

<IGBT Modules>

CM400DY-34T

**HIGH POWER SWITCHING USE
INSULATED TYPE**



dual switch (half-bridge)

Collector current I_C **4 0 0 A**
 Collector-emitter voltage V_{CES} **1 7 0 0 V**
 Maximum junction temperature T_{vjmax} **1 7 5 °C**

- Flat base type
- Copper base plate (Nickel-plating)
- Tin-plating signal terminals
- RoHS Directive compliant
- UL Recognized under UL1557, File No.E323585

APPLICATION

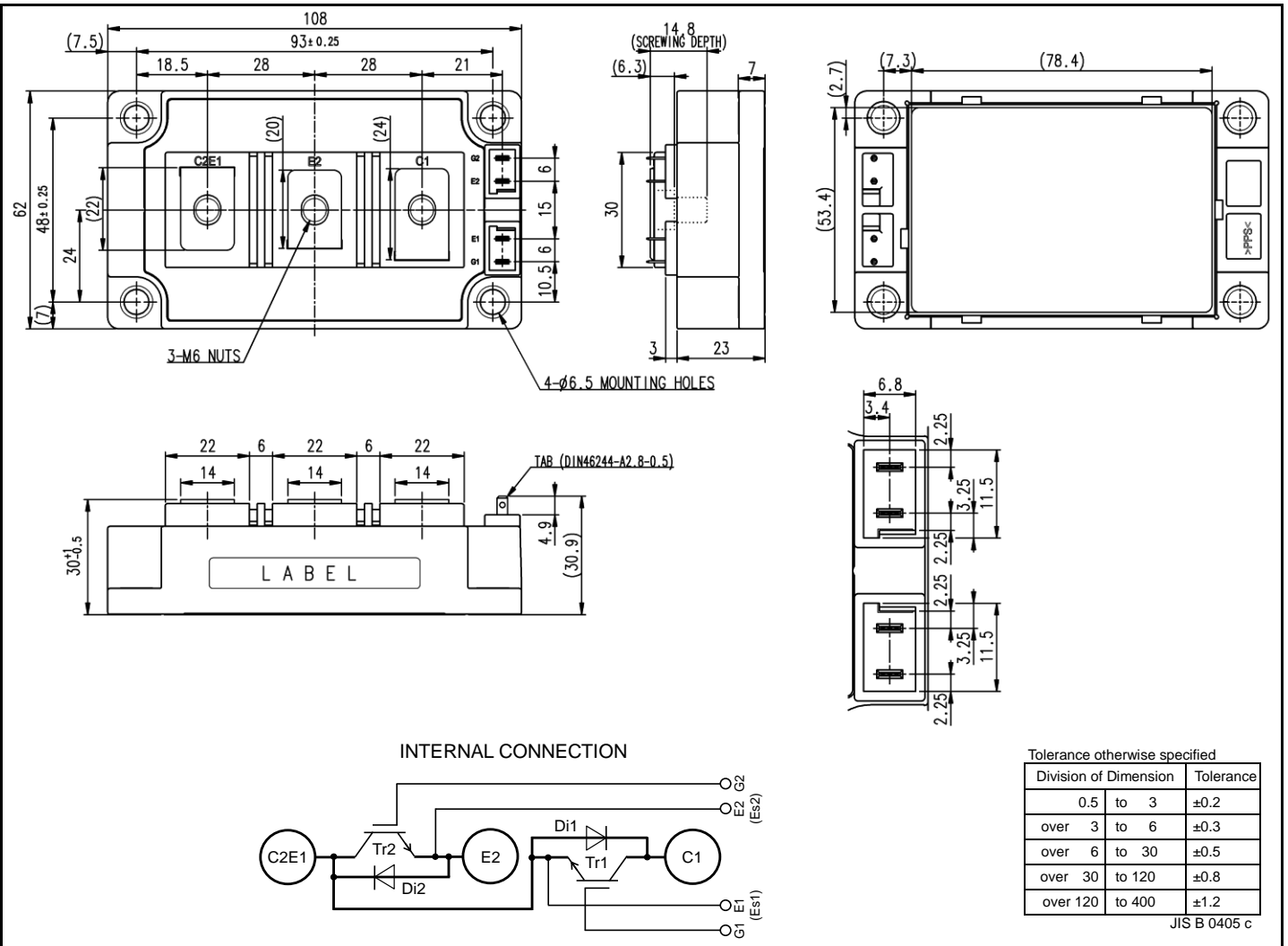
AC Motor Control, Motion/Servo Control, Power supply, etc.

