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# MOSFET

## OptiMOS™ Power Transistor, -60 V

D-PAK

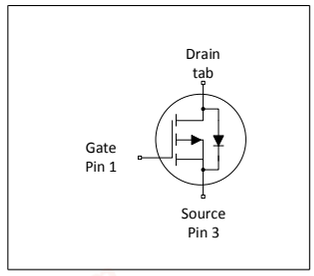



### Features

- 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 |
| $R_{DS(on),max}$ | 90 | mΩ |
| $I_D$ | -16.4 | A |

| Type / Ordering Code | Package | Marking | Related Links |
|---|---|---|---|
| IPD900P06NM | PG-TO 252-3 | 900P06NM | - |

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# 1 Maximum ratings

at $T_C$=25 °C, unless otherwise specified

**Table 2 Maximum ratings**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Continuous drain current | $I_D$ | -<br>- | -<br>- | -16.4<br>-12.7 | A | $V_{GS}$=-10 V, $T_C$=25 °C<br>$V_{GS}$=-10 V, $T_C$=100 °C |
| Pulsed drain current[1] | $I_{D,pulse}$ | - | - | -65.6 | A | $T_C$=25 °C |
| Avalanche energy, single pulse[2] | $E_{AS}$ | - | - | 209 | mJ | $I_D$=-16.4 A, $R_{GS}$=25 Ω |
| Gate source voltage | $V_{GS}$ | -20 | - | 20 | V | - |
| Power dissipation | $P_{tot}$ | - | - | 63 | W | $T_C$=25 °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, bottom | $R_{thJC}$ | - | - | 2.4 | °C/W | - |
| Device on PCB,<br>6 cm² cooling area[3] | $R_{thJA}$ | - | - | 75 | °C/W | - |

# 3 Electrical characteristics

at $T_j$=25 °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 V, $I_D$=-250 µA |
| Gate threshold voltage | $V_{GS(th)}$ | -2.1 | -3 | -4 | V | $V_{DS}$=$V_{GS}$, $I_D$=-710 µA |
| Zero gate voltage drain current | $I_{DSS}$ | -<br>- | -0.1<br>-10 | -1<br>-100 | µA | $V_{DS}$=-60 V, $V_{GS}$=0 V, $T_j$=25 °C<br>$V_{DS}$=-60 V, $V_{GS}$=0 V, $T_j$=125 °C |
| Gate-source leakage current | $I_{GSS}$ | - | -10 | -100 | nA | $V_{GS}$=-20 V, $V_{DS}$=0 V |
| Drain-source on-state resistance | $R_{DS(on)}$ | - | 75 | 90 | mΩ | $V_{GS}$=-10 V, $I_D$=-16.4 A |
| Gate resistance | $R_G$ | - | 5 | - | Ω | - |
| Transconductance | $g_{fs}$ | - | 15 | - | S | $\|V_{DS}\|\geq 2\|I_D\|R_{DS(on)max}$, $I_D$=-16.4 A |

[1] See Diagram 3 for more detailed information
[2] See Diagram 13 for more detailed information
[3] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

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## Table 5 Dynamic characteristics

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input capacitance | $C_{iss}$ | - | 1100 | - | pF | $V_{GS}$=0 V, $V_{DS}$=-30 V, $f$=1 MHz |
| Output capacitance | $C_{oss}$ | - | 160 | - | pF | $V_{GS}$=0 V, $V_{DS}$=-30 V, $f$=1 MHz |
| Reverse transfer capacitance | $C_{rss}$ | - | 39 | - | pF | $V_{GS}$=0 V, $V_{DS}$=-30 V, $f$=1 MHz |
| Turn-on delay time | $t_{d(on)}$ | - | 9 | - | ns | $V_{DD}$=-30 V, $V_{GS}$=-10 V, $I_D$=-8.2 A, $R_{G,ext}$=1.6 Ω |
| Rise time | $t_r$ | - | 12 | - | ns | $V_{DD}$=-30 V, $V_{GS}$=-10 V, $I_D$=-8.2 A, $R_{G,ext}$=1.6 Ω |
| Turn-off delay time | $t_{d(off)}$ | - | 25 | - | ns | $V_{DD}$=-30 V, $V_{GS}$=-10 V, $I_D$=-8.2 A, $R_{G,ext}$=1.6 Ω |
| Fall time | $t_f$ | - | 9 | - | ns | $V_{DD}$=-30 V, $V_{GS}$=-10 V, $I_D$=-8.2 A, $R_{G,ext}$=1.6 Ω |

