

<High Voltage Insulated Gate Bipolar Transistor: HVIGBT >

# CM2400HC-34N

HIGH POWER SWITCHING USE  
INSULATED TYPE

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

## CM2400HC-34N



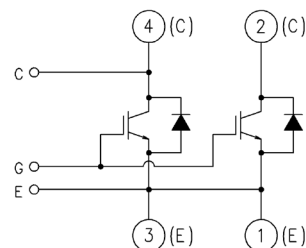
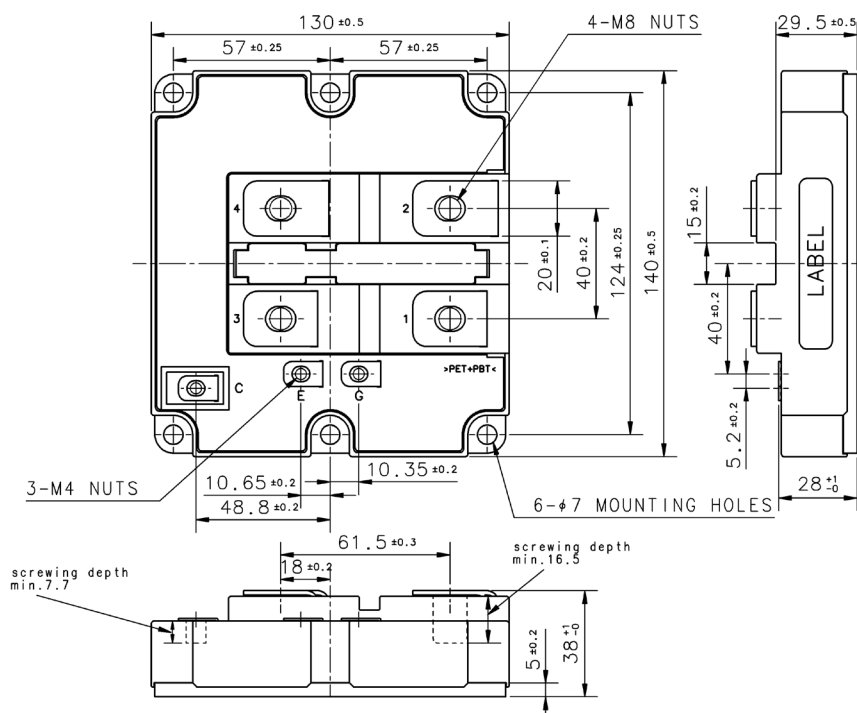
- $I_C$  ..... 2400 A
- $V_{CES}$  ..... 1700 V
- Insulated Type
- 1-element in a Pack
- AlSiC baseplate
- Trench Gate IGBT : CSTBT™
- Soft Reverse Recovery Diode

## 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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**MAXIMUM RATINGS**

| Symbol    | Item                               | Conditions                                                             | Ratings         | Unit       |
|-----------|------------------------------------|------------------------------------------------------------------------|-----------------|------------|
| $V_{CES}$ | Collector-emitter voltage          | $V_{GE} = 0V, T_J = 25^\circ C$                                        | 1700            | V          |
| $V_{GES}$ | Gate-emitter voltage               | $V_{CE} = 0V, T_J = 25^\circ C$                                        | $\pm 20$        | V          |
| $I_C$     | Collector current                  | DC, $T_c = 75^\circ C$                                                 | 2400            | A          |
| $I_{CRM}$ |                                    | Pulse (Note 1)                                                         | 4800            | A          |
| $I_E$     | Emitter current (Note 2)           | DC                                                                     | 2400            | A          |
| $I_{ERM}$ |                                    | Pulse (Note 1)                                                         | 4800            | A          |
| $P_{tot}$ | Maximum power dissipation (Note 3) | $T_c = 25^\circ C$ , IGBT part                                         | 13100           | W          |
| $V_{iso}$ | Isolation voltage                  | RMS, sinusoidal, $f = 60Hz, t = 1 \text{ min.}$                        | 4000            | V          |
| $T_J$     | Junction temperature               |                                                                        | $-40 \sim +150$ | $^\circ C$ |
| $T_{Jop}$ | Operating junction temperature     |                                                                        | $-40 \sim +125$ | $^\circ C$ |
| $T_{stg}$ | Storage temperature                |                                                                        | $-40 \sim +125$ | $^\circ C$ |
| $t_{psc}$ | Short circuit pulse width          | $V_{CC} = 1200V, V_{CE} \leq V_{CES}, V_{GE} = 15V, T_J = 125^\circ C$ | 10              | $\mu s$    |

