

< IGBT MODULES >

CM400C1Y-24S

HIGH POWER SWITCHING USE
INSULATED TYPE



Dual (AC switch)

Collector current I_C **350 A***
 Collector-emitter voltage V_{CES} **1200 V**
 Maximum junction temperature T_{jmax} **175 °C**

- Flat base Type
- Copper base plate
- RoHS Directive compliance
- UL Recognized under UL1557, File E323585

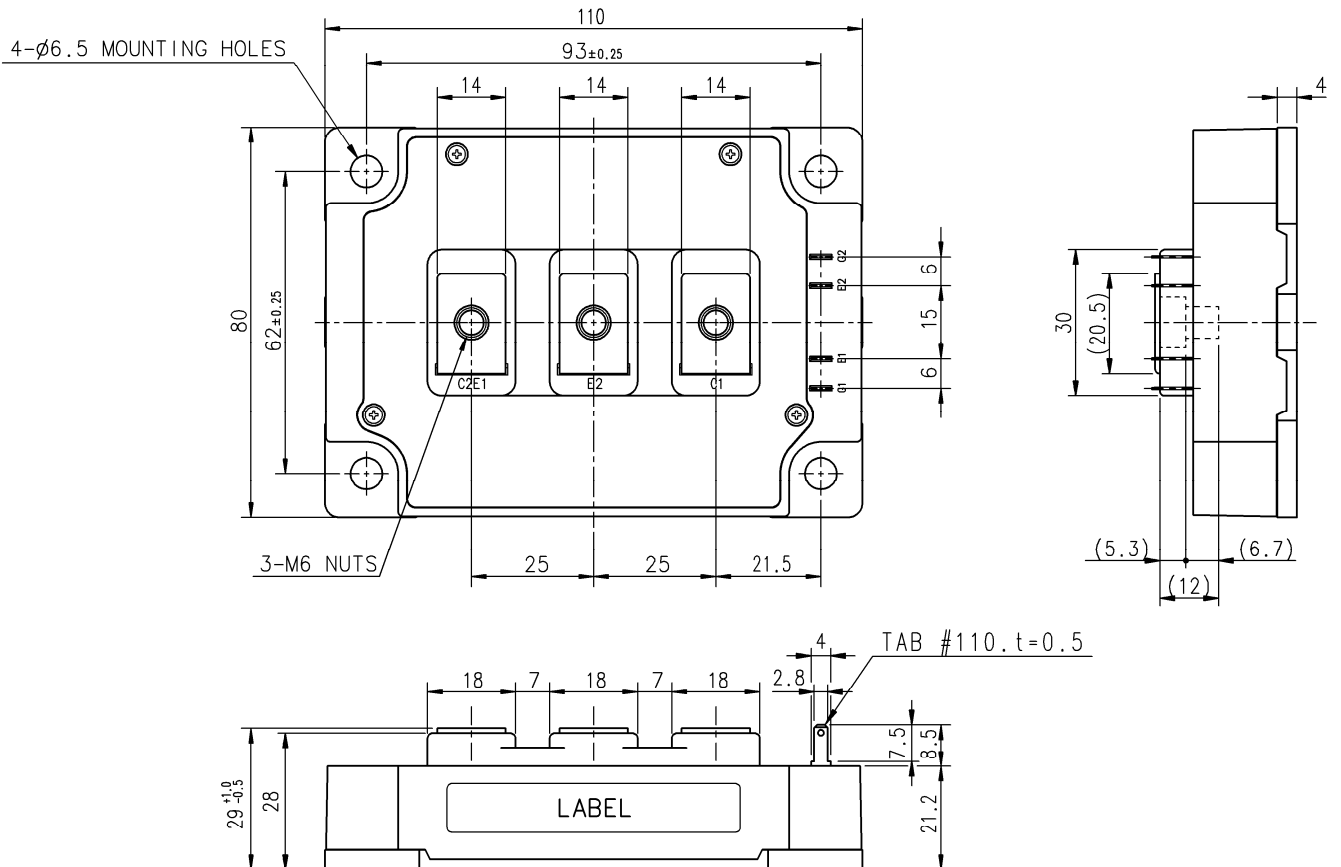
*. DC current rating is limited by power terminals.

