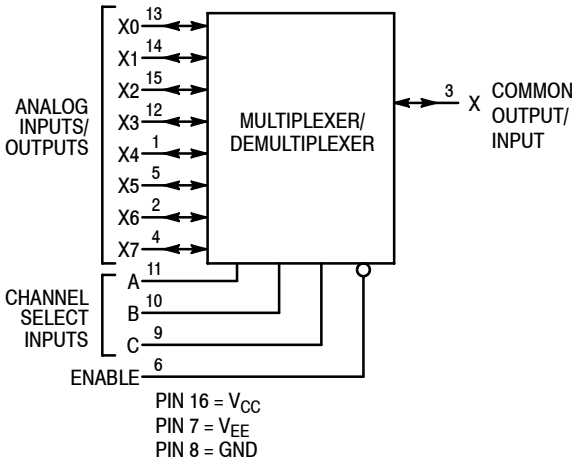
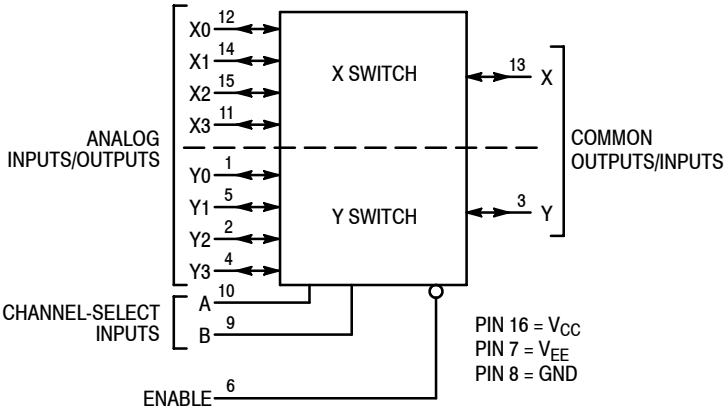
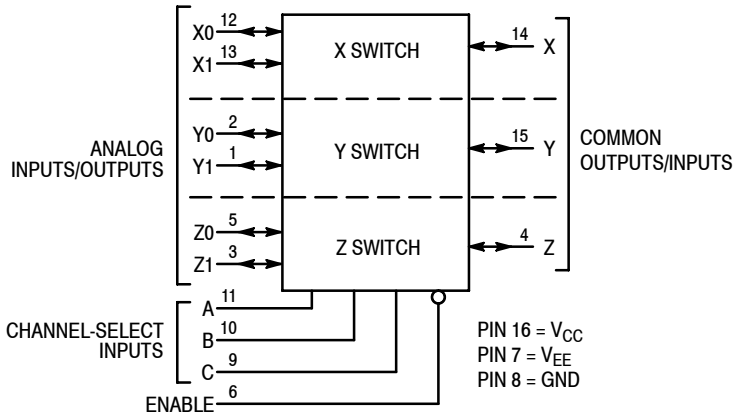


MC74VHC4051
Single-Pole, 8-Position Plus Common Off



MC74VHC4052
Double-Pole, 4-Position Plus Common Off



NOTE: This device allows independent control of each switch. Channel-Select Input A controls the X-Switch, Input B controls the Y-Switch and Input C controls the Z-Switch

MC74VHC4053
Triple Single-Pole, Double-Position Plus Common Off

Figure 1. Logic Diagrams

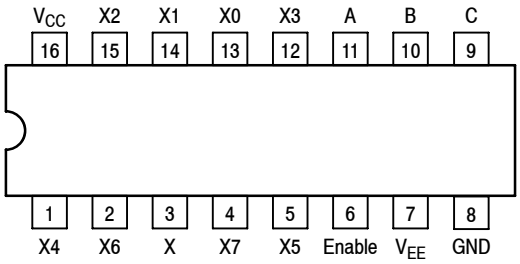


Figure 2. Pinout: MC74VHC4051 (Top View)

FUNCTION TABLE - MC74VHC4051

Control Inputs				
	Select			
Enable	C	B	A	ON Channels
L	L	L	L	X0
L	L	L	H	X1
L	L	H	L	X2
L	L	H	H	X3
L	H	L	L	X4
L	H	L	H	X5
L	H	H	L	X6
L	H	H	H	X7
H	X	X	X	NONE

X = Don't Care

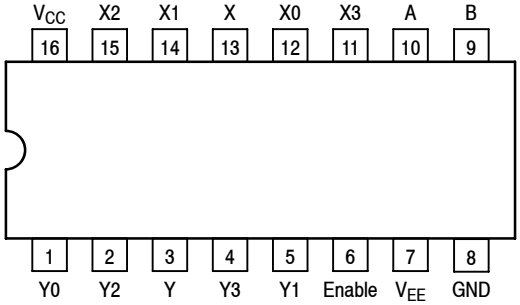


Figure 3. Pinout: MC74VHC4052 (Top View)

FUNCTION TABLE - MC74VHC4052

Control Inputs			
	Select		
Enable	B	A	ON Channels
L	L	L	Y0 X0
L	L	H	Y1 X1
L	H	L	Y2 X2
L	H	H	Y3 X3
H	X	X	NONE

X = Don't Care

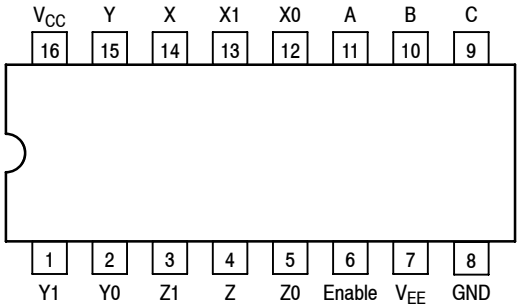


Figure 4. Pinout: MC74VHC4053 (Top View)

FUNCTION TABLE - MC74VHC4053

Control Inputs				
	Select			
Enable	C	B	A	ON Channels
L	L	L	L	Z0 Y0 X0
L	L	L	H	Z0 Y0 X1
L	L	H	L	Z0 Y1 X0
L	L	H	H	Z0 Y1 X1
L	H	L	L	Z1 Y0 X0
L	H	L	H	Z1 Y0 X1
L	H	H	L	Z1 Y1 X0
L	H	H	H	Z1 Y1 X1
H	X	X	X	NONE

X = Don't Care

MAXIMUM RATINGS*

Symbol	Parameter	Value	Unit
V_{CC}	Positive DC Supply Voltage (Referenced to GND) (Referenced to V_{EE})	− 0.5 to + 7.0 − 0.5 to + 14.0	V
V_{EE}	Negative DC Supply Voltage (Referenced to GND)	− 7.0 to + 5.0	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 V_{CC} + 0.5	V
I	DC Current, Into or Out of Any Pin	± 25	mA
P_D	Power Dissipation in Still Air SOIC Package† TSSOP Package†	500 450	mW
T_{stg}	Storage Temperature Range	− 65 to + 150	°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C

*Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.
†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 ≤ (V_{in} or V_{out}) ≤ 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.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CC}	Positive DC Supply Voltage (Referenced to GND) (Referenced to V_{EE})		2.0 2.0	6.0 12.0	V
V_{EE}	Negative DC Supply Voltage, Output (Referenced to GND)		− 6.0	GND	V
V_{IS}	Analog Input Voltage		V_{EE}	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 Range, All Package Types		− 55	+ 125	°C
t_r, t_f	Input Rise/Fall Time (Channel Select or Enable Inputs)	V_{CC} = 2.0 V V_{CC} = 3.0 V V_{CC} = 4.5 V V_{CC} = 6.0 V	0 0 0 0	1000 800 500 400	ns

*For voltage drops across switch greater than 1.2V (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 CHARACTERISTICS — Digital Section (Voltages Referenced to GND) V_{EE} = GND, Except Where Noted

Symbol	Parameter	Condition	V_{CC} V	Guaranteed Limit			Unit
				-55 to 25°C	≤85°C	≤125°C	
V_{IH}	Minimum High-Level Input Voltage, Channel-Select or Enable Inputs	R_{on} = Per Spec	2.0 3.0 4.5 6.0	1.50 2.10 3.15 4.20	1.50 2.10 3.15 4.20	1.50 2.10 3.15 4.20	V
V_{IL}	Maximum Low-Level Input Voltage, Channel-Select or Enable Inputs	R_{on} = Per Spec	2.0 3.0 4.5 6.0	0.5 0.9 1.35 1.8	0.5 0.9 1.35 1.8	0.5 0.9 1.35 1.8	V
I_{in}	Maximum Input Leakage Current, Channel-Select or Enable Inputs	V_{in} = V_{CC} or GND, V_{EE} = − 6.0 V	6.0	± 0.1	± 1.0	± 1.0	μA
I_{CC}	Maximum Quiescent Supply Current (per Package)	Channel Select, Enable and V_{IS} = V_{CC} or GND; V_{EE} = GND V_{IO} = 0 V V_{EE} = − 6.0	 6.0 6.0	 1 4	 10 40	 40 80	μA

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_{CC} to V_{EE} I_S ≤ 2.0 mA (Figures 5 through 11)	3.0 4.5 4.5 6.0	0.0 0.0 – 4.5 – 6.0	200 160 120 100	240 200 150 125	320 280 170 140	Ω
		V_{in} = V_{IL} or V_{IH} V_{IS} = V_{CC} or V_{EE} (Endpoints) I_S ≤ 2.0 mA (Figures 5 through11)	3.0 4.5 4.5 6.0	0.0 0.0 – 4.5 – 6.0	150 110 90 80	180 140 120 100	230 190 140 115	
ΔR_{on}	Maximum Difference in "ON" Resistance Between Any Two Channels in the Same Package	V_{in} = V_{IL} or V_{IH} V_{IS} = 1/2 (V_{CC} - V_{EE}) I_S ≤ 2.0 mA	3.0 4.5 4.5 6.0	0.0 0.0 – 4.5 – 6.0	40 20 10 10	50 25 15 12	80 40 18 14	Ω
I_{off}	Maximum Off-Channel Leakage Current, Any One Channel	V_{in} = V_{IL} or V_{IH}; V_{IO} = V_{CC} - V_{EE}; Switch Off (Figure 12)	6.0	- 6.0	0.1	0.5	1.0	μA
	Maximum Off-Channel Leakage Current, Common Channel	VHC4051 VHC4052 VHC4053	V_{in} = V_{IL} or V_{IH}; V_{IO} = V_{CC} - V_{EE}; Switch Off (Figure 13)	6.0 6.0 6.0	- 6.0 - 6.0 - 6.0	0.2 0.1 0.1	2.0 1.0 1.0	4.0 2.0 2.0	
I_{on}	Maximum On-Channel Leakage Current, Channel-to-Channel	VHC4051 VHC4052 VHC4053	V_{in} = V_{IL} or V_{IH}; Switch-to-Switch = V_{CC} - V_{EE}; (Figure 14)	6.0 6.0 6.0	- 6.0 - 6.0 - 6.0	0.2 0.1 0.1	2.0 1.0 1.0	4.0 2.0 2.0	μA

AC CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 6 ns)

Symbol	Parameter	V_{CC} V	Guaranteed Limit			Unit
			-55 to 25°C	≤85°C	≤125°C	
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Channel-Select to Analog Output (Figures 18, 19)	2.0 3.0 4.5 6.0	270 90 59 45	320 110 79 65	350 125 85 75	ns
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Analog Input to Analog Output (Figures 20, 21)	2.0 3.0 4.5 6.0	40 25 12 10	60 30 15 13	70 32 18 15	ns
t_{PLZ}, t_{PHZ}	Maximum Propagation Delay, Enable to Analog Output (Figures 22, 23)	2.0 3.0 4.5 6.0	160 70 48 39	200 95 63 55	220 110 76 63	ns
t_{PZL}, t_{PZH}	Maximum Propagation Delay, Enable to Analog Output (Figures 22, 23)	2.0 3.0 4.5 6.0	245 115 49 39	315 145 69 58	345 155 83 67	ns
C_{in}	Maximum Input Capacitance, Channel-Select or Enable Inputs		10	10	10	pF
$C_{I/O}$	Maximum Capacitance — Analog I/O		35	35	35	pF
	(All Switches Off) — Common O/I: VHC4051 VHC4052 VHC4053		130 80 50	130 80 50	130 80 50	
	Feedthrough		1.0	1.0	1.0	

			Typical @ 25°C, V_{CC} = 5.0 V, V_{EE} = 0 V	
C_{PD}	Power Dissipation Capacitance (Figure 25)*	VHC4051 VHC4052 VHC4053	45 80 45	pF

* Used to determine the no-load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$.

ADDITIONAL APPLICATION CHARACTERISTICS (GND = 0 V)

