# **74HC253; 74HCT253** Dual 4-input multiplexer; 3-state Rev. 6 – 1 February 2016

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

The 74HC253; 74HCT253 is a dual 4-bit multiplexer, each with four binary inputs (nI0 to nl3), an output enable input (nOE) and shared select inputs (S0 and S1). One of the four binary inputs is selected by the select inputs and routed to the output nY. A HIGH on nOE causes the outputs to assume a high-impedance OFF-state. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V<sub>CC</sub>.

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

- Non-inverting data path
- 3-state outputs interface directly with system bus
- Complies with JEDEC standard no. 7A
- Common select inputs
- Separate output enable inputs
- Input levels:
  - For 74HC253: CMOS level
  - For 74HCT253: TTL level
- 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 from –40 °C to +125 °C

#### Applications 3.

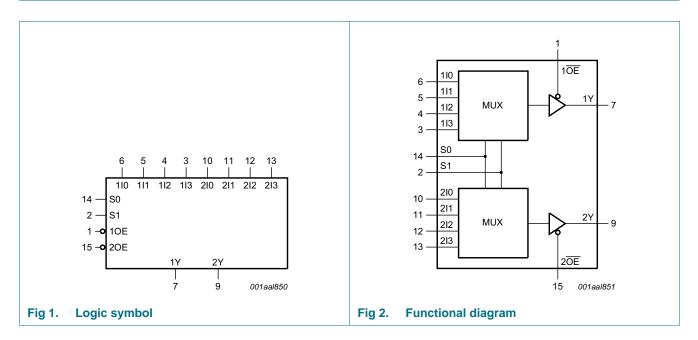
- Data selectors
- Data multiplexers



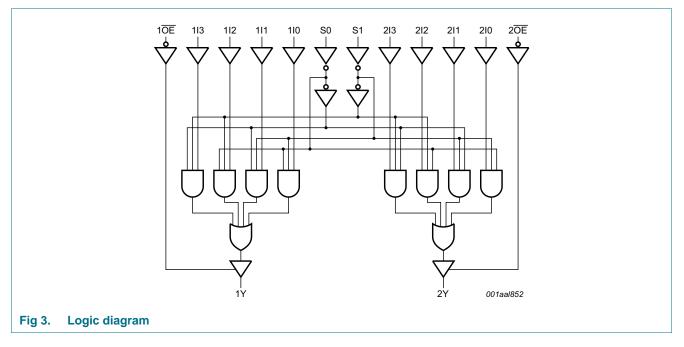
# 4. Ordering information

Table 1.         Ordering information										
Type number	Package	Package								
	Temperature range	Name	Description	Version						
74HC253D	–40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width	SOT109-1						
74HCT253D	-		3.9 mm							
74HC253DB	–40 °C to +125 °C	SSOP16	plastic shrink small outline package; 16 leads;	SOT338-1						
74HCT253DB			body width 5.3 mm							

# 5. Functional diagram

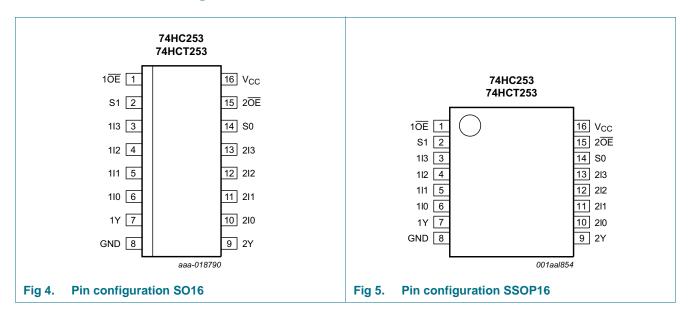


Dual 4-input multiplexer; 3-state



# 6. Pinning information

### 6.1 Pinning



Dual 4-input multiplexer; 3-state

### 6.2 Pin description

Table 2.   Pin description		
Symbol	Pin	Description
1 <u>0</u> , 2 <u>0</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

