



2N3904

SMALL SIGNAL NPN TRANSISTOR

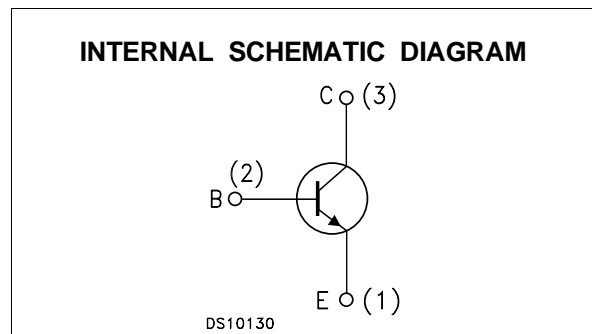
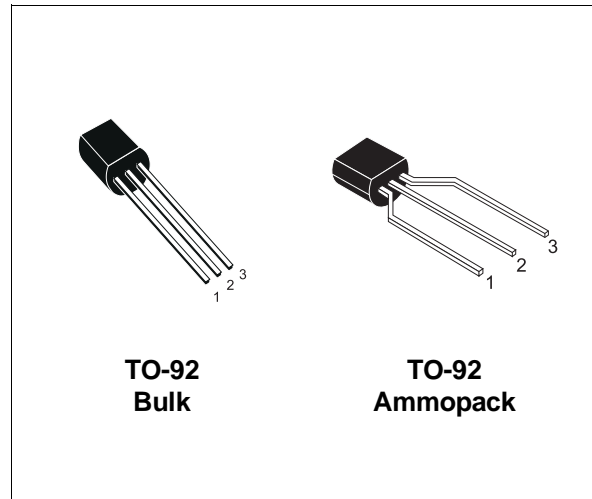
PRELIMINARY DATA

| 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



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 $T_C = 25\text{ }^\circ\text{C}$ | 625 | mW |
| T_{stg} | Storage Temperature | -65 to 150 | $^\circ\text{C}$ |
| T_j | Max. Operating Junction Temperature | 150 | $^\circ\text{C}$ |

THERMAL DATA

| | | | | |
|-------------------------|-------------------------------------|-----|------|------|
| R _{thj-amb} • | Thermal Resistance Junction-Ambient | Max | 200 | °C/W |
| R _{thj-case} • | Thermal Resistance Junction-Case | Max | 83.3 | °C/W |

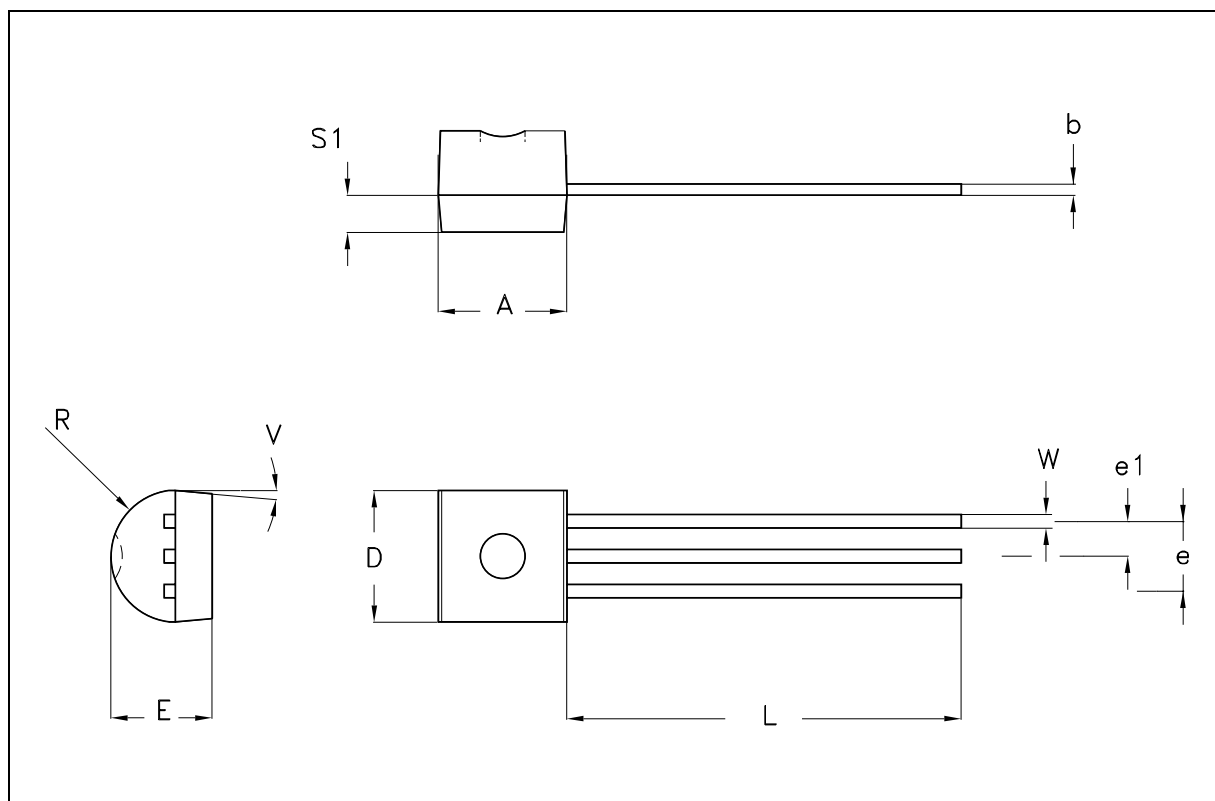
ELECTRICAL CHARACTERISTICS (T_{case} = 25 °C unless otherwise specified)

