

NLSV4T240

4-Bit Dual-Supply Inverting Level Translator

The NLSV4T240 is a 4-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: 1.7 mm x 2.0 mm UQFN12
- This is a Pb-Free Device

Typical Applications

- Mobile Phones, PDAs, Other Portable Devices

Important Information

- ESD Protection for All Pins:
HBM (Human Body Model) > 6000 V

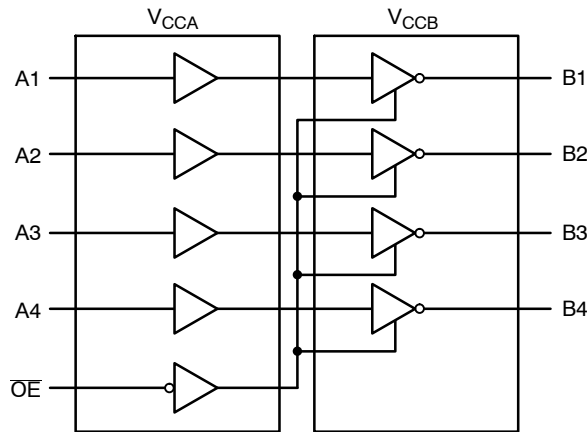
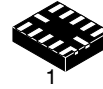


Figure 1. Logic Diagram



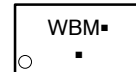
ON Semiconductor®

<http://onsemi.com>



UQFN12
MU SUFFIX
CASE 523AE

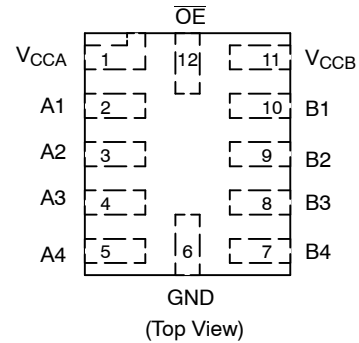
MARKING DIAGRAM



WB = Specific Device Code
M = Date Code
▪ = Pb-Free Package

(Note: Microdot may be in either location)

PIN ASSIGNMENT



ORDERING INFORMATION

| Device | Package | Shipping† |
|----------------|------------------|------------------|
| NLSV4T240MUTAG | UQFN12 (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.

NLSV4T240

PIN ASSIGNMENT

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

TRUTH TABLE

| Inputs | | Outputs |
|-----------------|----------------|----------------|
| \overline{OE} | A _n | B _n |
| L | L | H |
| L | H | L |
| 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 _n | -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 _n | -0.5 to +5.5 | V _{CCA} = V _{CCB} = 0 | V |
| | (Active Mode) B _n | -0.5 to +5.5 | | V |
| | (Tri-State Mode) B _n | -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 Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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 _n | GND | 4.5 | V |
| | (Active Mode) B _n | GND | V _{CCB} | V |
| | (Tri-State Mode) B _n | GND | 4.5 | V |
| T _A | Operating Temperature Range | -40 | +85 | °C |
| Δt / ΔV | Input Transition Rise or Rate V _I , from 30% to 70% of V _{CC} ; V _{CC} = 3.3 V ±0.3 V | 0 | 10 | nS |

NLSV4T240

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 (An, \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 (An, \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 μ A; 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 | – | | | |
| V _{OL} | Output LOW Voltage | I _{OL} = 100 μ A; V _I = V _{IL} | 0.9 – 4.5 | 0.9 – 4.5 | – | 0.2 | V |
| | | I _{OL} = 0.5 mA; V _I = V _{IH} | 1.1 | 1.1 | – | 0.3 | |
| | | I _{OL} = 2 mA; V _I = V _{IH} | 1.4 | 1.4 | – | 0.35 | |
| | | I _{OL} = 6 mA; V _I = V _{IL} | 1.65 | 1.65 | – | 0.3 | |
| | | | 2.3 | 2.3 | – | 0.4 | |
| | | I _{OL} = 12 mA; V _I = V _{IL} | 2.7 | 2.7 | – | 0.4 | |
| | | | 2.3 | 2.3 | – | 0.6 | |
| | | I _{OL} = 18 mA; V _I = V _{IL} | 3.0 | 3.0 | – | 0.4 | |
| 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 | μ A |
| I _{OFF} | Power-Off Leakage Current | \overline{OE} = 0 V | 0 0.9 – 4.5 | 0.9 – 4.5 0 | -1.0 -1.0 | 1.0 1.0 | μ A |
| 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 | – | 2.0 | μ A |
| 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 | μ A |
| 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 | – | 4.0 | μ A |
| Δ I _{CCA} | Increase in I _{CC} per Input Voltage, Other Inputs at V _{CCA} or GND | V _I = V _{CCA} - 0.6 V; V _I = V _{CCA} or GND | 4.5 | 4.5 | – | 10 | μ A |
| | | | 3.6 | 3.6 | – | 5.0 | |
| Δ I _{CCB} | Increase in I _{CC} per Input Voltage, Other Inputs at V _{CCA} or GND | V _I = V _{CCA} - 0.6 V; V _I = V _{CCA} or GND | 4.5 | 4.5 | – | 10 | μ A |
| | | | 3.6 | 3.6 | – | 5.0 | |
| 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 | μ A |

