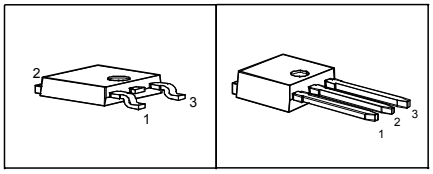
## Cool MOS™ Power Transistor

| | | |
|---|---|---|
| $V_{DS}$ | 600 | V |
| $R_{DS(on)}$ | 3 | Ω |
| $I_D$ | 1.8 | A |

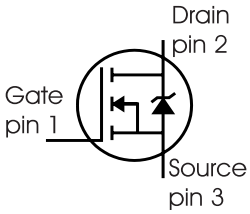
### Feature

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC[0)] for target applications

PG-TO252 PG-TO251




| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| SPU02N60S5 | PG-TO251 | Q67040-S4226 | 02N60S5 |
| SPD02N60S5 | PG-TO252 | Q67040-S4213 | 02N60S5 |




### Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Continuous drain current<br>$T_C$ = 25 °C<br>$T_C$ = 100 °C | $I_D$ | <br>1.8<br>1.1 | A |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$ | $I_{D\ puls}$ | 3.2 | |
| Avalanche energy, single pulse<br>$I_D$ = 1.35 A, $V_{DD}$ = 50 V | $E_{AS}$ | 50 | mJ |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$[1)]<br>$I_D$ = 1.8 A, $V_{DD}$ = 50 V | $E_{AR}$ | 0.07 | |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$ | $I_{AR}$ | 1.8 | A |
| Gate source voltage | $V_{GS}$ | ±20 | V |
| Gate source voltage AC (f >1Hz) | $V_{GS}$ | ±30 | |
| Power dissipation, $T_C$ = 25°C | $P_{tot}$ | 25 | W |
| Operating and storage temperature | $T_j$ , $T_{stg}$ | -55... +150 | °C |

**Maximum Ratings**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Drain Source voltage slope<br>$V_{DS}$ = 480 V, $I_D$ = 1.8 A, $T_j$ = 125 °C | d$v$/d$t$ | 20 | V/ns |

**Thermal Characteristics**

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| Thermal resistance, junction - case | $R_{thJC}$ | - | - | 5 | K/W |
| Thermal resistance, junction - ambient, leaded | $R_{thJA}$ | - | - | 75 | |
| SMD version, device on PCB:<br>@ min. footprint<br>@ 6 cm$^2$ cooling area 2) | $R_{thJA}$ | <br>-<br>- | <br>-<br>- | <br>75<br>50 | |
| Soldering temperature, *)<br>1.6 mm (0.063 in.) from case for 10s | $T_{sold}$ | - | - | 260 | °C |

**Electrical Characteristics,** at $T_j$=25°C unless otherwise specified

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $V_{GS}$=0V, $I_D$=0.25mA | 600 | - | - | V |
| Drain-Source avalanche breakdown voltage | $V_{(BR)DS}$ | $V_{GS}$=0V, $I_D$=1.8A | - | 700 | - | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$=80µA, $V_{GS}$=$V_{DS}$ | 3.5 | 4.5 | 5.5 | |
| Zero gate voltage drain current | $I_{DSS}$ | $V_{DS}$=600V, $V_{GS}$=0V,<br>$T_j$=25°C,<br>$T_j$=150°C | <br>-<br>- | <br>0.5<br>- | <br>1<br>50 | µA |
| Gate-source leakage current | $I_{GSS}$ | $V_{GS}$=20V, $V_{DS}$=0V | - | - | 100 | nA |
| Drain-source on-state resistance | $R_{DS(on)}$ | $V_{GS}$=10V, $I_D$=1.1A,<br>$T_j$=25°C<br>$T_j$=150°C | <br>-<br>- | <br>2.7<br>7.3 | <br>3<br>- | Ω |

*) TO252: reflow soldering, MSL3; TO251: wavesoldering

**Electrical Characteristics** , at $T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Characteristics** | | | | | | |
| Transconductance | $g_{fs}$ | $V_{DS}$≥2*$I_D$*$R_{DS(on)max}$, $I_D$=1.1A | - | 1.4 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V, $f$=1MHz | - | 240 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 77 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 4.4 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=350V, $V_{GS}$=0/10V, $I_D$=1.8A, $R_G$=50Ω | - | 35 | - | ns |
| Rise time | $t_r$ | | - | 35 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 35 | 42 | |
| Fall time | $t_f$ | | - | 20 | 30 | |

