

MITSUBISHI IGBT MODULES
CM600DU-12NFH
 HIGH POWER SWITCHING USE
 INSULATED TYPE

CM600DU-12NFH



Dual (Half-Bridge)

- 5th generation Fast switching IGBT module -

Collector current I_C **600 A**
 Collector-emitter voltage V_{CES} **600 V**
 Maximum junction temperature T_{jmax} ... **150 °C**

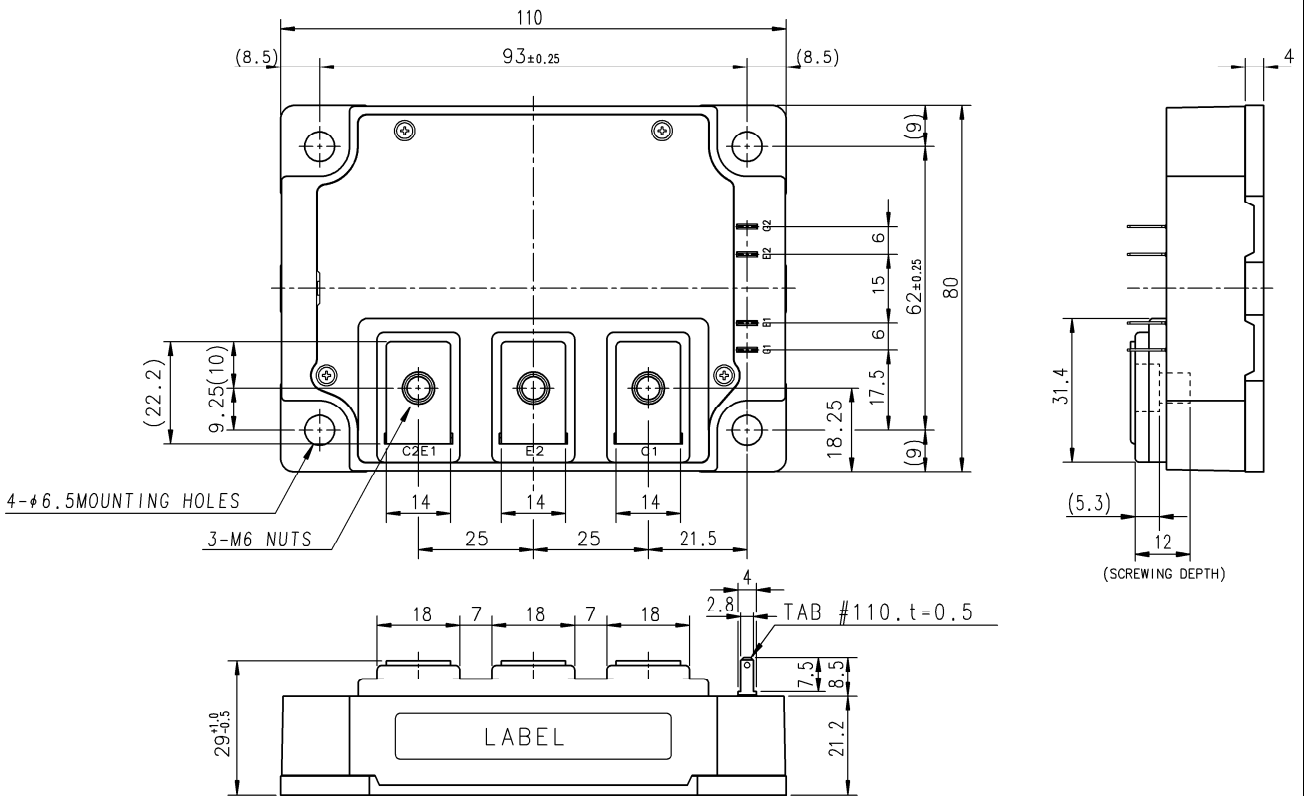
- Flat base Type
- Copper base plate
- RoHS Directive compliant
- UL Recognized under UL1557, File E323585

APPLICATION

High frequency (30 kHz ~ 60 kHz) switching use:
 Gradient amplifier, Induction heating, Power supply, etc.

