

# 8-Bit Dual-Supply Level Translator

## NL3V8T244, NL3V8T240

The NL3V8T244 / NL3V8T240 are 8-bit configurable dual-supply level translators with 3-state outputs. The A- and B- 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 3.6 V allowing universal voltage level translation between the A- to B- ports.

The NL3V8T244 is an 8-bit level translator that allows non-inverting translations from A to B ports. The NL3V8T240 is an 8-bit level translator that allows inverting translations from A to B ports.

The output enable pin ( $\overline{OE}$ ), when High, disables all the output ports by putting them in 3-state. The  $\overline{OE}$  pin is designed to track  $V_{CCA}$ .

### Features

- Wide  $V_{CCA}$  and  $V_{CCB}$  Operating Range: 0.9 V to 3.6 V
- Balanced Output Drive:  $\pm 24$  mA @ 3.0 V
- High-Speed w/ Balanced Propagation Delay: 2.8 ns max at 3.0 to 3.6 V
- Inputs Pins OVT to 3.6 V
- Non-preferential  $V_{CC}$  Sequencing
- Outputs at 3-State until Active  $V_{CC}$  is Reached
- Partial Power-Off Protection
- Outputs Switch to 3-State with either  $V_{CC}$  at GND
- Typical Max Data Rates:
  - 380 Mbps ( $\geq 1.8$ -V to 3.3-V Translation)
  - 200 Mbps ( $\geq 1.1$ -V to [1.8-V, 2.5-V, 3.3-V] Translation)
  - 150 Mbps ( $\geq 1.1$ -V to 1.5-V Translation)
  - 100 Mbps ( $\geq 1.1$ -V to 1.2-V Translation)
- Small Pb-Free Packaging: UDFN20, SOIC-20W, TSSOP-20
- -Q Suffix 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

