

74AHC139; 74AHCT139

Dual 2-to-4 line decoder/demultiplexer

Rev. 02 — 9 May 2008

Product data sheet

1. General description

The 74AHC139; 74AHCT139 is a high-speed Si-gate CMOS device and is pin compatible with Low-power Schottky TTL (LSTTL). It is specified in compliance with JEDEC standard No. 7-A.

The 74AHC139; 74AHCT139 is a high-speed, dual 2-to-4 line decoder/demultiplexer. This device has two independent decoders, each accepting two binary weighted inputs ($nA0$ and $nA1$) and providing four mutually exclusive active LOW outputs ($n\bar{Y}0$ to $n\bar{Y}3$). Each decoder has an active LOW enable input ($n\bar{E}$). When $n\bar{E}$ is HIGH, every output is forced HIGH. The enable input can be used as the data input for a 1-to-4 demultiplexer application.

The 74AHC139; 74AHCT139 is identical to the HEF4556 of the HE4000B family.

2. Features

- Balanced propagation delays
- All inputs have Schmitt-trigger actions
- Inputs accept voltages higher than V_{CC}
- Input levels:
 - ◆ For 74AHC139: CMOS level
 - ◆ For 74AHCT139: TTL level
- ESD protection:
 - ◆ HBM EIA/JESD22-A114E exceeds 2000 V
 - ◆ MM EIA/JESD22-A115-A exceeds 200 V
 - ◆ CDM EIA/JESD22-C101C exceeds 1000 V
- Multiple package options
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$

3. Ordering information

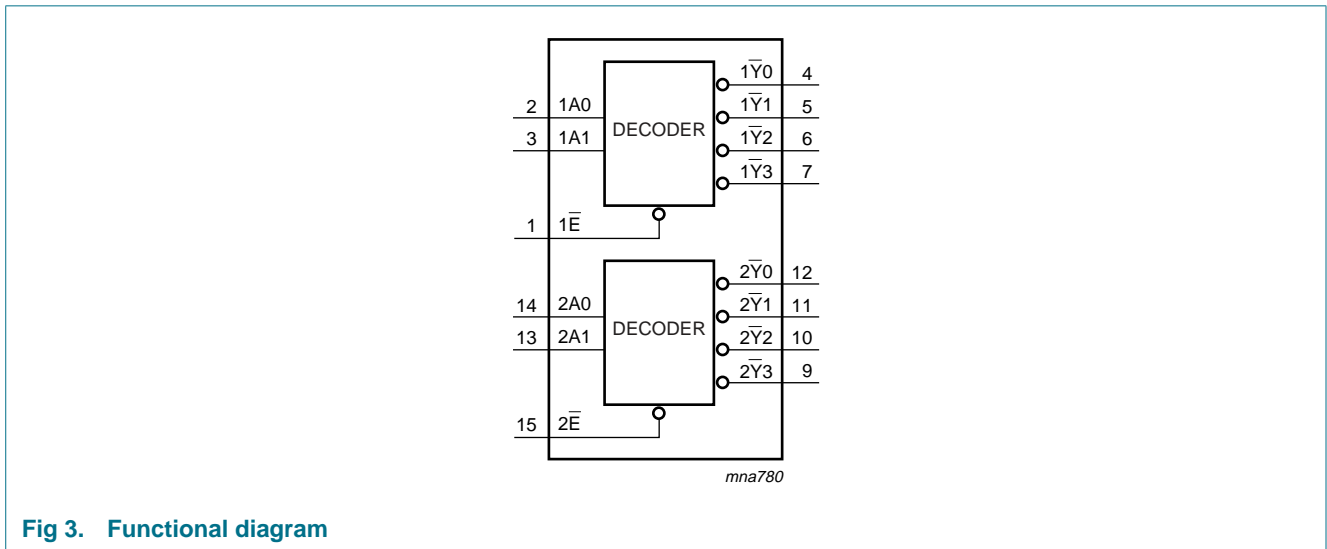
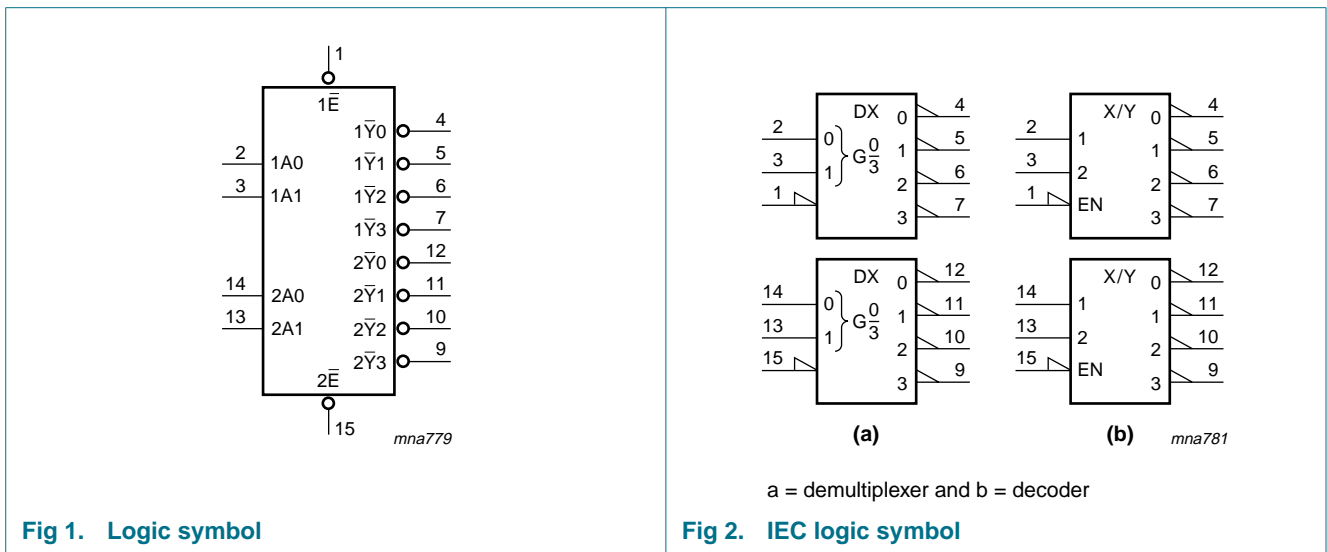
Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74AHC139				
74AHC139D	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74AHC139PW	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1

