

74HC139-Q100; 74HCT139-Q100

Dual 2-to-4 line decoder/demultiplexer

Rev. 1 — 19 June 2014

Product data sheet

1. General description

The 74HC139-Q100; 74HCT139-Q100 decodes two binary weighted address inputs ($nA0$, $nA1$) 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

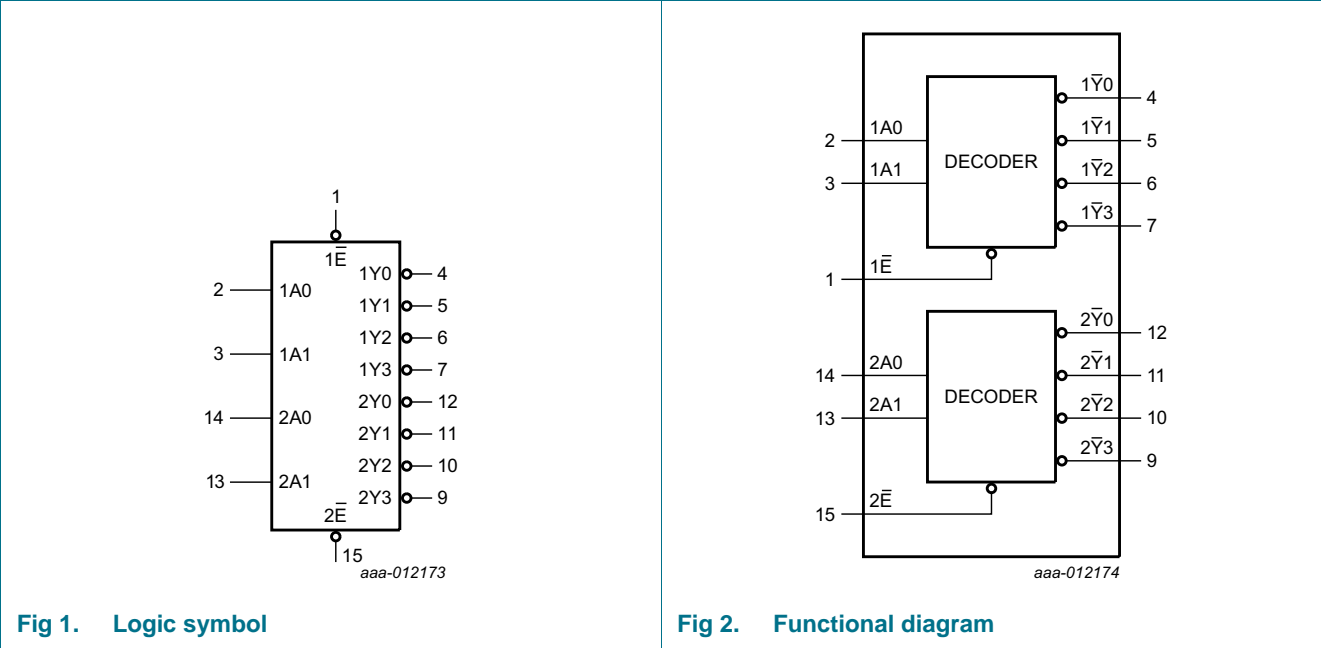
- Automotive product qualification in accordance with AEC-Q100 (Grade 1)
 - ◆ Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ and from $-40\text{ }^{\circ}\text{C}$ to $+125\text{ }^{\circ}\text{C}$
- Input levels:
 - ◆ For 74HC139-Q100: CMOS level
 - ◆ For 74HCT139-Q100: 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

