

# Quad Analog Switch/ Multiplexer/Demultiplexer

## High-Performance Silicon-Gate CMOS

### MC74LVX4066

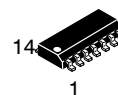
The MC74LVX4066 utilizes silicon-gate CMOS technology to achieve fast propagation delays, low ON resistances, and low OFF-channel leakage current. This bilateral switch/multiplexer/demultiplexer controls analog and digital voltages that may vary across the full power-supply range (from  $V_{CC}$  to GND).

The LVX4066 is identical in pinout to the metal-gate CMOS MC14066 and the high-speed CMOS HC4066A. Each device has four independent switches. The device has been designed so that the ON resistances ( $R_{ON}$ ) are much more linear over input voltage than  $R_{ON}$  of metal-gate CMOS analog switches.

The ON/OFF control inputs are compatible with standard CMOS outputs; with pull-up resistors, they are compatible with LSTTL outputs.

#### Features

- Fast Switching and Propagation Speeds
- High ON/OFF Output Voltage Ratio
- Low Crosstalk Between Switches
- Diode Protection on All Inputs/Outputs
- Wide Power-Supply Voltage Range ( $V_{CC} - GND$ ) = 2.0 to 6.0 Volts
- Analog Input Voltage Range ( $V_{CC} - GND$ ) = 2.0 to 6.0 Volts
- Improved Linearity and Lower ON Resistance over Input Voltage than the MC14016 or MC14066
- Low Noise
- Chip Complexity: 44 FETs or 11 Equivalent Gates
- These Devices are Pb-Free and are RoHS Compliant

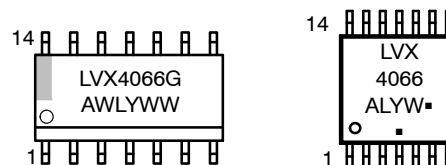


SOIC-14  
D SUFFIX  
CASE 751A



TSSOP-14  
DT SUFFIX  
CASE 948G

#### MARKING DIAGRAMS



LVX4066 = Specific Device Code  
A = Assembly Location  
WL, L = Wafer Lot  
Y = Year  
WW, W = Work Week  
G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

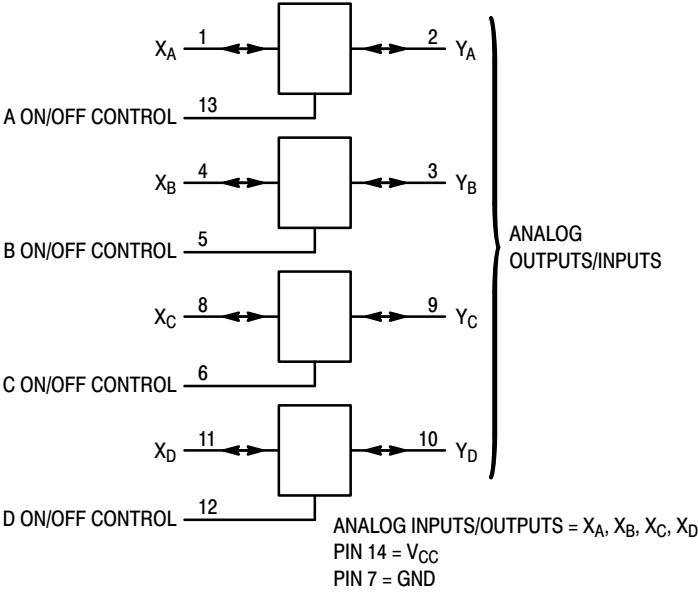
Device	Package	Shipping <sup>†</sup>
MC74LVX4066DR2G	SOIC-14 (Pb-Free)	2500 Tape & Reel
MC74LVX4066DTR2G	TSSOP-14* (Pb-Free)	2500 Tape & Reel

<sup>†</sup>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](#).

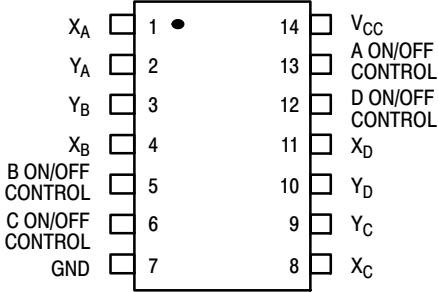
\*This package is inherently Pb-Free.

MC74LVX4066

LOGIC DIAGRAM



PIN CONNECTION (Top View)



FUNCTION TABLE

On/Off Control Input	State of Analog Switch
L	Off
H	On

# MC74LVX4066

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	Positive DC Supply Voltage (Referenced to GND)	– 0.5 to + 7.0	V
$V_{IS}$	Analog Input Voltage (Referenced to GND)	– 0.5 to $V_{CC} + 0.5$	V
$V_{in}$	Digital Input Voltage (Referenced to GND)	– 0.5 to $V_{CC} + 0.5$	V
$I_{in}$	DC Current Into or Out of ON/OFF Control Pins	$\pm 20$	mA
$I_s$	DC Current Into or Out of Switch Pins	$\pm 20$	mA
$P_D$	Power Dissipation in Still Air, SOIC Package† TSSOP Package†	500 450	mW
$T_{stg}$	Storage Temperature	– 65 to + 150	°C
$T_L$	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C

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.

