

HEF4067B

16-channel analog multiplexer/demultiplexer

Rev. 6 — 16 November 2011

Product data sheet

1. General description

The HEF4067B is a 16-channel analog multiplexer/demultiplexer with four address inputs (A0 to A3), an active LOW enable input (\bar{E}), sixteen independent inputs/outputs (Y0 to Y15) and a common input/output (Z). The device contains sixteen bidirectional analog switches, each with one side connected to an independent input/output (Y0 to Y15) and the other side connected to the common input/output (Z). With \bar{E} LOW, one of the sixteen switches is selected (low-impedance ON-state) by A0 to A3. All unselected switches are in the high-impedance OFF-state. With \bar{E} HIGH all switches are in the high-impedance OFF-state, independent of A0 to A3. The analog inputs/outputs (Y0 to Y15 and Z) can swing between V_{DD} as a positive limit and V_{SS} as a negative limit. V_{DD} to V_{SS} may not exceed 15 V.

2. Features and benefits

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B

3. Applications

- Analog multiplexing and demultiplexing
- Digital multiplexing and demultiplexing
- Signal gating

4. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|-------------|--|-------|--|----------|
| | Temperature range | Name | Description | Version |
| HEF4067BP | $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ | DIP24 | plastic dual in-line package; 24 leads (600 mil) | SOT101-1 |
| HEF4067BT | $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ | SO24 | plastic small outline package; 24 leads; body width 7.5 mm | SOT137-1 |



