

# HCS800FH170D3C1

1700V/800A Half Bridge SiC MOSFET Module

## Description

The HCS800FH170D3C1 is a Half Bridge SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as Motor drives and Renewable energy.



## Features

- Blocking voltage 1700V
- $R_{DS(on)} = 2.8m\Omega @ T_j = 25^\circ C$
- Low thermal resistance with  $Si_3N_4$  AMB
- Low Inductive Design
- Thermistor inside

## Applications

- xEV Applications
- Motor Drives
- Servo Drives
- SmartGrid/Grid-Tied Distributed Generation

## Circuit diagram

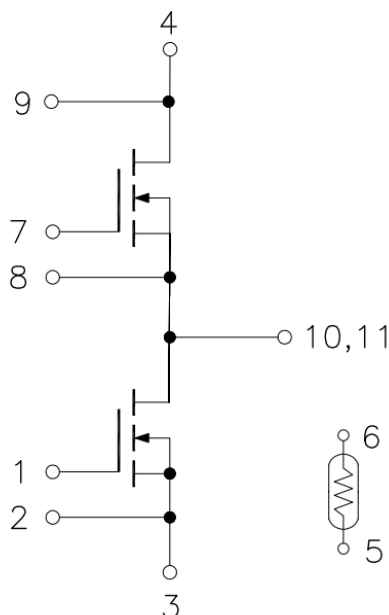


Figure 1. Out drawing & circuit diagram for HCS800FH170D3C1

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## 1700V/800A Half Bridge SiC MOSFET Module

