74ABT821

10-bit D-type flip-flop; positive-edge trigger; 3-state

Rev. 02 — 12 April 2005 Product data sheet

1. General description

The 74ABT821 high-performance BiCMOS device combines low static and dynamic power dissipation with high speed and high output drive.

The 74ABT821 bus interface register is designed to eliminate the extra packages required to buffer existing registers and provide extra data width for wider data/address paths of buses carrying parity.

The 74ABT821 is a buffered 10-bit wide version of the 74ABT374A and 74ABT534A functions.

The 74ABT821 is a 10-bit, edge triggered register coupled to ten 3-state output buffers. The two sections of the device are controlled independently by the clock (CP) and output enable ($\overline{OE}$) control gates.

The register is fully edge triggered. The state of each D input, one set-up time before the LOW-to-HIGH clock transition is transferred to the corresponding output Q of the flip-flop.

The 3-state output buffers are designed to drive heavily loaded 3-state buses, MOS memories, or MOS microprocessors.

The active LOW output enable ($\overline{OE}$) controls all ten 3-state buffers independent of the register operation. When $\overline{OE}$ is LOW, the data in the register appears at the outputs. When $\overline{OE}$ is HIGH, the outputs are in high-impedance OFF-state, which means they will neither drive nor load the bus.

2. Features

- High-speed parallel registers with positive-edge triggered D-type flip-flops
- Ideal where high speed, light loading, or increased fan-in are required with MOS microprocessors
- Output capability: +64 mA and –32 mA
- Power-on 3-state
- Power-on reset
- Latch-up protection:
  - JESD78: exceeds 500 mA
- ESD protection:
  - MIL STD 883 method 3015: exceeds 2000 V
  - Machine model: exceeds 200 V

PHILIPS

3. Quick reference data

Table 1: Quick reference data

GND = 0 V; T_{amb} = 25 °C.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{PHL}	propagation delay CP to Qn	C_L = 50 pF; V_{CC} = 5 V	-	4.6	-	ns
C_I	input capacitance	V_I = 0 V or V_{CC}	-	4	-	pF
C_O	output capacitance	outputs disabled; V_O = 0 V or V_{CC}	-	7	-	pF
I_{CC}	quiescent supply current	outputs disabled; V_{CC} = 5.5 V	-	500	-	nA

4. Ordering information

Table 2: Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74ABT821D	–40 °C to +85 °C	SO24	plastic small outline package; 24 leads; body width 7.5 mm	SOT137-1
74ABT821N	–40 °C to +85 °C	DIP24	plastic dual in-line package; 24 leads (300 mil)	SOT222-1
74ABT821DB	–40 °C to +85 °C	SSOP24	plastic shrink small outline package; 24 leads; body width 5.3 mm	SOT340-1
74ABT821PW	–40 °C to +85 °C	TSSOP24	plastic thin shrink small outline package; 24 leads; body width 4.4 mm	SOT355-1

