

< HVIGBT MODULES >

CM1500HG-66R

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM1500HG-66R



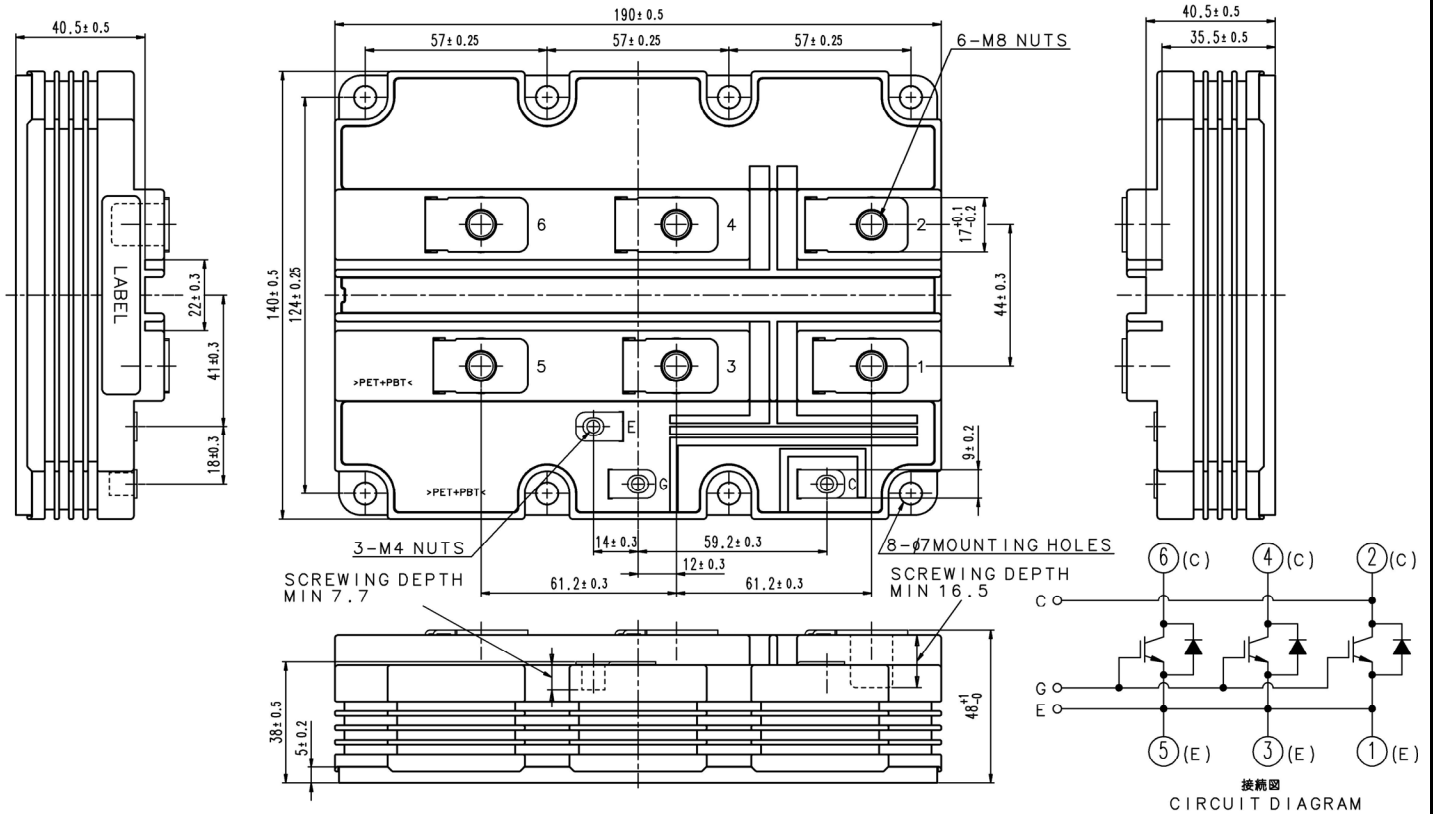
- I_C 1500A
- V_{CES} 3300V
- 1-element in a Pack
- High Insulated Type
- LPT-IGBT / Soft Recovery Diode
- AISiC Baseplate