5. Functional diagram

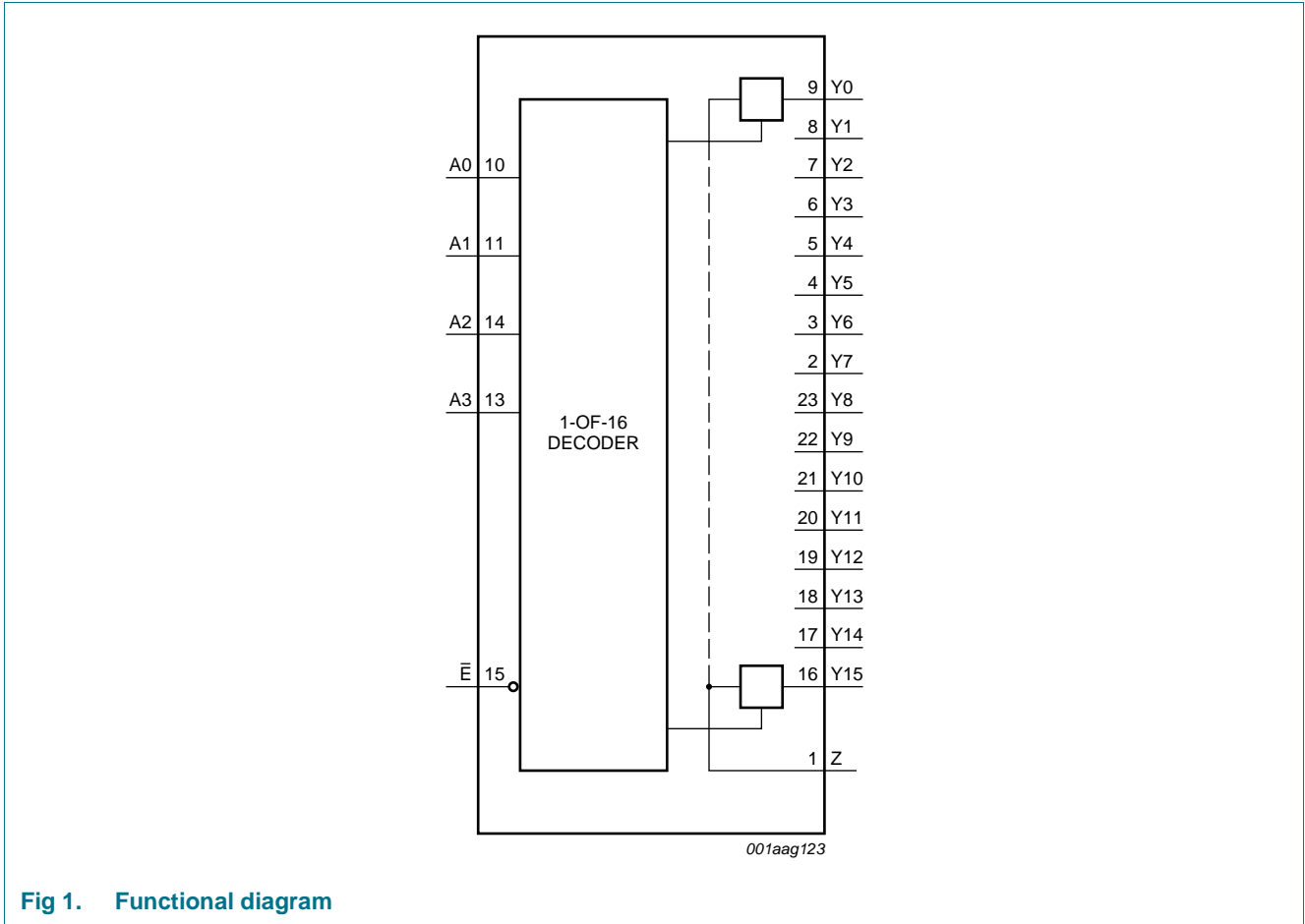


Fig 1. Functional diagram

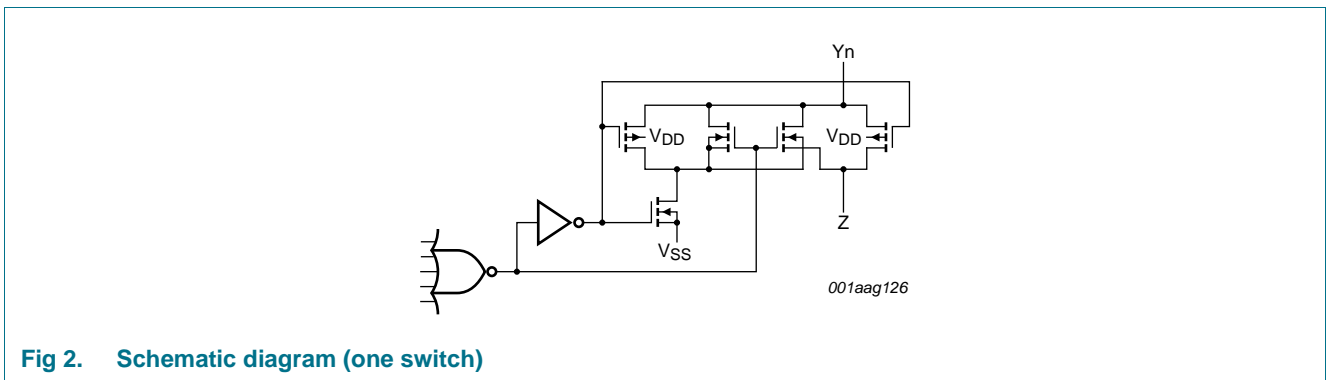


Fig 2. Schematic diagram (one switch)

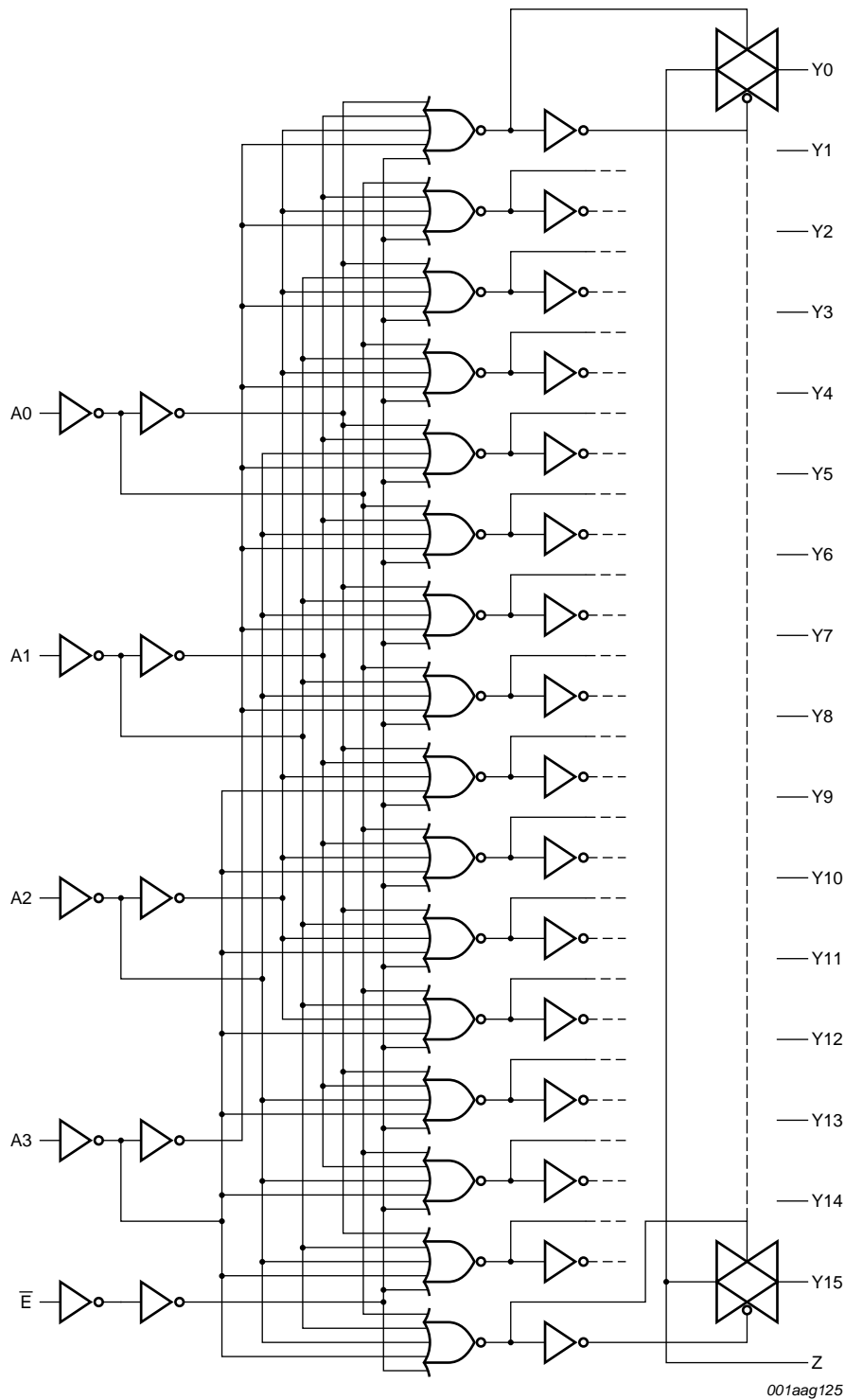


Fig 3. Logic diagram

6. Pinning information

6.1 Pinning

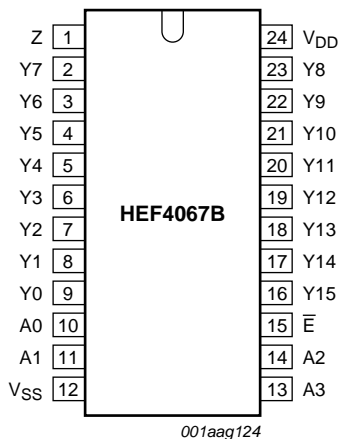


Fig 4. Pin configuration

6.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|--|---------------------------|
| Z | 1 | common input/output |
| Y0 to Y15 | 9, 8, 7, 6, 5, 4, 3, 2, 23, 22, 21, 20, 19, 18, 17, 16 | independent input/output |
| A0 to A3 | 10, 11, 14, 13 | address input |
| V _{SS} | 12 | ground (0 V) |
| \bar{E} | 15 | enable input (active LOW) |
| V _{DD} | 24 | supply voltage |

