

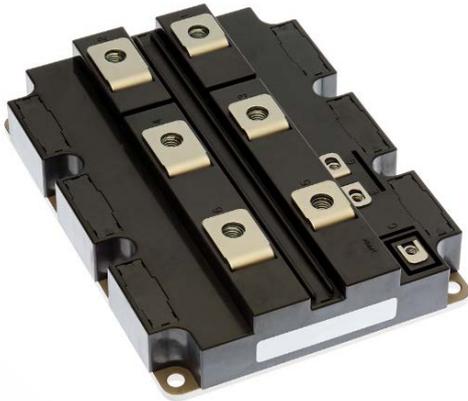
< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

# CM1500HC-90XA

HIGH POWER SWITCHING USE  
INSULATED TYPE

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

## CM1500HC-90XA



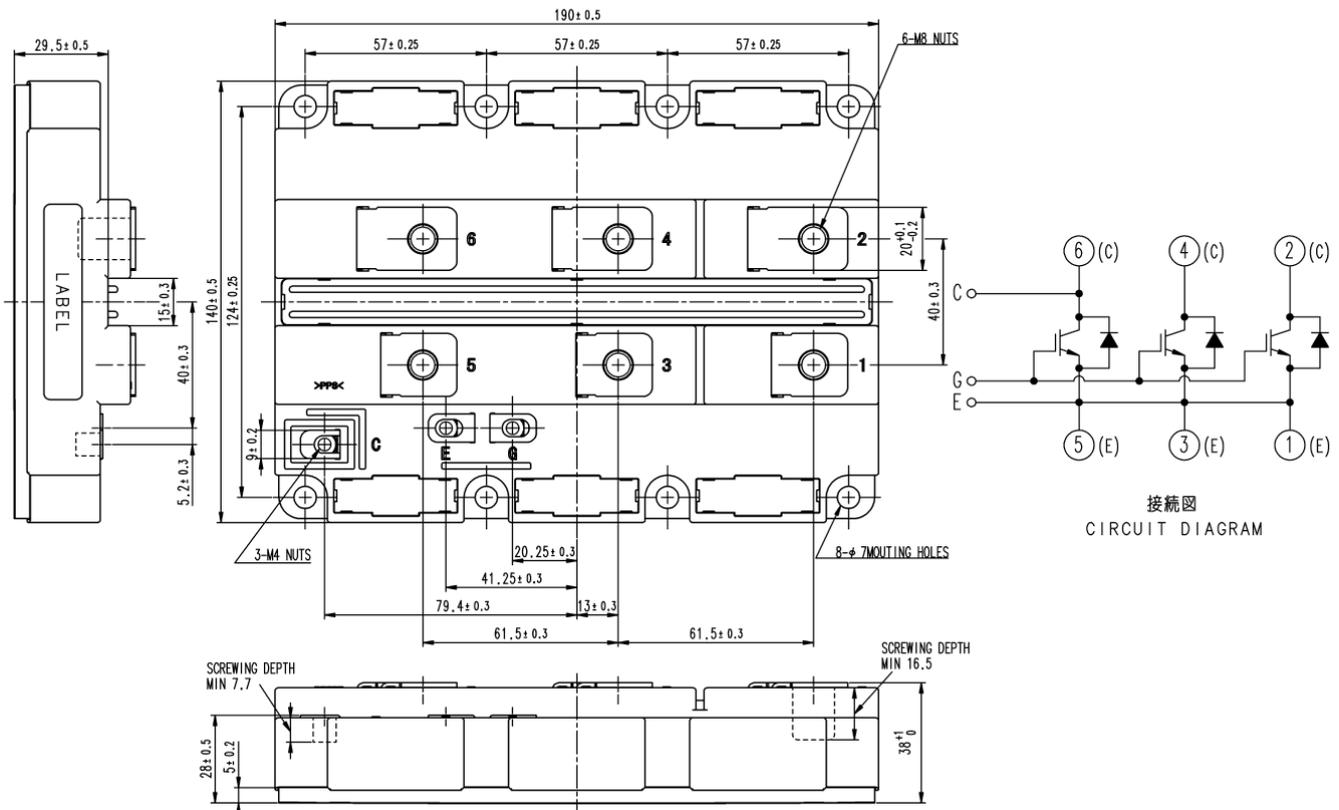
- $I_C$  ..... 1500A
- $V_{CES}$  ..... 4500V
- 1-element in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- AISiC Baseplate