## Table 6 Gate charge characteristics[1)]

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Gate to source charge | $Q_{gs}$ | - | -6 | - | nC | $V_{DD}$=-30 V, $I_D$=-16.4 A, $V_{GS}$=0 to -10 V |
| Gate charge at threshold | $Q_{g(th)}$ | - | -3 | - | nC | $V_{DD}$=-30 V, $I_D$=-16.4 A, $V_{GS}$=0 to -10 V |
| Gate to drain charge | $Q_{gd}$ | - | -11 | - | nC | $V_{DD}$=-30 V, $I_D$=-16.4 A, $V_{GS}$=0 to -10 V |
| Switching charge | $Q_{sw}$ | - | -13 | - | nC | $V_{DD}$=-30 V, $I_D$=-16.4 A, $V_{GS}$=0 to -10 V |
| Gate charge total | $Q_g$ | - | -27 | - | nC | $V_{DD}$=-30 V, $I_D$=-16.4 A, $V_{GS}$=0 to -10 V |
| Gate plateau voltage | $V_{plateau}$ | - | -5.6 | - | V | $V_{DD}$=-30 V, $I_D$=-16.4 A, $V_{GS}$=0 to -10 V |
| Output charge | $Q_{oss}$ | - | -12 | - | nC | $V_{DD}$=-30 V, $V_{GS}$=0 V |

## Table 7 Reverse diode

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Diode continuous forward current | $I_S$ | - | - | -16 | A | $T_C$=25 °C |
| Diode pulse current | $I_{S,pulse}$ | - | - | -65.6 | A | $T_C$=25 °C |
| Diode forward voltage | $V_{SD}$ | - | -0.9 | -1.2 | V | $V_{GS}$=0 V, $I_F$=-16.4 A, $T_j$=25 °C |
| Reverse recovery time | $t_{rr}$ | - | 50 | - | ns | $V_R$=-30 V, $I_F$=-16.4 A, $di_F/dt$=-100 A/µs |
| Reverse recovery charge | $Q_{rr}$ | - | -116 | - | nC | $V_R$=-30 V, $I_F$=-16.4 A, $di_F/dt$=-100 A/µs |

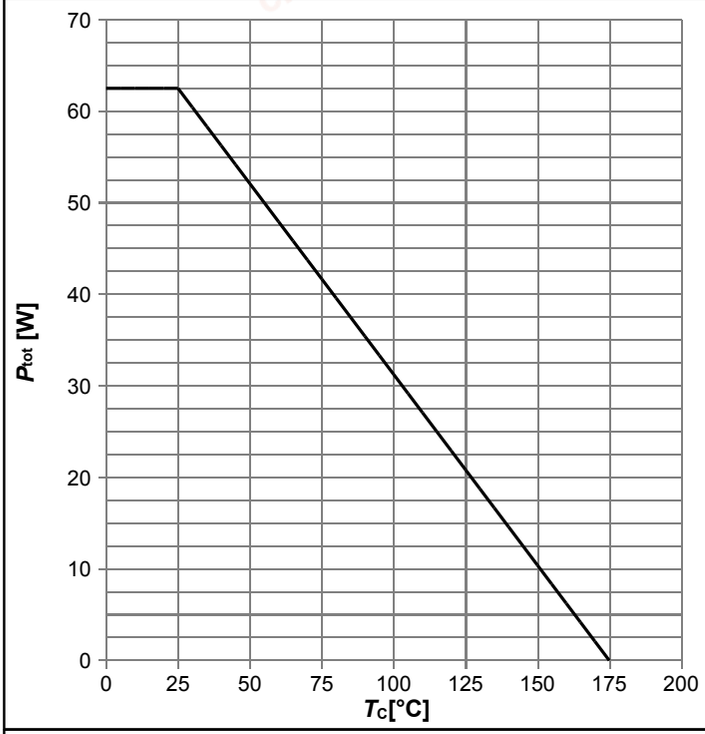
[1)] See diagram ,Gate charge waveforms, for gate charge parameter definition

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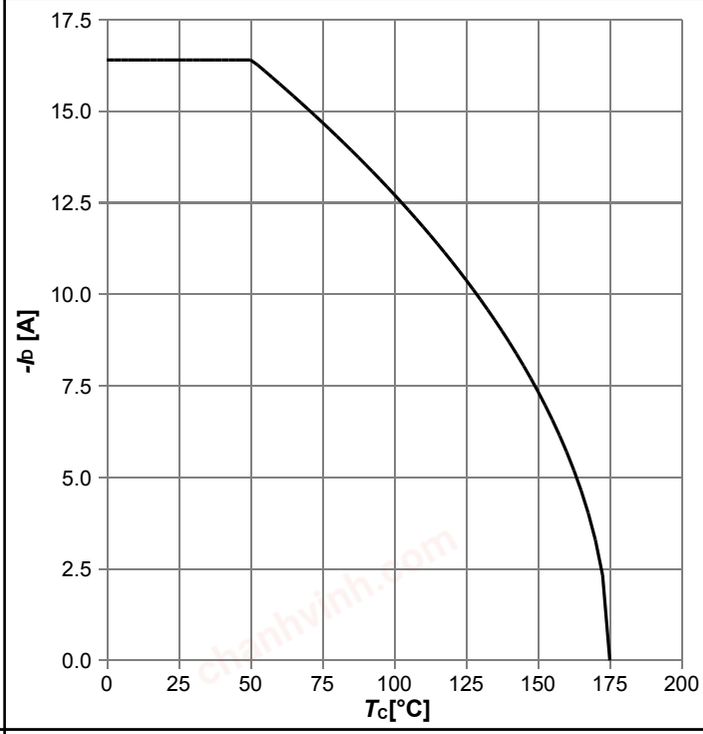
## 4 Electrical characteristics diagrams