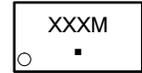
### Typical Applications

- Mobile Phones, PDAs, Other Portable Devices
- Automotive
- Industrial

### MARKING DIAGRAMS



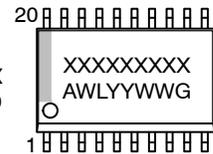
UQFN20  
MU SUFFIX  
CASE 517AK



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



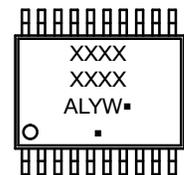
SOIC-20  
DW SUFFIX  
CASE 751D



A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package



TSSOP-20  
DT SUFFIX  
CASE 948E



A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

# NL3V8T244, NL3V8T240

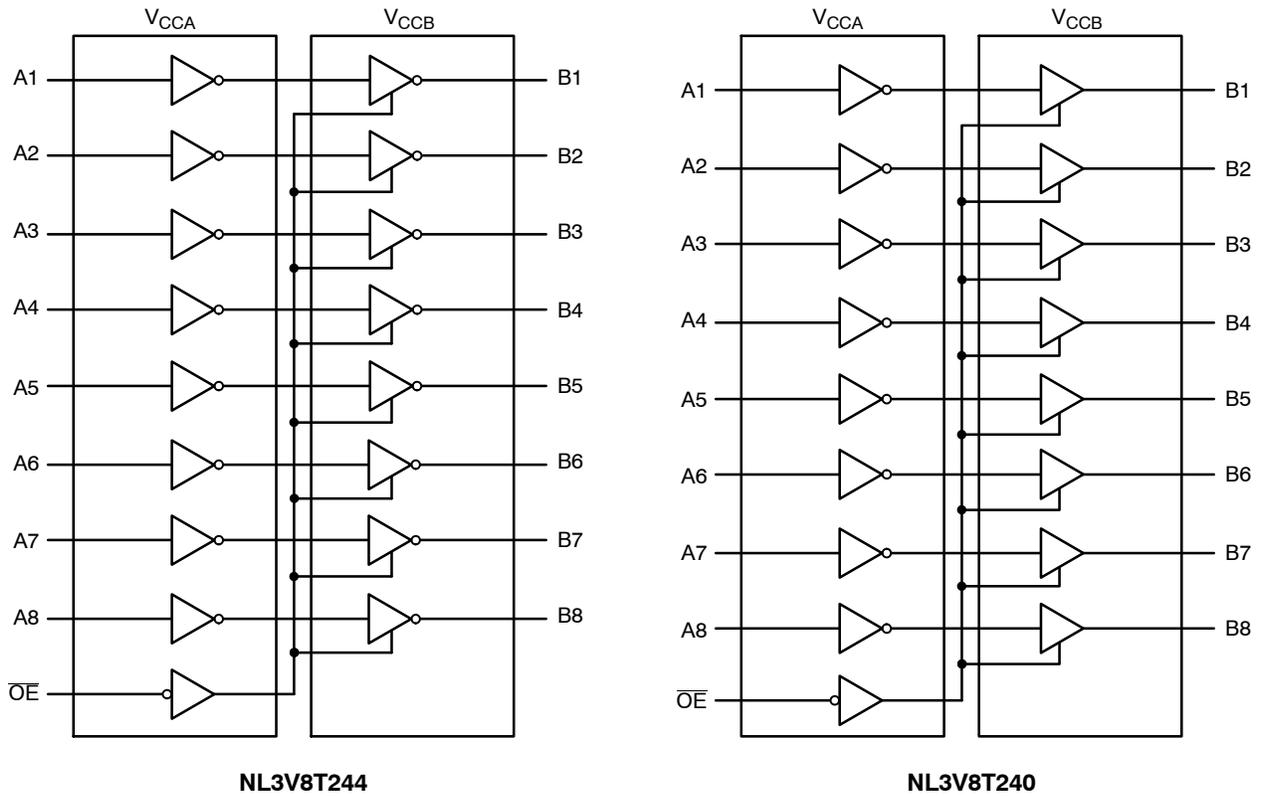


Figure 1. Logic Diagrams

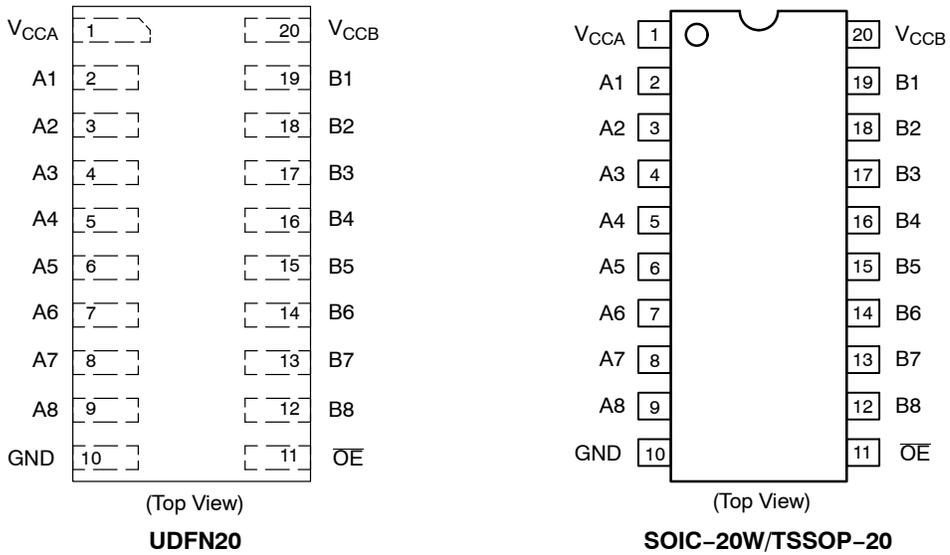


Figure 2. Pin Assignments (Top View)

## NL3V8T244, NL3V8T240

FUNCTION TABLE – NL3V8T244

Inputs		Output
$\overline{OE}$	$A_n$	$B_n$
L	L	L
L	H	H
H	X	3-State

FUNCTION TABLE – NL3V8T240

Inputs		Output
$\overline{OE}$	$A_n$	$B_n$
L	L	H
L	H	L
H	X	3-State

### PIN NAMES

PINS	DESCRIPTION
$V_{CCA}$	A Port DC Supply
$V_{CCB}$	B Port DC Supply
GND	Ground
$\overline{OE}$	Output Enable
A1, A2, A3, A4, A5, A6, A7, A8	Input Ports
B1, B2, B3, B4, B5, B6, B7, B8	Output Ports

### Application Recommendations

During power-up and power-down, it is recommended that the  $\overline{OE}$  pin be connected to  $V_{CC}$  through pull-up resistors to ensure high impedance at the I/O ports.

