



74HC238; 74HCT238

3-to-8 line decoder/demultiplexer

Rev. 8 — 21 March 2024

Product data sheet

1. General description

The 74HC238; 74HCT238 decodes three binary weighted address inputs (A0, A1 and A2) to eight mutually exclusive outputs (Y0 to Y7). The device features three enable inputs ($\bar{E}1$ and $\bar{E}2$ and E3). Every output will be LOW unless $\bar{E}1$ and $\bar{E}2$ are LOW and E3 is HIGH. This multiple enable function allows easy parallel expansion to a 1-of-32 (5 to 32 lines) decoder with just four '238 ICs and one inverter. The '238 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 include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC} .

2. Features and benefits

- Wide supply voltage range from 2.0 to 6.0 V
- CMOS low power dissipation
- High noise immunity
- Demultiplexing capability
- Multiple input enable for easy expansion
- Ideal for memory chip select decoding
- Active HIGH mutually exclusive outputs
- Input levels:
 - For 74HC238: CMOS level
 - For 74HCT238: TTL level
- Complies with JEDEC standards
 - JESD8C (2.7 V to 3.6 V)
 - JESD7A (2.0 V to 6.0 V)
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- ESD protection:
 - HBM: ANSI/ESDA/JEDEC JS-001 class 2 exceeds 2000 V
 - CDM: ANSI/ESDA/JEDEC JS-002 class C3 exceeds 1000 V
- Multiple package options
- 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 | |
| 74HC238D 74HCT238D | -40 °C to +125 °C | SO16 | plastic small outline package; 16 leads; body width 3.9 mm | SOT109-1 |
| 74HC238PW 74HCT238PW | -40 °C to +125 °C | TSSOP16 | plastic thin shrink small outline package; 16 leads; body width 4.4 mm | SOT403-1 |
| 74HC238BQ 74HCT238BQ | -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. Functional diagram

