

< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

# CM450DE-66X

HIGH POWER SWITCHING USE  
INSULATED TYPE

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

## CM450DE-66X



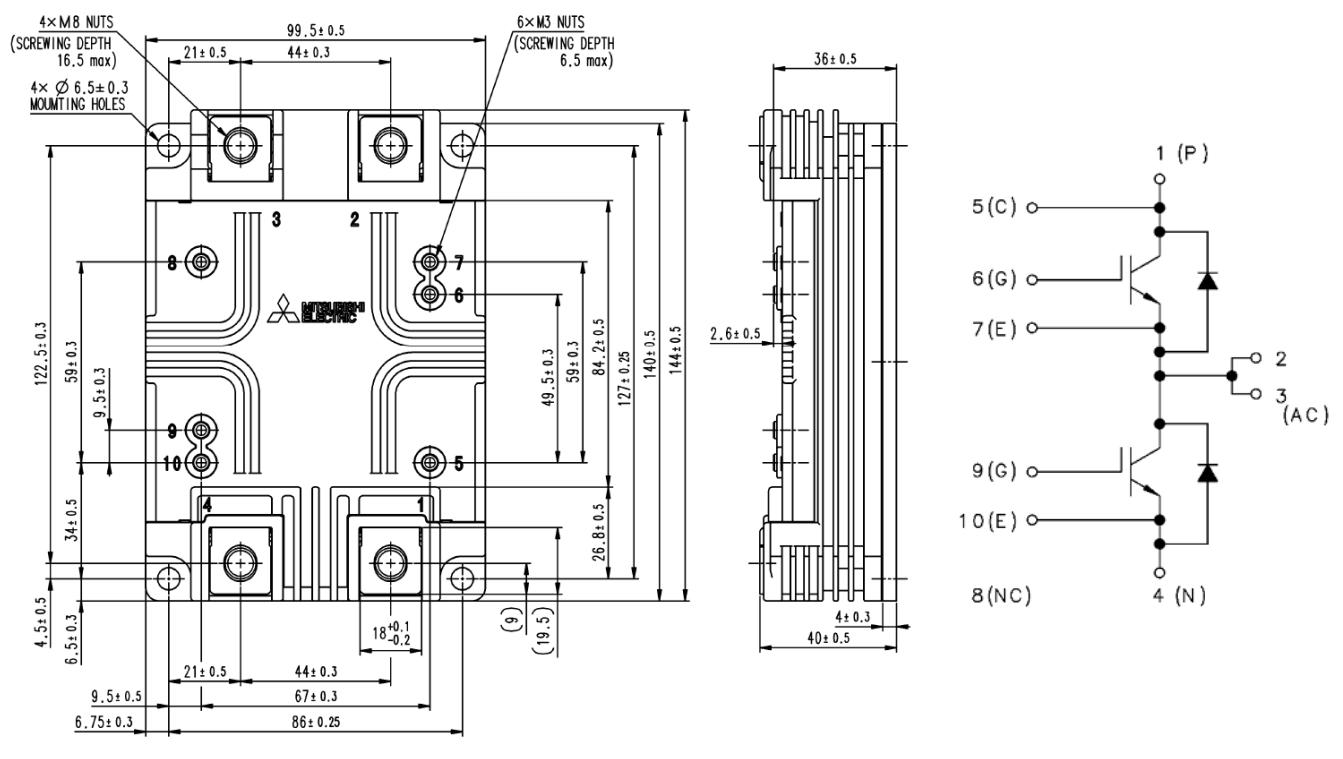
- $I_C$ ..... 450 A
- $V_{CES}$ ..... 3300 V
- 2-elements in a Pack
- Insulated Type (Al base type)
- CSTBT™(III) / RFC Diode

## 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	$V_{GE} = 0V, T_j = -50^\circ C$	3200	V
		$V_{GE} = 0V, T_j = -40...+150^\circ C$	3300	
$V_{GES}$	Gate-emitter voltage	$V_{CE} = 0V, T_j = 25^\circ C$	$\pm 20$	V
$I_c$	Collector current	DC, $T_c = 114^\circ C$	450	A
		Pulse (Note 1)	900	
$I_E$	Emitter current (Note 2)	DC, $T_c = 98^\circ C$	450	A
		Pulse (Note 1)	900	
$P_{tot}$	Maximum power dissipation	$T_c = 25^\circ C$ , IGBT part (Note 3)	5000	W
$V_{iso}$	Isolation voltage	Charged part to the base-plate RMS sinusoidal, 60 Hz 1 min., $T_c = 25^\circ C$	10200	V
$Q_{PD}$	Partial discharge	Charged part to the base-plate $V1 = 6900$ Vrms, $V2 = 5100$ Vrms AC 60 Hz, $T_c = 25^\circ C$ (acc. to IEC 61287-1)	10	pC
$T_j$	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	$V_{CC} \leq 2400$ V, $V_{GE} = \pm 15$ V $R_{G(on)} = 2.7 \Omega$ , $R_{G(off)} = 62 \Omega$ $T_j = T_{jop}$ , $C_{GE} = 33$ nF, $L_s = 85$ nH	10	μs

**ELECTRICAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
$I_{CES}$	Collector cutoff current	$V_{CE} = V_{CES}$ $V_{GE} = 0V$	$T_j = 25^\circ C$	—	1.5	mA	
			$T_j = 125^\circ C$	—	1.5		
			$T_j = 150^\circ C$	—	15.0		
$V_{GE(th)}$	Gate-emitter threshold voltage	$V_{CE} = 10$ V, $I_c = 45$ mA, $T_j = 25^\circ C$	6.5	7.0	7.5	V	
$I_{GES}$	Gate leakage current	$V_{GE} = V_{GES}$ , $V_{CE} = 0$ V, $T_j = 25^\circ C$	-0.5	—	0.5	μA	
$V_{CEsat}$	Collector-emitter saturation voltage	$I_c = 450$ A $V_{GE} = 15$ V (Note 4)	$T_j = 25^\circ C$	—	2.20	V	
			$T_j = 125^\circ C$	—	2.65		
			$T_j = 150^\circ C$	—	2.75		
$C_{ies}$	Input capacitance	$V_{CE} = 10$ V, $V_{GE} = 0$ V $f = 100$ kHz, $T_j = 25^\circ C$	—	44.5	—	nF	
$C_{oes}$	Output capacitance		—	3.1	—		
$C_{res}$	Reverse transfer capacitance		—	0.4	—		
$Q_G$	Total gate charge	$V_{CC} = 1800$ V, $I_c = 450$ A $V_{GE} = \pm 15$ V, $T_j = 25^\circ C$	—	3.0	—	μC	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 1800$ V $I_c = 450$ A $V_{GE} = \pm 15$ V $R_{G(on)} = 2.7 \Omega$ $C_{GE} = 33$ nF $L_s = 85$ nH	$T_j = 150^\circ C$	—	1.25	μs	
$t_r$	Rise time		$T_j = 150^\circ C$	—	0.50	μs	
$E_{on(10\%)}$	Turn-on switching energy per pulse (Note 5)		$T_j = 25^\circ C$	—	0.74	J	
			$T_j = 125^\circ C$	—	0.89		
			$T_j = 150^\circ C$	—	0.90		
$E_{on}$	Turn-on switching energy per pulse	Inductive load	$T_j = 25^\circ C$	—	0.79	J	
			$T_j = 125^\circ C$	—	0.95		
			$T_j = 150^\circ C$	—	0.96		
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 1800$ V $I_c = 450$ A $V_{GE} = \pm 15$ V $R_{G(off)} = 62 \Omega$ $C_{GE} = 33$ nF $L_s = 85$ nH	$T_j = 25^\circ C$	—	3.40	μs	
			$T_j = 125^\circ C$	—	3.60		
			$T_j = 150^\circ C$	—	3.65		
$t_f$	Fall time		$T_j = 25^\circ C$	—	0.24	μs	
			$T_j = 125^\circ C$	—	0.35		
			$T_j = 150^\circ C$	—	0.37		
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)	Inductive load	$T_j = 25^\circ C$	—	0.55	J	
			$T_j = 125^\circ C$	—	0.74		
			$T_j = 150^\circ C$	—	0.75		
$E_{off}$	Turn-off switching energy per pulse		$T_j = 25^\circ C$	—	0.62	J	
			$T_j = 125^\circ C$	—	0.84		
			$T_j = 150^\circ C$	—	0.85		

