

# MOSFET

## OptiMOS™ 5 Power-Transistor, 30 V

### Features

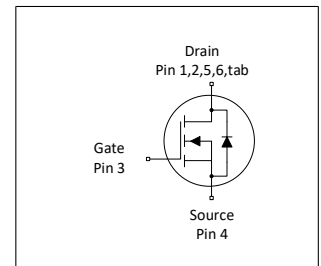
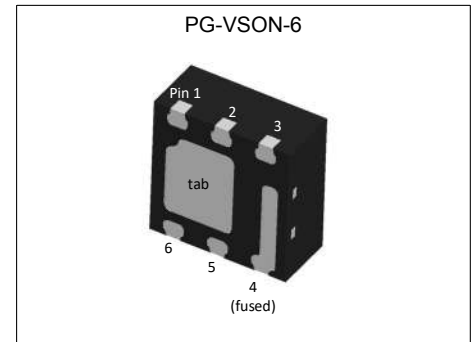
- Lowest on-resistance  $R_{DS(on)}$  in a 2x2 package
- Optimized for highest performance and power density
- 100% avalanche tested
- Superior thermal resistance for a 2x2 package
- N-channel
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

### Product validation

Fully qualified according to JEDEC for Industrial Applications

**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit       |
|------------------|-------|------------|
| $V_{DS}$         | 30    | V          |
| $R_{DS(on),max}$ | 3.6   | m $\Omega$ |
| $I_D$            | 81    | A          |
| $Q_{oss}$        | 8.2   | nC         |
| $Q_G(0V..4.5V)$  | 7.2   | nC         |



RoHS

| Type / Ordering Code | Package   | Marking | Related Links |
|----------------------|-----------|---------|---------------|
| ISK036N03LM5         | PG-VSON-6 | 3603    | -             |

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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>       | $I_D$          | -      | -    | 81<br>51<br>16.5 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=4.5\text{ V}$ , $T_A=25\text{ °C}$ , $R_{thJA}=60\text{ °C/W}^2)$ |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$  | -      | -    | 323              | A    | $T_C=25\text{ °C}$   |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$       | -      | -    | 7                | mJ   | $I_D=20\text{ A}$ , $R_{GS}=25\text{ }\Omega$  |
| Gate source voltage                          | $V_{GS}$       | -16    | -    | 16               | V    | -  |
| Power dissipation                            | $P_{tot}$      | -      | -    | 39<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   | -  |

## 2 Thermal characteristics

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

**Table 3 Thermal characteristics**

| Parameter   | Symbol     | Values |      |      | Unit | Note / Test Condition |
|---|------------|--------|------|------|------|-----------------------|
|   |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case, bottom                 | $R_{thJC}$ | -      | 1.6  | 3.2  | °C/W | -                     |
| Device on PCB, 6 cm <sup>2</sup> cooling area <sup>2)</sup> | $R_{thJA}$ | -      | -    | 60   | °C/W | -                     |

<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 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   | $V_{(BR)DSS}$ | 30     | -          | -          | V                | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$   |
| Gate threshold voltage           | $V_{GS(th)}$  | 1.2    | 1.6        | 2.0        | V                | $V_{DS}=V_{GS}$ , $I_D=250\text{ }\mu\text{A}$  |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10  | 1<br>100   | $\mu\text{A}$    | $V_{DS}=24\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=24\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 10         | 100        | nA               | $V_{GS}=16\text{ V}$ , $V_{DS}=0\text{ V}$  |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 2.6<br>3.3 | 3.6<br>4.6 | $\text{m}\Omega$ | $V_{GS}=10\text{ V}$ , $I_D=20\text{ A}$<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                 | $g_{fs}$      | -      | 96         | -          | 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>            | $C_{iss}$    | -      | 1010 | 1300 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=15\text{ V}$ , $f=1\text{ MHz}$                                       |
| Output capacitance <sup>1)</sup>           | $C_{oss}$    | -      | 270  | 350  | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=15\text{ V}$ , $f=1\text{ MHz}$                                       |
| Reverse transfer capacitance <sup>1)</sup> | $C_{rss}$    | -      | 32   | 56   | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=15\text{ V}$ , $f=1\text{ MHz}$                                       |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 7.7  | -    | ns   | $V_{DD}=15\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                                  | $t_r$        | -      | 1.4  | -    | ns   | $V_{DD}=15\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 14.6 | -    | ns   | $V_{DD}=15\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                                  | $t_f$        | -      | 1.5  | -    | ns   | $V_{DD}=15\text{ V}$ , $V_{GS}=4.5\text{ V}$ , $I_D=20\text{ A}$ ,<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    | $Q_{gs}$      | -      | 2.5  | 3.4  | nC   | $V_{DD}=15\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge at threshold | $Q_{g(th)}$   | -      | 1.6  | 2.2  | nC   | $V_{DD}=15\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate to drain charge     | $Q_{gd}$      | -      | 1.8  | 2.7  | nC   | $V_{DD}=15\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Switching charge         | $Q_{sw}$      | -      | 2.7  | 3.9  | nC   | $V_{DD}=15\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total        | $Q_g$         | -      | 7.2  | 9.0  | nC   | $V_{DD}=15\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate plateau voltage     | $V_{plateau}$ | -      | 2.5  | -    | V    | $V_{DD}=15\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }4.5\text{ V}$ |
| Gate charge total        | $Q_g$         | -      | 15.2 | 20.2 | nC   | $V_{DD}=15\text{ V}$ , $I_D=20\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$  |
| Output charge            | $Q_{oss}$     | -      | 8.2  | 10.9 | nC   | $V_{DD}=15\text{ V}$ , $V_{GS}=0\text{ V}$                                   |