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



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

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 = 90°C	1500	A
I _{CRM}		Pulse (Note 1)	3000	
I _E	Emitter current (Note 2)	DC	1500	A
I _{ERM}		Pulse (Note 1)	3000	
P _{tot}	Maximum power dissipation (Note 3)	T _c = 25°C, IGBT part	14700	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 ~ +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			Unit	
			Min	Typ	Max		
I _{CES}	Collector cutoff current	V _{CE} = V _{CES} , V _{GE} = 0V	T _J = 25°C	—	—	6.0	mA
			T _J = 125°C	—	6.0	—	
			T _J = 150°C	—	36.0	—	
V _{GE(th)}	Gate-emitter threshold voltage	V _{CE} = 10 V, I _C = 150 mA, T _J = 25°C	5.7	6.2	6.7	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	—	210.0	—	nF	
C _{oes}	Output capacitance		—	13.0	—	nF	
C _{res}	Reverse transfer capacitance		—	6.0	—	nF	
Q _G	Total gate charge	V _{CC} = 1800V, I _C = 1500A, V _{GE} = ±15V	—	16.0	—	μC	
V _{CEsat}	Collector-emitter saturation voltage	I _C = 1500 A (Note 4) V _{GE} = 15 V	T _J = 25°C	—	2.45	—	V
			T _J = 125°C	—	3.10	3.70	
			T _J = 150°C	—	3.25	—	
t _{d(on)}	Turn-on delay time	V _{CC} = 1800 V I _C = 1500 A V _{GE} = ±15 V	T _J = 25°C	—	1.00	—	μs
			T _J = 125°C	—	0.95	1.25	
			T _J = 150°C	—	0.95	1.25	
t _r	Turn-on rise time	R _{G(on)} = 1.6 Ω L _s = 100 nH Inductive load	T _J = 25°C	—	0.28	—	μs
			T _J = 125°C	—	0.30	0.50	
			T _J = 150°C	—	0.30	0.50	
E _{on(10%)}	Turn-on switching energy (Note 5)	Inductive load	T _J = 25°C	—	2.10	—	J
			T _J = 125°C	—	2.75	—	
			T _J = 150°C	—	3.00	—	
E _{on}	Turn-on switching energy (Note 6)	Inductive load	T _J = 25°C	—	2.20	—	J
			T _J = 125°C	—	2.90	—	
			T _J = 150°C	—	3.20	—	
t _{d(off)}	Turn-off delay time	V _{CC} = 1800 V I _C = 1500 A V _{GE} = ±15 V	T _J = 25°C	—	2.70	—	μs
			T _J = 125°C	—	2.80	3.30	
			T _J = 150°C	—	2.85	3.30	
t _f	Turn-off fall time	R _{G(off)} = 5.6 Ω L _s = 100 nH Inductive load	T _J = 25°C	—	0.30	—	μs
			T _J = 125°C	—	0.35	1.00	
			T _J = 150°C	—	0.40	1.00	
E _{off(10%)}	Turn-off switching energy (Note 5)	Inductive load	T _J = 25°C	—	2.00	—	J
			T _J = 125°C	—	2.45	—	
			T _J = 150°C	—	2.50	—	
E _{off}	Turn-off switching energy (Note 6)	Inductive load	T _J = 25°C	—	2.20	—	J
			T _J = 125°C	—	2.70	—	
			T _J = 150°C	—	2.80	—	

ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
V_{EC}	Emitter-collector voltage (Note 2)	$I_E = 1500 \text{ A}$ (Note 4) $V_{GE} = 0 \text{ V}$	$T_j = 25^\circ\text{C}$	—	2.15	—	V
			$T_j = 125^\circ\text{C}$	—	2.30	2.80	
			$T_j = 150^\circ\text{C}$	—	2.25	—	
t_{rr}	Reverse recovery time (Note 2)		$T_j = 25^\circ\text{C}$	—	0.50	—	μs
			$T_j = 125^\circ\text{C}$	—	0.70	—	
			$T_j = 150^\circ\text{C}$	—	0.80	—	
I_{rr}	Reverse recovery current (Note 2)	$V_{CC} = 1800 \text{ V}$ $I_C = 1500 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 1.6 \Omega$ $L_S = 100 \text{ nH}$ Inductive load	$T_j = 25^\circ\text{C}$	—	1250	—	A
			$T_j = 125^\circ\text{C}$	—	1500	—	
			$T_j = 150^\circ\text{C}$	—	1550	—	
Q_{rr}	Reverse recovery charge (Note 2)		$T_j = 25^\circ\text{C}$	—	1050	—	μC
			$T_j = 125^\circ\text{C}$	—	1700	—	
			$T_j = 150^\circ\text{C}$	—	2000	—	
$E_{rec(10\%)}$	Reverse recovery energy (Note 2) (Note 5)		$T_j = 25^\circ\text{C}$	—	1.05	—	J
			$T_j = 125^\circ\text{C}$	—	1.75	—	
			$T_j = 150^\circ\text{C}$	—	2.00	—	
E_{rec}	Reverse recovery energy (Note 2) (Note 6)		$T_j = 25^\circ\text{C}$	—	1.20	—	J
			$T_j = 125^\circ\text{C}$	—	2.00	—	
			$T_j = 150^\circ\text{C}$	—	2.30	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part	—	—	8.5	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part	—	—	15.5	
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, $\lambda_{grease} = 1\text{W/m}^2\text{K}$, $D_{(c-s)} = 100\mu\text{m}$	—	6.0	—	K/kW

MECHANICAL CHARACTERISTICS

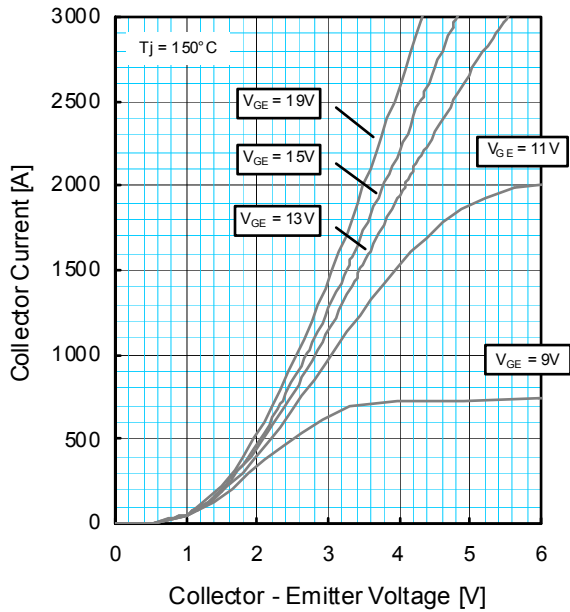
Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
M_t	Mounting torque	M8 : Main terminals screw	7.0	—	22.0	N·m
M_s		M6 : Mounting screw	3.0	—	6.0	N·m
M_t		M4 : Auxiliary terminals screw	1.0	—	3.0	N·m
m	Mass		—	1.4	—	kg
CTI	Comparative tracking index		600	—	—	—
d_a	Clearance		26.0	—	—	mm
d_s	Creepage distance		56.0	—	—	mm
L_{PCE}	Parasitic stray inductance		—	15.0	—	nH
R_{CC+EE}	Internal lead resistance	$T_C = 25^\circ\text{C}$	—	0.18	—	m Ω
r_g	Internal gate resistance	$T_C = 25^\circ\text{C}$	—	1.5	—	Ω

Note1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{opmax} rating(150°C).

