

## Preliminary datasheet

### EasyPACK™ module with CoolSiC™ Trench MOSFET and PressFIT / NTC

#### Features

- Electrical features
  - $V_{DS} = 1200\text{ V}$
  - $I_{DN} = 25\text{ A}$  /  $I_{DRM} = 50\text{ A}$
  - Low inductive design
  - Low switching losses
- Mechanical features
  - Rugged mounting due to integrated mounting clamps
  - PressFIT contact technology
  - Integrated NTC temperature sensor



Typical appearance

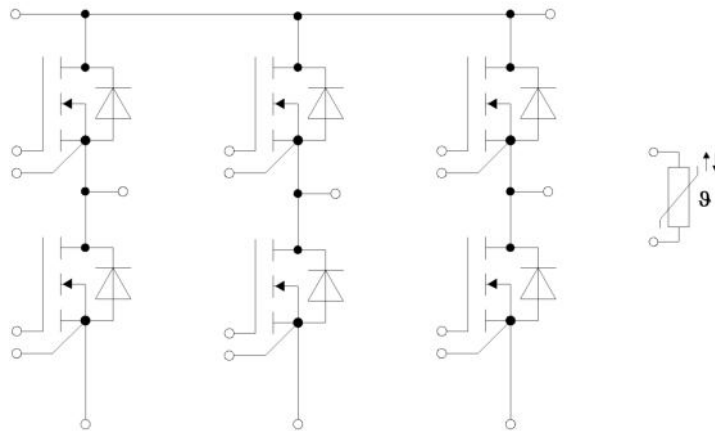
#### Potential applications

- High-frequency switching application
- DC/DC converter
- Motor drives
- UPS systems

#### Product validation

- Qualified for industrial applications according to the relevant tests of IEC 60747, 60749 and 60068

#### Description



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## 1 Package

**Table 1** Insulation coordination

| Parameter                           | Symbol      | Note or test condition                         | Values    | Unit |
|-------------------------------------|-------------|------------------------------------------------|-----------|------|
| Isolation test voltage              | $V_{ISOL}$  | RMS, $f = 50 \text{ Hz}$ , $t = 1 \text{ min}$ | 3.0       | kV   |
| Internal isolation                  |             | basic insulation (class 1, IEC 61140)          | $Al_2O_3$ |      |
| Creepage distance                   | $d_{Creep}$ | terminal to heatsink                           | 11.5      | mm   |
| Creepage distance                   | $d_{Creep}$ | terminal to terminal                           | 6.3       | mm   |
| Clearance                           | $d_{Clear}$ | terminal to heatsink                           | 10.0      | mm   |
| Clearance                           | $d_{Clear}$ | terminal to terminal                           | 5.0       | mm   |
| Comparative tracking index          | $CTI$       |                                                | > 200     |      |
| Relative thermal index (electrical) | $RTI$       | housing                                        | 140       | °C   |

**Table 2** Characteristic values

| Parameter                                | Symbol        | Note or test condition             | Values |      |      | Unit |
|------------------------------------------|---------------|------------------------------------|--------|------|------|------|
|                                          |               |                                    | Min.   | Typ. | Max. |      |
| Stray inductance module                  | $L_{SCE}$     |                                    |        | 18   |      | nH   |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_H = 25 \text{ °C}$ , per switch |        | 5.35 |      | mΩ   |
| Storage temperature                      | $T_{stg}$     |                                    | -40    |      | 125  | °C   |
| Mounting force per clamp                 | $F$           |                                    | 20     |      | 50   | N    |
| Weight                                   | $G$           |                                    |        | 24   |      | g    |

Note: The current under continuous operation is limited to 25 A rms per connector pin.

## 2 MOSFET

**Table 3** Maximum rated values

| Parameter                                   | Symbol    | Note or test condition                              |                          | Values | Unit |
|---------------------------------------------|-----------|-----------------------------------------------------|--------------------------|--------|------|
| Drain-source voltage                        | $V_{DSS}$ |                                                     | $T_{vj} = 25 \text{ °C}$ | 1200   | V    |
| Continuous DC drain current                 | $I_{DDC}$ | $T_{vj} = 175 \text{ °C}$ , $V_{GS} = 18 \text{ V}$ | $T_H = 85 \text{ °C}$    | 25     | A    |
| Repetitive peak drain current               | $I_{DRM}$ | verified by design, $t_p$ limited by $T_{vjmax}$    |                          | 50     | A    |
| Gate-source voltage, max. transient voltage | $V_{GS}$  | $D < 0.01$                                          |                          | -10/23 | V    |
| Gate-source voltage, max. static voltage    | $V_{GS}$  |                                                     |                          | -7/20  | V    |

**Table 4 Recommended values**

| Parameter              | Symbol        | Note or test condition | Values  | Unit |
|------------------------|---------------|------------------------|---------|------|
| On-state gate voltage  | $V_{GS(on)}$  |                        | 15...18 | V    |
| Off-state gate voltage | $V_{GS(off)}$ |                        | -5...0  | V    |

