

CM1500HC-90XA**HIGH POWER SWITCHING USE
INSULATED TYPE****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
I_{CRM}		Pulse (Note 1)	3000	A
I_E	Emitter current (Note 2)	DC, $T_c = 90^\circ C$	1500	A
I_{ERM}		Pulse (Note 1)	3000	A
P_{tot}	Maximum power dissipation (Note 3)	$T_c = 25^\circ C$, IGBT part	14700	W
V_{iso}	Isolation voltage	RMS, sinusoidal, $f = 60Hz, t = 1 \text{ min}$	6000	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, $f = 60Hz, Q_{PD} \leq 10 \text{ pC}$	3500	V
T_j	Junction temperature		$-50 \sim +150$	$^\circ C$
T_{jop}	Operating junction temperature		$-50 \sim +150$	$^\circ C$
T_{stg}	Storage temperature		$-55 \sim +150$	$^\circ C$
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°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 L _s = 100 nH Inductive load	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)		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 R _{G(off)} = 30 Ω L _s = 100 nH Inductive load	T _J = 25°C	—	—	—	μs
			T _J = 125°C	—	7.00	—	
			T _J = 150°C	—	7.20	10.0	
t _f	Fall time		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)		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)	T _J = 25°C	—	—	—	J	
		T _J = 125°C	—	5.50	—		
		T _J = 150°C	—	5.90	—		

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INSULATED TYPE****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)	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	—	—	—	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)		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	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
M_s		M6 : Mounting screw	3.0	—	6.0	N·m
M_t		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	—	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 $I_E = 0\text{A}$ to $10\%I_E$.

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

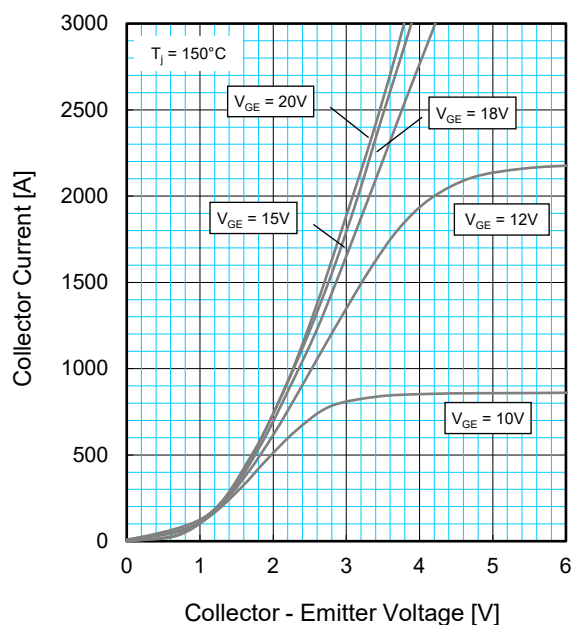
In case no PCB is used this maximum torque for M4 screw is 2.0 Nm.

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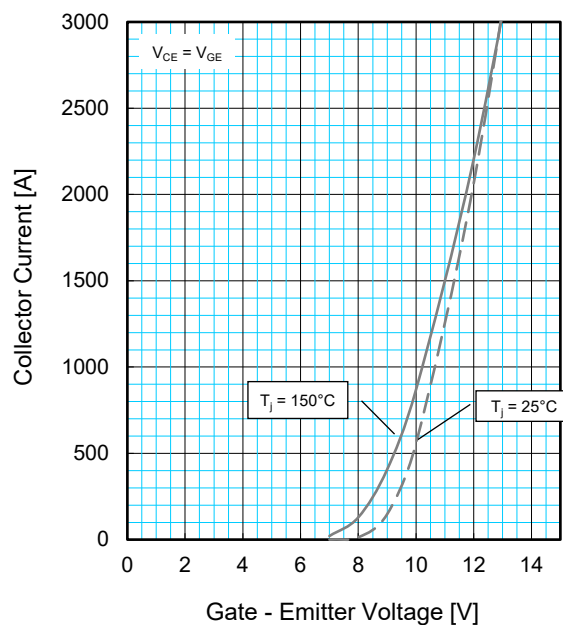
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

