

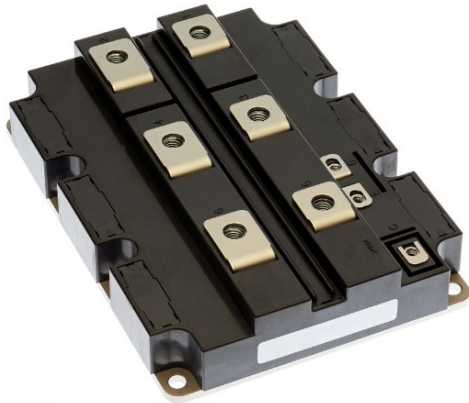
< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

CM1500HC-90XA

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM1500HC-90XA



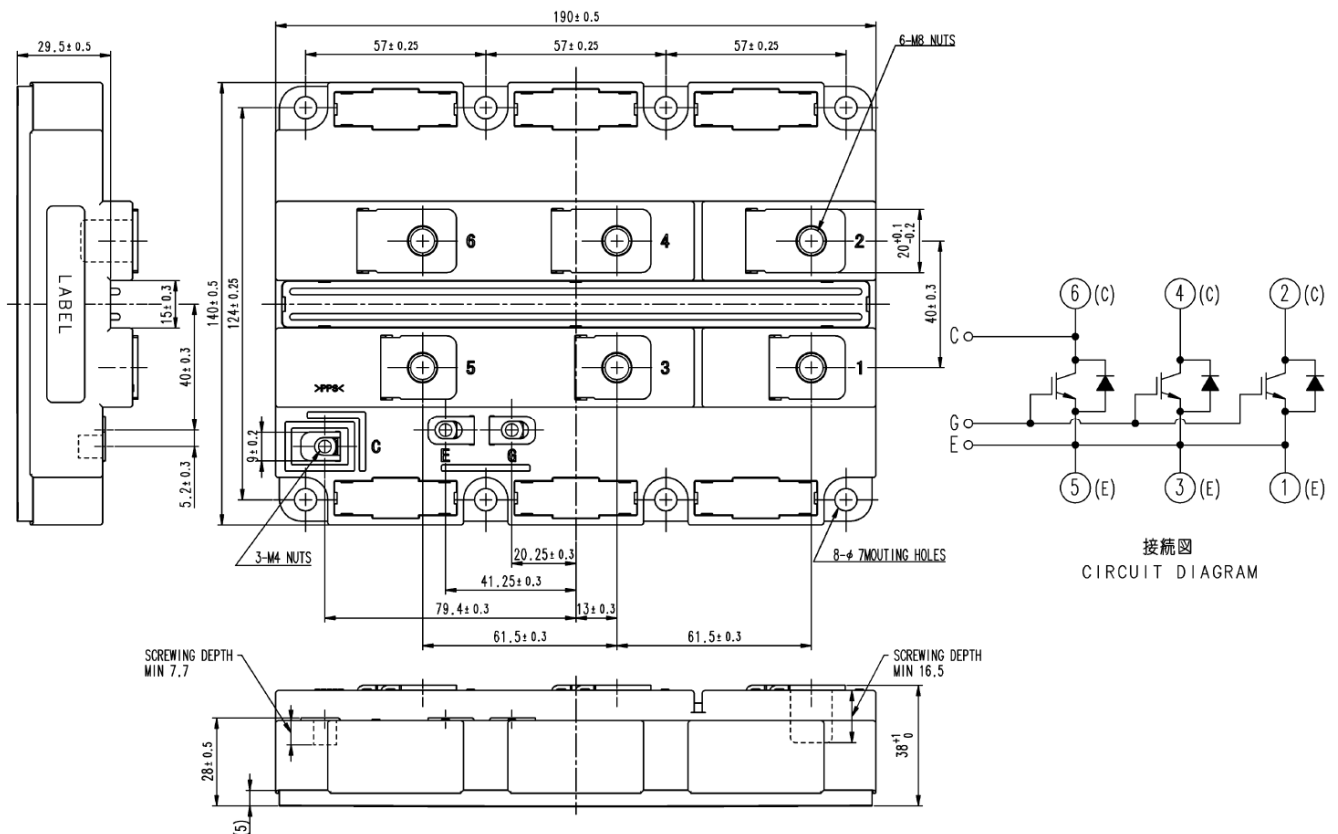
- I_c 1500A
- V_{CES} 4500V
- 1-element in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- AISiC Baseplate
- UL recognized under UL1557

