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Single Schmitt trigger buffer

Rev. 1 — 8 March 2016

Product data sheet

1. General description

The 74AHC1G17-Q100 and 74AHCT1G17-Q100 are single buffers with Schmitt-trigger inputs. Inputs are overvoltage tolerant. This feature allows the use of these devices as translators in mixed voltage environments.

The AHC device has CMOS input switching levels and supply voltage range 2 V to 5.5 V.

The AHCT device has TTL input switching levels and supply voltage range 4.5 V to 5.5 V.

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 °C to +85 °C and from -40 °C to +125 °C
- Symmetrical output impedance
- High noise immunity
- ESD protection:
 - MIL-STD-883, method 3015 exceeds 2000 V
 - HBM JESD22-A114F exceeds 2000 V
 - MM JESD22-A115-A exceeds 200 V (C = 200 pF, R = 0 Ω)
- Low power dissipation
- Balanced propagation delays

3. Applications

- Wave and pulse shapers
- Astable multivibrators
- Monostable multivibrators



Single Schmitt trigger buffer

4. Ordering information

| Table 1. Ordering information | | | | | | | | | | |
|-------------------------------|-------------------|------|--|----------|--|--|--|--|--|--|
| Type number Package | | | | | | | | | | |
| | Temperature range | Name | Description | Version | | | | | | |
| 74AHC1G17GW-Q100 | –40 °C to +125 °C | | plastic thin shrink small outline package; | SOT353-1 | | | | | | |
| 74AHCT1G17GW-Q100 | | | 5 leads; body width 1.25 mm | | | | | | | |

5. Marking

Table 2.Marking codes

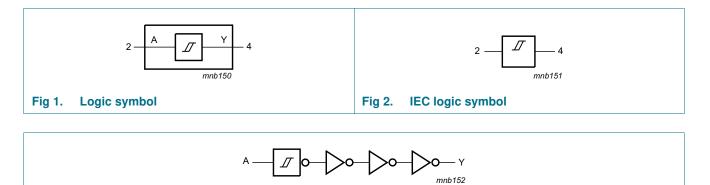
| Type number | Marking code ^[1] |
|-------------------|-----------------------------|
| 74AHC1G17GW-Q100 | AJ |
| 74AHCT1G17GW-Q100 | CJ |

[1] The pin 1 indicator is located on the lower left corner of the device, below the marking code.

6. Functional diagram

Logic diagram

Fig 3.

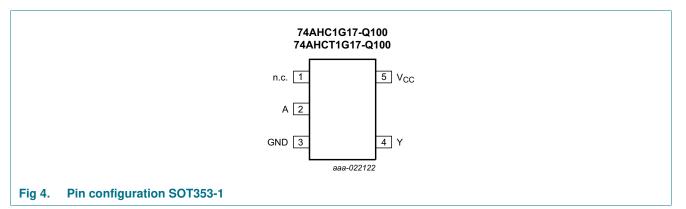


74AHC1G17-Q100; 74AHCT1G17-Q100

Single Schmitt trigger buffer

7. Pinning information

7.1 Pinning



7.2 Pin description

| Table 3. Pin description | | | | | | | | |
|--------------------------|-----|----------------|--|--|--|--|--|--|
| Symbol | Pin | Description | | | | | | |
| n.c. | 1 | not connected | | | | | | |
| A | 2 | data input | | | | | | |
| GND | 3 | ground (0 V) | | | | | | |
| Y | 4 | data output | | | | | | |
| V _{cc} | 5 | supply voltage | | | | | | |

