< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM450DE-66X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

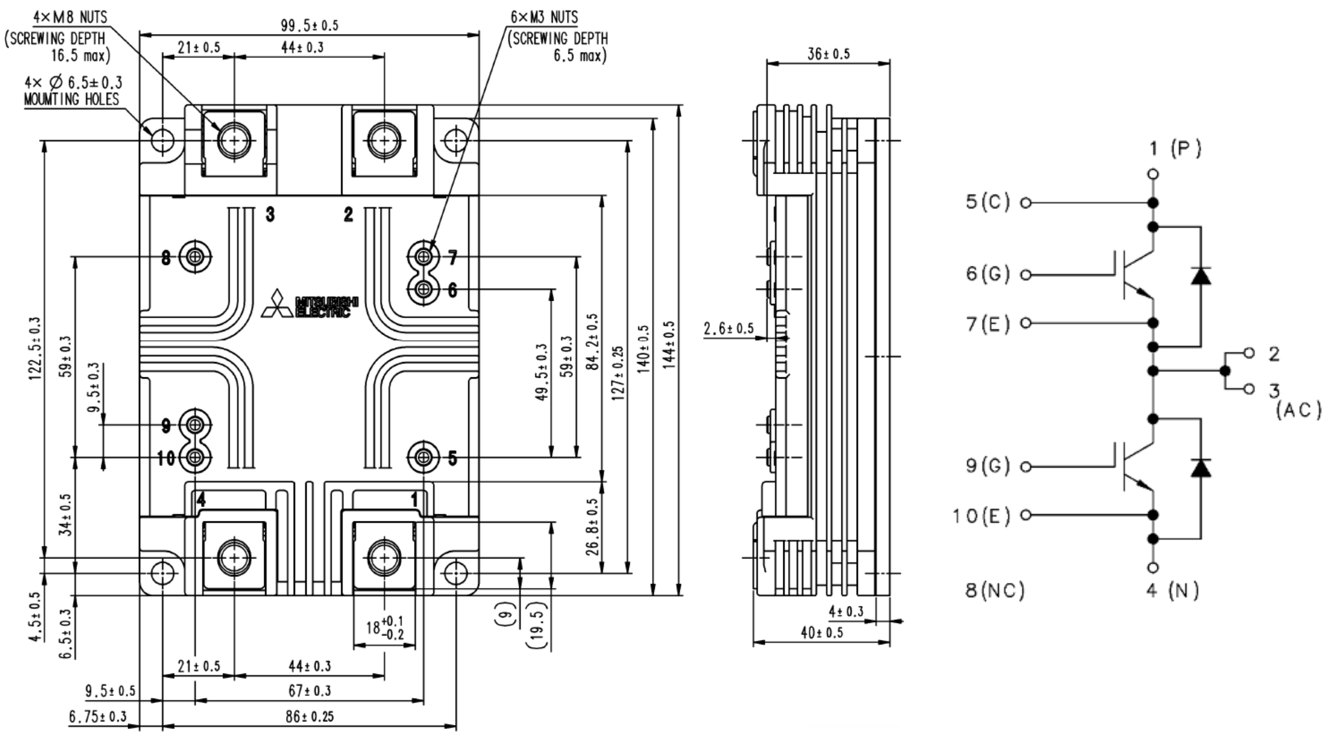
CM450DE-66X

- I_C .... 450 A
- V_{CES} .... 3300 V
- 2-elements in a Pack
- Insulated Type (Al base type)
- CSTBT^{TM}(III) / RFC Diode

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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



MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{CES}	Collector-emitter voltage	V_{GE} = 0V, T_j = -50 °C	3200	V
		V_{GE} = 0V, Tj = -40…+150 °C	3300	
V_{GES}	Gate-emitter voltage	V_{CE} = 0V, T_j = 25 °C	± 20	V
I_C	Collector current	DC, T_c = 114 °C	450	A
I_{CRM}		Pulse (Note 1)	900	
I_E	Emitter current (Note 2)	DC, T_c = 98 °C	450	A
I_{ERM}		Pulse (Note 1)	900	
P_{tot}	Maximum power dissipation	T_c = 25 °C, IGBT part (Note 3)	5000	W
V_{iso}	Isolation voltage	Charged part to the base-plate RMS sinusoidal, 60 Hz 1 min., T_c = 25 °C	10200	V
Q_{PD}	Partial discharge	Charged part to the base-plate V1 = 6900 Vrms, V2 = 5100 Vrms AC 60 Hz, T_c = 25 °C (acc. to IEC 61287-1)	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} ≤ 2400 V, V_{GE} = ±15 V $R_{G(on)}$ = 2.7 Ω, $R_{G(off)}$ = 62 Ω T_j = T_{jop}, C_{GE} = 33 nF, L_S = 85 nH	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	—	—	1.5	mA
			T_j = 125 °C	—	1.5	—	
			T_j = 150 °C	—	15.0	—	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE} = 10 V, I_C = 45 mA, T_j = 25 °C		6.5	7.0	7.5	V
I_{GES}	Gate leakage current	V_{GE} = V_{GES}, V_{CE} = 0 V, T_j = 25 °C		-0.5	—	0.5	μA
V_{CEsat}	Collector-emitter saturation voltage	I_C = 450 A V_{GE} = 15 V (Note 4)	T_j = 25 °C	—	2.20	—	V
			T_j = 125 °C	—	2.65	—	
			T_j = 150 °C	—	2.75	3.15	
C_{ies}	Input capacitance	V_{CE} = 10 V, V_{GE} = 0 V f = 100 kHz, T_j = 25 °C		—	44.5	—	nF
C_{oes}	Output capacitance			—	3.1	—	
C_{res}	Reverse transfer capacitance			—	0.4	—	
Q_G	Total gate charge	V_{CC} = 1800 V, I_C = 450 A V_{GE} = ±15 V, T_j = 25 °C		—	3.0	—	μC
$t_{d(on)}$	Turn-on delay time	V_{CC} = 1800 V I_C = 450 A V_{GE} = ±15 V $R_{G(on)}$ = 2.7 Ω C_{GE} = 33 nF L_S = 85 nH Inductive load	T_j = 150 °C	—	—	1.25	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	—	0.74	—	J
			T_j = 125 °C	—	0.89	—	
			T_j = 150 °C	—	0.90	—	
E_{on}	Turn-on switching energy per pulse		T_j = 25 °C	—	0.79	—	J
			T_j = 125 °C	—	0.95	—	
			T_j = 150 °C	—	0.96	—	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 1800 V I_C = 450 A V_{GE} = ±15 V $R_{G(off)}$ = 62 Ω C_{GE} = 33 nF L_S = 85 nH Inductive load	T_j = 25 °C	—	3.40	—	μs
			T_j = 125 °C	—	3.60	—	
			T_j = 150 °C	—	3.65	5.00	
t_f	Fall time		T_j = 25 °C	—	0.24	—	μs
			T_j = 125 °C	—	0.35	—	
			T_j = 150 °C	—	0.37	1.00	
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)		T_j = 25 °C	—	0.55	—	J
			T_j = 125 °C	—	0.74	—	
			T_j = 150 °C	—	0.75	—	
E_{off}	Turn-off switching energy per pulse		T_j = 25 °C	—	0.62	—	J
			T_j = 125 °C	—	0.84	—	
			T_j = 150 °C	—	0.85	—	