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



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MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V _{CES}	Collector-emitter voltage	V _{GE} = 0V, T _j = +25...+150°C	4500	V
		V _{GE} = 0V, T _j = -50°C	3900	
V _{GES}	Gate-emitter voltage	V _{CE} = 0V, T _j = 25°C	± 20	V
I _C	Collector current	DC, T _c = 105°C	1500	A
I _{CRM}		Pulse (Note 1)	3000	A
I _E	Emitter current (Note 2)	DC, T _c = 90°C	1500	A
I _{ERM}		Pulse (Note 1)	3000	A
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	6000	V
V _e	Partial discharge extinction voltage	RMS, sinusoidal, f = 60Hz, Q _{PD} ≤ 10 pC	3500	V
T _j	Junction temperature		-50 ~ +150	°C
T _{top}	Operating junction temperature		-50 ~ +150	°C
T _{stg}	Storage temperature		-55 ~ +150	°C
t _{psc}	Short circuit pulse width	V _{CC} = 3000V, 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	—	—	10.0	mA
			T _j = 125°C	—	10.0	—	
			T _j = 150°C	—	—	120	
V _{GE(th)}	Gate-emitter threshold voltage	V _{CE} = 10 V, I _C = 150 mA, T _j = 25°C	6.5	7.0	7.5	V	
I _{GES}	Gate leakage current	V _{GE} = V _{GES} , V _{CE} = 0V, T _j = 25°C	—	—	0.5	μA	
C _{ies}	Input capacitance	V _{CE} = 10 V, V _{GE} = 0 V, f = 100 kHz T _j = 25°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} = ±15V	—	12.6	—	μC	
V _{CEsat}	Collector-emitter saturation voltage	I _C = 1500 A (Note 4) V _{GE} = 15 V	T _j = 25°C	—	2.20	—	V
			T _j = 125°C	—	2.65	—	
			T _j = 150°C	—	2.80	3.30	
t _{d(on)}	Turn-on delay time	V _{CC} = 2800 V I _C = 1500 A V _{GE} = ±15 V R _{G(on)} = 2.4 Ω	T _j = 150°C	—	—	1.00	μs
t _r	Rise time		T _j = 150°C	—	—	0.50	μs
E _{on(10%)}	Turn-on switching energy per pulse (Note 5)		T _j = 25°C	—	—	—	J
		T _j = 125°C	—	7.20	—		
		T _j = 150°C	—	7.50	—		
E _{on}	Turn-on switching energy per pulse (Note 6)	L _s = 100 nH Inductive load	T _j = 25°C	—	—	—	J
			T _j = 125°C	—	7.50	—	
			T _j = 150°C	—	7.80	—	
t _{d(off)}	Turn-off delay time	V _{CC} = 2800 V I _C = 1500 A V _{GE} = ±15 V	T _j = 25°C	—	—	—	μs
			T _j = 125°C	—	7.00	—	
			T _j = 150°C	—	7.20	10.0	
t _f	Fall time	R _{G(off)} = 30 Ω L _s = 100 nH Inductive load	T _j = 25°C	—	—	—	μs
			T _j = 125°C	—	0.50	—	
			T _j = 150°C	—	0.50	1.20	
E _{off(10%)}	Turn-off switching energy per pulse (Note 5)	L _s = 100 nH Inductive load	T _j = 25°C	—	—	—	J
			T _j = 125°C	—	5.10	—	
			T _j = 150°C	—	5.50	—	
E _{off}	Turn-off switching energy per pulse (Note 6)	L _s = 100 nH Inductive load	T _j = 25°C	—	—	—	J
			T _j = 125°C	—	5.50	—	
			T _j = 150°C	—	5.90	—	

