

**Preliminary datasheet****EasyPACK™ module with CoolSiC™ Trench MOSFET and PressFIT / NTC****Features**

- Electrical features
  - $V_{DS} = 1200\text{ V}$
  - $I_{DN} = 75\text{ A} / I_{DRM} = 150\text{ A}$
  - Low inductive design
  - Low switching losses
  - High current density
- Mechanical features
  - PressFIT contact technology
  - Integrated NTC temperature sensor
  - Rugged mounting due to integrated mounting clamps
  - AlN substrate with low thermal resistance

**Potential applications**

- High-frequency switching application
- DC/DC converter
- UPS systems
- DC charger for EV

**Product validation**

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

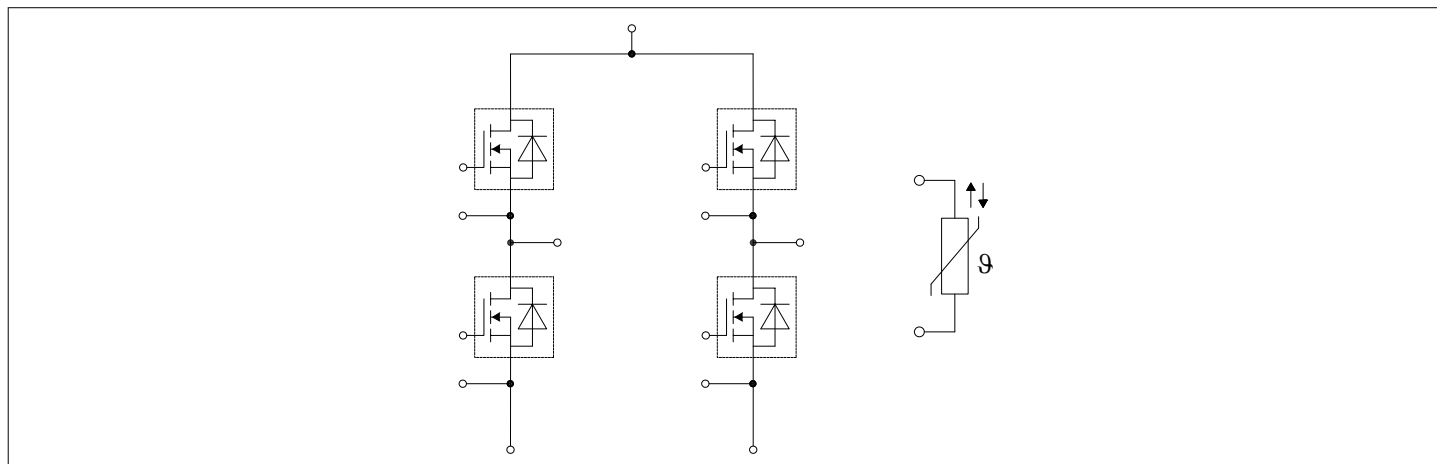
**Description**

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## 1 Package

**Table 1** Insulation coordination

| Parameter                           | Symbol     | Note or test condition                | Values | Unit |
|-------------------------------------|------------|---------------------------------------|--------|------|
| Isolation test voltage              | $V_{ISOL}$ | RMS, $f = 50$ Hz, $t = 1$ min         | 3.0    | kV   |
| Internal isolation                  |            | basic insulation (class 1, IEC 61140) | AlN    |      |
| 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                  | $L_{sCE}$     |                           |        | 9    |      | nH   |
| Module lead resistance, terminals - chip | $R_{CC'+EE'}$ | $T_H = 25$ °C, per switch |        | 2.2  |      | mΩ   |
| Storage temperature                      | $T_{stg}$     |                           | -40    |      | 125  | °C   |
| Mounting force per clamp                 | $F$           |                           | 40     |      | 80   | N    |
| Weight                                   | $G$           |                           |        | 39   |      | 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                        | $V_{DSS}$ |                                                  | $T_{vj} = 25$ °C | 1200   | V    |
| Continuous DC drain current                 | $I_{DDC}$ | $T_{vj} = 175$ °C, $V_{GS} = 18$ V               | $T_H = 100$ °C   | 75     | A    |
| Repetitive peak drain current               | $I_{DRM}$ | verified by design, $t_p$ limited by $T_{vjmax}$ |                  | 150    | 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           | $R_{DS(on)}$ | $I_D = 75\text{ A}$                                                                                                | $V_{GS}=18\text{ V}, T_{vj}=25\text{ °C}$     |        | 10.8  |      | mΩ   |
|                                      |              |                                                                                                                    | $V_{GS}=18\text{ V}, T_{vj}=125\text{ °C}$    |        | 17.4  |      |      |
|                                      |              |                                                                                                                    | $V_{GS}=18\text{ V}, T_{vj}=150\text{ °C}$    |        | 20.1  |      |      |
|                                      |              |                                                                                                                    | $V_{GS} = 15\text{ V}, T_{vj} = 25\text{ °C}$ |        | 12.9  |      |      |
| Gate threshold voltage               | $V_{GS(th)}$ | $I_D = 30\text{ mA}, V_{DS} = V_{GS}, T_{vj} = 25\text{ °C},$ (tested after 1ms pulse at $V_{GS} = +20\text{ V}$ ) |                                               | 3.45   | 4.3   | 5.15 | V    |
| Total gate charge                    | $Q_G$        | $V_{DD}=800\text{ V}, V_{GS} = -3/18\text{ V}$                                                                     |                                               |        | 0.223 |      | μC   |
| Internal gate resistor               | $R_{Gint}$   | $T_{vj}=25\text{ °C}$                                                                                              |                                               |        | 2.7   |      | Ω    |
| Input capacitance                    | $C_{ISS}$    | $f = 100\text{ kHz}, V_{DS}=800\text{ V}, V_{GS}=0\text{ V}$                                                       | $T_{vj}=25\text{ °C}$                         |        | 6.6   |      | nF   |
| Output capacitance                   | $C_{OSS}$    | $f = 100\text{ kHz}, V_{DS}=800\text{ V}, V_{GS}=0\text{ V}$                                                       | $T_{vj}=25\text{ °C}$                         |        | 0.315 |      | nF   |
| Reverse transfer capacitance         | $C_{rss}$    | $f = 100\text{ kHz}, V_{DS}=800\text{ V}, V_{GS}=0\text{ V}$                                                       | $T_{vj}=25\text{ °C}$                         |        | 0.021 |      | nF   |
| $C_{OSS}$ stored energy              | $E_{OSS}$    | $V_{DS}=800\text{ V}, V_{GS} = -3/18\text{ V}, T_{vj} = 25\text{ °C}$                                              |                                               |        | 129   |      | μJ   |
| Drain-source leakage current         | $I_{DSS}$    | $V_{DS} = 1200\text{ V}, V_{GS} = -3\text{ V}$                                                                     | $T_{vj} = 25\text{ °C}$                       |        | 0.045 | 300  | μA   |
| Gate-source leakage current          | $I_{GSS}$    | $V_{DS} = 0\text{ V}, T_{vj} = 25\text{ °C}$                                                                       | $V_{GS}=20\text{ V}$                          |        |       | 400  | nA   |
| Turn-on delay time (inductive load)  | $t_{d\ on}$  | $I_D = 75\text{ A}, R_{Gon} = 6.2\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$                        | $T_{vj} = 25\text{ °C}$                       |        | 43    |      | ns   |
|                                      |              |                                                                                                                    | $T_{vj} = 125\text{ °C}$                      |        | 43    |      |      |
|                                      |              |                                                                                                                    | $T_{vj} = 150\text{ °C}$                      |        | 43    |      |      |
| Rise time (inductive load)           | $t_r$        | $I_D = 75\text{ A}, R_{Gon} = 6.2\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$                        | $T_{vj} = 25\text{ °C}$                       |        | 53    |      | ns   |
|                                      |              |                                                                                                                    | $T_{vj} = 125\text{ °C}$                      |        | 53    |      |      |
|                                      |              |                                                                                                                    | $T_{vj} = 150\text{ °C}$                      |        | 53    |      |      |
| Turn-off delay time (inductive load) | $t_{d\ off}$ | $I_D = 75\text{ A}, R_{Goff} = 3.9\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$                       | $T_{vj} = 25\text{ °C}$                       |        | 80    |      | ns   |
|                                      |              |                                                                                                                    | $T_{vj} = 125\text{ °C}$                      |        | 87    |      |      |
|                                      |              |                                                                                                                    | $T_{vj} = 150\text{ °C}$                      |        | 89    |      |      |
| Fall time (inductive load)           | $t_f$        | $I_D = 75\text{ A}, R_{Goff} = 3.9\text{ Ω}, V_{DD} = 600\text{ V}, V_{GS} = -3/18\text{ V}$                       | $T_{vj} = 25\text{ °C}$                       |        | 23    |      | ns   |
|                                      |              |                                                                                                                    | $T_{vj} = 125\text{ °C}$                      |        | 23    |      |      |
|                                      |              |                                                                                                                    | $T_{vj} = 150\text{ °C}$                      |        | 23    |      |      |