**Gate Charge Characteristics**

| | | | | | | |
|---|---|---|---|---|---|---|
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=350V, $I_D$=1.8A | - | 2.3 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 4.5 | - | |
| Gate charge total | $Q_g$ | $V_{DD}$=350V, $I_D$=1.8A, $V_{GS}$=0 to 10V | - | 7.3 | 9.5 | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$=350V, $I_D$=1.8A | - | 8 | - | V |

[0]J-STD20 and JESD22

[1]Repetitve avalanche causes additional power losses that can be calculated as $P_{AV}$=$E_{AR}$*$f$.

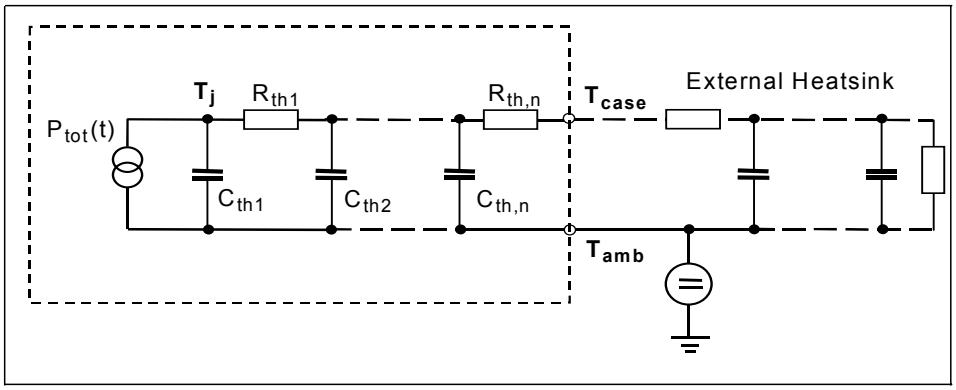
[2]Device on 40mm*40mm*1.5mm epoxy PCB FR4 with 6cm² (one layer, 70 µm thick) copper area for drain connection. PCB is vertical without blown air.

**Electrical Characteristics**, at $T_j$ = 25 °C, unless otherwise specified

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Inverse diode continuous forward current | $I_S$ | $T_C$=25°C | - | - | 1.8 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ | | - | - | 3.2 | |
| Inverse diode forward voltage | $V_{SD}$ | $V_{GS}$=0V, $I_F$=$I_S$ | - | 1 | 1.2 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=350V, $I_F$=$I_S$ , | - | 860 | 1460 | ns |
| Reverse recovery charge | $Q_{rr}$ | $di_F/dt$=100A/µs | - | 1.6 | - | µC |

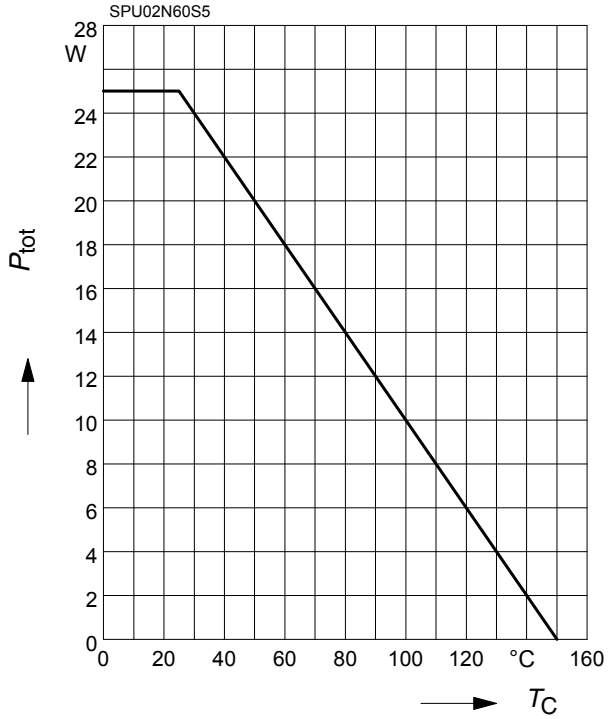
**Typical Transient Thermal Characteristics**

