

### Description

The DFS80FB12EYQ1 is a 3 Phase SiC MOSFET Power Module. It integrates high performance SiC MOSFET chips designed for the applications such as DC/DC Converter, Motor converter, UPS, High Frequency Switching application.



### Features

- Blocking voltage:1200V
- 80mΩ  $R_{ds(on)}$  @  $T_j = 25^\circ\text{C}$
- 25A @  $T_f = 65^\circ\text{C}$
- Low Switching Losses
- 175°C maximum junction temperature
- Thermistor inside

### Applications

- DC/DC converter
- Motor converter
- Uninterruptible Power Supplier
- High Frequency Switching application

### Circuit diagram

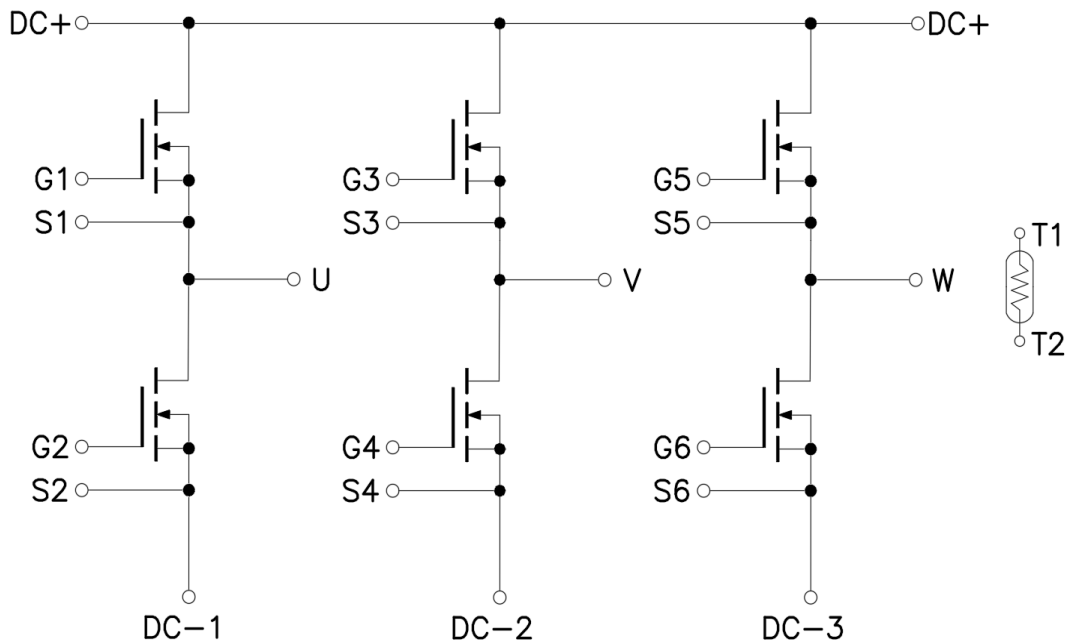


Figure 1. Out drawing & circuit diagram for DFS80FB12EYQ1

## Pin Configuration and Marking Information

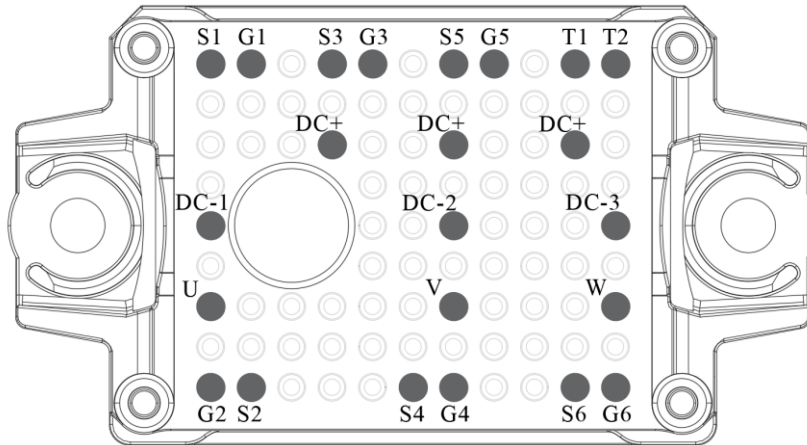


Figure 2. Pin configuration

| Symbol      | Description                      |
|-------------|----------------------------------|
| U, V, W     | Output terminal of 3 Phase       |
| S2, S4, S6  | Low side source signal terminal  |
| G2, G4, G6  | Low side gate signal terminal    |
| DC+ (3Pin)  | DC+ Bus connection               |
| DC- 1, 2, 3 | DC- Bus connection               |
| S1, S3, S5  | High side source signal terminal |
| G1, G3, G5  | High side gate signal terminal   |
| T1          | Thermistor connection 1          |
| T2          | Thermistor connection 2          |