Table 1. Ordering information ...continued

Type number	Package			Version
	Temperature range	Name	Description	
74AHCT139				
74AHCT139D	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74AHCT139PW	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1

4. Functional diagram



5. Pinning information

5.1 Pinning

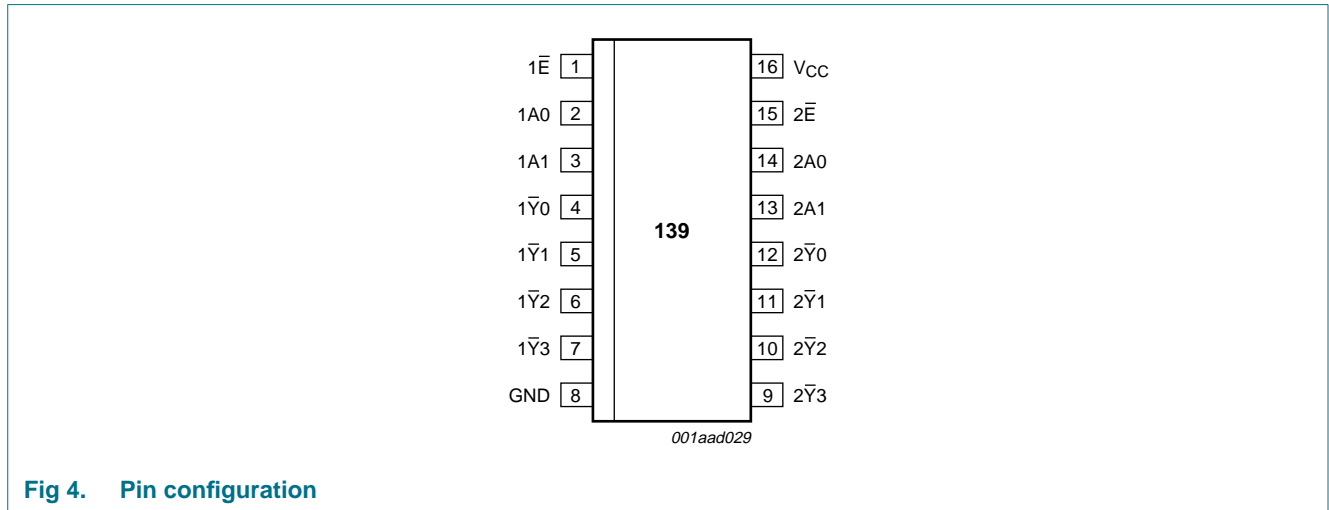


Fig 4. Pin configuration

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1Ē	1	enable input (active LOW)
1A0	2	address input
1A1	3	address input
1Ȳ0	4	output
1Ȳ1	5	output
1Ȳ2	6	output
1Ȳ3	7	output
GND	8	ground (0 V)
2Ȳ3	9	output
2Ȳ2	10	output
2Ȳ1	11	output
2Ȳ0	12	output
2A1	13	address input
2A0	14	address input
2Ē	15	enable input (active LOW)
V _{CC}	16	supply voltage

6. Functional description

Table 3. Function table^[1]

Control	Input		Output			
	nA0	nA1	nY0	nY1	nY2	nY3
H	X	X	H	H	H	H
L	L	L	L	H	H	H
	H	L	H	L	H	H
	L	H	H	H	L	H
	H	H	H	H	H	L

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

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	+7.0	V
V_I	input voltage		-0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V	^[1] -20	-	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	^[1] -20	+20	mA
I_O	output current	$V_O = -0.5$ V to $(V_{CC} + 0.5$ V)	-25	+25	mA
I_{CC}	supply current		-	+75	mA
I_{GND}	ground current		-75	-	mA
T_{stg}	storage temperature		-65	+150	°C
P_{tot}	total power dissipation	$T_{amb} = -40$ °C to +125 °C	^[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 packages: above 70 °C the value of P_{tot} derates linearly at 8 mW/K.
For TSSOP16 packages: above 60 °C the value of P_{tot} derates linearly at 5.5 mW/K.