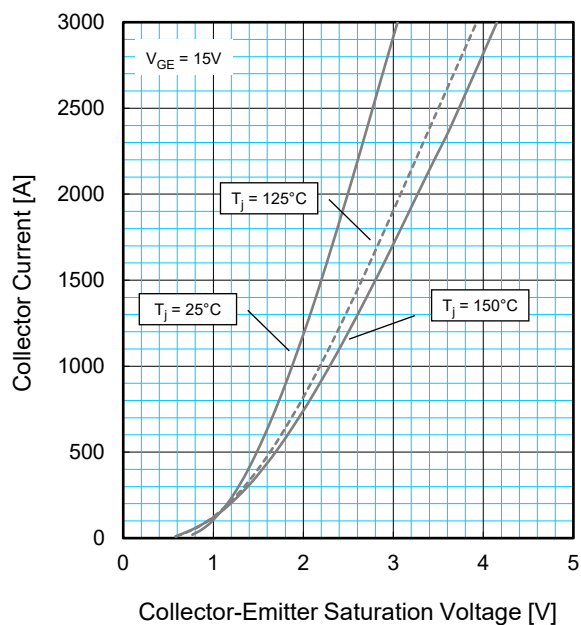
**OUTPUT CHARACTERISTICS
(TYPICAL)**



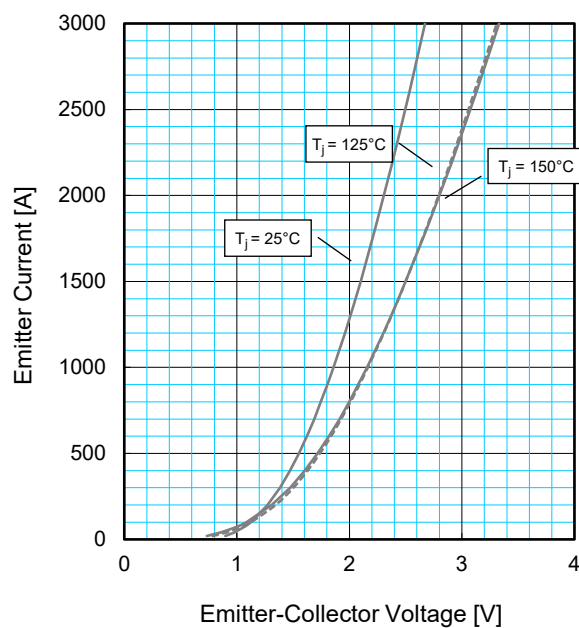
**TRANSFER CHARACTERISTICS
(TYPICAL)**



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



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

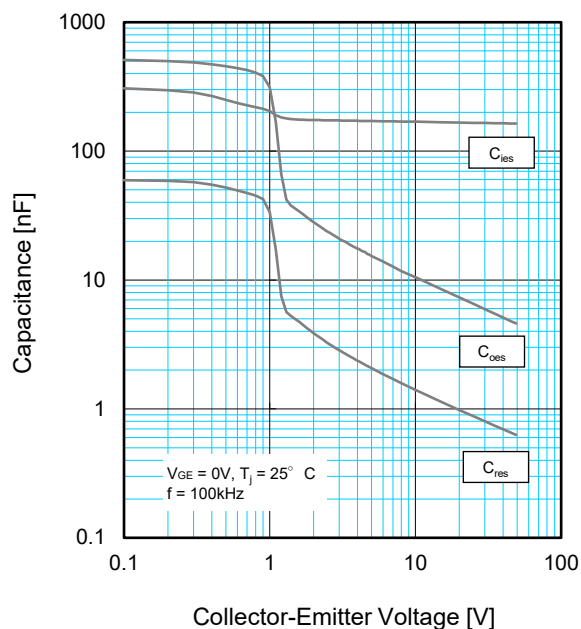