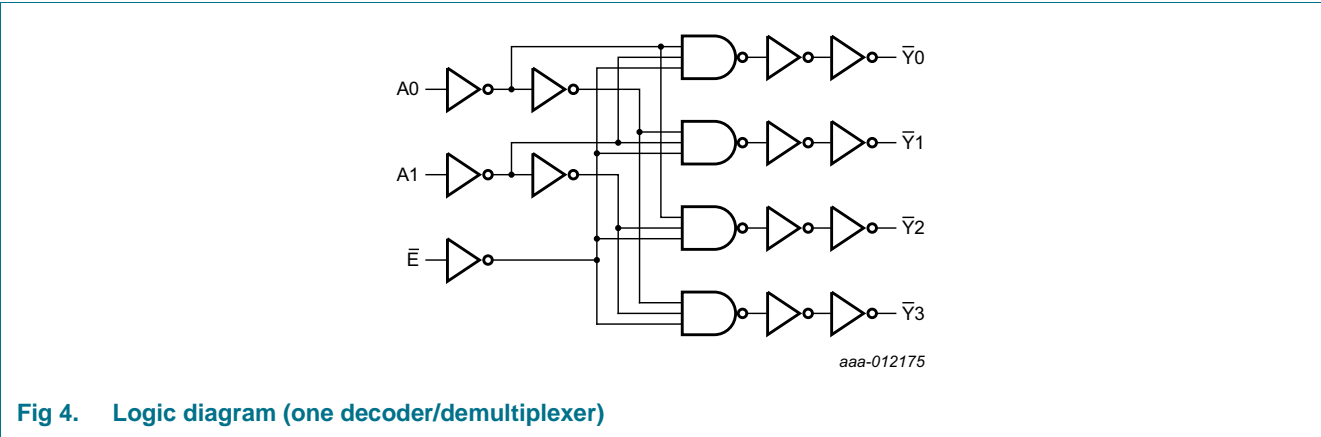
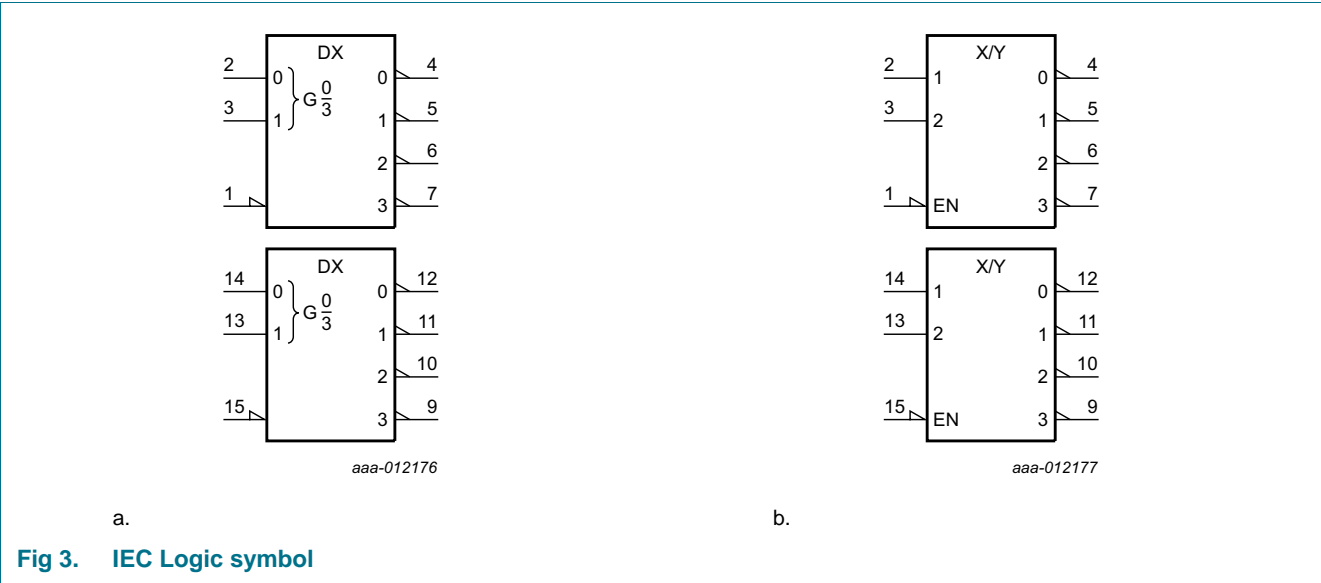
3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|-----------------|-------------------|---------|---|----------|
| | Temperature range | Name | Description | Version |
| 74HC139D-Q100 | -40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74 HCT139D-Q100 | | | | |
| 74HC139DB-Q100 | -40 °C to +125 °C | SSOP16 | plastic shrink small outline package; 16 leads; body width 5.3 mm | SOT338-1 |
| 74HCT139DB-Q100 | | | | |
| 74HC139PW-Q100 | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HCT139PW-Q100 | | | | |

