

<IGBT Modules>

CM400DU-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

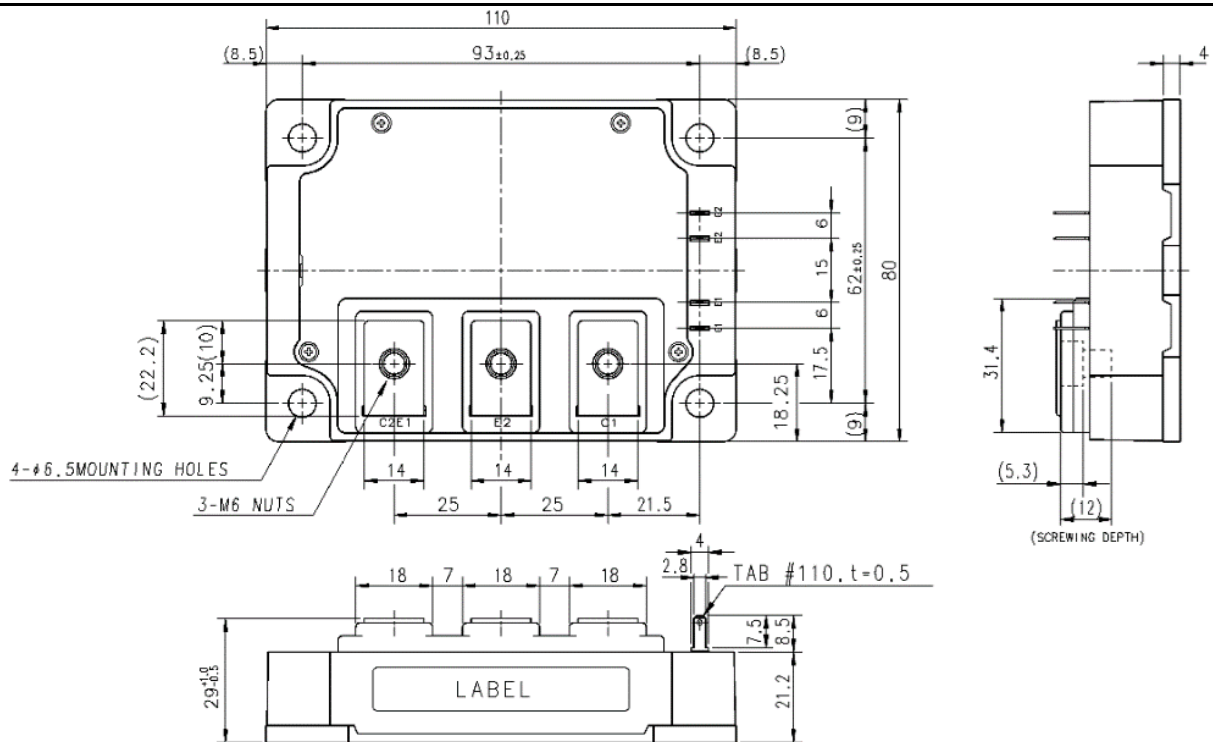
Medical equipment, Welder, Power supply, etc.

OPTION (Below options are available.)

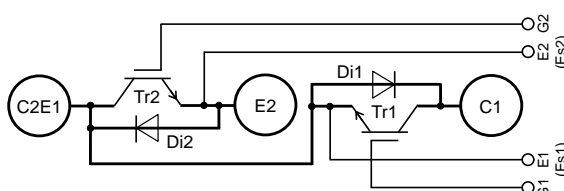
- V_{CESat} selection for parallel connection

