# NLSV1T244

# 1-Bit Dual-Supply Non-Inverting Level Translator

The NLSV1T244 is a 1−bit configurable dual−supply voltage level translator. The input $A_n$ and output $B_n$ ports are designed to track two different power supply rails, $V_{CCA}$ and $V_{CCB}$ respectively. Both supply rails are configurable from 0.9 V to 4.5 V allowing universal low−voltage translation from the input $A_n$ to the output $B_n$ port.

### Features

- Wide $V_{CCA}$ and $V_{CCB}$ Operating Range: 0.9 V to 4.5 V
- High−Speed w/ Balanced Propagation Delay
- Inputs and Outputs have OVT Protection to 4.5 V
- Non−preferential $V_{CCA}$ and $V_{CCB}$ Sequencing
- Outputs at 3−State until Active $V_{CC}$ is Reached
- Power−Off Protection
- Outputs Switch to 3−State with $V_{CCB}$ at GND
- Ultra−Small Packaging: 1.2 mm x 1.0 mm UDFN6
- NLVSV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

### Typical Applications

- Mobile Phones, PDAs, Other Portable Devices

### Important Information

- ESD Protection for All Pins:
  HBM (Human Body Model) > 3000 V

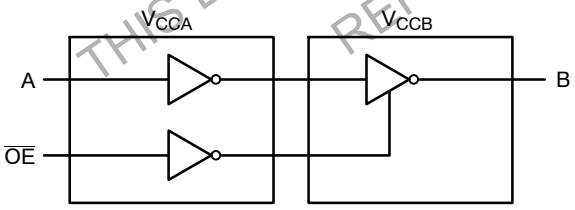


**Figure 1. Logic Diagram**

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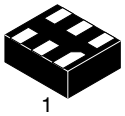
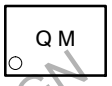


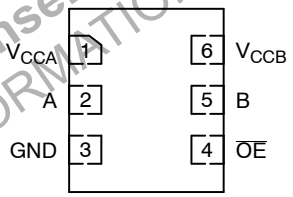

**UDFN6**
**MU SUFFIX**
**CASE 517AA**

**MARKING DIAGRAM**




Q = Specific Device Code
M = Date Code

**PIN ASSIGNMENT**




(Top View)

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NLSV1T244MUTBG, NLVSV1T244MUTBG | UDFN6 (Pb−Free) | 3000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specification Brochure, BRD8011/D.

## PIN ASSIGNMENT

| PIN | FUNCTION |
|---|---|
| $V_{CCA}$ | Input Port DC Power Supply |
| $V_{CCB}$ | Output Port DC Power Supply |
| GND | Ground |
| A | Input Port |
| B | Output Port |
| $\overline{OE}$ | Output Enable |

## TRUTH TABLE

| Inputs | | Outputs |
|---|---|---|
| $\overline{OE}$ | A | B |
| L | L | L |
| L | H | H |
| H | X | 3−State |

## MAXIMUM RATINGS

| Symbol | Rating | | Value | Condition | Unit |
|---|---|---|---|---|---|
| $V_{CCA}$, $V_{CCB}$ | DC Supply Voltage | | −0.5 to +5.5 | | V |
| $V_I$ | DC Input Voltage | A | −0.5 to +5.5 | | V |
| $V_C$ | Control Input | $\overline{OE}$ | −0.5 to +5.5 | | V |
| $V_O$ | DC Output Voltage (Power Down) | B | −0.5 to +5.5 | $V_{CCA}$ = $V_{CCB}$ = 0 | V |
| | (Active Mode) | B | −0.5 to +5.5 | | V |
| | (Tri−State Mode) | B | −0.5 to +5.5 | | V |
| $I_{IK}$ | DC Input Diode Current | | −20 | $V_I$ < GND | mA |
| $I_{OK}$ | DC Output Diode Current | | −50 | $V_O$ < GND | mA |
| $I_O$ | DC Output Source/Sink Current | | ±50 | | mA |
| $I_{CCA}$, $I_{CCB}$ | DC Supply Current Per Supply Pin | | ±100 | | mA |
| $I_{GND}$ | DC Ground Current per Ground Pin | | ±100 | | mA |
| $T_{STG}$ | Storage Temperature | | −65 to +150 | | °C |