## Pin Configuration and Marking Information

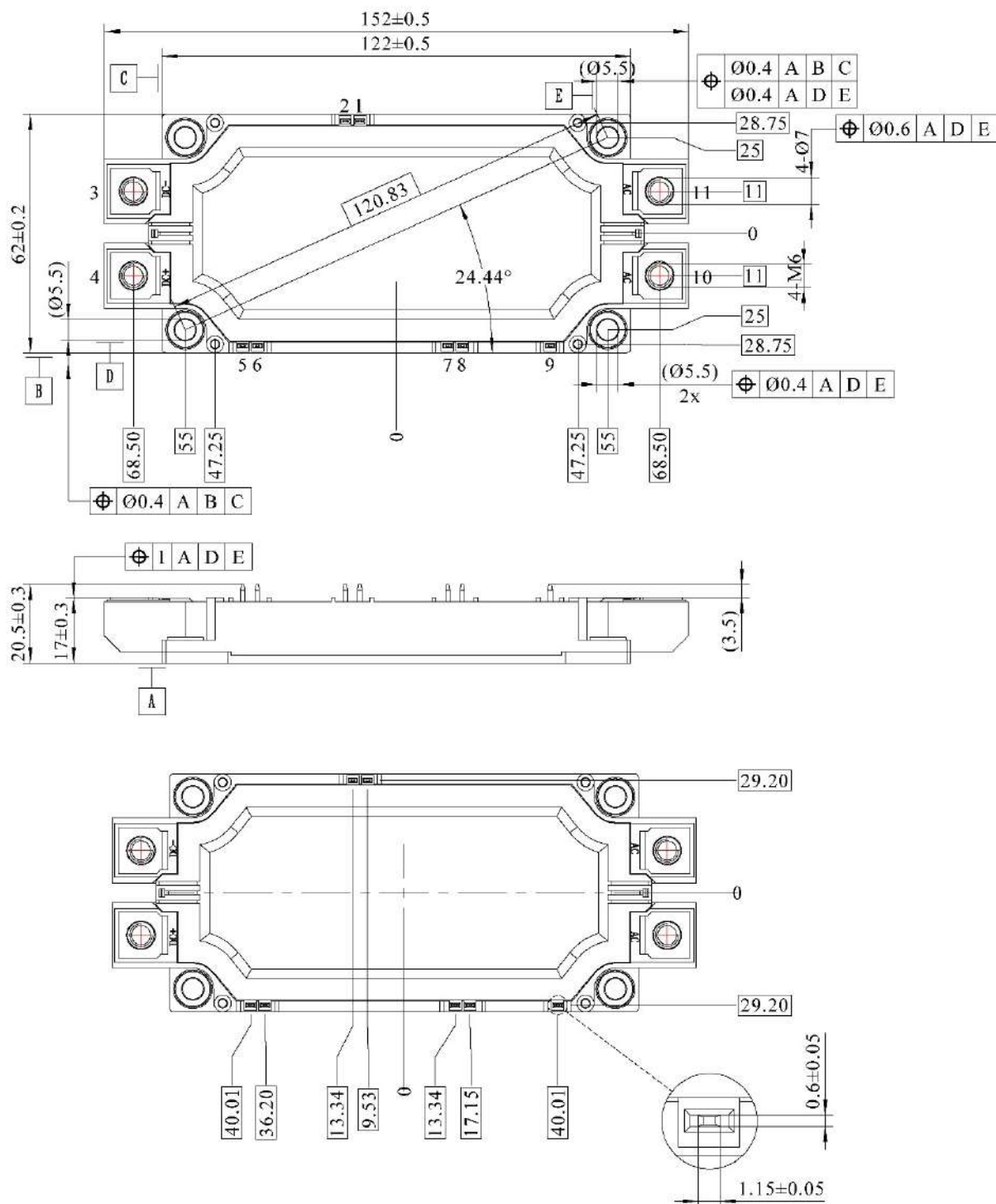


Figure 2. Pin configuration

# HCS800FH170D3C1

## 1700V/800A Half Bridge SiC MOSFET Module

### Module

| Parameter                              | Condition                                    | Value      | Unit |
|----------------------------------------|----------------------------------------------|------------|------|
| Isolation Voltage                      | RMS, f=50Hz, t=1min                          | 4.0        | kV   |
| Material of module baseplate           | -                                            | Cu         | -    |
| Creepage distance                      | terminal to heatsink<br>terminal to terminal | 14.5<br>10 | 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                         | 0.5        | mΩ   |
| Mounting torque for module mounting    | M5, M6                                       | 3 to 6     | Nm   |
| Weight                                 | -                                            | 385        | g    |

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

| Symbol                | Parameter                                | Condition                                     | Ratings    | Unit |
|-----------------------|------------------------------------------|-----------------------------------------------|------------|------|
| V <sub>DSS</sub>      | Drain-Source Voltage                     | G-S Short                                     | 1700       | V    |
| V <sub>GSS</sub>      | Gate-Source Voltage (+)                  | D-S Short                                     | 20         | V    |
| V <sub>GSS</sub>      | Gate-Source Voltage (-)                  | D-S Short                                     | -10        | V    |
| V <sub>GSSSurge</sub> | G-S Voltage(t <sub>surge</sub> <300nsec) | D-S Short, Note1                              | -10 to 20  | V    |
| I <sub>DS</sub>       | DC Continuous Drain Current              | T <sub>c</sub> =25°C, V <sub>GS</sub> =15V    | 800        | A    |
| I <sub>DS</sub>       | DC Continuous Drain Current              | T <sub>c</sub> =60°C, V <sub>GS</sub> =15V    | 690        | A    |
| I <sub>SD</sub>       | Source (Body diode) Current              | T <sub>c</sub> =25°C, with ON signal          | 800        | A    |
| I <sub>SD</sub>       | Source (Body diode) Current              | T <sub>c</sub> =60°C, with ON signal          | 690        | A    |
| I <sub>DSM</sub>      | Pulse Forward Current                    | T <sub>c</sub> =25°C, Pulse width =1ms, Note2 | 1600       | A    |
| P <sub>tot</sub>      | Total Power Dissipation                  | T <sub>c</sub> =25°C                          | 3947       | W    |
| T <sub>jmax</sub>     | Max Junction Temperature                 | -                                             | -55 to 175 | °C   |
| T <sub>stg</sub>      | Storage Temperature                      | -                                             | -55 to 125 | °C   |

Note1: Recommended Operating Value, +15V/-5V, +15V/-4V

Note2: Pulse width limited by maximum junction temperature

### NTC characteristics

| Symbol              | Parameter                     | Condition                                                                                   | Value |      |      | Unit |
|---------------------|-------------------------------|---------------------------------------------------------------------------------------------|-------|------|------|------|
|                     |                               |                                                                                             | Min.  | Typ. | Max. |      |
| R <sub>25</sub>     | Resistance                    | T <sub>C</sub> =25°C                                                                        | -     | 5    | -    | kΩ   |
| R/R                 | Deviation of R <sub>100</sub> | T <sub>C</sub> =100°C, R <sub>100</sub> =493 Ω                                              | -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    |

