

# Analog Multiplexers/ Demultiplexers

## High-Performance Silicon-Gate CMOS

The MC54/74HC4051, MC74HC4052 and MC54/74HC4053 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 HC4051, HC4052 and HC4053 are identical in pinout to the metal-gate MC14051B, MC14052B and MC14053B. 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.

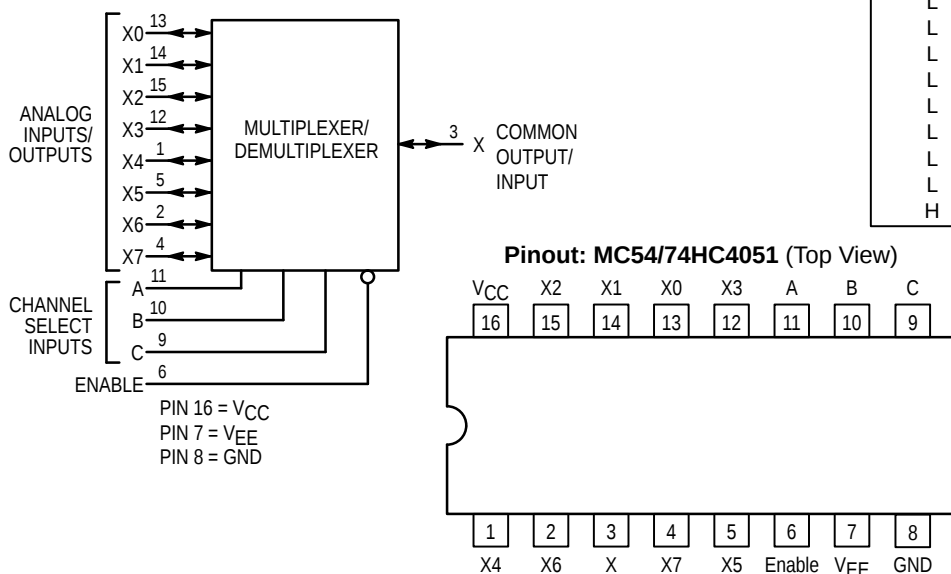
These devices have been designed so that the ON resistance ( $R_{ON}$ ) is more linear over input voltage than  $R_{ON}$  of metal-gate CMOS analog switches.

For multiplexers/demultiplexers with channel-select latches, see HC4351, HC4352 and HC4353.

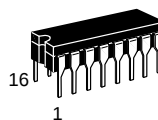
- Fast Switching and Propagation Speeds
- Low Crosstalk Between Switches
- Diode Protection on All Inputs/Outputs
- Analog Power Supply Range ( $V_{CC} - V_{EE}$ ) = 2.0 to 12.0 V
- Digital (Control) Power Supply Range ( $V_{CC} - GND$ ) = 2.0 to 6.0 V
- Improved Linearity and Lower ON Resistance Than Metal-Gate Counterparts
- Low Noise
- In Compliance With the Requirements of JEDEC Standard No. 7A
- Chip Complexity: HC4051 — 184 FETs or 46 Equivalent Gates  
HC4052 — 168 FETs or 42 Equivalent Gates  
HC4053 — 156 FETs or 39 Equivalent Gates

### LOGIC DIAGRAM MC54/74HC4051

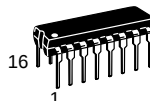
Single-Pole, 8-Position Plus Common Off



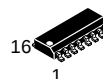
## MC54/74HC4051 MC74HC4052 MC54/74HC4053



**J SUFFIX**  
CERAMIC PACKAGE  
CASE 620-10



**N SUFFIX**  
PLASTIC PACKAGE  
CASE 648-08



**D SUFFIX**  
SOIC PACKAGE  
CASE 751B-05



**DW SUFFIX**  
SOIC PACKAGE  
CASE 751G-02



**DT SUFFIX**  
TSSOP PACKAGE  
CASE 948F-01

### ORDERING INFORMATION

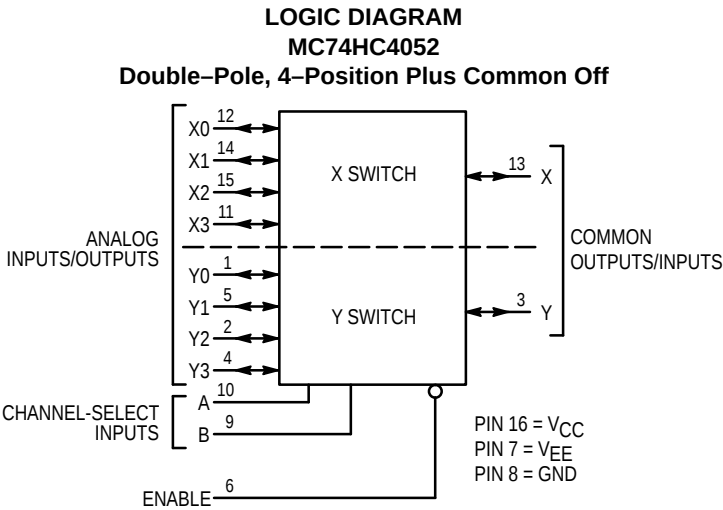
|              |           |
|--------------|-----------|
| MC54HCXXXXJ  | Ceramic   |
| MC74HCXXXXN  | Plastic   |
| MC74HCXXXXD  | SOIC      |
| MC74HCXXXXDW | SOIC Wide |
| MC74HCXXXXDT | TSSOP     |

### FUNCTION TABLE - MC54/74HC4051

| 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



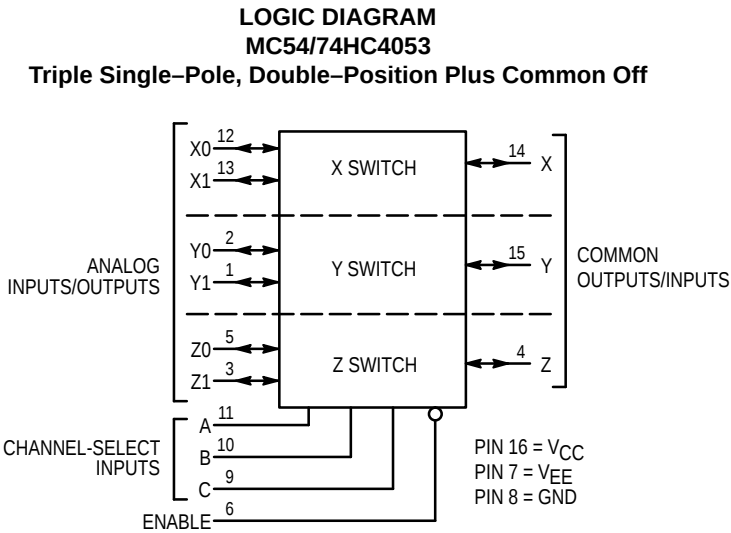
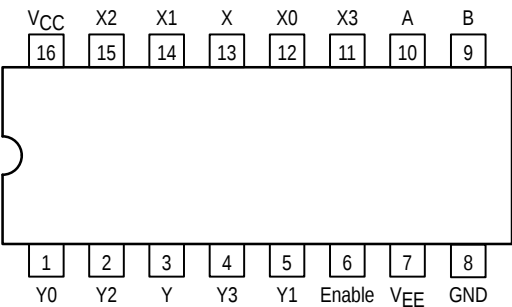


