MITSUBISHI ELECTRIC

<IGBT Modules>

CM400HA-24A

HIGH POWER SWITCHING USE
INSULATED TYPE

single switch

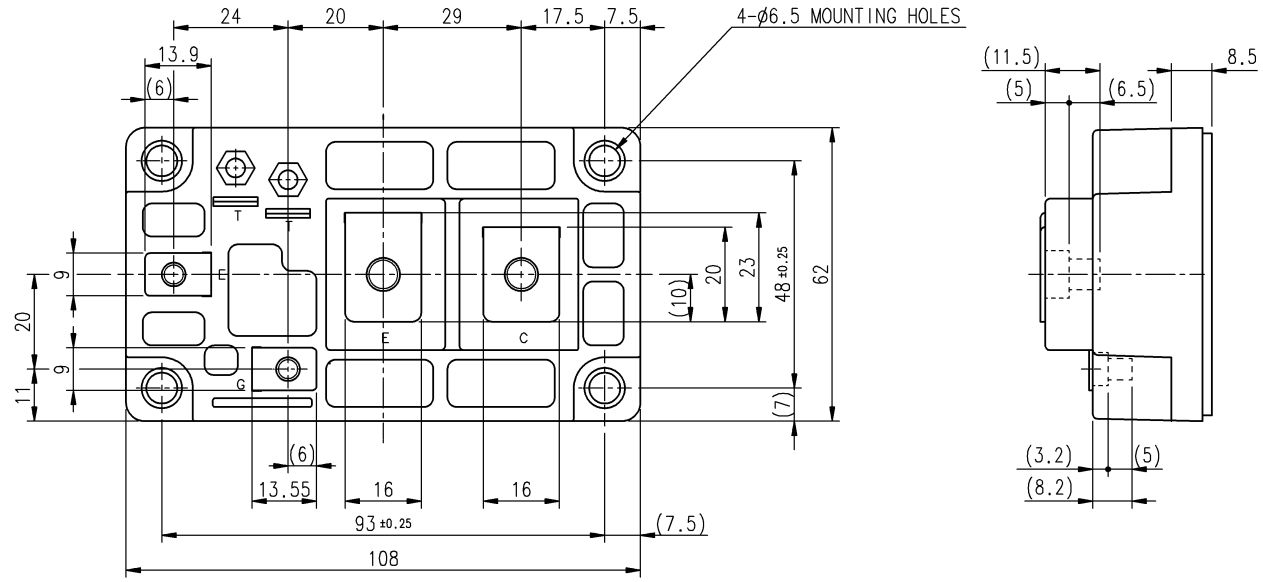
Collector current I_C ..... **400** A
Collector-emitter voltage V_{CES} ..... **1200** V
Maximum junction temperature T_{jmax} ..... **150** °C

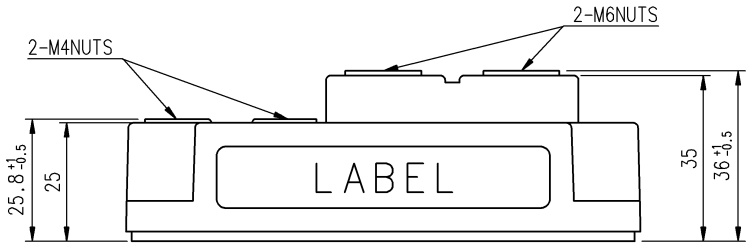
- ●Flatbase type
- ●Copper base plate (non-plating)
- ●Main terminal screws are not attached.
- ●RoHS Directive compliant
- ●Recognized under UL1557, File E323585

APPLICATION

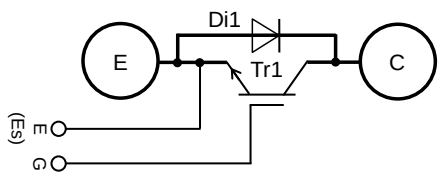
AC Motor Control, Motion/Servo Control, Power supply, etc.

