

# 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  $-40\text{ °C}$  to  $+85\text{ °C}$  and from  $-40\text{ °C}$  to  $+125\text{ °C}$

## 3. Ordering information

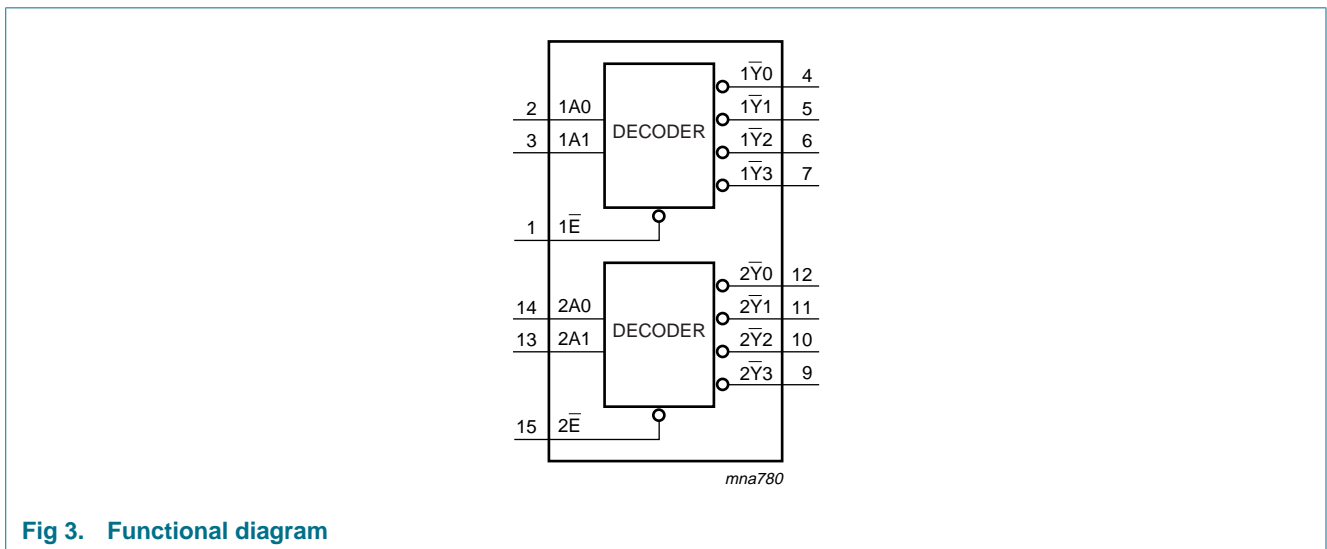
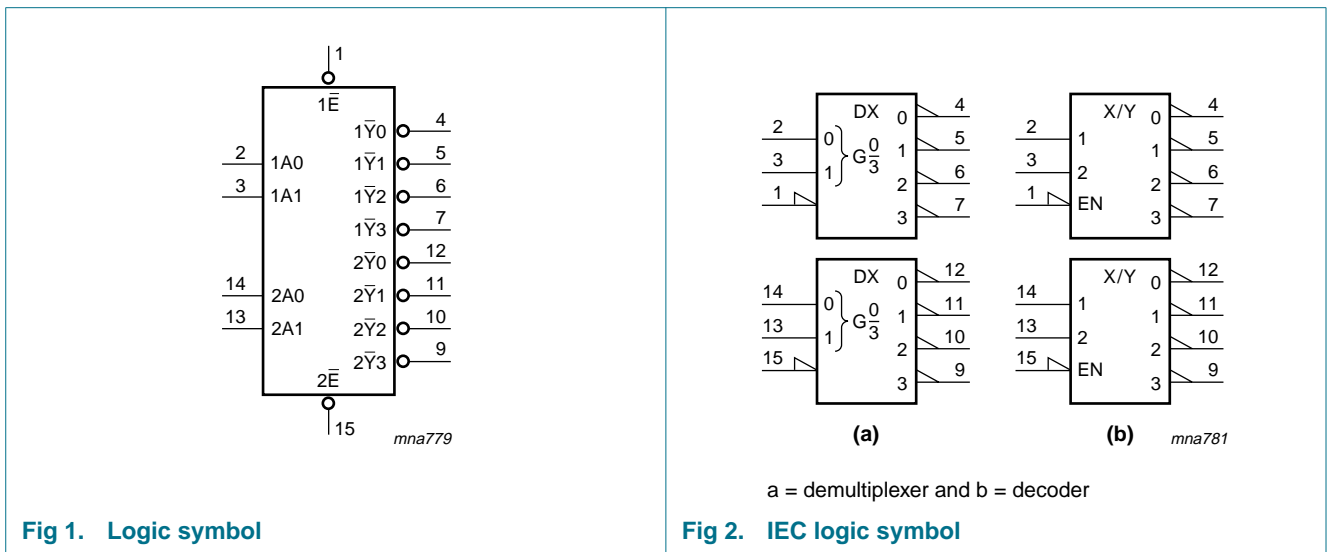
Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
<b>74AHC139</b>				
74AHC139D	$-40\text{ °C}$ to $+125\text{ °C}$	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74AHC139PW	$-40\text{ °C}$ to $+125\text{ °C}$	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	
<b>74AHCT139</b>				
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

