

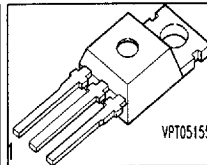
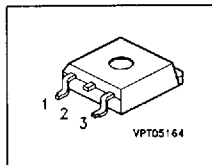
### SIPMOS® Power Transistor

#### Features

- N channel
- Enhancement mode
- Avalanche rated
- Logic Level
- $dv/dt$  rated
- 175 °C operating temperature

#### Product Summary

|                                  |              |       |          |
|----------------------------------|--------------|-------|----------|
| Drain source voltage             | $V_{DS}$     | 55    | V        |
| Drain-Source on-state resistance | $R_{DS(on)}$ | 0.064 | $\Omega$ |
| Continuous drain current         | $I_D$        | 12.5  | A        |



| Type            | Package     | Ordering Code   | Packaging     |
|-----------------|-------------|-----------------|---------------|
| BUZ104SL        | P-TO220-3-1 | Q67040-S4006-A2 | Tube          |
| BUZ104SL E3045A | P-TO263-3-2 | Q67040-S4006-A6 | Tape and Reel |
| BUZ104SL E3045  | P-TO263-3-2 | Q67040-S4006-A5 | Tube          |

| Pin 1 | Pin 2 | Pin 3 |
|-------|-------|-------|
| G     | D     | S     |

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

| Parameter                                                                                                                                    | Symbol         | Value       | Unit              |
|----------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------|-------------------|
| Continuous drain current<br>$T_C = 25\text{ °C}$<br>$T_C = 100\text{ °C}$                                                                    | $I_D$          | 12.5<br>8.8 | A                 |
| Pulsed drain current<br>$T_C = 25\text{ °C}$                                                                                                 | $I_{Dpulse}$   | 50          |                   |
| Avalanche energy, single pulse<br>$I_D = 12.5\text{ A}$ , $V_{DD} = 25\text{ V}$ , $R_{GS} = 25\text{ }\Omega$                               | $E_{AS}$       | 52          | mJ                |
| Avalanche energy, periodic limited by $T_{jmax}$                                                                                             | $E_{AR}$       | 3.5         |                   |
| Reverse diode $dv/dt$<br>$I_S = 12.5\text{ A}$ , $V_{DS} = 40\text{ V}$ , $di/dt = 200\text{ A}/\mu\text{s}$ ,<br>$T_{jmax} = 175\text{ °C}$ | $dv/dt$        | 6           | kV/ $\mu\text{s}$ |
| Gate source voltage                                                                                                                          | $V_{GS}$       | -20         | V                 |
| Power dissipation<br>$T_C = 25\text{ °C}$                                                                                                    | $P_{tot}$      | 35          | W                 |
| Operating and storage temperature                                                                                                            | $T_j, T_{stg}$ | -55... +175 | °C                |
| IEC climatic category; DIN IEC 68-1                                                                                                          |                | 55/175/56   |                   |

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**Thermal Characteristics**

| Parameter                                      | Symbol     | Values |      |      | Unit |
|------------------------------------------------|------------|--------|------|------|------|
|                                                |            | min.   | typ. | max. |      |
| Characteristics                                |            |        |      |      |      |
| Thermal resistance, junction - case            | $R_{thJC}$ | -      | -    | 4.3  | K/W  |
| Thermal resistance, junction - ambient, leded  | $R_{thJA}$ | -      | -    | 62   |      |
| SMD version, device on PCB:                    | $R_{thJA}$ |        |      |      |      |
| @ min. footprint                               |            | -      | -    | 62   |      |
| @ 6 cm <sup>2</sup> cooling area <sup>1)</sup> |            | -      | -    | 40   |      |

