1. DESCRIPTION

The XL/XD14051, XL/XD14052, and XL/XD14053 analog multiplexers are digitally−controlled analog switches. The XL/XD14051 effectively implements an SP8T solid state switch, the XL/XD14052 a DP4T, and the XL/XD14053 a Triple SPDT. All three devices feature low ON impedance and very low OFF leakage current. Control of analog signals up to the complete supply voltage range can be achieved.

2. FEATURES

- Triple Diode Protection on Control Inputs
- Switch Function is Break Before Make
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Analog Voltage Range (VDD − VEE) = 3.0 to 18 V

  Note: VEE must be ≤ VSS
- Linearized Transfer Characteristics
- Low−noise − 12 nV/Cycle, f ≥1.0 kHz Typical

3. MAXIMUMRATINGS

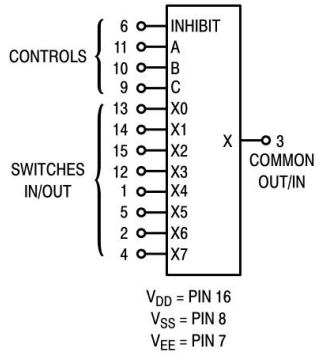
Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage Range (Referenced to V_{EE}, $V_{SS} \geq V_{EE}$)	−0.5 to +18.0	V
V_{in}, V_{out}	Input or Output Voltage Range (DC or Transient) (Referenced to V_{SS} for Control Inputs and V_{EE} for Switch I/O)	−0.5 to V_{DD} + 0.5	V
I_{in}	Input Current (DC or Transient) per Control Pin	+10	mA
I_{SW}	Switch Through Current	±25	mA
P_D	Power Dissipation per Package (Note 1)	500	mW
T_A	Ambient Temperature Range	−40to +85	°C
T_{stg}	Storage Temperature Range	−65 to +150	°C
T_L	Lead Temperature (8−Second Soldering)	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.

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 $V_{SS} \leq (V_{in}$ or $V_{out}) \leq V_{DD}$.

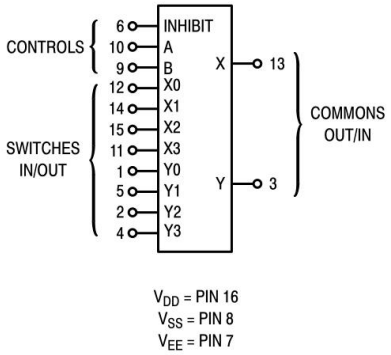
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS}, V_{EE} or V_{DD}). Unused outputs must be left open.

XL/XD14051
8−Channel Analog Multiplexer/Demultiplexer



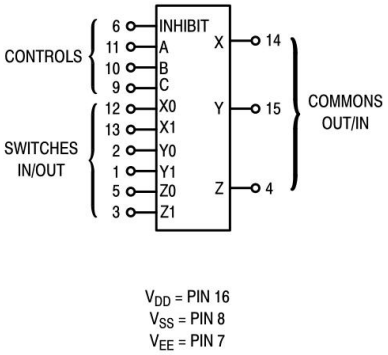
V_{DD} = PIN 16
V_{SS} = PIN 8
V_{EE} = PIN 7

XL/XD14052
Dual 4−Channel Analog Multiplexer/Demultiplexer



V_{DD} = PIN 16
V_{SS} = PIN 8
V_{EE} = PIN 7

XL/XD14053
Triple 2−Channel Analog Multiplexer/Demultiplexer

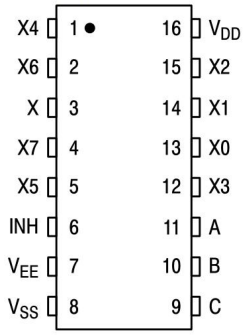


V_{DD} = PIN 16
V_{SS} = PIN 8
V_{EE} = PIN 7

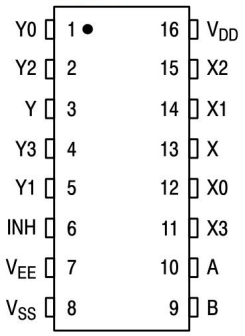
Note: Control Inputs referenced to V_{SS}, Analog Inputs and Outputs reference to V_{EE}. V_{EE} must be $\leq V_{SS}$.

