# HCS450FF220E3T1

2200V/450A Half Bridge SiC MOSFET Module

## Description

The HCS450FF220E3T1 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

- 2200V/4.2mΩ
- Low thermal resistance with AIN AMB
- Low Inductive Design
- Thermistor inside

## Applications

- xEV Applications
- Motor Drives
- Renewable energy

## Circuit diagram

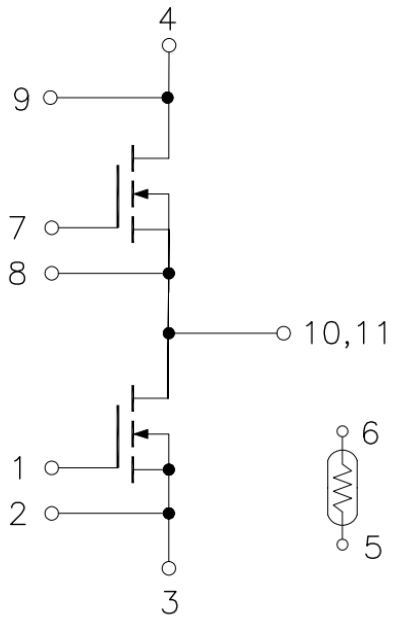


Figure 1. Out drawing & circuit diagram for HCS450FF220E3T1

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## Pin Configuration and Marking Information