7. Functional description

Table 3. Function table^[1]

| Control | Address | | | | Channel ON |
|---------|---------|----|----|----|------------|
| | A3 | A2 | A1 | A0 | |
| L | L | L | L | L | Y0 = Z |
| L | L | L | L | H | Y1 = Z |
| L | L | L | H | L | Y2 = Z |
| L | L | L | H | H | Y3 = Z |
| L | L | H | L | L | Y4 = Z |
| L | L | H | L | H | Y5 = Z |
| L | L | H | H | L | Y6 = Z |
| L | L | H | H | H | Y7 = Z |
| L | H | L | L | L | Y8 = Z |
| L | H | L | L | H | Y9 = Z |
| L | H | L | H | L | Y10 = Z |
| L | H | L | H | H | Y11 = Z |
| L | H | H | L | L | Y12 = Z |
| L | H | H | L | H | Y13 = Z |
| L | H | H | H | L | Y14 = Z |
| L | H | H | H | H | Y15 = Z |
| H | X | X | X | X | none |

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

8. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to $V_{SS} = 0$ V (ground).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|------------------------|---|------------------|----------------|------|
| V_{DD} | supply voltage | | -0.5 | +18 | V |
| I_{IK} | input clamping current | pins An and \bar{E} ; $V_I < -0.5$ V or $V_I > V_{DD} + 0.5$ V | - | ± 10 | mA |
| V_I | input voltage | | -0.5 | $V_{DD} + 0.5$ | V |
| $I_{I/O}$ | input/output current | | ^[1] - | ± 10 | mA |
| I_{DD} | supply current | | - | 50 | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| T_{amb} | ambient temperature | | -40 | +85 | °C |

Table 4. Limiting values ...continued

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to $V_{SS} = 0$ V (ground).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|---------------------------------|-------|-----|------|
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to $+125$ °C | | | |
| | | DIP24 | [2] - | 750 | mW |
| | | SO24 | [3] - | 500 | mW |
| P | power dissipation | per output | - | 100 | mW |

- [1] To avoid drawing V_{DD} current out of terminal Z, when switch current flows into terminals Y_n , the voltage drop across the bidirectional switch must not exceed 0.4 V. If the switch current flows into terminal Z, no V_{DD} current will flow out of terminals Y_n , in this case there is no limit for the voltage drop across the switch, but the voltages at Y and Z may not exceed V_{DD} or V_{SS} .
- [2] For DIP24 packages: above $T_{amb} = 70$ °C, P_{tot} derates linearly at 12 mW/K.
- [3] For SO24 packages: above $T_{amb} = 70$ °C, P_{tot} derates linearly at 8 mW/K.

9. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---------------------|-------------------------------------|-----------------|-----|-----|----------|-----------|
| V_{DD} | supply voltage | | 3 | - | 15 | V |
| V_I | input voltage | | 0 | - | V_{DD} | V |
| T_{amb} | ambient temperature | in free air | -40 | - | +85 | °C |
| $\Delta t/\Delta V$ | input transition rise and fall rate | $V_{DD} = 5$ V | - | - | 3.75 | μ s/V |
| | | $V_{DD} = 10$ V | - | - | 0.5 | μ s/V |
| | | $V_{DD} = 15$ V | - | - | 0.08 | μ s/V |

10. Static characteristics

Table 6. Static characteristics

$V_{SS} = 0$ V; $V_I = V_{SS}$ or V_{DD} ; unless otherwise specified.

| Symbol | Parameter | Conditions | V_{DD} | $T_{amb} = -40$ °C | | $T_{amb} = +25$ °C | | $T_{amb} = +85$ °C | | Unit |
|----------|--------------------------|-------------------------|----------|--------------------|-----------|--------------------|-----------|--------------------|-----------|---------|
| | | | | Min | Max | Min | Max | Min | Max | |
| V_{IL} | LOW-level input voltage | $ I_O < 1$ μ A | | | | | | | | |
| | | $V_O = 0.5$ V or 4.5 V | 5 V | - | 1 | - | 1 | - | 1 | V |
| | | $V_O = 1.0$ V or 9.0 V | 10 V | - | 2 | - | 2 | - | 2 | V |
| | | $V_O = 1.5$ V or 13.5 V | 15 V | - | 2.5 | - | 2.5 | - | 2.5 | V |
| V_{IH} | HIGH-level input voltage | $ I_O < 1$ μ A | | | | | | | | |
| | | $V_O = 0.5$ V or 4.5 V | 5 V | 4 | - | 4 | - | 4 | - | V |
| | | $V_O = 1.0$ V or 9.0 V | 10 V | 8 | - | 8 | - | 8 | - | V |
| | | $V_O = 1.5$ V or 13.5 V | 15 V | 12.5 | - | 12.5 | - | 12.5 | - | V |
| I_I | input leakage current | $V_I = 0$ V or 15 V | 15 V | - | ± 0.3 | - | ± 0.3 | - | ± 1.0 | μ A |
| I_{OZ} | OFF-state output current | output at V_{DD} | 15 V | - | 1.6 | - | 1.6 | - | 12.0 | μ A |
| | | output at V_{SS} | 15 V | - | -1.6 | - | -1.6 | - | -12.0 | μ A |

