

# MOSFET

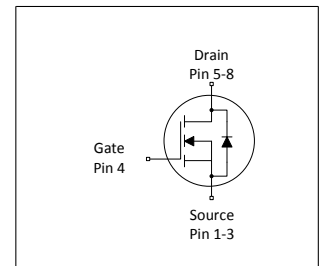
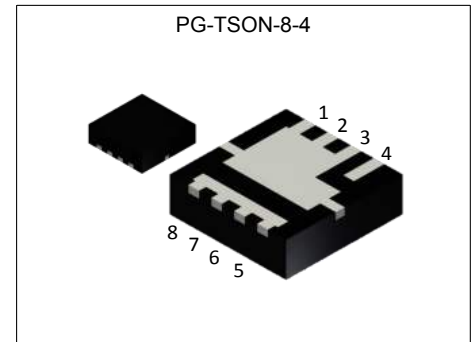
## OptiMOS™ 5 Power-Transistor, 25 V

### Features

- Very low on-resistance  $R_{DS(on)}$  @  $V_{GS}=4.5\text{ V}$
- 100% avalanche tested
- Superior thermal resistance
- N-channel
- 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**

| Parameter        | Value | Unit       |
|------------------|-------|------------|
| $V_{DS}$         | 25    | V          |
| $R_{DS(on),max}$ | 0.65  | m $\Omega$ |
| $I_D$            | 298   | A          |
| $Q_{oss}$        | 41    | nC         |
| $Q_G(0V..4.5V)$  | 29    | nC         |



| Type / Ordering Code | Package     | Marking | Related Links |
|----------------------|-------------|---------|---------------|
| IQE006NE2LM5         | PG-TSON-8-4 | 006E2L5 | -             |

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## 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>       | $I_D$          | -      | -    | 298<br>188<br>41 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=4.5\text{ V}$ , $T_A=25\text{ °C}$ ,<br>$R_{THJA}=60\text{ °C/W}^2)$ |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$  | -      | -    | 1192             | A    | $T_A=25\text{ °C}$  |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$       | -      | -    | 140              | mJ   | $I_D=20\text{ A}$ , $R_{GS}=25\text{ }\Omega$   |
| Gate source voltage                          | $V_{GS}$       | -16    | -    | 16               | V    | -   |
| Power dissipation                            | $P_{tot}$      | -      | -    | 89<br>2.1        | W    | $T_C=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{THJA}=60\text{ °C/W}^2)$   |
| Operating and storage temperature            | $T_j, T_{stg}$ | -55    | -    | 150              | °C   | IEC climatic category; DIN IEC 68-1:<br>55/150/56   |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter  | Symbol     | Values |      |      | Unit | Note / Test Condition |
|--|------------|--------|------|------|------|-----------------------|
|  |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case              | $R_{thJC}$ | -      | -    | 1.4  | °C/W | -                     |
| Device on PCB,<br>6 cm <sup>2</sup> cooling area | $R_{thJA}$ | -      | -    | 60   | °C/W | -                     |

<sup>1)</sup> Rating refers to the product only with datasheet specified absolute maximum values, maintaining case temperature at 25°C. For higher 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   | $V_{(BR)DSS}$ | 25     | -            | -            | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$   |
| Gate threshold voltage           | $V_{GS(th)}$  | 1.2    | 1.6          | 2            | V             | $V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$  |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10    | 1<br>100     | $\mu\text{A}$ | $V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=20\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10           | 100          | nA            | $V_{GS}=16\text{ V}$ , $V_{DS}=0\text{ V}$  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 0.50<br>0.65 | 0.65<br>0.80 | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$<br>$V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$   |
| Gate resistance <sup>1)</sup>    | $R_G$         | -      | 0.7          | 1.2          | $\Omega$      | -   |
| Transconductance                 | $g_{fs}$      | -      | 220          | -            | S             | $ V_{DS} \geq 2 I_D /R_{DS(on)max}$ , $I_D=20\text{ A}$   |

**Table 5 Dynamic characteristics**

| Parameter                                  | Symbol       | Values |      |      | Unit | Note / Test Condition   |
|--|--------------|--------|------|------|------|---|
|  |              | Min.   | Typ. | Max. |      |   |
| Input capacitance <sup>1)</sup>            | $C_{iss}$    | -      | 4100 | 5453 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                       |
| Output capacitance <sup>1)</sup>           | $C_{oss}$    | -      | 1700 | 2261 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                       |
| Reverse transfer capacitance <sup>1)</sup> | $C_{rss}$    | -      | 130  | 195  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=12\text{ V}$ , $f=1\text{ MHz}$                                       |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 5.3  | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                                  | $t_r$        | -      | 2.6  | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 27.0 | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                                  | $t_f$        | -      | 5.3  | -    | ns   | $V_{DD}=12\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<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              | $Q_{gs}$      | -      | 9.2  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge at threshold           | $Q_{g(th)}$   | -      | 5.8  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate to drain charge <sup>1)</sup> | $Q_{gd}$      | -      | 5.6  | 8.4  | nC   | $V_{DD}=12\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 9.0  | -    | nC   | $V_{DD}=12\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 28.5 | 37.9 | nC   | $V_{DD}=12\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 2.2  | -    | V    | $V_{DD}=12\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 61.7 | 82.1 | nC   | $V_{DD}=12\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Gate charge total, sync. FET       | $Q_{g(sync)}$ | -      | 60.4 | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                     |
| Output charge                      | $Q_{oss}$     | -      | 41.3 | -    | nC   | $V_{DD}=12\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