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ELECTRICAL CHARACTERISTICS (continuation)

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

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	—	—	13.0	
R _{th(c-s)}	Contact thermal resistance	Case to heat sink λ _{grease} = 1W/m ² ·K, D _(c-s) = 80μm	—	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
M _s		M6 : Mounting screw	3.0	—	6.0	
M _t		M4 : Auxiliary terminals screw (Note 8)	1.0	—	3.0	
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 °C	—	0.09	—	mΩ

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 (FWD).

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 = 0A 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.

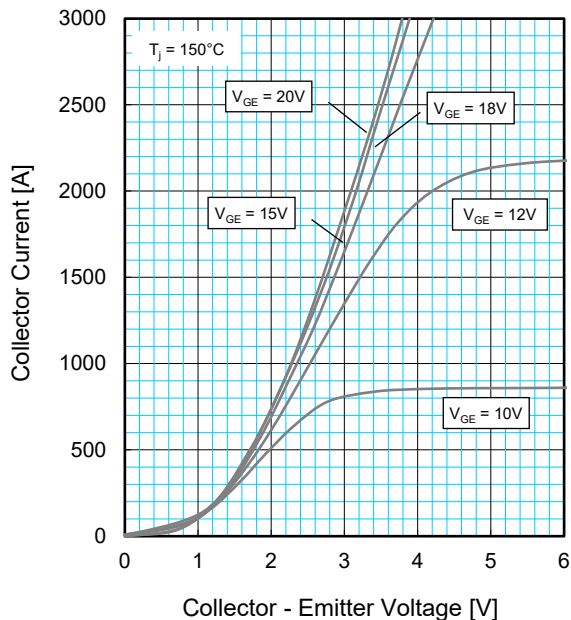
CM1500HC-90XA

HIGH POWER SWITCHING USE
INSULATED TYPE

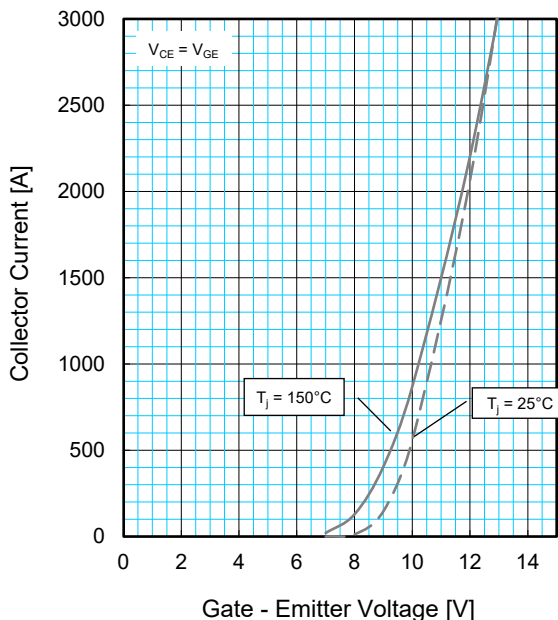
5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

