

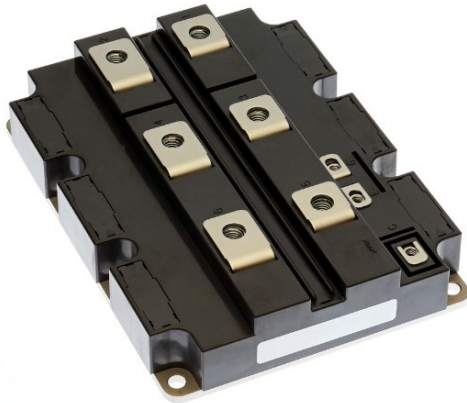
< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

CM1350HC-90X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM1350HC-90X



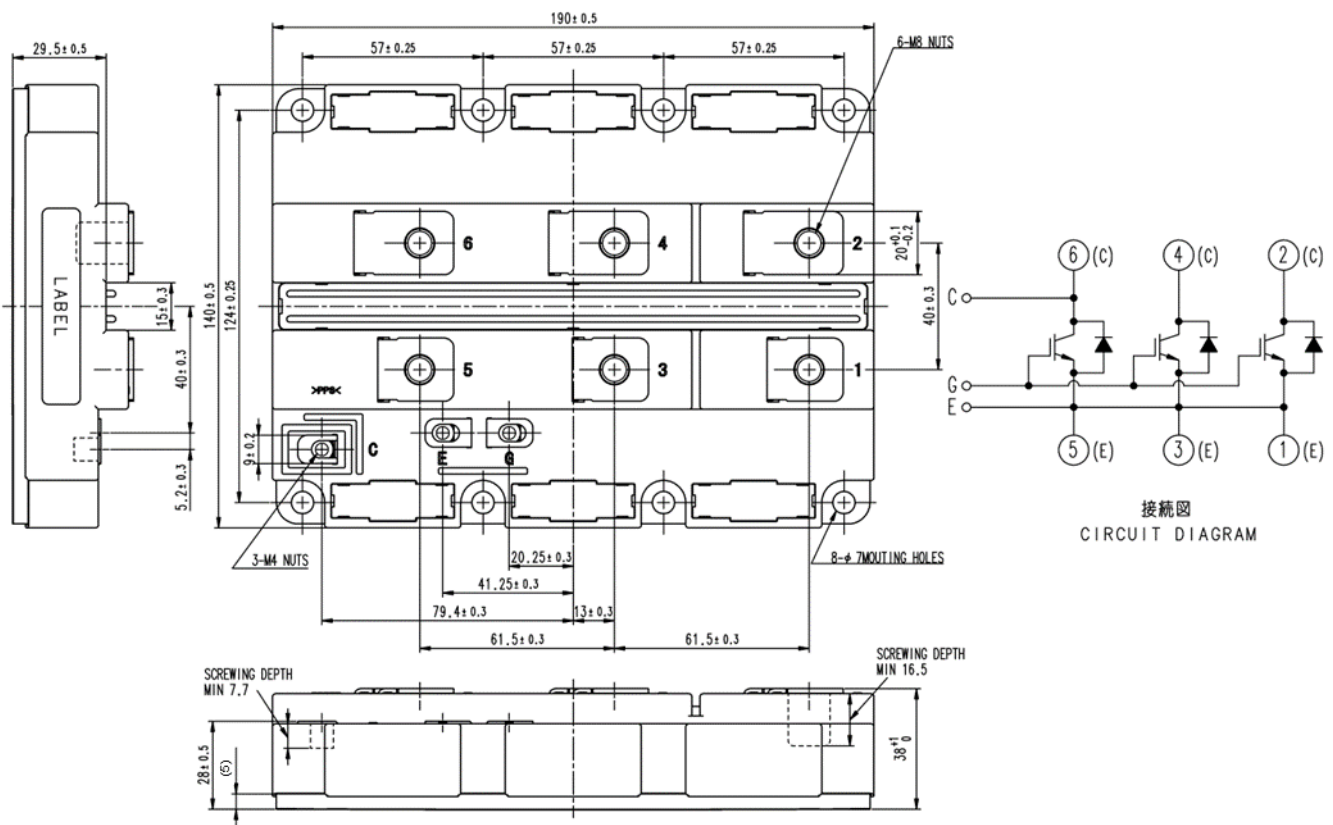
- I_C 1350A
- V_{CES} 4500V
- 1-element in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- AISiC Baseplate