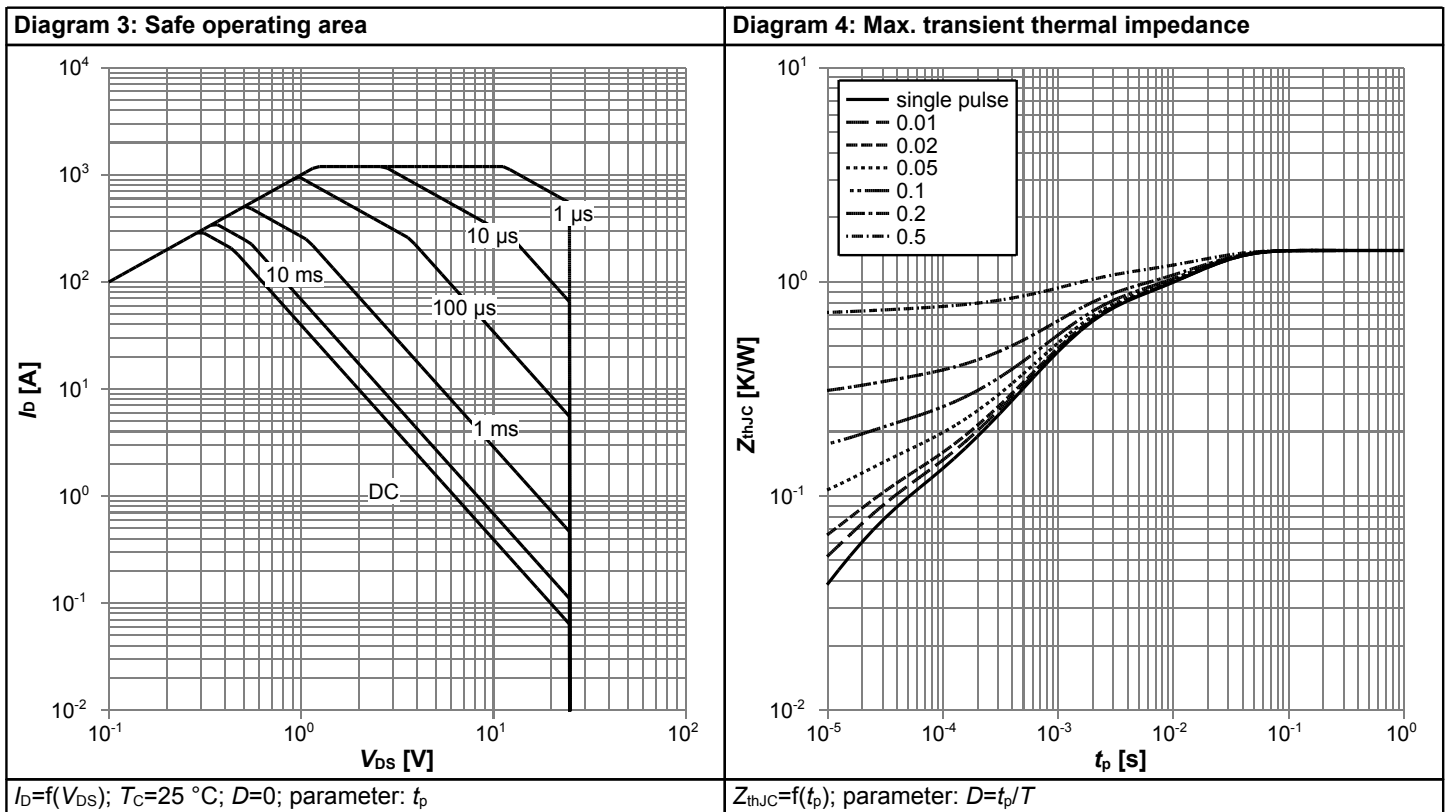
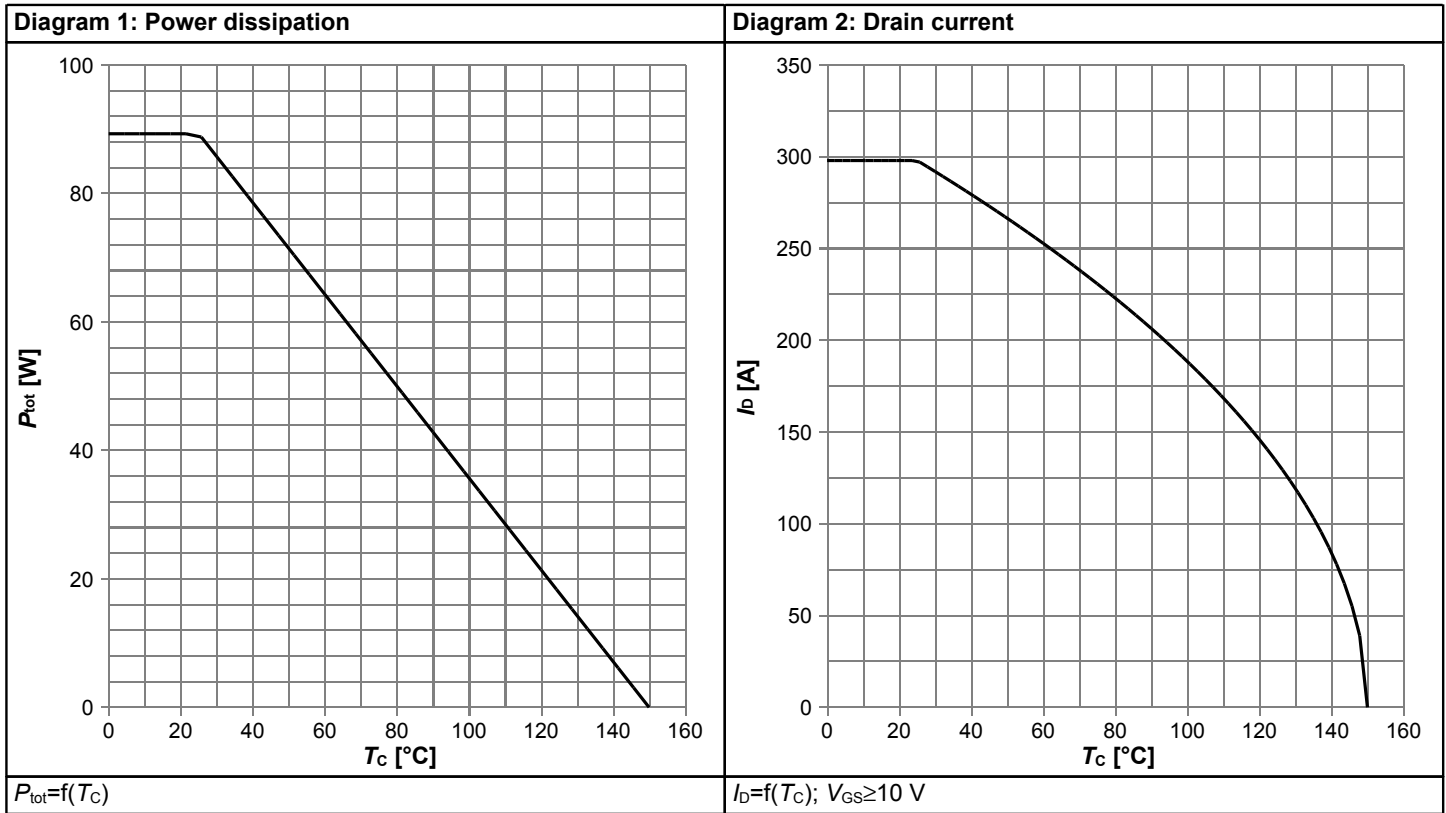
<sup>1)</sup> Defined by design. Not subject to production test.

