

# 74HC153-Q100; 74HCT153-Q100

## Dual 4-input multiplexer

Rev. 3 — 23 January 2014

Product data sheet

## 1. General description

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The 74HC153-Q100; 74HCT153-Q100 is a dual 4-input multiplexer. The device features independent enable inputs ( $n\bar{E}$ ) 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  $\bar{E}$  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  $V_{CC}$ .

This product has been qualified to the Automotive Electronics Council (AEC) standard Q100 (Grade 1) and is suitable for use in automotive applications.

## 2. Features and benefits

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- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
  - ◆ Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and from  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Input levels:
  - ◆ For 74HC153-Q100: CMOS level
  - ◆ For 74HCT153-Q100: 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:
  - ◆ MIL-STD-883, method 3015 exceeds 2000 V
  - ◆ HBM JESD22-A114F exceeds 2000 V
  - ◆ MM JESD22-A115-A exceeds 200 V ( $C = 200\text{ pF}$ ,  $R = 0\text{ }\Omega$ )
- Multiple package options

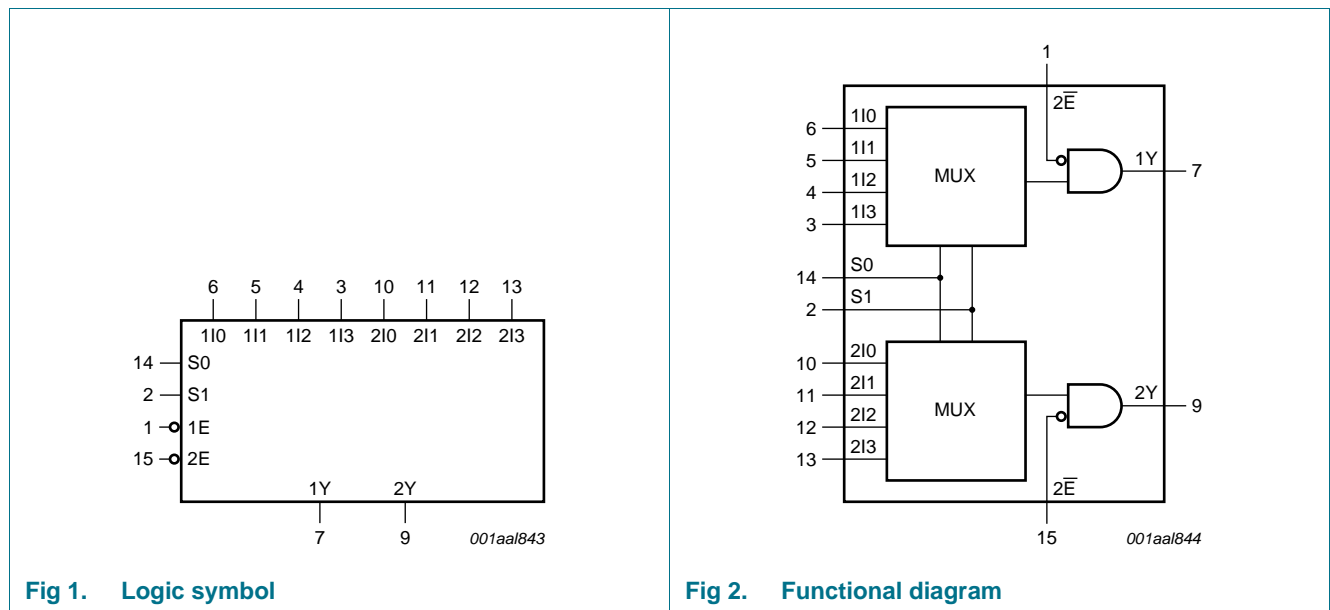


## 3. Ordering information

Table 1. Ordering information

Type number	Package			Version
	Temperature range	Name	Description	
74HC153D-Q100	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT153D-Q100				
74HC153PW-Q100	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1
74HCT153PW-Q100				