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.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CCA}$, $V_{CCB}$ | Positive DC Supply Voltage | | 0.9 | 4.5 | V |
| $V_I$ | Bus Input Voltage | | GND | 4.5 | V |
| $V_C$ | Control Input | $\overline{OE}$ | GND | 4.5 | V |
| $V_{IO}$ | Bus Output Voltage (Power Down Mode) | B | GND | 4.5 | V |
| | (Active Mode) | B | GND | $V_{CCB}$ | V |
| | (Tri−State Mode) | B | GND | 4.5 | V |
| $T_A$ | Operating Temperature Range | | −40 | +85 | °C |
| $\Delta t / \Delta V$ | Input Transition Rise or Rate<br>$V_I$, from 30% to 70% of $V_{CC}$; $V_{CC}$ = 3.3 V ±0.3 V | | 0 | 10 | nS |

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.

## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Test Conditions | $V_{CCA}$ (V) | $V_{CCB}$ (V) | −40°C to +85°C | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | |
| $V_{IH}$ | Input HIGH Voltage (A, $\overline{OE}$) | | 3.6 – 4.5 | 0.9 – 4.5 | 2.2 | – | V |
| | | | 2.7 – 3.6 | | 2.0 | – | |
| | | | 2.3 – 2.7 | | 1.6 | – | |
| | | | 1.4 – 2.3 | | 0.65 * $V_{CCA}$ | – | |
| | | | 0.9 – 1.4 | | 0.9 * $V_{CCA}$ | – | |
| $V_{IL}$ | Input LOW Voltage (A, $\overline{OE}$) | | 3.6 – 4.5 | 0.9 – 4.5 | – | 0.8 | V |
| | | | 2.7 – 3.6 | | – | 0.8 | |
| | | | 2.3 – 2.7 | | – | 0.7 | |
| | | | 1.4 – 2.3 | | – | 0.35 * $V_{CCA}$ | |
| | | | 0.9 – 1.4 | | – | 0.1 * $V_{CCA}$ | |
| $V_{OH}$ | Output HIGH Voltage | $I_{OH}$ = −100 μA; $V_I$ = $V_{IH}$ | 0.9 – 4.5 | 0.9 – 4.5 | $V_{CCB}$ – 0.2 | – | V |
| | | $I_{OH}$ = −0.5 mA; $V_I$ = $V_{IH}$ | 0.9 | 0.9 | 0.75 * $V_{CCB}$ | – | |
| | | $I_{OH}$ = −2 mA; $V_I$ = $V_{IH}$ | 1.4 | 1.4 | 1.05 | – | |
| | | $I_{OH}$ = −6 mA; $V_I$ = $V_{IH}$ | 1.65 | 1.65 | 1.25 | – | |
| | | | 2.3 | 2.3 | 2.0 | – | |
| | | $I_{OH}$ = −12 mA; $V_I$ = $V_{IH}$ | 2.3 | 2.3 | 1.8 | – | |
| | | | 2.7 | 2.7 | 2.2 | – | |
| | | $I_{OH}$ = −18 mA; $V_I$ = $V_{IH}$ | 2.3 | 2.3 | 1.7 | – | |
| | | | 3.0 | 3.0 | 2.4 | – | |
| | | $I_{OH}$ = −24 mA; $V_I$ = $V_{IH}$ | 3.0 | 3.0 | 2.2 | – | |
| $V_{OL}$ | Output LOW Voltage | $I_{OL}$ = 100 μA; $V_I$ = $V_{IL}$ | 0.9 – 4.5 | 0.9 – 4.5 | – | 0.2 | V |
| | | $I_{OL}$ = 0.5 mA; $V_I$ = $V_{IL}$ | 1.1 | 1.1 | – | 0.3 | |
| | | $I_{OL}$ = 2 mA; $V_I$ = $V_{IL}$ | 1.4 | 1.4 | – | 0.35 | |
| | | $I_{OL}$ = 6 mA; $V_I$ = $V_{IL}$ | 1.65 | 1.65 | – | 0.3 | |
