MITSUBISHI ELECTRIC

< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM400HG-66X

HIGH POWER SWITCHING USE
INSULATED TYPE 5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

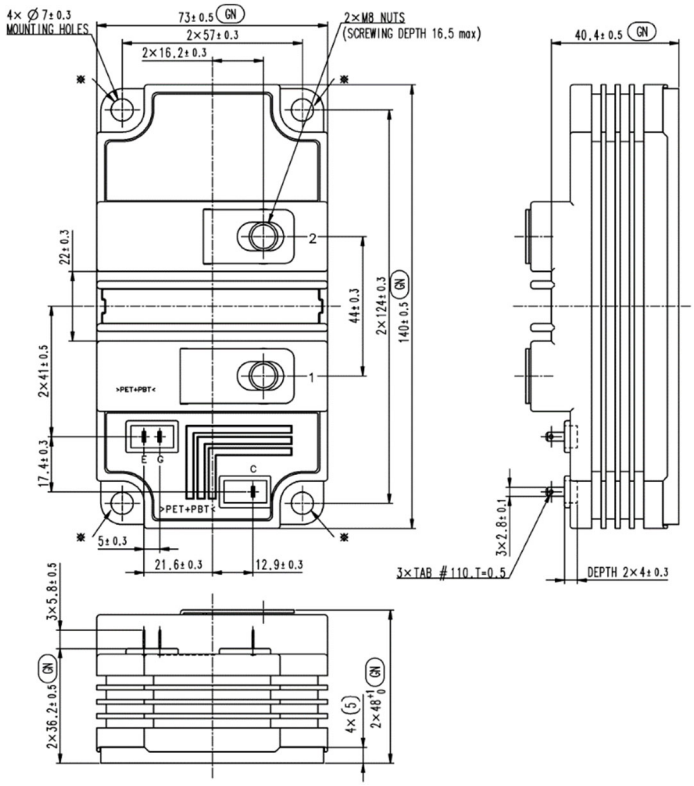
CM400HG-66X

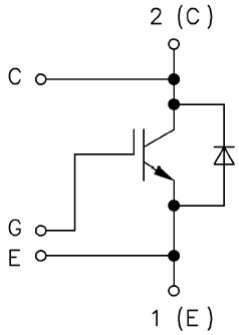
- I_C ..... 400 A
- V_{CES} ..... 3300 V
- 1-elements in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- AlSiC Baseplate

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM **Dimensions in mm**





CIRCUIT DIAGRAM

MAXIMUM RATINGS

Item	Symbol	Conditions	Ratings	Unit
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V, T_j = -40 ~ +125 °C	3300	V
Gate-emitter voltage	V_{GES}	V_{CE} = 0 V, T_j = 25 °C	±20	V
Collector current	I_C	T_c = 90 °C , DC	400	A
	I_{CRM}	Pulse (Note 1)	800	A
Emitter current (Note 2)	I_E	T_c = 90 °C , DC	400	A
	I_{ERM}	Pulse (Note 1)	800	A
Total power dissipation (Note 3)	P_{tot}	T_c = 25 °C , IGBT part (Note 1)	3590	W
Isolation voltage	V_{isol}	RMS, sinusoidal, f = 60 Hz, t = 1 min. T_c = 25 °C	10200	V_{rms}
Partial discharge charge	Q_{pd}	Charged part to the base-plate V1 = 6900 V_{rms}, V2 = 5100 V_{rms} AC 60 Hz, T_c = 25 °C (acc. to IEC 612287-1)	10	pC
Junction temperature	T_j	-	-40~+150	°C
Storage temperature	T_{stg}	-	-40~+125	°C
Operating junction temperature	T_{jop}	-	-40~+125	°C
Short circuit capability (maximum pulse width)	t_{pSC}	V_{GE} = ±15 V , V_{CC} ≤ 2500V, L_s ≤ 170nH, T_j = T_{jop}	10	µs

