

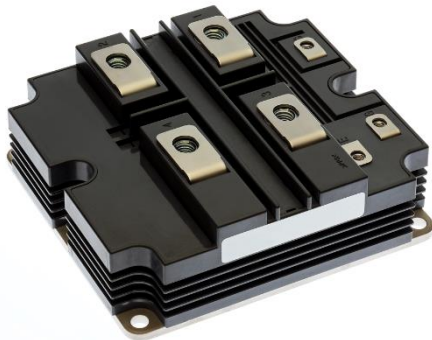
< High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

CM600HG-130X

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM600HG-130X



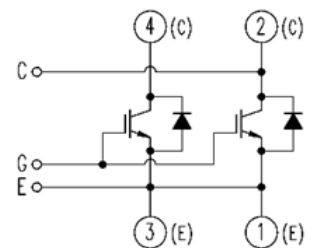
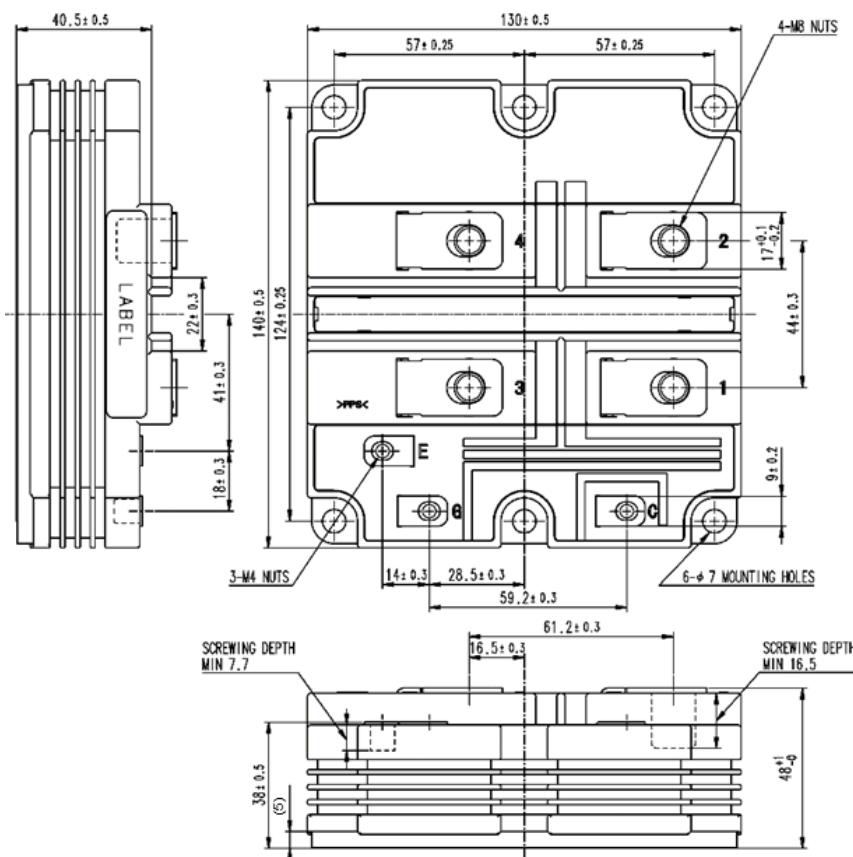
- I_C 600 A
- V_{CES} 6500 V
- 1-element in a Pack
- Insulated Type
- CSTBT™(III)
- RFC Diode
- AlSiC Baseplate

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



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CIRCUIT DIAGRAM

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

MAXIMUM RATINGS (T_J=25°C, unless otherwise specified)

Symbol	Item	Conditions	Ratings	Unit
V _{CES}	Collector-emitter voltage	V _{GE} = 0V, T _J = +150°C	6500	V
		V _{GE} = 0V, T _J = +25°C	6300	
		V _{GE} = 0V, T _J = -50°C	5700	
V _{GES}	Gate-emitter voltage	V _{CE} = 0V, T _J = 25°C	±20	V
I _C	Collector current	DC, T _C = 110°C	600	A
I _{CRM}		Pulse (Note 1)	1200	A
I _E	Emitter current (Note 2)	DC, T _C = 95°C	600	A
I _{ERM}		Pulse (Note 1)	1200	A
P _{tot}	Maximum power dissipation (Note 3)	T _C = 25°C, IGBT part	8300	W
V _{iso}	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1min.	10200	V
Q _{pd}	Partial discharge	V1 = 6900Vrms, V2 = 5100Vrms 60Hz	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} = 4500V, V _{CE} ≤ V _{CES} , V _{GE} = ±15V T _J = 150°C	10	μs