†Derating — SOIC Package: – 7 mW/°C from 65° to 125°C  
TSSOP Package: – 6.1 mW/°C from 65° to 125°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. I/O pins must be connected to a properly terminated line or bus.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
$V_{CC}$	Positive DC Supply Voltage (Referenced to GND)	2.0	6.0	V
$V_{IS}$	Analog Input Voltage (Referenced to GND)	GND	$V_{CC}$	V
$V_{in}$	Digital Input Voltage (Referenced to GND)	GND	$V_{CC}$	V
$V_{IO}^*$	Static or Dynamic Voltage Across Switch	–	1.2	V
$T_A$	Operating Temperature, All Package Types	– 55	+ 85	°C
$t_r, t_f$	Input Rise and Fall Time, ON/OFF Control Inputs (Figure 10) $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$ $V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$	0 0	100 20	ns/V

\*For voltage drops across the switch greater than 1.2 V (switch on), excessive  $V_{CC}$  current may be drawn; i.e., the current out of the switch may contain both  $V_{CC}$  and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded.

## DC ELECTRICAL CHARACTERISTIC Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	$V_{CC}$ V	Guaranteed Limit			Unit
				– 55 to 25°C	≤ 85°C	≤ 125°C	
$V_{IH}$	Minimum High-Level Voltage ON/OFF Control Inputs (Note 1)	$R_{on} = \text{Per Spec}$	2.0	1.5	1.5	1.5	V
			3.0	2.1	2.1	2.1	
			4.5	3.15	3.15	3.15	
			5.5	3.85	3.85	3.85	
$V_{IL}$	Maximum Low-Level Voltage ON/OFF Control Inputs (Note 1)	$R_{on} = \text{Per Spec}$	2.0	0.5	0.5	0.5	V
			3.0	0.9	0.9	0.9	
			4.5	1.35	1.35	1.35	
			5.5	1.65	1.65	1.65	
$I_{in}$	Maximum Input Leakage Current ON/OFF Control Inputs	$V_{in} = V_{CC} \text{ or } GND$	5.5V	$\pm 0.1$	$\pm 1.0$	$\pm 1.0$	μA
$I_{CC}$	Maximum Quiescent Supply Current (per Package)	$V_{in} = V_{CC} \text{ or } GND$ $V_{IO} = 0 \text{ V}$	5.5	4.0	40	160	μA

1. Specifications are for design target only. Not final specification limits.

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## DC ELECTRICAL CHARACTERISTICS Analog Section (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Guaranteed Limit			Unit
				– 55 to 25°C	≤ 85°C	≤ 125°C	
R <sub>on</sub>	Maximum “ON” Resistance	V <sub>in</sub> = V <sub>IH</sub> V <sub>IS</sub> = V <sub>CC</sub> to GND  I <sub>S</sub>   ≤ 10 mA (Figures 1, 2)	2.0†	–	–	–	Ω
			3.0	40	45	50	
			4.5	25	30	35	
			5.5	20	25	30	
		V <sub>in</sub> = V <sub>IH</sub> V <sub>IS</sub> = V <sub>CC</sub> or GND (Endpoints)  I <sub>S</sub>   ≤ 10 mA (Figures 1, 2)	2.0	–	–	–	
			3.0	30	35	40	
			4.5	25	30	35	
			5.5	20	25	30	
ΔR <sub>on</sub>	Maximum Difference in “ON” Resistance Between Any Two Channels in the Same Package	V <sub>in</sub> = V <sub>IH</sub> V <sub>IS</sub> = 1/2 (V <sub>CC</sub> – GND) I <sub>S</sub> ≤ 2.0 mA	3.0	15	20	25	Ω
			4.5	10	12	15	
			5.5	10	12	15	
I <sub>off</sub>	Maximum Off-Channel Leakage Current, Any One Channel	V <sub>in</sub> = V <sub>IL</sub> V <sub>IO</sub> = V <sub>CC</sub> or GND Switch Off (Figure 3)	5.5	0.1	0.5	1.0	μA
I <sub>on</sub>	Maximum On-Channel Leakage Current, Any One Channel	V <sub>in</sub> = V <sub>IH</sub> V <sub>IS</sub> = V <sub>CC</sub> or GND (Figure 4)	5.5	0.1	0.5	1.0	μA

† At supply voltage (V<sub>CC</sub>) approaching 2 V the analog switch-on resistance becomes extremely non-linear. Therefore, for low-voltage operation, it is recommended that these devices only be used to control digital signals (See Figure 1a).

## AC ELECTRICAL CHARACTERISTICS (C<sub>L</sub> = 50 pF, ON/OFF Control Inputs: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

Symbol	Parameter	V <sub>CC</sub> V	Guaranteed Limit			Unit
			– 55 to 25°C	≤ 85°C	≤ 125°C	
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Analog Input to Analog Output (Figures 8 and 9)	2.0	4.0	6.0	8.0	ns
		3.0	3.0	5.0	6.0	
		4.5	1.0	2.0	2.0	
		5.5	1.0	2.0	2.0	
t <sub>PLZ</sub> , t <sub>PHZ</sub>	Maximum Propagation Delay, ON/OFF Control to Analog Output (Figures 10 and 11)	2.0	30	35	40	ns
		3.0	20	25	30	
		4.5	15	18	22	
		5.5	15	18	20	
t <sub>PZL</sub> , t <sub>PZH</sub>	Maximum Propagation Delay, ON/OFF Control to Analog Output (Figures 10 and 1 1)	2.0	20	25	30	ns
		3.0	12	14	15	
		4.5	8.0	10	12	
		5.5	8.0	10	12	
C	Maximum Capacitance	ON/OFF Control Input	–	10	10	pF
		Control Input = GND	–	35	35	
		Analog I/O Feedthrough	–	1.0	1.0	
C <sub>PD</sub>	Power Dissipation Capacitance (Per Switch) (Figure 13)*	Typical @ 25°C, V <sub>CC</sub> = 5.0 V				pF
		15				

\* Used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> V<sub>CC</sub><sup>2</sup>f + I<sub>CC</sub> V<sub>CC</sub>.

