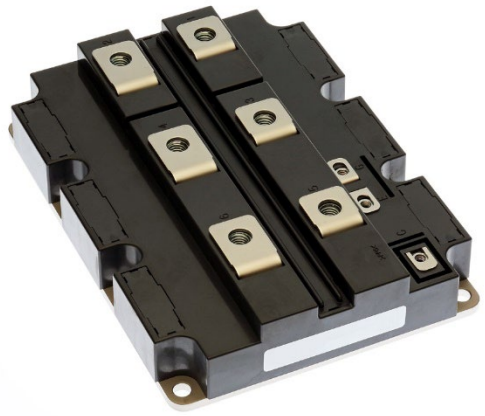
MITSUBISHI ELECTRIC

< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM1500HC-66XB

HIGH POWER SWITCHING USE
INSULATED TYPE

CM1500HC-66XB

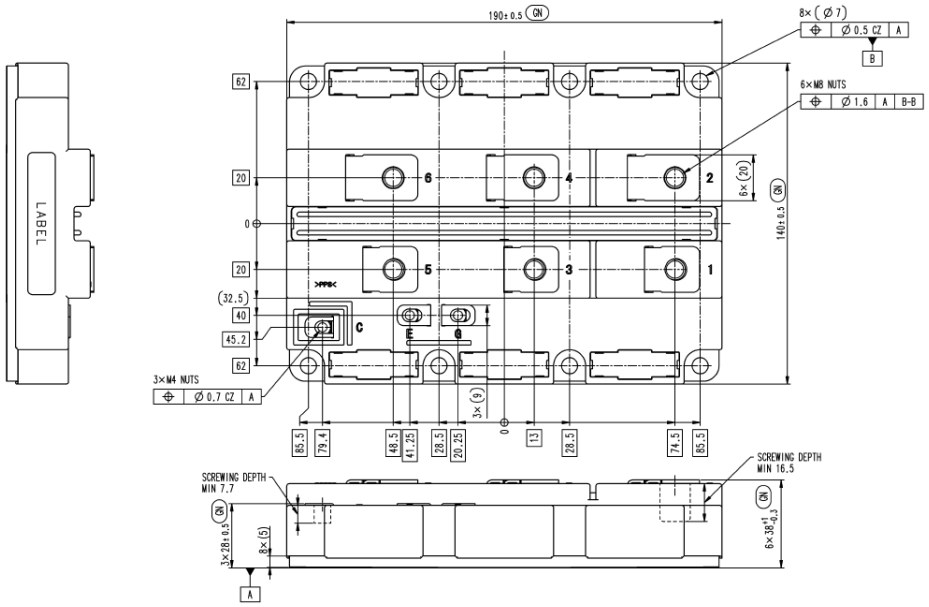


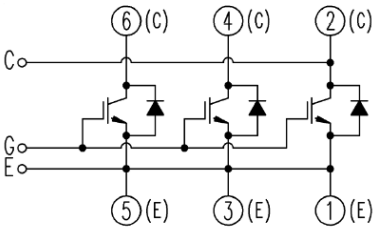
- I_C ..... 1500 A
- V_{CES} ..... 3300 V
- 1-elements in a Pack
- Insulated Type
- CSTBT™(III) / RFC Diode
- Flat Baseplate

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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