PIN ASSIGNMENT

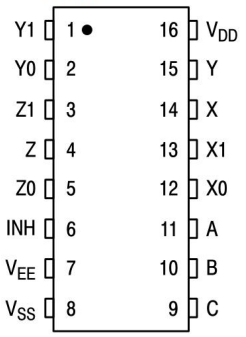
XL/XD14051



XL/XD14052



XL/XD14053



4. ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	V_{DD}	Test Conditions	−40°C Min	−40°C Max	25°C Min	25°C Typ (Note 2)	25°C Max	85°C Min	85°C Max	Unit
SUPPLY REQUIREMENTS (Voltages Referenced to V_{EE})											
Power Supply Voltage Range	V_{DD}	−	$V_{DD} - 3.0 \geq V_{SS} \geq V_{EE}$	3.0	18	3.0	−	18	3.0	18	V
Quiescent Current Per Package	I_{DD}	5.0 10 15	Control Inputs: $V_{in} = V_{SS}$ or V_{DD}, Switch I/O: $V_{EE} \leq V_{I/O} \leq V_{DD}$, and $\Delta V_{switch} \leq$ 500 mV (Note 3)	− − −	5.0 10 20	− − −	0.005 0.010 0.015	5.0 10 20	− − −	150 300 600	μA
Total Supply Current (Dynamic Plus Quiescent, Per Package	$I_{D(AV)}$	5.0 10 15	$T_A = 25°C$ only (The channel component, $(V_{in} - V_{out})/R_{on}$, is not included.)	Typical			(0.07 μA/kHz) f + I_{DD} (0.20 μA/kHz) f + I_{DD} (0.36 μA/kHz) f + I_{DD}				μA
CONTROL INPUTS — INHIBIT, A, B, C (Voltages Referenced to V_{SS})											
Low−Level Input Voltage	V_{IL}	5.0 10 15	R_{on} = per spec, I_{off} = per spec	− − −	1.5 3.0 4.0	− − −	2.25 4.50 6.75	1.5 3.0 4.0	− − −	1.5 3.0 4.0	V
High−Level Input Voltage	V_{IH}	5.0 10 15	R_{on} = per spec, I_{off} = per spec	3.5 7.0 11	− − −	3.5 7.0 11	2.75 5.50 8.25	− − −	3.5 7.0 11	− − −	V
Input Leakage Current	I_{in}	15	V_{in} = 0 or V_{DD}	−	±0.1	−	±0.00001	±0.1	−	1.0	μA
Input Capacitance	C_{in}	−		−	−	−	5.0	7.5	−	−	pF
SWITCHES IN/OUT AND COMMONS OUT/IN — X, Y, Z (Voltages Referenced to V_{EE})											
Recommended Peak−to−Peak Voltage Into or Out of the Switch	$V_{I/O}$	−	Channel On or Off	0	V_{DD}	0	−	V_{DD}	0	V_{DD}	V_{PP}
Recommended Static or Dynamic Voltage Across the Switch (Note 3) (Figure 5)	ΔV_{switch}	−	Channel On	0	600	0	−	600	0	300	mV
Output Offset Voltage	V_{OO}	−	V_{in} = 0 V, No Load	−	−	−	10	−	−	−	μV
ON Resistance	R_{on}	5.0 10 15	$\Delta V_{switch} \leq$ 500 mV (Note 3) $V_{in} = V_{IL}$ or V_{IH} (Control), and V_{in} = 0 to V_{DD} (Switch)	− − −	800 400 220	− − −	250 120 80	1050 500 280	− − −	1200 520 300	Ω
ΔON Resistance Between Any Two Channels in the Same Package	ΔR_{on}	5.0 10 15		− − −	70 50 45	− − −	25 10 10	70 50 45	− − −	135 95 65	Ω
Off−Channel Leakage Current (Figure 10)	I_{off}	15	$V_{in} = V_{IL}$ or V_{IH} (Control) Channel to Channel or Any One Channel	−	±100	−	±0.05	±100	−	±1000	nA
Capacitance, Switch I/O	$C_{I/O}$	−	Inhibit = V_{DD}	−	−	−	10	−	−	−	pF
Capacitance, Common O/I	$C_{O/I}$	−	Inhibit = V_{DD} (XL/XD14051) (XL/XD14052) (XL/XD14053)	 − − −	 − − −	 − − −	 60 32 17	 − − −	 − − −	 − − −	pF
Capacitance, Feedthrough (Channel Off)	$C_{I/O}$	− −	Pins Not Adjacent Pins Adjacent	− −	− −	− −	0.15 0.47	− −	− −	− −	pF

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.

2. Data labeled "Typ" is not to be used for design purposes, but is intended as an indication of the IC's potential performance.
3. For voltage drops across the switch (ΔVswitch) > 600 mV (> 300 mV at high temperature), excessive VDD current may be drawn, i.e. the current out of the switch may contain both VDD and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded. (See first page of this data sheet.)