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## ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> V	Limit* 25°C	Unit
BW	Maximum On-Channel Bandwidth or Minimum Frequency Response (Figure 5)	f <sub>in</sub> = 1 MHz Sine Wave Adjust f <sub>in</sub> Voltage to Obtain 0 dBm at V <sub>OS</sub> Increase f <sub>in</sub> Frequency Until dB Meter Reads – 3 dB R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF	4.5 5.5	150 160	MHz
–	Off-Channel Feedthrough Isolation (Figure 6)	f <sub>in</sub> ≡ Sine Wave Adjust f <sub>in</sub> Voltage to Obtain 0 dBm at V <sub>IS</sub> f <sub>in</sub> = 10 kHz, R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF f <sub>in</sub> = 1.0 MHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF	4.5 5.5 4.5 5.5	– 50 – 50 – 37 – 37	dB
–	Feedthrough Noise, Control to Switch (Figure 7)	V <sub>in</sub> ≤ 1 MHz Square Wave (t <sub>r</sub> = t <sub>f</sub> = 6 ns) Adjust R <sub>L</sub> at Setup so that I <sub>S</sub> = 0 A R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 10 pF	4.5 5.5 4.5 5.5	100 200 50 100	
–	Crosstalk Between Any Two Switches (Figure 12)	f <sub>in</sub> ≡ Sine Wave Adjust f <sub>in</sub> Voltage to Obtain 0 dBm at V <sub>IS</sub> f <sub>in</sub> = 10 kHz, R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF f <sub>in</sub> = 1.0 MHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF	4.5 5.5 4.5 5.5	– 70 – 70 – 80 – 80	dB
THD	Total Harmonic Distortion (Figure 14)	f <sub>in</sub> = 1 kHz, R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 50 pF THD = THD <sub>Measured</sub> – THD <sub>Source</sub> V <sub>IS</sub> = 4.0 V <sub>PP</sub> sine wave V <sub>IS</sub> = 5.0 V <sub>PP</sub> sine wave	4.5 5.5	0.10 0.06	

\*Guaranteed limits not tested. Determined by design and verified by qualification.

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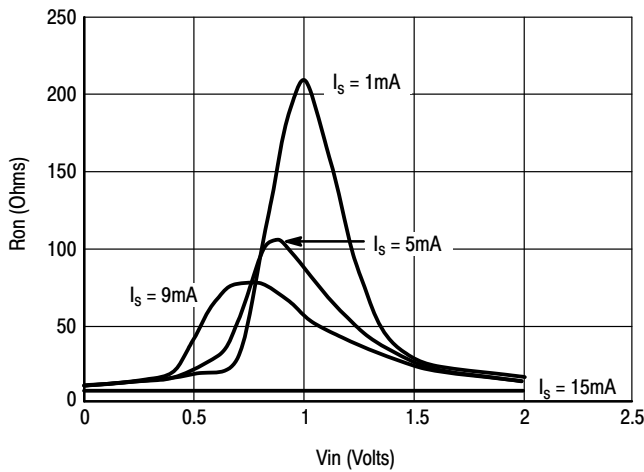


Figure 1a. Typical On Resistance,  $V_{CC} = 2.0\text{ V}$ ,  $T = 25^\circ\text{C}$

