

# MOSFET

## OptiMOS™ 5 Power-Transistor, 100 V

### Features

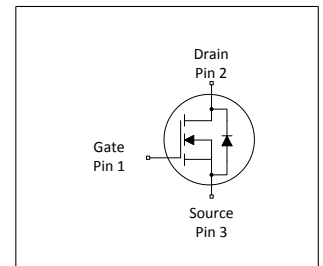
- Ideal for high frequency switching and sync. rec.
- Excellent gate charge x  $R_{DS(on)}$  product (FOM)
- Very low on-resistance  $R_{DS(on)}$
- N-channel, normal level
- 100% avalanche tested
- Pb-free plating; RoHS compliant
- Halogen-free according to IEC61249-2-21

### Product validation

Qualified according to JEDEC Standard

**Table 1 Key Performance Parameters**

| Parameter        | Value | Unit       |
|------------------|-------|------------|
| $V_{DS}$         | 100   | V          |
| $R_{DS(on),max}$ | 5.0   | m $\Omega$ |
| $I_D$            | 66    | A          |
| $Q_{oss}$        | 67    | nC         |
| $Q_G(0V..10V)$   | 51    | nC         |



| Type / Ordering Code | Package           | Marking  | Related Links |
|----------------------|-------------------|----------|---------------|
| IPA050N10NM5S        | PG-TO 220 FullPAK | 050N105S | -             |

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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                     | $I_D$             | -      | -    | 66<br>47 | A    | $V_{GS}=10\text{ V}$ , $T_C=25\text{ °C}$<br>$V_{GS}=10\text{ V}$ , $T_C=100\text{ °C}$ |
| Pulsed drain current <sup>1)</sup>           | $I_{D,pulse}$     | -      | -    | 264      | A    | $T_C=25\text{ °C}$                                                                      |
| Avalanche energy, single pulse <sup>2)</sup> | $E_{AS}$          | -      | -    | 110      | mJ   | $I_D=66\text{ A}$ , $R_{GS}=25\text{ }\Omega$                                           |
| Gate source voltage                          | $V_{GS}$          | -20    | -    | 20       | V    | -                                                                                       |
| Power dissipation                            | $P_{tot}$         | -      | -    | 38       | W    | $T_C=25\text{ °C}$                                                                      |
| Operating and storage temperature            | $T_j$ , $T_{stg}$ | -55    | -    | 175      | °C   | IEC climatic category; DIN IEC 68-1: 55/175/56                                          |

## 2 Thermal characteristics

**Table 3 Thermal characteristics**

| Parameter                           | Symbol     | Values |      |      | Unit | Note / Test Condition |
|-------------------------------------|------------|--------|------|------|------|-----------------------|
|                                     |            | Min.   | Typ. | Max. |      |                       |
| Thermal resistance, junction - case | $R_{thJC}$ | -      | -    | 3.9  | °C/W | -                     |

## 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   | $V_{(BR)DSS}$ | 100    | -          | -        | V             | $V_{GS}=0\text{ V}$ , $I_D=1\text{ mA}$                                                                                               |
| Gate threshold voltage           | $V_{GS(th)}$  | 2.2    | 3.0        | 3.8      | V             | $V_{DS}=V_{GS}$ , $I_D=84\text{ }\mu\text{A}$                                                                                         |
| Zero gate voltage drain current  | $I_{DSS}$     | -      | 0.1<br>10  | 1<br>100 | $\mu\text{A}$ | $V_{DS}=100\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=25\text{ °C}$<br>$V_{DS}=100\text{ V}$ , $V_{GS}=0\text{ V}$ , $T_j=125\text{ °C}$ |
| Gate-source leakage current      | $I_{GSS}$     | -      | 1          | 100      | nA            | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                                                                                            |
| Drain-source on-state resistance | $R_{DS(on)}$  | -      | 4.7<br>5.6 | 5.0<br>- | m $\Omega$    | $V_{GS}=10\text{ V}$ , $I_D=33\text{ A}$<br>$V_{GS}=6\text{ V}$ , $I_D=17\text{ A}$                                                   |
| Gate resistance <sup>3)</sup>    | $R_G$         | -      | 1.2        | -        | $\Omega$      | -                                                                                                                                     |
| Transconductance                 | $g_{fs}$      | -      | 85         | -        | S             | $ V_{DS} \geq 2 I_D /R_{DS(on)max}$ , $I_D=33\text{ A}$                                                                               |

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

<sup>2)</sup> See Diagram 13 for more detailed information

<sup>3)</sup> Defined by design. Not subject to production test.

**Table 5 Dynamic characteristics**

| Parameter                       | Symbol       | Values |      |      | Unit | Note / Test Condition                                                                     |
|---------------------------------|--------------|--------|------|------|------|-------------------------------------------------------------------------------------------|
|                                 |              | Min.   | Typ. | Max. |      |                                                                                           |
| Input capacitance <sup>1)</sup> | $C_{iss}$    | -      | 3600 | 4700 | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$                             |
| Output capacitance              | $C_{oss}$    | -      | 560  | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$                             |
| Reverse transfer capacitance    | $C_{rss}$    | -      | 25   | -    | pF   | $V_{GS}=0\text{ V}$ , $V_{DS}=50\text{ V}$ , $f=1\text{ MHz}$                             |
| Turn-on delay time              | $t_{d(on)}$  | -      | 13   | -    | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=33\text{ A}$ , $R_{G,ext}=1.6\ \Omega$ |
| Rise time                       | $t_r$        | -      | 7    | -    | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=33\text{ A}$ , $R_{G,ext}=1.6\ \Omega$ |
| Turn-off delay time             | $t_{d(off)}$ | -      | 27   | -    | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=33\text{ A}$ , $R_{G,ext}=1.6\ \Omega$ |
| Fall time                       | $t_f$        | -      | 7    | -    | ns   | $V_{DD}=50\text{ V}$ , $V_{GS}=10\text{ V}$ , $I_D=33\text{ A}$ , $R_{G,ext}=1.6\ \Omega$ |