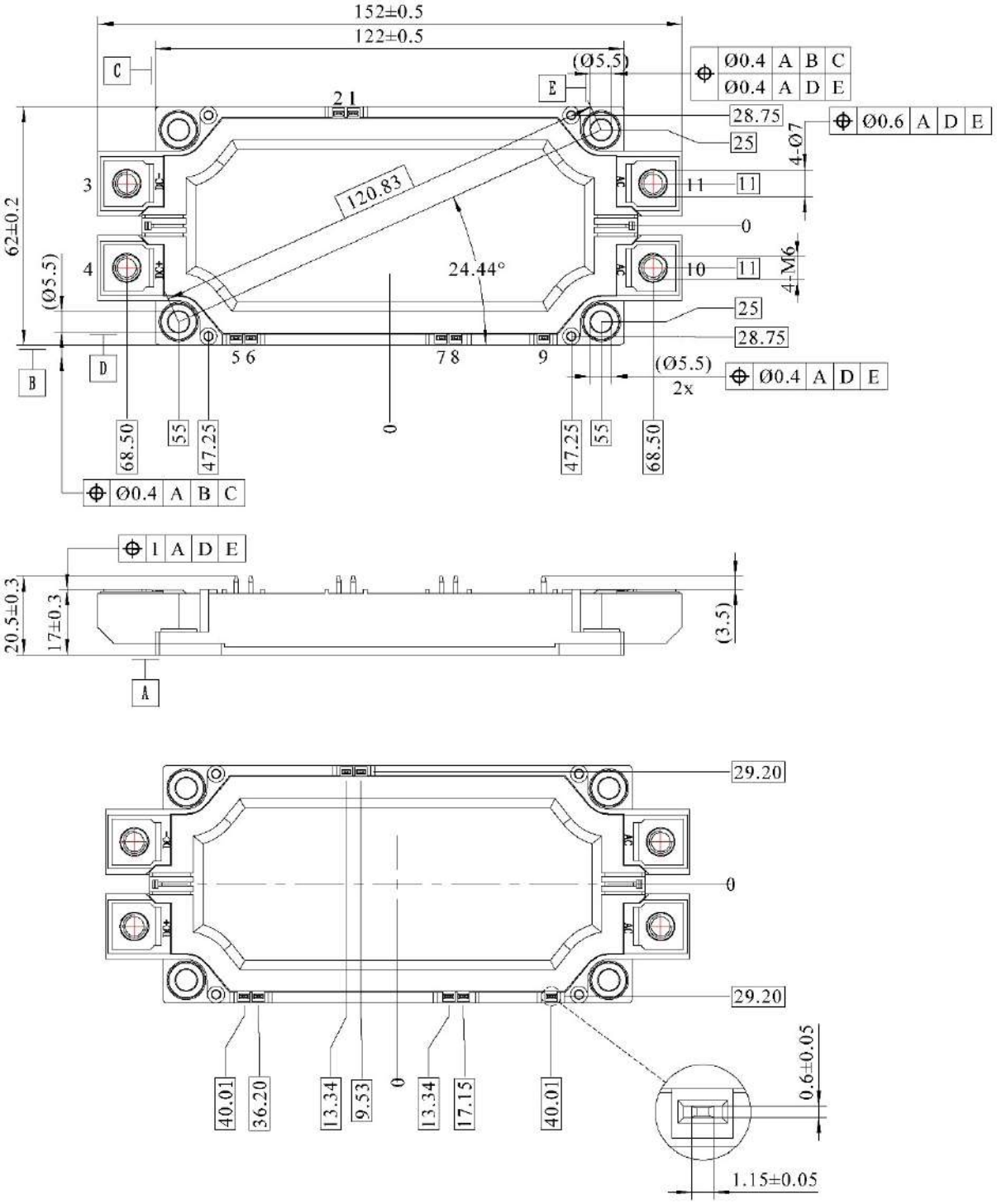


Figure 2. Pin configuration

# HCS450FF220E3T1

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## 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>13 | mm |
| Clearance | terminal to heatsink<br>terminal to terminal | 12.5<br>10 | mm |
| CTI | - | 600 | - |
| Module lead resistance, terminals – chip | $T_C$ =25°C | 0.5 | mΩ |
| Mounting torque for module mounting | M5, M6 | 3 to 6 | Nm |
| Weight | - | 350 | g |

## Maximum Ratings ($T_j$ =25°C unless otherwise specified)

| Symbol | Parameter | Condition | Ratings | Unit |
|---|---|---|---|---|
| $V_{DSS}$ | Drain-Source Voltage | G-S Short | 2200 | V |
| $V_{GSS}$ | Gate-Sourse Voltage | D-S Short, AC frequency ⩾1Hz, Note1 | -10 to 25 | V |
| $I_{DS}$ | DC Continuous Drain Current | $T_C$ =25°C , $V_{GS}$ =+20V | 520 | A |
| $I_{DS}$ | DC Continuous Drain Current | $T_C$ =60°C , $V_{GS}$ =+20V | 440 | A |
| $I_{SD}$ | Source (Body diode) Current | $T_C$ =25°C, with ON signal | 520 | A |
| $I_{SD}$ | Source (Body diode) Current | $T_C$ =60°C, with ON signal | 440 | A |
| $I_{DSM}$ | Pulse Drain Current | $T_C$ =25°C, Pulse width =1ms, $V_{GS}$ =+20V, Note2 | 1000 | A |
| $P_{tot}$ | Total Power Dissipation | $T_C$ =25°C | 2273 | W |
| $T_{jmax}$ | Max Junction Temperature | - | 150 | °C |
| $T_{stg}$ | Storage Temperature | - | -40 to 125 | °C |

Note1: Recommended Operating Value, +20V/-6V

Note2: Pulse width limited by maximum junction temperature

## NTC characteristics

| Symbol | Parameter | Condition | Value | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| $R_{25}$ | Resistance | $T_c$ =25°C | - | 5 | - | kΩ |
| △R/R | Deviation of $R_{100}$ | $T_c$ =100°C, $R_{100}$ =493Ω | -5 | - | 5 | % |
| $P_{25}$ | Power dissipation | $T_c$ =25°C | - | - | 20 | mW |
| $B_{25/50}$ | B-value | R2 =R25 exp [$B_{25/50}$(1/T2 - 1/(298,15 K))] | - | 3375 | - | K |
| $B_{25/80}$ | B-value | R2 =R25 exp [$B_{25/80}$(1/T2 - 1/(298,15 K))] | - | 3411 | - | K |
| $B_{25/100}$ | B-value | R2 =R25 exp [$B_{25/100}$(1/T2 - 1/(298,15 K))] | - | 3433 | - | K |

