Quad Bus Buffer

with 3-State Control Inputs

NLSF3T125

QFN-16
CASE 485G

The NLSF3T125 is a high speed CMOS quad bus buffer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The NLSF3T125 requires the 3-state control input ($\overline{OE}$) to be set High to place the output into the high impedance state.

The T125 inputs are compatible with TTL levels. This device can be used as a level converter for interfacing 3.3 V to 5.0 V, because it has full 5.0 V CMOS level output swings.

The NLSF3T125 input structures provide protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. The output structures also provide protection when V_{CC} = 0 V. These input and output structures help prevent device destruction caused by supply voltage − input/output voltage mismatch, battery backup, hot insertion, etc.

The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output. The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

Features

- High Speed: t_{PD} = 3.8 ns (Typ) at V_{CC} = 5.0 V
- Low Power Dissipation: I_{CC} = 4.0 μA (Max) at T_A = 25°C
- TTL-Compatible Inputs: V_{IL} = 0.8 V; V_{IH} = 2.0 V
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2.0 V to 5.5 V Operating Range
- Low Noise: V_{OLP} = 0.8 V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance: Human Body Model; > 2000 V,
  Machine Model; > 200 V
- Chip Complexity: 72 FETs or 18 Equivalent Gates
- These Devices are Pb-Free and are RoHS Compliant

FUNCTION TABLE

NLSF3T125		
Inputs		Output
A	$\overline{OE}$	Y
H	L	H
L	L	L
X	H	Z

MARKING DIAGRAM

NLSF3T125 = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb-Free Package

(Note: Microdot may be in either location)

ORDERING INFORMATION

Device	Package	Shipping†
NLSF3T125MNR2G	QFN-16 (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 Specifications Brochure, BRD8011/D.

© Semiconductor Components Industries, LLC, 2011

Active-Low Output Enables

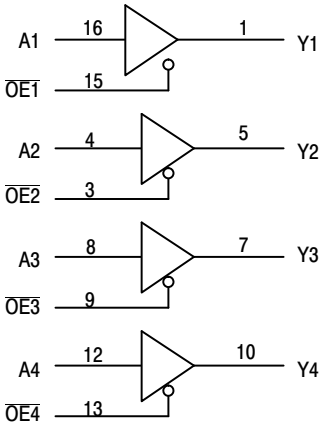


Figure 1. Logic Diagram

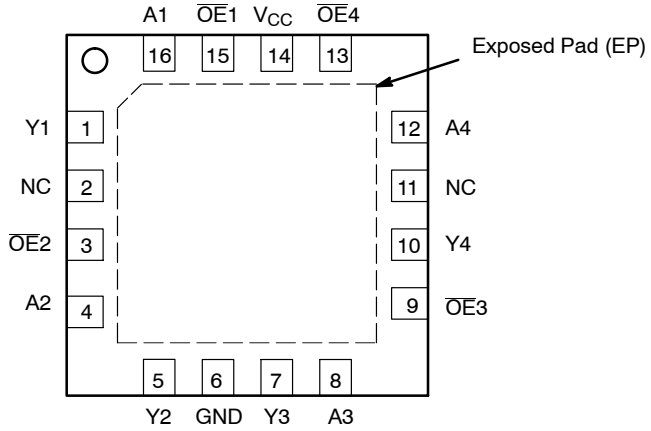


Figure 2. QFN – 16 Pinout (Top View)

MAXIMUM RATINGS

Symbol	Parameter	Value	Units
V_{CC}	DC Supply Voltage	−0.5 to +7.0	V
V_{in}	DC Input Voltage	−0.5 to +7.0	V
V_{out}	DC Output Voltage Output in 3-State High or Low State	 −0.5 to +7.0 −0.5 to V_{CC} + 0.5	V
I_{IK}	Input Diode Current	−20	mA
I_{OK}	Output Diode Current (V_{OUT} < GND; V_{OUT} > V_{CC})	±20	mA
I_{out}	DC Output Current, per Pin	±25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	±75	mA
P_D	Power Dissipation in Still Air QFN Packages	 500	mW
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.

