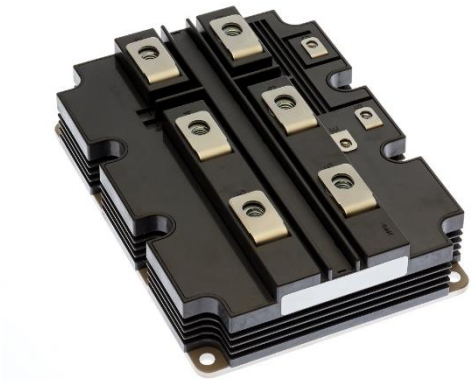
MITSUBISHI ELECTRIC

< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM1200HG-90XB

HIGH POWER SWITCHING USE
INSULATED TYPE

CM1200HG-90XB

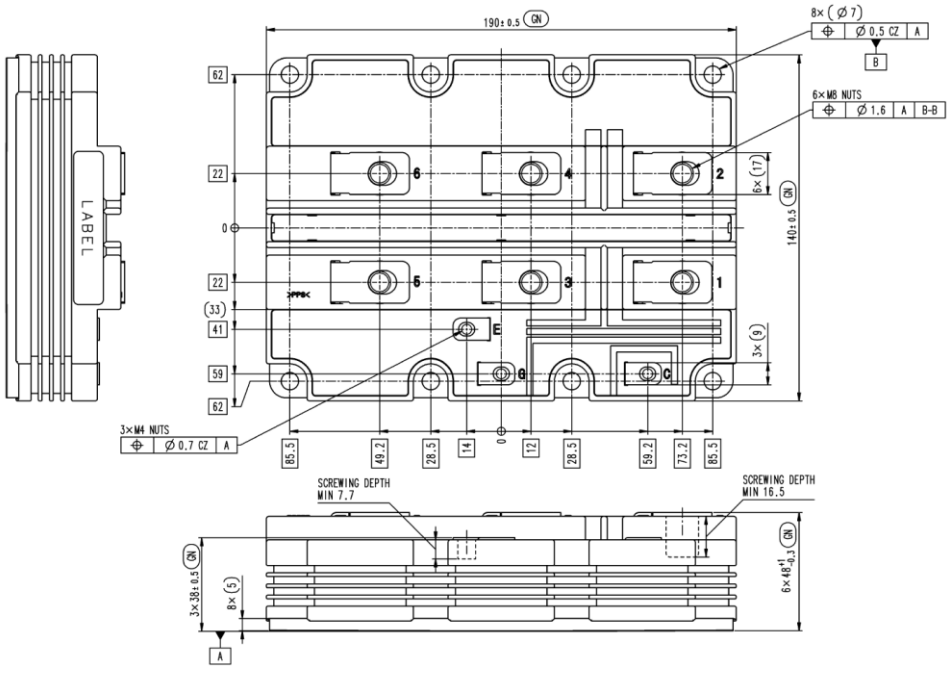


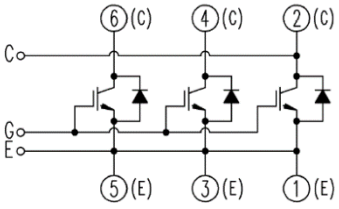
- I_C ..... 1200 A
- V_{CES} ..... 4500 V
- 1-elements in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- Flat Baseplate

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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





