MITSUBISHI ELECTRIC

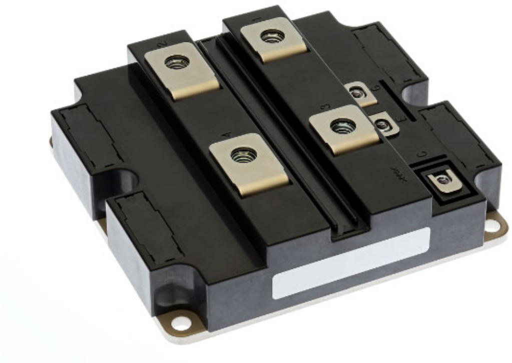
< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

CM1200HC-66X

HIGH POWER SWITCHING USE
INSULATED TYPE

5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

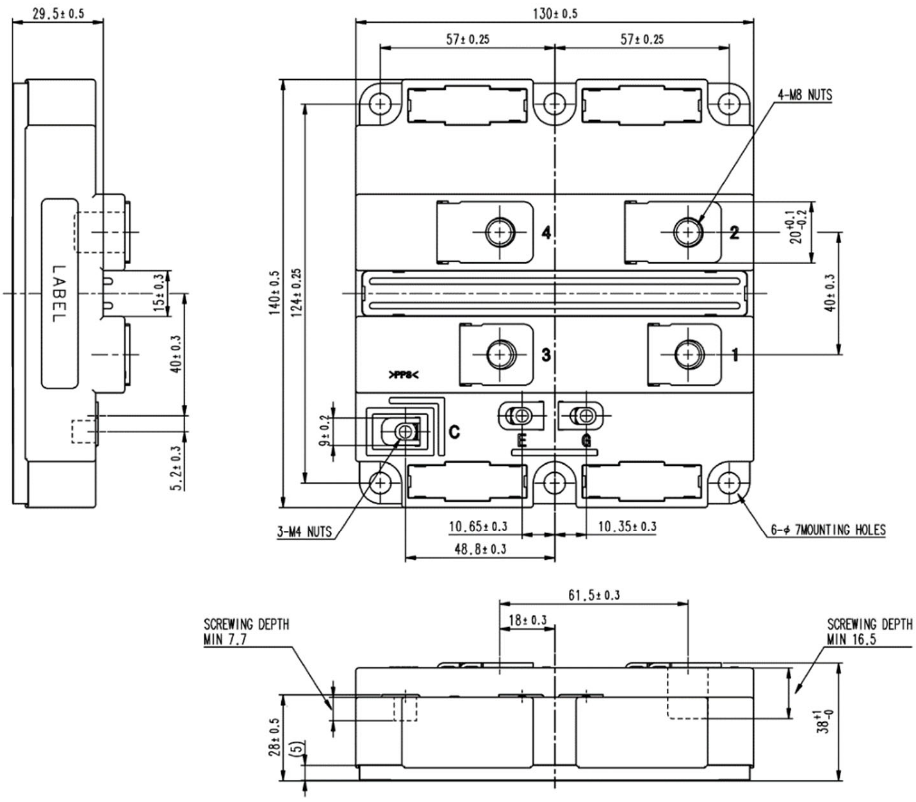
CM1200HC-66X

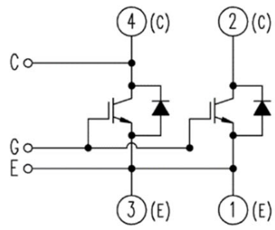


- I_C 1200A
- V_{CES} 3300V
- 1-element in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- AlSiC Baseplate
- UL recognized under UL1557

APPLICATION
Traction drives, High Reliability Converters / Inverters, DC choppers

