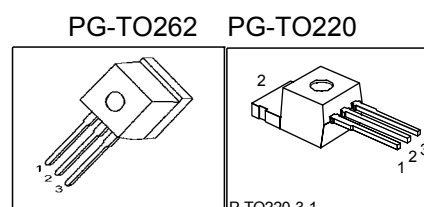


## Cool MOS™ Power Transistor

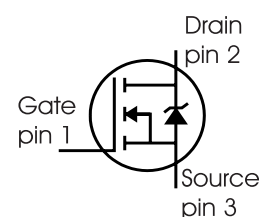
### Feature

- New revolutionary high voltage technology
- Worldwide best  $R_{DS(on)}$  in TO 220
- Ultra low gate charge
- Periodic avalanche rated
- Extreme  $dv/dt$  rated
- Ultra low effective capacitances
- Improved transconductance
- Pb-free lead plating; RoHS compliant
- Qualified according to JEDEC<sup>(0)</sup> for target applications

|              |     |          |
|--------------|-----|----------|
| $V_{DS}$     | 600 | V        |
| $R_{DS(on)}$ | 0.6 | $\Omega$ |
| $I_D$        | 7.3 | A        |



| Type       | Package  | Ordering Code | Marking |
|------------|----------|---------------|---------|
| SPP07N60S5 | PG-TO220 | Q67040-S4172  | 07N60S5 |
| SPI07N60S5 | PG-TO262 | Q67040-S4328  | 07N60S5 |



### Maximum Ratings

| Parameter                                                                                                                  | Symbol              | Value       | Unit |
|----------------------------------------------------------------------------------------------------------------------------|---------------------|-------------|------|
| Continuous drain current<br>$T_C = 25\text{ °C}$<br>$T_C = 100\text{ °C}$                                                  | $I_D$               | 7.3<br>4.6  | A    |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$                                                                          | $I_{D\text{ puls}}$ | 14.6        |      |
| Avalanche energy, single pulse<br>$I_D = -A$ , $V_{DD} = 50\text{ V}$                                                      | $E_{AS}$            | 230         | mJ   |
| Avalanche energy, repetitive $t_{AR}$ limited by $T_{jmax}$ <sup>1)</sup><br>$I_D = 7.3\text{ A}$ , $V_{DD} = 50\text{ V}$ | $E_{AR}$            | 0.5         |      |
| Avalanche current, repetitive $t_{AR}$ limited by $T_{jmax}$                                                               | $I_{AR}$            | 7.3         | A    |
| Gate source voltage                                                                                                        | $V_{GS}$            | $\pm 20$    | V    |
| Gate source voltage AC ( $f > 1\text{ Hz}$ )                                                                               | $V_{GS}$            | $\pm 30$    |      |
| Power dissipation, $T_C = 25\text{ °C}$                                                                                    | $P_{tot}$           | 83          | W    |
| Operating and storage temperature                                                                                          | $T_j, T_{stg}$      | -55... +150 | °C   |

**Maximum Ratings**

| Parameter                                                                                                           | Symbol  | Value | Unit |
|---------------------------------------------------------------------------------------------------------------------|---------|-------|------|
| Drain Source voltage slope<br>$V_{DS} = 480 \text{ V}$ , $I_D = 7.3 \text{ A}$ , $T_j = 125 \text{ }^\circ\text{C}$ | $dv/dt$ | 20    | V/ns |

**Thermal Characteristics**

| Parameter                                                                                         | Symbol     | Values |      |      | Unit             |
|---------------------------------------------------------------------------------------------------|------------|--------|------|------|------------------|
|                                                                                                   |            | min.   | typ. | max. |                  |
| Thermal resistance, junction - case                                                               | $R_{thJC}$ | -      | -    | 1.5  | K/W              |
| Thermal resistance, junction - ambient, leaded                                                    | $R_{thJA}$ | -      | -    | 62   | K/W              |
| SMD version, device on PCB:<br>@ min. footprint<br>@ 6 cm <sup>2</sup> cooling area <sup>2)</sup> | $R_{thJA}$ | -      | -    | 62   |                  |
|                                                                                                   |            | -      | 35   | -    |                  |
| Soldering temperature, wavesoldering<br>1.6 mm (0.063 in.) from case for 10s                      | $T_{sold}$ | -      | -    | 260  | $^\circ\text{C}$ |

**Electrical Characteristics, at  $T_j=25^\circ\text{C}$  unless otherwise specified**

| Parameter                                   | Symbol        | Conditions                                                                                         | Values |              |          | Unit          |
|---------------------------------------------|---------------|----------------------------------------------------------------------------------------------------|--------|--------------|----------|---------------|
|                                             |               |                                                                                                    | min.   | typ.         | max.     |               |
| Drain-source breakdown voltage              | $V_{(BR)DSS}$ | $V_{GS}=0\text{V}$ , $I_D=0.25\text{mA}$                                                           | 600    | -            | -        | V             |
| Drain-Source avalanche<br>breakdown voltage | $V_{(BR)DS}$  | $V_{GS}=0\text{V}$ , $I_D=7.3\text{A}$                                                             | -      | 700          | -        |               |
| Gate threshold voltage                      | $V_{GS(th)}$  | $I_D=350\mu\text{A}$ , $V_{GS}=V_{DS}$                                                             | 3.5    | 4.5          | 5.5      |               |
| Zero gate voltage drain current             | $I_{DSS}$     | $V_{DS}=600\text{V}$ , $V_{GS}=0\text{V}$ ,<br>$T_j=25^\circ\text{C}$ ,<br>$T_j=150^\circ\text{C}$ | -<br>- | 0.5<br>-     | 1<br>100 | $\mu\text{A}$ |
| Gate-source leakage current                 | $I_{GSS}$     | $V_{GS}=20\text{V}$ , $V_{DS}=0\text{V}$                                                           | -      | -            | 100      |               |
| Drain-source on-state resistance            | $R_{DS(on)}$  | $V_{GS}=10\text{V}$ , $I_D=4.6\text{A}$ ,<br>$T_j=25^\circ\text{C}$<br>$T_j=150^\circ\text{C}$     | -<br>- | 0.54<br>1.46 | 0.6<br>- | $\Omega$      |
| Gate input resistance                       | $R_G$         | $f=1\text{MHz}$ , open Drain                                                                       | -      | 19           | -        |               |