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits Min.	Limits Typ.	Limits Max.	Unit
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 450 A, V_{GE} = 0 V (Note 4)	T_j = 25°C	—	2.00	—	V
			T_j = 125°C	—	2.20	—	
			T_j = 150°C	—	2.30	2.80	
t_{rr}	Reverse recovery time (Note 2)	V_{CC} = 1800 V, I_C = 450 A, V_{GE} = ±15 V, $R_{G(on)}$ = 2.7 Ω, C_{GE} = 33 nF, L_s = 85 nH, Inductive load	T_j = 25°C	—	0.65	—	μs
			T_j = 125°C	—	0.80	—	
			T_j = 150°C	—	0.85	—	
I_{rr}	Reverse recovery current (Note 2)		T_j = 25°C	—	720	—	A
			T_j = 125°C	—	690	—	
			T_j = 150°C	—	680	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 2, 6)		T_j = 25°C	—	450	—	μC
			T_j = 125°C	—	555	—	
			T_j = 150°C	—	585	—	
Q_{rr}	Reverse recovery charge (Note 2)		T_j = 25°C	—	490	—	μC
			T_j = 125°C	—	605	—	
			T_j = 150°C	—	635	—	
$E_{rec(10\%)}$	Reverse recovery energy per pulse (Note 2, 5)		T_j = 25°C	—	0.46	—	J
			T_j = 125°C	—	0.62	—	
			T_j = 150°C	—	0.64	—	
E_{rec}	Reverse recovery energy per pulse (Note 2)		T_j = 25°C	—	0.53	—	J
			T_j = 125°C	—	0.71	—	
			T_j = 150°C	—	0.73	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits Min.	Limits Typ.	Limits Max.	Unit
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part, 1/2 module	—	—	25.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part, 1/2 module	—	—	41.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, 1/2 module λ_{grease} = 1 W/m·K, $D_{(c-s)}$ = 70 μm	—	16.0	—	K/kW

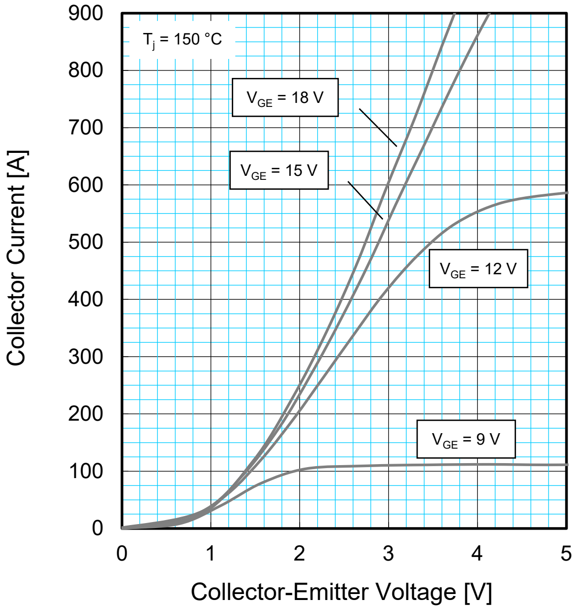
MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits Min.	Limits Typ.	Limits Max.	Unit
M_t	Mounting torque	Main terminals screw: M8	7.0	—	14.0	N·m
M_s		Mounting screw: M6	3.0	—	6.0	N·m
M_t		Auxiliary terminals screw: M3	0.4	—	0.8	N·m
m	Mass	—	—	0.75	—	kg
CTI	Comparative tracking index	—	600	—	—	—
d_a	Clearance	—	26.0	—	—	mm
d_s	Creepage distance	—	56.0	—	—	mm
$L_{P\ P\text{-}N}$	Parasitic stray inductance	Between P-side terminal and N-side terminal	—	40	—	nH
$R_{CC'+EE'}$	Internal lead resistance	T_c = 25 °C, 1/2 module	—	0.59	—	mΩ

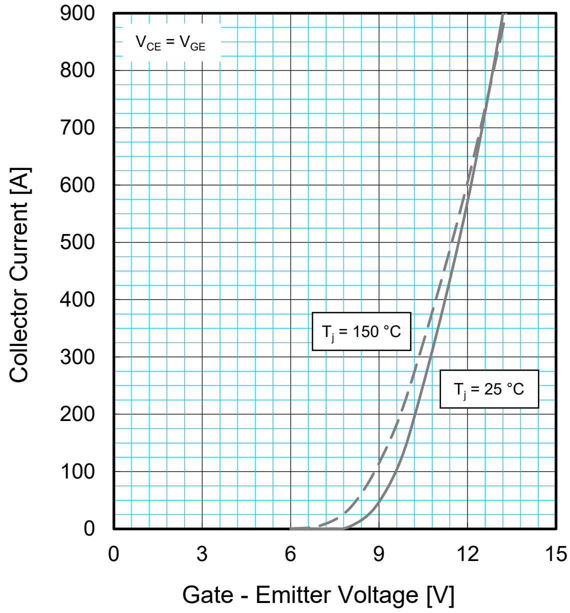
Note1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed maximum T_{jop} rating (150°C).
Note2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWDi).
Note3. Junction temperature (T_j) should not exceed T_{jmax} 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(I_E).
Note6. The integration range of reverse recovery charge is from I_E=0A to 10%I_E

