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NS3L500

3.3V, 8-Channel, 2:1 Gigabit Ethernet LAN Switch with LED Switch

The NS3L500 is a 8−channel 2:1 LAN switch with 3 additional built−in SPDT switches for LED routing. This switch is ideal for Gigabit LAN applications due to its low ON−state resistance and capacitance giving the switch a typical bandwidth of 800 MHz. The switch also has excellent ON−state resistance match, low bit−to−bit skew, and low crosstalk among channels. The switch is bidirectional and offers little or no attenuation of the high−speed signals at the outputs.

This part can be used to replace mechanical relays in low−voltage LAN applications that interface a physical layer over CAT 5 or CAT 6 unshielded twisted pair cable through an isolation transformer. The NS3L500 is available in a 56−pin WQFN package and operates over the extended −40°C to +85°C temperature range.

Features

- V_{CC} Operating Range: +3.0 V to +3.6 V
- Low ON−State Resistance (R_{ON} = 4 Ω Typical)
- Low ON−State Capacitance (C_{ON} = 7 pF Typical)
- Flat ON−State Resistance (R_{ON}(flat) = 0.5 Ω Typical)
- Wide Bandwidth (800 MHz Typical)
- Low Crosstalk (X_{TALK} = −37 dB Typical)
- Near−Zero Propagation Delay: 250 ps
- Low Bit−to−Bit Skew (tsk(o) = 100 ps Max)
- Three SPDT Channels for LED Signal Switching
- Packaging: 56−Pin WQFN
- Pin−to−Pin Compatible with PI3L500−A, TS3L500AE and MAX4927
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

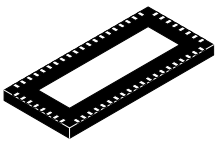
Typical Applications

- 10/100/1000 Base−T Ethernet Signal Switching
- Notebooks and Docking Stations
- Hub and Router Signal Switching
- Differential (LVDS, LVPECL) Signal Switching

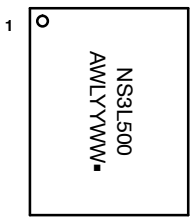
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MARKING DIAGRAMS



WQFN56
MT SUFFIX
CASE 510AK



A	= Assembly Location
WL	= Wafer Lot
YY	= Year
WW	= Work Week
▪	= Pb−Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

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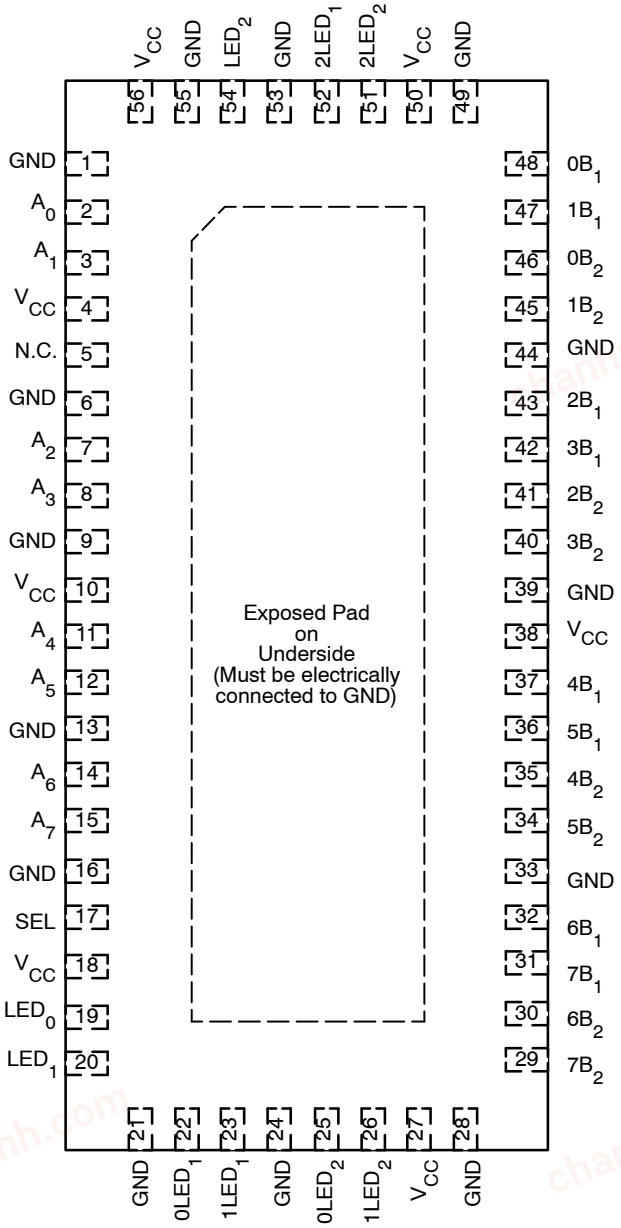