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range GND ≤ (V_{in} or V_{out}) ≤ V_{CC}.

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Units
V_{CC}	DC Supply Voltage	2.0	5.5	V
V_{in}	DC Input Voltage	0	5.5	V
V_{out}	DC Output Voltage Output in 3-State High or Low State	 0 0	 5.5 V_{CC}	V
T_A	Operating Temperature	−40	+85	°C
t_r, t_f	Input Rise and Fall Time V_{CC} = 5.0 V ±0.5 V	 0	 20	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CC} (V)	T_A = 25°C			$T_A \le$ 85°C		$T_A \le$ 125°C		Units
				Min	Typ	Max	Min	Max	Min	Max	
V_{IH}	Minimum High-Level Input Voltage	2.3 V ±0.3 V 3.3 V ±0.3 V 5.0 V ±0.5 V		0.5 V_{CC} 0.4 V_{CC} 0.44 V_{CC}			0.5 V_{CC} 0.4 V_{CC} 0.44 V_{CC}		0.5 V_{CC} 0.4 V_{CC} 0.44 V_{CC}		V
V_{IL}	Maximum Low-Level Input Voltage	2.3 V ±0.3 V 3.3 V ±0.3 V 5.0 V ±0.5 V				0.3 V_{CC} 0.18 V_{CC} 0.18 V_{CC}		0.3 V_{CC} 0.18 V_{CC} 0.18 V_{CC}		0.3 V_{CC} 0.18 V_{CC} 0.18 V_{CC}	V
V_{OH}	Minimum High-Level Output Voltage V_{IN} = V_{IH} or V_{IL}	V_{OL} @ I_{OL}, 50 mA V_{IN} = V_{IH} or V_{IL} I_{OH} = −50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5		1.9 2.9 4.4		1.9 2.9 4.4		V
		V_{IN} = V_{IH} or V_{IL} I_{OH} = −2.0 mA I_{OH} = −4.0 mA I_{OH} = −8.0 mA	 2.0 3.0 4.5	 1.82 2.58 3.94			 1.72 2.48 3.80		 1.60 2.34 3.66		
V_{OL}	Maximum Low-Level Output Voltage V_{IN} = V_{IH} or V_{IL}	V_{OL} @ I_{OL}, 50 mA V_{IN} = V_{IH} or V_{IL} I_{OL} = 50 μA	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1		0.1 0.1 0.1	V
		V_{IN} = V_{IH} or V_{IL} I_{OL} = 2.0 mA I_{OL} = 4.0 mA I_{OL} = 8.0 mA	 2.0 3.0 4.5			 0.36 0.36 0.36		 0.44 0.44 0.44		 0.52 0.52 0.52	
I_{IN}	Maximum Input Leakage Current	V_{IN} = 5.5 V or GND	0 to 5.5			±0.1		±1.0		±1.0	μA
I_{CC}	Maximum Quiescent Supply Current	V_{IN} = V_{CC} or GND	5.5			2.0		20		40	μA
I_{CCT}	Quiescent Supply Current	Input: V_{IN} = 3.4 V	5.5			1.35		1.50		1.65	mA
I_{OZ}	Maximum 3-State Leakage Current	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND	5.5			±0.25		±2.5		±2.5	μA
I_{OPD}	Output Leakage Current	V_{OUT} = 5.5 V	0.0			0.5		5.0		10	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.

