

< HVIGBT MODULES >

# CM1500HC-66R

HIGH POWER SWITCHING USE  
INSULATED TYPE

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

CM1500HC-66R



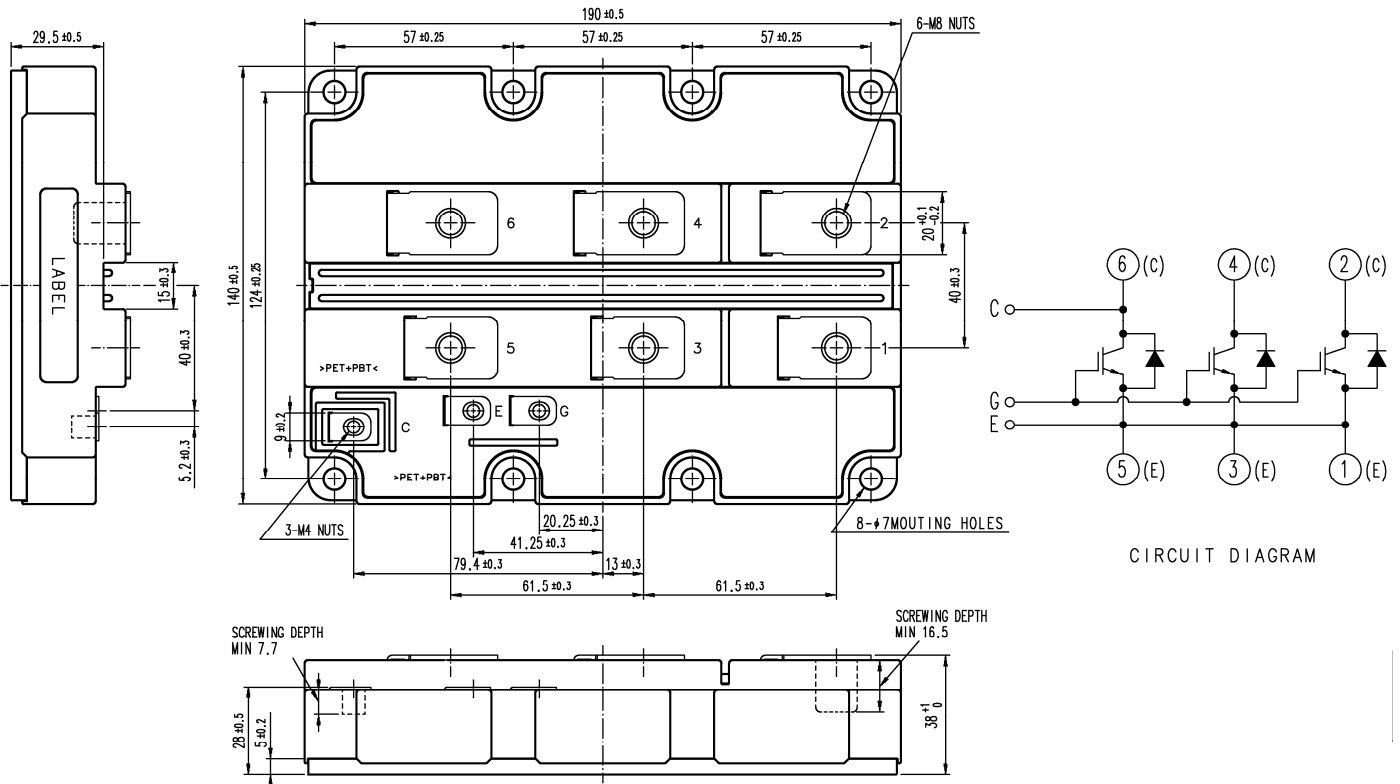
- $I_C$ .....1500A
- $V_{CES}$ .....3300V
- 1-element in a Pack
- Insulated Type
- LPT-IGBT / Soft Recovery Diode
- AISiC Baseplate

## APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

## OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



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**MAXIMUM RATINGS**

Symbol	Item	Conditions	Ratings	Unit
V <sub>CES</sub>	Collector-emitter voltage	V <sub>GE</sub> = 0V, T <sub>J</sub> = -40...+150°C	3300	V
		V <sub>GE</sub> = 0V, T <sub>J</sub> = -50°C	3200	
V <sub>GES</sub>	Gate-emitter voltage	V <sub>CE</sub> = 0V, T <sub>J</sub> = 25°C	± 20	V
I <sub>C</sub>	Collector current	DC, T <sub>C</sub> = 95°C	1500	A
I <sub>CRM</sub>		Pulse (Note 1)	3000	
I <sub>E</sub>	Emitter current (Note 2)	DC	1500	A
I <sub>ERM</sub>		Pulse (Note 1)	3000	
P <sub>tot</sub>	Maximum power dissipation (Note 3)	T <sub>C</sub> = 25°C, IGBT part	15600	W
V <sub>iso</sub>	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1 min.	6000	V
V <sub>e</sub>	Partial discharge extinction voltage	RMS, sinusoidal, f = 60Hz, Q <sub>PD</sub> ≤ 10 pC	2600	V
T <sub>J</sub>	Junction temperature		-50 ~ +150	°C
T <sub>Jop</sub>	Operating junction temperature		-50 ~ +150	°C
T <sub>stg</sub>	Storage temperature		-55 ~ +150	°C
t <sub>psc</sub>	Short circuit pulse width	V <sub>CC</sub> = 2500V, V <sub>CE</sub> ≤ V <sub>CES</sub> , V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C	10	μs

**ELECTRICAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
I <sub>CES</sub>	Collector cutoff current	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0V	T <sub>J</sub> = 25°C	—	—	6.0	mA
			T <sub>J</sub> = 125°C	—	6.0	—	
			T <sub>J</sub> = 150°C	—	36.0	—	
V <sub>GE(th)</sub>	Gate-emitter threshold voltage	V <sub>CE</sub> = 10 V, I <sub>C</sub> = 150 mA, T <sub>J</sub> = 25°C	5.7	6.2	6.7	V	
I <sub>GES</sub>	Gate leakage current	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0V, T <sub>J</sub> = 25°C	-0.5	—	0.5	μA	
C <sub>ies</sub>	Input capacitance	V <sub>CE</sub> = 10 V, V <sub>GE</sub> = 0 V, f = 100 kHz T <sub>J</sub> = 25°C	—	210.0	—	nF	
C <sub>oes</sub>	Output capacitance		—	13.0	—	nF	
C <sub>res</sub>	Reverse transfer capacitance		—	6.0	—	nF	
Q <sub>G</sub>	Total gate charge	V <sub>CC</sub> = 1800V, I <sub>C</sub> = 1500A, V <sub>GE</sub> = ±15V	—	16.0	—	μC	
V <sub>CESat</sub>	Collector-emitter saturation voltage	I <sub>C</sub> = 1500 A (Note 4) V <sub>GE</sub> = 15 V	T <sub>J</sub> = 25°C	—	2.45	—	V
			T <sub>J</sub> = 125°C	—	3.10	3.70	
			T <sub>J</sub> = 150°C	—	3.25	—	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> = 1800 V I <sub>C</sub> = 1500 A V <sub>GE</sub> = ±15 V	T <sub>J</sub> = 25°C	—	1.00	—	μs
			T <sub>J</sub> = 125°C	—	0.95	1.25	
			T <sub>J</sub> = 150°C	—	0.95	1.25	
t <sub>r</sub>	Turn-on rise time	R <sub>G(on)</sub> = 1.6 Ω L <sub>s</sub> = 100 nH Inductive load	T <sub>J</sub> = 25°C	—	0.28	—	μs
			T <sub>J</sub> = 125°C	—	0.30	0.50	
			T <sub>J</sub> = 150°C	—	0.30	0.50	
E <sub>on(10%)</sub>	Turn-on switching energy (Note 5)	Inductive load	T <sub>J</sub> = 25°C	—	2.10	—	J
			T <sub>J</sub> = 125°C	—	2.75	—	
			T <sub>J</sub> = 150°C	—	3.00	—	
E <sub>on</sub>	Turn-on switching energy (Note 6)	Inductive load	T <sub>J</sub> = 25°C	—	2.20	—	J
			T <sub>J</sub> = 125°C	—	2.90	—	
			T <sub>J</sub> = 150°C	—	3.20	—	
t <sub>d(off)</sub>	Turn-off delay time	V <sub>CC</sub> = 1800 V I <sub>C</sub> = 1500 A V <sub>GE</sub> = ±15 V	T <sub>J</sub> = 25°C	—	2.70	—	μs
			T <sub>J</sub> = 125°C	—	2.80	3.30	
			T <sub>J</sub> = 150°C	—	2.85	3.30	
t <sub>f</sub>	Turn-off fall time	R <sub>G(off)</sub> = 5.6 Ω L <sub>s</sub> = 100 nH Inductive load	T <sub>J</sub> = 25°C	—	0.30	—	μs
			T <sub>J</sub> = 125°C	—	0.35	1.00	
			T <sub>J</sub> = 150°C	—	0.40	1.00	
E <sub>off(10%)</sub>	Turn-off switching energy (Note 5)	Inductive load	T <sub>J</sub> = 25°C	—	2.00	—	J
			T <sub>J</sub> = 125°C	—	2.45	—	
			T <sub>J</sub> = 150°C	—	2.50	—	
E <sub>off</sub>	Turn-off switching energy (Note 6)	Inductive load	T <sub>J</sub> = 25°C	—	2.20	—	J
			T <sub>J</sub> = 125°C	—	2.70	—	
			T <sub>J</sub> = 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	—	$\mu\text{s}$
			$T_j = 125^\circ\text{C}$	—	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	—	$\mu\text{C}$
			$T_j = 125^\circ\text{C}$	—	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	—	—	8.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part	—	—	15.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, $\lambda_{grease} = 1\text{W/m}^2\text{K}$ , $D_{(c-s)} = 100\mu\text{m}$	—	6.0	—	K/kW