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Collector-emitter cut-off current	I_{CES}	V_{CE} = 3300 V , V_{GE} = 0 V	T_j = 25 °C	-	-	2.0	mA
			T_j = 125 °C	-	2.0	18.0	mA
Gate-emitter threshold voltage	$V_{GE(th)}$	V_{CE} = 10 V , I_C = 40mA	T_j = 25 °C	6.35	6.90	7.45	V
Gate leakage current	I_{GES}	V_{CE} = 0 V , V_{GE} = ±20 V	T_j = 25 °C	-0.5	-	0.5	µA
Gate charge	Q_G	V_{CC} = 1800 V , I_C = 400 A , V_{GE} = ±15 V	T_j = 25 °C	-	3.6	-	µC
Input capacitance	C_{ies}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100kHz	T_j = 25 °C	-	53.4	-	nF
Output capacitance	C_{oes}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100kHz	T_j = 25 °C	-	3.8	-	nF
Reverse transfer capacitance	C_{res}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100kHz	T_j = 25 °C	-	0.5	-	nF
Collector-emitter saturation voltage	V_{CEsat}	I_C = 400 A (Note 4) V_{GE} = +15 V	T_j = 25 °C	-	1.90	-	V
			T_j = 125 °C	-	2.30	2.80	V
Emitter-collector voltage (Note 2)	V_{EC}	I_E = 400 A (Note 4) V_{GE} = 0 V	T_j = 25 °C	-	1.90	-	V
			T_j = 125 °C	-	2.00	2.50	V
Turn-on delay time	$t_{d(on)}$	V_{CC} = 1800 V , I_C = 400 A V_{GE} = ±15 V , L_s = 170 nH $R_{G(on)}$ = 3.6 Ω , C_{GE} = 47 nF Inductine load	T_j = 125 °C	-	-	0.70	µs
Rise time	t_r		T_j = 125 °C	-	-	0.50	µs
Turn-on switching energy per pulse	E_{on}		T_j = 25 °C	-	0.97	-	J
			T_j = 125 °C	-	1.10	-	J
Turn-on switching energy per pulse (Note 5)	$E_{on(10\%)}$		T_j = 25 °C	-	0.94	-	J
			T_j = 125 °C	-	1.06	-	J

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Reverse recovery time (Note 2)	t_{rr}	V_{CC} = 1800 V , I_E = 400 A V_{GE} = ±15 V , L_s = 170 nH $R_{G(on)}$ = 3.6 Ω , C_{GE} = 47 nF Inductive load	T_j = 25 °C	-	1.18	-	µs
			T_j = 125 °C	-	1.46	-	µs
Reverse recovery current (Note 2)	I_{rr}		T_j = 25 °C	-	530	-	A
			T_j = 125 °C	-	540	-	A
Reverse recovered charge (Note 2)	Q_{rr}		T_j = 25 °C	-	480	-	µC
			T_j = 125 °C	-	640	-	µC
Reverse recovered charge (Note 2, 6)	$Q_{rr(10\%)}$		T_j = 25 °C	-	470	-	µC
			T_j = 125 °C	-	610	-	µC
Reverse recovery energy per pulse (Note 2)	E_{rec}		T_j = 25 °C	-	0.43	-	J
			T_j = 125 °C	-	0.64	-	J
Reverse recovery energy per pulse (Note 2, 5)	$E_{rec(10\%)}$		T_j = 25 °C	-	0.40	-	J
			T_j = 125 °C	-	0.58	-	J
Turn-off delay time	$t_{d(off)}$	V_{CC} = 1800 V , I_C = 400 A V_{GE} = ±15 V , L_s = 170 nH $R_{G(off)}$ = 20 Ω , C_{GE} = 47 nF Inductive load	T_j = 125 °C	-	-	2.81	µs
Fall time	t_f		T_j = 125 °C	-	-	1.42	µs
Turn-off switching energy per pulse	E_{off}		T_j = 25 °C	-	0.52	-	J
			T_j = 125 °C	-	0.71	-	J
Turn-off switching energy per pulse (Note 5)	$E_{off(10\%)}$		T_j = 25 °C	-	0.48	-	J
			T_j = 125 °C	-	0.64	-	J

THERMAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Thermal resistance	$R_{th(j-c)Q}$	Junction to case, IGBT part	-	-	32.5	K/kW
Thermal resistance	$R_{th(j-c)D}$	Junction to case, FWDi part	-	-	38.5	K/kW
Contact thermal resistance	$R_{th(c-s)}$	Case to heat sink λ_{grease} = 1W/m·K, $D_{(c-s)}$ = 100 µm	-	19.8	-	K/kW

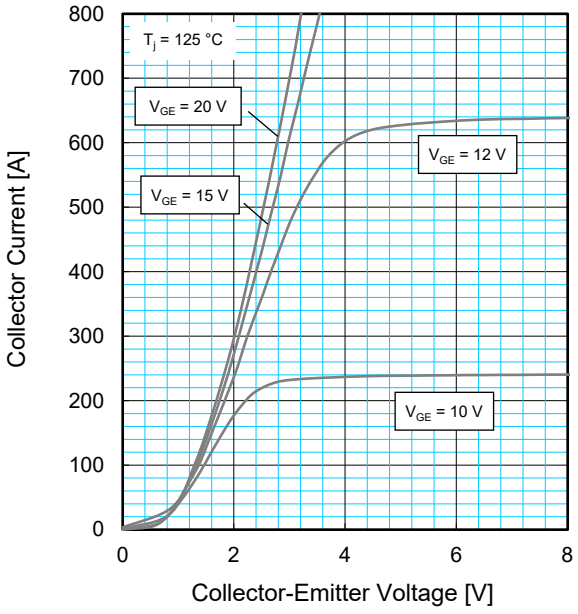
MECHANICAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Mounting torque	M_t	Main terminals screw: M8	7.0	-	15.0	N·m
Mounting torque	M_s	Mounting screw: M6	3.0	-	6.0	N·m
Mass	m	-	-	0.5	-	kg
Comparative tracking index	CTI	-	600	-	-	-
Clearance distance in air	d_a	-	26.0	-	-	mm
Creepage distance along surface	d_s	-	56.0	-	-	mm
Internal inductance (C-E)	$L_{P(C-E)}$	-	-	42.8	-	nH
Internal lead resistance, CC'-EE'	$R_{CC'+EE'}$	T_c = 25 °C	-	0.37	-	mΩ

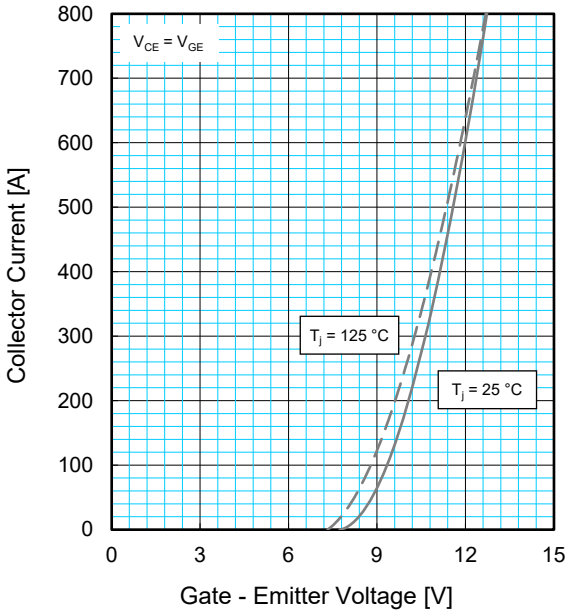
Note 1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed maximum T_{jop} rating (125°C).
Note 2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD_i).
Note 3. Junction temperature (T_j) should not exceed T_{j_max} rating (150°C).
Note 4. Pulse width and repetition rate should be such as to cause negligible temperature rise.
Note 5. The integration range of switching energies is from 10%V_{CE} to 10%I_C(I_E).
Note 6. The integration range of reverse recovery charge is from I_E=0A to 10%I_E

