

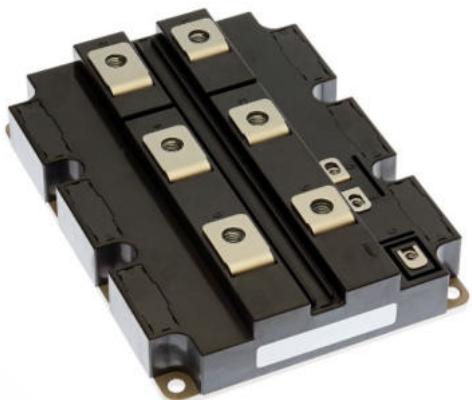
< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM1500HC-90XA

HIGH POWER SWITCHING USE INSULATED TYPE

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

CM1500HC-90XA



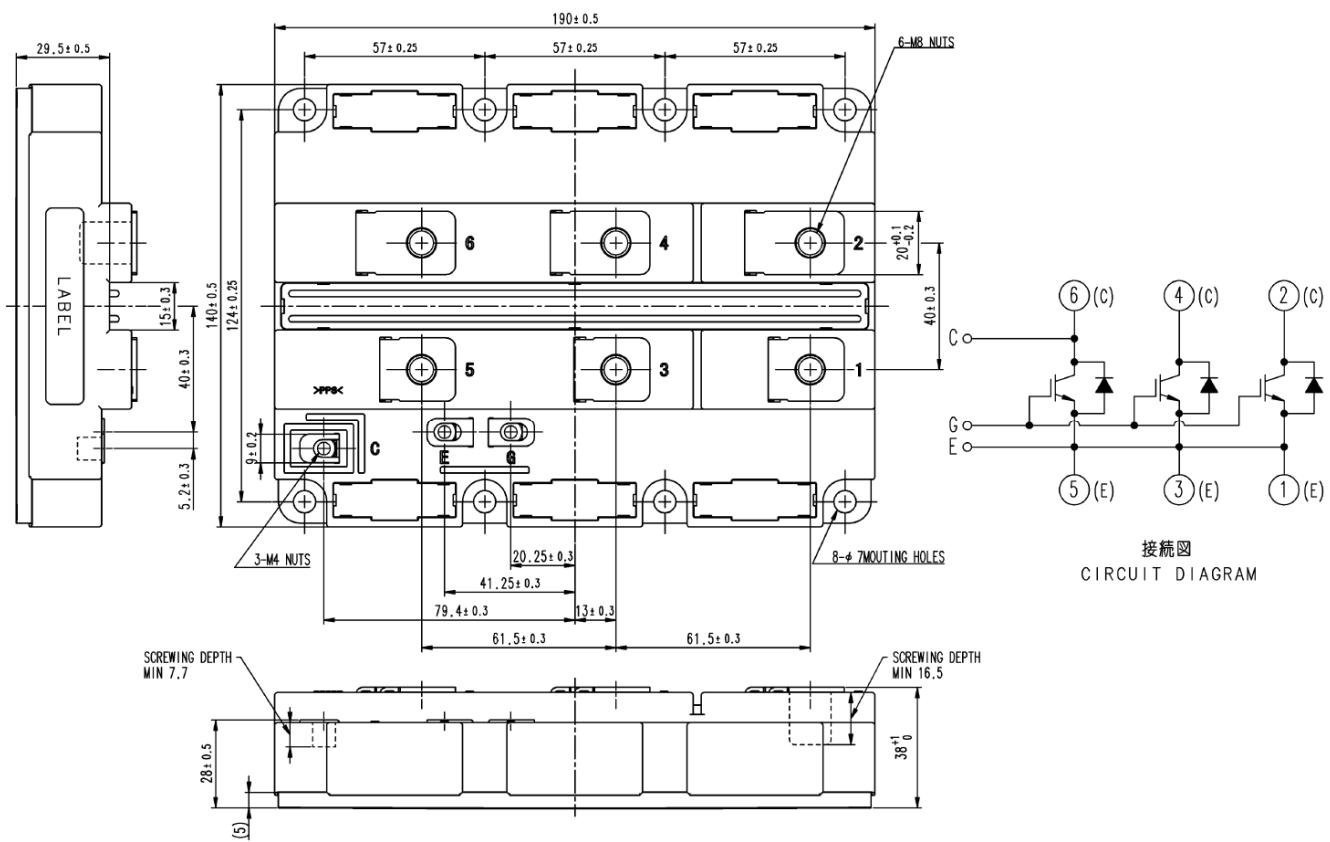
- I_C 1500A
- V_{CES} 4500V
- 1-element in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- AISiC Baseplate
- UL recognized under UL1557

