MITSUBISHI ELECTRIC

< HVIGBT MODULES >

CM1500HC-66R

HIGH POWER SWITCHING USE
INSULATED TYPE

4th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

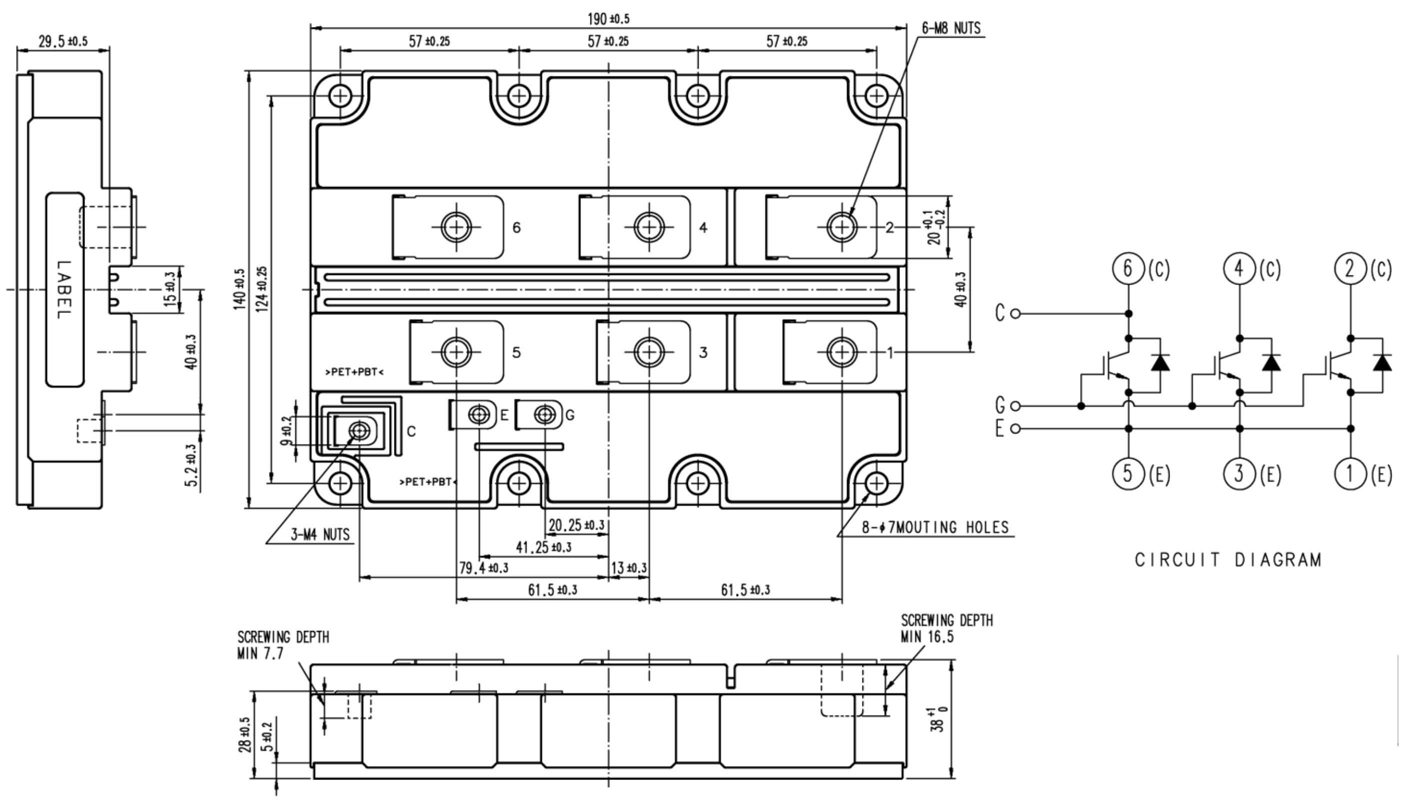
CM1500HC-66R

- I_C 1500A
- V_{CES} 3300V
- 1-element in a Pack
- Insulated Type
- LPT-IGBT / Soft Recovery Diode
- AlSiC Baseplate

