

# 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 ( $\bar{E}$ ) is active LOW.

When  $\bar{E}$  is HIGH, all the outputs ( $1\bar{Y}$  to  $4\bar{Y}$ ) 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:

$$1\bar{Y} = \bar{E} \cdot (1I1 \cdot S + 1I0 \cdot \bar{S})$$

$$2\bar{Y} = \bar{E} \cdot (2I1 \cdot S + 2I0 \cdot \bar{S})$$

$$3\bar{Y} = \bar{E} \cdot (3I1 \cdot S + 3I0 \cdot \bar{S})$$

$$4\bar{Y} = \bar{E} \cdot (4I1 \cdot S + 4I0 \cdot \bar{S})$$

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  $-40\text{ }^{\circ}\text{C}$  to  $+80\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$ .

**PHILIPS**

### 3. Quick reference data

**Table 1: Quick reference data**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$t_{PHL}$ , $t_{PLH}$	propagation delay	$C_L = 15\text{ pF}$ ; $V_{CC} = 5\text{ V}$				
	nI0, nI1 to nY		-	12	-	ns
	$\bar{E}$ to $n\bar{Y}$		-	14	-	ns
	S to $n\bar{Y}$		-	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  $\mu\text{W}$ ).

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

$f_i$  = 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;

$\sum(C_L \times V_{CC}^2 \times f_o)$  = 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

