

# 74AHC139-Q100; 74AHCT139-Q100

Dual 2-to-4 line decoder/demultiplexer

Rev. 3 — 7 September 2023

Product data sheet

## 1. General description

The 74AHC139-Q100; 74AHCT139-Q100 decodes two binary weighted address inputs ( $nA0$ ,  $nA1$ ) to four mutually exclusive outputs ( $nY0$  to  $nY3$ ). Each decoder features an enable input ( $nE$ ). When  $nE$  is HIGH all outputs are forced HIGH. The enable input can be used as the data input for a 1-to-4 demultiplexer application. Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

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

- 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  $+125\text{ }^{\circ}\text{C}$
- Wide supply voltage range from 2.0 to 5.5 V
- Balanced propagation delays
- High noise immunity
- CMOS low power dissipation
- All inputs have Schmitt-trigger actions
- Overvoltage tolerant inputs to 5.5 V
- Input levels:
  - For 74AHC139-Q100: CMOS level
  - For 74AHCT139-Q100: TTL level
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level A
- ESD protection:
  - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
  - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V

## 3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
<a href="#">74AHC139D-Q100</a> <a href="#">74AHCT139D-Q100</a>	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	SO16	plastic small outline package; 16 leads; body width 3.9 mm	<a href="#">SOT109-1</a>
<a href="#">74AHC139PW-Q100</a> <a href="#">74AHCT139PW-Q100</a>	$-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	<a href="#">SOT403-1</a>

