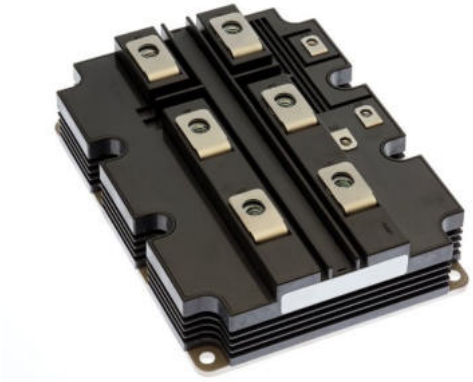
MITSUBISHI ELECTRIC

< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

CM900E2G-90X

HIGH POWER SWITCHING USE
INSULATED TYPE 5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

CM900E2G-90X

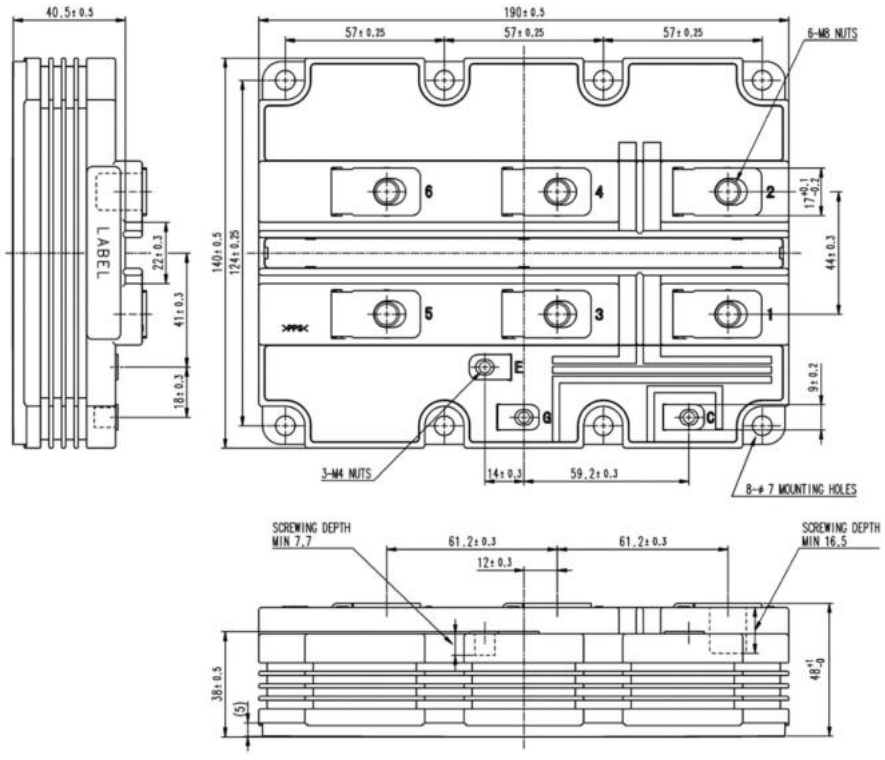


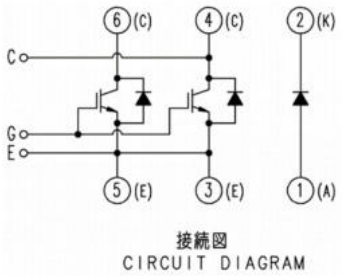
- I_C ..... 900 A
- V_{CES} ..... 4500 V
- 1-element in pack
- High Insulated type
- CSTBT™(III) / RFC Diode
- AlSiC baseplate