## 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> = +25...+150°C	4500	V
		V <sub>GE</sub> = 0V, T <sub>j</sub> = -50°C	3900	
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> = 105°C	1500	A
I <sub>CRM</sub>		Pulse (Note 1)	3000	A
I <sub>E</sub>	Emitter current (Note 2)	DC, T <sub>c</sub> = 90°C	1500	A
I <sub>ERM</sub>		Pulse (Note 1)	3000	A
P <sub>tot</sub>	Maximum power dissipation (Note 3)	T <sub>c</sub> = 25°C, IGBT part	14700	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	3500	V
T <sub>j</sub>	Junction temperature		-50 ~ +150	°C
T <sub>top</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> = 3000V, 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	—	—	10.0	mA
			T <sub>j</sub> = 125°C	—	10.0	—	
			T <sub>j</sub> = 150°C	—	60.0	—	
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	6.5	7.0	7.5	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	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	—	170	—	nF	
C <sub>oes</sub>	Output capacitance		—	11	—	nF	
C <sub>res</sub>	Reverse transfer capacitance		—	1.5	—	nF	
Q <sub>G</sub>	Total gate charge	V <sub>CC</sub> = 2800V, I <sub>C</sub> = 1500A, V <sub>GE</sub> = ±15V	—	12.6	—	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	—	2.20	—	V
			T <sub>j</sub> = 125°C	—	2.65	—	
			T <sub>j</sub> = 150°C	—	2.80	3.30	
t <sub>d(on)</sub>	Turn-on delay time	V <sub>CC</sub> = 2800 V I <sub>C</sub> = 1500 A V <sub>GE</sub> = ±15 V	T <sub>j</sub> = 25°C	—	—	—	μs
			T <sub>j</sub> = 125°C	—	0.55	—	
			T <sub>j</sub> = 150°C	—	0.55	1.00	
t <sub>r</sub>	Rise time	V <sub>CC</sub> = 2800 V I <sub>C</sub> = 1500 A V <sub>GE</sub> = ±15 V	T <sub>j</sub> = 25°C	—	—	—	μs
			T <sub>j</sub> = 125°C	—	0.25	—	
			T <sub>j</sub> = 150°C	—	0.25	0.50	
E <sub>on(10%)</sub>	Turn-on switching energy per pulse (Note 5)	R <sub>G(on)</sub> = 2.4 Ω L <sub>s</sub> = 100 nH Inductive load	T <sub>j</sub> = 25°C	—	—	—	J
			T <sub>j</sub> = 125°C	—	6.90	—	
			T <sub>j</sub> = 150°C	—	7.20	—	
E <sub>on</sub>	Turn-on switching energy per pulse (Note 6)	R <sub>G(on)</sub> = 2.4 Ω L <sub>s</sub> = 100 nH Inductive load	T <sub>j</sub> = 25°C	—	—	—	J
			T <sub>j</sub> = 125°C	—	7.20	—	
			T <sub>j</sub> = 150°C	—	7.50	—	
t <sub>d(off)</sub>	Turn-off delay time	V <sub>CC</sub> = 2800 V I <sub>C</sub> = 1500 A V <sub>GE</sub> = ±15 V	T <sub>j</sub> = 25°C	—	—	—	μs
			T <sub>j</sub> = 125°C	—	7.00	—	
			T <sub>j</sub> = 150°C	—	7.20	10.0	
t <sub>f</sub>	Fall time	V <sub>CC</sub> = 2800 V I <sub>C</sub> = 1500 A V <sub>GE</sub> = ±15 V	T <sub>j</sub> = 25°C	—	—	—	μs
			T <sub>j</sub> = 125°C	—	0.50	—	
			T <sub>j</sub> = 150°C	—	0.50	1.20	
E <sub>off(10%)</sub>	Turn-off switching energy per pulse (Note 5)	R <sub>G(off)</sub> = 30 Ω L <sub>s</sub> = 100 nH Inductive load	T <sub>j</sub> = 25°C	—	—	—	J
			T <sub>j</sub> = 125°C	—	5.80	—	
			T <sub>j</sub> = 150°C	—	6.30	—	
E <sub>off</sub>	Turn-off switching energy per pulse (Note 6)	R <sub>G(off)</sub> = 30 Ω L <sub>s</sub> = 100 nH Inductive load	T <sub>j</sub> = 25°C	—	—	—	J
			T <sub>j</sub> = 125°C	—	6.30	—	
			T <sub>j</sub> = 150°C	—	6.80	—	