### 4. Functional diagram

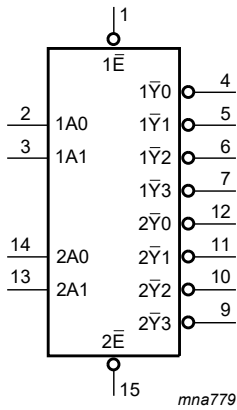


Fig. 1. Logic symbol

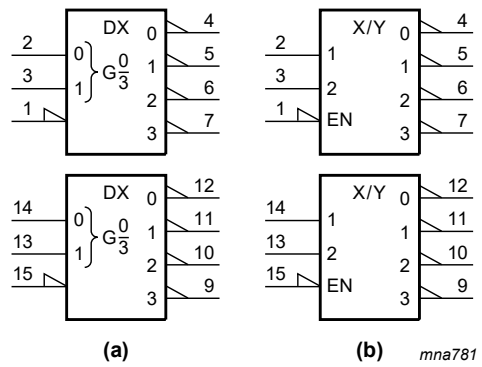


Fig. 2. IEC logic symbol

a = demultiplexer and b = decoder

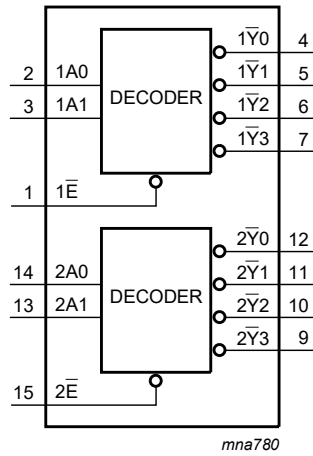
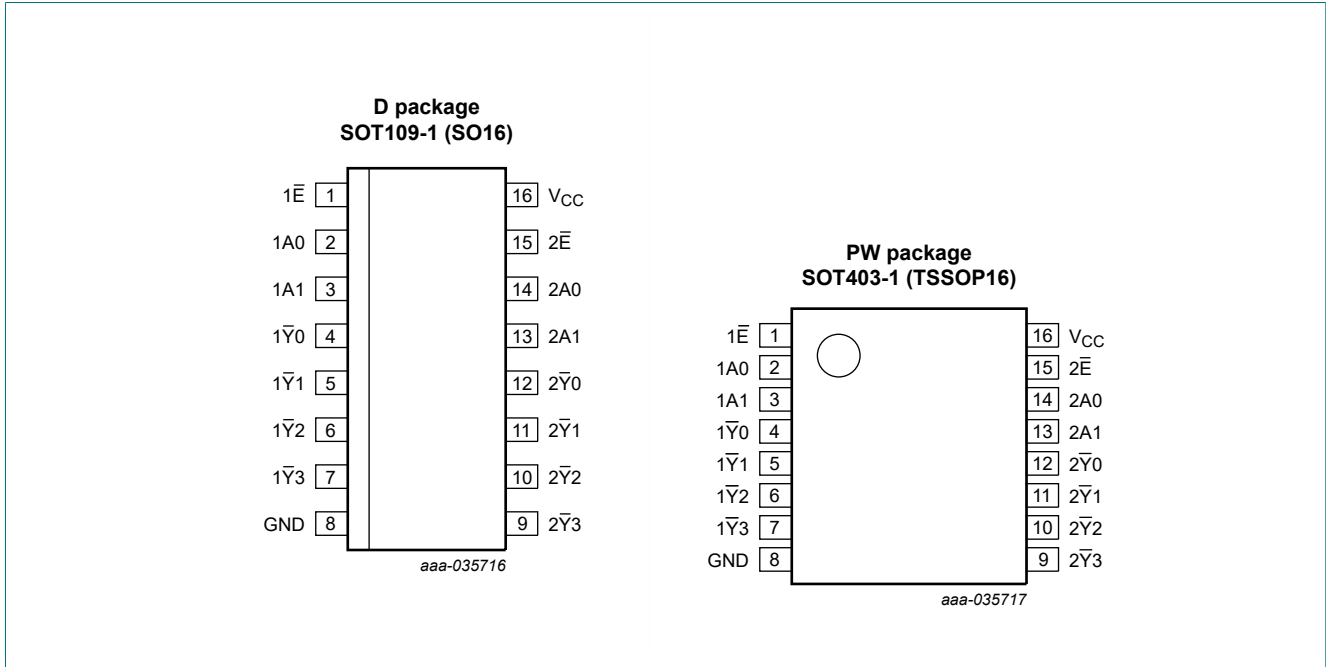


Fig. 3. Functional diagram

## 5. Pinning information

### 5.1. Pinning



### 5.2. Pin description

Table 2. Pin description

Symbol	Pin	Description
1E, 2E	1, 15	enable input (active LOW)
1A0, 1A1	2, 3	address input
1Y0, 1Y1, 1Y2, 1Y3	4, 5, 6, 7	output
GND	8	ground (0 V)
2Y3, 2Y2, 2Y1, 2Y0	9, 10, 11, 12	output
2A1, 2A0	13, 14	address input
VCC	16	supply voltage

## 6. Functional description

Table 3. Function table

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

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

## 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 SOT109-1 (SO16) package:  $P_{tot}$  derates linearly with 12.4 mW/K above 110 °C.

For SOT403-1 (TSSOP16) package:  $P_{tot}$  derates linearly with 8.5 mW/K above 91 °C.

## 8. Recommended operating conditions

**Table 5. Operating conditions**

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>74AHC139-Q100</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	$V_{CC} = 3.0$ V to 3.6 V	-	-	100	ns/V
		$V_{CC} = 4.5$ V to 5.5 V	-	-	20	ns/V
<b>74AHCT139-Q100</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	$V_{CC} = 4.5$ V to 5.5 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-Q100</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	-	-	1.5	-	1.5	-	V
		V <sub>CC</sub> = 3.0 V	2.1	-	-	2.1	-	2.1	-	V
		V <sub>CC</sub> = 5.5 V	3.85	-	-	3.85	-	3.85	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	-	0.5	-	0.5	-	0.5	V
		V <sub>CC</sub> = 3.0 V	-	-	0.9	-	0.9	-	0.9	V
		V <sub>CC</sub> = 5.5 V	-	-	1.65	-	1.65	-	1.65	V
V <sub>OH</sub>	HIGH-level output voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub>								
		I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 2.0 V	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 3.0 V	2.9	3.0	-	2.9	-	2.9	-	V
		I <sub>O</sub> = -50 µA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 3.0 V	2.58	-	-	2.48	-	2.40	-	V
I <sub>O</sub> = -8.0 mA; V <sub>CC</sub> = 4.5 V	3.94	-	-	3.80	-	3.70	-	V		
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> = 50 µA; V <sub>CC</sub> = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 3.0 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 50 µA; V <sub>CC</sub> = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA; V <sub>CC</sub> = 3.0 V	-	-	0.36	-	0.44	-	0.55	V
I <sub>O</sub> = 8.0 mA; V <sub>CC</sub> = 4.5 V	-	-	0.36	-	0.44	-	0.55	V		
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	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	-	-	4.0	-	40	-	80	µA
C <sub>I</sub>	input capacitance	V <sub>I</sub> = V <sub>CC</sub> or GND	-	3	10	-	10	-	10	pF
C <sub>O</sub>	output capacitance		-	4	-	-	-	-	-	pF

