

# 74HC9115

Nine wide Schmitt trigger buffer; open drain outputs

Rev. 3 — 10 April 2018

Product data sheet

## 1 General description

The 74HC9115 is a 9-bit buffer with Schmitt trigger inputs and open drain outputs. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of  $V_{CC}$ . Schmitt trigger inputs transform slowly changing input signals into sharply defined jitter-free output signals.

## 2 Features and benefits

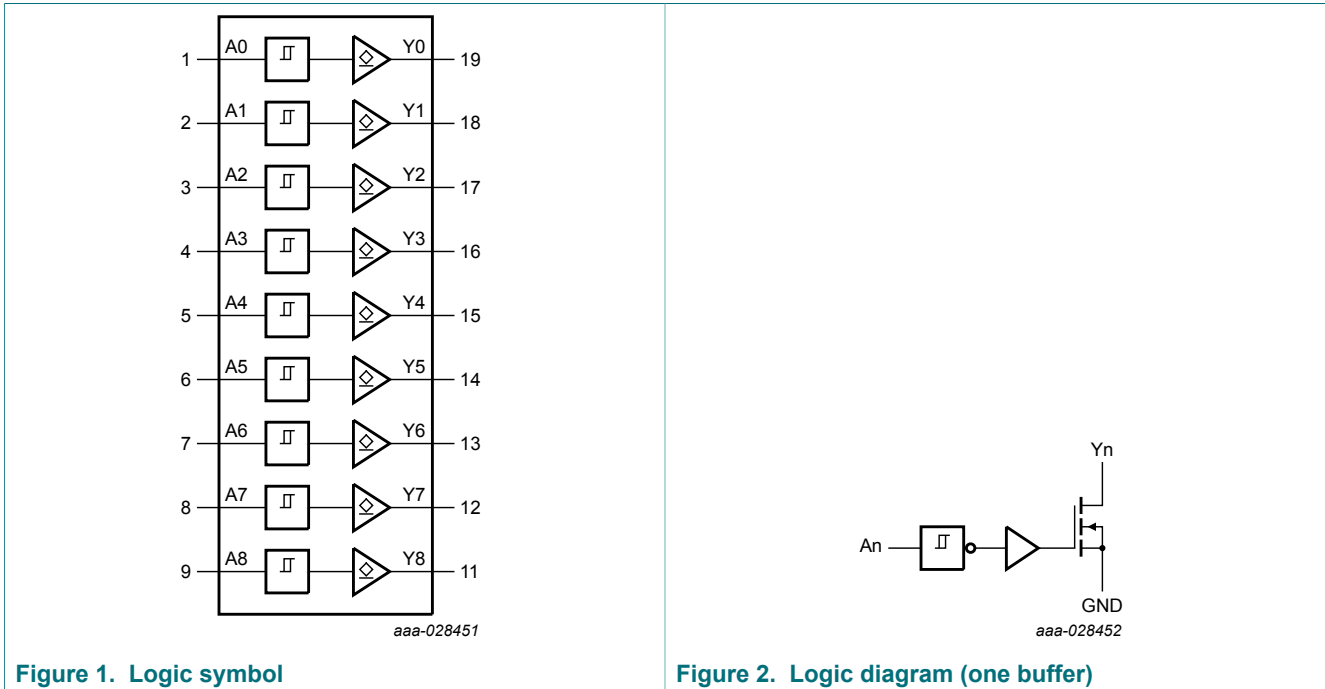
- Wide operating voltage 2.0 V to 6.0 V
- Schmitt trigger action on all data inputs
- CMOS low power dissipation
- High noise immunity
- Unlimited input rise and fall times
- Latch-up performance exceeds 100 mA per JESD 78 Class II Level B
- Complies with JEDEC standards:
  - JESD8C (2.7 V to 3.6 V)
  - JESD7A (2.0 V to 6.0 V)
- ESD protection:
  - HBM JESD22-A114-A exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from -40 °C to +85 °C and from -40 °C to +125 °C

