

< HVIGBT MODULES >

CM1200HG-90R

HIGH POWER SWITCHING USE
INSULATED TYPE

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

CM1200HG-90R



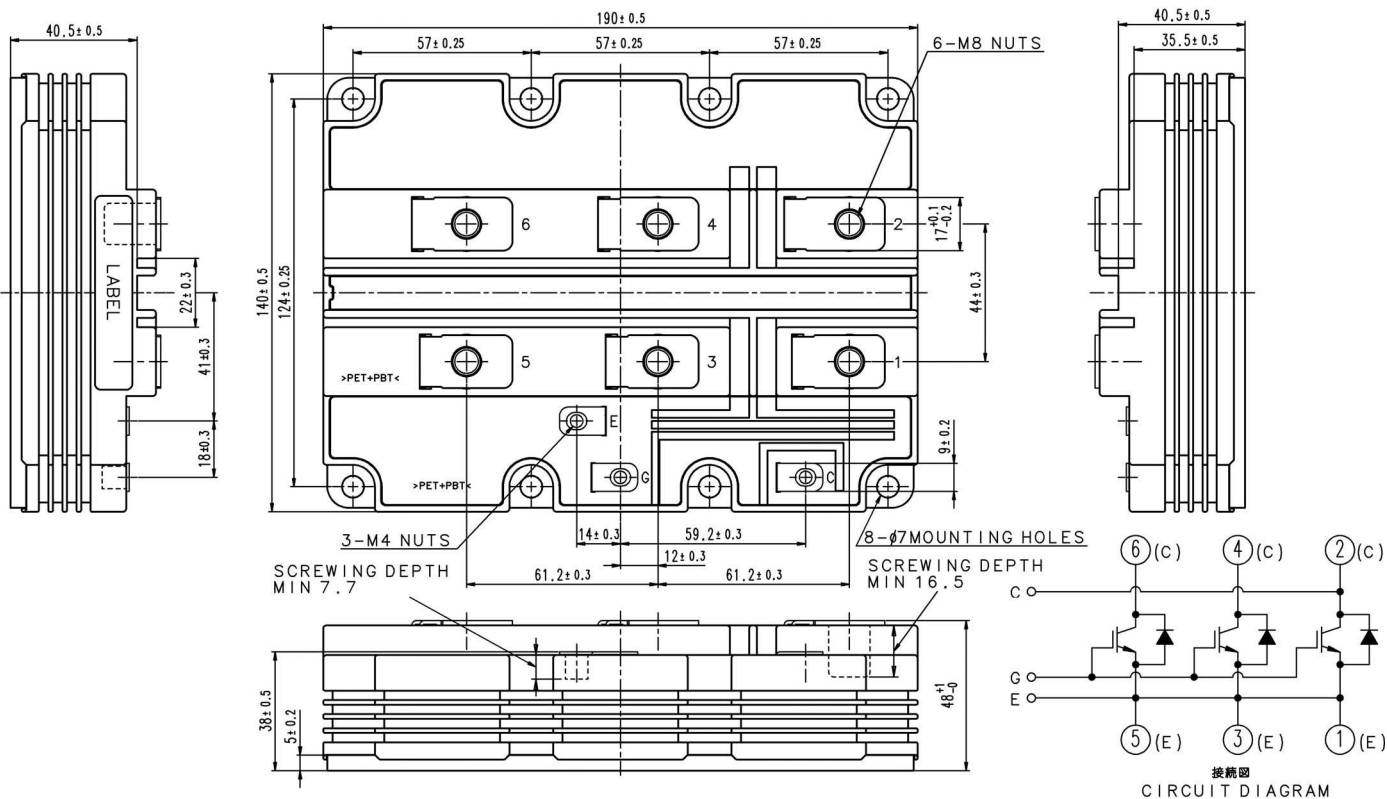
- I_C 1200A
- V_{CES} 4500V
- 1-element in a pack
- High Insulated type
- LPT-IGBT / Soft Recovery Diode
- AISiC baseplate