| | | $I_{OL}$ = 12 mA; $V_I$ = $V_{IL}$ | 2.3 | 2.3 | – | 0.4 | |
| | | | 2.7 | 2.7 | – | 0.4 | |
| | | $I_{OL}$ = 18 mA; $V_I$ = $V_{IL}$ | 2.3 | 2.3 | – | 0.6 | |
| | | | 3.0 | 3.0 | – | 0.4 | |
| | | $I_{OL}$ = 24 mA; $V_I$ = $V_{IL}$ | 3.0 | 3.0 | – | 0.55 | |
| $I_I$ | Input Leakage Current | $V_I$ = $V_{CCA}$ or GND | 0.9 – 4.5 | 0.9 – 4.5 | −1.0 | 1.0 | μA |
| $I_{OFF}$ | Power−Off Leakage Current | $\overline{OE}$ = 0 V | 0<br>0.9 – 4.5 | 0.9 – 4.5<br>0 | −1.0<br>−1.0 | 1.0<br>1.0 | μA |
| $I_{CCA}$ | Quiescent Supply Current | $V_I$ = $V_{CCA}$ or GND; $I_O$ = 0, $V_{CCA}$ = $V_{CCB}$ | 0.9 – 4.5 | 0.9 – 4.5 | – | 1.0 | μA |
| $I_{CCB}$ | Quiescent Supply Current | $V_I$ = $V_{CCA}$ or GND; $I_O$ = 0, $V_{CCA}$ = $V_{CCB}$ | 0.9 – 4.5 | 0.9 – 4.5 | – | 1.0 | μA |
| $I_{CCA}$ + $I_{CCB}$ | Quiescent Supply Current | $V_I$ = $V_{CCA}$ or GND; $I_O$ = 0, $V_{CCA}$ = $V_{CCB}$ | 0.9 – 4.5 | 0.9 – 4.5 | – | 2.0 | μA |
| $\Delta I_{CCA}$ | Increase in $I_{CC}$ per Input Voltage, Other Inputs at $V_{CCA}$ or GND | $V_I$ = $V_{CCA}$ – 0.6 V;<br>$V_I$ = $V_{CCA}$ or GND | 4.5<br>3.6 | 4.5<br>3.6 | – | 10<br>5.0 | μA |
| $\Delta I_{CCB}$ | Increase in $I_{CC}$ per Input Voltage, Other Inputs at $V_{CCA}$ or GND | $V_I$ = $V_{CCA}$ – 0.6 V;<br>$V_I$ = $V_{CCA}$ or GND | 4.5<br>3.6 | 4.5<br>3.6 | – | 10<br>5.0 | μA |
| $I_{OZ}$ | I/O Tri−State Output Leakage Current | $T_A$ = 25°C, $\overline{OE}$ = 0 V | 0.9 – 4.5 | 0.9 – 4.5 | −1.0 | 1.0 | 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.

### TOTAL STATIC POWER CONSUMPTION ($I_{CCA}$ + $I_{CCB}$)

| | −40°C to +85°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $V_{CCB}$ (V) | | | | | | | | | | |
| | 4.5 | | 3.3 | | 2.8 | | 1.8 | | 0.9 | | |
| $V_{CCA}$ (V) | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Unit |
| 4.5 | | 2 | | 2 | | 2 | | 2 | | < 1.5 | μA |
| 3.3 | | 2 | | 2 | | 2 | | 2 | | < 1.5 | μA |
| 2.8 | | < 2 | | < 1 | | < 1 | | < 0.5 | | < 0.5 | μA |
| 1.8 | | < 1 | | < 1 | | < 0.5 | | < 0.5 | | < 0.5 | μA |
| 0.9 | | < 0.5 | | < 0.5 | | < 0.5 | | < 0.5 | | < 0.5 | μA |

NOTE: Connect ground before applying supply voltage $V_{CCA}$ or $V_{CCB}$. This device is designed with the feature that the power−up sequence of $V_{CCA}$ and $V_{CCB}$ will not damage the IC.

