

Description

The DFS900HF12I4C1 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 1200V
- $R_{DS(on)} = 2.0m\Omega$
- Low thermal resistance with Si₃N₄ AMB
- 175°C maximum junction temperature
- Thermistor inside
- Low Switching Losses

Applications

- xEV Applications
- Motor Drives
- Vehicle Fast Chargers
- Smart-Grid/Grid-Tied Distributed Generation

Circuit diagram

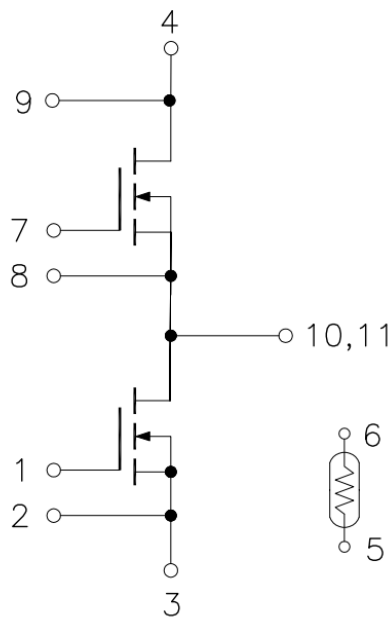


Figure 1. Out drawing & circuit diagram for DFS900HF12I4C1

Pin Configuration and Marking Information

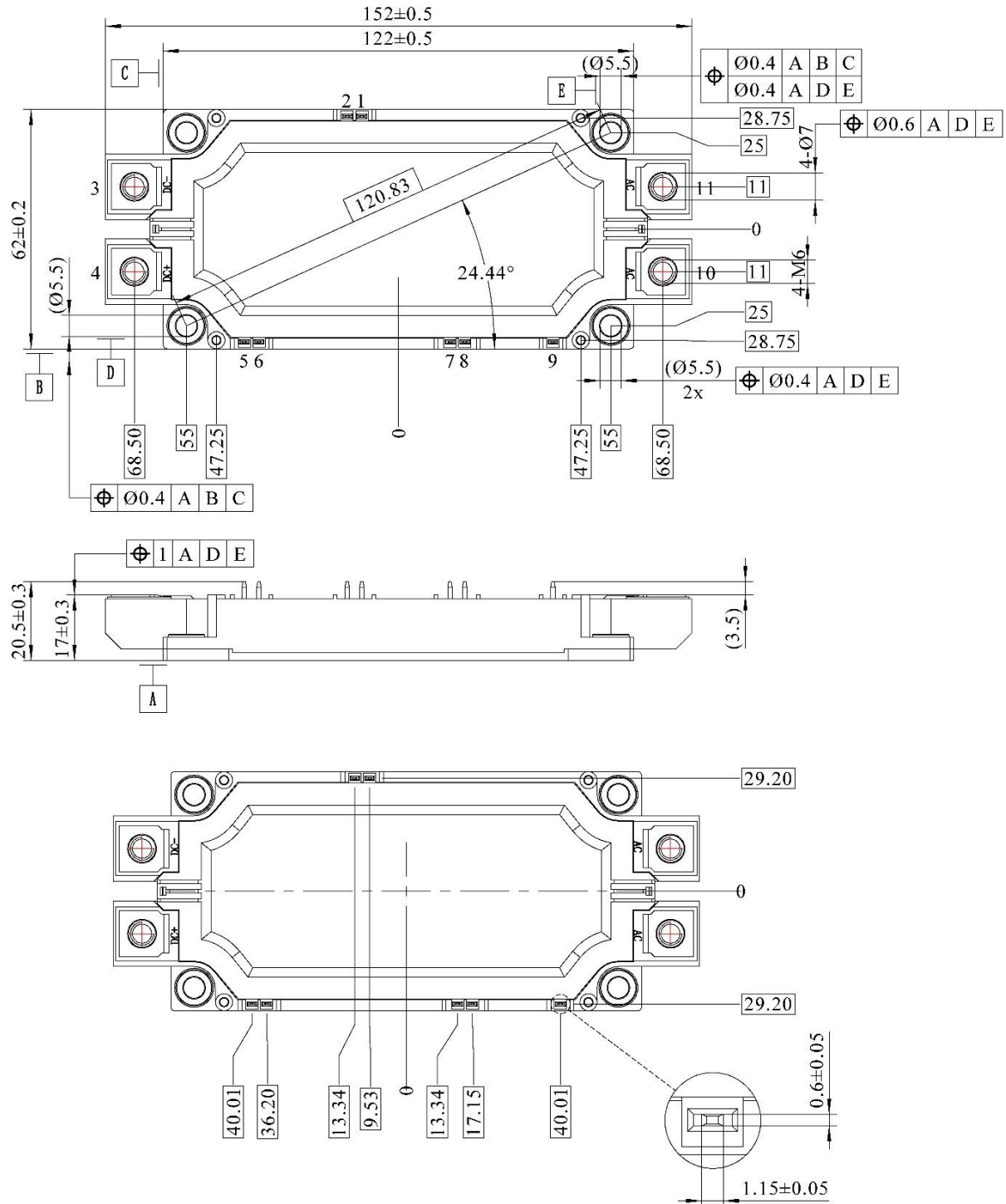


Figure 2. Pin configuration

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 terminal to terminal | 14.5 13 | mm |
| Clearance | terminal to heatsink terminal to terminal | 12.5 10 | mm |
| CTI | - | >400 | - |
| Module lead resistance, terminals–chip | T _c =25°C | 0.5 | mΩ |
| Mounting torque for module mounting | M5, M6 | 3 to 6 | Nm |
| Weight | - | 340 | g |

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

| Symbol | Parameter | Condition | Ratings | Unit |
|-------------------|-----------------------------|---|------------|------|
| V _{DSS} | Drain-Source Voltage | G-S Short | 1200 | V |
