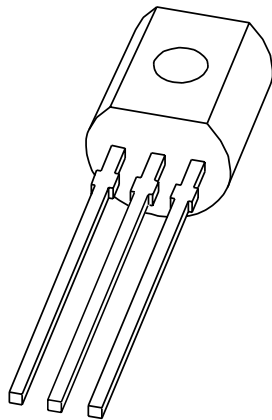


# DATA SHEET



## **2N3906** PNP switching transistor

Product specification  
Supersedes data of September 1994  
File under Discrete Semiconductors, SC04

1997 Jun 20

# PNP switching transistor

2N3906

## FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 40 V).

## APPLICATIONS

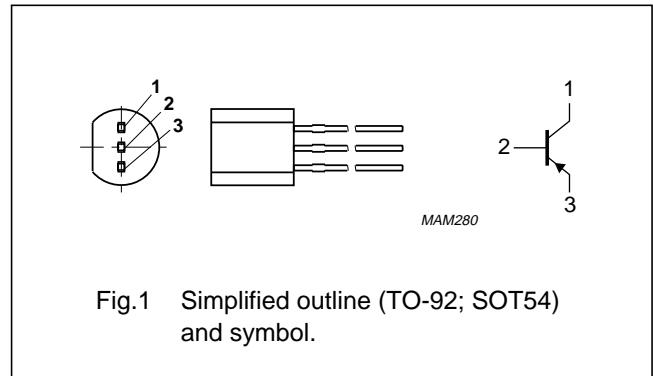
- High-speed switching in industrial applications.

## DESCRIPTION

PNP switching transistor in a TO-92; SOT54 plastic package. NPN complement: 2N3904.

## PINNING

PIN	DESCRIPTION
1	collector
2	base
3	emitter



## QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$V_{CBO}$	collector-base voltage	open emitter	-	-40	V
$V_{CEO}$	collector-emitter voltage	open base	-	-40	V
$I_C$	collector current (DC)		-	-200	mA
$P_{tot}$	total power dissipation	$T_{amb} \leq 25\text{ }^\circ\text{C}$	-	500	mW
$h_{FE}$	DC current gain	$I_C = -10\text{ mA}; V_{CE} = -1\text{ V}$	100	300	
$f_T$	transition frequency	$I_C = -10\text{ mA}; V_{CE} = -20\text{ V}; f = 100\text{ MHz}$	250	-	MHz
$t_{off}$	turn-off time	$I_{Con} = -10\text{ mA}; I_{Bon} = -1\text{ mA}; I_{Boff} = 1\text{ mA}$	-	300	ns

## PNP switching transistor

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**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	–	–40	V
$V_{CEO}$	collector-emitter voltage	open base	–	–40	V
$V_{EBO}$	emitter-base voltage	open collector	–	–6	V
$I_C$	collector current (DC)		–	–200	mA
$I_{CM}$	peak collector current		–	–300	mA
$I_{BM}$	peak base current		–	–100	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	$^\circ\text{C}$

**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** $T_{amb} = 25\text{ }^\circ\text{C}$  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	$I_C = 0; V_{EB} = -6\text{ V}$	–	–50	nA
$h_{FE}$	DC current gain	$V_{CE} = -1\text{ V}$ ; note 1; see Fig.2 $I_C = -0.1\text{ mA}$ $I_C = -1\text{ mA}$ $I_C = -10\text{ mA}$ $I_C = -50\text{ mA}$ $I_C = -100\text{ mA}$	60 80 100 60 30	– – 300 – –	
$V_{CEsat}$	collector-emitter saturation voltage	$I_C = -10\text{ mA}; I_B = -1\text{ mA}$ ; note 1 $I_C = -50\text{ mA}; I_B = -5\text{ mA}$ ; note 1	– –	–200 –200	mV mV
$V_{BEsat}$	base-emitter saturation voltage	$I_C = -10\text{ mA}; I_B = -1\text{ mA}$ ; note 1 $I_C = -50\text{ mA}; I_B = -5\text{ mA}$ ; note 1	– –	–850 –950	mV mV
$C_c$	collector capacitance	$I_E = i_e = 0; V_{CB} = -5\text{ V}; f = 1\text{ MHz}$	–	4.5	pF
$C_e$	emitter capacitance	$I_C = i_c = 0; V_{EB} = -500\text{ mV}; f = 1\text{ MHz}$	–	10	pF
$f_T$	transition frequency	$I_C = -10\text{ mA}; V_{CE} = -20\text{ V}; f = 100\text{ MHz}$	250	–	MHz
F	noise figure	$I_C = -100\text{ }\mu\text{A}; V_{CE} = -5\text{ V}; R_S = 1\text{ k}\Omega$ ; $f = 10\text{ Hz to }15.7\text{ kHz}$	–	4	dB