PERFORMANCE CURVES

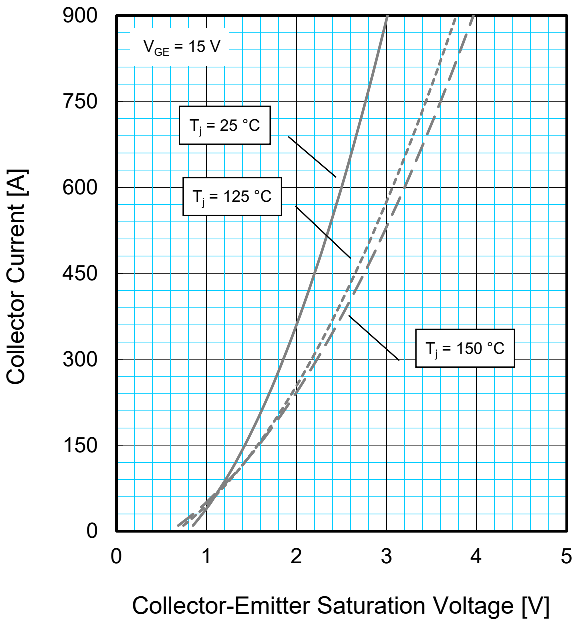
OUTPUT CHARACTERISTICS (TYPICAL)



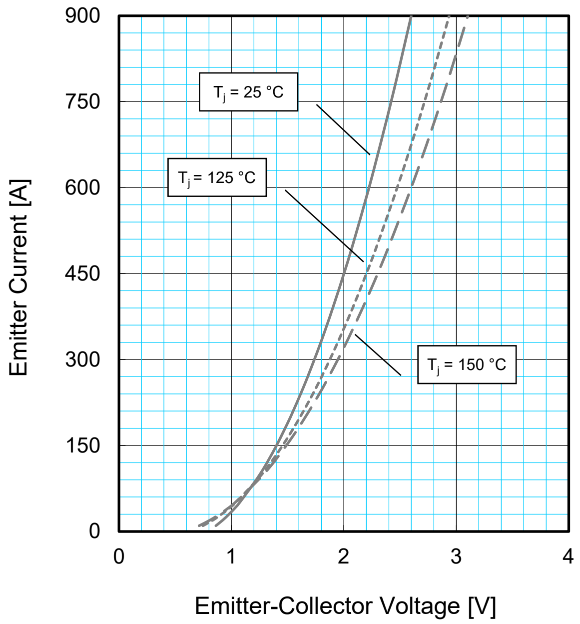
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