Table 6. Static characteristics ...continued
 $V_{SS} = 0\text{ V}$; $V_I = V_{SS}$ or V_{DD} ; unless otherwise specified.

| Symbol | Parameter | Conditions | V_{DD} | $T_{amb} = -40\text{ }^\circ\text{C}$ | | $T_{amb} = +25\text{ }^\circ\text{C}$ | | $T_{amb} = +85\text{ }^\circ\text{C}$ | | Unit |
|--------------|---------------------------|--|----------|---------------------------------------|-----|---------------------------------------|------|---------------------------------------|-----|---------------|
| | | | | Min | Max | Min | Max | Min | Max | |
| $I_{S(OFF)}$ | OFF-state leakage current | Z port; all channels OFF; see Figure 5 | 15 V | - | - | - | 1000 | - | - | nA |
| | | Y_n port; per channel; see Figure 6 | 15 V | - | - | - | 200 | - | - | nA |
| I_{DD} | supply current | all valid input combinations; $I_O = 0\text{ A}$ | 5 V | - | 20 | - | 20 | - | 150 | μA |
| | | | 10 V | - | 40 | - | 40 | - | 300 | μA |
| | | | 15 V | - | 80 | - | 80 | - | 600 | μA |
| C_I | input capacitance | digital inputs | 15 V | - | - | - | 7.5 | - | - | pF |

10.1 Test circuits

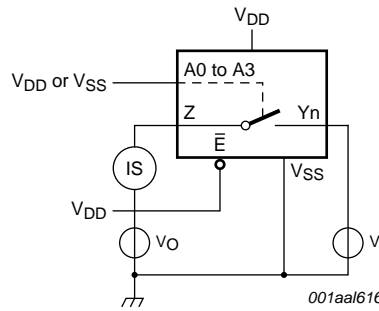


Fig 5. Test circuit for measuring OFF-state leakage current Z port

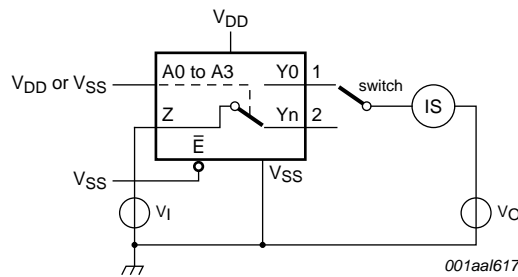


Fig 6. Test circuit for measuring OFF-state leakage current Y_n port

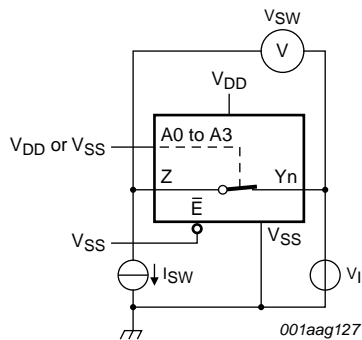
10.2 On resistance

Table 7. ON resistance

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $I_{SW} = 200\text{ }\mu\text{A}$; $V_{SS} = 0\text{ V}$.

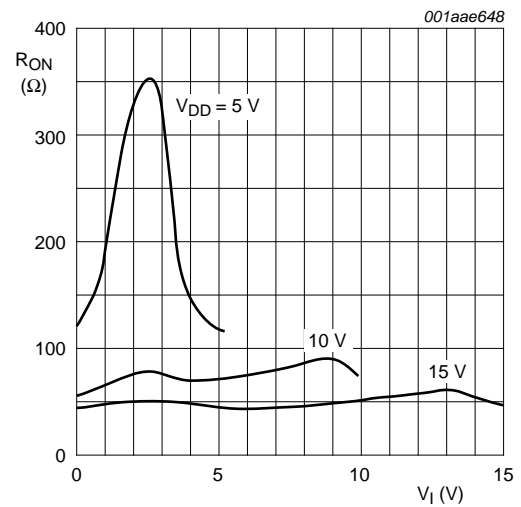
| Symbol | Parameter | Conditions | V _{DD} | Typ | Max | Unit |
|-----------------------|---|---|-----------------|-----|------|------|
| R _{ON(peak)} | ON resistance (peak) | V _I = 0 V to V _{DD} ; see Figure 7 and Figure 8 | 5 V | 350 | 2500 | Ω |
| | | | 10 V | 80 | 245 | Ω |
| | | | 15 V | 60 | 175 | Ω |
| R _{ON(rail)} | ON resistance (rail) | V _I = 0 V; see Figure 7 and Figure 8 | 5 V | 115 | 340 | Ω |
| | | | 10 V | 50 | 160 | Ω |
| | | | 15 V | 40 | 115 | Ω |
| | | V _I = V _{DD} ; see Figure 7 and Figure 8 | 5 V | 120 | 365 | Ω |
| | | | 10 V | 65 | 200 | Ω |
| | | | 15 V | 50 | 155 | Ω |
| ΔR _{ON} | ON resistance mismatch between channels | V _I = 0 V to V _{DD} ; see Figure 7 | 5 V | 25 | - | Ω |
| | | | 10 V | 10 | - | Ω |
| | | | 15 V | 5 | - | Ω |

10.2.1 On resistance waveform and test circuit



$R_{ON} = V_{SW} / I_{SW}$.

Fig 7. Test circuit for measuring R_{ON}



$I_{is} = 200\text{ }\mu\text{A}$; $V_{SS} = 0\text{ V}$.