OUTLINE DRAWING & INTERNAL CONNECTION

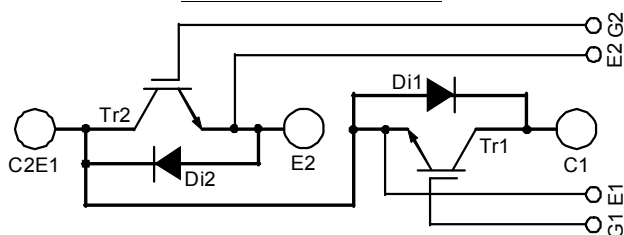
Dimension in mm



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	600	V
V_{GES}	Gate-emitter voltage	C-E short-circuited	± 20	V
I_C	Collector current	Operation (Note.5)	600	A
$I_{C(rms)}$		Pulse, Repetitive (Note.4)	400	
I_{CRM}			1200	
P_{tot}	Total power dissipation	$T_C=25\text{ }^\circ\text{C}$ (Note.2, 5)	1130	W
P_{tot}'		$T_C'=25\text{ }^\circ\text{C}$ (Note.3, 5)	2350	
I_E (Note.1)	Emitter current (Free wheeling diode forward current)	Operation (Note.5)	600	A
$I_{E(rms)}$ (Note.1)		Pulse, Repetitive (Note.4)	400	
I_{ERM} (Note.1)			1200	
T_j	Junction temperature	-	$-40 \sim +150$	$^\circ\text{C}$
T_{stg}	Storage temperature	-	$-40 \sim +125$	
V_{isol}	Isolation voltage	Terminals to base plate, RMS, $f=60\text{ Hz}$, AC 1 min	2500	V

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	mA	
I_{GES}	Gate-emitter leakage current	$\pm V_{GE}=V_{GES}$, C-E short-circuited	-	-	0.5	μA	
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=60\text{ mA}$, $V_{CE}=10\text{ V}$	5	6	7	V	
V_{CESat}	Collector-emitter saturation voltage	$I_C=600\text{ A}$ (Note.6), $V_{GE}=15\text{ V}$	$T_j=25\text{ }^\circ\text{C}$	-	2.0	2.7	V
			$T_j=125\text{ }^\circ\text{C}$	-	1.95	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	166	nF	
C_{oes}	Output capacitance		-	-	11		
C_{res}	Reverse transfer capacitance		-	-	6.0		
Q_G	Gate charge	$V_{CC}=300\text{ V}$, $I_C=600\text{ A}$, $V_{GE}=15\text{ V}$	-	3720	-	nC	
$t_{d(on)}$	Turn-on delay time	$V_{CC}=300\text{ V}$, $I_C=600\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=2.0\ \Omega$, Inductive load	-	-	650	ns	
t_r	Rise time		-	-	250		
$t_{d(off)}$	Turn-off delay time		-	-	800		
t_f	Fall time		-	-	150		
V_{EC} (Note.1)	Emitter-collector voltage	$I_E=600\text{ A}$ (Note.6), G-E short-circuited	-	2.0	2.6	V	
t_{rr} (Note.1)	Reverse recovery time	$V_{CC}=300\text{ V}$, $I_E=600\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=2.0\ \Omega$, Inductive load	-	-	200	ns	
Q_{rr} (Note.1)	Reverse recovery charge		-	11	-	μC	
E_{on}	Turn-on switching energy per pulse	$V_{CC}=300\text{ V}$, $I_C=I_E=600\text{ A}$,	-	11	-	mJ	
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=2.0\ \Omega$, $T_j=125\text{ }^\circ\text{C}$,	-	27	-		
E_{rr} (Note.1)	Reverse recovery energy per pulse	Inductive load	-	6.3	-		
r_g	Internal gate resistance	Per switch, $T_C=25\text{ }^\circ\text{C}$	-	0.8	-	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	-	-	0.11	K/W
$R_{th(j-c)D}$		Junction to case, per FWDi	-	-	0.12	
$R_{th(c-s)}$	Contact thermal resistance (Note.2)	Case to heat sink, per 1/2 module, Thermal grease applied (Note.7)	-	0.02	-	K/W
$R_{th(j-c)Q}$	Thermal resistance (Note.3)	Junction to case, per IGBT	-	-	53	K/kW
$R_{th(j-c)D}$		Junction to case, per FWDi	-	-	78	

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	
m	Weight	-	-	580	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.8)	-100	-	+100	μm

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RECOMMENDED OPERATING CONDITIONS (T_a=25 °C)

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V _{CC}	(DC) Supply voltage	Applied across C1-E2	-	300	400	V
V _{GEon}	Gate (-emitter drive) voltage	Applied across G1-Es1/G2-Es2	13.5	15.0	16.5	
R _G	External gate resistance	Per switch	1.0	-	10	Ω

Note.1: Represent ratings and characteristics of the anti-parallel, emitter-collector free wheeling diode (FWDi).