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	$V_{GE} = 0V, T_j = +25\dots+150^\circ C$	4500	V
		$V_{GE} = 0V, T_j = -50^\circ C$	3900	
V_{GES}	Gate-emitter voltage	$V_{CE} = 0V, T_j = 25^\circ C$	± 20	V
I_C	Collector current	DC, $T_c = 105^\circ C$	1500	A
		Pulse (Note 1)	3000	
I_E	Emitter current (Note 2)	DC, $T_c = 90^\circ C$	1500	A
		Pulse (Note 1)	3000	
P_{tot}	Maximum power dissipation (Note 3)	$T_c = 25^\circ C$, IGBT part	14700	W
V_{iso}	Isolation voltage	RMS, sinusoidal, $f = 60Hz$, $t = 1$ min	6000	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, $f = 60Hz$, $Q_{PD} \leq 10$ pC	3500	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	$V_{CC} = 3000V, V_{CE} \leq V_{CES}, V_{GE} = 15V, T_j = 150^\circ C$	10	μs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
I_{CES}	Collector cutoff current	$V_{CE} = V_{CES}, V_{GE} = 0V$	$T_j = 25^\circ C$	—	—	10.0	
			$T_j = 125^\circ C$	—	10.0	—	
			$T_j = 150^\circ C$	—	—	120	
$V_{GE(th)}$	Gate-emitter threshold voltage	$V_{CE} = 10V, I_C = 150mA, T_j = 25^\circ C$	6.5	7.0	7.5	V	
I_{GES}	Gate leakage current	$V_{GE} = V_{GES}, V_{CE} = 0V, T_j = 25^\circ C$	—	—	0.5	μA	
C_{ies}	Input capacitance	$V_{CE} = 10V, V_{GE} = 0V, f = 100kHz$ $T_j = 25^\circ C$	—	170	—	nF	
C_{oes}	Output capacitance		—	11	—	nF	
C_{res}	Reverse transfer capacitance		—	1.5	—	nF	
Q_G	Total gate charge	$V_{CC} = 2800V, I_C = 1500A, V_{GE} = \pm 15V$	—	12.6	—	μC	
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 1500A$ (Note 4) $V_{GE} = 15V$	$T_j = 25^\circ C$	—	2.20	—	
			$T_j = 125^\circ C$	—	2.65	—	
			$T_j = 150^\circ C$	—	2.80	3.30	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 2800V$ $I_C = 1500A$ $V_{GE} = \pm 15V$ $R_{G(on)} = 2.4\Omega$ $L_s = 100nH$ Inductive load	$T_j = 150^\circ C$	—	—	1.00	
t_r	Rise time		$T_j = 150^\circ C$	—	—	0.50	
$E_{on(10\%)}$	Turn-on switching energy per pulse (Note 5)		$T_j = 25^\circ C$	—	—	—	
			$T_j = 125^\circ C$	—	7.20	—	
			$T_j = 150^\circ C$	—	7.50	—	
E_{on}	Turn-on switching energy per pulse (Note 6)		$T_j = 25^\circ C$	—	—	—	
			$T_j = 125^\circ C$	—	7.50	—	
			$T_j = 150^\circ C$	—	7.80	—	
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 2800V$ $I_C = 1500A$ $V_{GE} = \pm 15V$ $R_{G(off)} = 30\Omega$ $L_s = 100nH$ Inductive load	$T_j = 25^\circ C$	—	—	—	
			$T_j = 125^\circ C$	—	7.00	—	
			$T_j = 150^\circ C$	—	7.20	10.0	
t_f	Fall time		$T_j = 25^\circ C$	—	—	—	
			$T_j = 125^\circ C$	—	0.50	—	
			$T_j = 150^\circ C$	—	0.50	1.20	
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)		$T_j = 25^\circ C$	—	—	—	
			$T_j = 125^\circ C$	—	5.10	—	
			$T_j = 150^\circ C$	—	5.50	—	
E_{off}	Turn-off switching energy per pulse (Note 6)		$T_j = 25^\circ C$	—	—	—	
			$T_j = 125^\circ C$	—	5.50	—	
			$T_j = 150^\circ C$	—	5.90	—	

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CM1500HC-90XAHIGH POWER SWITCHING USE
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5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

