

< 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



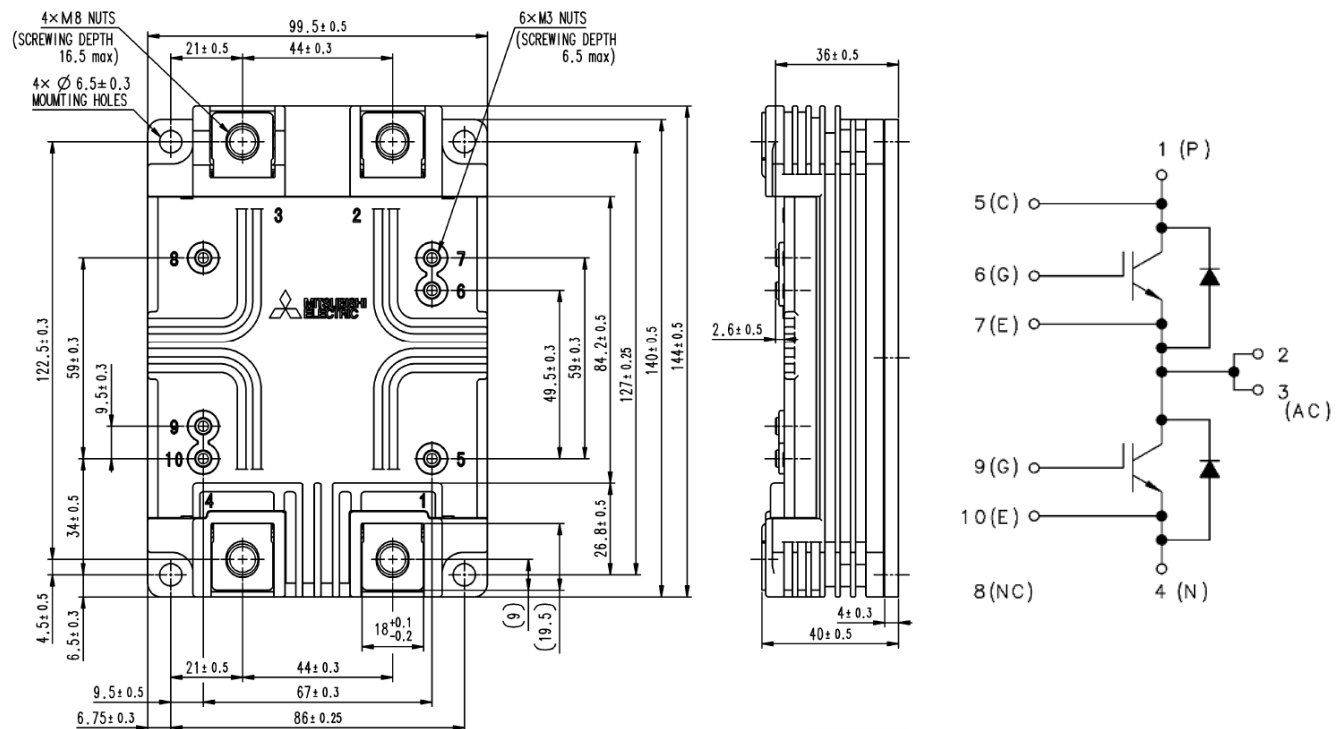
- I_C450 A
- V_{CES}3300 V
- 2-elements in a Pack
- Insulated Type (Al base type)
- CSTBT™(III) / RFC Diode