8. Recommended operating conditions

Table 5. Operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
74AHC139						
V_{CC}	supply voltage		2.0	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$	-	-	100	ns/V
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	20	ns/V
74AHCT139						
V_{CC}	supply voltage		4.5	5.0	5.5	V
V_I	input voltage		0	-	5.5	V
V_O	output voltage		0	-	V_{CC}	V
T_{amb}	ambient temperature		-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 4.5\text{ V to }5.5\text{ V}$	-	-	20	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	
74AHC139										
V_{IH}	HIGH-level input voltage	$V_{CC} = 2.0\text{ V}$	1.5	-	-	1.5	-	1.5	-	V
		$V_{CC} = 3.0\text{ V}$	2.1	-	-	2.1	-	2.1	-	V
		$V_{CC} = 5.5\text{ V}$	3.85	-	-	3.85	-	3.85	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 2.0\text{ V}$	-	-	0.5	-	0.5	-	0.5	V
		$V_{CC} = 3.0\text{ V}$	-	-	0.9	-	0.9	-	0.9	V
		$V_{CC} = 5.5\text{ V}$	-	-	1.65	-	1.65	-	1.65	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL}								
		$I_O = -50\ \mu\text{A}; V_{CC} = 2.0\text{ V}$	1.9	2.0	-	1.9	-	1.9	-	V
		$I_O = -50\ \mu\text{A}; V_{CC} = 3.0\text{ V}$	2.9	3.0	-	2.9	-	2.9	-	V
		$I_O = -50\ \mu\text{A}; V_{CC} = 4.5\text{ V}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -4.0\text{ mA}; V_{CC} = 3.0\text{ V}$	2.58	-	-	2.48	-	2.40	-	V
	$I_O = -8.0\text{ mA}; V_{CC} = 4.5\text{ V}$	3.94	-	-	3.80	-	3.70	-	V	
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL}								
		$I_O = 50\ \mu\text{A}; V_{CC} = 2.0\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 50\ \mu\text{A}; V_{CC} = 3.0\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 50\ \mu\text{A}; V_{CC} = 4.5\text{ V}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 4.0\text{ mA}; V_{CC} = 3.0\text{ V}$	-	-	0.36	-	0.44	-	0.55	V
	$I_O = 8.0\text{ mA}; V_{CC} = 4.5\text{ V}$	-	-	0.36	-	0.44	-	0.55	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	
I_I	input leakage current	$V_I = 5.5 \text{ V}$ or GND; $V_{CC} = 0 \text{ V}$ to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	μA
C_I	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF
C_O	output capacitance		-	4	-	-	-	-	-	pF
74AHCT139										
V_{IH}	HIGH-level input voltage	$V_{CC} = 4.5 \text{ V}$ to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V_{IL}	LOW-level input voltage	$V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	0.8	-	0.8	-	0.8	V
V_{OH}	HIGH-level output voltage	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$ $I_O = -50 \mu\text{A}$	4.4	4.5	-	4.4	-	4.4	-	V
		$I_O = -8.0 \text{ mA}$	3.94	-	-	3.80	-	3.70	-	V
V_{OL}	LOW-level output voltage	$V_I = V_{IH}$ or V_{IL} ; $V_{CC} = 4.5 \text{ V}$ $I_O = 50 \mu\text{A}$	-	0	0.1	-	0.1	-	0.1	V
		$I_O = 8.0 \text{ mA}$	-	-	0.36	-	0.44	-	0.55	V
I_I	input leakage current	$V_I = 5.5 \text{ V}$ or GND; $V_{CC} = 0 \text{ V}$ to 5.5 V	-	-	0.1	-	1.0	-	2.0	μA
I_{CC}	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	μA
ΔI_{CC}	additional supply current	per input pin; $V_I = V_{CC} - 2.1 \text{ V}$; other pins at V_{CC} or GND; $I_O = 0 \text{ A}$; $V_{CC} = 4.5 \text{ V}$ to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C_I	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF
C_O	output capacitance		-	4	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Figure 7.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ ^[1]	Max	Min	Max	Min	Max	
74AHC139										
t _{pd}	propagation delay	nAn to nȳn; see Figure 5 ^[2]								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	5.5	11.0	1.0	13.0	1.0	14.0	ns
		C _L = 50 pF	-	7.9	14.5	1.0	16.5	1.0	18.5	ns
		V _{CC} = 4.5 V to 5.5 V								
		C _L = 15 pF	-	3.9	7.2	1.0	8.5	1.0	9.0	ns
		C _L = 50 pF	-	5.6	9.2	1.0	10.5	1.0	11.5	ns
		nĒ to nȳn; see Figure 6 ^[2]								
		V _{CC} = 3.0 V to 3.6 V								
		C _L = 15 pF	-	4.8	9.2	1.0	11.0	1.0	11.5	ns
		C _L = 50 pF	-	6.9	12.7	1.0	14.5	1.0	16.0	ns
		C _{PD}	power dissipation capacitance	V _{CC} = 4.5 V to 5.5 V						
C _L = 15 pF	-			3.4	6.3	1.0	7.5	1.0	8.0	ns
C _{PD}	power dissipation capacitance	C _L = 50 pF	-	4.9	8.3	1.0	9.5	1.0	10.5	ns
		f _i = 1 MHz; V _I = GND to V _{CC} ^[3]	-	26	-	-	-	-	-	pF
74AHCT139; V_{CC} = 4.5 V to 5.5 V										
t _{pd}	propagation delay	nAn to nȳn; see Figure 5 ^[2]								
		C _L = 15 pF	-	4.7	7.2	1.0	8.5	1.0	9.0	ns
		C _L = 50 pF	-	6.5	9.2	1.0	10.5	1.0	11.5	ns
		nĒ to nȳn; see Figure 6 ^[2]								
		C _L = 15 pF	-	3.6	6.3	1.0	7.5	1.0	8.0	ns
		C _L = 50 pF	-	5.2	8.3	1.0	9.5	1.0	10.5	ns
C _{PD}	power dissipation capacitance	f _i = 1 MHz; V _I = GND to V _{CC} ^[3]	-	23	-	-	-	-	-	pF