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



MAXIMUM RATINGS

| Symbol | Item | Conditions | Ratings | Unit |
|------------------|--------------------------------------|---|------------|------|
| V _{CES} | Collector-emitter voltage | V _{GE} = 0V, T _j = -40...+125°C | 4500 | V |
| | | V _{GE} = 0V, T _j = -50°C | 4400 | |
| V _{GES} | Gate-emitter voltage | V _{CE} = 0V, T _j = 25°C | ± 20 | V |
| I _C | Collector current | DC, T _c = 85°C | 1200 | A |
| I _{CRM} | | Pulse (Note 1) | 2400 | |
| I _E | Emitter current (Note 2) | DC | 1200 | A |
| I _{ERM} | | Pulse (Note 1) | 2400 | |
| P _{tot} | Maximum power dissipation (Note 3) | T _c = 25°C, IGBT part | 11900 | W |
| V _{iso} | Isolation voltage | RMS, sinusoidal, f = 60Hz, t = 1 min. | 10200 | V |
| V _e | Partial discharge extinction voltage | RMS, sinusoidal, f = 60Hz, Q _{PD} ≤ 10 pC | 3500 | V |
| T _j | Junction temperature | | -50 ~ +150 | °C |
| T _{jop} | Operating junction temperature | | -50 ~ +125 | °C |
| T _{stg} | Storage temperature | | -55 ~ +125 | °C |
| t _{psc} | Short circuit pulse width | V _{CC} = 3200V, V _{CE} ≤ V _{CES} , V _{GE} = 15V, T _j = 125°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°C | — | — | 16.0 | mA |
| | | | T _j = 125°C | — | 16.0 | — | |
| V _{GE(th)} | Gate-emitter threshold voltage | V _{CE} = 10 V, I _C = 120 mA, T _j = 25°C | 5.8 | 6.3 | 6.8 | 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 | — | 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} = ±15V | — | 13.5 | — | μC | |
| V _{CESat} | Collector-emitter saturation voltage | I _C = 1200 A (Note 4) V _{GE} = 15 V | T _j = 25°C | — | 3.50 | — | V |
| | | | T _j = 125°C | — | 4.40 | 5.10 | |
| t _{d(on)} | Turn-on delay time | V _{CC} = 2800 V I _C = 1200 A V _{GE} = ±15 V | T _j = 25°C | — | 1.00 | — | μs |
| | | | T _j = 125°C | — | 0.95 | 1.50 | |
| t _r | Turn-on rise time | V _{CC} = 2800 V I _C = 1200 A V _{GE} = ±15 V | T _j = 25°C | — | 0.28 | — | μs |
| | | | T _j = 125°C | — | 0.30 | 0.50 | |
| E _{on(10%)} | Turn-on switching energy (Note 5) | R _{G(on)} = 2.7 Ω L _s = 150 nH Inductive load | T _j = 25°C | — | 4.30 | — | J |
| | | | T _j = 125°C | — | 5.10 | — | |
| E _{on} | Turn-on switching energy (Note 6) | Inductive load | T _j = 25°C | — | 4.60 | — | J |
| | | | T _j = 125°C | — | 5.50 | — | |
| t _{d(off)} | Turn-off delay time | V _{CC} = 2800 V I _C = 1200 A V _{GE} = ±15 V | T _j = 25°C | — | 3.60 | — | μs |
| | | | T _j = 125°C | — | 3.80 | 5.00 | |
| t _f | Turn-off fall time | V _{CC} = 2800 V I _C = 1200 A V _{GE} = ±15 V | T _j = 25°C | — | 0.35 | — | μs |
| | | | T _j = 125°C | — | 0.45 | 1.00 | |
| E _{off(10%)} | Turn-off switching energy (Note 5) | R _{G(off)} = 10 Ω L _s = 150 nH Inductive load | T _j = 25°C | — | 2.90 | — | J |
| | | | T _j = 125°C | — | 3.85 | — | |
| E _{off} | Turn-off switching energy (Note 6) | Inductive load | T _j = 25°C | — | 3.20 | — | J |
| | | | T _j = 125°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) | | $T_j = 25^\circ\text{C}$ | — | 0.70 | — | μs |
| | | | $T_j = 125^\circ\text{C}$ | — | 0.90 | — | |
| I_{rr} | Reverse recovery current (Note 2) | $V_{CC} = 2800 \text{ V}$ $I_C = 1200 \text{ A}$ | $T_j = 25^\circ\text{C}$ | — | 1100 | — | A |
| | | | $T_j = 125^\circ\text{C}$ | — | 1200 | — | |
| Q_{rr} | Reverse recovery charge (Note 2) | $V_{GE} = \pm 15 \text{ V}$ $R_{G(on)} = 2.7 \Omega$ | $T_j = 25^\circ\text{C}$ | — | 1000 | — | μC |
| | | | $T_j = 125^\circ\text{C}$ | — | 1500 | — | |
| $E_{rec(10\%)}$ | Reverse recovery energy (Note 2) (Note 5) | $L_s = 150 \text{ nH}$ Inductive load | $T_j = 25^\circ\text{C}$ | — | 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 | |
| $R_{th(c-s)}$ | 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 (FWD).