**Table 5 Characteristic values**

| Parameter                           | Symbol       | Note or test condition                                                                                             | Values                   |                                                |      | Unit |
|-------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------------------------|------|------|
|                                     |              |                                                                                                                    | Min.                     | Typ.                                           | Max. |      |
| Drain-source on-resistance          | $R_{DS(on)}$ | $I_D = 25\text{ A}$                                                                                                |                          | $V_{GS} = 18\text{ V}, T_{vj} = 25\text{ °C}$  | 32.3 | mΩ   |
|                                     |              |                                                                                                                    |                          | $V_{GS} = 18\text{ V}, T_{vj} = 125\text{ °C}$ | 52.2 |      |
|                                     |              |                                                                                                                    |                          | $V_{GS} = 18\text{ V}, T_{vj} = 175\text{ °C}$ | 69.4 |      |
|                                     |              |                                                                                                                    |                          | $V_{GS} = 15\text{ V}, T_{vj} = 25\text{ °C}$  | 38.8 |      |
| Gate threshold voltage              | $V_{GS(th)}$ | $I_D = 10\text{ mA}, V_{DS} = V_{GS}, T_{vj} = 25\text{ °C},$ (tested after 1ms pulse at $V_{GS} = +20\text{ V}$ ) | 3.45                     | 4.3                                            | 5.15 | V    |
| Total gate charge                   | $Q_G$        | $V_{DD} = 800\text{ V}, V_{GS} = -3/18\text{ V}$                                                                   |                          | 0.074                                          |      | μC   |
| Internal gate resistor              | $R_{Gint}$   | $T_{vj} = 25\text{ °C}$                                                                                            |                          | 8.2                                            |      | Ω    |
| Input capacitance                   | $C_{ISS}$    | $f = 100\text{ kHz}, V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_{vj} = 25\text{ °C}$                            |                          | 2.2                                            |      | nF   |
| Output capacitance                  | $C_{OSS}$    | $f = 100\text{ kHz}, V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_{vj} = 25\text{ °C}$                            |                          | 0.105                                          |      | nF   |
| Reverse transfer capacitance        | $C_{RSS}$    | $f = 100\text{ kHz}, V_{DS} = 800\text{ V}, V_{GS} = 0\text{ V}, T_{vj} = 25\text{ °C}$                            |                          | 0.007                                          |      | nF   |
| $C_{OSS}$ stored energy             | $E_{OSS}$    | $V_{DS} = 800\text{ V}, V_{GS} = -3/18\text{ V}, T_{vj} = 25\text{ °C}$                                            |                          | 43                                             |      | μJ   |
| Drain-source leakage current        | $I_{DSS}$    | $V_{DS} = 1200\text{ V}, V_{GS} = -3\text{ V}, T_{vj} = 25\text{ °C}$                                              |                          | 0.015                                          | 110  | μA   |
| Gate-source leakage current         | $I_{GSS}$    | $V_{DS} = 0\text{ V}, T_{vj} = 25\text{ °C}$                                                                       |                          |                                                | 400  | nA   |
| Turn-on delay time (inductive load) | $t_{don}$    | $I_D = 25\text{ A}, R_{Gon} = 8.2\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$                        | $T_{vj} = 25\text{ °C}$  | 37                                             |      | ns   |
|                                     |              |                                                                                                                    | $T_{vj} = 125\text{ °C}$ | 37                                             |      |      |
|                                     |              |                                                                                                                    | $T_{vj} = 175\text{ °C}$ | 37                                             |      |      |
| Rise time (inductive load)          | $t_r$        | $I_D = 25\text{ A}, R_{Gon} = 8.2\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$                        | $T_{vj} = 25\text{ °C}$  | 31                                             |      | ns   |
|                                     |              |                                                                                                                    | $T_{vj} = 125\text{ °C}$ | 32                                             |      |      |
|                                     |              |                                                                                                                    | $T_{vj} = 175\text{ °C}$ | 32                                             |      |      |

(table continues...)

**Table 5** (continued) **Characteristic values**

| Parameter                                 | Symbol       | Note or test condition                                                                                                                                         | Values                                        |       |      | Unit       |
|-------------------------------------------|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|-------|------|------------|
|                                           |              |                                                                                                                                                                | Min.                                          | Typ.  | Max. |            |
| Turn-off delay time<br>(inductive load)   | $t_{d\ off}$ | $I_D = 25\ A, R_{Goff} = 4.7\ \Omega,$<br>$V_{DD} = 600\ V, V_{GS} = -3/18\ V$                                                                                 | $T_{vj} = 25\ ^\circ C$                       | 58    |      | ns         |
|                                           |              |                                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                      | 65    |      |            |
|                                           |              |                                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                      | 67    |      |            |
| Fall time (inductive load)                | $t_f$        | $I_D = 25\ A, R_{Goff} = 4.7\ \Omega,$<br>$V_{DD} = 600\ V, V_{GS} = -3/18\ V$                                                                                 | $T_{vj} = 25\ ^\circ C$                       | 17    |      | ns         |
|                                           |              |                                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                      | 17    |      |            |
|                                           |              |                                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                      | 17    |      |            |
| Turn-on energy loss per pulse             | $E_{on}$     | $I_D = 25\ A, V_{DD} = 600\ V,$<br>$L_\sigma = 35\ nH, V_{GS} = -3/18\ V,$<br>$R_{Gon} = 8.2\ \Omega, di/dt = 1.88\ kA/\mu s$<br>( $T_{vj} = 175\ ^\circ C$ )  | $T_{vj} = 25\ ^\circ C$                       | 0.341 |      | mJ         |
|                                           |              |                                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                      | 0.418 |      |            |
|                                           |              |                                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                      | 0.471 |      |            |
| Turn-off energy loss per pulse            | $E_{off}$    | $I_D = 25\ A, V_{DD} = 600\ V,$<br>$L_\sigma = 35\ nH, V_{GS} = -3/18\ V,$<br>$R_{Goff} = 4.7\ \Omega, dv/dt = 28.2\ kV/\mu s$<br>( $T_{vj} = 175\ ^\circ C$ ) | $T_{vj} = 25\ ^\circ C$                       | 0.117 |      | mJ         |
|                                           |              |                                                                                                                                                                | $T_{vj} = 125\ ^\circ C$                      | 0.123 |      |            |
|                                           |              |                                                                                                                                                                | $T_{vj} = 175\ ^\circ C$                      | 0.127 |      |            |
| SC data                                   | $I_{SC}$     | $V_{GS} = -5/15\ V, V_{DD} = 800\ V,$<br>$V_{DSmax} = V_{DSS} - L_{SDS} \cdot di/dt,$<br>$R_G = 10\ \Omega$                                                    | $t_P = 2\ \mu s,$<br>$T_{vj} = 25\ ^\circ C$  | 210   |      | A          |
|                                           |              |                                                                                                                                                                | $t_P = 2\ \mu s,$<br>$T_{vj} = 150\ ^\circ C$ | 205   |      |            |
| Thermal resistance, junction to heat sink | $R_{thJH}$   | per MOSFET, $\lambda_{grease} = 1\ W/(m \cdot K)$                                                                                                              |                                               | 1.54  |      | K/W        |
| Temperature under switching conditions    | $T_{vj\ op}$ |                                                                                                                                                                | -40                                           |       | 175  | $^\circ C$ |

**Note:** The selection of positive and negative gate-source voltages impacts losses and the long-term behavior of the MOSFET and body diode. The design guidelines described in Application Notes AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.

$T_{vj,op} > 150\ ^\circ C$  is allowed for operation at overload conditions for MOSFET and body diode. For detailed specifications, please refer to AN 2021-13.