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
<b>74AHCT139-Q100</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	2.0	-	-	2.0	-	2.0	-	V
V <sub>IL</sub>	LOW-level input voltage	V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	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> = -50 µA	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -8.0 mA	3.94	-	-	3.80	-	3.70	-	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> = 50 µA	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 8.0 mA	-	-	0.36	-	0.44	-	0.55	V
I <sub>I</sub>	input leakage current	V <sub>I</sub> = 5.5 V or GND; V <sub>CC</sub> = 0 V to 5.5 V	-	-	0.1	-	1.0	-	2.0	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	-	-	4.0	-	40	-	80	µA
ΔI <sub>CC</sub>	additional supply current	per input pin; V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other pins at V <sub>CC</sub> or GND; I <sub>O</sub> = 0 A; V <sub>CC</sub> = 4.5 V to 5.5 V	-	-	1.35	-	1.5	-	1.5	mA
C <sub>I</sub>	input capacitance	V <sub>I</sub> = V <sub>CC</sub> or GND	-	3	10	-	10	-	10	pF
C <sub>O</sub>	output capacitance		-	4	-	-	-	-	-	pF

## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 6.

Symbol	Parameter	Conditions	25 °C			-40 °C to +85 °C		-40 °C to +125 °C		Unit
			Min	Typ[1]	Max	Min	Max	Min	Max	
<b>74AHC139-Q100</b>										
$t_{pd}$	propagation delay	nAn to n $\bar{Y}$ n; see Fig. 4 [2]								
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 15\text{ pF}$	-	5.5	11.0	1.0	13.0	1.0	14.0	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 50\text{ pF}$	-	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
		$V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$	-	5.6	9.2	1.0	10.5	1.0	11.5	ns
		n $\bar{E}$ to n $\bar{Y}$ n; see Fig. 5 [2]								
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 15\text{ pF}$	-	4.8	9.2	1.0	11.0	1.0	11.5	ns
		$V_{CC} = 3.0\text{ V to }3.6\text{ V}; C_L = 50\text{ pF}$	-	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
$V_{CC} = 4.5\text{ V to }5.5\text{ V}; C_L = 50\text{ pF}$	-	4.9	8.3	1.0	9.5	1.0	10.5	ns		
$C_{PD}$	power dissipation capacitance	$f_i = 1\text{ MHz}; V_i = \text{GND to }V_{CC}$ [3]	-	26	-	-	-	-	-	pF
<b>74AHCT139-Q100; <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 Fig. 4 [2]								
		$C_L = 15\text{ pF}$	-	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 Fig. 5 [2]								
		$C_L = 15\text{ pF}$	-	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	$f_i = 1\text{ MHz}; V_i = \text{GND to }V_{CC}$ [3]	-	23	-	-	-	-	-	pF

[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.