PERFORMANCE CURVES

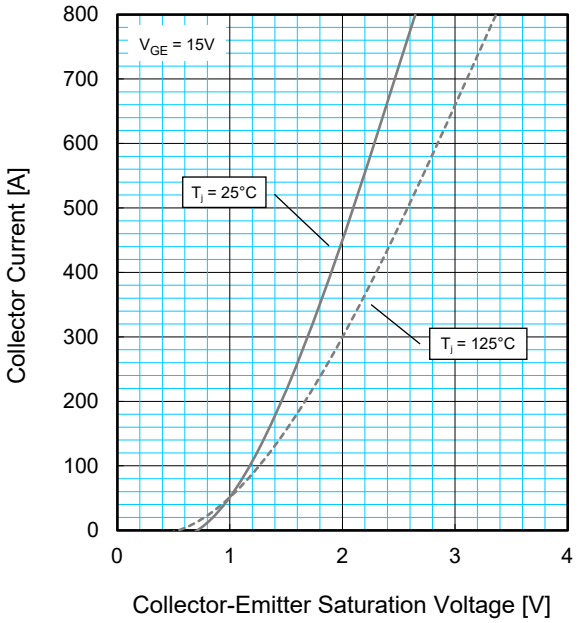
OUTPUT CHARACTERISTICS (TYPICAL)



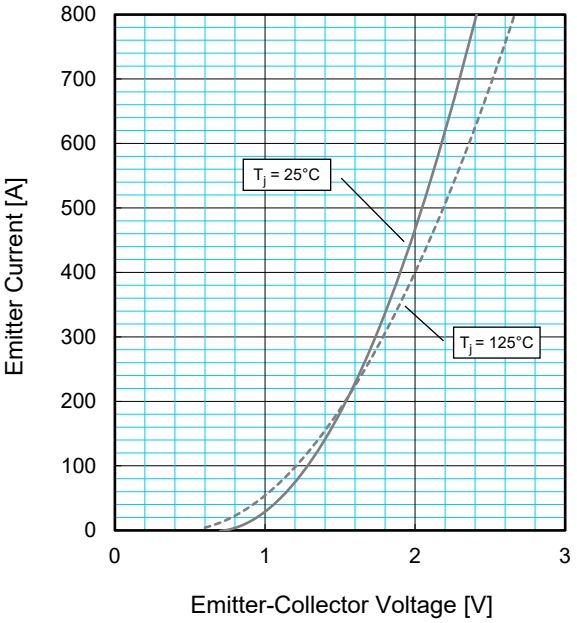
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

