MITSUBISHI ELECTRIC

< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CMH600DC-66X

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

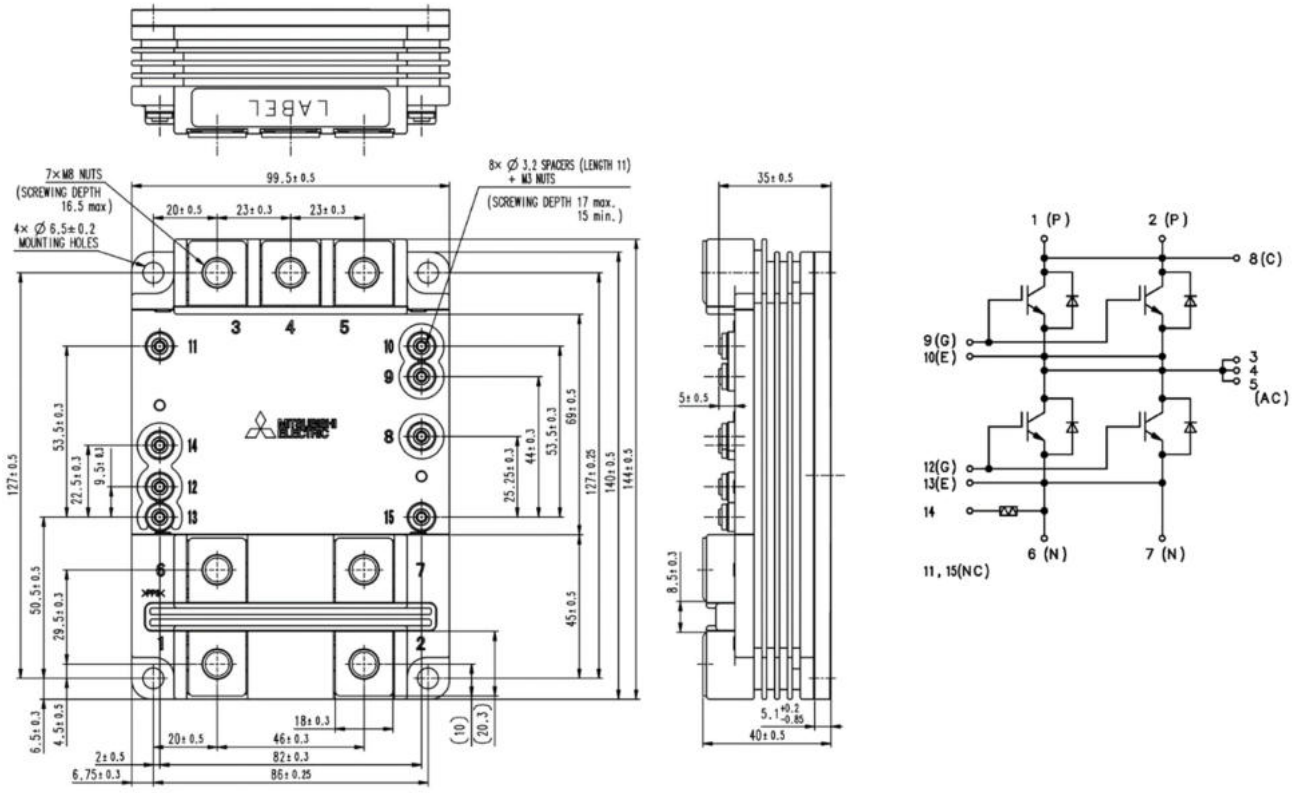
CMH600DC-66X

- I_C 600A
- V_{CES} 3300V
- 2-elements in a Pack
- Insulated Type (AlSiC base type)
- CSTBT™(III)
- SiC Schottky-Barrier Diode