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

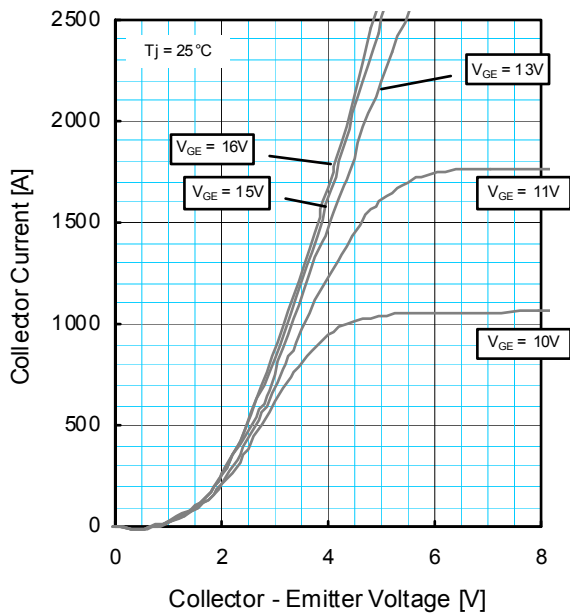
4. Pulse width and repetition rate should be such as to cause negligible temperature rise.

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

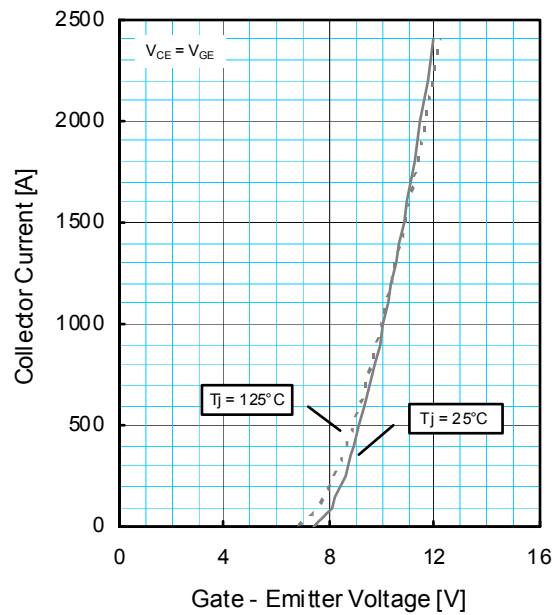
6. Definition of all items is according to IEC 60747, unless otherwise specified.

