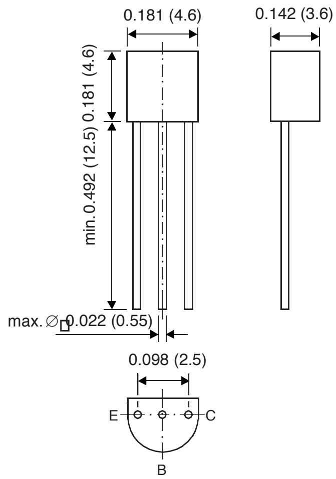
2N3904

SMALL SIGNAL TRANSISTORS (NPN)

TO-92



Dimensions in inches and (millimeters)

FEATURES

- NPN Silicon Epitaxial Planar Transistor for switching and amplifier applications.
- As complementary type, the PNP transistor 2N3906 is recommended.
- On special request, this transistor is also manufactured in the pin configuration TO-18.
- This transistor is also available in the SOT-23 case with the type designation MMBT3904.

MECHANICAL DATA

Case: TO-92 Plastic Package
Weight: approx. 0.18g

MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

Ratings at 25°C ambient temperature unless otherwise specified

	SYMBOL	VALUE	UNIT
Collector-Base Voltage	V_{CBO}	60	V
Collector-Emitter Voltage	V_{CEO}	40	V
Emitter-Base Voltage	V_{EBO}	6.0	V
Collector Current	I_C	200	mA
Power Dissipation at T_A = 25°C at T_C = 25°C	P_{tot}	625 1.5	mW W
Thermal Resistance Junction to Ambient Air	$R_{\theta JA}$	250[1]	°C/W
Junction Temperature	T_j	150	°C
Storage Temperature Range	T_S	– 65 to +150	°C

NOTES:
(1) Valid provided that leads are kept at ambient temperature.

GENERAL SEMICONDUCTOR®

2N3904

ELECTRICAL CHARACTERISTICS

Ratings at 25°C ambient temperature unless otherwise specified

	SYMBOL	MIN.	MAX.	UNIT
Collector-Base Breakdown Voltage at I_C = 10 μA, I_E = 0	$V_{(BR)CBO}$	60	–	V
Collector-Emitter Breakdown Voltage at I_C = 1 mA, I_B = 0	$V_{(BR)CEO}$	40	–	V
Emitter-Base Breakdown Voltage at I_E = 10 μA, I_C = 0	$V_{(BR)EBO}$	6	–	V
Collector Saturation Voltage at I_C = 10 mA, I_B = 1 mA at I_C = 50 mA, I_B = 5 mA	 V_{CEsat} V_{CEsat}	 – –	 0.2 0.3	 V V
Base Saturation Voltage at I_C = 10 mA, I_B = 1 mA at I_C = 50 mA, I_B = 5 mA	 V_{BEsat} V_{BEsat}	 – –	 0.85 0.95	 V V
Collector-Emitter Cutoff Current V_{EB} = 3 V, V_{CE} = 30 V	I_{CEV}	–	50	nA
Emitter-Base Cutoff Current V_{EB} = 3 V, V_{CE} = 30 V	I_{EBV}	–	50	nA
DC Current Gain at V_{CE} = 1 V, I_C = 0.1 mA at V_{CE} = 1 V, I_C = 1 mA at V_{CE} = 1 V, I_C = 10 mA at V_{CE} = 1 V, I_C = 50 mA at V_{CE} = 1 V, I_C = 100 mA	 h_{FE} h_{FE} h_{FE} h_{FE} h_{FE}	 40 70 100 60 30	 – – 300 – –	 – – – – –
Input Impedance at V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{ie}	1	10	kΩ
Voltage Feedback Ratio at V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{re}	$0.5 \cdot 10^{-4}$	$8 \cdot 10^{-4}$	–
Gain-Bandwidth Product at V_{CE} = 20 V, I_C = 10 mA, f = 100 MHz	f_T	300	–	MHz
Collector-Base Capacitance at V_{CB} = 5 V, f = 100 kHz	C_{CBO}	–	4	pF
Emitter-Base Capacitance at V_{EB} = 0.5 V, f = 100 kHz	C_{EBO}	–	8	pF

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ELECTRICAL CHARACTERISTICS

Ratings at 25°C ambient temperature unless otherwise specified

	SYMBOL	MIN.	MAX.	UNIT
Small Signal Current Gain at V_{CE} = 10 V, I_C = 1 mA, f = 1 kHz	h_{fe}	100	400	–
Output Admittance at V_{CE} = 1 V, I_C = 1 mA, f = 1 kHz	h_{oe}	1	40	µS
Noise Figure at V_{CE} = 5 V, I_C = 100 µA, R_G = 1 kΩ, f = 10 … 15000 Hz	NF	–	5	dB
Delay Time (see Fig. 1) at I_{B1} = 1 mA, I_C = 10 mA	t_d	–	35	ns
Rise Time (see Fig. 1) at I_{B1} = 1 mA, I_C = 10 mA	t_r	–	35	ns
Storage Time (see Fig. 2) at $–I_{B1}$ = I_{B2} = 1 mA, I_C = 10 mA	t_s	–	200	ns
Fall Time (see Fig. 2) at $–I_{B1}$ = I_{B2} = 1 mA, I_C = 10 mA	t_f	–	50	ns

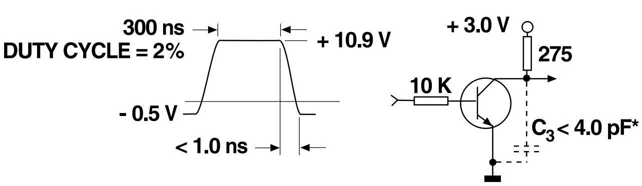

Fig. 1: Test circuit for delay and rise time
* total shunt capacitance of test jig and connectors

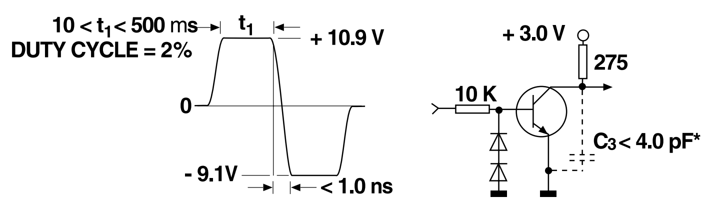

Fig. 2: Test circuit for storage and fall time
* total shunt capacitance of test jig and connectors