MITSUBISHI ELECTRIC

< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

CM600E1A-66X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM600E1A-66X

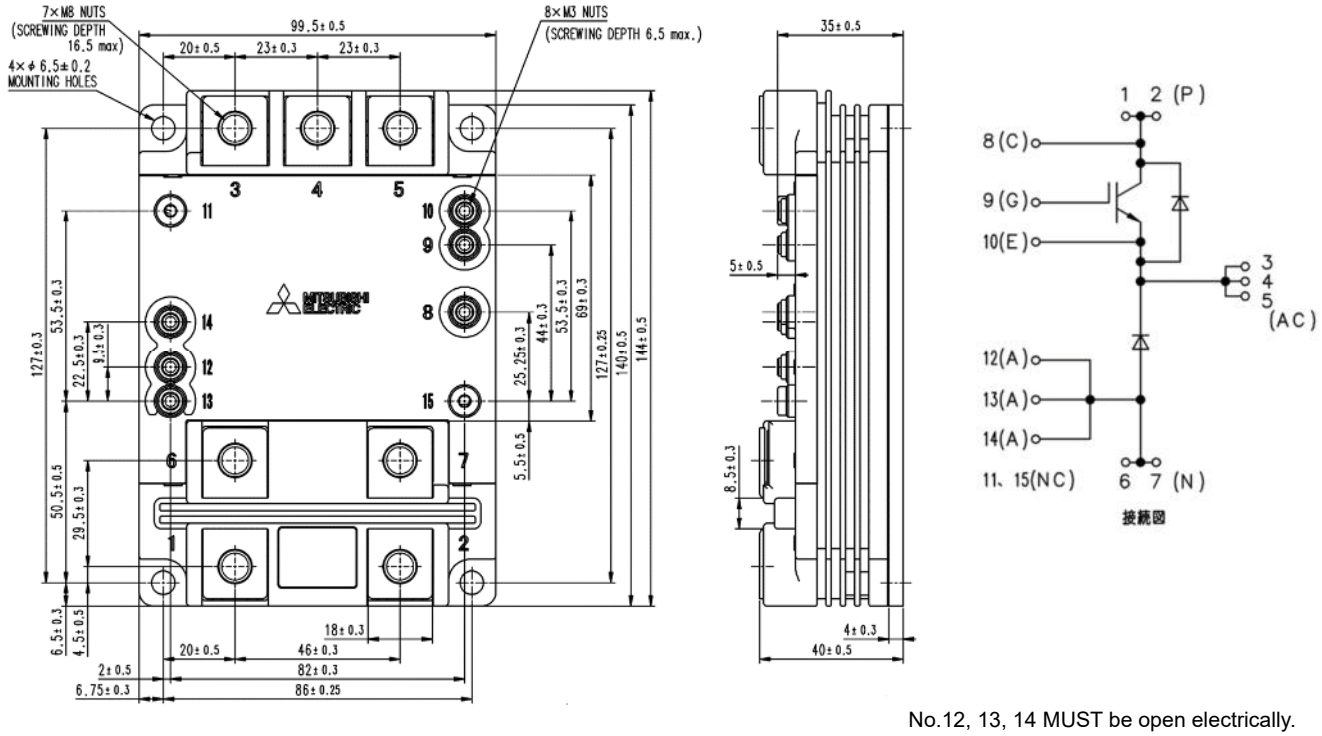
- I_C 600A
- V_{CES} 3300V
- 2-elements in a Pack (for brake chopper*)
- Insulated Type (Al base type)
- CSTBT™(III) / RFC Diode

*Not allowed for 3-level use. Limited to use as a brake chopper.

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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



No.12, 13, 14 MUST be open electrically.

