

# Analog Multiplexers/ Demultiplexers

## High-Performance Silicon-Gate CMOS

### MC74HC4051A, MC74HC4052A, MC74HC4053A

The MC74HC4051A, MC74HC4052A and MC74HC4053A utilize silicon-gate CMOS technology to achieve fast propagation delays, low ON resistances, and low OFF leakage currents. These analog multiplexers/demultiplexers control analog voltages that may vary across the complete power supply range (from  $V_{CC}$  to  $V_{EE}$ ).

The HC4051A, HC4052A and HC4053A are identical in pinout to the metal-gate MC14051AB, MC14052AB and MC14053AB. The Channel-Select inputs determine which one of the Analog Inputs/Outputs is to be connected, by means of an analog switch, to the Common Output/Input. When the Enable pin is HIGH, all analog switches are turned off.

The Channel-Select and Enable inputs are compatible with standard CMOS outputs; with pullup resistors they are compatible with LSTTL outputs.

These devices have been designed so that the ON resistance ( $R_{ON}$ ) is more linear over input voltage than  $R_{ON}$  of metal-gate CMOS analog switches.

For a multiplexer/demultiplexer with injection current protection, see HC4851A and HC4852A.

#### Features

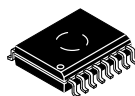
- Fast Switching and Propagation Speeds
- Low Crosstalk Between Switches
- Diode Protection on All Inputs/Outputs
- Analog Power Supply Range ( $V_{CC} - V_{EE}$ ) = 2.0 to 12.0 V
- Digital (Control) Power Supply Range ( $V_{CC} - GND$ ) = 2.0 to 6.0 V
- Improved Linearity and Lower ON Resistance Than Metal-Gate Counterparts
- Low Noise
- In Compliance with the Requirements of JEDEC Standard No. 7A
- Chip Complexity: HC4051A – 184 FETs or 46 Equivalent Gates  
HC4052A – 168 FETs or 42 Equivalent Gates  
HC4053A – 156 FETs or 39 Equivalent Gates
- 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

This document contains information on some products that are still under development. ON Semiconductor reserves the right to change or discontinue these products without notice.

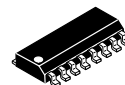


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SOIC-16 WIDE  
DW SUFFIX  
CASE 751G



SOIC-16  
D SUFFIX  
CASE 751B

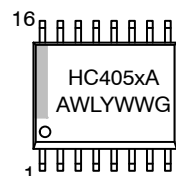


TSSOP-16  
DT SUFFIX  
CASE 948F

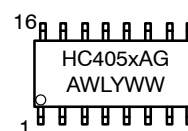


QFN16  
MN SUFFIX  
CASE 485AW

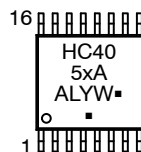
#### MARKING DIAGRAMS



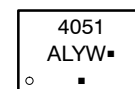
SOIC-16 WIDE



SOIC-16



TSSOP-16



QFN16

x = 1, 2 or 3  
A = Assembly Location  
WL, L = Wafer Lot  
YY, Y = Year  
WW, W = Work Week  
G or ■ = Pb-Free Package

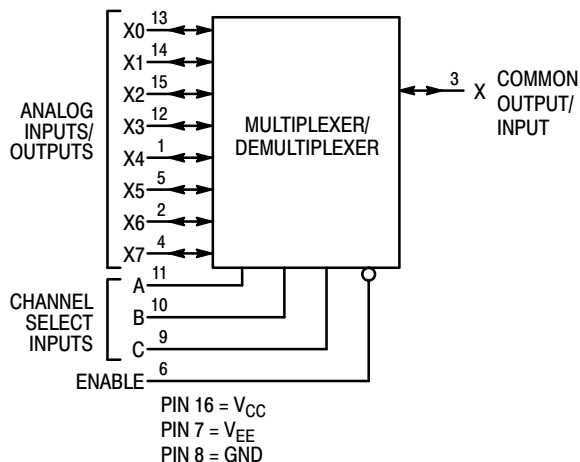
(Note: Microdot may be in either location)

#### ORDERING INFORMATION

See detailed ordering and shipping information on page 13 of this data sheet.

# MC74HC4051A, MC74HC4052A, MC74HC4053A

**LOGIC DIAGRAM**  
**MC74HC4051A**  
**Single-Pole, 8-Position Plus Common Off**

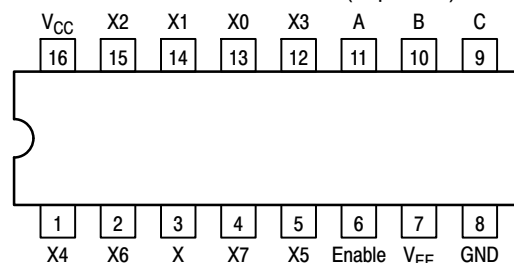


**FUNCTION TABLE – MC74HC4051A**

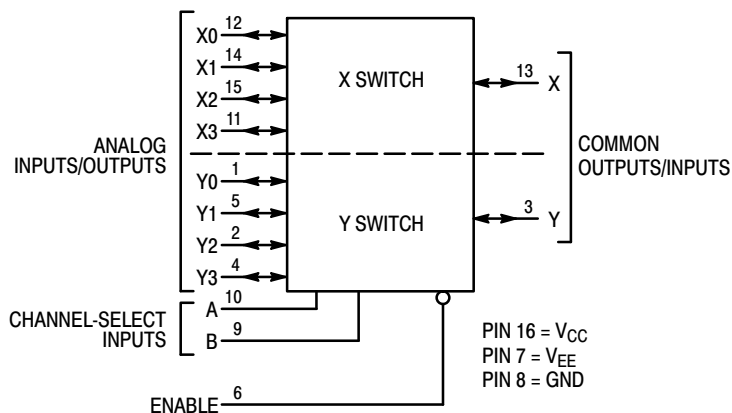
| Control Inputs |        |   |   | ON Channels |
|----------------|--------|---|---|-------------|
| Enable         | Select |   |   |             |
|                | C      | B | A |             |
| L              | L      | L | L | X0          |
| L              | L      | L | H | X1          |
| 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

**Pinout: MC74HC4051A (Top View)**



**LOGIC DIAGRAM**  
**MC74HC4052A**  
**Double-Pole, 4-Position Plus Common Off**

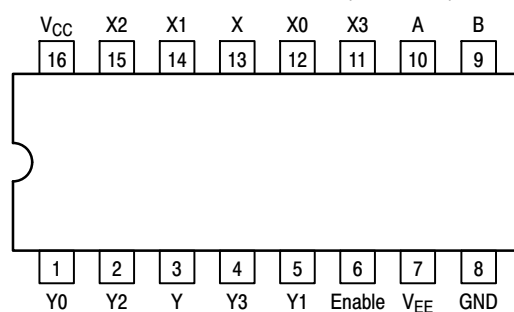


**FUNCTION TABLE – MC74HC4052A**

| Control Inputs |        |   |             |    |
|----------------|--------|---|-------------|----|
| Enable         | Select |   |             |    |
|                | 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

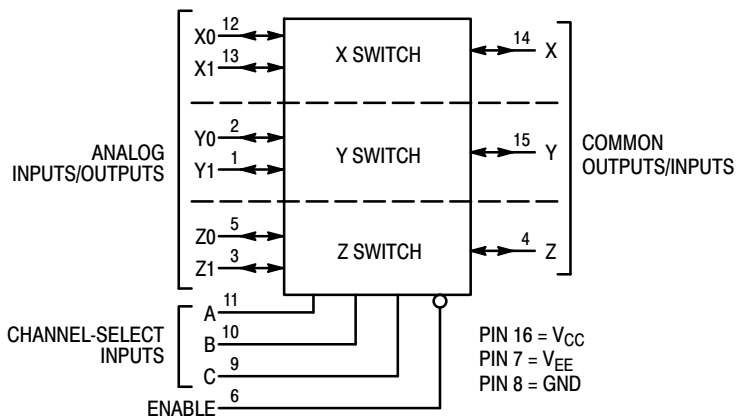
**Pinout: MC74HC4052A (Top View)**



# MC74HC4051A, MC74HC4052A, MC74HC4053A

## LOGIC DIAGRAM MC74HC4053A

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



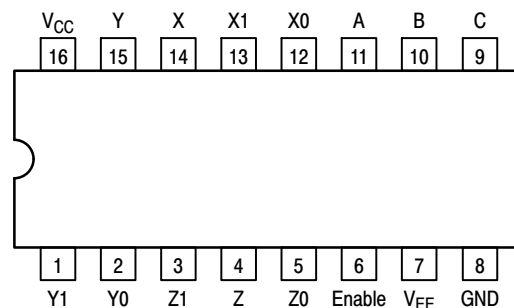
NOTE: This device allows independent control of each switch. Channel-Select Input A controls the X-Switch, Input B controls the Y-Switch and Input C controls the Z-Switch

**FUNCTION TABLE – MC74HC4053A**

| Control Inputs |   |   |   | ON Channels |    |    |
|----------------|---|---|---|-------------|----|----|
| Enable         | C | B | A |             |    |    |
| 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

**Pinout: MC74HC4053A (Top View)**



## MAXIMUM RATINGS

| Symbol    | Parameter                                                                   | Value                            | Unit |
|-----------|-----------------------------------------------------------------------------|----------------------------------|------|
| $V_{CC}$  | Positive DC Supply Voltage (Referenced to GND)<br>(Referenced to $V_{EE}$ ) | –0.5 to +7.0<br>–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†<br>TSSOP Package†             | 500<br>450                       | mW   |
| $T_{stg}$ | Storage Temperature Range                                                   | –65 to +150                      | °C   |
| $T_L$     | Lead Temperature, 1 mm from Case for 10 Seconds<br>SOIC or TSSOP Package    | 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.

