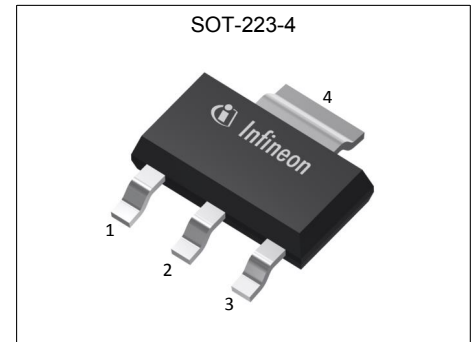


# MOSFET

## OptiMOS™ Small Signal Transistor, -60 V

### Features

- P-Channel
- Very low on-resistance  $R_{DS(on)}$
- 100% avalanche tested
- Normal Level
- Enhancement mode
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

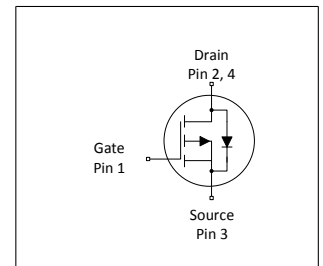


### Product validation

Fully qualified according to JEDEC for Industrial Applications

**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit      |
|------------------|-------|-----------|
| $V_{DS}$         | -60   | V         |
| $R_{DS(on),max}$ | 250   | $m\Omega$ |
| $I_D$            | -1.9  | A         |



| Type / Ordering Code | Package   | Marking  | Related Links |
|----------------------|-----------|----------|---------------|
| ISP25DP06NM          | PG-SOT223 | 25DP06NM | -             |

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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>       | $I_D$             | -      | -    | -1.9       | A    | $V_{GS}=-10\text{ V}$ , $T_A=25\text{ °C}$ ,<br>$R_{THJA}=70\text{ °C/W}$  |
| Continuous drain current <sup>1)</sup>       | $I_D$             | -      | -    | -1.2       | A    | $V_{GS}=-10\text{ V}$ , $T_A=100\text{ °C}$ ,<br>$R_{THJA}=70\text{ °C/W}$ |
| Pulsed drain current <sup>2)</sup>           | $I_{D,pulse}$     | -      | -    | -7.6       | A    | $T_A=25\text{ °C}$   |
| Avalanche energy, single pulse <sup>3)</sup> | $E_{AS}$          | -      | -    | 257        | mJ   | $I_D=-1.9\text{ A}$ , $R_{GS}=25\text{ }\Omega$                            |
| Gate source voltage                          | $V_{GS}$          | -20    | -    | 20         | V    | -  |
| Power dissipation                            | $P_{tot}$         | -      | -    | 4.2<br>1.8 | W    | $T_S=25\text{ °C}$<br>$T_A=25\text{ °C}$ , $R_{THJA}=70\text{ °C/W}^{1)}$  |
| 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 - soldering point                 | $R_{thJS}$ | -      | -    | 25   | °C/W | -                     |
| Device on PCB,<br>6 cm <sup>2</sup> cooling area <sup>1)</sup> | $R_{thJA}$ | -      | -    | 70   | °C/W | -                     |

<sup>1)</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>2)</sup> See Diagram 3 for more detailed information

<sup>3)</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             | $V_{GS}=0\text{ V}$ , $I_D=-250\text{ }\mu\text{A}$   |
| Gate threshold voltage           | $V_{GS(th)}$  | -2.1   | -3          | -4         | V             | $V_{DS}=V_{GS}$ , $I_D=-270\text{ }\mu\text{A}$   |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | -0.1<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 | $R_{DS(on)}$  | -      | 189         | 250        | m $\Omega$    | $V_{GS}=-10\text{ V}$ , $I_D=-1.9\text{ A}$   |
| Gate resistance                  | $R_G$         | -      | 5           | -          | $\Omega$      | -   |
| Transconductance                 | $g_{fs}$      | -      | 3.1         | -          | S             | $ V_{DS} \geq 2 I_D R_{DS(on)max}$ , $I_D=-1.9\text{ A}$  |

**Table 5 Dynamic characteristics**

| Parameter                    | Symbol       | Values |      |      | Unit | Note / Test Condition  |
|------------------------------|--------------|--------|------|------|------|--|
|                              |              | Min.   | Typ. | Max. |      |  |
| Input capacitance            | $C_{iss}$    | -      | 420  | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=-30\text{ V}$ , $f=1\text{ MHz}$   |
| Output capacitance           | $C_{oss}$    | -      | 62   | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=-30\text{ V}$ , $f=1\text{ MHz}$   |
| Reverse transfer capacitance | $C_{rss}$    | -      | 18   | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=-30\text{ V}$ , $f=1\text{ MHz}$   |
| Turn-on delay time           | $t_{d(on)}$  | -      | 5    | -    | ns   | $V_{DD}=-30\text{ V}$ , $V_{GS}=-10\text{ V}$ , $I_D=-1.9\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                    | $t_r$        | -      | 7    | -    | ns   | $V_{DD}=-30\text{ V}$ , $V_{GS}=-10\text{ V}$ , $I_D=-1.9\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time          | $t_{d(off)}$ | -      | 15   | -    | ns   | $V_{DD}=-30\text{ V}$ , $V_{GS}=-10\text{ V}$ , $I_D=-1.9\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                    | $t_f$        | -      | 5    | -    | ns   | $V_{DD}=-30\text{ V}$ , $V_{GS}=-10\text{ V}$ , $I_D=-1.9\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |

**Table 6 Gate charge characteristics<sup>1)</sup>**

| Parameter                | Symbol        | Values |       |      | Unit | Note / Test Condition   |
|--------------------------|---------------|--------|-------|------|------|---|
|                          |               | Min.   | Typ.  | Max. |      |   |
| Gate to source charge    | $Q_{gs}$      | -      | -1.9  | -    | nC   | $V_{DD}=-30\text{ V}$ , $I_D=-1.9\text{ A}$ , $V_{GS}=0\text{ to }-10\text{ V}$ |
| Gate charge at threshold | $Q_{g(th)}$   | -      | -1.2  | -    | nC   | $V_{DD}=-30\text{ V}$ , $I_D=-1.9\text{ A}$ , $V_{GS}=0\text{ to }-10\text{ V}$ |
| Gate to drain charge     | $Q_{gd}$      | -      | -3.8  | -    | nC   | $V_{DD}=-30\text{ V}$ , $I_D=-1.9\text{ A}$ , $V_{GS}=0\text{ to }-10\text{ V}$ |
| Switching charge         | $Q_{sw}$      | -      | -4.5  | -    | nC   | $V_{DD}=-30\text{ V}$ , $I_D=-1.9\text{ A}$ , $V_{GS}=0\text{ to }-10\text{ V}$ |
| Gate charge total        | $Q_g$         | -      | -10.8 | -    | nC   | $V_{DD}=-30\text{ V}$ , $I_D=-1.9\text{ A}$ , $V_{GS}=0\text{ to }-10\text{ V}$ |
| Gate plateau voltage     | $V_{plateau}$ | -      | -4.6  | -    | V    | $V_{DD}=-30\text{ V}$ , $I_D=-1.9\text{ A}$ , $V_{GS}=0\text{ to }-10\text{ V}$ |
| Output charge            | $Q_{oss}$     | -      | -5    | -    | nC   | $V_{DD}=-30\text{ V}$ , $V_{GS}=0\text{ V}$                                     |

<sup>1)</sup> See diagram ,Gate charge waveforms, for gate charge parameter definition

**Table 7 Reverse diode**

| Parameter                        | Symbol        | Values |       |      | Unit | Note / Test Condition  |
|----------------------------------|---------------|--------|-------|------|------|--|
|                                  |               | Min.   | Typ.  | Max. |      |  |
| Diode continuous forward current | $I_S$         | -      | -     | -1.5 | A    | $T_A=25\text{ °C}$   |
| Diode pulse current              | $I_{S,pulse}$ | -      | -     | -6   | A    | $T_A=25\text{ °C}$   |
| Diode forward voltage            | $V_{SD}$      | -      | -0.81 | -1.2 | V    | $V_{GS}=0\text{ V}$ , $I_F=-1.5\text{ A}$ , $T_j=25\text{ °C}$                 |
| Reverse recovery time            | $t_{rr}$      | -      | 30    | -    | ns   | $V_R=-30\text{ V}$ , $I_F=-1.5\text{ A}$ , $di_F/dt=-100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge          | $Q_{rr}$      | -      | -58   | -    | nC   | $V_R=-30\text{ V}$ , $I_F=-1.5\text{ A}$ , $di_F/dt=-100\text{ A}/\mu\text{s}$ |

