Low Voltage Single Supply Dual DPDT Analog Switch

The NLAST9431 is an advanced CMOS dual-independent DPDT (double pole-double throw) analog switch, fabricated with silicon gate CMOS technology. It achieves high-speed propagation delays and low ON resistances while maintaining CMOS low-power dissipation. This DPDT controls analog and digital voltages that may vary across the full power-supply range (from V_{CC} to GND).

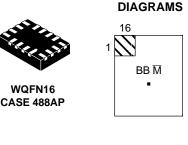
The device has been designed so the ON resistance (R_{ON}) is much lower and more linear over input voltage than R_{ON} of typical CMOS analog switches.

The channel-select input structure provides protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. This input structure helps prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

The NLAST9431 can also be used as a quad 2-to-1 multiplexerdemultiplexer analog switch with two Select pins that each controls two multiplexer-demultiplexers.

- Select Pins Compatible with TTL Levels
- Channel Select Input Overvoltage Tolerant to 5.5 V
- Fast Switching and Propagation Speeds
- Break–Before–Make Circuitry
- Low Power Dissipation: $I_{CC} = 2 \ \mu A$ (Max) at $T_A = 25^{\circ}C$
- Diode Protection Provided on Channel Select Input
- Improved Linearity and Lower ON Resistance over Input Voltage
- Latch-up Performance Exceeds 300 mA
- Chip Complexity: 158 FETs
- Pb-Free Packages are Available







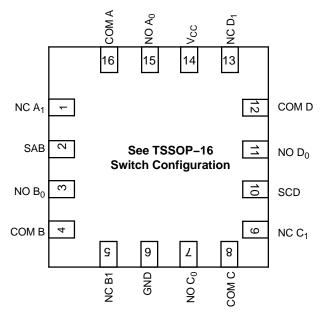
M = Date Code & Assembly Location

= Pb–Free Device

ORDERING INFORMATION

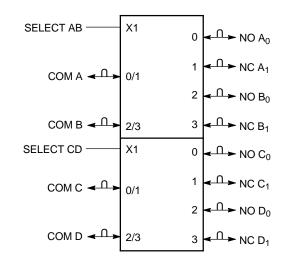
See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

QFN-16 PACKAGE

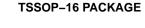


FUNCTION TABLE

Select AB or CD	ON Channel
L	NC to COM
H	NO to COM







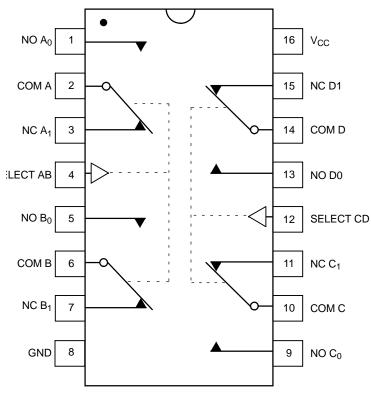


Figure 1. Logic Diagram

MAXIMUM RATINGS

Symbol	Paran	neter	Value	Unit
V _{CC}	Positive DC Supply Voltage		-0.5 to +7.0	V
V _{IS}	Analog Input Voltage (V_{NO} or V_{COM})		$-0.5 \leq V_{IS} \leq V_{CC} + 0.5$	V
V _{IN}	Digital Select Input Voltage		$-0.5 \leq V_{l} \leq +7.0$	V
I _{IK}	DC Current, Into or Out of Any Pin		±50	mA
PD	Power Dissipation in Still Air	QFN-16	800	mW
		TSSOP-16	450	
T _{STG}	Storage Temperature Range		-65 to +150	°C
TL	Lead Temperature, 1 mm from Case for 10 S	econds	260	°C
TJ	Junction Temperature Under Bias		+150	°C
MSL	Moisture Sensitivity		Level 1	
F _R	Flammability Rating	Oxygen Index: 30% – 35%	UL-94-VO (0.125 in)	
I _{LATCH-UP}	Latch–Up Performance Ab	hove V_{CC} and Below GND at 125°C (Note 1)	±300	mA
θ_{JA}	Thermal Resistance	QFN-16	80	°C/W
		TSSOP-16	164	

Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Extended exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute–maximum–rated conditions is not implied. Functional operation should be restricted to the Recommended Operating Conditions.