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

| Parameter                                                                                                                                                                                                      | Symbol        | Values |       |       | Unit          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------|-------|-------|---------------|
|                                                                                                                                                                                                                |               | min.   | typ.  | max.  |               |
| Static Characteristics                                                                                                                                                                                         |               |        |       |       |               |
| Drain- source breakdown voltage<br>$V_{GS} = 0\text{ V}$ , $I_D = 0.25\text{ mA}$                                                                                                                              | $V_{(BR)DSS}$ | 55     | -     | -     | V             |
| Gate threshold voltage, $V_{GS} = V_{DS}$<br>$I_D = 20\text{ }\mu\text{A}$                                                                                                                                     | $V_{GS(th)}$  | 1.2    | 1.6   | 2     |               |
| Zero gate voltage drain current<br>$V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 25\text{ }^{\circ}\text{C}$<br>$V_{DS} = 50\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_j = 150\text{ }^{\circ}\text{C}$ | $I_{DSS}$     | -      | 0.1   | 1     | $\mu\text{A}$ |
|                                                                                                                                                                                                                |               | -      | -     | 100   |               |
| Gate-source leakage current<br>$V_{GS} = 20\text{ V}$ , $V_{DS} = 0\text{ V}$                                                                                                                                  | $I_{GSS}$     | -      | 10    | 100   | nA            |
| Drain-Source on-state resistance<br>$V_{GS} = 4.5\text{ V}$ , $I_D = 8.8\text{ A}$<br>$V_{GS} = 10\text{ V}$ , $I_D = 8.8\text{ A}$                                                                            | $R_{DS(on)}$  | -      | 0.1   | 0.11  | $\Omega$      |
|                                                                                                                                                                                                                |               | -      | 0.061 | 0.064 |               |

<sup>1</sup> Device on 40mm\*40mm\*1.5mm epoxy PCB FR4 with 6 cm<sup>2</sup> (one layer, 70 $\mu\text{m}$  thick) copper area for drain connection. PCB is vertical without blown air.

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

| Parameter                                                                                                                     | Symbol       | Values |      |      | Unit |
|-------------------------------------------------------------------------------------------------------------------------------|--------------|--------|------|------|------|
|                                                                                                                               |              | min.   | typ. | max. |      |
| Dynamic Characteristics                                                                                                       |              |        |      |      |      |
| Transconductance<br>$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}$ , $I_D = 8.8\text{ A}$                                      | $g_{fs}$     | 5      | 8    | -    | S    |
| Input capacitance<br>$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$                                      | $C_{iss}$    | -      | 317  | 400  | pF   |
| Output capacitance<br>$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$                                     | $C_{oss}$    | -      | 97   | 120  |      |
| Reverse transfer capacitance<br>$V_{GS} = 0\text{ V}$ , $V_{DS} = 25\text{ V}$ , $f = 1\text{ MHz}$                           | $C_{rss}$    | -      | 54   | 70   |      |
| Turn-on delay time<br>$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 12.5\text{ A}$ ,<br>$R_G = 16\text{ }\Omega$  | $t_{d(on)}$  | -      | 14.5 | 22   | ns   |
| Rise time<br>$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 12.5\text{ A}$ ,<br>$R_G = 16\text{ }\Omega$           | $t_r$        | -      | 106  | 160  |      |
| Turn-off delay time<br>$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 12.5\text{ A}$ ,<br>$R_G = 16\text{ }\Omega$ | $t_{d(off)}$ | -      | 11   | 17   |      |
| Fall time<br>$V_{DD} = 30\text{ V}$ , $V_{GS} = 4.5\text{ V}$ , $I_D = 12.5\text{ A}$ ,<br>$R_G = 16\text{ }\Omega$           | $t_f$        | -      | 13.5 | 20   |      |

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

| Parameter                                                                                                | Symbol                 | Values |      |      | Unit |
|----------------------------------------------------------------------------------------------------------|------------------------|--------|------|------|------|
|                                                                                                          |                        | min.   | typ. | max. |      |
| Dynamic Characteristics                                                                                  |                        |        |      |      |      |
| Gate to source charge<br>$V_{DD} = 40\text{ V}$ , $I_D = 12.5\text{ A}$                                  | $Q_{gs}$               | -      | 1.5  | 2.3  | nC   |
| Gate to drain charge<br>$V_{DD} = 40\text{ V}$ , $I_D = 12.5\text{ A}$                                   | $Q_{gd}$               | -      | 5.3  | 8    |      |
| Gate charge total<br>$V_{DD} = 40\text{ V}$ , $I_D = 12.5\text{ A}$ , $V_{GS} = 0\text{ to }10\text{ V}$ | $Q_g$                  | -      | 13.5 | 20   |      |
| Gate plateau voltage<br>$V_{DD} = 40\text{ V}$ , $I_D = 12.5\text{ A}$                                   | $V_{(\text{plateau})}$ | -      | 4    | -    | V    |