| V _{GSS} | Gate-Source Voltage | D-S Short, AC frequency ≥1Hz, Note1 | -10 to 22 | V |
| I _{DS} | DC Continuous Drain Current | T _C =25°C, V _{GS} =18V | 1000 | A |
| I _{DS} | DC Continuous Drain Current | T _C =60°C, V _{GS} =18V | 900 | A |
| I _{SD} | Source (Body diode) Current | T _C =25°C, with ON signal | 1000 | A |
| I _{SD} | Source (Body diode) Current | T _C =60°C, with ON signal | 900 | A |
| I _{DSM} | Pulse Forward Current | T _C =25°C, Pulse width =1ms, V _{GS} =20V, Note2 | 1800 | A |
| P _{tot} | Total Power Dissipation | T _C =25°C | 3000 | W |
| T _{jmax} | Max Junction Temperature | - | 175 | °C |
| T _{stg} | Storage Temperature | - | -40 to 125 | °C |

Note1: Recommended Operating Value, +18V/-5V, +18V/-4V, +15V/-4V

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 |
| ΔR/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 | R ₂ =R ₂₅ exp [B _{25/50} (1/T ₂ - 1/(298,15 K))] | - | 3375 | - | K |
| B _{25/80} | B-value | R ₂ =R ₂₅ exp [B _{25/80} (1/T ₂ - 1/(298,15 K))] | - | 3411 | - | K |
| B _{25/100} | B-value | R ₂ =R ₂₅ exp [B _{25/100} (1/T ₂ - 1/(298,15 K))] | - | 3433 | - | K |