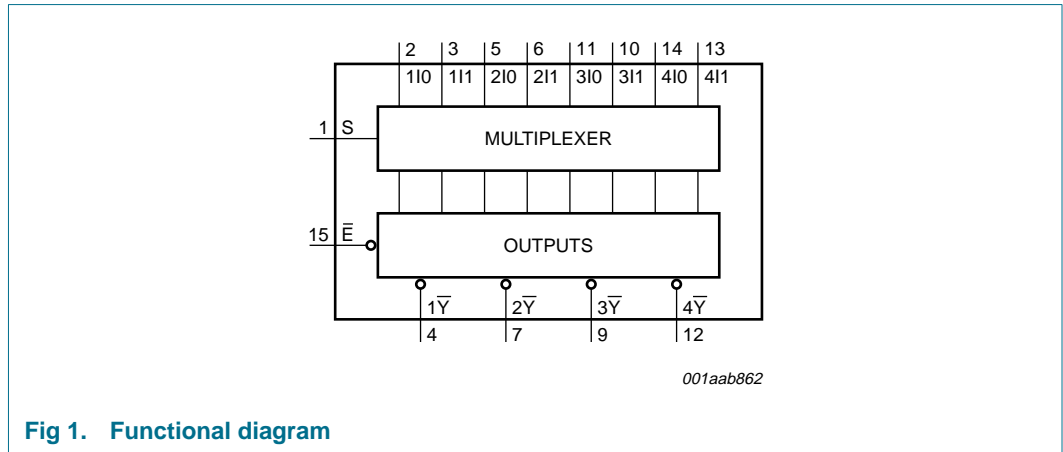


Fig 1. Functional diagram

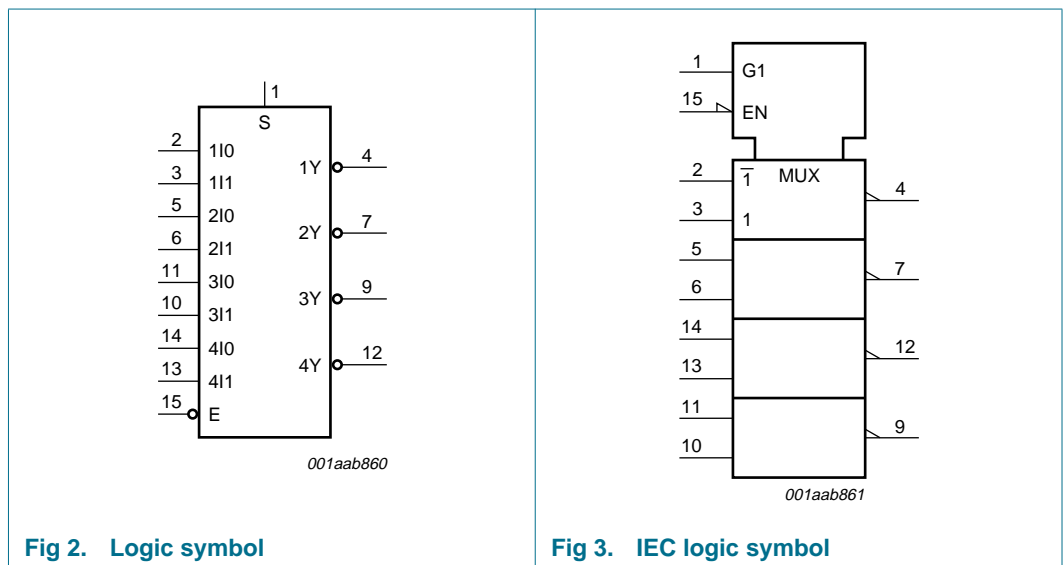


Fig 2. Logic symbol

Fig 3. IEC logic symbol

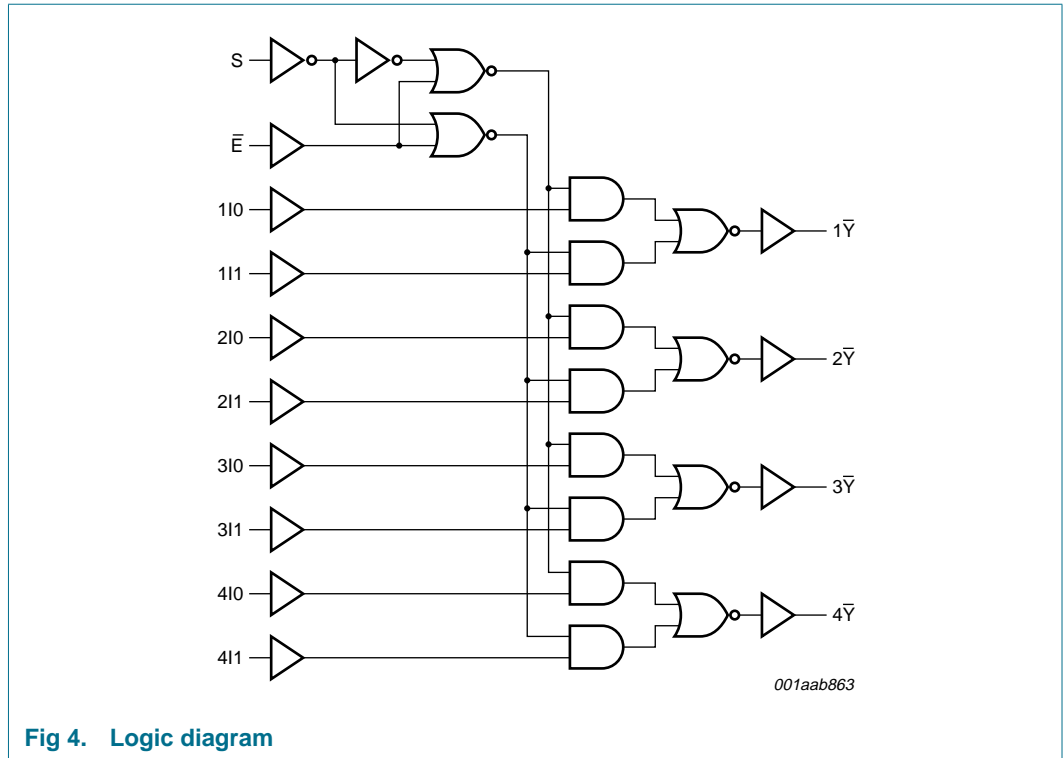


Fig 4. Logic diagram

## 6. Pinning information

### 6.1 Pinning

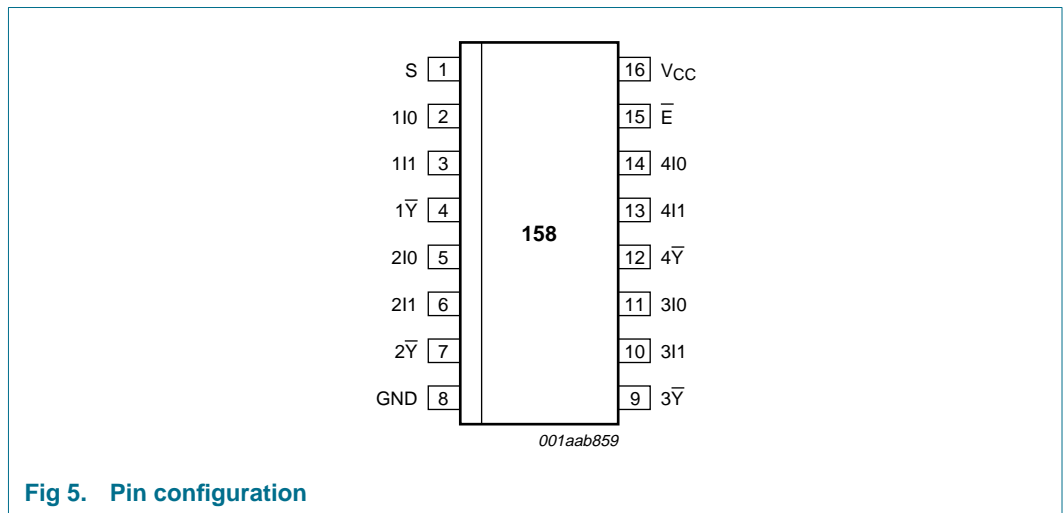


Fig 5. Pin configuration

## 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 $\bar{Y}$	4	multiplexer output 1
2I0	5	data input 2 from source 0
2I1	6	data input 2 from source 1
2 $\bar{Y}$	7	multiplexer output 2
GND	8	ground (0 V)
3 $\bar{Y}$	9	multiplexer output 3
3I1	10	data input 3 from source 1
3I0	11	data input 3 from source 0
4 $\bar{Y}$	12	multiplexer output 4
4I1	13	data input 4 from source 1
4I0	14	data input 4 from source 0
$\bar{E}$	15	enable input (active LOW)
V <sub>CC</sub>	16	positive supply voltage

## 7. Functional description

### 7.1 Function table

Table 4: Function [\[1\]](#)

Control		Input		Output
$\bar{E}$	S	nI0	nI1	n $\bar{Y}$
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	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_{OK}$	output diode current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA
$I_O$	output source or sink current	$V_O = -0.5\text{ V}$ to $V_{CC} + 0.5\text{ V}$	-	$\pm 25$	mA
$I_{CC}, I_{GND}$	$V_{CC}$ or GND current		-	$\pm 50$	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	$V_{CC} = 2.0\text{ V}$	-	-	1000	ns
		$V_{CC} = 4.5\text{ V}$	-	6.0	500	ns
		$V_{CC} = 6.0\text{ V}$	-	-	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
<b>T<sub>amb</sub> = 25 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	V
		V <sub>CC</sub> = 4.5 V	3.15	2.4	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	V
		V <sub>CC</sub> = 4.5 V	-	2.1	1.35	V
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V	-	0	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	μA
		V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	8.0	μA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	8.0	μA
C <sub>I</sub>	input capacitance		-	3.5	-	pF
<b>T<sub>amb</sub> = -40 °C to +85 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	-	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 4.5 V	3.84	-	-	V
I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 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 <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V	-	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 4.5 V	-	-	0.33	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	-	0.33	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±1.0	μA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	80	μA
<b>T<sub>amb</sub> = -40 °C to +125 °C</b>						
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	V
		V <sub>CC</sub> = 4.5 V	3.15	-	-	V
		V <sub>CC</sub> = 6.0 V	4.2	-	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	V
		V <sub>CC</sub> = 4.5 V	-	-	1.35	V
		V <sub>CC</sub> = 6.0 V	-	-	1.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 2.0 V	1.9	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	-	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	-	-	V
		I <sub>O</sub> = -4 mA; V <sub>CC</sub> = 4.5 V	3.7	-	-	V
		I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V	5.2	-	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>				
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 2.0 V	-	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	-	0.1	V
		I <sub>O</sub> = 4 mA; V <sub>CC</sub> = 4.5 V	-	-	0.4	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	-	0.4	V
I <sub>LI</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±1.0	μA
I <sub>CC</sub>	quiescent supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 6.0 V	-	-	160	μA



