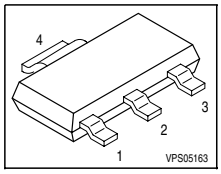
## Cool MOS™ Power Transistor

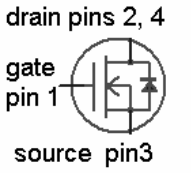
| | | |
|---|---|---|
| $V_{DS}$ | 600 | V |
| $R_{DS(on)}$ | 0.95 | Ω |
| $I_D$ | 0.8 | A |

### Feature

- New revolutionary high voltage technology
- Worldwide best $R_{DS(on)}$ in SOT 223
- Ultra low gate charge
- Extreme d*v*/d*t* rated
- Ultra low effective capacitances
- Improved transconductance
- Qualified according to JEDEC[0)] for target applications

SOT-223




| Type | Package | Ordering Code | Marking |
|---|---|---|---|
| SPN04N60S5 | SOT-223 | Q67040-S4211 | 04N60S5 |

### Maximum Ratings

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Continuous drain current<br>$T_A$ = 25 °C<br>$T_A$ = 70 °C | $I_D$ | <br>0.8<br>0.65 | A |
| Pulsed drain current, $t_p$ limited by $T_{jmax}$<br>$T_A$ = 25 °C | $I_{D\ puls}$ | 3 | |
| Gate source voltage | $V_{GS}$ | ±20 | V |
| Gate source voltage AC (f >1Hz) | $V_{GS}$ | ±30 | |
| Power dissipation, $T_A$ = 25°C | $P_{tot}$ | 1.8 | 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, $I_D$ = 4.5 A, $T_j$ = 125 °C | d$v$/d$t$ | 20 | V/ns |

**Thermal Characteristics**

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | min. | typ. | max. | |
| Thermal resistance, junction - soldering point | $R_{thJS}$ | - | 20 | - | K/W |
| SMD version, device on PCB:<br>@ min. footprint<br>@ 6 cm$^2$ cooling area [1)] | $R_{thJA}$ | <br>-<br>- | <br>110<br>- | <br>-<br>70 | |
| 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, $I_D$=4.5A | - | 700 | - | |
| Gate threshold voltage | $V_{GS(th)}$ | $I_D$=200µA, $V_{GS}$=$V_{DS}$ | 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, $I_D$=2.8A,<br>$T_j$=25°C<br>$T_j$=150°C | <br>-<br>- | <br>0.8<br>2.3 | <br>0.95<br>- | Ω |
| Gate input resistance | $R_G$ | $f$=1MHz, open Drain | - | 20 | - | |

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| **Characteristics** | | | | | | |
| Transconductance | $g_{fs}$ | $V_{DS}\geq 2*I_D*R_{DS(on)max}$, $I_D$=0.65A | - | 1 | - | S |
| Input capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=25V, $f$=1MHz | - | 600 | - | pF |
| Output capacitance | $C_{oss}$ | | - | 325 | - | |
| Reverse transfer capacitance | $C_{rss}$ | | - | 15 | - | |
| Effective output capacitance,[2] energy related | $C_{o(er)}$ | $V_{GS}$=0V, $V_{DS}$=0V to 480V | - | 20 | - | pF |
| Effective output capacitance,[3] time related | $C_{o(tr)}$ | | - | 35 | - | |
| Turn-on delay time | $t_{d(on)}$ | $V_{DD}$=350V, $V_{GS}$=0/10V, $I_D$=0.8A, $R_G$=18Ω | - | 40 | - | ns |
| Rise time | $t_r$ | | - | 20 | - | |
| Turn-off delay time | $t_{d(off)}$ | | - | 130 | - | |
| Fall time | $t_f$ | | - | 30 | - | |

**Gate Charge Characteristics**

| | | | | | | |
|---|---|---|---|---|---|---|
| Gate to source charge | $Q_{gs}$ | $V_{DD}$=350V, $I_D$=0.8A | - | 4.1 | - | nC |
| Gate to drain charge | $Q_{gd}$ | | - | 9.2 | - | |
| Gate charge total | $Q_g$ | $V_{DD}$=350V, $I_D$=0.8A, $V_{GS}$=0 to 10V | - | 17 | - | |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD}$=350V, $I_D$=0.8A | - | 8 | - | V |

[0] J-STD20 and JESD22

[1] 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.

