

HEF40106B-Q100

Hex inverting Schmitt trigger

Rev. 1 — 7 August 2012

Product data sheet

1. General description

The HEF40106B-Q100 provides six inverting buffers. Each input has a Schmitt trigger circuit. The inverting buffer switches at different points for positive-going and negative-going signals. The difference between the positive voltage (V_{T+}) and the negative voltage (V_{T-}) is defined as hysteresis voltage (V_H).

The HEF40106B-Q100 may be used for enhanced noise immunity or to “square up” slowly changing waveforms.

It operates over a recommended V_{DD} power supply range of 3 V to 15 V referenced to V_{SS} (usually ground). Unused inputs must be connected to V_{DD} , V_{SS} , or another input.

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 $+125\text{ }^{\circ}\text{C}$
- Schmitt trigger input discrimination
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- ESD protection:
 - ◆ MIL-STD-883C, method 3015 exceeds 2000 V
 - ◆ HBM JESD22-A114F exceeds 2000 V
 - ◆ MM JESD22-A115-A exceeds 200 V ($C = 200\text{ pF}$, $R = 0\text{ }\Omega$)
- Complies with JEDEC standard JESD 13-B

3. Applications

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

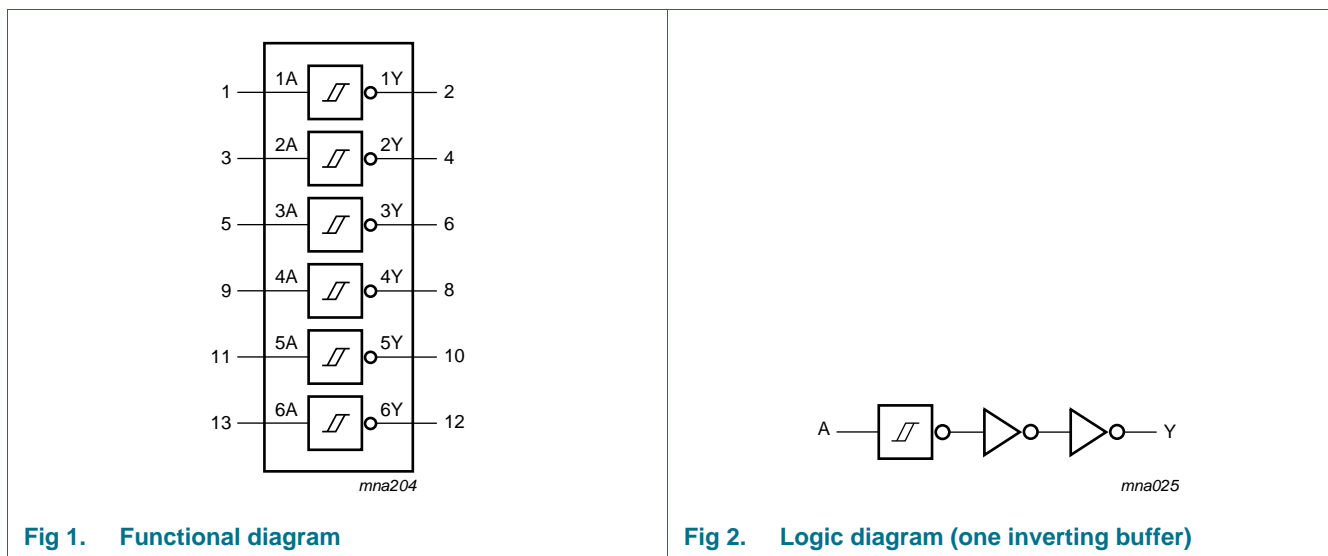
4. Ordering information

Table 1. Ordering information

All types operate from -40°C to $+125^{\circ}\text{C}$

| Type number | Package | | Version |
|------------------|---------|--|----------|
| | Name | Description | |
| HEF40106BT-Q100 | SO14 | plastic small outline package; 14 leads; body width 3.9 mm | SOT108-1 |
| HEF40106BTT-Q100 | TSSOP14 | plastic thin shrink small outline package; 14 leads; body width 4.4 mm | SOT402-1 |