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 =900μA | 1200 | - | - | V | |
| I _{DSS} | Zero gate voltage drain Current | V _{DS} =1200V, V _{GS} =0V | - | 30 | - | μA | |
| V _{GS(th)} | Gate-source threshold Voltage | I _D =315mA V _{DS} =V _{GS} | T _j =25°C | 1.8 | 2.7 | - | V |
| | | | T _j =175°C | - | 2.1 | - | V |
| I _{GSS} | Gate-Source Leakage Current | V _{GS} =20V, V _{DS} =0V, T _j =25°C | - | - | 900 | nA | |
| R _{DS(on)} (Chip) | Static drain-source On-state resistance | I _D =900A V _{GS} =+15V | T _j =25°C | - | 2.5 | 3.3 | mΩ |
| | | | T _j =175°C | - | 3.5 | - | mΩ |
| | On-state resistance | I _D =900A V _{GS} =+18V | T _j =25°C | - | 2.0 | - | mΩ |
| | | | T _j =175°C | - | 2.8 | - | mΩ |
| V _{DS(on)} (Chip) | Static drain-source On-state Voltage | I _D =900A V _{GS} =+15V | T _j =25°C | - | 2.25 | 2.97 | V |
| | | | T _j =175°C | - | 3.15 | - | V |
| | On-state Voltage | I _D =900A V _{GS} =+18V | T _j =25°C | - | 1.80 | - | V |
| | | | T _j =175°C | - | 2.52 | - | V |
| C _{iss} | Input Capacitance | V _D =1000V, V _{GS} =0V f =200kHz, V _{AC} =25mV | - | 52.2 | - | nF | |
| C _{oss} | Output Capacitance | | - | 1.60 | - | nF | |
| C _{rss} | Reverse transfer Capacitance | | - | 0.13 | - | nF | |
| R _{Gint} | Internal gate resistor | - | - | 0.7 | - | Ω | |
| Q _G | Total gate charge | V _{DD} =800V, I _D =540A, V _{GS} =+18/-5V | - | 1890 | - | nC | |
| t _{d(on)} | Turn-on delay time | V _{DD} =600V I _D =900A V _{GS} =+18/-4V R _{gon} /R _{goff} =3.3/2.2Ω Inductive load switching operation | T _j =25°C | - | 51 | - | ns |
| | | | T _j =150°C | - | 47 | - | |
| t _r | Rise time | | T _j =25°C | - | 29 | - | ns |
| | | | T _j =150°C | - | 27 | - | |
| t _{d(off)} | Turn-off delay time | | T _j =25°C | - | 116 | - | ns |
| | | | T _j =150°C | - | 132 | - | |
| t _f | Fall time | | T _j =25°C | - | 25 | - | ns |
| | | | T _j =150°C | - | 42 | - | |
| E _{on} | Turn-on power dissipation | | T _j =25°C | - | 35.5 | - | mJ |
| | | | T _j =150°C | - | 41.7 | - | |
| E _{off} | Turn-off power dissipation | T _j =25°C | - | 18.5 | - | mJ | |
| | | T _j =150°C | - | 21.8 | - | | |
| R _{th(j-c)} | FET Thermal Resistance | Junction to Case | - | 0.05 | - | 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.

Body Diode Electrical characteristics (T_j=25°C unless otherwise specified, chip)

| Symbol | Item | Condition | Value | | | Unit | |
|-----------------|-----------------------------------|---|------------------------|------|------|------|----|
| | | | Min. | Typ. | Max. | | |
| V _{SD} | Body Diode Forward Voltage | V _{GS} = -5V I _{SD} = 900A | T _j = 25°C | - | 6.3 | - | V |
| | | | T _j = 175°C | - | 5.6 | - | |
| T _{rr} | Reverse recovery time | V _{DD} = 600V I _D = 900A | T _j = 25°C | - | 29 | - | ns |
| | | | T _j = 150°C | - | 47 | - | |
| Q _{rr} | Reverse recovery charge | V _{GS} = +18/-4V R _{gon} /R _{goff} = 3.3/2.2Ω | T _j = 25°C | - | 3.5 | - | uC |
| | | | T _j = 150°C | - | 13.2 | - | |
| E _{rr} | Diode switching power dissipation | Inductive load switching operation | T _j = 25°C | - | 1.82 | - | mJ |
| | | | T _j = 150°C | - | 5.65 | - | |