[2] $C_{o(er)}$ is a fixed capacitance that gives the same stored energy as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

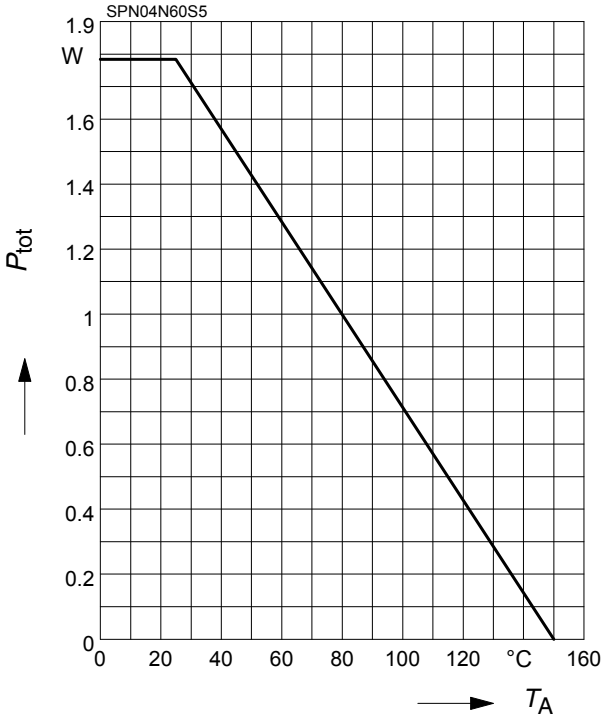
[3] $C_{o(tr)}$ is a fixed capacitance that gives the same charging time as $C_{oss}$ while $V_{DS}$ is rising from 0 to 80% $V_{DSS}$.

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

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | min. | typ. | max. | |
| Inverse diode continuous forward current | $I_S$ | $T_A$=25°C | - | - | 0.8 | A |
| Inverse diode direct current, pulsed | $I_{SM}$ | | - | - | 3 | |
| Inverse diode forward voltage | $V_{SD}$ | $V_{GS}$=0V, $I_F$=$I_S$ | - | 0.85 | 1.05 | V |
| Reverse recovery time | $t_{rr}$ | $V_R$=350V, $I_F$=$I_S$ , | - | 200 | - | ns |
| Reverse recovery charge | $Q_{rr}$ | d$i_F$/d$t$=100A/µs | - | 1.2 | - | µC |

