

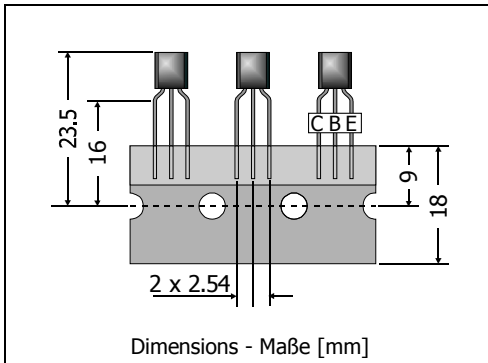
## 2N3904

**NPN**

**Si-Epitaxial-Planar Switching Transistors**  
**Si-Epitaxial-Planar Schalttransistoren**

**NPN**

Version 2010-02-09


 Power dissipation  
Verlustleistung

625 mW

 Plastic case  
Kunststoffgehäuse

 TO-92  
(10D3)

Weight approx. – Gewicht ca.

0.18 g

 Plastic material has UL classification 94V-0  
Gehäusematerial UL94V-0 klassifiziert

 Standard packaging taped in ammo pack  
Standard Lieferform gegurtet in Ammo-Pack

**Maximum ratings (T<sub>A</sub> = 25°C)**
**Grenzwerte (T<sub>A</sub> = 25°C)**

|  |        |                  | <b>2N3904</b>        |
|--|--------|------------------|----------------------|
| Collector-Emitter-volt. – Kollektor-Emitter-Spannung | B open | V <sub>CEO</sub> | 40 V                 |
| Collector-Base-voltage – Kollektor-Basis-Spannung    | E open | V <sub>CB0</sub> | 60 V                 |
| Emitter-Base-voltage – Emitter-Basis-Spannung        | C open | V <sub>EB0</sub> | 6 V                  |
| Power dissipation – Verlustleistung                  |        | P <sub>tot</sub> | 625 mW <sup>1)</sup> |
| Collector current – Kollektorstrom (dc)              |        | I <sub>C</sub>   | 200 mA               |
| Junction temperature – Sperrschichttemperatur        |        | T <sub>j</sub>   | -55...+150°C         |
| Storage temperature – Lagerungstemperatur            |        | T <sub>S</sub>   | -55...+150°C         |

**Characteristics (T<sub>j</sub> = 25°C)**
**Kennwerte (T<sub>j</sub> = 25°C)**

|  |                 | <b>Min.</b>          | <b>Typ.</b> | <b>Max.</b>        |
|--|-----------------|----------------------|-------------|--------------------|
| DC current gain – Kollektor-Basis-Stromverhältnis <sup>2)</sup>                |                 |                      |             |                    |
| I <sub>C</sub> = 0.1 mA, V <sub>CE</sub> = 1 V                                 | h <sub>FE</sub> | 4070                 | –           | –                  |
| I <sub>C</sub> = 1 mA, V <sub>CE</sub> = 1 V                                   | h <sub>FE</sub> | 100                  | –           | –                  |
| I <sub>C</sub> = 10 mA, V <sub>CE</sub> = 1 V                                  | h <sub>FE</sub> | 60                   | –           | 300                |
| I <sub>C</sub> = 50 mA, V <sub>CE</sub> = 1 V                                  | h <sub>FE</sub> | 30                   | –           | –                  |
| I <sub>C</sub> = 100 mA, V <sub>CE</sub> = 1 V                                 | h <sub>FE</sub> | –                    | –           | –                  |
| h-Parameters at/bei V <sub>CE</sub> = 10 V, - I <sub>C</sub> = 1 mA, f = 1 kHz |                 |                      |             |                    |
| Small signal current gain – Kleinsignal-Stromverstärkung                       | h <sub>fe</sub> | 100                  | –           | 400                |
| Input impedance – Eingangs-Impedanz  | h <sub>ie</sub> | 1 kΩ                 | –           | 10 kΩ              |
| Output admittance – Ausgangs-Leitwert  | h <sub>oe</sub> | 1 μS                 | –           | 40 μS              |
| Reverse voltage transfer ratio – Spannungsrückwirkung                          | h <sub>re</sub> | 0.5*10 <sup>-4</sup> | –           | 8*10 <sup>-4</sup> |

1 Mounted on P.C. board with 3 mm<sup>2</sup> copper pad at each terminal  
Montage auf Leiterplatte mit 3 mm<sup>2</sup> Kupferbelag (Löt-pad) an jedem Anschluss

