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Kind regards,

Team Nexperia

# 74HC139-Q100; 74HCT139-Q100

## Dual 2-to-4 line decoder/demultiplexer

Rev. 1 — 19 June 2014

Product data sheet

## 1. General description

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The 74HC139-Q100; 74HCT139-Q100 decodes two binary weighted address inputs ( $nA_0$ ,  $nA_1$ ) to four mutually exclusive outputs ( $n\bar{Y}_0$  to  $n\bar{Y}_3$ ). Each decoder features an enable input ( $n\bar{E}$ ). When  $n\bar{E}$  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 include clamp diodes that enable 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 74HC139-Q100: CMOS level
  - ◆ For 74HCT139-Q100: TTL level
- Demultiplexing capability
- 2 independent 2-to-4 decoders
- Multifunction capability
- Suitable for memory decoding, data routing or code conversion
- Complies with JEDEC standard no. 7A
- Active LOW mutually exclusive outputs
- 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	
74HC139D-Q100 74HCT139D-Q100	-40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HC139DB-Q100 74HCT139DB-Q100				
74HC139PW-Q100 74HCT139PW-Q100	-40 °C to +125 °C	TSSOP16	plastic thin shrink small outline package; 16 leads; body width 4.4 mm	SOT403-1

### 4. Functional diagram

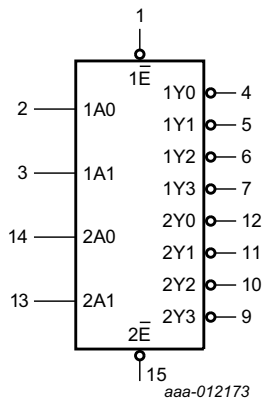


Fig 1. Logic symbol

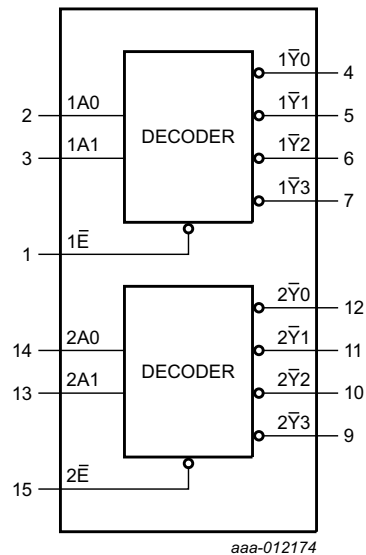
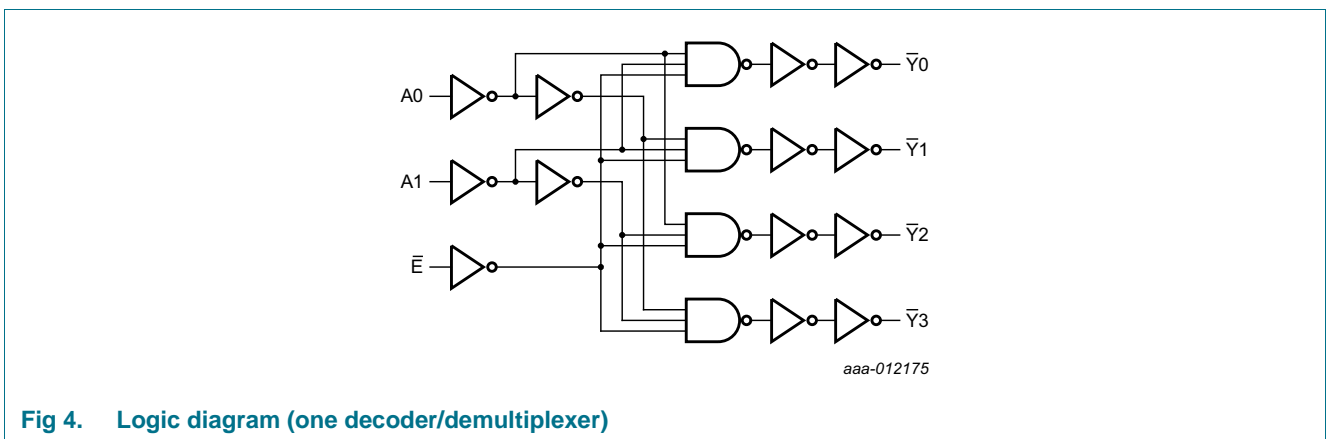
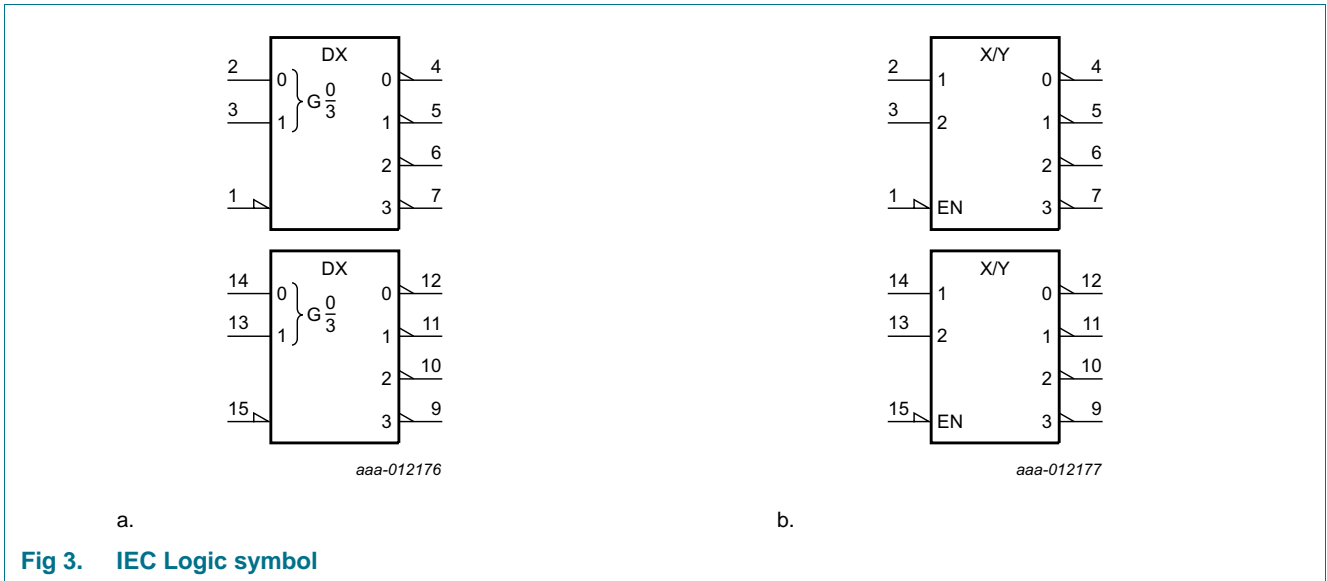


