

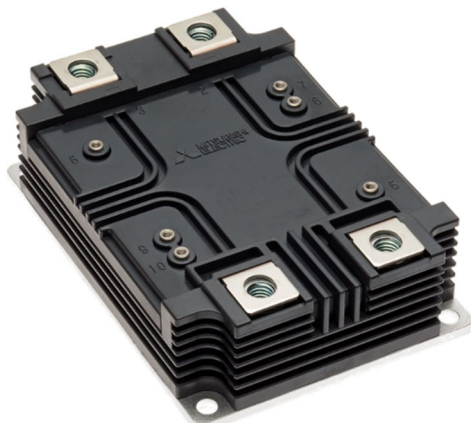
< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM450DE-90X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM450DE-90X



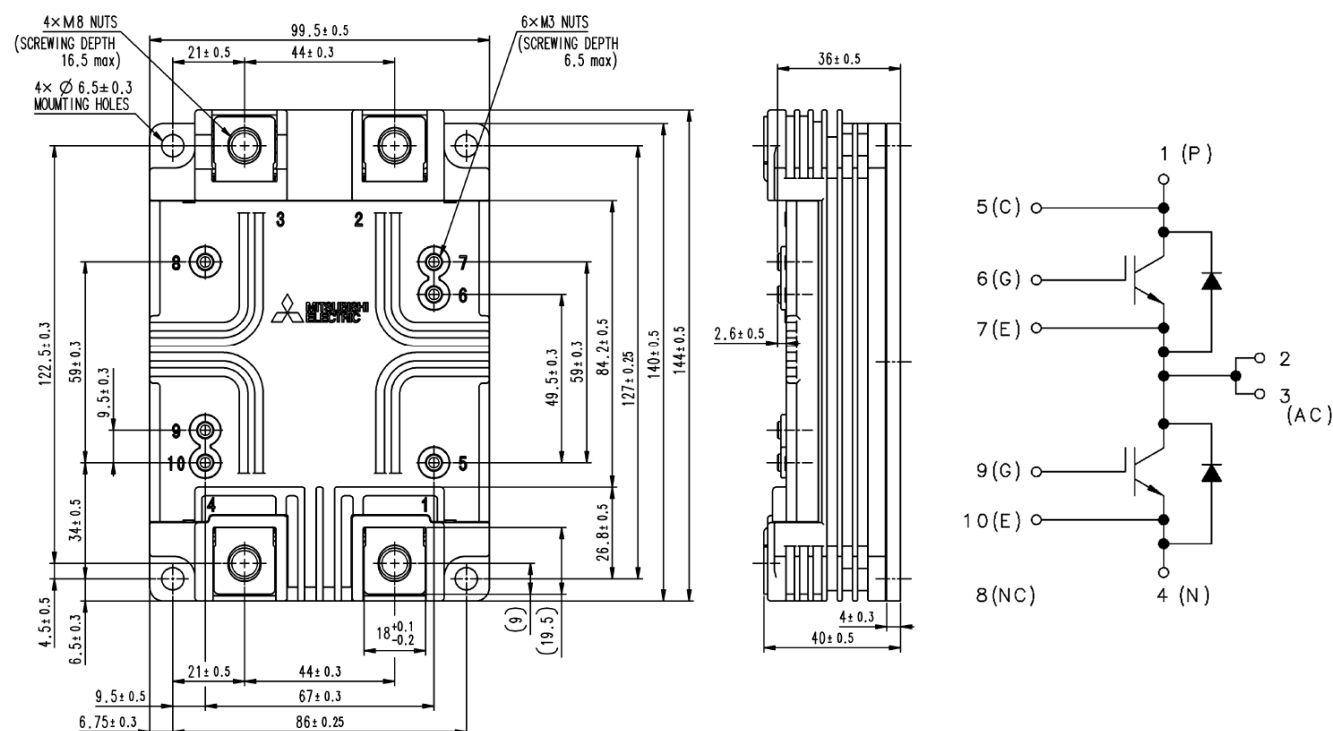
- I_C450 A
- V_{CES}4500 V
- 2-elements in a Pack
- Insulated Type (Al base type)
- CSTBT™(III) / RFC Diode

