

CM400HA-24A

Single

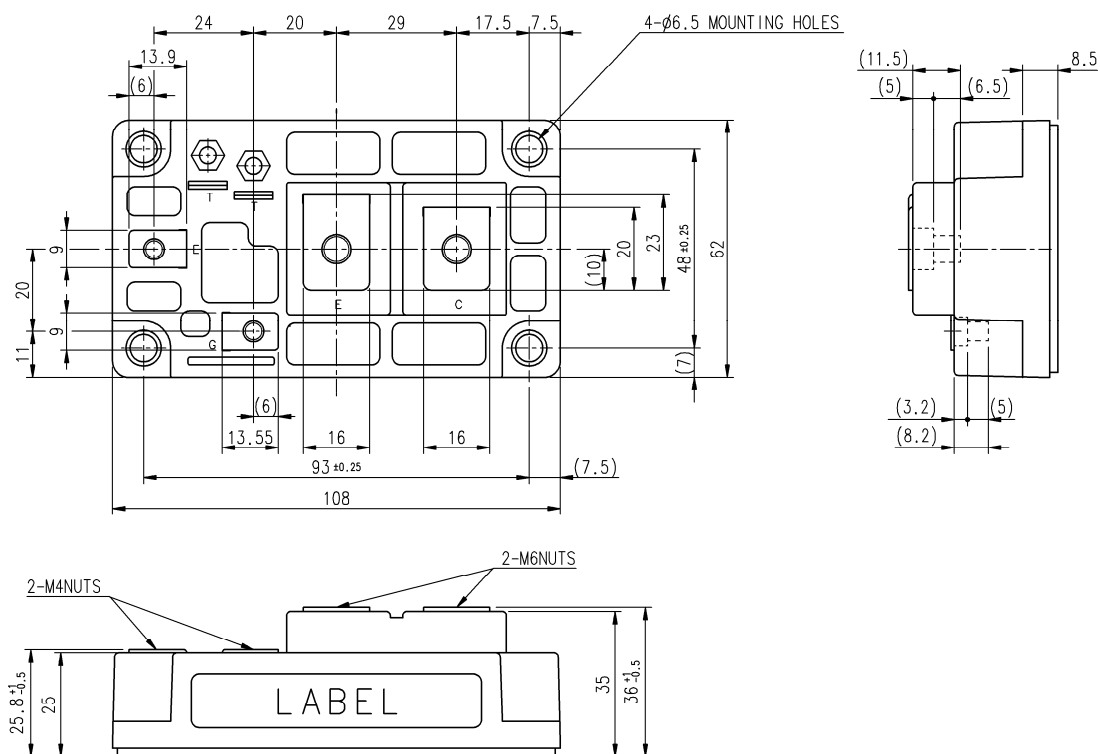
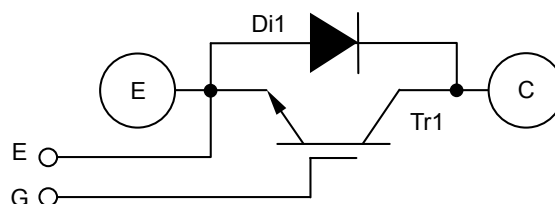
- I_C 400 A
- V_{CES} 1200 V
- Flat base Type
Copper (non-plating) base plate
No accessory (terminal screw) attach
- RoHS Directive compliant

APPLICATION

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

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

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, $T_C=87\text{ }^{\circ}\text{C}$ (Note.2)	400	A
I_{CRM}		Pulse, Repetitive (Note.3)	800	
P_{tot}	Total power dissipation	$T_C=25\text{ }^{\circ}\text{C}$ (Note.2, 4)	2350	W
I_E (Note.1)	Emitter current (Free wheeling diode forward current)	$T_C=25\text{ }^{\circ}\text{C}$ (Note.2, 4)	400	A
I_{ERM} (Note.1)		Pulse, Repetitive (Note.3)	800	
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

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M_t	Mounting torque	Main terminals M 6 screw	1.96	2.45	2.94	N·m
M_t		Auxiliary terminals M 4 screw	0.98	1.18	1.47	
M_s		Mounting to heat sink M 6 screw	1.96	2.45	2.94	
m	Weight	-	-	480	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note.5)	± 0	-	+100	μm