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

<sup>2)</sup> See figure 16 for gate charge parameter definition. 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      | $I_S$         | -      | -    | 37   | A    | $T_C=25\text{ °C}$   |
| Diode pulse current                   | $I_{S,pulse}$ | -      | -    | 323  | A    | $T_C=25\text{ °C}$   |
| Diode forward voltage                 | $V_{SD}$      | -      | 0.79 | 1.0  | V    | $V_{GS}=0\text{ V}, I_F=20\text{ A}, T_j=25\text{ °C}$               |
| Reverse recovery time <sup>1)</sup>   | $t_{rr}$      | -      | 25.8 | 51.6 | ns   | $V_R=15\text{ V}, I_F=20\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge <sup>1)</sup> | $Q_{rr}$      | -      | 17.0 | 34   | nC   | $V_R=15\text{ V}, I_F=20\text{ A}, di_F/dt=100\text{ A}/\mu\text{s}$ |

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

### 4 Electrical characteristics diagrams

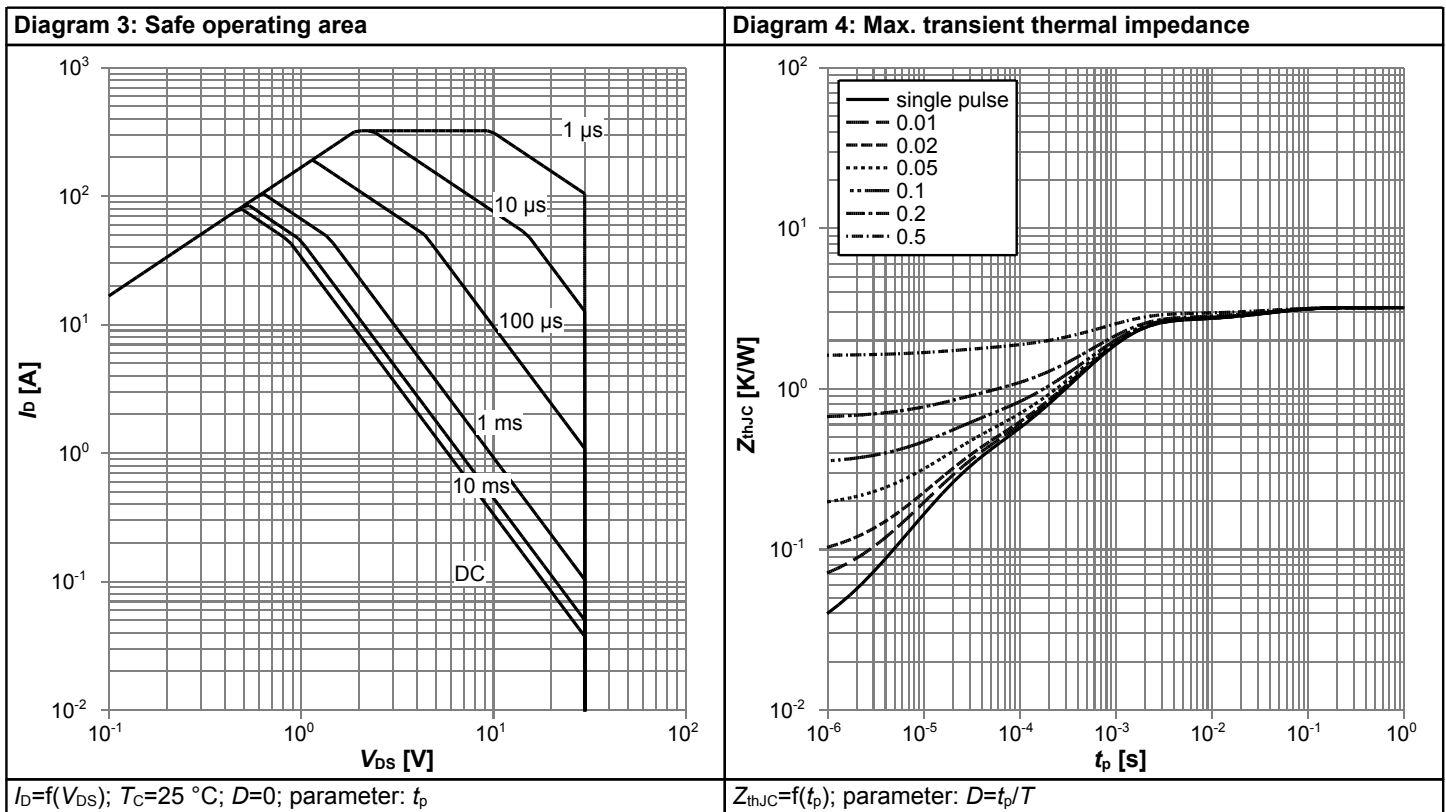
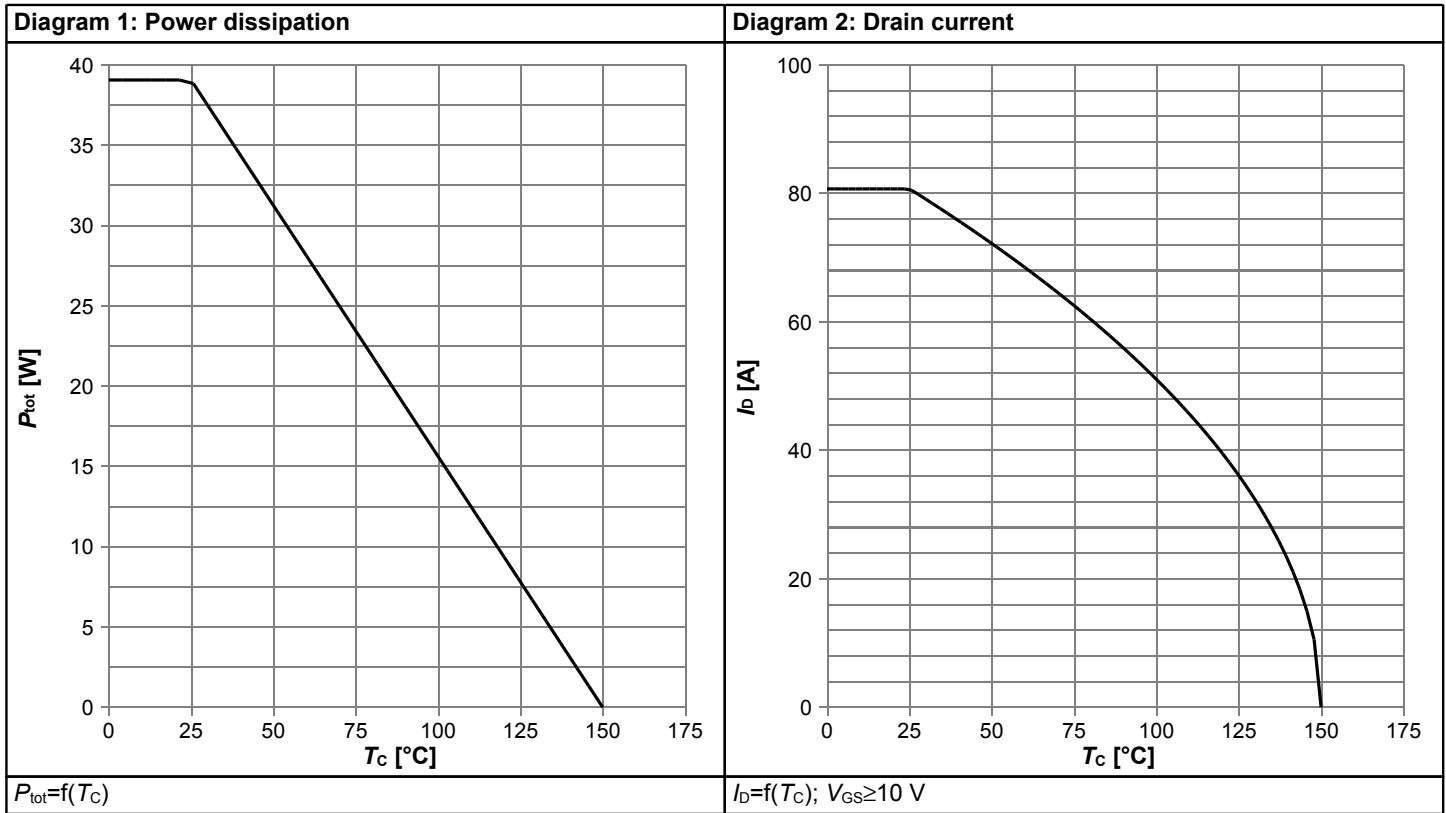
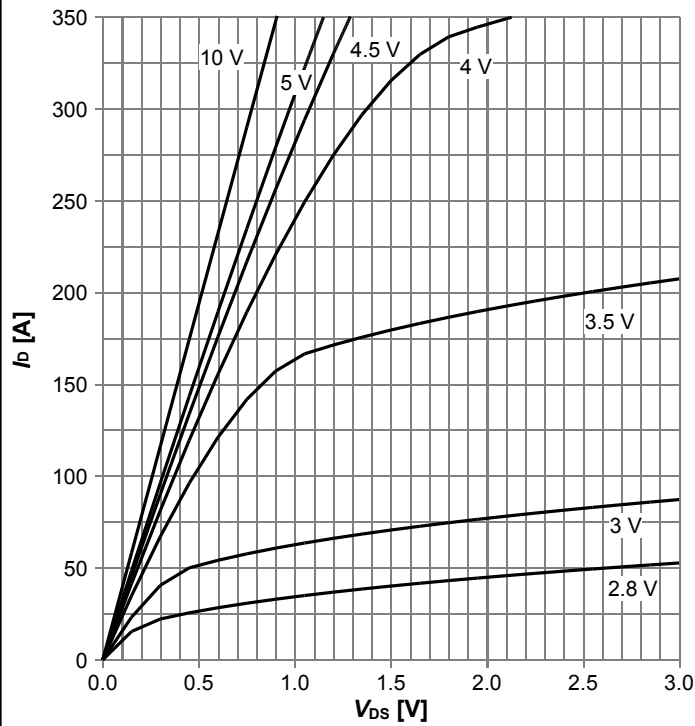
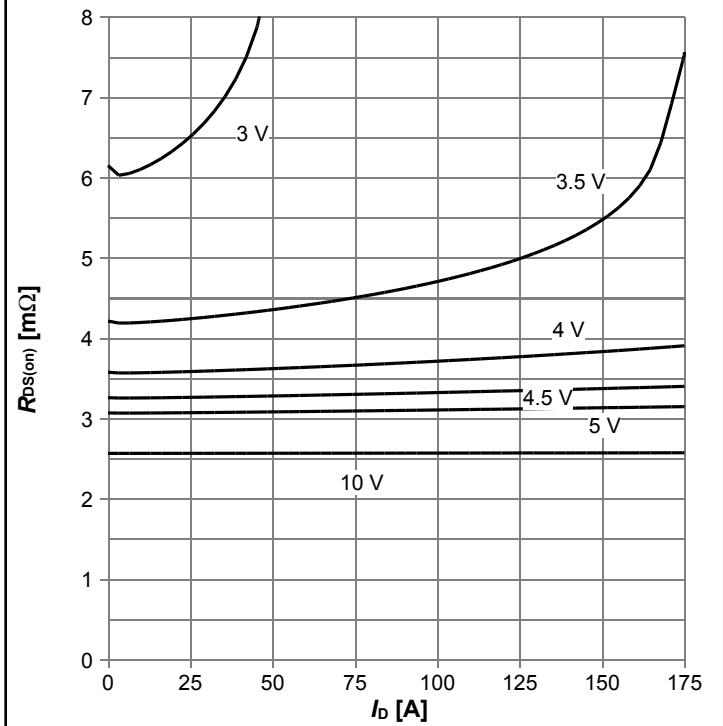


