MITSUBISHI ELECTRIC

< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

CM450DA-66X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

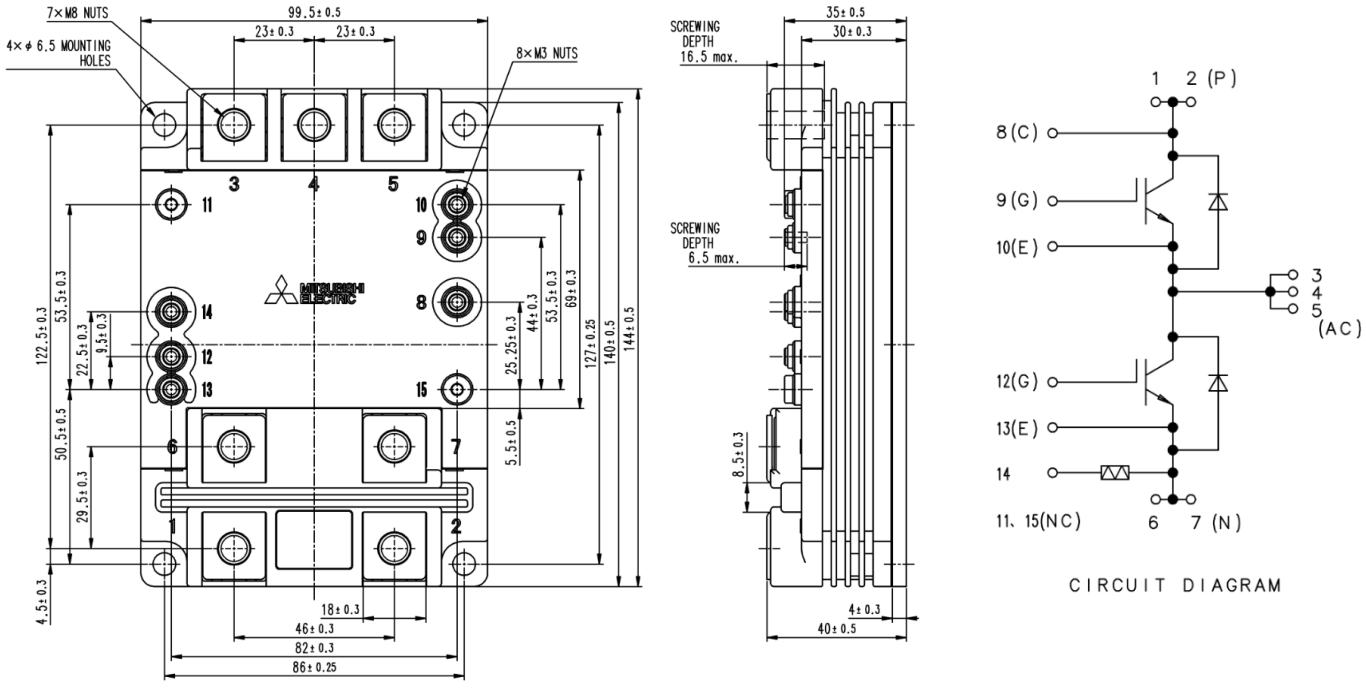
CM450DA-66X

- I_C 450A
- V_{CES} 3300V
- 2-elements in a Pack
- Insulated Type
- Al baseplate
- CSTBT™(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 = -40…+150°C	3300	V
		V_{GE} = 0V, T_j = −50°C	3200	
V_{GES}	Gate-emitter voltage	V_{CE} = 0V, T_j = 25°C	± 20	V
I_C	Collector current	DC, T_c = 110°C	450	A
I_{CRM}		Pulse (Note 1)	900	A
I_E	Emitter current (Note 2)	DC, T_c = 95°C	450	A
I_{ERM}		Pulse (Note 1)	900	A
P_{tot}	Maximum power dissipation (Note 3)	T_c = 25°C, IGBT part	4500	W
V_{iso}	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1 min., T_C = 25°C	6000	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, f = 60Hz, Q_{PD} ≤ 10 pC., T_C = 25°C	2600	V
T_j	Junction temperature		−50 ~ +150	°C
T_{jop}	Operating junction temperature		−50 ~ +150	°C
T_{stg}	Storage temperature		−55 ~ +125	°C
t_{psc}	Short circuit pulse width	V_{CC} = 2400V, V_{CE} ≤ V_{CES}, V_{GE} =15V, T_j =150°C $R_{g(on)}$ = 2.7Ω, $R_{g(off)}$ = 62Ω, C_{GE}=33nF	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	—	—	2.0	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} = 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		—	44.5	—	nF
C_{oes}	Output capacitance			—	3.1	—	nF
C_{res}	Reverse transfer capacitance			—	0.4	—	nF
Q_G	Total gate charge	V_{CC} = 1800V, I_C = 450A, V_{GE} = ±15V		—	3.0	—	µC
V_{CEsat}	Collector-emitter saturation voltage	I_C = 450 A (Note 4) V_{GE} = 15 V	T_j = 25°C	—	2.20	—	V
			T_j = 125°C	—	2.65	3.05	
			T_j = 150°C	—	2.75	3.15	
$t_{d(on)}$	Turn-on delay time	V_{CC} = 1800 V I_C = 450 A V_{GE} = ±15 V $R_{G(on)}$ = 2.7 Ω L_s = 65nH Inductive load C_{GE} = 33nF	T_j = 125°C	—	—	1.25	µs
			T_j = 150°C	—	—	1.25	
t_r	Rise time		T_j = 125°C	—	—	0.50	µs
			T_j = 150°C	—	—	0.50	
$E_{on(10\%)}$	Turn-on switching energy per pulse (Note 5)		T_j = 25°C	—	0.57	—	J
			T_j = 125°C	—	0.69	—	
			T_j = 150°C	—	0.70	—	
E_{on}	Turn-on switching energy per pulse (Note 6)		T_j = 25°C	—	0.62	—	J
			T_j = 125°C	—	0.74	—	
