

# TinyLogic® Low Power Configurable Gate with Voltage-Level Translator

## 74AUP1T97

### Description

The 74AUP1T97 is a universal configurable 2-input logic gate that provides single supply voltage level translation. This device is designed for applications with inputs 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 74AUP1T97 is an ideal low power solution for mixed voltage signal applications especially for battery-powered portable applications. This product guarantees very low static and dynamic power consumption across entire voltage range. All inputs are implemented with hysteresis to allow for slower transition input signals and better switching noise immunity.

The 74AUP1T97 provides for multiple functions as determined by various configurations of the three inputs. The potential logic functions provided are MUX, AND, NAND, OR, and NOR, inverter and buffer. Refer to Figures 3 to 9.

### Features

- Single Supply Voltage Translator
  - ◆ 1.8 V to 3.3 V Input at  $V_{CC} = 3.3$  V
  - ◆ 1.8 V to 2.5 V Input at  $V_{CC} = 2.5$  V
- 2.3 V to 3.6 V  $V_{CC}$  Supply Voltage Operation
- 3.6 V Over-Voltage Tolerant I/O's at  $V_{CC}$  from 2.3 V to 3.6 V
- Power-Off High-Impedance Inputs and Outputs
- Low Static Power Consumption
  - ◆  $I_{CC} = 0.9$   $\mu$ A Maximum
- Low Dynamic Power Consumption
  - ◆  $C_{PD} = 2.7$  pF Typical at 3.3 V
- Ultra-Small MicroPak™ Packages

### Logic Diagram

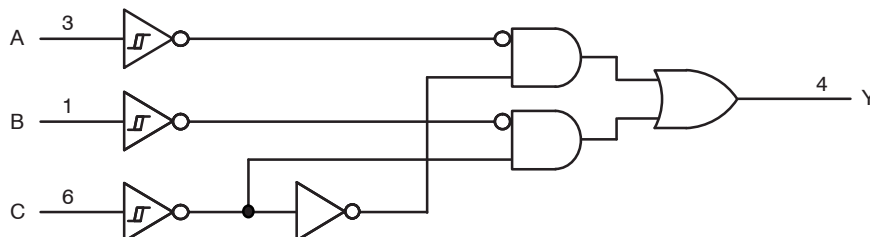


Figure 1. Logic Diagram (Positive Logic)

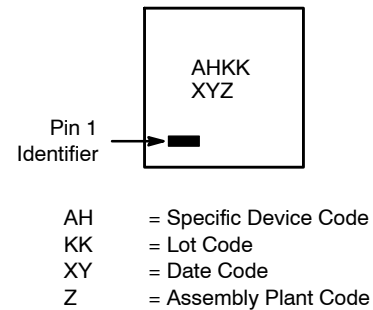


UDFN6  
CASE 517DP



SIP6  
CASE 127EB

### MARKING DIAGRAM



### ORDERING INFORMATION

| Device       | Package                         | Shipping†             |
|--------------|---------------------------------|-----------------------|
| 74AUP1T97FHX | UDFN-6<br>(Pb-Free/Halide Free) | 5000 /<br>Tape & Reel |
| 74AUP1T97L6X | SIP-6<br>(Pb-Free/Halide Free)  | 5000 /<br>Tape & Reel |

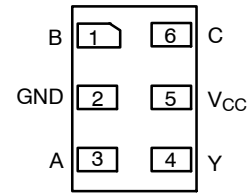
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, [BRD8011/D](http://www.onsemi.com/BRD8011/D).