8. Functional description

Table 4.Function table

H = HIGH voltage level; L = LOW voltage level

| Input | Output |
|-------|--------|
| Α | Y |
| L | L |
| Н | Н |

Single Schmitt trigger buffer

9. Limiting values

Table 5. Limiting values

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|------------------|-------------------------|---|-----|------|------|------|
| V _{CC} | supply voltage | | | -0.5 | +7.0 | V |
| VI | input voltage | | | -0.5 | +7.0 | V |
| I _{IK} | input clamping current | V _I < -0.5 V | | -20 | - | mA |
| I _{ОК} | output clamping current | $V_O < -0.5 \ V$ or $V_O > V_{CC}$ + 0.5 V | [1] | - | ±20 | mA |
| lo | output current | $-0.5 \text{ V} < \text{V}_{\text{O}} < \text{V}_{\text{CC}} + 0.5 \text{ V}$ | | - | ±25 | mA |
| I _{CC} | supply current | | | - | 75 | mA |
| I _{GND} | ground current | | | -75 | - | mA |
| T _{stg} | storage temperature | | | -65 | +150 | °C |
| P _{tot} | total power dissipation | $T_{amb} = -40 \ ^{\circ}C \ to +125 \ ^{\circ}C$ | [2] | - | 250 | mW |

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

[2] For TSSOP5 package: above 87.5 °C the value of P_{tot} derates linearly with 4.0 mW/K.

10. Recommended operating conditions

Table 6. Recommended operating conditions

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

| Symbol Parameter | | Conditions | 74AHC1G17-Q100 | | | 74AHCT1G17-Q100 | | | Unit |
|------------------|---------------------|------------|----------------|-----|-----------------|-----------------|-----|-----------------|------|
| | | | Min | Тур | Max | Min | Тур | Max | |
| V _{CC} | supply voltage | | 2.0 | 5.0 | 5.5 | 4.5 | 5.0 | 5.5 | V |
| VI | input voltage | | 0 | - | 5.5 | 0 | - | 5.5 | V |
| Vo | output voltage | | 0 | - | V _{CC} | 0 | - | V _{CC} | V |
| T _{amb} | ambient temperature | | -40 | +25 | +125 | -40 | +25 | +125 | °C |

Single Schmitt trigger buffer

11. Static characteristics

Table 7.Static characteristics

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

| Symbol | Parameter | Conditions | | 25 °C | | –40 °C | to +85 °C | –40 °C t | o +125 °C | Unit |
|------------------|---------------------------|--|------|-------|------|--------|-----------|----------|-----------|------|
| | | | Min | Тур | Max | Min | Max | Min | Max | |
| 74AHC1 | G17-Q100 | | | | | 1 | 1 | 1 | I | |
| | | $V_{I} = V_{T+} \text{ or } V_{T-}$ | | | | | | | | |
| | output voltage | $I_{O} = -50 \ \mu A; V_{CC} = 2.0 \ V$ | 1.9 | 2.0 | - | 1.9 | - | 1.9 | - | V |
| | | $I_{O} = -50 \ \mu A; V_{CC} = 3.0 \ V$ | 2.9 | 3.0 | - | 2.9 | - | 2.9 | - | V |
| | | $I_{O} = -50 \ \mu A; V_{CC} = 4.5 \ V$ | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | $I_{O} = -4.0 \text{ mA}; V_{CC} = 3.0 \text{ V}$ | 2.58 | - | - | 2.48 | - | 2.40 | - | V |
| | | $I_{O} = -8.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$ | 3.94 | - | - | 3.8 | - | 3.70 | - | V |
| V _{OL} | LOW-level | $V_{I} = V_{T+} \text{ or } V_{T-}$ | | | | | | | | |
| | output voltage | $I_{O} = 50 \ \mu A; V_{CC} = 2.0 \ V$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_{O} = 50 \ \mu A; V_{CC} = 3.0 \ V$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_{O} = 50 \ \mu A; V_{CC} = 4.5 \ V$ | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | $I_{O} = 4.0 \text{ mA}; V_{CC} = 3.0 \text{ V}$ | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| | | $I_{O} = 8.0 \text{ mA}; V_{CC} = 4.5 \text{ V}$ | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| lı | input leakage current | V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | μA |
| I _{CC} | supply current | | - | - | 1.0 | - | 10 | - | 40 | μA |
| Cı | input capacitance | | - | 1.5 | 10 | - | 10 | - | 10 | pF |
| 74AHCT | 1G17-Q100 | 1 | | | | | | | 1 | |
| V _{OH} | HIGH-level | $V_{I} = V_{T+}$ or V_{T-} ; $V_{CC} = 4.5 V$ | | | | | | | | |
| | output voltage | I _O = -50 μA | 4.4 | 4.5 | - | 4.4 | - | 4.4 | - | V |
| | | I _O = -8.0 mA | 3.94 | - | - | 3.8 | - | 3.70 | - | V |
| V _{OL} | LOW-level | $V_{I} = V_{T+}$ or V_{T-} ; $V_{CC} = 4.5 V$ | | | | | | | | |
| | output voltage | l _O = 50 μA | - | 0 | 0.1 | - | 0.1 | - | 0.1 | V |
| | | l _O = 8.0 mA | - | - | 0.36 | - | 0.44 | - | 0.55 | V |
| l _l | input leakage current | V _I = 5.5 V or GND; V _{CC} = 0 V to 5.5 V | - | - | 0.1 | - | 1.0 | - | 2.0 | μA |
| I _{CC} | supply current | $V_I = V_{CC}$ or GND; $I_O = 0$ A; $V_{CC} = 5.5$ V | - | - | 1.0 | - | 10 | - | 40 | μA |
| ΔI _{CC} | additional supply current | per input pin; V _I = 3.4 V; other inputs at V _{CC} or GND; $I_O = 0 A$; V _{CC} = 5.5 V | - | - | 1.35 | - | 1.5 | - | 1.5 | mA |
| Cı | input capacitance | | - | 1.5 | 10 | - | 10 | - | 10 | pF |

