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74HC158

Quad 2-input multiplexer; inverting

Rev. 03 — 12 November 2004 Product data sheet

1. General description

The 74HC is a high-speed Si-gate CMOS device and is pin compatible with low power Schottky TTL (LSTTL). The 74HC158 is specified in compliance with JEDEC standard no. 7A.

The 74HC158 is a quad 2-input multiplexer which select 4 bits of data from two sources and are controlled by a common data select input (S). The four outputs present the selected data in the inverted form. The enable input ($\overline{E}$) is active LOW.

When $\overline{E}$ is HIGH, all the outputs ($1\overline{Y}$ to $4\overline{Y}$) are forced HIGH regardless of all other input conditions.

Moving the data from two groups of registers to four common output buses is a common use of the 74HC158. The state of S determines the particular register from which the data comes. It can also be used as a function generator.

The device is useful for implementing highly irregular logic by generating any four of the 16 different functions of two variables with one variable common.

The 74HC158 is the logic implementation of a 4-pole, 2-position switch, where the position of the switch is determined by the logic levels applied to S.

The logic equations for the output are:

$1\overline{Y} = \overline{E}.(1I1.S + 1I0.\overline{S})$

$2\overline{Y} = \overline{E}.(2I1.S + 2I0.\overline{S})$

$3\overline{Y} = \overline{E}.(3I1.S + 3I0.\overline{S})$

$4\overline{Y} = \overline{E}.(4I1.S + 4I0.\overline{S})$

The 74HC158 is identical to the 74HC157 but has inverting outputs.

2. Features

- Low-power dissipation
- Inverting data path
- Complies with JEDEC standard no. 7A
- ESD protection:
  - HBM EIA/JESD22-A114-B exceeds 2000 V
  - MM EIA/JESD22-A115-A exceeds 200 V.
- Multiple package options
- Specified from −40 °C to +80 °C and from −40 °C to +125 °C.

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3. Quick reference data

Table 1: Quick reference data

GND = 0 V; T_{amb} = 25 °C; t_r = t_f = 6 ns.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_{PHL}, t_{PLH}	propagation delay	C_L = 15 pF; V_{CC} = 5 V					
	nI0, nI1 to nY			-	12	-	ns
	$\overline{E}$ to n$\overline{Y}$			-	14	-	ns
	S to n$\overline{Y}$			-	14	-	ns
C_I	input capacitance			-	3.5	-	pF
C_{PD}	power dissipation capacitance per multiplexer	V_I = GND to V_{CC}	[1]	-	40	-	pF

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

4. Ordering information

Table 2: Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC158N	–40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4
74HC158D	–40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1