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 = 109°C	600	A
I_{CRM}		Pulse (Note 1)	1200	A
I_E	Emitter current (Note 2)	DC, T_c = 90°C	600	A
I_{ERM}		Pulse (Note 1)	1200	A
I_F	Forward current (Note 3)	DC, T_c = 90°C	600	A
I_{FRM}		Pulse (Note 1)	1200	A
P_{tot}	Maximum power dissipation (Note 4)	T_c = 25°C, IGBT part	5400	W
V_{iso}	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1 min., T_C = 25°C	6000	V
Q_{PD}	Partial discharge	Charged part to the baseplate V1 = 3500 Vrms, V2 = 2600 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 ~ +125	°C
t_{psc}	Short circuit pulse width	V_{CC} = 2400V, V_{CE} ≤ V_{CES}, V_{GE} =15V, T_j =150°C $R_{g(on)}$ = 2.2Ω, $R_{g(off)}$ = 51Ω, 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	—	2.0	—	
			T_j = 150°C	—	—	55.5	
$V_{GE(th)}$	Gate-emitter threshold voltage	V_{CE} = 10 V, I_C = 60 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		—	53.4	—	nF
C_{oes}	Output capacitance			—	3.8	—	nF
C_{res}	Reverse transfer capacitance			—	0.5	—	nF
Q_G	Total gate charge	V_{CC} = 1800V, I_C = 600A, V_{GE} = ±15V		—	3.6	—	μC
V_{CEsat}	Collector-emitter saturation voltage	I_C = 600 A (Note 5) V_{GE} = 15 V	T_j = 25°C	—	2.30	—	V
			T_j = 125°C	—	2.80	—	
			T_j = 150°C	—	2.90	3.30	
$t_{d(on)}$	Turn-on delay time	V_{CC} = 1800 V I_C = 600 A V_{GE} = ±15 V $R_{G(on)}$ = 2.2 Ω L_s = 65nH Inductive load C_{GE} = 33 nF	T_j = 150°C	—	—	1.25	
t_r	Rise time		T_j = 150°C	—	—	0.50	
$E_{on(10\%)}$	Turn-on switching energy (Note 5)		T_j = 25°C	—	0.76	—	J
			T_j = 125°C	—	0.92	—	
			T_j = 150°C	—	0.93	—	
E_{on}	Turn-on switching energy		T_j = 25°C	—	0.82	—	J
			T_j = 125°C	—	0.99	—	
			T_j = 150°C	—	1.00	—	
$t_{d(off)}$	Turn-off delay time	V_{CC} = 1800 V I_C = 600 A V_{GE} = ±15 V $R_{G(off)}$ = 51 Ω L_s = 65nH Inductive load C_{GE} = 33 nF	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	—	0.23	—	μs
			T_j = 125°C	—	0.33	—	
			T_j = 150°C	—	0.35	1.00	
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)		T_j = 25°C	—	0.67	—	J
			T_j = 125°C	—	0.91	—	
			T_j = 150°C	—	0.92	—	
E_{off}	Turn-off switching energy per pulse		T_j = 25°C	—	0.76	—	J
			T_j = 125°C	—	1.03	—	
			T_j = 150°C	—	1.04	—	
V_{EC}	Emitter-collector voltage (Note 2)	I_E = 600 A (Note 5) V_{GE} = 0 V	T_j = 25°C	—	2.10	—	V
			T_j = 125°C	—	2.30	—	
			T_j = 150°C	—	2.40	2.90	

ELECTRICAL CHARACTERISTICS (Clamp-Di part)

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
I_{RRM}	Repetitive reverse current (Note 3)	$V_{AK} = V_{RRM}$	T_j = 25°C	—	—	1.0	mA
			T_j = 125°C	—	1.0	—	
			T_j = 150°C	—	—	18.0	
V_{FM}	Forward voltage (Note 3)	I_F = 600 A (Note 5)	T_j = 25°C	—	2.10	—	V
			T_j = 125°C	—	2.30	—	
			T_j = 150°C	—	2.40	2.90	
t_{rr}	Reverse recovery time (Note 3)	V_{CC} = 1800 V I_C = 600 A V_{GE} = ±15 V $R_{G(on)}$ = 2.2 Ω L_s = 65nH Inductive load C_{GE} = 33 nF	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 3)		T_j = 25°C	—	1170	—	A
			T_j = 125°C	—	1120	—	
			T_j = 150°C	—	1100	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 3), (Note 7)		T_j = 25°C	—	620	—	μC
			T_j = 125°C	—	740	—	
			T_j = 150°C	—	770	—	
Q_{rr}	Reverse recovery charge (Note 3)		T_j = 25°C	—	650	—	μC
			T_j = 125°C	—	805	—	
			T_j = 150°C	—	845	—	
$E_{rec(10\%)}$	Reverse recovery energy per pulse (Note 3) , (Note 6)		T_j = 25°C	—	0.66	—	J
			T_j = 125°C	—	0.88	—	
			T_j = 150°C	—	0.91	—	
E_{rec}	Reverse recovery energy per pulse (Note 3)		T_j = 25°C	—	0.75	—	J
			T_j = 125°C	—	1.01	—	
			T_j = 150°C	—	1.03	—	