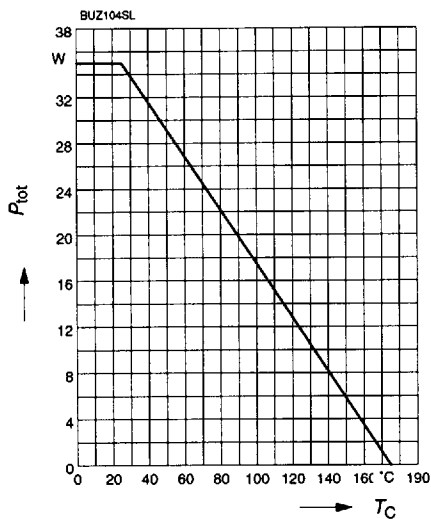
**Reverse Diode**

|                                                                                                     |          |   |      |      |               |
|-----------------------------------------------------------------------------------------------------|----------|---|------|------|---------------|
| Inverse diode continuous forward current<br>$T_C = 25\text{ }^{\circ}\text{C}$                      | $I_S$    | - | -    | 12.5 | A             |
| Inverse diode direct current, pulsed<br>$T_C = 25\text{ }^{\circ}\text{C}$                          | $I_{SM}$ | - | -    | 50   |               |
| Inverse diode forward voltage<br>$V_{GS} = 0\text{ V}$ , $I_F = 25\text{ A}$                        | $V_{SD}$ | - | 1.14 | 1.8  | V             |
| Reverse recovery time<br>$V_R = 30\text{ V}$ , $I_F = I_S$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$   | $t_{rr}$ | - | 50   | 75   | ns            |
| Reverse recovery charge<br>$V_R = 30\text{ V}$ , $I_F = I_S$ , $dI_F/dt = 100\text{ A}/\mu\text{s}$ | $Q_{rr}$ | - | 0.1  | 0.15 | $\mu\text{C}$ |

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### Power Dissipation

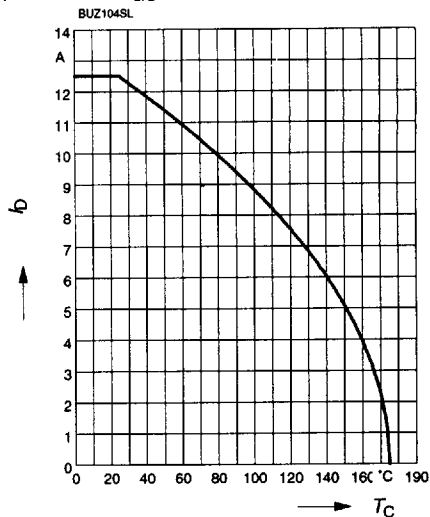
$$P_{\text{tot}} = f(T_C)$$



### Drain current

$$I_D = f(T_C)$$

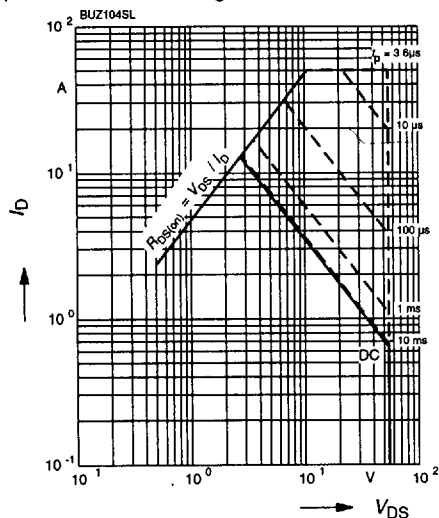
parameter:  $V_{\text{GS}} \geq 10 \text{ V}$



### Safe operating area

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

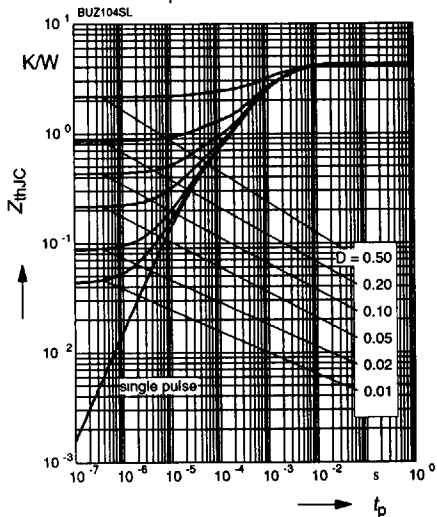
parameter:  $D = 0$ ,  $T_C = 25^{\circ}\text{C}$