**ELECTRICAL CHARACTERISTICS**

| Symbol          | Item                                       | Conditions                                                                                                                             | Limits |              |             | Unit    |
|-----------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------|--------------|-------------|---------|
|                 |                                            |                                                                                                                                        | Min    | Typ          | Max         |         |
| $I_{CES}$       | Collector cutoff current                   | $V_{CE} = V_{CES}, V_{GE} = 0V$<br>$T_J = 25^\circ C$<br>$T_J = 125^\circ C$                                                           | —      | —            | 8.0<br>16.0 | mA      |
| $V_{GE(th)}$    | Gate-emitter threshold voltage             | $V_{CE} = 10V, I_C = 240 \text{ mA}, T_J = 25^\circ C$                                                                                 | 6.0    | 7.0          | 8.0         | V       |
| $I_{GES}$       | Gate leakage current                       | $V_{GE} = V_{GES}, V_{CE} = 0V, T_J = 25^\circ C$                                                                                      | —      | —            | 0.5         | $\mu A$ |
| $C_{ies}$       | Input capacitance                          | $V_{CE} = 10V, V_{GE} = 0V, f = 100 \text{ kHz}$<br>$T_J = 25^\circ C$                                                                 | —      | 352          | —           | nF      |
| $C_{oes}$       | Output capacitance                         |                                                                                                                                        | —      | 19.2         | —           | nF      |
| $C_{res}$       | Reverse transfer capacitance               |                                                                                                                                        | —      | 5.6          | —           | nF      |
| $Q_G$           | Total gate charge                          | $V_{CC} = 850V, I_C = 2400A, V_{GE} = \pm 15V, T_J = 25^\circ C$                                                                       | —      | 24.5         | —           | $\mu C$ |
| $V_{CEsat}$     | Collector-emitter saturation voltage       | $I_C = 2400A$ (Note 4)<br>$V_{GE} = 15V$<br>$T_J = 25^\circ C$<br>$T_J = 125^\circ C$                                                  | —      | 2.15<br>2.40 | 2.80<br>—   | V       |
| $t_{d(on)}$     | Turn-on delay time                         | $V_{CC} = 850V, I_C = 2400A, V_{GE} = \pm 15V$<br>$R_{G(on)} = 0.7 \Omega, T_J = 125^\circ C, L_s = 100 \text{ nH}$<br>Inductive load  | —      | —            | 1.50        | $\mu s$ |
| $t_r$           | Turn-on rise time                          |                                                                                                                                        | —      | —            | 0.70        | $\mu s$ |
| $E_{on(10\%)}$  | Turn-on switching energy (Note 5)          |                                                                                                                                        | —      | 640          | —           | mJ      |
| $t_{d(off)}$    | Turn-off delay time                        | $V_{CC} = 850V, I_C = 2400A, V_{GE} = \pm 15V$<br>$R_{G(off)} = 1.6 \Omega, T_J = 125^\circ C, L_s = 100 \text{ nH}$<br>Inductive load | —      | —            | 3.00        | $\mu s$ |
| $t_f$           | Turn-off fall time                         |                                                                                                                                        | —      | —            | 0.60        | $\mu s$ |
| $E_{off(10\%)}$ | Turn-off switching energy (Note 5)         |                                                                                                                                        | —      | 840          | —           | mJ      |
| $V_{EC}$        | Emitter-collector voltage (Note 2)         | $I_E = 2400A$ (Note 4)<br>$V_{GE} = 0V$<br>$T_J = 25^\circ C$<br>$T_J = 125^\circ C$                                                   | —      | 2.60<br>2.30 | 3.30<br>—   | V       |
| $t_{rr}$        | Reverse recovery time (Note 2)             | $V_{CC} = 850V, I_C = 2400A, V_{GE} = \pm 15V$<br>$R_{G(on)} = 0.7 \Omega, T_J = 125^\circ C, L_s = 100 \text{ nH}$<br>Inductive load  | —      | —            | 1.50        | $\mu s$ |
| $Q_{rr}$        | Reverse recovery charge (Note 2)           |                                                                                                                                        | —      | 620          | —           | $\mu C$ |
| $E_{rec(10\%)}$ | Reverse recovery energy (Note 2), (Note 5) |                                                                                                                                        | —      | 380          | —           | mJ      |

