

< HVIGBT MODULES >

CM1000E4C-66R

HIGH POWER SWITCHING USE
INSULATED TYPE

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 = 95°C	1000	A
I _{CRM}		Pulse (Note 1)	2000	
I _E	Emitter current (Note 2)	DC	1000	A
I _{ERM}		Pulse (Note 1)	2000	
P _{tot}	Maximum power dissipation (Note 3)	T _C = 25°C, IGBT part	10400	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} ≤ 10 pC	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			Unit	
			Min	Typ	Max		
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} = 10 V, I _C = 100 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	—	140.0	—	nF	
C _{oes}	Output capacitance		—	8.7	—	nF	
C _{res}	Reverse transfer capacitance		—	4.0	—	nF	
Q _G	Total gate charge	V _{CC} = 1800V, I _C = 1000A, V _{GE} = ±15V	—	10.7	—	μC	
V _{CESat}	Collector-emitter saturation voltage	I _C = 1000 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 = 1000 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)} = 2.4 Ω L _s = 150 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	—	1.40	—	J
			T _J = 125°C	—	1.85	—	
			T _J = 150°C	—	2.00	—	
E _{on}	Turn-on switching energy (Note 6)	Inductive load	T _J = 25°C	—	1.50	—	J
			T _J = 125°C	—	1.95	—	
			T _J = 150°C	—	2.15	—	
t _{d(off)}	Turn-off delay time	V _{CC} = 1800 V I _C = 1000 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)} = 8.4 Ω L _s = 150 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	—	1.35	—	J
			T _J = 125°C	—	1.65	—	
			T _J = 150°C	—	1.70	—	
E _{off}	Turn-off switching energy (Note 6)	Inductive load	T _J = 25°C	—	1.50	—	J
			T _J = 125°C	—	1.80	—	
			T _J = 150°C	—	1.90	—	

ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
V_{EC}	Emitter-collector voltage (Note 2)	$I_E = 1000 \text{ A}$ (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)	$V_{CC} = 1800 \text{ V}$ $I_C = 1000 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 2.4 \Omega$ $L_s = 150 \text{ nH}$ Inductive load	$T_j = 25^\circ\text{C}$	—	850	—	A
			$T_j = 125^\circ\text{C}$	—	1000	—	
			$T_j = 150^\circ\text{C}$	—	1050	—	
Q_{rr}	Reverse recovery charge (Note 2)		$T_j = 25^\circ\text{C}$	—	700	—	μC
			$T_j = 125^\circ\text{C}$	—	1150	—	
			$T_j = 150^\circ\text{C}$	—	1350	—	
$E_{rec(10\%)}$	Reverse recovery energy (Note 2) (Note 5)		$T_j = 25^\circ\text{C}$	—	0.70	—	J
			$T_j = 125^\circ\text{C}$	—	1.20	—	
			$T_j = 150^\circ\text{C}$	—	1.35	—	
E_{rec}	Reverse recovery energy (Note 2) (Note 6)		$T_j = 25^\circ\text{C}$	—	0.80	—	J
			$T_j = 125^\circ\text{C}$	—	1.35	—	
			$T_j = 150^\circ\text{C}$	—	1.55	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part	—	—	12.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part	—	—	22.5	K/kW
		Junction to Case, Clamp-Di part	—	—	22.5	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, $\lambda_{grease} = 1\text{W/m}^2\text{K}$, $D_{(c-s)} = 100\mu\text{m}$	—	7.0	—	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		—	1.2	—	kg
CTI	Comparative tracking index		600	—	—	—
d_a	Clearance		19.5	—	—	mm
d_s	Creepage distance		32.0	—	—	mm
L_{PCE}	Parasitic stray inductance	Collector to Emitter	—	16.5	—	nH
		Anode to Cathode	—	33.0	—	nH
$R_{CC+EE'}$	Internal lead resistance	$T_C = 25^\circ\text{C}$, Collector to Emitter	—	0.18	—	m Ω
$R_{AA+KK'}$	Internal lead resistance	$T_C = 25^\circ\text{C}$, Anode to Cathode	—	0.36	—	m Ω
r_g	Internal gate resistance	$T_C = 25^\circ\text{C}$	—	2.25	—	Ω

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

2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD,) and the brake chopper, anode to cathode clamp diode (Clamp-Di).

3. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).

