

HEF40373B

Octal transparent latch with 3-state outputs

Rev. 4 — 29 June 2018

Product data sheet

1 General description

The HEF40373B is an 8-bit transparent latch with 3-state buffered outputs. The output stages have high current output capability suitable for driving highly capacitive loads. The latch outputs follow the data inputs when the latch enable (E) is HIGH. When E is LOW, the data that meets the set-up times is latched. The 3-state outputs are controlled by the output enable input \overline{EO} . A HIGH on \overline{EO} causes the outputs to assume a high impedance OFF-state. The device features hysteresis on the E input to improve noise rejection. Schmitt-trigger action in the E input makes the circuit highly tolerant to slower input rise and fall times.

2 Features and benefits

- Octal bus interface
- 3-state buffers
- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$

3 Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|-------------|--|------|---|----------|
| | Temperature range | Name | Description | Version |
| HEF40373BT | $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ | SO20 | plastic small outline package; 20 leads; body width 7.5 mm | SOT163-1 |

4 Functional diagram

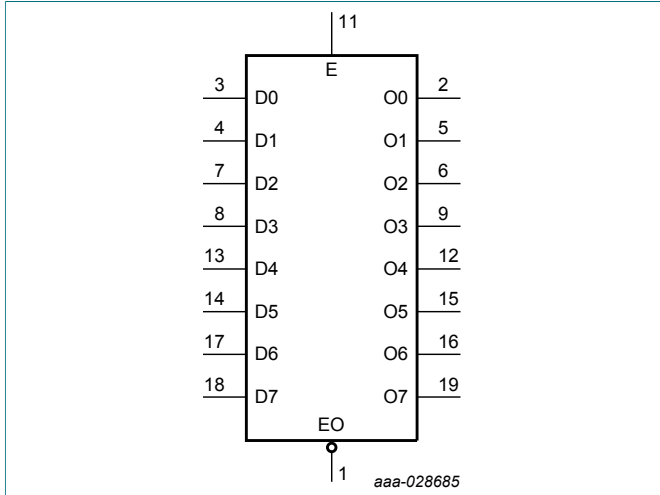


Figure 1. Logic symbol

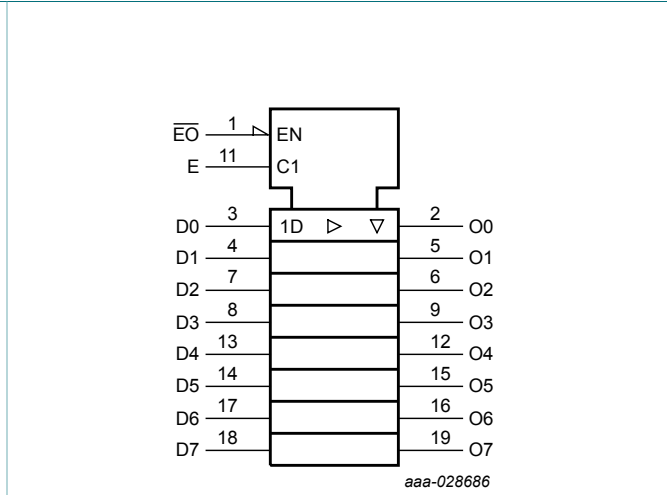


Figure 2. IEC logic symbol

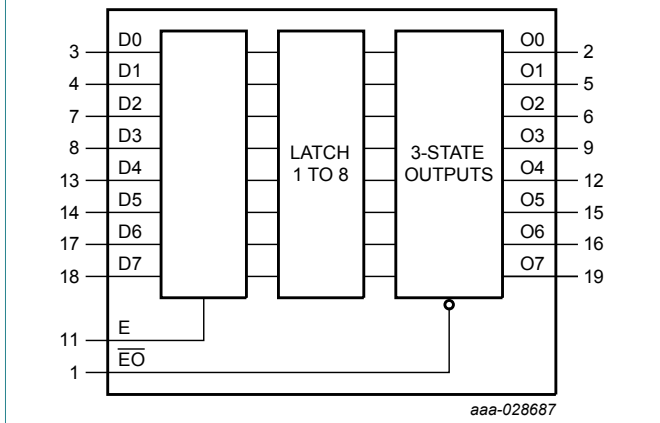


Figure 3. Functional diagram

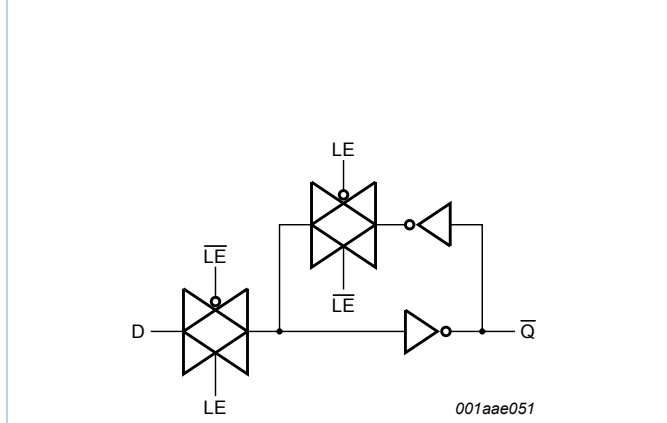


Figure 4. Logic diagram (one latch)

