

# MOSFET

## OptiMOS™5 Power-Transistor, 60 V

### Features

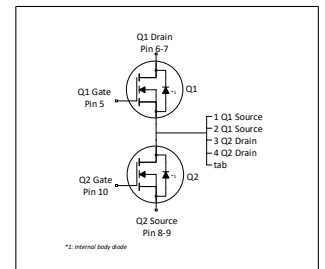
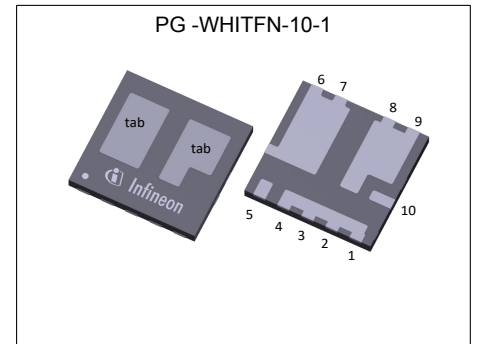
- Symmetrical Half Bridge
- Optimized for low voltage drives and battery powered applications
- Optimized for high performance SMPS
- N-channel
- Very low on-resistance  $R_{DS(on)}$
- Superior thermal resistance
- 100% avalanche tested
- Pb-free lead plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

### Product validation

Fully qualified according to JEDEC for Industrial Applications

**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit       |
|------------------|-------|------------|
| $V_{DS}$         | 60    | V          |
| $R_{DS(on),max}$ | 1.6   | m $\Omega$ |
| $I_D$            | 233   | A          |
| $Q_{oss}$        | 74    | nC         |
| $Q_G (0V..10V)$  | 68    | nC         |



RoHS

| Type / Ordering Code | Package         | Marking   | Related Links |
|----------------------|-----------------|-----------|---------------|
| ISG0614N06NM5HSC     | PG -WHITFN-10-1 | 61406N5HC | -             |

## Table of Contents

|   |    |
|---|----|
| Description .....                         | 1  |
| Maximum ratings .....                     | 3  |
| Thermal characteristics .....             | 3  |
| Electrical characteristics .....          | 4  |
| Electrical characteristics diagrams ..... | 6  |
| Package Outlines .....                    | 10 |
| Revision History .....                    | 11 |
| Trademarks .....                          | 11 |
| Disclaimer .....                          | 11 |

## 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>       | $I_D$             | -      | -    | 233<br>165<br>31 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_A=25\text{ °C}$ , $R_{THJA}=50\text{ °C/W}^2)$ |
| Pulsed drain current <sup>3)</sup>           | $I_{D,pulse}$     | -      | -    | 932              | A    | $T_A=25\text{ °C}$  |
| Avalanche energy, single pulse <sup>4)</sup> | $E_{AS}$          | -      | -    | 313              | mJ   | $I_D=50\text{ A}$ , $R_{GS}=25\text{ }\Omega$   |
| Gate source voltage                          | $V_{GS}$          | -20    | -    | 20               | V    | -   |
| Power dissipation                            | $P_{tot}$         | -      | -    | 167<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  | $R_{thJC}$ | -      | 0.6  | 0.9  | °C/W | -                     |
| Thermal resistance, junction - case, top   | $R_{thJC}$ | -      | 0.40 | 0.86 | °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 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   | $V_{(BR)DSS}$ | 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                | $V_{DS}=V_{GS}$ , $I_D=86\text{ }\mu\text{A}$   |
| 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 | $R_{DS(on)}$  | -      | 1.29<br>1.9 | 1.6<br>2.5 | $\text{m}\Omega$ | $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$<br>$V_{GS}=6\text{ V}$ , $I_D=25\text{ A}$   |
| Gate resistance                  | $R_G$         | -      | 0.8         | -          | $\Omega$         | -   |
| Transconductance <sup>1)</sup>   | $g_{fs}$      | 70     | -           | -          | 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                          | $C_{iss}$    | -      | 4900 | 6400 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                      |
| Output capacitance <sup>1)</sup>           | $C_{oss}$    | -      | 1110 | 1440 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                      |
| Reverse transfer capacitance <sup>1)</sup> | $C_{rss}$    | -      | 46   | 81   | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=30\text{ V}$ , $f=1\text{ MHz}$                                      |
| Turn-on delay time                         | $t_{d(on)}$  | -      | 18   | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Rise time                                  | $t_r$        | -      | 8.7  | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Turn-off delay time                        | $t_{d(off)}$ | -      | 31   | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<br>$R_{G,ext}=1.6\text{ }\Omega$ |
| Fall time                                  | $t_f$        | -      | 6.8  | -    | ns   | $V_{DD}=30\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=50\text{ A}$ ,<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              | $Q_{gs}$      | -      | 21   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold           | $Q_{g(th)}$   | -      | 14   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge <sup>1)</sup> | $Q_{gd}$      | -      | 13   | 19   | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                   | $Q_{sw}$      | -      | 20   | -    | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup>    | $Q_g$         | -      | 68   | 102  | nC   | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage               | $V_{plateau}$ | -      | 4.4  | -    | V    | $V_{DD}=30\text{ V}$ , $I_D=50\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET       | $Q_{g(sync)}$ | -      | 60   | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                    |
| Output charge <sup>1)</sup>        | $Q_{oss}$     | -      | 74   | 96   | 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 | $I_S$         | -      | -    | 148  | A    | $T_C=25\text{ °C}$   |
| Diode pulse current              | $I_{S,pulse}$ | -      | -    | 932  | A    | $T_C=25\text{ °C}$   |
| Diode forward voltage            | $V_{SD}$      | -      | 0.84 | 1    | V    | $V_{GS}=0\text{ V}, I_F=50\text{ A}, T_j=25\text{ °C}$               |
| Reverse recovery time            | $t_{rr}$      | -      | 39   | -    | ns   | $V_R=30\text{ V}, I_F=50\text{ A}, di_F/dt=500\text{ A}/\mu\text{s}$ |
| Reverse recovery charge          | $Q_{rr}$      | -      | 143  | -    | nC   | $V_R=30\text{ V}, I_F=50\text{ A}, di_F/dt=500\text{ A}/\mu\text{s}$ |