ELECTRICAL CHARACTERISTICS (Note 4) (C_L = 50 pF, T_A = 25°C) ($V_{EE} \le V_{SS}$ unless otherwise indicated)

Characteristic	Symbol	$V_{DD} - V_{EE}$ Vdc	Typ (Note 5) All Types	Max	Unit
Propagation Delay Times (Figure 6) Switch Input to Switch Output (R_L = 1 kΩ)	t_{PLH}, t_{PHL}				ns
MC14051					
t_{PLH}, t_{PHL} = (0.17 ns/pF) C_L + 26.5 ns t_{PLH}, t_{PHL} = (0.08 ns/pF) C_L + 11 ns t_{PLH}, t_{PHL} = (0.06 ns/pF) C_L + 9.0 ns		5.0	35	90	
		10	15	40	
		15	12	30	
MC14052					ns
t_{PLH}, t_{PHL} = (0.17 ns/pF) C_L + 21.5 ns t_{PLH}, t_{PHL} = (0.08 ns/pF) C_L + 8.0 ns t_{PLH}, t_{PHL} = (0.06 ns/pF) C_L + 7.0 ns		5.0	30	75	
		10	12	30	
		15	10	25	
MC14053					ns
t_{PLH}, t_{PHL} = (0.17 ns/pF) C_L + 16.5 ns t_{PLH}, t_{PHL} = (0.08 ns/pF) C_L + 4.0 ns t_{PLH}, t_{PHL} = (0.06 ns/pF) C_L + 3.0 ns		5.0	25	65	
		10	8.0	20	
		15	6.0	15	
Inhibit to Output (R_L = 10 kΩ, V_{EE} = V_{SS}) Output "1" or "0" to High Impedance, or High Impedance to "1" or "0" Level	t_{PHZ}, t_{PLZ}, t_{PZH}, t_{PZL}				ns
XL/XD14051		5.0	350	700	
		10	170	340	
		15	140	280	
XL/XD14052		5.0	300	600	ns
		10	155	310	
		15	125	250	
XL/XD14053		5.0	275	550	ns
		10	140	280	
		15	110	220	
Control Input to Output (R_L = 1 kΩ, V_{EE} = V_{SS})	t_{PLH}, t_{PHL}				ns
XL/XD14051		5.0	360	720	
		10	160	320	
		15	120	240	
XL/XD14052		5.0	325	650	ns
		10	130	260	
		15	90	180	
XL/XD14053		5.0	300	600	ns
		10	120	240	
		15	80	160	
Second Harmonic Distortion (R_L = 10KΩ, f = 1 kHz) V_{in} = 5 V_{PP}	–	10	0.07	–	%
Bandwidth (Figure 7) (R_L = 50 Ω, V_{in} = 1/2 (V_{DD}–V_{EE}) p–p, C_L = 50pF 20 Log (V_{out}/V_{in}) = – 3 dB)	BW	10	17	–	MHz
Off Channel Feedthrough Attenuation (Figure 7) R_L = 1KΩ, V_{in} = 1/2 (V_{DD} – V_{EE}) p–p f_{in} = 4.5 MHz — XL/XD14051 f_{in} = 30 MHz — XL/XD14052 f_{in} = 55 MHz — XL/XD14053	–	10	–50	–	dB

Channel Separation (Figure 8) (R_L = 1 kΩ, V_{in} = 1/2 (V_{DD}–V_{EE}) p–p, f_{in} = 3.0 MHz	–	10	–50	–	dB
Crosstalk, Control Input to Common O/I (Figure 9) (R_1 = 1 kΩ, R_L = 10 kΩ Control t_{TLH} = t_{THL} = 20 ns, Inhibit = V_{SS})	–	10	75	–	mV

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.

4. The formulas given are for the typical characteristics only at 25°C.
5. Data labelled "Typ" is not lo be used for design purposes but In intended as an indication of the IC's potential performance.

