

74LVC138A

3-to-8 line decoder/demultiplexer; inverting

Rev. 9 — 3 August 2023

Product data sheet

1. General description

The 74LVC138A decodes three binary weighted address inputs (A0, A1 and A2) to eight mutually exclusive outputs ($\bar{Y}0$ to $\bar{Y}7$). The 74LVC138A features three enable inputs ($\bar{E}1$, E2 and E3). Every output will be HIGH unless $\bar{E}1$ and E2 are LOW and E3 is HIGH. This multiple enable function allows easy parallel expansion of the 74LVC138A to a 1-of-32 (5 to 32 lines) decoder with just four 74LVC138A ICs and one inverter. The 74LVC138A can be used as an eight output demultiplexer by using one of the active LOW enable inputs as the data input and the remaining enable inputs as strobes. Inputs can be driven from either 3.3 V or 5 V devices. This feature allows the use of these devices as translators in mixed 3.3 V and 5 V environments.

Schmitt-trigger action at all inputs makes the circuit tolerant of slower input rise and fall times.

2. Features and benefits

- Overvoltage tolerant inputs to 5.5 V
- Wide supply voltage range from 1.2 V to 3.6 V
- CMOS low power consumption
- Direct interface with TTL levels
- Demultiplexing capability
- Multiple input enable for easy expansion
- Ideal for memory chip select decoding
- Mutually exclusive outputs
- Output drive capability 50 Ω transmission lines at 125 °C
- Complies with JEDEC standard:
 - JESD8-7A (1.65 V to 1.95 V)
 - JESD8-5A (2.3 V to 2.7 V)
 - JESD8-C/JESD36 (2.7 V to 3.6 V)
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | Version |
|-----------------------------|-------------------|----------|--|--------------------------|
| | Temperature range | Name | Description | |
| 74LVC138AD | -40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74LVC138APW | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74LVC138ABQ | -40 °C to +125 °C | DHVQFN16 | plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 × 3.5 × 0.85 mm | SOT763-1 |

4. Functional diagram

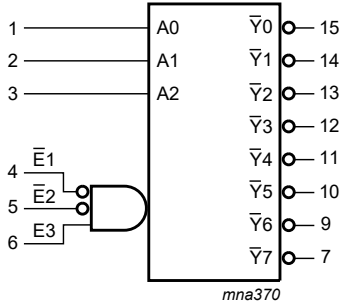


Fig. 1. Logic symbol

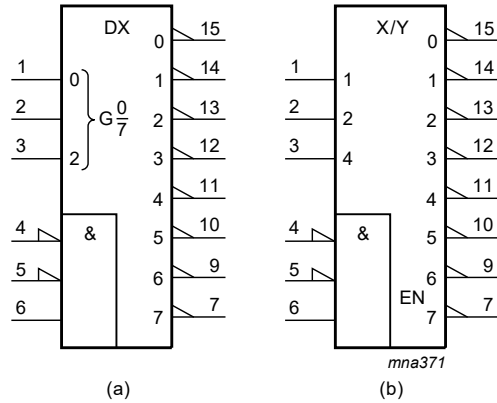


Fig. 2. IEC logic symbol

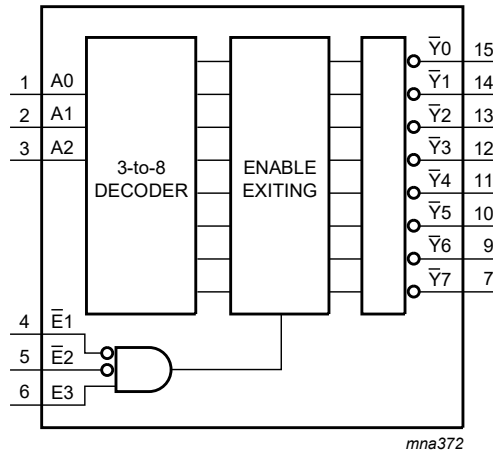


Fig. 3. Functional diagram

5. Pinning information

5.1. Pinning

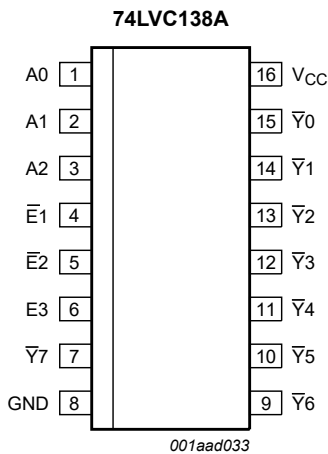


Fig. 4. Pin configuration SOT109-1 (SO16)