ELECTRICAL CHARACTERISTICS (T_J=25°C, unless otherwise specified)

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
I _{CES}	Collector cutoff current	V _{CE} = V _{CES} V _{GE} = 0V	T _J = 25°C	—	—	4.0	mA
			T _J = 125°C	—	3.5	—	
			T _J = 150°C	—	—	100	
V _{GE(th)}	Gate-emitter threshold voltage	V _{CE} = 10V, I _C = 60mA, 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} = 10V, V _{GE} = 0V, f = 100kHz T _J = 25°C	—	101	—	nF	
C _{oes}	Output capacitance		—	4.1	—		
C _{res}	Reverse transfer capacitance		—	0.5	—		
Q _G	Total gate charge	V _{CC} = 3600V, I _C = 600A V _{GE} = ±15V, T _J = 25°C	—	6.6	—	μC	
V _{CEsat}	Collector-emitter saturation voltage	I _C = 600A (Note 4) V _{GE} = 15V	T _J = 25°C	—	2.50	—	V
			T _J = 125°C	—	3.20	—	
			T _J = 150°C	—	3.30	3.80	
t _{d(on)}	Turn-on delay time	V _{CC} = 3600V I _C = 600A V _{GE} = ±15V R _{G(on)} = 6.2Ω L _S = 225nH	T _J = 150°C	—	—	1.45	μs
t _r	Rise time		T _J = 150°C	—	—	0.50	μs
E _{on(10%)}	Turn-on switching energy (Note 7) (per pulse)		T _J = 25°C	—	4.15	—	J
		T _J = 125°C	—	4.50	—		
		T _J = 150°C	—	5.10	—		
E _{on}	Turn-on switching energy (Note 5) (per pulse)	Inductive load	T _J = 25°C	—	4.40	—	J
			T _J = 125°C	—	4.85	—	
			T _J = 150°C	—	5.50	—	
t _{d(off)}	Turn-off delay time	V _{CC} = 3600V I _C = 600A V _{GE} = ±15V R _{G(off)} = 45Ω L _S = 225nH	T _J = 25°C	—	5.90	—	μs
			T _J = 125°C	—	7.00	—	
			T _J = 150°C	—	7.00	10.5	
t _f	Fall time	V _{CC} = 3600V I _C = 600A V _{GE} = ±15V R _{G(off)} = 45Ω L _S = 225nH	T _J = 25°C	—	0.40	—	μs
			T _J = 125°C	—	0.80	—	
			T _J = 150°C	—	0.80	—	
E _{off(10%)}	Turn-off switching energy (Note 7) (per pulse)	Inductive load	T _J = 25°C	—	2.40	—	J
			T _J = 125°C	—	3.85	—	
			T _J = 150°C	—	4.00	—	
E _{off}	Turn-off switching energy (Note 5) (per pulse)	Inductive load	T _J = 25°C	—	2.55	—	J
			T _J = 125°C	—	4.10	—	
			T _J = 150°C	—	4.25	—	

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HIGH POWER SWITCHING USE
INSULATED TYPE