XL/XD14051, XL/XD14052, XL/XD14053

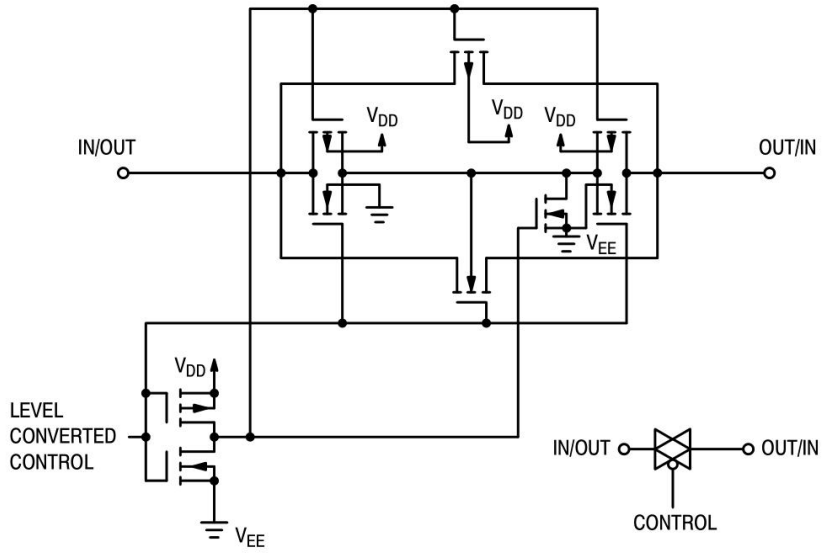


Figure 1. Switch Circuit Schematic

Control Inputs				ON Switches					
	Select								
Inhibit	C*	B	A	XL/XD14051	XL/XD14052		XL/XD14053		
0	0	0	0	X0	Y0	X0	Z0	Y0	X0
0	0	0	1	X1	Y1	X1	Z0	Y0	X1
0	0	1	0	X2	Y2	X2	Z0	Y1	X0
0	0	1	1	X3	Y3	X3	Z0	Y1	X1
0	1	0	0	X4			Z1	Y0	X0
0	1	0	1	X5			Z1	Y0	X1
0	1	1	0	X6			Z1	Y1	X0
0	1	1	1	X7			Z1	Y1	X1
1	x	x	x	None	None		None		

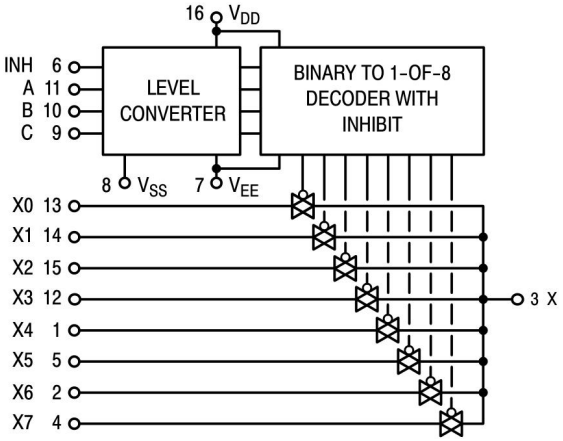


Figure 2. XL/XD14051 Functional Diagram

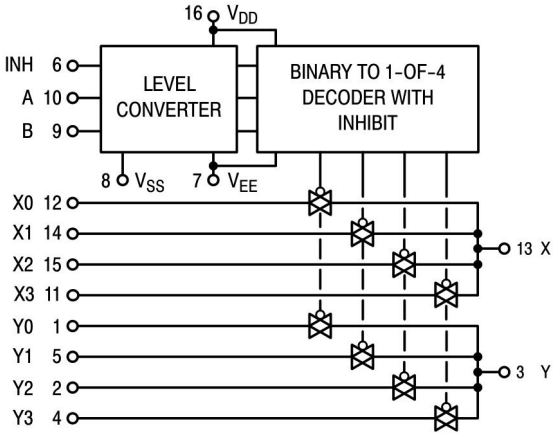


Figure 3. XL/XD14052 Functional Diagram

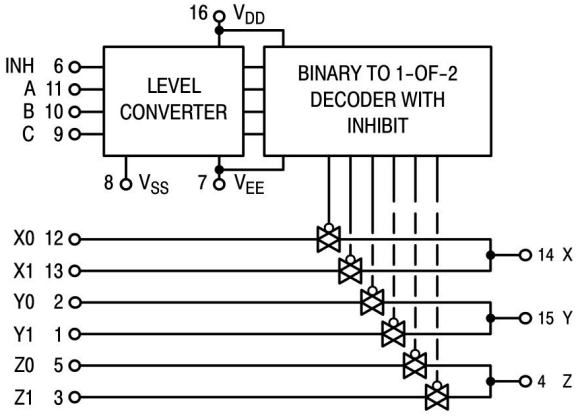


Figure 4. XL/XD14053 Functional Diagram

TEST CIRCUITS

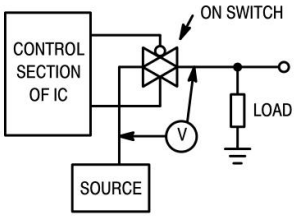


Figure 5. ΔV Across Switch

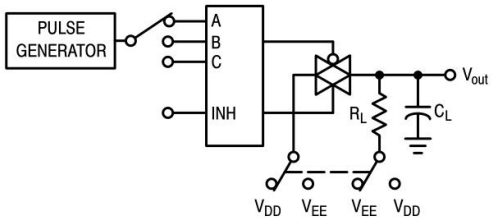


Figure 6. Propagation Delay Times, Control and Inhibit to Output

A, B, and C inputs used to turn ON or OFF the switch under test.