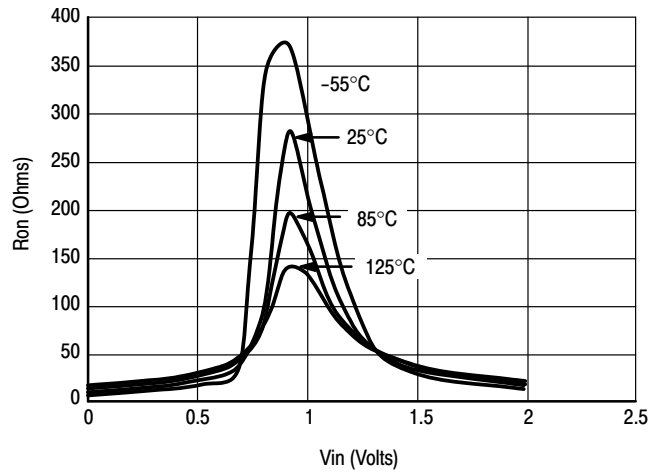


Figure 1b. Typical On Resistance,  $V_{CC} = 2.0\text{ V}$

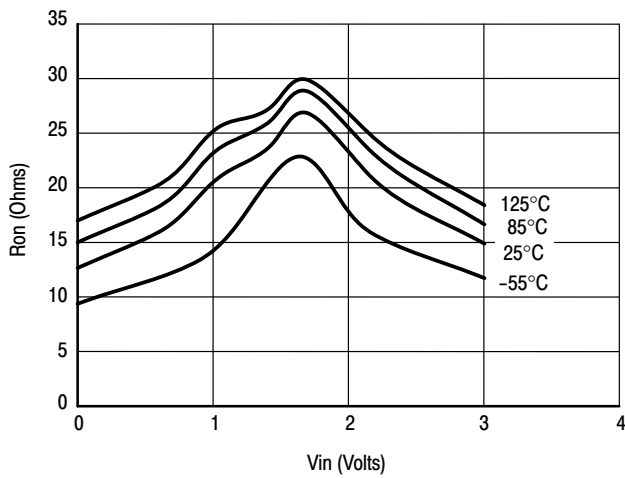


Figure 1c. Typical On Resistance,  $V_{CC} = 3.0\text{ V}$

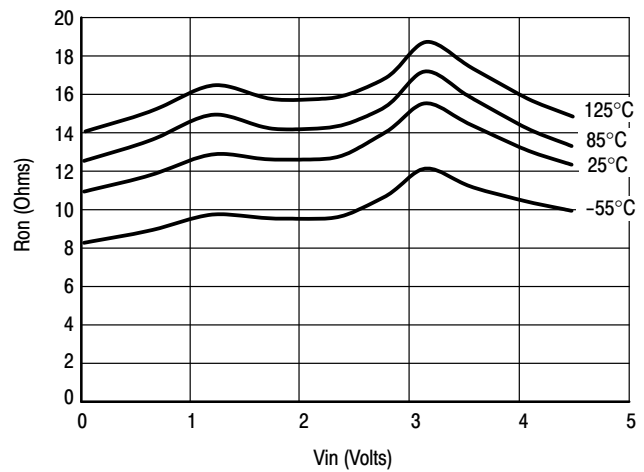


Figure 1d. Typical On Resistance,  $V_{CC} = 4.5\text{ V}$

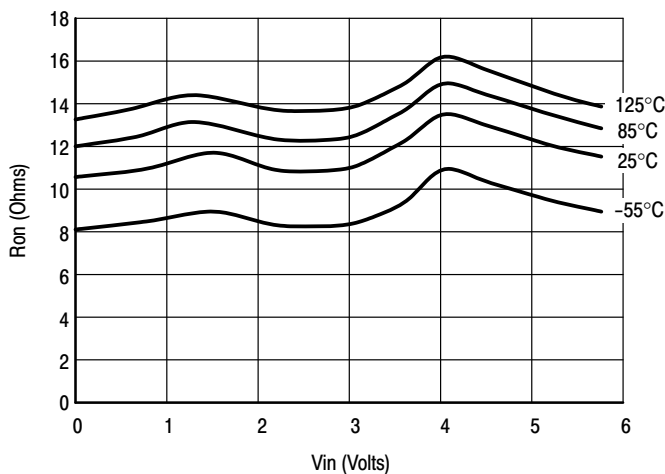


Figure 1e. Typical On Resistance,  $V_{CC} = 5.5\text{ V}$

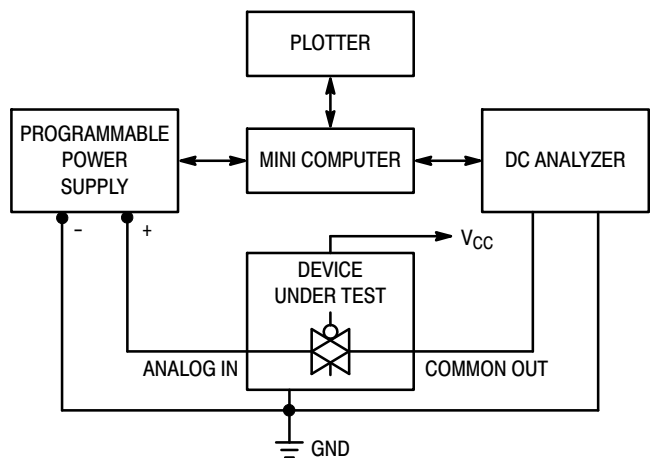


Figure 2. On Resistance Test Set-Up

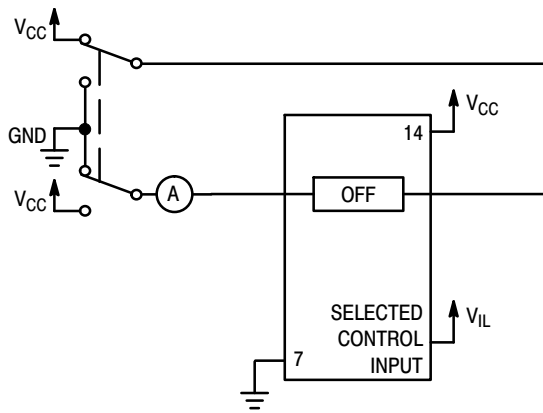


Figure 3. Maximum Off Channel Leakage Current, Any One Channel, Test Set-Up

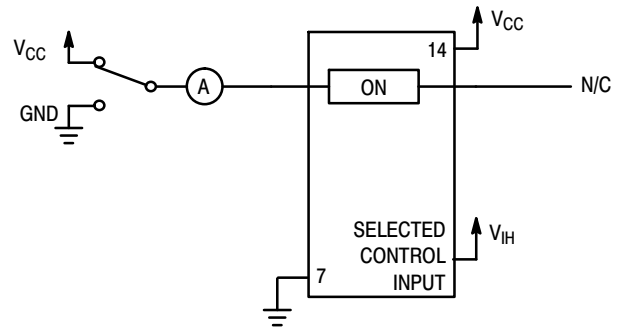
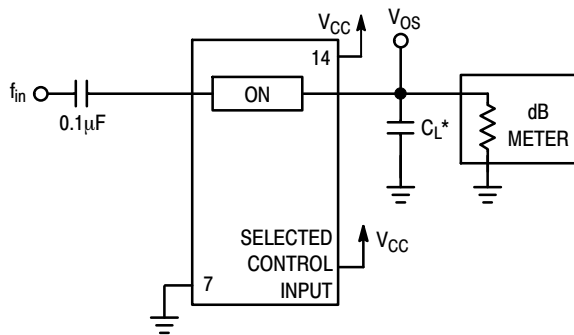
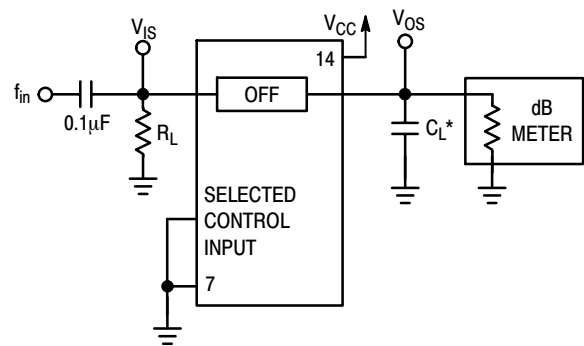