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

| Parameter                       | Symbol        | Values |      |      | Unit | Note / Test Condition                                                       |
|---------------------------------|---------------|--------|------|------|------|-----------------------------------------------------------------------------|
|                                 |               | Min.   | Typ. | Max. |      |                                                                             |
| Gate to source charge           | $Q_{gs}$      | -      | 16   | -    | nC   | $V_{DD}=50\text{ V}$ , $I_D=33\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge at threshold        | $Q_{g(th)}$   | -      | 11   | -    | nC   | $V_{DD}=50\text{ V}$ , $I_D=33\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate to drain charge            | $Q_{gd}$      | -      | 10   | -    | nC   | $V_{DD}=50\text{ V}$ , $I_D=33\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Switching charge                | $Q_{sw}$      | -      | 16   | -    | nC   | $V_{DD}=50\text{ V}$ , $I_D=33\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total <sup>1)</sup> | $Q_g$         | -      | 51   | 68   | nC   | $V_{DD}=50\text{ V}$ , $I_D=33\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate plateau voltage            | $V_{plateau}$ | -      | 4.5  | -    | V    | $V_{DD}=50\text{ V}$ , $I_D=33\text{ A}$ , $V_{GS}=0\text{ to }10\text{ V}$ |
| Gate charge total, sync. FET    | $Q_{g(sync)}$ | -      | 44   | -    | nC   | $V_{DS}=0.1\text{ V}$ , $V_{GS}=0\text{ to }10\text{ V}$                    |
| Output charge                   | $Q_{oss}$     | -      | 67   | -    | nC   | $V_{DD}=50\text{ V}$ , $V_{GS}=0\text{ V}$                                  |

**Table 7 Reverse diode**

| Parameter                             | Symbol        | Values |      |      | Unit | Note / Test Condition                                                      |
|---------------------------------------|---------------|--------|------|------|------|----------------------------------------------------------------------------|
|                                       |               | Min.   | Typ. | Max. |      |                                                                            |
| Diode continuous forward current      | $I_S$         | -      | -    | 32   | A    | $T_C=25\text{ °C}$                                                         |
| Diode pulse current                   | $I_{S,pulse}$ | -      | -    | 264  | A    | $T_C=25\text{ °C}$                                                         |
| Diode forward voltage                 | $V_{SD}$      | -      | 0.95 | 1.2  | V    | $V_{GS}=0\text{ V}$ , $I_F=66\text{ A}$ , $T_J=25\text{ °C}$               |
| Reverse recovery time <sup>1)</sup>   | $t_{rr}$      | -      | 48   | -    | ns   | $V_R=50\text{ V}$ , $I_F=66\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |
| Reverse recovery charge <sup>1)</sup> | $Q_{rr}$      | -      | 62   | -    | nC   | $V_R=50\text{ V}$ , $I_F=66\text{ A}$ , $di_F/dt=100\text{ A}/\mu\text{s}$ |

