

74AUP1T08-Q100

Low-power 2-input AND gate with voltage-level translator

Rev. 2 — 25 January 2022

Product data sheet

1. General description

The 74AUP1T08-Q100 provides the single 2-input AND function. This device ensures a very low static and dynamic power consumption across the entire V_{CC} range from 2.3 V to 3.6 V.

The 74AUP1T08-Q100 is designed for logic-level translation applications with input switching levels that accept 1.8 V low-voltage CMOS signals, while operating from either a single 2.5 V or 3.3 V supply voltage.

The wide supply voltage range ensures normal operation as battery voltage drops from 3.6 V to 2.3 V.

This device is fully specified for partial power-down applications using I_{OFF} . The I_{OFF} circuitry disables the output, preventing the damaging backflow current through the device when it is powered down.

Schmitt trigger inputs make the circuit tolerant to slower input rise and fall times across the entire V_{CC} range.

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
- Wide supply voltage range from 2.3 V to 3.6 V
- High noise immunity
- ESD protection:
 - HBM JESD22-A114F Class 3A exceeds 5000 V
 - CDM JESD22-C101E exceeds 1000 V
- Low static power consumption; $I_{CC} = 1.5 \mu\text{A}$ (maximum)
- Latch-up performance exceeds 100 mA per JESD 78 Class II
- Inputs accept voltages up to 3.6 V
- Low noise overshoot and undershoot < 10 % of V_{CC}
- I_{OFF} circuitry provides partial power-down mode operation

3. Ordering information

Table 1. Ordering information

| Type number | Package | | | |
|------------------|-------------------|--------|--|----------|
| | Temperature range | Name | Description | Version |
| 74AUP1T08GW-Q100 | -40 °C to +125 °C | TSSOP5 | plastic thin shrink small outline package; 5 leads; body width 1.25 mm | SOT353-1 |

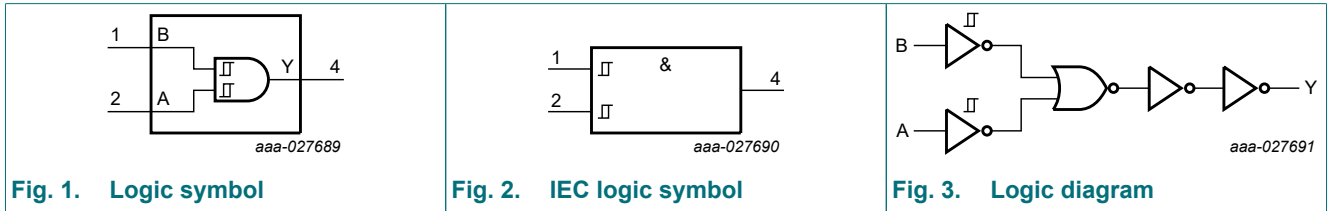
4. Marking

Table 2. Marking

| Type number | Marking code[1] |
|------------------|-----------------|
| 74AUP1T08GW-Q100 | 5J |

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

5. Functional diagram



6. Pinning information

6.1. Pinning

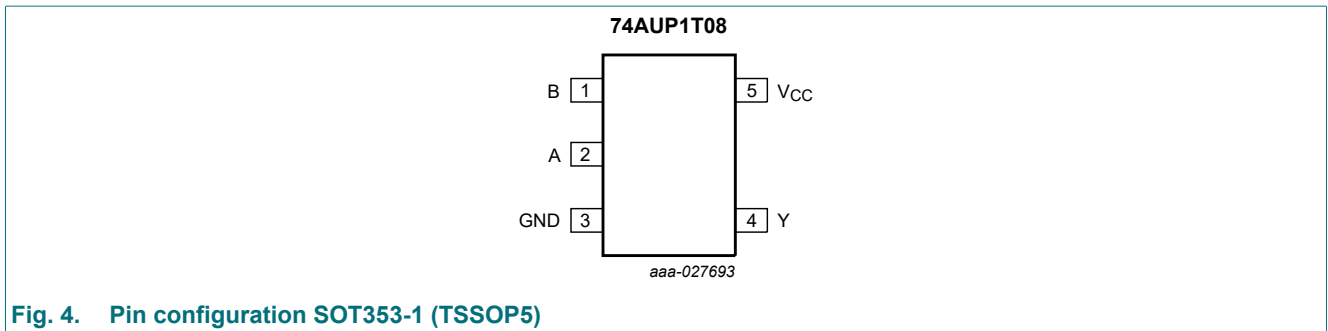


Fig. 4. Pin configuration SOT353-1 (TSSOP5)