## 1 Power dissipation

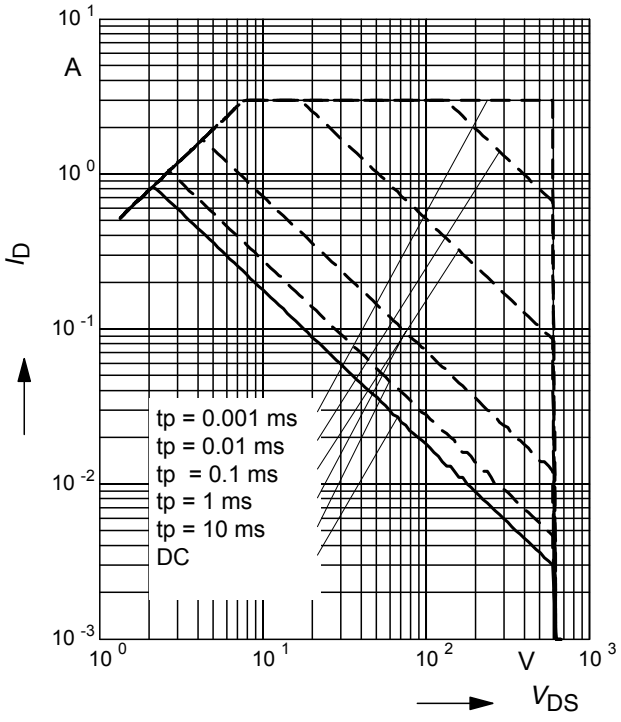
$P_{tot} = f(T_A)$




## 2 Safe operating area

$I_D = f(V_{DS})$

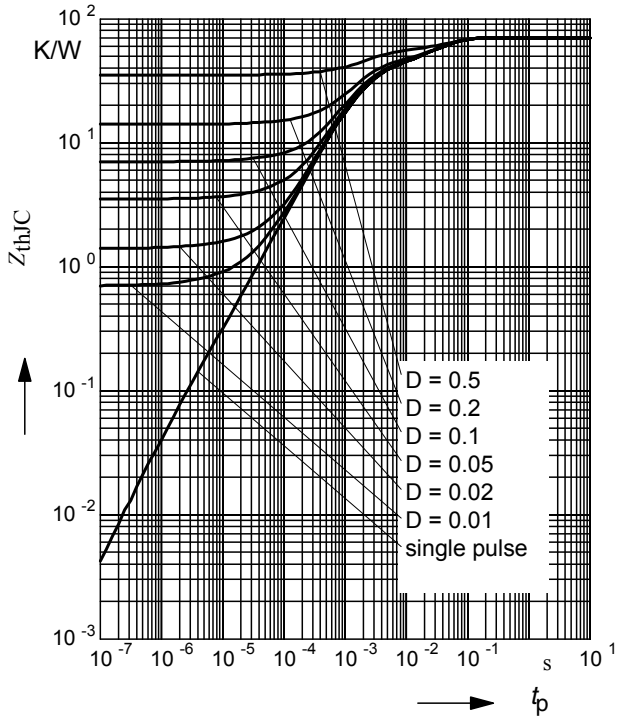
parameter : $D = 0$ , $T_A$=25°C




## 3 Transient thermal impedance

$Z_{thJC} = f(t_p)$

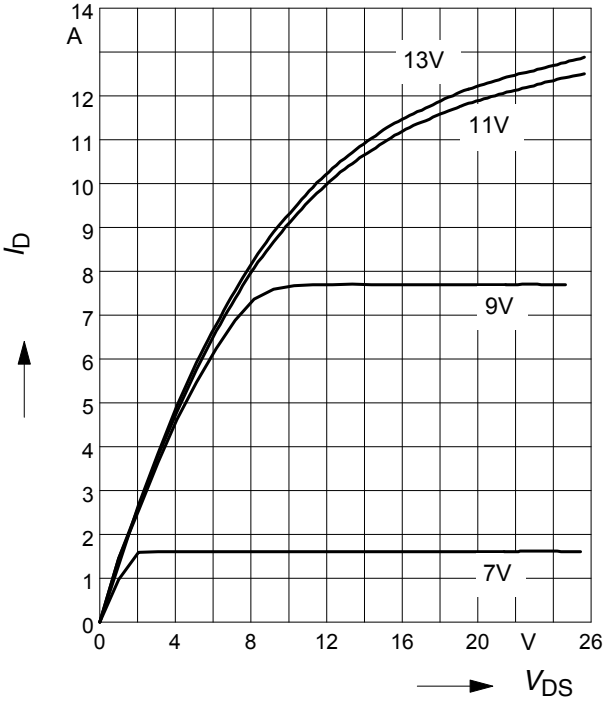
parameter: $D = t_p/T$