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**THERMAL CHARACTERISTICS**

| Symbol         | Item                       | Conditions                                                               | Limits |     |      | Unit |
|----------------|----------------------------|--------------------------------------------------------------------------|--------|-----|------|------|
|                |                            |                                                                          | Min    | Typ | Max  |      |
| $R_{th(l-c)Q}$ | Thermal resistance         | Junction to Case, IGBT part                                              | —      | —   | 9.5  | K/kW |
| $R_{th(l-c)D}$ |                            | Junction to Case, FWDi part                                              | —      | —   | 21.0 | K/kW |
| $R_{th(c-s)}$  | Contact thermal resistance | Case to heat sink, $\lambda_{grease} = 1W/m^2K$ , $D_{(c-s)} = 100\mu m$ | —      | 8.0 | —    | K/kW |

**MECHANICAL CHARACTERISTICS**

| Symbol       | Item                       | Conditions                     | Limits |      |      | Unit |
|--------------|----------------------------|--------------------------------|--------|------|------|------|
|              |                            |                                | Min    | Typ  | Max  |      |
| $M_t$        | Mounting torque            | M8 : Main terminals screw      | 7.0    | —    | 20.0 | 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                       |                                | —      | 0.8  | —    | kg   |
| CTI          | Comparative tracking index |                                | 600    | —    | —    | —    |
| $d_a$        | Clearance                  |                                | 19.5   | —    | —    | mm   |
| $d_s$        | Creepage distance          |                                | 32.0   | —    | —    | mm   |
| $L_{PCE}$    | Parasitic stray inductance | IGBT part                      | —      | 16   | —    | nH   |
| $R_{CC+EE'}$ | Internal lead resistance   | IGBT part, $T_c = 25^\circ C$  | —      | 0.14 | —    | mΩ   |

Note 1. Pulse width and repetition rate should be such that junction temperature ( $T_j$ ) does not exceed  $T_{jopmax}$  rating.

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  $T_{jmax}$  rating ( $150^\circ C$ ).

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

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

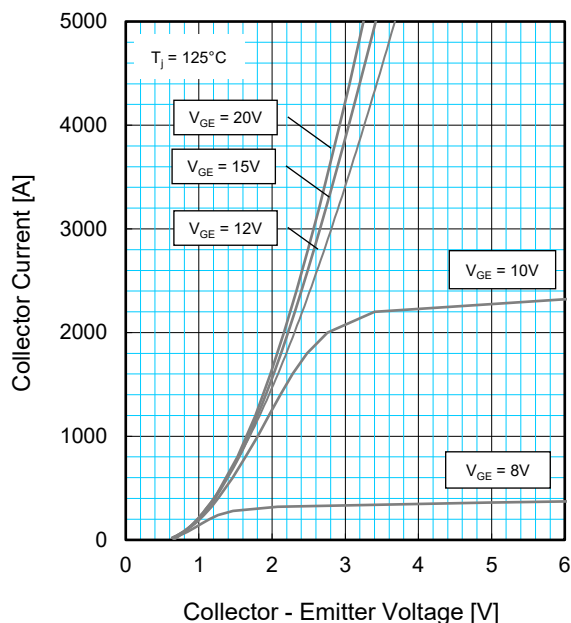
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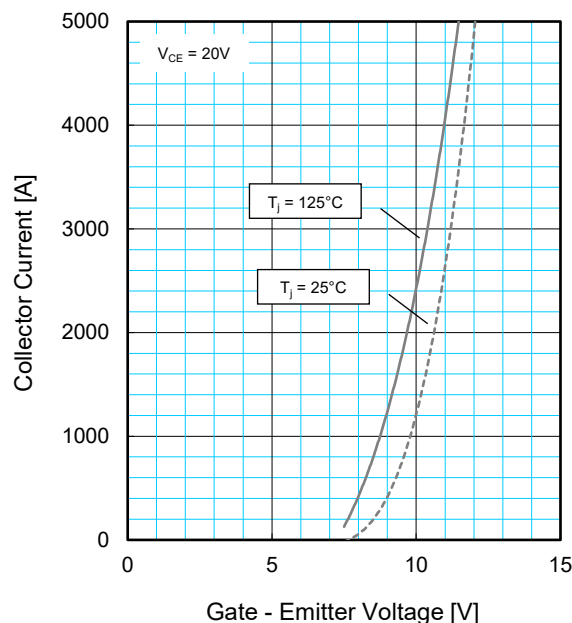
4th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