# HCS450FF220E3T1

2200V/450A Half Bridge SiC MOSFET Module

## MOSFET Electrical characteristics ($T_j$ =25°C unless otherwise specified, chip)

| Symbol | Item | Condition | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max | |
| $V_{(BR)DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$ =0V, $I_D$ =1mA | | 2200 | - | - | V |
| $I_{DSS}$ | Zero gate voltage drain Current | $V_{DS}$ =2200V, $V_{GS}$ =0V | | - | - | 200 | μA |
| $V_{GS(th)}$ | Gate-source threshold Voltage | $I_D$ =170mA, $V_{DS}$ =10V | | 3.5 | 4.5 | 5.5 | V |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$ =25V/-10V, $V_{DS}$ =0V | | - | - | ±400 | nA |
| $R_{DS(on)}$ (Chip) | Static drain-source On-state resistance | $I_D$ =450A, $V_{GS}$ =+20V | $T_j$ =25°C | - | 4.2 | - | mΩ |
| | | | $T_j$ =150°C | - | 8.4 | 11.8 | mΩ |
| $V_{DS(on)}$ (Chip) | Static drain-source On-state Voltage | $I_D$ =450A, $V_{GS}$ =+20V | $T_j$ =25°C | - | 1.89 | - | V |
| | | | $T_j$ =150°C | - | 3.78 | 5.31 | V |
| $R_{Gint}$ | Internal Gate Resistance | $T_j$ =25°C | | - | 4.1 | - | Ω |
| $C_{iss}$ | Input Capacitance | $V_{DS}$ =1100V, $V_{GS}$ =0V, f =10kHz | | - | 36.7 | - | nF |
| $C_{oss}$ | Output Capacitance | | | - | 1.2 | - | nF |
| $C_{rss}$ | Reverse transfer Capacitance | | | - | 0.03 | - | nF |
| $Q_g$ | Total gate charge | $V_{DS}$ =1100V, $I_D$ =170A, $V_{GS}$ =+20V/-6V | | - | 1080 | - | nC |
| $t_{d(on)}$ | Turn-on delay time | $V_{DD}$ =1100V, $I_D$ =450A, $V_{GS}$ =+20/-6V, $R_{gon}$ /$R_{goff}$ =0.75/3.0Ω, Inductive load switching operation | $T_j$ =25°C | - | 135 | - | ns |
| | | | $T_j$ =150°C | - | 160 | - | |
| $t_r$ | Rise time | | $T_j$ =25°C | - | 35 | - | ns |
| | | | $T_j$ =150°C | - | 40 | - | |
| $t_{d(off)}$ | Turn-off delay time | | $T_j$ =25°C | - | 345 | - | ns |
| | | | $T_j$ =150°C | - | 300 | - | |
| $t_f$ | Fall time | | $T_j$ =25°C | - | 115 | - | ns |
| | | | $T_j$ =150°C | - | 60 | - | |
| $E_{on}$ | Turn-on power dissipation | | $T_j$ =25°C | - | 16.0 | - | mJ |
| | | | $T_j$ =150°C | - | 14.2 | - | |
| $E_{off}$ | Turn-off power dissipation | | $T_j$ =25°C | - | 24.8 | - | mJ |
| | | | $T_j$ =150°C | - | 22.6 | - | |
| $R_{th(j-c)}$ | FET Thermal Resistance | Junction to Case | | - | 0.055 | - | K/W |
| $R_{th(c-f)}$ | Contact thermal Resistance | With thermal conductive grease, Note3 | | - | 0.015 | - | K/W |

Note3: Assumes Thermal Conductivity of grease is 0.9W/m · K and thickness is 50um.

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2200V/450A Half Bridge SiC MOSFET Module

## Body Diode Electrical characteristics ($T_j$ =25℃ unless otherwise specified, chip)

| Symbol | Item | Condition | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min. | Typ. | Max | |
| $V_{SD}$ | Body Diode Forward Voltage | $V_{GS}$ =-6V<br>$I_{SD}$ =450A | $T_j$ =25°C | - | 3.0 | - | V |
| | | | $T_j$ =150°C | - | 5.0 | - | |
| $T_{rr}$ | Reverse recovery time | $V_{DD}$ =1100V, $I_D$ =450A<br>$V_{GS}$ =+20/-6V,<br>$R_{gon}/R_{goff}$ =0.75/3.0Ω<br>Inductive load | $T_j$ =25°C | - | 40 | - | ns |
| | | | $T_j$ =150°C | - | 30 | - | |
| $E_{rr}$ | Diode switching power dissipation | | $T_j$ =25°C | - | 1.35 | - | mJ |
| | | | $T_j$ =150°C | - | 1.20 | - | |