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



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MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{CES}	Collector-emitter voltage	$V_{GE} = 0V, T_J = -50\text{ }^{\circ}\text{C}$	3200	V
		$V_{GE} = 0V, T_J = -40\ldots+150\text{ }^{\circ}\text{C}$	3300	
V_{GES}	Gate-emitter voltage	$V_{CE} = 0V, T_J = 25\text{ }^{\circ}\text{C}$	± 20	V
I_C	Collector current	DC, $T_c = 114\text{ }^{\circ}\text{C}$	450	A
I_{CRM}		Pulse (Note 1)	900	
I_E	Emitter current (Note 2)	DC, $T_c = 98\text{ }^{\circ}\text{C}$	450	A
I_{ERM}		Pulse (Note 1)	900	
P_{tot}	Maximum power dissipation	$T_c = 25\text{ }^{\circ}\text{C}$, IGBT part (Note 3)	5000	W
V_{iso}	Isolation voltage	Charged part to the base-plate RMS sinusoidal, 60 Hz 1 min., $T_c = 25\text{ }^{\circ}\text{C}$	10200	V
Q_{PD}	Partial discharge	Charged part to the base-plate $V_1 = 6900\text{ Vrms}$, $V_2 = 5100\text{ Vrms}$ AC 60 Hz, $T_c = 25\text{ }^{\circ}\text{C}$ (acc. to IEC 61287-1)	10	pC
T_J	Junction temperature	—	$-50 \sim +150$	$^{\circ}\text{C}$
T_{Jop}	Operating junction temperature	—	$-50 \sim +150$	$^{\circ}\text{C}$
T_{stg}	Storage temperature	—	$-55 \sim +150$	$^{\circ}\text{C}$
t_{psc}	Short circuit pulse width	$V_{CC} \leq 2400\text{ V}$, $V_{GE} = \pm 15\text{ V}$ $R_{G(on)} = 2.7\text{ }\Omega$, $R_{G(off)} = 62\text{ }\Omega$ $T_J = T_{Jop}$, $C_{GE} = 33\text{ nF}$, $L_S = 85\text{ nH}$	10	μs

ELECTRICAL CHARACTERISTICS

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

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ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
V_{EC}	Emitter-collector voltage (Note 2)	$I_E = 450\text{ A}$ $V_{GE} = 0\text{ V}$ (Note 4)	$T_J = 25^\circ\text{C}$ — $T_J = 125^\circ\text{C}$ — $T_J = 150^\circ\text{C}$ —	2.00 2.20 2.30	— — 2.80	V
t_{rr}	Reverse recovery time (Note 2)	$V_{CC} = 1800\text{ V}$ $I_C = 450\text{ A}$ $V_{GE} = \pm 15\text{ V}$ $R_{G(on)} = 2.7\ \Omega$ $C_{GE} = 33\text{ nF}$ $L_s = 85\text{ nH}$ Inductive load	$T_J = 25^\circ\text{C}$ — $T_J = 125^\circ\text{C}$ — $T_J = 150^\circ\text{C}$ —	0.65 0.80 0.85	— — —	μs
I_{rr}	Reverse recovery current (Note 2)		$T_J = 25^\circ\text{C}$ — $T_J = 125^\circ\text{C}$ — $T_J = 150^\circ\text{C}$ —	720 690 680	— — —	A
$Q_{rr(10\%)}$	Reverse recovery charge (Note 2, 6)		$T_J = 25^\circ\text{C}$ — $T_J = 125^\circ\text{C}$ — $T_J = 150^\circ\text{C}$ —	450 555 585	— — —	μC
Q_{rr}	Reverse recovery charge (Note 2)		$T_J = 25^\circ\text{C}$ — $T_J = 125^\circ\text{C}$ — $T_J = 150^\circ\text{C}$ —	490 605 635	— — —	μC
$E_{rec(10\%)}$	Reverse recovery energy per pulse (Note 2, 5)		$T_J = 25^\circ\text{C}$ — $T_J = 125^\circ\text{C}$ — $T_J = 150^\circ\text{C}$ —	0.46 0.62 0.64	— — —	J
E_{rec}	Reverse recovery energy per pulse (Note 2)		$T_J = 25^\circ\text{C}$ — $T_J = 125^\circ\text{C}$ — $T_J = 150^\circ\text{C}$ —	0.53 0.71 0.73	— — —	J