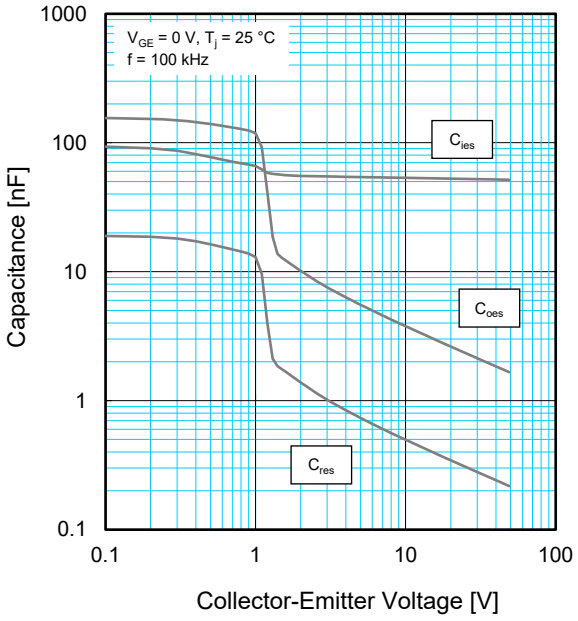


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

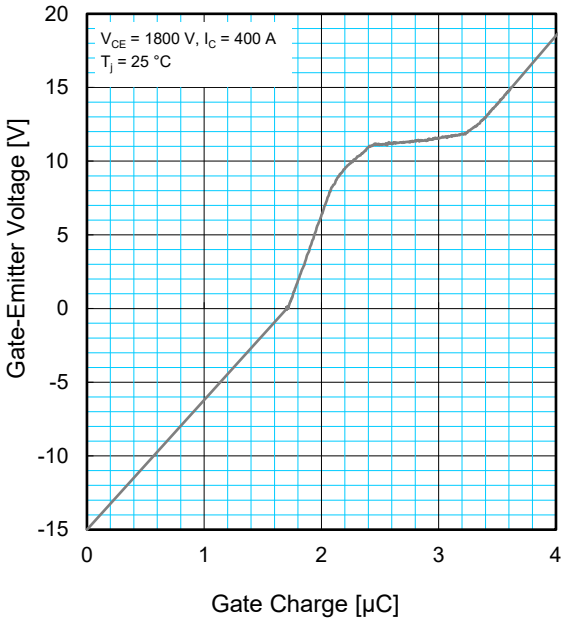


PERFORMANCE CURVES

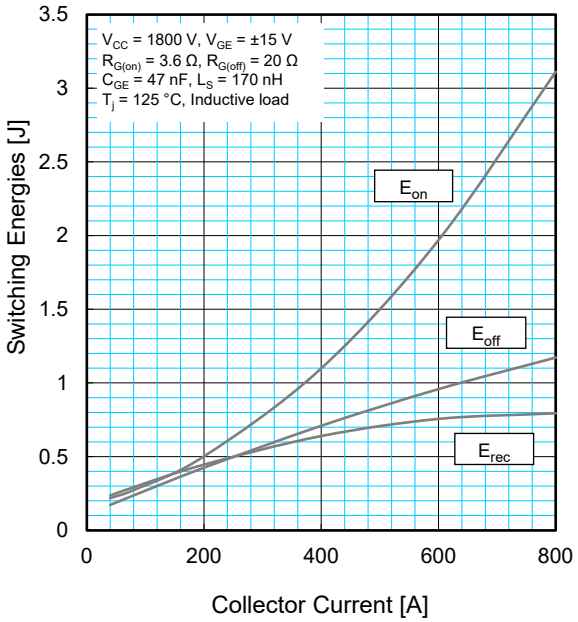
CAPACITANCE CHARACTERISTICS (TYPICAL)



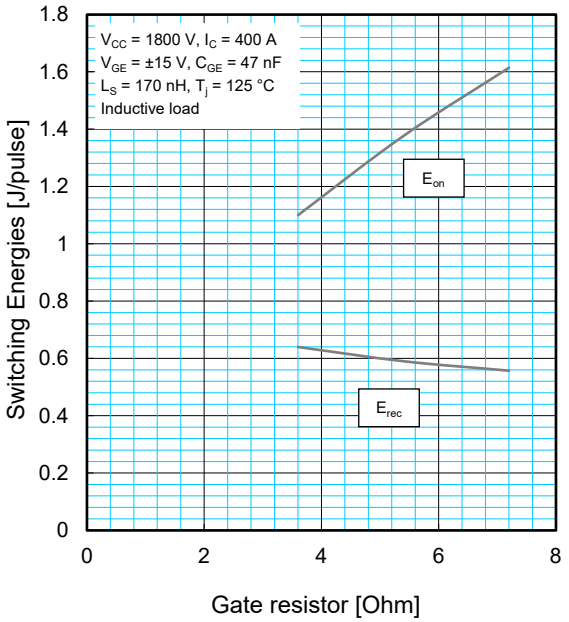
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

