MITSUBISHI ELECTRIC

< HVIGBT MODULES >

CM1200HG-90R

HIGH POWER SWITCHING USE
INSULATED TYPE

4th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

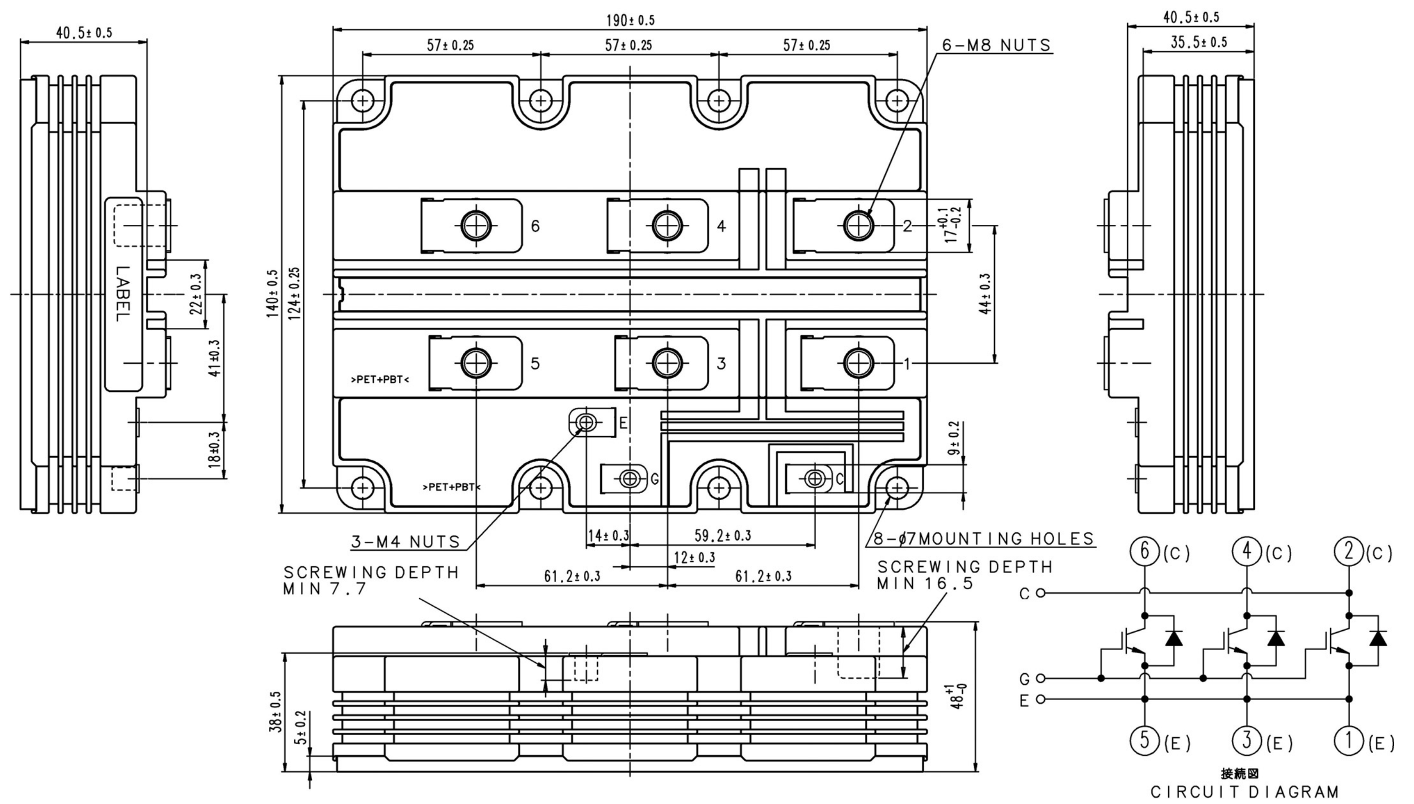
CM1200HG-90R

- I_C 1200A
- V_{CES} 4500V
- 1-element in a pack
- High Insulated type
- LPT-IGBT / Soft Recovery Diode
- AlSiC baseplate