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	—	—	25.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part, 1/2 module	—	—	41.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, 1/2 module $\lambda_{grease} = 1\text{ W/m}\cdot\text{K}$, $D_{(c-s)} = 70\ \mu\text{m}$	—	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	—	26.0	—	—	mm
d_s	Creepage distance	—	56.0	—	—	mm
L_{P-P-N}	Parasitic stray inductance	Between P-side terminal and N-side terminal	—	40	—	nH
$R_{CC'+EE'}$	Internal lead resistance	$T_c = 25^\circ\text{C}$, 1/2 module	—	0.59	—	m Ω

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 $I_E=0\text{A}$ to $10\%I_E$.

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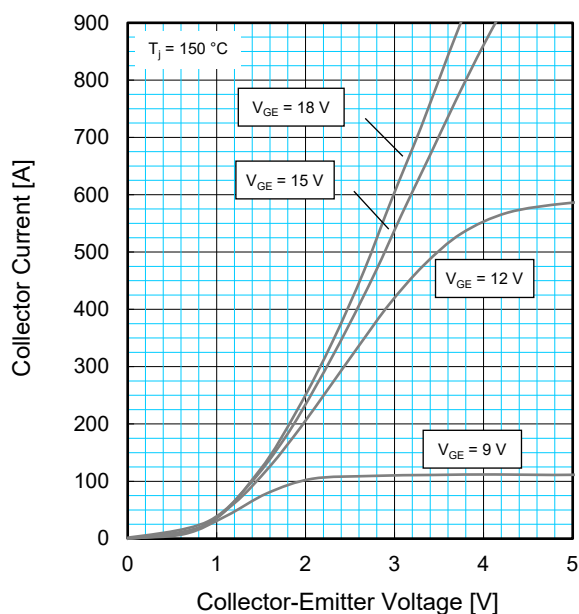
HIGH POWER SWITCHING USE

INSULATED TYPE

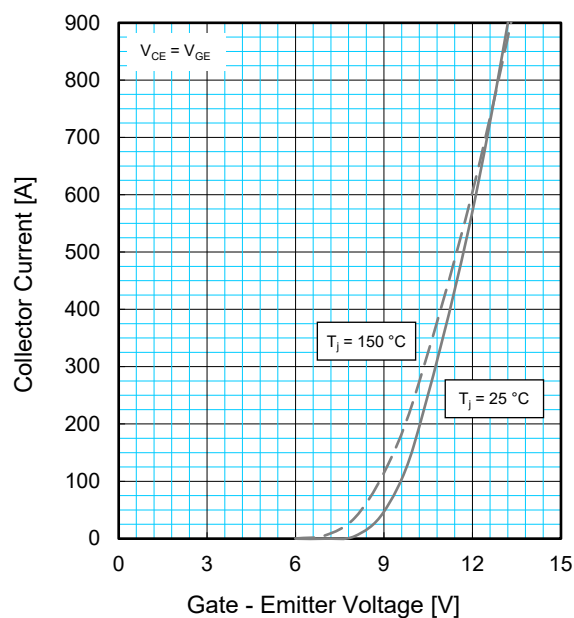
5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

PERFORMANCE CURVES

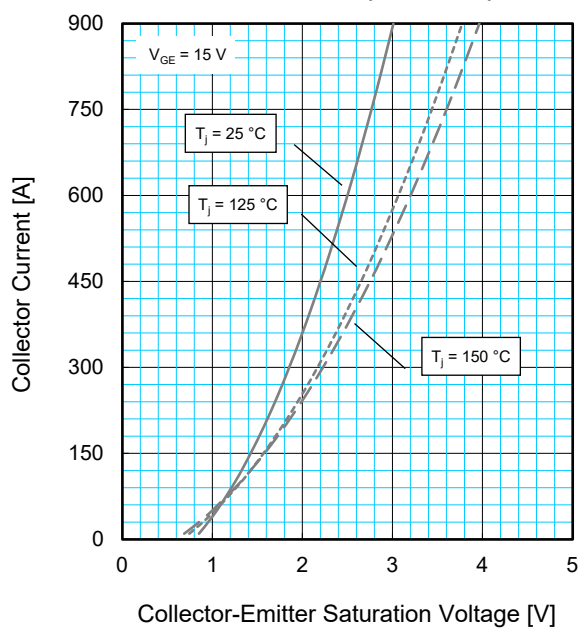
OUTPUT CHARACTERISTICS
(TYPICAL)



