



## MM74HC4066 Quad Analog Switch

### Features

- Typical switch enable time: 15ns
- Wide analog input voltage range: 0V–12V
- Low “ON” resistance: 30 typ. (MM74HC4066)
- Low quiescent current: 80μA maximum (74HC)
- Matched switch characteristics
- Individual switch controls


### General Description

The MM74HC4066 devices are digitally controlled analog switches utilizing advanced silicon-gate CMOS technology. These switches have low “ON” resistance and low “OFF” leakages. They are bidirectional switches, thus any analog input may be used as an output and visa-versa. Also the MM74HC4066 switches contain linearization circuitry which lowers the “ON” resistance and increases switch linearity. The MM74HC4066 devices allow control of up to 12V (peak) analog signals with digital control signals of the same range. Each switch has its own control input which disables each switch when LOW. All analog inputs and outputs and digital inputs are protected from electrostatic damage by diodes to  $V_{CC}$  and ground.

### Ordering Information

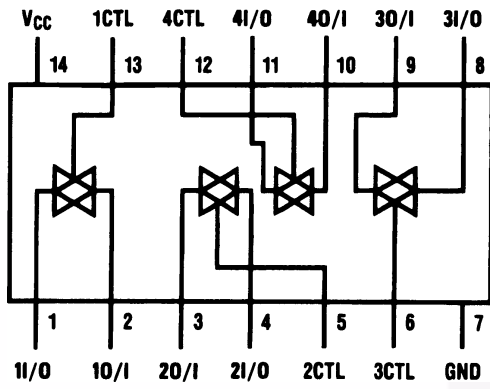
| Order Number  | Package Number | Package Description  |
|---------------|----------------|--|
| MM74HC4066M   | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| MM74HC4066SJ  | M14D           | 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide                |
| MM74HC4066MTC | MTC14          | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  |
| MM74HC4066N   | N14A           | 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide       |

Device also available in Tape and Reel. Specify by appending suffix letter “X” to the ordering number.

 All packages are lead free per JEDEC: J-STD-020B standard.



Connection Diagram

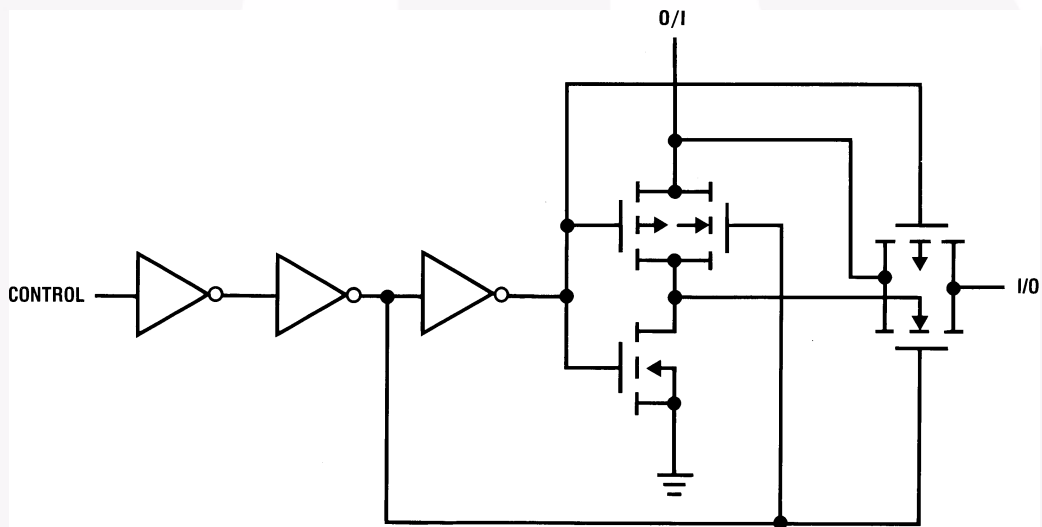


Top View

Truth Table

| Input | Switch  |
|-------|---------|
| CTL   | I/O-O/I |
| L     | "OFF"   |
| H     | "ON"    |