**Electrical Characteristics** , at  $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

| Parameter                                                     | Symbol       | Conditions                                                              | Values |      |      | Unit |
|---------------------------------------------------------------|--------------|-------------------------------------------------------------------------|--------|------|------|------|
|                                                               |              |                                                                         | min.   | typ. | max. |      |
| Characteristics                                               |              |                                                                         |        |      |      |      |
| Transconductance                                              | $g_{fs}$     | $V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ ,<br>$I_D = 4.6A$         | -      | 4    | -    | S    |
| Input capacitance                                             | $C_{iss}$    | $V_{GS} = 0V$ , $V_{DS} = 25V$ ,<br>$f = 1MHz$                          | -      | 970  | -    | pF   |
| Output capacitance                                            | $C_{oss}$    |                                                                         | -      | 370  | -    |      |
| Reverse transfer capacitance                                  | $C_{rss}$    |                                                                         | -      | 10   | -    |      |
| Effective output capacitance, <sup>3)</sup><br>energy related | $C_{o(er)}$  | $V_{GS} = 0V$ ,<br>$V_{DS} = 0V$ to 480V                                | -      | 30   | -    | pF   |
| Effective output capacitance, <sup>4)</sup><br>time related   | $C_{o(tr)}$  |                                                                         | -      | 55   | -    |      |
| Turn-on delay time                                            | $t_{d(on)}$  | $V_{DD} = 350V$ , $V_{GS} = 0/10V$ ,<br>$I_D = 7.3A$ , $R_G = 12\Omega$ | -      | 120  | -    | ns   |
| Rise time                                                     | $t_r$        |                                                                         | -      | 40   | -    |      |
| Turn-off delay time                                           | $t_{d(off)}$ |                                                                         | -      | 170  | 255  |      |
| Fall time                                                     | $t_f$        |                                                                         | -      | 20   | 30   |      |

### Gate Charge Characteristics

|                       |                 |                                                                                      |   |      |    |    |
|-----------------------|-----------------|--------------------------------------------------------------------------------------|---|------|----|----|
| Gate to source charge | $Q_{gs}$        | $V_{DD} = 350\text{V}$ , $I_D = 7.3\text{A}$                                         | - | 7.5  | -  | nC |
| Gate to drain charge  | $Q_{gd}$        |                                                                                      | - | 16.5 | -  |    |
| Gate charge total     | $Q_g$           | $V_{DD} = 350\text{V}$ , $I_D = 7.3\text{A}$ ,<br>$V_{GS} = 0\text{ to } 10\text{V}$ | - | 27   | 35 |    |
| Gate plateau voltage  | $V_{(plateau)}$ | $V_{DD} = 350\text{V}$ , $I_D = 7.3\text{A}$                                         | - | 8    | -  | V  |

<sup>0</sup>J-STD20 and JESD22

<sup>1</sup>Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV} = E_{AR} \cdot f$ .

<sup>2</sup>Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6cm<sup>2</sup> (one layer, 70 μm thick) copper area for drain connection. PCB is vertical without blown air.

<sup>3</sup> $C_{o(er)}$  is a fixed capacitance that gives the same stored energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

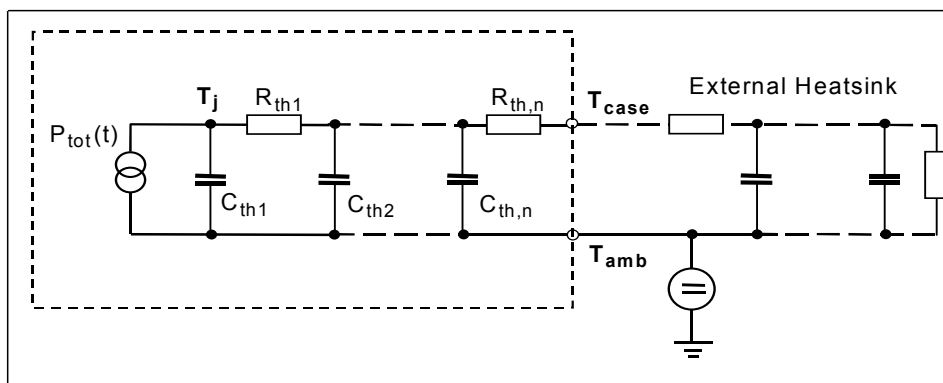
<sup>4</sup> $C_{o(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 to 80%  $V_{DSS}$ .

**Electrical Characteristics**, at  $T_j = 25^\circ\text{C}$ , unless otherwise specified

| Parameter                                | Symbol   | Conditions                                                        | Values |      |      | Unit |
|------------------------------------------|----------|-------------------------------------------------------------------|--------|------|------|------|
|                                          |          |                                                                   | min.   | typ. | max. |      |
| Inverse diode continuous forward current | $I_S$    | $T_C = 25^\circ\text{C}$                                          | -      | -    | 7.3  | A    |
| Inverse diode direct current, pulsed     | $I_{SM}$ |                                                                   | -      | -    | 14.6 |      |
| Inverse diode forward voltage            | $V_{SD}$ | $V_{GS} = 0\text{V}, I_F = I_S$                                   | -      | 1    | 1.2  | V    |
| Reverse recovery time                    | $t_{rr}$ | $V_R = 350\text{V}, I_F = I_S, di_F/dt = 100\text{A}/\mu\text{s}$ | -      | 750  | 1275 | ns   |
| Reverse recovery charge                  | $Q_{rr}$ |                                                                   | -      | 4.9  | -    |      |