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	$V_{GE} = 0 \text{ V}$, $T_j = -40 \dots +150 \text{ }^\circ\text{C}$	4500	V
		$V_{GE} = 0 \text{ V}$, $T_j = -50 \text{ }^\circ\text{C}$	4400	
V_{GES}	Gate-emitter voltage	$V_{CE} = 0 \text{ V}$, $T_j = 25 \text{ }^\circ\text{C}$	± 20	V
I_C	Collector current	DC, $T_c = 100 \text{ }^\circ\text{C}$	450	A
I_{CRM}		Pulse (Note 1)	900	
I_E	Emitter current (Note 2)	DC, $T_c = 75 \text{ }^\circ\text{C}$	450	A
I_{ERM}		Pulse (Note 1)	900	
P_{tot}	Maximum power dissipation (Note 3)	$T_c = 25 \text{ }^\circ\text{C}$, IGBT part	4800	W
V_{iso}	Isolation voltage	RMS, sinusoidal, $f = 60 \text{ Hz}$, $t = 1 \text{ min.}$ $T_c = 25 \text{ }^\circ\text{C}$	10200	V
Q_{PD}	Partial discharge	Charged part to the baseplate $V_1 = 6900 \text{ Vrms}$, $V_2 = 5100 \text{ Vrms}$ AC 60 Hz, $T_c = 25 \text{ }^\circ\text{C}$ (acc. to IEC 61287)	10	pC
T_j	Junction temperature	—	$-50 \sim +150$	$^\circ\text{C}$
T_{stg}	Storage temperature	—	$-55 \sim +150$	$^\circ\text{C}$
T_{jop}	Operating junction temperature	—	$-50 \sim +150$	$^\circ\text{C}$
t_{psc}	Short circuit pulse width	$V_{CC} \leq 3400 \text{ V}$, $L_s = 100 \text{ nH}$, $T_j = T_{jop}$ $V_{GE} = \pm 15 \text{ V}$, $R_{G(on)} = 6.8 \text{ } \Omega$, $R_{G(off)} = 100 \text{ } \Omega$	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
			$T_j = 125 \text{ }^\circ\text{C}$	—	—	
			$T_j = 150 \text{ }^\circ\text{C}$	—	18.0	
$V_{GE(th)}$	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	$I_C = 450 \text{ A}$ (Note 4) $V_{GE} = 15 \text{ V}$	$T_j = 25 \text{ }^\circ\text{C}$	2.60	—	V
			$T_j = 125 \text{ }^\circ\text{C}$	3.30	—	
			$T_j = 150 \text{ }^\circ\text{C}$	3.50	4.00	
C_{ies}	Input capacitance	$V_{CE} = 10 \text{ V}$, $V_{GE} = 0 \text{ V}$ $f = 100 \text{ kHz}$, $T_j = 25 \text{ }^\circ\text{C}$	—	50.0	—	nF
C_{oes}	Output capacitance		—	3.0	—	
C_{res}	Reverse transfer capacitance		—	0.4	—	
Q_G	Total gate charge	$V_{CC} = 2800 \text{ V}$, $I_C = 450 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$, $T_j = 25 \text{ }^\circ\text{C}$	—	3.3	—	μC
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 2800 \text{ V}$ $I_C = 450 \text{ A}$	$T_j = 150 \text{ }^\circ\text{C}$	—	0.80	μs
t_r	Rise time		$T_j = 150 \text{ }^\circ\text{C}$	—	0.45	μs
$E_{on(10\%)}$	Turn-on switching energy per pulse (Note 5)	$V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 6.8 \text{ } \Omega$ $L_s = 100 \text{ nH}$	$T_j = 25 \text{ }^\circ\text{C}$	1.80	—	J
			$T_j = 125 \text{ }^\circ\text{C}$	2.05	—	
			$T_j = 150 \text{ }^\circ\text{C}$	2.05	—	
			$T_j = 150 \text{ }^\circ\text{C}$	2.05	—	
E_{on}	Turn-on switching energy per pulse	Inductive load	$T_j = 25 \text{ }^\circ\text{C}$	1.80	—	J
			$T_j = 125 \text{ }^\circ\text{C}$	2.10	—	
			$T_j = 150 \text{ }^\circ\text{C}$	2.15	—	
$t_{d(off)}$	Turn-off delay time		$T_j = 25 \text{ }^\circ\text{C}$	5.50	—	μs
			$T_j = 125 \text{ }^\circ\text{C}$	5.90	—	
			$T_j = 150 \text{ }^\circ\text{C}$	5.90	—	
t_f	Fall time	$V_{CC} = 2800 \text{ V}$ $I_C = 450 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G(off)} = 100 \text{ } \Omega$ $L_s = 100 \text{ nH}$	$T_j = 25 \text{ }^\circ\text{C}$	0.35	—	μs
			$T_j = 125 \text{ }^\circ\text{C}$	0.40	—	
			$T_j = 150 \text{ }^\circ\text{C}$	0.45	—	
			$T_j = 150 \text{ }^\circ\text{C}$	0.45	—	
$E_{off(10\%)}$	Turn-off switching energy per pulse (Note 5)	Inductive load	$T_j = 25 \text{ }^\circ\text{C}$	1.10	—	J
			$T_j = 125 \text{ }^\circ\text{C}$	1.40	—	
			$T_j = 150 \text{ }^\circ\text{C}$	1.45	—	
E_{off}	Turn-off switching energy per pulse		$T_j = 25 \text{ }^\circ\text{C}$	1.25	—	J
			$T_j = 125 \text{ }^\circ\text{C}$	1.60	—	
			$T_j = 150 \text{ }^\circ\text{C}$	1.70	—	