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	-	-	1	μA
$V_{GE(th)}$	Gate-emitter threshold voltage	$I_C=40\text{ mA}$, $V_{CE}=10\text{ V}$	6	7	8	V
V_{CESat}	Collector-emitter saturation voltage	$I_C=400\text{ A}$ (Note.6), $T_j=25\text{ }^{\circ}\text{C}$	-	2.1	3.0	V
		$V_{GE}=15\text{ V}$, $T_j=125\text{ }^{\circ}\text{C}$	-	2.4	-	
C_{ies}	Input capacitance	$V_{CE}=10\text{ V}$, G-E short-circuited	-	-	70	nF
C_{oes}	Output capacitance		-	-	6.0	
C_{res}	Reverse transfer capacitance		-	-	1.4	
Q_G	Gate charge	$V_{CC}=600\text{ V}$, $I_C=400\text{ A}$, $V_{GE}=15\text{ V}$	-	2000	-	nC
$t_{d(on)}$	Turn-on delay time	$V_{CC}=600\text{ V}$, $I_C=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.78\text{ }\Omega$, Inductive load	-	-	550	ns
t_r	Rise time		-	-	180	
$t_{d(off)}$	Turn-off delay time		-	-	600	
t_f	Fall time		-	-	350	
V_{EC} (Note.1)	Emitter-collector voltage	$I_E=400\text{ A}$ (Note.6), G-E short-circuited	-	3.0	3.8	V
t_{rr} (Note.1)	Reverse recovery time	$V_{CC}=600\text{ V}$, $I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$,	-	-	250	ns
Q_{rr} (Note.1)	Reverse recovery charge	$R_G=0.78\text{ }\Omega$, Inductive load	-	14.7	-	μC
E_{on}	Turn-on switching energy per pulse	$V_{CC}=600\text{ V}$, $I_C=I_E=400\text{ A}$,	-	50.4	-	mJ
E_{off}	Turn-off switching energy per pulse	$V_{GE}=\pm 15\text{ V}$, $R_G=0.78\text{ }\Omega$,	-	41.8	-	
E_{rr} (Note.1)	Reverse recovery energy per pulse	$T_j=125\text{ }^{\circ}\text{C}$, Inductive load	-	20	-	
r_g	Internal gate resistance	$T_C=25\text{ }^{\circ}\text{C}$	-	1.5	-	Ω
R_G	External gate resistance	-	0.78	-	10	Ω

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance (Note.2)	Junction to case, IGBT part	-	-	53	K/kW
$R_{th(j-c)D}$		Junction to case, FWDi part	-	-	80	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note.2)	Case to heat sink, Thermal grease applied (Note.7)	-	20	-	K/kW

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

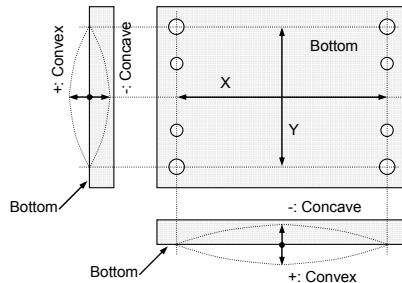
Note.2: Case temperature (T_c) and heat sink temperature (T_s) are defined on the each surface of base plate and heat sink just under the chips. (Refer to the figure of chip location)

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

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

Note.4: Junction temperature (T_j) should not increase beyond T_{jmax} rating.

Note.5: Base plate flatness measurement point is as in the following figure.



