NLAST4051

Analog Multiplexer/ Demultiplexer
TTL Compatible, Single–Pole, 8–Position Plus Common Off

The NLAST4051 is an improved version of the MC14051 and MC74HC4051 fabricated in sub–micron Silicon Gate CMOS technology for lower $R_{DS(on)}$ resistance and improved linearity with low current. This device may be operated either with a single supply or dual supply up to ±3 V to pass a 6 V_{PP} signal without coupling capacitors.

When operating in single supply mode, it is only necessary to tie V_{EE}, pin 7 to ground. For dual supply operation, V_{EE} is tied to a negative voltage, not to exceed maximum ratings. Translation is provided in the device, the Address and Inhibit are standard TTL level compatible. For CMOS compatibility see NLAS4051. Pin for pin compatible with all industry standard versions of '4051.'

Features

- Improved $R_{DS(on)}$ Specifications
- Pin for Pin Replacement for MAX4051 and MAX4051A
  – One Half the Resistance Operating at 5.0 V
- Single or Dual Supply Operation
  – Single 3.0 – 5.0 V Operation, or Dual ±3 V Operation
  – With V_{CC} of 3.0 to 3.3 V, Device Can Interface with 1.8 V Logic, No Translators Needed
  – Address and Inhibit Logic are Over–Voltage Tolerant and May Be Driven Up +6 V Regardless of V_{CC}
- Address and Inhibit Pins Standard TTL Compatible
  – Greatly Improved Noise Margin Over MAX4051 and MAX4051A
  – True TTL Compatibility $V_{IL} = 0.8$ V, $V_{IH} = 2.0$ V
- Improved Linearity Over Standard HC4051 Devices
- Space Saving TSSOP Package
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC–Q100 Qualified and PPAP Capable
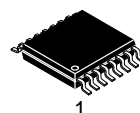- These Devices are Pb–Free, Halogen Free/BFR Free and are RoHS Compliant
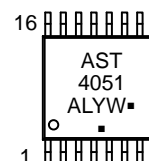

Figure 1. Pin Connection
(Top View)

ON Semiconductor®

MARKING DIAGRAM

TSSOP–16
DT SUFFIX
CASE 948F

AST
4051
ALYW∎

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 10 of this data sheet.

NLAST4051

TRUTH TABLE

Inhibit	Address			ON SWITCHES*
	C	B	A	
1	X don't care	X don't care	X don't care	All switches open
0	0	0	0	COM–NO_0
0	0	0	1	COM–NO_1
0	0	1	0	COM–NO_2
0	0	1	1	COM–NO_3
0	1	0	0	COM–NO_4
0	1	0	1	COM–NO_5
0	1	1	0	COM–NO_6
0	1	1	1	COM–NO_7

*NO and COM pins are identical and interchangeable. Either may be considered an input or output; signals pass equally well in either direction.
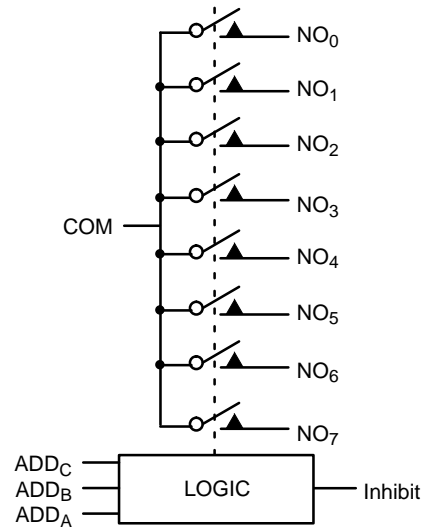
Figure 2. Logic Diagram

MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{EE}	Negative DC Supply Voltage	(Referenced to GND)	−7.0 to +0.5	V
V_{CC}	Positive DC Supply Voltage (Note 1)	(Referenced to GND) (Referenced to V_{EE})	−0.5 to +7.0 −0.5 to +7.0	V
V_{IS}	Analog Input Voltage		V_{EE} −0.5 to V_{CC} +0.5	V
V_{IN}	Digital Input Voltage	(Referenced to GND)	−0.5 to 7.0	V
I	DC Current, Into or Out of Any Pin		±50	mA
T_{STG}	Storage Temperature Range		−65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds		260	°C
T_J	Junction Temperature under Bias		+150	°C
θ_{JA}	Thermal Resistance		164	°C/W
P_D	Power Dissipation in Still Air		450	mW
MSL	Moisture Sensitivity		Level 1	
F_R	Flammability Rating	Oxygen Index: 30% – 35%	UL 94 V−0 @ 0.125 in	
V_{ESD}	ESD Withstand Voltage	Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	>2000 >200 >1000	V
$I_{LATCHUP}$	Latchup Performance	Above V_{CC} and Below GND at 125°C (Note 5)	±300	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. The absolute value of V_{CC} ±|V_{EE}| ≤ 7.0.
2. Tested to EIA/JESD22−A114−A.
3. Tested to EIA/JESD22−A115−A.
4. Tested to JESD22−C101−A.
5. Tested to EIA/JESD78.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{EE}	Negative DC Supply Voltage	(Referenced to GND)	−5.5	GND	V
V_{CC}	Positive DC Supply Voltage	(Referenced to GND) (Referenced to V_{EE})	2.5 2.5	5.5 6.6	V
V_{IS}	Analog Input Voltage		V_{EE}	V_{CC}	V
V_{IN}	Digital Input Voltage	(Note 6) (Referenced to GND)	0	5.5	V
T_A	Operating Temperature Range, All Package Types		−55	125	°C
t_r, t_f	Input Rise/Fall Time (Channel Select or Enable Inputs)	V_{CC} = 3.0 V ± 0.3 V V_{CC} = 5.0 V ± 0.5 V	0 0	100 20	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.
6. Unused digital inputs may not be left open. All digital inputs must be tied to a high–logic voltage level or a low–logic input voltage level.