CIRCUIT DIAGRAM

CM1500HC-66XB

HIGH POWER SWITCHING USE
INSULATED TYPE

MAXIMUM RATINGS

Item	Symbol	Conditions		Ratings	Unit
Collector-emitter voltage	V_{CES}	V_{GE} = 0 V	T_j = -40~+150 °	3300	V
			T_j = -50 °C	3200	V
Gate-emitter voltage	V_{GES}	V_{CE} = 0 V		±20	V
Collector current	I_C	T_c = 100 °C , DC		1500	A
(Repetitive peak) Collector current	I_{CRM}	Pulse(Note 1)		3000	A
Emitter current (Note 2)	I_E	T_c = 95 °C , DC		1500	A
(Repetitive peak) Emitter current (Note 2)	I_{ERM}	Pulse(Note 1)		3000	A
Total power dissipation	P_{tot}	T_c = 25 °C , IGBT part(Note 3)		14300	W
Isolation voltage	V_{isol}	RMS, sinusoidal, f = 60 Hz, t = 1min. T_c = 25 °C		6000	V_{rms}
Partial discharge charge	Q_{pd}	Charged part to the base-plate V1 = 3500 V_{rms} , V2 = 2600 V_{rms} AC 60 Hz, Tc = 25 °C (acc. to IEC61287-1)		10	pC
Junction temperature	T_j	-		-50 ~ +150	°C
Storage temperature	T_{stg}	-		-55 ~ +150	°C
Operating junction temperature	T_{jop}	-		-50 ~ +150	°C
Short-circuit withstand pulse duration	t_{pSC}	V_{CC} ≤ 2500 V , V_{GE} = ±15.0 V , L_s ≤ 100μH	T_j = T_{jop}	10	μs

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Collector-emitter cut-off current	I_{CES}	V_{CE} = 3300 V , V_{GE} = 0 V	T_j = 25 °C	-	-	3.0	mA
			T_j = 125 °C	-	4.0	-	mA
			T_j = 150 °C	-	26.0	75.0	mA
Gate-emitter threshold voltage	$V_{GE(th)}$	V_{CE} = 10 V , I_C = 150mA	T_j = 25 °C	5.80	6.30	6.80	V
Gate leakage current	I_{GES}	V_{CE} = 0 V , V_{GE} = ±20 V	T_j = 25 °C	-0.5	-	0.5	μA
Gate charge	Q_G	V_{CC} = 1800 V , I_C = 1500 A ,V_{GE} = ±15 V	T_j = 25 °C	-	8.2	-	μC
Input capacitance	C_{ies}	V_{CE} = 10 V , V_{GE} = 0 V , f = 100 kHz	T_j = 25 °C	-	164	-	nF
Output capacitance	C_{oes}		T_j = 25 °C	-	11	-	nF
Reverse transfer capacitance	C_{res}		T_j = 25 °C	-	1.4	-	nF
Collector-emitter saturation voltage	V_{CEsat}	I_C = 1500 A (Note 4) , V_{GE} = 15 V	T_j = 25 °C	-	2.60	-	V
			T_j = 125 °C	-	3.20	-	V
			T_j = 150 °C	-	3.30	3.70	V
Emitter-collector voltage (Note 2)	V_{EC}	I_E = 1500 A (Note 4) , V_{GE} = 0 V	T_j = 25 °C	-	2.30	-	V
			T_j = 125 °C	-	2.60	-	V
			T_j = 150 °C	-	2.60	3.20	V
Turn-on delay time	$t_{d(on)}$	V_{CC} = 1800 V , I_C = 1500 A ,	T_j = 150 °C	-	-	1.40	μs
Rise time	t_r	V_{GE} = ±15 V , L_s = 100 nH ,	T_j = 150 °C	-	-	0.50	μs
Turn-on switching energy per pulse (Note 5)	$E_{on(10\%)}$	$R_{G(on)}$ = 2.0 Ω , $R_{G(off)}$ = 27 Ω , Inductive load	T_j = 25 °C	-	1.57	-	J
			T_j = 125 °C	-	2.06	-	J
			T_j = 150 °C	-	2.24	-	J
Turn-on switching energy per pulse	E_{on}		T_j = 25 °C	-	1.66	-	J
			T_j = 125 °C	-	2.20	-	J
			T_j = 150 °C	-	2.40	-	J