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

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit	
			Min.	Typ.	Max.		
V _{EC}	Emitter-collector voltage (Note 2)	I _E = 600A (Note 4) V _{GE} = 0V	T _J = 25°C	—	2.50	—	V
			T _J = 125°C	—	3.20	—	
			T _J = 150°C	—	3.30	3.80	
t _{rr}	Reverse recovery time (Note 2)		T _J = 25°C	—	1.70	—	μs
			T _J = 125°C	—	2.05	—	
			T _J = 150°C	—	2.15	—	
I _{rr}	Reverse recovery current (Note 2)		T _J = 25°C	—	950	—	A
			T _J = 125°C	—	900	—	
			T _J = 150°C	—	900	—	
Q _{rr(10%)}	Reverse recovery charge (Note 2,6)	V _{CC} = 3600V I _E = 600A V _{GE} = ±15V R _{G(on)} = 6.2Ω L _S = 225nH	T _J = 25°C	—	1200	—	μC
			T _J = 125°C	—	1550	—	
			T _J = 150°C	—	1600	—	
Q _{rr}	Reverse recovery charge (Note 2,5)	Inductive load	T _J = 25°C	—	1200	—	μC
			T _J = 125°C	—	1550	—	
			T _J = 150°C	—	1650	—	
E _{rec(10%)}	Reverse recovery energy (Note 2,7) (per pulse)		T _J = 25°C	—	2.35	—	J
			T _J = 125°C	—	3.40	—	
			T _J = 150°C	—	3.65	—	
E _{rec}	Reverse recovery energy (Note 2,5) (per pulse)		T _J = 25°C	—	2.50	—	J
			T _J = 125°C	—	3.60	—	
			T _J = 150°C	—	4.00	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
R _{th(j-c)Q}	Thermal resistance	Junction to Case, IGBT part	—	—	15.0	K/kW
R _{th(j-c)D}		Junction to Case, FWDi part	—	—	24.0	K/kW
R _{th(c-s)}	Contact thermal resistance	Case to heat sink λ _{grease} = 1W/m·K, D _(c-s) = 80μm	—	7.5	—	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min.	Typ.	Max.	
M _t	Mounting torque	Main terminals screw: M8	7.0	—	19.0	N·m
M _s		Mounting screw: M6	3.0	—	6.0	N·m
M _t		Auxiliary terminals screw: M4	1.0	—	3.0	N·m
m	Mass	—	—	1.0	—	kg
CTI	Comparative tracking index	—	600	—	—	—
d _a	Clearance	—	26.0	—	—	mm
d _s	Creepage distance	—	56.0	—	—	mm
L _{P(C-E)}	Parasitic stray inductance	—	—	20.5	—	nH
R _{CC+EE'}	Internal lead resistance	T _C = 25°C	—	0.18	—	mΩ

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

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. Definition of all items is according to IEC 60747, unless otherwise specified.

Note6. The integration range of reverse recovery charge is from I_E = 0A to 10%I_E.

Note7. The integration range of switching energies is from 10%V_{CE} to 10%I_C(I_E).

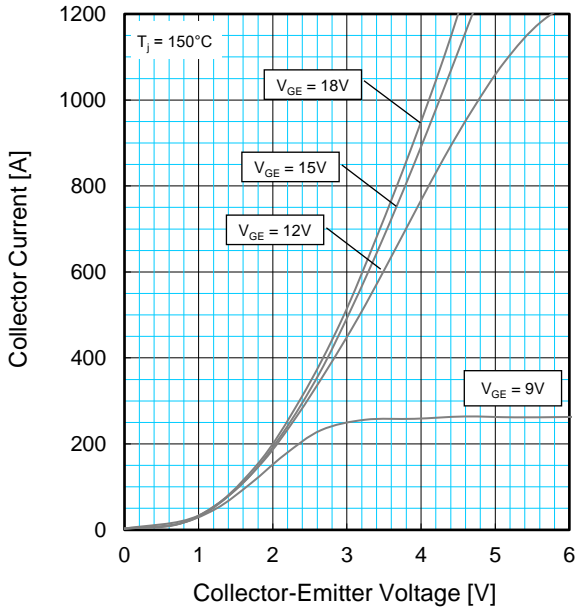
CM600HG-130X

HIGH POWER SWITCHING USE
INSULATED TYPE

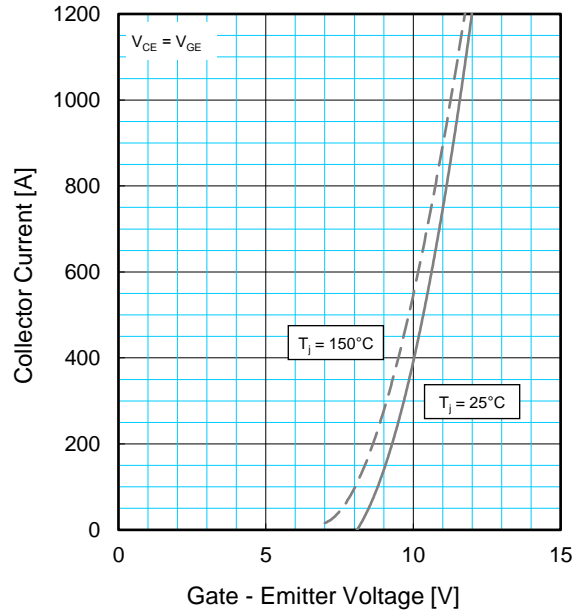
5th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor)