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_{vj}=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Rating	Unit
V _{CES}	Collector-emitter voltage	G-E short-circuited	1200	V
V _{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I _C	Collector current	DC, T _C =25 °C (Note2, 4)	400	A
I _{CRM}		Pulse, Repetitive (Note3)	800	
P _{tot}	Total power dissipation	T _C =25 °C (Note2, 4)	1970	W
I _E (Note1)	Emitter current	DC, T _C =25 °C (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) (Note 8)	175	°C
T _{Cmax}	Maximum case temperature	(Note4, 8)	125	
T _{vjop}	Operating junction temperature	Continuous operation (under switching) (Note 8)	-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	T _{vj} =25 °C	-	-	1.0	mA
			T _{vj} =150 °C	-	-	75.0	
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	5.40	6.00	6.60	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	-	4.40	5.10	V
			T _{vj} =125 °C	-	4.50	-	
			T _{vj} =150 °C	-	4.40	-	
V _{CESat} (Chip)	Collector-emitter saturation voltage	I _C =400 A, V _{GE} =15 V, (Note5)	T _{vj} =25 °C	-	4.35	5.05	V
			T _{vj} =125 °C	-	4.45	-	
			T _{vj} =150 °C	-	4.35	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	60.0	nF	
C _{oes}	Output capacitance		-	-	5.0		
C _{res}	Reverse transfer capacitance		-	-	1.0		
Q _G	Gate charge	V _{CC} =600 V, I _C =400 A, V _{GE} =15 V	-	1.0	-	µC	
t _{d(on)}	Turn-on delay time	V _{CC} =600 V, I _C =400 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	300	ns	
t _r	Rise time		-	-	100		
t _{d(off)}	Turn-off delay time		-	-	500		
t _f	Fall time		-	-	150		
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	-	2.40	2.80	V
			T _{vj} =125 °C	-	2.55	-	
			T _{vj} =150 °C	-	2.50	-	
V _{EC} (Note.1) (Chip)	Emitter-collector voltage	I _E =400 A, G-E short-circuited, (Note5)	T _{vj} =25 °C	-	2.35	2.75	V
			T _{vj} =125 °C	-	2.50	-	
			T _{vj} =150 °C	-	2.45	-	
t _{rr} (Note1)	Reverse recovery time	V _{CC} =600 V, I _E =400 A, V _{GE} =±15 V, R _G =0 Ω, Inductive load	-	-	250	ns	
Q _{rr} (Note1)	Reverse recovery charge	R _G =0 Ω, Inductive load	-	26	-	µC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =600 V, I _C =I _E =400 A, V _{GE} =±15 V, R _G =0 Ω, T _{vj} =150 °C,	-	10.0	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =0 Ω, T _{vj} =150 °C,	-	20.0	-		
E _{rr} (Note1)	Reverse recovery energy per pulse	Inductive load	-	25.0	-	mJ	
R _{CC+EE'}	Internal lead resistance	Main terminals-chip, per switch, T _C =25 °C (Note4)	-	0.2	-	mΩ	
r _g	Internal gate resistance	Per switch	-	0.8	-	Ω	

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HIGH POWER SWITCHING USE
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THERMAL RESISTANCE CHARACTERISTICS

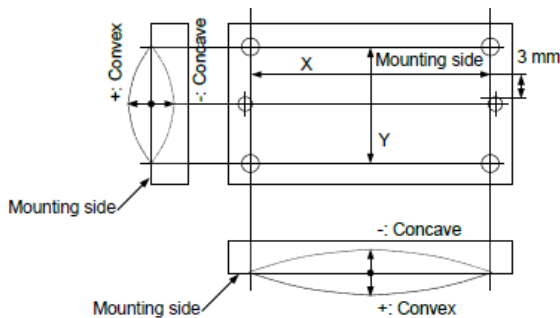
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, per Inverter IGBT (Note4)	-	-	76	K/kW
$R_{th(j-c)D}$		Junction to case, per Inverter FWD (Note4)	-	-	140	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, Thermal grease applied (Note4, 6, 8) 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 torque	Mounting to heat sink M 6 screw	3.5	4.0	4.5	N·m
d_s	Creepage distance	Terminal to terminal	17.0	-	-	mm
		Terminal to base plate	42.6	-	-	
d_a	Clearance	Terminal to terminal	11.0	-	-	mm
		Terminal to base plate	28.1	-	-	
e_c	Flatness of base plate	On the centerline X,Y (Note7)	-50	-	+100	μ m
m	mass	-	-	580	-	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 $\lambda=0.9$ W/(m·K)/ $D_{(C-S)}=50$ μ 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.

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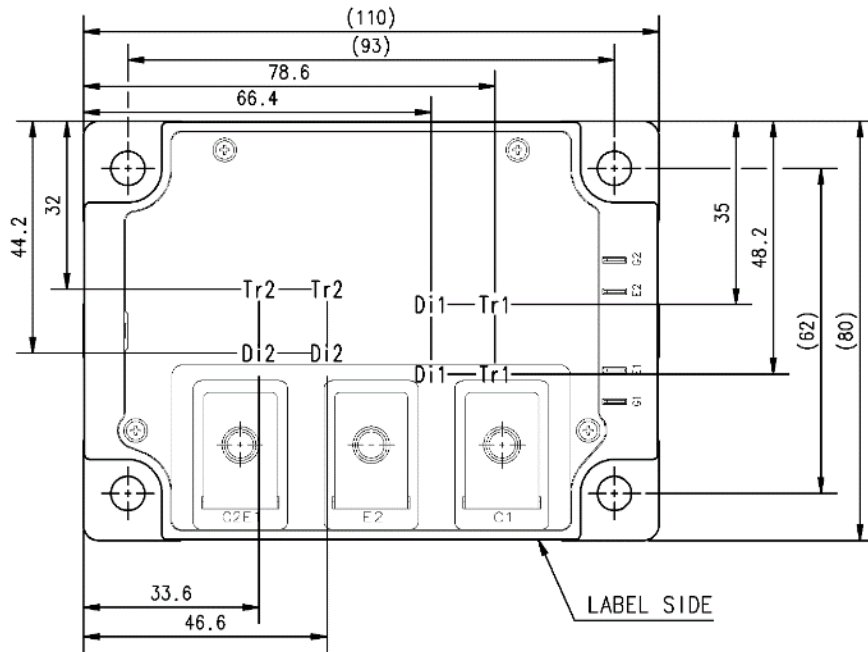
HIGH POWER SWITCHING USE
INSULATED TYPE

RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2 terminals	-	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	Ω
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: $\pm 1\text{ mm}$

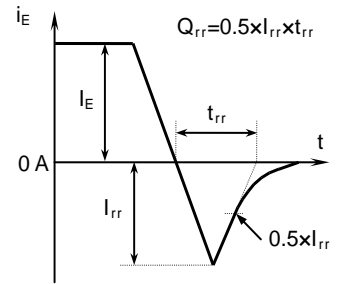
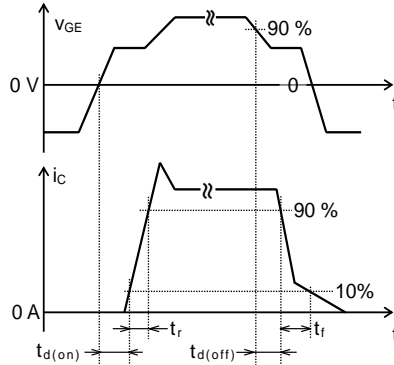
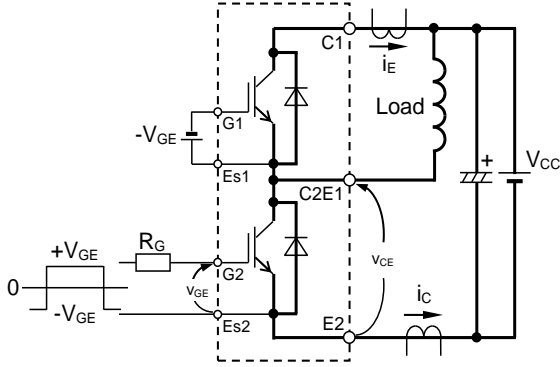


Tr1/Tr2: IGBT, Di1/Di2: FWD

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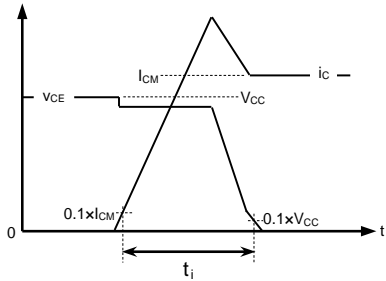
HIGH POWER SWITCHING USE
 INSULATED TYPE

TEST CIRCUIT AND WAVEFORMS

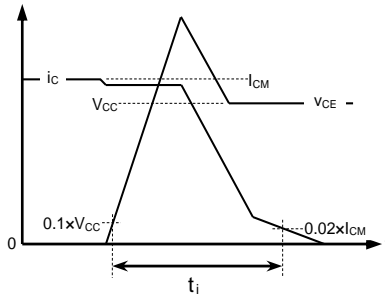


Switching characteristics test circuit and waveforms

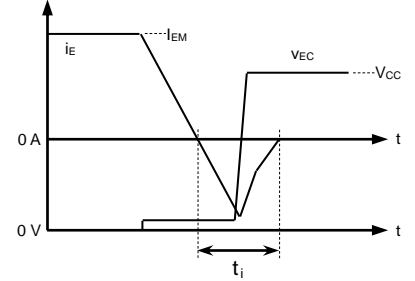
t_{rr} , Q_{rr} characteristics test waveform