ELECTRICAL CHARACTERISTICS

Item	Symbol	Conditions		Limits			Unit
				Min.	Typ.	Max.	
Reverse recovery time (Note 2)	t_{rr}	V_{CC} = 1800 V , I_E = 1500 A ,	T_j = 150 °C	-	-	1.20	μs
Reverse recovery current (Note 2)	I_{rr}	V_{GE} = ±15 V , L_s = 100 nH ,	T_j = 25 °C	-	1580	-	A
		$R_{G(on)}$ = 2.0 Ω , $R_{G(off)}$ = 27 Ω ,	T_j = 125 °C	-	1620	-	A
		Inductive load	T_j = 150 °C	-	1670	-	A
Reverse recovery charge (Note 2, 6)	$Q_{rr(10\%)}$		T_j = 25 °C	-	830	-	μC
			T_j = 125 °C	-	1160	-	μC
			T_j = 150 °C	-	1400	-	μC
Reverse recovered charge of a reverse-blocking IGBT (Note 2)	Q_{rr}		T_j = 25 °C	-	880	-	μC
			T_j = 125 °C	-	1250	-	μC
			T_j = 150 °C	-	1500	-	μC
Reverse recovery energy per pulse (Note 2, 5)	$E_{rec(10\%)}$		T_j = 25 °C	-	0.95	-	J
			T_j = 125 °C	-	1.31	-	J
			T_j = 150 °C	-	1.58	-	J
Reverse recovery energy per pulse (Note 2)	E_{rec}		T_j = 25 °C	-	1.05	-	J
			T_j = 125 °C	-	1.48	-	J
			T_j = 150 °C	-	1.79	-	J
Turn-off delay time	$t_{d(off)}$	V_{CC} = 1800 V , I_C = 1500 A ,	T_j = 150 °C	-	-	6.40	μs
Fall time	t_f	V_{GE} = ±15 V , L_s = 100 nH ,	T_j = 150 °C	-	-	0.70	μs
Turn-off switching energy per pulse (Note 5)	$E_{off(10\%)}$	$R_{G(on)}$ = 2.0 Ω , $R_{G(off)}$ = 27 Ω ,	T_j = 25 °C	-	2.00	-	J
		Inductive load	T_j = 125 °C	-	2.54	-	J
			T_j = 150 °C	-	2.48	-	J
Turn-off (switching) energy per pulse	E_{off}		T_j = 25 °C	-	2.32	-	J
			T_j = 125 °C	-	2.96	-	J
			T_j = 150 °C	-	2.87	-	J

THERMAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Thermal resistance	$R_{th(j-c)Q}$	Junction to case, IGBT part	-	-	9.0	K/kW
Thermal resistance (Note 2)	$R_{th(j-c)D}$	Junction to case, FWDi part	-	-	11.6	K/kW
Contact thermal resistance	$R_{th(c-s)}$	Case to heat sink, λ_{grease} = 1W/m·K, $D_{(c-s)}$ = 80 μm	-	5.3	-	K/kW

MECHANICAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Mounting torque	M_t	Main terminal screw: M8	7.0	-	19.0	N·m
Mounting torque	M_s	Mounting screw: M6	3.0	-	6.0	N·m
Mounting torque (Note 7)	M_t	Auxiliary terminal screw : M4	1.0	-	3.0	N·m
mass	m	-	-	1.3	-	kg
Comparative tracking index	CTI	-	600	-	-	-
Clearance distance in air	d_a	-	19.5	-	-	mm
Creepage distance along surface	d_s	-	32.0	-	-	mm
Internal inductance	$L_{P(C-E)}$	IGBT part, T_c=25°C	-	8.0	-	nH
Internal lead resistance	$R_{CC'+EE'}$	T_C = 25 °C	-	0.09	-	mΩ

Note 1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed maximum T_{jop} rating.

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

Note 3. Junction temperature (T_j) should not exceed T_{j_max} rating.