			T_j = 150°C	—	0.75	—	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 1800 V I_C = 450 A V_{GE} = ±15 V $R_{G(off)}$ = 62 Ω L_s = 65nH Inductive load C_{GE} = 33nF	T_j = 25°C	—	2.75	—	µs
			T_j = 125°C	—	3.10	5.00	
			T_j = 150°C	—	3.20	5.00	
t_f	Fall time		T_j = 25°C	—	0.23	—	µs
			T_j = 125°C	—	0.33	1.00	
			T_j = 150°C	—	0.35	1.00	
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)		T_j = 25°C	—	0.50	—	J
			T_j = 125°C	—	0.67	—	
			T_j = 150°C	—	0.69	—	
E_{off}	Turn-off switching energy per pulse (Note 6)		T_j = 25°C	—	0.57	—	J
			T_j = 125°C	—	0.76	—	
			T_j = 150°C	—	0.78	—	

ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 450 A (Note 4) V_{GE} = 0 V	T_j = 25°C	—	2.00	—	V
			T_j = 125°C	—	2.20	2.70	
			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 $R_{G(on)}$ = 2.7Ω L_s = 65 nH Inductive load C_{GE} = 33nF	T_j = 25°C	—	0.55	—	μs
			T_j = 125°C	—	0.65	—	
			T_j = 150°C	—	0.70	—	
I_{rr}	Reverse recovery current (Note 2)		T_j = 25°C	—	920	—	A
			T_j = 125°C	—	850	—	
			T_j = 150°C	—	840	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 2,7)		T_j = 25°C	—	465	—	μC
			T_j = 125°C	—	555	—	
			T_j = 150°C	—	580	—	
Q_{rr}	Reverse recovery charge (Note 2,6)		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	—	0.50	—	J
			T_j = 125°C	—	0.66	—	
			T_j = 150°C	—	0.68	—	
E_{rec}	Reverse recovery energy per pulse (Note 2,6)		T_j = 25°C	—	0.56	—	J
			T_j = 125°C	—	0.75	—	
			T_j = 150°C	—	0.77	—	

THERMAL CHARACTERISTICS

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

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
R_{25}	Zero-power resistance	T_c=25°C	-	5.00	-	kΩ
$B_{(25/50)}$	B-constant (Note 8)	Approximate by equation	-	3375	-	K

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
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	Between terminals and baseplate	19.5	—	—	mm
d_s	Creepage distance	Between terminals and baseplate	32.0	—	—	mm
$L_{P\ P\text{-}N}$	Parasitic stray inductance	Between terminal 1, 2 and terminal 6,7	—	10.0	—	nH
$R_{CC'+EE'}$	Internal lead resistance	T_C = 25 °C, 1/2 module	—	0.46	—	mΩ
r_g	Internal gate resistance	T_C = 25 °C	—	1.0	—	Ω

Note1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jopmax} rating.

