

# HCG450FF120E3ME7

## 1200V/450A Half Bridge IGBT Module

### Description

The HCG450FF120E3ME7 is a Half Bridge IGBT Power Module. It integrates high performance IGBT chips designed for the applications such as High Power supply and Motor control.



### Features

- Blocking voltage:1200V
- Low saturation voltage  $V_{CE(sat)}$
- Low Switching Losses
- Thermistor inside

### Applications

- High Power Switching Applications
- Motor Drives
- Solar inverter Systems
- Uninterrupted Power Supply

### Circuit diagram

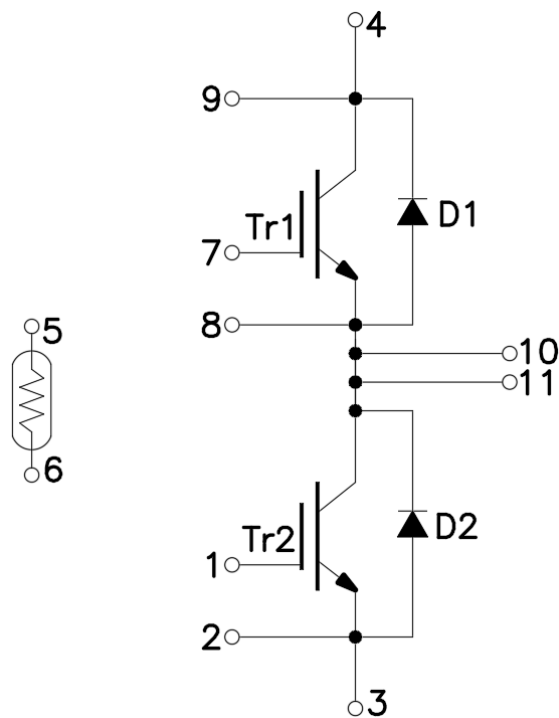


Figure 1. Out drawing & circuit diagram for HCG450FF120E3ME7

### Pin Configuration and Marking Information

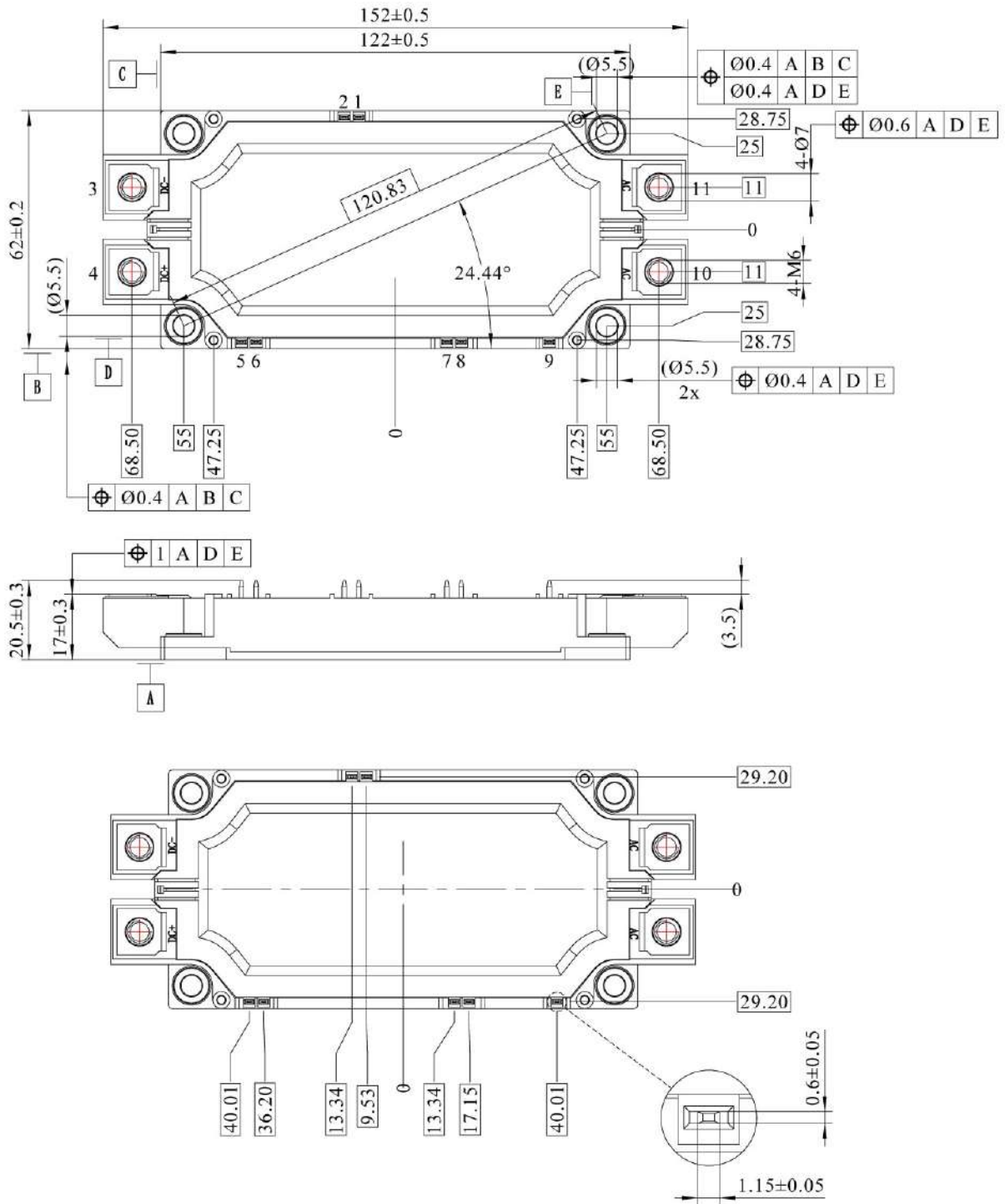


Figure 2. Pin configuration

## HCG450FF120E3ME7

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#### Module

| Parameter                                | Condition                                    | Value      | Unit |
|--|--|------------|------|
| Isolation Voltage                        | RMS, f = 50Hz, t = 1min                      | 3.4        | kV   |
| Material of module baseplate             | -  | Cu         | -    |
| Creepage distance                        | terminal to heatsink<br>terminal to terminal | 14.5<br>13 | mm   |
| Clearance                                | terminal to heatsink<br>terminal to terminal | 12.5<br>10 | mm   |
| CTI                                      | -  | 600        | -    |
| Module lead resistance, terminals – chip | T <sub>C</sub> = 25°C                        | 0.8        | mΩ   |
| Mounting torque for module mounting      | M5, M6                                       | 3 to 6     | Nm   |
| Weight                                   | -  | 350        | g    |

#### Maximum Ratings (T<sub>j</sub> = 25°C unless otherwise specified)

| Symbol            | Parameter                       | Condition                   | Ratings    | Unit |
|-------------------|---------------------------------|-----------------------------|------------|------|
| V <sub>CES</sub>  | Collector-Emitter Voltage       | G-E Short                   | 1200       | V    |
| V <sub>GES</sub>  | Gate-Emitter Voltage            | C-E Short                   | ±20        | V    |
