

# MC74HC4067A

## Quad Analog Switch/ Multiplexer/Demultiplexer

### High-Performance Silicon-Gate CMOS

The MC74HC4067A utilizes silicon-gate CMOS technology to achieve fast propagation delays, low ON resistances, and low OFF-channel leakage current. This bilateral switch/multiplexer/demultiplexer controls analog and digital voltages that may vary across the full power-supply range (from  $V_{CC}$  to GND).

The ON/OFF control inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs. For analog switches with voltage-level translators, see the HC4316A.

#### Features

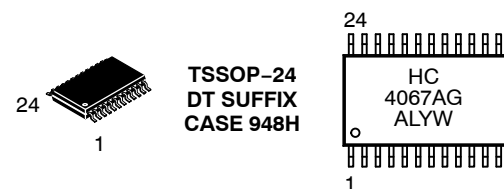
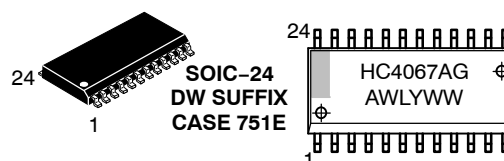
- Fast Switching and Propagation Speeds
- High ON/OFF Output Voltage Ratio
- Low Crosstalk Between Switches
- Diode Protection on All Inputs/Outputs
- Wide Power-Supply Voltage Range ( $V_{CC} - GND$ ) = 2.0 to 6.0 V
- Analog Input Voltage Range ( $V_{CC} - GND$ ) = 0 to 6.0 V
- Improved Linearity and Lower ON Resistance over Input Voltage
- Low Noise
- These are Pb-Free Devices



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#### MARKING DIAGRAMS



A = Assembly Location  
L, WL = Wafer Lot  
Y, YY = Year  
W, WW = Work Week  
G = Pb-Free Package

(Note: Microdot may be in either location)

#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

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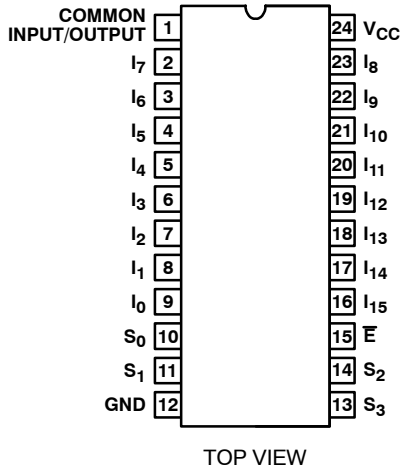


Figure 1. Pin Assignment

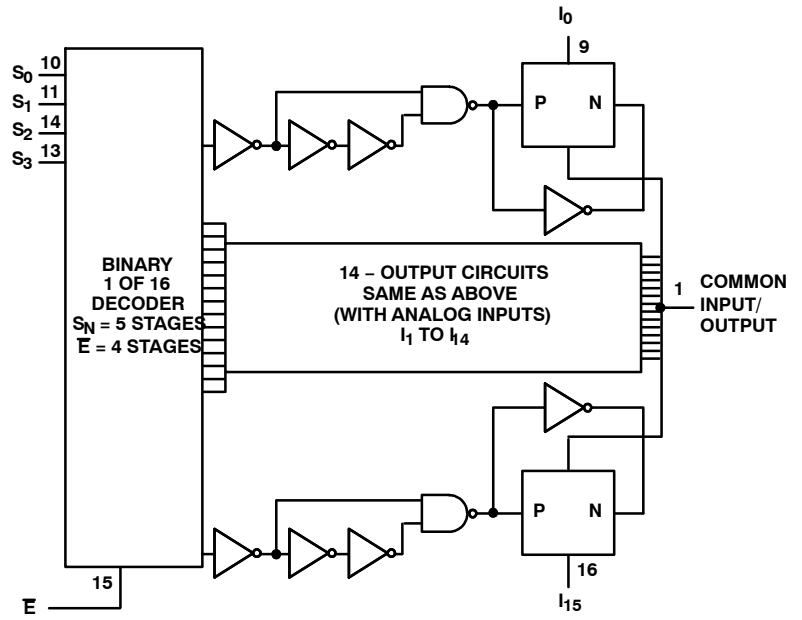


Figure 2. Function Diagram

## TRUTH TABLE

| S0 | S1 | S2 | S3 | $\bar{E}$ | SELECTED CHANNEL |
|----|----|----|----|-----------|------------------|
| X  | X  | X  | X  | 1         | None             |
| 0  | 0  | 0  | 0  | 0         | 0                |
| 1  | 0  | 0  | 0  | 0         | 1                |
| 0  | 1  | 0  | 0  | 0         | 2                |
| 1  | 1  | 0  | 0  | 0         | 3                |
| 0  | 0  | 1  | 0  | 0         | 4                |
| 1  | 0  | 1  | 0  | 0         | 5                |
| 0  | 1  | 1  | 0  | 0         | 6                |
| 1  | 1  | 1  | 0  | 0         | 7                |
| 0  | 0  | 0  | 1  | 0         | 8                |
| 1  | 0  | 0  | 1  | 0         | 9                |
| 0  | 1  | 0  | 1  | 0         | 10               |
| 1  | 1  | 0  | 1  | 0         | 11               |
| 0  | 0  | 1  | 1  | 0         | 12               |
| 1  | 0  | 1  | 1  | 0         | 13               |
| 0  | 1  | 1  | 1  | 0         | 14               |
| 1  | 1  | 1  | 1  | 0         | 15               |