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) $V_{GE} = 0 \text{ V}$	$T_j = 25^\circ\text{C}$	—	2.10	—	
			$T_j = 125^\circ\text{C}$	—	2.50	—	
			$T_j = 150^\circ\text{C}$	—	2.50	3.00	
	Reverse recovery time (Note 2)	$V_{CC} = 2800 \text{ V}$ $I_E = 1500 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 2.4 \Omega$ $L_s = 100 \text{ nH}$ Inductive load	$T_j = 25^\circ\text{C}$	—	—	—	
			$T_j = 125^\circ\text{C}$	—	1.55	—	
			$T_j = 150^\circ\text{C}$	—	1.60	—	
	Reverse recovery current (Note 2)		$T_j = 25^\circ\text{C}$	—	—	—	
			$T_j = 125^\circ\text{C}$	—	2100	—	
			$T_j = 150^\circ\text{C}$	—	2100	—	
	Reverse recovery charge (Note 2, 7)		$T_j = 25^\circ\text{C}$	—	—	—	
			$T_j = 125^\circ\text{C}$	—	2750	—	
			$T_j = 150^\circ\text{C}$	—	2900	—	
Q_{rr}	Reverse recovery charge (Note 2, 6)		$T_j = 25^\circ\text{C}$	—	—	—	
			$T_j = 125^\circ\text{C}$	—	2850	—	
			$T_j = 150^\circ\text{C}$	—	3000	—	
			$T_j = 25^\circ\text{C}$	—	—	—	
			$T_j = 125^\circ\text{C}$	—	4.10	—	
			$T_j = 150^\circ\text{C}$	—	4.50	—	
$E_{rec(10\%)}$	Reverse recovery energy per pulse (Note 2, 5)		$T_j = 25^\circ\text{C}$	—	—	—	
			$T_j = 125^\circ\text{C}$	—	4.40	—	
			$T_j = 150^\circ\text{C}$	—	4.80	—	
E_{rec}	Reverse recovery energy per pulse (Note 2, 6)		$T_j = 25^\circ\text{C}$	—	—	—	
			$T_j = 125^\circ\text{C}$	—	—	—	
			$T_j = 150^\circ\text{C}$	—	—	—	

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
		Junction to Case, FWDi part	—	—	13.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink $\lambda_{grease} = 1 \text{ W/m}\cdot\text{K}$, $D_{(c-s)} = 80 \mu\text{m}$	—	5.0	—	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
M_t	Mounting torque	M8 : Main terminals screw	7.0	—	19.0	N·m
		M6 : Mounting screw	3.0	—	6.0	N·m
		M4 : Auxiliary terminals screw (Note 8)	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		—	8.0	—	nH
R_{CC+EE}	Internal lead resistance	$T_c = 25^\circ\text{C}$	—	0.09	—	$\text{m}\Omega$

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

Note2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWDi).

Note3. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).

Note4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

Note5. The integration range of switching energies is from 10% V_{CE} to 10% $I_C(10\%I_E)$.

Note6. Definition of all items is according to IEC 60747, unless otherwise specified.

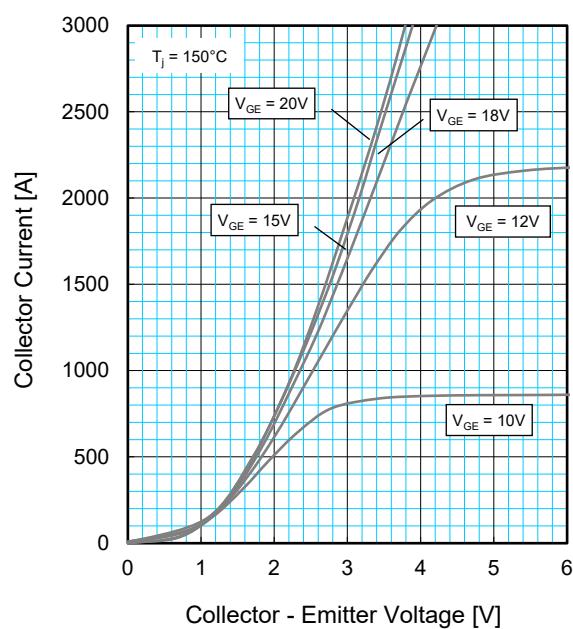
Note7. The integration range of reverse recovery charge is from $I_E = 0 \text{ A}$ to 10% I_E .

Note8. The maximum specified value is under the condition of using PCB mounted on the power module.