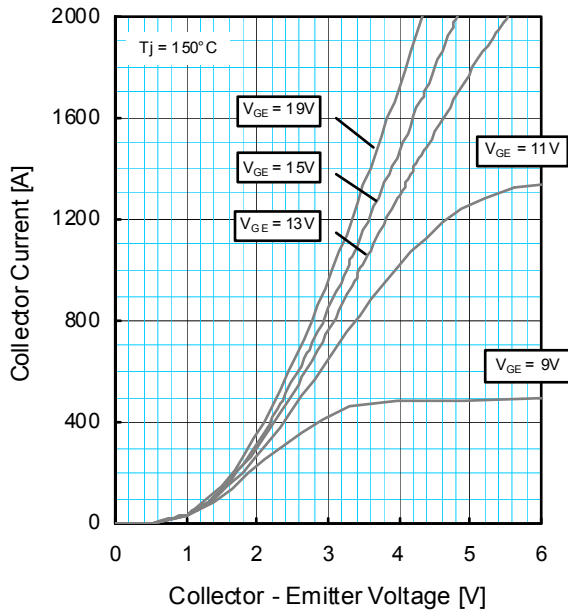
4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

5. $E_{on(10\%)} / E_{off(10\%)} / E_{rec(10\%)}$ are the integral of $0.1V_{CE} \times 0.1I_C \times dt$.

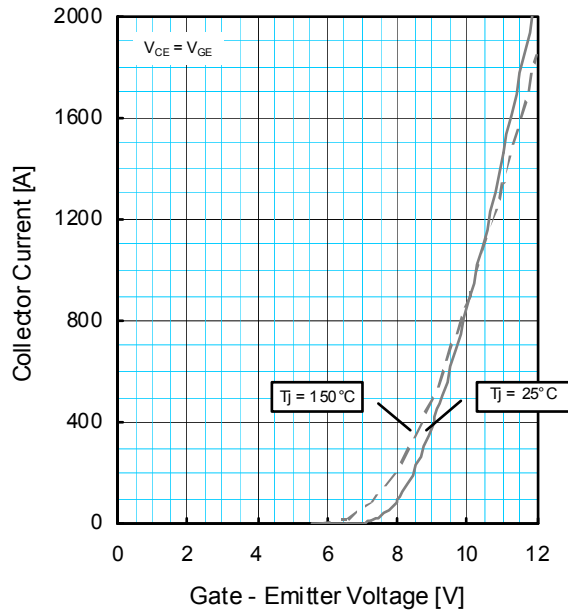
6. Definition of all items is according to IEC 60747, unless otherwise specified.

PERFORMANCE CURVES

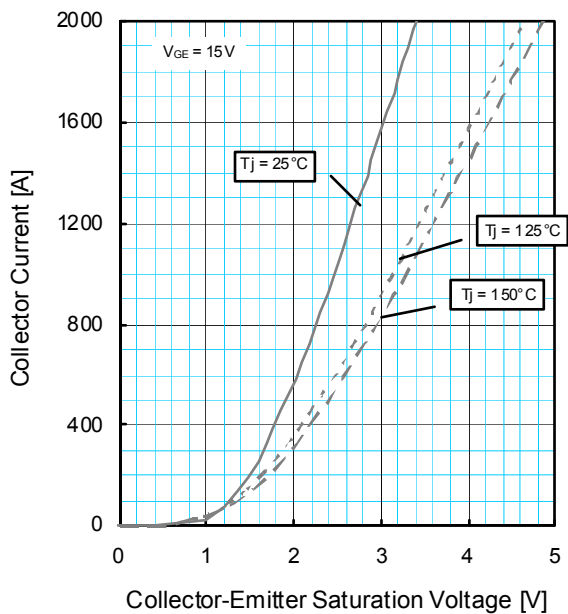
OUTPUT CHARACTERISTICS (TYPICAL)