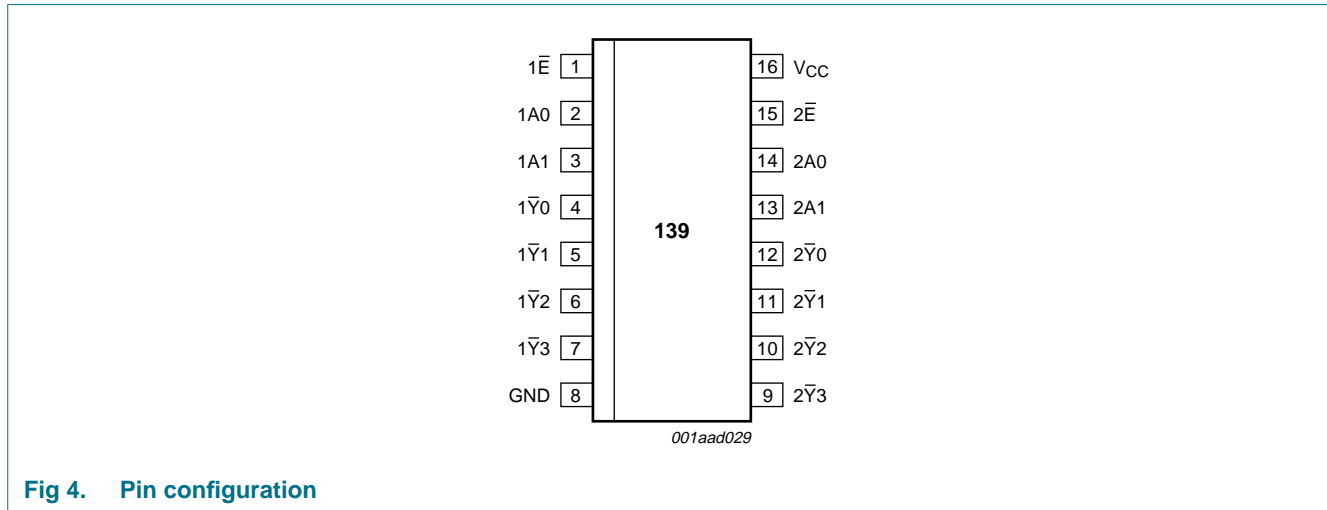


Fig 4. Pin configuration

### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$1\bar{E}$	1	enable input (active LOW)
1A0	2	address input
1A1	3	address input
$1\bar{Y}0$	4	output
$1\bar{Y}1$	5	output
$1\bar{Y}2$	6	output
$1\bar{Y}3$	7	output
GND	8	ground (0 V)
$2\bar{Y}3$	9	output
$2\bar{Y}2$	10	output
$2\bar{Y}1$	11	output
$2\bar{Y}0$	12	output
2A1	13	address input
2A0	14	address input
$2\bar{E}$	15	enable input (active LOW)
V <sub>CC</sub>	16	supply voltage