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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



MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{CES}	Collector-emitter voltage	V_{GE} = 0V, T_j = -40…+125°C	4500	V
		V_{GE} = 0V, T_j = −50°C	4400	
V_{GES}	Gate-emitter voltage	V_{CE} = 0V, T_j = 25°C	± 20	V
I_C	Collector current	DC, T_c = 85°C	1200	A
I_{CRM}		Pulse (Note 1)	2400	A
I_E	Emitter current (Note 2)	DC	1200	A
I_{ERM}		Pulse (Note 1)	2400	A
P_{tot}	Maximum power dissipation (Note 3)	T_c = 25°C, IGBT part	11900	W
V_{iso}	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1 min.	10200	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, f = 60Hz, Q_{PD} ≤ 10 pC	5100	V
T_j	Junction temperature		−50 ~ +150	°C
T_{jop}	Operating junction temperature		−50 ~ +125	°C
T_{stg}	Storage temperature		−55 ~ +125	°C
t_{psc}	Short circuit pulse width	V_{CC} = 3200V, V_{CE} ≤ V_{CES}, V_{GE} =15V, T_j =125°C	10	µs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
I_{CES}	Collector cutoff current	V_{CE} = V_{CES}, V_{GE} = 0V	T_j = 25°C	—	—	16.0	mA
			T_j = 125°C	—	16.0	—	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE} = 10 V, I_C = 120 mA, T_j = 25°C		5.8	6.3	6.8	V
I_{GES}	Gate leakage current	V_{GE} = V_{GES}, V_{CE} = 0V, T_j = 25°C		−0.5	—	0.5	μA
C_{ies}	Input capacitance	V_{CE} = 10 V, V_{GE} = 0 V, f = 100 kHz T_j = 25°C		—	175.0	—	nF
C_{oes}	Output capacitance			—	11.0	—	nF
C_{res}	Reverse transfer capacitance			—	5.0	—	nF
Q_G	Total gate charge	V_{CC} = 2800V, I_C = 1200A, V_{GE} = ±15V		—	13.5	—	μC
V_{CEsat}	Collector-emitter saturation voltage	I_C = 1200 A (Note 4) V_{GE} = 15 V	T_j = 25°C	—	3.50	—	V
			T_j = 125°C	—	4.40	5.10	
$t_{d(on)}$	Turn-on delay time	V_{CC} = 2800 V I_C = 1200 A V_{GE} = ±15 V $R_{G(on)}$ = 2.7 Ω L_s = 150 nH Inductive load	T_j = 25°C	—	1.00	—	μs
			T_j = 125°C	—	0.95	1.50	
t_r	Turn-on rise time		T_j = 25°C	—	0.28	—	μs
			T_j = 125°C	—	0.30	0.50	
$E_{on(10\%)}$	Turn-on switching energy (Note 5)		T_j = 25°C	—	4.30	—	J
			T_j = 125°C	—	5.10	—	
E_{on}	Turn-on switching energy (Note 6)		T_j = 25°C	—	4.60	—	J
			T_j = 125°C	—	5.50	—	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 2800 V I_C = 1200 A V_{GE} = ±15 V $R_{G(off)}$ = 10 Ω L_s = 150 nH Inductive load	T_j = 25°C	—	3.60	—	μs
			T_j = 125°C	—	3.80	5.00	
t_f	Turn-off fall time		T_j = 25°C	—	0.35	—	μs
			T_j = 125°C	—	0.45	1.00	
$E_{off(10\%)}$	Turn-off switching energy (Note 5)		T_j = 25°C	—	2.90	—	J
			T_j = 125°C	—	3.85	—	
E_{off}	Turn-off switching energy (Note 6)		T_j = 25°C	—	3.20	—	J
			T_j = 125°C	—	4.30	—	

ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 1200 A (Note 4) V_{GE} = 0 V	T_j = 25°C	—	2.50	—	V
			T_j = 125°C	—	2.80	3.40	
t_{rr}	Reverse recovery time (Note 2)	V_{CC} = 2800 V I_C = 1200 A V_{GE} = ±15 V $R_{G(on)}$ = 2.7 Ω L_s = 150 nH Inductive load	T_j = 25°C	—	0.70	—	μs
			T_j = 125°C	—	0.90	—	
I_{rr}	Reverse recovery current (Note 2)		T_j = 25°C	—	1100	—	A
			T_j = 125°C	—	1200	—	
Q_{rr}	Reverse recovery charge (Note 2)		T_j = 25°C	—	1000	—	μC
			T_j = 125°C	—	1500	—	
$E_{rec(10\%)}$	Reverse recovery energy (Note 2) (Note 5)		T_j = 25°C	—	1.30	—	J
			T_j = 125°C	—	2.10	—	
E_{rec}	Reverse recovery energy (Note 2) (Note 6)		T_j = 25°C	—	1.55	—	J
			T_j = 125°C	—	2.40	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part	—	—	10.5	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part	—	—	19.5	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, λ_{grease} = 1W/m·k, $D_{(c-s)}$ = 100μm	—	6.0	—	K/kW

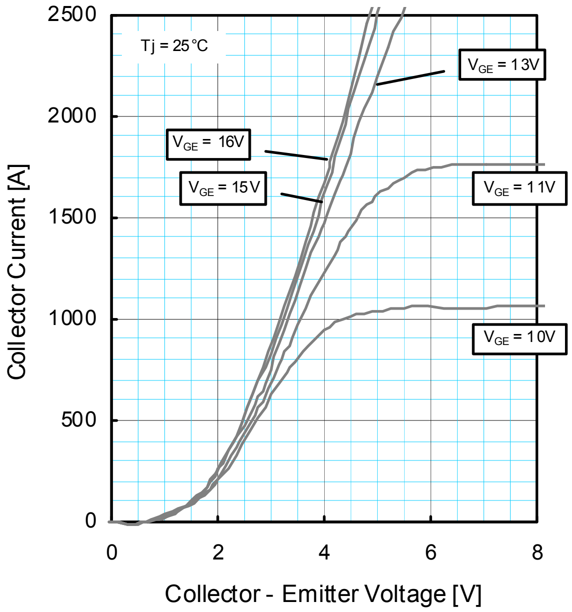
MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
M_t	Mounting torque	M8 : Main terminals screw	7.0	—	22.0	N·m
M_s		M6 : Mounting screw	3.0	—	6.0	N·m
M_t		M4 : Auxiliary terminals screw	1.0	—	3.0	N·m
m	Mass		—	1.4	—	kg
CTI	Comparative tracking index		600	—	—	—
d_a	Clearance		26.0	—	—	mm
d_s	Creepage distance		56.0	—	—	mm
$L_{P\ CE}$	Parasitic stray inductance		—	15.0	—	nH
$R_{CC'+EE'}$	Internal lead resistance	T_C = 25°C	—	0.18	—	mΩ
r_g	Internal gate resistance	T_C = 25°C	—	1.7	—	Ω

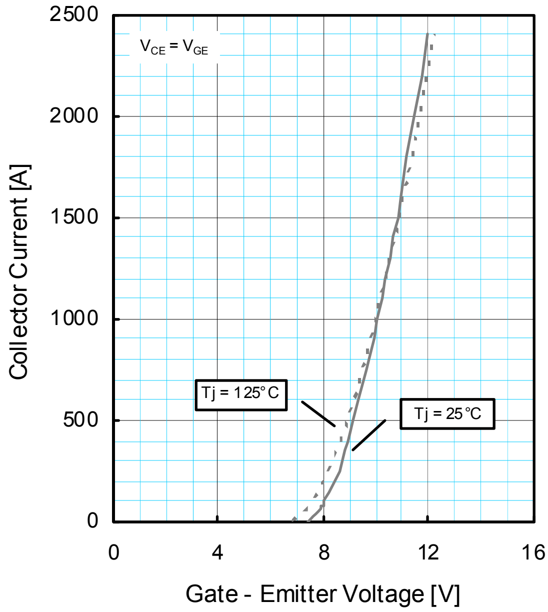
Note1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jopmax} rating.
2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD_i).
3. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).
4. Pulse width and repetition rate should be such as to cause negligible temperature rise.
5. $E_{on(10\%)}$ / $E_{off(10\%)}$ / $E_{rec(10\%)}$ are the integral of $0.1V_{CE}\ x\ 0.1I_C\ x\ dt$.
6. Definition of all items is according to IEC 60747, unless otherwise specified.

