

< High Voltage Insulated Gate Bipolar Transistor : HVIGBT >

CM450DA-66X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM450DA-66X



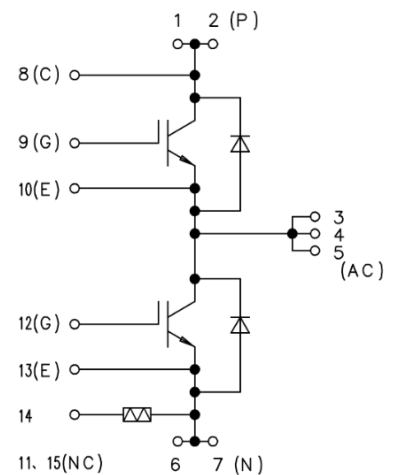
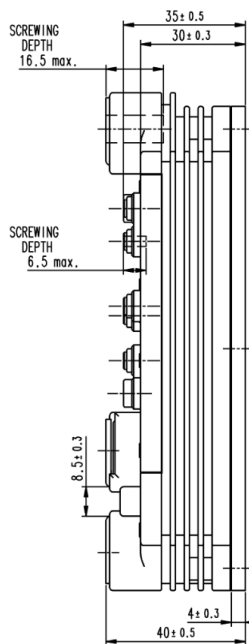
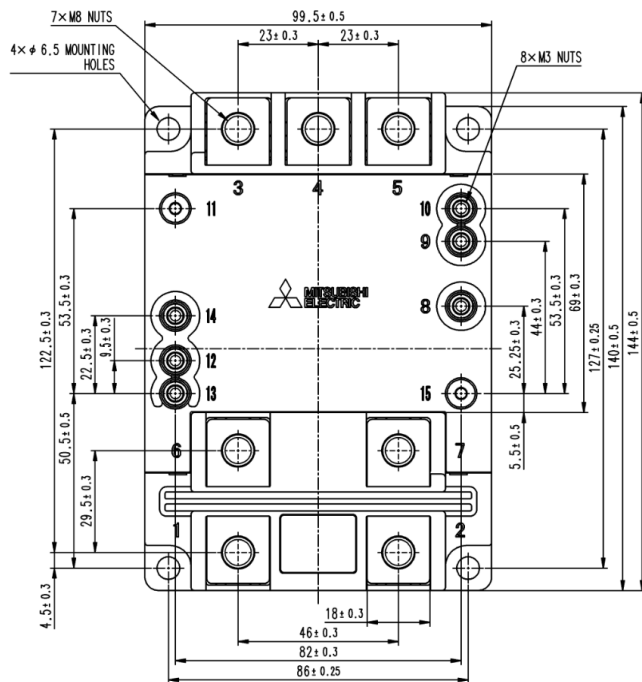
- I_C 450A
- V_{CES} 3300V
- 2-elements in a Pack
- Insulated Type
- Al baseplate
- CSTBT™(III) / RFC Diode