Note.2: Case temperature (T_c) measured point is base plate side. (Refer to the figure of chip location)

Note.3: Case temperature (T_c') and heat sink temperature (T_s') are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)

The heat sink thermal resistance {R_{th(s-a)}} should measure just under the chips.

Note.4: Pulse width and repetition rate should be such that the device junction temperature (T_j) dose not exceed T_{jmax} rating.

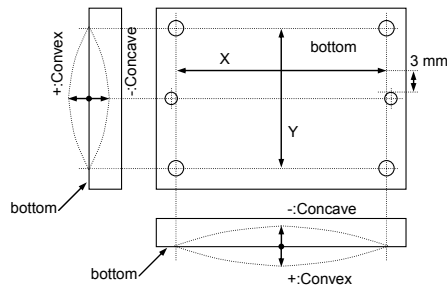
Note.5: Junction temperature (T_j) should not increase beyond T_{jmax} rating.

Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise.

(Refer to the figure of test circuit)

Note.7: Typical value is measured by using thermally conductive grease of λ=0.9 W/(m·K).

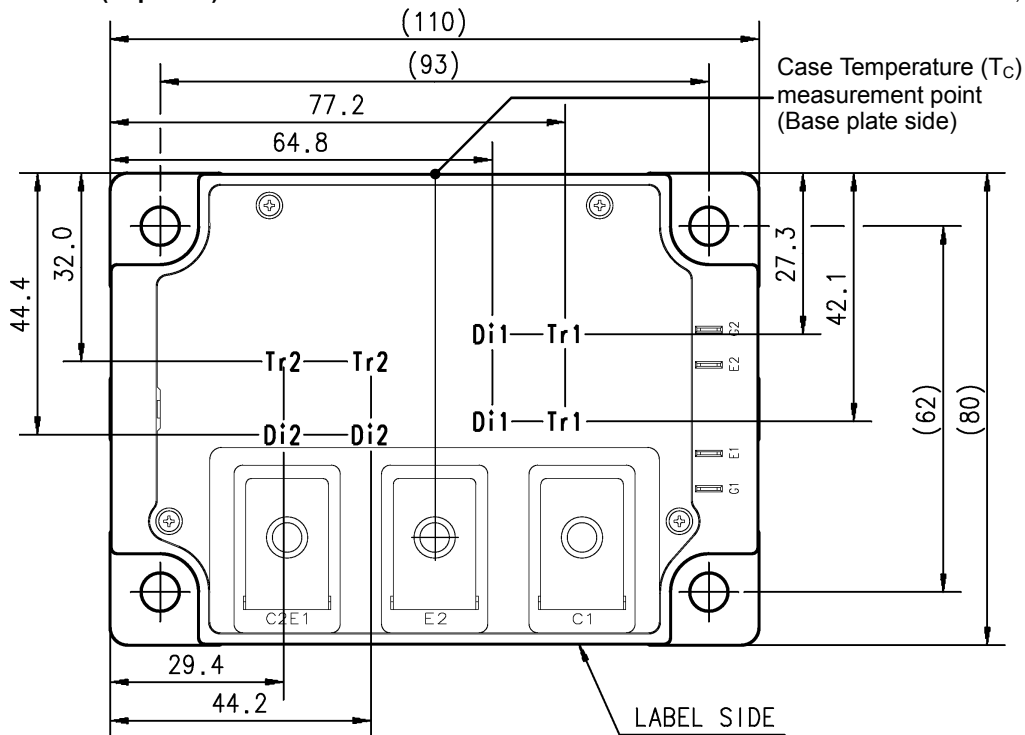
Note.8: Base plate flatness measurement points are as in the following figure.



Note.9: No short circuit capability is designed.