## 3 Ordering information

Table 1. Ordering information

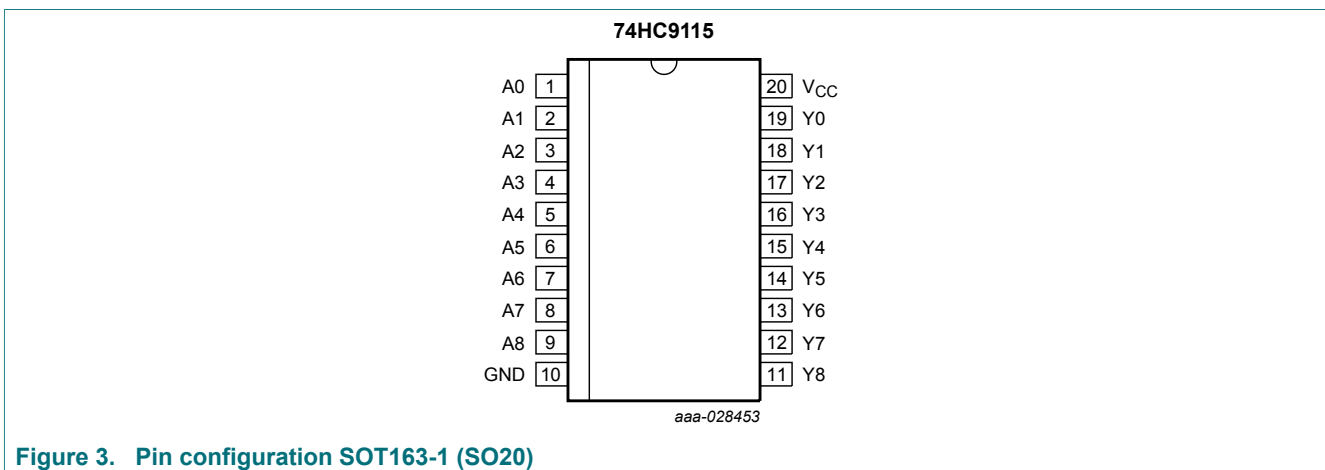
| Type number | Package           |      |   |          |
|-------------|-------------------|------|---|----------|
|             | Temperature range | Name | Description   | Version  |
| 74HC9115D   | -40 °C to +125 °C | SO20 | plastic small outline package; 20 leads;<br>body width 7.5 mm | SOT163-1 |

### 4 Functional diagram



### 5 Pinning information

#### 5.1 Pinning



## 5.2 Pin description

Table 2. Pin description

| Symbol                             | Pin                                | Description    |
|------------------------------------|------------------------------------|----------------|
| A0, A1, A2, A3, A4, A5, A6, A7, A8 | 1, 2, 3, 4, 5, 6, 7, 8, 9          | data inputs    |
| GND                                | 10                                 | ground (0 V)   |
| Y0, Y1, Y2, Y3, Y4, Y5, Y6, Y7, Y8 | 19, 18, 17, 16, 15, 14, 13, 12, 11 | data outputs   |
| V <sub>CC</sub>                    | 20                                 | supply voltage |

## 6 Functional description

Table 3. Function table <sup>[1]</sup>

| Input          | Output         |
|----------------|----------------|
| A <sub>n</sub> | Y <sub>n</sub> |
| L              | L              |
| H              | Z              |

[1] H = HIGH voltage level; L = LOW voltage level; Z = high-impedance OFF-state.

