

## CoolMOS™ Power Transistor

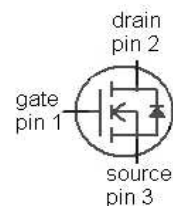
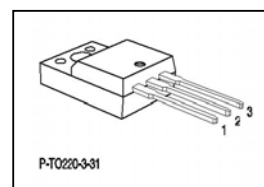
### Features

- New revolutionary high voltage technology
- Ultra low gate charge
- Periodic avalanche rated
- High peak current capability
- Ultra low effective capacitances
- Extreme  $dV/dt$  rated
- Improved transconductance
- Fully isolated package (2500 V AC; 1 minute)

### Product Summary

|                      |      |          |
|----------------------|------|----------|
| $V_{DS} @ T_{j,max}$ | 650  | V        |
| $R_{DS(on),max}$     | 0.75 | $\Omega$ |
| $I_D^{1)}$           | 6.2  | A        |

P-TO220-3-31



| Type       | Package       | Ordering Code | Marking |
|------------|---------------|---------------|---------|
| SPA06N60C3 | PG-TO220-3-31 | Q67040-S4631  | 06N60C3 |

**Maximum ratings**, at  $T_j=25\text{ °C}$ , unless otherwise specified

| Parameter                                     | Symbol         | Conditions                                                          | Value       | Unit |
|-----------------------------------------------|----------------|---------------------------------------------------------------------|-------------|------|
| Continuous drain current <sup>1)</sup>        | $I_D$          | $T_C=25\text{ °C}$                                                  | 6.2         | A    |
|                                               |                | $T_C=100\text{ °C}$                                                 | 3.9         |      |
| Pulsed drain current <sup>1)</sup>            | $I_{D,pulse}$  | $T_C=25\text{ °C}$                                                  | 18.6        |      |
| Avalanche energy, single pulse                | $E_{AS}$       | $I_D=3.1\text{ A}$ , $V_{DD}=50\text{ V}$                           | 200         | mJ   |
| Avalanche energy, repetitive $t_{AR}^{1),2)}$ | $E_{AR}$       | $I_D=6.2\text{ A}$ , $V_{DD}=50\text{ V}$                           | 0.5         |      |
| Avalanche current, repetitive $t_{AR}^{1)}$   | $I_{AR}$       |                                                                     | 6.2         | A    |
| Drain source voltage slope                    | $dv/dt$        | $I_D=6.2\text{ A}$ , $V_{DS}=480\text{ V}$ ,<br>$T_j=125\text{ °C}$ | 50          | V/ns |
| Gate source voltage                           | $V_{GS}$       | static                                                              | $\pm 20$    | V    |
|                                               | $V_{GS}$       | AC ( $f>1\text{ Hz}$ )                                              | $\pm 30$    |      |
| Power dissipation                             | $P_{tot}$      | $T_C=25\text{ °C}$                                                  | 32          | W    |
| Operating and storage temperature             | $T_j, T_{stg}$ |                                                                     | -55 ... 150 | °C   |

| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

**Thermal characteristics**

|                                        |              |                                          |   |   |      |     |
|----------------------------------------|--------------|------------------------------------------|---|---|------|-----|
| Thermal resistance, junction - case    | $R_{thJC}$   |                                          | - | - | 3.92 | K/W |
| Thermal resistance, junction - ambient | $R_{thJA}$   | leaded                                   | - | - | 80   |     |
| Soldering temperature                  | $T_{solder}$ | 1.6 mm (0.063 in.)<br>from case for 10 s | - | - | 260  | °C  |

**Electrical characteristics, at  $T_j=25\text{ °C}$ , unless otherwise specified**
**Static characteristics**

|                                  |               |                                                                      |     |      |      |               |
|----------------------------------|---------------|----------------------------------------------------------------------|-----|------|------|---------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0\text{ V}$ , $I_D=250\text{ }\mu\text{A}$                   | 600 | -    | -    | V             |
| Avalanche breakdown voltage      | $V_{(BR)DS}$  | $V_{GS}=0\text{ V}$ , $I_D=6.2\text{ A}$                             | -   | 700  | -    |               |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}$ , $I_D=0.26\text{ mA}$                               | 2.1 | 3    | 3.9  |               |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=600\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=25\text{ °C}$  | -   | 0.1  | 1    | $\mu\text{A}$ |
|                                  |               | $V_{DS}=600\text{ V}$ , $V_{GS}=0\text{ V}$ ,<br>$T_j=150\text{ °C}$ | -   | -    | 100  |               |
| Gate-source leakage current      | $I_{GSS}$     | $V_{GS}=20\text{ V}$ , $V_{DS}=0\text{ V}$                           | -   | -    | 100  | nA            |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=10\text{ V}$ , $I_D=3.9\text{ A}$ ,<br>$T_j=25\text{ °C}$    | -   | 0.68 | 0.75 | $\Omega$      |
|                                  |               | $V_{GS}=10\text{ V}$ , $I_D=3.9\text{ A}$ ,<br>$T_j=150\text{ °C}$   | -   | 1.82 | -    |               |
| Gate resistance                  | $R_G$         | $f=1\text{ MHz}$ , open drain                                        | -   | 1    | -    |               |
| Transconductance                 | $g_{fs}$      | $ V_{DS} >2 I_D R_{DS(on)max}$ ,<br>$I_D=3.9\text{ A}$               | -   | 5.6  | -    | S             |

| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

**Dynamic characteristics**

|                                                            |              |                                                                                       |   |     |   |    |
|------------------------------------------------------------|--------------|---------------------------------------------------------------------------------------|---|-----|---|----|
| Input capacitance                                          | $C_{iss}$    | $V_{GS}=0\text{ V}, V_{DS}=25\text{ V},$<br>$f=1\text{ MHz}$                          | - | 620 | - | pF |
| Output capacitance                                         | $C_{oss}$    |                                                                                       | - | 200 | - |    |
| Reverse transfer capacitance                               | $C_{rss}$    |                                                                                       | - | 17  | - |    |
| Effective output capacitance, energy related <sup>3)</sup> | $C_{o(er)}$  | $V_{GS}=0\text{ V}, V_{DS}=0\text{ V}$<br>to 480 V                                    | - | 28  | - |    |
| Effective output capacitance, time related <sup>4)</sup>   | $C_{o(tr)}$  |                                                                                       | - | 47  | - |    |
| Turn-on delay time                                         | $t_{d(on)}$  | $V_{DD}=480\text{ V},$<br>$V_{GS}=10\text{ V}, I_D=6.2\text{ A},$<br>$R_G=12\ \Omega$ | - | 7   | - | ns |
| Rise time                                                  | $t_r$        |                                                                                       | - | 12  | - |    |
| Turn-off delay time                                        | $t_{d(off)}$ |                                                                                       | - | 52  | - |    |
| Fall time                                                  | $t_f$        |                                                                                       | - | 10  | - |    |

**Gate Charge Characteristics**

|                       |               |                                                                              |   |     |    |    |
|-----------------------|---------------|------------------------------------------------------------------------------|---|-----|----|----|
| Gate to source charge | $Q_{gs}$      | $V_{DD}=480\text{ V}, I_D=6.2\text{ A},$<br>$V_{GS}=0\text{ to }10\text{ V}$ | - | 3.3 | -  | nC |
| Gate to drain charge  | $Q_{gd}$      |                                                                              | - | 12  | -  |    |
| Gate charge total     | $Q_g$         |                                                                              | - | 24  | 31 |    |
| Gate plateau voltage  | $V_{plateau}$ |                                                                              | - | 5.5 | -  | V  |

<sup>1)</sup> Pulse width limited by maximum temperature  $T_{j,max}$  only

<sup>2)</sup> Repetitive avalanche causes additional power losses that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .

<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%  $V_{DSS}$ .

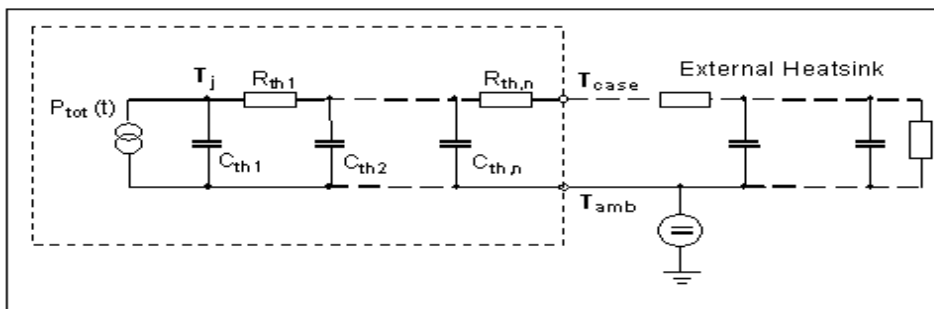
| Parameter | Symbol | Conditions | Values |      |      | Unit |
|-----------|--------|------------|--------|------|------|------|
|           |        |            | min.   | typ. | max. |      |

**Reverse Diode**

|                                  |               |                                                                       |   |      |      |               |
|----------------------------------|---------------|-----------------------------------------------------------------------|---|------|------|---------------|
| Diode continuous forward current | $I_S$         | $T_C=25\text{ }^{\circ}\text{C}$                                      | - | -    | 6.2  | A             |
| Diode pulse current              | $I_{S,pulse}$ |                                                                       | - | -    | 18.6 |               |
| Diode forward voltage            | $V_{SD}$      | $V_{GS}=0\text{ V}, I_F=6.2\text{ A}, T_j=25\text{ }^{\circ}\text{C}$ | - | 0.97 | 1.2  | V             |
| Reverse recovery time            | $t_{rr}$      | $V_R=480\text{ V}, I_F=I_S, di_F/dt=100\text{ A}/\mu\text{s}$         | - | 400  | -    | ns            |
| Reverse recovery charge          | $Q_{rr}$      |                                                                       | - | 3.5  | -    | $\mu\text{C}$ |
| Peak reverse recovery current    | $I_{rrm}$     |                                                                       | - | 25   | -    | A             |