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

Symbol	Item	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E short-circuited	1700	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =125 °C (Note2, 4)	400	A
I _{CRM}		Pulse, Repetitive (Note3)	800	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	4345	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 _{jmax}	Maximum junction temperature	Instantaneous event (overload)	175	°C
T _{Cmax}	Maximum case temperature	(Note4)	125	
T _{jop}	Operating junction temperature	Continuous operation (under switching)	-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	-	-	1.0	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 =40 mA, V _{CE} =10 V	5.4	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	-	2.10	2.50	V
			T _{vj} =125 °C	-	2.55	-	
			T _{vj} =150 °C	-	2.65	-	
V _{CESat} (Chip)		I _C =400 A, V _{GE} =15 V, (Note5)	T _{vj} =25 °C	-	1.95	2.35	V
			T _{vj} =125 °C	-	2.35	-	
			T _{vj} =150 °C	-	2.45	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	110	nF	
C _{oes}	Output capacitance		-	-	2.9		
C _{res}	Reverse transfer capacitance		-	-	0.9		
Q _G	Gate charge	V _{CC} =1000 V, I _C =400 A, V _{GE} =15 V	-	3.1	-	µC	
t _{d(on)}	Turn-on delay time	V _{CC} =1000 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		-	-	600		
V _{EC} (Note.1) (Terminal)	Emitter-collector voltage	I _E =400 A, G-E short-circuited, Refer to the figure of test circuit (Note5)	T _{vj} =25 °C	-	2.80	3.55	V
			T _{vj} =125 °C	-	3.05	-	
			T _{vj} =150 °C	-	3.05	-	
V _{EC} (Note.1) (Chip)		I _E =400 A, G-E short-circuited, (Note5)	T _{vj} =25 °C	-	2.65	3.35	V
			T _{vj} =125 °C	-	2.75	-	
			T _{vj} =150 °C	-	2.75	-	
t _{rr} (Note1)	Reverse recovery time	V _{CC} =1000 V, I _E =400 A, V _{GE} =±15 V,	-	-	300	ns	
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load	-	20	-	µC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =1000 V, I _C =I _E =400 A,	-	80.6	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _{vj} =150 °C,	-	97.5	-		
E _{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	50.6	-	mJ	
R _{CC+EE}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C (Note4)	-	0.3	-	mΩ	
r _g	Internal gate resistance	Per switch	-	2.0	-	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)	-	-	34.5	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	58.3	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, Thermal grease applied (Note4, 6)	-	13.3	-	K/kW
		per 1 module, PC-TIM applied (Note4, 7)	-	3.5	-	

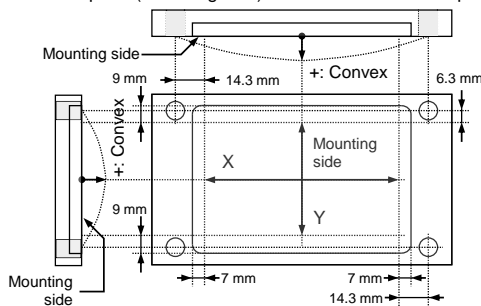
MECHANICAL CHARACTERISTICS

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	17.3	-	-	mm
		Terminal to base plate	25.3	-	-	
d_a	Clearance	Terminal to terminal	12.6	-	-	mm
		Terminal to base plate	21.8	-	-	
e_c	Flatness of base plate	On the centerline X, Y (Note8)	±0	-	+200	µm
m	mass	-	-	260	-	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.

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 $\lambda=0.9 \text{ W}/(\text{m}\cdot\text{K})/D_{(c-s)}=50 \text{ }\mu\text{m}$.
- Typical value is measured by using PC-TIM of $\lambda=3.4 \text{ W}/(\text{m}\cdot\text{K})/D_{(c-s)}=50 \text{ }\mu\text{m}$.
- The base plate (mounting side) flatness measurement points (X, Y) are shown in the following figure.



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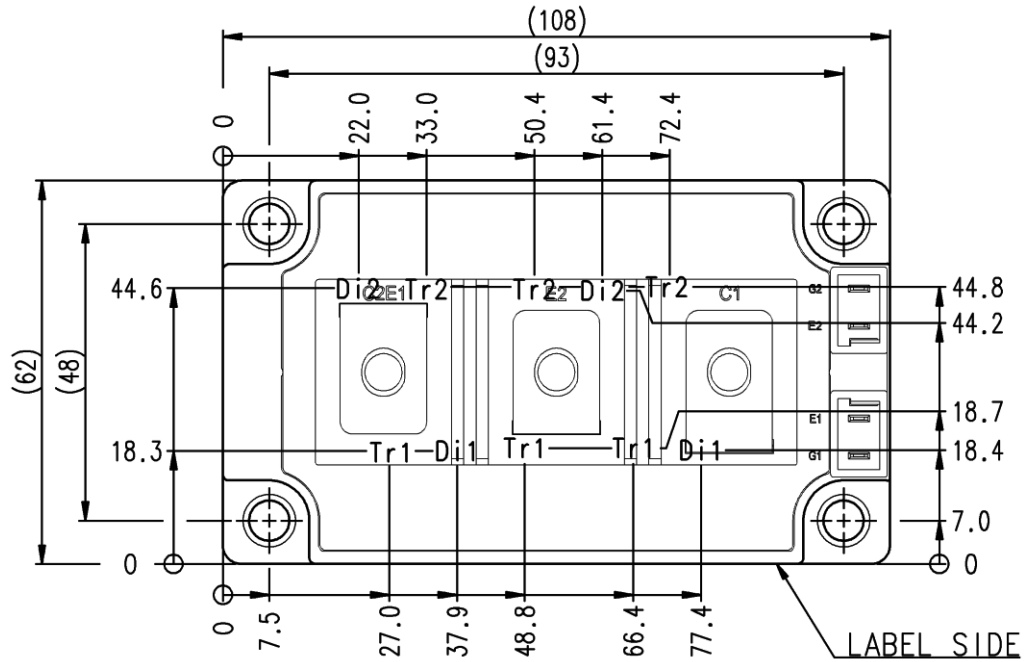
HIGH POWER SWITCHING USE
INSULATED TYPE

RECMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	1000	1200	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	-	30	Ω

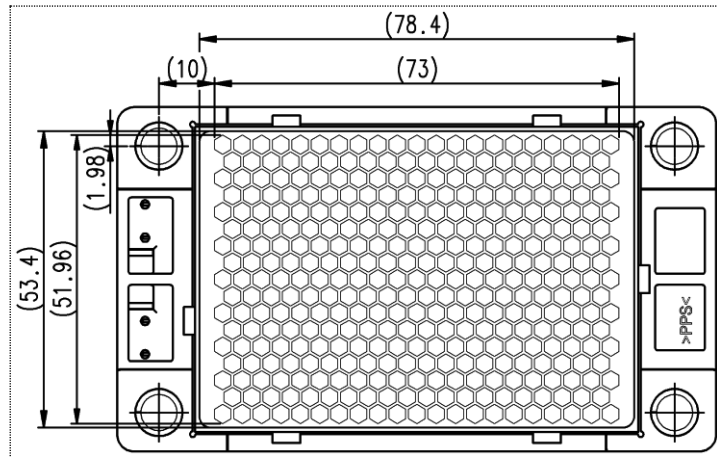
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



Tr1/Tr2: IGBT, Di1/Di2: FWD

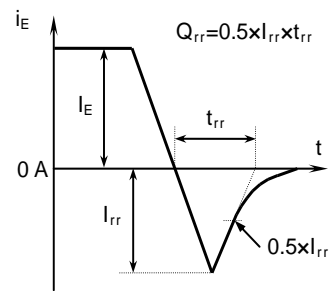
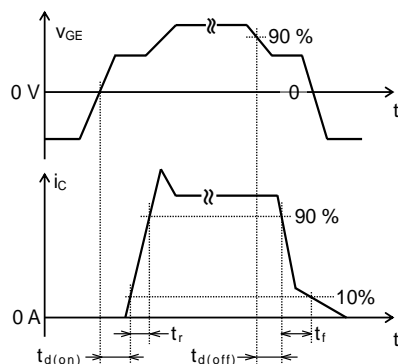
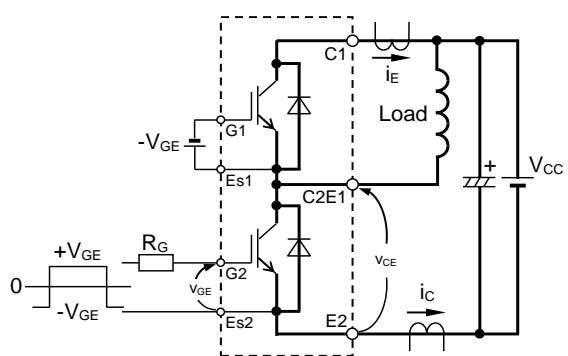
Option: PC-TIM applied baseplate outline



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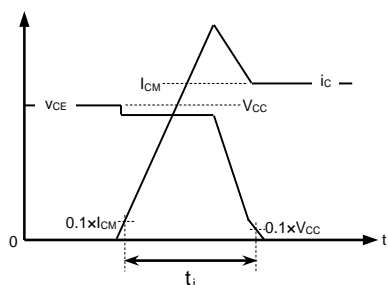
HIGH POWER SWITCHING USE
 INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

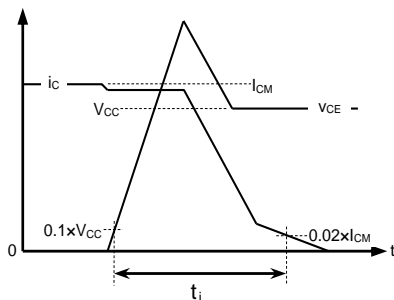


Switching characteristics test circuit and waveforms

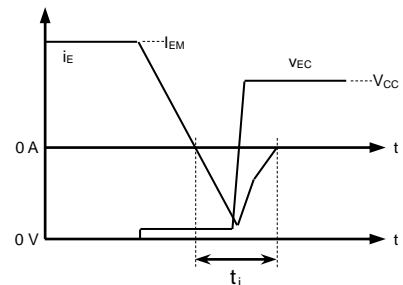
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