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

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

## 4 Electrical characteristics diagrams

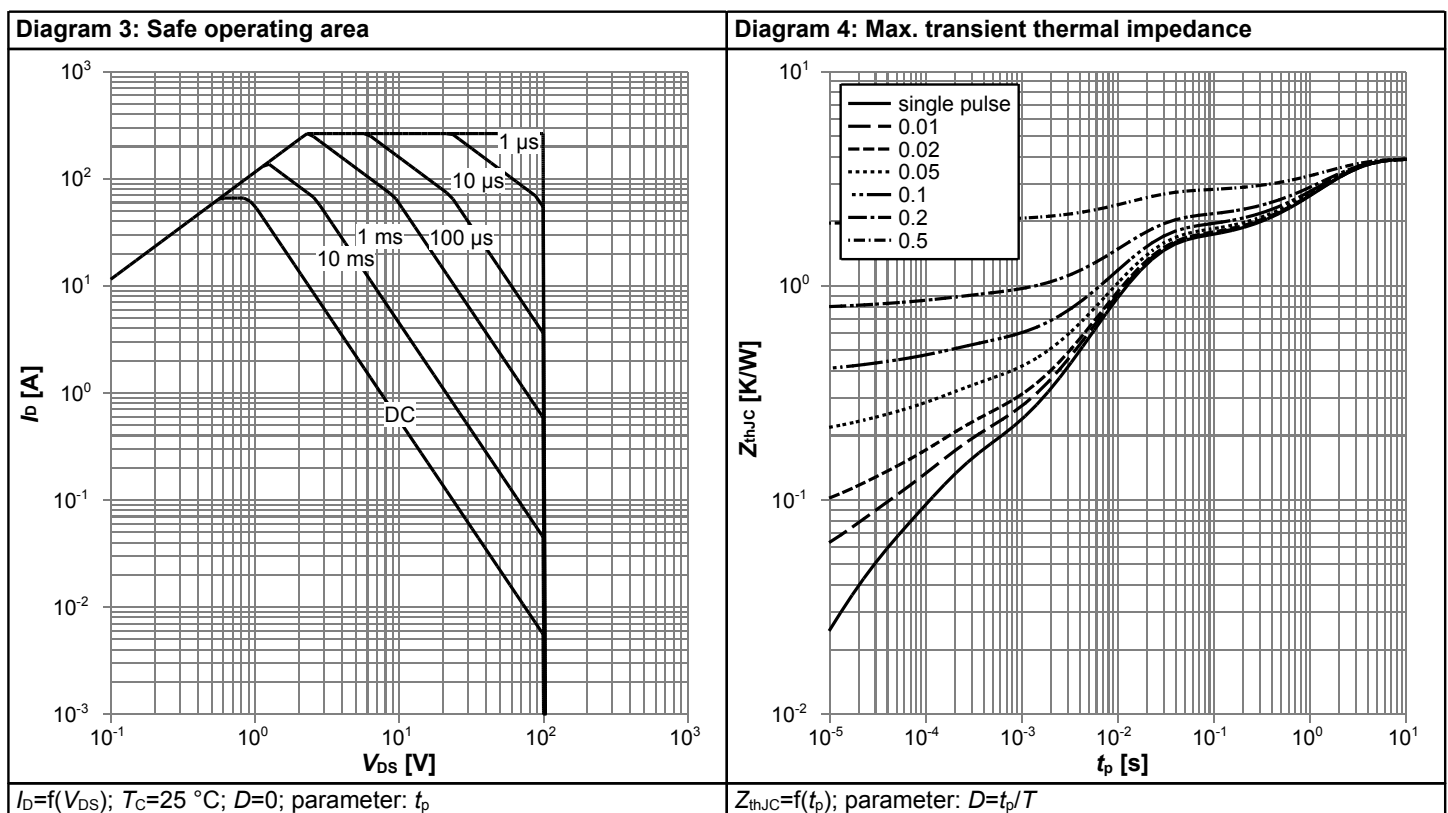
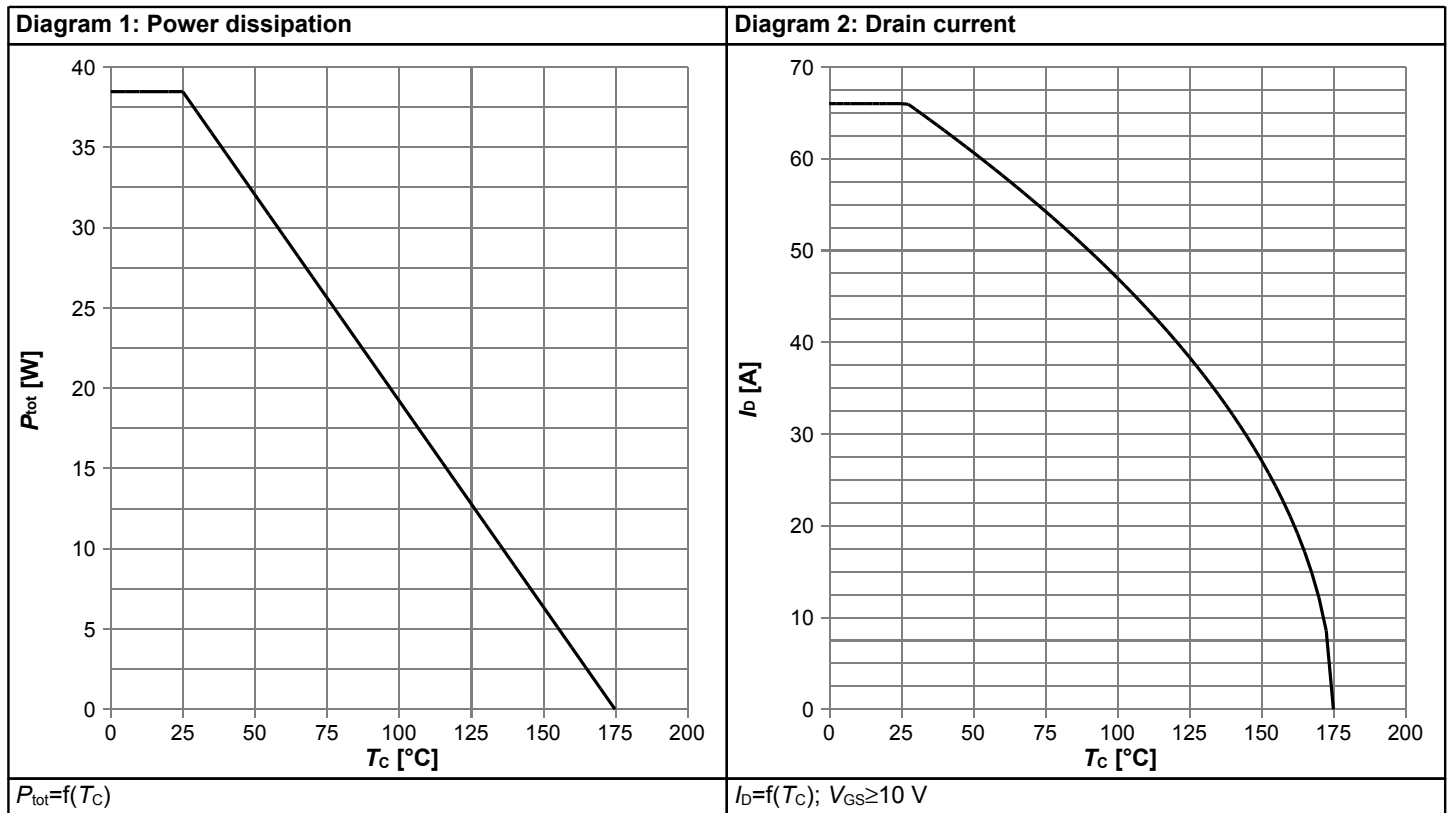
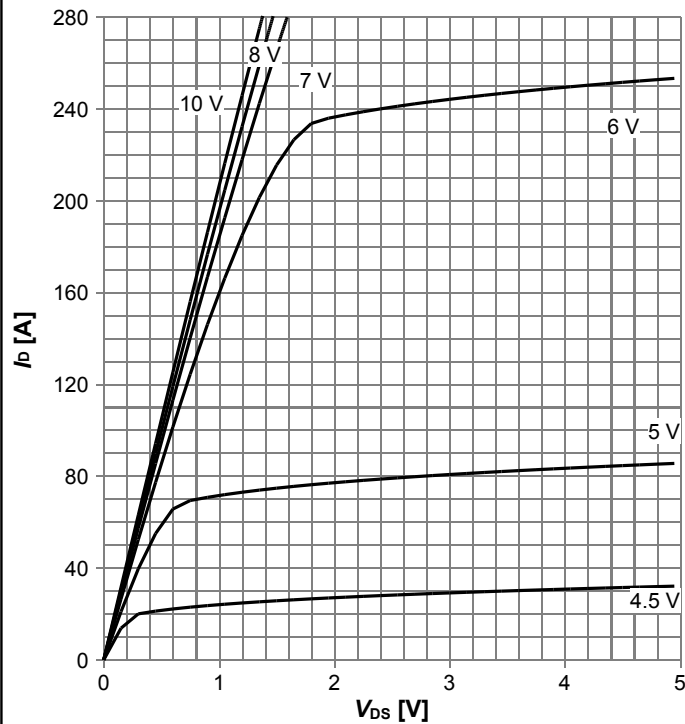
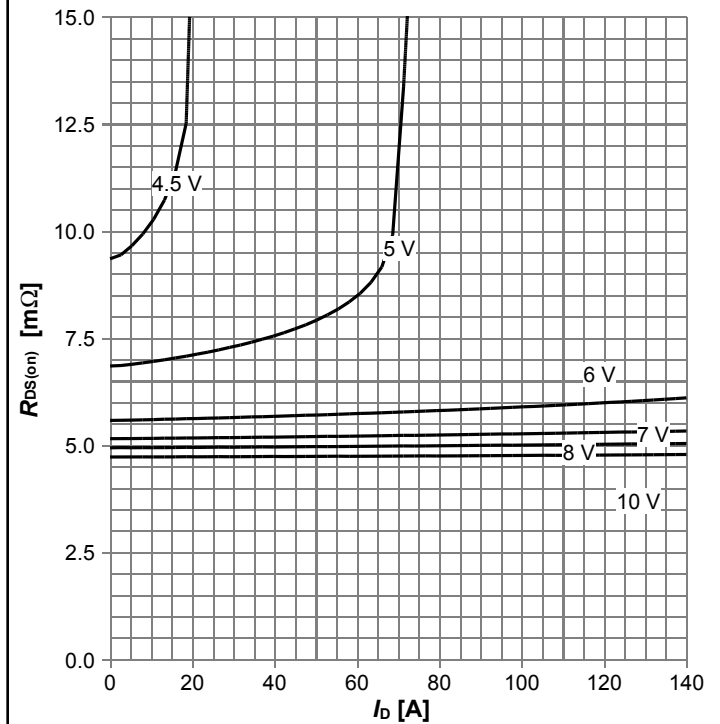