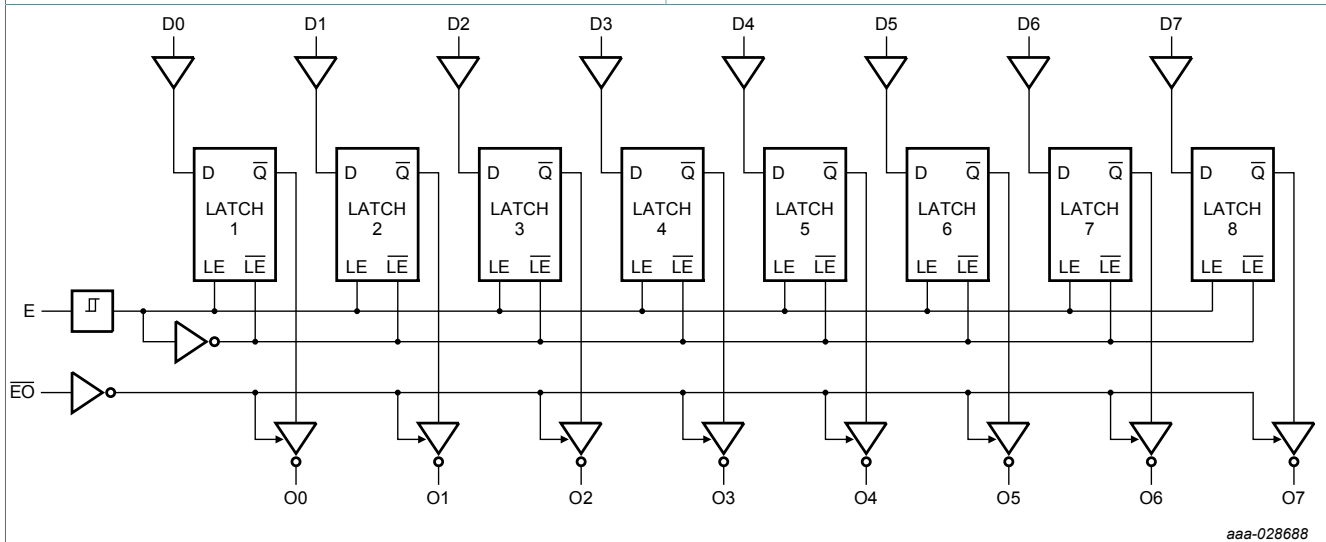
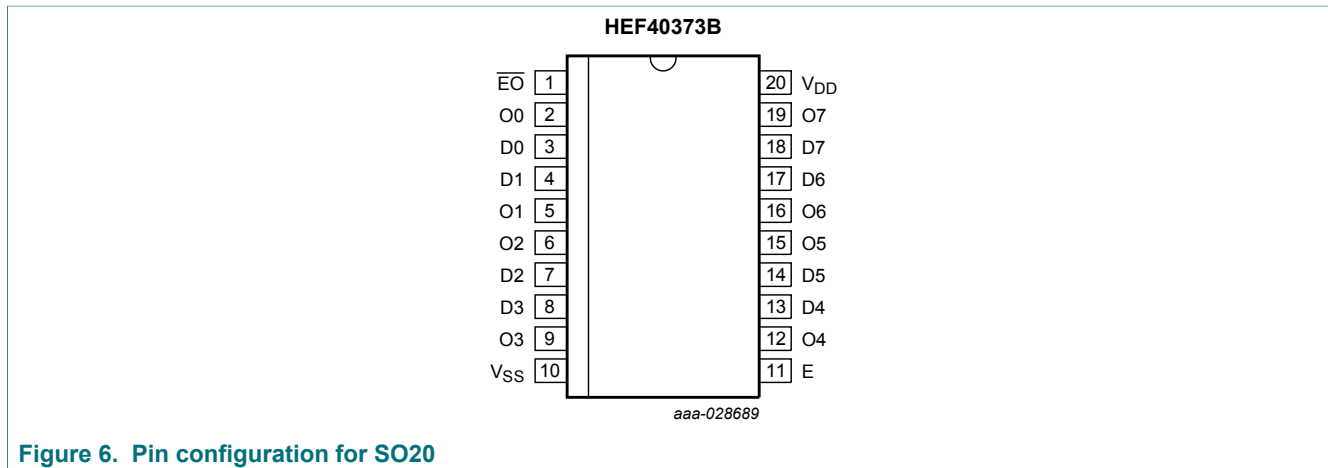