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 = 95°C	1500	A
I_{CRM}		Pulse (Note 1)	3000	A
I_E	Emitter current (Note 2)	DC	1500	A
I_{ERM}		Pulse (Note 1)	3000	A
P_{tot}	Maximum power dissipation (Note 3)	T_c = 25°C, IGBT part	15600	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	2600	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} = 2500V, 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	—	36.0	—	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE} = 10 V, I_C = 150 mA, T_j = 25°C		5.7	6.2	6.7	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		—	210.0	—	nF
C_{oes}	Output capacitance			—	13.0	—	nF
C_{res}	Reverse transfer capacitance			—	6.0	—	nF
Q_G	Total gate charge	V_{CC} = 1800V, I_C = 1500A, V_{GE} = ±15V		—	16.0	—	µC
V_{CEsat}	Collector-emitter saturation voltage	I_C = 1500 A (Note 4) V_{GE} = 15 V	T_j = 25°C	—	2.45	—	V
			T_j = 125°C	—	3.10	3.70	
			T_j = 150°C	—	3.25	—	
$t_{d(on)}$	Turn-on delay time	V_{CC} = 1800 V I_C = 1500 A V_{GE} = ±15 V $R_{G(on)}$ = 1.6 Ω L_s = 100 nH Inductive load	T_j = 25°C	—	1.00	—	µs
			T_j = 125°C	—	0.95	1.25	
			T_j = 150°C	—	0.95	1.25	
t_r	Turn-on rise time		T_j = 25°C	—	0.28	—	µs
			T_j = 125°C	—	0.30	0.50	
			T_j = 150°C	—	0.30	0.50	
$E_{on(10\%)}$	Turn-on switching energy (Note 5)		T_j = 25°C	—	2.10	—	J
			T_j = 125°C	—	2.75	—	
			T_j = 150°C	—	3.00	—	
E_{on}	Turn-on switching energy (Note 6)		T_j = 25°C	—	2.20	—	J
			T_j = 125°C	—	2.90	—	
			T_j = 150°C	—	3.20	—	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 1800 V I_C = 1500 A V_{GE} = ±15 V $R_{G(off)}$ = 5.6 Ω L_s = 100 nH Inductive load	T_j = 25°C	—	2.70	—	µs
			T_j = 125°C	—	2.80	3.30	
			T_j = 150°C		2.85	3.30	
t_f	Turn-off fall time		T_j = 25°C	—	0.30	—	µs
			T_j = 125°C	—	0.35	1.00	
			T_j = 150°C	—	0.40	1.00	
$E_{off(10\%)}$	Turn-off switching energy (Note 5)		T_j = 25°C	—	2.00	—	J
			T_j = 125°C	—	2.45	—	
			T_j = 150°C		2.50	—	
E_{off}	Turn-off switching energy (Note 6)		T_j = 25°C	—	2.20	—	J
			T_j = 125°C	—	2.70	—	
			T_j = 150°C	—	2.80	—	

ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions		Limits Min	Limits Typ	Limits Max	Unit
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 1500 A (Note 4), V_{GE} = 0 V	T_j = 25°C	—	2.15	—	V
			T_j = 125°C	—	2.30	2.80	
			T_j = 150°C	—	2.25	—	
t_{rr}	Reverse recovery time (Note 2)	V_{CC} = 1800 V, I_C = 1500 A, V_{GE} = ±15 V, $R_{G(on)}$ = 1.6 Ω, L_s = 100 nH, Inductive load	T_j = 25°C	—	0.50	—	µs
			T_j = 125°C	—	0.70		
			T_j = 150°C	—	0.80	—	
I_{rr}	Reverse recovery current (Note 2)		T_j = 25°C	—	1250	—	A
			T_j = 125°C	—	1500	—	
			T_j = 150°C	—	1550	—	
Q_{rr}	Reverse recovery charge (Note 2)		T_j = 25°C	—	1050	—	µC
			T_j = 125°C	—	1700		
			T_j = 150°C	—	2000	—	
$E_{rec(10\%)}$	Reverse recovery energy (Note 2) (Note 5)		T_j = 25°C		1.05	—	J
			T_j = 125°C	—	1.75		
			T_j = 150°C	—	2.00	—	
E_{rec}	Reverse recovery energy (Note 2) (Note 6)		T_j = 25°C		1.20	—	J
			T_j = 125°C	—	2.00		
			T_j = 150°C	—	2.30	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits Min	Limits Typ	Limits Max	Unit
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part	—	—	8.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part	—	—	15.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, λ_{grease} = 1W/m·k, $D_{(c-s)}$ = 100µm	—	6.0	—	K/kW

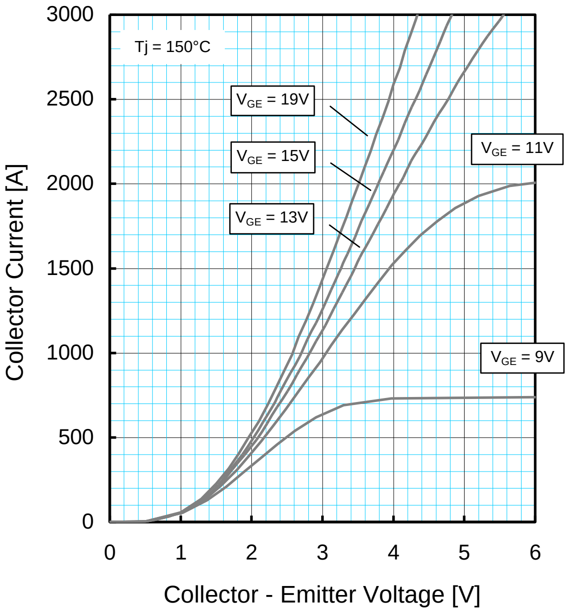
MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits Min	Limits Typ	Limits Max	Unit
M_t	Mounting torque	M8 : Main terminals screw	7.0	—	22.0	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		—	1.2	—	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		—	11.0	—	nH
$R_{CC'+EE'}$	Internal lead resistance	T_C = 25°C	—	0.12	—	mΩ
r_g	Internal gate resistance	T_C = 25°C	—	1.5	—	Ω

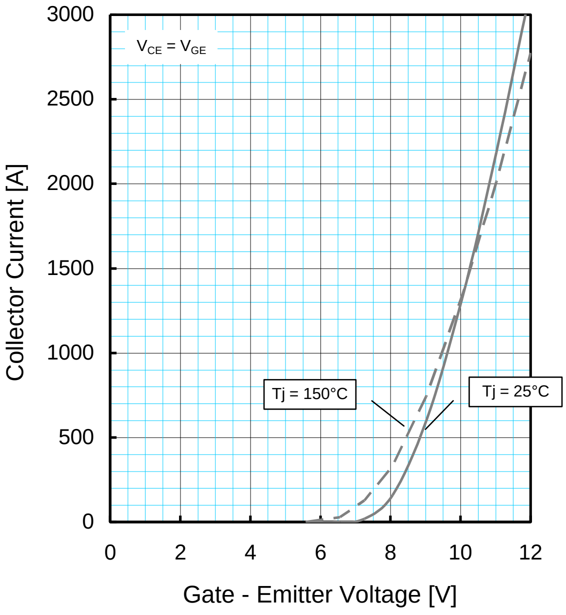
Note1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{opmax} rating(150°C).
2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD_i).
3. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).
4. Pulse width and repetition rate should be such as to cause negligible temperature rise.
5. $E_{on(10\%)}$ / $E_{off(10\%)}$ / $E_{rec(10\%)}$ are the integral of $0.1V_{CE}\ x\ 0.1I_C\ x\ dt$.
6. Definition of all items is according to IEC 60747, unless otherwise specified.