5. Functional diagram



6. Pinning information

6.1 Pinning

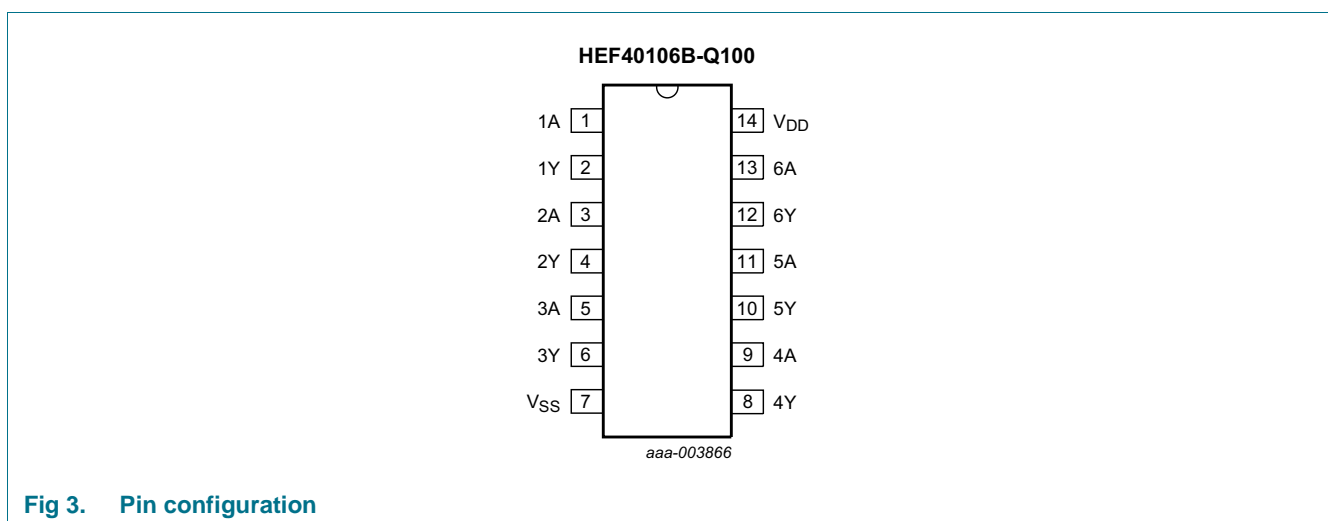


Fig 3. Pin configuration

6.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|-----------------|--------------------|----------------|
| 1A to 6A | 1, 3, 5, 9, 11, 13 | input |
| 1Y to 6Y | 2, 4, 6, 8, 10, 12 | output |
| V _{DD} | 14 | supply voltage |
| V _{SS} | 7 | ground (0 V) |

7. Functional description

Table 3. Function table^[1]

| Input | Output |
|-------|--------|
| nA | nY |
| L | H |
| H | L |

[1] H = HIGH voltage level; L = LOW voltage level.

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 | 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 _{OK} | output clamping current | V _O < -0.5 V or V _O > V _{DD} + 0.5 V | - | ±10 | mA |
| I _{I/O} | input/output current | | - | ±10 | mA |
| I _{DD} | supply current | | - | 50 | mA |
| T _{stg} | storage temperature | | -65 | +150 | °C |
| T _{amb} | ambient temperature | | -40 | +125 | °C |
| P _{tot} | total power dissipation | T _{amb} = -40 °C to +125 °C | | | |
| | | SO14 | ^[1] - | 500 | mW |
| | | TSSOP14 | ^[2] - | 500 | mW |
| P | power dissipation | per output | - | 100 | mW |

[1] For SO14 packages: above T_{amb} = 70 °C, P_{tot} derates linearly with 8 mW/K.

[2] For TSSOP14 packages: above T_{amb} = 60 °C, P_{tot} derates linearly with 5.5 mW/K.