### 3 Body diode

**Table 6** **Maximum rated values**

| Parameter                     | Symbol   | Note or test condition                                           | Values | Unit |
|-------------------------------|----------|------------------------------------------------------------------|--------|------|
| DC body diode forward current | $I_{SD}$ | $T_{vj} = 175\ ^\circ C, V_{GS} = -3\ V$<br>$T_H = 85\ ^\circ C$ | 10     | A    |

**Table 7** Characteristic values

| Parameter       | Symbol   | Note or test condition                            | Values |      |      | Unit |
|-----------------|----------|---------------------------------------------------|--------|------|------|------|
|                 |          |                                                   | Min.   | Typ. | Max. |      |
| Forward voltage | $V_{SD}$ | $I_{SD} = 25 \text{ A}$ , $V_{GS} = -3 \text{ V}$ |        | 4.2  | 5.35 | V    |
|                 |          |                                                   |        | 3.9  |      |      |
|                 |          |                                                   |        | 3.8  |      |      |

## 4 NTC-Thermistor

**Table 8** Characteristic values

| Parameter              | Symbol       | Note or test condition                                        | Values |      |      | Unit |
|------------------------|--------------|---------------------------------------------------------------|--------|------|------|------|
|                        |              |                                                               | Min.   | Typ. | Max. |      |
| Rated resistance       | $R_{25}$     | $T_{NTC} = 25 \text{ °C}$                                     |        | 5    |      | kΩ   |
| Deviation of $R_{100}$ | $\Delta R/R$ | $T_{NTC} = 100 \text{ °C}$ , $R_{100} = 493 \text{ Ω}$        | -5     |      | 5    | %    |
| Power dissipation      | $P_{25}$     | $T_{NTC} = 25 \text{ °C}$                                     |        |      | 20   | mW   |
| B-value                | $B_{25/50}$  | $R_2 = R_{25} \exp[B_{25/50}(1/T_2 - 1/(298,15 \text{ K}))]$  |        | 3375 |      | K    |
| B-value                | $B_{25/80}$  | $R_2 = R_{25} \exp[B_{25/80}(1/T_2 - 1/(298,15 \text{ K}))]$  |        | 3411 |      | K    |
| B-value                | $B_{25/100}$ | $R_2 = R_{25} \exp[B_{25/100}(1/T_2 - 1/(298,15 \text{ K}))]$ |        | 3433 |      | K    |

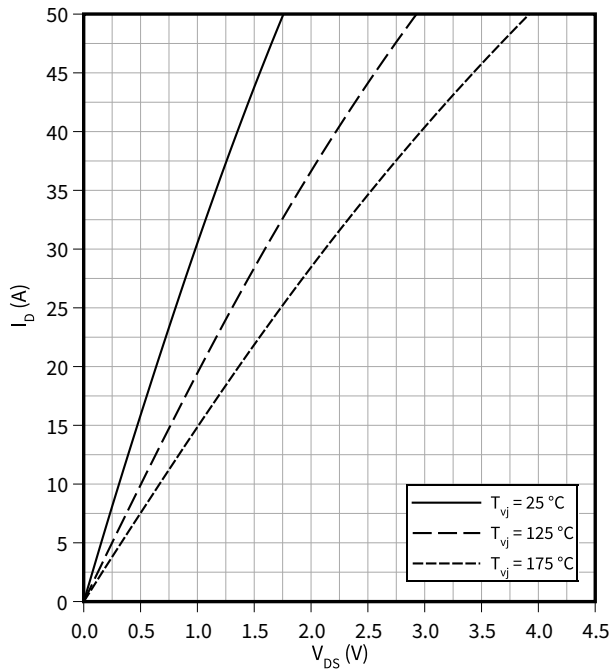
Note: Specification according to the valid application note.

