

MOSFET
OptiMOS™ 5 Power-Transistor, 25 V

Features

- N-channel, logic level
- Very low on-resistance R\_DS(on)
- Superior thermal resistance
- Optimized design for double side cooling
- 100% avalanche tested
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

Table with 3 columns: Parameter, Value, Unit. Rows include V\_DS (25 V), R\_DS(on),max (0.29 mΩ), I\_D (789 A), Q\_oss (127 nC), and Q\_G (88 nC).

PG-WHTFN-9

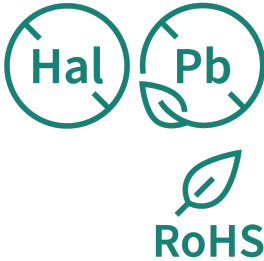
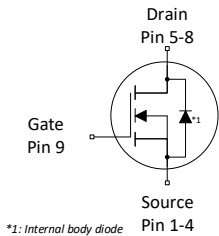
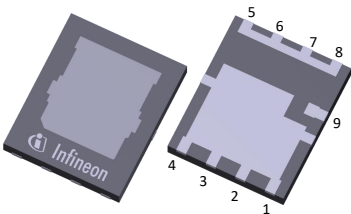


Table with 4 columns: Type/Ordering Code, Package, Marking, Related Links. Row 1: IQDH29NE2LM5CGSC, PG-WHTFN-9, KA, -



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## 1 Maximum ratings

unless otherwise specified

**Table 2 Maximum ratings**

| Parameter                                    | Symbol            | Values |      |                         | Unit | Note/ Test Condition                                                                                                                                                                                                          |
|----------------------------------------------|-------------------|--------|------|-------------------------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                              |                   | Min.   | Typ. | Max.                    |      |                                                                                                                                                                                                                               |
| Continuous drain current <sup>1)</sup>       | $I_D$             | -      | -    | 789<br>499<br>454<br>75 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=4.5\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ , $R_{thJA}=50\text{ °C/W}$ <sup>2)</sup> |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$     | -      | -    | 3156                    | A    | $T_C=25\text{ °C}$                                                                                                                                                                                                            |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$          | -      | -    | 1200                    | mJ   | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                                                                                                                                 |
| Gate source voltage                          | $V_{GS}$          | -16    | -    | 16                      | V    | -                                                                                                                                                                                                                             |
| Power dissipation                            | $P_{tot}$         | -      | -    | 278<br>2.5              | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{thJA}=50\text{ °C/W}$ <sup>2)</sup>                                                                                                                                            |
| Operating and storage temperature            | $T_j$ , $T_{stg}$ | -55    | -    | 150                     | °C   | -                                                                                                                                                                                                                             |

<sup>1)</sup> Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature as specified. For other case temperatures please refer to Diagram 2. De-rating will be required based on the actual environmental conditions.

<sup>2)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 µm thick) copper area for source connection. PCB is vertical in still air.

<sup>3)</sup> See Diagram 3 for more detailed information

<sup>4)</sup> See Diagram 13 for more detailed information

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                                                            | Symbol     | Values |      |      | Unit | Note/ Test Condition |
|--------------------------------------------------------------------------------------|------------|--------|------|------|------|----------------------|
|                                                                                      |            | Min.   | Typ. | Max. |      |                      |
| Thermal resistance, junction - case, bottom                                          | $R_{thJC}$ | -      | -    | 0.45 | °C/W | -                    |
| Thermal resistance, junction - case, top                                             | $R_{thJC}$ | -      | -    | 0.56 | °C/W | -                    |
| Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>5)</sup> | $R_{thJA}$ | -      | -    | 50   | °C/W | -                    |

<sup>5)</sup> Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 µm thick) copper area for source connection. PCB is vertical in still air.

### 3 Electrical characteristics

unless otherwise specified

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |            |              | Unit          | Note/ Test Condition                                                                                                                                        |
|----------------------------------|---------------|--------|------------|--------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  |               | Min.   | Typ.       | Max.         |               |                                                                                                                                                             |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 25     | -          | -            | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                                                     |
| Gate threshold voltage           | $V_{GS(th)}$  | 1.2    | 1.6        | 2.0          | V             | $V_{DS}=V_{GS}$ , $I_D=1448\text{ }\mu\text{A}$                                                                                                             |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10  | 1<br>100     | $\mu\text{A}$ | $V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ }^\circ\text{C}$<br>$V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ }^\circ\text{C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10         | 100          | nA            | $V_{GS}=16\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                                                  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.2<br>0.3 | 0.29<br>0.35 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$<br>$V_{GS}=4.5\text{ V}$ , $I_D=50\text{ A}$                                                                       |
| Gate resistance                  | $R_G$         | -      | 0.46       | -            | $\Omega$      | -                                                                                                                                                           |
| Transconductance                 | $g_{fs}$      | 305    | 610        | -            | S             | $ V_{DS} \geq 2 I_D R_{DS(on)max}$ , $I_D=50\text{ A}$                                                                                                      |

**Table 5 Dynamic characteristics**

| Parameter                                  | Symbol       | Values |       |       | Unit | Note/ Test Condition                                                                               |
|--------------------------------------------|--------------|--------|-------|-------|------|----------------------------------------------------------------------------------------------------|
|                                            |              | Min.   | Typ.  | Max.  |      |                                                                                                    |
| Input capacitance <sup>6)</sup>            | $C_{iss}$    | -      | 13000 | 17000 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Output capacitance <sup>6)</sup>           | $C_{oss}$    | -      | 5400  | 7000  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Reverse transfer capacitance <sup>6)</sup> | $C_{rss}$    | -      | 380   | 660   | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                      |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 14    | -     | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                                  | $t_r$        | -      | 6     | -     | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 77    | -     | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                                  | $t_f$        | -      | 19    | -     | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

<sup>6)</sup> Defined by design. Not subject to production test.