APPLICATION

AC Power Switch for NPC

OUTLINE DRAWING & INTERNAL CONNECTION

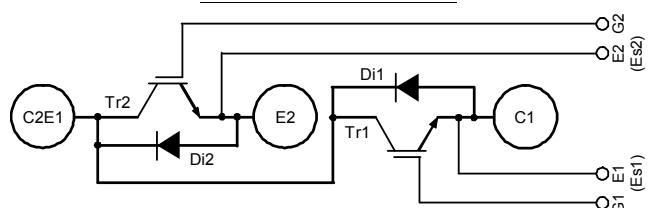
Dimension in mm



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

INTERNAL CONNECTION



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ABSOLUTE MAXIMUM RATINGS ($T_j=25\text{ }^\circ\text{C}$, 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, $T_C=124\text{ }^\circ\text{C}$ (Note.2, 4)	350 *	A
I_{CRM}		Pulse, Repetitive (Note.3)	800	
P_{tot}	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	2670	W
I_E (Note.1)	Emitter current	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 4)	350 *	A
I_{ERM} (Note.1)		Pulse, Repetitive (Note.3)	800	
V_{isol}	Isolation voltage	Terminals to base plate, RMS, f=60 Hz, AC 1 min	2500	V
T_{jmax}	Maximum junction temperature	-	175	$^\circ\text{C}$
T_{cmax}	Maximum case temperature	(Note.2)	125	
T_{jopr}	Operating junction temperature	-	-40 ~ +150	$^\circ\text{C}$
T_{stg}	Storage temperature	-	-40 ~ +125	

ELECTRICAL CHARACTERISTICS ($T_j=25\text{ }^\circ\text{C}$, 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	$I_C=40\text{ mA}$, $V_{CE}=10\text{ V}$	5.4	6.0	6.6	V	
V_{CESat}	Collector-emitter saturation voltage	$I_C=400\text{ A}$ (Note.5), $V_{GE}=15\text{ V}$, Terminal	$T_j=25\text{ }^\circ\text{C}$	-	1.85	2.30	V
			$T_j=125\text{ }^\circ\text{C}$	-	2.05	-	
			$T_j=150\text{ }^\circ\text{C}$	-	2.10	-	
		$I_C=400\text{ A}$ (Note.5), $V_{GE}=15\text{ V}$, Chip	$T_j=25\text{ }^\circ\text{C}$	-	1.70	2.15	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.90	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.95	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	40	nF	
C_{oes}	Output capacitance		-	-	8.0		
C_{res}	Reverse transfer capacitance		-	-	0.66		
Q_G	Gate charge	$V_{CC}=600\text{ V}$, $I_C=400\text{ A}$, $V_{GE}=15\text{ V}$	-	934	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, Inductive load	-	-	800	ns	
t_r	Rise time		-	-	200		
$t_{d(off)}$	Turn-off delay time		-	-	600		
t_f	Fall time		-	-	300		
V_{EC} (Note.1)	Emitter-collector voltage	$I_E=400\text{ A}$ (Note.5), G-E short-circuited, Terminal	$T_j=25\text{ }^\circ\text{C}$	-	1.85	2.30	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.85	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.85	-	
		$I_E=400\text{ A}$ (Note.5), G-E short-circuited, Chip	$T_j=25\text{ }^\circ\text{C}$	-	1.70	2.15	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.70	-	
			$T_j=150\text{ }^\circ\text{C}$	-	1.70	-	
t_{rr} (Note.1)	Reverse recovery time	$V_{CC}=600\text{ V}$, $I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$, Inductive load	-	-	300	ns	
Q_{rr} (Note.1)	Reverse recovery charge	$R_G=0\text{ }\Omega$, Inductive load	-	21.4	-	μC	
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\text{ }\Omega$,	-	39.8	-	mJ	
E_{off}	Turn-off switching energy per pulse	$T_j=150\text{ }^\circ\text{C}$, Inductive load	-	44.9	-		
E_{rr} (Note.1)	Reverse recovery energy per pulse	$T_j=150\text{ }^\circ\text{C}$, Inductive load	-	35.2	-	mJ	
r_g	Internal gate resistance	Per switch	-	4.9	-	Ω	

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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	-	-	56	K/kW
$R_{th(j-c)D}$		Junction to case, per FWDi	-	-	95	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note.2)	Case to heat sink, per 1/2 module, Thermal grease applied (Note.6)	-	18	-	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
m	Weight	-	-	580	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.7)	-100	-	+100	μm

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.