6.2. Pin description

Table 3. Pin description

| Symbol | Pin | Description |
|-----------------|-----|----------------|
| B | 1 | data input |
| A | 2 | data input |
| GND | 3 | ground (0 V) |
| Y | 4 | data output |
| V _{CC} | 5 | supply voltage |

7. Functional description

Table 4. Function table

H = HIGH voltage level; L = LOW voltage level.

| Input | | Output |
|-------|---|--------|
| A | B | Y |
| L | L | L |
| L | H | L |
| H | L | L |
| H | H | H |

8. Limiting values

Table 5. 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_{CC} | supply voltage | | -0.5 | +4.6 | V |
| I_{IK} | input clamping current | $V_I < 0$ V | -50 | - | mA |
| V_I | input voltage | [1] | -0.5 | +4.6 | V |
| I_{OK} | output clamping current | $V_O < 0$ V | -50 | - | mA |
| V_O | output voltage | Active mode and Power-down mode [1] | -0.5 | +4.6 | V |
| I_O | output current | $V_O = 0$ V to V_{CC} | - | ± 20 | mA |
| I_{CC} | supply current | | - | 50 | mA |
| I_{GND} | ground current | | -50 | - | mA |
| T_{stg} | storage temperature | | -65 | +150 | °C |
| P_{tot} | total power dissipation | $T_{amb} = -40$ °C to +125 °C [2] | - | 250 | mW |

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

[2] For SOT353-1 (TSSOP5) package: P_{tot} derates linearly with 3.3 mW/K above 74 °C.

9. Recommended operating conditions

Table 6. Recommended operating conditions

| Symbol | Parameter | Conditions | Min | Max | Unit |
|-----------|---------------------|---------------------------------|-----|----------|------|
| V_{CC} | supply voltage | | 2.3 | 3.6 | V |
| V_I | input voltage | | 0 | 3.6 | V |
| V_O | output voltage | Active mode | 0 | V_{CC} | V |
| | | Power-down mode; $V_{CC} = 0$ V | 0 | 3.6 | V |
| T_{amb} | ambient temperature | | -40 | +125 | °C |