(table continues...)

**Table 5** (continued) Characteristic values

| Parameter                                 | Symbol             | Note or test condition                                                                                                                                                                                                      | Values                               |       |      | Unit             |
|-------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|-------|------|------------------|
|                                           |                    |                                                                                                                                                                                                                             | Min.                                 | Typ.  | Max. |                  |
| Turn-on energy loss per pulse             | $E_{on}$           | $I_D = 75\text{ A}$ , $V_{DD} = 600\text{ V}$ ,<br>$L_\sigma = 3\text{ nH}$ , $V_{GS} = -3/18\text{ V}$ ,<br>$R_{Gon} = 6.2\text{ }\Omega$ , $di/dt = 3.98\text{ kA}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ )  | $T_{vj} = 25\text{ }^\circ\text{C}$  | 1.49  |      | mJ               |
|                                           |                    |                                                                                                                                                                                                                             | $T_{vj} = 125\text{ }^\circ\text{C}$ | 1.61  |      |                  |
|                                           |                    |                                                                                                                                                                                                                             | $T_{vj} = 150\text{ }^\circ\text{C}$ | 1.67  |      |                  |
| Turn-off energy loss per pulse            | $E_{off}$          | $I_D = 75\text{ A}$ , $V_{DD} = 600\text{ V}$ ,<br>$L_\sigma = 3\text{ nH}$ , $V_{GS} = -3/18\text{ V}$ ,<br>$R_{Goff} = 3.9\text{ }\Omega$ , $dv/dt = 20.9\text{ kV}/\mu\text{s}$ ( $T_{vj} = 150\text{ }^\circ\text{C}$ ) | $T_{vj} = 25\text{ }^\circ\text{C}$  | 0.496 |      | mJ               |
|                                           |                    |                                                                                                                                                                                                                             | $T_{vj} = 125\text{ }^\circ\text{C}$ | 0.536 |      |                  |
|                                           |                    |                                                                                                                                                                                                                             | $T_{vj} = 150\text{ }^\circ\text{C}$ | 0.566 |      |                  |
| Thermal resistance, junction to heat sink | $R_{thJH}$         | per MOSFET, $\lambda_{grease} = 1\text{ W}/(\text{m}\cdot\text{K})$                                                                                                                                                         |                                      | 0.423 |      | K/W              |
| Temperature under switching conditions    | $T_{vj\text{ op}}$ |                                                                                                                                                                                                                             | -40                                  |       | 150  | $^\circ\text{C}$ |

*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 Note AN 2018-09 and AN 2021-13 must be considered to ensure sound operation of the device over the planned lifetime.*

### 3 Body diode (MOSFET)

**Table 6** Maximum rated values

| Parameter                     | Symbol   | Note or test condition                                                                             | Values | Unit |
|-------------------------------|----------|----------------------------------------------------------------------------------------------------|--------|------|
| DC body diode forward current | $I_{SD}$ | $T_{vj} = 175\text{ }^\circ\text{C}$ , $V_{GS} = -3\text{ V}$<br>$T_H = 100\text{ }^\circ\text{C}$ | 40     | A    |

**Table 7** Characteristic values

| Parameter       | Symbol   | Note or test condition                          | Values                               |      |      | Unit |
|-----------------|----------|-------------------------------------------------|--------------------------------------|------|------|------|
|                 |          |                                                 | Min.                                 | Typ. | Max. |      |
| Forward voltage | $V_{SD}$ | $I_{SD} = 75\text{ A}$ , $V_{GS} = -3\text{ V}$ | $T_{vj} = 25\text{ }^\circ\text{C}$  | 4.2  | 5.35 | V    |
|                 |          |                                                 | $T_{vj} = 125\text{ }^\circ\text{C}$ | 3.9  |      |      |
|                 |          |                                                 | $T_{vj} = 150\text{ }^\circ\text{C}$ | 3.85 |      |      |

### 4 NTC-Thermistor

**Table 8** Characteristic values

| Parameter              | Symbol       | Note or test condition                                                | Values |      |      | Unit       |
|------------------------|--------------|-----------------------------------------------------------------------|--------|------|------|------------|
|                        |              |                                                                       | Min.   | Typ. | Max. |            |
| Rated resistance       | $R_{25}$     | $T_{NTC} = 25\text{ }^\circ\text{C}$                                  |        | 5    |      | k $\Omega$ |
| Deviation of $R_{100}$ | $\Delta R/R$ | $T_{NTC} = 100\text{ }^\circ\text{C}$ , $R_{100} = 493\text{ }\Omega$ | -5     |      | 5    | %          |

(table continues...)

