## 74HC153; 74HCT153

# Dual 4-input multiplexer Rev. 5 — 23 January 2014

Product data sheet

#### 1. **General description**

The 74HC153; 74HCT153 is a dual 4-input multiplexer. The device features independent enable inputs (nE) and common data select inputs (S0 and S1). For each multiplexer, the select inputs select one of the four binary inputs and routes it to the multiplexer output (nY). A HIGH on E forces the corresponding multiplexer outputs LOW. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V<sub>CC</sub>.

#### 2. **Features and benefits**

- Input levels:
  - ◆ For 74HC153: CMOS level
  - For 74HCT153: TTL level
- Non-inverting outputs
- Separate enable input for each output
- Common select inputs
- Complies with JEDEC standard no. 7A
- Permits multiplexing from n lines to 1 line
- Enable line provided for cascading (n lines to 1 line)
- ESD protection:
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ♦ MM JESD22-A115-A exceeds 200 V
- Multiple package options
- Specified from -40 °C to +85 °C and -40 °C to +125 °C.

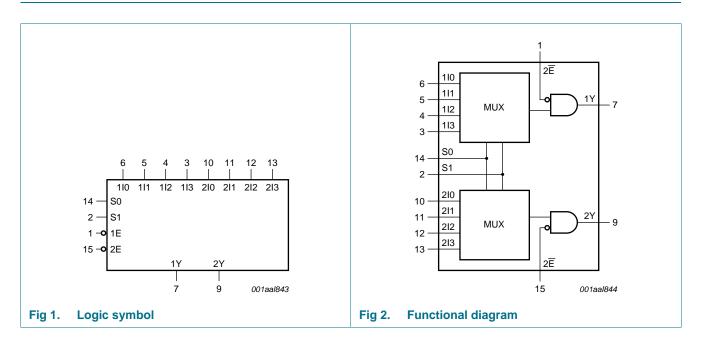


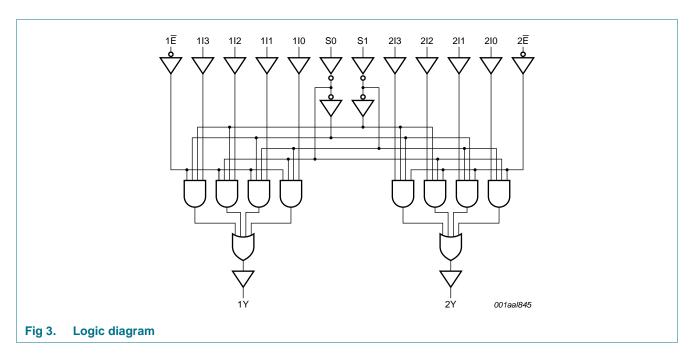
## 3. Ordering information

Table 1. Ordering information

Type number	Package										
	Temperature range	Name	Description	Version							
74HC153N	−40 °C to +125 °C	DIP16	plastic dual in-line package; 16 leads (300 mil)	SOT38-4							
74HCT153N											
74HC153D	–40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width	SOT109-1							
74HCT153D			3.9 mm								
74HC153DB	−40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads; body	SOT338-1							
74HCT153DB			width 5.3 mm								
74HC153PW	−40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads;	SOT403-1							
74HCT153PW			body width 4.4 mm								

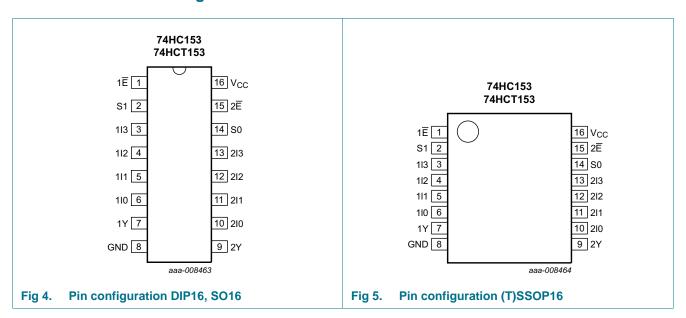
## 4. Functional diagram





## 5. Pinning information

#### 5.1 Pinning



### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1 <u>E</u> , 2 <u>E</u>	1, 15	output enable inputs (active LOW)
S0, S1	14, 2	data select inputs
110, 111, 112, 113	6, 5, 4, 3	data inputs source 1
1Y	7	multiplexer output source 1
GND	8	ground (0 V)
2Y	9	multiplexer output source 2
210, 211, 212, 213	10, 11, 12, 13	data inputs source 2
V <sub>CC</sub>	16	supply voltage