Figure 1. Pinout
(Top View)

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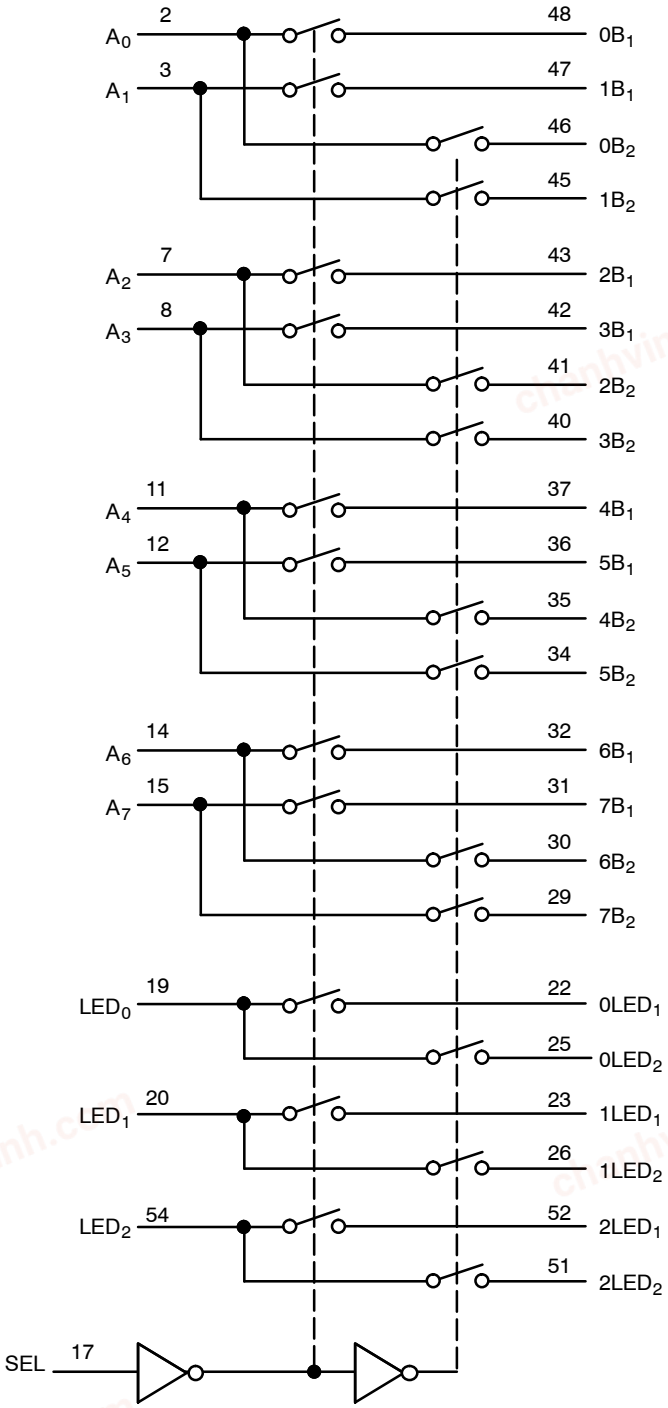


Figure 2. Block Diagram

PIN DESCRIPTION

Pin Name	Description
A_x	Data I/Os
xB_y	Data I/Os
SEL	Select Input
LED_x	LED I/O Port
$xLED_y$	LED I/O Port