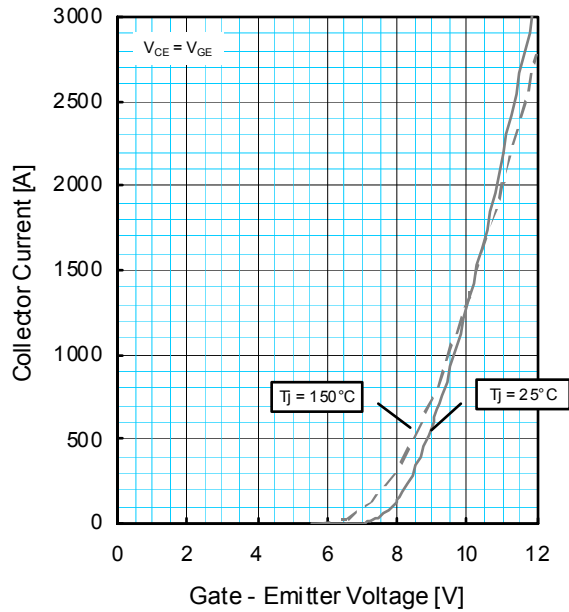
- The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD).
- Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).
- Pulse width and repetition rate should be such as to cause negligible temperature rise.
- $E_{on(10\%)} / E_{off(10\%)}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

PERFORMANCE CURVES

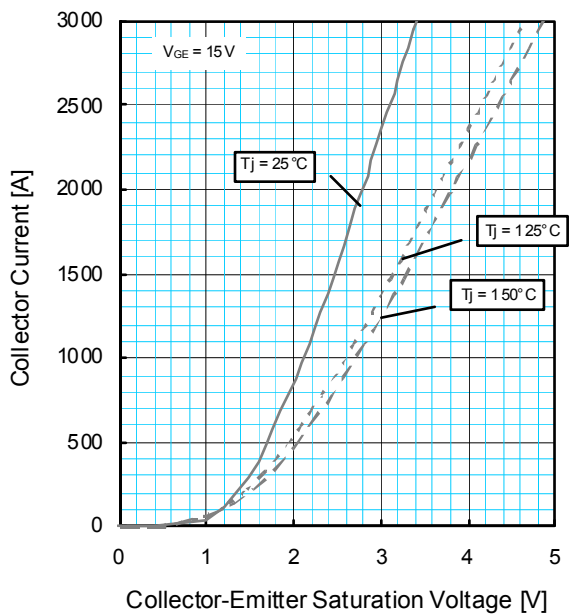
OUTPUT CHARACTERISTICS (TYPICAL)



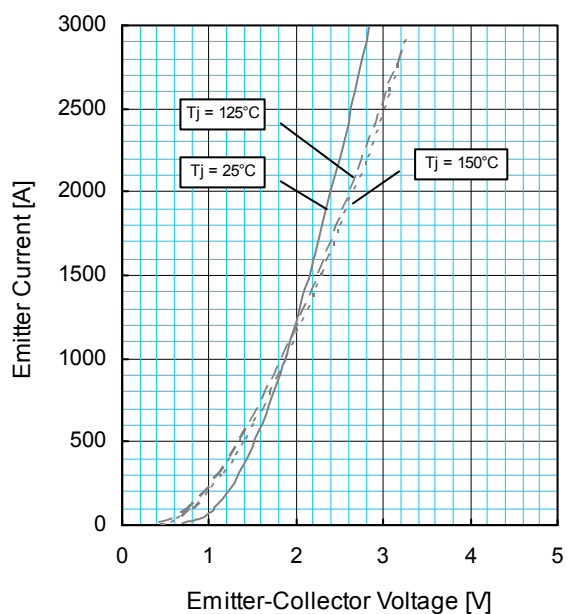
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