74AHC_AHCT1G17_Q100

Single Schmitt trigger buffer

11.1 Transfer characteristics

Table 8.Transfer characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V). See Figure 7 and Figure 8.

| Symbol | Parameter | Conditions | | 25 °C | | –40 °C | to +85 °C | –40 °C t | o +125 °C | Unit |
|-------------------|---------------------------|-------------------------|------|-------|------|--------|-----------|----------|-----------|------|
| | | Min | Тур | Max | Min | Max | Min | Max | 1 | |
| 74AHC1 | G17-Q100 | | | | | | | | | _ |
| V_{T+} | positive-going | V _{CC} = 3.0 V | - | - | 2.2 | - | 2.2 | - | 2.2 | V |
| | threshold voltage | $V_{CC} = 4.5 V$ | - | - | 3.15 | - | 3.15 | - | 3.15 | V |
| | voltage | V _{CC} = 5.5 V | - | - | 3.85 | - | 3.85 | - | 3.85 | V |
| V_{T-} | negative-going | V _{CC} = 3.0 V | 0.9 | - | - | 0.9 | - | 0.9 | - | V |
| | threshold | $V_{CC} = 4.5 V$ | 1.35 | - | - | 1.35 | - | 1.35 | - | V |
| | voltage | V _{CC} = 5.5 V | 1.65 | - | - | 1.65 | - | 1.65 | - | V |
| V _H | V _H hysteresis | $V_{CC} = 3.0 V$ | 0.3 | - | 1.2 | 0.3 | 1.2 | 0.25 | 1.2 | V |
| | voltage | $V_{CC} = 4.5 V$ | 0.4 | - | 1.4 | 0.4 | 1.4 | 0.35 | 1.4 | V |
| | | V _{CC} = 5.5 V | 0.5 | - | 1.6 | 0.5 | 1.6 | 0.45 | 1.6 | V |
| 74AHCT | 1G17-Q100 | | | | | | | | | |
| V_{T+} | positive-going | $V_{CC} = 4.5 V$ | - | - | 2.0 | - | 2.0 | - | 2.0 | V |
| | threshold voltage | V _{CC} = 5.5 V | - | - | 2.0 | - | 2.0 | - | 2.0 | V |
| V _{T-} | negative-going | $V_{CC} = 4.5 V$ | 0.5 | - | - | 0.5 | - | 0.5 | - | V |
| threshold voltage | V _{CC} = 5.5 V | 0.6 | - | - | 0.6 | - | 0.6 | - | V | |
| V _H | hysteresis | $V_{CC} = 4.5 V$ | 0.4 | - | 1.4 | 0.4 | 1.4 | 0.35 | 1.4 | V |
| | voltage | V _{CC} = 5.5 V | 0.4 | - | 1.6 | 0.4 | 1.6 | 0.35 | 1.6 | V |