**Table 6 Gate charge characteristics** <sup>7)</sup>

| Parameter                          | Symbol        | Values |      |      | Unit | Note/ Test Condition                                                         |
|------------------------------------|---------------|--------|------|------|------|------------------------------------------------------------------------------|
|                                    |               | Min.   | Typ. | Max. |      |                                                                              |
| Gate to source charge              | $Q_{gs}$      | -      | 28   | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge at threshold           | $Q_{g(th)}$   | -      | 20   | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate to drain charge <sup>8)</sup> | $Q_{gd}$      | -      | 17   | 25   | nC   | $V_{DD}=12\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 25   | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total <sup>8)</sup>    | $Q_g$         | -      | 88   | 110  | nC   | $V_{DD}=12\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 2.2  | -    | V    | $V_{DD}=12\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total <sup>8)</sup>    | $Q_g$         | -      | 191  | 254  | nC   | $V_{DD}=12\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Gate charge total, sync. FET       | $Q_{g(sync)}$ | -      | 84   | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }4.5\text{ V}$                    |
| Output charge <sup>8)</sup>        | $Q_{oss}$     | -      | 127  | 169  | nC   | $V_{DS}=12\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

<sup>7)</sup> See "Gate charge waveforms" for parameter definition

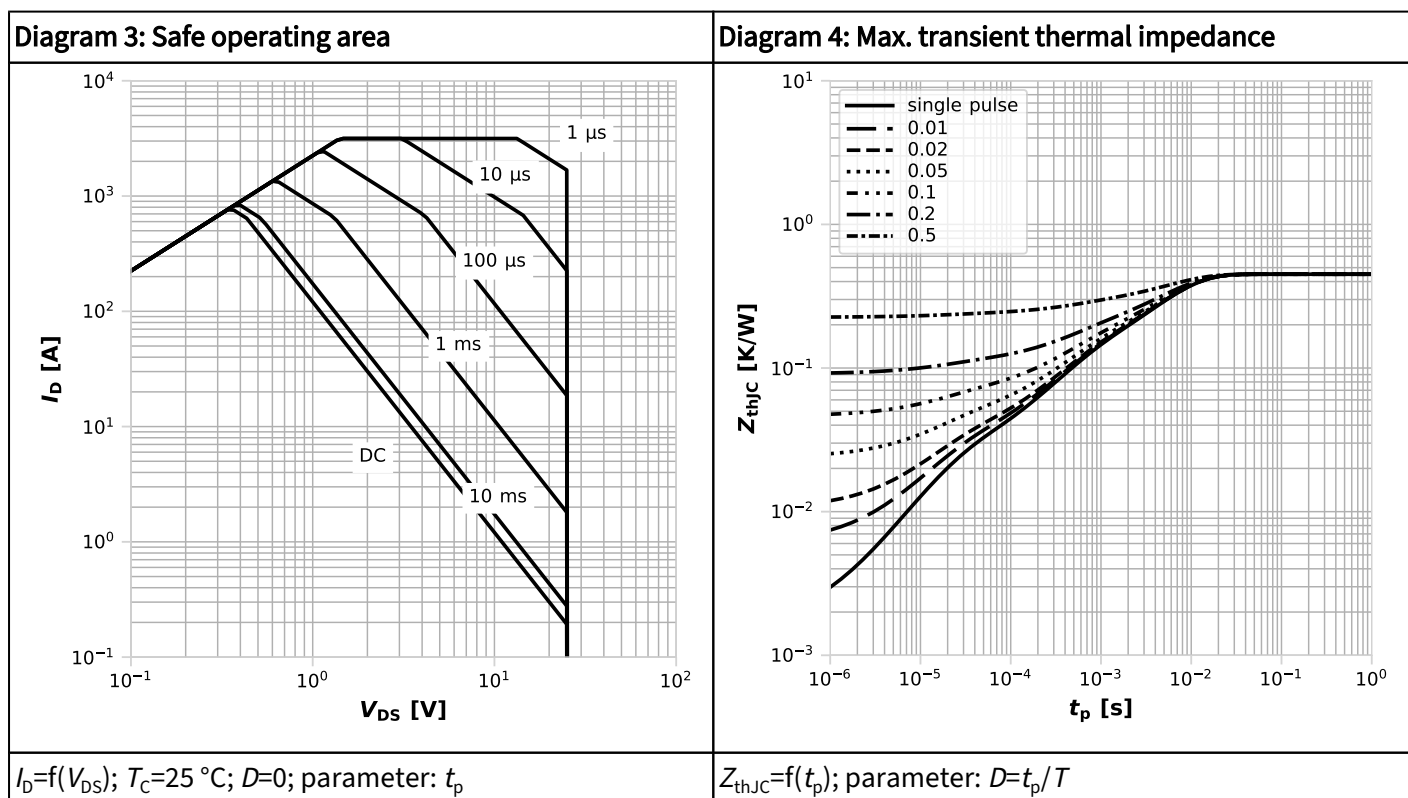
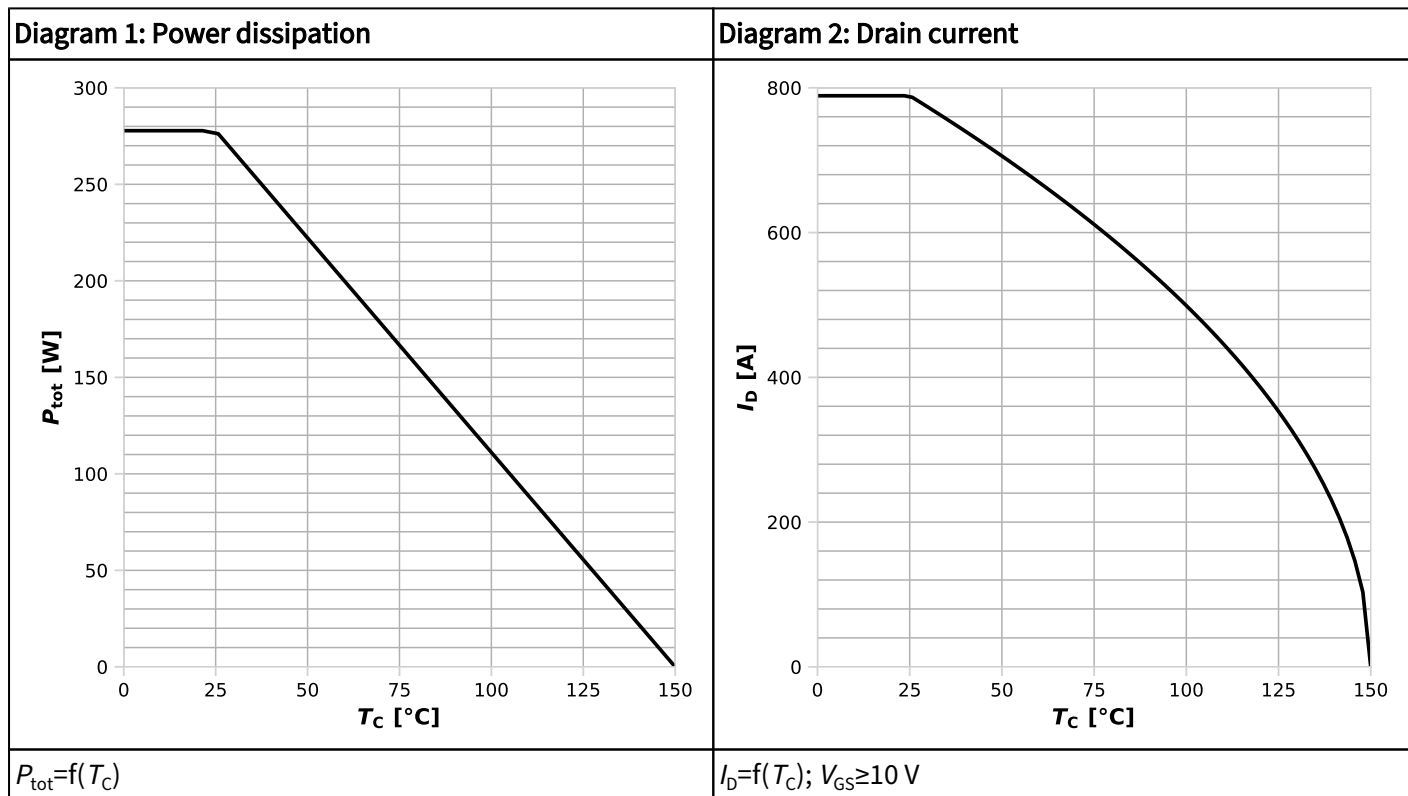
<sup>8)</sup> Defined by design. Not subject to production test.