## 6. Functional description

Table 3. Function table

H = HIGH voltage level; L = LOW voltage level; X = don't care.

select Inputs	3	data inputs		output enable	output		
S0	S1	nI0	nl1	nl2	nl3	nE	nY
Χ	X	X	X	X	X	Н	L
L	L	L	X	X	X	L	L
L	L	Н	Χ	Χ	Χ	L	Н
Н	L	X	L	X	X	L	L
Н	L	X	Н	X	X	L	Н
L	Н	Χ	Χ	L	Χ	L	L
L	Н	Χ	Χ	Н	Χ	L	Н
Н	Н	Χ	Χ	Χ	L	L	L
Н	Н	X	X	X	Н	L	Н

## 7. Limiting values

Table 4. 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 <sub>IK</sub>	input clamping current	$V_I < -0.5 \text{ V or } V_I > V_{CC} + 0.5 \text{ V}$	<u>[1]</u> -	±20	mA
I <sub>OK</sub>	output clamping current	$V_O < -0.5 \text{ V or } V_O > V_{CC} + 0.5 \text{ V}$	<u>[1]</u> -	±20	mA
I <sub>O</sub>	output current	$-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$	-	±25	mA
I <sub>CC</sub>	supply current		-	50	mA
$I_{GND}$	ground current		-50	-	mA
T <sub>stg</sub>	storage temperature		<b>–65</b>	+150	°C

Table 4. Limiting values ...continued

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

Symbol	Parameter	Conditions	Min	Max	Unit
P <sub>tot</sub>	total power dissipation		[2]		
	DIP16 package		-	750	mW
	SO16 and (T)SSOP16 packages		-	500	mW

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

#### 8. Recommended operating conditions

#### Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions		74HC153	3	74HCT153			Unit
			Min	Тур	Max	Min	Тур	Max	
$V_{CC}$	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
VI	input voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
Vo	output voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
T <sub>amb</sub>	ambient temperature		-40	+25	+125	-40	+25	+125	°C
Δt/ΔV	input transition rise and fall rate	$V_{CC} = 2.0 \text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5 \text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0 \text{ V}$	-	-	83	-	-	-	ns/V

#### 9. Static characteristics

#### Table 6. Static characteristics

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

Symbol Parameter		Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC1	53									
$V_{IH}$	HIGH-level	$V_{CC} = 2.0 \text{ V}$	1.5	1.2	-	1.5	-	1.5	-	V
input voltage	$V_{CC} = 4.5 \text{ V}$	3.15	2.4	-	3.15	-	3.15	-	V	
		$V_{CC} = 6.0 \text{ V}$	4.2	3.2	-	4.2	-	4.2	-	V
$V_{IL}$	LOW-level	$V_{CC} = 2.0 \text{ V}$	-	8.0	0.5	-	0.5	-	0.5	V
input voltage	$V_{CC} = 4.5 \text{ V}$	-	2.1	1.35	-	1.35	-	1.35	V	
		V <sub>CC</sub> = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V

<sup>[2]</sup> For DIP16 package: P<sub>tot</sub> derates linearly with 12 mW/K above 70 °C.
For SO16 package: P<sub>tot</sub> derates linearly with 8 mW/K above 70 °C.
For (T)SSOP16 packages: P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.