PERFORMANCE CURVES

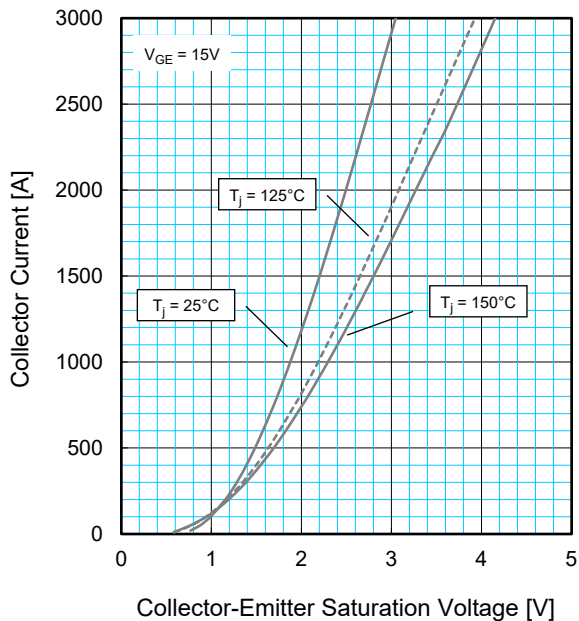
OUTPUT CHARACTERISTICS (TYPICAL)



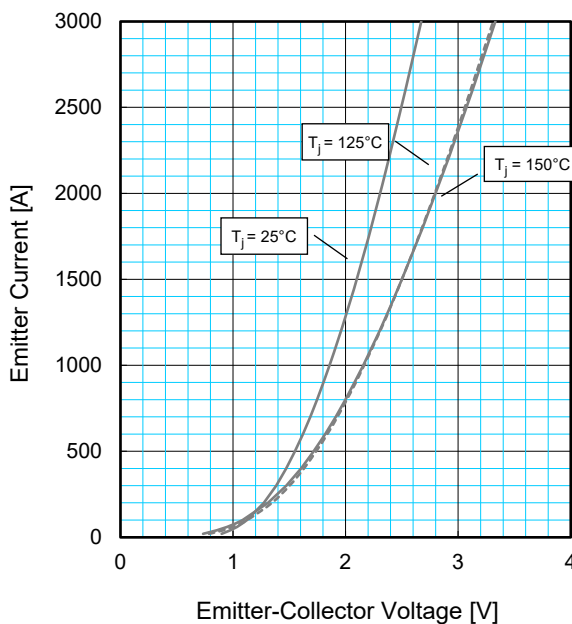
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



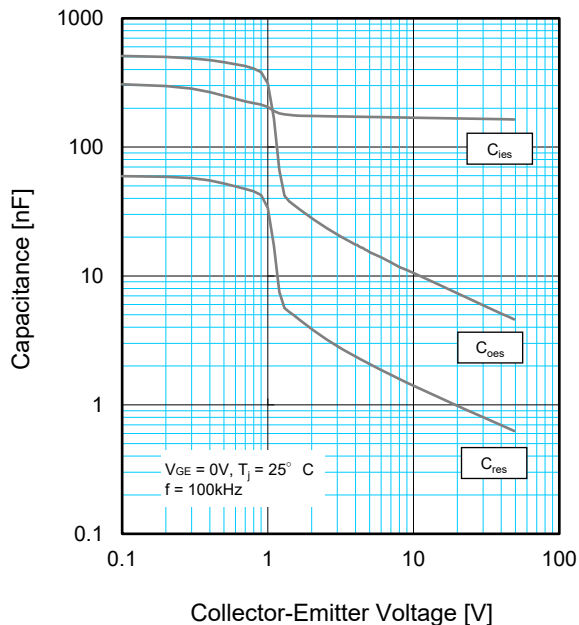
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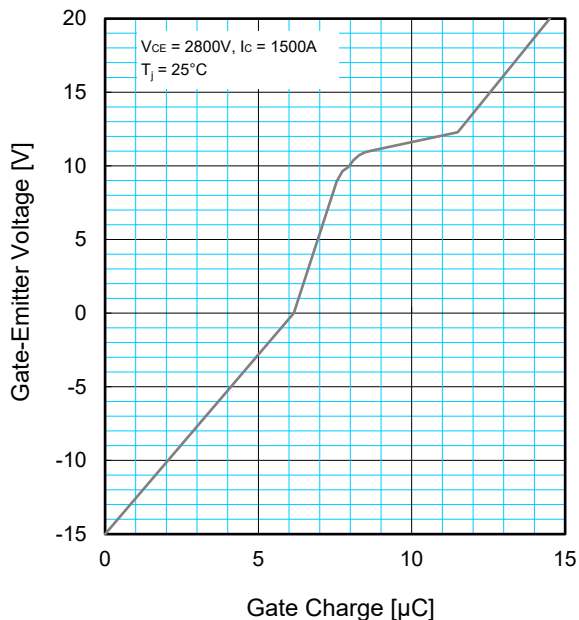
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PERFORMANCE CURVES

