

< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM600DE-66X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM600DE-66X



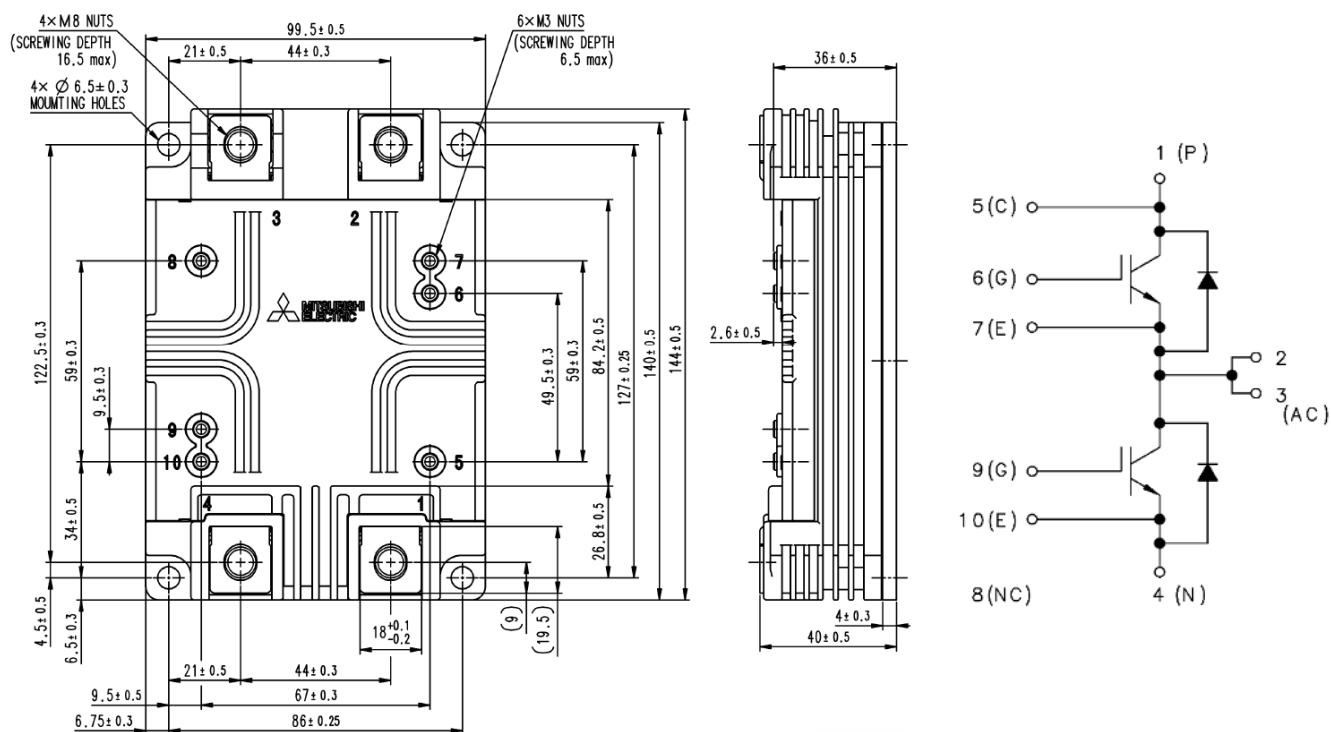
- I_C 600 A
- V_{CES} 3300 V
- 2-elements in a Pack
- High Insulated Type
- AI base type
- CSTBT™(III) / RFC Diode

