# SILICON PLANAR EPITAXIAL TRANSISTORS

NPN silicon planar epitaxial transistors in a microminiature SMD envelope (SOT-223), primarily intended for linear and switching applications.
PNP complements are PZT2907/2907A.

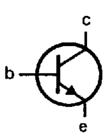
## QUICK REFERENCE DATA

| | | | PZT2222 | PZT2222A | |
|---|---|---|---|---|---|
| Collector-emitter voltage (open base) | $V_{CEO}$ | max. | 30 | 40 | V |
| Collector-base voltage (open emitter) | $V_{CBO}$ | max. | 60 | 75 | V |
| Collector current (DC) | $I_C$ | max. | 600 | | mA |
| Total power dissipation up to $T_{amb}$ = 25 °C * | $P_{tot}$ | max. | 1,5 | | W |
| Collector-emitter saturation voltage $I_C$ = 150 mA; $I_B$ = 15 mA | $V_{CEsat}$ | max. | 0,4 | 0,3 | V |
| DC current gain $I_C$ = 150 mA; $V_{CE}$ = 10 V | $h_{FE}$ | min. | 100 | | |
| | | max. | 300 | | |

## MECHANICAL DATA

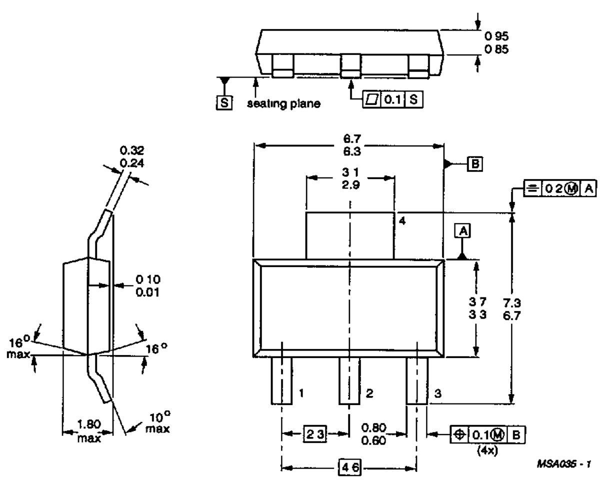
Dimensions in mm

Fig. 1 SOT-223




Pinning:

1 = base
2 = collector
3 = emitter
4 = collector



## RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

| | | | PZT2222 | PZT2222A | |
|---|---|---|---|---|---|
| Collector-emitter voltage (open base) | $V_{CEO}$ | max. | 30 | 40 | V |
| Collector-base voltage (open emitter) | $V_{CBO}$ | max. | 60 | 75 | V |
| Emitter-base voltage (open collector) | $V_{EBO}$ | max. | 5,0 | 6,0 | V |
| Collector current (DC) | $I_C$ | max. | 600 | | mA |
| Total power dissipation up to $T_{amb}$ = 25 °C * | $P_{tot}$ | max. | 1,5 | | W |
| Storage temperature range | $T_{stg}$ | | −55 to +150 | | °C |
| Junction temperature | $T_j$ | max. | 150 | | °C |

## THERMAL RESISTANCE

| | | | | |
|---|---|---|---|---|
| From junction to ambient in free air * | $R_{th\ j\text{-}a}$ | = | 83,3 | K/W |

## CHARACTERISTICS

$T_j$ = 25 °C unless otherwise specified

| | | | PZT2222 | PZT2222A | |
|---|---|---|---|---|---|
| Collector-emitter breakdown voltage $I_B = 0$; $I_C$ = 10 mA | $V_{(BR)CEO}$ | min. | 30 | 40 | V |
| Collector-base breakdown voltage $I_E = 0$; $I_C$ = 10 μA | $V_{(BR)CBO}$ | min. | 60 | 75 | V |
| Emitter-base breakdown voltage $I_E$ = 10 μA; $I_C = 0$ | $V_{(BR)EBO}$ | min. | 5,0 | 6,0 | V |
| Base cut-off current $V_{CE}$ = 60 V; $-V_{BE}$ = 3 V | $I_{BEX}$ | max. | – | 20 | nA |
| Collector cut-off current $V_{CE}$ = 60 V; $-V_{BE}$ = 3 V | $I_{CEX}$ | r ax. | – | 10 | nA |
| Emitter cut-off current $I_C = 0$; $V_{EB}$ = 3 V | $I_{EBO}$ | max. | – | 10 | nA |
| Collector cut-off current | | | | | |
| $I_E = 0$; $V_{CB}$ = 50 V | $I_{CBO}$ | max. | 10 | – | nA |
| $I_E = 0$; $V_{CB}$ = 60 V | $I_{CBO}$ | max. | – | 10 | nA |
| $I_E = 0$; $V_{CB}$ = 50 V; $T_{amb}$ = 125 °C | $I_{CBO}$ | max. | 10 | – | μA |
| $I_E = 0$; $V_{CB}$ = 60 V; $T_{amb}$ = 125 °C | $I_{CBO}$ | max. | – | 10 | μA |

