

MOSFET

OptiMOS™5 Power-Transistor, 60 V

Features

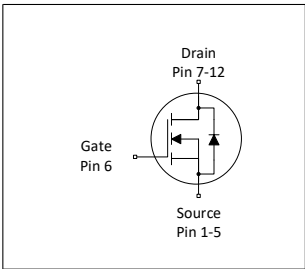
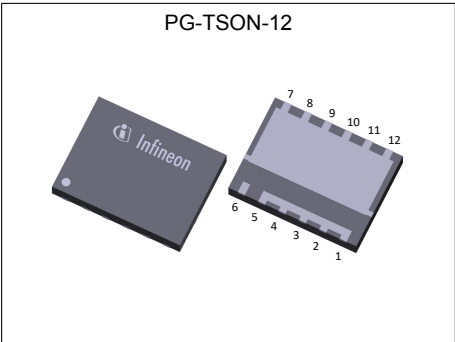
- Optimized for Low Voltage Drives applications
- Optimized for Battery Powered applications
- Optimized for Synchronous Rectification
- Very low on-resistance  $R_{DS(on)}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21
- 175°C rated

Product validation

Fully qualified according to JEDEC for Industrial Applications

Table 1 Key Performance Parameters

| Parameter        | Value | Unit |
|------------------|-------|------|
| $V_{DS}$         | 60    | V    |
| $R_{DS(on),max}$ | 0.68  | mΩ   |
| $I_D$            | 460   | A    |
| $Q_{oss}$        | 179   | nC   |
| $Q_G$ (0V..10V)  | 168   | nC   |



RoHS

| Type / Ordering Code | Package    | Marking   | Related Links |
|----------------------|------------|-----------|---------------|
| IQFH68N06NM5         | PG-TSON-12 | H68N06NM5 | -             |

**Table of Contents**

Description ..... 1

Maximum ratings ..... 3

Thermal characteristics ..... 3

Electrical characteristics ..... 4

Electrical characteristics diagrams ..... 6

Package Outlines ..... 10

Revision History ..... 12

Trademarks ..... 12

Disclaimer ..... 12

## 1 Maximum ratings

at  $T_A=25\text{ °C}$ , unless otherwise specified

**Table 2 Maximum ratings**

| Parameter                                    | Symbol            | Values |      |                  | Unit | Note / Test Condition                                                                                                                                                    |
|----------------------------------------------|-------------------|--------|------|------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                              |                   | Min.   | Typ. | Max.             |      |                                                                                                                                                                          |
| Continuous drain current <sup>1)</sup>       | $I_D$             | -      | -    | 460<br>326<br>48 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ ,<br>$R_{THJA}=50\text{ °C/W}^{2)}$ |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$     | -      | -    | 1840             | A    | $T_C=25\text{ °C}$                                                                                                                                                       |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$          | -      | -    | 992              | mJ   | $I_D=100\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                                                                                                           |
| Gate source voltage                          | $V_{GS}$          | -20    | -    | 20               | V    | -                                                                                                                                                                        |
| Power dissipation                            | $P_{tot}$         | -      | -    | 273<br>3.0       | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{THJA}=50\text{ °C/W}^{2)}$                                                                                                |
| Operating and storage temperature            | $T_j$ , $T_{stg}$ | -55    | -    | 175              | °C   | -                                                                                                                                                                        |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                                                                            | Symbol     | Values |      |      | Unit | Note / Test Condition |
|--------------------------------------------------------------------------------------|------------|--------|------|------|------|-----------------------|
|                                                                                      |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case, bottom                                          | $R_{thJC}$ | -      | -    | 0.55 | °C/W | -                     |
| Thermal resistance, junction - case, top                                             | $R_{thJC}$ | -      | -    | 20   | °C/W | -                     |
| Thermal resistance, junction - ambient, 6 cm <sup>2</sup> cooling area <sup>2)</sup> | $R_{thJA}$ | -      | -    | 50   | °C/W | -                     |

<sup>1)</sup> Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at specified. For other case temperature 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 drain 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

### 3 Electrical characteristics

at  $T_j=25\text{ °C}$ , unless otherwise specified

**Table 4 Static characteristics**

| Parameter                        | Symbol        | Values |             |              | Unit          | Note / Test Condition                                                                                                               |
|----------------------------------|---------------|--------|-------------|--------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------|
|                                  |               | Min.   | Typ.        | Max.         |               |                                                                                                                                     |
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | 60     | -           | -            | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                             |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.1    | 2.8         | 3.3          | V             | $V_{DS}=V_{GS}$ , $I_D=217\text{ }\mu\text{A}$                                                                                      |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.5<br>10   | 1<br>100     | $\mu\text{A}$ | $V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=60\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10          | 100          | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                          |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.56<br>0.8 | 0.68<br>1.12 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$<br>$V_{GS}=6\text{ V}$ , $I_D=50\text{ A}$                                                |
| Gate resistance                  | $R_G$         | -      | 0.7         | -            | $\Omega$      | -                                                                                                                                   |
| Transconductance <sup>1)</sup>   | $g_{fs}$      | 150    | -           | -            | S             | $ V_{DS} \geq 2 I_D /R_{DS(on)max}$ , $I_D=100\text{ A}$                                                                            |

**Table 5 Dynamic characteristics**

| Parameter                                  | Symbol       | Values |       |       | Unit | Note / Test Condition                                                                               |
|--------------------------------------------|--------------|--------|-------|-------|------|-----------------------------------------------------------------------------------------------------|
|                                            |              | Min.   | Typ.  | Max.  |      |                                                                                                     |
| Input capacitance                          | $C_{iss}$    | -      | 12200 | 15900 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                       |
| Output capacitance <sup>1)</sup>           | $C_{oss}$    | -      | 2670  | 3470  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                       |
| Reverse transfer capacitance <sup>1)</sup> | $C_{rss}$    | -      | 100   | 170   | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                       |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 26    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                                  | $t_r$        | -      | 71    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 54    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                                  | $t_f$        | -      | 25    | -     | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=100\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