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	—	—	20.5	K/kW
$R_{th(j-c)D}$	Thermal resistance	Junction to Case, FWDi part, per 1/2 module	—	—	34.0	K/kW
$R_{th(j-c)D}$	Thermal resistance	Junction to Case, Clamp-Di part	—	—	34.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, Switching part , 1/2 module λ_{grease} = 1W/m･k, $D_{(c-s)}$ = 70μm	—	16.0	—	K/kW

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, Between terminal 1, 2 and terminal 3, 4, 5	—	0.28	—	mΩ
$R_{AA'+KK'}$		T_C = 25 °C, Between terminal 3, 4, 5 and terminal 6,7	—	0.18	—	mΩ
r_g	Internal gate resistance	T_C = 25 °C	—	0.83	—	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. The symbols represent characteristics of the clamp diode (Clamp-Di).

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

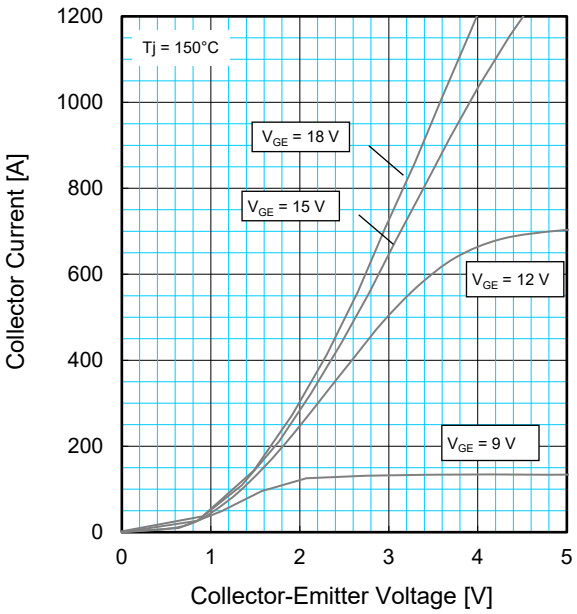
5. Pulse width and repetition rate should be such as to cause negligible temperature rise.

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

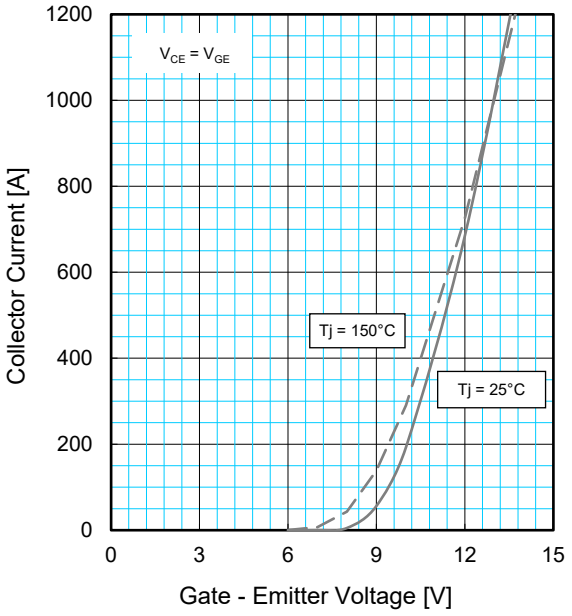
7. The integration range of reverse recovery charge is from I_E = 0A to 10%I_E.