# MC74HC4051A, MC74HC4052A, MC74HC4053A

## RECOMMENDED OPERATING CONDITIONS

| Symbol     | Parameter                                                                                                                                                             | Min              | Max                       | Unit |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------|------|
| $V_{CC}$   | Positive DC Supply Voltage<br>(Referenced to GND)<br>(Referenced to $V_{EE}$ )                                                                                        | 2.0<br>2.0       | 6.0<br>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<br>(Channel Select or Enable Inputs)<br>$V_{CC} = 2.0\text{ V}$<br>$V_{CC} = 3.0\text{ V}$<br>$V_{CC} = 4.5\text{ V}$<br>$V_{CC} = 6.0\text{ V}$ | 0<br>0<br>0<br>0 | 1000<br>600<br>500<br>400 | ns   |

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.

\*For voltage drops across 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 CHARACTERISTICS — Digital Section (Voltages Referenced to GND) $V_{EE} = \text{GND}$ , Except Where Noted

| Symbol   | Parameter                                                            | Condition                                                                                                              | $V_{CC}$<br>V            | Guaranteed Limit             |                              |                              | Unit |
|----------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------|------------------------------|------------------------------|------------------------------|------|
|          |                                                                      |                                                                                                                        |                          | -55 to 25°C                  | ≤85°C                        | ≤125°C                       |      |
| $V_{IH}$ | Minimum High-Level Input Voltage,<br>Channel-Select or Enable Inputs | $R_{on} = \text{Per Spec}$                                                                                             | 2.0<br>3.0<br>4.5<br>6.0 | 1.50<br>2.10<br>3.15<br>4.20 | 1.50<br>2.10<br>3.15<br>4.20 | 1.50<br>2.10<br>3.15<br>4.20 | V    |
| $V_{IL}$ | Maximum Low-Level Input Voltage,<br>Channel-Select or Enable Inputs  | $R_{on} = \text{Per Spec}$                                                                                             | 2.0<br>3.0<br>4.5<br>6.0 | 0.5<br>0.9<br>1.35<br>1.8    | 0.5<br>0.9<br>1.35<br>1.8    | 0.5<br>0.9<br>1.35<br>1.8    | V    |
| $I_{in}$ | Maximum Input Leakage Current,<br>Channel-Select or Enable Inputs    | $V_{in} = V_{CC}$ or GND,<br>$V_{EE} = -6.0\text{ V}$                                                                  | 6.0                      | ± 0.1                        | ± 1.0                        | ± 1.0                        | μA   |
| $I_{CC}$ | Maximum Quiescent Supply<br>Current (per Package)                    | Channel Select, Enable and<br>$V_{IS} = V_{CC}$ or GND; $V_{EE} = \text{GND}$<br>$V_{IO} = 0\text{ V}$ $V_{EE} = -6.0$ | 6.0<br>6.0               | 1<br>4                       | 10<br>40                     | 20<br>80                     | μA   |

# MC74HC4051A, MC74HC4052A, MC74HC4053A

## DC CHARACTERISTICS — Analog Section

| Symbol           | Parameter                                                                          | Condition                                                                                                                                                       | V <sub>CC</sub>   | V <sub>EE</sub>       | Guaranteed Limit  |                   |                   | Unit |
|------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|-------------------|-------------------|-------------------|------|
|                  |                                                                                    |                                                                                                                                                                 |                   |                       | –55 to 25°C       | ≤85°C             | ≤125°C            |      |
| R <sub>on</sub>  | Maximum “ON” Resistance                                                            | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> ; V <sub>IS</sub> = V <sub>CC</sub> to V <sub>EE</sub> ; I <sub>S</sub> ≤ 2.0 mA (Figures 1, 2)            | 4.5<br>4.5<br>6.0 | 0.0<br>– 4.5<br>– 6.0 | 190<br>120<br>100 | 240<br>150<br>125 | 280<br>170<br>140 | Ω    |
|                  |                                                                                    | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> ; V <sub>IS</sub> = V <sub>CC</sub> or V <sub>EE</sub> (Endpoints); I <sub>S</sub> ≤ 2.0 mA (Figures 1, 2) | 4.5<br>4.5<br>6.0 | 0.0<br>– 4.5<br>– 6.0 | 150<br>100<br>80  | 190<br>125<br>100 | 230<br>140<br>115 |      |
| ΔR <sub>on</sub> | Maximum Difference in “ON” Resistance Between Any Two Channels in the Same Package | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> ; V <sub>IS</sub> = 1/2 (V <sub>CC</sub> – V <sub>EE</sub> ); I <sub>S</sub> ≤ 2.0 mA                      | 4.5<br>4.5<br>6.0 | 0.0<br>– 4.5<br>– 6.0 | 30<br>12<br>10    | 35<br>15<br>12    | 40<br>18<br>14    | Ω    |
| I <sub>off</sub> | Maximum Off–Channel Leakage Current, Any One Channel                               | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> ; V <sub>IO</sub> = V <sub>CC</sub> – V <sub>EE</sub> ; Switch Off (Figure 3)                              | 6.0               | – 6.0                 | 0.1               | 0.5               | 1.0               | μA   |
|                  | Maximum Off–Channel Leakage Current, HC4051A                                       | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> ; V <sub>IO</sub> = V <sub>CC</sub> – V <sub>EE</sub> ; Switch Off (Figure 4)                              | 6.0               | – 6.0                 | 0.2               | 2.0               | 4.0               |      |
|                  | Leakage Current, HC4052A                                                           |                                                                                                                                                                 | 6.0               | – 6.0                 | 0.1               | 1.0               | 2.0               |      |
| I <sub>on</sub>  | Common Channel Leakage Current, HC4053A                                            |                                                                                                                                                                 | 6.0               | – 6.0                 | 0.1               | 1.0               | 2.0               | μA   |
|                  | Maximum On–Channel Leakage Current, HC4051A                                        | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub> ; Switch–to–Switch =                                                                                       | 6.0               | – 6.0                 | 0.2               | 2.0               | 4.0               |      |
|                  | Channel–to–Channel Leakage Current, HC4052A                                        | V <sub>CC</sub> – V <sub>EE</sub> ; (Figure 5)                                                                                                                  | 6.0               | – 6.0                 | 0.1               | 1.0               | 2.0               |      |
| I <sub>on</sub>  | Channel–to–Channel Leakage Current, HC4053A                                        |                                                                                                                                                                 | 6.0               | – 6.0                 | 0.1               | 1.0               | 2.0               | μA   |
|                  |                                                                                    |                                                                                                                                                                 | 6.0               | – 6.0                 | 0.1               | 1.0               | 2.0               |      |
|                  |                                                                                    |                                                                                                                                                                 | 6.0               | – 6.0                 | 0.1               | 1.0               | 2.0               |      |

## AC CHARACTERISTICS (C<sub>L</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Symbol                                 | Parameter                                                             | V <sub>CC</sub><br>V                                           | Guaranteed Limit |       |        | Unit |
|----------------------------------------|-----------------------------------------------------------------------|----------------------------------------------------------------|------------------|-------|--------|------|
|                                        |                                                                       |                                                                | –55 to 25°C      | ≤85°C | ≤125°C |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Channel–Select to Analog Output (Figure 9) | 2.0                                                            | 270              | 320   | 350    | ns   |
|                                        |                                                                       | 3.0                                                            | 90               | 110   | 125    |      |
|                                        |                                                                       | 4.5                                                            | 59               | 79    | 85     |      |
|                                        |                                                                       | 6.0                                                            | 45               | 65    | 75     |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Analog Input to Analog Output (Figure 10)  | 2.0                                                            | 40               | 60    | 70     | ns   |
|                                        |                                                                       | 3.0                                                            | 25               | 30    | 32     |      |
|                                        |                                                                       | 4.5                                                            | 12               | 15    | 18     |      |
|                                        |                                                                       | 6.0                                                            | 10               | 13    | 15     |      |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Maximum Propagation Delay, Enable to Analog Output (Figure 11)        | 2.0                                                            | 160              | 200   | 220    | ns   |
|                                        |                                                                       | 3.0                                                            | 70               | 95    | 110    |      |
|                                        |                                                                       | 4.5                                                            | 48               | 63    | 76     |      |
|                                        |                                                                       | 6.0                                                            | 39               | 55    | 63     |      |
| t <sub>PZL</sub> ,<br>t <sub>PZH</sub> | Maximum Propagation Delay, Enable to Analog Output (Figure 11)        | 2.0                                                            | 245              | 315   | 345    | ns   |
|                                        |                                                                       | 3.0                                                            | 115              | 145   | 155    |      |
|                                        |                                                                       | 4.5                                                            | 49               | 69    | 83     |      |
|                                        |                                                                       | 6.0                                                            | 39               | 58    | 67     |      |
| C <sub>in</sub>                        | Maximum Input Capacitance, Channel–Select or Enable Inputs            |                                                                | 10               | 10    | 10     | pF   |
| C <sub>I/O</sub>                       | Maximum Capacitance Analog I/O                                        |                                                                | 35               | 35    | 35     | pF   |
|                                        | (All Switches Off)                                                    |                                                                |                  |       |        |      |
|                                        | Common O/I: HC4051A                                                   |                                                                | 130              | 130   | 130    |      |
|                                        | HC4052A                                                               |                                                                | 80               | 80    | 80     |      |
| C <sub>PD</sub>                        | HC4053A                                                               |                                                                | 50               | 50    | 50     | pF   |
|                                        | Feed–through                                                          |                                                                | 1.0              | 1.0   | 1.0    |      |
| C <sub>PD</sub>                        | Power Dissipation Capacitance (Figure 13)*                            | Typical @ 25°C, V <sub>CC</sub> = 5.0 V, V <sub>EE</sub> = 0 V |                  |       |        | pF   |
|                                        |                                                                       | HC4051A                                                        | 45               |       |        |      |
|                                        |                                                                       | HC4052A                                                        | 80               |       |        |      |
|                                        |                                                                       | HC4053A                                                        | 45               |       |        |      |

\* 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>.