## 11. Dynamic characteristics

**Table 8: Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; see [Figure 8](#).

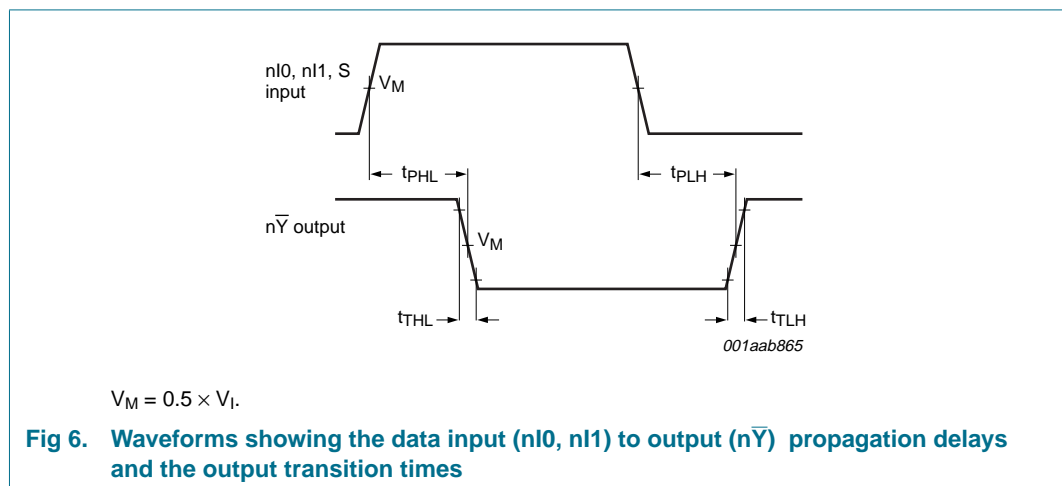
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b><math>T_{amb} = 25\text{ °C}</math></b>						
$t_{PHL}$ , $t_{PLH}$	propagation delay $nI0$ , $nI1$ to $n\bar{Y}$	see <a href="#">Figure 6</a>				
		$V_{CC} = 2.0\text{ V}$	-	41	125	ns
		$V_{CC} = 4.5\text{ V}$	-	15	25	ns
		$V_{CC} = 6.0\text{ V}$	-	12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

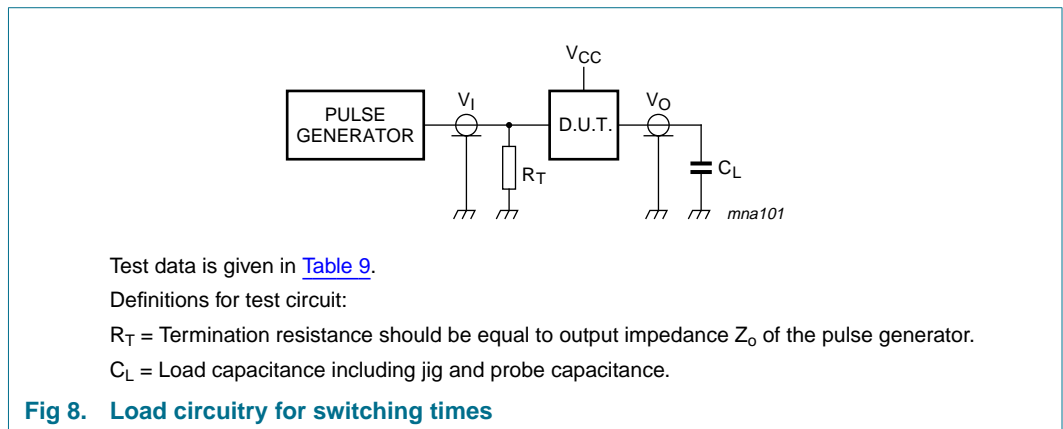
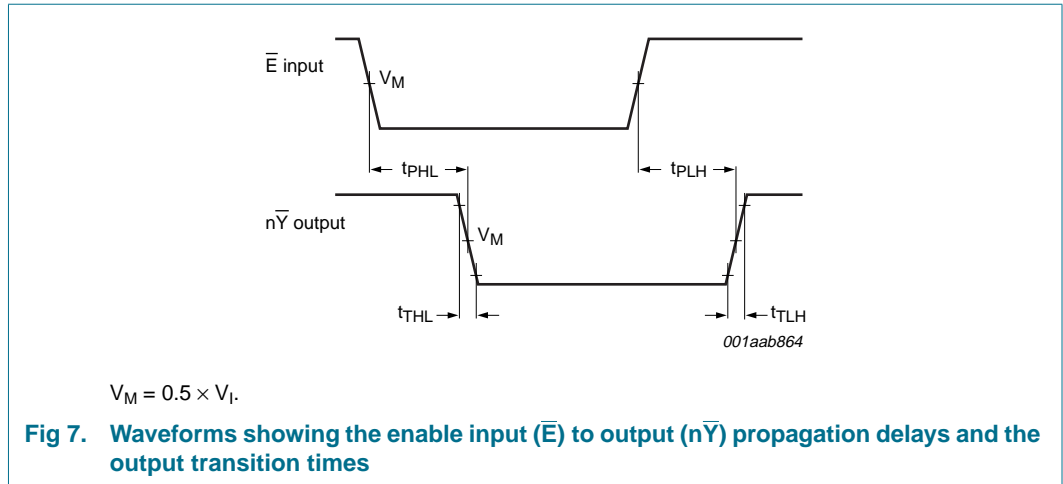
**Table 8: Dynamic characteristics ...continued**  
*GND = 0 V;  $t_r = t_f = 6 \text{ ns}$ ;  $C_L = 50 \text{ pF}$ ; see [Figure 8](#).*