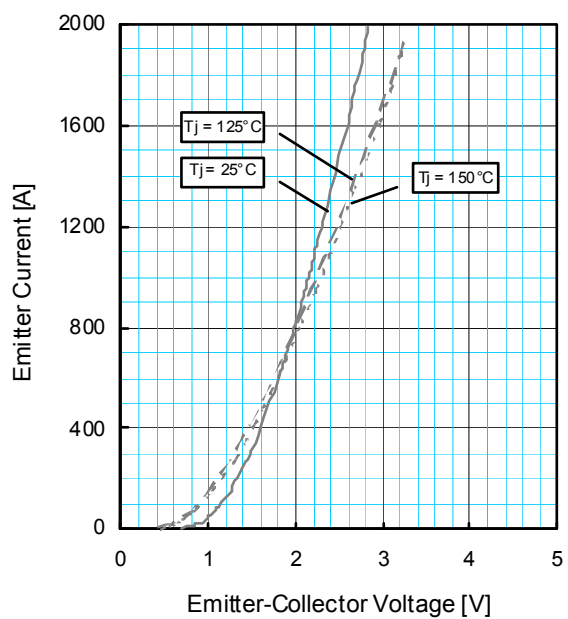
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

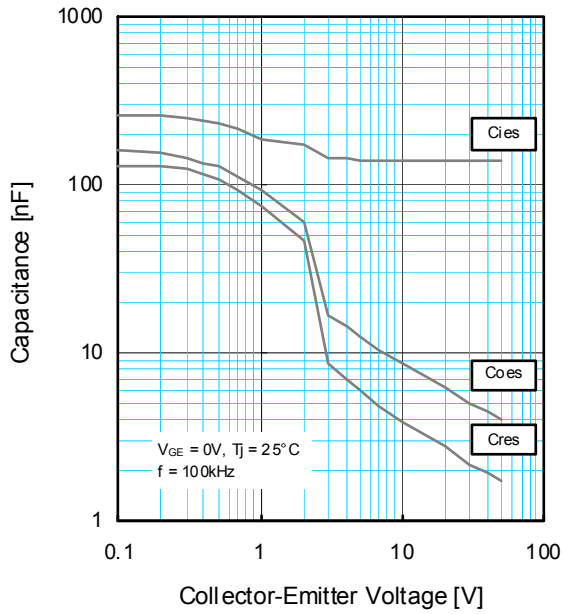


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

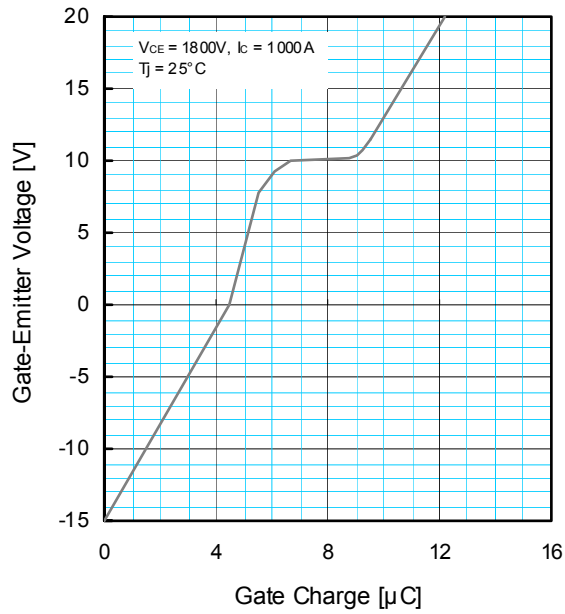


PERFORMANCE CURVES

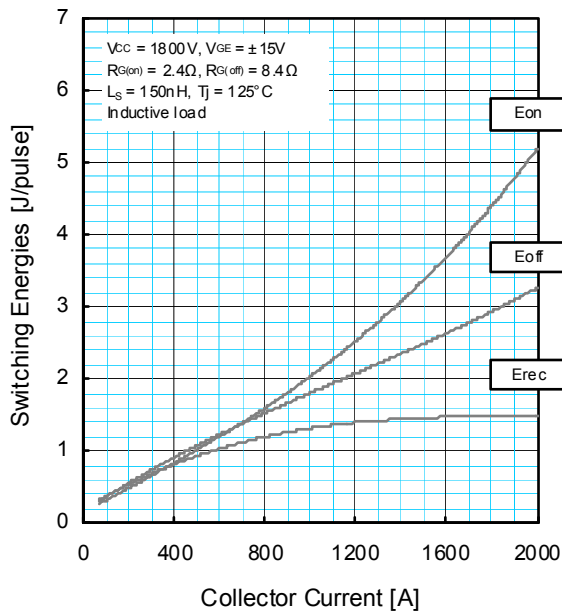
CAPACITANCE CHARACTERISTICS (TYPICAL)