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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 _{EC}	Emitter-collector voltage ^(Note 2)	I _E = 450 A ^(Note 4) V _{GE} = 0 V	T _J = 25 °C	—	2.50	—	V
			T _J = 125 °C	—	3.05	—	
			T _J = 150 °C	—	3.20	3.70	
t _{rr}	Reverse recovery time ^(Note 2)	V _{CC} = 2800 V I _E = 450 A V _{GE} = ±15 V R _{G(on)} = 6.8 Ω L _s = 100 nH Inductive load	T _J = 25 °C	—	1.80	—	μs
			T _J = 125 °C	—	2.10	—	
			T _J = 150 °C	—	2.20	—	
I _{rr}	Reverse recovery current ^(Note 2)		T _J = 25 °C	—	400	—	A
			T _J = 125 °C	—	400	—	
			T _J = 150 °C	—	400	—	
Q _{rr(10%)}	Reverse recovery charge ^(Note 2, 6)		T _J = 25 °C	—	500	—	μC
			T _J = 125 °C	—	670	—	
			T _J = 150 °C	—	710	—	
Q _{rr}	Reverse recovery charge ^(Note 2)		T _J = 25 °C	—	520	—	μC
			T _J = 125 °C	—	720	—	
			T _J = 150 °C	—	770	—	
E _{rec(10%)}	Reverse recovery energy per pulse ^(Note 2, 5)		T _J = 25 °C	—	0.80	—	J
			T _J = 125 °C	—	1.15	—	
			T _J = 150 °C	—	1.20	—	
E _{rec}	Reverse recovery energy per pulse ^(Note 2)		T _J = 25 °C	—	0.85	—	J
			T _J = 125 °C	—	1.30	—	
			T _J = 150 °C	—	1.35	—	

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	—	—	26.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part, 1/2 module	—	—	43.0	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	—	—	40.0	—	nH
R_{CC+EE}	Internal lead resistance	$T_c = 25^\circ\text{C}$, 1/2 module	—	0.59	—	mΩ

Note 1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed maximum T_{jop} rating (150°C).

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

Note 3. Junction temperature (T_j) should not exceed T_{j_max} rating (150°C).

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

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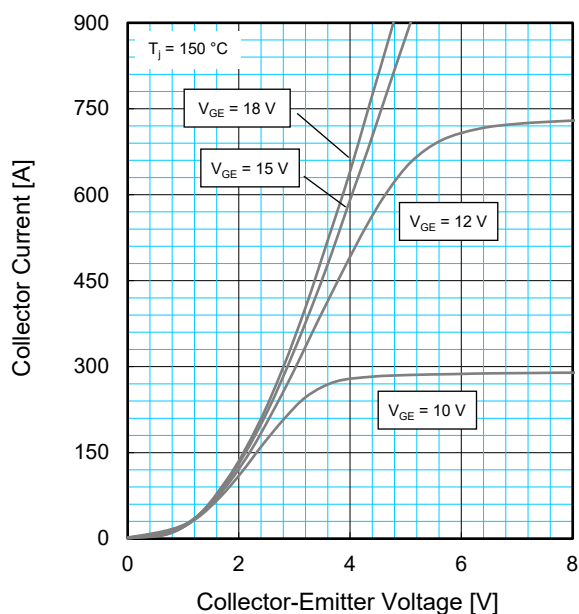
HIGH POWER SWITCHING USE