PERFORMANCE CURVES

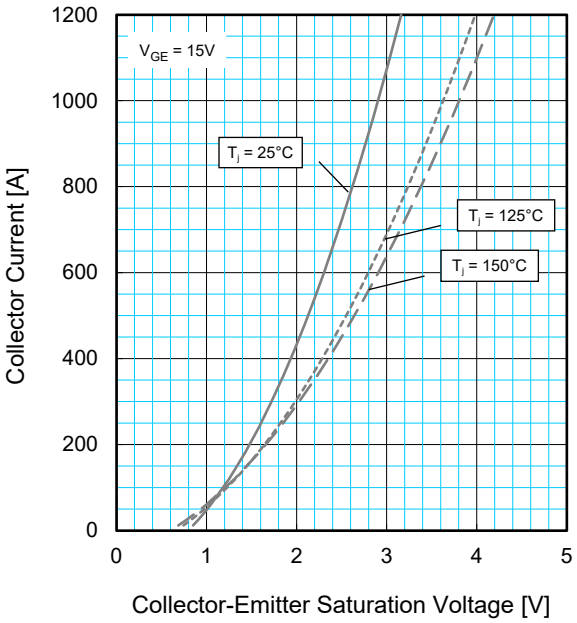
OUTPUT CHARACTERISTICS (TYPICAL)



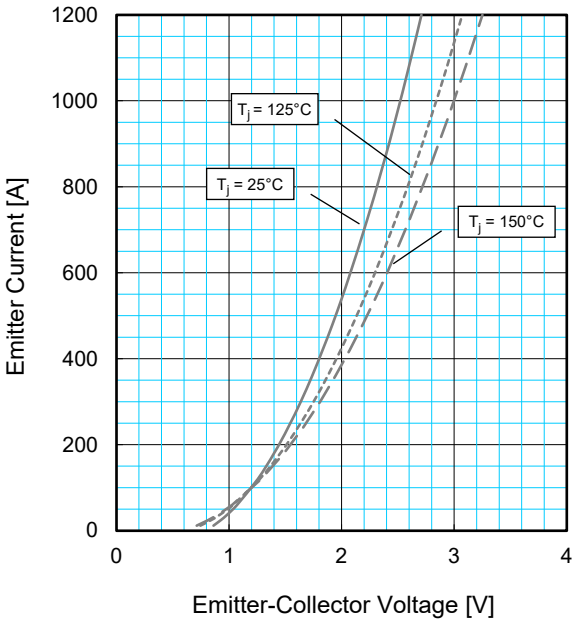
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

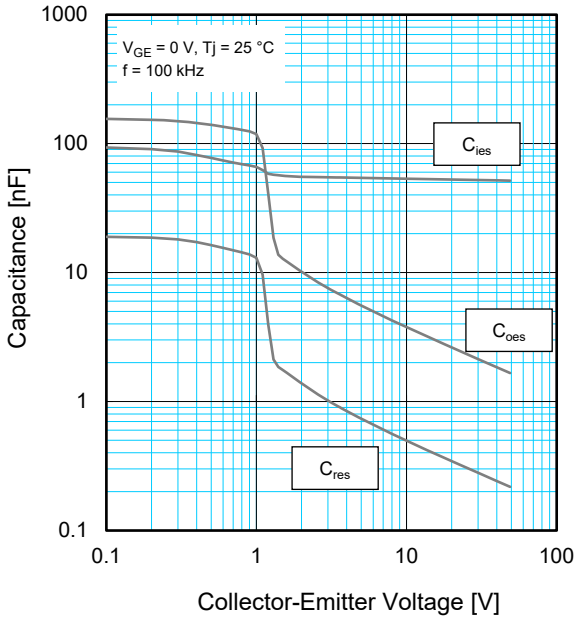


DIODE FORWARD CHARACTERISTICS (TYPICAL)