Diagram 5: Typ. output characteristics



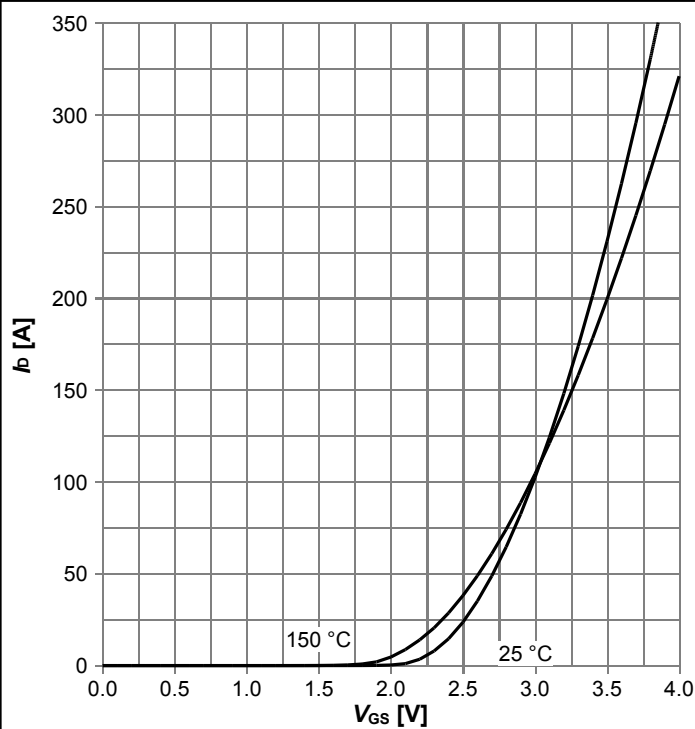
$I_D = f(V_{DS})$ ,  $T_j = 25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



