

NLAST4051

Analog Multiplexer/ Demultiplexer

TTL Compatible, Single-Pole, 8-Position Plus Common Off



ON Semiconductor®

www.onsemi.com

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 NLA4051. 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)

MARKING DIAGRAM



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.

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.

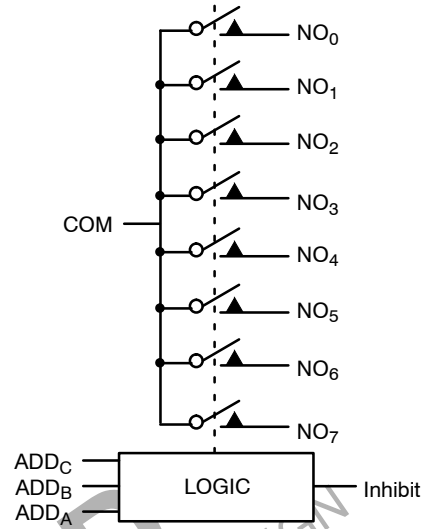


Figure 2. Logic Diagram

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) $V_{CC} = 3.0 \text{ V} \pm 0.3 \text{ V}$ $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$	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} $V_{IS} = (V_{EE} \text{ to } V_{CC})$ $ I_S = 10 \text{ 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} , $ I_S = 10 \text{ mA}$, $V_{IS} = 2.0 \text{ V}$ $V_{IS} = 3.0 \text{ V}$ $V_{IS} = 2.0 \text{ V}$	3.0 4.5 3.0	0 0 -3.0	15 13 10	20 18 15	20 18 15	Ω
$R_{flat(ON)}$	ON Resistance Flatness	$V_{COM} = 1, 2, 3.5 \text{ V}$ $V_{COM} = 2, 0, 2 \text{ V}$	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} $V_{IO} = V_{CC} - 1.0 \text{ V}$ or $V_{EE} + 1.0 \text{ V}$ (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 $V_{IO} = V_{CC} - 1.0 \text{ V}$ or $V_{EE} + 1.0 \text{ V}$ (Figure 17)	6.0 3.0	0 -3.0	0.1 0.1	5.0 5.0	100 100	nA

NLAST4051

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 Ω, 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	0			40		45		50	ns
		3.0	0			28		30		35	
		4.5	0			23		25		30	
		3.0	-3.0			23		25		28	
t _{ON}	Turn-on Time (Figures 14, 15, 20, and 21) Enable to N _O or N _C	2.5	0			40		45		50	ns
		3.0	0			28		30		35	
		4.5	0			23		25		30	
		3.0	-3.0			23		25		28	
t _{OFF}	Turn-off Time (Figures 14, 15, 20, and 21) Enable to N _O or N _C	2.5	0			40		45		50	ns
		3.0	0			28		30		35	
		4.5	0			23		25		30	
		3.0	-3.0			23		25		28	

		Typical @ 25°C, V _{CC} = 5.0 V	pF
C _{IN}	Maximum Input Capacitance,Select Inputs	8	
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	Unit
					25°C	
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, $Q = C_L \cdot \Delta V_{OUT}$ (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, $R_L = 10$ K Ω , $C_L = 50$ 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