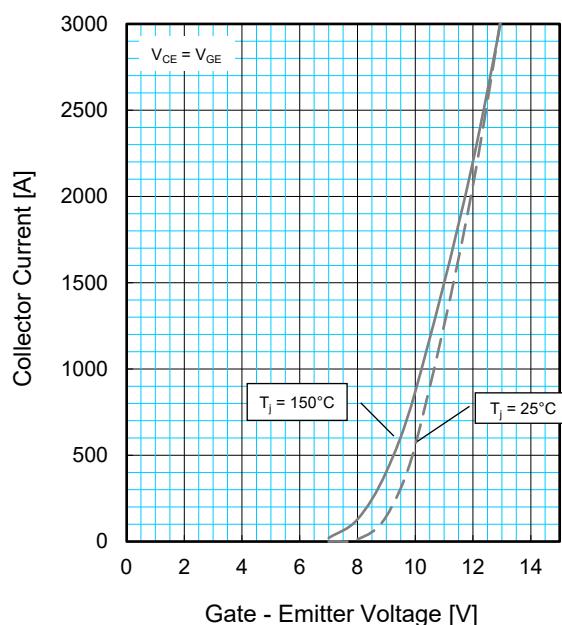
In case no PCB is used this maximum torque for M4 screw is 2.0 Nm.