DC CHARACTERISTICS – Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC} V	Guaranteed Limit			Unit
				−55 to 25°C	≤85°C	≤125°C	
V_{IH}	Minimum High–Level Input Voltage, Address or Inhibit Inputs		3.0 4.5 5.5	1.6 2.0 2.0	1.6 2.0 2.0	1.6 2.0 2.0	V
V_{IL}	Maximum Low–Level Input Voltage, Address or Inhibit 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, Address or Inhibit Inputs	V_{IN} = 6.0 or GND	0 V to 6.0 V	± 0.1	± 1.0	± 1.0	µA
I_{CC}	Maximum Quiescent Supply Current (per Package)	Address or Inhibit and V_{IS} = V_{CC} or GND	6.0	4.0	40	80	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.

DC ELECTRICAL CHARACTERISTICS – Analog Section

Symbol	Parameter	Test Conditions	V_{CC} V	V_{EE} V	Guaranteed Limit			Unit
					−55 to 25°C	≤85°C	≤125°C	
R_{ON}	Maximum "ON" Resistance	V_{IN} = V_{IL} or V_{IH} V_{IS} = (V_{EE} to V_{CC}) $|I_S|$ = 10 mA (Figures 4 thru 9)	3.0 4.5 3.0	0 0 −3.0	86 37 26	108 46 33	120 55 37	Ω
ΔR_{ON}	Maximum Difference in "ON" Resistance Between Any Two Channels in the Same Package	V_{IN} = V_{IL} or V_{IH}, V_{IS}= 2.0 V V_{IS}= 3.0 V $|I_S|$ = 10 mA, V_{IS}= 2.0 V	3.0 4.5 3.0	0 0 −3.0	15 13 10	20 18 15	20 18 15	Ω
$Rflat_{(ON)}$	ON Resistance Flatness	V_{COM} = 1, 2, 3.5 V V_{COM} = 2, 0, 2 V	4.5 3.0	 3.0	4 2	4 2	5 3	Ω
$I_{NC(OFF)}$ $I_{NO(OFF)}$	Maximum Off–Channel Leakage Current	Switch Off V_{IN} = V_{IL} or V_{IH} V_{IO} = V_{CC} −1.0 V or V_{EE} +1.0 V (Figure 17)	6.0 3.0	0 −3.0	0.1 0.1	5.0 5.0	100 100	nA
$I_{COM(ON)}$	Maximum On–Channel Leakage Current, Channel-to-Channel	Switch On V_{IO} = V_{CC} −1.0 V or V_{EE} +1.0 V (Figure 17)	6.0 3.0	0 −3.0	0.1 0.1	5.0 5.0	100 100	nA

AC CHARACTERISTICS (Input $t_r = t_f = 3$ ns)

Symbol	Parameter	Test Conditions	V_{CC} V	V_{EE} V	Guaranteed Limit				Unit
					−55 to 25°C		≤85°C	≤125°C	
					Min	Typ*			
t_{BBM}	Minimum Break−Before−Make Time	$V_{IN} = V_{IL}$ or V_{IH} $V_{IS} = V_{CC}$ $R_L = 300\ \Omega$, $C_L = 35$ pF (Figure 19)	3.0 4.5 3.0	0.0 0.0 −3.0	1.0 1.0 1.0	6.5 5.0 3.5	− − −	− − −	ns

*Typical Characteristics are at 25°C.

AC CHARACTERISTICS ($C_L = 35$ pF, Input $t_r = t_f = 3$ ns)

Symbol	Parameter	V_{CC} V	V_{EE} V	Guaranteed Limit							Unit
				−55 to 25°C			≤ 85°C		≤ 125°C		
				Min	Typ	Max	Min	Max	Min	Max	
t_{TRANS}	Transition Time (Address Selection Time) (Figure 18)	2.5 3.0 4.5 3.0	0 0 0 −3.0			40 28 23 23		45 30 25 25		50 35 30 28	ns
t_{ON}	Turn−on Time (Figures 14, 15, 20, and 21) Enable to N_O or N_C	2.5 3.0 4.5 3.0	0 0 0 −3.0			40 28 23 23		45 30 25 25		50 35 30 28	ns
t_{OFF}	Turn−off Time (Figures 14, 15, 20, and 21) Enable to N_O or N_C	2.5 3.0 4.5 3.0	0 0 0 −3.0			40 28 23 23		45 30 25 25		50 35 30 28	ns

		Typical @ 25°C, $V_{CC} = 5.0$ V	
C_{IN}	Maximum Input Capacitance, Select Inputs	8	pF
C_{NO} or C_{NC}	Analog I/O	10	
C_{COM}	Common I/O	10	
$C_{(ON)}$	Feedthrough	1.0	

ADDITIONAL APPLICATION CHARACTERISTICS (GND = 0 V)