Fig 8. Typical R_{ON} as a function of input voltage

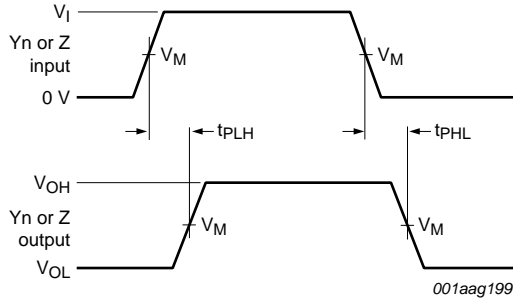
11. Dynamic characteristics

Table 8. Dynamic characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $V_{SS} = 0\text{ V}$; for test circuit see [Figure 12](#).

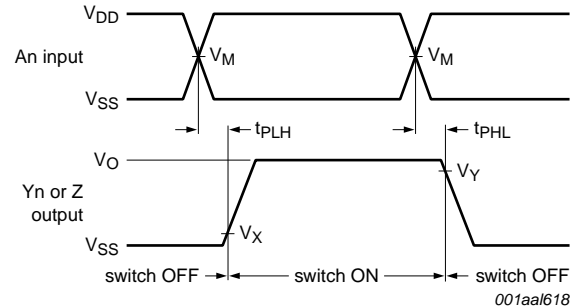
| Symbol | Parameter | Conditions | V_{DD} | Min | Typ | Max | Unit |
|-----------|-------------------------------------|---|----------|-----|-----|-----|------|
| t_{PHL} | HIGH to LOW propagation delay | Y_n, Z to Z, Y_n ; see Figure 9 | 5 V | - | 30 | 60 | ns |
| | | | 10 V | - | 15 | 25 | ns |
| | | | 15 V | - | 10 | 20 | ns |
| | | A_n to Y_n, Z ; see Figure 10 | 5 V | - | 190 | 380 | ns |
| | | | 10 V | - | 70 | 145 | ns |
| | | | 15 V | - | 50 | 100 | ns |
| t_{PLH} | LOW to HIGH propagation delay | Y_n, Z to Z, Y_n ; see Figure 9 | 5 V | - | 25 | 50 | ns |
| | | | 10 V | - | 10 | 20 | ns |
| | | | 15 V | - | 10 | 20 | ns |
| | | A_n to Y_n, Z ; see Figure 10 | 5 V | - | 175 | 345 | ns |
| | | | 10 V | - | 70 | 140 | ns |
| | | | 15 V | - | 50 | 100 | ns |
| t_{PHZ} | HIGH to OFF-state propagation delay | \bar{E} to Y_n, Z ; see Figure 11 | 5 V | - | 195 | 385 | ns |
| | | | 10 V | - | 140 | 280 | ns |
| | | | 15 V | - | 130 | 260 | ns |
| t_{PLZ} | LOW to OFF-state propagation delay | \bar{E} to Y_n, Z ; see Figure 11 | 5 V | - | 215 | 435 | ns |
| | | | 10 V | - | 180 | 355 | ns |
| | | | 15 V | - | 170 | 340 | ns |
| t_{PZH} | OFF-state to HIGH propagation delay | \bar{E} to Y_n, Z ; see Figure 11 | 5 V | - | 155 | 315 | ns |
| | | | 10 V | - | 70 | 135 | ns |
| | | \bar{E} to Y_n, Z ; see Figure 11 | 15 V | - | 50 | 100 | ns |
| t_{PZL} | OFF-state to LOW propagation delay | | 5 V | - | 170 | 340 | ns |
| | | | 10 V | - | 70 | 140 | ns |
| | | | 15 V | - | 50 | 100 | ns |

11.1 Waveforms and test circuit



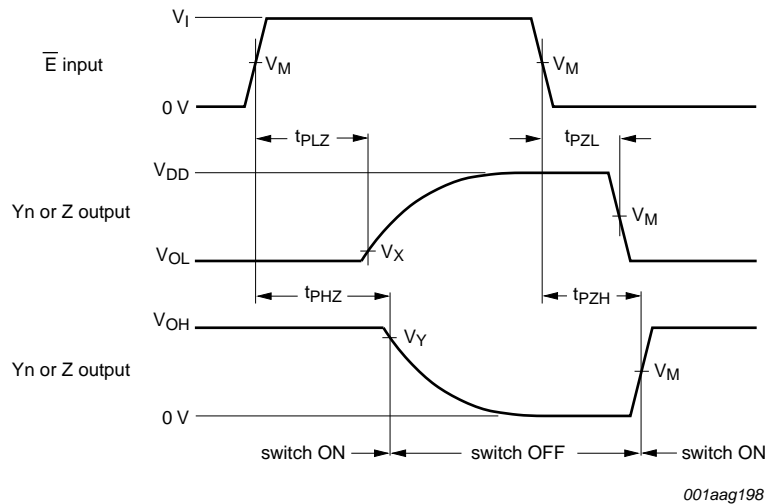
Measurement points are given in [Table 9](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 9. Yn, Z to Z, Yn propagation delays



Measurement points are given in [Table 9](#).

Fig 10. Sn to Yn, Z propagation delays

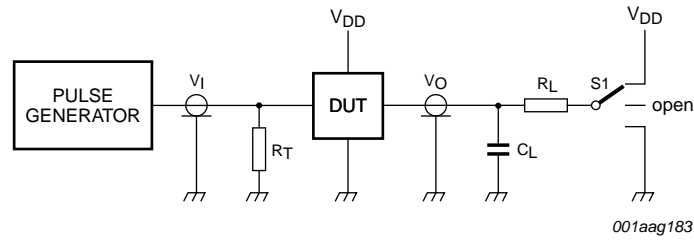


Measurement points are shown in [Table 9](#).
 V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 11. Enable and disable times

Table 9. Measurement points

| Supply voltage | Input | | Output | | |
|-------------------------|-------------|-----------------|-------------|-------|-------|
| | V_M | V_I | V_M | V_X | V_Y |
| V_{CC} 5 V to 15 V | $0.5V_{DD}$ | GND to V_{DD} | $0.5V_{DD}$ | 10% | 90% |



Test data is given in [Table 10](#).

