

<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

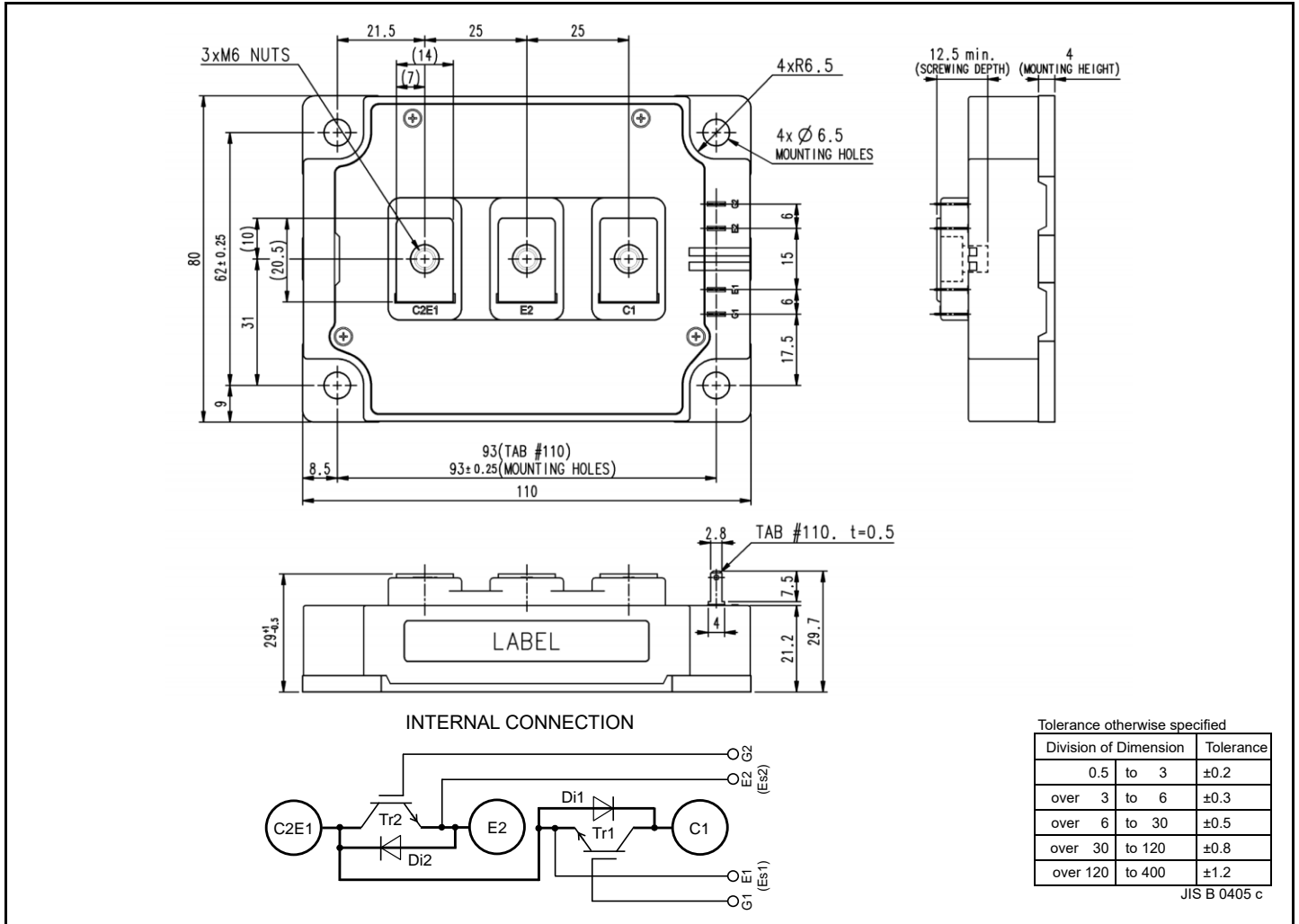
Photo-voltaic , ESS , etc.