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**CM450DE-66X**

## HIGH POWER SWITCHING USE

## INSULATED TYPE

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

**ELECTRICAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
V <sub>EC</sub>	Emitter-collector voltage (Note 2)	I <sub>E</sub> = 450 A V <sub>GE</sub> = 0 V (Note 4)	T <sub>j</sub> = 25°C	—	2.00	—	
			T <sub>j</sub> = 125°C	—	2.20	—	
			T <sub>j</sub> = 150°C	—	2.30	2.80	
t <sub>rr</sub>	Reverse recovery time (Note 2)	V <sub>CC</sub> = 1800 V I <sub>C</sub> = 450 A V <sub>GE</sub> = ±15 V R <sub>G(on)</sub> = 2.7 Ω C <sub>GE</sub> = 33 nF L <sub>s</sub> = 85 nH Inductive load	T <sub>j</sub> = 25°C	—	0.65	—	
			T <sub>j</sub> = 125°C	—	0.80	—	
			T <sub>j</sub> = 150°C	—	0.85	—	
I <sub>rr</sub>	Reverse recovery current (Note 2)		T <sub>j</sub> = 25°C	—	720	—	
			T <sub>j</sub> = 125°C	—	690	—	
			T <sub>j</sub> = 150°C	—	680	—	
Q <sub>rr(10%)</sub>	Reverse recovery charge (Note 2, 6)		T <sub>j</sub> = 25°C	—	450	—	
			T <sub>j</sub> = 125°C	—	555	—	
			T <sub>j</sub> = 150°C	—	585	—	
Q <sub>rr</sub>	Reverse recovery charge (Note 2)		T <sub>j</sub> = 25°C	—	490	—	
			T <sub>j</sub> = 125°C	—	605	—	
			T <sub>j</sub> = 150°C	—	635	—	
E <sub>rec(10%)</sub>	Reverse recovery energy per pulse (Note 2, 5)		T <sub>j</sub> = 25°C	—	0.46	—	
			T <sub>j</sub> = 125°C	—	0.62	—	
			T <sub>j</sub> = 150°C	—	0.64	—	
E <sub>rec</sub>	Reverse recovery energy per pulse (Note 2)		T <sub>j</sub> = 25°C	—	0.53	—	
			T <sub>j</sub> = 125°C	—	0.71	—	
			T <sub>j</sub> = 150°C	—	0.73	—	

**THERMAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R <sub>th(j-c)Q</sub>	Thermal resistance	Junction to Case, IGBT part, 1/2 module	—	—	25.0	K/kW
R <sub>th(j-c)D</sub>		Junction to Case, FWDi part, 1/2 module	—	—	41.0	K/kW
R <sub>th(c-s)</sub>	Contact thermal resistance	Case to heat sink, 1/2 module λ <sub>grease</sub> = 1 W/m·K, D <sub>(c-s)</sub> = 70 μm	—	16.0	—	K/kW

**MECHANICAL CHARACTERISTICS**

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M <sub>t</sub>	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 <sub>a</sub>	Clearance	—	26.0	—	—	mm
d <sub>s</sub>	Creepage distance	—	56.0	—	—	mm
L <sub>PP-N</sub>	Parasitic stray inductance	Between P-side terminal and N-side terminal	—	40	—	nH
R <sub>CC+EE'</sub>	Internal lead resistance	T <sub>c</sub> = 25 °C, 1/2 module	—	0.59	—	mΩ

Note1. Pulse width and repetition rate should be such that junction temperature (T<sub>j</sub>) does not exceed maximum T<sub>jop</sub> rating (150°C).

Note2. The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWDi).

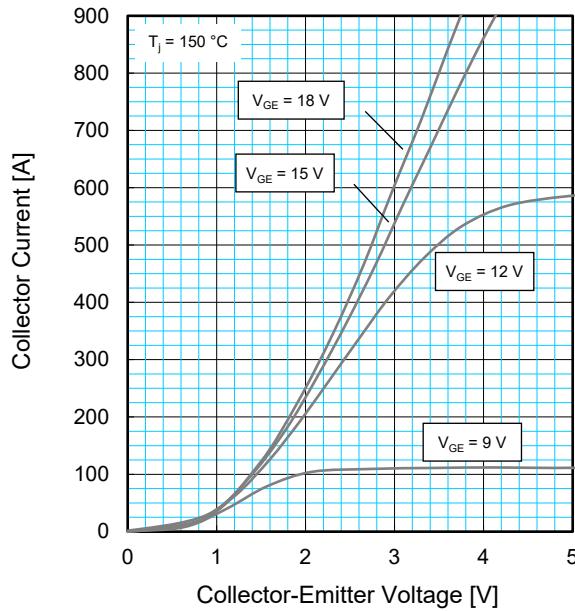
Note3. Junction temperature (T<sub>j</sub>) should not exceed T<sub>jmax</sub> rating (150°C).