## 6. Functional description

Table 3. Function table<sup>[1]</sup>

Control $\overline{nE}$	Input		Output			
	nA0	nA1	$\overline{nY0}$	$\overline{nY1}$	$\overline{nY2}$	$\overline{nY3}$
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	<sup>[1]</sup> -20	-	mA
$I_{OK}$	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	<sup>[1]</sup> -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	<sup>[2]</sup> -	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
<b>74AHC139</b>						
$V_{CC}$	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
<b>74AHCT139</b>						
$V_{CC}$	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	
<b>74AHC139</b>										
$V_{IH}$	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	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	$\mu\text{A}$
$C_I$	input capacitance	$V_I = V_{CC}$ or GND	-	3	10	-	10	-	10	pF
$C_O$	output capacitance		-	4	-	-	-	-	-	pF
<b>74AHCT139</b>										
$V_{IH}$	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	$\mu\text{A}$
$I_{CC}$	supply current	$V_I = V_{CC}$ or GND; $I_O = 0 \text{ A}$ ; $V_{CC} = 5.5 \text{ V}$	-	-	4.0	-	40	-	80	$\mu\text{A}$
$\Delta I_{CC}$	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 <sup>[1]</sup>	Max	Min	Max	Min	Max	
<b>74AHC139</b>										
$t_{pd}$	propagation delay	nAn to n $\bar{Y}$ n; see <a href="#">Figure 5</a> <sup>[2]</sup>								
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}$								
		$C_L = 15\text{ pF}$	-	5.5	11.0	1.0	13.0	1.0	14.0	ns
		$C_L = 50\text{ pF}$	-	7.9	14.5	1.0	16.5	1.0	18.5	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$								
		$C_L = 15\text{ pF}$	-	3.9	7.2	1.0	8.5	1.0	9.0	ns
	n $\bar{E}$ to n $\bar{Y}$ n; see <a href="#">Figure 6</a> <sup>[2]</sup>	$V_{CC} = 3.0\text{ V to }3.6\text{ V}$								
		$C_L = 15\text{ pF}$	-	4.8	9.2	1.0	11.0	1.0	11.5	ns
		$C_L = 50\text{ pF}$	-	6.9	12.7	1.0	14.5	1.0	16.0	ns
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}$								
		$C_L = 15\text{ pF}$	-	3.4	6.3	1.0	7.5	1.0	8.0	ns
		$C_L = 50\text{ pF}$	-	4.9	8.3	1.0	9.5	1.0	10.5	ns
$C_{PD}$	power dissipation capacitance	$f_i = 1\text{ MHz}; V_I = \text{GND to }V_{CC}$ <sup>[3]</sup>	-	26	-	-	-	-	-	pF
<b>74AHCT139; <math>V_{CC} = 4.5\text{ V to }5.5\text{ V}</math></b>										
$t_{pd}$	propagation delay	nAn to n $\bar{Y}$ n; see <a href="#">Figure 5</a> <sup>[2]</sup>								
		$C_L = 15\text{ pF}$	-	4.7	7.2	1.0	8.5	1.0	9.0	ns
	$C_L = 50\text{ pF}$	-	6.5	9.2	1.0	10.5	1.0	11.5	ns	
	n $\bar{E}$ to n $\bar{Y}$ n; see <a href="#">Figure 6</a> <sup>[2]</sup>	$C_L = 15\text{ pF}$	-	3.6	6.3	1.0	7.5	1.0	8.0	ns
		$C_L = 50\text{ pF}$	-	5.2	8.3	1.0	9.5	1.0	10.5	ns
	$C_{PD}$	power dissipation capacitance	$f_i = 1\text{ MHz}; V_I = \text{GND to }V_{CC}$ <sup>[3]</sup>	-	23	-	-	-	-	-

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

[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  $\mu\text{W}$ ).

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

$f_i$  = input frequency in MHz;

$f_o$  = output frequency in MHz;

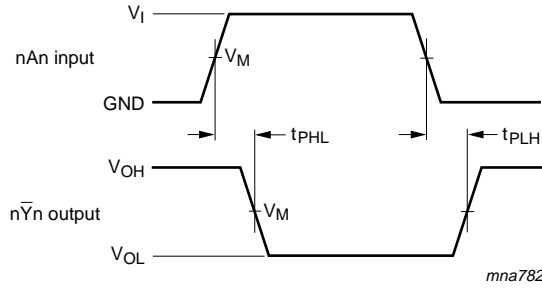
$C_L$  = output load capacitance in pF;

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

$N$  = number of inputs switching;

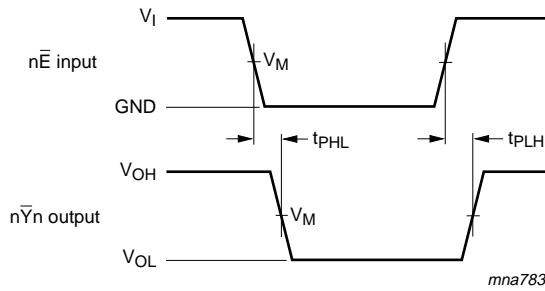
$\Sigma(C_L \times V_{CC}^2 \times f_o)$  = sum of the outputs.