OPTION

- V_{CEsat} selection for parallel connection

OUTLINE DRAWING & INTERNAL CONNECTION

Dimension in mm



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MAXIMUM RATINGS (T_{vj}=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E short-circuited	2000	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =94 °C (Note2, 4)	400	A
I _{CRM}		Pulse, Repetitive (Note3)	800	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	2235	W
I _E (Note1)	Emitter current	DC (Note2)	400	A
I _{ERM} (Note1)		Pulse, Repetitive (Note3)	800	
V _{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	4000	V
T _{vjmax}	Maximum junction temperature	Instantaneous event (overload) (Note8)	175	°C
T _{Cmax}	Maximum case temperature	(Note4, 8)	125	
T _{vjop}	Operating junction temperature	Continuous operation (Note8)	-40 ~ +150	°C
T _{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS (T_{vj}=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I _{CES}	Collector-emitter cut-off current	V _{CE} =V _{CES} , G-E short-circuited	-	-	1	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 =40 mA, V _{CE} =10 V	5.5	6.0	6.6	V	
V _{CEsat} (Terminal)	Collector-emitter saturation voltage	I _C =400 A, V _{GE} =15 V, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	2.20	2.55	V
V _{CEsat} (Chip)			T _{vj} =125 °C	-	2.60	-	
			T _{vj} =150 °C	-	2.70	-	
	T _{vj} =25 °C	-	2.10	2.35	V		
V _{CEsat} (Chip)	T _{vj} =125 °C	-	2.50	-			
	T _{vj} =150 °C	-	2.60	-			
	C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	110	nF
C _{oes}	Output capacitance	-		-	1.9		
C _{res}	Reverse transfer capacitance	-		-	0.8		
Q _G	Gate charge	V _{CC} =1300 V, I _C =400 A, V _{GE} =15 V	-	3.2	-	μC	
t _{d(on)}	Turn-on delay time	V _{CC} =1300 V, I _C =400 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		-	-	800		
t _f	Fall time		-	-	900		
V _{EC} (Note1) (Terminal)	Emitter-collector voltage	I _E =400 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	3.45	4.30	V
V _{EC} (Note1) (Chip)			T _{vj} =125 °C	-	3.80	-	
			T _{vj} =150 °C	-	3.70	-	
	T _{vj} =25 °C	-	3.35	4.10	V		
V _{EC} (Note1) (Chip)	T _{vj} =125 °C	-	3.70	-			
	T _{vj} =150 °C	-	3.60	-			
	t _{rr} (Note1)	Reverse recovery time	V _{CC} =1300 V, I _E =400 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	300	ns
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load	-	45	-	μC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =1300 V, I _C =I _E =400 A,	-	100	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _{vj} =150 °C,	-	175	-		
E _{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	78	-		
R _{CC+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C (Note4)	-	0.65	-	mΩ	
r _g	Internal gate resistance	Per switch	-	1.9	-	Ω	

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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)		-	-	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.	Thermal grease applied (Note4, 6, 8)	-	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	N·m
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.

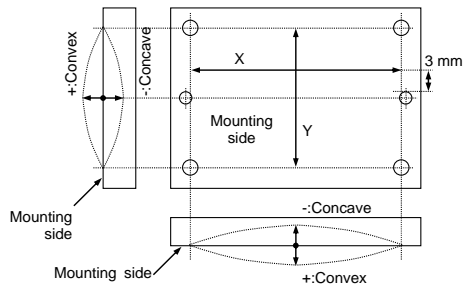
3. Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.

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 $\lambda=0.9 \text{ W/(m}\cdot\text{K)}$ and thickness $D_{(c-s)}=50 \mu\text{m}$.

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.