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 _{CES}	Collector-emitter voltage	V _{GE} = 0V, T _j = -40...+150°C	4500	V
		V _{GE} = 0V, T _j = -50°C	4400	
V _{GES}	Gate-emitter voltage	V _{CE} = 0V, T _j = 25°C	± 20	V
I _C	Collector current	DC, T _c = 105°C	1350	A
I _{CRM}		Pulse (Note 1)	2700	A
I _E	Emitter current (Note 2)	DC	1350	A
I _{ERM}		Pulse (Note 1)	2700	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	3400	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} = 3400V, 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	—	—	6.0	mA
			T _j = 125°C	—	6.0	—	
			T _j = 150°C	—	60.0	—	
V _{GE(th)}	Gate-emitter threshold voltage	V _{CE} = 10 V, I _C = 135 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	—	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		—	11.0	—	nF	
C _{res}	Reverse transfer capacitance		—	1.5	—	nF	
Q _G	Total gate charge	V _{CC} = 2800V, I _C = 1350A, V _{GE} = ±15V	—	12.6	—	μC	
V _{CESat}	Collector-emitter saturation voltage	I _C = 1350 A (Note 4) V _{GE} = 15 V	T _j = 25°C	—	2.25	—	V
			T _j = 125°C	—	2.90	—	
			T _j = 150°C	—	3.00	3.50	
t _{d(on)}	Turn-on delay time	V _{CC} = 2800 V I _C = 1350 A V _{GE} = ±15 V R _{G(on)} = 2.4 Ω L _s = 100 nH Inductive load	T _j = 150°C	—	—	1.00	μs
t _r	Turn-on rise time		T _j = 150°C	—	—	0.50	μs
E _{on(10%)}	Turn-on switching energy per pulse (Note 7)		T _j = 25°C	—	6.50	—	J
		T _j = 125°C	—	6.90	—		
		T _j = 150°C	—	6.95	—		
E _{on}	Turn-on switching energy per pulse (Note 5)	T _j = 25°C	—	6.55	—	J	
		T _j = 125°C	—	7.30	—		
		T _j = 150°C	—	7.35	—		
t _{d(off)}	Turn-off delay time	V _{CC} = 2800 V I _C = 1350 A V _{GE} = ±15 V R _{G(off)} = 30 Ω L _s = 100 nH Inductive load	T _j = 125°C	—	7.00	—	μs
			T _j = 150°C	—	7.20	10.0	
t _f	Turn-off fall time		T _j = 125°C	—	0.45	—	μs
			T _j = 150°C	—	0.45	1.20	
			T _j = 25°C	—	3.85	—	
E _{off(10%)}	Turn-off switching energy per pulse (Note 7)		T _j = 25°C	—	5.20	—	J
		T _j = 125°C	—	5.50	—		
		T _j = 150°C	—	5.50	—		
E _{off}	Turn-off switching energy per pulse (Note 5)	T _j = 25°C	—	4.30	—	J	
		T _j = 125°C	—	5.85	—		
		T _j = 150°C	—	6.15	—		

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ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
V_{EC}	Emitter-collector voltage (Note 2)	$I_E = 1350 \text{ A}$ (Note 4) $V_{GE} = 0 \text{ V}$	$T_J = 25^\circ\text{C}$	—	2.35	—	V
			$T_J = 125^\circ\text{C}$	—	2.90	—	
			$T_J = 150^\circ\text{C}$	—	3.00	3.50	
t_{rr}	Reverse recovery time (Note 2)	$V_{CC} = 2800 \text{ V}$ $I_C = 1350 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 2.4 \Omega$ $L_s = 100 \text{ nH}$ Inductive load	$T_J = 125^\circ\text{C}$	—	1.50	—	μs
			$T_J = 150^\circ\text{C}$	—	1.70	—	
I_{rr}	Reverse recovery current (Note 2)		$T_J = 125^\circ\text{C}$	—	1950	—	A
			$T_J = 150^\circ\text{C}$	—	1950	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 2,6)		$T_J = 125^\circ\text{C}$	—	2750	—	μC
			$T_J = 150^\circ\text{C}$	—	2800	—	
Q_{rr}	Reverse recovery charge (Note 2,5)		$T_J = 125^\circ\text{C}$	—	2860	—	μC
			$T_J = 150^\circ\text{C}$	—	2900	—	
$E_{rec(10\%)}$	Reverse recovery energy per pulse (Note 2,7)		$T_J = 25^\circ\text{C}$	—	3.35	—	J
			$T_J = 125^\circ\text{C}$	—	4.25	—	
		$T_J = 150^\circ\text{C}$	—	4.35	—		
E_{rec}	Reverse recovery energy per pulse (Note 2,5)	$T_J = 25^\circ\text{C}$	—	3.40	—	J	
		$T_J = 125^\circ\text{C}$	—	4.55	—		
		$T_J = 150^\circ\text{C}$	—	4.65	—		