# HCS800FH170D3C1

## 1700V/800A Half Bridge SiC MOSFET Module

### MOSFET Electrical characteristics (T<sub>j</sub>=25°C unless otherwise specified, chip)

| Symbol                        | Item                                       | Condition                                                                                                                                                                   |                       | Value |       |      | Unit |
|-------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------|-------|------|------|
|                               |                                            |                                                                                                                                                                             |                       | Min.  | Typ.  | Max  |      |
| V <sub>(BR)DSS</sub>          | Drain-Source Breakdown Voltage             | V <sub>GS</sub> =0V, I <sub>D</sub> =800μA                                                                                                                                  |                       | 1700  | -     | -    | V    |
| I <sub>DSS</sub>              | Zero gate voltage drain Current            | V <sub>DS</sub> =1700V, V <sub>GS</sub> =0V                                                                                                                                 |                       | -     | -     | 1    | mA   |
| I <sub>GSS</sub>              | Gate-Source Leakage Current                | V <sub>GS</sub> =20V, V <sub>DS</sub> =0V                                                                                                                                   |                       | -     | -     | 800  | nA   |
|                               |                                            | V <sub>GS</sub> =-10V, V <sub>DS</sub> =0V                                                                                                                                  |                       | -     | -     | -800 | nA   |
| V <sub>GS(th)</sub>           | Gate-source threshold Voltage              | I <sub>D</sub> =480mA                                                                                                                                                       | T <sub>j</sub> =25°C  | 1.80  | 2.70  | -    | V    |
|                               |                                            | V <sub>DS</sub> =V <sub>GS</sub>                                                                                                                                            | T <sub>j</sub> =175°C | -     | 1.90  | -    | V    |
| R <sub>DS(on)</sub><br>(Chip) | Static drain-source<br>On-state resistance | I <sub>D</sub> =800A                                                                                                                                                        | T <sub>j</sub> =25°C  | -     | 2.80  | -    | mΩ   |
|                               |                                            | V <sub>GS</sub> =15V                                                                                                                                                        | T <sub>j</sub> =175°C | -     | 6.30  | -    | mΩ   |
| V <sub>DS(on)</sub><br>(Chip) | Static drain-source<br>On-state Voltage    | I <sub>D</sub> =800A                                                                                                                                                        | T <sub>j</sub> =25°C  | -     | 2.24  | -    | V    |
|                               |                                            | V <sub>GS</sub> =15V                                                                                                                                                        | T <sub>j</sub> =175°C | -     | 5.04  | -    | V    |
| C <sub>iss</sub>              | Input Capacitance                          | V <sub>D</sub> =1000V, V <sub>GS</sub> =0V<br>f =1MHz, Vac =25mV                                                                                                            |                       | -     | 61.0  | -    | nF   |
| C <sub>oss</sub>              | Output Capacitance                         |                                                                                                                                                                             |                       | -     | 1.64  | -    | nF   |
| C <sub>rss</sub>              | Reverse transfer Capacitance               |                                                                                                                                                                             |                       | -     | 0.29  | -    | nF   |
| Q <sub>g</sub>                | Total gate charge                          | V <sub>DD</sub> =1000V<br>I <sub>D</sub> =600A<br>V <sub>GS</sub> =+15/-5V                                                                                                  |                       | -     | 2048  | -    | nC   |
| Q <sub>gd</sub>               | Gate-Drain Charge                          |                                                                                                                                                                             |                       | -     | 720   | -    | nC   |
| Q <sub>gs</sub>               | Gate-Source Charge                         |                                                                                                                                                                             |                       | -     | 616   | -    | nC   |
| R <sub>Gint</sub>             | Internal Gate Resistance                   | T <sub>j</sub> =25°C                                                                                                                                                        |                       | -     | 0.6   | -    | Ω    |
| t <sub>d(on)</sub>            | Turn-on delay time                         | V <sub>DD</sub> =900V<br>I <sub>D</sub> =800A<br>V <sub>GS</sub> =+15/-5V<br>R <sub>G(on)</sub> =3.3Ω<br>R <sub>G(off)</sub> =3.3Ω<br>Inductive load<br>switching operation | T <sub>j</sub> =25°C  | -     | 173   | -    | ns   |
|                               |                                            |                                                                                                                                                                             | T <sub>j</sub> =150°C | -     | 158   | -    |      |
| t <sub>r</sub>                | Rise time                                  |                                                                                                                                                                             | T <sub>j</sub> =25°C  | -     | 125   | -    | ns   |
|                               |                                            |                                                                                                                                                                             | T <sub>j</sub> =150°C | -     | 107   | -    |      |
| t <sub>d(off)</sub>           | Turn-off delay time                        |                                                                                                                                                                             | T <sub>j</sub> =25°C  | -     | 612   | -    | ns   |
|                               |                                            |                                                                                                                                                                             | T <sub>j</sub> =150°C | -     | 653   | -    |      |
| t <sub>f</sub>                | Fall time                                  |                                                                                                                                                                             | T <sub>j</sub> =25°C  | -     | 112   | -    | ns   |
|                               |                                            |                                                                                                                                                                             | T <sub>j</sub> =150°C | -     | 129   | -    |      |
| E <sub>on</sub>               | Turn-on power dissipation                  |                                                                                                                                                                             | T <sub>j</sub> =25°C  | -     | 67.8  | -    | mJ   |
|                               |                                            |                                                                                                                                                                             | T <sub>j</sub> =150°C | -     | 58.5  | -    |      |
| E <sub>off</sub>              | Turn-off power dissipation                 |                                                                                                                                                                             | T <sub>j</sub> =25°C  | -     | 72.3  | -    | mJ   |
|                               |                                            |                                                                                                                                                                             | T <sub>j</sub> =150°C | -     | 80.6  | -    |      |
| R <sub>th(j-c)</sub>          | FET Thermal Resistance                     | Junction to Case                                                                                                                                                            |                       | -     | 0.038 | -    | K/W  |
| R <sub>th(c-f)</sub>          | Contact thermal Resistance                 | With thermal conductive grease, Note1                                                                                                                                       |                       | -     | 0.015 | -    | K/W  |