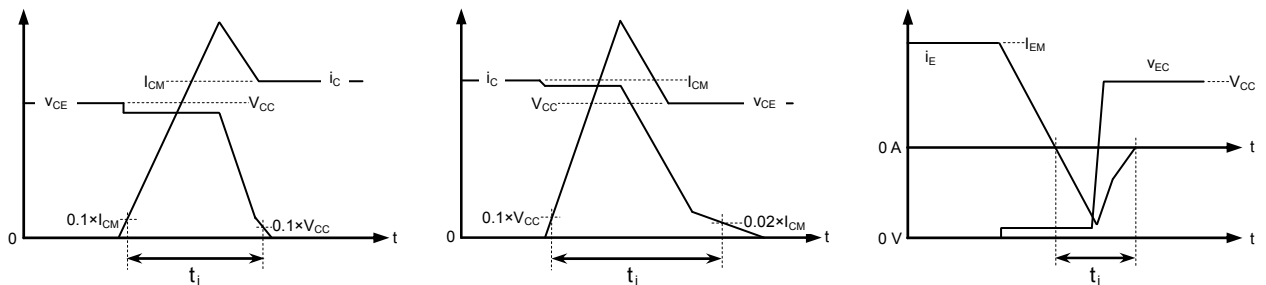
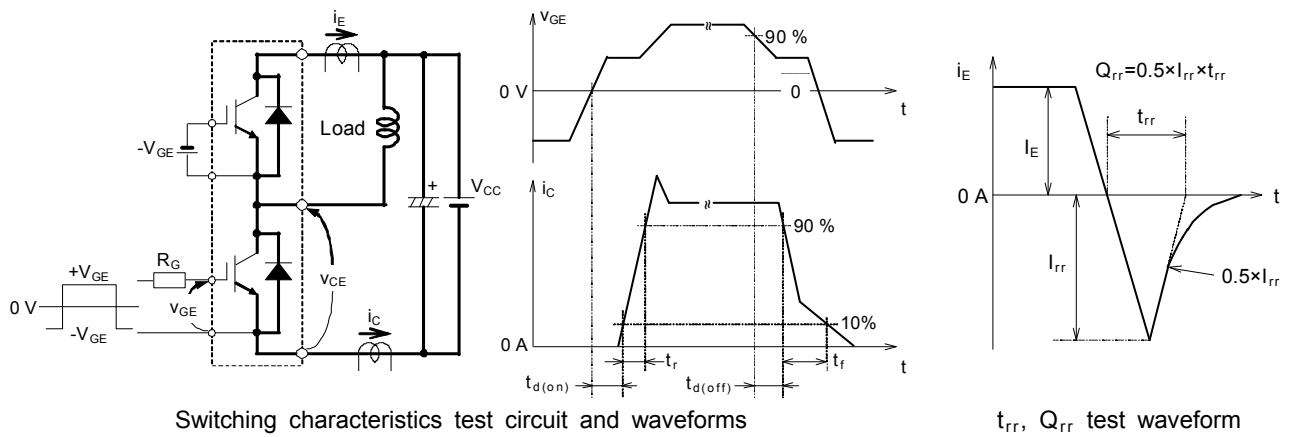
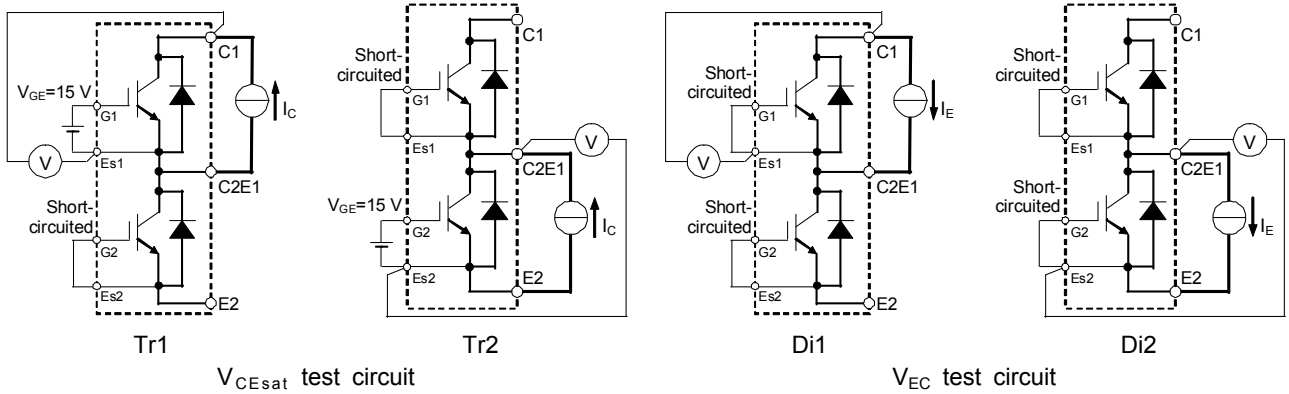
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm



Tr1/Tr2: IGBT, Di1/Di2: FWDi

TEST CIRCUIT AND WAVEFORMS

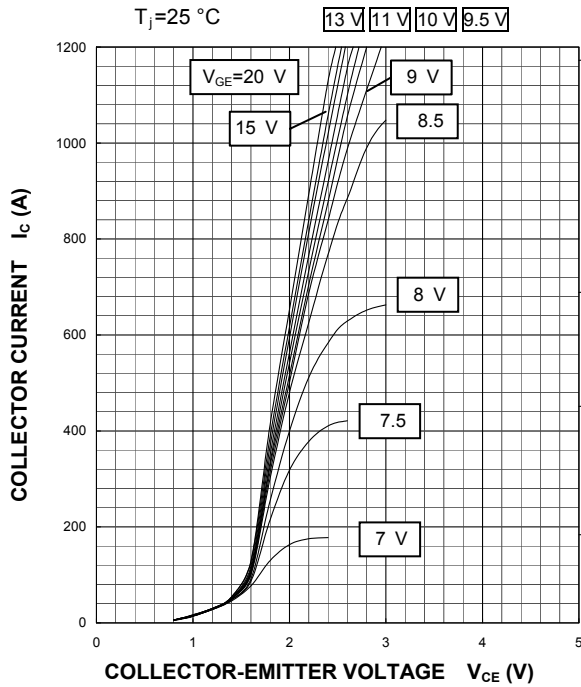


Turn-on / Turn-off switching energy and Reverse recovery energy test waveforms (Integral time instruction drawing)

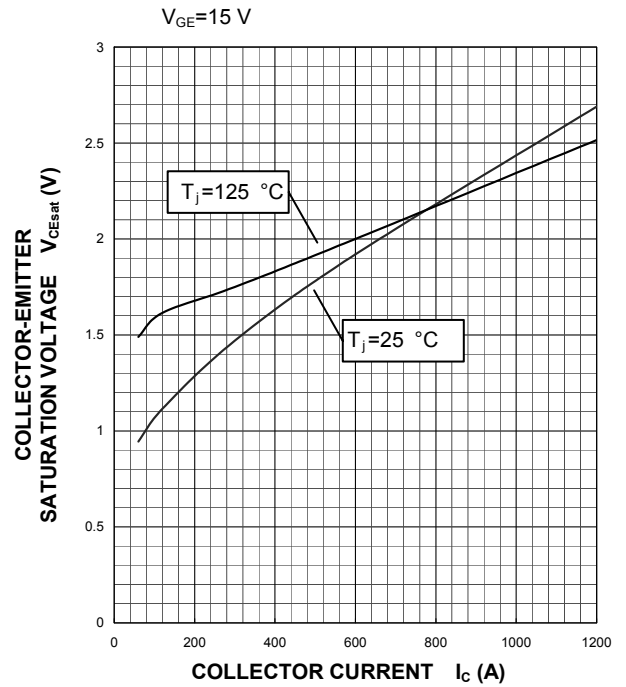
PERFORMANCE CURVES

INVERTER PART

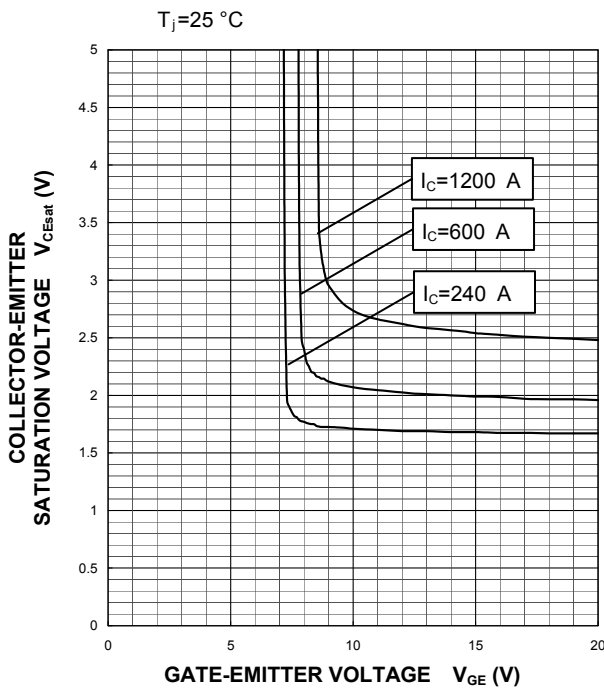
OUTPUT CHARACTERISTICS
 (TYPICAL)