### Transient thermal impedance

$$Z_{\text{thJC}} = f(t_p)$$

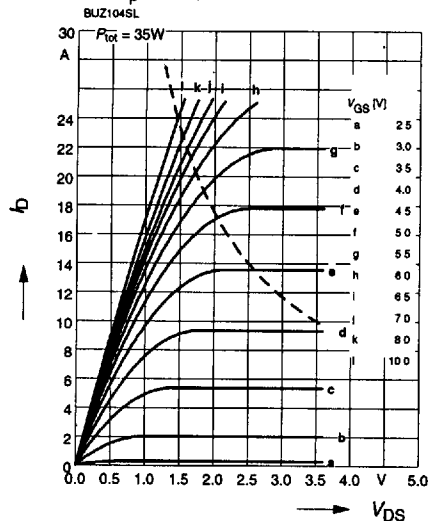
parameter:  $D = t_p/T$



**Typ. output characteristics**

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

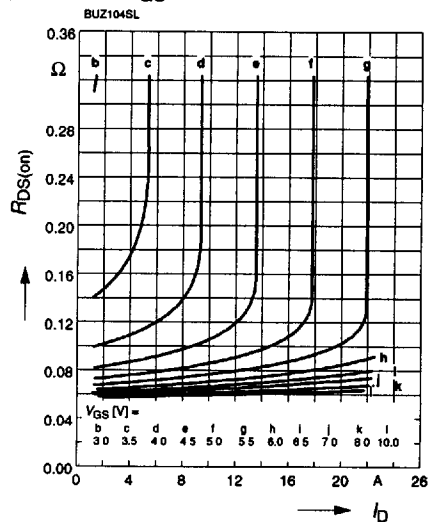
parameter:  $t_p = 80 \mu s$



**Typ. drain-source-on-resistance**

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

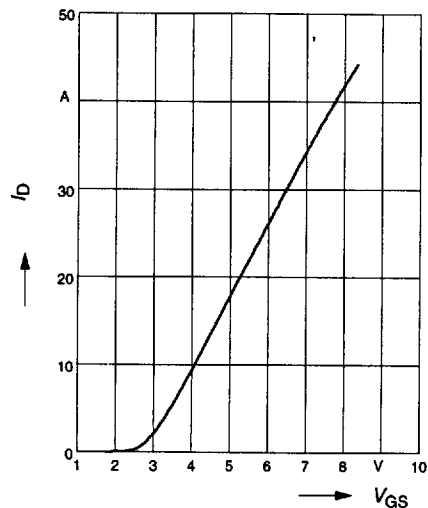
parameter:  $V_{GS}$



**Typ. transfer characteristics  $I_D = f(V_{GS})$**

parameter:  $t_p = 80 \mu s$

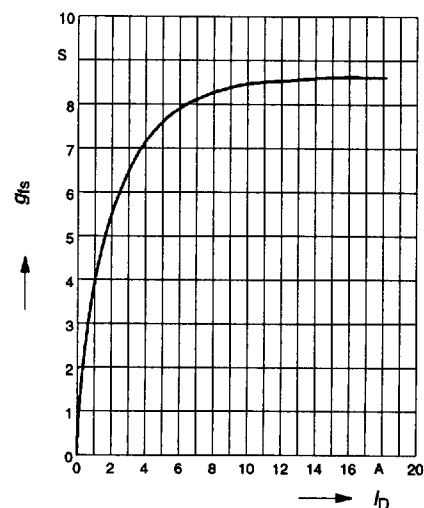
$$V_{DS} \geq 2 \times I_D \times R_{DS(on)max}$$