Diagram 5: Typ. output characteristics



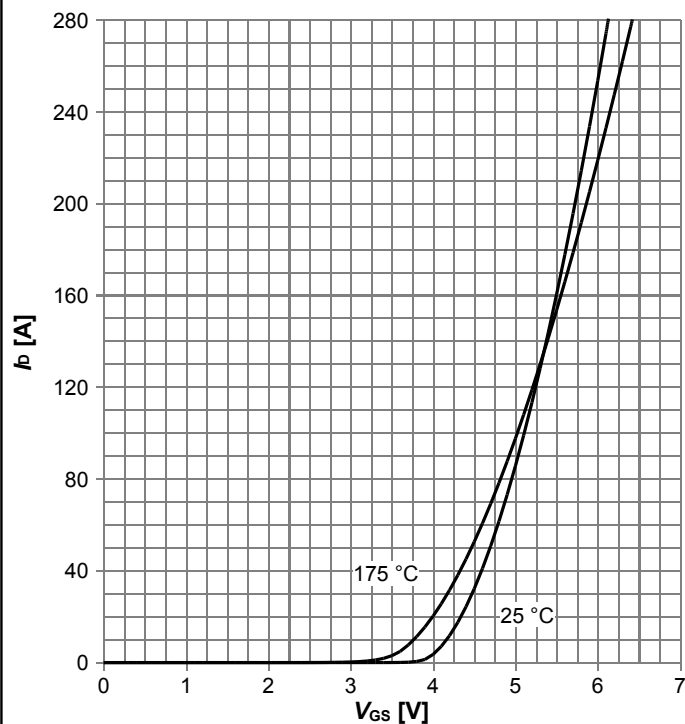
$I_D = f(V_{DS})$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 6: Typ. drain-source on resistance