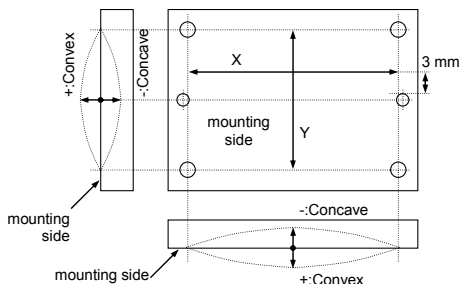
3. Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.

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 $\lambda=0.9$ W/(m·K).

7. Base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.



*. DC current rating is limited by power terminals.

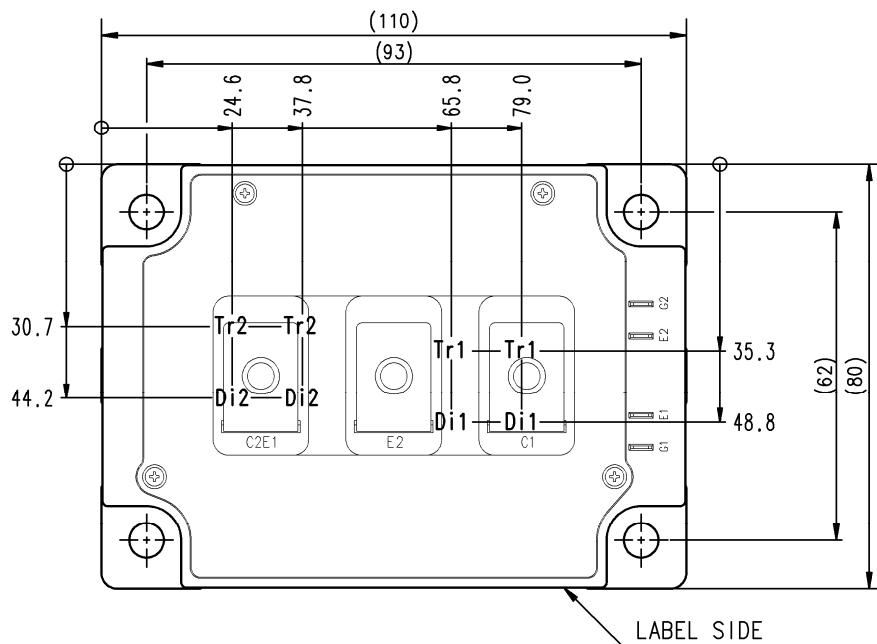
RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C1-E2	-	600	850	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	0	-	10	Ω

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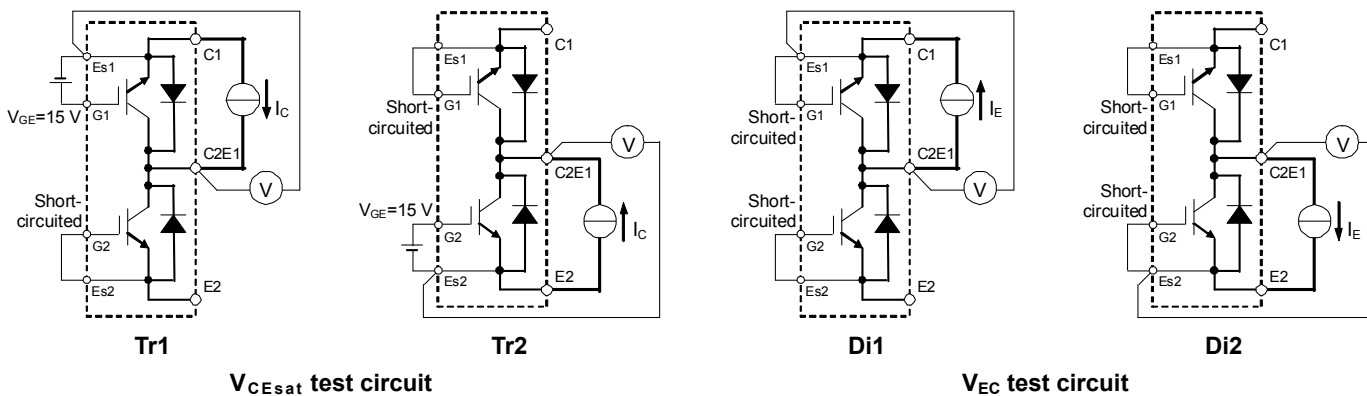
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ± 1 mm