CIRCUIT DIAGRAM

CM1200HG-90XB

HIGH POWER SWITCHING USE
INSULATED TYPE

MAXIMUM RATINGS

Item	Symbol	Conditions		Ratings	Unit
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V	T_j = -40~+150 °C	4500	V
			T_j = -50 °C	4400	V
Gate-emitter voltage	V_{GES}	V_{CE} = 0 V		±20	V
Collector current	I_C	T_c = 89 °C , DC		1200	A
(Repetitive peak) Collector current	I_{CRM}	Pulse (Note 1)		2400	A
Emitter current (Note 2)	I_E	T_c = 89 °C , DC		1200	A
(Repetitive peak) Emitter current (Note 2)	I_{ERM}	Pulse (Note 1)		2400	A
Total power dissipation	P_{tot}	T_c = 25 °C , IGBT part (Note 3)		11500	W
Isolation voltage	V_{isol}	Charged part to the baseplate RMS sinusoidal AC 60Hz 1min		10200	V_{rms}
Partial discharge charge	Q_{pd}	V1 = 6900 V_{rms} , V2 = 5100 V_{rms} , Charged part to the baseplate, RMS sinusoidal AC 60Hz (IEC61287-1 Ed.3.0:2014)		10	pC
Junction temperature	T_j	-		-50 ~ +150	°C
Storage temperature	T_{stg}	-		-55 ~ +150	°C
Operating junction temperature	T_{jop}	-		-50 ~ +150	°C
Maximum turn-off switching current	$I_{C(off)}$	V_{CC} ≤ 3200 V , V_{GE} = ±15.0 V , L_s ≤ 150 nH	T_j = T_{jop}	2400	A
Short-circuit withstand pulse duration	t_{pSC}	V_{CC} ≤ 3200 V , V_{GE} = ±15.0 V , L_s ≤ 150 nH	T_j = T_{jop}	10	µs
Maximum reverse recovery power dissipation (Note 2)	P_{rr}	V_{CC} ≤ 3200 V ,L_s ≤ 150nH, Ic ≤ 2400A, di_{on}/dt ≤ 6200A/µs	T_j = 150 °C	3.3	MW

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Collector-emitter cut-off current	I_{CES}	V_{CE} = 4500 V , V_{GE} = 0 V	T_j = 25 °C	-	-	5.0	mA
			T_j = 125 °C	-	4.5	-	mA
			T_j = 150 °C	-	25.0	72.0	mA
Gate-emitter threshold voltage	$V_{GE(th)}$	V_{CE} = 10 V , I_C = 120mA	T_j = 25 °C	5.80	6.30	6.80	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} = 2800 V , I_C = 1200 A , V_{GE} = ±15 V	T_j = 25 °C	-	7.2	-	µC
Input capacitance	C_{ies}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100 kHz	T_j = 25 °C	-	130	-	nF
Output capacitance	C_{oes}		T_j = 25 °C	-	9	-	nF
Reverse transfer capacitance	C_{res}		T_j = 25 °C	-	1.2	-	nF
Collector-emitter saturation voltage	V_{CEsat}	I_C = 1200 A (Note 4) , V_{GE} = 15 V , Between auxiliary terminals	T_j = 25 °C	-	3.00	-	V
			T_j = 125 °C	-	3.90	-	V
			T_j = 150 °C	-	4.15	4.65	V
Emitter-collector voltage (Note 2)	V_{EC}	I_E = 1200 A (Note 4) , V_{GE} = 0 V , Between auxiliary terminals	T_j = 25 °C	-	2.75	-	V
			T_j = 125 °C	-	3.10	-	V
			T_j = 150 °C	-	3.10	3.70	V

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Turn-on delay time	$t_{d(on)}$	V_{CC} = 2800 V , I_C = 1200 A , V_{GE} = ±15 V , L_s = 150 nH , $R_{G(on)}$ = 3.3 Ω , $R_{G(off)}$ = 36 Ω , Inductive Load	T_j = 150 °C	-	-	0.90	µs
Rise time	t_r		T_j = 150 °C	-	-	0.40	µs
Turn-on switching energy per pulse (Note 5)	$E_{on(10\%)}$		T_j = 25 °C	-	2.75	-	J
			T_j = 125 °C	-	3.50	-	J
			T_j = 150 °C	-	3.80	-	J
Turn-on switching energy per pulse	E_{on}		T_j = 25 °C	-	2.80	-	J
			T_j = 125 °C	-	3.70	-	J
			T_j = 150 °C	-	4.10	-	J
Reverse recovery time (Note 2)	t_{rr}	V_{CC} = 2800 V , I_E = 1200 A , V_{GE} = ±15 V , L_s = 150 nH , $R_{G(on)}$ = 3.3 Ω , $R_{G(off)}$ = 36 Ω , Inductive Load	T_j = 150 °C	-	-	1.60	µs
Reverse recovery current (Note 2)	I_{rr}		T_j = 25 °C	-	1150	-	A
			T_j = 125 °C	-	1250	-	A
			T_j = 150 °C	-	1300	-	A
Reverse recovery charge (Note 2, 6)	$Q_{rr(10\%)}$		T_j = 25 °C	-	850	-	µC
			T_j = 125 °C	-	1400	-	µC
			T_j = 150 °C	-	1650	-	µC
Reverse recovered charge (Note 2)	Q_{rr}		T_j = 25 °C	-	900	-	µC
			T_j = 125 °C	-	1500	-	µC
			T_j = 150 °C	-	1700	-	µC
Reverse recovery energy per pulse (Note 2, 5)	$E_{rec(10\%)}$		T_j = 25 °C	-	1.60	-	J
			T_j = 125 °C	-	2.70	-	J
			T_j = 150 °C	-	3.10	-	J
Reverse recovery energy per pulse (Note 2)	E_{rec}		T_j = 25 °C	-	1.70	-	J
			T_j = 125 °C	-	2.90	-	J
			T_j = 150 °C	-	3.30	-	J
Turn-off delay time	$t_{d(off)}$	V_{CC} = 2800 V , I_C = 1200 A , V_{GE} = ±15 V , L_s = 150 nH , $R_{G(on)}$ = 3.3 Ω , $R_{G(off)}$ = 36 Ω , Inductive Load	T_j = 150 °C	-	-	7.40	µs
Fall time	t_f		T_j = 150 °C	-	-	0.75	µs
Turn-off switching energy per pulse (Note 5)	$E_{off(10\%)}$		T_j = 25 °C	-	2.60	-	J
			T_j = 125 °C	-	3.30	-	J
			T_j = 150 °C	-	3.60	-	J
Turn-off switching energy per pulse	E_{off}		T_j = 25 °C	-	2.90	-	J
			T_j = 125 °C	-	3.80	-	J
			T_j = 150 °C	-	4.20	-	J

THERMAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Thermal resistance	$R_{th(j-c)Q}$	IGBT part, Junction to case	-	-	10.8	K/kW
Thermal resistance (Note 2)	$R_{th(j-c)D}$	FWDi part , Junction to case	-	-	13.6	K/kW
Contact thermal resistance	$R_{th(c-s)}$	Case to heat sink λgrease = 1W/m·K, D(c-s) = 80 μm	-	5.3	-	K/kW

MECHANICAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Mounting torque	M_t	Main terminal screw: M8	7.0	-	19.0	N·m
Mounting torque	M_s	Mounting screw: M6	3.0	-	6.0	N·m
Mounting torque	M_t	Auxiliary terminal screw: M4	1.0	-	3.0	N·m
mass	m	-	-	1.5	-	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	$L_{P(C-E)}$	IGBT part, T_c = 25 °C	-	13.5	-	nH
Internal lead resistance	$R_{CC'+EE'}$	T_c = 25 °C	-	0.12	-	mΩ

Note 1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed maximum T_{jop} rating (150°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).

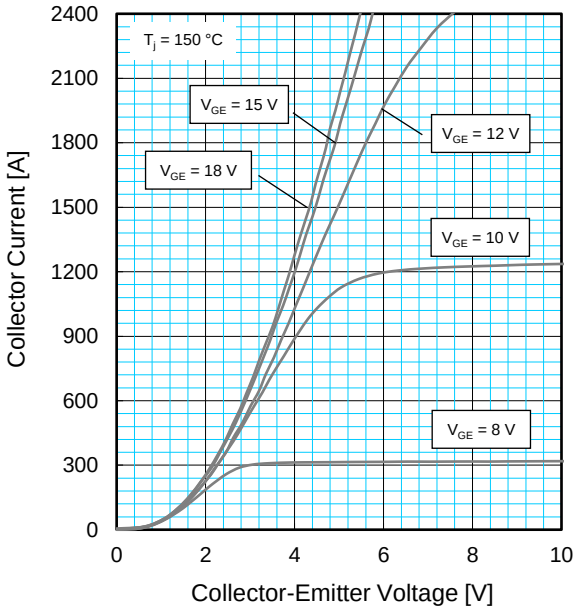
Note 4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

Note 5. The integration range of switching energies is from 10%V_{CE} to 10%I_C(I_E).