**Typ. forward transconductance**

$$g_{fs} = f(I_D); T_j = 25^\circ C$$

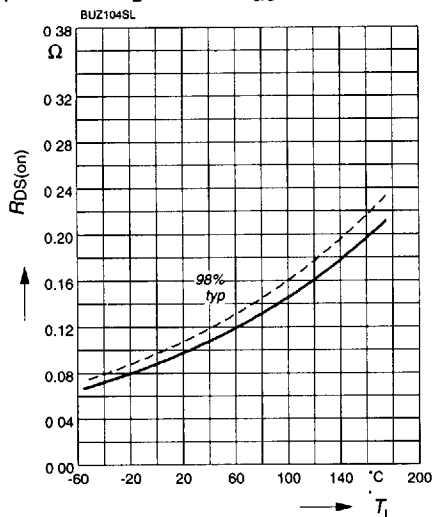
parameter:  $g_{fs}$



**Drain-source on-resistance**

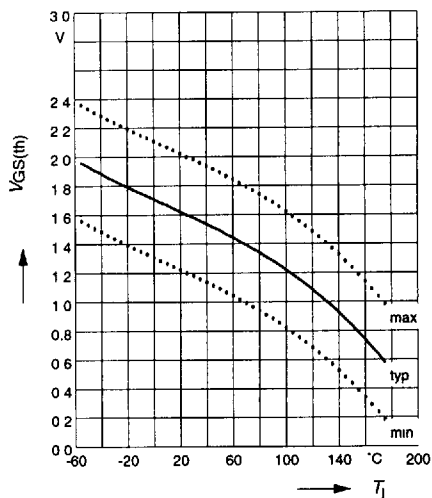
$$R_{DS(on)} = f(T_J)$$

parameter :  $I_D = 8.8 \text{ A}$ ,  $V_{GS} = 4.5 \text{ V}$


**Gate threshold voltage**

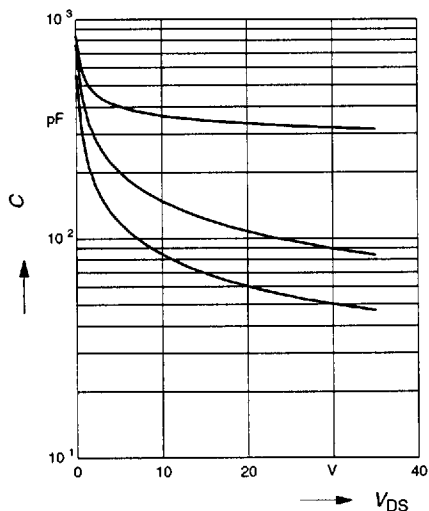
$$V_{GS(th)} = f(T_J)$$

parameter :  $V_{GS} = V_{DS}$ ,  $I_D = 20 \mu\text{A}$


**Typ. capacitances**

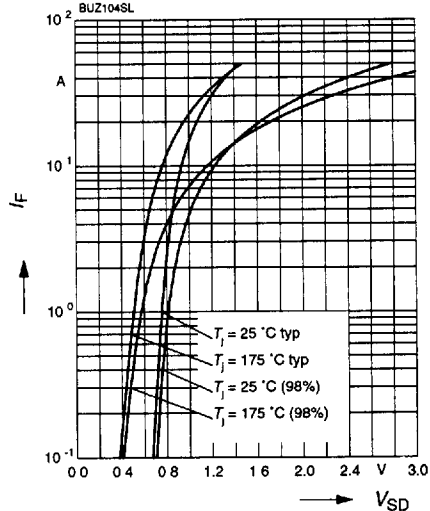
$$C = f(V_{DS})$$

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

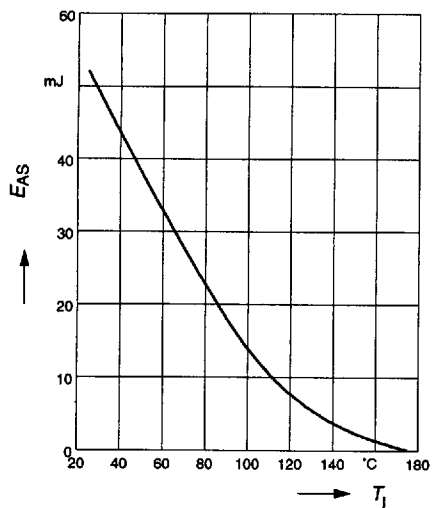

**Forward characteristics of reverse diode**

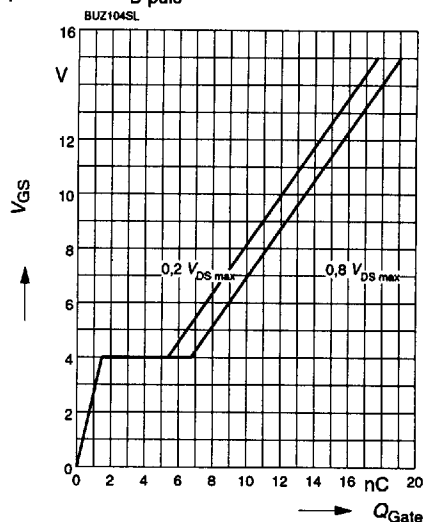
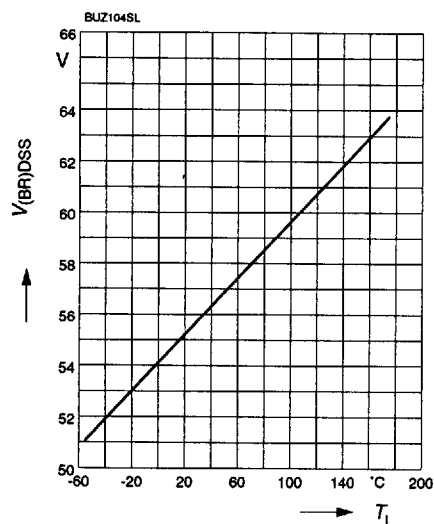
$$I_F = f(V_{SD})$$

