



2N3904

## SMALL SIGNAL NPN TRANSISTOR

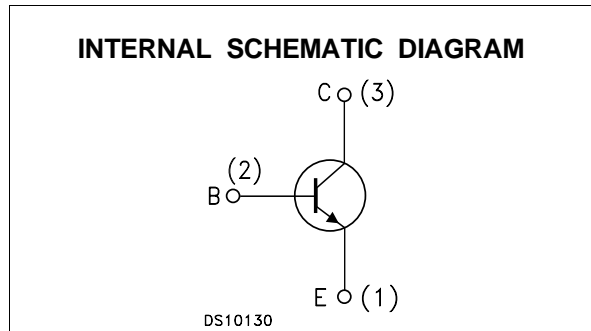
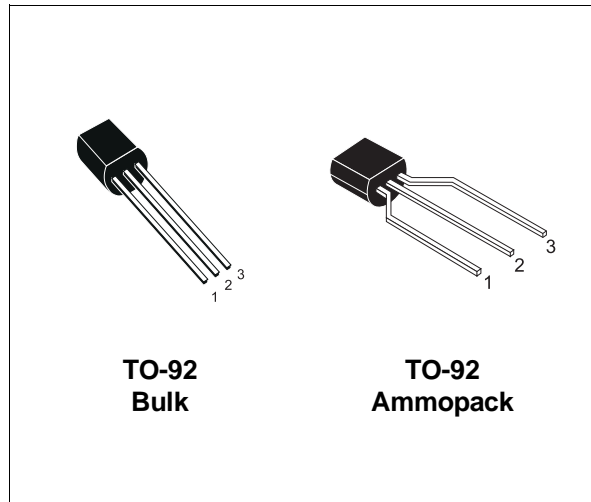
PRELIMINARY DATA

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 <sub>thj-amb</sub> •	Thermal Resistance Junction-Ambient	Max	200	°C/W
R <sub>thj-case</sub> •	Thermal Resistance Junction-Case	Max	83.3	°C/W