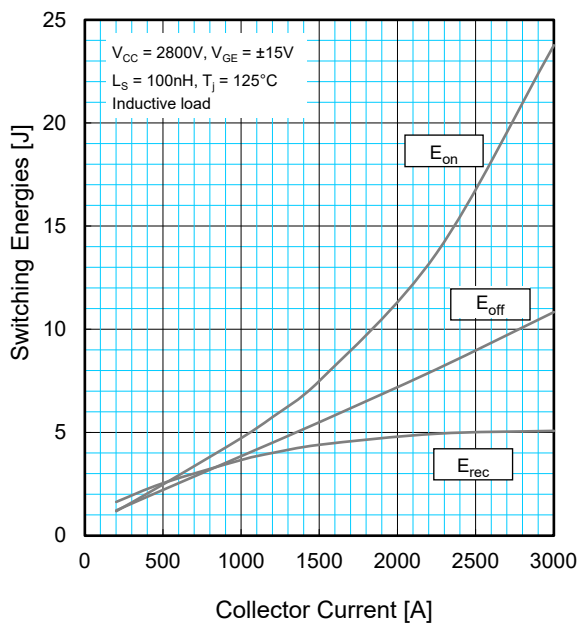
CAPACITANCE CHARACTERISTICS (TYPICAL)



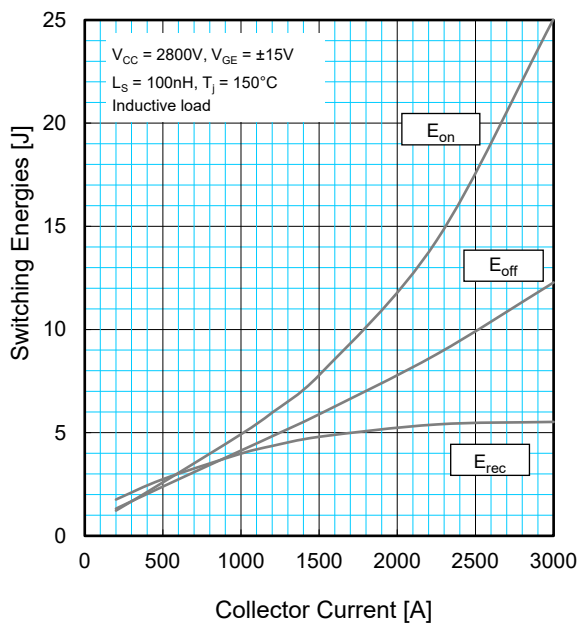
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