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

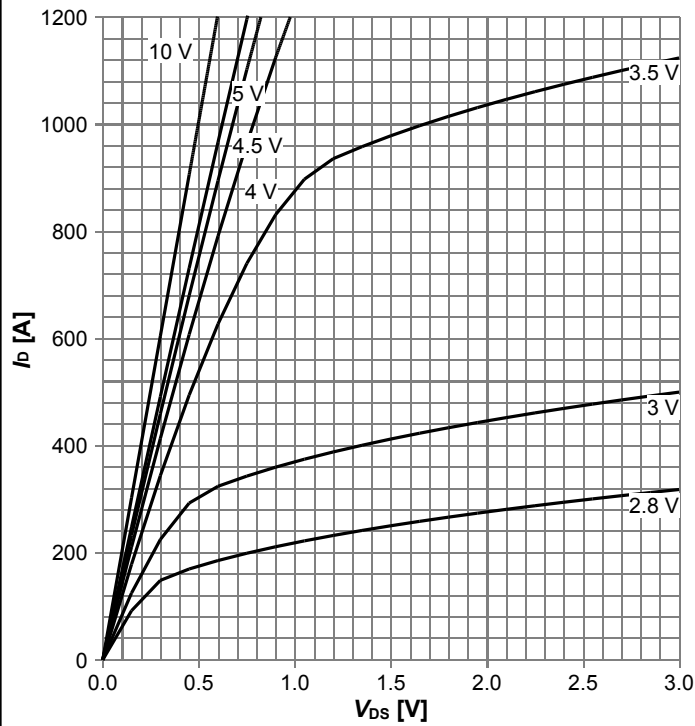
**Table 7 Reverse diode**

| Parameter                        | Symbol        | Values |      |      | Unit | Note / Test Condition  |
|----------------------------------|---------------|--------|------|------|------|--|
|                                  |               | Min.   | Typ. | Max. |      |  |
| Diode continuous forward current | $I_S$         | -      | -    | 83   | A    | $T_C=25\text{ °C}$   |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 1192 | A    | $T_C=25\text{ °C}$   |
| Diode forward voltage            | $V_{SD}$      | -      | 0.75 | 1    | V    | $V_{GS}=0\text{ V}, I_F=20\text{ A}, T_j=25\text{ °C}$               |
| Reverse recovery charge          | $Q_{rr}$      | -      | 25   | -    | nC   | $V_R=12\text{ V}, I_F=20\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |