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HIGH POWER SWITCHING USE

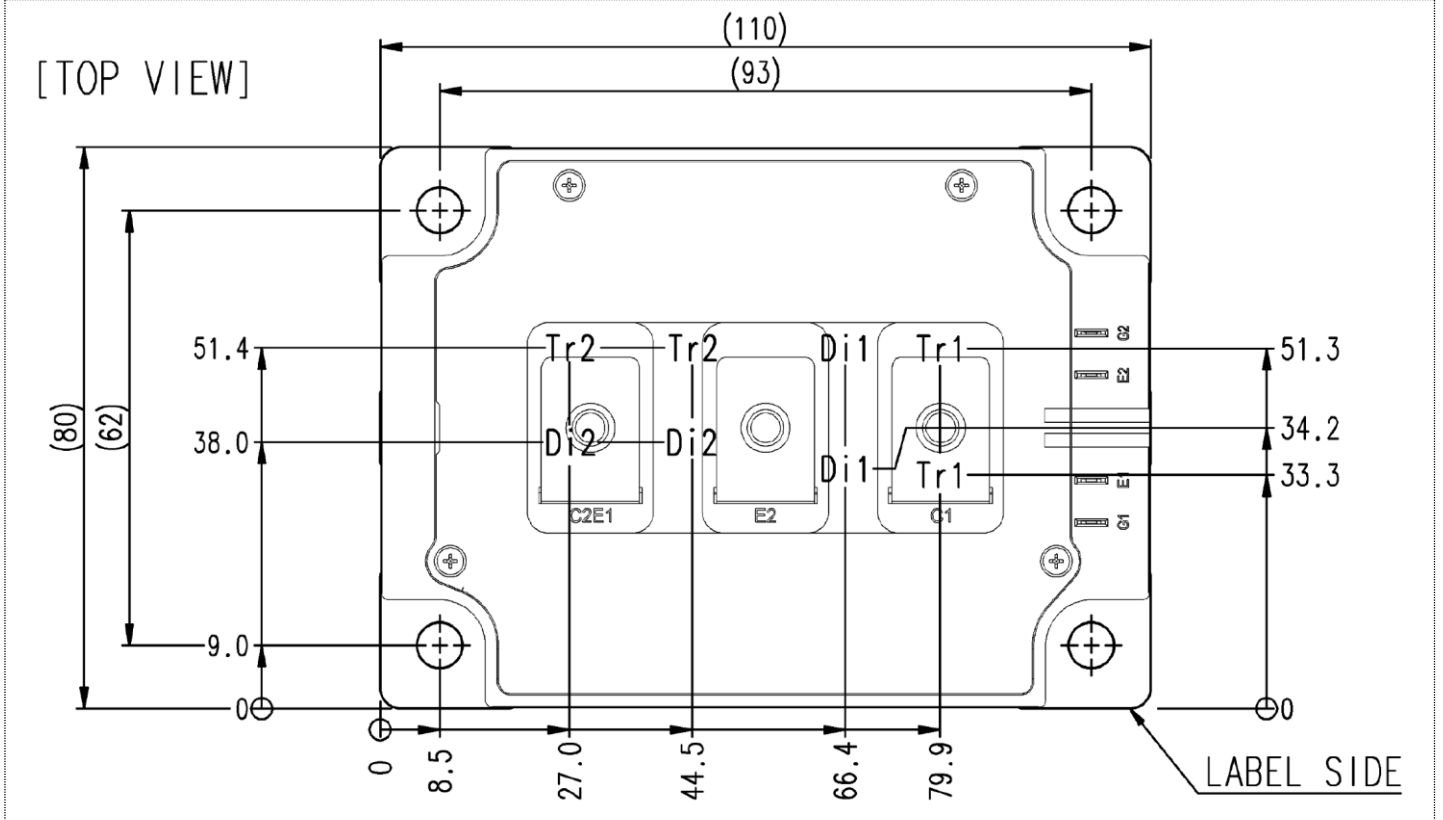
INSULATED TYPE

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	Ω

CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



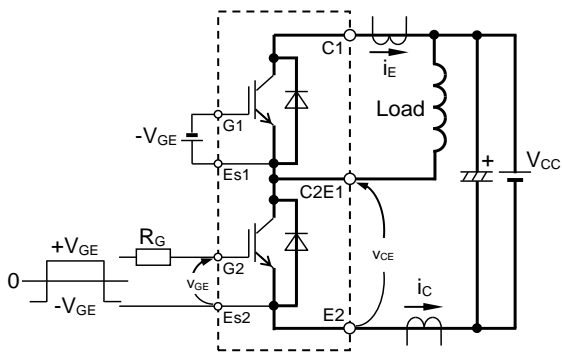
Tr1/Tr2: IGBT, Di1/Di2: FWD

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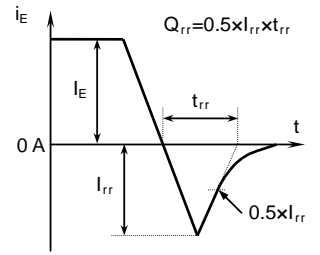
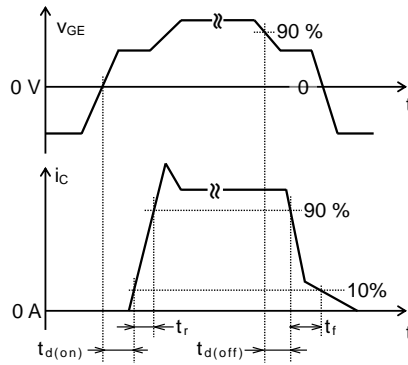
HIGH POWER SWITCHING USE

INSULATED TYPE

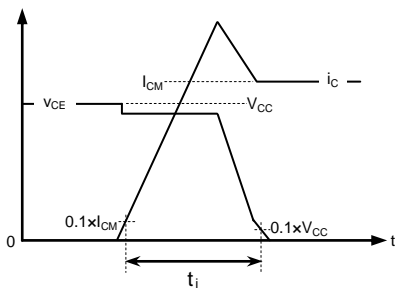
TEST CIRCUIT AND WAVEFORMS



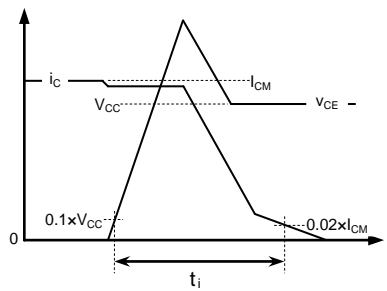
Switching characteristics test circuit and waveforms



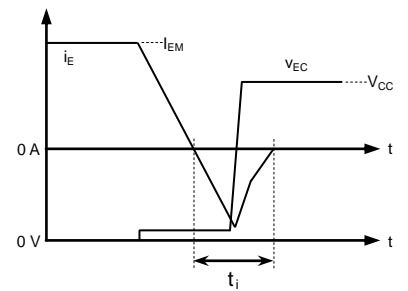
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy

