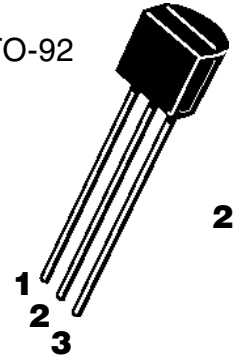
Semiconductor *Data Sheet*

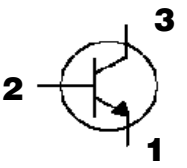
NPN General Purpose Transistors

2N3903, 2N3904

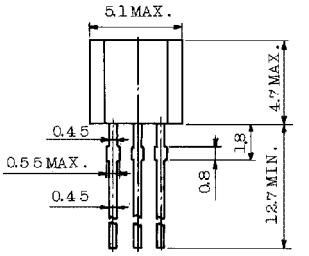
Description

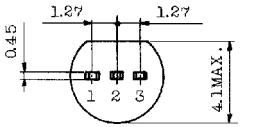
TO-92





Mechanical Dimensions





Maximum Ratings

Ratings	Symbol	Value	Units
Collector - Emitter Voltage	V_{CEO}	40	Vdc
Collector - Base Voltage	V_{CBO}	60	Vdc
Emitter - Base Voltage	V_{EBO}	6.0	Vdc
Collector Current (Continuous)	I_C	200	mAdc

Thermal Characteristics

Characteristic	Symbol	Max	Units
Total Device Dissipation @ T_A = 25°C Derate above 25°C	P_D	625 5.0	mW mW/°C
Total Device Dissipation @ T_C = 25°C Derate above 25°C	P_D	1.5 12	W mW/°C
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	°C/W
Junction and Storage Temperature	T_J, T_{STG}	-55 to 150	°C

Electrical Characteristics @ 25°C

Off Characteristic	Symbol	Min	Max	Unit
Collector - Emitter Breakdown Voltage (Note 1) (I_C = 1.0mAdc, I_B = 0)	$V_{BR(CEO)}$	40	---	Vdc
Collector - Base Breakdown Voltage (I_C = 10μAdc, I_E = 0)	$V_{BR(CBO)}$	60	---	Vdc
Emitter - Base Breakdown Voltage (I_E = 10μAdc, I_C = 0)	$V_{BR(EBO)}$	6.0	---	Vdc
Base Cutoff Current (V_{CE} = 30Vdc, V_{EB} = 3.0Vdc)	I_{BL}	---	50	nAdc
Collector Cutoff Current (V_{CE} = 30Vdc, V_{EB} = 3.0Vdc)	I_{CEX}	---	50	nAdc

Notes:
(1) Pulse test: Pulse width ≤ 300 μs, duty cycle ≤ 2.0%.

Semiconductor *Data Sheet*

2N3903, 2N3904 NPN General Purpose Transistors

Electrical Characteristics @ 25°C

			Symbol	Min	Max	Unit
On Characteristic						
DC Current Gain			H_{FE}			---
(I_C = 0.1 mAdc, V_{CE} = 1.0 Vdc)	2N3903			20	---	
	2N3904			40	---	
(I_C = 1.0 mAdc, V_{CE} = 1.0 Vdc)	2N3903			35	---	
	2N3904			70	---	
(I_C = 10 mAdc, V_{CE} = 1.0 Vdc)	2N3903			50	150	
	2N3904			100	300	
(I_C = 50 mAdc, V_{CE} = 1.0 Vdc)	2N3903			30	---	
	2N3904			60	---	
(I_C = 100 mAdc, V_{CE} = 1.0 Vdc)	2N3903			15	---	
	2N3904			30	---	
Collector - Emitter Saturation Voltage (Note 1)			$V_{CE(sat)}$			Vdc
(I_C = 10 mAdc, I_B = 1.0 mAdc)				---	0.2	
(I_C = 50 mAdc, I_B = 5.0 mAdc)				---	0.3	
Base - Emitter Saturation Voltage (Note 1)			$V_{BE(sat)}$			Vdc
(I_C = 10 mAdc, I_B = 1.0 mAdc)				0.65	0.85	
(I_C = 50 mAdc, I_B = 5.0 mAdc)				---	0.95	
Small-Signal Characteristic						
Current - Gain - Bandwidth Product	2N3903		f_T	250	---	MHz
(I_C = 10 mAdc, V_{CE} = 20 Vdc, f = 100 MHz)	2N3904			300	---	
Output Capacitance			C_{obo}	---	4.0	pF
(V_{CB} = 5.0 Vdc, I_E = 0, f = 1.0 MHz)						
Input Capacitance			C_{ibo}	---	8.0	pF
(V_{EB} = 0.5 Vdc, I_C = 0, f = 1.0 MHz)						
Input Impedance	2N3903		h_{ie}	1.0	8.0	kΩ
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	2N3904			1.0	10	
Voltage Feedback Ratio	2N3903		h_{re}	0.1	5.0	$x10^{-4}$
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	2N3904			0.5	8.0	
Small - Signal Current Gain	2N3903		h_{fe}	50	200	---
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)	2N3904			100	400	
Output Admittance			h_{oe}	1.0	40	μmhos
(V_{CE} = 10 Vdc, I_C = 1.0 mAdc, f = 1.0 kHz)						
Noise Figure			NF			dB
(V_{CE} = 5.0 Vdc, I_C = 100 μAdc,	2N3903			---	6.0	
R_S = 1.0 kΩ, f = 1.0 kHz)	2N3904			---	5.0	
Switching Characteristic						
Delay Time	(V_{CC} = 3.0 Vdc, V_{BE} = 0.5 Vdc,		t_d	---	35	ns
Rise Time	I_C = 10 mAdc, I_{B1} = 1.0 mAdc)		t_r	---	35	
Storage Time	(V_{CC} = 3.0 Vdc, I_C = 10 mAdc,	2N3903	t_s	---	175	ns
	I_{B1} = I_{B2} = 1.0 mAdc)	2N3904		---	200	
Fall Time			t_f	---	50	ns