Fig 2. Functional diagram



## 5. Pinning information

### 5.1 Pinning

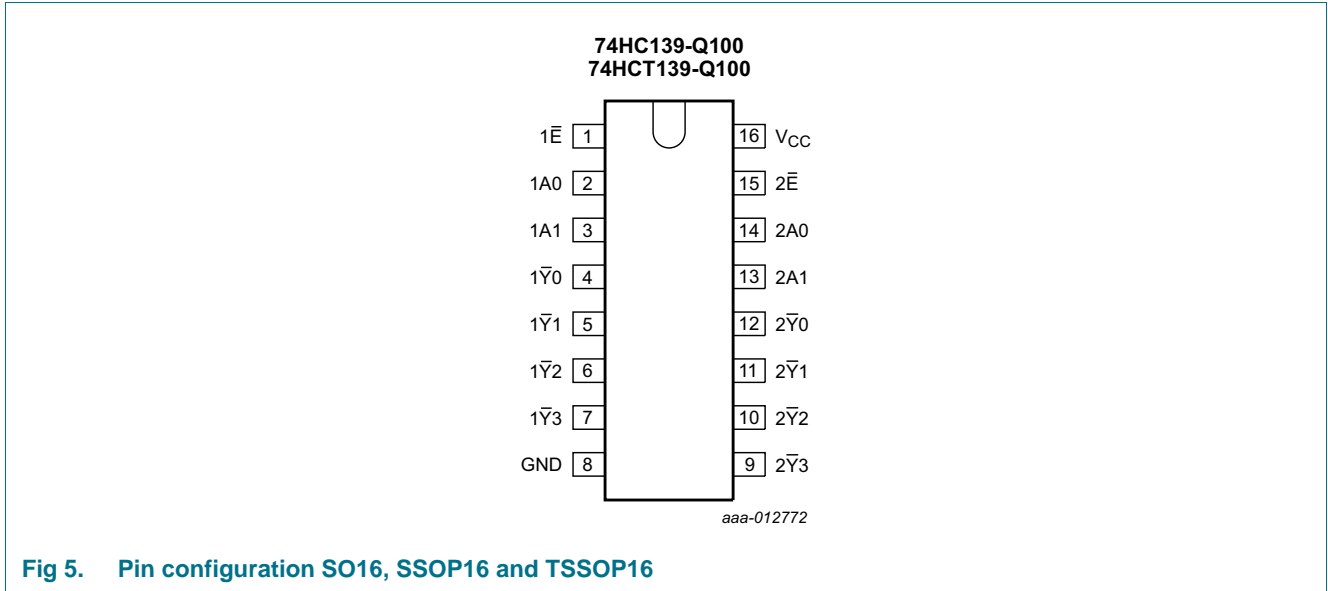


Fig 5. Pin configuration SO16, SSOP16 and TSSOP16

### 5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
1Ē, 2Ē	1, 15	enable input (active LOW)
1A0, 1A1	2, 3	address input
1Y0̄, 1Y1̄, 1Y2̄, 1Y3̄	4, 5, 6, 7	output (active LOW)
GND	8	ground (0 V)
2Y0̄, 2Y1̄, 2Y2̄, 2Y3̄	12, 11, 10, 9	output (active LOW)
2A0, 2A1	14, 13	address input
V <sub>CC</sub>	16	positive supply voltage

## 6. Functional description

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

Control	Input		Output			
	nA1	nA0	nY3̄	nY2̄	nY1̄	nY0̄
H	X	X	H	H	H	H
L	L	L	H	H	H	L
L	L	H	H	H	L	H
L	H	L	H	L	H	H
L	H	H	L	H	H	H

[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	V	
$I_{IK}$	input clamping current	$V_I < -0.5\text{ V}$ or $V_I > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA	
$I_{OK}$	output clamping current	$V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$	-	$\pm 20$	mA	
$I_O$	output current	$V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$	-	$\pm 25$	mA	
$I_{CC}$	supply current		-	50	mA	
$I_{GND}$	ground current		-50	-	mA	
$T_{stg}$	storage temperature		-65	+150	°C	
$P_{tot}$	total power dissipation					
	SO16 package		[1]	-	500	mW
	SSOP16 package		[2]	-	500	mW
	TSSOP16 package		[2]	-	500	mW

[1] For SO16 package:  $P_{tot}$  derates linearly with 8 mW/K above 70 °C.

[2] For SSOP16 and TSSOP16 packages:  $P_{tot}$  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	74HC139-Q100			74HCT139-Q100			Unit
			Min	Typ	Max	Min	Typ	Max	
$V_{CC}$	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
$V_I$	input voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
$V_O$	output voltage		0	-	$V_{CC}$	0	-	$V_{CC}$	V
$T_{amb}$	ambient temperature		-40	+25	+125	-40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	$V_{CC} = 2.0\text{ V}$	-	-	625	-	-	-	ns/V
		$V_{CC} = 4.5\text{ V}$	-	1.67	139	-	1.67	139	ns/V
		$V_{CC} = 6.0\text{ V}$	-	-	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	T <sub>amb</sub>						Unit	
			25 °C			-40 °C to +85 °C		-40 °C to +125 °C		
			Min	Typ	Max	Min	Max	Min		Max
<b>74HC139-Q100</b>										
V <sub>IH</sub>	HIGH-level input voltage	V <sub>CC</sub> = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		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>	LOW-level input voltage	V <sub>CC</sub> = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		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 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	1.9	2.0	-	1.9	-	1.9	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 4.5 V	4.4	4.5	-	4.4	-	4.4	-	V
		I <sub>O</sub> = -20 μA; V <sub>CC</sub> = 6.0 V	5.9	6.0	-	5.9	-	5.9	-	V
		I <sub>O</sub> = -4.0 mA; V <sub>CC</sub> = 4.5 V	3.98	4.32	-	3.84	-	3.7	-	V
I <sub>O</sub> = -5.2 mA; V <sub>CC</sub> = 6.0 V	5.48	5.81	-	5.34	-	5.2	-	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> = 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	-	±1.0	-	±1.0	μA
I <sub>OZ</sub>	OFF-state output current	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; V <sub>CC</sub> = 6.0 V	-	-	±0.5	-	±5.0	-	±10.0	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> = 6.0 V	-	-	8.0	-	80	-	160	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF