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



CIRCUIT DIAGRAM

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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 = 114°C	450	A
I _{CRM}		Pulse (Note 1)	900	
I _E	Emitter current (Note 2)	DC, T _c = 98°C	450	A
I _{ERM}		Pulse (Note 1)	900	
P _{tot}	Maximum power dissipation (Note 3)	T _c = 25°C, IGBT part	5000	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 ~ +150	°C
t _{psc}	Short circuit pulse width	V _{CC} = 2400V, V _{CE} ≤ V _{CES} , V _{GE} = 15V, T _j = 150°C R _{g(on)} = 2.7Ω, R _{g(off)} = 62Ω, 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	—	—	1.5	mA
			T _j = 125°C	—	1.5	—	
			T _j = 150°C	—	15.0	—	
V _{GE(th)}	Gate-emitter threshold voltage	V _{CE} = 10 V, I _C = 45 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	—	44.5	—	nF	
C _{oes}	Output capacitance		—	3.1	—	nF	
C _{res}	Reverse transfer capacitance		—	0.4	—	nF	
Q _G	Total gate charge	V _{CC} = 1800V, I _C = 450A, V _{GE} = ±15V	—	3.0	—	μC	
V _{CESat}	Collector-emitter saturation voltage	I _C = 450 A (Note 4) V _{GE} = 15 V	T _j = 25°C	—	2.20	—	V
			T _j = 125°C	—	2.65	3.05	
			T _j = 150°C	—	2.75	3.15	
t _{d(on)}	Turn-on delay time	V _{CC} = 1800 V I _C = 450 A V _{GE} = ±15 V R _{G(on)} = 2.7 Ω L _s = 65nH Inductive load	T _j = 125°C	—	—	1.25	μs
			T _j = 150°C	—	—	1.25	
t _r	Rise time	V _{CC} = 1800 V I _C = 450 A V _{GE} = ±15 V R _{G(on)} = 2.7 Ω L _s = 65nH Inductive load	T _j = 125°C	—	—	0.50	μs
			T _j = 150°C	—	—	0.50	
E _{on(10%)}	Turn-on switching energy per pulse (Note 5)	C _{GE} = 33nF	T _j = 25°C	—	0.57	—	J
			T _j = 125°C	—	0.69	—	
			T _j = 150°C	—	0.70	—	
E _{on}	Turn-on switching energy per pulse (Note 6)	C _{GE} = 33nF	T _j = 25°C	—	0.62	—	J
			T _j = 125°C	—	0.74	—	
			T _j = 150°C	—	0.75	—	
t _{d(off)}	Turn-off delay time	V _{CC} = 1800 V I _C = 450 A V _{GE} = ±15 V R _{G(off)} = 62 Ω L _s = 65nH Inductive load C _{GE} = 33nF	T _j = 25°C	—	2.75	—	μs
			T _j = 125°C	—	3.10	5.00	
			T _j = 150°C	—	3.20	5.00	
t _f	Fall time	V _{CC} = 1800 V I _C = 450 A V _{GE} = ±15 V R _{G(off)} = 62 Ω L _s = 65nH Inductive load C _{GE} = 33nF	T _j = 25°C	—	0.23	—	μs
			T _j = 125°C	—	0.33	1.00	
			T _j = 150°C	—	0.35	1.00	
E _{off(10%)}	Turn-off switching energy per pulse (Note 5)	C _{GE} = 33nF	T _j = 25°C	—	0.50	—	J
			T _j = 125°C	—	0.67	—	
			T _j = 150°C	—	0.69	—	
E _{off}	Turn-off switching energy per pulse (Note 6)	C _{GE} = 33nF	T _j = 25°C	—	0.57	—	J
			T _j = 125°C	—	0.76	—	
			T _j = 150°C	—	0.78	—	

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ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
V_{EC}	Emitter-collector voltage (Note 2)	$I_E = 450 \text{ A}$ (Note 4) $V_{GE} = 0 \text{ V}$	$T_j = 25^\circ\text{C}$	—	2.00	—	V
			$T_j = 125^\circ\text{C}$	—	2.20	2.70	
			$T_j = 150^\circ\text{C}$	—	2.30	2.80	
t_{rr}	Reverse recovery time (Note 2)		$T_j = 25^\circ\text{C}$	—	0.55	—	μs
			$T_j = 125^\circ\text{C}$	—	0.65	—	
			$T_j = 150^\circ\text{C}$	—	0.70	—	
I_{rr}	Reverse recovery current (Note 2)		$T_j = 25^\circ\text{C}$	—	920	—	A
			$T_j = 125^\circ\text{C}$	—	850	—	
			$T_j = 150^\circ\text{C}$	—	840	—	
$Q_{rr(10\%)}$	Reverse recovery charge (Note 2,7)	$V_{CC} = 1800 \text{ V}$ $I_C = 450 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$	$T_j = 25^\circ\text{C}$	—	465	—	μC
			$T_j = 125^\circ\text{C}$	—	555	—	
			$T_j = 150^\circ\text{C}$	—	580	—	
Q_{rr}	Reverse recovery charge (Note 2,6)	$R_{G(on)} = 2.7 \Omega$ $L_s = 65 \text{ nH}$ Inductive load $C_{GE} = 33 \text{ nF}$	$T_j = 25^\circ\text{C}$	—	490	—	μC
			$T_j = 125^\circ\text{C}$	—	605	—	
			$T_j = 150^\circ\text{C}$	—	635	—	
$E_{rec(10\%)}$	Reverse recovery energy per pulse (Note 2,5)		$T_j = 25^\circ\text{C}$	—	0.50	—	J
			$T_j = 125^\circ\text{C}$	—	0.66	—	
			$T_j = 150^\circ\text{C}$	—	0.68	—	
E_{rec}	Reverse recovery energy per pulse (Note 2,6)		$T_j = 25^\circ\text{C}$	—	0.56	—	J
			$T_j = 125^\circ\text{C}$	—	0.75	—	
			$T_j = 150^\circ\text{C}$	—	0.77	—	

