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NLSV4T3144

4-Bit Dual-Supply Non-Inverting Level Translator

The NLSV4T3144 is a 4−bit configurable dual−supply bus buffer level translator. The input (IN_x_n) and output (OUT_x_n) ports are designed to track two different power supply rails, V_{CCA} and V_{CCB} respectively. Both supply rails are configurable from 1.6 V to 3.6 V allowing low−voltage translation from the input to the output port.

Features

- Wide V_{CCA} and V_{CCB} Operating Range: 1.6 V to 3.6 V
- High−Speed w/ Balanced Propagation Delay
- Inputs and Outputs have OVT Protection to 5.5 V
- Outputs at 3−State until Active V_{CCA} and V_{CCB} are Reached
- Power−Off Protection
- Ultra−Small Packaging: 1.7 mm x 2.0 mm UQFN−12
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

Typical Applications

- Mobile Phones, PDAs, Other Portable Devices
- SPI™ Bus Voltage Translation

Important Information

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

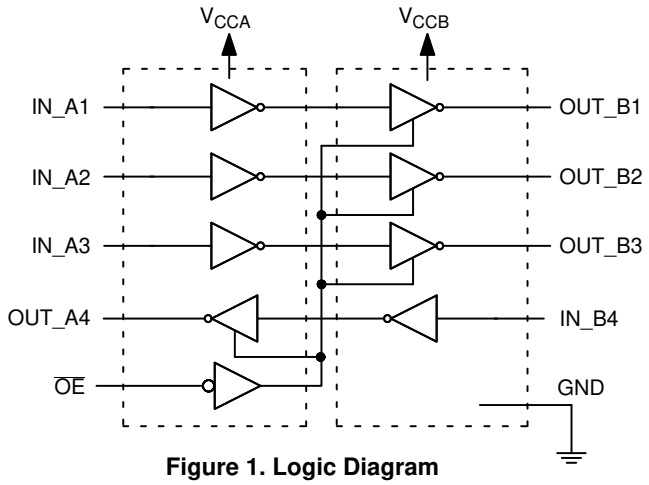

Figure 1. Logic Diagram

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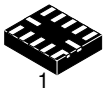
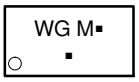


UQFN12
MU SUFFIX
CASE 523AE

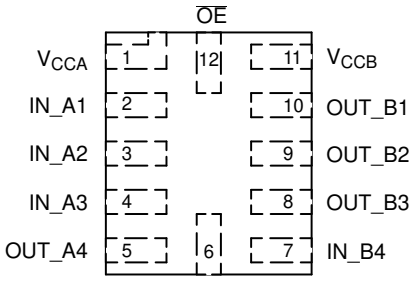
MARKING DIAGRAM



WG = Specific Device Code
M = Date Code
▪ = Pb−Free Package

(Note: Microdot may be in either location)

PIN ASSIGNMENTS



(Top View)

ORDERING INFORMATION

Device	Package	Shipping†
NLSV4T3144MUTAG	UQFN−12 (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.