### 4 Electrical characteristics diagrams

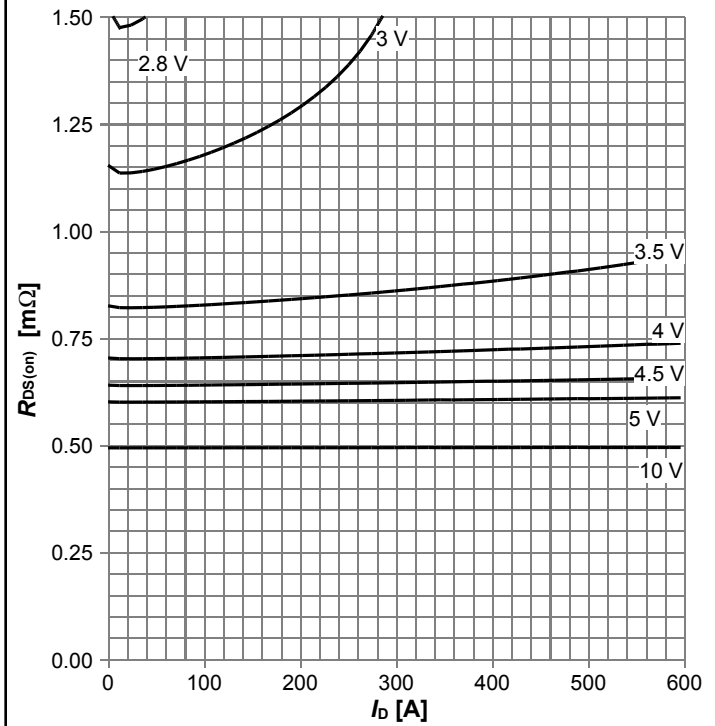


**Diagram 5: Typ. output characteristics**



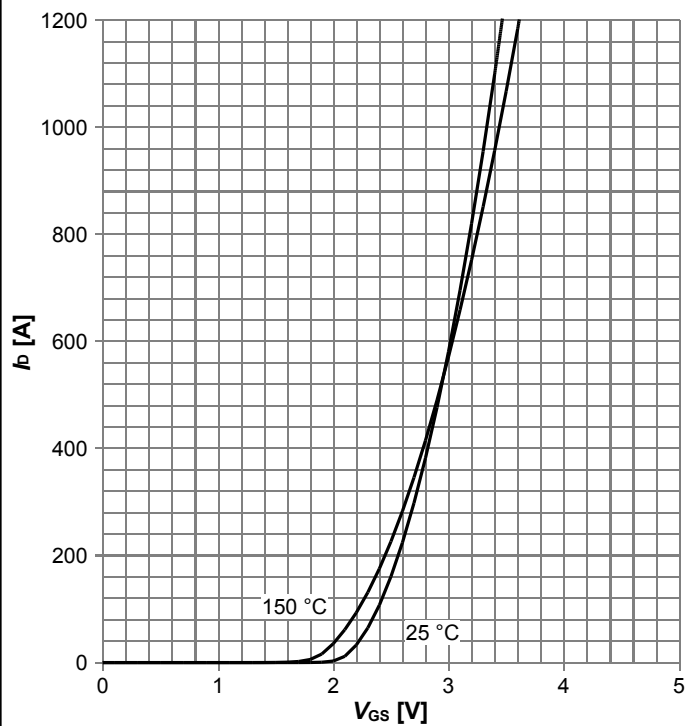
$I_D = f(V_{DS}), T_j = 25\text{ °C};$  parameter:  $V_{GS}$

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



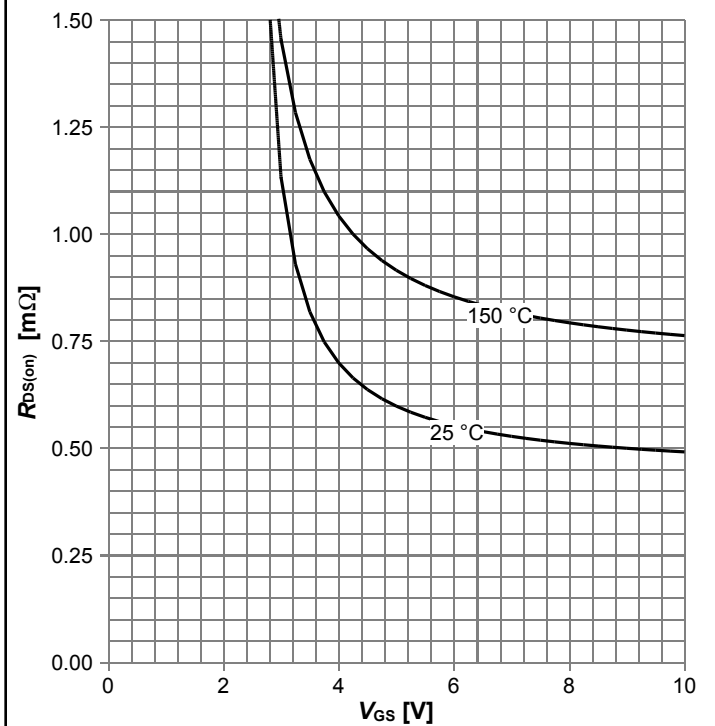
$R_{DS(on)} = f(I_D), T_j = 25\text{ °C};$  parameter:  $V_{GS}$

**Diagram 7: Typ. transfer characteristics**



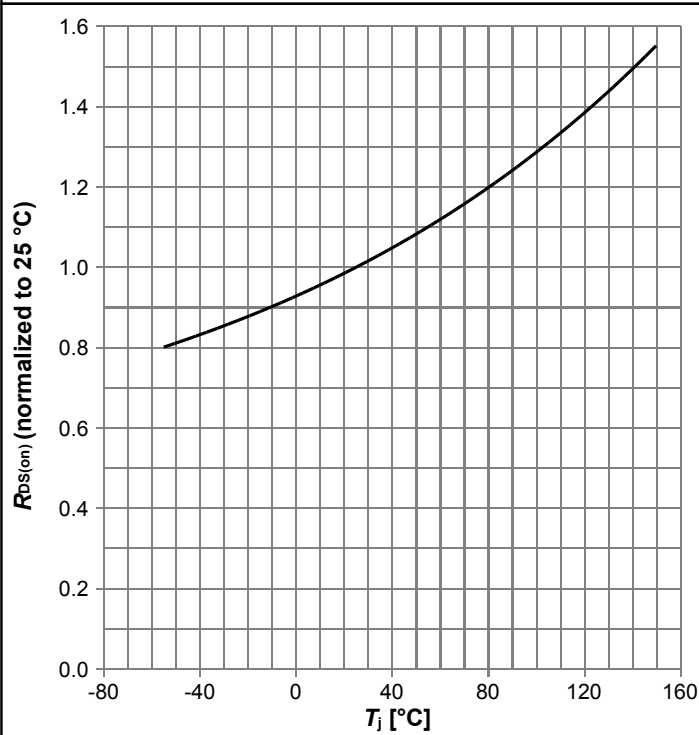
$I_D = f(V_{GS}), |V_{DS}| > 2|I_D| R_{DS(on)max};$  parameter:  $T_j$