9. Recommended operating conditions

Table 5. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | 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 | +125 | °C |

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 | | $T_{amb} = +125$ °C | | Unit |
|----------|---------------------------|--|----------|--------------------|-----------|--------------------|-----------|--------------------|-----------|---------------------|-----------|---------|
| | | | | Min | Max | Min | Max | Min | Max | Min | Max | |
| V_{OH} | HIGH-level output voltage | $ I_O < 1$ μ A | 5 V | 4.95 | - | 4.95 | - | 4.95 | - | 4.95 | - | V |
| | | | 10 V | 9.95 | - | 9.95 | - | 9.95 | - | 9.95 | - | V |
| | | | 15 V | 14.95 | - | 14.95 | - | 14.95 | - | 14.95 | - | V |
| V_{OL} | LOW-level output voltage | $ I_O < 1$ μ A | 5 V | - | 0.05 | - | 0.05 | - | 0.05 | - | 0.05 | V |
| | | | 10 V | - | 0.05 | - | 0.05 | - | 0.05 | - | 0.05 | V |
| | | | 15 V | - | 0.05 | - | 0.05 | - | 0.05 | - | 0.05 | V |
| I_{OH} | HIGH-level output current | $V_O = 2.5$ V | 5 V | - | -1.7 | - | -1.4 | - | -1.1 | - | -1.1 | mA |
| | | $V_O = 4.6$ V | 5 V | - | -0.64 | - | -0.5 | - | -0.36 | - | -0.36 | mA |
| | | $V_O = 9.5$ V | 10 V | - | -1.6 | - | -1.3 | - | -0.9 | - | -0.9 | mA |
| | | $V_O = 13.5$ V | 15 V | - | -4.2 | - | -3.4 | - | -2.4 | - | -2.4 | mA |
| I_{OL} | LOW-level output current | $V_O = 0.4$ V | 5 V | 0.64 | - | 0.5 | - | 0.36 | - | 0.36 | - | mA |
| | | $V_O = 0.5$ V | 10 V | 1.6 | - | 1.3 | - | 0.9 | - | 0.9 | - | mA |
| | | $V_O = 1.5$ V | 15 V | 4.2 | - | 3.4 | - | 2.4 | - | 2.4 | - | mA |
| I_I | input leakage current | | 15 V | - | ± 0.1 | - | ± 0.1 | - | ± 1.0 | - | ± 1.0 | μ A |
| I_{DD} | supply current | all valid input combinations; $I_O = 0$ A | 5 V | - | 0.25 | - | 0.25 | - | 7.5 | - | 7.5 | μ A |
| | | | 10 V | - | 0.5 | - | 0.5 | - | 15.0 | - | 15.0 | μ A |
| | | | 15 V | - | 1.0 | - | 1.0 | - | 30.0 | - | 30.0 | μ A |
| C_I | input capacitance | | | - | - | - | 7.5 | - | - | - | pF | |

11. Dynamic characteristics

Table 7. Dynamic characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$; $C_L = 50\text{ pF}$; $t_r = t_f \leq 20\text{ ns}$; wave forms see [Figure 4](#); test circuit see [Figure 5](#); unless otherwise specified.

| Symbol | Parameter | Conditions | V _{DD} | Extrapolation formula ^[1] | Min | Typ | Max | Unit |
|------------------|------------------------------------|------------------|-----------------|--------------------------------------|-----|-----|-----|------|
| t _{PHL} | HIGH to LOW propagation delay | nA or nB to nY | 5 V | 63 ns + (0.55 ns/pF)C _L | - | 90 | 180 | ns |
| | | | 10 V | 29 ns + (0.23 ns/pF)C _L | - | 35 | 70 | ns |
| | | | 15 V | 22 ns + (0.16 ns/pF)C _L | - | 30 | 60 | ns |
| t _{PLH} | LOW to HIGH propagation delay | nA or nB to nY | 5 V | 58 ns + (0.55 ns/pF)C _L | - | 75 | 150 | ns |
| | | | 10 V | 29 ns + (0.23 ns/pF)C _L | - | 35 | 70 | ns |
| | | | 15 V | 22 ns + (0.16 ns/pF)C _L | - | 30 | 60 | ns |
| t _{THL} | HIGH to LOW output transition time | nY to LOW | 5 V | 10 ns + (1.00 ns/pF)C _L | - | 60 | 120 | ns |
| | | | 10 V | 9 ns + (0.42 ns/pF)C _L | - | 30 | 60 | ns |
| | | | 15 V | 6 ns + (0.28 ns/pF)C _L | - | 20 | 40 | ns |
| t _{TLH} | LOW to HIGH output transition time | nA or nB to HIGH | 5 V | 10 ns + (1.00 ns/pF)C _L | - | 60 | 120 | ns |
| | | | 10 V | 9 ns + (0.42 ns/pF)C _L | - | 30 | 60 | ns |
| | | | 15 V | 6 ns + (0.28 ns/pF)C _L | - | 20 | 40 | ns |