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**



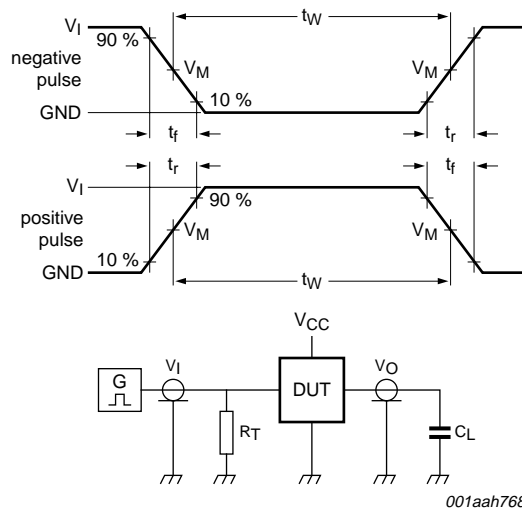
Measurement points are given in [Table 8](#).  
 $V_{OL}$  and  $V_{OH}$  are typical voltage output levels that occur with the output load.

**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	$V_{CC}$	$\leq 3.0$ ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$
74AHCT139	3.0 V	$\leq 3.0$ 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

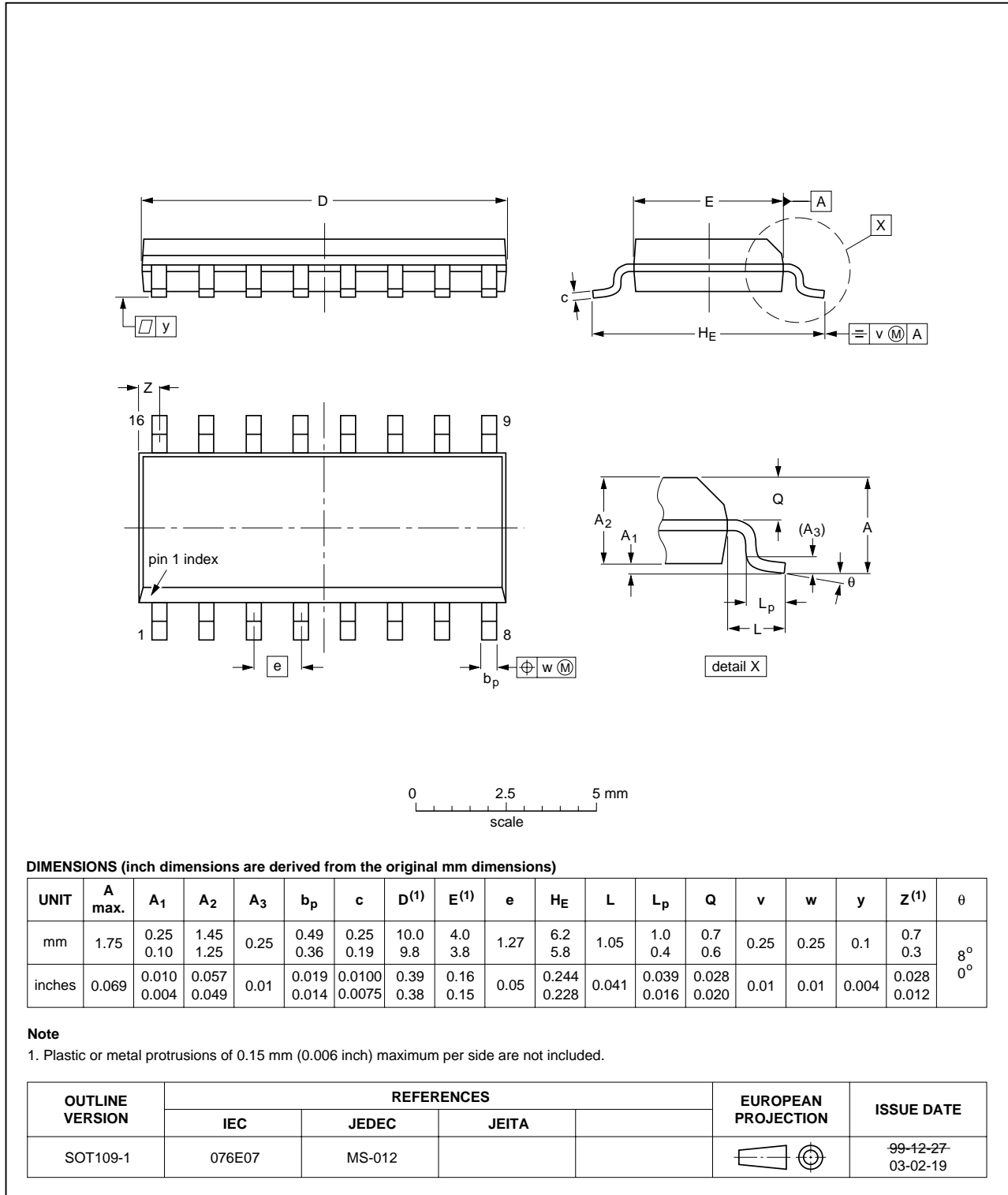


Fig 8. Package outline SOT109-1 (SO16)