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, per 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

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NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
R ₂₅	Zero-power resistance	T _c =25°C	-	5.00	-	kΩ
B _(25/50)	B-constant (Note 8)	Approximate by equation	-	3375	-	K

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-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, 1/2 module	—	0.46	—	mΩ
r _g	Internal gate resistance	T _C = 25 °C	—	1.0	—	Ω

Note1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jopmax} rating.

- The symbols represent characteristics of the anti-parallel, emitter to collector free-wheel diode (FWD).
- Junction temperature (T_j) should not exceed T_{jmax} rating (150°C).
- Pulse width and repetition rate should be such as to cause negligible temperature rise.
- The integration range of switching energies is from 10%V_{CE} to 10%I_C(10%I_E).
- Definition of all items is according to IEC 60747, unless otherwise specified.
- The integration range of reverse recovery charge is from I_E = 0A to 10%I_E.
- $B_{(25/50)} = \ln \left(\frac{R_{25}}{R_{50}} \right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}} \right)$

R₂₅: resistance at absolute temperature T₂₅ [K]; T₂₅ = 25[°C] + 273.15 = 298.15[K]

R₅₀: resistance at absolute temperature T₅₀ [K]; T₅₀ = 50[°C] + 273.15 = 323.15[K]

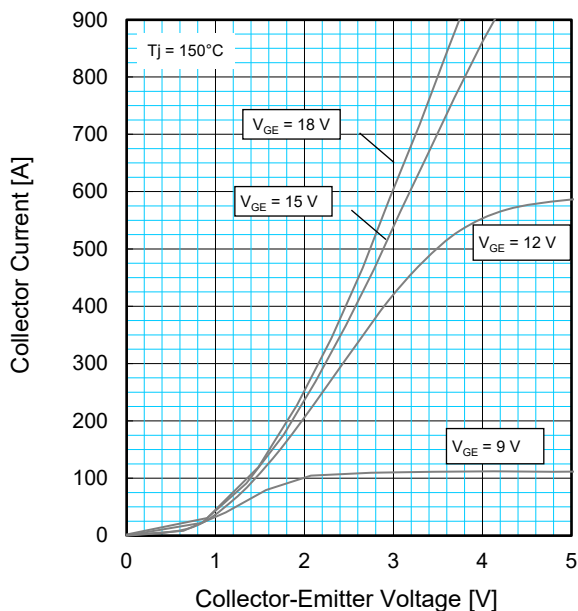
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INSULATED TYPE

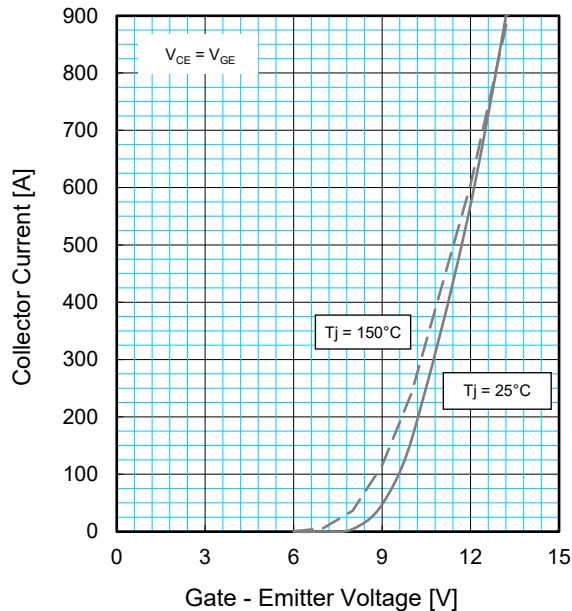
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PERFORMANCE CURVES