**Diagram 1: Power dissipation**



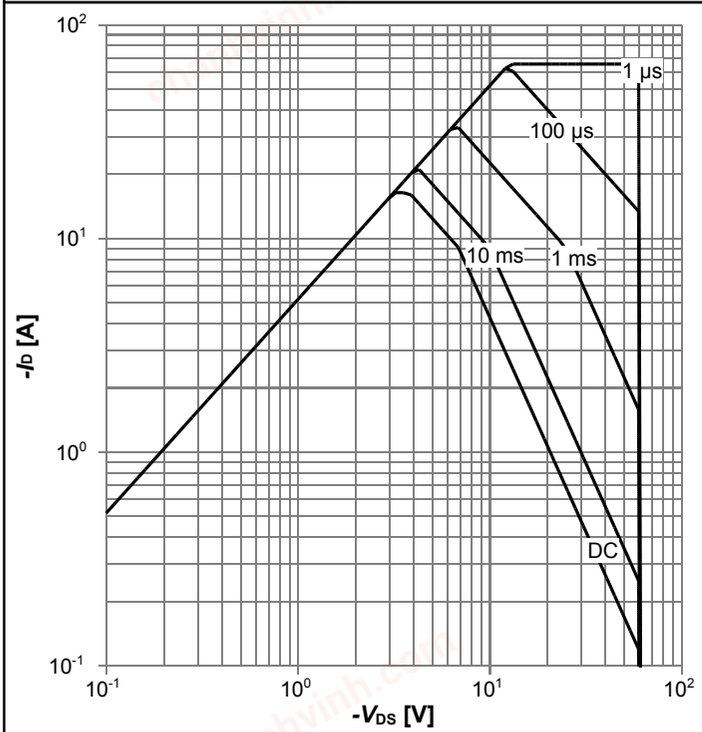

$P_{tot}=f(T_C)$

**Diagram 2: Drain current**



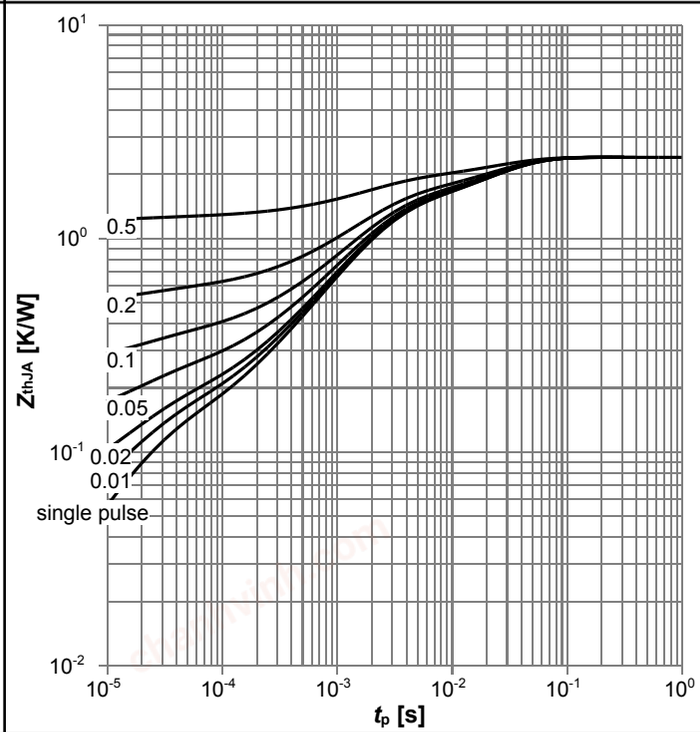

$I_D=f(T_C)$; $|V_{GS}|\geq 10$ V

**Diagram 3: Safe operating area**




$I_D=f(V_{DS})$; $T_C$=25 °C; $D$=0; parameter: $t_p$