 Table 6.
 Static characteristics ...continued

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

Symbol	Parameter	Conditions		25 °C		–40 °C t	o +85 °C	-40 °C t	o +125 °C	Un
			Min	Тур	Max	Min	Max	Min	Max	
√ <sub>OH</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$				I				
	output voltage	$I_O = -20 \mu A$ ; $V_{CC} = 2.0 \text{ V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -20 \mu A$ ; $V_{CC} = 4.5 \text{ V}$	4.4	4.5	-	4.4	-	4.4	-	٧
		$I_O = -20 \mu A; V_{CC} = 6.0 \text{ V}$	5.9	6.0	-	5.9	-	5.9	-	٧
		$I_{O} = -4.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.98	4.32	-	3.84	-	3.7	-	٧
		$I_{O} = -5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	5.48	5.81	-	5.34	-	5.2	-	٧
V <sub>OL</sub>	LOW-level	$V_I = V_{IH}$ or $V_{IL}$								
	output voltage	$I_O = 20 \mu A; V_{CC} = 2.0 V$	-	0	0.1	-	0.1	-	0.1	٧
		$I_O = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	٧
		$I_O = 20 \mu A; V_{CC} = 6.0 V$	-	0	0.1	-	0.1	-	0.1	٧
		$I_O = 4.0 \text{ mA}$ ; $V_{CC} = 4.5 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	٧
		$I_O = 5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	٧
l <sub>l</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1	-	±1	μΑ
lcc	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 6.0 \text{ V}$	-	-	8.0	-	80	-	160	μA
Cl	input capacitance		-	3.5	-	-	-	-	-	рF
74HCT1	53									
V <sub>IH</sub>	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	2.0	1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	$V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$	-	1.2	0.8	-	0.8	-	0.8	V
V <sub>ОН</sub>	HIGH-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	$I_{O} = -20 \mu A$	4.4	4.5	-	4.4	-	4.4	-	٧
		$I_0 = -4.0 \text{ mA}$	3.98	4.32	-	3.84	-	3.7	-	٧
V <sub>OL</sub>	LOW-level	$V_I = V_{IH}$ or $V_{IL}$ ; $V_{CC} = 4.5 \text{ V}$								
	output voltage	$I_O = 20 \mu A; V_{CC} = 4.5 V$	-	0	0.1	-	0.1	-	0.1	٧
		$I_{O} = 5.2 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	٧
l <sub>l</sub>	input leakage current	$V_I = V_{CC}$ or GND; $V_{CC} = 5.5 \text{ V}$	-	-	±0.1	-	±1	-	±1	μΑ
lcc	supply current	$V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5 \text{ V}$	-	-	8	-	80	-	160	μA
Δl <sub>CC</sub>	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V; } I_O = 0 \text{ A;}$ other inputs at $V_{CC}$ or GND; $V_{CC} = 4.5 \text{ V to } 5.5 \text{ V}$								
		1ln, 2ln	-	45	162	-	203	-	221	μA
		nĒ	-	60	216	-	270	-	294	μA
		Sn	-	135	486	-	608	-	662	μA
Cı	input capacitance		-	3.5	-	-	-	-	-	pF

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## 10. Dynamic characteristics

Table 7. Dynamic characteristics

 $GND = 0 \ V; \ t_r = t_f = 6 \ ns; \ C_L = 50 \ pF; \ for \ test \ circuit, \ see \ Figure 8; \ unless \ otherwise \ specified$ 

Symbol	Parameter	Conditions			25 °C		-40 °C t	o +85 °C	–40 °C to	+125 °C	Unit
				Min	Тур	Max	Min	Max	Min	Max	
74HC153	3										
t <sub>pd</sub>	propagation delay	1In to nY, 2In to nY; see Figure 6	[1]								
		V <sub>CC</sub> = 2.0 V		-	47	145	-	180	-	220	ns
		V <sub>CC</sub> = 4.5 V		-	17	29	-	36	-	44	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	14	-	-	-	-	-	ns
		$V_{CC} = 6.0 \text{ V}$		-	14	25	-	31	-	38	ns
		Sn to nY; see Figure 7									
		$V_{CC} = 2.0 \text{ V}$		-	50	150	-	190	-	225	ns
		$V_{CC} = 4.5 \text{ V}$		-	18	30	-	38	-	45	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	15	-	-	-	-	-	ns
		$V_{CC} = 6.0 \text{ V}$		-	14	26	-	33	-	38	ns
		nE to nY; see Figure 7									
		$V_{CC} = 2.0 \text{ V}$		-	33	100	-	125	-	150	ns
		$V_{CC} = 4.5 \text{ V}$		-	12	20	-	25	-	30	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	10	-	-	-	-	-	ns
		V <sub>CC</sub> = 6.0 V		-	10	17	-	21	-	26	ns
t <sub>t</sub>	transition time	see Figure 6	[2]								
		V <sub>CC</sub> = 2.0 V		-	19	75	-	95	-	110	ns
		V <sub>CC</sub> = 4.5 V		-	7	15	-	19	-	22	ns
		V <sub>CC</sub> = 6.0 V		-	6	13	-	16	-	19	ns
$C_{PD}$	power dissipation capacitance	per package; $V_I = GND$ to $V_{CC}$	[3]	-	30	-	-	-	-	-	pF
74HCT1	53										
t <sub>PHL</sub>	HIGH to LOW propagation	1In to nY, 2In to nY; see Figure 6	[1]								
	delay	$V_{CC} = 4.5 \text{ V}$		-	19	34	-	43	-	51	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	16	-	-	-	-	-	ns
t <sub>PLH</sub>	LOW to HIGH propagation	1In to nY, 2In to nY; see Figure 6	[1]								
	delay	$V_{CC} = 4.5 V$		-	13	24	-	30	-	36	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	16	-	-	-	-	-	ns