**Table 6 Gate charge characteristics<sup>2)</sup>**

| Parameter                          | Symbol        | Values |      |      | Unit | Note / Test Condition                                                        |
|------------------------------------|---------------|--------|------|------|------|------------------------------------------------------------------------------|
|                                    |               | Min.   | Typ. | Max. |      |                                                                              |
| Gate to source charge              | $Q_{gs}$      | -      | 53   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold           | $Q_{g(th)}$   | -      | 34   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge <sup>1)</sup> | $Q_{gd}$      | -      | 30   | 45   | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 49   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 168  | 252  | nC   | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 4.3  | -    | V    | $V_{DD}=30\text{ V}$ , $I_D=100\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET       | $Q_{g(sync)}$ | -      | 150  | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                     |
| Output charge <sup>1)</sup>        | $Q_{oss}$     | -      | 179  | 233  | nC   | $V_{DS}=30\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

<sup>1)</sup> Defined by design. Not subject to production test.

<sup>2)</sup> See "Gate charge waveforms" for parameter definition

**Table 7 Reverse diode**

| Parameter                             | Symbol        | Values |      |      | Unit | Note / Test Condition                                                       |
|---------------------------------------|---------------|--------|------|------|------|-----------------------------------------------------------------------------|
|                                       |               | Min.   | Typ. | Max. |      |                                                                             |
| Diode continuous forward current      | $I_S$         | -      | -    | 227  | A    | $T_C=25\text{ °C}$                                                          |
| Diode pulse current                   | $I_{S,pulse}$ | -      | -    | 1840 | A    | $T_C=25\text{ °C}$                                                          |
| Diode forward voltage                 | $V_{SD}$      | -      | 0.82 | 1.1  | V    | $V_{GS}=0\text{ V}$ , $I_F=100\text{ A}$ , $T_J=25\text{ °C}$               |
| Reverse recovery time <sup>1)</sup>   | $t_{rr}$      | -      | 56   | 112  | ns   | $V_R=30\text{ V}$ , $I_F=100\text{ A}$ , $di_F/dt=500\text{ A}/\mu\text{s}$ |
| Reverse recovery charge <sup>1)</sup> | $Q_{rr}$      | -      | 486  | 972  | nC   | $V_R=30\text{ V}$ , $I_F=100\text{ A}$ , $di_F/dt=500\text{ A}/\mu\text{s}$ |

<sup>1)</sup> Defined by design. Not subject to production test.