**FUNCTION TABLE – MC74HC4052**

| 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: MC74HC4052 (Top View)**



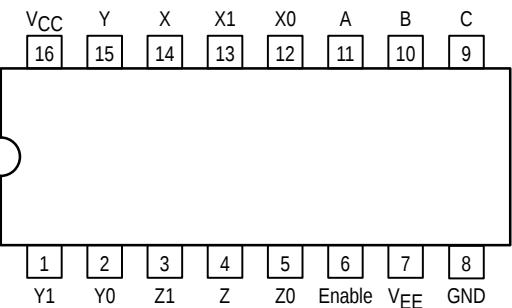
NOTE: This device allows independent control of each switch. Channel-Select Input A controls the X-Switch, Input B controls the Y-Switch and Input C controls the Z-Switch

**FUNCTION TABLE – MC54/74HC4053**

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

**Pinout: MC54/74HC4053 (Top View)**



**MAXIMUM RATINGS\***

| Symbol           | Parameter                                                                                            | Value                                             | Unit |
|------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------|------|
| V <sub>CC</sub>  | Positive DC Supply Voltage (Referenced to GND)<br>(Referenced to V <sub>EE</sub> )                   | – 0.5 to + 7.0<br>– 0.5 to + 14.0                 | V    |
| V <sub>EE</sub>  | Negative DC Supply Voltage (Referenced to GND)                                                       | – 7.0 to + 5.0                                    | V    |
| V <sub>IS</sub>  | Analog Input Voltage                                                                                 | V <sub>EE</sub> – 0.5 to<br>V <sub>CC</sub> + 0.5 | V    |
| V <sub>in</sub>  | Digital Input Voltage (Referenced to GND)                                                            | – 0.5 to V <sub>CC</sub> + 0.5                    | V    |
| I                | DC Current, Into or Out of Any Pin                                                                   | ± 25                                              | mA   |
| P <sub>D</sub>   | Power Dissipation in Still Air, Plastic or Ceramic DIP†<br>SOIC Package†<br>TSSOP Package†           | 750<br>500<br>450                                 | mW   |
| T <sub>stg</sub> | Storage Temperature Range                                                                            | – 65 to + 150                                     | °C   |
| T <sub>L</sub>   | Lead Temperature, 1 mm from Case for 10 Seconds<br>Plastic DIP, SOIC or TSSOP Package<br>Ceramic DIP | 260<br>300                                        | °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<sub>in</sub> and V<sub>out</sub> should be constrained to the range GND ≤ (V<sub>in</sub> or V<sub>out</sub>) ≤ V<sub>CC</sub>. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V<sub>CC</sub>). Unused outputs must be left open.

\* Maximum Ratings are those values beyond which damage to the device may occur. Functional operation should be restricted to the Recommended Operating Conditions.

† Derating — Plastic DIP: – 10 mW/°C from 65° to 125°C  
Ceramic DIP: – 10 mW/°C from 100° to 125°C  
SOIC Package: – 7 mW/°C from 65° to 125°C  
TSSOP Package: – 6.1 mW/°C from 65° to 125°C

For high frequency or heavy load considerations, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

**RECOMMENDED OPERATING CONDITIONS**

| Symbol                          | Parameter                                                                                                                               | Min             | Max                | Unit |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------|------|
| V <sub>CC</sub>                 | Positive DC Supply Voltage (Referenced to GND)<br>(Referenced to V <sub>EE</sub> )                                                      | 2.0<br>2.0      | 6.0<br>12.0        | V    |
| V <sub>EE</sub>                 | Negative DC Supply Voltage, Output (Referenced to GND)                                                                                  | – 6.0           | GND                | V    |
| V <sub>IS</sub>                 | Analog Input Voltage                                                                                                                    | V <sub>EE</sub> | V <sub>CC</sub>    | V    |
| V <sub>in</sub>                 | Digital Input Voltage (Referenced to GND)                                                                                               | GND             | V <sub>CC</sub>    | V    |
| V <sub>IO</sub> *               | Static or Dynamic Voltage Across Switch                                                                                                 |                 | 1.2                | V    |
| T <sub>A</sub>                  | Operating Temperature Range, All Package Types                                                                                          | – 55            | + 125              | °C   |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise/Fall Time (Channel Select or Enable Inputs)<br>V <sub>CC</sub> = 2.0 V<br>V <sub>CC</sub> = 4.5 V<br>V <sub>CC</sub> = 6.0 V | 0<br>0<br>0     | 1000<br>500<br>400 | ns   |

\* For voltage drops across switch greater than 1.2V (switch on), excessive V<sub>CC</sub> current may be drawn; i.e., the current out of the switch may contain both V<sub>CC</sub> 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, Channel-Select or Enable Inputs | $R_{ON} = \text{Per Spec}$                                                                                              | 2.0<br>4.5<br>6.0 | 1.50<br>3.15<br>4.20 | 1.50<br>3.15<br>4.20 | 1.50<br>3.15<br>4.20 | V    |
| $V_{IL}$ | Maximum Low-Level Input Voltage, Channel-Select or Enable Inputs  | $R_{ON} = \text{Per Spec}$                                                                                              | 2.0<br>4.5<br>6.0 | 0.3<br>0.9<br>1.2    | 0.3<br>0.9<br>1.2    | 0.3<br>0.9<br>1.2    | V    |
| $I_{in}$ | Maximum Input Leakage Current, 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 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        | 2<br>8               | 20<br>80             | 40<br>160            | μA   |

NOTE: Information on typical parametric values can be found in Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

**DC CHARACTERISTICS — Analog Section**

| Symbol          | Parameter                                                                          | Condition                                                                                                              | $V_{CC}$ | $V_{EE}$ | 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 $V_{EE}$ ; $I_S \leq 2.0 \text{ mA}$<br>(Figures 1, 2)            | 4.5      | 0.0      | 190              | 240   | 280    | Ω    |
|                 |                                                                                    |                                                                                                                        | 4.5      | - 4.5    | 120              | 150   | 170    |      |
|                 |                                                                                    |                                                                                                                        | 6.0      | - 6.0    | 100              | 125   | 140    |      |
|                 |                                                                                    | $V_{in} = V_{IL}$ or $V_{IH}$ ; $V_{IS} = V_{CC}$ or $V_{EE}$ (Endpoints); $I_S \leq 2.0 \text{ mA}$<br>(Figures 1, 2) | 4.5      | 0.0      | 150              | 190   | 230    |      |
|                 |                                                                                    |                                                                                                                        | 4.5      | - 4.5    | 100              | 125   | 140    |      |
|                 |                                                                                    |                                                                                                                        | 6.0      | - 6.0    | 80               | 100   | 115    |      |
| $\Delta R_{ON}$ | Maximum Difference in "ON" Resistance Between Any Two Channels in the Same Package | $V_{in} = V_{IL}$ or $V_{IH}$ ;<br>$V_{IS} = 1/2 (V_{CC} - V_{EE})$ ;<br>$I_S \leq 2.0 \text{ mA}$                     | 4.5      | 0.0      | 30               | 35    | 40     | Ω    |
|                 |                                                                                    |                                                                                                                        | 4.5      | - 4.5    | 12               | 15    | 18     |      |
|                 |                                                                                    |                                                                                                                        | 6.0      | - 6.0    | 10               | 12    | 14     |      |
| $I_{off}$       | Maximum Off-Channel Leakage Current, Any One Channel                               | $V_{in} = V_{IL}$ or $V_{IH}$ ;<br>$V_{IO} = V_{CC} - V_{EE}$ ;<br>Switch Off (Figure 3)                               | 6.0      | - 6.0    | 0.1              | 0.5   | 1.0    | μA   |
|                 |                                                                                    |                                                                                                                        |          |          |                  |       |        |      |
|                 | Maximum Off-Channel Leakage Current, Common Channel                                | $V_{in} = V_{IL}$ or $V_{IH}$ ;<br>$V_{IO} = V_{CC} - V_{EE}$ ;<br>Switch Off (Figure 4)                               | 6.0      | - 6.0    | 0.2              | 2.0   | 4.0    |      |
|                 |                                                                                    |                                                                                                                        | 6.0      | - 6.0    | 0.1              | 1.0   | 2.0    |      |
| $I_{on}$        | Maximum On-Channel Leakage Current, Channel-to-Channel                             | $V_{in} = V_{IL}$ or $V_{IH}$ ;<br>Switch-to-Switch =<br>$V_{CC} - V_{EE}$ ; (Figure 5)                                | 6.0      | - 6.0    | 0.2              | 2.0   | 4.0    | μA   |
|                 |                                                                                    |                                                                                                                        | 6.0      | - 6.0    | 0.1              | 1.0   | 2.0    |      |
|                 |                                                                                    |                                                                                                                        | 6.0      | - 6.0    | 0.1              | 1.0   | 2.0    |      |