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## ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
V <sub>EC</sub>	Emitter-collector voltage (Note 2)	I <sub>E</sub> = 1500 A (Note 4) V <sub>GE</sub> = 0 V	T <sub>J</sub> = 25°C	—	2.10	—	V
			T <sub>J</sub> = 125°C	—	2.50	—	
			T <sub>J</sub> = 150°C	—	2.50	3.00	
t <sub>rr</sub>	Reverse recovery time (Note 2)		T <sub>J</sub> = 25°C	—	—	—	μs
			T <sub>J</sub> = 125°C	—	1.55	—	
			T <sub>J</sub> = 150°C	—	1.60	—	
I <sub>rr</sub>	Reverse recovery current (Note 2)		T <sub>J</sub> = 25°C	—	—	—	A
			T <sub>J</sub> = 125°C	—	2100	—	
			T <sub>J</sub> = 150°C	—	2100	—	
Q <sub>rr(10%)</sub>	Reverse recovery charge (Note 2,7)	V <sub>CC</sub> = 2800 V I <sub>E</sub> = 1500 A V <sub>GE</sub> = ±15 V R <sub>G(on)</sub> = 2.4 Ω L <sub>s</sub> = 100 nH Inductive load	T <sub>J</sub> = 25°C	—	—	—	μC
			T <sub>J</sub> = 125°C	—	2750	—	
			T <sub>J</sub> = 150°C	—	2900	—	
Q <sub>rr</sub>	Reverse recovery charge (Note 2,6)		T <sub>J</sub> = 25°C	—	—	—	μC
			T <sub>J</sub> = 125°C	—	2850	—	
			T <sub>J</sub> = 150°C	—	3000	—	
E <sub>rec(10%)</sub>	Reverse recovery energy per pulse (Note 2, 5)		T <sub>J</sub> = 25°C	—	—	—	J
			T <sub>J</sub> = 125°C	—	4.10	—	
			T <sub>J</sub> = 150°C	—	4.50	—	
E <sub>rec</sub>	Reverse recovery energy per pulse (Note 2, 6)		T <sub>J</sub> = 25°C	—	—	—	J
			T <sub>J</sub> = 125°C	—	4.40	—	
			T <sub>J</sub> = 150°C	—	4.80	—	

## THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
R <sub>th(j-c)Q</sub>	Thermal resistance	Junction to Case, IGBT part	—	—	8.5	K/kW
R <sub>th(j-c)D</sub>		Junction to Case, FWDi part	—	—	13.0	
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink λ <sub>grease</sub> = 1W/m·K, D <sub>(c-s)</sub> = 80μm	—	5.0	—	K/kW

## MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
M <sub>t</sub>	Mounting torque	M8 : Main terminals screw	7.0	—	19.0	N·m
M <sub>s</sub>		M6 : Mounting screw	3.0	—	6.0	
M <sub>t</sub>		M4 : Auxiliary terminals screw	1.0	—	3.0	
m	Mass		—	1.2	—	kg
CTI	Comparative tracking index		600	—	—	—
d <sub>a</sub>	Clearance		19.5	—	—	mm
d <sub>s</sub>	Creepage distance		32.0	—	—	mm
L <sub>P CE</sub>	Parasitic stray inductance		—	8.0	—	nH
R <sub>CC+EE'</sub>	Internal lead resistance	T <sub>c</sub> = 25 °C	—	0.09	—	mΩ

Note1. Pulse width and repetition rate should be such that junction temperature (T<sub>J</sub>) does not exceed T<sub>Jopmax</sub> rating.

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

Note3. Junction temperature (T<sub>J</sub>) should not exceed T<sub>Jmax</sub> 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<sub>CE</sub> to 10%I<sub>C</sub>(10%I<sub>E</sub>).

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

Note7. The integration range of reverse recovery charge is from I<sub>E</sub> = 0A to 10%I<sub>E</sub>.