## 4 Electrical characteristics diagrams

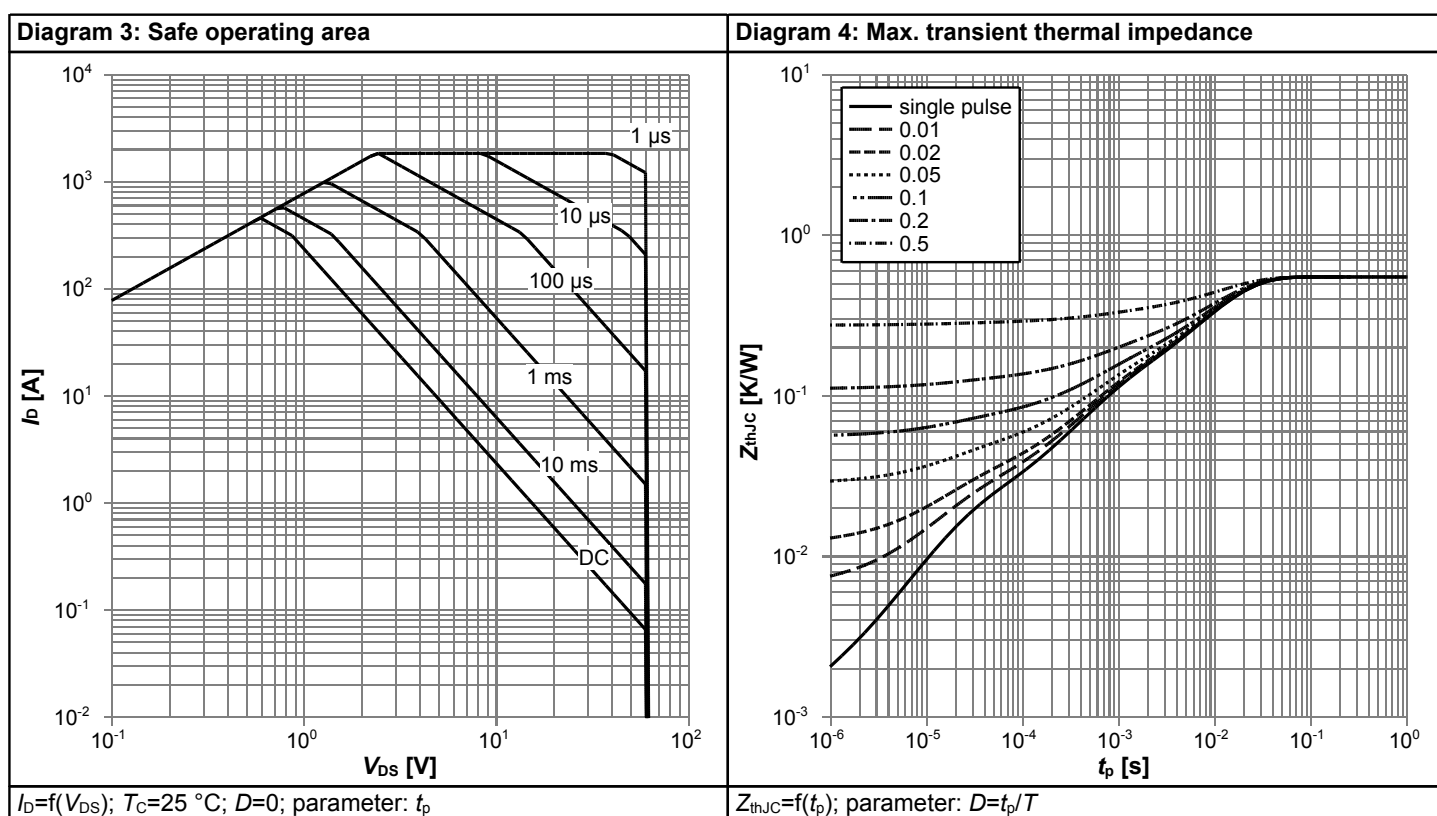
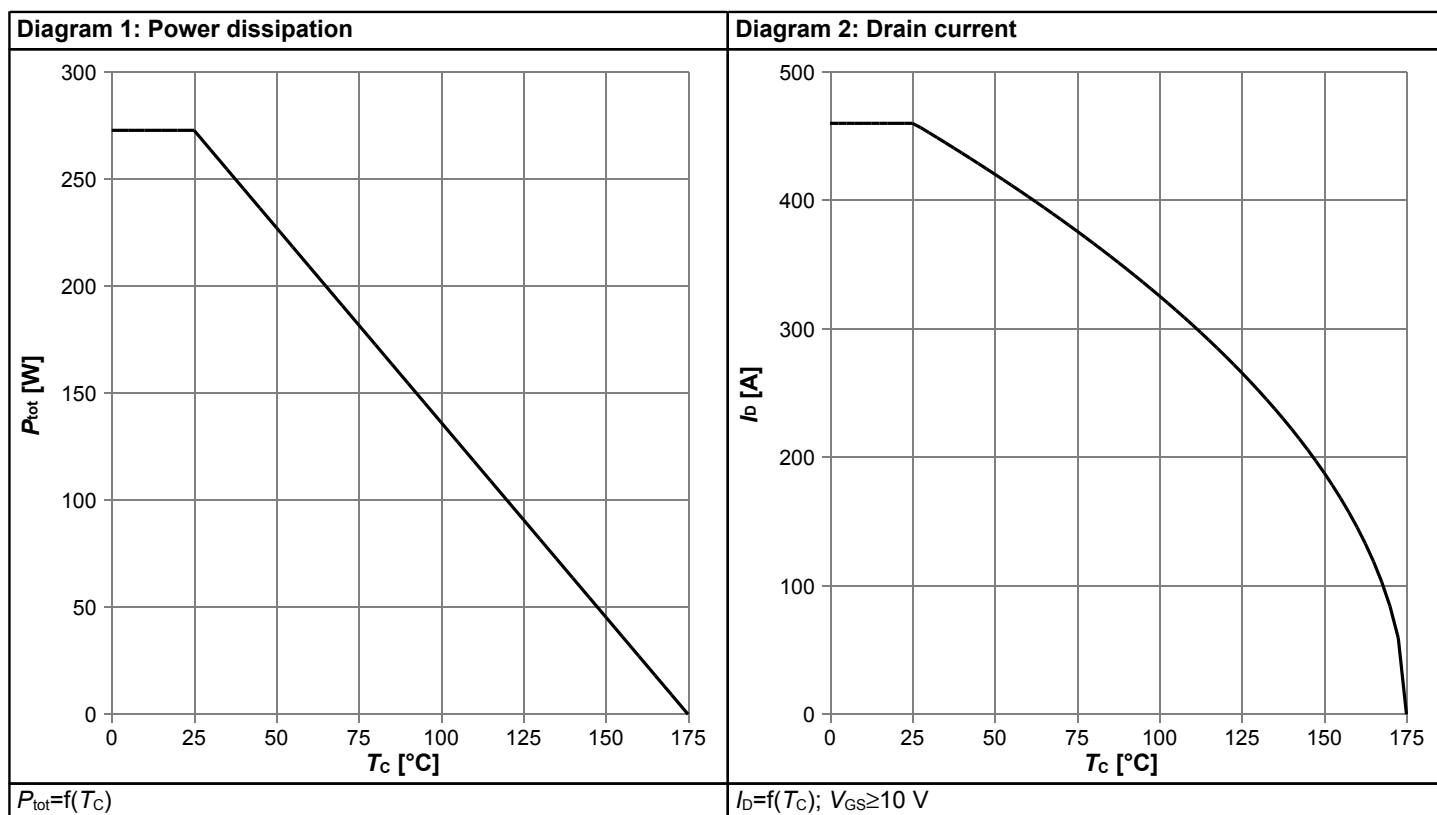
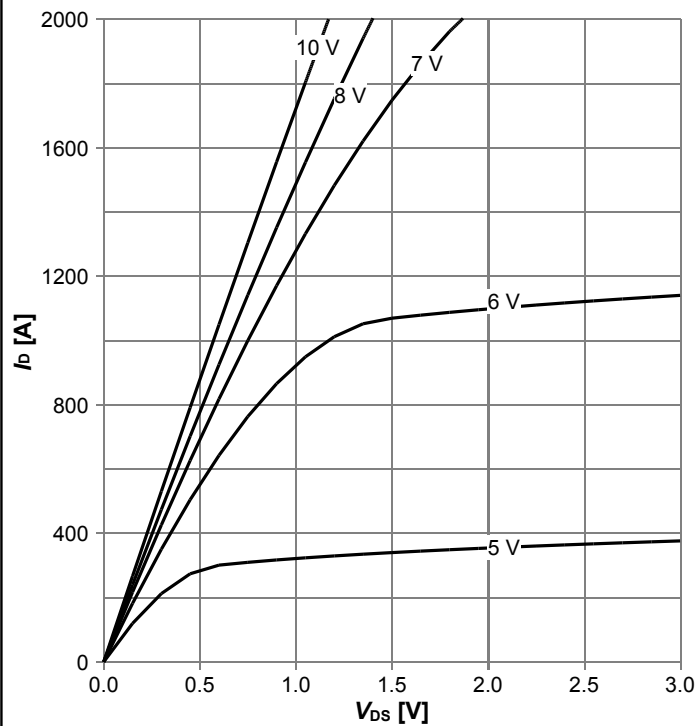
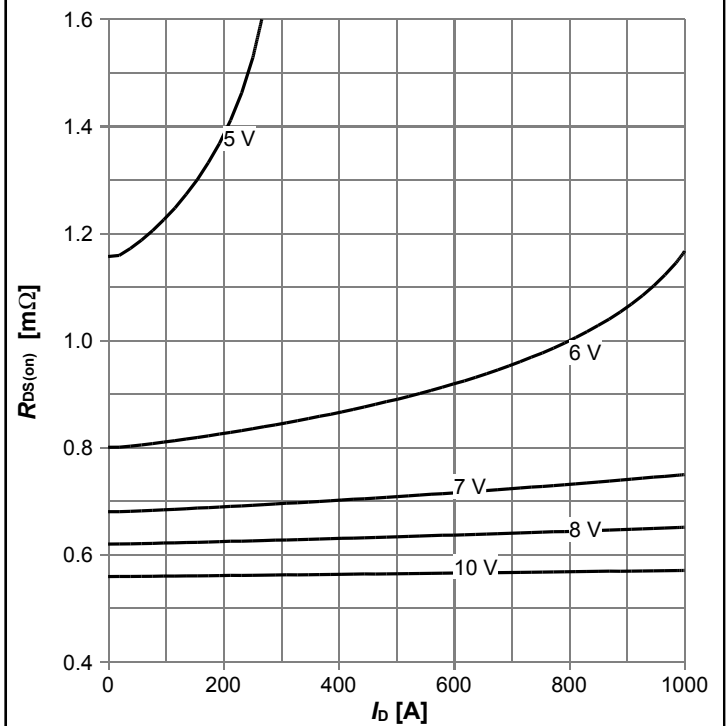