INSULATED TYPE

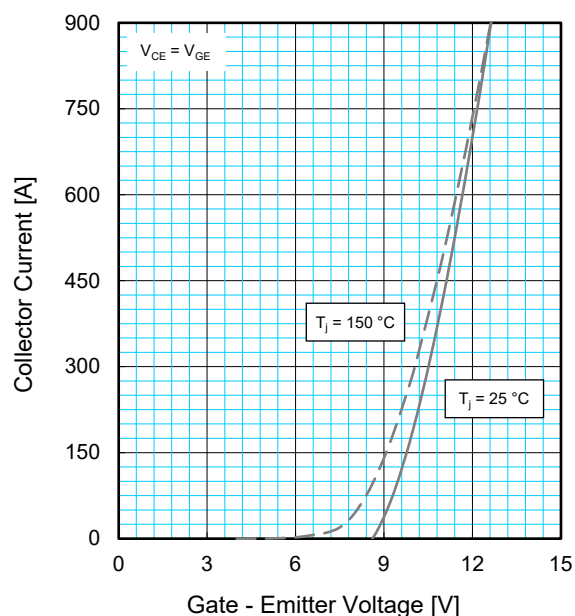
5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

PERFORMANCE CURVES

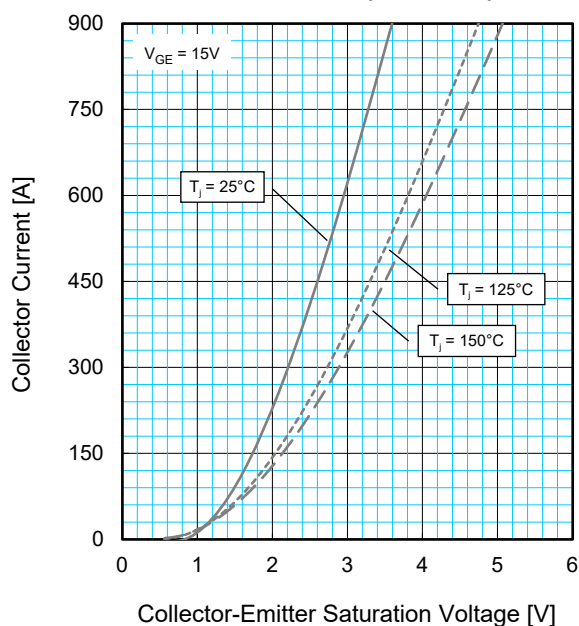
OUTPUT CHARACTERISTICS
(TYPICAL)



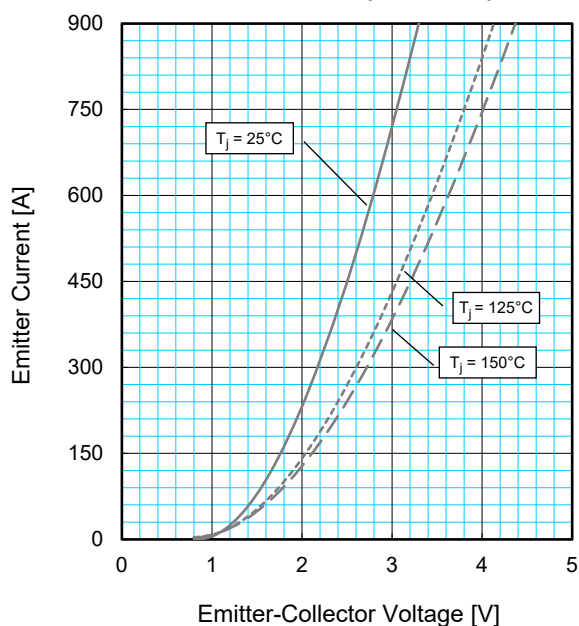
TRANSFER CHARACTERISTICS
(TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE FORWARD
CHARACTERISTICS (TYPICAL)