### 4 Electrical characteristics diagrams

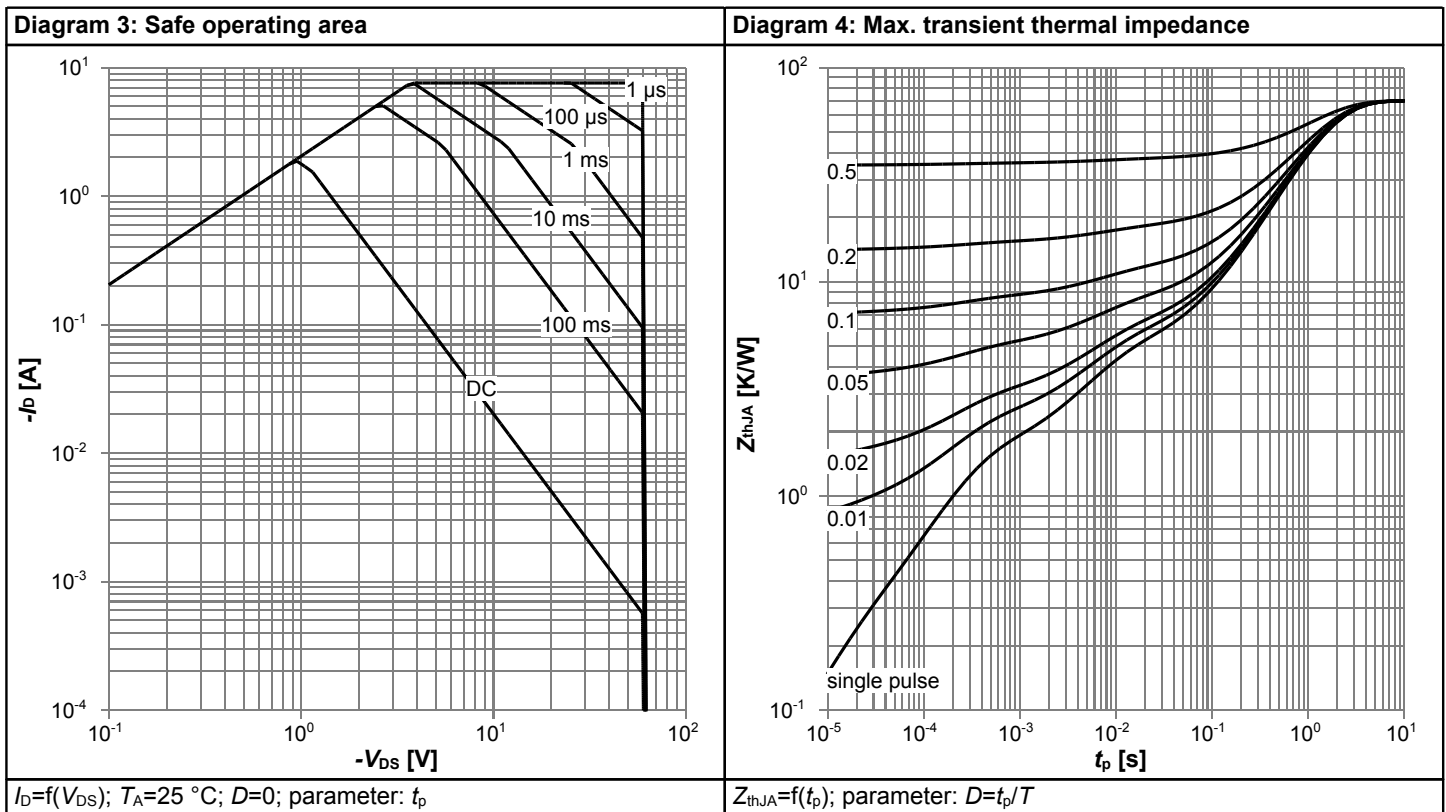