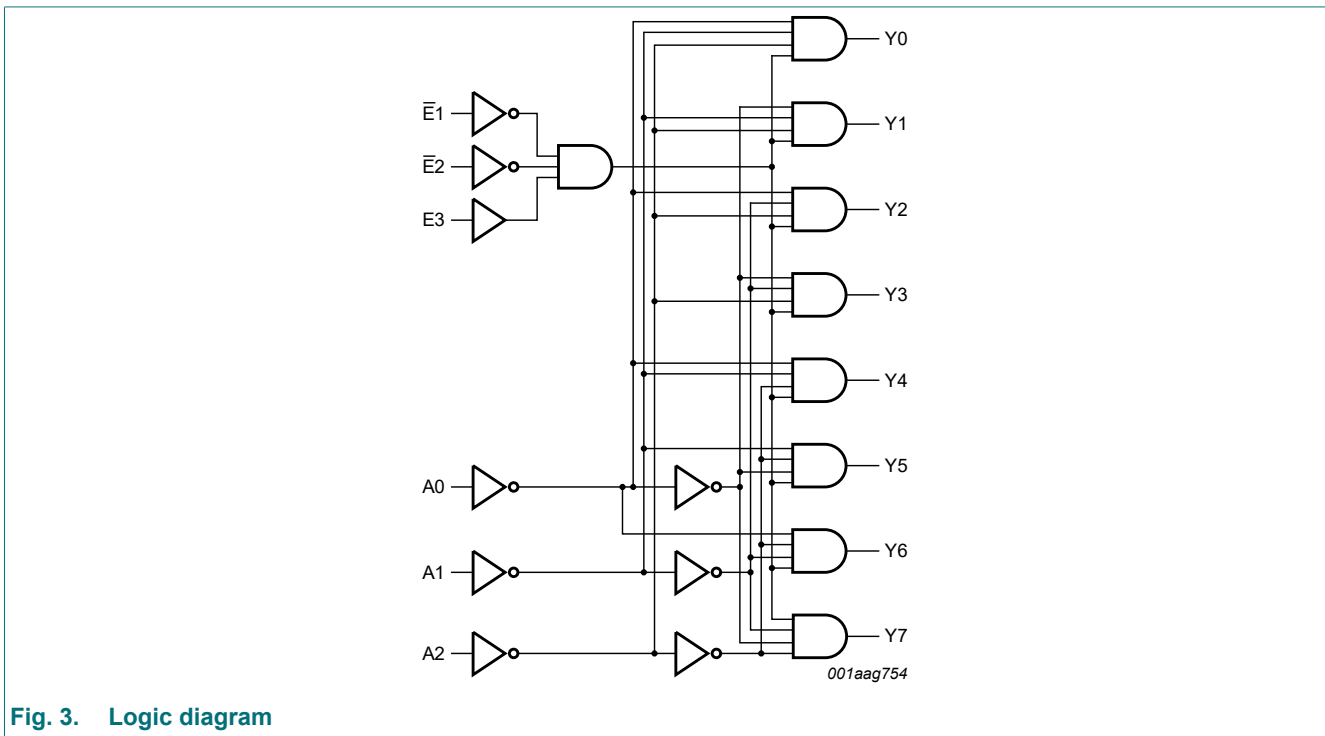
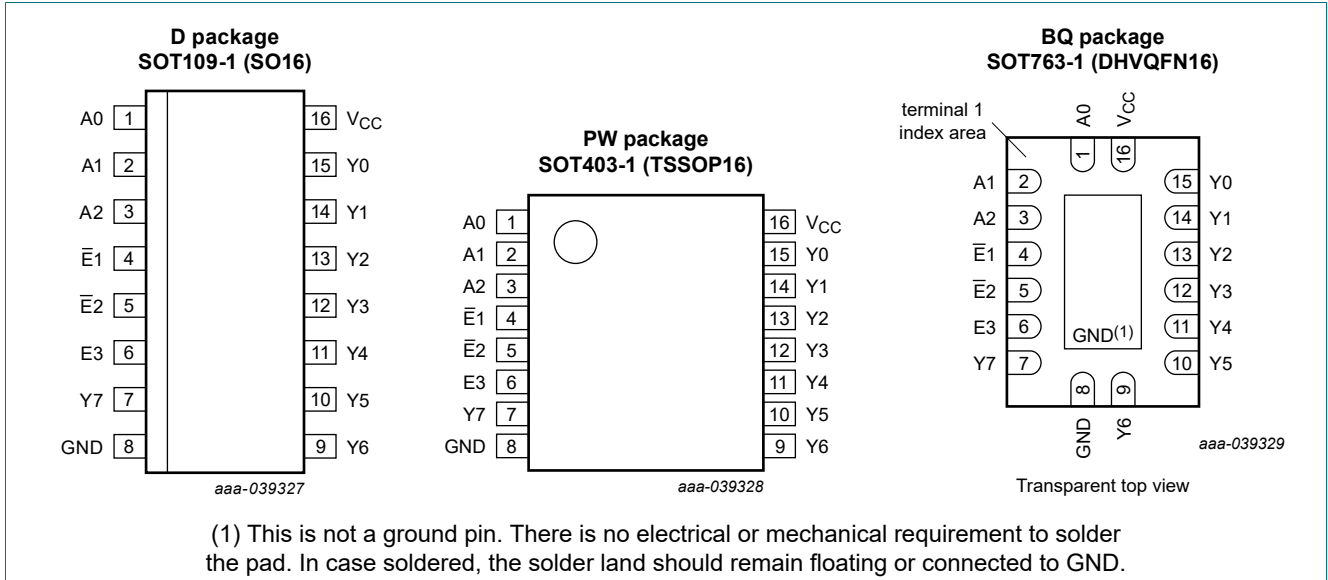


Fig. 3. Logic diagram

5. Pinning information

5.1. Pinning



5.2. Pin description

Table 2. Pin description

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

6. Functional description

Table 3. Function table

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

| Inputs | | | | | | Outputs | | | | | | | |
|--------|----|----|----|----|----|---------|----|----|----|----|----|----|----|
| E1 | E2 | E3 | A0 | A1 | A2 | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 |
| H | X | X | X | X | X | L | L | L | L | L | L | L | L |
| X | H | X | X | X | X | L | L | L | L | L | L | L | L |
| X | X | L | X | X | X | L | L | L | L | L | L | L | L |
| L | L | H | L | L | L | H | L | L | L | L | L | L | L |
| L | L | H | H | L | L | L | H | L | L | L | L | L | L |
| L | L | H | L | H | L | L | L | H | L | L | L | L | L |
| L | L | H | H | H | L | L | L | L | H | L | L | L | L |
| L | L | H | L | L | H | L | L | L | L | H | L | L | L |
| L | L | H | H | L | H | L | L | L | L | L | H | L | L |
| L | L | H | L | H | H | L | L | L | L | L | L | H | L |
| L | L | H | H | H | H | L | L | L | L | L | L | L | H |