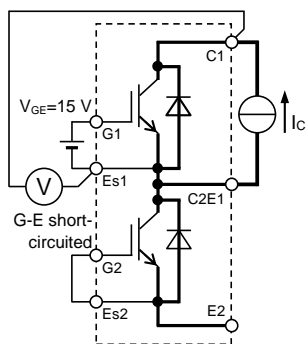
IGBT Turn-off switching energy



FWD Reverse recovery energy

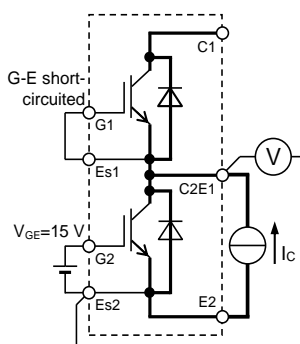
Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

TEST CIRCUIT

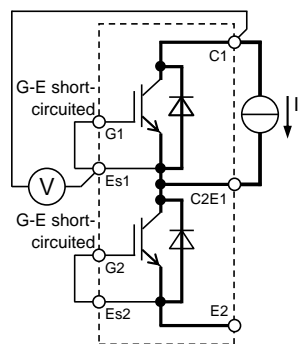


Tr1

V_{CEsat} characteristics test circuit

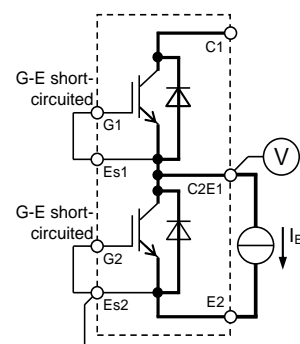


Tr2



Di1

V_{CE} characteristics test circuit



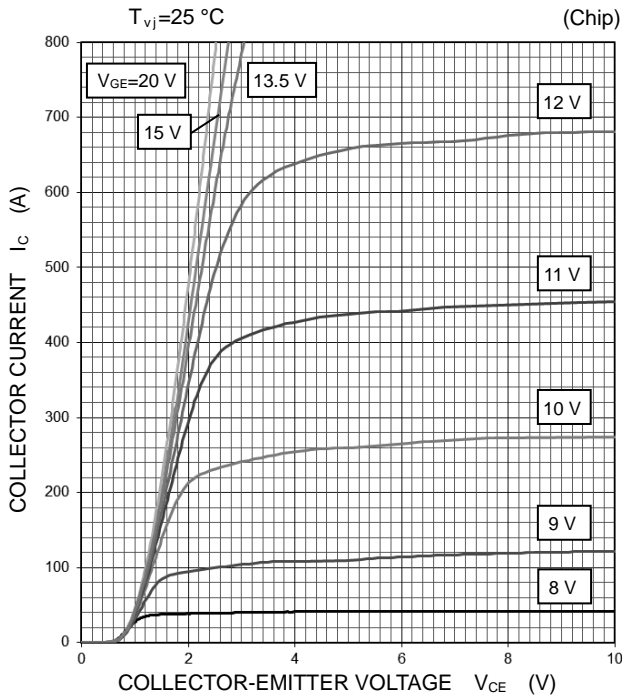
Di2

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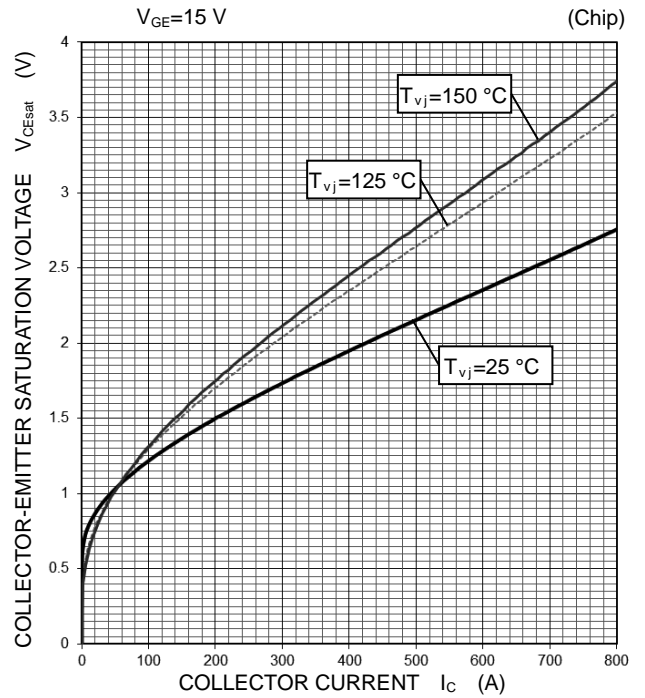
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