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





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CIRCUIT DIAGRAM

MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{CES}	Collector-emitter voltage	V_{GE} = 0V, T_j = -40…+150°C	3300	V
		V_{GE} = 0V, T_j = −50°C	3200	
V_{GES}	Gate-emitter voltage	V_{CE} = 0V, T_j = 25°C	±20	V
I_C	Collector current	DC, T_c = 105°C	1200	A
I_{CRM}		Pulse (Note1)	2400	A
I_E	Emitter current (Note2)	DC, T_c = 90°C	1200	A
I_{ERM}		Pulse (Note1)	2400	A
P_{tot}	Maximum power dissipation (Note3)	T_c = 25°C, IGBT part	11900	W
V_{iso}	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1 min.	6000	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, f = 60Hz, Q_{PD} ≤ 10pC	2600	V
T_j	Junction temperature		−50 ~ +150	°C
T_{jop}	Operating junction temperature		−50 ~ +150	°C
T_{stg}	Storage temperature		−55 ~ +150	°C
t_{psc}	Short circuit pulse width	V_{CC} = 2500V, V_{CE} ≤ V_{CES}, V_{GE} =15V, T_j =150°C	10	μs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits Min	Limits Typ	Limits Max	Unit
I_{CES}	Collector cutoff current	V_{CE} = V_{CES}, V_{GE} = 0V	T_j = 25°C	—	—	4.0	mA
			T_j = 125°C	—	4.0	—	
			T_j = 150°C	—	24.0	—	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE} = 10V, I_C = 120mA, T_j = 25°C		6.5	7.0	7.5	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} = 10V, V_{GE} = 0V, f = 100kHz T_j = 25°C		—	139	—	nF
C_{oes}	Output capacitance			—	9.3	—	
C_{res}	Reverse transfer capacitance			—	1.3	—	
Q_G	Total gate charge	V_{CC} = 1800V, I_C = 1200A, V_{GE} = ±15V		—	9.0	—	μC
V_{CEsat}	Collector-emitter saturation voltage	I_C = 1200A (Note4) V_{GE} = 15V	T_j = 25°C	—	2.00	—	V
			T_j = 125°C	—	2.50	—	
			T_j = 150°C	—	2.60	3.10	
$t_{d(on)}$	Turn-on delay time	V_{CC} = 1800V I_C = 1200A V_{GE} = ±15V $R_{G(on)}$ = 2.2Ω L_s = 150nH Inductive load	T_j = 150°C	—	—	0.90	μs
t_r	Rise time		T_j = 150°C	—	—	0.50	μs
$E_{on(10\%)}$	Turn-on switching energy per pulse (Note5)		T_j = 25°C	—	1.95	—	J
			T_j = 125°C	—	2.15	—	
			T_j = 150°C	—	2.25	—	
E_{on}	Turn-on switching energy per pulse (Note6)		T_j = 25°C	—	2.00	—	J
			T_j = 125°C	—	2.25	—	
			T_j = 150°C	—	2.35	—	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 1800V I_C = 1200A V_{GE} = ±15V $R_{G(off)}$ = 18Ω L_s = 150nH Inductive load	T_j = 25°C	—	2.90	—	μs
			T_j = 125°C	—	3.20	—	
			T_j = 150°C	—	3.20	4.25	
t_f	Fall time		T_j = 25°C	—	0.40	—	μs
			T_j = 125°C	—	0.45	—	
			T_j = 150°C	—	0.50	1.00	
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note5)		T_j = 25°C	—	1.55	—	J
			T_j = 125°C	—	2.00	—	
			T_j = 150°C	—	2.05	—	
E_{off}	Turn-off switching energy per pulse (Note6)		T_j = 25°C	—	1.65	—	J
			T_j = 125°C	—	2.10	—	
			T_j = 150°C	—	2.25	—	

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits Min	Limits Typ	Limits Max	Unit
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 1200A (Note 4), V_{GE} = 0V	T_j = 25°C	—	2.20	—	V
			T_j = 125°C	—	2.40	—	
			T_j = 150°C	—	2.50	3.00	
t_{rr}	Reverse recovery time (Note 2)	V_{CC} = 1800V, I_E = 1200A, V_{GE} = ±15V, $R_{G(on)}$ = 2.2Ω, L_s = 150nH, Inductive load	T_j = 25°C	—	0.95	—	μs
			T_j = 125°C	—	1.10	—	
			T_j = 150°C	—	1.15	—	
I_{rr}	Reverse recovery current (Note 2)		T_j = 25°C	—	—	—	A
			T_j = 125°C	—	1550	—	
			T_j = 150°C	—	1650	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 2,7)		T_j = 25°C	—	1050	—	μC
			T_j = 125°C	—	1600	—	
			T_j = 150°C	—	1650	—	
Q_{rr}	Reverse recovery charge (Note 2,6)		T_j = 25°C	—	1200	—	μC
			T_j = 125°C	—	1750	—	
			T_j = 150°C	—	1800	—	
$E_{rec(10\%)}$	Reverse recovery energy per pulse (Note 2,5)		T_j = 25°C	—	1.15	—	J
			T_j = 125°C	—	1.65	—	
			T_j = 150°C	—	1.85	—	
E_{rec}	Reverse recovery energy per pulse (Note 2,6)		T_j = 25°C	—	1.25	—	J
			T_j = 125°C	—	1.75	—	
			T_j = 150°C	—	1.95	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits Min	Limits Typ	Limits Max	Unit
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part	—	—	10.5	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part	—	—	16.5	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, λ_{grease} = 1W/m·k, $D_{(c-s)}$ = 80μm	—	7.5	—	K/kW