Single Schmitt trigger buffer

12. Dynamic characteristics

Table 9. Dynamic characteristics

GND = 0 V; $t_r = t_f \le 3.0 \text{ ns. For waveform, see <u>Figure 5</u>. For test circuit, see <u>Figure 6</u>.$

| Symbol | Parameter | Conditions | | | 25 °C | | –40 °C | to +85 °C | –40 °C t | o +125 °C | Unit |
|-----------------|-------------------------------------|---|---------------|-----|-------|------|--------|-----------|----------|-----------|------|
| | | | | Min | Тур | Max | Min | Max | Min | Max | - |
| 74AHC1 | G17-Q100 | | | 1 | 1 | 1 | | | | | - |
| | propagation | A to Y; | [1] | | | | | | | | |
| | delay | $V_{CC} = 3.0 \text{ V} \text{ to } 3.6 \text{ V}$ | [2] | | | | | | | | |
| | | C _L = 15 pF | | - | 4.2 | 12.8 | 1.0 | 15.0 | 1.0 | 16.5 | ns |
| | | C _L = 50 pF | | - | 6.0 | 16.3 | 1.0 | 18.5 | 1.0 | 20.5 | ns |
| | | V_{CC} = 4.5 V to 5.5 V | [3] | | | | | | | | |
| | C _L = 15 pF | | - | 3.2 | 8.6 | 1.0 | 10.0 | 1.0 | 11.0 | ns | |
| | | C _L = 50 pF | | - | 4.6 | 10.6 | 1.0 | 12.0 | 1.0 | 13.5 | ns |
| C _{PD} | power dissipation capacitance | per buffer; $C_L = 50 \text{ pF}; f = 1 \text{ MHz};$ $V_I = \text{GND to } V_{CC}$ | [4] | - | 12 | - | - | - | - | - | pF |
| 74AHCT | 1G17-Q100 | | | | 1 | 1 | | | | | + |
| t _{pd} | propagation delay | A to Y; V _{CC} = 4.5 V to 5.5 V | <u>[1][3]</u> | | | | | | | | |
| | | C _L = 15 pF | | - | 4.1 | 7.0 | 1.0 | 8.0 | 1.0 | 9.0 | ns |
| | | C _L = 50 pF | | - | 5.9 | 8.5 | 1.0 | 10.0 | 1.0 | 11.0 | ns |
| C _{PD} | power dissipation capacitance | per buffer; $V_I = GND$ to V_{CC} | [4] | - | 13 | - | - | - | - | - | pF |

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

[2] Typical values are measured at V_{CC} = 3.3 V.

[3] Typical values are measured at $V_{CC} = 5.0$ V.

[4] C_{PD} is used to determine the dynamic power dissipation P_D (μW).

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

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13. Waveforms

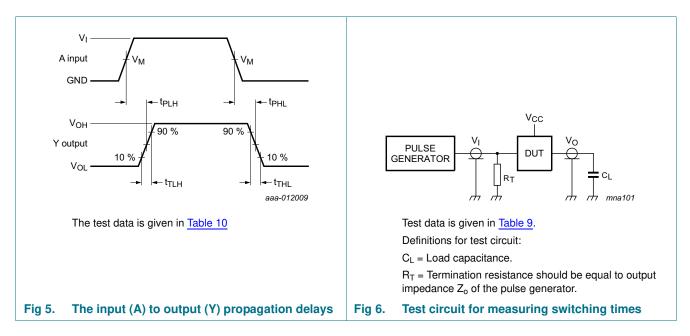
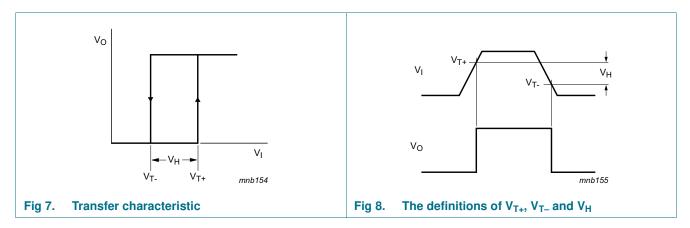


