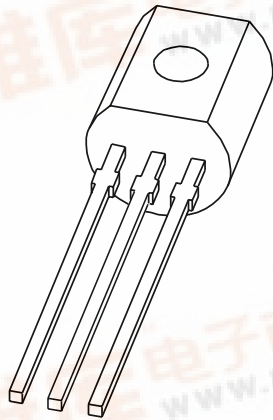


**DISCRETE SEMICONDUCTORS**

# DATA SHEET



## **PH2369; PH2369A** **NPN switching transistors**

Product specification

1997 May 27

Supersedes data of September 1994

File under Discrete Semiconductors, SC04

# NPN switching transistors

# PH2369; PH2369A

## FEATURES

- Low current (max. 200 mA)
- Low voltage (max. 15 V).

## APPLICATIONS

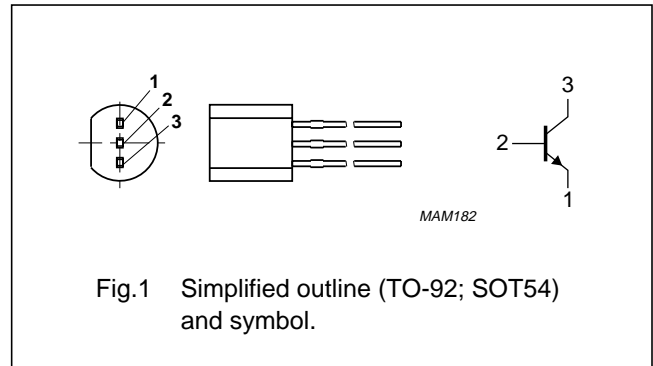
- High-speed switching.

## DESCRIPTION

NPN switching transistor in a TO-92; SOT54 plastic package.

## PINNING

PIN	DESCRIPTION
1	emitter
2	base
3	collector



## 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	–	15	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	$I_C = 10\text{ mA}; V_{CE} = 1\text{ V}$	40	120	
		$I_C = 10\text{ mA}; V_{CE} = 350\text{ mV}$	40	120	
$f_T$	transition frequency	$I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$	500	–	MHz
$t_{off}$	turn-off time	$I_{Con} = 10\text{ mA}; I_{Bon} = 3\text{ mA}; I_{Boff} = -1.5\text{ mA}$	–	30	ns
		$I_{Con} = 100\text{ mA}; I_{Bon} = 40\text{ mA}; I_{Boff} = -20\text{ mA}$	–	35	ns

## NPN switching transistors

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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	–	15	V
$V_{EBO}$	emitter-base voltage	open collector	–	4.5	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	$T_{amb} \leq 25\text{ °C}$	–	500	mW
$T_{stg}$	storage temperature		–65	+150	°C
$T_j$	junction temperature		–	150	°C
$T_{amb}$	operating ambient temperature		–65	+150	°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.

## NPN switching transistors

## PH2369; PH2369A

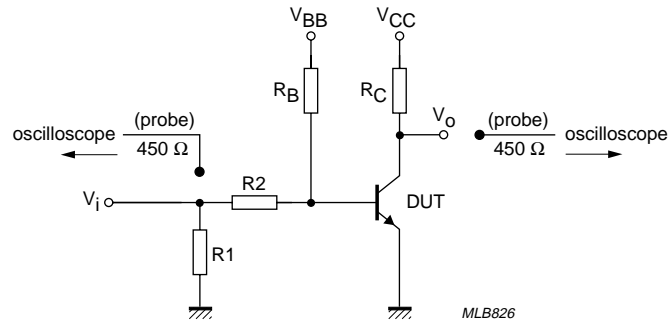
**CHARACTERISTICS**

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
$I_{CBO}$	collector cut-off current	$I_E = 0; V_{CB} = 20\text{ V}$	–	400	nA
		$I_E = 0; V_{CB} = 20\text{ V}; T_j = 125\text{ °C}$	–	30	$\mu\text{A}$
$I_{EBO}$	emitter cut-off current	$I_C = 0; V_{EB} = 4\text{ V}$	–	100	nA
$h_{FE}$	DC current gain PH2369	$I_C = 10\text{ mA}; V_{CE} = 1\text{ V}$	40	120	
		$I_C = 10\text{ mA}; V_{CE} = 1\text{ V}; T_{amb} = -55\text{ °C}$	20	–	
		$I_C = 100\text{ mA}; V_{CE} = 2\text{ V}$	20	–	
$h_{FE}$	DC current gain PH2369A	$I_C = 10\text{ mA}; V_{CE} = 350\text{ mV}$	40	120	
		$I_C = 10\text{ mA}; V_{CE} = 350\text{ mV}; T_{amb} = -55\text{ °C}$	20	–	
		$I_C = 30\text{ mA}; V_{CE} = 400\text{ mV}$	30	–	
		$I_C = 100\text{ mA}; V_{CE} = 1\text{ V}$	20	–	
$V_{CEsat}$	collector-emitter saturation voltage PH2369	$I_C = 10\text{ mA}; I_B = 1\text{ mA}$	–	250	mV
$V_{CEsat}$	collector-emitter saturation voltage PH2369A	$I_C = 10\text{ mA}; I_B = 1\text{ mA}$	–	200	mV
		$I_C = 10\text{ mA}; I_B = 10\text{ mA}$	–	300	mV
		$I_C = 30\text{ mA}; I_B = 3\text{ mA}$	–	250	mV
		$I_C = 100\text{ mA}; I_B = 10\text{ mA}$	–	500	mV
$V_{BEsat}$	base-emitter saturation voltage	$I_C = 10\text{ mA}; I_B = 1\text{ mA}$	700	850	mV
$C_c$	collector capacitance	$I_E = i_e = 0; V_{CB} = 5\text{ V}; f = 1\text{ MHz}$	–	4	pF
$C_e$	emitter capacitance	$I_C = i_c = 0; V_{EB} = 1\text{ V}; f = 1\text{ MHz}$	–	4.5	pF
$f_T$	transition frequency	$I_C = 10\text{ mA}; V_{CE} = 10\text{ V}; f = 100\text{ MHz}$	500	–	MHz
<b>Switching times (between 10% and 90% levels)</b>					
$t_{on}$	turn-on time	$I_{Con} = 10\text{ mA}; I_{Bon} = 3\text{ mA}; I_{Boff} = -1.5\text{ mA};$ see Fig.2 test conditions A	–	10	ns
$t_d$	delay time		–	4	ns
$t_r$	rise time		–	6	ns
$t_{off}$	turn-off time		–	30	ns
$t_s$	storage time		–	15	ns
$t_f$	fall time		–	15	ns
$t_{on}$	turn-on time	$I_{Con} = 100\text{ mA}; I_{Bon} = 40\text{ mA}; I_{Boff} = -20\text{ mA};$ see Fig.2 test conditions B	–	13	ns
$t_{off}$	turn-off time		–	35	ns

