



DONGGUAN NANJING ELECTRONICS LTD.,

## TO-92 Plastic-Encapsulate Transistors

### 2N3904 TRANSISTOR (NPN)

#### FEATURE

- NPN silicon epitaxial planar transistor for switching and Amplifier applications
- As complementary type, the PNP transistor 2N3906 is Recommended
- This transistor is also available in the SOT-23 case with the type designation MMBT3904

#### MAXIMUM RATINGS ( $T_a=25^{\circ}\text{C}$ unless otherwise noted)

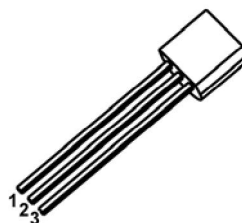
| Symbol    | Parameter                     | Value   | Unit               |
|-----------|-------------------------------|---------|--------------------|
| $V_{CBO}$ | Collector-Base Voltage        | 60      | V                  |
| $V_{CEO}$ | Collector-Emitter Voltage     | 40      | V                  |
| $V_{EBO}$ | Emitter-Base Voltage          | 6       | V                  |
| $I_C$     | Collector Current -Continuous | 0.2     | A                  |
| $P_C$     | Collector Power Dissipation   | 0.625   | W                  |
| $T_J$     | Junction Temperature          | 150     | $^{\circ}\text{C}$ |
| $T_{stg}$ | Storage Temperature           | -55-150 | $^{\circ}\text{C}$ |

#### TO-92

1. EMITTER

2. BASE

3. COLLECTOR



#### ELECTRICAL CHARACTERISTICS ( $T_a=25^{\circ}\text{C}$ unless otherwise specified)

| Parameter                            | Symbol        | Test conditions                                                                        | Min | Typ | Max  | Unit          |
|--------------------------------------|---------------|----------------------------------------------------------------------------------------|-----|-----|------|---------------|
| Collector-base breakdown voltage     | $V_{(BR)CBO}$ | $I_C=10\mu\text{A}$ , $I_E=0$                                                          | 60  |     |      | V             |
| Collector-emitter breakdown voltage  | $V_{(BR)CEO}$ | $I_C=1\text{mA}$ , $I_B=0$                                                             | 40  |     |      | V             |
| Emitter-base breakdown voltage       | $V_{(BR)EBO}$ | $I_E=10\mu\text{A}$ , $I_C=0$                                                          | 6   |     |      | V             |
| Collector cut-off current            | $I_{CBO}$     | $V_{CB}=60\text{V}$ , $I_E=0$                                                          |     |     | 0.1  | $\mu\text{A}$ |
| Collector cut-off current            | $I_{CEO}$     | $V_{CE}=40\text{V}$ , $I_B=0$                                                          |     |     | 0.1  | $\mu\text{A}$ |
| Emitter cut-off current              | $I_{EBO}$     | $V_{EB}=5\text{V}$ , $I_C=0$                                                           |     |     | 0.1  | $\mu\text{A}$ |
| DC current gain                      | $h_{FE1}$     | $V_{CE}=1\text{V}$ , $I_C=10\text{mA}$                                                 | 100 |     | 400  |               |
|                                      | $h_{FE2}$     | $V_{CE}=1\text{V}$ , $I_C=50\text{mA}$                                                 | 60  |     |      |               |
|                                      | $h_{FE3}$     | $V_{CE}=1\text{V}$ , $I_C=100\text{mA}$                                                | 30  |     |      |               |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $I_C=50\text{mA}$ , $I_B=5\text{mA}$                                                   |     |     | 0.3  | V             |
| Base-emitter saturation voltage      | $V_{BE(sat)}$ | $I_C=50\text{mA}$ , $I_B=5\text{mA}$                                                   |     |     | 0.95 | V             |
| Transition frequency                 | $f_T$         | $V_{CE}=20\text{V}$ , $I_C=10\text{mA}$ , $f=100\text{MHz}$                            | 300 |     |      | $\text{MHz}$  |
| Delay Time                           | $t_d$         | $V_{CC}=3\text{V}$ , $V_{BE}=0.5\text{V}$ ,<br>$I_C=10\text{mA}$ , $I_{B1}=1\text{mA}$ |     |     | 35   | ns            |
| Rise Time                            | $t_r$         |                                                                                        |     |     | 35   | ns            |
| Storage Time                         | $t_s$         | $V_{CC}=3\text{V}$ , $I_C=10\text{mA}$                                                 |     |     | 200  | ns            |
| Fall Time                            | $t_f$         | $I_{B1}=I_{B2}=1\text{mA}$                                                             |     |     | 50   | ns            |

#### CLASSIFICATION OF $h_{FE1}$

| Rank  | O       | Y       | G       |
|-------|---------|---------|---------|
| Range | 100-200 | 200-300 | 300-400 |

# Typical Characteristics

# 2N3904