| I <sub>C</sub>    | DC Continuous Collector Current | T <sub>C</sub> = 95°C       | 450        | A    |
| I <sub>CM</sub>   | Pulse Collector Current         | t <sub>p</sub> = 1ms, Note1 | 900        | A    |
| P <sub>C</sub>    | Maximum Power Dissipation       | T <sub>C</sub> = 25°C, IGBT | 2239       | W    |
| I <sub>F</sub>    | Diode Forward Current           | -                           | 450        | A    |
| I <sub>FRM</sub>  | Repetitive peak forward Current | t <sub>p</sub> = 1ms, Note1 | 900        | A    |
| T <sub>vjop</sub> | Operating junction temperature  | Note2                       | -40 to 175 | °C   |
| T <sub>stg</sub>  | Storage temperature             | -                           | -40 to 125 | °C   |

Note1: Pulse width limited by maximum junction temperature

Note2: T<sub>vjop</sub> > 150°C is only allowed for operation at overload conditions

#### NTC characteristics

| Symbol              | Parameter                     | Condition  | Value |      |      | Unit |
|---------------------|-------------------------------|--|-------|------|------|------|
|                     |                               |  | Min.  | Typ. | Max. |      |
| R <sub>25</sub>     | Resistance                    | T <sub>C</sub> = 25°C  | -     | 5    | -    | kΩ   |
| ΔR/R                | Deviation of R <sub>100</sub> | T <sub>C</sub> = 100°C, R <sub>100</sub> = 493Ω  | -5    | -    | 5    | %    |
| P <sub>25</sub>     | Power dissipation             | T <sub>C</sub> = 25°C  | -     | -    | 20   | mW   |
| B <sub>25/50</sub>  | B-value                       | R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/50</sub> (1/T <sub>2</sub> - 1/(298,15 K))]  | -     | 3375 | -    | K    |
| B <sub>25/80</sub>  | B-value                       | R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/80</sub> (1/T <sub>2</sub> - 1/(298,15 K))]  | -     | 3411 | -    | K    |
| B <sub>25/100</sub> | B-value                       | R <sub>2</sub> = R <sub>25</sub> exp [B <sub>25/100</sub> (1/T <sub>2</sub> - 1/(298,15 K))] | -     | 3433 | -    | K    |

**HCG450FF120E3ME7**
**1200V/450A Half Bridge IGBT Module**
**IGBT Electrical characteristics** ( $T_j=25^\circ\text{C}$  unless otherwise specified, chip)