### 4 Electrical characteristics diagrams

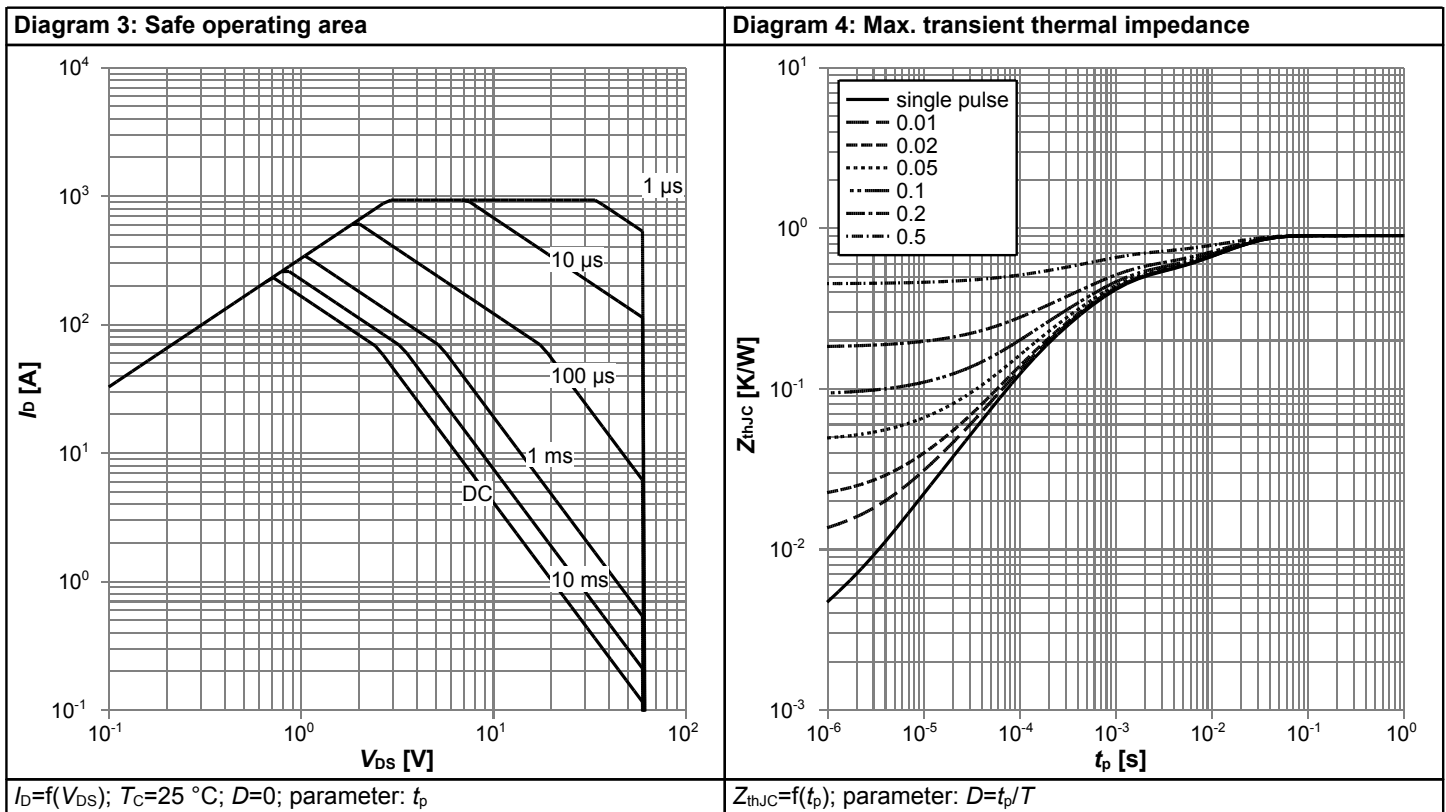