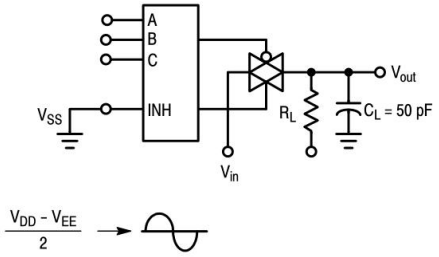


Figure 7. Bandwidth and Off−Channel Feedthrough Attenuation

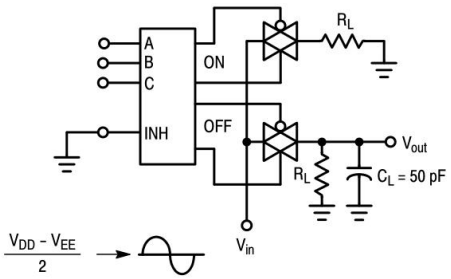


Figure 8. Channel Separation (Adjacent Channels Used For Setup)

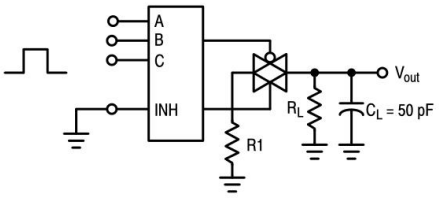


Figure 9. Crosstalk, Control Input to Common O/I

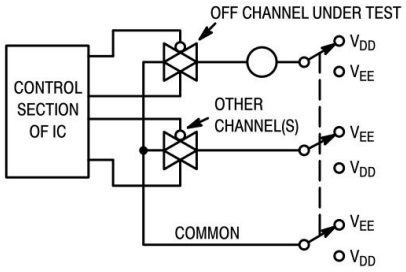


Figure 10. Off Channel Leakage

NOTE: See also Figures 7 and 8 in the MC14016B data sheet.