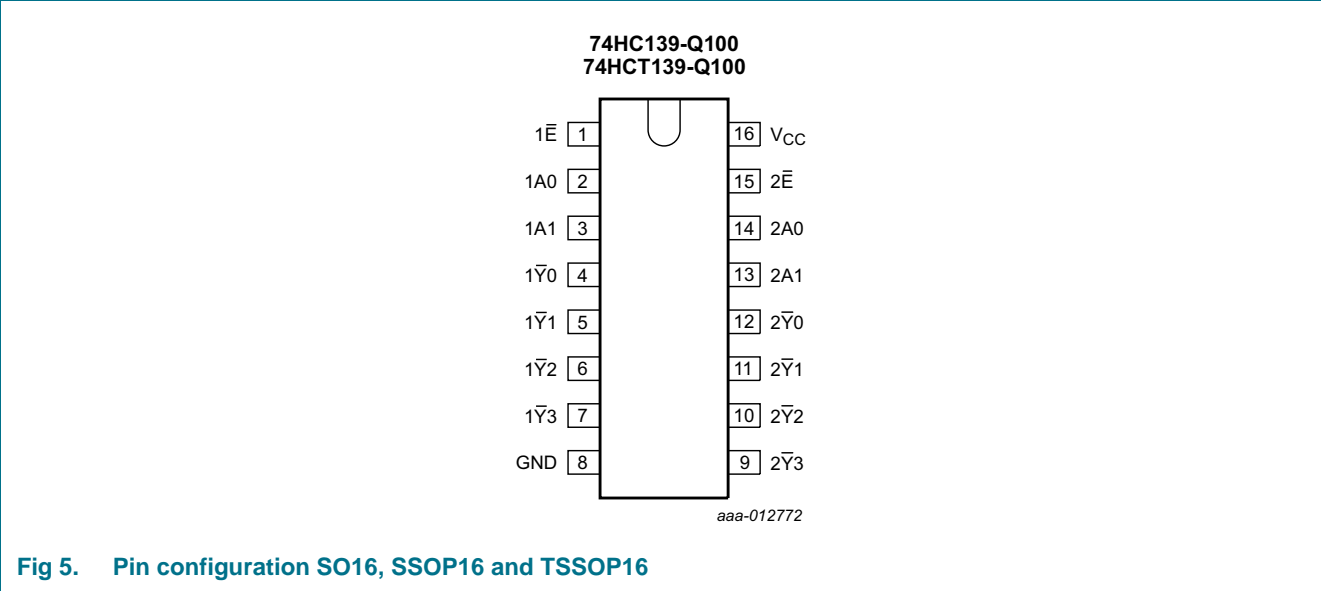
4. Functional diagram





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 (active LOW) |
| GND | 8 | ground (0 V) |
| 2Y0, 2Y1, 2Y2, 2Y3 | 12, 11, 10, 9 | output (active LOW) |
| 2A0, 2A1 | 14, 13 | address input |
| V _{CC} | 16 | positive supply voltage |

6. Functional description

Table 3. Function table^[1]