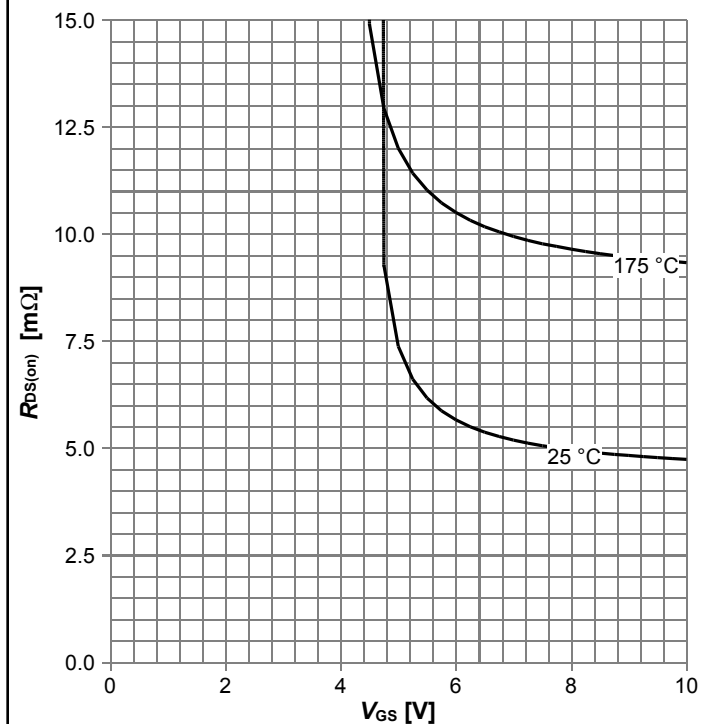
$R_{DS(on)} = f(I_D)$ ,  $T_j = 25^\circ\text{C}$ ; parameter:  $V_{GS}$

Diagram 7: Typ. transfer characteristics



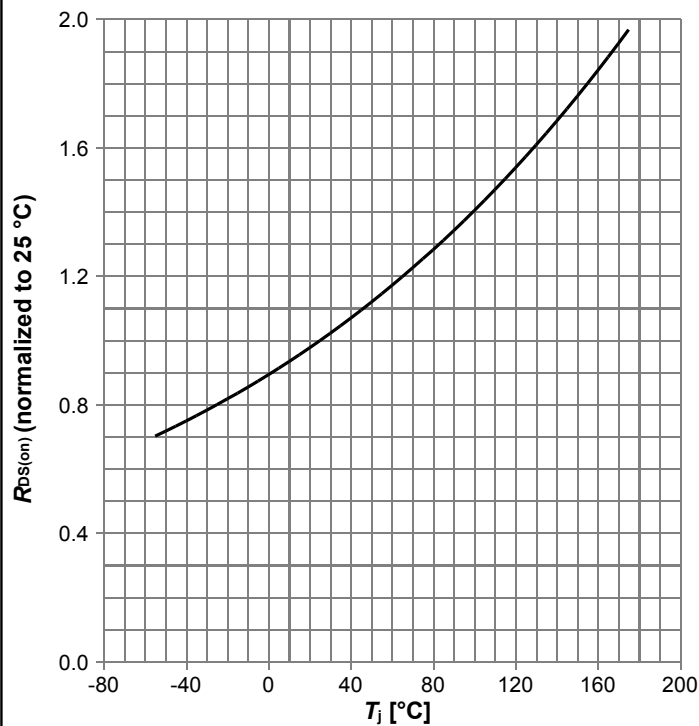
$I_D = f(V_{GS})$ ,  $|V_{DS}| > 2|I_D|R_{DS(on)\text{max}}$ ; parameter:  $T_j$

Diagram 8: Typ. drain-source on resistance



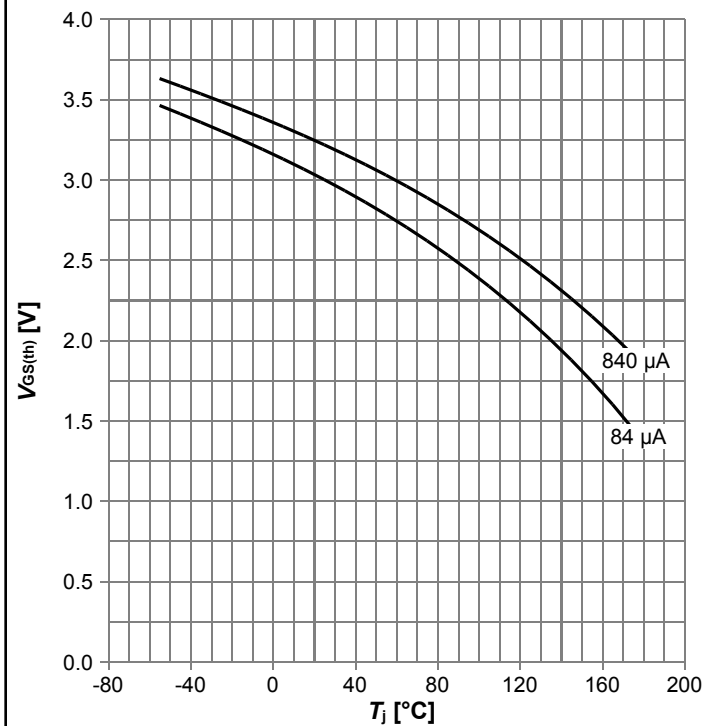
$R_{DS(on)} = f(V_{GS})$ ,  $I_D = 33\text{ A}$ ; parameter:  $T_j$