**Table 8** (continued) Characteristic values

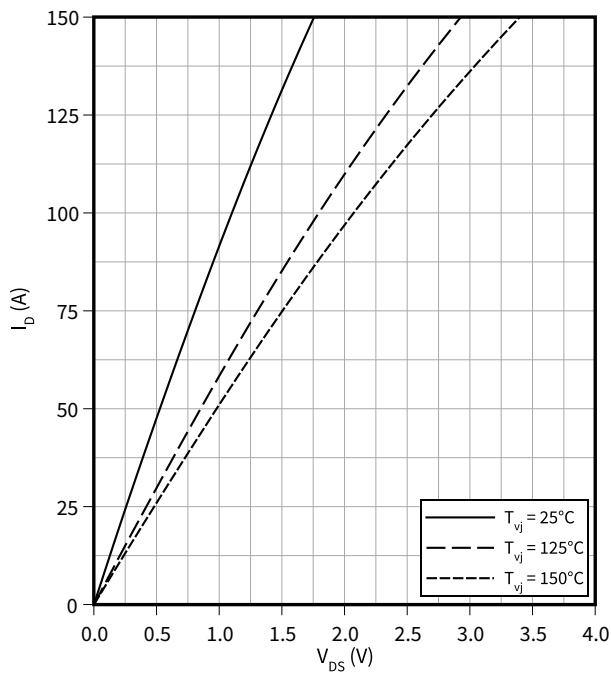
| Parameter         | Symbol       | Note or test condition                                       | Values |      |      | Unit |
|-------------------|--------------|--------------------------------------------------------------|--------|------|------|------|
|                   |              |                                                              | Min.   | Typ. | Max. |      |
| 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:* For an analytical description of the NTC characteristics please refer to AN2009-10, chapter 4.

5 Characteristics diagrams

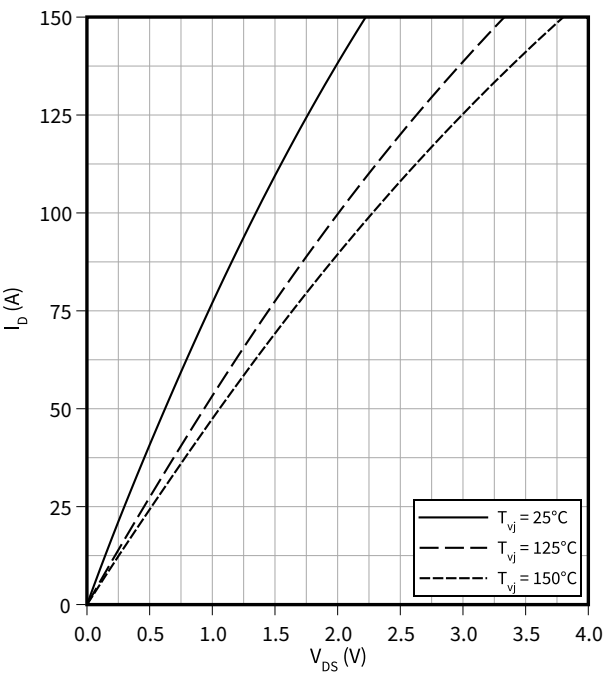
Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$   
 $V_{GS} = 18\text{ V}$



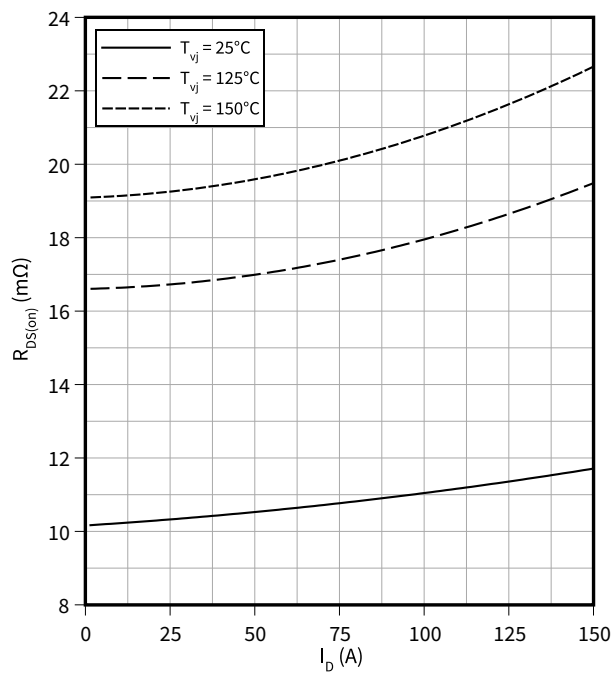
Output characteristic (typical), MOSFET

$I_D = f(V_{DS})$   
 $V_{GS} = 15\text{ V}$



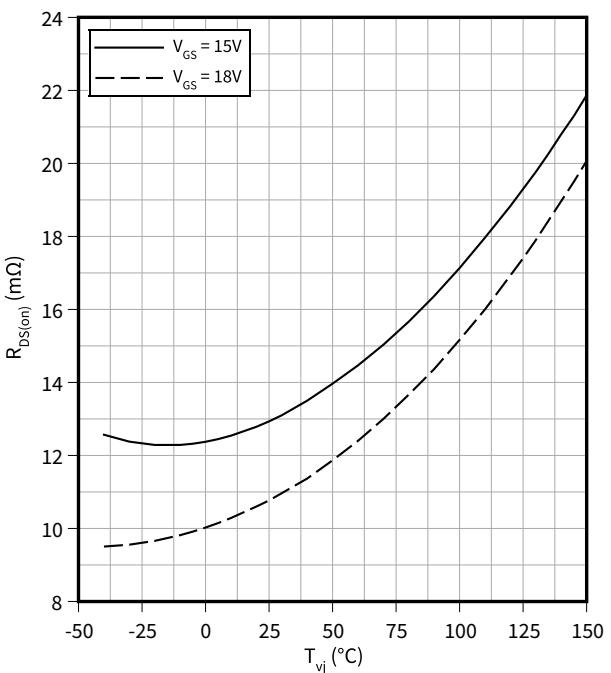
Drain source on-resistance (typical), MOSFET