10. Static characteristics

Table 7. Static characteristics

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

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------------------|--------------------------------------|--|-----------------------|-----|------|------|
| T_{amb} = 25 °C | | | | | | |
| V _{T+} | positive-going threshold voltage | V _{CC} = 2.3 V to 2.7 V | 0.60 | - | 1.10 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.75 | - | 1.16 | V |
| V _{T-} | negative-going threshold voltage | V _{CC} = 2.3 V to 2.7 V | 0.35 | - | 0.60 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.50 | - | 0.85 | V |
| V _H | hysteresis voltage | (V _H = V _{T+} - V _{T-}) | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | 0.23 | - | 0.60 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.25 | - | 0.56 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{T+} or V _{T-} | | | | |
| | | I _O = -20 μA; V _{CC} = 2.3 V to 3.6 V | V _{CC} - 0.1 | - | - | V |
| | | I _O = -2.3 mA; V _{CC} = 2.3 V | 2.05 | - | - | V |
| | | I _O = -3.1 mA; V _{CC} = 2.3 V | 1.9 | - | - | V |
| | | I _O = -2.7 mA; V _{CC} = 3.0 V | 2.72 | - | - | V |
| | | I _O = -4.0 mA; V _{CC} = 3.0 V | 2.6 | - | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | |
| | | I _O = 20 μA; V _{CC} = 2.3 V to 3.6 V | - | - | 0.10 | V |
| | | I _O = 2.3 mA; V _{CC} = 2.3 V | - | - | 0.31 | V |
| | | I _O = 3.1 mA; V _{CC} = 2.3 V | - | - | 0.44 | V |
| | | I _O = 2.7 mA; V _{CC} = 3.0 V | - | - | 0.31 | V |
| | | I _O = 4.0 mA; V _{CC} = 3.0 V | - | - | 0.44 | V |
| I _I | input leakage current | V _I = GND to 3.6 V; V _{CC} = 0 V to 3.6 V | - | - | ±0.1 | μA |
| I _{OFF} | power-off leakage current | V _I or V _O = 0 V to 3.6 V; V _{CC} = 0 V | - | - | ±0.1 | μA |
| ΔI _{OFF} | additional power-off leakage current | V _I or V _O = 0 V to 3.6 V; V _{CC} = 0 V to 0.2 V | - | - | ±0.1 | μA |
| I _{CC} | supply current | V _I = GND or V _{CC} ; I _O = 0 A; V _{CC} = 2.3 V to 3.6 V | - | - | 1.2 | μA |
| C _I | input capacitance | V _{CC} = 0 V to 3.6 V; V _I = GND or V _{CC} | - | 0.8 | - | pF |
| C _O | output capacitance | V _O = GND; V _{CC} = 0 V | - | 1.7 | - | pF |

Low-power 2-input AND gate with voltage-level translator

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|--------------------------------------|---|-----------------------|-----|------|------|
| T_{amb} = -40 °C to +85 °C | | | | | | |
| V _{T+} | positive-going threshold voltage | V _{CC} = 2.3 V to 2.7 V | 0.60 | - | 1.10 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.75 | - | 1.19 | V |
| V _{T-} | negative-going threshold voltage | V _{CC} = 2.3 V to 2.7 V | 0.35 | - | 0.60 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.50 | - | 0.85 | V |
| V _H | hysteresis voltage | (V _H = V _{T+} - V _{T-}) | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | 0.10 | - | 0.60 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.15 | - | 0.56 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{T+} or V _{T-} | | | | |
| | | I _O = -20 μA; V _{CC} = 2.3 V to 3.6 V | V _{CC} - 0.1 | - | - | V |
| | | I _O = -2.3 mA; V _{CC} = 2.3 V | 1.97 | - | - | V |
| | | I _O = -3.1 mA; V _{CC} = 2.3 V | 1.85 | - | - | V |
| | | I _O = -2.7 mA; V _{CC} = 3.0 V | 2.67 | - | - | V |
| | | I _O = -4.0 mA; V _{CC} = 3.0 V | 2.55 | - | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | |
| | | I _O = 20 μA; V _{CC} = 2.3 V to 3.6 V | - | - | 0.1 | V |
| | | I _O = 2.3 mA; V _{CC} = 2.3 V | - | - | 0.33 | V |
| | | I _O = 3.1 mA; V _{CC} = 2.3 V | - | - | 0.45 | V |
| | | I _O = 2.7 mA; V _{CC} = 3.0 V | - | - | 0.33 | V |
| | | I _O = 4.0 mA; V _{CC} = 3.0 V | - | - | 0.45 | V |
| I _I | input leakage current | V _I = GND to 3.6 V; V _{CC} = 0 V to 3.6 V | - | - | ±0.5 | μA |
| I _{OFF} | power-off leakage current | V _I or V _O = 0 V to 3.6 V; V _{CC} = 0 V | - | - | ±0.5 | μA |
| ΔI _{OFF} | additional power-off leakage current | V _I or V _O = 0 V to 3.6 V; V _{CC} = 0 V to 0.2 V | - | - | ±0.5 | μA |
| I _{CC} | supply current | V _I = GND or V _{CC} ; I _O = 0 A; V _{CC} = 2.3 V to 3.6 V | - | - | 1.5 | μA |
| ΔI _{CC} | additional supply current | V _{CC} = 2.3 V to 2.7 V; I _O = 0 A [1] | - | - | 0.6 | μA |
| | | V _{CC} = 3.0 V to 3.6 V; I _O = 0 A [2] | - | - | 10 | μA |

