

# DATA SHEET



## **MPS3904** NPN switching transistor

Product specification  
Supersedes data of 1997 Mar 03

1999 Apr 12

# NPN switching transistor

# MPS3904

## FEATURES

- Low current (max. 100 mA)
- Low voltage (max. 40 V).

## APPLICATIONS

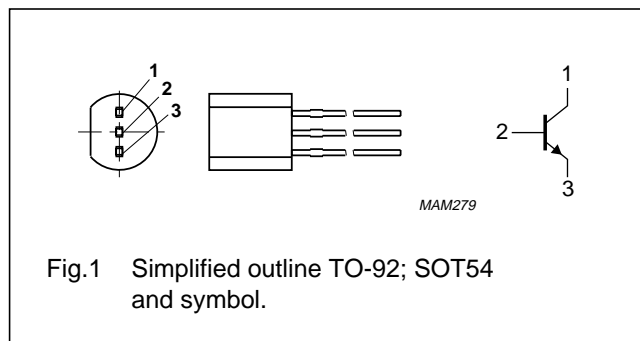
- General purpose switching and amplification.

## DESCRIPTION

NPN transistor in a TO-92; SOT54 plastic package.  
PNP complement: MPS3906.

## PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter



## LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CBO}$	collector-base voltage	open emitter	–	60	V
$V_{CEO}$	collector-emitter voltage	open base	–	40	V
$V_{EBO}$	emitter-base voltage	open collector	–	6	V
$I_C$	collector current (DC)		–	100	mA
$I_{CM}$	peak collector current		–	200	mA
$I_{BM}$	peak base current		–	200	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ }^\circ\text{C}$	–	500	mW
$T_{stg}$	storage temperature		–65	+150	$^\circ\text{C}$
$T_j$	junction temperature		–	150	$^\circ\text{C}$
$T_{amb}$	operating ambient temperature		–65	+150	$^\circ\text{C}$

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## THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j-a}$	thermal resistance from junction to ambient	note 1	250	K/W

## Note

1. Transistor mounted on an FR4 printed-circuit board.

## CHARACTERISTICS

$T_{amb} = 25\text{ °C}$  unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$I_{CBO}$	collector cut-off current	$I_E = 0$ ; $V_{CB} = 30\text{ V}$	–	50	nA
$I_{EBO}$	emitter cut-off current	$I_C = 0$ ; $V_{EB} = 5\text{ V}$	–	50	nA
$h_{FE}$	DC current gain	$V_{CE} = 1\text{ V}$ ; note 1 $I_C = 0.1\text{ mA}$ $I_C = 1\text{ mA}$ $I_C = 10\text{ mA}$ $I_C = 50\text{ mA}$ $I_C = 100\text{ mA}$	40 70 100 60 30	– – 300 – –	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = 10\text{ mA}$ ; $I_B = 1\text{ mA}$ ; note 1	–	200	mV
		$I_C = 50\text{ mA}$ ; $I_B = 5\text{ mA}$ ; note 1	–	300	mV
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 10\text{ mA}$ ; $I_B = 1\text{ mA}$ ; note 1	650	850	mV
		$I_C = 50\text{ mA}$ ; $I_B = 5\text{ mA}$ ; note 1	–	950	mV
$C_c$	collector capacitance	$I_E = i_e = 0$ ; $V_{CB} = 5\text{ V}$ ; $100\text{ kHz} \leq f \leq 1\text{ MHz}$	–	5	pF
$C_e$	emitter capacitance	$I_C = i_c = 0$ ; $V_{EB} = 0.5\text{ V}$ ; $100\text{ kHz} \leq f \leq 1\text{ MHz}$	–	15	pF
$f_T$	transition frequency	$I_C = 10\text{ mA}$ ; $V_{CE} = 20\text{ V}$ ; $f = 100\text{ MHz}$	180	–	MHz
F	noise figure	$I_C = 100\text{ }\mu\text{A}$ ; $V_{CE} = 5\text{ V}$ ; $R_S = 1\text{ k}\Omega$ ; $f = 10\text{ Hz}$ to $15.7\text{ kHz}$	–	5	dB

## Switching times (between 10% and 90% levels); (see Fig.2)

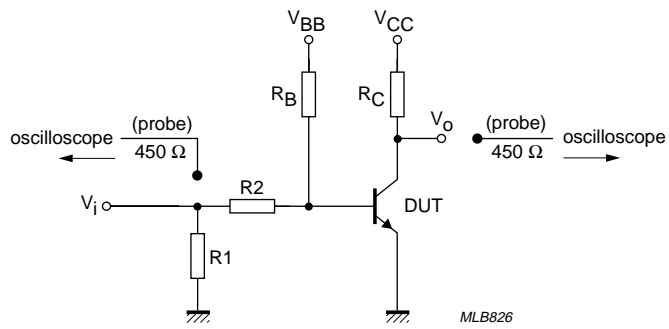
$t_{on}$	turn-on time	$I_{Con} = 10\text{ mA}$ ; $I_{Bon} = 1\text{ mA}$ ; $I_{Boff} = -1\text{ mA}$ ; $V_{CC} = 3\text{ V}$ ; $V_{BB} = -1.9\text{ V}$	–	110	ns
$t_d$	delay time		–	50	ns
$t_r$	rise time		–	60	ns
$t_{off}$	turn-off time		–	1200	ns
$t_s$	storage time		–	1000	ns
$t_f$	fall time		–	200	ns

## Note

1. Pulse test:  $t_p \leq 300\text{ }\mu\text{s}$ ;  $\delta = 0.02$ .

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$V_i = 5\text{ V}$ ;  $t_p \geq 4\text{ }\mu\text{s}$ ;  $t_r = t_f \leq 3\text{ ns}$ .  
 $R_1 = 56\text{ }\Omega$ ;  $R_2 = 2.5\text{ k}\Omega$ ;  $R_B = 3.9\text{ k}\Omega$ ;  $R_C = 270\text{ }\Omega$ .  
 Oscilloscope: input impedance  $Z_i = 50\text{ }\Omega$ .

Fig.2 Test circuit for switching times.

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PACKAGE OUTLINE

Plastic single-ended leaded (through hole) package; 3 leads

SOT54



DIMENSIONS (mm are the original dimensions)

UNIT	A	b	b <sub>1</sub>	c	D	d	E	e	e <sub>1</sub>	L	L <sub>1</sub> <sup>(1)</sup>
mm	5.2 5.0	0.48 0.40	0.66 0.56	0.45 0.40	4.8 4.4	1.7 1.4	4.2 3.6	2.54	1.27	14.5 12.7	2.5

Note

1. Terminal dimensions within this zone are uncontrolled to allow for flow of plastic and terminal irregularities.

OUTLINE VERSION	REFERENCES			EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ		
SOT54		TO-92	SC-43		97-02-28

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**DEFINITIONS**

<b>Data Sheet Status</b>	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
<b>Limiting values</b>	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
<b>Application information</b>	
Where application information is given, it is advisory and does not form part of the specification.	

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