# 7. Functional description

Table 3.	Function tab						
select In	outs	data inp	uts	output enable	output		
S0	S1	nl0	nl1	nl2	nl3	nOE	nY
Х	Х	Х	Х	Х	Х	н	Z
L	L	L	Х	Х	Х	L	L
L	L	Н	Х	Х	Х	L	Н
Н	L	Х	L	X	Х	L	L
Н	L	Х	Н	X	Х	L	Н
L	Н	Х	Х	L	Х	L	L
L	Н	Х	Х	Н	Х	L	Н
Н	Н	Х	Х	X	L	L	L
Н	Н	Х	Х	Х	Н	L	Н

[1] H = HIGH voltage level; L = LOW voltage level; X = don't care; Z = high-impedance OFF-state.

# 8. 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 <sub>CC</sub>	supply voltage			-0.5	+7.0	V
I <sub>IK</sub>	input clamping current	$V_{\rm I}$ < –0.5 V or $V_{\rm I}$ > $V_{\rm CC}$ + 0.5 V	<u>[1]</u>	-	±20	mA
I <sub>OK</sub>	output clamping current	$V_{O}$ < -0.5 V or $V_{O}$ > $V_{CC}$ + 0.5 V	<u>[1]</u>	-	±50	mA
lo	output current	$-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$		-	±35	mA
I <sub>CC</sub>	supply current			-	70	mA
I <sub>GND</sub>	ground current			-70	-	mA
T <sub>stg</sub>	storage temperature			-65	+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	$T_{amb} = -40 \text{ °C to } +125 \text{ °C}$			
		SO16 package [2]	-	500	mW
		SSOP16 package [3]	-	500	mW

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

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

[3] P<sub>tot</sub> derates linearly with 5.5 mW/K above 60 °C.

# 9. Recommended operating conditions

### Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions		74HC253			74HCT253		
			Min	Тур	Max	Min	Тур	Max	
V <sub>CC</sub>	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
VI	input voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
Vo	output voltage		0	-	V <sub>CC</sub>	0	-	V <sub>CC</sub>	V
T <sub>amb</sub>	ambient temperature		-40	-	+125	-40	-	+125	°C
$\Delta t / \Delta V$	input transition rise and fall rate	$V_{CC} = 2.0 V$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5 V$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0 V$	-	-	83	-	-	-	ns/V

# **10. 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 t	o +85 °C	–40 °C to	o +125 °C	Unit
			Min	Тур	Max	Min	Max	Min	Max	
74HC25	3	1				1				
	HIGH-level	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
	input voltage	V <sub>CC</sub> = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V <sub>CC</sub> = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V <sub>IL</sub> L	LOW-level	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
	input voltage	V <sub>CC</sub> = 4.5 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
V <sub>OH</sub>	HIGH-level	$V_{I} = V_{IH} \text{ or } V_{IL}$								
	output voltage	$I_{O} = -20 \ \mu A; \ V_{CC} = 2.0 \ V$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_0 = -20 \ \mu\text{A}; \ V_{CC} = 4.5 \ \text{V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_0 = -20 \ \mu A; \ V_{CC} = 6.0 \ V$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_{O} = -6.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	3.98	4.32	-	3.84	-	3.7	-	V
		$I_{O} = -7.8 \text{ mA}; V_{CC} = 6.0 \text{ V}$	5.48	5.81	-	5.34	-	5.2	-	V

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Dual 4-input multiplexer; 3-state