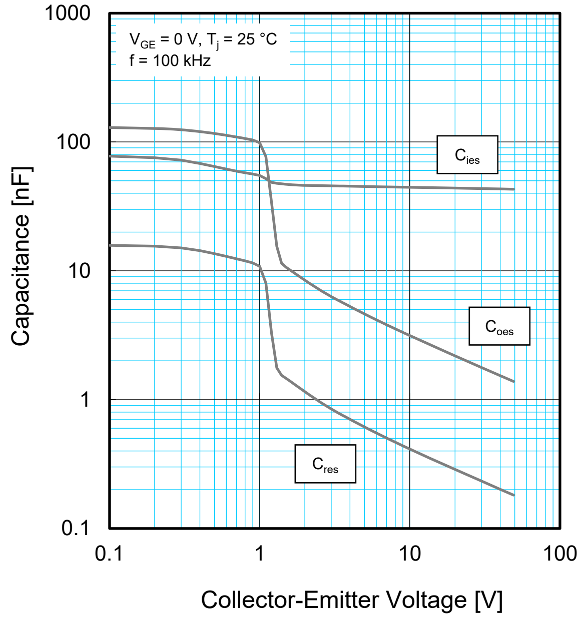


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

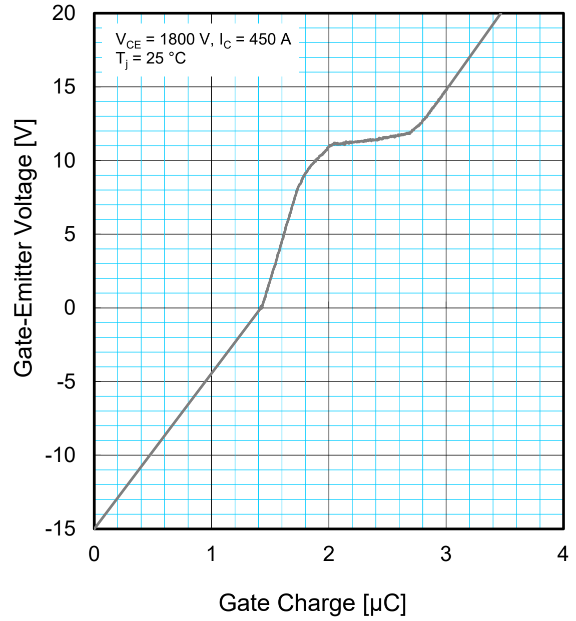


PERFORMANCE CURVES

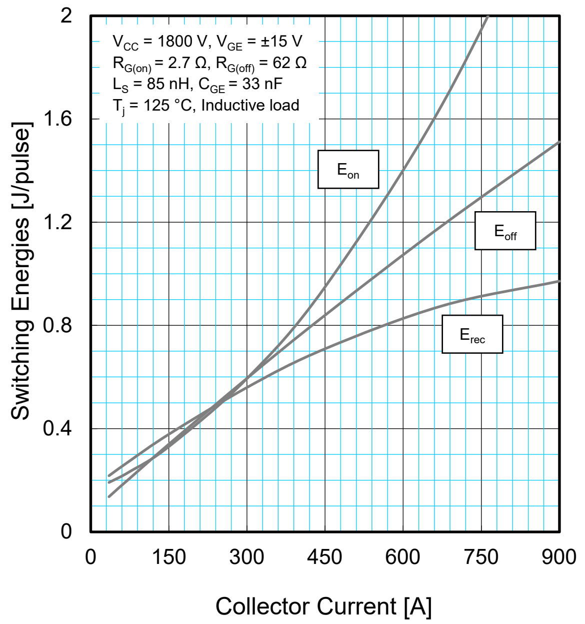
CAPACITANCE CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



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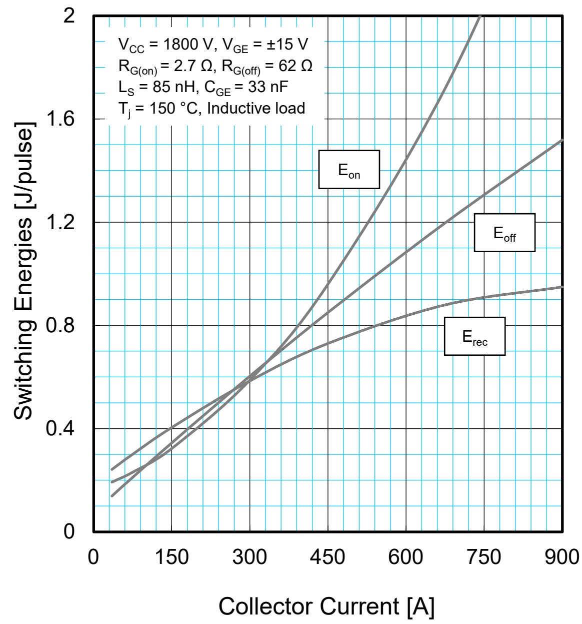