# NL3V8T244, NL3V8T240

## MAXIMUM RATINGS

Symbol	Rating	Value	Condition	Unit	
$V_{CCA}, V_{CCB}$	DC Supply Voltage	-0.5 to +4.3		V	
$V_I$	DC Input Voltage	-0.5 to +4.3		V	
$V_O$	DC Output Voltage (Power Down Mode)	-0.5 to +4.3	$V_{CCA} = V_{CCB} = 0$	V	
	(3-State Mode)	-0.5 to +4.3			
	(Active Mode)	-0.5 to $V_{CCB}+0.5$			
$I_{IK}$	DC Input Diode Current	-50	$V_I < \text{GND}$	mA	
$I_{OK}$	DC Output Diode Current	-50	$V_O < \text{GND}$	mA	
$I_O$	DC Output Source/Sink Current	$\pm 50$		mA	
$I_{CC}$	DC Supply Current Per Supply Pin	$\pm 100$		mA	
$I_{GND}$	DC Ground Current per Ground Pin	$\pm 100$		mA	
$T_{STG}$	Storage Temperature Range	-65 to +150		°C	
$\theta_{JA}$	Thermal Resistance (Note 1)	SOIC-20W	96	°C/W	
		TSSOP-20			150
		UDFN20			123
$P_D$	Power Dissipation in Still Air	SOIC-20W	1302	mW	
		TSSOP-20			833
		UDFN20			1016
MSL	Moisture Sensitivity Level		Level 1	-	
$F_R$	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	-	
$V_{ESD}$	ESD Withstand Voltage (Note 2)	Human Body Model	2	kV	
		Charged Device Model	1		
$I_{LATCHUP}$	Latchup Performance (Note 3)		$\pm 100$	mA	

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.

1. Measured with minimum pad spacing on an FR4 board, using 76mm-by-114mm, 2-ounce copper trace no air flow per JESD51-7.
2. HBM tested to ANSI/ESDA/JEDEC JS-001-2017. CDM tested to EIA/JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued per JEDEC/JEP172A.
3. Tested to EIA/JESD78 Class II.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CCA}, V_{CCB}$	Positive DC Supply Voltage	0.9	3.6	V
$V_I$	Input Voltage	GND	3.6	V
$V_O$	Output Voltage (Power Down Mode)	GND	3.6	V
	(3-State Mode)	GND	3.6	
	(Active Mode)	GND	$V_{CCB}$	
$T_A$	Operating Temperature Range	-40	+125	°C
$\Delta t / \Delta V$	Input Transition Rise or Rate	0	5	nS/V

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.

# NL3V8T244, NL3V8T240

## DC ELECTRICAL CHARACTERISTICS – INPUT VOLTAGES

Symbol	Parameter	Test Conditions	Port	V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	-40°C to +85°C			-40°C to +125°C		Unit
						Min	Typ (Note 4)	Max	Min	Max	
V <sub>IH</sub>	Input HIGH Voltage		OE, A	2.7 – 3.6	0.9 – 3.6	2.0	–	–	2.0	–	V
				2.3 – 2.7		1.6	–	–	1.6	–	
				1.65–1.95		0.65 V <sub>CCA</sub>	–	–	0.65 V <sub>CCA</sub>	–	
				1.1 – 1.6		0.7 V <sub>CCA</sub>	–	–	0.7 V <sub>CCA</sub>	–	
				0.9		–	0.9 V <sub>CCA</sub>	–	–	–	
V <sub>IL</sub>	Input LOW Voltage		OE, A	2.7 – 3.6	0.9 – 3.6	–	–	0.8	–	0.8	V
				2.3 – 2.7		–	–	0.7	–	0.7	
				1.65–1.95		–	–	0.35 V <sub>CCA</sub>	–	0.35 V <sub>CCA</sub>	
				1.1 – 1.6		–	–	0.3 V <sub>CCA</sub>	–	0.3 V <sub>CCA</sub>	
				0.9		–	0.1 V <sub>CCA</sub>	–	–	–	