PERFORMANCE CURVES

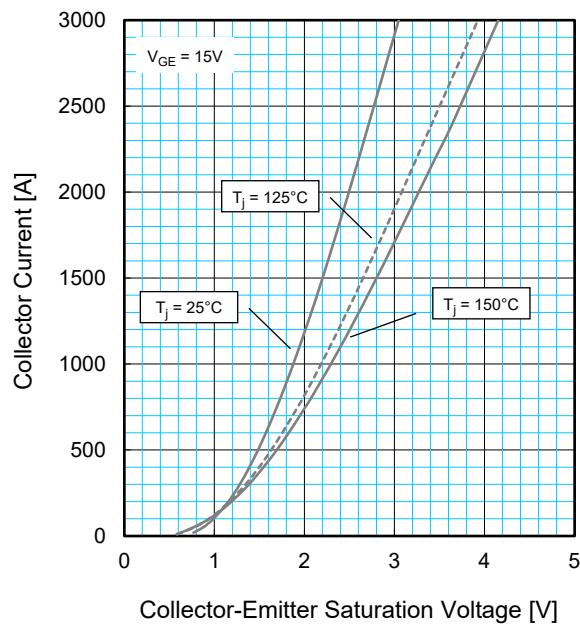
**OUTPUT CHARACTERISTICS
(TYPICAL)**



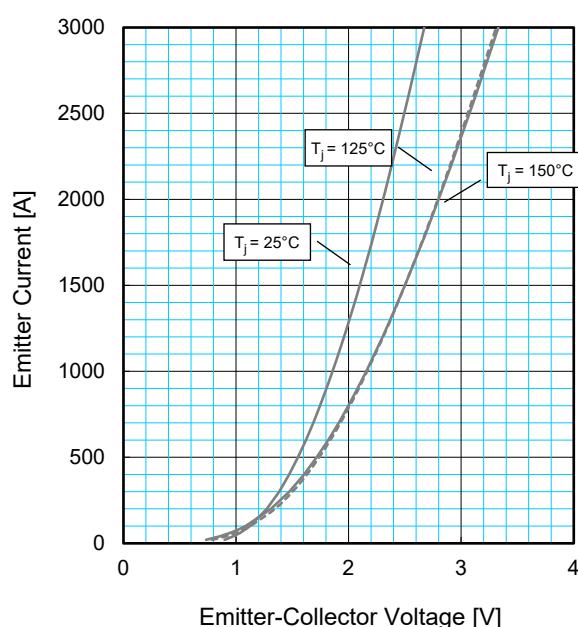
**TRANSFER CHARACTERISTICS
(TYPICAL)**



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



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

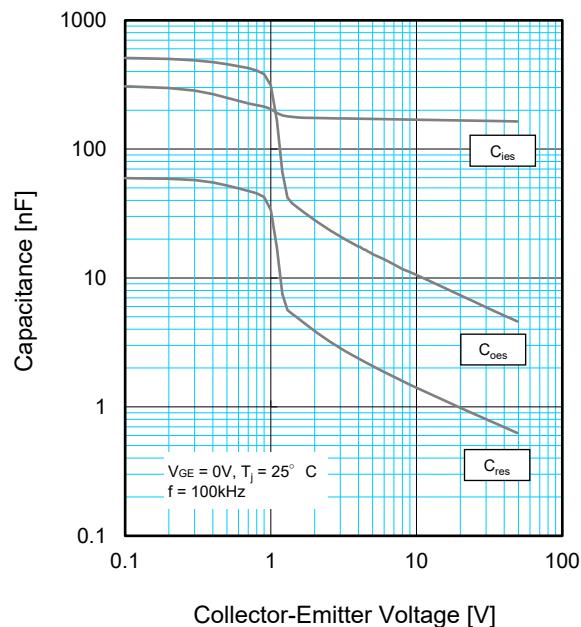
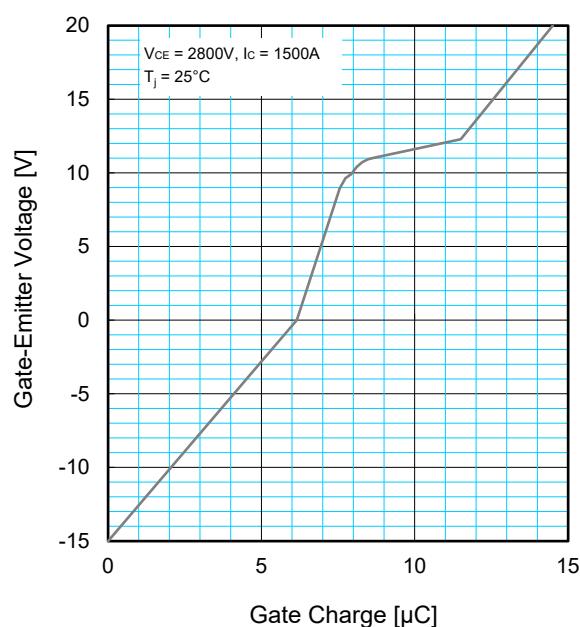
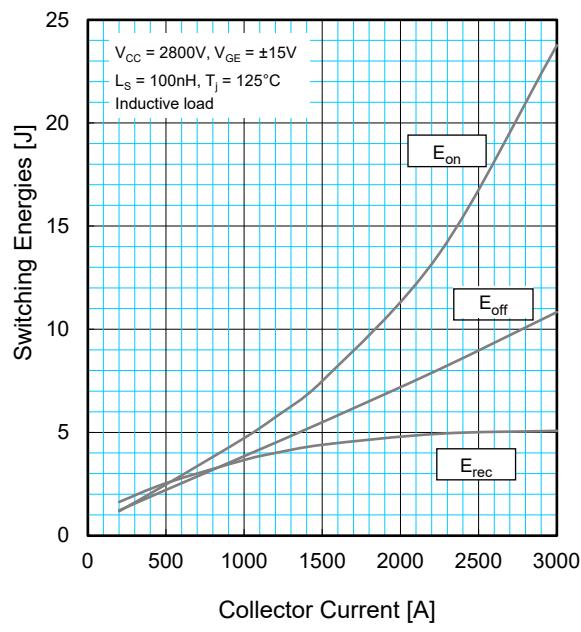
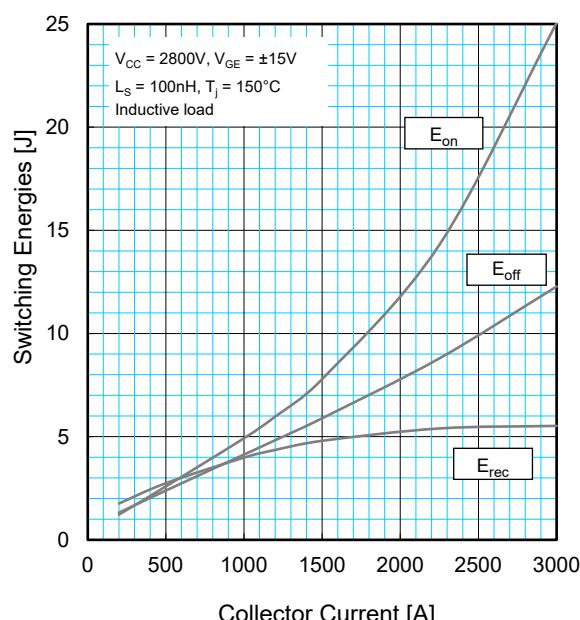