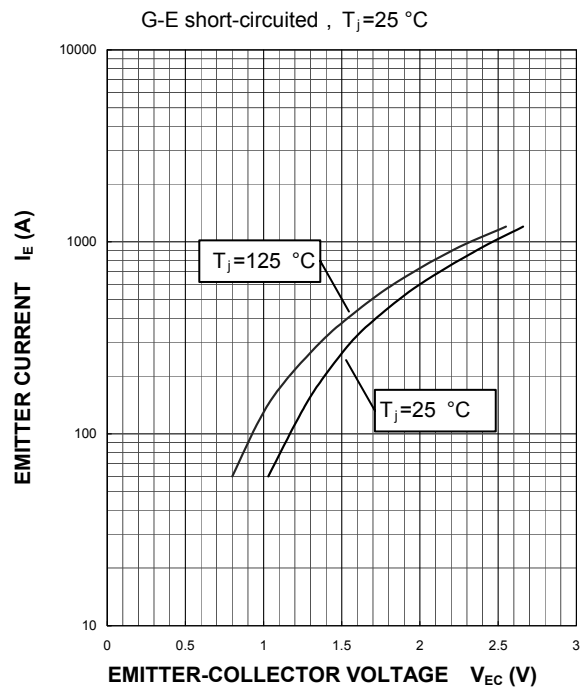
COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)



COLLECTOR-EMITTER SATURATION
 VOLTAGE CHARACTERISTICS
 (TYPICAL)



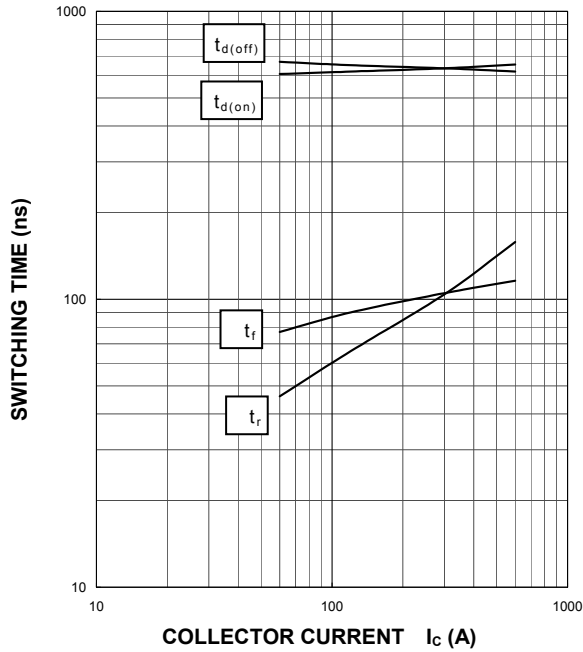
FREE WHEELING DIODE
 FORWARD CHARACTERISTICS
 (TYPICAL)



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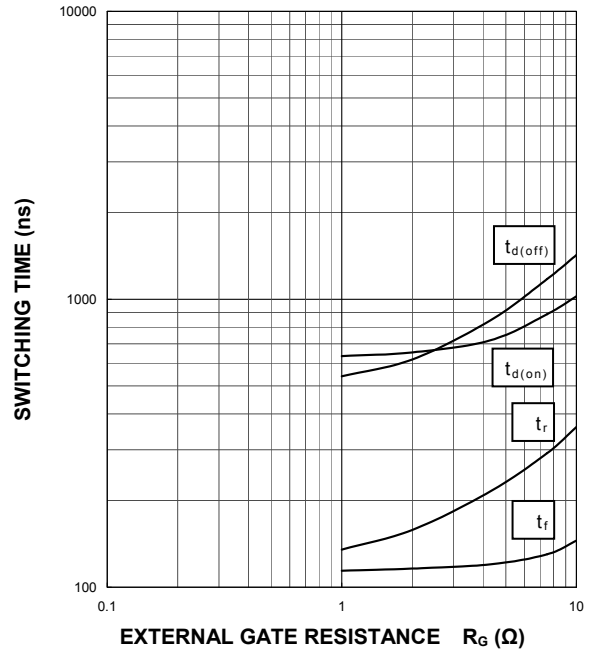
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=2.0\ \Omega$,
 $T_j=125\text{ }^\circ\text{C}$, INDUCTIVE LOAD