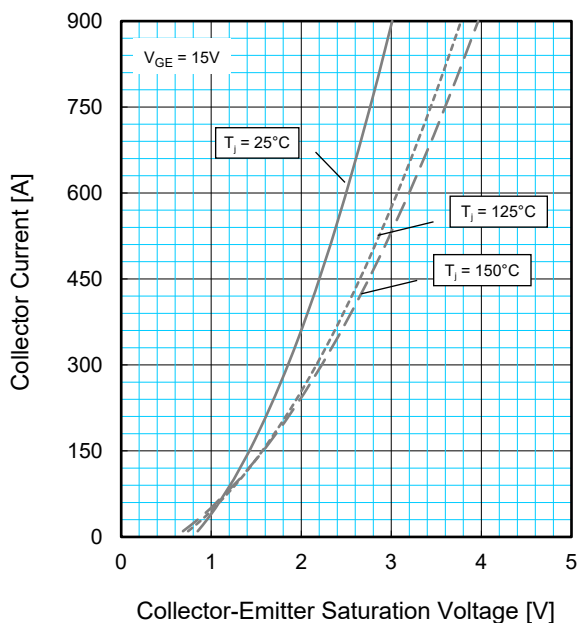
OUTPUT CHARACTERISTICS (TYPICAL)



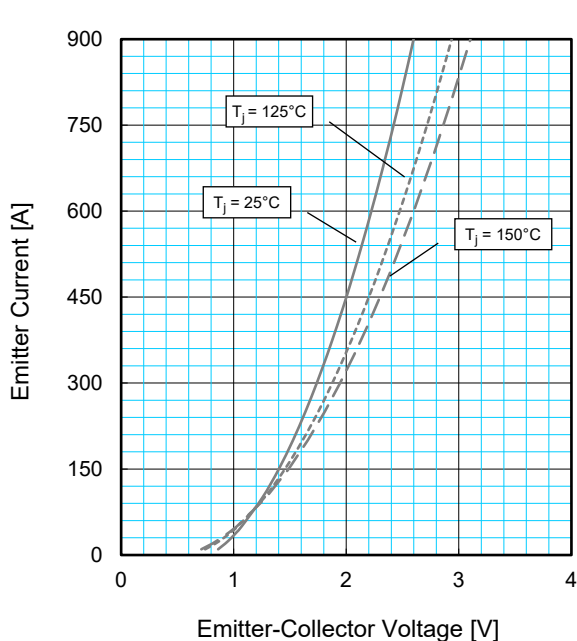
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



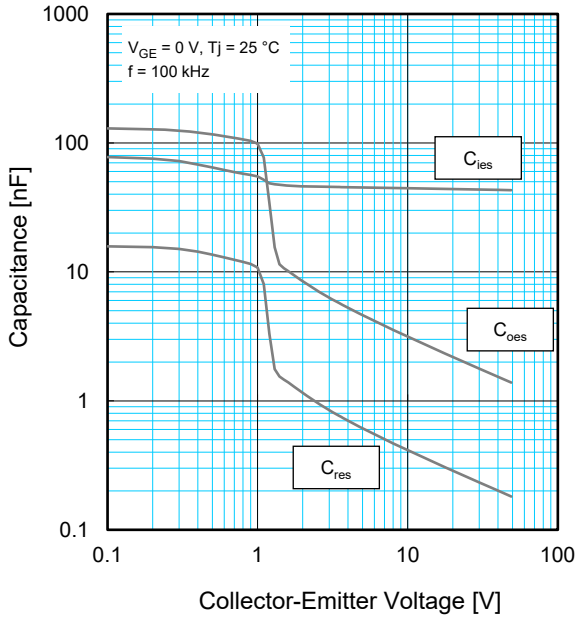