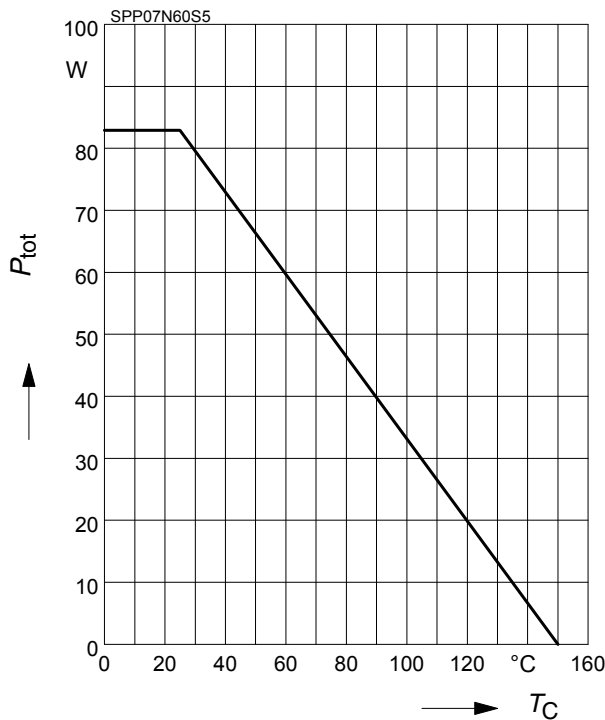
### Typical Transient Thermal Characteristics

| Symbol             | Value | Unit | Symbol              | Value     | Unit |
|--------------------|-------|------|---------------------|-----------|------|
|                    | typ.  |      |                     | typ.      |      |
| Thermal resistance |       |      | Thermal capacitance |           |      |
| $R_{th1}$          | 0.024 | K/W  | $C_{th1}$           | 0.00012   | Ws/K |
| $R_{th2}$          | 0.046 |      | $C_{th2}$           | 0.0004578 |      |
| $R_{th3}$          | 0.085 |      | $C_{th3}$           | 0.000645  |      |
| $R_{th4}$          | 0.308 |      | $C_{th4}$           | 0.001867  |      |
| $R_{th5}$          | 0.317 |      | $C_{th5}$           | 0.004795  |      |
| $R_{th6}$          | 0.112 |      | $C_{th6}$           | 0.045     |      |



### 1 Power dissipation

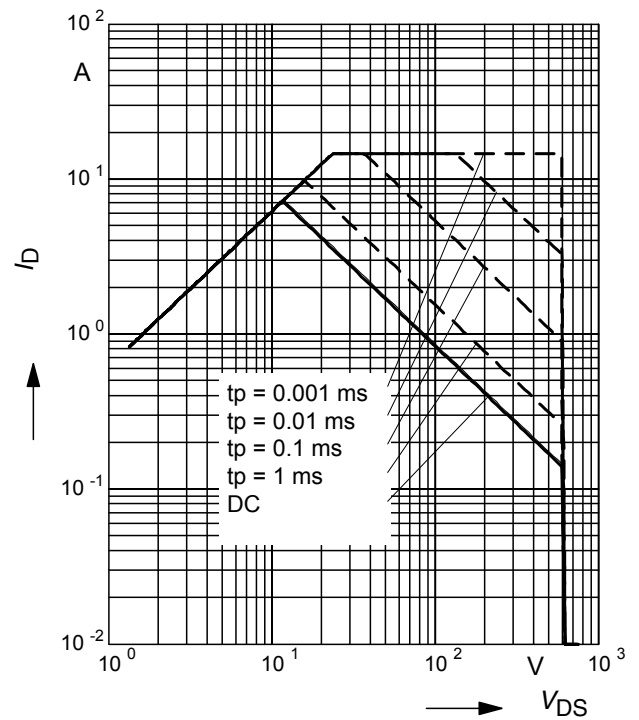
$$P_{\text{tot}} = f(T_C)$$



### 2 Safe operating area

$$I_D = f(V_{DS})$$

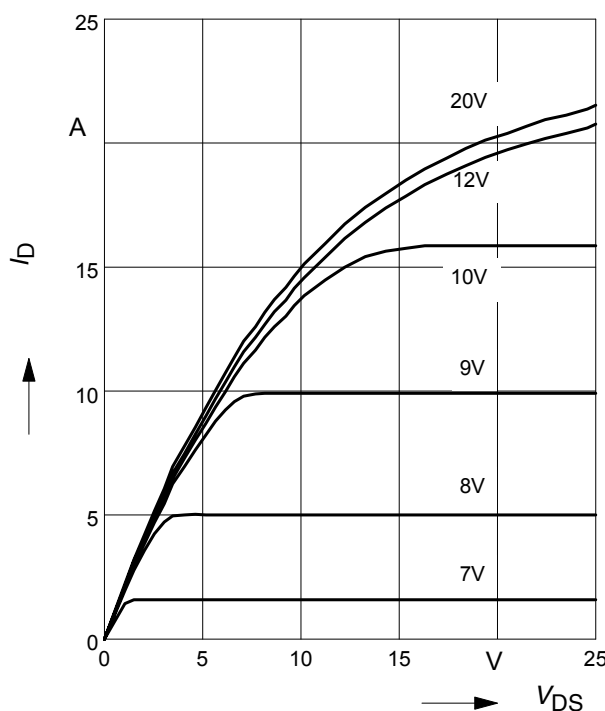
parameter :  $D = 0$  ,  $T_C = 25^\circ\text{C}$