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



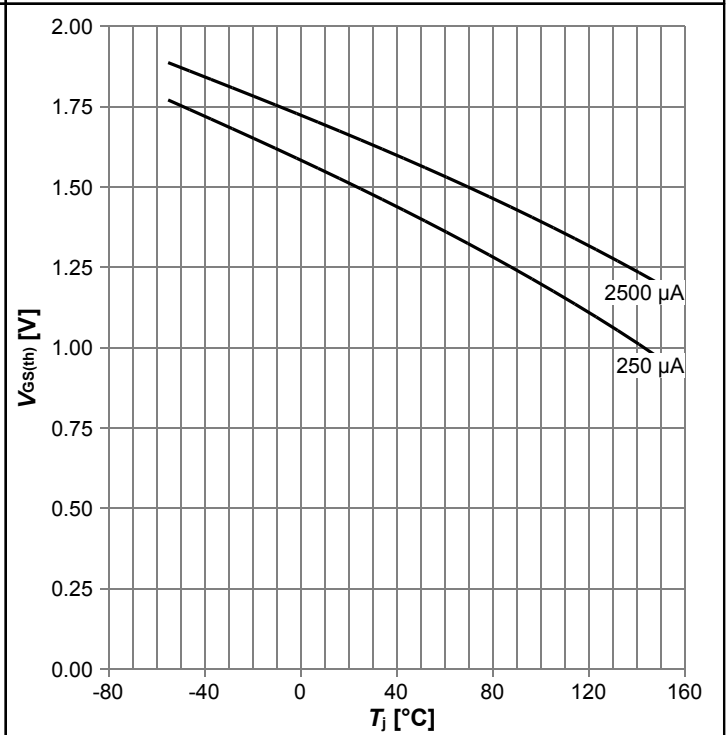
$R_{DS(on)} = f(V_{GS}), I_D = 20\text{ A};$  parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



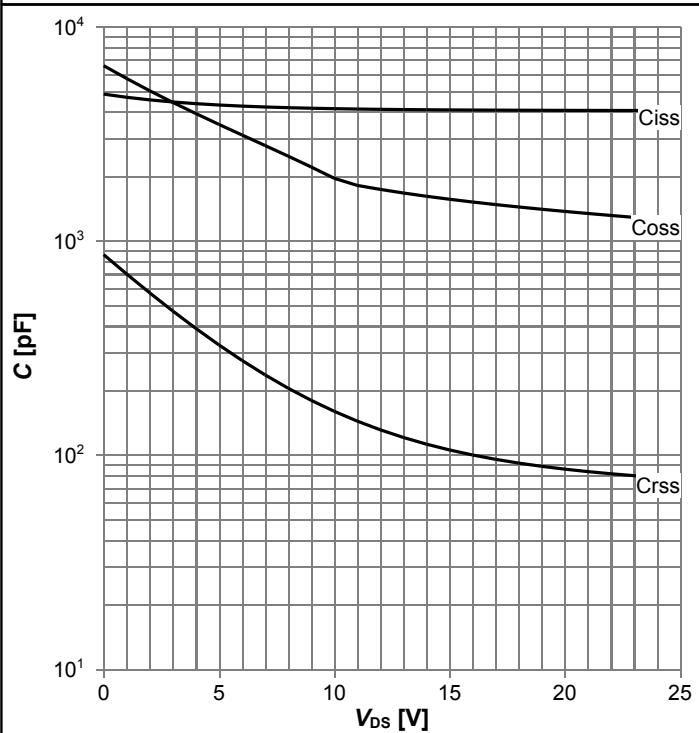
$R_{DS(on)}=f(T_j)$ ,  $I_D=20$  A,  $V_{GS}=10$  V

Diagram 10: Typ. gate threshold voltage



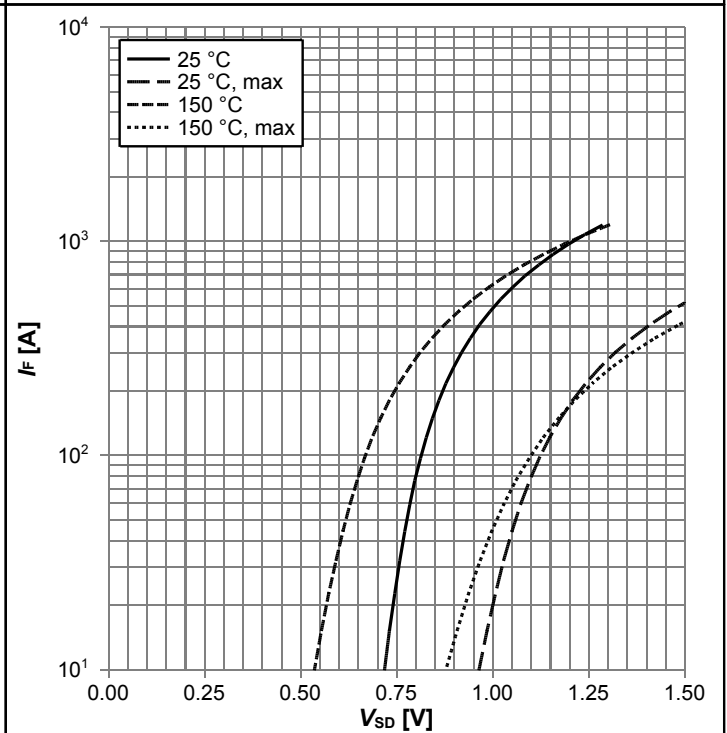
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