### 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	Unit
			Min	Тур	Max	Min	Max	Min	Max	
V <sub>OL</sub>	LOW-level	$V_{I} = V_{IH} \text{ or } V_{IL}$								
	output voltage	$I_0 = 20 \ \mu A; V_{CC} = 2.0 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_{O} = 20 \ \mu A; V_{CC} = 4.5 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_{O} = 20 \ \mu A; V_{CC} = 6.0 \ V$	-	0	0.1	-	0.1	-	0.1	V
		$I_{O} = 6.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$	-	0.15	0.26	-	0.33	-	0.4	V
		$I_{O} = 7.8 \text{ mA}; V_{CC} = 6.0 \text{ V}$	-	0.16	0.26	-	0.33	-	0.4	V
I	input leakage current	$V_I = V_{CC} \text{ or GND};$ $V_{CC} = 6.0 \text{ V}$	-	-	±0.1	-	±1.0	-	±1.0	μA
l <sub>oz</sub>	$\begin{array}{ll} \text{OFF-state} & \text{V}_{\text{I}} = \text{V}_{\text{IH}} \text{ or } \text{V}_{\text{IL}};\\ \text{output current} & \text{V}_{\text{O}} = \text{V}_{\text{CC}} \text{ or } \text{GND};\\ \text{V}_{\text{CC}} = 6.0 \text{ V} \end{array}$		-	-	±0.5	-	±5.0	-	±10.0	μA
I <sub>CC</sub>	supply current	$V_{I} = V_{CC} \text{ or GND; } I_{O} = 0 \text{ A;}$ $V_{CC} = 6.0 \text{ V}$	-	-	8.0	-	80	-	160	μA
Cı	input capacitance		-	3.5	-	-	-	-	-	pF
74HCT2	53									
V <sub>IH</sub>	HIGH-level input voltage			1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	$V_{CC}$ = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
/ <sub>ОН</sub> HIGH-level	$V_{I} = V_{IH} \text{ or } V_{IL}; V_{CC} = 4.5 \text{ V}$									
	output voltage	I <sub>O</sub> = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -6 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level	$V_{I} = V_{IH} \text{ or } V_{IL}; V_{CC} = 4.5 \text{ V}$								
	output voltage	I <sub>O</sub> = 20 μA	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 6.0 mA	-	0.15	0.26	-	0.33	-	0.4	V
lı	input leakage current	$V_1 = V_{CC}$ or GND; $V_{CC} = 5.5 V$	-	-	±0.1	-	±1.0	-	±1.0	μA
loz	OFF-state output current		-	-	±0.5	-	±5.0	-	±10	μA
lcc	supply current		-	-	8.0	-	80	-	160	μA
∆l <sub>CC</sub>	additional supply current	$\label{eq:VI} \begin{array}{l} V_I = V_{CC} - 2.1 \text{ V};\\ \text{other inputs at } V_{CC} \text{ or GND};\\ V_{CC} = 4.5 \text{ V to 5.5 V};\\ I_O = 0 \text{ A} \end{array}$								
		per input pin; 1In, 2In inputs	-	40	144	-	180	-	196	μA
		per input pin; nOE input	-	110	396	-	495	-	539	μΑ
		per input pin; Sn input	-	110	396	-	495	-	539	μΑ
CI	input capacitance		-	3.5	-	-	-	-	-	pF

Product data sheet

# **11. Dynamic characteristics**

### Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); For test circuit see Figure 8.