IGBT Turn-on switching energy



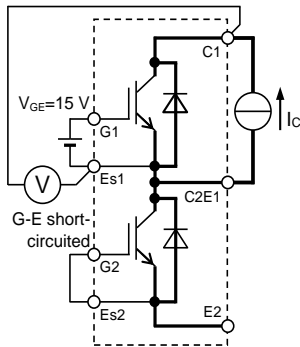
IGBT Turn-off switching energy



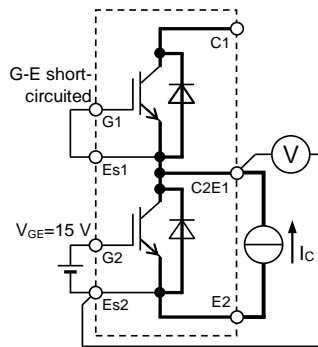
FWD Reverse recovery energy

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

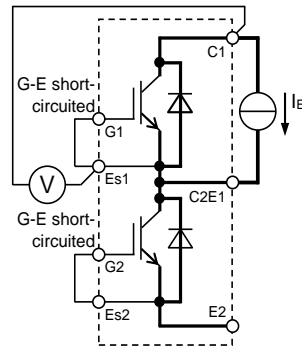
TEST CIRCUIT



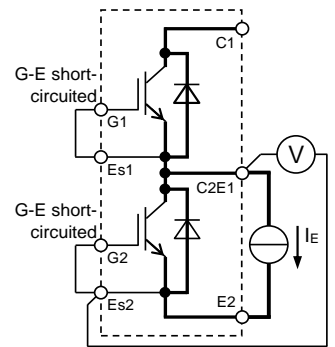
Tr1
 V_{CEsat} characteristics test circuit



Tr2



Di1

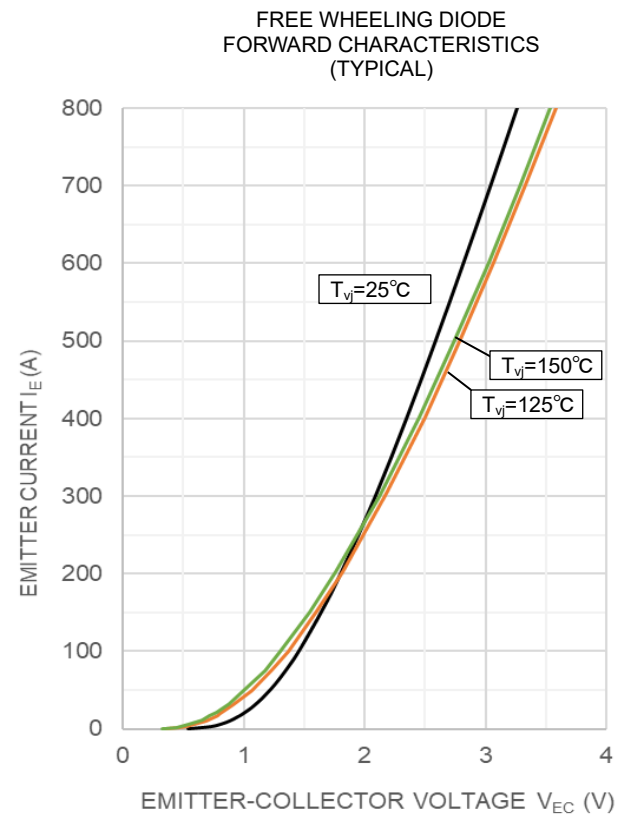
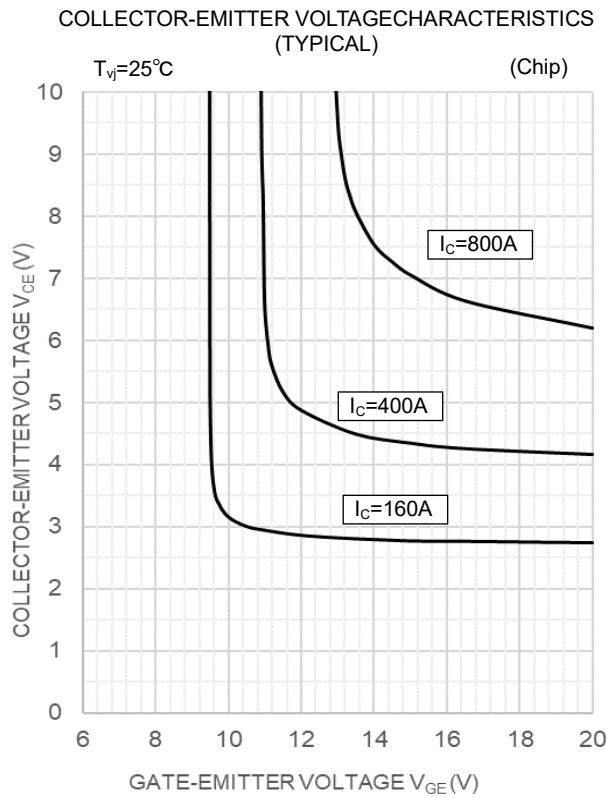
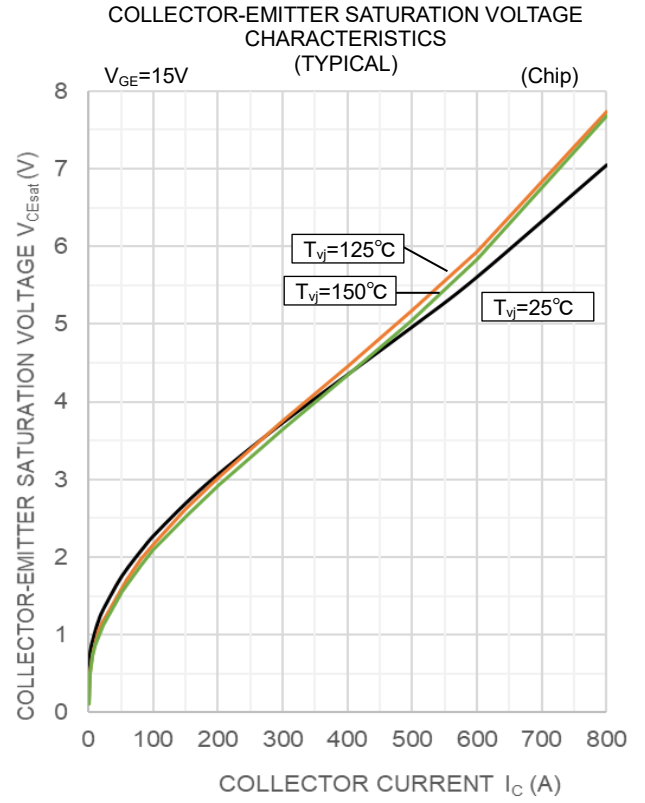
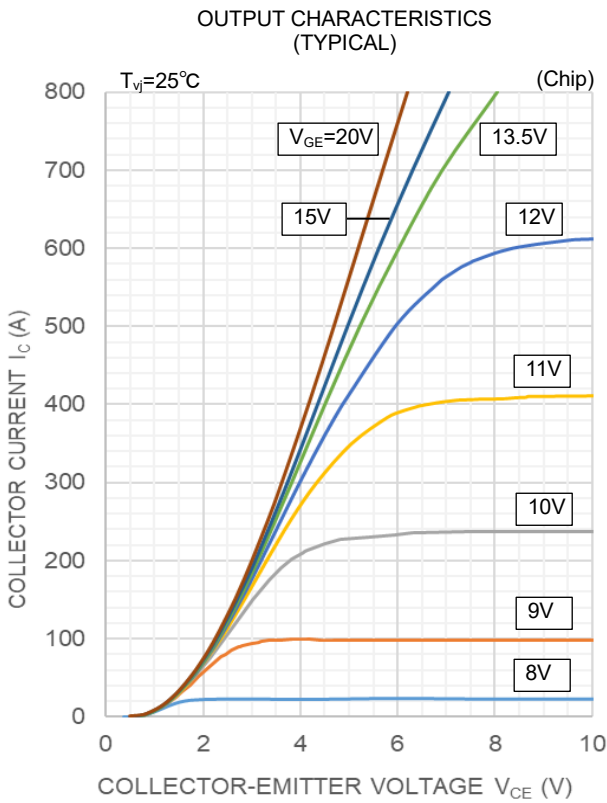