Schematic Diagram



## Absolute Maximum Ratings<sup>(1)</sup>

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

| Symbol           | Parameter                               | Rating                        |
|------------------|---|-------------------------------|
| $V_{CC}$         | Supply Voltage                          | -0.5 to +15V                  |
| $V_{IN}$         | DC Control Input Voltage                | -1.5 to $V_{CC}+1.5V$         |
| $V_{OUT}$        | DC Switch I/O Voltage                   | $V_{EE}-0.5$ to $V_{CC}+0.5V$ |
| $I_{IK}, I_{OK}$ | Clamp Diode Current                     | $\pm 20mA$                    |
| $I_{OUT}$        | DC Output Current, per pin              | $\pm 25mA$                    |
| $I_{CC}$         | DC $V_{CC}$ or GND Current, per pin     | $\pm 50mA$                    |
| $T_{STG}$        | Storage Temperature Range               | -65°C to +150°C               |
| $P_D$            | Power Dissipation<br>Note 2             | 600mW                         |
|                  | S.O. Package only                       | 500mW                         |
| $T_L$            | Lead Temperature (Soldering 10 seconds) | 260°C                         |

### Notes:

1. Unless otherwise specified all voltages are referenced to ground.
2. Power Dissipation temperature derating — plastic “N” package: -12mW/°C from 65°C to 85°C.

## Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

| Symbol            | Parameter                                   | Min. | Max.     | Units |
|-------------------|---|------|----------|-------|
| $V_{CC}$          | Supply Voltage                              | 2    | 12       | V     |
| $V_{IN}, V_{OUT}$ | DC Input or Output Voltage                  | 0    | $V_{CC}$ | V     |
| $T_A$             | Operating Temperature Range                 | -40  | +85      | °C    |
| $t_r, t_f$        | Input Rise or Fall Times<br>$V_{CC} = 2.0V$ |      | 1000     | ns    |
|                   | $V_{CC} = 4.5V$                             |      | 500      | ns    |
|                   | $V_{CC} = 6.0V$                             |      | 400      | ns    |

DC Electrical Characteristics<sup>(3)</sup>

| Symbol          | Parameter                              | V <sub>CC</sub> (V) | Conditions   | T <sub>A</sub> = 25°C |                   | T <sub>A</sub> = -40°C<br>to 85°C | T <sub>A</sub> = -55°C<br>to 125°C | Units |
|-----------------|--|---------------------|--|-----------------------|-------------------|-----------------------------------|------------------------------------|-------|
|                 |  |                     |  | Typ.                  | Guaranteed Limits |                                   |                                    |       |
| V <sub>IH</sub> | Minimum HIGH Level Input Voltage       | 2.0                 |  |                       | 1.5               | 1.5                               | 1.5                                | V     |
|                 |  | 4.5                 |  |                       | 3.15              | 3.15                              | 3.15                               |       |
|                 |  | 9.0                 |  |                       | 6.3               | 5.3                               | 6.3                                |       |
|                 |  | 12.0                |  |                       | 8.4               | 8.4                               | 8.4                                |       |
| V <sub>IL</sub> | Maximum LOW Level Input Voltage        | 2.0                 |  |                       | 0.5               | 0.5                               | 0.5                                | V     |
|                 |  | 4.5                 |  |                       | 1.35              | 1.35                              | 1.35                               |       |
|                 |  | 9.0                 |  |                       | 2.7               | 2.7                               | 2.7                                |       |
|                 |  | 12.0                |  |                       | 3.6               | 3.6                               | 3.6                                |       |