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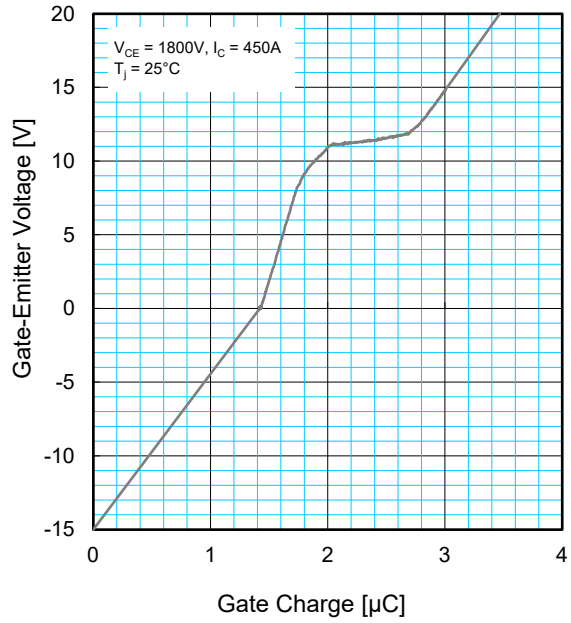
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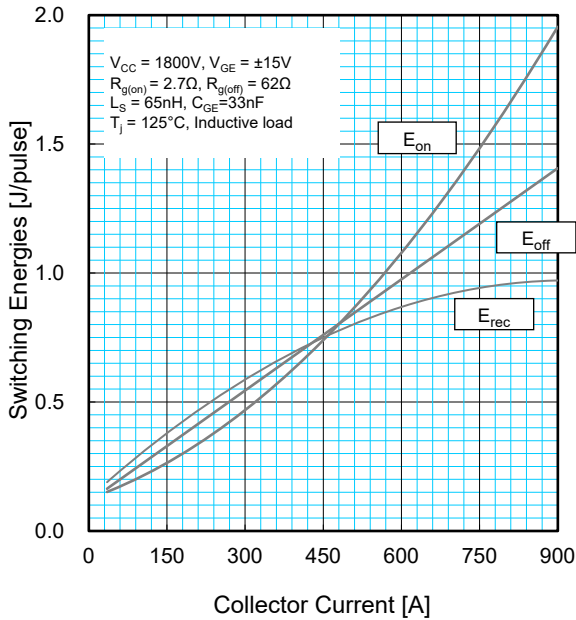
CAPACITANCE CHARACTERISTICS (TYPICAL)