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

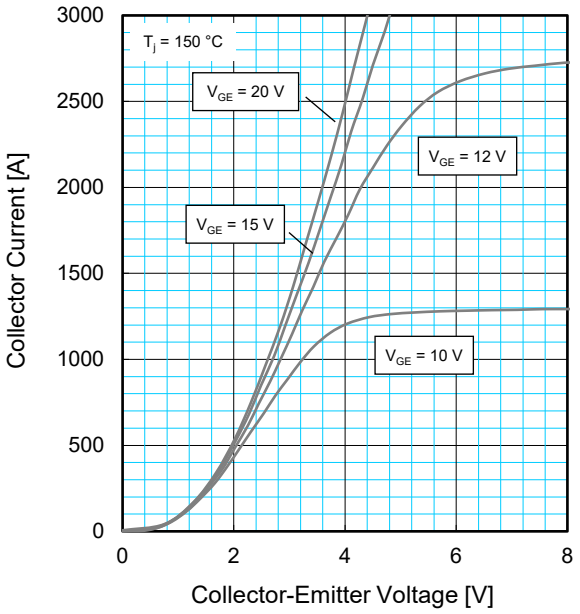
Note 5. The integration range of switching energies is from 10%V_{CE} to 10%I_C(I_E).

Note 6. The integration range of reverse recovery charge is from I_E=0A to 10%I_E

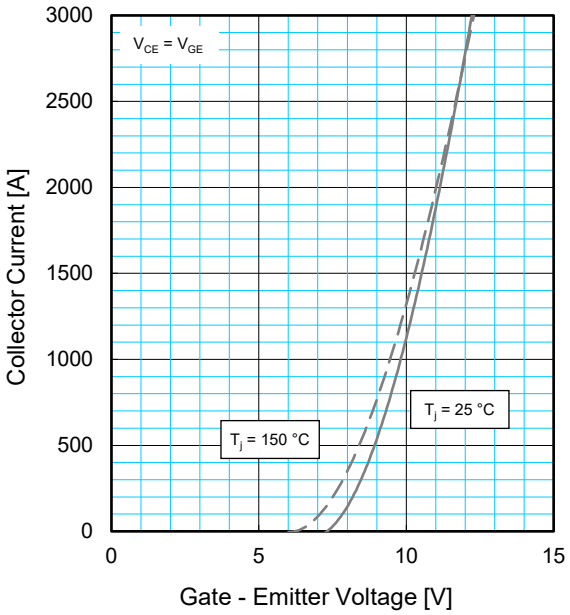
Note 7. The maximum specified value is under the condition of using PCB mounted on the power module. In case no PCB is used this maximum torque for M4 screw is 2.0 N·m.

PERFORMANCE CURVES

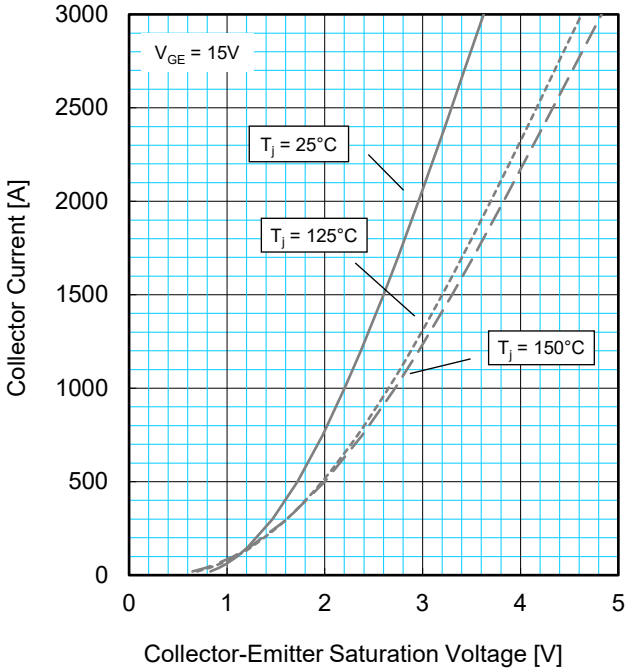
OUTPUT CHARACTERISTICS (TYPICAL)