| Symbol | Value | Unit | Symbol | Value | Unit |
|---|---|---|---|---|---|
| | typ. | | | typ. | |
| Thermal resistance | | | Thermal capacitance | | |
| $R_{th1}$ | 0.1 | K/W | $C_{th1}$ | 0.00002806 | Ws/K |
| $R_{th2}$ | 0.184 | | $C_{th2}$ | 0.0001113 | |
| $R_{th3}$ | 0.306 | | $C_{th3}$ | 0.0001679 | |
| $R_{th4}$ | 1.207 | | $C_{th4}$ | 0.000547 | |
| $R_{th5}$ | 0.974 | | $C_{th5}$ | 0.001388 | |
| $R_{th6}$ | 0.251 | | $C_{th6}$ | 0.019 | |



**1 Power dissipation**

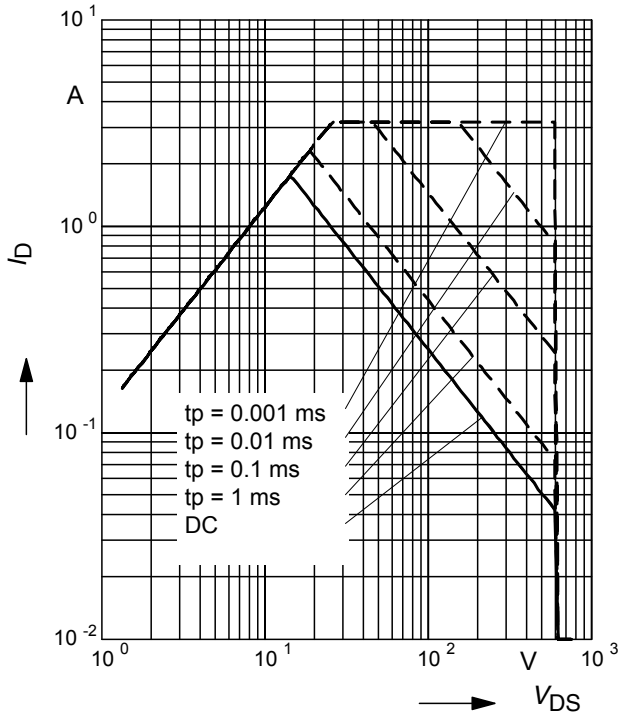
$P_{tot} = f(T_C)$




**2 Safe operating area**

$I_D = f(V_{DS})$

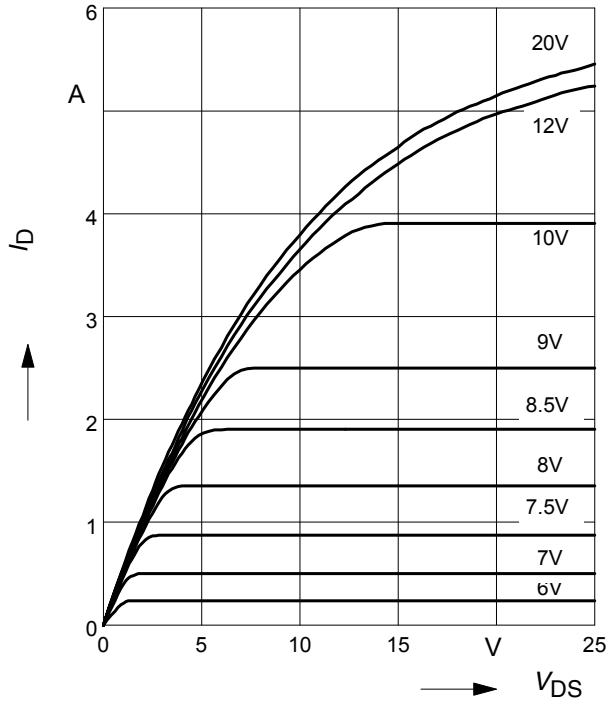
parameter : $D = 0$ , $T_C$=25°C




**3 Typ. output characteristic**

$I_D = f(V_{DS})$; $T_j$=25°C

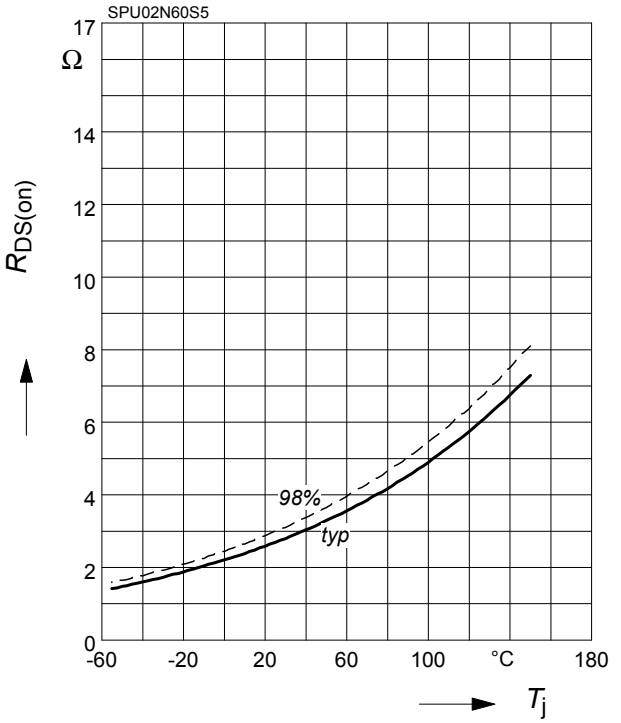
parameter: $t_p$ = 10 µs, $V_{GS}$




**4 Drain-source on-state resistance**

$R_{DS(on)} = f(T_j)$

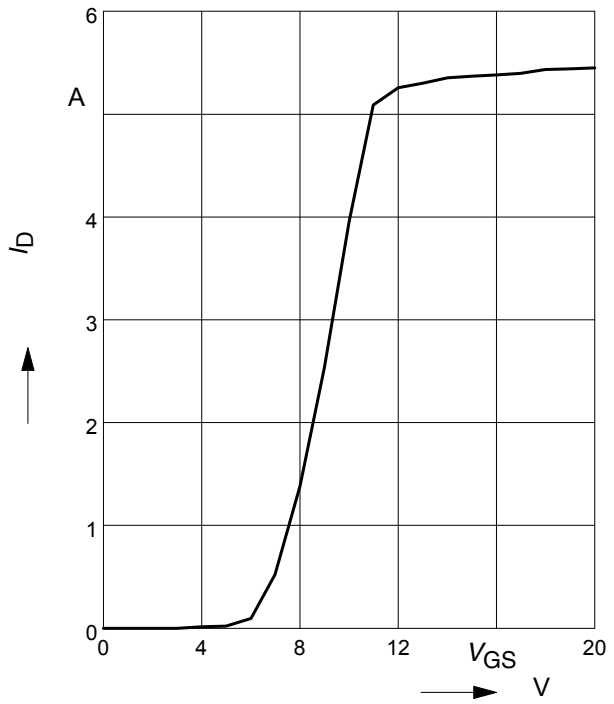
parameter : $I_D$ = 1.1 A, $V_{GS}$ = 10 V