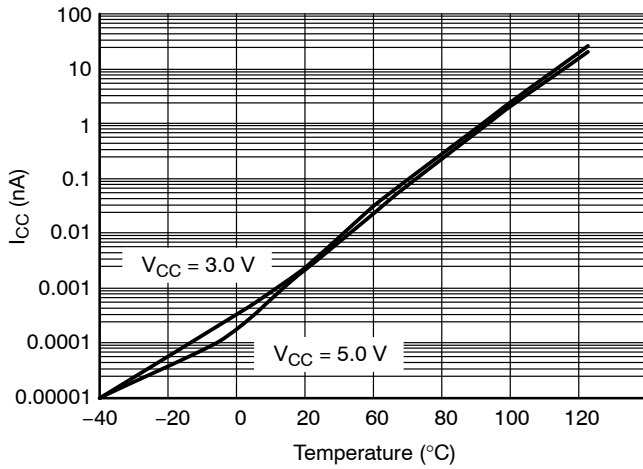


Figure 3. I_{CC} versus Temp, $V_{CC} = 3\text{ V}$ and 5 V

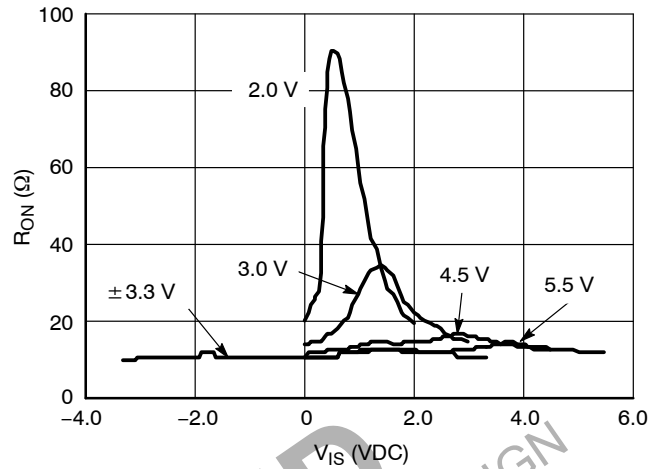


Figure 4. R_{ON} versus V_{CC} , Temp = 25°C

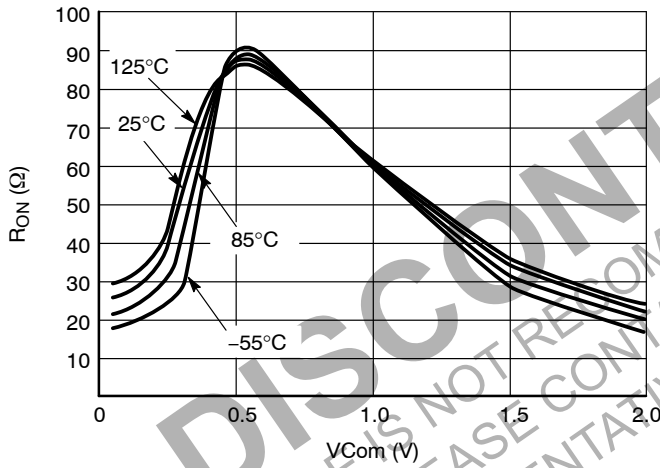


Figure 5. Typical On Resistance
 $V_{CC} = 2.0\text{ V}$, $V_{EE} = 0\text{ V}$

