

< HVIGBT MODULES >

CM1200HG-90R

HIGH POWER SWITCHING USE
INSULATED TYPE

4th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

CM1200HG-90R



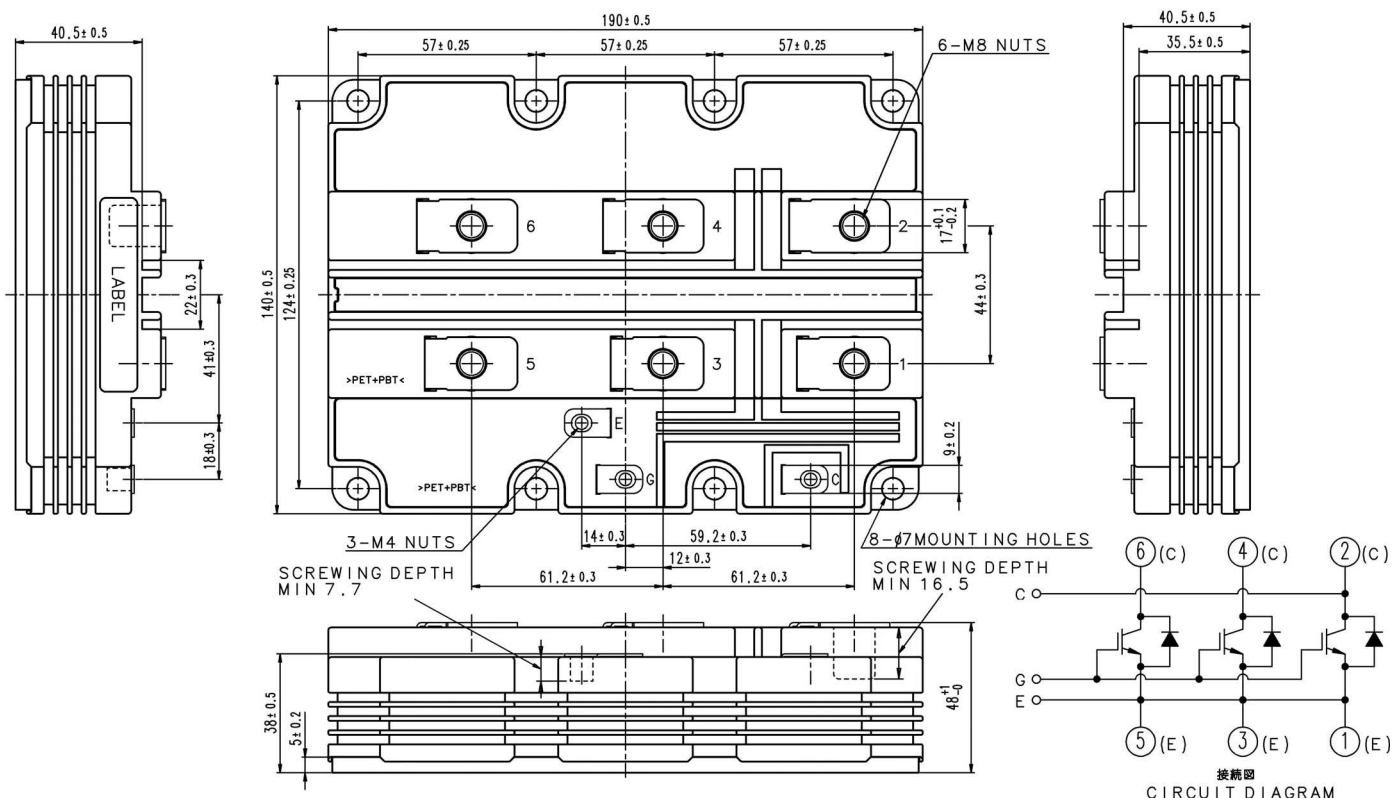
- I_C 1200A
- V_{CES} 4500V
- 1-element in a pack
- High Insulated type
- LPT-IGBT / Soft Recovery Diode
- AISiC baseplate