2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD_i).

3. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).

4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

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

6. Definition of all items is according to IEC 60747, unless otherwise specified.

7. The integration range of reverse recovery charge is from I_E = 0A to 10%I_E.

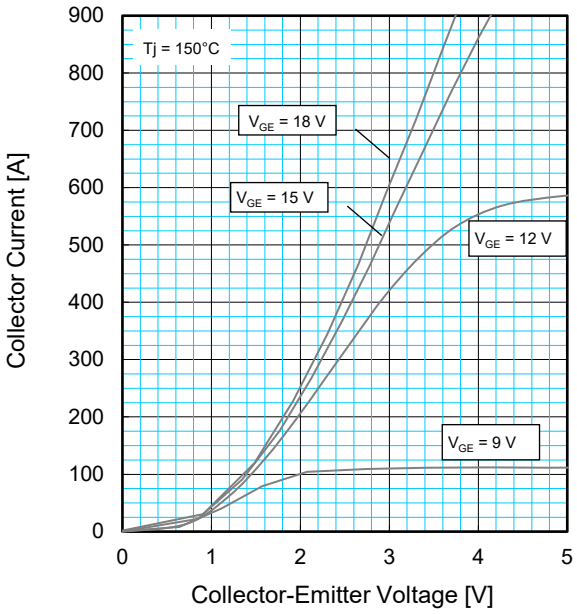
8. $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

R_{25}: resistance at absolute temperature T_{25} [K]; T_{25} = 25[°C] + 273.15 = 298.15[K]

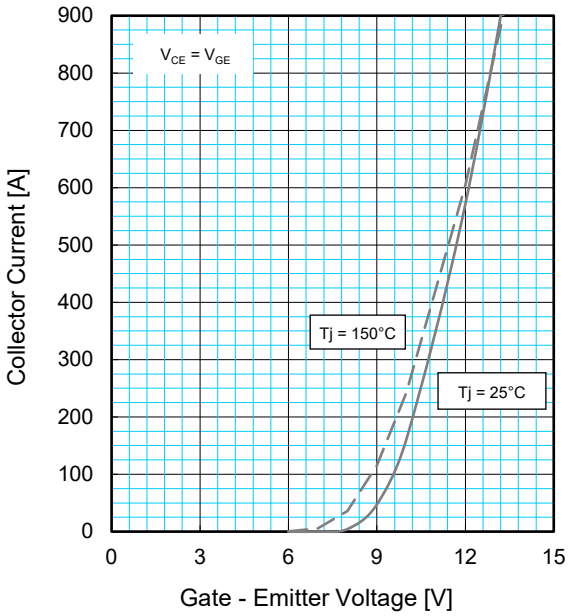
R_{50}: resistance at absolute temperature T_{25} [K]; T_{50} = 50[°C] + 273.15 = 323.15[K]

PERFORMANCE CURVES

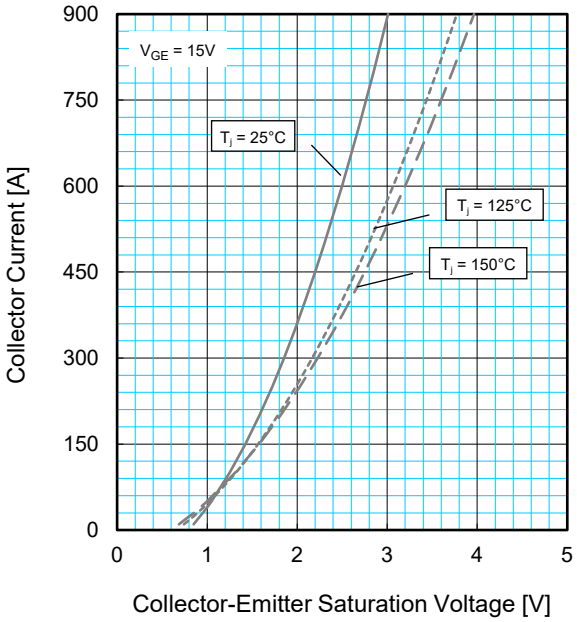
OUTPUT CHARACTERISTICS (TYPICAL)