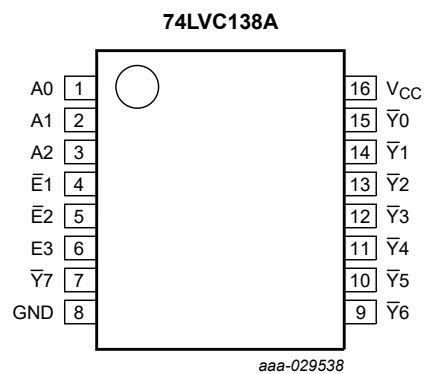
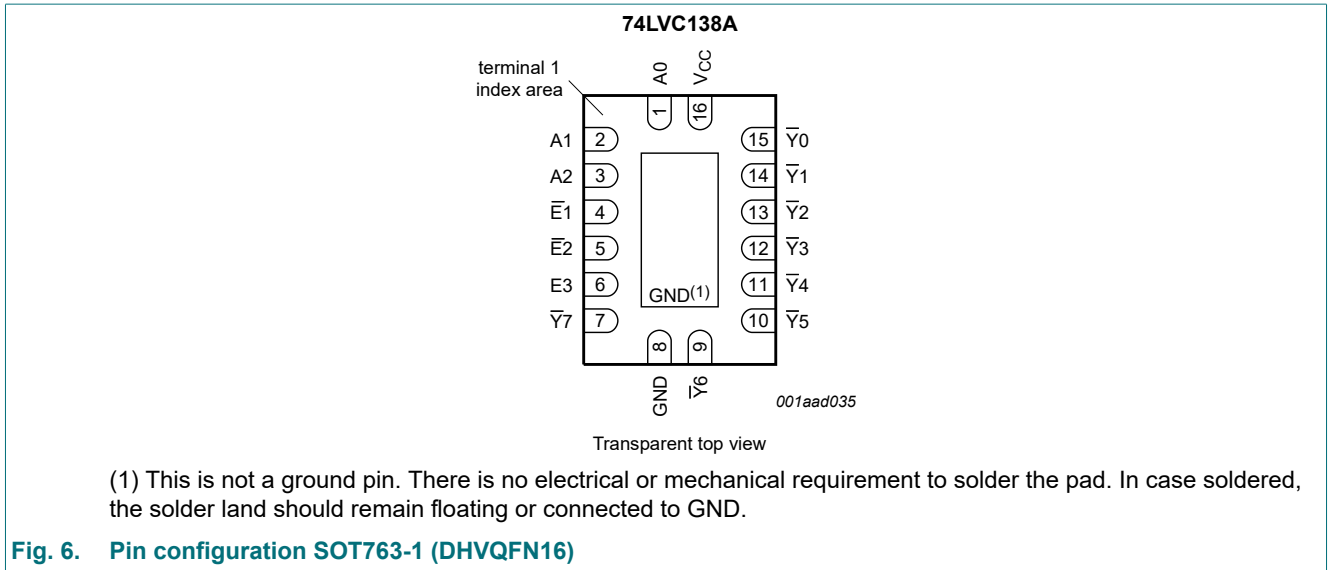


Fig. 5. Pin configuration SOT403-1 (TSSOP16)



5.2. Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|--------------------------------|------------------------------|----------------------------|
| A0, A1, A2 | 1, 2, 3 | address input |
| E1, E2 | 4, 5 | enable input (active LOW) |
| E3 | 6 | enable input (active HIGH) |
| GND | 8 | ground (0 V) |
| Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7 | 15, 14, 13, 12, 11, 10, 9, 7 | output |
| V _{CC} | 16 | supply voltage |

6. Functional description

Table 3. Function table

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

| Input | | | | | | Output | | | | | | | |
|-------|----|----|----|----|----|--------|----|----|----|----|----|----|----|
| E1 | E2 | E3 | A0 | A1 | A2 | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| H | X | X | X | X | X | H | H | H | H | H | H | H | H |
| X | H | X | X | X | X | H | H | H | H | H | H | H | H |
| X | X | L | X | X | X | H | H | H | H | H | H | H | H |
| L | L | H | L | L | L | L | H | H | H | H | H | H | H |
| | | | H | L | L | H | L | H | H | H | H | H | |
| | | | L | H | L | H | H | L | H | H | H | H | |
| | | | H | H | L | H | H | L | H | H | H | H | |
| | | | L | L | H | H | H | H | H | L | H | H | |
| | | | H | L | H | H | H | H | H | H | L | H | |
| | | | L | H | H | H | H | H | H | H | H | L | |
| | | | H | H | H | H | 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 | +6.5 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -50 | - | mA |
| V_I | input voltage | | [1] -0.5 | +6.5 | V |
| I_{OK} | output clamping current | $V_O > V_{CC}$ or $V_O < 0$ V | - | ±50 | mA |
| V_O | output voltage | output HIGH or LOW state | [2] -0.5 | $V_{CC} + 0.5$ | V |
| I_O | output current | $V_O = 0$ V to V_{CC} | - | ±50 | mA |
| I_{CC} | supply current | | - | 100 | mA |
| I_{GND} | ground current | | -100 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to +125 °C | [3] - | 500 | mW |

[1] The minimum input voltage ratings may be exceeded if the input current ratings are observed.

[2] The output voltage ratings may be exceeded if the output current ratings are observed.

[3] 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.