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

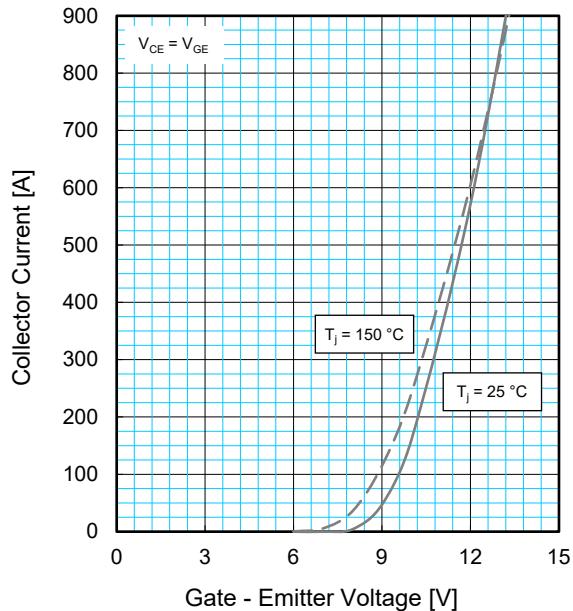
Note5. The integration range of switching energies is from 10%V<sub>CE</sub> to 10%I<sub>C</sub>(I<sub>E</sub>).Note6. The integration range of reverse recovery charge is from I<sub>E</sub>=0A to 10%I<sub>E</sub>

## PERFORMANCE CURVES

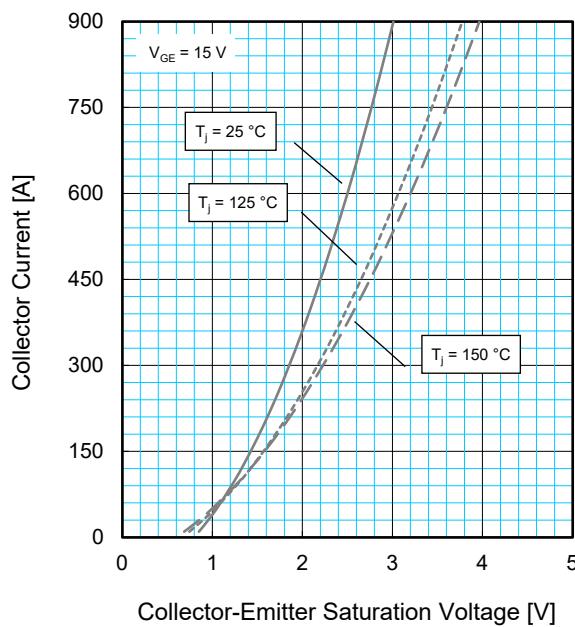
**OUTPUT CHARACTERISTICS  
(TYPICAL)**



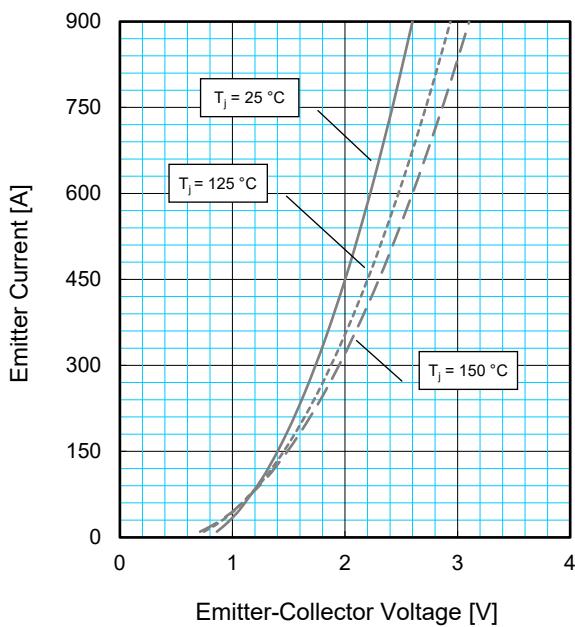
**TRANSFER CHARACTERISTICS  
(TYPICAL)**