H= High Level  
 L= Low Level  
 X= Don't Care

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## MAXIMUM RATINGS

| Symbol               | Parameter                                       | Value   | Unit                |      |
|----------------------|---|---|---------------------|------|
| V <sub>CC</sub>      | DC Supply Voltage                               | -0.5 to +7.0  | V                   |      |
| V <sub>IS</sub>      | Analog Input Voltage                            | -0.5 to V <sub>CC</sub> + 0.5   | V                   |      |
| V <sub>IN</sub>      | Digital Input Voltage                           | -0.5 to V <sub>CC</sub> + 0.5   | V                   |      |
| I <sub>IK</sub>      | Input Clamping Current                          | V <sub>IN</sub> < -0.5 V or V <sub>IN</sub> > V <sub>CC</sub> + 0.5 V | ±20                 | mA   |
| I <sub>SK</sub>      | Switch Input Clamping Current                   | V <sub>IS</sub> < -0.5 V or V <sub>IS</sub> > V <sub>CC</sub> + 0.5 V | ±20                 | mA   |
| I <sub>IS</sub>      | DC Switch Current                               |   | ±25                 | mA   |
| I <sub>O</sub>       | DC Output Source / Sink Current                 |   | ±25                 | mA   |
| I <sub>CC</sub>      | DC Supply Current per Supply Pin                |   | ±100                | mA   |
| I <sub>GND</sub>     | DC Ground Current per Ground Pin                |   | ±100                | mA   |
| T <sub>STG</sub>     | Storage Temperature Range                       |   | -65 to +150         | °C   |
| T <sub>L</sub>       | Lead Temperature, 1 mm from Case for 10 Seconds |   | 260                 | °C   |
| T <sub>J</sub>       | Junction Temperature under Bias                 |   | +150                | °C   |
| θ <sub>JA</sub>      | Thermal Resistance                              | SOIC<br>TSSOP   | 97<br>148           | °C/W |
| P <sub>D</sub>       | Power Dissipation in Still Air at 85°C          | SOIC<br>TSSOP   | 500<br>450          | mW   |
| MSL                  | Moisture Sensitivity                            |   | Level 1             |      |
| F <sub>R</sub>       | Flammability Rating                             | Oxygen Index: 30% – 35%   | UL-94-VO (0.125 in) |      |
| V <sub>ESD</sub>     | ESD Withstand Voltage                           | Human Body Model (Note 1)<br>Machine Model (Note 2)                   | >3000<br>>200       | V    |
| I <sub>Latchup</sub> | Latchup Performance                             | Above V <sub>CC</sub> and Below GND at 85°C (Note 3)                  | ±100                | mA   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Tested to EIA/JESD22-A114-A.
2. Tested to EIA/JESD22-A115-A.
3. Tested to EIA/JESD78.

## RECOMMENDED OPERATING CONDITIONS

| Symbol                          | Parameter                                      | Min  | Max              | Unit                      |    |
|---------------------------------|--|--|------------------|---------------------------|----|
| V <sub>CC</sub>                 | Positive DC Supply Voltage (Referenced to GND) | 2.0  | 6.0              | V                         |    |
| V <sub>IS</sub>                 | Analog Input Voltage (Referenced to GND)       | GND  | 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, All Package Types       | -55  | +125             | °C                        |    |
| t <sub>r</sub> , t <sub>f</sub> | Input Rise and Fall Rate (Digital Inputs)      | V <sub>CC</sub> = 2.0 V<br>V <sub>CC</sub> = 3.0 V<br>V <sub>CC</sub> = 4.5 V<br>V <sub>CC</sub> = 6.0 V | 0<br>0<br>0<br>0 | 1000<br>600<br>500<br>400 | ns |

\*For voltage drops across the switch greater than 1.2 V (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.