PERFORMANCE CURVES

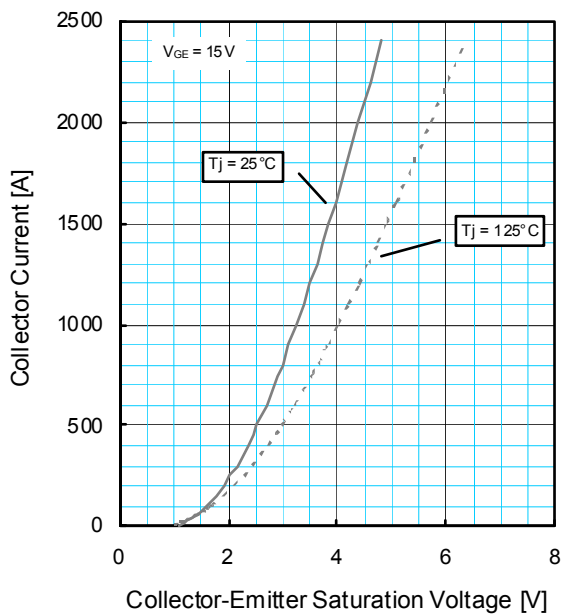
OUTPUT CHARACTERISTICS (TYPICAL)



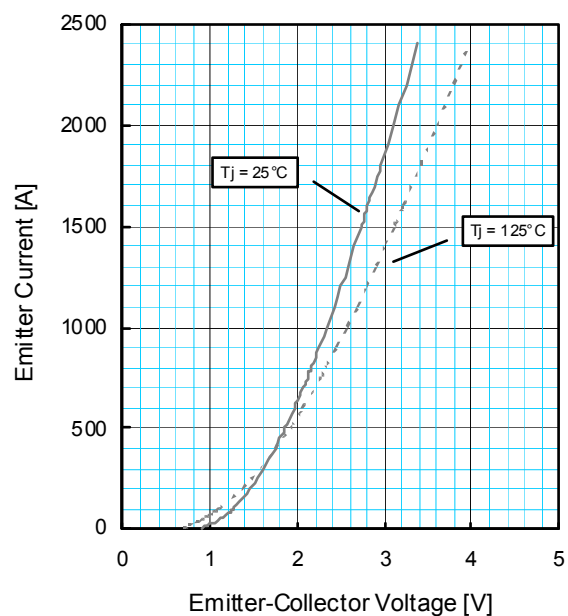
TRANSFER CHARACTERISTICS (TYPICAL)



COLLECTOR-EMITTER SATURATION VOLTAGE CHARACTERISTICS (TYPICAL)