4. All typical values are at T<sub>A</sub> = 25°C.

## DC ELECTRICAL CHARACTERISTICS – OUTPUT VOLTAGES

Symbol	Parameter	Test Conditions	V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	-40°C to +85°C			-40°C to +125°C		Unit
					Min	Typ (Note 4)	Max	Min	Max	
V <sub>OH</sub>	Output HIGH Voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> :								V
		I <sub>OH</sub> = -100 μA	0.9	0.9	–	V <sub>CCB</sub> - 0.1	–	–	–	
			1.1 – 3.6	1.1 – 3.6	V <sub>CCB</sub> - 0.1	–	–	V <sub>CCB</sub> - 0.1	–	
		I <sub>OH</sub> = -3 mA	1.1	1.1	0.85	–	–	0.85	–	
		I <sub>OH</sub> = -6 mA	1.4	1.4	1.05	–	–	1.05	–	
		I <sub>OH</sub> = -8 mA	1.65	1.65	1.2	–	–	1.2	–	
			2.3	2.3	1.8	–	–	1.8	–	
		I <sub>OH</sub> = -12 mA	2.7	2.7	2.2	–	–	2.2	–	
			2.3	2.3	1.7	–	–	1.7	–	
I <sub>OH</sub> = -18 mA	3.0	3.0	2.4	–	–	2.4	–			
	3.0	3.0	2.2	–	–	2.2	–			
V <sub>OL</sub>	Output LOW Voltage	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> :								V
		I <sub>OL</sub> = 100 μA	0.9	0.9	–	0.1	–	–	–	
			1.1 – 3.6	1.1 – 3.6	–	–	0.1	–	0.1	
		I <sub>OL</sub> = 3 mA	1.1	1.1	–	–	0.25	–	0.25	
		I <sub>OL</sub> = 6 mA	1.4	1.4	–	–	0.35	–	0.35	
		I <sub>OL</sub> = 8 mA	1.65	1.65	–	–	0.3	–	0.3	
			2.3	2.3	–	–	0.4	–	0.4	
		I <sub>OL</sub> = 12 mA	2.7	2.7	–	–	0.4	–	0.4	
			2.3	2.3	–	–	0.4	–	0.4	
I <sub>OL</sub> = 18 mA	3.0	3.0	–	–	0.4	–	0.4			
	3.0	3.0	–	–	0.55	–	0.55			

# NL3V8T244, NL3V8T240

## DC ELECTRICAL CHARACTERISTICS – LEAKAGE AND SUPPLY CURRENTS

Symbol	Parameter	Test Conditions	V <sub>CCA</sub> (V)	V <sub>CCB</sub> (V)	-40°C to +85°C		-40°C to +125°C		Unit	
					Min	Max	Min	Max		
I <sub>I</sub>	Input Leakage Current	V <sub>I</sub> = 3.6 V or GND	0.9 – 3.6	0.9 – 3.6	–	±1.0	–	±5.0	μA	
I <sub>OZ</sub>	3-State Output Leakage	$\overline{OE} = V_{IH}; V_O = \text{GND to } 3.6 \text{ V}$	3.6	3.6	–	±1.0	–	±5.0	μA	
I <sub>OFF</sub>	Power-Off Leakage Current	V <sub>I</sub> or V <sub>O</sub> = 0 to 3.6 V	A	0	0.9 – 3.6	–	±1.0	–	±5.0	μA
			B	0.9 – 3.6	0	–	±1.0	–	±5.0	
I <sub>CCA</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCA</sub> or GND; I <sub>O</sub> = 0	0.9 – 3.6	0.9 – 3.6	–	5.0	–	10	μA	
			0	0.9 – 3.6	–	–1.0	–	–5.0		
			0.9 – 3.6	0	–	5.0	–	10		
I <sub>CCB</sub>	Quiescent Supply Current	V <sub>I</sub> = V <sub>CCA</sub> or GND; I <sub>O</sub> = 0	0.9 – 3.6	0.9 – 3.6	–	5.0	–	10	μA	
			0	0.9 – 3.6	–	5.0	–	10		
			0.9 – 3.6	0	–	–1.0	–	–5.0		

NOTE: Connect ground before applying supply voltage V<sub>CCA</sub> or V<sub>CCB</sub>. This device is designed with the feature that the power-up sequence of V<sub>CCA</sub> and V<sub>CCB</sub> will not damage the IC.