Tr1/Tr2: IGBT, Di1/Di2: FWDi

TEST CIRCUIT

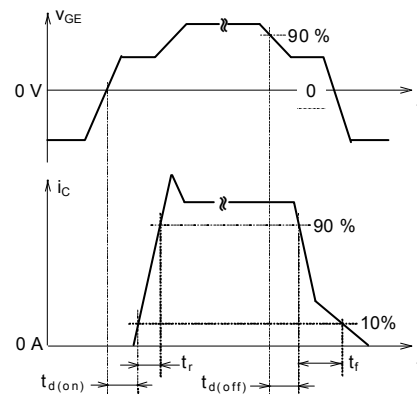
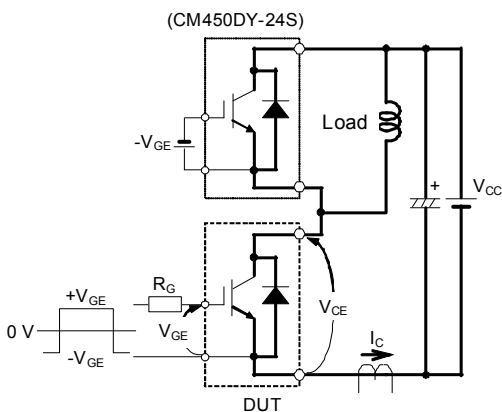


V_{CESat} test circuit

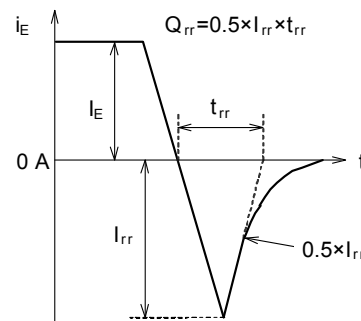
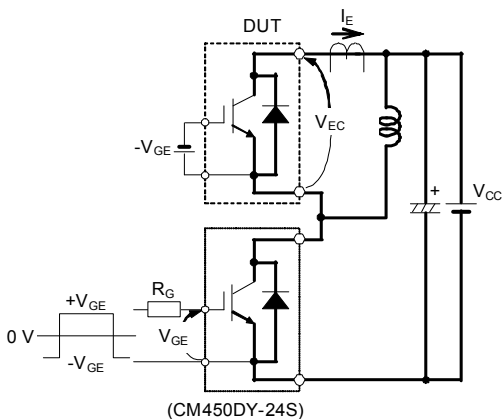
V_{EC} test circuit

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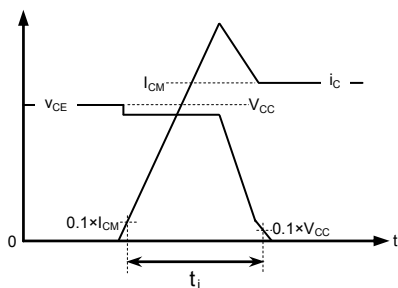
TEST CIRCUIT AND WAVEFORMS



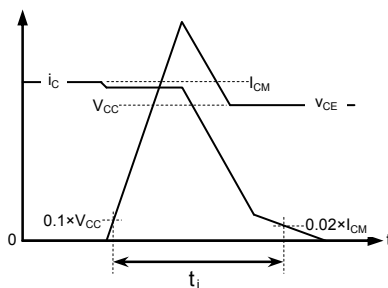
Switching characteristics test circuit and waveform



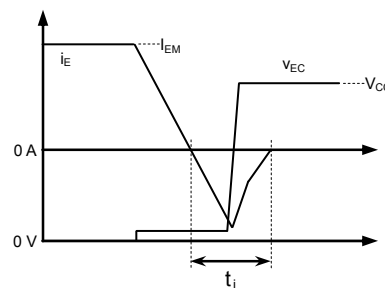
Reverse recovery characteristics (t_{rr} , Q_{rr}) test circuit