**Diagram 4: Max. transient thermal impedance**

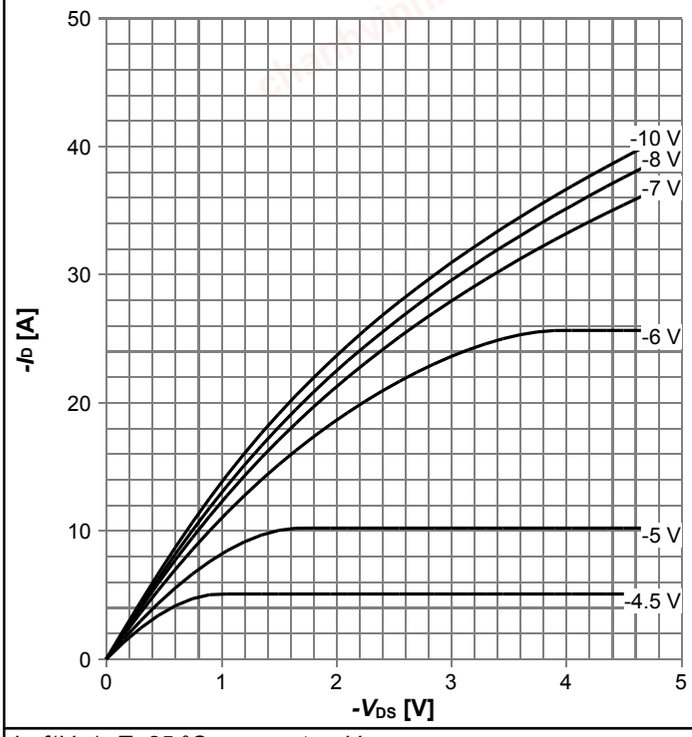



$Z_{thJC}=f(t_p)$; parameter: $D=t_p/T$

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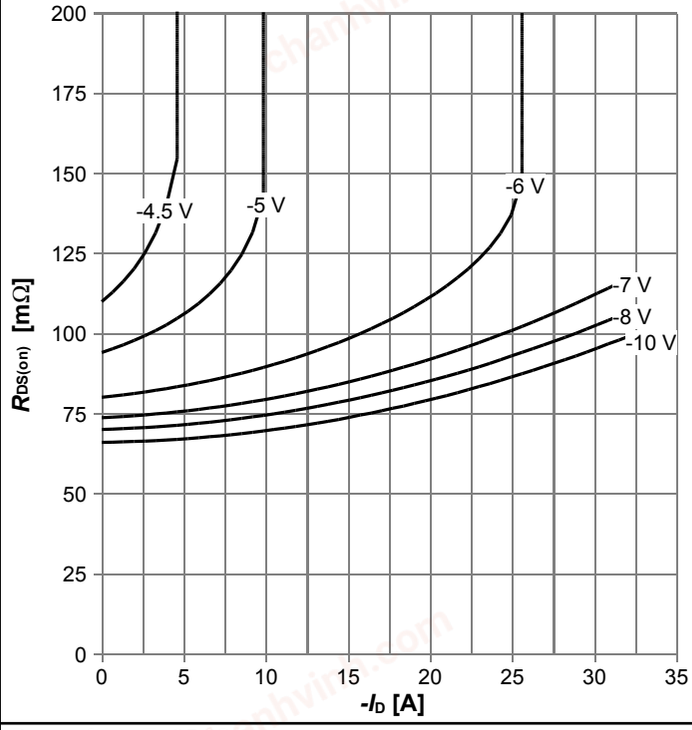