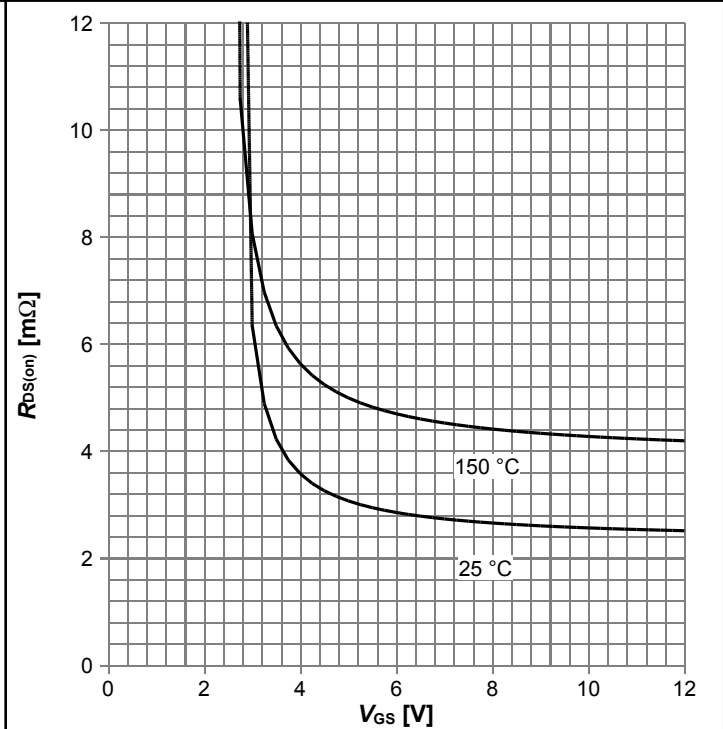
$R_{DS(on)} = f(I_D)$ ,  $T_j = 25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



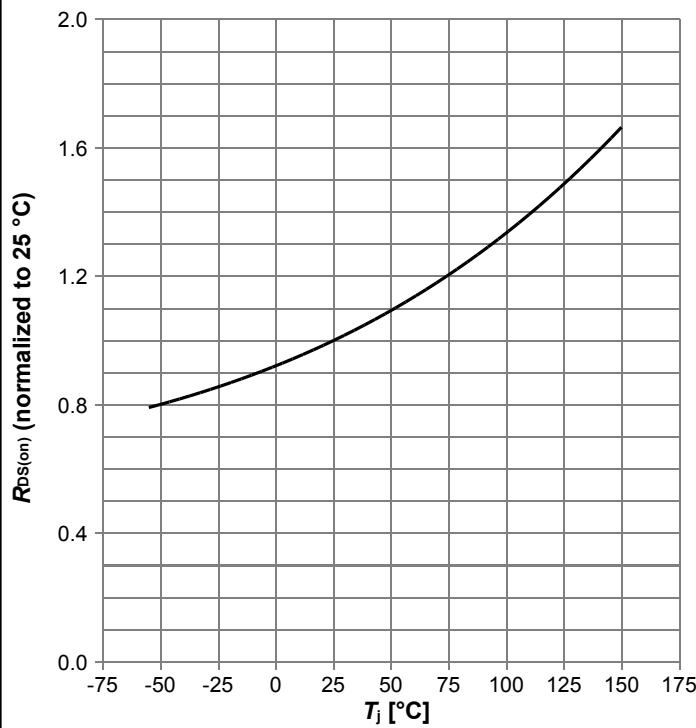
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2 I_D R_{DS(on)max}$ ; parameter:  $T_j$