$R_{DS(on)} = f(I_D)$   
 $V_{GS} = 18\text{ V}$



Drain source on-resistance (typical), MOSFET

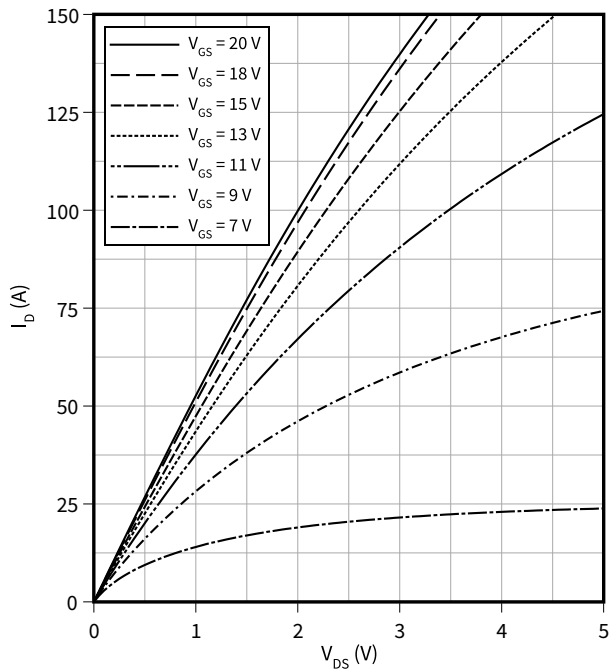
$R_{DS(on)} = f(T_{vj})$   
 $I_D = 75\text{ A}$



5 Characteristics diagrams

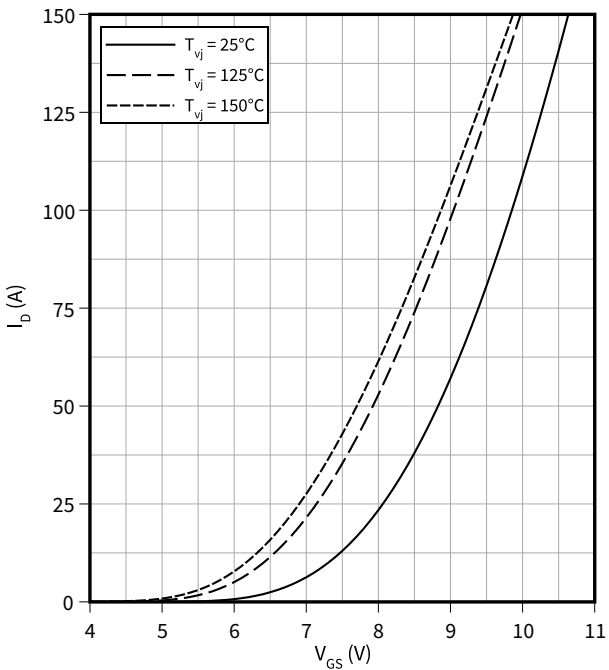
Output characteristic field (typical), MOSFET

$I_D = f(V_{DS})$   
 $T_{vj} = 150\text{ °C}$



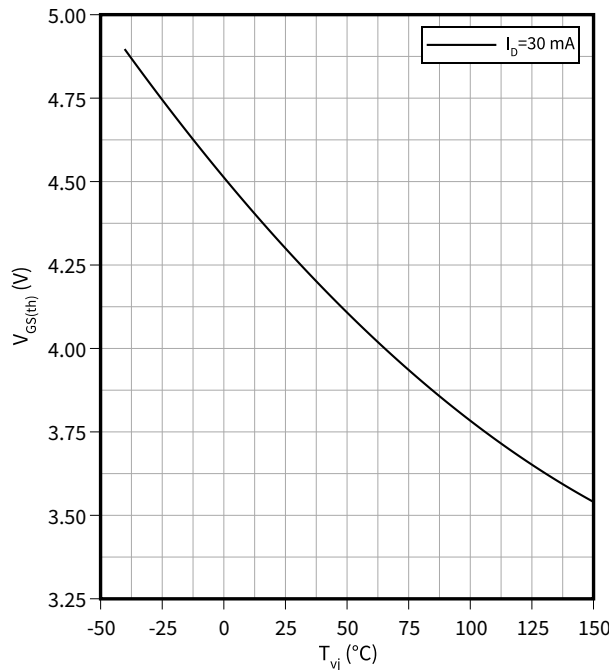
Transfer characteristic (typical), MOSFET

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



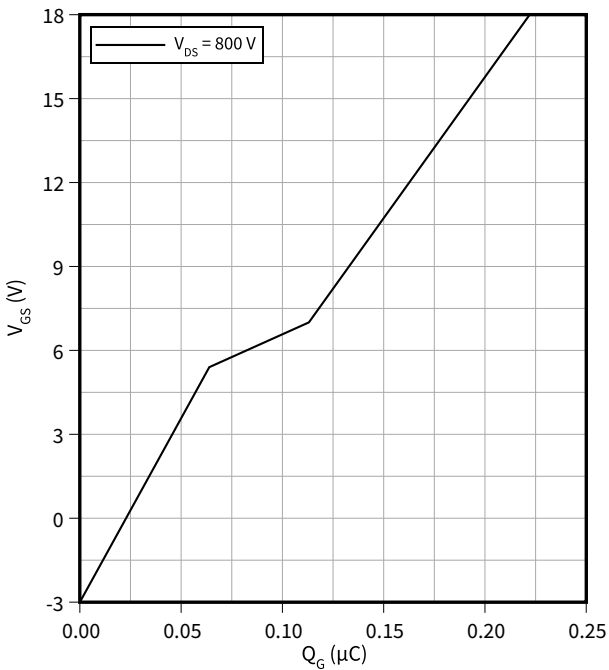
Gate-source threshold voltage (typical), MOSFET