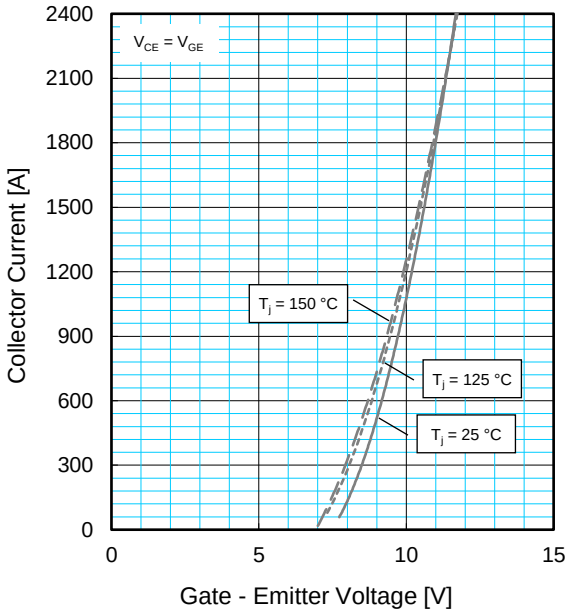
Note 6. The integration range of reverse recovery charge is from I_E=0A to 10%I_E

PERFORMANCE CURVES

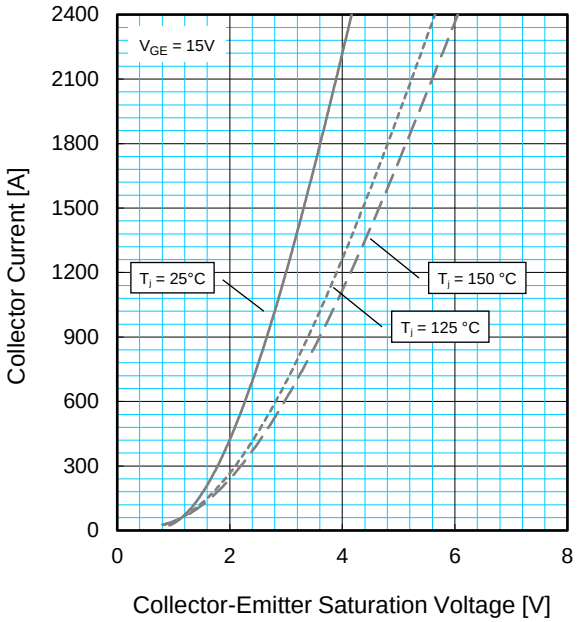
OUTPUT CHARACTERISTICS (TYPICAL)



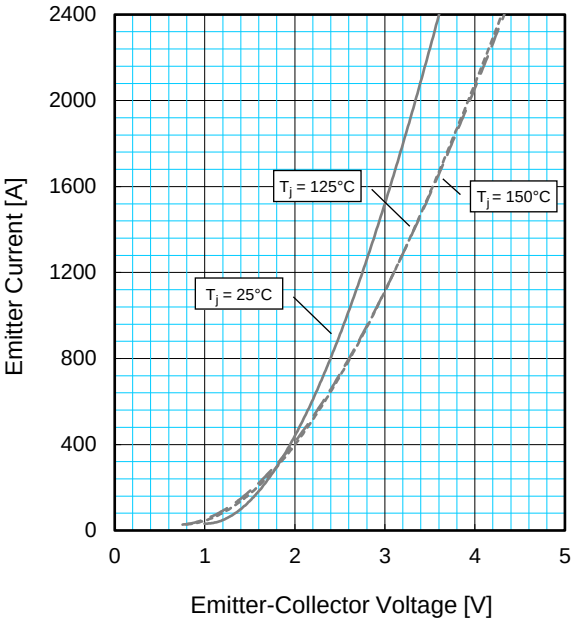
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