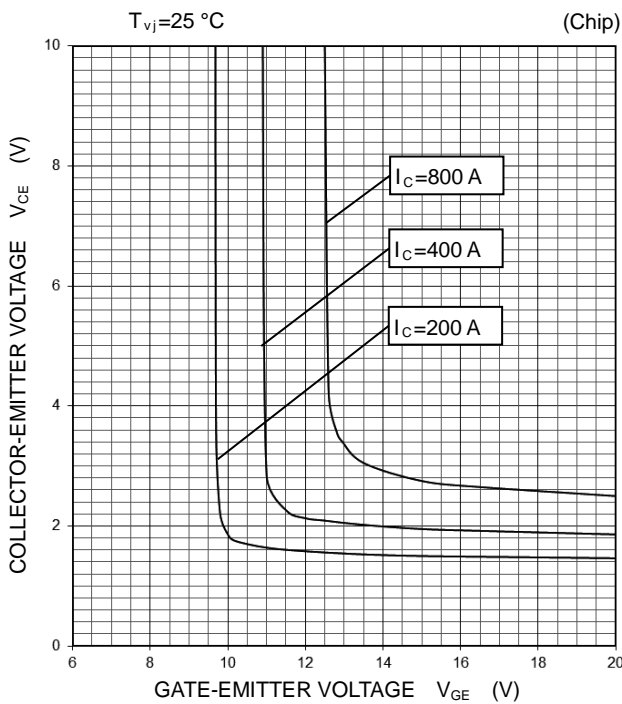
**OUTPUT CHARACTERISTICS
(TYPICAL)**



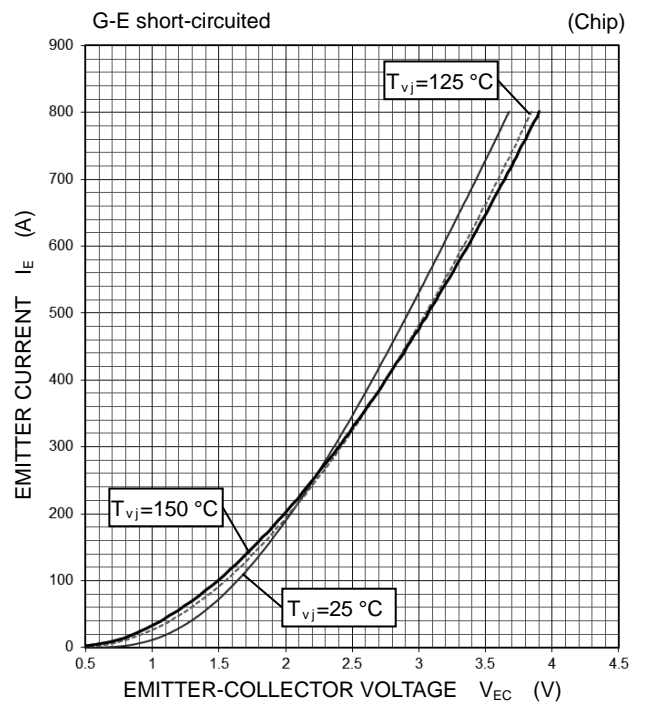
**COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS
(TYPICAL)**



**COLLECTOR-EMITTER VOLTAGE CHARACTERISTICS
(TYPICAL)**



**FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)**



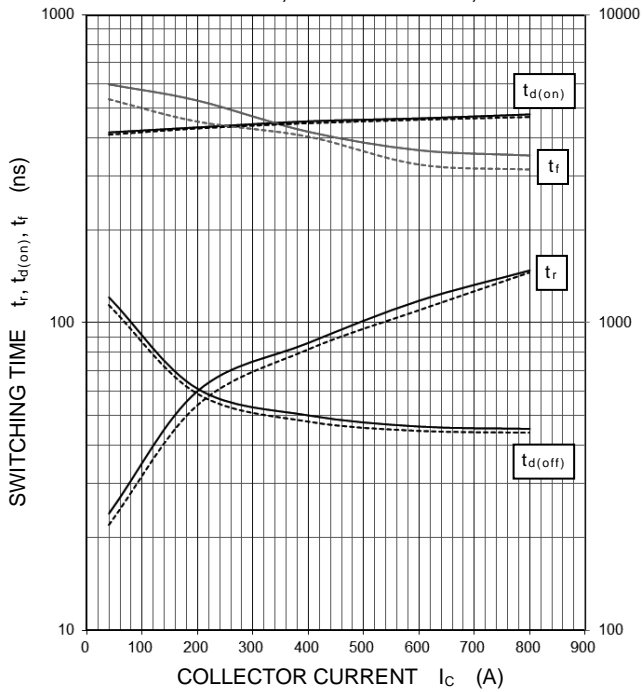
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HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