### 3 Typ. output characteristic

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

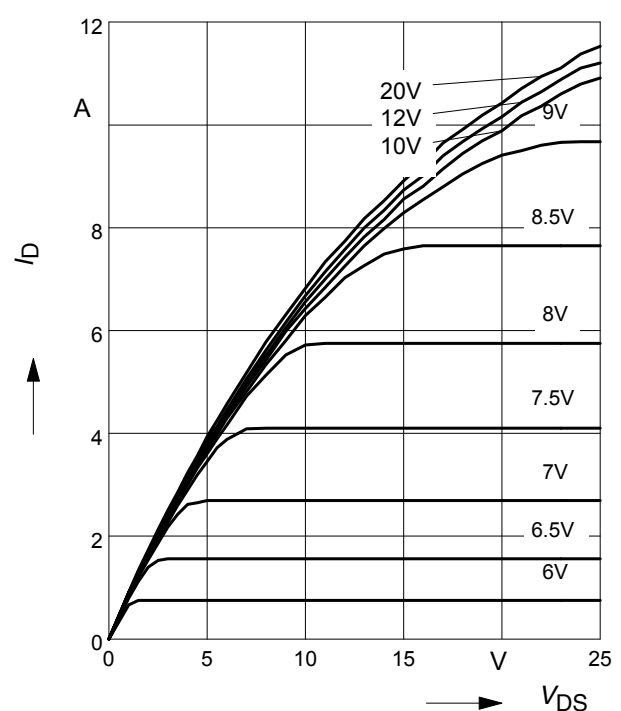
parameter:  $t_p = 10 \mu\text{s}$ ,  $V_{GS}$



### 4 Typ. output characteristic

$$I_D = f(V_{DS}); T_j = 150^\circ\text{C}$$

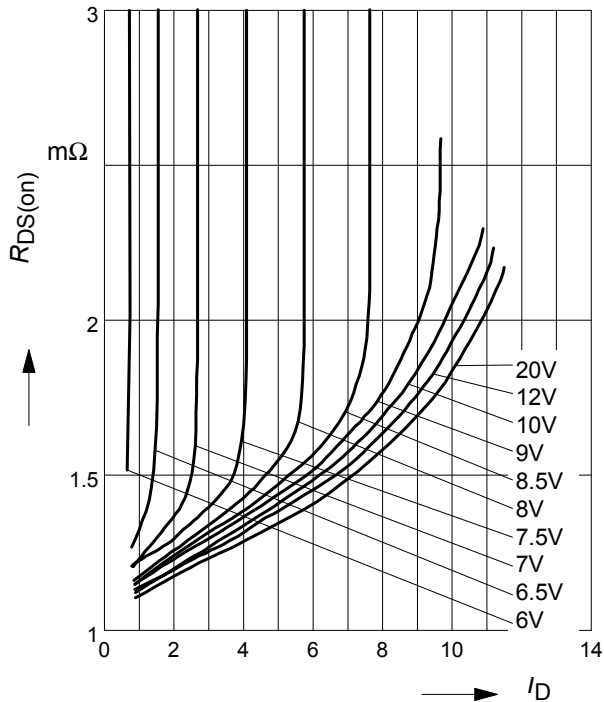
parameter:  $t_p = 10 \mu\text{s}$ ,  $V_{GS}$



### 5 Typ. drain-source on resistance

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

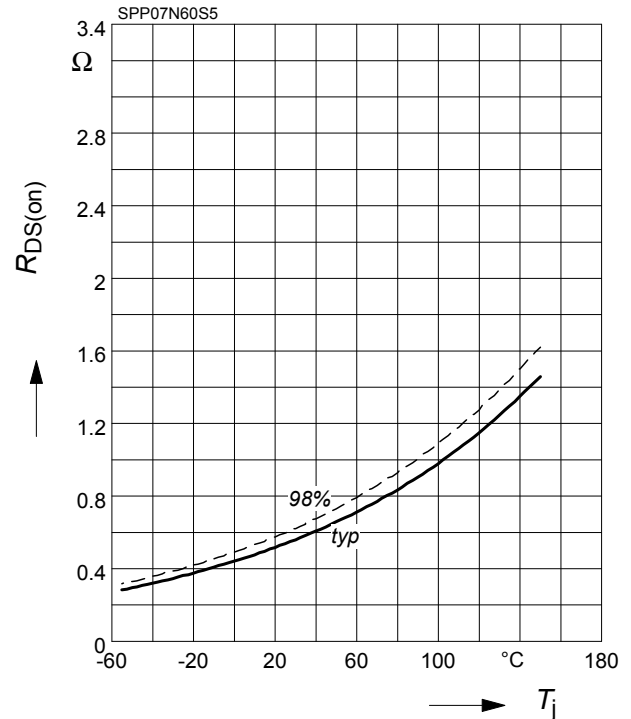
parameter:  $T_j = 150^\circ\text{C}$ ,  $V_{GS}$



### 6 Drain-source on-state resistance

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

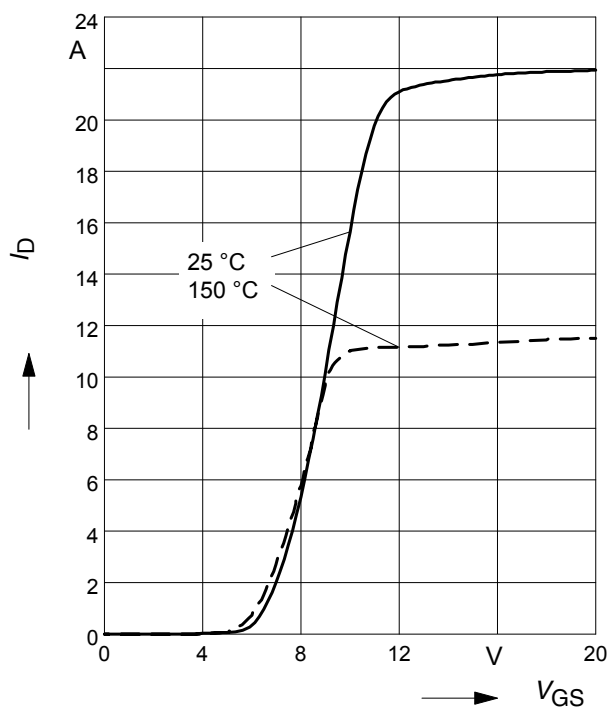
parameter:  $I_D = 4.6\text{ A}$ ,  $V_{GS} = 10\text{ V}$