PERFORMANCE CURVES

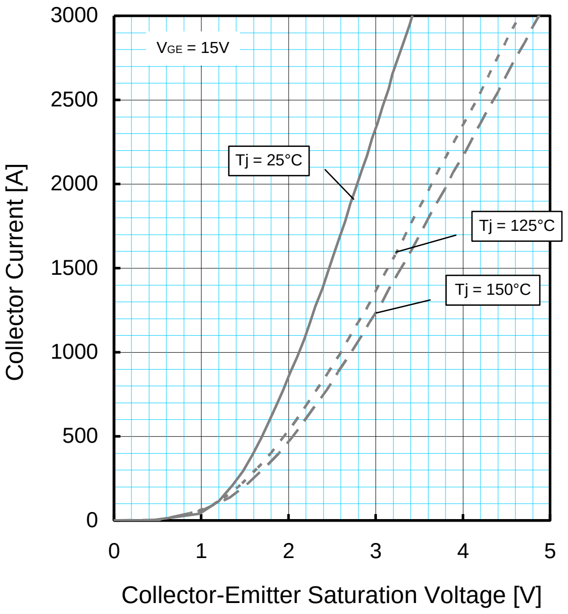
OUTPUT CHARACTERISTICS (TYPICAL)



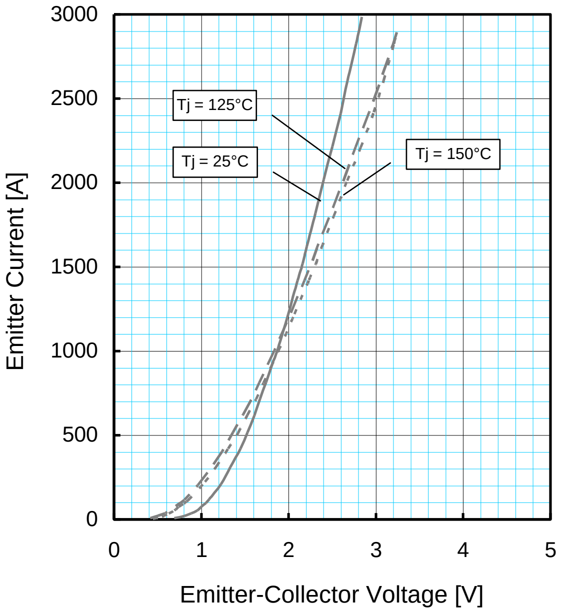
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