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

CM400HA-24A

HIGH POWER SWITCHING USE
INSULATED TYPE

MAXIMUM RATINGS (T_j=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=87 °C (Note2, 4)	400	A
I_{CRM}		Pulse, Repetitive (Note3)	800	
P_{tot}	Total power dissipation	T_C=25 °C (Note2, 4)	2350	W
I_E (Note1)	Emitter current	DC (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	2500	V
T_j	Operating junction temperature	-	-40 ~ +150	°C
T_{stg}	Storage temperature	-	-40 ~ +125	

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		-	-	1.0	μA
$V_{GE(th)}$	Gate-emitter threshold voltage	I_C=40 mA, V_{CE}=10 V		6	7	8	V
V_{CEsat}	Collector-emitter saturation voltage	I_C=400 A, V_{GE}=15 V (Note5)	T_j=25 °C	-	2.1	3.0	V
		Refer to the figure of test circuit	T_j=125 °C	-	2.4	-	
C_{ies}	Input capacitance	V_{CE}=10 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 V, I_C=400 A, V_{GE}=15 V		-	2.0	-	μC
$t_{d(on)}$	Turn-on delay time	V_{CC}=600 V, I_C=400 A, V_{GE}=±15 V, R_G=0.78 Ω, 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 A, G-E short-circuited (Note5) Refer to the figure of test circuit			3.0	3.8	V
t_{rr} (Note1)	Reverse recovery time	V_{CC}=600 V, I_E=400 A, V_{GE}=±15 V, R_G=0.78 Ω, Inductive load		-	-	250	ns
Q_{rr} (Note1)	Reverse recovery charge			-	14.7	-	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=0.78 Ω, T_j=125 °C, Inductive load		-	50.4	-	mJ
E_{off}	Turn-off switching energy per pulse			-	41.8	-	
E_{rr} (Note1)	Reverse recovery energy per pulse			-	20	-	mJ
r_g	Internal gate resistance	T_c=25 °C (Note4)		-	1.5	-	Ω

THERMAL RESISTANCE CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to case, per IGBT (Note4)	-	-	53	K/kW
$R_{th(j-c)D}$		Junction to case, per FWD (Note4)	-	-	80	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, Thermal grease applied (Note4, 6)	-	20	-	K/kW

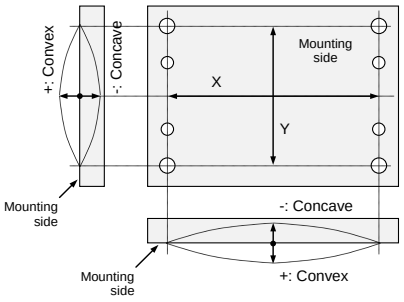
MECHANICAL CHARACTERISTICS

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
		G/E auxiliary terminals	M 4 screw	0.98	1.18	1.47	
M_s	Mounting torque	Mounting to heat sink	M 6 screw	1.96	2.45	2.94	N·m
m	mass	-		-	480	-	g
e_c	Flatness of base plate	On the centerline X, Y (Note7)		±0	-	+100	μm

*: This product is compliant with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) directive 2011/65/EU.

Note1. Represent ratings and characteristics of the anti-parallel, emitter-collector free-wheeling diode (FWD).

2. Junction temperature (T_{vj}) should not increase beyond T_{vjmax} rating.
3. Pulse width and repetition rate should be such that the device junction temperature (T_{vj}) dose not exceed T_{vjmax} rating.
4. 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.
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 λ=0.9 W/(m·K)
7. The base plate (mounting side) flatness measurement points (X, Y) are as follows of the following figure.