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

Symbol	Parameter	Test Conditions	T_A = 25 °C			$T_A \le$ 85 °C		$T_A \le$ 125 °C		Units
			Min	Typ	Max	Min	Max	Min	Max	
t_{PLH}, t_{PHL}	Maximum Propagation Delay, A to Y	V_{CC} = 2.3 ± 0.3 V C_L = 15 pF	1.0	14.5	16.9	1.0	18.1	1.0	19.2	ns
		V_{CC} = 3.3 ± 0.3 V C_L = 15 pF C_L = 50 pF	1.0 1.0	5.6 8.1	8.0 11.5	1.0 1.0	9.5 13.0	1.0 1.0	12.0 16.0	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 15 pF C_L = 50 pF	1.0 1.0	3.8 5.3	5.5 7.5	1.0 1.0	6.5 8.5	1.0 1.0	8.5 10.5	
t_{PZL}, t_{PZH}	Maximum Output Enable TIme, $\overline{OE}$ to Y	V_{CC} = 2.3 ± 0.3 V C_L = 15 pF	1.0	14.8	16.2	1.0	17.4	1.0	19.3	ns
		V_{CC} = 3.3 ± 0.3 V C_L = 15 pF R_L = 1.0 kΩ C_L = 50 pF	1.0 1.0	5.4 7.9	8.0 11.5	1.0 1.0	9.5 13.0	1.0 1.0	11.5 15.0	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 15 pF R_L = 1.0 kΩ C_L = 50 pF	1.0 1.0	3.6 5.1	5.1 7.1	1.0 1.0	6.0 8.0	1.0 1.0	7.5 9.5	
t_{PLZ}, t_{PHZ}	Maximum Output Disable Time, $\overline{OE}$ to Y	V_{CC} = 2.3 ± 0.3 V C_L = 15 pF	1.0	15.4	18.0	1.0	19.8	1.0	22.0	ns
		V_{CC} = 3.3 ± 0.3 V C_L = 50 pF R_L = 1.0 kΩ	1.0	9.5	13.2	1.0	15.0	1.0	18.0	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 50 pF R_L = 1.0 kΩ	1.0	6.1	8.8	1.0	10.0	1.0	12.0	ns
t_{OSLH}, t_{OSHL}	Output-to-Output Skew	V_{CC} = 3.3 ± 0.3 V C_L = 50 pF (Note 1)			1.5		1.5		2.0	ns
		V_{CC} = 5.0 ± 0.5 V C_L = 50 pF (Note 1)			1.0		1.0		1.5	
C_{in}	Maximum Input Capacitance			4	10		10		10	pF
C_{out}	Maximum Three-State Output Capacitance (Output in High Impedance State)			6						pF
			Typical @ 25 °C, V_{CC} = 5.0 V							
C_{PD}	Power Dissipation Capacitance (Note 2)		15							pF

1. Parameter guaranteed by design. $t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$.
2. C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}/4$ (per buffer). C_{PD} is used to determine the no-load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.

NOISE CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns, $C_L = 50$ pF, $V_{CC} = 5.0$ V)

Symbol	Characteristic	T_A = 25 °C		Units
		Typ	Max	
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}	0.3	0.8	V
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	−0.3	−0.8	V
V_{IHD}	Minimum High Level Dynamic Input Voltage		3.5	V
V_{ILD}	Maximum Low Level Dynamic Input Voltage		1.5	V

SWITCHING WAVEFORMS

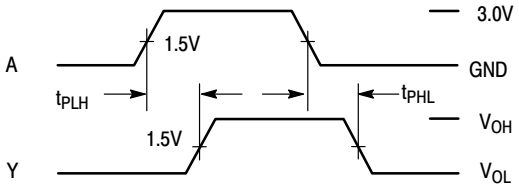


Figure 3.

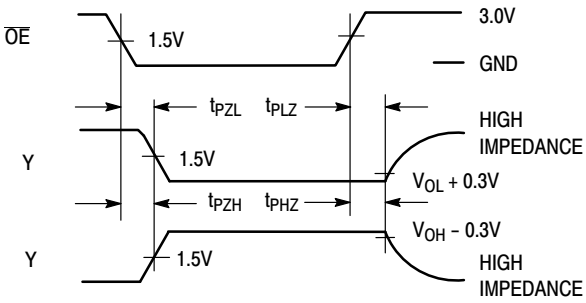
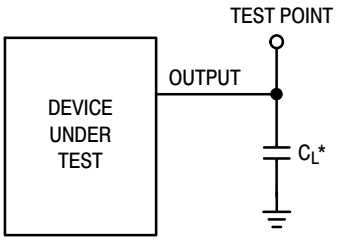
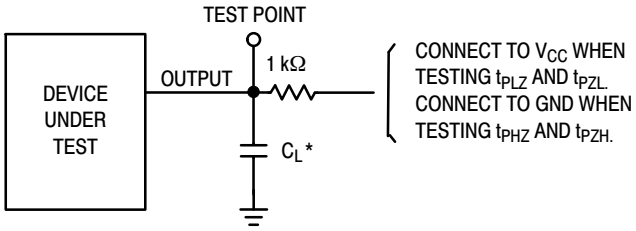


Figure 4.