Symbol	Parameter	Condition	V_{CC} V	V_{EE} V	Limit* 25°C '51	Limit* 25°C '52	Limit* 25°C '53	Unit
BW	Maximum On−Channel Bandwidth or Minimum Frequency Response (Figure 15)	f_{in} = 1MHz Sine Wave; Adjust f_{in} Voltage to Obtain 0dBm at V_{OS}; Increase f_{in} Frequency Until dB Meter Reads −3dB; R_L = 50Ω, C_L = 10pF	2.25 4.50 6.00	−2.25 −4.50 −6.00	80 80 80	95 95 95	120 120 120	MHz
—	Off−Channel Feedthrough Isolation (Figure 16)	f_{in} = Sine Wave; Adjust f_{in} Voltage to Obtain 0dBm at V_{IS} f_{in} = 10kHz, R_L = 600Ω, C_L = 50pF	2.25 4.50 6.00	−2.25 −4.50 −6.00	−50 −50 −50			dB
		f_{in} = 1.0MHz, R_L = 50Ω, C_L = 10pF	2.25 4.50 6.00	−2.25 −4.50 −6.00	−40 −40 −40			
—	Feedthrough Noise. Channel−Select Input to Common I/O (Figure 17)	V_{in} ≤ 1MHz Square Wave (t_r = t_f = 6ns); Adjust R_L at Setup so that I_S = 0A; Enable = GND R_L = 600Ω, C_L = 50pF	2.25 4.50 6.00	−2.25 −4.50 −6.00	25 105 135			mV_{PP}
		R_L = 10kΩ, C_L = 10pF	2.25 4.50 6.00	−2.25 −4.50 −6.00	35 145 190			
—	Crosstalk Between Any Two Switches (Figure 24) (Test does not apply to VHC4051)	f_{in} = Sine Wave; Adjust f_{in} Voltage to Obtain 0dBm at V_{IS} f_{in} = 10kHz, R_L = 600Ω, C_L = 50pF	2.25 4.50 6.00	−2.25 −4.50 −6.00	−50 −50 −50			dB
		f_{in} = 1.0MHz, R_L = 50Ω, C_L = 10pF	2.25 4.50 6.00	−2.25 −4.50 −6.00	−60 −60 −60			
THD	Total Harmonic Distortion (Figure 26)	f_{in} = 1kHz, R_L = 10kΩ, C_L = 50pF $THD = THD_{measured} - THD_{source}$ V_{IS} = 4.0V_{PP} sine wave V_{IS} = 8.0V_{PP} sine wave V_{IS} = 11.0V_{PP} sine wave	2.25 4.50 6.00	−2.25 −4.50 −6.00	0.10 0.08 0.05			%

*Limits not tested. Determined by design and verified by qualification.