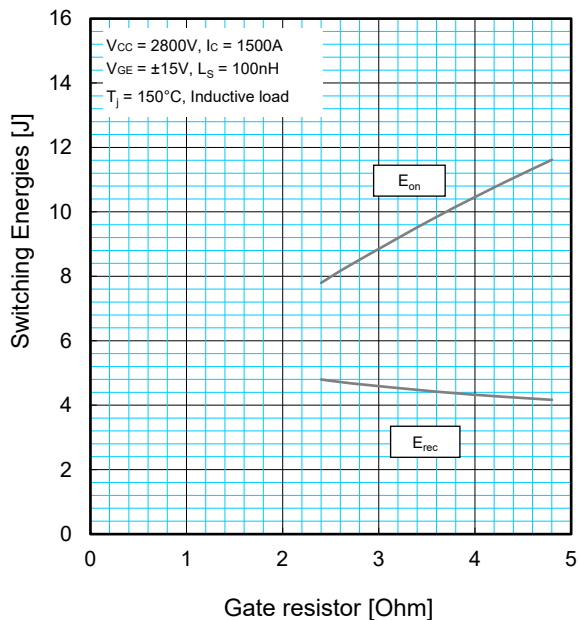
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HIGH POWER SWITCHING USE
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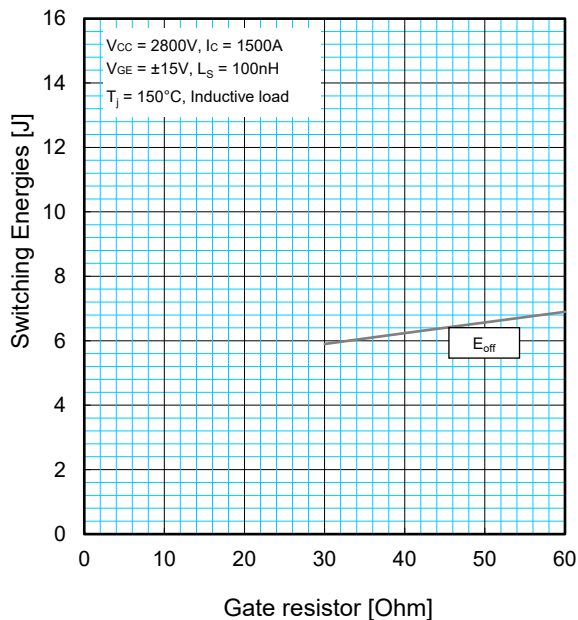
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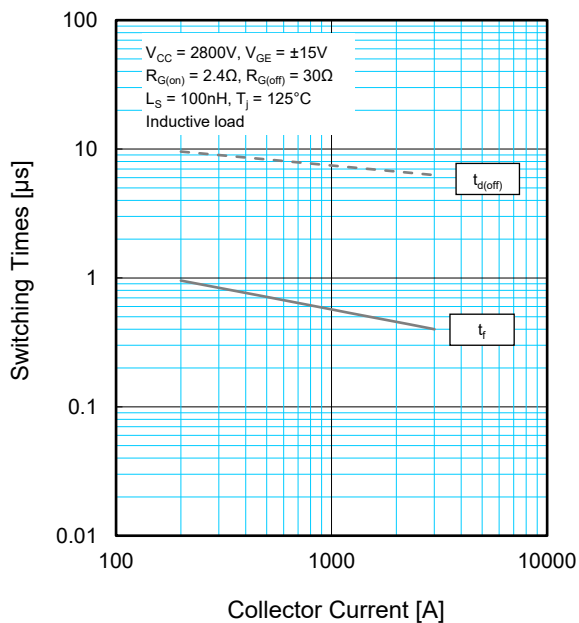
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



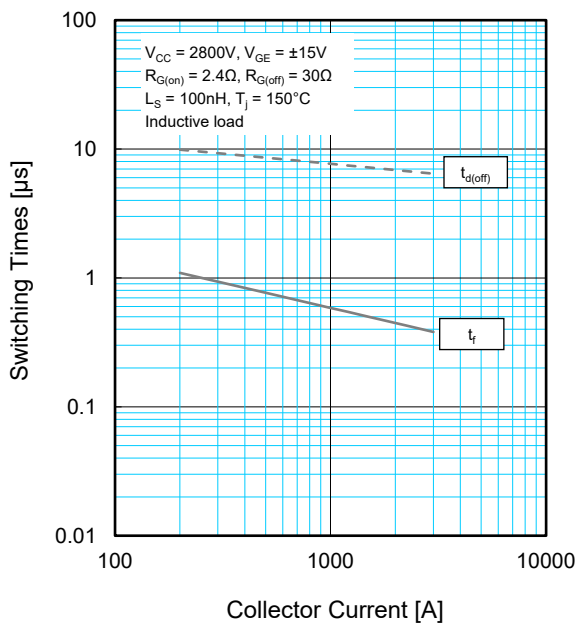
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