Test Conditions

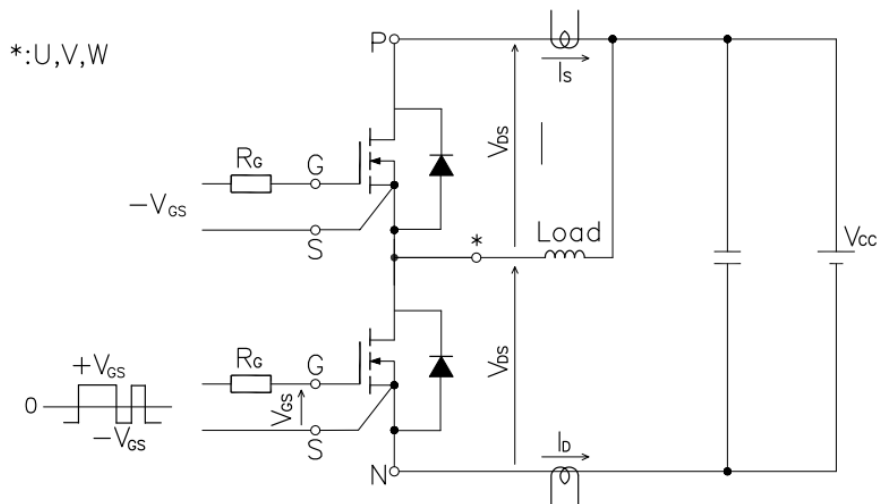


Figure 3. Switching time measure circuit

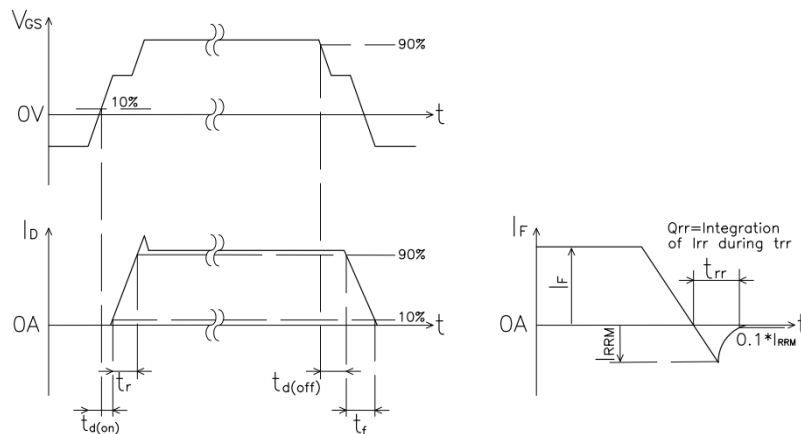


Figure 4. Switching time definition

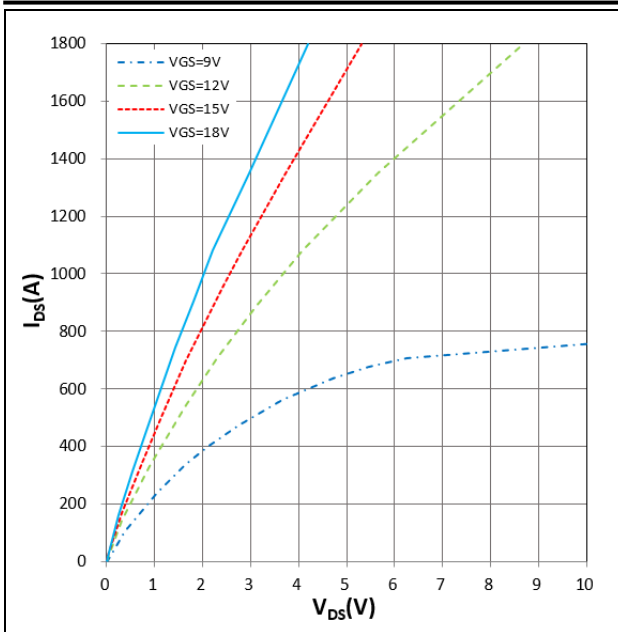


Figure 5. I_{DS} vs V_{DS}
 $T_j=25^\circ\text{C}$, V_{GS} parameter

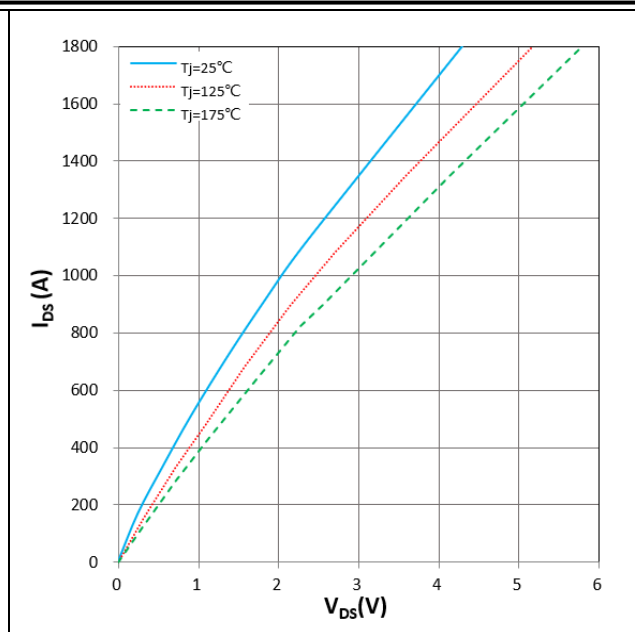