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	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	Main terminals screw	7.0	—	19.0	N·m
M_s		Mounting screw	3.0	—	6.0	N·m
M_t		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
$L_{p\ CE}$	Parasitic stray inductance		—	8.0	—	nH
R_{CC+EE}	Internal lead resistance	$T_C = 25^\circ\text{C}$	—	0.09	—	mΩ

Note1. Pulse width and repetition rate should be such that junction temperature (T_J) does not exceed T_{Jpmax} 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. Definition of all items is according to IEC 60747, unless otherwise specified.

Note6. The integration range of reverse recovery charge is from $I_E = 0\text{A}$ to $10\%I_E$.

Note7. The integration range of switching energies is from $10\%V_{CE}$ to $10\%I_C(10\%I_E)$.

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 N·m.

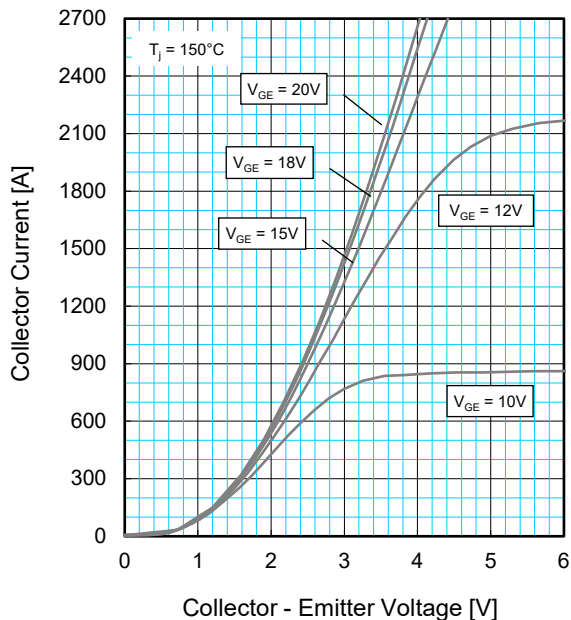
CM1350HC-90X

HIGH POWER SWITCHING USE
INSULATED TYPE

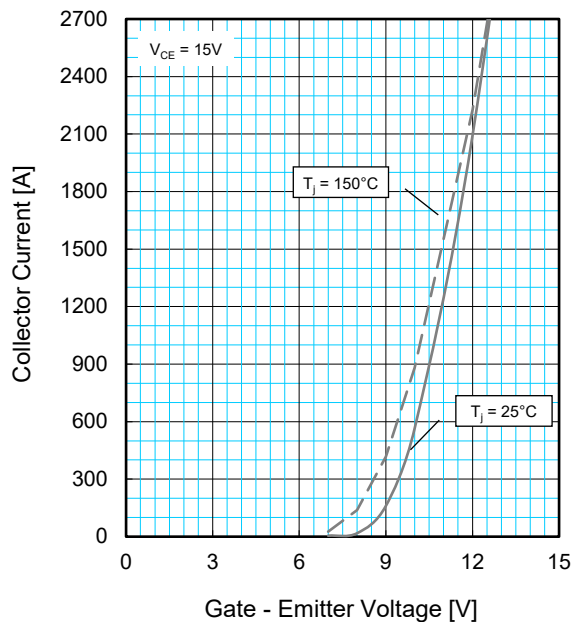
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PERFORMANCE CURVES

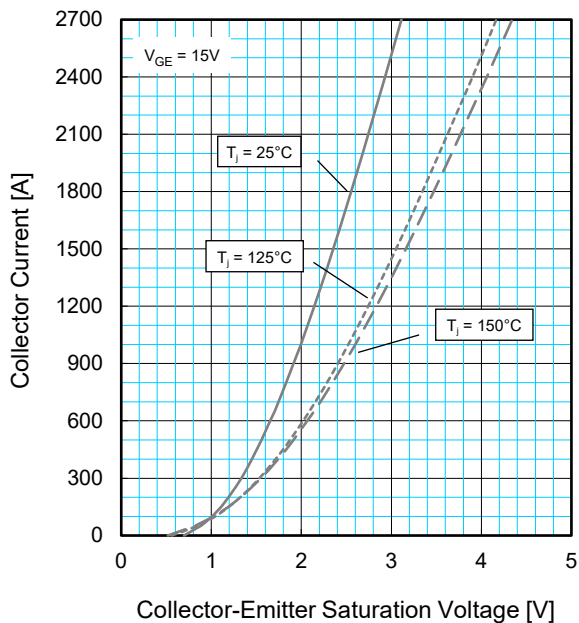
OUTPUT CHARACTERISTICS (TYPICAL)