| Symbol                  | Item   | Condition  |                         | Value |      |                           | Unit          |
|-------------------------|--|--|-------------------------|-------|------|---------------------------|---------------|
|                         |  |  |                         | Min.  | Typ. | Max.                      |               |
| $V_{CE(sat)}$<br>(Chip) | Collector-Emitter Saturation Voltage                                 | $I_C=450\text{A}$<br>$V_{GE}=15\text{V}$   | $T_j=25^\circ\text{C}$  | -     | 1.60 | 1.92                      | V             |
|                         |  |  | $T_j=125^\circ\text{C}$ | -     | 1.73 | -                         |               |
|                         |  |  | $T_j=150^\circ\text{C}$ | -     | 1.80 | -                         |               |
|                         |  |  | $T_j=175^\circ\text{C}$ | -     | 1.85 | -                         |               |
| $V_{GE(th)}$            | Gate-Emitter threshold Voltage                                       | $I_C=17\text{mA}$ , $V_{CE}=V_{GE}$  |                         | 5.0   | 5.8  | 6.5                       | V             |
| $Q_G$                   | Gate charge  | $V_{GE} = -15\text{V to } +15\text{V}$   |                         | -     | 5.2  | -                         | $\mu\text{C}$ |
| $R_{Gint}$              | Internal gate resistor   | -  | $T_j=25^\circ\text{C}$  | -     | 0.7  | -                         | $\square$     |
| $C_{ies}$               | Input Capacitance  | $V_{CE}=25\text{V}$  | $T_j=25^\circ\text{C}$  | -     | 64.8 | -                         | nF            |
| $C_{oes}$               | Output Capacitance   | $V_{GE}=0\text{V}$   |                         | -     | 1.76 | -                         | nF            |
| $C_{res}$               | Reverse transfer Capacitance   | $f=1\text{MHz}$  |                         | -     | 0.50 | -                         | nF            |
| $I_{CES}$               | Collector- Emitter Cut off Current                                   | $V_{CE}=1200\text{V}$ , $V_{GE}=0\text{V}$   | $T_j=25^\circ\text{C}$  | -     | -    | 1                         | mA            |
| $I_{GES}$               | Gate-Emitter Leakage Current   | $V_{GE} = 20\text{V}$ , $V_{CE}=0\text{V}$   | $T_j=25^\circ\text{C}$  | -     | -    | 1                         | $\mu\text{A}$ |
| $t_{d(on)}$             | Turn-on delay time   | $V_{CC}=600\text{V}$<br>$I_C=450\text{A}$<br>$V_{GE}=+15\text{V}/-8\text{V}$<br>$R_G=1.3\square$<br>Inductive load | $T_j=25^\circ\text{C}$  | -     | 221  | -                         | ns            |
|                         |  |  | $T_j=125^\circ\text{C}$ | -     | 197  | -                         |               |
|                         |  |  | $T_j=150^\circ\text{C}$ | -     | 196  | -                         |               |
| $t_r$                   | Rise time  |  | $T_j=25^\circ\text{C}$  | -     | 55   | -                         | ns            |
|                         |  |  | $T_j=125^\circ\text{C}$ | -     | 59   | -                         |               |
|                         |  |  | $T_j=150^\circ\text{C}$ | -     | 64   | -                         |               |
| $t_{d(off)}$            | Turn-off delay time  |  | $T_j=25^\circ\text{C}$  | -     | 698  | -                         | ns            |
|                         |  |  | $T_j=125^\circ\text{C}$ | -     | 865  | -                         |               |
|                         |  |  | $T_j=150^\circ\text{C}$ | -     | 930  | -                         |               |
| $t_f$                   | Fall time  | $T_j=25^\circ\text{C}$   | -                       | 143   | -    | ns                        |               |
|                         |  | $T_j=125^\circ\text{C}$  | -                       | 271   | -    |                           |               |
|                         |  | $T_j=150^\circ\text{C}$  | -                       | 303   | -    |                           |               |
| $E_{on}$                | Turn-on power dissipation  | $T_j=25^\circ\text{C}$   | -                       | 21.10 | -    | mJ                        |               |
|                         |  | $T_j=125^\circ\text{C}$  | -                       | 29.56 | -    |                           |               |
|                         |  | $T_j=150^\circ\text{C}$  | -                       | 39.32 | -    |                           |               |
| $E_{off}$               | Turn-off power dissipation   | $T_j=25^\circ\text{C}$   | -                       | 46.31 | -    | mJ                        |               |
|                         |  | $T_j=125^\circ\text{C}$  | -                       | 61.32 | -    |                           |               |
|                         |  | $T_j=150^\circ\text{C}$  | -                       | 63.94 | -    |                           |               |
| $R_{th(j-c)}$           | Thermal Resistance, Junction to Case (IGBT)                          |  | -                       | 0.067 | -    | $^\circ\text{C}/\text{W}$ |               |
| $R_{th(c-s)}$           | Thermal Resistance, Case to sink (Conductive Grease applied) , Note1 |  | -                       | 0.020 | -    | $^\circ\text{C}/\text{W}$ |               |

 Note1: Assumes Thermal Conductivity of grease is  $2.8 \text{ W/m} \cdot \text{K}$  and thickness is  $50\mu\text{m}$