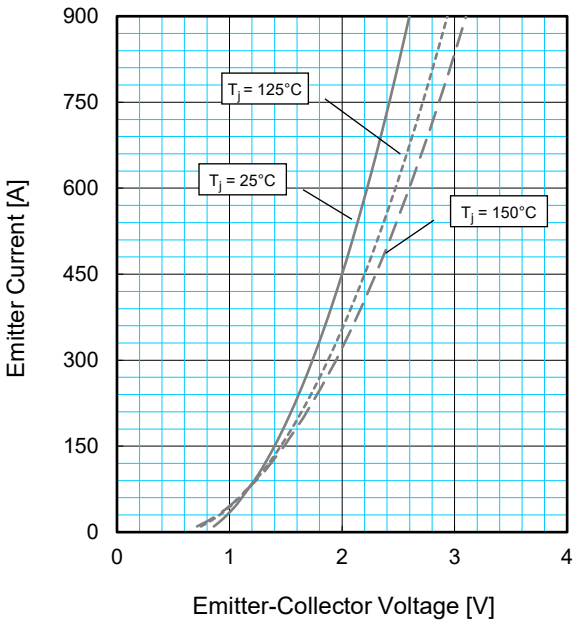
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

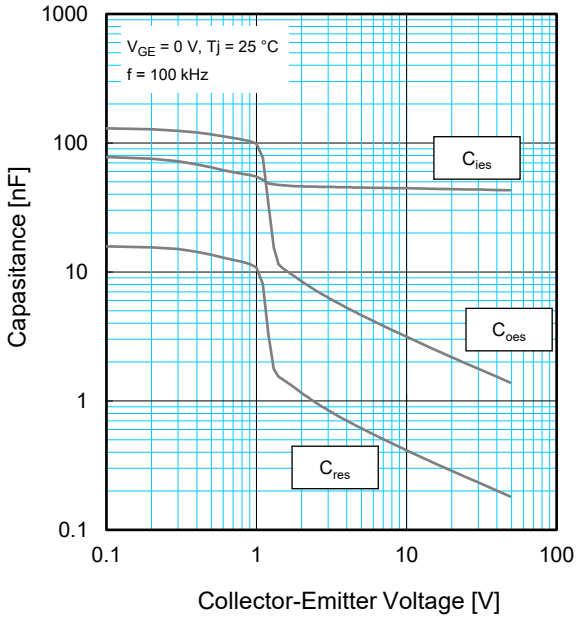


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

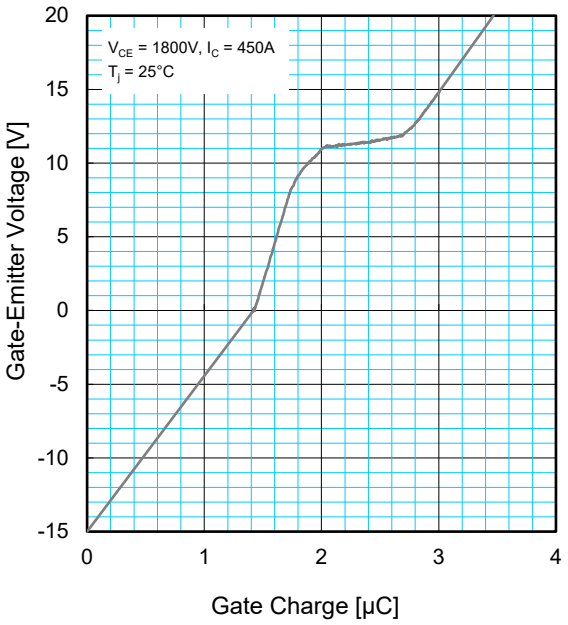