| R <sub>ON</sub> | Maximum "ON" Resistance <sup>(4)</sup> | 4.5                 | V <sub>CTL</sub> = V <sub>IH</sub> , I <sub>S</sub> = 2.0mA,<br>V <sub>IS</sub> = V <sub>CC</sub> to GND<br>(Figure 1)                   | 100                   | 170               | 200                               | 220                                | Ω     |
|                 |  | 9.0                 |  | 50                    | 85                | 105                               | 110                                |       |
|                 |  | 12.0                |  | 30                    | 70                | 85                                | 90                                 |       |
|                 |  | 2.0                 | V <sub>CTL</sub> = V <sub>IH</sub> , I <sub>S</sub> = 2.0mA,<br>V <sub>IS</sub> = V <sub>CC</sub> or GND<br>(Figure 1)                   | 120                   | 180               | 215                               | 240                                |       |
|                 |  | 4.5                 |  | 50                    | 80                | 100                               | 120                                |       |
|                 |  | 9.0                 |  | 35                    | 60                | 75                                | 80                                 |       |
|                 |  | 12.0                |  | 20                    | 40                | 60                                | 70                                 |       |
| R <sub>ON</sub> | Maximum "ON" Resistance Matching       | 4.5                 | V <sub>CTL</sub> = V <sub>IH</sub> ,<br>V <sub>IS</sub> = V <sub>CC</sub> to GND   | 10                    | 15                | 20                                | 20                                 | Ω     |
|                 |  | 9.0                 |  | 5                     | 10                | 15                                | 15                                 |       |
|                 |  | 12.0                |  | 5                     | 10                | 15                                | 15                                 |       |
| I <sub>IN</sub> | Maximum Control Input Current          |                     | V <sub>IN</sub> = V <sub>CC</sub> or GND,<br>V <sub>CC</sub> = 2–6V  |                       | ±0.1              | ±1.0                              | ±1.0                               | μA    |
| I <sub>IZ</sub> | Maximum Switch "OFF" Leakage Current   | 6.0                 | V <sub>OS</sub> = V <sub>CC</sub> or GND,<br>V <sub>IS</sub> = GND or V <sub>CC</sub> ,<br>V <sub>CTL</sub> = V <sub>IL</sub> (Figure 3) | 10                    | ±60               | ±600                              | ±600                               | nA    |
|                 |  | 9.0                 |  | 15                    | ±80               | ±800                              | ±800                               |       |
|                 |  | 12.0                |  | 20                    | ±100              | ±1000                             | ±1000                              |       |
| I <sub>IZ</sub> | Maximum Switch "ON" Leakage Current    | 6.0                 | V <sub>IS</sub> = V <sub>CC</sub> to GND,<br>V <sub>CTL</sub> = V <sub>IH</sub> ,<br>V <sub>OS</sub> = OPEN (Figure 2)                   | 10                    | ±40               | ±150                              | ±150                               | nA    |
|                 |  | 9.0                 |  | 15                    | ±50               | ±200                              | ±200                               |       |
|                 |  | 12.0                |  | 20                    | ±60               | ±300                              | ±300                               |       |
| I <sub>CC</sub> | Maximum Quiescent Supply Current       | 6.0                 | V <sub>IN</sub> = V <sub>CC</sub> or GND,<br>I <sub>OUT</sub> = 0μA  |                       | 2.0               | 20                                | 40                                 | μA    |
|                 |  | 9.0                 |  |                       | 4.0               | 40                                | 80                                 |       |
|                 |  | 12.0                |  |                       | 8.0               | 80                                | 160                                |       |