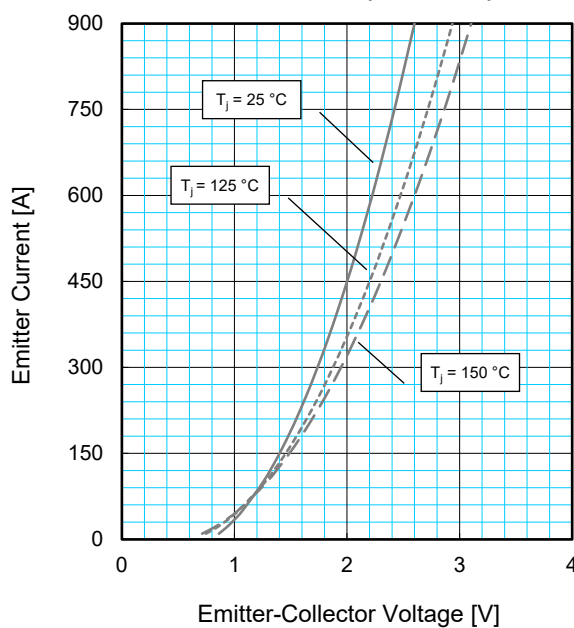
TRANSFER CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE FORWARD
CHARACTERISTICS (TYPICAL)



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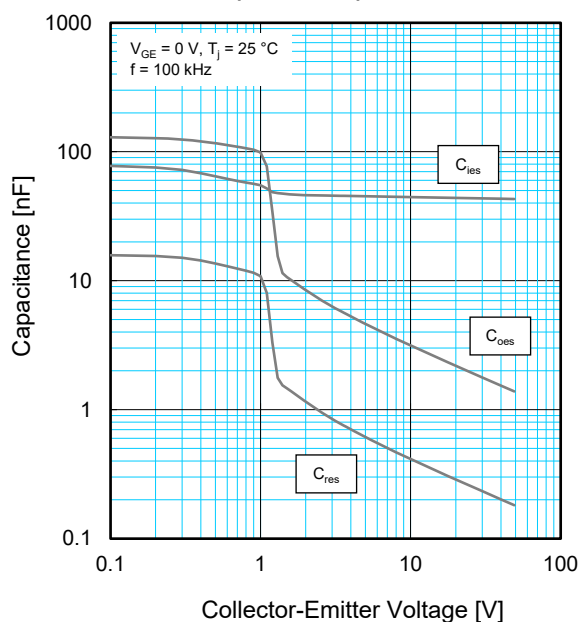
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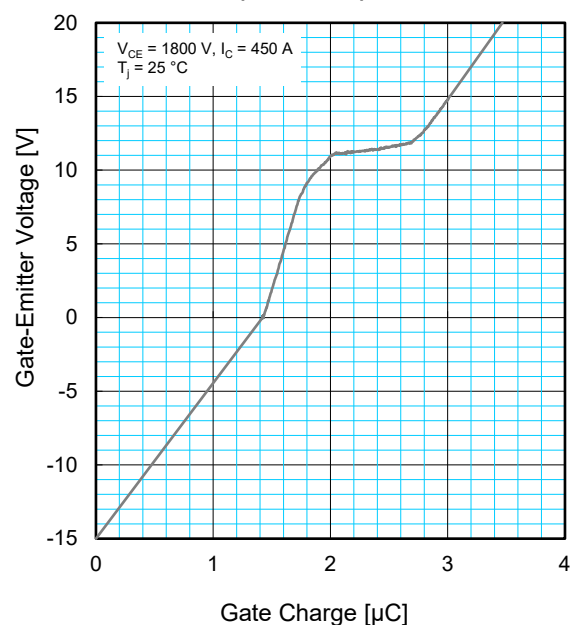
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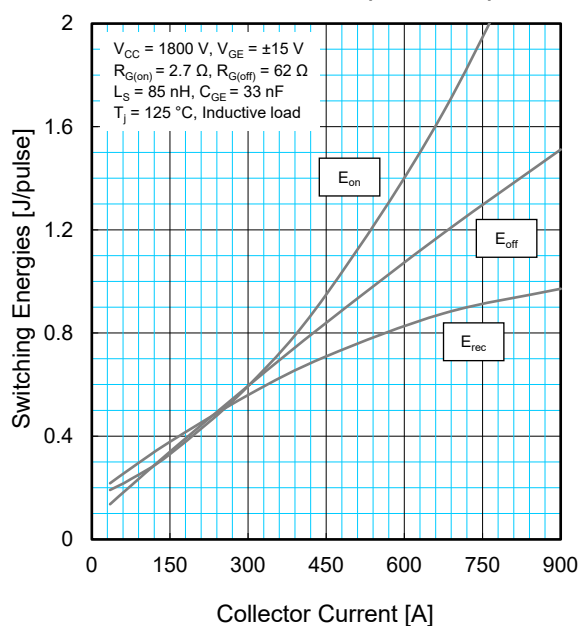
**CAPACITANCE CHARACTERISTICS
(TYPICAL)**