PERFORMANCE CURVES

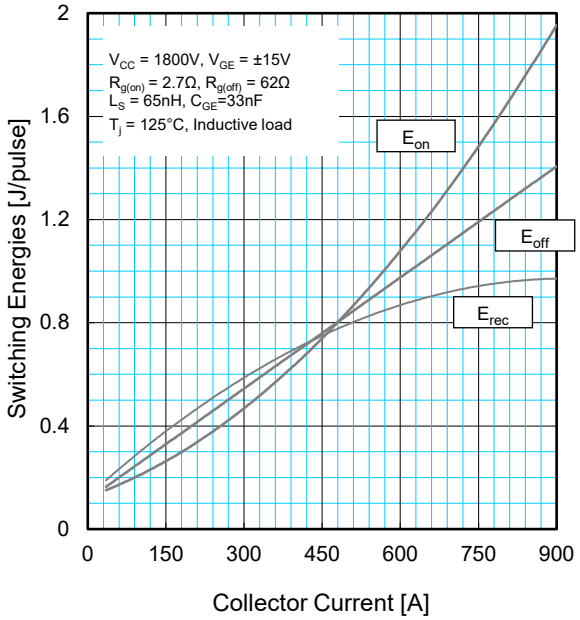
CAPACITANCE CHARACTERISTICS (TYPICAL)



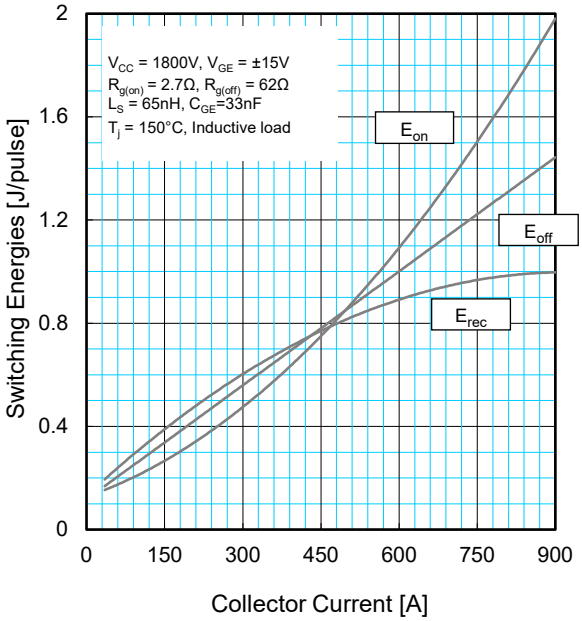
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