Note1: Assumes Thermal Conductivity of grease is 0.9W/m·K and thickness is 50um.

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1700V/800A Half Bridge SiC MOSFET Module

## Body Diode Electrical characteristics (T<sub>j</sub>=25°C unless otherwise specified, chip)

| Symbol          | Item                              | Condition                                                                    |                        | Value |      |     | Unit |
|-----------------|-----------------------------------|------------------------------------------------------------------------------|------------------------|-------|------|-----|------|
|                 |                                   |                                                                              |                        | Min.  | Typ. | Max |      |
| V <sub>SD</sub> | Body Diode Forward Voltage        | V <sub>GS</sub> = -5V<br>I <sub>SD</sub> = 800A                              | T <sub>j</sub> = 25°C  | -     | 5.6  | -   | V    |
|                 |                                   |                                                                              | T <sub>j</sub> = 175°C | -     | 5.3  | -   |      |
| T <sub>rr</sub> | Reverse recovery time             | V <sub>RR</sub> = 900V, I <sub>D</sub> = 800A<br>MOSFET side:                | T <sub>j</sub> = 25°C  | -     | 41   | -   | ns   |
|                 |                                   |                                                                              | T <sub>j</sub> = 150°C | -     | 129  | -   |      |
| Q <sub>rr</sub> | Reverse recovery charge           | V <sub>GS</sub> = +15/-5V<br>R <sub>G(on)</sub> = R <sub>G(off)</sub> = 3.3Ω | T <sub>j</sub> = 25°C  | -     | 3.98 | -   | μC   |
|                 |                                   |                                                                              | T <sub>j</sub> = 150°C | -     | 16.9 | -   |      |
| E <sub>rr</sub> | Diode switching power dissipation | Inductive load<br>switching operation                                        | T <sub>j</sub> = 25°C  | -     | 1.2  | -   | mJ   |
|                 |                                   |                                                                              | T <sub>j</sub> = 150°C | -     | 9.7  | -   |      |