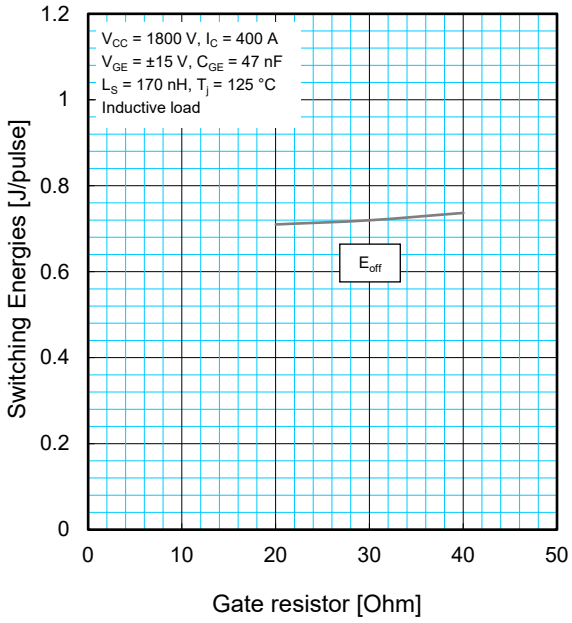


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

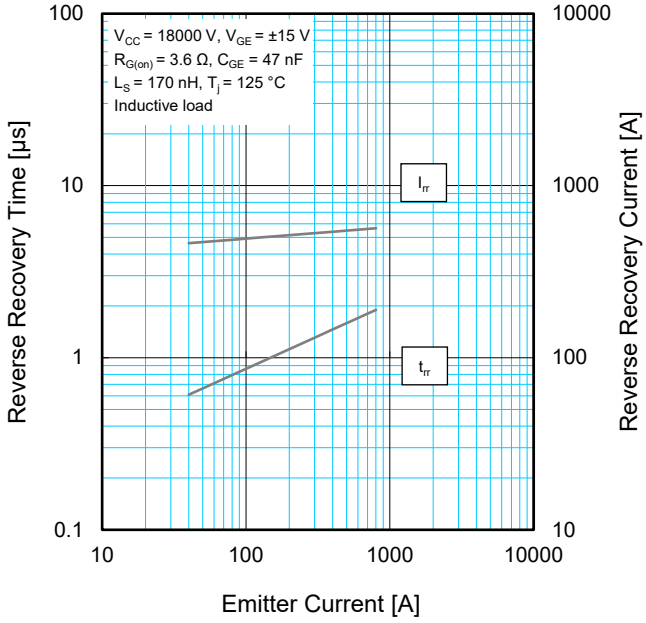


PERFORMANCE CURVES

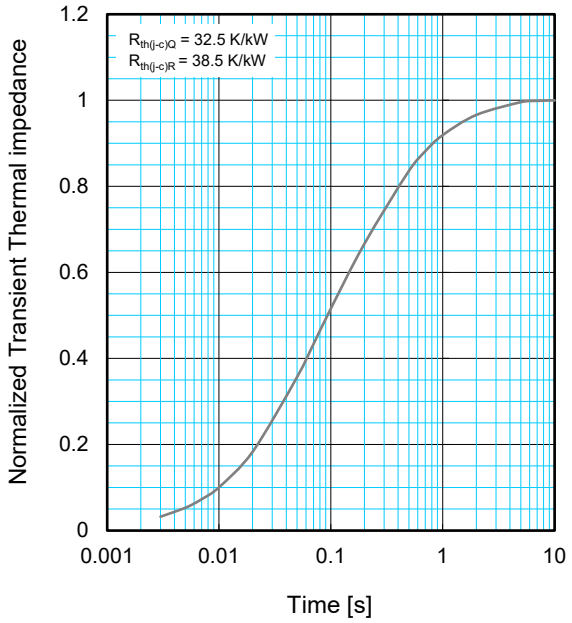
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