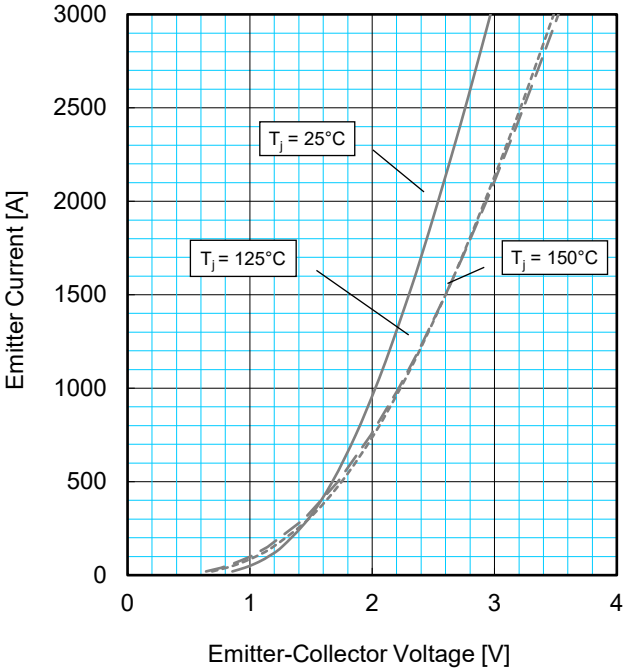
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