[1] Typical values are measured at nominal supply voltage (V_{CC} = 3.3 V and V_{CC} = 5.0 V).

[2] t_{pd} is the same as t_{PLH} and t_{PHL}.

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

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

f_i = input frequency in MHz;

f_o = output frequency in MHz;

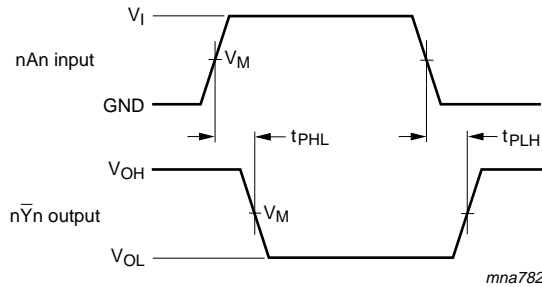
C_L = output load capacitance in pF;

V_{CC} = supply voltage in V;

N = number of inputs switching;

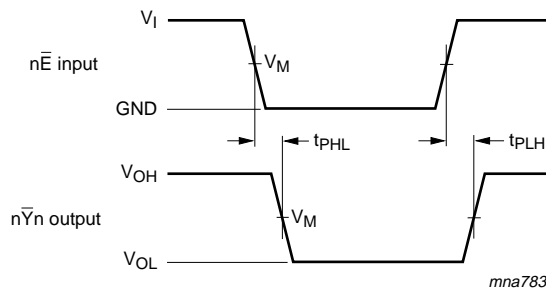
Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

11. Waveforms



Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 5. Address input to output propagation delays

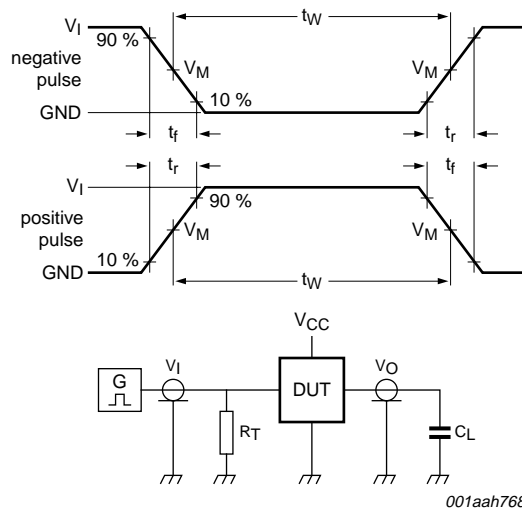


Measurement points are given in [Table 8](#).
 V_{OL} and V_{OH} are typical voltage output levels that occur with the output load.

Fig 6. Enable input to output propagation delays

Table 8. Measurement points

Type	Input	Output
	V_M	V_M
74AHC139	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT139	1.5 V	$0.5 \times V_{CC}$



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 7. Load circuitry for measuring switching times

Table 9. Test data

Type	Input		Load	Test
	V_I	t_r, t_f	C_L	
74AHC139	V_{CC}	≤ 3.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}
74AHCT139	3.0 V	≤ 3.0 ns	15 pF, 50 pF	t_{PLH}, t_{PHL}