IGBT Turn-on switching energy



IGBT Turn-off switching energy



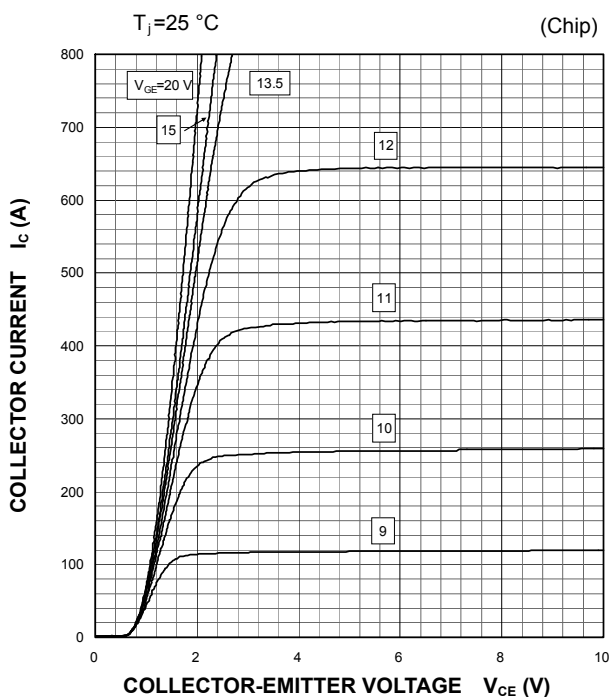
FWDi Reverse recovery energy

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

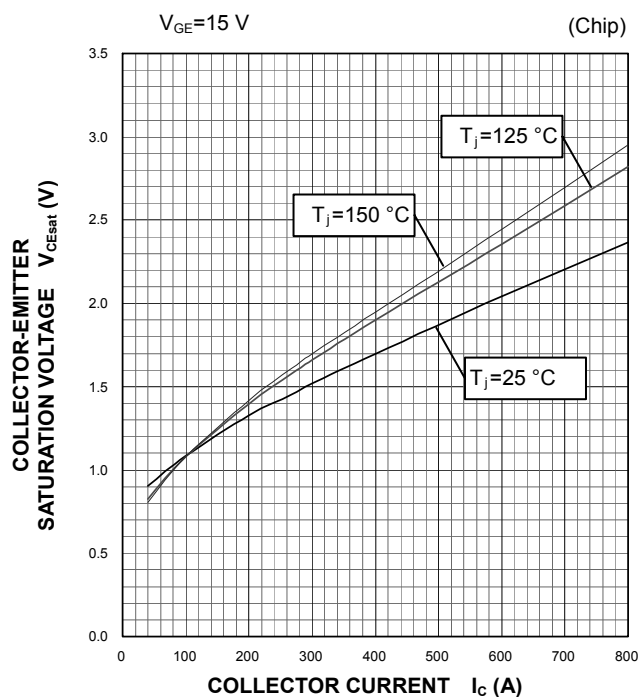
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PERFORMANCE CURVES

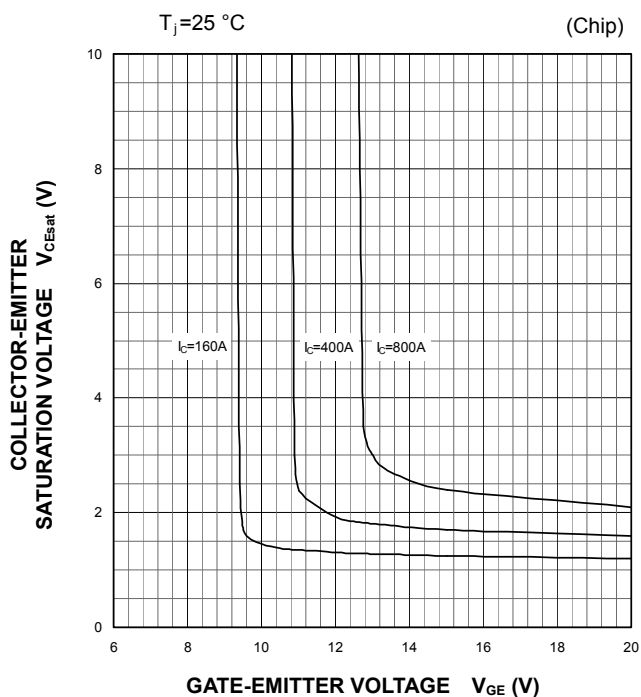
OUTPUT CHARACTERISTICS
 (TYPICAL)