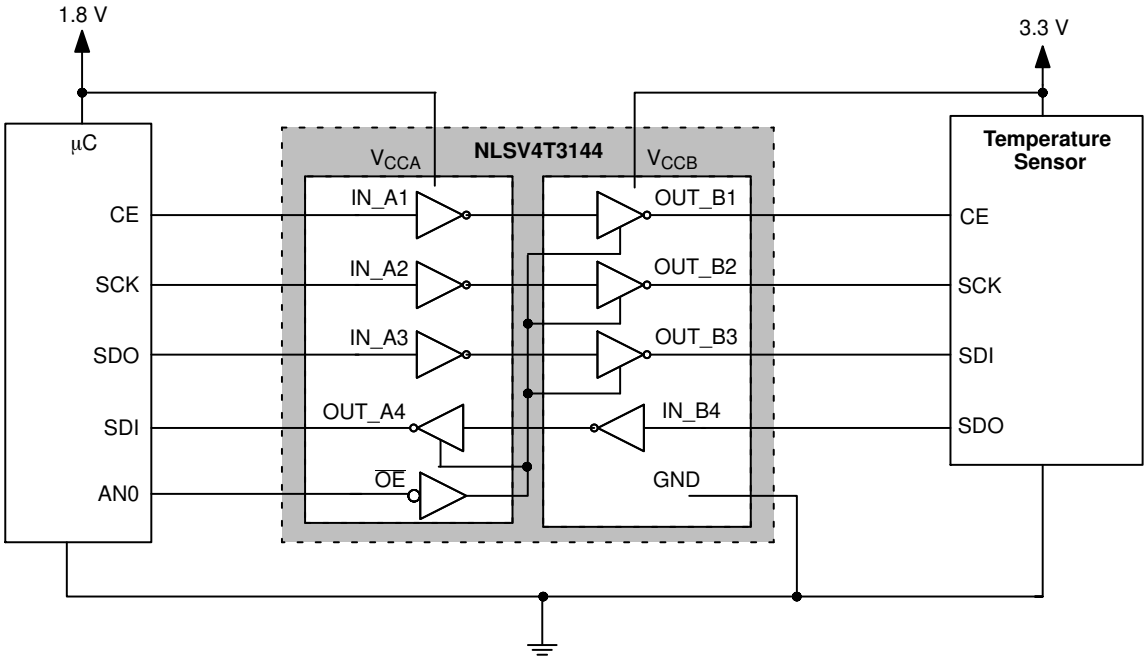


Figure 2. Typical Application: SPI Bus Voltage Translator

PIN NAMES

Pins	Description
V_{CCA}	'A' DC Power Supply
V_{CCB}	'B' DC Power Supply
GND	Ground
IN_A1, IN_A2, IN_A3	Input (Referenced to V_{CCA})
IN_B4	Input (Referenced to V_{CCB})
OUT_B1, OUT_B2, OUT_B3	Output (Referenced to V_{CCB})
OUT_A4	Output (Referenced to V_{CCA})
$\overline{OE}$	Output Enable (Referenced to V_{CCA})

TRUTH TABLE

Inputs		Outputs
$\overline{OE}$	IN_A1, IN_A2, IN_A3, IN_B4	OUT_B1, OUT_B2, OUT_B3, OUT_A4
H	X	3−State
L	L	L
	H	H

MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Unit
V_{CCA}, V_{CCB}	DC Supply Voltage, $V_{CCA} \le V_{CCB}$	−0.5 to +5.5		V
V_I	DC Input Voltage IN_x_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) OUT_x_n	−0.5 to +5.5	$V_{CCA} = V_{CCB} = 0$	V
	(Active Mode) OUT_x_n	−0.5 to +5.5		
	(Tri−State Mode) OUT_x_n	−0.5 to +5.5		
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, $V_{CCA} \le V_{CCB}$	1.6	3.6	V
V_I	Bus Input Voltage	GND	3.6	V
V_C	Control Input $\overline{OE}$	GND	3.6	V
V_{IO}	DC Output Voltage (Power Down) OUT_x_n	GND	3.6	V
	(Active Mode) OUT_x_n			
	(Tri−State Mode) OUT_x_n			
T_A	Operating Temperature Range	−40	+85	°C
$\Delta t / \Delta V$	Input Transition Rise or Rate V_I, from 30% to 70% of V_{CCA} and V_{CCB}; $V_{CCA} = V_{CCB} = 3.3$ V ±0.3 V	0	10	ns