APPLICATION

Brake chopper

OUTLINE DRAWING & CIRCUIT DIAGRAM **Dimensions in mm**





MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{CES}	Collector-emitter voltage	V_{GE} = 0 V, T_j = -40…+150 °C	4500	V
		V_{GE} = 0 V, T_j = −50 °C	4400	
V_{RRM}	Repetitive peak reverse voltage (Note 3)	V_{GE} = 0 V, T_j = -40…+150 °C	4500	V
		V_{GE} = 0 V, T_j = −50 °C	4400	
V_{RSM}	Non-repetitive peak reverse voltage (Note 3)	V_{GE} = 0 V, T_j = -40…+150 °C	4500	V
		V_{GE} = 0 V, T_j = −50 °C	4400	
V_{GES}	Gate-emitter voltage	V_{CE} = 0 V, T_j = 25 °C	± 20	V
I_C	Collector current	DC, T_c = 105 °C	900	A
I_{CRM}		Pulse (Note 1)	1800	
I_E	Emitter current (Note 2)	DC, T_c = 90 °C	900	A
I_{ERM}		Pulse (Note 1)	1800	
I_F	Forward current (Note 3)	DC, T_c = 90 °C	900	A
I_{FRM}		Pulse (Note 1)	1800	
I_{FSM}	Surge forward current (Note 3)	T_{j_start} = 150 °C, t_p = 10ms, V_R = 0 V F(t) = 1 %, Half-sine wave	8.1	kA
I^2t	Surge current load integral (Note 3)		328	kA^2s
P_{tot}	Maximum power dissipation (Note 4)	T_c = 25 °C, IGBT part	9800	W
V_{iso}	Isolation voltage	RMS, sinusoidal, f = 60 Hz, t = 1 min.	10200	V
Q_{PD}	Partial discharge	Charged part to the baseplate V1 = 6900 Vrms, V2 = 5100 Vrms AC 60 Hz, T_c = 25 °C (acc. to IEC 61287)	10	pC
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} = 3400 V, V_{CE} ≤ V_{CES}, V_{GE} = ±15 V, T_j =150 °C $R_{G(on)}$ = 3.6 Ω, $R_{G(off)}$ = 45 Ω, L_S ≤ 225 nH	10	µs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
I_{CES}	Collector cutoff current	V_{CE} = V_{CES}, V_{GE} = 0 V	T_j = 25 °C	—	—	4.0	mA
			T_j = 125 °C	—	4.0	—	
			T_j = 150 °C	—	—	80	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE} = 10 V, I_C = 90 mA, T_j = 25 °C		6.5	7.0	7.5	V
I_{GES}	Gate leakage current	V_{CE} = 0 V, V_{GE} = V_{GES}, 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		—	115	—	nF
C_{oes}	Output capacitance			—	7.5	—	nF
C_{res}	Reverse transfer capacitance			—	1.0	—	nF
Q_G	Total gate charge	V_{CC} = 2800 V, I_C = 900 A, V_{GE} = ±15 V, T_j = 25 °C		—	8.4	—	µC
V_{CEsat}	Collector-emitter saturation voltage	I_C = 900 A (Note 5) 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 = 900 A V_{GE} = ±15 V $R_{G(on)}$ = 3.6 Ω L_S = 225 nH Inductive load	T_j = 150 °C	—	—	0.90	µs
t_r	Rise time		T_j = 150 °C	—	—	0.50	µs
$E_{on(10\%)}$	Turn-on switching energy (Note 6) per pulse		T_j = 25 °C	—	4.10	—	J
			T_j = 125 °C	—	4.40	—	
			T_j = 150 °C	—	4.45	—	
E_{on}	Turn-on switching energy per pulse		T_j = 25 °C	—	4.15	—	J
			T_j = 125 °C	—	4.60	—	
			T_j = 150 °C	—	4.65	—	

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 2800 V I_C = 900 A V_{GE} = ±15 V $R_{G(off)}$ = 45 Ω L_S = 225 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 (Note 6) per pulse		T_j = 25 °C	—	2.60	—	J
			T_j = 125 °C	—	3.55	—	
			T_j = 150 °C	—	3.75	—	
E_{off}	Turn-off switching energy per pulse		T_j = 25 °C	—	2.90	—	J
			T_j = 125 °C	—	3.95	—	
			T_j = 150 °C	—	4.15	—	
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 900 A (Note 5) V_{GE} = 0 V	T_j = 25 °C	—	2.35	—	V
			T_j = 125 °C	—	2.90	—	
			T_j = 150 °C	—	3.00	3.50	
t_{rr}	Reverse recovery time (Note 2)	V_{CC} = 2800 V I_E = 900 A V_{GE} = ±15 V $R_{G(on)}$ = 3.6 Ω L_S = 225 nH Inductive load	T_j = 25 °C	—	—	—	μs
			T_j = 125 °C	—	1.60	—	
			T_j = 150 °C	—	1.85	—	
I_{rr}	Reverse recovery current (Note 2)		T_j = 25 °C	—	—	—	A
			T_j = 125 °C	—	1300	—	
			T_j = 150 °C	—	1300	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 2.7)		T_j = 25 °C	—	—	—	μC
			T_j = 125 °C	—	1830	—	
			T_j = 150 °C	—	1870	—	
Q_{rr}	Reverse recovery charge (Note 2)		T_j = 25 °C	—	—	—	μC
			T_j = 125 °C	—	1910	—	
			T_j = 150 °C	—	1930	—	
$E_{rec(10\%)}$	Reverse recovery energy (Note 2,6) per pulse		T_j = 25 °C	—	2.30	—	J
			T_j = 125 °C	—	3.00	—	
			T_j = 150 °C	—	3.10	—	
E_{rec}	Reverse recovery energy (Note 2) per pulse		T_j = 25 °C	—	2.35	—	J
			T_j = 125 °C	—	3.20	—	
			T_j = 150 °C	—	3.25	—	