For SOT763-1 (DHVQFN16) package: P_{tot} derates linearly with 11.2 mW/K above 106 °C.

8. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|----------------------------|------|-----|----------|------|
| V_{CC} | supply voltage | | 1.65 | - | 3.6 | V |
| | | functional | 1.2 | - | - | V |
| V_I | input voltage | | 0 | - | 5.5 | V |
| V_O | output voltage | output HIGH or LOW state | 0 | - | V_{CC} | V |
| T_{amb} | ambient temperature | | -40 | - | +125 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{CC} = 1.65$ V to 2.7 V | 0 | - | 20 | ns/V |
| | | $V_{CC} = 2.7$ V to 3.6 V | 0 | - | 10 | ns/V |

9. Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|------------------|---------------------------|---|-----------------------|---------|---------------------|-----------------------|---------------------|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| V _{IH} | HIGH-level input voltage | V _{CC} = 1.2 V | 1.08 | - | - | 1.08 | - | V |
| | | V _{CC} = 1.65 V to 1.95 V | 0.65V _{CC} | - | - | 0.65V _{CC} | - | V |
| | | V _{CC} = 2.3 V to 2.7 V | 1.7 | - | - | 1.7 | - | V |
| | | V _{CC} = 2.7 V to 3.6 V | 2.0 | - | - | 2.0 | - | V |
| V _{IL} | LOW-level input voltage | V _{CC} = 1.2 V | - | - | 0.12 | - | 0.12 | V |
| | | V _{CC} = 1.65 V to 1.95 V | - | - | 0.35V _{CC} | - | 0.35V _{CC} | V |
| | | V _{CC} = 2.3 V to 2.7 V | - | - | 0.7 | - | 0.7 | V |
| | | V _{CC} = 2.7 V to 3.6 V | - | - | 0.8 | - | 0.8 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | |
| | | I _O = -100 µA; V _{CC} = 1.65 V to 3.6 V | V _{CC} - 0.2 | - | - | V _{CC} - 0.3 | - | V |
| | | I _O = -4 mA; V _{CC} = 1.65 V | 1.2 | - | - | 1.05 | - | V |
| | | I _O = -8 mA; V _{CC} = 2.3 V | 1.8 | - | - | 1.65 | - | V |
| | | I _O = -12 mA; V _{CC} = 2.7 V | 2.2 | - | - | 2.05 | - | V |
| | | I _O = -18 mA; V _{CC} = 3.0 V | 2.4 | - | - | 2.25 | - | V |
| | | I _O = -24 mA; V _{CC} = 3.0 V | 2.2 | - | - | 2.0 | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{IH} or V _{IL} | | | | | | |
| | | I _O = 100 µA; V _{CC} = 1.65 V to 3.6 V | - | - | 0.2 | - | 0.3 | V |
| | | I _O = 4 mA; V _{CC} = 1.65 V | - | - | 0.45 | - | 0.65 | V |
| | | I _O = 8 mA; V _{CC} = 2.3 V | - | - | 0.6 | - | 0.8 | V |
| | | I _O = 12 mA; V _{CC} = 2.7 V | - | - | 0.4 | - | 0.6 | V |
| | | I _O = 24 mA; V _{CC} = 3.0 V | - | - | 0.55 | - | 0.8 | V |
| I _I | input leakage current | V _{CC} = 3.6 V; V _I = 5.5 V or GND | - | ±0.1 | ±5 | - | ±20 | µA |
| I _{CC} | supply current | V _{CC} = 3.6 V; V _I = V _{CC} or GND; I _O = 0 A | - | 0.1 | 10 | - | 40 | µA |
| ΔI _{CC} | additional supply current | per input pin; V _{CC} = 2.7 V to 3.6 V; V _I = V _{CC} - 0.6 V; I _O = 0 A | - | 5 | 500 | - | 5000 | µA |
| C _I | input capacitance | V _{CC} = 0 V to 3.6 V; V _I = GND to V _{CC} | - | 4.0 | - | - | - | pF |

[1] All typical values are measured at V_{CC} = 3.3 V (unless stated otherwise) and T_{amb} = 25 °C.

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V). For test circuit see Fig. 9.