**MECHANICAL CHARACTERISTICS**

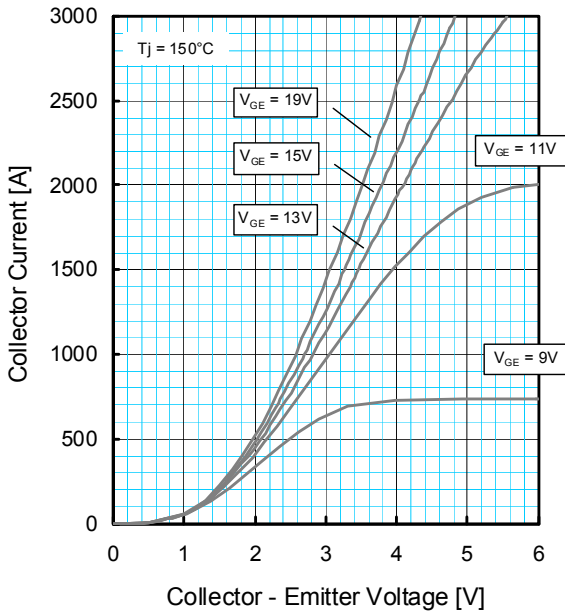
Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
$M_t$	Mounting torque	M8 : Main terminals screw	7.0	—	22.0	N·m
$M_s$		M6 : Mounting screw	3.0	—	6.0	N·m
$M_t$		M4 : Auxiliary terminals screw	1.0	—	3.0	N·m
$m$	Mass		—	1.2	—	kg
CTI	Comparative tracking index		600	—	—	—
$d_a$	Clearance		19.5	—	—	mm
$d_s$	Creepage distance		32.0	—	—	mm
$L_{PCE}$	Parasitic stray inductance		—	11.0	—	nH
$R_{CC+EE}$	Internal lead resistance	$T_C = 25^\circ\text{C}$	—	0.12	—	m $\Omega$
$r_g$	Internal gate resistance	$T_C = 25^\circ\text{C}$	—	1.5	—	$\Omega$