Figure 5. Logic diagram

5 Pinning information

5.1 Pinning



5.2 Pin description

Table 2. Pin description

| Symbol | Pin | Description |
|--------------------------------|----------------------------|----------------------------------|
| \overline{EO} | 1 | output enable input (active low) |
| E | 11 | latch enable input |
| D0, D1, D2, D3, D4, D5, D6, D7 | 3, 4, 7, 8, 13, 14, 17, 18 | data inputs |
| O0, O1, O2, O3, O4, O5, O6, O7 | 2, 5, 6, 9, 12, 15, 16, 19 | data outputs |
| V _{SS} | 10 | ground supply voltage |
| V _{DD} | 20 | supply voltage |

6 Functional description

Table 3. Function table ^[1]

| Operating mode | Inputs | | | Internal latches | Outputs On |
|---|-----------------|---|-----|------------------|------------|
| | \overline{EO} | E | Dn | | |
| enable and read register (transparent mode) | L | H | L | L | L |
| | L | H | H | H | H |
| latch and read register | L | ↓ | l | L | L |
| | L | ↓ | h | H | H |
| Hold | L | L | X | NC | NC |
| Latch register and disable outputs | H | L | X | NC | Z |
| | H | H | nDn | nDn | Z |

- [1] H = HIGH voltage level;
 L = LOW voltage level;
 ↓ = HIGH-to-LOW E transition;
 h = HIGH voltage level one set-up time prior to the HIGH-to-LOW E transition;
 l = LOW voltage level one set-up time prior to the HIGH-to-LOW E transition;
 X = don't care;
 NC = No change;
 Z = high-impedance OFF-state.

7 Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|-------------------------|--|------|----------------|------|
| V_{DD} | supply voltage | | -0.5 | +18 | V |
| V_I | input voltage | | -0.5 | $V_{DD} + 0.5$ | V |
| I_{DD} | supply current | | - | ±100 | mA |
| I_{IK} | input clamping current | | - | ±10 | mA |
| I_{OK} | output clamping current | | - | ±25 | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| T_{amb} | ambient temperature | | -40 | +85 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40\text{ °C to }+85\text{ °C}$ | | | |
| | | SO20 package ^[1] | - | 500 | mW |
| P | power dissipation | per output | - | 100 | mW |

- [1] For SO20 package: P_{tot} derates linearly with 8 mW/K above 70 °C.

8 Recommended operating conditions

Table 5. Operating conditions

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---------------------|-------------------------------------|---|-----|----------|-----------------|
| V_{DD} | supply voltage | referenced to V_{SS} (usually ground) | 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 | $V_{DD} = 5\text{ V}$ | - | 3.75 | $\mu\text{s/V}$ |
| | | $V_{DD} = 10\text{ V}$ | - | 0.5 | $\mu\text{s/V}$ |
| | | $V_{DD} = 15\text{ V}$ | - | 0.08 | $\mu\text{s/V}$ |

9 Static characteristics

Table 6. Static characteristics

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

| Symbol | Parameter | Conditions | $T_{amb} = -40\text{ °C}$ | | | $T_{amb} = 25\text{ °C}$ | | | $T_{amb} = 85\text{ °C}$ | | Unit |
|----------|---------------------------|---|---------------------------|-------|------|--------------------------|------|-------|--------------------------|------|------|
| | | | V_{DD} | Min | Max | Min | Typ | Max | Min | Max | |
| V_{IH} | HIGH-level input voltage | $ I_{O1} < 1\ \mu\text{A}$ | | | | | | | | | |
| | | $V_O = 0.5\text{ V}$ or 4.5 V | 5 V | 3.5 | - | 3.5 | - | - | 3.5 | - | V |
| | | $V_O = 1.0\text{ V}$ or 9.0 V | 10 V | 7.0 | - | 7.0 | - | - | 7.0 | - | V |
| | | $V_O = 1.5\text{ V}$ or 13.5 V | 15 V | 11.0 | - | 11.0 | - | - | 11.0 | - | V |
| V_{IL} | LOW-level input voltage | $ I_{O1} < 1\ \mu\text{A}$ | | | | | | | | | |
| | | $V_O = 0.5\text{ V}$ or 4.5 V | 5 V | - | 1.5 | - | - | 1.5 | - | 1.5 | V |
| | | $V_O = 1.0\text{ V}$ or 9.0 V | 10 V | - | 3.0 | - | - | 3.0 | - | 3.0 | V |
| | | $V_O = 1.5\text{ V}$ or 13.5 V | 15 V | - | 4.0 | - | - | 4.0 | - | 4.0 | V |
| V_{OH} | HIGH-level output voltage | $ I_{O1} < 1\ \mu\text{A}$ | 5 V | 4.95 | - | 4.95 | - | - | 4.95 | - | V |
| | | | 10 V | 9.95 | - | 9.95 | - | - | 9.95 | - | V |
| | | | 15 V | 14.95 | - | 14.95 | - | - | 14.95 | - | V |
| V_{OL} | LOW-level output voltage | $ I_{O1} < 1\ \mu\text{A}$ | 5 V | - | 0.05 | - | - | 0.05 | - | 0.05 | V |
| | | | 10 V | - | 0.05 | - | - | 0.05 | - | 0.05 | V |
| | | | 15 V | - | 0.05 | - | - | 0.05 | - | 0.05 | V |
| I_{OH} | HIGH-level output current | see Figure 7 and Figure 8 . | | | | | | | | | |
| | | $V_{OH} = 3.6\text{ V}$ | 5 V | -9.3 | - | -10 | -24 | - | -10.7 | - | mA |
| | | $V_{OH} = 4.6\text{ V}$ | 5 V | -0.75 | - | -0.6 | -1.2 | - | -0.45 | - | mA |
| | | $V_{OH} = 8.4\text{ V}$ | 10 V | -14.4 | - | -15 | -46 | - | -15 | - | mA |
| | | $V_{OH} = 9.5\text{ V}$ | 10 V | -1.85 | - | -1.5 | -3.0 | - | -1.1 | - | mA |
| | | $V_{OH} = 13.2\text{ V}$ | 15 V | -19.5 | - | -20 | -62 | - | -19.8 | - | mA |
| | $V_{OH} = 13.5\text{ V}$ | 15 V | -14.5 | - | -15 | -50 | - | -15.5 | - | mA | |