# HCG450FF120E3ME7

## 1200V/450A Half Bridge IGBT Module

### Freewheeling Diode Electrical characteristics ( $T_j=25^\circ\text{C}$ unless otherwise specified, chip)

| Symbol        | Item   | Condition  | Value                   |       |       | Unit                      |    |
|---------------|--|--|-------------------------|-------|-------|---------------------------|----|
|               |  |  | Min.                    | Typ.  | Max.  |                           |    |
| $V_F$         | Diode Forward Voltage  | $I_F=450\text{A}, V_{GE}=0\text{V}$                              | $T_j=25^\circ\text{C}$  | -     | 1.64  | 1.97                      | V  |
|               |  |  | $T_j=125^\circ\text{C}$ | -     | 1.48  | -                         |    |
|               |  |  | $T_j=150^\circ\text{C}$ | -     | 1.49  | -                         |    |
|               |  |  | $T_j=175^\circ\text{C}$ | -     | 1.44  | -                         |    |
| $t_{rr}$      | Reverse recovery time  | (Switch side)<br>$V_{CC}=600\text{V}$<br>$I_C=450\text{A}$       | $T_j=25^\circ\text{C}$  | -     | 0.562 | -                         | us |
|               |  |  | $T_j=125^\circ\text{C}$ | -     | 0.861 | -                         |    |
|               |  |  | $T_j=150^\circ\text{C}$ | -     | 0.947 | -                         |    |
| $I_{RM}$      | Peak reverse recovery Current  | (FRD side)<br>$V_{GE}=+15\text{V}/-8\text{V}$<br>$R_G=1.3\Omega$ | $T_j=25^\circ\text{C}$  | -     | 287   | -                         | A  |
|               |  |  | $T_j=125^\circ\text{C}$ | -     | 371   | -                         |    |
|               |  |  | $T_j=150^\circ\text{C}$ | -     | 390   | -                         |    |
| $Q_{rr}$      | Recovered charge   | $V_{rr}=600\text{V}$<br>$I_F=450\text{A}$<br>$V_{GE}=-8\text{V}$ | $T_j=25^\circ\text{C}$  | -     | 66.21 | -                         | uC |
|               |  |  | $T_j=125^\circ\text{C}$ | -     | 121.7 | -                         |    |
|               |  |  | $T_j=150^\circ\text{C}$ | -     | 137.3 | -                         |    |
| $E_{rr}$      | Reverse recovered energy   | Inductive load<br>switching operation                            | $T_j=25^\circ\text{C}$  | -     | 31.94 | -                         | mJ |
|               |  |  | $T_j=125^\circ\text{C}$ | -     | 58.24 | -                         |    |
|               |  |  | $T_j=150^\circ\text{C}$ | -     | 65.47 | -                         |    |
| $R_{th(j-c)}$ | Thermal Resistance, Junction to Case (Diode)                         |  | -                       | 0.093 | -     | $^\circ\text{C}/\text{W}$ |    |
| $R_{th(c-s)}$ | Thermal Resistance, Case to sink (Conductive Grease applied) , Note1 |  | -                       | 0.025 | -     | $^\circ\text{C}/\text{W}$ |    |

Note1: Assumes Thermal Conductivity of grease is  $2.8 \text{ W/m} \cdot \text{K}$  and thickness is  $50\mu\text{m}$