**5 Typ. transfer characteristics**

$I_D = f(V_{GS})$; $V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$

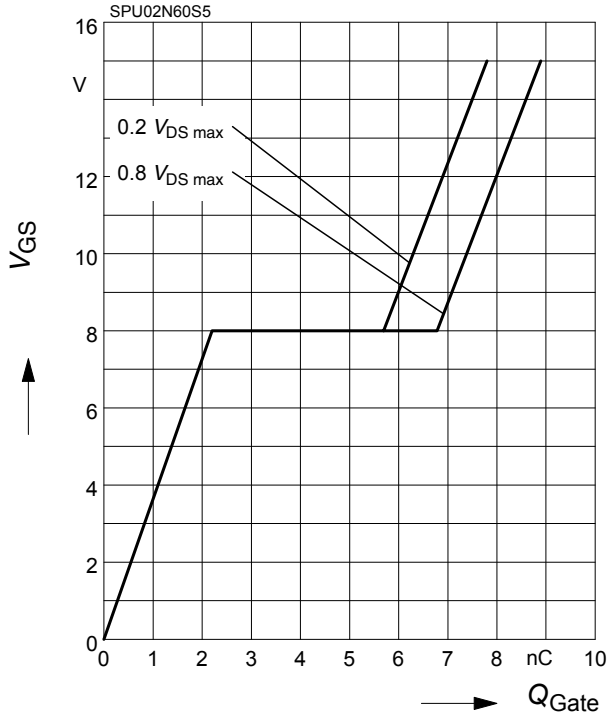
parameter: $t_p$ = 10 µs




**6 Typ. gate charge**

$V_{GS} = f(Q_{Gate})$

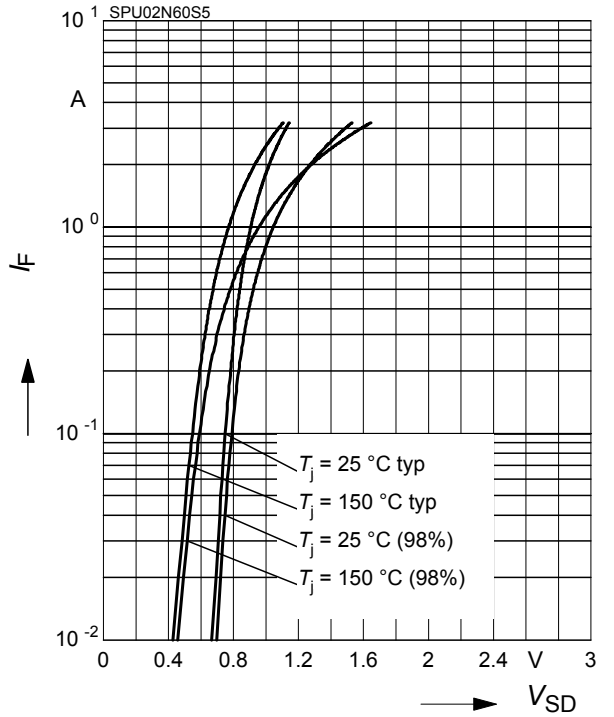
parameter: $I_D$ = 1.8 A pulsed




**7 Forward characteristics of body diode**

$I_F = f(V_{SD})$

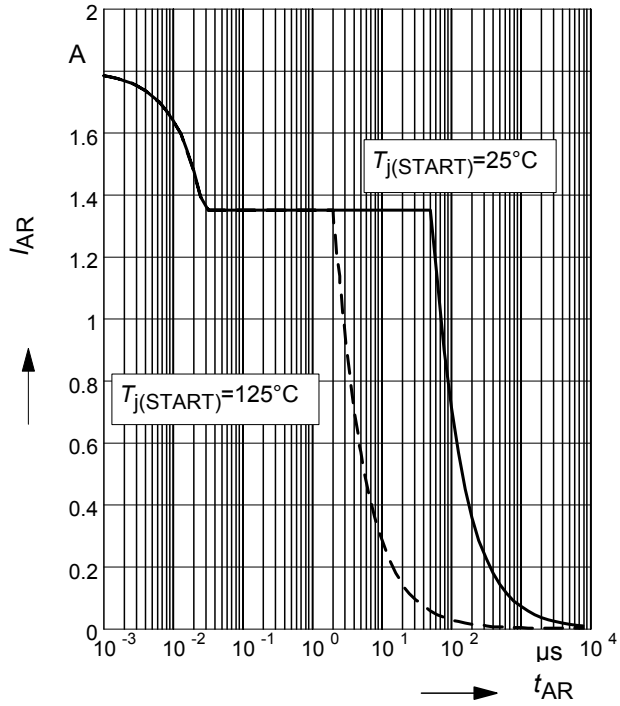
parameter: $T_j$ , tp = 10 µs




**8 Avalanche SOA**

$I_{AR} = f(t_{AR})$

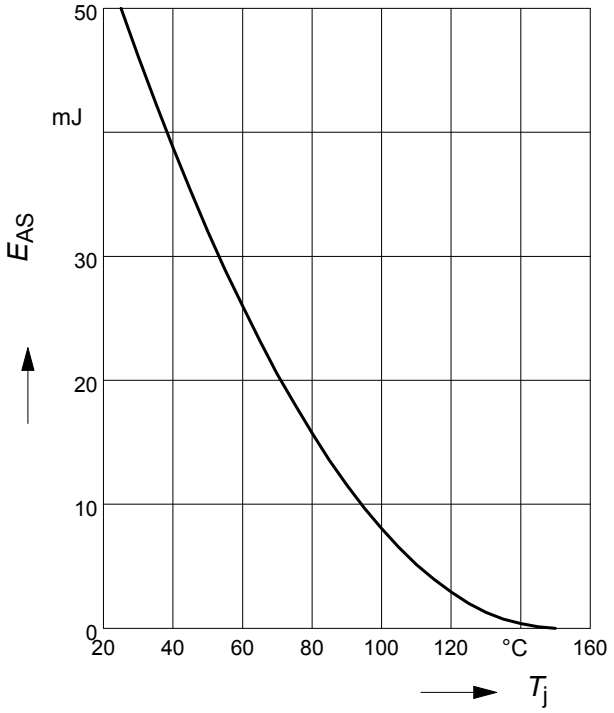
par.: $T_j \leq$ 150 °C



**9 Avalanche energy**

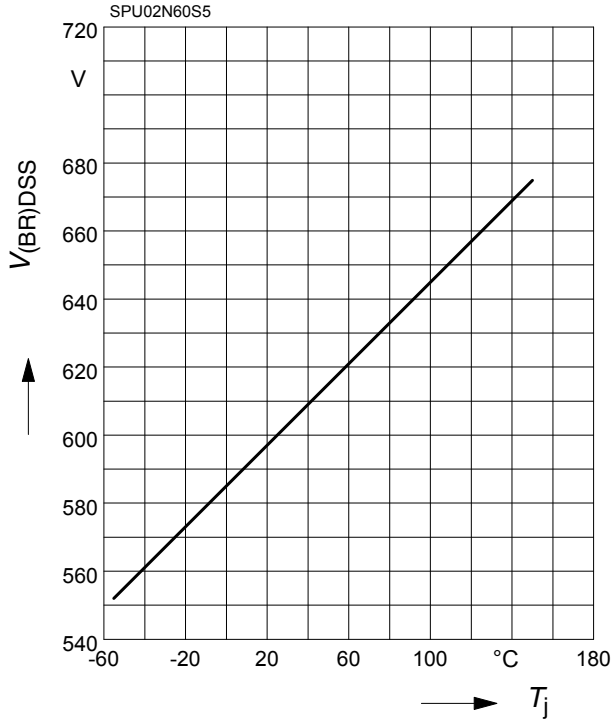
$E_{AS} = f(T_j)$

par.: $I_D$ = 1.35 A, $V_{DD}$ = 50 V




**10 Drain-source breakdown voltage**

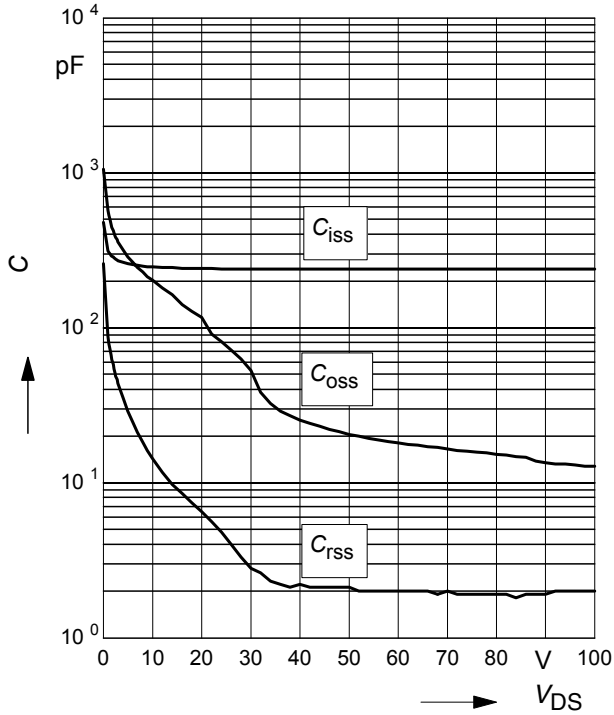