| Symbol | Parameter | Conditions | T _{amb} = -40 °C | | | T _{amb} = 25 °C | | | T _{amb} = 85 °C | | Unit |
|-----------------|--------------------------|----------------------------------|---------------------------|------|------|--------------------------|-----|------|--------------------------|-------|------|
| | | | V _{DD} | Min | Max | Min | Typ | Max | Min | Max | |
| I _{OL} | LOW-level output current | V _{OL} = 0.4 V | 5 V | 2.9 | - | 2.3 | 5.4 | - | 1.75 | - | mA |
| | | V _{OL} = 0.5 V | 10 V | 9.5 | - | 7.6 | 17 | - | 5.5 | - | mA |
| | | V _{OL} = 1.5 V | 15 V | 30.0 | - | 25 | 45 | - | 19.0 | - | mA |
| I _I | input leakage current | [1] | 15 V | - | ±0.3 | - | - | ±0.3 | - | ±1.0 | µA |
| I _{OZ} | OFF-state output current | V _O = V _{DD} | 15 V | - | 1.6 | - | - | 1.6 | - | 12.0 | µA |
| | | V _O = V _{SS} | 15 V | - | -1.6 | - | - | -1.6 | - | -12.0 | µA |
| I _{DD} | supply current | I _O = 0 A | 5 V | - | 20.0 | - | - | 20.0 | - | 150 | µA |
| | | | 10 V | - | 40.0 | - | - | 40.0 | - | 300 | µA |
| | | | 15 V | - | 80.0 | - | - | 80.0 | - | 600 | µA |
| V _H | hysteresis voltage | E input | 5 V | - | - | - | 220 | - | - | - | mV |
| | | | 10 V | - | - | - | 250 | - | - | - | mV |
| | | | 15 V | - | - | - | 320 | - | - | - | mV |
| C _I | input capacitance | | | - | - | - | 7.5 | - | - | - | pF |

[1] Unused inputs must be connected to V_{DD}, V_{SS} or another input.

10 Dynamic characteristics

Table 7. Dynamic characteristics

V_{SS} = 0 V; T_{amb} = 25 °C; unless otherwise specified; for waveform and test circuit, see [Figure 13](#).

| Symbol | Parameter | Conditions | Extrapolation formula | Min | Typ | Max | Unit |
|------------------|-------------------------------------|---|-------------------------------------|-----|-----|-----|------|
| t _{PHL} | HIGH to LOW propagation delay | E to On; see Figure 9 . [1] | | | | | |
| | | V _{DD} = 5 V | 138 ns + (0.24 ns/pF)C _L | - | 150 | 300 | ns |
| | | V _{DD} = 10 V | 59 ns + (0.01 ns/pF)C _L | - | 60 | 120 | ns |
| | | V _{DD} = 15 V | 36 ns + (0.07 ns/pF)C _L | - | 40 | 80 | ns |
| t _{PLH} | LOW to HIGH propagation delay | E to On; see Figure 9 . [1] | | | | | |
| | | V _{DD} = 5 V | 122 ns + (0.06 ns/pF)C _L | - | 125 | 250 | ns |
| | | V _{DD} = 10 V | 48 ns + (0.03 ns/pF)C _L | - | 50 | 100 | ns |
| | | V _{DD} = 15 V | 39 ns + (0.02 ns/pF)C _L | - | 40 | 60 | ns |
| t _{PZH} | OFF-state to HIGH propagation delay | \overline{E} O to On; see Figure 11 . | | | | | |
| | | V _{DD} = 5 V | | - | 65 | 130 | ns |
| | | V _{DD} = 10 V | | - | 30 | 60 | ns |
| | | V _{DD} = 15 V | | - | 25 | 50 | ns |
| t _{PZL} | OFF-state to LOW propagation delay | \overline{E} O to On; see Figure 11 . | | | | | |
| | | V _{DD} = 5 V | | - | 85 | 170 | ns |
| | | V _{DD} = 10 V | | - | 35 | 70 | ns |
| | | V _{DD} = 15 V | | - | 25 | 50 | ns |