## AC ELECTRICAL CHARACTERISTICS (Notes 5 and 6)

Symbol	Parameter	V <sub>CCA</sub> (V)	T <sub>A</sub> = -40°C to +85°C					T <sub>A</sub> = -40°C to +125°C					Unit
			V <sub>CCB</sub> (V)					V <sub>CCB</sub> (V)					
			3.3	2.5	1.8	1.5	1.2	3.3	2.5	1.8	1.5	1.2	
			Max	Max	Max	Max	Max	Max	Max	Max	Max	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A to B	3.3	2.9	3.3	4.5	5.6	9.3	3.3	3.8	5.0	6.2	9.5	nS
		2.5	3.6	3.7	4.6	5.7	9.4	4.0	4.0	5.1	6.3	9.6	
		1.8	3.9	4.0	4.9	6.0	9.6	4.3	4.3	5.4	6.6	9.8	
		1.5	4.2	4.3	5.2	6.3	9.8	4.7	4.7	5.8	7.0	10.0	
		1.2	5.1	5.2	6.2	7.1	11.0	5.7	5.8	6.9	7.9	11.2	
t <sub>PZH</sub> , t <sub>PZL</sub>	Output Enable, OE to B	3.3	3.8	4.7	6.8	8.7	11.3	4.2	5.2	7.5	9.6	12.4	nS
		2.5	4.0	4.8	7.0	8.8	11.3	4.4	5.3	7.7	9.7	12.4	
		1.8	4.6	5.3	7.4	9.2	11.7	5.1	5.9	8.2	10.2	12.9	
		1.5	5.6	5.8	7.7	9.6	12.1	6.2	6.4	8.5	10.6	13.3	
		1.2	7.7	7.9	8.9	10.0	13.5	8.5	8.7	9.8	11.0	14.7	
t <sub>PHZ</sub> , t <sub>PLZ</sub>	Output Disable, OE to B	3.3	6.2	6.4	8.1	9.3	10.2	6.9	7.1	9.0	10.3	11.3	nS
		2.5	5.2	6.2	8.2	8.8	10.4	5.8	6.9	9.1	10.4	11.5	
		1.8	6.9	6.9	8.7	9.9	10.9	7.6	7.6	9.6	10.9	12.0	
		1.5	7.6	7.4	9.1	10.3	11.3	8.2	8.4	10.1	11.4	12.5	
		1.2	8.1	8.1	9.5	9.6	12.4	9.0	10.1	10.5	10.6	13.7	

5. Propagation delays defined per Figure 3.

6. These parameters are guaranteed by characterization and are not production tested.

## CAPACITANCE

Symbol	Parameter	Test Conditions	Typ (Note 4)	Unit
C <sub>IN</sub>	Control Pin Input Capacitance	V <sub>CCA</sub> = V <sub>CCB</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CCA</sub>	2.5	pF
C <sub>I/O</sub>	I/O Pin Input Capacitance	V <sub>CCA</sub> = V <sub>CCB</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CCA</sub>	5.0	pF
C <sub>PD</sub> (Note 7)	Power Dissipation Capacitance	V <sub>CCA</sub> = V <sub>CCB</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CCA</sub> , f = 10 MHz	12	pF

7. C<sub>PD</sub> is defined as the value of the IC's equivalent capacitance from which the operating current can be calculated from: I<sub>CC(operating)</sub> ≈ C<sub>PD</sub> × V<sub>CC</sub> × f<sub>IN</sub> × N<sub>SW</sub> where I<sub>CC</sub> = I<sub>CCA</sub> + I<sub>CCB</sub> and N<sub>SW</sub> = total number of outputs switching.

# NL3V8T244, NL3V8T240

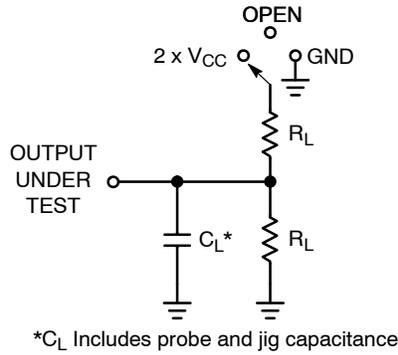


Figure 3. AC Test Circuit

Test	Switch	C <sub>L</sub>	R <sub>L</sub>
t <sub>PLH</sub> , t <sub>PHL</sub>	OPEN	15 pF	2 kΩ
t <sub>PLZ</sub> , t <sub>PZL</sub>	2 x V <sub>CC</sub>		
t <sub>PHZ</sub> , t <sub>PZH</sub>	GND		

C<sub>L</sub> includes probe and jig capacitance  
Pulse generator Z<sub>O</sub> = 50 Ω  
Input f = 1.0 MHz; t<sub>W</sub> = 500 ns