## Test Conditions

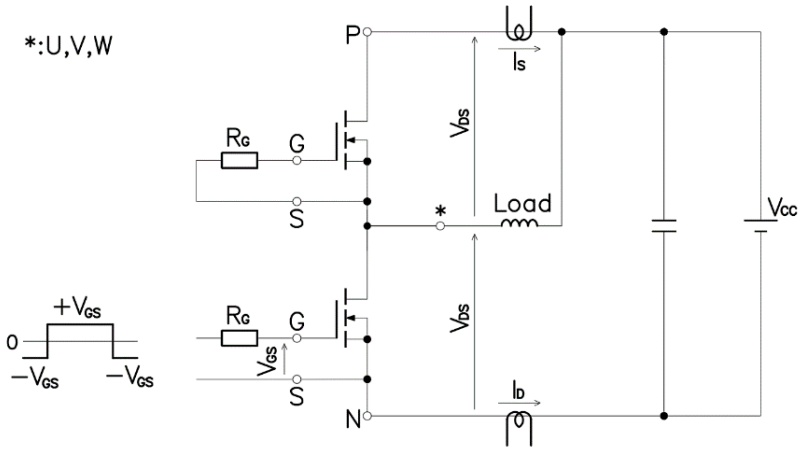


Figure 3. Switching time measure circuit

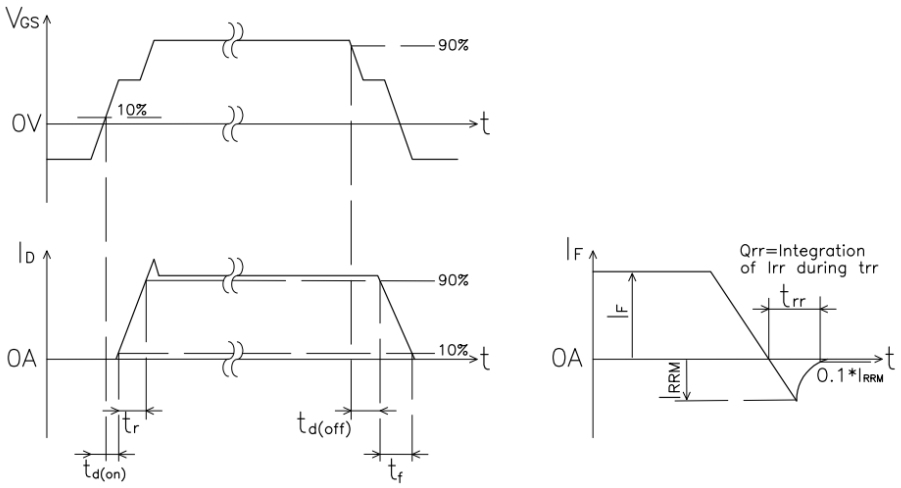


Figure 4. Switching time definition

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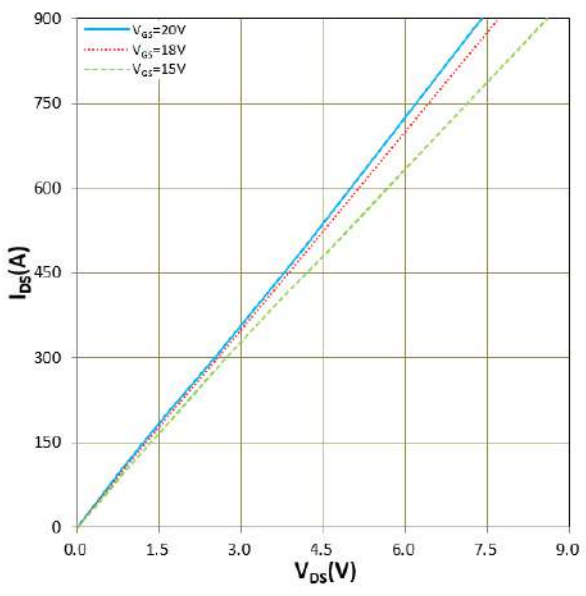