PERFORMANCE CURVES

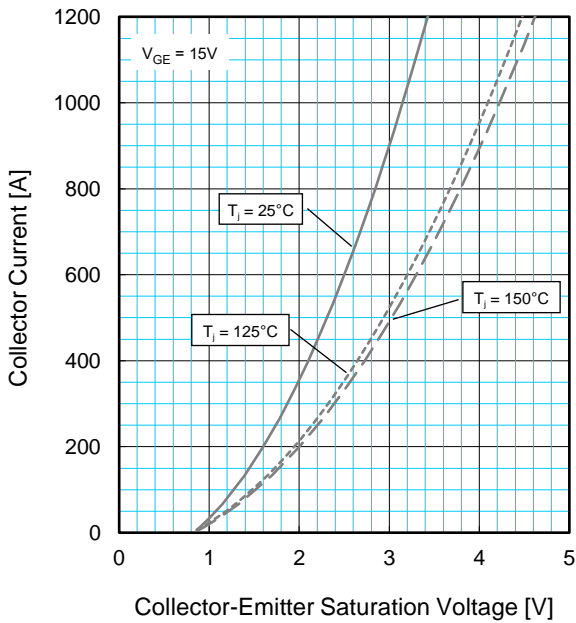
OUTPUT CHARACTERISTICS (TYPICAL)



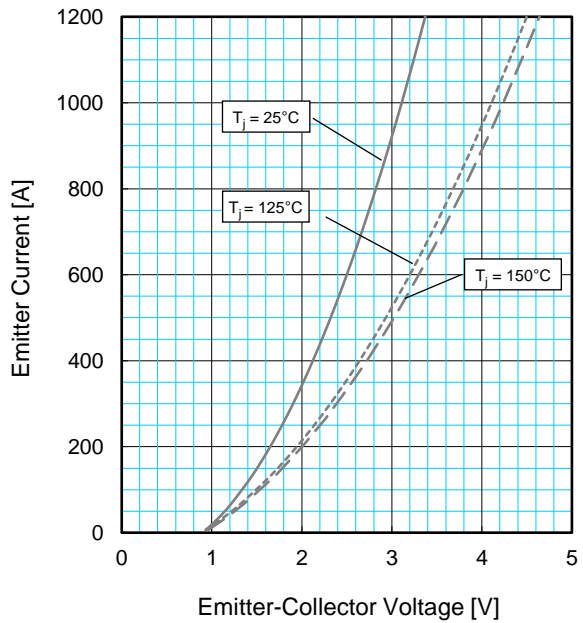
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)



FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



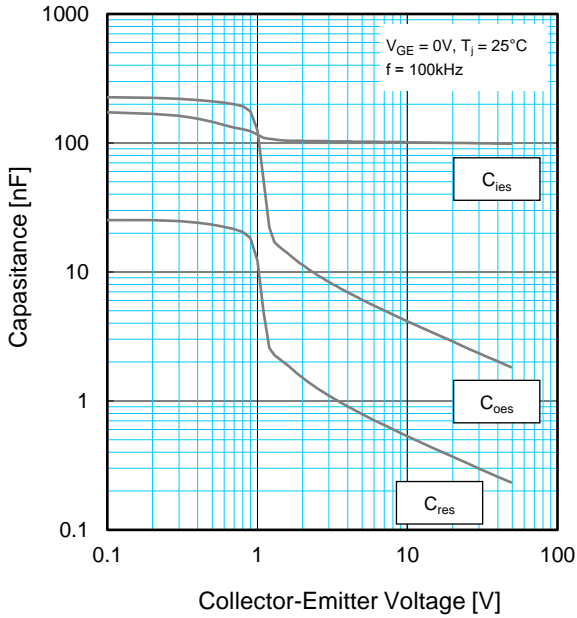
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HIGH POWER SWITCHING USE
INSULATED TYPE