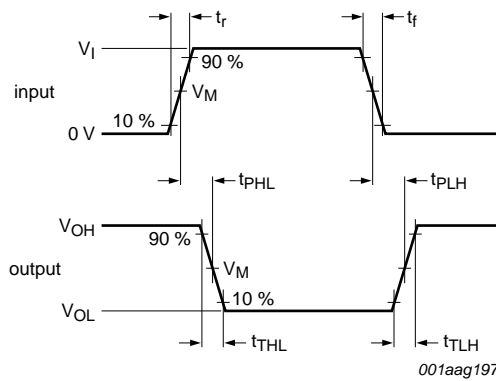
[1] Typical value of the propagation delay and output transition time can be calculated with the extrapolation formula (C_L in pF).

Table 8. Dynamic power dissipation

$V_{SS} = 0\text{ V}$; $t_r = t_f \leq 20\text{ ns}$; $T_{amb} = 25\text{ }^{\circ}\text{C}$.

| Symbol | Parameter | V _{DD} | Typical formula | where: |
|----------------|---------------------------|-----------------|--|--|
| P _D | dynamic power dissipation | 5 V | $P_D = 2300 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | f _i = input frequency in MHz; |
| | | 10 V | $P_D = 9000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | f _o = output frequency in MHz; |
| | | 15 V | $P_D = 20000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | C _L = output load capacitance in pF; Σ(f _o × C _L) = sum of the outputs; V _{DD} = supply voltage in V. |

12. Waveforms

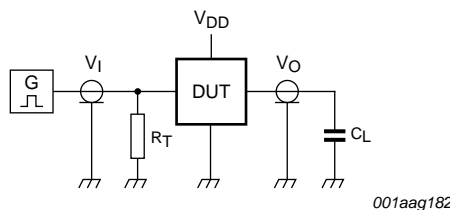


Measurement points are given in [Table 9](#).
 Logic levels: V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.
 t_r , t_f = input rise and fall times.

Fig 4. Propagation delay and output transition time

Table 9. Measurement points

| Supply voltage | Input | Output |
|----------------|-------------|-------------|
| V_{DD} | V_M | V_M |
| 5 V to 15 V | $0.5V_{DD}$ | $0.5V_{DD}$ |



Test data given in [Table 10](#).
 Definitions for test circuit:
 DUT = Device Under Test.
 C_L = load capacitance including jig and probe capacitance.
 R_T = termination resistance should be equal to the output impedance Z_o of the pulse generator.

Fig 5. Test circuit

Table 10. Test data

| Supply voltage | Input | Load |
|----------------|----------------------|--------------|
| V_{DD} | V_I | C_L |
| 5 V to 15 V | V_{SS} or V_{DD} | ≤ 20 ns |
| | | 50 pF |

13. Transfer characteristics

Table 11. Transfer characteristics

$V_{SS} = 0\text{ V}$; see [Figure 6](#) and [Figure 7](#).