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} = 0 V, T_j = −40…+150 °C	3300	V
		V_{GE} = 0 V, T_j = −50 °C	3200	
V_{GES}	Gate-emitter voltage	V_{CE} = 0 V, T_j = 25 °C	± 20	V
I_C	Collector current	DC, T_c = 90 °C	600	A
I_{CRM}		Pulse (Note 1)	1200	A
I_E	Emitter current (Note 2)	DC	600	A
I_{ERM}		Pulse (Note 1)	1200	A
P_{tot}	Maximum power dissipation (Note 3)	T_c = 25 °C, IGBT part	4100	W
V_{iso}	Isolation voltage	RMS, sinusoidal, f = 60 Hz, t = 1 min	6000	V
Q_{PD}	Partial discharge	Charged part to the base-plate V1 = 3500 V_{rms}, V2 = 2600 V_{rms} AC 60 Hz, T_c = 25 °C (acc. to IEC 61287-1)	10	pC
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} ≤ 2400 V, V_{GE} = ±15 V $R_{G(on)}$ = 2.2 Ω, $R_{G(off)}$ = 51 Ω T_j = 150 °C, C_{GE} = 33 nH, L_S = 65 nH	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	—	—	2.0	mA
			T_j = 125 °C	—	2.0	—	
			T_j = 150 °C	—	20.0	—	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE} = 10 V, I_C = 60 mA, T_j = 25 °C		6.5	7.0	7.5	V
I_{GES}	Gate leakage current	V_{GE} = V_{GES}, V_{CE} = 0 V, T_j = 25 °C		−0.5	—	0.5	µA
V_{CEsat}	Collector-emitter saturation voltage	I_C = 600 A (Note 4) V_{GE} = 15 V	T_j = 25 °C	—	2.30	—	V
			T_j = 125 °C	—	2.80	—	
			T_j = 150 °C	—	2.90	3.30	
C_{ies}	Input capacitance	V_{CE} = 10 V, V_{GE} = 0 V, f = 100 kHz T_j = 25 °C		—	53.4	—	nF
C_{oes}	Output capacitance			—	3.8	—	nF
C_{res}	Reverse transfer capacitance			—	0.48	—	nF
Q_G	Total gate charge	V_{CC} = 1800 V, I_C = 600 A, V_{GE} = ±15 V		—	3.6	—	µC
$t_{d(on)}$	Turn-on delay time	V_{CC} = 1800 V $I_{C/E}$ = 600 A V_{GE} = ±15 V $R_{G(on)}$ = 2.2 Ω, C_{GE} = 33 nF L_S = 65 nH Inductive load	T_j = 150 °C	—	—	1.25	µs
t_r	Rise time		T_j = 150 °C	—	—	0.50	µs
$E_{on(10\%)}$	Turn-on switching energy per pulse (Note 5)		T_j = 25 °C	—	0.27	—	J
			T_j = 125 °C	—	0.29	—	
			T_j = 150 °C	—	0.30	—	
E_{on}	Turn-on switching energy per pulse		T_j = 25 °C	—	0.29	—	J
			T_j = 125 °C	—	0.34	—	
			T_j = 150 °C	—	0.35	—	
$E_{off\_diode(10\%)}$	Diode-off switching energy per pulse (Note 2, 5)		T_j = 25 °C	—	0.01	—	J
			T_j = 125 °C	—	0.01	—	
			T_j = 150 °C	—	0.01	—	
$Q_{C(10\%)}$	Total capacitive charge (Note 2, 6)		T_j = 25 °C	—	8.55	—	µC
			T_j = 125 °C	—	9.25	—	
			T_j = 150 °C	—	10.0	—	

Symbol	Item	Conditions		Limits			Unit
				Min.	Typ.	Max.	
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 600 A (Note 4) V_{GE} = 0 V	T_j = 25 °C	—	2.25	—	V
			T_j = 125 °C	—	3.55	—	
			T_j = 150 °C	—	4.55	7.00	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 1800 V I_C = 600 A V_{GE} = ±15 V $R_{G(off)}$ = 51 Ω C_{GE} = 33 nF L_S = 65 nH Inductive load	T_j = 150 °C	—	—	5.00	μs
t_f	Fall time		T_j = 150 °C	—	—	1.00	μs
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)		T_j = 25 °C	—	0.68	—	J
			T_j = 125 °C	—	0.91	—	
			T_j = 150 °C	—	0.92	—	
E_{off}	Turn-off switching energy per pulse		T_j = 25 °C	—	0.75	—	J
			T_j = 125 °C	—	1.03	—	
			T_j = 150 °C	—	1.04	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part, 1/2 module	—	—	30.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part, 1/2 module	—	—	45.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, 1/2 module λ_{grease} = 1 W/m·k, $D_{(c-s)}$ = 70 μm	—	16.0	—	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M_t	Mounting torque	Main terminals screw M8 (Note 7)	7.0	—	14.0	N·m
M_s		Mounting screw M6	3.0	—	6.0	N·m
M_t		Auxiliary terminals screw M3	0.4	—	0.8	N·m
m	Mass	—	—	0.80	—	Kg
CTI	Comparative tracking index	—	600	—	—	—
d_a	Clearance	Between terminals and baseplate	19.5	—	—	Mm
d_s	Creepage distance	—	32.0	—	—	Mm
$L_{P(P-N)}$	Parasitic stray inductance	Between terminal 1, 2 and terminal 6, 7	—	14.0	—	nH
$R_{CC'+EE'}$	Internal lead resistance	T_c = 25 °C, 1/2 module	—	0.33	—	mΩ