## 4. Functional diagram



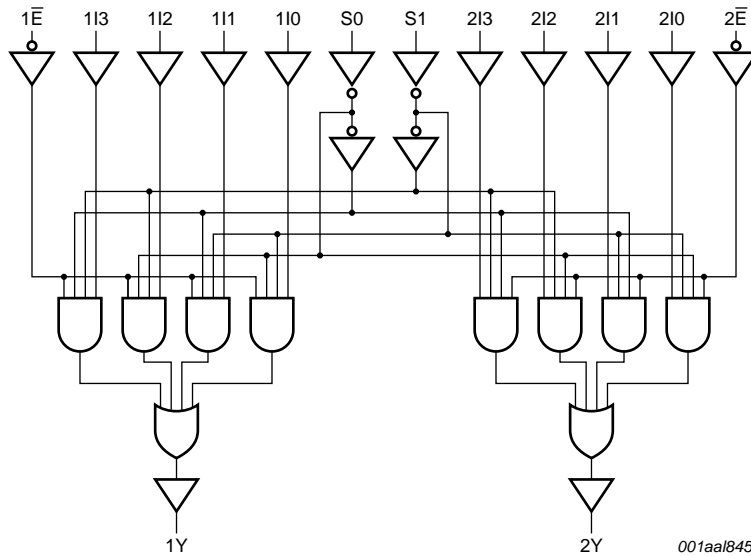


Fig 3. Logic diagram

## 5. Pinning information

### 5.1 Pinning

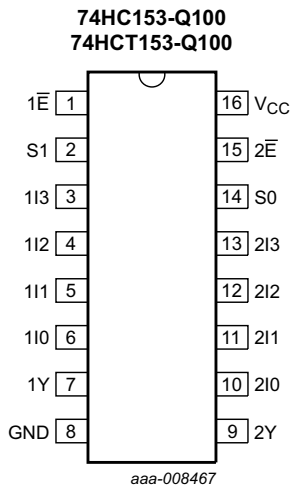


Fig 4. Pin configuration SO16

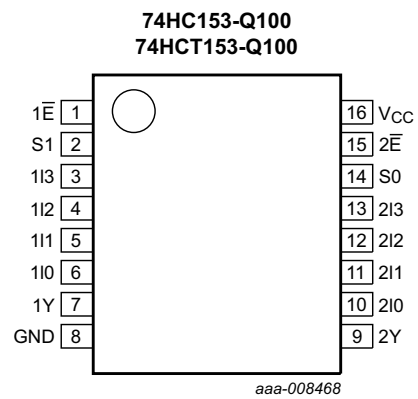


Fig 5. Pin configuration TSSOP16

## 5.2 Pin description

**Table 2. Pin description**

Symbol	Pin	Description
1 $\bar{E}$ , 2 $\bar{E}$	1, 15	output enable inputs (active LOW)
S0, S1	14, 2	data select inputs
1I0, 1I1, 1I2, 1I3	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
2I0, 2I1, 2I2, 2I3	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		data inputs				output enable	output
S0	S1	nI0	nI1	nI2	nI3	n $\bar{E}$	nY
X	X	X	X	X	X	H	L
L	L	L	X	X	X	L	L
L	L	H	X	X	X	L	H
H	L	X	L	X	X	L	L
H	L	X	H	X	X	L	H
L	H	X	X	L	X	L	L
L	H	X	X	H	X	L	H
H	H	X	X	X	L	L	L
H	H	X	X	X	H	L	H

## 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 <sub>CC</sub>	supply voltage		-0.5	+7	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V	<a href="#">1</a> -	±20	mA
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V	<a href="#">1</a> -	±20	mA
I <sub>O</sub>	output current	-0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V	-	±25	mA
I <sub>CC</sub>	supply current		-	50	mA
I <sub>GND</sub>	ground current		-50	-	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
$P_{\text{tot}}$	total power dissipation		[2] -	500	mW

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

[2] For SO16 package:  $P_{\text{tot}}$  derates linearly with 8 mW/K above 70 °C.  
For TSSOP16 packages:  $P_{\text{tot}}$  derates linearly with 5.5 mW/K above 60 °C.