$V_{(BR)DSS} = f(T_j)$



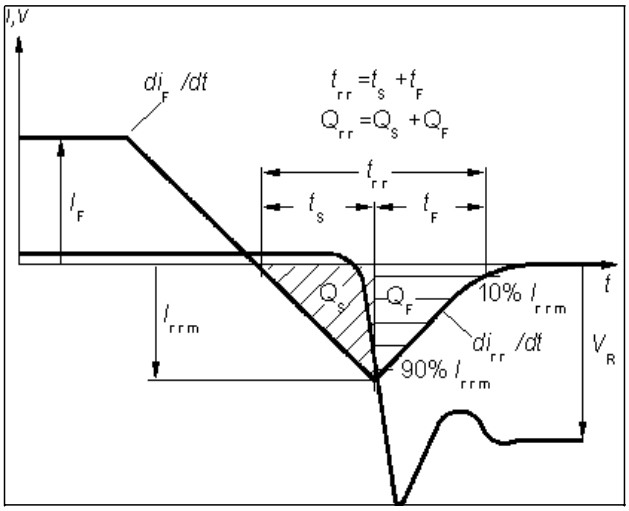

**11 Typ. capacitances**

$C = f(V_{DS})$

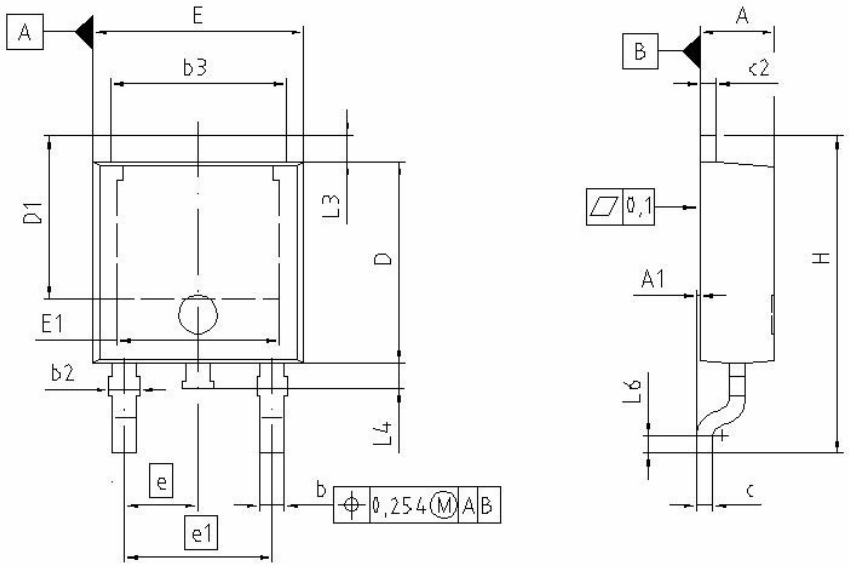
parameter: $V_{GS}$=0V, $f$=1 MHz

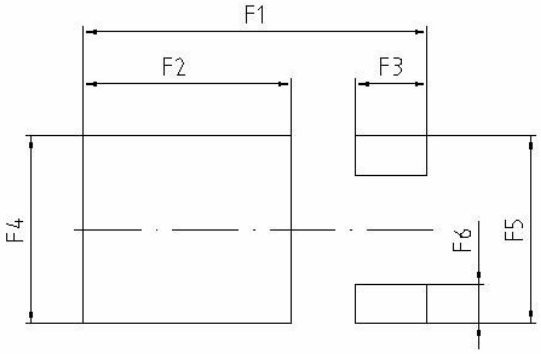


Definition of diodes switching characteristics



PG-TO252-3-1, PG-TO252-3-11, PG-TO252-3-21 (D-PAK)

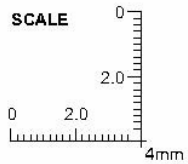


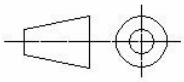

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| **A** | 2.159 | 2.413 | 0.085 | 0.095 |
| **A1** | 0.000 | 0.150 | 0.000 | 0.006 |
| **b** | 0.635 | 0.889 | 0.025 | 0.035 |
| **b2** | 0.650 | 1.150 | 0.026 | 0.045 |
| **b3** | 5.004 | 5.500 | 0.197 | 0.217 |
| **c** | 0.457 | 0.580 | 0.018 | 0.023 |