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	$V_{GE} = 0 \text{ V}, T_j = -50 \text{ }^\circ\text{C}$	3200	V
		$V_{GE} = 0 \text{ V}, T_j = -40 \dots +150 \text{ }^\circ\text{C}$	3300	
V_{GES}	Gate-emitter voltage	$V_{CE} = 0 \text{ V}, T_j = 25 \text{ }^\circ\text{C}$	± 20	V
I_c	Collector current	DC, $T_c = 109 \text{ }^\circ\text{C}$	600	A
		Pulse (Note 1)	1200	
I_E	Emitter current (Note 2)	DC, $T_c = 90 \text{ }^\circ\text{C}$	600	A
		Pulse (Note 1)	1200	
P_{tot}	Maximum power dissipation	$T_c = 25 \text{ }^\circ\text{C}$, IGBT part (Note 3)	6000	W
V_{iso}	Isolation voltage	Charged part to the base-plate RMS sinusoidal, 60 Hz, 1 min., $T_c = 25 \text{ }^\circ\text{C}$	10200	V
Q_{PD}	Partial discharge	Charged part to the base-plate $V1 = 6900 \text{ Vrms}, V2 = 5100 \text{ Vrms}$ AC 60 Hz, $T_c = 25 \text{ }^\circ\text{C}$ (acc. to IEC 61287-1)	10	pC
T_j	Junction temperature	—	$-50 \dots +150$	$^\circ\text{C}$
T_{jop}	Operating junction temperature	—	$-50 \dots +150$	$^\circ\text{C}$
T_{stg}	Storage temperature	—	$-55 \dots +150$	$^\circ\text{C}$
t_{psc}	Short circuit pulse width	$V_{CC} \leq 2400 \text{ V}, V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 2.2 \Omega, R_{G(off)} = 51 \Omega$ $T_j = T_{jop}, C_{GE} = 33 \text{ nF}, L_s = 85 \text{ nH}$	10	μs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I_{CES}	Collector cutoff current	$V_{CE} = V_{CES}$ $V_{GE} = 0 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$	—	2.0	mA	
			$T_j = 125 \text{ }^\circ\text{C}$	—	2.0		
			$T_j = 150 \text{ }^\circ\text{C}$	—	20.0		
$V_{GE(th)}$	Gate-emitter threshold voltage	$V_{CE} = 10 \text{ V}, I_c = 60 \text{ mA}, T_j = 25 \text{ }^\circ\text{C}$	6.5	7.0	7.5	V	
I_{GES}	Gate leakage current	$V_{GE} = V_{GES}, V_{CE} = 0 \text{ V}, T_j = 25 \text{ }^\circ\text{C}$	-0.5	—	0.5	μA	
V_{CEsat}	Collector-emitter saturation voltage	$I_c = 600 \text{ A}$ $V_{GE} = 15 \text{ V}$ (Note 4)	$T_j = 25 \text{ }^\circ\text{C}$	—	2.30	V	
			$T_j = 125 \text{ }^\circ\text{C}$	—	2.80		
			$T_j = 150 \text{ }^\circ\text{C}$	—	2.90		
C_{ies}	Input capacitance	$V_{CE} = 10 \text{ V}, V_{GE} = 0 \text{ V}$ $f = 100 \text{ kHz}, T_j = 25 \text{ }^\circ\text{C}$	—	53.4	—	nF	
C_{oes}	Output capacitance		—	3.8	—		
C_{res}	Reverse transfer capacitance		—	0.5	—		
Q_G	Total gate charge	$V_{CC} = 1800 \text{ V}, I_c = 600 \text{ A}$ $V_{GE} = 15 \text{ V}, T_j = 25 \text{ }^\circ\text{C}$	—	3.6	—	μC	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 1800 \text{ V}$ $I_c = 600 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 2.2 \Omega$ $C_{GE} = 33 \text{ nF}$ $L_s = 85 \text{ nH}$	$T_j = 150 \text{ }^\circ\text{C}$	—	1.25	μs	
t_r	Rise time		$T_j = 150 \text{ }^\circ\text{C}$	—	0.50	μs	
$E_{on(10\%)}$	Turn-on switching energy per pulse (Note 5)		$T_j = 25 \text{ }^\circ\text{C}$	—	0.98	J	
			$T_j = 125 \text{ }^\circ\text{C}$	—	1.19		
			$T_j = 150 \text{ }^\circ\text{C}$	—	1.20		
E_{on}	Turn-on switching energy per pulse	Inductive load	$T_j = 25 \text{ }^\circ\text{C}$	—	1.05	J	
			$T_j = 125 \text{ }^\circ\text{C}$	—	1.27		
			$T_j = 150 \text{ }^\circ\text{C}$	—	1.28		
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 1800 \text{ V}$ $I_c = 600 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G(off)} = 51 \Omega$ $C_{GE} = 33 \text{ nF}$ $L_s = 85 \text{ nH}$	$T_j = 25 \text{ }^\circ\text{C}$	—	3.40	μs	
			$T_j = 125 \text{ }^\circ\text{C}$	—	3.60		
			$T_j = 150 \text{ }^\circ\text{C}$	—	3.65	5.00	
t_f	Fall time		$T_j = 25 \text{ }^\circ\text{C}$	—	0.24	μs	
			$T_j = 125 \text{ }^\circ\text{C}$	—	0.35		
			$T_j = 150 \text{ }^\circ\text{C}$	—	0.37	1.00	
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)	Inductive load	$T_j = 25 \text{ }^\circ\text{C}$	—	0.73	J	
			$T_j = 125 \text{ }^\circ\text{C}$	—	0.99		
			$T_j = 150 \text{ }^\circ\text{C}$	—	1.00		
E_{off}	Turn-off switching energy per pulse		$T_j = 25 \text{ }^\circ\text{C}$	—	0.83	J	
			$T_j = 125 \text{ }^\circ\text{C}$	—	1.12		
			$T_j = 150 \text{ }^\circ\text{C}$	—	1.13		