| Symbol | Parameter | Conditions | -40 °C to +85 °C | | | -40 °C to +125 °C | | Unit |
|-------------|-------------------------------|---|------------------|---------|------|-------------------|------|------|
| | | | Min | Typ [1] | Max | Min | Max | |
| t_{pd} | propagation delay | An to \bar{Y}_n ; see Fig. 7 [2] | | | | | | |
| | | $V_{CC} = 1.2\text{ V}$ | - | 14 | - | - | - | ns |
| | | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ | 0.5 | 5.2 | 11.5 | 0.5 | 12.7 | ns |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | 1.5 | 3.0 | 6.5 | 1.5 | 7.3 | ns |
| | | $V_{CC} = 2.7\text{ V}$ | 1.5 | 3.2 | 6.8 | 1.5 | 8.5 | ns |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | 1.0 | 2.7 | 5.8 | 1.0 | 7.5 | ns |
| | | E3 to \bar{Y}_n ; see Fig. 7 [2] | | | | | | |
| | | $V_{CC} = 1.2\text{ V}$ | - | 14 | - | - | - | ns |
| | | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ | 1.0 | 5.5 | 11.4 | 1.0 | 12.5 | ns |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | 1.5 | 3.2 | 6.5 | 1.5 | 7.1 | ns |
| | | $V_{CC} = 2.7\text{ V}$ | 1.5 | 3.3 | 6.8 | 1.5 | 8.5 | ns |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | 1.0 | 2.9 | 5.8 | 1.0 | 7.5 | ns |
| | | \bar{E}_n to \bar{Y}_n ; see Fig. 8 [2] | | | | | | |
| | | $V_{CC} = 1.2\text{ V}$ | - | 15 | - | - | - | ns |
| | | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ | 1.0 | 5.6 | 11.5 | 1.0 | 12.8 | ns |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | 1.8 | 3.3 | 6.5 | 1.8 | 7.3 | ns |
| | | $V_{CC} = 2.7\text{ V}$ | 1.5 | 3.4 | 6.4 | 1.5 | 8.0 | ns |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | 1.0 | 2.9 | 5.8 | 1.0 | 7.5 | ns |
| $t_{sk(o)}$ | output skew time | [3] | - | - | 1.0 | - | 1.5 | ns |
| C_{PD} | power dissipation capacitance | $V_I = \text{GND to } V_{CC}$ [4] | | | | | | |
| | | $V_{CC} = 1.65\text{ V to }1.95\text{ V}$ | - | 9.9 | - | - | - | pF |
| | | $V_{CC} = 2.3\text{ V to }2.7\text{ V}$ | - | 15.8 | - | - | - | pF |
| | | $V_{CC} = 3.0\text{ V to }3.6\text{ V}$ | - | 21.1 | - | - | - | pF |

[1] Typical values are measured at $T_{amb} = 25\text{ °C}$ and $V_{CC} = 1.2\text{ V}, 1.8\text{ V}, 2.5\text{ V}, 2.7\text{ V},$ and 3.3 V respectively.

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

[3] Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

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

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

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

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

10.1. Waveforms and test circuit

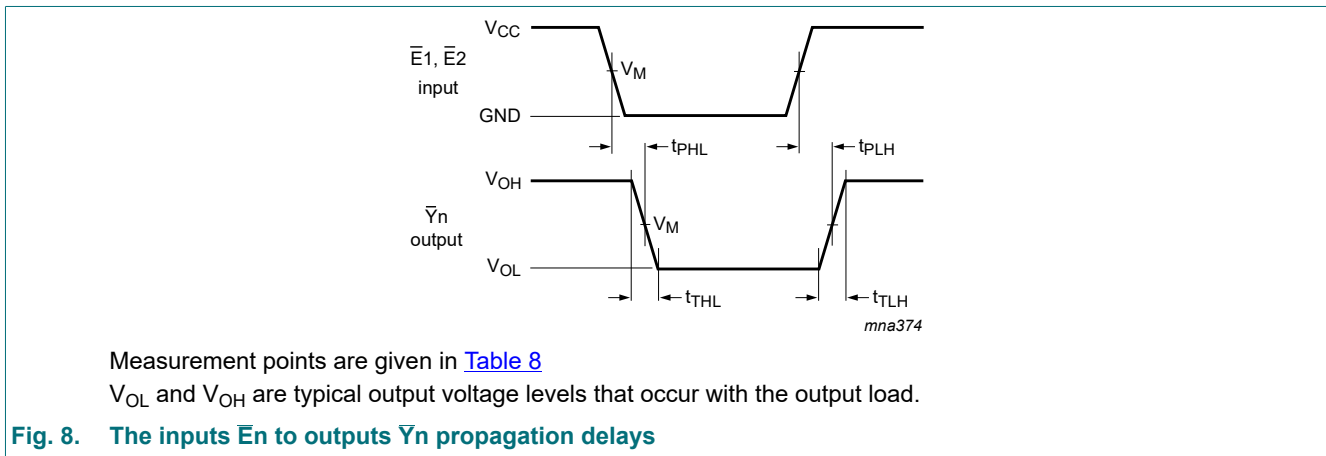
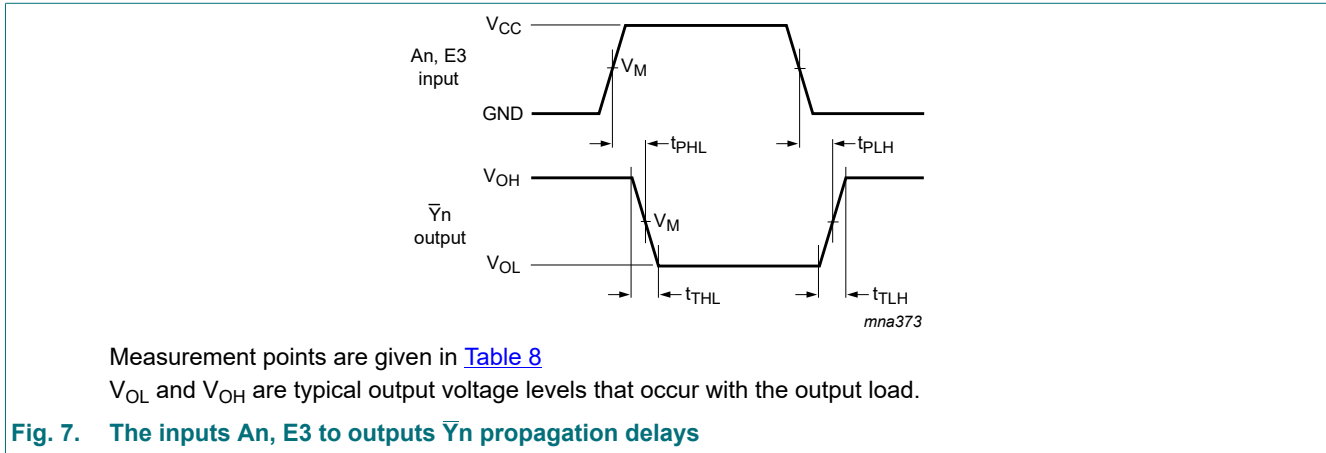