### 7 Typ. transfer characteristics

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

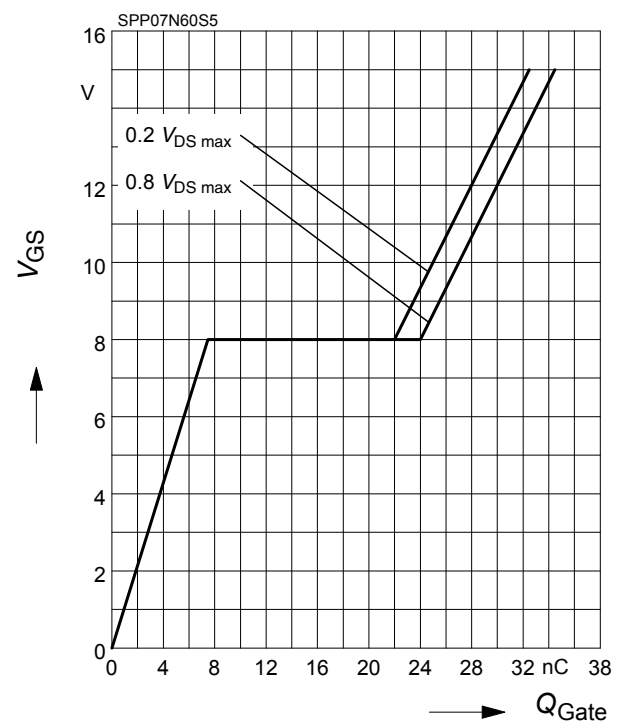
parameter:  $t_p = 10\text{ }\mu\text{s}$



### 8 Typ. gate charge

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

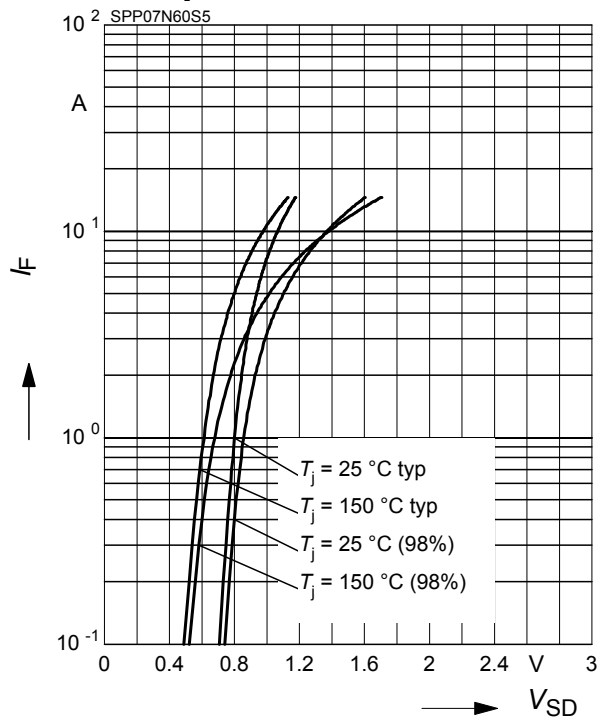
parameter:  $I_D = 7.3\text{ A}$  pulsed