| 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 I _C = 50 mA I _B = 5 mA | | | 0.2 0.2 | V V |
| V _{BE(sat)*} | Base-Emitter Saturation Voltage | I _C = 10 mA I _B = 1 mA I _C = 50 mA I _B = 5 mA | 0.65 | | 0.85 0.95 | V V |
| h _{FE*} | DC Current Gain | I _C = 0.1 mA V _{CE} = 1 V I _C = 1 mA V _{CE} = 1 V I _C = 10 mA V _{CE} = 1 V I _C = 50 mA V _{CE} = 1 V I _C = 100 mA V _{CE} = 1 V | 60 80 100 60 30 | | 300 | |
| f _T | Transition Frequency | I _C = 10 mA V _{CE} = 20 V f = 100 MHz | 250 | 270 | | MHz |
| C _{CB0} | 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 | Delay Time | I _C = 10 mA I _B = 1 mA | | | 35 | ns |
| t _r | Rise Time | V _{CC} = 30 V | | | 35 | ns |
| t _s | Storage Time | I _C = 10 mA I _{B1} = -I _{B2} = 1 mA | | | 200 | ns |
| t _f | Fall Time | V _{CC} = 30 V | | | 50 | ns |

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

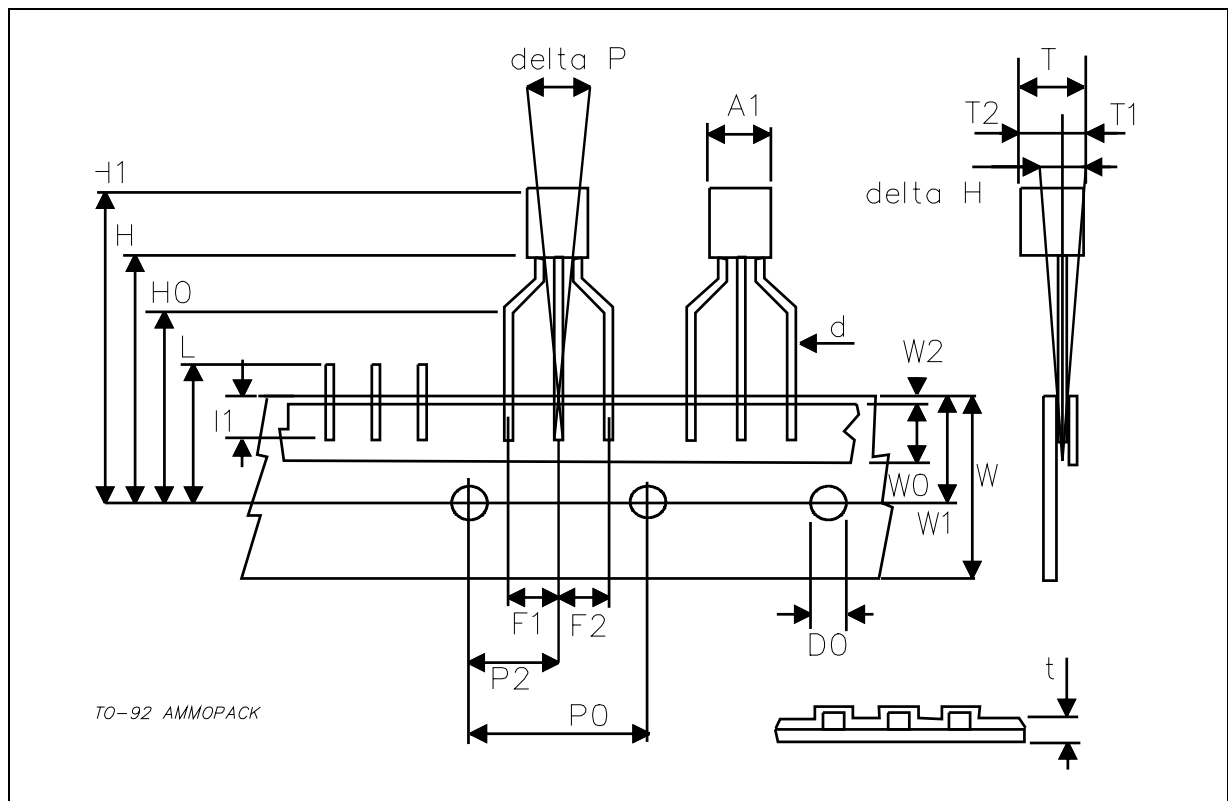
TO-92 MECHANICAL DATA

| 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 |



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