**AC CHARACTERISTICS** ( $C_L = 50$  pF, Input  $t_r = t_f = 6$  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<br>(Figure 9) | 2.0<br>4.5<br>6.0    | 370<br>74<br>63  | 465<br>93<br>79 | 550<br>110<br>94 | ns   |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Analog Input to Analog Output<br>(Figure 10)  | 2.0<br>4.5<br>6.0    | 60<br>12<br>10   | 75<br>15<br>13  | 90<br>18<br>15   | ns   |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Maximum Propagation Delay, Enable to Analog Output<br>(Figure 11)        | 2.0<br>4.5<br>6.0    | 290<br>58<br>49  | 364<br>73<br>62 | 430<br>86<br>73  | ns   |
| t <sub>PZL</sub> ,<br>t <sub>PZH</sub> | Maximum Propagation Delay, Enable to Analog Output<br>(Figure 11)        | 2.0<br>4.5<br>6.0    | 345<br>69<br>59  | 435<br>87<br>74 | 515<br>103<br>87 | ns   |
| 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: HC4051                                    |                      | 130              | 130             | 130              |      |
|                                        | HC4052                                                                   |                      | 80               | 80              | 80               |      |
|                                        | HC4053                                                                   |                      | 50               | 50              | 50               |      |
|                                        | Feedthrough                                                              |                      | 1.0              | 1.0             | 1.0              |      |

NOTE: For propagation delays with loads other than 50 pF, and information on typical parametric values, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

| 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 |
|-----------------|--------------------------------------------|--|----------------------------------------------------------------|--------|----|
|                 |                                            |  | HC4051                                                         | HC4052 |    |
|                 |                                            |  | 45                                                             | 80     |    |
|                 |                                            |  | 45                                                             |        |    |

\* Used to determine the no-load dynamic power consumption:  $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$ . For load considerations, see Chapter 2 of the Motorola High-Speed CMOS Data Book (DL129/D).

## 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                                                                       | 2.25                 | -2.25                | '51    | '52 | '53 | MHz              |
|        |                                                                                |                                                                                                                                                                                                                                                                                      | 4.50                 | -4.50                | 80     | 95  | 120 |                  |
|        |                                                                                |                                                                                                                                                                                                                                                                                      | 6.00                 | -6.00                | 80     | 95  | 120 |                  |
|        |                                                                                |                                                                                                                                                                                                                                                                                      |                      |                      |        |     |     |                  |
| —      | Off-Channel Feedthrough 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 HC4051) | 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.

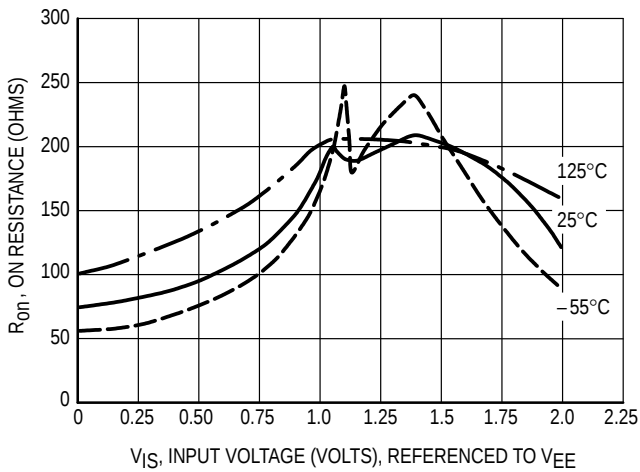
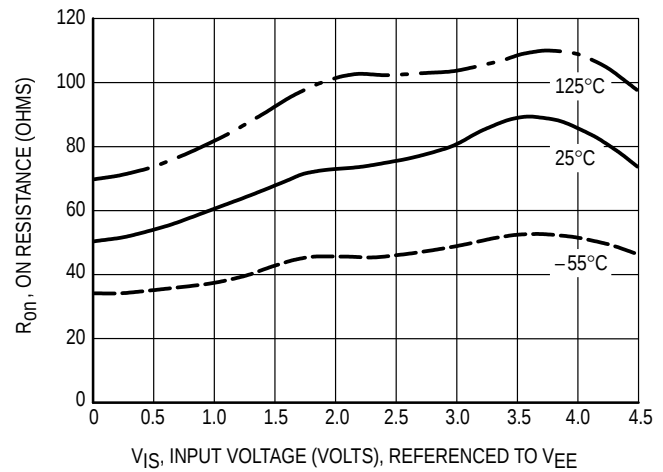
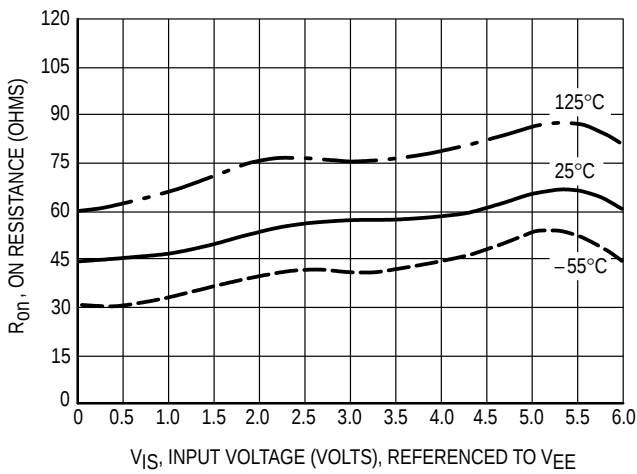
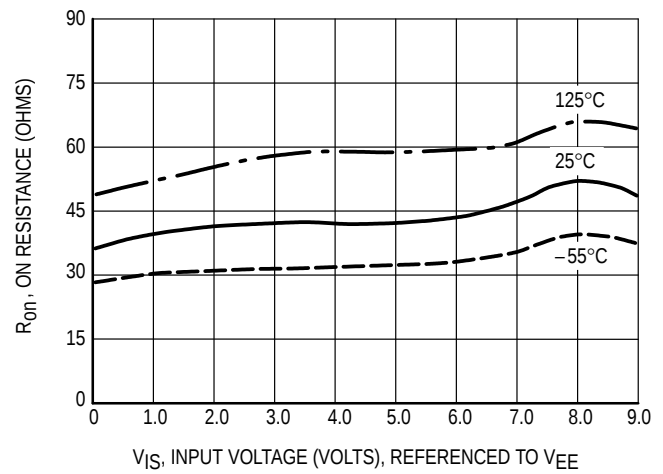
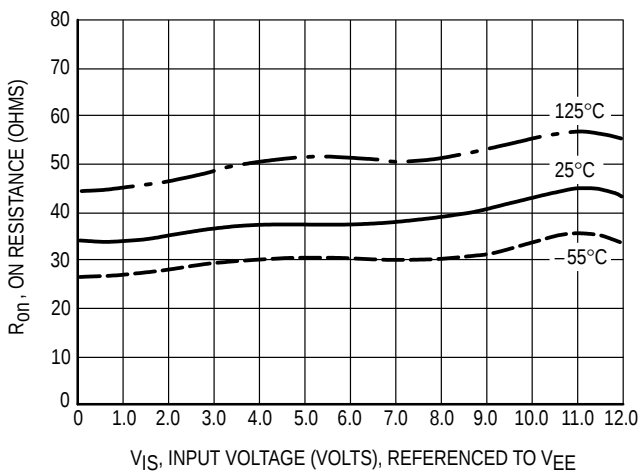
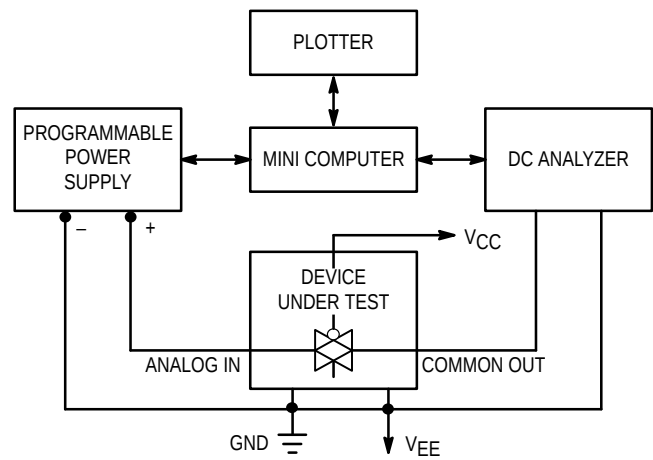
Figure 1a. Typical On Resistance,  $V_{CC} - V_{EE} = 2.0$  VFigure 1b. Typical On Resistance,  $V_{CC} - V_{EE} = 4.5$  VFigure 1c. Typical On Resistance,  $V_{CC} - V_{EE} = 6.0$  VFigure 1d. Typical On Resistance,  $V_{CC} - V_{EE} = 9.0$  VFigure 1e. Typical On Resistance,  $V_{CC} - V_{EE} = 12.0$  V