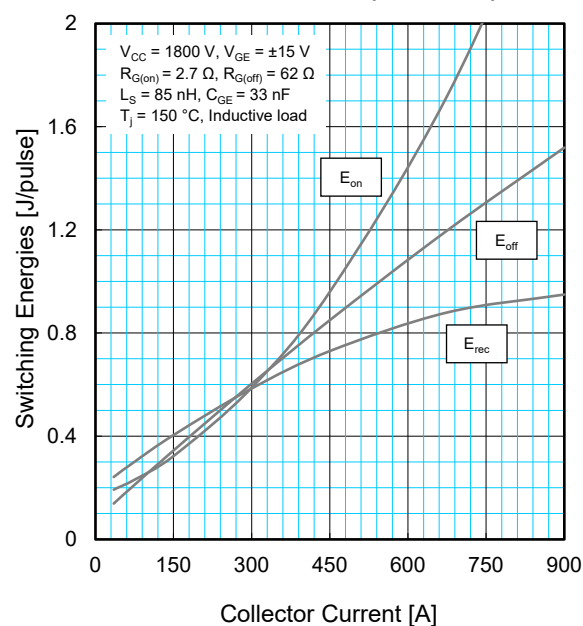
**GATE CHARGE CHARACTERISTICS
(TYPICAL)**