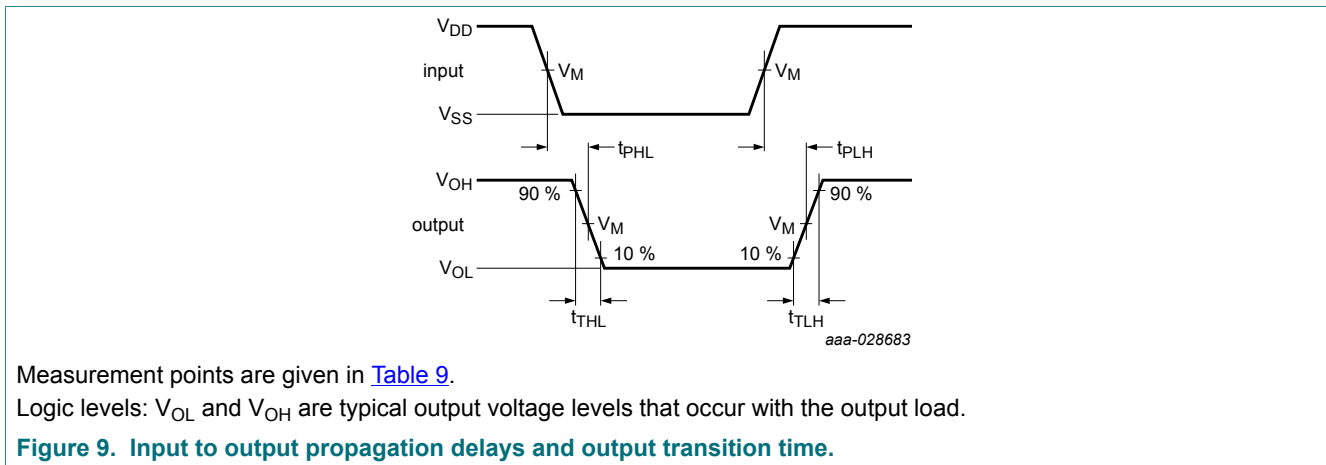
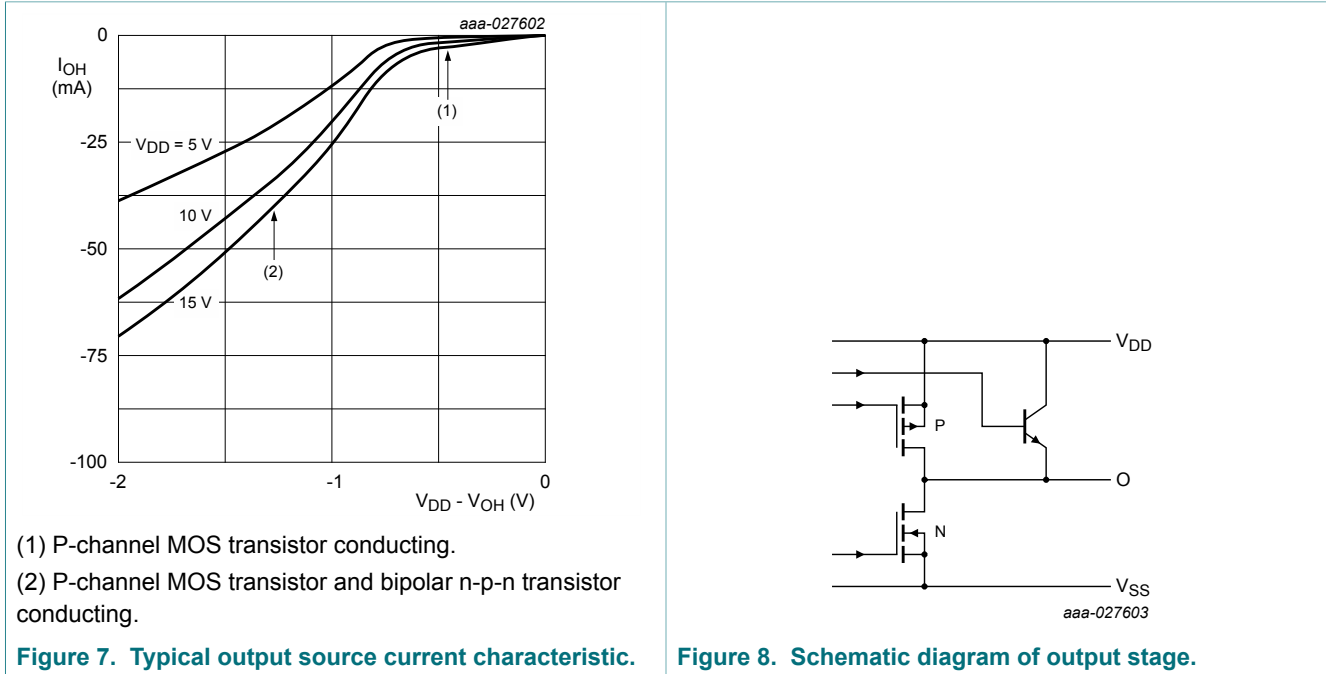
| Symbol | Parameter | Conditions | Extrapolation formula | Min | Typ | Max | Unit |
|------------------|-------------------------------------|--|-----------------------|-----|-----|-----|------|
| t _{PHZ} | HIGH to OFF-state propagation delay | E \bar{O} to On; see Figure 11 . | | | | | |
| | | V _{DD} = 5 V | | - | 65 | 130 | ns |
| | | V _{DD} = 10 V | | - | 30 | 60 | ns |
| | | V _{DD} = 15 V | | - | 25 | 50 | ns |
| t _{PLZ} | LOW to OFF-state propagation delay | E \bar{O} to On; see Figure 11 . | | | | | |
| | | V _{DD} = 5 V | | - | 75 | 150 | ns |
| | | V _{DD} = 10 V | | - | 40 | 80 | ns |
| | | V _{DD} = 15 V | | - | 30 | 60 | ns |
| t _{THL} | HIGH to LOW output transition time | On; see Figure 9 and Figure 10 . | | | | | |
| | | V _{DD} = 5 V | | - | 40 | 80 | ns |
| | | V _{DD} = 10 V | | - | 20 | 40 | ns |
| | | V _{DD} = 15 V | | - | 15 | 30 | ns |
| t _{TLH} | LOW to HIGH output transition time | On; see Figure 9 and Figure 10 . | | | | | |
| | | V _{DD} = 5 V | | - | 30 | 60 | ns |
| | | V _{DD} = 10 V | | - | 20 | 40 | ns |
| | | V _{DD} = 15 V | | - | 15 | 30 | ns |
| t _{su} | set-up time | Dn to E; see Figure 12 . | | | | | |
| | | V _{DD} = 5 V | | 15 | 7 | - | ns |
| | | V _{DD} = 10 V | | 10 | 5 | - | ns |
| | | V _{DD} = 15 V | | 10 | 5 | - | ns |
| t _h | hold time | Dn to E; see Figure 12 . | | | | | |
| | | V _{DD} = 5 V | | 25 | 15 | - | ns |
| | | V _{DD} = 10 V | | 15 | 4 | - | ns |
| | | V _{DD} = 15 V | | 10 | 3 | - | ns |
| t _w | pulse width | E; LOW; see Figure 13 . | | | | | |
| | | V _{DD} = 5 V | | 60 | 30 | - | ns |
| | | V _{DD} = 10 V | | 30 | 15 | - | ns |
| | | V _{DD} = 15 V | | 20 | 10 | - | ns |