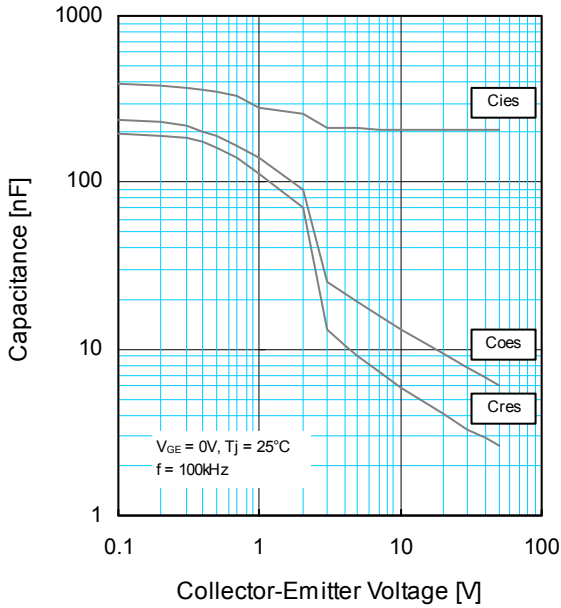


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

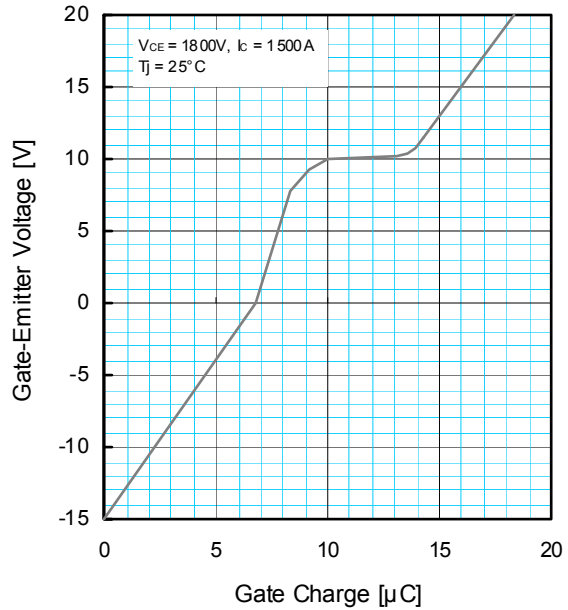


PERFORMANCE CURVES

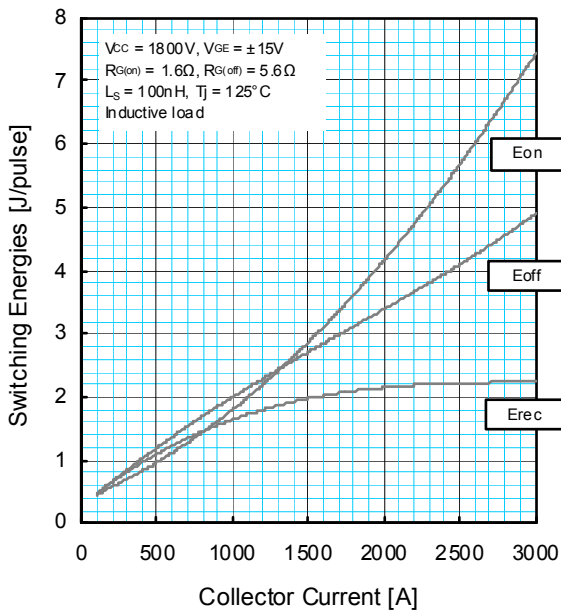
CAPACITANCE CHARACTERISTICS (TYPICAL)



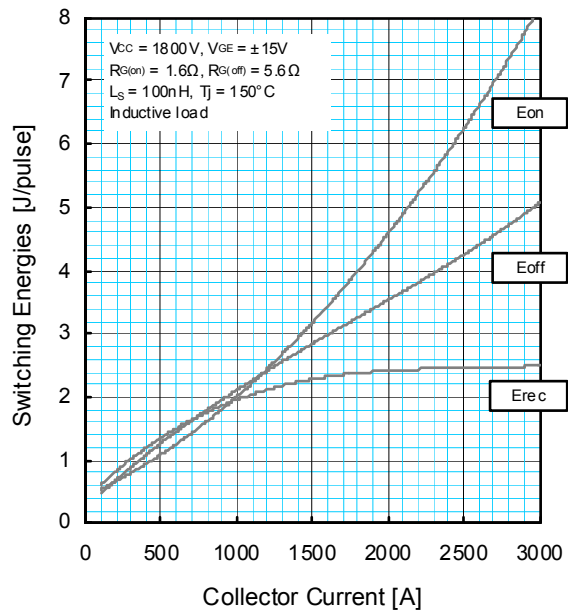
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