Low-power 2-input AND gate with voltage-level translator

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--|--------------------------------------|---|------------------------|-----|-------|------|
| T_{amb} = -40 °C to +125 °C | | | | | | |
| V _{T+} | positive-going threshold voltage | V _{CC} = 2.3 V to 2.7 V | 0.60 | - | 1.10 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.75 | - | 1.19 | V |
| V _{T-} | negative-going threshold voltage | V _{CC} = 2.3 V to 2.7 V | 0.33 | - | 0.64 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.46 | - | 0.85 | V |
| V _H | hysteresis voltage | (V _H = V _{T+} - V _{T-}) | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | 0.10 | - | 0.60 | V |
| | | V _{CC} = 3.0 V to 3.6 V | 0.15 | - | 0.56 | V |
| V _{OH} | HIGH-level output voltage | V _I = V _{T+} or V _{T-} | | | | |
| | | I _O = -20 µA; V _{CC} = 2.3 V to 3.6 V | V _{CC} - 0.11 | - | - | V |
| | | I _O = -2.3 mA; V _{CC} = 2.3 V | 1.77 | - | - | V |
| | | I _O = -3.1 mA; V _{CC} = 2.3 V | 1.67 | - | - | V |
| | | I _O = -2.7 mA; V _{CC} = 3.0 V | 2.40 | - | - | V |
| | | I _O = -4.0 mA; V _{CC} = 3.0 V | 2.30 | - | - | V |
| V _{OL} | LOW-level output voltage | V _I = V _{T+} or V _{T-} | | | | |
| | | I _O = 20 µA; V _{CC} = 2.3 V to 3.6 V | - | - | 0.11 | V |
| | | I _O = 2.3 mA; V _{CC} = 2.3 V | - | - | 0.36 | V |
| | | I _O = 3.1 mA; V _{CC} = 2.3 V | - | - | 0.50 | V |
| | | I _O = 2.7 mA; V _{CC} = 3.0 V | - | - | 0.36 | V |
| | | I _O = 4.0 mA; V _{CC} = 3.0 V | - | - | 0.50 | V |
| I _I | input leakage current | V _I = GND to 3.6 V; V _{CC} = 0 V to 3.6 V | - | - | ±0.75 | µA |
| I _{OFF} | power-off leakage current | V _I or V _O = 0 V to 3.6 V; V _{CC} = 0 V | - | - | ±0.75 | µA |
| ΔI _{OFF} | additional power-off leakage current | V _I or V _O = 0 V to 3.6 V; V _{CC} = 0 V to 0.2 V | - | - | ±0.75 | µA |
| I _{CC} | supply current | V _I = GND or V _{CC} ; I _O = 0 A; V _{CC} = 2.3 V to 3.6 V | - | - | 3.5 | µA |
| ΔI _{CC} | additional supply current | V _{CC} = 2.3 V to 2.7 V; I _O = 0 A [1] | - | - | 1.8 | µA |
| | | V _{CC} = 3.0 V to 3.6 V; I _O = 0 A [2] | - | - | 18 | µA |

[1] One input at 0.3 V or 1.1 V, other input at V_{CC} or GND.

[2] One input at 0.45 V or 1.2 V, other input at V_{CC} or GND.

11. Dynamic characteristics

Table 8. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); for test circuit see Fig. 6.