parameter:  $T_J, t_p = 80 \mu\text{s}$



**Avalanche Energy  $E_{AS} = f(T_j)$** 

 parameter:  $I_D = 12.5\text{ A}$ ,  $V_{DD} = 25\text{ V}$ 
 $R_{GS} = 25\text{ }\Omega$ 

**Typ. gate charge**
 $V_{GS} = f(Q_{Gate})$ 

 parameter:  $I_{D\text{ puls}} = 12.5\text{ A}$ 

**Drain-source breakdown voltage**
 $V_{(BR)DSS} = f(T_j)$ 




## Gehäusemaßbilder

(Maße in mm, wenn nicht anders angegeben)

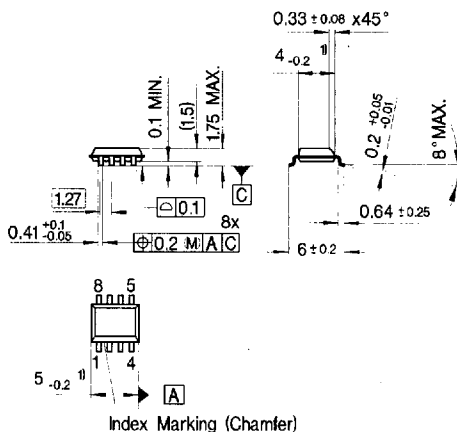
## Package Outlines

(Dimensions in mm, unless otherwise specified)

**P-DSO-8-6/-7**

Gewicht etwa 0.15 g

Approx. weight 0.15 g



1) Does not include plastic or metal protrusion of 0.15 max. per side

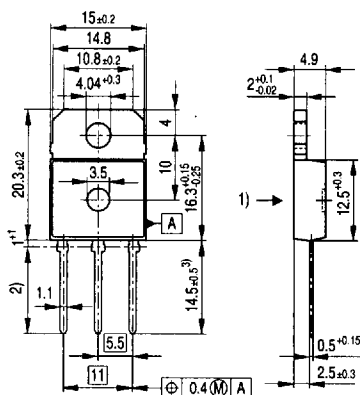
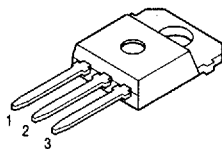
### Bild 16

### Figure 16

**P-T0218-AA (P-T0218-2-1)**

Gewicht etwa 4.9 g

Approx. weight 4.9 g



- 1) Punch direction, burr max. 0.04
- 2) Dip tinning
- 3) Max. 15.5 by dip tinning  
press burr max. 0.05  
radii not dimensioned max. 0.2

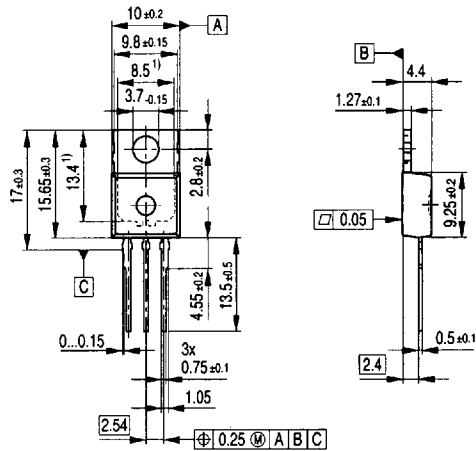
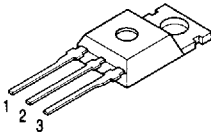
GPT05156

### Bild 17

**Figure 17**

**P-TO220-3-1**

Gewicht etwa 1.8 g  
Approx. weight 1.8 g



<sup>1)</sup> Typical

All metal surfaces tin plated, except area of cut.