12. Package outline

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

SOT109-1

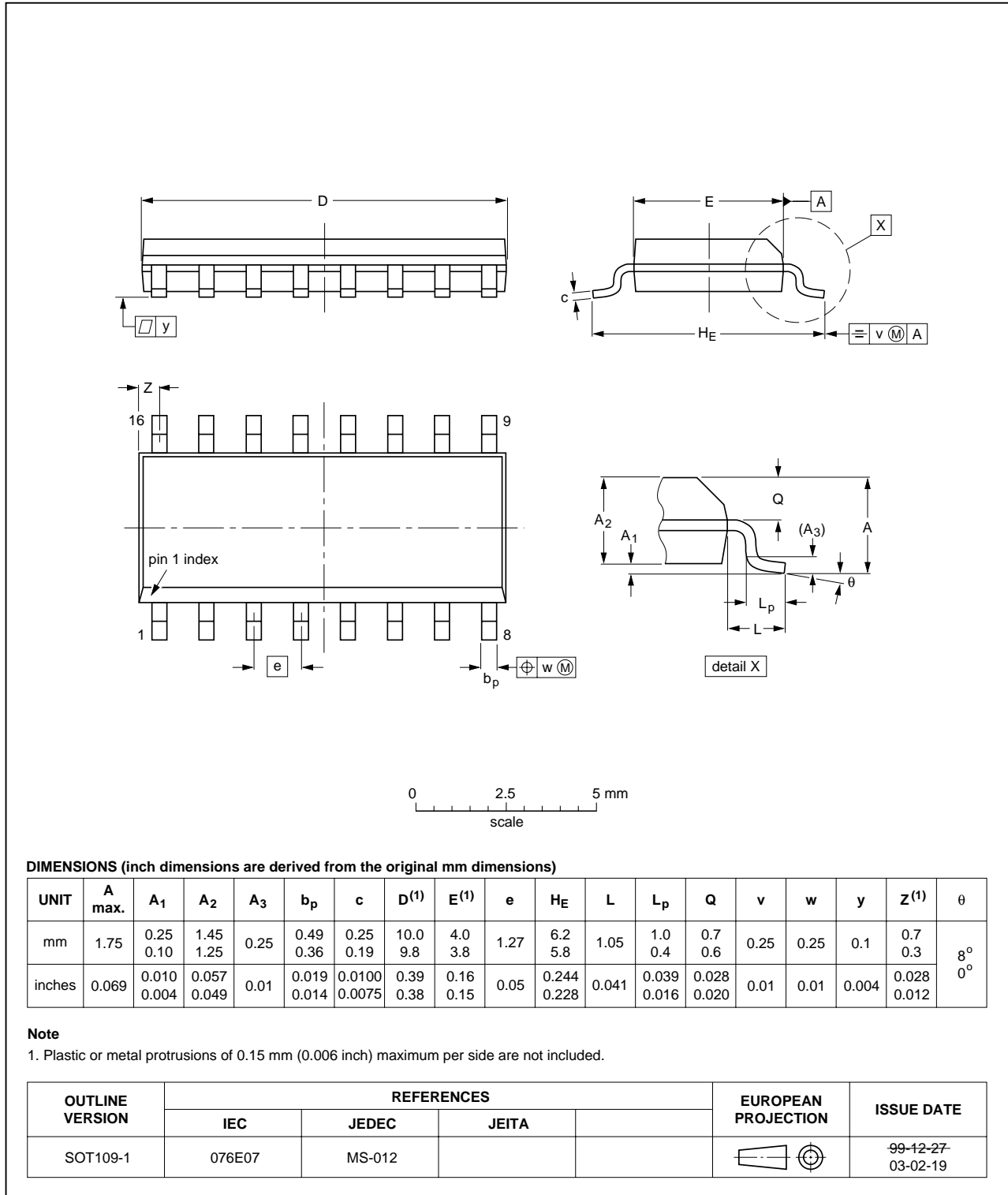


Fig 8. Package outline SOT109-1 (SO16)