## 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 <sub>CC</sub>  | supply voltage          |  | -0.5 | +7.0 | V    |
| I <sub>IK</sub>  | input clamping current  | V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>CC</sub> + 0.5 V <sup>[1]</sup> | -    | ±20  | mA   |
| I <sub>OK</sub>  | output clamping current | V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>CC</sub> + 0.5 V <sup>[1]</sup> | -    | ±20  | mA   |
| I <sub>O</sub>   | output current          | -0.5 V < V <sub>O</sub> < V <sub>CC</sub> + 0.5 V <sup>[1]</sup>                   | -    | ±25  | mA   |
| I <sub>CC</sub>  | supply current          |  | -    | 50   | mA   |
| I <sub>GND</sub> | ground current          |  | -50  | -    | mA   |
| T <sub>stg</sub> | storage temperature     |  | -65  | +150 | °C   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> = -40 °C to +125 °C <sup>[2]</sup>                                | -    | 500  | mW   |

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

[2] Above 70 °C the value of P<sub>tot</sub> derates linearly with 8 mW/K.

## 8 Recommended operating conditions

**Table 5. Recommended operating conditions**

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

| Symbol    | Parameter           | Conditions | Min | Typ | Max      | Unit |
|-----------|---------------------|------------|-----|-----|----------|------|
| $V_{CC}$  | supply voltage      |            | 2.0 | 5.0 | 6.0      | V    |
| $V_I$     | input voltage       |            | 0   | -   | $V_{CC}$ | V    |
| $V_O$     | output voltage      |            | 0   | -   | $V_{CC}$ | V    |
| $T_{amb}$ | ambient temperature |            | -40 | +25 | +125     | °C   |

## 9 Static characteristics

**Table 6. Static characteristics**

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

| Symbol   | Parameter                 | Conditions  | $T_{amb} = 25\text{ °C}$ |      |           | $T_{amb} = -40\text{ °C}$<br>to $+85\text{ °C}$ |           | $T_{amb} = -40\text{ °C}$<br>to $+125\text{ °C}$ |           | Unit          |
|----------|---------------------------|---|--------------------------|------|-----------|---|-----------|--|-----------|---------------|
|          |                           |   | Min                      | Typ  | Max       | Min   | Max       | Min  | Max       |               |
| $V_{OH}$ | HIGH-level output voltage | $V_I = V_{T+}$ or $V_{T-}$  |                          |      |           |   |           |  |           |               |
|          |                           | $I_O = -20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$            | 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             |
|          |                           | $I_O = -5.2\text{ mA}$ ; $V_{CC} = 6.0\text{ V}$                    | 5.48                     | 5.81 | -         | 5.34  | -         | 5.2  | -         | V             |
| $V_{OL}$ | LOW-level output voltage  | $V_I = V_{T+}$ or $V_{T-}$  |                          |      |           |   |           |  |           |               |
|          |                           | $I_O = 20\text{ }\mu\text{A}$ ; $V_{CC} = 2.0\text{ V}$             | -                        | 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             |
|          |                           | $I_O = 5.2\text{ mA}$ ; $V_{CC} = 6.0\text{ V}$                     | -                        | 0.16 | 0.26      | -   | 0.33      | -  | 0.4       | V             |
| $I_I$    | input leakage current     | $V_I = V_{CC}$ or GND; $V_{CC} = 6.0\text{ V}$                      | -                        | -    | $\pm 0.1$ | -   | $\pm 1.0$ | -  | $\pm 1.0$ | $\mu\text{A}$ |
| $I_{CC}$ | supply current            | $V_I = V_{CC}$ or GND; $I_O = 0\text{ A}$ ; $V_{CC} = 6.0\text{ V}$ | -                        | -    | 8.0       | -   | 80        | -  | 160       | $\mu\text{A}$ |
| $C_I$    | input capacitance         |   | -                        | 3.5  | -         | -   | -         | -  | -         | pF            |

## 10 Dynamic characteristics

**Table 7. Dynamic characteristics**

GND = 0 V; C<sub>L</sub> = 50 pF; for test circuit see [Figure 5](#).