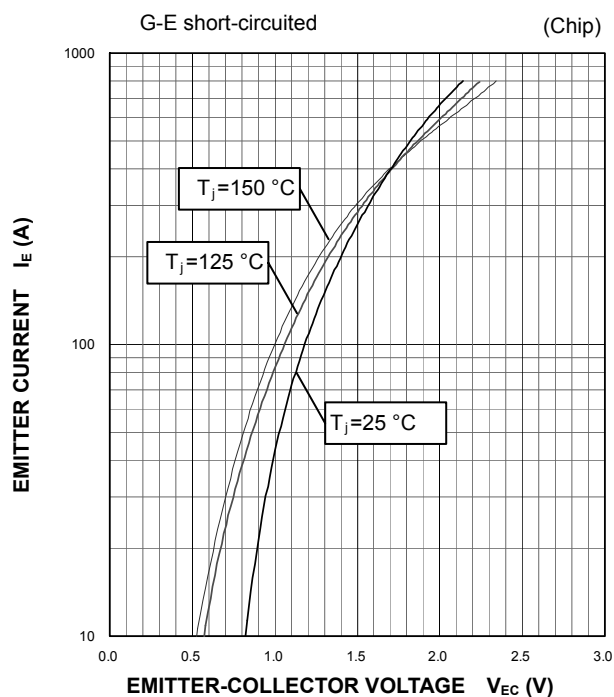
COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)



COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)



FREE WHEELING DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)



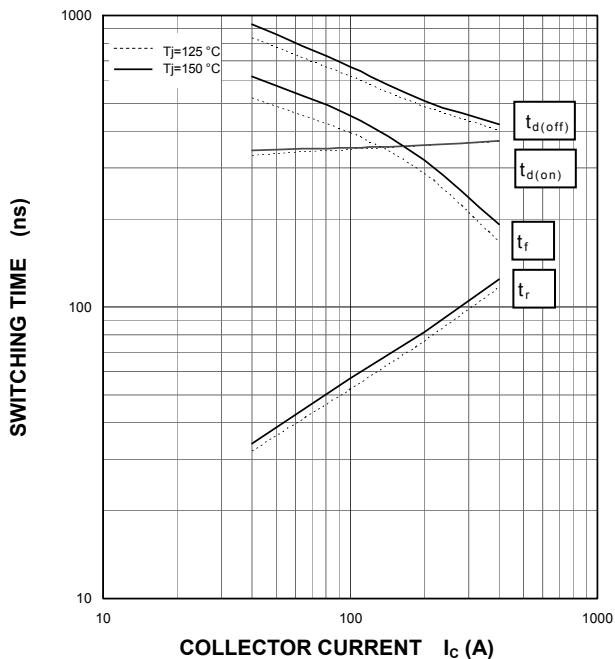
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PERFORMANCE CURVES

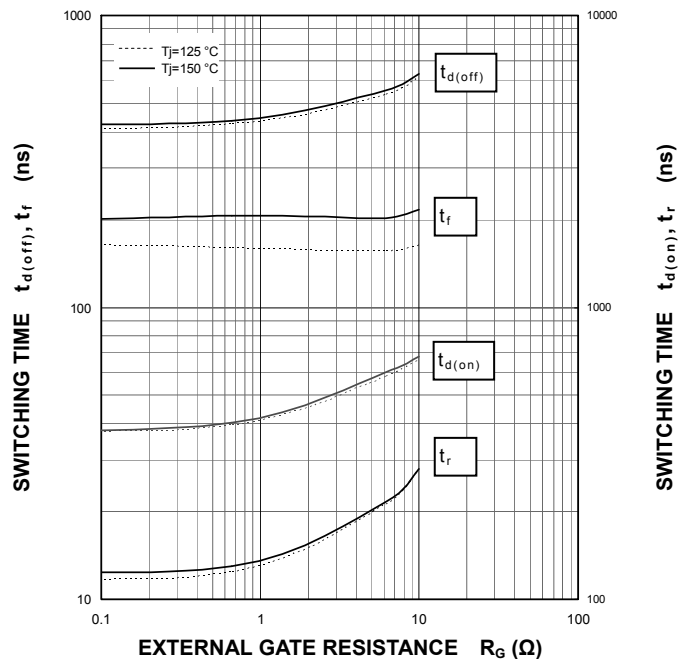
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$,
 INDUCTIVE LOAD