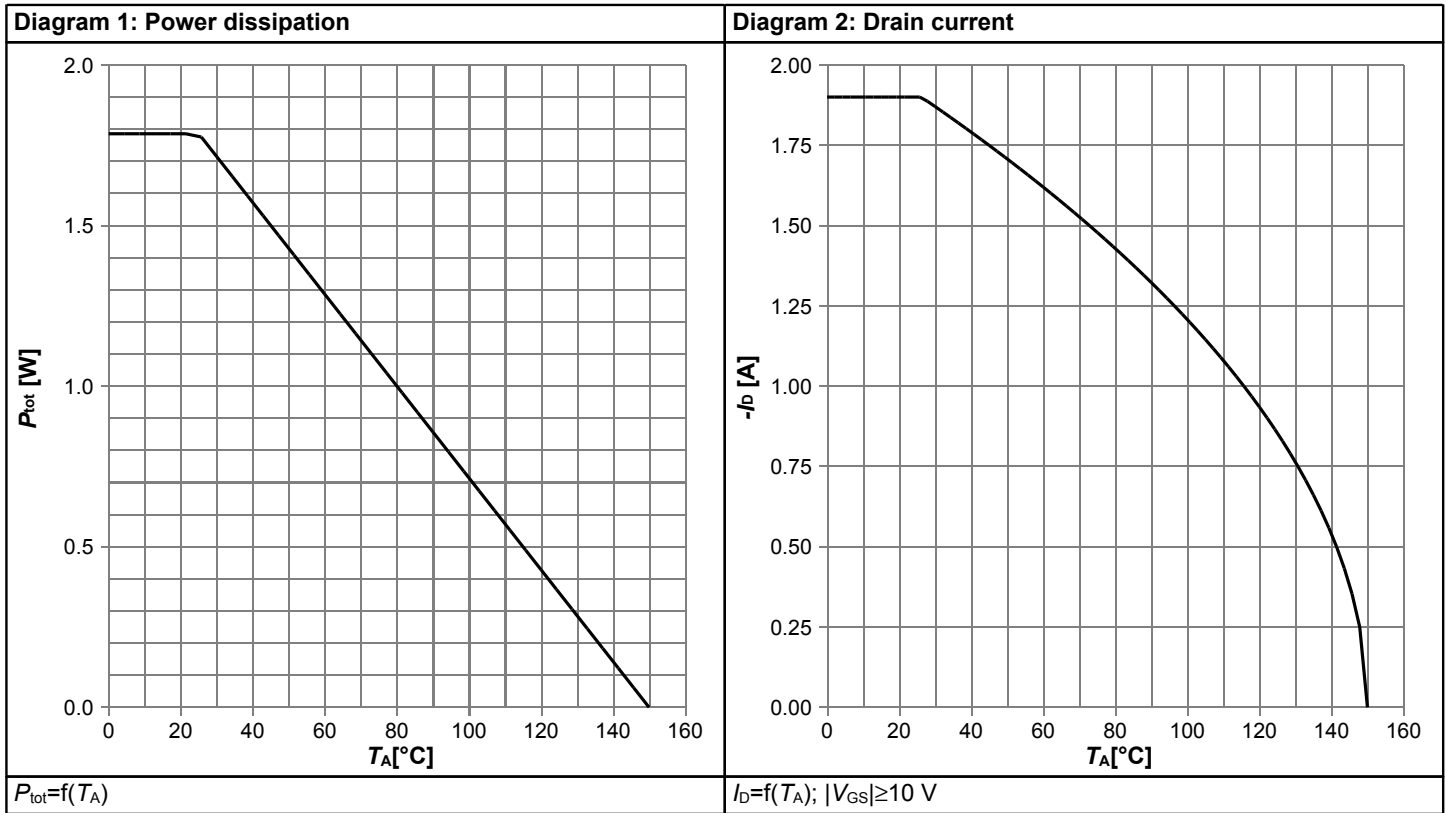
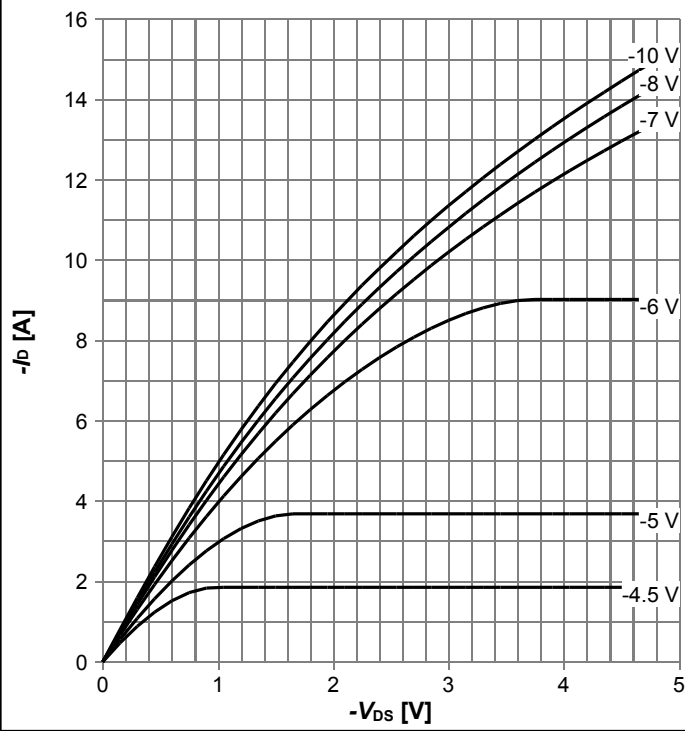
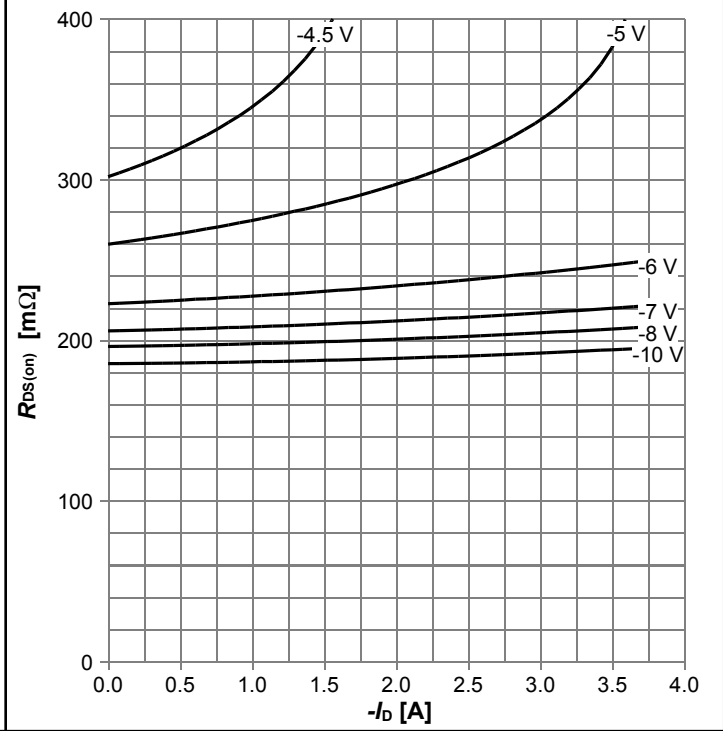