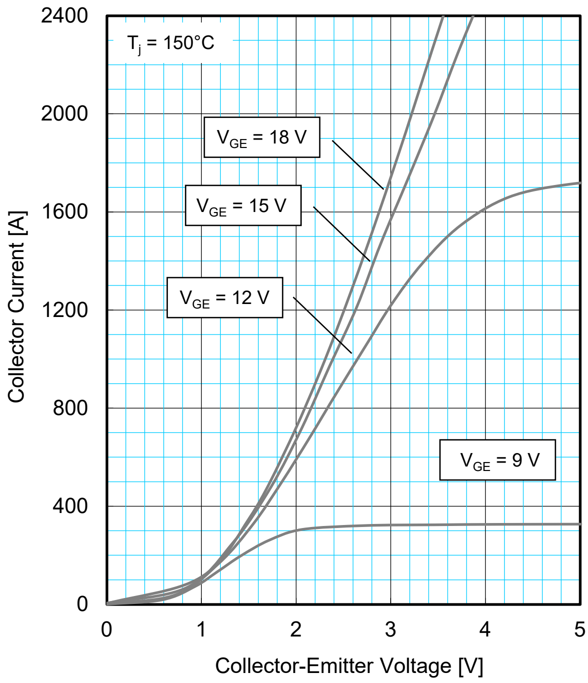
MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits Min	Limits Typ	Limits Max	Unit
M_t	Mounting torque	M8 : Main terminals screw	7.0	—	19.0	N·m
M_s	Mounting torque	M6 : Mounting screw	3.0	—	6.0	N·m
M_t	Mounting torque (Note 8)	M4 : Auxiliary terminals screw	1.0	—	3.0	N·m
M	Mass		—	0.9	—	kg
CTI	Comparative tracking index		600	—	—	—
d_a	Clearance		19.5	—	—	mm
d_s	Creepage distance		32.0	—	—	mm
$L_{P\ CE}$	Parasitic stray inductance		—	12.0	—	nH
$R_{CC'+EE'}$	Internal lead resistance	T_c = 25°C	—	0.14	—	mΩ

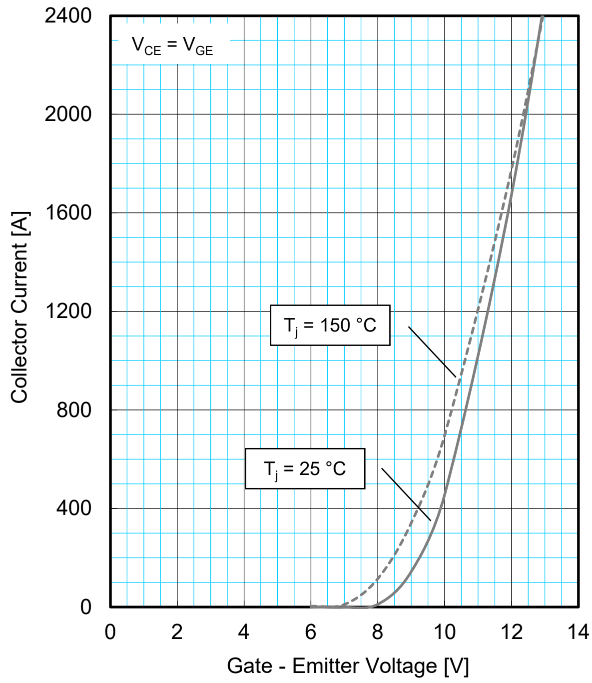
Note 1: Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jopmax} rating.
Note 2: The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWDi).
Note 3: Junction temperature (T_j) should not exceed T_{jmax} rating (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(10%I_E).
Note 6: Definition of all items is according to IEC 60747, unless otherwise specified.
Note 7: The integration range of reverse recovery charge is from I_E = 0A to 10%I_E.
Note 8: The maximum specified value is under the condition of using PCB mounted on the power module.
In case no PCB is used this maximum torque for M4 screw is 1.9 N·m.