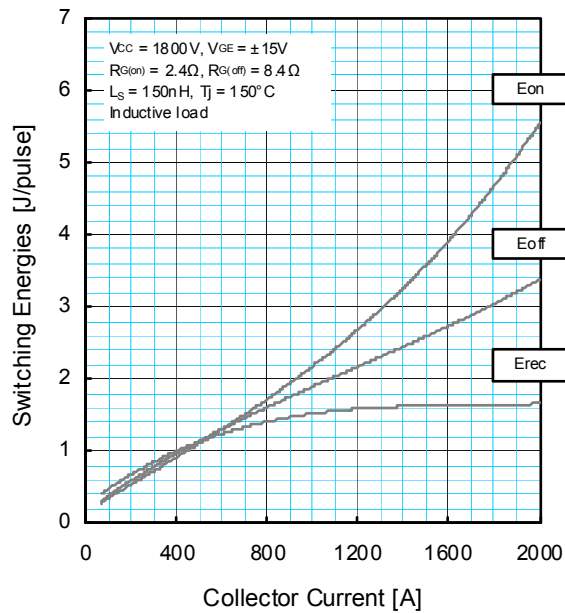
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

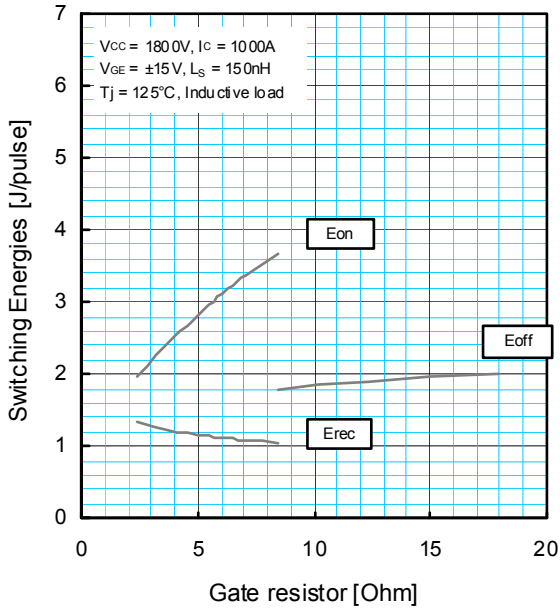


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

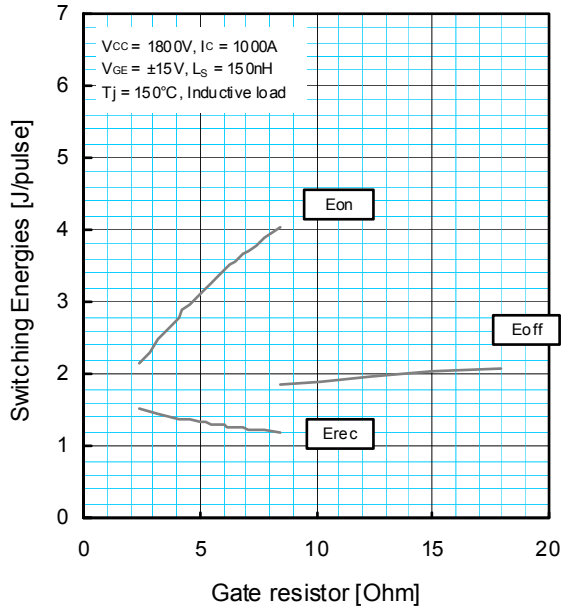


PERFORMANCE CURVES

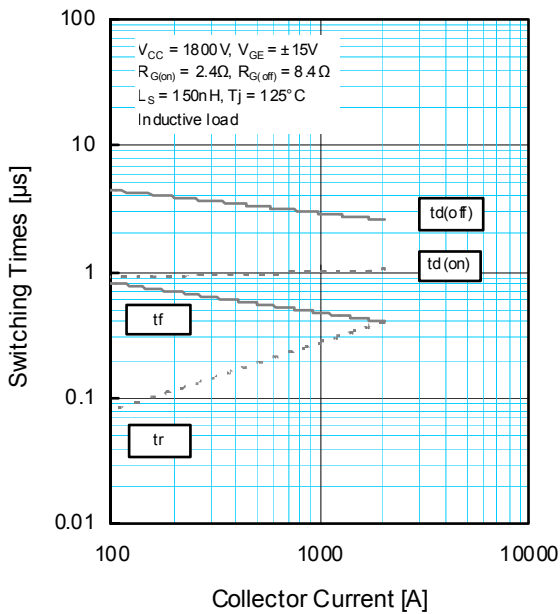