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

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	T <sub>amb</sub>						Unit	
			25 °C			-40 °C to +85 °C		-40 °C to +125 °C		
			Min	Typ	Max	Min	Max	Min		Max
<b>74HCT139-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 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	-	0	0.1	-	0.1	-	0.1	V
		I <sub>O</sub> = 4.0 mA	-	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	-	±1.0	-	±1.0	μA
I <sub>oz</sub>	OFF-state output current	per input pin; V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> ; V <sub>O</sub> = V <sub>CC</sub> or GND; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 5.5 V; I <sub>O</sub> = 0 A	-	-	±0.5	-	±5.0	-	±10	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	-	-	8.0	-	80	-	160	μA
ΔI <sub>CC</sub>	additional supply current	V <sub>I</sub> = V <sub>CC</sub> - 2.1 V; other inputs at V <sub>CC</sub> or GND; V <sub>CC</sub> = 4.5 V to 5.5 V; I <sub>O</sub> = 0 A								
		per input pin; 1An inputs	-	70	252	-	315	-	343	μA
		per input pin; 2An inputs	-	70	252	-	315	-	343	μA
		per input pin; nE inputs	-	135	486	-	607.5	-	661.5	μA
C <sub>I</sub>	input capacitance		-	3.5	-	-	-	-	-	pF



## 10. Dynamic characteristics

**Table 7. Dynamic characteristics**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50$  pF unless otherwise specified; for test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	$T_{amb}$						Unit	
			25 °C			-40 °C to +85 °C		-40 °C to +125 °C		
			Min	Typ	Max	Min	Max	Min		Max
<b>74HC139-Q100</b>										
$t_{pd}$	propagation delay	nAn to $n\bar{Y}n$ ; see <a href="#">Figure 6</a> <sup>[1]</sup>								
		$V_{CC} = 2.0$ V	-	39	145	-	180	-	220	ns
		$V_{CC} = 4.5$ V	-	14	29	-	36	-	44	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	11	-	-	-	-	-	ns
		$V_{CC} = 6.0$ V	-	11	25	-	31	-	38	ns
		$n\bar{E}$ to $n\bar{Y}n$ ; see <a href="#">Figure 7</a> <sup>[1]</sup>								
		$V_{CC} = 2.0$ V	-	33	135	-	170	-	205	ns
		$V_{CC} = 4.5$ V	-	12	27	-	34	-	41	ns
$t_t$	transition time	$n\bar{Y}n$ ; see <a href="#">Figure 6</a> and <a href="#">Figure 7</a> <sup>[2]</sup>								
		$V_{CC} = 2.0$ V	-	19	75	-	95	-	110	ns
		$V_{CC} = 4.5$ V	-	7	15	-	19	-	22	ns
		$V_{CC} = 6.0$ V	-	6	13	-	16	-	19	ns
$C_{PD}$	power dissipation capacitance	$C_L = 50$ pF; $f = 1$ MHz; $V_I = GND$ to $V_{CC}$ <sup>[3]</sup>	-	42	-	-	-	-	-	pF
<b>74HCT139-Q100</b>										
$t_{pd}$	propagation delay	nAn to $n\bar{Y}n$ ; see <a href="#">Figure 6</a> <sup>[1]</sup>								
		$V_{CC} = 4.5$ V	-	16	34	-	43	-	51	ns
		$V_{CC} = 5.0$ V; $C_L = 15$ pF	-	13	-	-	-	-	-	ns
		$n\bar{E}$ to $n\bar{Y}n$ ; see <a href="#">Figure 7</a> <sup>[1]</sup>								
		$V_{CC} = 4.5$ V	-	16	34	-	43	-	51	ns
$t_t$	transition time	$n\bar{Y}n$ ; see <a href="#">Figure 6</a> and <a href="#">Figure 7</a> <sup>[2]</sup>								
		$V_{CC} = 4.5$ V	-	7	15	-	19	-	22	ns