Di2
 V_{EC} characteristics test circuit

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HIGH POWER SWITCHING USE
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PERFORMANCE CURVES



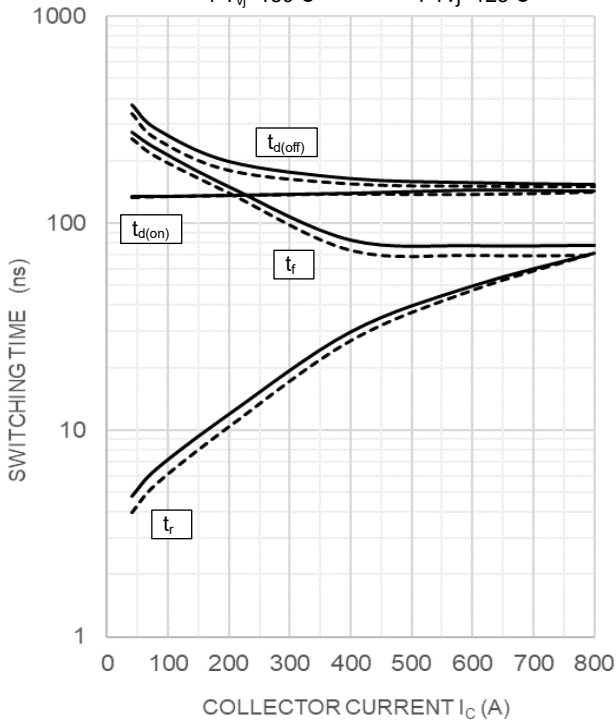
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HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