Table 8. Measurement points

| Supply voltage | Input | | Output |
|------------------|----------|---------------------|---------------------|
| V_{CC} | V_I | V_M | V_M |
| 1.2 V | V_{CC} | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 1.65 V to 1.95 V | V_{CC} | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 2.3 V to 2.7 V | V_{CC} | $0.5 \times V_{CC}$ | $0.5 \times V_{CC}$ |
| 2.7 V | 2.7 V | 1.5 V | 1.5 V |
| 3.0 V to 3.6 V | 2.7 V | 1.5 V | 1.5 V |

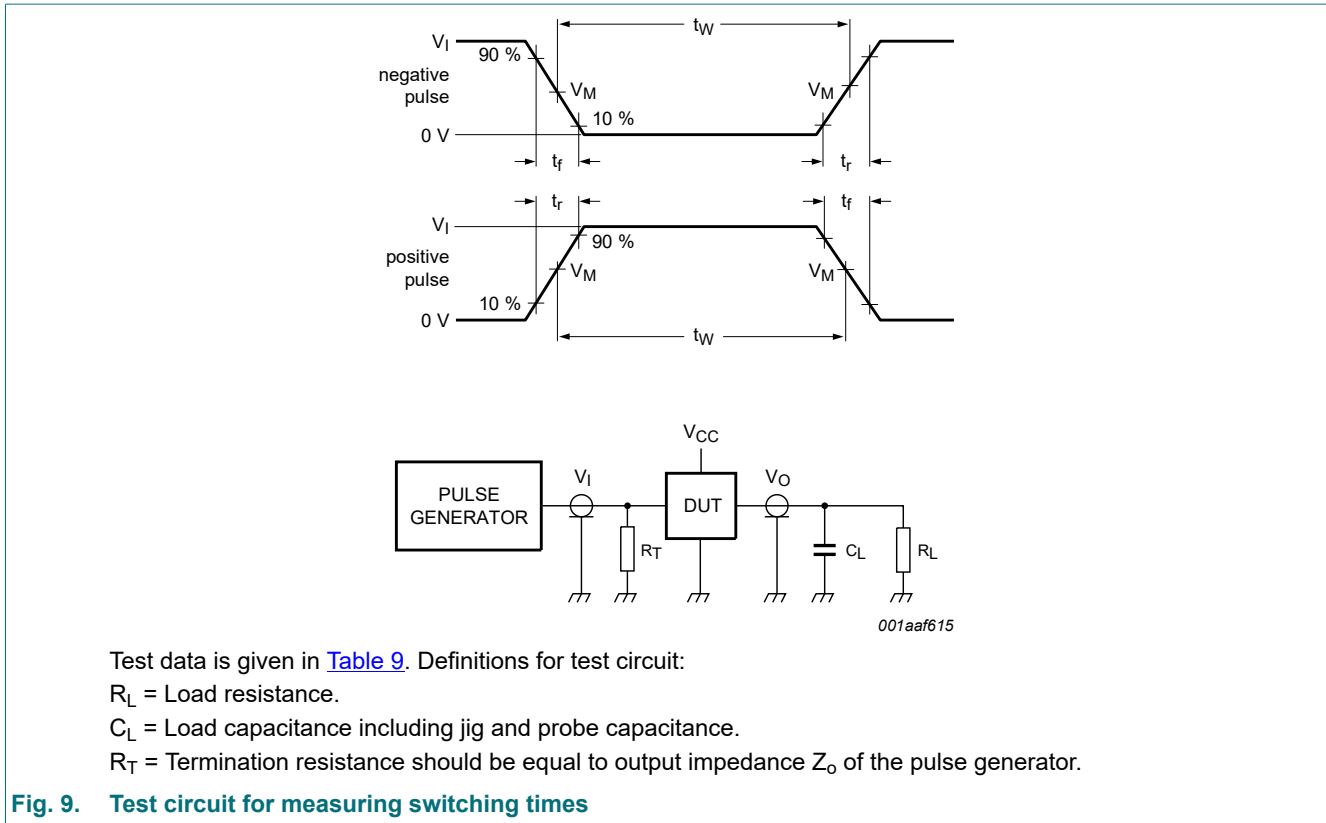


Table 9. Test data

| Supply voltage | Input | | Load | |