PERFORMANCE CURVES

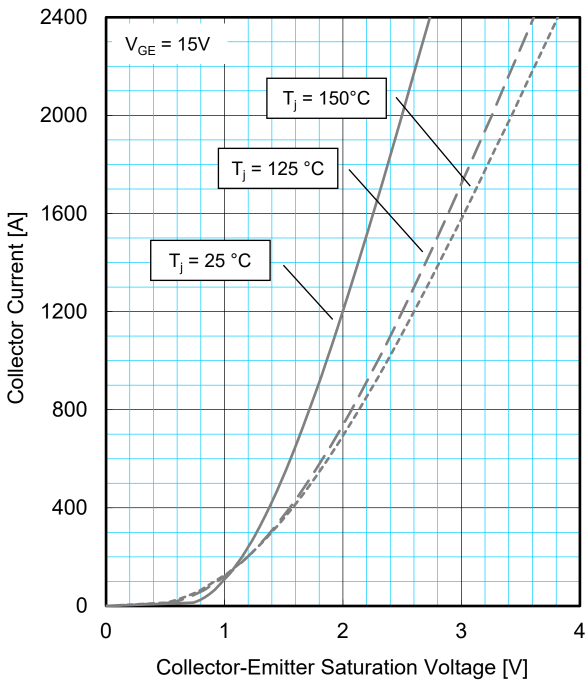
OUTPUT CHARACTERISTICS (TYPICAL)



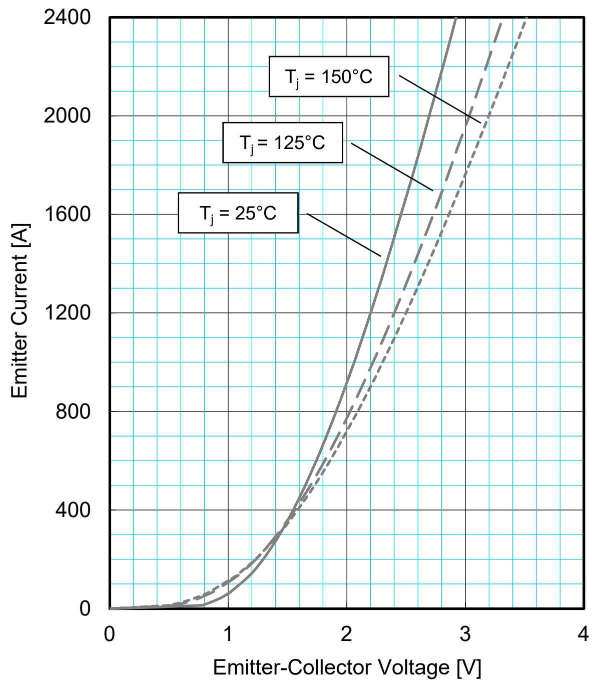
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