| Symbol           | Parameter                          | Conditions   | T <sub>amb</sub> = 25 °C |     |     | T <sub>amb</sub> = -40 °C to +85 °C |     | T <sub>amb</sub> = -40 °C to +125 °C |     | Unit |
|------------------|------------------------------------|--|--------------------------|-----|-----|-------------------------------------|-----|--------------------------------------|-----|------|
|                  |                                    |  | Min                      | Typ | Max | Min                                 | Max | Min                                  | Max |      |
| t <sub>pd</sub>  | propagation delay                  | An to Yn; see <a href="#">Figure 4</a> <sup>[1]</sup>              |                          |     |     |                                     |     |                                      |     |      |
|                  |                                    | V <sub>CC</sub> = 2.0 V  | -                        | 36  | 115 | -                                   | 140 | -                                    | 165 | ns   |
|                  |                                    | V <sub>CC</sub> = 4.5 V  | -                        | 13  | 22  | -                                   | 28  | -                                    | 33  | ns   |
|                  |                                    | V <sub>CC</sub> = 5.0 V; C <sub>L</sub> = 15 pF                    | -                        | 12  | -   | -                                   | -   | -                                    | -   | ns   |
|                  |                                    | V <sub>CC</sub> = 6.0 V  | -                        | 10  | 19  | -                                   | 24  | -                                    | 28  | ns   |
| t <sub>THL</sub> | HIGH to LOW output transition time | Yn; see <a href="#">Figure 4</a>                                   |                          |     |     |                                     |     |                                      |     |      |
|                  |                                    | V <sub>CC</sub> = 2.0 V  | -                        | 19  | 75  | -                                   | 95  | -                                    | 110 | ns   |
|                  |                                    | V <sub>CC</sub> = 4.5 V  | -                        | 7   | 15  | -                                   | 19  | -                                    | 22  | ns   |
|                  |                                    | V <sub>CC</sub> = 6.0 V  | -                        | 6   | 13  | -                                   | 16  | -                                    | 19  | ns   |
| C <sub>PD</sub>  | power dissipation capacitance      | per buffer; V <sub>I</sub> = GND to V <sub>CC</sub> <sup>[2]</sup> | -                        | 5   | -   | -                                   | -   | -                                    | -   | pF   |

[1] t<sub>pd</sub> is the same as t<sub>PLZ</sub> and t<sub>PZL</sub>.

[2] C<sub>PD</sub> is used to determine the dynamic power dissipation (P<sub>D</sub> in μW):

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

f<sub>i</sub> = input frequency in MHz;

f<sub>o</sub> = output frequency in MHz;

C<sub>L</sub> = output load capacitance in pF;

V<sub>CC</sub> = supply voltage in V;

N = number of inputs switching;

∑ (C<sub>L</sub> × V<sub>CC</sub><sup>2</sup> × f<sub>o</sub>) = sum of outputs.