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

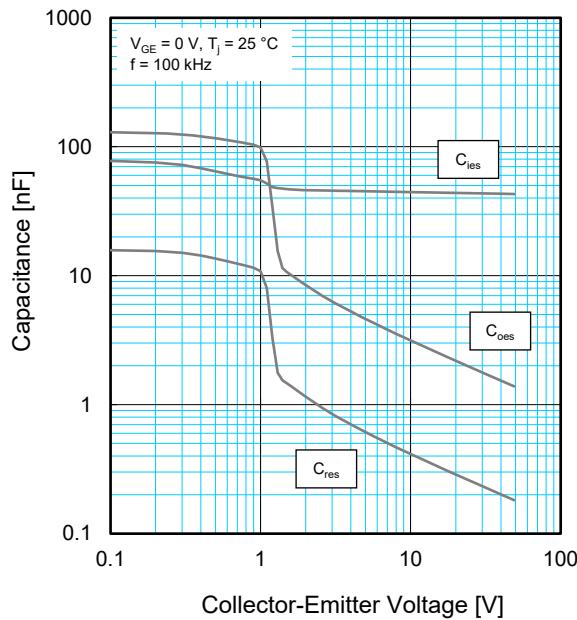


**FREE-WHEEL DIODE FORWARD  
CHARACTERISTICS (TYPICAL)**

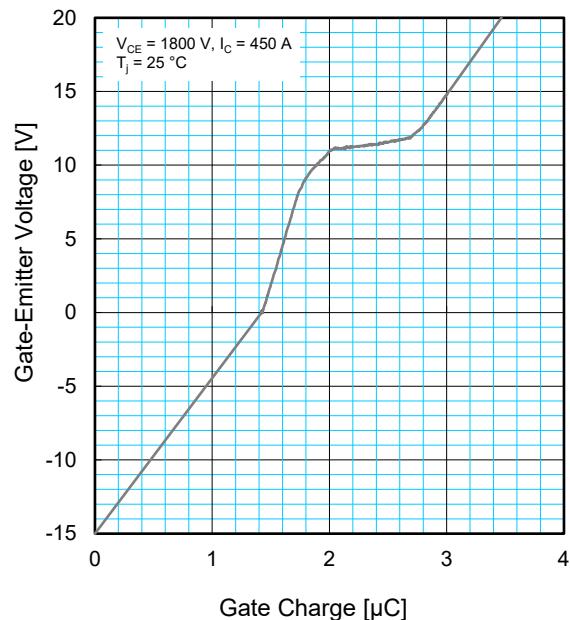


## PERFORMANCE CURVES

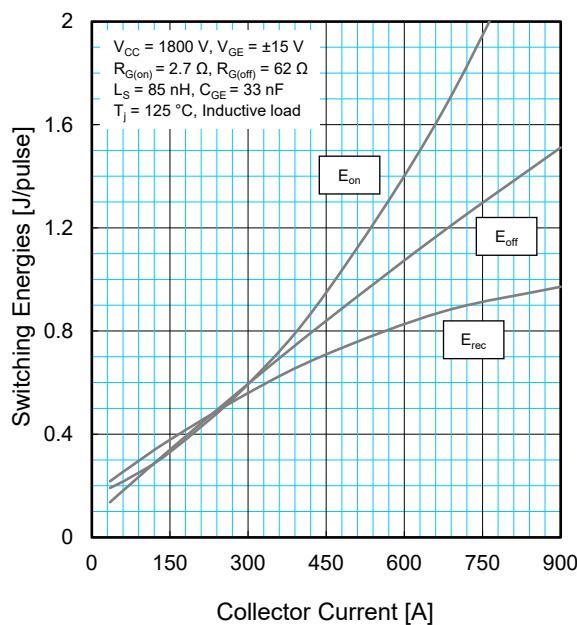
**CAPACITANCE CHARACTERISTICS  
(TYPICAL)**



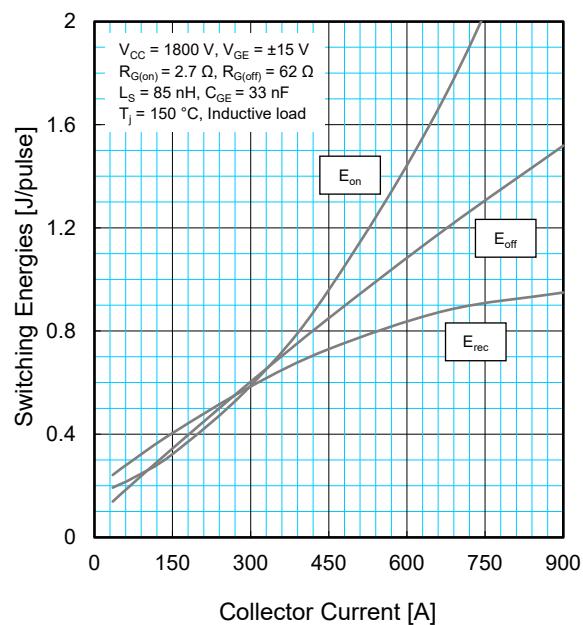
**GATE CHARGE CHARACTERISTICS  
(TYPICAL)**