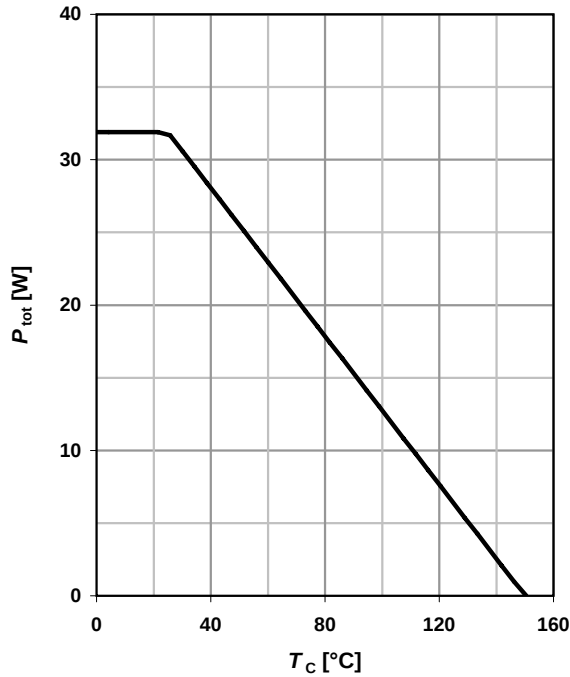
**Typical Transient Thermal Characteristics**

| Symbol    | Value | Unit | Symbol    | Value     | Unit |
|-----------|-------|------|-----------|-----------|------|
|           | typ.  |      |           | typ.      |      |
| $R_{th1}$ | 0.034 | K/W  | $C_{th1}$ | 0.0000507 | Ws/K |
| $R_{th2}$ | 0.15  |      | $C_{th2}$ | 0.00045   |      |
| $R_{th3}$ | 0.388 |      | $C_{th3}$ | 0.00117   |      |
| $R_{th4}$ | 0.713 |      | $C_{th4}$ | 0.0114    |      |
| $R_{th5}$ | 1.6   |      | $C_{th5}$ | 0.939     |      |