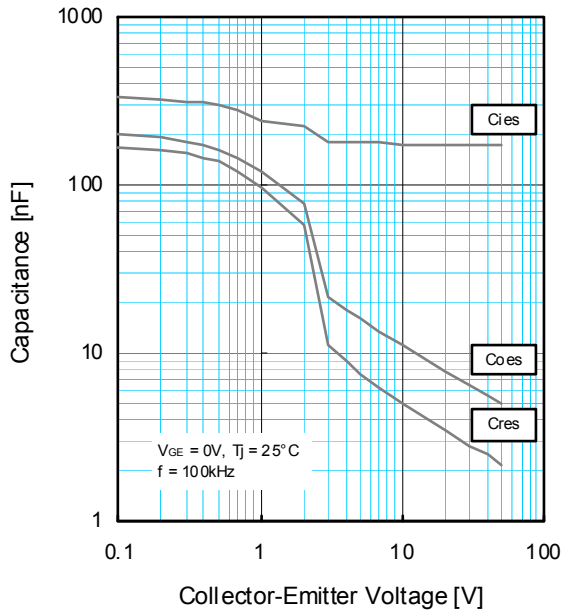


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

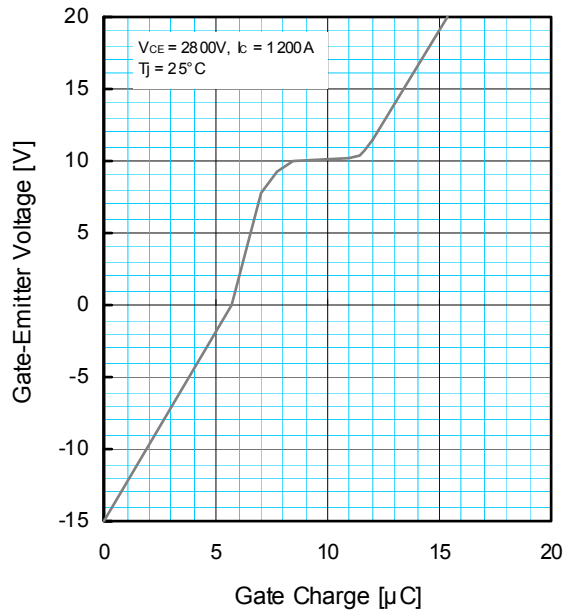


PERFORMANCE CURVES

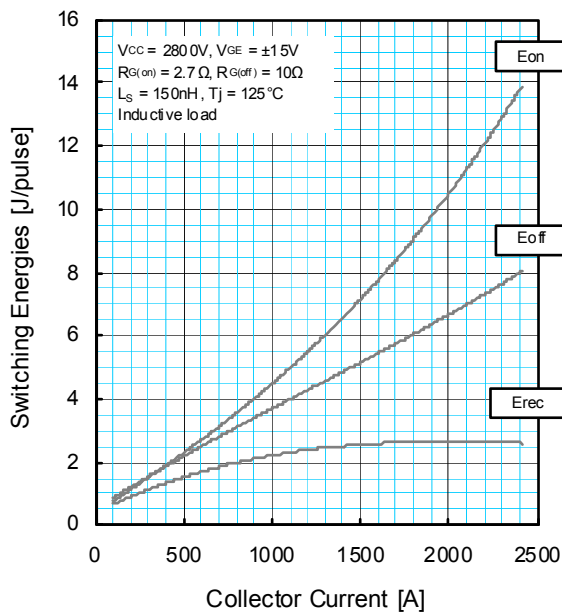
CAPACITANCE CHARACTERISTICS (TYPICAL)



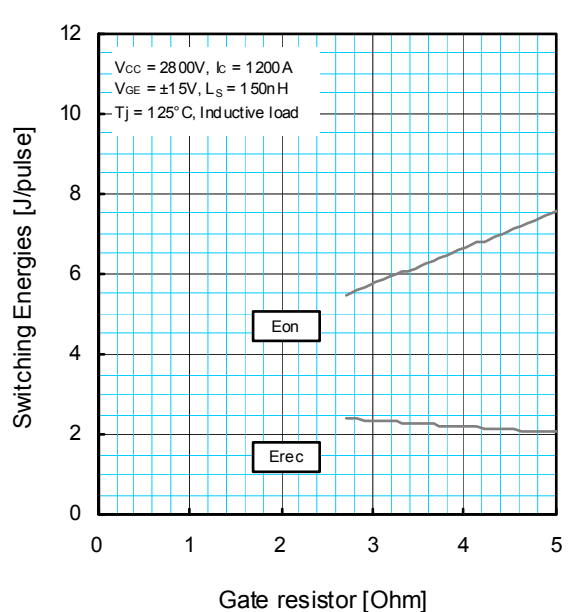
GATE CHARGE CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