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



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

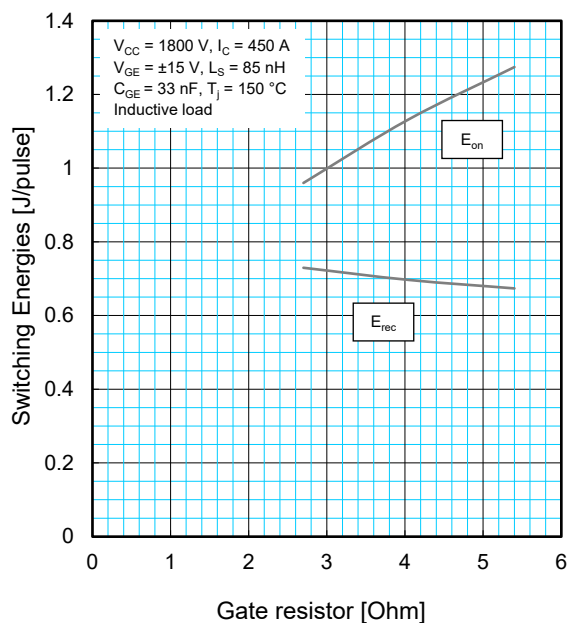
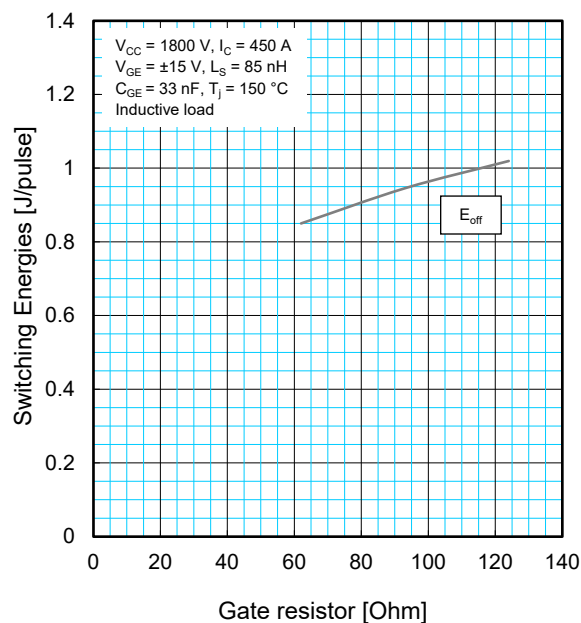
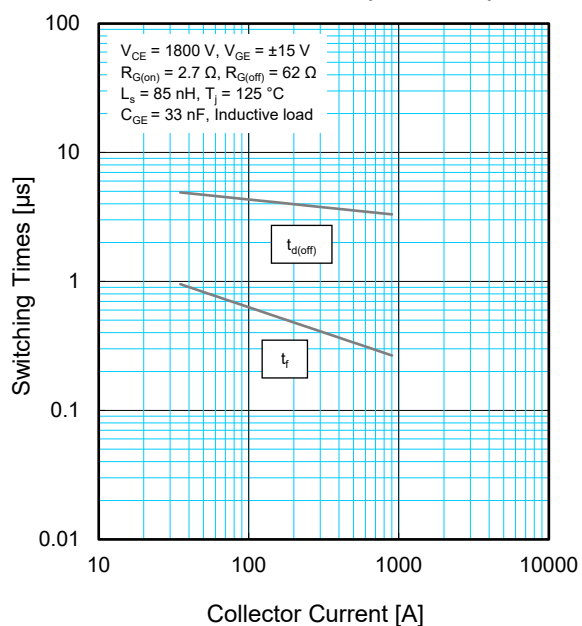
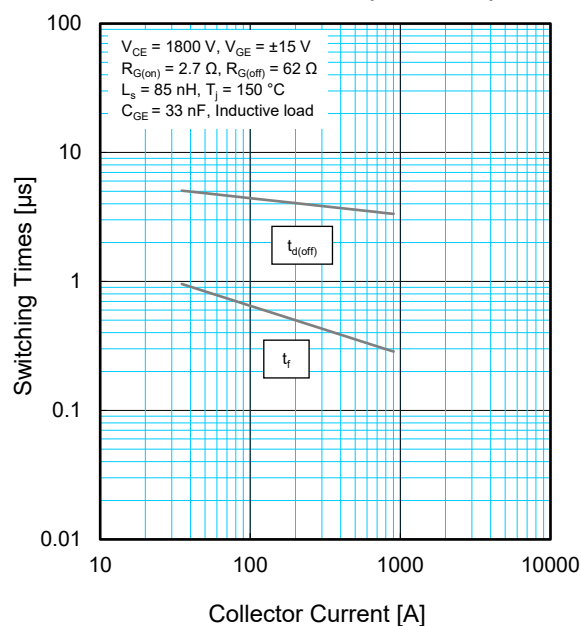