PERFORMANCE CURVES

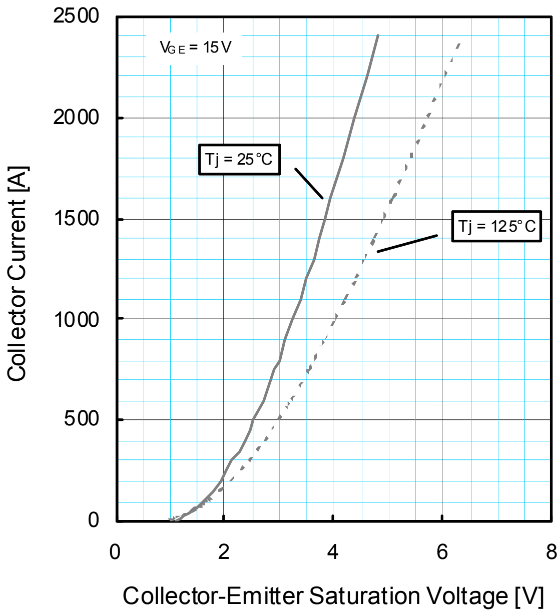
OUTPUT CHARACTERISTICS (TYPICAL)



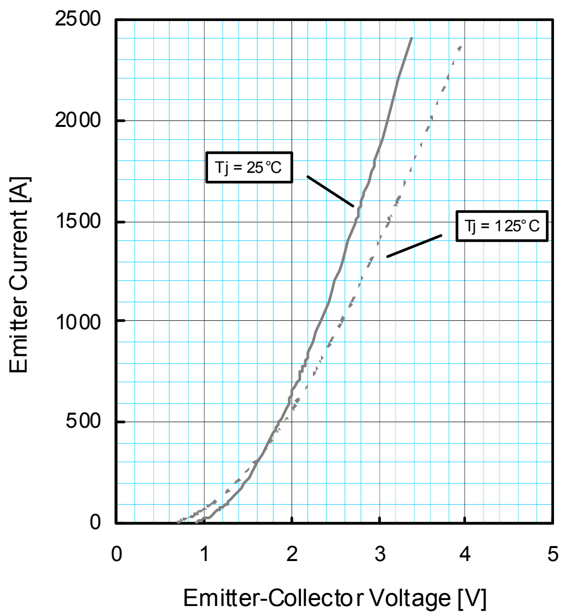
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