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 $V_I > V_{CC} + 0.5\text{ V}$ [1] | - | ± 20 | mA |
| I_{OK} | output clamping current | $V_O < -0.5\text{ V}$ or $V_O > V_{CC} + 0.5\text{ V}$ [1] | - | ± 20 | mA |
| I_O | output current | $-0.5\text{ V} < V_O < V_{CC} + 0.5\text{ V}$ | - | ± 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 | [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.

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

Voltages are referenced to GND (ground = 0 V).

| Symbol | Parameter | Conditions | 74HC238 | | | 74HCT238 | | | 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 | - | +125 | -40 | - | +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 | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|----------------|---------------------------|---|-------|------|-----------|------------------|-----------|-------------------|-----------|---------------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC238 | | | | | | | | | | |
| V_{IH} | HIGH-level input voltage | $V_{CC} = 2.0\text{ V}$ | 1.5 | 1.2 | - | 1.5 | - | 1.5 | - | V |
| | | $V_{CC} = 4.5\text{ V}$ | 3.15 | 2.4 | - | 3.15 | - | 3.15 | - | V |
| | | $V_{CC} = 6.0\text{ V}$ | 4.2 | 3.2 | - | 4.2 | - | 4.2 | - | V |
| V_{IL} | LOW-level input voltage | $V_{CC} = 2.0\text{ V}$ | - | 0.8 | 0.5 | - | 0.5 | - | 0.5 | V |
| | | $V_{CC} = 4.5\text{ V}$ | - | 2.1 | 1.35 | - | 1.35 | - | 1.35 | V |
| | | $V_{CC} = 6.0\text{ V}$ | - | 2.8 | 1.8 | - | 1.8 | - | 1.8 | V |
| V_{OH} | HIGH-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | | | |
| | | $I_O = -20\text{ }\mu\text{A}$; $V_{CC} = 2.0\text{ V}$ | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | $I_O = -20\text{ }\mu\text{A}$; $V_{CC} = 4.5\text{ V}$ | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_O = -20\text{ }\mu\text{A}$; $V_{CC} = 6.0\text{ V}$ | 5.9 | 6.0 | - | 5.9 | - | 5.9 | - | V |
| | | $I_O = -4.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$ | 3.98 | 4.32 | - | 3.84 | - | 3.7 | - | V |
| V_{OL} | LOW-level output voltage | $V_I = V_{IH}$ or V_{IL} | | | | | | | | |
| | | $I_O = 20\text{ }\mu\text{A}$; $V_{CC} = 2.0\text{ V}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 20\text{ }\mu\text{A}$; $V_{CC} = 4.5\text{ V}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 20\text{ }\mu\text{A}$; $V_{CC} = 6.0\text{ V}$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_O = 4.0\text{ mA}$; $V_{CC} = 4.5\text{ V}$ | - | 0.15 | 0.26 | - | 0.33 | - | 0.4 | V |
| I_I | input leakage current | $V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$ | - | - | ± 0.1 | - | ± 1.0 | - | ± 1.0 | μA |
| | | $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$; $V_{CC} = 6.0\text{ V}$ | - | - | 8.0 | - | 80 | - | 160 | μA |
| C_I | input capacitance | | - | 3.5 | - | - | - | - | pF | |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|------------------|---------------------------|---|-------|------|------|------------------|------|-------------------|------|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HCT238 | | | | | | | | | | |
| 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 = -4.0 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 | - | 0.16 | 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 _{CC} | supply current | V _I = V _{CC} or GND; V _{CC} = 5.5 V; I _O = 0 A | - | - | 8.0 | - | 80 | - | 160 | µA |
| ΔI _{CC} | additional supply current | per input pin; V _I = V _{CC} - 2.1 V; I _O = 0 A; other inputs at V _{CC} or GND; V _{CC} = 4.5 V to 5.5 V | | | | | | | | |
| | | An inputs | - | 70 | 252 | - | 315 | - | 343 | µA |
| | | E1, E2 inputs | - | 40 | 144 | - | 180 | - | 196 | µA |
| | | E3 input | - | 145 | 522 | - | 653 | - | 711 | µA |
| C _I | input capacitance | | - | 3.5 | - | - | - | - | - | pF |

10. Dynamic characteristics

Table 7. Dynamic characteristics

$GND = 0\text{ V}$; test circuit see [Fig. 6](#).