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

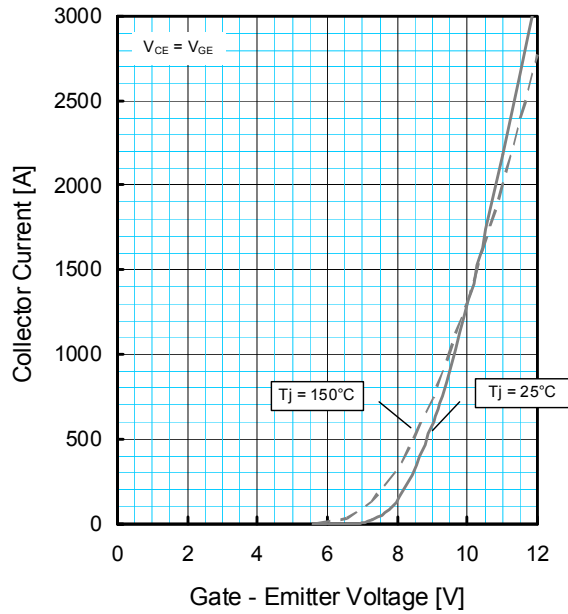
- The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD).
- Junction temperature ( $T_j$ ) should not exceed  $T_{jmax}$  rating (150°C).
- Pulse width and repetition rate should be such as to cause negligible temperature rise.
- $E_{on(10\%)}$  /  $E_{off(10\%)}$  /  $E_{rec(10\%)}$  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**