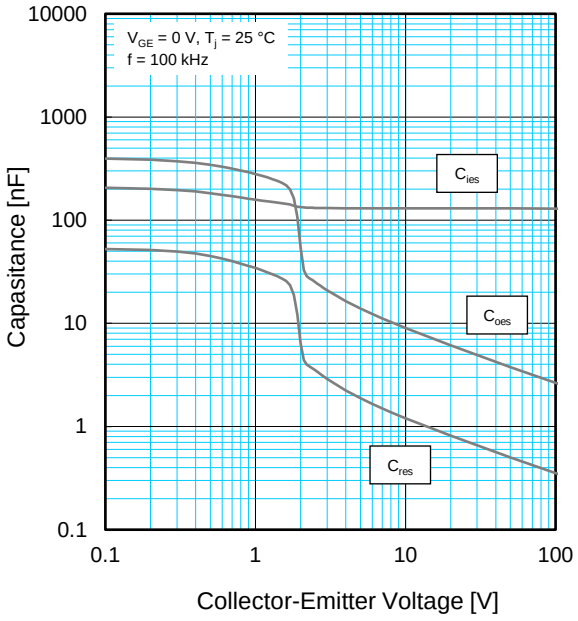


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

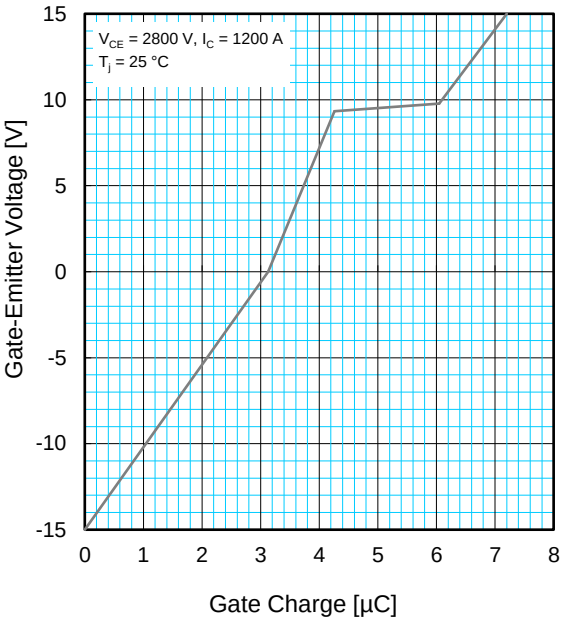


PERFORMANCE CURVES

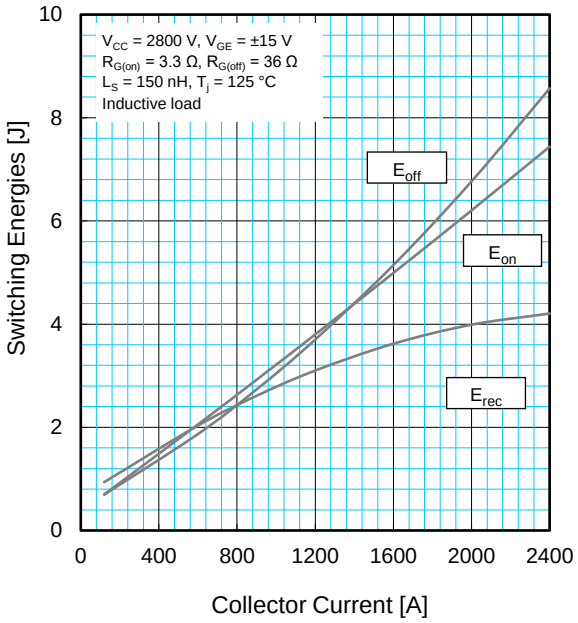
CAPACITANCE CHARACTERISTICS (TYPICAL)



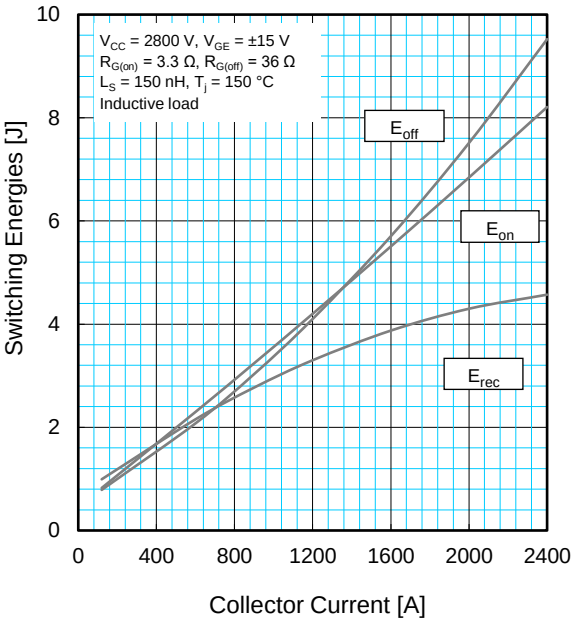
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