Symbol	Parameter	Condition	V_{CC} V	V_{EE} V	Typ 25°C	Unit
BW	Maximum On−Channel Bandwidth or Minimum Frequency Response	$V_{IS} = \frac{1}{2}(V_{CC} - V_{EE})$ Source Amplitude = 0 dBm (Figures 10 and 22)	3.0 4.5 6.0 3.0	0.0 0.0 0.0 −3.0	80 90 95 95	MHz
V_{ISO}	Off−Channel Feedthrough Isolation	$f = 100$ kHz; $V_{IS} = \frac{1}{2}(V_{CC} - V_{EE})$ Source = 0 dBm (Figures 12 and 22)	3.0 4.5 6.0 3.0	0.0 0.0 0.0 −3.0	−93 −93 −93 −93	dB
V_{ONL}	Maximum Feedthrough On Loss	$V_{IS} = \frac{1}{2}(V_{CC} - V_{EE})$ Source = 0 dBm (Figures 10 and 22)	3.0 4.5 6.0 3.0	0.0 0.0 0.0 −3.0	−2 −2 −2 −2	dB
Q	Charge Injection	$V_{IN} = V_{CC}$ to V_{EE}, $f_{IS} = 1$ kHz, $t_r = t_f = 3$ ns $R_{IS} = 0\ \Omega$, $C_L = 1000$ pF, $Q = C_L * \Delta V_{OUT}$ (Figures 16 and 23)	5.0 3.0	0.0 −3.0	9.0 12	pC