**Dynamic characteristics** ...continued Table 7.

GND = 0 V;  $t_r = t_f = 6$  ns;  $C_L = 50$  pF; for test circuit, see Figure 8; unless otherwise specified

Symbol	Parameter	Conditions			25 °C		-40 °C t	o +85 °C	-40 °C to	o +125 °C	Unit
				Min	Тур	Max	Min	Max	Min	Max	
t <sub>pd</sub> propagation		Sn to nY; see Figure 7	[1]						•	•	
	delay	$V_{CC} = 4.5 \text{ V}$		-	20	34	-	43	-	51	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	17	-	-	-	-	-	ns
		nE to nY; see Figure 7	[1]								
		$V_{CC} = 4.5 \text{ V}$		-	14	27	-	34	-	41	ns
		$V_{CC} = 5.0 \text{ V}; C_L = 15 \text{ pF}$		-	11	-	-	-	-	-	ns
t <sub>t</sub>	transition time	see Figure 6	[2]								
		$V_{CC} = 4.5 \text{ V}$		-	7	15	-	19	-	22	ns
C <sub>PD</sub>	power dissipation capacitance	per package; $V_I = GND \text{ to } V_{CC} - 1.5 \text{ V}$	[3]	-	30	-	-	-	-	-	pF

- [1]  $t_{pd}$  is the same as  $t_{PHL}$  and  $t_{PLH}$ .
- [2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu W$ ):

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

f<sub>i</sub> = input frequency in MHz;

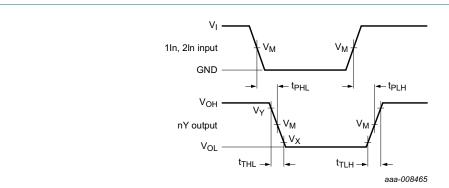
f<sub>o</sub> = output frequency in MHz;

C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

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



(1) Measurement points are given in Table 8.

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

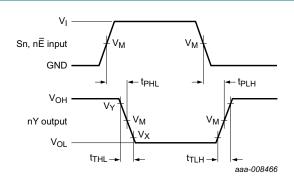
Waveforms showing the input (1In, 2In) to output (1Y, 2Y) propagation delays and output transition times Fig 6.

Table 8. **Measurement points** 

Туре	Input	Output					
	V <sub>M</sub>	V <sub>M</sub>	V <sub>X</sub>	V <sub>Y</sub>			
74HC153	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>			
74HCT153	1.3 V	1.3 V	0.1V <sub>CC</sub>	0.9V <sub>CC</sub>			

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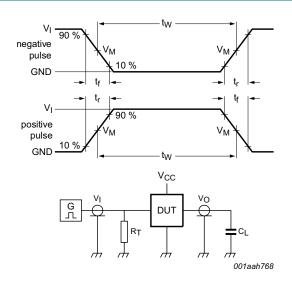
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(1) Measurement points are given in Table 8.

 $V_{\text{OL}}$  and  $V_{\text{OH}}$  are typical voltage output levels that occur with the output load.

Fig 7. Waveforms showing the input (Sn, nE) to output (nY) propagation delays



Test data is given in Table 9.

Definitions test circuit:

 $R_T$  = termination resistance should be equal to output impedance  $Z_0$  of the pulse generator.

 $C_L$  = load capacitance including jig and probe capacitance.