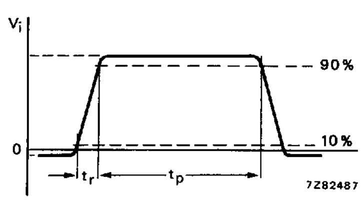
* Device mounted on an epoxy printed circuit board 40 mm x 40 mm x 1,5 mm; mounting pad for the collector lead min. 6 $cm^2$.

# PZT2222
# PZT2222A

<table>
<tr><th></th><th></th><th></th><th>PZT2222</th><th>PZT2222A</th><th></th></tr>
<tr><td>DC current gain</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 0,1 mA; $V_{CE}$ = 10 V</td><td>$h_{FE}$</td><td>min.</td><td colspan="2">35</td><td></td></tr>
<tr><td>$I_C$ = 1 mA; $V_{CE}$ = 10 V</td><td>$h_{FE}$</td><td>min.</td><td colspan="2">50</td><td></td></tr>
<tr><td>$I_C$ = 10 mA; $V_{CE}$ = 10 V</td><td>$h_{FE}$</td><td>min.</td><td colspan="2">75</td><td></td></tr>
<tr><td>$I_C$ = 10 mA; $V_{CE}$ = 10 V; $T_{amb}$ = −55 °C</td><td>$h_{FE}$</td><td>min.</td><td>–</td><td>35</td><td></td></tr>
<tr><td>$I_C$ = 150 mA; $V_{CE}$ = 10 V</td><td>$h_{FE}$</td><td>min.<br>max.</td><td colspan="2">100<br>300</td><td></td></tr>
<tr><td>$I_C$ = 150 mA; $V_{CE}$ = 1 V</td><td>$h_{FE}$</td><td>min.</td><td colspan="2">50</td><td></td></tr>
<tr><td>$I_C$ = 500 mA; $V_{CE}$ = 10 V</td><td>$h_{FE}$</td><td>min.</td><td>30</td><td>40</td><td></td></tr>
<tr><td>Saturation voltages</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 150 mA; $I_B$ = 15 mA</td><td>$V_{CEsat}$</td><td>max.</td><td>0,4</td><td>0,3</td><td>V</td></tr>
<tr><td>$I_C$ = 500 mA; $I_B$ = 50 mA</td><td>$V_{CEsat}$</td><td>min.</td><td>1,6</td><td>1,0</td><td>V</td></tr>
<tr><td>$I_C$ = 150 mA; $I_B$ = 15 mA</td><td>$V_{BEsat}$</td><td>max.</td><td>1,3</td><td>–</td><td>V</td></tr>
<tr><td>$I_C$ = 150 mA; $I_B$ = 15 mA</td><td>$V_{BEsat}$</td><td>min.<br>max.</td><td></td><td>0,6<br>1,2</td><td>V<br>V</td></tr>
<tr><td>$I_C$ = 500 mA; $I_B$ = 50 mA</td><td>$V_{BEsat}$</td><td>max.</td><td>2,6</td><td>2,0</td><td>V</td></tr>
<tr><td>Transition frequency at f = 100 MHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 20 mA; $V_{CE}$ = 20 V; $T_{amb}$ = 25 °C</td><td>$f_T$</td><td>min.</td><td>250</td><td>300</td><td>MHz</td></tr>
<tr><td>Output capacitance at f = 1 MHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_E$ = 0; $V_{CB}$ = 10 V</td><td>$C_c$</td><td>max.</td><td colspan="2">8,0</td><td>pF</td></tr>
<tr><td>Input capacitance at f = 1 MHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 0; $V_{EB}$ = 0,5 V</td><td>$C_e$</td><td>max.</td><td>30</td><td>25</td><td>pF</td></tr>
<tr><td>Input impedance at f = 1 kHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 1 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{ie}$</td><td>min.<br>max.</td><td>–<br>–</td><td>2,0<br>8,0</td><td>kΩ<br>kΩ</td></tr>
<tr><td>$I_C$ = 10 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{ie}$</td><td>min.<br>max.</td><td>–<br>–</td><td>0,25<br>1,25</td><td>kΩ<br>kΩ</td></tr>
<tr><td>Voltage feedback ratio at f = 1 kHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 1 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{re}$</td><td>max.</td><td>–</td><td>$8,0 \times 10^{-4}$</td><td></td></tr>
<tr><td>$I_C$ = 10 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{re}$</td><td>max.</td><td>–</td><td>$4,0 \times 10^{-4}$</td><td></td></tr>
<tr><td>Small-signal current gain at f = 1 kHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 1 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{fe}$</td><td>min.<br>max.</td><td>–<br>–</td><td>50<br>300</td><td></td></tr>
<tr><td>$I_C$ = 10 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{fe}$</td><td>min.<br>max.</td><td>–<br>–</td><td>75<br>375</td><td></td></tr>
<tr><td>Output admittance at f = 1 kHz</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>$I_C$ = 1 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{oe}$</td><td>min.<br>max.</td><td>–<br>–</td><td>5,0<br>35</td><td>µmhos<br>µmhos</td></tr>
<tr><td>$I_C$ = 10 mA; $V_{CE}$ = 10 V; $T_{amb}$ = 25 °C</td><td>$h_{oe}$</td><td>min.<br>max.</td><td>–<br>–</td><td>25<br>200</td><td>µmhos<br>µmhos</td></tr>
</table>