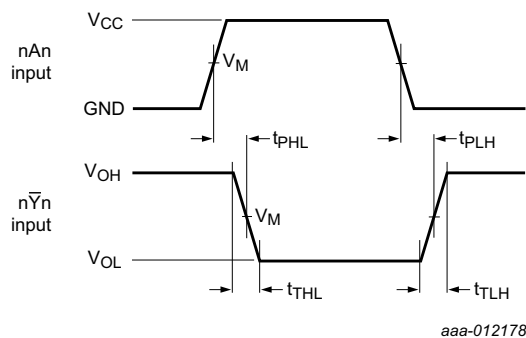
**Table 7. Dynamic characteristics ...continued**

Voltages are referenced to GND (ground = 0 V);  $C_L = 50 \text{ pF}$  unless otherwise specified; for test circuit see [Figure 8](#).

Symbol	Parameter	Conditions	$T_{amb}$						Unit	
			25 °C			-40 °C to +85 °C		-40 °C to +125 °C		
			Min	Typ	Max	Min	Max	Min		Max
$C_{PD}$	power dissipation capacitance	$C_L = 50 \text{ pF}$ ; $f = 1 \text{ MHz}$ ; $V_I = \text{GND to } V_{CC} - 1.5 \text{ V}$	-	44	-	-	-	-	-	pF

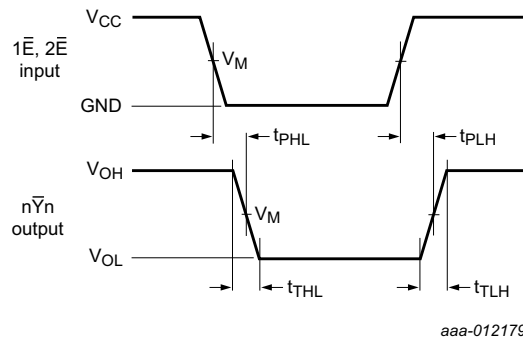
- [1]  $t_{pd}$  is the same as  $t_{PLH}$  and  $t_{PHL}$ .
- [2]  $t_t$  is the same as  $t_{THL}$  and  $t_{TLH}$ .
- [3]  $C_{PD}$  is used to determine the dynamic power dissipation ( $P_D$  in  $\mu\text{W}$ ).  
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \sum(C_L \times V_{CC}^2 \times f_o)$  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.

## 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 6. Propagation delay input ( $nAn$ ) to output ( $nYn$ ) and transition time output ( $nYn$ )**



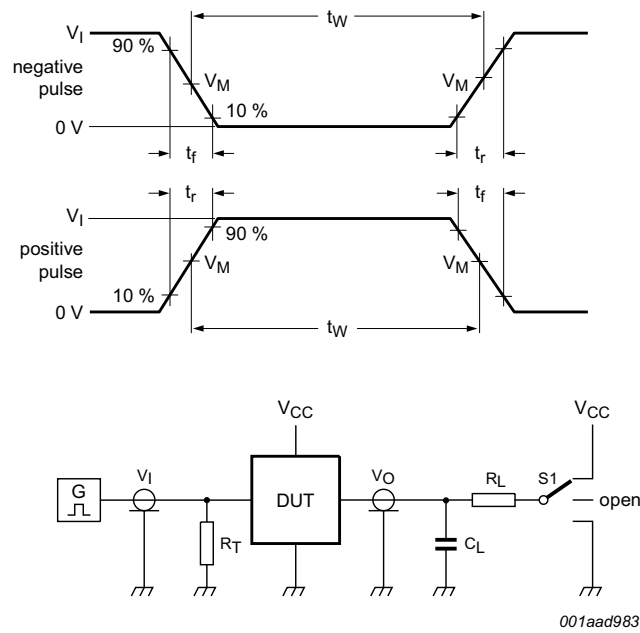
Measurement points are given in [Table 8](#).

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

**Fig 7. Propagation delay enable input ( $\overline{nE}$ ) to output ( $\overline{nYn}$ ) and transition time output ( $\overline{nYn}$ )**

**Table 8. Measurement points**

Type	Input	Output
	$V_M$	$V_M$
74HC139-Q100	$0.5V_{CC}$	$0.5V_{CC}$
74HCT139-Q100	1.3 V	1.3 V



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.