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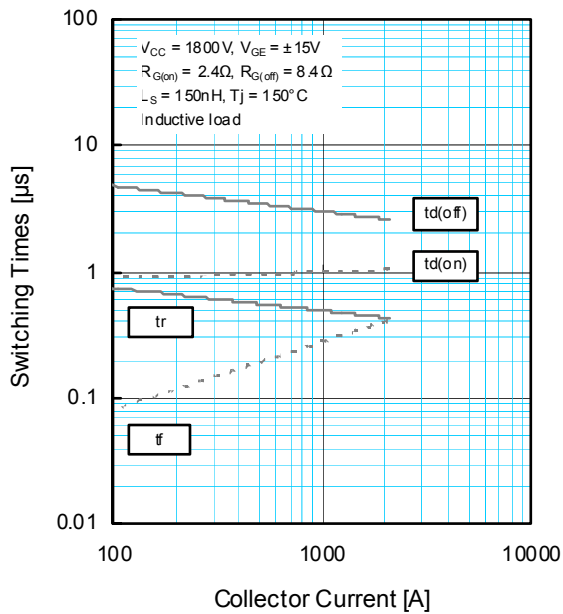
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

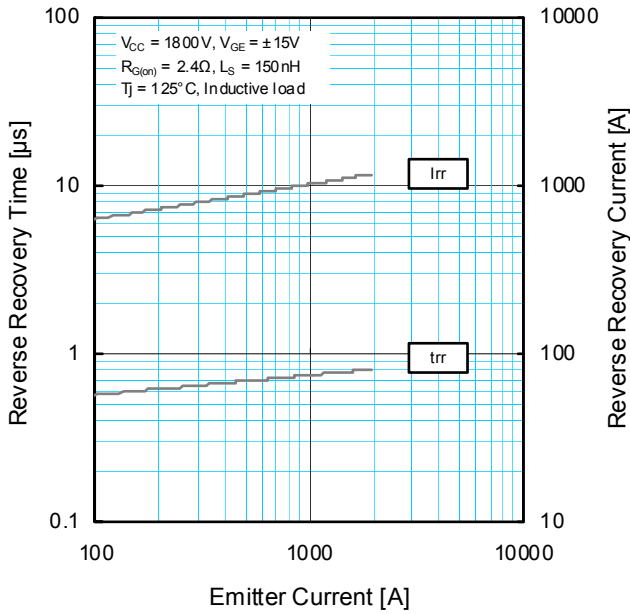


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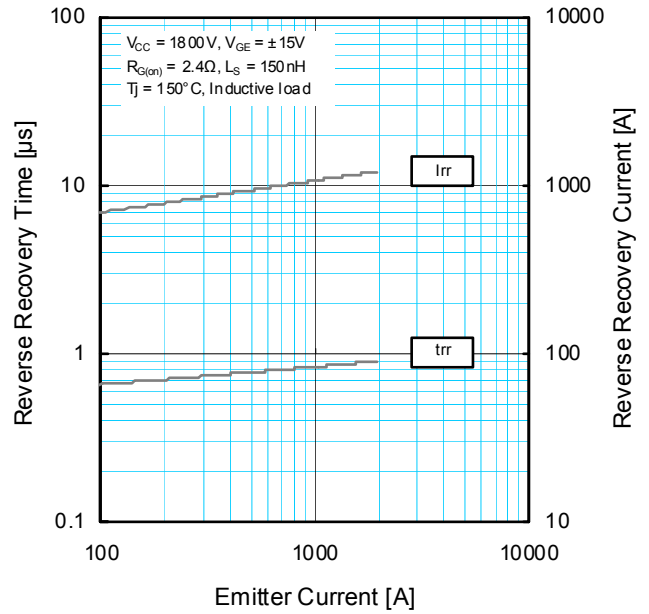