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 resistor

S1 = test selection switch

Fig 12. Test circuit for measuring switching times

Table 10. Test data

| Input | | | | Load | | S1 position | | | | |
|----------------------|----------------------|--------------|-------------|-------|---------------|----------------------|-----------|--------------------|--------------------|----------|
| Yn, Z | An and \bar{E} | t_r, t_f | V_M | C_L | R_L | t_{PHL} [1] | t_{PLH} | t_{PZH}, t_{PHZ} | t_{PZL}, t_{PLZ} | other |
| V_{DD} or V_{SS} | V_{DD} or V_{SS} | ≤ 20 ns | $0.5V_{DD}$ | 50 pF | 10 k Ω | V_{DD} or V_{SS} | V_{SS} | V_{SS} | V_{DD} | V_{SS} |

[1] For Yn to Z or Z to Yn propagation delays use V_{SS} . For An or to Yn or Z propagation delays use V_{DD} .

11.2 Additional dynamic parameters

Table 11. Additional dynamic characteristics

$V_{SS} = 0\text{ V}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

| Symbol | Parameter | Conditions | V_{DD} | Typ | Max | Unit |
|----------------|---------------------------|--|----------|----------|-----|------|
| THD | total harmonic distortion | see Figure 13 ; $R_L = 10\text{ k}\Omega$; $C_L = 15\text{ pF}$; channel ON; $V_I = 0.5V_{DD}$ (p-p); $f_i = 1\text{ kHz}$ | 5 V | [1] 0.25 | - | % |
| | | | 10 V | [1] 0.04 | - | % |
| | | | 15 V | [1] 0.04 | - | % |
| $f_{(-3dB)}$ | -3 dB frequency response | see Figure 14 ; $R_L = 1\text{ k}\Omega$; $C_L = 5\text{ pF}$; channel ON; $V_I = 0.5V_{DD}$ (p-p) | 5 V | [1] 13 | - | MHz |
| | | | 10 V | [1] 40 | - | MHz |
| | | | 15 V | [1] 70 | - | MHz |
| α_{iso} | isolation (OFF-state) | see Figure 15 ; $f_i = 1\text{ MHz}$; $R_L = 1\text{ k}\Omega$; $C_L = 5\text{ pF}$; channel OFF; $V_I = 0.5V_{DD}$ (p-p) | 10 V | [1] -50 | - | dB |
| V_{ct} | crosstalk voltage | digital inputs to switch; see Figure 16 ; $R_L = 10\text{ k}\Omega$; $C_L = 15\text{ pF}$; \bar{E} or $A_n = V_{DD}$ (square-wave) | 10 V | 50 | - | mV |
| Xtalk | crosstalk | between switches; see Figure 17 ; $f_i = 1\text{ MHz}$; $R_L = 1\text{ k}\Omega$; $V_I = 0.5V_{DD}$ (p-p) | 10 V | [1] -50 | - | dB |

[1] f_i is biased at $0.5 V_{DD}$; $V_I = 0.5V_{DD}$ (p-p).

Table 12. Dynamic power dissipation P_D

P_D can be calculated from the formulas shown; $V_{SS} = 0\text{ V}$; $t_r = t_f \leq 20\text{ ns}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

| Symbol | Parameter | V_{DD} | Typical formula for P_D (μW) | where: |
|--------|---------------------------|----------|---|---|
| P_D | dynamic power dissipation | 5 V | $P_D = 1000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ | f_i = input frequency in MHz; |
| | | 10 V | $P_D = 5500 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ | f_o = output frequency in MHz; |
| | | 15 V | $P_D = 15000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ | C_L = output load capacitance in pF; V_{DD} = supply voltage in V; $\Sigma(C_L \times f_o)$ = sum of the outputs. |