**HALF-BRIDGE SWITCHING ENERGY  
CHARACTERISTICS (TYPICAL)**

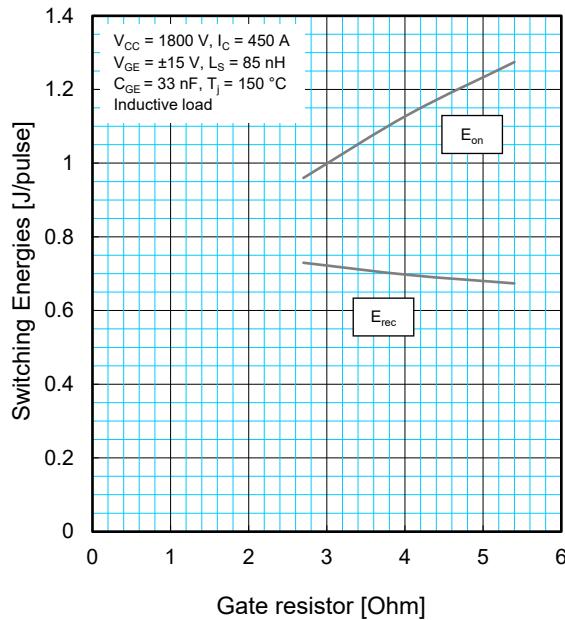


**HALF-BRIDGE SWITCHING ENERGY  
CHARACTERISTICS (TYPICAL)**

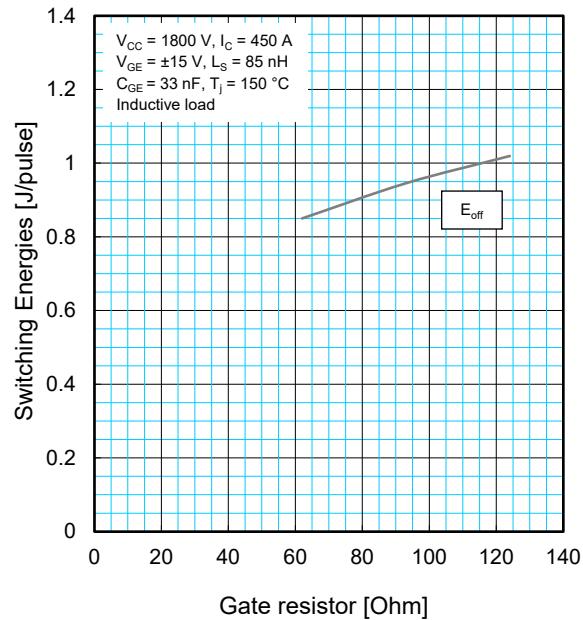


## PERFORMANCE CURVES

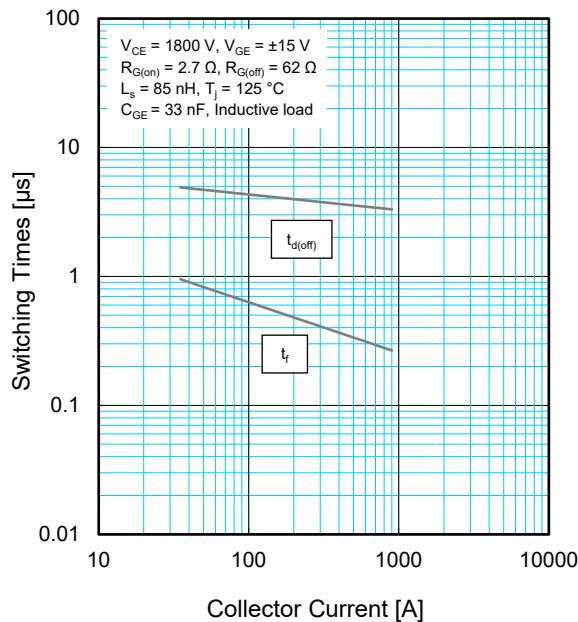
### HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