**Notes:**

- For a power supply of 5V ±10% the worst case on resistance (R<sub>ON</sub>) occurs for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case V<sub>IH</sub> and V<sub>IL</sub> occur at V<sub>CC</sub> = 5.5V and 4.5V respectively. (The V<sub>IH</sub> value at 5.5V is 3.85V.) The worst case leakage current occurs for CMOS at the higher voltage and so the 5.5V values should be used.
- At supply voltages (V<sub>CC</sub>–GND) approaching 2V the analog switch on resistance becomes extremely non-linear. Therefore it is recommended that these devices be used to transmit digital only when using these supply voltages.

## AC Electrical Characteristics

$V_{CC} = 2.0V-6.0V$   $V_{EE} = 0V-12V$ ,  $C_L = 50pF$  (unless otherwise specified)

| Symbol                | Parameter   | $V_{CC}$ (V) | Conditions  | $T_A = 25^\circ C$ |                   |     |     | Units |
|-----------------------|---|--------------|---|--------------------|-------------------|-----|-----|-------|
|                       |   |              |   | Typ.               | Guaranteed Limits |     |     |       |
| $t_{PHL}$ , $t_{PLH}$ | Maximum Propagation Delay Switch In to Out                          | 2.0V         |   | 25                 | 50                | 30  | 75  | ns    |
|                       |   | 4.5V         |   | 5                  | 10                | 13  | 15  |       |
|                       |   | 9.0V         |   | 4                  | 8                 | 10  | 12  |       |
|                       |   | 12.0V        |   | 3                  | 7                 | 11  | 13  |       |
| $t_{PZL}$ , $t_{PZH}$ | Maximum Switch Turn "ON" Delay                                      | 2.0V         | $R_L = 1k\Omega$  | 30                 | 100               | 125 | 150 | ns    |
|                       |   | 4.5V         |   | 12                 | 20                | 25  | 30  |       |
|                       |   | 9.0V         |   | 6                  | 12                | 15  | 18  |       |
|                       |   | 12.0V        |   | 5                  | 10                | 13  | 15  |       |
| $t_{PHZ}$ , $t_{PLZ}$ | Maximum Switch Turn "OFF" Delay                                     | 2.0V         | $R_L = 1k\Omega$  | 60                 | 168               | 210 | 252 | ns    |
|                       |   | 4.5V         |   | 25                 | 36                | 45  | 54  |       |
|                       |   | 9.0V         |   | 20                 | 32                | 40  | 48  |       |
|                       |   | 12.0V        |   | 15                 | 30                | 38  | 45  |       |
| $f_{MAX}$             | Minimum Frequency Response (Figure 7)<br>$20 \log (V_O/V_I) = -3dB$ | 4.5V         | $R_L = 600\Omega$ ,<br>$V_{IS} = 2 V_{PP}$ at<br>$(V_{CC}/2)^{(5)(6)}$                          | 40                 |                   |     |     | MHz   |
|                       |   | 9.0V         |   | 100                |                   |     |     |       |
|                       | Crosstalk Between any Two Switches (Figure 8)                       | 4.5V         | $R_L = 600\Omega$ ,<br>$F = 1MHz^{(6)(7)}$  | -52                |                   |     |     | dB    |
|                       |   | 9.0V         |   | -50                |                   |     |     |       |
|                       | Peak Control to Switch Feedthrough Noise (Figure 9)                 | 4.5V         | $R_L = 600\Omega$ , $F = 1MHz$ ,<br>$C_L = 50pF$  | 100                |                   |     |     | mV    |
|                       |   | 9.0V         |   | 250                |                   |     |     |       |
|                       | Switch OFF Signal Feedthrough Isolation (Figure 10)                 | 4.5V         | $R_L = 600\Omega$ , $F = 1MHz$ ,<br>$V_{(CT)}V_{IL}^{(6)(7)}$                                   | -42                |                   |     |     | dB    |
|                       |   | 9.0V         |   | -44                |                   |     |     |       |
| THD                   | Total Harmonic Distortion (Figure 11)                               | 4.5V         | $R_L = 10k\Omega$ , $C_L = 50pF$ ,<br>$F = 1kHz$ , $V_{IS} = 4 V_{PP}$ ,<br>$V_{IS} = 8 V_{PP}$ | .013               |                   |     |     | %     |
|                       |   | 9.0V         |   | .008               |                   |     |     |       |
| $C_{IN}$              | Maximum Control Input Capacitance                                   |              |   | 5                  | 10                | 10  | 10  | pF    |
| $C_{IN}$              | Maximum Switch Input Capacitance                                    |              |   | 20                 |                   |     |     | pF    |
| $C_{IN}$              | Maximum Feedthrough Capacitance                                     |              | $V_{CTL} = GND$   | 0.5                |                   |     |     | pF    |
| $C_{PD}$              | Power Dissipation Capacitance                                       |              |   | 15                 |                   |     |     | pF    |

### Notes:

- Adjust 0dBm for  $F = 1kHz$  (Null  $R_L/R_{ON}$  Attenuation).
- $V_{IS}$  is centered at  $V_{CC}/2$ .
- Adjust input for 0dBm.