| Control | Input | | Output | | | |
|---------|-------|-----|--------|-----|-----|-----|
| nE | nA1 | nA0 | nY3 | nY2 | nY1 | nY0 |
| 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 $V_I > V_{CC} + 0.5\text{ V}$ | - | ± 20 | mA |
| I_{OK} | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ | - | ± 20 | mA |
| I_O | output current | $V_O = -0.5\text{ V}$ to $(V_{CC} + 0.5\text{ V})$ | - | ± 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 _{amb} | | | | | | | Unit |
|-----------------|---------------------------|--|------------------|------|------|------------------|------|-------------------|-------|------|
| | | | 25 °C | | | –40 °C to +85 °C | | –40 °C to +125 °C | | |
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC139-Q100 | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 2.0 V | 1.5 | 1.2 | - | 1.5 | - | 1.5 | - | V |
| | | V _{CC} = 4.5 V | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | V _{CC} = 6.0 V | 4.2 | 3.2 | - | 4.2 | - | 4.2 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 2.0 V | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | V _{CC} = 4.5 V | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | V _{CC} = 6.0 V | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = –20 μA; V _{CC} = 2.0 V | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | I _O = –20 μA; V _{CC} = 4.5 V | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = –20 μA; V _{CC} = 6.0 V | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | I _O = –4.0 mA; V _{CC} = 4.5 V | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V |
| | | I _O = –5.2 mA; V _{CC} = 6.0 V | 5.48 | 5.81 | - | 5.34 | - | 5.2 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | | | |
| | | I _O = 20 μA; V _{CC} = 2.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 μA; V _{CC} = 4.5 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 20 μA; V _{CC} = 6.0 V | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | I _O = 4.0 mA; V _{CC} = 4.5 V | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| | | I _O = 5.2 mA; V _{CC} = 6.0 V | - | 0.16 | 0.26 | - | 0.33 | - | 0.4 | V |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 6.0 V | - | - | ±0.1 | - | ±1.0 | - | ±1.0 | μA |
| I _{OZ} | OFF-state output current | V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; V _{CC} = 6.0 V | - | - | ±0.5 | - | ±5.0 | - | ±10.0 | μA |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 6.0 V | - | - | 8.0 | - | 80 | - | 160 | μA |
| C _I | 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 _{amb} | | | | | | | | Unit |
|------------------|---------------------------|--|------------------|------|------|------------------|-------|-------------------|-------|----|------|
| | | | 25 °C | | | −40 °C to +85 °C | | −40 °C to +125 °C | | | |
| | | | Min | Typ | Max | Min | Max | Min | Max | | |
| 74HCT139-Q100 | | | | | | | | | | | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 4.5 V to 5.5 V | 2.0 | 1.6 | - | 2.0 | - | 2.0 | - | V | |
| V _{IL} | LOW-level input voltage | V _{CC} = 4.5 V to 5.5 V | - | 1.2 | 0.8 | - | 0.8 | - | 0.8 | V | |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | | |
| | | I _O = −20 μA | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V | |
| | | I _O = −4 mA | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V | |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} ; V _{CC} = 4.5 V | | | | | | | | | |
| | | I _O = 20 μA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V | |
| | | I _O = 4.0 mA | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V | |
| I _I | input leakage current | V _I = V _{CC} or GND; V _{CC} = 5.5 V | - | - | ±0.1 | - | ±1.0 | - | ±1.0 | μA | |
| I _{OZ} | OFF-state output current | per input pin; V _I = V _{IH} or V _{IL} ; V _O = V _{CC} or GND; other inputs at V _{CC} or GND; V _{CC} = 5.5 V; I _O = 0 A | - | - | ±0.5 | - | ±5.0 | - | ±10 | μA | |
| I _{CC} | supply current | V _I = V _{CC} or GND; I _O = 0 A; V _{CC} = 5.5 V | - | - | 8.0 | - | 80 | - | 160 | μA | |
| ΔI _{CC} | additional supply current | V _I = V _{CC} − 2.1 V; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V; I _O = 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 _I | 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](#).

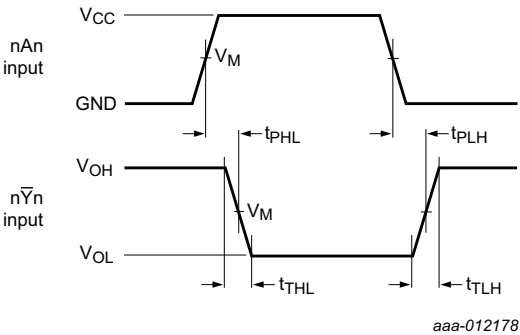
| Symbol | Parameter | Conditions | T _{amb} | | | | | | | Unit |
|-------------------------|-------------------------------|--|------------------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | 25 °C | | | −40 °C to +85 °C | | −40 °C to +125 °C | | |
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC139-Q100 | | | | | | | | | | |
| t _{pd} | propagation delay | nAn to nȲn; see Figure 6 [1] | | | | | | | | |
| | | 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 |
| | | nĒ to nȲn; see Figure 7 [1] | | | | | | | | |
| | | V _{CC} = 2.0 V | - | 33 | 135 | - | 170 | - | 205 | ns |
| | | V _{CC} = 4.5 V | - | 12 | 27 | - | 34 | - | 41 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 10 | - | - | - | - | - | ns |
| V _{CC} = 6.0 V | - | 10 | 23 | - | 29 | - | 35 | ns | | |
| t _t | transition time | nȲn; see Figure 6 and Figure 7 [2] | | | | | | | | |
| | | 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} [3] | - | 42 | - | - | - | - | - | pF |
| 74HCT139-Q100 | | | | | | | | | | |
| t _{pd} | propagation delay | nAn to nȲn; see Figure 6 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 16 | 34 | - | 43 | - | 51 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 13 | - | - | - | - | - | ns |
| | | nĒ to nȲn; see Figure 7 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 16 | 34 | - | 43 | - | 51 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 13 | - | - | - | - | - | ns |
| t _t | transition time | nȲn; see Figure 6 and Figure 7 [2] | | | | | | | | |
| | | 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 pF; f = 1 MHz; V _I = GND to V _{CC} − 1.5 V [3] | - | 44 | - | - | - | - | - | pF | |

