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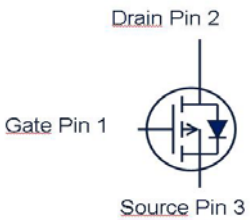
## SIPMOS® Power-Transistor

### Features

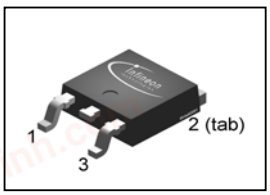
- P-Channel
- Enhancement mode
- Logic level
- Avalanche rated
- Pb-free lead plating; RoHS compliant
- ° Qualified according to AEC Q101

### Product Summary

| | | |
|---|---|---|
| $V_{DS}$ | -100 | V |
| $R_{DS(on),max}$ | 850 | mΩ |
| $I_D$ | -4.2 | A |




PG-TO-252-3




| Type | Package | Marking | Lead free | Packing | Tape and reel information |
|---|---|---|---|---|---|
| SPD04P10PL G | PG-TO252-3 | 04P10PL | Yes | Non dry | 1000 pcs / reel |

**Maximum ratings,** at $T_j$=25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Value | Unit |
|---|---|---|---|---|
| | | | steady state | |
| Continuous drain current | $I_D$ | $T_C$=25 °C | -4.2 | A |
| | | $T_C$=100 °C | 3.0 | |
| Pulsed drain current | $I_{D,pulse}$ | $T_C$=25 °C | -16.8 | |
| Avalanche energy, single pulse | $E_{AS}$ | $I_D$=-4.2 A, $R_{GS}$=25 Ω | 57 | mJ |
| Gate source voltage | $V_{GS}$ | | ±20 | V |
| Power dissipation | $P_{tot}$ | $T_C$=25 °C | 38 | W |
| Operating and storage temperature | $T_j$, $T_{stg}$ | | -55 ... 175 | °C |
| ESD class | | JESD22-A114-HBM | 1A (250 V to 500 V) | |
| Soldering temperature | | | 260 °C | |
| IEC climatic category; DIN IEC 68-1 | | | 55/175/56 | |

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| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Thermal characteristics** | | | | | | |
| Thermal resistance, junction - soldering point | $R_{thJC}$ | | - | - | 3.9 | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$ | minimal footprint, steady state | - | - | 75 | |
| | | 6 cm$^2$ cooling area[1)], steady state | - | - | 50 | |
| **Electrical characteristics,** at $T_j$=25 °C, unless otherwise specified | | | | | | |
| **Static characteristics** | | | | | | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$=0 V, $I_D$=-250 mA | -100 | - | - | V |
| Gate threshold voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=-380 µA | -1 | -1.5 | -2 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$=-100 V, $V_{GS}$=0 V, $T_j$=25 °C | - | -0.1 | -1 | µA |
| | | $V_{DS}$=-100 V, $V_{GS}$=0 V, $T_j$=150 °C | - | -10 | -100 | |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=-20 V, $V_{DS}$=0 V | - | -10 | -100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=-4.5 V, $I_D$=-2.75 A | - | 787 | 1050 | mΩ |
| | | $V_{GS}$=-10 V, $I_D$=-3.0 A | - | 550 | 850 | |
| Transconductance | $g_{fs}$ | $\|V_{DS}\|>2\|I_D\|R_{DS(on)max}$, $I_D$=-3.0 A | 1.5 | 3.0 | - | S |

[1)] Device on 40 mm x 40 mm x 1.5 mm epoxy PCB FR4 with 6 cm$^2$ (one layer, 70 µm thick) copper area for drain connection. PCB is vertical in still air.