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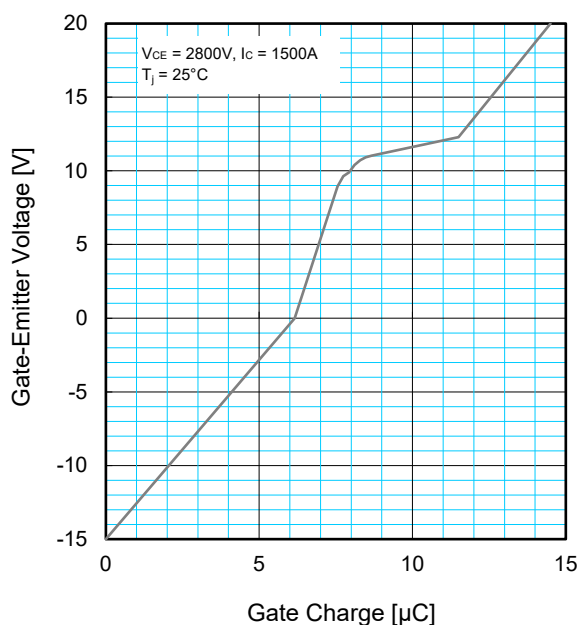
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

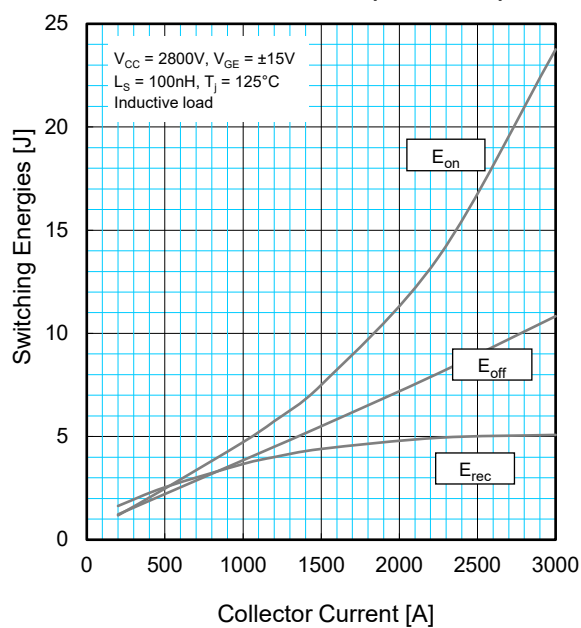
**CAPACITANCE CHARACTERISTICS
(TYPICAL)**



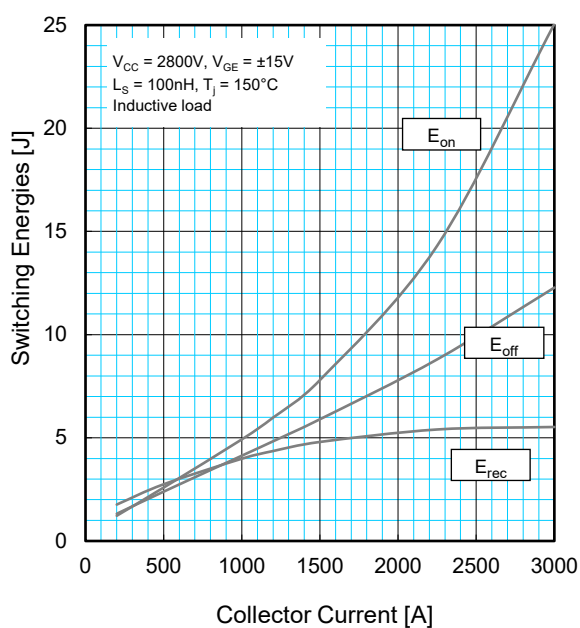
**GATE CHARGE CHARACTERISTICS
(TYPICAL)**