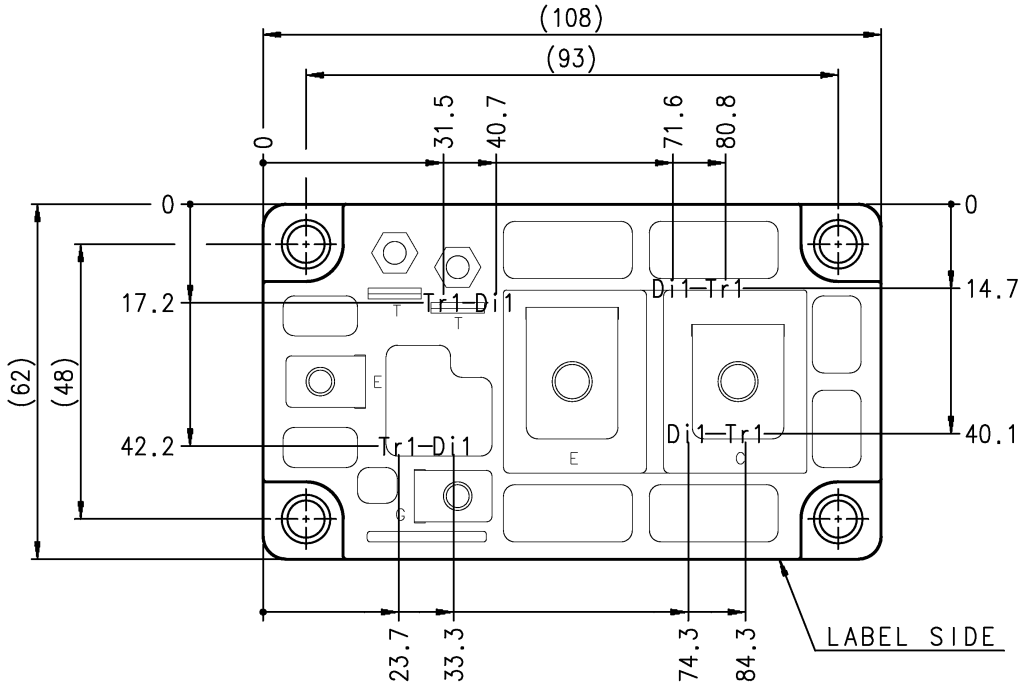


RECOMMENDED OPERATING CONDITIONS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{CC}	(DC) Supply voltage	Applied across C-E terminals	-	600	800	V
V_{GEon}	Gate (-emitter drive) voltage	Applied across G-Es terminals	13.5	15.0	16.5	V
R_G	External gate resistance	Per switch	0.78	-	10	Ω

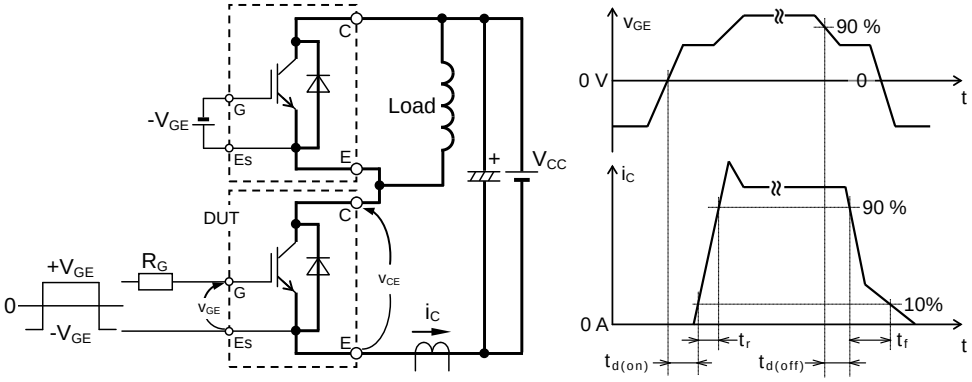
CHIP LOCATION (Top view)

Dimension in mm, tolerance: ±1 mm

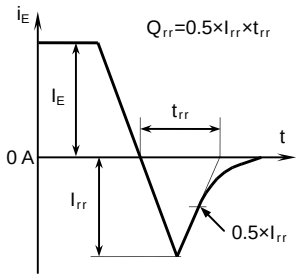


Tr1/Tr2: IGBT, Di1/Di2: FWD

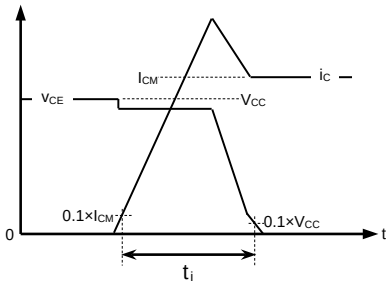
TEST CIRCUIT AND WAVEFORMS



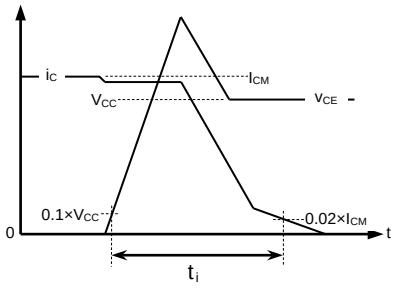
Switching characteristics test circuit and waveforms