## Module

| Parameter                  | Conditions              | Value | Unit |
|----------------------------|-------------------------|-------|------|
| Isolation Voltage          | RMS, f = 50Hz, t = 1min | 3.4   | kV   |
| Clearance                  | Terminal to Terminal    | 5     | mm   |
|                            | Terminal to Heatsink    | 10    | mm   |
| Creepage distance          | Terminal to Terminal    | 6.3   | mm   |
|                            | Terminal to Heatsink    | 12.7  | mm   |
| Comparative Tracking Index | -                       | 400   | -    |
| Weight                     | -                       | 24    | g    |

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

| Symbol                | Parameter                                | Conditions                           | Ratings    | Unit |
|-----------------------|--|--------------------------------------|------------|------|
| V <sub>DSS</sub>      | Drain-Source Voltage                     | G-S Short                            | 1200       | V    |
| V <sub>GSS</sub>      | Gate-Source Voltage(+)                   | D-S Short                            | 20         | V    |
| V <sub>GSS</sub>      | Gate-Source Voltage(-)                   | D-S Short                            | -5         | V    |
| V <sub>GSSSurge</sub> | G-S Voltage(t <sub>surge</sub> <300nsec) | D-S Short, Note1                     | -10 to 25  | V    |
| I <sub>DS</sub>       | DC Continuous Drain Current              | T <sub>f</sub> =65°C, Note2          | 25         | A    |
| I <sub>SD</sub>       | Source (Body Diode) Current              | T <sub>f</sub> =65°C, with ON signal | 25         | A    |
| I <sub>DP</sub>       | Drain Pulse Current, Peak                | Less than 1ms, Note3                 | 50         | A    |
| T <sub>j</sub>        | junction temperature                     | -                                    | -40 to 175 | °C   |
| T <sub>stg</sub>      | Storage temperature                      | -                                    | -40 to 125 | °C   |

Note1: Recommended Operating Value, +20V/-5V; +18V/-5V; +15V/-4V

Note2: Case temperature(T<sub>c</sub>) is defined on the surface of AMB substrate bottom just under the chips

Note3: 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   |
| ΔR/R                | Deviation of R100 | 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           | $R_2 = R_{25} \exp [B_{25/50}(1/T_2 - 1/(298,15 K))]$  | -     | 3375 | -    | K    |
| B <sub>25/80</sub>  | B-value           | $R_2 = R_{25} \exp [B_{25/80}(1/T_2 - 1/(298,15 K))]$  | -     | 3411 | -    | K    |
| B <sub>25/100</sub> | B-value           | $R_2 = R_{25} \exp [B_{25/100}(1/T_2 - 1/(298,15 K))]$ | -     | 3433 | -    | K    |