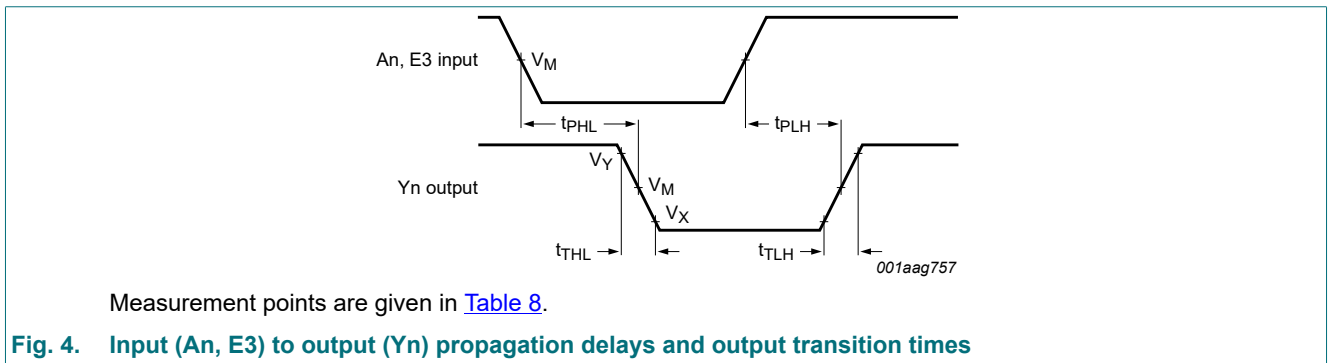
| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|-------------------------|-------------------------------|---|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HC238 | | | | | | | | | | |
| t_{pd} | propagation delay | An to Yn; see Fig. 4 [1] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 47 | 150 | - | 190 | - | 225 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 17 | 30 | - | 38 | - | 45 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 14 | - | - | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 14 | 26 | - | 33 | - | 38 | ns |
| | | E3 to Yn; see Fig. 4 [1] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 52 | 160 | - | 200 | - | 240 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 19 | 32 | - | 40 | - | 48 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 16 | - | - | - | - | - | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 15 | 27 | - | 34 | - | 41 | ns |
| | | $\bar{E}n$ to Yn or see Fig. 5 [1] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 50 | 155 | - | 195 | - | 235 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 18 | 31 | - | 39 | - | 47 | ns |
| | | $V_{CC} = 5.0\text{ V}$; $C_L = 15\text{ pF}$ | - | 17 | - | - | - | - | - | ns |
| $V_{CC} = 6.0\text{ V}$ | - | 14 | 26 | - | 33 | - | 40 | ns | | |
| t_t | transition time | see Fig. 4 and Fig. 5 [2] | | | | | | | | |
| | | $V_{CC} = 2.0\text{ V}$ | - | 19 | 75 | - | 95 | - | 110 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | - | 7 | 15 | - | 19 | - | 22 | ns |
| | | $V_{CC} = 6.0\text{ V}$ | - | 6 | 13 | - | 16 | - | 19 | ns |
| C_{PD} | power dissipation capacitance | per package; $V_I = GND$ to V_{CC} [3] | - | 72 | - | - | - | - | - | pF |

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|---|-------------------------------|--|-------|-----|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ | Max | Min | Max | Min | Max | |
| 74HCT238 | | | | | | | | | | |
| t _{pd} | propagation delay | An to Y _n ; see Fig. 4 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 19 | 35 | - | 44 | - | 53 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 18 | - | - | - | - | - | ns |
| | | E3 to Y _n ; see Fig. 4 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 20 | 37 | - | 46 | - | 56 | ns |
| | | V _{CC} = 5.0 V; C _L = 15 pF | - | 20 | - | - | - | - | - | ns |
| | | En to Y _n or see Fig. 5 [1] | | | | | | | | |
| | | V _{CC} = 4.5 V | - | 20 | 35 | - | 44 | - | 53 | ns |
| V _{CC} = 5.0 V; C _L = 15 pF | - | 21 | - | - | - | - | - | ns | | |
| t _t | transition time | V _{CC} = 4.5 V; see Fig. 4 and Fig. 5 [2] | - | 7 | 15 | - | 19 | - | 22 | ns |
| C _{PD} | power dissipation capacitance | per package; V _I = GND to V _{CC} - 1.5 V [3] | - | 76 | - | - | - | - | - | pF |