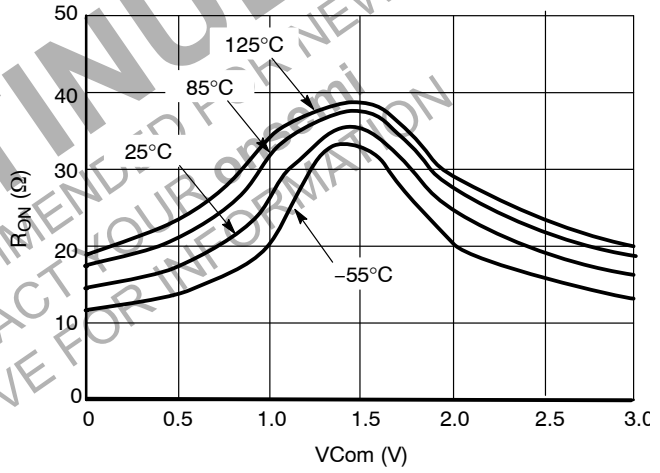


Figure 6. Typical On Resistance
 $V_{CC} = 3.0\text{ V}$, $V_{EE} = 0\text{ V}$

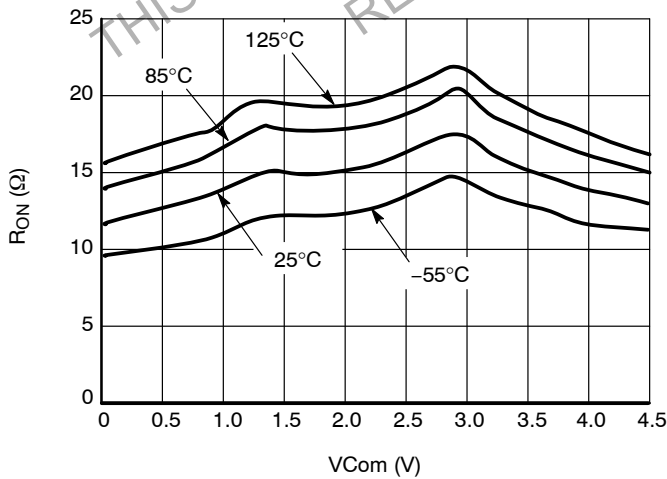


Figure 7. Typical On Resistance
 $V_{CC} = 4.5\text{ V}$, $V_{EE} = 0\text{ V}$

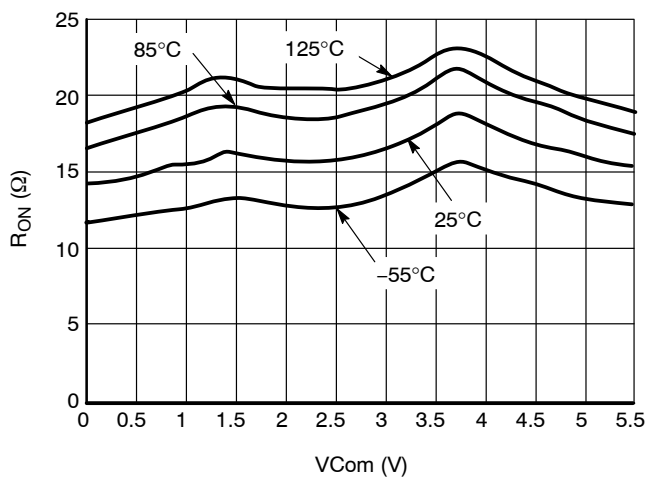


Figure 8. Typical On Resistance
 $V_{CC} = 5.5\text{ V}$, $V_{EE} = 0\text{ V}$