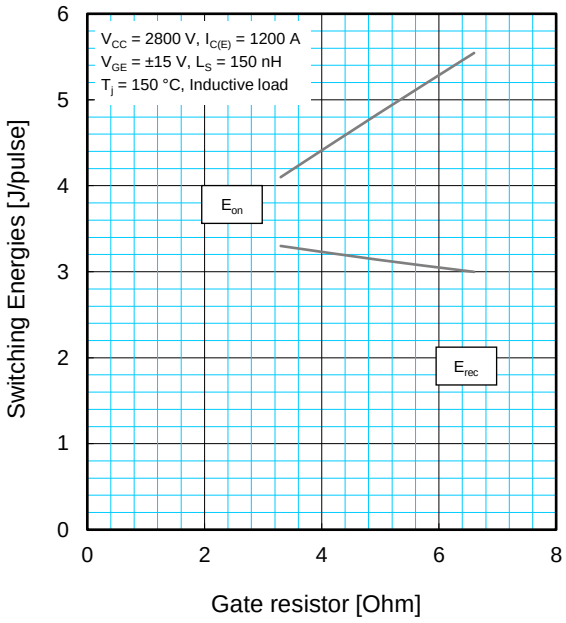


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

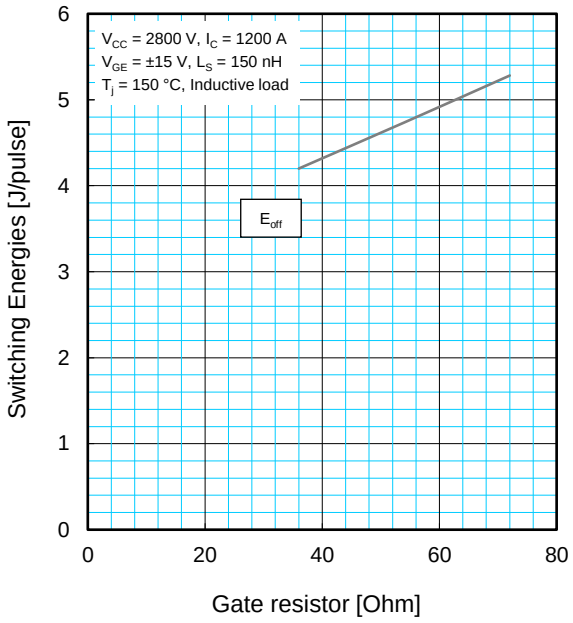


PERFORMANCE CURVES

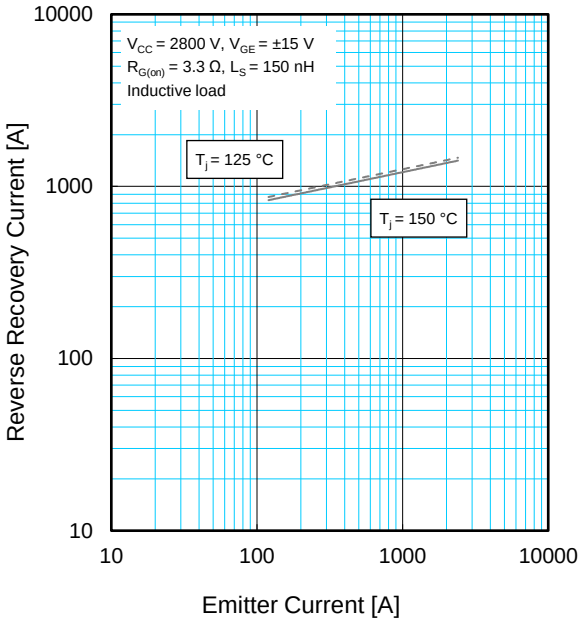
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

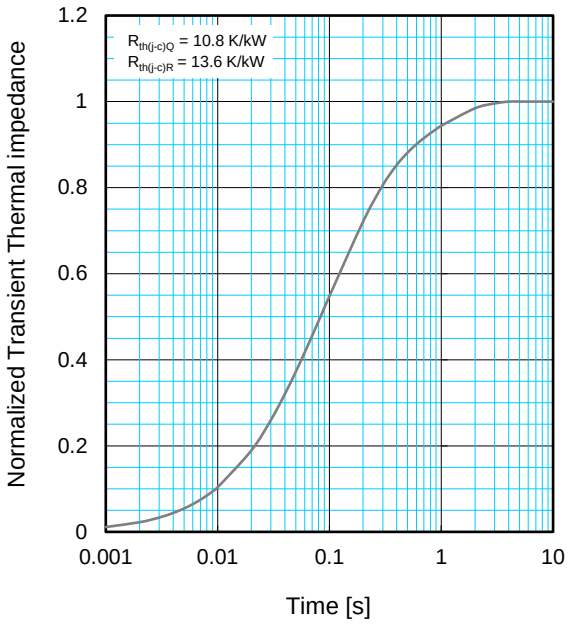


FREE-WHEEL DIODE REVERSE RECOVERY CURRENT CHARACTERISTICS (TYPICAL)



