

# Quad Bus Buffer

with 3-State Control Inputs

## NLSF3T125

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:  $I_{CC} = 4.0$   $\mu$ A (Max) at  $T_A = 25^\circ$ 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	OE	Y
H	L	H
L	L	L
X	H	Z



1  
QFN-16  
CASE 485G

### 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.

# NLSF3T125

## Active-Low Output Enables

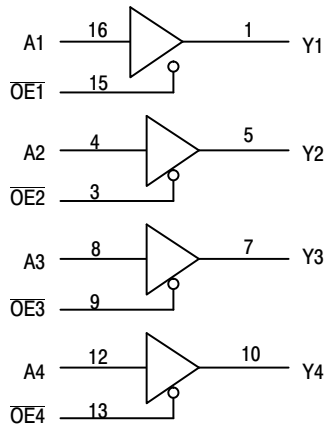


Figure 1. Logic Diagram

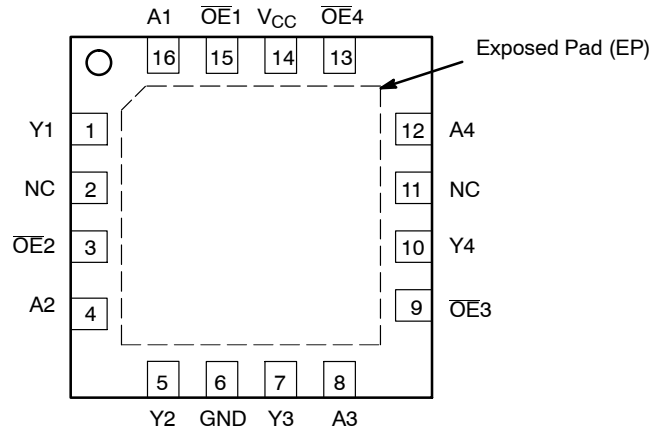


Figure 2. QFN – 16 Pinout (Top View)

## 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 ( $V_{OUT} < GND$ ; $V_{OUT} > V_{CC}$ )	$\pm 20$	mA
$I_{out}$	DC Output Current, per Pin	$\pm 25$	mA
$I_{CC}$	DC Supply Current, $V_{CC}$ and GND Pins	$\pm 75$	mA
$P_D$	Power Dissipation in Still Air QFN Packages	500	mW
$T_{stg}$	Storage Temperature	-65 to +150	$^{\circ}C$

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  $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$ . 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.

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.

# NLSF3T125

## 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 $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$	0	20	ns/V

## DC ELECTRICAL CHARACTERISTICS

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

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.

# NLSF3T125

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

Symbol	Parameter	Test Conditions	$T_A = 25\text{ }^\circ\text{C}$			$T_A \leq 85\text{ }^\circ\text{C}$		$T_A \leq 125\text{ }^\circ\text{C}$		Units
			Min	Typ	Max	Min	Max	Min	Max	
$t_{PLH}$ , $t_{PHL}$	Maximum Propagation Delay, A to Y	$V_{CC} = 2.3 \pm 0.3$ V $C_L = 15$ pF	1.0	14.5	16.9	1.0	18.1	1.0	19.2	ns
		$V_{CC} = 3.3 \pm 0.3$ 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
		$V_{CC} = 5.0 \pm 0.5$ 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	ns
$t_{PZL}$ , $t_{PZH}$	Maximum Output Enable Time, OE to Y	$V_{CC} = 2.3 \pm 0.3$ V $C_L = 15$ pF	1.0	14.8	16.2	1.0	17.4	1.0	19.3	ns
		$V_{CC} = 3.3 \pm 0.3$ V $C_L = 15$ pF $R_L = 1.0$ k $\Omega$ $C_L = 50$ 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
		$V_{CC} = 5.0 \pm 0.5$ V $C_L = 15$ pF $R_L = 1.0$ k $\Omega$ $C_L = 50$ 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	ns
$t_{PLZ}$ , $t_{PHZ}$	Maximum Output Disable Time, OE to Y	$V_{CC} = 2.3 \pm 0.3$ V $C_L = 15$ pF	1.0	15.4	18.0	1.0	19.8	1.0	22.0	ns
		$V_{CC} = 3.3 \pm 0.3$ V $C_L = 50$ pF $R_L = 1.0$ k $\Omega$	1.0	9.5	13.2	1.0	15.0	1.0	18.0	ns
		$V_{CC} = 5.0 \pm 0.5$ V $C_L = 50$ pF $R_L = 1.0$ k $\Omega$	1.0	6.1	8.8	1.0	10.0	1.0	12.0	ns
$t_{OSLH}$ , $t_{OSHL}$	Output-to-Output Skew	$V_{CC} = 3.3 \pm 0.3$ V $C_L = 50$ pF (Note 1)			1.5		1.5		2.0	ns
		$V_{CC} = 5.0 \pm 0.5$ V $C_L = 50$ pF (Note 1)			1.0		1.0		1.5	ns
$C_{in}$	Maximum Input Capacitance			4	10		10		10	pF
$C_{out}$	Maximum Three-State Output Capacitance (Output in High Impedance State)			6						pF
			<b>Typical @ 25 °C, V<sub>CC</sub> = 5.0 V</b>							
$C_{PD}$	Power Dissipation Capacitance (Note 2)						15			pF