**Diagram 5: Typ. output characteristics**



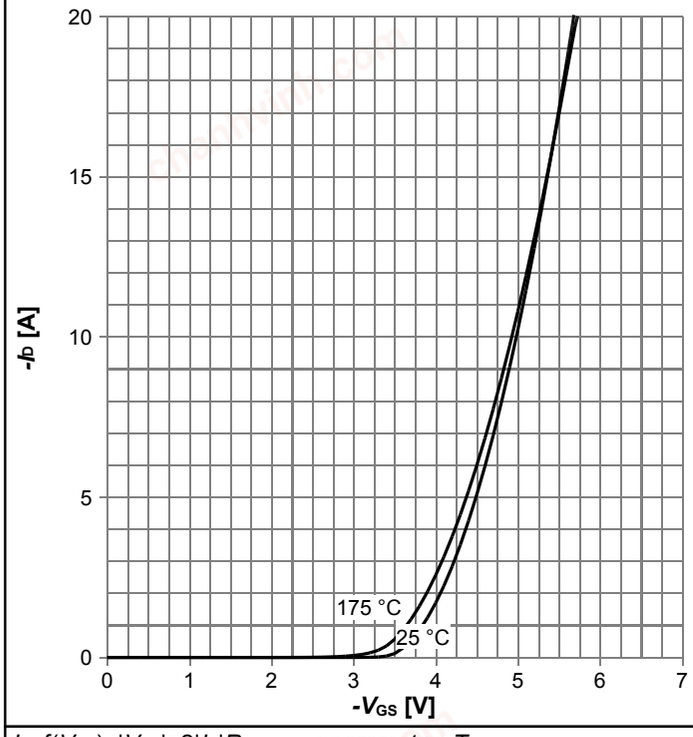

$I_D$=f($V_{DS}$), $T_j$=25 °C; parameter: $V_{GS}$

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



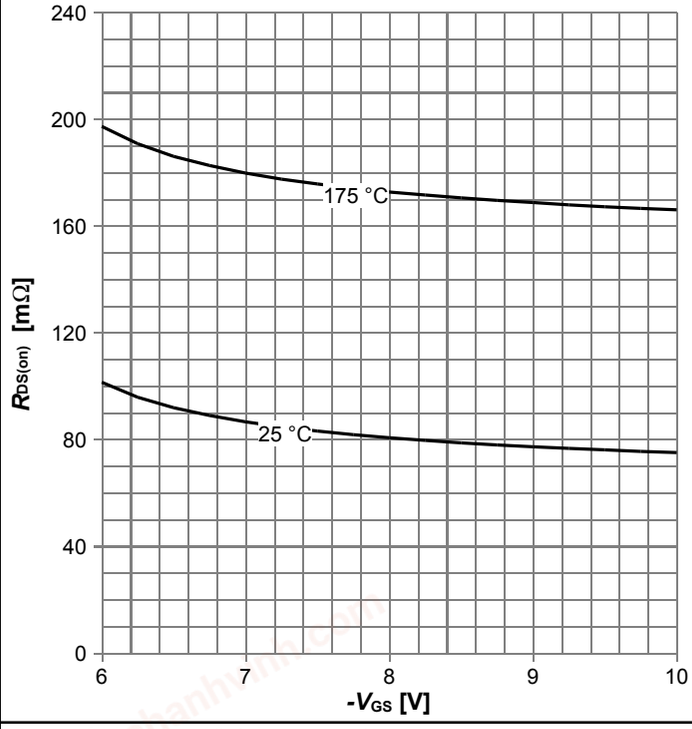

$R_{DS(on)}$=f($I_D$), $T_j$=25 °C; parameter: $V_{GS}$

**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**

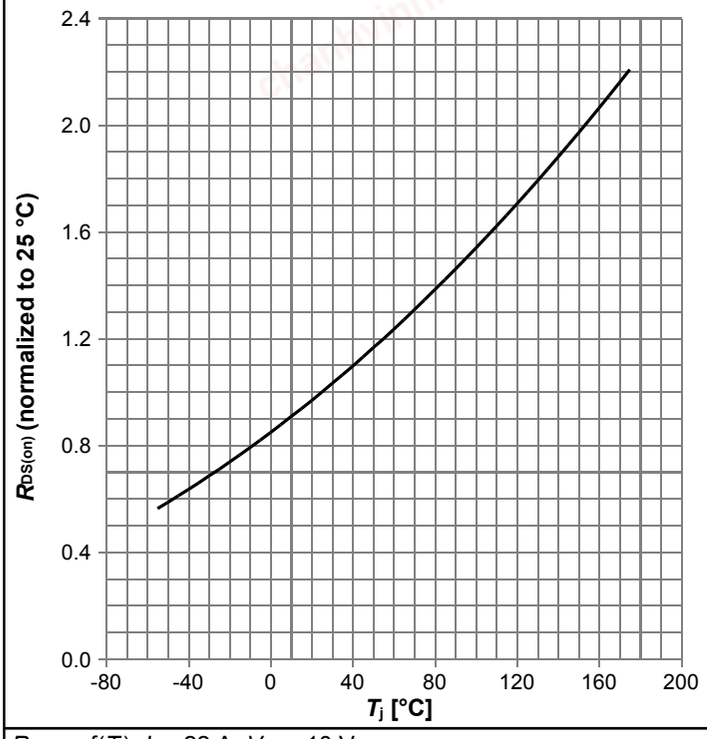



$R_{DS(on)}$=f($V_{GS}$), $I_D$=-16.4 A; parameter: $T_j$

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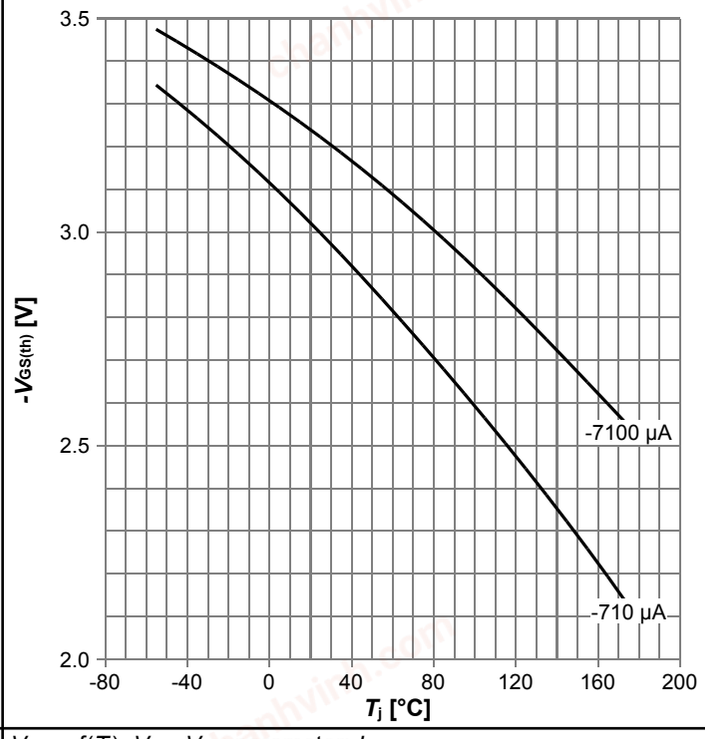