11.2.1 Test circuits

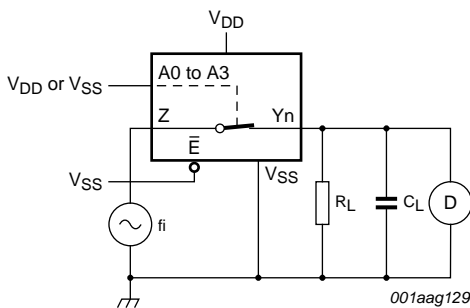


Fig 13. Test circuit for measuring total harmonic distortion

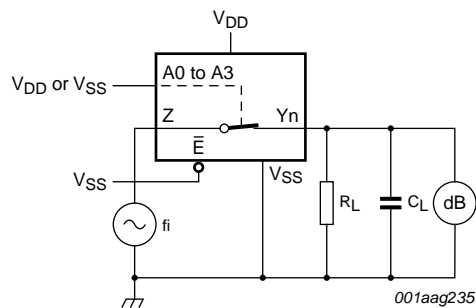


Fig 14. Test circuit for measuring frequency response

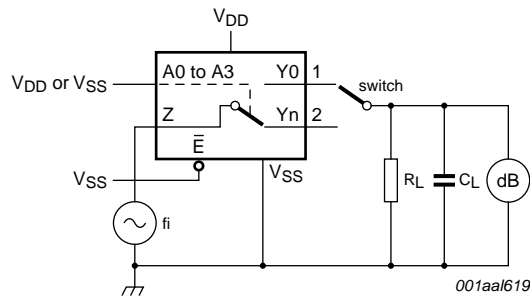
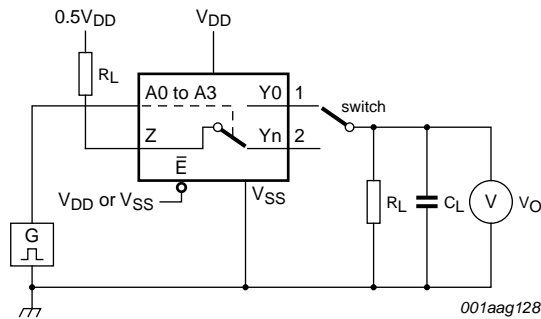
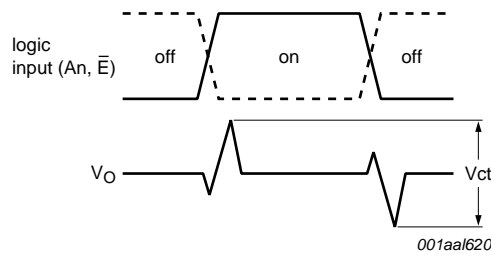


Fig 15. Test circuit for measuring isolation (OFF-state)

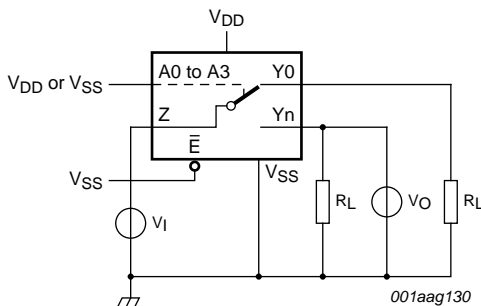


a. Test circuit

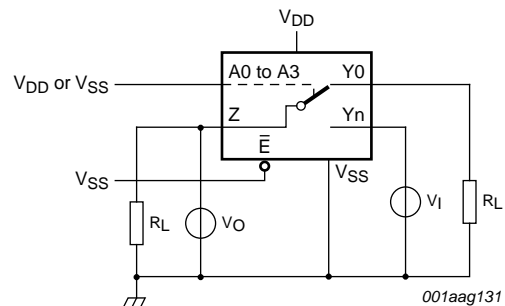


b. Input and output pulse definitions

Fig 16. Test circuit for measuring crosstalk voltage between digital inputs and switch



a. Switch closed condition



b. Switch open condition

Fig 17. Test circuit for measuring crosstalk between switches

12. Package outline

DIP24: plastic dual in-line package; 24 leads (600 mil)

SOT101-1

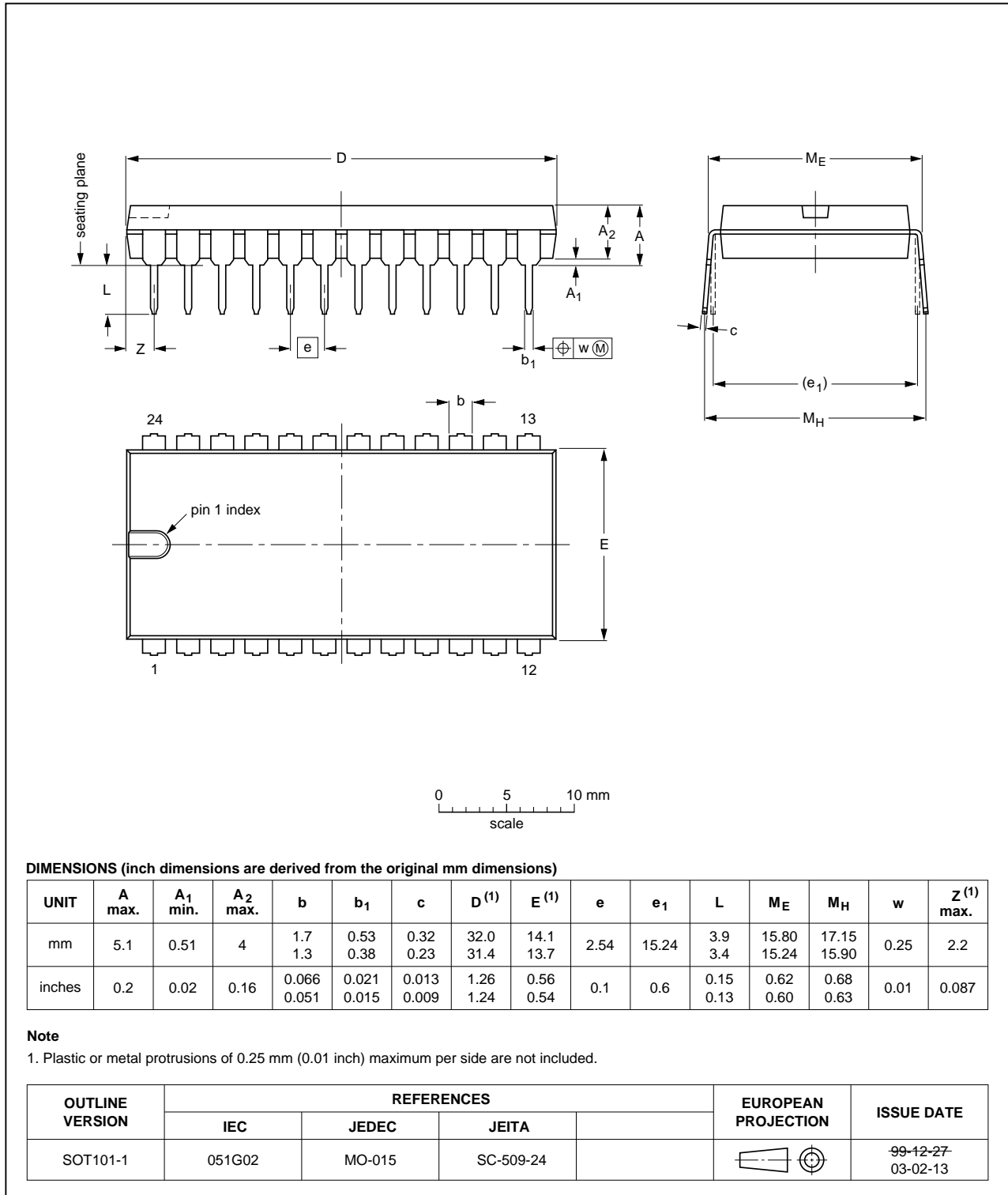


Fig 18. Package outline SOT101-1 (DIP24)