## 9 Forward characteristics of body diode

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

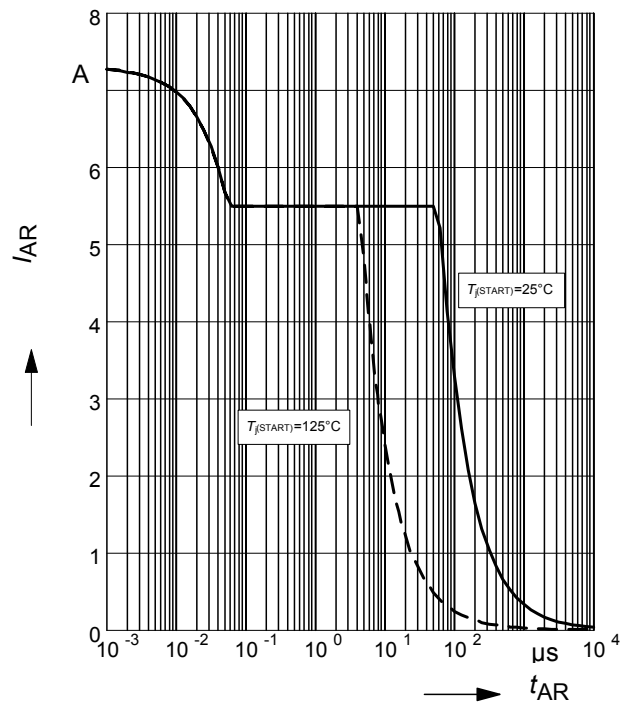
parameter:  $T_j$ ,  $t_p = 10 \mu s$



## 10 Avalanche SOA

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

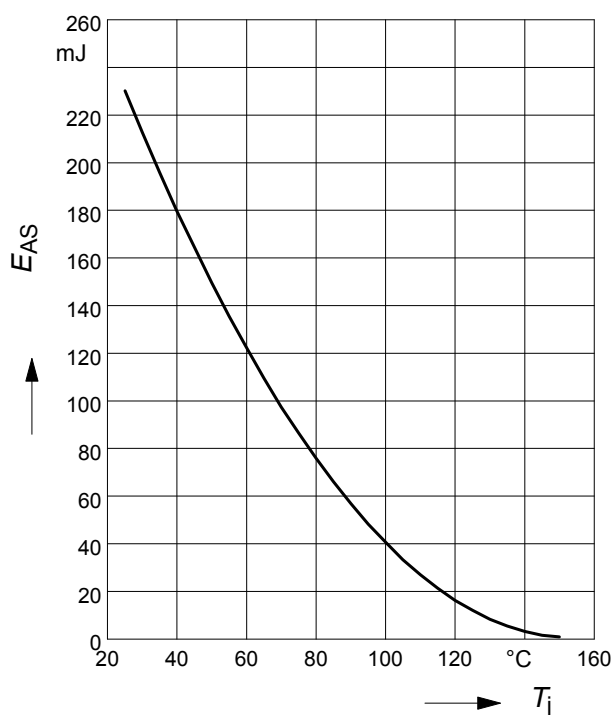
par.:  $T_j \leq 150 \text{ °C}$



## 11 Avalanche energy

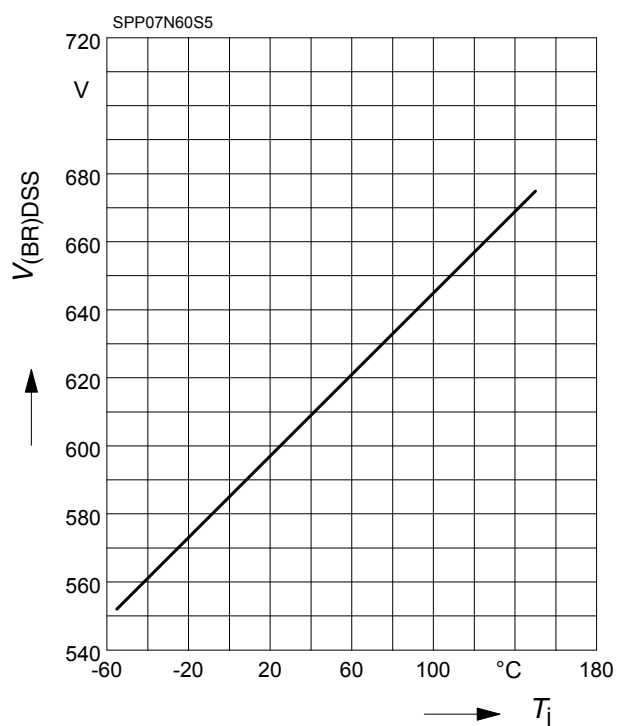
$$E_{AS} = f(T_j)$$

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



## 12 Drain-source breakdown voltage

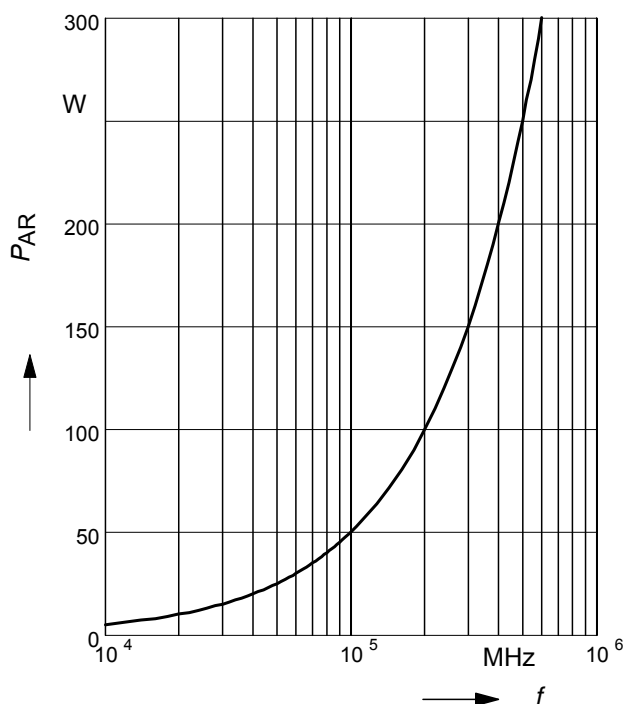
$$V_{(BR)DSS} = f(T_j)$$



### 13 Avalanche power losses

$$P_{AR} = f(f)$$

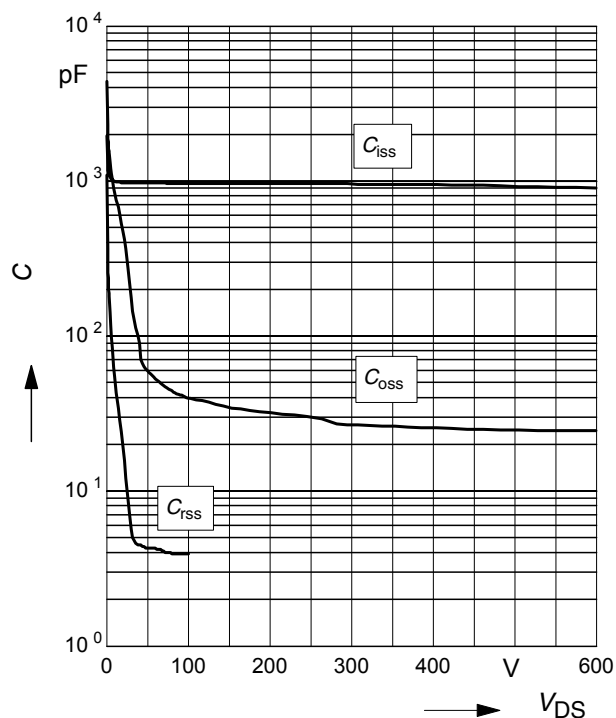
parameter:  $E_{AR}=0.5\text{mJ}$



### 14 Typ. capacitances

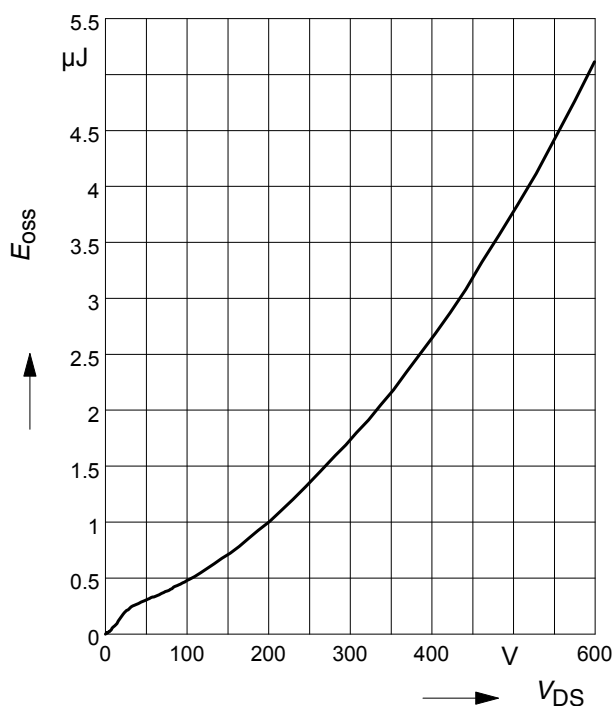
$$C = f(V_{DS})$$

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



### 15 Typ. $C_{oss}$ stored energy

$$E_{oss}=f(V_{DS})$$



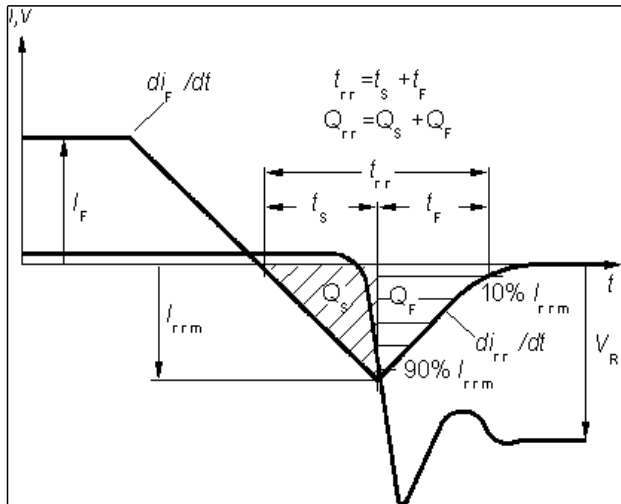
### 16 Typ. gate threshold voltage

$$V_{GS(th)} = f(T_j)$$

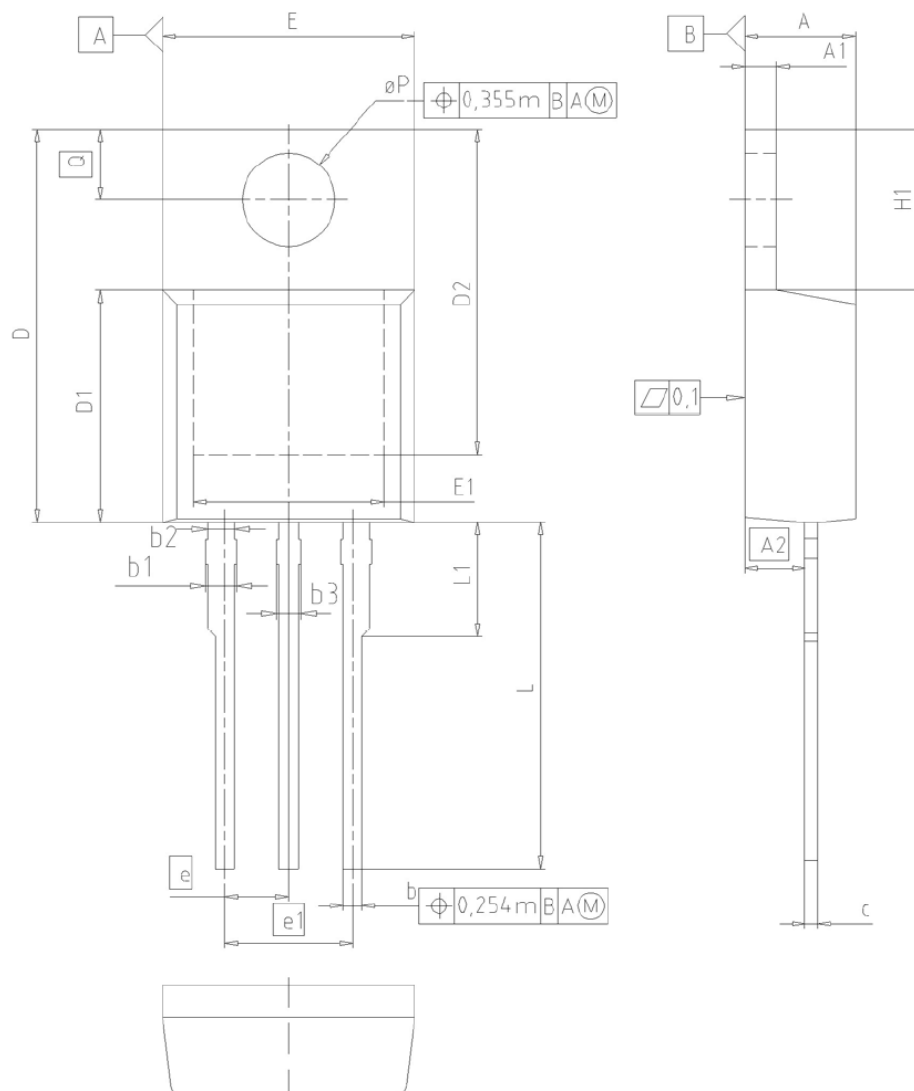
parameter:  $V_{GS} = V_{DS}$



## Definition of diodes switching characteristics



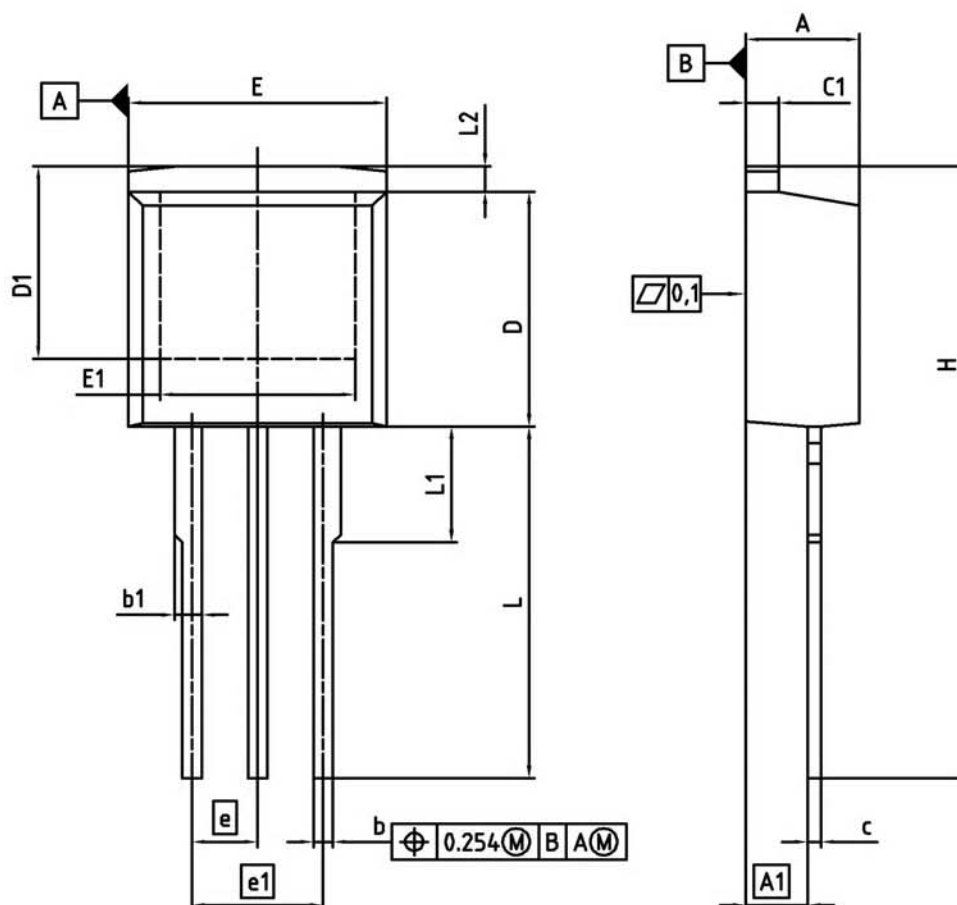
PG-TO220-3-1, PG-TO220-3-21



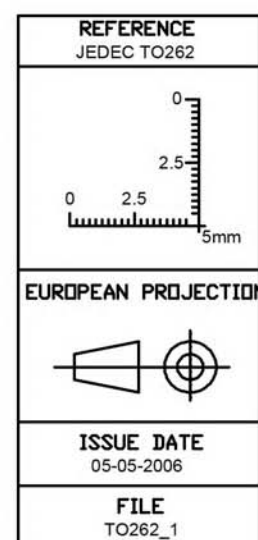
| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 4.30        | 4.57  | 0.169  | 0.180 |