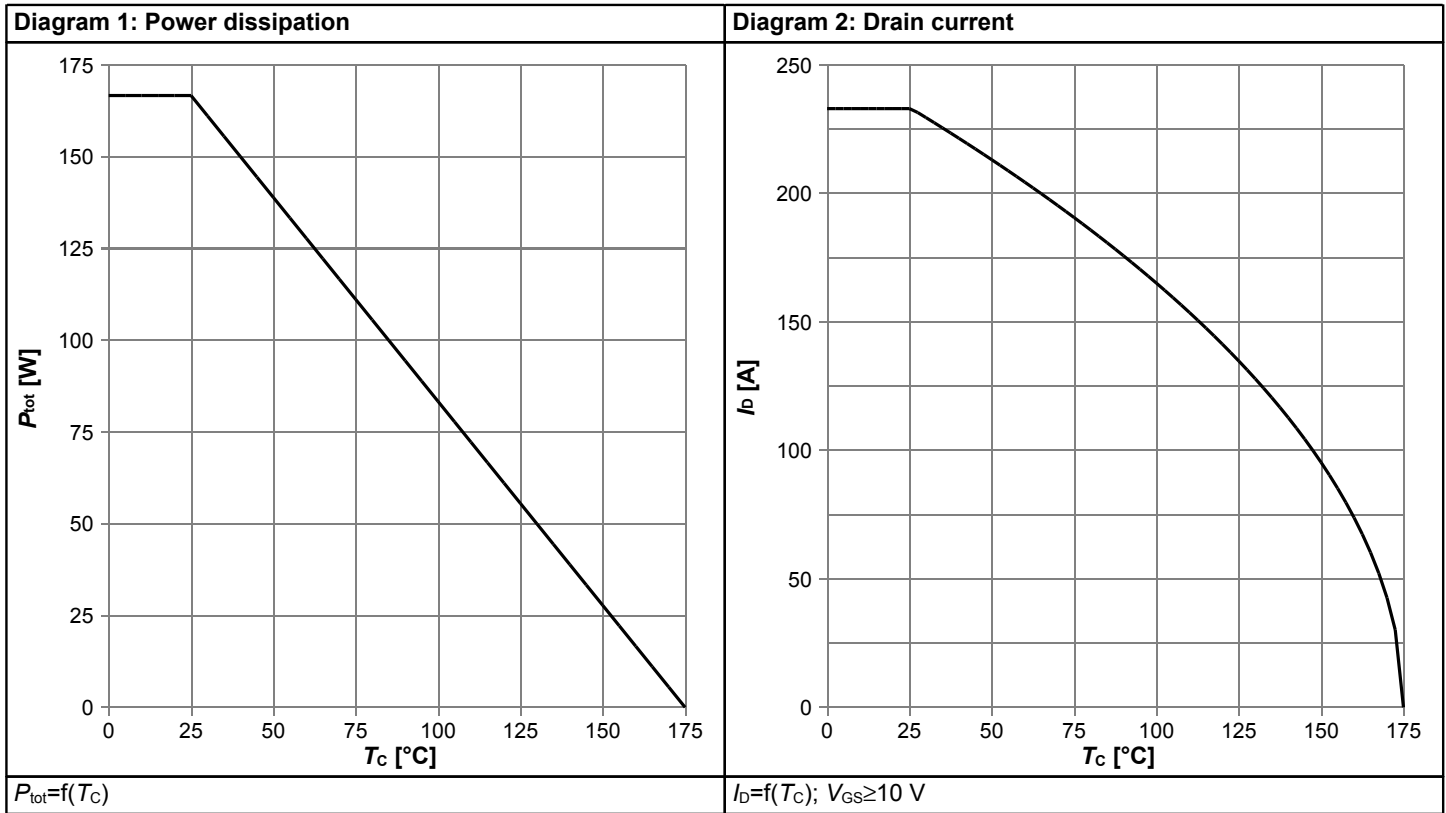
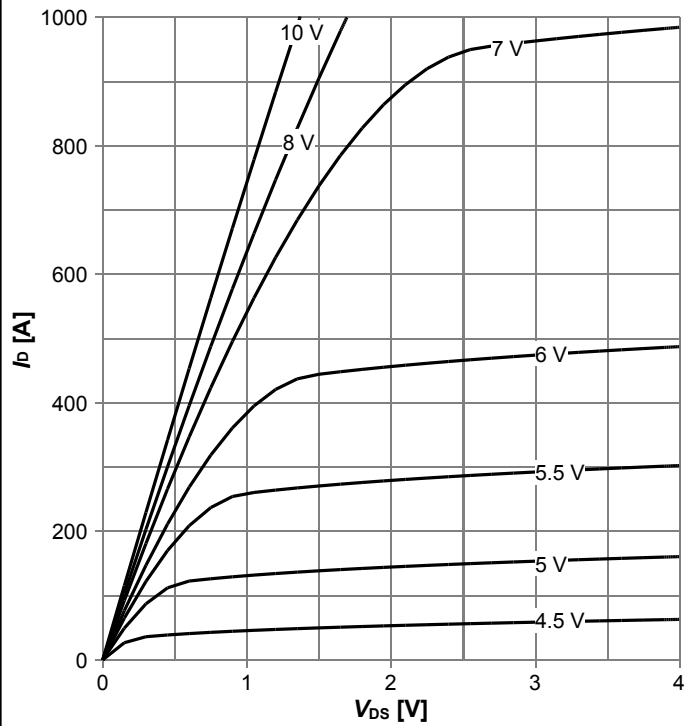
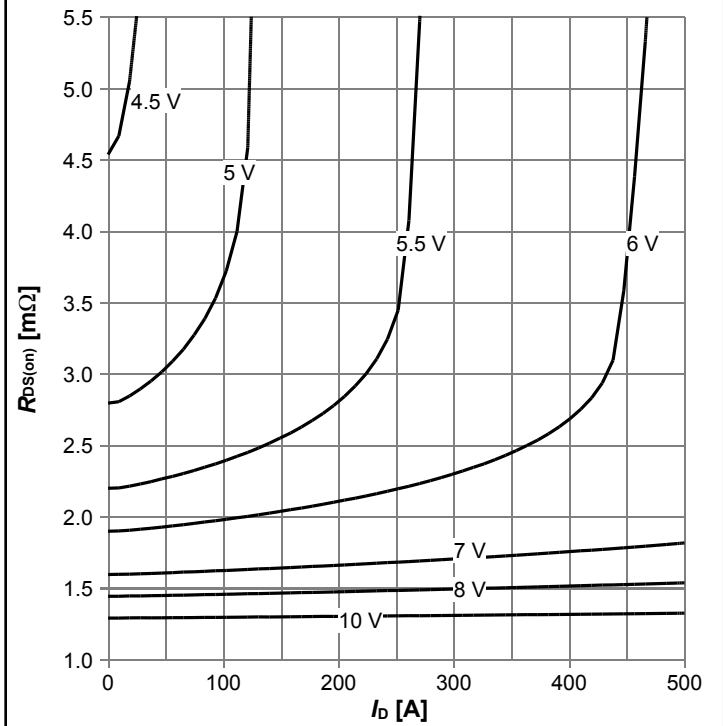