5 Characteristics diagrams

output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

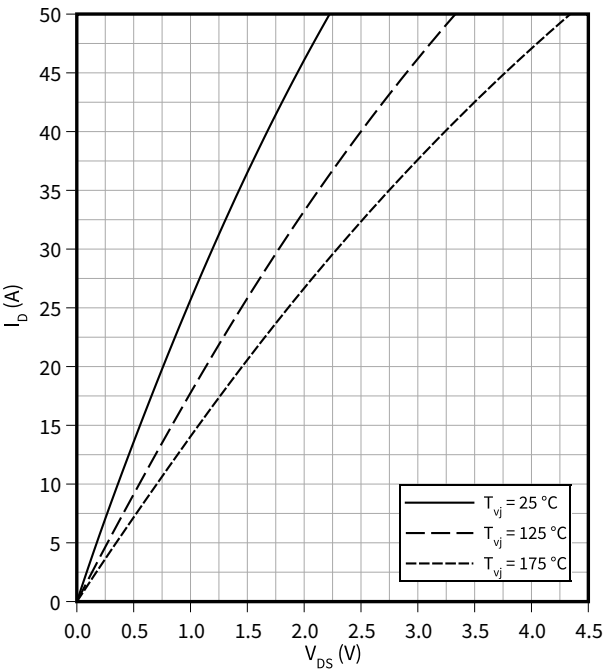
$V_{GS} = 18\text{ V}$



output characteristic (typical), MOSFET

$I_D = f(V_{DS})$

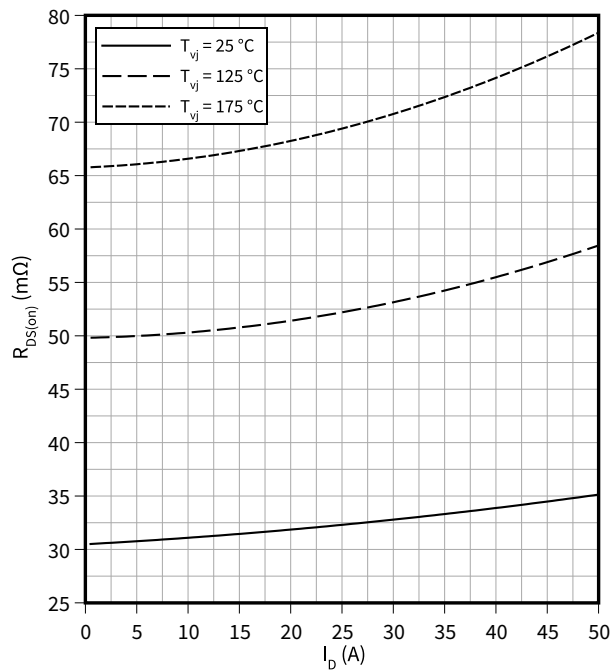
$V_{GS} = 15\text{ V}$



Drain source on-resistance (typical), MOSFET

$R_{DS(on)} = f(I_D)$

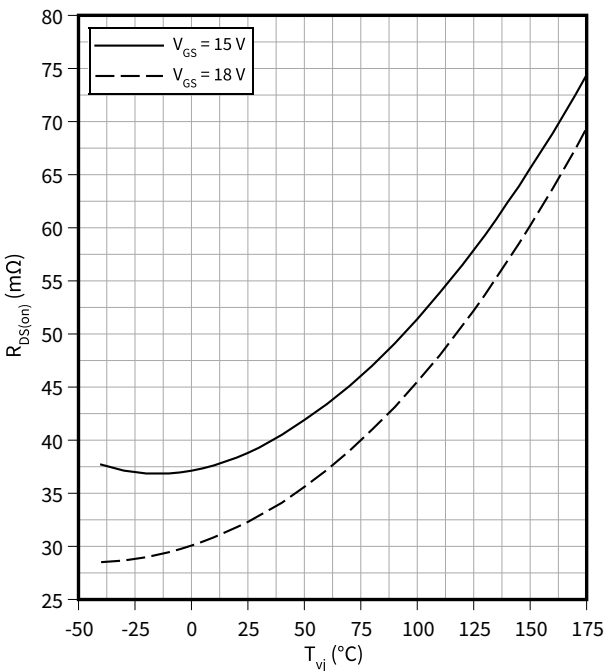
$V_{GS} = 18\text{ V}$



Drain source on-resistance (typical), MOSFET

$R_{DS(on)} = f(T_{vj})$

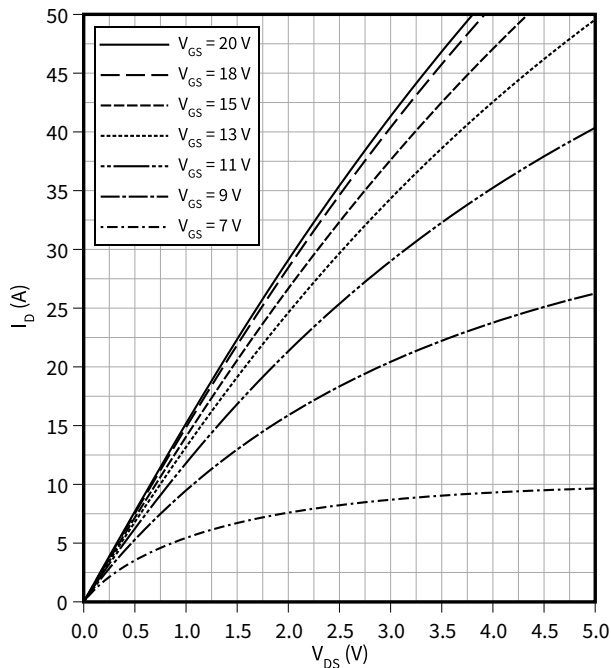
$I_D = 25\text{ A}$



5 Characteristics diagrams

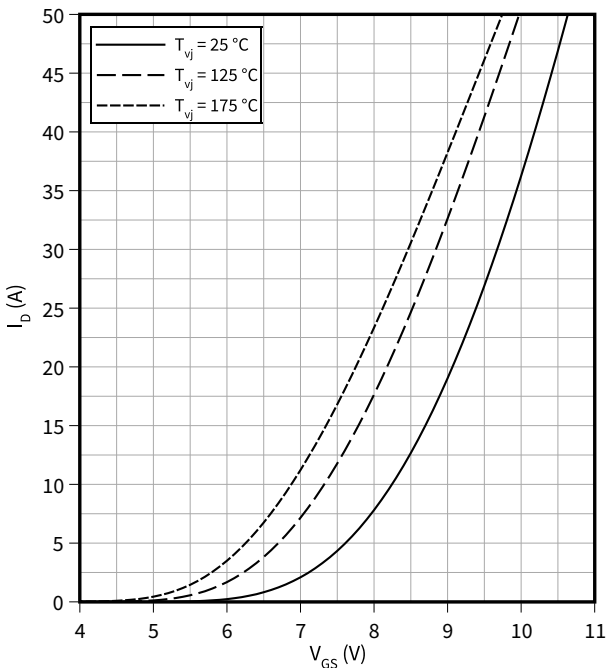
Output characteristic field (typical), MOSFET

$I_D = f(V_{DS})$   
 $T_{vj} = 175\text{ °C}$



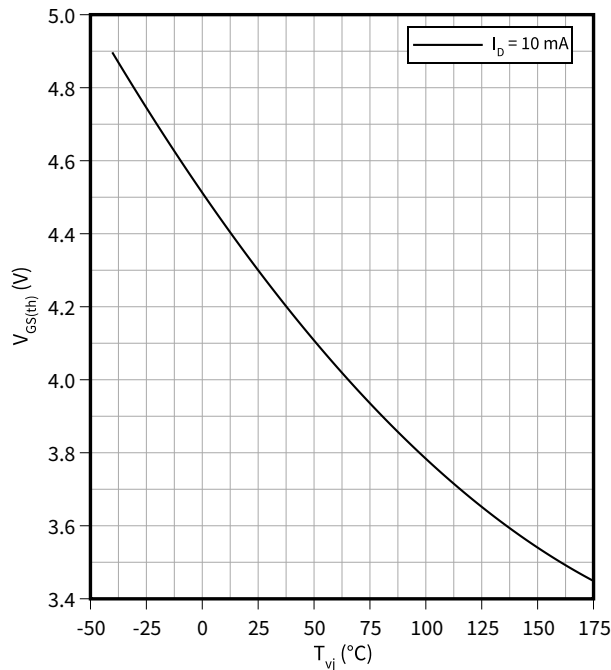
Transfer characteristic (typical), MOSFET

$I_D = f(V_{GS})$   
 $V_{DS} = 20\text{ V}$



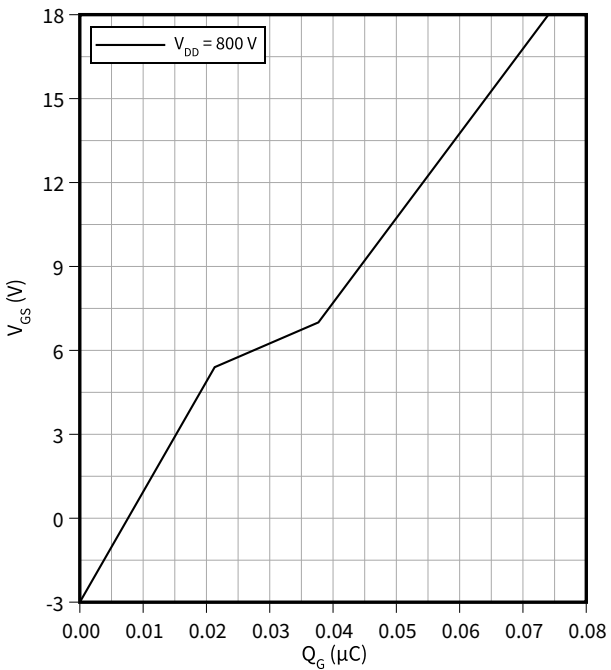
Gate-source threshold voltage (typical), MOSFET