| A1  | 1.17        | 1.40  | 0.046  | 0.055 |
| A2  | 2.15        | 2.72  | 0.085  | 0.107 |
| b   | 0.65        | 0.86  | 0.026  | 0.034 |
| b1  | 0.95        | 1.40  | 0.037  | 0.055 |
| b2  | 0.95        | 1.15  | 0.037  | 0.045 |
| b3  | 0.65        | 1.15  | 0.026  | 0.045 |
| c   | 0.33        | 0.60  | 0.013  | 0.024 |
| D   | 14.81       | 15.95 | 0.583  | 0.628 |
| D1  | 8.51        | 9.45  | 0.335  | 0.372 |
| D2  | 12.19       | 13.10 | 0.480  | 0.516 |
| E   | 9.70        | 10.36 | 0.382  | 0.408 |
| E1  | 6.50        | 8.60  | 0.256  | 0.339 |
| e   | 2.54        |       | 0.100  |       |
| e1  | 5.08        |       | 0.200  |       |
| N   | 3           |       | 3      |       |
| H1  | 5.90        | 6.90  | 0.232  | 0.272 |
| L   | 13.00       | 14.00 | 0.512  | 0.551 |
| L1  | -           | 4.80  | -      | 0.189 |
| øP  | 3.60        | 3.89  | 0.142  | 0.153 |
| Q   | 2.60        | 3.00  | 0.102  | 0.118 |

|                                                                                                                     |
|---------------------------------------------------------------------------------------------------------------------|
| <b>DOCUMENT NO.</b><br>Z8B00003318                                                                                  |