## 8. Recommended operating conditions

**Table 5.** Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC153-Q100			74HCT153-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
$V_{\text{CC}}$	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
$V_{\text{I}}$	input voltage		0	-	$V_{\text{CC}}$	0	-	$V_{\text{CC}}$	V
$V_{\text{O}}$	output voltage		0	-	$V_{\text{CC}}$	0	-	$V_{\text{CC}}$	V
$T_{\text{amb}}$	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{\text{CC}} = 2.0 \text{ V}$	-	-	625	-	-	-	ns/V
		$V_{\text{CC}} = 4.5 \text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{\text{CC}} = 6.0 \text{ V}$	-	-	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	Typ	Max	Min	Max	Min	Max	
<b>74HC153-Q100</b>										
$V_{\text{IH}}$	HIGH-level input voltage	$V_{\text{CC}} = 2.0 \text{ V}$	1.5	1.2	-	1.5	-	1.5	-	V
		$V_{\text{CC}} = 4.5 \text{ V}$	3.15	2.4	-	3.15	-	3.15	-	V
		$V_{\text{CC}} = 6.0 \text{ V}$	4.2	3.2	-	4.2	-	4.2	-	V
$V_{\text{IL}}$	LOW-level input voltage	$V_{\text{CC}} = 2.0 \text{ V}$	-	0.8	0.5	-	0.5	-	0.5	V
		$V_{\text{CC}} = 4.5 \text{ V}$	-	2.1	1.35	-	1.35	-	1.35	V
		$V_{\text{CC}} = 6.0 \text{ V}$	-	2.8	1.8	-	1.8	-	1.8	V
$V_{\text{OH}}$	HIGH-level output voltage	$V_{\text{I}} = V_{\text{IH}}$ or $V_{\text{IL}}$								
		$I_{\text{O}} = -20 \mu\text{A}; V_{\text{CC}} = 2.0 \text{ V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_{\text{O}} = -20 \mu\text{A}; V_{\text{CC}} = 4.5 \text{ V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_{\text{O}} = -20 \mu\text{A}; V_{\text{CC}} = 6.0 \text{ V}$	5.9	6.0	-	5.9	-	5.9	-	V
		$I_{\text{O}} = -4.0 \text{ mA}; V_{\text{CC}} = 4.5 \text{ V}$	3.98	4.32	-	3.84	-	3.7	-	V
	$I_{\text{O}} = -5.2 \text{ mA}; V_{\text{CC}} = 6.0 \text{ V}$	5.48	5.81	-	5.34	-	5.2	-	V	

**Table 6. Static characteristics ...continued**

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	Typ	Max	Min	Max	Min	Max	
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	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.1	-	±1	-	±1	μA
I <sub>CC</sub>	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	-	80	-	160	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF
<b>74HCT153-Q100</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = -20 μA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA	3.98	4.32	-	3.84	-	3.7	-	V
V <sub>OL</sub>	LOW-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>CC</sub> = 4.5 V								
		I <sub>O</sub> = 20 μA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 5.2 mA; V <sub>CC</sub> = 6.0 V	-	0.15	0.26	-	0.33	-	0.4	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V	-	-	±0.1	-	±1	-	±1	μA
I <sub>CC</sub>	supply current	V <sub>I</sub> = V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 5.5 V	-	-	8	-	80	-	160	μA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; I <sub>O</sub> = 0 A; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V								
		1In, 2In	-	45	162	-	203	-	221	μA
		n $\bar{E}$	-	60	216	-	270	-	294	μA
		Sn	-	135	486	-	608	-	662	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; for test circuit, see [Figure 8](#); unless otherwise specified

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74HC153-Q100</b>										
$t_{pd}$	propagation delay	1In to nY, 2In to nY; see <a href="#">Figure 6</a> <sup>[1]</sup>								
		$V_{CC} = 2.0\text{ V}$	-	47	145	-	180	-	220	ns
		$V_{CC} = 4.5\text{ V}$	-	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 <a href="#">Figure 7</a>								
		$V_{CC} = 2.0\text{ V}$	-	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
		n $\bar{E}$ to nY; see <a href="#">Figure 7</a>								
		$V_{CC} = 2.0\text{ V}$	-	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		
$V_{CC} = 6.0\text{ V}$	-	10	17	-	21	-	26	ns		
$t_t$	transition time	see <a href="#">Figure 6</a> <sup>[2]</sup>								
		$V_{CC} = 2.0\text{ V}$	-	19	75	-	95	-	110	ns
		$V_{CC} = 4.5\text{ V}$	-	7	15	-	19	-	22	ns
		$V_{CC} = 6.0\text{ V}$	-	6	13	-	16	-	19	ns
$C_{PD}$	power dissipation capacitance	per package; $V_I = GND$ to $V_{CC}$ <sup>[3]</sup>	-	30	-	-	-	-	-	pF
<b>74HCT153-Q100</b>										
$t_{PHL}$	HIGH to LOW propagation delay	1In to nY, 2In to nY; see <a href="#">Figure 6</a> <sup>[1]</sup>								
		$V_{CC} = 4.5\text{ V}$	-	19	34	-	43	-	51	ns
		$V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$	-	16	-	-	-	-	-	ns
$t_{PLH}$	LOW to HIGH propagation delay	1In to nY, 2In to nY; see <a href="#">Figure 6</a> <sup>[1]</sup>								
		$V_{CC} = 4.5\text{ V}$	-	13	24	-	30	-	36	ns
		$V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$	-	16	-	-	-	-	-	ns