TYPICAL CHARACTERISTICS

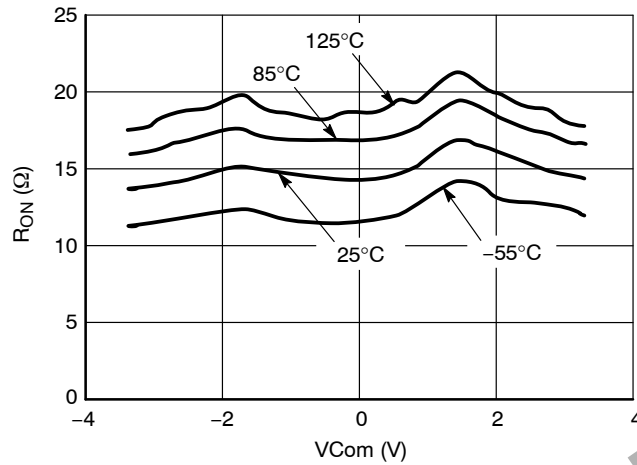


Figure 9. Typical On Resistance
 $V_{CC} = 3.3$ V, $V_{EE} = -3.3$ V

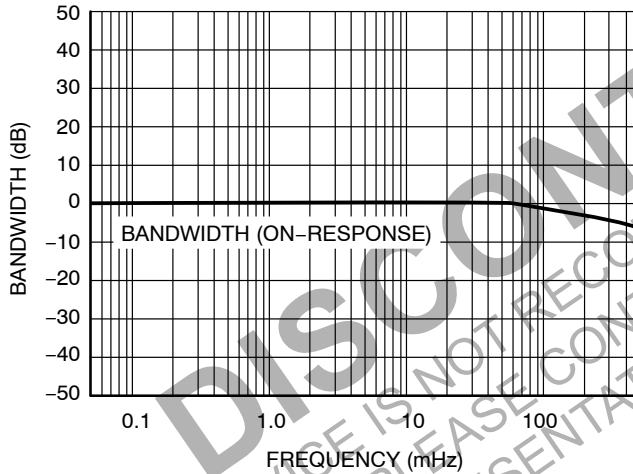


Figure 10. Bandwidth

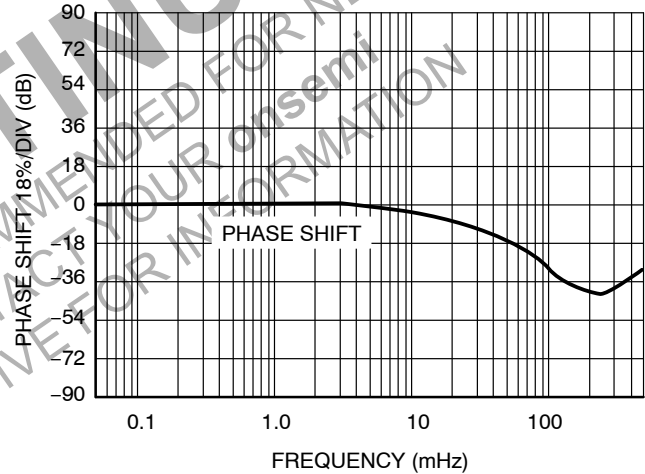


Figure 11. Phase Shift

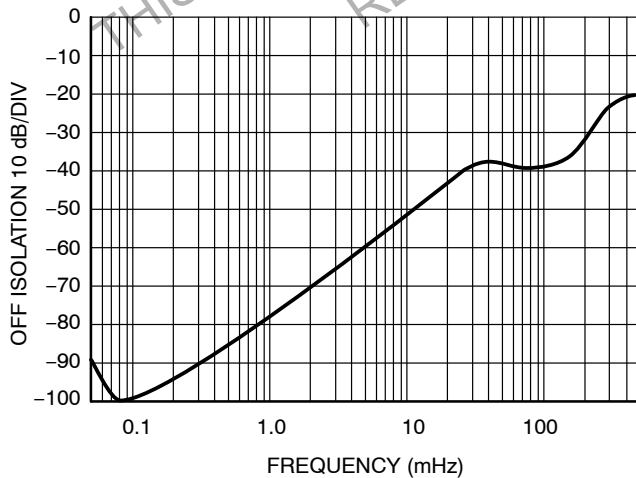