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| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Dynamic characteristics** | | | | | | |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0 V, $V_{DS}$=-25 V, $f$=1 MHz | - | 280 | 372 | pF |
| Output capacitance | $C_{oss}$ | | - | 70 | 94 | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 34 | 51 | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=-50 V, $V_{GS}$=-10 V, $I_D$=-4.2 A, $R_G$=6 Ω | - | 4.6 | 6.9 | ns |
| Rise time | $t_r$ | | - | 5.7 | 8.6 | |
| Turn-off delay time | $t_{d(off)}$ | | - | 18 | 27 | |
| Fall time | $t_f$ | | - | 5.0 | 7.5 | |
| Gate Charge Characteristics[2)] | | | | | | |
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=-80 V, $I_D$=-4.2 A, $V_{GS}$=0 to -10 V | - | 1.1 | 1.5 | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 4.6 | 6.9 | |
| Gate charge total | $Q_g$ | | - | 12 | 16 | |
| Gate plateau voltage | $V_{plateau}$ | | - | 4.1 | - | V |
| **Reverse Diode** | | | | | | |
| Diode continuous forward current | $I_S$ | $T_C$=25 °C | - | - | -4.2 | A |
| Diode pulse current | $I_{S,pulse}$ | | - | - | 16.8 | |
| Diode forward voltage | $V_{SD}$ | $V_{GS}$=0 V, $I_F$=-4.2 A, $T_j$=25 °C | - | 0.94 | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=50 V, $I_F$=$\|I_S\|$, $di_F/dt$=100 A/µs | - | 68 | 85 | ns |
| Reverse recovery charge | $Q_{rr}$ | | - | 178 | 223 | nC |

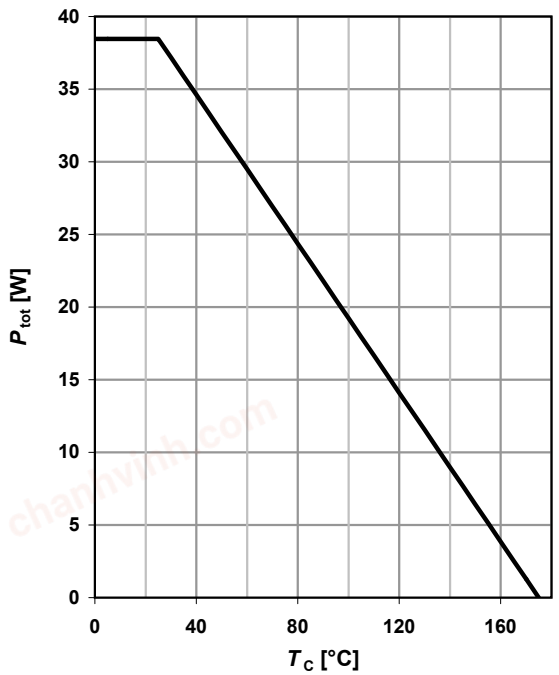
[2)] See figure 16 for gate charge parameter definition

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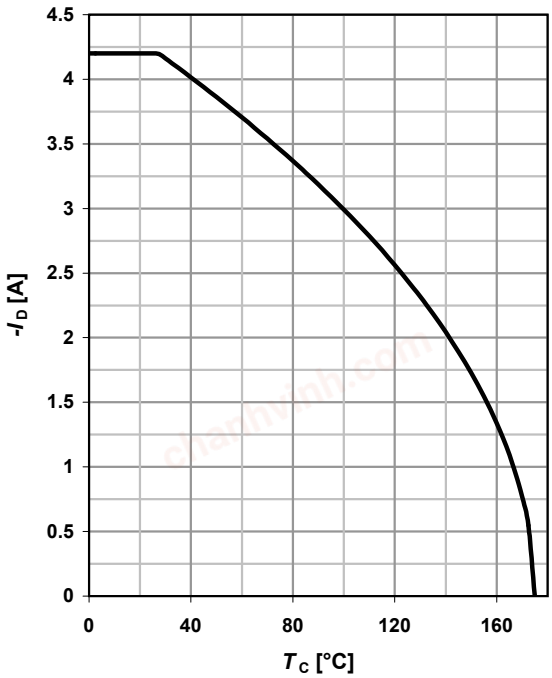
### 1 Power dissipation