Figure 6. I_{DS} vs V_{DS}
 $V_{GS}=18\text{V}$, T_j parameter

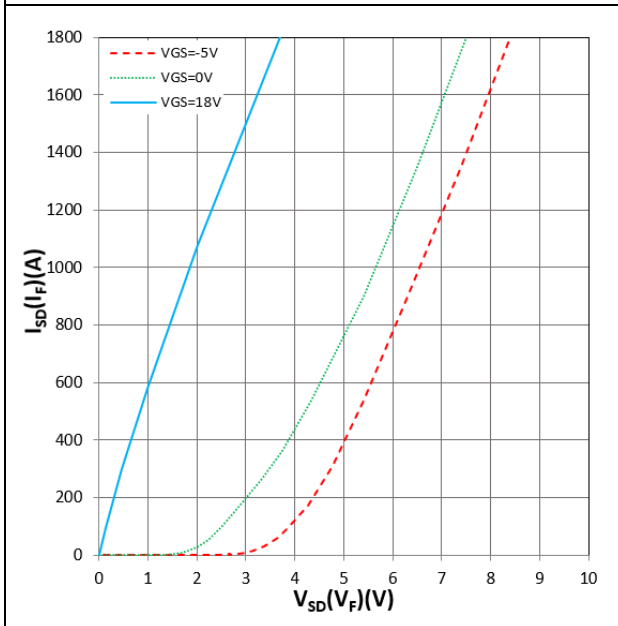


Figure 7. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j=25^\circ\text{C}$, V_{GS} parameter

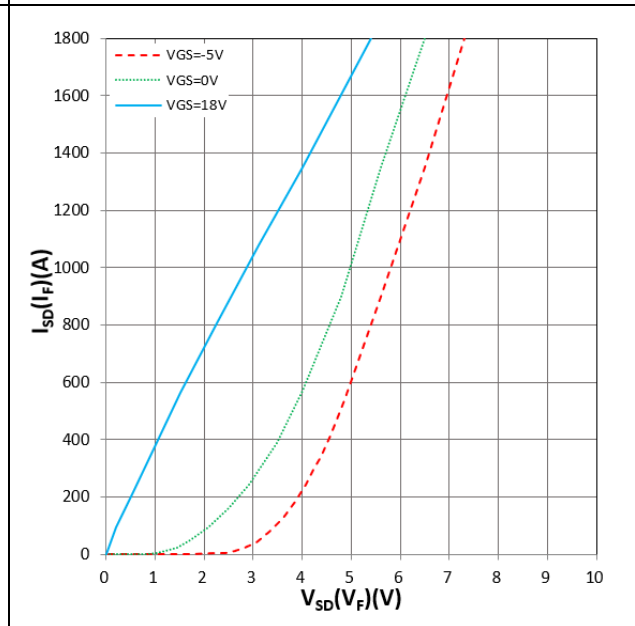


Figure 8. $I_{SD}(I_F)$ vs $V_{SD}(V_F)$
 $T_j=175^\circ\text{C}$, V_{GS} parameter