| <b>SCALE</b><br>0 2.5 5mm                                                                                           |
| <b>EUROPEAN PROJECTION</b><br> |
| <b>ISSUE DATE</b><br>23-08-2007                                                                                     |
| <b>REVISION</b><br>05                                                                                               |

PG-TO262-3-1, PG-TO262-3-21 (I<sup>2</sup>-PAK)



| DIM | MILLIMETERS |        | INCHES |       |
|-----|-------------|--------|--------|-------|
|     | MIN         | MAX    | MIN    | MAX   |
| A   | 4.300       | 4.572  | 0.169  | 0.180 |
| A1  | 2.150       | 2.718  | 0.085  | 0.107 |
| b   | 0.650       | 0.864  | 0.026  | 0.034 |
| b1  | 0.635       | 1.400  | 0.025  | 0.055 |
| c   | 0.330       | 0.600  | 0.013  | 0.024 |
| c1  | 1.170       | 1.400  | 0.046  | 0.055 |
| D   | 8.509       | 9.450  | 0.335  | 0.372 |
| D1  | 6.900       | -      | 0.272  | -     |
| E   | 9.700       | 10.363 | 0.382  | 0.408 |
| E1  | 6.500       | 8.600  | 0.256  | 0.339 |
| e   | 2.540       |        | 0.100  |       |
| e1  | 5.080       |        | 0.200  |       |
| N   | 3           |        | 3      |       |
| L   | 13.000      | 14.000 | 0.512  | 0.551 |
| L1  | -           | 4.800  | -      | 0.189 |
| L2  | -           | 1.727  | -      | 0.068 |



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