Figure 12. Off Isolation

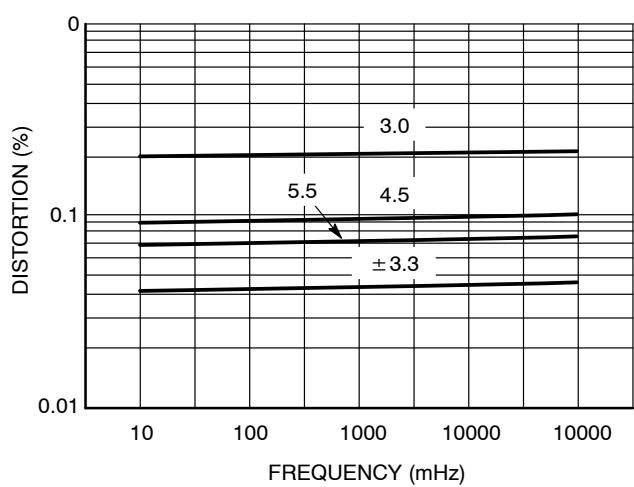


Figure 13. Total Harmonic Distortion

TYPICAL CHARACTERISTICS

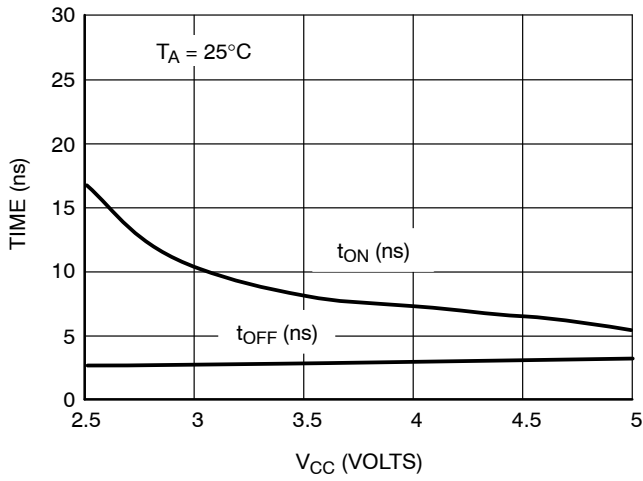


Figure 14. t_{ON} and t_{OFF} versus V_{CC}

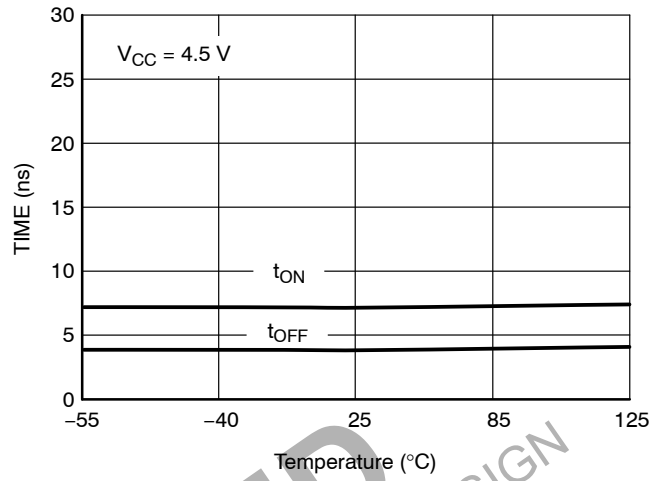


Figure 15. t_{ON} and t_{OFF} versus Temp

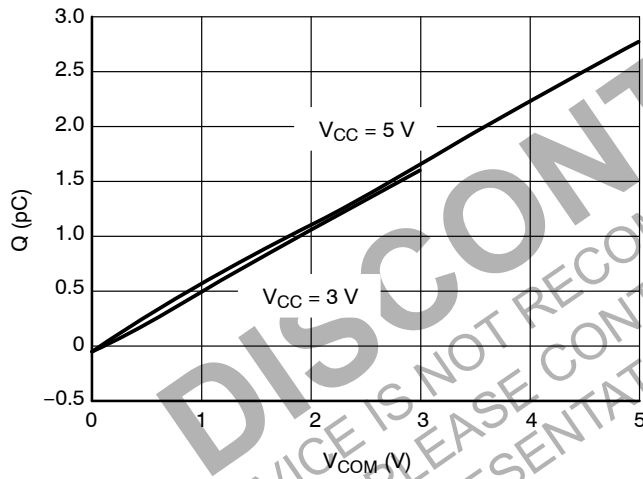