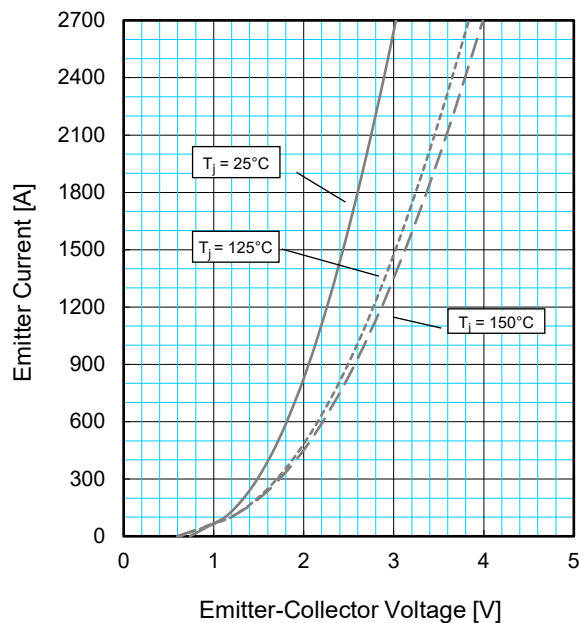
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



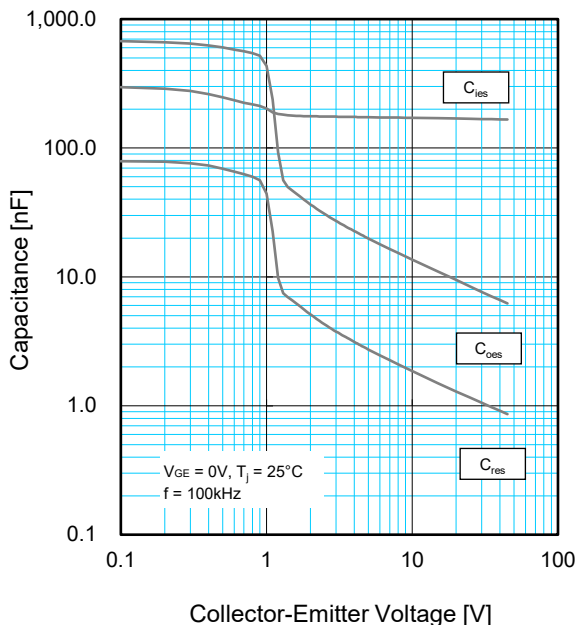
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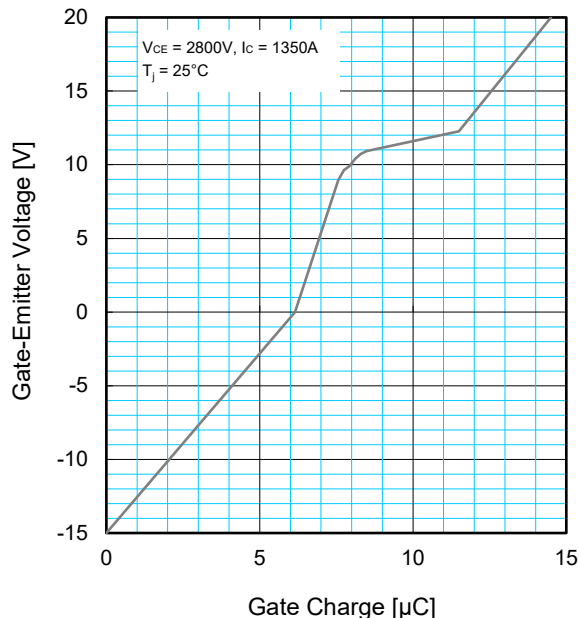
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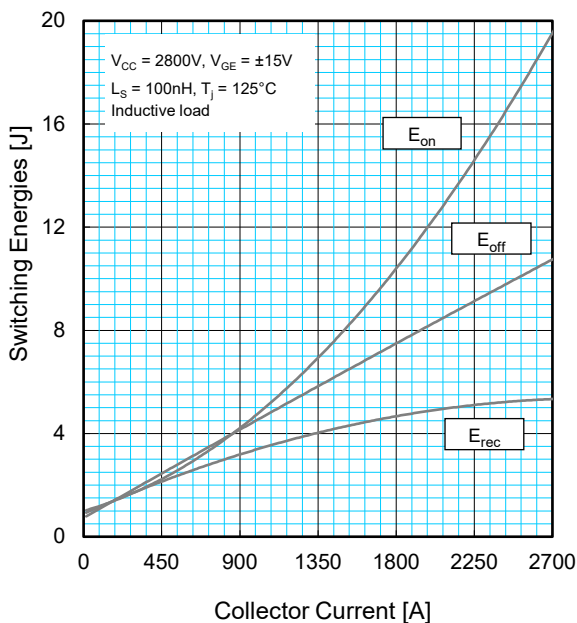
CAPACITANCE CHARACTERISTICS (TYPICAL)