**Table 7 Reverse diode**

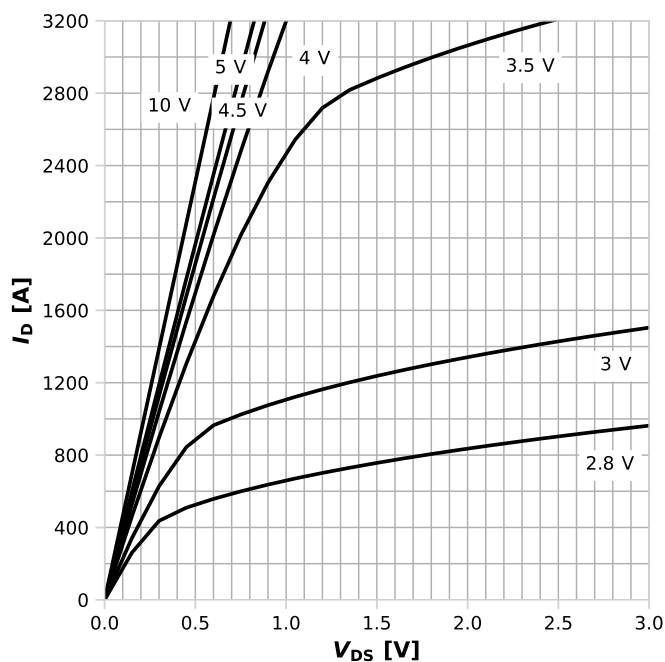
| Parameter                             | Symbol        | Values |      |      | Unit | Note/ Test Condition                                                       |
|---------------------------------------|---------------|--------|------|------|------|----------------------------------------------------------------------------|
|                                       |               | Min.   | Typ. | Max. |      |                                                                            |
| Diode continuous forward current      | $I_S$         | -      | -    | 244  | A    | $T_C=25\text{ °C}$                                                         |
| Diode pulse current                   | $I_{S,pulse}$ | -      | -    | 3156 | A    | $T_C=25\text{ °C}$                                                         |
| Diode forward voltage                 | $V_{SD}$      | -      | 0.74 | 1.0  | V    | $V_{GS}=0\text{ V}$ , $I_F=50\text{ A}$ , $T_j=25\text{ °C}$               |
| Reverse recovery time <sup>9)</sup>   | $t_{rr}$      | -      | 59   | 118  | ns   | $V_R=12\text{ V}$ , $I_F=25\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge <sup>9)</sup> | $Q_{rr}$      | -      | 120  | 240  | nC   | $V_R=12\text{ V}$ , $I_F=25\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery time <sup>9)</sup>   | $t_{rr}$      | -      | 39   | 78   | ns   | $V_R=12\text{ V}$ , $I_F=50\text{ A}$ , $di_F/dt=500\text{ A}/\mu\text{s}$ |
| Reverse recovery charge <sup>9)</sup> | $Q_{rr}$      | -      | 203  | 406  | nC   | $V_R=12\text{ V}$ , $I_F=50\text{ A}$ , $di_F/dt=500\text{ A}/\mu\text{s}$ |

<sup>9)</sup> Defined by design. Not subject to production test.

## 4 Electrical characteristics diagrams

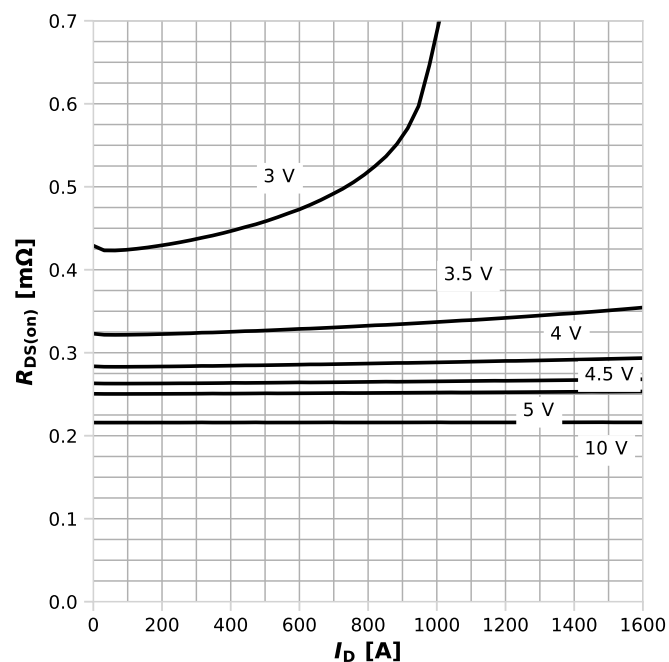


**Diagram 5: Typ. output characteristics**



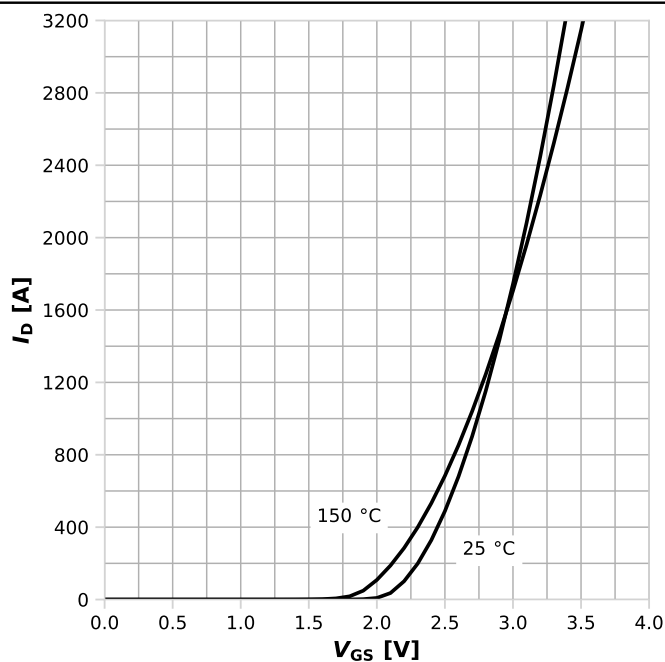
$I_D = f(V_{DS})$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