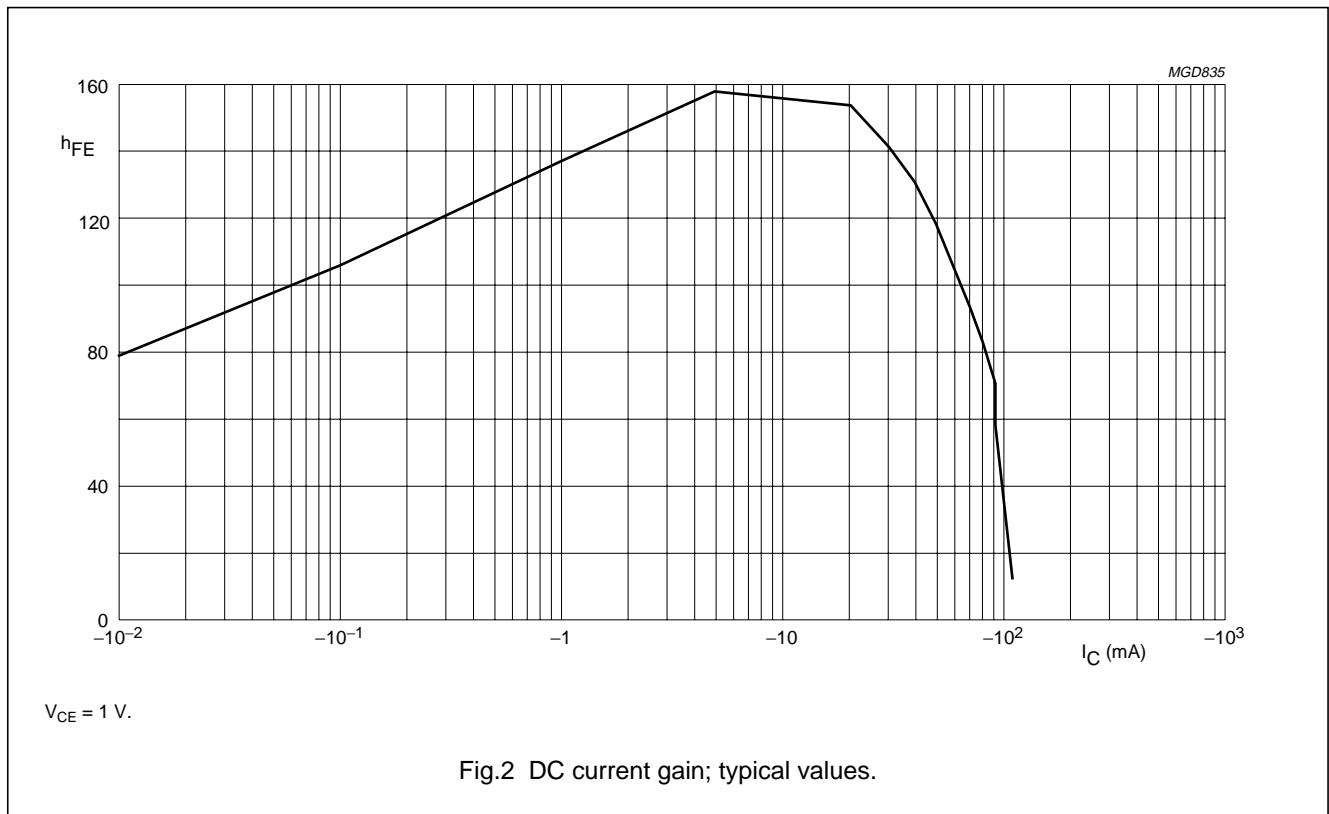
PNP switching transistor

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SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
<b>Switching times (between 10% and 90% levels); see Fig.3</b>					
$t_{on}$	turn-on time	$I_{Con} = -10 \text{ mA}; I_{Bon} = -1 \text{ mA}; I_{Boff} = 1 \text{ mA}$	–	65	ns
$t_d$	delay time		–	35	ns
$t_r$	rise time		–	35	ns
$t_{off}$	turn-off time		–	300	ns
$t_s$	storage time		–	225	ns
$t_f$	fall time		–	75	ns

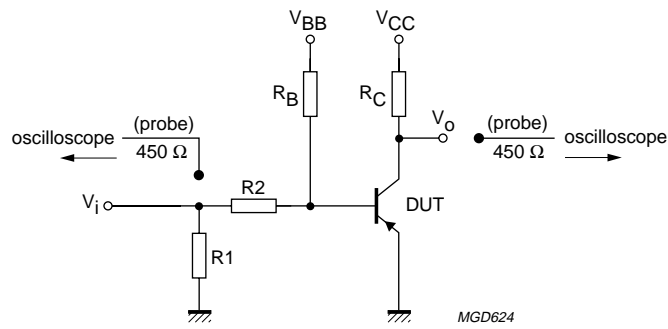
**Note**

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



PNP switching transistor

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$V_i = -5 \text{ V}$ ;  $T = 500 \text{ } \mu\text{s}$ ;  $t_p = 10 \text{ } \mu\text{s}$ ;  $t_r = t_f \leq 3 \text{ ns}$ .  
 $R_1 = 56 \text{ } \Omega$ ;  $R_2 = 2.5 \text{ k}\Omega$ ;  $R_B = 3.9 \text{ k}\Omega$ ;  $R_C = 270 \text{ } \Omega$ .  
 $V_{BB} = 1.9 \text{ V}$ ;  $V_{CC} = -3 \text{ V}$ .  
 Oscilloscope input impedance  $Z_i = 50 \text{ } \Omega$ .

Fig.3 Test circuit for switching times.

PNP switching transistor

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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

## PNP switching transistor

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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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