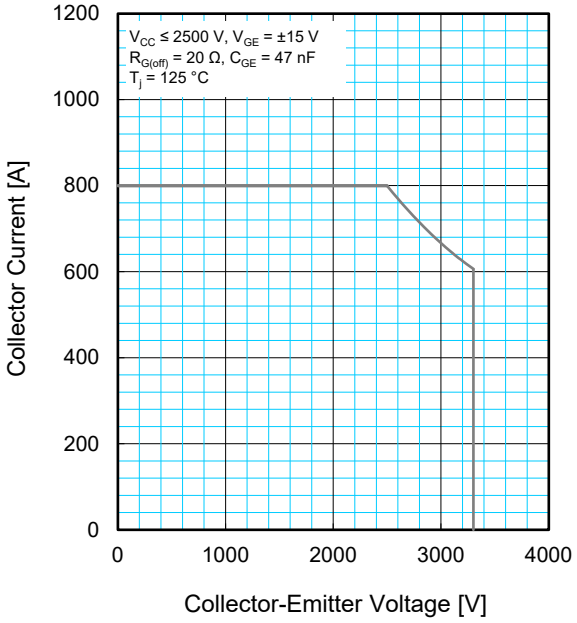


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{1 - exp\left(-\frac{t}{\tau_i}\right)\right\}$$

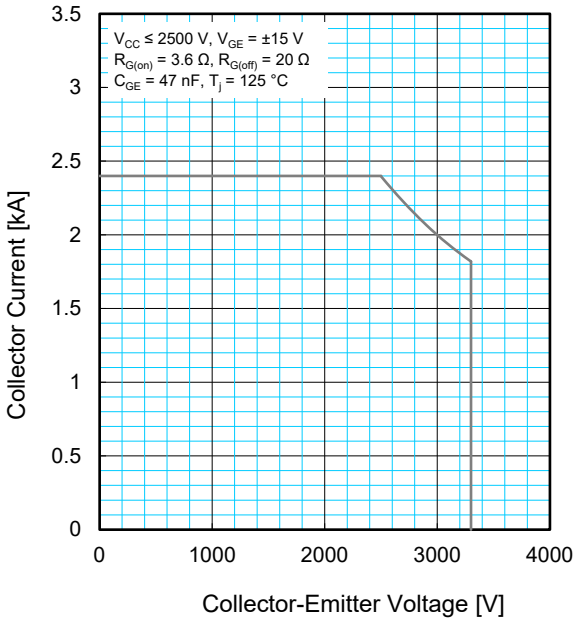
	1	2	3	4
R_i / $R_{th(j-c)}$	0.2859	0.2677	0.3171	0.1293
τ_i [s]	0.1383	0.3486	0.0385	1.4684

PERFORMANCE CURVES

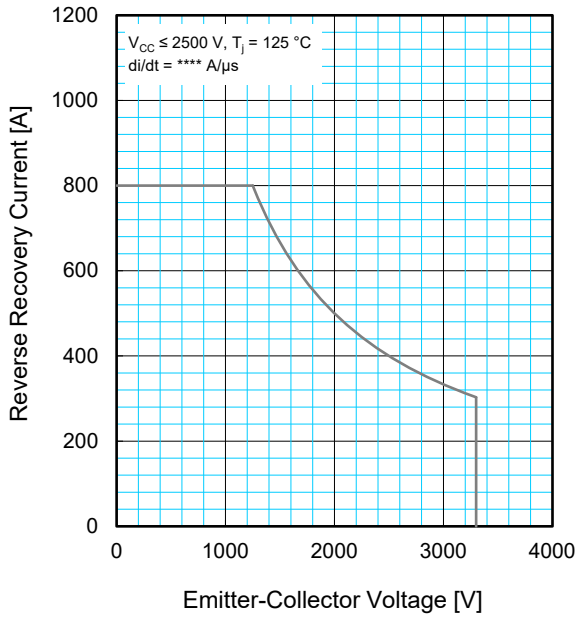
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



FREE-WHEEL DIODE REVERSE RECOVERY SAFE OPERATING AREA (RRSOA)



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