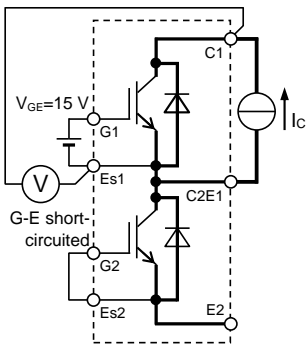


IGBT Turn-off switching energy



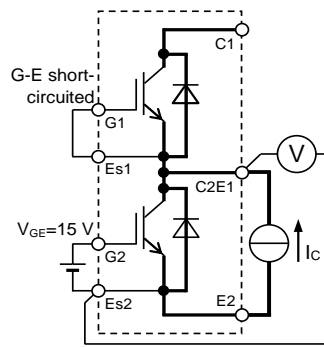
FWD Reverse recovery energy

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

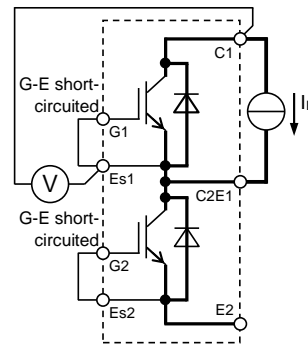


Tr1

V_{CEsat} characteristics test circuit

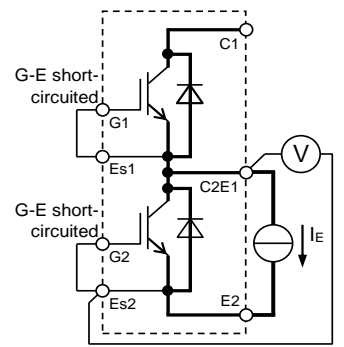


Tr2



Di1

V_{EC} characteristics test circuit



Di2

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HIGH POWER SWITCHING USE

INSULATED TYPE

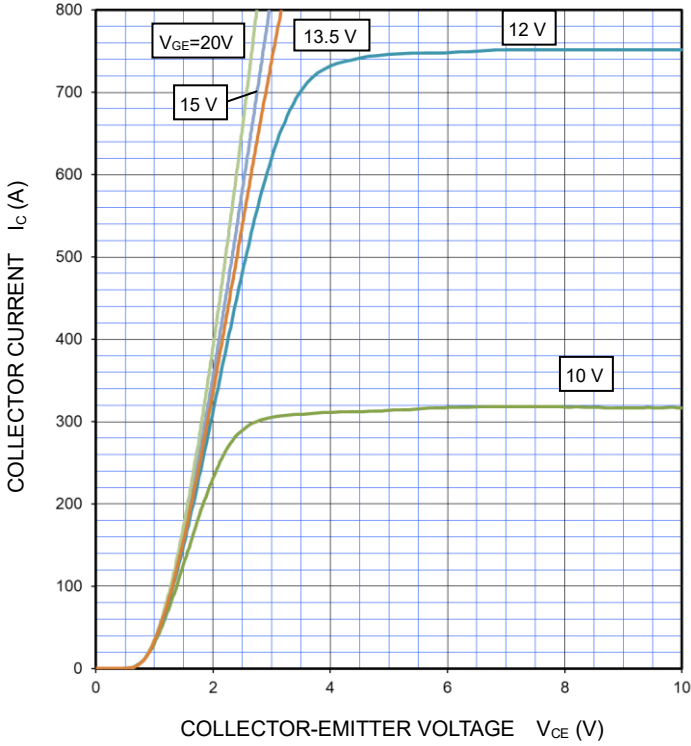
PERFORMANCE CURVES

OUTPUT CHARACTERISTICS

(TYPICAL)

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

(Chip)

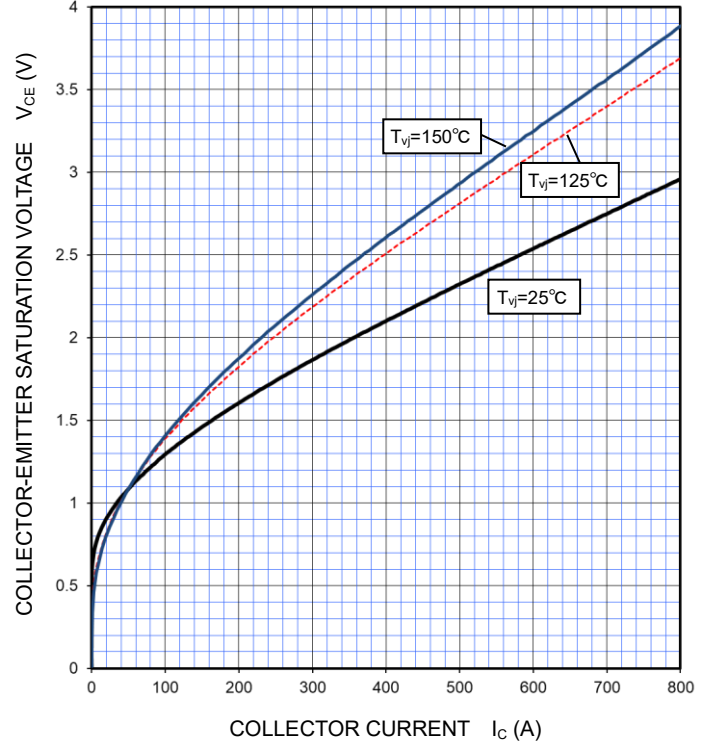


COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)

$V_{ge}=15\text{V}$

(Chip)

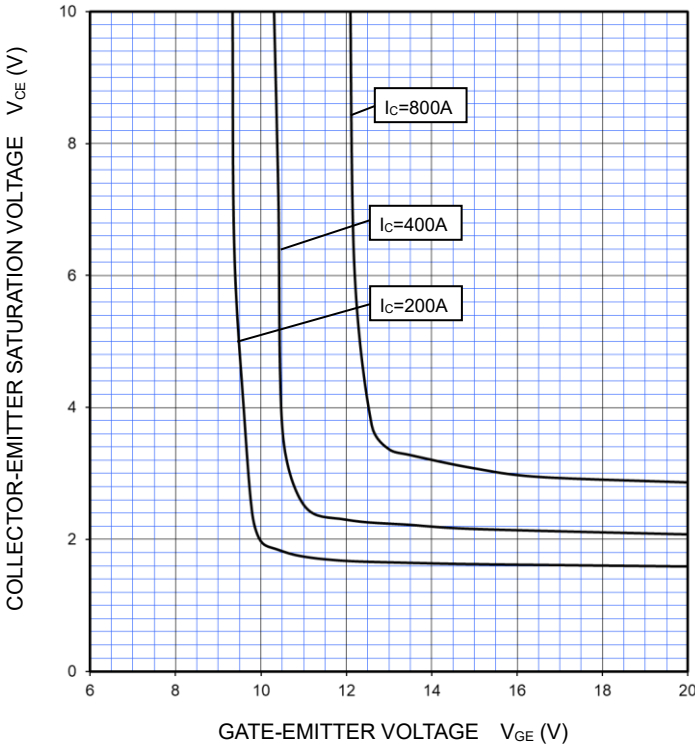


COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS

(TYPICAL)