AC Test Circuits and Switching Time Waveforms

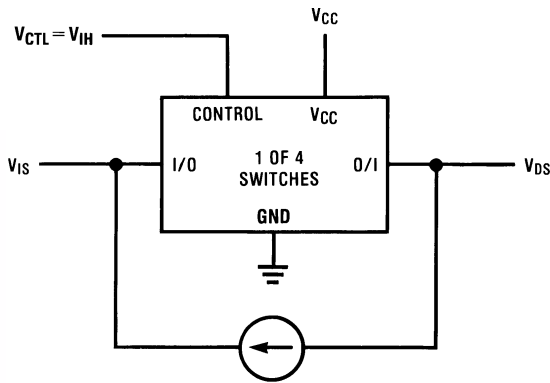


Figure 1. "ON" Resistance

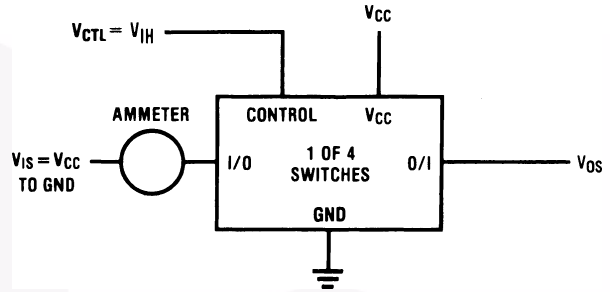


Figure 2. "ON" Channel Leakage Current

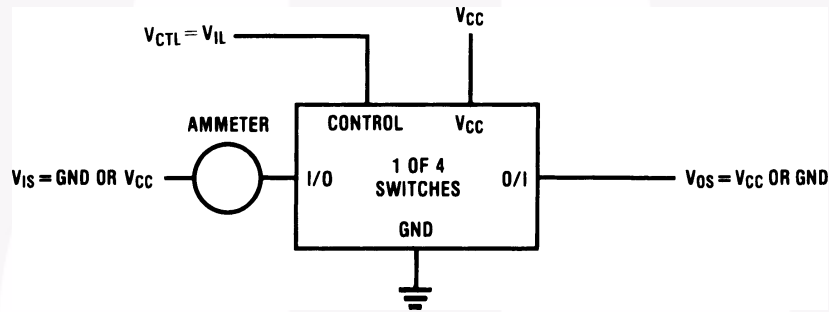


Figure 3. "OFF" Channel Leakage Current

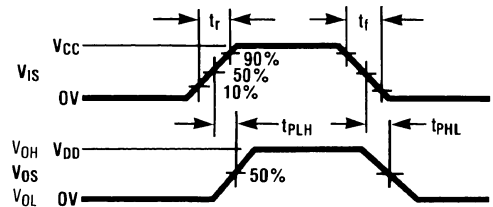
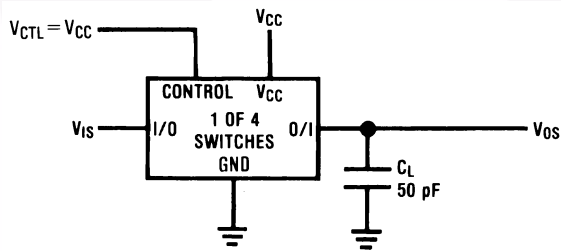


Figure 4.  $t_{PHL}$ ,  $t_{PLH}$  Propagation Delay Time Signal Input to Signal Output

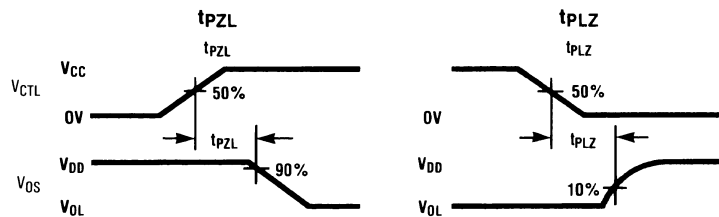
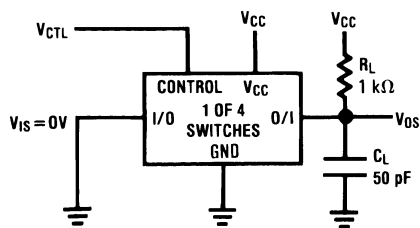


Figure 5.  $t_{PZL}$ ,  $t_{PLZ}$  Propagation Delay Time Control to Signal Output

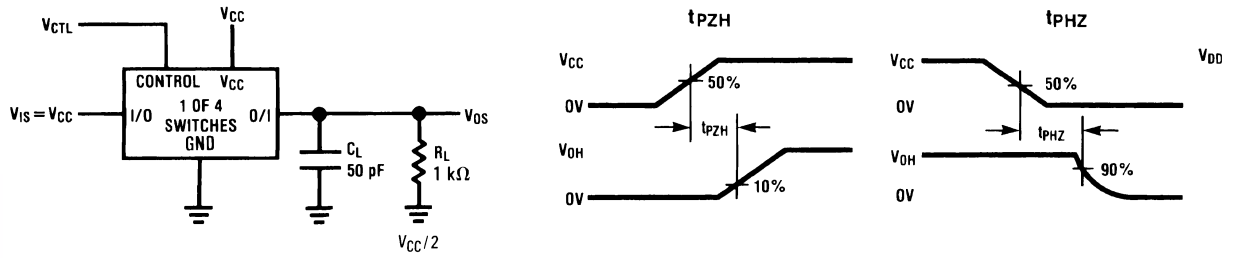


Figure 6.  $t_{PZH}$ ,  $t_{PHZ}$  Propagation Delay Time Control to Signal Output