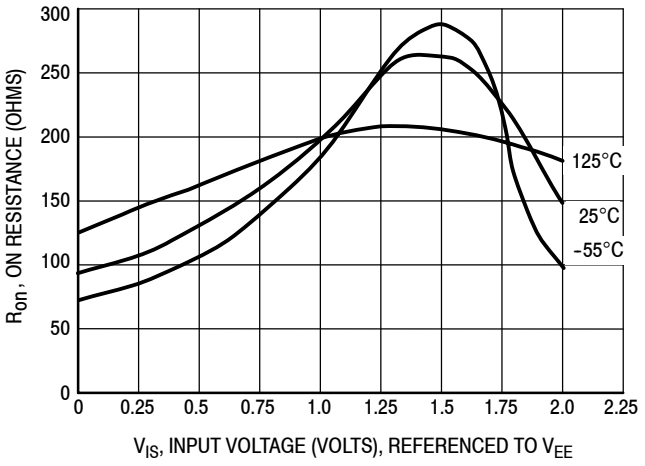


Figure 5. Typical On Resistance, V_{CC} − V_{EE} = 2.0 V

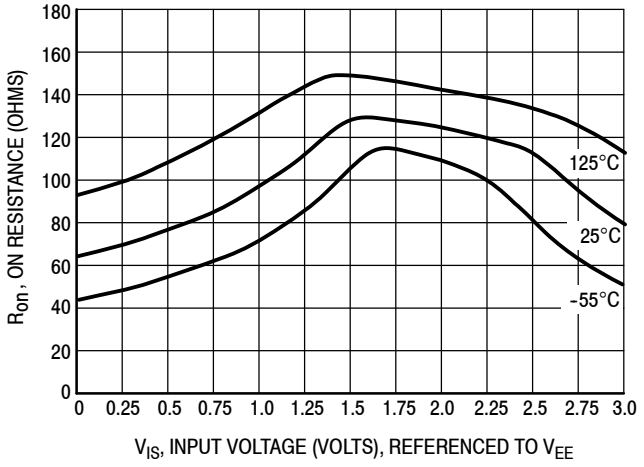


Figure 6. Typical On Resistance, V_{CC} − V_{EE} = 3.0 V

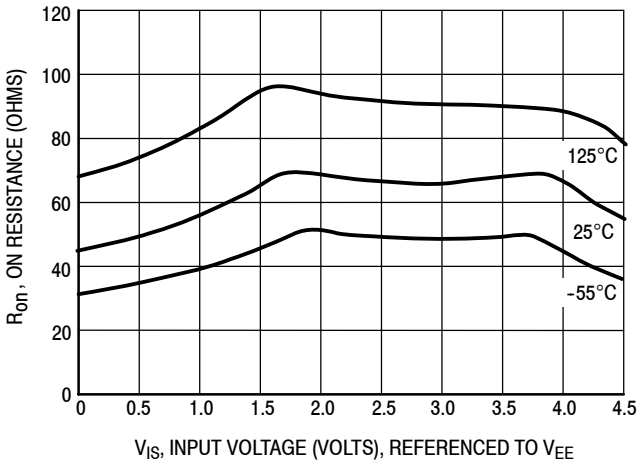


Figure 7. Typical On Resistance, V_{CC} - V_{EE} = 4.5 V

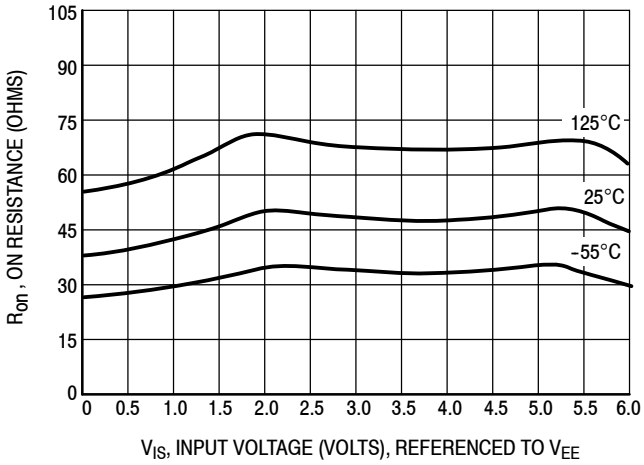


Figure 8. Typical On Resistance, V_{CC} - V_{EE} = 6.0 V

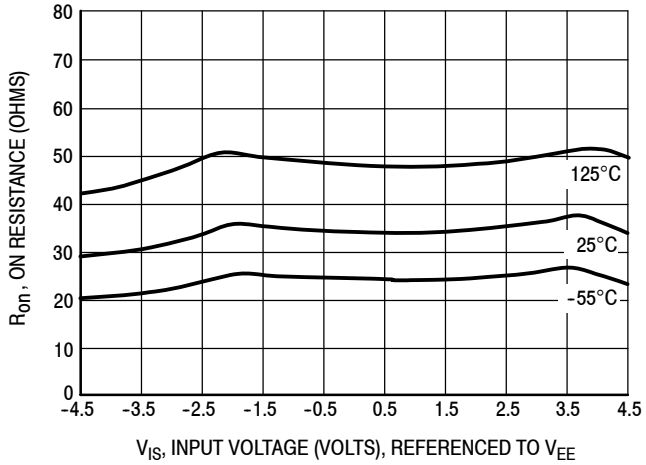


Figure 9. Typical On Resistance, V_{CC} - V_{EE} = 9.0 V

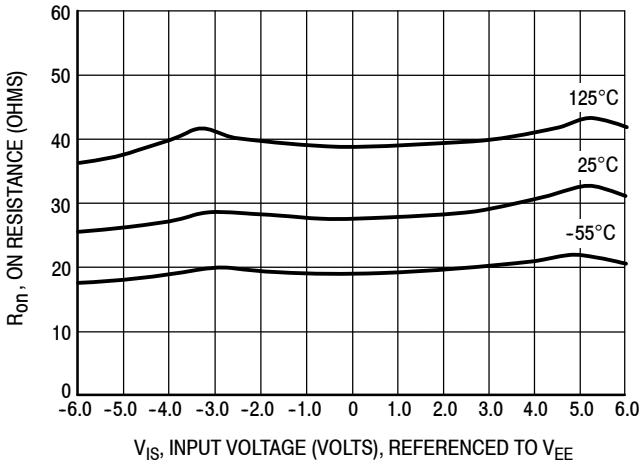


Figure 10. Typical On Resistance, V_{CC} - V_{EE} = 12.0 V

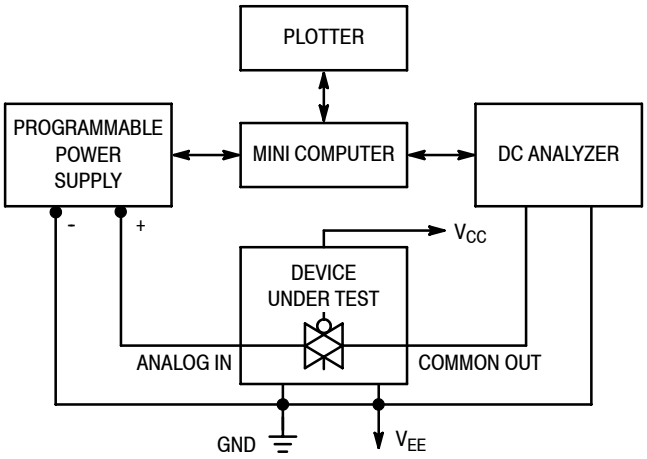


Figure 11. On Resistance Test Set-Up

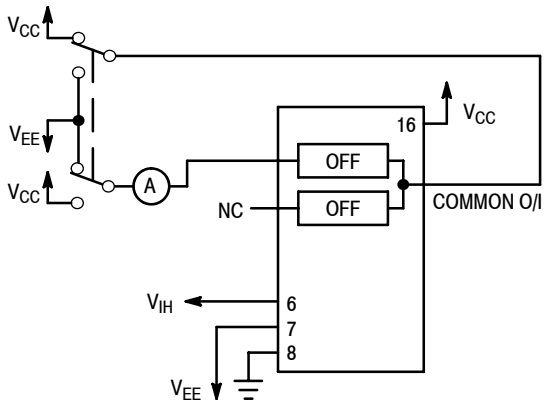


Figure 12. Maximum Off Channel Leakage Current, Any One Channel, Test Set-Up

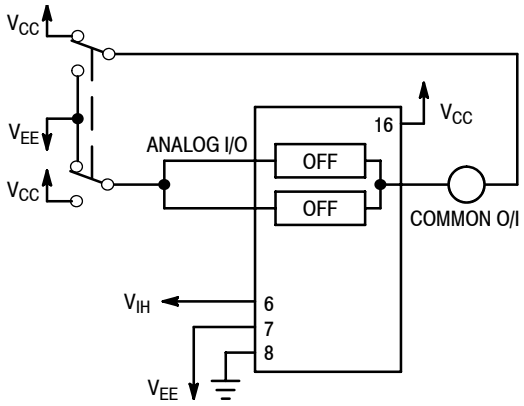