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|--|-------------------|---------------------------|-------|--------|-----|------------------|------|-------------------|------|------|
| | | | Min | Typ[1] | Max | Min | Max | Min | Max | |
| V_{CC} = 2.3 V to 2.7 V; V_I = 1.65 V to 1.95 V | | | | | | | | | | |
| t _{pd} | propagation delay | A, B to Y; see Fig. 5 [2] | | | | | | | | |
| | | C _L = 5 pF | 2.0 | 3.3 | 5.2 | 0.5 | 6.8 | 0.5 | 7.5 | ns |
| | | C _L = 10 pF | 2.3 | 3.9 | 6.0 | 1.0 | 7.9 | 1.0 | 8.7 | ns |
| | | C _L = 15 pF | 2.7 | 4.4 | 6.6 | 1.0 | 8.7 | 1.0 | 9.6 | ns |
| | | C _L = 30 pF | 3.5 | 5.5 | 8.1 | 1.5 | 10.8 | 1.5 | 11.9 | ns |
| V_{CC} = 2.3 V to 2.7 V; V_I = 2.3 V to 2.7 V | | | | | | | | | | |
| t _{pd} | propagation delay | A, B to Y; see Fig. 5 [2] | | | | | | | | |
| | | C _L = 5 pF | 1.6 | 3.2 | 5.2 | 0.5 | 6.0 | 0.5 | 6.6 | ns |
| | | C _L = 10 pF | 1.9 | 3.8 | 6.0 | 1.0 | 7.1 | 1.0 | 7.9 | ns |
| | | C _L = 15 pF | 2.3 | 4.2 | 6.6 | 1.0 | 7.9 | 1.0 | 8.7 | ns |
| | | C _L = 30 pF | 3.1 | 5.4 | 8.1 | 1.5 | 10.0 | 1.5 | 11.0 | ns |
| V_{CC} = 2.3 V to 2.7 V; V_I = 3.0 V to 3.6 V | | | | | | | | | | |
| t _{pd} | propagation delay | A, B to Y; see Fig. 5 [2] | | | | | | | | |
| | | C _L = 5 pF | 1.2 | 2.9 | 4.7 | 0.5 | 5.5 | 0.5 | 6.1 | ns |
| | | C _L = 10 pF | 1.6 | 3.5 | 5.4 | 1.0 | 6.5 | 1.0 | 7.2 | ns |
| | | C _L = 15 pF | 1.9 | 4.0 | 6.1 | 1.0 | 7.4 | 1.0 | 8.2 | ns |
| | | C _L = 30 pF | 2.7 | 5.1 | 7.5 | 1.5 | 9.5 | 1.5 | 10.5 | ns |
| V_{CC} = 3.0 V to 3.6 V; V_I = 1.65 V to 1.95 V | | | | | | | | | | |
| t _{pd} | propagation delay | A, B to Y; see Fig. 5 [2] | | | | | | | | |
| | | C _L = 5 pF | 1.8 | 2.7 | 3.8 | 0.5 | 8.0 | 0.5 | 8.8 | ns |
| | | C _L = 10 pF | 2.3 | 3.3 | 4.5 | 1.0 | 8.5 | 1.0 | 9.4 | ns |
| | | C _L = 15 pF | 2.6 | 3.8 | 5.0 | 1.0 | 9.1 | 1.0 | 10.1 | ns |
| | | C _L = 30 pF | 3.4 | 4.9 | 6.5 | 1.5 | 9.8 | 1.5 | 10.8 | ns |
| V_{CC} = 3.0 V to 3.6 V; V_I = 2.3 V to 2.7 V | | | | | | | | | | |
| t _{pd} | propagation delay | A, B to Y; see Fig. 5 [2] | | | | | | | | |
| | | C _L = 5 pF | 1.5 | 2.6 | 4.0 | 0.5 | 5.3 | 0.5 | 5.9 | ns |
| | | C _L = 10 pF | 1.9 | 3.2 | 4.8 | 1.0 | 6.1 | 1.0 | 6.8 | ns |
| | | C _L = 15 pF | 2.1 | 3.7 | 5.4 | 1.0 | 6.8 | 1.0 | 7.5 | ns |
| | | C _L = 30 pF | 2.9 | 4.8 | 6.9 | 1.5 | 8.5 | 1.5 | 9.4 | ns |
| V_{CC} = 3.0 V to 3.6 V; V_I = 3.0 V to 3.6 V | | | | | | | | | | |
| t _{pd} | propagation delay | A, B to Y; see Fig. 5 [2] | | | | | | | | |
| | | C _L = 5 pF | 1.1 | 2.6 | 4.1 | 0.5 | 4.7 | 0.5 | 5.2 | ns |
| | | C _L = 10 pF | 1.5 | 3.2 | 4.8 | 1.0 | 5.7 | 1.0 | 6.3 | ns |
| | | C _L = 15 pF | 1.8 | 3.6 | 5.5 | 1.0 | 6.2 | 1.0 | 6.9 | ns |
| | | C _L = 30 pF | 2.5 | 4.8 | 7.0 | 1.5 | 7.8 | 1.5 | 8.6 | ns |