### 10.1 Waveforms and test circuit

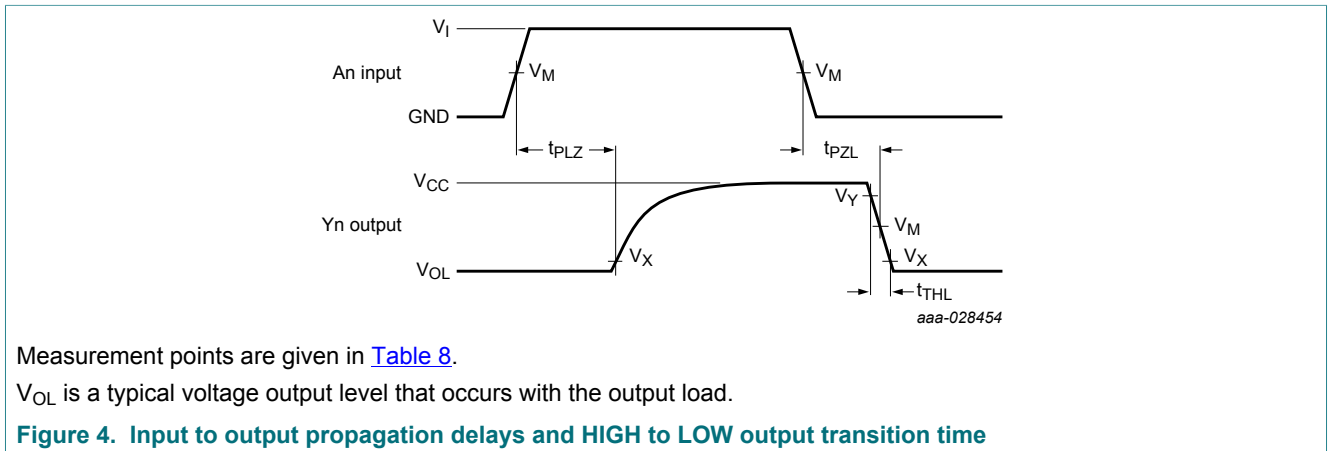


Table 8. Measurement points

| Input       | Output      |             |             |
|-------------|-------------|-------------|-------------|
| $V_M$       | $V_M$       | $V_X$       | $V_Y$       |
| $0.5V_{CC}$ | $0.5V_{CC}$ | $0.1V_{CC}$ | $0.9V_{CC}$ |