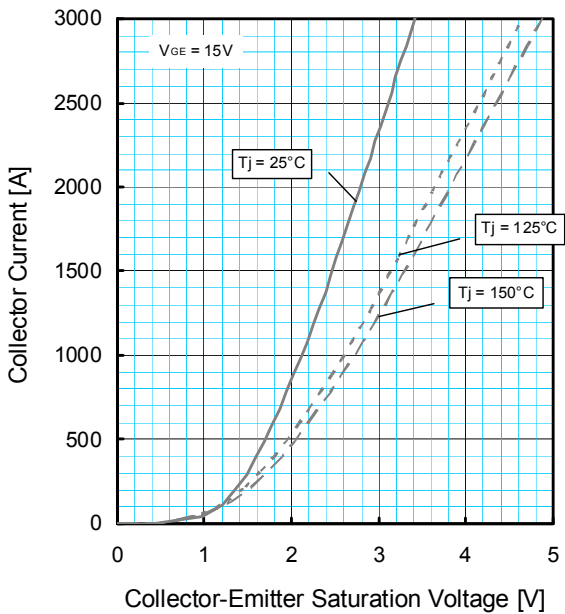
**OUTPUT CHARACTERISTICS (TYPICAL)**



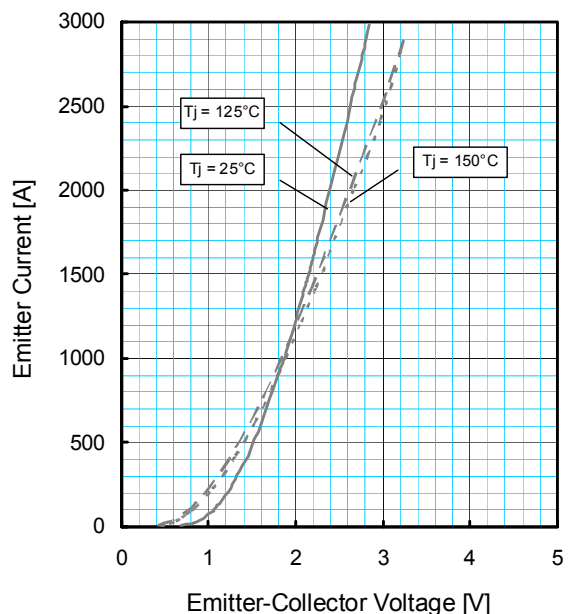
**TRANSFER CHARACTERISTICS (TYPICAL)**



**COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)**

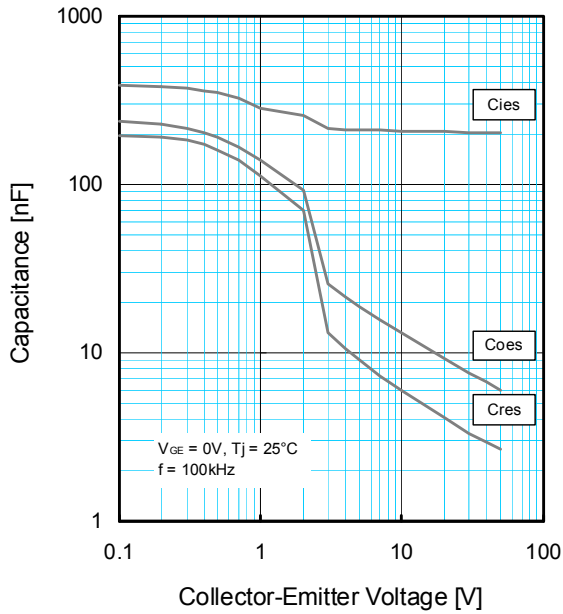


**FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)**

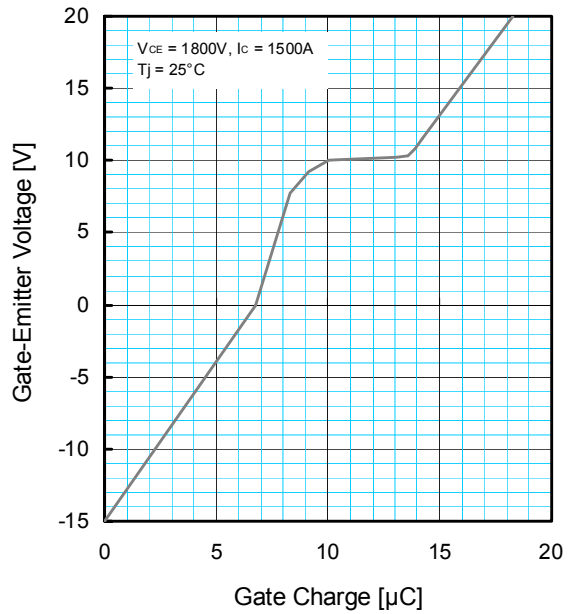


PERFORMANCE CURVES

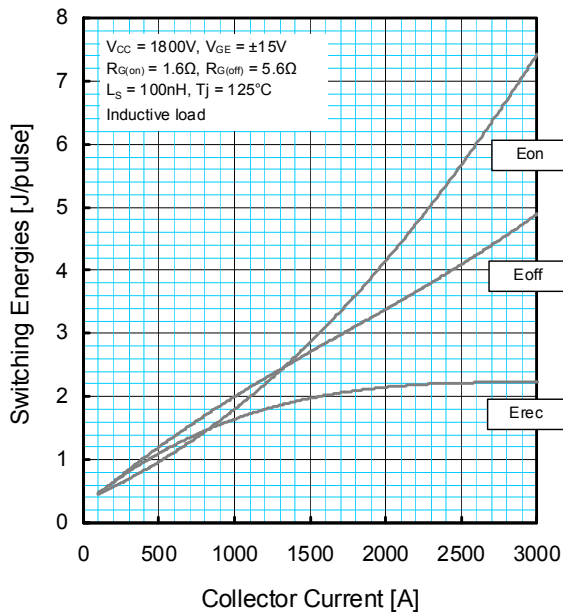
**CAPACITANCE CHARACTERISTICS (TYPICAL)**



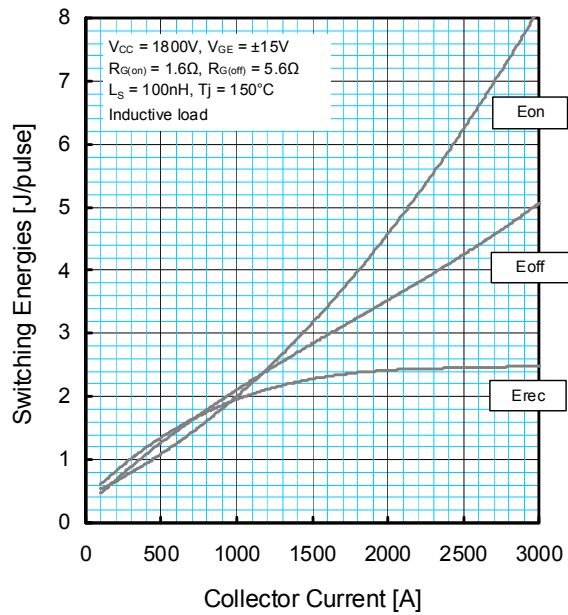
**GATE CHARGE CHARACTERISTICS (TYPICAL)**