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R_{25}	Zero-power resistance	T_c = 25 °C	—	5.00	—	kΩ
$B_{(25/50)}$	B-constant (Note 8)	Approximate by equation	—	3375	—	K

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

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 total capacitive charge is from I_E=0A to 10%I_E.

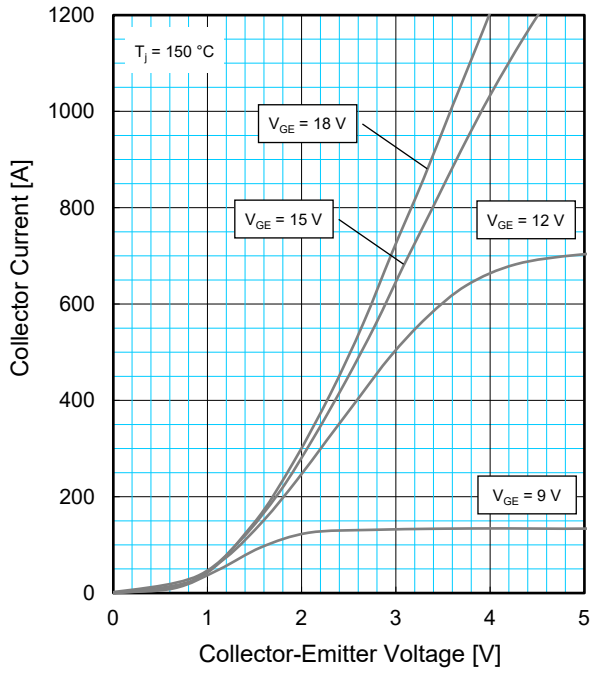
Note 7 This is the case when installing the product on the bus bar.

Note 8. $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

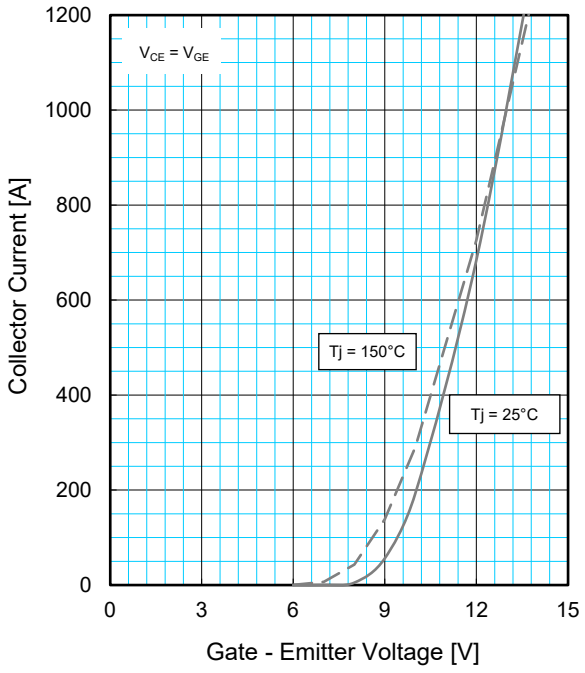
R_{25}: resistance at 25 ºC
R_{50}: resistance at 50 ºC
T_{25} [K]: T_{25} = 25 [ºC] + 273.15 = 298.15 [K]
T_{50} [K]: T_{50} = 50 [ºC] + 273.15 = 323.15 [K]
R_{25}: resistance at absolute temperature T_{25} [K]; T_{25} = 25 [ºC] + 273.15 = 298.15 [K]
R_{50}: resistance at absolute temperature T_{25} [K]; T_{50} = 50 [ºC] + 273.15 = 323.15 [K]