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CM1500HC-90XAHIGH POWER SWITCHING USE
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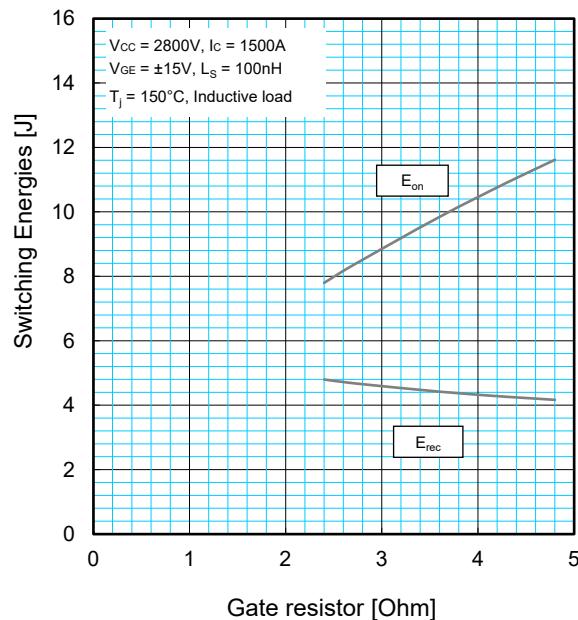
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PERFORMANCE CURVES

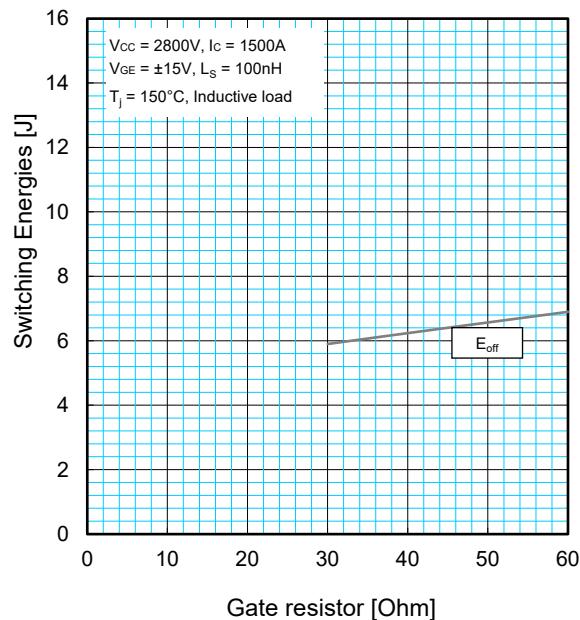
CAPACITANCE CHARACTERISTICS
(TYPICAL)GATE CHARGE CHARACTERISTICS
(TYPICAL)HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)

PERFORMANCE CURVES

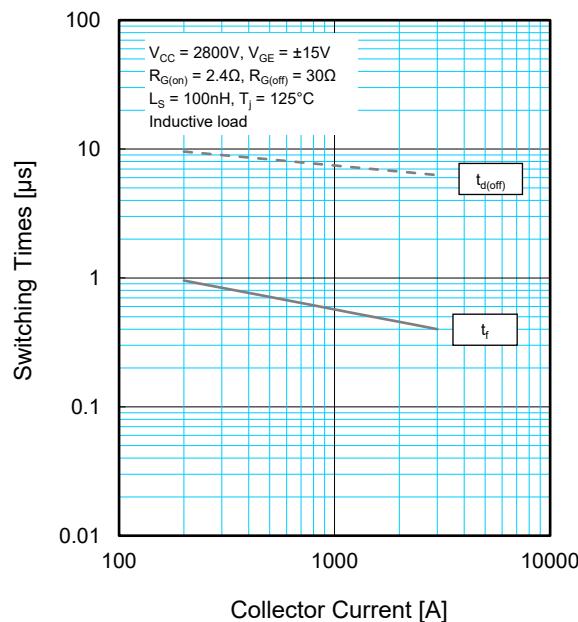
**HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)**



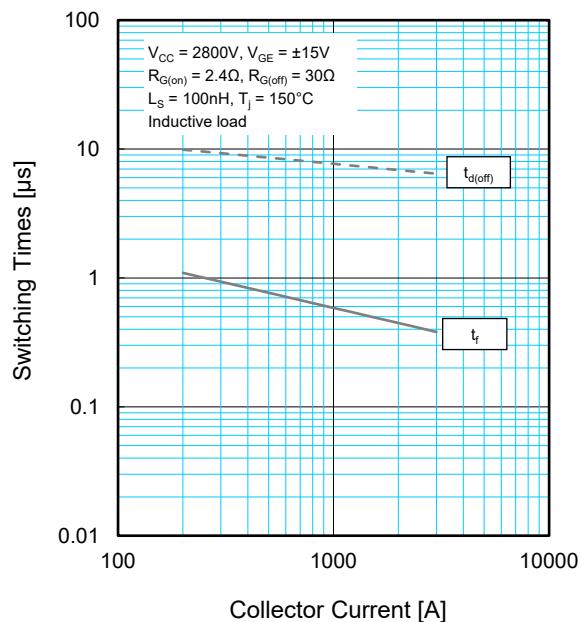
**HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)**