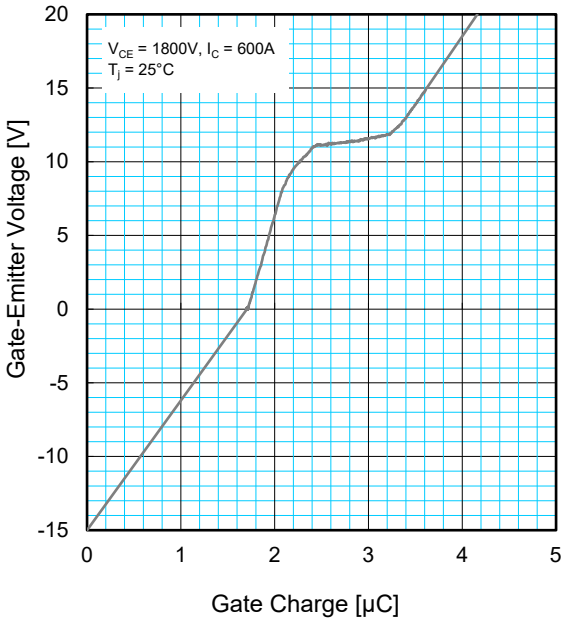


PERFORMANCE CURVES

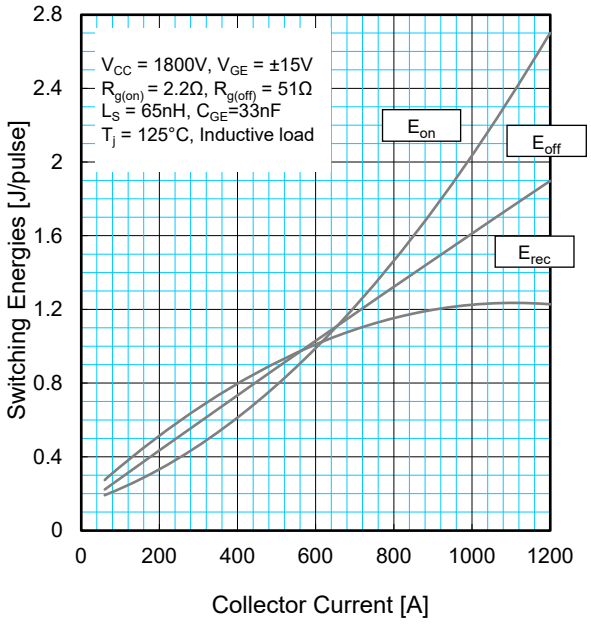
CAPACITANCE CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



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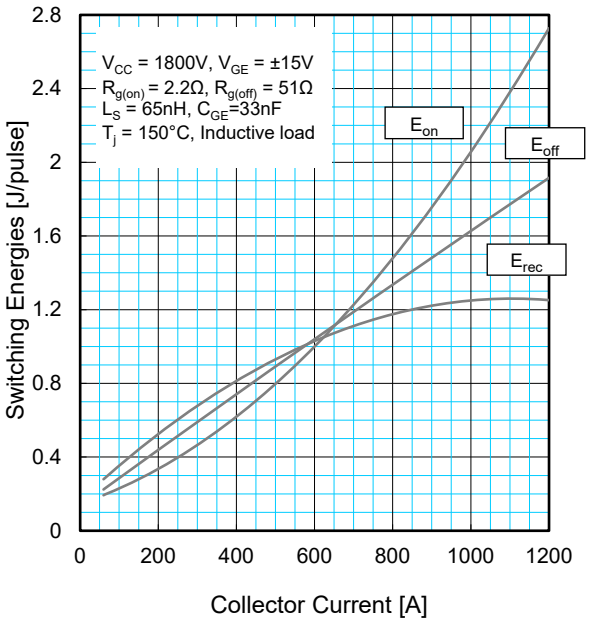

PERFORMANCE CURVES

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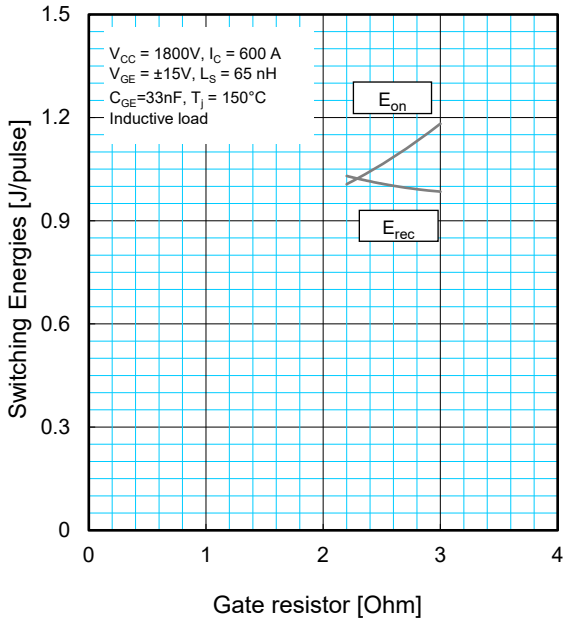