## 4 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=25°C

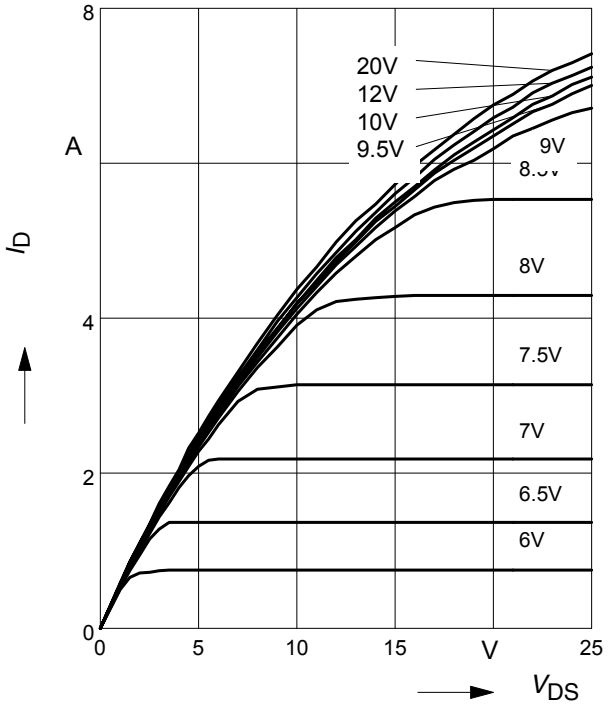
parameter: $t_p$ = 10 µs, $V_{GS}$



## 5 Typ. output characteristic

$I_D = f(V_{DS})$; $T_j$=150°C

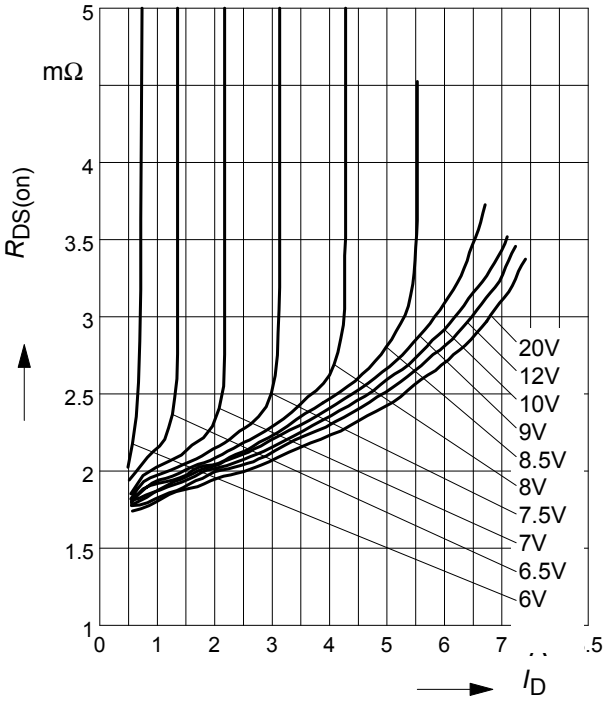
parameter: $t_p$ = 10 µs, $V_{GS}$