$R_L$  = Load resistance.

S1 = Test selection switch.

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

**Table 9. Test data**

Type	Input		Load		S1 position		
	$V_I$	$t_r, t_f$	$C_L$	$R_L$	$t_{PHL}, t_{PLH}$	$t_{PZH}, t_{PHZ}$	$t_{PZL}, t_{PLZ}$
74HC139-Q100	$V_{CC}$	6 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$
74HCT139-Q100	3 V	6 ns	15 pF, 50 pF	1 k $\Omega$	open	GND	$V_{CC}$

12. Package outline

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

SOT109-1

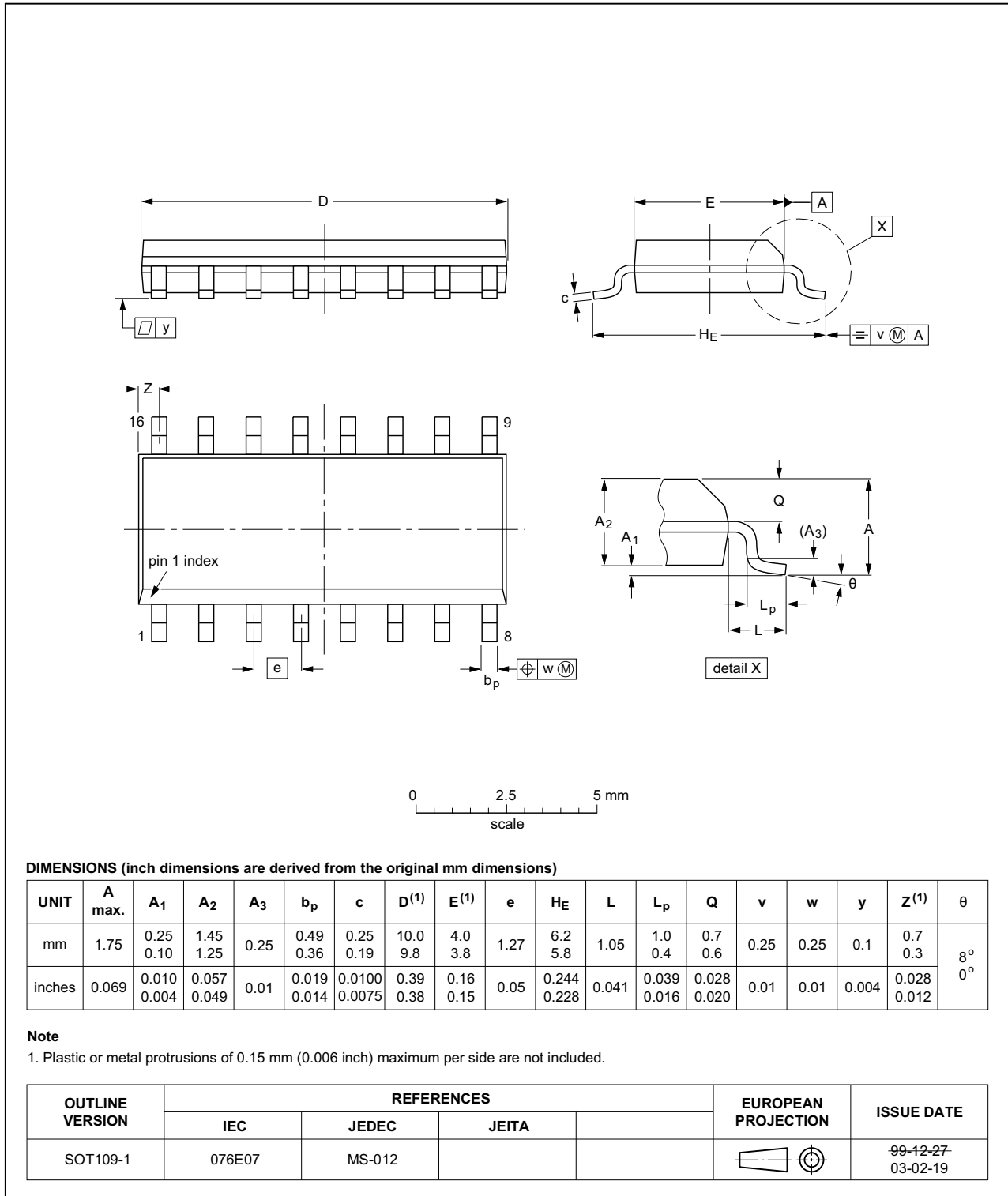


Fig 9. Package outline SOT109-1 (SO16)