Figure 2. On Resistance Test Set-Up

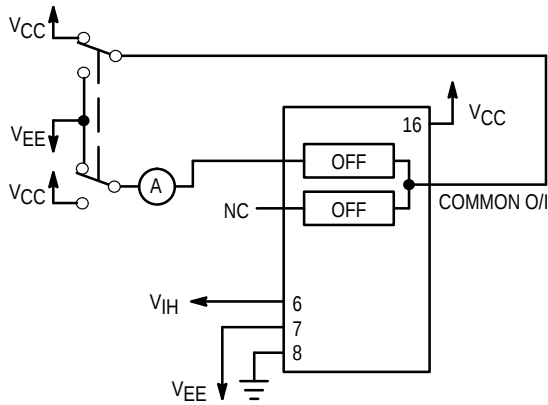


Figure 3. Maximum Off Channel Leakage Current, Any One Channel, Test Set-Up

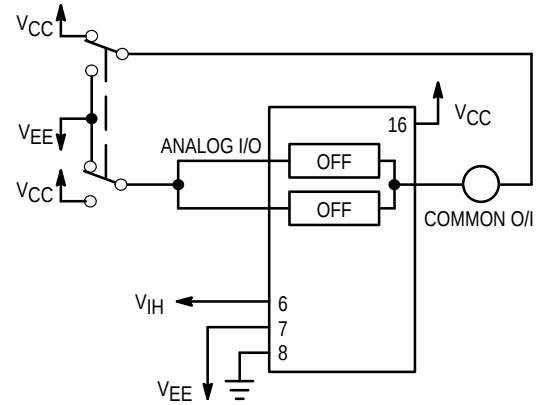


Figure 4. Maximum Off Channel Leakage Current, Common Channel, Test Set-Up

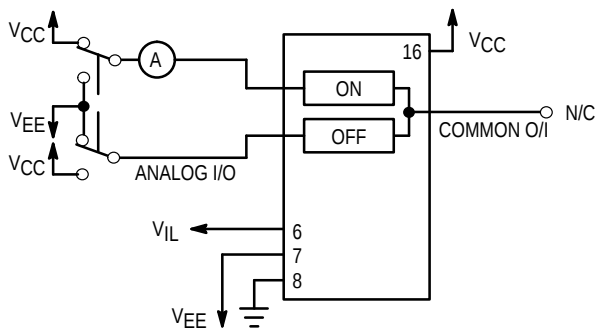
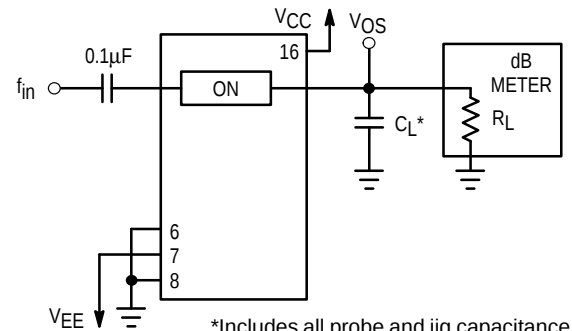
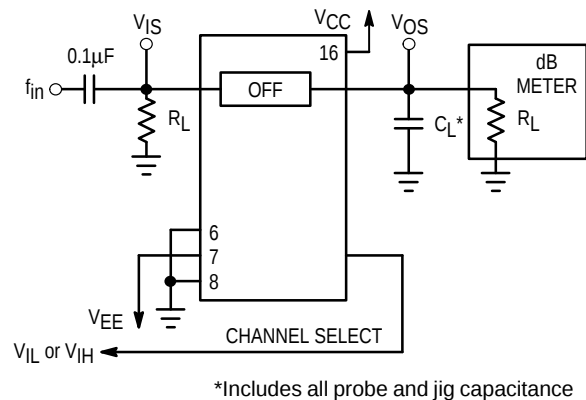


Figure 5. Maximum On Channel Leakage Current, Channel to Channel, Test Set-Up



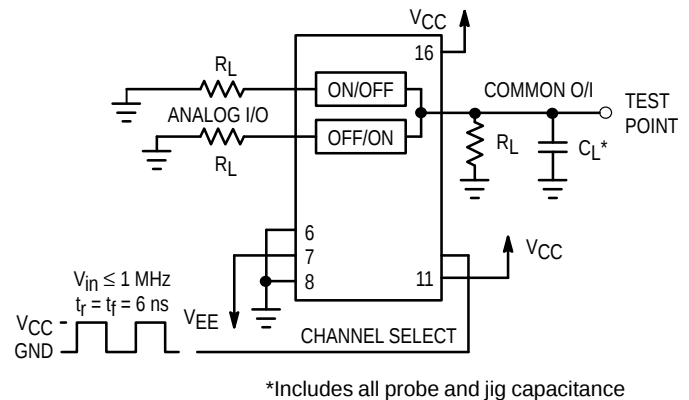
\*Includes all probe and jig capacitance

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



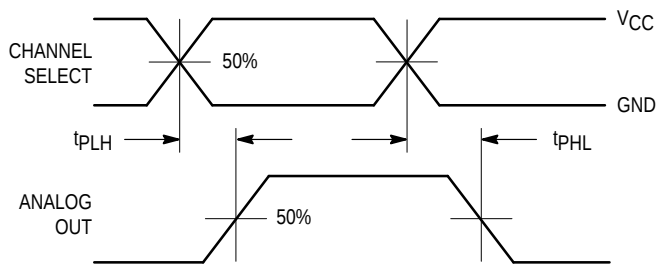
\*Includes all probe and jig capacitance