## 6 Typ. drain-source on resistance

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

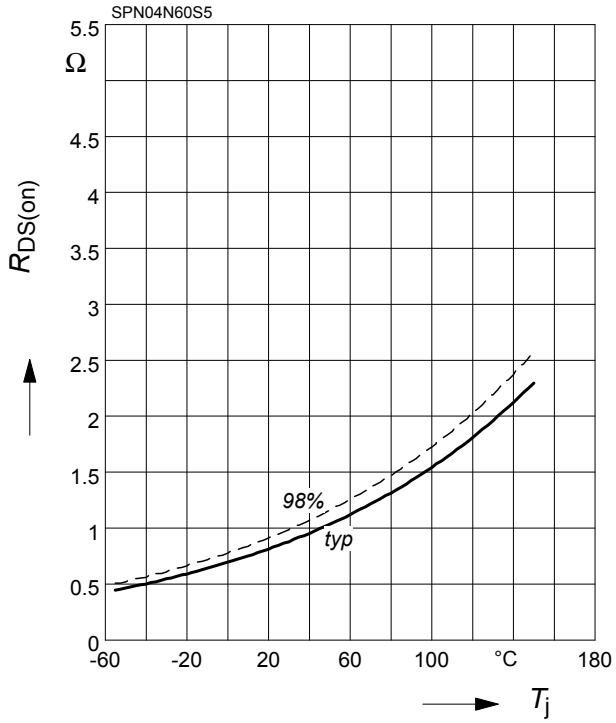
parameter: $T_j$=150°C, $V_{GS}$




## 7 Drain-source on-state resistance

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

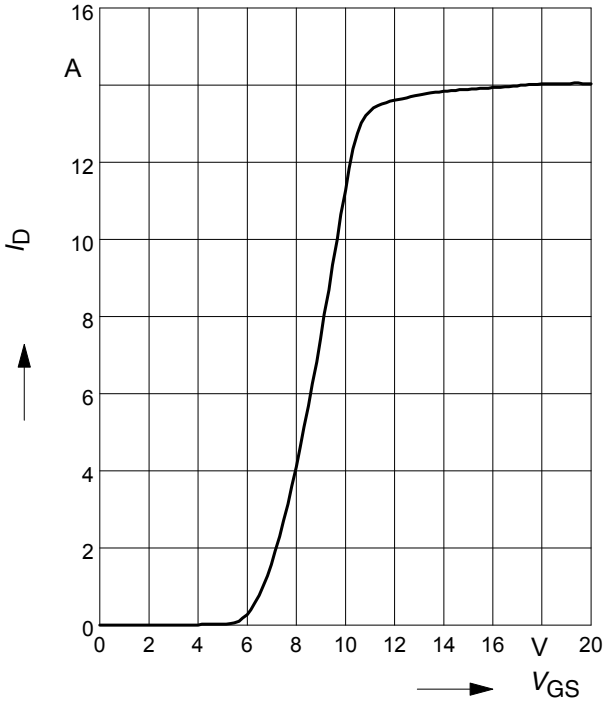
parameter : $I_D$ = 0.65 A, $V_{GS}$ = 10 V