*Includes all probe and jig capacitance

Figure 5. Test Circuit



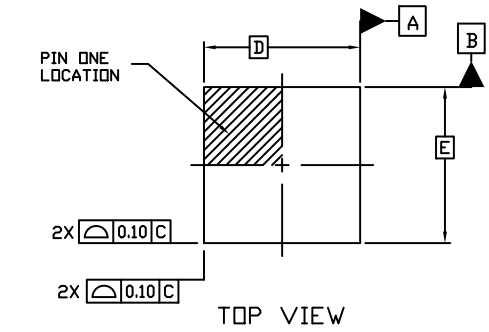
*Includes all probe and jig capacitance

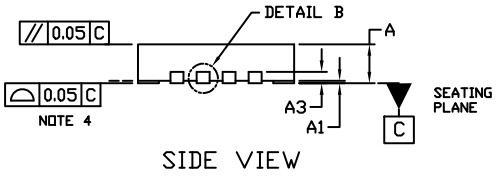
Figure 6. Test Circuit

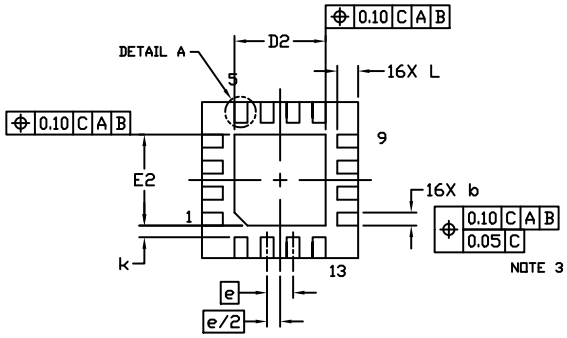
QFN16 3x3, 0.5P
CASE 485G
ISSUE G

DATE 08 OCT 2021

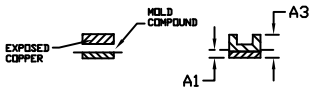
SCALE 2:1



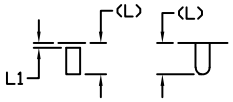




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.



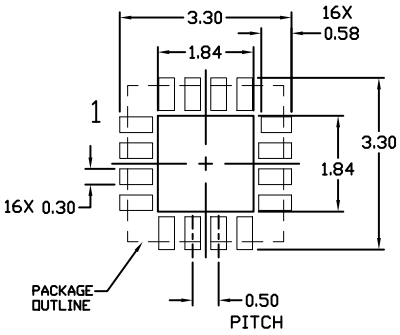
DETAIL B
ALTERNATE CONSTRUCTIONS



DETAIL A
ALTERNATE TERMINAL CONSTRUCTIONS

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.80	0.90	1.00
A1	0.00	0.03	0.05
A3		0.20 REF	
b	0.18	0.24	0.30
D		3.00 BSC	
D2	1.65	1.75	1.85
E		3.00 BSC	
E2	1.65	1.75	1.85
e		0.50 BSC	
k		0.18 TYP	
L	0.30	0.40	0.50
L1	0.00	0.08	0.15

MOUNTING FOOTPRINT



GENERIC MARKING DIAGRAM*

XXXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*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. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	**98AON04795D**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.	
DESCRIPTION:	**QFN16 3X3, 0.5P**		**PAGE 1 OF 1**

onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba **onsemi** or its subsidiaries in the United States and/or other countries. **onsemi** reserves the right to make changes without further notice to any products herein. **onsemi** makes no warranty, representation or guarantee regarding the 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. **onsemi** does not convey any license under its patent rights nor the rights of others.

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−Marking.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
onsemi Website: www.onsemi.com

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