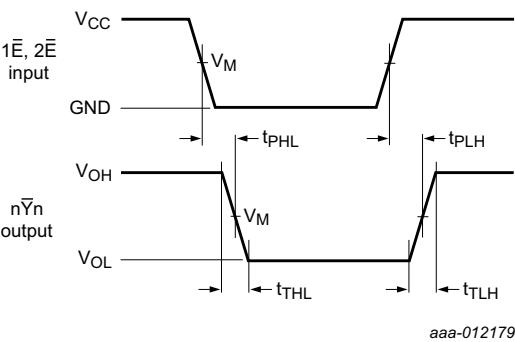
- [1] t_{pd} is the same as t_{PLH} and t_{PHL} .
[2] t_t is the same as t_{THL} and t_{TLH} .
[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
f_i = input frequency in MHz;
f_o = output frequency in MHz;
C_L = output load capacitance in pF;
V_{CC} = supply voltage in V;
N = number of inputs switching;
 $\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

11. Waveforms



Measurement points are given in [Table 8](#).
VOL and VOH 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 ($n\bar{E}$) to output ($n\bar{Y}_n$) and transition time output ($n\bar{Y}_n$)

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 |

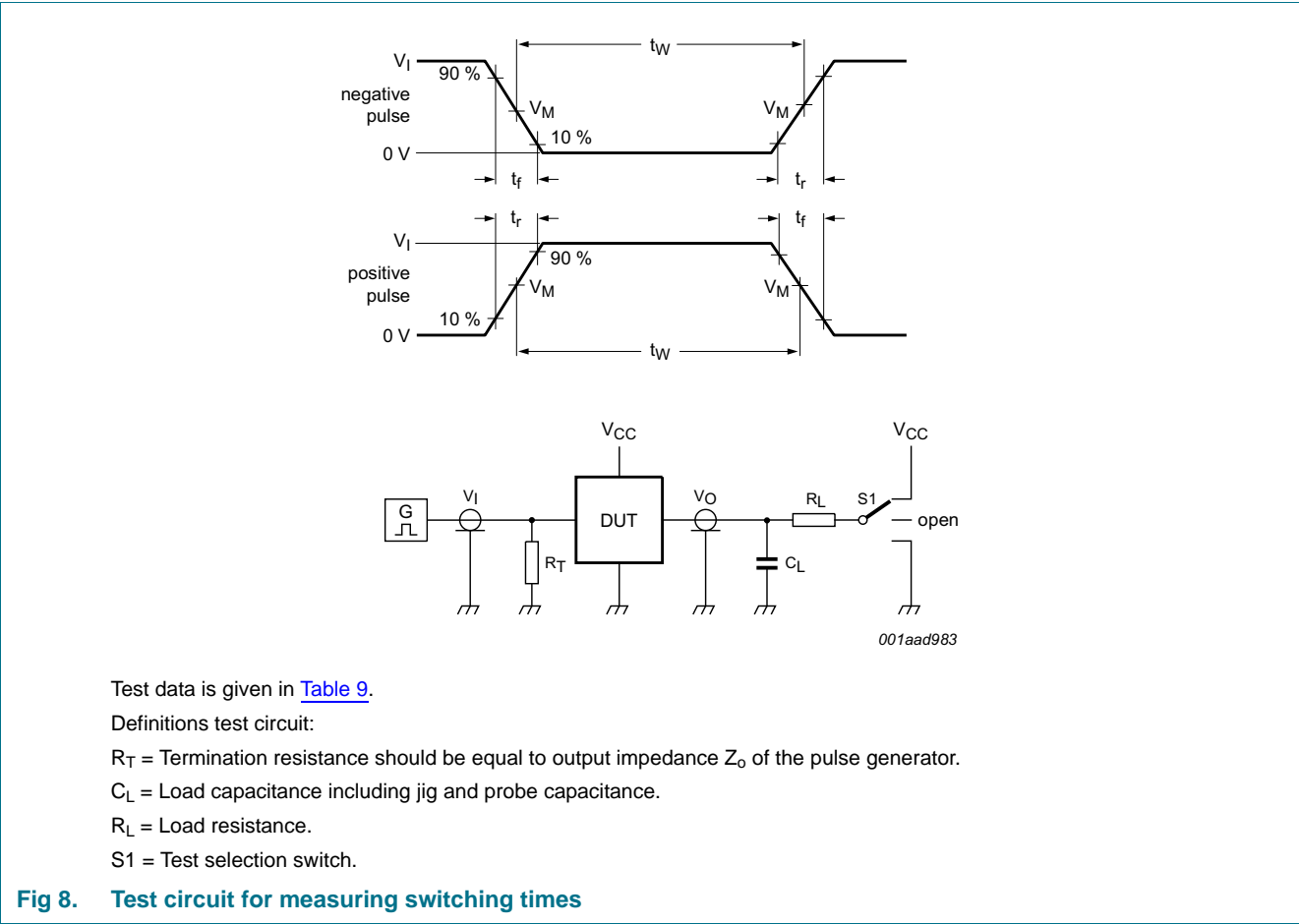


Table 9. Test data

| 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 Ω | open | GND | V_{CC} |
| 74HCT139-Q100 | 3 V | 6 ns | 15 pF, 50 pF | 1 k Ω | open | GND | V_{CC} |