Diagram 5: Typ. output characteristics



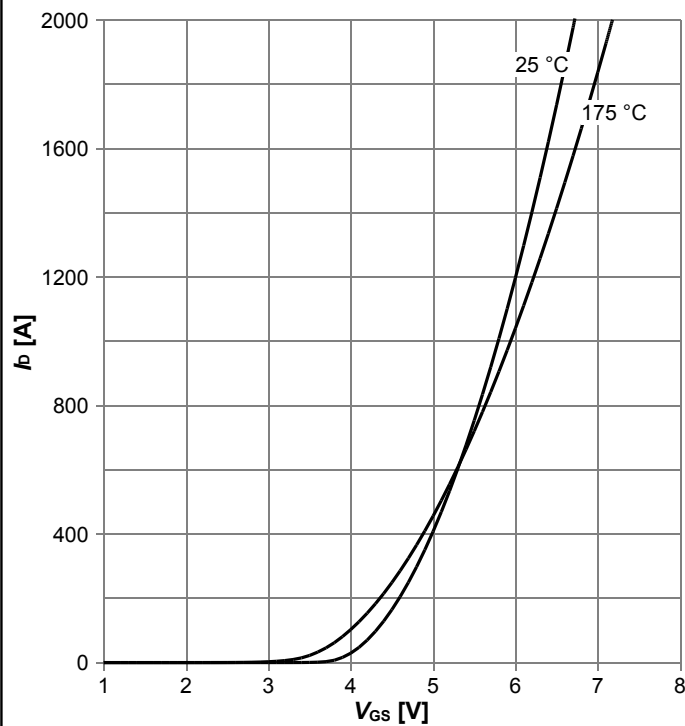
$I_D = f(V_{DS})$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



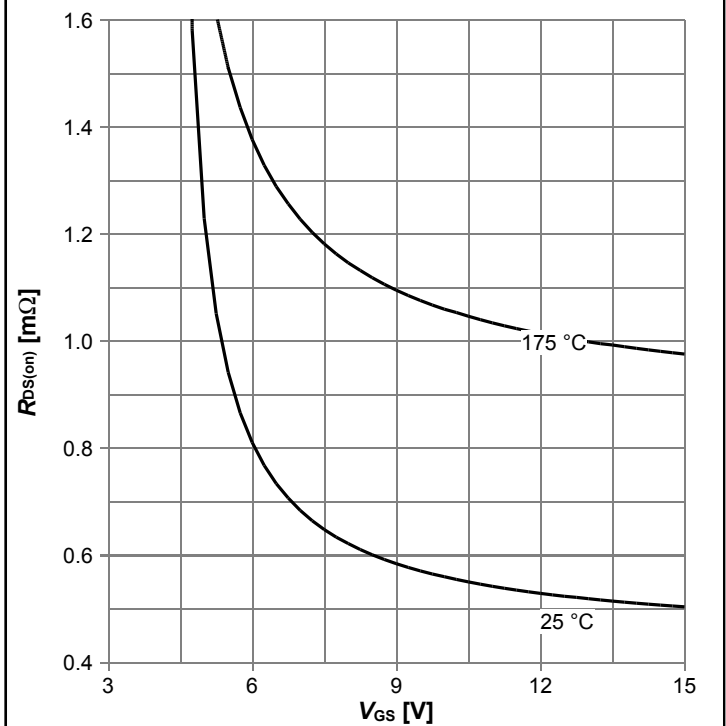
$R_{DS(on)} = f(I_D)$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