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
I_{RRM}	Repetitive reverse current (Note 3)	$V_{AK} = V_{RRM}$	T_j = 25 °C	—	—	1.6	mA
			T_j = 125 °C	—	1.6	—	
			T_j = 150 °C	—	—	32	
V_F	Forward voltage (Note 3)	I_F = 900 A (Note 5)	T_j = 25 °C	—	2.35	—	V
			T_j = 125 °C	—	2.90	—	
			T_j = 150 °C	—	3.00	3.50	
t_{rr}	Reverse recovery time (Note 3)	V_{CC} = 2800 V I_F = 900 A $-di_F/dt \cong$ 3000 A/µs @ T_j = 25 °C 2800 A/µs @ T_j = 125 °C 2700 A/µs @ T_j = 150 °C L_S = 225 nH Inductive load	T_j = 25 °C	—	—	—	µs
			T_j = 125 °C	—	1.60	—	
			T_j = 150 °C	—	1.85	—	
I_{rr}	Reverse recovery current (Note 3)		T_j = 25 °C	—	—	—	A
			T_j = 125 °C	—	1300	—	
			T_j = 150 °C	—	1300	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 3.7)		T_j = 25 °C	—	—	—	µC
			T_j = 125 °C	—	1830	—	
			T_j = 150 °C	—	1870	—	
Q_{rr}	Reverse recovery charge (Note 3)		T_j = 25 °C	—	—	—	µC
			T_j = 125 °C	—	1910	—	
			T_j = 150 °C	—	1930	—	
$E_{rec(10\%)}$	Reverse recovery energy (Note 3,6) per pulse		T_j = 25 °C	—	2.30	—	J
			T_j = 125 °C	—	3.00	—	
			T_j = 150 °C	—	3.10	—	
E_{rec}	Reverse recovery energy (Note 3) per pulse		T_j = 25 °C	—	2.35	—	J
			T_j = 125 °C	—	3.20	—	
			T_j = 150 °C	—	3.25	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part	—	—	12.8	K/kW
$R_{th(j-c)D}$	Thermal resistance (Note 2)	Junction to Case, FWDi part	—	—	19.5	K/kW
$R_{th(j-c)D}$	Thermal resistance (Note 3)	Junction to Case, Clamp-Di part	—	—	19.5	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note 2)	Case to heat sink, Switching part λ_{grease} = 1W/m·k, $D_{(c-s)}$ = 80 μm	—	7.5	—	K/kW
$R_{th(c-s)}$	Contact thermal resistance (Note 3)	Case to heat sink, Clamp-Di part λ_{grease} = 1 W/m·K, $D_{(c-s)}$ = 80 μm	—	15.0	—	K/kW

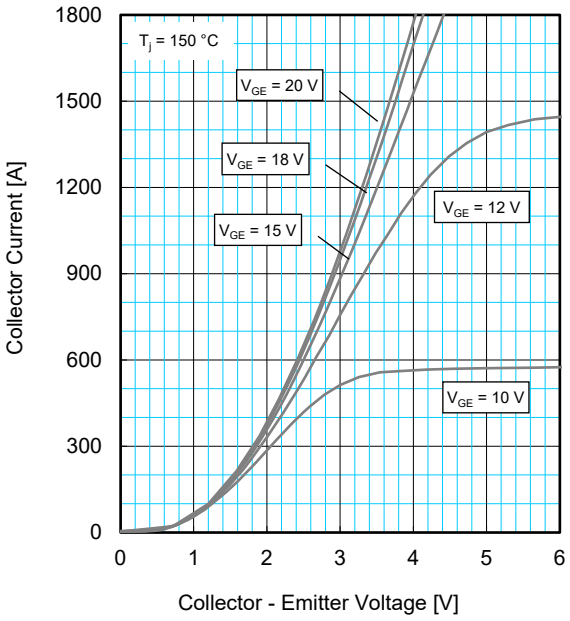
MECHANICAL CHARACTERISTICS

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	1.0	—	3.0	N·m
M	Mass		—	1.5	—	kg
CTI	Comparative tracking index		600	—	—	—
d_a	Clearance		26.0	—	—	mm
d_s	Creepage distance		56.0	—	—	mm
$L_{P(C-E)}$	Internal inductance	Collector to Emitter	—	20.5	—	nH
$L_{P(A-K)}$		Anode to Cathode	—	41.0	—	nH
$R_{CC'+EE'}$	Internal lead resistance	T_C = 25 °C, Collector to Emitter	—	0.18	—	mΩ
$R_{AA'+KK'}$		T_C = 25 °C, Anode to Cathode	—	0.36	—	mΩ