# 74AUP1T97

## PIN CONFIGURATIONS

**Table 1. PIN DESCRIPTIONS**

| Pin | Name            | Description    |
|-----|-----------------|----------------|
| 1   | B               | Data Input     |
| 2   | GND             | Ground         |
| 3   | A               | Data Input     |
| 4   | Y               | Output         |
| 5   | V <sub>CC</sub> | Supply Voltage |
| 6   | C               | Data Input     |



**Figure 2. MicroPak™ (Top View)**

**Table 2. FUNCTION TABLE**

| Inputs |   |   | Output |
|--------|---|---|--------|
| C      | B | A | Y      |
| L      | L | L | L      |
| L      | L | H | L      |
| L      | H | L | H      |
| L      | H | H | H      |
| H      | L | L | L      |
| H      | L | H | H      |
| H      | H | L | L      |
| H      | H | H | H      |

1. H = HIGH Logic Level

2. L = LOW Logic Level

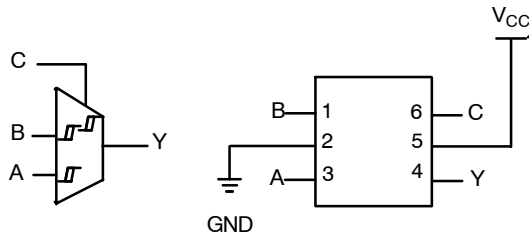
**Table 3. FUNCTION SELECTION TABLE**

| Logic Function                            | Connection Configuration |
|-------------------------------------------|--------------------------|
| 2-to-1 MUX                                | Figure 3                 |
| 2-Input AND Gate                          | Figure 4                 |
| 2-Input OR Gate with One Inverted Input   | Figure 5                 |
| 2-Input NAND Gate with One Inverted Input | Figure 5                 |
| 2-Input AND Gate with One Inverted Input  | Figure 6                 |
| 2-Input NOR Gate with One Inverted Input  | Figure 6                 |
| 2-Input OR Gate                           | Figure 7                 |
| Inverter                                  | Figure 8                 |
| Buffer                                    | Figure 9                 |

### Logic Configurations

Figure 3 through Figure 9 show the logical functions that can be implemented using the 74AUP1T97. The diagrams show the DeMorgan's equivalent logic duals for a given

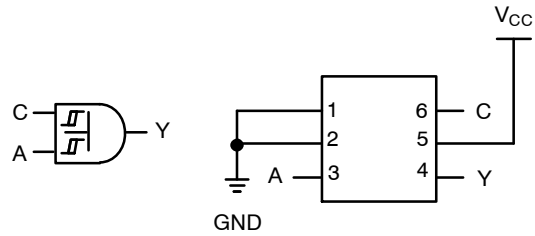
two-input function. The logical implementation is next to the board-level physical implementation of how the pins of the function should be connected.



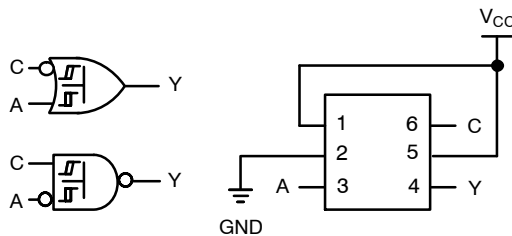
**Note:**

1. When C is L, Y = B.
2. When C is H, Y = A.

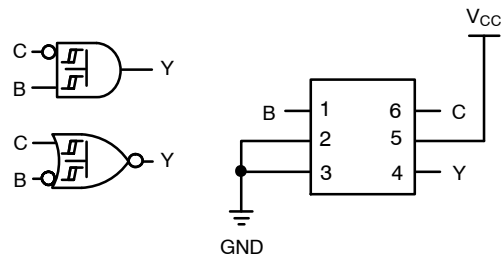
**Figure 3. 2-to-1 MUX**



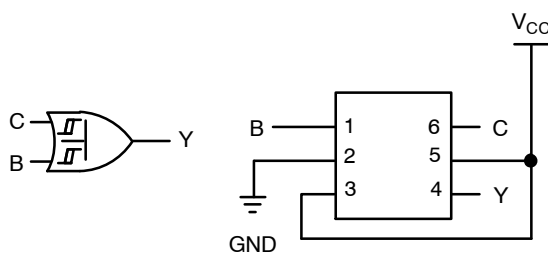
**Figure 4. 2-Input AND Gate**



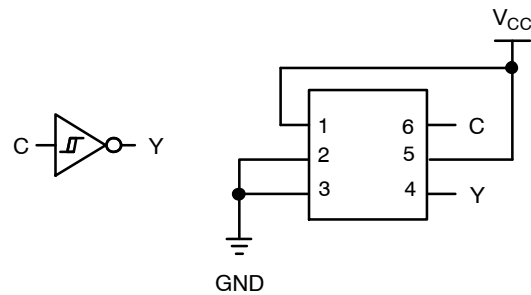
**Figure 5. Input OR Gate with One Inverted Input  
2-Input NAND Gate with One Inverted Input**