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

(Chip)

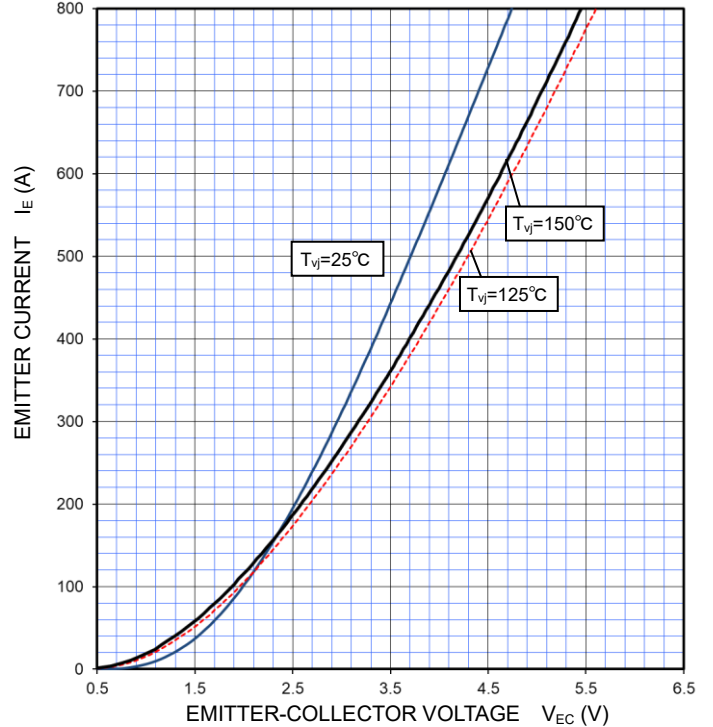


FREE WHEELING DIODE FORWARD CHARACTERISTICS

(TYPICAL)

G-E short circuited

(Chip)



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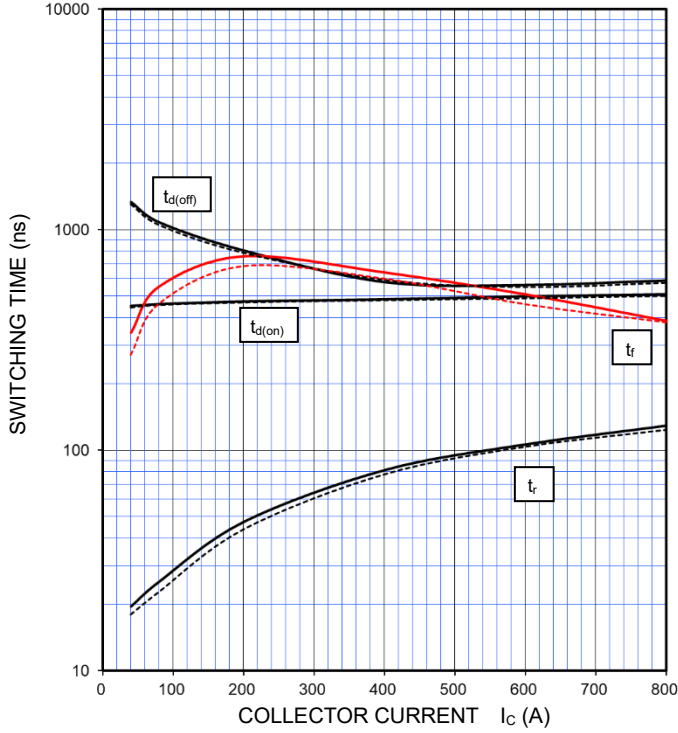
HIGH POWER SWITCHING USE

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PERFORMANCE CURVES

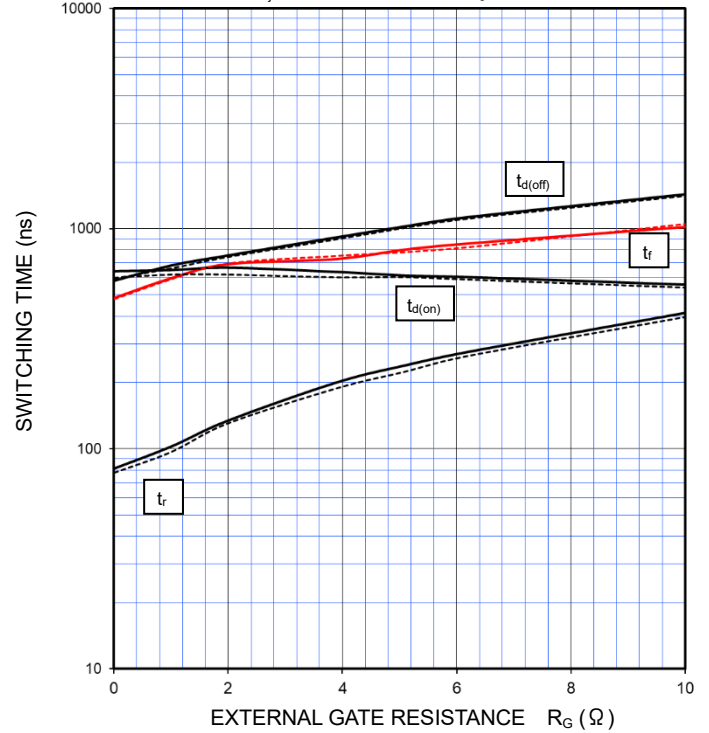
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300V, R_G=0\Omega, V_{GE}=\pm 15V, \text{INDUCTIVE LOAD}$
 — : $T_{vj}=150^\circ C$ - - - : $T_{vj}=125^\circ C$