THD	Total Harmonic Distortion THD + Noise	$f_{IS} = 1$ MHz, $R_L = 10$ KΩ, $C_L = 50$ pF, $V_{IS} = 5.0\ V_{PP}$ sine wave $V_{IS} = 6.0\ V_{PP}$ sine wave (Figure 13)	6.0 3.0	0.0 −3.0	0.10 0.05	%

TYPICAL CHARACTERISTICS
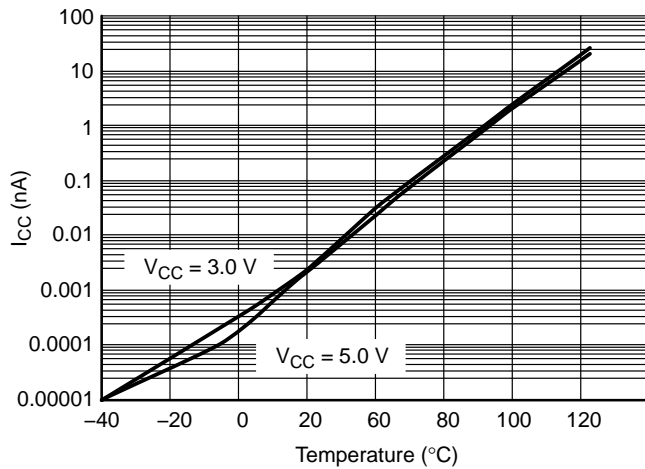
Figure 3. I_{CC} versus Temp, V_{CC} = 3 V and 5 V
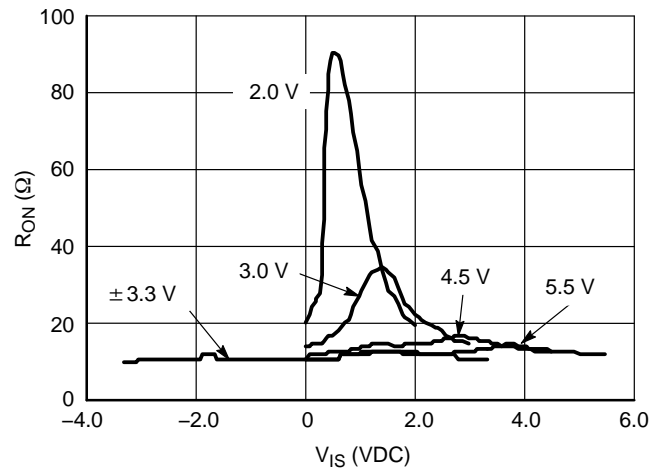
Figure 4. R_{ON} versus V_{CC}, Temp = 25°C
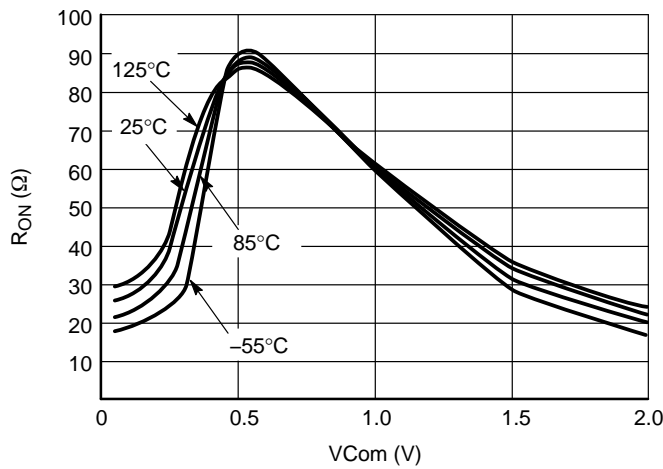
Figure 5. Typical On Resistance
V_{CC} = 2.0 V, V_{EE} = 0 V
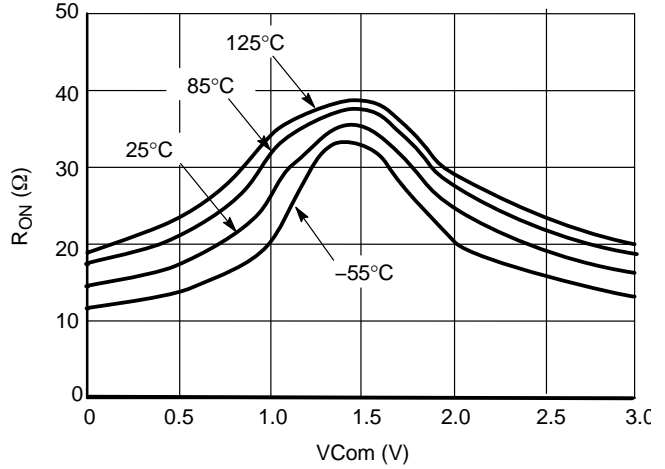
Figure 6. Typical On Resistance
V_{CC} = 3.0 V, V_{EE} = 0 V
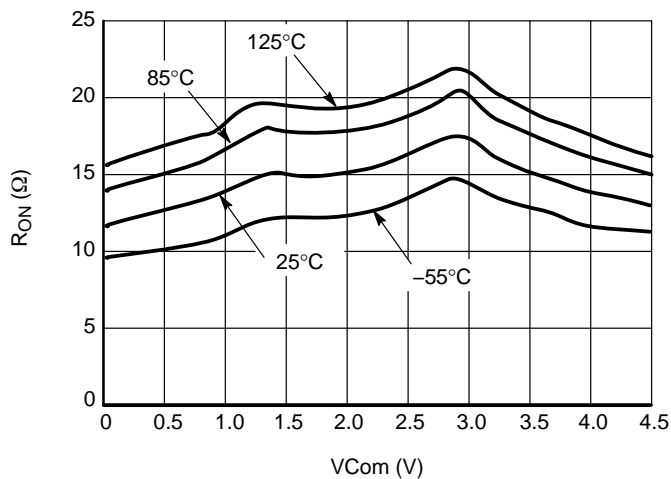
Figure 7. Typical On Resistance
V_{CC} = 4.5 V, V_{EE} = 0 V
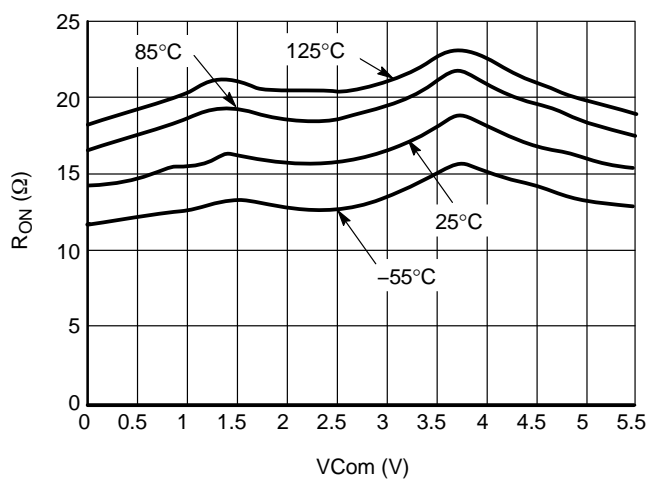
Figure 8. Typical On Resistance
V_{CC} = 5.5 V, V_{EE} = 0 V