**Diagram 6: Typ. drain-source on resistance**



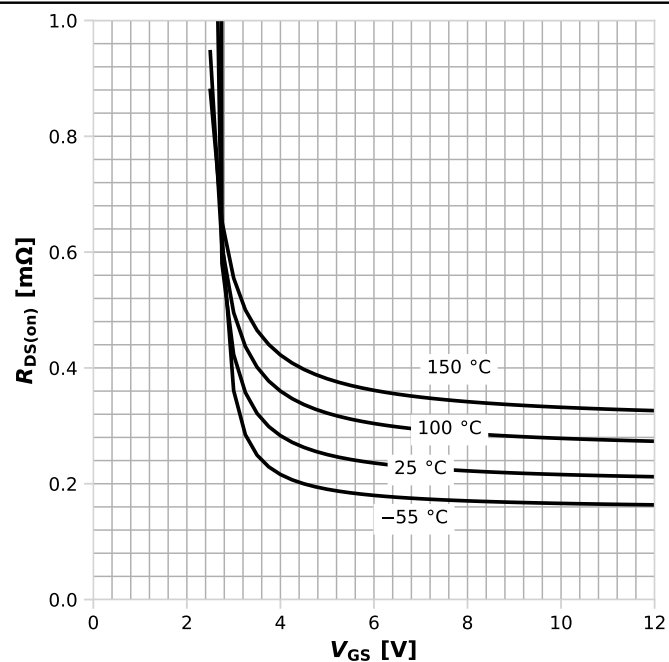
$R_{DS(on)} = f(I_D)$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



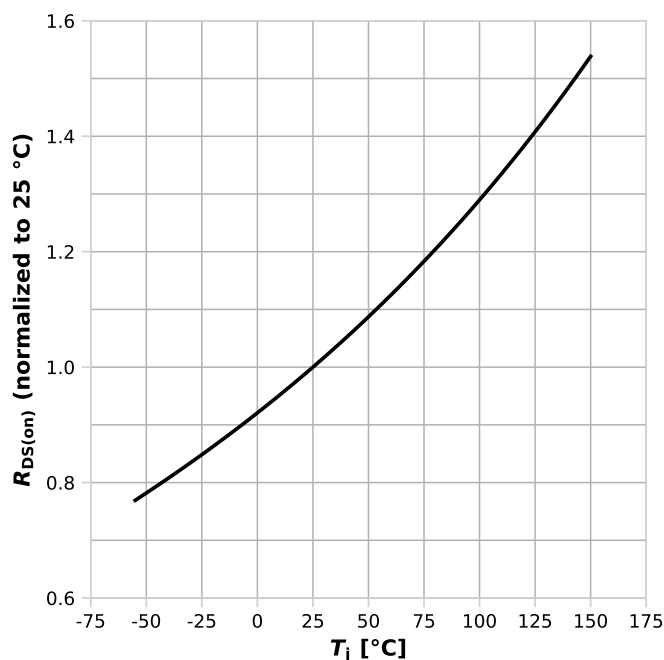
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2|I_D|R_{DS(on)max}$ ; parameter:  $T_j$

**Diagram 8: Typ. drain-source on resistance**



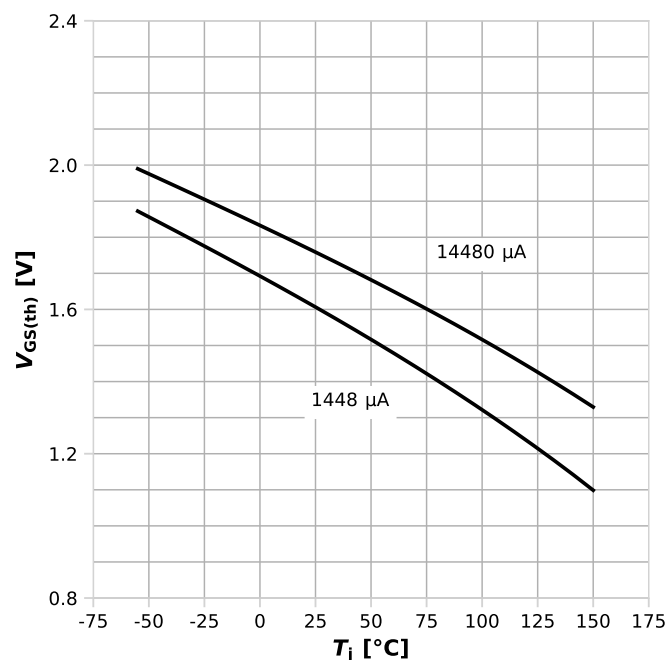
$R_{DS(on)} = f(V_{GS})$ ,  $I_D = 50$  A; parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



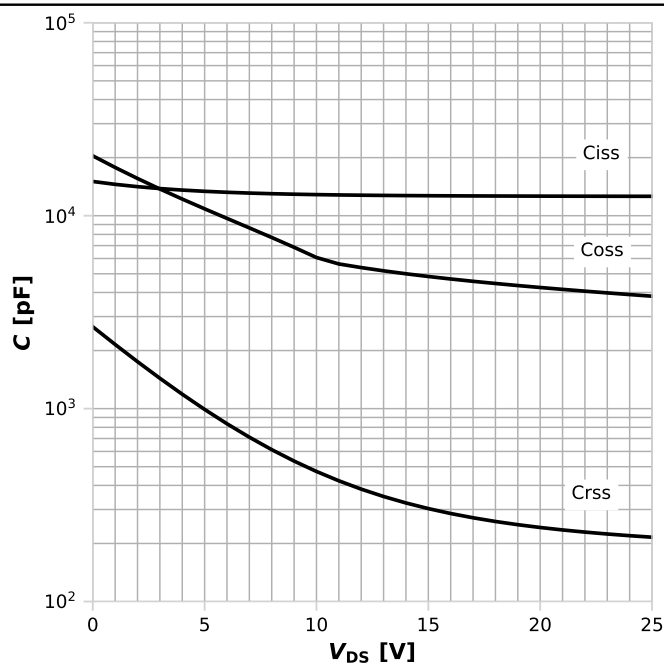
$$R_{DS(on)} = f(T_j), I_D = 50 \text{ A}, V_{GS} = 10 \text{ V}$$