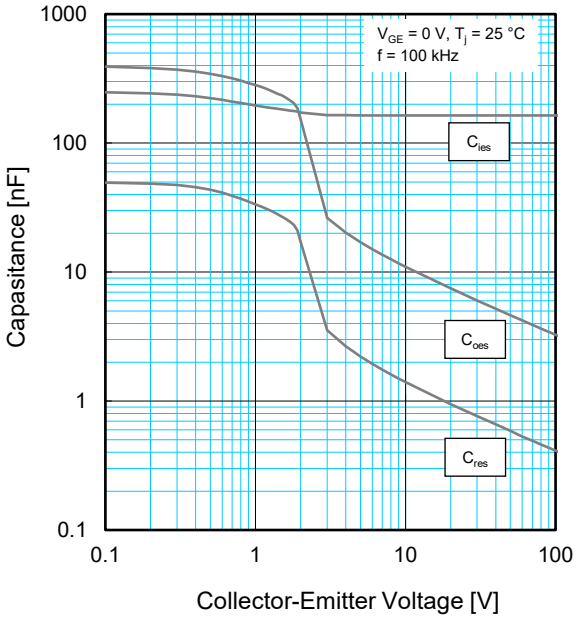


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

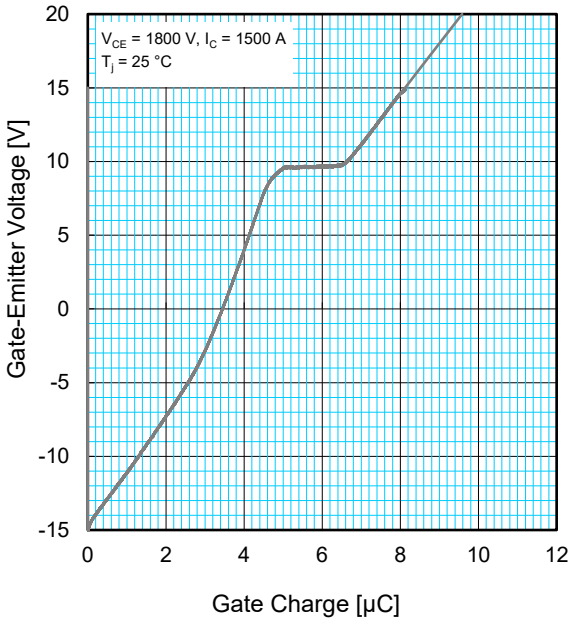


PERFORMANCE CURVES

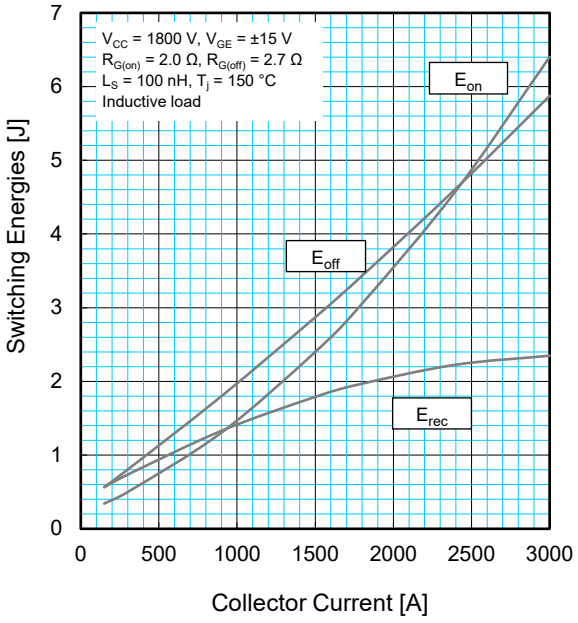
CAPACITANCE CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)