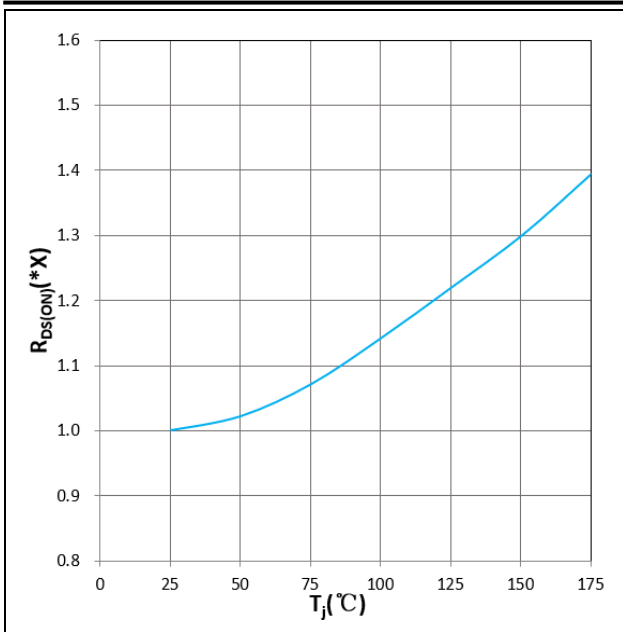


Figure 9. $R_{DS(ON)}$ vs T_j
 $V_{GS}=+18V, I_D=900A, 1.0X=2.0m\Omega$

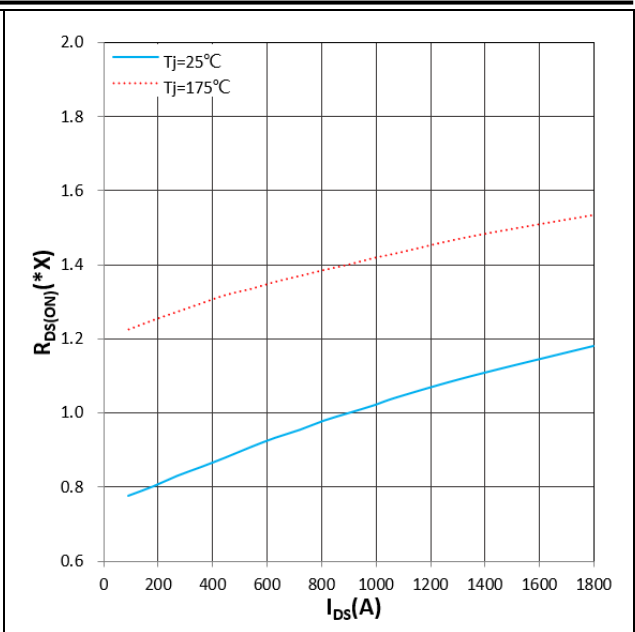


Figure 10. $R_{DS(ON)}$ vs I_{DS}
 $T_j=25^\circ C/175^\circ C, V_{GS}=+18V, 1.0X=2.0m\Omega$