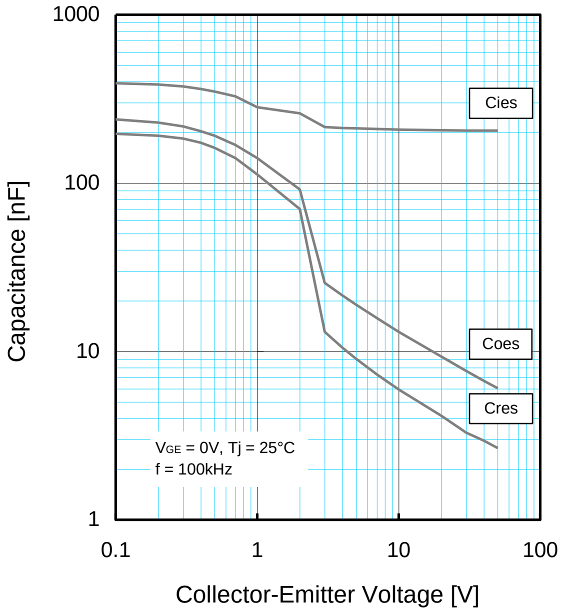


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

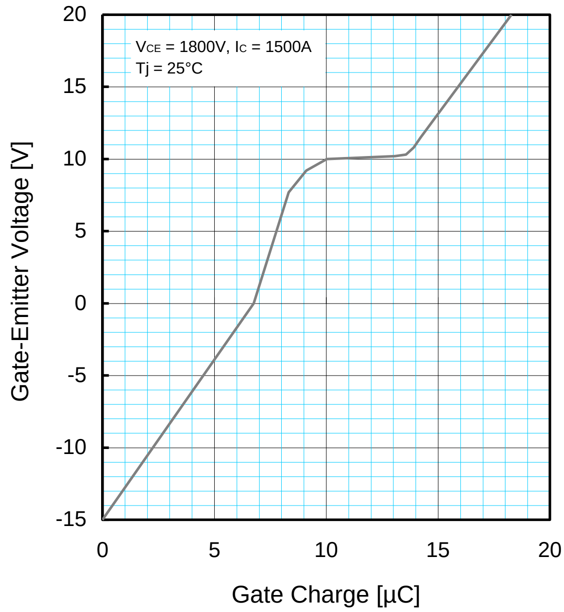


PERFORMANCE CURVES

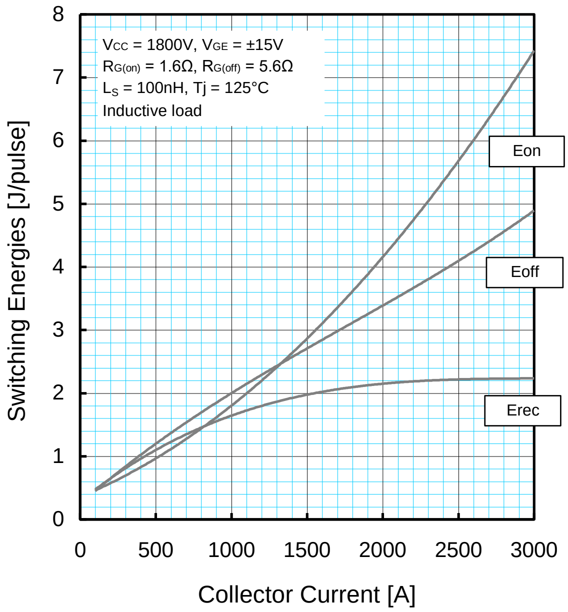
CAPACITANCE CHARACTERISTICS (TYPICAL)



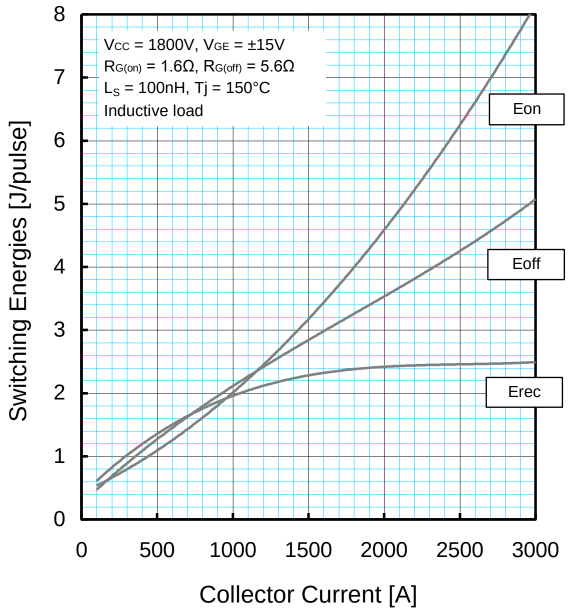
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

