

# NLSV4T244

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

The NLSV4T244 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) > 1500 V

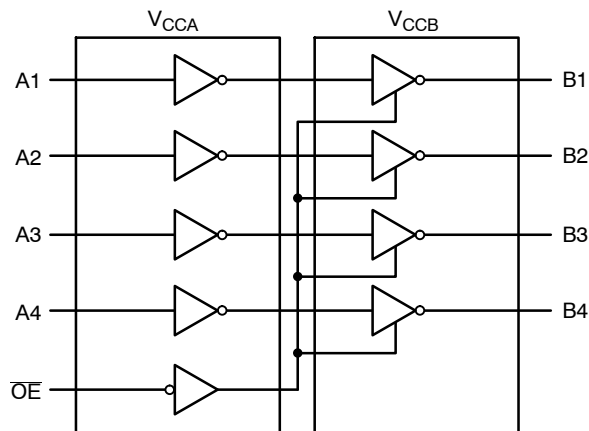


Figure 1. Logic Diagram



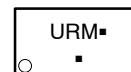
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UQFN12  
MU SUFFIX  
CASE 523AE

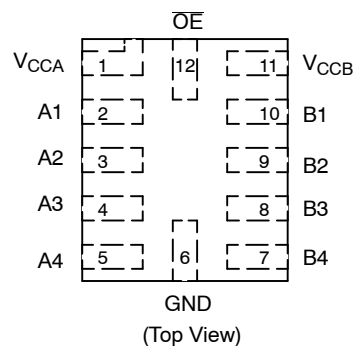
### MARKING DIAGRAM



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

(Note: Microdot may be in either location)

### PIN ASSIGNMENT



### ORDERING INFORMATION

Device	Package	Shipping†
NLSV4T244MUTAG	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.

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## PIN ASSIGNMENT

PIN	FUNCTION
V <sub>CCA</sub>	Input Port DC Power Supply
V <sub>CCB</sub>	Output Port DC Power Supply
GND	Ground
A <sub>n</sub>	Input Port
B <sub>n</sub>	Output Port
$\overline{OE}$	Output Enable

## TRUTH TABLE

Inputs		Outputs
$\overline{OE}$	A <sub>n</sub>	B <sub>n</sub>
L	L	L
L	H	H
H	X	3-State

## MAXIMUM RATINGS

Symbol	Rating	Value	Condition	Unit
V <sub>CCA</sub> , V <sub>CCB</sub>	DC Supply Voltage	-0.5 to +5.5		V
V <sub>I</sub>	DC Input Voltage A <sub>n</sub>	-0.5 to +5.5		V
V <sub>C</sub>	Control Input $\overline{OE}$	-0.5 to +5.5		V
V <sub>O</sub>	DC Output Voltage (Power Down) B <sub>n</sub>	-0.5 to +5.5	V <sub>CCA</sub> = V <sub>CCB</sub> = 0	V
	(Active Mode) B <sub>n</sub>	-0.5 to +5.5		V
	(Tri-State Mode) B <sub>n</sub>	-0.5 to +5.5		V
I <sub>IK</sub>	DC Input Diode Current	-20	V <sub>I</sub> < GND	mA
I <sub>OK</sub>	DC Output Diode Current	-50	V <sub>O</sub> < GND	mA
I <sub>O</sub>	DC Output Source/Sink Current	±50		mA
I <sub>CCA</sub> , I <sub>CCB</sub>	DC Supply Current Per Supply Pin	±100		mA
I <sub>GND</sub>	DC Ground Current per Ground Pin	±100		mA
T <sub>STG</sub>	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 <sub>CCA</sub> , V <sub>CCB</sub>	Positive DC Supply Voltage	0.9	4.5	V
V <sub>I</sub>	Bus Input Voltage	GND	4.5	V
V <sub>C</sub>	Control Input $\overline{OE}$	GND	4.5	V
V <sub>IO</sub>	Bus Output Voltage (Power Down Mode) B <sub>n</sub>	GND	4.5	V
	(Active Mode) B <sub>n</sub>	GND	V <sub>CCB</sub>	V
	(Tri-State Mode) B <sub>n</sub>	GND	4.5	V
T <sub>A</sub>	Operating Temperature Range	-40	+85	°C
Δt / ΔV	Input Transition Rise or Rate V <sub>I</sub> , from 30% to 70% of V <sub>CC</sub> ; V <sub>CC</sub> = 3.3 V ±0.3 V	0	10	nS