# MC74HC4051A, MC74HC4052A, MC74HC4053A

## ADDITIONAL APPLICATION CHARACTERISTICS (GND = 0 V)

| Symbol | Parameter                                                                       | Condition                                                                                                                                                                                                                                                                            | V <sub>CC</sub><br>V | V <sub>EE</sub><br>V | Limit* |     |     | Unit             |
|--------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|----------------------|--------|-----|-----|------------------|
|        |                                                                                 |                                                                                                                                                                                                                                                                                      |                      |                      | 25°C   |     |     |                  |
| BW     | Maximum On-Channel Bandwidth or Minimum Frequency Response (Figure 6)           | f <sub>in</sub> = 1MHz Sine Wave; Adjust f <sub>in</sub> Voltage to Obtain 0dBm at V <sub>OS</sub> ; Increase f <sub>in</sub> Frequency Until dB Meter Reads -3dB; R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF                                                                       |                      |                      | '51    | '52 | '53 | MHz              |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 2.25                 | -2.25                | 80     | 95  | 120 |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | 80     | 95  | 120 |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | 80     | 95  | 120 |                  |
| -      | Off-Channel Feed-through Isolation (Figure 7)                                   | f <sub>in</sub> = Sine Wave; Adjust f <sub>in</sub> Voltage to Obtain 0dBm at V <sub>IS</sub><br>f <sub>in</sub> = 10kHz, R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF                                                                                                               | 2.25                 | -2.25                | -50    |     |     | dB               |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | -50    |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | -50    |     |     |                  |
|        |                                                                                 | f <sub>in</sub> = 1.0MHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF                                                                                                                                                                                                                |                      | 2.25                 | -2.25  | -40 |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | -40    |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | -40    |     |     |                  |
| -      | Feedthrough Noise. Channel-Select Input to Common I/O (Figure 8)                | V <sub>in</sub> ≤ 1MHz Square Wave (t <sub>r</sub> = t <sub>f</sub> = 6ns); Adjust R <sub>L</sub> at Setup so that I <sub>S</sub> = 0A; Enable = GND R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF                                                                                    | 2.25                 | -2.25                | 25     |     |     | mV <sub>pp</sub> |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | 105    |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | 135    |     |     |                  |
|        |                                                                                 | R <sub>L</sub> = 10kΩ, C <sub>L</sub> = 10pF                                                                                                                                                                                                                                         |                      | 2.25                 | -2.25  | 35  |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | 145    |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | 190    |     |     |                  |
| -      | Crosstalk Between Any Two Switches (Figure 12) (Test does not apply to HC4051A) | f <sub>in</sub> = Sine Wave; Adjust f <sub>in</sub> Voltage to Obtain 0dBm at V <sub>IS</sub><br>f <sub>in</sub> = 10kHz, R <sub>L</sub> = 600Ω, C <sub>L</sub> = 50pF                                                                                                               | 2.25                 | -2.25                | -50    |     |     | dB               |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | -50    |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | -50    |     |     |                  |
|        |                                                                                 | f <sub>in</sub> = 1.0MHz, R <sub>L</sub> = 50Ω, C <sub>L</sub> = 10pF                                                                                                                                                                                                                |                      | 2.25                 | -2.25  | -60 |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | -60    |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | -60    |     |     |                  |
| THD    | Total Harmonic Distortion (Figure 14)                                           | f <sub>in</sub> = 1kHz, R <sub>L</sub> = 10kΩ, C <sub>L</sub> = 50pF<br>THD = THD <sub>measured</sub> - THD <sub>source</sub><br>V <sub>IS</sub> = 4.0V <sub>pp</sub> sine wave<br>V <sub>IS</sub> = 8.0V <sub>pp</sub> sine wave<br>V <sub>IS</sub> = 11.0V <sub>pp</sub> sine wave |                      |                      |        |     |     | %                |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 2.25                 | -2.25                | 0.10   |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | 0.08   |     |     |                  |
|        |                                                                                 |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | 0.05   |     |     |                  |