**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**

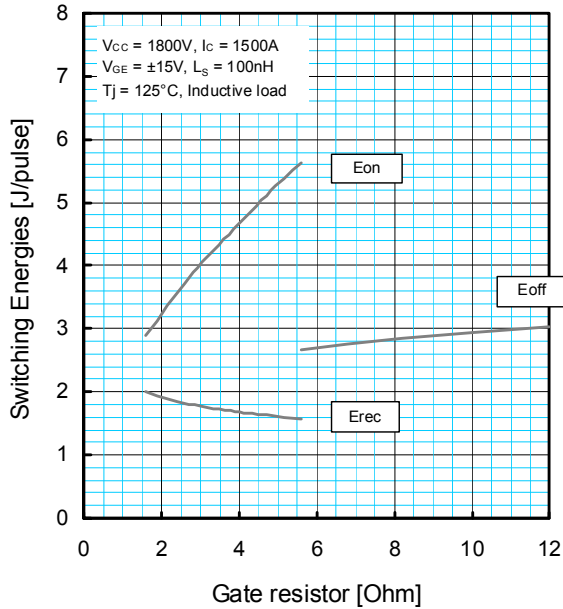


**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**

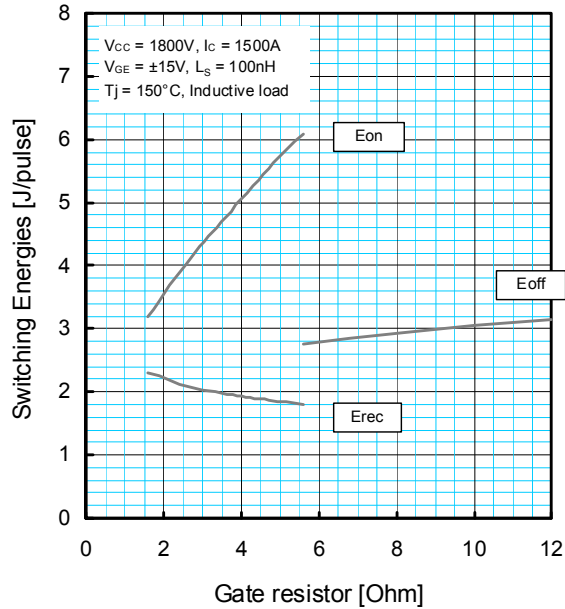


PERFORMANCE CURVES

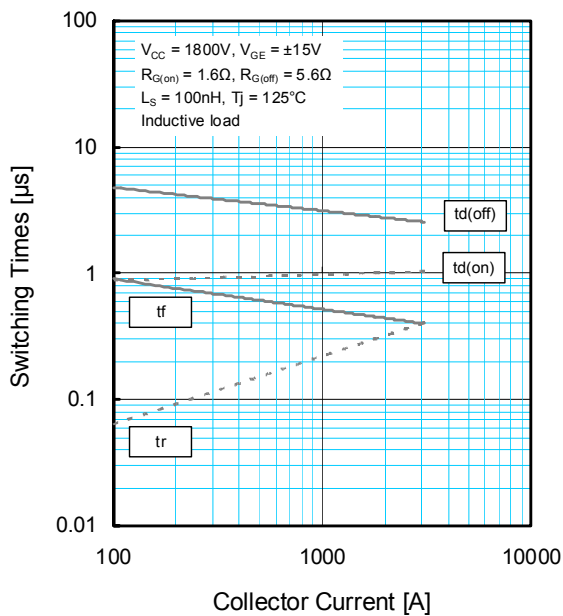
**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