1. Tested to EIA/JESD78.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V _{CC}	DC Supply Voltage		2.0	5.5	V
V _{IN}	Digital Select Input Voltage		GND	5.5	V
V _{IS}	Analog Input Voltage (NC, NO, COM)		GND	V _{CC}	V
T _A	Operating Temperature Range		- 55	+ 125	°C
t _r , t _f	Input Rise or Fall Time, SELECT V _{CC} : V _{CC} :	= 3.3 V ± 0.3 V = 5.0 V ± 0.5 V	0 0	100 20	ns/V

DEVICE JUNCTION TEMPERATURE VERSUS TIME TO 0.1% BOND FAILURES

Junction Temperature °C	Time, Hours	Time, Years
80	1,032,200	117.8
90	419,300	47.9
100	178,700	20.4
110	79,600	9.4
120	37,000	4.2
130	17,800	2.0
140	8,900	1.0

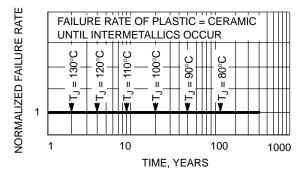


Figure 3. Failure Rate vs. Time Junction Temperature

				Guaranteed Limit			
Symbol	Parameter	Condition	v _{cc}	- 55°C to 25°C	<85°C	<125°C	Unit
V _{IH}	Minimum High–Level Input Voltage, Select Inputs		3.0 4.5 5.5	2.0 2.0 2.0	2.0 2.0 2.0	2.0 2.0 2.0	V
V _{IL}	Maximum Low–Level Input Voltage, Select Inputs		3.0 4.5 5.5	0.5 0.8 0.8	0.5 0.8 0.8	0.5 0.8 0.8	V
I _{IN}	Maximum Input Leakage Current	$V_{IN} = 5.5 V \text{ or GND}$	5.5	±0.2	±2.0	±2.0	μΑ
I _{OFF}	Power Off Leakage Current, Select Inputs	$V_{IN} = 5.5 V \text{ or GND}$	0	±10	±10	±10	μΑ
I _{CC}	Maximum Quiescent Supply Current	Select and $V_{IS} = V_{CC}$ or GND	5.5	4.0	4.0	8.0	μΑ

DC CHARACTERISTICS - Digital Section (Voltages Referenced to GND)

DC ELECTRICAL CHARACTERISTICS – Analog Section

				Guarai	nteed Limit	t	
Symbol	Parameter	Condition	V _{CC}	- 55°C to 25°C	<85°C	<125°C	Unit
R _{ON}	Maximum "ON" Resistance (Figures 17 – 23)	$\begin{split} V_{IN} &= V_{IL} \text{ or } V_{IH} \\ V_{IS} &= GND \text{ to } V_{CC} \\ I_{IN}I &\leq 10.0 \text{ mA} \end{split}$	2.5 3.0 4.5 5.5	85 45 30 25	95 50 35 30	105 55 40 35	Ω
R _{FLAT} (ON)	ON Resistance Flatness (Figures 17 – 23)	$\begin{split} V_{IN} &= V_{IL} \text{ or } V_{IH} \\ I_{IN} I &\leq 10.0 \text{ mA} \\ V_{IS} &= 1 \text{ V}, 2 \text{ V}, 3.5 \text{ V} \end{split}$	4.5	4	4	5	Ω
I _{NC(OFF)} I _{NO(OFF)}	NO or NC Off Leakage Current (Figure 9)	$V_{IN} = V_{IL} \text{ or } V_{IH}$ $V_{NO} \text{ or } V_{NC} = 1.0 V_{COM} 4.5 V$	5.5	1	10	100	nA
I _{COM(ON)}	COM ON Leakage Current (Figure 9)	$\begin{split} V_{IN} &= V_{IL} \text{ or } V_{IH} \\ V_{NO} \ 1.0 \ V \text{ or } 4.5 \ V \text{ with } V_{NC} \text{ floating or } \\ V_{NO} \ 1.0 \ V \text{ or } 4.5 \ V \text{ with } V_{NO} \text{ floating } \\ V_{COM} &= 1.0 \ V \text{ or } 4.5 \ V \end{split}$	5.5	1	10	100	nA