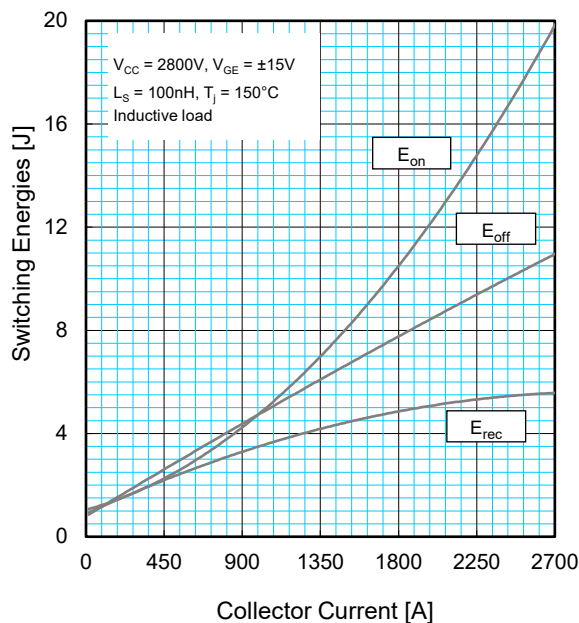
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



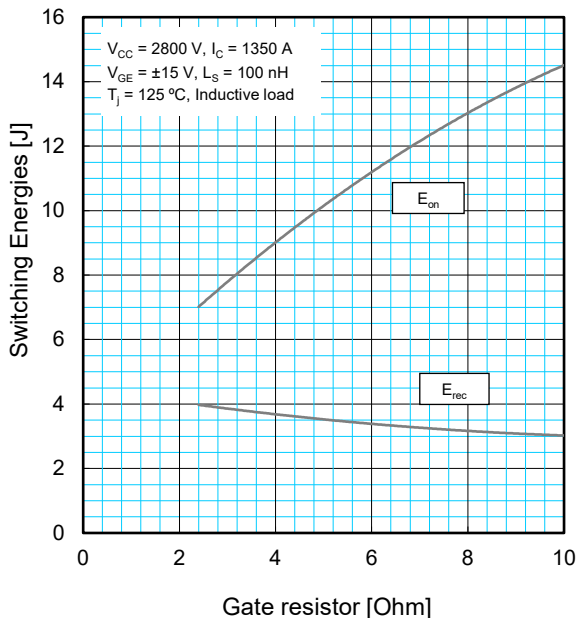
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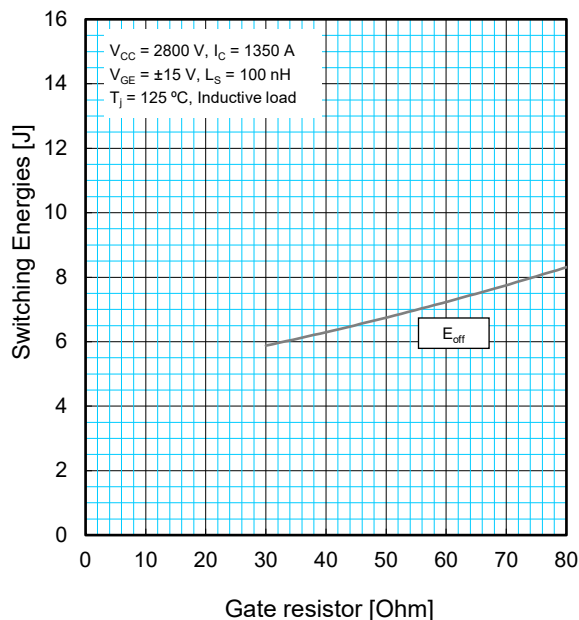
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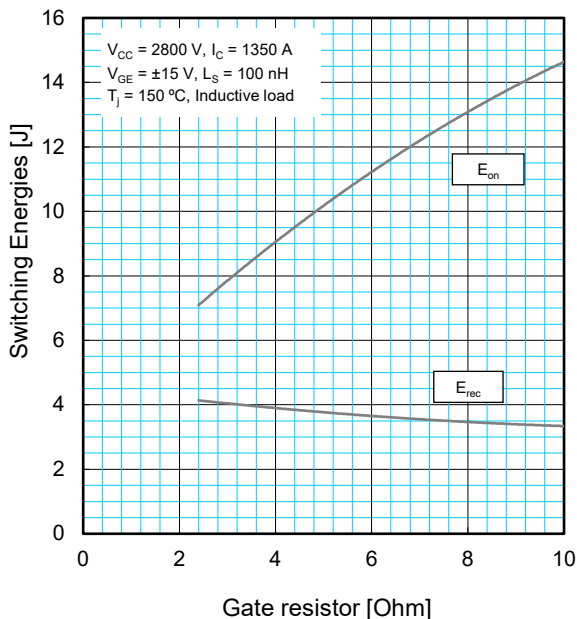
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