Figure 4. Maximum On Channel Leakage Current, Test Set-Up



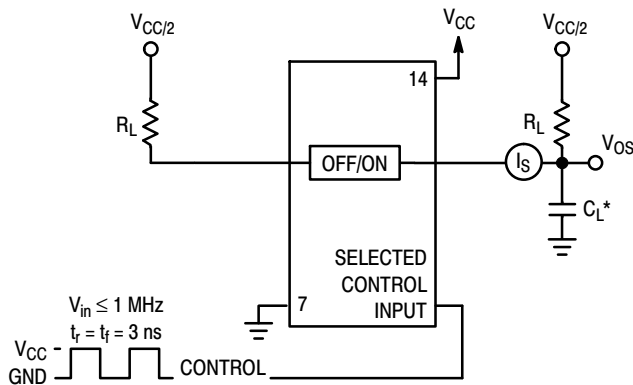
\*Includes all probe and jig capacitance.

Figure 5. Maximum On-Channel Bandwidth Test Set-Up



\*Includes all probe and jig capacitance.

Figure 6. Off-Channel Feedthrough Isolation, Test Set-Up



\*Includes all probe and jig capacitance.

Figure 7. Feedthrough Noise, ON/OFF Control to Analog Out, Test Set-Up

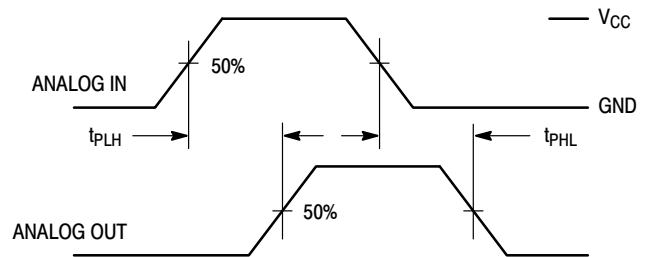
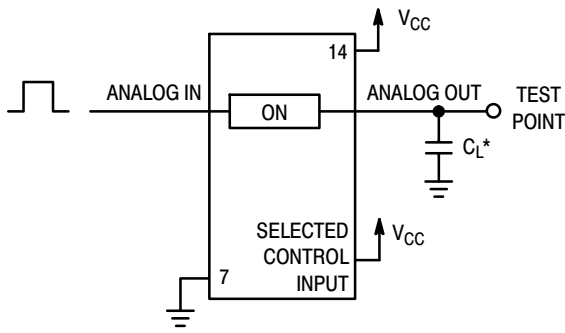


Figure 8. Propagation Delays, Analog In to Analog Out



\*Includes all probe and jig capacitance.

Figure 9. Propagation Delay Test Set-Up

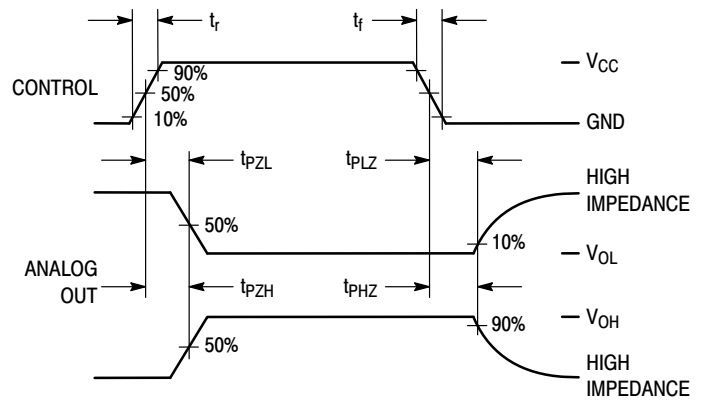
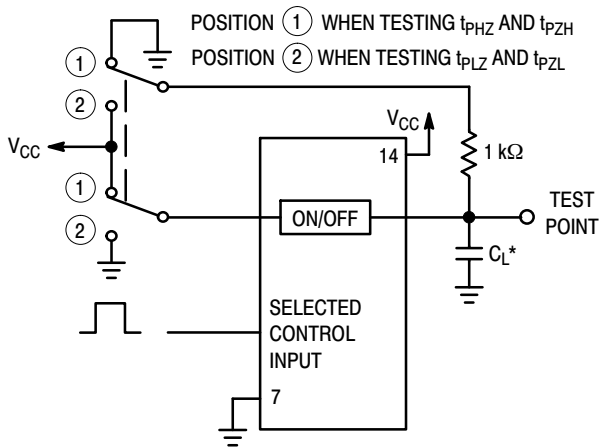
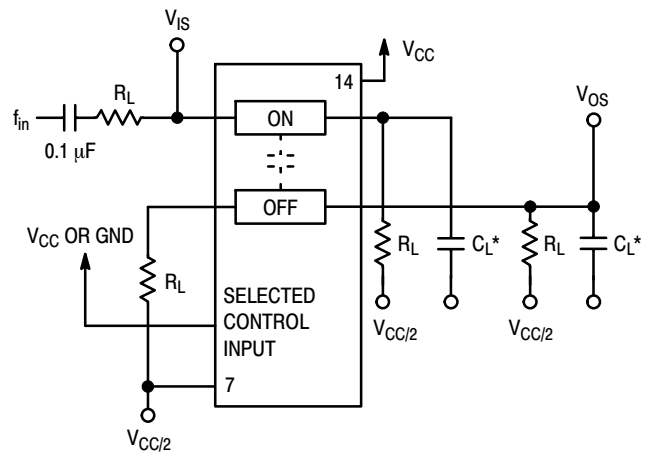