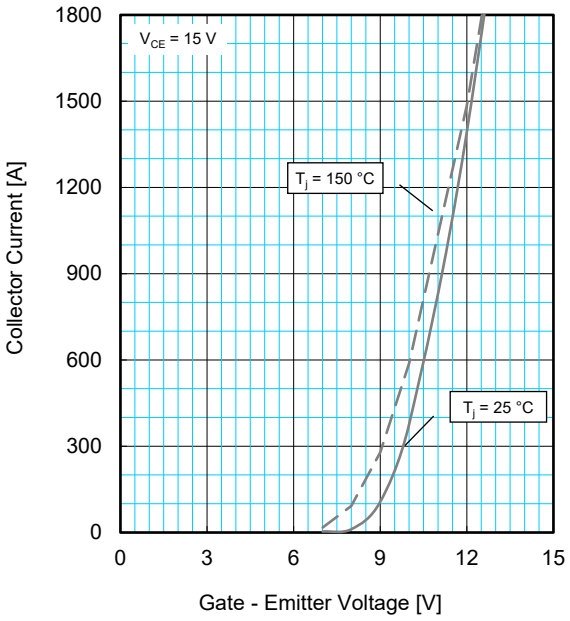
Note 1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jopmax} rating.
Note 2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD_i).
Note 3. The symbols represent characteristics of the clamp diode (Clamp-Di).
Note 4. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).
Note 5. Pulse width and repetition rate should be such as to cause negligible temperature rise.
Note 6. The integration range of switching energies is from 10%V_{CE} to 10%I_C(10%I_E).
Note 7. The integration range of reverse recovery charge is from I_E = 0A to 10%I_E.

PERFORMANCE CURVES

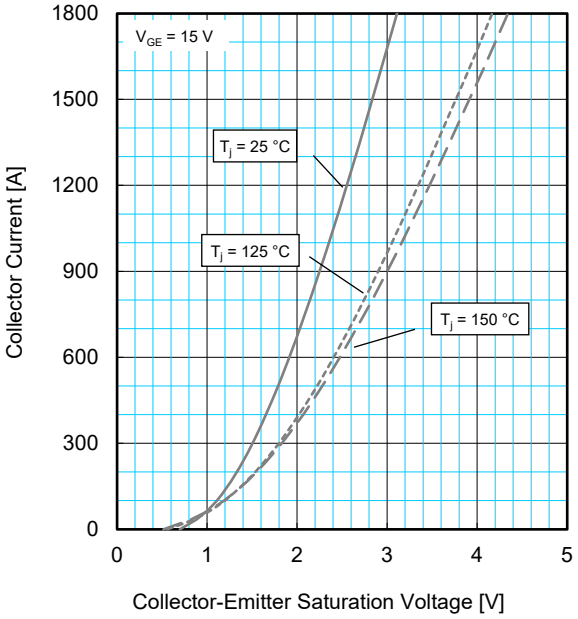
OUTPUT CHARACTERISTICS (TYPICAL)



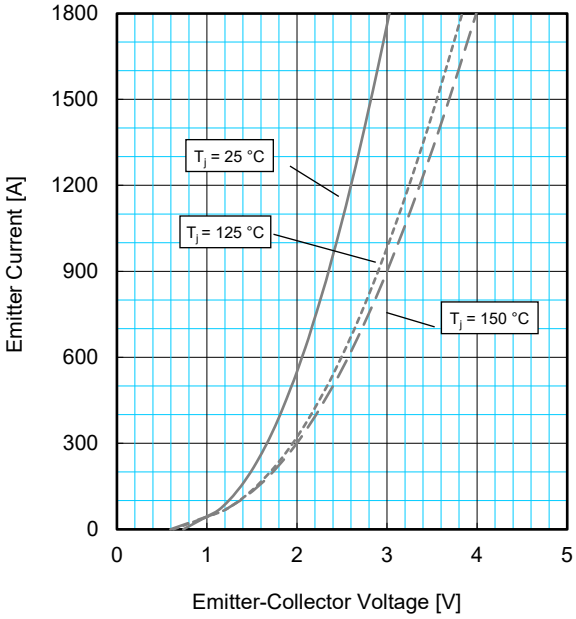
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

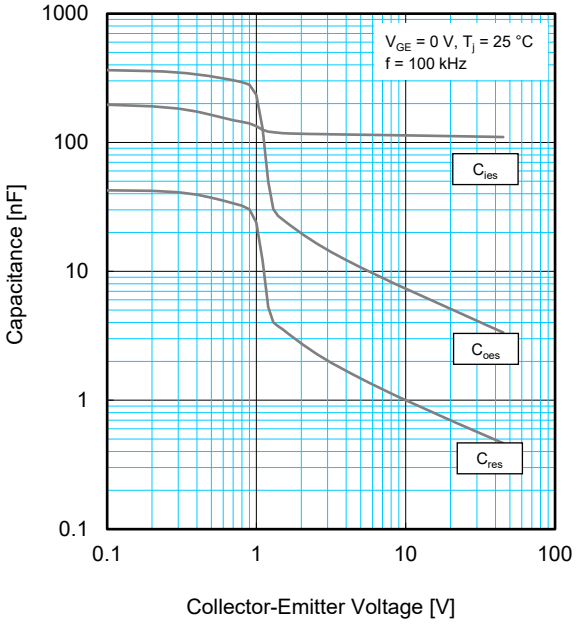


FREE-WHEEL DIODE / CLAMP DIODE FORWARD CHARACTERISTICS (TYPICAL)