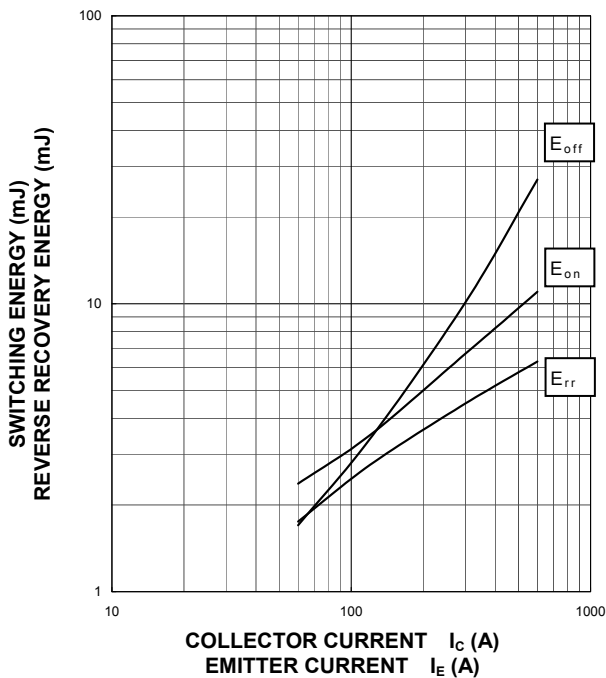
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $I_C=600\text{ A}$, $V_{GE}=\pm 15\text{ V}$,
 $T_j=125\text{ }^\circ\text{C}$, INDUCTIVE LOAD



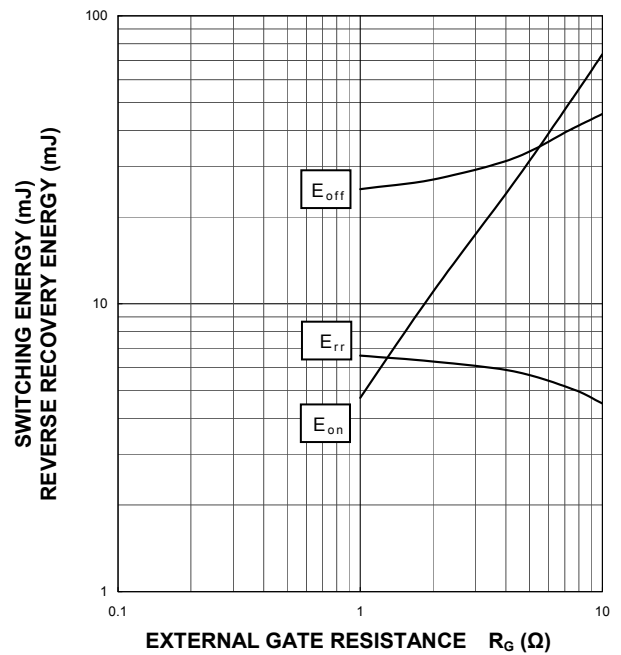
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=2.0\ \Omega$, $T_j=125\text{ }^\circ\text{C}$,
 INDUCTIVE LOAD, PER PULSE



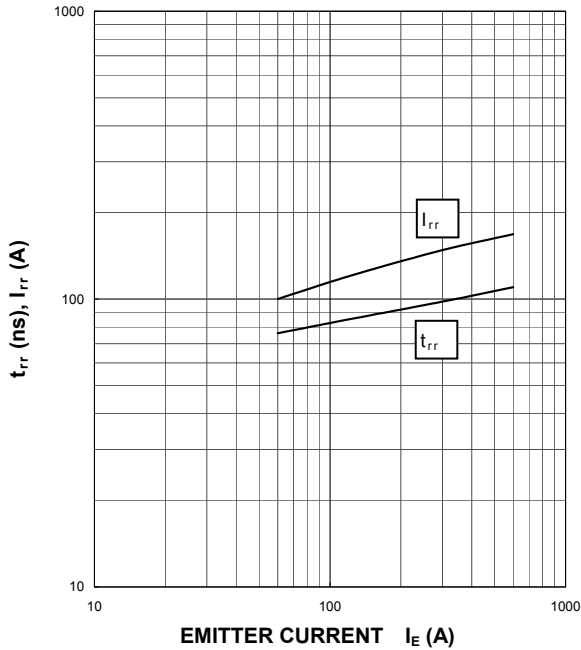
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=300\text{ V}$, $I_C/I_E=600\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $T_j=125\text{ }^\circ\text{C}$,
 INDUCTIVE LOAD, PER PULSE