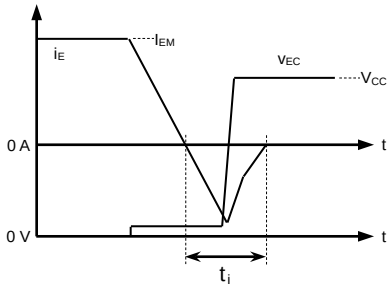
trr, Qrr characteristics test waveform



IGBT Turn-on switching energy



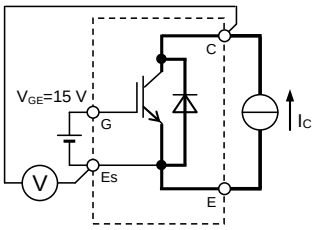
IGBT Turn-off switching energy



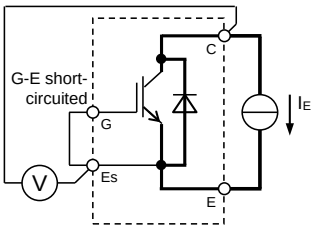
FWD Reverse recovery energy

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

TEST CIRCUIT



VCEsat characteristics test circuit

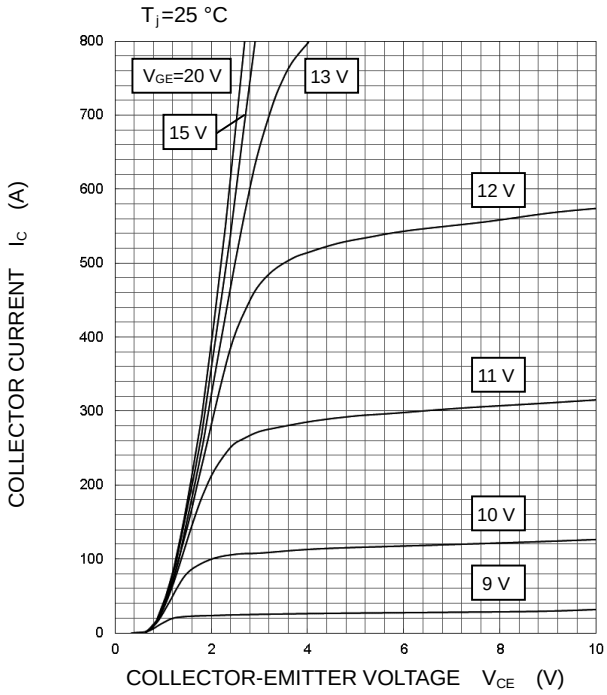


VEC characteristics test circuit

PERFORMANCE CURVES

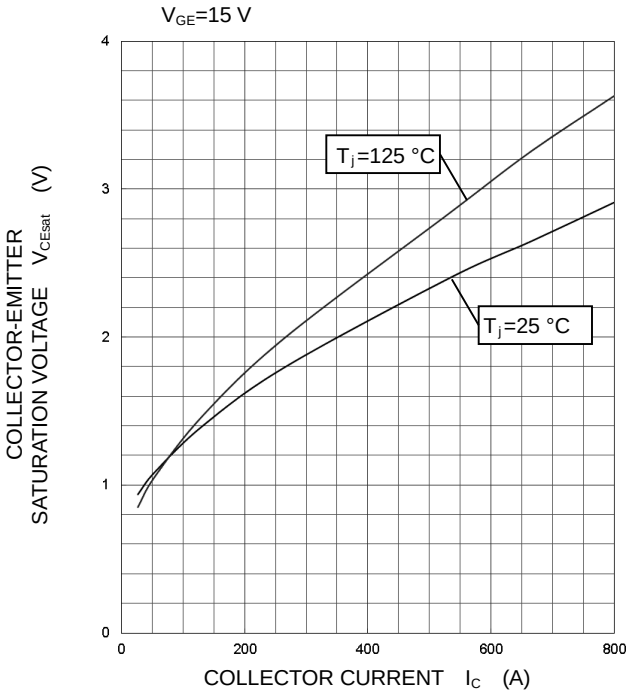
OUTPUT CHARACTERISTICS

(TYPICAL)