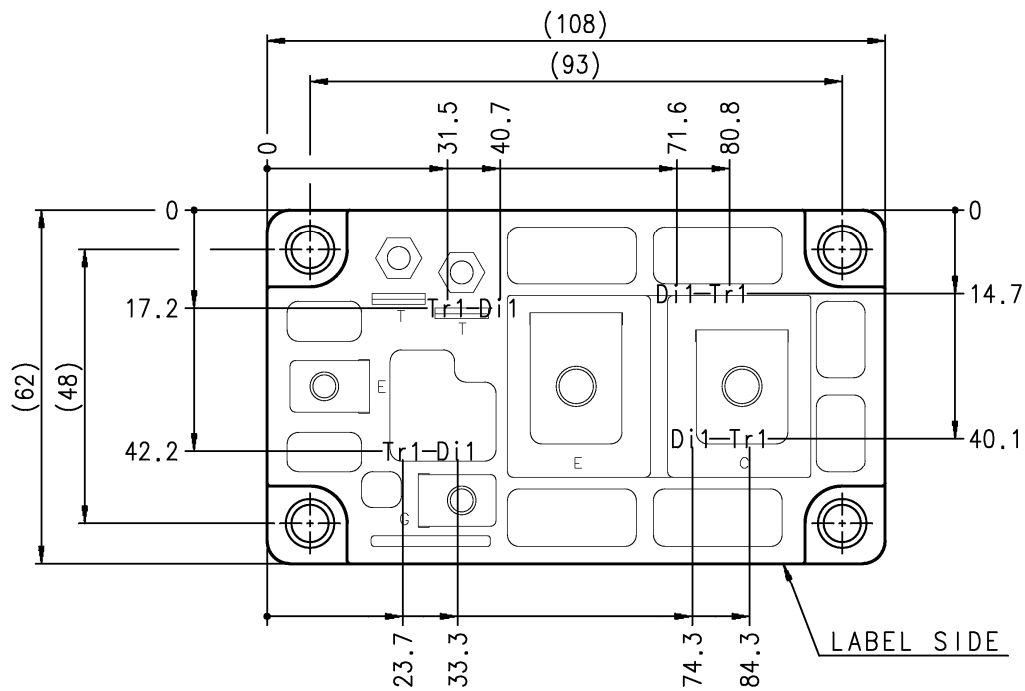
Note.6: Pulse width and repetition rate should be such as to cause negligible temperature rise.

(Refer to the figure of test circuit)

Note.7: Typical value is measured by using thermally conductive grease of $\lambda=0.9 \text{ W/(m}\cdot\text{K)}$.

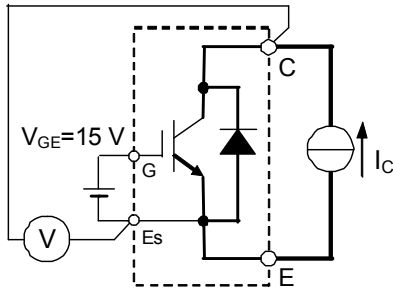
CHIP LOCATION (Top view)

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

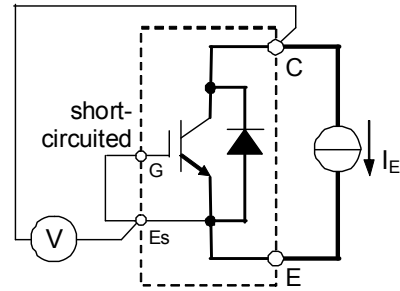


Tr1: IGBT, Di1: FWDi. Each mark points the center position of each chip.

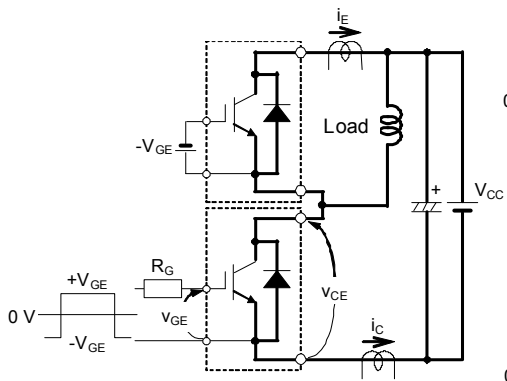
TEST CIRCUIT AND WAVEFORMS



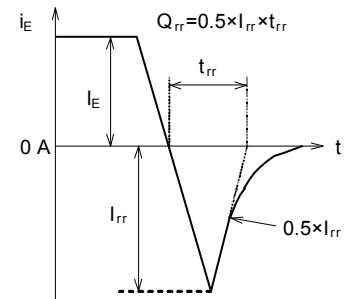
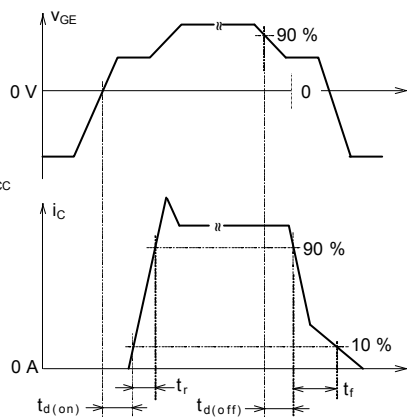
V_{CEsat} test circuit