$P_{tot}=f(T_C)$




### 2 Drain current

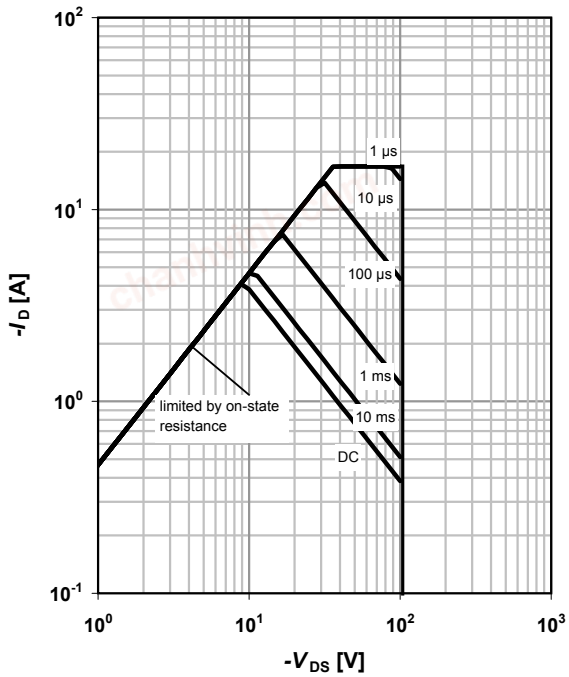
$I_D=f(T_C)$; $|V_{GS}|\geq 10$ V




### 3 Safe operating area

$I_D=f(V_{DS})$; $T_C=25$ °C; $D=0$

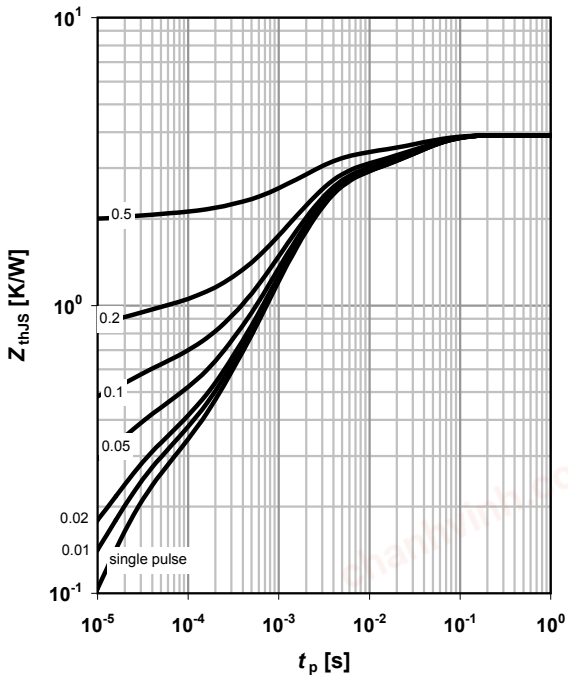
parameter: $t_p$




### 4 Max. transient thermal impedance

$Z_{thJC}=f(t_p)$

parameter: $D=t_p/T$



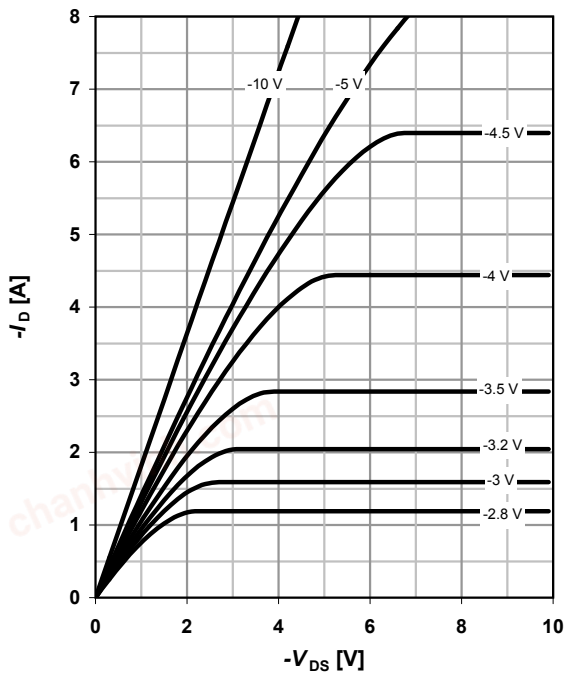
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### 5 Typ. output characteristics