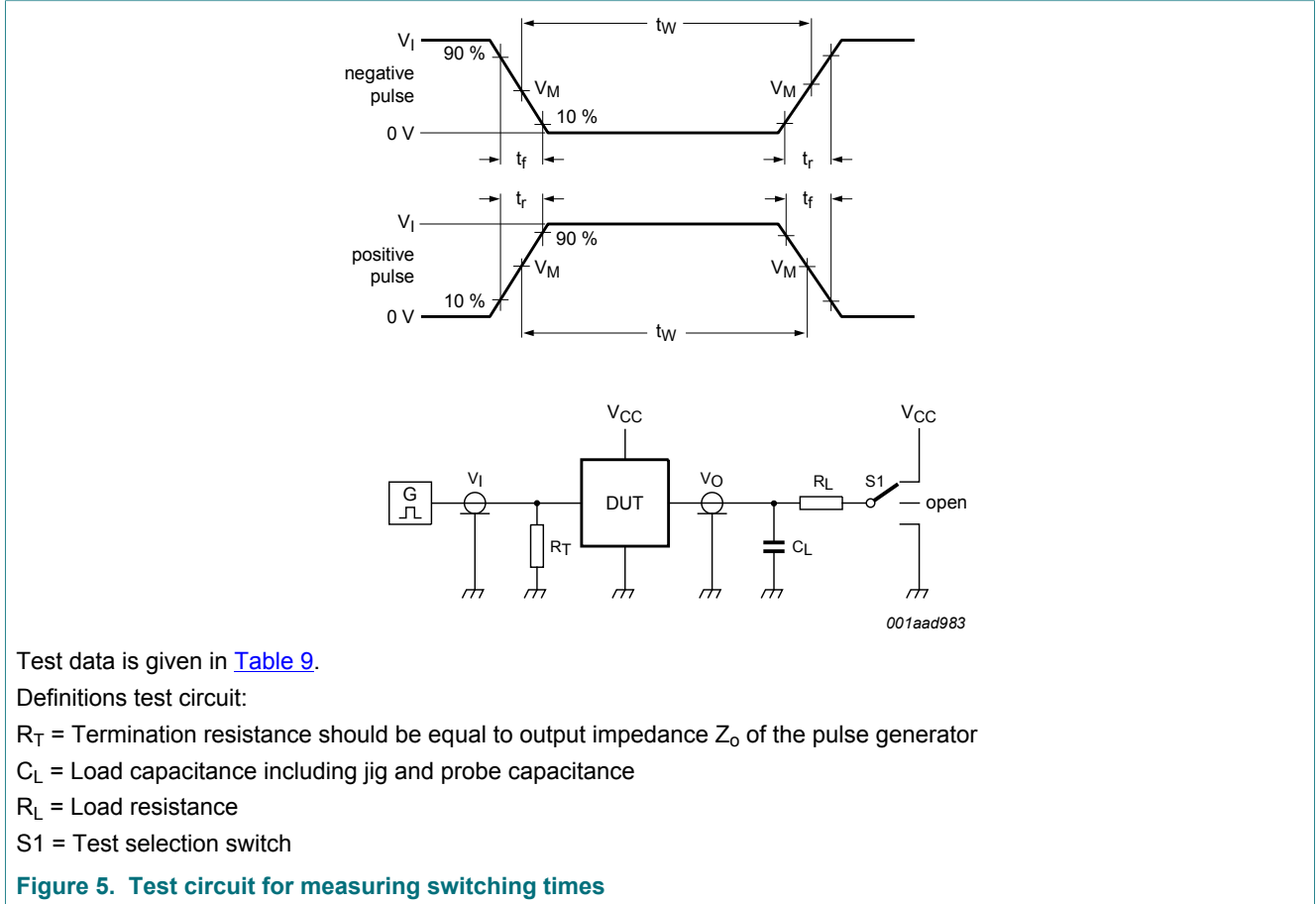


Table 9. Test data

| Input    |            | Load         |       | S1 position        |
|----------|------------|--------------|-------|--------------------|
| $V_I$    | $t_r, t_f$ | $C_L$        | $R_L$ | $t_{pZL}, t_{PLZ}$ |
| $V_{CC}$ | 6 ns       | 15 pF, 50 pF | 1 kΩ  | $V_{CC}$           |

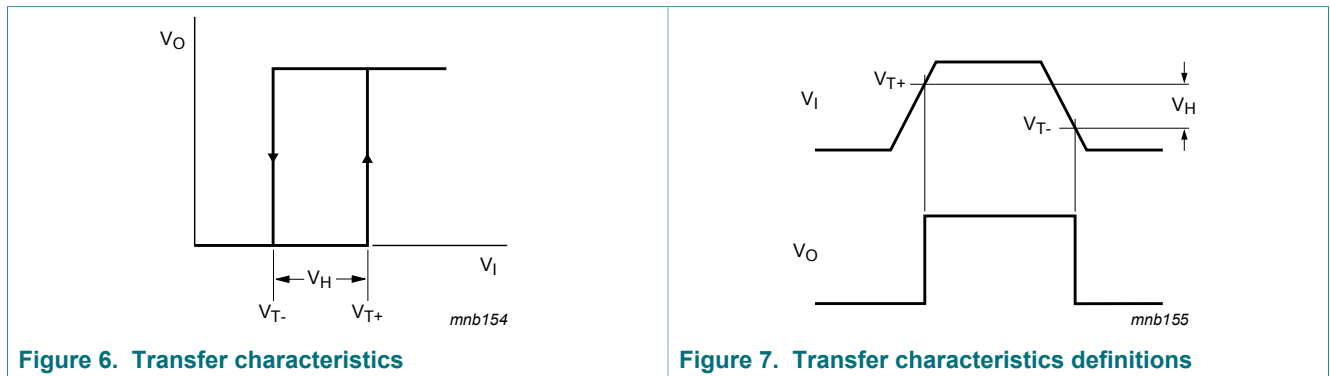
### 10.2 Transfer characteristics

**Table 10. Transfer characteristics**

At recommended operating conditions; voltages are referenced to GND (ground = 0 V); see [Figure 6](#) and [Figure 7](#).