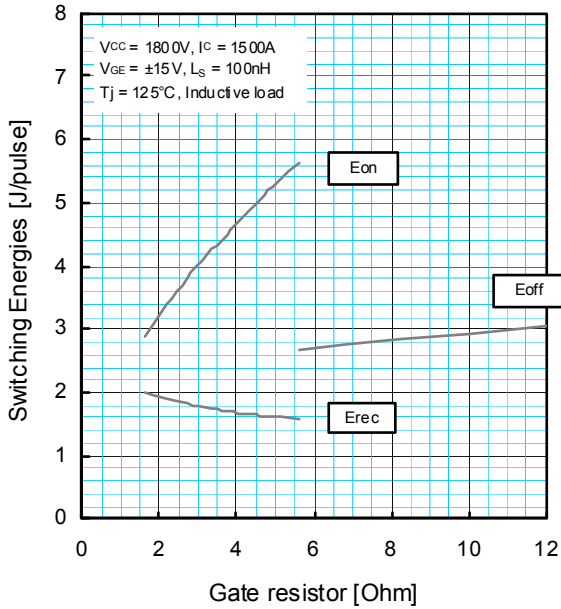


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

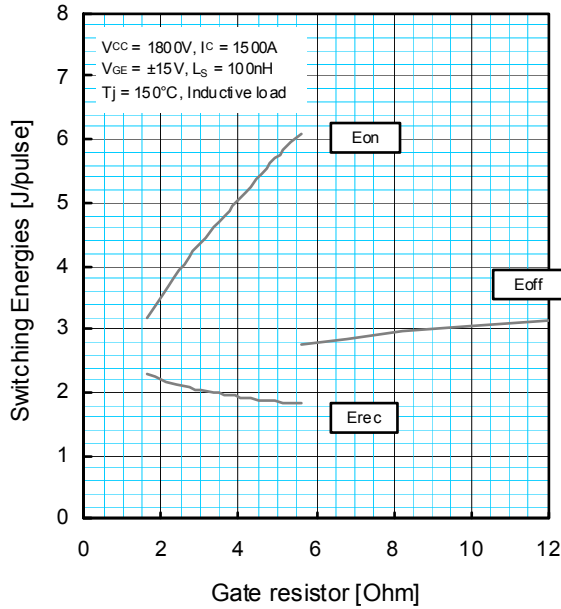


PERFORMANCE CURVES

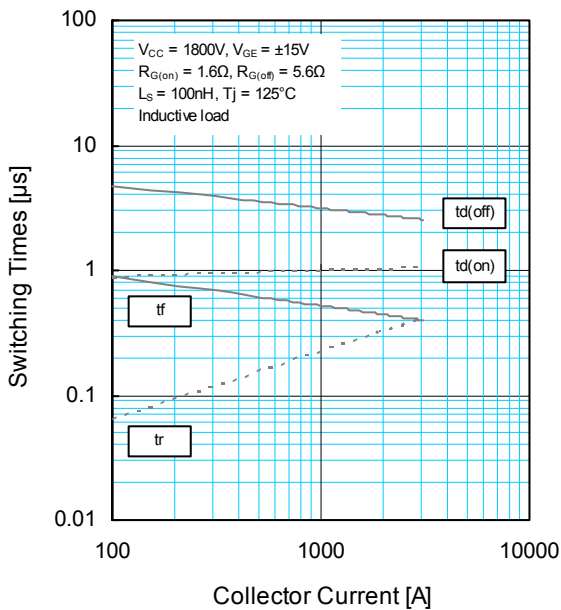
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



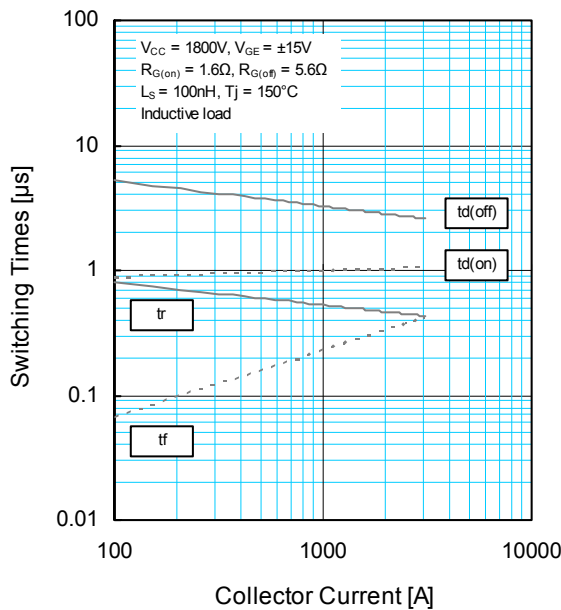
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