5. Functional diagram

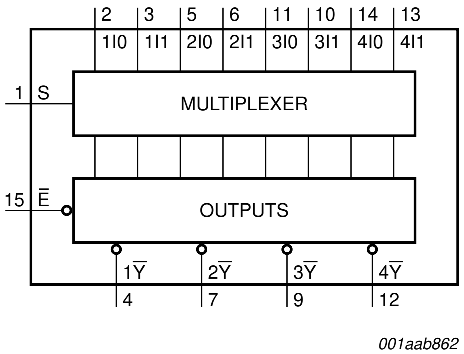


Fig 1. Functional diagram

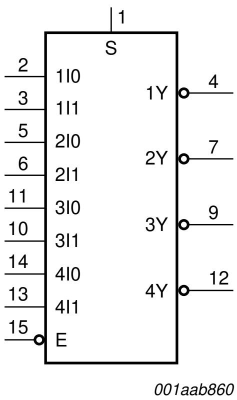


Fig 2. Logic symbol

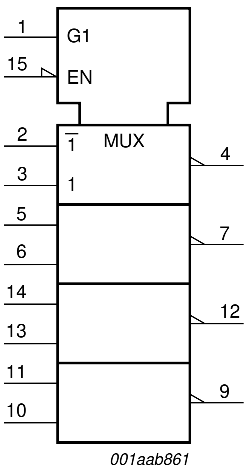


Fig 3. IEC logic symbol

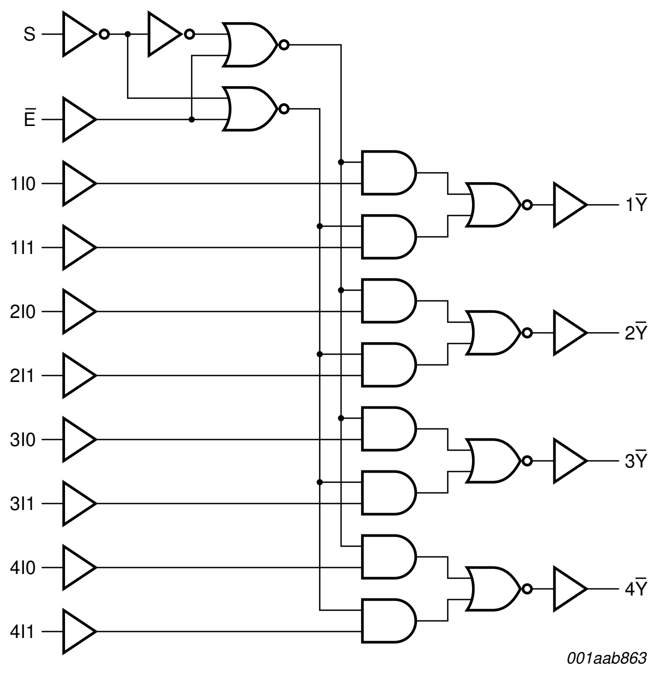


Fig 4. Logic diagram

6. Pinning information

6.1 Pinning

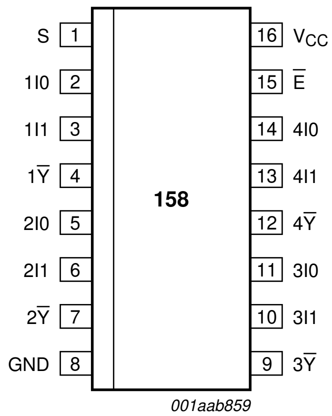


Fig 5. Pin configuration

6.2 Pin description

Table 3: Pin description

Symbol	Pin	Description
S	1	common data select input
1I0	2	data input 1 from source 0
1I1	3	data input 1 from source 1
1$\overline{Y}$	4	multiplexer output 1
2I0	5	data input 2 from source 0
2I1	6	data input 2 from source 1
2$\overline{Y}$	7	multiplexer output 2
GND	8	ground (0 V)
3$\overline{Y}$	9	multiplexer output 3
3I1	10	data input 3 from source 1
3I0	11	data input 3 from source 0
4$\overline{Y}$	12	multiplexer output 4
4I1	13	data input 4 from source 1
4I0	14	data input 4 from source 0
$\overline{E}$	15	enable input (active LOW)
V_{CC}	16	positive supply voltage

7. Functional description

7.1 Function table

Table 4: Function [1]

Control		Input		Output
$\overline{E}$	S	nI0	nI1	n$\overline{Y}$
H	X	X	X	H
L	L	L	X	H
		H	X	L
	H	X	L	H
		X	H	L

[1] H = HIGH voltage level;
L = LOW voltage level;
X = don’t care.

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	V
I_{IK}	input diode current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	±20	mA
I_{OK}	output diode current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	-	±20	mA
I_O	output source or sink current	$V_O = -0.5$ V to $V_{CC} + 0.5$ V	-	±25	mA
I_{CC}, I_{GND}	V_{CC} or GND current		-	±50	mA
T_{stg}	storage temperature		–65	+150	°C
P_{tot}	power dissipation				
	DIP16 package	[1]	-	750	mW
	SO16 package	[2]	-	500	mW

[1] Above 70 °C: P_{tot} derates linearly with 12 mW/K.

[2] Above 70 °C: P_{tot} derates linearly with 8 mW/K.