PERFORMANCE CURVES

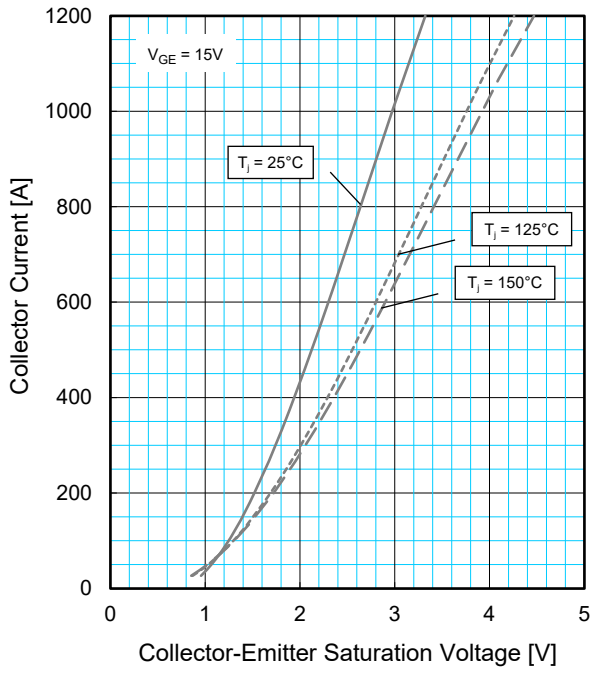
OUTPUT CHARACTERISTICS (TYPICAL)



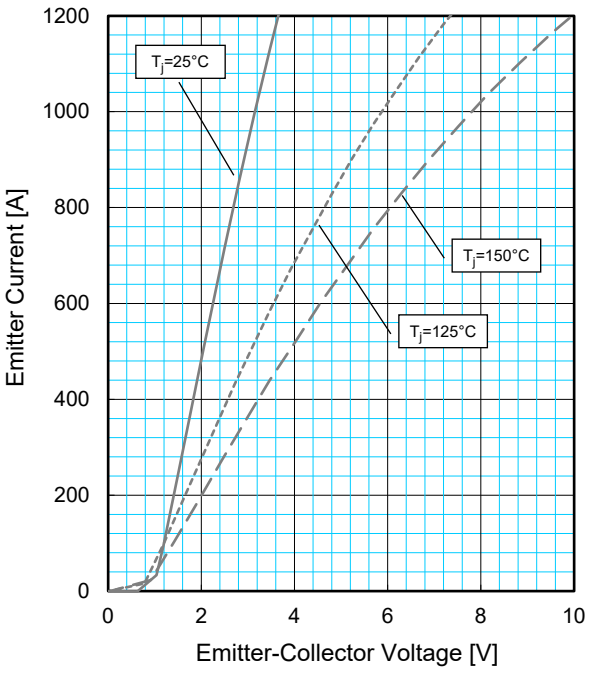
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