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	$V_{GE} = 0V, T_j = -40 \dots +125^\circ C$	4500	V
		$V_{GE} = 0V, T_j = -50^\circ C$	4400	
V_{GES}	Gate-emitter voltage	$V_{CE} = 0V, T_j = 25^\circ C$	± 20	V
I_C	Collector current	DC, $T_c = 85^\circ C$	1200	A
I_{CRM}		Pulse (Note 1)	2400	A
I_E	Emitter current (Note 2)	DC	1200	A
I_{ERM}		Pulse (Note 1)	2400	A
P_{tot}	Maximum power dissipation (Note 3)	$T_c = 25^\circ C$, IGBT part	11900	W
V_{iso}	Isolation voltage	RMS, sinusoidal, $f = 60Hz$, $t = 1 \text{ min.}$	10200	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, $f = 60Hz$, $Q_{PD} \leq 10 \text{ pC}$	3500	V
T_j	Junction temperature		$-50 \sim +150$	$^\circ C$
T_{jop}	Operating junction temperature		$-50 \sim +125$	$^\circ C$
T_{stg}	Storage temperature		$-55 \sim +125$	$^\circ C$
t_{psc}	Short circuit pulse width	$V_{CC} = 3200V, V_{CE} \leq V_{CES}, V_{GE} = 15V, T_j = 125^\circ C$	10	μs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
I_{CES}	Collector cutoff current	$V_{CE} = V_{CES}, V_{GE} = 0V$	$T_j = 25^\circ C$	—	16.0	mA
			$T_j = 125^\circ C$	—	—	
$V_{GE(th)}$	Gate-emitter threshold voltage	$V_{CE} = 10V, I_C = 120 \text{ mA}, T_j = 25^\circ C$	5.8	6.3	6.8	V
I_{GES}	Gate leakage current	$V_{GE} = V_{GES}, V_{CE} = 0V, T_j = 25^\circ C$	-0.5	—	0.5	μA
C_{ies}	Input capacitance	$V_{CE} = 10V, V_{GE} = 0V, f = 100 \text{ kHz}$ $T_j = 25^\circ C$	—	175.0	—	nF
C_{oes}	Output capacitance		—	11.0	—	nF
C_{res}	Reverse transfer capacitance		—	5.0	—	nF
Q_G	Total gate charge	$V_{CC} = 2800V, I_C = 1200A, V_{GE} = \pm 15V$	—	13.5	—	μC
V_{CEsat}	Collector-emitter saturation voltage	$I_C = 1200A$ (Note 4) $V_{GE} = 15V$	$T_j = 25^\circ C$	3.50	—	V
			$T_j = 125^\circ C$	4.40	5.10	
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 2800V$ $I_C = 1200A$ $V_{GE} = \pm 15V$	$T_j = 25^\circ C$	1.00	—	μs
			$T_j = 125^\circ C$	0.95	1.50	
t_r	Turn-on rise time		$T_j = 25^\circ C$	0.28	—	μs
			$T_j = 125^\circ C$	0.30	0.50	
$E_{on(10\%)}$	Turn-on switching energy (Note 5)	$R_{G(on)} = 2.7 \Omega$ $L_s = 150 \text{ nH}$ Inductive load	$T_j = 25^\circ C$	4.30	—	J
			$T_j = 125^\circ C$	5.10	—	
E_{on}	Turn-on switching energy (Note 6)		$T_j = 25^\circ C$	4.60	—	J
			$T_j = 125^\circ C$	5.50	—	
$t_{d(off)}$	Turn-off delay time	$V_{CC} = 2800V$ $I_C = 1200A$ $V_{GE} = \pm 15V$	$T_j = 25^\circ C$	3.60	—	μs
			$T_j = 125^\circ C$	3.80	5.00	
t_f	Turn-off fall time		$T_j = 25^\circ C$	0.35	—	μs
			$T_j = 125^\circ C$	0.45	1.00	
$E_{off(10\%)}$	Turn-off switching energy (Note 5)	$R_{G(off)} = 10 \Omega$ $L_s = 150 \text{ nH}$ Inductive load	$T_j = 25^\circ C$	2.90	—	J
			$T_j = 125^\circ C$	3.85	—	
E_{off}	Turn-off switching energy (Note 6)		$T_j = 25^\circ C$	3.20	—	J
			$T_j = 125^\circ C$	4.30	—	

ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
V_{EC}	Emitter-collector voltage (Note 2)	$I_E = 1200\text{ A}$ (Note 4) $V_{GE} = 0\text{ V}$	$T_J = 25^\circ\text{C}$ —	2.50	—	V
			$T_J = 125^\circ\text{C}$ —	2.80	3.40	
t_{rr}	Reverse recovery time (Note 2)	$V_{CC} = 2800\text{ V}$ $I_C = 1200\text{ A}$ $V_{GE} = \pm 15\text{ V}$ $R_{G(on)} = 2.7\ \Omega$ $L_s = 150\text{ nH}$ Inductive load	$T_J = 25^\circ\text{C}$ —	0.70	—	μs
			$T_J = 125^\circ\text{C}$ —	0.90	—	
I_{rr}	Reverse recovery current (Note 2)		$T_J = 25^\circ\text{C}$ —	1100	—	A
			$T_J = 125^\circ\text{C}$ —	1200	—	
Q_{rr}	Reverse recovery charge (Note 2)		$T_J = 25^\circ\text{C}$ —	1000	—	μC
			$T_J = 125^\circ\text{C}$ —	1500	—	
$E_{rec(10\%)}$	Reverse recovery energy (Note 2) (Note 5)		$T_J = 25^\circ\text{C}$ —	1.30	—	J
			$T_J = 125^\circ\text{C}$ —	2.10	—	
E_{rec}	Reverse recovery energy (Note 2) (Note 6)		$T_J = 25^\circ\text{C}$ —	1.55	—	J
			$T_J = 125^\circ\text{C}$ —	2.40	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, IGBT part	—	—	10.5	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part	—	—	19.5	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, $\lambda_{grease} = 1\text{ W/m}^2\text{K}$, $D_{(c-s)} = 100\ \mu\text{m}$	—	6.0	—	K/kW

MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
M_t	Mounting torque	M8 : Main terminals screw	7.0	—	22.0	N·m
M_s		M6 : Mounting screw	3.0	—	6.0	N·m
M_t		M4 : Auxiliary terminals screw	1.0	—	3.0	N·m
m	Mass		—	1.4	—	kg
CTI	Comparative tracking index		600	—	—	—
d_a	Clearance		26.0	—	—	mm
d_s	Creepage distance		56.0	—	—	mm
L_{PCE}	Parasitic stray inductance		—	15.0	—	nH
$R_{CC+EE'}$	Internal lead resistance	$T_C = 25^\circ\text{C}$	—	0.18	—	m Ω
r_g	Internal gate resistance	$T_C = 25^\circ\text{C}$	—	1.7	—	Ω

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

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

3. Junction temperature (T_J) should not exceed T_{Jmax} rating (150°C).

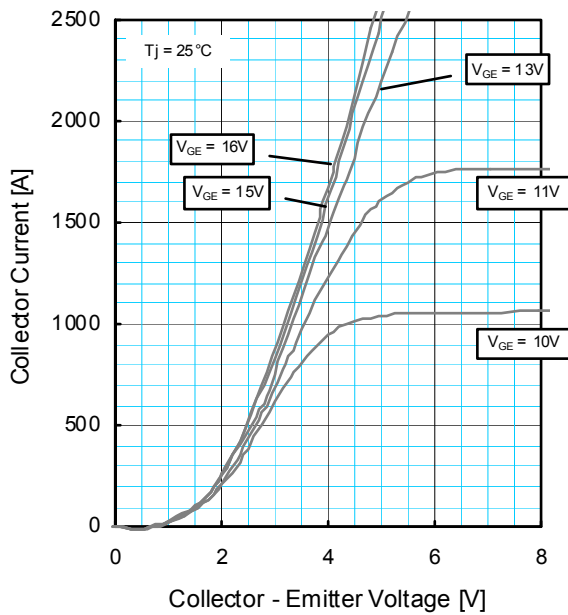
4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

5. $E_{on(10\%)}$ / $E_{off(10\%)}$ / $E_{rec(10\%)}$ are the integral of $0.1V_{CE} \times 0.1I_C \times dt$.

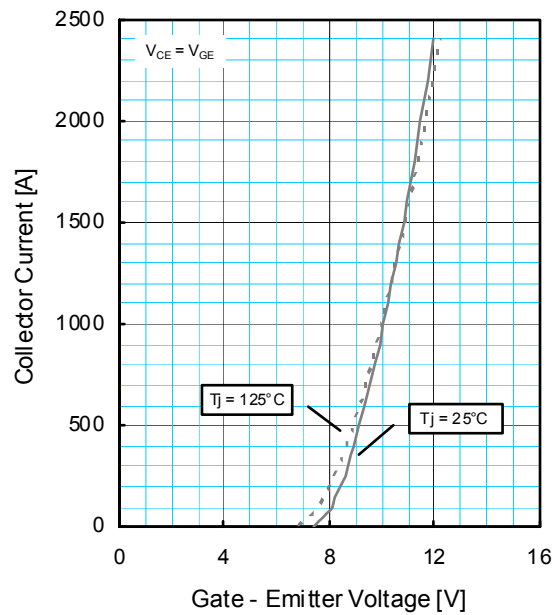
6. Definition of all items is according to IEC 60747, unless otherwise specified.