Fig 8. Test circuit for measuring switching times

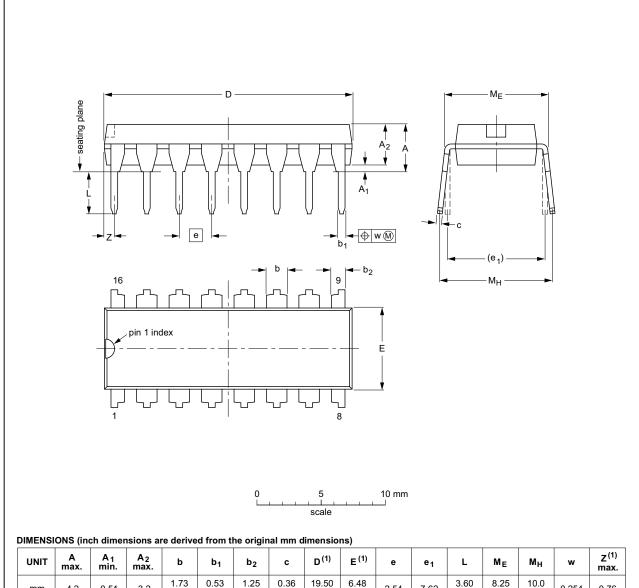
Table 9. Test data

Туре	Input I		Load	Test
	VI	t <sub>r</sub> , t <sub>f</sub>	CL	
74HC153	V <sub>CC</sub>	6.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>
74HCT153	3.0 V	6.0 ns	15 pF, 50 pF	t <sub>PLH</sub> , t <sub>PHL</sub>

## 11. Package outline

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

SOT38-4



UNIT	A max.	A <sub>1</sub> min.	A <sub>2</sub> max.	b	b <sub>1</sub>	b <sub>2</sub>	С	D <sup>(1)</sup>	E <sup>(1)</sup>	е	e <sub>1</sub>	L	ME	Мн	w	Z <sup>(1)</sup> 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		REFER	EUROPEAN	ISSUE DATE		
VERSION	IEC	JEDEC	JEITA	PROJECTION	ISSUE DATE	
SOT38-4					<del>95-01-14</del> 03-02-13	

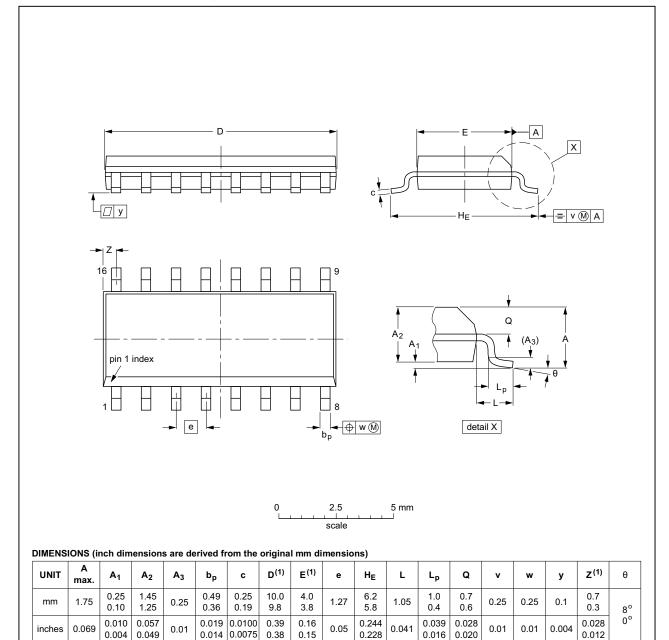
Fig 9. Package outline SOT38-4 (DIP16)

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

SOT109-1



#### Note

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

OUTLINE		REFER	EUROPEAN	ISSUE DATE			
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE	
SOT109-1	076E07	MS-012				<del>99-12-27</del> 03-02-19	

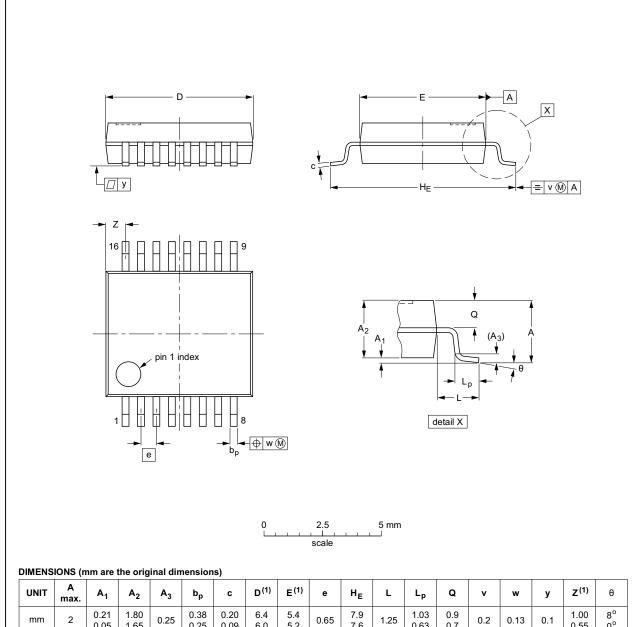
Fig 10. Package outline SOT109-1 (SO16)