[1] The typical values of the propagation delay are calculated from the extrapolation formulas shown (C_L in pF).

Table 8. Dynamic power dissipation

| Symbol | Parameter | V _{DD} | Typical formula | where: |
|----------------|---------------------------|-----------------|--|---|
| P _D | dynamic power dissipation | 5 V | $P_D = 3325 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | f _i = input frequency in MHz; f _o = output frequency in MHz; C _L = output load capacitance in pF; Σ(f _o × C _L) = sum of the outputs; V _{DD} = supply voltage in V. |
| | | 10 V | $P_D = 14200 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | |
| | | 15 V | $P_D = 37425 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2$ (μW) | |

10.1 Waveforms and test circuit



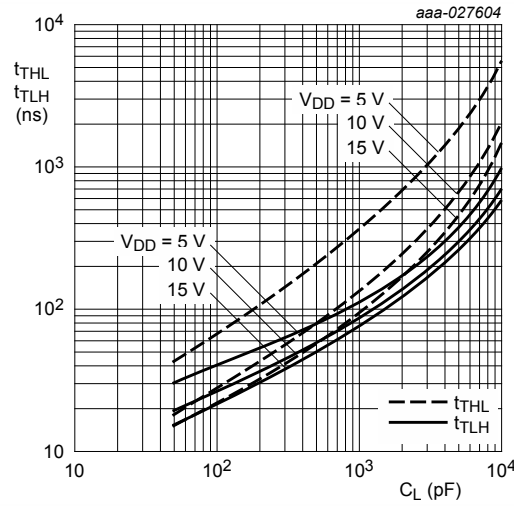
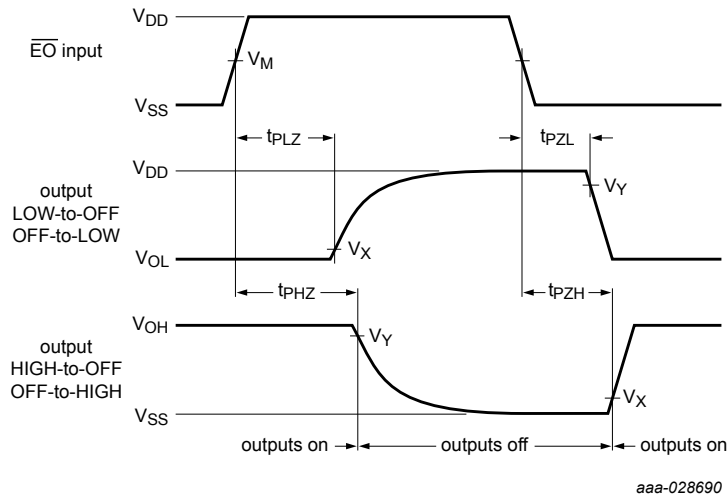


Figure 10. Output transition times as a function of the load capacitance



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.