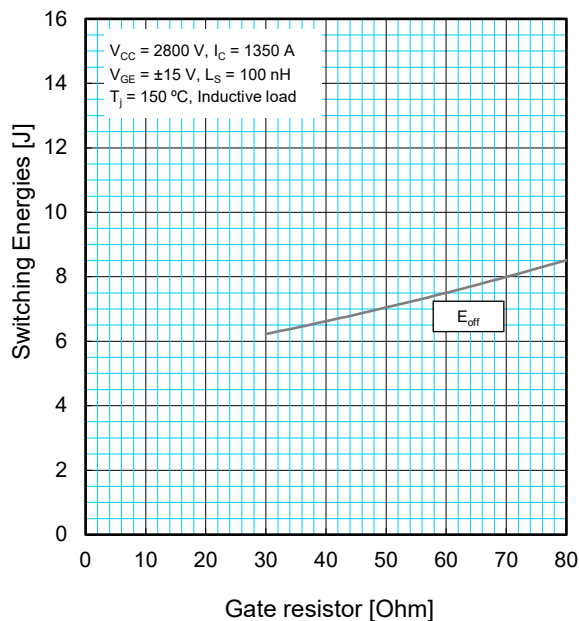
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



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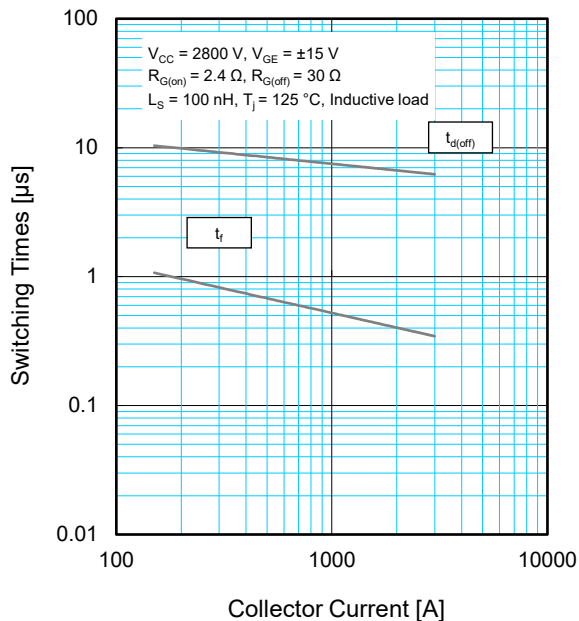
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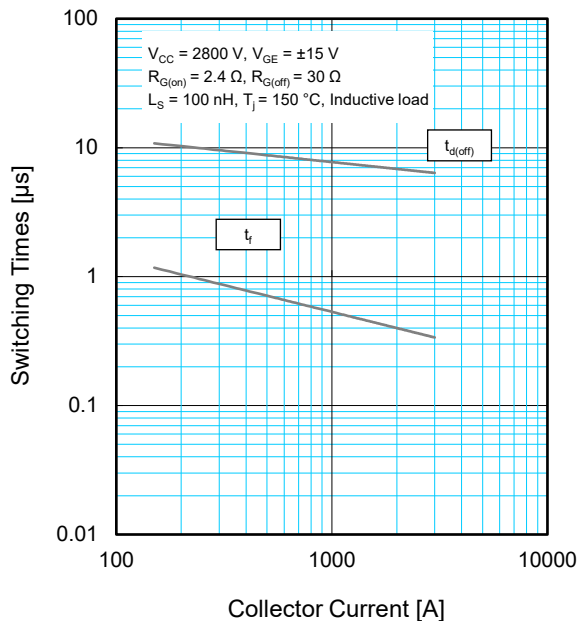
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PERFORMANCE CURVES