5. Functional diagram

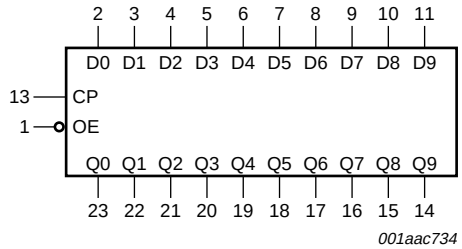


Fig 1. Logic symbol

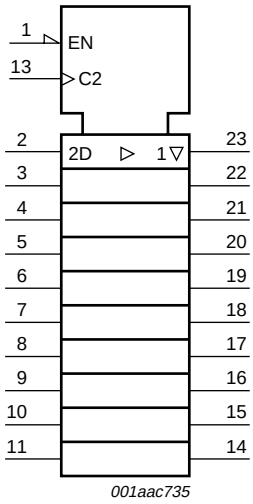


Fig 2. IEC logic symbol

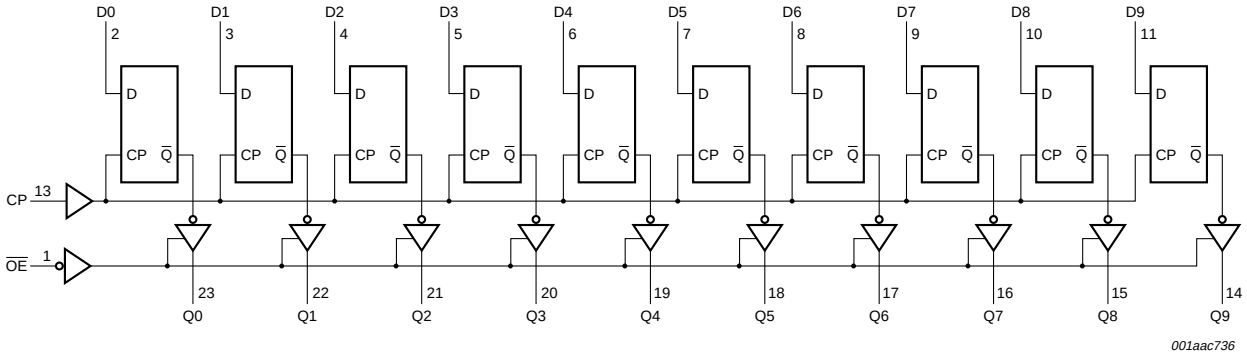


Fig 3. Logic diagram

6. Pinning information

6.1 Pinning

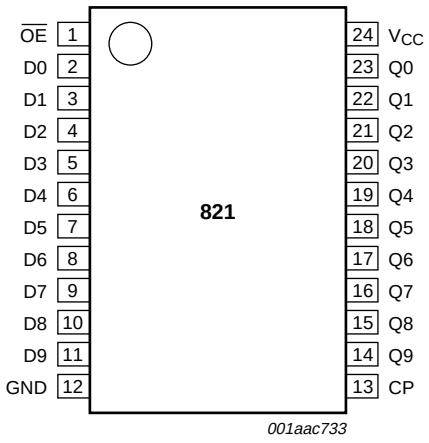


Fig 4. Pin configuration

6.2 Pin description

Table 3: Pin description

Symbol	Pin	Description
$\overline{OE}$	1	output enable input (active LOW)
D0	2	data input 0
D1	3	data input 1
D2	4	data input 2
D3	5	data input 3
D4	6	data input 4
D5	7	data input 5
D6	8	data input 6
D7	9	data input 7

Table 3: Pin description *...continued*

Symbol	Pin	Description
D8	10	data input 8
D9	11	data input 9
GND	12	ground (0 V)
CP	13	clock pulse input (active rising edge)
Q9	14	data output 9
Q8	15	data output 8
Q7	16	data output 7
Q6	17	data output 6
Q5	18	data output 5
Q4	19	data output 4
Q3	20	data output 3
Q2	21	data output 2
Q1	22	data output 1
Q0	23	data output 0
V_{CC}	24	supply voltage

7. Functional description

7.1 Function table

Table 4: Function table [1]

Operating mode	Input			Internal register	Output
	$\overline{OE}$	CP	D0 to D9		Q0 to Q9
Load and read register	L	↑	l	L	L
	L	↑	h	H	H
Hold	L	NC	X	NC	NC
Disable outputs	H	NC	X	NC	Z
	H	↑	Dn	Dn	Z

[1] H = HIGH voltage level;
h = HIGH voltage level one set-up time prior to the LOW-to-HIGH clock transition;
L = LOW voltage level;
l = LOW voltage level one set-up time prior to the LOW-to-HIGH clock transition;
NC = no change;
X = don't care;
Z = high-impedance OFF-state;
↑ = LOW-to-HIGH clock transition.

8. Limiting values

Table 5: Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Max	Unit
V_{CC}	supply voltage			–0.5	+7.0	V
V_I	input voltage		[1]	–1.2	+7.0	V
V_O	output voltage	output in OFF-state or HIGH-state	[1]	–0.5	+5.5	V
I_{IK}	input diode current	$V_I < 0$ V		-	–18	mA
I_O	output current	output in LOW-state		-	128	mA
I_{OK}	output diode current	$V_O < 0$ V		-	–50	mA
T_j	junction temperature		[2]	–	+150	°C
T_{stg}	storage temperature			–65	+150	°C

[1] The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

[2] The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150 °C.

9. Recommended operating conditions

Table 6: Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		4.5	-	5.5	V
V_I	input voltage		0	-	V_{CC}	V
V_{IH}	HIGH-level input voltage		2.0	-	-	V
V_{IL}	LOW-level input voltage		-	-	0.8	V
I_{OH}	HIGH-level output current		-	-	–32	mA
I_{OL}	LOW-level output current		-	-	64	mA
$\Delta t/\Delta V$	input transition rise or fall rate		0	-	10	ns/V
T_{amb}	ambient temperature	in free air	–40	-	+85	°C