Diagram 5: Typ. output characteristics



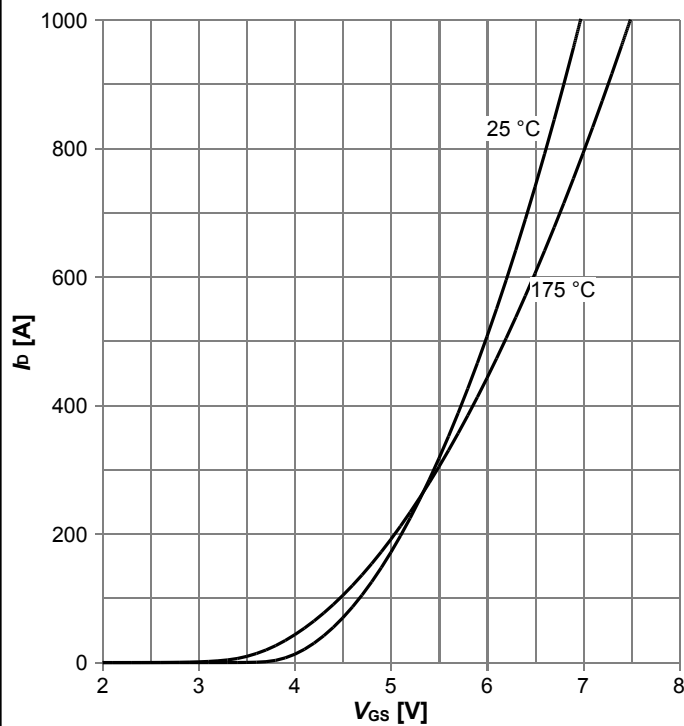
$I_D = f(V_{DS}), T_j = 25^\circ\text{C};$  parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