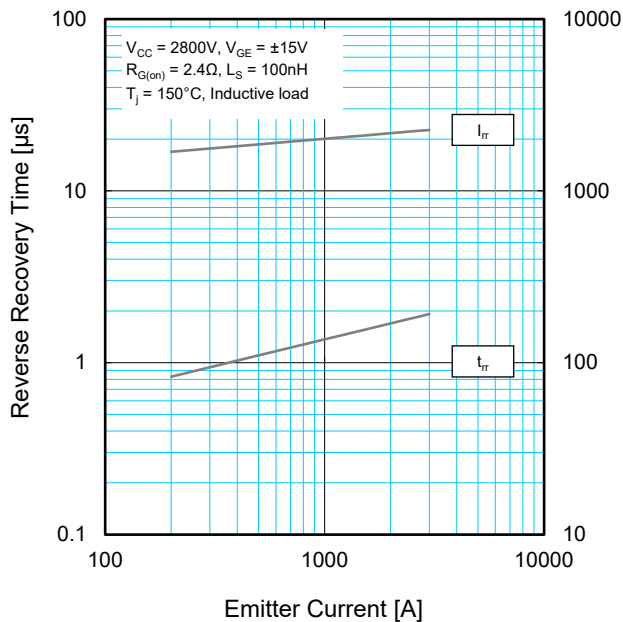
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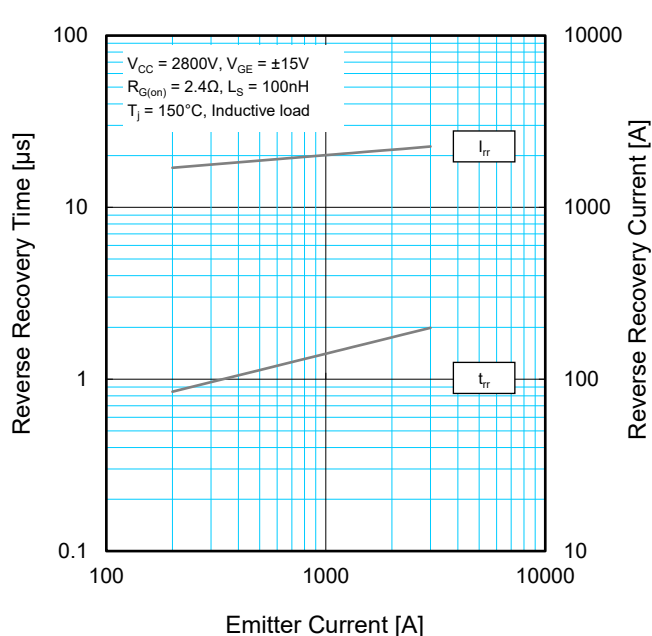
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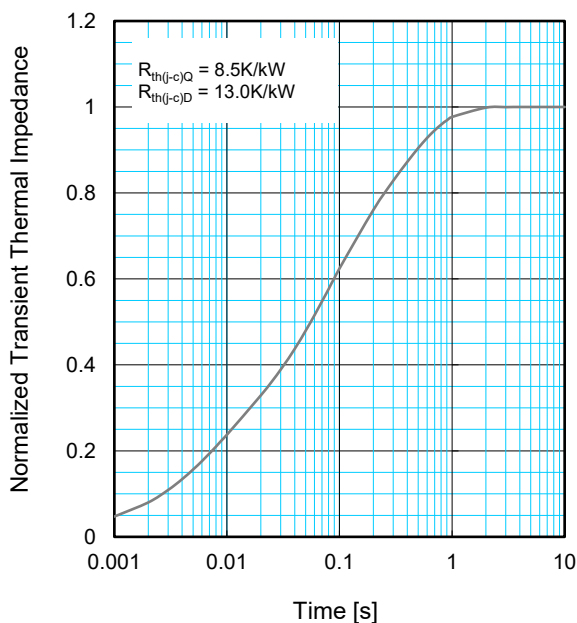
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