| Symbol | Parameter | Conditions | V_{DD} | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | | | $T_{amb} = -40\text{ °C to }+125\text{ °C}$ | | Unit |
|----------|----------------------------------|------------|----------|--|--------------------|------|---|------|------|
| | | | | Min | Typ ^[1] | Max | Min | Max | |
| V_{T+} | positive-going threshold voltage | | 5 V | 2.0 | 3.0 | 3.5 | 2.0 | 3.5 | V |
| | | | 10 V | 3.7 | 5.8 | 7.0 | 3.7 | 7.0 | V |
| | | | 15 V | 4.9 | 8.3 | 11.0 | 4.9 | 11.0 | V |
| V_{T-} | negative-going threshold voltage | | 5 V | 1.5 | 2.2 | 3.0 | 1.5 | 3.0 | V |
| | | | 10 V | 3.0 | 4.5 | 6.3 | 3.0 | 6.3 | V |
| | | | 15 V | 4.0 | 6.5 | 10.1 | 4.0 | 10.1 | V |
| V_H | hysteresis voltage | | 5 V | 0.5 | 0.8 | - | 0.5 | - | V |
| | | | 10 V | 0.7 | 1.3 | - | 0.7 | - | V |
| | | | 15 V | 0.9 | 1.8 | - | 0.9 | - | V |

[1] All typical values are at $T_{amb} = 25\text{ °C}$.

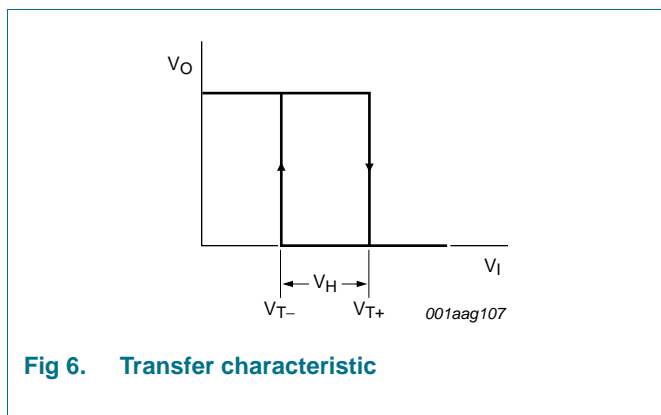


Fig 6. Transfer characteristic

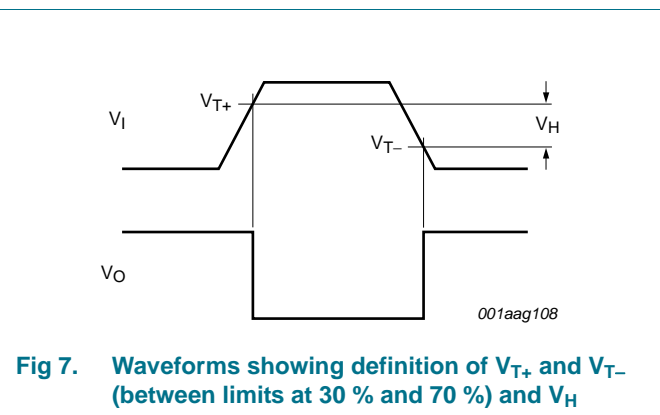
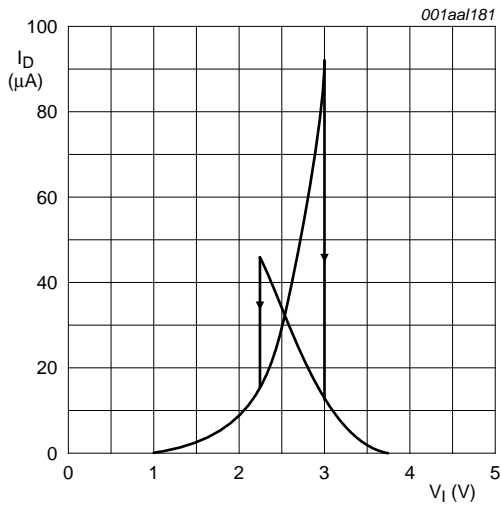
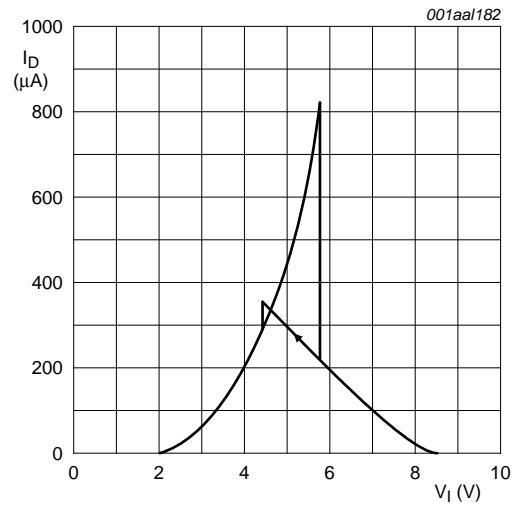