Diagram 8: Typ. drain-source on resistance



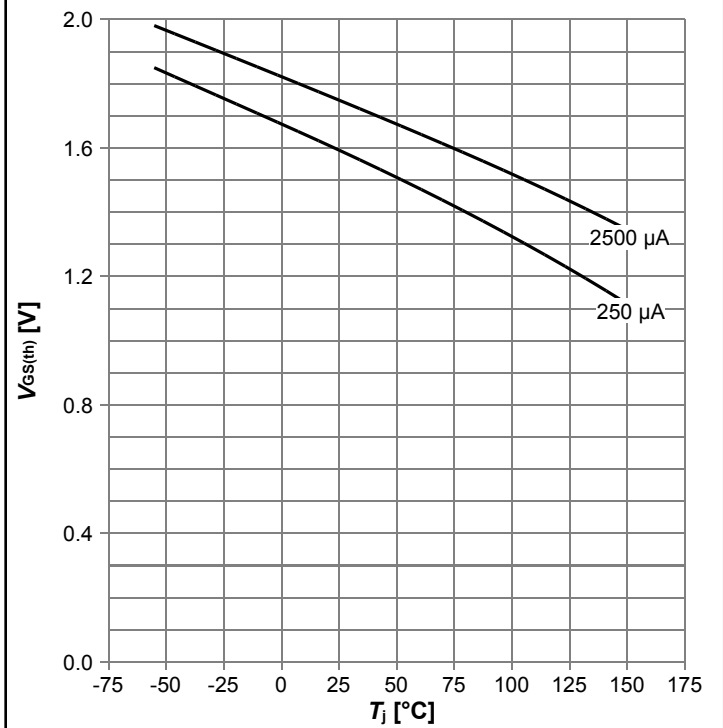
$R_{DS(on)} = f(V_{GS})$ ,  $I_D = 20\text{ A}$ ; parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



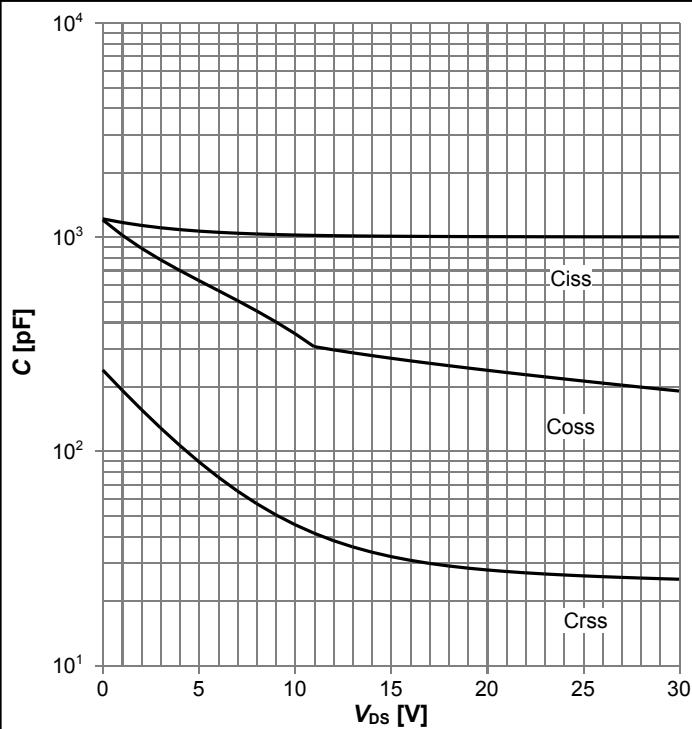
$R_{DS(on)}=f(T_j)$ ,  $I_D=20$  A,  $V_{GS}=10$  V

Diagram 10: Typ. gate threshold voltage



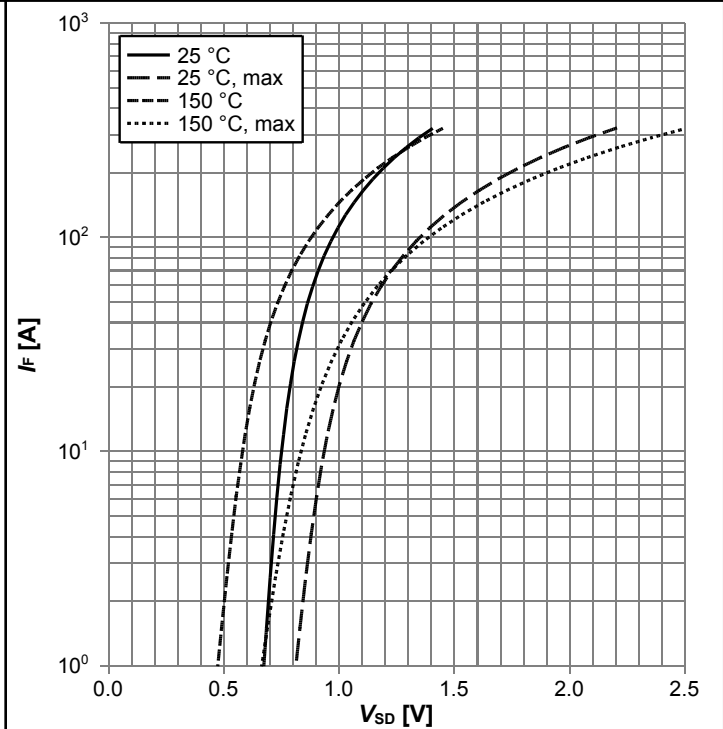
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