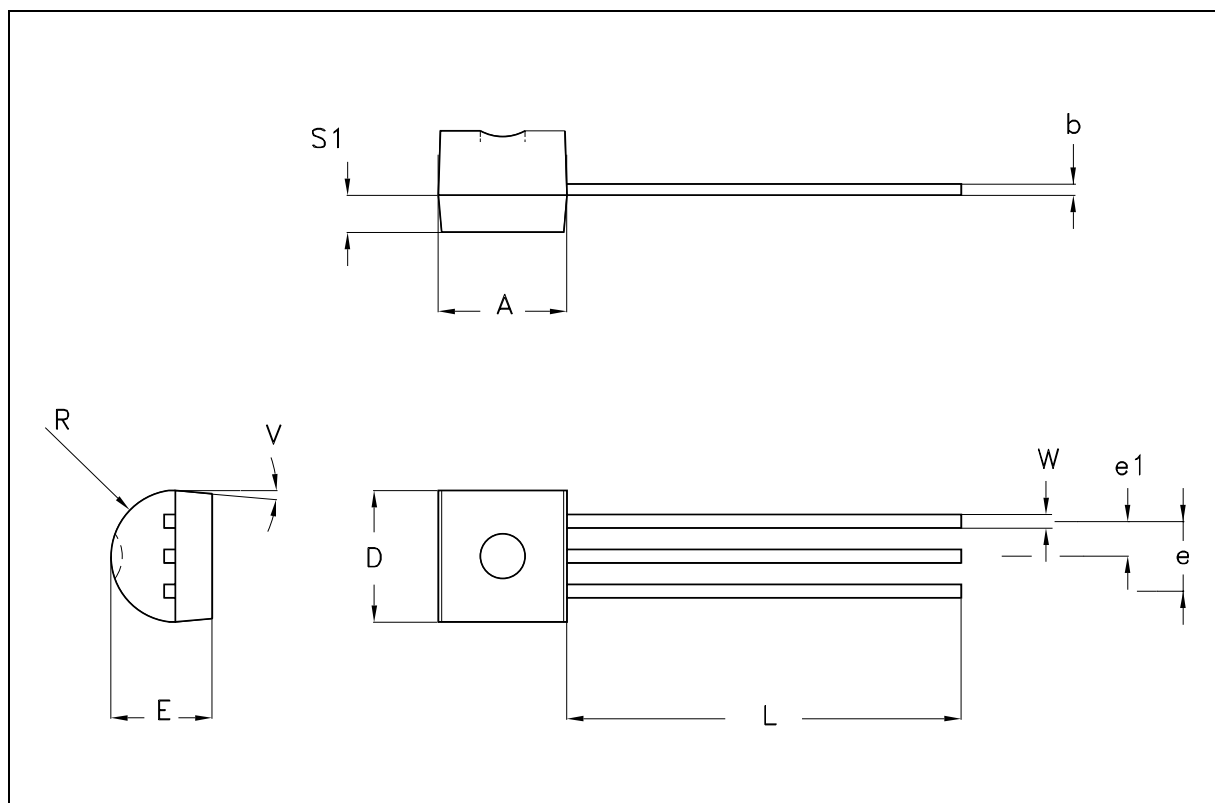
ELECTRICAL CHARACTERISTICS (T<sub>case</sub> = 25 °C unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I <sub>CEX</sub>	Collector Cut-off Current (V <sub>BE</sub> = -3 V)	V <sub>CE</sub> = 30 V			50	nA
I <sub>BEX</sub>	Base Cut-off Current (V <sub>BE</sub> = -3 V)	V <sub>CE</sub> = 30 V			50	nA
V <sub>(BR)CEO*</sub>	Collector-Emitter Breakdown Voltage (I <sub>B</sub> = 0)	I <sub>C</sub> = 1 mA	40			V
V <sub>(BR)CBO</sub>	Collector-Base Breakdown Voltage (I <sub>E</sub> = 0)	I <sub>C</sub> = 10 μA	60			V
V <sub>(BR)EBO</sub>	Emitter-Base Breakdown Voltage (I <sub>C</sub> = 0)	I <sub>E</sub> = 10 μA	6			V
V <sub>CE(sat)*</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> = 10 mA    I <sub>B</sub> = 1 mA I <sub>C</sub> = 50 mA    I <sub>B</sub> = 5 mA			0.2 0.2	V V
V <sub>BE(sat)*</sub>	Base-Emitter Saturation Voltage	I <sub>C</sub> = 10 mA    I <sub>B</sub> = 1 mA I <sub>C</sub> = 50 mA    I <sub>B</sub> = 5 mA	0.65		0.85 0.95	V V
h <sub>FE*</sub>	DC Current Gain	I <sub>C</sub> = 0.1 mA    V <sub>CE</sub> = 1 V I <sub>C</sub> = 1 mA       V <sub>CE</sub> = 1 V I <sub>C</sub> = 10 mA      V <sub>CE</sub> = 1 V I <sub>C</sub> = 50 mA      V <sub>CE</sub> = 1 V I <sub>C</sub> = 100 mA     V <sub>CE</sub> = 1 V	60 80 100 60 30		300	
f <sub>T</sub>	Transition Frequency	I <sub>C</sub> = 10 mA    V <sub>CE</sub> = 20 V    f = 100 MHz	250	270		MHz
C <sub>CB0</sub>	Collector-Base Capacitance	I <sub>E</sub> = 0    V <sub>CB</sub> = 10 V    f = 1 MHz		4		pF
C <sub>EBO</sub>	Emitter-Base Capacitance	I <sub>C</sub> = 0    V <sub>EB</sub> = 0.5 V    f = 1 MHz		18		pF
NF	Noise Figure	V <sub>CE</sub> = 5 V    I <sub>C</sub> = 0.1 mA    f = 10 Hz to 15.7 KHz    R <sub>G</sub> = 1 KΩ		5		dB
t <sub>d</sub>	Delay Time	I <sub>C</sub> = 10 mA    I <sub>B</sub> = 1 mA			35	ns
t <sub>r</sub>	Rise Time	V <sub>CC</sub> = 30 V			35	ns
t <sub>s</sub>	Storage Time	I <sub>C</sub> = 10 mA    I <sub>B1</sub> = -I <sub>B2</sub> = 1 mA			200	ns
t <sub>f</sub>	Fall Time	V <sub>CC</sub> = 30 V			50	ns