TRUTH TABLE

SEL	Function
L	A_x to xB_1: LED_x to $xLED_1$
H	A_x to xB_2: LED_x to $xLED_2$

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MAXIMUM RATINGS

Symbol	Pins	Parameter	Value	Unit
V_{CC}	V_{CC}	Positive DC Supply Voltage	−0.5 to +5.5	V
V_{IN}	SEL	Control Input Voltage	−0.5 to +5.5	V
$V_{I/O}$	A_X, xB_Y, LED_X, $xLED_Y$	Switch I/O Voltage Range	−0.5 to V_{CC} +0.5	V
I_{CC}	V_{CC}	DC Output Current	± 120	mA
I_{IK}	SEL	Control Input Clamp Current	−50	mA
$I_{I/O}$	A_X, xB_Y, LED_X, $xLED_Y$	ON−State Switch Current	± 120	mA
$R_{\theta JA}$		Thermal Resistance, Junction−to−Air	125	°C/W
T_S		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	Pins	Parameter	Value	Unit
V_{CC}	V_{CC}	Positive DC Supply Voltage	+3.0 to +3.6	V
V_{IN}	SEL	Control Input Voltage	0 to +5.5	V
$V_{I/O}$	A_X, xB_Y, LED_X, $xLED_Y$	Switch I/O Voltage Range	0 to V_{CC}	V
T_A		Operating Temperature	−40 to +85	°C

Minimum and maximum values are guaranteed through test or design across the Recommended Operating Conditions, where applicable. Typical values are listed for guidance only and are based on the particular conditions listed for section, where applicable. These conditions are valid for all values found in the characteristics tables unless otherwise specified in the test conditions.

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DC ELECTRICAL CHARACTERISTICS (Typical: T = 25°C, V_{CC} = 3.3 V)

Symbol	Pins	Parameters	Conditions	−40°C to +85°C			Unit
				Min	Typ	Max	
1000 BASE−T ETHERNET SWITCHING							
V_{IH}	SEL	Control Input HIGH Voltage		2		5.5	V
V_{IL}	SEL	Control Input LOW Voltage		−0.5		0.8	V
V_{IK}	SEL	Clamp Diode Voltage	V_{CC} = Max, I_{IN} = −18 mA		−0.7	−1.2	V
I_{IH}	SEL	Input HIGH Current	V_{CC} = Max, V_{IN} = V_{CC}	−1		+1	μA
I_{IL}	SEL	Input LOW Current	V_{CC} = Max, V_{IN} = GND	−1		+1	μA