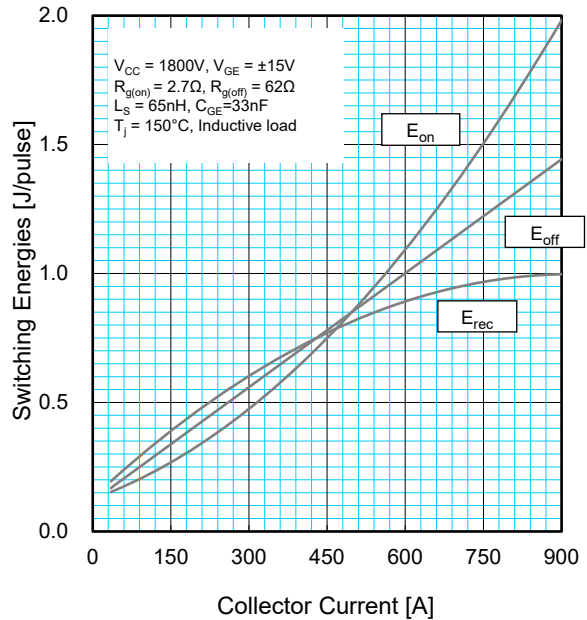
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



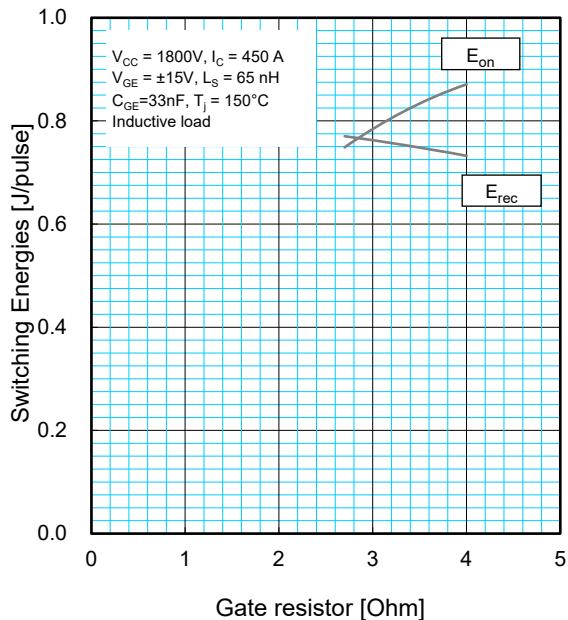
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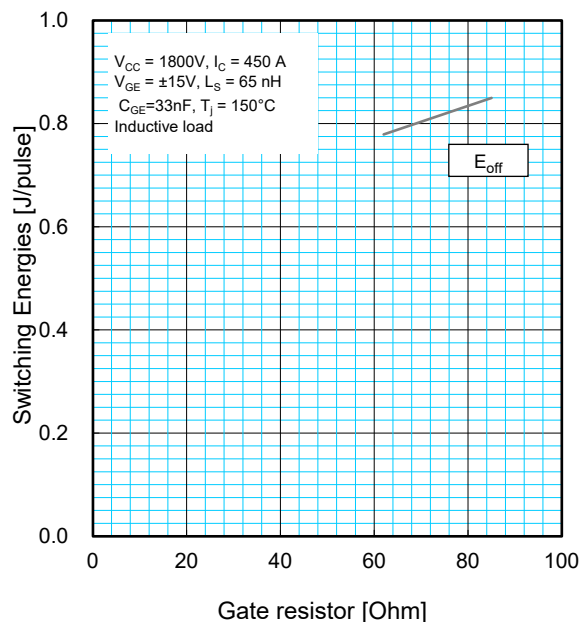
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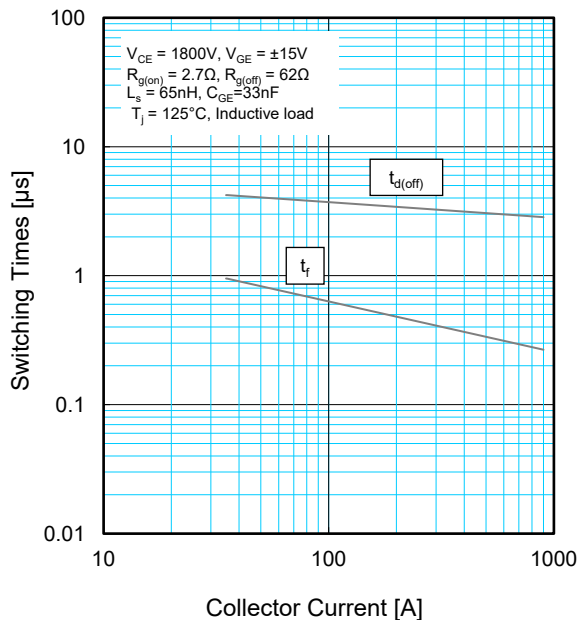
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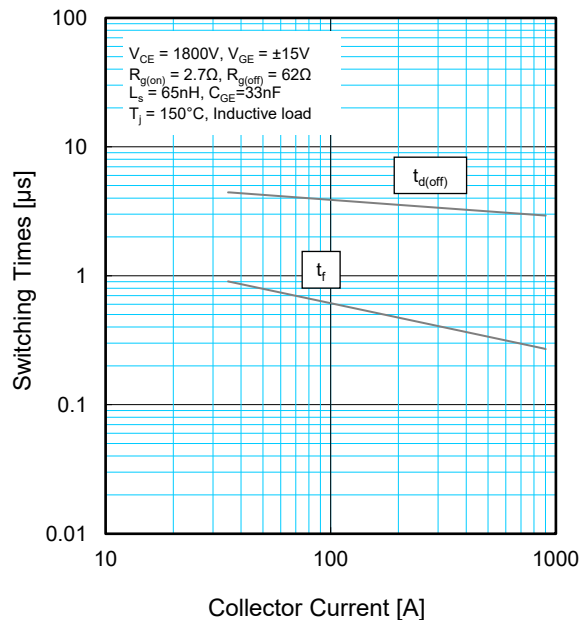
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