Diagram 10: Typ. gate threshold voltage



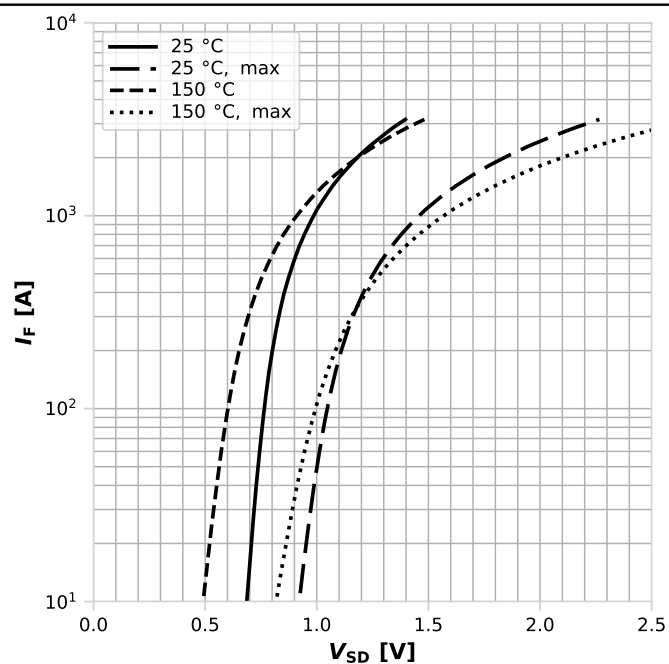
$$V_{GS(th)} = f(T_j), V_{GS} = V_{DS}; \text{ parameter: } I_D$$

Diagram 11: Typ. capacitances



$$C = f(V_{DS}); V_{GS} = 0 \text{ V}; f = 1 \text{ MHz}$$

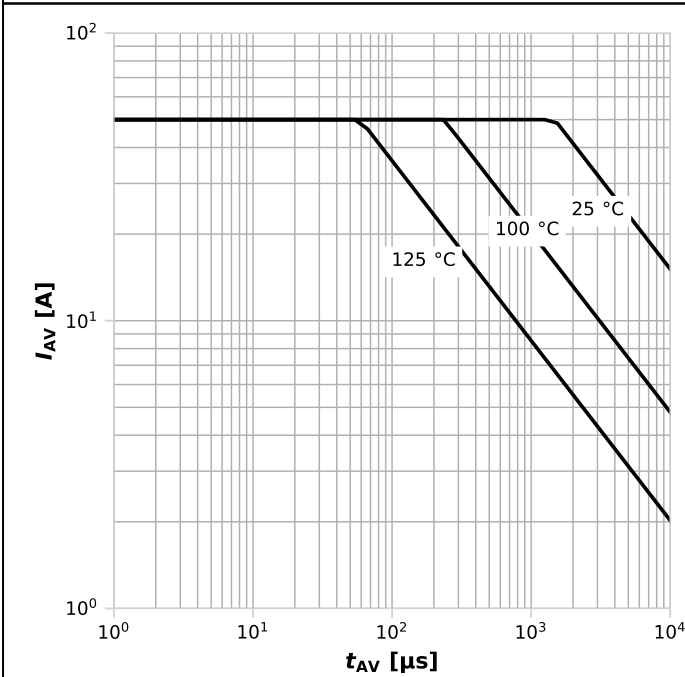
Diagram 12: Forward characteristics of reverse diode