9. Recommended operating conditions

Table 6: Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{CC}	supply voltage		2.0	5.0	6.0	V
V_I	input voltage		0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	V
t_r, t_f	input rise and fall times	$V_{CC} = 2.0$ V	-	-	1000	ns
		$V_{CC} = 4.5$ V	-	6.0	500	ns
		$V_{CC} = 6.0$ V	-	-	400	ns
T_{amb}	ambient temperature		–40	-	+125	°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_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.5	1.2	-	V
		V_{CC} = 4.5 V	3.15	2.4	-	V
		V_{CC} = 6.0 V	4.2	3.2	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V	-	0.8	0.5	V
		V_{CC} = 4.5 V	-	2.1	1.35	V
		V_{CC} = 6.0 V	-	2.8	1.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}				
		I_O = −20 µA; V_{CC} = 2.0 V	1.9	2.0	-	V
		I_O = −20 µA; V_{CC} = 4.5 V	4.4	4.5	-	V
		I_O = −20 µA; V_{CC} = 6.0 V	5.9	6.0	-	V
		I_O = −4 mA; V_{CC} = 4.5 V	3.98	4.32	-	V
		I_O = −5.2 mA; V_{CC} = 6.0 V	5.48	5.81	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}				
		I_O = 20 µA; V_{CC} = 2.0 V	-	0	0.1	V
		I_O = 20 µA; V_{CC} = 4.5 V	-	0	0.1	V
		I_O = 20 µA; V_{CC} = 6.0 V	-	0	0.1	V
		I_O = 4 mA; V_{CC} = 4.5 V	-	0.15	0.26	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.26	V
I_{LI}	input leakage current	V_I = V_{CC} or GND; V_{CC} = 6.0 V	-	-	±0.1	µA
I_{CC}	quiescent supply current	V_I = V_{CC} or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	8.0	µA
C_I	input capacitance		-	3.5	-	pF
T_{amb} = −40 °C to +85 °C						
V_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.5	-	-	V
		V_{CC} = 4.5 V	3.15	-	-	V
		V_{CC} = 6.0 V	4.2	-	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V	-	-	0.5	V
		V_{CC} = 4.5 V	-	-	1.35	V
		V_{CC} = 6.0 V	-	-	1.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}				
		I_O = −20 µA; V_{CC} = 2.0 V	1.9	-	-	V
		I_O = −20 µA; V_{CC} = 4.5 V	4.4	-	-	V
		I_O = −20 µA; V_{CC} = 6.0 V	5.9	-	-	V
		I_O = −4 mA; V_{CC} = 4.5 V	3.84	-	-	V
		I_O = −5.2 mA; V_{CC} = 6.0 V	5.34	-	-	V

Table 7: Static characteristics *...continued*

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		I_O = 20 μA; V_{CC} = 2.0 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 4.5 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 6.0 V	-	-	0.1	V
		I_O = 4 mA; V_{CC} = 4.5 V	-	-	0.33	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	-	0.33	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 6.0 V	-	-	±1.0	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	80	μA
T_{amb} = −40 °C to +125 °C						
V_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.5	-	-	V
		V_{CC} = 4.5 V	3.15	-	-	V
		V_{CC} = 6.0 V	4.2	-	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V	-	-	0.5	V
		V_{CC} = 4.5 V	-	-	1.35	V
		V_{CC} = 6.0 V	-	-	1.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		I_O = −20 μA; V_{CC} = 2.0 V	1.9	-	-	V
		I_O = −20 μA; V_{CC} = 4.5 V	4.4	-	-	V
		I_O = −20 μA; V_{CC} = 6.0 V	5.9	-	-	V
		I_O = −4 mA; V_{CC} = 4.5 V	3.7	-	-	V
		I_O = −5.2 mA; V_{CC} = 6.0 V	5.2	-	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}				
		I_O = 20 μA; V_{CC} = 2.0 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 4.5 V	-	-	0.1	V
		I_O = 20 μA; V_{CC} = 6.0 V	-	-	0.1	V
		I_O = 4 mA; V_{CC} = 4.5 V	-	-	0.4	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	-	0.4	V
I_{LI}	input leakage current	$V_I = V_{CC}$ or GND; V_{CC} = 6.0 V	-	-	±1.0	μA
I_{CC}	quiescent supply current	$V_I = V_{CC}$ or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	160	μA