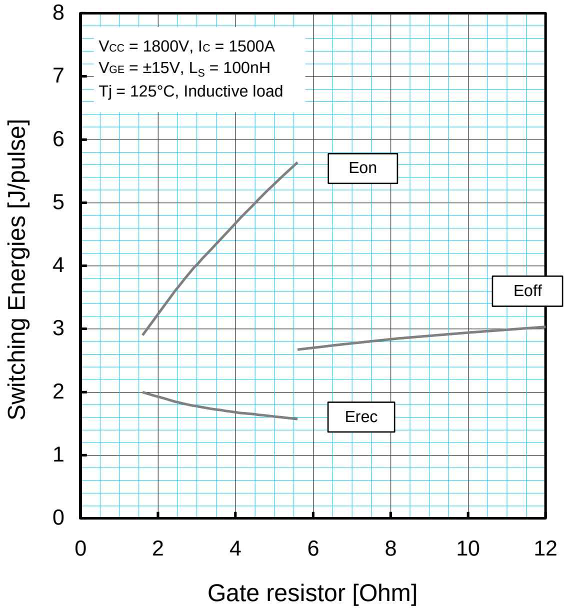


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

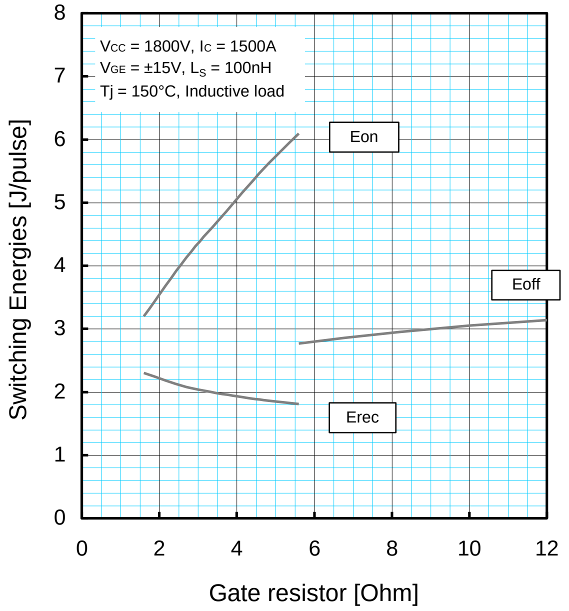


PERFORMANCE CURVES

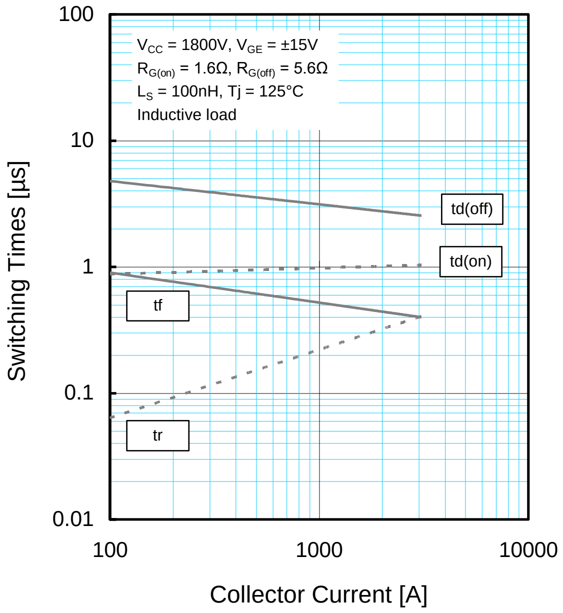
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



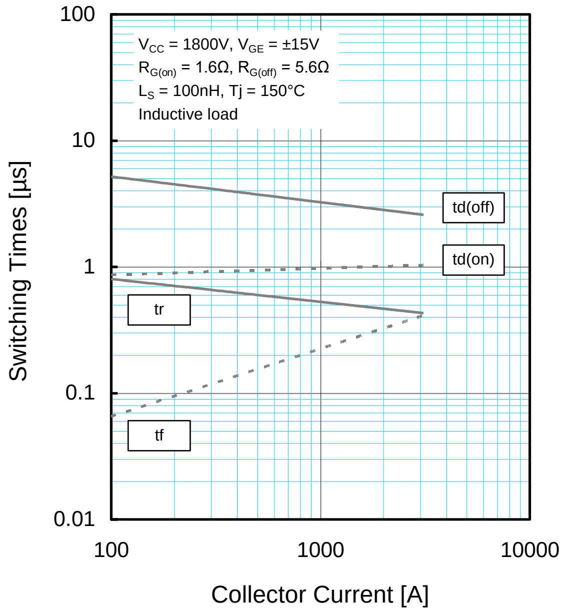
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