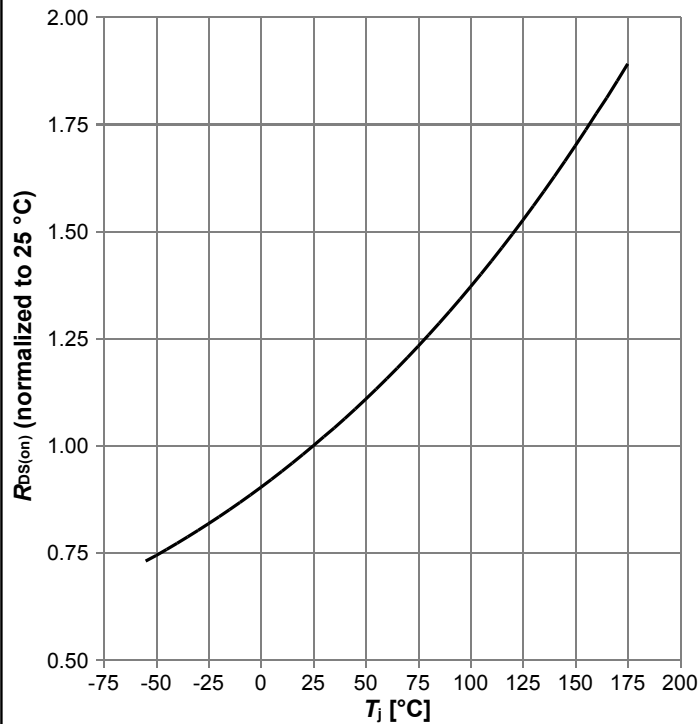
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2|I_D|R_{DS(on)max}$ ; parameter:  $T_j$

Diagram 8: Typ. drain-source on resistance



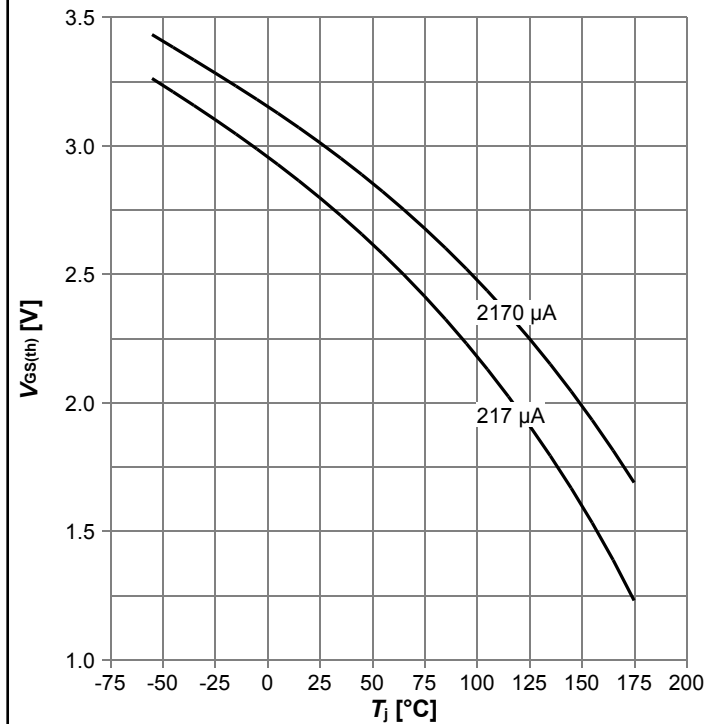
$R_{DS(on)} = f(V_{GS})$ ,  $I_D = 100\text{ A}$ ; parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



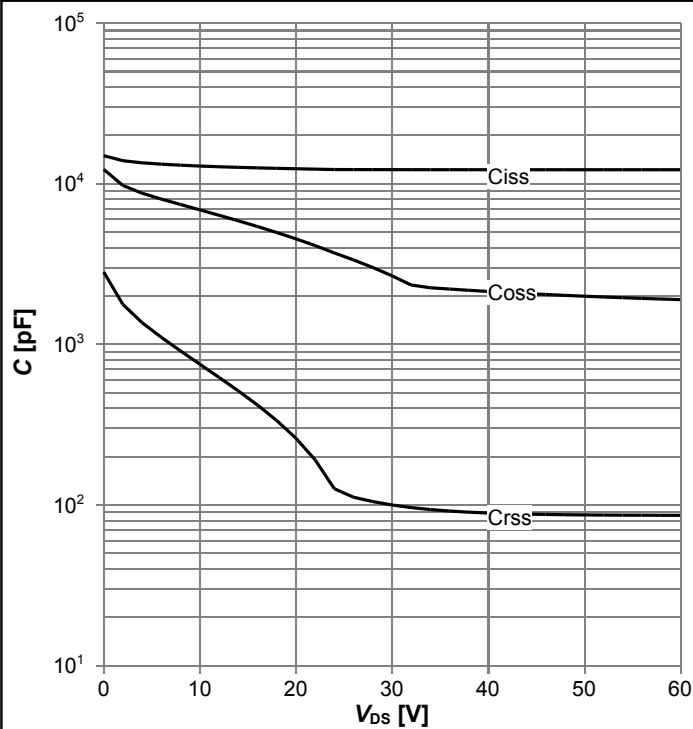
$R_{DS(on)}=f(T_j)$ ,  $I_D=100$  A,  $V_{GS}=10$  V