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ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
V _{EC}	Emitter-collector voltage (Note 2)	I _E = 600 A V _{GE} = 0 V (Note 4)	T _j = 25 °C	—	2.10	—	
			T _j = 125 °C	—	2.30	—	
			T _j = 150 °C	—	2.40	2.90	
t _{rr}	Reverse recovery time (Note 2)	V _{CC} = 1800 V I _E = 600 A V _{GE} = ±15 V R _{G(on)} = 2.2 Ω C _{GE} = 33 nF L _S = 85 nH	T _j = 25 °C	—	0.65	—	
			T _j = 125 °C	—	0.80	—	
			T _j = 150 °C	—	0.85	—	
I _{rr}	Reverse recovery current (Note 2)		T _j = 25 °C	—	970	—	
			T _j = 125 °C	—	930	—	
			T _j = 150 °C	—	910	—	
Q _{rr(10%)}	Reverse recovery charge (Note 2, 6)		T _j = 25 °C	—	600	—	
			T _j = 125 °C	—	740	—	
			T _j = 150 °C	—	775	—	
Q _{rr}	Reverse recovery charge (Note 2)	Inductive load	T _j = 25 °C	—	650	—	
			T _j = 125 °C	—	805	—	
			T _j = 150 °C	—	845	—	
E _{rec(10%)}	Reverse recovery energy per pulse (Note 2, 5)		T _j = 25 °C	—	0.62	—	
			T _j = 125 °C	—	0.83	—	
			T _j = 150 °C	—	0.85	—	
E _{rec}	Reverse recovery energy per pulse (Note 2)		T _j = 25 °C	—	0.71	—	
			T _j = 125 °C	—	0.95	—	
			T _j = 150 °C	—	0.97	—	

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
		Junction to Case, FWDi part, 1/2 module	—	—	34.0	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			Unit
			Min.	Typ.	Max.	
M _t	Mounting torque	Main terminals screw: M8	7.0	—	14.0	N·m
		Mounting screw: M6	3.0	—	6.0	N·m
		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 _{PP-N}	Parasitic stray inductance	Between P-side terminal and N-side terminal	—	40.0	—	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).

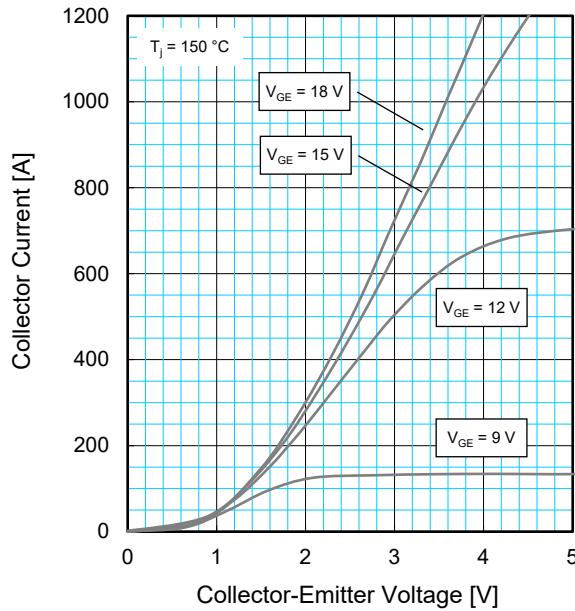
Note3. Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).