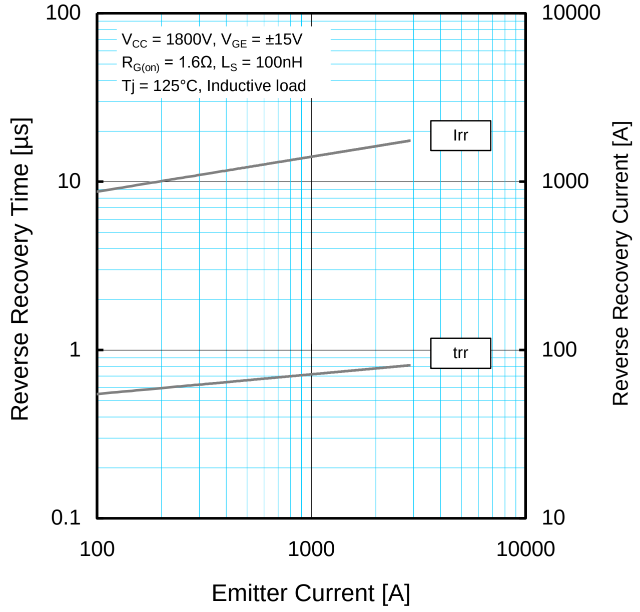


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

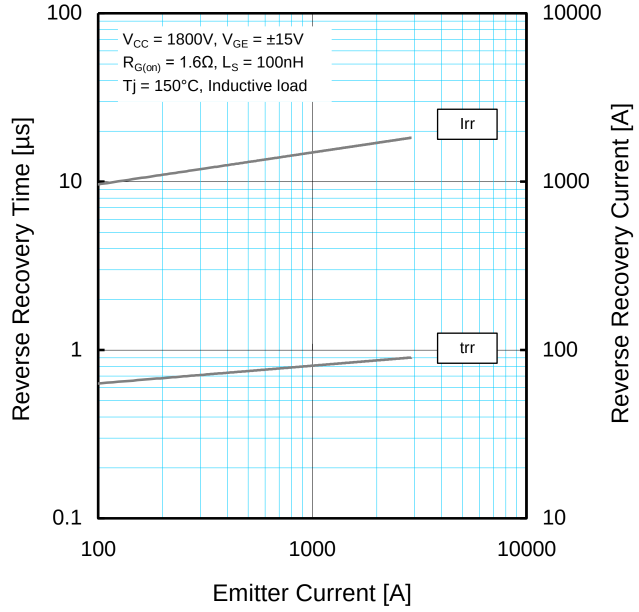


PERFORMANCE CURVES

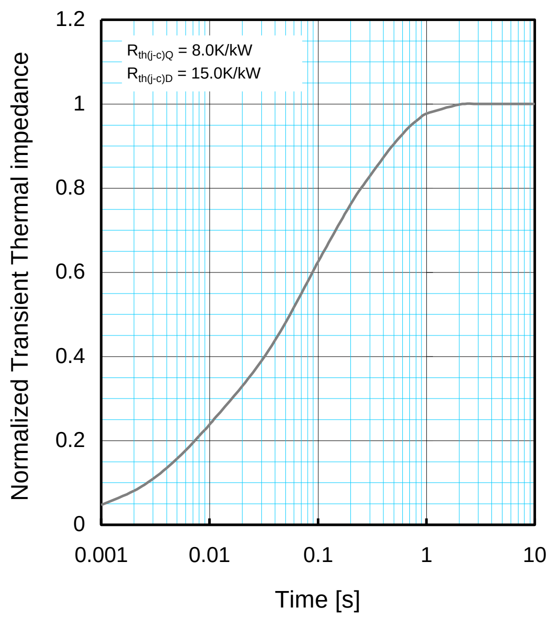
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