Symbol	Parameter	Conditions	Min	Typ	Max	Unit	
<b><math>T_{\text{amb}} = -40 \text{ }^\circ\text{C to } +125 \text{ }^\circ\text{C}</math></b>							
$t_{\text{PHL}}, t_{\text{PLH}}$	propagation delay $n10, n11$ to $n\bar{Y}$	see <a href="#">Figure 6</a>					
		$V_{\text{CC}} = 2.0 \text{ V}$	-	-	190	ns	
		$V_{\text{CC}} = 4.5 \text{ V}$	-	-	38	ns	
			$V_{\text{CC}} = 6.0 \text{ V}$	-	-	32	ns
	propagation delay $\bar{E}$ to $n\bar{Y}$	see <a href="#">Figure 7</a>					
		$V_{\text{CC}} = 2.0 \text{ V}$	-	-	220	ns	
		$V_{\text{CC}} = 4.5 \text{ V}$	-	-	44	ns	
			$V_{\text{CC}} = 6.0 \text{ V}$	-	-	38	ns
	propagation delay $S$ to $n\bar{Y}$	see <a href="#">Figure 6</a>					
$V_{\text{CC}} = 2.0 \text{ V}$		-	-	220	ns		
$V_{\text{CC}} = 4.5 \text{ V}$		-	-	44	ns		
		$V_{\text{CC}} = 6.0 \text{ V}$	-	-	38	ns	
$t_{\text{THL}}, t_{\text{TLH}}$	output transition time	see <a href="#">Figure 6 and 7</a>					
		$V_{\text{CC}} = 2.0 \text{ V}$	-	-	110	ns	
		$V_{\text{CC}} = 4.5 \text{ V}$	-	-	22	ns	
		$V_{\text{CC}} = 6.0 \text{ V}$	-	-	19	ns	

- [1]  $C_{\text{PD}}$  is used to determine the dynamic power dissipation ( $P_{\text{D}}$  in  $\mu\text{W}$ ).  
 $P_{\text{D}} = C_{\text{PD}} \times V_{\text{CC}}^2 \times f_i \times N + \Sigma(C_L \times V_{\text{CC}}^2 \times f_o)$  where:  
 $f_i$  = input frequency in MHz;  
 $f_o$  = output frequency in MHz;  
 $C_L$  = output load capacitance in pF;  
 $V_{\text{CC}}$  = supply voltage in V;  
 $N$  = number of inputs switching;  
 $\Sigma(C_L \times V_{\text{CC}}^2 \times f_o)$  = sum of outputs.