Figure 16. Charge Injection versus COM Voltage

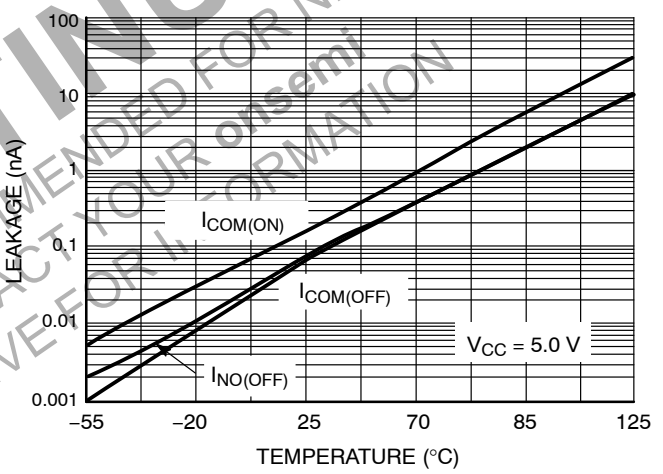


Figure 17. Switch Leakage versus Temperature

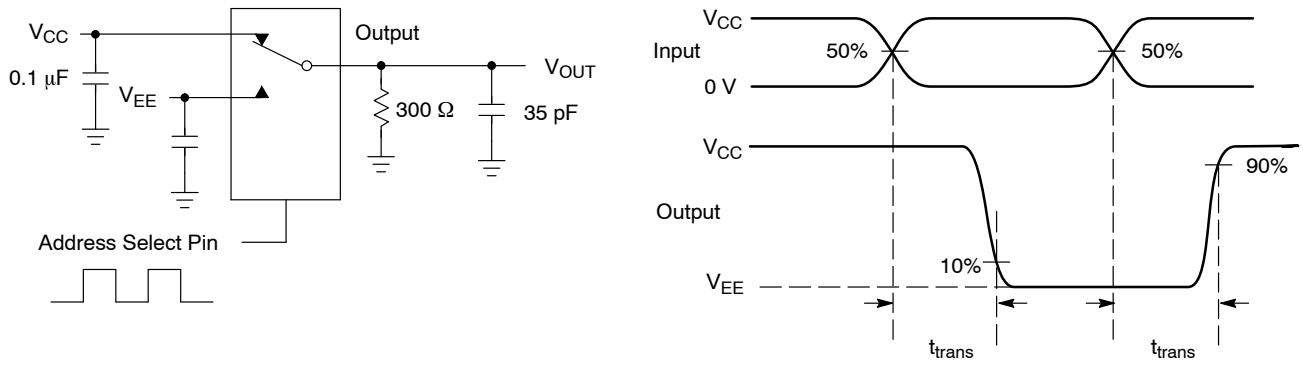


Figure 18. Channel Selection Propagation Delay

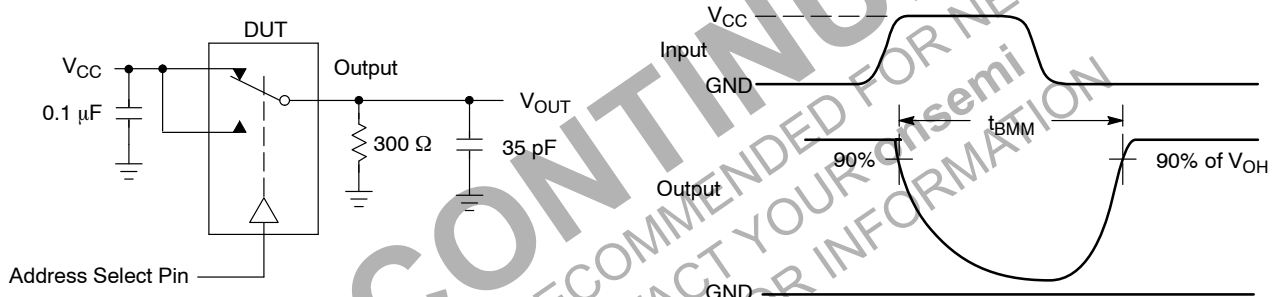


Figure 19. t_{BMM} (Time Break-Before-Make)