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## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	-40°C to +85°C		Unit
					Min	Max	
V <sub>IH</sub>	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 <sub>CCA</sub>	–	
			0.9 – 1.4		0.9 * V <sub>CCA</sub>	–	
V <sub>IL</sub>	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 <sub>CCA</sub>	
			0.9 – 1.4		–	0.1 * V <sub>CCA</sub>	
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -100 $\mu$ A; V <sub>I</sub> = V <sub>IH</sub>	0.9 – 4.5	0.9 – 4.5	V <sub>CCB</sub> - 0.2	–	V
		I <sub>OH</sub> = -0.5 mA; V <sub>I</sub> = V <sub>IH</sub>	0.9	0.9	0.75 * V <sub>CCB</sub>	–	
		I <sub>OH</sub> = -2 mA; V <sub>I</sub> = V <sub>IH</sub>	1.4	1.4	1.05	–	
		I <sub>OH</sub> = -6 mA; V <sub>I</sub> = V <sub>IH</sub>	1.65	1.65	1.25	–	
			2.3	2.3	2.0	–	
		I <sub>OH</sub> = -12 mA; V <sub>I</sub> = V <sub>IH</sub>	2.3	2.3	1.8	–	
			2.7	2.7	2.2	–	
		I <sub>OH</sub> = -18 mA; V <sub>I</sub> = V <sub>IH</sub>	2.3	2.3	1.7	–	
3.0	3.0		2.4	–			
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 100 $\mu$ A; V <sub>I</sub> = V <sub>IL</sub>	0.9 – 4.5	0.9 – 4.5	–	0.2	V
		I <sub>OL</sub> = 0.5 mA; V <sub>I</sub> = V <sub>IH</sub>	1.1	1.1	–	0.3	
		I <sub>OL</sub> = 2 mA; V <sub>I</sub> = V <sub>IH</sub>	1.4	1.4	–	0.35	
		I <sub>OL</sub> = 6 mA; V <sub>I</sub> = V <sub>IL</sub>	1.65	1.65	–	0.3	
			2.3	2.3	–	0.4	
		I <sub>OL</sub> = 12 mA; V <sub>I</sub> = V <sub>IL</sub>	2.7	2.7	–	0.4	
			2.3	2.3	–	0.6	
		I <sub>OL</sub> = 18 mA; V <sub>I</sub> = V <sub>IL</sub>	3.0	3.0	–	0.45	
3.0	3.0		–	0.6			
I <sub>I</sub>	Input Leakage Current	V <sub>I</sub> = V <sub>CCA</sub> or GND	0.9 – 4.5	0.9 – 4.5	-1.0	1.0	$\mu$ A
I <sub>OFF</sub>	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	$\mu$ A
I <sub>CCA</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCA</sub> or GND; I <sub>O</sub> = 0, V <sub>CCA</sub> = V <sub>CCB</sub>	0.9 – 4.5	0.9 – 4.5	–	2.0	$\mu$ A
I <sub>CCB</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCA</sub> or GND; I <sub>O</sub> = 0, V <sub>CCA</sub> = V <sub>CCB</sub>	0.9 – 4.5	0.9 – 4.5	–	2.0	$\mu$ A
I <sub>CCA</sub> + I <sub>CCB</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCA</sub> or GND; I <sub>O</sub> = 0, V <sub>CCA</sub> = V <sub>CCB</sub>	0.9 – 4.5	0.9 – 4.5	–	4.0	$\mu$ A
$\Delta$ I <sub>CCA</sub>	Increase in I <sub>CC</sub> per Input Voltage, Other Inputs at V <sub>CCA</sub> or GND	V <sub>I</sub> = V <sub>CCA</sub> - 0.6 V; V <sub>I</sub> = V <sub>CCA</sub> or GND	4.5	4.5	–	10	$\mu$ A
			3.6	3.6	–	5.0	
$\Delta$ I <sub>CCB</sub>	Increase in I <sub>CC</sub> per Input Voltage, Other Inputs at V <sub>CCA</sub> or GND	V <sub>I</sub> = V <sub>CCA</sub> - 0.6 V; V <sub>I</sub> = V <sub>CCA</sub> or GND	4.5	4.5	–	10	$\mu$ A
			3.6	3.6	–	5.0	
I <sub>OZ</sub>	I/O Tri-State Output Leakage Current	T <sub>A</sub> = 25°C, $\overline{OE}$ = 0 V	0.9 – 4.5	0.9 – 4.5	-1.0	1.0	$\mu$ A

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## 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	$\mu$ A
3.3		2		2		2		2		< 1.5	$\mu$ A
2.8		< 2		< 1		< 1		< 0.5		< 0.5	$\mu$ A
1.8		< 1		< 1		< 0.5		< 0.5		< 0.5	$\mu$ A
0.9		< 0.5		< 0.5		< 0.5		< 0.5		< 0.5	$\mu$ 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.