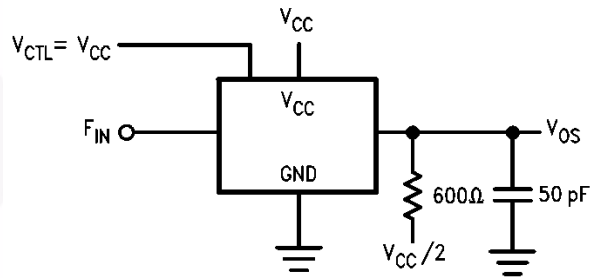


Figure 7. Frequency Response

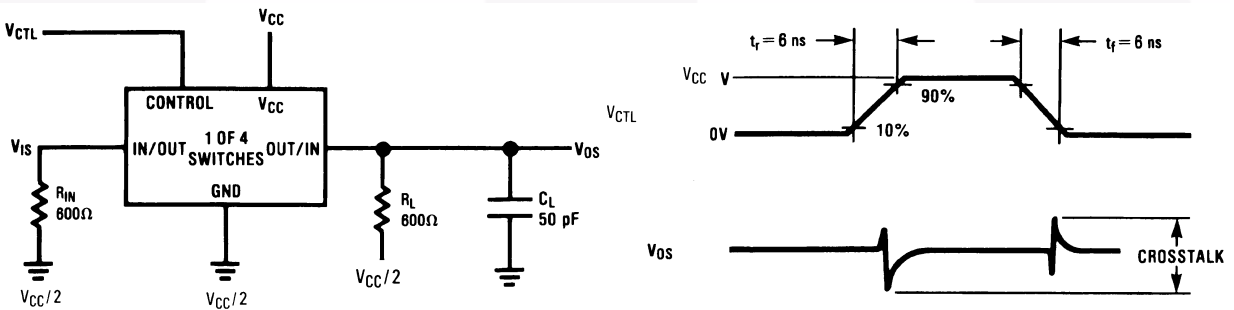


Figure 8. Crosstalk: Control Input to Signal Output

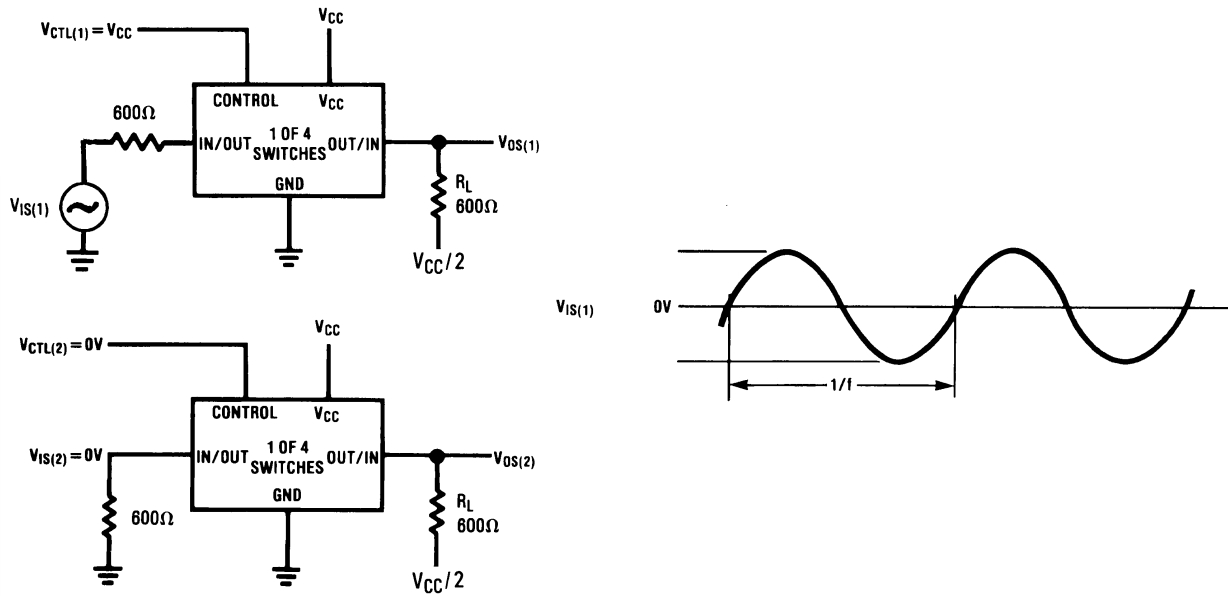


Figure 9. Crosstalk Between Any Two Switches

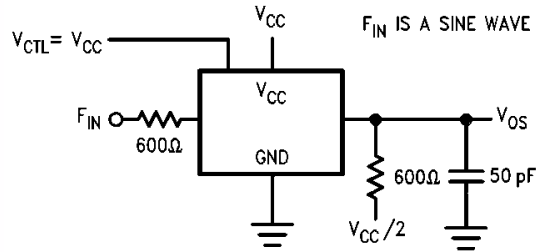


Figure 10. Switch OFF Signal Feedthrough Isolation

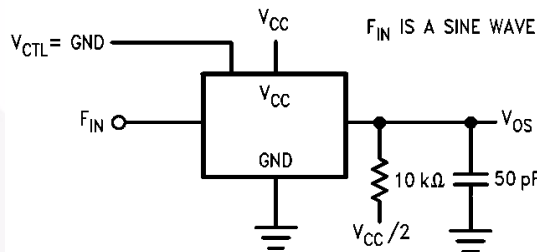