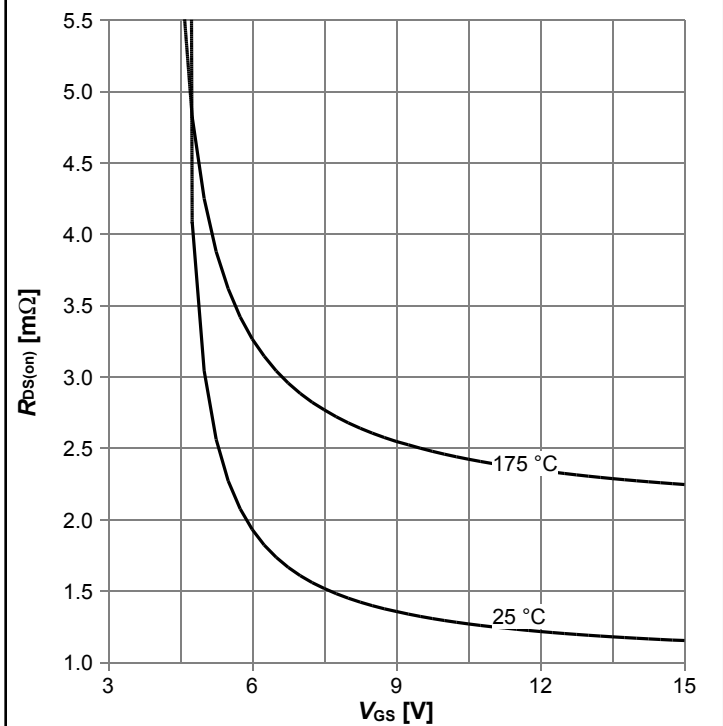
$R_{DS(on)} = f(I_D), T_j = 25^\circ\text{C};$  parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



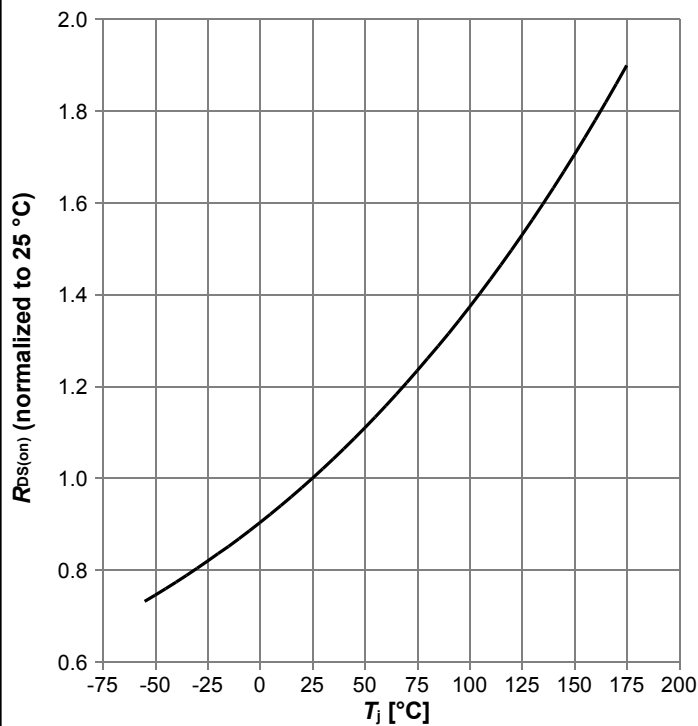
$I_D = f(V_{GS}), |V_{DS}| > 2|I_D|R_{DS(on)max};$  parameter:  $T_j$

Diagram 8: Typ. drain-source on resistance



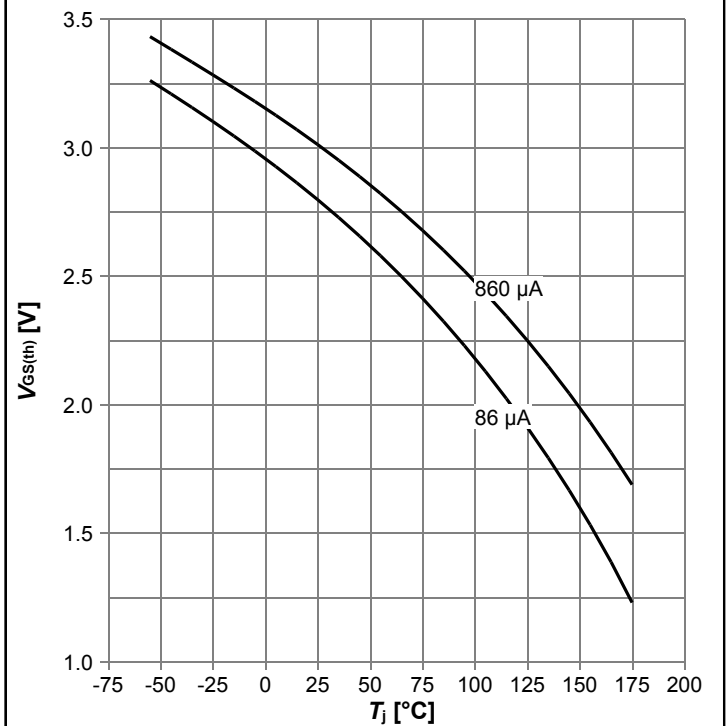
$R_{DS(on)} = f(V_{GS}), I_D = 50\text{ A};$  parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