PERFORMANCE CURVES

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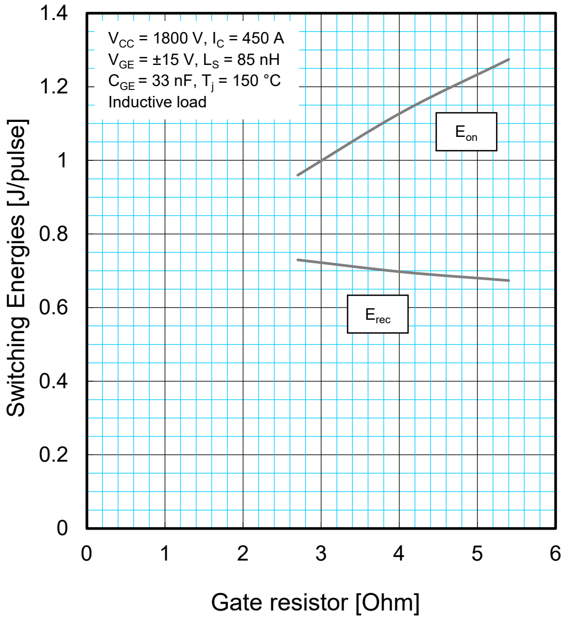

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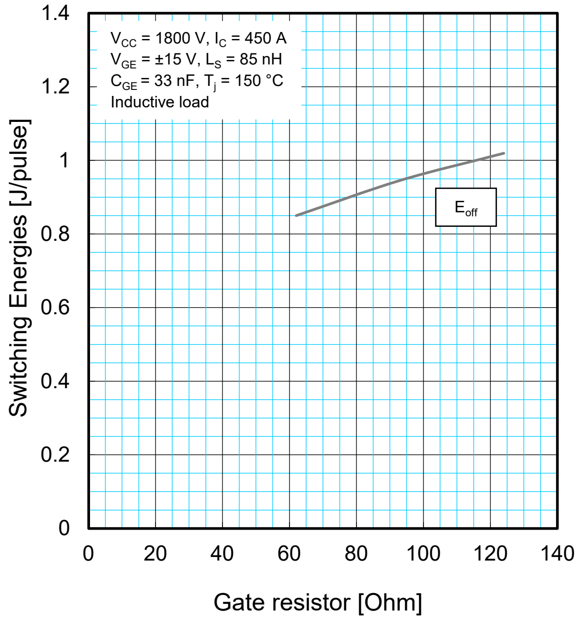
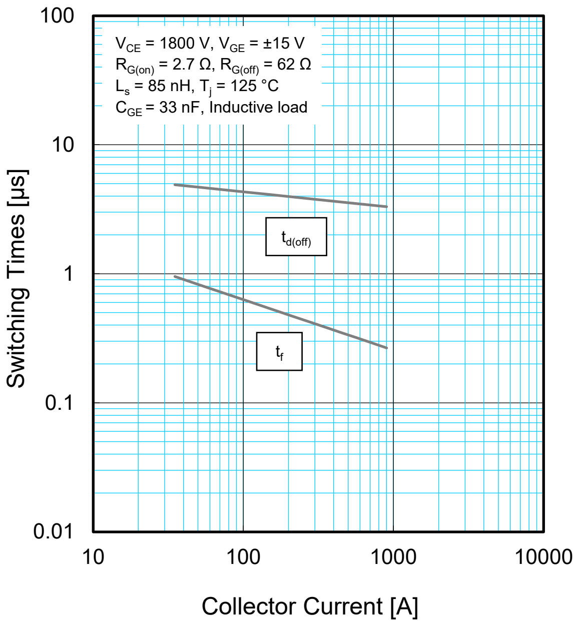
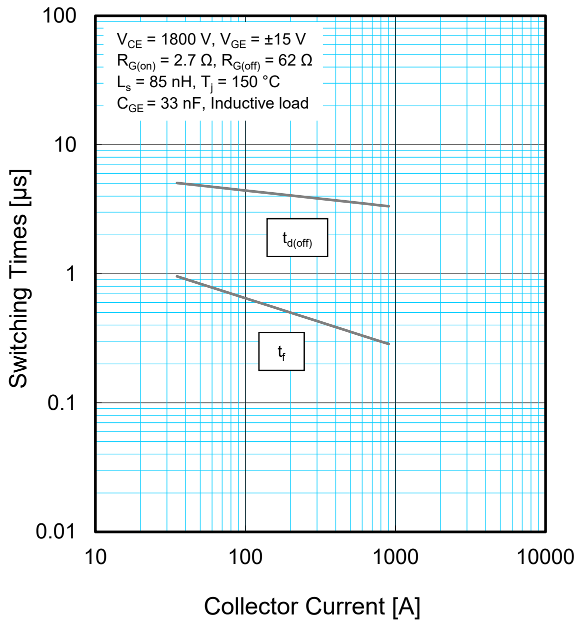


