# 2N3904

## SMALL SIGNAL NPN TRANSISTOR

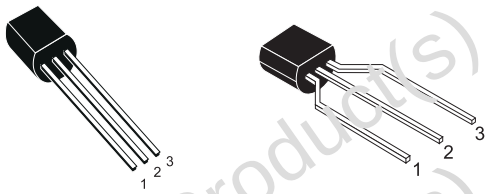
**PRELIMINARY DATA**

| Ordering Code | Marking | Package / Shipment |
|---|---|---|
| 2N3904 | 2N3904 | TO-92 / Bulk |
| 2N3904-AP | 2N3904 | TO-92 / Ammopack |

- SILICON EPITAXIAL PLANAR NPN TRANSISTOR
- TO-92 PACKAGE SUITABLE FOR THROUGH-HOLE PCB ASSEMBLY
- THE PNP COMPLEMENTARY TYPE IS 2N3906

**APPLICATIONS**

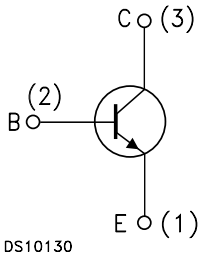
- WELL SUITABLE FOR TV AND HOME APPLIANCE EQUIPMENT
- SMALL LOAD SWITCH TRANSISTOR WITH HIGH GAIN AND LOW SATURATION VOLTAGE




**TO-92**
**Bulk**

**TO-92**
**Ammopack**

**INTERNAL SCHEMATIC DIAGRAM**




DS10130



**ABSOLUTE MAXIMUM RATINGS**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{CBO}$ | Collector-Base Voltage ($I_E$ = 0) | 60 | V |
| $V_{CEO}$ | Collector-Emitter Voltage ($I_B$ = 0) | 40 | V |
| $V_{EBO}$ | Emitter-Base Voltage ($I_C$ = 0) | 6 | V |
| $I_C$ | Collector Current | 200 | mA |
| $P_{tot}$ | Total Dissipation at $T_C$ = 25 $^oC$ | 625 | mW |
| $T_{stg}$ | Storage Temperature | -65 to 150 | $^oC$ |
| $T_j$ | Max. Operating Junction Temperature | 150 | $^oC$ |

## THERMAL DATA

| | | | | |
|---|---|---|---|---|
| $R_{thj\text{-}amb}$ • | Thermal Resistance Junction-Ambient | Max | 200 | °C/W |
| $R_{thj\text{-}case}$ • | Thermal Resistance Junction-Case | Max | 83.3 | °C/W |