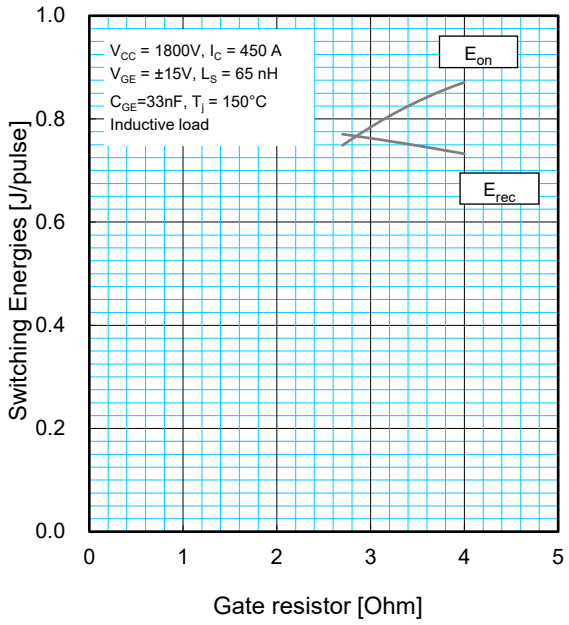


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

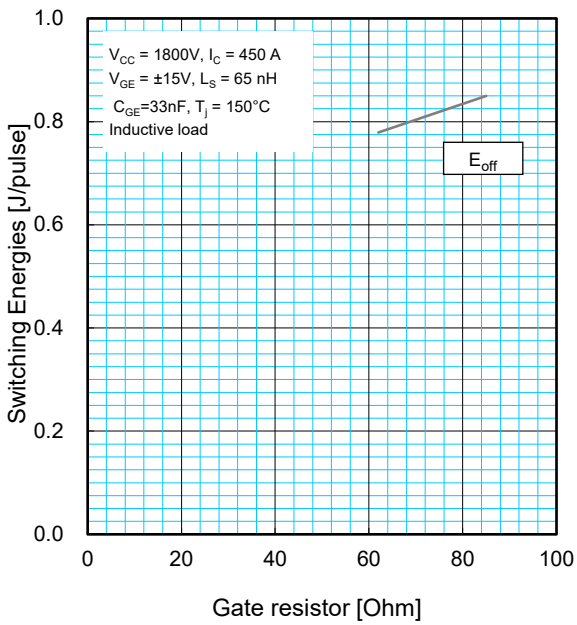


PERFORMANCE CURVES

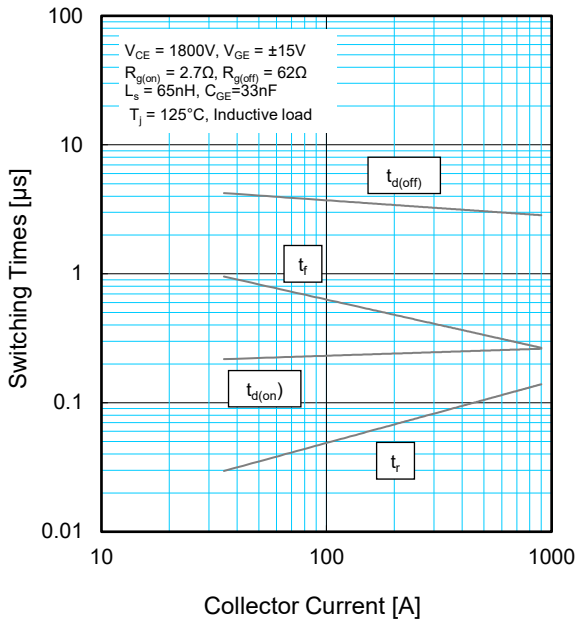
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



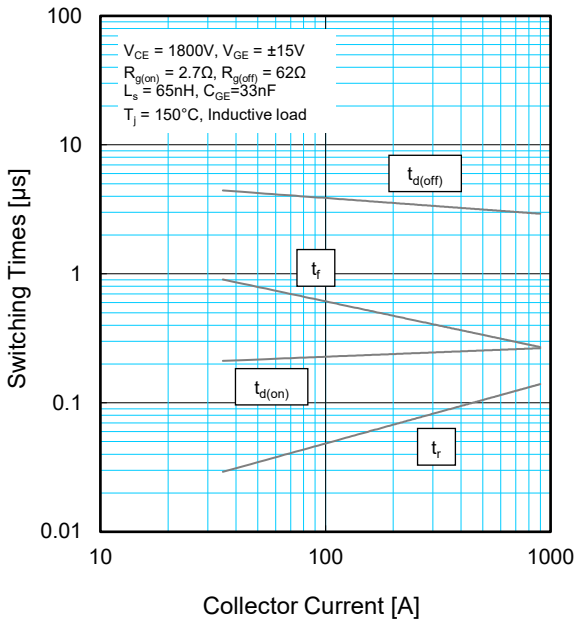
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