$$I_F = f(V_{SD}); \text{ parameter: } T_j$$

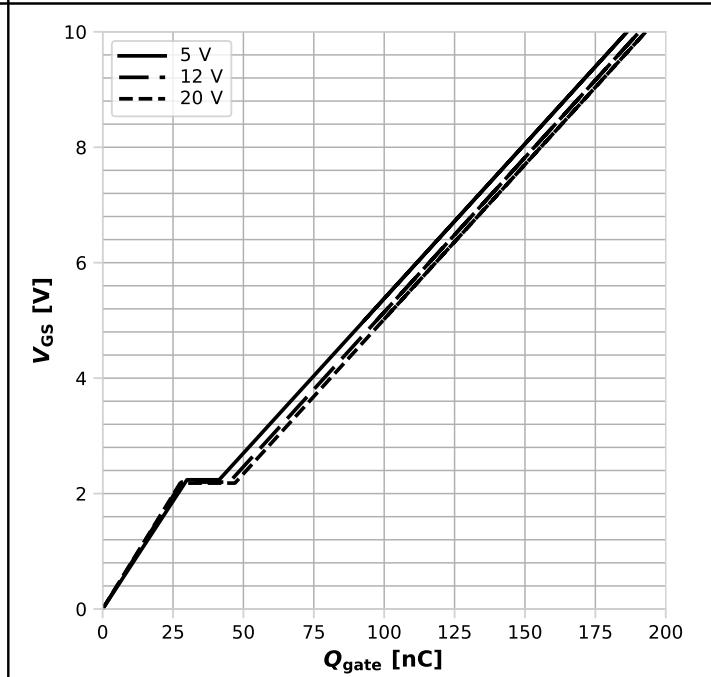


Diagram 13: Avalanche characteristics



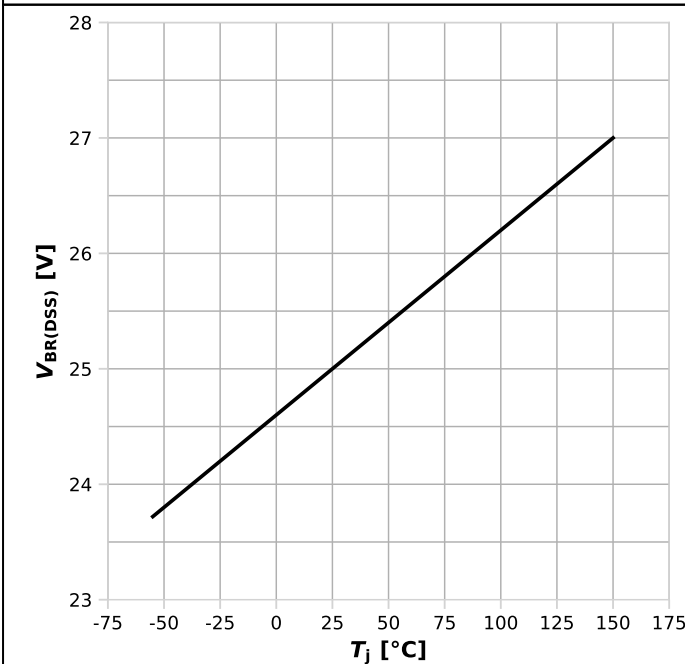
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j,start}$

Diagram 14: Typ. gate charge



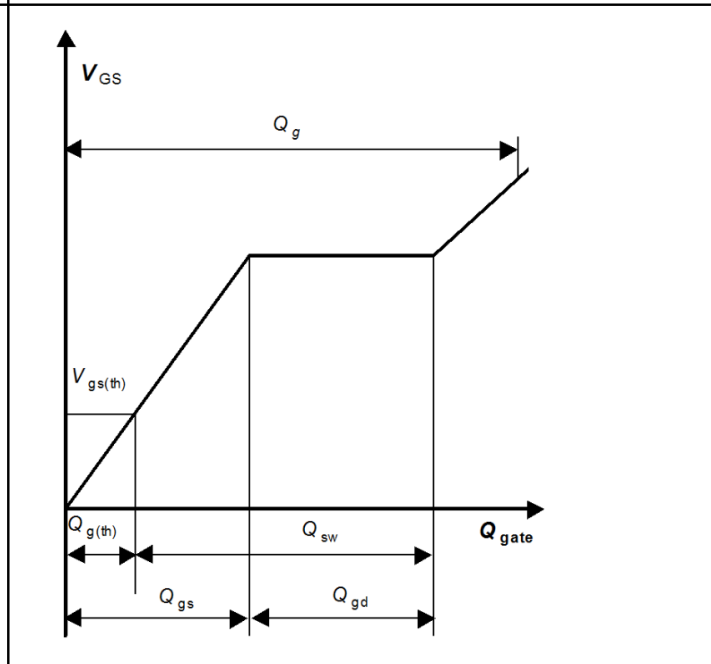
$V_{GS}=f(Q_{gate})$ ,  $I_D=50\text{ A}$  pulsed,  $T_j=25\text{ °C}$ ; parameter:  $V_{DD}$

Diagram 15: Min. drain-source breakdown voltage



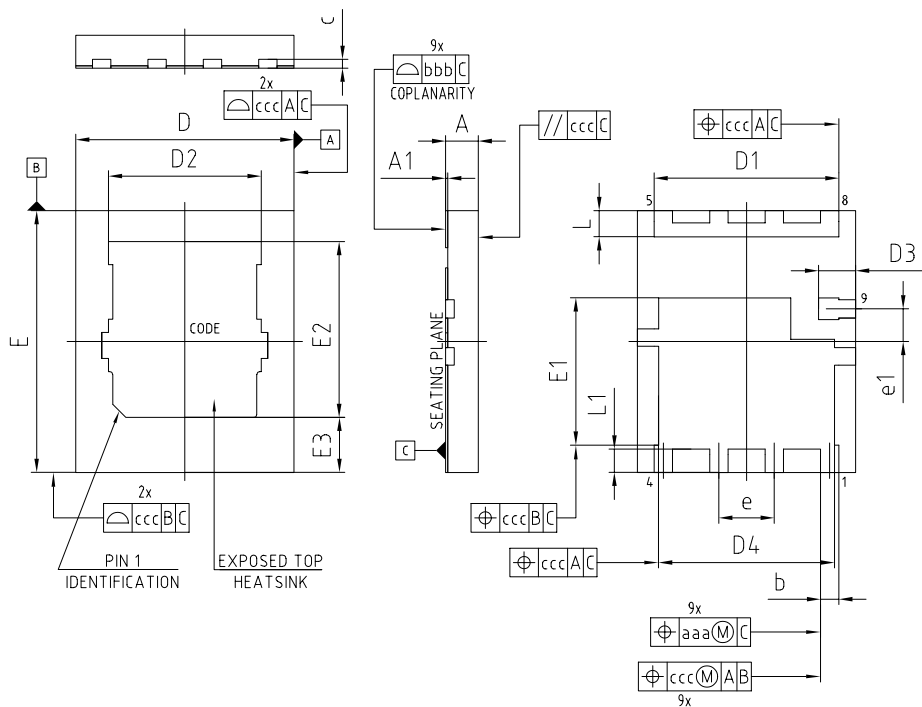
$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1\text{ mA}$