### 1 Power dissipation

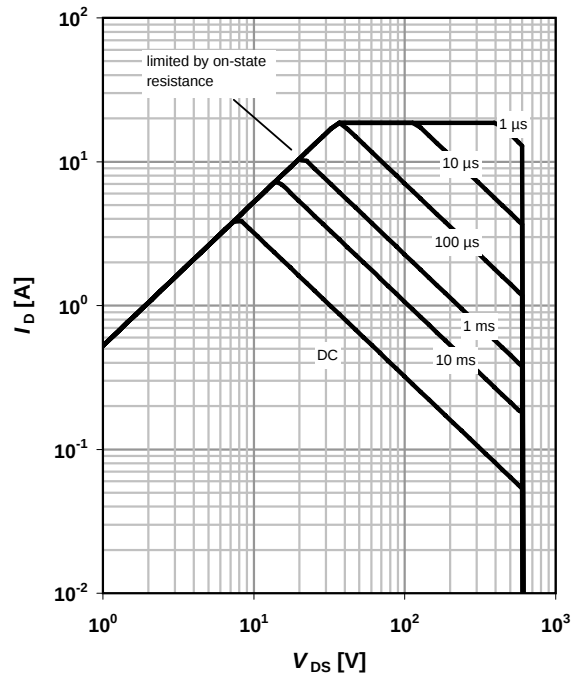
$$P_{\text{tot}} = f(T_C)$$



### 2 Safe operating area

$$I_D = f(V_{DS}); T_C = 25^\circ\text{C}; D = 0$$

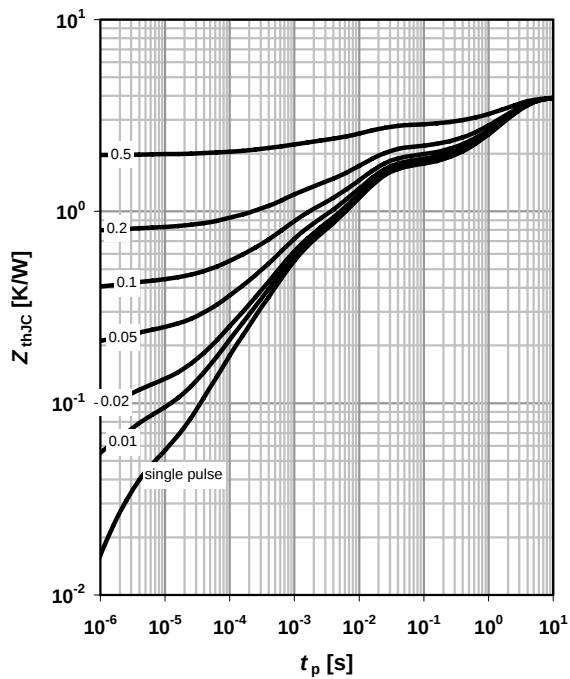
parameter:  $t_p$



### 3 Max. transient thermal impedance

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

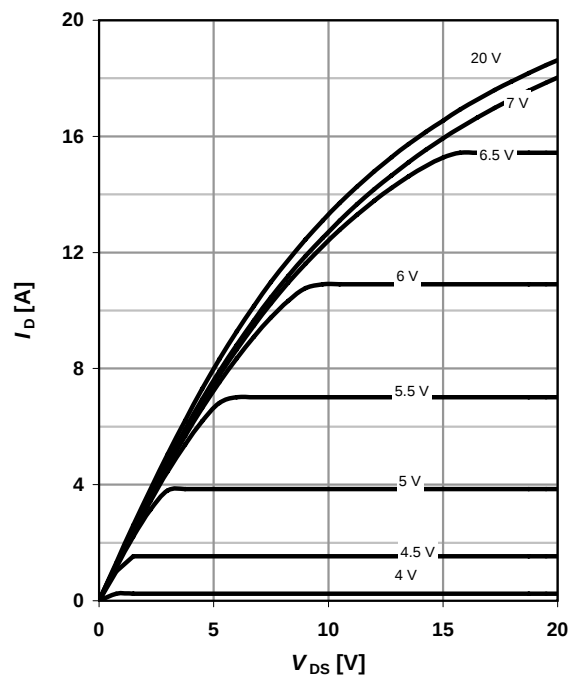
parameter:  $D = t_p/T$



### 4 Typ. output characteristics

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