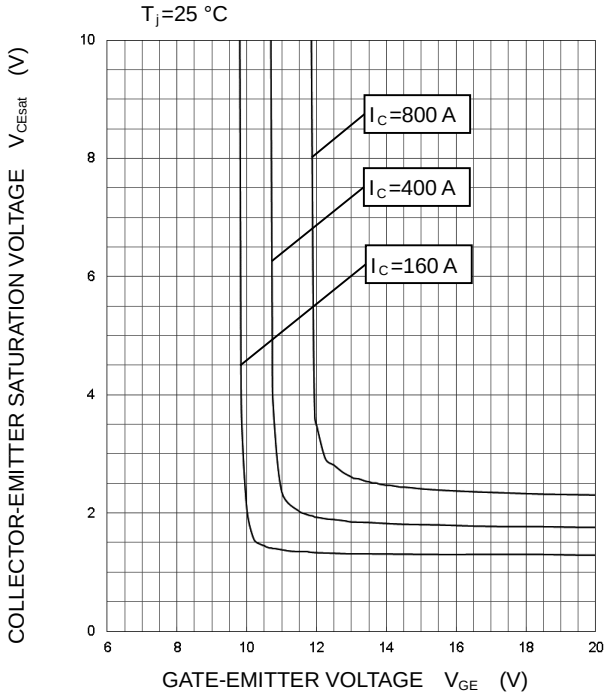
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



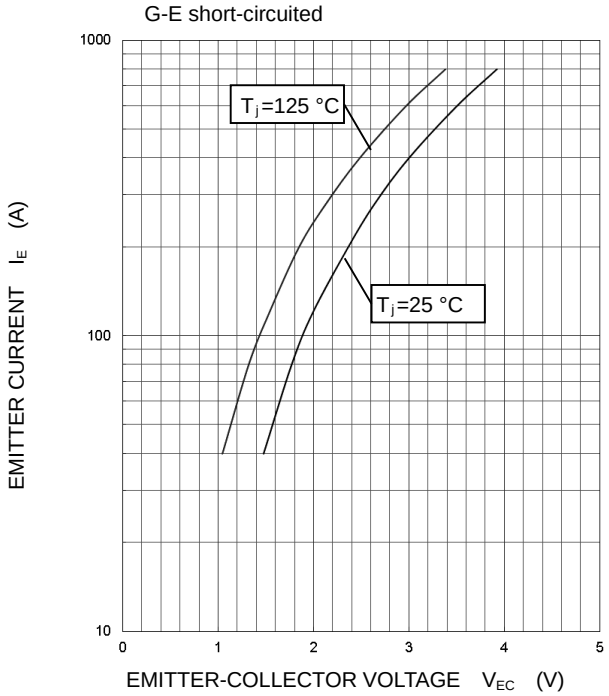
COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS

(TYPICAL)



FREE WHEELING DIODE FORWARD CHARACTERISTICS

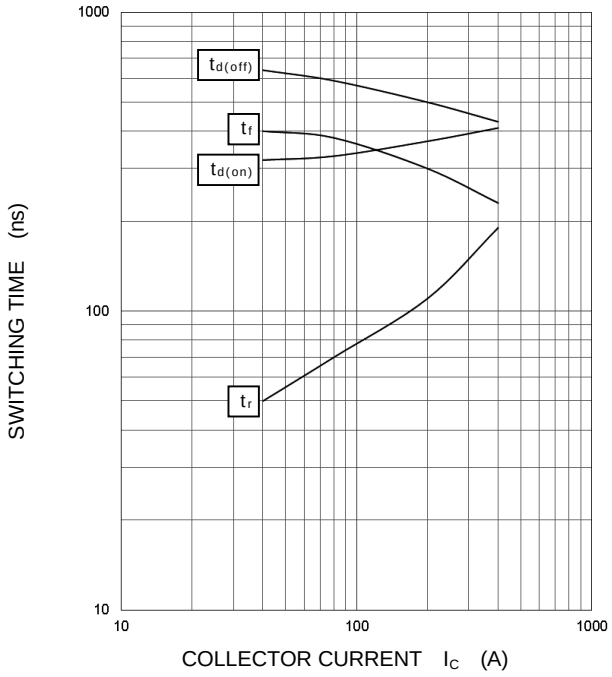
(TYPICAL)