$V_{GS(th)} = f(T_{vj})$   
 $V_{GS} = V_{DS}$



Gate charge characteristic (typical), MOSFET

$V_{GS} = f(Q_G)$   
 $I_D = 25\text{ A}, T_{vj} = 25\text{ °C}$

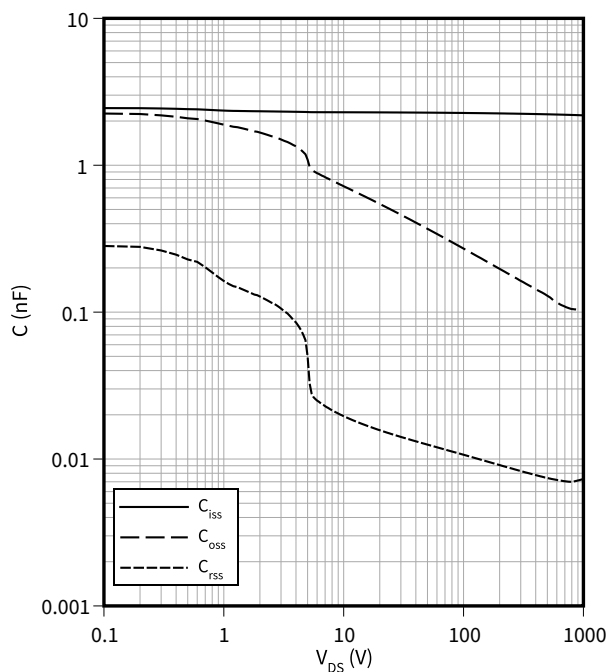


5 Characteristics diagrams

**Capacity characteristic (typical), MOSFET**

$$C = f(V_{DS})$$

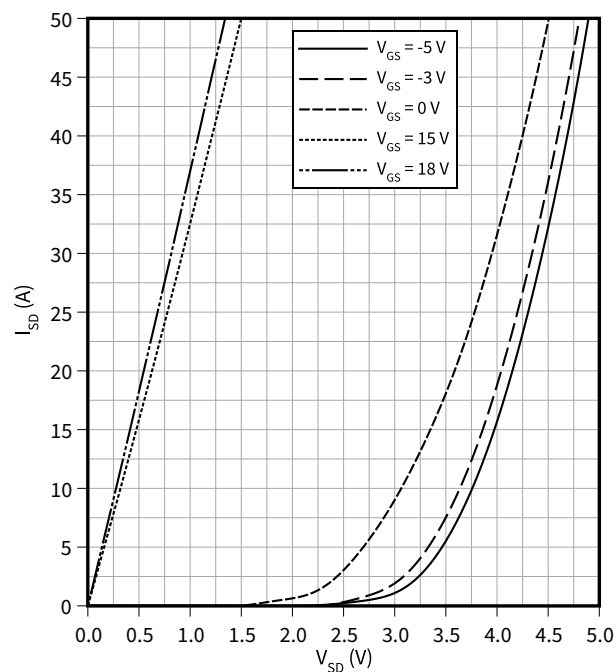
$T_{vj} = 25\text{ °C}$ ,  $f = 100\text{ kHz}$ ,  $V_{GS} = 0\text{ V}$



**Forward characteristic body diode (typical), MOSFET**

$$I_{SD} = f(V_{SD})$$

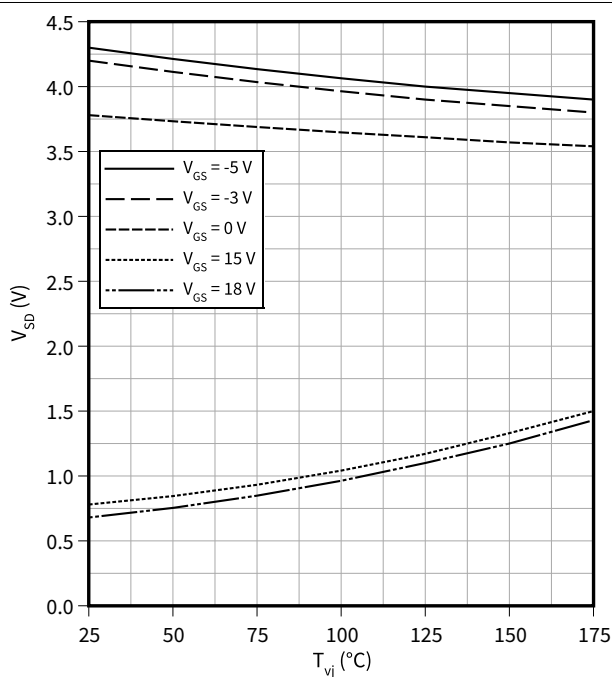
$T_{vj} = 25\text{ °C}$



**Forward voltage of body diode (typical), MOSFET**

$$V_{SD} = f(T_{vj})$$

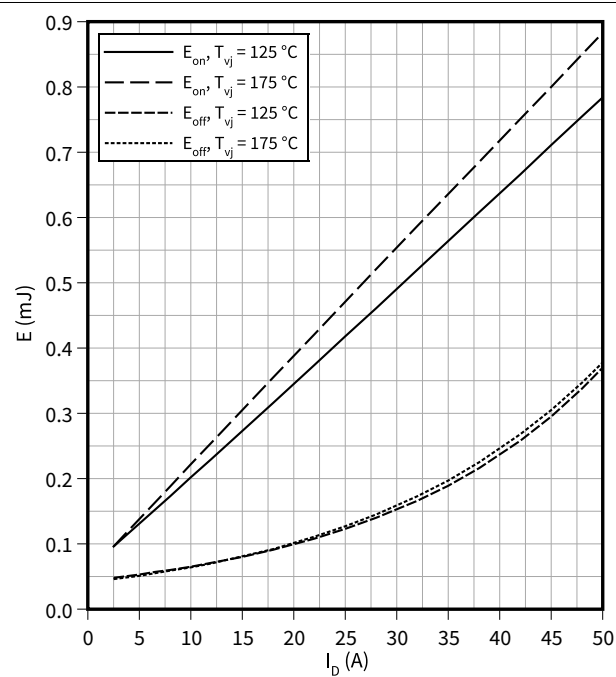
$I_{SD} = 25\text{ A}$



**Switching losses (typical), MOSFET**

$$E = f(I_D)$$

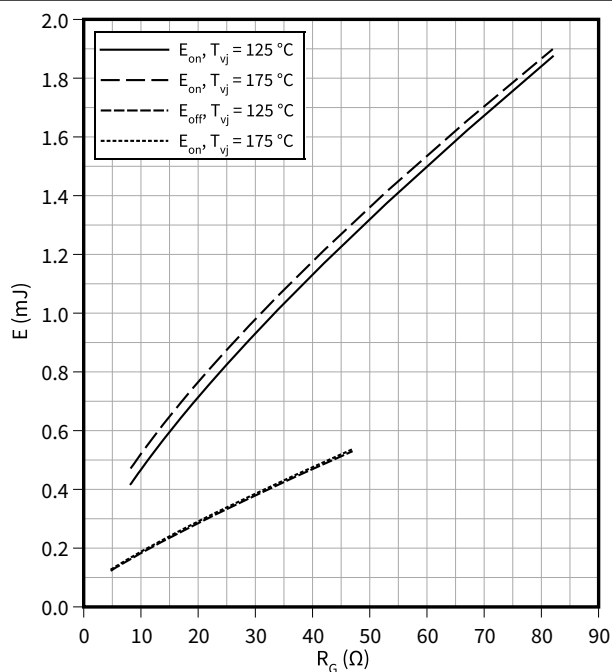
$R_{Goff} = 4.7\text{ }\Omega$ ,  $R_{Gon} = 8.2\text{ }\Omega$ ,  $V_{DD} = 600\text{ V}$ ,  $V_{GS} = -3/18\text{ V}$