Diagram 9: Normalized drain-source on resistance



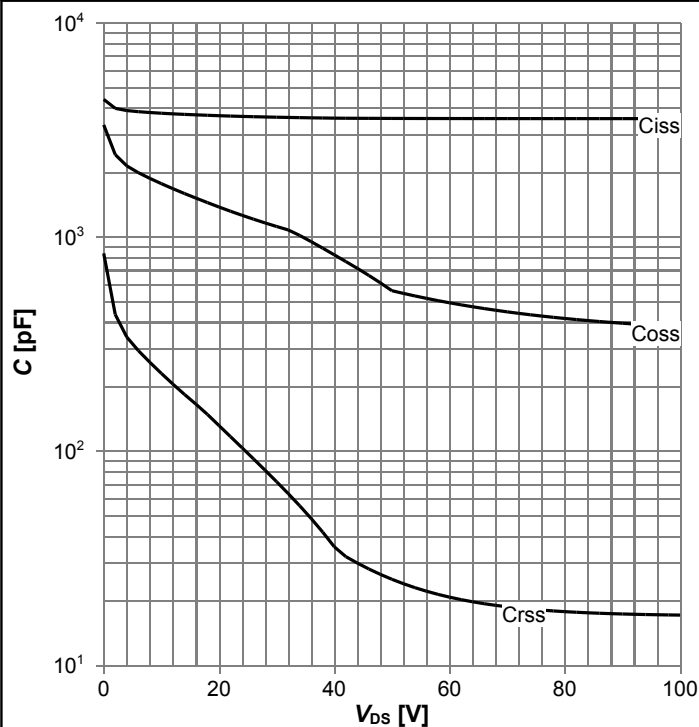
$R_{DS(on)} = f(T_j)$ ,  $I_D = 33$  A,  $V_{GS} = 10$  V

Diagram 10: Typ. gate threshold voltage



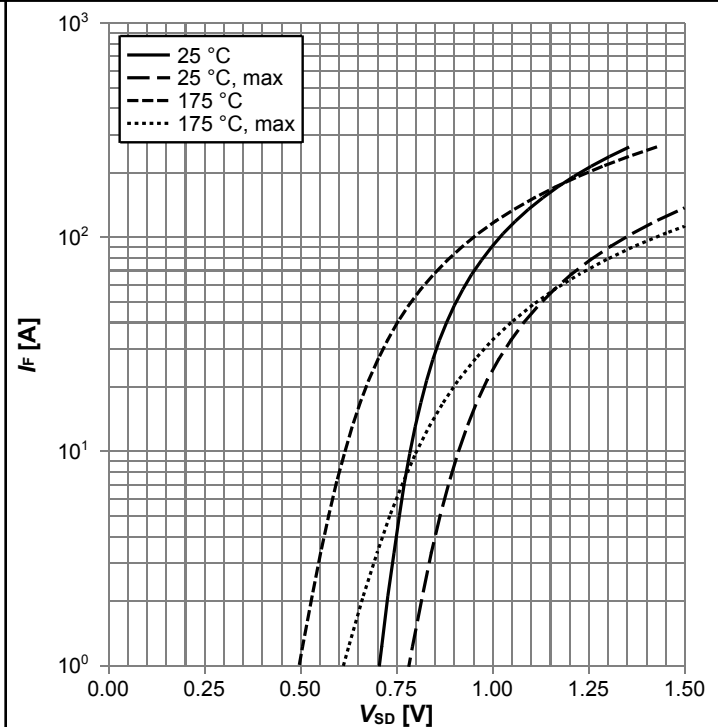
$V_{GS(th)} = f(T_j)$ ,  $V_{GS} = V_{DS}$ ; parameter:  $I_D$

Diagram 11: Typ. capacitances



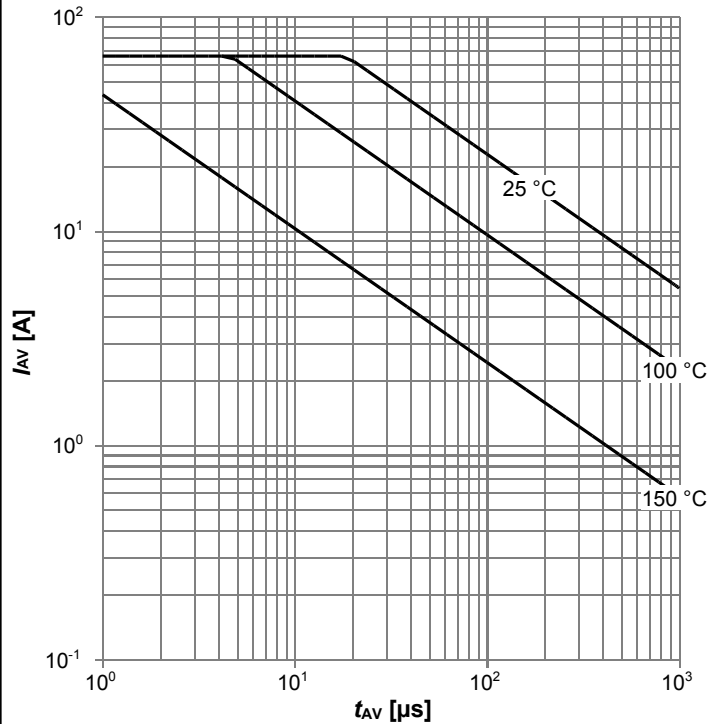
$C = f(V_{DS})$ ;  $V_{GS} = 0$  V;  $f = 1$  MHz