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



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

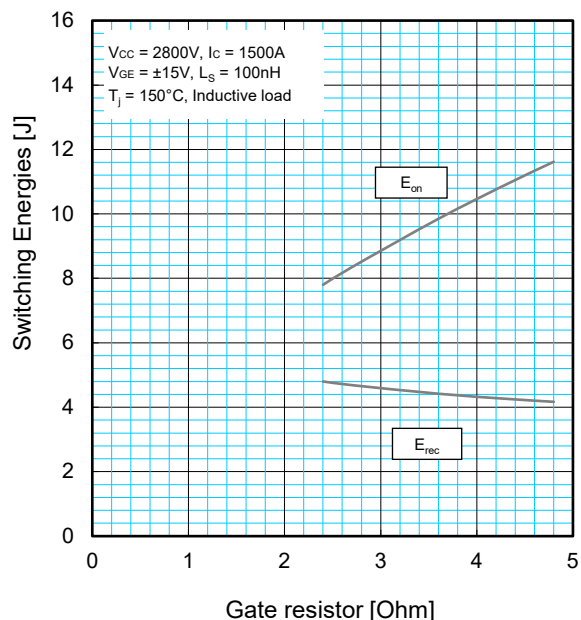


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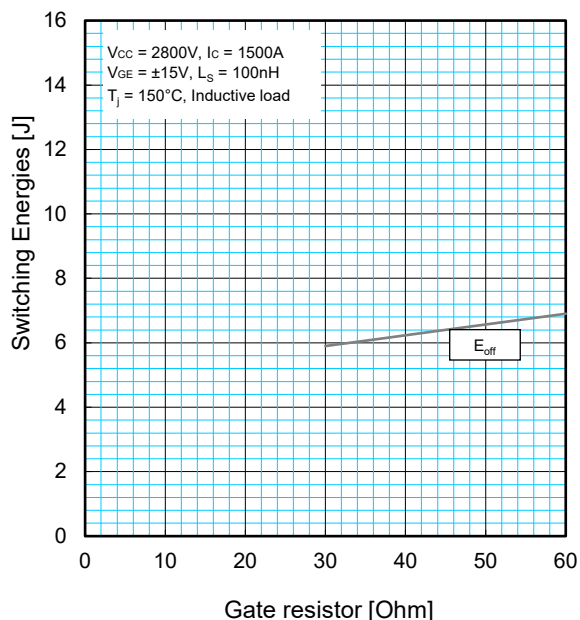
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

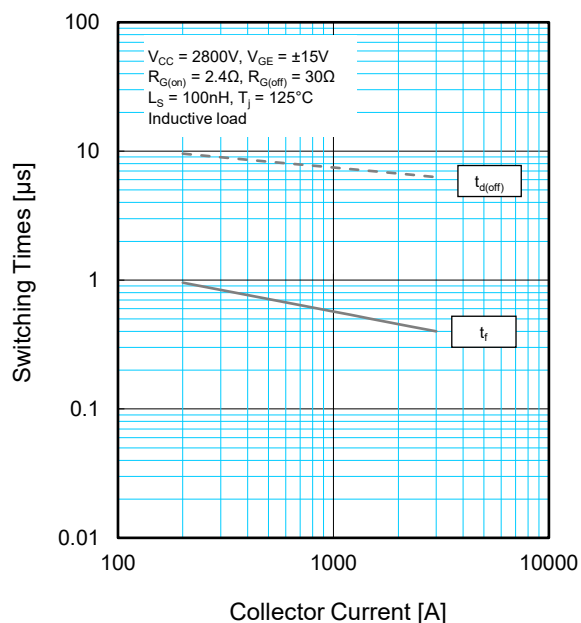
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



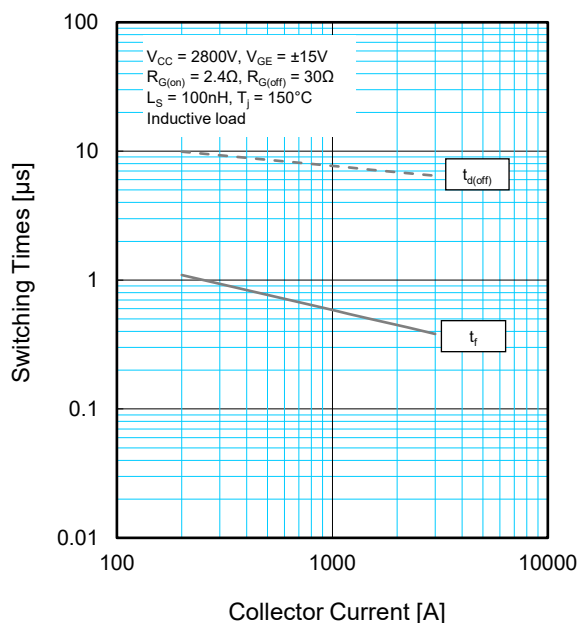
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HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