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

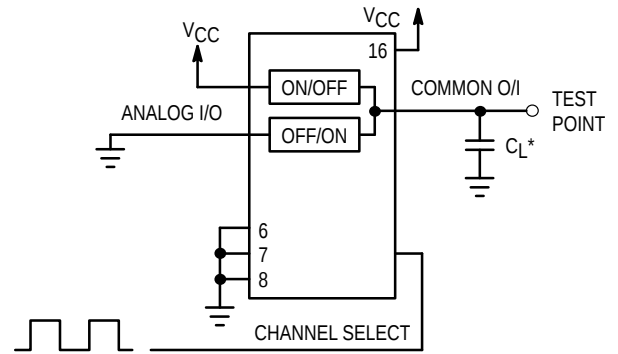


\*Includes all probe and jig capacitance

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

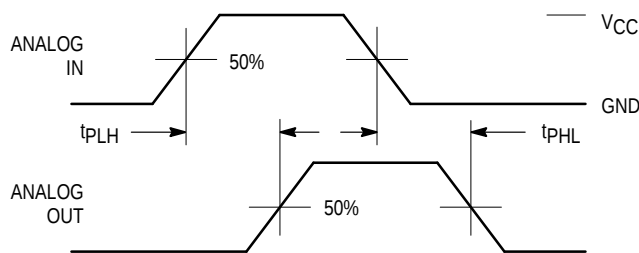


**Figure 9a. Propagation Delays, Channel Select to Analog Out**

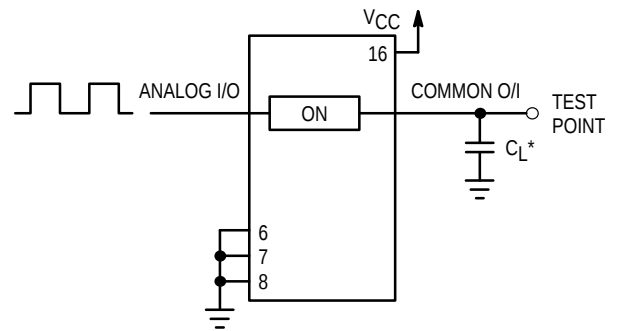


\*Includes all probe and jig capacitance

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

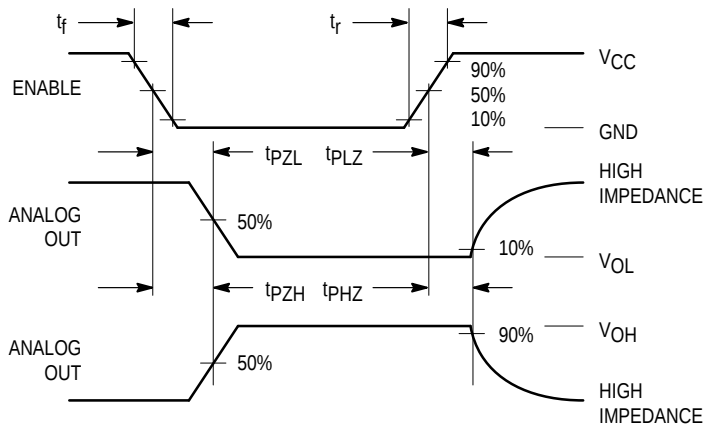


**Figure 10a. Propagation Delays, Analog In to Analog Out**

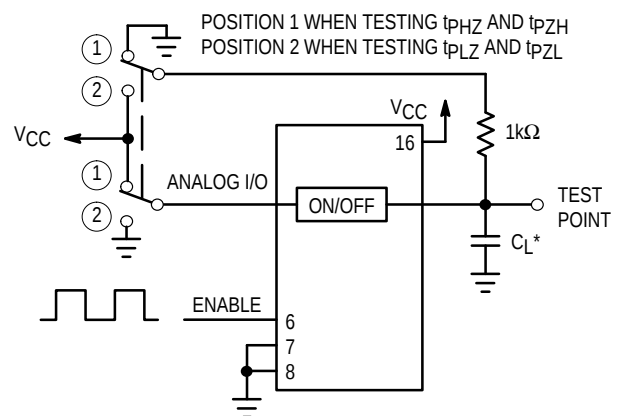


\*Includes all probe and jig capacitance

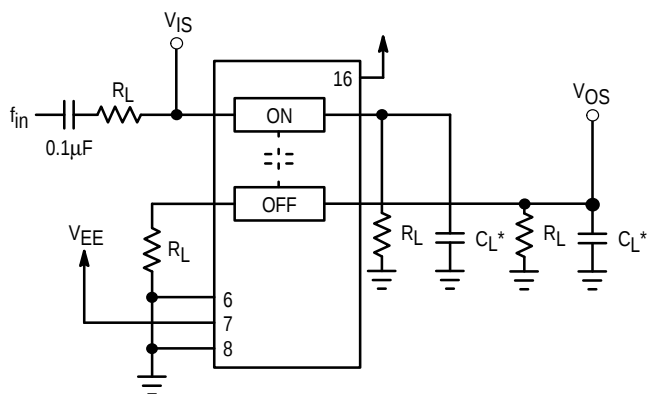
**Figure 10b. Propagation Delay, Test Set-Up Analog In to Analog Out**



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

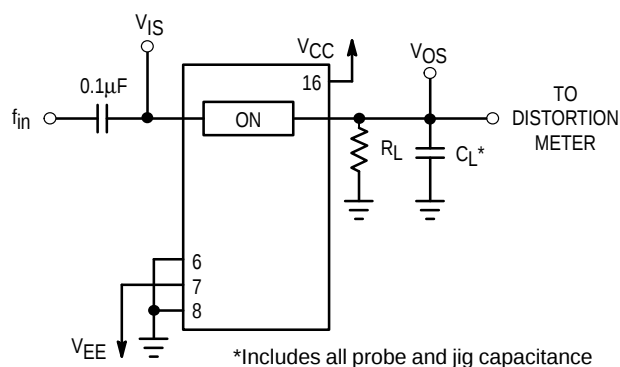


**Figure 11b. Propagation Delay, Test Set-Up Enable to Analog Out**



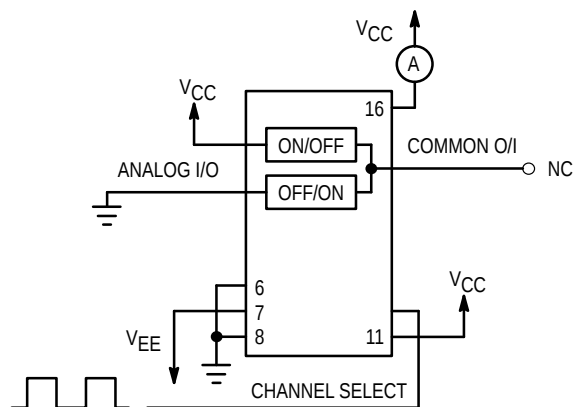
\*Includes all probe and jig capacitance

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

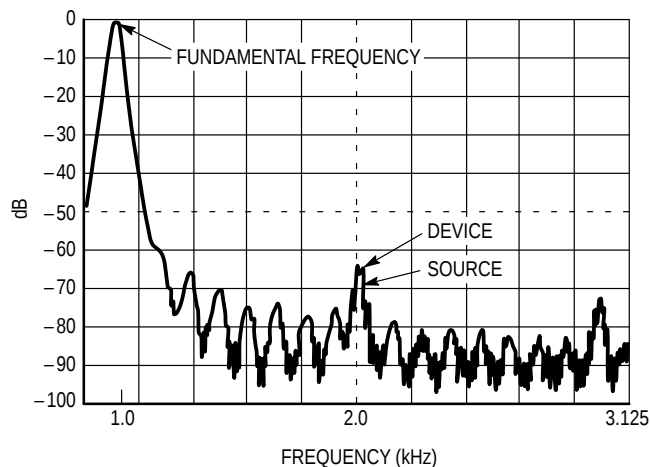


\*Includes all probe and jig capacitance

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



**Figure 13. Power Dissipation Capacitance, 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:

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

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 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:

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

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.