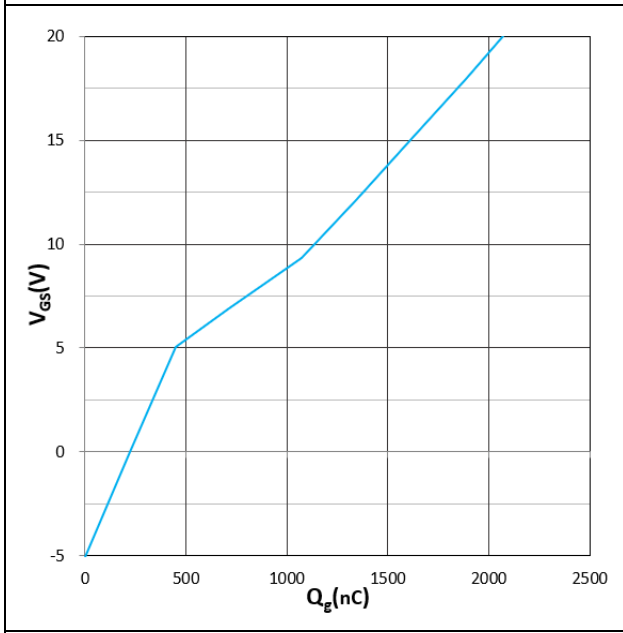


Figure 11. V_{GS} vs Q_g
 $T_j=25^\circ C, V_{DS}=800V, I_D=540A$

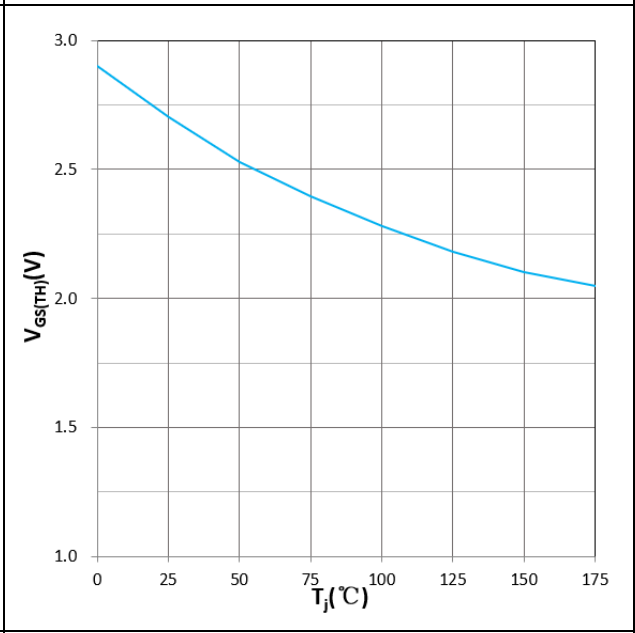


Figure 12. $V_{GS(TH)}$ vs T_j
 $V_{GS}=V_{DS}, I_D=315mA$

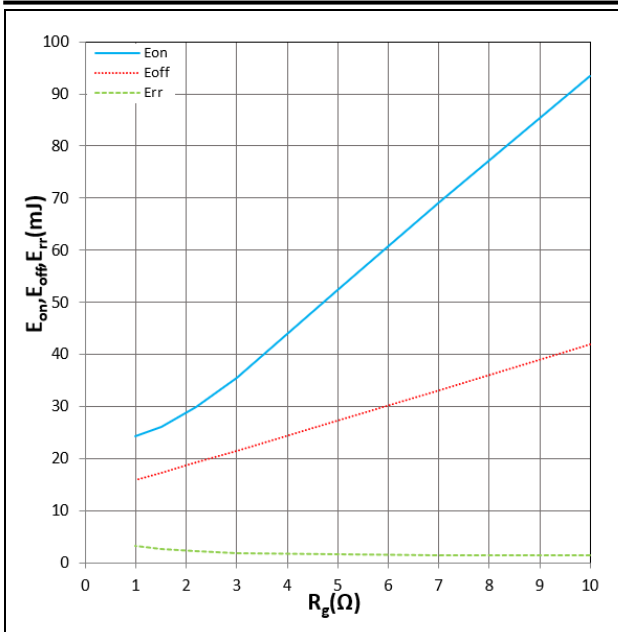


Figure 13. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=25^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $I_D=900\text{A}$
 Inductive Load