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

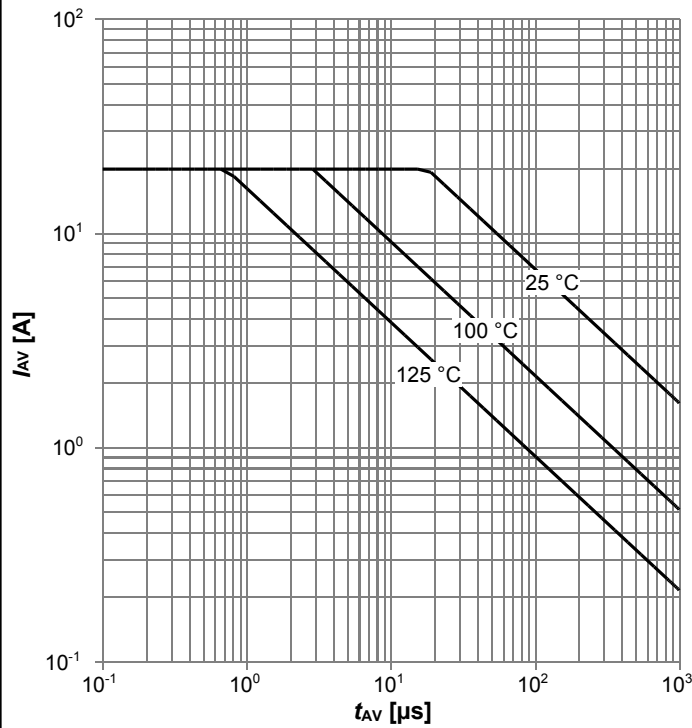
Diagram 12: Forward characteristics of reverse diode



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

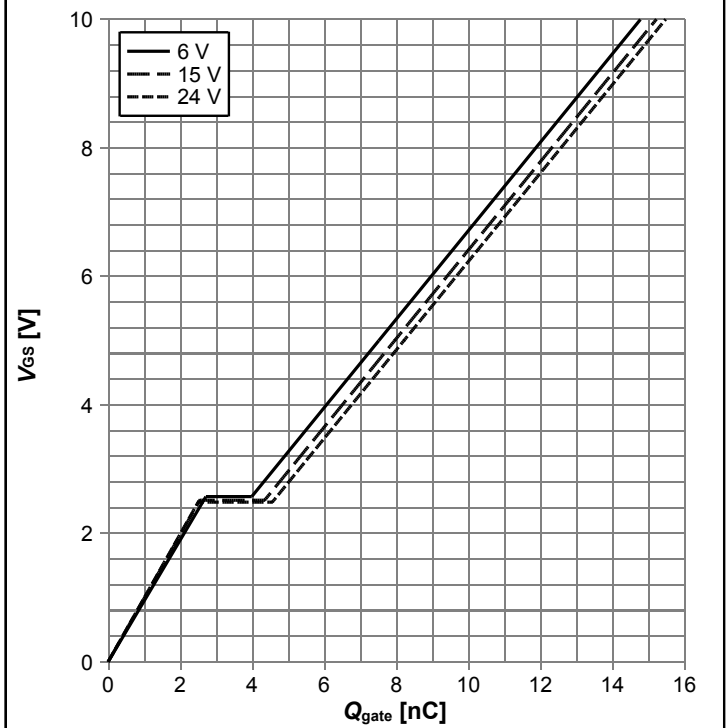


Diagram 13: Avalanche characteristics



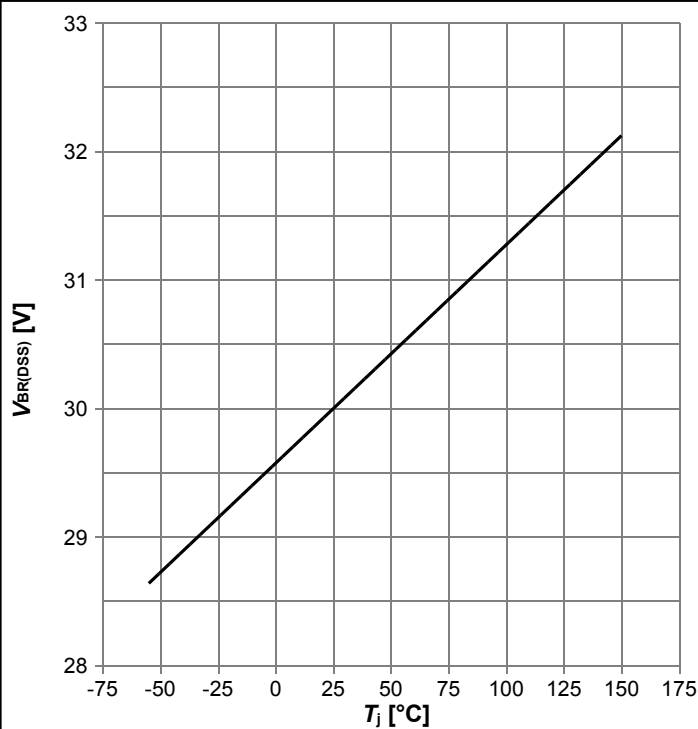
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25 \Omega$ ; parameter:  $T_{j,start}$