Figure 13. Maximum Off Channel Leakage Current, Common Channel, Test Set-Up

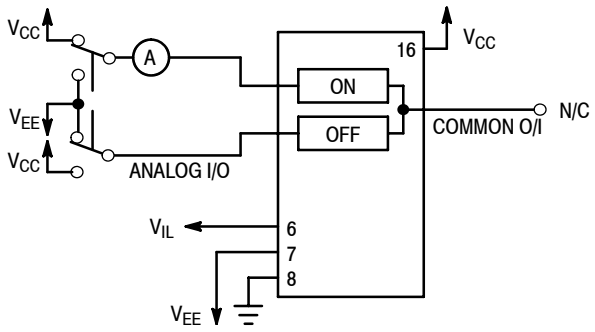


Figure 14. Maximum On Channel Leakage Current, Channel to Channel, Test Set-Up

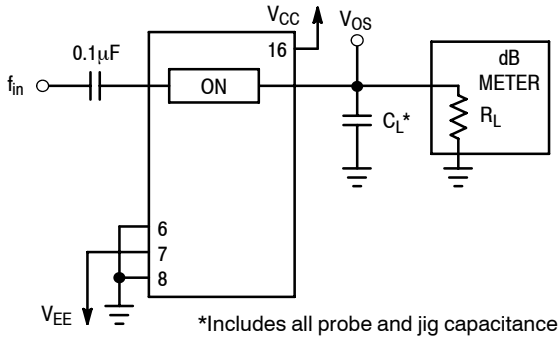


Figure 15. Maximum On Channel Bandwidth, Test Set-Up

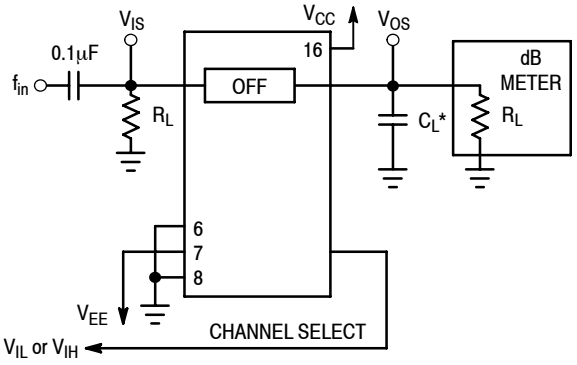


Figure 16. Off Channel Feedthrough Isolation, Test Set-Up

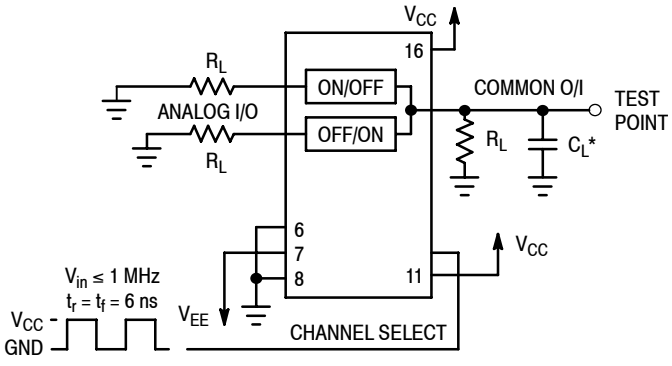


Figure 17. Feedthrough Noise, Channel Select to Common Out, Test Set-Up

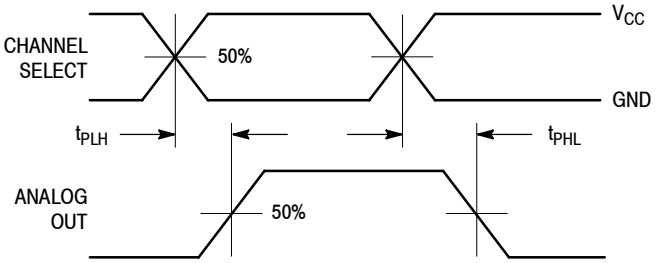
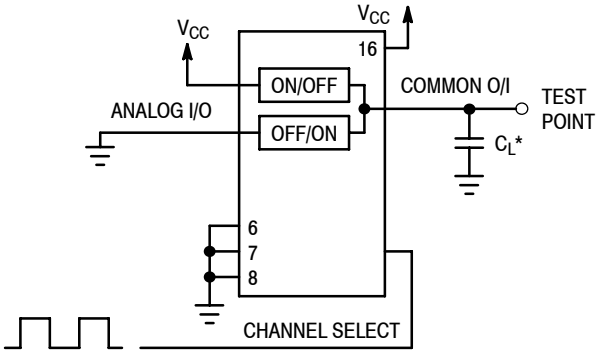


Figure 18. Propagation Delays, Channel Select to Analog Out



*Includes all probe and jig capacitance

Figure 19. Propagation Delay, Test Set-Up Channel Select to Analog Out

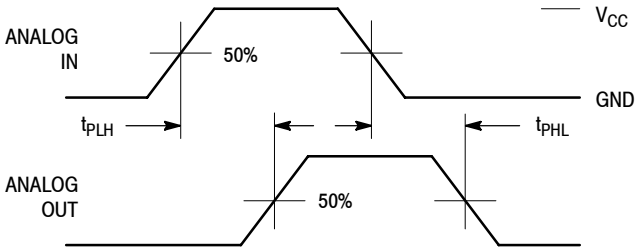
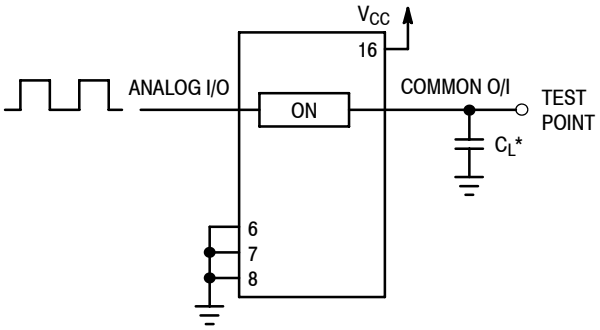