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

| Symbol                 | Item                                       | Condition   | Value             |       |      | Unit     |           |
|------------------------|--|---|-------------------|-------|------|----------|-----------|
|                        |  |   | Min.              | Typ.  | Max  |          |           |
| $V_{(BR)DSS}$          | Drain-Source Breakdown Voltage             | $V_{GS}=0V, I_D=1mA$  | 1200              | -     | -    | V        |           |
| $I_{DSS}$              | Zero gate voltage drain Current            | $V_{DS}=1200V, V_{GS}=0V$   | -                 | -     | 80   | $\mu A$  |           |
| $V_{GS(th)}$           | Gate-Source threshold Voltage              | $I_D=10mA, V_{DS}=V_{GS}$   | 2.0               | 2.8   | 4.0  | V        |           |
| $I_{GSS+}$             | Gate-Source Leakage Current                | $V_{GS}=20V, V_{DS}=0V, T_j=25^\circ C$   | -                 | -     | 100  | nA       |           |
| $I_{GSS-}$             |  | $V_{GS}=-5V, V_{DS}=0V, T_j=25^\circ C$   | -100              | -     | -    | nA       |           |
| $R_{DS(on)}$<br>(Chip) | Static drain-source<br>On-state resistance | $I_D=25A$<br>$V_{GS}=+20V$  | $T_j=25^\circ C$  | -     | 80   | 100      | $m\Omega$ |
|                        |  |   | $T_j=175^\circ C$ | -     | 149  | -        | $m\Omega$ |
| $V_{DS(on)}$<br>(Chip) | Static drain-source<br>On-state Voltage    | $I_D=25A$<br>$V_{GS}=+20V$  | $T_j=25^\circ C$  | -     | 2.0  | 2.5      | V         |
|                        |  |   | $T_j=175^\circ C$ | -     | 3.73 | -        | V         |
| $C_{iss}$              | Input Capacitance                          | $V_{DS}=1000V, V_{GS}=0V, f=200kHz$   | -                 | 1436  | -    | pF       |           |
| $C_{oss}$              | Output Capacitance                         |   | -                 | 62    | -    | pF       |           |
| $C_{rss}$              | Reverse transfer Capacitance               |   | -                 | 3     | -    | pF       |           |
| $Q_G$                  | Total gate charge                          | $V_{DD}=800V, I_D=20A, V_{GS}=+20/-4V$  | -                 | 58    | -    | nC       |           |
| $R_{Gint}$             | Internal Gate Resistance                   | $T_j=25^\circ C$  | -                 | 3.0   | -    | $\Omega$ |           |
| $t_{d(on)}$            | Turn-on delay time                         | $V_{DD}=600V$<br>$I_D=25A$<br>$V_{GS}=+15/-4V$<br>$R_G=10\Omega$<br>Inductive load<br>switching operation | $T_j=25^\circ C$  | -     | 21   | -        | ns        |
|                        |  |   | $T_j=150^\circ C$ | -     | 20   | -        |           |
| $t_r$                  | Rise time                                  |   | $T_j=25^\circ C$  | -     | 9    | -        | ns        |
|                        |  |   | $T_j=150^\circ C$ | -     | 8    | -        |           |
| $t_{d(off)}$           | Turn-off delay time                        |   | $T_j=25^\circ C$  | -     | 29   | -        | ns        |
|                        |  |   | $T_j=150^\circ C$ | -     | 33   | -        |           |
| $t_f$                  | Fall time                                  |   | $T_j=25^\circ C$  | -     | 15   | -        | ns        |
|                        |  |   | $T_j=150^\circ C$ | -     | 14   | -        |           |
| $E_{on}$               | Turn-on power dissipation                  |   | $T_j=25^\circ C$  | -     | 0.15 | -        | mJ        |
|                        |  |   | $T_j=150^\circ C$ | -     | 0.22 | -        |           |
| $E_{off}$              | Turn-off power dissipation                 | $T_j=25^\circ C$  | -                 | 0.055 | -    | mJ       |           |
|                        |  | $T_j=150^\circ C$   | -                 | 0.04  | -    |          |           |
| $R_{th(j-c)}$          | FET Thermal Resistance                     | Junction to Case/MOSFET   | -                 | 1.03  | -    | K/W      |           |
| $R_{th(c-f)}$          | Contact thermal resistance                 | With thermal conductive grease<br>/MOSFET   | -                 | 0.15  | -    | K/W      |           |

Assumes Thermal Conductivity of grease is 2.8 W/m · K and thickness is 50um.

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

| Symbol          | Item                              | Condition   | Value                  |      |      | Unit |    |
|-----------------|-----------------------------------|---|------------------------|------|------|------|----|
|                 |                                   |   | Min.                   | Typ. | Max. |      |    |
| V <sub>SD</sub> | Body Diode Forward Voltage        | V <sub>GS</sub> = -4V<br>I <sub>SD</sub> = 25A    | T <sub>j</sub> = 25°C  | -    | 4.5  | -    | V  |
|                 |                                   |   | T <sub>j</sub> = 175°C | -    | 4.0  | -    |    |
| T <sub>rr</sub> | Reverse recovery time             | V <sub>DD</sub> = 600V<br>I <sub>D</sub> = 25A    | T <sub>j</sub> = 25°C  | -    | 27   | -    | ns |
|                 |                                   |   | T <sub>j</sub> = 150°C | -    | 28   | -    |    |
| Q <sub>rr</sub> | Reverse recovery charge           | V <sub>GS</sub> = +15/-4V<br>R <sub>G</sub> = 10Ω | T <sub>j</sub> = 25°C  | -    | 0.33 | -    | μC |
|                 |                                   |   | T <sub>j</sub> = 150°C | -    | 0.89 | -    |    |
| E <sub>rr</sub> | Diode switching power dissipation | Inductive load<br>switching operation             | T <sub>j</sub> = 25°C  | -    | 0.17 | -    | mJ |
|                 |                                   |   | T <sub>j</sub> = 150°C | -    | 0.49 | -    |    |