Figure 11. 3-state enable and disable times

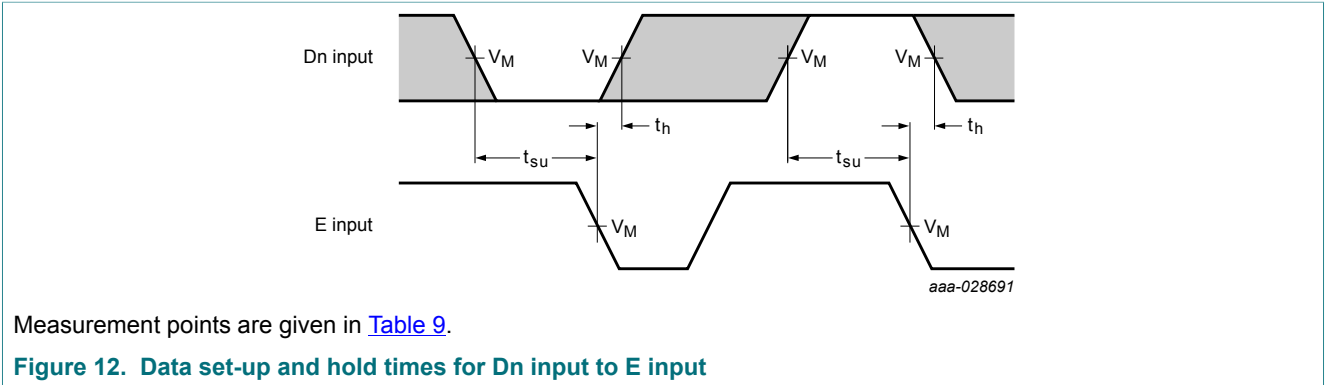


Table 9. Measurement points

| Supply voltage | Input | Output | | |
|----------------|-------------|-------------|----------------------|----------------------|
| V_{DD} | V_M | V_M | V_X | V_Y |
| 5 V to 15 V | $0.5V_{DD}$ | $0.5V_{DD}$ | $V_{OL} + 0.1V_{DD}$ | $V_{OH} - 0.1V_{DD}$ |