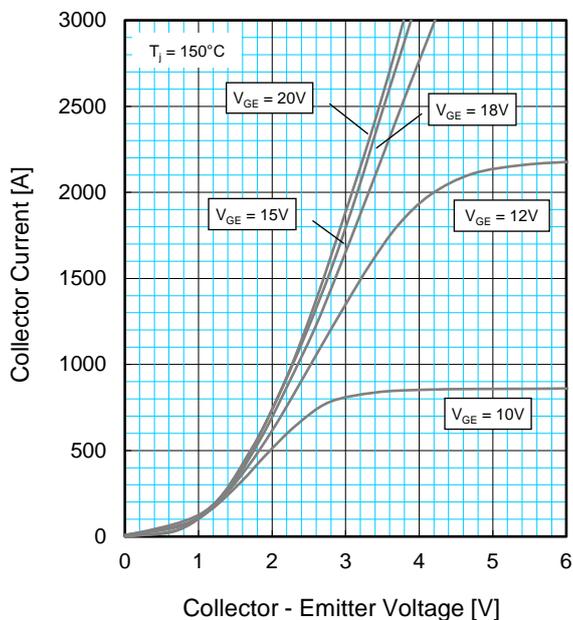
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INSULATED TYPE

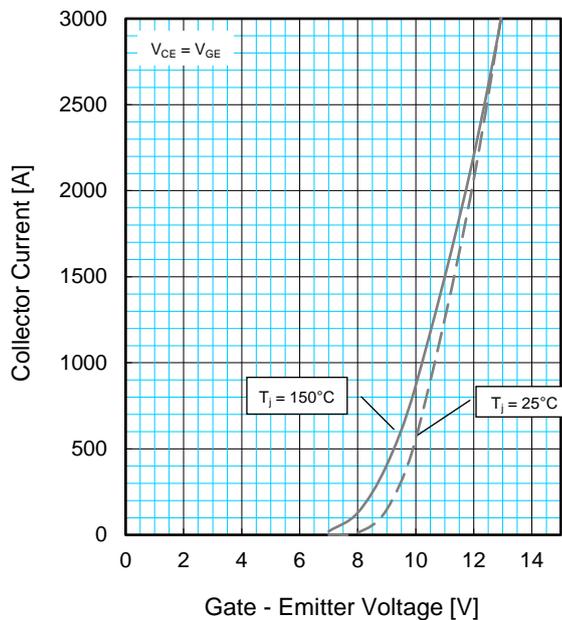
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## PERFORMANCE CURVES