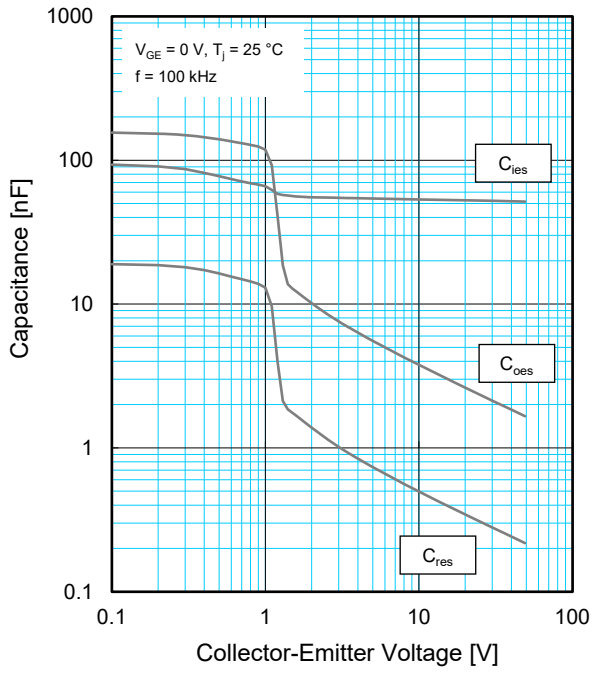


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

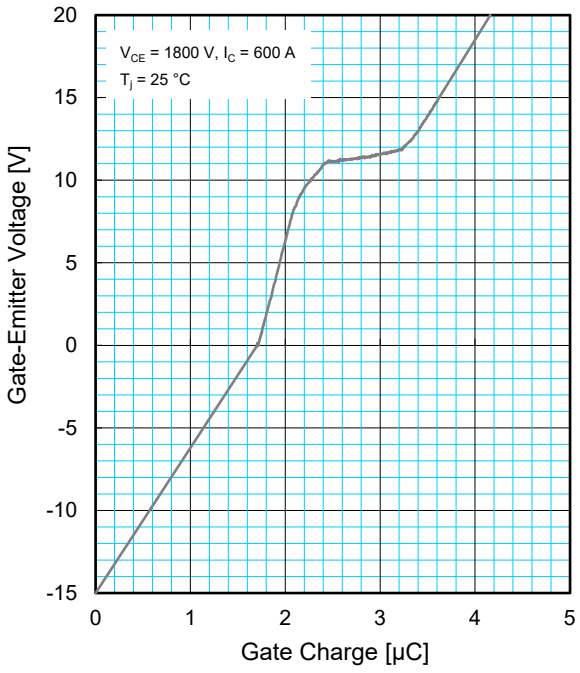


PERFORMANCE CURVES

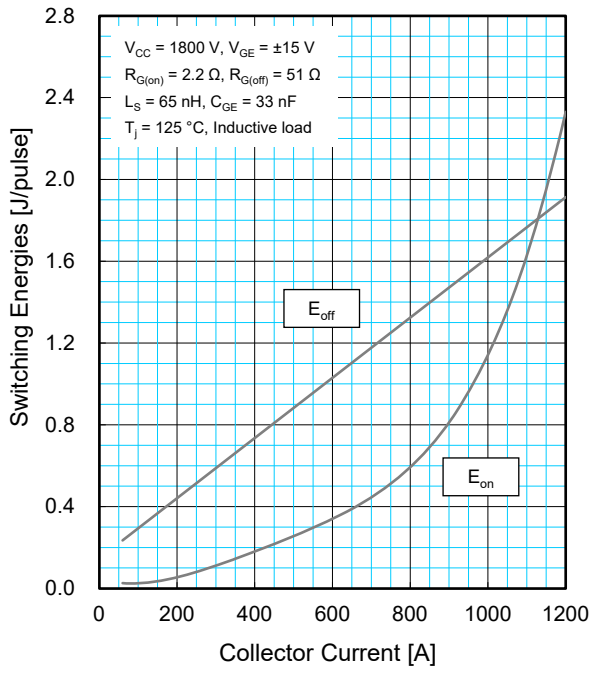
CAPACITANCE CHARACTERISTICS (TYPICAL)



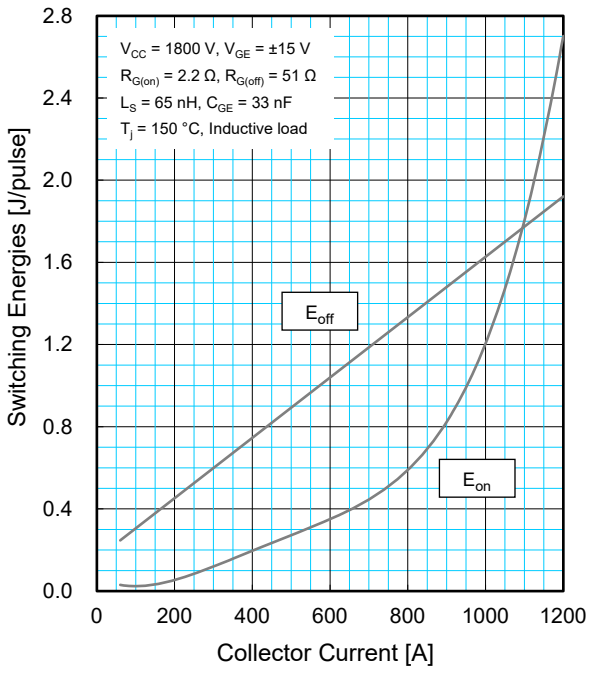
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