## 8 Typ. transfer characteristics

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

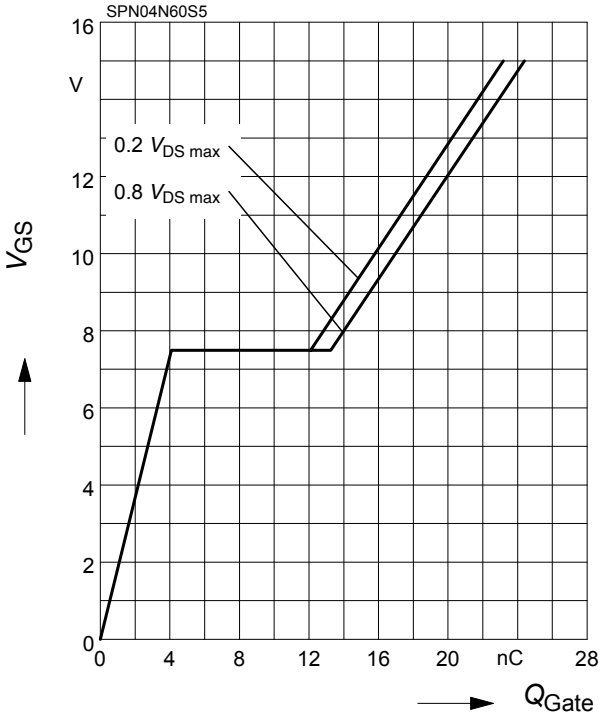
parameter: $t_p$ = 10 µs



## 9 Typ. gate charge

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

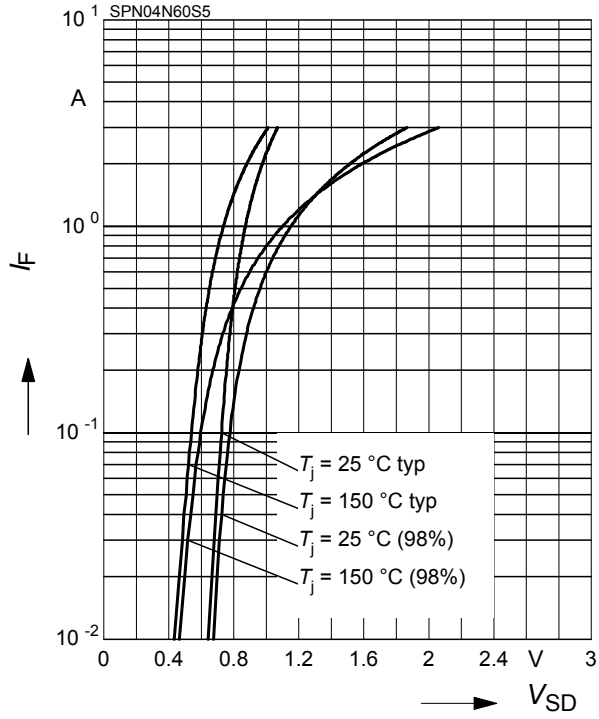
parameter: $I_D$ = 0.8 A pulsed




## 10 Forward characteristics of body diode

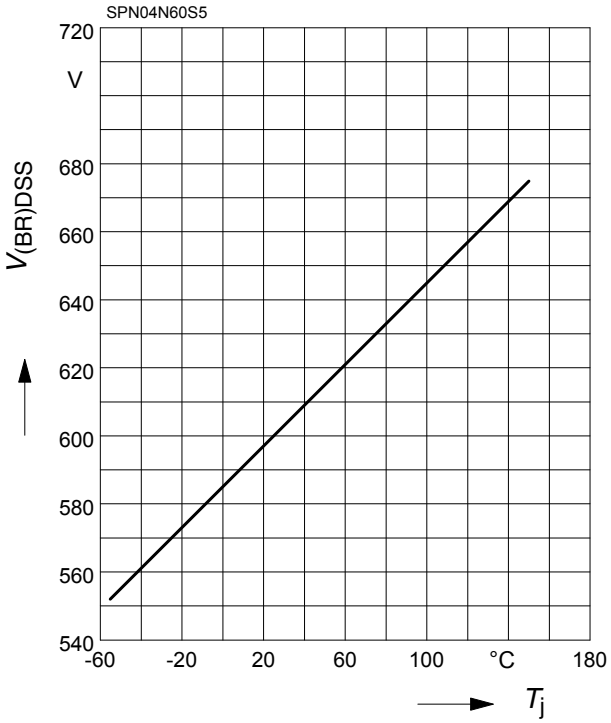
$I_F = f\ (V_{SD})$

parameter: $T_j$ , tp = 10 µs




## 11 Drain-source breakdown voltage

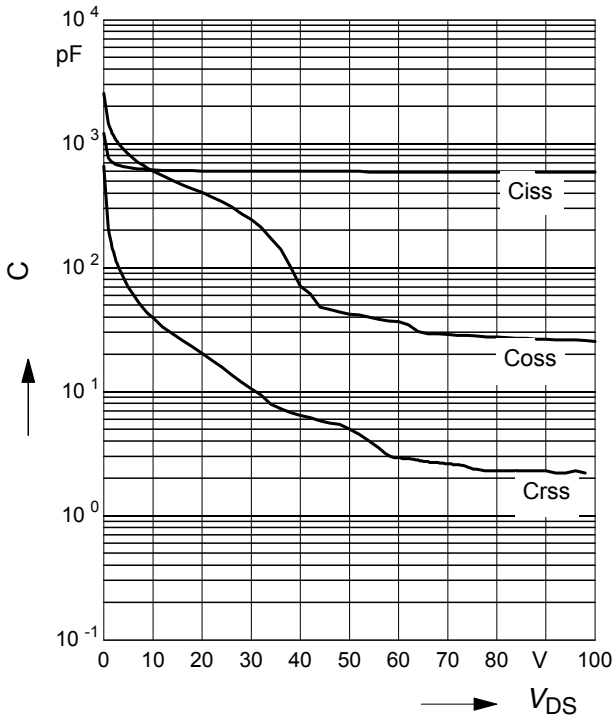
$V_{(BR)DSS} = f\ (T_j)$




## 12 Typ. capacitances

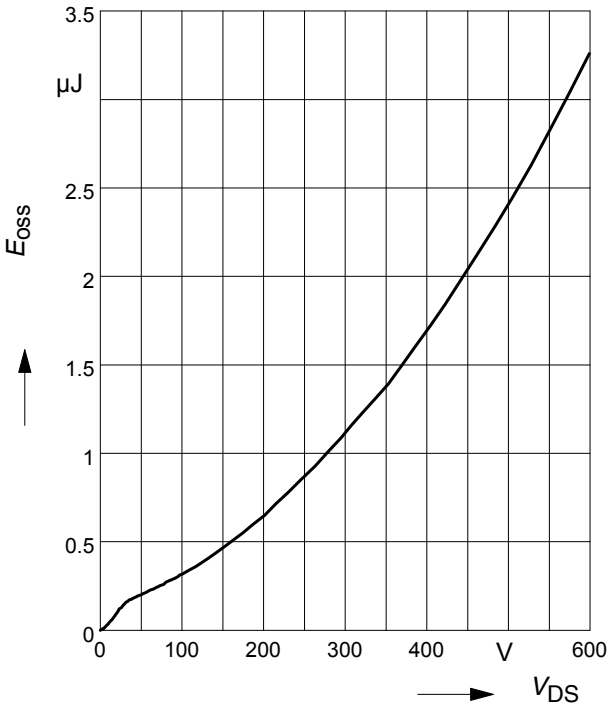
$C = f\ (V_{DS})$

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

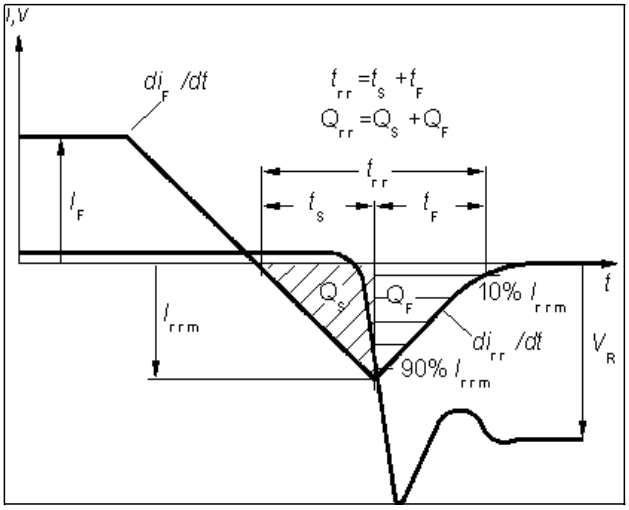


## 13 Typ. $C_{oss}$ stored energy

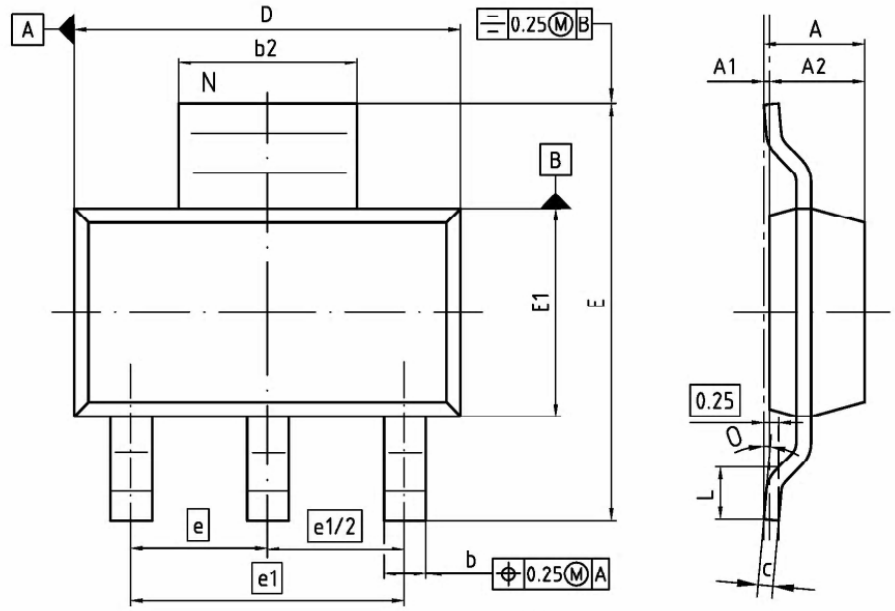
$E_{oss}=f(V_{DS})$