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

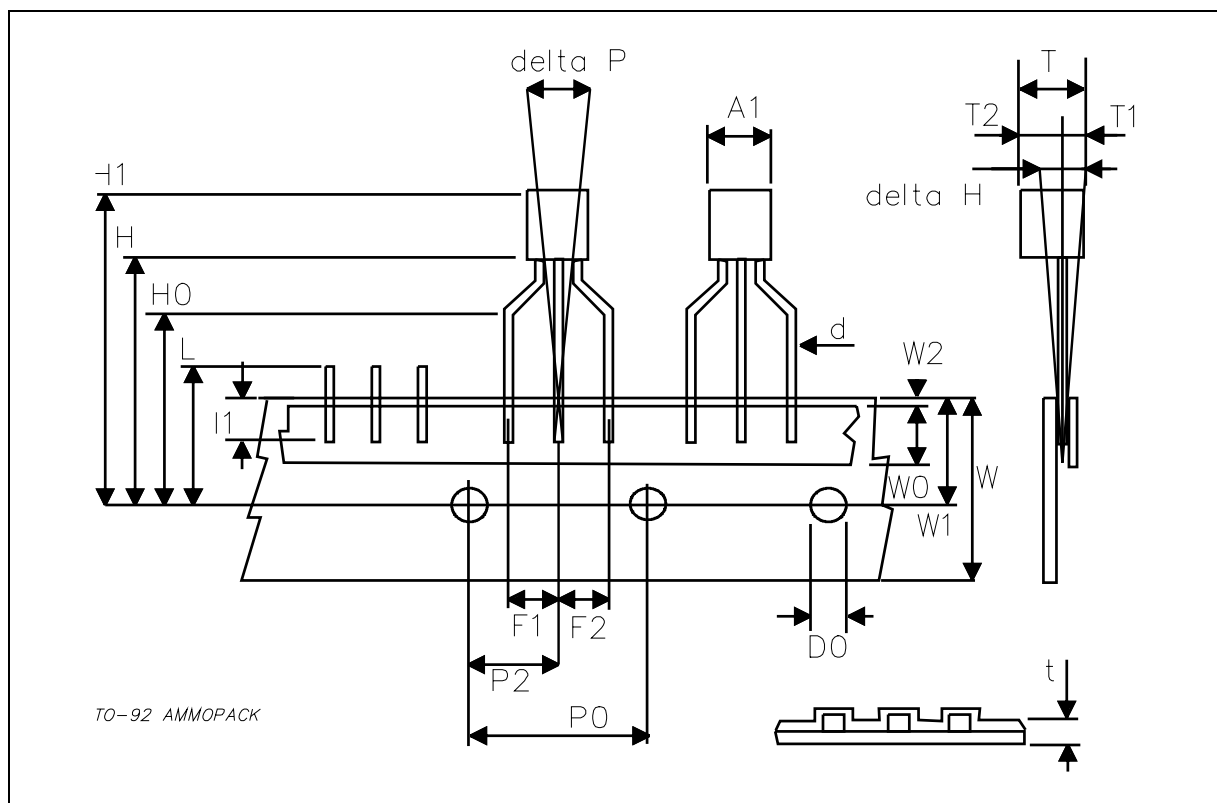
## TO-92 MECHANICAL DATA

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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