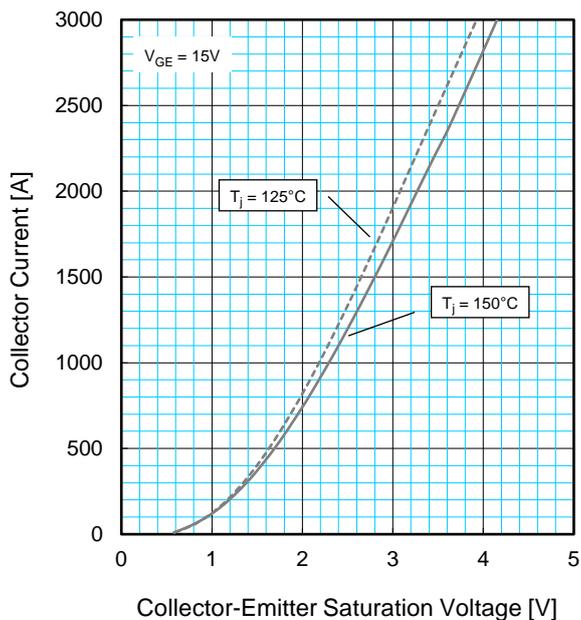
**OUTPUT CHARACTERISTICS (TYPICAL)**



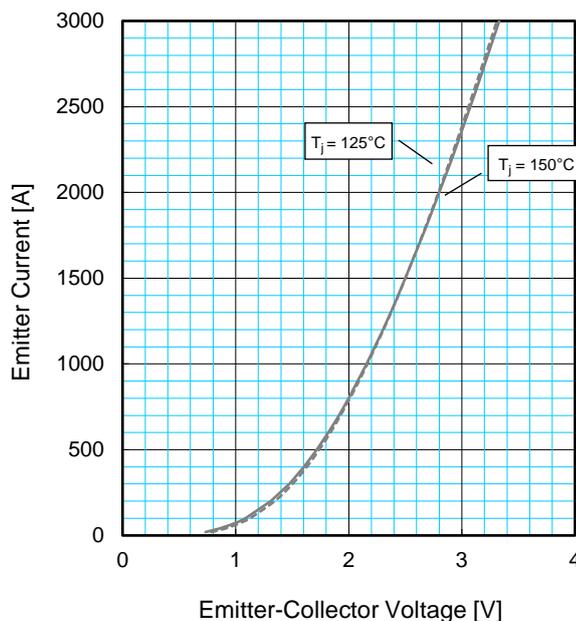
**TRANSFER CHARACTERISTICS (TYPICAL)**



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



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



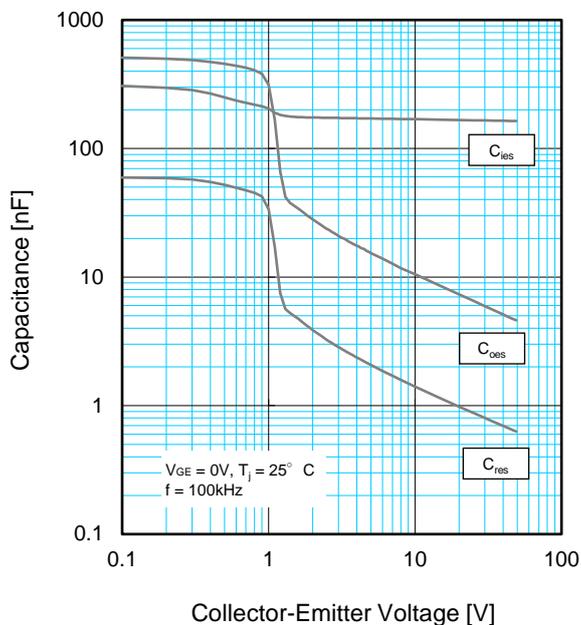
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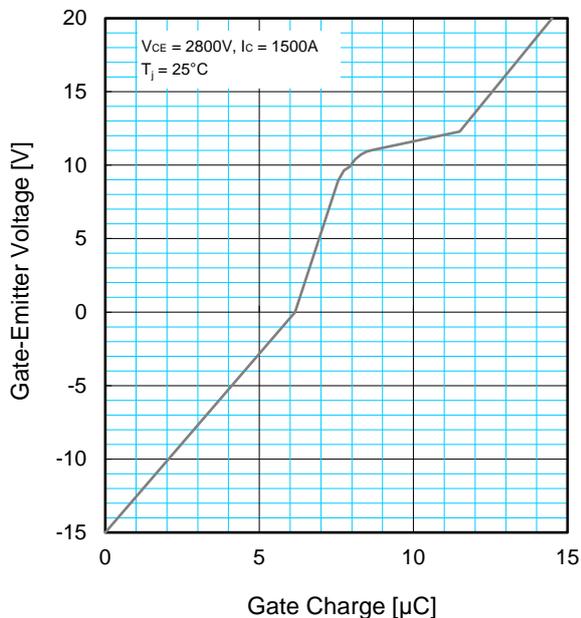
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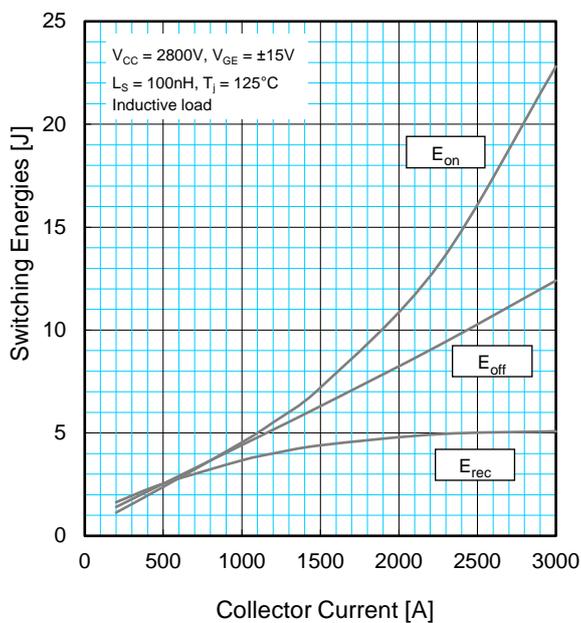
**CAPACITANCE CHARACTERISTICS (TYPICAL)**



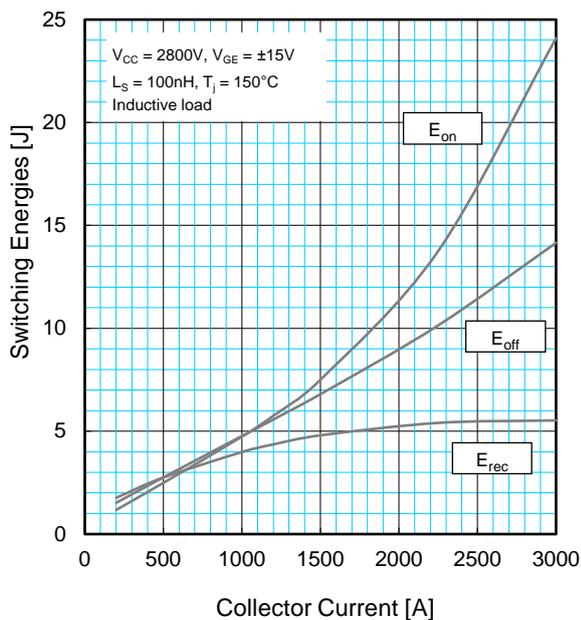
**GATE CHARGE CHARACTERISTICS (TYPICAL)**