Table 10. Test data

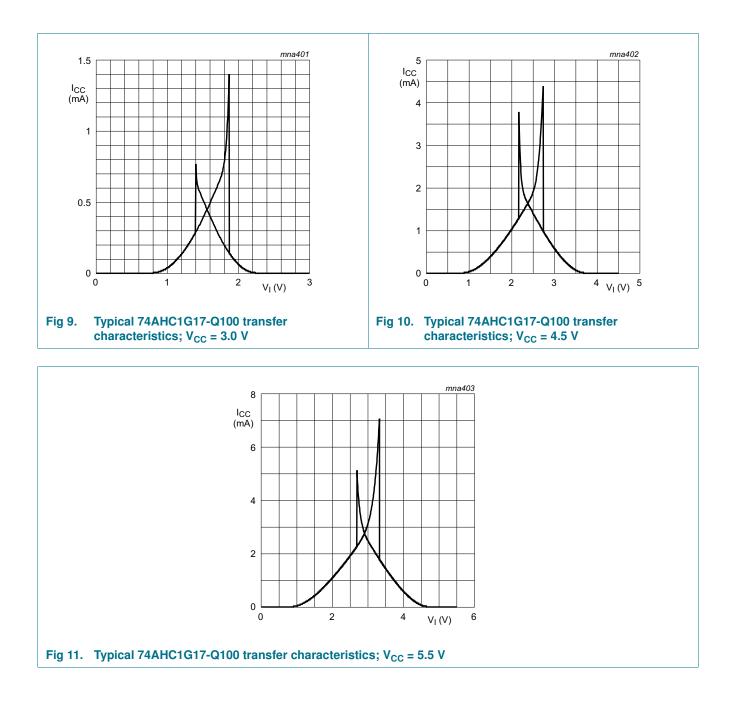
| Type number | Input | Output | |
|-----------------|-------------------------------|--------------------|--------------------|
| | V _I V _M | | V _M |
| 74AHC1G17-Q100 | GND to V _{CC} | $0.5 	imes V_{CC}$ | $0.5 	imes V_{CC}$ |
| 74AHCT1G17-Q100 | GND to 3.0 V | 1.5 V | $0.5 	imes V_{CC}$ |

13.1 Transfer characteristic waveforms



74AHC1G17-Q100; 74AHCT1G17-Q100

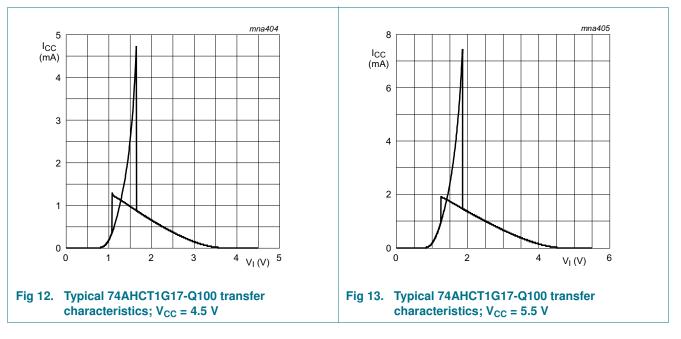
Single Schmitt trigger buffer



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14. Application information

The slow input rise and fall times cause additional power dissipation, which can be calculated using the following formula:

 $P_{add} = f_i \times (t_r \times \Delta I_{CC(AV)} + t_f \times \Delta I_{CC(AV)}) \times V_{CC}$ where:

 P_{add} = additional power dissipation (μ W);

 $f_i = input frequency (MHz);$

 t_r = input rise time (ns); 10 % to 90 %;

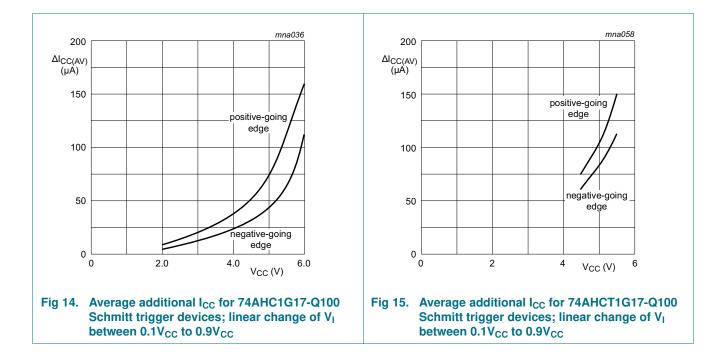
 t_f = input fall time (ns); 90 % to 10 %;

 $\Delta I_{CC(AV)}$ = average additional supply current (µA).

Average additional I_{CC} differs with positive or negative input transitions, as shown in Figure 14 and Figure 15.

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Single Schmitt trigger buffer

15. Package outline

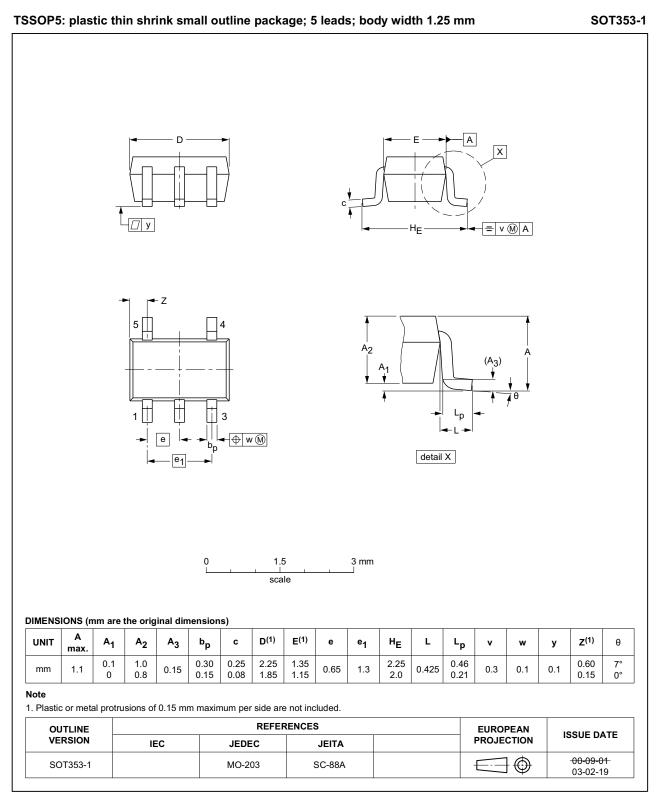


Fig 16. Package outline SOT353-1 (TSSOP5)

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16. Abbreviations

| Table 11. Abbr | Table 11. Abbreviations | | | | | | |
|----------------|---|--|--|--|--|--|--|
| Acronym | Description | | | | | | |
| CDM | Charged Device Model | | | | | | |
| CMOS | Complementary Metal-Oxide Semiconductor | | | | | | |
| DUT | Device Under Test | | | | | | |
| ESD | ElectroStatic Discharge | | | | | | |
| НВМ | Human Body Model | | | | | | |
| MM | Machine Model | | | | | | |
| TTL | Transistor-Transistor Logic | | | | | | |
| MIL | Military | | | | | | |

17. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|-------------------------|--------------|--------------------|---------------|------------|
| 74AHC_AHCT1G17_Q100 v.1 | 20160308 | 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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74AHC_AHCT1G17_Q100
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Single Schmitt trigger buffer

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