- [1] t_{pd} is the same as t_{PHL} and t_{PLH}.
- [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):

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

10.1. Waveforms and test circuit



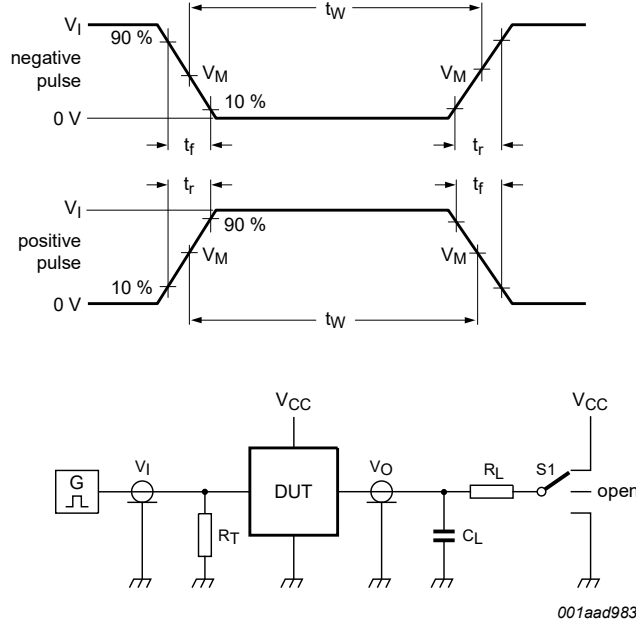


Measurement points are given in [Table 8](#).

Fig. 5. Input ($\bar{E}1, \bar{E}2$) to output (Yn) propagation delays and output transition times

Table 8. Measurement points

| Type | Input | | Output | |
|----------|---------------------|---------------------|---------------------|---------------------|
| | V_M | V_X | V_M | V_Y |
| 74HC238 | $0.5 \times V_{CC}$ | $0.1 \times V_{CC}$ | $0.5 \times V_{CC}$ | $0.9 \times V_{CC}$ |
| 74HCT238 | 1.3 V | $0.1 \times V_{CC}$ | 1.3 V | $0.9 \times V_{CC}$ |



Test data is given in [Table 9](#).

Definitions for 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. 6. Test circuit for measuring switching times

Table 9. Test data

| Type | Input | | Load | | S1 position |
|----------|----------|------------|--------------|--------------|--------------------|
| | V_1 | t_r, t_f | C_L | R_L | t_{PHL}, t_{PLH} |
| 74HC238 | V_{CC} | 6 ns | 15 pF, 50 pF | 1 k Ω | open |
| 74HCT238 | 3 V | 6 ns | 15 pF, 50 pF | 1 k Ω | open |