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

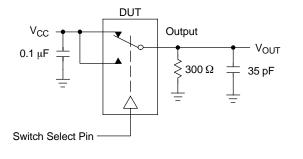
						Guaranteed Maximum Limit						
			v_{cc}	VIS	- 5	5°C to 2	5°C	<8	5°C	<12	25°C	
Symbol	Parameter	Test Conditions	(V)	(V)	Min	Тур*	Max	Min	Max	Min	Max	Unit
t _{ON}	Turn–On Time	$R_L = 300 \Omega, C_L = 35 pF$	2.5	2.0	5	23	35	5	38	5	41	ns
	(Figures 12 and 13)	(Figures 5 and 6)	3.0	2.0	5	16	24	5	27	5	30	
			4.5	3.0	2	11	16	2	19	2	22	
			5.5	3.0	2	9	14	2	17	2	20	
t _{OFF}	Turn–Off Time	$R_L = 300 \Omega, C_L = 35 pF$	2.5	2.0	1	7	12	1	15	1	18	ns
	(Figures 12 and 13)	(Figures 5 and 6)	3.0	2.0	1	5	10	1	13	1	16	
			4.5	3.0	1	4	6	1	9	1	12	
			5.5	3.0	1	3	5	1	8	1	11	
t _{BBM}	Minimum Break-Before-Make	V _{IS} = 3.0 V (Figure 4)	2.5	2.0	1	12		1		1		ns
	Time	$R_L = 300 \Omega, C_L = 35 pF$	3.0	2.0	1	11		1		1		
			4.5	3.0	1	6		1		1		
			5.5	3.0	1	5		1		1		

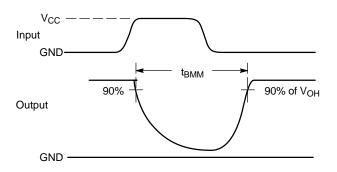
*Typical Characteristics are at 25°C.

		Typical @ 25, VCC = 5.0 V	
C _{IN}	Maximum Input Capacitance, Select Input	8	pF
C _{NO} or C _{NC}	Analog I/O (Switch Off)	10	
C _{COM}	Common I/O (Switch Off)	10	
C _(ON)	Feedthrough (Switch On)	20	

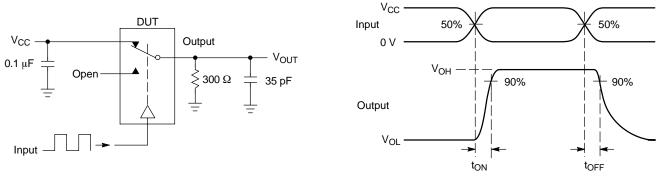
ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

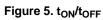
			V _{CC}	Typical	
Symbol	Parameter	Condition	v	25°C	Unit
BW	Maximum On–Channel – 3 dB Bandwidth or	V _{IN} = 0 dBm	3.0	145	MHz
	Minimum Frequency Response	V _{IN} centered between V _{CC} and GND	4.5	170	
	(Figure 11)	(Figure 7)	5.5	175	
V _{ONL}	Maximum Feedthrough On Loss	V _{IN} = 0 dBm @ 100 kHz to 50 MHz	3.0	-3	dB
		$V_{\mbox{IN}}$ centered between $V_{\mbox{CC}}$ and GND	4.5	-3	
		(Figure 7)	5.5	-3	
V _{ISO}	Off-Channel Isolation	f = 100 kHz; V _{IS} = 1 V RMS	3.0	-93	dB
	(Figure 10)	V_{IN} centered between V_{CC} and GND	4.5	-93	
		(Figure 7)	5.5	-93	
Q	Charge Injection Select Input to Common I/O	$V_{IN} = V_{CC}$ to GND, $F_{IS} = 20$ kHz	3.0	1.5	рС
	(Figure 15)	$t_r = t_f = 3 \text{ ns}$	5.5	3.0	
		$R_{IS} = 0 \Omega, C_L = 1000 \text{ pF}$			
		$Q = C_L * \Delta V_{OUT}$ (Figure 8)			
THD	Total Harmonic Distortion	F_{IS} = 20 Hz to 100 kHz, R_L = Rgen = 600 Ω , C_I = 50 pF			%
	THD + Noise	$V_{IS} = 5.0 V_{PP}$ sine wave	5.5	0.1	
	(Figure 14)		0.0		
VCT	Channel to Channel Crosstalk	f = 100 kHz; V _{IS} = 1 V RMS			dB
		$V_{\mbox{\scriptsize IN}}$ centered between $V_{\mbox{\scriptsize CC}}$ and GND	5.5	-90	1
		(Figure 7)	3.0	-90	