Note4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

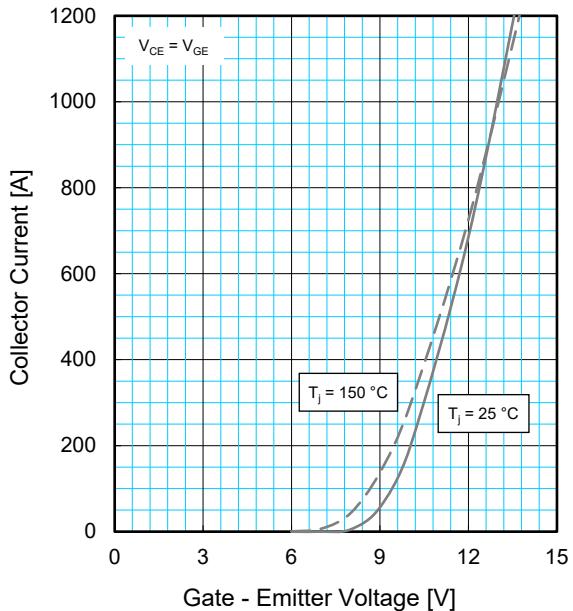
Note5. The integration range of switching energies is from 10%V_{CE} to 10%I_C(I_E).Note6. The integration range of reverse recovery charge is from I_E=0A to 10%I_E