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

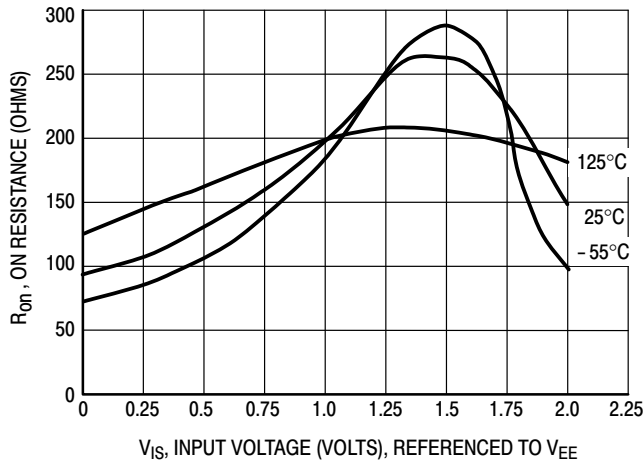


Figure 1a. Typical On Resistance, V<sub>CC</sub> - V<sub>EE</sub> = 2.0 V

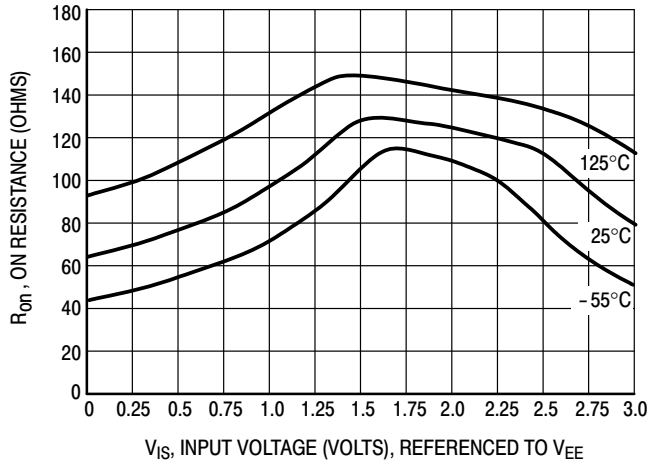


Figure 1b. Typical On Resistance, V<sub>CC</sub> - V<sub>EE</sub> = 3.0 V

# MC74HC4051A, MC74HC4052A, MC74HC4053A

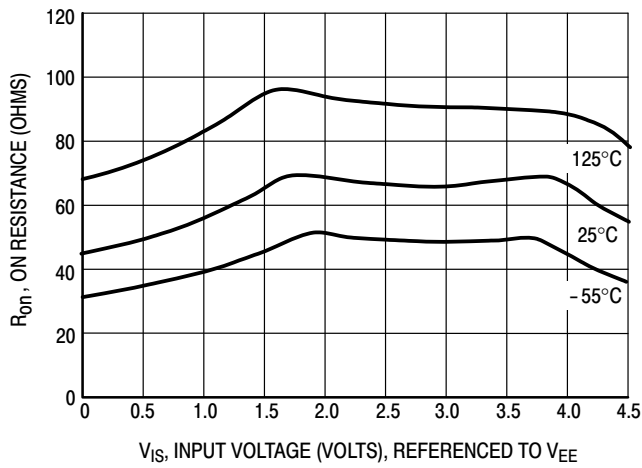


Figure 1c. Typical On Resistance,  $V_{CC} - V_{EE} = 4.5$  V

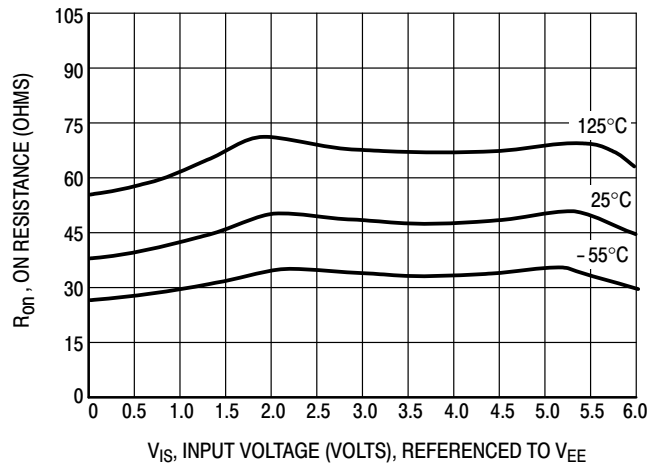


Figure 1d. Typical On Resistance,  $V_{CC} - V_{EE} = 6.0$  V

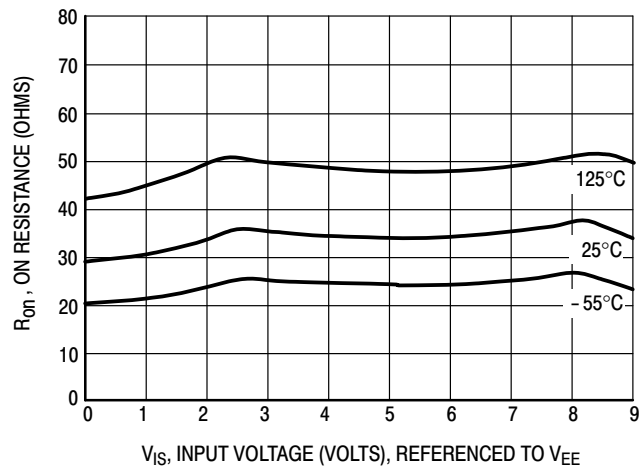


Figure 1e. Typical On Resistance,  $V_{CC} - V_{EE} = 9.0$  V

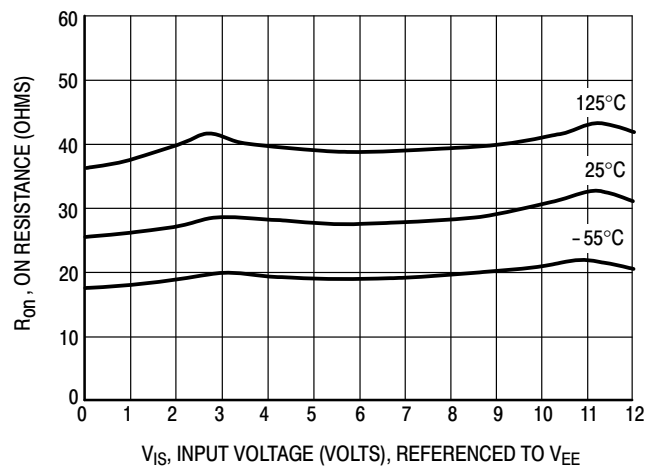


Figure 1f. Typical On Resistance,  $V_{CC} - V_{EE} = 12.0$  V

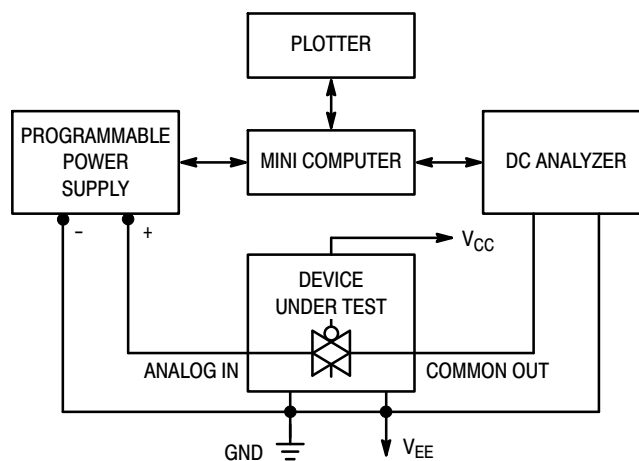
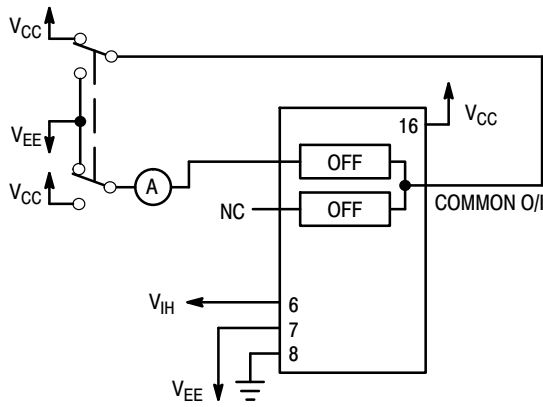
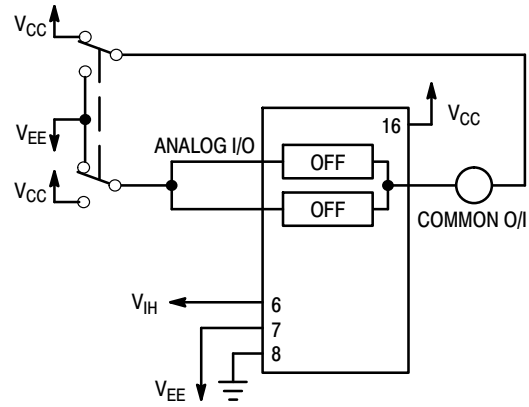


Figure 2. On Resistance Test Set-Up

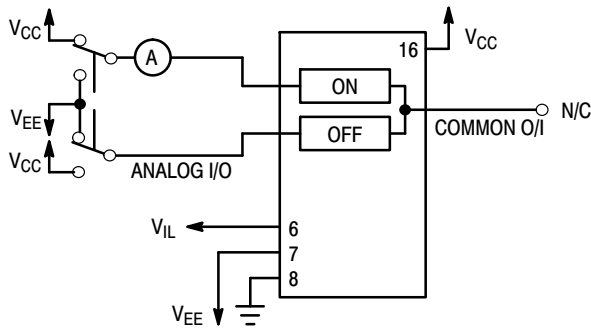
# MC74HC4051A, MC74HC4052A, MC74HC4053A



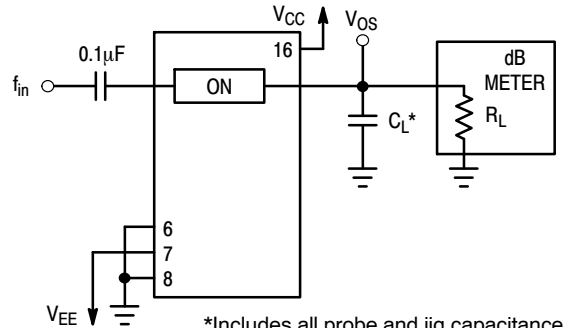
**Figure 3. Maximum Off Channel Leakage Current, Any One Channel, Test Set-Up**



**Figure 4. Maximum Off Channel Leakage Current, Common Channel, Test Set-Up**

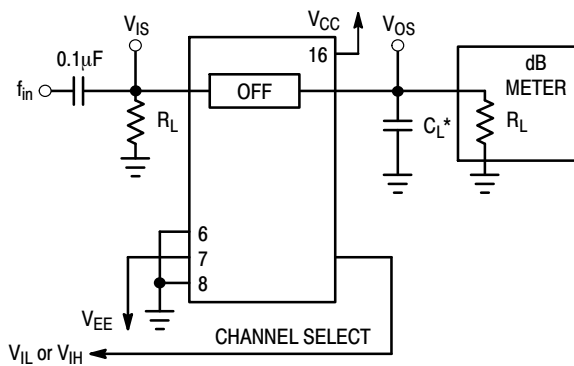


**Figure 5. Maximum On Channel Leakage Current, Channel to Channel, Test Set-Up**



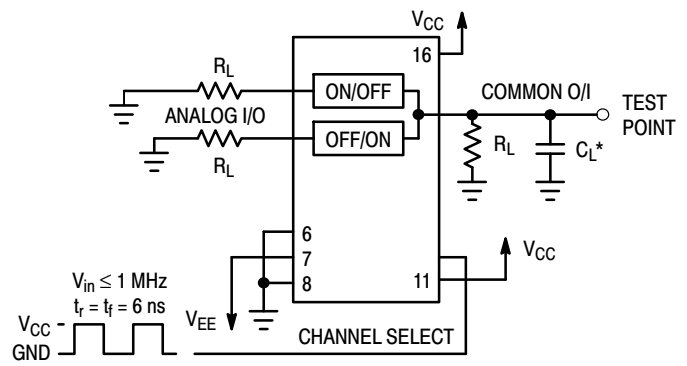
\*Includes all probe and jig capacitance

**Figure 6. Maximum On Channel Bandwidth, Test Set-Up**



\*Includes all probe and jig capacitance

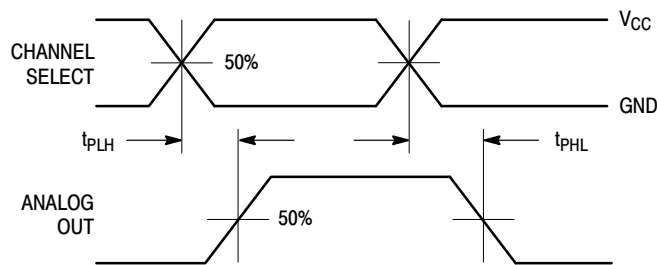
**Figure 7. Off Channel Feedthrough Isolation, Test Set-Up**



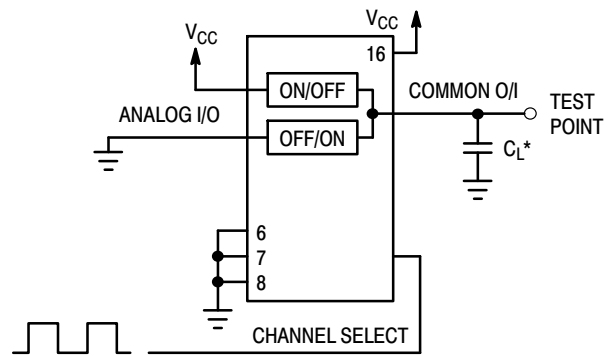
\*Includes all probe and jig capacitance