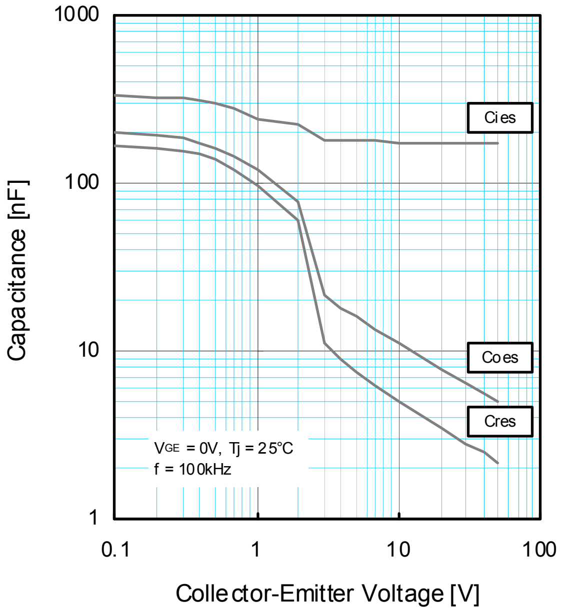


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

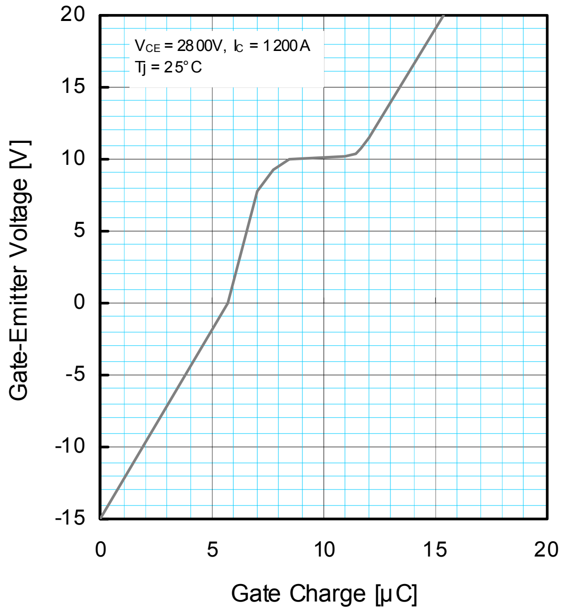


PERFORMANCE CURVES

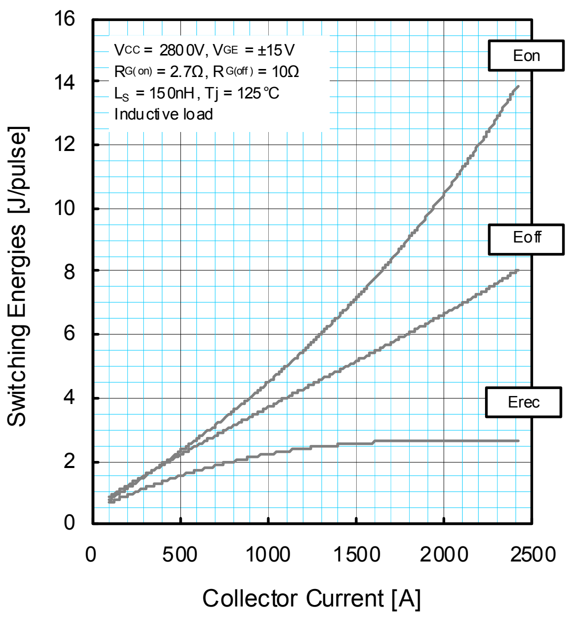
CAPACITANCE CHARACTERISTICS (TYPICAL)



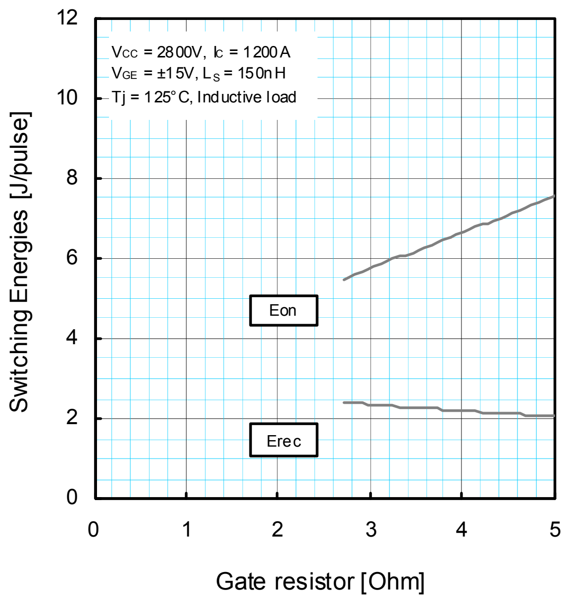
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