SO24: plastic small outline package; 24 leads; body width 7.5 mm

SOT137-1

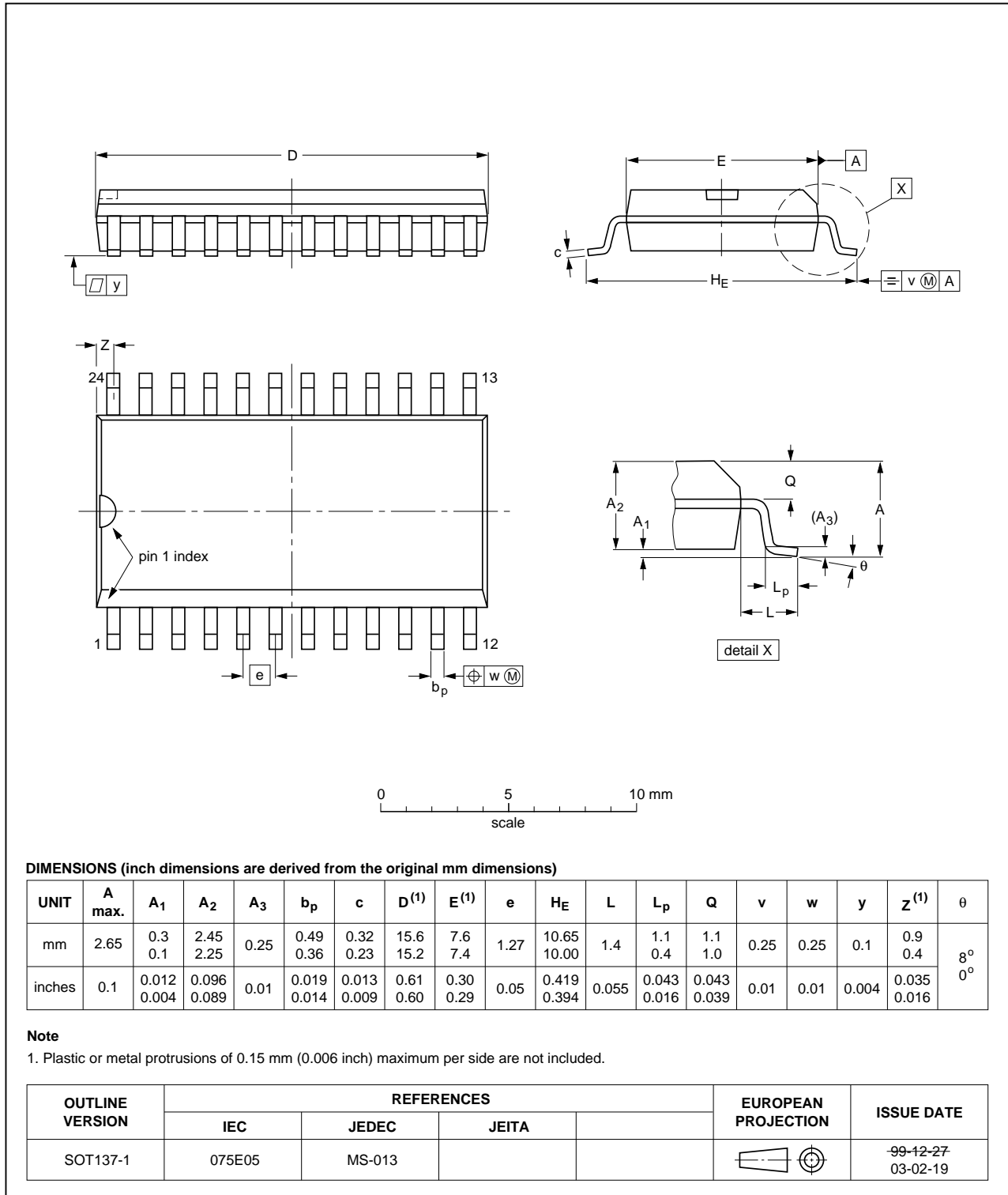


Fig 19. Package outline SOT137-1 (SO24)

13. Abbreviations

Table 13. Abbreviations

| Acronym | Description |
|---------|-------------------|
| DUT | Device Under Test |

14. Revision history

Table 14. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|------------------|--|-----------------------|---------------|------------------|
| HEF4067B v.6 | 20111116 | Product data sheet | - | HEF4067B v.5 |
| Modifications: | <ul style="list-style-type: none">• Legal pages updated.• Changes in “General description”, “Features and benefits” and “Applications”. | | | |
| HEF4067B v.5 | 20100325 | Product data sheet | - | HEF4067B v.4 |
| HEF4067B v.4 | 20100308 | Product data sheet | - | HEF4067B_CNV v.3 |
| HEF4067B_CNV v.3 | 19950101 | Product specification | - | HEF4067B_CNV v.2 |
| HEF4067B_CNV v.2 | 19950101 | Product specification | - | - |

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".

[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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