11. Dynamic characteristics

Table 8: Dynamic characteristics

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF; see Figure 8.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
$T_{amb} = 25$ °C							
t_{PHL}, t_{PLH}	propagation delay nI0, nI1 to $n\overline{Y}$	see Figure 6					
		$V_{CC} = 2.0$ V		-	41	125	ns
		$V_{CC} = 4.5$ V		-	15	25	ns
		$V_{CC} = 6.0$ V		-	12	21	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF		-	12	-	ns
	propagation delay $\overline{E}$ to $n\overline{Y}$	see Figure 7					
		$V_{CC} = 2.0$ V		-	47	145	ns
		$V_{CC} = 4.5$ V		-	17	29	ns
		$V_{CC} = 6.0$ V		-	14	25	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF		-	14	-	ns
	propagation delay S to $n\overline{Y}$	see Figure 6					
		$V_{CC} = 2.0$ V		-	47	145	ns
		$V_{CC} = 4.5$ V		-	17	29	ns
		$V_{CC} = 6.0$ V		-	14	25	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF		-	14	-	ns
t_{THL}, t_{TLH}	output transition time	see Figure 6 and 7					
		$V_{CC} = 2.0$ V		-	19	75	ns
		$V_{CC} = 4.5$ V		-	7	15	ns
		$V_{CC} = 6.0$ V		-	6	13	ns
C_{PD}	power dissipation capacitance per multiplexer	V_I = GND to V_{CC}	[1]	-	40	-	pF
$T_{amb} = -40$ °C to +85 °C							
t_{PHL}, t_{PLH}	propagation delay nI0, nI1 to $n\overline{Y}$	see Figure 6					
		$V_{CC} = 2.0$ V		-	-	155	ns
		$V_{CC} = 4.5$ V		-	-	31	ns
		$V_{CC} = 6.0$ V		-	-	26	ns
	propagation delay $\overline{E}$ to $n\overline{Y}$	see Figure 7					
		$V_{CC} = 2.0$ V		-	-	180	ns
		$V_{CC} = 4.5$ V		-	-	36	ns
		$V_{CC} = 6.0$ V		-	-	31	ns
	propagation delay S to $n\overline{Y}$	see Figure 6					
		$V_{CC} = 2.0$ V		-	-	180	ns
		$V_{CC} = 4.5$ V		-	-	36	ns
		$V_{CC} = 6.0$ V		-	-	31	ns
t_{THL}, t_{TLH}	output transition time	see Figure 6 and 7					
		$V_{CC} = 2.0$ V		-	-	95	ns
		$V_{CC} = 4.5$ V		-	-	19	ns
		$V_{CC} = 6.0$ V		-	-	16	ns

Table 8: Dynamic characteristics *...continued*

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF; see Figure 8.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$T_{amb} = -40$ °C to +125 °C						
t_{PHL}, t_{PLH}	propagation delay nI0, nI1 to n$\overline{Y}$	see Figure 6				
		$V_{CC} = 2.0$ V	-	-	190	ns
		$V_{CC} = 4.5$ V	-	-	38	ns
		$V_{CC} = 6.0$ V	-	-	32	ns
	propagation delay $\overline{E}$ to n$\overline{Y}$	see Figure 7				
		$V_{CC} = 2.0$ V	-	-	220	ns
		$V_{CC} = 4.5$ V	-	-	44	ns
		$V_{CC} = 6.0$ V	-	-	38	ns
	propagation delay S to n$\overline{Y}$	see Figure 6				
		$V_{CC} = 2.0$ V	-	-	220	ns
		$V_{CC} = 4.5$ V	-	-	44	ns
		$V_{CC} = 6.0$ V	-	-	38	ns
t_{THL}, t_{TLH}	output transition time	see Figure 6 and 7				
		$V_{CC} = 2.0$ V	-	-	110	ns
		$V_{CC} = 4.5$ V	-	-	22	ns
		$V_{CC} = 6.0$ V	-	-	19	ns

[1] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).

$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:

f_i = input frequency in MHz;

f_o = output frequency in MHz;

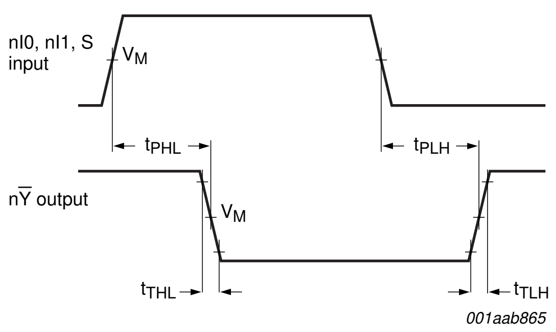
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

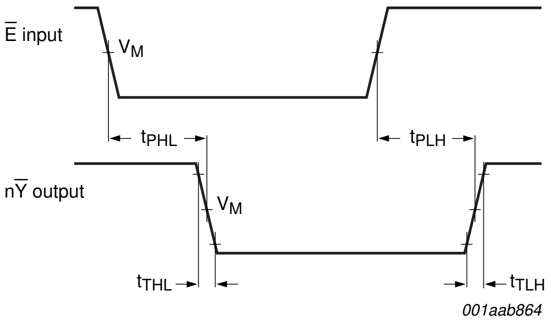
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