### Switching losses (typical), MOSFET

$$E = f(R_G)$$

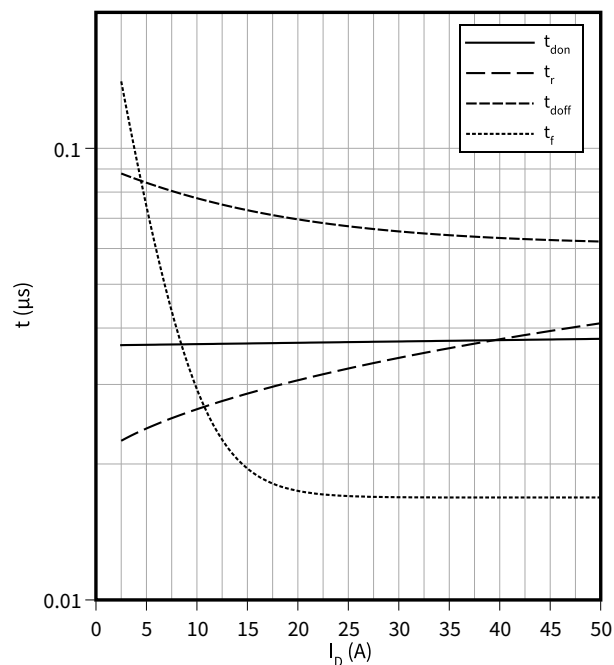
$V_{DD} = 600 \text{ V}$ ,  $I_D = 25 \text{ A}$ ,  $V_{GS} = -3/18 \text{ V}$



### Switching times (typical), MOSFET

$$t = f(I_D)$$

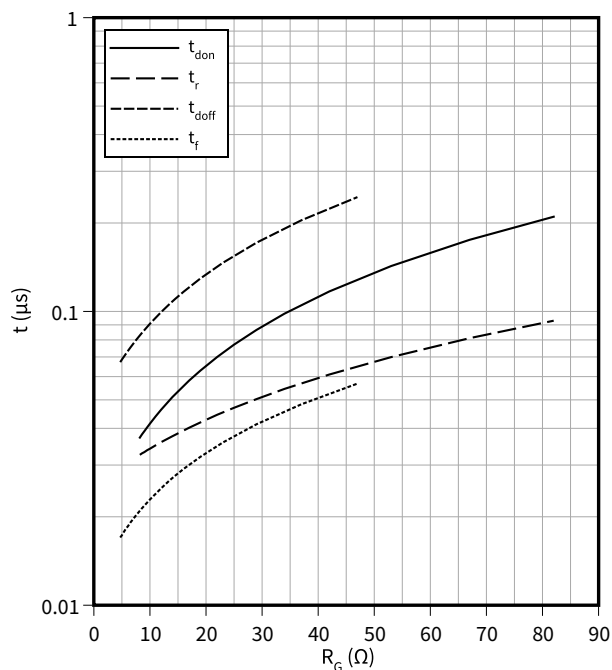
$R_{Goff} = 4.7 \text{ } \Omega$ ,  $R_{Gon} = 8.2 \text{ } \Omega$ ,  $V_{DD} = 600 \text{ V}$ ,  $T_{vj} = 175 \text{ } ^\circ\text{C}$ ,  $V_{GS} = -3/18 \text{ V}$



### Switching times (typical), MOSFET

$$t = f(R_G)$$

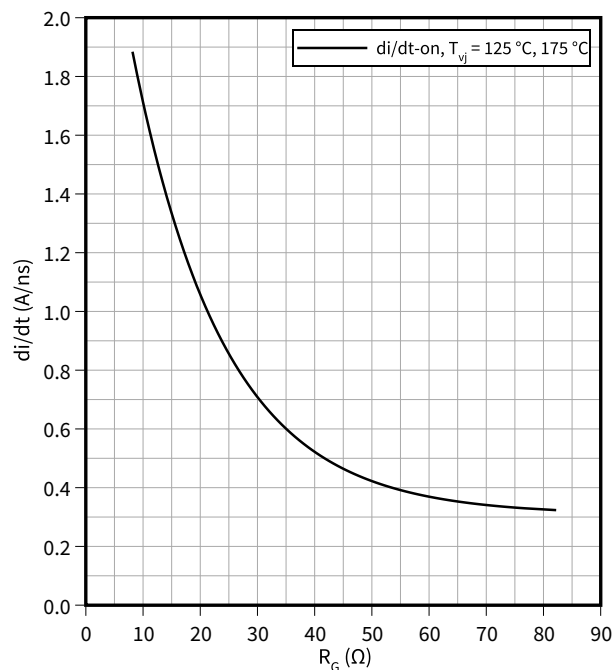
$V_{DD} = 600 \text{ V}$ ,  $I_D = 25 \text{ A}$ ,  $T_{vj} = 175 \text{ } ^\circ\text{C}$ ,  $V_{GS} = -3/18 \text{ V}$