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



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

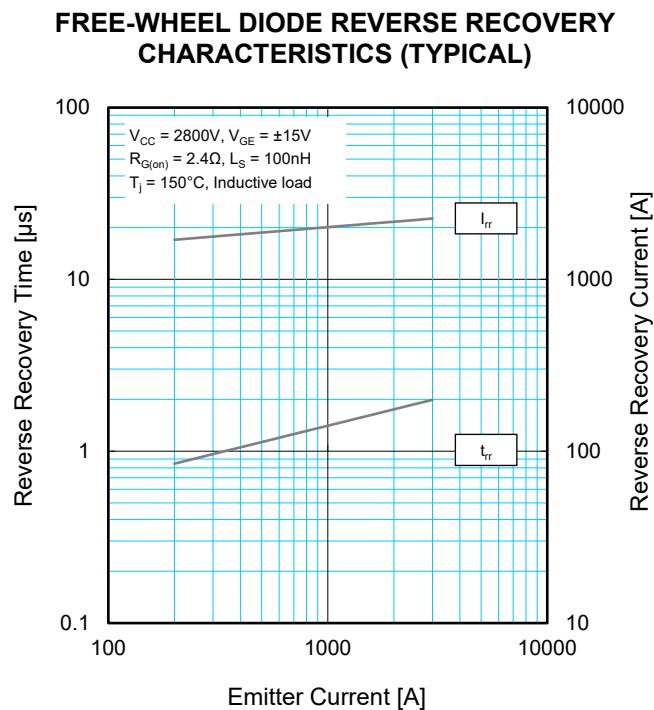
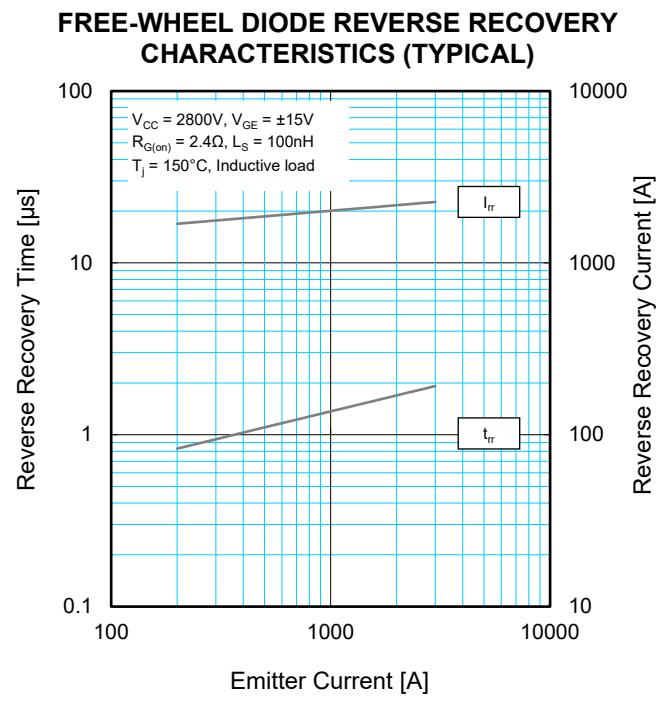
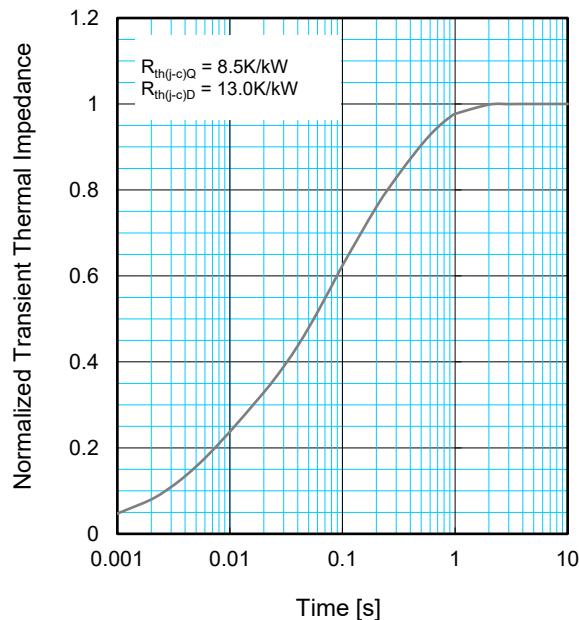