TYPICAL CHARACTERISTICS
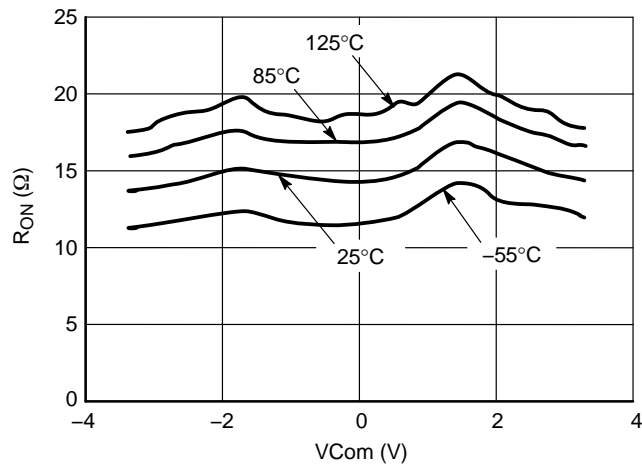
Figure 9. Typical On Resistance
V_{CC} = 3.3 V, V_{EE} = −3.3 V
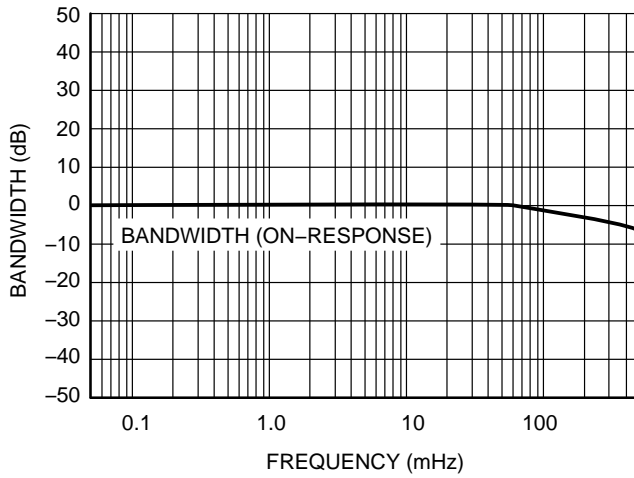
Figure 10. Bandwidth
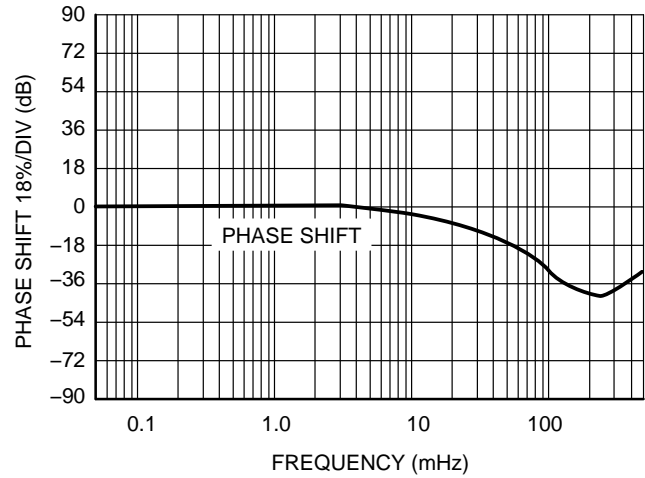
Figure 11. Phase Shift
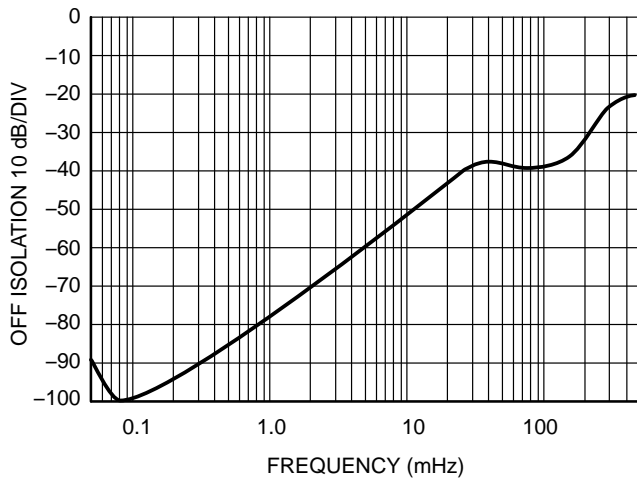
Figure 12. Off Isolation
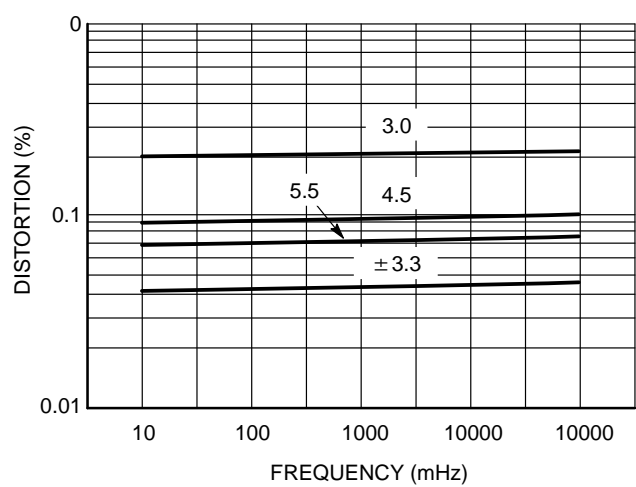
Figure 13. Total Harmonic Distortion