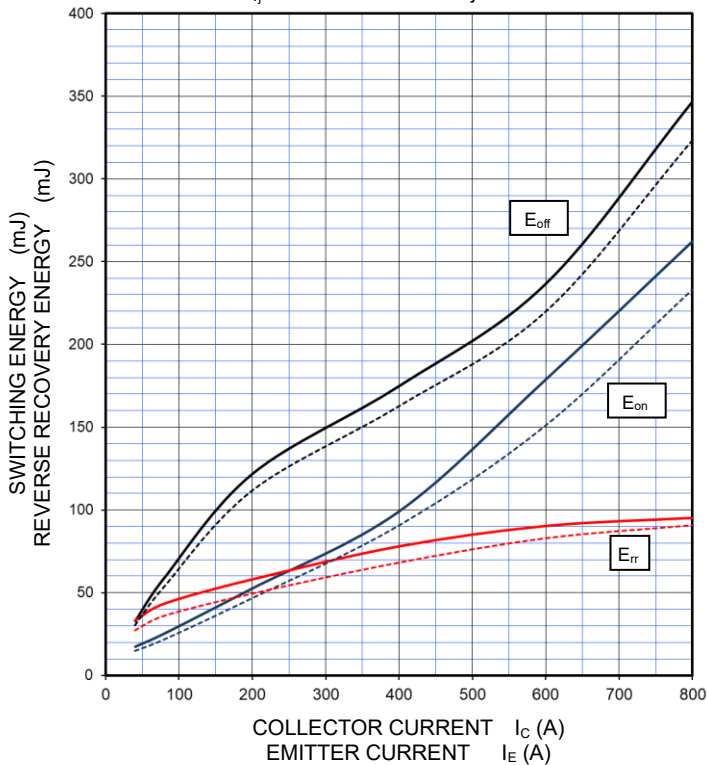
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300V, I_C=400A, V_{GE}=\pm 15V, \text{INDUCTIVE LOAD}$
 — : $T_{vj}=150^\circ C$ - - - : $T_{vj}=125^\circ C$



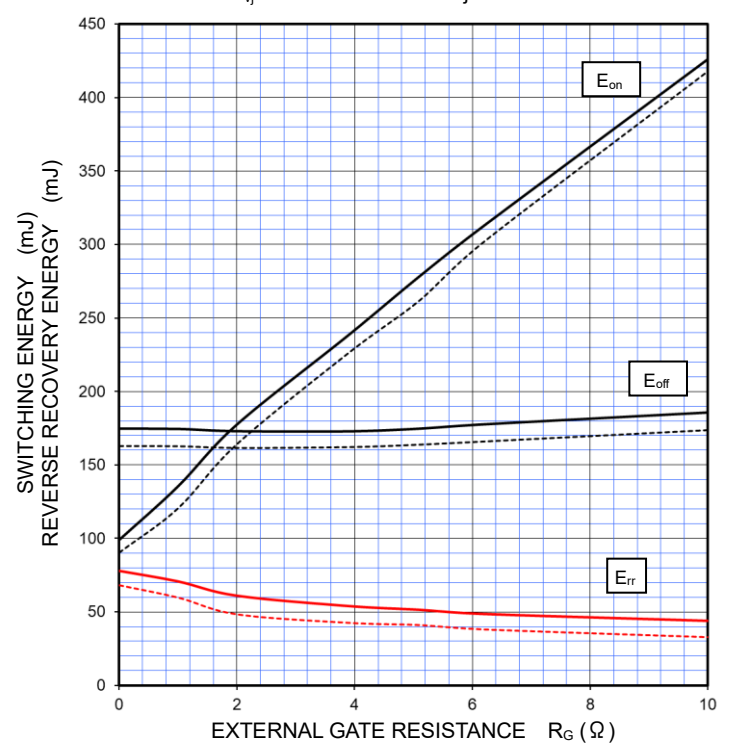
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300V, R_G=0\Omega, V_{GE}=\pm 15V, \text{INDUCTIVE LOAD}$
 — : $T_{vj}=150^\circ C$ - - - : $T_{vj}=125^\circ C$



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1300V, I_C=400A, V_{GE}=\pm 15V, \text{INDUCTIVE LOAD}$
 — : $T_{vj}=150^\circ C$ - - - : $T_{vj}=125^\circ C$