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

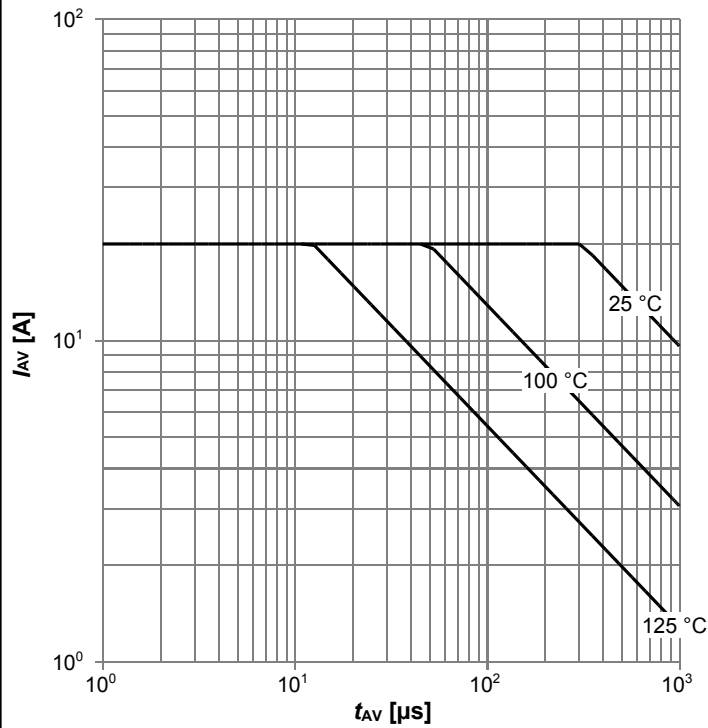
Diagram 12: Forward characteristics of reverse diode



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

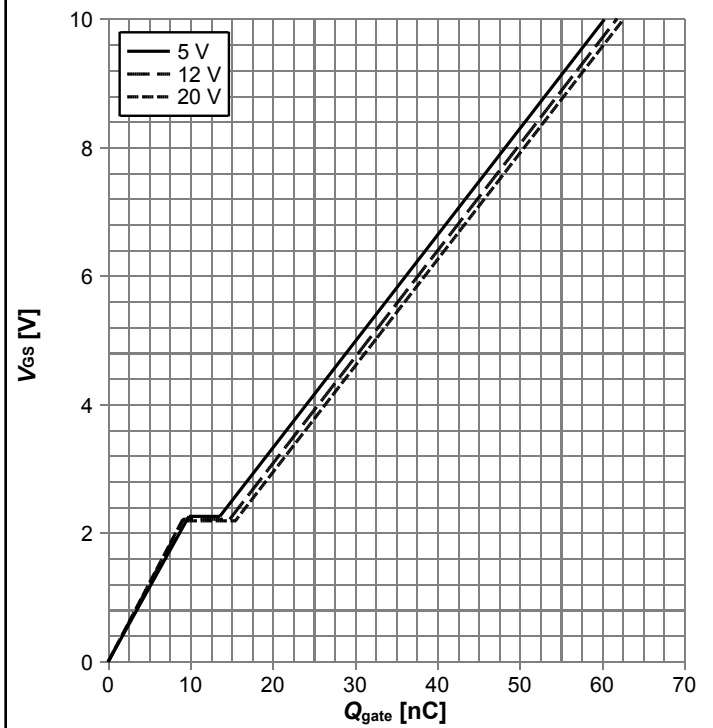


Diagram 13: Avalanche characteristics



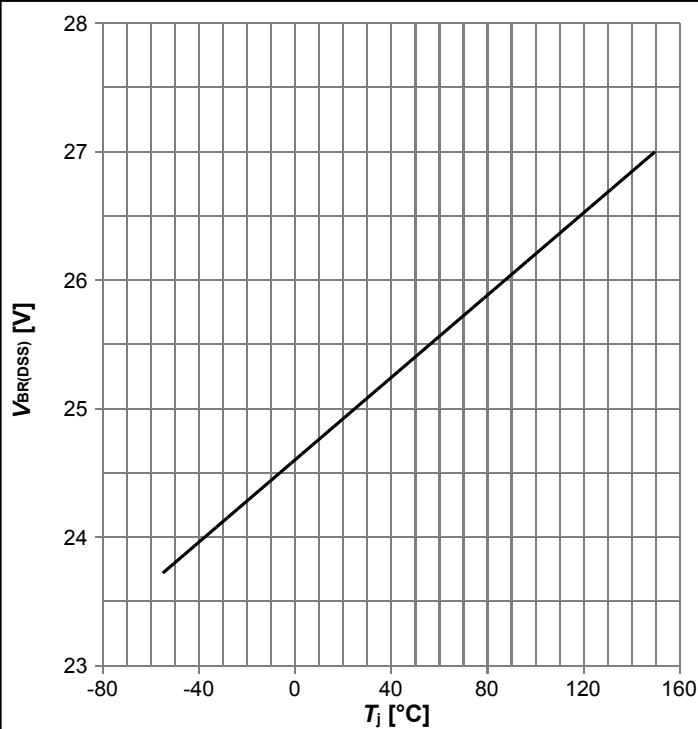
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25 \Omega$ ; parameter:  $T_{j,start}$

Diagram 14: Typ. gate charge



$V_{GS}=f(Q_{gate})$ ,  $I_D=20$  A pulsed,  $T_j=25$  °C; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage

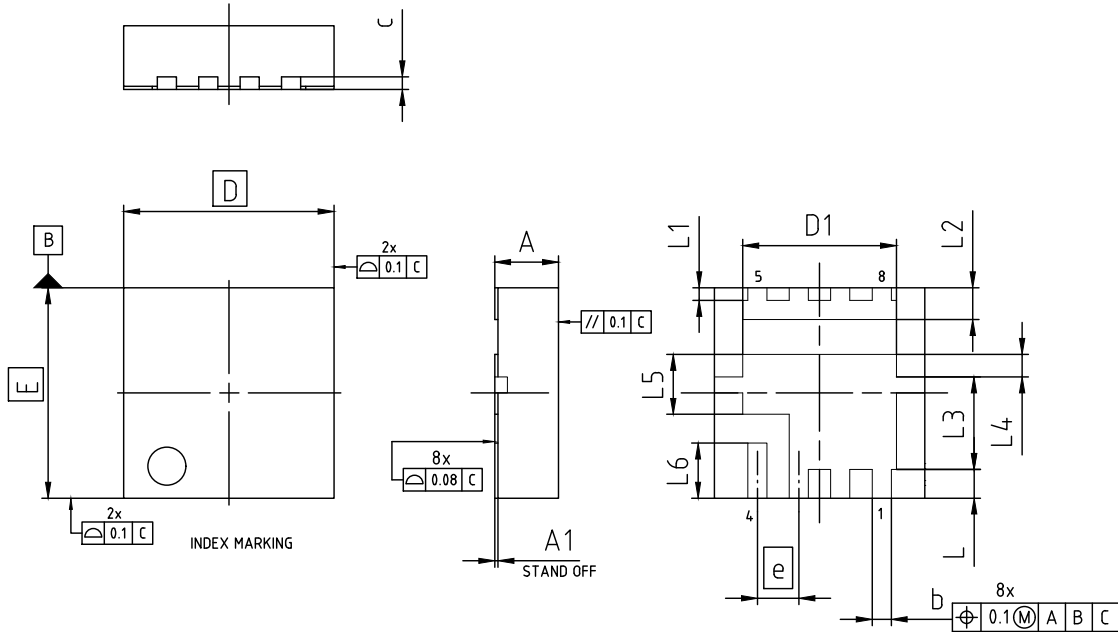


$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1$  mA

Diagram Gate charge waveforms



## 5 Package Outlines



| DIMENSION | MILLIMETERS |      |
|-----------|-------------|------|
|           | MIN.        | MAX. |
| A         | -           | 1.10 |
| A1        | -           | 0.05 |
| b         | 0.20        | 0.40 |
| c         | 0.20        |      |
| D         | 3.30        |      |
| D1        | 2.31        | 2.51 |
| E         | 3.30        |      |
| e         | 0.65        |      |
| L         | 0.35        | 0.55 |
| L1        | 0.10        | 0.30 |
| L2        | 0.40        | 0.60 |
| L3        | 1.35        | 1.55 |
| L4        | 0.26        | 0.46 |
| L5        | 0.84        | 1.04 |
| L6        | 0.77        | 0.97 |

|                             |
|-----------------------------|
| DOCUMENT NO.<br>Z8B00198723 |
| REVISION<br>01              |
| SCALE 10:1<br>0 1 2mm<br>   |
| EUROPEAN PROJECTION<br>     |
| ISSUE DATE<br>06.11.2019    |