12. Waveforms



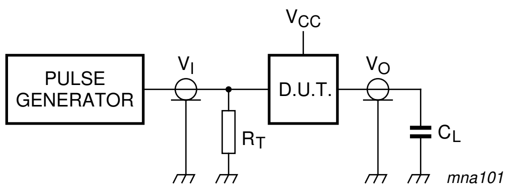
$V_M = 0.5 \times V_I$.

Fig 6. Waveforms showing the data input (nI0, nI1) to output (n$\overline{Y}$) propagation delays and the output transition times



$V_M = 0.5 \times V_I$.

Fig 7. Waveforms showing the enable input (Ē) to output (nȲ) propagation delays and the output transition times



Test data is given in Table 9.

Definitions for test circuit:

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

C_L = Load capacitance including jig and probe capacitance.

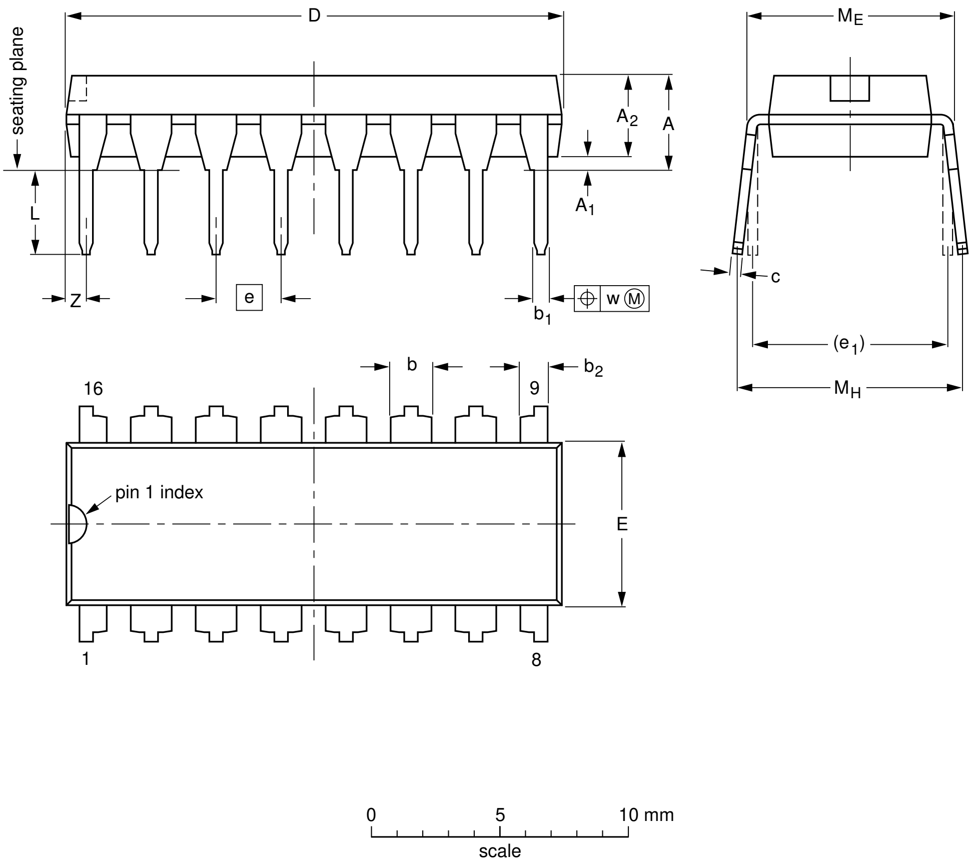
Fig 8. Load circuitry for switching times

Table 9: Test data

Supply	Input		Load
V_{CC}	V_I	t_r, t_f	C_L
2.0 V	V_{CC}	6 ns	50 pF
4.5 V	V_{CC}	6 ns	50 pF
6.0 V	V_{CC}	6 ns	50 pF
5.0 V	V_{CC}	6 ns	15 pF