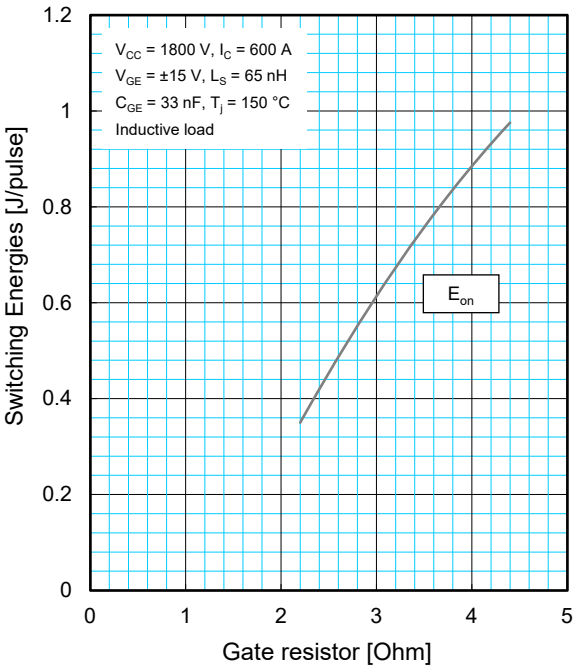


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

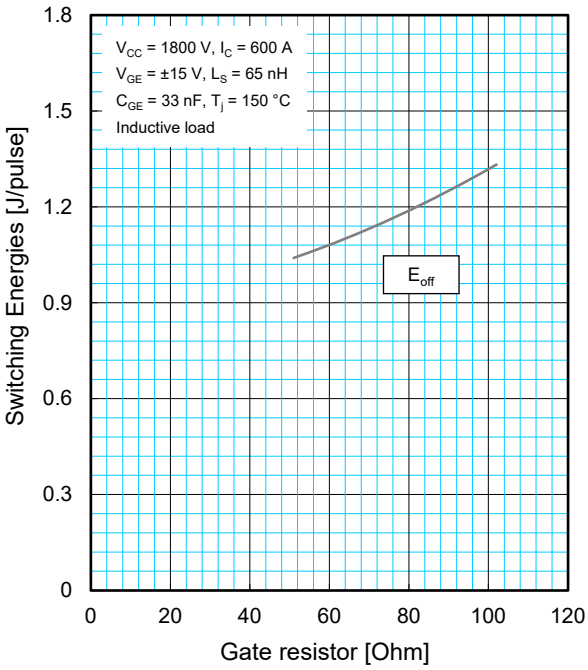


PERFORMANCE CURVES

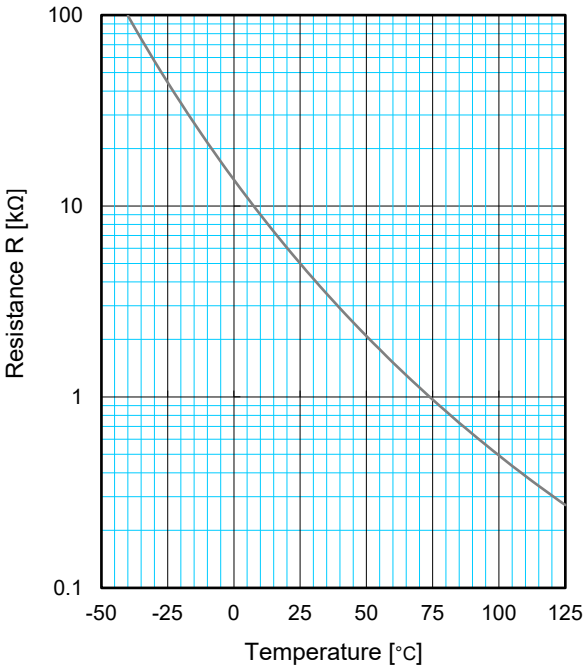
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