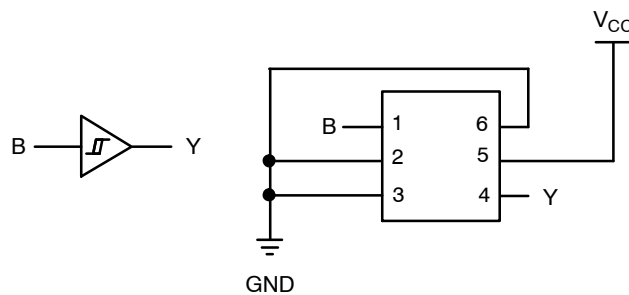
**Figure 6. 2-Input AND Gate with One Inverted Input  
2-Input NOR Gate with One Inverted Input**



**Figure 7. 2-Input OR Gate**



**Figure 8. Inverter**



**Figure 9. Buffer**

**ABSOLUTE MAXIMUM RATINGS**

| Symbol                | Parameter                                                                      | Min.         | Max.                  | Unit |
|-----------------------|--------------------------------------------------------------------------------|--------------|-----------------------|------|
| $V_{CC}$              | Supply Voltage                                                                 | -0.5         | 4.6                   | V    |
| $V_{IN}$              | DC Input Voltage                                                               | -0.5         | 4.6                   | V    |
| $V_{OUT}$             | DC Output Voltage<br>HIGH or LOW State(Note 3)<br>$V_{CC} = 0\text{ V}$        | -0.5<br>-0.5 | $V_{CC} + 0.5$<br>4.6 | V    |
| $I_{IK}$              | DC Input Diode Current<br>$V_{IN} < 0\text{ V}$                                | -            | -50                   | mA   |
| $I_{OK}$              | DC Output Diode Current<br>$V_{OUT} < 0\text{ V}$<br>$V_{OUT} > V_{CC}$        | -            | -50<br>+50            | mA   |
| $I_{OH} / I_{OL}$     | DC Output Source / Sink Current                                                | -            | $\pm 50$              | mA   |
| $I_O$                 | Continuous Output Current                                                      | -            | $\pm 20$              | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current per Supply Pin                                   | -            | $\pm 50$              | mA   |
| $T_{STG}$             | Storage Temperature Range                                                      | -65          | +150                  | °C   |
| $T_J$                 | Junction Temperature Under Bias                                                | -            | +150                  | °C   |
| $T_L$                 | Junction Lead Temperature, Soldering 10s                                       | -            | +260                  | °C   |
| $P_D$                 | Power Dissipation at +85°C<br>MicroPak-6<br>MicroPak2-6                        | -            | 130<br>120            | mW   |
| ESD                   | Human Body Model, JEDEC:JESD22-A114<br>Charged Device Model, JEDEC:JESD22-C101 | -            | 5000+<br>2000         | V    |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

3.  $I_O$  absolute maximum rating must be observed.

**Table 4. RECOMMENDED OPERATING CONDITIONS** (Note 4)

| Symbol            | Parameter                      | Conditions                                                                           | Min    | Max                    | Unit |
|-------------------|--------------------------------|--------------------------------------------------------------------------------------|--------|------------------------|------|
| $V_{CC}$          | Supply Voltage                 |                                                                                      | 2.3    | 3.6                    | V    |
| $V_{IN}$          | Input Voltage                  |                                                                                      | 0      | 3.6                    | V    |
| $V_{OUT}$         | Output Voltage                 | $V_{CC} = 0\text{ V}$<br>HIGH or LOW State                                           | 0<br>0 | 3.6<br>$V_{CC}$        | V    |
| $I_{OH} / I_{OL}$ | Output Current                 | $V_{CC} = 3.0\text{ V to } 3.6\text{ V}$<br>$V_{CC} = 2.3\text{ V to } 2.7\text{ V}$ | -      | $\pm 4.0$<br>$\pm 3.1$ | mA   |
| $T_A$             | Operating Free-Air Temperature |                                                                                      | -40    | +85                    | °C   |
| $\theta_{JA}$     | Thermal Resistance             | MicroPak-6<br>MicroPak2-6                                                            | -      | 500<br>560             | °C/W |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. Unused inputs must be held HIGH or LOW. They may not float.