Diagram 10: Typ. gate threshold voltage



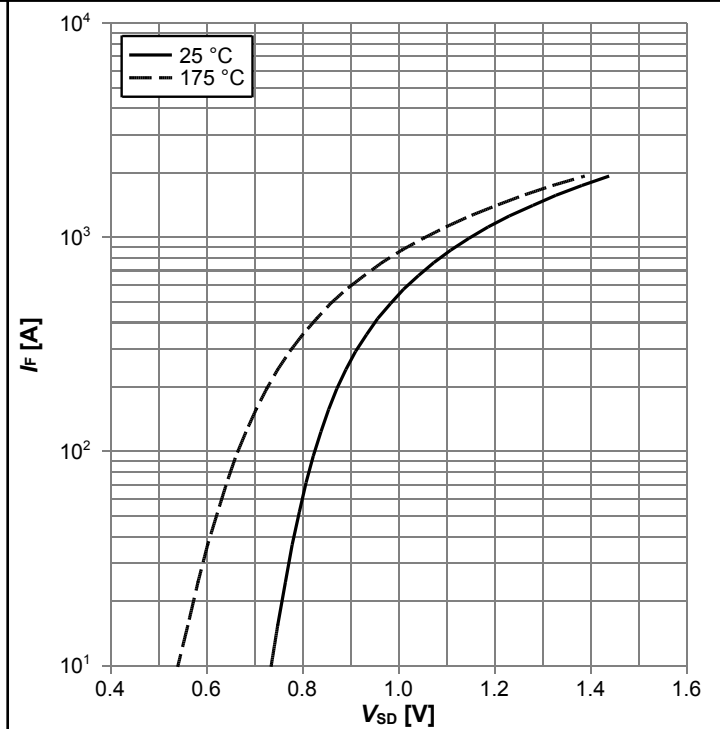
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



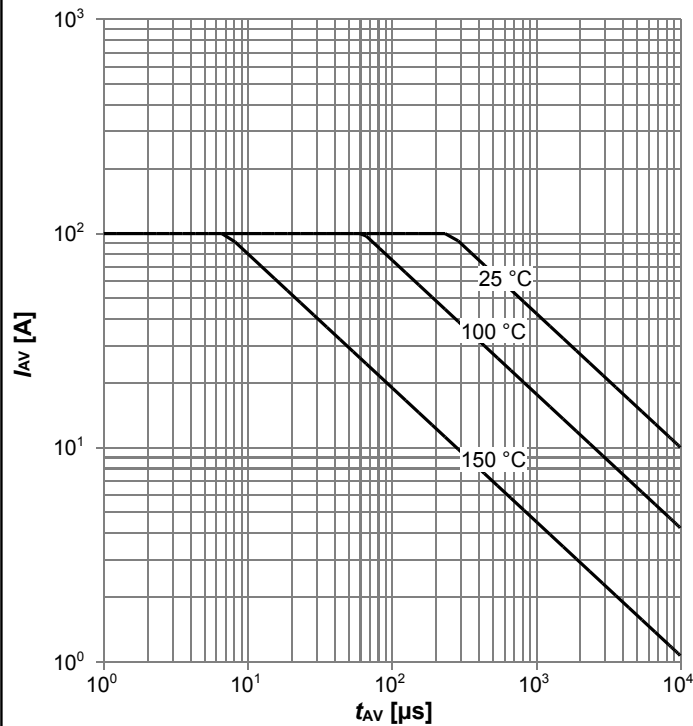
$C=f(V_{DS})$ ;  $V_{GS}=0$  V;  $f=1$  MHz