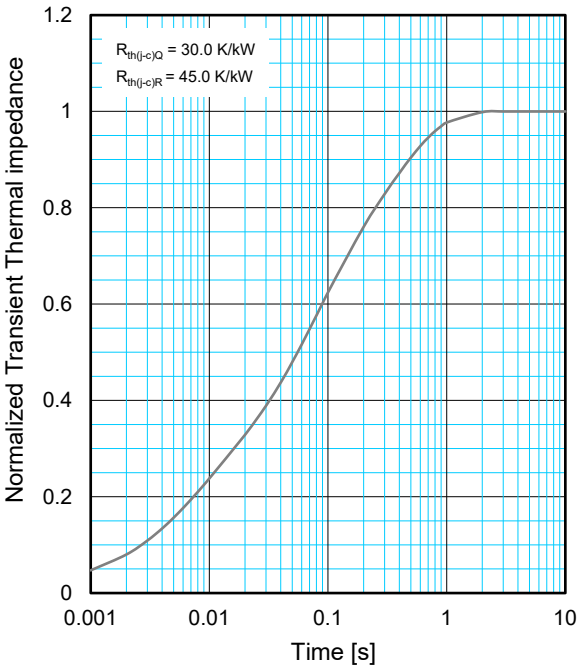


NTC THERMISTOR TEMPERATURE CHARACTERISTICS (TYPICAL)



PERFORMANCE CURVES

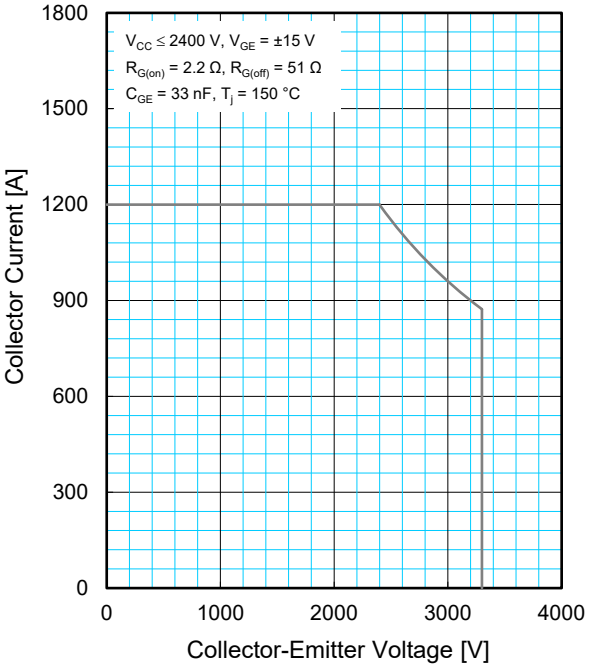
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



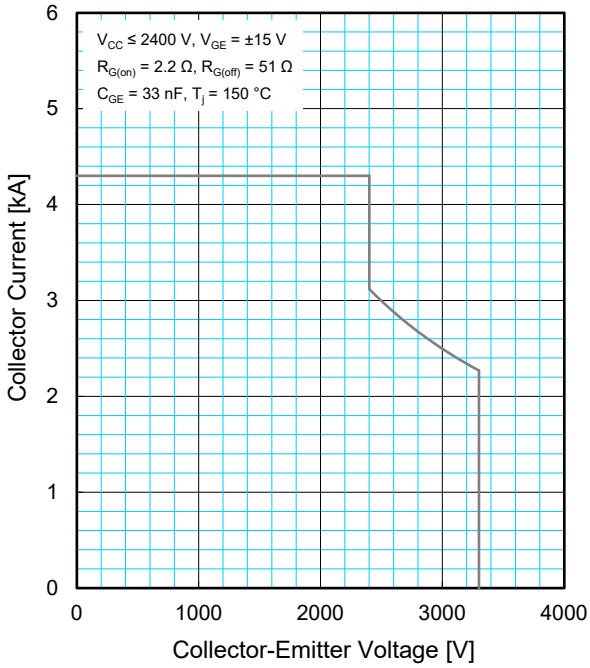
$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{1 - exp^{\left(-\frac{t}{\tau_i}\right)}\right\}$$

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

REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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