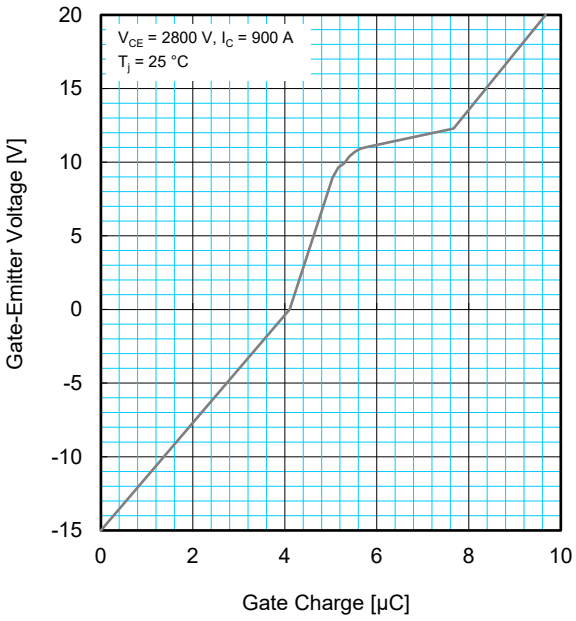


PERFORMANCE CURVES

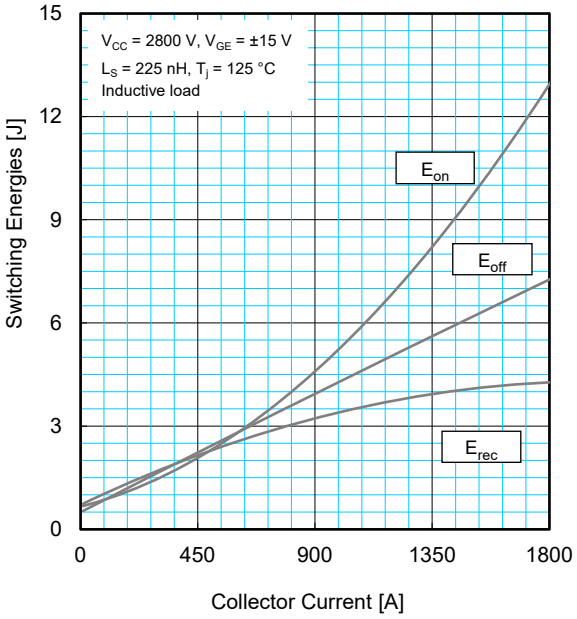
CAPACITANCE CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



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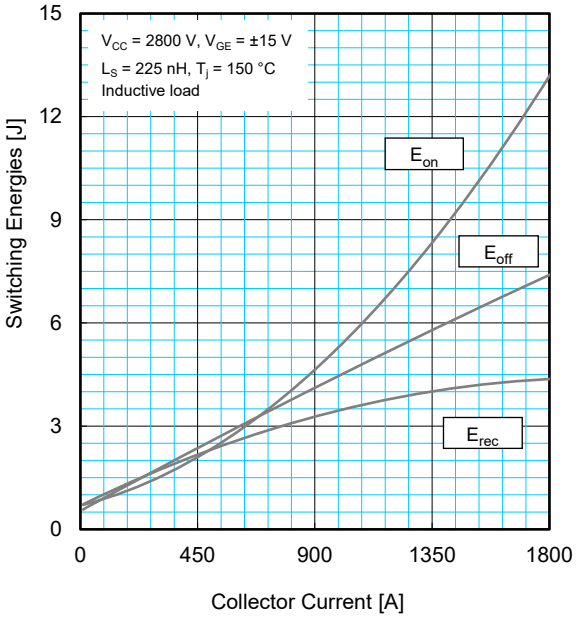
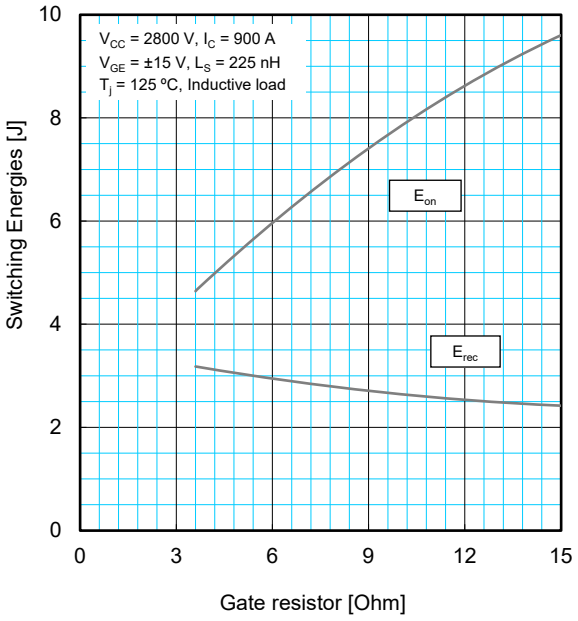
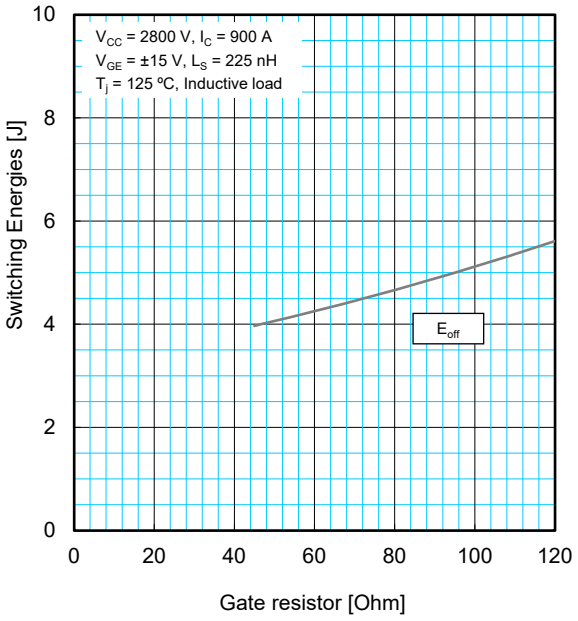