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



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



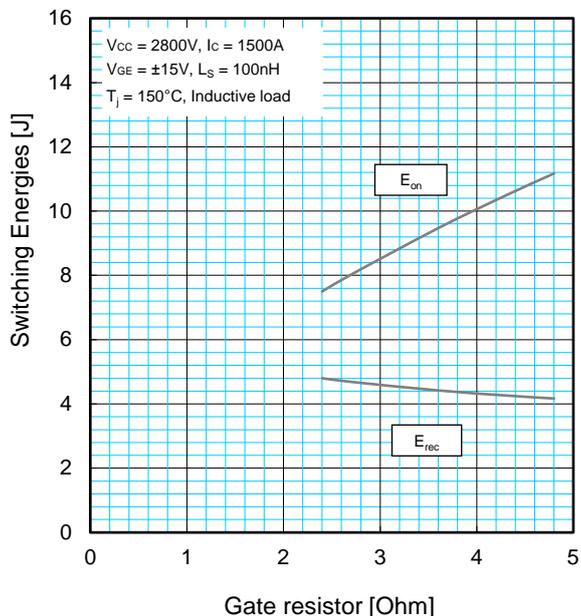
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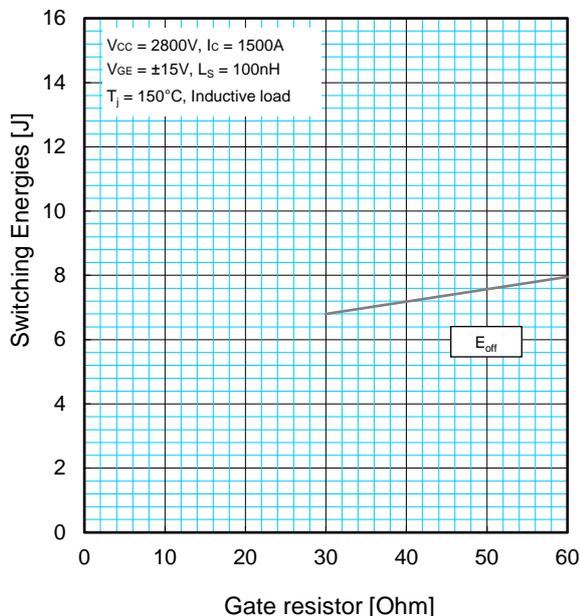
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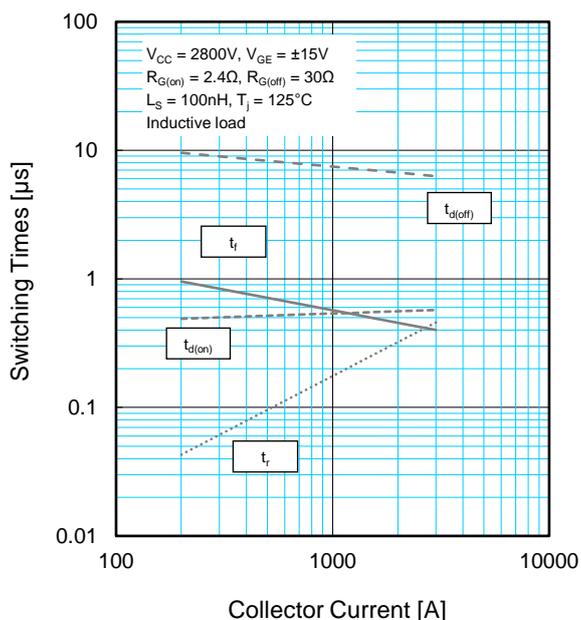
**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