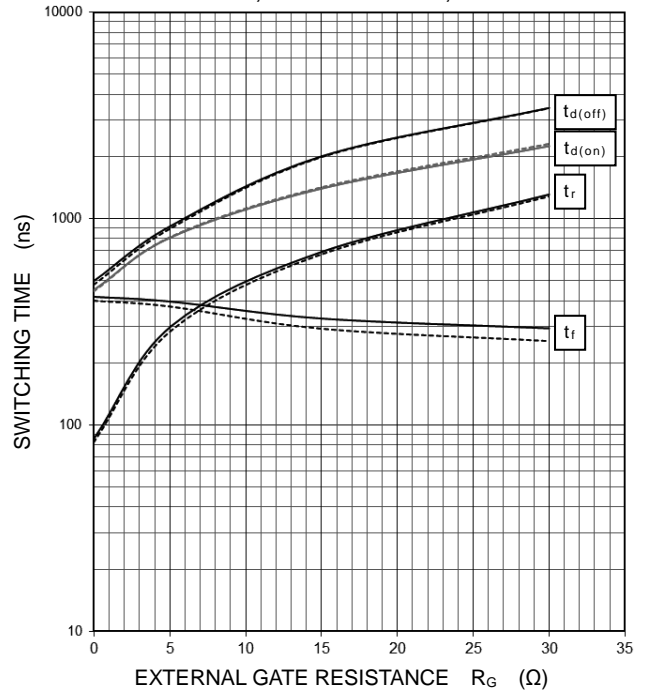
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



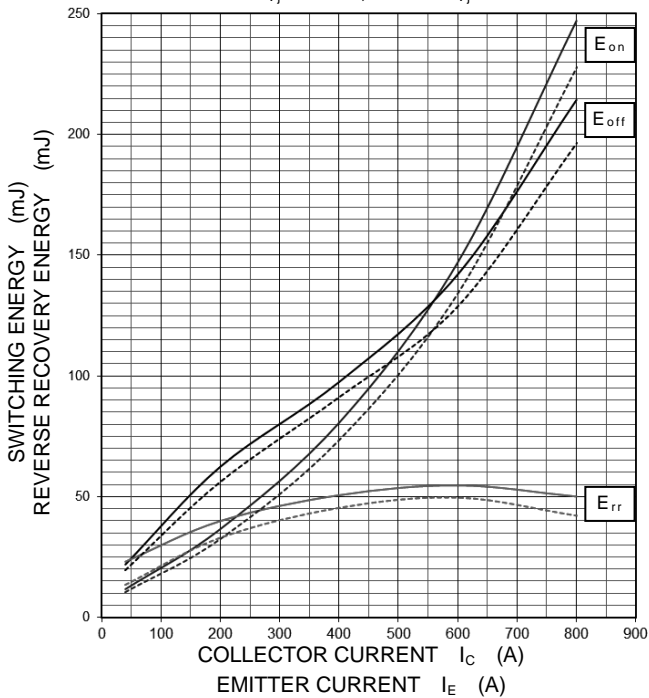
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=400\text{ A}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



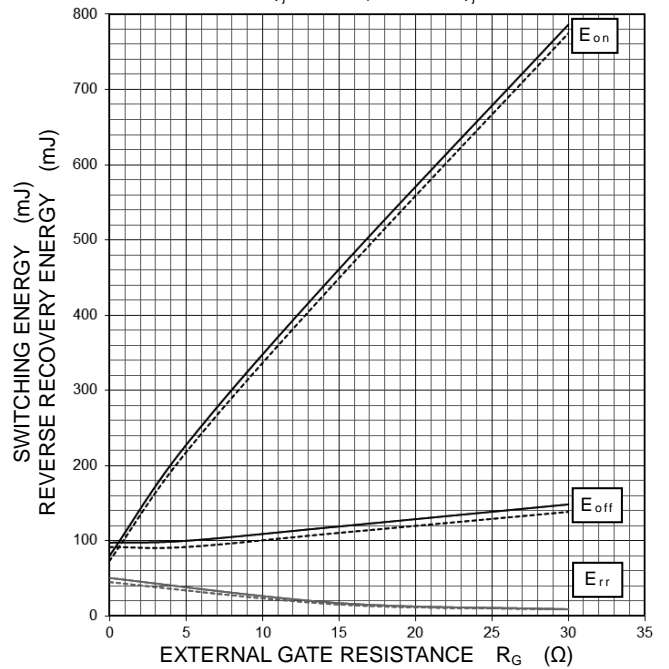
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $I_C=400\text{ A}$, INDUCTIVE LOAD
 —: $T_{vj}=150\text{ }^\circ\text{C}$, - - - -: $T_{vj}=125\text{ }^\circ\text{C}$