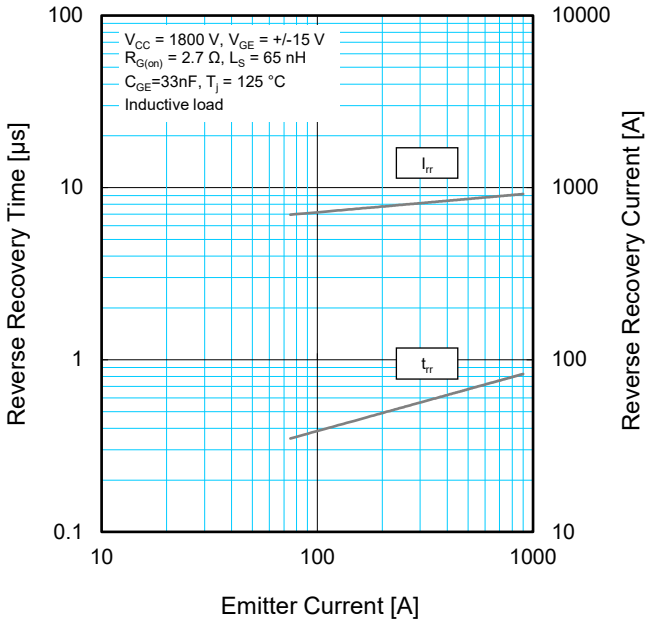


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

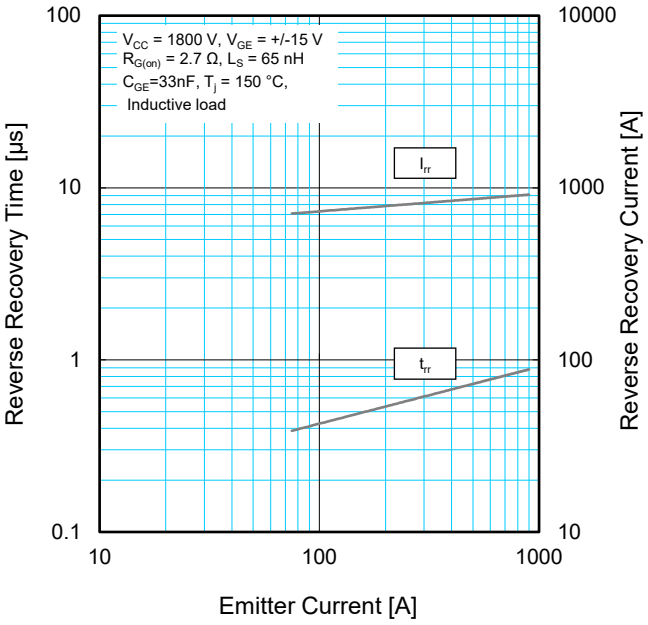


PERFORMANCE CURVES

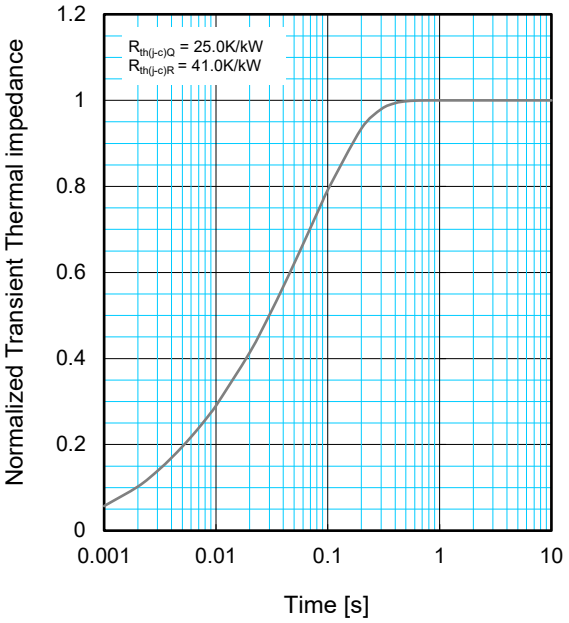
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

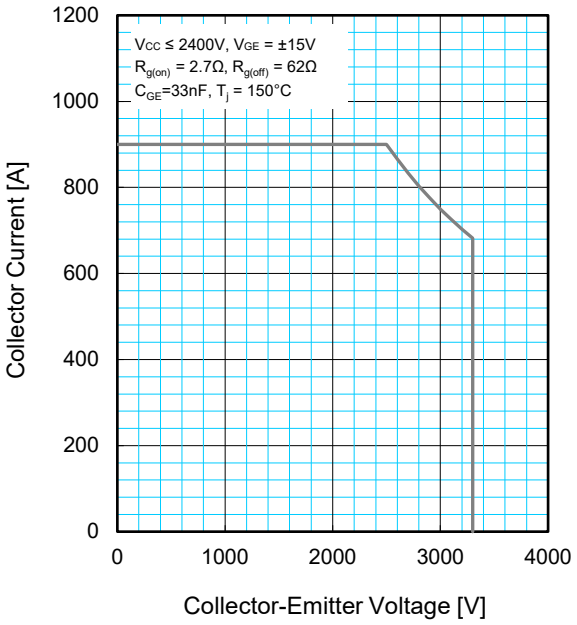


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{ 1 - exp^{\left(-\frac{t}{\tau_i}\right)} \right\}$$