Figure 1 Outline PG-TSON-8-4, dimensions in mm

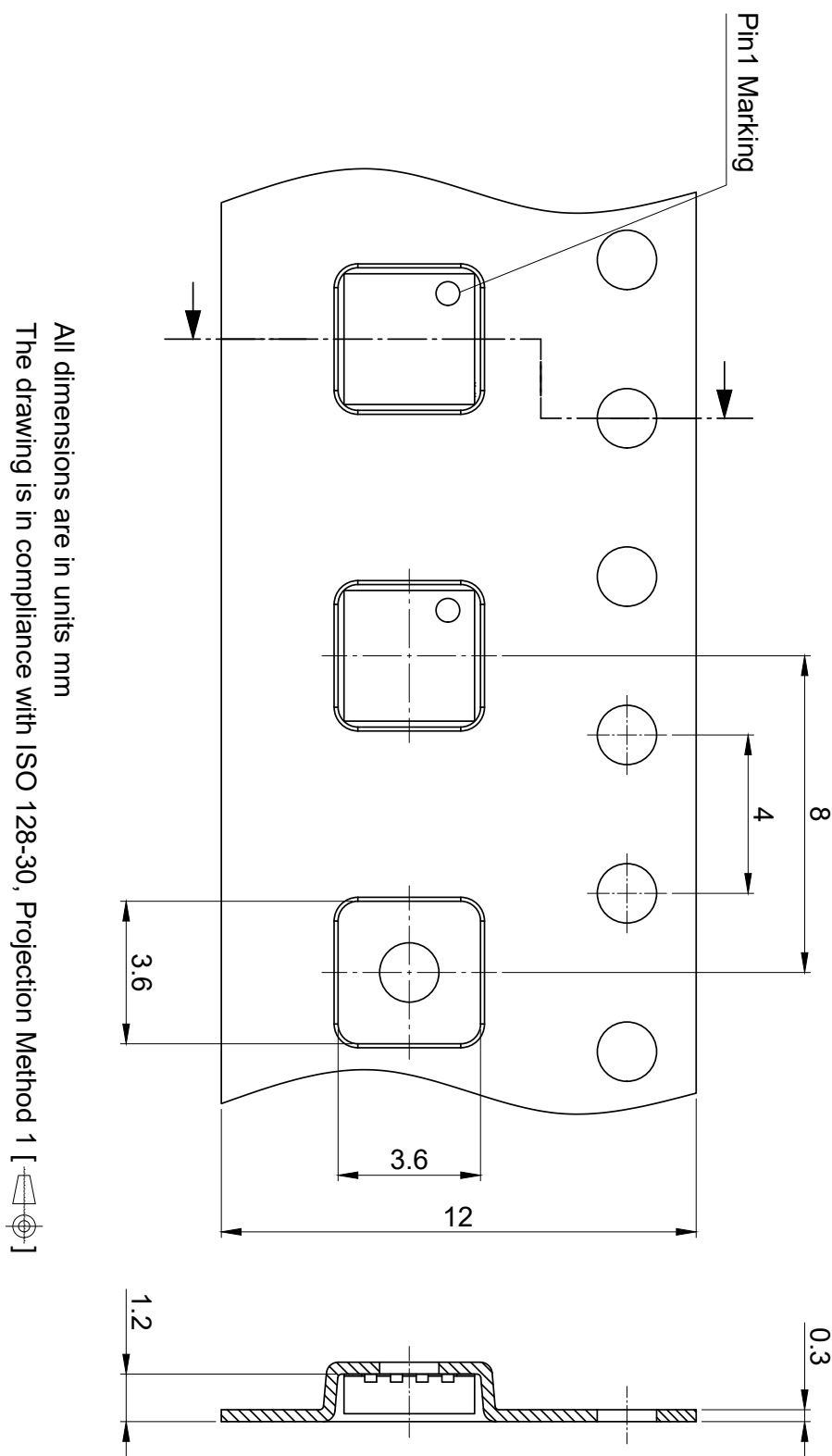


Figure 2 Outline Tape (PG-TSON-8-4)

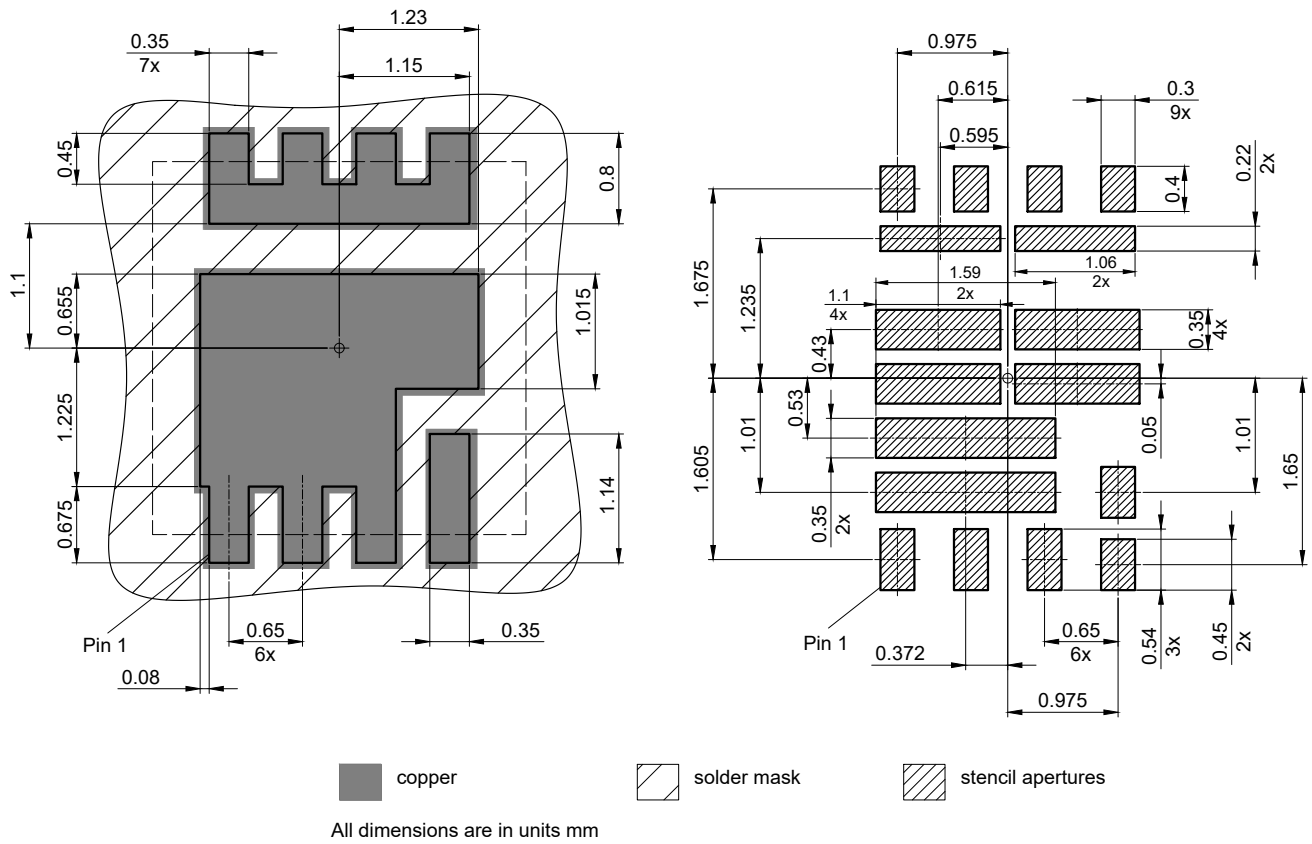


Figure 3 Outline Boardpad (PG-TSON-8-4)

## Revision History

IQE006NE2LM5

**Revision: 2020-03-16, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0      | 2019-12-05 | Release of final version                     |
| 2.1      | 2020-03-16 | Update footnotes                             |

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### Published by

**Infineon Technologies AG**

**81726 München, Germany**

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