Symbol	Parameter	Conditions	25	°C	–40 °C to +85 °C	–40 °C to +125 °C	Unit
			Тур	Max	Max	Мах	-
74HC25	3				1		
t <sub>pd</sub>	propagation delay	1In to 1Y or 2In to 2Y;[1]see Figure 6					
		V <sub>CC</sub> = 2.0 V	55	175	220	265	ns
		V <sub>CC</sub> = 4.5 V	20	35	44	53	ns
		$V_{CC} = 5.0 \text{ V}; \text{ C}_{L} = 15 \text{ pF}$	17	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	16	30	37	45	ns
		Sn to nY; see Figure 6					
	V <sub>CC</sub> = 2.0 V	58	175	220	265	ns	
	V <sub>CC</sub> = 4.5 V	21	35	44	53	ns	
		$V_{CC} = 5.0 \text{ V}; \text{ C}_{L} = 15 \text{ pF}$	18	-	-	-	ns
		V <sub>CC</sub> = 6.0 V	17	30	37	45	ns
t <sub>en</sub>	enable time	nOE to nY; see Figure 7 [2]					
	V <sub>CC</sub> = 2.0 V	30	100	125	150	ns	
	V <sub>CC</sub> = 4.5 V	11	20	25	30	ns	
		V <sub>CC</sub> = 6.0 V	9	17	21	26	ns
t <sub>dis</sub>	disable time	nOE to nY; see Figure 7 [3]					
		V <sub>CC</sub> = 2.0 V	41	150	190	225	ns
		V <sub>CC</sub> = 4.5 V	15	30	38	45	ns
		V <sub>CC</sub> = 6.0 V	12	26	33	38	ns
t <sub>t</sub>	transition time	see Figure 6					
		V <sub>CC</sub> = 2.0 V	14	60	75	90	ns
		V <sub>CC</sub> = 4.5 V	5	12	15	18	ns
		V <sub>CC</sub> = 6.0 V	4	10	13	15	ns
C <sub>PD</sub>	power dissipation capacitance	per multiplexer; [5] $V_1 = GND$ to $V_{CC}$	55	-	-	-	pF
74HCT2	53		1	1	1		
t <sub>pd</sub>	propagation delay	1In to 1Y or 2In to 2Y;[1]see Figure 6					
		V <sub>CC</sub> = 4.5 V	20	38	48	57	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	17	-	-	-	ns
		Sn to nY; see Figure 6					-
		V <sub>CC</sub> = 4.5 V	22	40	50	60	ns
		V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF	19	-			ns
t <sub>en</sub>	enable time	nOE to nY; V <sub>CC</sub> = 4.5 V; [2] see Figure 7	14	30	38	45	ns

### Table 7. Dynamic characteristics ...continued

Voltages are referenced to GND (ground = 0 V); For test circuit see Figure 8.

Symbol	Parameter	Conditions	25	25 °C –40 °C to +4		–40 °C to +125 °C	Unit
			Тур	Max	Max	Мах	
t <sub>dis</sub>	disable time	$n\overline{OE}$ to nY; V <sub>CC</sub> = 4.5 V; [3] see Figure 7	13	30	38	45	ns
tt	transition time	V <sub>CC</sub> = 4.5 V; see <u>Figure 6</u>	5	12	15	18	ns
C <sub>PD</sub>	power dissipation capacitance	$\begin{array}{ll} \mbox{per multiplexer;} & \mbox{[5]} \\ \mbox{V}_{I} = GND \mbox{ to } V_{CC} - 1.5 \mbox{ V} \end{array}$	55	-	-	-	pF

[1]  $t_{pd}$  is the same as  $t_{PHL}$ ,  $t_{PLH}$ .

[2]  $t_{en}$  is the same as  $t_{PZH}$ ,  $t_{PZL}$ .

[3]  $t_{dis}$  is the same as  $t_{PHZ}$ ,  $t_{PLZ}$ .

[4]  $t_t$  is the same as  $t_{THL}$ ,  $t_{TLH}$ .

[5]  $C_{PD}$  is used to determine the dynamic power dissipation (P<sub>D</sub> in  $\mu$ W).

 $P_{D} = C_{PD} \times V_{CC}^{2} \times f_{i} \times N + \sum (C_{L} \times V_{CC}^{2} \times f_{o}) \text{ where:}$ 

 $f_i$  = input frequency in MHz;

 $f_o$  = output frequency in MHz;

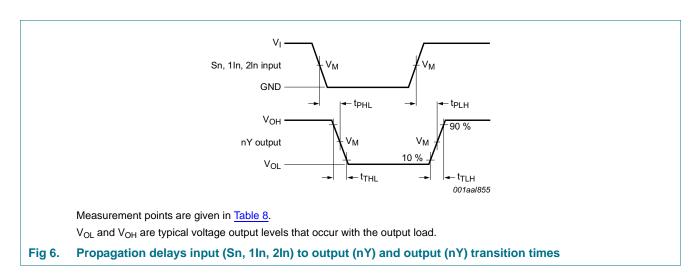
 $C_L$  = output load capacitance in pF;

 $V_{CC}$  = supply voltage in V;