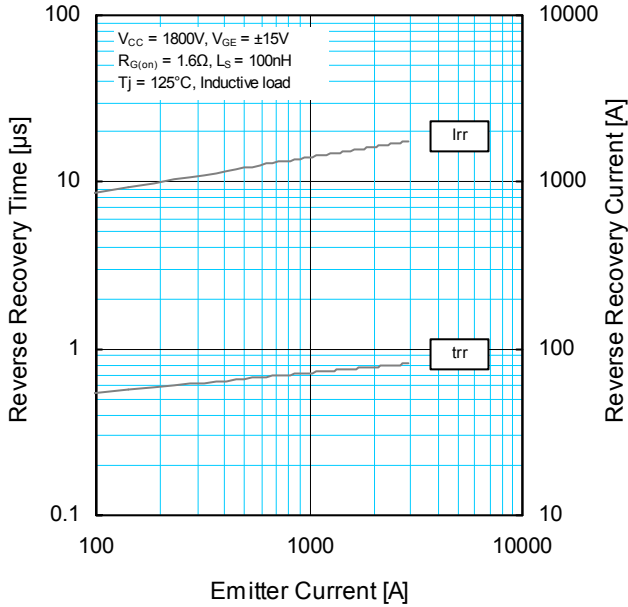


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

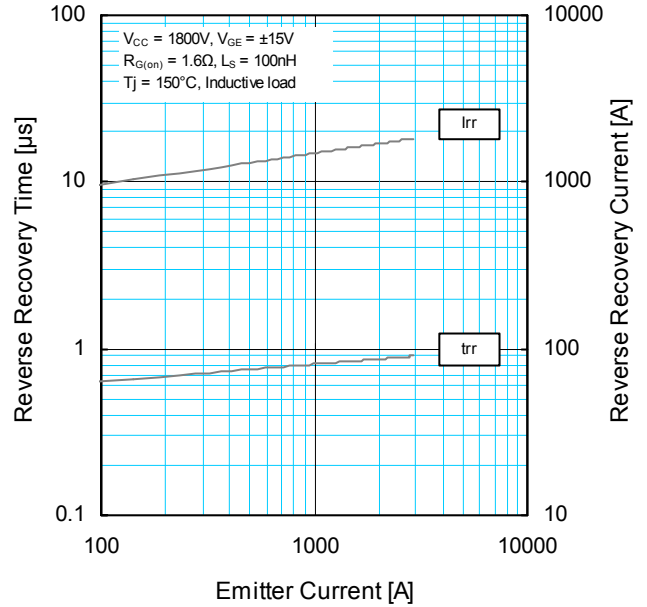


PERFORMANCE CURVES

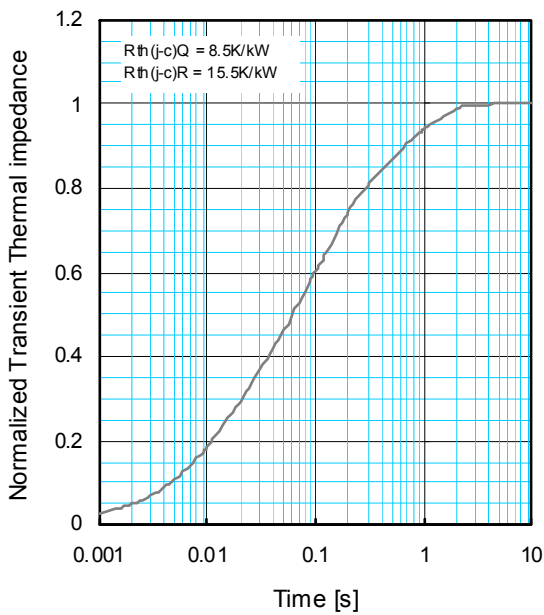
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