### Current slope (typical), MOSFET

$$di/dt = f(R_G)$$

$V_{DD} = 600 \text{ V}$ ,  $I_D = 25 \text{ A}$ ,  $V_{GS} = -3/18 \text{ V}$

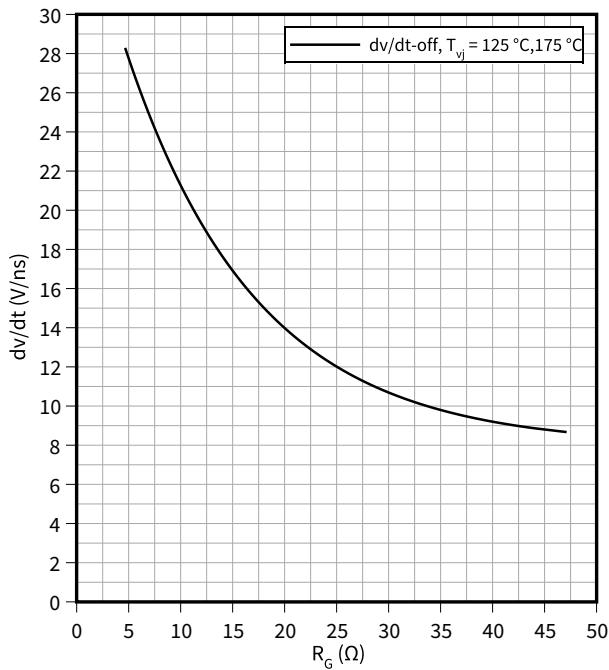


5 Characteristics diagrams

Voltage slope (typical), MOSFET

$dv/dt = f(R_G)$

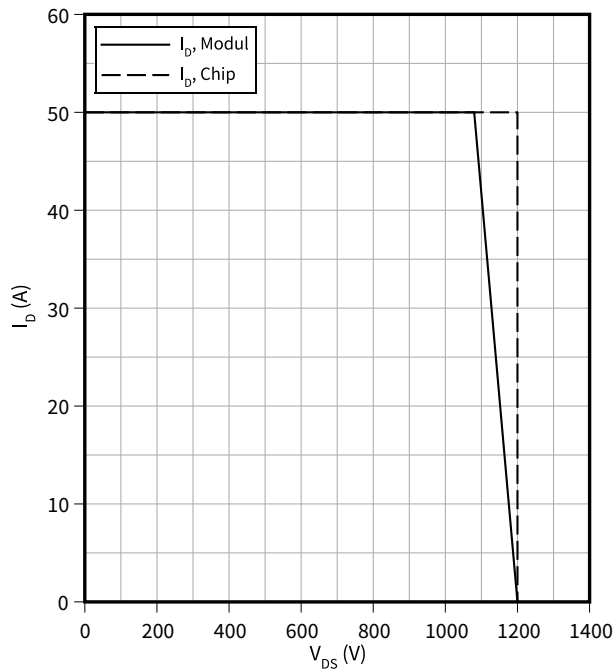
$V_{DD} = 600\text{ V}, I_D = 25\text{ A}, V_{GS} = -3/18\text{ V}$