12. Package outline

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

SOT109-1

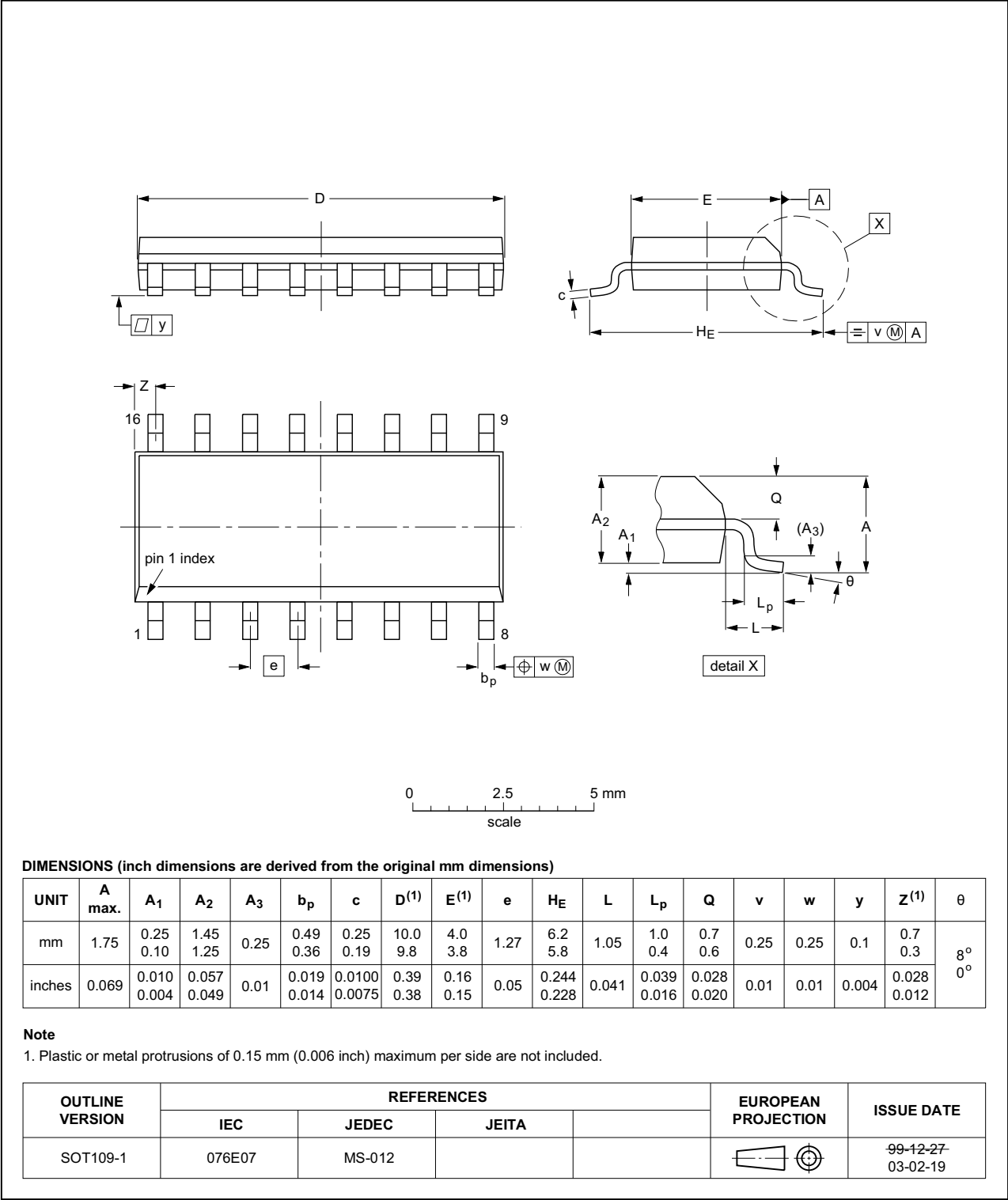


Fig 9. Package outline SOT109-1 (SO16)