**Figure 8. Feedthrough Noise, Channel Select to Common Out, Test Set-Up**

# MC74HC4051A, MC74HC4052A, MC74HC4053A

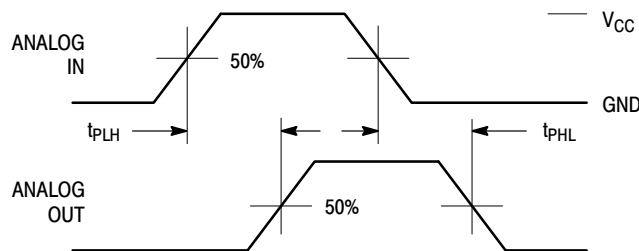


**Figure 9a. Propagation Delays, Channel Select to Analog Out**

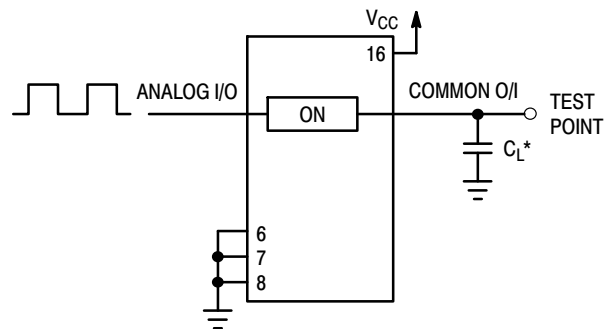


\*Includes all probe and jig capacitance

**Figure 9b. Propagation Delay, Test Set-Up Channel Select to Analog Out**

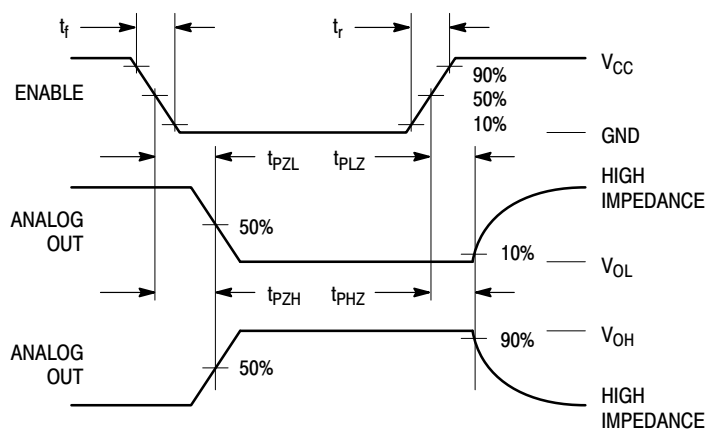


**Figure 10a. Propagation Delays, Analog In to Analog Out**

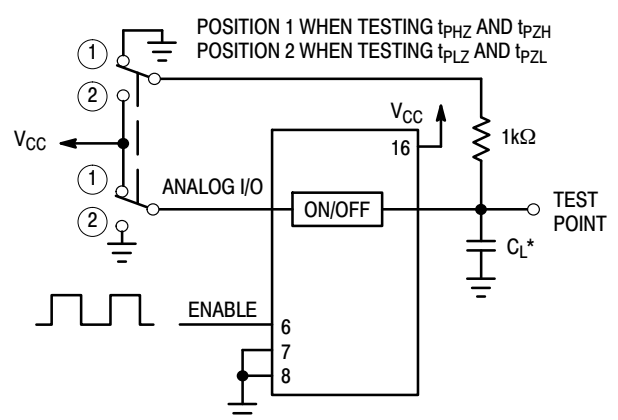


\*Includes all probe and jig capacitance

**Figure 10b. Propagation Delay, Test Set-Up Analog In to Analog Out**

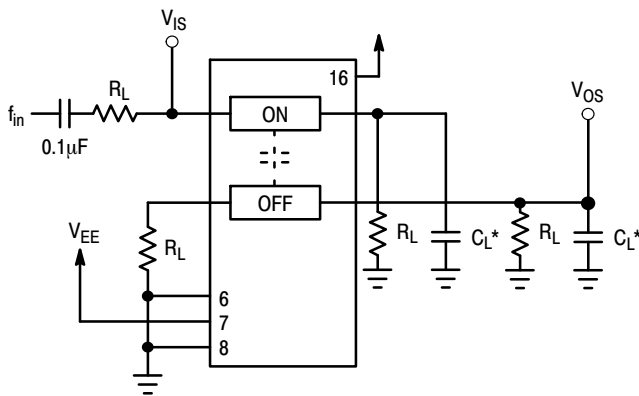


**Figure 11a. Propagation Delays, Enable to Analog Out**



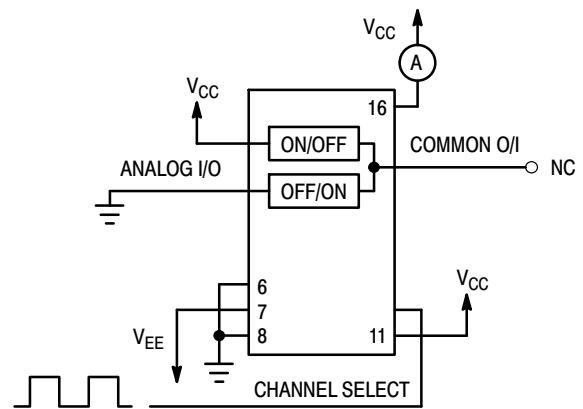
**Figure 11b. Propagation Delay, Test Set-Up Enable to Analog Out**

## MC74HC4051A, MC74HC4052A, MC74HC4053A

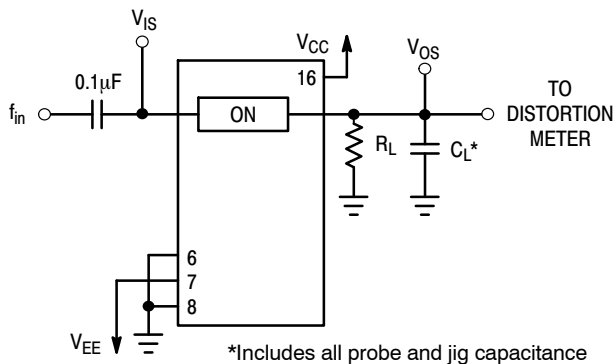


\*Includes all probe and jig capacitance

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

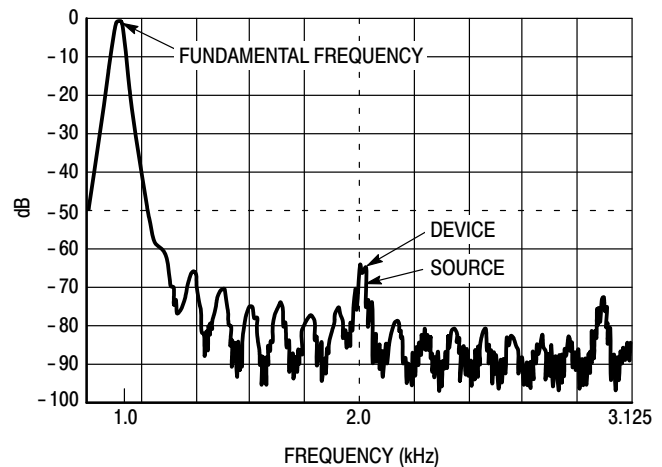


**Figure 13. Power Dissipation Capacitance, Test Set-Up**



\*Includes all probe and jig capacitance

**Figure 14a. Total Harmonic Distortion, Test Set-Up**



**Figure 14b. 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:

$$\begin{aligned} V_{CC} &= +5V = \text{logic high} \\ \text{GND} &= 0V = \text{logic low} \end{aligned}$$

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 15, 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 feed-through 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:

$$\begin{aligned} V_{CC} - \text{GND} &= 2 \text{ to } 6 \text{ volts} \\ V_{EE} - \text{GND} &= 0 \text{ to } -6 \text{ volts} \\ V_{CC} - V_{EE} &= 2 \text{ to } 12 \text{ volts} \\ &\text{and } V_{EE} \leq \text{GND} \end{aligned}$$

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 16. These diodes should be able to absorb the maximum anticipated current surges during clipping.

# MC74HC4051A, MC74HC4052A, MC74HC4053A

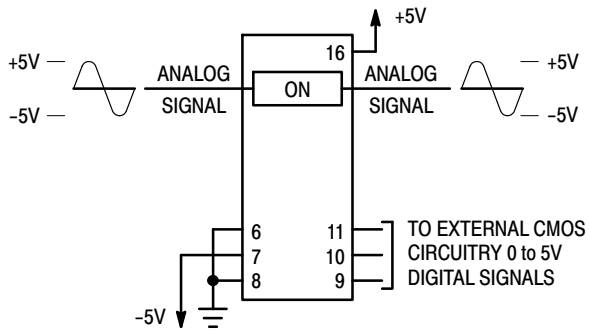


Figure 15. Application Example

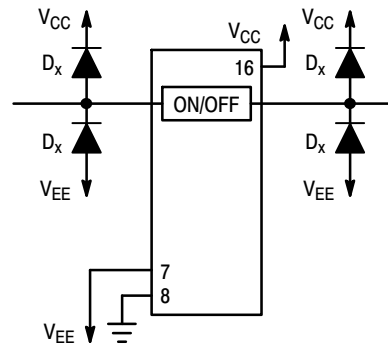
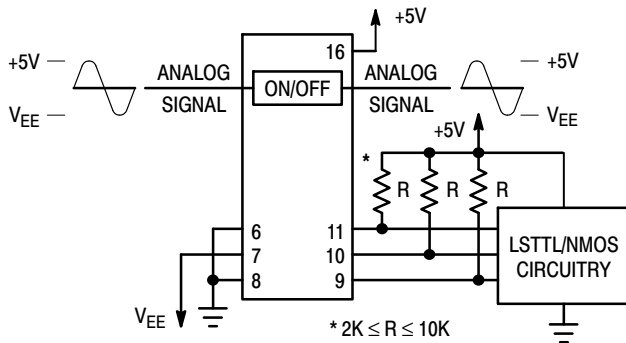
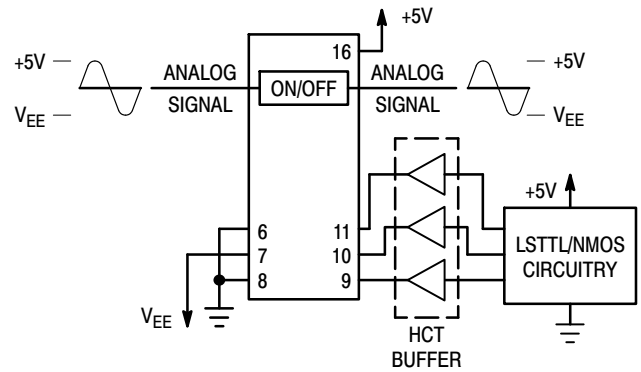