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



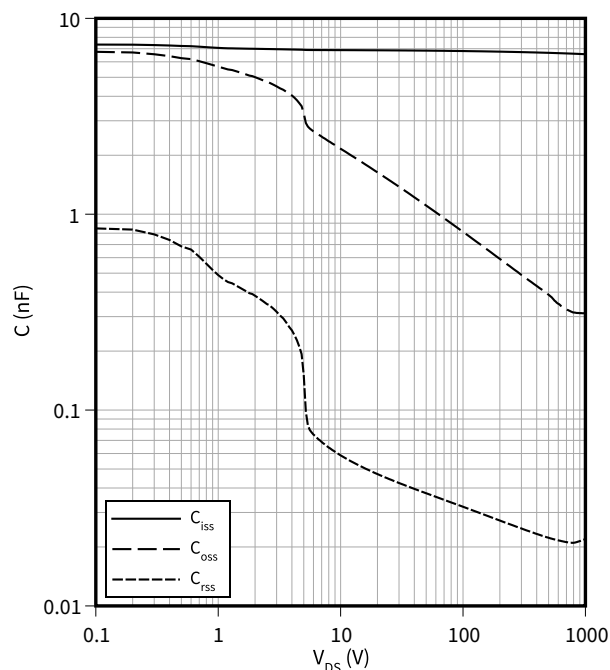
Gate charge characteristic (typical), MOSFET

$V_{GS} = f(Q_G)$   
 $I_D = 75\text{ A}, T_{vj} = 25\text{ °C}$

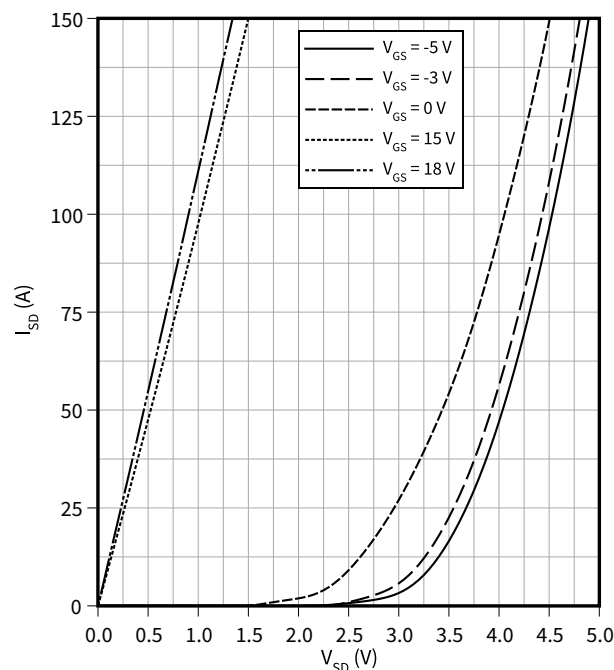


**Capacity characteristic (typical), MOSFET**

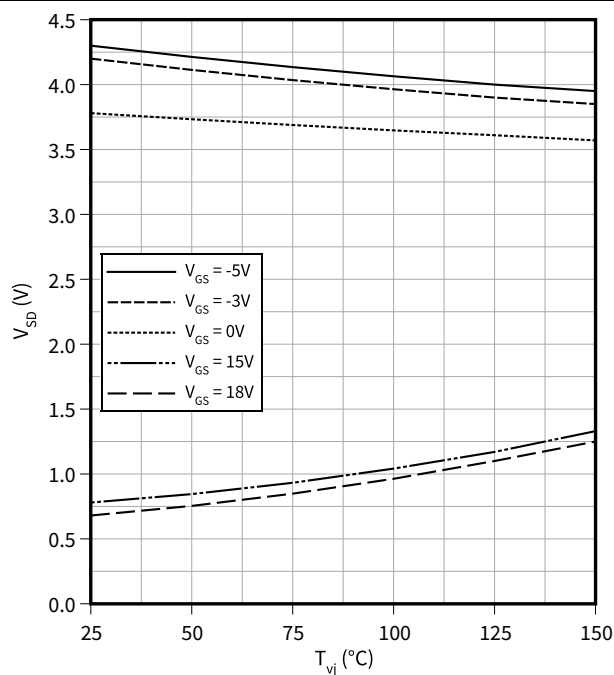
$$C = f(V_{DS})$$

 $f = 100 \text{ kHz}, T_{vj} = 25^\circ\text{C}, V_{GS} = 0 \text{ V}$ 
**Forward characteristic body diode (typical), MOSFET**

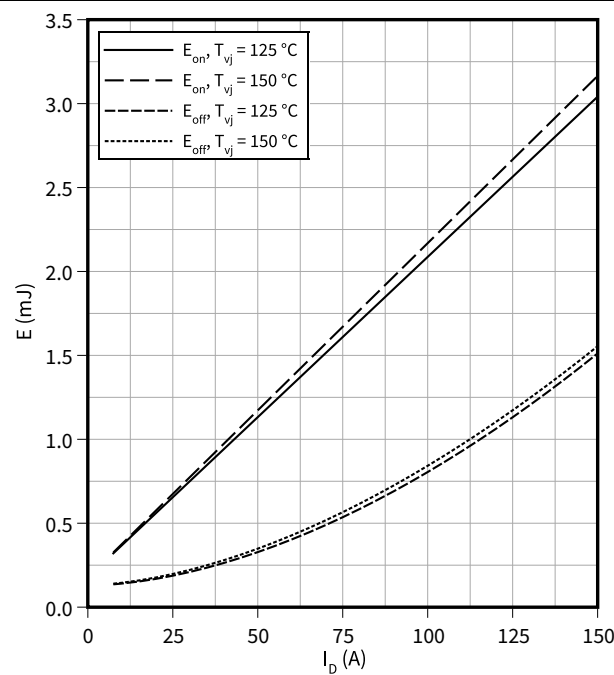
$$I_{SD} = f(V_{SD})$$

 $T_{vj} = 25^\circ\text{C}$ 
**Forward voltage of body diode (typical), MOSFET**

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

 $I_{SD} = 75 \text{ A}$ 
**Switching losses (typical), MOSFET**

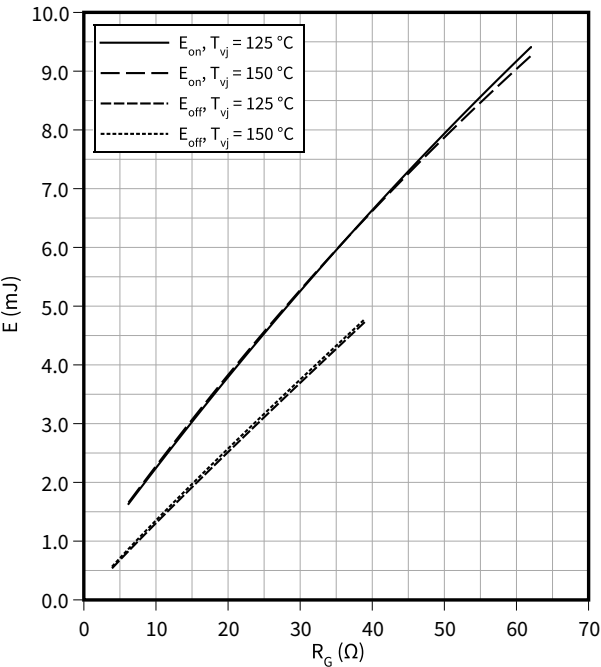
$$E = f(I_D)$$

 $R_{Goff} = 3.9 \Omega, R_{Gon} = 6.2 \Omega, V_{DD} = 600 \text{ V}, V_{GS} = -3/18 \text{ V}$ 