### Test Conditions

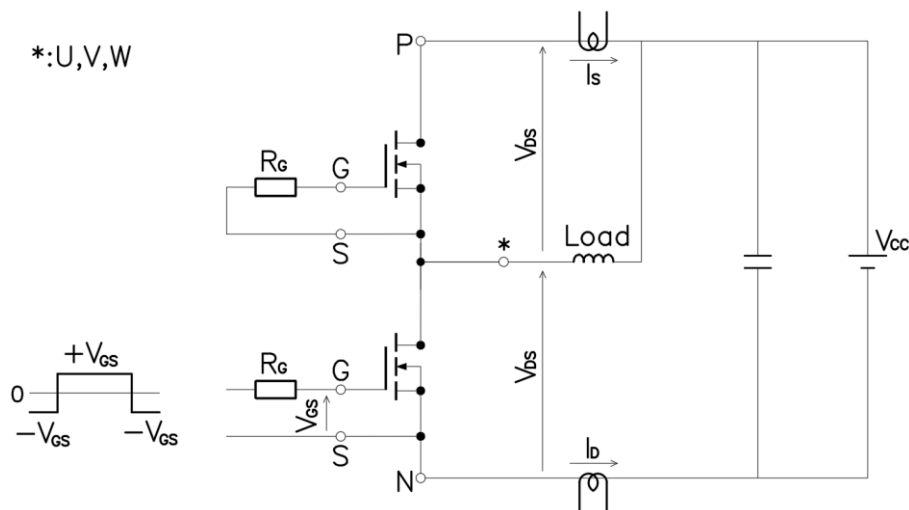


Figure 3. Switching time measure circuit

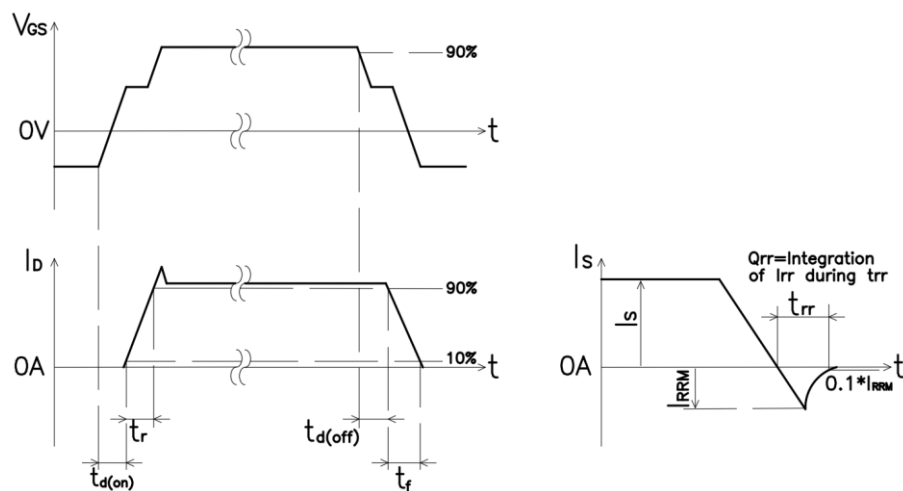


Figure 4. Switching time definition

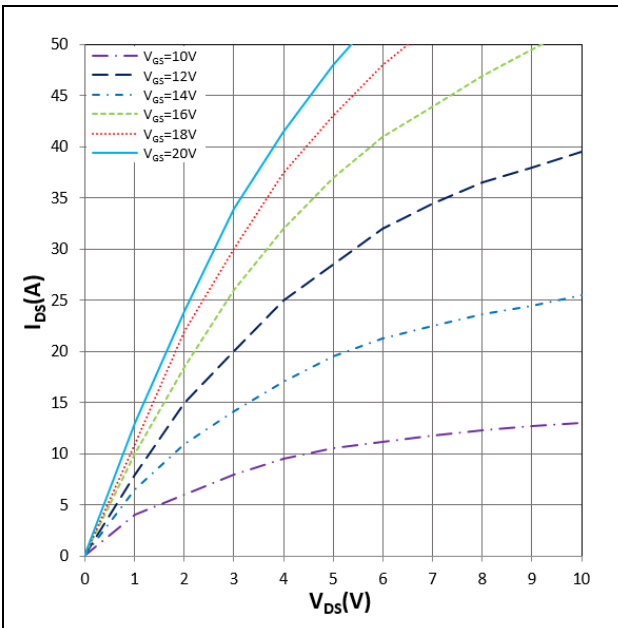


Figure 5.  $I_{D_S}$  vs  $V_{D_S}$   
 $T_j = 25^\circ\text{C}$ ,  $V_{G_S}$  parameter