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CCA} (V)	V_{CCB} (V)	–40°C to + 85°C		Unit
					Min	Max	
V_{IH} (IN_A1, IN_A2, IN_A3, $\overline{OE}$)	Input HIGH Voltage		2.7 – 3.6	≥ V_{CCA}	2.0	–	V
			2.3 – 2.7		1.6	–	
			1.6 –2.3		0.65 * V_{CCA}	–	
V_{IH} (IN_B4)	Input HIGH Voltage		≤ V_{CCB}	2.7 – 3.6	2.0	–	V
				2.3 – 2.7	1.6	–	
				1.6 –2.3	0.65 * V_{CCB}	–	
V_{IL} (IN_A1, IN_A2, IN_A3, $\overline{OE}$)	Input LOW Voltage		2.7 – 3.6	≥ V_{CCA}	–	0.8	V
			2.3 – 2.7		–	0.7	
			1.6 –2.3		–	0.35 * V_{CCA}	
V_{IL} (IN_B4)	Input LOW Voltage		≤ V_{CCB}	2.7 – 3.6	–	0.8	V
				2.3 – 2.7	–	0.7	
				1.6 –2.3	–	0.35 * V_{CCB}	
V_{OH} (OUT_B1, OUT_B2, OUT_B3)	Output HIGH Voltage	I_{OH} = –100 μA; V_I = V_{IH}	≤ V_{CCB}	1.6 – 3.6	V_{CCB} – 0.2	–	V
		I_{OH} = –6 mA; V_I = V_{IH}	1.6	1.6	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_{OH} (OUT_A4)	Output HIGH Voltage	I_{OH} = –100 μA; V_I = V_{IH}	1.6 – 3.6	≥ V_{CCA}	V_{CCA} – 0.2	–	V
		I_{OH} = –6 mA; V_I = V_{IH}	1.6	1.6	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} (OUT_B1, OUT_B2, OUT_B3)	Output LOW Voltage	I_{OL} = 100 μA; V_I = V_{IH}	≤ V_{CCB}	1.6 – 3.6	–	0.2	V
		I_{OL} = 6 mA; V_I = V_{IH}	1.6	1.6	–	0.3	
		I_{OL} = 12 mA; V_I = V_{IH}	2.3	2.3	–	0.4	
			2.7	2.7	–	0.4	
		I_{OL} = 18 mA; V_I = V_{IH}	2.3	2.3	–	0.6	
			3.0	3.0	–	0.5	
		I_{OL} = 24 mA; V_I = V_{IH}	3.0	3.0	–	0.6	
V_{OL} (OUT_A4)	Output LOW Voltage	I_{OL} = 100 μA; V_I = V_{IH}	1.6 – 3.6	≥ V_{CCA}	–	0.2	V
		I_{OL} = 6 mA; V_I = V_{IH}	1.6	1.6	–	0.3	
		I_{OL} = 12 mA; V_I = V_{IH}	2.3	2.3	–	0.4	
			2.7	2.7	–	0.4	
		I_{OL} = 18 mA; V_I = V_{IH}	2.3	2.3	–	0.6	
			3.0	3.0	–	0.5	
		I_{OL} = 24 mA; V_I = V_{IH}	3.0	3.0	–	0.6	

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CCA} (V)	V_{CCB} (V)	–40°C to + 85°C		Unit
					Min	Max	
I_{IN}	Input Leakage Current	V_{IN_A1} = V_{IN_A2} = V_{IN_A3} = V_{CCA} or GND; V_{IN_B4} = V_{CCB} or GND	≤ V_{CCB}	1.6 – 3.6	–1.0	+1.0	μA
I_{OZ}	I/O Tri – State Output Leakage Current	TA = 25°C, $\overline{OE}$ = V_{CCA}	≤ V_{CCB}	1.6 – 3.6	–	1.0	μA
I_{CCA}	Quiescent Supply Current	V_{IN_A1} = V_{IN_A2} = V_{IN_A3} = V_{CCA} or GND; V_{IN_B4} = V_{CCB} or GND $\overline{OE}$ = GND, I_O = 0	≤ V_{CCB}	1.6 – 3.6	–	3.0	μA
I_{CCB}	Quiescent Supply Current	V_{IN_A1} = V_{IN_A2} = V_{IN_A3} = V_{CCA} or GND; V_{IN_B4} = V_{CCB} or GND $\overline{OE}$ = GND, I_O = 0	≤ V_{CCB}	1.6 – 3.6	–	3.0	μA
I_{CCA} + I_{CCB}	Quiescent Supply Current	V_{IN_A1} = V_{IN_A2} = V_{IN_A3} = V_{CCA} or GND; V_{IN_B4} = V_{CCB} or GND $\overline{OE}$ = GND, I_O = 0	≤ V_{CCB}	1.6 – 3.6	–	6.0	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