Low-power 2-input AND gate with voltage-level translator

| Symbol | Parameter | Conditions | 25 °C | | | -40 °C to +85 °C | | -40 °C to +125 °C | | Unit |
|--------------------------------|-------------------------------|---|-------|--------|-----|------------------|-----|-------------------|-----|------|
| | | | Min | Typ[1] | Max | Min | Max | Min | Max | |
| T_{amb} = 25 °C | | | | | | | | | | |
| C _{PD} | power dissipation capacitance | f _i = 1 MHz; V _I = GND to V _{CC} [3] | | | | | | | | |
| | | V _{CC} = 2.3 V to 2.7 V | - | 4 | - | - | - | - | - | pF |
| | | V _{CC} = 3.0 V to 3.6 V | - | 5 | - | - | - | - | - | pF |

- [1] All typical values are measured at nominal V_{CC}.
- [2] t_{pd} is the same as t_{PLH} and t_{PHL}
- [3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW).
 $P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ 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 V;
 N = number of inputs switching;
 Σ(C_L × V_{CC}² × f_o) = sum of the outputs.

11.1. Waveform and test circuit

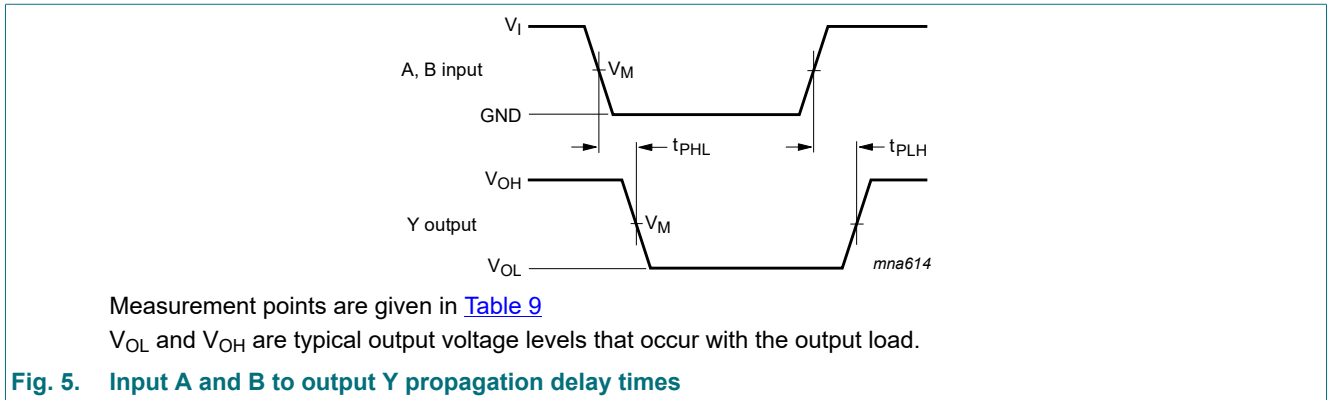


Table 9. Measurement points

| Supply voltage | Output | Input | | |
|-----------------|-----------------------|----------------------|-----------------|---------------------------------|
| V _{CC} | V _M | V _M | V _I | t _r = t _f |
| 2.3 V to 3.6 V | 0.5 × V _{CC} | 0.5 × V _I | 1.65 V to 3.6 V | ≤ 3.0 ns |