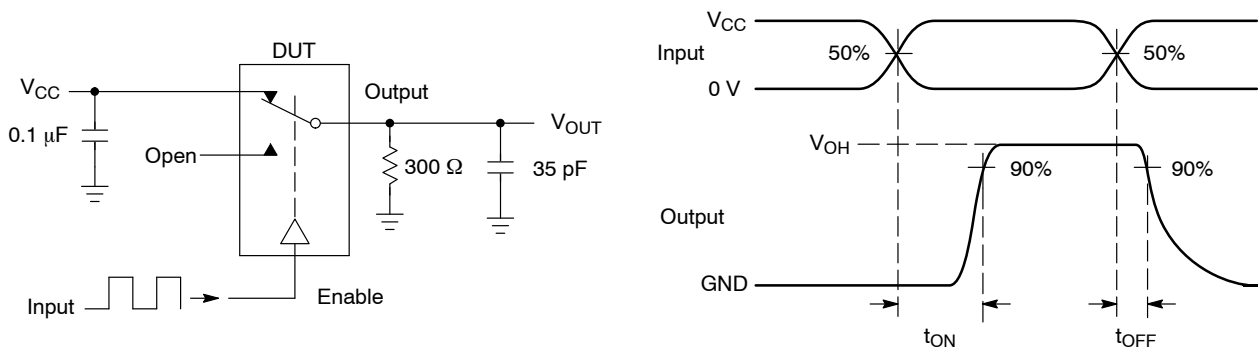


Figure 20. t_{ON}/t_{OFF}

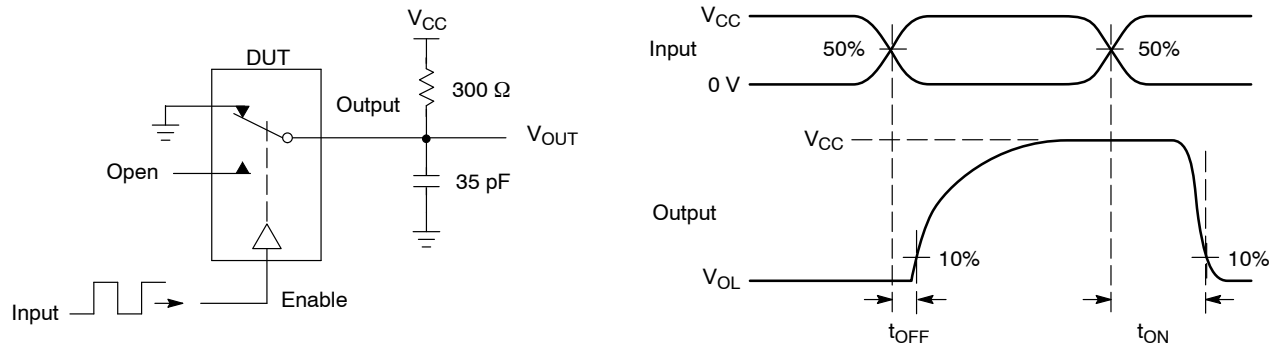
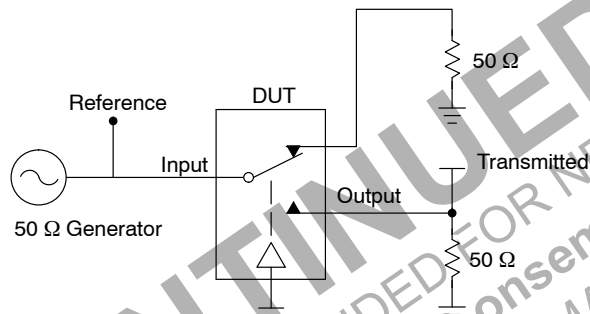


Figure 21. t_{ON}/t_{OFF}



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.

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

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

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}

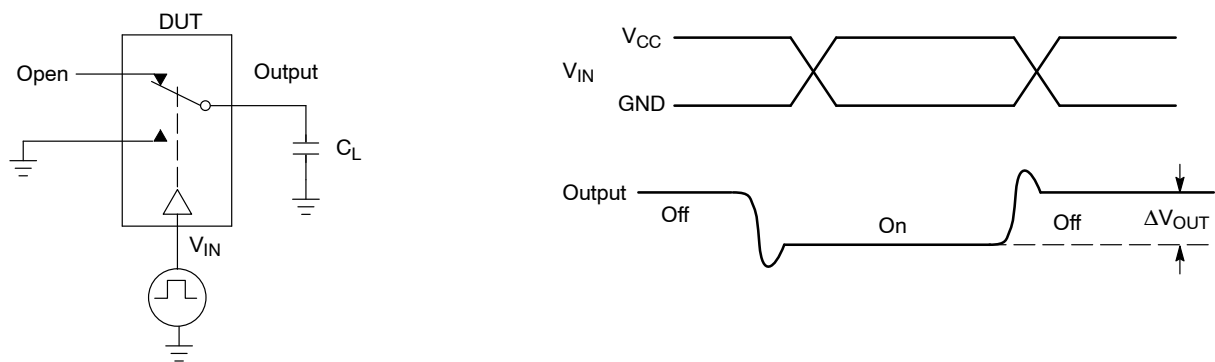


Figure 23. Charge Injection: (Q)

TYPICAL OPERATION

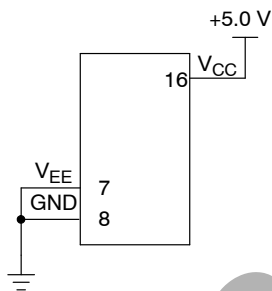


Figure 24. 5.0 Volts Single Supply
 $V_{CC} = 5.0\text{ V}$, $V_{EE} = 0$

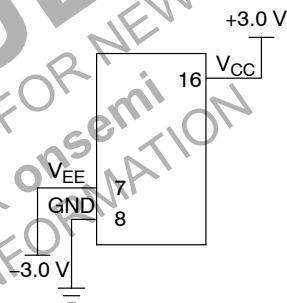


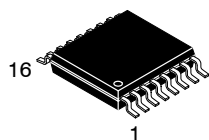
Figure 25. Dual Supply
 $V_{CC} = 3.0\text{ V}$, $V_{EE} = -3.0\text{ V}$