PERFORMANCE CURVES

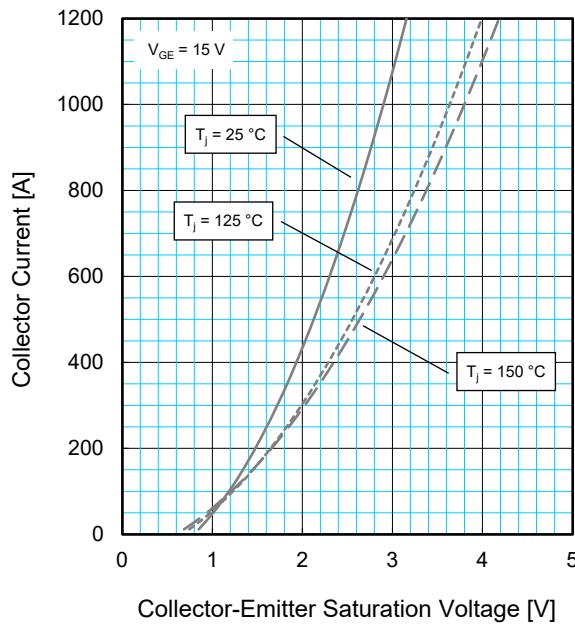
**OUTPUT CHARACTERISTICS
(TYPICAL)**



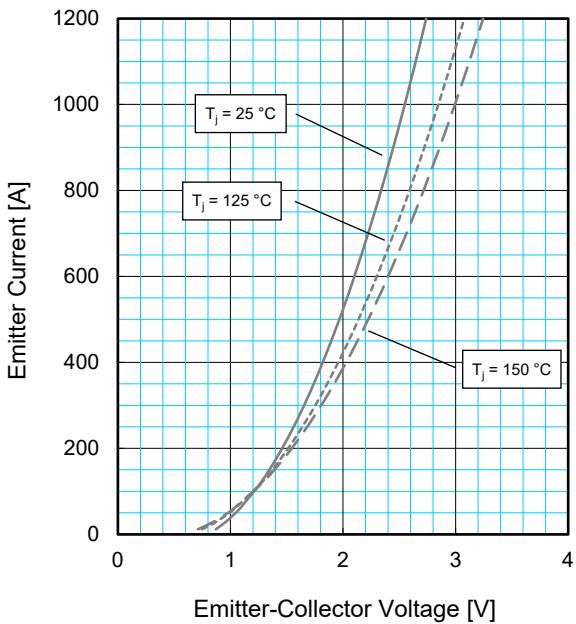
**TRANSFER CHARACTERISTICS
(TYPICAL)**

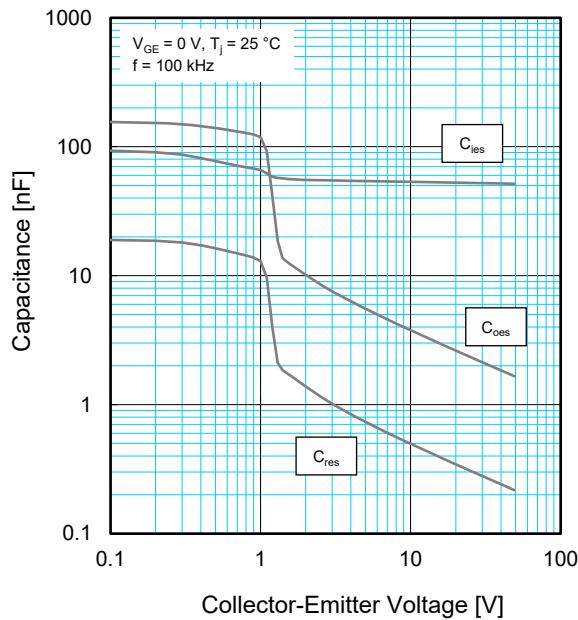
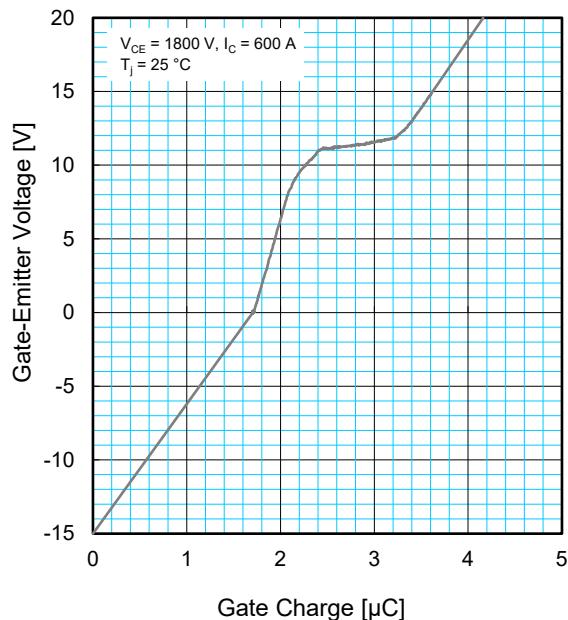
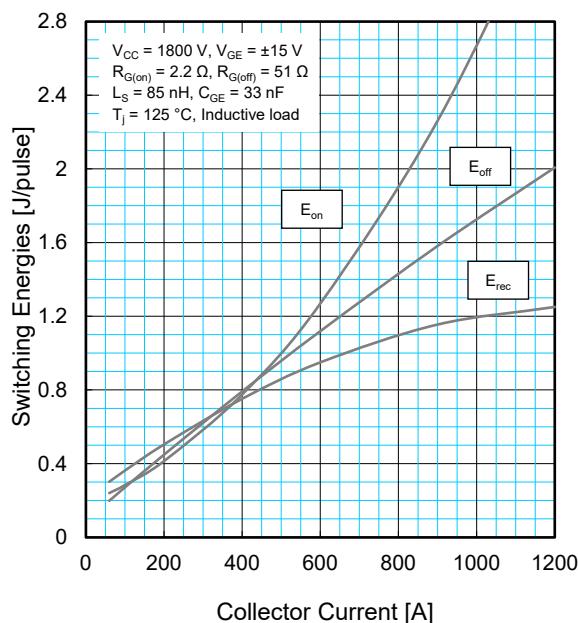
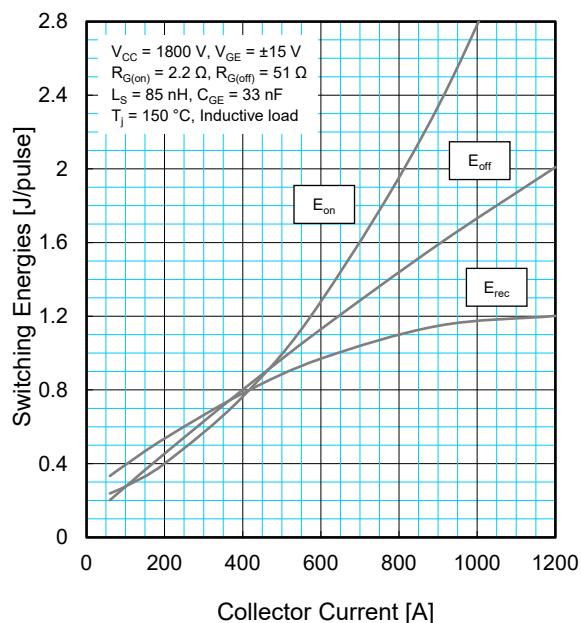


**COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS (TYPICAL)**



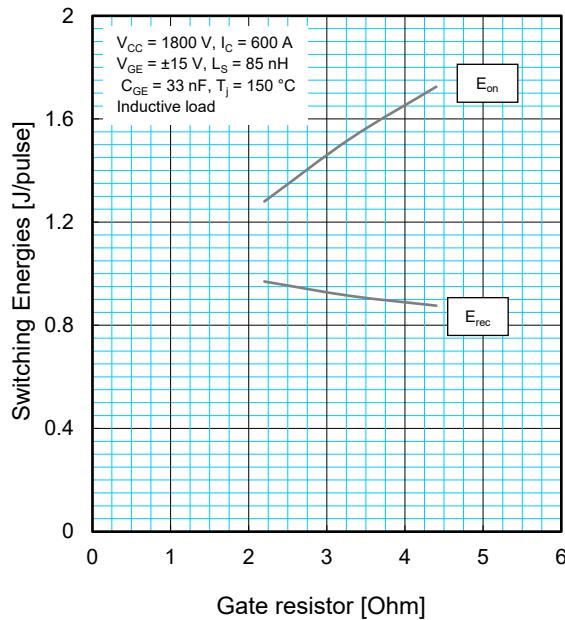
**FREE-WHEEL DIODE FORWARD
CHARACTERISTICS (TYPICAL)**



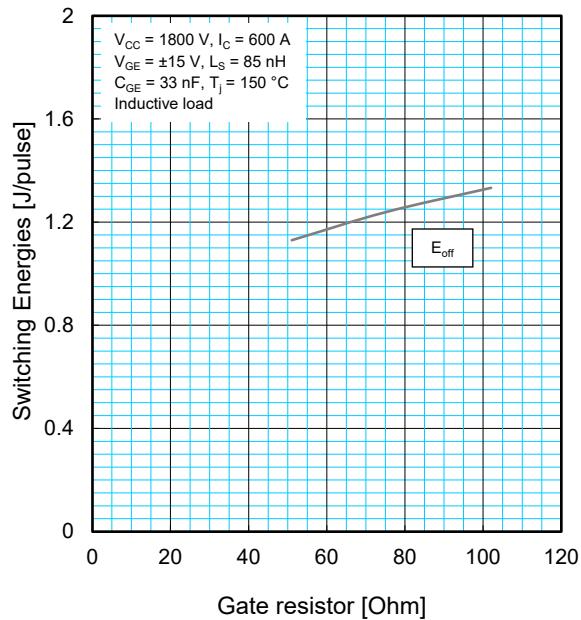
PERFORMANCE CURVES**CAPACITANCE CHARACTERISTICS
(TYPICAL)****GATE CHARGE CHARACTERISTICS
(TYPICAL)****HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)****HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)**

PERFORMANCE CURVES

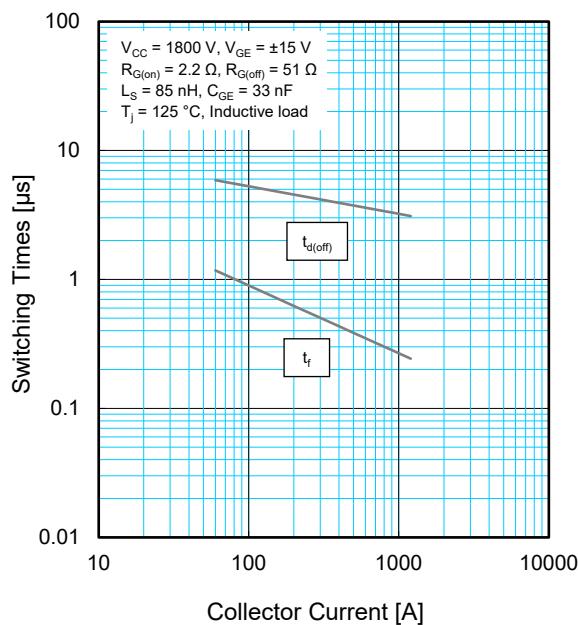
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