10. Static characteristics

Table 7: Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
T_{amb} = 25 °C							
V_{IK}	input diode voltage	V_{CC} = 4.5 V; I_{IK} = –18 mA		-	–0.9	–1.2	V
V_{OH}	HIGH-level output voltage	V_I = V_{IL} or V_{IH}					
		V_{CC} = 4.5 V; I_{OH} = –3 mA		2.5	2.9	-	V
		V_{CC} = 5.0 V; I_{OH} = –3 mA		3.0	3.4	-	V
		V_{CC} = 4.5 V; I_{OH} = –32 mA		2.0	2.4	-	V
V_{OL}	LOW-level output voltage	V_{CC} = 4.5 V; I_{OL} = 64 mA; V_I = V_{IL} or V_{IH}		-	0.42	0.55	V
V_{RST}	restart LOW-level output voltage	V_{CC} = 5.5 V; I_O = 1 mA; V_I = GND or V_{CC}	[1]	-	0.13	0.55	V
I_{LI}	input leakage current	V_{CC} = 5.5 V; V_I = GND or 5.5 V		-	±0.01	±1.0	µA
I_{OFF}	power-down leakage current	V_{CC} = 0.0 V; V_O or V_I ≤ 4.5 V		-	±5.0	±100	µA
I_{PU}, I_{PD}	power-up or power-down down 3-state output current	V_{CC} = 2.0 V; V_O = 0.5 V; V_I = GND or V_{CC}; V_{OE} = V_{CC}	[2]	-	±5.0	±50	µA
I_{OZ}	3-state output current	V_{CC} = 5.5 V; V_I = V_{IL} or V_{IH}					
		output HIGH-state at V_O = 2.7 V		-	5.0	50	µA
		output LOW-state at V_O = 0.5 V		-	–5.0	–50	µA
I_{CEX}	output HIGH-state leakage current	V_{CC} = 5.5 V; V_O = 5.5 V; V_I = GND or V_{CC}		-	5.0	50	µA
I_O	output current	V_{CC} = 5.5 V; V_O = 2.5 V	[3]	–50	–100	–180	mA
I_{CC}	quiescent supply current	V_{CC} = 5.5 V; V_I = GND or V_{CC}					
		outputs HIGH-state		-	0.5	250	µA
		outputs LOW-state		-	25	38	mA
		outputs 3-state		-	0.5	250	µA
ΔI_{CC}	additional supply current per input pin	V_{CC} = 5.5 V; one input at 3.4 V and other inputs at V_{CC} or GND	[4]	-	0.5	1.5	mA
C_I	input capacitance	V_I = 0 V or V_{CC}		-	4	-	pF
C_O	output capacitance	outputs disabled; V_O = 0 V or V_{CC}		-	7	-	pF
T_{amb} = –40 °C to +85 °C							
V_{IK}	input diode voltage	V_{CC} = 4.5 V; I_{IK} = –18 mA		-	-	–1.2	V
V_{OH}	HIGH-level output voltage	V_I = V_{IL} or V_{IH}					
		V_{CC} = 4.5 V; I_{OH} = –3 mA		2.5	-	-	V
		V_{CC} = 5.0 V; I_{OH} = –3 mA		3.0	-	-	V
		V_{CC} = 4.5 V; I_{OH} = –32 mA		2.0	-	-	V
V_{OL}	LOW-level output voltage	V_{CC} = 4.5 V; I_{OL} = 64 mA; V_I = V_{IL} or V_{IH}		-	-	0.55	V
V_{RST}	restart LOW-level output voltage	V_{CC} = 5.5 V; I_O = 1 mA; V_I = GND or V_{CC}	[1]	-	-	0.55	V
I_{LI}	input leakage current	V_{CC} = 5.5 V; V_I = GND or 5.5 V		-	-	±1.0	µA
I_{OFF}	power-down leakage current	V_{CC} = 0.0 V; V_O or V_I ≤ 4.5 V		-	-	±100	µA
I_{PU}, I_{PD}	power-up or power-down down 3-state output current	V_{CC} = 2.0 V; V_O = 0.5 V; V_I = GND or V_{CC}; V_{OE} = V_{CC}	[2]	-	-	±50	µA

Table 7: Static characteristics *…continued*

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{OZ}	3-state output current	V_{CC} = 5.5 V; V_I = V_{IL} or V_{IH}					
		output HIGH-state at V_O = 2.7 V		-	-	50	µA
		output LOW-state at V_O = 0.5 V		-	-	–50	µA
I_{CEX}	output HIGH-state leakage current	V_{CC} = 5.5 V; V_O = 5.5 V; V_I = GND or V_{CC}		-	-	50	µA
I_O	output current	V_{CC} = 5.5 V; V_O = 2.5 V	[3]	–50	-	–180	mA
I_{CC}	quiescent supply current	V_{CC} = 5.5 V; V_I = GND or V_{CC}					
		outputs HIGH-state		-	-	250	µA
		outputs LOW-state		-	-	38	mA
		outputs 3-state		-	-	250	µA
ΔI_{CC}	additional supply current per input pin	V_{CC} = 5.5 V; one input at 3.4 V and other inputs at V_{CC} or GND	[4]	-	-	1.5	mA

[1] For valid test results, data must not be loaded into the flip-flops (or latches) after applying the power.

[2] This parameter is valid for any V_{CC} between 0 V and 2.1 V with a transition time of up to 10 ms. For V_{CC} = 2.1 V to V_{CC} = 5 V ± 10 %, a transition time of up to 100 µs is permitted.