ORDERING INFORMATION

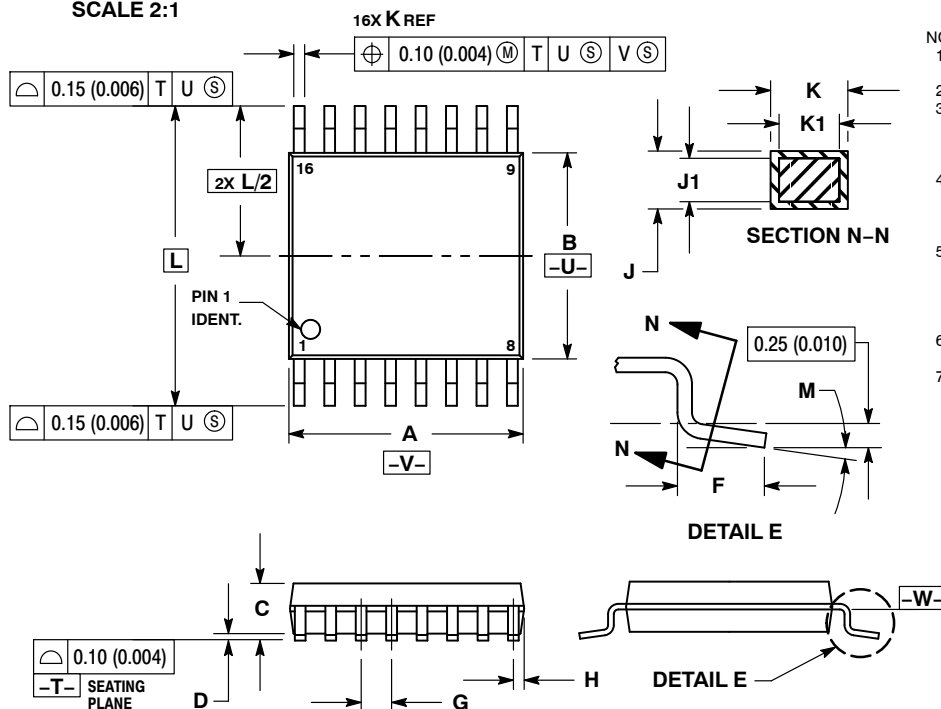
Device	Package	Shipping†
NLAST4051DTR2G	TSSOP-16 (Pb-Free)	2500 / Tape & Reel
NLFAST4051DTR2G*	TSSOP-16 (Pb-Free)	2500 / Tape & Reel

†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.

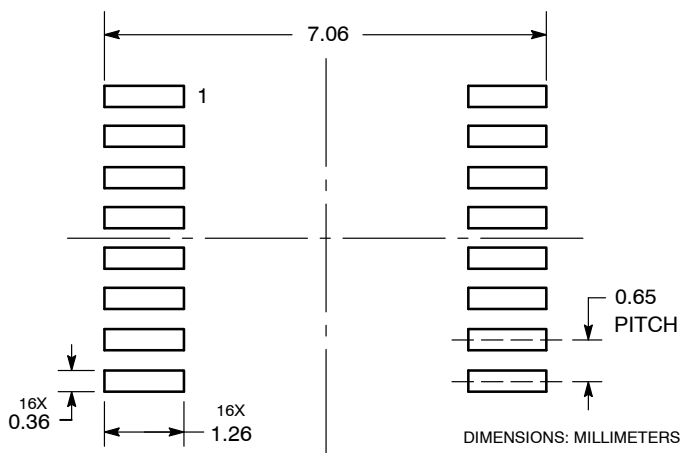

TSSOP-16 WB
CASE 948F
ISSUE B

DATE 19 OCT 2006

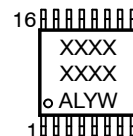

NOTES:

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°

**RECOMMENDED
SOLDERING FOOTPRINT***


*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

**GENERIC
MARKING DIAGRAM***


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. Some products may not follow the Generic Marking.

DOCUMENT NUMBER:	98ASH70247A	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TSSOP-16	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