### AC ELECTRICAL CHARACTERISTICS

| | | | −40°C to +85°C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $V_{CCB}$ (V) | | | | | | | | | | |
| | | | 4.5 | | 3.3 | | 2.8 | | 1.8 | | 1.2 | | |
| Symbol | Parameter | $V_{CCA}$ (V) | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | Unit |
| $t_{PLH}$, $t_{PHL}$ (Note 1) | Propagation Delay, A to B | 4.5 | | 1.6 | | 1.8 | | 2.0 | | 2.1 | | 2.3 | nS |
| | | 3.3 | | 1.7 | | 1.9 | | 2.1 | | 2.3 | | 2.6 | |
| | | 2.8 | | 1.9 | | 2.1 | | 2.3 | | 2.5 | | 2.8 | |
| | | 1.8 | | 2.1 | | 2.4 | | 2.5 | | 2.7 | | 3.0 | |
| | | 1.2 | | 2.4 | | 2.7 | | 2.8 | | 3.0 | | 3.3 | |
| $t_{PZH}$, $t_{PZL}$ (Note 1) | Output Enable, $\overline{O}$ to B | 4.5 | | 2.6 | | 3.8 | | 4.0 | | 4.1 | | 4.3 | nS |
| | | 3.3 | | 3.7 | | 3.9 | | 4.1 | | 4.3 | | 4.6 | |
| | | 2.5 | | 3.9 | | 4.1 | | 4.3 | | 4.5 | | 4.8 | |
| | | 1.8 | | 4.1 | | 4.4 | | 4.5 | | 4.7 | | 5.0 | |
| | | 1.2 | | 4.4 | | 4.7 | | 4.8 | | 5.0 | | 5.3 | |
| $t_{PHZ}$, $t_{PLZ}$ (Note 1) | Output Disable, $\overline{OE}$ to B | 4.5 | | 2.6 | | 3.8 | | 4.0 | | 4.1 | | 4.3 | nS |
| | | 3.3 | | 3.7 | | 3.9 | | 4.1 | | 4.3 | | 4.6 | |
| | | 2.5 | | 3.9 | | 4.1 | | 4.3 | | 4.5 | | 4.8 | |
| | | 1.8 | | 4.1 | | 4.4 | | 4.5 | | 4.7 | | 5.0 | |
| | | 1.2 | | 4.4 | | 4.7 | | 4.8 | | 5.0 | | 5.3 | |
| $t_{OSHL}$, $t_{OSLH}$ (Note 1) | Output to Output Skew, Tim | 4.5 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | nS |
| | | 3.3 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | |
| | | 2.5 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | |
| | | 1.8 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | |
| | | 1.2 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | | 0.15 | |

1. Propagation delays defined per Figure 2.



### CAPACITANCE

| Symbol | Parameter | Test Conditions | Typ (Note 2) | Unit |
|---|---|---|---|---|
| $C_{IN}$ | Control Pin Input Capacitance | $V_{CCA}$ = $V_{CCB}$ = 3.3 V, $V_I$ = 0 V or $V_{CCA/B}$ | 3.5 | pF |
| $C_{I/O}$ | I/O Pin Input Capacitance | $V_{CCA}$ = $V_{CCB}$ = 3.3 V, $V_I$ = 0 V or $V_{CCA/B}$ | 5.0 | pF |
| $C_{PD}$ | Power Dissipation Capacitance | $V_{CCA}$ = $V_{CCB}$ = 3.3 V, $V_I$ = 0 V or $V_{CCA}$, f = 10 MHz | 5.0 | pF |

2. Typical values are at $T_A$ = +25°C.
3. $C_{PD}$ is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from: $I_{CC(operating)} \cong C_{PD} \times V_{CC} \times f_{IN}$ where $I_{CC} = I_{CCA} + I_{CCB}$.