PERFORMANCE CURVES

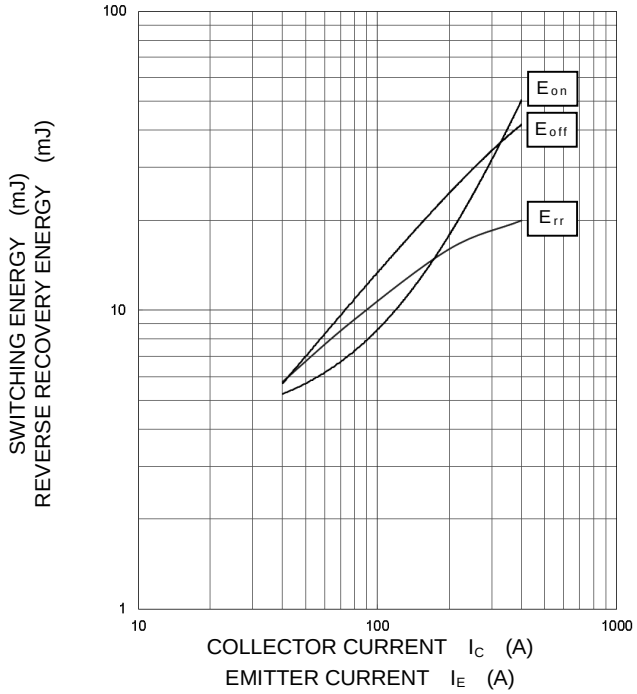
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=0.78 Ω,
T_j=125 °C, INDUCTIVE LOAD



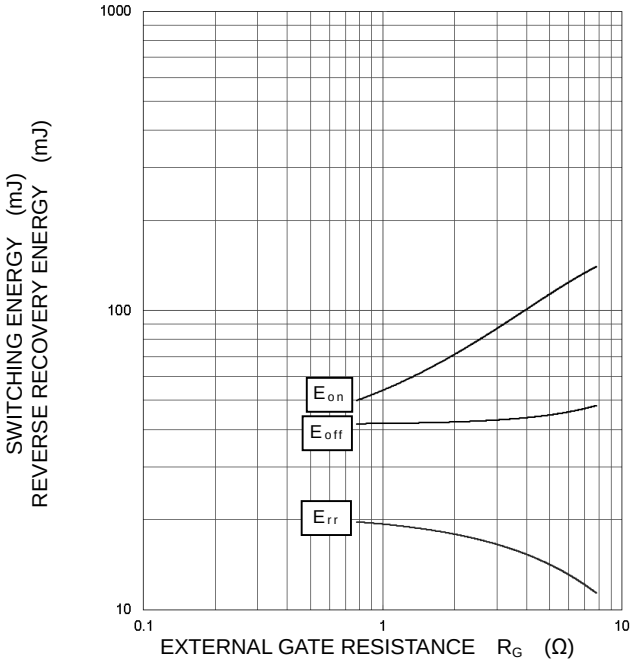
HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=0.78 Ω, T_j=125 °C
INDUCTIVE LOAD, PER PULSE



HALF-BRIDGE SWITCHING CHARACTERISTICS (TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, I_C/I_E=400 A, T_j=125 °C
INDUCTIVE LOAD, PER PULSE