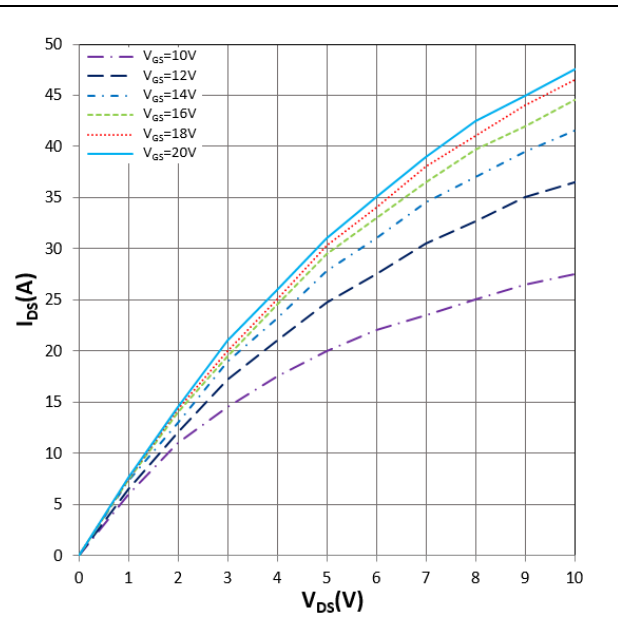


Figure 6.  $I_{D_S}$  vs  $V_{D_S}$   
 $T_j = 175^\circ\text{C}$ ,  $V_{G_S}$  parameter

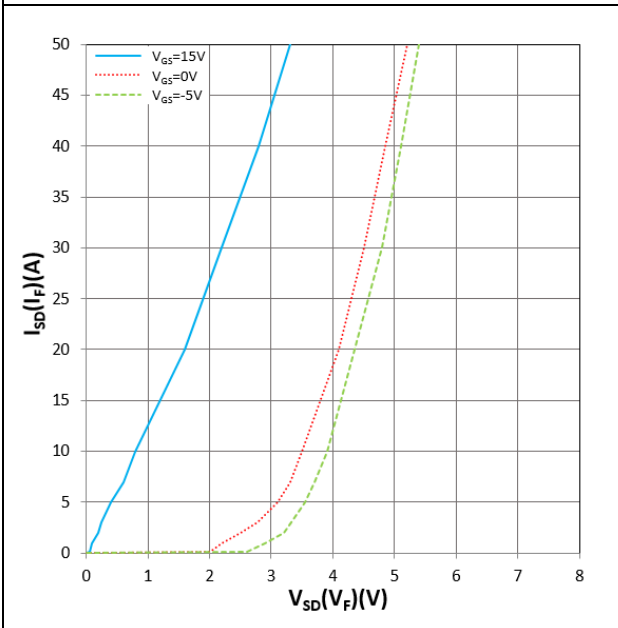


Figure 7.  $I_{S_D}(I_F)$  vs  $V_{S_D}(V_F)$   
 $T_j = 25^\circ\text{C}$ ,  $V_{G_S}$  parameter

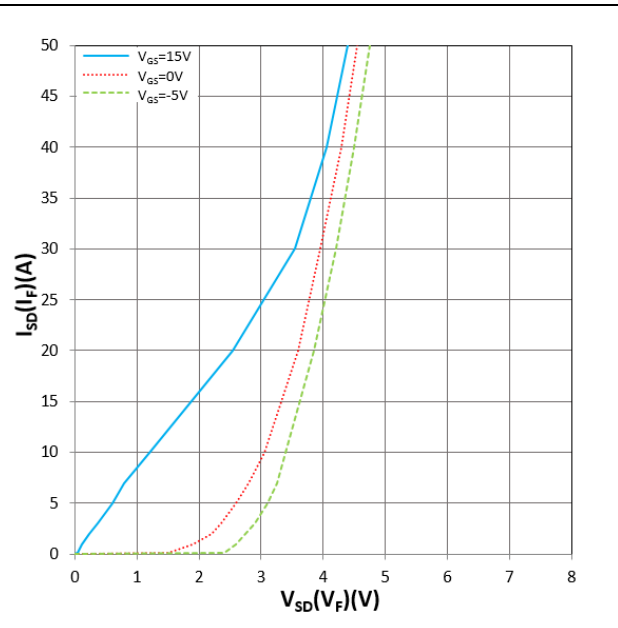


Figure 8.  $I_{S_D}(I_F)$  vs  $V_{S_D}(V_F)$   
 $T_j = 175^\circ\text{C}$ ,  $V_{G_S}$  parameter

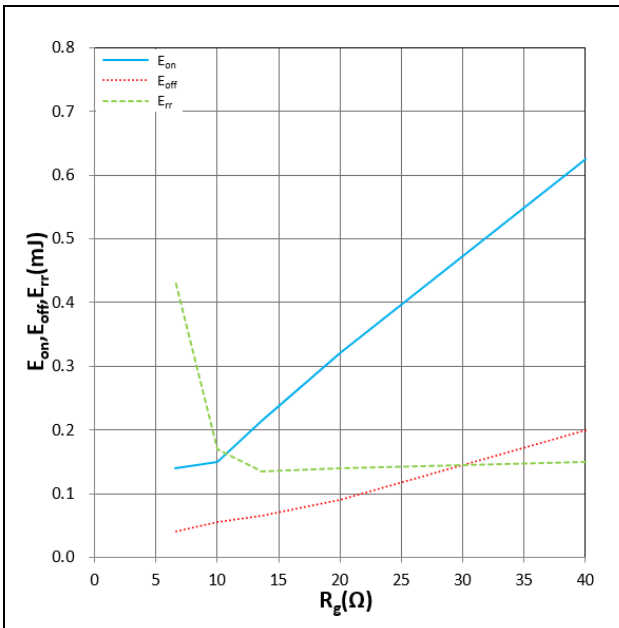


Figure 8.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_G$   
 $T_j = 25^\circ\text{C}$ ,  $I_D = 25\text{A}$ ,  $V_{GS} = +15/-4\text{V}$