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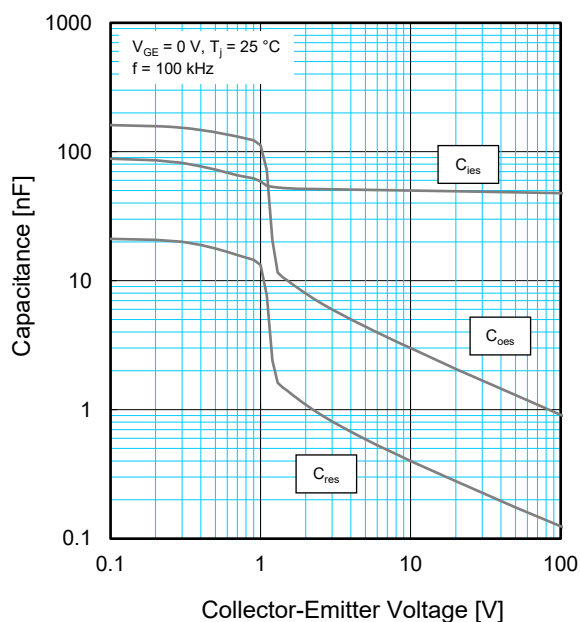
HIGH POWER SWITCHING USE

INSULATED TYPE

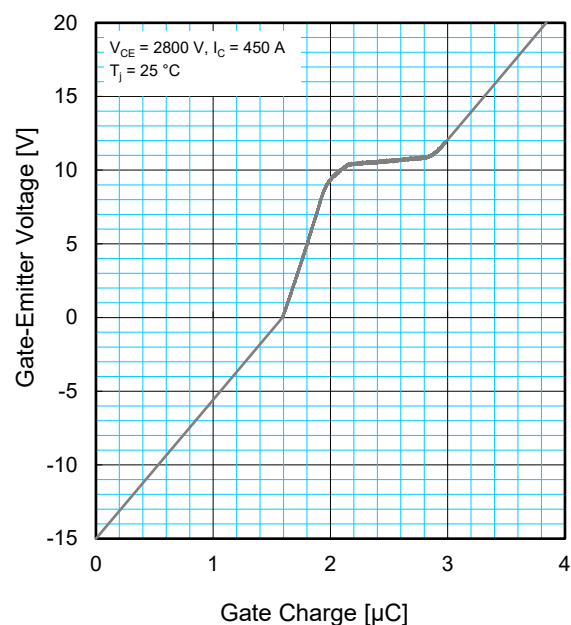
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PERFORMANCE CURVES

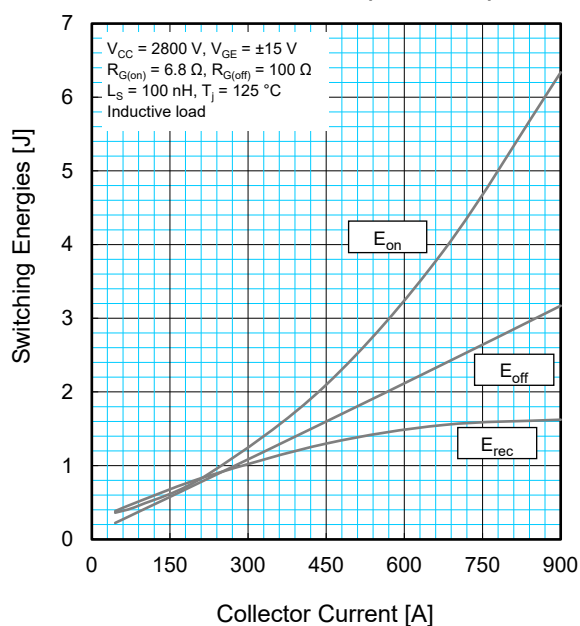
CAPACITANCE CHARACTERISTICS
(TYPICAL)



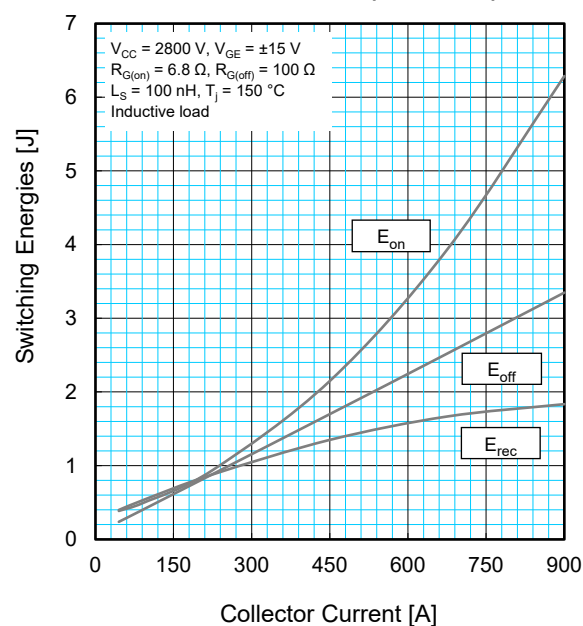
GATE CHARGE CHARACTERISTICS
(TYPICAL)



HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)



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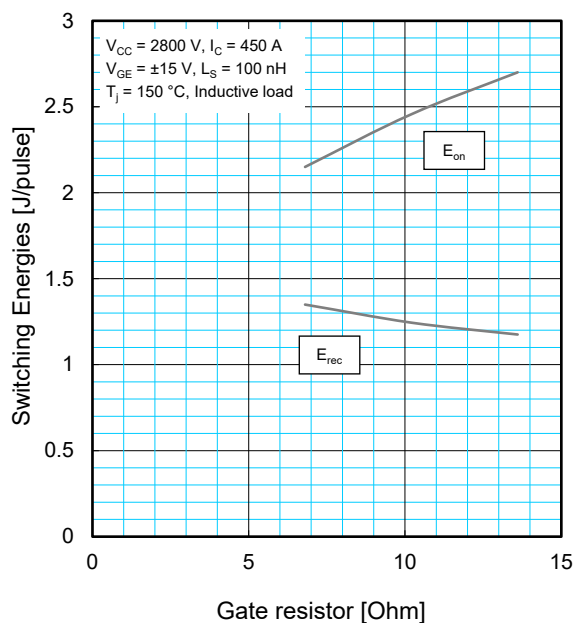
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INSULATED TYPE

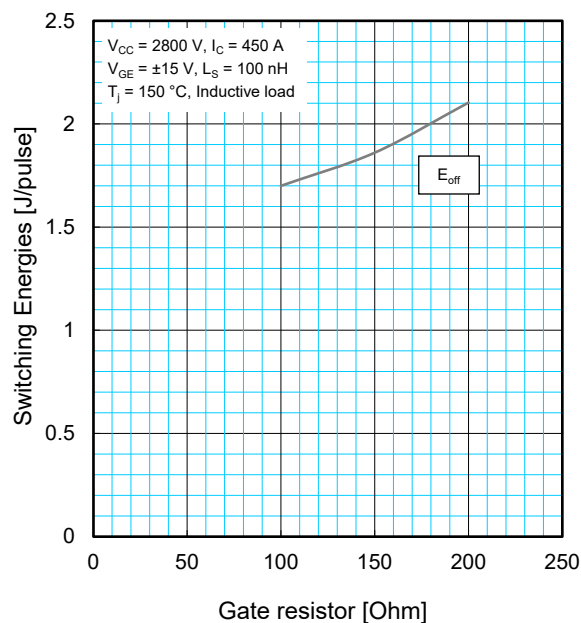
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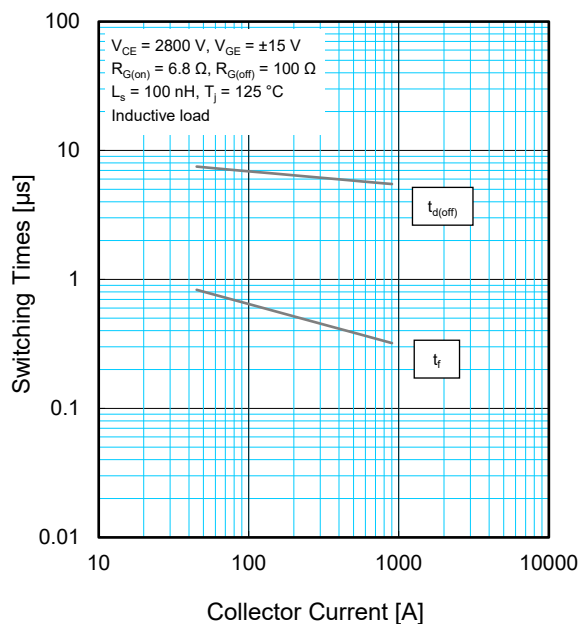
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