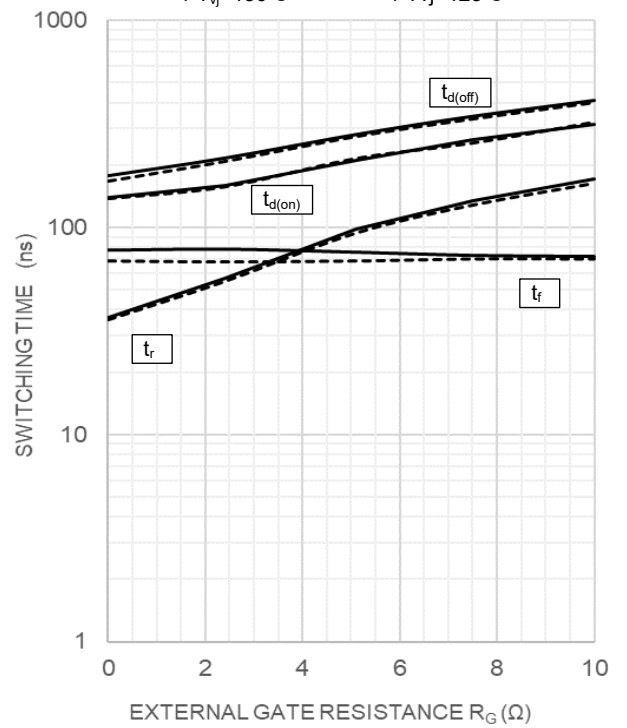
HALF-BRIDGE SWITCHING CHARACTERISTICS
 (TYPICAL)

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



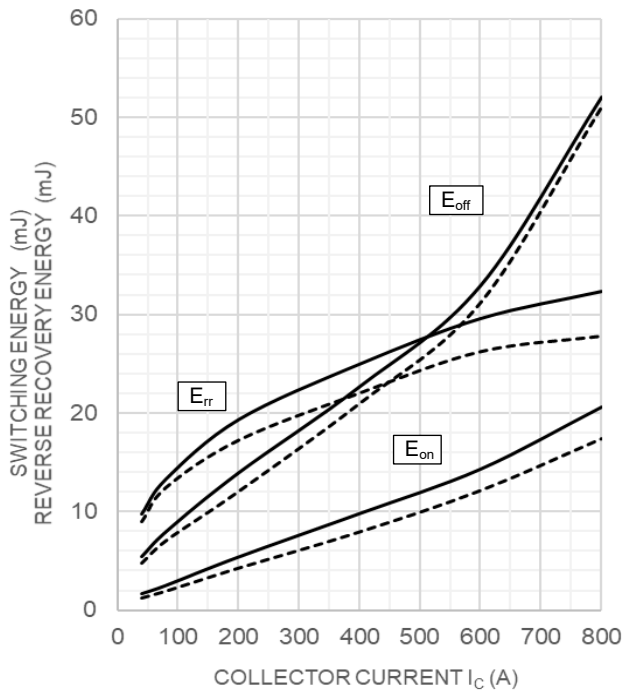
HALF-BRIDGE SWITCHING CHARACTERISTICS
 (TYPICAL)

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



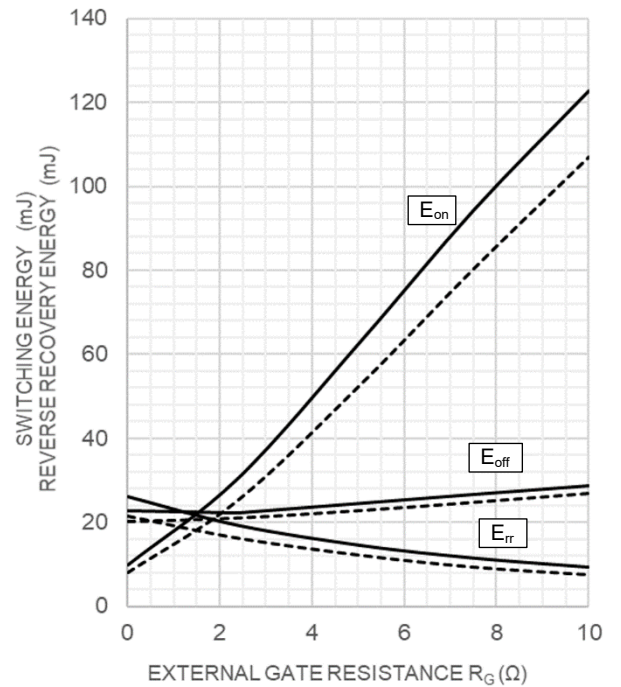
HALF-BRIDGE SWITCHING CHARACTERISTICS
 (TYPICAL)