PERFORMANCE CURVES

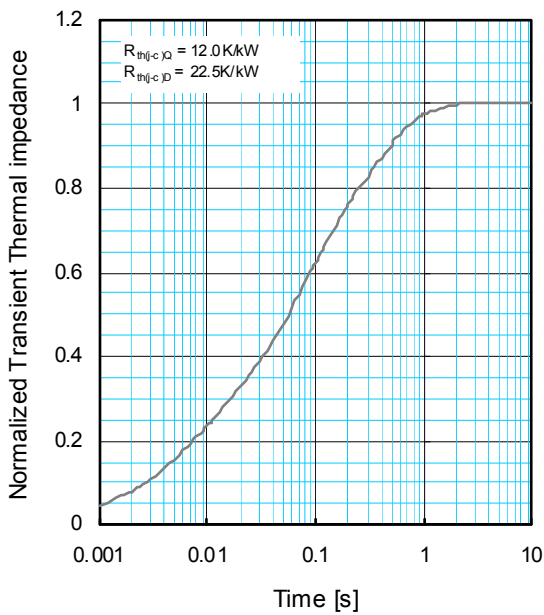
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

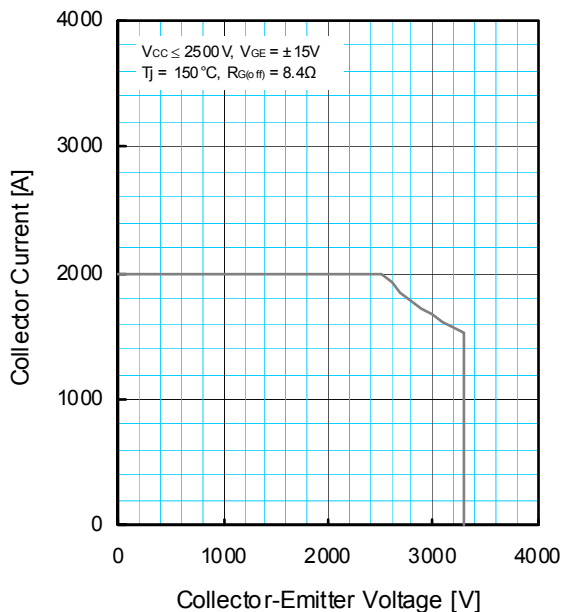


$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i}\right) \right\}$$

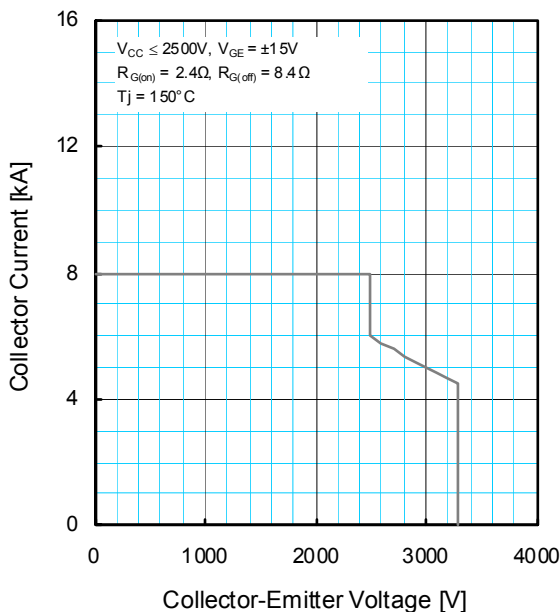
	1	2	3	4
R_i [K/kW] :	0.0096	0.1893	0.4044	0.3967
τ_i [sec] :	0.0001	0.0058	0.0602	0.3512

PERFORMANCE CURVES

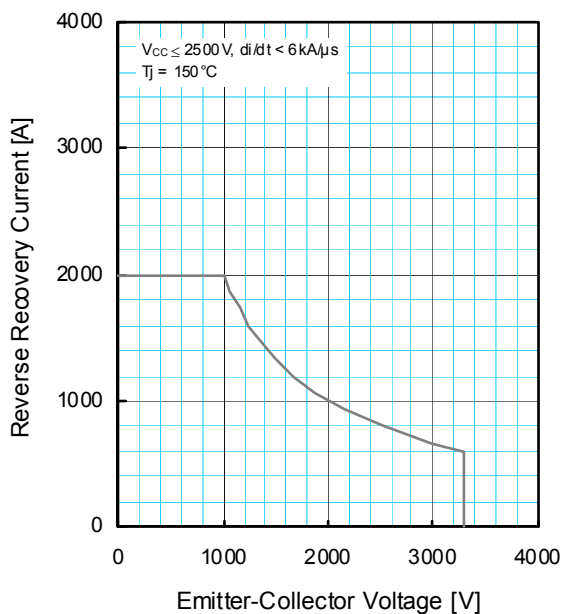
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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