PERFORMANCE CURVES

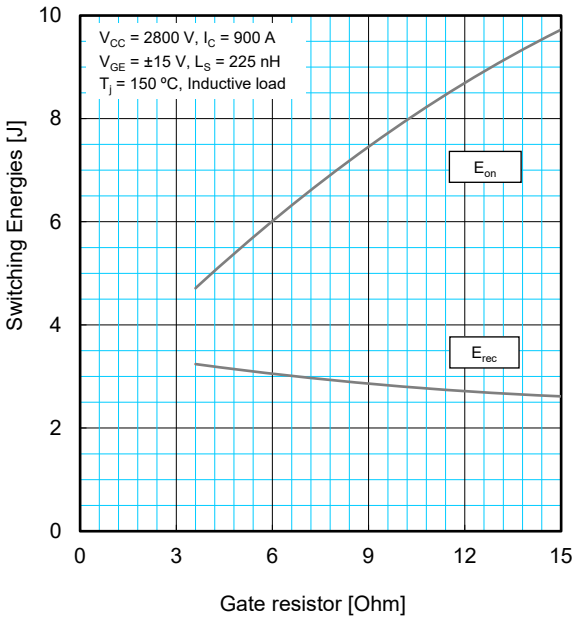
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



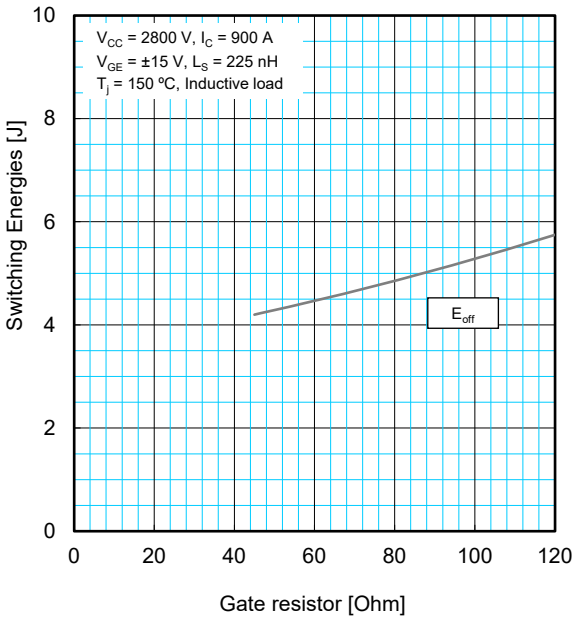
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