Figure 5. $I_{DS}$ vs $V_{DS}$
$T_j$ =150°C

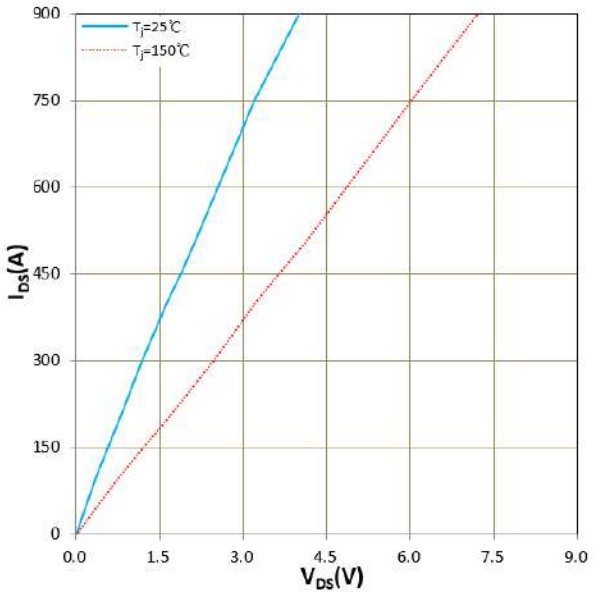


Figure 6. $I_{DS}$ vs $V_{DS}$
$V_{GS}$ =+20V

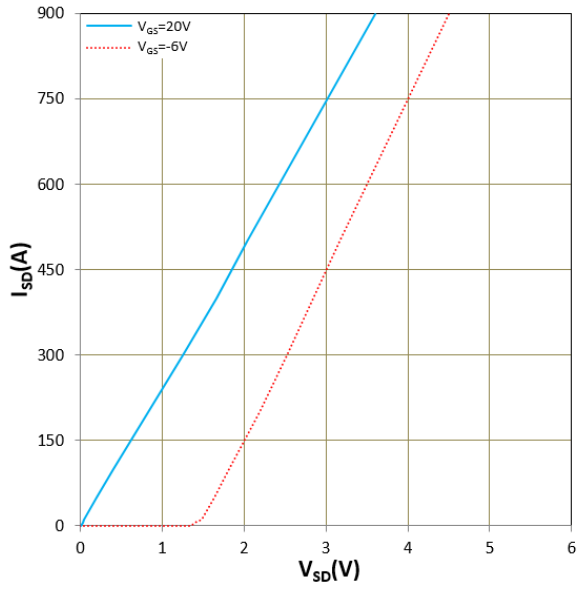


Figure 7. $I_{SD}$ vs $V_{SD}$ ($V_F$)
$T_j$ =25°C

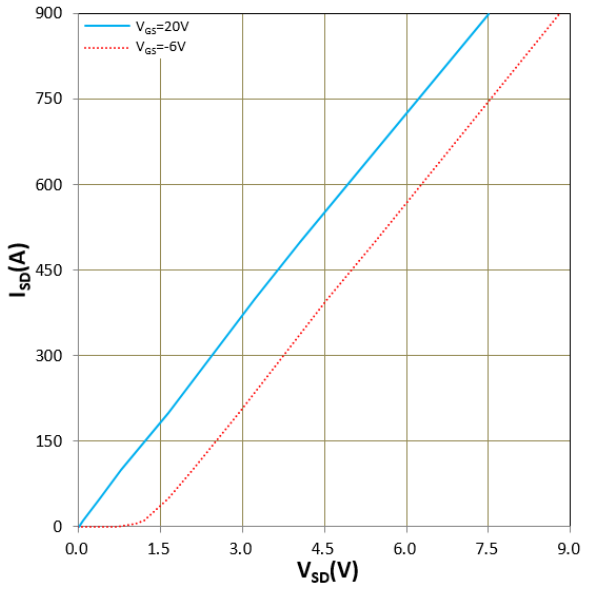


Figure8. $I_{SD}$ vs $V_{SD}$ ($V_F$)
$T_j$ =150°C

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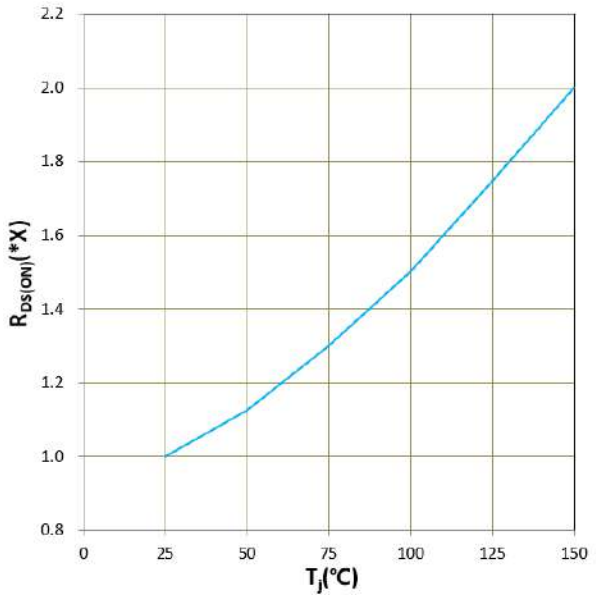