Diagram 5: Typ. output characteristics



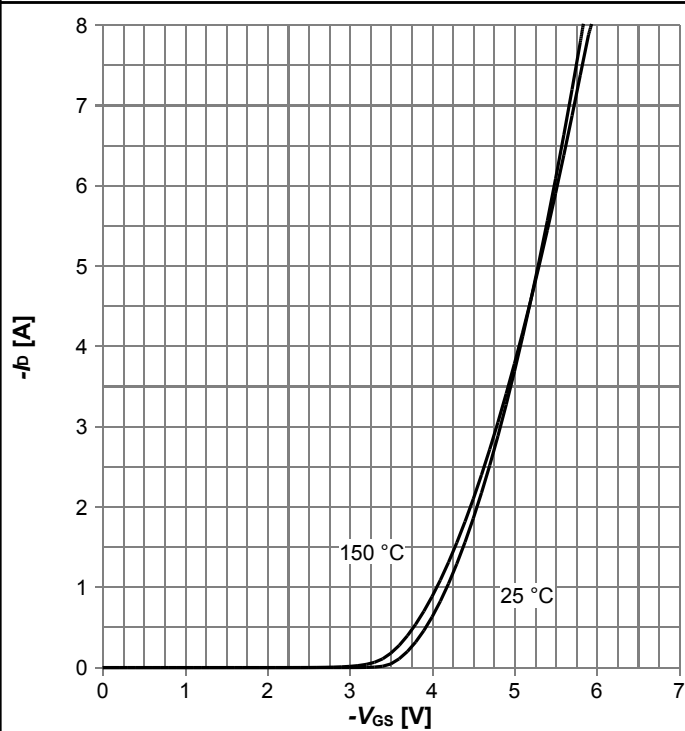
$I_D = f(V_{DS})$ ,  $T_j = 25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



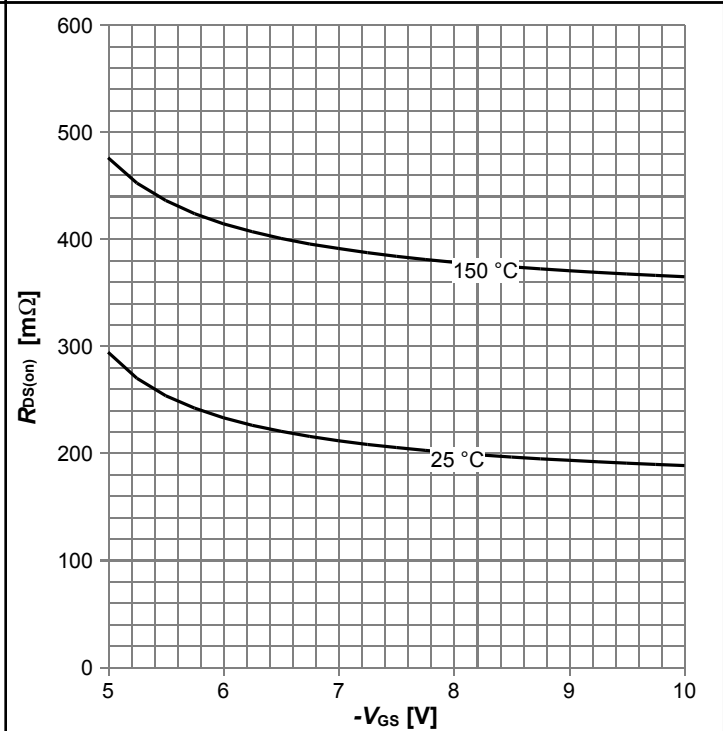
$R_{DS(on)} = f(I_D)$ ,  $T_j = 25\text{ °C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



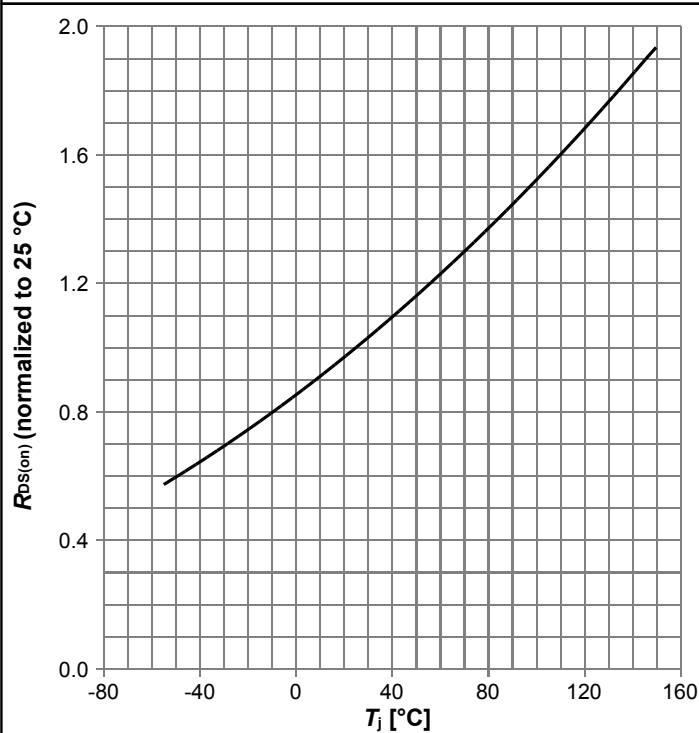
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2|I_D|R_{DS(on)max}$ ; parameter:  $T_j$