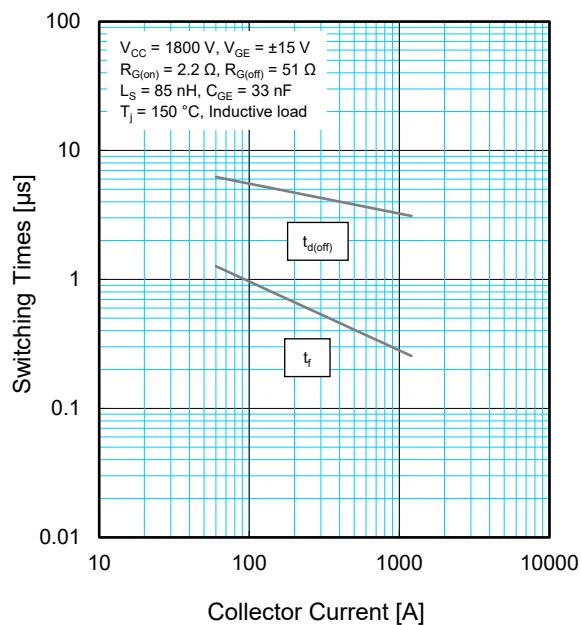
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

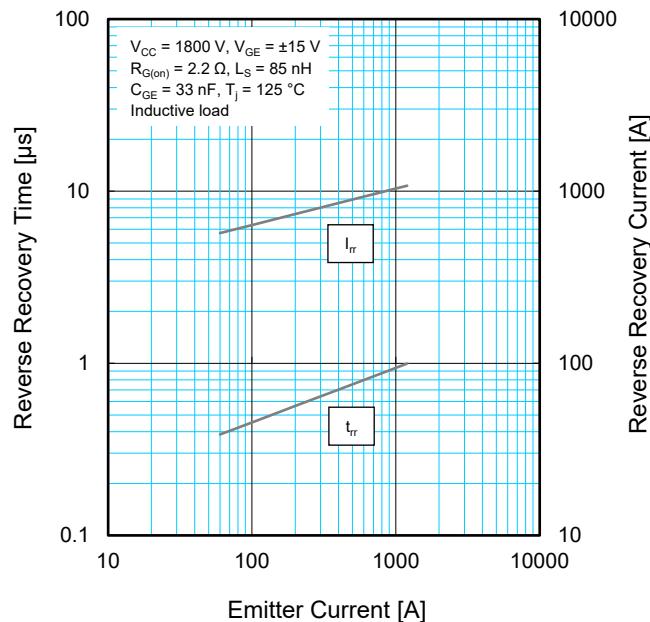


HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)

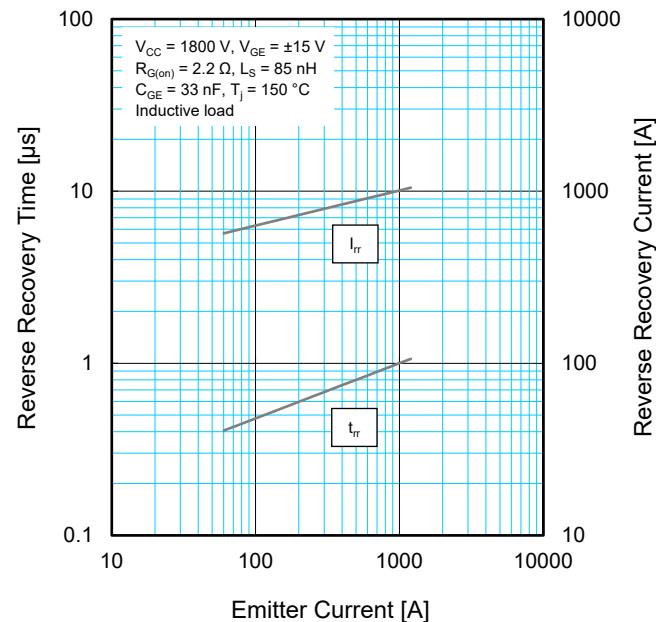


PERFORMANCE CURVES

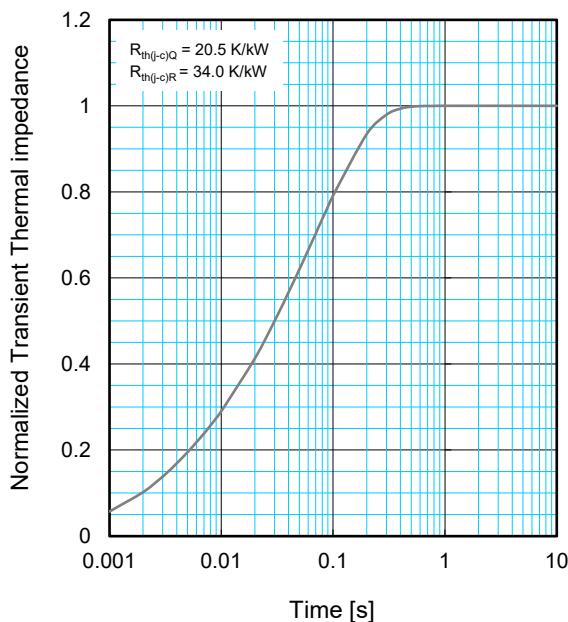
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

