

< IGBT MODULES >

CM400DY-34A

HIGH POWER SWITCHING USE
INSULATED TYPE

ABSOLUTE MAXIMUM RATINGS (T_J=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 =107 °C (Note.2, 4)	400	A
I _{CRM}		Pulse, Repetitive (Note.3)	800	
P _{tot}	Total power dissipation	T _C =25 °C (Note.2, 4)	3780	W
I _E (Note.1)	Emitter current	T _C =25 °C (Note.2, 4)	400	A
I _{ERM} (Note.1)		Pulse, Repetitive (Note.3)	800	
T _J	Junction temperature	-	-40 ~ +150	°C
T _{stg}	Storage temperature	-	-40 ~ +125	
V _{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	3500	V

ELECTRICAL CHARACTERISTICS (T_J=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	-	-	2.0	µA	
V _{GE(th)}	Gate-emitter threshold voltage	I _C =40 mA, V _{CE} =10 V	5.5	7.0	8.5	V	
V _{CEsat}	Collector-emitter saturation voltage	I _C =400 A (Note.5), V _{GE} =15 V	T _J =25 °C	-	2.2	2.8	V
			T _J =125 °C	-	2.45	-	
C _{ies}	Input capacitance	V _{CE} =10 V, G-E short-circuited	-	-	98.8	nF	
C _{oes}	Output capacitance		-	-	11.2		
C _{res}	Reverse transfer capacitance		-	-	2.1		
Q _G	Gate charge	V _{CC} =1000 V, I _C =400 A, V _{GE} =15 V	-	2670	-	nC	
t _{d(on)}	Turn-on delay time	V _{CC} =1000 V, I _C =400 A, V _{GE} =±15 V, R _G =1.2 Ω, Inductive load	-	-	950	ns	
t _r	Rise time		-	-	300		
t _{d(off)}	Turn-off delay time		-	-	1000		
t _f	Fall time		-	-	350		
V _{EC} (Note.1)	Emitter-collector voltage	I _E =400 A (Note.5), G-E short-circuited	-	2.3	3.0	V	
t _{rr} (Note.1)	Reverse recovery time	V _{CC} =1000 V, I _E =400 A, V _{GE} =±15 V,	-	-	450	ns	
Q _{rr} (Note.1)	Reverse recovery charge	R _G =1.2 Ω, Inductive load	-	40	-	µC	
E _{on}	Turn-on switching energy per pulse	V _{CC} =1000 V, I _C =I _E =400 A,	-	197.3	-	mJ	
E _{off}	Turn-off switching energy per pulse	V _{GE} =±15 V, R _G =1.2 Ω, T _J =125 °C,	-	117.9	-		
E _{rr} (Note.1)	Reverse recovery energy per pulse	Inductive load	-	98.5	-	mJ	
r _g	Internal gate resistance	Per switch, T _c =25 °C	-	3.7	-	Ω	

THERMAL RESISTANCE CHARACTERISTICS

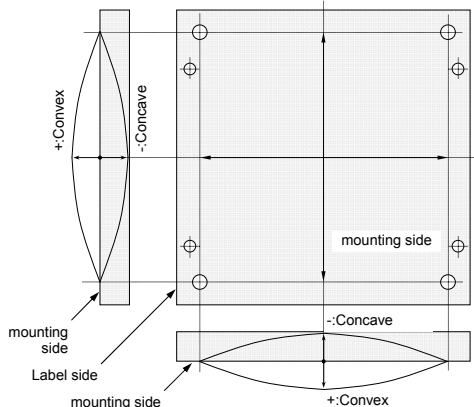
Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance (Note.2)	Junction to case, per IGBT	-	-	33	K/kW
R _{th(j-c)D}		Junction to case, per FWDi	-	-	55	
R _{th(c-s)}	Contact thermal resistance (Note.2)	Case to heat sink, per 1/2 module, Thermal grease applied (Note.6)	-	19	-	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M _t	Mounting torque	Main terminals M 8 screw	8.8	9.7	10.8	N·m
		Auxiliary (G, E) terminals M 4 screw	1.3	1.5	1.7	
M _s	Mounting to heat sink	M 6 screw	3.5	4.0	4.5	N·m
m	Weight	-	-	1200	-	g
e _c	Flatness of base plate	On the centerline X, Y (Note.7)	-100	-	+100	µm

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- Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).
 2. 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.
 The heat sink thermal resistance should measure just under the chips.
 3. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.
 4. Junction temperature (T_j) should not increase beyond T_{jmax} rating.
 5. Pulse width and repetition rate should be such as to cause negligible temperature rise. Refer to the figure of test circuit.
 6. Typical value is measured by using thermally conductive grease of $\lambda=0.9 \text{ W/(m}\cdot\text{K)}$.
 7. Base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.