## PERFORMANCE CURVES

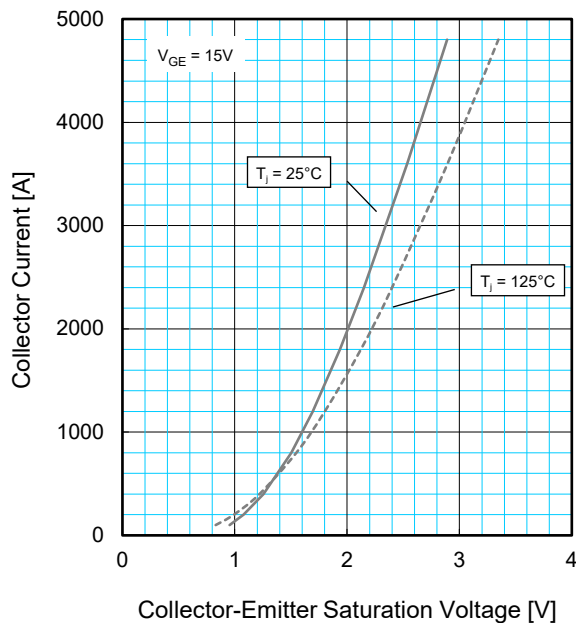
**OUTPUT CHARACTERISTICS  
(TYPICAL)**



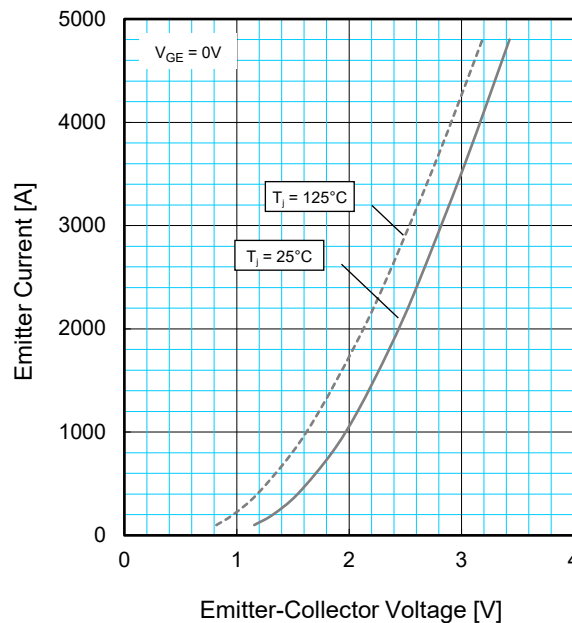
**TRANSFER CHARACTERISTICS  
(TYPICAL)**