- Parameter guaranteed by design.  $t_{OSLH} = |t_{PLHm} - t_{PLHn}|$ ,  $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$ .
- $C_{PD}$  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:  $I_{CC(OPR)} = C_{PD} \cdot V_{CC} \cdot f_{in} + I_{CC}/4$  (per buffer).  $C_{PD}$  is used to determine the no-load dynamic power consumption;  $P_D = C_{PD} \cdot V_{CC}^2 \cdot f_{in} + I_{CC} \cdot V_{CC}$ .

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

Symbol	Characteristic	$T_A = 25\text{ }^\circ\text{C}$		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

# NLSF3T125

## SWITCHING WAVEFORMS

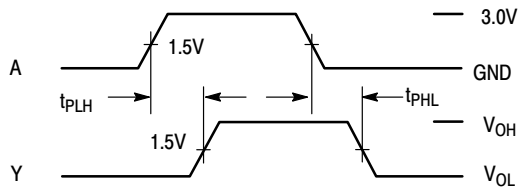


Figure 3.

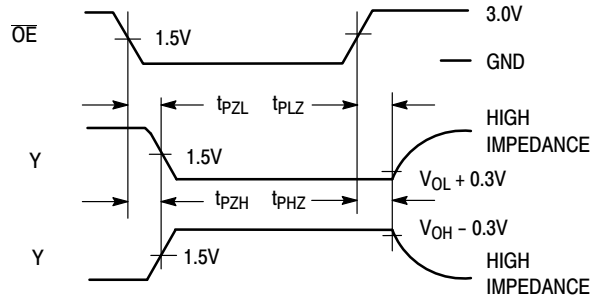
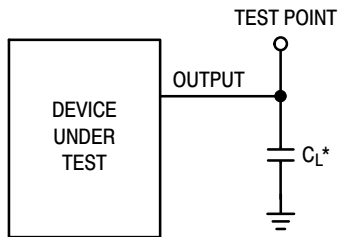
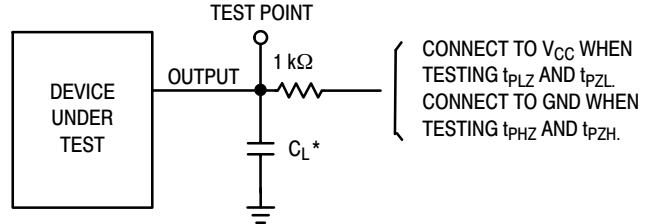


Figure 4.



\*Includes all probe and jig capacitance

Figure 5. Test Circuit



\*Includes all probe and jig capacitance

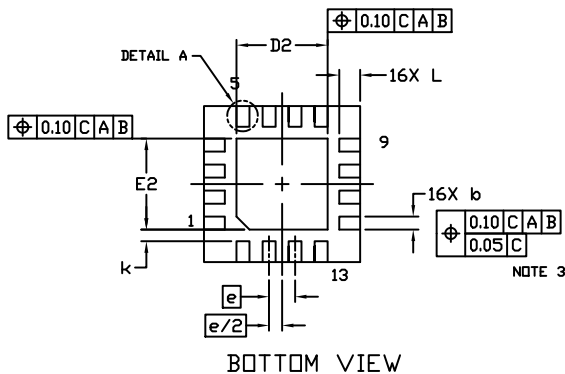
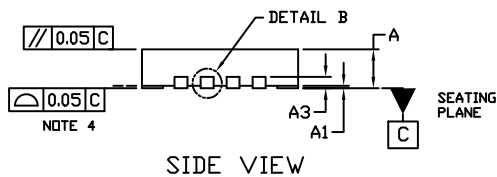
Figure 6. Test Circuit



1  
SCALE 2:1

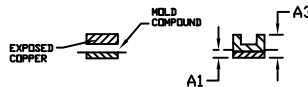
QFN16 3x3, 0.5P  
CASE 485G  
ISSUE G

DATE 08 OCT 2021

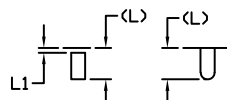


NOTES:

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.



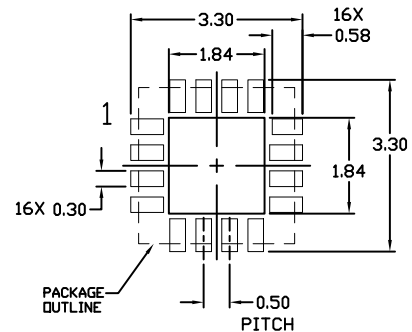
DETAIL B  
ALTERNATE  
CONSTRUCTIONS



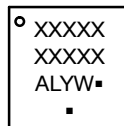
DETAIL A  
ALTERNATE TERMINAL  
CONSTRUCTIONS

DIM	MILLIMETERS		
	MIN.	NDM.	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.

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