[3] Not more than one output should be tested at a time, and the duration of the test should not exceed one second.

[4] This is the increase in supply current for each input at 3.4 V.

11. Dynamic characteristics

Table 8: Dynamic characteristics

GND = 0 V; for test circuit see Figure 8.

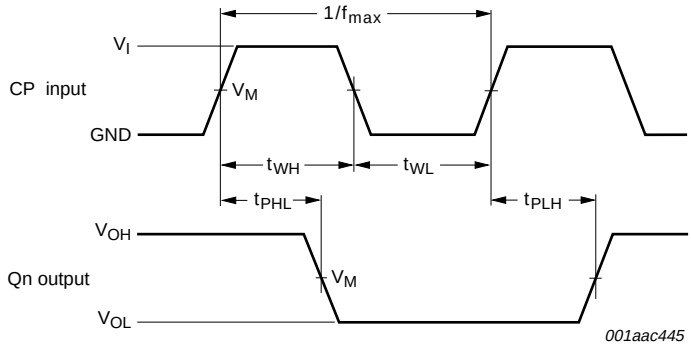
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T_{amb} = 25 °C; V_{CC} = 5.0 V						
t_{PLH}	propagation delay CP to Qn	see Figure 5	2.1	4.1	5.6	ns
t_{PHL}	propagation delay CP to Qn	see Figure 5	2.8	4.6	6.2	ns
t_{PZH}	output enable time to HIGH-level	see Figure 7	1.0	3.0	4.5	ns
t_{PZL}	output enable time to LOW-level	see Figure 7	2.2	4.1	5.6	ns
t_{PHZ}	output disable time from HIGH-level	see Figure 7	2.7	4.7	6.2	ns
t_{PLZ}	output disable time from LOW-level	see Figure 7	2.3	4.6	6.1	ns
$t_{su(H)}$	set-up time HIGH Dn to CP	see Figure 6	2.1	0.5	-	ns
$t_{su(L)}$	set-up time LOW Dn to CP	see Figure 6	2.1	0.3	-	ns
$t_{h(H)}$	hold time HIGH Dn to CP	see Figure 6	1.3	0.0	-	ns
$t_{h(L)}$	hold time LOW Dn to CP	see Figure 6	+1.3	–0.3	-	ns
t_{WH}	pulse width HIGH of CP	see Figure 5	2.9	1.8	-	ns
t_{WL}	pulse width LOW of CP	see Figure 5	3.8	2.8	-	ns
f_{max}	maximum clock frequency	see Figure 5	125	185	-	ns
T_{amb} = –40 °C to +85 °C; V_{CC} = 5.0 V ± 0.5 V						
t_{PLH}	propagation delay CP to Qn	see Figure 5	2.1	-	6.2	ns
t_{PHL}	propagation delay CP to Qn	see Figure 5	2.8	-	6.7	ns
t_{PZH}	output enable time to HIGH-level	see Figure 7	1.0	-	5.3	ns

Table 8: Dynamic characteristics *...continued*

GND = 0 V; for test circuit see Figure 8.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
t_{PZL}	output enable time to LOW-level	see Figure 7	2.2	-	6.3	ns
t_{PHZ}	output disable time from HIGH-level	see Figure 7	2.7	-	6.7	ns
t_{PLZ}	output disable time from LOW-level	see Figure 7	2.3	-	6.5	ns
$t_{su(H)}$	set-up time HIGH Dn to CP	see Figure 6	2.1	-	-	ns
$t_{su(L)}$	set-up time LOW Dn to CP	see Figure 6	2.1	-	-	ns
$t_{h(H)}$	hold time HIGH Dn to CP	see Figure 6	1.3	-	-	ns
$t_{h(L)}$	hold time LOW Dn to CP	see Figure 6	1.3	-	-	ns
t_{WH}	pulse width HIGH of CP	see Figure 5	2.9	-	-	ns
t_{WL}	pulse width LOW of CP	see Figure 5	3.8	-	-	ns
f_{max}	maximum clock frequency	see Figure 5	-	125	-	ns

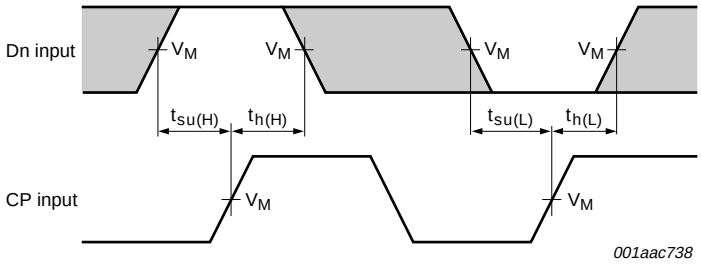
12. Waveforms



V_M = 1.5 V

V_{OL} and V_{OH} are typical voltage output drop that occur with the output load.