PERFORMANCE CURVES

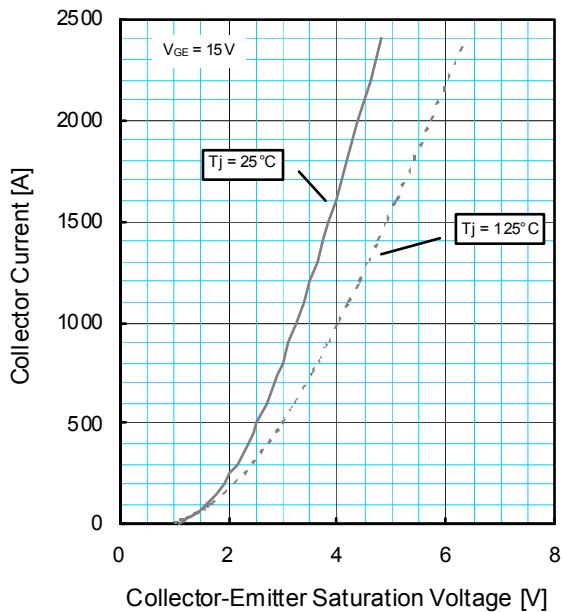
**OUTPUT CHARACTERISTICS
(TYPICAL)**



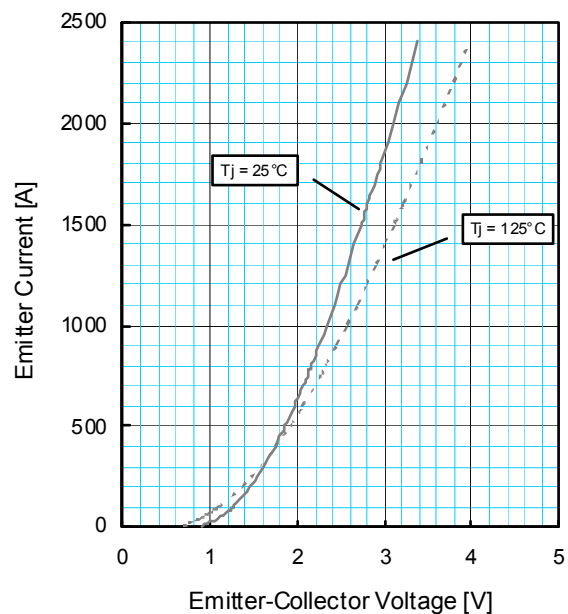
**TRANSFER CHARACTERISTICS
(TYPICAL)**