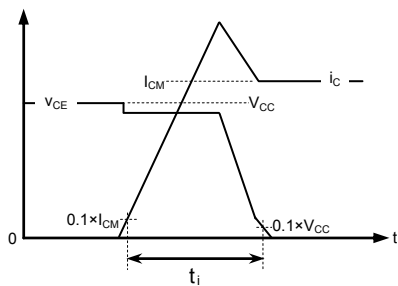
V_{EC} test circuit



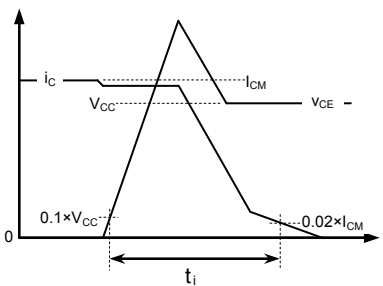
Switching characteristics test circuit and waveforms



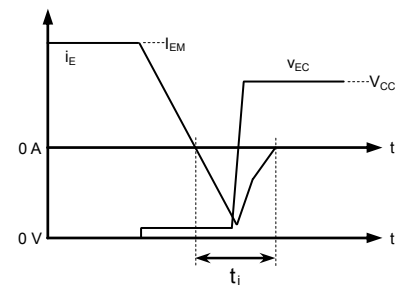
t_{rr} , Q_{rr} test waveform



IGBT Turn-on switching energy



IGBT Turn-off switching energy

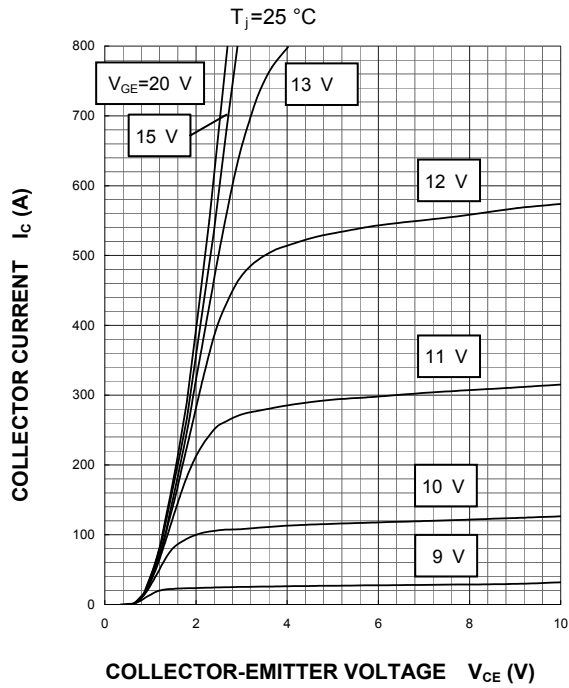


FWDi Reverse recovery energy

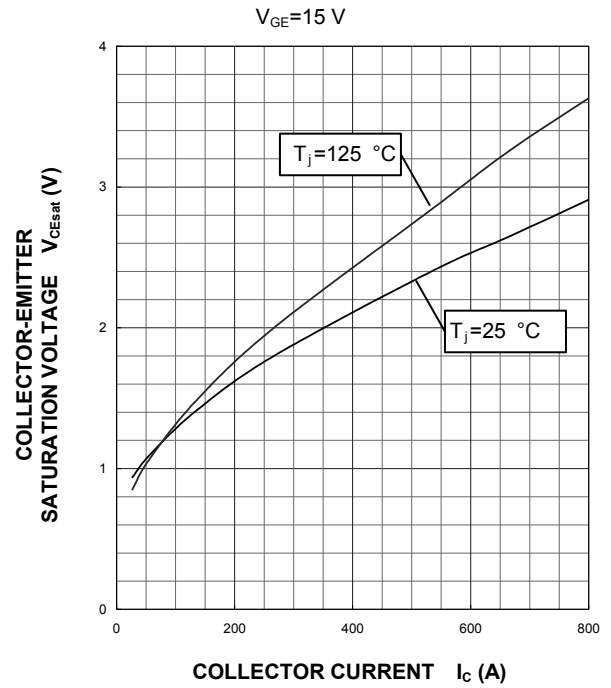
Turn-on, Turn-off switching and Reverse recovery energy test waveforms (integral range)