**Diagram 9: Normalized drain-source on resistance**



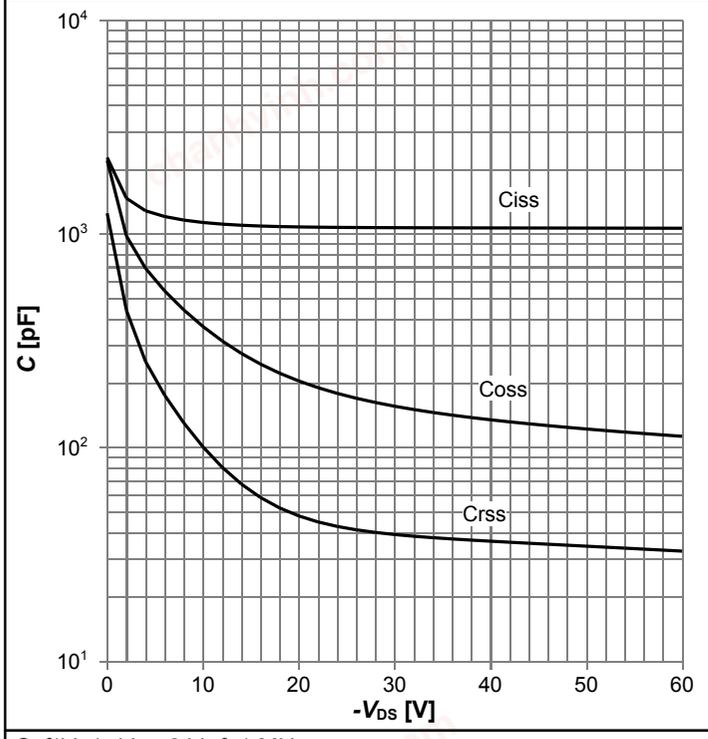

$R_{DS(on)}$=f($T_j$), $I_D$=-22 A, $V_{GS}$=-10 V

**Diagram 10: Typ. gate threshold voltage**



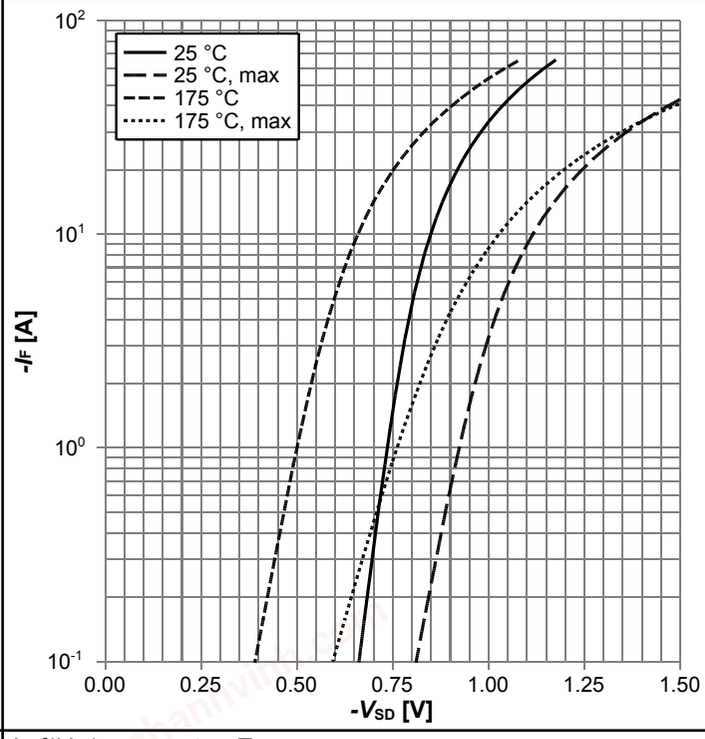

$V_{GS(th)}$=f($T_j$), $V_{GS}$=$V_{DS}$; parameter: $I_D$

**Diagram 11: Typ. capacitances**




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