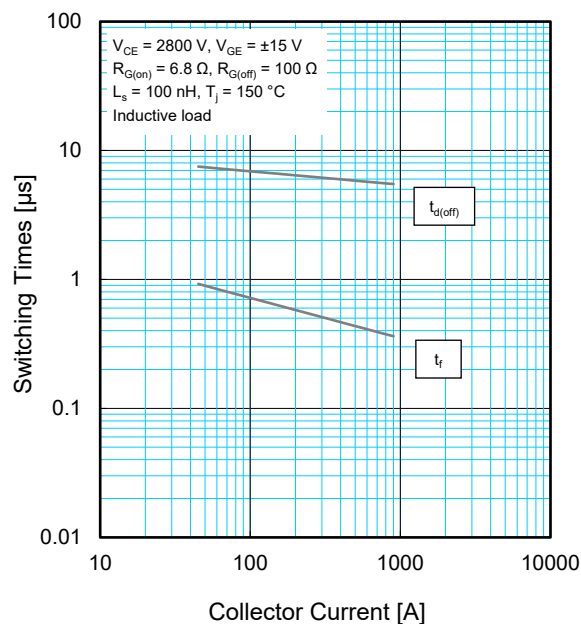
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



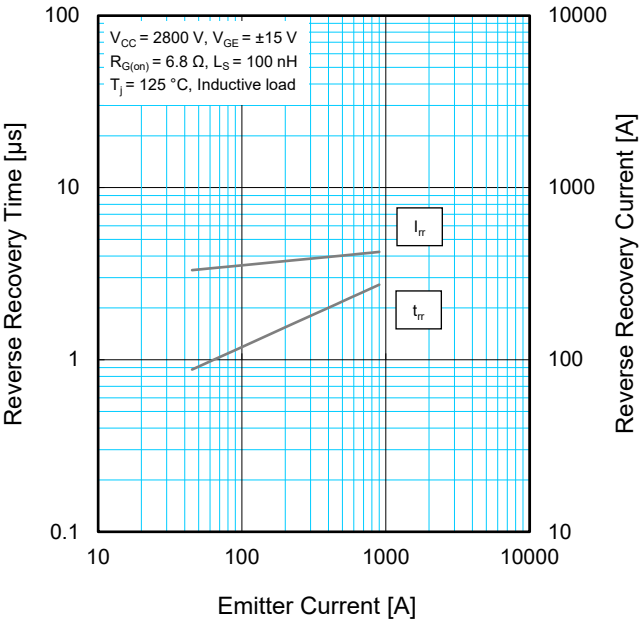
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HIGH POWER SWITCHING USE
INSULATED TYPE

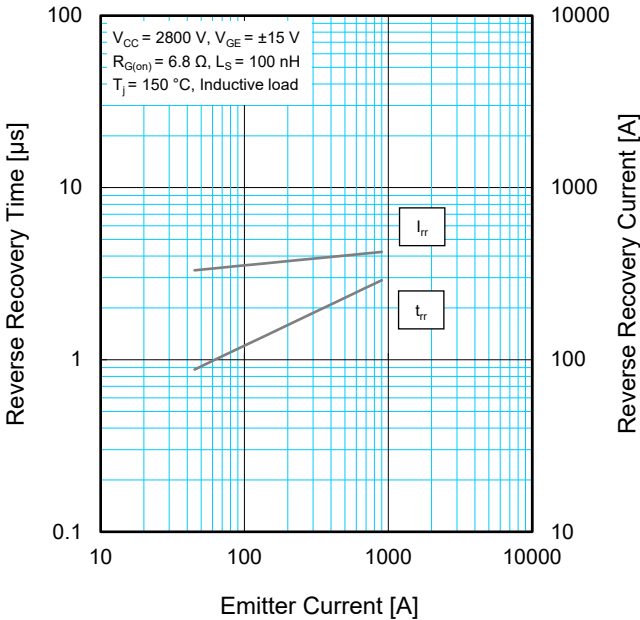
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PERFORMANCE CURVES