Figure 10. Propagation Delay, ON/OFF Control to Analog Out



\*Includes all probe and jig capacitance.

Figure 11. Propagation Delay Test Set-Up



\*Includes all probe and jig capacitance.

Figure 12. Crosstalk Between Any Two Switches, Test Set-Up

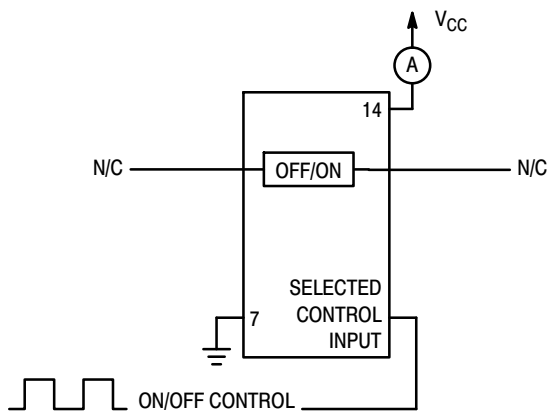
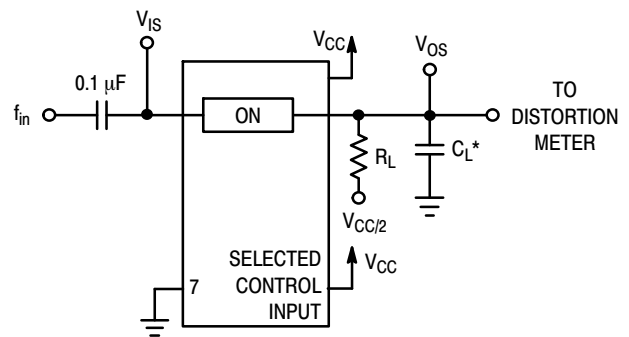


Figure 13. Power Dissipation Capacitance Test Set-Up



\*Includes all probe and jig capacitance.

Figure 14. Total Harmonic Distortion, Test Set-Up



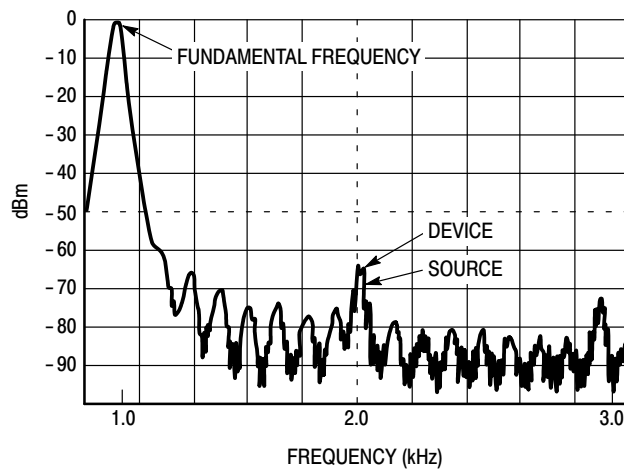


Figure 15. Plot, Harmonic Distortion

### APPLICATION INFORMATION

The ON/OFF Control pins should be at  $V_{CC}$  or GND logic levels,  $V_{CC}$  being recognized as logic high and GND being recognized as a logic low. Unused analog inputs/outputs may be left floating (not connected). However, it is advisable to tie unused analog inputs and outputs to  $V_{CC}$  or GND through a low value resistor. This minimizes crosstalk and feedthrough noise that may be picked-up by the unused I/O pins.

The maximum analog voltage swings are determined by the supply voltages  $V_{CC}$  and GND. The positive peak analog voltage should not exceed  $V_{CC}$ . Similarly, the negative peak analog voltage should not go below GND. In the example below, the difference between  $V_{CC}$  and GND is six volts.

Therefore, using the configuration in Figure 16, a maximum analog signal of six volts peak-to-peak can be controlled.

When voltage transients above  $V_{CC}$  and/or below GND are anticipated on the analog channels, external diodes ( $D_x$ ) are recommended as shown in Figure 17. These diodes should be small signal, fast turn-on types able to absorb the maximum anticipated current surges during clipping. An alternate method would be to replace the  $D_x$  diodes with Mosorbs (MOSORB™ is an acronym for high current surge protectors). Mosorbs are fast turn-on devices ideally suited for precise DC protection with no inherent wear out mechanism.