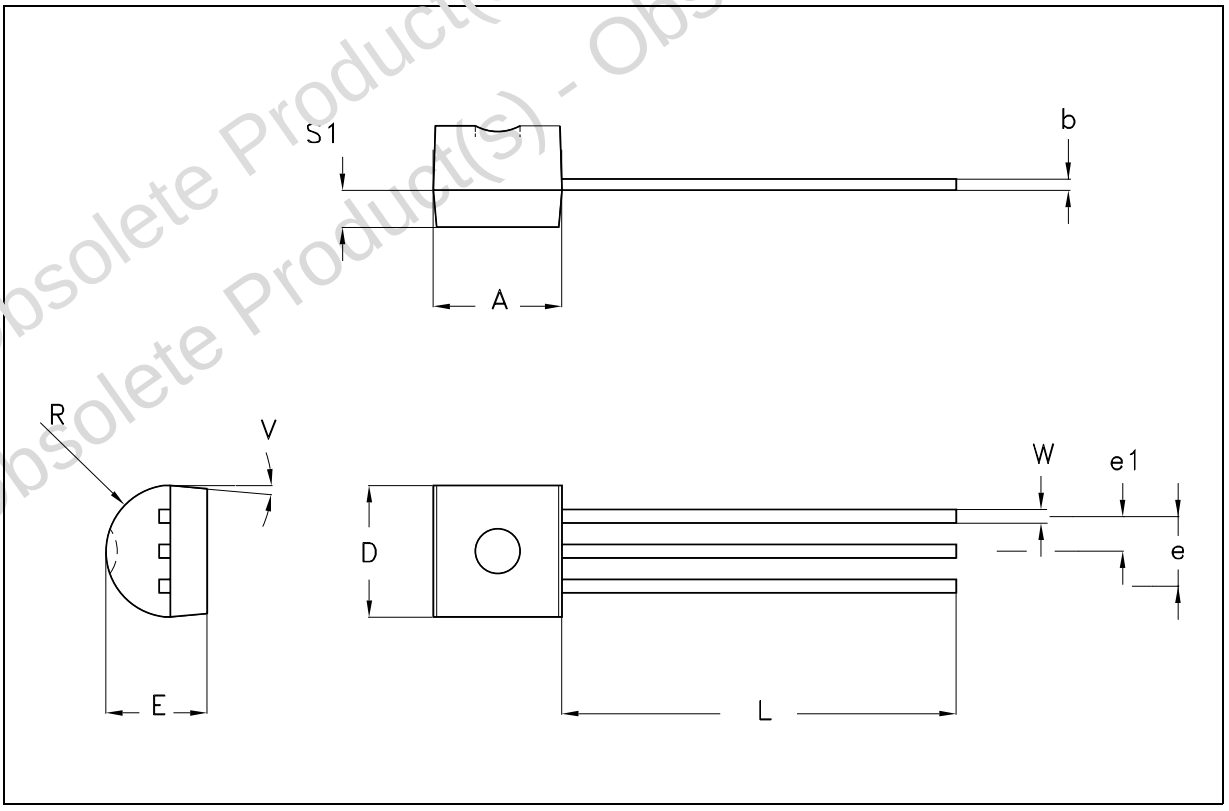
## ELECTRICAL CHARACTERISTICS ($T_{case}$ = 25 °C unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{CEX}$ | Collector Cut-off Current ($V_{BE}$ = -3 V) | $V_{CE}$ = 30 V | | | 50 | nA |
| $I_{BEX}$ | Base Cut-off Current ($V_{BE}$ = -3 V) | $V_{CE}$ = 30 V | | | 50 | nA |
| $V_{(BR)CEO}$* | Collector-Emitter Breakdown Voltage ($I_B$ = 0) | $I_C$ = 1 mA | 40 | | | V |
| $V_{(BR)CBO}$ | Collector-Base Breakdown Voltage ($I_E$ = 0) | $I_C$ = 10 µA | 60 | | | V |
| $V_{(BR)EBO}$ | Emitter-Base Breakdown Voltage ($I_C$ = 0) | $I_E$ = 10 µA | 6 | | | V |
| $V_{CE(sat)}$* | Collector-Emitter Saturation Voltage | $I_C$ = 10 mA $I_B$ = 1 mA<br>$I_C$ = 50 mA $I_B$ = 5 mA | | | 0.2<br>0.2 | V<br>V |
| $V_{BE(sat)}$* | Base-Emitter Saturation Voltage | $I_C$ = 10 mA $I_B$ = 1 mA<br>$I_C$ = 50 mA $I_B$ = 5 mA | <br>0.65 | | 0.85<br>0.95 | V<br>V |
| $h_{FE}$* | DC Current Gain | $I_C$ = 0.1 mA $V_{CE}$ = 1 V<br>$I_C$ = 1 mA $V_{CE}$ = 1 V<br>$I_C$ = 10 mA $V_{CE}$ = 1 V<br>$I_C$ = 50 mA $V_{CE}$ = 1 V<br>$I_C$ = 100 mA $V_{CE}$ = 1 V | 60<br>80<br>100<br>60<br>30 | | 300 | |
| $f_T$ | Transition Frequency | $I_C$ = 10 mA $V_{CE}$ = 20 V f = 100 MHz | 250 | 270 | | MHz |
| $C_{CBO}$ | Collector-Base Capacitance | $I_E$ = 0 $V_{CB}$ = 10 V f = 1 MHz | | 4 | | pF |
| $C_{EBO}$ | Emitter-Base Capacitance | $I_C$ = 0 $V_{EB}$ = 0.5 V f = 1 MHz | | 18 | | pF |
| NF | Noise Figure | $V_{CE}$ = 5 V $I_C$ = 0.1 mA f = 10 Hz to 15.7 KHz $R_G$ = 1 KΩ | | 5 | | dB |
| $t_d$<br>$t_r$ | Delay Time<br>Rise Time | $I_C$ = 10 mA $I_B$ = 1 mA<br>$V_{CC}$ = 30 V | | | 35<br>35 | ns<br>ns |
| $t_s$<br>$t_f$ | Storage Time<br>Fall Time | $I_C$ = 10 mA $I_{B1}$ = -$I_{B2}$ = 1 mA<br>$V_{CC}$ = 30 V | | | 200<br>50 | ns<br>ns |

