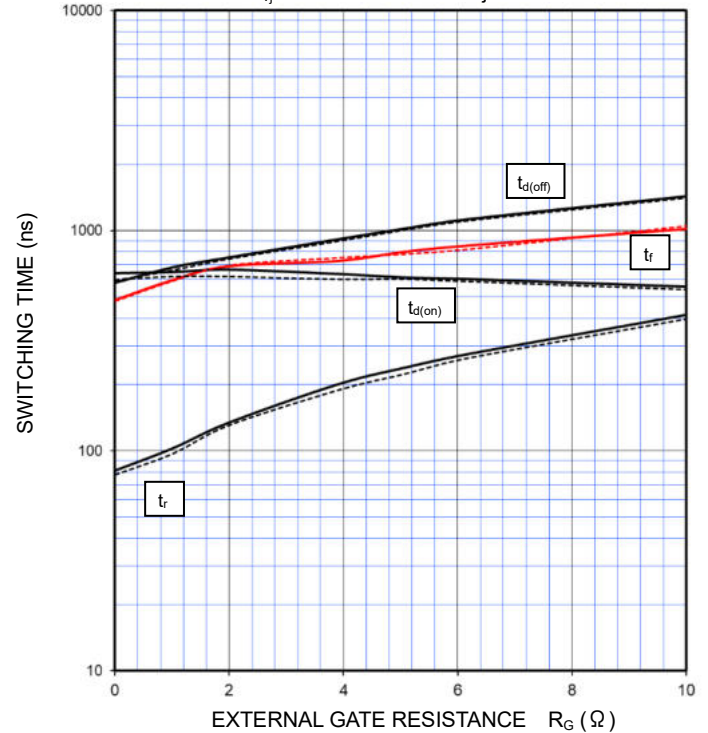
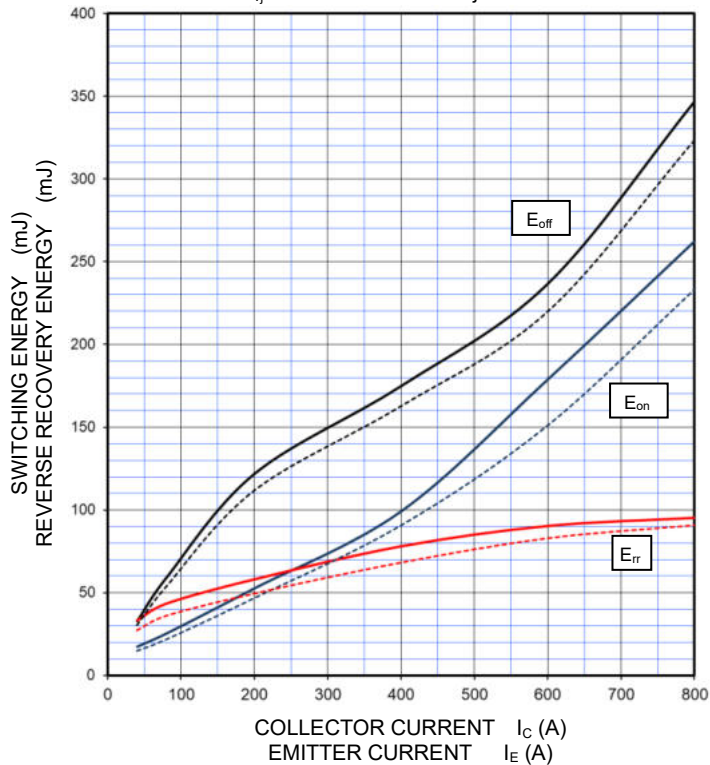
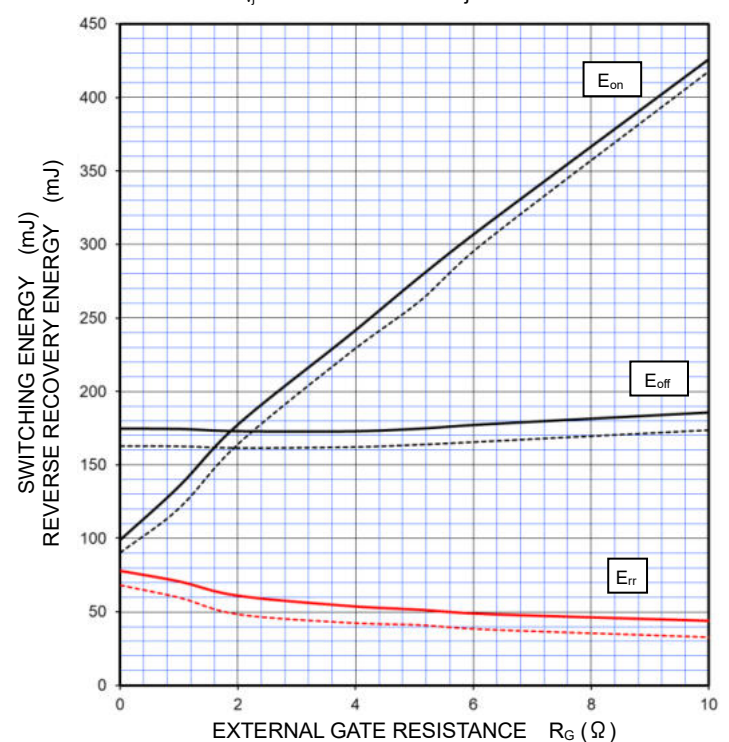
**FREE WHEELING DIODE FORWARD CHARACTERISTICS**