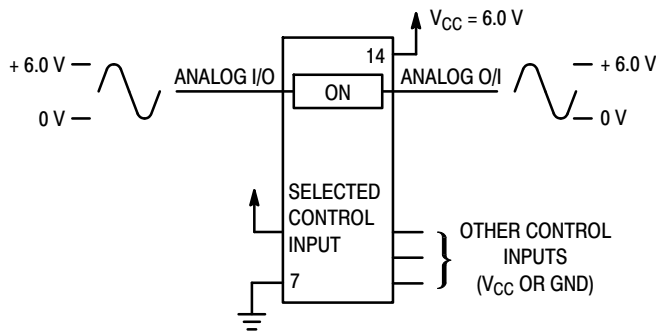


Figure 16. 6.0 V Application

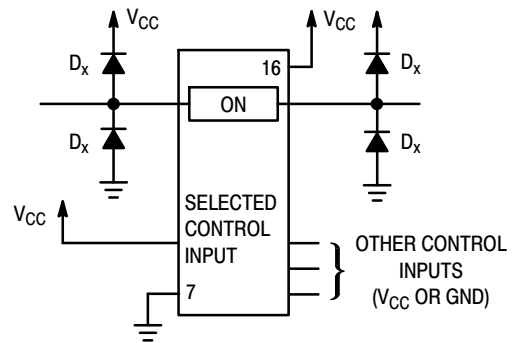


Figure 17. Transient Suppressor Application

## MC74LVX4066

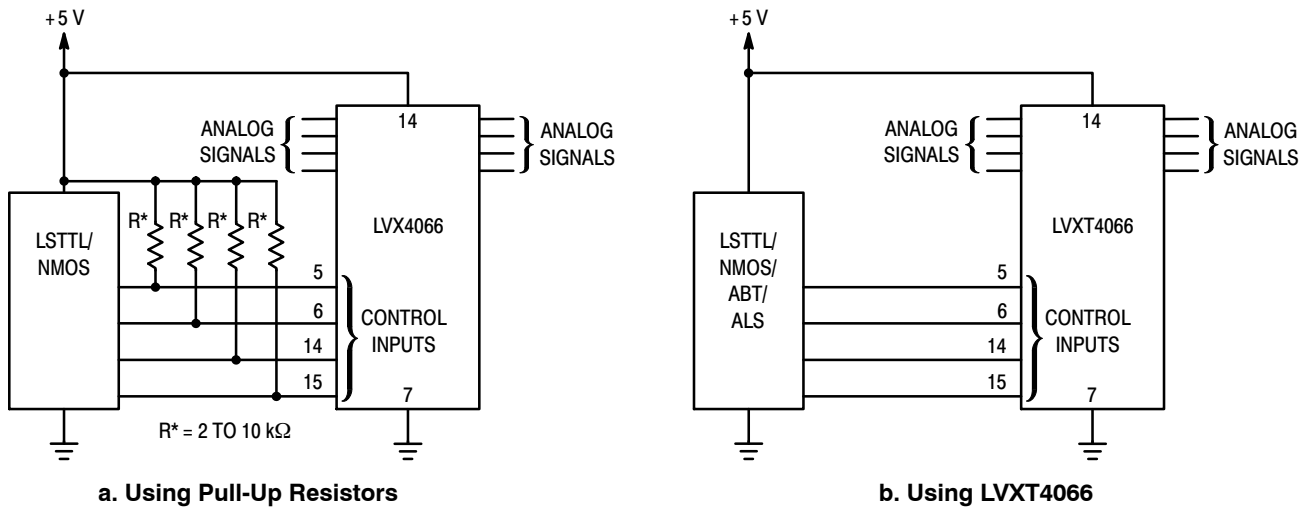


Figure 18. LSTTL/NMOS to CMOS Interface

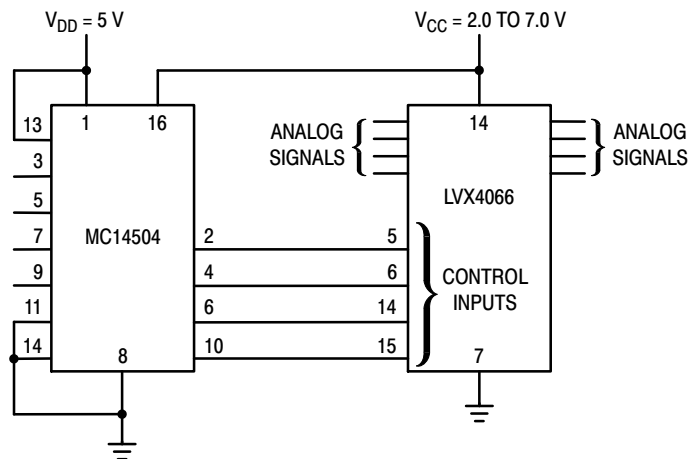


Figure 19. TTL/NMOS-to-CMOS Level Converter  
Analog Signal Peak-to-Peak Greater than 5 V

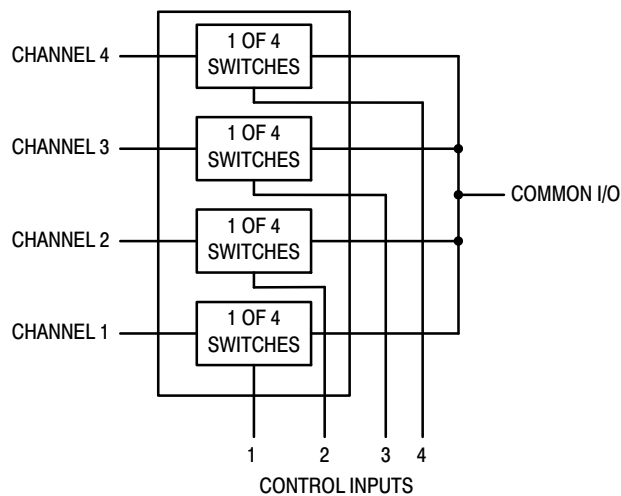


Figure 20. 4-Input Multiplexer

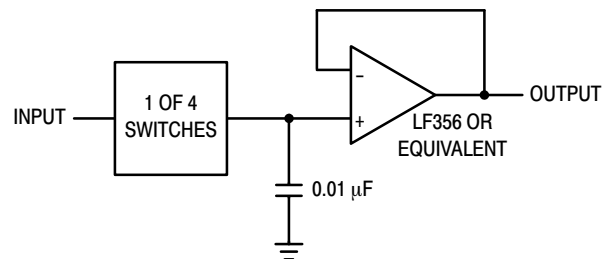
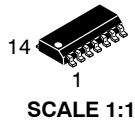