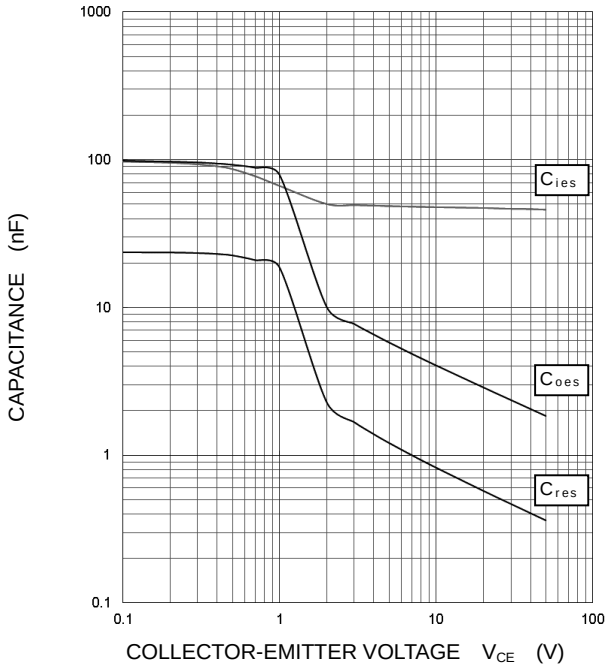


PERFORMANCE CURVES

CAPACITANCE CHARACTERISTICS

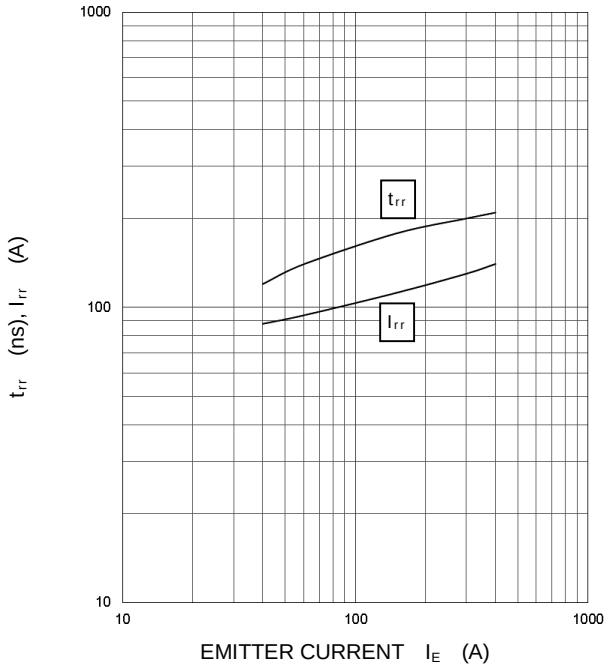
(TYPICAL)

G-E short-circuited, T_j=25 °C



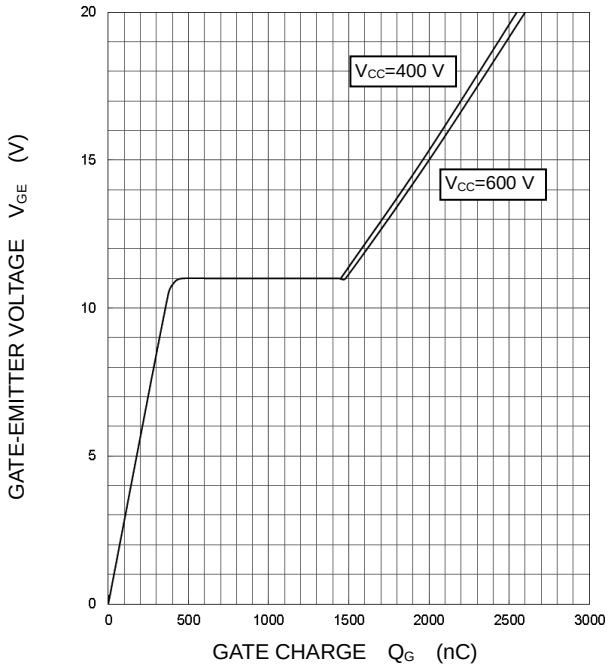
FREE WHEELING DIODE
REVERSE RECOVERY CHARACTERISTICS
(TYPICAL)