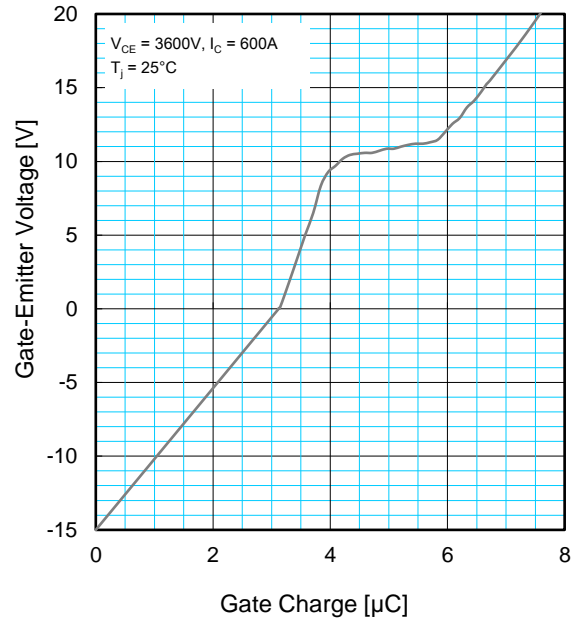
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PERFORMANCE CURVES

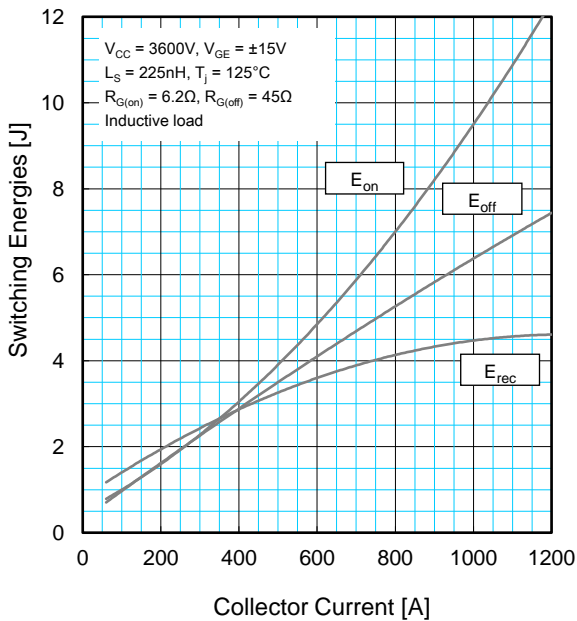
CAPACITANCE CHARACTERISTICS (TYPICAL)



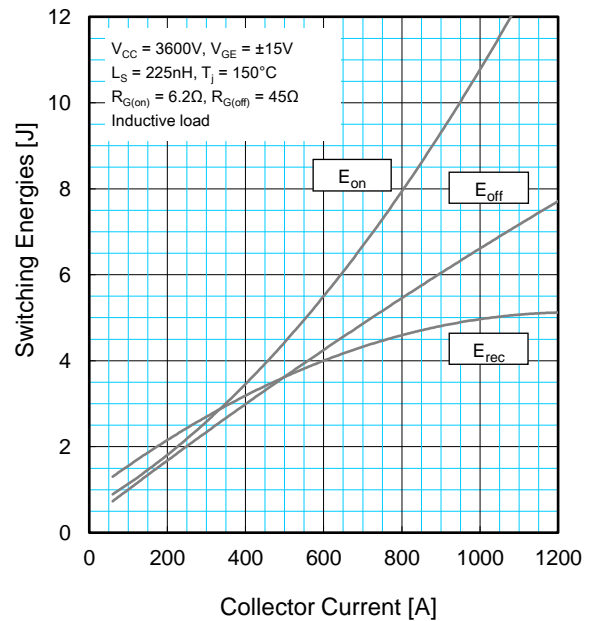
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