Figure 16. External Germanium or Schottky Clipping Diodes



a. Using Pull-Up Resistors



b. Using HCT Interface

Figure 17. Interfacing LSTTL/NMOS to CMOS Inputs

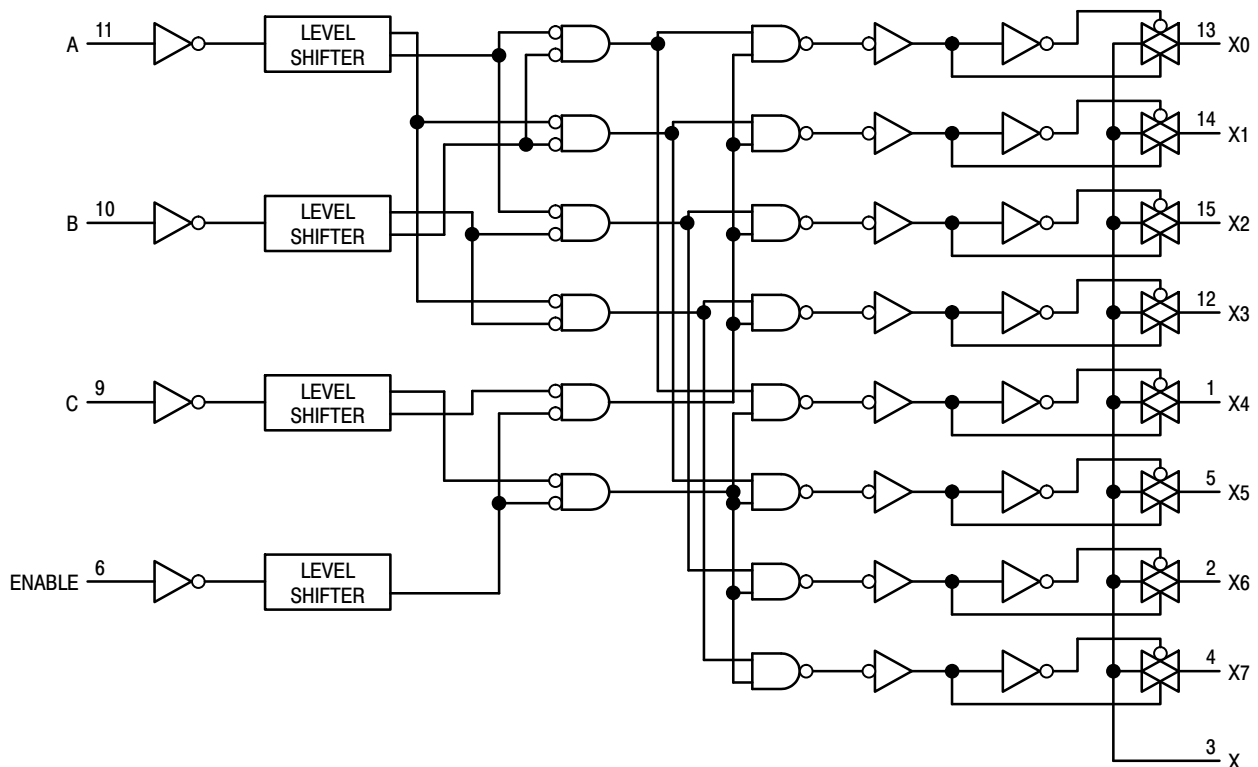


Figure 18. Function Diagram, HC4051A

# MC74HC4051A, MC74HC4052A, MC74HC4053A

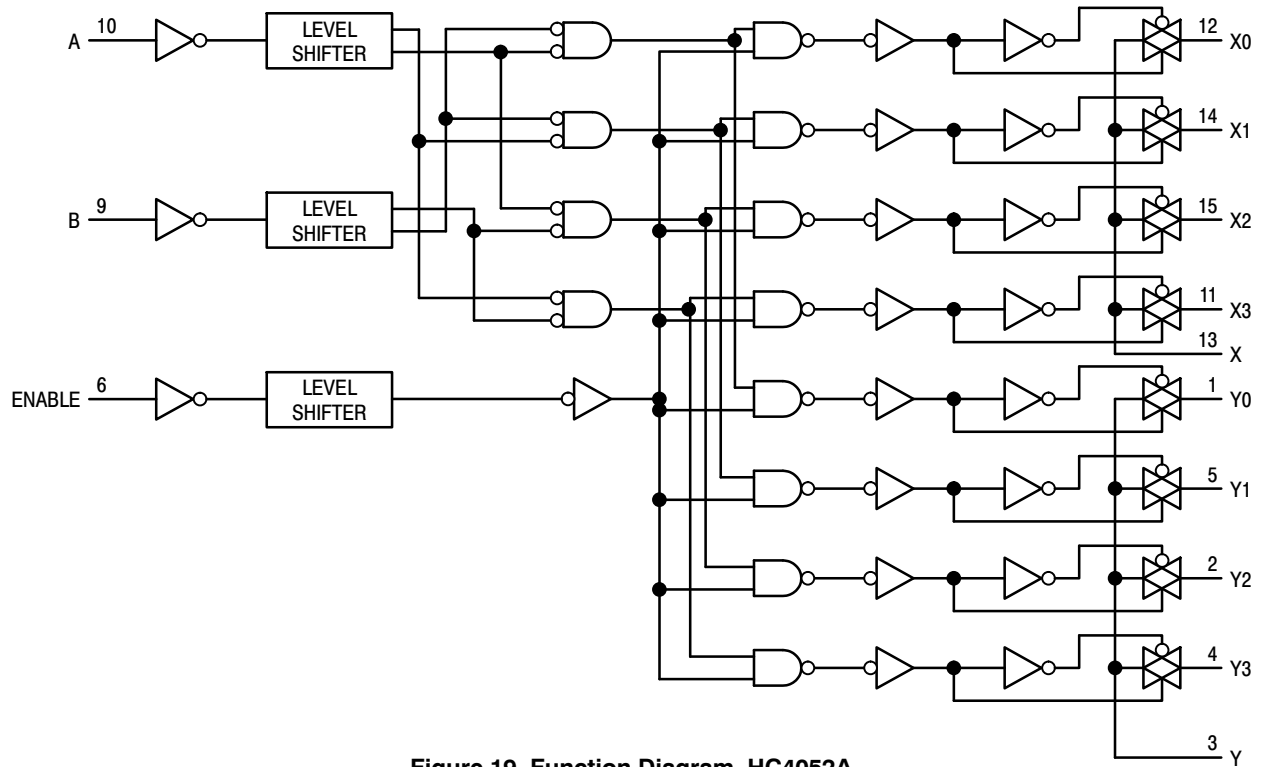


Figure 19. Function Diagram, HC4052A

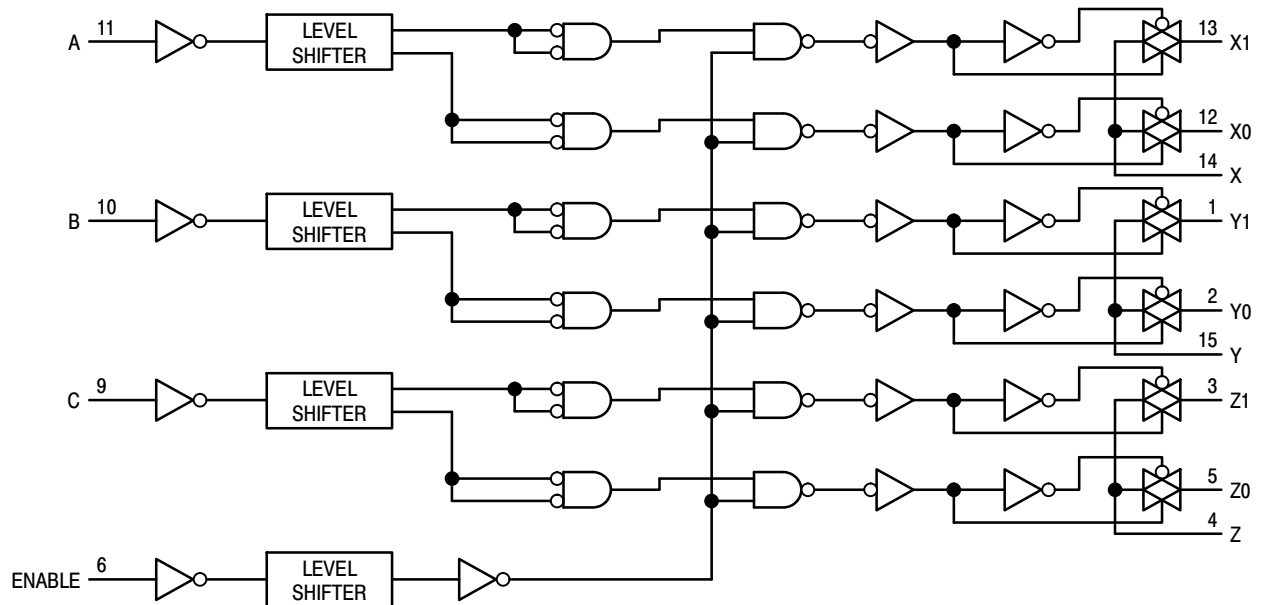


Figure 20. Function Diagram, HC4053A

# MC74HC4051A, MC74HC4052A, MC74HC4053A

## ORDERING INFORMATION

| Device                               | Package                   | Shipping†                |
|--------------------------------------|---------------------------|--------------------------|
| MC74HC4051ADG                        | SOIC–16<br>(Pb–Free)      | 48 Units / Rail          |
| MC74HC4051ADR2G                      |                           | 2500 Units / Tape & Reel |
| NLV74HC4051ADR2G*                    |                           | 2500 Units / Tape & Reel |
| MC74HC4051AADR2G                     |                           | 2500 Units / Tape & Reel |
| NLV74HC4051AADR2G*                   |                           | 2500 Units / Tape & Reel |
| MC74HC4051ADWG                       | SOIC–16 WIDE<br>(Pb–Free) | 48 Units / Rail          |
| MC74HC4051ADWR2G                     |                           | 1000 Units / Tape & Reel |
| NLVHC4051ADWR2G*                     |                           | 1000 Units / Tape & Reel |
| MC74HC4051ADTG                       | TSSOP–16<br>(Pb–Free)     | 96 Units / Rail          |
| MC74HC4051ADTR2G                     |                           | 2500 Units / Tape & Reel |
| NLVHC4051ADTR2G*                     |                           | 2500 Units / Tape & Reel |
| NLVHC4051AADTR2G*                    |                           | 2500 Units / Tape & Reel |
| NLVHC4051AMNTWG*<br>(In Development) | QFN16<br>(Pb–Free)        | 3000 Units / Tape & Reel |