| **c2** | 0.460 | 0.980 | 0.018 | 0.039 |
| **D** | 5.969 | 6.223 | 0.235 | 0.245 |
| **D1** | 5.020 | 5.842 | 0.198 | 0.230 |
| **E** | 6.400 | 6.731 | 0.252 | 0.265 |
| **E1** | 4.850 | 5.207 | 0.191 | 0.205 |
| **e** | 2.286 | | 0.090 | |
| **e1** | 4.572 | | 0.180 | |
| **N** | 3 | | 3 | |
| **H** | 9.400 | 10.480 | 0.370 | 0.413 |
| **L3** | 0.900 | 1.143 | 0.035 | 0.045 |
| **L4** | 0.584 | 0.950 | 0.023 | 0.037 |
| **L6** | 0.510 | 0.686 | 0.020 | 0.027 |
| **F1** | 10.500 | 10.700 | 0.413 | 0.421 |
| **F2** | 6.300 | 6.500 | 0.248 | 0.256 |
| **F3** | 2.100 | 2.300 | 0.083 | 0.091 |
| **F4** | 5.700 | 5.900 | 0.224 | 0.232 |
| **F5** | 5.660 | 5.860 | 0.222 | 0.231 |
| **F6** | 1.100 | 1.300 | 0.043 | 0.051 |