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SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1



UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	<b>A</b> <sub>3</sub>	b <sub>p</sub>	C	D <sup>(1)</sup>	E <sup>(1)</sup>	е	HE	L	Lp	Q	v	w	у	Z <sup>(1)</sup>	θ
mm	2	0.21 0.05	1.80 1.65	0.25	0.38 0.25	0.20 0.09	6.4 6.0	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	1.00 0.55	8° 0°

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

OUTLINE		REFER	EUROPEAN	ISSUE DATE				
VERSION	IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE		
SOT338-1		MO-150				<del>99-12-27</del> 03-02-19		

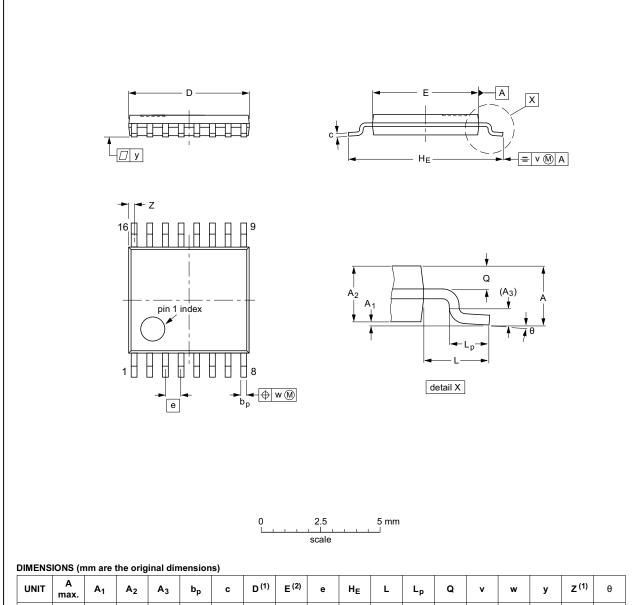
Fig 11. Package outline SOT338-1 (SSOP16)

74HC\_HCT153

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TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1



UNIT	A max.	<b>A</b> <sub>1</sub>	A <sub>2</sub>	<b>A</b> <sub>3</sub>	b <sub>p</sub>	С	D <sup>(1)</sup>	E <sup>(2)</sup>	е	HE	L	Lp	Q	v	w	у	Z <sup>(1)</sup>	θ	
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	5.1 4.9	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	0.40 0.06	8° 0°	

#### 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		REFER	EUROPEAN	ISSUE DATE			
VERSION		IEC	JEDEC	JEITA		PROJECTION	ISSUE DATE	
	SOT403-1		MO-153				<del>-99-12-27</del> 03-02-18	
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Fig 12. Package outline SOT403-1 (TSSOP16)

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## 12. Abbreviations

#### Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
НВМ	Human Body Model
LSTTL	Low-power Schottky Transistor-Transistor Logic
MM	Machine Model
TTL	Transistor-Transistor Logic

## 13. Revision history

#### Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT153 v.5	20140123	Product data sheet	-	74HC_HCT153 v.4
Modifications:	• Table 1 and	Section 11: all references t	o 14 pin packages r	emoved.
74HC_HCT153 v.4	20131128	Product data sheet	-	74HC_HCT153 v.3
74HC_HCT153 v.3	20130722	Product data sheet	-	74HC_HCT153_CNV v.2
74HC_HCT153_CNV v.2	19970827	Product specification	-	-

#### 14. Legal information

#### 14.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

- [1] Please consult the most recently issued document before initiating or completing a design.
- [2] The term 'short data sheet' is explained in section "Definitions"
- [3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <a href="http://www.nxp.com">http://www.nxp.com</a>.

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