10.1. Waveforms and test circuit

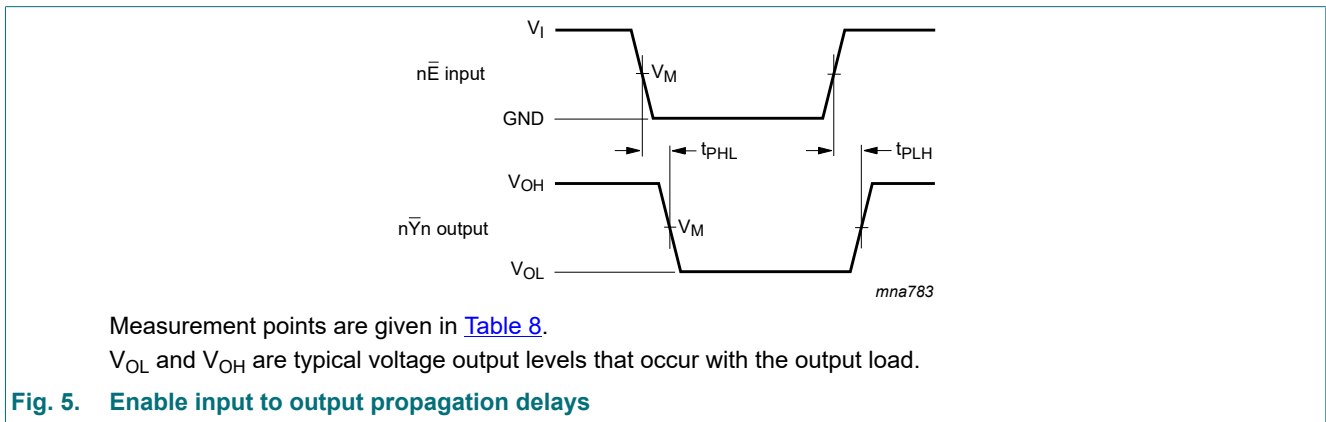
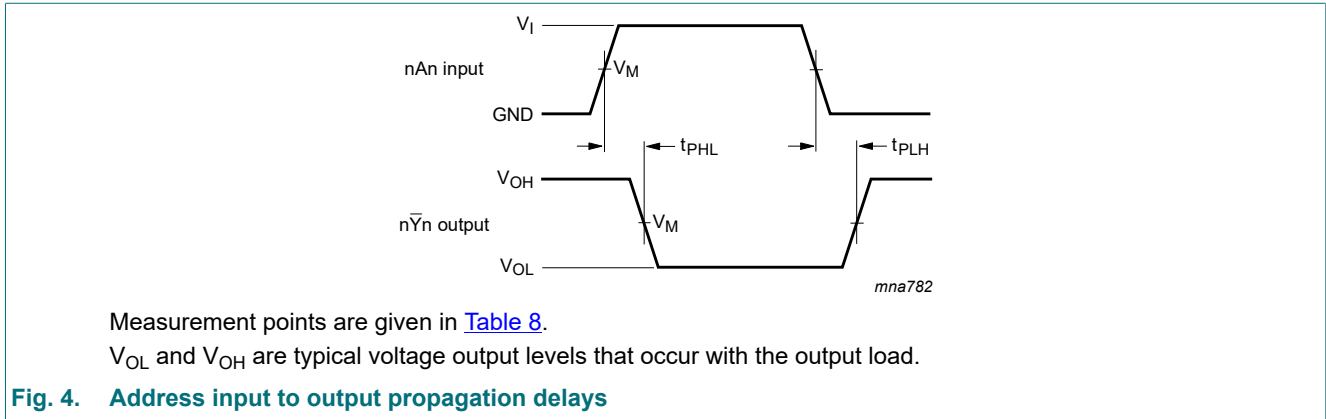
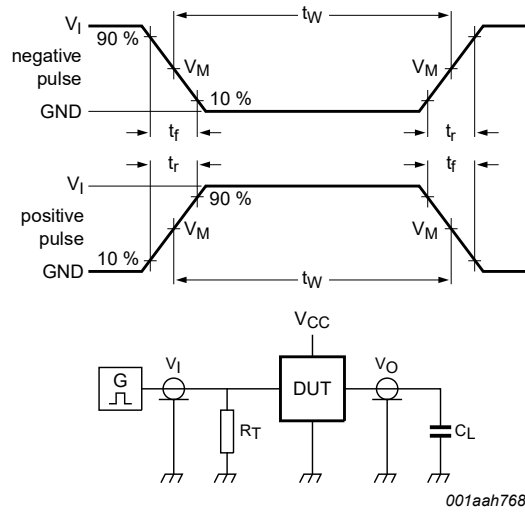


Table 8. Measurement points

Type	Input	Output
	$V_M$	$V_M$
74AHC139-Q100	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$
74AHCT139-Q100	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. 6. Test circuit for measuring switching times**

**Table 9. Test data**

Type	Input		Load	Test
	$V_I$	$t_r, t_f$	$C_L$	
74AHC139-Q100	$V_{CC}$	$\leq 3.0$ ns	15 pF, 50 pF	$t_{PLH}, t_{PHL}$
74AHCT139-Q100	3.0 V	$\leq 3.0$ 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