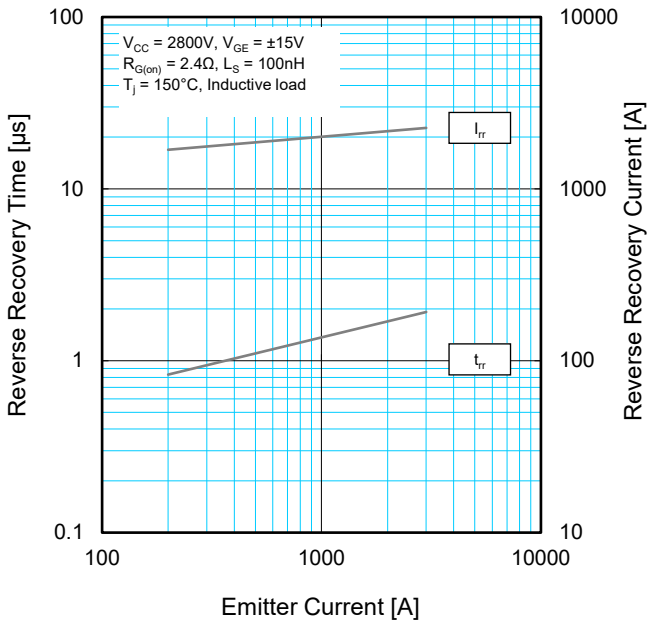
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



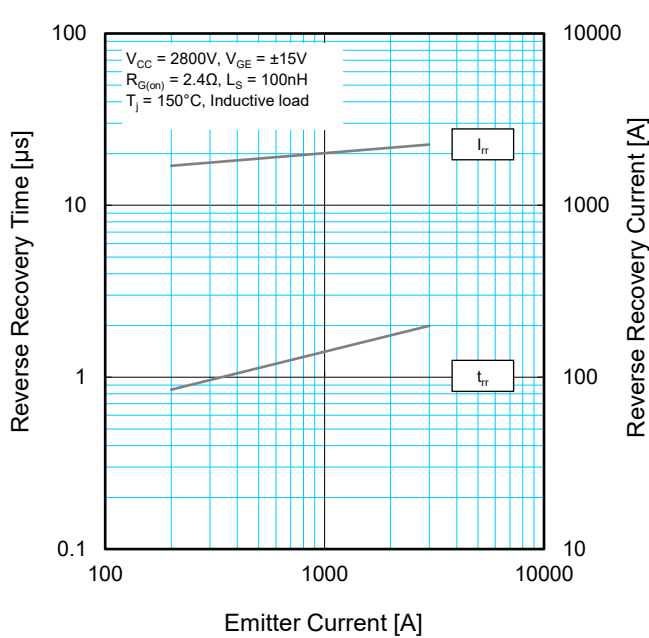
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HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

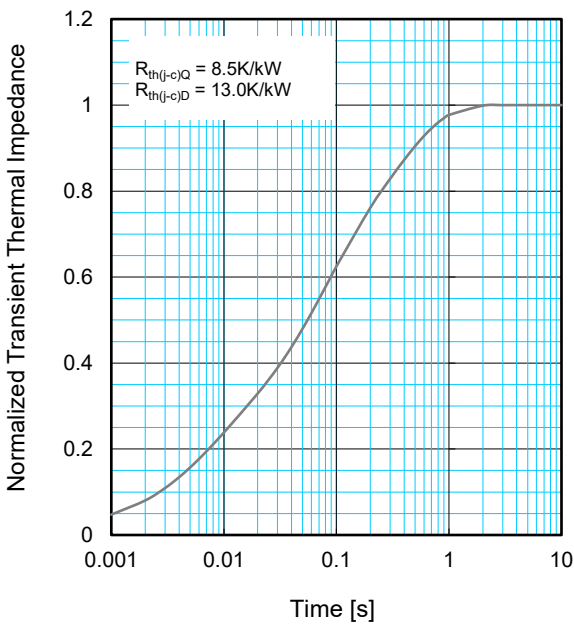
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