## Test Conditions

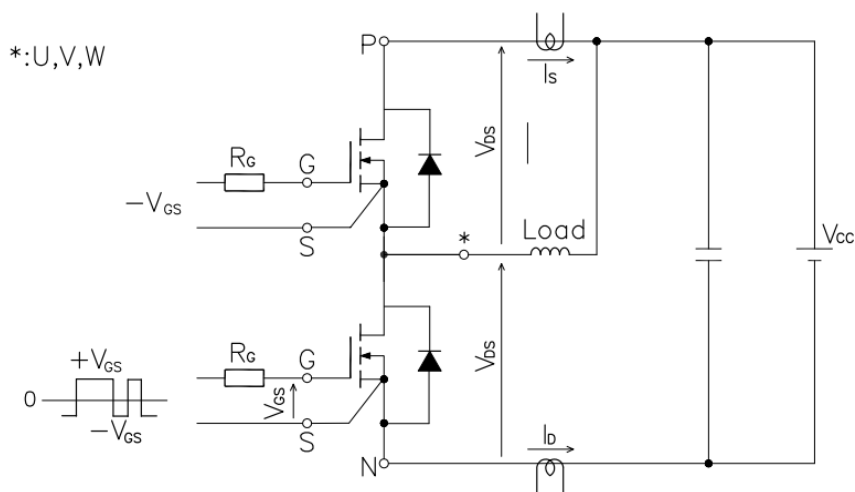


Figure 3. Switching time measure circuit

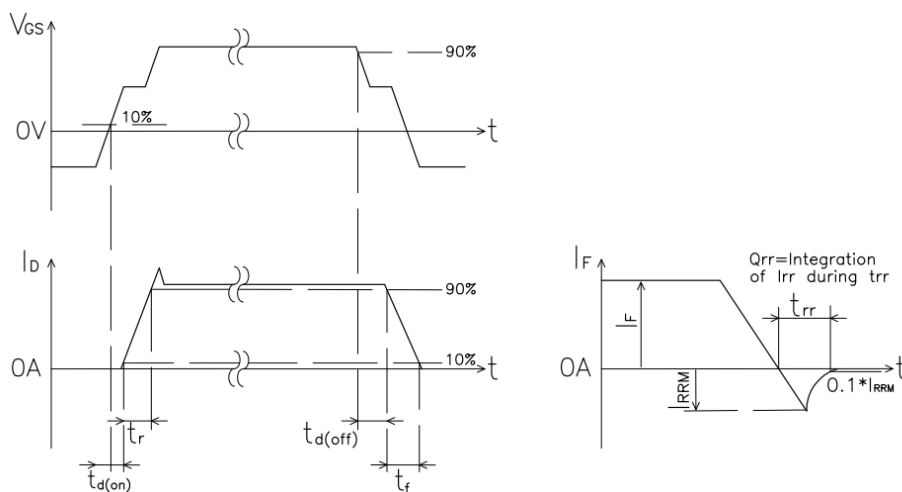


Figure 4. Switching time definition

# HCS800FH170D3C1

## 1700V/800A Half Bridge SiC MOSFET Module

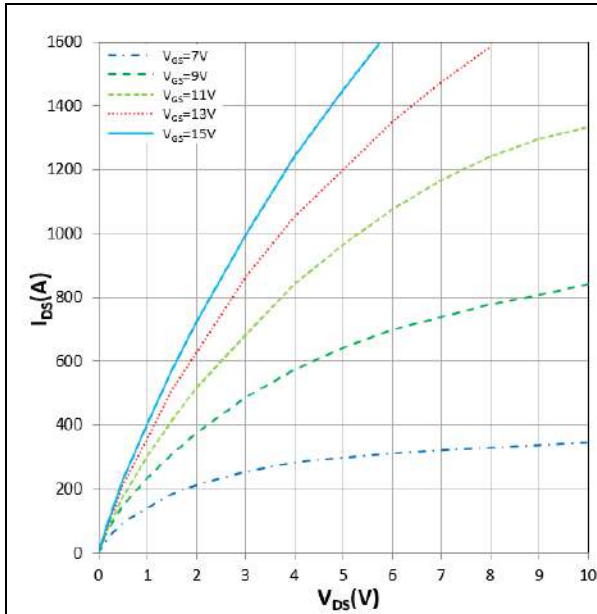


Figure 5.  $I_{DS}$  vs  $V_{DS}$   
 $T_j = 25^\circ\text{C}$ ,  $V_{GS}$  parameter