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

| Symbol                | Parameter   | Conditions  | V <sub>CC</sub><br>(V) | Guaranteed Limit |           |      |             |      |              | Unit |     |
|-----------------------|---|---|------------------------|------------------|-----------|------|-------------|------|--------------|------|-----|
|                       |   |   |                        | 25°C             |           |      | -40 to 85°C |      | -55 to 125°C |      |     |
|                       |   |   |                        | Min              | Typ       | Max  | Min         | Max  | Min          |      | Max |
| V <sub>IH</sub>       | Minimum High-Level Input Voltage, Channel-Select or Enable Inputs |   | 2.0                    | 1.5              |           |      | 1.5         |      |              | 1.5  | V   |
|                       |   |   | 3.0                    | 2.1              |           |      | 2.1         |      |              | 2.1  |     |
|                       |   |   | 4.5                    | 3.15             |           |      | 3.15        |      |              | 3.15 |     |
|                       |   |   | 6.0                    | 4.2              |           |      | 4.2         |      |              | 4.2  |     |
| V <sub>IL</sub>       | Maximum Low-Level Input Voltage, Channel-Select or Enable Inputs  |   | 2.0                    |                  |           | 0.5  |             | 0.5  |              | 0.5  | V   |
|                       |   |   | 3.0                    |                  |           | 0.9  |             | 0.9  |              | 0.9  |     |
|                       |   |   | 4.5                    |                  |           | 1.35 |             | 1.35 |              | 1.35 |     |
|                       |   |   | 6.0                    |                  |           | 1.8  |             | 1.8  |              | 1.8  |     |
| I <sub>IN</sub>       | Input Leakage Current, Control Inputs                             | V <sub>IN</sub> = V <sub>CC</sub> or GND  | 6.0                    |                  |           | ±0.1 |             | ±1.0 |              | ±1.0 | μA  |
| I <sub>CC</sub>       | Maximum Supply Current per Package                                | V <sub>IN</sub> = V <sub>CC</sub> or GND, I <sub>O</sub> =0<br>V <sub>IS</sub> = GND or V <sub>CC</sub> ,<br>V <sub>OS</sub> = V <sub>CC</sub> or GND | 6.0                    |                  |           | 4.0  |             | 40   |              | 80   | μA  |
| R <sub>ON</sub>       | ON Resistance   | I <sub>O</sub> = 1 mA<br>V <sub>IN</sub> = V <sub>CC</sub> or GND,<br>V <sub>IS</sub> = V <sub>CC</sub> or GND  | 4.5                    |                  | 70        | 160  |             | 200  |              | 240  | Ω   |
|                       |   |   | 6.0                    |                  | 60        | 140  |             | 175  |              | 210  |     |
| R <sub>ON(peak)</sub> | ON Resistance (peak)  | I <sub>O</sub> = 1 mA<br>V <sub>IN</sub> = V <sub>CC</sub> to GND,<br>V <sub>IS</sub> = V <sub>CC</sub> to GND  | 4.5                    |                  | 90        | 180  |             | 225  |              | 270  | Ω   |
|                       |   |   | 6.0                    |                  | 80        | 160  |             | 200  |              | 240  |     |
| ΔR <sub>on</sub>      | ON Resistance Mismatch Between Any 2 Switches                     |   | 4.5<br>6.0             |                  | 10<br>8.5 |      |             |      |              |      | Ω   |
| I <sub>OFF</sub>      | OFF-State Leakage Current, All Channels                           | SW OFF,<br>V <sub>IS</sub> = V <sub>CC</sub> or GND   | 6.0                    |                  |           | ±0.8 |             | ±8   |              | ±8   | μA  |
| I <sub>ON</sub>       | ON-State Leakage Current  | SW OFF,<br>V <sub>IS</sub> = V <sub>CC</sub> or GND   | 6.0                    |                  |           | ±0.8 |             | ±8   |              | ±8   | μA  |

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## AC CHARACTERISTICS (INPUT $t_r, t_f = 6$ ns)

| Symbol                  | Parameter                              | Conditions    | $V_{CC}$<br>(V) | Guaranteed Limits |     |     |             |     |              | Unit |     |
|-------------------------|--|---------------|-----------------|-------------------|-----|-----|-------------|-----|--------------|------|-----|
|                         |  |               |                 | 25°C              |     |     | -40 to 85°C |     | -55 to 125°C |      |     |
|                         |  |               |                 | Min               | Typ | Max | Min         | Max | Min          |      | Max |
| $t_{PLH},$<br>$t_{PHL}$ | Propagation Delay Switch In to Out     | $C_L = 50$ pF | 2.0             |                   |     | 75  |             | 95  |              | 110  | ns  |
|                         |  |               | 4.5             |                   |     | 15  |             | 19  |              | 22   |     |
|                         |  | $C_L = 15$ pF | 5.0             |                   | 6.0 |     |             |     |              |      |     |
| $t_{ON}$                | Switch Turn-ON Time                    |               |                 |                   |     |     |             |     |              |      | ns  |
|                         | $\bar{E}$ to Out                       | $C_L = 50$ pF | 2.0             |                   |     | 275 |             | 345 |              | 415  |     |
|                         |  |               | 4.5             |                   |     | 55  |             | 69  |              | 83   |     |
|                         |  |               | 6.0             |                   |     | 47  |             | 59  |              | 71   |     |
|                         | SN to Out                              | $C_L = 50$ pF | 2.0             |                   |     | 300 |             | 375 |              | 450  |     |
| 4.5                     |  |               |                 |                   | 60  |     | 75          |     | 90           |      |     |
|                         |  | $C_L = 15$ pF | 5.0             |                   | 23  |     |             |     |              |      |     |
| $t_{OFF}$               | Switch Turn-OFF Time                   |               |                 |                   |     |     |             |     |              |      | ns  |
|                         | $\bar{E}$ to Out                       | $C_L = 50$ pF | 2.0             |                   |     | 275 |             | 345 |              | 415  |     |
|                         |  |               | 4.5             |                   |     | 55  |             | 69  |              | 83   |     |
|                         |  |               | 6.0             |                   |     | 47  |             | 59  |              | 71   |     |
|                         | SN to Out                              | $C_L = 50$ pF | 2.0             |                   |     | 290 |             | 365 |              | 435  |     |
| 4.5                     |  |               |                 |                   | 58  |     | 73          |     | 87           |      |     |
|                         |  | $C_L = 15$ pF | 5.0             |                   | 21  |     |             |     |              |      |     |
| $C_{in}$                | Input Capacitance, Control Pins        |               |                 |                   | 3.5 | 10  |             | 10  |              | 10   | pF  |
| $C_{PD}$                | Power Dissipation Capacitance (Note 4) | $C_L = 15$ pF | 5.0             |                   |     | 29  |             |     |              |      | pF  |