Figure 20. Propagation Delays, Analog In to Analog Out



*Includes all probe and jig capacitance

Figure 21. Propagation Delay, Test Set-Up Analog In to Analog Out

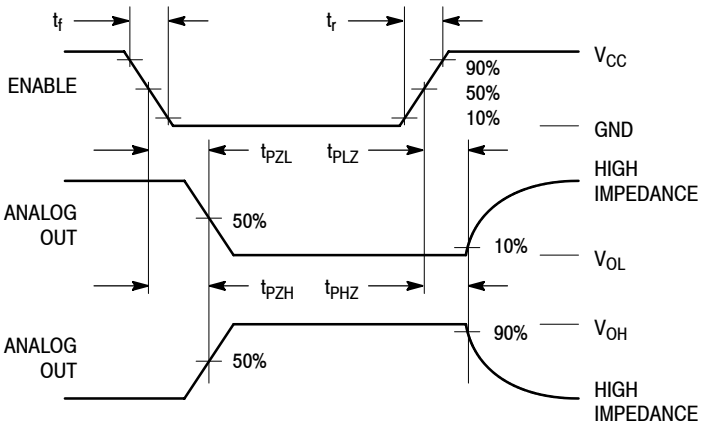


Figure 22. Propagation Delays, Enable to Analog Out

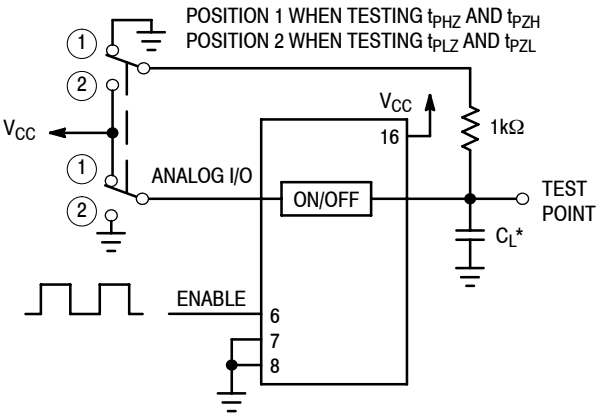


Figure 23. Propagation Delay, Test Set-Up Enable to Analog Out

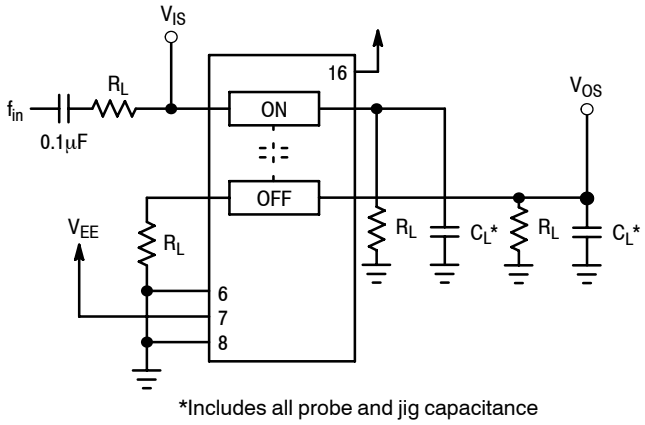


Figure 24. Crosstalk Between Any Two Switches, Test Set-Up

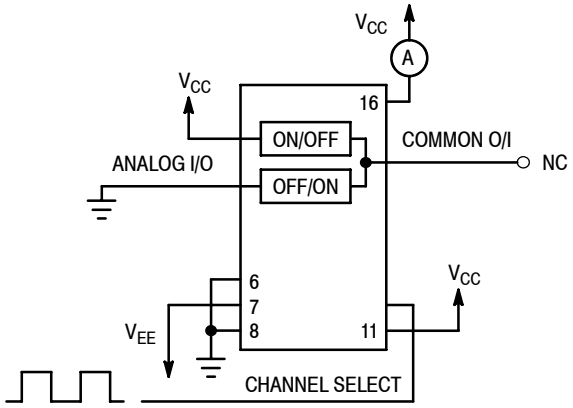


Figure 25. Power Dissipation Capacitance, Test Set-Up

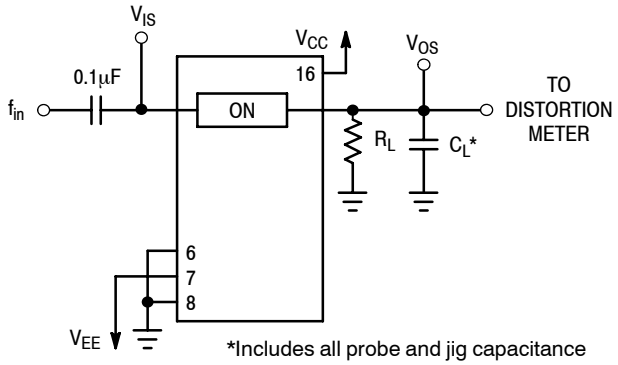


Figure 26. Total Harmonic Distortion, Test Set-Up

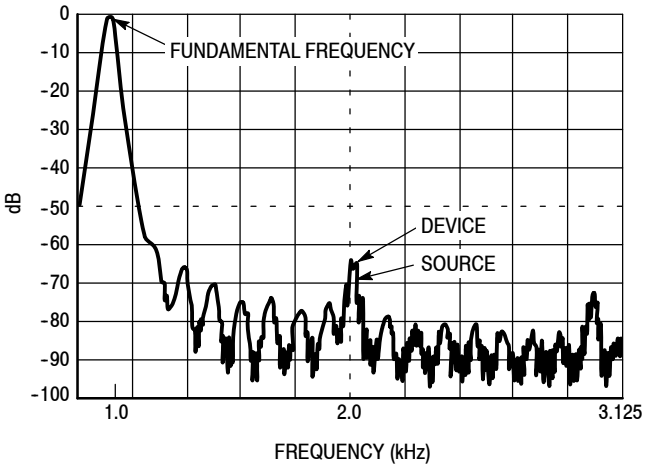


Figure 27. Plot, Harmonic Distortion

APPLICATIONS INFORMATION

The Channel Select and Enable control pins should be at V_{CC} or GND logic levels. V_{CC} being recognized as a logic high and GND being recognized as a logic low. In this example:

V_{CC} = +5V = logic high
GND = 0V = logic low

The maximum analog voltage swings are determined by the supply voltages V_{CC} and V_{EE}. The positive peak analog voltage should not exceed V_{CC}. Similarly, the negative peak analog voltage should not go below V_{EE}. In this example, the difference between V_{CC} and V_{EE} is ten volts. Therefore, using the configuration of Figure 28, a maximum analog signal of ten volts peak-to-peak can be controlled. Unused analog inputs/outputs may be left floating (i.e., not connected). However, tying unused analog inputs and outputs to V_{CC} or GND through a low value resistor helps minimize crosstalk and feedthrough noise that may be picked up by an unused switch.

Although used here, balanced supplies are not a requirement. The only constraints on the power supplies are that:

V_{CC} - GND = 2 to 6 volts
V_{EE} - GND = 0 to -6 volts
V_{CC} - V_{EE} = 2 to 12 volts
and $V_{EE} \leq$ GND

When voltage transients above V_{CC} and/or below V_{EE} are anticipated on the analog channels, external Germanium or Schottky diodes (D_x) are recommended as shown in Figure 29. These diodes should be able to absorb the maximum anticipated current surges during clipping.

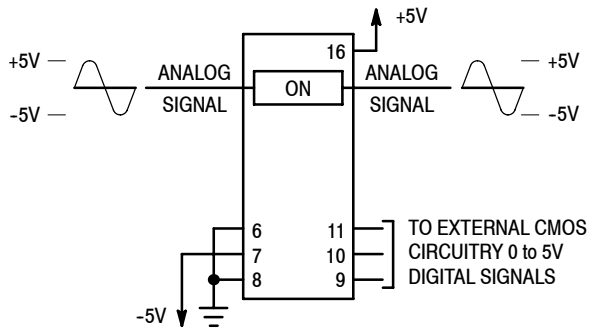


Figure 28. Application Example

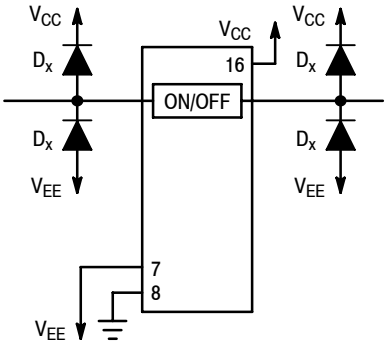
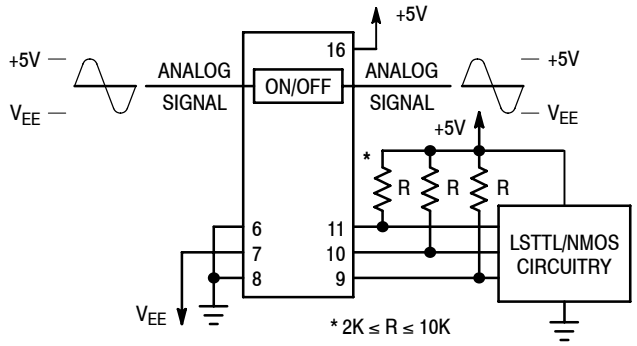
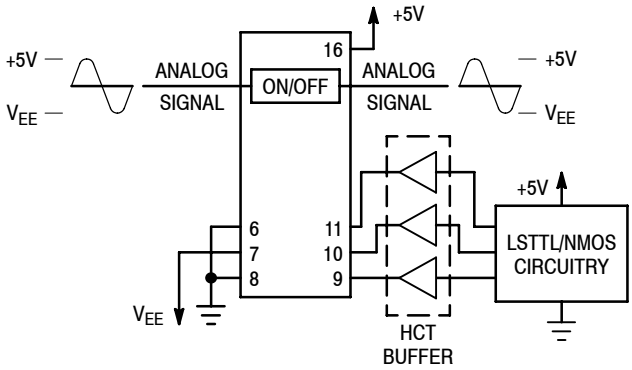