11. Package outline

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

SOT109-1

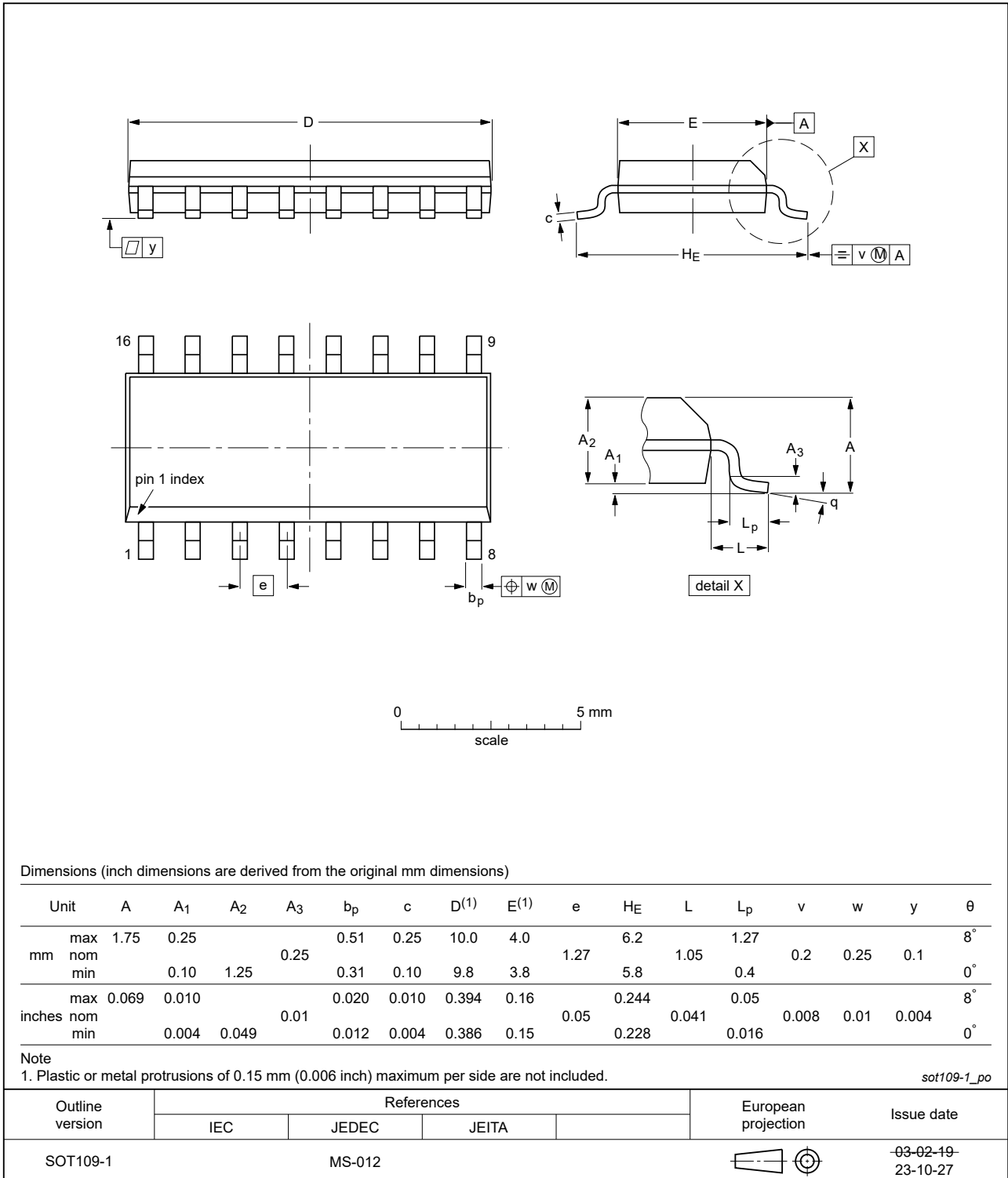


Fig. 7. Package outline SOT109-1 (SO16)