4.  $C_{PD}$  is used to determine the dynamic power consumption, per multivibrator.

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## ANALOG SWITCH CHANNEL CHARACTERISTICS

| Symbol           | Parameter  | Conditions   | V <sub>CC</sub><br>(V) | Limit*<br>25°C | Unit             |
|------------------|--|--|------------------------|----------------|------------------|
| BW               | Maximum On-Channel Bandwidth or Minimum Frequency Response | f <sub>in</sub> = 1 MHz Sine Wave<br>Adjust f <sub>in</sub> Voltage to Obtain 0 dBm at V <sub>OS</sub><br>Increase f <sub>in</sub> Frequency Until dB Meter Reads - 3 dB<br>R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF                                | 4.5                    | 90             | MHz              |
| -                | Off-Channel Feedthrough Isolation                          | f <sub>in</sub> ≡ Sine Wave<br>Adjust f <sub>in</sub> Voltage to Obtain 0 dBm at V <sub>IS</sub><br>f <sub>in</sub> = 10 kHz, R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF<br>f <sub>in</sub> = 1.0 MHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF | 4.5<br>4.5             | -65<br>-75     | dB               |
| -                | Feedthrough Noise<br>E <sub>̄</sub> , Sn to Switch         | V <sub>in</sub> ≤ 1 MHz Square Wave (t <sub>r</sub> = t <sub>f</sub> = 6 ns)<br>Adjust R <sub>L</sub> at Setup so that I <sub>S</sub> = 0 A<br>R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF<br>R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 10 pF          | 4.5<br>4.5             | 60<br>30       | mV <sub>PP</sub> |
| -                | Crosstalk Between Any Two Switches                         | f <sub>in</sub> ≡ Sine Wave<br>Adjust f <sub>in</sub> Voltage to Obtain 0 dBm at V <sub>IS</sub><br>f <sub>in</sub> = 10 kHz, R <sub>L</sub> = 600 Ω, C <sub>L</sub> = 50 pF<br>f <sub>in</sub> = 1.0 MHz, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 10 pF | 4.5<br>4.5             | -70<br>-80     | dB               |
| THD              | Total Harmonic Distortion                                  | f <sub>in</sub> = 1 kHz, R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 50 pF<br>THD = THD <sub>Measured</sub> - THD <sub>Source</sub><br>V <sub>IS</sub> = 4.0 V <sub>PP</sub> sine wave  | 4.5                    | 0.04           | %                |
| C <sub>S</sub>   | Switch Input Capacitance                                   |  |                        | 5              | pF               |
| C <sub>COM</sub> | Switch Common Capacitance                                  |  |                        | 45             | pF               |