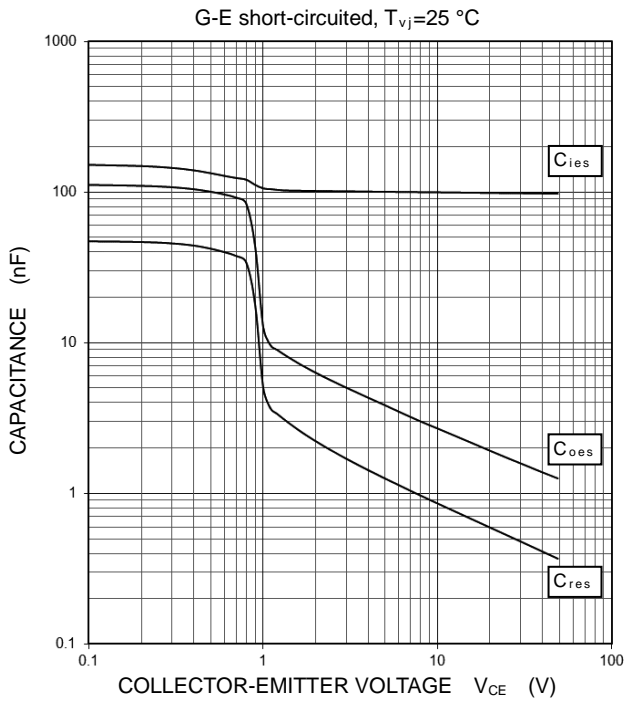


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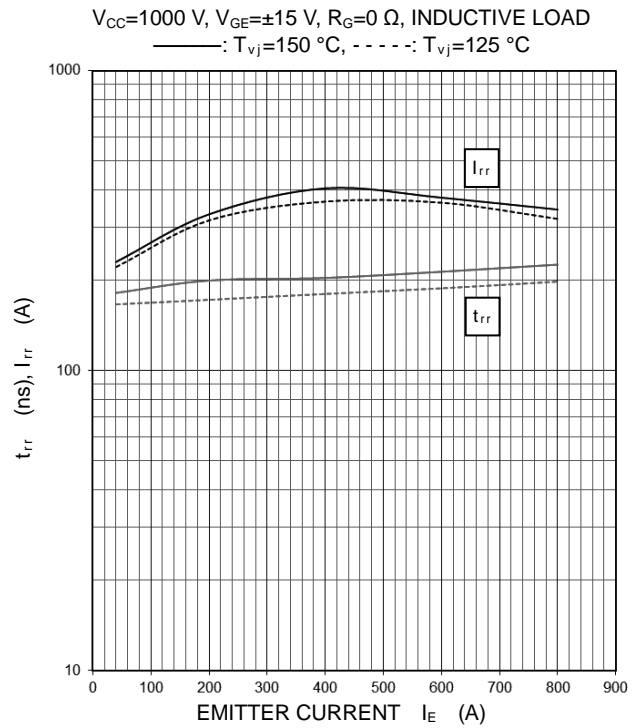
HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

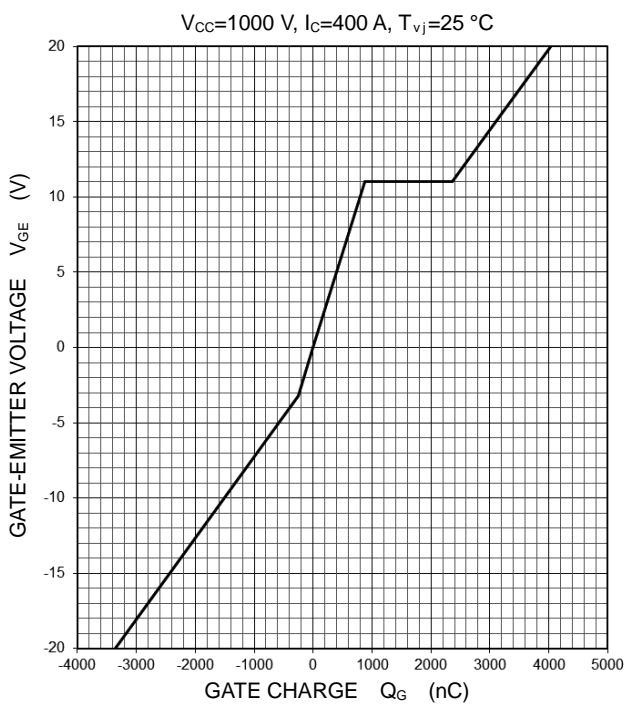
CAPACITANCE CHARACTERISTICS (TYPICAL)