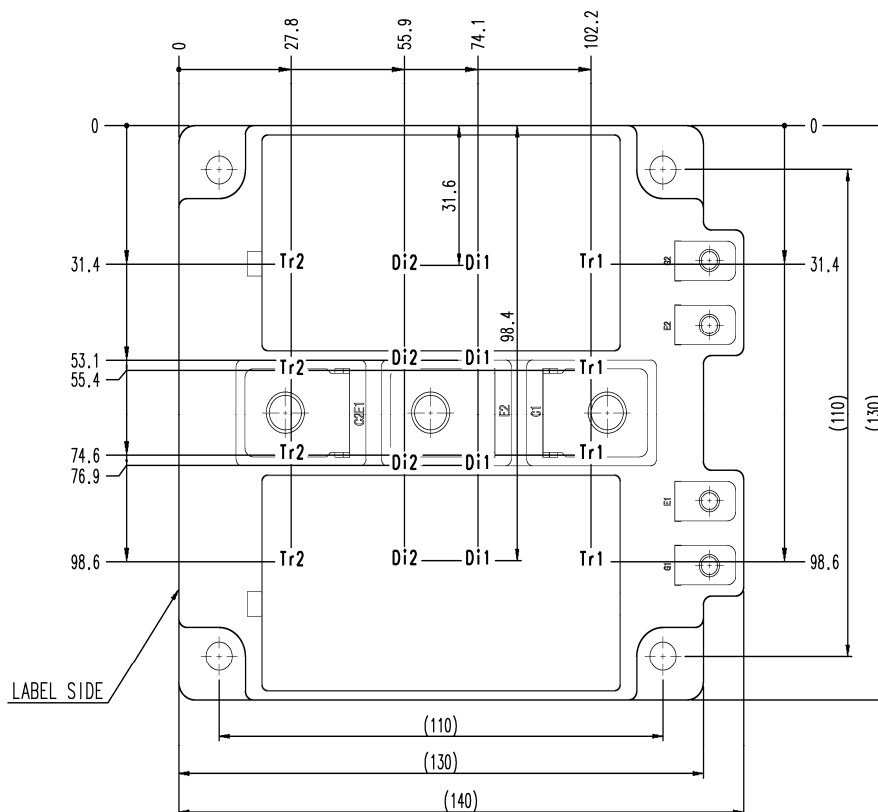


RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2	-	1000	1100	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	1.2	-	12	Ω

CHIP LOCATION (Top view)

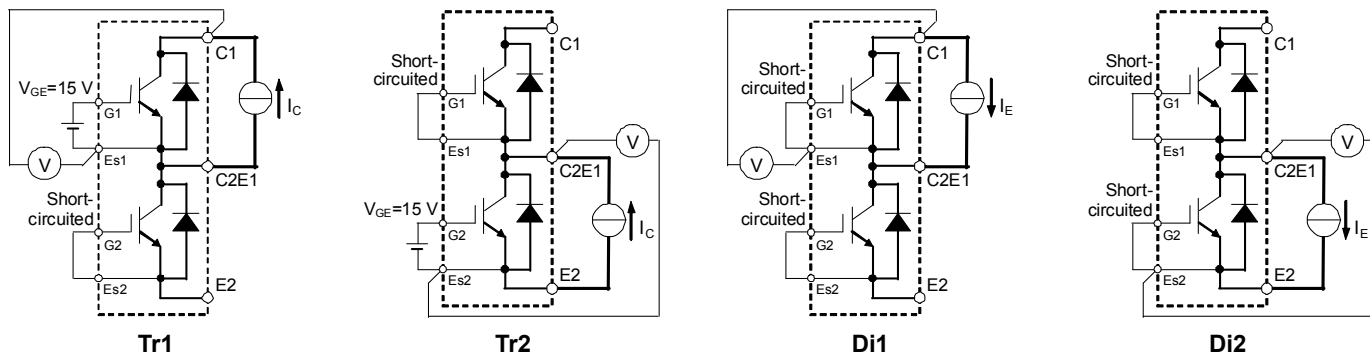
Dimension in mm, tolerance: $\pm 1 \text{ mm}$