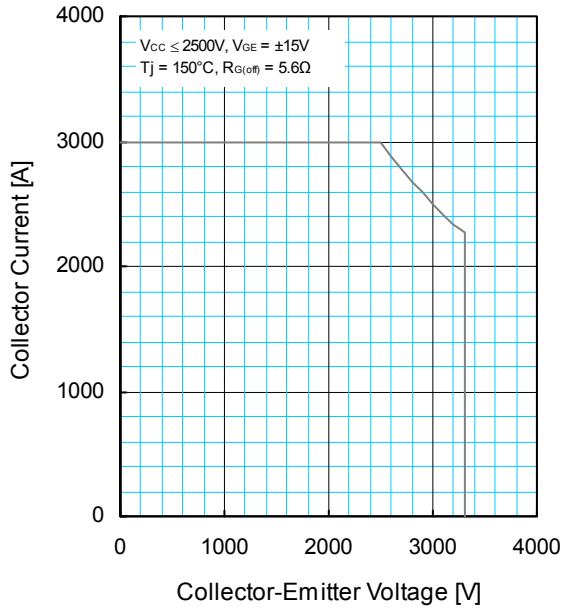


$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i}\right) \right\}$$

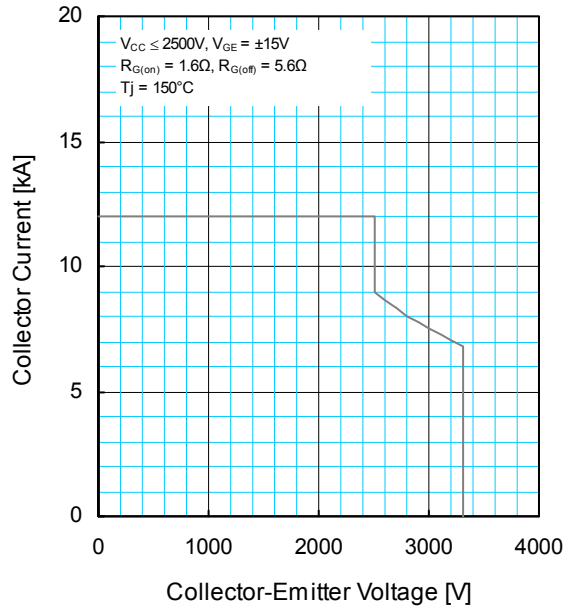
	1	2	3	4
R_i [K/kW] :	0.0055	0.2360	0.4680	0.2905
τ_i [sec] :	0.0001	0.0131	0.0878	0.6247

PERFORMANCE CURVES

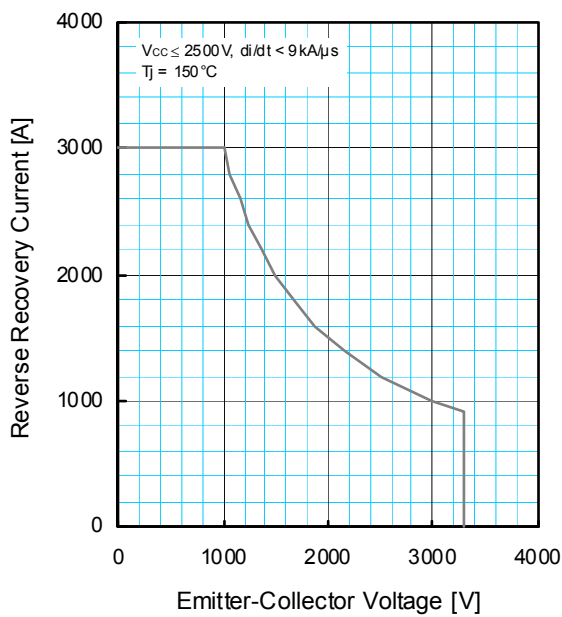
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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