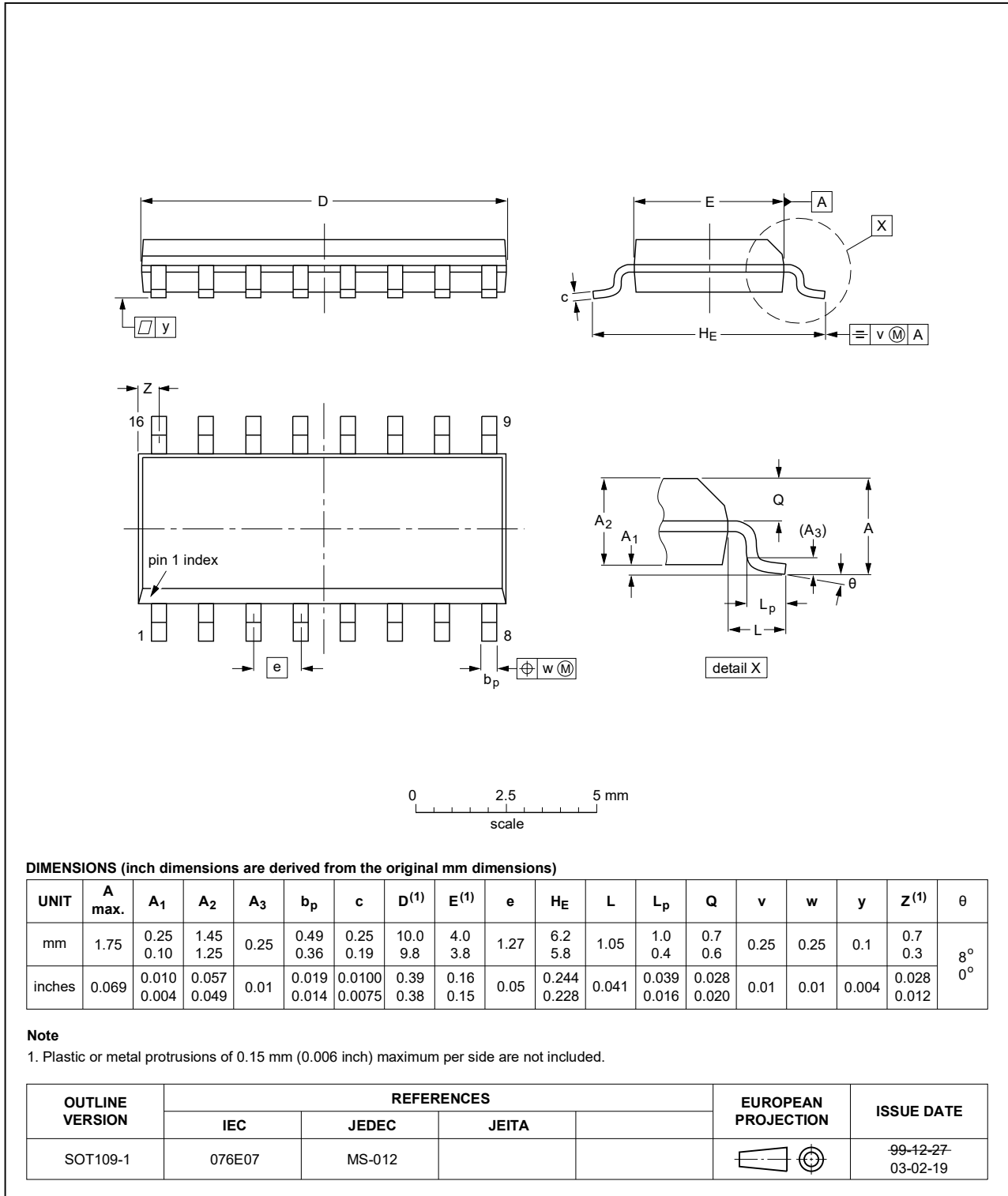


Fig. 7. Package outline SOT109-1 (SO16)