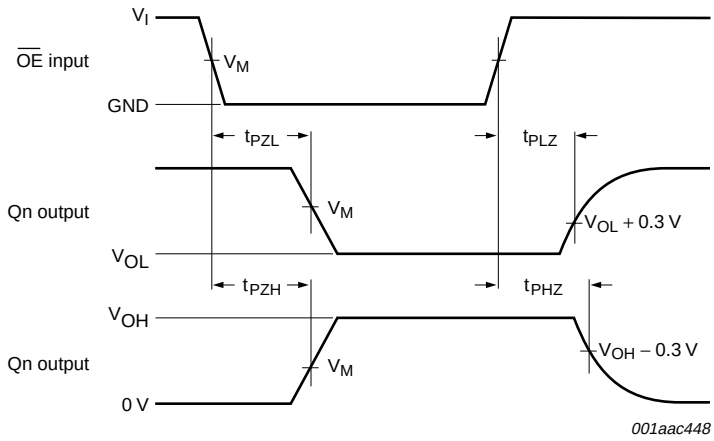
Fig 5. Propagation delay clock input (CP) to output Qn, clock pulse (CP) width and maximum clock (CP) frequency



V_M = 1.5 V

The shaded areas indicate when the input is permitted to change for predictable output performance.

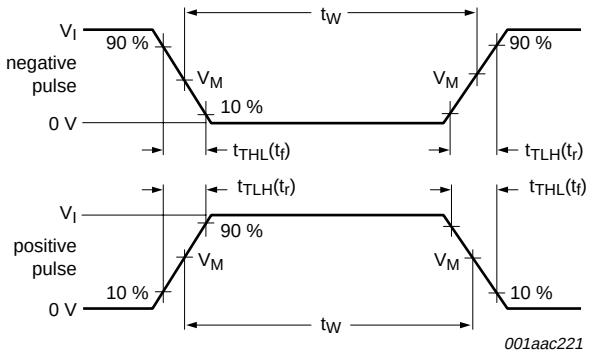
Fig 6. Set-up and hold times data output (Dn) to clock (CP)



V_M = 1.5 V.

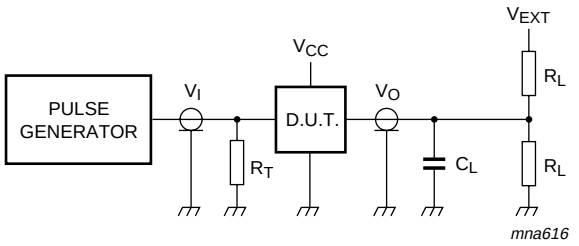
V_{OL} and V_{OH} are typical voltage output drop that occur with the output load.

Fig 7. 3-state output (Qn) enable and disable times



V_M = 1.5 V.

a. Input pulse definition



Test data is given in Table 9.

Definitions test circuit:

R_L = Load resistor.

C_L = Load capacitance including jig and probe capacitance.

R_T = Termination resistance should be equal to output impedance Z_o of pulse generator.

V_{EXT} = Test voltage for switching times.

b. Test circuit

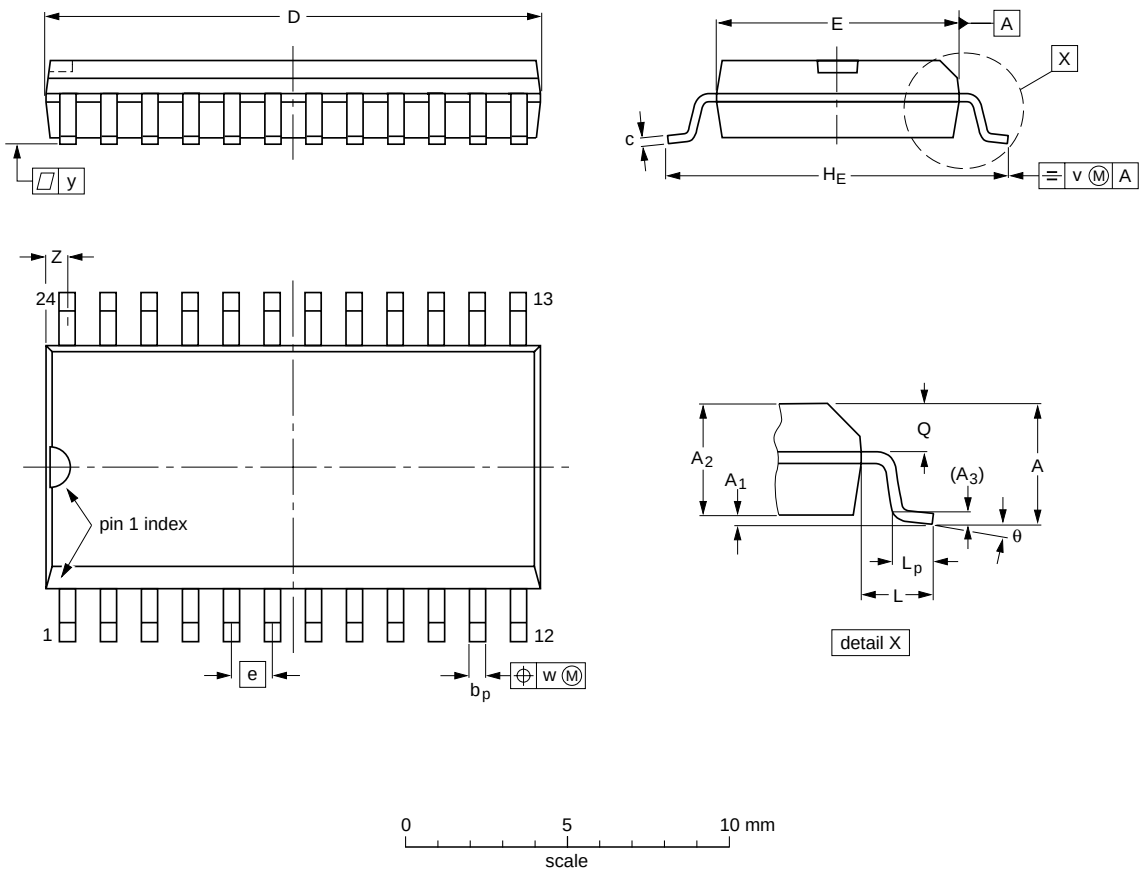
Fig 8. Load circuitry for switching times