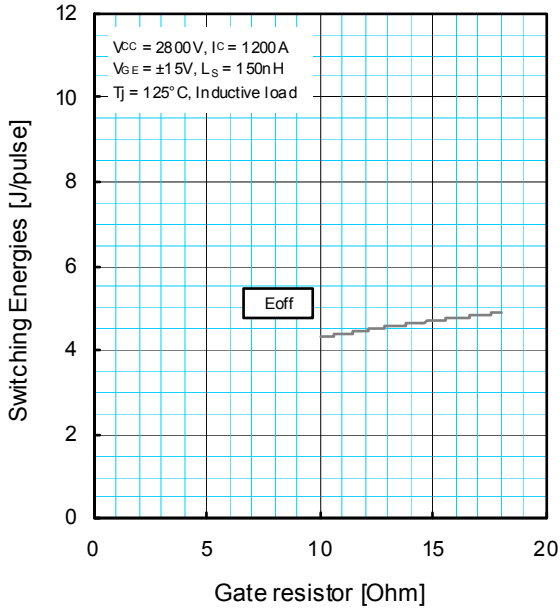


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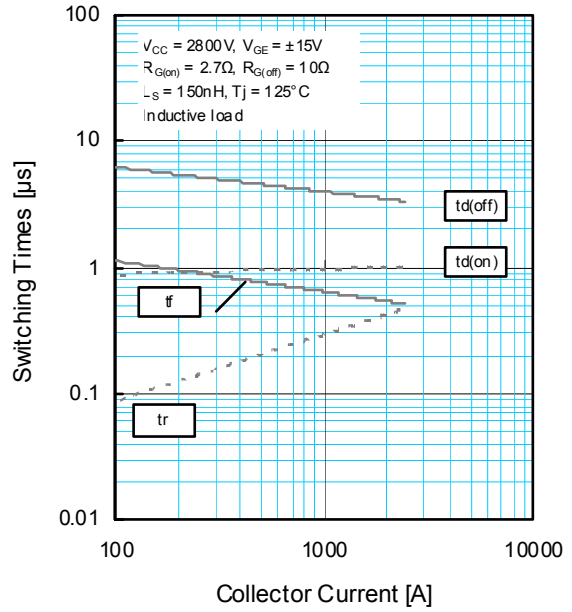
HIGH POWER SWITCHING USE
INSULATED TYPE

PERFORMANCE CURVES

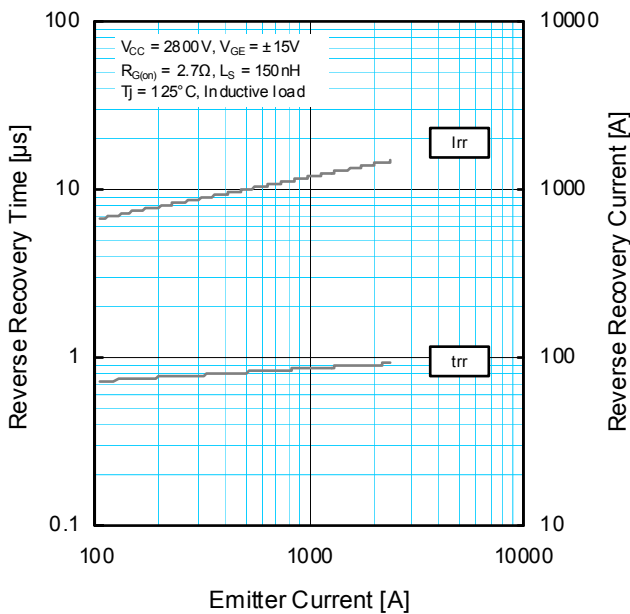
SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



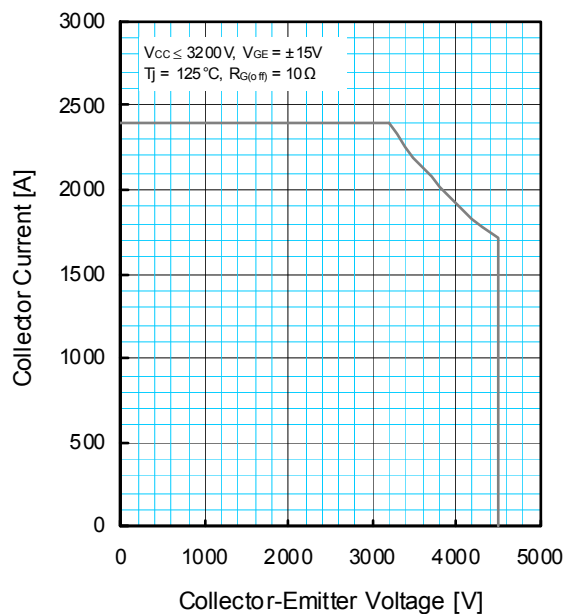
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL) HALF-BRIDGE