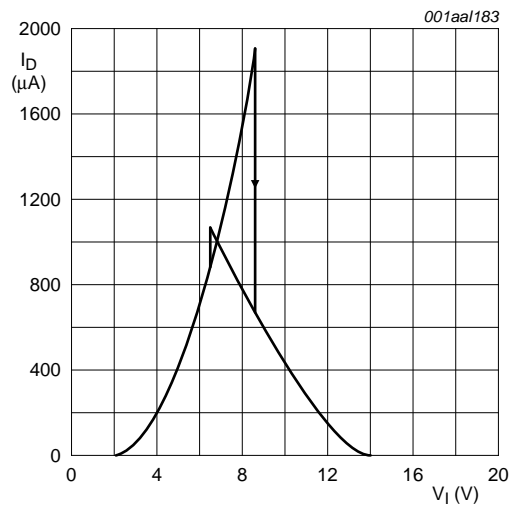
Fig 7. Waveforms showing definition of V_{T+} and V_{T-} (between limits at 30% and 70%) and V_H



a. $V_{DD} = 5\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$

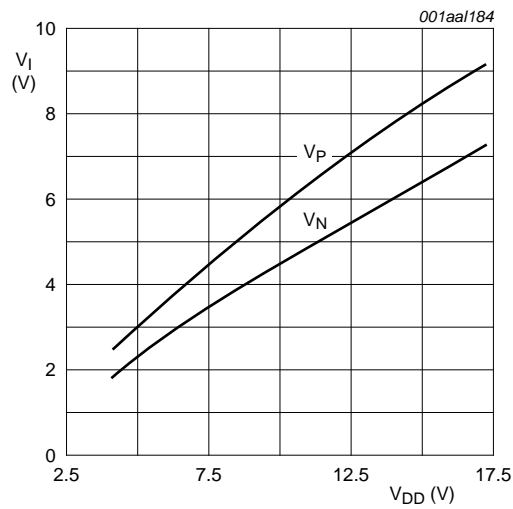


b. $V_{DD} = 10\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$



c. $V_{DD} = 15\text{ V}$; $T_{amb} = 25\text{ }^\circ\text{C}$

Fig 8. Typical drain current as a function of input



T_{amb} = 25 °C.

Fig 9. Typical switching levels as a function of supply voltage

14. Application information

Some examples of applications for the HEF40106B-Q100 are:

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators

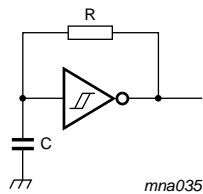


Fig 10. Astable multivibrator

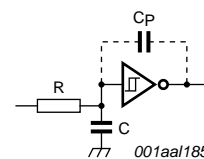


Fig 11. Schmitt trigger driven via a high-impedance input

If a Schmitt trigger is driven via a high-impedance ($R > 1 \text{ k}\Omega$), then it is necessary to incorporate a capacitor C with a value of $\frac{C}{C_P} > \frac{V_{DD} - V_{SS}}{V_H}$; otherwise oscillation can occur on the edges of a pulse.

C_P is the external parasitic capacitance between inputs and output; the value depends on the circuit board layout.