(TYPICAL)

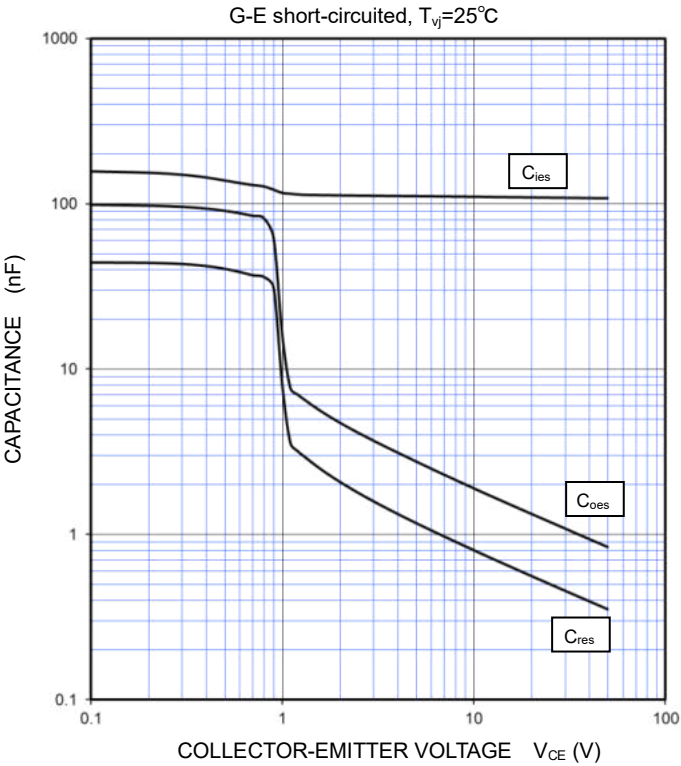
(Chip)