5 Characteristics diagrams

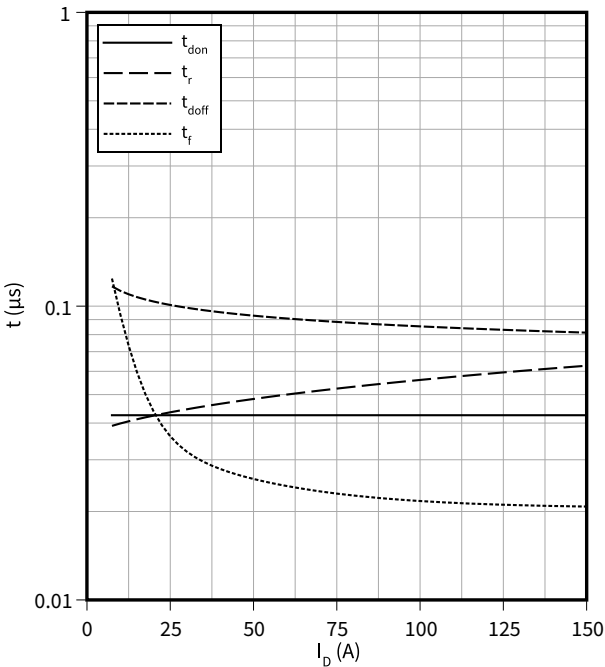
Switching losses (typical), MOSFET

$E = f(R_G)$   
 $V_{DD} = 600\text{ V}$ ,  $I_D = 75\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$



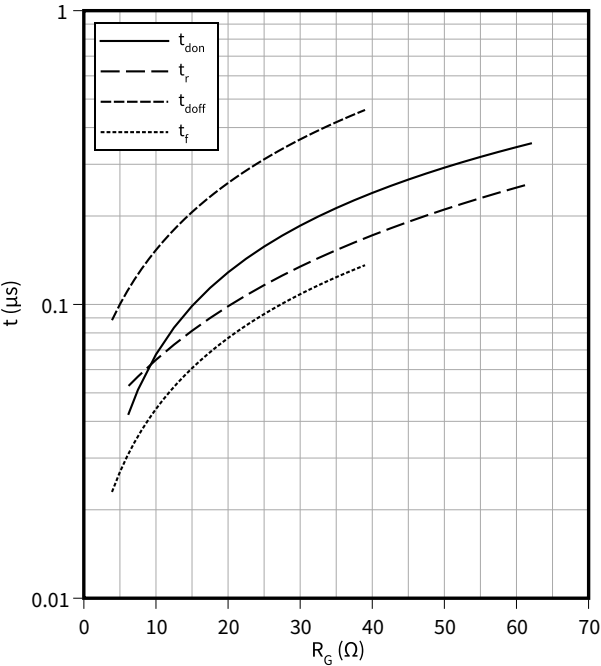
Switching times (typical), MOSFET

$t = f(I_D)$   
 $R_{Goff} = 3.9\text{ }\Omega$ ,  $R_{Gon} = 6.2\text{ }\Omega$ ,  $V_{DD} = 600\text{ V}$ ,  $T_{vj} = 150\text{ }^\circ\text{C}$ ,  $V_{GS} = -3/18\text{ V}$



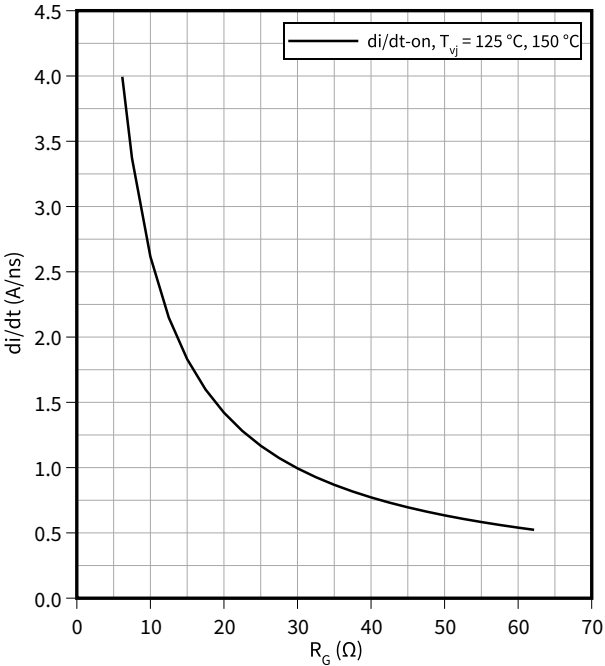
Switching times (typical), MOSFET

$t = f(R_G)$   
 $V_{DD} = 600\text{ V}$ ,  $I_D = 75\text{ A}$ ,  $T_{vj} = 150\text{ }^\circ\text{C}$ ,  $V_{GS} = -3/18\text{ V}$



Current slope (typical), MOSFET

$di/dt = f(R_G)$   
 $V_{DD} = 600\text{ V}$ ,  $I_D = 75\text{ A}$ ,  $V_{GS} = -3/18\text{ V}$