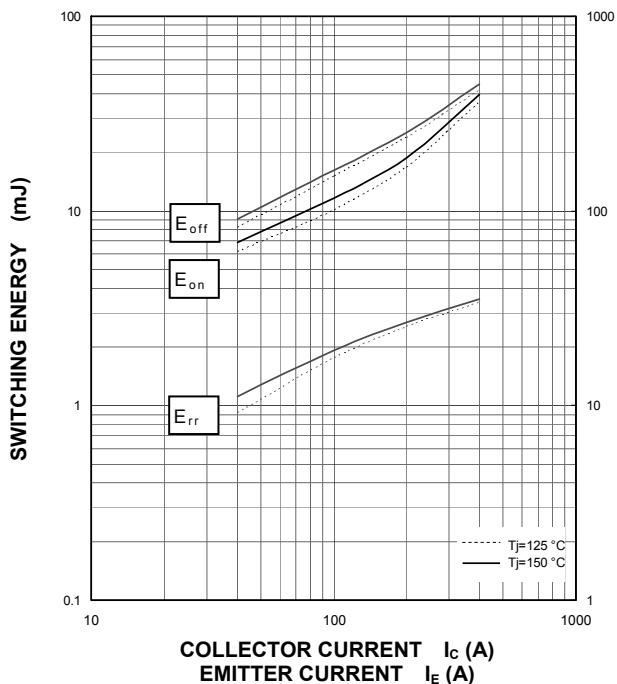
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=600\text{ V}$, $I_C=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
 INDUCTIVE LOAD



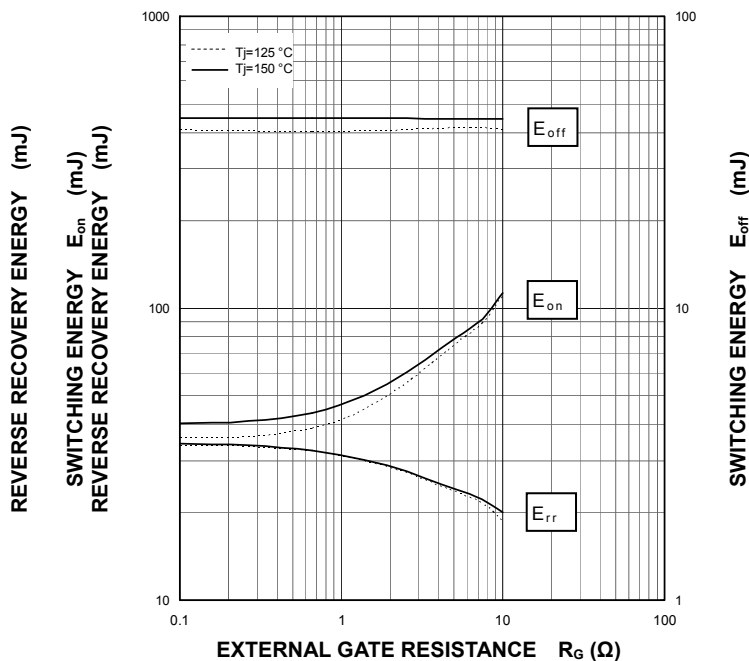
**HALF-BRIDGE
 SWITCHING CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0\ \Omega$,
 INDUCTIVE LOAD, PER PULSE



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

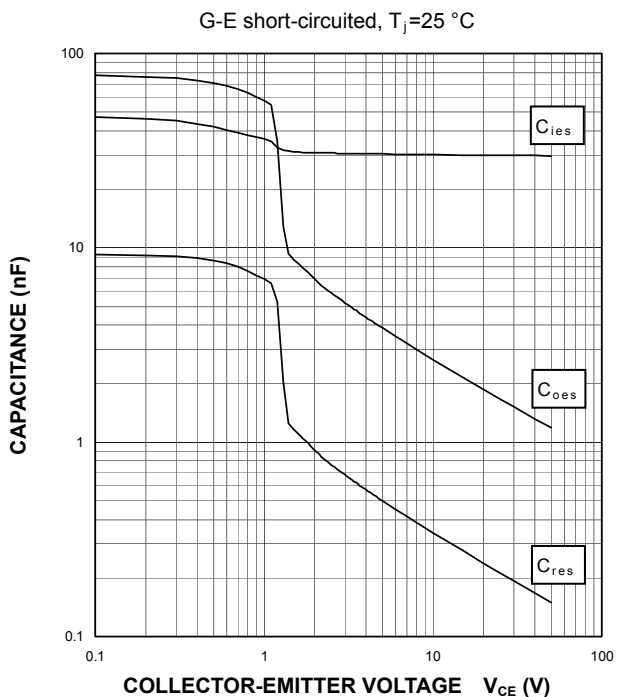
$V_{CC}=600\text{ V}$, $I_C/I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
 INDUCTIVE LOAD, PER PULSE