Tr1/Tr2: IGBT, Di1/Di2: FWDi

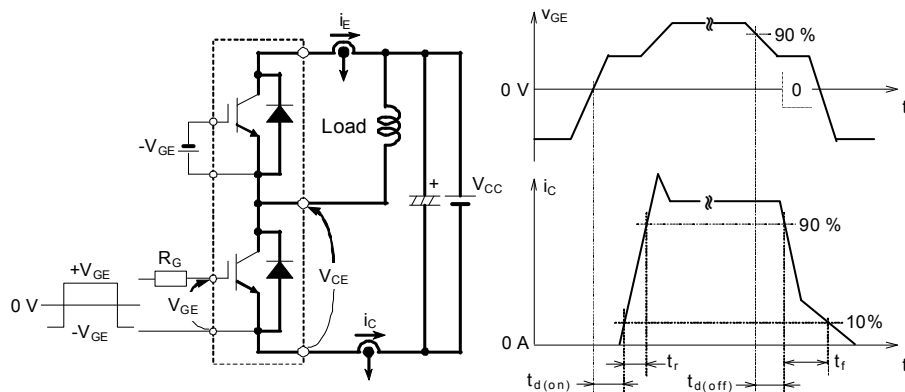
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TEST CIRCUIT AND WAVEFORMS



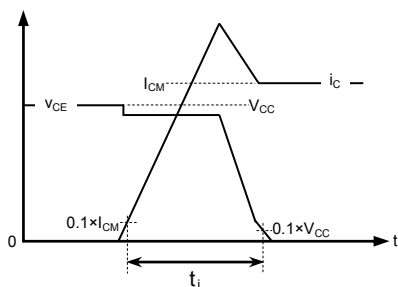
V_{CEsat} test circuit

V_{EC} test circuit

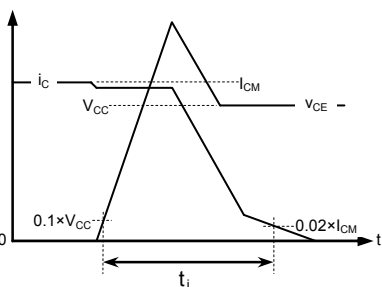


Switching characteristics test circuit and waveforms

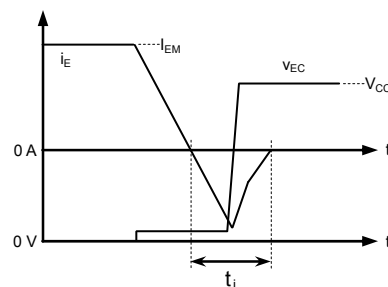
t_{rr}, Q_{rr} test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy



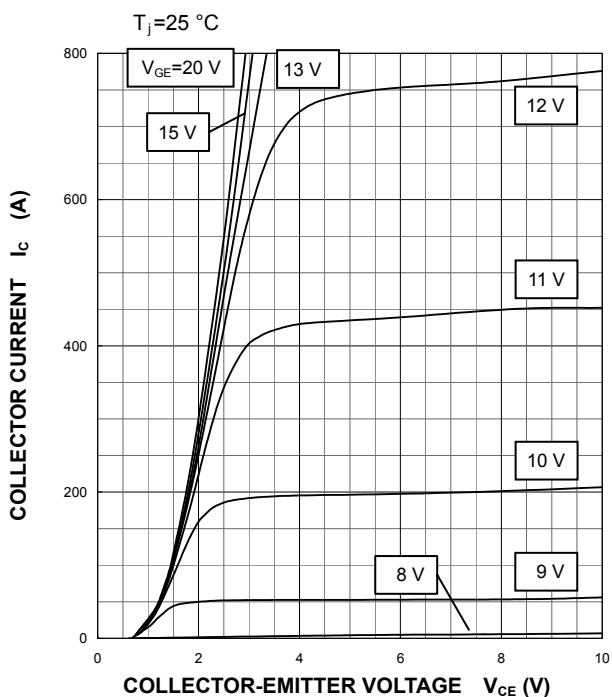
FWDi Reverse recovery energy

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

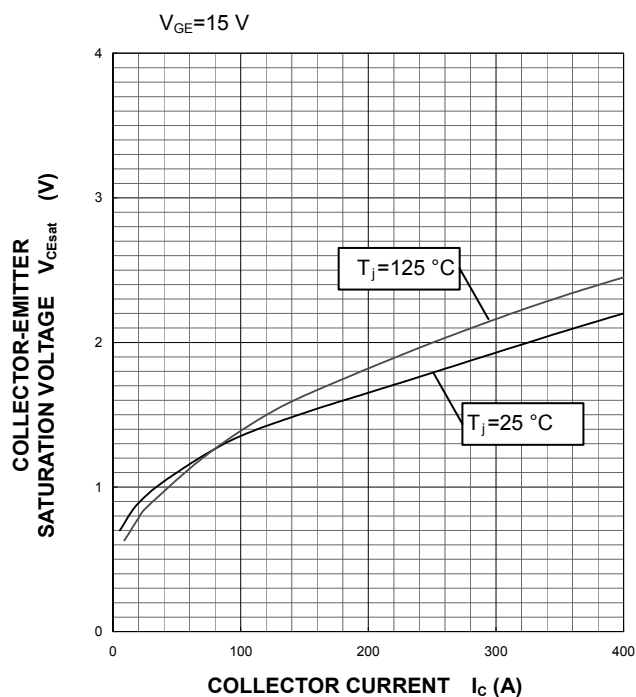
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PERFORMANCE CURVES

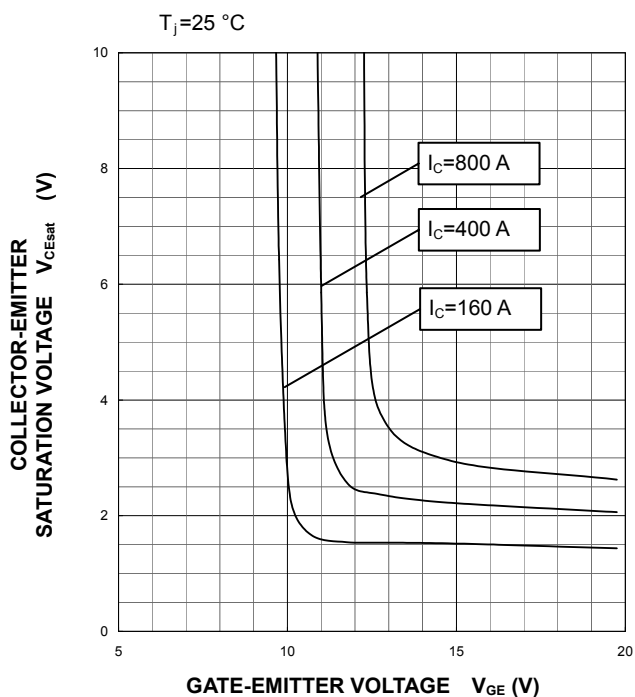
OUTPUT CHARACTERISTICS
 (TYPICAL)



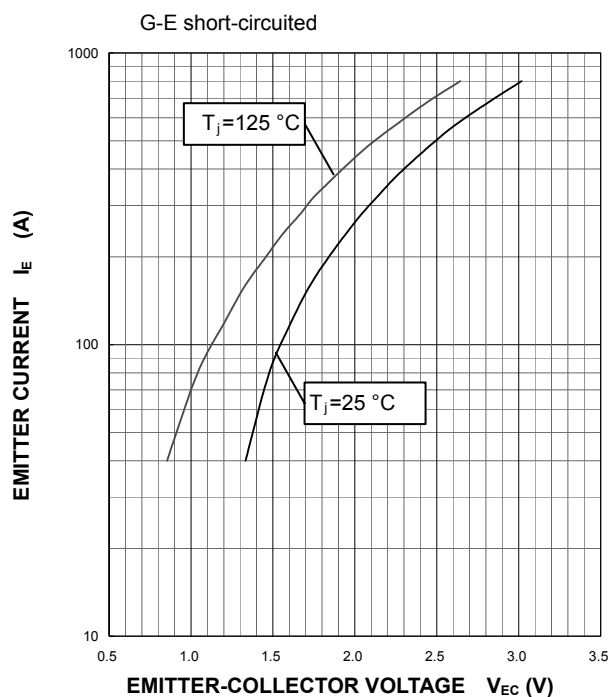
COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)



COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)



FREE WHEELING DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)

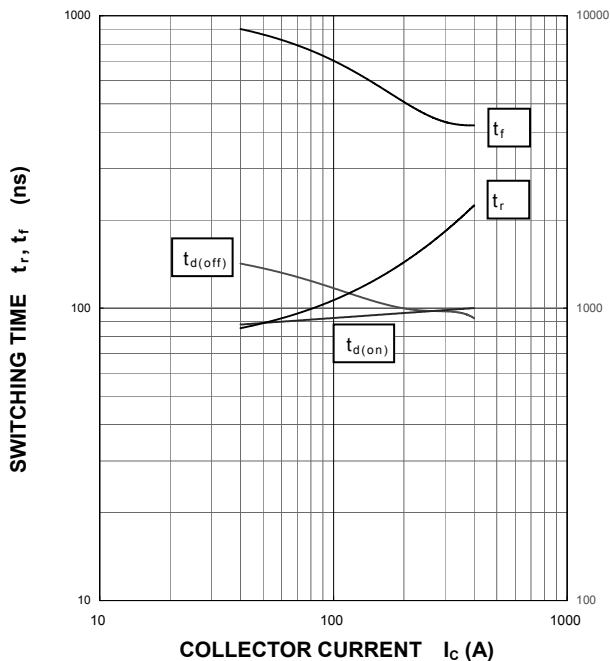


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PERFORMANCE CURVES

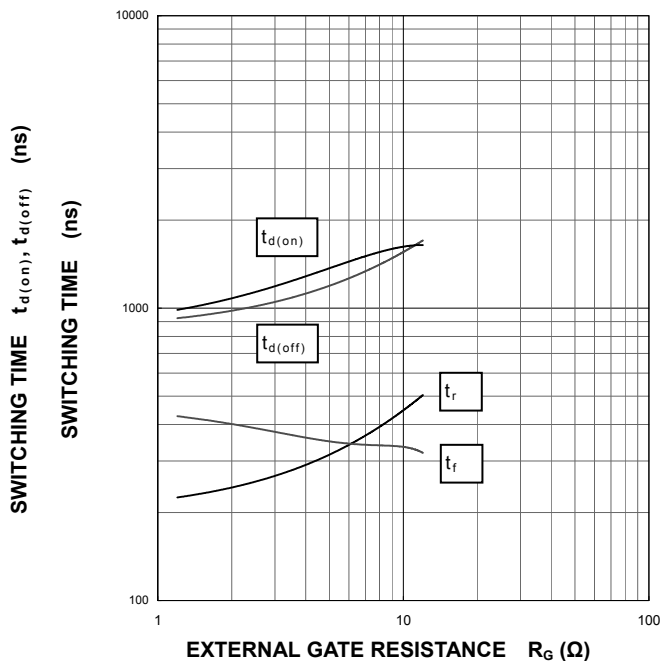
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.2\ \Omega$,
 $T_j=125\text{ }^\circ\text{C}$, INDUCTIVE LOAD