Diagram 8: Typ. drain-source on resistance



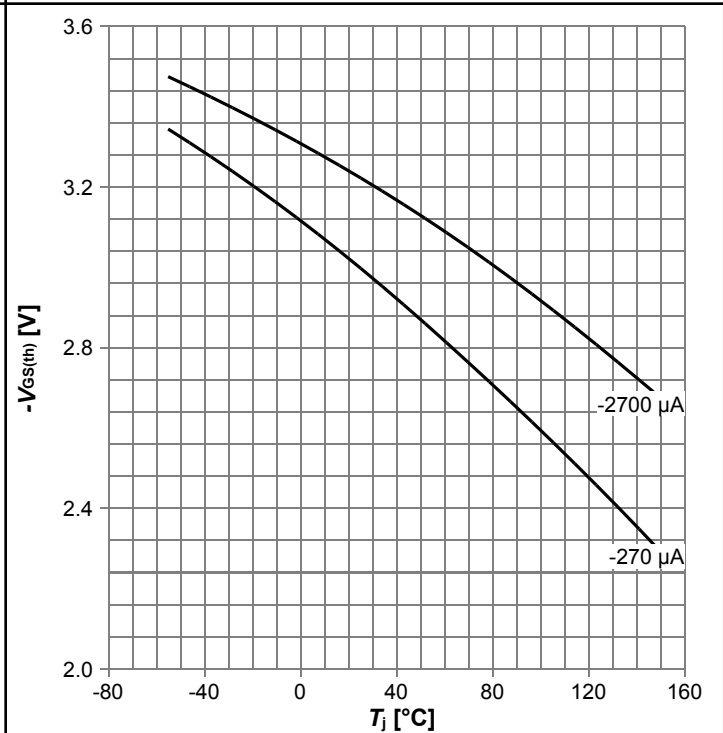
$R_{DS(on)} = f(V_{GS})$ ,  $I_D = -1.9\text{ A}$ ; parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



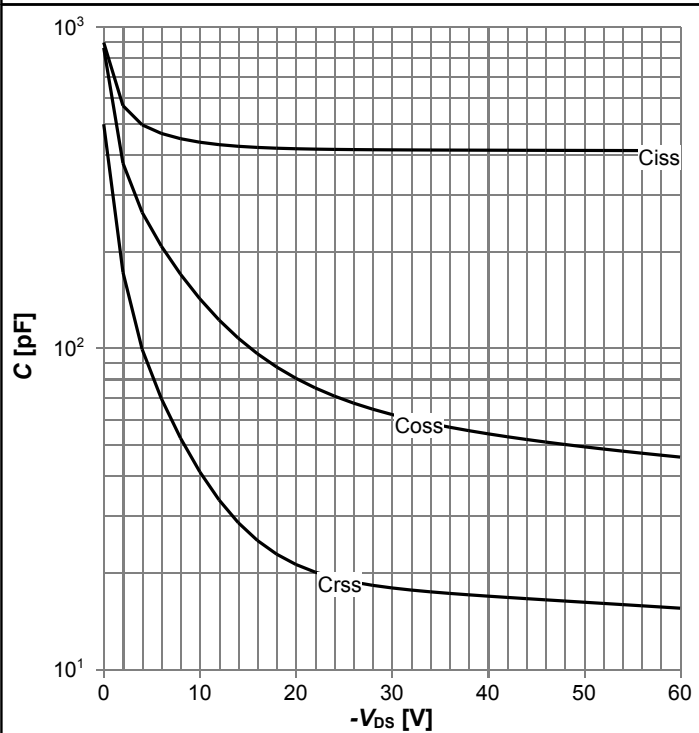
$R_{DS(on)}=f(T_j)$ ,  $I_D=-1.9$  A,  $V_{GS}=-10$  V