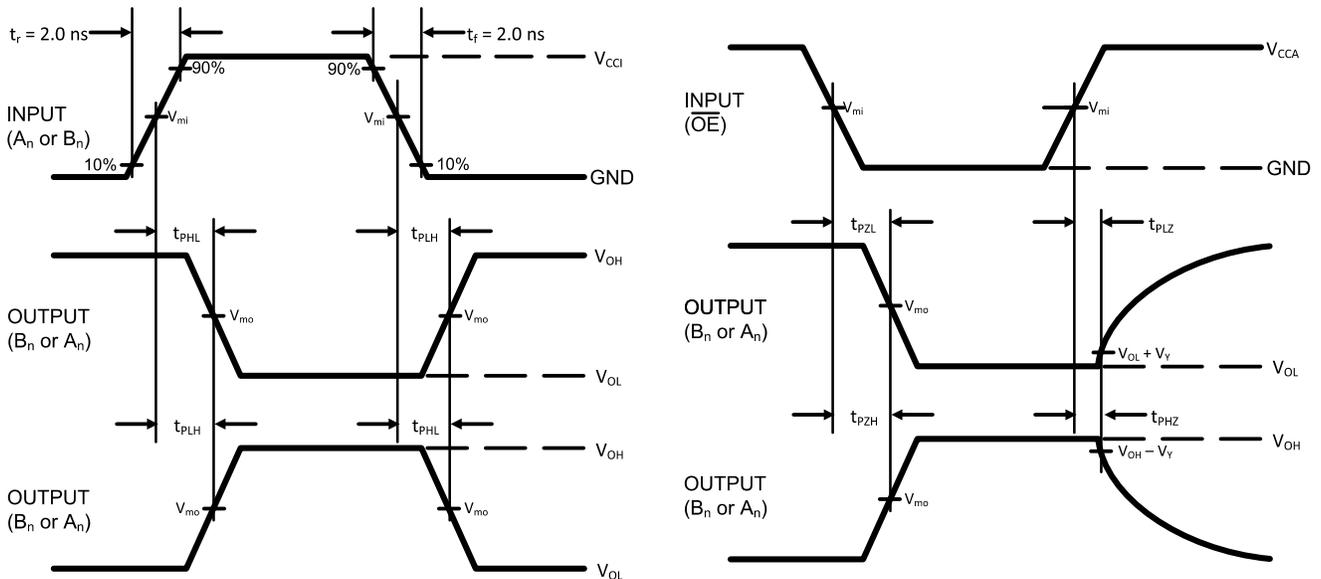


Figure 4. AC Waveforms

Symbol	V <sub>CC</sub>				
	3.0 V – 3.6 V	2.3 V – 2.7 V	1.65 V – 1.95 V	1.4 V – 1.6 V	1.1 V – 1.3 V
V <sub>mi</sub>	V <sub>CCI</sub> /2				
V <sub>mo</sub>	V <sub>CCO</sub> /2				
V <sub>Y</sub>	0.3 V	0.15 V	0.15 V	0.1 V	0.1 V

8. V<sub>CCI</sub> is the V<sub>CC</sub> associated with the input port.  
9. V<sub>CCO</sub> is the V<sub>CC</sub> associated with the output port.

# NL3V8T244, NL3V8T240

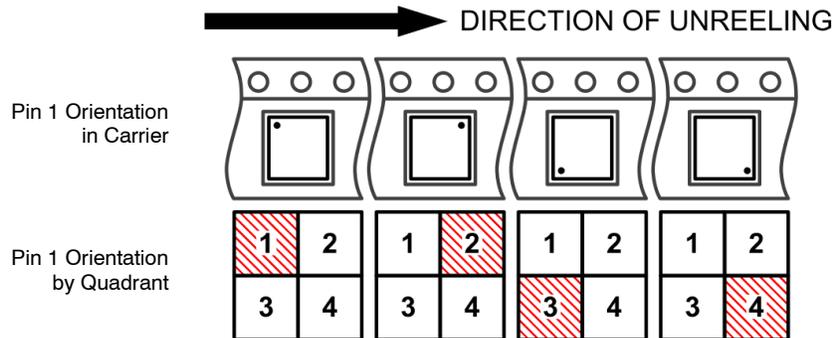
## ORDERING INFORMATION

Device	Marking	Package	Pin 1 Quadrant	Shipping <sup>†</sup>
NL3V8T244DWR2G (Contact <b>onsemi</b> sales)	TBD	SOIC-20W	1	1000 Units / Tape & Reel
NL3V8T244DTR2G (Contact <b>onsemi</b> sales)	TBD	TSSOP-20	1	2500 Units / Tape & Reel
NL3V8T244MU2TAG	AC	UDFN20	1	3000 Units / Tape & Reel
NL3V8T240MU2TAG	LA	UDFN20	1	3000 Units / Tape & Reel

<sup>†</sup>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.