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

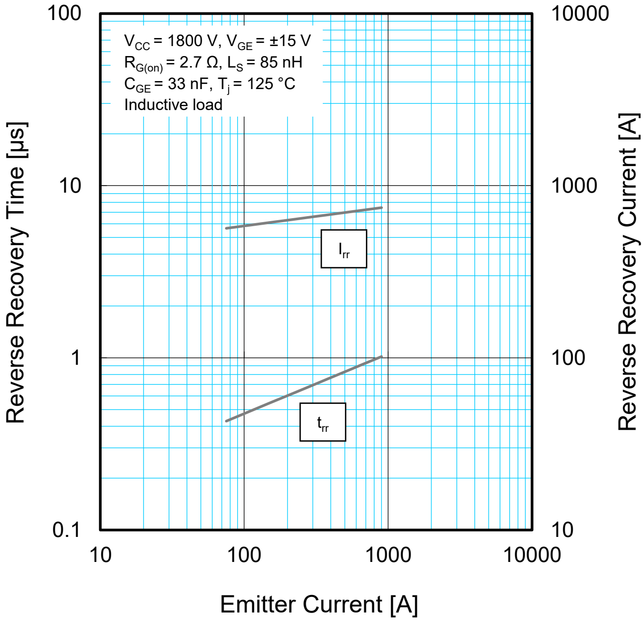


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

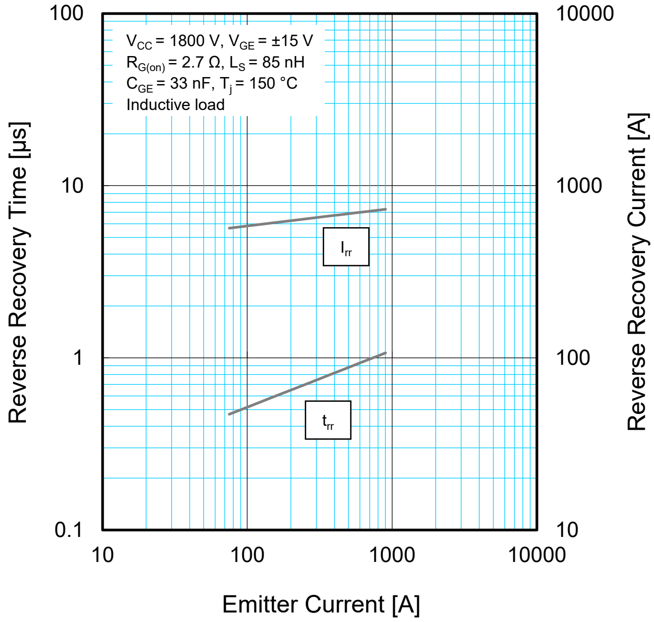


PERFORMANCE CURVES

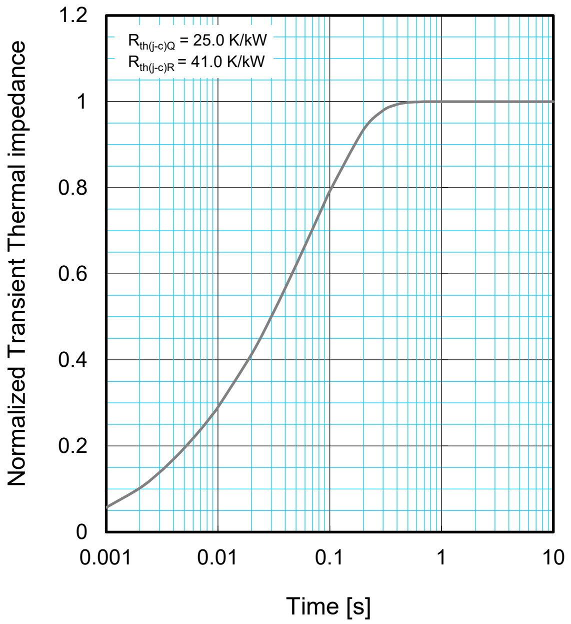
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