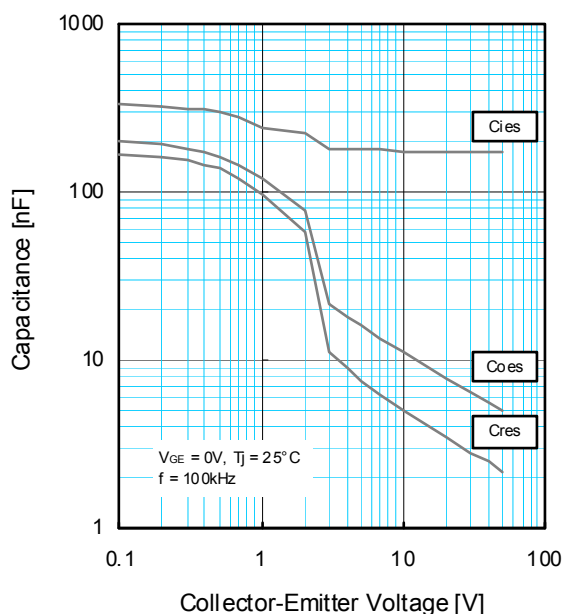
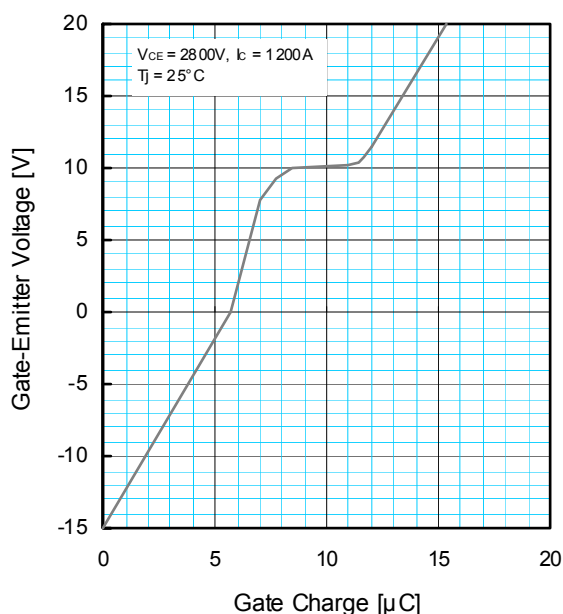
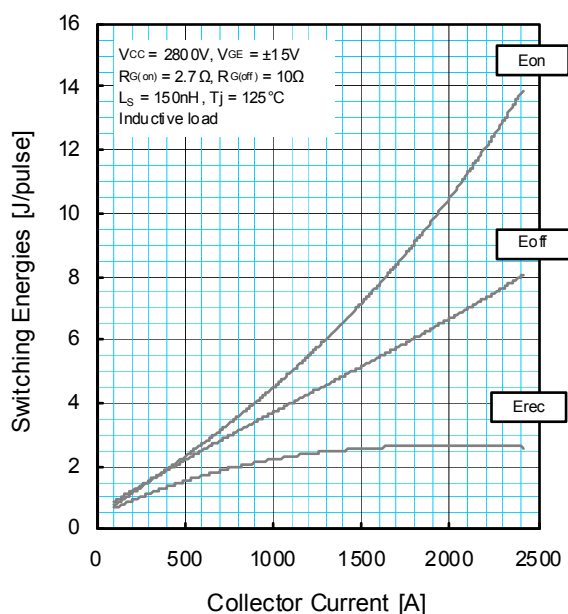
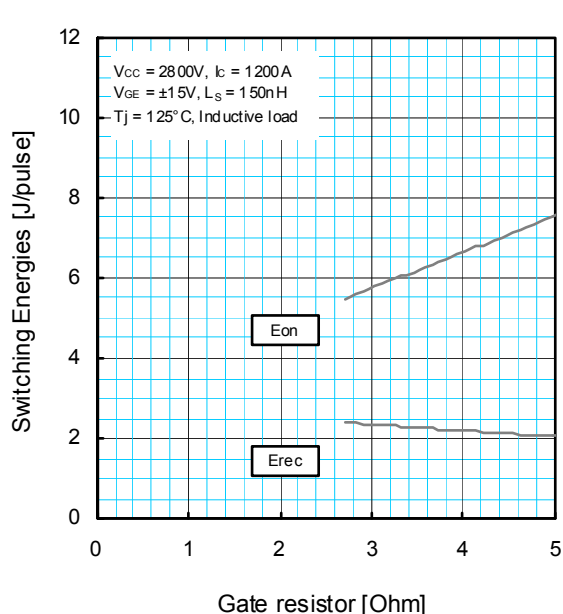