Table 5. DC ELECTRICAL CHARACTERISTICS

| Symbol            | Parameter                             | Conditions                                                         | V <sub>CC</sub> (V)             | T <sub>A</sub> = +25°C |       | T <sub>A</sub> = -40°C to +85°C |       | Unit |
|-------------------|---------------------------------------|--------------------------------------------------------------------|---------------------------------|------------------------|-------|---------------------------------|-------|------|
|                   |                                       |                                                                    |                                 | Min                    | Max   | Min                             | Max   |      |
| V <sub>P</sub>    | Positive Threshold Voltage            | –                                                                  | 2.3 V to 2.7 V                  | 0.60                   | 1.10  | 0.60                            | 1.10  | V    |
|                   |                                       |                                                                    | 3.0 V to 3.6 V                  | 0.75                   | 1.16  | 0.75                            | 1.19  | V    |
| V <sub>N</sub>    | Negative Threshold Voltage            | –                                                                  | 2.3 V to 2.7 V                  | 0.35                   | 0.60  | 0.35                            | 0.60  | V    |
|                   |                                       |                                                                    | 3.0 V to 3.6 V                  | 0.50                   | 0.85  | 0.50                            | 0.85  | V    |
| V <sub>H</sub>    | Hysteresis Voltage                    | –                                                                  | 2.3 V to 2.7 V                  | 0.23                   | 0.60  | 0.10                            | 0.60  | V    |
|                   |                                       |                                                                    | 3.0 V to 3.6 V                  | 0.25                   | 0.56  | 0.15                            | 0.56  | V    |
| V <sub>OH</sub>   | HIGH Level Output Voltage             | I <sub>OH</sub> = -20 µA                                           | 2.3 V ≤ V <sub>CC</sub> ≤ 3.6 V | V <sub>CC</sub> - 0.1  | –     | V <sub>CC</sub> - 0.1           | –     | V    |
|                   |                                       | I <sub>OH</sub> = -2.3 mA                                          | 2.3 V                           | 2.05                   | –     | 1.97                            | –     | V    |
|                   |                                       | I <sub>OH</sub> = -3.1 mA                                          |                                 | 1.90                   | –     | 1.85                            | –     | V    |
|                   |                                       | I <sub>OH</sub> = -2.7 mA                                          | 3.0 V                           | 2.72                   | –     | 2.67                            | –     | V    |
|                   |                                       | I <sub>OH</sub> = -4 mA                                            |                                 | 2.60                   | –     | 2.55                            | –     | V    |
| V <sub>OL</sub>   | LOW Level Output Voltage              | I <sub>OL</sub> = 20 µA                                            | 2.3 V ≤ V <sub>CC</sub> ≤ 3.6 V | –                      | 0.10  | –                               | 0.10  | V    |
|                   |                                       | I <sub>OL</sub> = 2.3 mA                                           | 2.3 V                           | –                      | 0.31  | –                               | 0.33  | V    |
|                   |                                       | I <sub>OH</sub> = 3.1 mA                                           |                                 | –                      | 0.44  | –                               | 0.45  | V    |
|                   |                                       | I <sub>OL</sub> = 2.7 mA                                           | 3.0 V                           | –                      | 0.31  | –                               | 0.33  | V    |
|                   |                                       | I <sub>OL</sub> = 4.0 mA                                           |                                 | –                      | 0.44  | –                               | 0.45  | V    |
| I <sub>IN</sub>   | Input Leakage Current                 | 0 ≤ V <sub>IN</sub> ≤ 3.6                                          | 0 V to 3.6 V                    | –                      | ±0.10 | –                               | ±0.50 | µA   |
| I <sub>OFF</sub>  | Power Off Leakage Current             | 0 ≤ (V <sub>IN</sub> , V <sub>O</sub> ) ≤ 3.6                      | 0 V                             | –                      | 0.10  | –                               | 0.50  | µA   |
| ΔI <sub>OFF</sub> | Additional Power Off Leakage Current  | V <sub>IN</sub> or V <sub>O</sub> = 0 V to 3.6 V                   | 0 V to 0.2 V                    | –                      | 0.20  | –                               | 0.60  | µA   |
| I <sub>CC</sub>   | Quiescent Supply Current              | V <sub>IN</sub> = V <sub>CC</sub> or GND                           | 2.3 V to 3.6 V                  | –                      | 0.50  | –                               | 0.90  | µA   |
|                   |                                       | V <sub>CC</sub> ≤ V <sub>IN</sub> ≤ 3.6 V                          |                                 | –                      | –     | –                               | ±0.90 | µA   |
| ΔI <sub>CC</sub>  | Increase in I <sub>CC</sub> per Input | One Input at 0.3 V or 1.1 V, other Inputs at 0 or V <sub>CC</sub>  | 2.3 V to 2.7 V                  | –                      | –     | –                               | 4     | µA   |
|                   |                                       | One Input at 0.45 V or 1.2 V, other Inputs at 0 or V <sub>CC</sub> | 3.0 V to 3.6 V                  | –                      | –     | –                               | 12    | µA   |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Table 6. AC ELECTRICAL CHARACTERISTICS