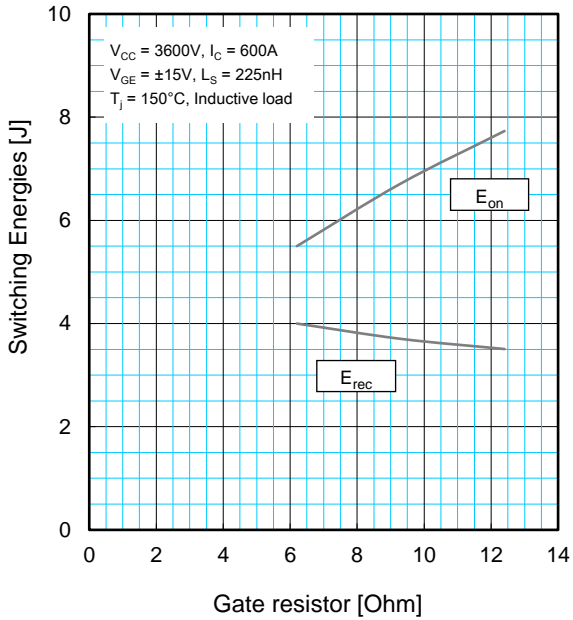
CM600HG-130X

HIGH POWER SWITCHING USE
INSULATED TYPE

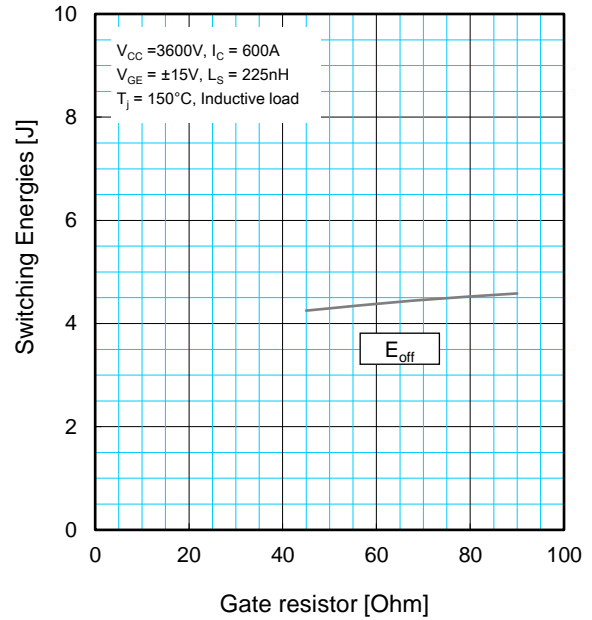
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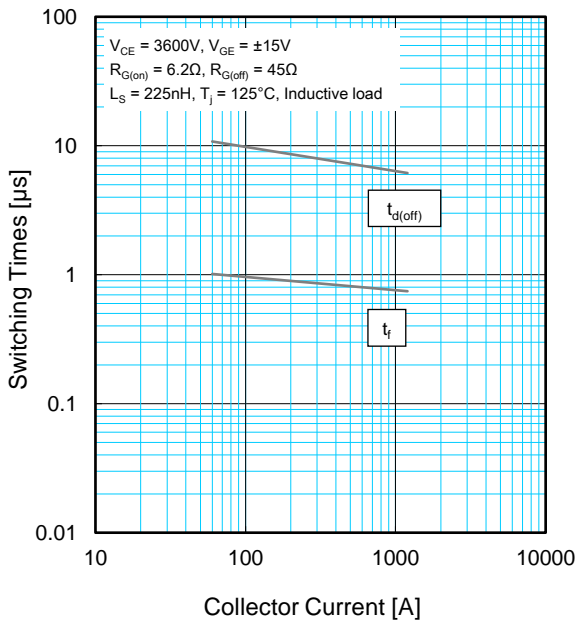
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



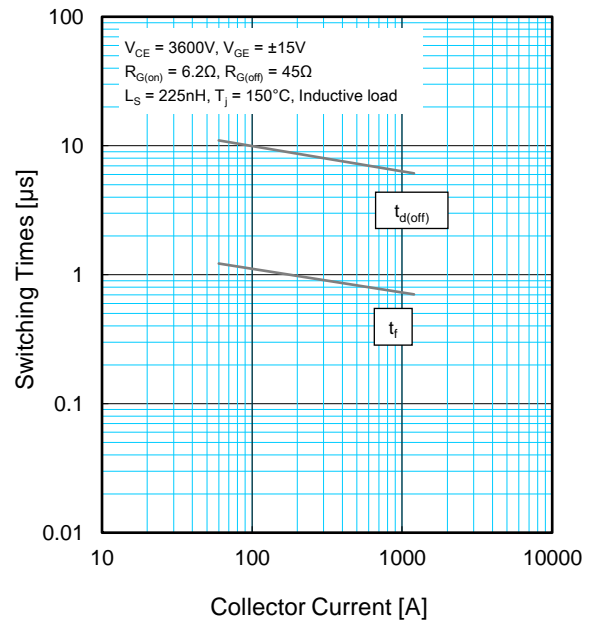
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