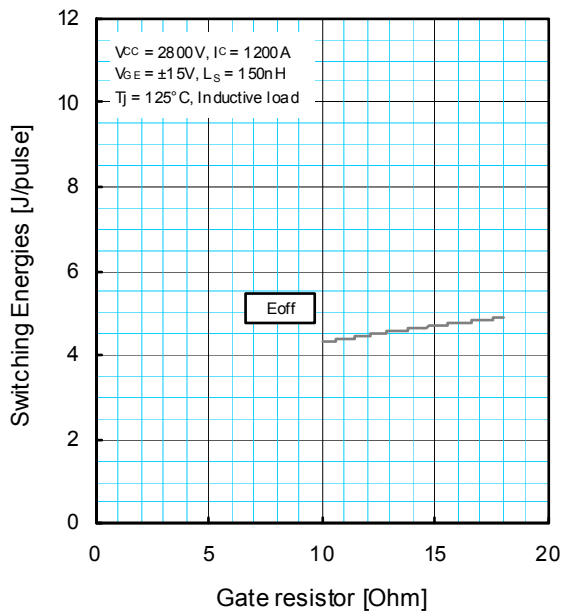
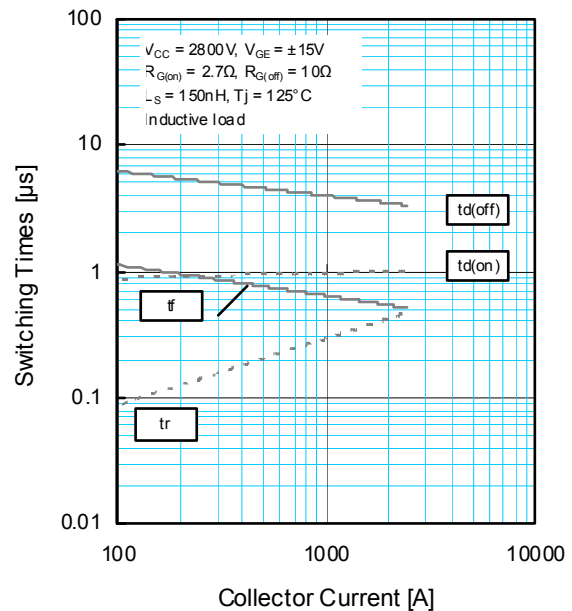
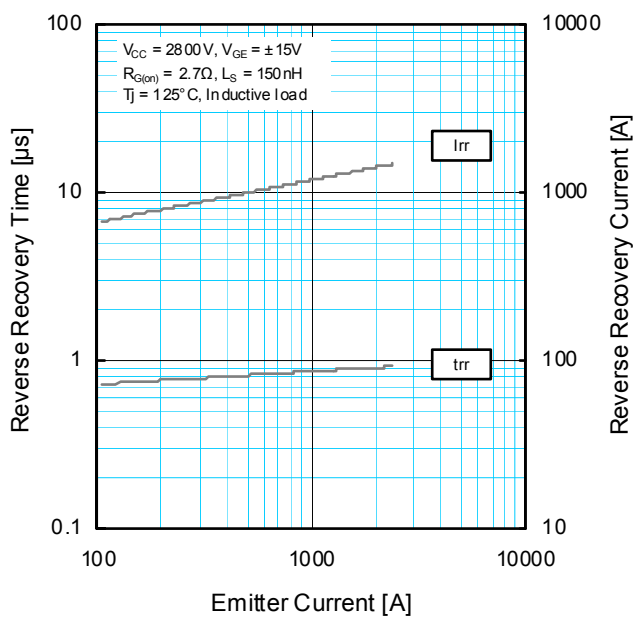
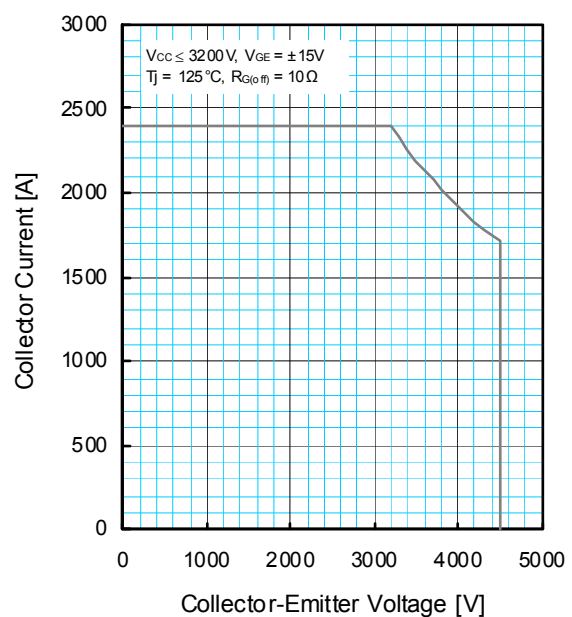
**COLLECTOR-EMITTER SATURATION VOLTAGE
CHARACTERISTICS (TYPICAL)**