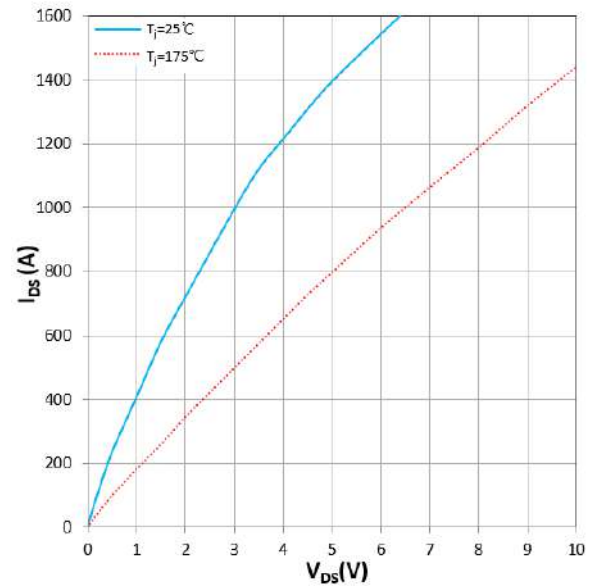


Figure 6.  $I_{DS}$  vs  $V_{DS}$   
 $V_{GS} = 15\text{V}$ ,  $T_j$  parameter

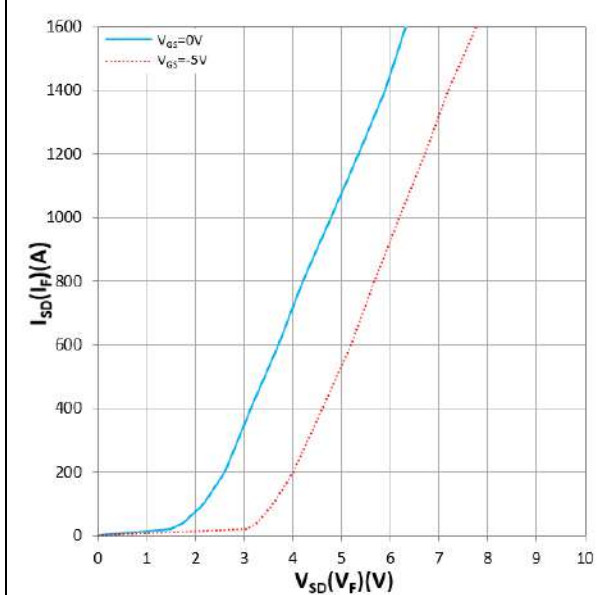


Figure 7.  $I_{SD}(I_F)$  vs  $V_{SD}(V_F)$   
 $T_j = 25^\circ\text{C}$ ,  $V_{GS}$  parameter

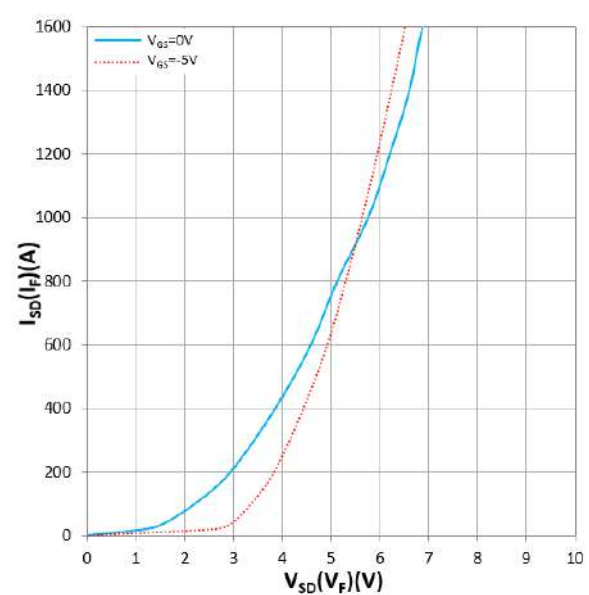


Figure 8.  $I_{SD}(I_F)$  vs  $V_{SD}(V_F)$   
 $T_j = 175^\circ\text{C}$ ,  $V_{GS}$  parameter

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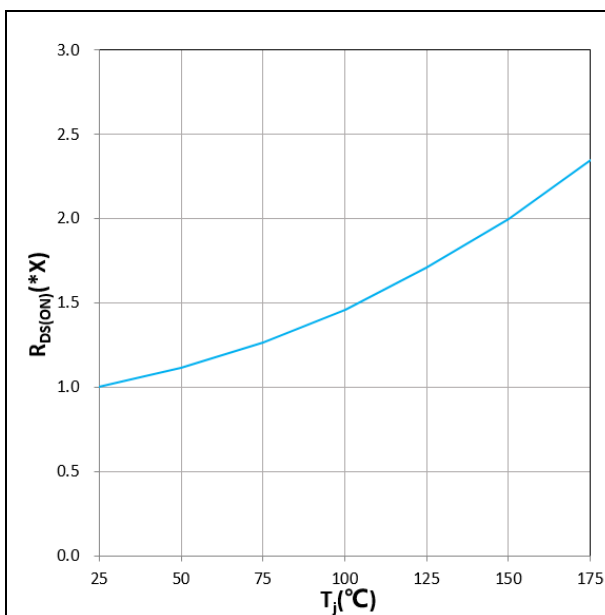


Figure 9. R<sub>DS(ON)</sub> vs T<sub>j</sub>  
V<sub>GS</sub> = +15V, I<sub>D</sub> = 800A, 1.0X = 2.8m

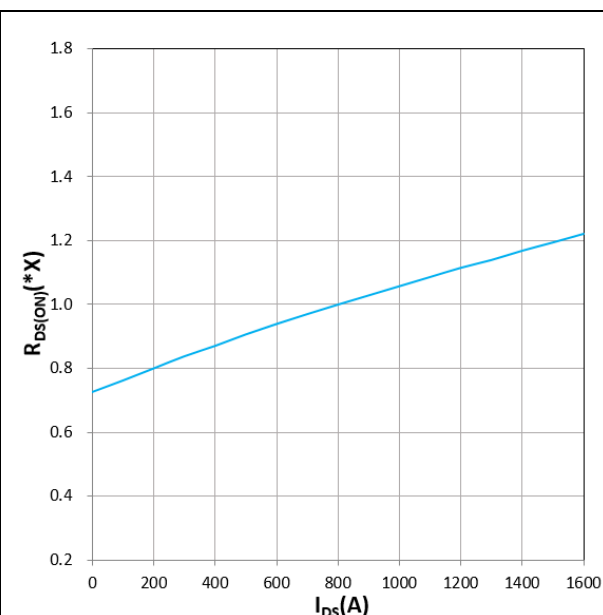


Figure 10. R<sub>DS(ON)</sub> vs I<sub>DS</sub>  
T<sub>j</sub> = 25°C, V<sub>GS</sub> = +15V, 1.0X = 2.8m