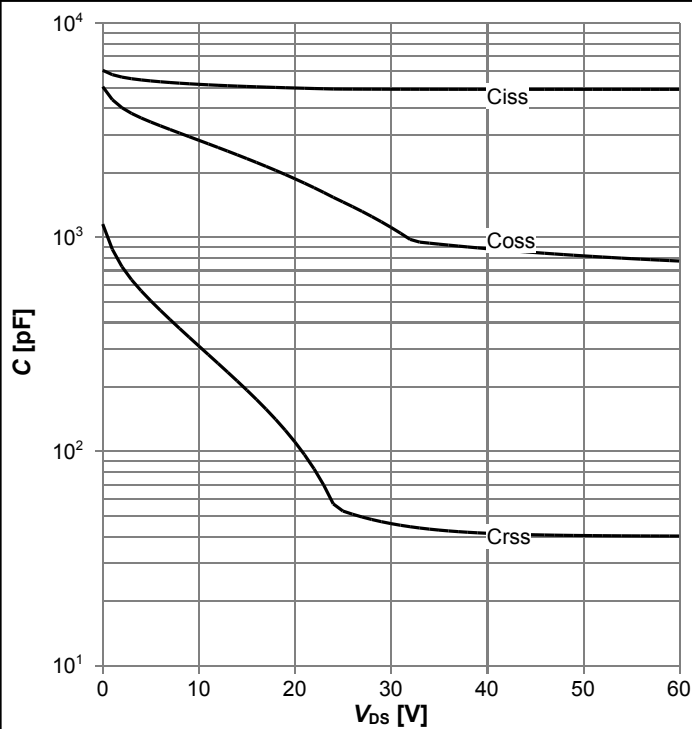
$R_{DS(on)}=f(T_j)$ ,  $I_D=50$  A,  $V_{GS}=10$  V

Diagram 10: Typ. gate threshold voltage



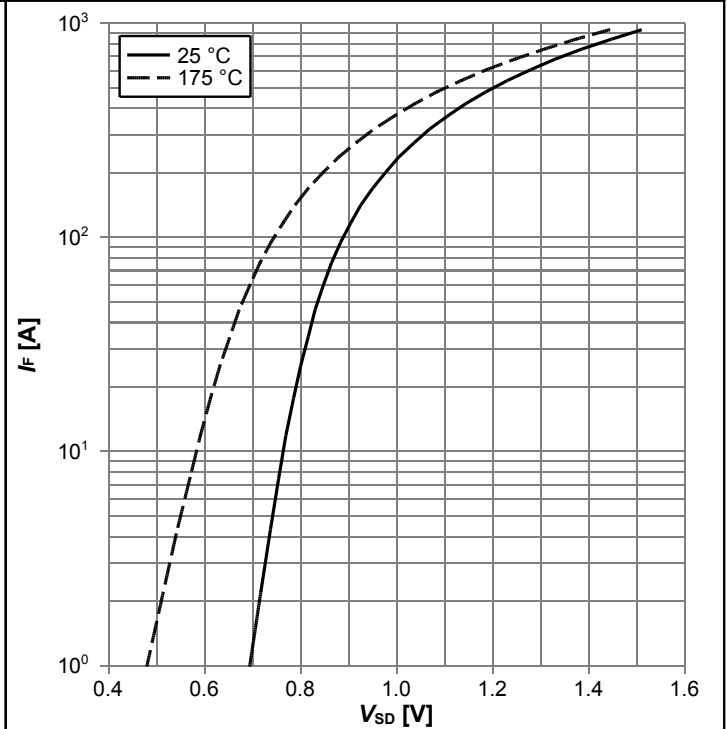
$V_{GS(th)}=f(T_j)$ ,  $V_{GS}=V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



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

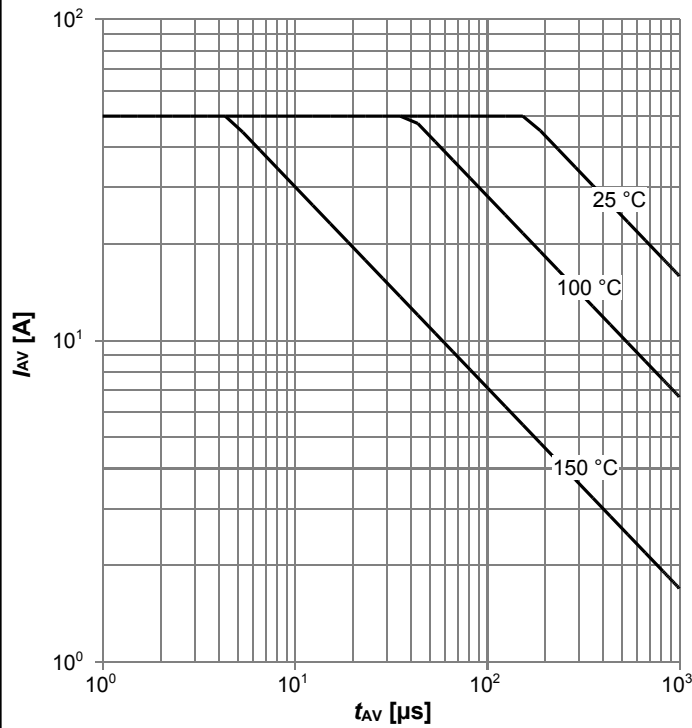
Diagram 12: Typ. forward characteristics of reverse diode