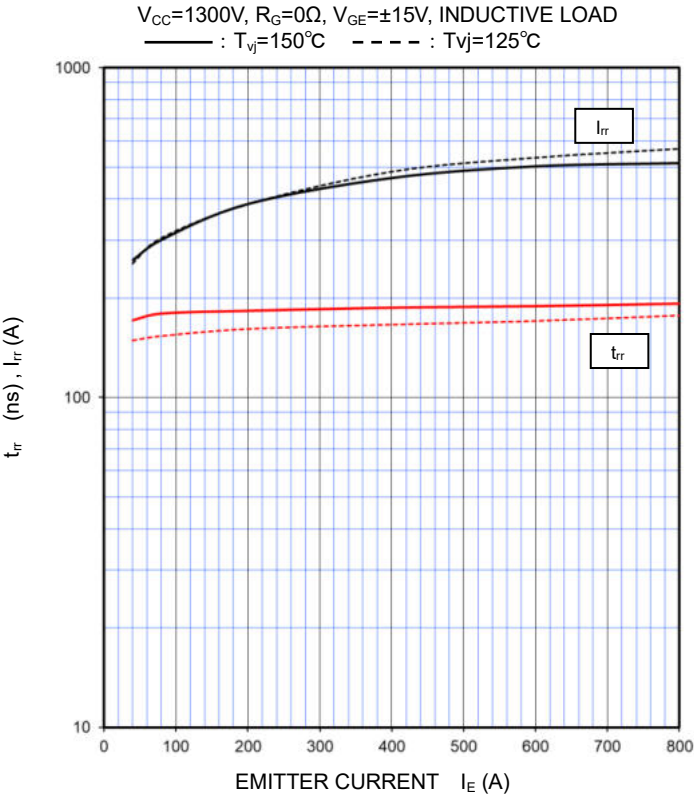
## PERFORMANCE CURVES

HALF-BRIDGE SWITCHING CHARACTERISTICS  
(TYPICAL) $V_{CC}=1300V$ ,  $R_G=0\Omega$ ,  $V_{GE}=\pm 15V$ , INDUCTIVE LOAD  
— :  $T_{vj}=150^\circ C$  - - - :  $T_{vj}=125^\circ C$ HALF-BRIDGE SWITCHING CHARACTERISTICS  
(TYPICAL) $V_{CC}=1300V$ ,  $I_C=400A$ ,  $V_{GE}=\pm 15V$ , INDUCTIVE LOAD  
— :  $T_{vj}=150^\circ C$  - - - :  $T_{vj}=125^\circ C$ HALF-BRIDGE SWITCHING CHARACTERISTICS  
(TYPICAL) $V_{CC}=1300V$ ,  $R_G=0\Omega$ ,  $V_{GE}=\pm 15V$ , INDUCTIVE LOAD  
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(TYPICAL) $V_{CC}=1300V$ ,  $I_C=400A$ ,  $V_{GE}=\pm 15V$ , INDUCTIVE LOAD  
— :  $T_{vj}=150^\circ C$  - - - :  $T_{vj}=125^\circ C$ 

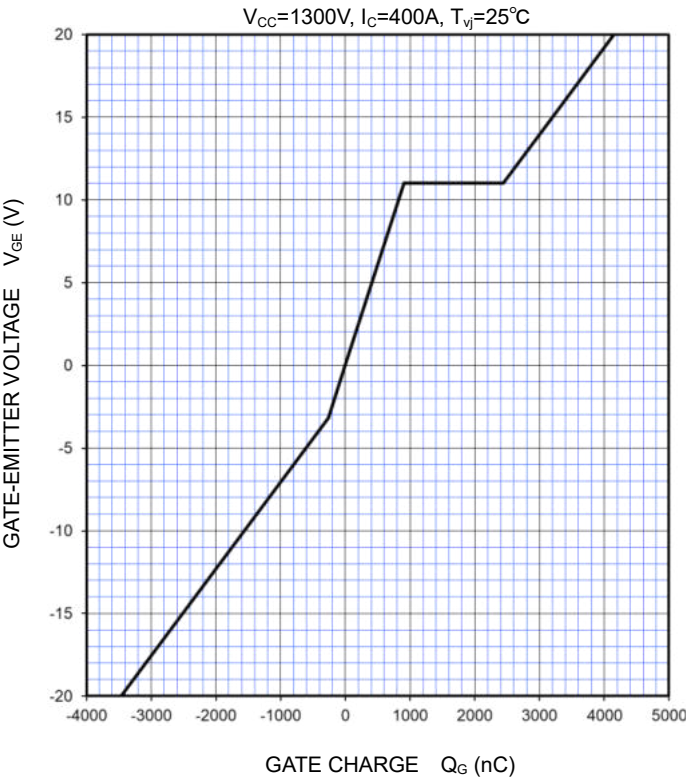
PERFORMANCE CURVES  
CAPACITANCE CHARACTERISTICS  
(TYPICAL)



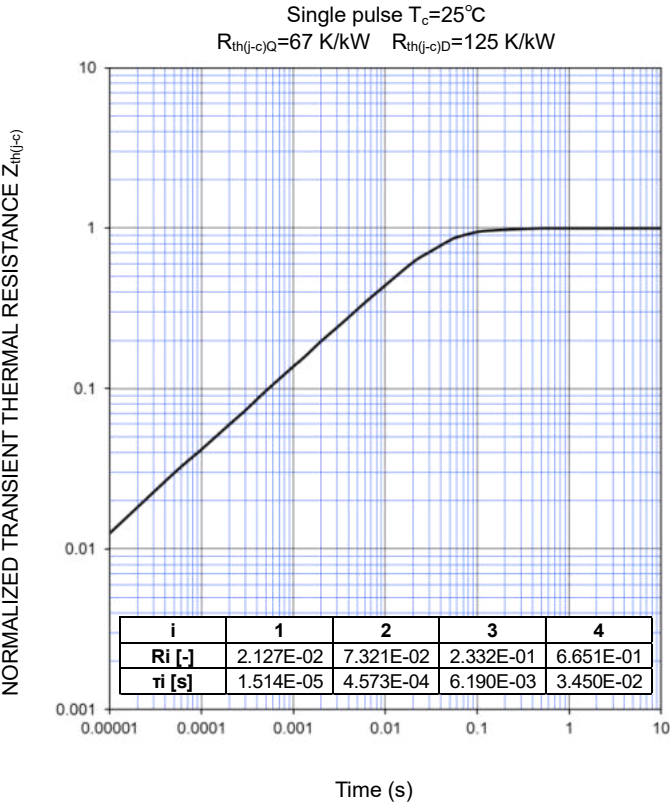
FREE WHEELING DIODE  
REVERSE RECOVERY CHARACTERISTICS  
(TYPICAL)