|                                      |                           |                          |
|--------------------------------------|---------------------------|--------------------------|
| MC74HC4052ADG                        | SOIC–16<br>(Pb–Free)      | 48 Units / Rail          |
| MC74HC4052ADR2G                      |                           | 2500 Units / Tape & Reel |
| NLV74HC4052ADR2G*                    |                           | 2500 Units / Tape & Reel |
| MC74HC4052ADWG                       | SOIC–16 WIDE<br>(Pb–Free) | 48 Units / Rail          |
| MC74HC4052ADWR2G                     |                           | 1000 Units / Tape & Reel |
| MC74HC4052ADTG                       | TSSOP–16<br>(Pb–Free)     | 96 Units / Rail          |
| MC74HC4052ADTR2G                     |                           | 2500 Units / Tape & Reel |
| NLV74HC4052ADTRG*                    |                           | 2500 Units / Tape & Reel |
| NLVHC4052ADTR2G*                     |                           | 2500 Units / Tape & Reel |
| NLVHC4052AMNTWG*<br>(In Development) | QFN16<br>(Pb–Free)        | 3000 Units / Tape & Reel |

|                    |                           |                          |
|--------------------|---------------------------|--------------------------|
| MC74HC4053ADG      | SOIC–16<br>(Pb–Free)      | 48 Units / Rail          |
| MC74HC4053ADR2G    |                           | 2500 Units / Tape & Reel |
| NLV74HC4053ADR2G*  |                           | 2500 Units / Tape & Reel |
| MC74HC4053ADWG     | SOIC–16 WIDE<br>(Pb–Free) | 48 Units / Rail          |
| NLV74HC4053ADWRG*  |                           | 1000 Units / Tape & Reel |
| MC74HC4053ADWR2G   |                           | 1000 Units / Tape & Reel |
| NLV74HC4053ADWR2G* |                           | 1000 Units / Tape & Reel |
| MC74HC4053ADTG     | TSSOP–16<br>(Pb–Free)     | 96 Units / Rail          |
| MC74HC4053ADTR2G   |                           | 2500 Units / Tape & Reel |
| NLVHC4053ADTR2G*   |                           | 2500 Units / 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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®

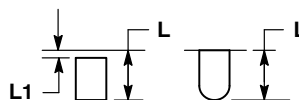
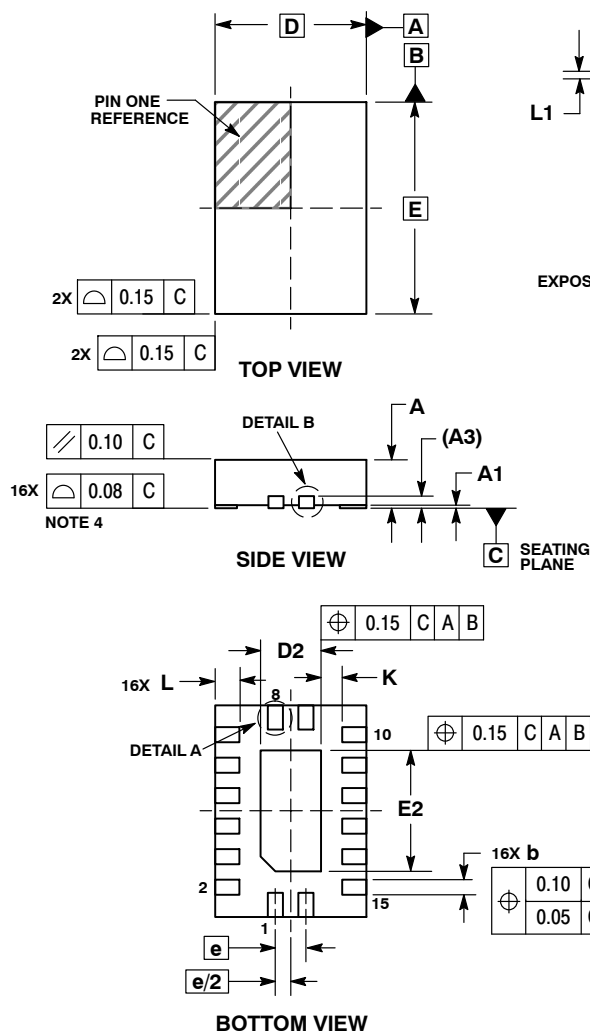
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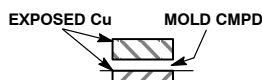
SCALE 2:1

**QFN16, 2.5x3.5, 0.5P**  
CASE 485AW-01  
ISSUE O

DATE 11 DEC 2008



**DETAIL A**  
ALTERNATE TERMINAL  
CONSTRUCTIONS



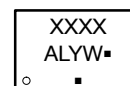
**DETAIL B**  
ALTERNATE  
CONSTRUCTIONS

### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSIONS b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.15 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

| DIM | MILLIMETERS |      |
|-----|-------------|------|
|     | MIN         | MAX  |
| A   | 0.80        | 1.00 |
| A1  | 0.00        | 0.05 |
| A3  | 0.20 REF    |      |
| b   | 0.20        | 0.30 |
| D   | 2.50 BSC    |      |
| D2  | 0.85        | 1.15 |
| E   | 3.50 BSC    |      |
| E2  | 1.85        | 2.15 |
| e   | 0.50 BSC    |      |
| K   | 0.20        | ---  |
| L   | 0.35        | 0.45 |
| L1  | ---         | 0.15 |

### GENERIC MARKING DIAGRAM\*

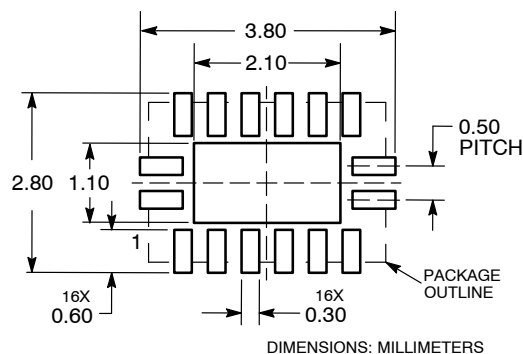


XXXX = Specific Device Code  
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*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.

### SOLDERING FOOTPRINT\*



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

|                         |                             |                                                                                                                                                                                  |
|-------------------------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>QFN16, 2.5X3.5, 0.5P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

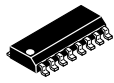
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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®

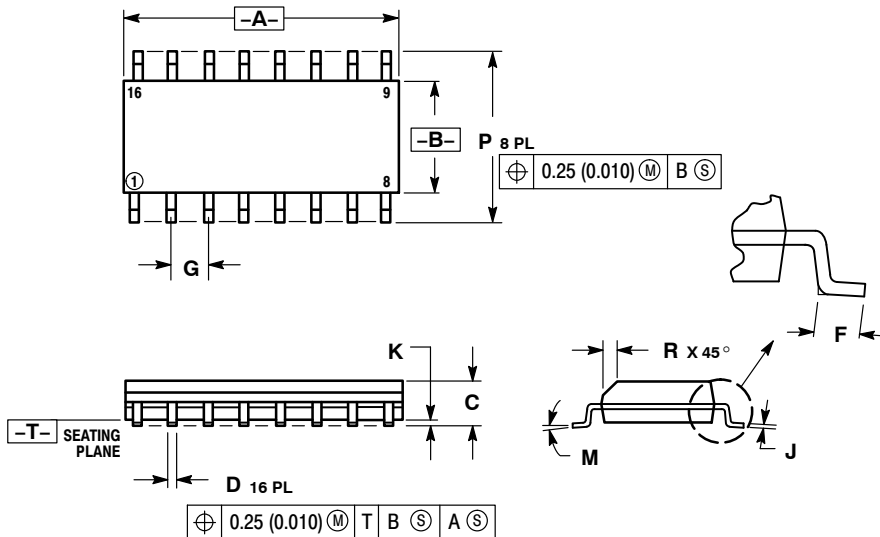
ON



SCALE 1:1

### SOIC-16 CASE 751B-05 ISSUE K

DATE 29 DEC 2006



#### NOTES:

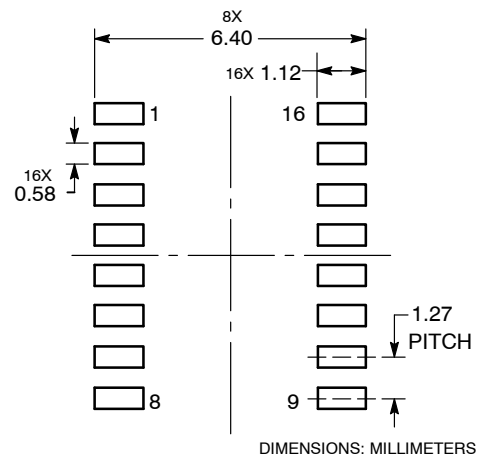
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL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

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | 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 |
| E   | 0.40        | 1.25  | 0.016     | 0.049 |
| F   | 1.27 BSC    |       | 0.050 BSC |       |
| G   | 0.19        | 0.25  | 0.008     | 0.009 |
| H   | 0.10        | 0.25  | 0.004     | 0.009 |
| I   | 0°          | 7°    | 0°        | 7°    |
| J   | 5.80        | 6.20  | 0.229     | 0.244 |
| K   | 0.25        | 0.50  | 0.010     | 0.019 |

|                   |                   |                          |                          |
|-------------------|-------------------|--------------------------|--------------------------|
| STYLE 1:          | STYLE 2:          | STYLE 3:                 | STYLE 4:                 |
| PIN 1. COLLECTOR  | PIN 1. CATHODE    | PIN 1. COLLECTOR, DYE #1 | PIN 1. COLLECTOR, DYE #1 |
| 2. BASE           | 2. ANODE          | 2. BASE, #1              | 2. COLLECTOR, #1         |
| 3. EMITTER        | 3. NO CONNECTION  | 3. EMITTER, #1           | 3. COLLECTOR, #2         |
| 4. NO CONNECTION  | 4. CATHODE        | 4. COLLECTOR, #1         | 4. COLLECTOR, #2         |
| 5. EMITTER        | 5. CATHODE        | 5. COLLECTOR, #2         | 5. COLLECTOR, #3         |
| 6. BASE           | 6. NO CONNECTION  | 6. BASE, #2              | 6. COLLECTOR, #3         |
| 7. COLLECTOR      | 7. ANODE          | 7. EMITTER, #2           | 7. COLLECTOR, #4         |
| 8. COLLECTOR      | 8. CATHODE        | 8. COLLECTOR, #2         | 8. COLLECTOR, #4         |
| 9. BASE           | 9. CATHODE        | 9. COLLECTOR, #3         | 9. BASE, #4              |
| 10. EMITTER       | 10. ANODE         | 10. BASE, #3             | 10. EMITTER, #4          |
| 11. NO CONNECTION | 11. NO CONNECTION | 11. EMITTER, #3          | 11. BASE, #3             |
| 12. EMITTER       | 12. CATHODE       | 12. COLLECTOR, #3        | 12. EMITTER, #3          |
| 13. BASE          | 13. CATHODE       | 13. COLLECTOR, #4        | 13. BASE, #2             |
| 14. COLLECTOR     | 14. NO CONNECTION | 14. BASE, #4             | 14. EMITTER, #2          |
| 15. EMITTER       | 15. ANODE         | 15. EMITTER, #4          | 15. BASE, #1             |
| 16. COLLECTOR     | 16. CATHODE       | 16. COLLECTOR, #4        | 16. EMITTER, #1          |