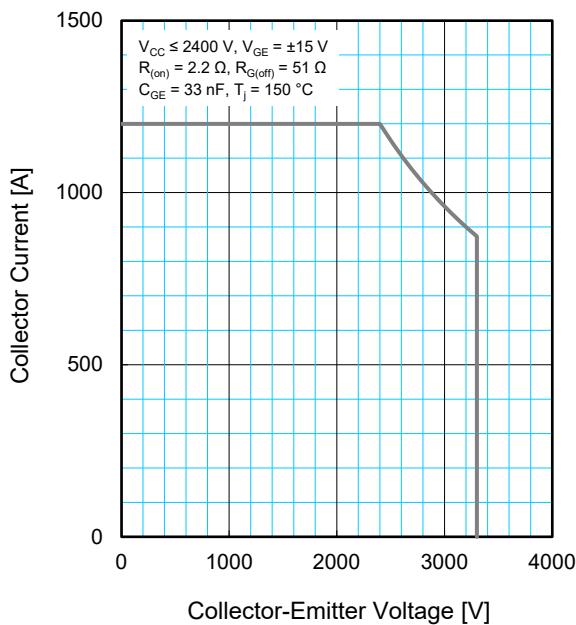
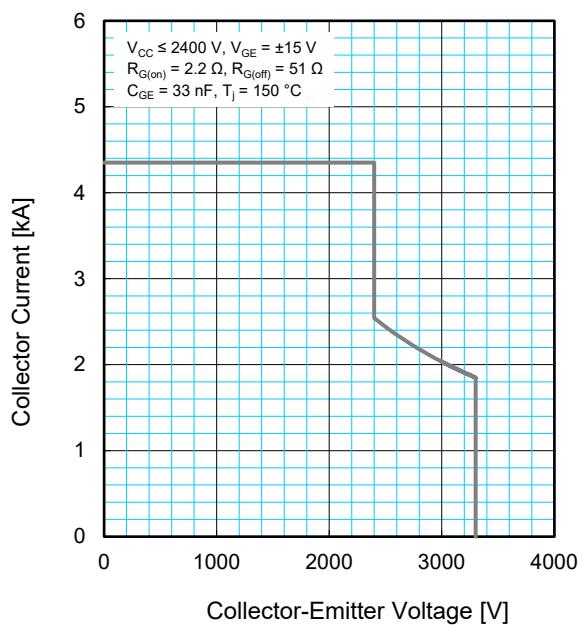
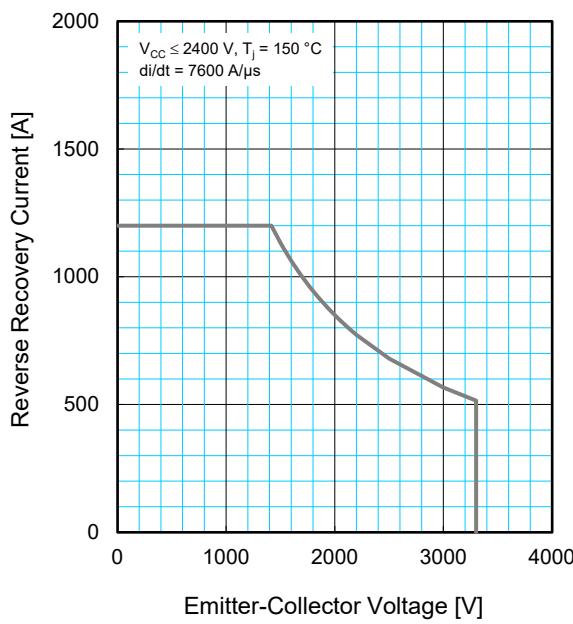


TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



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

	1	2	3	4
$R_i / R_{th(j-c)}$	0.0292	0.0832	0.2277	0.6599
$\tau_i \text{ [s]}$	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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