V_{CC}=600 V, V_{GE}=±15 V, R_G=0.78 Ω,
T_{vj}=125 °C. INDUCTIVE LOAD



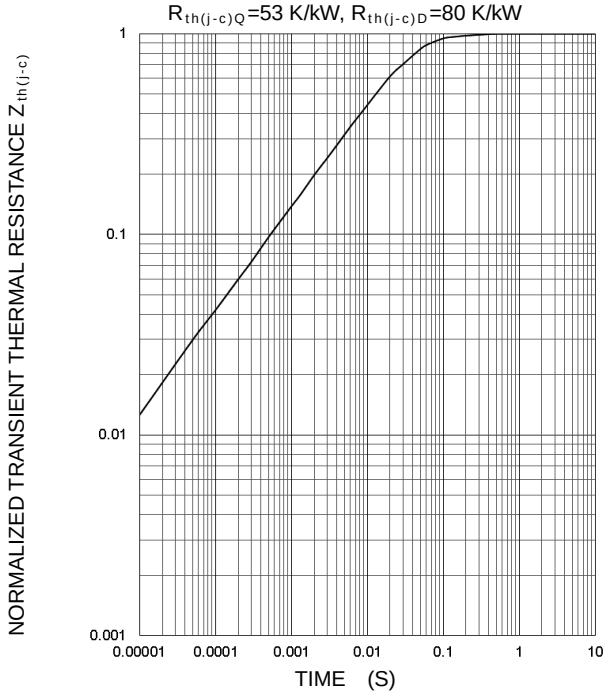
GATE CHARGE CHARACTERISTICS
(TYPICAL)

I_C=400 A, T_j=25 °C



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS
(MAXIMUM)

Single pulse, T_C=25 °C
$R_{th(j-c)Q}$=53 K/kW, $R_{th(j-c)D}$=80 K/kW

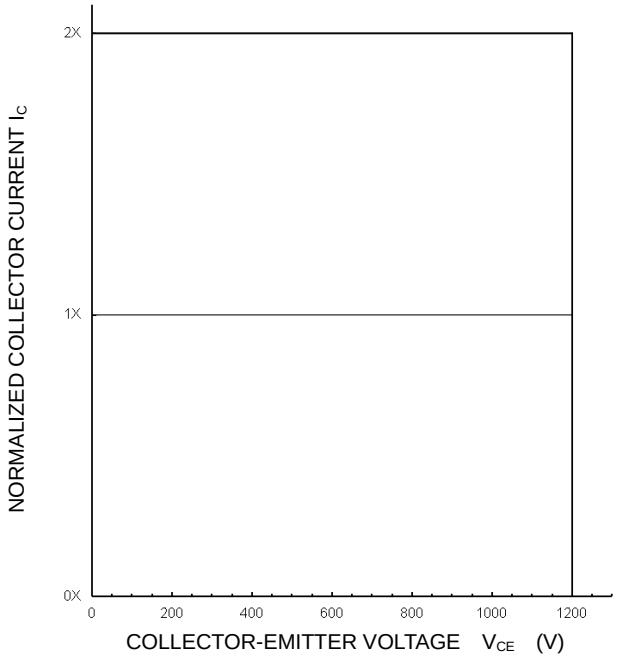


Note: The characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

PERFORMANCE CURVES

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

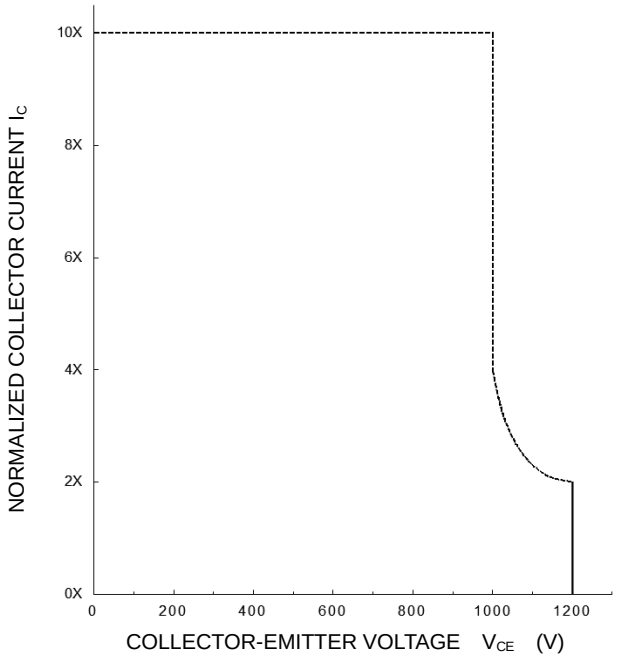
V_{CC}≤800 V, V_{GE}=±15 V, R_G=0.78~10 Ω, T_j=25~125 °C



SHORT-CIRCUIT SAFE OPERATING AREA

(MAXIMUM)

V_{CC}≤800 V, V_{GE}=±15 V, R_G=0.78~10 Ω,
T_j= 25 ~ 125 °C, t_W≤10 μs, Non-Repetitive



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