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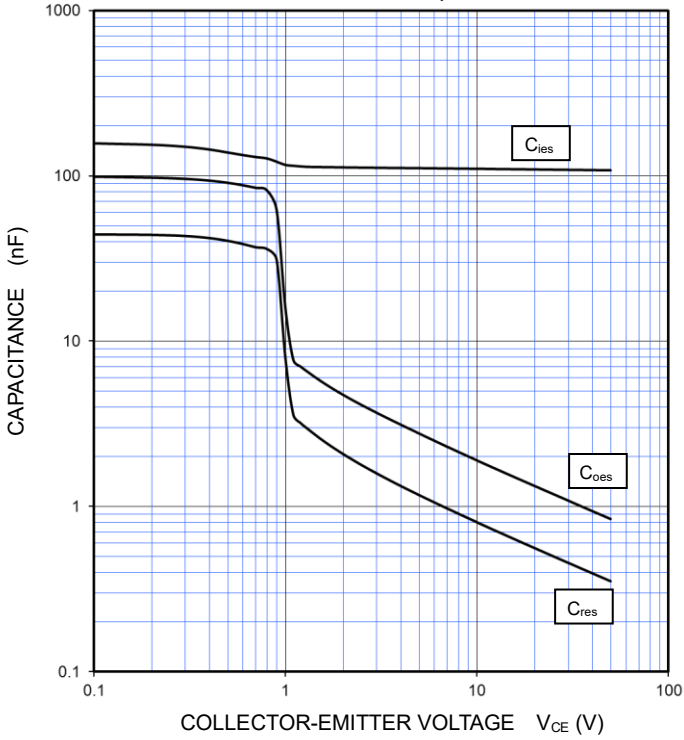
INSULATED TYPE

PERFORMANCE CURVES

CAPACITANCE CHARACTERISTICS

(TYPICAL)

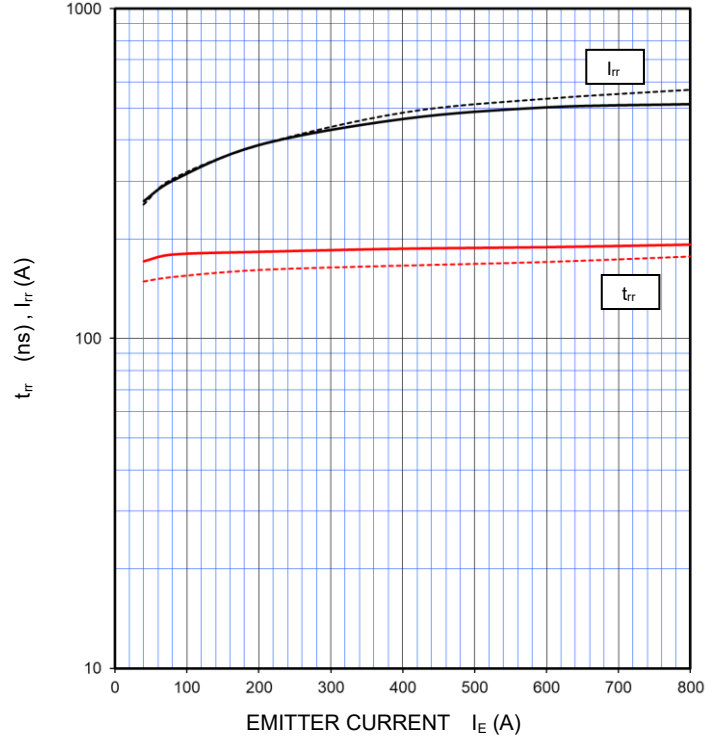
G-E short-circuited, $T_{vj}=25^{\circ}\text{C}$



FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS

(TYPICAL)

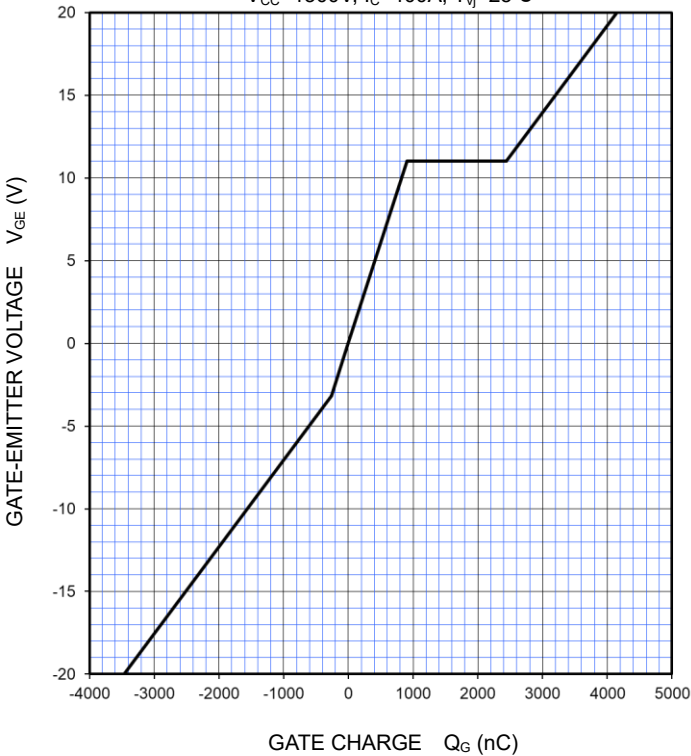
$V_{CC}=1300\text{V}$, $R_G=0\Omega$, $V_{GE}=\pm 15\text{V}$, INDUCTIVE LOAD
 — : $T_{vj}=150^{\circ}\text{C}$ - - - : $T_{vj}=125^{\circ}\text{C}$



GATE CHARGE CHARACTERISTICS

(TYPICAL)