I_{OFF}	SEL	Off−Leakage Current	V_{CC} = 0 V, V_{IN} = 0 V to 3.6 V			±1.5	μA
I_{CC}	V_{CC}	Quiescent Supply Current	V_{CC} = 3.6 V,, V_{IN} = V_{CC} or GND, I_O = 0 mA		250	600	μA
$I_{LA(OFF)}$	A_X, xB_Y	Off−Leakage Current	V_{CC} = 3.6 V, VA_X = 0.3 V, 3.3 V; VxB_1 or VxB_2 = 3.3 V, 0.3 V	−1		+1	μA
$I_{LA_(ON)}$	A_X, xB_Y	On−Leakage Current	V_{CC} = 3.6 V, VA_X = 0.3 V, 3.3 V; VxB_1 or VxB_2 = 0.3 V, 3.3 V, or floating	−1		+1	μA
R_{ON}	A_X, xB_Y	On−Resistance	V_{CC} = 3 V, 1.5 V ≤ V_{IN} ≤ V_{CC}, I_O = −40 mA		4	7	Ω
$R_{ON(FLAT)}$	A_X, xB_Y	On−Resistance Flatness	V_{CC} = 3 V, V_{IN} = 1.5 V and V_{CC}, I_O = −40 mA		0.5		Ω
ΔR_{ON}	A_X, xB_Y	On−Resistance Match Between Switch Pairs	V_{CC} = 3 V, 1.5 V ≤ V_{IN} ≤ V_{CC}, I_O = −40 mA		0.4	1	Ω
10/100 BASE−T ETHERNET SWITCHING							
V_{IH}	SEL	Control Input HIGH Voltage		2		5.5	V
V_{IL}	SEL	Control Input LOW Voltage		−0.5		0.8	V
V_{IK}	SEL	Clamp Diode Voltage	V_{CC} = Max, I_{IN} = −18 mA		−0.7	−1.2	V
I_{IH}	SEL	Input HIGH Current	V_{CC} = Max, V_{IN} = V_{CC}	−1		+1	μA
I_{IL}	SEL	Input LOW Current	V_{CC} = Max, V_{IN} = GND	−1		+1	μA
I_{OFF}	SEL	Off−Leakage Current	V_{CC} = 0 V, V_{IN} = 0 V to 3.6 V			±1.5	μA
I_{CC}	V_{CC}	Quiescent Supply Current	V_{CC} = 3.6 V, V_{IN} = V_{CC} or GND I_O = 0 mA		250	600	μA
$I_{LA(OFF)}$	A_X, xB_Y	Off−Leakage Current	V_{CC} = 3.6 V, VA_X = 0.3 V, 3.3 V; VxB_1 or VxB_2 = 3.3 V, 0.3 V	−1		+1	μA
$I_{LA_(ON)}$	A_X, xB_Y	On−Leakage Current	V_{CC} = 3.6 V, VA_X = 0.3 V, 3.3 V; VxB_1 or VxB_2 = 0.3 V, 3.3 V, or floating	−1		+1	μA
R_{ON}	A_X, xB_Y	On−Resistance	V_{CC} = 3 V, 1.25 V ≤ V_{IN} ≤ V_{CC}, I_O = −10 mA to −30 mA		4	6	Ω
$R_{ON(FLAT)}$	A_X, xB_Y	On−Resistance Flatness	V_{CC} = 3 V, V_{IN} = 1.25 V and V_{CC}, I_O = −10 mA to −30 mA		0.5		Ω
ΔR_{ON}	A_X, xB_Y	On−Resistance Match Between Switch Pairs	V_{CC} = 3 V, 1.25 V ≤ V_{IN} ≤ V_{CC}, I_O = −10 mA to −30 mA		0.4	1	Ω