SSOP16: plastic shrink small outline package; 16 leads; body width 5.3 mm

SOT338-1

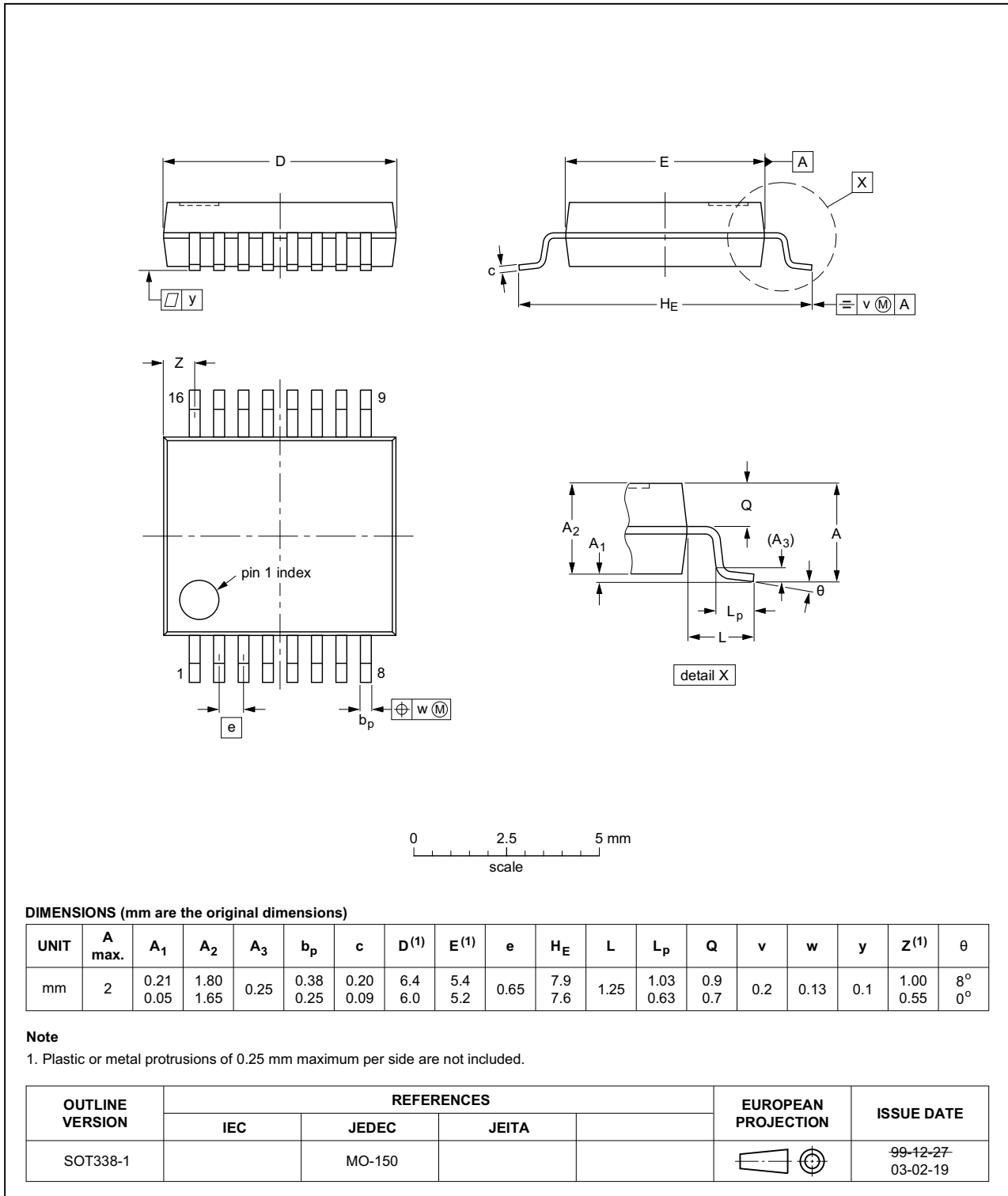


Fig 10. Package outline SOT338-1 (SSOP16)