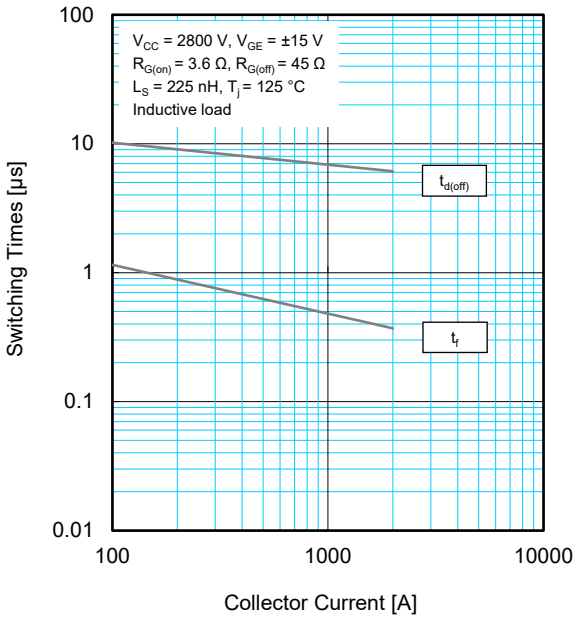


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

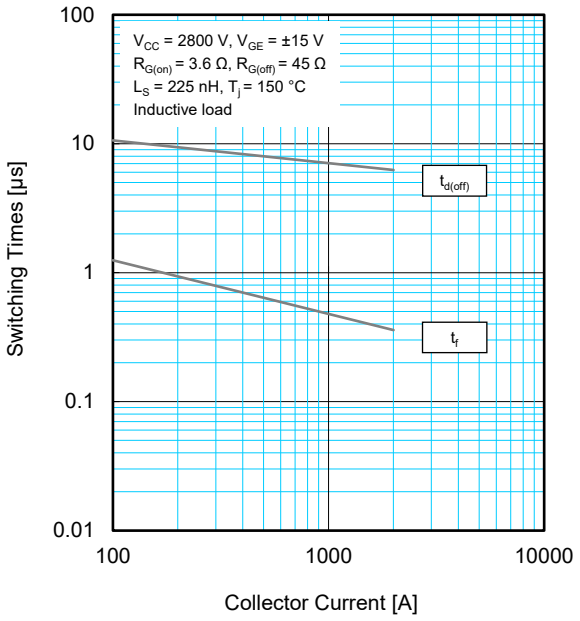


PERFORMANCE CURVES

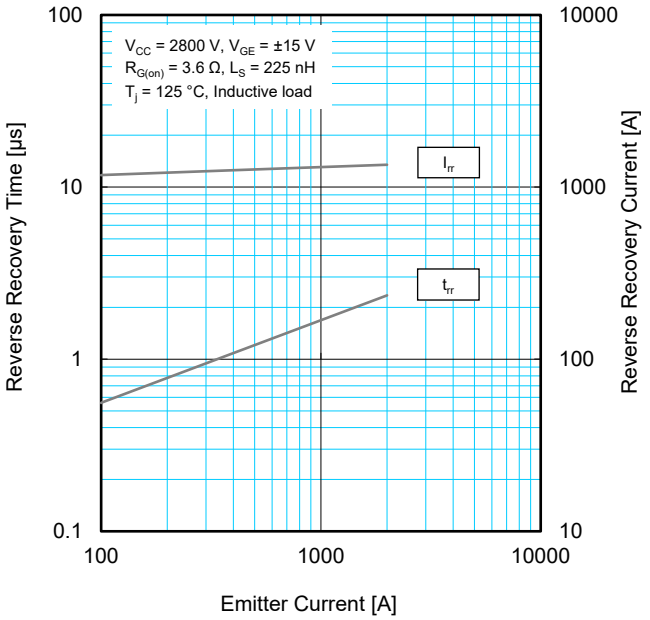
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



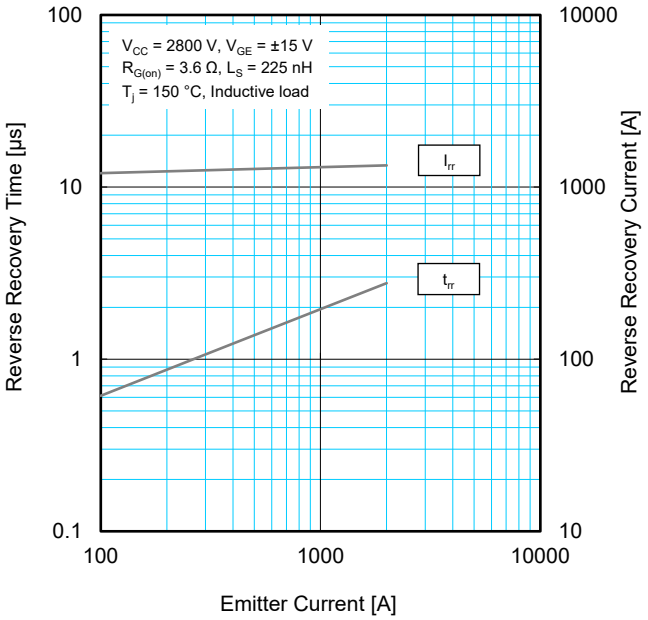
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE / CLAMP DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