Figure 9. $R_{DS(ON)}$ vs $T_j$
$V_{GS}$ =+20V, $I_D$ =450A, 1.0X =4.2mΩ

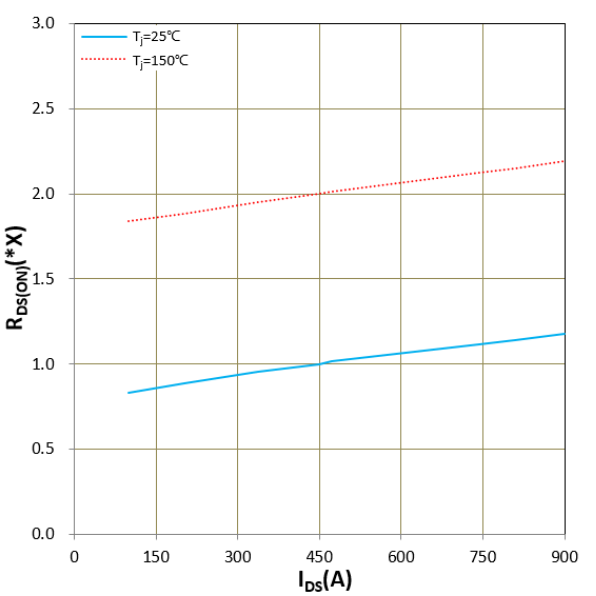


Figure 10. $R_{DS(ON)}$ vs $I_{DS}$
$V_{GS}$ =+20V, 1.0X =4.2mΩ

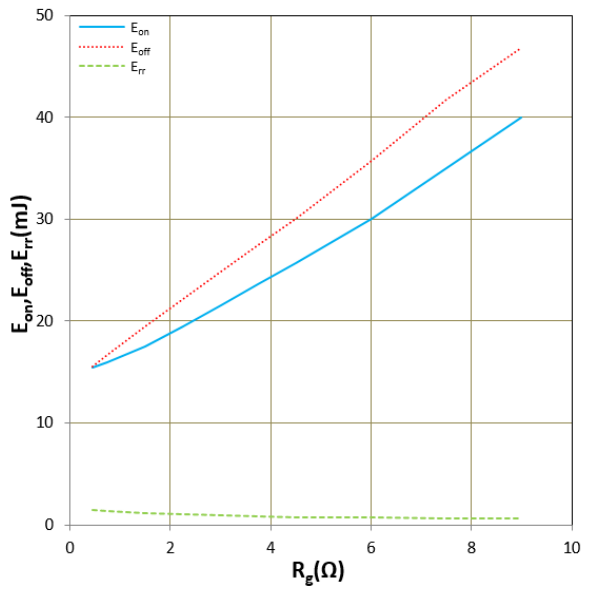


Figure 11. $E_{on}$, $E_{off}$, $E_{rr}$ vs $R_g$
$T_j$ =25°C, $V_{DD}$ =1100V, $I_D$ =450A, $V_{GS}$ =+20V/-6V
Inductive Load

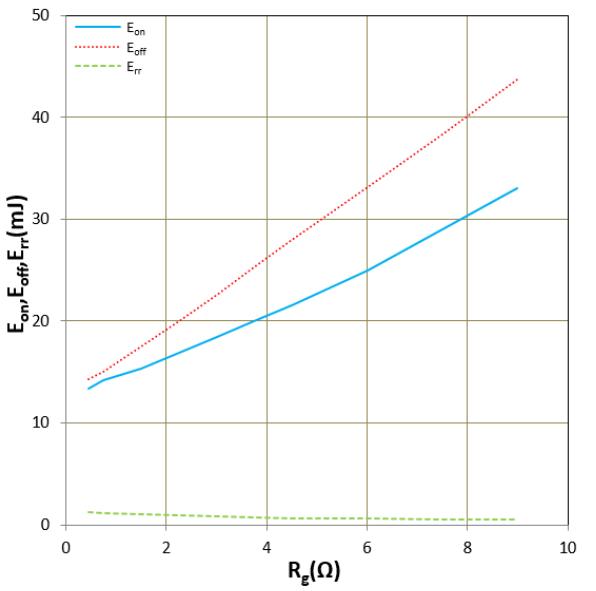


Figure 12. $E_{on}$, $E_{off}$ , $E_{rr}$ vs $R_g$
$T_j$ =150°C, $V_{DD}$ =1100V, $I_D$ =450A, $V_{GS}$ =+20V/-6V
Inductive Load