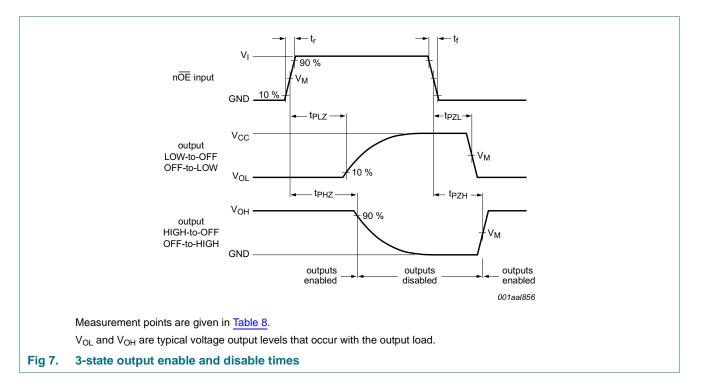
N = number of inputs switching;

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

### 12. Waveforms



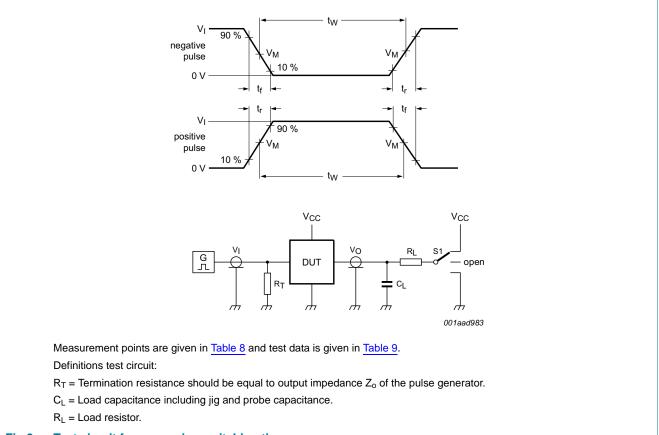
### Dual 4-input multiplexer; 3-state



#### Table 8.Measurement points

Туре	Input	Output	
	V <sub>M</sub>	V <sub>M</sub>	
74HC253	0.5V <sub>CC</sub>	0.5V <sub>CC</sub>	
74HCT253	1.3 V	1.3 V	