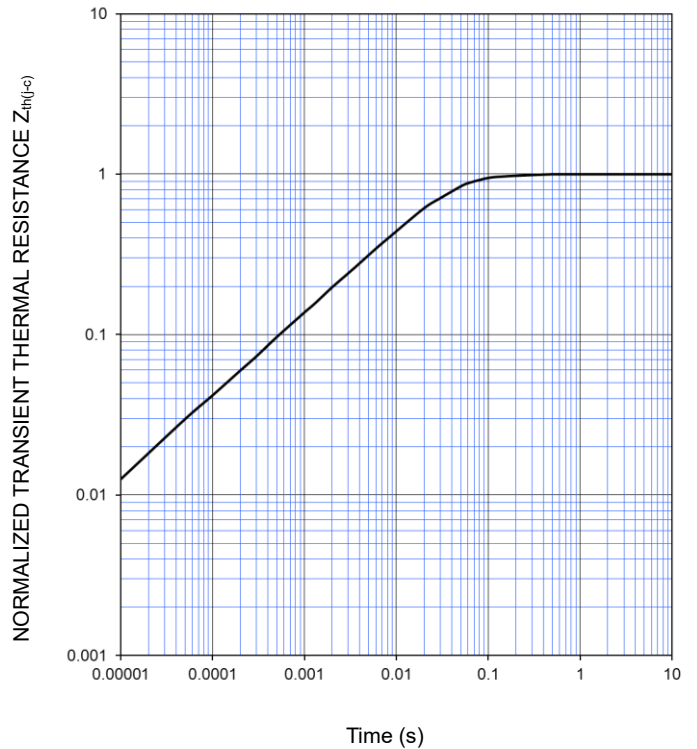
$V_{CC}=1300\text{V}$, $I_C=400\text{A}$, $T_{vj}=25^{\circ}\text{C}$



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

(MAXIMUM)

Single pulse $T_c=25^{\circ}\text{C}$
 $R_{th(j-c)Q}=67\text{ K/kW}$ $R_{th(j-c)D}=125\text{ K/kW}$



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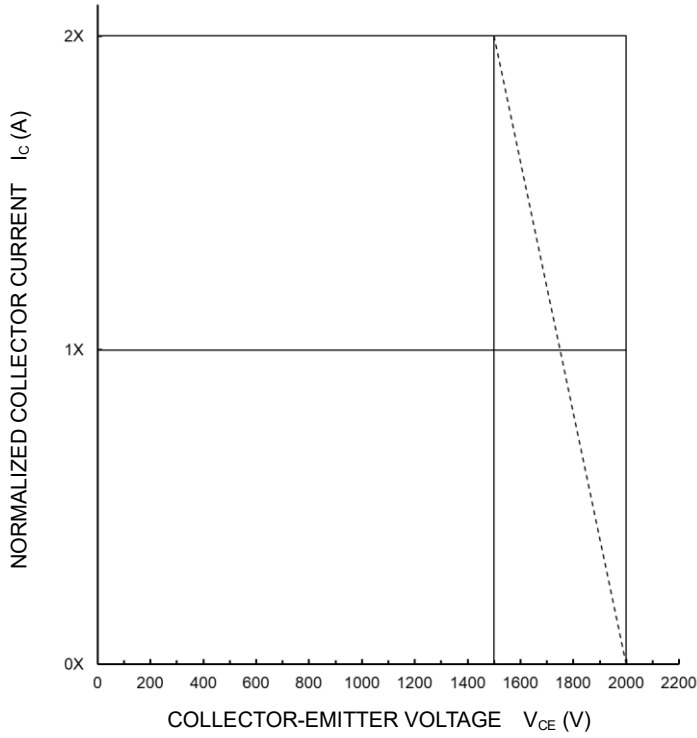
PERFORMANCE CURVES

**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))

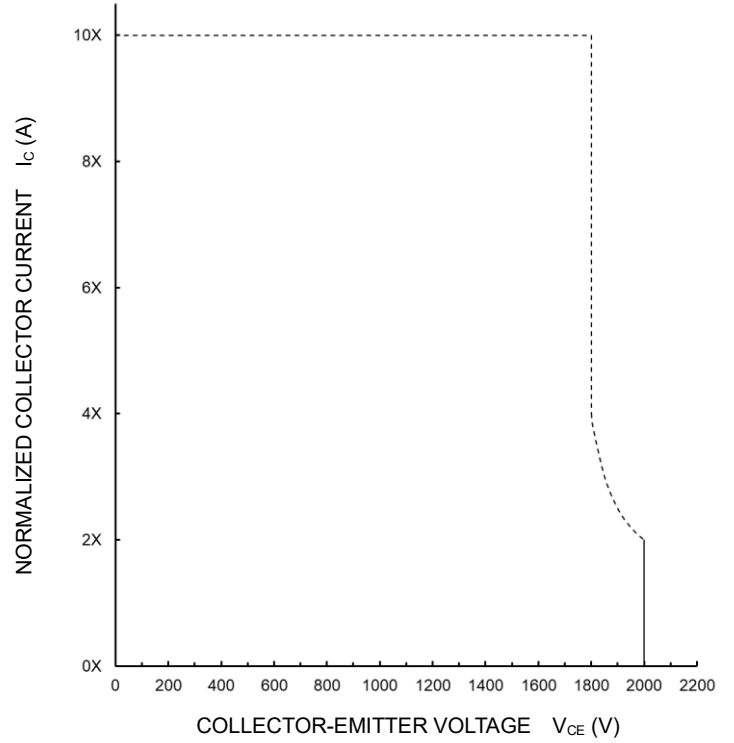
- - - : $T_{vj} = 175^\circ C$ (Unusual load operations(Limited period))



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

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

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



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