NLSV4T240

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

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

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

| Symbol | Parameter | V_{CCA} (V) | -40°C to +85°C | | | | | | | | | | Unit |
|--|---|---------------|----------------|------|-----|------|-----|------|-----|------|-----|------|------|
| | | | V_{CCB} (V) | | | | | | | | | | |
| | | | 4.5 | | 3.3 | | 2.8 | | 1.8 | | 1.2 | | |
| | | | Min | Max | Min | Max | Min | Max | Min | Max | Min | Max | |
| t_{PLH} , t_{PHL} (Note 1) | Propagation Delay, A_n to B_n | 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{OE} to B_n | 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_n | 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, Time | 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 | 20 | pF |

2. Typical values are at $T_A = +25^\circ\text{C}$.

3. C_{PD} is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from:
 $I_{CC(\text{operating})} \cong C_{PD} \times V_{CC} \times f_{IN} \times N_{SW}$ where $I_{CC} = I_{CCA} + I_{CCB}$ and N_{SW} = total number of outputs switching.

NLSV4T240

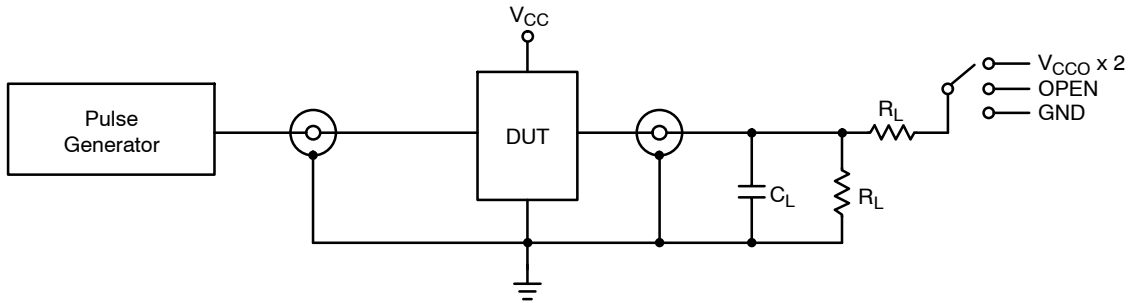
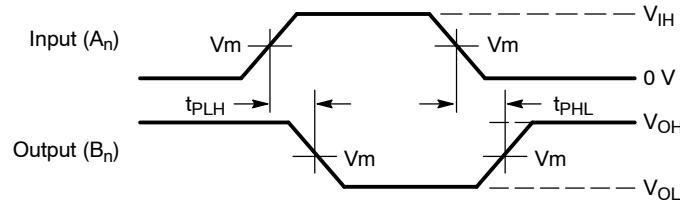


Figure 2. AC (Propagation Delay) Test Circuit

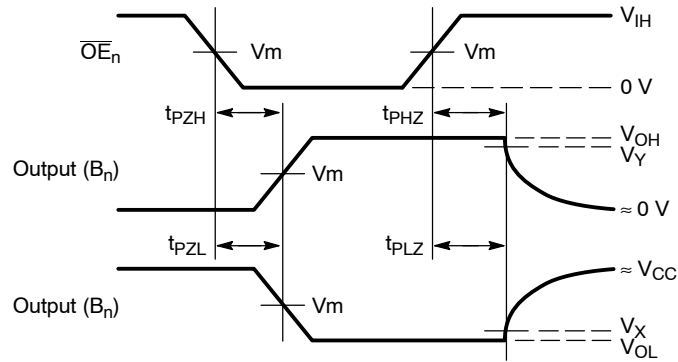
| Test | Switch |
|-----------------------|--------------------|
| t_{PLH} , t_{PHL} | OPEN |
| t_{PLZ} , t_{PZL} | $V_{CCO} \times 2$ |
| t_{PHZ} , t_{PZH} | GND |