Symbol	Parameter	V_{CCA} (V)	–40°C to +85°C						Unit
			V_{CCB} (V)						
			3.6		2.8		1.6		
			Min	Max	Min	Max	Min	Max	
t_{PLH}, t_{PHL}	Propagation Delay, Input to Output	3.6		3					ns
		2.8		3.1		3.3			
		1.6		4.3		4.5		6.1	
t_{PZH}, t_{PZL}	Output Enable, $\overline{OE}$ to Output	3.6		8.7					ns
		2.8		10.3		10.7			
		1.6		17.2		18		20	
t_{PHZ}, t_{PLZ}	Output Disable, $\overline{OE}$ to Output	3.6		7.8					ns
		2.8		8.2		8.4			
		1.6		9.5		9.8		10.5	
t_{OSHL}, t_{OSLH}	Output to Output Skew	3.6		0.25					ns
		2.8		0.25		0.25			
		1.6		0.25		0.25		0.25	

NOTE: Propagation delays defined per Figure 3.

CAPACITANCE

Symbol	Parameter	Test Conditions	**Typ** (Note 1)	Unit
C_I	Control Pin ($\overline{OE}$) Input Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_I = 0 V or $V_{CCA/B}$	3.5	pF
C_{IN}	Input Pin Capacitance	V_{CCA} = V_{CCB} = 3.3 V, V_I = 0 V or $V_{CCA/B}$	5.0	pF
C_{OUT}	Output Pin 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_{CC2} = 3.3 V, V_I = 0 V or 3.3 V, f = 10 MHz	10	pF

1. Typical values are at T_A = +25°C.

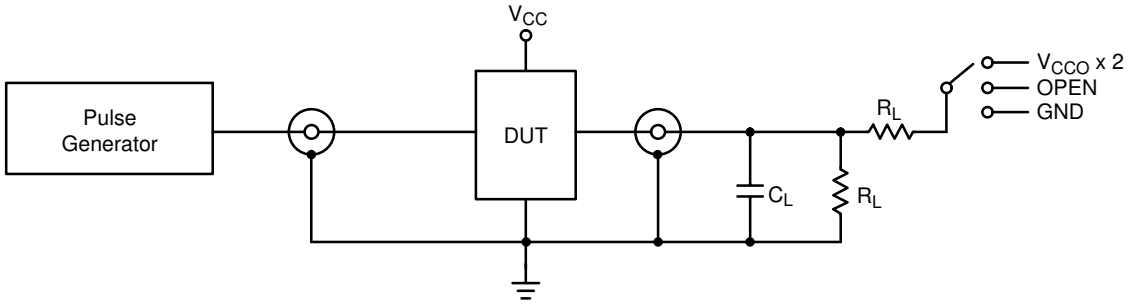
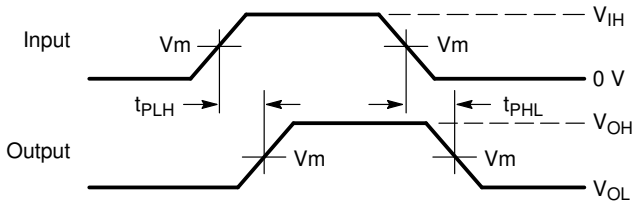
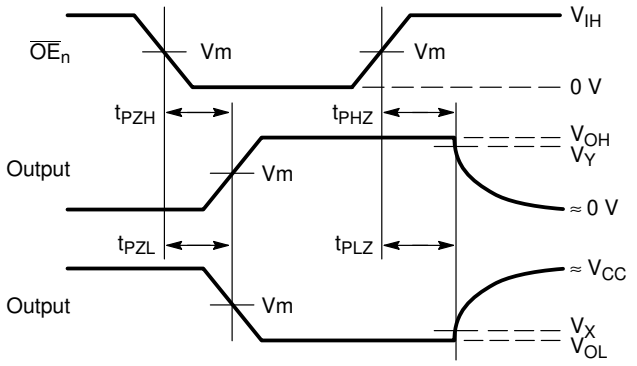