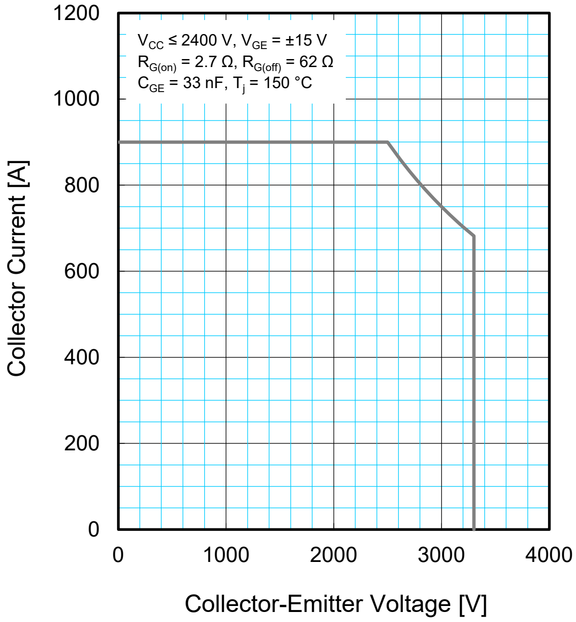


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{1 - exp^{\left(-\frac{t}{\tau_i}\right)}\right\}$$

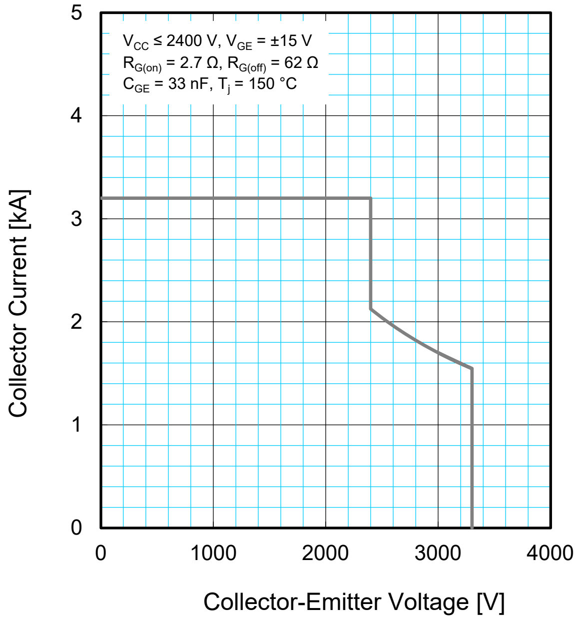
	1	2	3	4
R_i / $R_{th(j-c)}$	0.0292	0.0832	0.2277	0.6599
τ_i [s]	0.0025	0.0027	0.0155	0.0865

PERFORMANCE CURVES

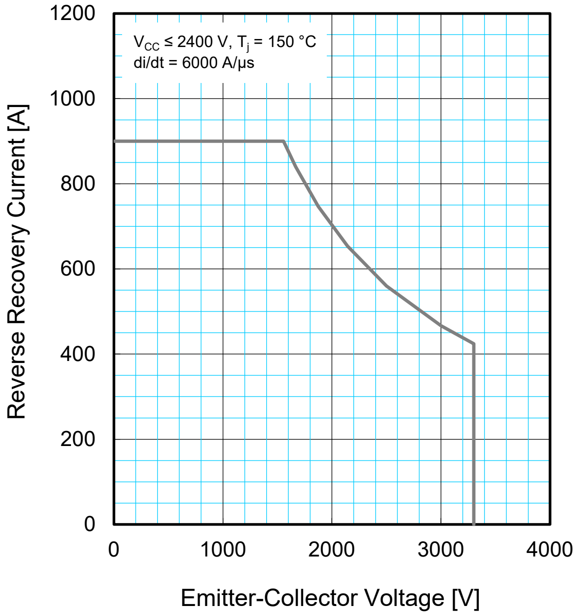
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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