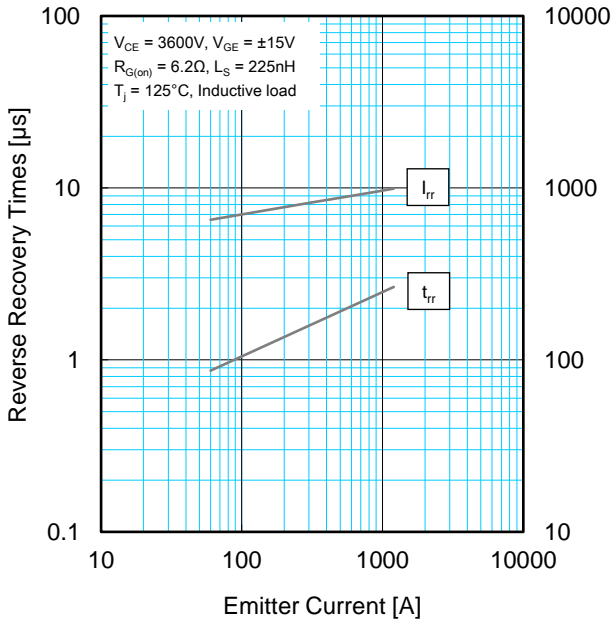
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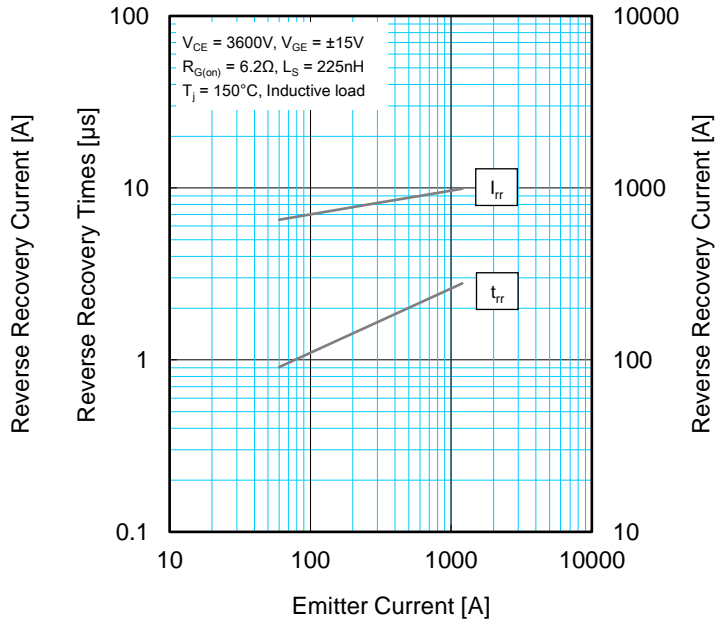
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PERFORMANCE CURVES

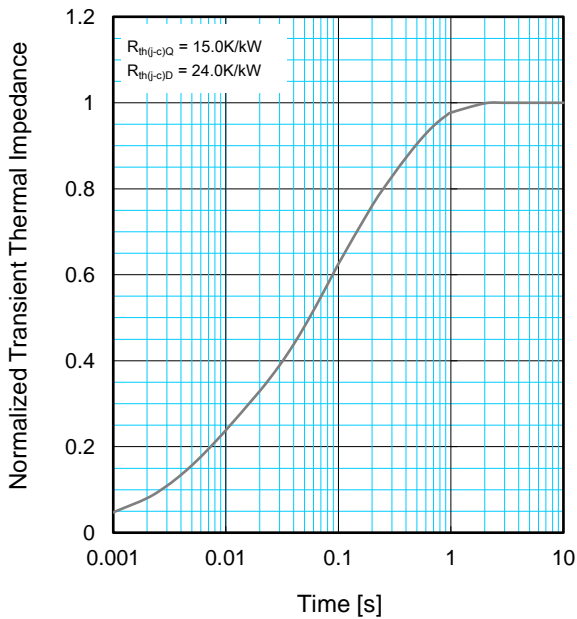
FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)