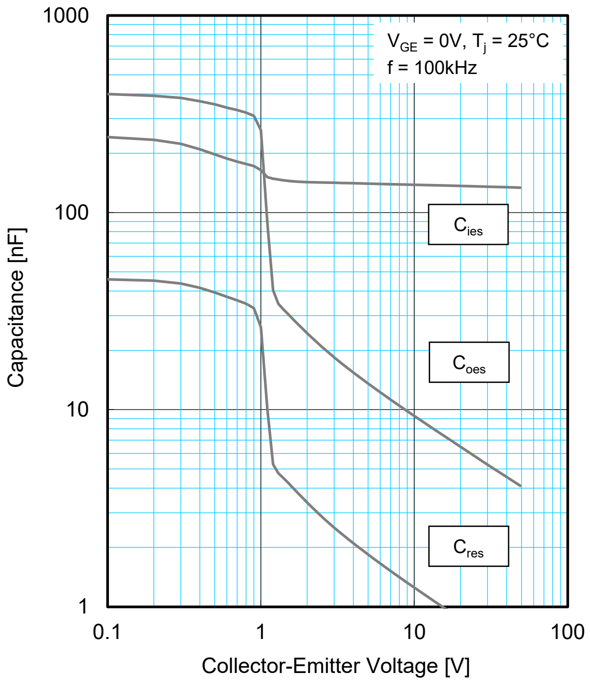


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

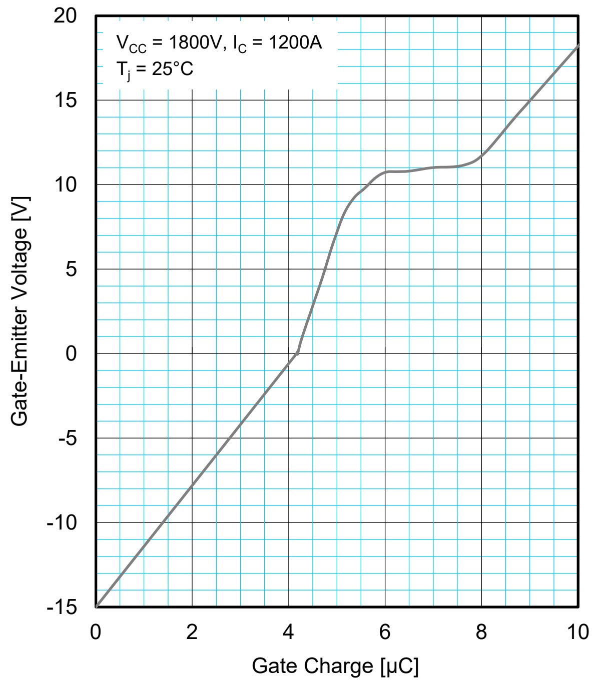


PERFORMANCE CURVES

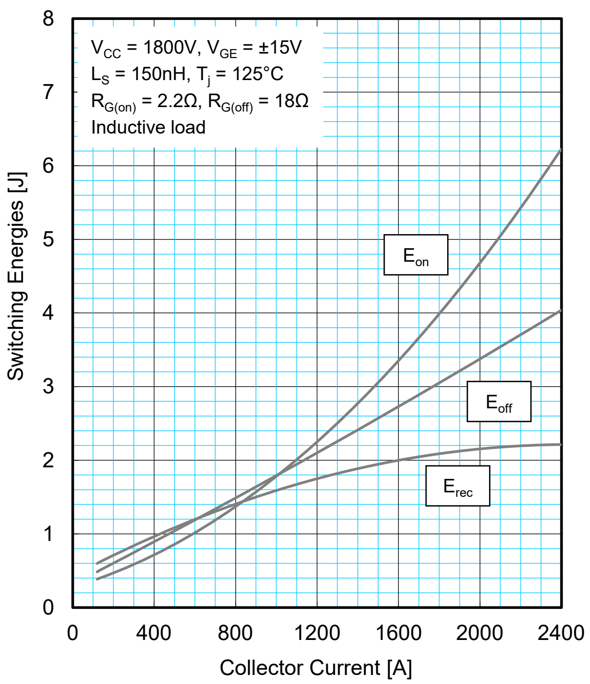
CAPACITANCE CHARACTERISTICS (TYPICAL)



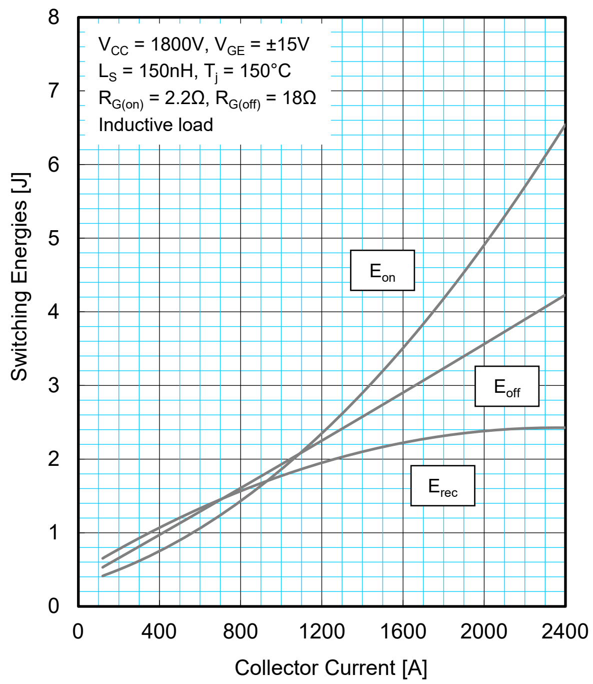
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