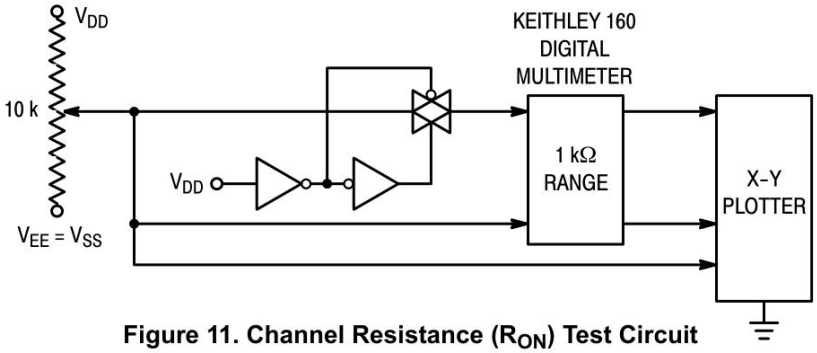


Figure 11. Channel Resistance (R_{ON}) Test Circuit

TYPICAL RESISTANCE CHARACTERISTICS

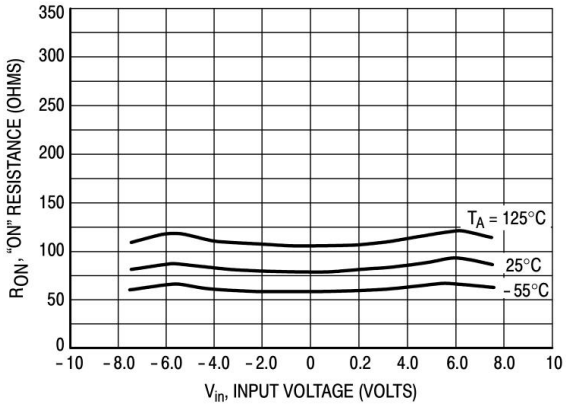


Figure 12. V_{DD} = 7.5 V, V_{EE} = − 7.5 V

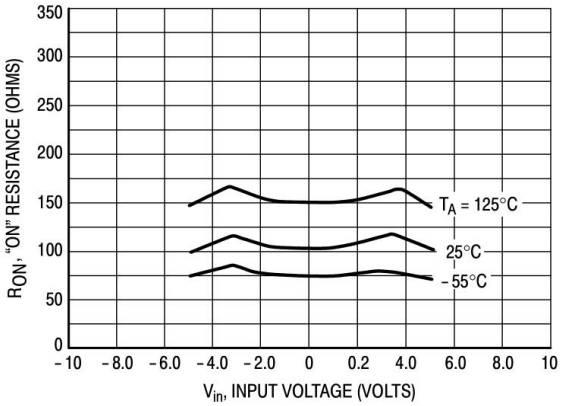


Figure 13. V_{DD} = 5.0 V, V_{EE} = − 5.0 V

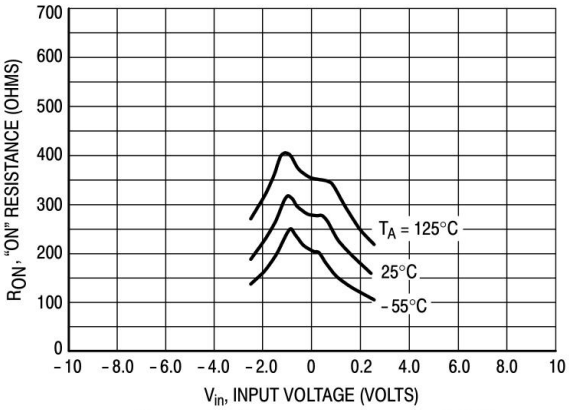


Figure 14. V_{DD} = 2.5 V, V_{EE} = − 2.5 V

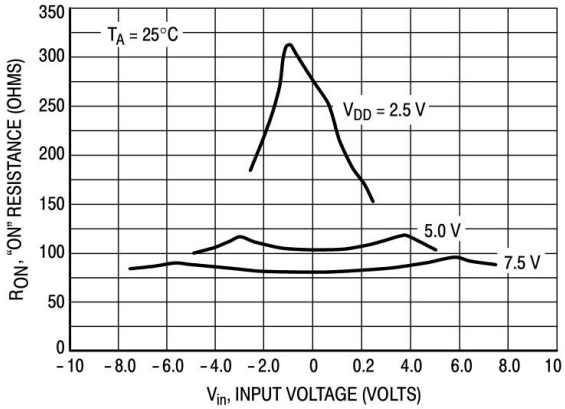


Figure 15. Comparison at 25°C, V_{DD} = −V_{EE}

5. APPLICATION INFORMATION

Figure A illustrates use of the on−chip level converter detailed in Figures 2, 3, and 4. The 0−to−5 V Digital Control signal is used to directly control a 9 V_{p-p} analog signal.

The digital control logic levels are determined by V_{DD} and V_{SS}. The V_{DD} voltage is the logic high voltage; the V_{SS} voltage is logic low. For the example, V_{DD} = +5 V = logic high at the control inputs; V_{SS} = GND = 0 V = logic low.

The maximum analog signal level is determined by V_{DD} and V_{EE}. The V_{DD} voltage determines the maximum recommended peak above V_{SS}. The V_{EE} voltage determines the maximum swing below V_{SS}. For the example, V_{DD} − V_{SS} = 5 V maximum swing above V_{SS}; V_{SS} − V_{EE} = 5 V maximum swing below V_{SS}. The example shows a 4.5 V signal which allows a 1/2 volt margin at each peak. If voltage transients above V_{DD} and/or below V_{EE} are anticipated on the analog channels, external diodes (Dx) are recommended as shown in Figure B. These diodes should be small signal types able to absorb the maximum anticipated current surges during clipping.

The *absolute* maximum potential difference between V_{DD} and V_{EE} is 18.0 V. Most parameters are specified up to 15 V which is the *recommended* maximum difference between V_{DD} and V_{EE}.

Balanced supplies are not required. However, V_{SS} must be greater than or equal to V_{EE}. For example, V_{DD} = +10 V, V_{SS} = +5 V, and V_{EE} – 3 V is acceptable. See the Table below.

