

New Jersey Semi-Conductor Products, Inc.

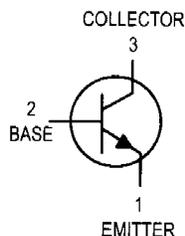
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## General Purpose Transistor

### NPN Silicon

# MPS3904



TO-92

#### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
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	$I_C$	100	mAdc
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 Power Dissipation @ $T_A = 60^\circ\text{C}$	$P_D$	450	mW
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	1.5 12	Watts mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J, T_{stg}$	-55 to +150	$^\circ\text{C}$

#### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	200	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	83.3	$^\circ\text{C}/\text{W}$

#### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
Collector-Emitter Breakdown Voltage <sup>(1)</sup> ( $I_C = 1.0 \text{ mAdc}, I_B = 0$ )	$V_{(BR)CEO}$	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
Collector Cutoff Current ( $V_{CE} = 30 \text{ Vdc}, V_{EB(off)} = 3.0 \text{ Vdc}$ )	$I_{CEX}$	—	50	nAdc
Base Cutoff Current ( $V_{CE} = 30 \text{ Vdc}, V_{EB(off)} = 3.0 \text{ Vdc}$ )	$I_{BL}$	—	50	nAdc

1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

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Quality Semi-Conductors

**MPS3904**

**ELECTRICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$  unless otherwise noted) (Continued)

Characteristic	Symbol	Min	Max	Unit
<b>ON CHARACTERISTICS(1)</b>				
DC Current Gain ( $I_C = 0.1 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 1.0 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 10 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 50 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 100 \text{ mA}$ , $V_{CE} = 1.0 \text{ Vdc}$ )	$h_{FE}$	40 70 100 60 30	— — 300 — —	—
Collector–Emitter Saturation Voltage ( $I_C = 10 \text{ mA}$ , $I_B = 1.0 \text{ mA}$ ) ( $I_C = 50 \text{ mA}$ , $I_B = 5.0 \text{ mA}$ )	$V_{CE(sat)}$	— —	0.2 0.3	Vdc
Base–Emitter Saturation Voltage ( $I_C = 10 \text{ mA}$ , $I_B = 1.0 \text{ mA}$ ) ( $I_C = 50 \text{ mA}$ , $I_B = 5.0 \text{ mA}$ )	$V_{BE(sat)}$	0.65 —	0.85 1.1	Vdc

**SMALL-SIGNAL CHARACTERISTICS**

Current–Gain — Bandwidth Product ( $I_C = 10 \text{ mA}$ , $V_{CE} = 20 \text{ Vdc}$ , $f = 100 \text{ MHz}$ )	$f_T$	200	—	MHz
Output Capacitance ( $V_{CB} = 5.0 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{obo}$	—	4.0	pF
Input Capacitance ( $V_{EB} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{ibo}$	—	8.0	pF
Input Impedance ( $I_C = 1.0 \text{ mA}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{ie}$	1.0	10	k $\Omega$
Voltage Feedback Ratio ( $I_C = 1.0 \text{ mA}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{re}$	0.5	8.0	$\times 10^{-4}$
Small-Signal Current Gain ( $I_C = 1.0 \text{ mA}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{fe}$	100	400	—
Output Admittance ( $I_C = 1.0 \text{ mA}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{oe}$	1.0	40	$\mu\text{mhos}$
Noise Figure ( $I_C = 100 \mu\text{A}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $R_S = 1.0 \text{ k}\Omega$ , $f = 1.0 \text{ kHz}$ )	NF	—	5.0	dB

**SWITCHING CHARACTERISTICS**

Delay Time	$(V_{CC} = 3.0 \text{ Vdc}$ , $V_{BE(off)} = -0.5 \text{ Vdc}$ , $I_C = 10 \text{ mA}$ , $I_{B1} = 1.0 \text{ mA}$ )	$t_d$	—	35	ns
Rise Time		$t_r$	—	50	ns
Storage Time	$(V_{CC} = 3.0 \text{ Vdc}$ , $I_C = 10 \text{ mA}$ , $I_{B1} = I_{B2} = 1.0 \text{ mA}$ )	$t_s$	—	900	ns
Fall Time		$t_f$	—	90	ns

1. Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

**EQUIVALENT SWITCHING TIME TEST CIRCUITS**

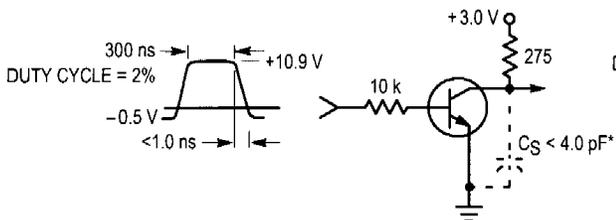


Figure 1. Turn–On Time

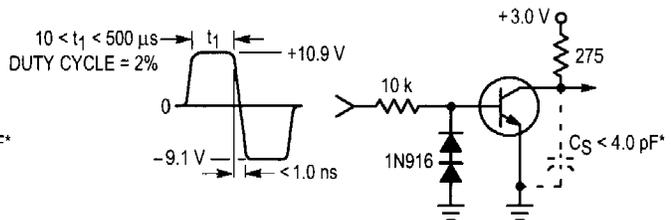


Figure 2. Turn–Off Time

\*Total shunt capacitance of test jig and connectors