15. Package outline

SO14: plastic small outline package; 14 leads; body width 3.9 mm

SOT108-1

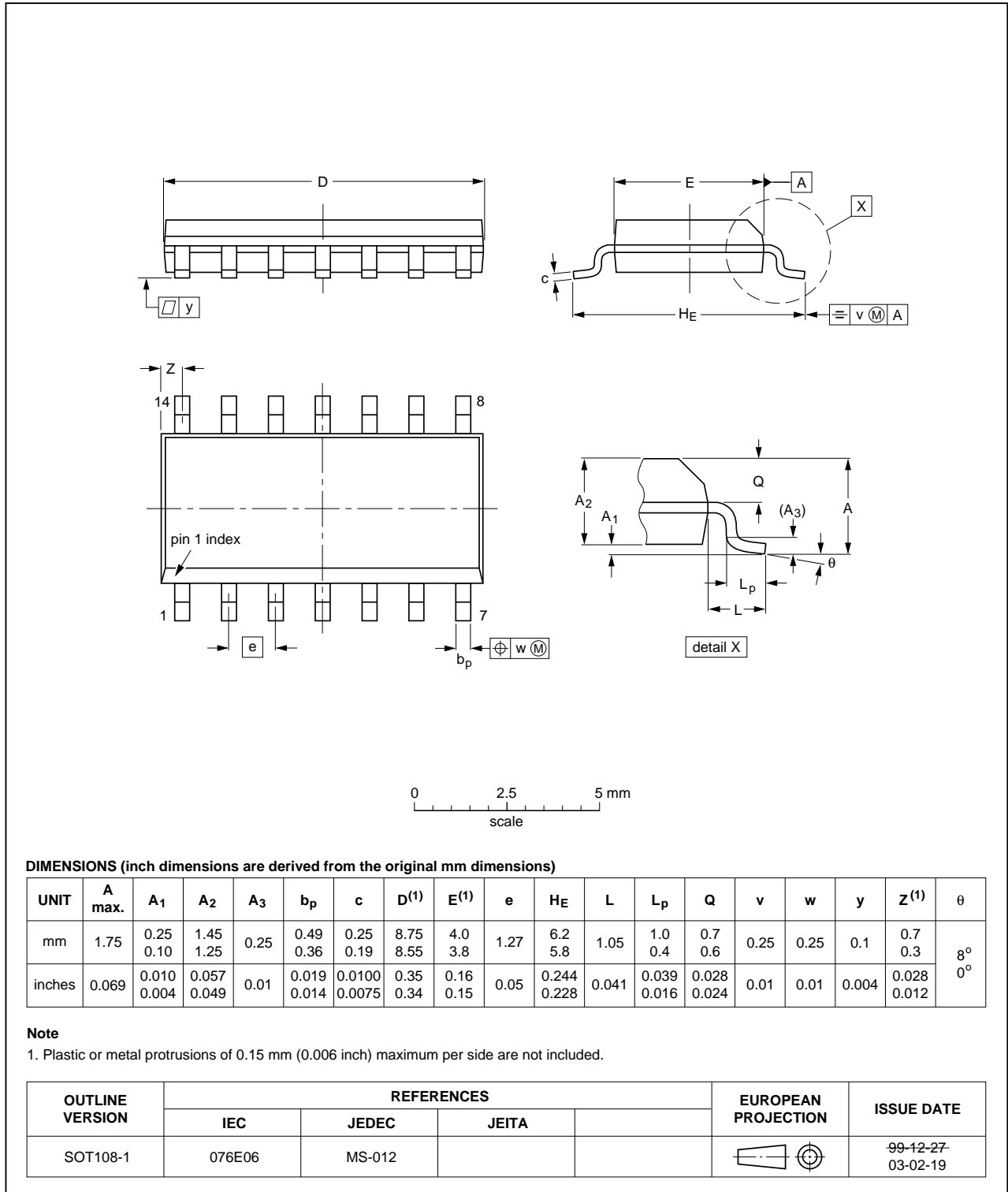


Fig 12. Package outline SOT108-1 (SO14)