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

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## TYPICAL CHARACTERISTICS

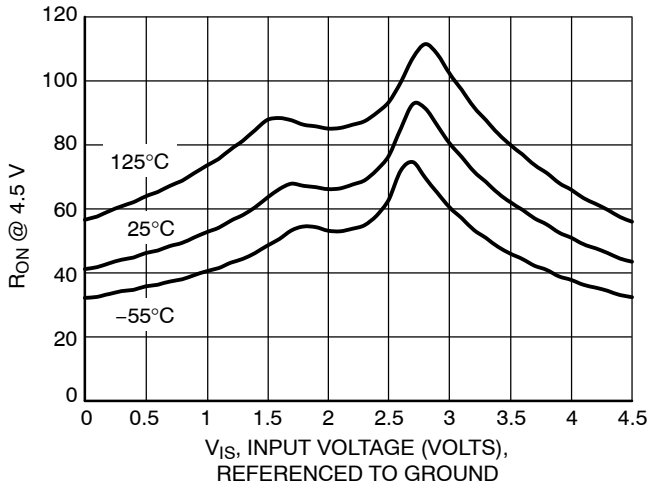


Figure 3. Typical On Resistance,  $V_{CC} = 4.5$  V

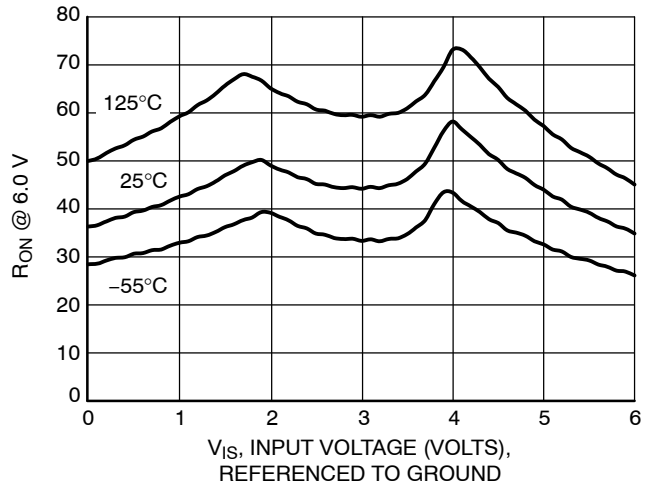


Figure 4. Typical On Resistance,  $V_{CC} = 6.0$  V

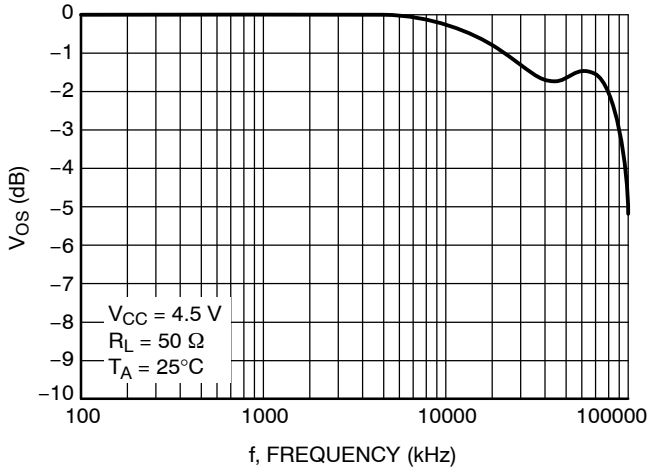


Figure 5. Typical Switch Frequency Response

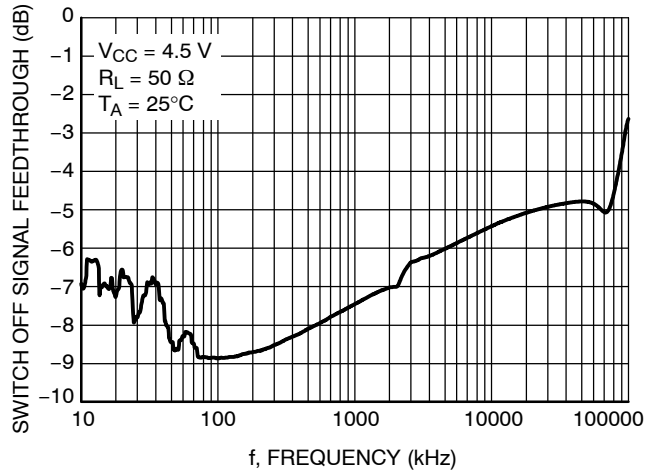


Figure 6. Typical Switch OFF Signal Feedthrough vs Frequency

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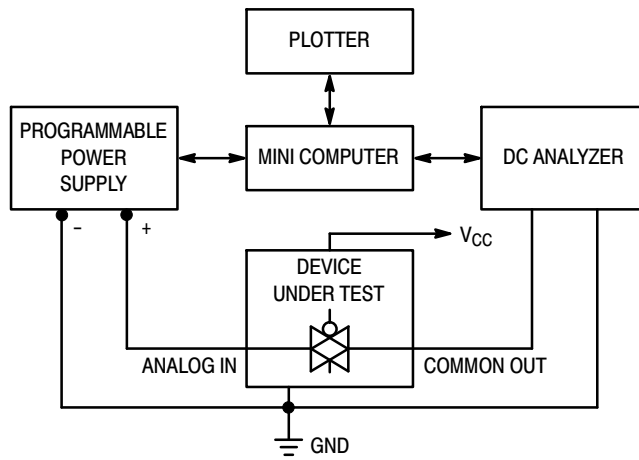