* Pulsed: Pulse duration = 300 µs, duty cycle ≤ 2 %

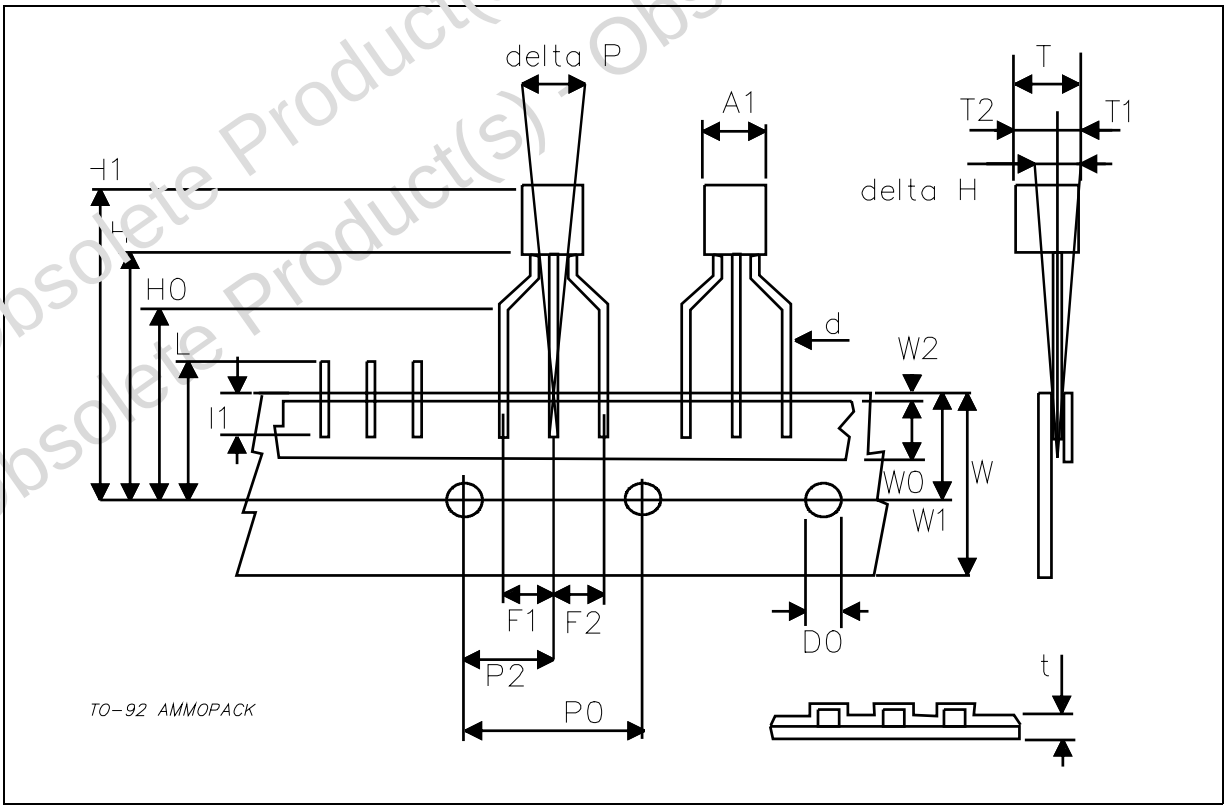
## TO-92 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 4.32 | | 4.95 | 0.170 | | 0.195 |
| b | 0.36 | | 0.51 | 0.014 | | 0.020 |
| D | 4.45 | | 4.95 | 0.175 | | 0.194 |
| E | 3.30 | | 3.94 | 0.130 | | 0.155 |
| e | 2.41 | | 2.67 | 0.095 | | 0.105 |
| e1 | 1.14 | | 1.40 | 0.045 | | 0.055 |
| L | 12.70 | | 15.49 | 0.500 | | 0.609 |
| R | 2.16 | | 2.41 | 0.085 | | 0.094 |
| S1 | 1.14 | | 1.52 | 0.045 | | 0.059 |
| W | 0.41 | | 0.56 | 0.016 | | 0.022 |
| V | 4 degree | | 6 degree | 4 degree | | 6 degree |



## TO-92 AMMOPACK SHIPMENT (Suffix"-AP") MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A1 | | | 4.80 | | | 0.189 |
| T | | | 3.80 | | | 0.150 |
| T1 | | | 1.60 | | | 0.063 |
| T2 | | | 2.30 | | | 0.091 |
| d | | | 0.48 | | | 0.019 |
| P0 | 12.50 | 12.70 | 12.90 | 0.492 | 0.500 | 0.508 |
| P2 | 5.65 | 6.35 | 7.05 | 0.222 | 0.250 | 0.278 |
| F1,F2 | 2.44 | 2.54 | 2.94 | 0.096 | 0.100 | 0.116 |
| delta H | -2.00 | | 2.00 | -0.079 | | 0.079 |
| W | 17.50 | 18.00 | 19.00 | 0.689 | 0.709 | 0.748 |
| W0 | 5.70 | 6.00 | 6.30 | 0.224 | 0.236 | 0.248 |
| W1 | 8.50 | 9.00 | 9.25 | 0.335 | 0.354 | 0.364 |
| W2 | | | 0.50 | | | 0.020 |
| H | 18.50 | | 20.50 | 0.728 | | 0.807 |
| H0 | 15.50 | 16.00 | 16.50 | 0.610 | 0.630 | 0.650 |
| H1 | | | 25.00 | | | 0.984 |
| D0 | 3.80 | 4.00 | 4.20 | 0.150 | 0.157 | 0.165 |
| t | | | 0.90 | | | 0.035 |
| L | | | 11.00 | | | 0.433 |
| l1 | 3.00 | | | 0.118 | | |
| delta P | -1.00 | | 1.00 | -0.039 | | 0.039 |



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