Diagram 12: Forward characteristics of reverse diode



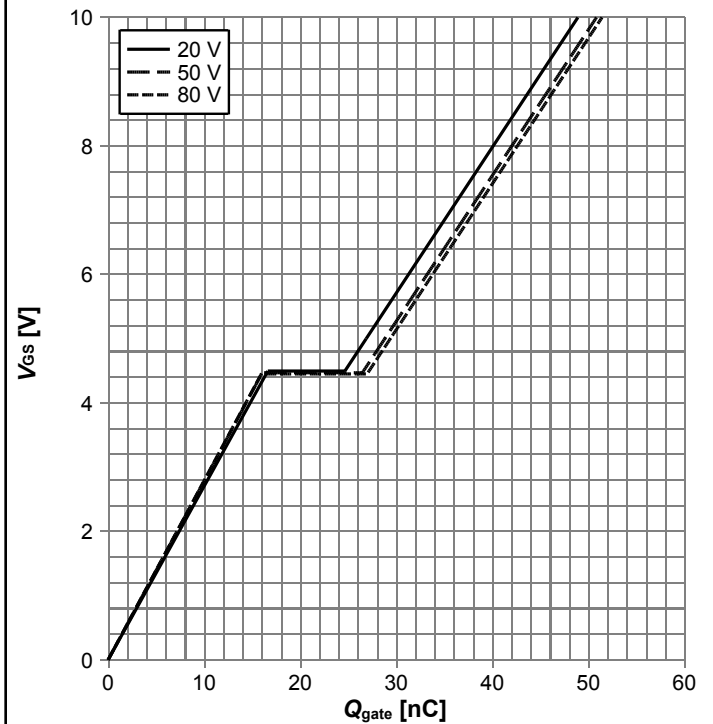
$I_F = f(V_{SD})$ ; parameter:  $T_j$

Diagram 13: Avalanche characteristics



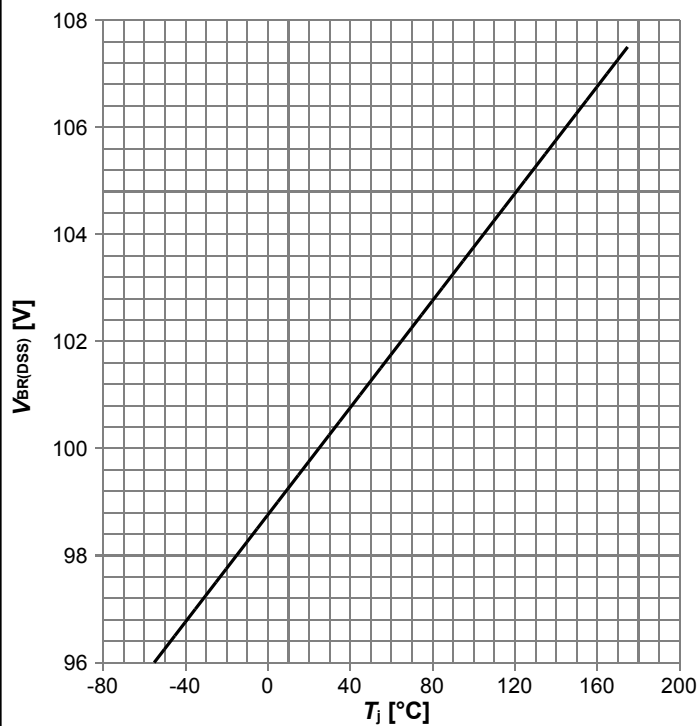
$I_{AS}=f(t_{AV})$ ;  $R_{GS}=25\ \Omega$ ; parameter:  $T_{j,start}$

Diagram 14: Typ. gate charge



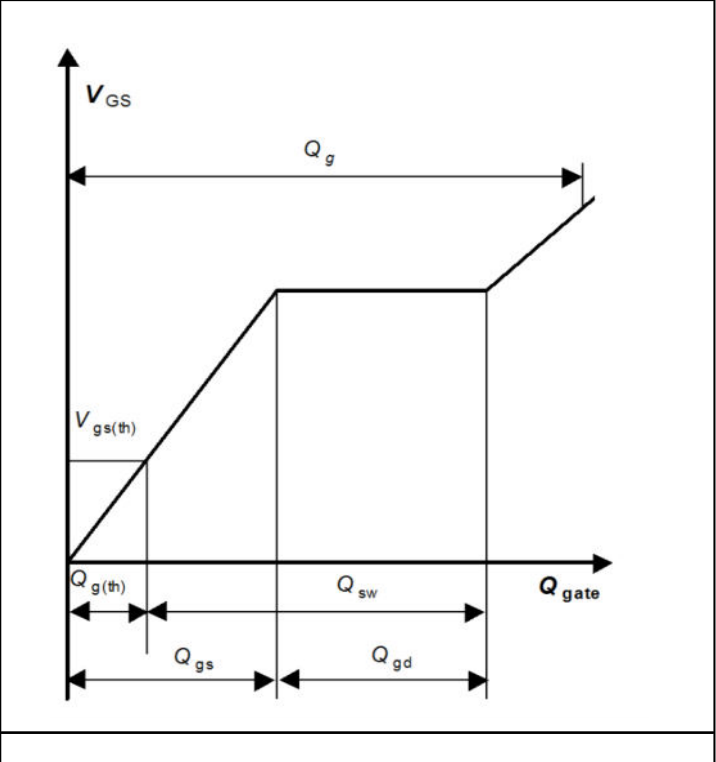
$V_{GS}=f(Q_{gate})$ ,  $I_D=33\text{ A}$  pulsed,  $T_j=25\text{ °C}$ ; parameter:  $V_{DD}$