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

$GND = 0\text{ V}$ ;  $t_r = t_f = 6\text{ ns}$ ;  $C_L = 50\text{ pF}$ ; for test circuit, see [Figure 8](#); unless otherwise specified

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
$t_{pd}$	propagation delay	$S_n$ to $nY$ ; see <a href="#">Figure 7</a> [1]								
		$V_{CC} = 4.5\text{ V}$	-	20	34	-	43	-	51	ns
		$V_{CC} = 5.0\text{ V}$ ; $C_L = 15\text{ pF}$	-	17	-	-	-	-	-	ns
		$n\bar{E}$ to $nY$ ; see <a href="#">Figure 7</a> [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	
$t_t$	transition time	see <a href="#">Figure 6</a> [2]								
		$V_{CC} = 4.5\text{ V}$	-	7	15	-	19	-	22	ns
$C_{PD}$	power dissipation capacitance	per package; $V_I = GND$ 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  $\mu\text{W}$ ):

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

$f_i$  = input frequency in MHz;

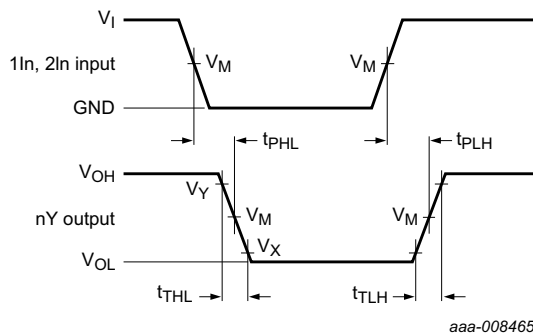
$f_o$  = output frequency in MHz;

$C_L$  = 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.



(1) Measurement points are given in [Table 8](#).

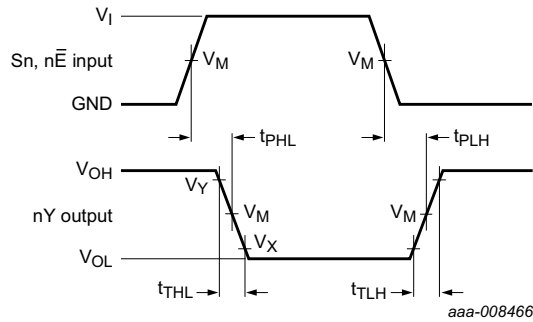
$V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

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

**Table 8. Measurement points**

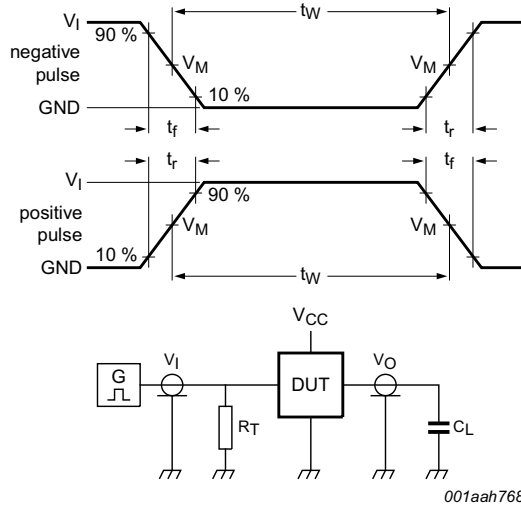
Type	Input		Output		
	$V_M$		$V_M$	$V_X$	$V_Y$
74HC153-Q100	$0.5V_{CC}$		$0.5V_{CC}$	$0.1V_{CC}$	$0.9V_{CC}$
74HCT153-Q100	1.3 V		1.3 V	$0.1V_{CC}$	$0.9V_{CC}$





- (1) Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  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  $Z_o$  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**