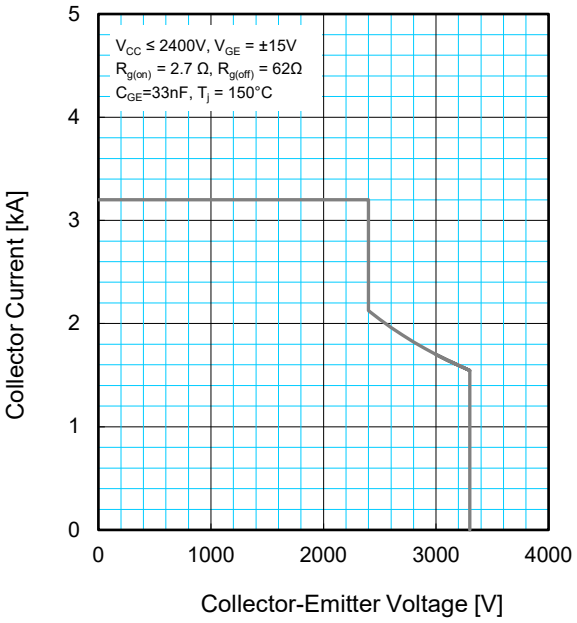
	1	2	3	4
R_i / R_{th} :	0.0292	0.0832	0.2277	0.6599
τ_i [sec.] :	0.0025	0.0027	0.0155	0.0865

PERFORMANCE CURVES

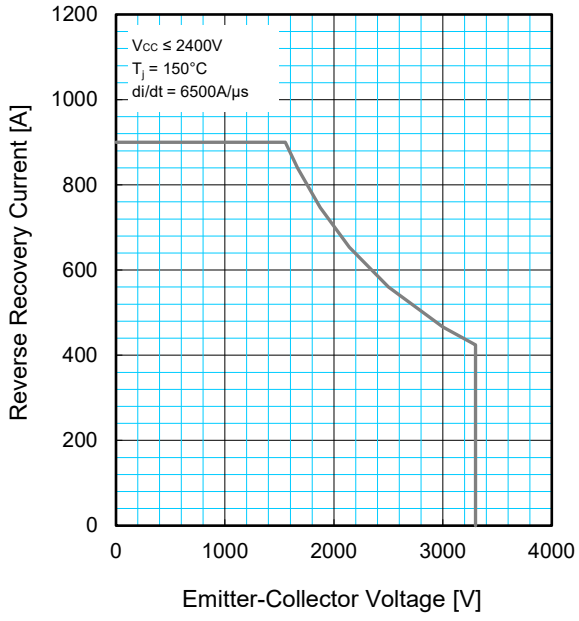
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



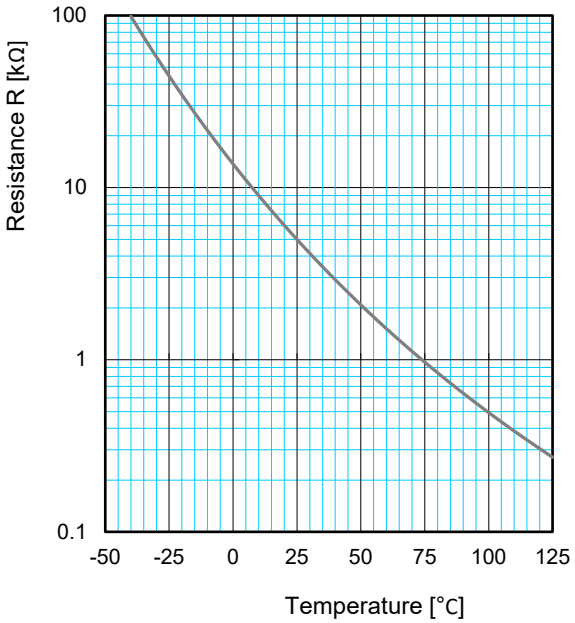
SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



NTC THERMISTOR TEMPERATURE CHARACTERISTICS (TYPICAL)



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