Figure 29. External Germanium or Schottky Clipping Diodes



a. Using Pull-Up Resistors



b. Using HCT Interface

Figure 30. Interfacing LSTTL/NMOS to CMOS Inputs

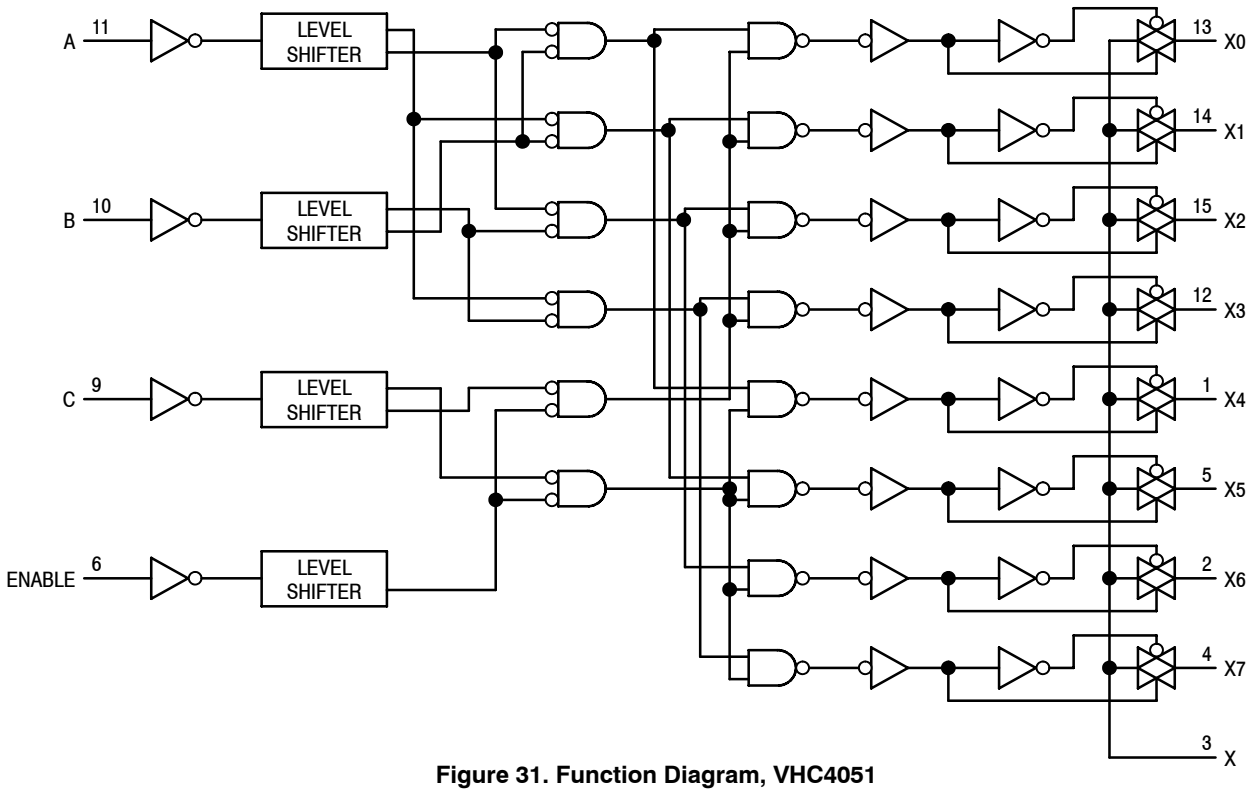


Figure 31. Function Diagram, VHC4051

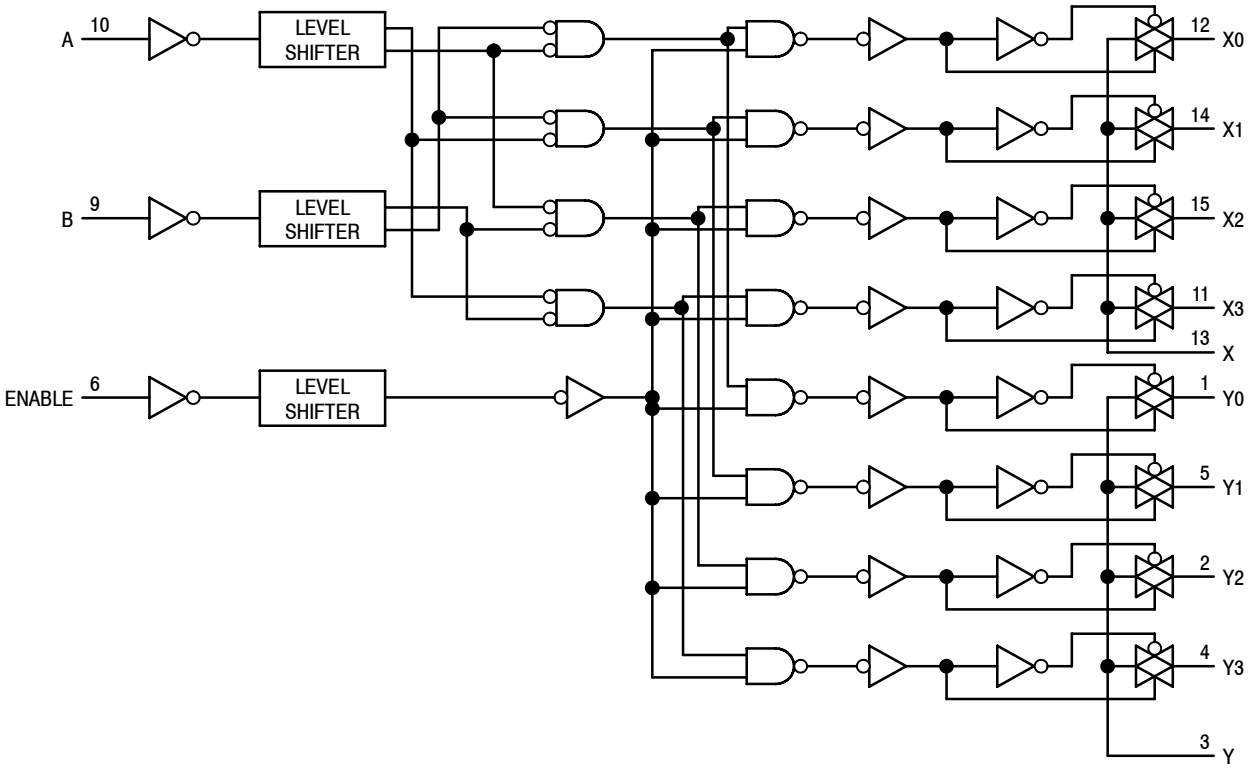


Figure 33. Function Diagram, VHC4052

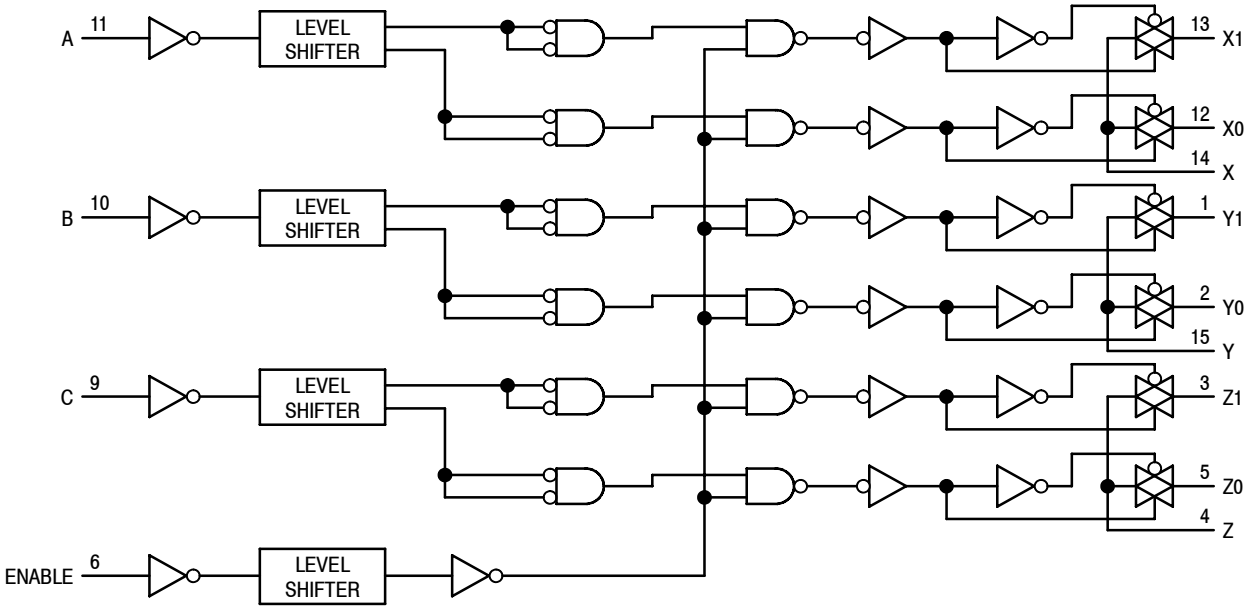


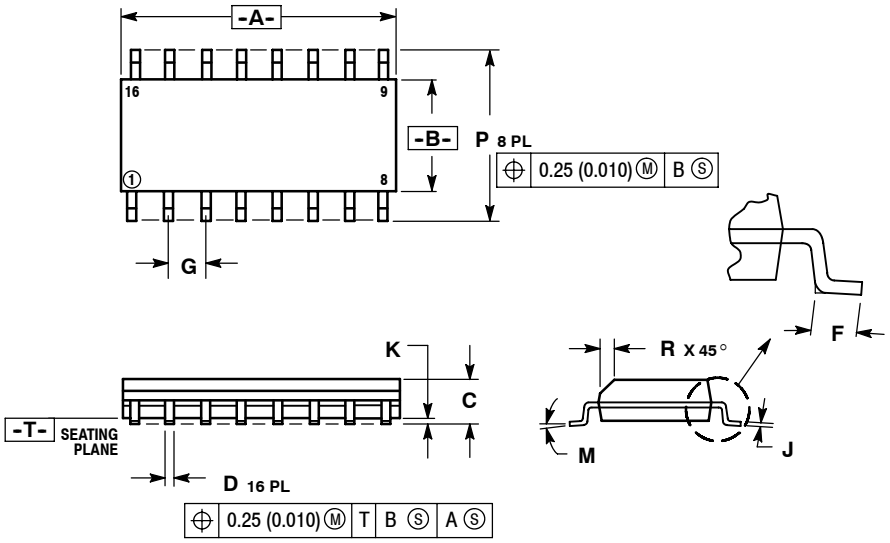
Figure 32. Function Diagram, VHC4053

ORDERING & SHIPPING INFORMATION

Device	Package	Shipping
MC74VHC4051D	SOIC−16	48 Units / Rail
MC74VHC4051DR2	SOIC−16	2500 Units / Tape & Reel
MC74VHC4051DT	TSSOP−16	96 Units / Rail
MC74VHC4051DTR2	TSSOP−16	2500 Units / Tape & Reel
MC74VHC4052D	SOIC−16	48 Units / Rail
