Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!


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# 2N3904

## SMALL SIGNAL NPN TRANSISTOR

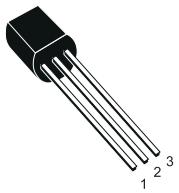
**PRELIMINARY DATA**

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

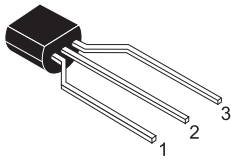
- SILICON EPITAXIAL PLANAR NPN TRANSISTOR
- TO-92 PACKAGE SUITABLE FOR THROUGH-HOLE PCB ASSEMBLY
- THE PNP COMPLEMENTARY TYPE IS 2N3906

**APPLICATIONS**

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

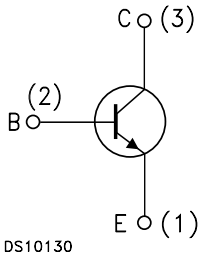



**TO-92**
**Bulk**




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

**INTERNAL SCHEMATIC DIAGRAM**




**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 °C | 625 | mW |
| $T_{stg}$ | Storage Temperature | -65 to 150 | °C |
| $T_j$ | Max. Operating Junction Temperature | 150 | °C |

## 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 |

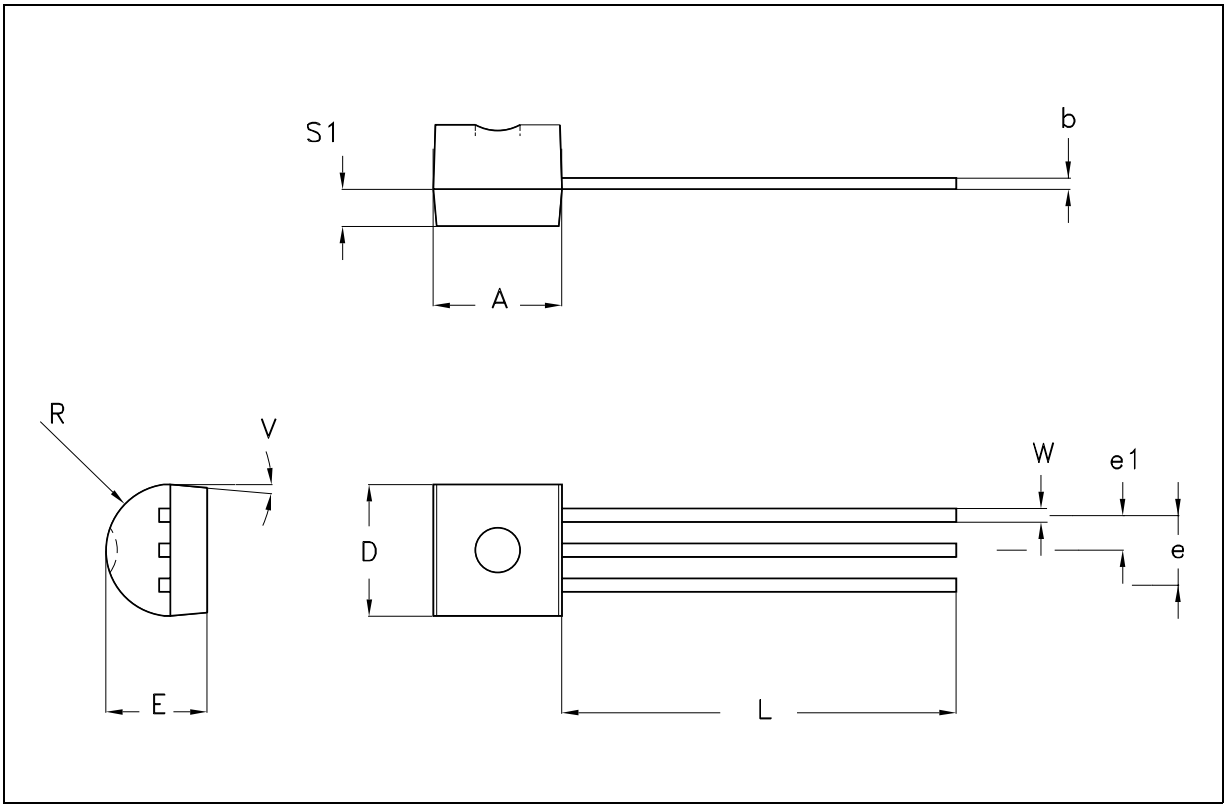
## ELECTRICAL CHARACTERISTICS ($T_{case}$ = 25 °C unless otherwise specified)

| 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 | | <br><br>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 |
| I1 | 3.00 | | | 0.118 | | |
| delta P | -1.00 | | 1.00 | -0.039 | | 0.039 |