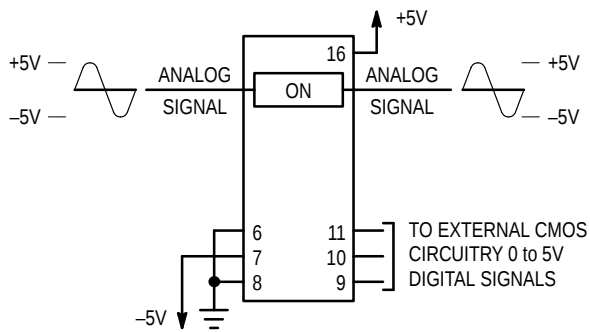


Figure 15. Application Example

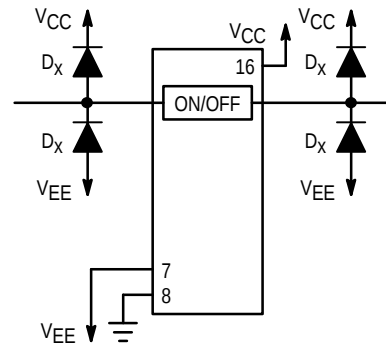
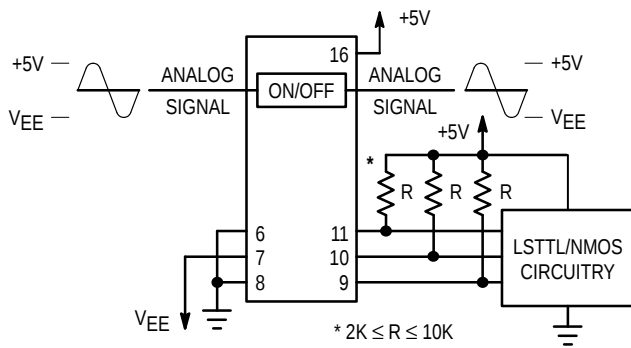
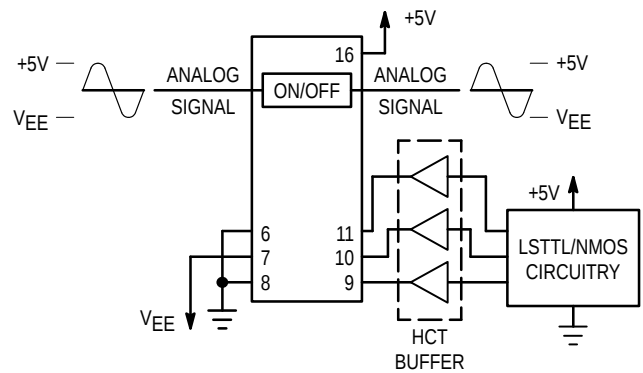