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
$R_i / R_{th(j-c)}$	0.0096	0.1893	0.4044	0.3967
τ_i [s]	0.0001	0.0058	0.0602	0.3512

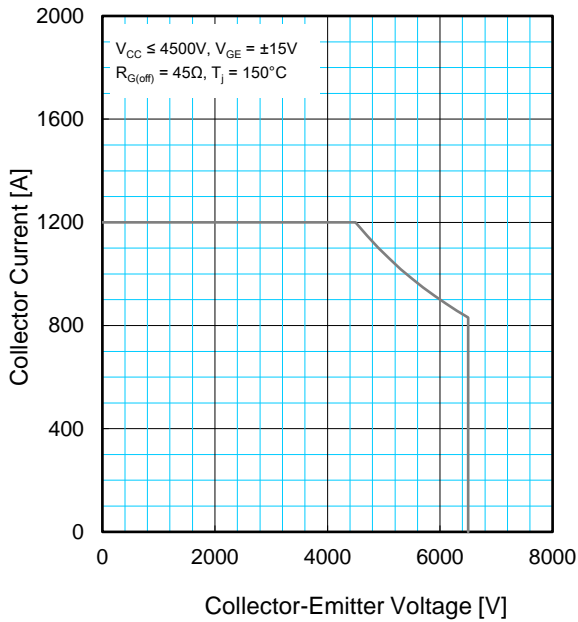
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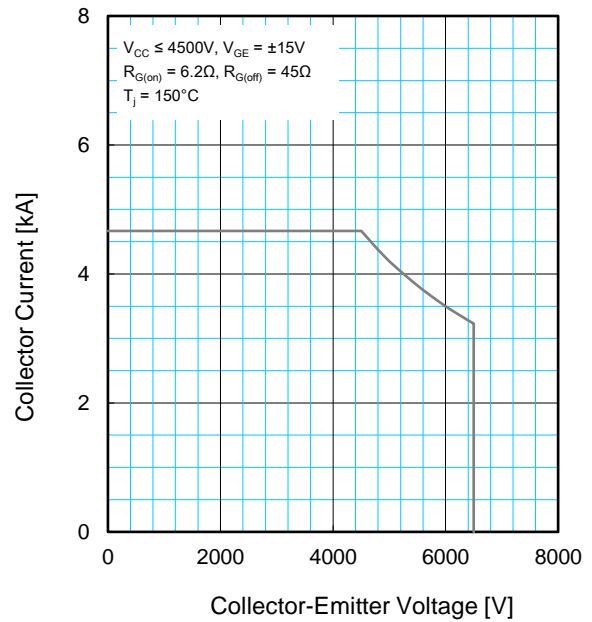
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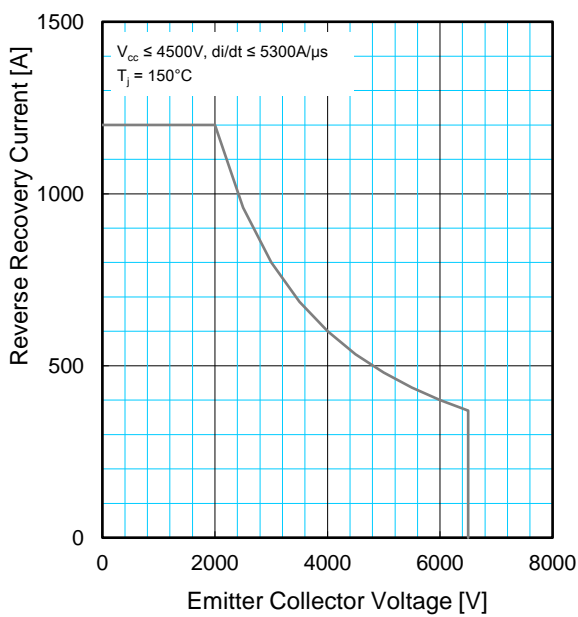
REVERSE BIAS SAFE OPERATING AREA (RBSOA)



SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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



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

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