$I_D$=f($V_{DS}$); $T_j$=25 °C

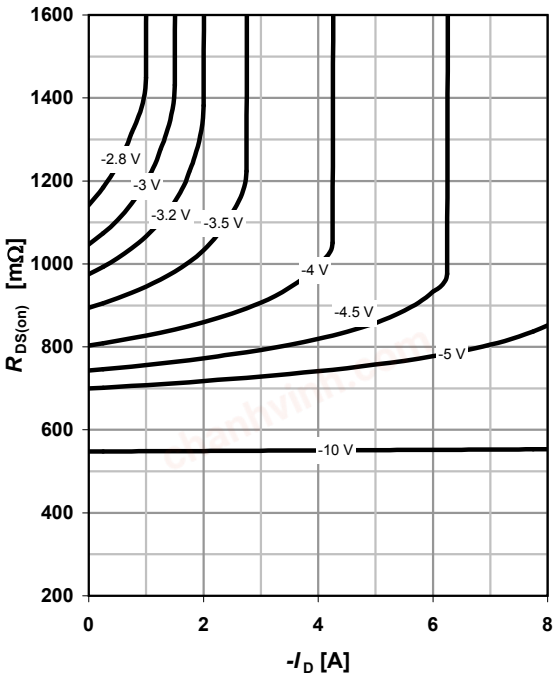
parameter: $V_{GS}$




### 6 Typ. drain-source on resistance

$R_{DS(on)}$=f($I_D$); $T_j$=25 °C

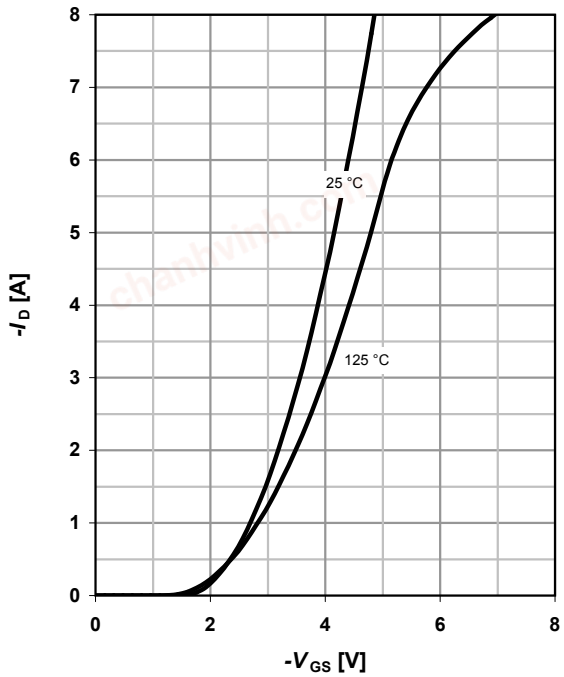
parameter: $V_{GS}$




### 7 Typ. transfer characteristics

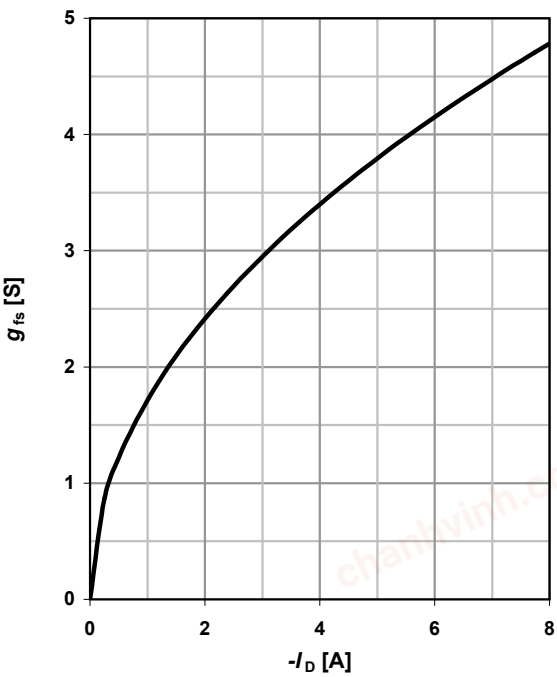
$I_D$=f($V_{GS}$); $|V_{DS}|>2|I_D|R_{DS(on)max}$