Figure 16. External Germanium or Schottky Clipping Diodes



a. Using Pull-Up Resistors



b. Using HCT Interface

Figure 17. Interfacing LSTTL/NMOS to CMOS Inputs

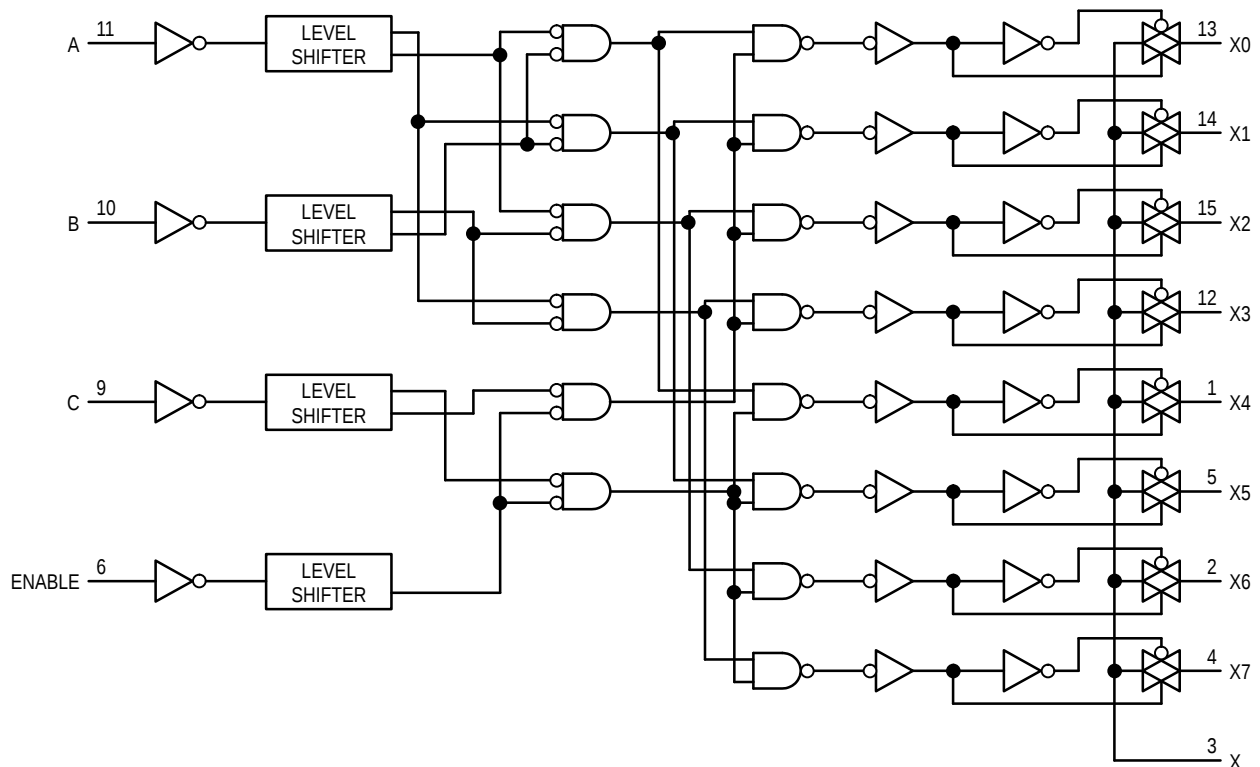


Figure 18. Function Diagram, HC4051

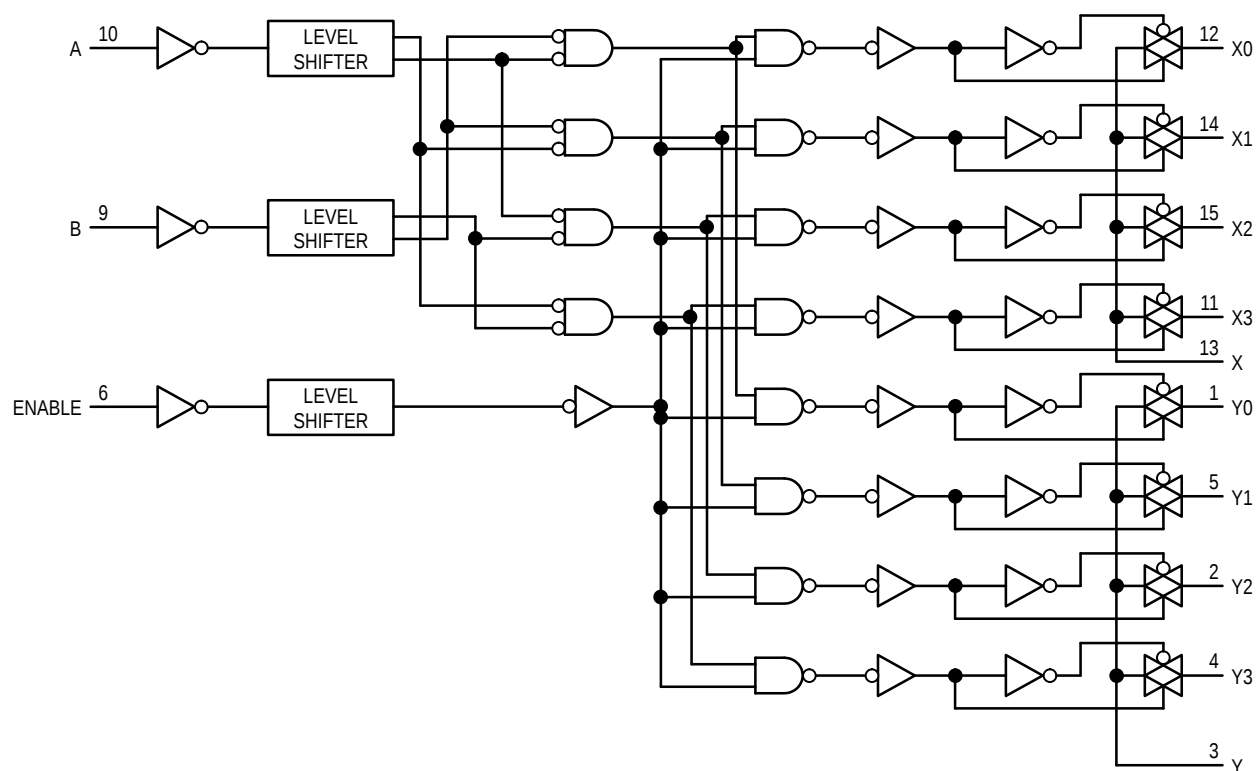


Figure 19. Function Diagram, HC4052

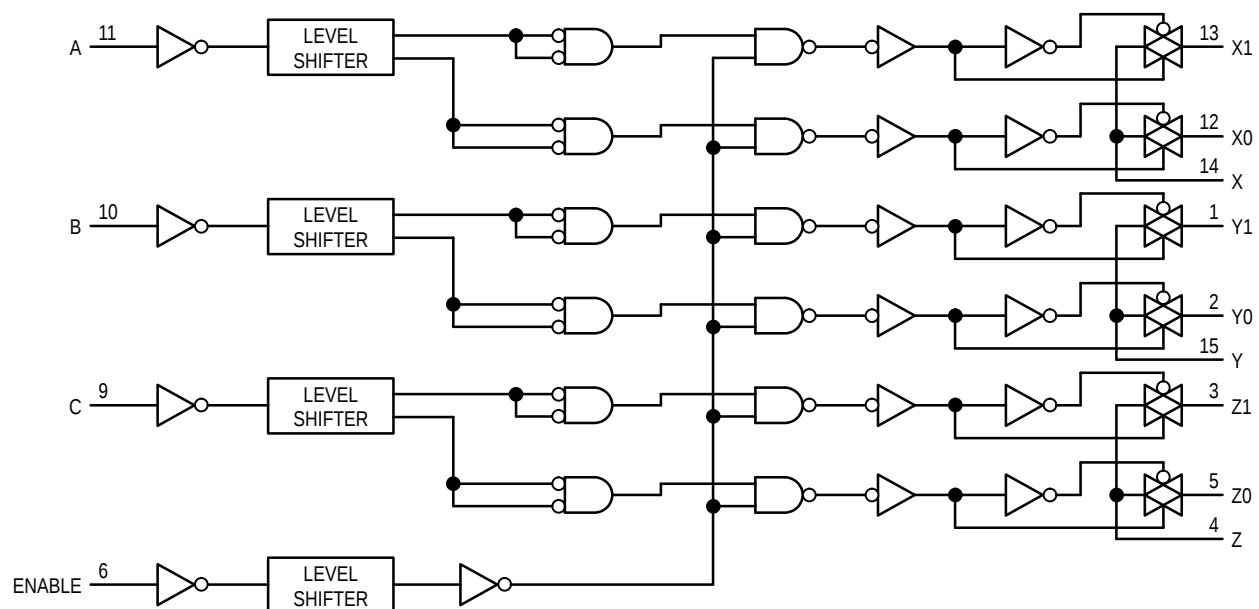
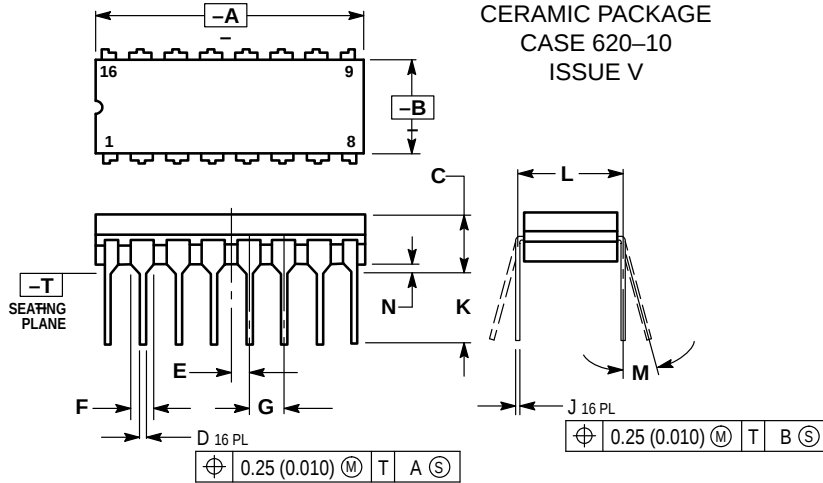