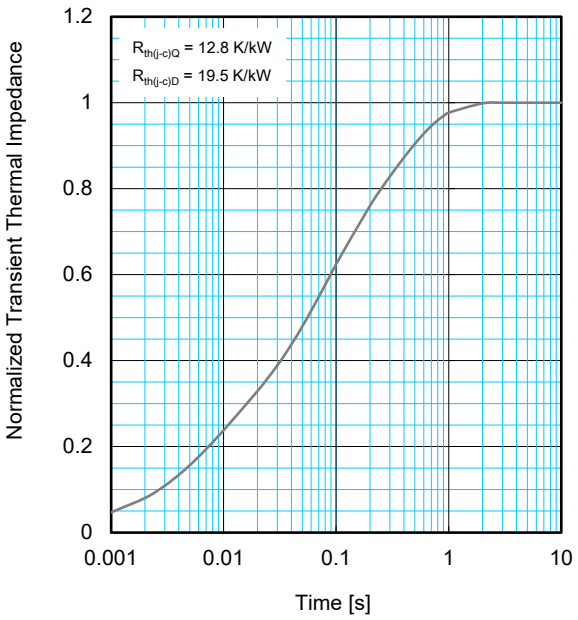


FREE-WHEEL DIODE / CLAMP DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



PERFORMANCE CURVES

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

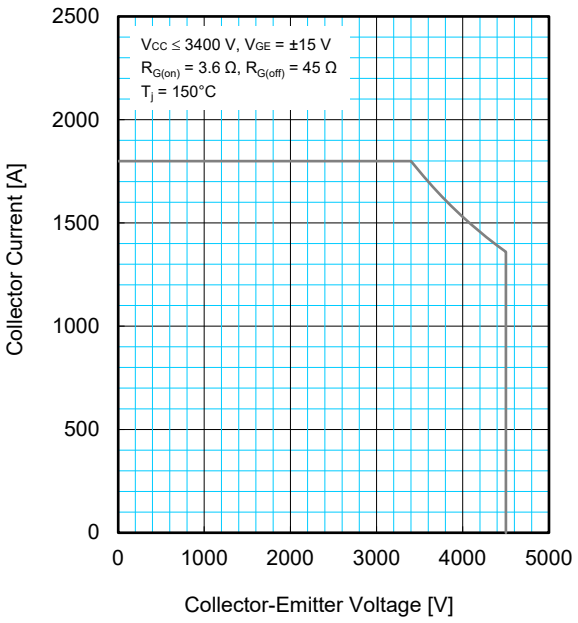


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i} \right) \right\}$$

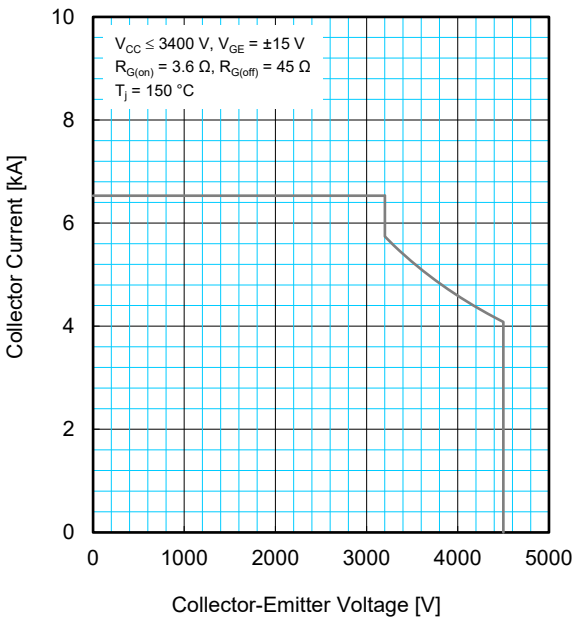
	1	2	3	4
R_i / R_{th} :	0.0096	0.1893	0.4044	0.3967
τ_i [sec.] :	0.0001	0.0058	0.0602	0.3512

PERFORMANCE CURVES

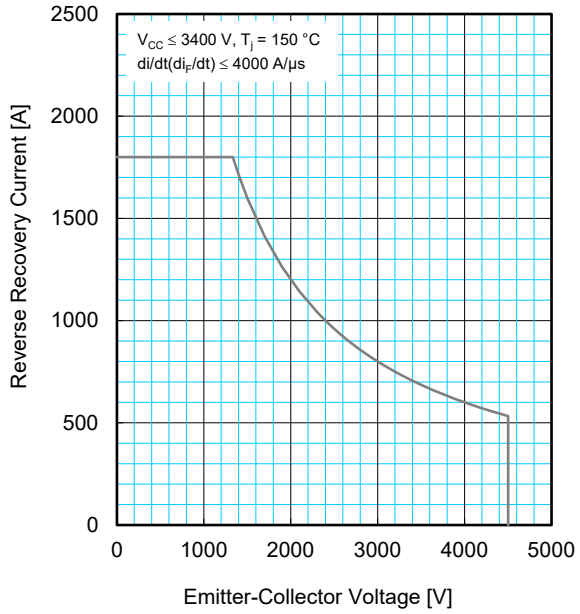
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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Keep safety first in your circuit designs!

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