Diagram 14: Typ. gate charge



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

Diagram 15: Min. drain-source breakdown voltage

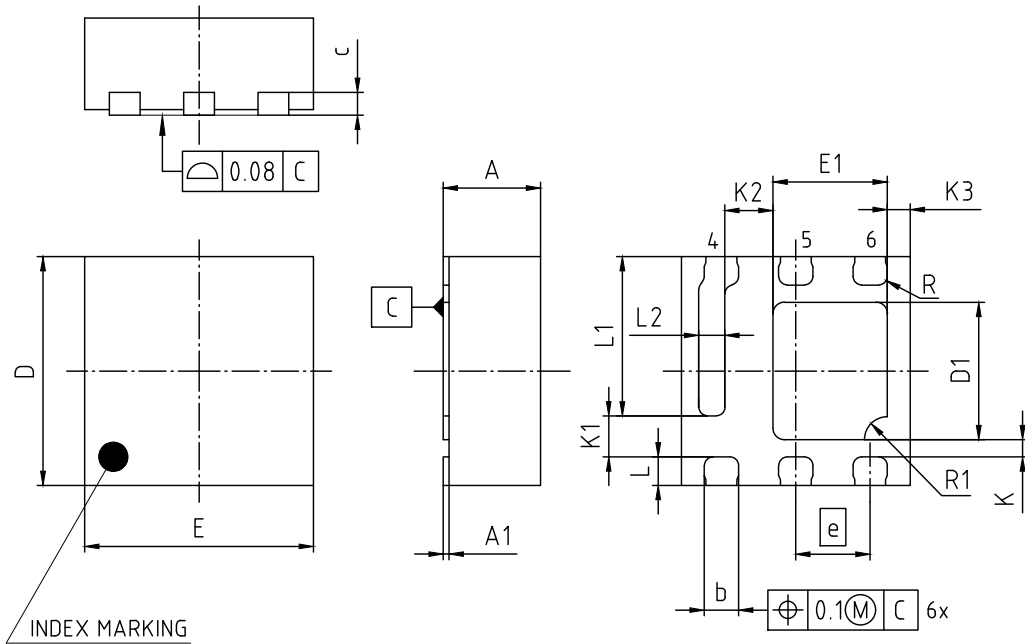


$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1$  mA

Diagram Gate charge waveforms



## 5 Package Outlines



| DIMENSION | MILLIMETERS |      |
|-----------|-------------|------|
|           | MIN.        | MAX. |
| A         | -           | 0.90 |
| A1        | -           | 0.05 |
| b         | 0.25        | 0.35 |
| c         | (0.20)      |      |
| D         | 1.90        | 2.10 |
| D1        | 1.10        | 1.30 |
| E         | 1.90        | 2.10 |
| E1        | 0.90        | 1.10 |
| e         | 0.65        |      |
| K         | 0.05        | -    |
| K1        | 0.26        | -    |
| K2        | 0.32        | -    |
| K3        | 0.10        | 0.30 |
| L         | 0.20        | 0.30 |
| L1        | 0.10        | 3.70 |
| L2        | 0.13        | 0.33 |
| R         | (0.08)      |      |
| R1        | (0.20)      |      |

|                             |
|-----------------------------|
| DOCUMENT NO.<br>Z8B00188375 |
| REVISION<br>01              |
| SCALE 20:1<br>              |
| EUROPEAN PROJECTION<br>     |
| ISSUE DATE<br>01.03.2018    |

Figure 1 Outline PG-VSON-6, dimensions in mm

## Revision History

ISK036N03LM5

**Revision: 2023-06-05, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision)  |
|----------|------------|---|
| 2.0      | 2020-11-26 | Release of final version  |
| 2.1      | 2023-06-05 | Update RthJC, Ptot, current rating, RDS(on)typ, Gfs, Capacitances and Gate charges. |

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### Published by

**Infineon Technologies AG**

**81726 München, Germany**

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