Figure 20. Function Diagram, HC4053

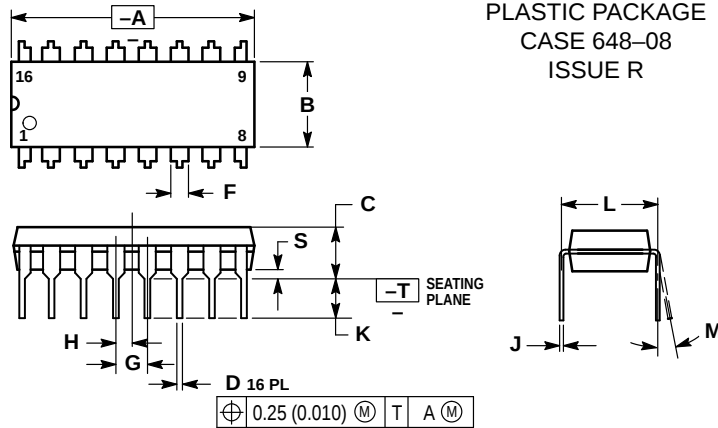
## OUTLINE DIMENSIONS

**J SUFFIX**  
 CERAMIC PACKAGE  
 CASE 620-10  
 ISSUE V


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

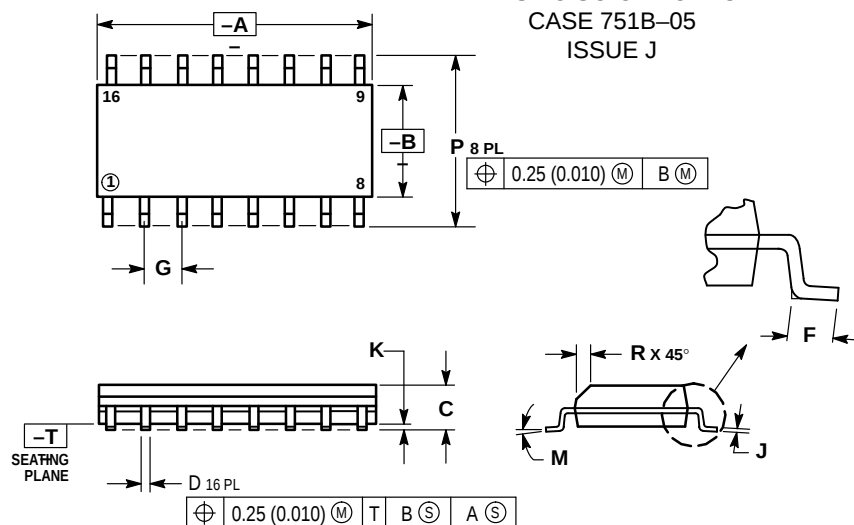
| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.750     | 0.785 | 19.05       | 19.93 |
| B   | 0.240     | 0.295 | 6.10        | 7.49  |
| C   | —         | 0.200 | —           | 5.08  |
| D   | 0.015     | 0.020 | 0.39        | 0.50  |
| E   | 0.050 BSC |       | 1.27 BSC    |       |
| F   | 0.055     | 0.065 | 1.40        | 1.65  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.125     | 0.170 | 3.18        | 4.31  |
| L   | 0.300 BSC |       | 7.62 BSC    |       |
| M   | 0°        | 15°   | 0°          | 15°   |
| N   | 0.020     | 0.040 | 0.51        | 1.01  |

**N SUFFIX**  
 PLASTIC PACKAGE  
 CASE 648-08  
 ISSUE R


## NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES    |       | MILLIMETERS |       |
|-----|-----------|-------|-------------|-------|
|     | MIN       | MAX   | MIN         | MAX   |
| A   | 0.740     | 0.770 | 18.80       | 19.55 |
| B   | 0.250     | 0.270 | 6.35        | 6.85  |
| C   | 0.145     | 0.175 | 3.69        | 4.44  |
| D   | 0.015     | 0.021 | 0.39        | 0.53  |
| F   | 0.040     | 0.070 | 1.02        | 1.77  |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| H   | 0.050 BSC |       | 1.27 BSC    |       |
| J   | 0.008     | 0.015 | 0.21        | 0.38  |
| K   | 0.110     | 0.130 | 2.80        | 3.30  |
| L   | 0.295     | 0.305 | 7.50        | 7.74  |
| M   | 0°        | 10°   | 0°          | 10°   |
| S   | 0.020     | 0.040 | 0.51        | 1.01  |

**D SUFFIX**  
 PLASTIC SOIC PACKAGE  
 CASE 751B-05  
 ISSUE J


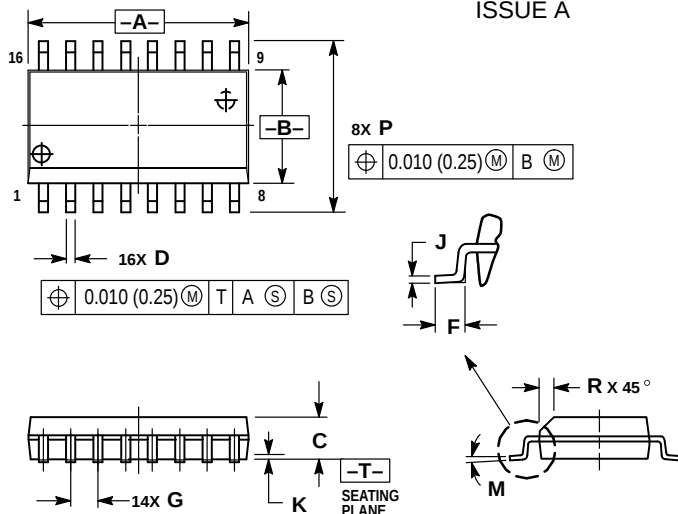
## NOTES:

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.

| 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 |
| 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 |

## OUTLINE DIMENSIONS

**DW SUFFIX**  
**PLASTIC SOIC PACKAGE**  
**CASE 751G-02**  
**ISSUE A**

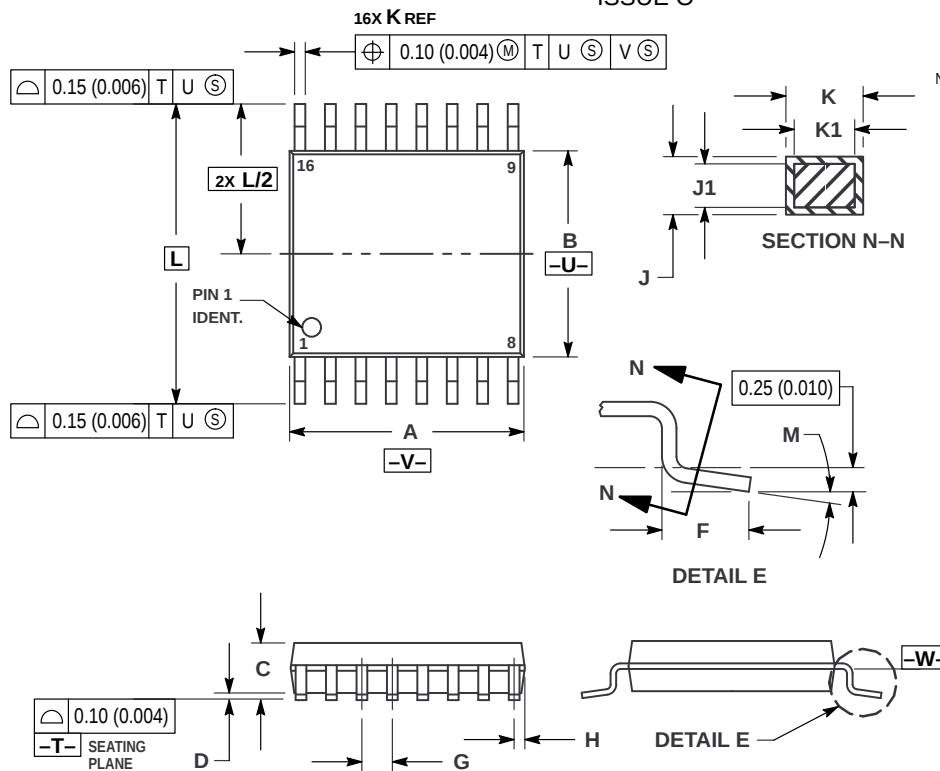


## NOTES:

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 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 10.15       | 10.45 | 0.400     | 0.411 |
| B   | 7.40        | 7.60  | 0.292     | 0.299 |
| C   | 2.35        | 2.65  | 0.093     | 0.104 |
| D   | 0.35        | 0.49  | 0.014     | 0.019 |
| F   | 0.50        | 0.90  | 0.020     | 0.035 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.25        | 0.32  | 0.010     | 0.012 |
| K   | 0.10        | 0.25  | 0.004     | 0.009 |
| M   | 0°          | 7°    | 0°        | 7°    |
| P   | 10.05       | 10.55 | 0.395     | 0.415 |
| R   | 0.25        | 0.75  | 0.010     | 0.029 |

**DT SUFFIX**  
**PLASTIC TSSOP PACKAGE**  
**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-.

| 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°    |

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