|------------------|----------|---------------|-------|--------------|
| | V_I | t_r, t_f | C_L | R_L |
| 1.2 V | V_{CC} | ≤ 2 ns | 30 pF | 1 k Ω |
| 1.65 V to 1.95 V | V_{CC} | ≤ 2 ns | 30 pF | 1 k Ω |
| 2.3 V to 2.7 V | V_{CC} | ≤ 2 ns | 30 pF | 500 Ω |
| 2.7 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω |
| 3.0 V to 3.6 V | 2.7 V | ≤ 2.5 ns | 50 pF | 500 Ω |

11. Package outline

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

SOT109-1

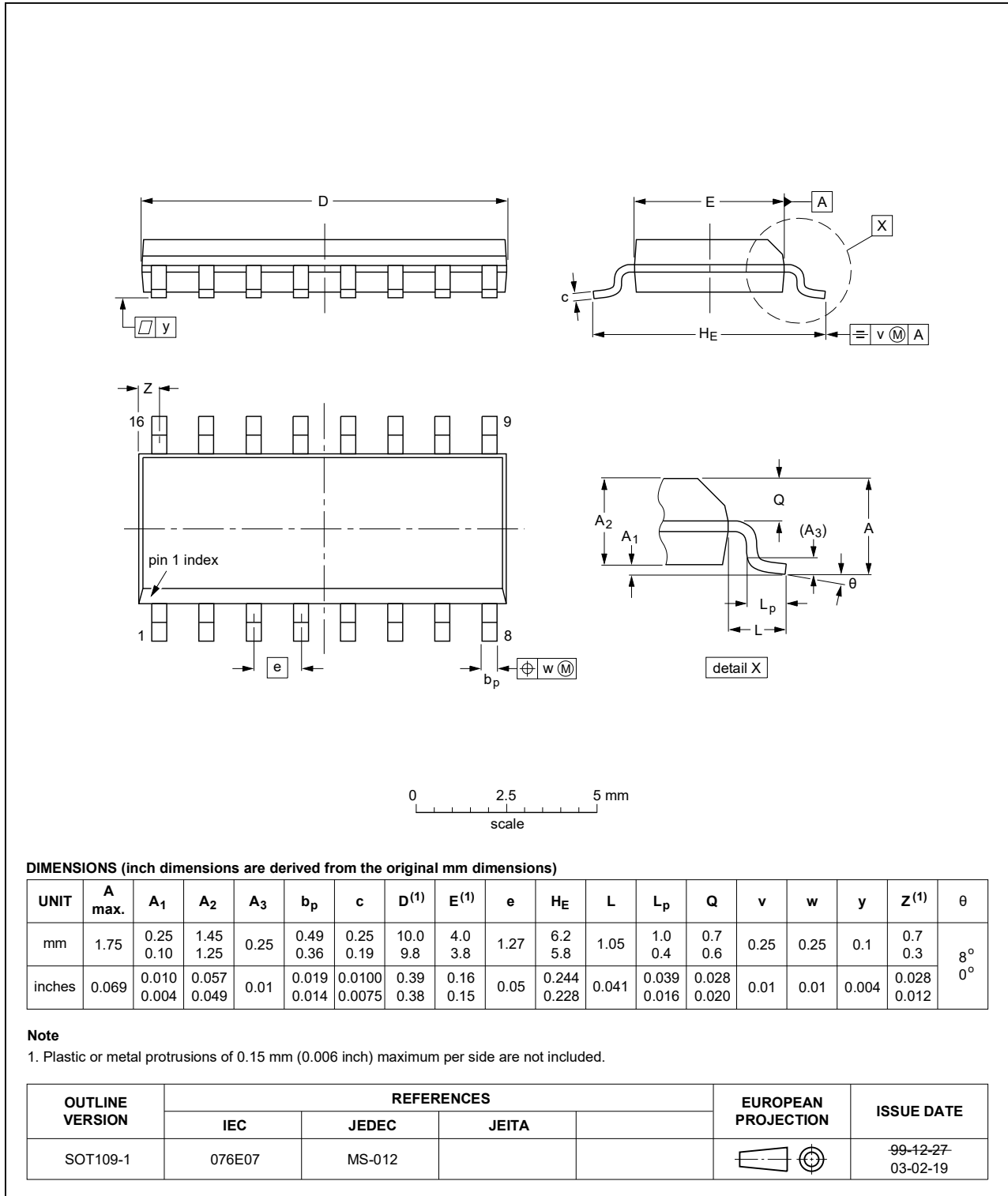


Fig. 10. Package outline SOT109-1 (SO16)