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

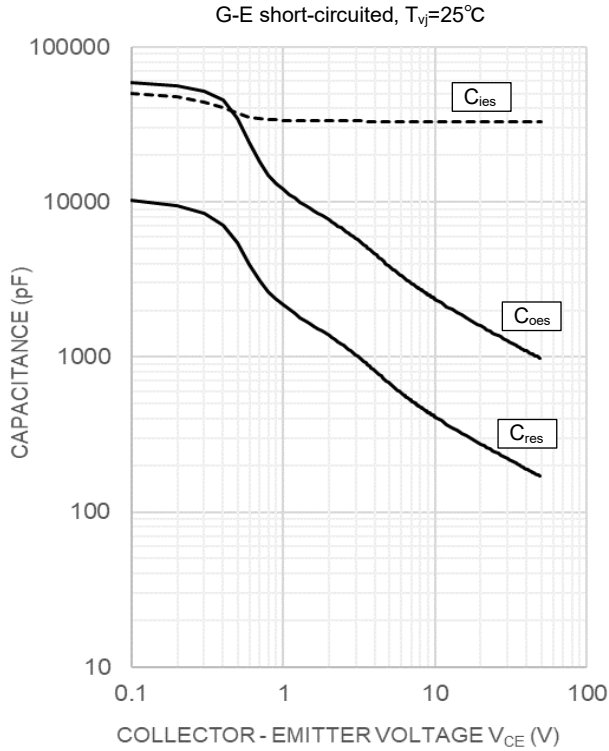


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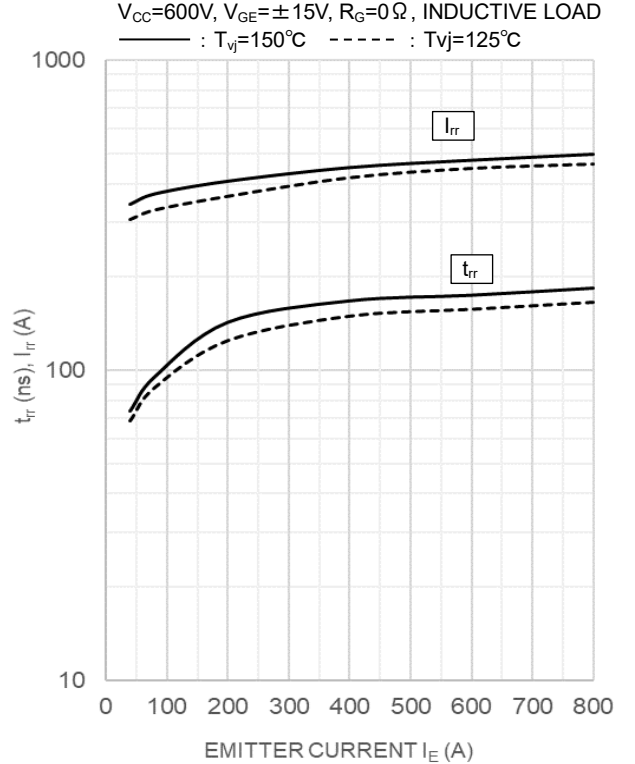
HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

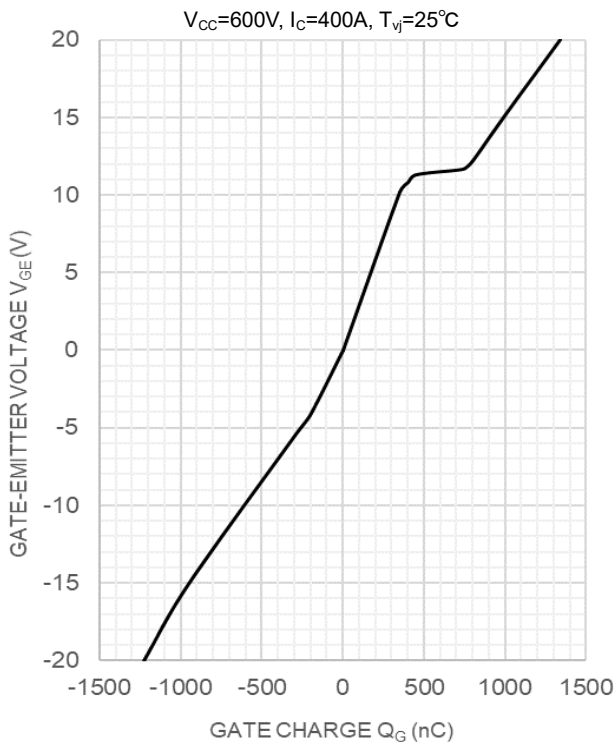
CAPACITANCE CHARACTERISTICS
 (TYPICAL)