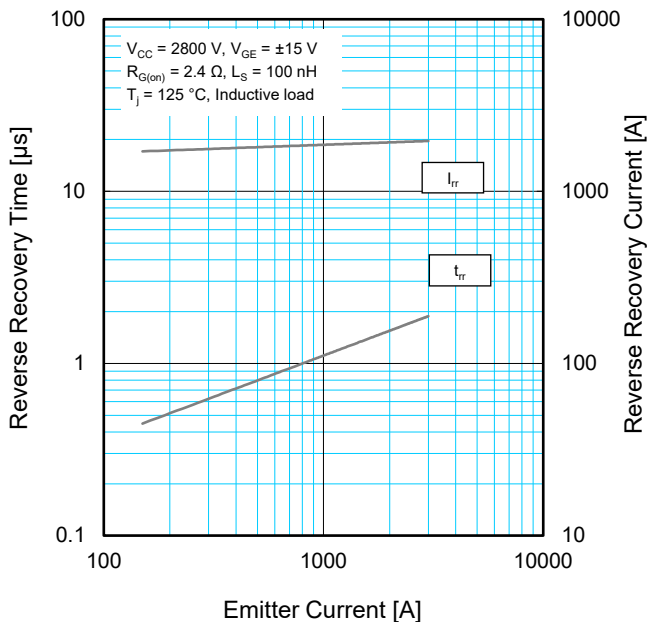
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



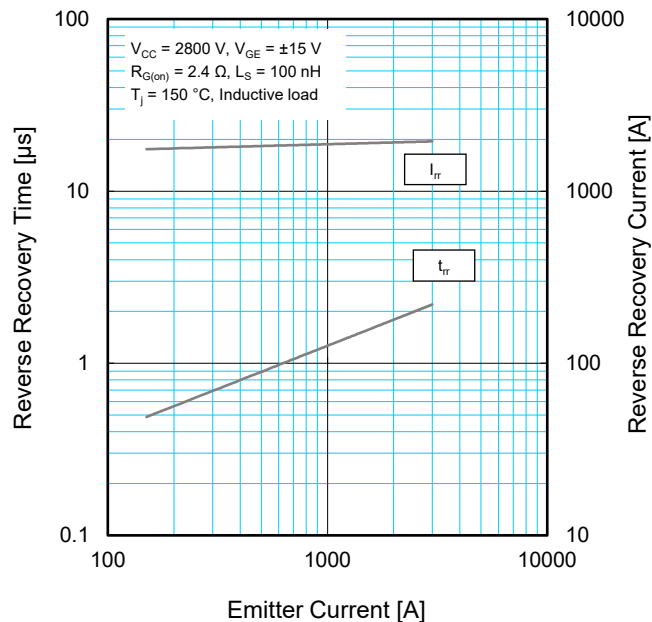
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