TSSOP14: plastic thin shrink small outline package; 14 leads; body width 4.4 mm

SOT402-1

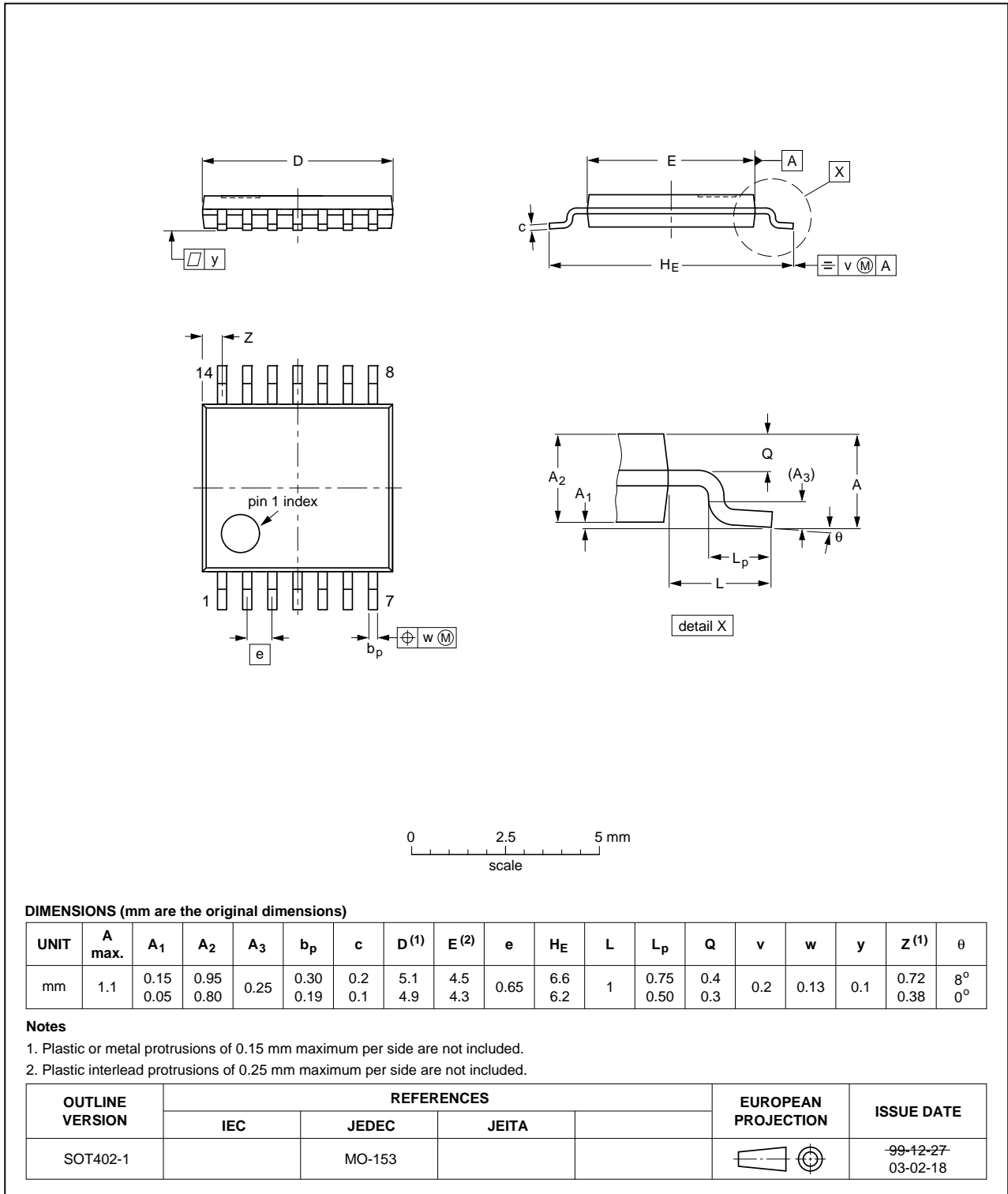


Fig 13. Package outline SOT402-1 (TSSOP14)

16. Abbreviations

Table 12. Abbreviations

| Acronym | Description |
|---------|-------------------------|
| HBM | Human Body Model |
| ESD | ElectroStatic Discharge |
| MM | Machine Model |
| MIL | Military |

17. Revision history

Table 13. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--------------------|--------------|--------------------|---------------|------------|
| HEF40106B_Q100 v.1 | 20120807 | Product data sheet | - | - |

18. Legal information

18.1 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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- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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