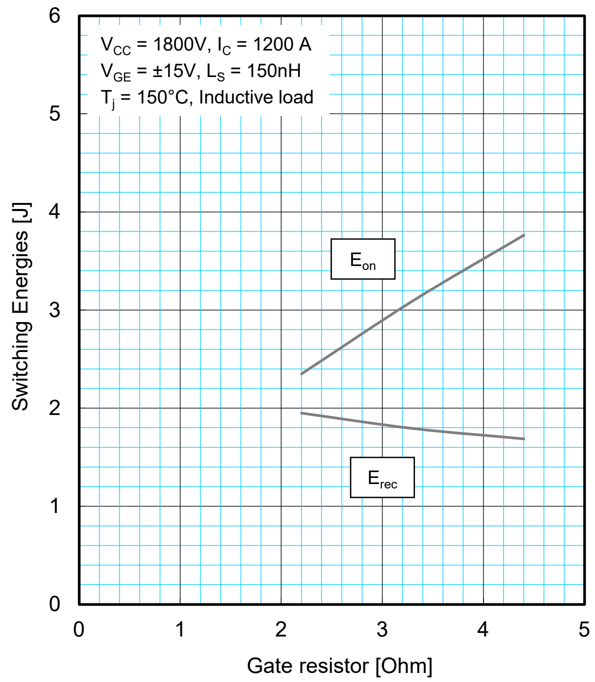


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

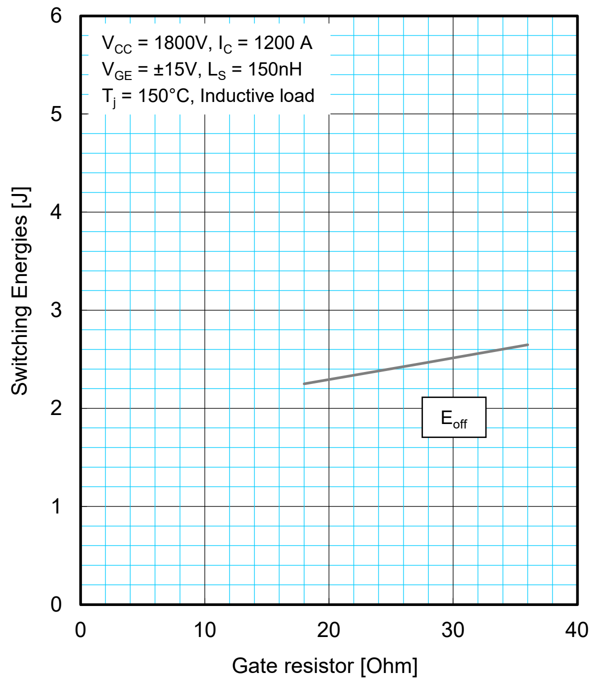


PERFORMANCE CURVES

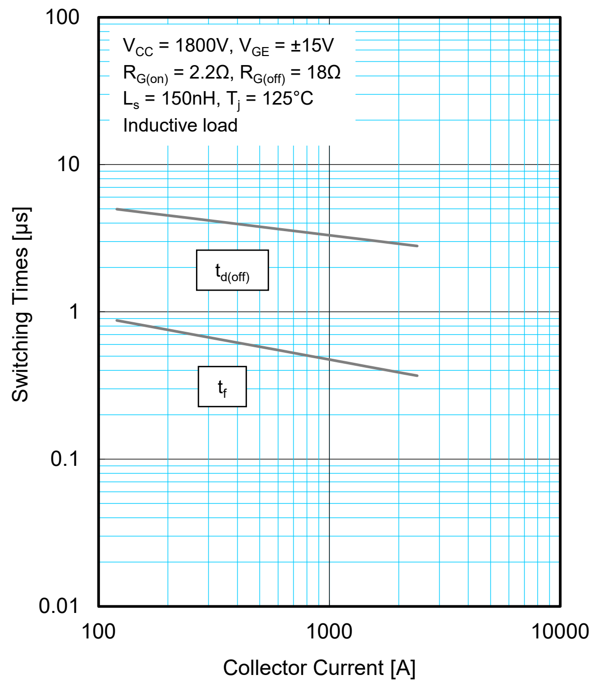
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



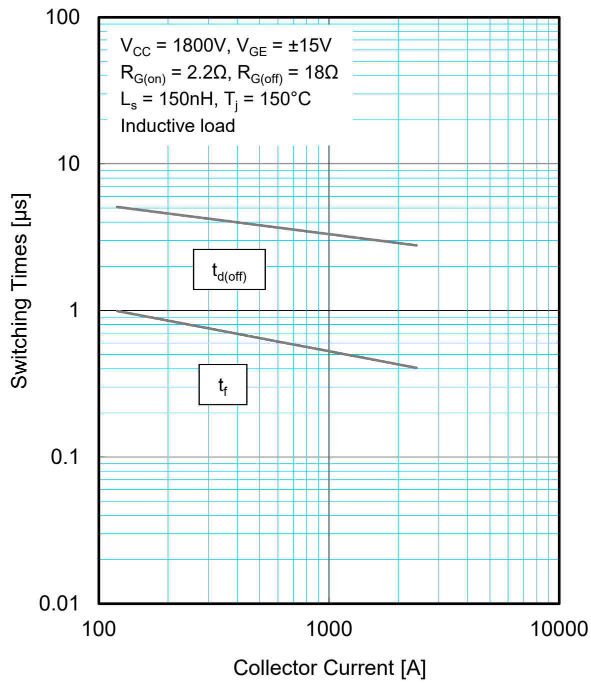
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