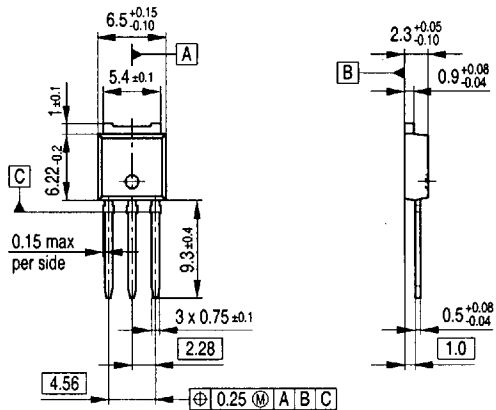
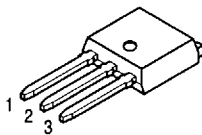
GPT05155

**Bild 18**

**Figure 18**

**P-TO251-3-1**

Gewicht etwa 2.0 g  
Approx. weight 2.0 g



All metal surfaces tin plated, except area of cut.

GPT09060

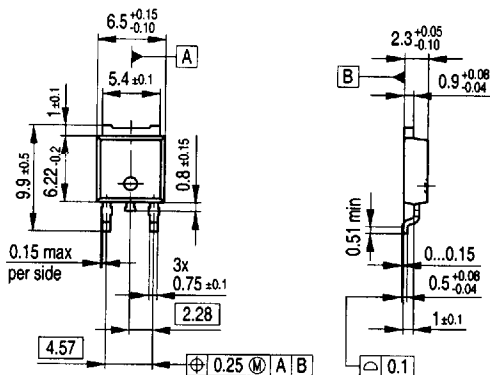
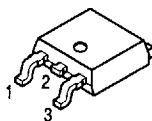
**Bild 19**

**Figure 19**

## P-TO252-3-1

Gewicht etwa 0.38 g

Approx. weight 0.38 g



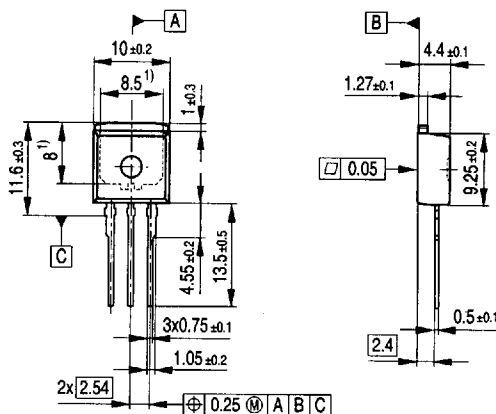
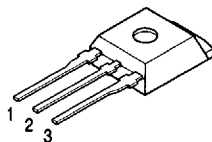
All metal surfaces tin plated, except area of cut.

GPT09051

Bild 20

Figure 20

## P-TO262-3-1/I<sup>2</sup>PAK



<sup>1)</sup> Typical

Metal surface min. X = 7.25, Y = 7.35

All metal surfaces tin plated, except area of cut.

GPT09244

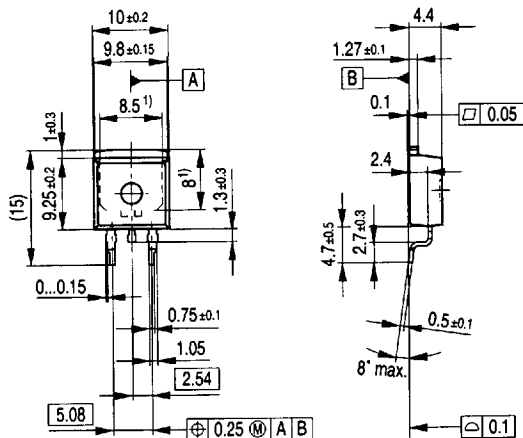
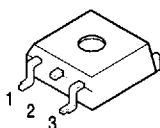
Bild 21

Figure 21

**P-TO263-3-2/D<sup>2</sup>PAK**

Gewicht etwa 1.38 g

Approx. weight 1.38 g



<sup>1)</sup> Typical

All metal surfaces tin plated, except area of cut.