**Diagram 12: Forward characteristics of reverse diode**

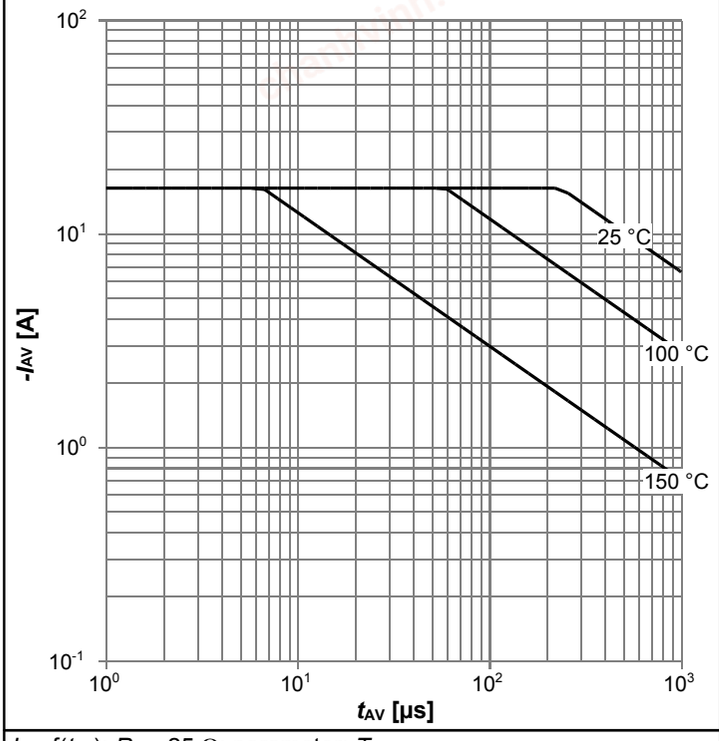



$I_F$=f($V_{SD}$); parameter: $T_j$

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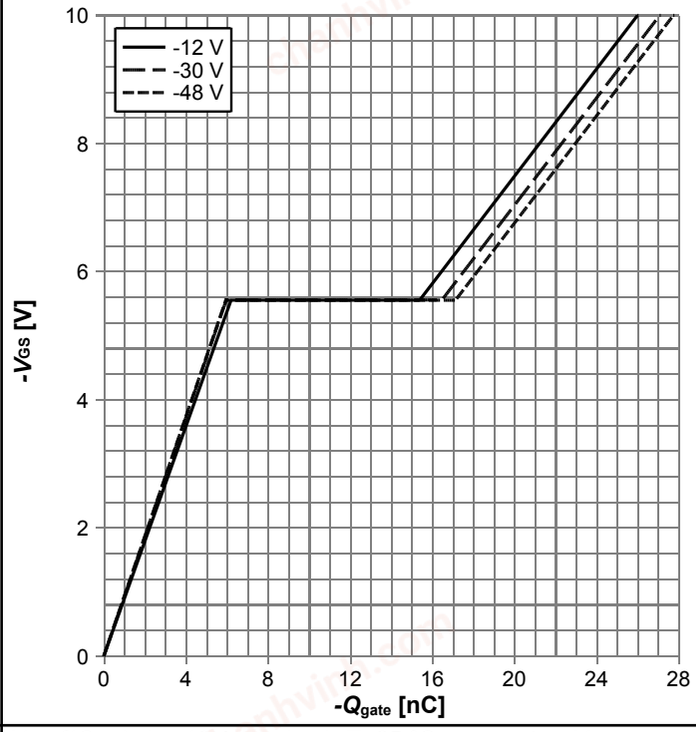


**Diagram 13: Avalanche characteristics**



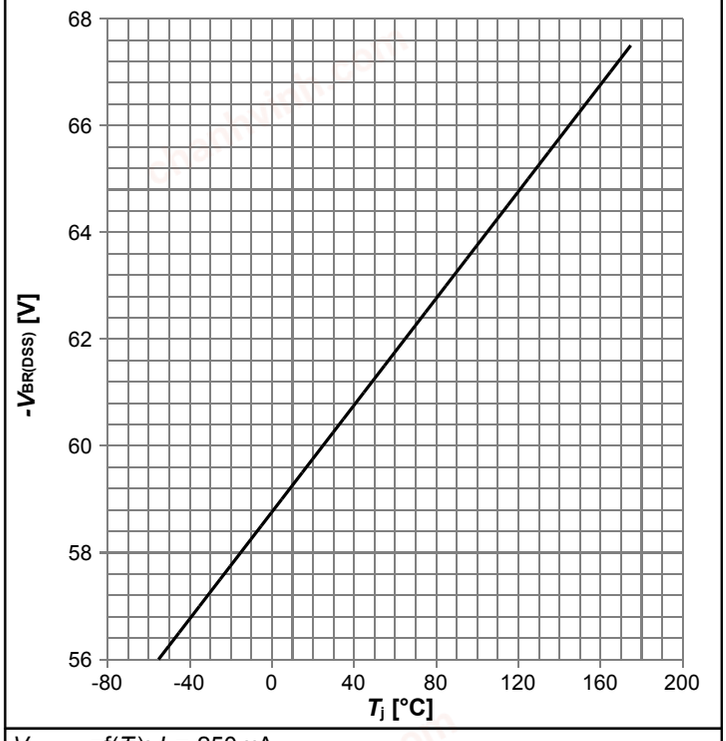

$I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω; parameter: $T_{j,start}$