TYPICAL CHARACTERISTICS
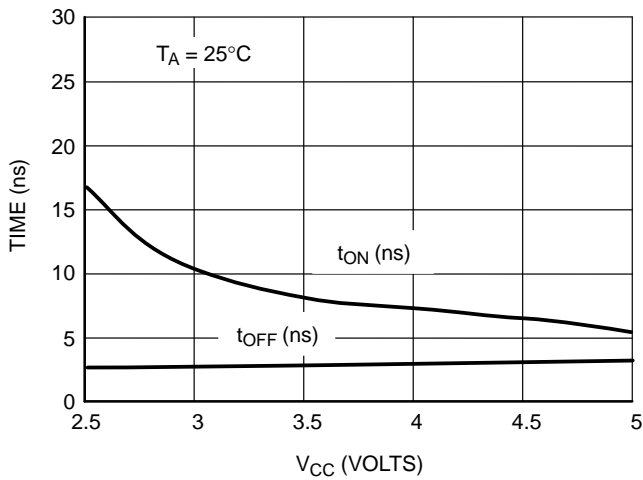
Figure 14. t$_{ON}$ and t$_{OFF}$ versus V$_{CC}$
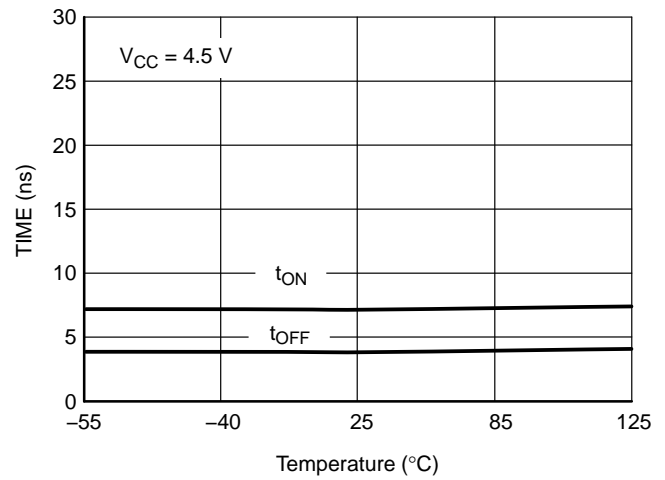
Figure 15. t$_{ON}$ and t$_{OFF}$ versus Temp
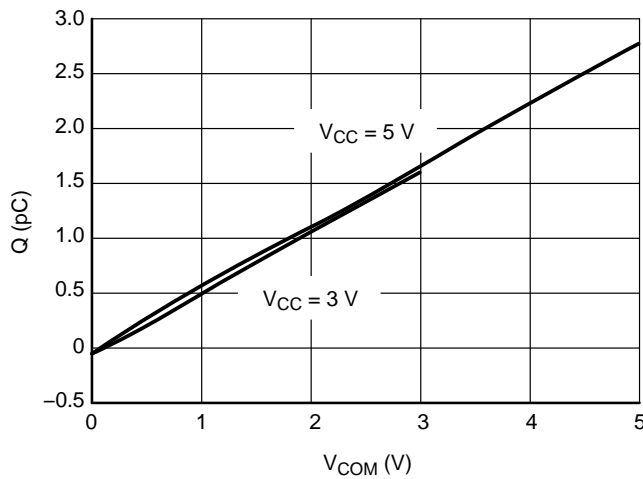
Figure 16. Charge Injection versus COM Voltage
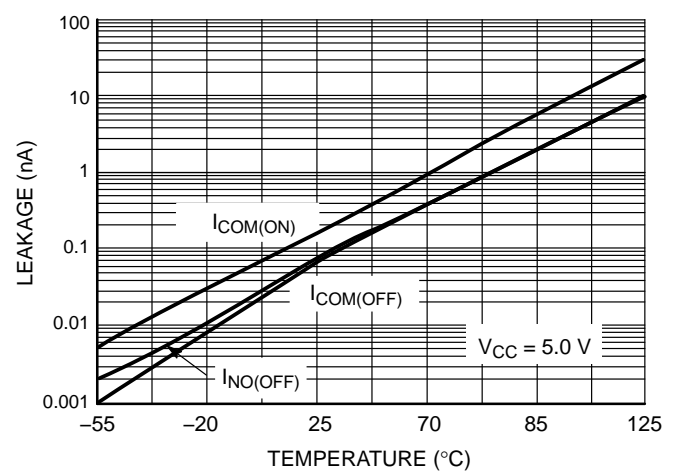
Figure 17. Switch Leakage versus Temperature
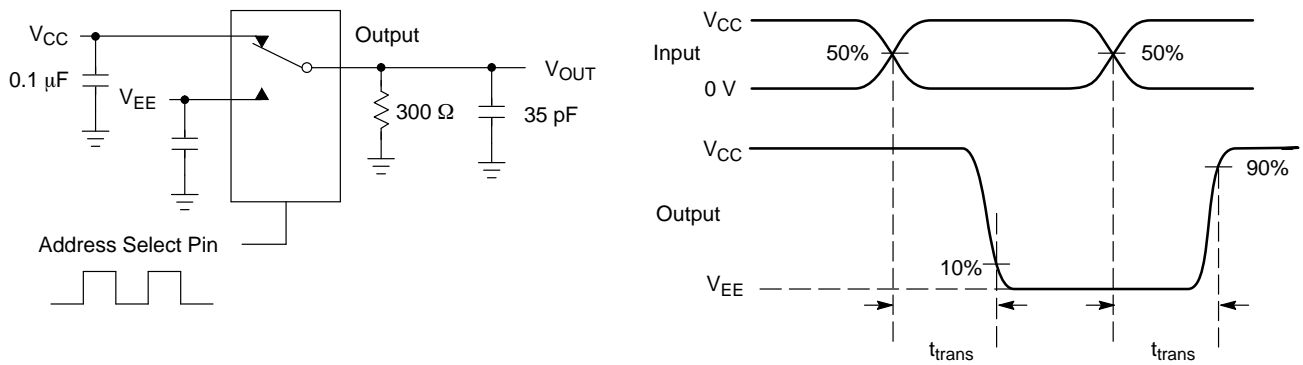
Figure 18. Channel Selection Propagation Delay
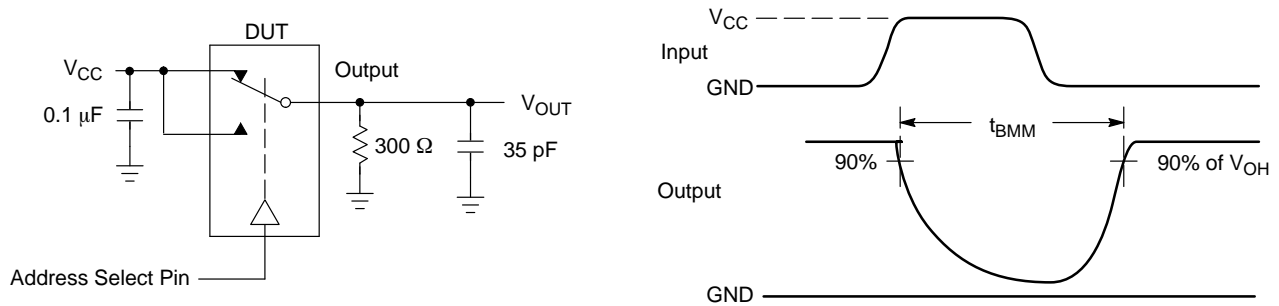
Figure 19. t$_{BBM}$ (Time Break−Before−Make)