Diagram 10: Typ. gate threshold voltage



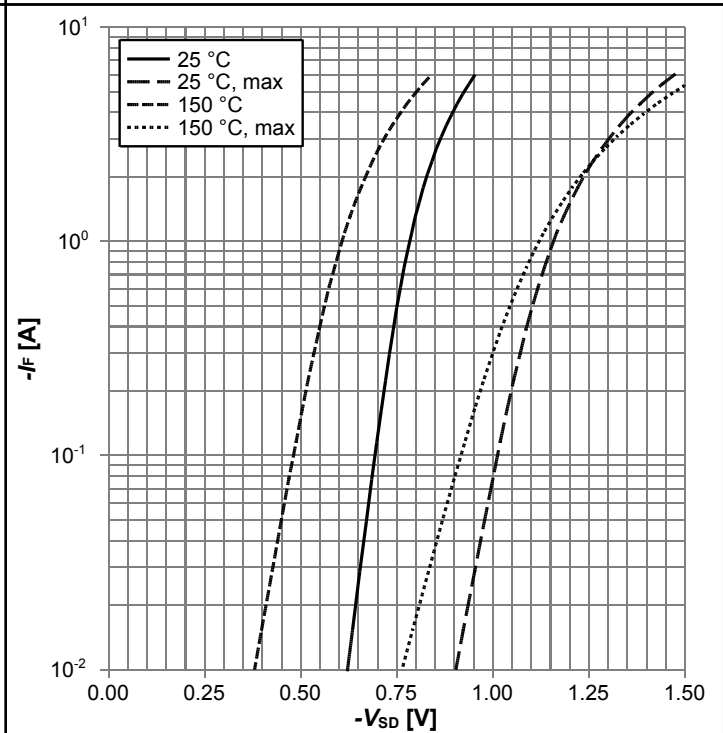
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



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

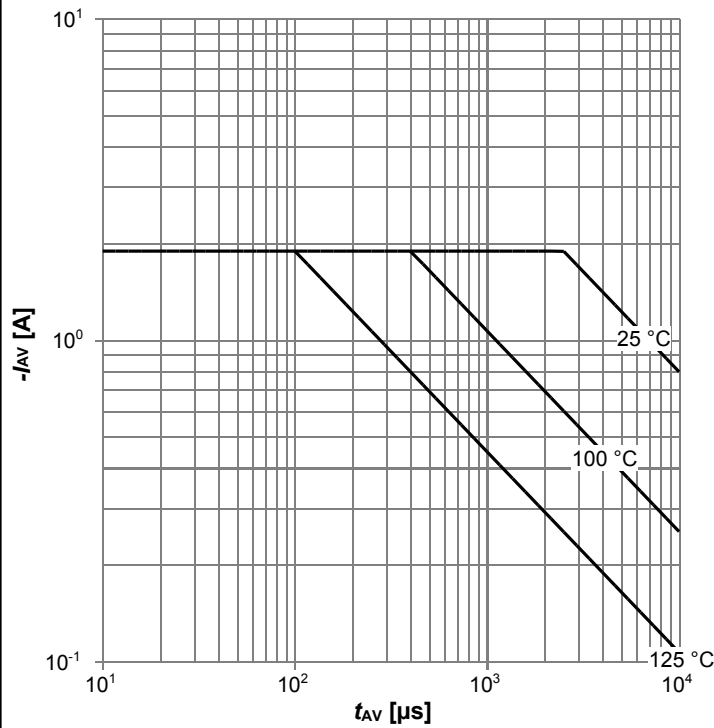
Diagram 12: Forward characteristics of reverse diode