$I_F=f(V_{SD})$

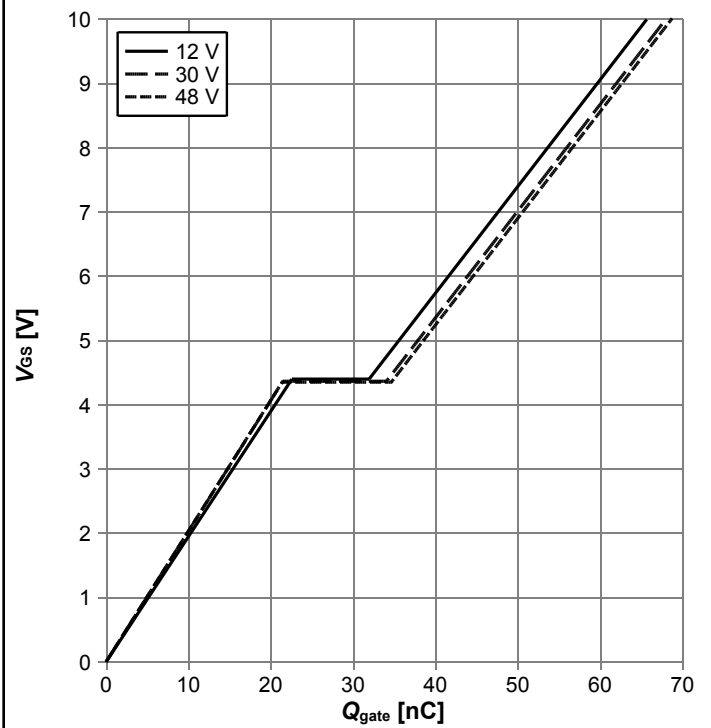


**Diagram 13: Avalanche characteristics**



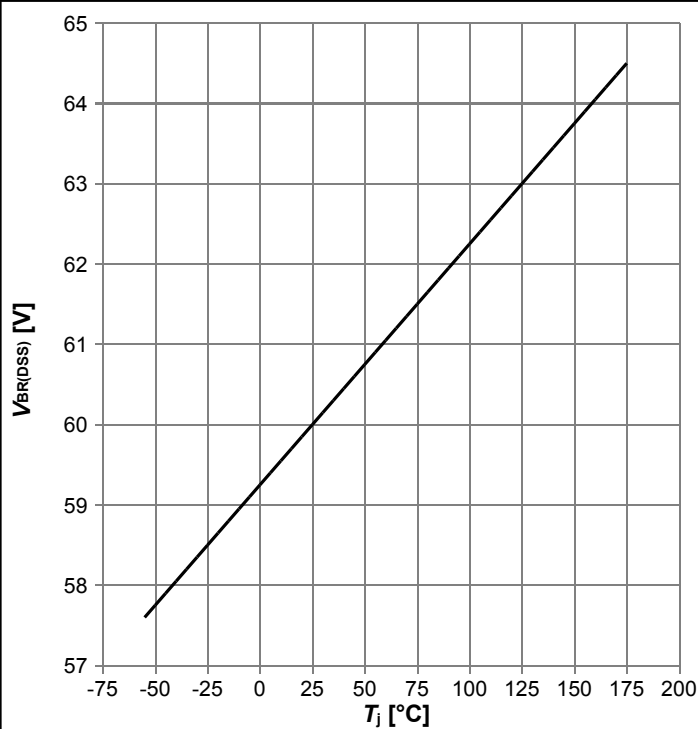
$I_{AS}=f(t_{AV}); R_{GS}=25 \Omega$ ; parameter:  $T_{j,start}$

**Diagram 14: Typ. gate charge**



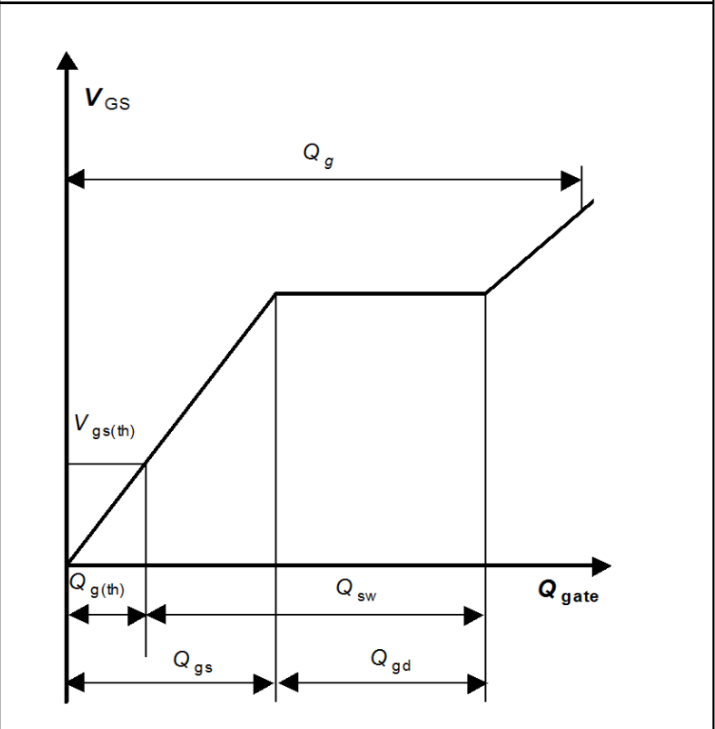
$V_{GS}=f(Q_{gate}), I_D=50 \text{ A pulsed}, T_j=25 \text{ °C}$ ; parameter:  $V_{DD}$