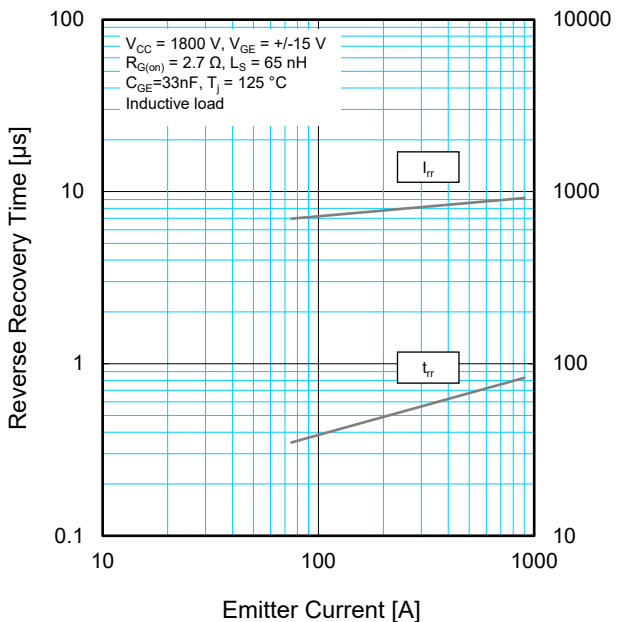
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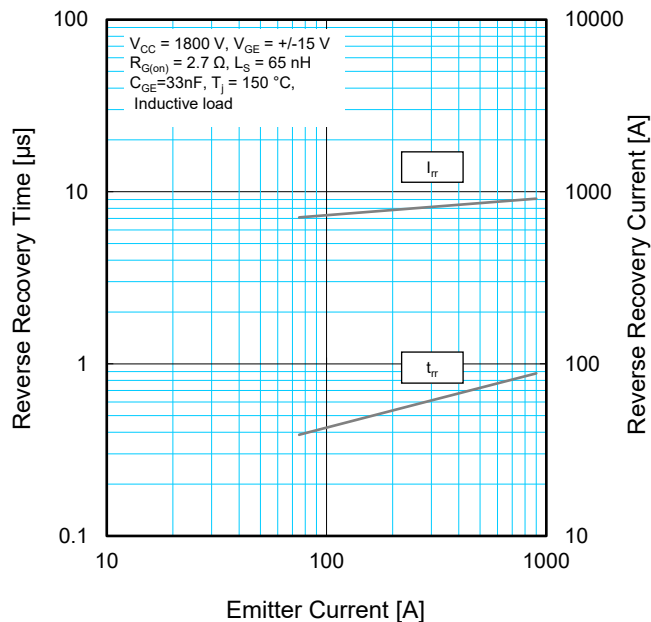
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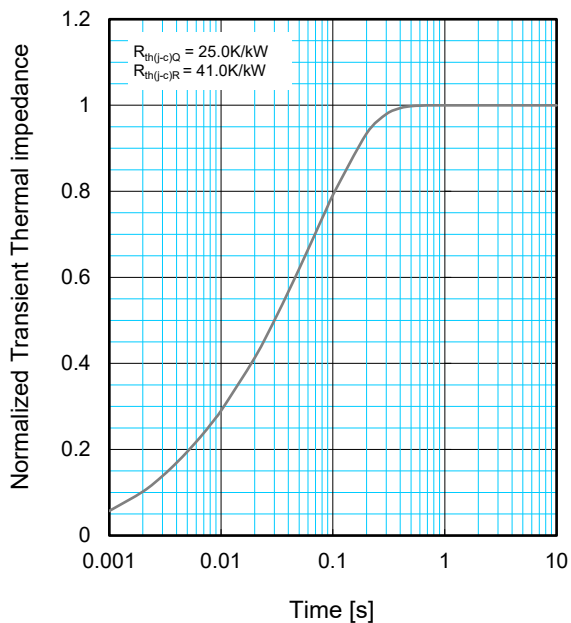
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



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} :	0.0292	0.0832	0.2277	0.6599
τ_i [sec.] :	0.0025	0.0027	0.0155	0.0865