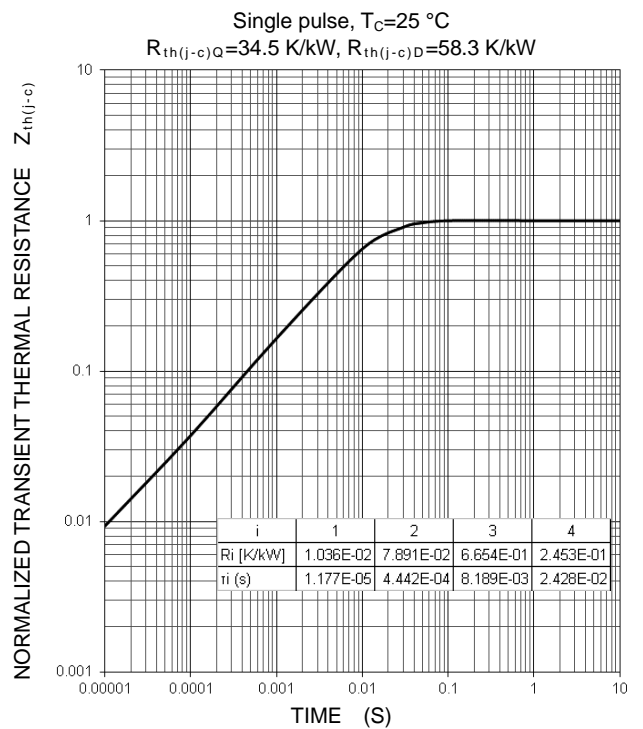
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



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

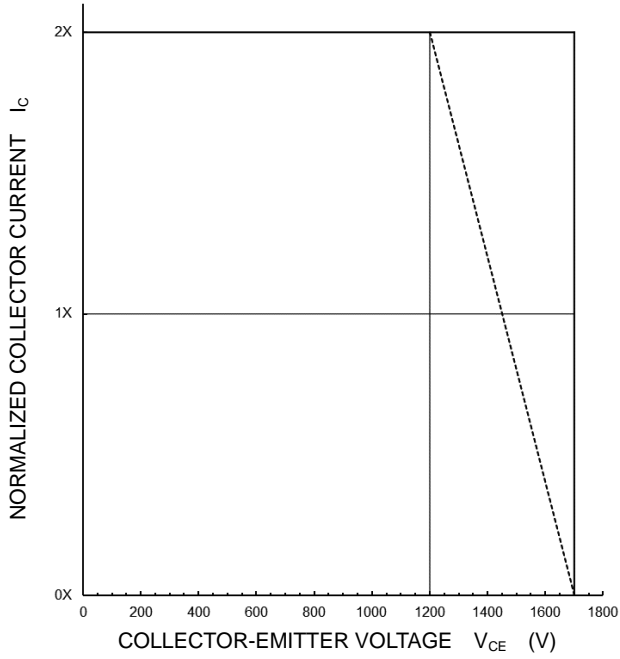
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HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

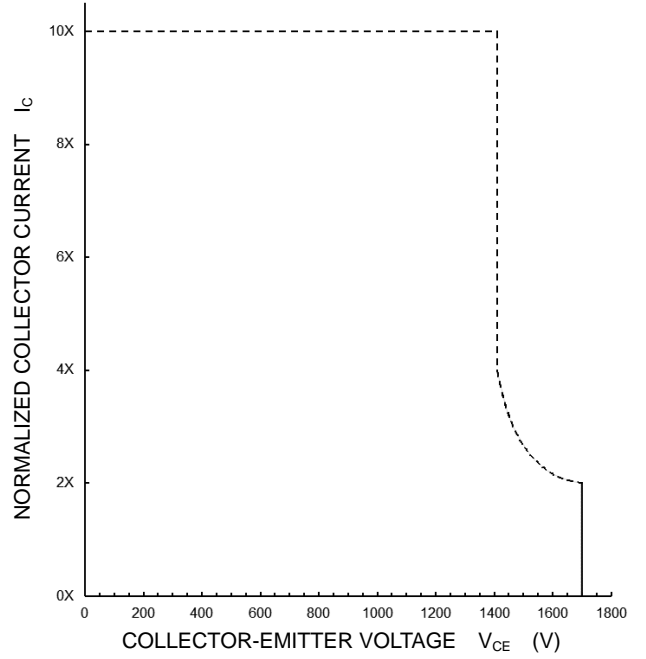
**TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)**

$V_{CC} \leq 1200 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0 \sim 30 \ \Omega$,
——: $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$ (Normal load operations (Continuous))
- - - -: $T_{vj} = 175 \text{ }^\circ\text{C}$ (Unusual load operations (Limited period))



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

$V_{CC} \leq 1200 \text{ V}$, $V_{GE} = \pm 15 \text{ V}$, $R_G = 0 \sim 30 \ \Omega$,
 $T_{vj} = 25 \sim 150 \text{ }^\circ\text{C}$, $t_W \leq 8 \ \mu\text{s}$, Non-Repetitive



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