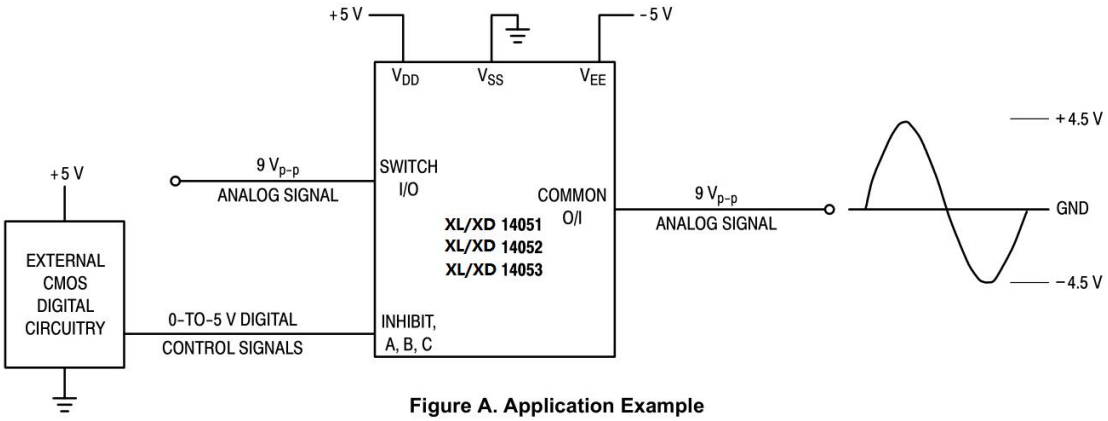


Figure A. Application Example

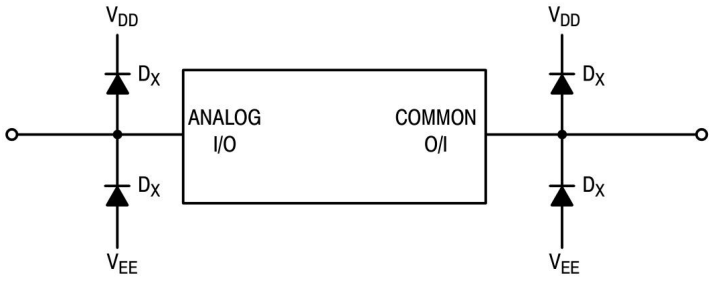


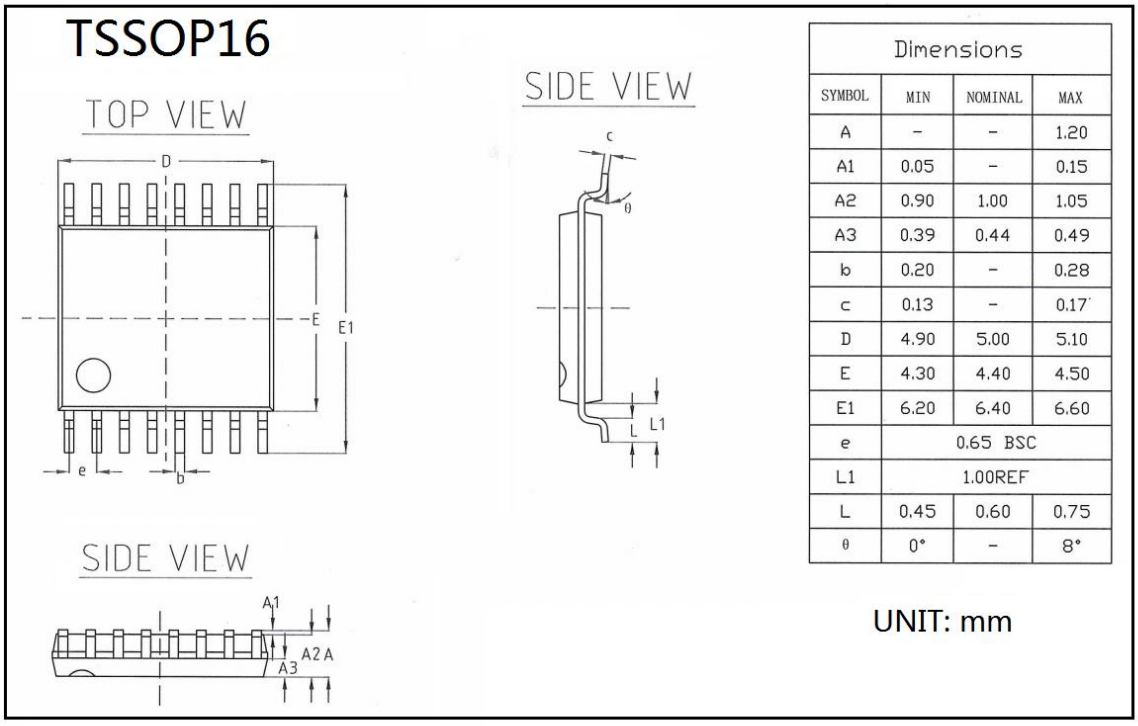
Figure B. External Germanium or Schottky Clipping Diodes

6. ORDERING INFORMATION

Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL14051BDTR	XL14051	TSSOP16	5.00 * 4.40	- 40 to 85	MSL3	T&R	2500
XL14051BDR	XL14051B	SOP16	10.00 * 3.95	- 40 to 85	MSL3	T&R	2500
XD14051	XD14051	DIP16	19.05 * 6.35	- 40 to 85	MSL3	Tube 25	1000
XL14052BDTR	XL14052	TSSOP16	5.00 * 4.40	- 40 to 85	MSL3	T&R	2500
XL14052BDR	XL14052B	SOP16	10.00 * 3.95	- 40 to 85	MSL3	T&R	2500
XD14052	XD14052	DIP16	19.05 * 6.35	- 40 to 85	MSL3	Tube 25	1000
XL14053BDTR	XL14053	TSSOP16	5.00 * 4.40	- 40 to 85	MSL3	T&R	2500
XL14053BDR	XL14053B	SOP16	10.00 * 3.95	- 40 to 85	MSL3	T&R	2500
XD14053	XD14053	DIP16	19.05 * 6.35	- 40 to 85	MSL3	Tube 25	1000