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

SOT403-1

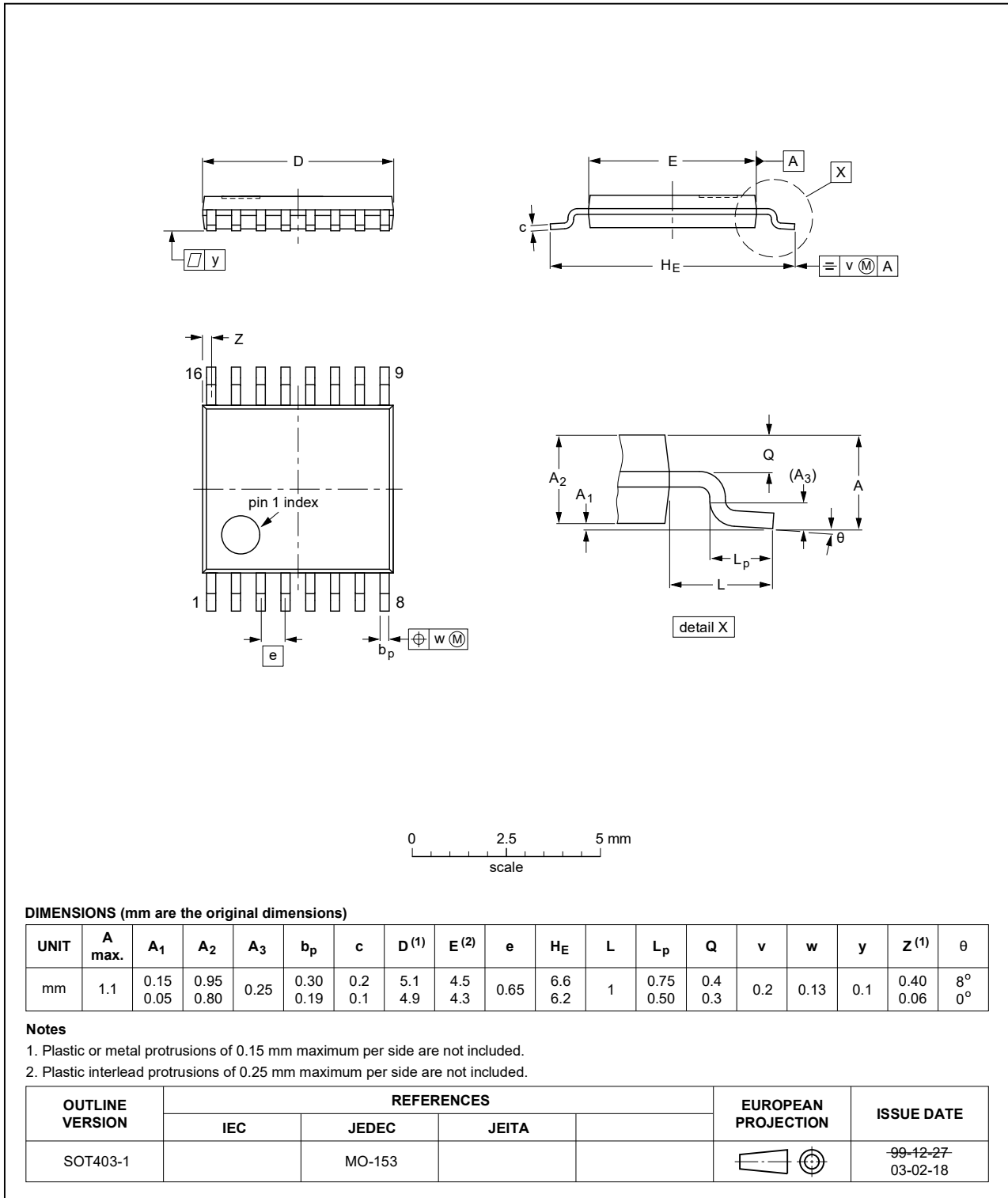


Fig. 8. Package outline SOT403-1 (TSSOP16)

## 12. 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
TTL	Transistor-Transistor Logic

## 13. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74AHC_AHCT139_Q100 v.2	20230907	Product data sheet	-	74AHC_AHCT139_Q100 v.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 Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> <li><a href="#">Section 1</a> updated.</li> <li><a href="#">Section 2</a>: updated, ESD specification updated according to the latest JEDEC standard.</li> <li><a href="#">Table 4</a>: Derating values for <math>P_{tot}</math> total power dissipation updated.</li> </ul>			
74AHC_AHCT139_Q100 v.1	20130605	Product data sheet	-	-

## 14. Legal information

### 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.

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- [2] The term 'short data sheet' is explained in section "Definitions".
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