PERFORMANCE CURVES

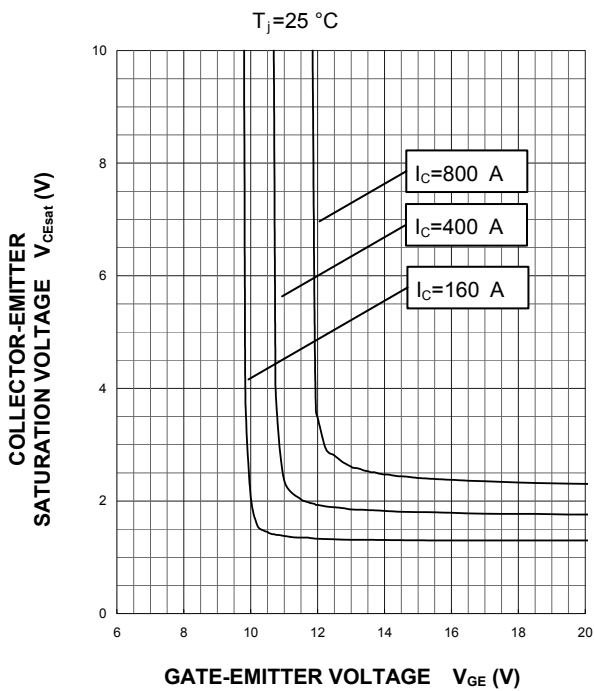
OUTPUT CHARACTERISTICS
(TYPICAL)



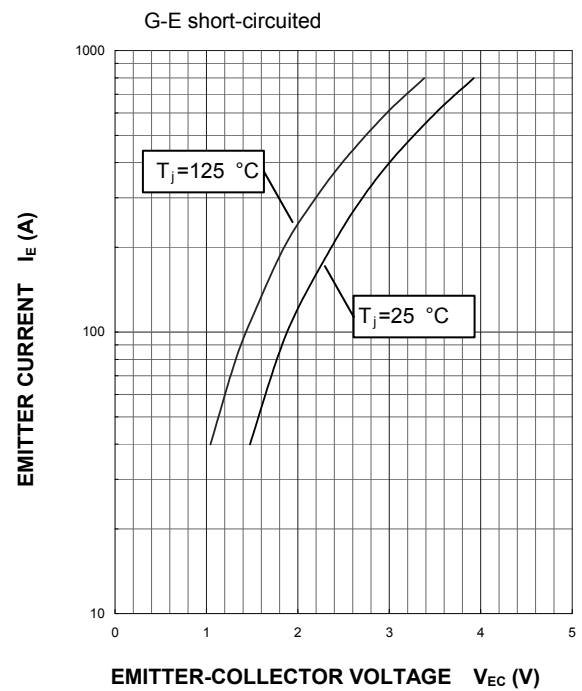
COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION
VOLTAGE CHARACTERISTICS
(TYPICAL)

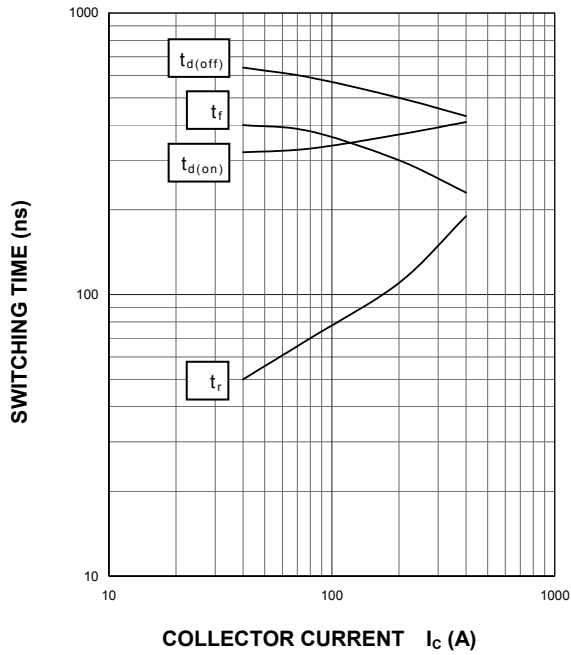


FREE WHEELING DIODE
FORWARD CHARACTERISTICS
(TYPICAL)