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

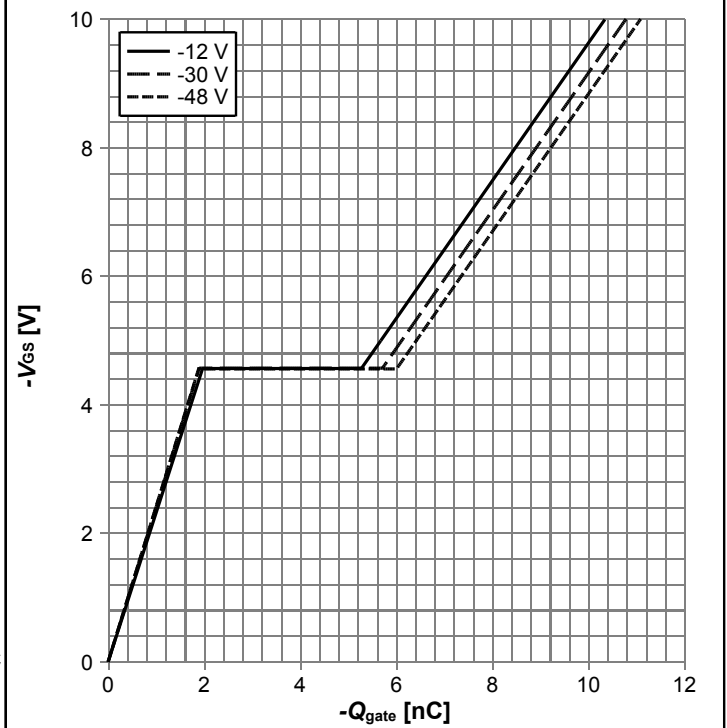


Diagram 13: Avalanche characteristics



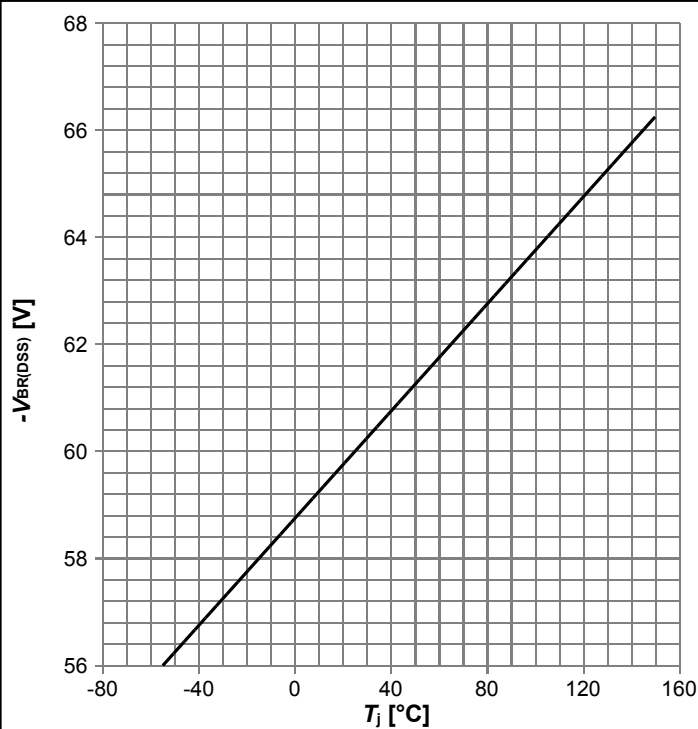
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25 \Omega$ ; parameter:  $T_{j,start}$

Diagram 14: Typ. gate charge



$V_{GS}=f(Q_{gate})$ ,  $I_D=-1.9$  A pulsed,  $T_j=25$  °C; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage



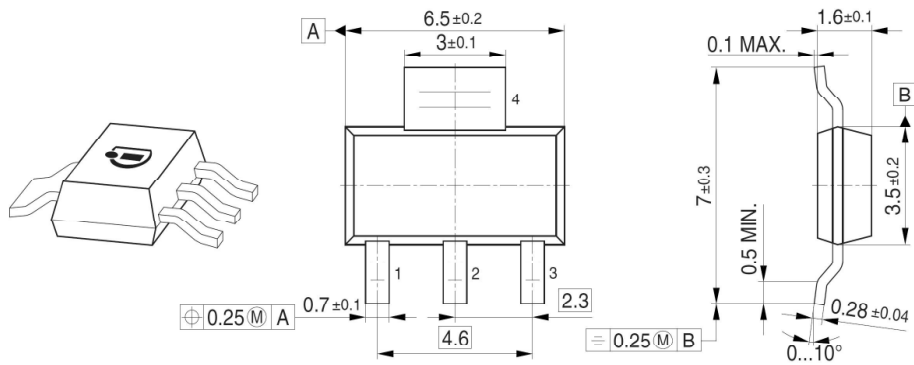
$V_{BR(DSS)}=f(T_j)$ ;  $I_D=-250 \mu$ A

Diagram Gate charge waveforms



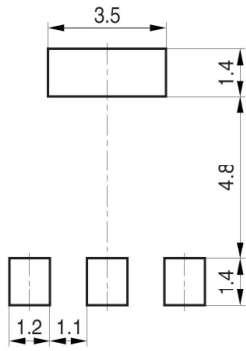
## 5 Package Outlines

### Package Outline

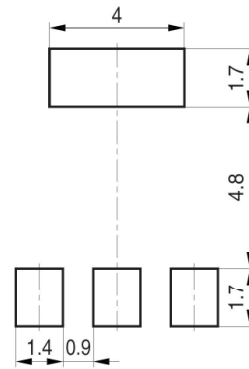


### Foot Print

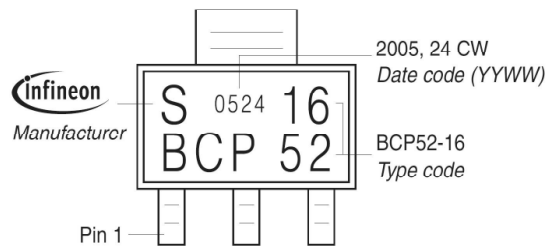
Soldering Type: Reflow Soldering



Soldering Type: Wave Soldering



### Marking Layout (Example)



### Tape and Reel

Reel  $\phi$ 180 mm: 1.000 Pieces/Reel  
Reels/Box: 1 x 1.000 = 1.000

Reel  $\phi$ 330 mm: 4.000 Pieces/Reel  
Reels/Box: 1 x 4.000 = 4.000

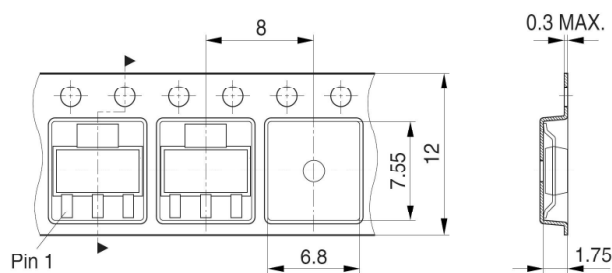


Figure 1 Outline PG-SOT223, dimensions in mm/inches

## Revision History

ISP25DP06NM

**Revision: 2019-03-26, Rev. 2.0**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0      | 2019-03-26 | Release of final version                     |

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