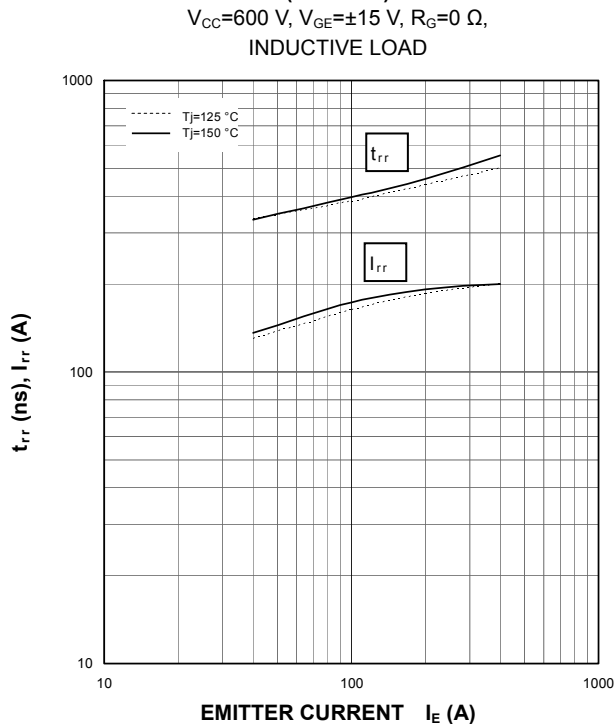
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PERFORMANCE CURVES

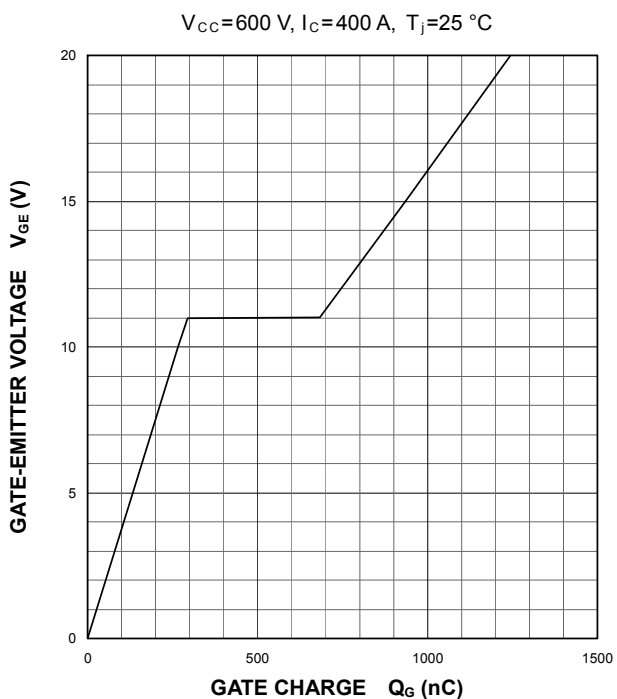
**CAPACITANCE CHARACTERISTICS
 (TYPICAL)**



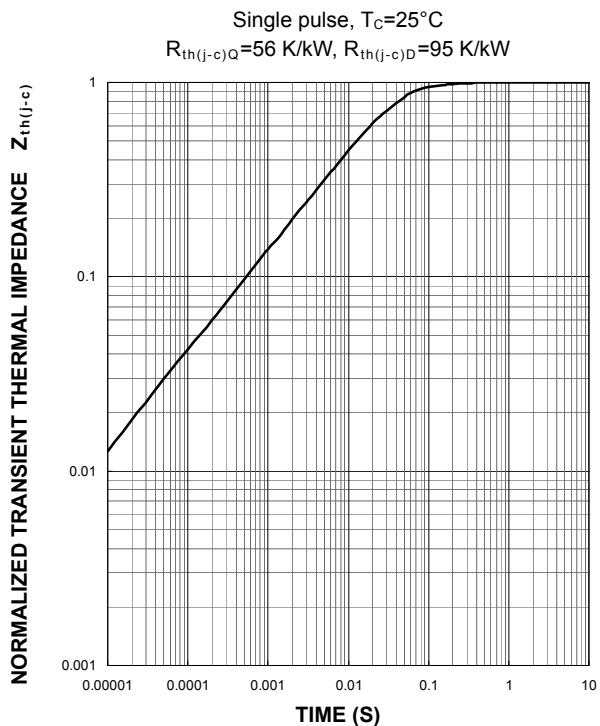
**FREE WHEELING DIODE
 REVERSE RECOVERY CHARACTERISTICS
 (TYPICAL)**



**GATE CHARGE CHARACTERISTICS
 (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
 (MAXIMUM)**



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