Low-power 2-input AND gate with voltage-level translator

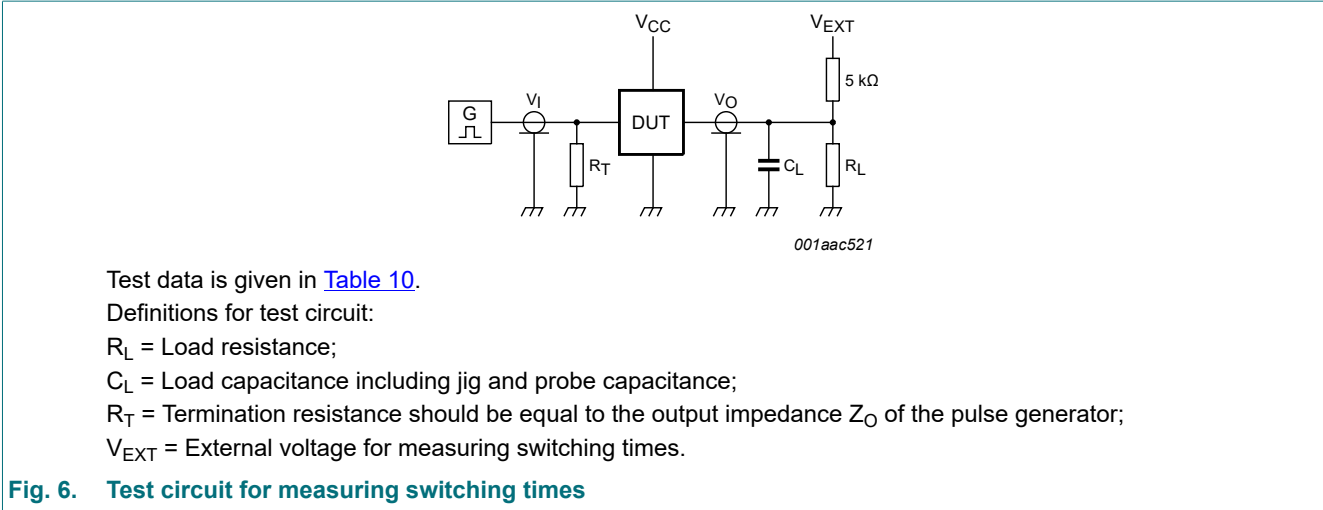


Fig. 6. Test circuit for measuring switching times

Table 10. Test data

| Supply voltage | Load | | V_{EXT} | | |
|----------------|------------------------------|--------------|-----------------------|-----------------------|-----------------------|
| V_{CC} | C_L | R_L [1] | t_{PLH} , t_{PHL} | t_{PZH} , t_{PHZ} | t_{PZL} , t_{PLZ} |
| 2.3 V to 3.6 V | 5 pF, 10 pF, 15 pF and 30 pF | 5 kΩ or 1 MΩ | open | GND | $2 \times V_{CC}$ |

[1] For measuring enable and disable times $R_L = 5 \text{ k}\Omega$.
 For measuring propagation delays, setup and hold times and pulse width $R_L = 1 \text{ M}\Omega$.

12. Package outline

TSSOP5: plastic thin shrink small outline package; 5 leads; body width 1.25 mm

SOT353-1



Fig. 7. Package outline SOT353-1 (TSSOP5)

13. Abbreviations

Table 11. Abbreviations

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

14. Revision history

Table 12. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|--------------------|--|--------------------|---------------|--------------------|
| 74AUP1T08_Q100 v.2 | 20220125 | Product data sheet | - | 74AUP1T08_Q100 v.1 |
| Modifications | <ul style="list-style-type: none"> Fig. 7: Package outline drawing for SOT353-1 (TSSOP5) has changed. | | | |
| 74AUP1T08_Q100 v.1 | 20210715 | Product data sheet | - | - |

15. Legal information

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 <https://www.nexperia.com>.

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For more information, please visit: <http://www.nexperia.com>

For sales office addresses, please send an email to: salesaddresses@nexperia.com

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