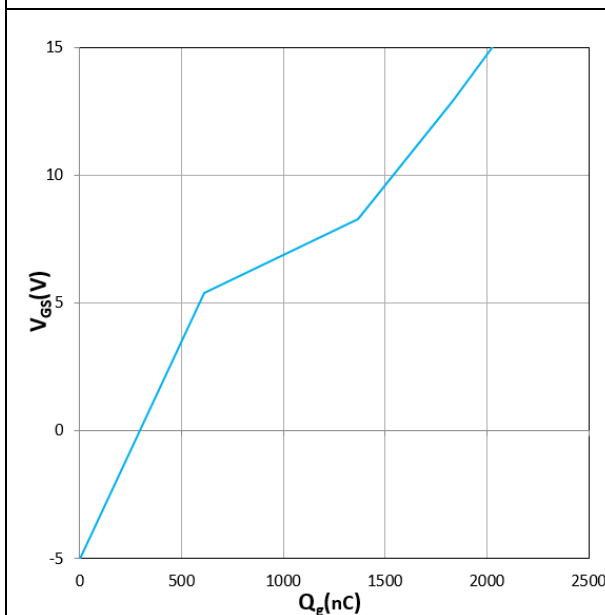


Figure 11. V<sub>GS</sub> vs Q<sub>g</sub>  
T<sub>j</sub> = 25°C, V<sub>DS</sub> = 1000V, I<sub>D</sub> = 600A

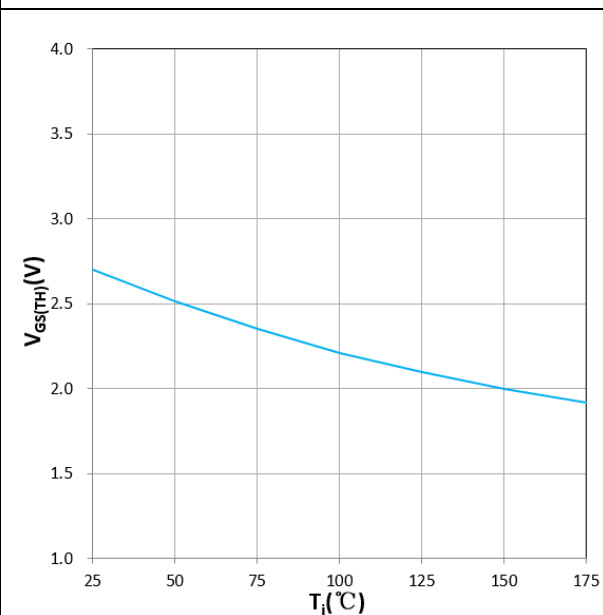


Figure 12. V<sub>GS(TH)</sub> vs T<sub>j</sub>  
V<sub>GS</sub> = V<sub>DS</sub>, I<sub>D</sub> = 480mA

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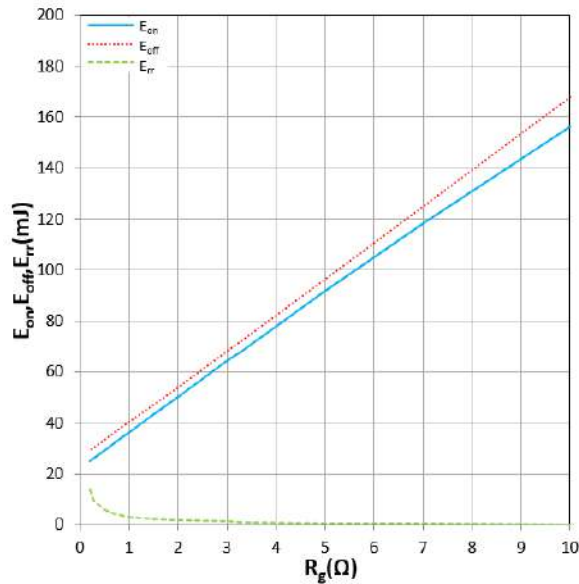


Figure 13. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs R<sub>g</sub>  
T<sub>j</sub>=25°C, V<sub>DD</sub>=900V, V<sub>GS</sub>=+15V/-5V, I<sub>D</sub>=800A  
Inductive Load