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



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



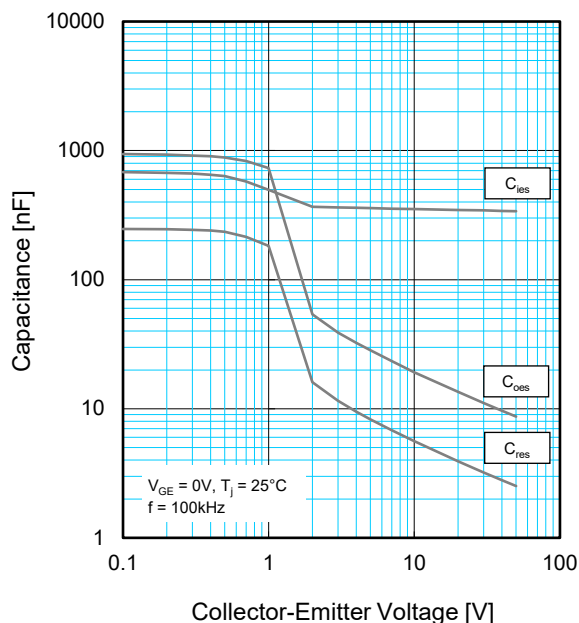
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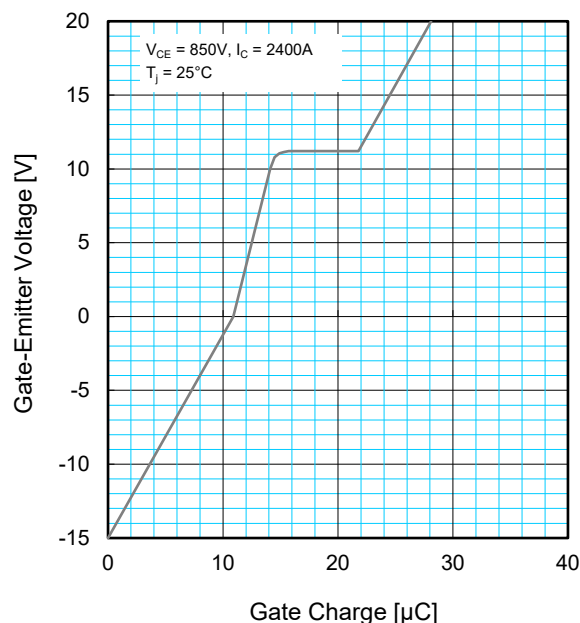
4th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

### PERFORMANCE CURVES

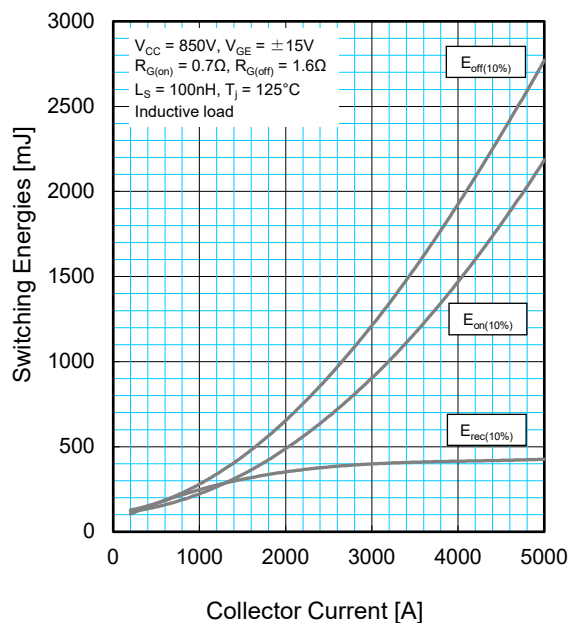
CAPACITANCE CHARACTERISTICS  
(TYPICAL)



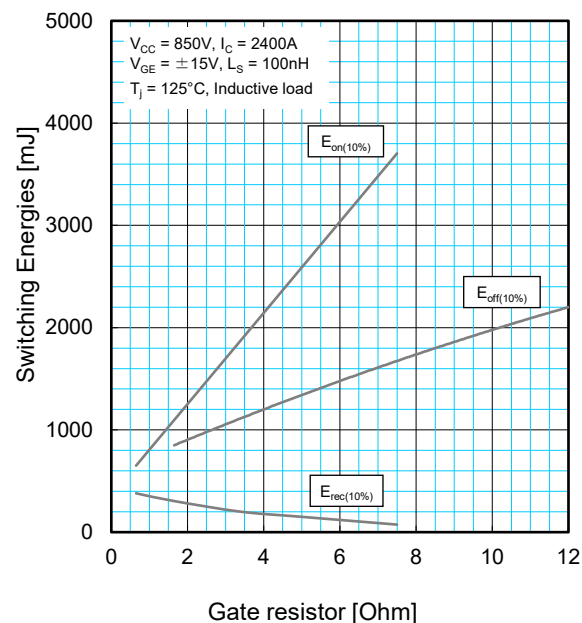
GATE CHARGE CHARACTERISTICS  
(TYPICAL)