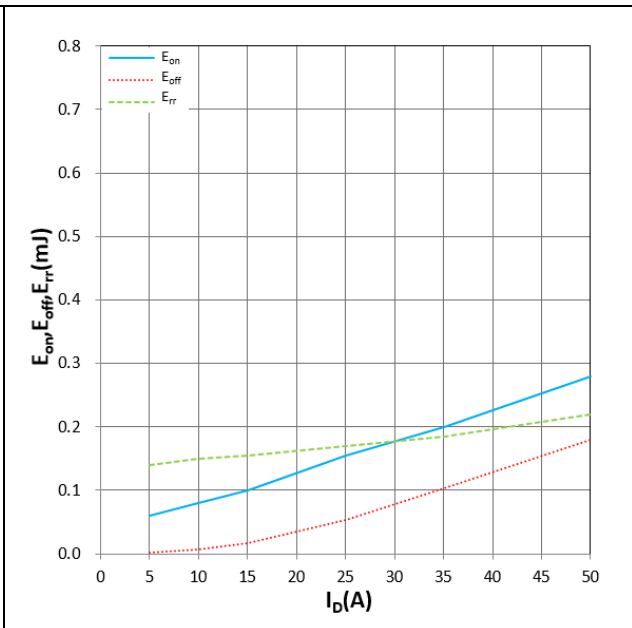


Figure 9.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_D$   
 $T_j = 25^\circ\text{C}$ ,  $R_G = 10\Omega$ ,  $V_{GS} = +15/-4\text{V}$

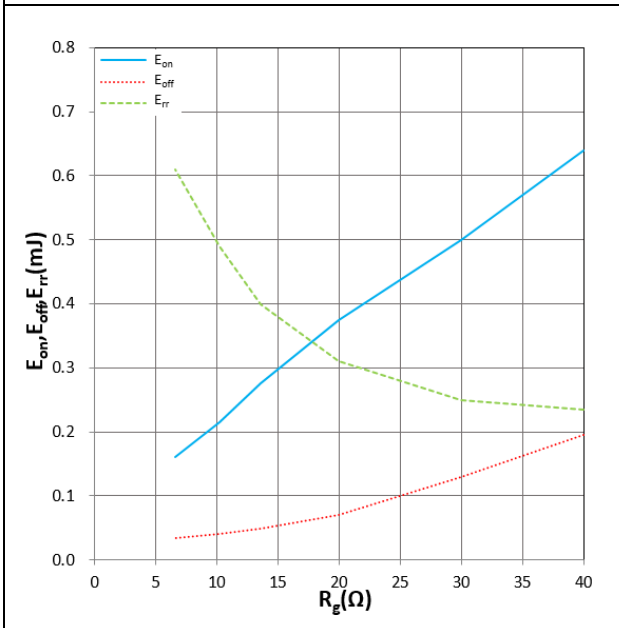


Figure 10.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $R_G$   
 $T_j = 150^\circ\text{C}$ ,  $I_D = 25\text{A}$ ,  $V_{GS} = +15/-4\text{V}$

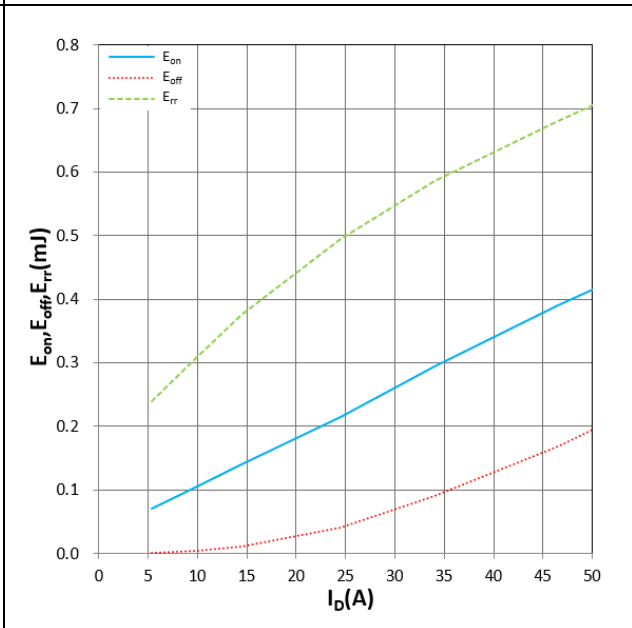


Figure 11.  $E_{on}$ ,  $E_{off}$ ,  $E_{rr}$  vs  $I_D$   
 $T_j = 150^\circ\text{C}$ ,  $R_G = 10\Omega$ ,  $V_{GS} = +15/-4\text{V}$