\*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

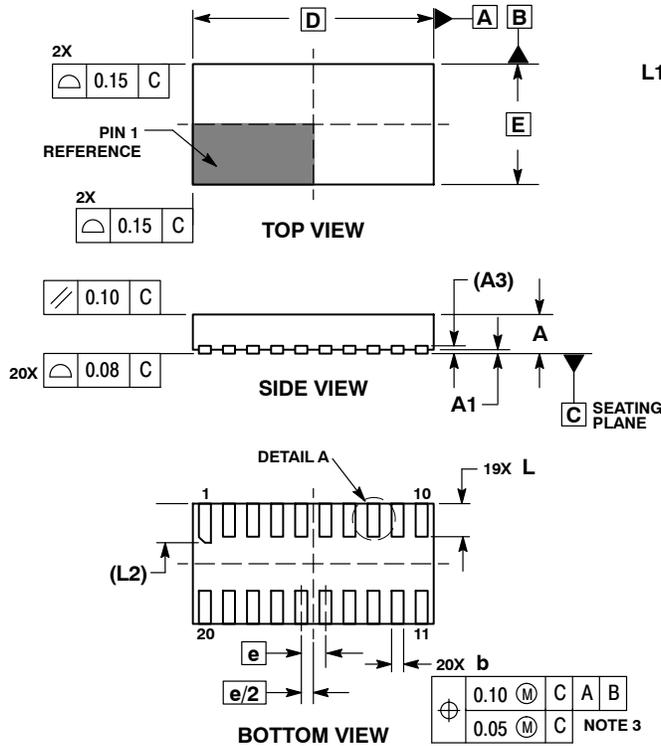
### Pin 1 Orientation in Tape and Reel



# NL3V8T244, NL3V8T240

## PACKAGE DIMENSIONS

UDFN20 4x2, 0.4P  
CASE 517AK  
ISSUE O

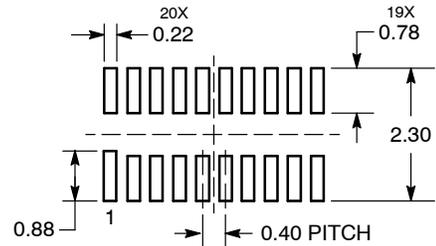


**NOTES:**

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS 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 MAY NOT EXCEED 0.03 ONTO 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	0.13 REF	
b	0.15	0.25
D	4.00 BSC	
E	2.00 BSC	
e	0.40 BSC	
L	0.50	0.60
L1	0.00	0.03
L2	0.60	0.70