Table 9: Test data

Input				Load		V_{EXT}		
V_I	f_i	t_W	t_r, t_f	C_L	R_L	t_{PHZ}, t_{PZH}	t_{PLZ}, t_{PZL}	t_{PLH}, t_{PHL}
3.0 V	1 MHz	500 ns	2.5 ns	50 pF	500 Ω	open	7.0 V	open

13. Package outline

SO24: plastic small outline package; 24 leads; body width 7.5 mm **SOT137-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.3 0.1	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.1	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.05	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

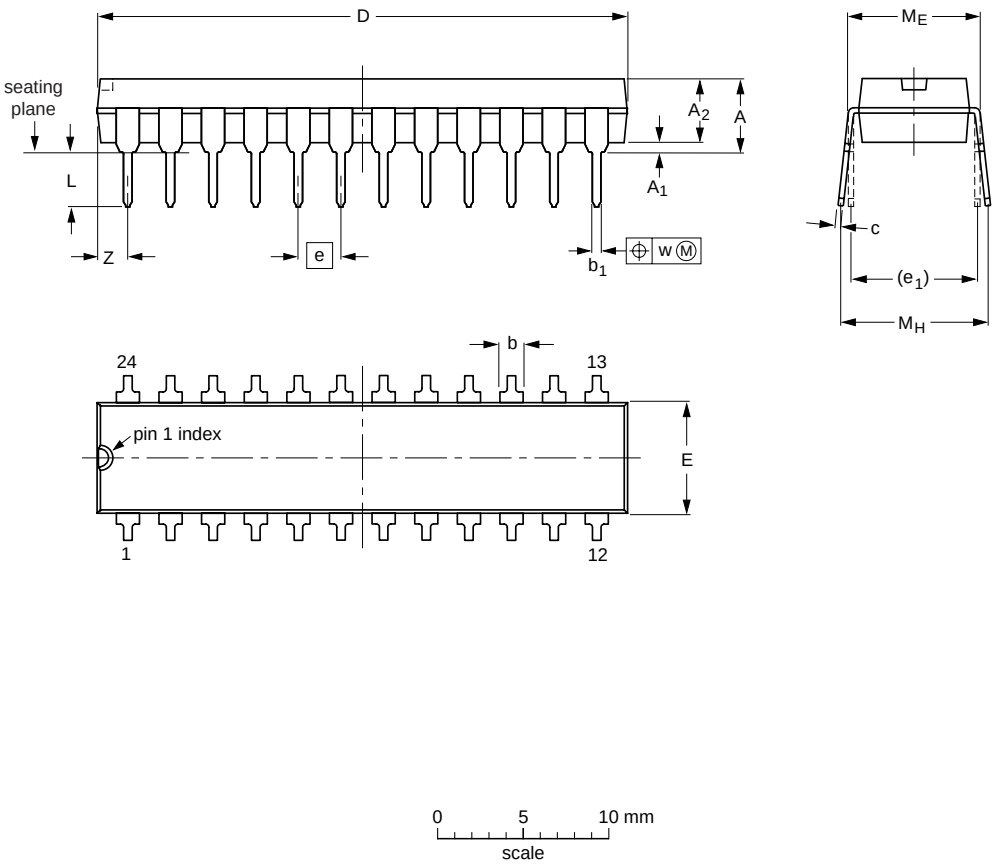
Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT137-1	075E05	MS-013				~~99-12-27~~ 03-02-19