GPT09085

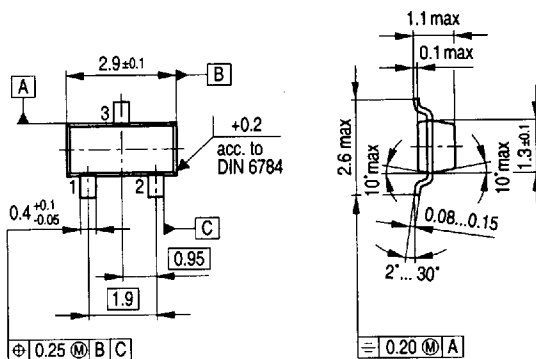
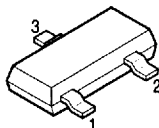
**Bild 22**

**Figure 22**

**SOT-23 (P-SOT23-3-1)**

Gewicht etwa 0.01 g

Approx. weight 0.01 g



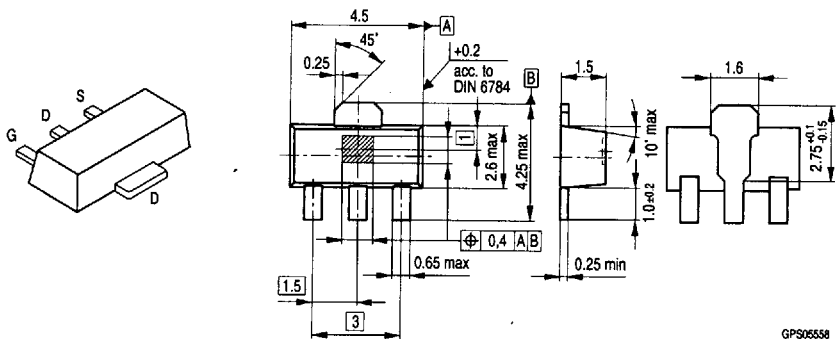
GPS05557

**Bild 23**

**Figure 23**

**SOT-89**

Gewicht etwa 0.01 g  
Approx. weight 0.01 g

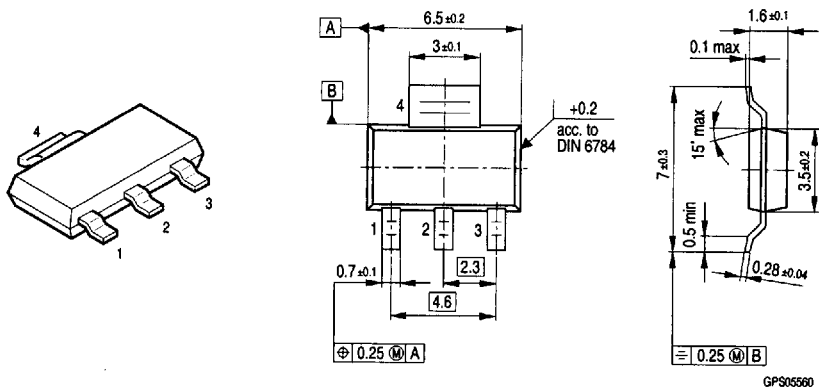


**Bild 24**

**Figure 24**

**SOT-223 (P-SOT223-4-1)**

Gewicht etwa 0.15 g  
Approx. weight 0.15 g



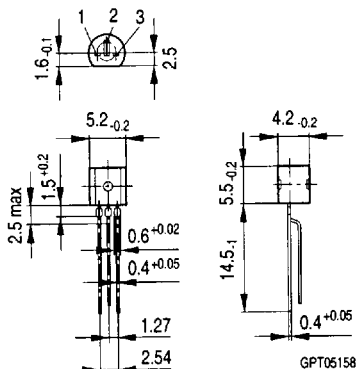
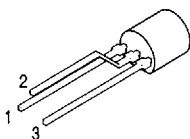
**Bild 25**

**Figure 25**

**TO-92**

Gewicht etwa 0.23 g

Approx. weight 0.23 g



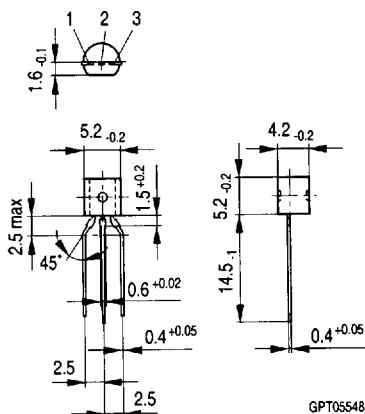
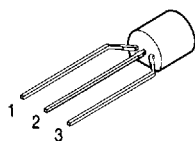
**Bild 26**

**Figure 26**

**TO-92-E6288**

Gewicht etwa 0.23 g

Approx. weight 0.23 g



**Bild 27**

**Figure 27**

**Sorts of Packing**

Package outlines for tubes, trays etc. are contained in our Data Book "Package Information".

**SMD = Surface Mounted Device**