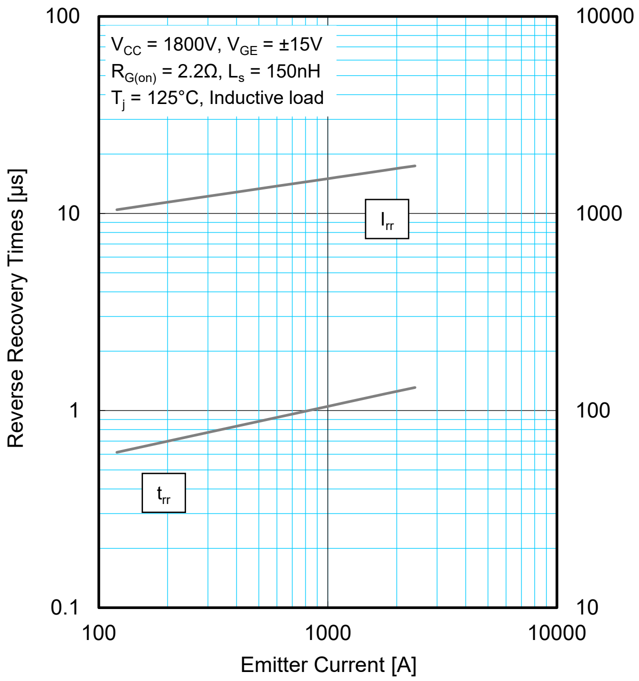


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

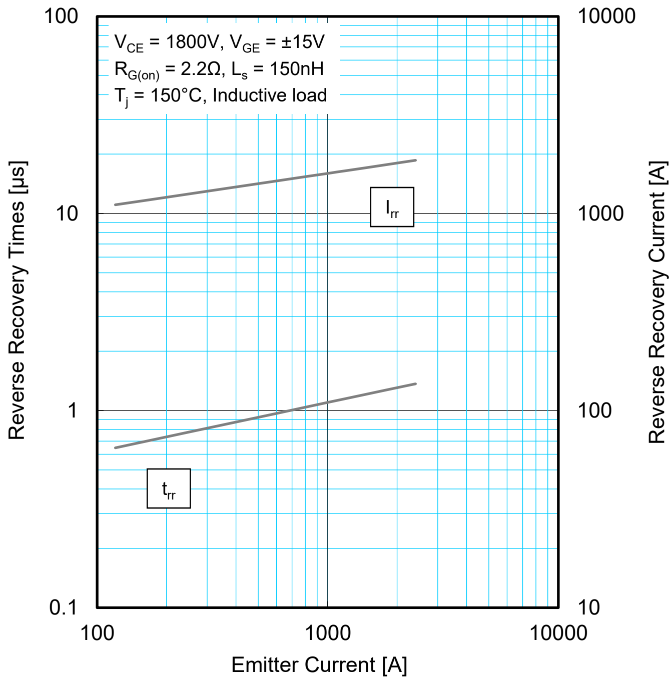


PERFORMANCE CURVES

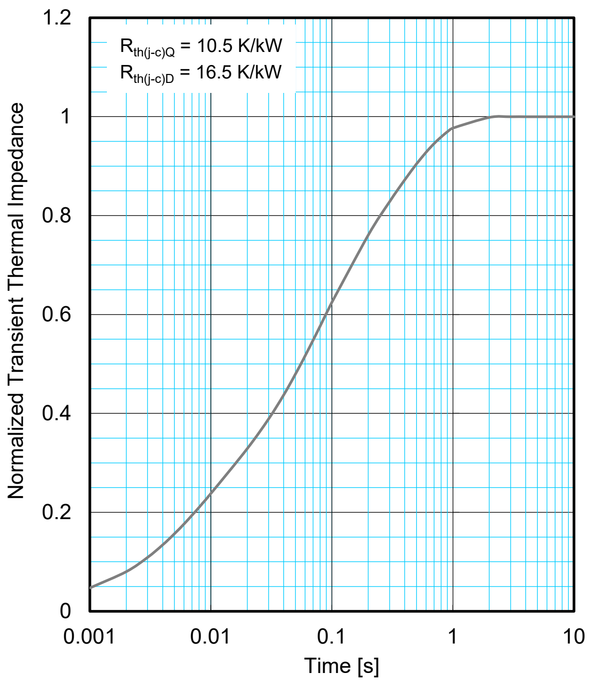
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