**PZT2222A**

| | | | |
|---|---|---|---|
| Noise figure at $R_S = 1$ kΩ<br>$I_C = 100\ \mu A$; $V_{CE} = 10$ V;<br>$f = 1$ kHz; $T_{amb} = 25\ ^oC$ | F | max. | 4,0 dB |
| **Switching times at $T_{amb} = 25\ ^oC$** | | | |
| Turn-on time (see Fig. 2)<br>$I_C = 150$ mA; $I_{Bon} = 15$ mA<br>$V_{CC} = 30$ V; $V_{EB(off)} = 0,5$ V | | | |
| delay time | $t_d$ | max. | 10 ns |
| rise time | $t_r$ | max. | 25 ns |
| Turn-off time (see Fig. 3)<br>$I_C = 150$ mA; $I_{Bon} = I_{Boff} = 15$ mA<br>$V_{CC} = 30$ V | | | |
| storage time | $t_s$ | max. | 225 ns |
| fall time | $t_f$ | max. | 60 ns |



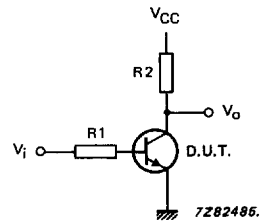
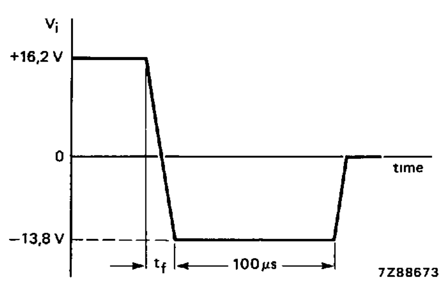




Fig. 2 Input waveform and test circuit for determining delay time and rise time.

$V_i = -0,5$ V to $+9,9$ V; $V_{CC} = +30$ V; R1 = 619 Ω; R2 = 200 Ω.

| Pulse generator: | | | | Oscilloscope: | | | |
|---|---|---|---|---|---|---|---|
| pulse duration | $t_p$ | ≤ | 200 ns | input impedance | $Z_i$ | > | 100 kΩ |
| rise time | $t_r$ | ≤ | 2 ns | input capacitance | $C_i$ | < | 12 pF |
| duty factor | δ | = | 0,02 | rise time | $t_r$ | < | 5 ns |



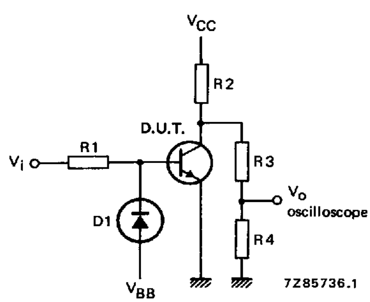




Fig. 3 Input waveform and test circuit for determining storage time and fall time.