| Symbol                              | Parameter                     | Conditions                                       | V <sub>CC</sub> (V)                                                      | T <sub>A</sub> = +25°C |     |     | T <sub>A</sub> = -40 to +85°C |     | Unit | Figure         |
|-------------------------------------|-------------------------------|--------------------------------------------------|--------------------------------------------------------------------------|------------------------|-----|-----|-------------------------------|-----|------|----------------|
|                                     |                               |                                                  |                                                                          | Min                    | Typ | Max | Typ                           | Max |      |                |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Propagation Delay             | C <sub>L</sub> = 5 pF,<br>R <sub>L</sub> = 1 MΩ  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.1                    | 3.7 | 5.5 | 1.1                           | 6.8 | ns   | Figure 10 & 11 |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.1                    | 3.8 | 6.5 | 1.1                           | 7.0 |      |                |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 3.0 V to 3.60 V  | 1.1                    | 3.9 | 6.0 | 1.1                           | 6.5 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.0                    | 3.3 | 4.9 | 1.0                           | 8.0 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.0                    | 3.2 | 4.6 | 1.0                           | 5.8 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 3.00 V to 3.60 V | 1.0                    | 3.1 | 4.7 | 1.0                           | 5.5 |      |                |
|                                     |                               | C <sub>L</sub> = 10 pF,<br>R <sub>L</sub> = 1 MΩ | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.3                    | 4.1 | 6.5 | 1.0                           | 7.9 |      |                |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.3                    | 4.0 | 6.2 | 1.0                           | 7.1 |      |                |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 3.0 V to 3.60 V  | 1.3                    | 3.7 | 5.7 | 1.0                           | 6.5 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.3                    | 3.5 | 5.6 | 1.0                           | 8.5 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.3                    | 3.4 | 5.3 | 1.0                           | 6.1 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 3.00 V to 3.60 V | 1.3                    | 3.3 | 5.2 | 1.0                           | 5.9 |      |                |
|                                     |                               | C <sub>L</sub> = 15 pF,<br>R <sub>L</sub> = 1 MΩ | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.5                    | 4.6 | 6.9 | 1.0                           | 8.7 |      |                |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.5                    | 4.4 | 6.8 | 1.0                           | 7.9 |      |                |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 3.0 V to 3.60 V  | 1.5                    | 4.2 | 6.3 | 1.0                           | 7.4 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.3                    | 3.9 | 6.2 | 1.0                           | 9.1 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.3                    | 3.8 | 5.6 | 1.0                           | 6.8 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 3.00 V to 3.60 V | 1.3                    | 3.8 | 5.6 | 1.0                           | 6.2 |      |                |
|                                     |                               | C <sub>L</sub> = 30 pF,<br>R <sub>L</sub> = 1 MΩ | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.3                    | 4.2 | 7.9 | 1.3                           | 8.5 |      |                |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.3                    | 3.9 | 7.9 | 1.3                           | 8.5 |      |                |
|                                     |                               |                                                  | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V,<br>V <sub>IN</sub> = 3.0 V to 3.60 V  | 1.0                    | 3.7 | 7.3 | 1.0                           | 8.9 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 1.65 V to 1.95 V | 1.3                    | 3.5 | 6.1 | 1.3                           | 7.9 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.1                    | 3.0 | 5.9 | 1.1                           | 6.8 |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V,<br>V <sub>IN</sub> = 2.30 V to 2.70 V | 1.0                    | 2.7 | 5.7 | 1.0                           | 6.5 |      |                |
| C <sub>IN</sub>                     | Input Capacitance             | –                                                | 0                                                                        | –                      | 2.1 | –   | –                             | –   | pF   | –              |
| C <sub>OUT</sub>                    | Output Capacitance            | –                                                | 0                                                                        | –                      | 3.0 | –   | –                             | –   |      |                |
| C <sub>PD</sub>                     | Power Dissipation Capacitance | –                                                | 2.30 V ≤ V <sub>CC</sub> ≤ 2.70 V                                        | –                      | 2.0 | –   | –                             | –   |      |                |
|                                     |                               |                                                  | 3.00 V ≤ V <sub>CC</sub> ≤ 3.60 V                                        | –                      | 2.7 | –   | –                             | –   |      |                |