parameter: $T_j$




### 8 Typ. forward transconductance

$g_{fs}$=f($I_D$); $T_j$=25 °C

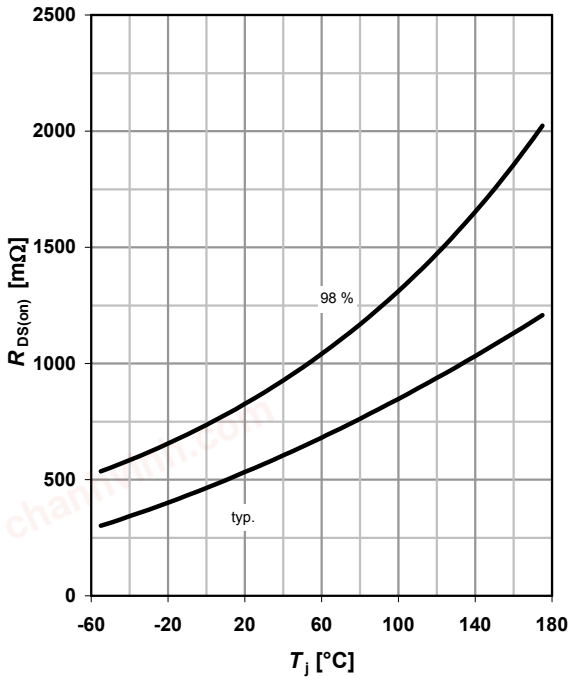


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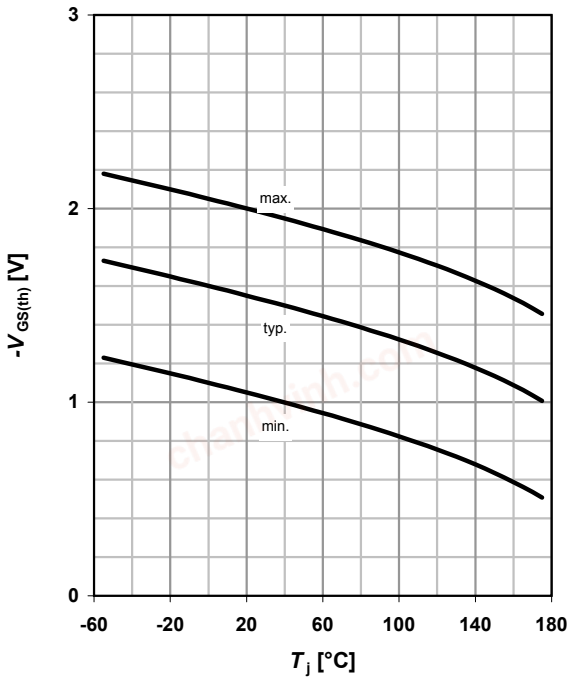
### 9 Drain-source on-state resistance