MC74VHC4052DR2	SOIC−16	2500 Units / Tape & Reel
MC74VHC4052DT	TSSOP−16	96 Units / Rail
MC74VHC4052DTR2	TSSOP−16	2500 Units / Tape & Reel
MC74VHC4053D	SOIC−16	48 Units / Rail
MC74VHC4053DR2	SOIC−16	2500 Units / Tape & Reel
MC74VHC4053DT	TSSOP−16	96 Units / Rail
MC74VHC4053DTR2	TSSOP−16	2500 Units / Tape & Reel

PACKAGE DIMENSIONS

D SUFFIX
SOIC
CASE 751B-05
ISSUE J

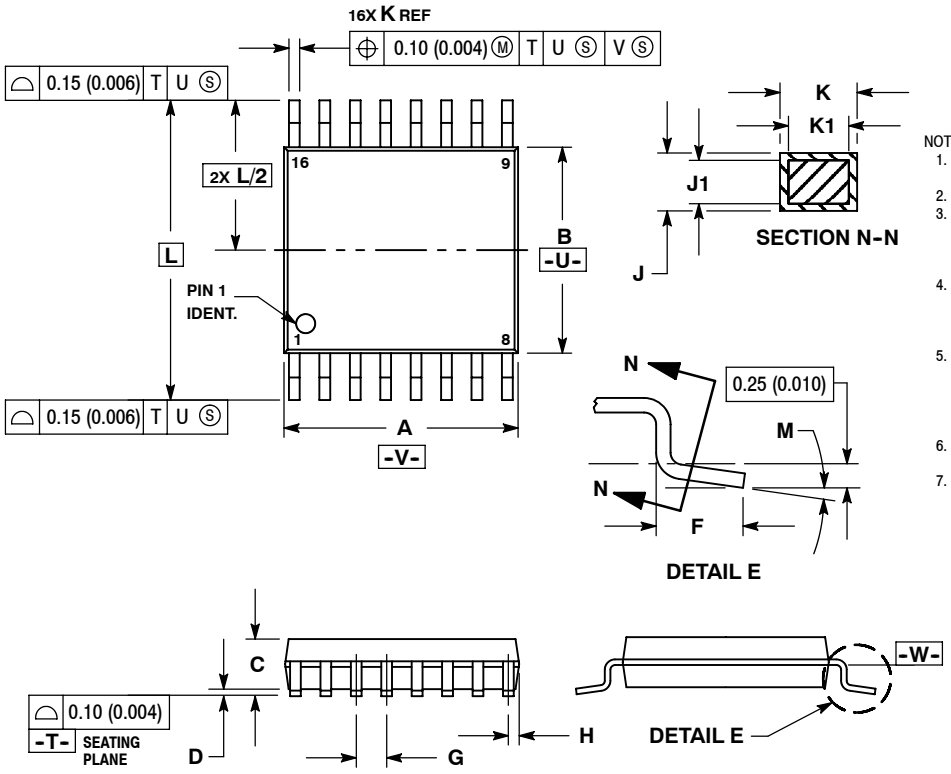


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

PACKAGE DIMENSIONS

DT SUFFIX
TSSOP
CASE 948F-01
ISSUE O



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-.

	MILLIMETERS		INCHES	
DIM	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°

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MC74VHC4051/D