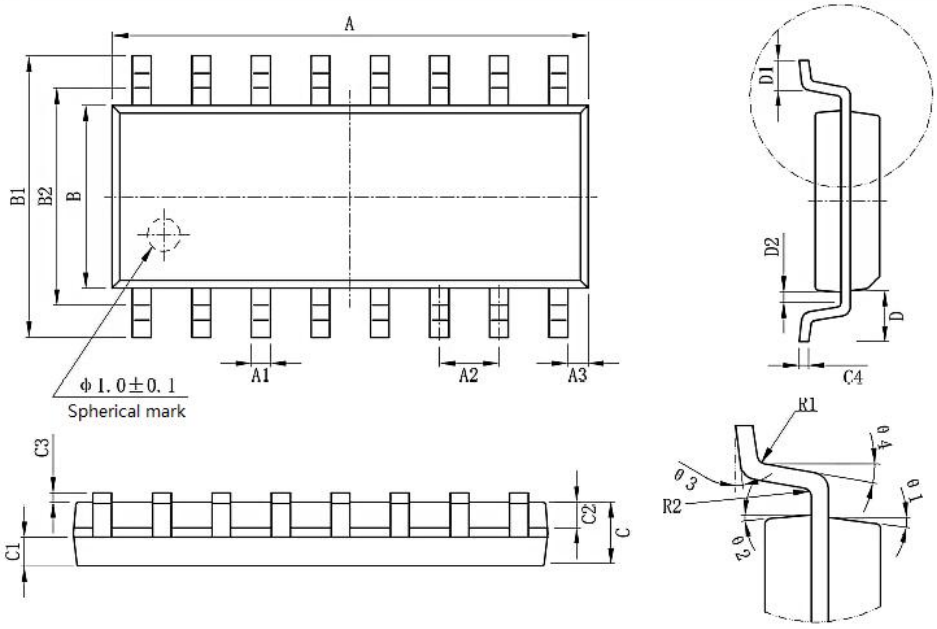
7. DIMENSIONAL DRAWINGS



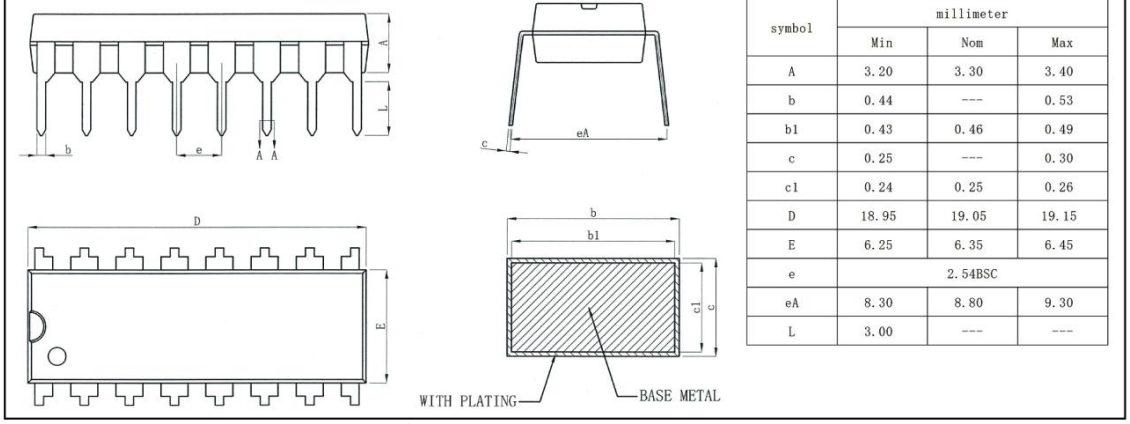
Dimensions			
SYMBOL	MIN	NOMINAL	MAX
A	–	–	1.20
A1	0.05	–	0.15
A2	0.90	1.00	1.05
A3	0.39	0.44	0.49
b	0.20	–	0.28
c	0.13	–	0.17
D	4.90	5.00	5.10
E	4.30	4.40	4.50
E1	6.20	6.40	6.60
e	0.65 BSC		
L1	1.00REF		
L	0.45	0.60	0.75
θ	0°	–	8°

SOP16

SYM / MARK	MIN (mm)	MAX (mm)	SYM / MARK	MIN (mm)	MAX (mm)
A	9.80	10.00	C4	0.203	0.233
A1	0.356	0.456	D	1.05TYP	
A2	1.27TYP		D1	0.40	0.70
A3	0.302TYP		D2	0.15	0.25
B	3.85	3.95	R1	0.20TYP	
B1	5.84	6.24	R2	0.20TYP	
B2	5.00TYP		θ1	8° ~ 12° TYP4	
C	1.40	1.60	θ2	8° ~ 12° TYP4	
C1	0.61	0.71	θ3	0° ~ 8°	
C2	0.54	0.64	θ4	4° ~ 12°	
C3	0.05	0.25			



DIP16



symbol	millimeter		
	Min	Nom	Max
A	3.20	3.30	3.40
b	0.44	---	0.53
b1	0.43	0.46	0.49
c	0.25	---	0.30
c1	0.24	0.25	0.26
D	18.95	19.05	19.15
E	6.25	6.35	6.45
e	2.54BSC		
eA	8.30	8.80	9.30
L	3.00	---	---

[if you need help contact us. Xinluda reserves the right to change the above information without prior notice]