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

SOT403-1

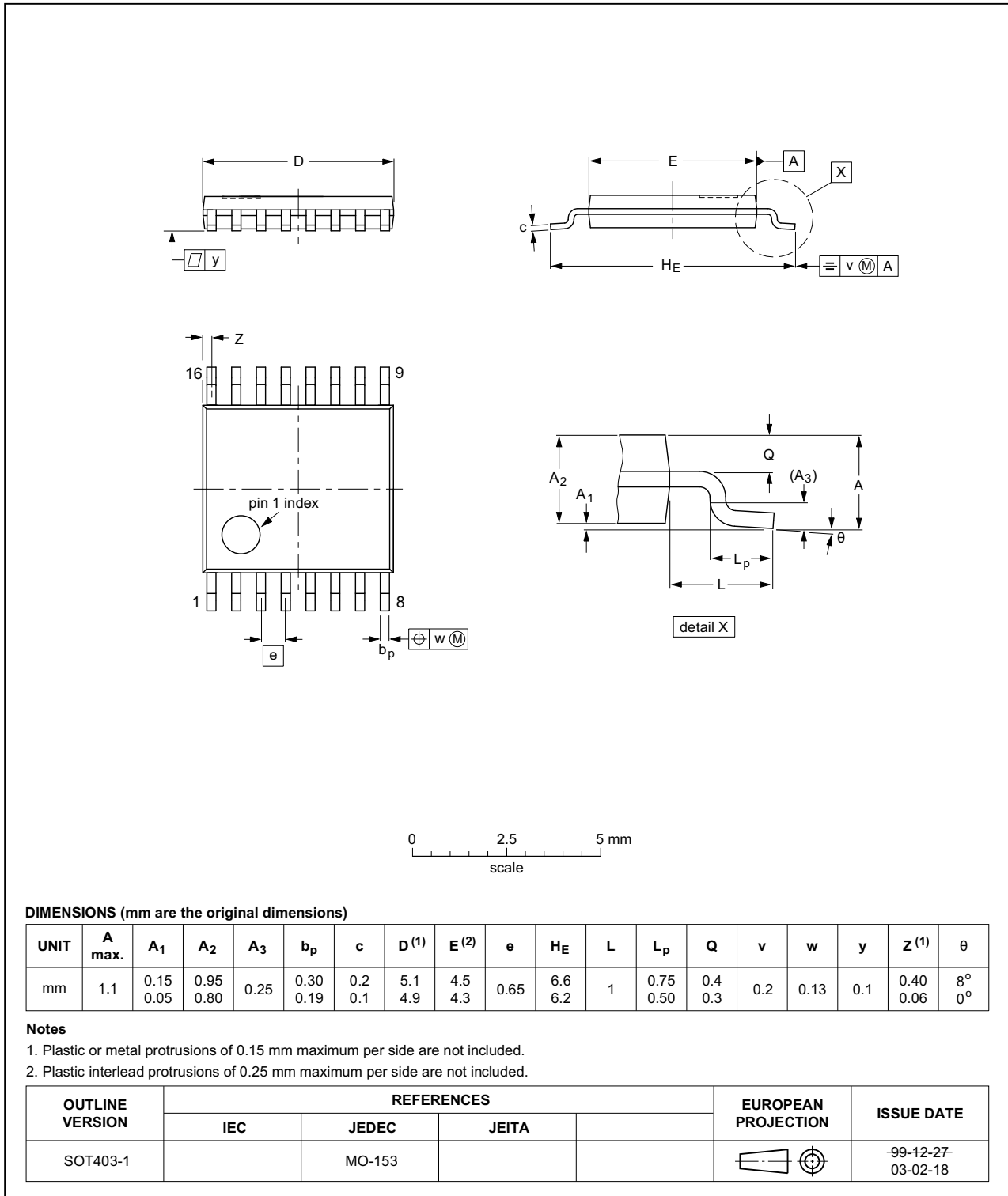


Fig 11. Package outline SOT403-1 (TSSOP16)

## 13. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MIL	Military
MM	Machine Model

## 14. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT139_Q100 v.1	20140619	Product data sheet	-	-



## 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".

[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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Date of release: 19 June 2014

Document identifier: 74HC\_HCT139\_Q100