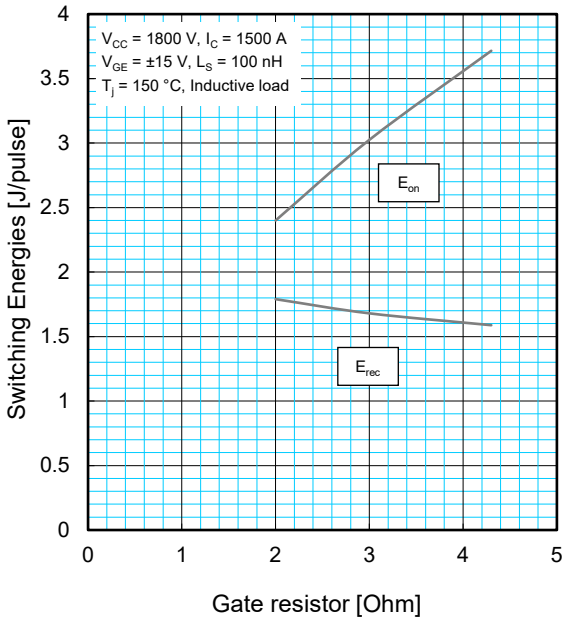


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

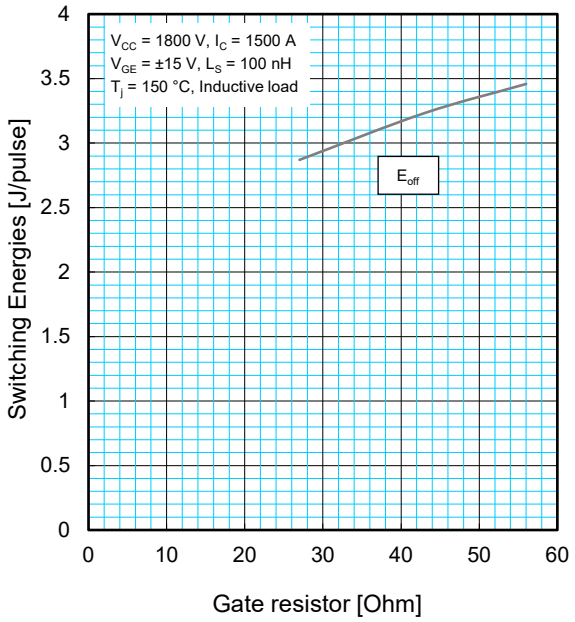


PERFORMANCE CURVES

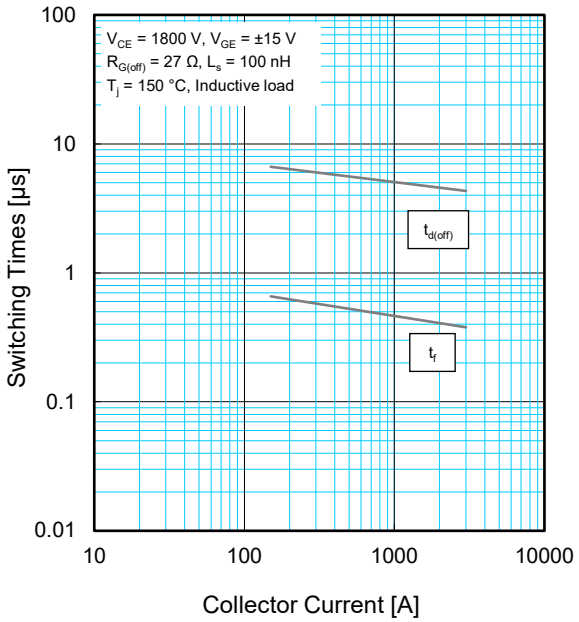
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



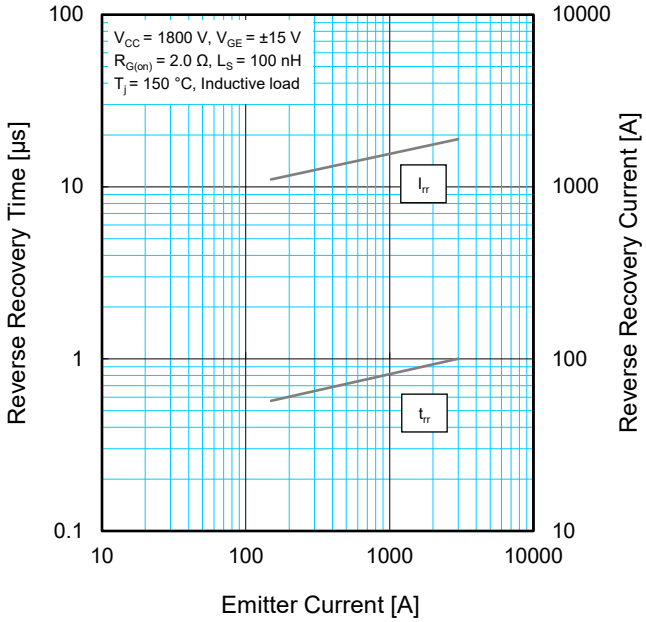
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