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
$R_i / R_{th(j-c)}$	0.0000	0.1893	0.4044	0.3967
τ_i [sec]	0.0001	0.0058	0.0602	0.3512

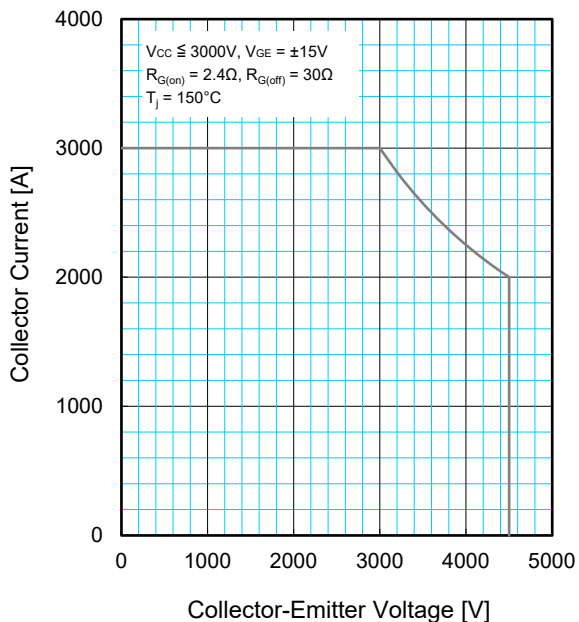
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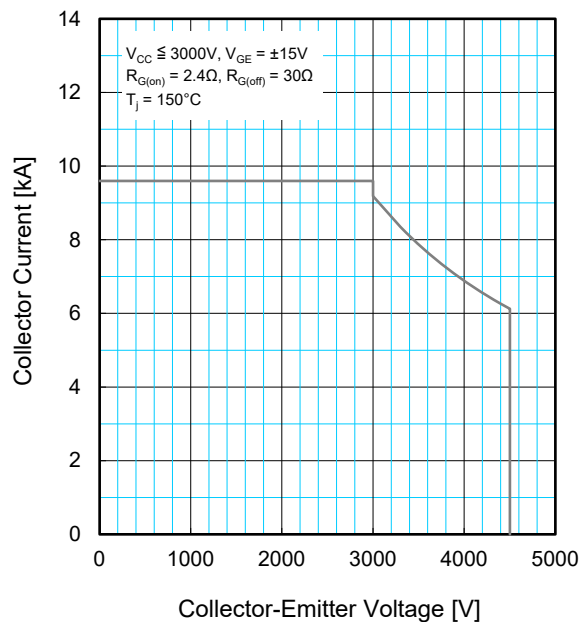
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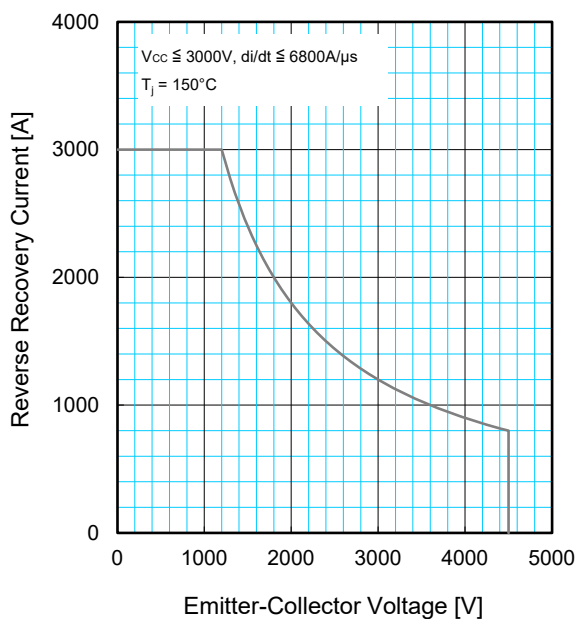
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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