HALF-BRIDGE SWITCHING ENERGY  
CHARACTERISTICS (TYPICAL)

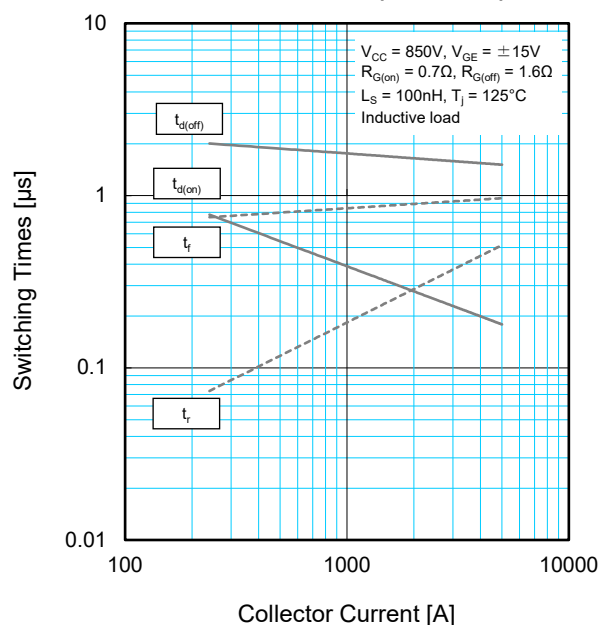
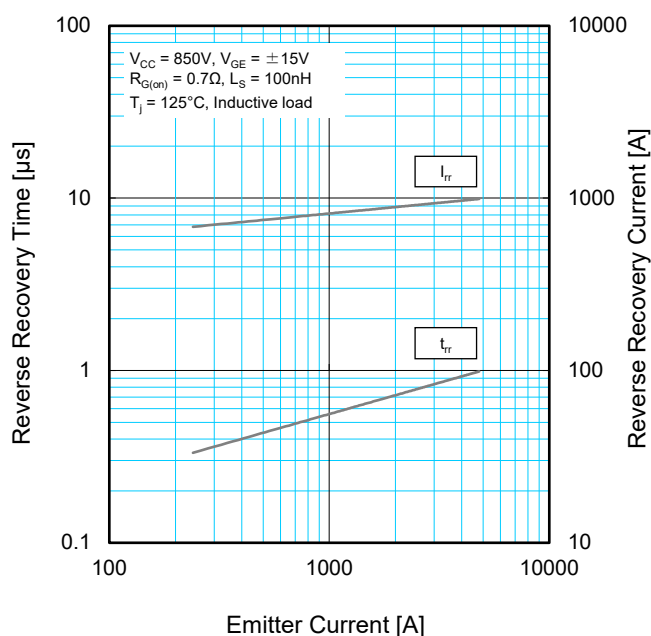
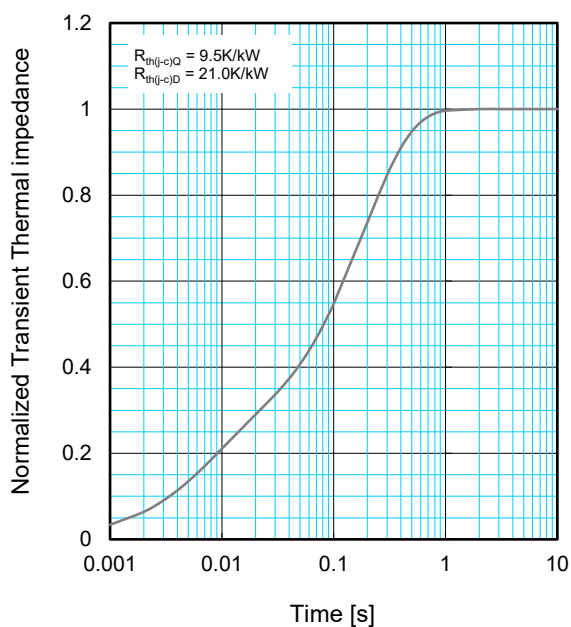


HALF-BRIDGE SWITCHING ENERGY  
CHARACTERISTICS (TYPICAL)