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PERFORMANCE CURVES**HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)****HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)****HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)****HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)**

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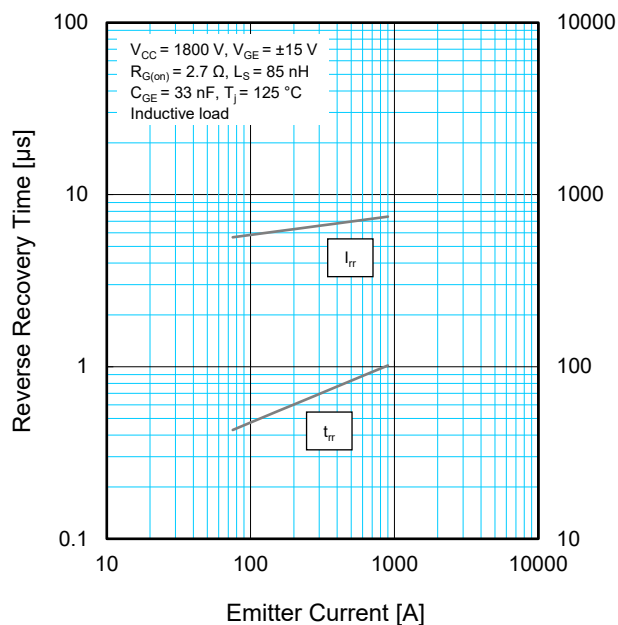
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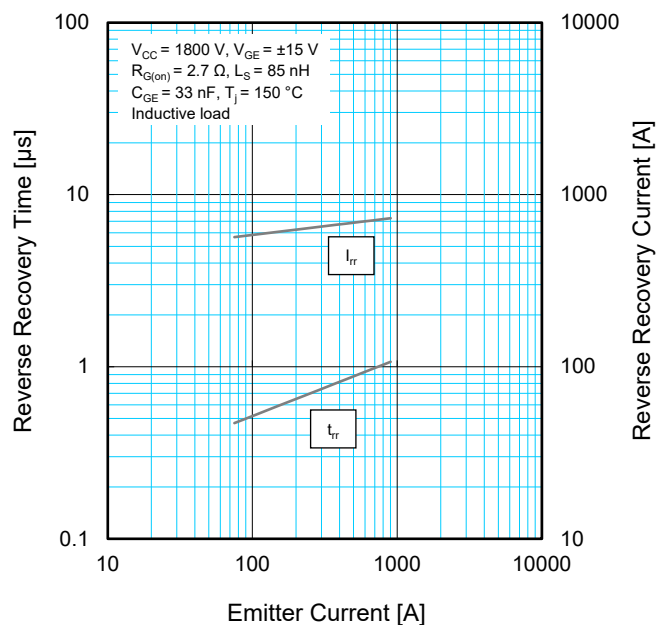
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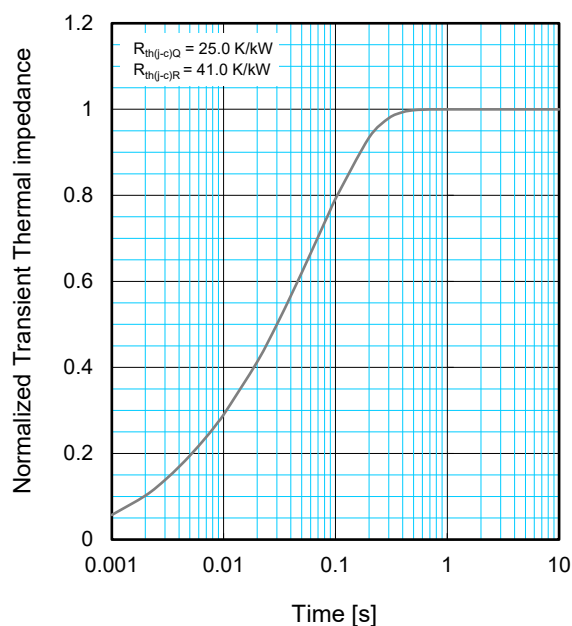
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