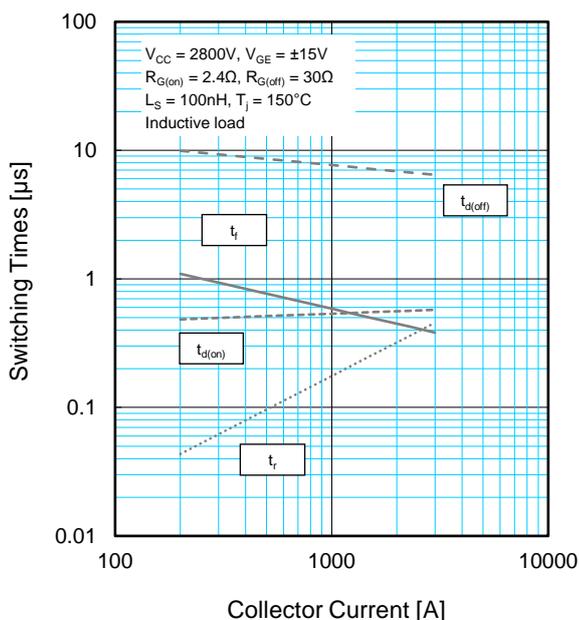
**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)**



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



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



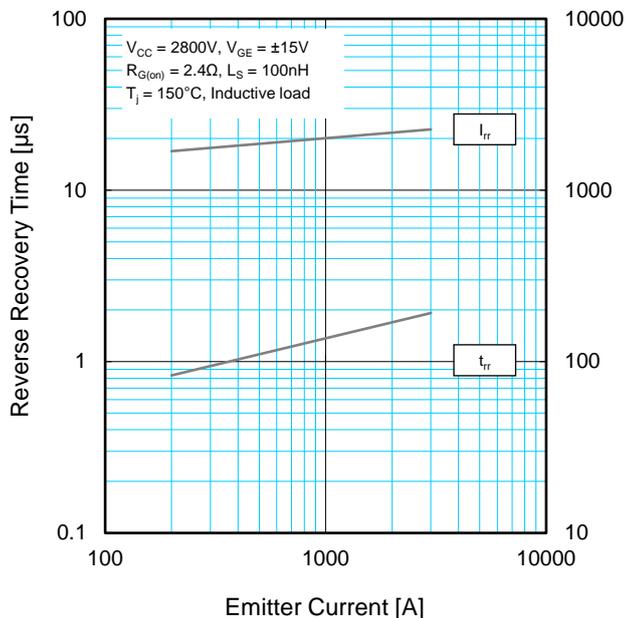
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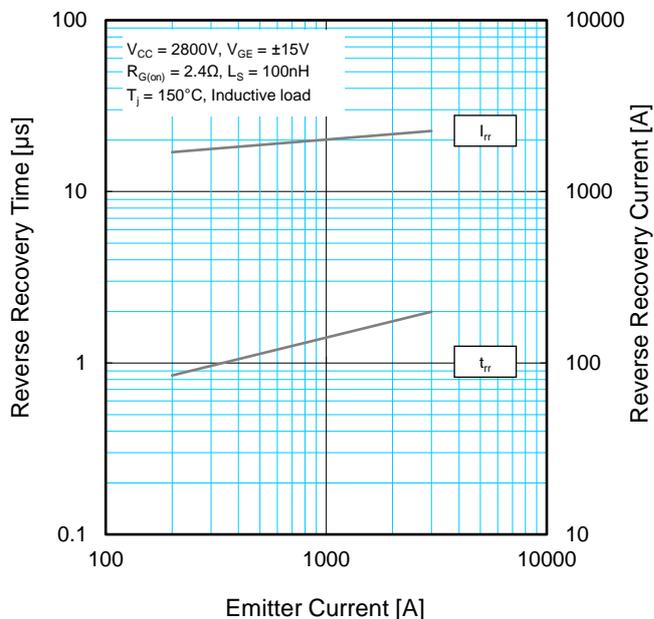
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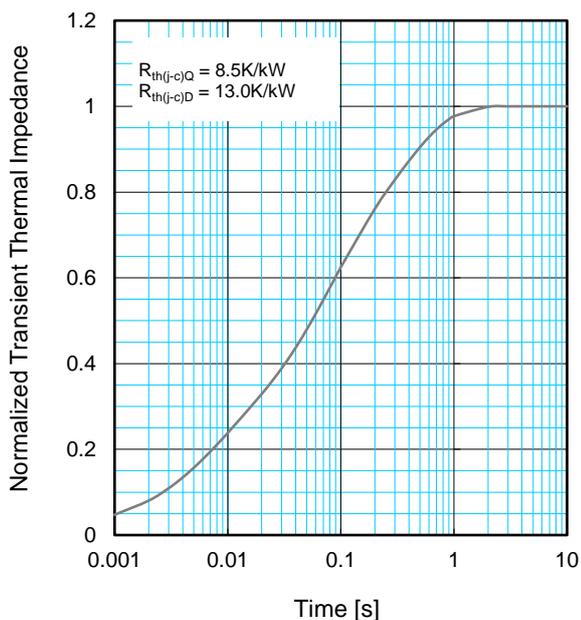
**FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)**