FREE-WHEEL DIODE REVERSE RECOVERY CHARACTERISTICS (TYPICAL)

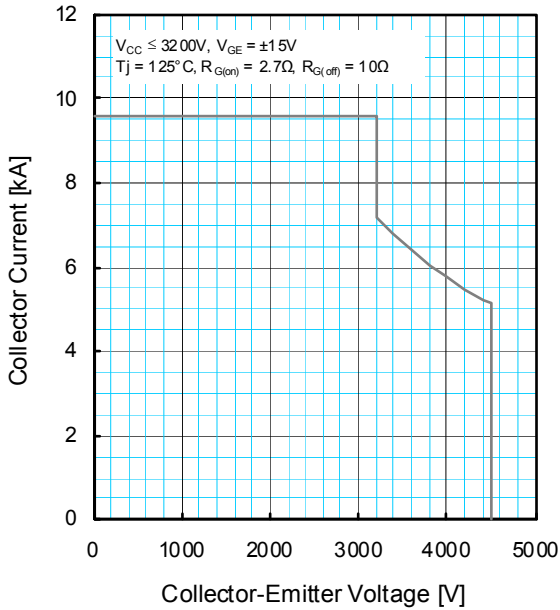


REVERSE BIAS SAFE OPERATING AREA (RBSOA)

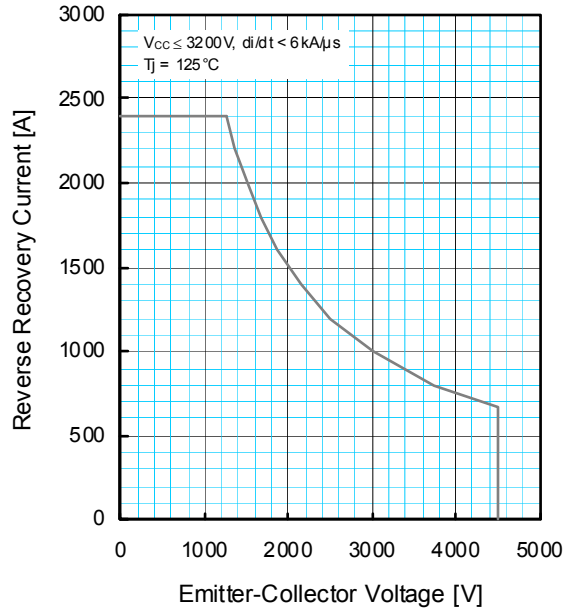


PERFORMANCE CURVES

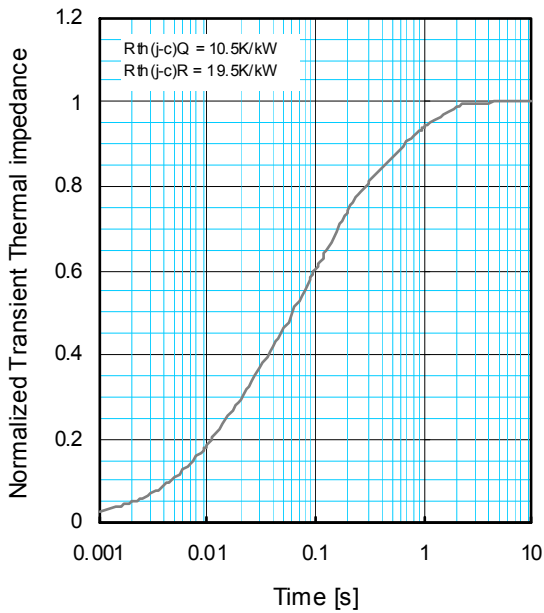
**SHORT CIRCUIT
SAFE OPERATING AREA (SCSOA)**



**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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