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
τ_i [s]	0.0025	0.0027	0.0155	0.0865

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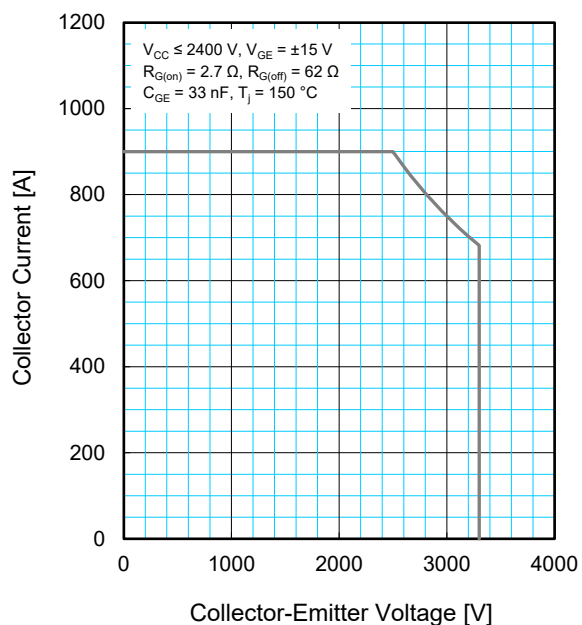
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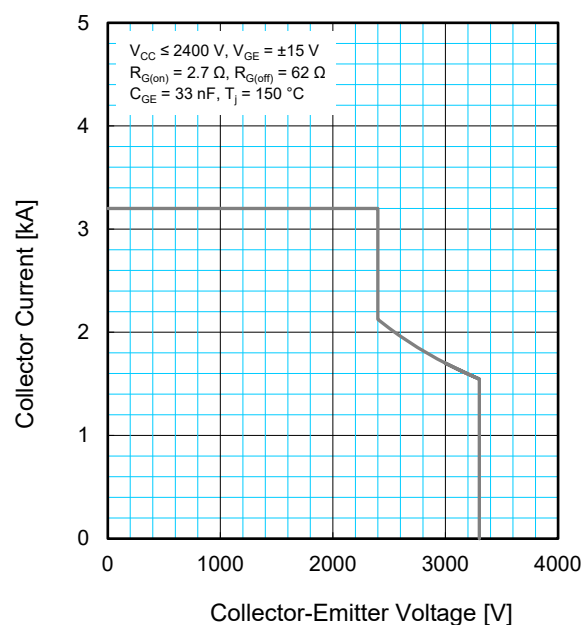
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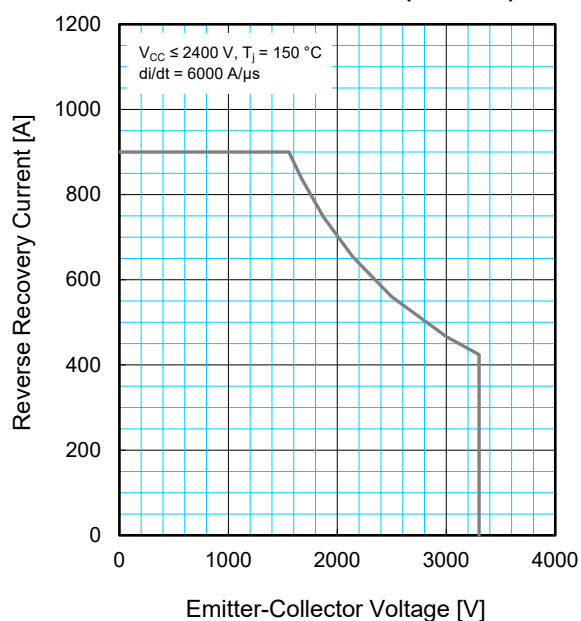
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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