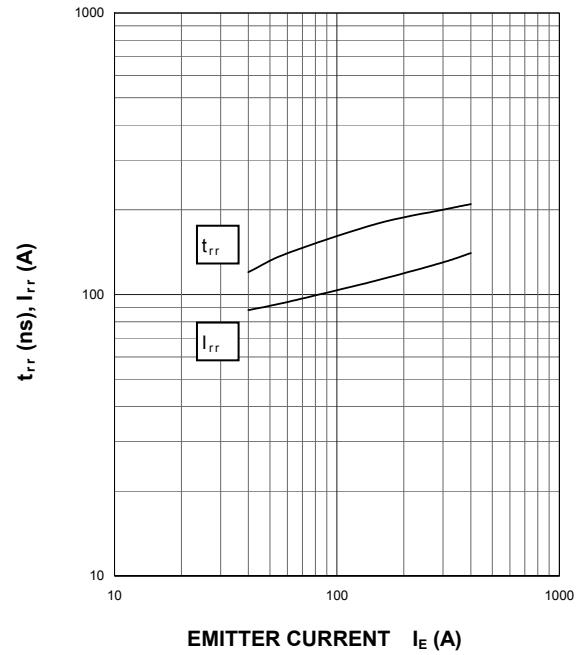
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.78\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
INDUCTIVE LOAD



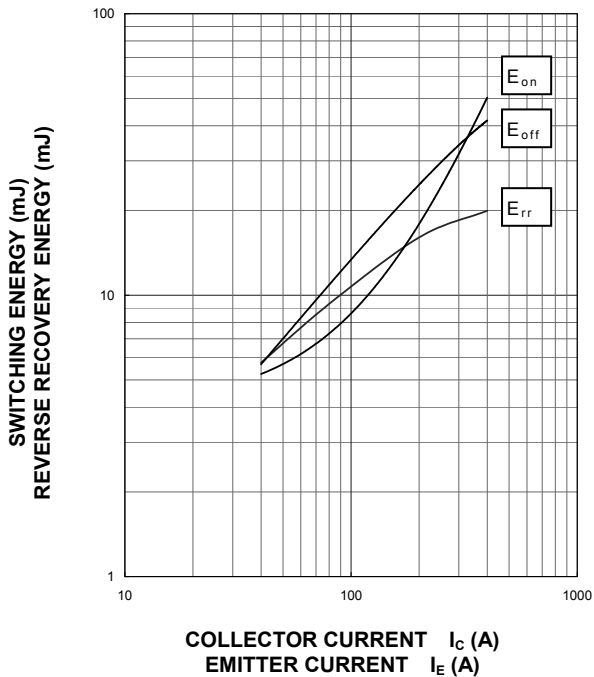
FREE WHEELING DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.78\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
INDUCTIVE LOAD



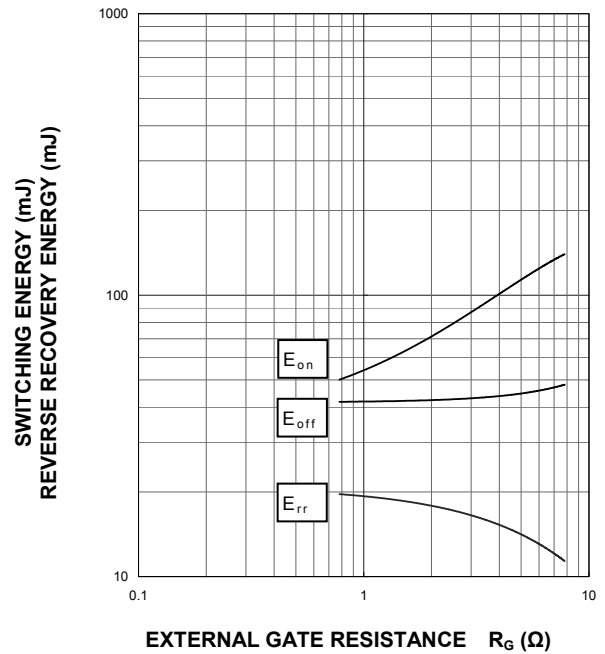
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

$V_{CC}=600\text{ V}$, $V_{GE}=\pm 15\text{ V}$, $R_G=0.78\ \Omega$, $T_j=125\text{ }^\circ\text{C}$
INDUCTIVE LOAD, PER PULSE