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

SOT403-1

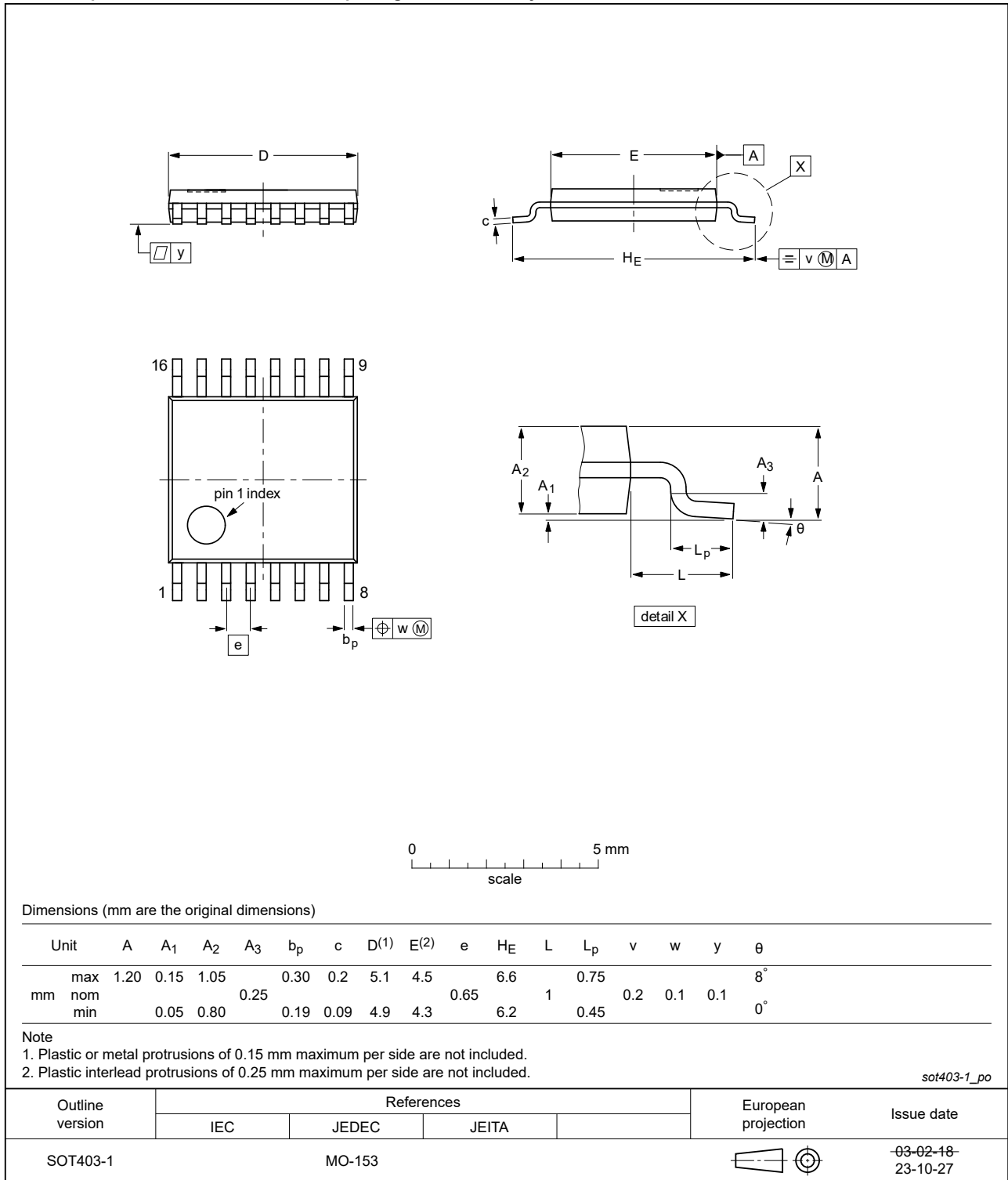


Fig. 8. Package outline SOT403-1 (TSSOP16)

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. 9. 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 |
|---------------------|--|-----------------------|---------------|---------------------|
| 74HC_HCT238 v.8 | 20240321 | Product data sheet | - | 74HC_HCT238 v.7 |
| Modifications: | <ul style="list-style-type: none"> • Section 2: ESD specification updated according to the latest JEDEC standard. • Fig. 7, Fig. 8: Aligned SO and TSSOP package outline drawings to JEDEC MS-012 and MO-153 | | | |
| 74HC_HCT238 v.7 | 20210902 | Product data sheet | - | 74HC_HCT238 v.6 |
| Modifications: | <ul style="list-style-type: none"> • Type number 74HCT238DB (SOT338-1) removed. | | | |
| 74HC_HCT238 v.6 | 20200403 | Product data sheet | - | 74HC_HCT238 v.5 |
| Modifications: | <ul style="list-style-type: none"> • Type number 74HC238DB (SOT338-1) removed. • Table 4: Derating values for P_{tot} total power dissipation updated. | | | |
| 74HC_HCT238 v.5 | 20180613 | Product data sheet | - | 74HC_HCT238 v.4 |
| 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. • Fig. 3: typo corrected. | | | |
| 74HC_HCT238 v.4 | 20160127 | Product data sheet | - | 74HC_HCT238 v.3 |
| Modifications: | <ul style="list-style-type: none"> • Type numbers 74HC238N and 74HCT238N (SOT38-4) removed. | | | |
| 74HC_HCT238 v.3 | 20070716 | Product data sheet | - | 74HC_HCT238_CNV v.2 |
| 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. • Added type number 74HC238BQ and 74HCT238BQ (DHVQFN16 package) | | | |
| 74HC_HCT238_CNV v.2 | 19970828 | Product specification | - | - |

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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