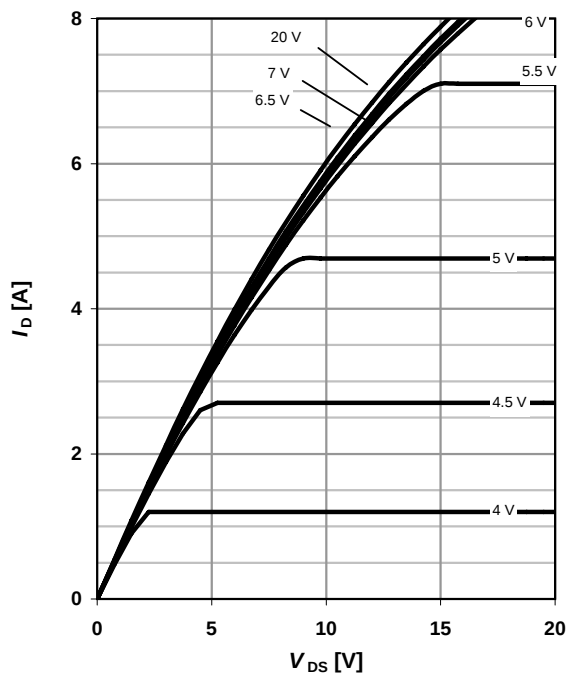
parameter:  $V_{GS}$



### 5 Typ. output characteristics

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

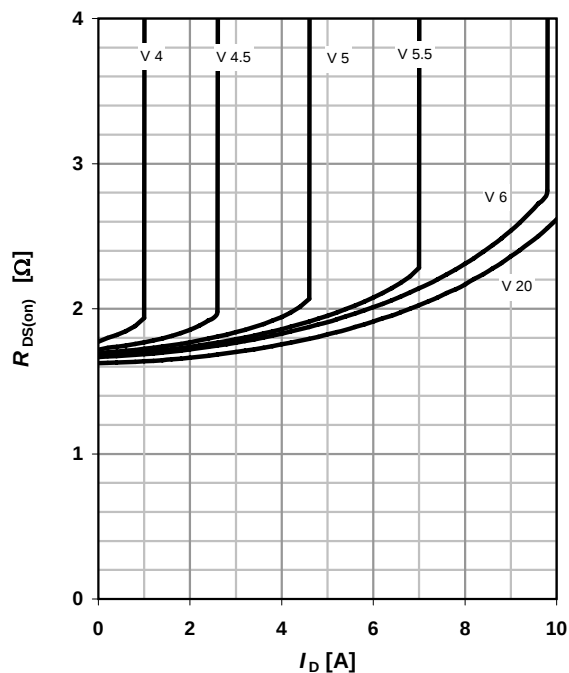
parameter:  $V_{GS}$



### 6 Typ. drain-source on-state resistance

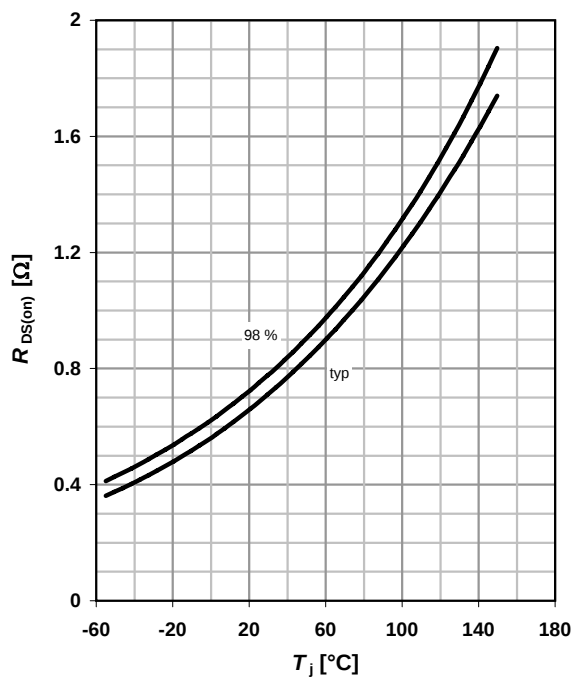
$$R_{DS(on)} = f(I_D); T_j = 150^\circ\text{C}$$

parameter:  $V_{GS}$



### 7 Drain-source on-state resistance

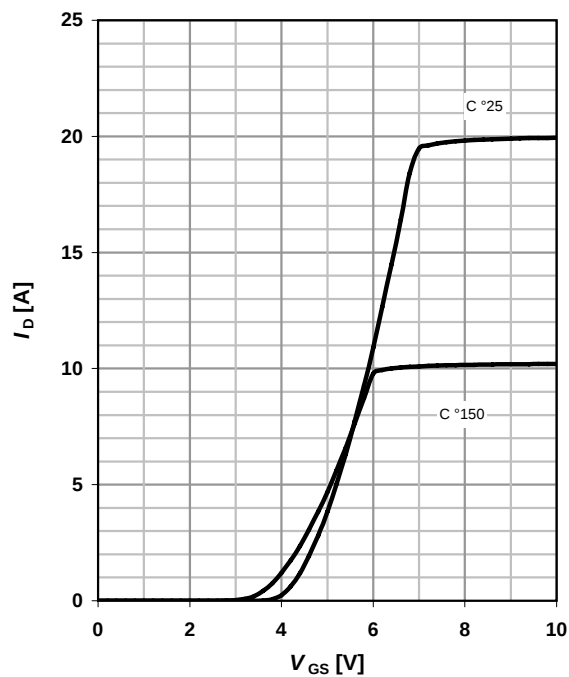
$$R_{DS(on)} = f(T_j); I_D = 3.9\text{ A}; V_{GS} = 10\text{ V}$$