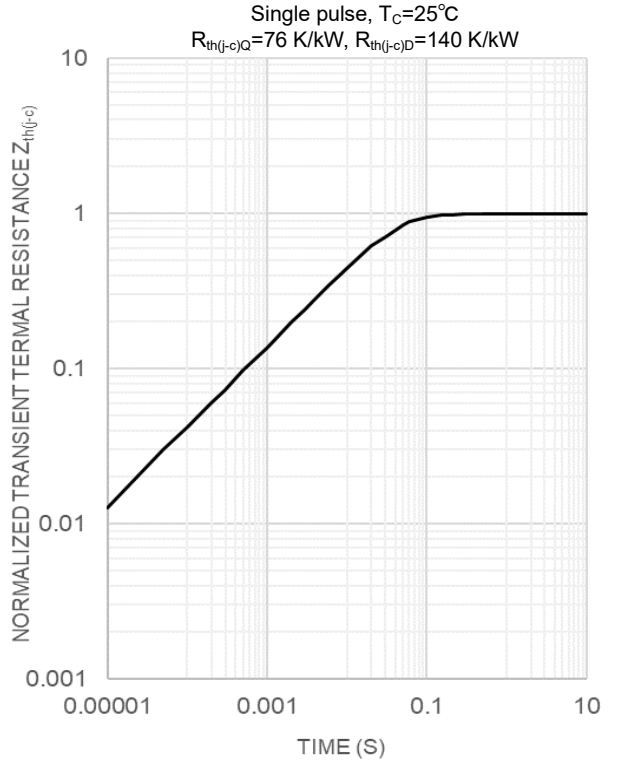
FREE WHEELING DIODE
 REVERSE RECOVERY CHARACTERISTICS
 (TYPICAL)



GATE CHARGE CHARACTERISTICS
 (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
 (MAXIMUM)



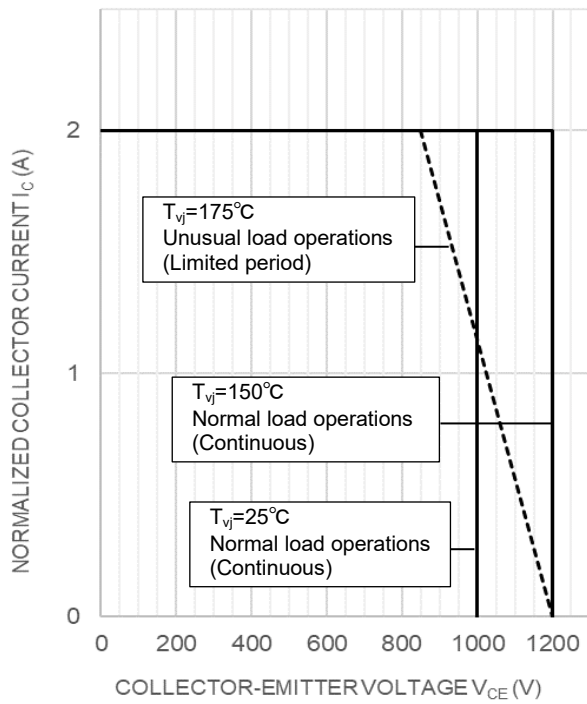
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HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

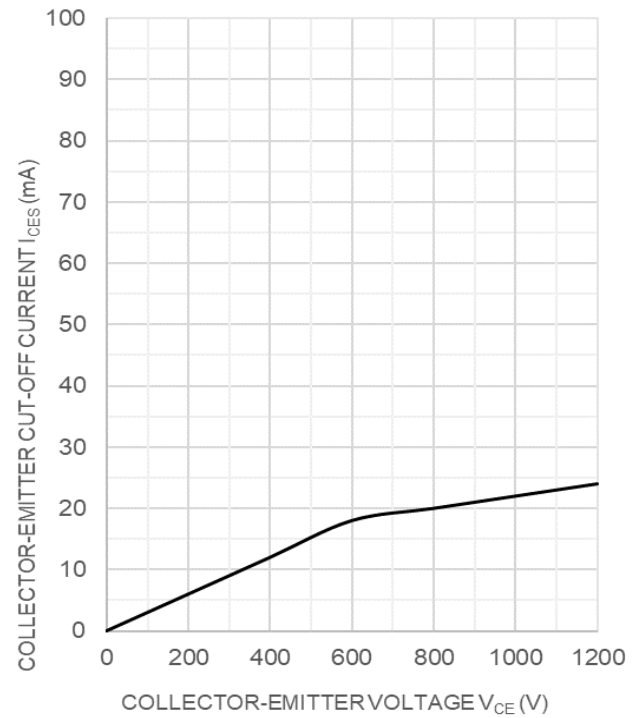
TURN-OFF SWITCHING SAFE OPERATING AREA
(REVERSE BIAS SAFE OPERATING AREA)
(MAXIMUM)

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



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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