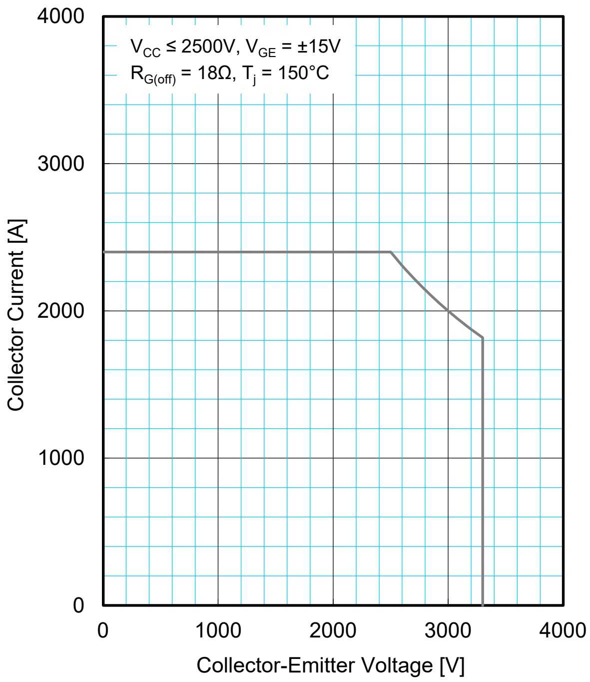


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i} \right) \right\}$$

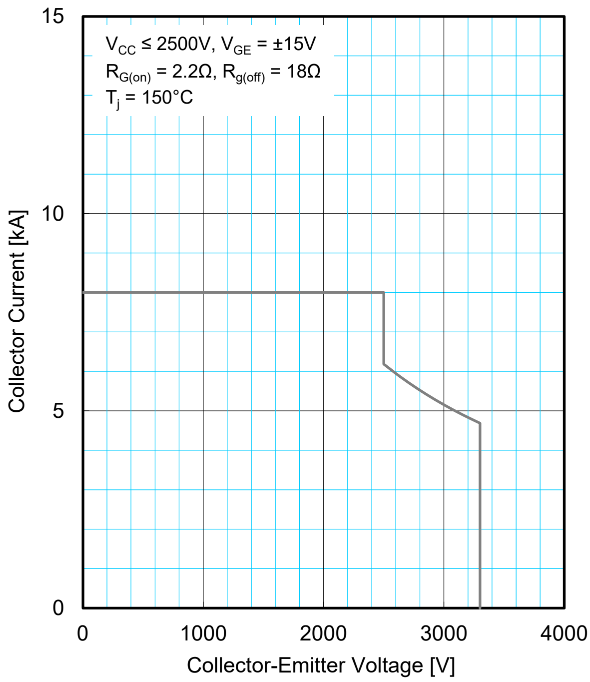
	1	2	3	4
R_i / $R_{th(j-c)}$	0.0096	0.1893	0.4044	0.3967
τ_i [sec]	0.0001	0.0058	0.0602	0.3512

PERFORMANCE CURVES

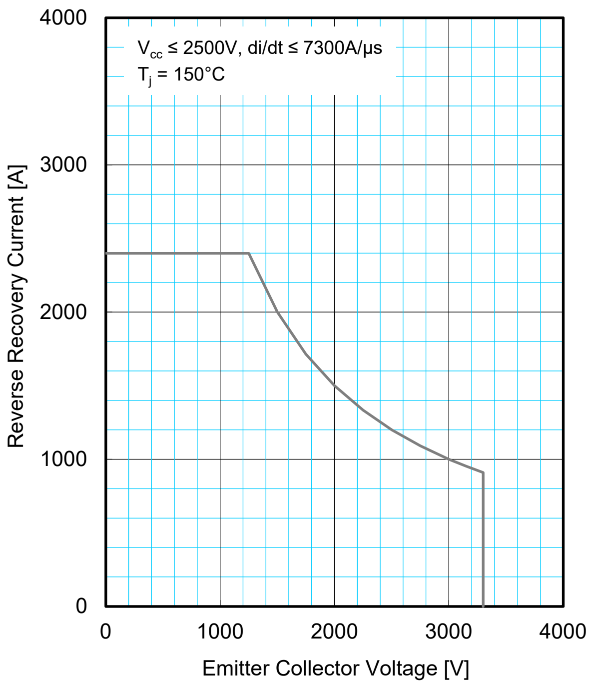
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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