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DC ELECTRICAL CHARACTERISTICS (Typical: T = 25°C, V_{CC} = 3.3 V)

Symbol	Pins	Parameters	Conditions	−40°C to +85°C Min	Typ	Max	Unit
LED SWITCHING							
R_{ON}	LED_X, $xLED_Y$	On−Resistance	V_{CC} = 3 V, 1.25 V ≤ V_{IN} ≤ V_{CC}, I_O = −40 mA		15	25	Ω
$R_{ON(FLAT)}$	LED_X, $xLED_Y$	On−Resistance Flatness	V_{CC} = 3 V, V_{IN} = 1.25 V and V_{CC}, I_O = −40 mA		8		Ω
ΔR_{ON}	LED_X, $xLED_Y$	On−Resistance Match Between Switch Pairs	V_{CC} = 3 V, 1.25 V ≤ V_{IN} ≤ V_{CC}, I_O = −40 mA		1	2	Ω

AC ELECTRICAL CHARACTERISTICS (Typicals: T = 25°C, V_{CC} = 3.3 V)*

Symbol	Pins	Parameters	Conditions	−40°C to +85°C Min	Typ	Max	Unit
SWITCHING CHARACTERISTICS							
t_{PLH}, t_{PHL}	A_x, xB_y	Propagation Delay	V_{CC} = 3.0 V to 3.6 V (Figure 3)		0.25		ns
t_{ON}	SEL, $xLED_y$	Line Enable Time − SEL to $xLED_Y$	Output: Closed to Open V_{CC} = 3.0 V to 3.6 V (Figure 4)	0.5		15	ns
	SEL, xB_y	Lines Enable Time − SEL to xB_y		0.5		3	μs
t_{OFF}	SEL, $xLED_y$	Line Enable Time − SEL to $xLED_Y$	Output: Open to Closed V_{CC} = 3.0 V to 3.6 V (Figure 4)	0.5		9	ns
	SEL, xB_y	Lines Enable Time − SEL to xB_y		0.5		35	ns
$t_{SK(O)}$	A_x, xB_y	Output Skew between center port to any other port	V_{CC} = 3.0 V to 3.6 V (Calculated, Figure 3)		50	100	ps
$t_{SK(P)}$	A_x, xB_y	Skew between opposite transition of the same output (t_{PHL} − t_{PLH})	V_{CC} = 3.0 V to 3.6 V (Calculated, Figure 3)		50	100	ps
DYNAMIC ELECTRICAL CHARACTERISTICS							
BW	xB_y, $xLED_y$	−3 dB Bandwidth	R_L = 100 Ω (Figure 5)		800		MHz
O_{IRR}	A_X, LED_X	Off − Isolation	R_L = 100 Ω, f = 250 MHz (Figure 6)		−37		dB
X_{TALK}	A_X to xB_Y $A_{(X+2)}$ to $(X+2)B_Y$	Crosstalk	R_L = 100 Ω, f = 250 MHz (Figure 7)		−37		dB
CAPACITANCE							
C_{IN}	SEL	Control Pin Input Capacitance	V_{IN} = 0 V, f = 1 MHz		2	3	pF
C_{ON}	A_X, xB_y	ON Capacitance	V_{IN} = 0 V, f = 1 MHz, Outputs Open, Switch ON		7	10	pF
C_{OFF}	xBy	B Port Switch Capacitance	V_{IN} = 0 V, f = 1 MHz, Outputs Open, Switch OFF		5	6	pF

*Guaranteed by design and/or characterization.

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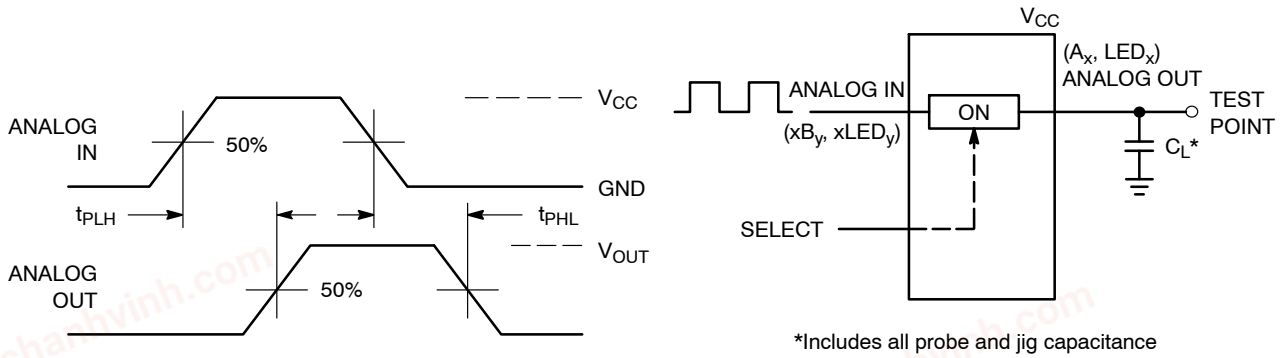