**Diagram 14: Typ. gate charge**



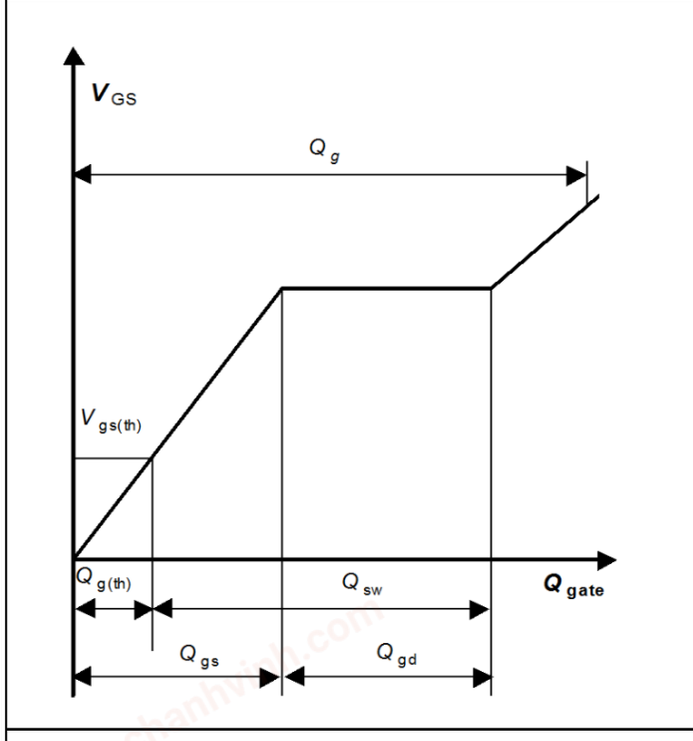

$V_{GS}$=f($Q_{gate}$), $I_D$=-16.4 A pulsed, $T_j$=25 °C; parameter: $V_{DD}$

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




$V_{BR(DSS)}$=f($T_j$); $I_D$=-250 µA

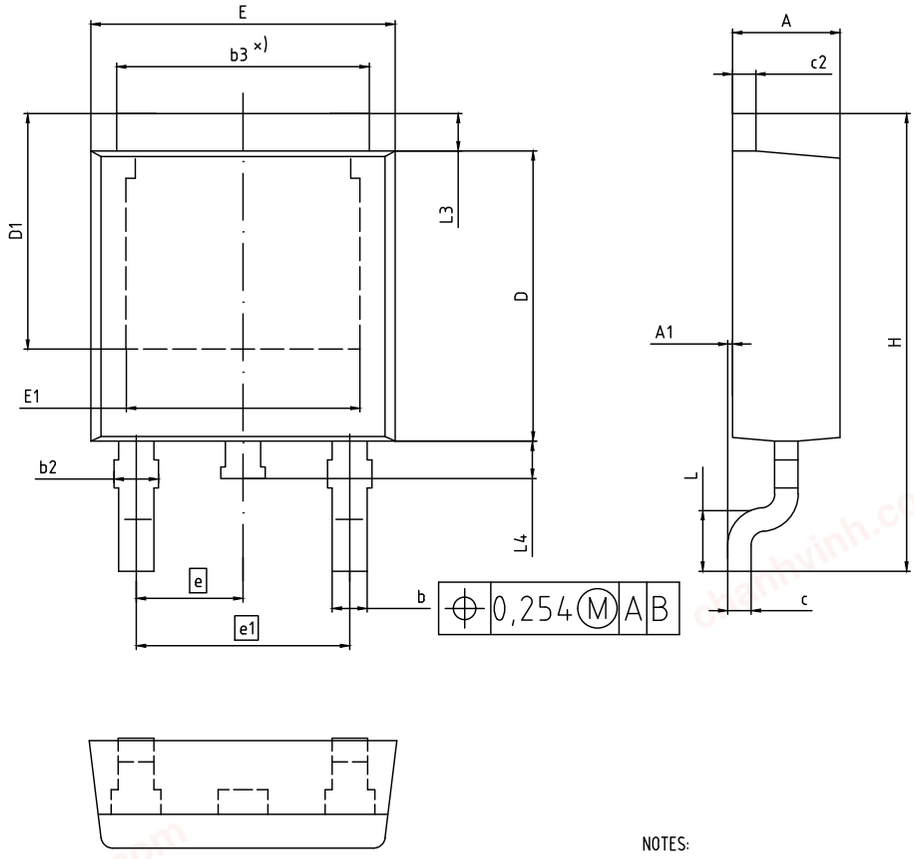
**Diagram Gate charge waveforms**



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# 5 Package Outlines




NOTES:

1. INDUSTRIAL QUALITY GRADE
2. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-252 DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 2.16 | 2.41 | 0.085 | 0.095 |
| A1 | 0.00 | 0.15 | 0.000 | 0.006 |
| b | 0.64 | 0.89 | 0.025 | 0.035 |
| b2 | 0.65 | 1.15 | 0.026 | 0.045 |
| b3 | 4,95 | 5.50 | 0.195 | 0.217 |
| c | 0.46 | 0.61 | 0.018 | 0.024 |
| c2 | 0.40 | 0.98 | 0.016 | 0.039 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.02 | 5.84 | 0.198 | 0.230 |
| E | 6.35 | 6.73 | 0.250 | 0.265 |
| E1 | 4.32 | 5.21 | 0.185 | 0.205 |
| e | 2.29 (BSC) | | 0.090 (BSC) | |
| e1 | 4.57 (BSC) | | 0.180 (BSC) | |
| N | 3 | | 3 | |
| H | 9.40 | 10.48 | 0.370 | 0.413 |
| L | 1.18 | 1.78 | 0.046 | 0.070 |
| L3 | 0.89 | 1.27 | 0.035 | 0.050 |
| L4 | 0.51 | 1.02 | 0.020 | 0.040 |

| | |
|---|---|
| DOCUMENT NO. | Z8B00003328 |
| SCALE | 0 2.5 5mm |
| EUROPEAN PROJECTION | |
| ISSUE DATE | 05-02-2016 |
| REVISION | 06 |

**Figure 1 Outline PG-TO 252-3, dimensions in mm/inches**

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## Revision History

IPD900P06NM

**Revision: 2019-04-03, Rev. 2.0**

Previous Revision

| Revision | Date | Subjects (major changes since last revision) |
|---|---|---|
| 2.0 | 2019-04-03 | Release of final version |

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