PERFORMANCE CURVES

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

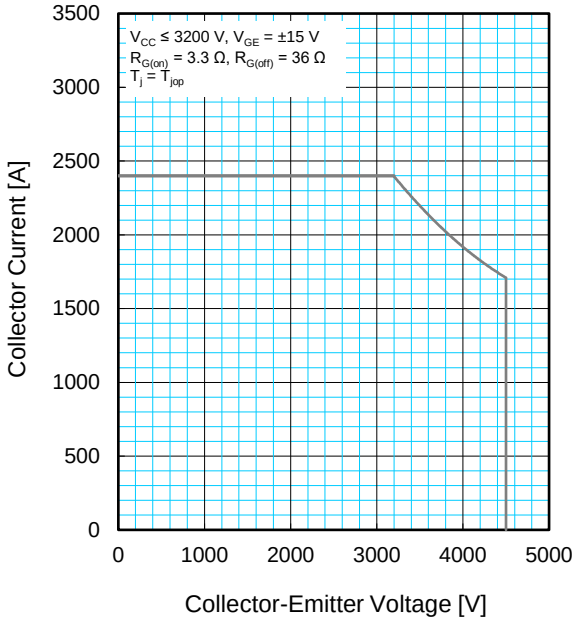


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{1 - exp^{\left(-\frac{t}{\tau_i}\right)}\right\}$$

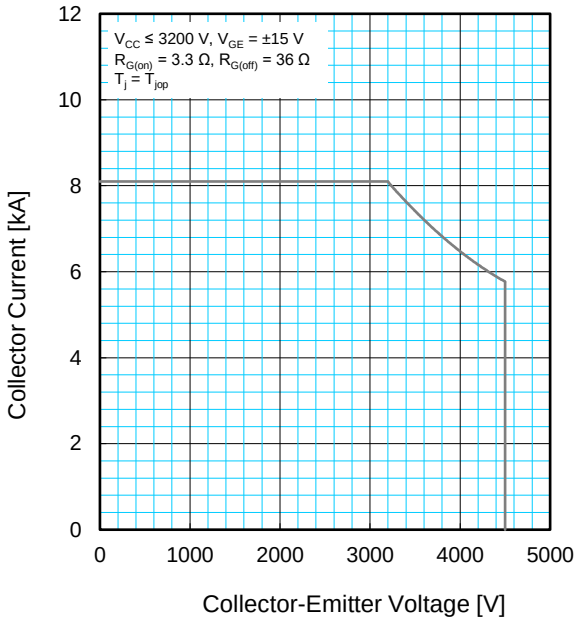
	1	2	3	4
R_i / $R_{th(j-c)}$	0.0000	0.2002	0.2401	0.5596
τ_i [s]	0.0001	0.7842	0.0347	0.1319

PERFORMANCE CURVES

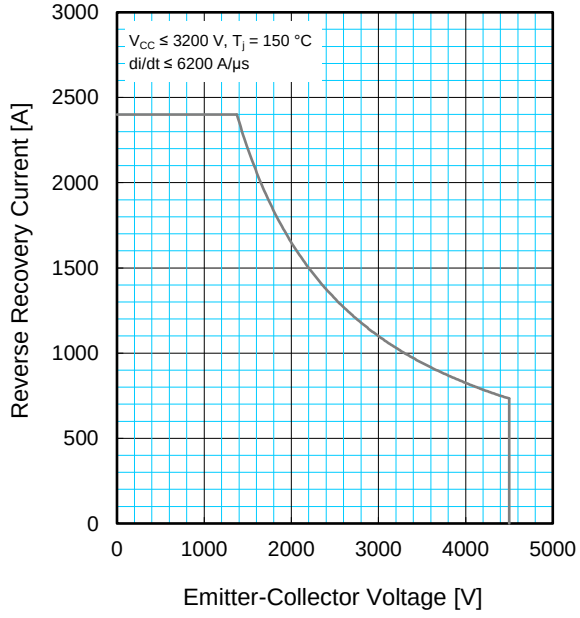
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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