## Test Conditions

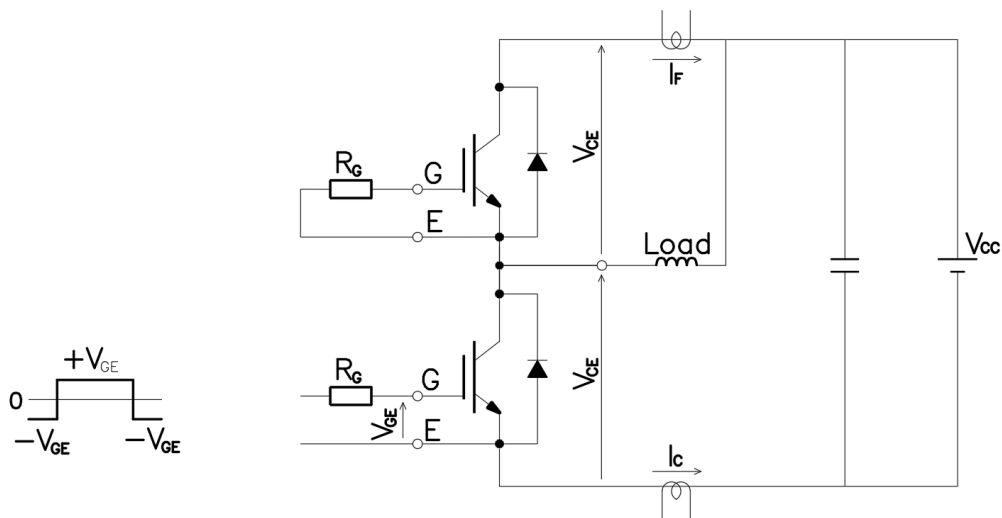


Figure 3. Switching time measure circuit

**HCG450FF120E3ME7**

## 1200V/450A Half Bridge IGBT Module

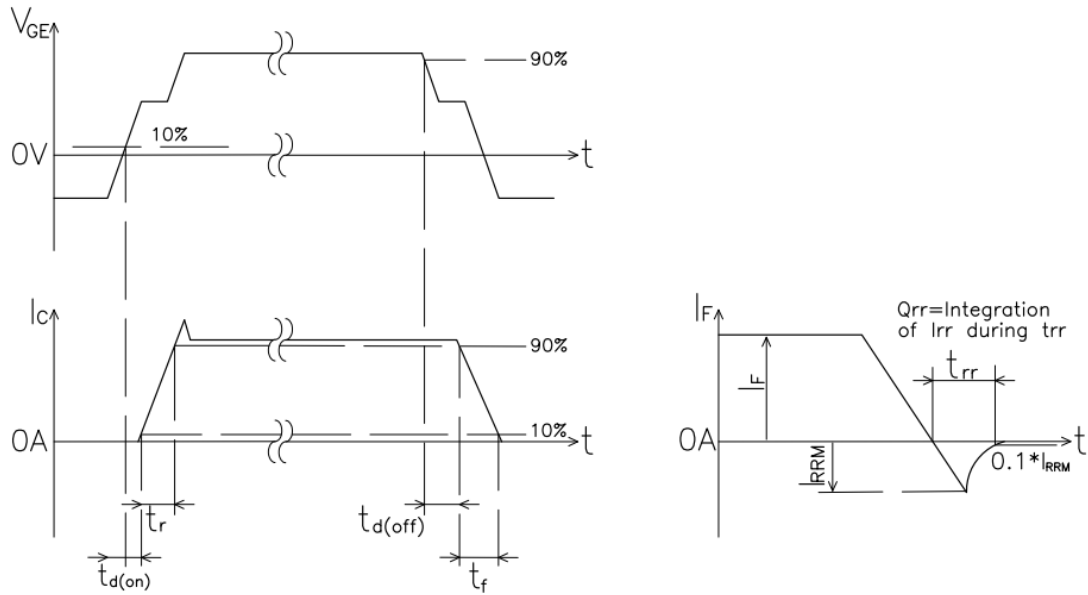