### 8 Typ. transfer characteristics

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

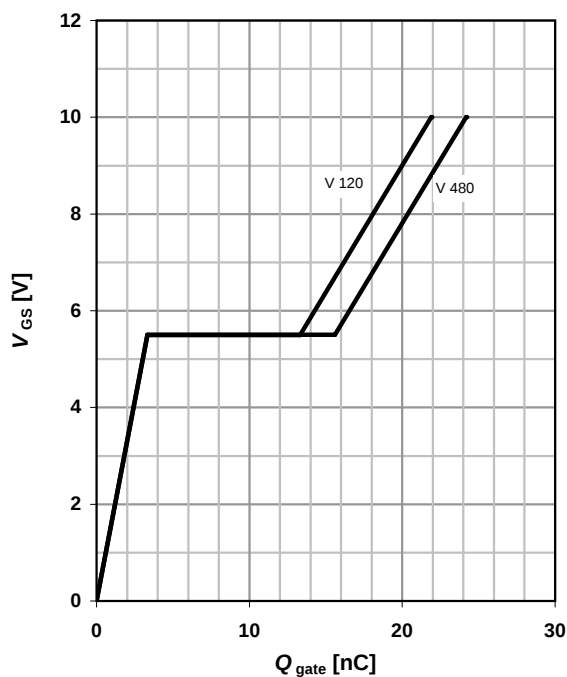
parameter:  $T_j$



### 9 Typ. gate charge

$$V_{GS}=f(Q_{gate}); I_D=6.2 \text{ A pulsed}$$

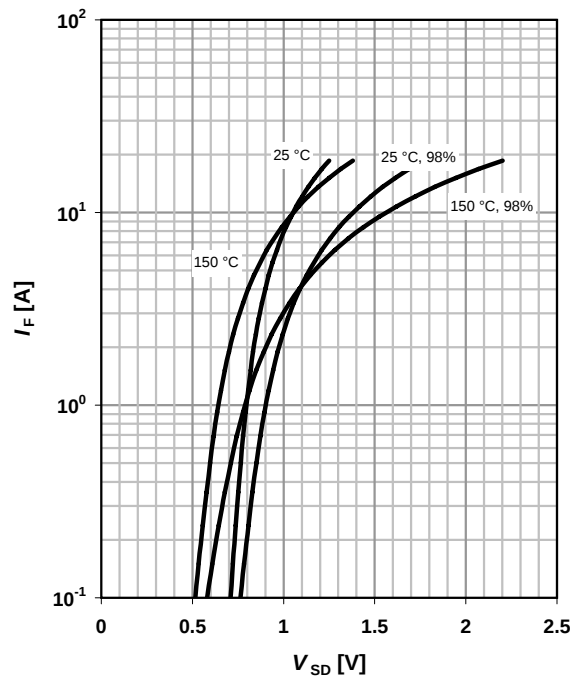
parameter:  $V_{DD}$



### 10 Forward characteristics of reverse diode

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

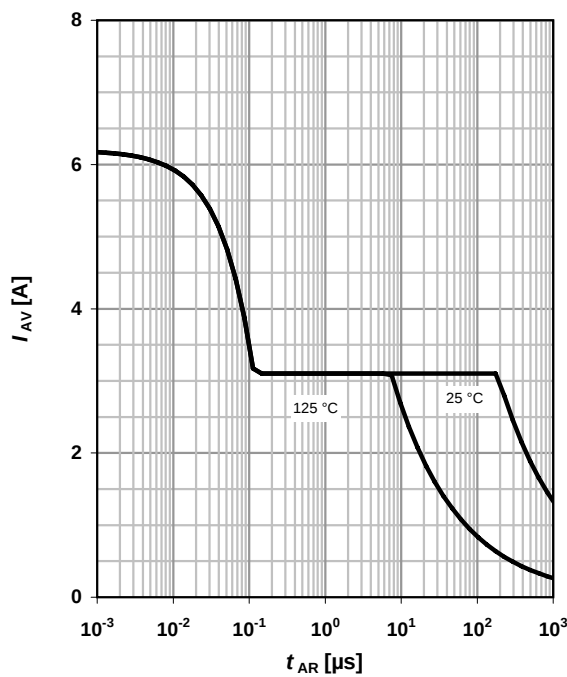
parameter:  $T_j$



### 11 Avalanche SOA

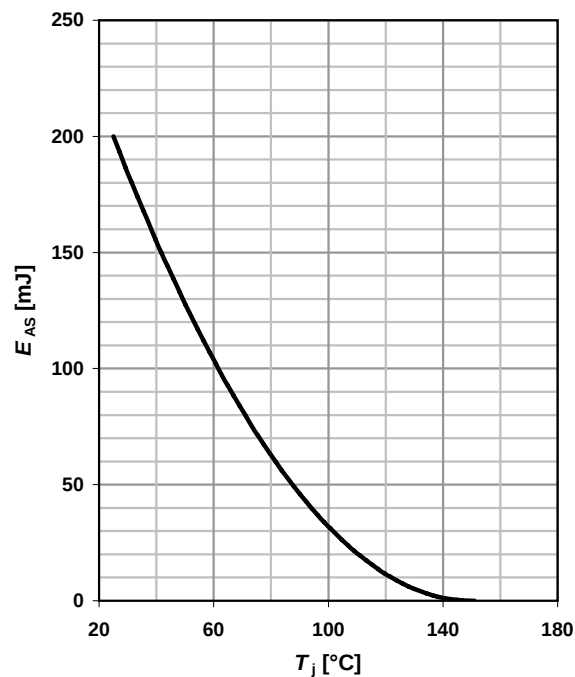
$$I_{AR}=f(t_{AR})$$

parameter:  $T_{j(start)}$



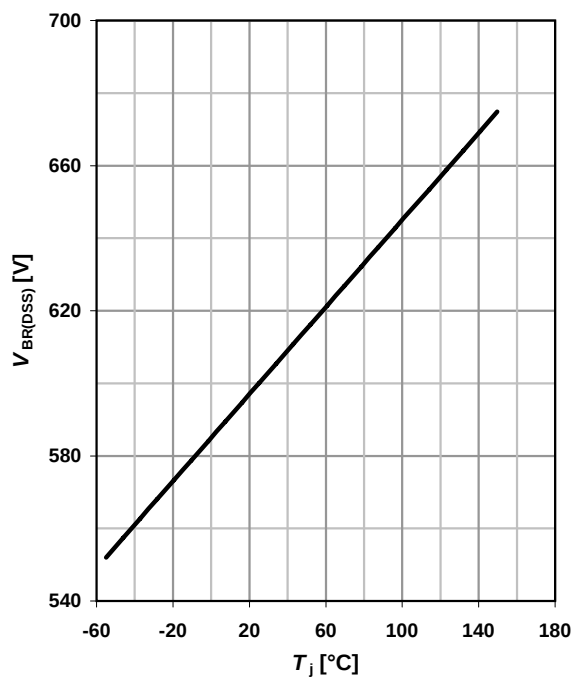
### 12 Avalanche energy

$$E_{AS}=f(T_j); I_D=3.1 \text{ A}; V_{DD}=50 \text{ V}$$



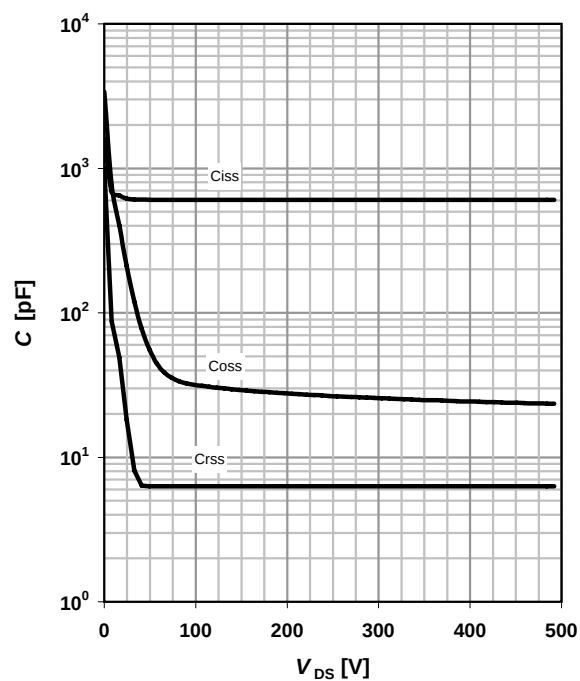
### 13 Drain-source breakdown voltage

$$V_{BR(DSS)} = f(T_J); I_D = 0.25 \text{ mA}$$



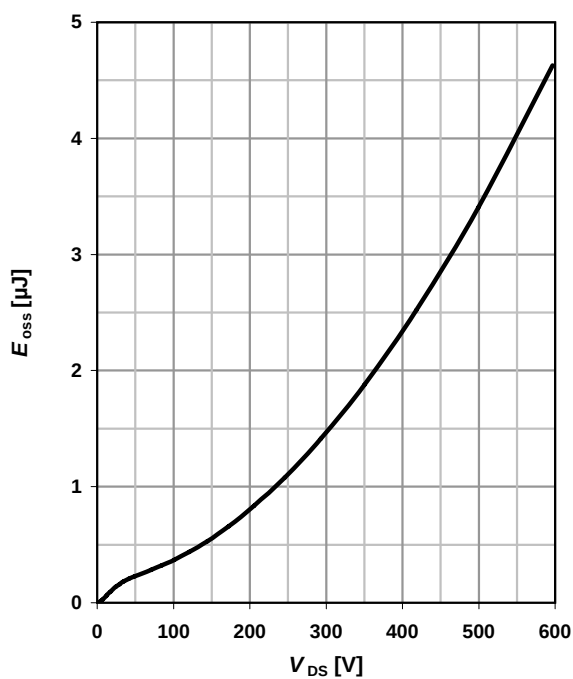
### 14 Typ. capacitances

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