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

SOT338-1

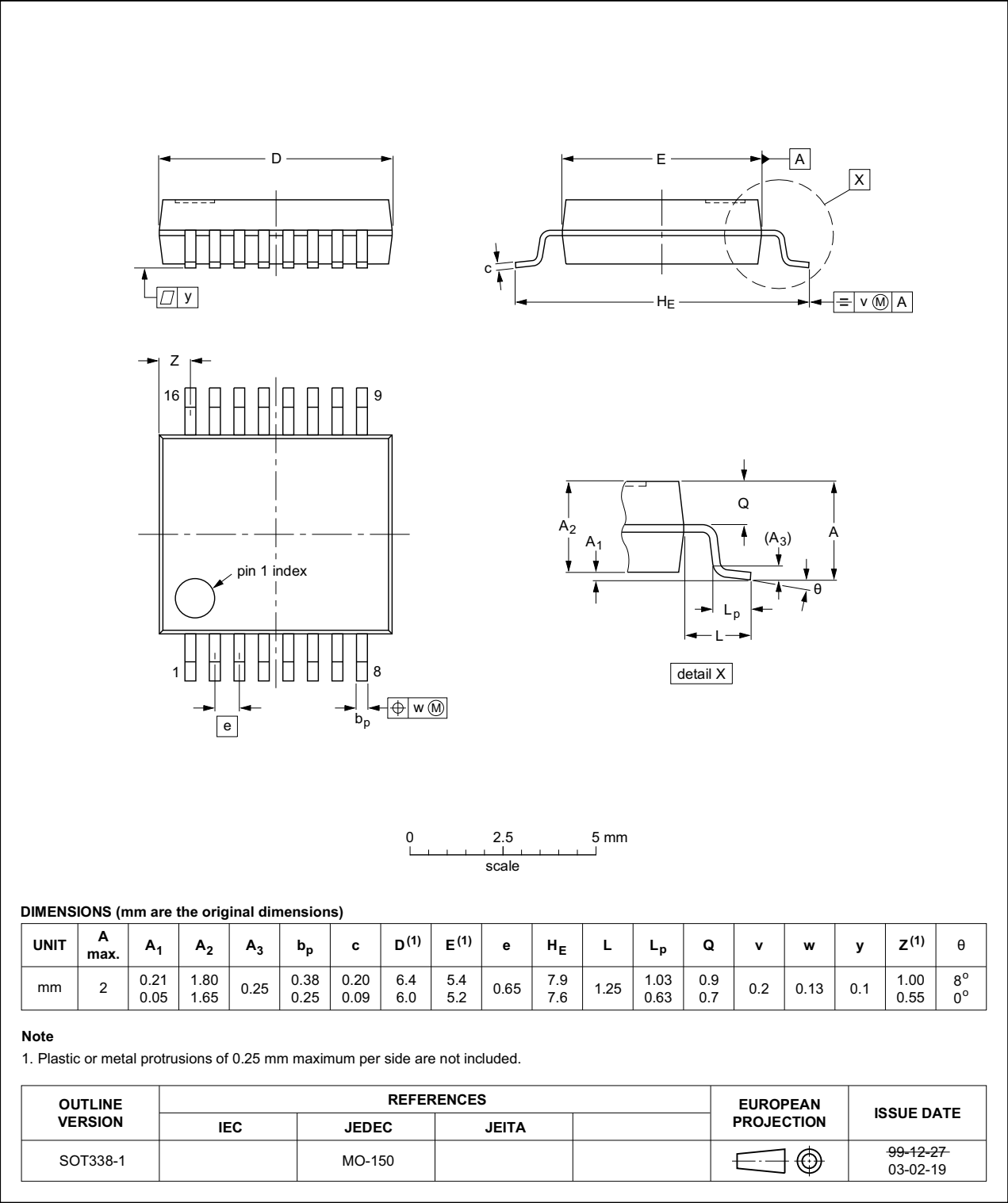
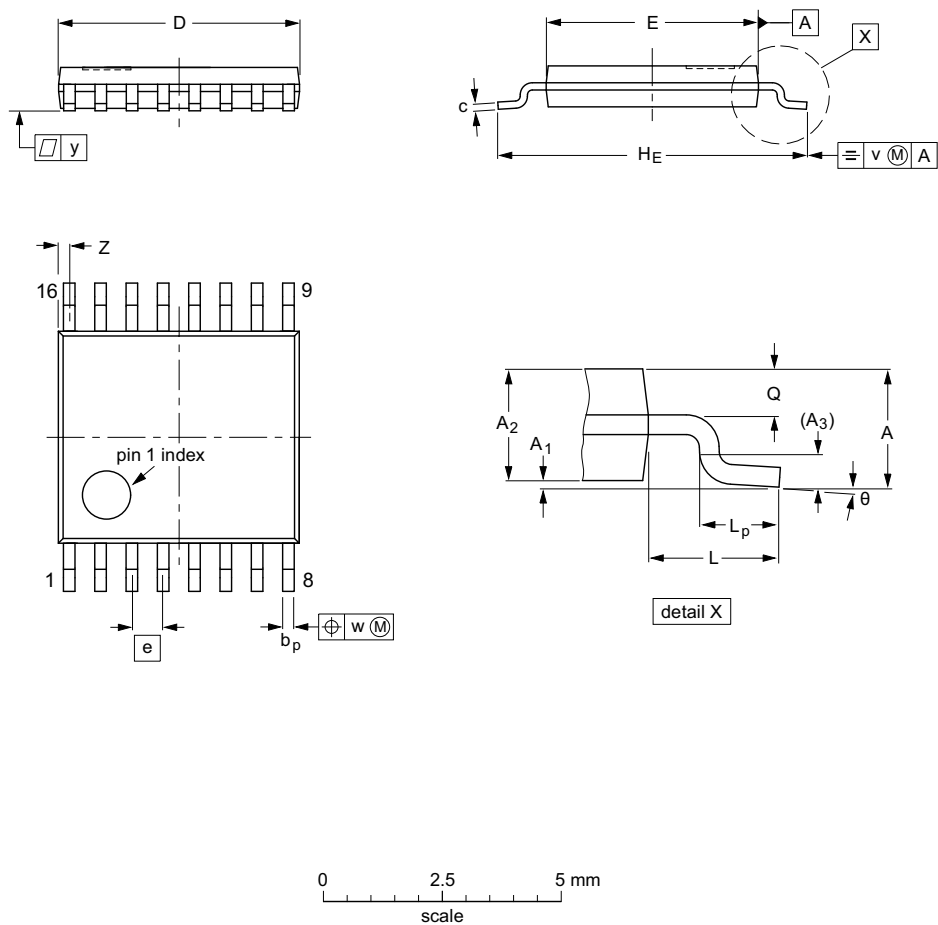


Fig 10. Package outline SOT338-1 (SSOP16)

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

SOT403-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|-----------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|---|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.1 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 5.1 4.9 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.40 0.06 | 8° 0° |

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|--------|-------|--|------------------------|-----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT403-1 | | MO-153 | | | | -99-12-27 03-02-18 |

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 ^{[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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