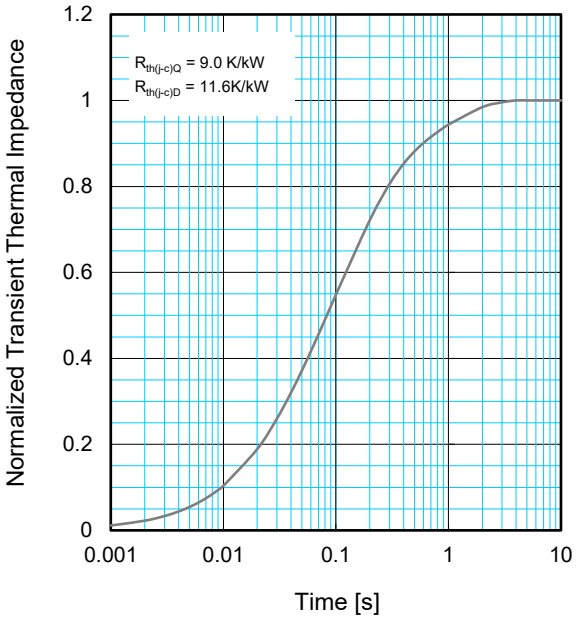


FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



PERFORMANCE CURVES

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

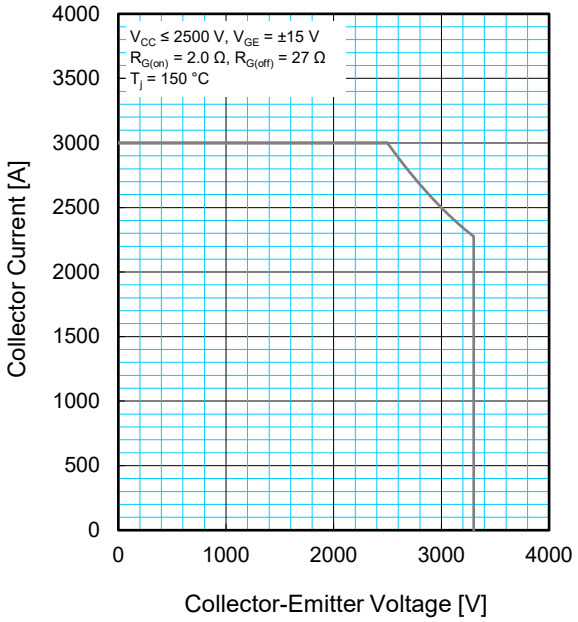


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{ 1 - \exp\left(-\frac{t}{\tau_i} \right) \right\}$$

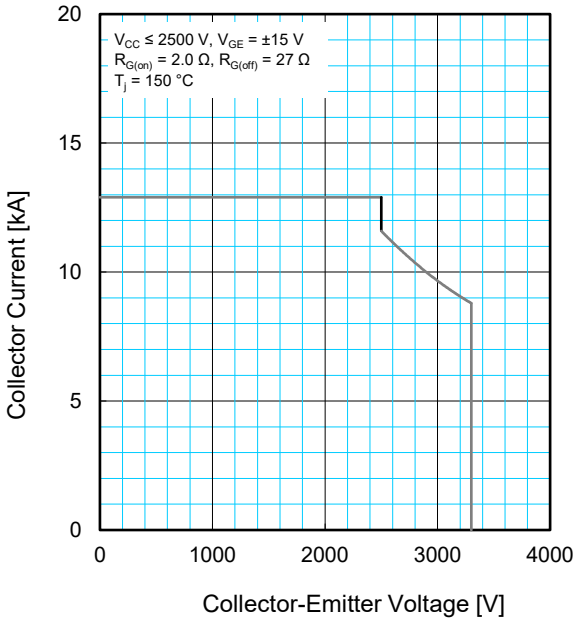
	1	2	3	4
R_i / R_{th} :	0.0000	0.2002	0.2401	0.5596
τ_i [sec.] :	0.0001	0.7842	0.0347	0.1319

PERFORMANCE CURVES

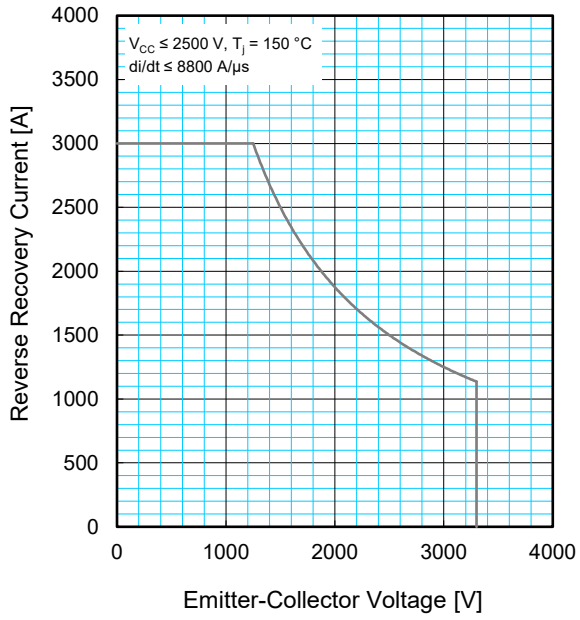
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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