Reverse bias safe operating area (RBSOA), MOSFET

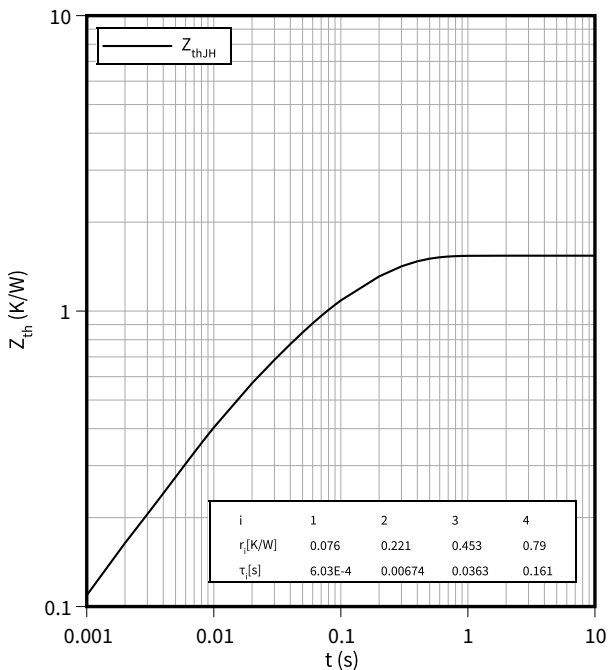
$I_D = f(V_{DS})$

$R_{Goff} = 4.7\text{ Ω}, T_{vj} = 175\text{ °C}, V_{GS} = -3/18\text{ V}$



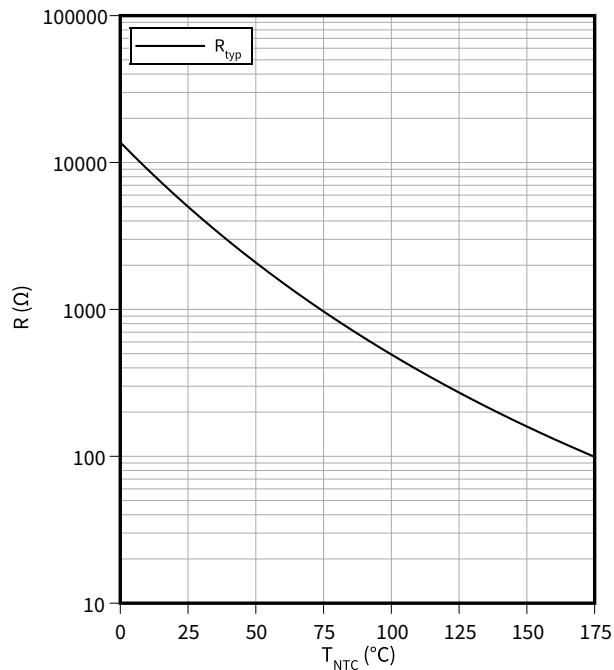
Transient thermal impedance, MOSFET

$Z_{th} = f(t)$

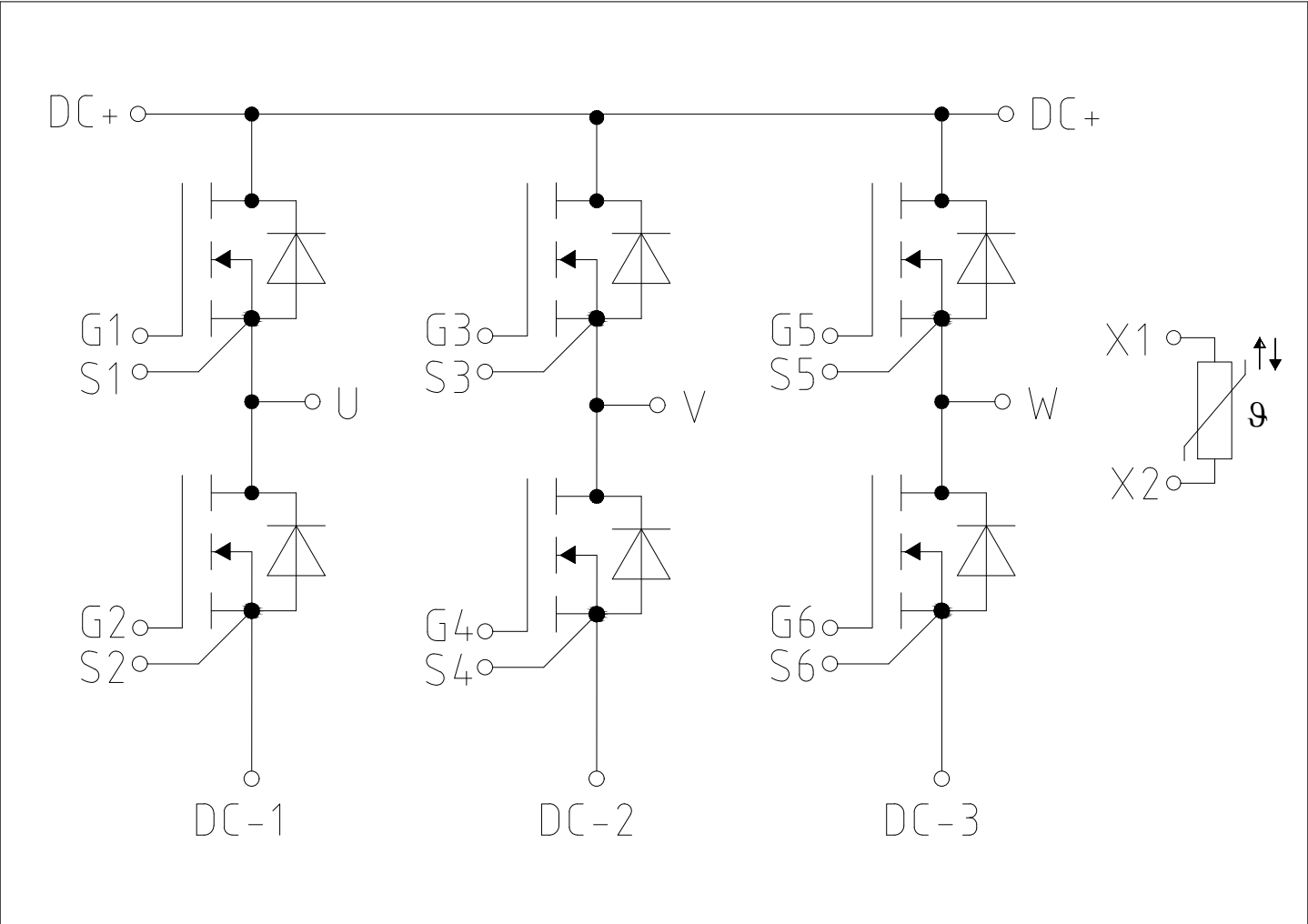


Temperature characteristic (typical), NTC-Thermistor

$R = f(T_{NTC})$



6      **Circuit diagram**



**Figure 1**

7 Package outlines

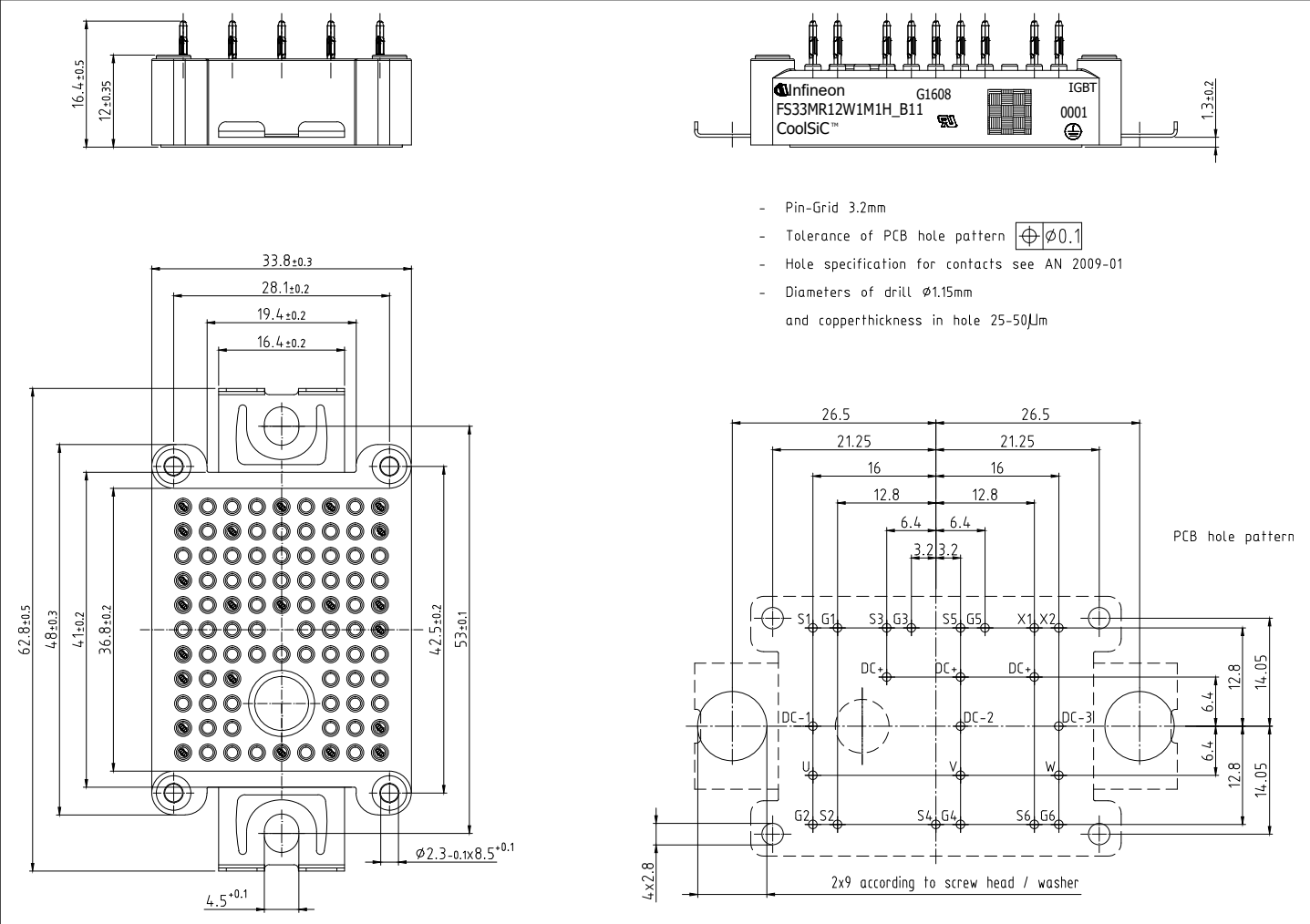


Figure 2

8 Module label code

| Module label code       |                                                                                     |                         |                 |
|-------------------------|-------------------------------------------------------------------------------------|-------------------------|-----------------|
| Code format             | Data Matrix                                                                         |                         | Barcode Code128 |
| Encoding                | ASCII text                                                                          |                         | Code Set A      |
| Symbol size             | 16x16                                                                               |                         | 23 digits       |
| Standard                | IEC24720 and IEC16022                                                               |                         | IEC8859-1       |
| Code content            | <i>Content</i>                                                                      | <i>Digit</i>            | <i>Example</i>  |
|                         | Module serial number                                                                | 1 – 5                   | 71549           |
|                         | Module material number                                                              | 6 - 11                  | 142846          |
|                         | Production order number                                                             | 12 - 19                 | 55054991        |
|                         | Date code (production year)                                                         | 20 – 21                 | 15              |
|                         | Date code (production week)                                                         | 22 – 23                 | 30              |
| Example                 |   |                         |                 |
|                         |  |                         |                 |
| 71549142846550549911530 |                                                                                     | 71549142846550549911530 |                 |

Figure 3

## Revision history

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|------------------------|
| 0.10              | 2022-07-29      | Initial version        |
| 0.20              | 2022-12-06      | Preliminary datasheet  |

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