74AUP1T97

AC LOADINGS AND WAVEFORMS

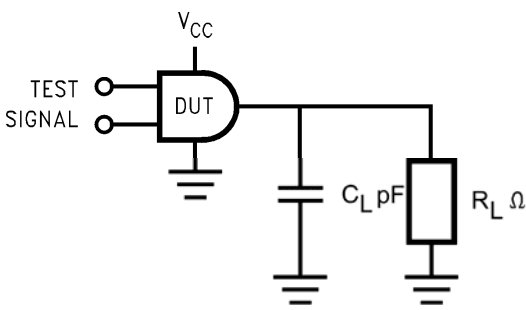


Figure 10. AC Test Circuit

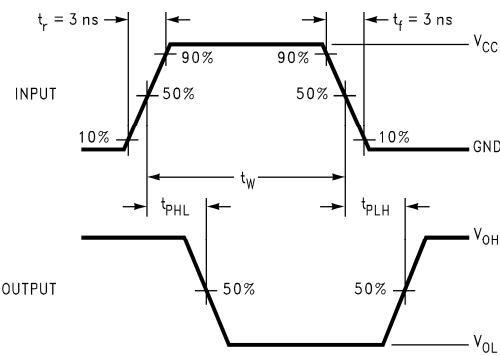


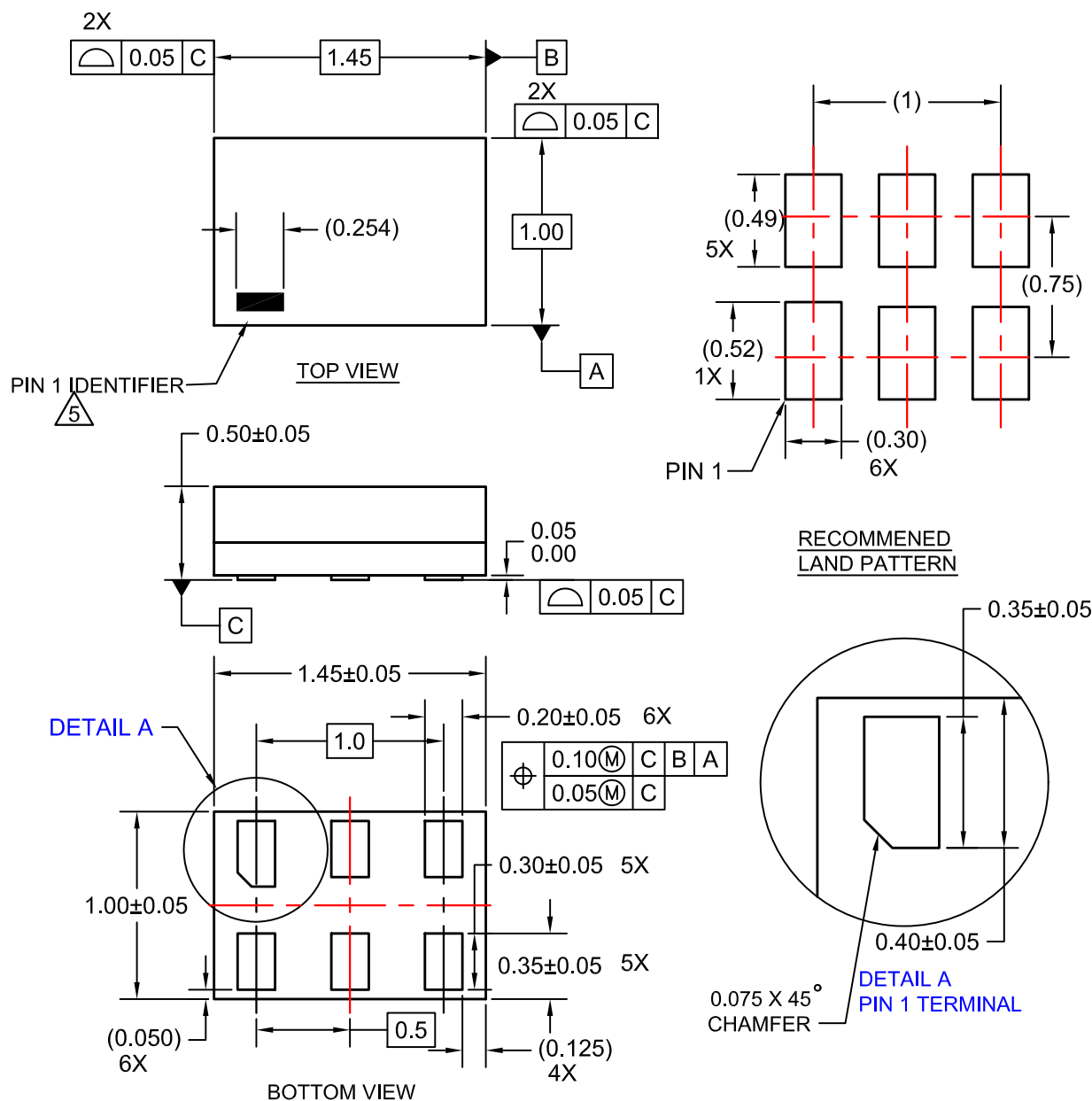
Figure 11. AC Waveforms

| Symbol   | $V_{CC}$          |                   |
|----------|-------------------|-------------------|
|          | 3.3 V $\pm 0.3$ V | 2.5 V $\pm 0.2$ V |
| $V_{mi}$ | $V_{IN} / 2$      | $V_{IN} / 2$      |
| $V_{mo}$ | $V_{CC} / 2$      | $V_{CC} / 2$      |

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**SIP6 1.45X1.0**  
**CASE 127EB**  
**ISSUE O**

DATE 31 AUG 2016



NOTES:

1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

|                         |                      |                                                                                                                                                                                     |
|-------------------------|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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**UDFN6 1.0X1.0, 0.35P**  
CASE 517DP  
ISSUE O

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- NOTES:**
- A. COMPLIES TO JEDEC MO-252 STANDARD
  - B. DIMENSIONS ARE IN MILLIMETERS.
  - C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009



|                         |                             |                                                                                                                                                                                     |
|-------------------------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>UDFN6 1.0X1.0, 0.35P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                                  |

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