Figure 7. On Resistance Test Setup

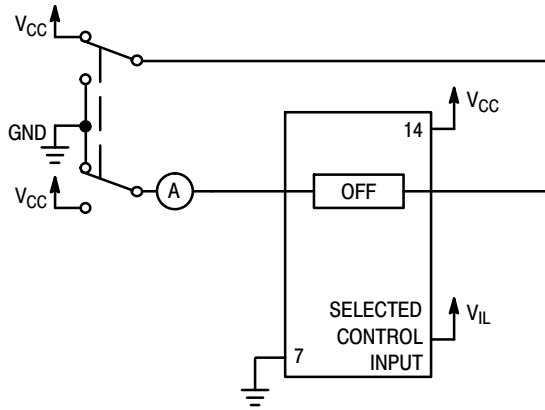


Figure 8. OFF Channel Leakage Current Test Setup, Any One Channel

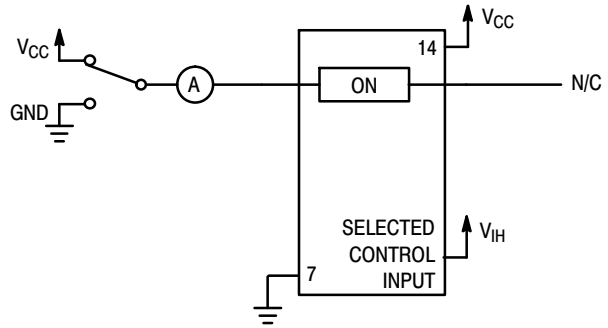


Figure 9. ON Channel Leakage Current Test Setup

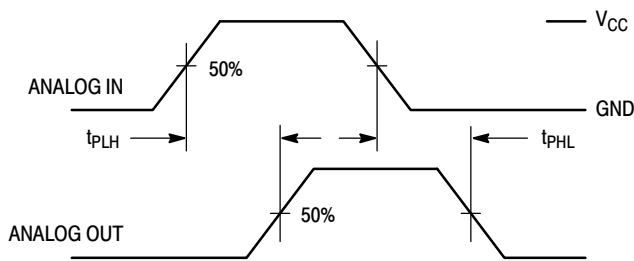
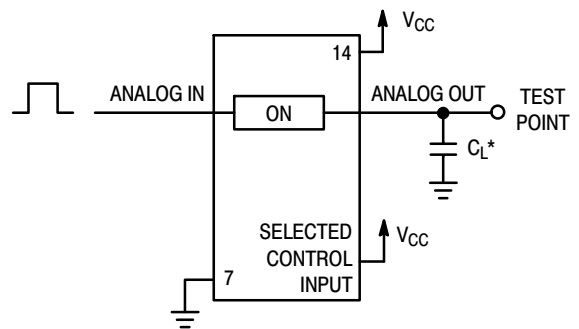


Figure 10. Propagation Delay, Analog In to Analog Out



\*Includes all probe and jig capacitance.

Figure 11. Propagation Delay Test Setup



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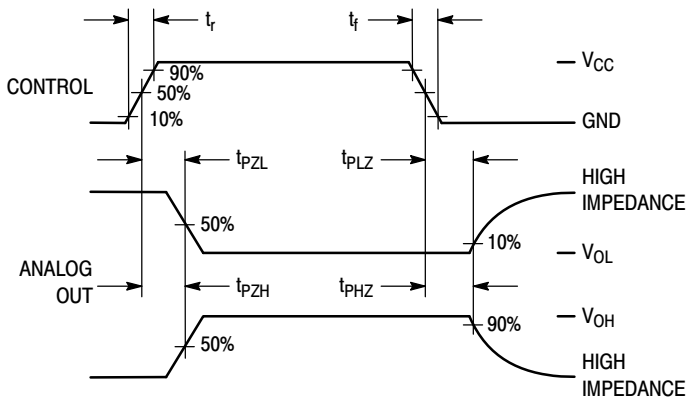
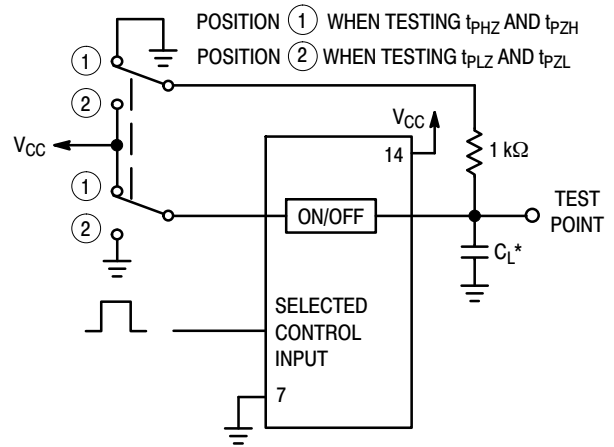


Figure 12. Turn-ON / Turn-OFF Times



\*Includes all probe and jig capacitance.