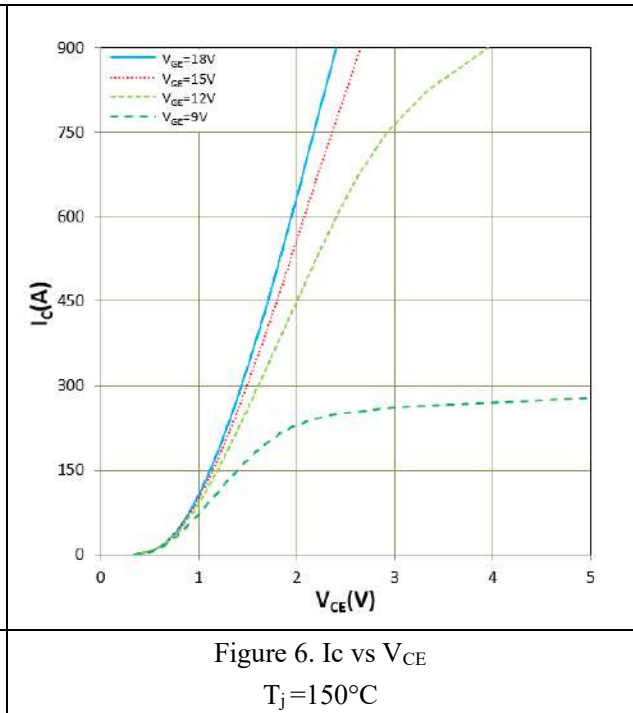
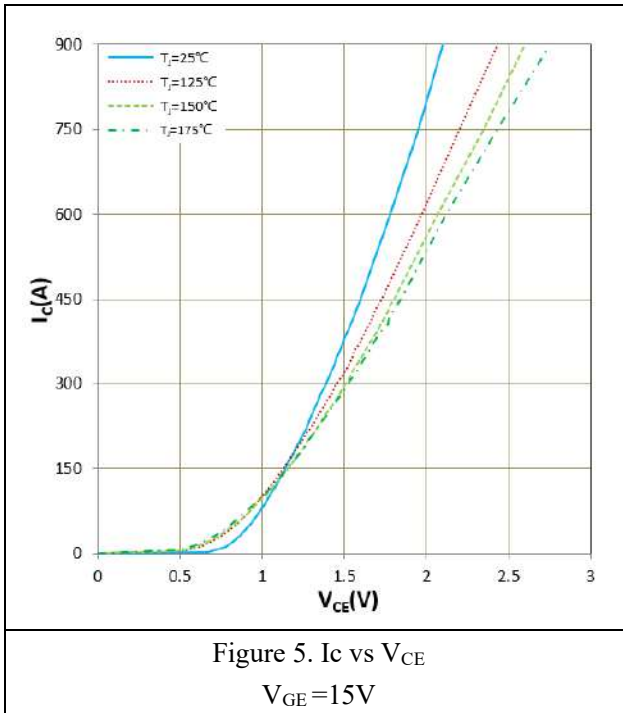
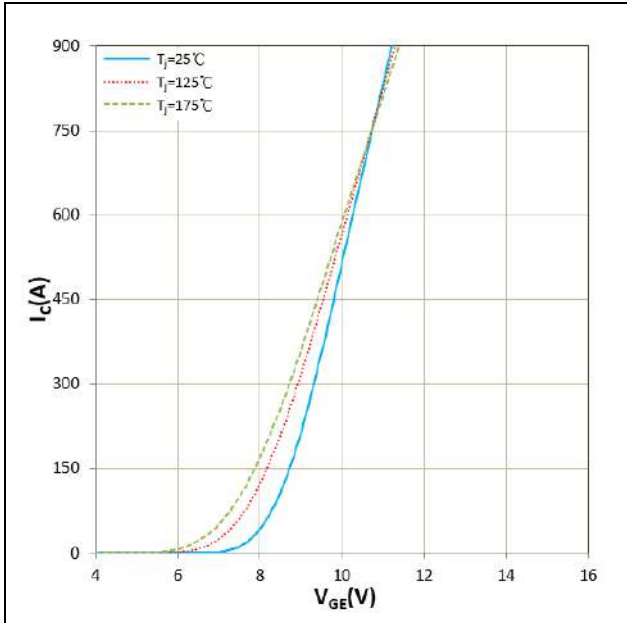
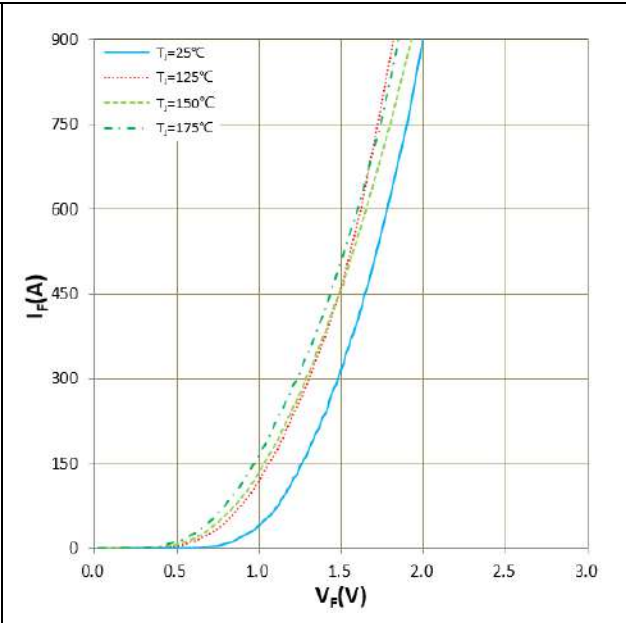
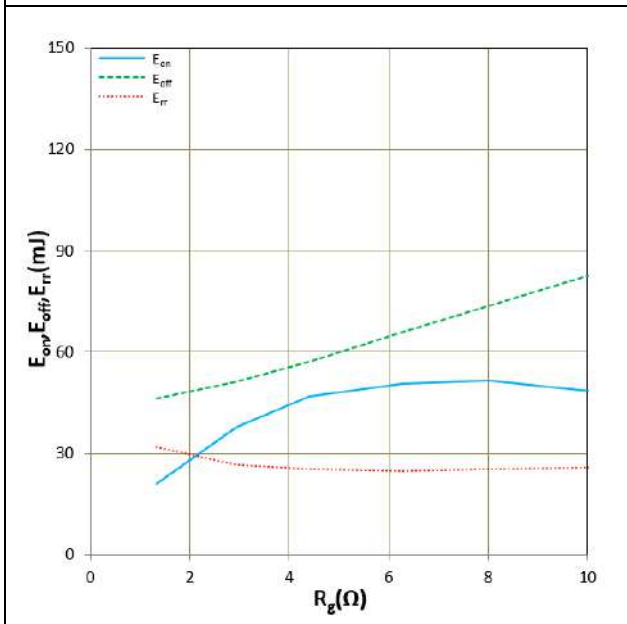
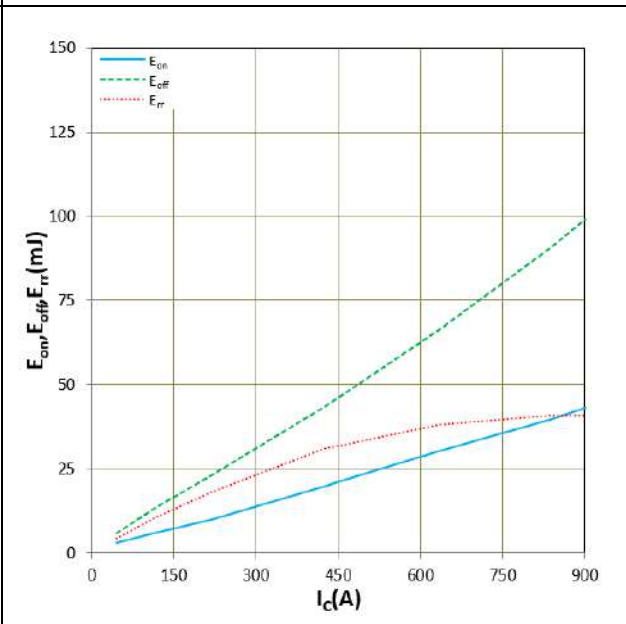