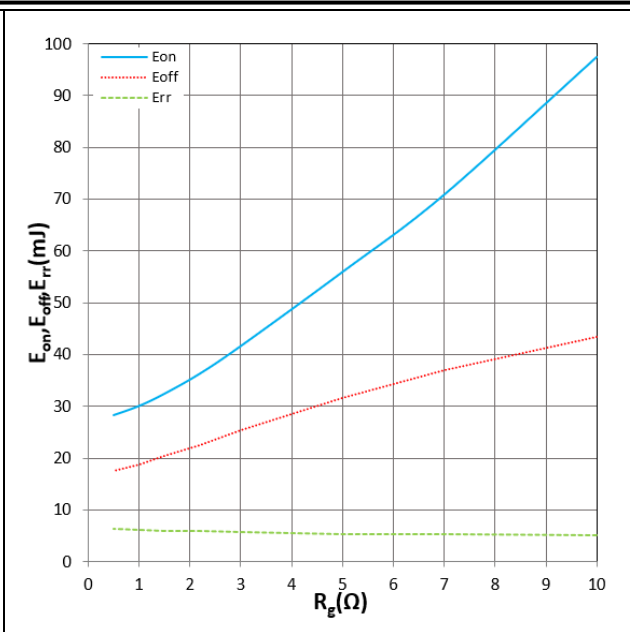


Figure 14. E_{on} , E_{off} , E_{rr} vs R_g
 $T_j=150^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$, $I_D=900\text{A}$
 Inductive Load

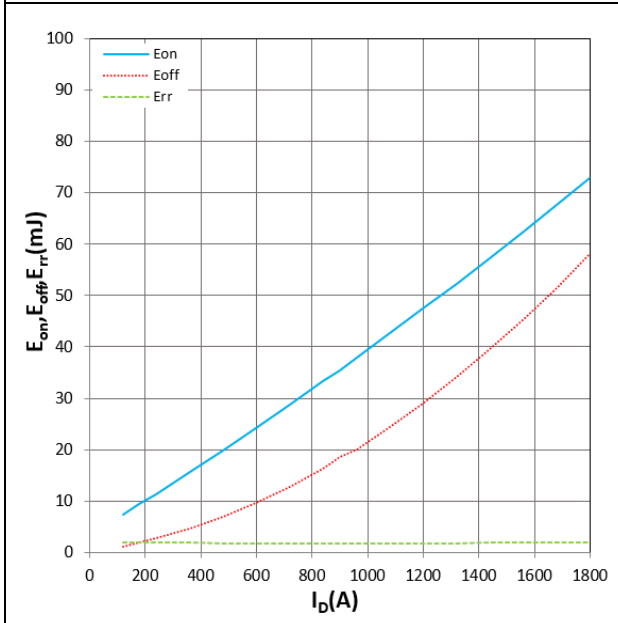


Figure 15. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=25^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff}=3.3/2.2\Omega$, Inductive Load

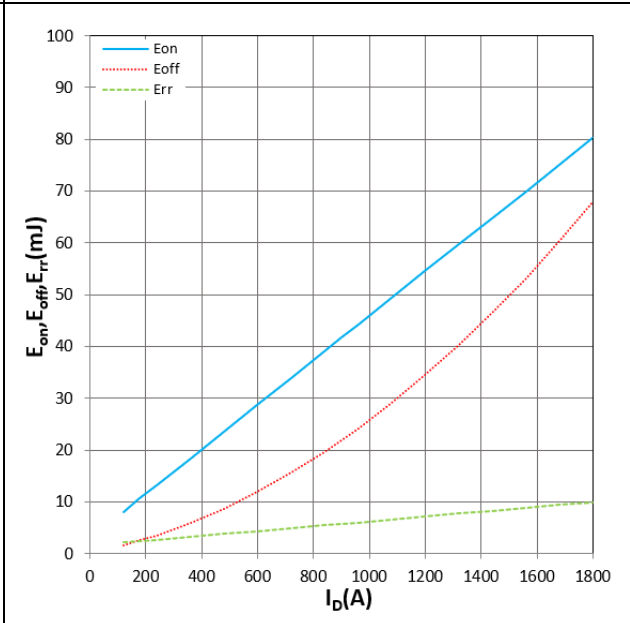


Figure 16. E_{on} , E_{off} , E_{rr} vs I_D
 $T_j=150^\circ\text{C}$, $V_{DD}=600\text{V}$, $V_{GS}=+18\text{V}/-4\text{V}$,
 $R_{gon}/R_{goff}=3.3/2.2\Omega$, Inductive Load

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