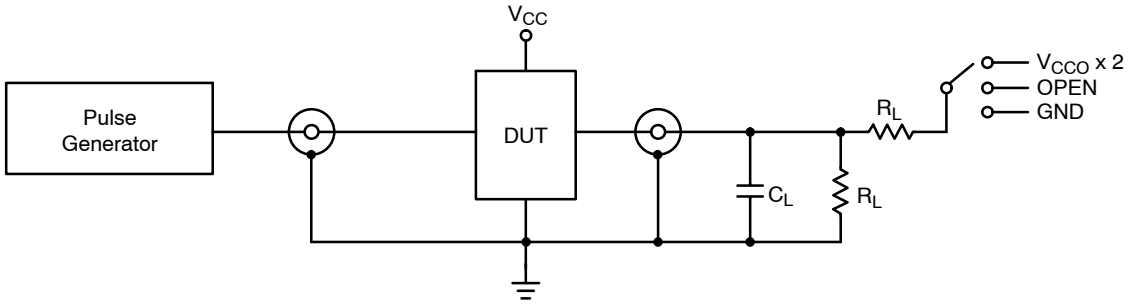
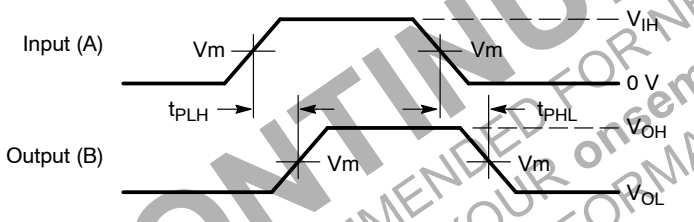
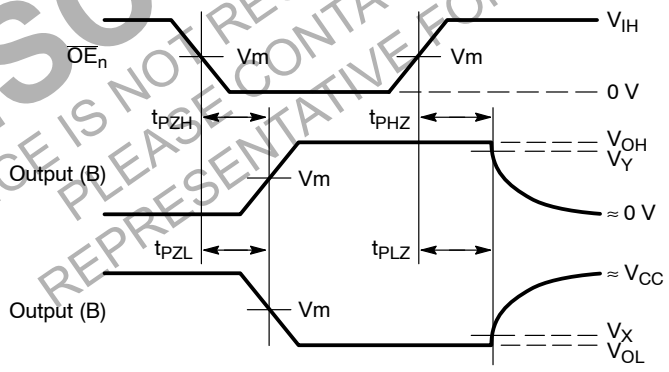



**Figure 2. AC (Propagation Delay) Test Circuit**

| Test | Switch |
|---|---|
| $t_{PLH}$, $t_{PHL}$ | OPEN |
| $t_{PLZ}$, $t_{PZL}$ | $V_{CCO}$ x 2 |
| $t_{PHZ}$, $t_{PZH}$ | GND |
| $C_L$ = 15 pF or equivalent (includes probe and jig capacitance)<br>$R_L$ = 2 kΩ or equivalent<br>$Z_{OUT}$ of pulse generator = 50 Ω | |