GATE CHARGE CHARACTERISTICS  
(TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS  
(MAXIMUM)



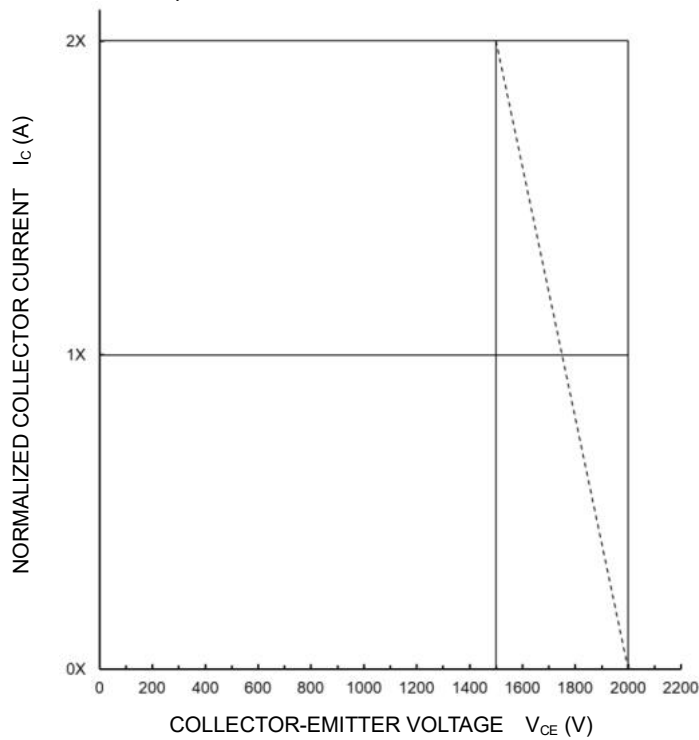
PERFORMANCE CURVES

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

$V_{CC} \leq 1500V$ ,  $V_{GE} = \pm 15V$ ,  $R_G = 0 \sim 10\Omega$ ,

— :  $T_{vj} = 25 \sim 150^\circ C$  (Normal load operations(Continuous))

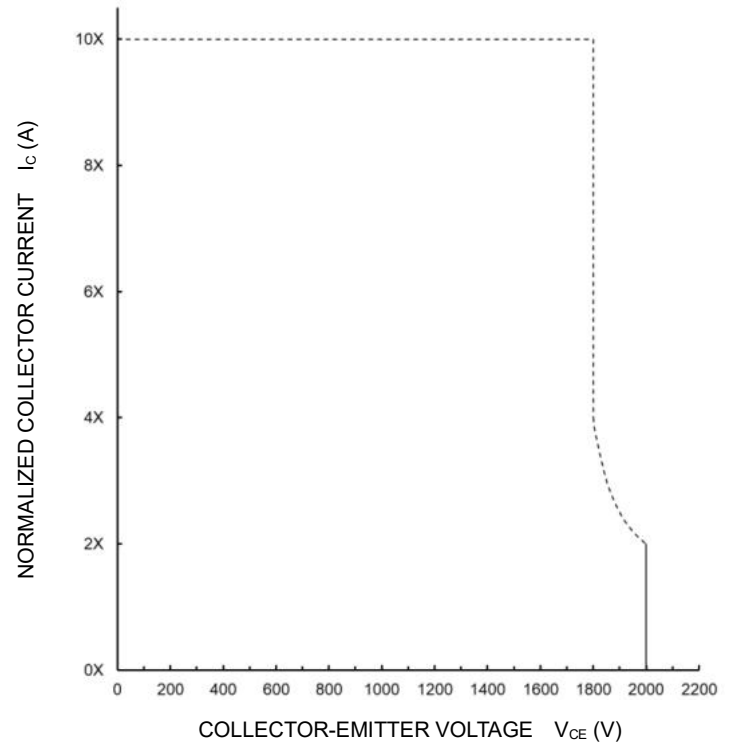
- - - :  $T_{vj} = 175^\circ C$  (Unusual load operations(Limited period))



SHORT-CIRCUIT SAFE OPERATING AREA  
(MAXIMUM)

$V_{CC} \leq 1500V$ ,  $V_{GE} = \pm 15V$ ,  $R_G = 0 \sim 10\Omega$ ,

$T_{vj} = 25 \sim 150^\circ C$ ,  $tw \leq 6\mu s$ , Non-Repetitive



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