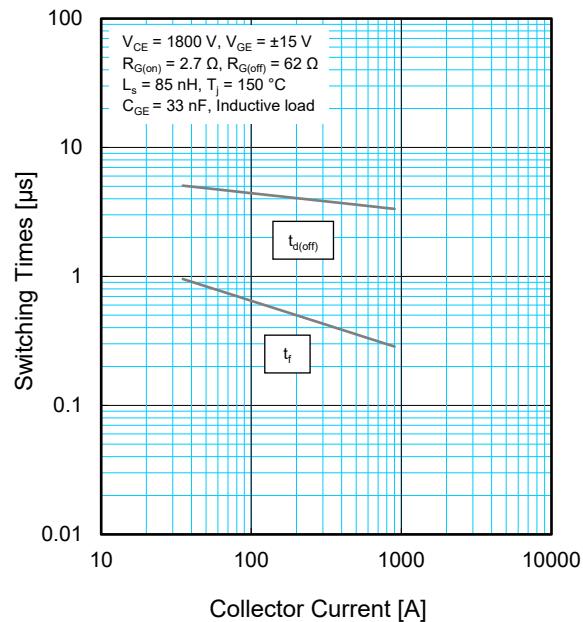
### HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

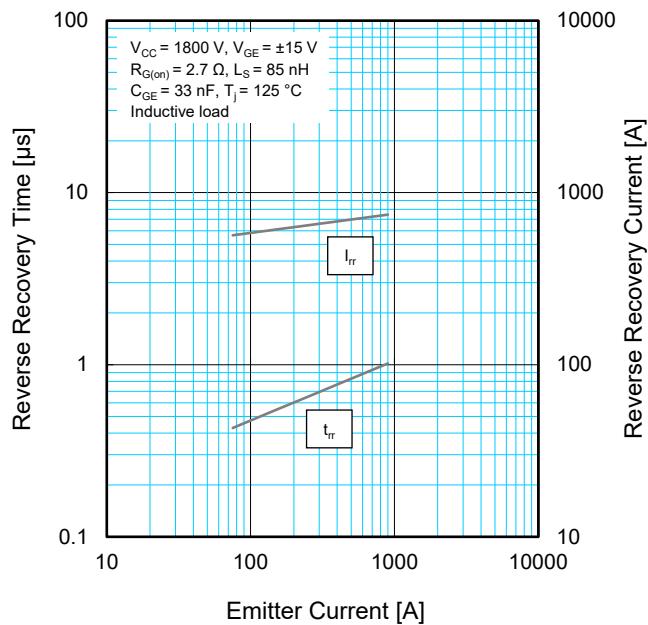
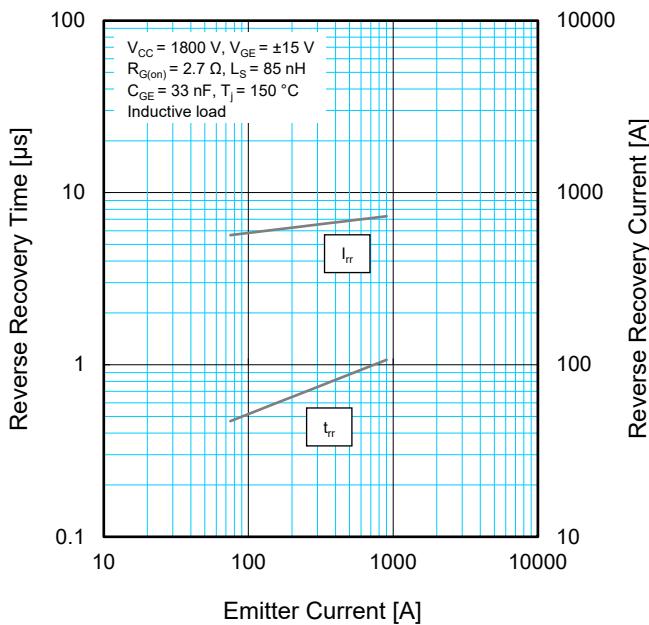
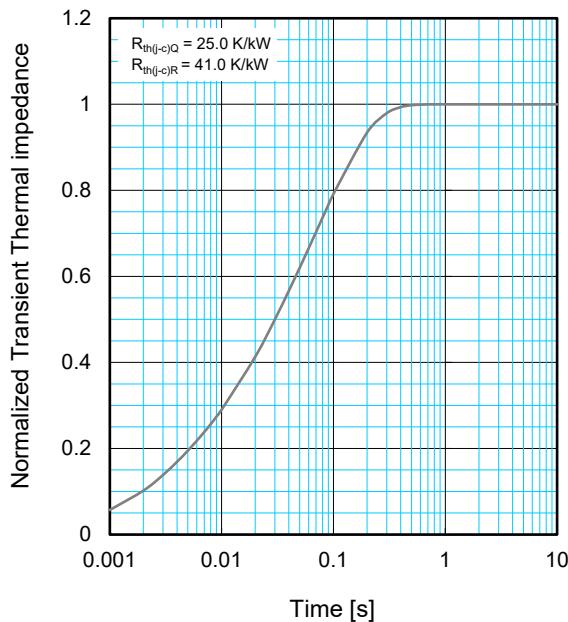


### HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



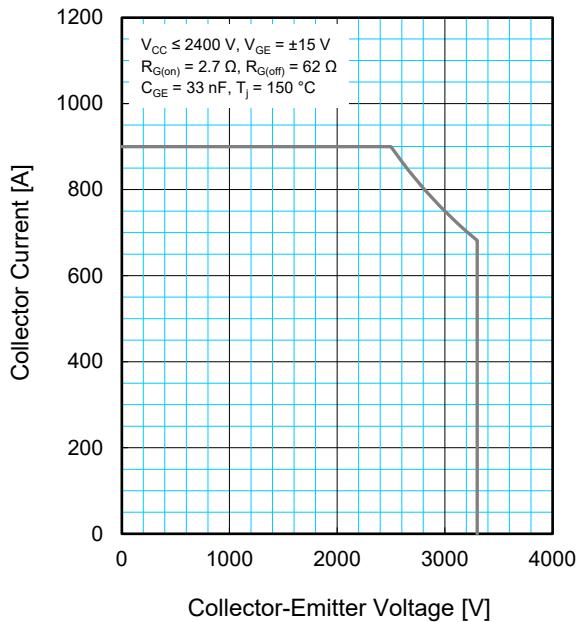
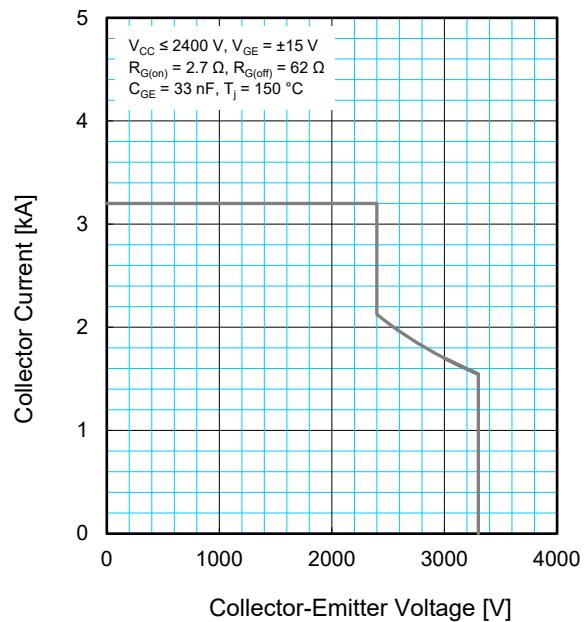
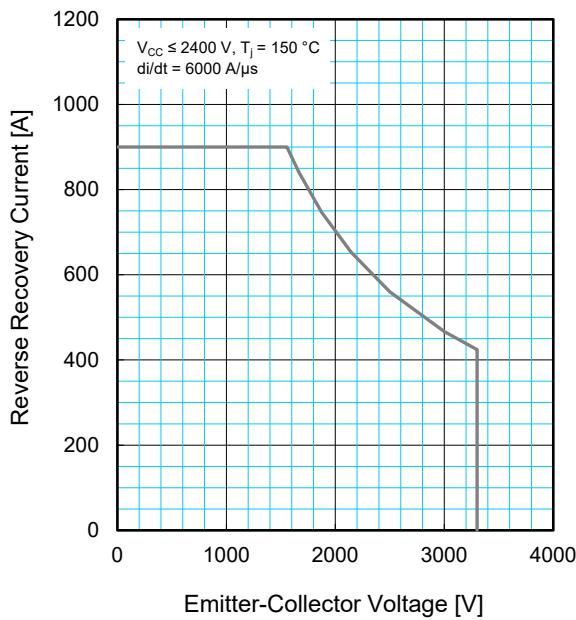
### HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



**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
$\tau_i$ [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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