Fig 9. Package outline SOT137-1 (SO24)

DIP24: plastic dual in-line package; 24 leads (300 mil) **SOT222-1**



DIMENSIONS (mm dimensions are derived from the original inch dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.38	3.94	1.63 1.14	0.56 0.43	0.36 0.25	31.9 31.5	6.73 6.25	2.54	7.62	3.51 3.05	8.13 7.62	10.03 7.62	0.25	2.05
inches	0.185	0.015	0.155	0.064 0.045	0.022 0.017	0.014 0.010	1.256 1.240	0.265 0.246	0.1	0.3	0.138 0.120	0.32 0.30	0.395 0.300	0.01	0.081

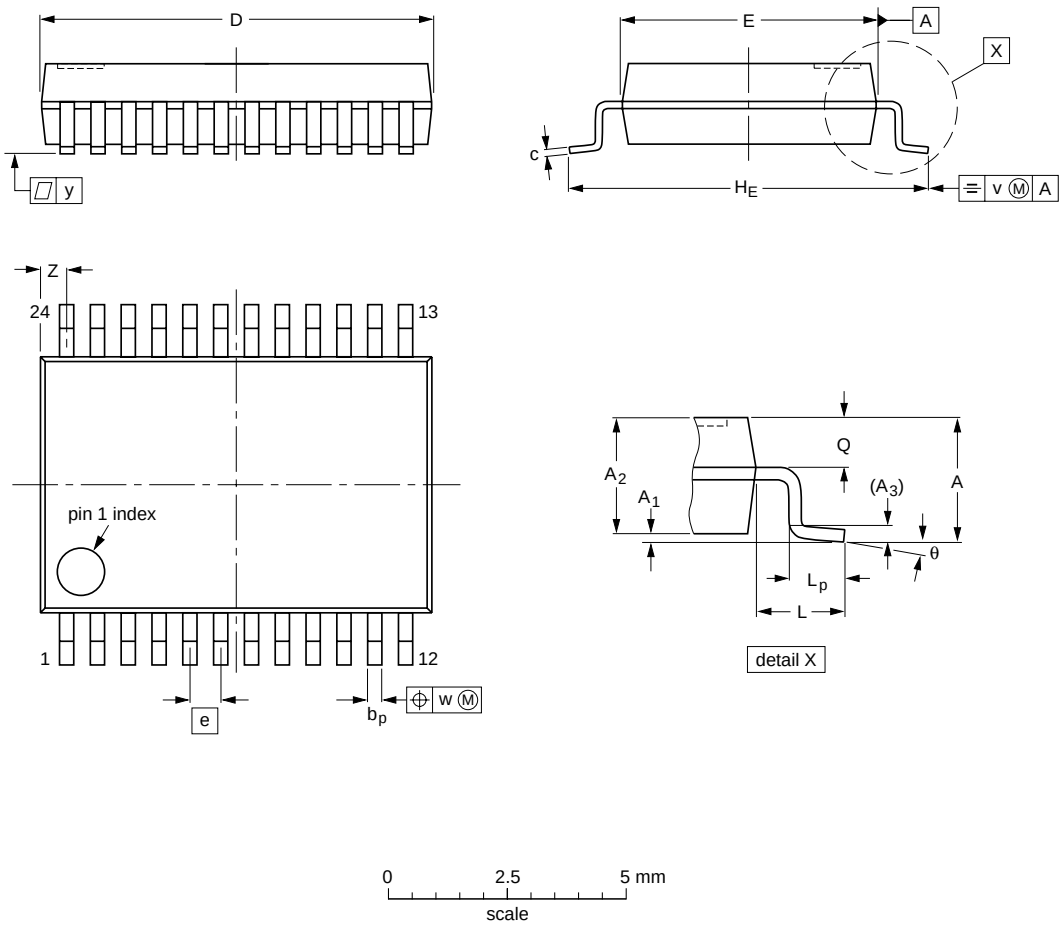
Note

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT222-1		MS-001				~~99-12-27~~ 03-03-12

Fig 10. Package outline SOT222-1 (DIP24)

SSOP24: plastic shrink small outline package; 24 leads; body width 5.3 mm **SOT340-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	8.4 8.0	5.4 5.2	0.65	7.9 7.6	1.25	1.03 0.63	0.9 0.7	0.2	0.13	0.1	0.8 0.4	8^o 0^o