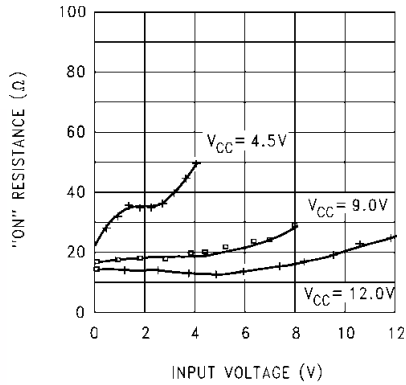


Figure 11. Sinewave Distortion

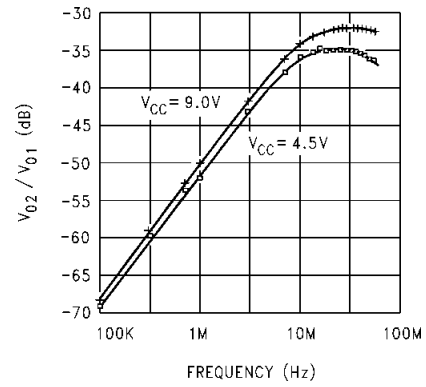


## Typical Performance Characteristics

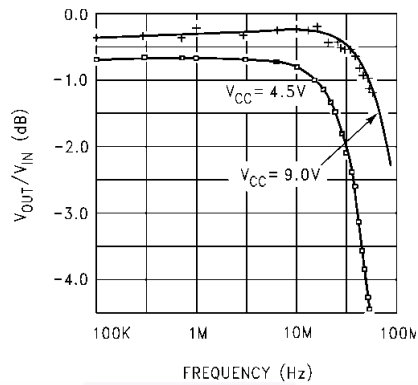
Typical "ON" Response



Typical Crosstalk Between Any Two Switches



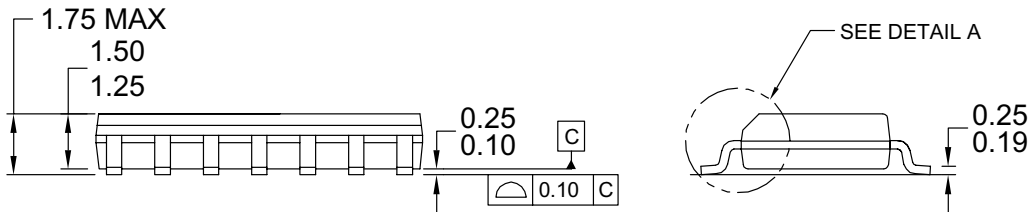
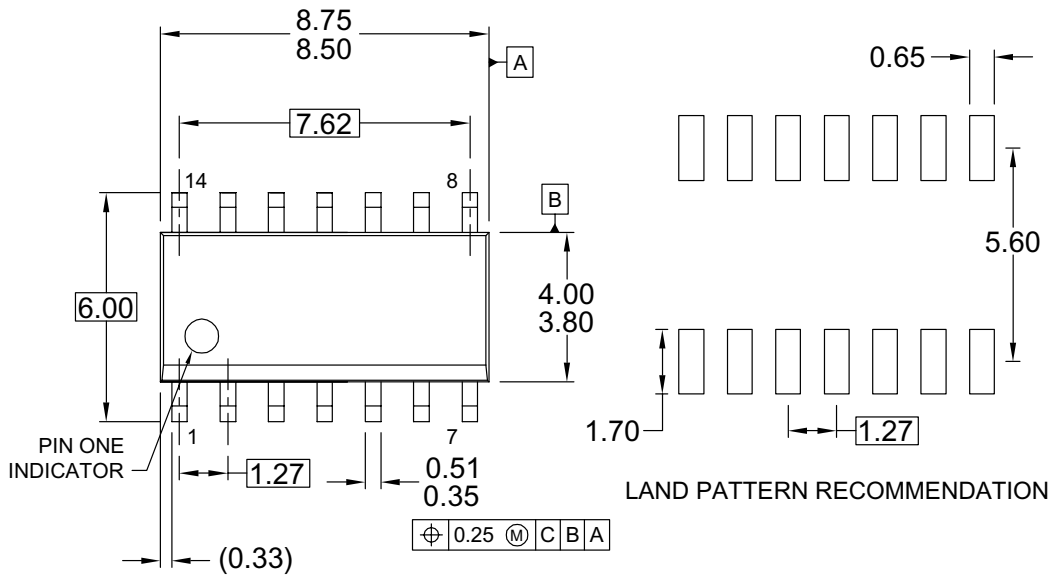
Typical Frequency Response