$R_{DS(on)}$=f($T_j$); $I_D$=-3 A; $V_{GS}$=-10 V



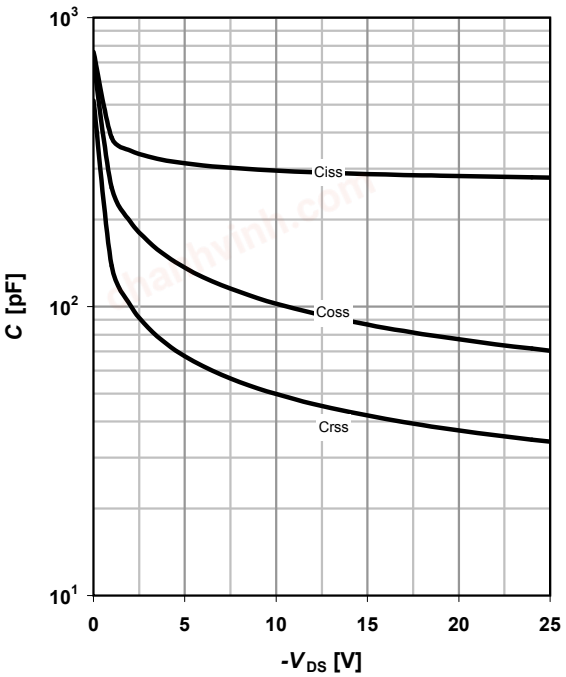

### 10 Typ. gate threshold voltage

$V_{GS(th)}$=f($T_j$); $V_{GS}$=$V_{DS}$; $I_D$=-380 µA




### 11 Typ. capacitances

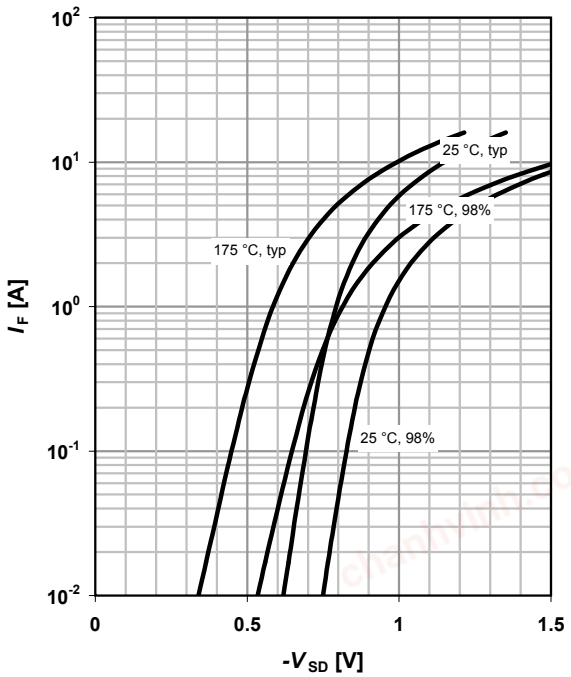
$C$=f($V_{DS}$); $V_{GS}$=0 V; $f$=1 MHz




### 12 Forward characteristics of reverse diode

$I_F$=f($V_{SD}$)

parameter: $T_j$



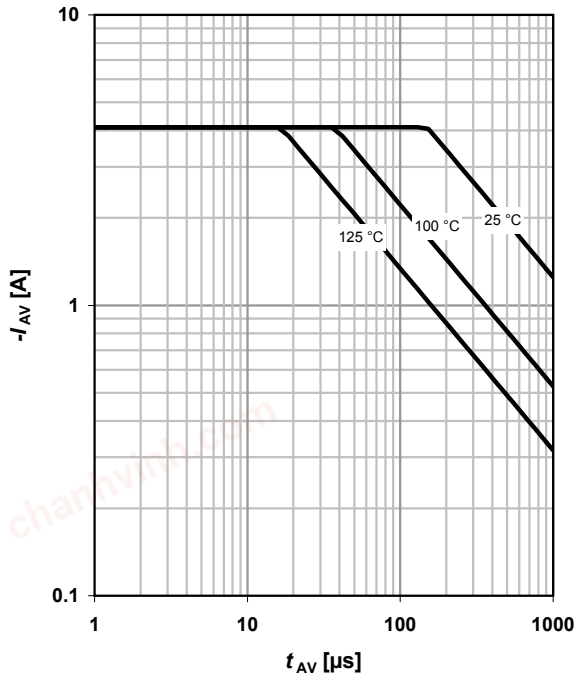
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## 13 Avalanche characteristics