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



**TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS**



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

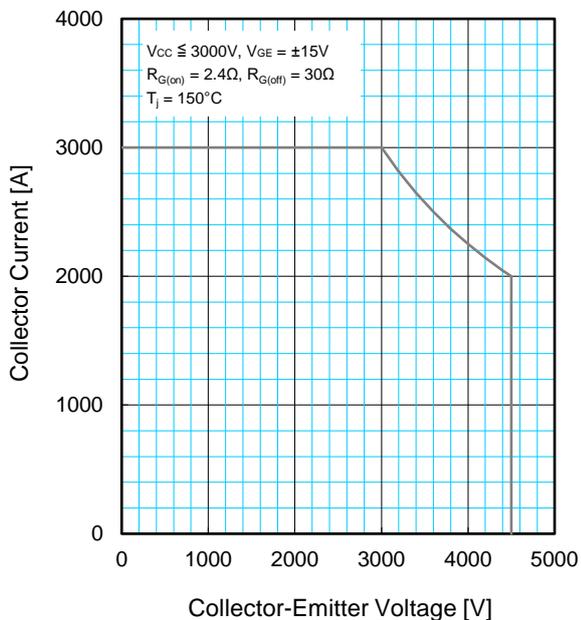
	1	2	3	4
$R_i / R_{th(j-c)}$ :	0.0096	0.1893	0.4044	0.3967
$\tau_i$ [sec] :	0.0001	0.0058	0.0602	0.3512

# CM1500HC-90XA

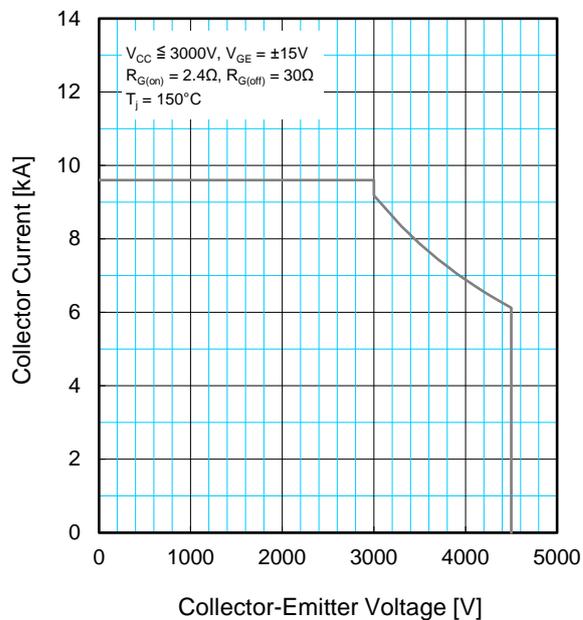
HIGH POWER SWITCHING USE  
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## PERFORMANCE CURVES

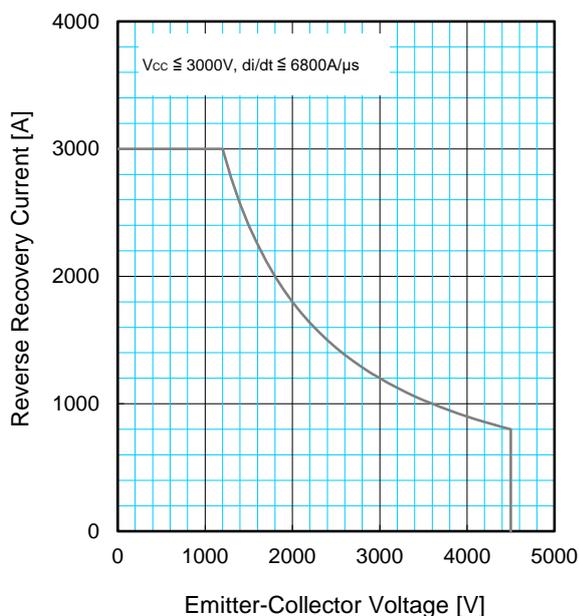
**REVERSE BIAS SAFE OPERATING AREA (RBSOA)**



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



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



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