Diagram 12: Typ. forward characteristics of reverse diode



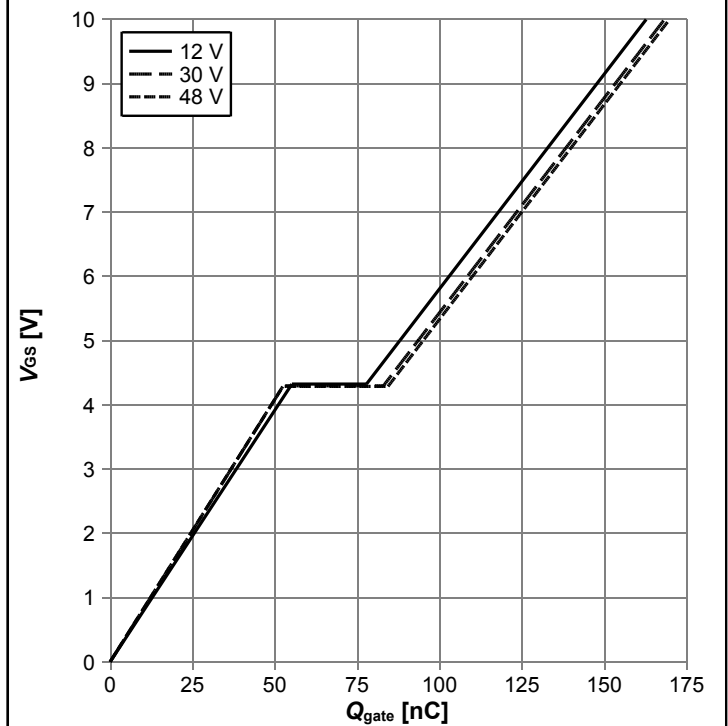
$I_F=f(V_{SD})$ ; parameter:  $T_j$

Diagram 13: Avalanche characteristics



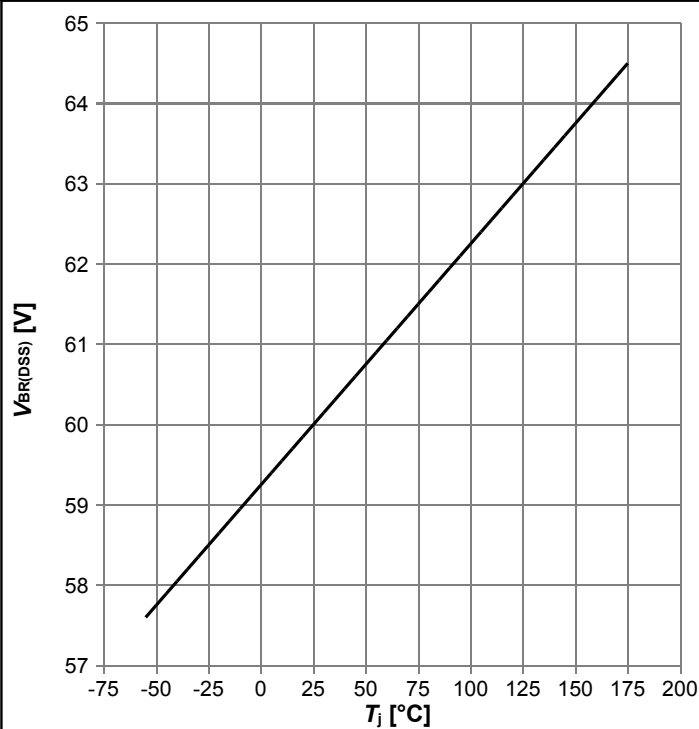
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j,start}$

Diagram 14: Typ. gate charge



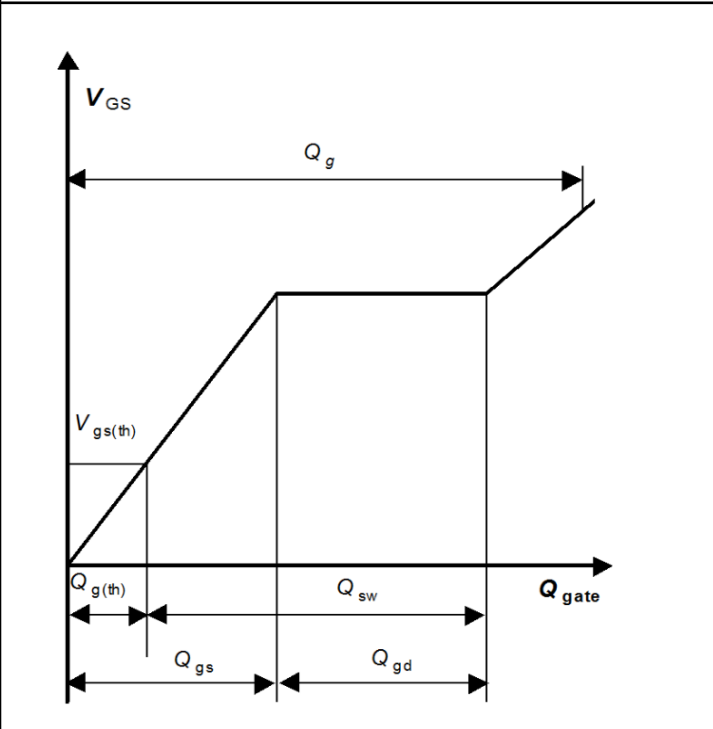
$V_{GS}=f(Q_{gate})$ ,  $I_D=100\text{ A}$  pulsed,  $T_j=25\text{ °C}$ ; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage

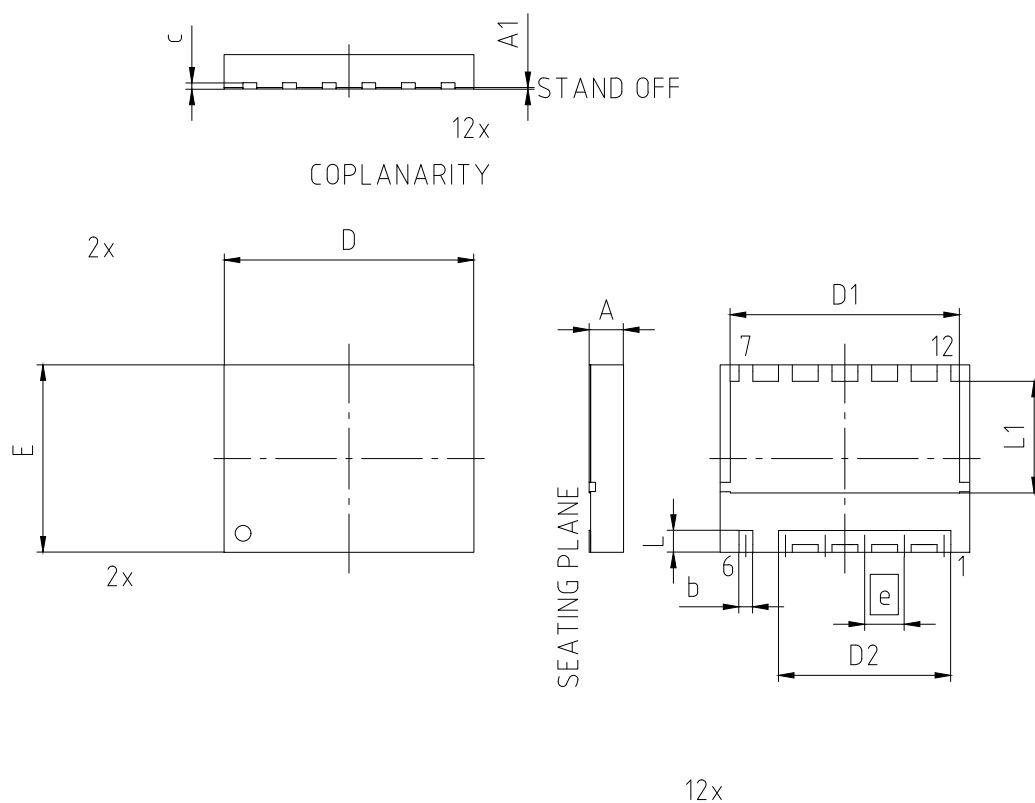


$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1\text{ mA}$

Diagram Gate charge waveforms

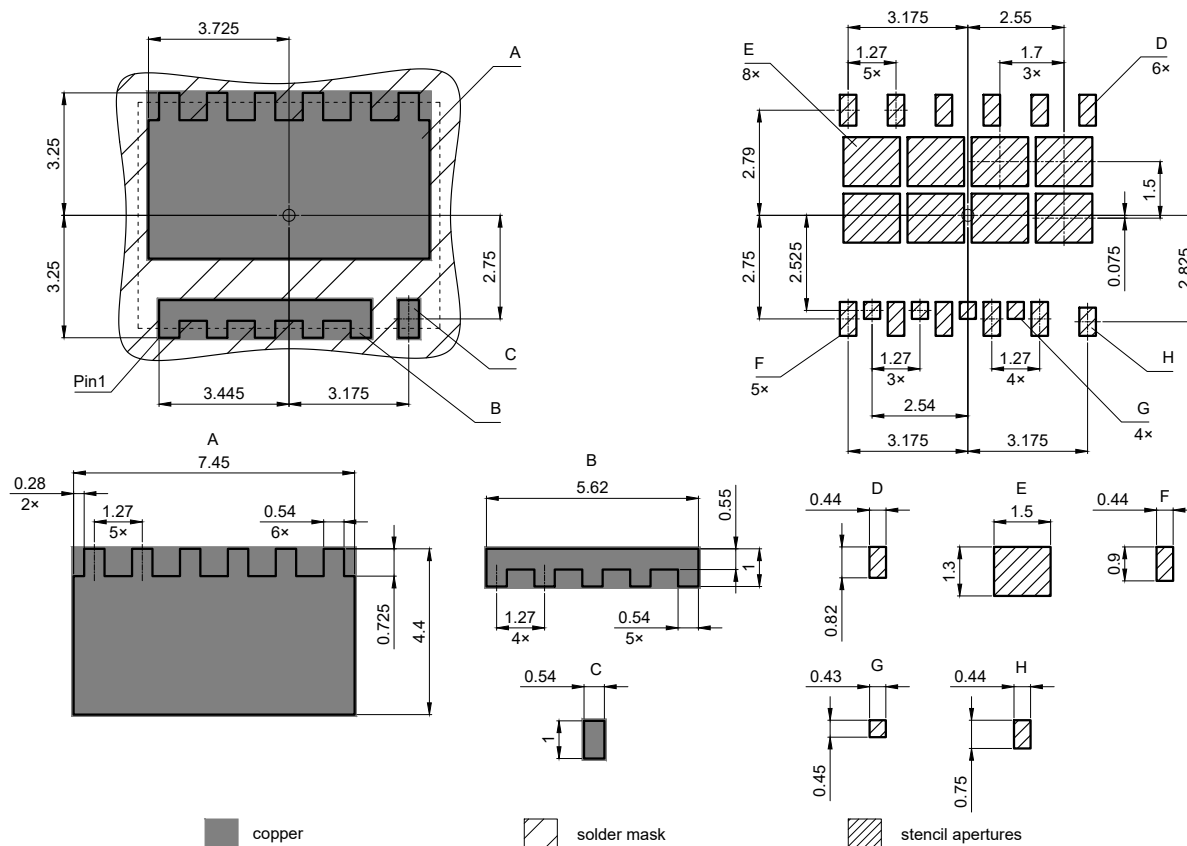


## 5 Package Outlines



| PACKAGE - GROUP<br>NUMBER: <b>PG-TSON-12-U01</b> |             |      |
|--------------------------------------------------|-------------|------|
| DIMENSIONS                                       | MILLIMETERS |      |
|                                                  | MIN.        | MAX. |
| <b>A</b>                                         | -           | 1.10 |
| <b>A1</b>                                        | -           | 0.05 |
| <b>b</b>                                         | 0.39        | 0.49 |
| <b>c</b>                                         | 0.20        |      |
| <b>D</b>                                         | 8.00        |      |
| <b>D1</b>                                        | 7.25        | 7.45 |
| <b>D2</b>                                        | 5.42        | 5.62 |
| <b>E</b>                                         | 6.00        |      |
| <b>e</b>                                         | 1.27        |      |
| <b>L</b>                                         | 0.60        | 0.80 |
| <b>L1</b>                                        | 3.48        | 3.68 |

Figure 1 Outline PG-TSON-12, dimensions in mm



All dimensions are in units mm  
All pads are solder mask defined

Figure 2 Outline Boardpad (PG-TSON-12), dimensions in mm

## Revision History

IQFH68N06NM5

**Revision: 2023-09-06, Rev. 2.0**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2023-09-06 | Release of final version                     |

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### Published by

**Infineon Technologies AG**

**81726 München, Germany**

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