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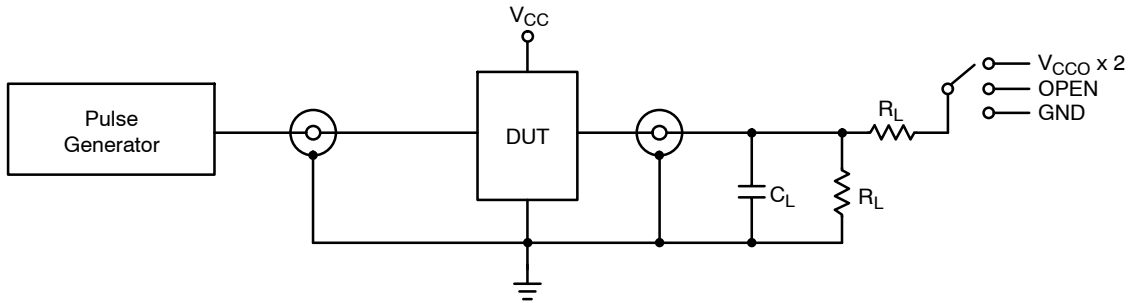
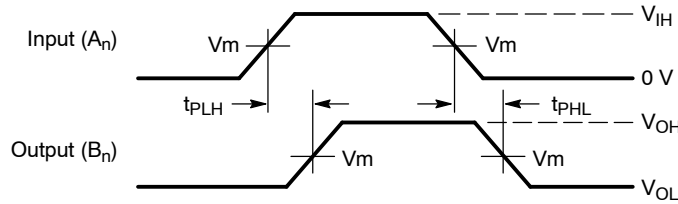


Figure 2. AC (Propagation Delay) Test Circuit

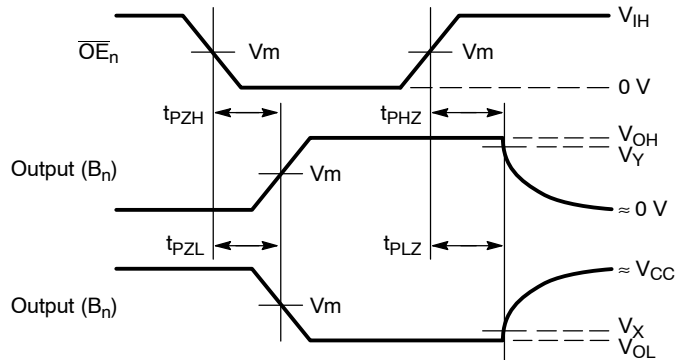
Test	Switch
$t_{PLH}$ , $t_{PHL}$	OPEN
$t_{PLZ}$ , $t_{PZL}$	$V_{CC} \times 2$
$t_{PHZ}$ , $t_{PZH}$	GND

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



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%;  $f = 1 \text{ MHz}$ ;  $t_W = 500 \text{ ns}$

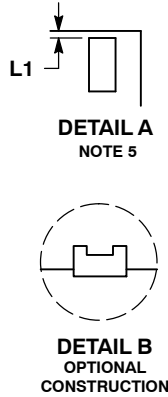
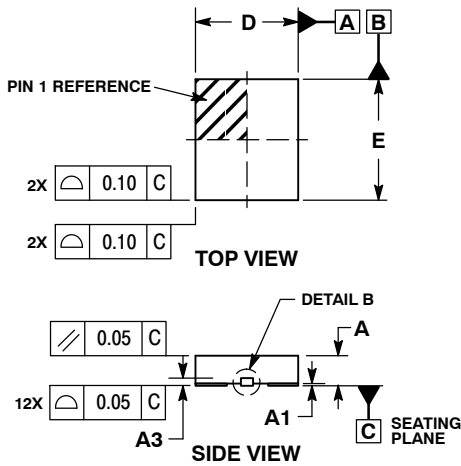
Figure 3. AC (Propagation Delay) Test Circuit Waveforms

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
$V_{mA}$	$V_{CCA}/2$	$V_{CCA}/2$	$V_{CCA}/2$	$V_{CCA}/2$	$V_{CCA}/2$
$V_{mB}$	$V_{CCB}/2$	$V_{CCB}/2$	$V_{CCB}/2$	$V_{CCB}/2$	$V_{CCB}/2$
$V_X$	$V_{OL} \times 0.1$	$V_{OL} \times 0.1$	$V_{OL} \times 0.1$	$V_{OL} \times 0.1$	$V_{OL} \times 0.1$
$V_Y$	$V_{OH} \times 0.9$	$V_{OH} \times 0.9$	$V_{OH} \times 0.9$	$V_{OH} \times 0.9$	$V_{OH} \times 0.9$

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## PACKAGE DIMENSIONS

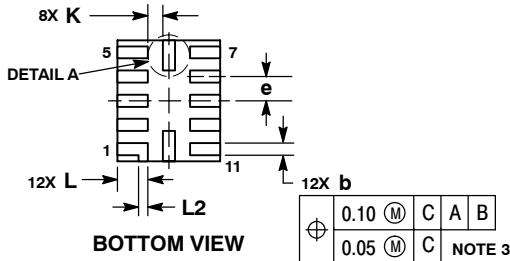
UQFN12 1.7x2.0, 0.4P  
CASE 523AE-01  
ISSUE A



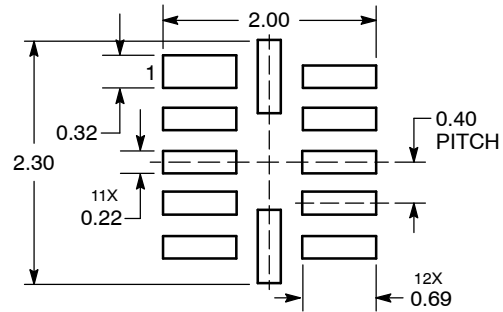
**NOTES:**

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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