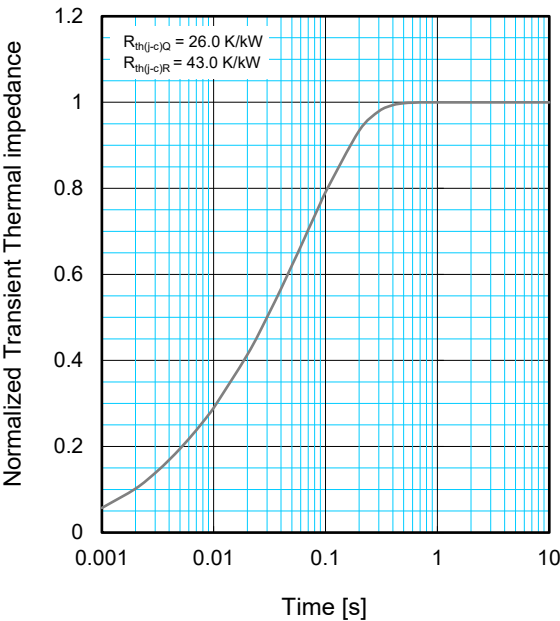
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



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
τ_i [s]	0.0025	0.0027	0.0155	0.0865

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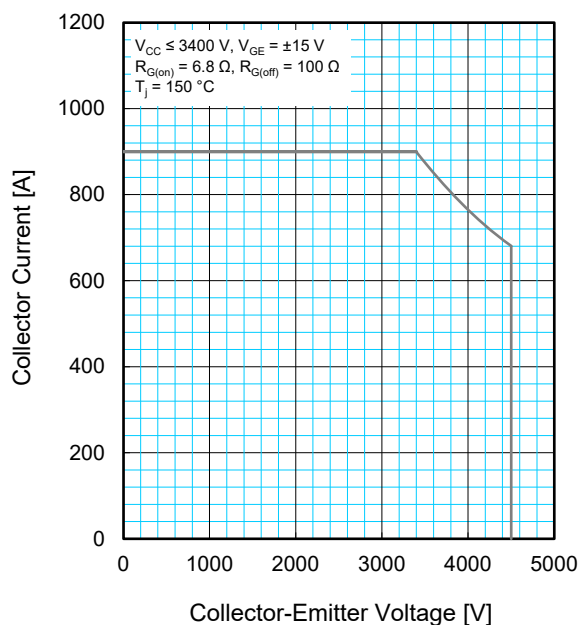
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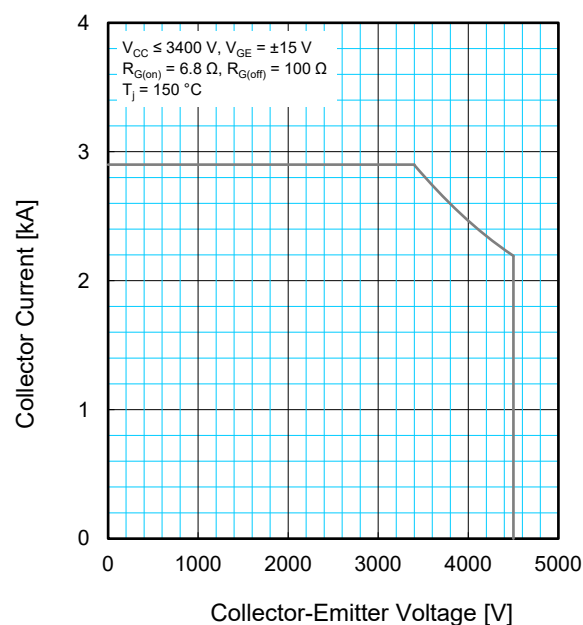
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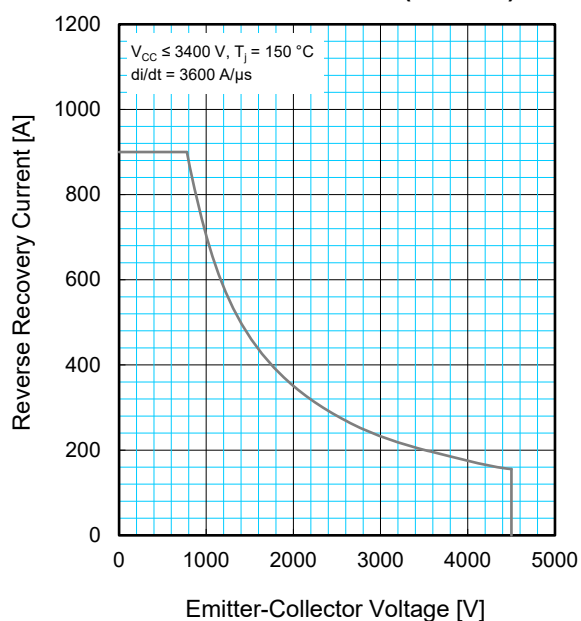
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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