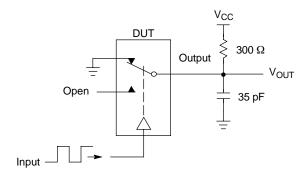


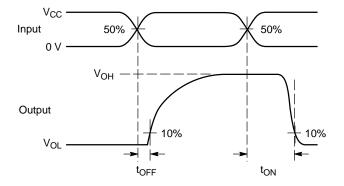


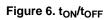


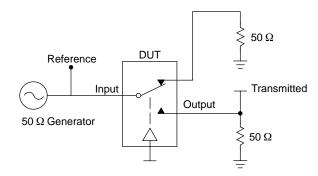








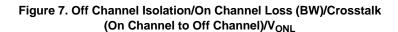


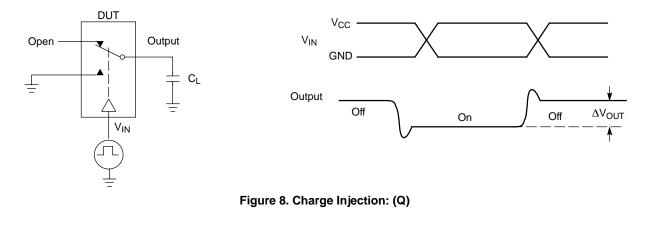


Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch. V_{ISO} , Bandwidth and V_{ONL} are independent of the input signal direction.

$$\begin{split} &V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log } \left(\frac{V\text{OUT}}{V\text{IN}}\right) &\text{for } V_{\text{IN}} \text{ at } 100 \text{ kHz} \\ &V_{\text{ONL}} = \text{On Channel Loss} = 20 \text{ Log } \left(\frac{V\text{OUT}}{V\text{IN}}\right) &\text{for } V_{\text{IN}} \text{ at } 100 \text{ kHz} \text{ to } 50 \text{ MHz} \end{split}$$

Bandwidth (BW) = the frequency 3 dB below V_{ONL} V_{CT} = Use V_{ISO} setup and test to all other switch analog input/outputs terminated with 50 Ω





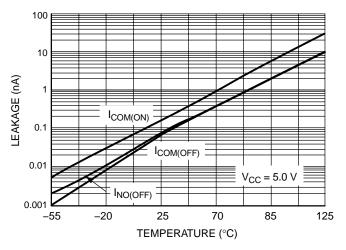


Figure 9. Switch Leakage vs. Temperature

0

1.0

2.0

3.0

4.0

6.0

7.0

8.0

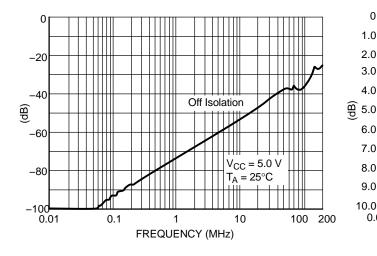
9.0

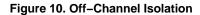
0.01

 $V_{CC} = 5.0 V$

0.1

 $T_A = 25^{\circ}C$







FREQUENCY (MHz)

1

10

Bandwidth (ON–RESPONSE)

PHASE SHIFT

+15

+10

+5

-5 (₀) -10 PHASE (₀) -15

-20

-25

-30

0

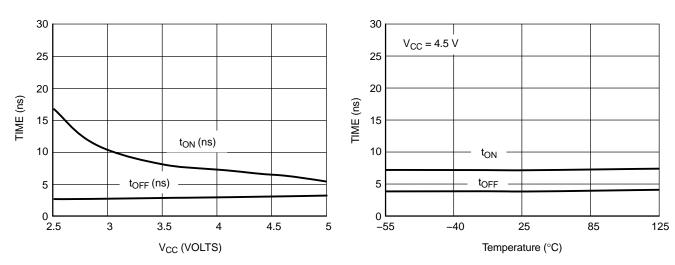
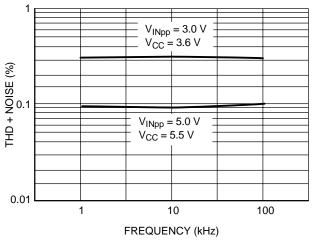


Figure 12. t_{ON} and t_{OFF} vs. V_{CC} at 25°C



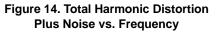
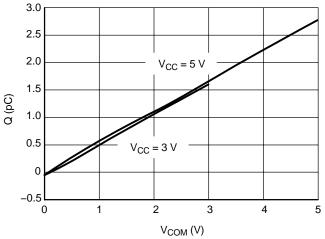