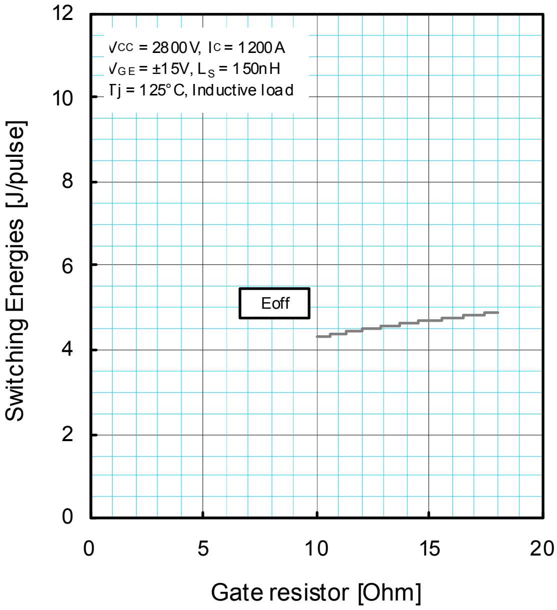


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

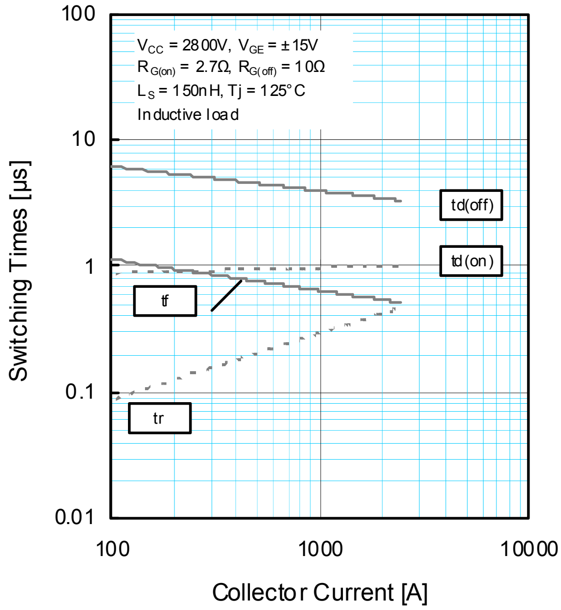


PERFORMANCE CURVES

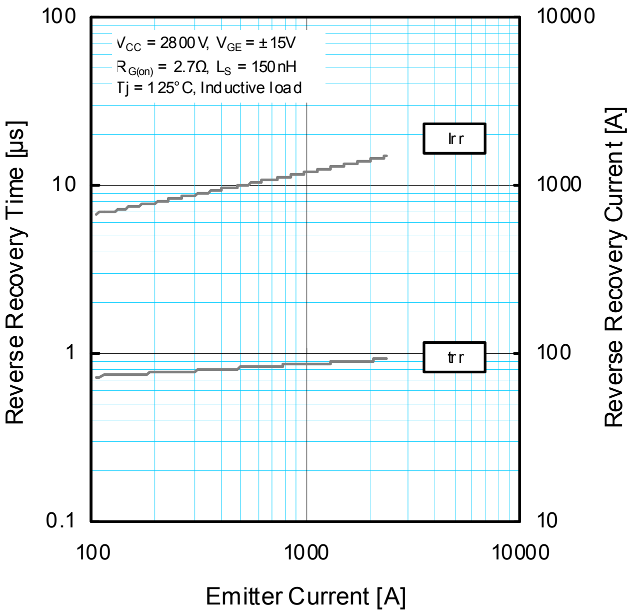
SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



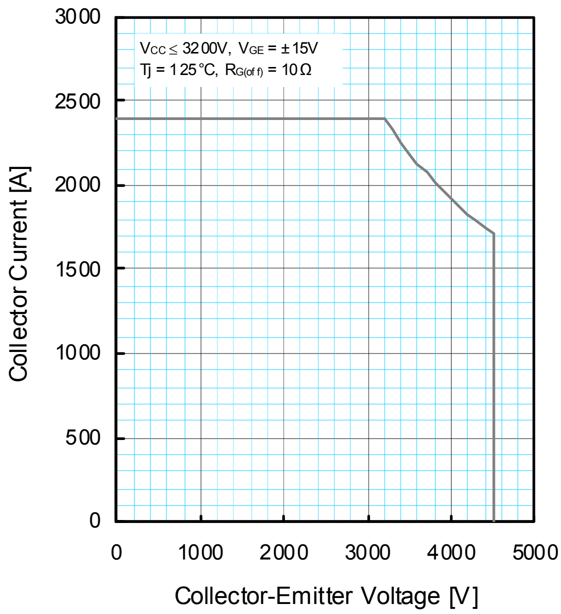
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)HALF-BRIDGE