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74HC153-Q100	$V_{CC}$	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$
74HCT153-Q100	3.0 V	6.0 ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$

11. Package outline

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

SOT109-1

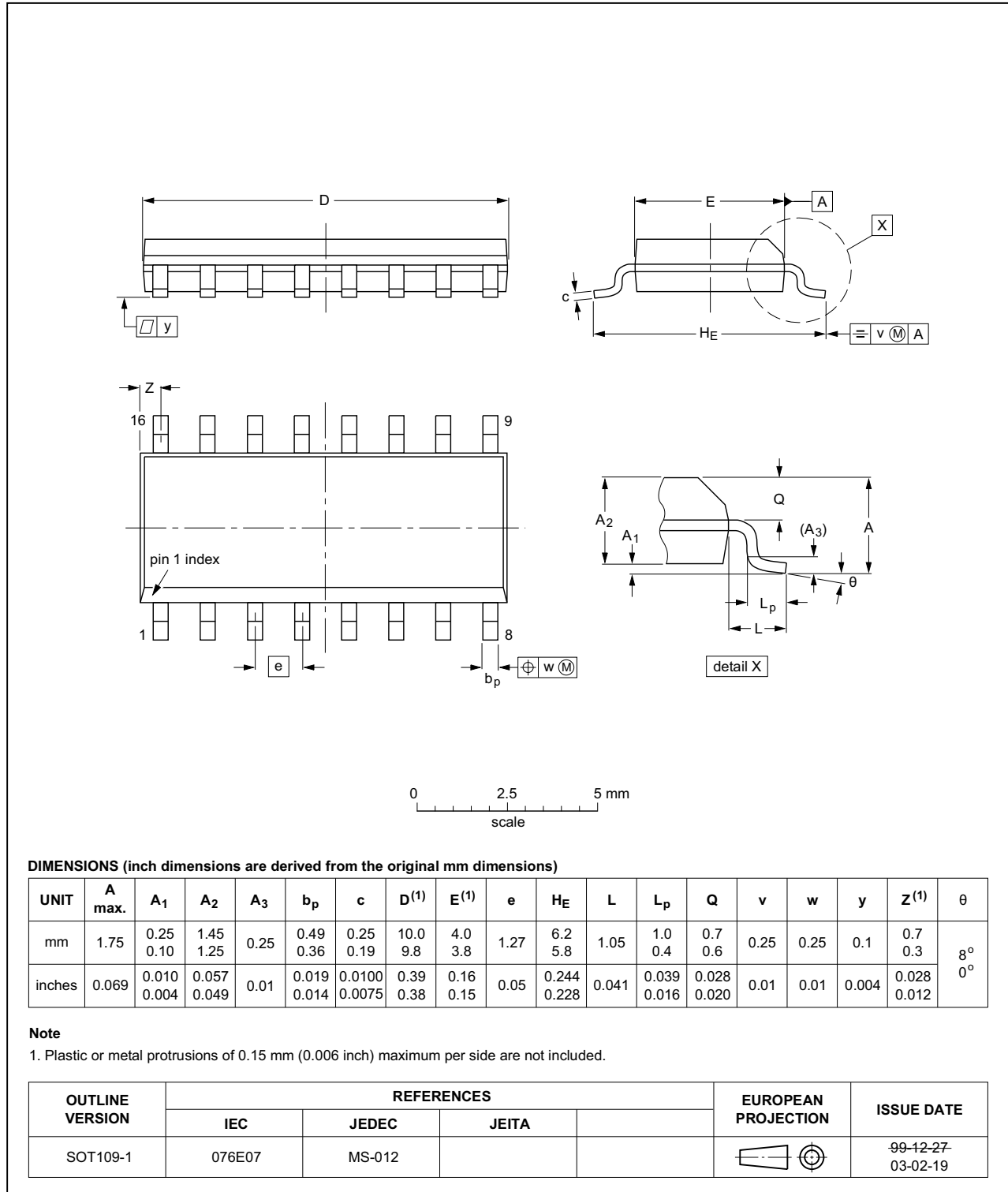


Fig 9. Package outline SOT109-1 (SO16)