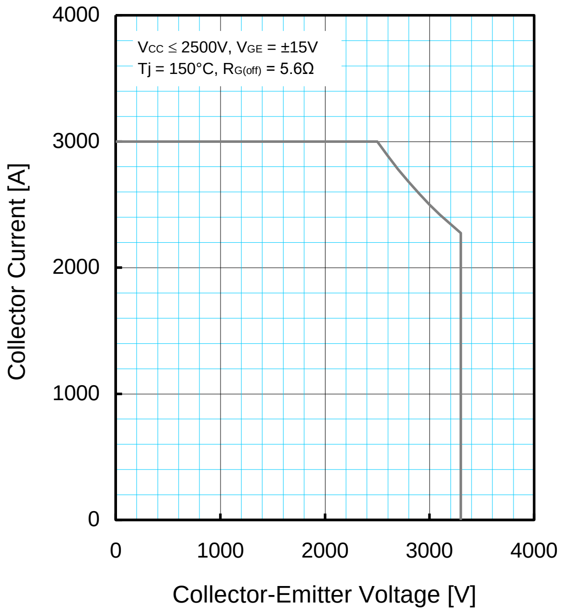


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i} \right) \right\}$$

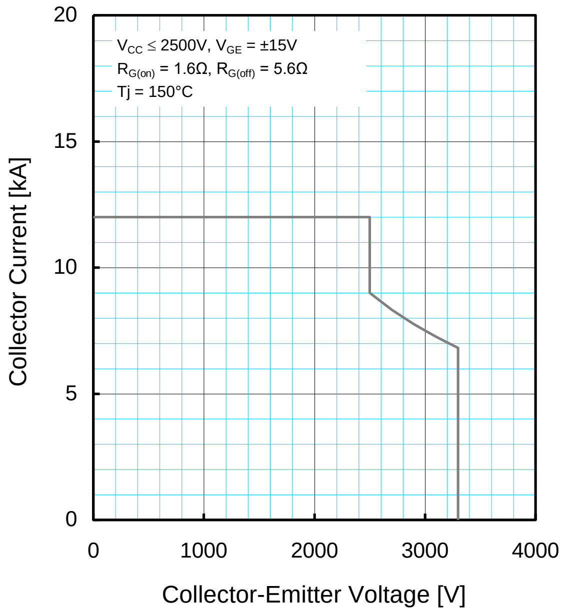
	1	2	3	4
R_i [K/kW] :	0.0096	0.1893	0.4044	0.3967
τ_i [sec] :	0.0001	0.0058	0.0602	0.3512

PERFORMANCE CURVES

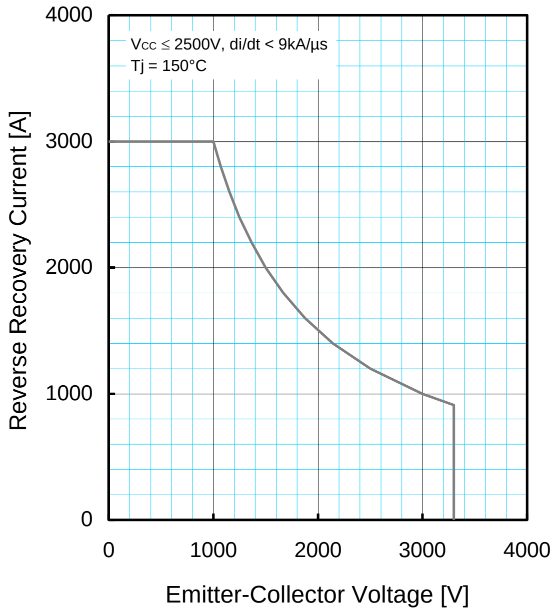
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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