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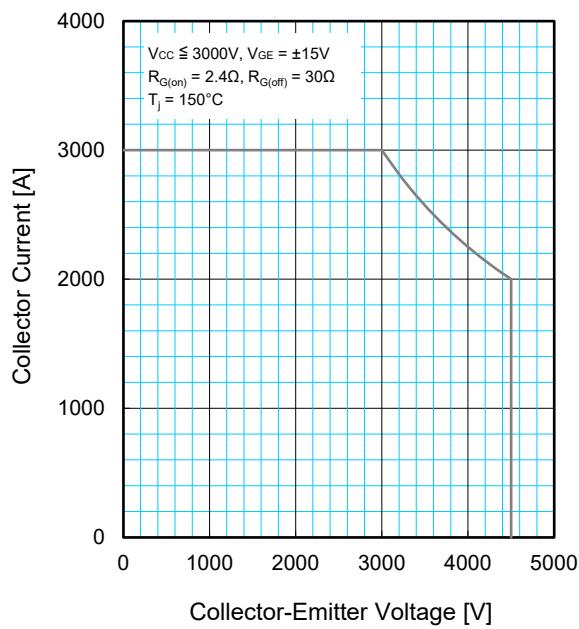
**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS**

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

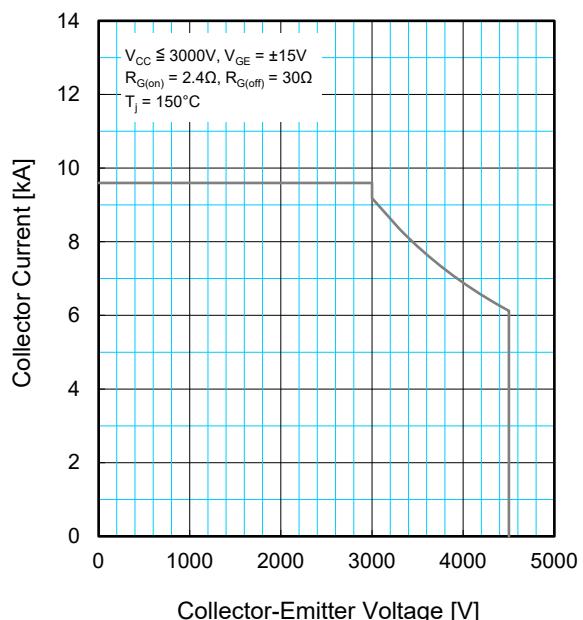
	1	2	3	4
$R_i / R_{th(j-c)}$:	0.0***	0.1893	0.4044	0.3967
τ_i [sec] :	0.0001	0.0058	0.0602	0.3512

PERFORMANCE CURVES

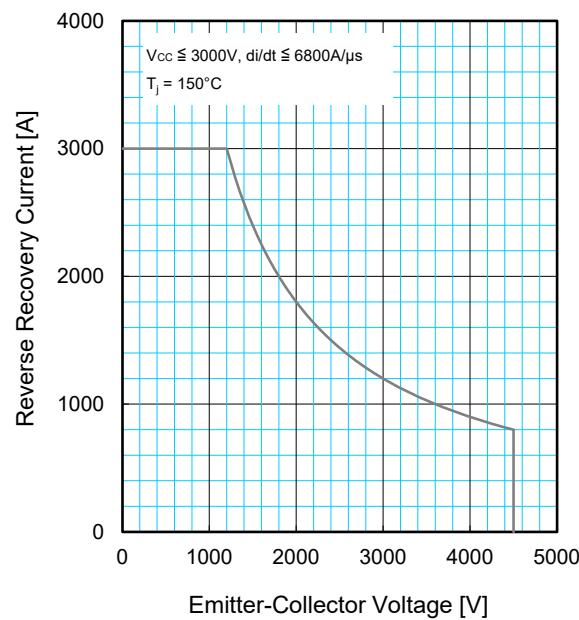
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



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



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



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