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

SOT403-1

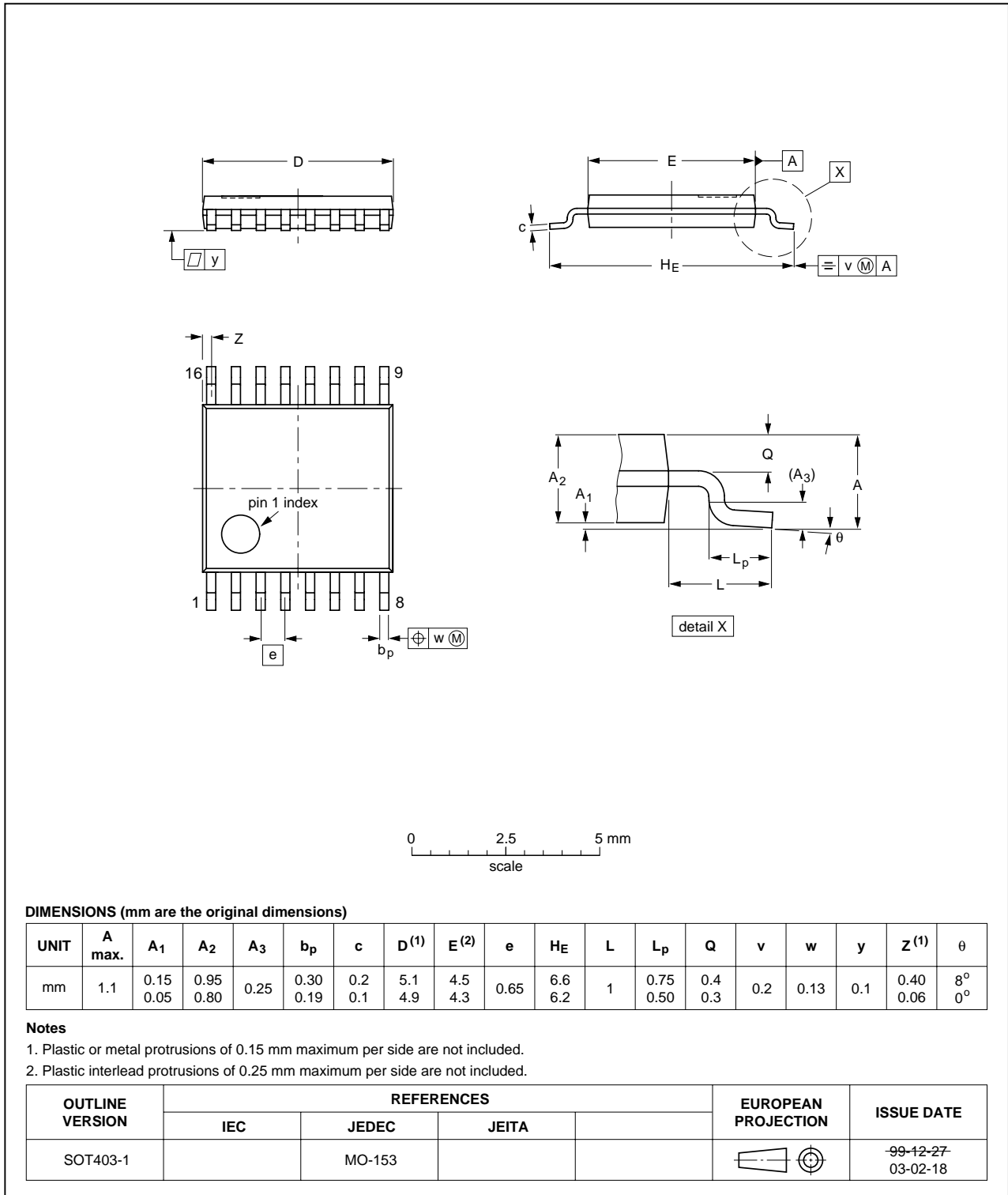


Fig 9. Package outline SOT403-1 (TSSOP16)

13. Abbreviations

Table 10. Abbreviations

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

14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT139_2	20080509	Product data sheet	-	74AHC_AHCT139_1
Modifications:	<ul style="list-style-type: none"> • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Table 6: the conditions for input leakage current have been changed. 			
74AHC_AHCT139_1	19990901	Product specification	-	-

15. Legal information

15.1 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".

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