Figure 20. t$_{ON}$/t$_{OFF}$

NLAST4051
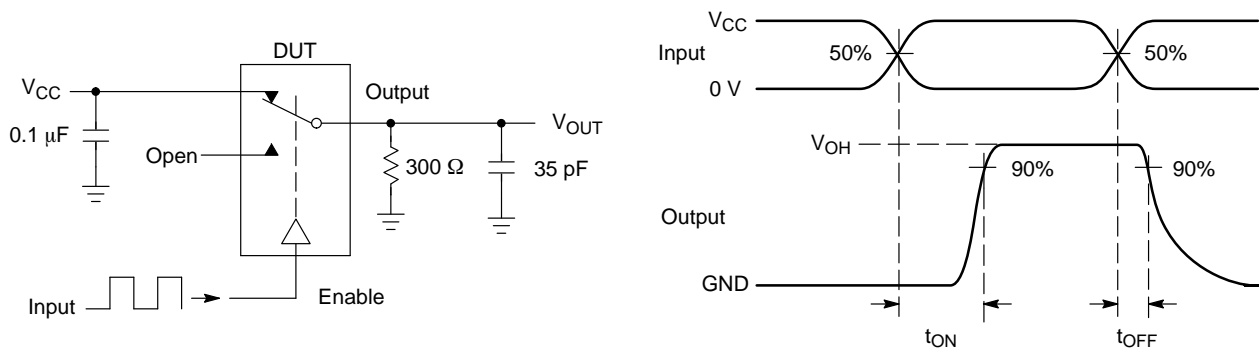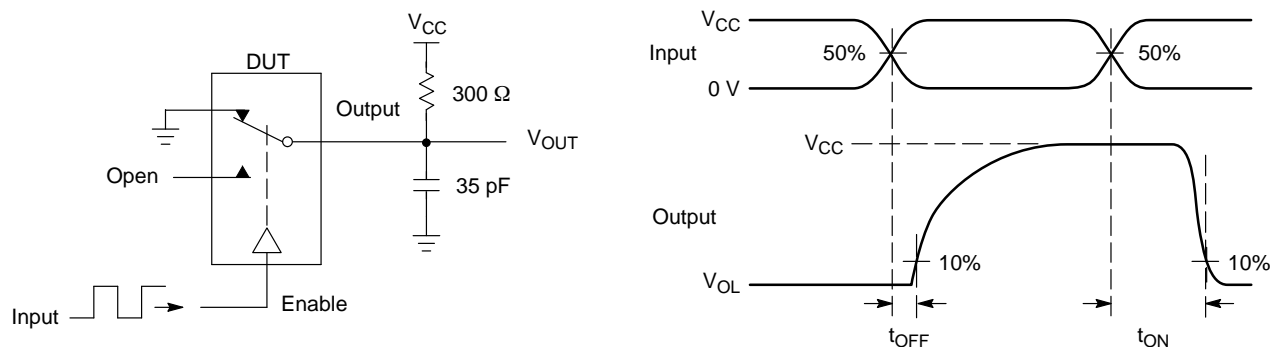
Figure 21. t_{ON}/t_{OFF}
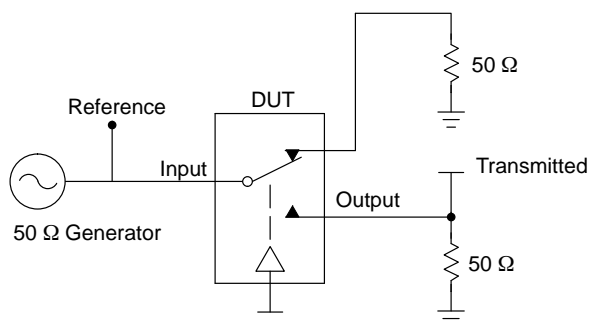
Channel switch Address and Inhibit/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch. V_{ISO}, Bandwidth and V_{ONL} are independent of the input signal direction.

$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log} \left(\frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at 100 kHz}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \text{ Log} \left(\frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at 100 kHz to 50 MHz}$$

Bandwidth (BW) = the frequency 3 dB below V_{ONL}

Figure 22. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/V_{ONL}
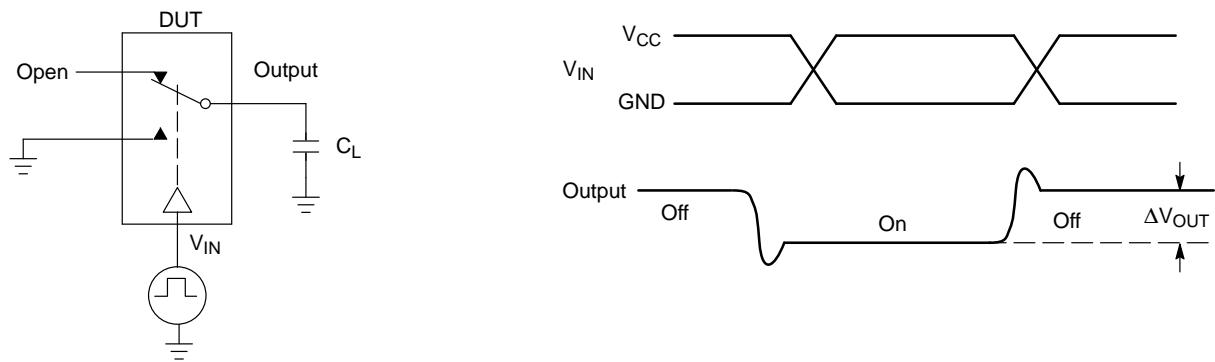
Figure 23. Charge Injection: (Q)

TYPICAL OPERATION
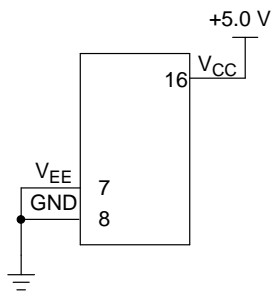
Figure 24. 5.0 Volts Single Supply
$V_{CC} = 5.0$ V, $V_{EE} = 0$
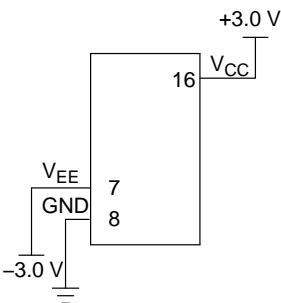
Figure 25. Dual Supply
$V_{CC} = 3.0$ V, $V_{EE} = -3.0$ V

ORDERING INFORMATION

Device	Package	Shipping†
NLAST4051DTR2G	TSSOP−16 (Pb−Free)	2500 / Tape & Reel
NLVAST4051DTR2G*	TSSOP−16 (Pb−Free)	2500 / 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.