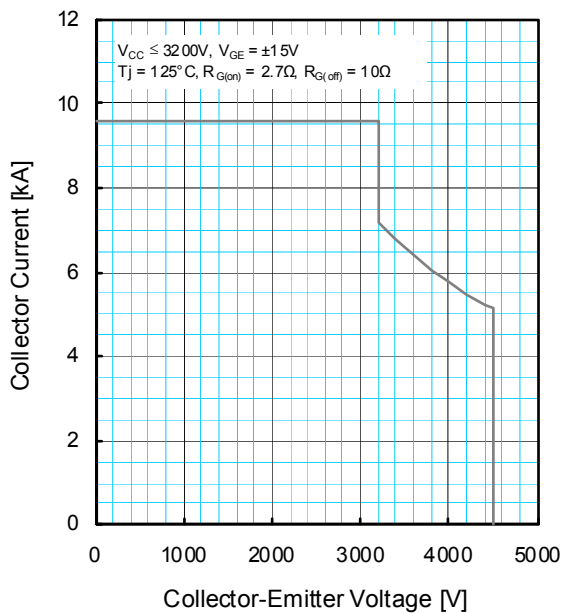
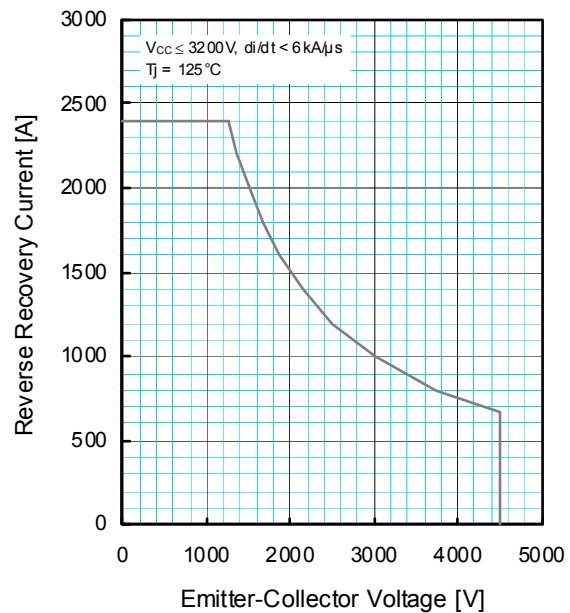
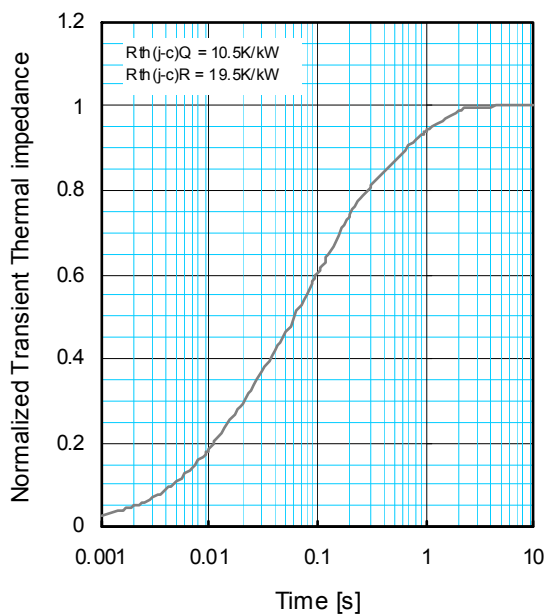


**FREE-WHEEL DIODE FORWARD
CHARACTERISTICS (TYPICAL)**



PERFORMANCE CURVES**CAPACITANCE CHARACTERISTICS
(TYPICAL)****GATE CHARGE CHARACTERISTICS
(TYPICAL)****HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)****HALF-BRIDGE SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)**

PERFORMANCE CURVES**SWITCHING ENERGY
CHARACTERISTICS (TYPICAL)****HALF-BRIDGE SWITCHING TIME
CHARACTERISTICS
(TYPICAL) HALF-BRIDGE****FREE-WHEEL DIODE REVERSE RECOVERY
CHARACTERISTICS (TYPICAL)****REVERSE BIAS SAFE OPERATING AREA
(RBSOA)**

PERFORMANCE CURVES**SHORT CIRCUIT
SAFE OPERATING AREA (SCSOA)****FREE-WHEEL DIODE REVERSE RECOVERY
SAFE OPERATING AREA (RRSOA)****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 [K/kW] :	0.0055	0.2360	0.4680	0.2905
t_i [sec] :	0.0001	0.0131	0.0878	0.6247

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