Diagram 15: Drain-source breakdown voltage

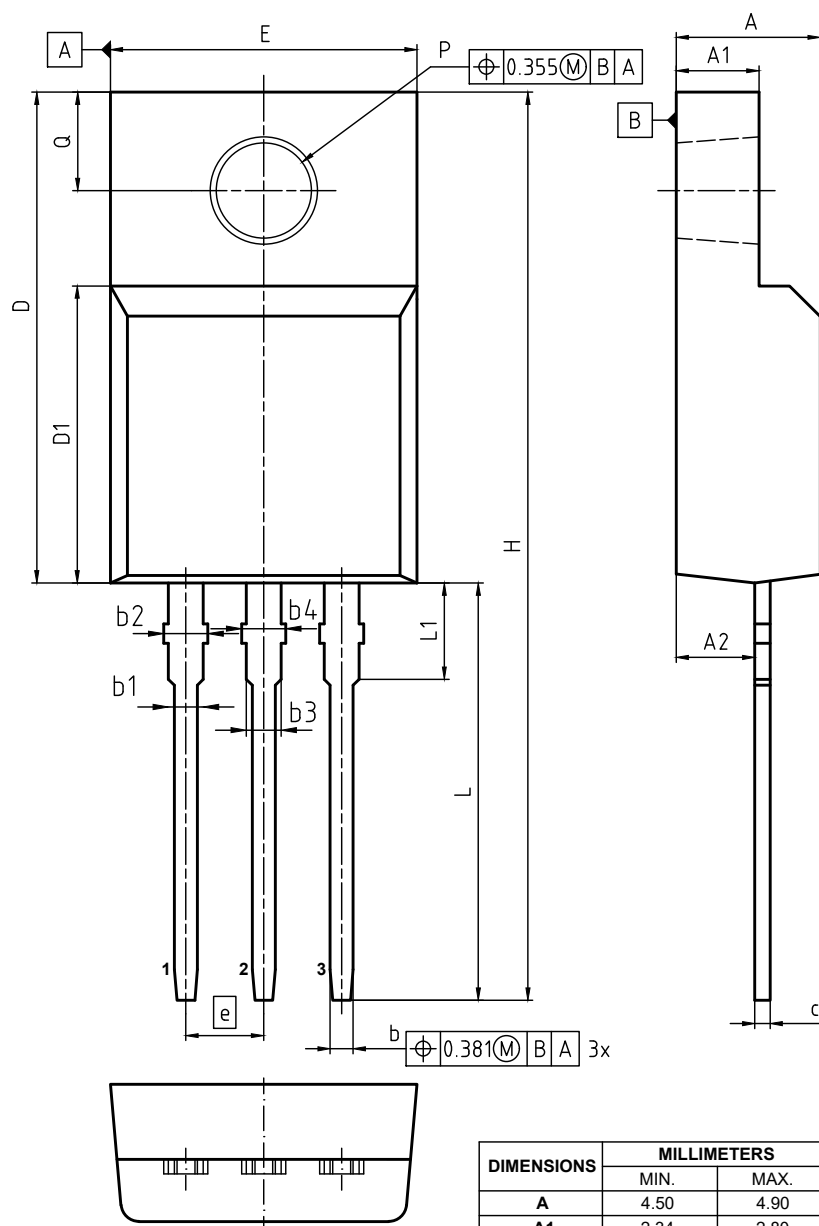


$V_{BR(DSS)}=f(T_j)$ ;  $I_D=1\text{ mA}$

Diagram Gate charge waveforms



## 5 Package Outlines



NOTES:  
STANDARD QUALITY GRADE  
DIMENSIONS DO NOT INCLUDE MOLD FLASH, PRO-  
TRUSIONS OR GATE BURRS

| DIMENSIONS | MILLIMETERS |       |
|------------|-------------|-------|
|            | MIN.        | MAX.  |
| A          | 4.50        | 4.90  |
| A1         | 2.34        | 2.80  |
| A2         | 2.42        | 2.86  |
| b          | 0.65        | 0.90  |
| b1         | 0.95        | 1.38  |
| b2         | 1.20        | 1.50  |
| b3         | 0.65        | 1.38  |
| b4         | 1.20        | 1.50  |
| c          | 0.40        | 0.63  |
| D          | 15.67       | 16.15 |
| D1         | 8.97        | 9.83  |
| E          | 10.00       | 10.65 |
| e          | 2.54        |       |
| H          | 28.70       | 29.75 |
| L          | 12.78       | 13.75 |
| L1         | 2.83        | 3.45  |
| øP         | 3.00        | 3.38  |
| Q          | 3.15        | 3.50  |

|                                    |
|------------------------------------|
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| <b>SCALE</b> 5:1<br>0 1 2 3 4 5mm  |
| <b>EUROPEAN PROJECTION</b><br>     |

Figure 1 Outline PG-TO 220 FullPAK, dimensions in mm/inches

## Revision History

IPA050N10NM5S

**Revision: 2019-08-28, Rev. 2.1**

Previous Revision

| Revision | Date       | Subjects (major changes since last revision) |
|----------|------------|----------------------------------------------|
| 2.0      | 2019-07-03 | Release of final version                     |
| 2.1      | 2019-08-28 | Update package outline                       |

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