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

SOT403-1

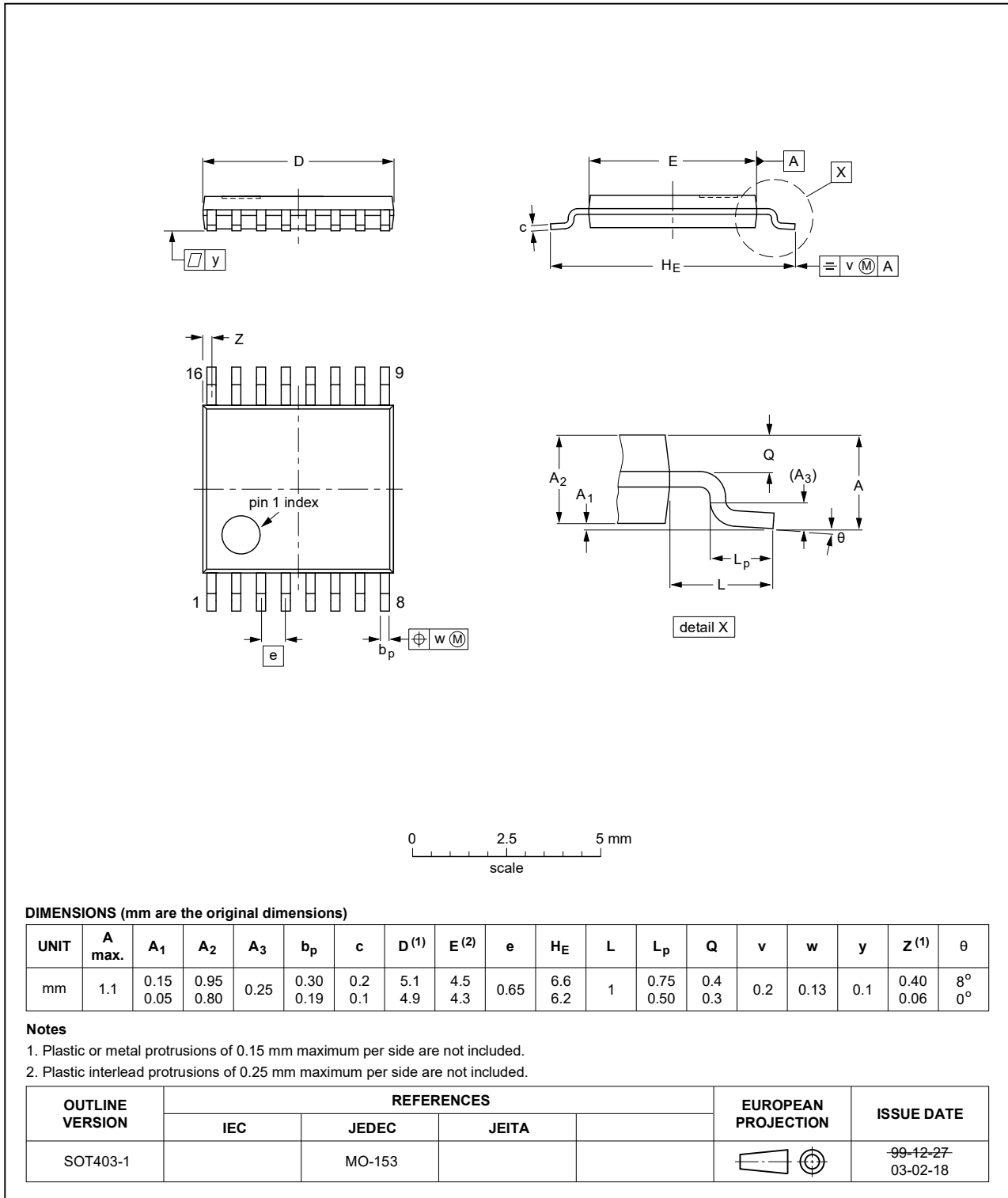


Fig. 11. Package outline SOT403-1 (TSSOP16)

DHVQFN16: plastic dual in-line compatible thermal enhanced very thin quad flat package; no leads; 16 terminals; body 2.5 x 3.5 x 0.85 mm