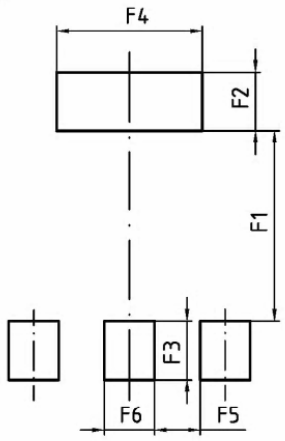



Definition of diodes switching characteristics



## SOT223



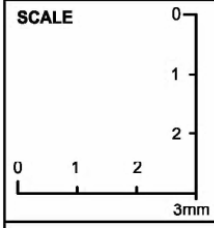




**FOOTPRINT (REFLOW SOLDERING)**

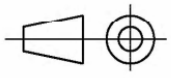
| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 1.6 | 1.8 | 0.063 | 0.071 |
| A1 | - | 0.1 | - | 0.004 |
| A2 | 1.5 | 1.7 | 0.059 | 0.067 |
| b | 0.6 | 0.8 | 0.024 | 0.031 |
| b2 | 2.9 | 3.1 | 0.114 | 0.122 |
| c | 0.24 | 0.32 | 0.009 | 0.013 |
| D | 6.3 | 6.7 | 0.248 | 0.264 |
| E | 6.7 | 7.3 | 0.264 | 0.287 |
| E1 | 3.3 | 3.7 | 0.123 | 0.146 |
| e | 2.3 BASIC | | 0.091 BASIC | |
| e1 | 4.6 BASIC | | 0.181 BASIC | |
| L | 0.75 | - | 0.023 | - |
| N | 4 | | 4 | |
| O | 0° | 10° | 0° | 10° |
| F1 | 4.8 BASIC | | 0.189 BASIC | |
| F2 | 1.4 BASIC | | 0.055 BASIC | |
| F3 | 1.4 BASIC | | 0.055 BASIC | |
| F4 | 3.5 BASIC | | 0.138 BASIC | |
| F5 | 1.1 BASIC | | 0.043 BASIC | |
| F6 | 1.2 BASIC | | 0.047 BASIC | |

**REFERENCE**
JEDEC TO261 AA

**SCALE**




**EUROPEAN PROJECTION**



**ISSUE DATE**
04-28-2006

**FILE**
SOT223

**Published by**
**Infineon Technologies AG,**
**Bereichs Kommunikation**
**St.-Martin-Strasse 53,**
**D-81541 München**


**Attention please!**
The information herein is given to describe certain components and shall not be considered as warranted characteristics.

Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

Infineon Technologies is an approved CECC manufacturer.

**Information**
For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office in Germany or our Infineon Technologies Reprensatives worldwide (see address list).

**Warnings**
Due to technical requirements components may contain dangerous substances.
For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.