**Diagram 15: Drain-source breakdown voltage**



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

**Diagram Gate charge waveforms**



## 5 Package Outlines

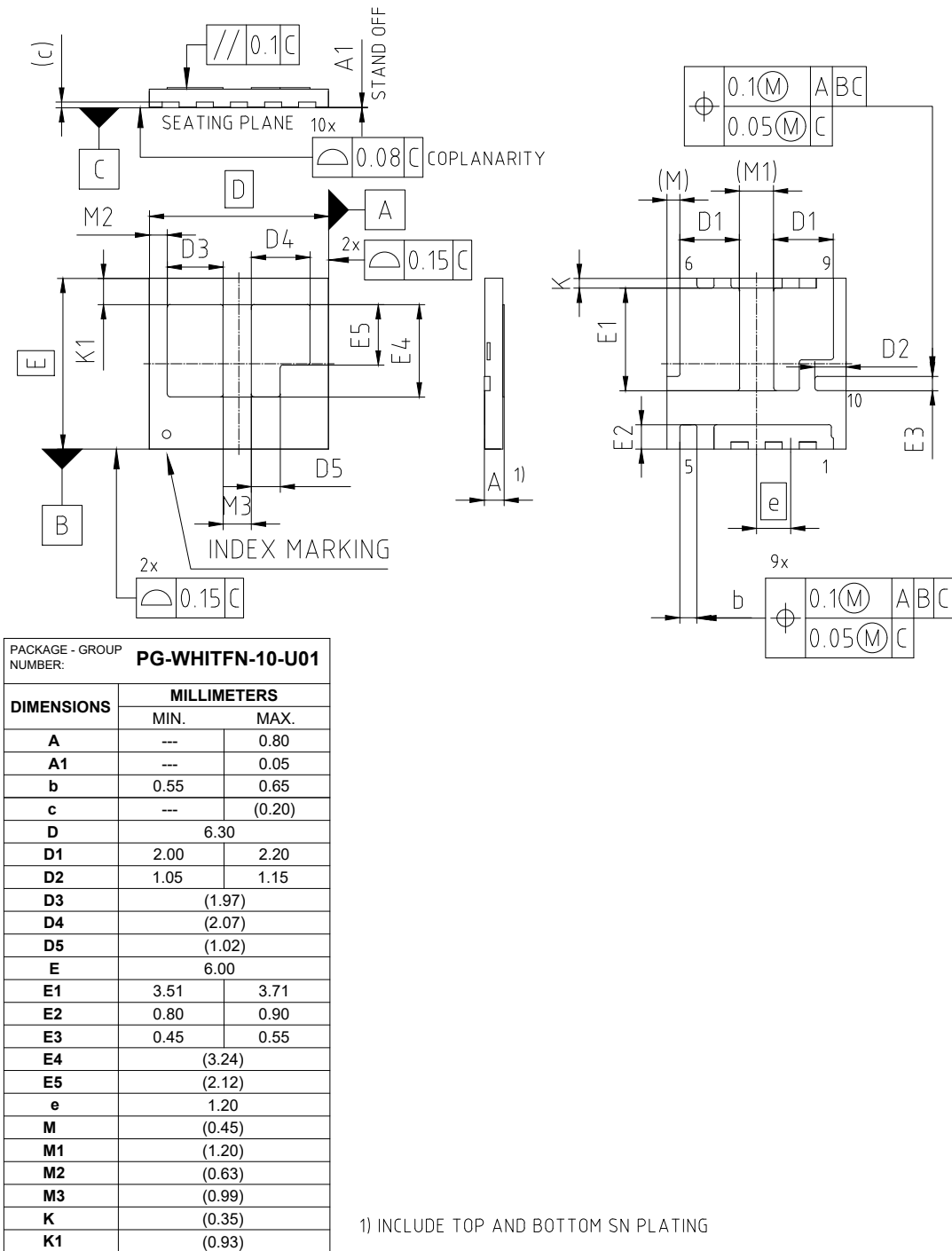


Figure 1 Outline PG -WHITFN-10-1, dimensions in mm

## Revision History

ISG0614N06NM5HSC

**Revision: 2023-12-05, Rev. 2.0**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|--|
| 2.0      | 2023-12-05 | Release of final version                     |

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