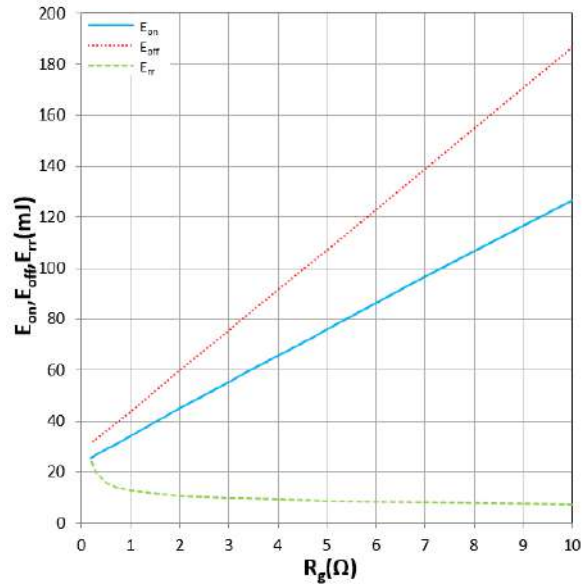


Figure 14. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs R<sub>g</sub>  
T<sub>j</sub>=150°C, V<sub>DD</sub>=900V, V<sub>GS</sub>=+15V/-5V, I<sub>D</sub>=800A  
Inductive Load

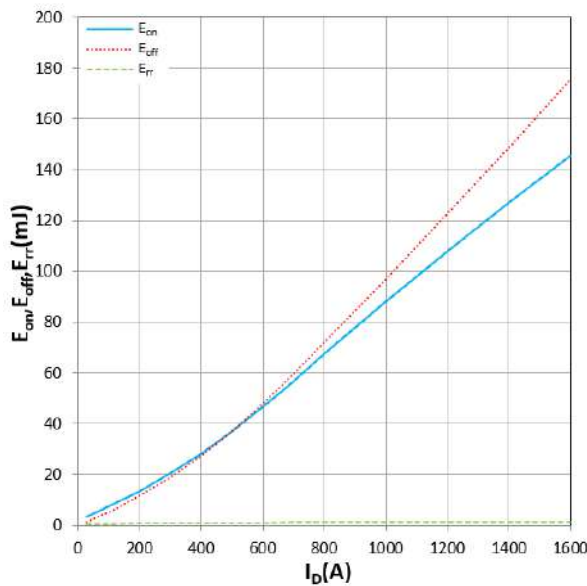


Figure 15. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs I<sub>D</sub>  
T<sub>j</sub>=25°C, V<sub>DD</sub>=900V, V<sub>GS</sub>=+15V/-5V, R<sub>g</sub>=3.3Ω  
Inductive Load

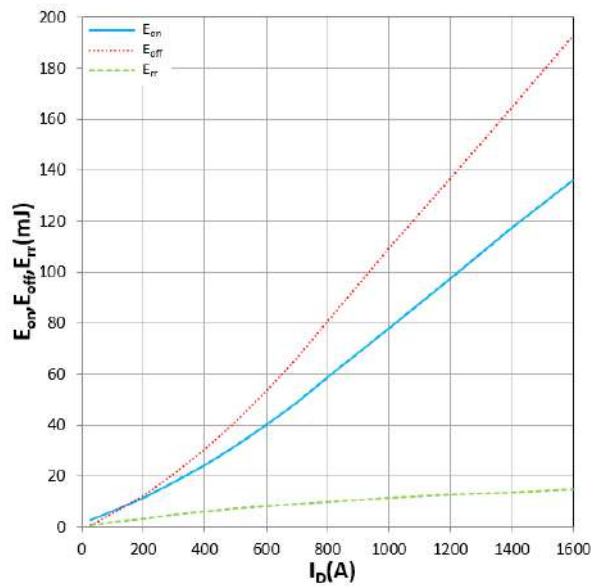


Figure 16. E<sub>on</sub>, E<sub>off</sub>, E<sub>rr</sub> vs I<sub>D</sub>  
T<sub>j</sub>=150°C, V<sub>DD</sub>=900V, V<sub>GS</sub>=+15V/-5V, R<sub>g</sub>=3.3Ω  
Inductive Load



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## 1700V/800A Half Bridge SiC MOSFET Module

### 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](mailto:sales@hiitio.com)) for further information on the product, technology, delivery terms, conditions and prices.

**Revision History**

| Document Version | Description of Changes |
|------------------|------------------------|
| RevX.0.1         | Released               |
|                  |                        |
|                  |                        |

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