### Dual 4-input multiplexer; 3-state



### Fig 8. Test circuit for measuring switching times

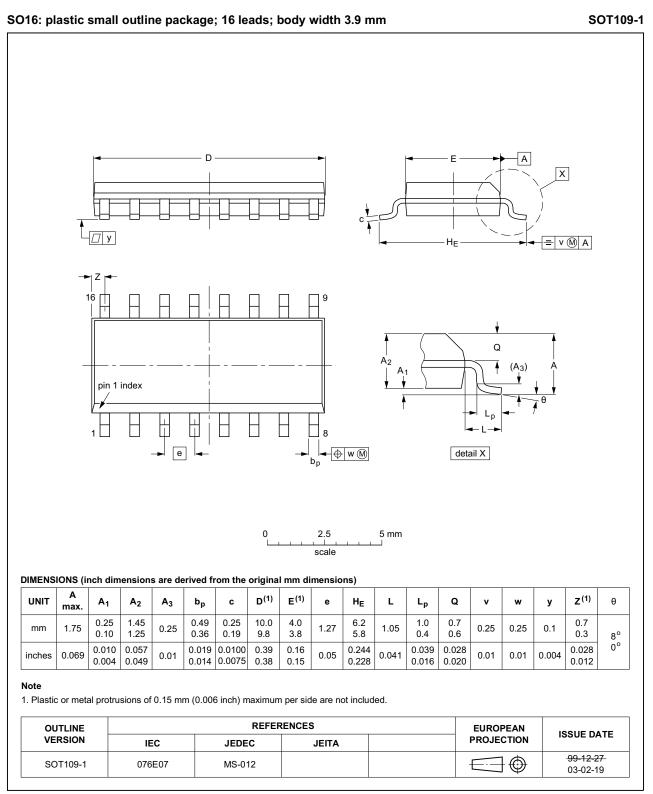
### Table 9. Test data

Туре	Input		Load		Switch position		
	VI	t <sub>r</sub> , t <sub>f</sub>	CL	RL	t <sub>PHL</sub> , t <sub>PLH</sub>	t <sub>PZH</sub> , t <sub>PHZ</sub>	t <sub>PZL</sub> , t <sub>PLZ</sub>
74HC253	V <sub>CC</sub>	6 ns	50 pF	1 kΩ	open	GND	V <sub>CC</sub>
74HCT253	3 V	6 ns	50 pF	1 kΩ	open	GND	V <sub>CC</sub>



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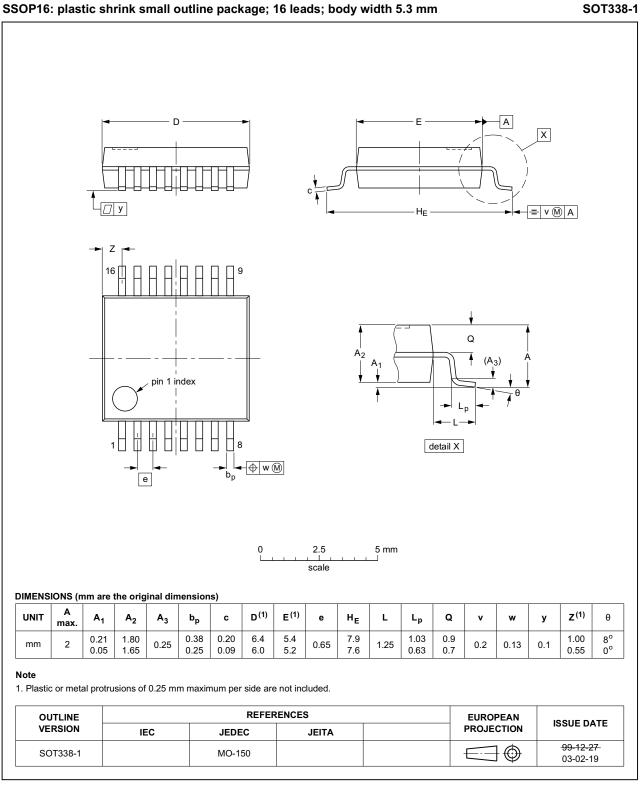
# 13. Package outline



### Fig 9. Package outline SOT109-1 (SO16)

74HC\_HCT253

Dual 4-input multiplexer; 3-state



#### Fig 10. Package outline SOT338-1 (SSOP16)

74HC\_HCT253

# 14. Abbreviations

Table 10. Abbreviations			
Acronym	Description		
CMOS	Complementary Metal Oxide Semiconductor		
DUT	Device Under Test		
ESD	ElectroStatic Discharge		
НВМ	Human Body Model		
MM	Machine Model		
TTL	Transistor-Transistor Logic		

# **15. Revision history**

### Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT253 v.6	20160201	Product data sheet	-	74HC_HCT253 v.5
Modifications:	<ul> <li>Type numbers 74HC253N and 74HCT253N (SOT38-4) removed.</li> </ul>			
74HC_HCT253 v.5	20150121	Product data sheet	-	74HC_HCT253 v.4
Modifications:	• <u>Table 7</u> : Power di	ssipation capacitance cor	ndition for 74HCT253 i	s corrected.
74HC_HCT253 v.4	20111212	Product data sheet	-	74HC_HCT253 v.3
Modifications:	Legal pages updated.			
74HC_HCT253 v.3	20100422	Product data sheet	-	74HC_HCT253_CNV v.2
74HC_HCT253_CNV v.2	970828	Product specification	-	-

# 16. Legal information

### 16.1 Data sheet status

Document status <sup>[1][2]</sup>	Product status <sup>[3]</sup>	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".

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Product data sheet

### Dual 4-input multiplexer; 3-state

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### Dual 4-input multiplexer; 3-state

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