Gate charge waveforms



-

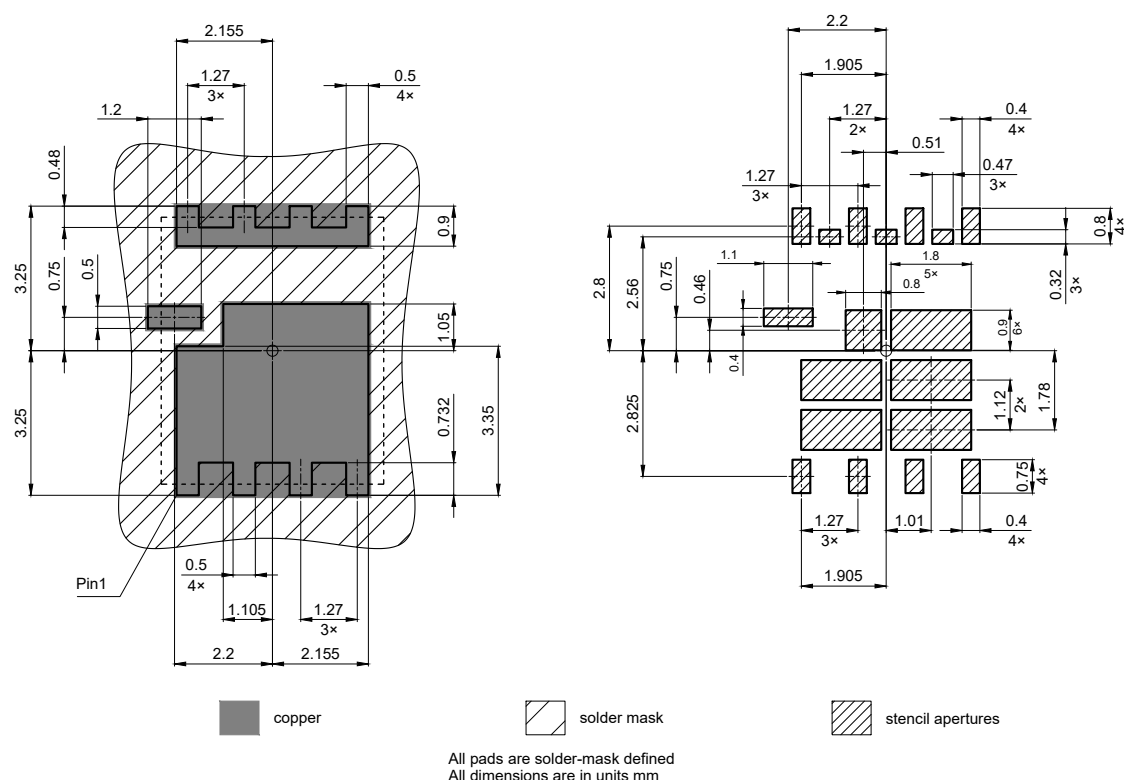
5 Package Outlines



| PACKAGE - GROUP<br>NUMBER: PG-WHTFN-9-U02 |             |      |            |             |      |
|-------------------------------------------|-------------|------|------------|-------------|------|
| DIMENSIONS                                | MILLIMETERS |      | DIMENSIONS | MILLIMETERS |      |
|                                           | MIN.        | MAX. |            | MIN.        | MAX. |
| A                                         | 0.55        | 0.75 | e          |             | 1.27 |
| A1                                        | 0.00        | 0.05 | e1         |             | 0.75 |
| b                                         | 0.32        | 0.52 | L          | 0.50        | 0.70 |
| c                                         | 0.10        | 0.30 | L1         | 0.44        | 0.64 |
| D                                         |             | 5.00 | aaa        |             | 0.05 |
| D1                                        | 4.13        | 4.33 | bbb        |             | 0.08 |
| D2                                        | 3.40        | 3.60 | ccc        |             | 0.10 |
| D3                                        | 0.75        | 0.95 |            |             |      |
| D4                                        | 3.93        | 4.13 |            |             |      |
| E                                         |             | 6.00 |            |             |      |
| E1                                        | 3.28        | 3.48 |            |             |      |
| E2                                        | 3.93        | 4.13 |            |             |      |
| E3                                        | 1.16        | 1.36 |            |             |      |

NOTE: DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURRS

Figure 1 Outline PG-WHTFN-9, dimensions in mm



**Figure 2** Outline PG-WHTFN-9, dimensions in mm

## Revision History

IQDH29NE2LM5CGSC

### Revision 2024-06-17, Rev. 2.0

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2024-06-17 | Release of final                             |

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