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

SOT403-1

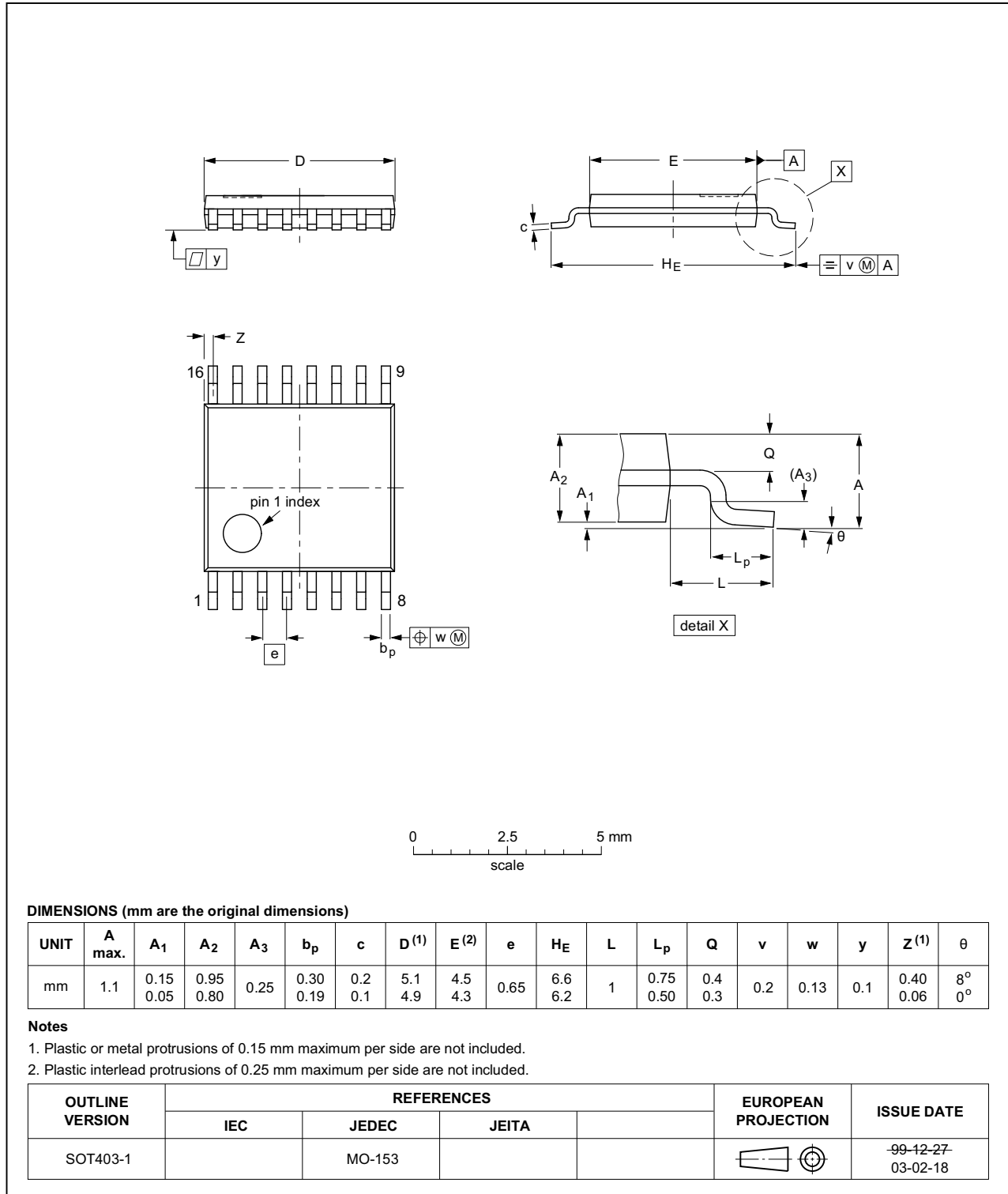


Fig 10. Package outline SOT403-1 (TSSOP16)

## 12. Abbreviations

Table 10. Abbreviations

Acronym	Description
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
MIL	Military

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT153_Q100 v.3	20140123	Product data sheet	-	74HC_HCT153_Q100 v.2
Modifications:	• <a href="#">Table 1</a> and <a href="#">Section 11</a> : all references to 14 pin packages removed.			
74HC_HCT153_Q100 v.2	20131128	Product data sheet	-	74HC_HCT153_Q100 v.1
74HC_HCT153_Q100 v.1	20130722	Product data sheet	-	-

## 14. Legal information

### 14.1 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".

[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 <http://www.nxp.com>.

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