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

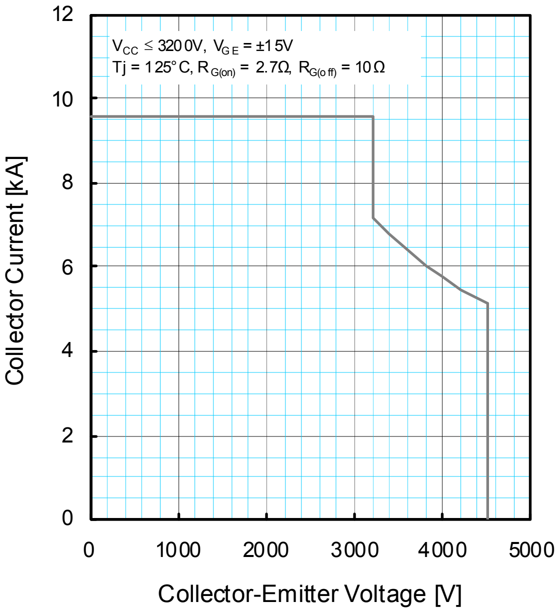


REVERSE BIAS SAFE OPERATING AREA (RBSOA)

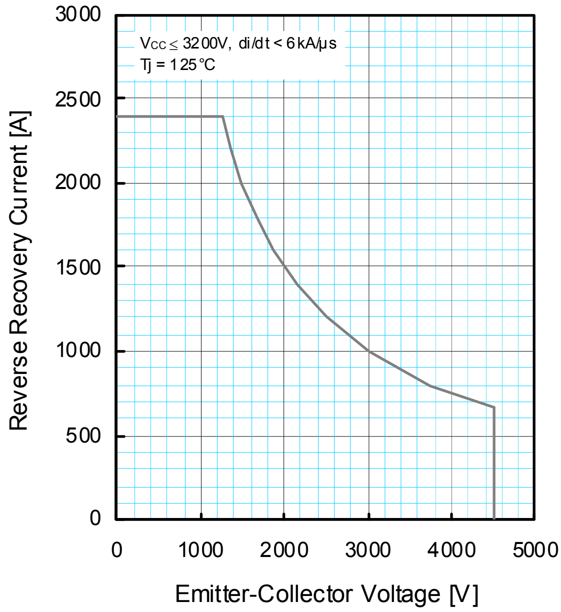


PERFORMANCE CURVES

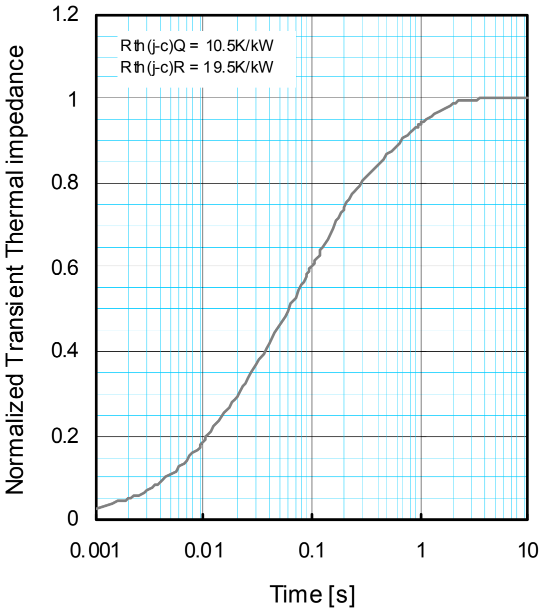
SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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 [K/kW] :	0.0055	0.2360	0.4680	0.2905
t_i [sec] :	0.0001	0.0131	0.0878	0.6247

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