| Symbol          | Parameter                        | Conditions              | T <sub>amb</sub> = 25 °C |      |      | T <sub>amb</sub> = -40 °C to +85 °C |      | T <sub>amb</sub> = -40 °C to +125 °C |      | Unit |
|-----------------|----------------------------------|-------------------------|--------------------------|------|------|-------------------------------------|------|--------------------------------------|------|------|
|                 |                                  |                         | Min                      | Typ  | Max  | Min                                 | Max  | Min                                  | Max  |      |
| V <sub>T+</sub> | positive-going threshold voltage | V <sub>CC</sub> = 2.0 V | 0.70                     | 1.13 | 1.50 | 0.70                                | 1.50 | 0.70                                 | 1.50 | V    |
|                 |                                  | V <sub>CC</sub> = 4.5 V | 1.75                     | 2.37 | 3.15 | 1.75                                | 3.15 | 1.75                                 | 3.15 | V    |
|                 |                                  | V <sub>CC</sub> = 6.0 V | 2.30                     | 3.11 | 4.20 | 2.30                                | 4.20 | 2.30                                 | 4.20 | V    |
| V <sub>T-</sub> | negative-going threshold voltage | V <sub>CC</sub> = 2.0 V | 0.30                     | 0.70 | 1.10 | 0.30                                | 1.10 | 0.30                                 | 1.10 | V    |
|                 |                                  | V <sub>CC</sub> = 4.5 V | 1.35                     | 1.80 | 2.40 | 1.35                                | 2.40 | 1.35                                 | 2.40 | V    |
|                 |                                  | V <sub>CC</sub> = 6.0 V | 1.8                      | 2.43 | 3.30 | 1.80                                | 3.30 | 1.80                                 | 3.30 | V    |
| V <sub>H</sub>  | hysteresis voltage               | V <sub>CC</sub> = 2.0 V | 0.2                      | 0.43 | 0.80 | 0.18                                | 0.80 | 0.15                                 | 0.80 | V    |
|                 |                                  | V <sub>CC</sub> = 4.5 V | 0.4                      | 0.57 | 1.00 | 0.40                                | 1.00 | 0.40                                 | 1.00 | V    |
|                 |                                  | V <sub>CC</sub> = 6.0 V | 0.5                      | 0.68 | 1.10 | 0.50                                | 1.10 | 0.50                                 | 1.10 | V    |

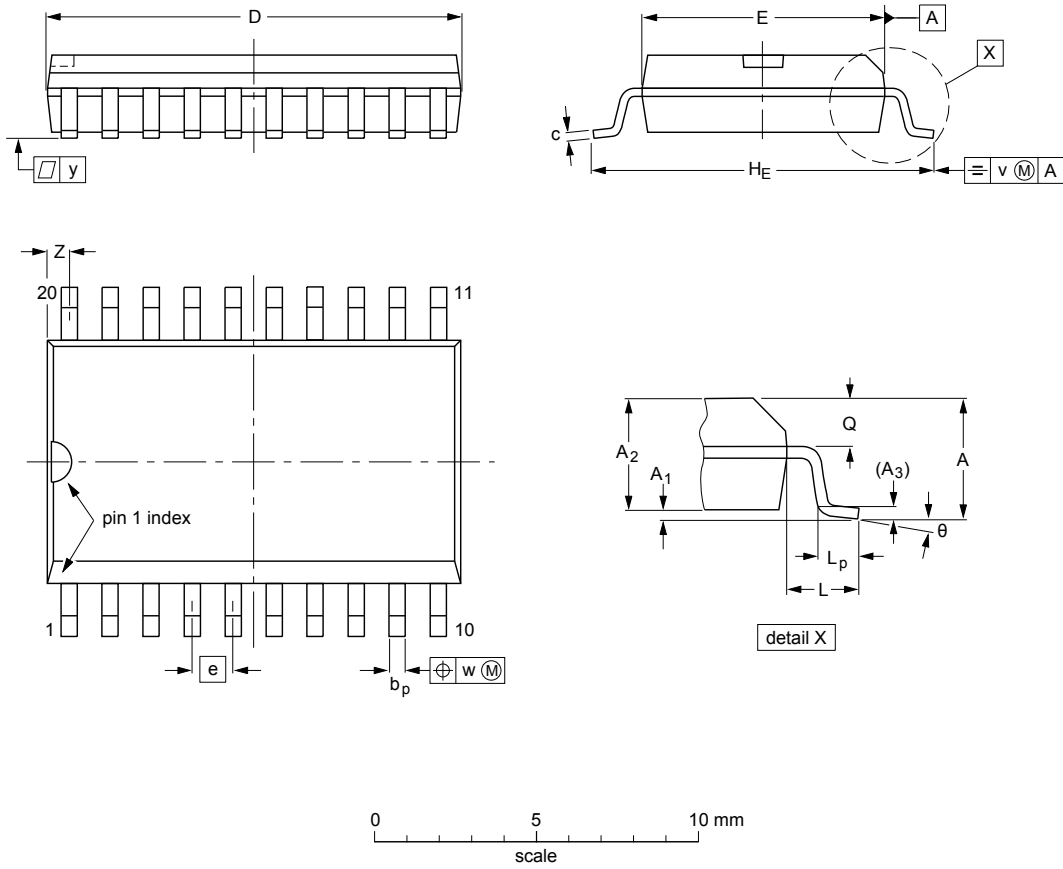
### 10.3 Transfer characteristics waveforms