Figure 13. Turn-ON / Turn-OFF Time Test Setup

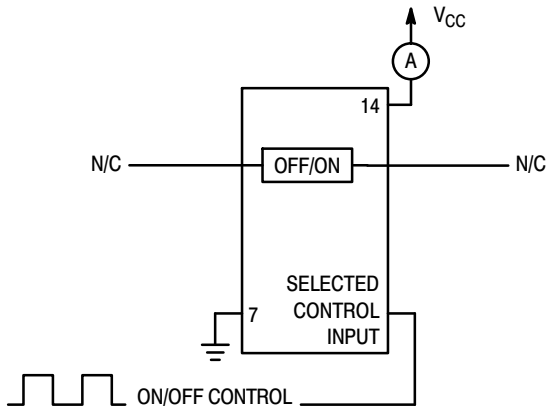
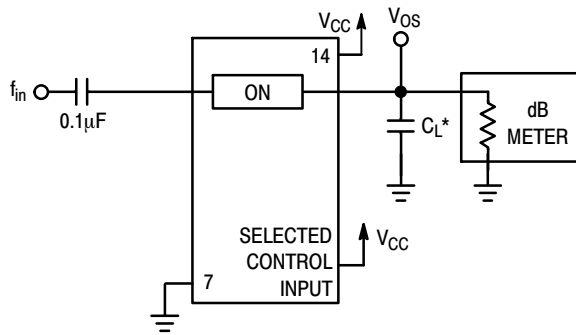
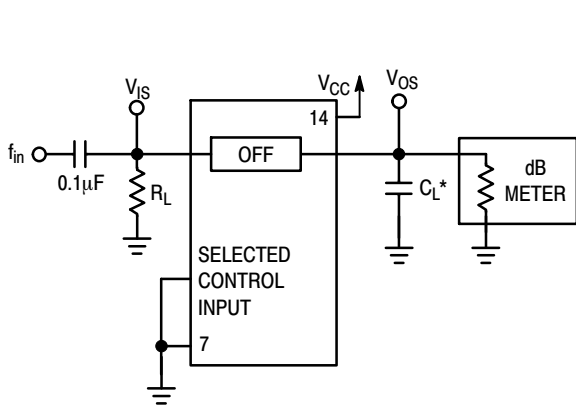


Figure 14. Power Dissipation Capacitance Test Setup



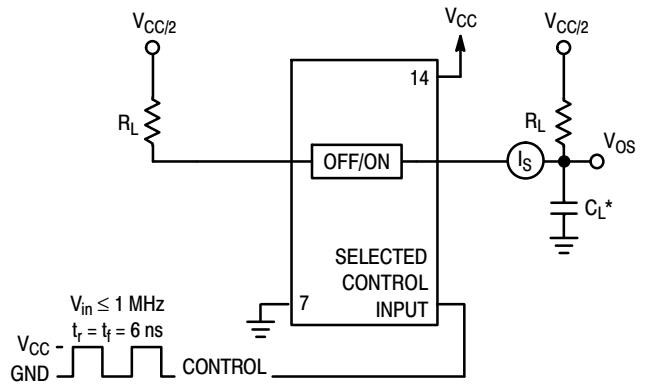
\*Includes all probe and jig capacitance.

Figure 15. ON Channel Bandwidth Test Setup



\*Includes all probe and jig capacitance.

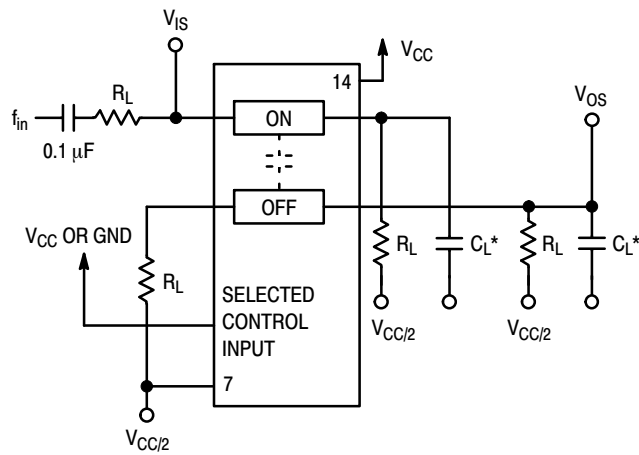
Figure 16. OFF Channel Feedthrough Isolation Test Setup



\*Includes all probe and jig capacitance.

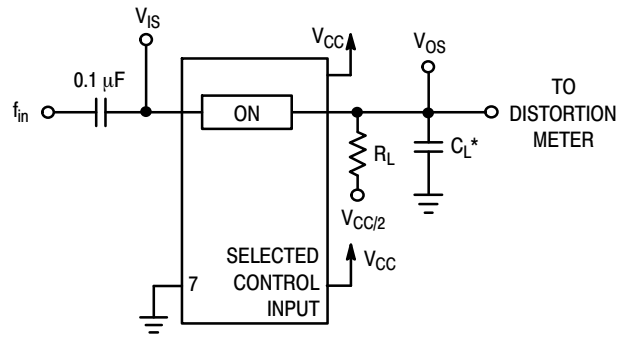
Figure 17. Feedthrough Noise Test Setup

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\*Includes all probe and jig capacitance.

**Figure 18. Crosstalk Between Any Two Switches Test Setup**



\*Includes all probe and jig capacitance.