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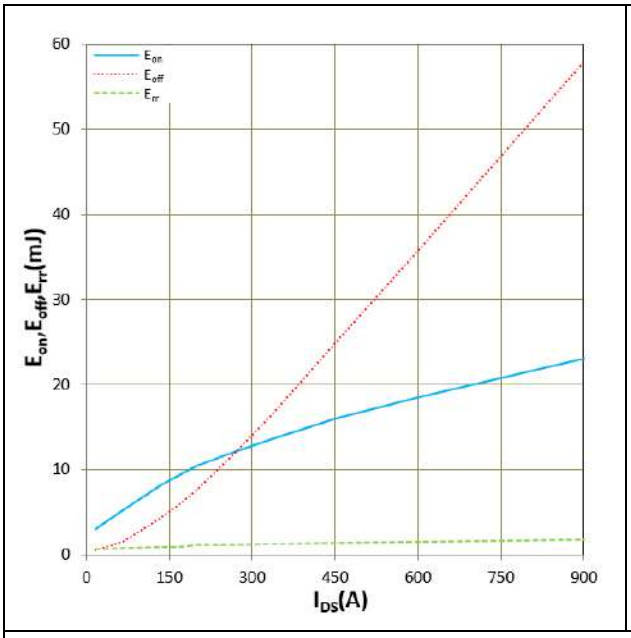


Figure 13. $E_{on}$, $E_{off}$ , $E_{rr}$ vs $I_{DS}$
$T_j$ =25°C, $V_{DD}$ =1100V, $R_{GON}$ / $R_{GOFF}$ =0.75/3.0Ω
$V_{GS}$ =+20V/-6V, Inductive Load

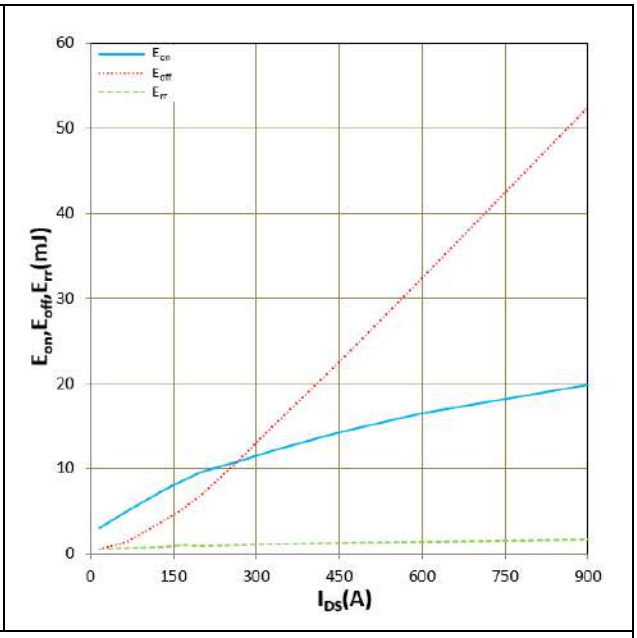


Figure 14. $E_{on}$, $E_{off}$ , $E_{rr}$ vs $I_{DS}$
$T_j$ =150°C, $V_{DD}$ =1100V, $R_{GON}$ / $R_{GOFF}$ =0.75/3.0Ω
$V_{GS}$ =+20V/-6V, Inductive Load