SOT763-1

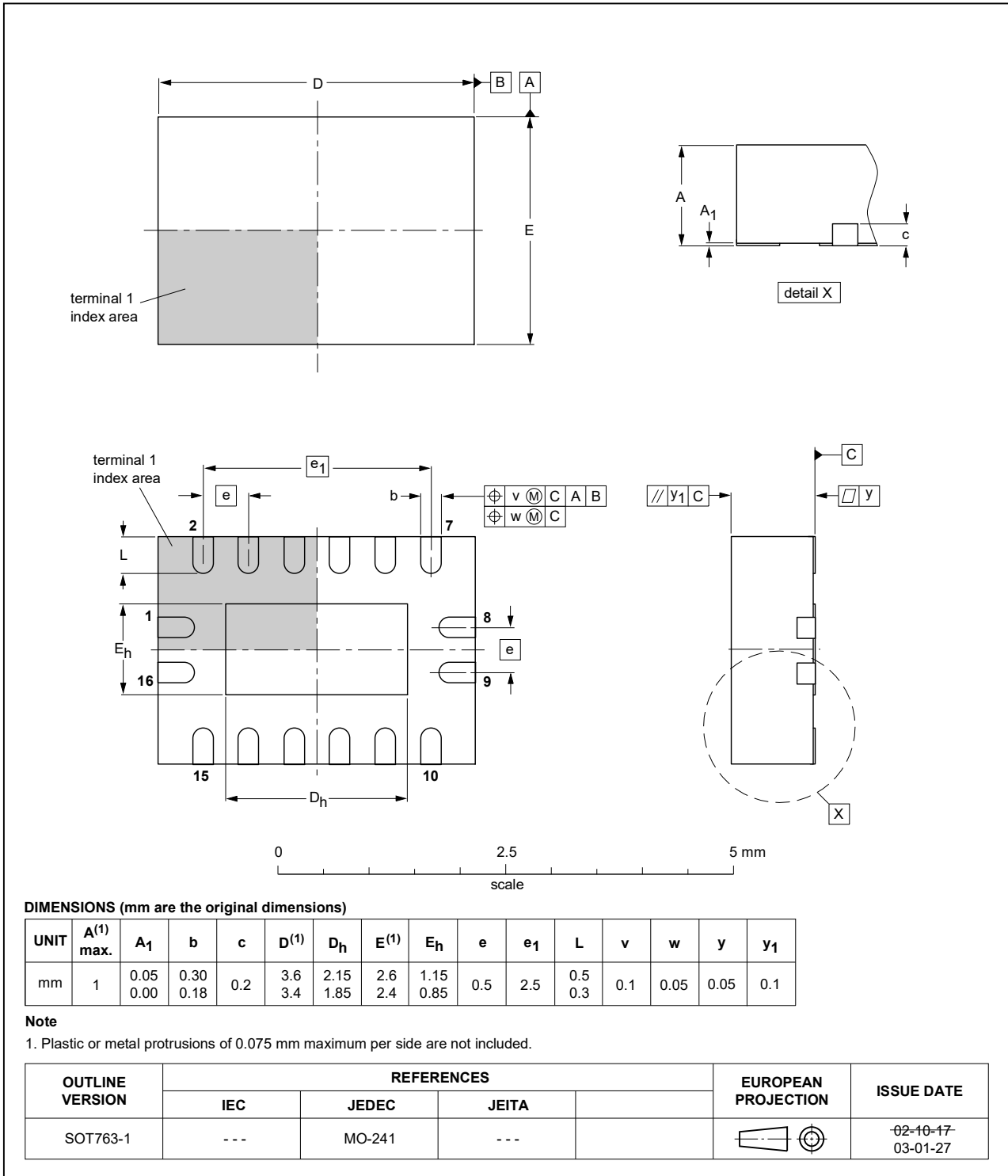


Fig. 12. Package outline SOT763-1 (DHVQFN16)

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 |
|----------------|---|-----------------------|---------------|---------------|
| 74LVC138A v.9 | 20230803 | Product data sheet | - | 74LVC138A v.8 |
| Modifications: | <ul style="list-style-type: none"> Section 2: ESD specification updated according to the latest JEDEC standard. | | | |
| 74LVC138A v.8 | 20210920 | Product data sheet | - | 74LVC138A v.7 |
| Modifications: | <ul style="list-style-type: none"> Type number 74LVC138ADB (SOT338-1/SSOP16) removed. | | | |
| 74LVC138A v.7 | 20200828 | Product data sheet | - | 74LVC138A v.6 |
| Modifications: | <ul style="list-style-type: none"> Section 1 updated. Table 4: Derating values for P_{tot} total power dissipation updated. | | | |
| 74LVC138A v.6 | 20190123 | Product data sheet | - | 74LVC138A v.5 |
| Modifications: | <ul style="list-style-type: none"> The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia. Legal texts have been adapted to the new company name where appropriate. | | | |
| 74LVC138A v.5 | 20111019 | Product data sheet | - | 74LVC138A v.4 |
| 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 4, Table 5, Table 6, Table 7 and Table 9: values added for lower voltage ranges. | | | |
| 74LVC138A v.4 | 20030506 | Product specification | - | 74LVC138A v.3 |
| 74LVC138A v.3 | 20020312 | Product specification | - | 74LVC138A v.2 |
| 74LVC138A v.2 | 19980428 | Product specification | - | 74LVC138A v.1 |
| 74LVC138A v.1 | - | - | - | - |

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. |

- [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 <https://www.nexperia.com>.

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