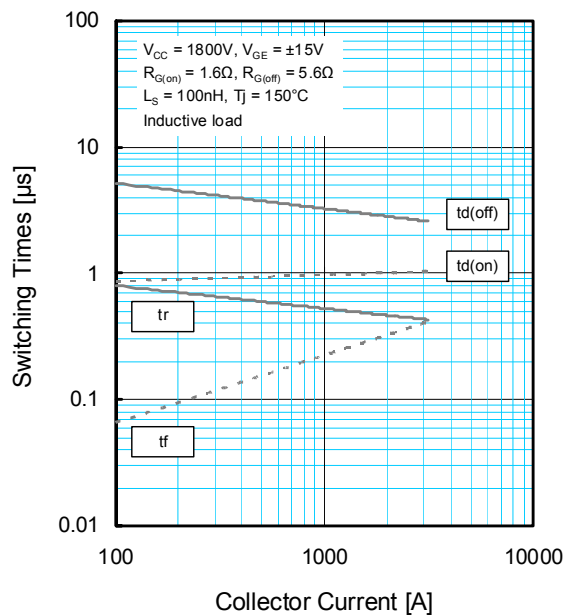
**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



**HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)**

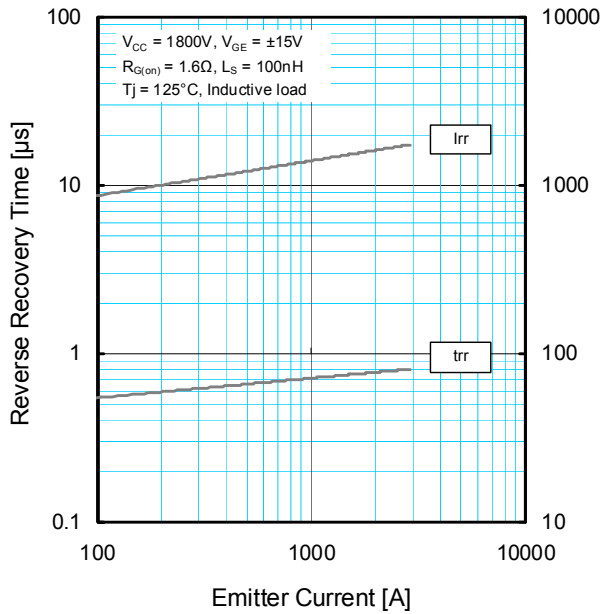


**HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)**

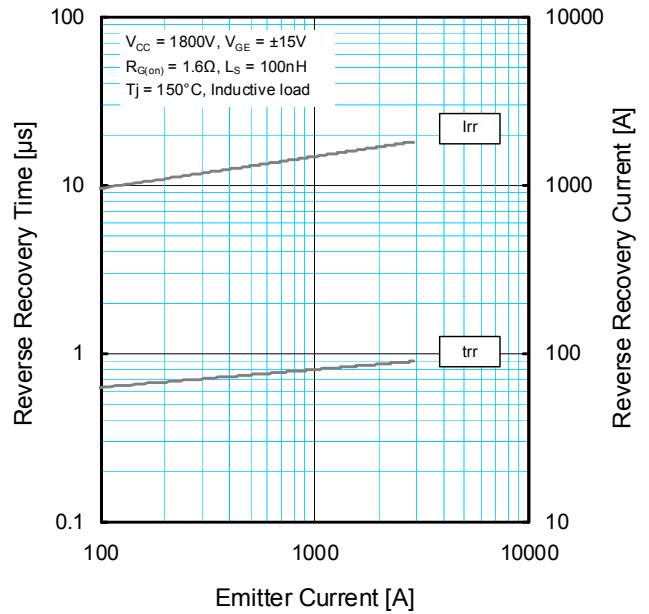


**PERFORMANCE CURVES**

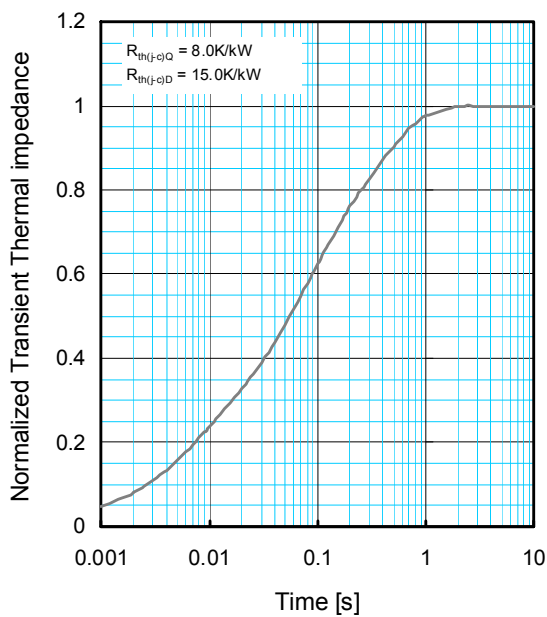
**FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



**FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS**

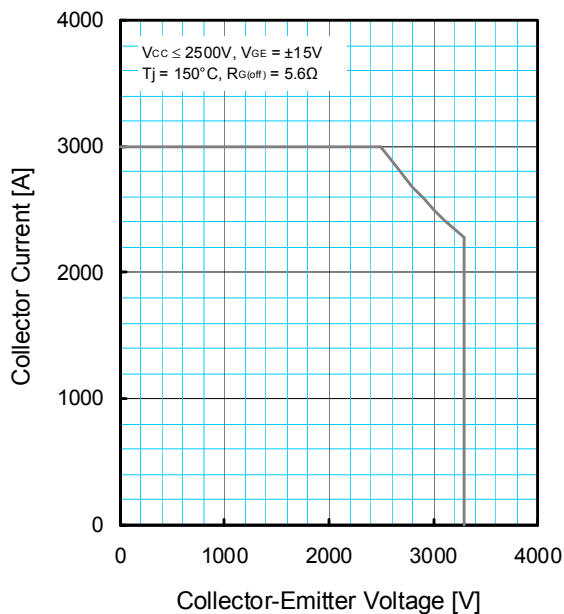


$$Z_{th(j-c)}(t) = \sum_{i=1}^n R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i}\right) \right\}$$

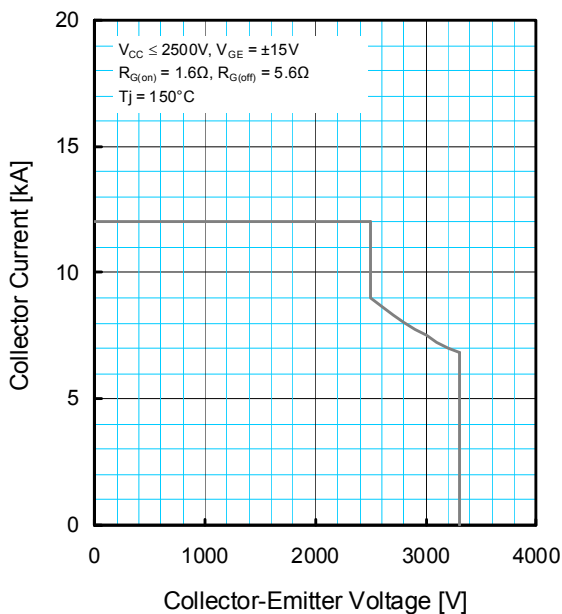
	1	2	3	4
$R_i$ [K/kW] :	0.0096	0.1893	0.4044	0.3967
$\tau_i$ [sec] :	0.0001	0.0058	0.0602	0.3512

**PERFORMANCE CURVES**

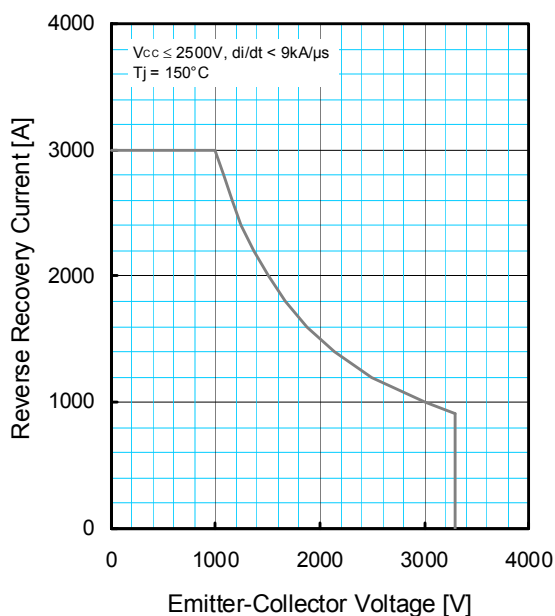
**REVERSE BIAS SAFE OPERATING AREA (RBSOA)**



**SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)**



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





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