Figure 3. AC (Propagation Delay) Test Circuit

Test	Switch
t_{PLH}, t_{PHL}	OPEN
t_{PLZ}, t_{PZL}	V_{CCO} x 2 at V_{CCO} = 3.0 V – 3.6 V, 2.3 V – 2.7 V, 1.65 V – 1.95 V, 1.4 V – 1.6 V
t_{PHZ}, t_{PZH}	GND
C_L = 15 pF or equivalent (includes probe and jig capacitance) R_L = 2 kΩ or equivalent Z_{OUT} of pulse generator = 50 Ω V_{CCO} is the supply voltage referenced to by the output being tested	



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



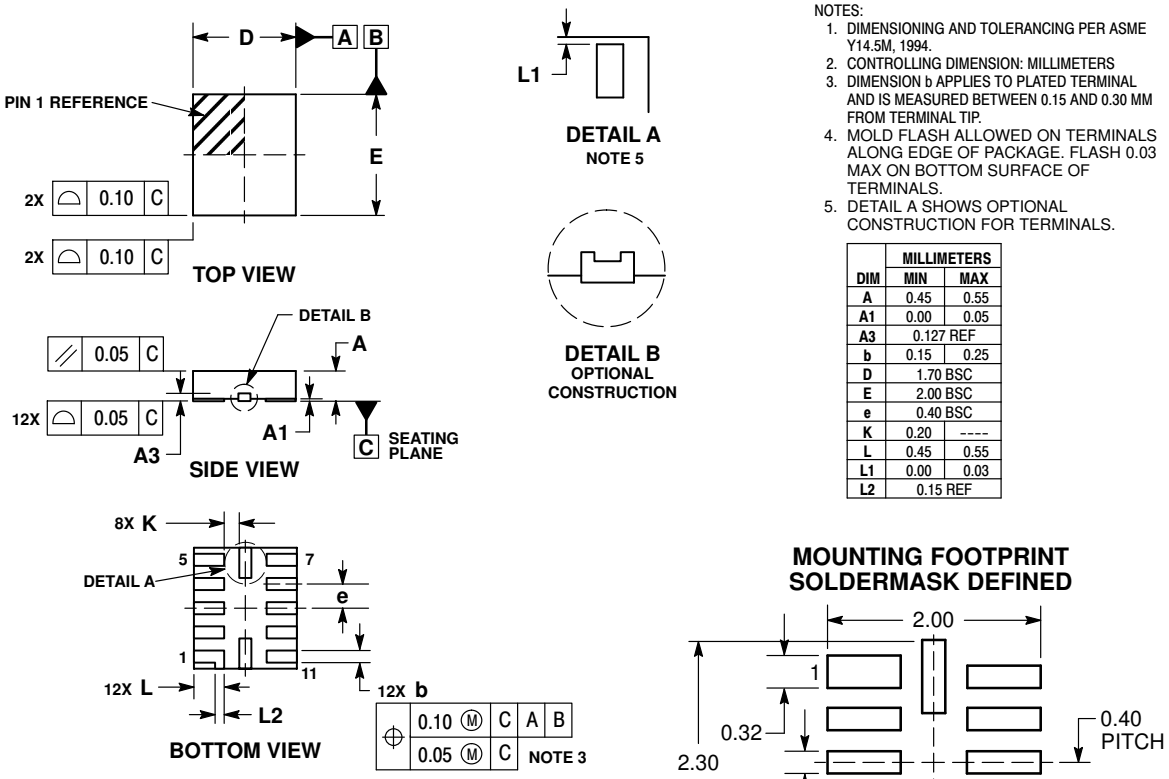
Waveform 2 – Output Enable and Disable Times
$t_R = t_F$ = 2.0 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns

Figure 4. AC (Propagation Delay) Test Circuit Waveforms

Symbol	Input Pin Output Pin
V_m	$V_{CCX}/2$
V_X	V_{OL} x 0.1
V_Y	V_{OH} x 0.9

PACKAGE DIMENSIONS

UQFN12 1.7x2.0, 0.4P
CASE 523AE
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.

	MILLIMETERS	
DIM	MIN	MAX
A	0.45	0.55
A1	0.00	0.05
A3	0.127 REF	
b	0.15	0.25
D	1.70 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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