## NPN switching transistors

## PH2369; PH2369A

**Test conditions A.**

$V_i = 0.5$  to  $4.2$  V;  $T = 500$   $\mu$ s;  $t_p = 10$   $\mu$ s;  $t_r = t_f \leq 3$  ns.

$R_1 = 56$   $\Omega$ ;  $R_2 = 1$  k $\Omega$ ;  $R_B = 1$  k $\Omega$ ;  $R_C = 270$   $\Omega$ .

$V_{BB} = 0.2$  V;  $V_{CC} = 2.7$  V.

Oscilloscope: input impedance  $Z_i = 50$   $\Omega$ .

**Test conditions B.**

$V_i = 0.5$  to  $4.52$  V;  $T = 200$   $\mu$ s;  $t_p = 10$   $\mu$ s;  $t_r = t_f \leq 3$  ns.

$R_1 = 100$   $\Omega$ ;  $R_2 = 68$   $\Omega$ ;  $R_B = 390$   $\Omega$ ;  $R_C = 47$   $\Omega$ .

$V_{BB} = -3$  V;  $V_{CC} = 4.6$  V.

Oscilloscope: input impedance  $Z_i = 50$   $\Omega$ .

Fig.2 Test circuit for switching times.

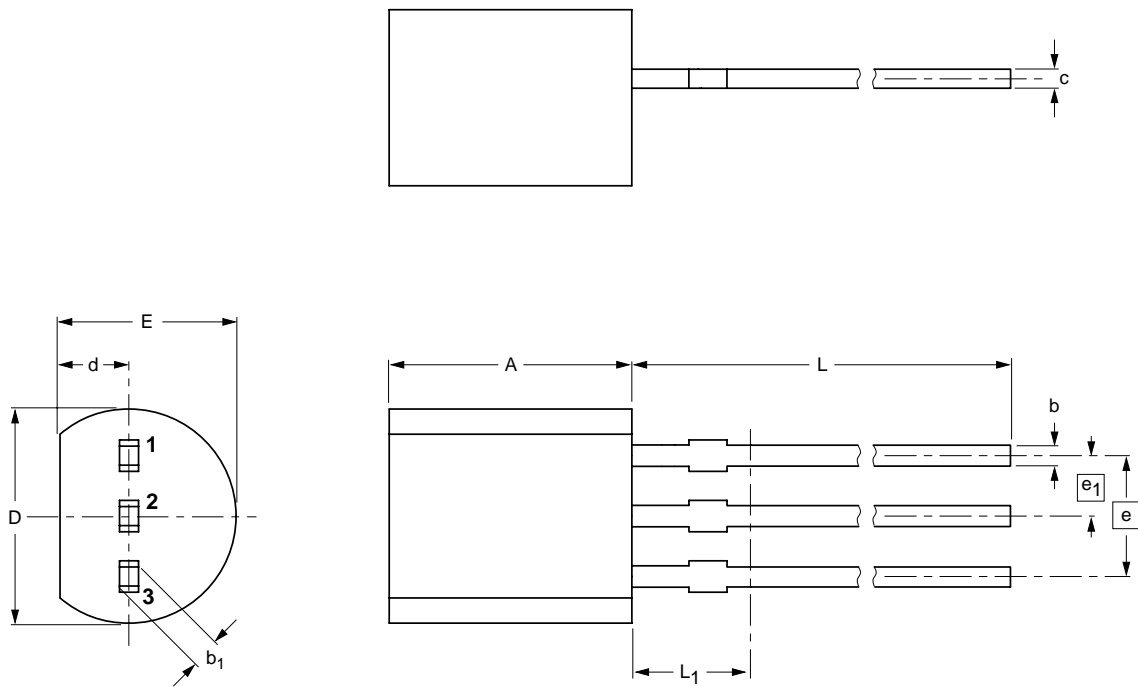
NPN switching transistors

PH2369; PH2369A

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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**NPN switching transistors****PH2369; PH2369A**

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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.	
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Printed in The Netherlands

117047/00/02/pp8

Date of release: 1997 May 27

Document order number: 9397 750 02165

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