## 12. Waveforms





**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

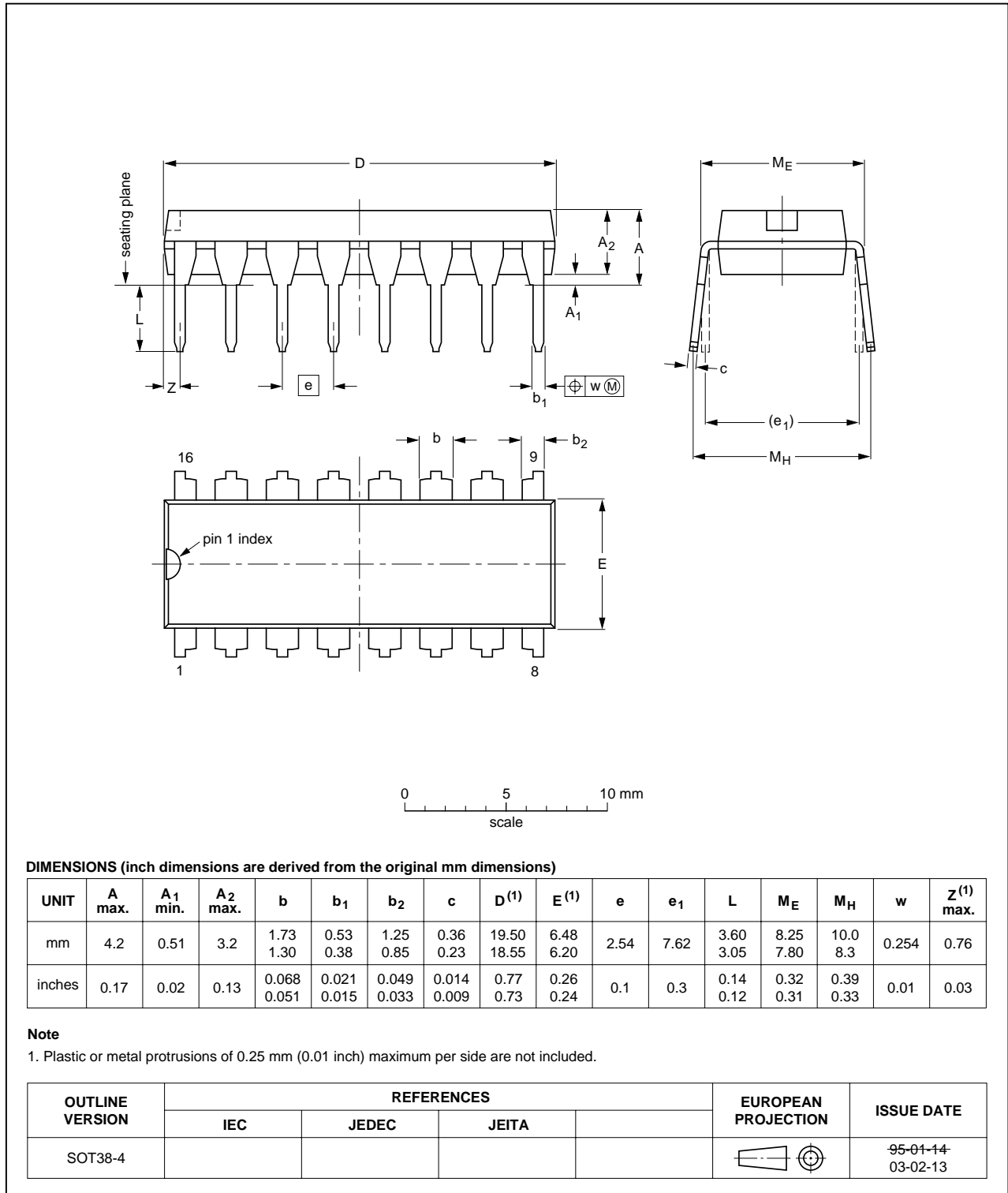


Fig 9. Package outline SOT38-4 (DIP16)