Figure 3. Propagation Delay

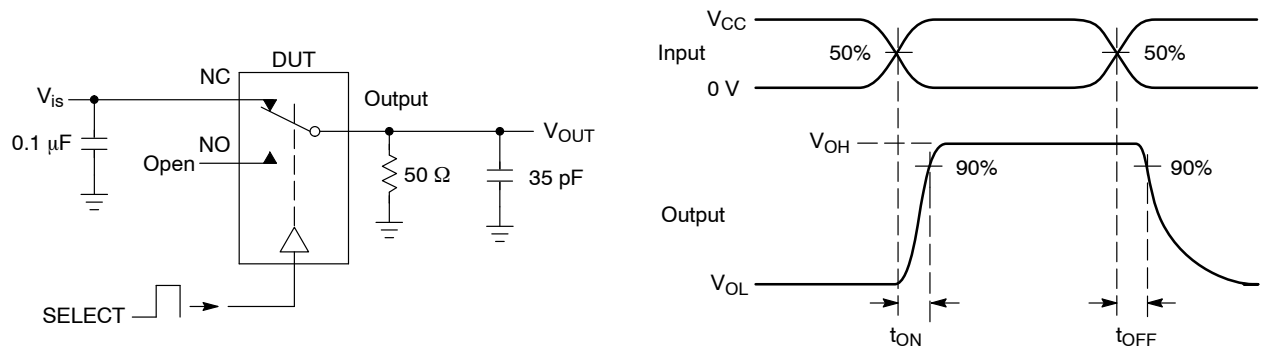


Figure 4. t_{ON}/t_{OFF}

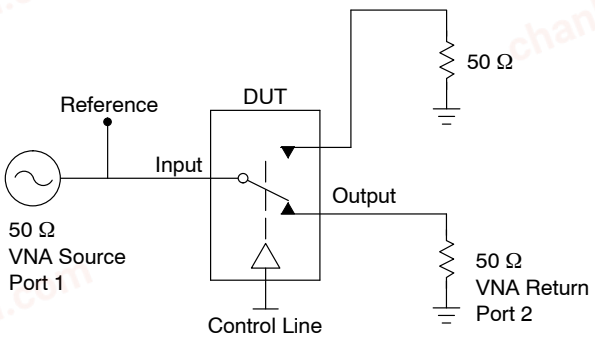


Figure 5. Bandwidth

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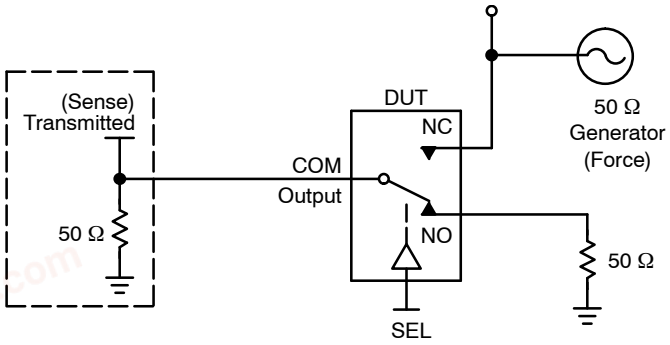
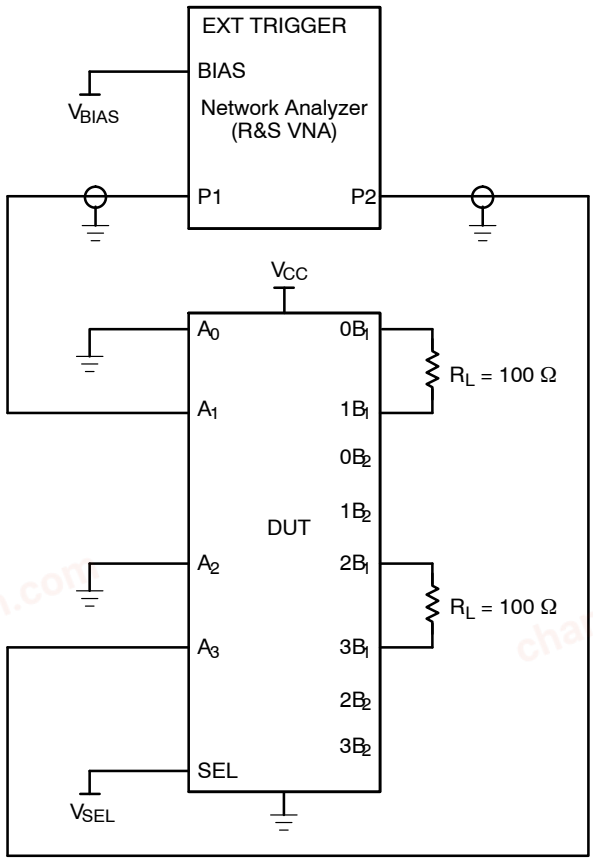


Figure 6. Off−Isolation



1. C_L includes probe and jig capacitance.
2. A 50 Ω termination resistor is needed to match the loading of the network analyzer.

Figure 7. Test Circuit for Crosstalk (X_{TALK})

Crosstalk is measured at the output of the nonadjacent ON channel. For example, when V_{SEL} = 0 and A_0 is the input, the output is measured at $1B_1$. All unused analog input (A) ports are connected to GND, and output (B) ports are connected to GND through 50 Ω pulldown resistors.