|                      |                |                           |
|----------------------|----------------|---------------------------|
| STYLE 5:             | STYLE 6:       | STYLE 7:                  |
| PIN 1. DRAIN, DYE #1 | PIN 1. CATHODE | PIN 1. SOURCE N-CH        |
| 2. DRAIN, #1         | 2. CATHODE     | 2. COMMON DRAIN (OUTPUT)  |
| 3. DRAIN, #2         | 3. CATHODE     | 3. COMMON DRAIN (OUTPUT)  |
| 4. DRAIN, #2         | 4. CATHODE     | 4. GATE P-CH              |
| 5. DRAIN, #3         | 5. CATHODE     | 5. COMMON DRAIN (OUTPUT)  |
| 6. DRAIN, #3         | 6. CATHODE     | 6. COMMON DRAIN (OUTPUT)  |
| 7. DRAIN, #4         | 7. CATHODE     | 7. COMMON DRAIN (OUTPUT)  |
| 8. DRAIN, #4         | 8. CATHODE     | 8. SOURCE P-CH            |
| 9. GATE, #4          | 9. ANODE       | 9. SOURCE P-CH            |
| 10. SOURCE, #4       | 10. ANODE      | 10. COMMON DRAIN (OUTPUT) |
| 11. GATE, #3         | 11. ANODE      | 11. COMMON DRAIN (OUTPUT) |
| 12. SOURCE, #3       | 12. ANODE      | 12. COMMON DRAIN (OUTPUT) |
| 13. GATE, #2         | 13. ANODE      | 13. GATE N-CH             |
| 14. SOURCE, #2       | 14. ANODE      | 14. COMMON DRAIN (OUTPUT) |
| 15. GATE, #1         | 15. ANODE      | 15. COMMON DRAIN (OUTPUT) |
| 16. SOURCE, #1       | 16. ANODE      | 16. SOURCE N-CH           |

#### SOLDERING FOOTPRINT



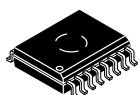
DIMENSIONS: MILLIMETERS

|                  |             |                                                                                                                                                                                     |
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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

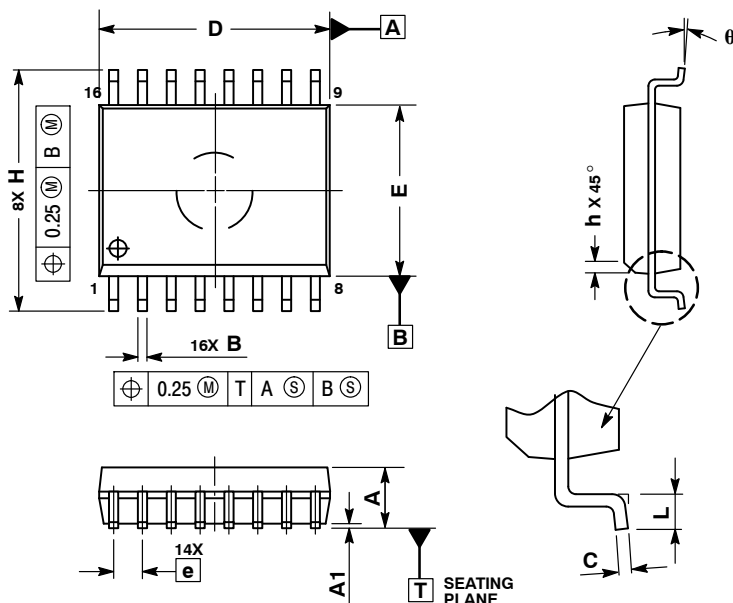
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1  
SCALE 1:1

SOIC-16 WB  
CASE 751G-03  
ISSUE D

DATE 12 FEB 2013

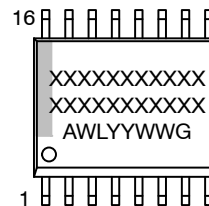


## NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

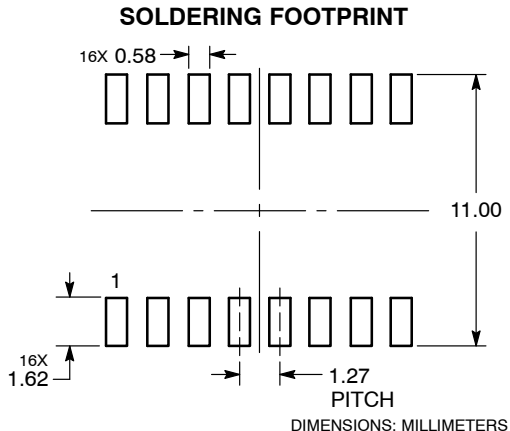
| MILLIMETERS |          |       |
|-------------|----------|-------|
| DIM         | MIN      | MAX   |
| A           | 2.35     | 2.65  |
| A1          | 0.10     | 0.25  |
| B           | 0.35     | 0.49  |
| C           | 0.23     | 0.32  |
| D           | 10.15    | 10.45 |
| E           | 7.40     | 7.60  |
| e           | 1.27 BSC |       |
| H           | 10.05    | 10.55 |
| h           | 0.25     | 0.75  |
| L           | 0.50     | 0.90  |
| q           | 0°       | 7°    |

## GENERIC MARKING DIAGRAM\*



XXXXXX = Specific Device Code  
A = Assembly Location  
WL = Wafer Lot  
YY = 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.

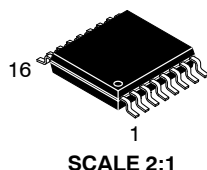


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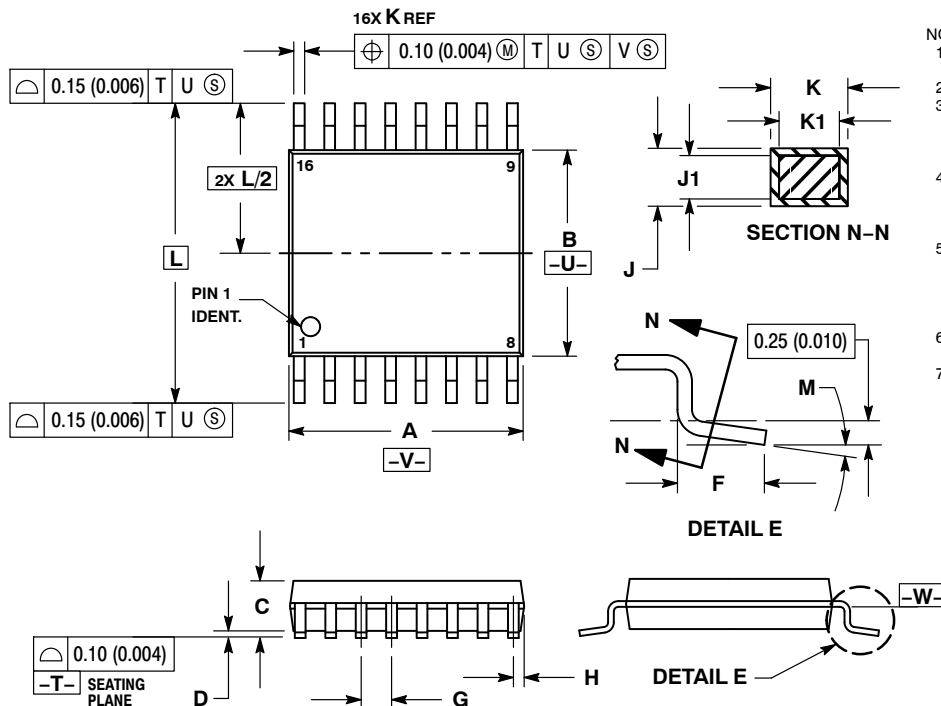
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

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**TSSOP-16**  
CASE 948F-01  
ISSUE B

DATE 19 OCT 2006

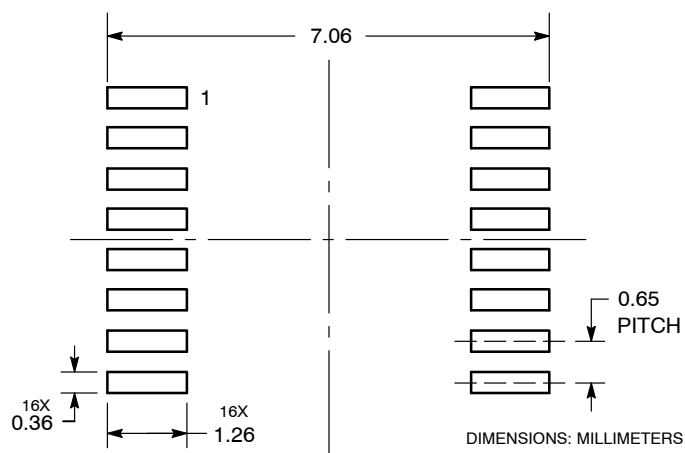


## NOTES:

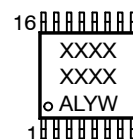
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD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

## SOLDERING FOOTPRINT



## 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.

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