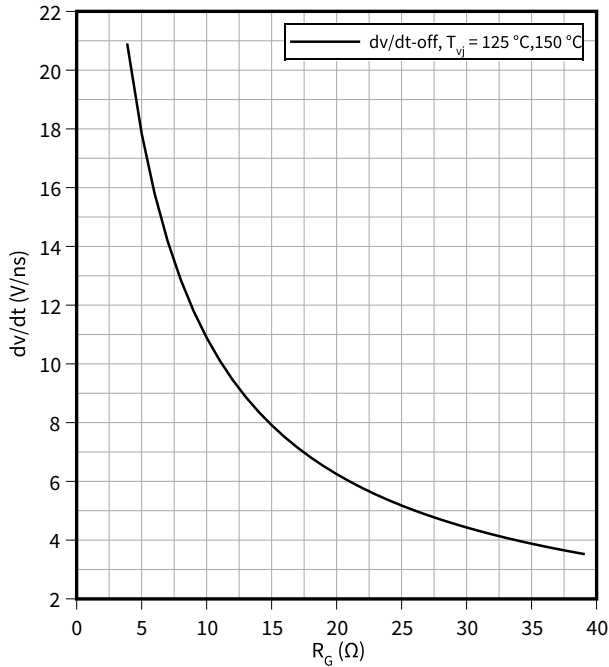


5 Characteristics diagrams

Voltage slope (typical), MOSFET

$dv/dt = f(R_G)$

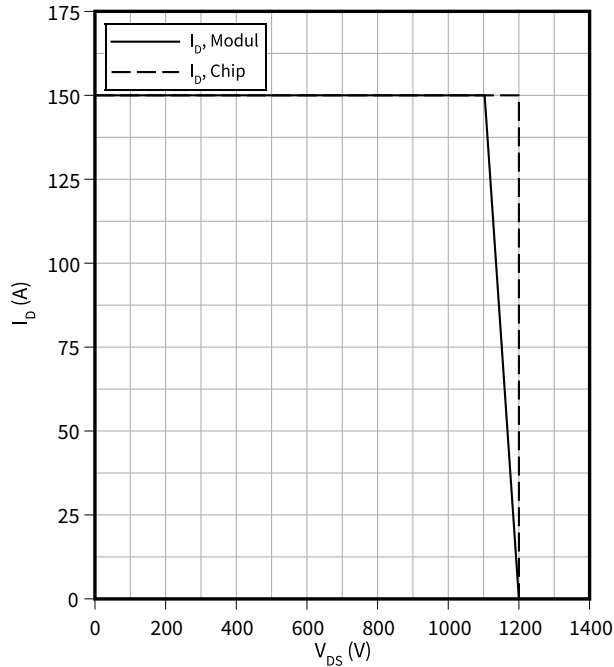
$V_{DD} = 600\text{ V}, I_D = 75\text{ A}, V_{GS} = -3/18\text{ V}$