**Waveform 1 – Propagation Delays**
$t_R = t_F$ = 2.0 ns, 10% to 90%; f = 1 MHz; $t_W$ = 500 ns



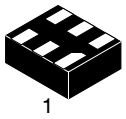

**Waveform 2 – Output Enable and Disable Times**
$t_R = t_F$ = 2.0 ns, 10% to 90%; f = 1 MHz; $t_W$ = 500 ns

**Figure 3. AC (Propagation Delay) Test Circuit Waveforms**

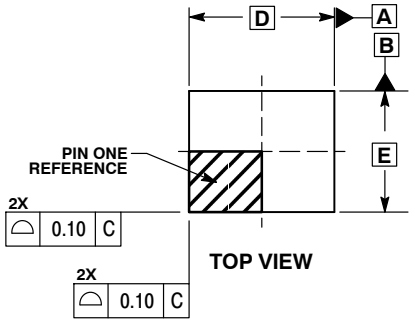
| Symbol | $V_{CC}$ | | | | |
|---|---|---|---|---|---|
| | 3.0 V – 4.5 V | 2.3 V – 2.7 V | 1.65 V – 1.95 V | 1.4 V – 1.6 V | 0.9 V – 1.3 V |
| $V_{mA}$ | $V_{CCA}/2$ | $V_{CCA}/2$ | $V_{CCA}/2$ | $V_{CCA}/2$ | $V_{CCA}/2$ |
| $V_{mB}$ | $V_{CCB}/2$ | $V_{CCB}/2$ | $V_{CCB}/2$ | $V_{CCB}/2$ | $V_{CCB}/2$ |
| $V_X$ | $V_{OL}$ x 0.1 | $V_{OL}$ x 0.1 | $V_{OL}$ x 0.1 | $V_{OL}$ x 0.1 | $V_{OL}$ x 0.1 |
| $V_Y$ | $V_{OH}$ x 0.9 | $V_{OH}$ x 0.9 | $V_{OH}$ x 0.9 | $V_{OH}$ x 0.9 | $V_{OH}$ x 0.9 |

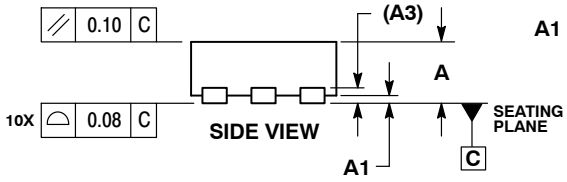
**UDFN6, 1.2x1.0, 0.4P**
CASE 517AA
ISSUE D

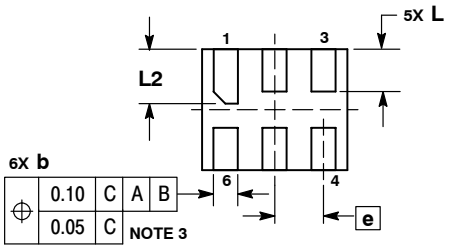
DATE 03 SEP 2010



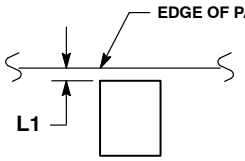
SCALE 8:1



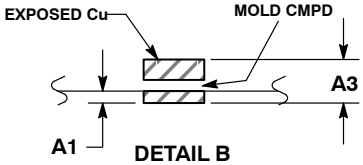




BOTTOM VIEW




DETAIL A
Bottom View
(Optional)




DETAIL B
Side View
(Optional)

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 mm FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

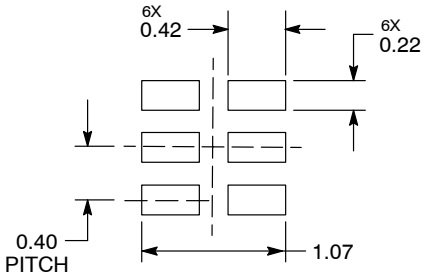
| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 0.45 | 0.55 |
| A1 | 0.00 | 0.05 |
| A3 | 0.127 REF | |
| b | 0.15 | 0.25 |
| D | 1.20 BSC | |
| E | 1.00 BSC | |
| e | 0.40 BSC | |
| L | 0.30 | 0.40 |
| L1 | 0.00 | 0.15 |
| L2 | 0.40 | 0.50 |

## GENERIC MARKING DIAGRAM*


X = Specific Device Code
M = Date Code

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

## MOUNTING FOOTPRINT*




DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

| | | |
|---|---|---|
| **DOCUMENT NUMBER:** | **98AON22068D** | Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red. |
| **DESCRIPTION:** | **6 PIN UDFN, 1.2X1.0, 0.4P** | **PAGE 1 OF 1** |

## ADDITIONAL INFORMATION

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