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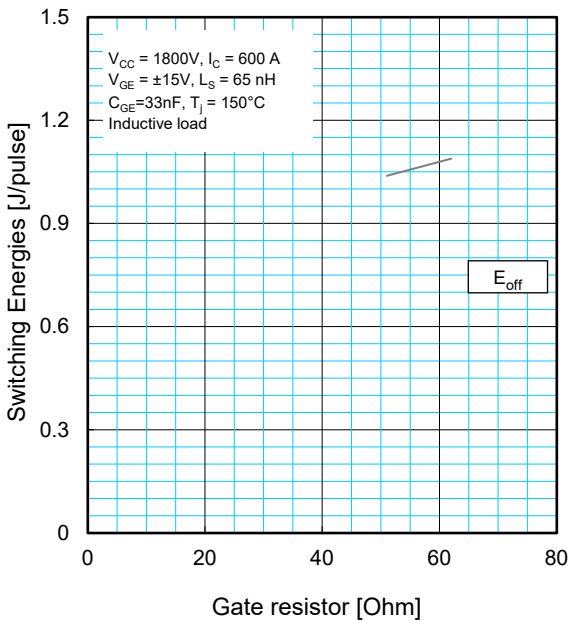
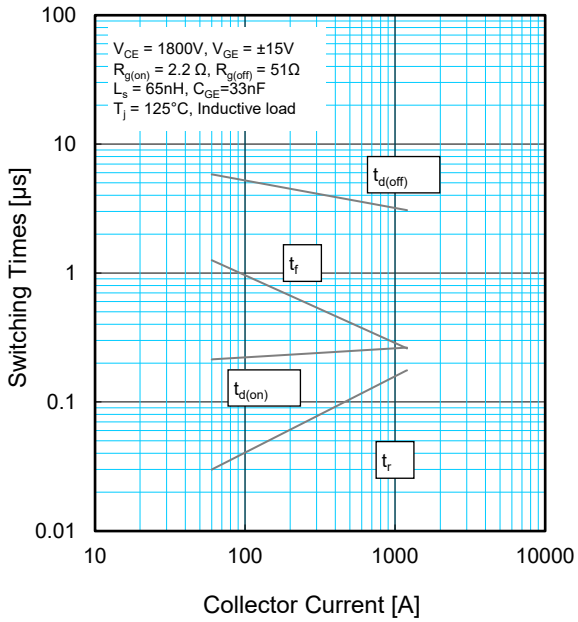
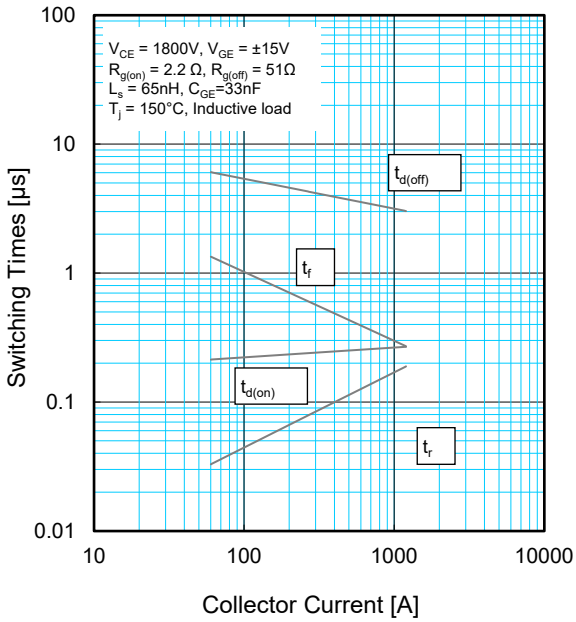