*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable.
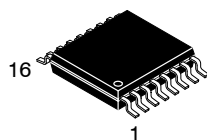
TSSOP−16
CASE 948F−01
ISSUE B

DATE 19 OCT 2006

16

1

SCALE 2:1

16X K REF

⊕ | 0.10 (0.004) Ⓜ | T | U Ⓢ | V Ⓢ

◯ 0.15 (0.006) | T | U Ⓢ

2X L/2

16   9

L

B
–U–

PIN 1
IDENT.

1   8

◯ 0.15 (0.006) | T | U Ⓢ

A
–V–

K
K1

J1

J

SECTION N–N

N

0.25 (0.010)

M

N

F

DETAIL E

C

◯ 0.10 (0.004)

–T– SEATING
PLANE

D

G

H

DETAIL E

–W–
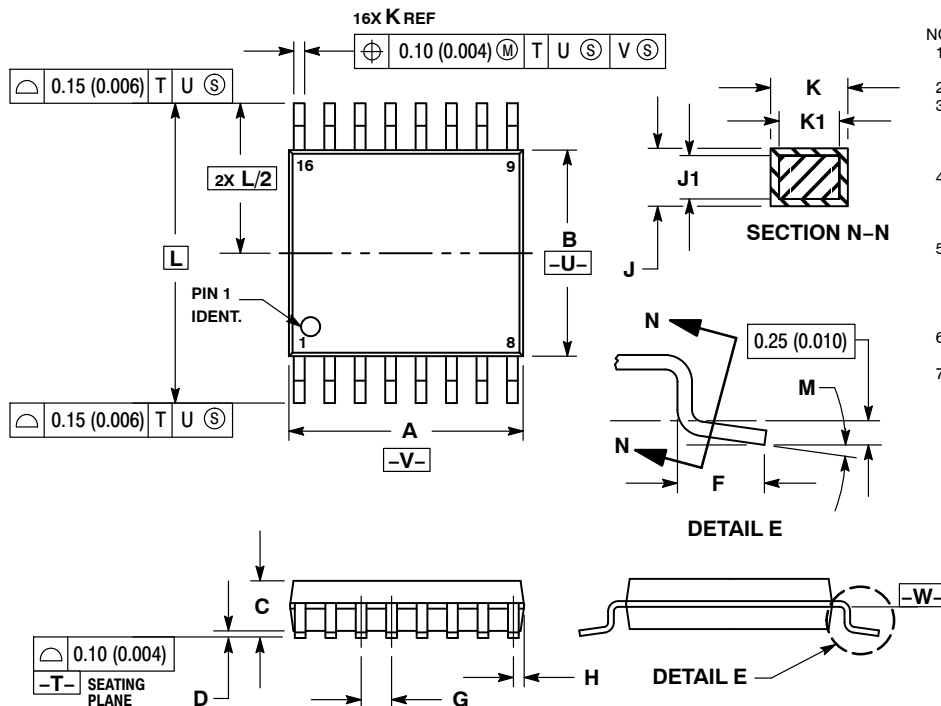
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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 –W–.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
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	0.18	0.28	0.007	0.011
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 °

SOLDERING FOOTPRINT

7.06

1

0.65
PITCH

16X
0.36

16X
1.26

DIMENSIONS: MILLIMETERS
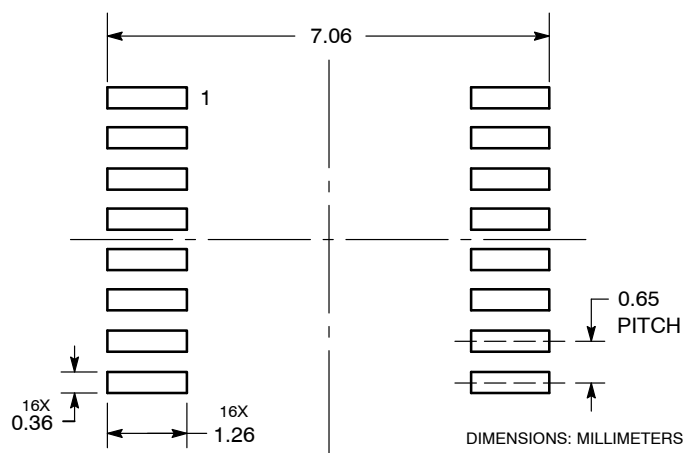
**GENERIC
MARKING DIAGRAM***

16

XXXX
XXXX
ALYW

1
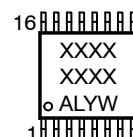
XXXX = Specific Device Code
A = Assembly Location
L = Wafer Lot
Y = Year
W = Work Week
G or ▪ = Pb−Free Package

*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.

DOCUMENT NUMBER:	98ASH70247A	
DESCRIPTION:	**TSSOP−16**	**PAGE 1 OF 1**

PUBLICATION ORDERING INFORMATION

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