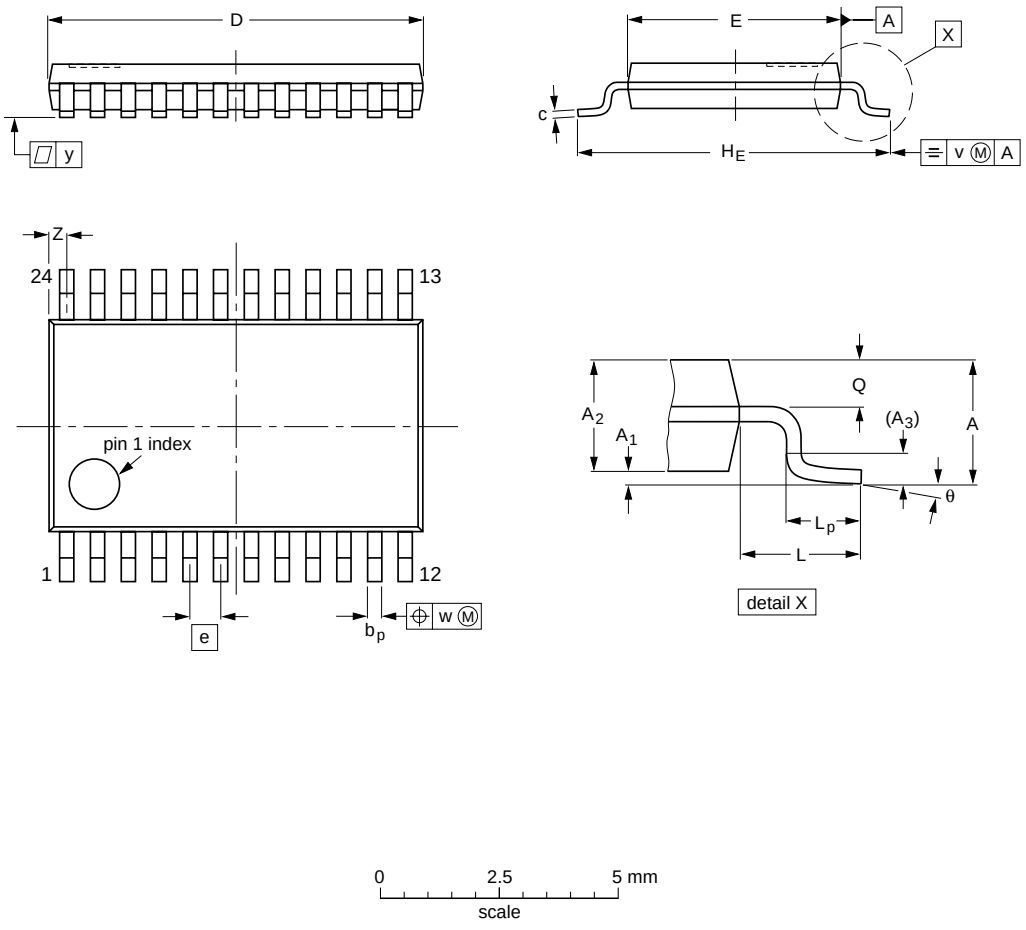
Note

1. Plastic or metal protrusions of 0.2 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT340-1		MO-150				~~99-12-27~~ 03-02-19

Fig 11. Package outline SOT340-1 (SSOP24)

TSSOP24: plastic thin shrink small outline package; 24 leads; body width 4.4 mm **SOT355-1**



DIMENSIONS (mm are the original dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(2)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	7.9 7.7	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.5 0.2	8^o 0^o

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT355-1		MO-153				~~99-12-27~~ 03-02-19

Fig 12. Package outline SOT355-1 (TSSOP24)

14. Revision history

Table 10: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
74ABT821_2	20050412	Product data sheet	-	9397 750 14867	74ABT821
Modifications:	• The format of this data sheet has been redesigned to comply with the new presentation and information standard of Philips Semiconductors. • Section 2 “Features”: modified ‘JEDEC Std. 17’ into ‘JESD78’. • Table 8 “Dynamic characteristics”: changed min value of t_{PLZ} from 2.8 ns into 2.3 ns for both conditions at T_{amb} = 25 °C; V_{CC} = 5.0 V and at T_{amb} = −40 °C to +85 °C; V_{CC} = 5.0 V ± 0.5 V				
74ABT821	19950906	Product specification	-	-	-

15. Data sheet status

Level	Data sheet status [1]	Product status [2] [3]	Definition
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
II	Preliminary data	Qualification	This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.
III	Product data	Production	This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN).

[1] Please consult the most recently issued data sheet before initiating or completing a design.

[2] The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL http://www.semiconductors.philips.com.

[3] For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

16. Definitions

Short-form specification — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

Limiting values definition — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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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For additional information, please visit: **http://www.semiconductors.philips.com**

For sales office addresses, send an email to: **sales.addresses@www.semiconductors.philips.com**

19. Contents

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