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**PERFORMANCE CURVES****HALF-BRIDGE SWITCHING TIME  
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      |
|----------------|--------|--------|--------|--------|
| $R_i$ [K/kW]   | 0.0096 | 0.1893 | 0.4044 | 0.3967 |
| $\tau_i$ [sec] | 0.0001 | 0.0058 | 0.0602 | 0.3512 |

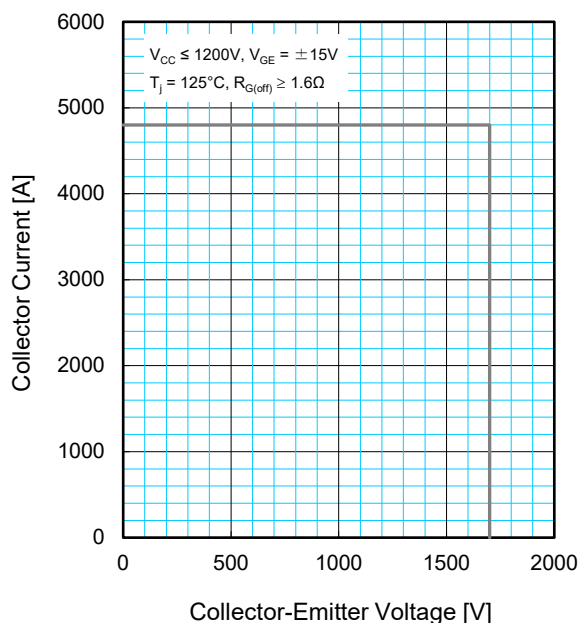
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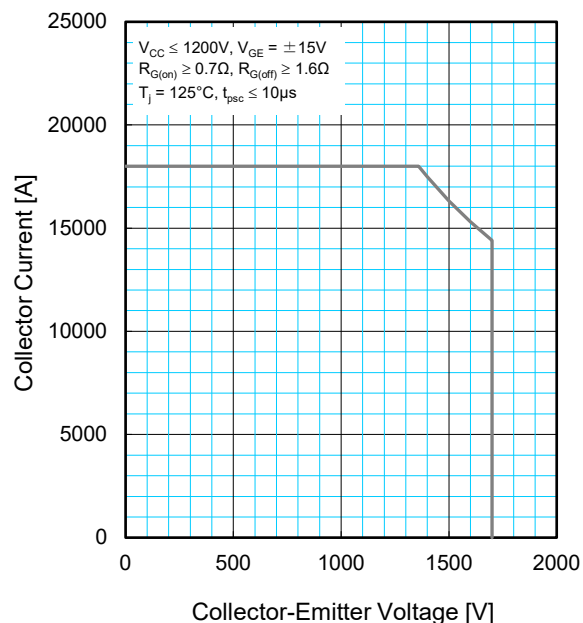
4th-Version HVIGBT (High Voltage Insulated Gate Bipolar Transistor) Modules

### PERFORMANCE CURVES

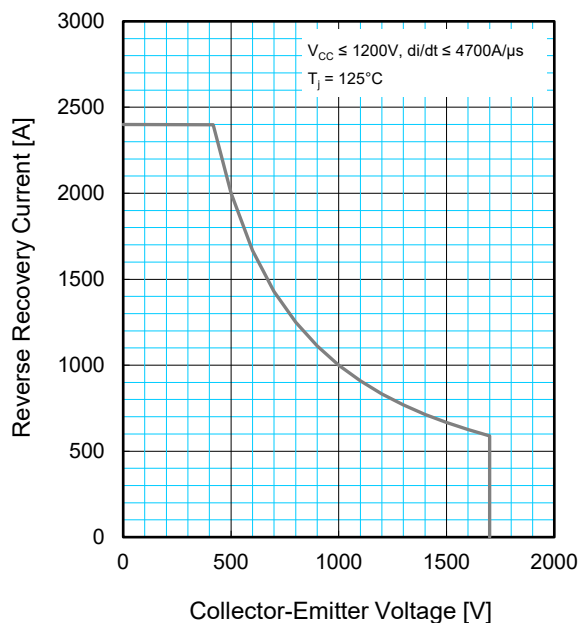
**REVERSE BIAS SAFE OPERATING AREA (RBSOA)**



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



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



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