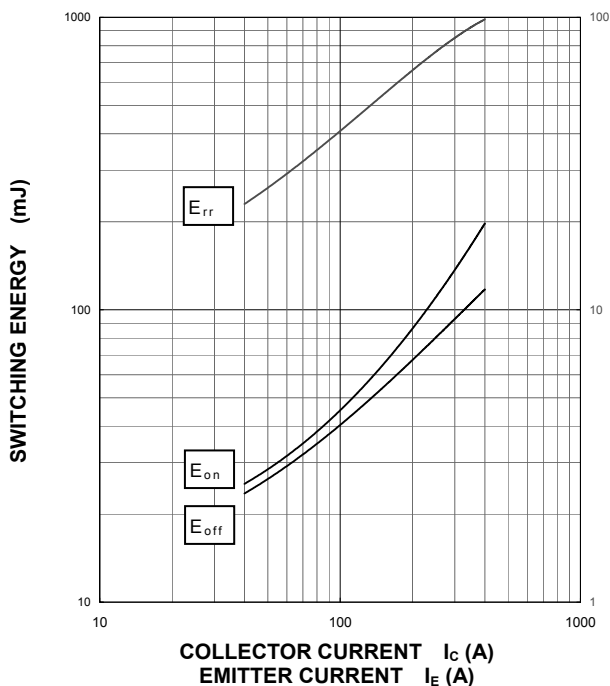
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=1000\text{ V}$, $I_c=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
 $T_j=125\text{ }^\circ\text{C}$, INDUCTIVE LOAD



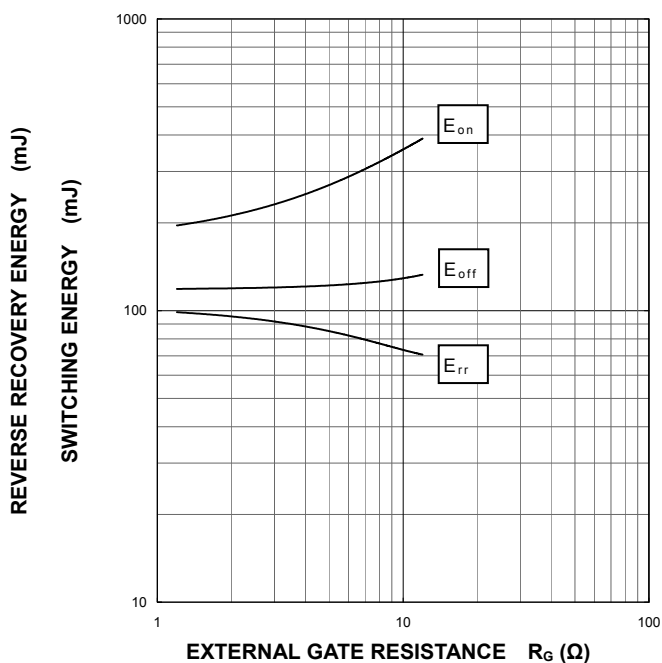
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.2\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
 INDUCTIVE LOAD, PER PULSE



**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=1000\text{ V}$, $I_c/I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $T_j=125\text{ }^\circ\text{C}$
 INDUCTIVE LOAD, PER PULSE