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

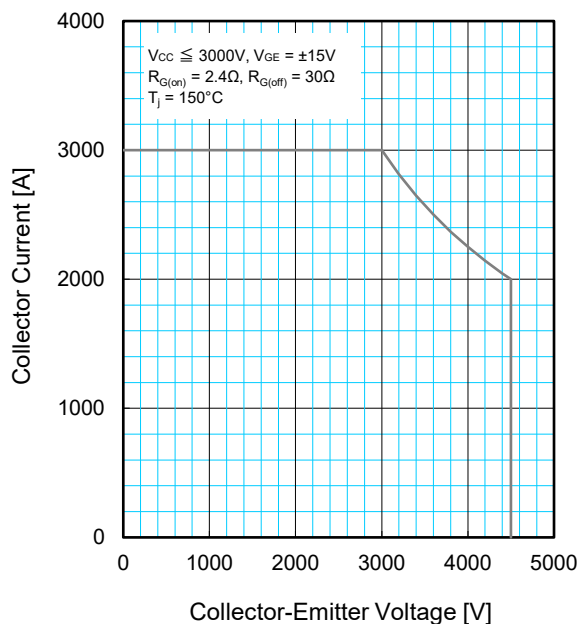
	1	2	3	4
$R_i / R_{th(j-c)}$	0.0096	0.1893	0.4044	0.3967
τ_i [sec]	0.0001	0.0058	0.0602	0.3512

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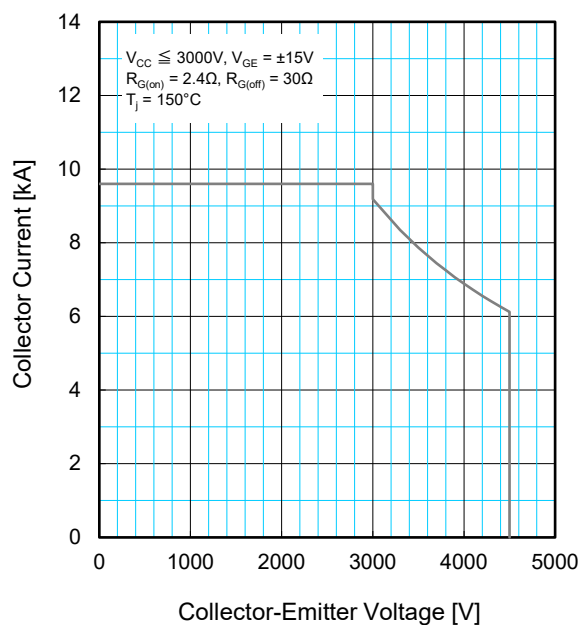
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

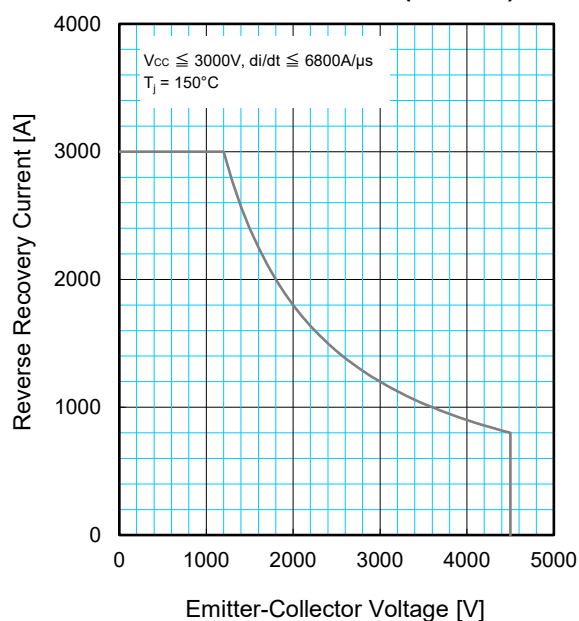
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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HIGH POWER SWITCHING USE
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Keep safety first in your circuit designs!

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