Figure 4. Switching time definition



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## 1200V/450A Half Bridge IGBT Module


 Figure 7.  $I_c$  vs  $V_{GE}$   
 $V_{CE}=20V$ 

 Figure 8.  $I_F$  vs  $V_F$ 

 Figure 9.  $E_{on}$ ,  $E_{off}$ ,  $E_{Tr}$  vs  $R_g$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $I_c=450A$ ,  $T_j=25^\circ C$   
 Inductive Load

 Figure 10.  $E_{on}$ ,  $E_{off}$ ,  $E_{Tr}$  vs  $I_c$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $R_g=1.3\Omega$ ,  $T_j=25^\circ C$   
 Inductive Load

**HCG450FF120E3ME7**

## 1200V/450A Half Bridge IGBT Module

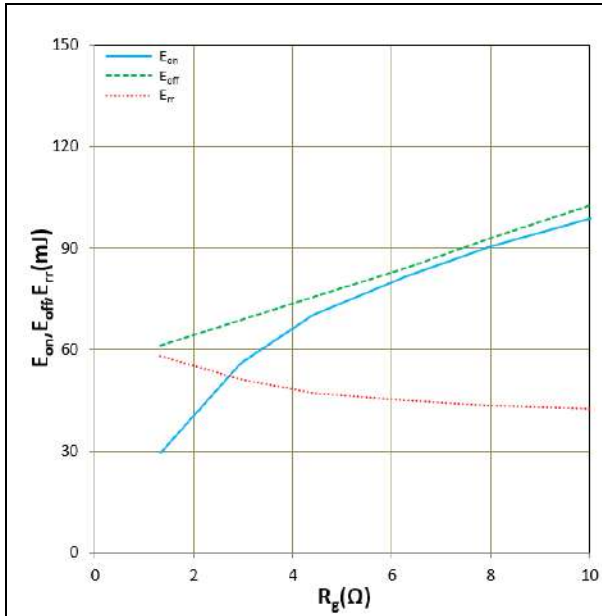


Figure 11.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $I_C=450A$ ,  $T_j=125^\circ C$   
 Inductive Load

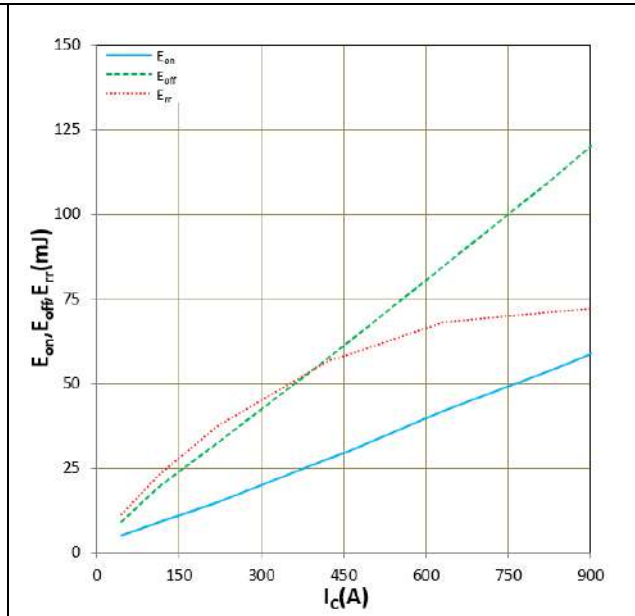


Figure 12.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_c$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $R_g=1.3\Omega$ ,  $T_j=125^\circ C$   
 Inductive Load

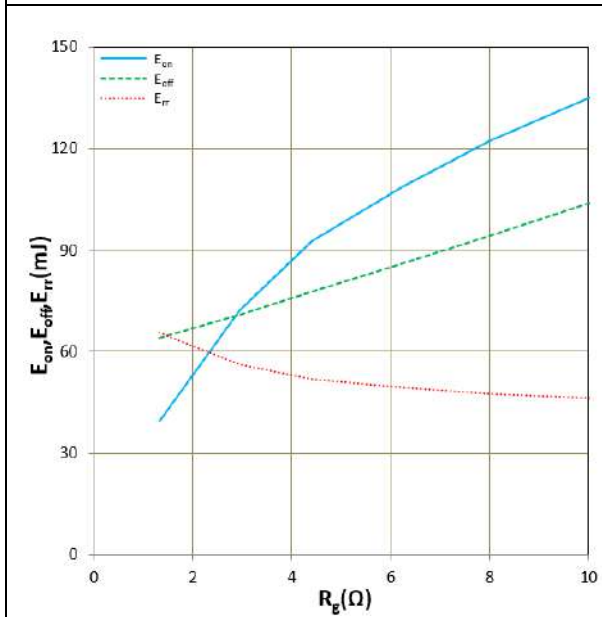


Figure 13.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_g$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $I_C=450A$ ,  $T_j=150^\circ C$   
 Inductive Load

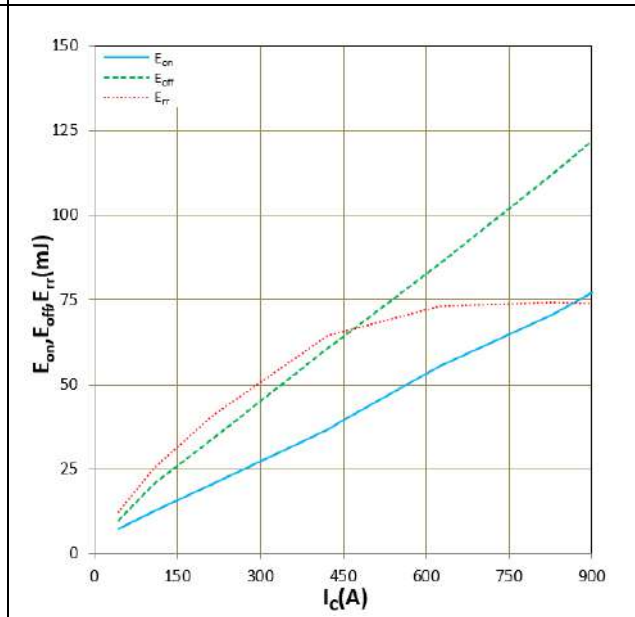


Figure 14.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_c$ (Typ)  
 $V_{CC}=600V$ ,  $V_{GE}=+15V/-8V$ ,  $R_g=1.3\Omega$ ,  $T_j=150^\circ C$   
 Inductive Load