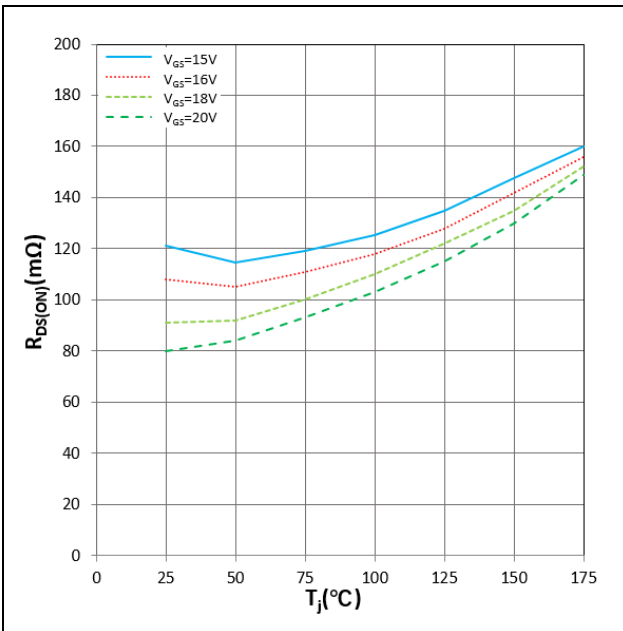


Figure 12.  $R_{DS(ON)}$  vs  $T_j$   
 $I_D = 25A$

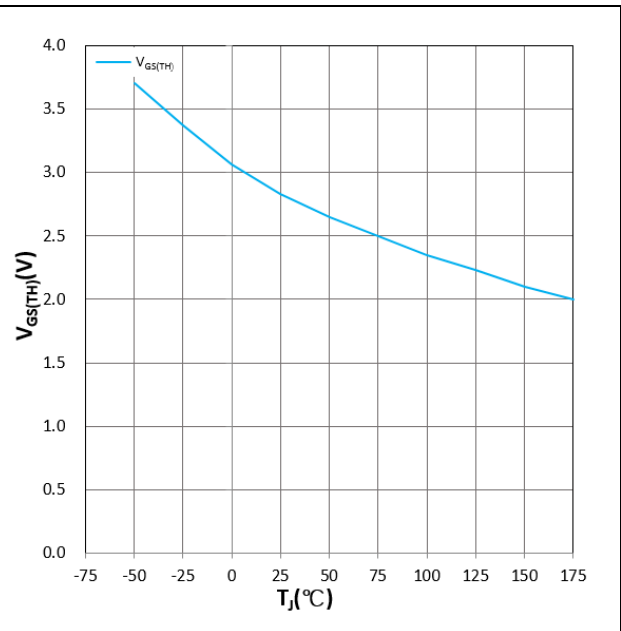


Figure 13.  $V_{GS(TH)}$  vs  $T_j$   
 $V_{DS} = V_{GS}, I_{DS} = 10mA$

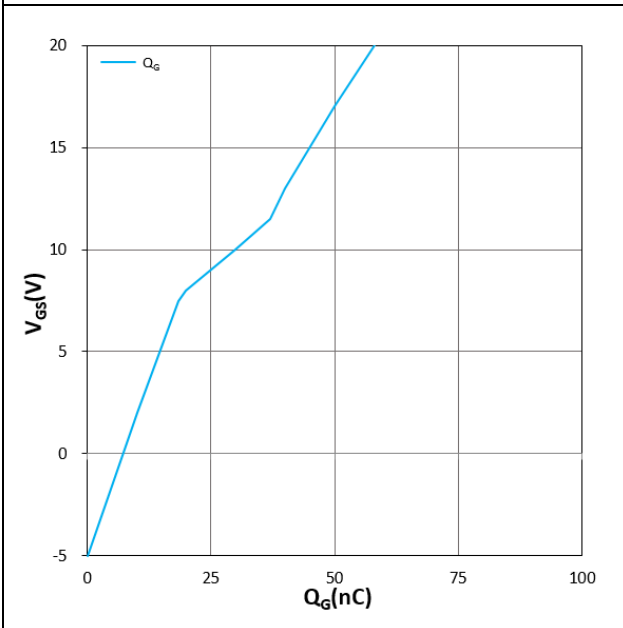


Figure 14.  $V_{GS}$  vs  $Q_G$   
 $V_{DD} = 800V, I_D = 20A$

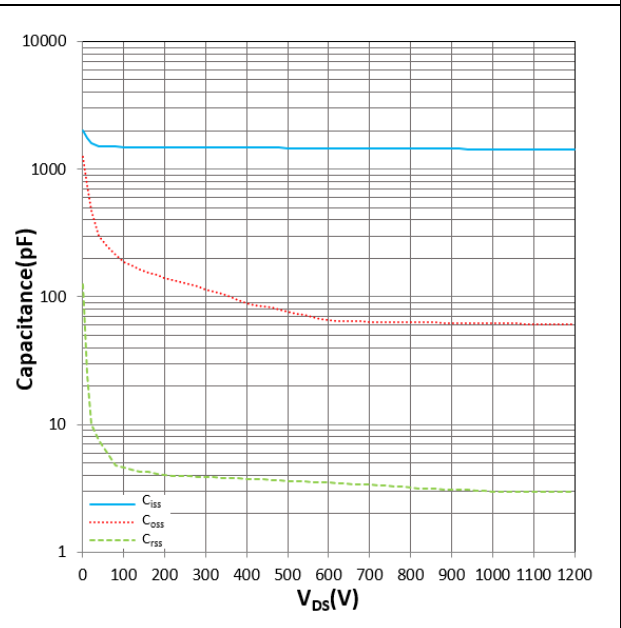
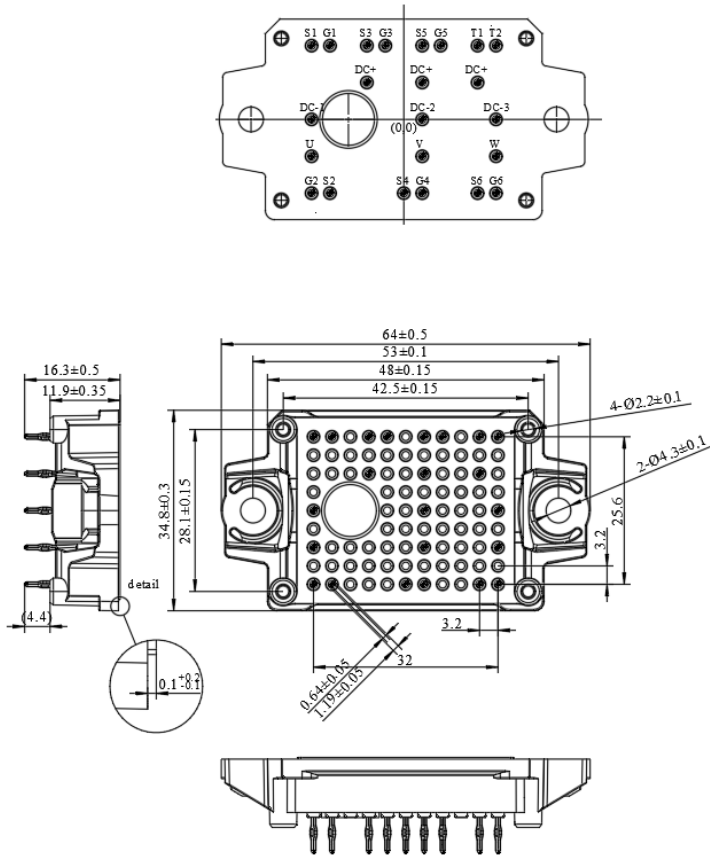


Figure 15.  $C_{iss}, C_{oss}, C_{rss}$  vs  $V_{DS}$   
 $T_j = 25^\circ C$



### Package dimensions



| Pin table |       |       |
|-----------|-------|-------|
| Pin       | X     | Y     |
| T2        | 16    | 12.8  |
| T1        | 12.8  | 12.8  |
| G5        | 6.4   | 12.8  |
| S5        | 3.2   | 12.8  |
| G3        | -3.2  | 12.8  |
| S3        | -6.4  | 12.8  |
| G1        | -12.8 | 12.8  |
| S1        | -16   | 12.8  |
| DC+       | 12.8  | 6.4   |
| DC+       | 3.2   | 6.4   |
| DC+       | -6.4  | 6.4   |
| DC-3      | 16    | 0     |
| DC-2      | 3.2   | 0     |
| DC-1      | -16   | 0     |
| W         | 16    | -6.4  |
| V         | 3.2   | -6.4  |
| U         | -16   | -6.4  |
| G6        | 16    | -12.8 |
| S6        | 12.8  | -12.8 |
| G4        | 3.2   | -12.8 |
| S4        | 0     | -12.8 |
| S2        | -12.8 | -12.8 |
| G2        | -16   | -12.8 |

### IMPORTANT NOTICE:

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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.

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