**MOUNTING FOOTPRINT  
SOLDERMASK DEFINED**

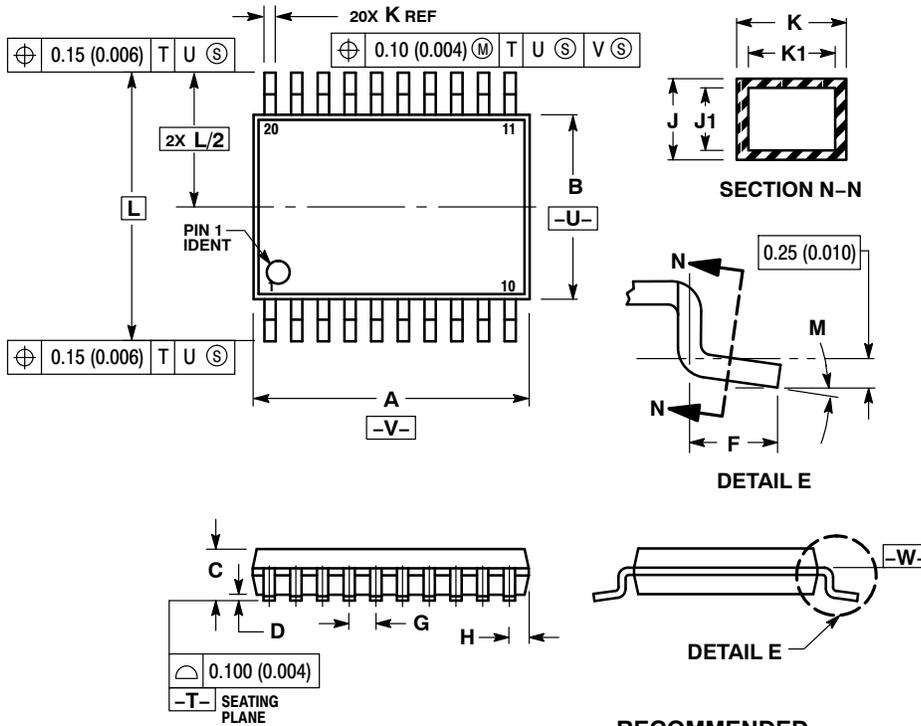


DIMENSIONS: MILLIMETERS

# NL3V8T244, NL3V8T240

## PACKAGE DIMENSIONS

TSSOP-20 WB  
CASE 948E  
ISSUE D

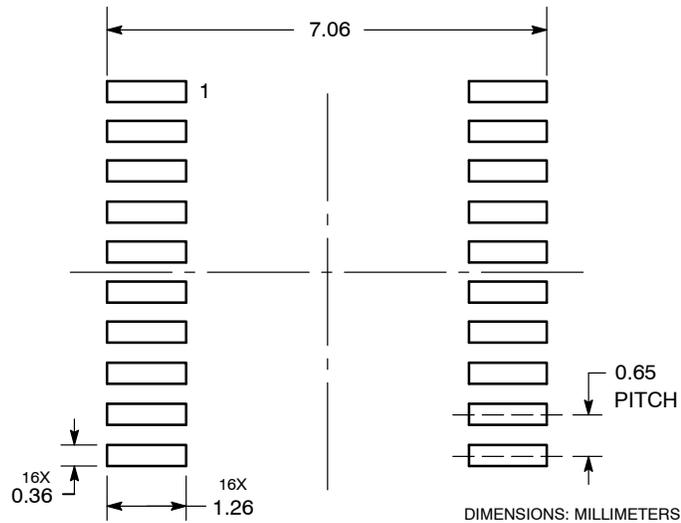


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -V-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	6.40	6.60	0.252	0.260
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.27	0.37	0.011	0.015
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

### RECOMMENDED SOLDERING FOOTPRINT\*

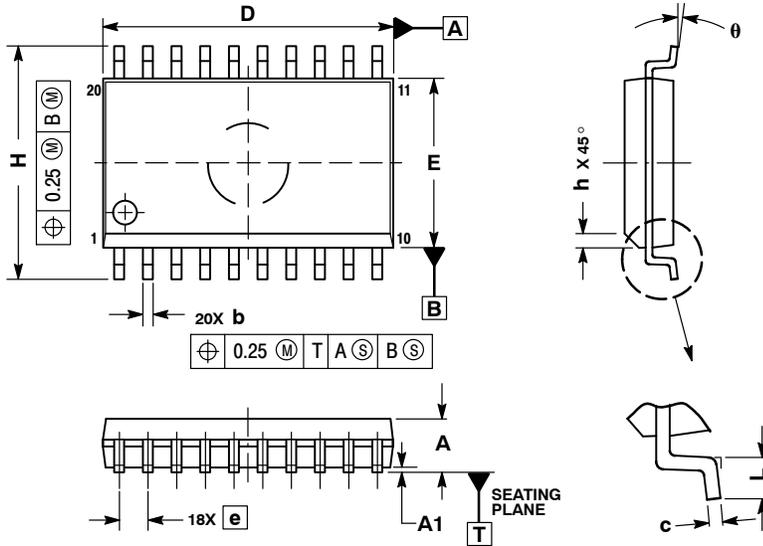


\*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# NL3V8T244, NL3V8T240

## PACKAGE DIMENSIONS

SOIC-20 WB  
CASE 751D-05  
ISSUE H

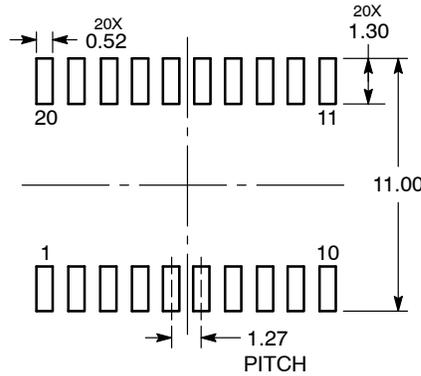


NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS	
	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
b	0.35	0.49
c	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°

### RECOMMENDED SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marketing.pdf](http://www.onsemi.com/site/pdf/Patent-Marketing.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

### ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:  
Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)  
For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)