

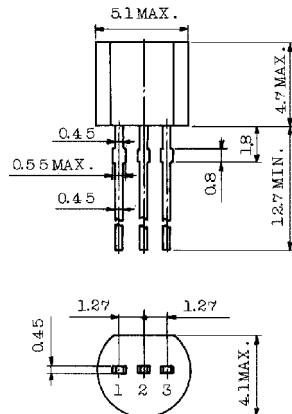
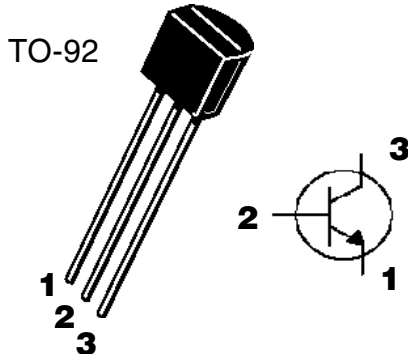


Description

NPN General Purpose Transistors

Mechanical Dimensions

2N3903, 2N3904



Maximum Ratings

Ratings	Symbol	Value	Units
Collector - Emitter Voltage	$V_{CE0}$	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 @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.5 12	W mW/ $^\circ\text{C}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$
Junction and Storage Temperature	$T_J, T_{STG}$	-55 to 150	$^\circ\text{C}$

Electrical Characteristics @  $25^\circ\text{C}$

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

Notes:

(1) Pulse test: Pulse width  $\leq 300 \mu\text{s}$ , duty cycle  $\leq 2.0\%$ .

# 2N3903, 2N3904 NPN General Purpose Transistors

## Electrical Characteristics @ 25°C

On Characteristic		Symbol	Min	Max	Unit
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	k $\Omega$
( $V_{CE} = 10$ Vdc, $I_C = 1.0$ mAdc, $f = 1.0$ kHz)	2N3904		1.0	10	
Voltage Feedback Ratio	2N3903	$h_{re}$	0.1	5.0	$\times 10^{-4}$
( $V_{CE} = 10$ 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	$\mu$ mhos
( $V_{CE} = 10$ Vdc, $I_C = 1.0$ mAdc, $f = 1.0$ kHz)					
Noise Figure		NF			dB
( $V_{CE} = 5.0$ Vdc, $I_C = 100$ $\mu$ Adc,	2N3903		---	6.0	
$R_S = 1.0$ k $\Omega$ , $f = 1.0$ 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,	$t_s$	---	175	ns
	$I_{B1} = I_{B2} = 1.0$ mAdc)		---	200	
Fall Time		$t_f$	---	50	ns