13. Package outline

DIP16: plastic dual in-line package; 16 leads (300 mil) **SOT38-4**



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

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	b_2	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.2	0.51	3.2	1.73 1.30	0.53 0.38	1.25 0.85	0.36 0.23	19.50 18.55	6.48 6.20	2.54	7.62	3.60 3.05	8.25 7.80	10.0 8.3	0.254	0.76
inches	0.17	0.02	0.13	0.068 0.051	0.021 0.015	0.049 0.033	0.014 0.009	0.77 0.73	0.26 0.24	0.1	0.3	0.14 0.12	0.32 0.31	0.39 0.33	0.01	0.03

Note

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

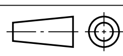
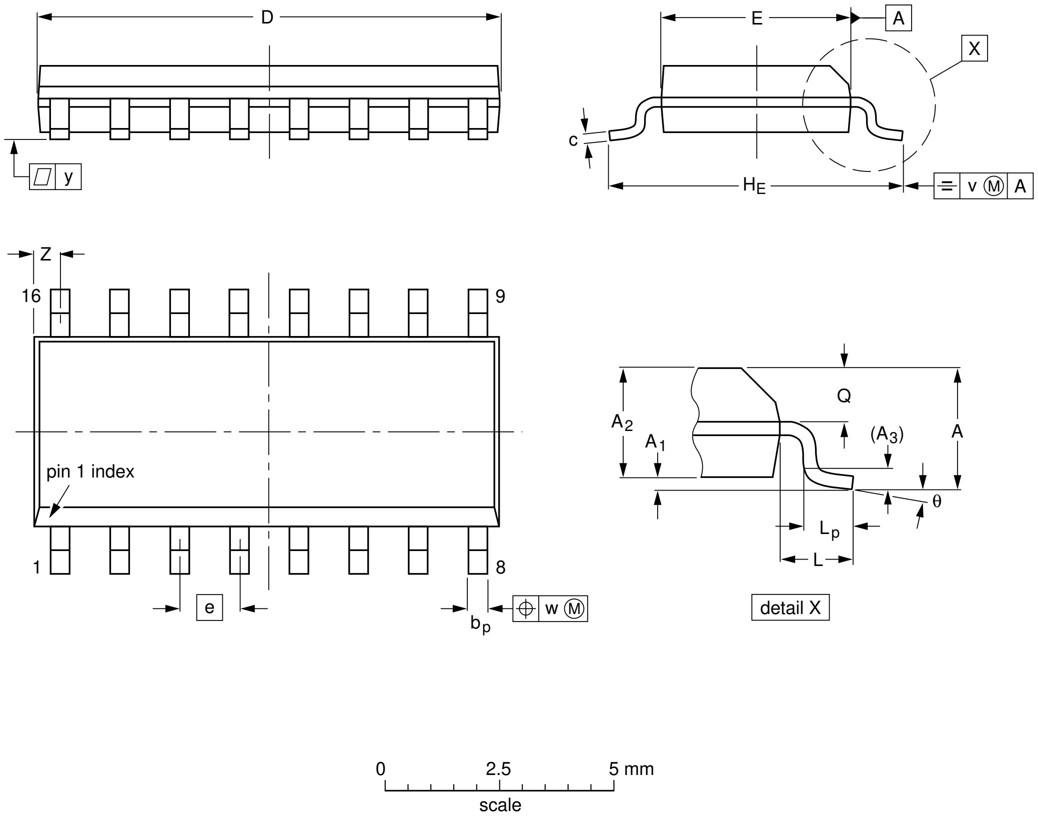
OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT38-4						~~95-01-14~~ 03-02-13

Fig 9. Package outline SOT38-4 (DIP16)

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



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	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8° 0°
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

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			
SOT109-1	076E07	MS-012				~~99-12-27~~ 03-02-19

Fig 10. Package outline SOT109-1 (SO16)

14. Revision history

Table 10: Revision history

Document ID	Release date	Data sheet status	Change notice	Doc. number	Supersedes
74HC158_3	20041112	Product data sheet	-	9397 750 13805	74HC_HCT158_CNV_2
Modifications:	• The format of this data sheet has been redesigned to comply with the current presentation and information standard of Philips Semiconductors. • Removed type number 74HCT158. • Inserted family specification.				
74HC_HCT158_CNV_2	19970827	Product specification	-	-	74HC_HCT158_1
74HC_HCT158_1	19901201	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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18. Contact information

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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