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### 1200V/450A Half Bridge IGBT Module

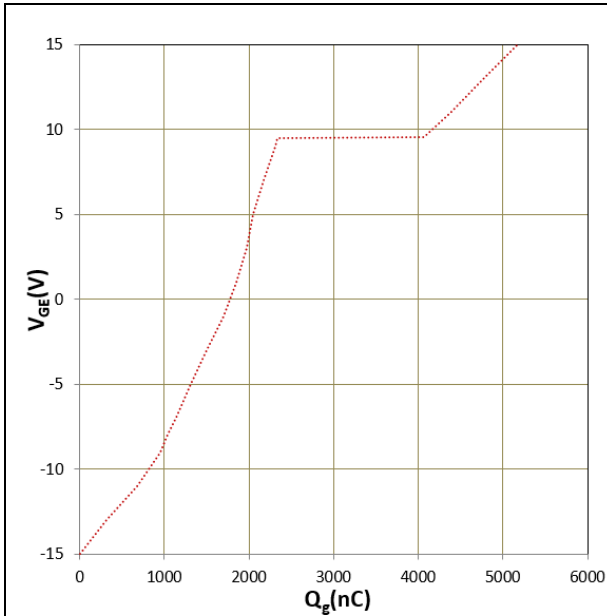


Figure 15. Gate charge

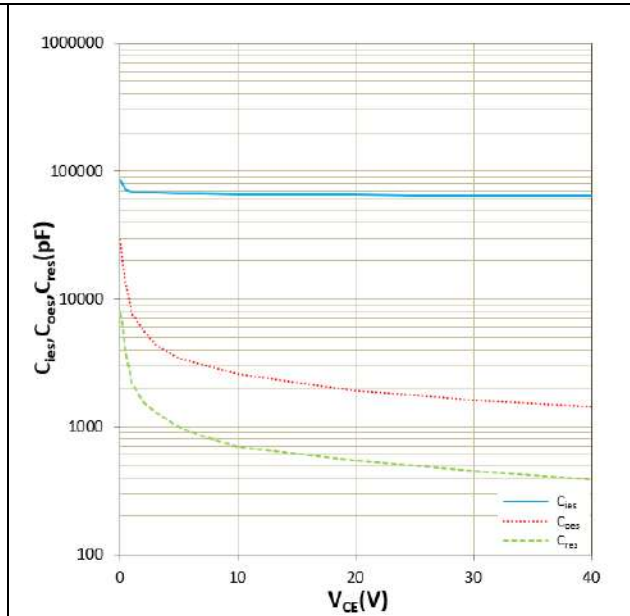


Figure 16.  $C_{ies}$ ,  $C_{oes}$ ,  $C_{res}$  vs  $V_{CE}$   
 $T_j = 25^\circ\text{C}$ ,  $f = 1\text{MHz}$

#### IMPORTANT NOTICE:

This product data sheet describes the characteristics of this product for which a warranty is granted. Any such warranty is granted exclusively under the terms and conditions of the supply agreement. There will be no guarantee or of any kind for the product and its characteristics.

The data contained in this document is exclusively intended for technically trained staff. You and your technical departments will have to evaluate the product's suitability for the intended application and the completeness of the product data concerning such application.

Due to technical requirements, our product may contain dangerous substances. For information on the types in question, please contact the sales staff responsible for you.

Changes to this product data sheet are reserved.

Please contact the sales staff (sales@hiitio.com) for further information on the product, technology, delivery terms, conditions and prices.

## Instruction note

Naming rules for power module product models (Industrial module)

| Product Model  |           |          |            |           |             |           |          |
|--|-----------|----------|------------|-----------|-------------|-----------|----------|
|  | <b>HC</b> | <b>G</b> | <b>450</b> | <b>FF</b> | <b>1200</b> | <b>E3</b> | <b>A</b> |
| Hecheng Code   |           |          |            |           |             |           |          |
| Module type G : IGBT module<br>D : FRD module<br>S : SiC module<br>H : Si/SiC hybrid   |           |          |            |           |             |           |          |
| Current level (A) 50~900   |           |          |            |           |             |           |          |
| Topology structure FZ : A switch unit FF :<br>FS : Three phase F4 : H Bridge<br>F3L : Three level DF : Bo<br>FD : Braking Circuit<br>FP : Rectification+Inverter+Control move<br>AL : ANPC CL : Chopper  |           |          |            |           |             |           |          |
| Voltage level (x10) (V) 650~2200   |           |          |            |           |             |           |          |
| Packaging form+features (A...Z) A1: 34 mm A2: 62 mm<br>B1: Easy 1B B1A B1B...<br>B2: Easy 2B... B3: Easy 3B...<br>D1: Flow0 D2: Flow1 D3: Flow2<br>E0 : E0 E1: Econo 2... : E2<br>E3: ED3 E4 : E4 E5 : ED3S<br>E6 : EPM2 E7 : EPM3 E8 : EconoPIM3<br>E9 : ED3H F0 : F0 P2 : EPM2 |           |          |            |           |             |           |          |
| Feature :A: Special Code   |           |          |            |           |             |           |          |

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