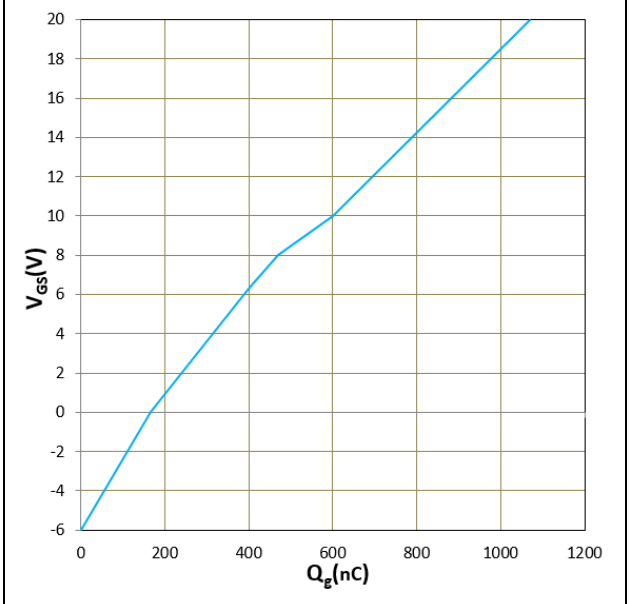


Figure15. $V_{GS}$ vs $Q_g$
$V_{CC}$ =1100V, $I_D$ =450A, $T_j$ =150°C

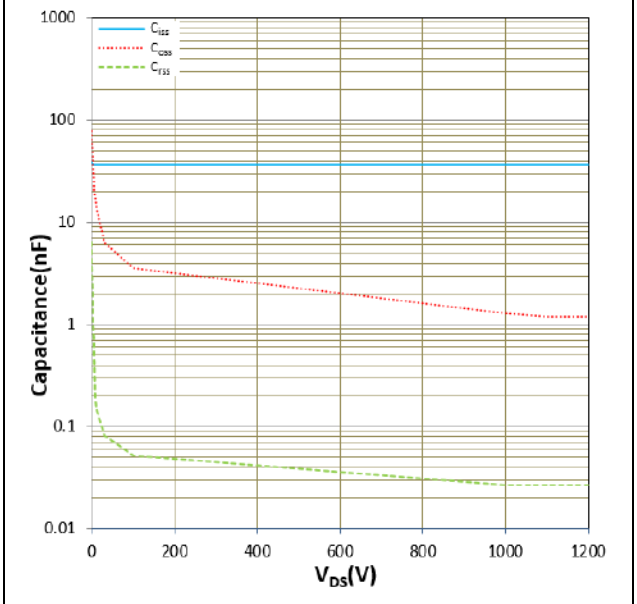


Figure 16. $C_{ies}$,$C_{oss}$,$C_{rss}$ vs $V_{DS}$
$T_j$ =25°C, $V_{GS}$ =0V, f =10kHz

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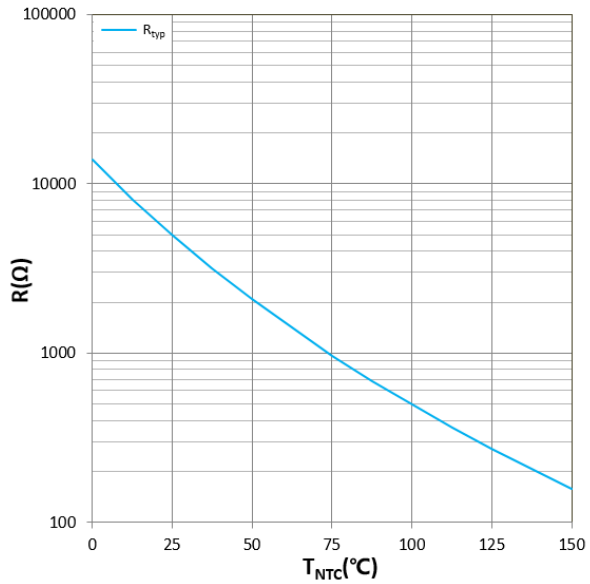


Figure 17. R vs $T_{NTC}$

**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 | | | | | | | |
|---|---|---|---|---|---|---|---|
| | HC | G | 100 | FF | 120 | E3 | A |

Hecheng Code

Module type G : IGBT module
D : FRD module
S : SiC module
H : Si/SiC hybrid

Current level (A) 50~900

Topology structure FZ : A switch unit FF : Half bridge
FS : Three phase F4 : H Bridge
F3L : Three level DF : Boost Circuit
FD : Braking Circuit
FP : Rectification+Inverter+Control move
AL : ANPC CL : Chopper

Voltage level (x10)（V） 650~2200

Packaging form+features（A…Z）

| | | |
|---|---|---|
| A1： 34 mm | A2： 62 mm | |
| B1： Easy 1B | B1A | B1B… |
| B2： Easy 2B… | B3： Easy 3B… | |
| D1： Flow0 | D2： Flow1 | D3： Flow2 |
| E0 : E0 | E1： Econo 2… | E2： E2 |
| E3： ED3 | E4 : E4 | E5 : ED3S |
| E6 : EPM2 | E7 : EPM3 | E8 : EconoPIM3 |
| E9 : ED3H | F0 : F0 | P2 : EPM2 |

Feature :A: Special Code Nil: Standard

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