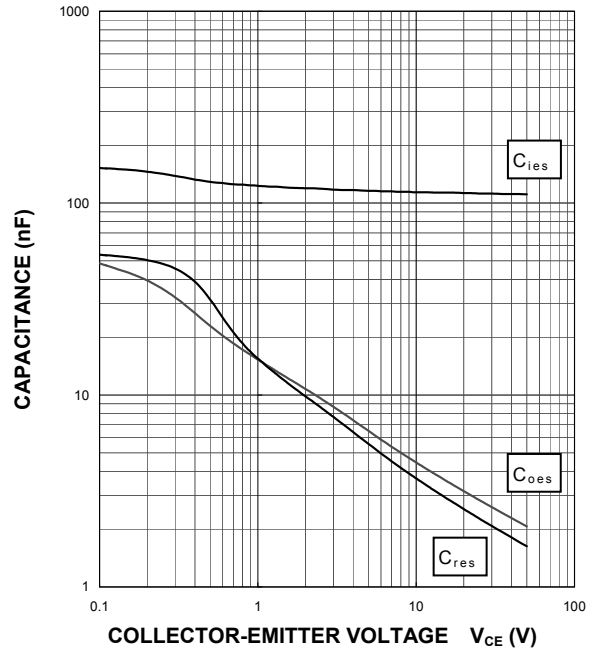
**FREE WHEELING DIODE
 REVERSE RECOVERY CHARACTERISTICS
 (TYPICAL)**

$V_{CC}=300\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=2.0\ \Omega$,
 $T_J=25\text{ }^\circ\text{C}$, INDUCTIVE LOAD



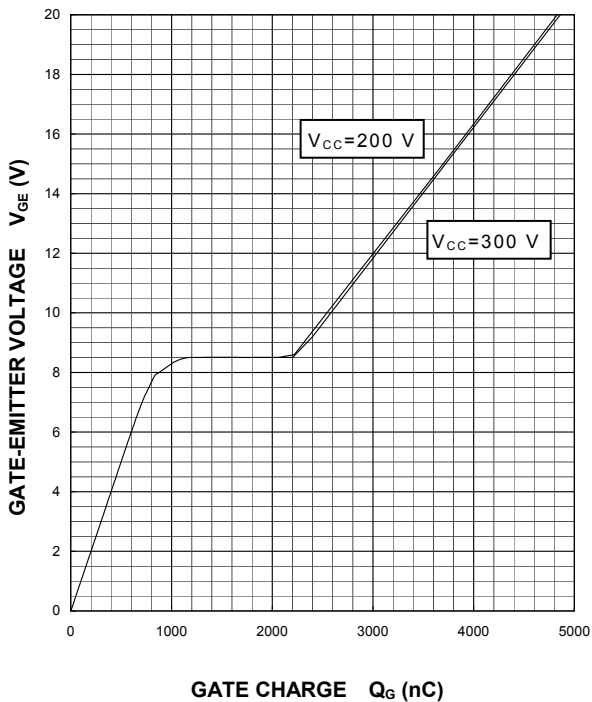
**CAPACITANCE CHARACTERISTICS
 (TYPICAL)**

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



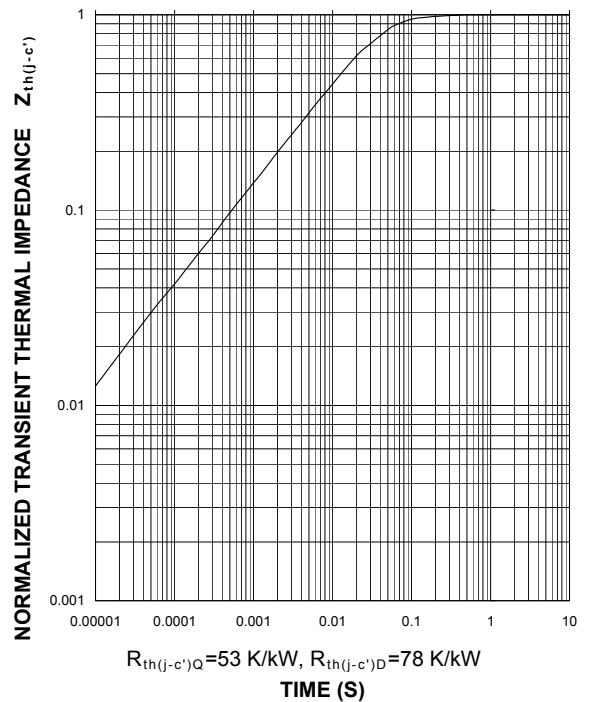
**GATE CHARGE CHARACTERISTICS
 (TYPICAL)**

$I_C=600\text{ A}$, $T_J=25\text{ }^\circ\text{C}$



**TRANSIENT THERMAL IMPEDANCE
 CHARACTERISTICS
 (MAXIMUM)**

Single pulse, $T_C=25\text{ }^\circ\text{C}$



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