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

SOT403-1

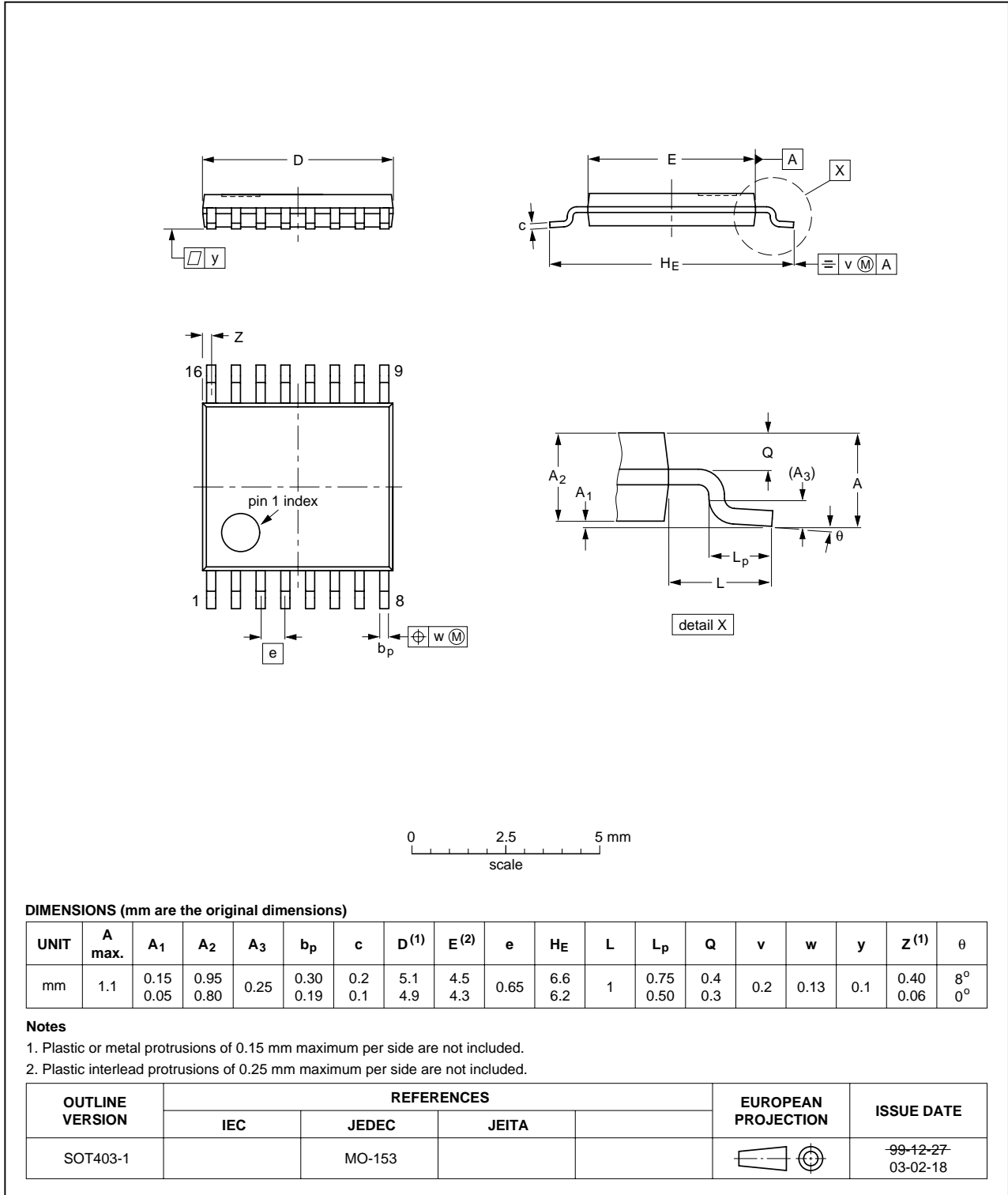


Fig 9. Package outline SOT403-1 (TSSOP16)

## 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"><li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors.</li><li>• Legal texts have been adapted to the new company name where appropriate.</li><li>• <a href="#">Table 6</a>: the conditions for input leakage current have been changed.</li></ul>		
74AHC_AHCT139_1	19990901	Product specification	-	-

## 15. Legal information

### 15.1 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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