$I_{AS}$=f($t_{AV}$); $R_{GS}$=25 Ω

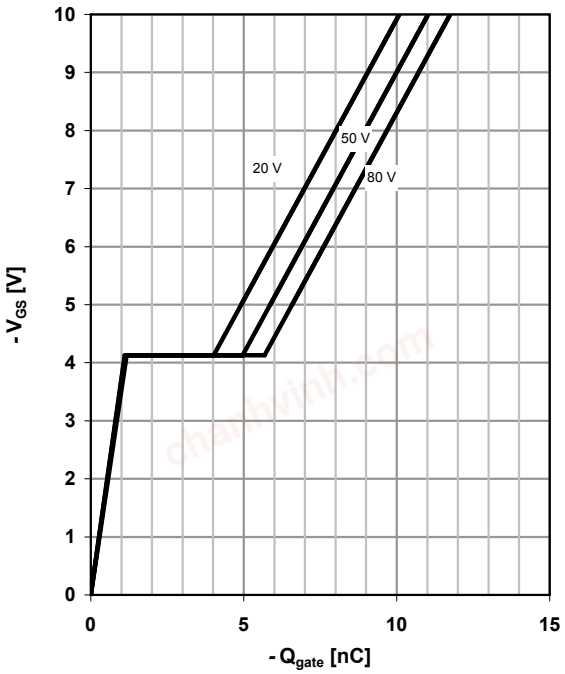
parameter: $T_{j(start)}$




## 14 Typ. gate charge

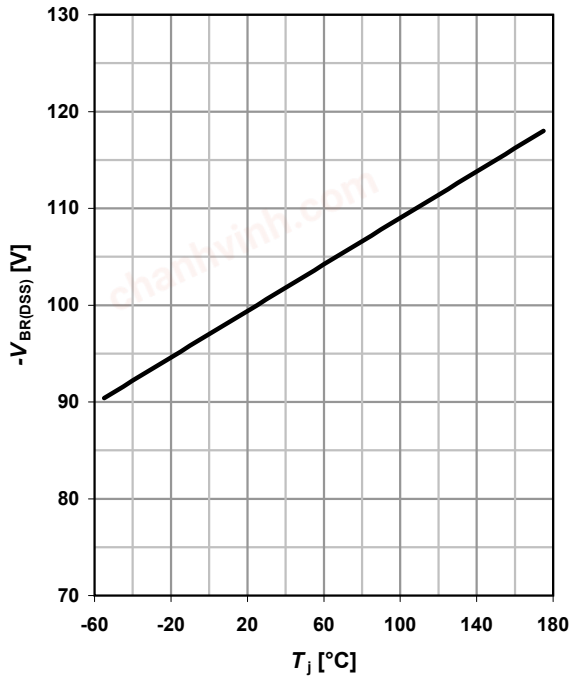
$V_{GS}$=f($Q_{gate}$); $I_D$=-4.2 A pulsed