$C_L = 15 \text{ pF}$ or equivalent (includes probe and jig capacitance)
 $R_L = 2 \text{ k}\Omega$ or equivalent
 Z_{OUT} of pulse generator = 50Ω



Waveform 1 – Propagation Delays

$t_R = t_F = 2.0 \text{ ns}$, 10% to 90%; $f = 1 \text{ MHz}$; $t_W = 500 \text{ ns}$



Waveform 2 – Output Enable and Disable Times

$t_R = t_F = 2.0 \text{ ns}$, 10% to 90%; $f = 1 \text{ MHz}$; $t_W = 500 \text{ ns}$

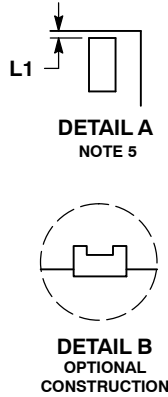
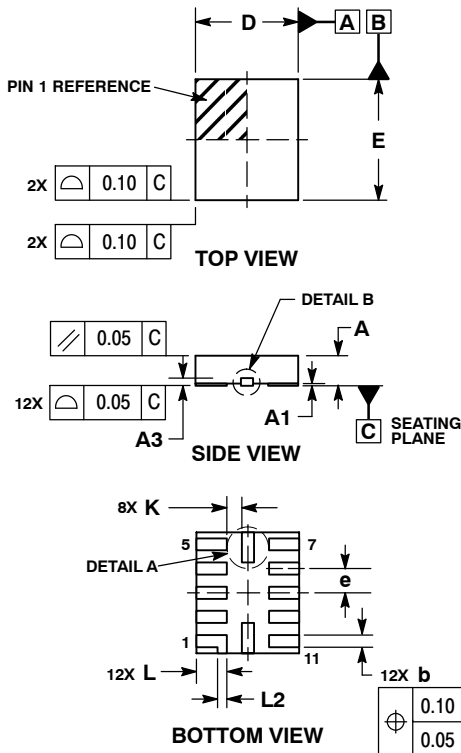
Figure 3. AC (Propagation Delay) Test Circuit Waveforms

| 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 | $V_{OL} \times 0.1$ | $V_{OL} \times 0.1$ | $V_{OL} \times 0.1$ | $V_{OL} \times 0.1$ | $V_{OL} \times 0.1$ |
| V_Y | $V_{OH} \times 0.9$ | $V_{OH} \times 0.9$ | $V_{OH} \times 0.9$ | $V_{OH} \times 0.9$ | $V_{OH} \times 0.9$ |

NLSV4T240

PACKAGE DIMENSIONS

UQFN12 1.7x2.0, 0.4P
CASE 523AE-01
ISSUE A

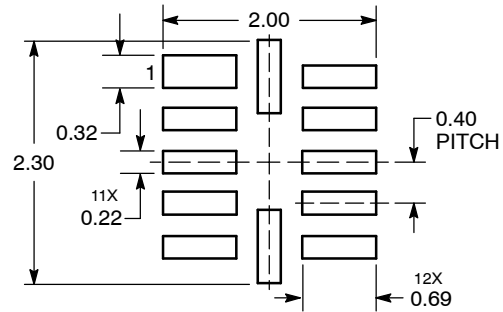


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. MOLD FLASH ALLOWED ON TERMINALS ALONG EDGE OF PACKAGE. FLASH 0.03 MAX ON BOTTOM SURFACE OF TERMINALS.
5. DETAIL A SHOWS OPTIONAL CONSTRUCTION FOR TERMINALS.

| DIM | MILLIMETERS | |
|-----|-------------|------|
| | MIN | MAX |
| A | 0.45 | 0.55 |
| A1 | 0.00 | 0.05 |
| A3 | 0.127 REF | |
| b | 0.15 | 0.25 |
| D | 1.70 BSC | |
| E | 2.00 BSC | |
| e | 0.40 BSC | |
| K | 0.20 | ---- |
| L | 0.45 | 0.55 |
| L1 | 0.00 | 0.03 |
| L2 | 0.15 REF | |

MOUNTING FOOTPRINT SOLDERMASK DEFINED



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.

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