Reverse bias safe operating area (RBSOA), MOSFET

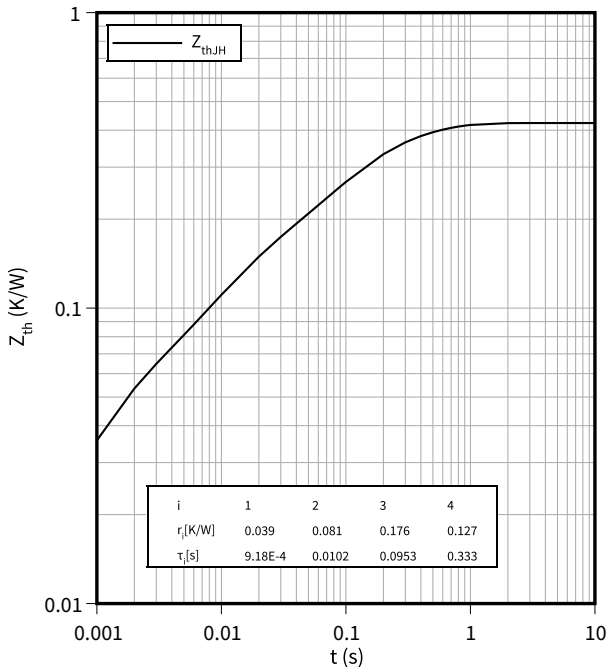
$I_D = f(V_{DS})$

$R_{Goff} = 3.9\text{ Ω}, T_{vj} = 150\text{ °C}, V_{GS} = -3/18\text{ V}$



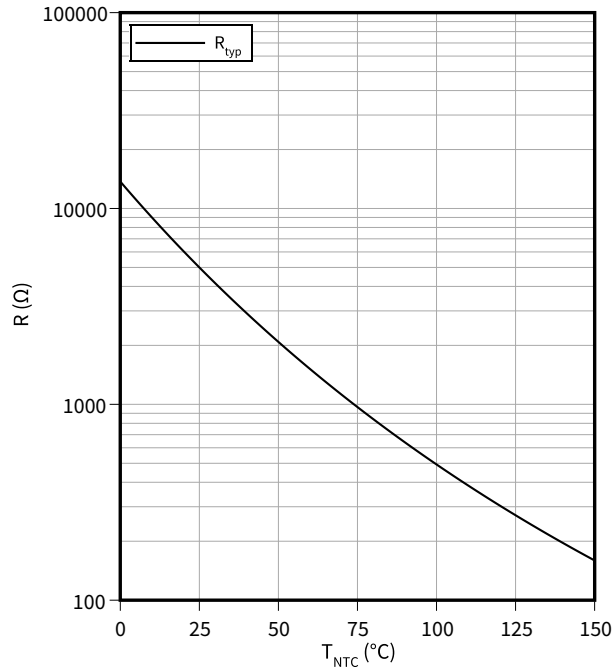
Transient thermal impedance, MOSFET

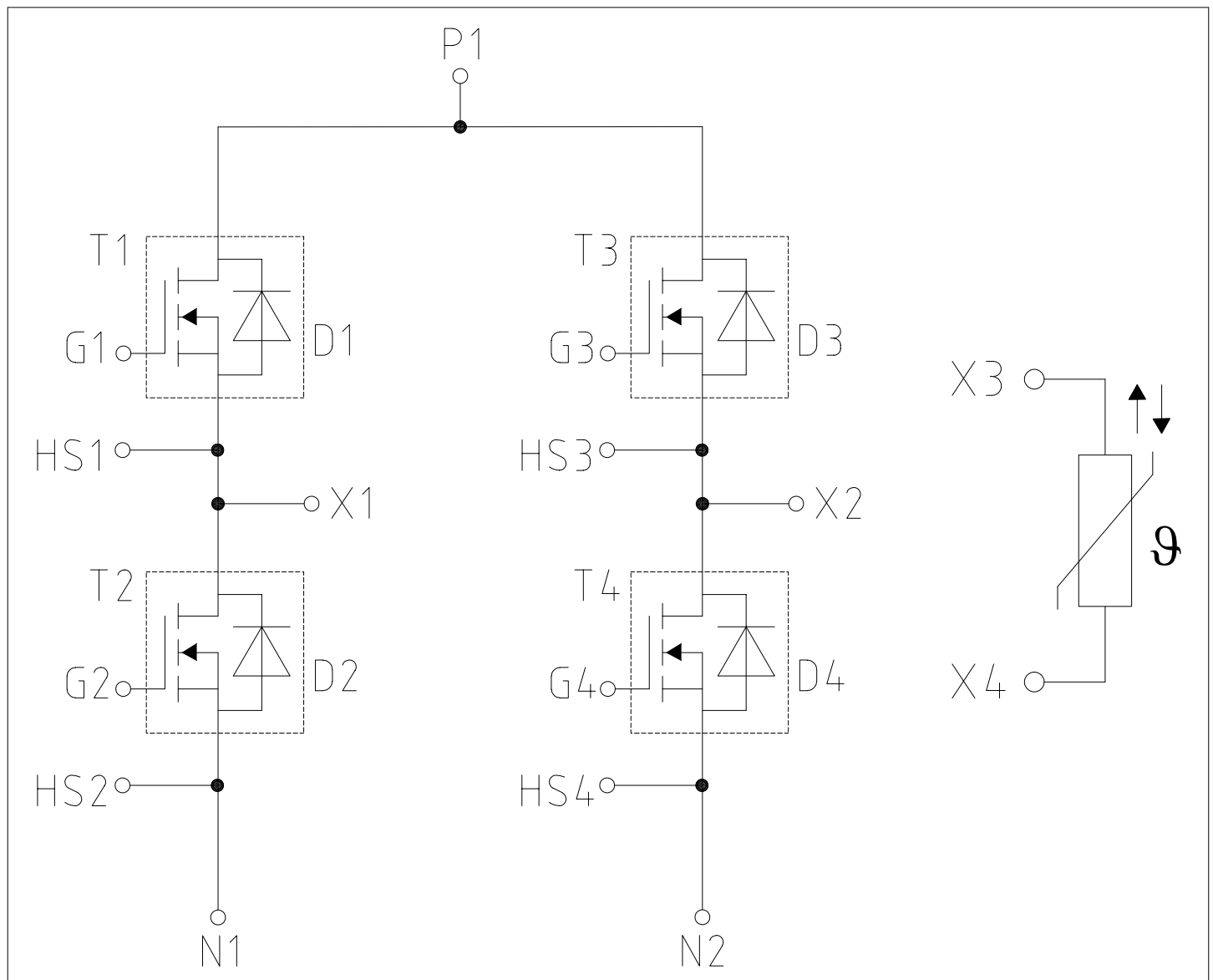
$Z_{th} = f(t)$



Temperature characteristic (typical), NTC-Thermistor

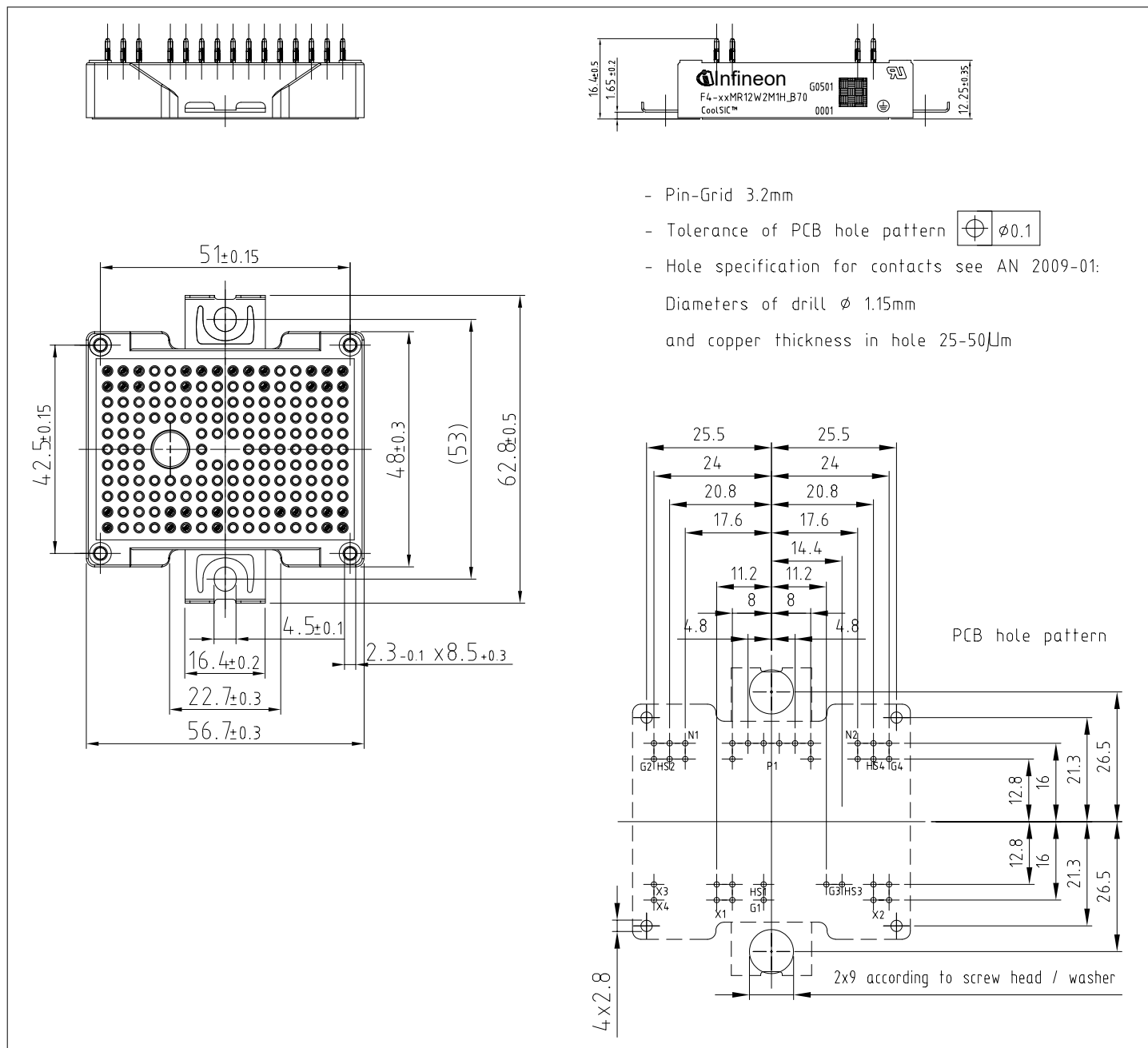
$R = f(T_{NTC})$





### Figure 1

**7**



### 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           |                                                                                                               |                                                                                                                |                 |
|                   | <br>71549142846550549911530 | <br>71549142846550549911530 |                 |

Figure 3

## Revision history

| Document revision | Date of release | Description of changes |
|-------------------|-----------------|------------------------|
| 0.10              | 2022-08-03      | Initial version        |
| 0.20              | 2023-06-09      | Preliminary datasheet  |

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