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

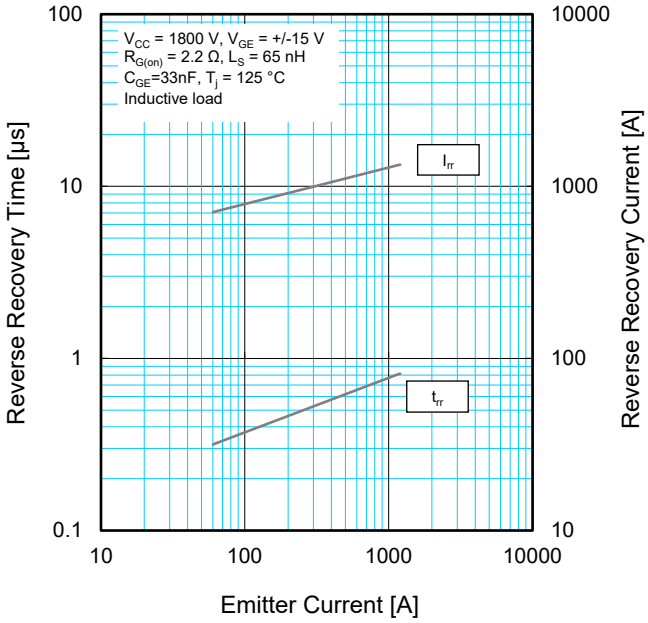


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

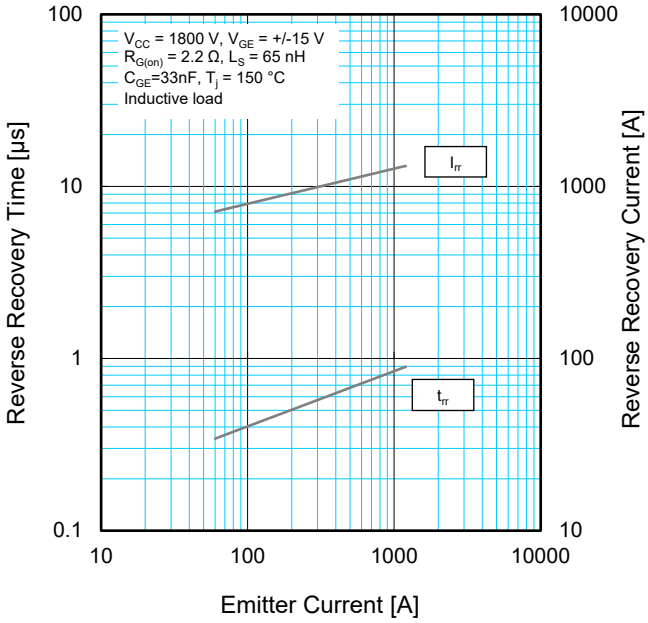


PERFORMANCE CURVES

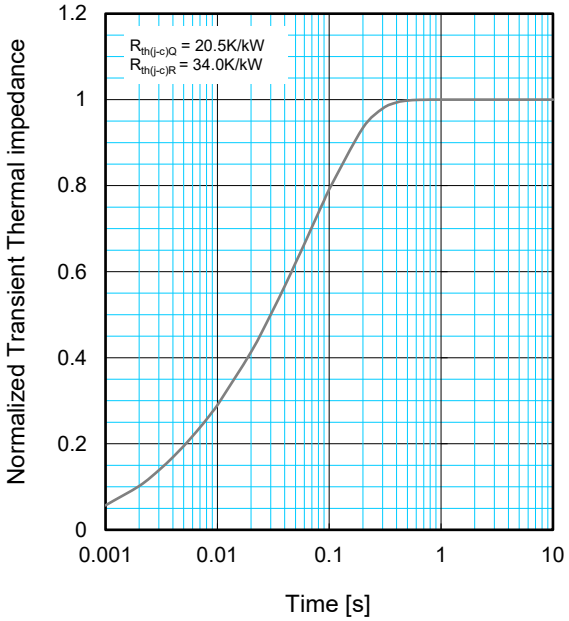
DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS

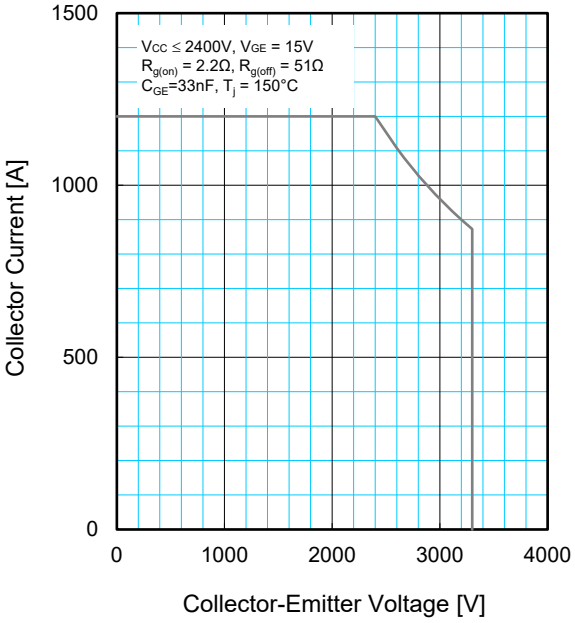


$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{ 1 - exp\left(-\frac{t}{\tau_i} \right) \right\}$$

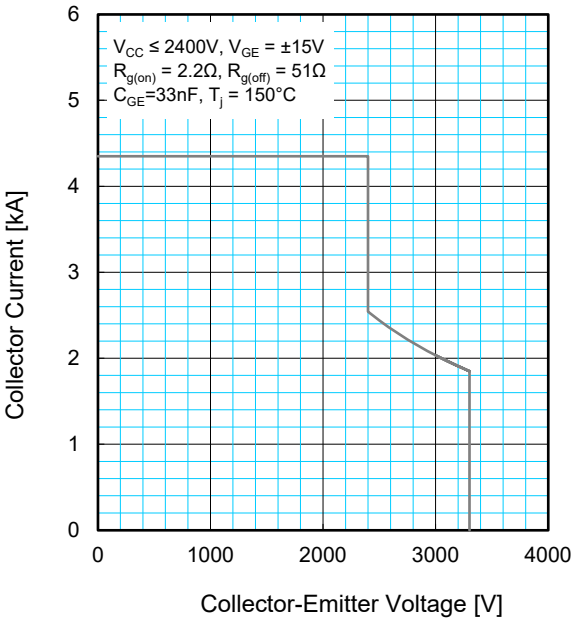
	1	2	3	4
R_i / R_{th} :	0.0292	0.0832	0.2277	0.6599
τ_i [sec.] :	0.0025	0.0027	0.0155	0.0865

PERFORMANCE CURVES

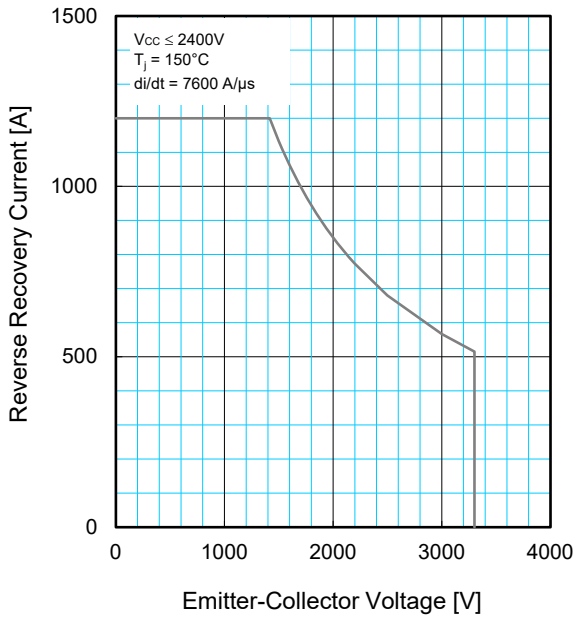
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



DIODE REVERSE RECOVERY SAFE OPERATING AREA (RRSOA)



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