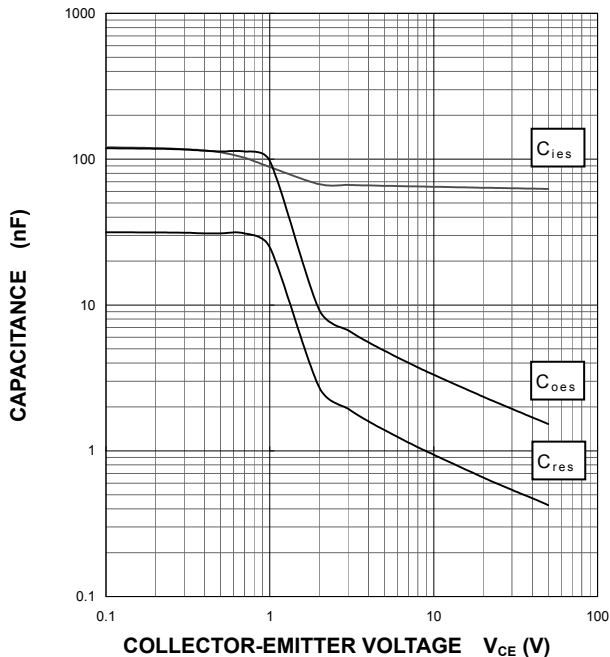


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PERFORMANCE CURVES

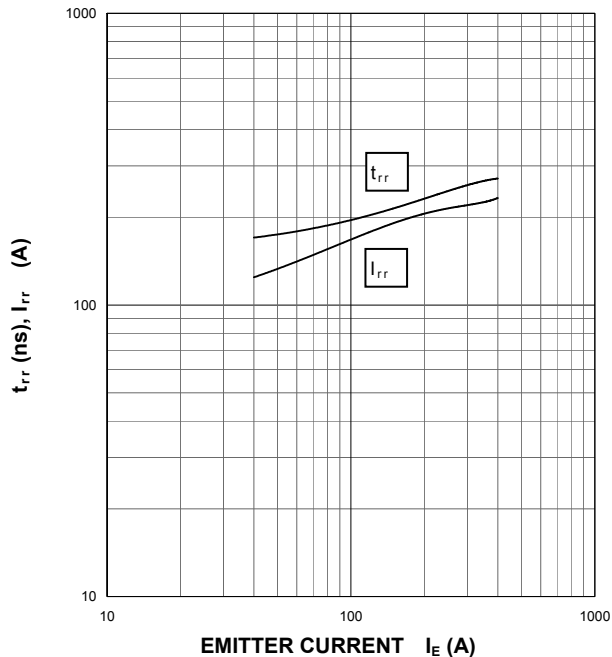
**CAPACITANCE CHARACTERISTICS
 (TYPICAL)**

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



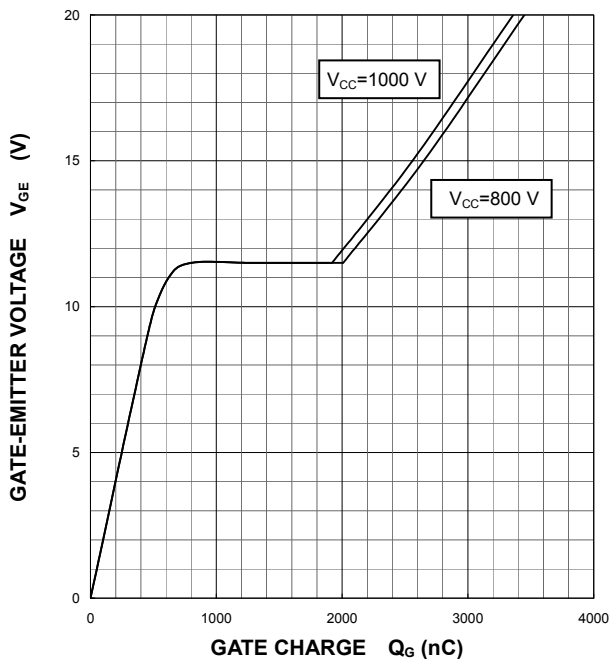
**FREE WHEELING DIODE
 REVERSE RECOVERY CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=1000\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=1.2\ \Omega$,
 $T_j=25^\circ\text{C}$, INDUCTIVE LOAD



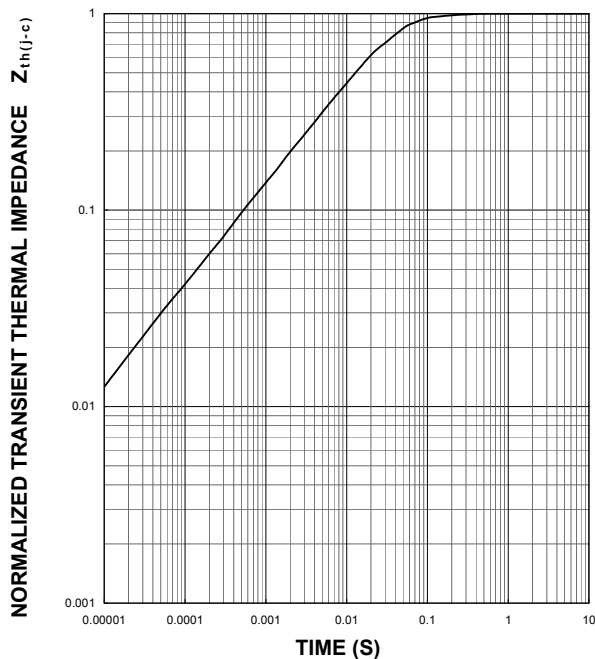
**GATE CHARGE CHARACTERISTICS
 (TYPICAL)**

$I_C=400\text{ A}$, $T_j=25^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
 (MAXIMUM)**

Single pulse, $T_C=25^\circ\text{C}$
 $R_{th(j-c)Q}=33\text{ K/kW}$, $R_{th(j-c)D}=55\text{ K/kW}$



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