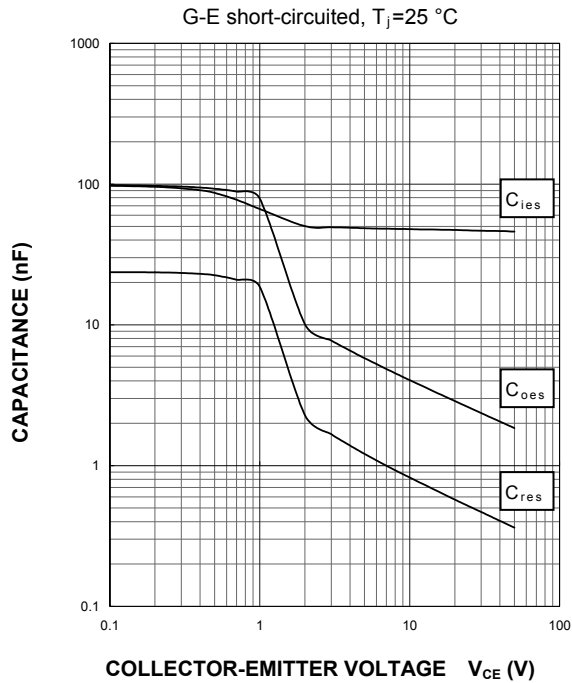


HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

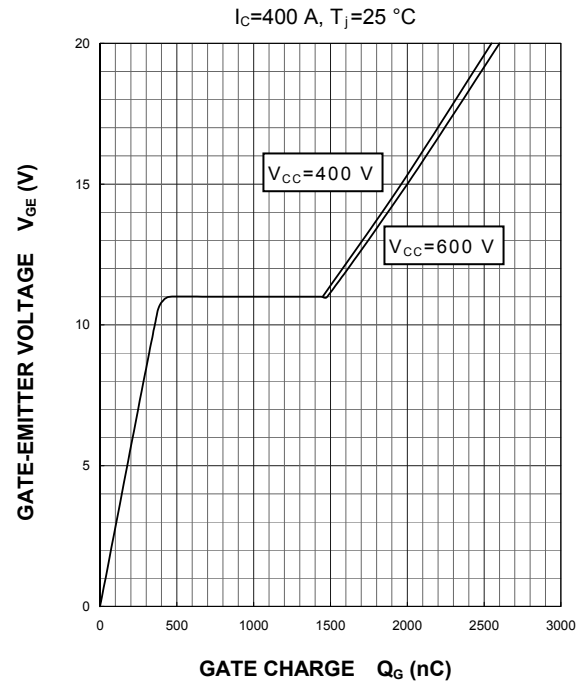
$V_{CC}=600\text{ V}$, $I_C/I_E=400\text{ A}$, $V_{GE}=\pm 15\text{ V}$, $T_j=125\text{ }^\circ\text{C}$
INDUCTIVE LOAD, PER PULSE



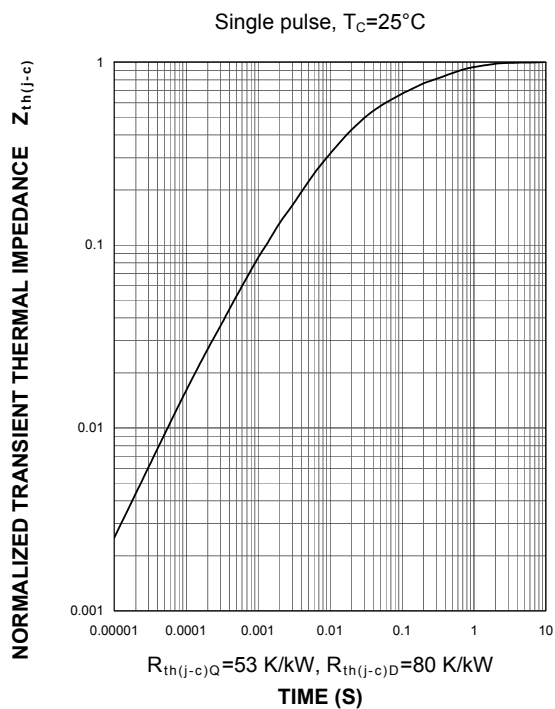
CAPACITANCE CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS (MAXIMUM)



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