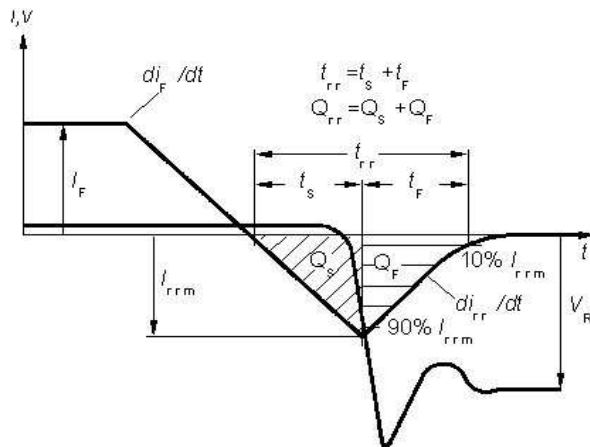


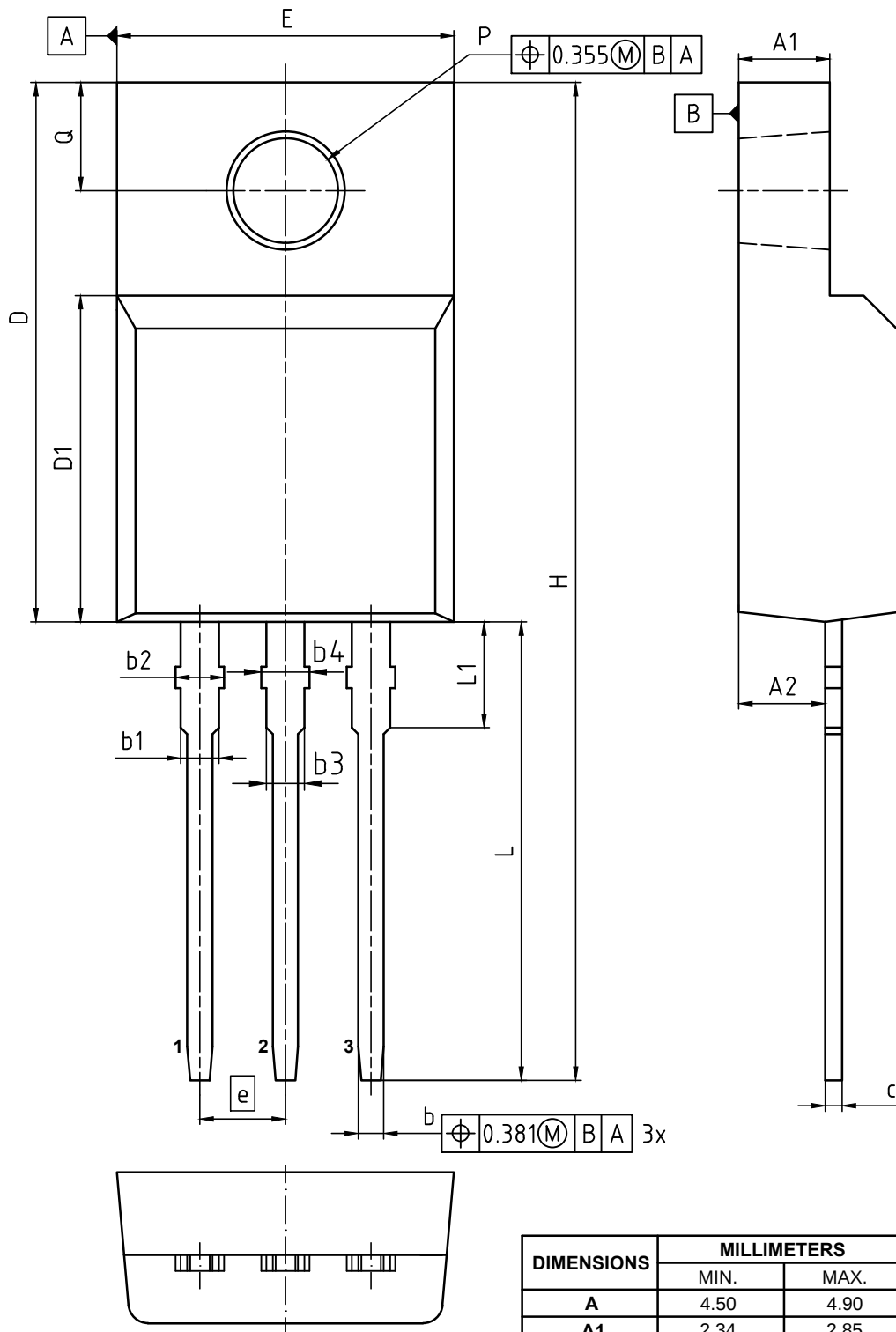
### 15 Typ. $C_{oss}$ stored energy

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



# Definition of diode switching characteristics





#### NOTES:

ALL DIMENSIONS REFER TO JEDEC STANDARD TO-281  
AND DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS  
OR GATE BURRS  
GATE BURRS ARE LESS THAN 0.5 mm

| DIMENSIONS | MILLIMETERS |       |
|------------|-------------|-------|
|            | MIN.        | MAX.  |
| A          | 4.50        | 4.90  |
| A1         | 2.34        | 2.85  |
| A2         | 2.42        | 2.86  |
| b          | 0.65        | 0.90  |
| b1         | 0.95        | 1.38  |
| b2         | 0.95        | 1.51  |
| b3         | 0.65        | 1.38  |
| b4         | 0.65        | 1.51  |
| 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        | 3.30  |
| Q          | 3.15        | 3.50  |

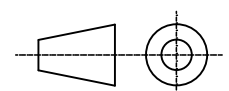
**DOCUMENT NO.**  
Z8B00003319

**REVISION**  
07

**SCALE 5:1**

0 1 2 3 4 5mm

**EUROPEAN PROJECTION**



**ISSUE DATE**  
27.01.2017

## Revision History

SPA06N60C3

**Revision: 2017-08-17, Rev. 1.4**

|                           |             |                                                    |
|---------------------------|-------------|----------------------------------------------------|
| <b>Previous Revision:</b> |             |                                                    |
| <b>Revision</b>           | <b>Date</b> | <b>Subjects (major changes since last version)</b> |
| 1.4                       | 2017-08-17  | Updated package drawing on Page 10                 |

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Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

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