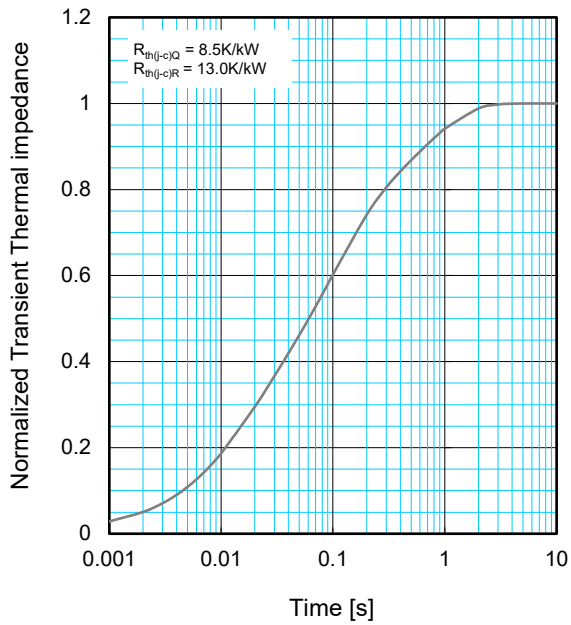


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PERFORMANCE CURVES

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



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

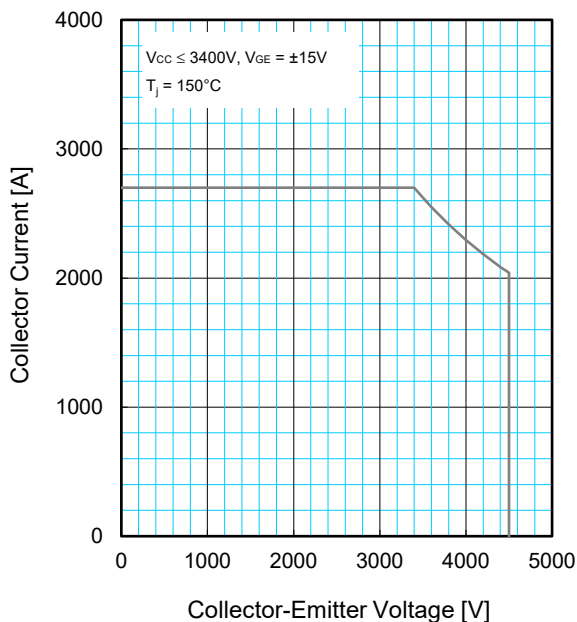
	1	2	3	4
$R_i / R_{th(j-c)}$:	0.0096	0.1893	0.4044	0.3967
τ_i [sec] :	0.0001	0.0058	0.0602	0.3512

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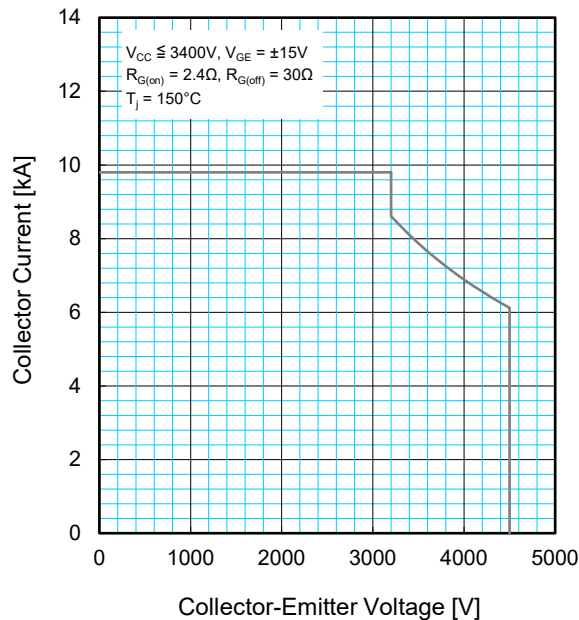
HIGH POWER SWITCHING USE
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PERFORMANCE CURVES

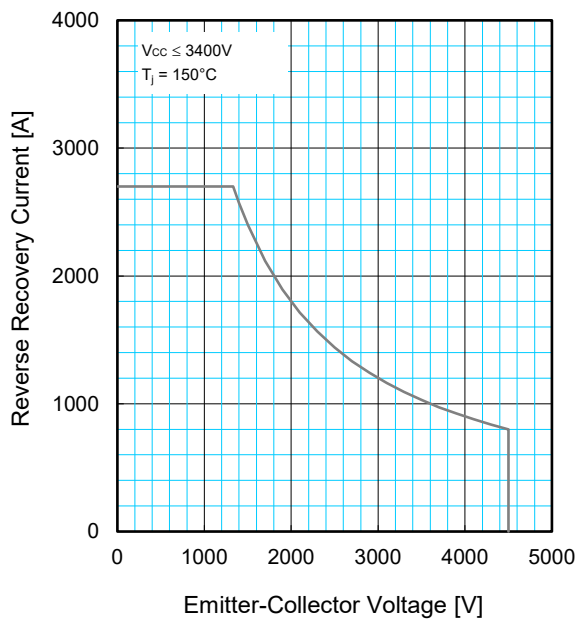
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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