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 <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c              | D <sup>(1)</sup> | E <sup>(1)</sup> | e    | H <sub>E</sub> | L     | L <sub>p</sub> | Q              | v    | w    | y     | Z <sup>(1)</sup> | θ        |
|--------|--------|----------------|----------------|----------------|----------------|----------------|------------------|------------------|------|----------------|-------|----------------|----------------|------|------|-------|------------------|----------|
| mm     | 2.65   | 0.3<br>0.1     | 2.45<br>2.25   | 0.25           | 0.49<br>0.36   | 0.32<br>0.23   | 13.0<br>12.6     | 7.6<br>7.4       | 1.27 | 10.65<br>10.00 | 1.4   | 1.1<br>0.4     | 1.1<br>1.0     | 0.25 | 0.25 | 0.1   | 0.9<br>0.4       | 8°<br>0° |
| inches | 0.1    | 0.012<br>0.004 | 0.096<br>0.089 | 0.01           | 0.019<br>0.014 | 0.013<br>0.009 | 0.51<br>0.49     | 0.30<br>0.29     | 0.05 | 0.419<br>0.394 | 0.055 | 0.043<br>0.016 | 0.043<br>0.039 | 0.01 | 0.01 | 0.004 | 0.035<br>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<br>03-02-19 |

Figure 8. Package outline SOT163-1 (SO20)



## 12 Abbreviations

Table 11. Abbreviations

| Acronym | Description                             |
|---------|---|
| CMOS    | Complementary Metal-Oxide Semiconductor |
| DUT     | Device Under Test                       |
| ESD     | ElectroStatic Discharge                 |
| HBM     | Human Body Model                        |
| MM      | Machine Model                           |

## 13 Revision history

Table 12. Revision history

| Document ID      | Release date  | Data sheet status     | Change notice | Supersedes       |
|------------------|---|-----------------------|---------------|------------------|
| 74HC9115 v.3     | 20180410  | Product data sheet    | -             | 74HC_HCT9115 v.2 |
| Modifications:   | <ul style="list-style-type: none"> <li>Type numbers 74HC9115N, 74HCT9115N and 74HCT9115D have been removed from this datasheet.</li> <li>The format of this data sheet has been redesigned to comply with the identity guidelines of Nexperia.</li> <li>Legal texts have been adapted to the new company name where appropriate.</li> </ul> |                       |               |                  |
| 74HC_HCT9115 v.2 | 19901201  | Product specification | -             | 74HC_HCT9115 v.1 |
| 74HC_HCT9115 v.1 | 19880301  | Product specification | -             | -                |

## 14 Legal information

### 14.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | 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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