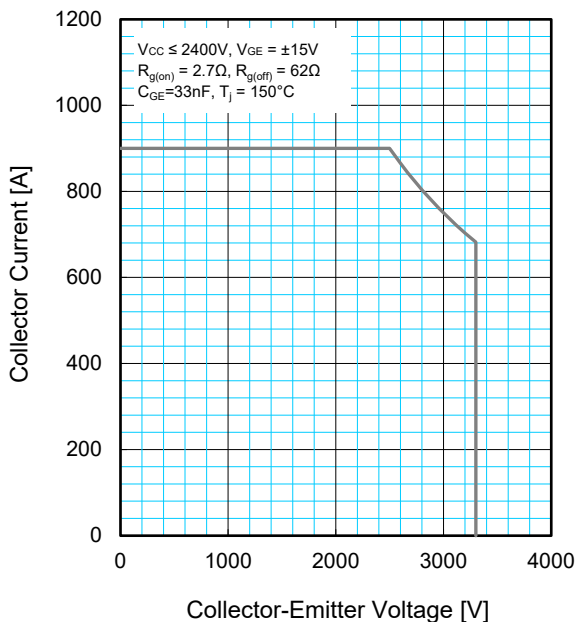
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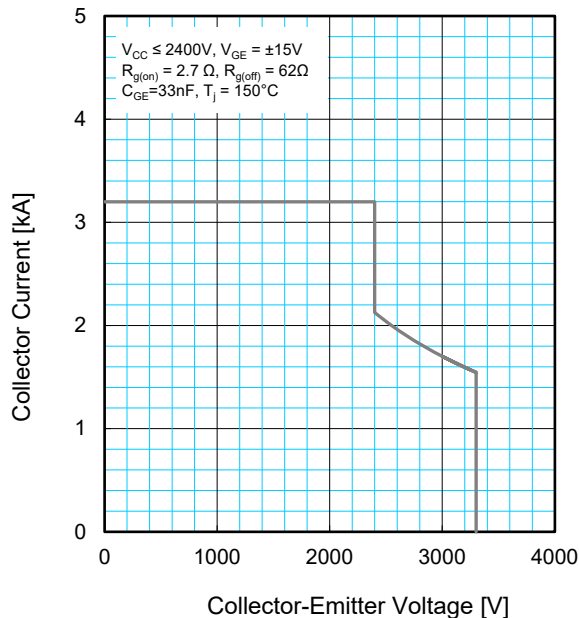
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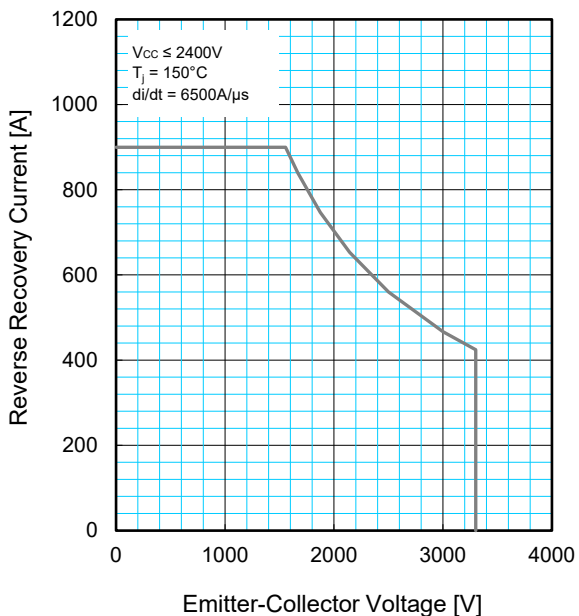
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



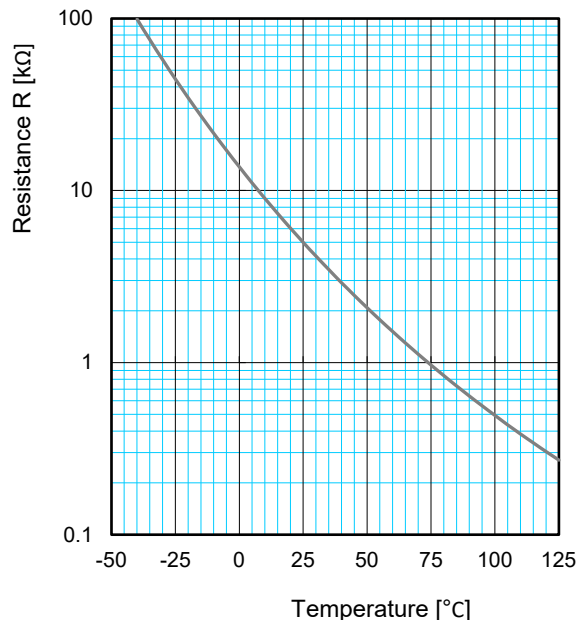
SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



NTC THERMISTOR TEMPERATURE CHARACTERISTICS (TYPICAL)



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