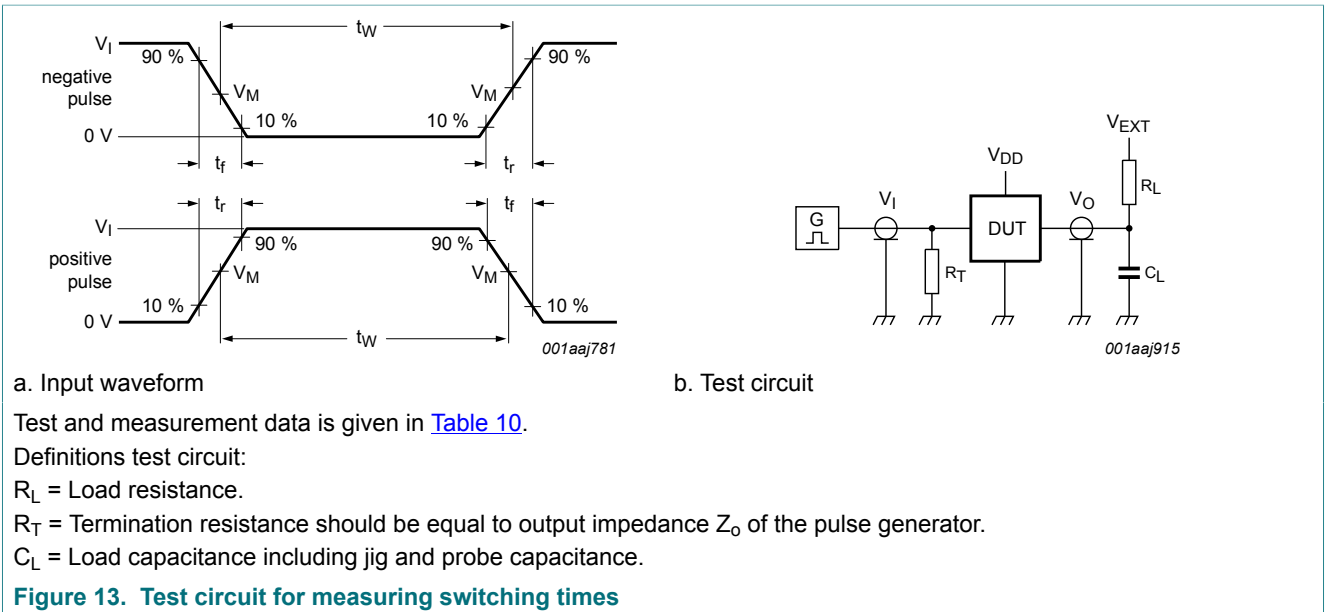


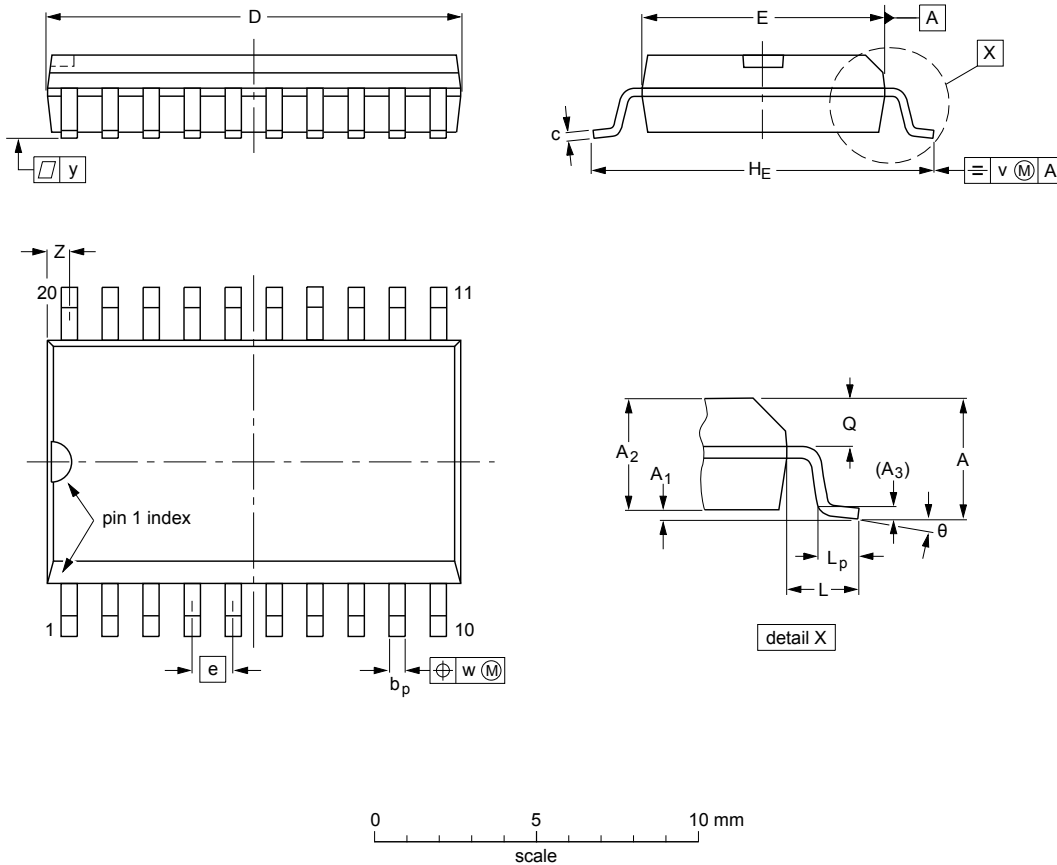
Table 10. Test data

| Supply voltage | Input | | Load | | V_{EXT} | | |
|----------------|----------|--------------|-------|--------------|--------------------|--------------------|--------------------|
| | V_I | t_r, t_f | C_L | R_L | t_{PLH}, t_{PHL} | t_{PHZ}, t_{PZH} | t_{PLZ}, t_{PZL} |
| 5 V to 15 V | V_{DD} | ≤ 20 ns | 50 pF | 1 k Ω | open | V_{SS} | V_{DD} |

11 Package outline

SO20: plastic small outline package; 20 leads; body width 7.5 mm

SOT163-1



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|--------|--------|----------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm | 2.65 | 0.3 0.1 | 2.45 2.25 | 0.25 | 0.49 0.36 | 0.32 0.23 | 13.0 12.6 | 7.6 7.4 | 1.27 | 10.65 10.00 | 1.4 | 1.1 0.4 | 1.1 1.0 | 0.25 | 0.25 | 0.1 | 0.9 0.4 | 8° 0° |
| inches | 0.1 | 0.012 0.004 | 0.096 0.089 | 0.01 | 0.019 0.014 | 0.013 0.009 | 0.51 0.49 | 0.30 0.29 | 0.05 | 0.419 0.394 | 0.055 | 0.043 0.016 | 0.043 0.039 | 0.01 | 0.01 | 0.004 | 0.035 0.016 | |

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|-------|--|---------------------|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT163-1 | 075E04 | MS-013 | | | | 99-12-27 03-02-19 |

Figure 14. Package outline SOT163-1 (SO20)

12 Abbreviations

Table 11. Abbreviations

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

13 Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|----------------|--|-----------------------|---------------|---------------|
| HEF40373B v.4 | 20180629 | Product data sheet | - | HEF40373B v.3 |
| 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. | | | |
| HEF40373B v.3 | 19950101 | Product specification | - | HEF40373B v.2 |
| HEF40373B v.2 | 19950101 | Product specification | - | - |

14 Legal information

14.1 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.nexperia.com>.

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