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APPLICATION INFORMATION

Logic Inputs

The logic control inputs can be driven up to +3.6 V regardless of the supply voltage. For example, given a +3.3 V supply, the output enables or select pins may be driven low to 0 V and high to 3.6 V> Driving IN Rail−to−Rail® minimizes power consumption.

Power−Supply Sequencing

Proper power−supply sequencing is advised for all CMOS devices. It is recommended to always apply V_{CC} before applying signals to the input/output or control pins.

ORDERING INFORMATION

Device	Package	Shipping†
NS3L500MTTWG	WQFN56 (Pb−free)	2000 / Tape & Reel

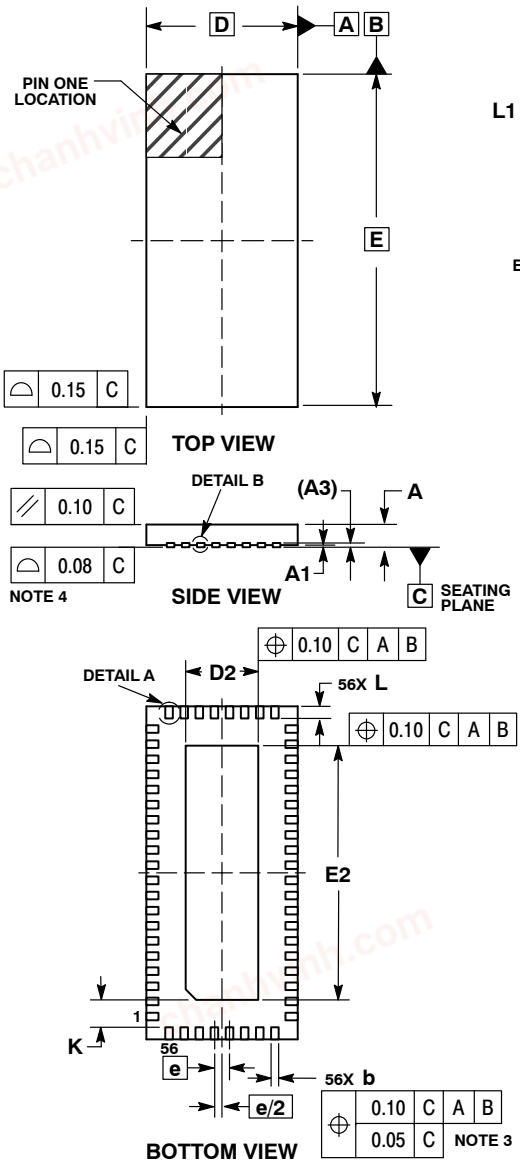
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

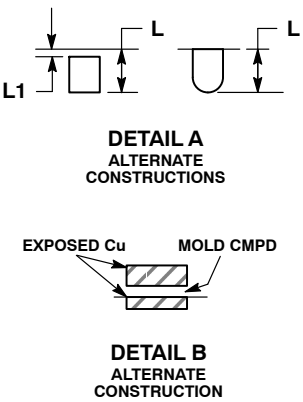
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NS3L500

PACKAGE DIMENSIONS

WQFN56 5x11, 0.5P
CASE 510AK−01
ISSUE A

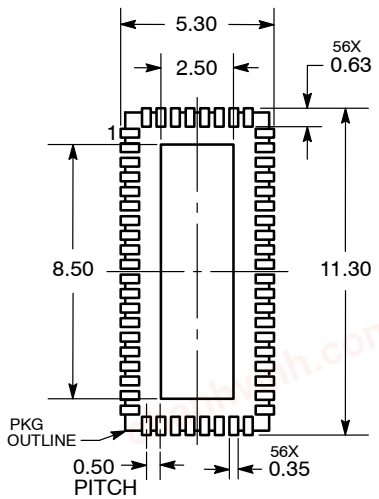




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSIONS: MILLIMETERS.
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30mm FROM THE TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.70	0.80
A1	---	0.05
A3	0.20 REF	
b	0.20	0.30
D	5.00 BSC	
D2	2.30	2.50
E	11.00 BSC	
E2	8.30	8.50
e	0.50 BSC	
K	0.20 MIN	
L	0.30	0.50
L1	---	0.15

RECOMMENDED SOLDERING FOOTPRINT*



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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