**Figure 19. Total Harmonic Distortion Test Setup**

## ORDERING INFORMATION

| Device           | Package              | Shipping†          |
|------------------|----------------------|--------------------|
| MC74HC4067ADWR2G | SOIC-24<br>(Pb-Free) | 1000 / Tape & Reel |
| MC74HC4067ADTR2G | TSSOP-24*            | 2500 / Tape & Reel |

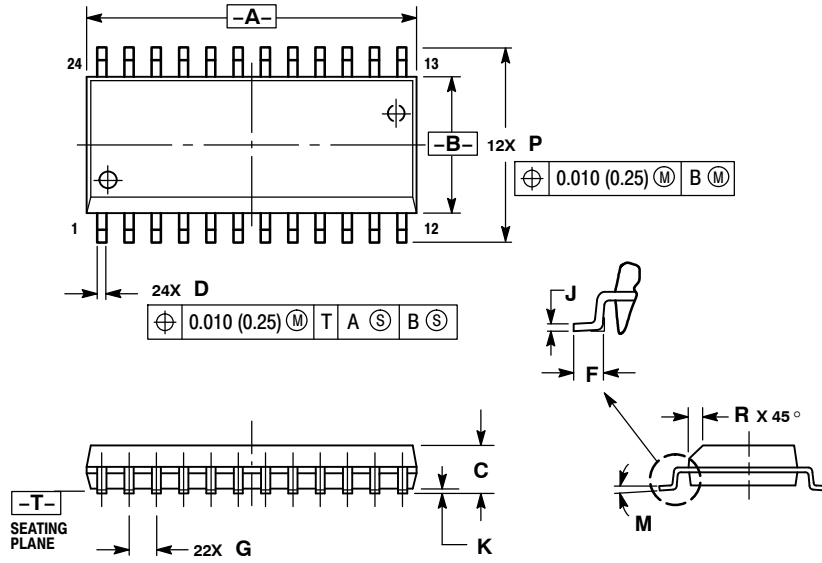
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*This package is inherently Pb-Free.

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## PACKAGE DIMENSIONS

SOIC-24  
CASE 751E-04  
ISSUE E



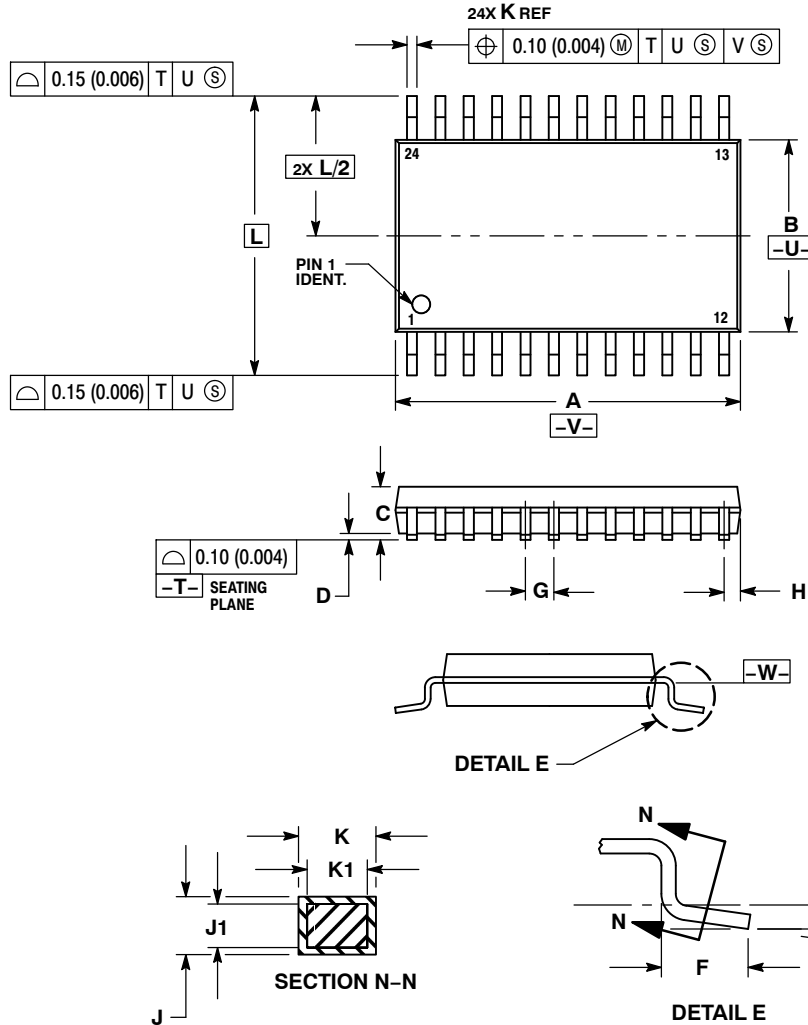
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
  5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 15.25       | 15.54 | 0.601     | 0.612 |
| 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   | 0.41        | 0.90  | 0.016     | 0.035 |
| G   | 1.27 BSC    |       | 0.050 BSC |       |
| J   | 0.23        | 0.32  | 0.009     | 0.013 |
| K   | 0.13        | 0.29  | 0.005     | 0.011 |
| M   | 0°          | 8°    | 0°        | 8°    |
| P   | 10.05       | 10.55 | 0.395     | 0.415 |
| R   | 0.25        | 0.75  | 0.010     | 0.029 |

# MC74HC4067A

## PACKAGE DIMENSIONS

TSSOP-24  
CASE 948H-01  
ISSUE A



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   | 7.70        | 7.90 | 0.303     | 0.311 |
| 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   | 0.27        | 0.37 | 0.011     | 0.015 |
| 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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#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.