Figure 13. toN and toFF vs. Temp





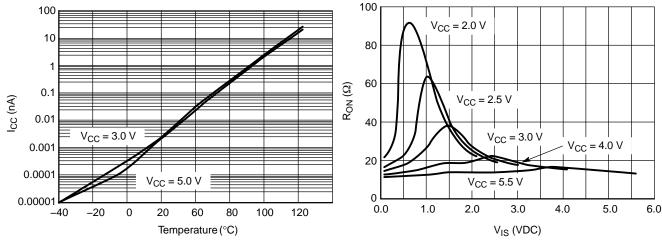
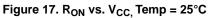
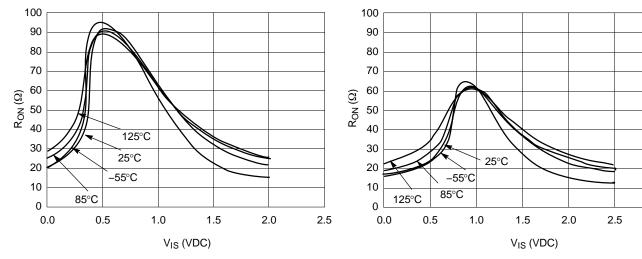


Figure 16. I_{CC} vs. Temp, V_{CC} = 3 V and 5 V







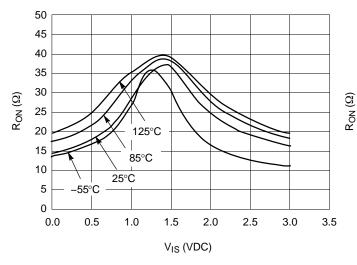
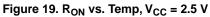


Figure 20. R_{ON} vs. Temp, V_{CC} = 3.0 V



3.0

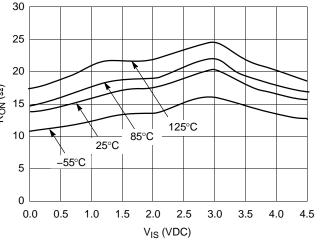


Figure 21. R_{ON} vs. Temp, V_{CC} = 4.5 V

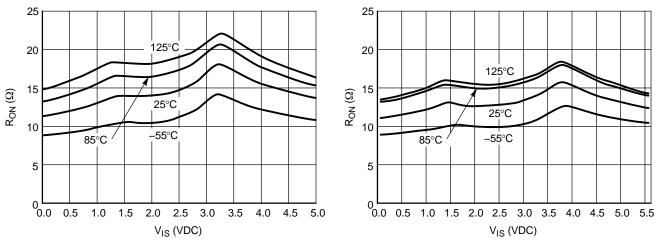


Figure 22. R_{ON} vs. Temp, V_{CC} = 5.0 V

Figure 23. R_{ON} vs. Temp, V_{CC} = 5.5 V

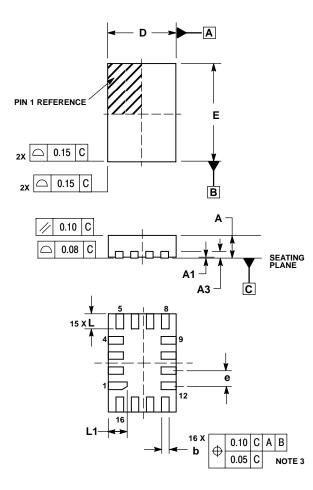
DEVICE ORDERING INFORMATION

	Device Nomenclature						
Device Order Number	Circuit Indicator	Technology	Device Function			Package Type	Shipping [†]
NLAST9431MTR2G	NL	AST	9431	MT	R2G	WQFN-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. *This package is inherently Pb–Free.

PACKAGE DIMENSIONS

WQFN16 MN SUFFIX CASE 488AP-01 ISSUE A

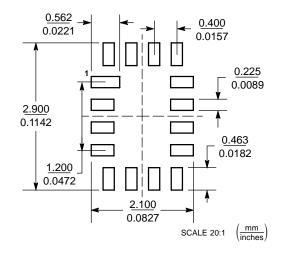


NOTES:

- 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
- 2. CONTROLLING DIMENSION: MILLIMETERS 3. DIMENSION 6 APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM
- FROM TERMINAL 4. COPLANARITY APPLIES TO THE EXPOSED PAD
- AS WELL AS THE TERMINALS. 5. EXPOSED PADS CONNECTED TO DIE FLAG. USED AS TEST CONTACTS.

BOED AS TEST CONTAG					
	MILLIMETERS				
DIM	MIN	MAX			
Α	0.70	0.80			
A1	0.00	0.050			
A3	0.20 REF				
b	0.15	0.25			
D	1.80	BSC			
Е	2.60	BSC			
е	0.40	BSC			
L	0.30	0.50			
L1	0.40	0.60			

MOUNTING FOOTPRINT



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