



2N3904

## SMALL SIGNAL NPN TRANSISTOR

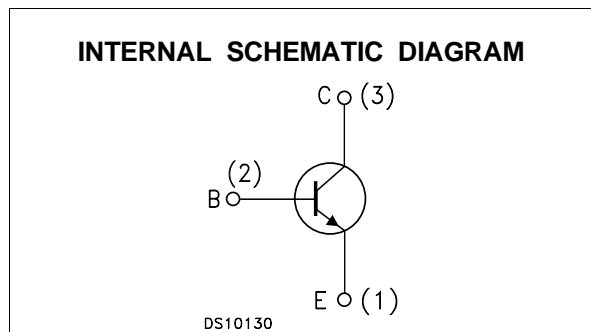
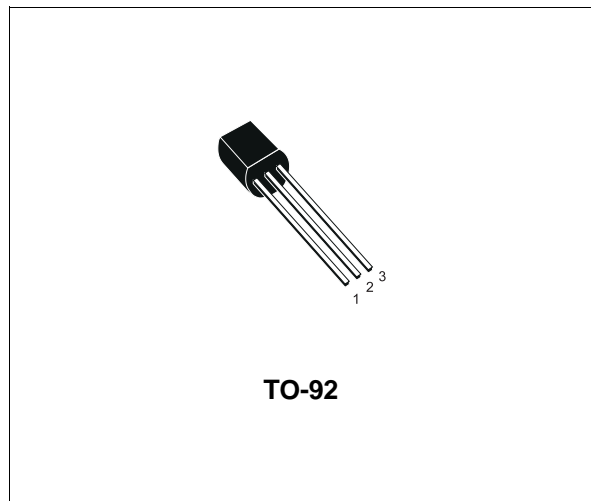
PRELIMINARY DATA

Type	Marking
2N3904	2N3904

- 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 $T_C = 25^\circ\text{C}$	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	$^{\circ}\text{C/W}$
$R_{thj-case}$	Thermal Resistance Junction-Case	Max	83.3	$^{\circ}\text{C/W}$

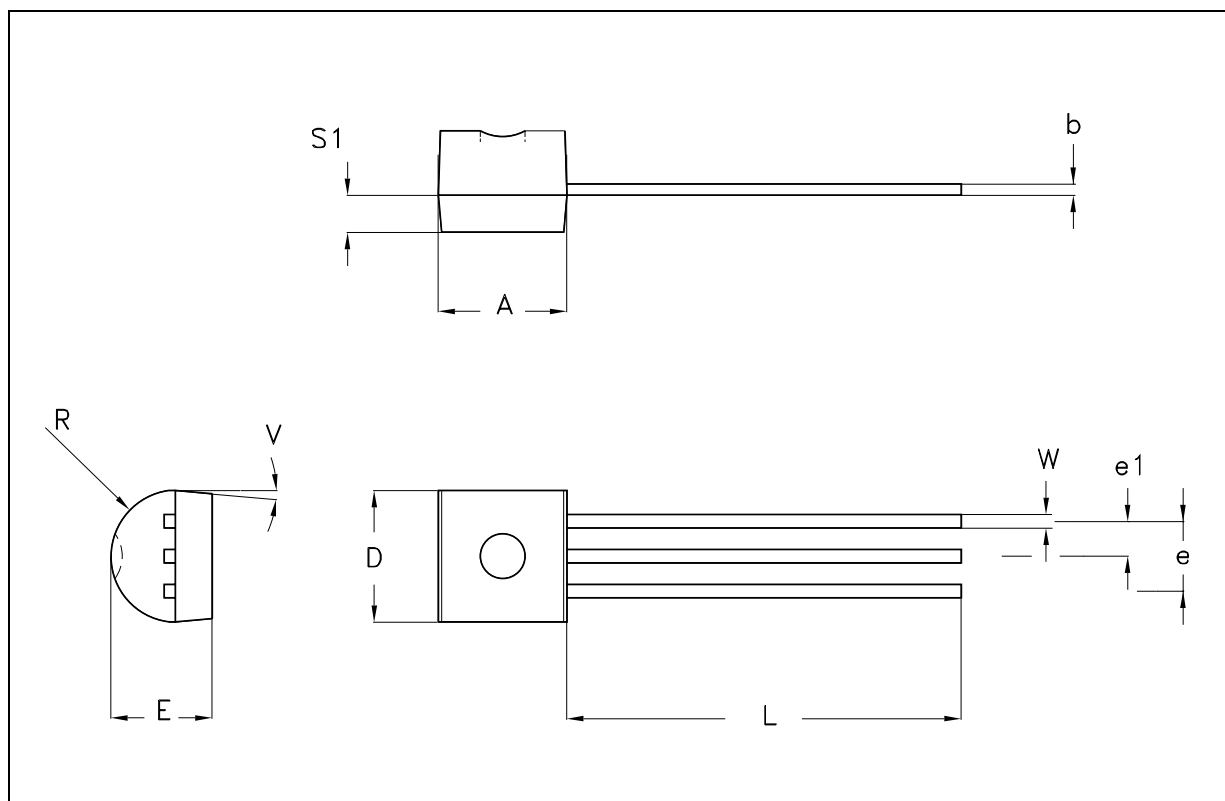
ELECTRICAL CHARACTERISTICS ( $T_{case} = 25^{\circ}\text{C}$  unless otherwise specified)

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

\* Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle  $\leq 2\%$

## 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



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