parameter: $V_{DD}$

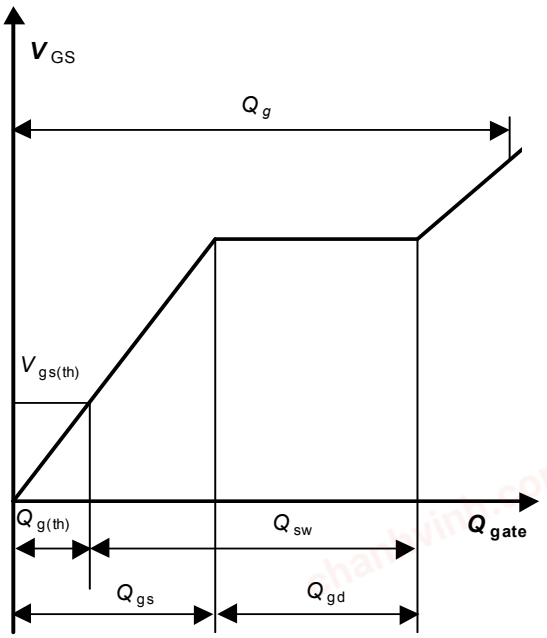



## 15 Drain-source breakdown voltage

$V_{BR(DSS)}$=f($T_j$); $I_D$=-250 µA



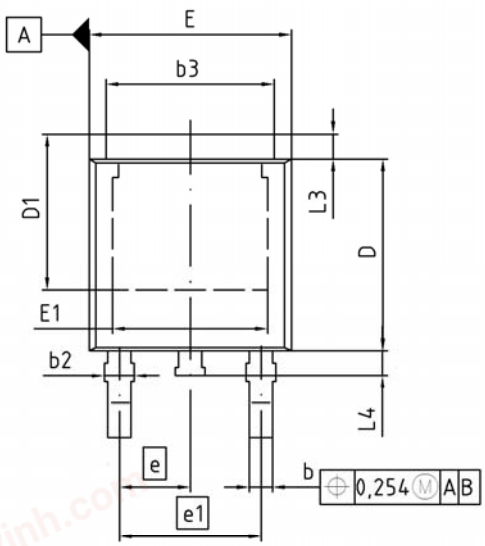

## 16 Gate charge waveforms

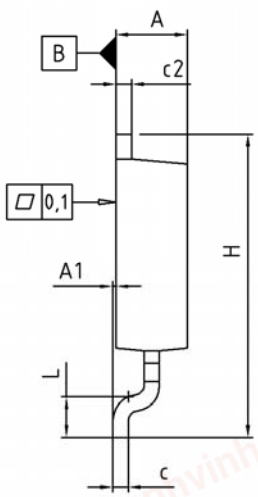


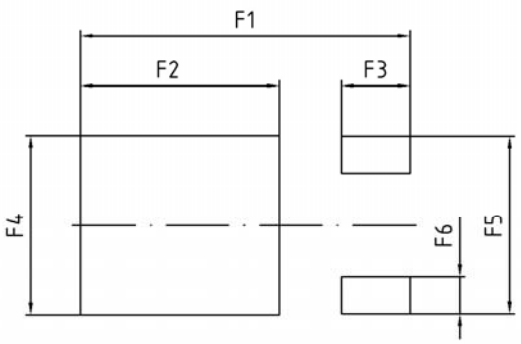
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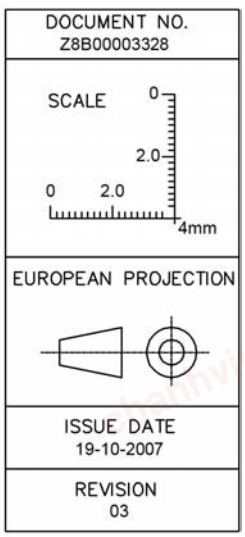
**Package Outline: PG-TO-252-3**




| 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 | 5.00 | 5.50 | 0.197 | 0.217 |
| c | 0.46 | 0.60 | 0.018 | 0.024 |
| c2 | 0.46 | 0.98 | 0.018 | 0.039 |
| D | 5.97 | 6.22 | 0.235 | 0.245 |
| D1 | 5.02 | 5.84 | 0.198 | 0.230 |
| E | 6.40 | 6.73 | 0.252 | 0.265 |
| E1 | 4.70 | 5.21 | 0.185 | 0.205 |
| e | 2.29 | | 0.090 | |
| e1 | 4.57 | | 0.180 | |
| N | 3 | | 3 | |
| H | 9.40 | 10.48 | 0.370 | 0.413 |
| L | 1.18 | 1.70 | 0.046 | 0.067 |
| L3 | 0.90 | 1.25 | 0.035 | 0.049 |
| L4 | 0.51 | 1.00 | 0.020 | 0.039 |
| F1 | 10.50 | 10.70 | 0.413 | 0.421 |
| F2 | 6.30 | 6.50 | 0.248 | 0.256 |
| F3 | 2.10 | 2.30 | 0.083 | 0.091 |
| F4 | 5.70 | 5.90 | 0.224 | 0.232 |
| F5 | 5.66 | 5.86 | 0.223 | 0.231 |
| F6 | 1.10 | 1.30 | 0.043 | 0.051 |



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