SO16: plastic small outline package; 16 leads; body width 3.9 mm

SOT109-1

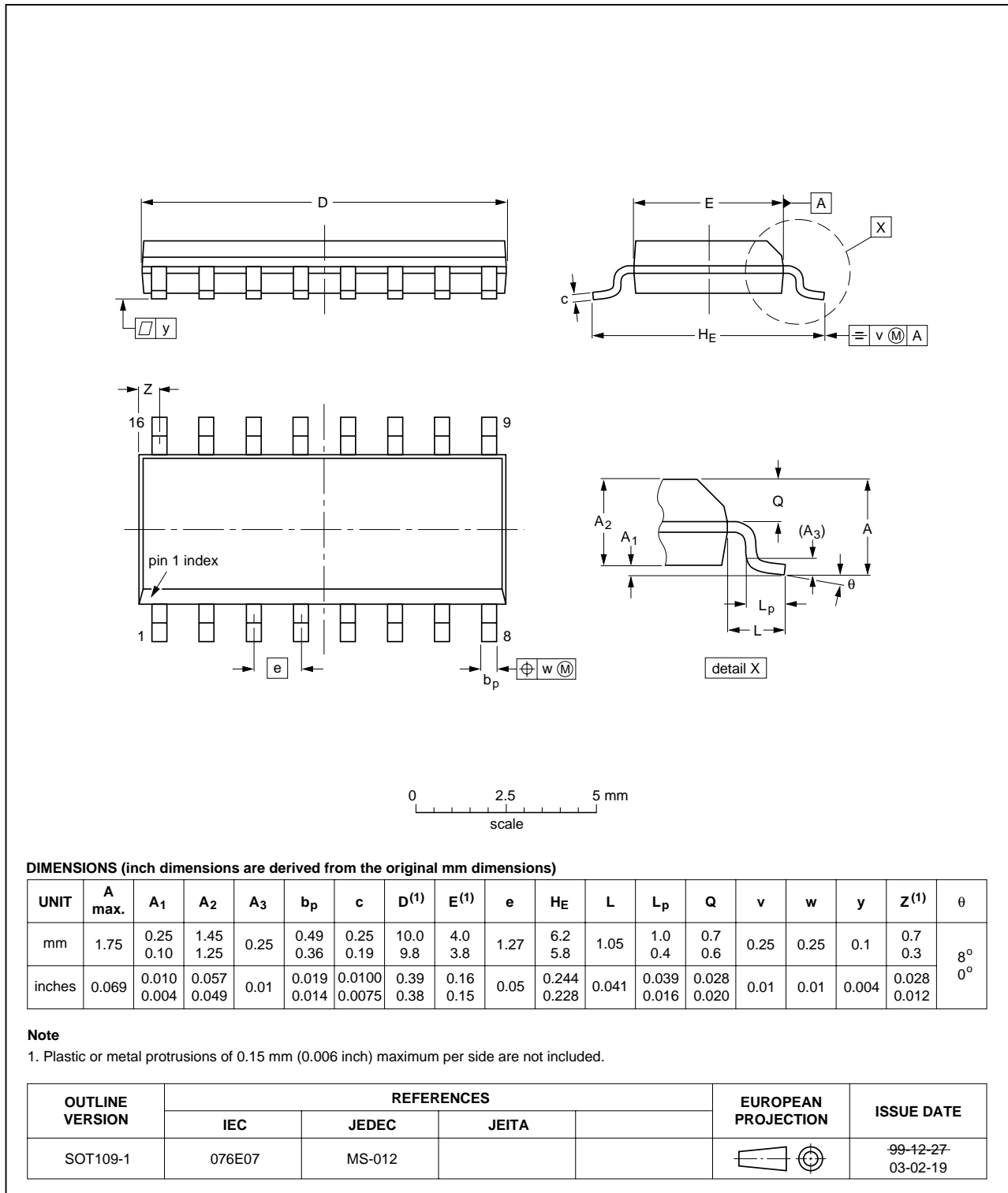


Fig 10. Package outline SOT109-1 (SO16)

## 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:					
					<ul style="list-style-type: none"><li>• The format of this data sheet has been redesigned to comply with the current presentation and information standard of Philips Semiconductors.</li><li>• Removed type number 74HCT158.</li><li>• Inserted family specification.</li></ul>
74HC_HCT158_CNV_2	19970827	Product specification	-	-	74HC_HCT158_1
74HC_HCT158_1	19901201	Product specification	-	-	-

## 15. Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2]</sup> <sup>[3]</sup>	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.
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[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

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**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](mailto:sales.addresses@www.semiconductors.philips.com)

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Date of release: 12 November 2004  
Document number: 9397 750 13805

Published in The Netherlands