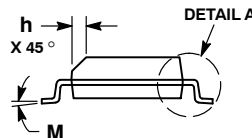
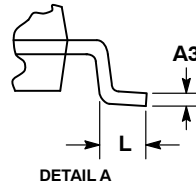
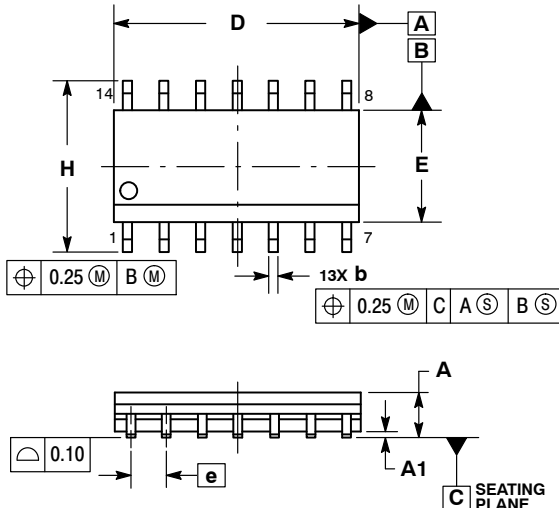
Figure 21. Sample/Hold Amplifier

\*MOSORB, MiniMOSORB, Thermowatt and Thermopad are now trademarks of Littelfuse, Inc.



SOIC-14 NB  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016

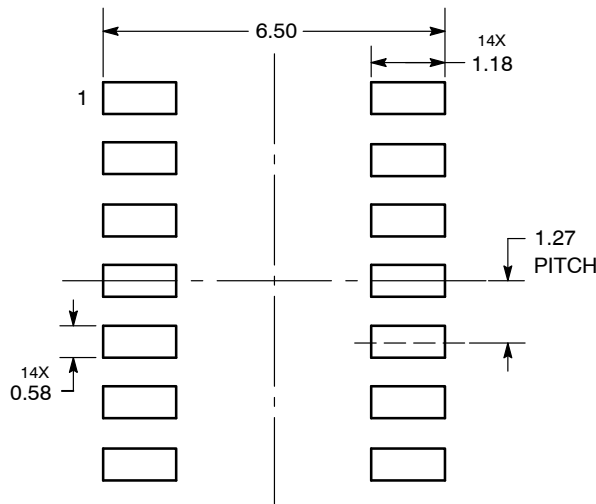


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0°	7°	0°	7°

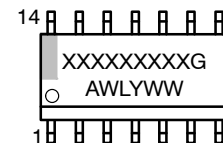
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*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\*



XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
Y = Year  
WW = Work Week  
G = 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.

STYLES ON PAGE 2

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**SOIC-14**  
**CASE 751A-03**  
**ISSUE L**

DATE 03 FEB 2016

STYLE 1:  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. NO CONNECTION  
5. ANODE/CATHODE  
6. NO CONNECTION  
7. ANODE/CATHODE  
8. ANODE/CATHODE  
9. ANODE/CATHODE  
10. NO CONNECTION  
11. ANODE/CATHODE  
12. ANODE/CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

STYLE 2:  
CANCELLED

STYLE 3:  
PIN 1. NO CONNECTION  
2. ANODE  
3. ANODE  
4. NO CONNECTION  
5. ANODE  
6. NO CONNECTION  
7. ANODE  
8. ANODE  
9. ANODE  
10. NO CONNECTION  
11. ANODE  
12. ANODE  
13. NO CONNECTION  
14. COMMON CATHODE

STYLE 4:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. CATHODE  
4. NO CONNECTION  
5. CATHODE  
6. NO CONNECTION  
7. CATHODE  
8. CATHODE  
9. CATHODE  
10. NO CONNECTION  
11. CATHODE  
12. CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

STYLE 5:  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE  
6. NO CONNECTION  
7. COMMON ANODE  
8. COMMON CATHODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. ANODE/CATHODE  
12. ANODE/CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

STYLE 6:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE  
4. CATHODE  
5. CATHODE  
6. CATHODE  
7. CATHODE  
8. ANODE  
9. ANODE  
10. ANODE  
11. ANODE  
12. ANODE  
13. ANODE  
14. ANODE

STYLE 7:  
PIN 1. ANODE/CATHODE  
2. COMMON ANODE  
3. COMMON CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE  
6. ANODE/CATHODE  
7. ANODE/CATHODE  
8. ANODE/CATHODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. COMMON CATHODE  
12. COMMON ANODE  
13. ANODE/CATHODE  
14. ANODE/CATHODE

STYLE 8:  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. NO CONNECTION  
5. ANODE/CATHODE  
6. ANODE/CATHODE  
7. COMMON ANODE  
8. COMMON ANODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. NO CONNECTION  
12. ANODE/CATHODE  
13. ANODE/CATHODE  
14. COMMON CATHODE

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