**REFERENCE**
JEDEC TO252

**SCALE**



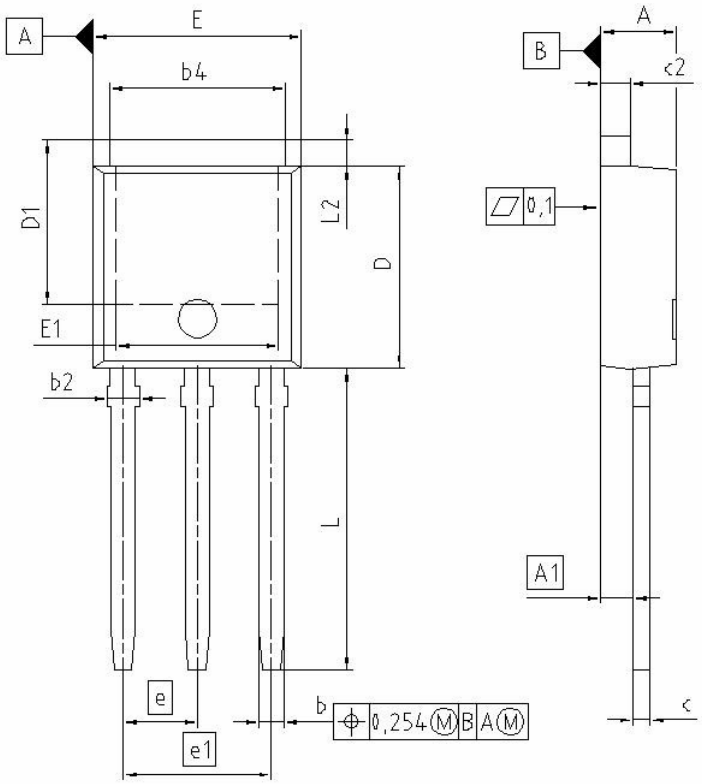

**EUROPEAN PROJECTION**



**ISSUE DATE**
21-09-2005

**FILE**
TO252_1

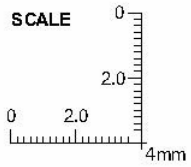
PG-TO251-3-1, PG-TO251-3-21 (I-PAK)



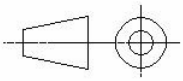

| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 2.159 | 2.413 | 0.085 | 0.095 |
| A1 | 0.900 | 1.118 | 0.035 | 0.044 |
| b | 0.650 | 0.850 | 0.026 | 0.033 |
| b2 | 0.650 | 1.150 | 0.026 | 0.045 |
| b4 | 5.004 | 5.500 | 0.197 | 0.217 |
| c | 0.457 | 0.580 | 0.018 | 0.023 |
| c2 | 0.737 | 0.980 | 0.029 | 0.039 |
| D | 5.969 | 6.223 | 0.235 | 0.245 |
| D1 | 5.100 | 6.121 | 0.201 | 0.241 |
| E | 6.400 | 6.731 | 0.252 | 0.265 |
| E1 | 4.850 | 5.207 | 0.191 | 0.205 |
| e | 2.280 | | 0.090 | |
| e1 | 4.570 | | 0.180 | |
| N | 3 | | 3 | |
| L | 8.900 | 9.525 | 0.350 | 0.375 |
| L1 | 0.900 | 1.143 | 0.035 | 0.045 |

REFERENCE
JEDEC TO251

SCALE




EUROPEAN PROJECTION



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