2 Tested with pulses t<sub>p</sub> = 300 μs, duty cycle ≤ 2% – Gemessen mit Impulsen t<sub>p</sub> = 300 μs, Schaltverhältnis ≤ 2%

**Characteristics (T<sub>j</sub> = 25°C)****Kennwerte (T<sub>j</sub> = 25°C)**

|   |  | <b>Min.</b>      | <b>Typ.</b>             | <b>Max.</b> |
|---|--|------------------|-------------------------|-------------|
| Collector-Emitter saturation voltage – Kollektor-Sättigungsspannung <sup>2)</sup>           |  |                  |                         |             |
| I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA   | V <sub>CEsat</sub>                             | –                | –                       | 0.2 V       |
| I <sub>C</sub> = 50 mA, I <sub>B</sub> = 5 mA   | V <sub>CEsat</sub>                             | –                | –                       | 0.3 V       |
| Base-Emitter saturation voltage – Basis-Sättigungsspannung <sup>2)</sup>                    |  |                  |                         |             |
| I <sub>C</sub> = 10 mA, I <sub>B</sub> = 1 mA   | V <sub>BEsat</sub>                             | 0.65 V           | –                       | 0.65 V      |
| I <sub>C</sub> = 50 mA, I <sub>B</sub> = 5 mA   | V <sub>BEsat</sub>                             | –                | –                       | 0.95 V      |
| Collector-Base cutoff current – Kollektor-Basis-Reststrom                                   |  |                  |                         |             |
| V <sub>CE</sub> = 30 V, V <sub>EB</sub> = 3 V   | I <sub>CBX</sub>                               | –                | –                       | 50 nA       |
| Emitter-Base cutoff current – Emitter-Basis-Reststrom                                       |  |                  |                         |             |
| - V <sub>CE</sub> = 30 V, - V <sub>EB</sub> = 3 V   | I <sub>EBV</sub>                               | –                | –                       | 50 nA       |
| Gain-Bandwidth Product – Transitfrequenz  |  |                  |                         |             |
| I <sub>C</sub> = 10 mA, V <sub>CE</sub> = 20 V, f = 100 MHz                                 | f <sub>T</sub>                                 | 300 MHz          | –                       | –           |
| Collector-Base Capacitance – Kollektor-Basis-Kapazität                                      |  |                  |                         |             |
| V <sub>CB</sub> = 5 V, I <sub>E</sub> = i <sub>e</sub> = 0, f = 1 MHz                       | C <sub>CB0</sub>                               | –                | –                       | 4 pF        |
| Emitter-Base Capacitance – Emitter-Basis-Kapazität  |  |                  |                         |             |
| V <sub>EB</sub> = 0.5 V, I <sub>C</sub> = i <sub>c</sub> = 0, f = 1 MHz                     | C <sub>EBO</sub>                               | –                | –                       | 8 pF        |
| Noise figure – Rauschzahl   |  |                  |                         |             |
| V <sub>CE</sub> = 5 V, I <sub>C</sub> = 1 μA, R <sub>G</sub> = 1 kΩ, f = 1 kHz              | F  | –                | –                       | 5 dB        |
| Switching times – Schaltzeiten (between 10% and 90% levels)                                 |  |                  |                         |             |
| delay time  | V <sub>CC</sub> = 3 V, V <sub>BE</sub> = 0.5 V | t <sub>d</sub>   | –                       | –           |
| rise time   | I <sub>C</sub> = 10 mA, I <sub>B1</sub> = 1 mA | t <sub>r</sub>   | –                       | –           |
| storage time  | V <sub>CC</sub> = 3 V, I <sub>C</sub> = 10 mA, | t <sub>s</sub>   | –                       | –           |
| fall time   | I <sub>B1</sub> = I <sub>B2</sub> = 1 mA       | t <sub>f</sub>   | –                       | –           |
| Thermal resistance junction to ambient air<br>Wärmewiderstand Sperrschicht – umgebende Luft |  | R <sub>thA</sub> | < 200 K/W <sup>1)</sup> |             |
| Recommended complementary PNP transistors<br>Empfohlene komplementäre PNP-Transistoren      |  | 2N3906           |                         |             |

<sup>2)</sup> Tested with pulses t<sub>p</sub> = 300 μs, duty cycle ≤ 2% – Gemessen mit Impulsen t<sub>p</sub> = 300 μs, Schaltverhältnis ≤ 2%

<sup>1)</sup> Mounted on P.C. board with 3 mm<sup>2</sup> copper pad at each terminal  
Montage auf Leiterplatte mit 3 mm<sup>2</sup> Kupferbelag (Löt-pad) an jedem Anschluss