## Special Considerations

In certain applications the external load-resistor current may include both  $V_{CC}$  and signal line components. To avoid drawing  $V_{CC}$  current when switch current flows into the analog switch input pins, the voltage drop across the switch must not exceed 0.6V (calculated from the ON resistance).

Physical Dimensions



NOTES: UNLESS OTHERWISE SPECIFIED

- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AB, ISSUE C,
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) LANDPATTERN STANDARD: SOIC127P600X145-14M
- E) DRAWING CONFORMS TO ASME Y14.5M-1994
- F) DRAWING FILE NAME: M14AREV13

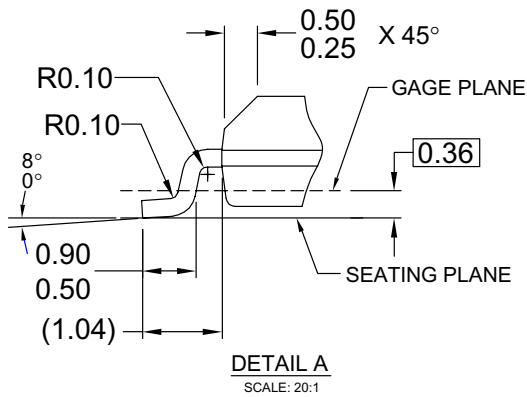


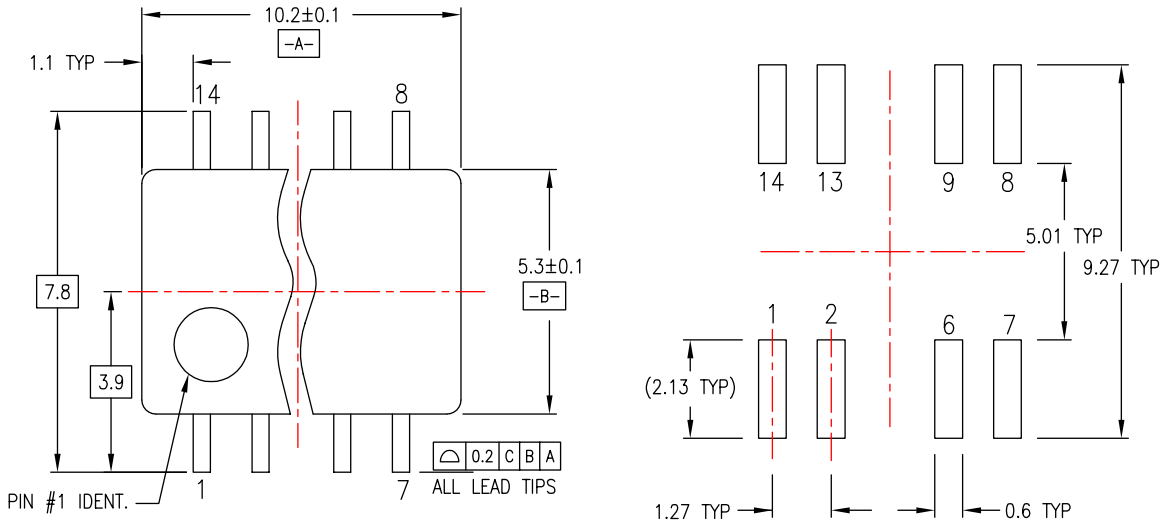
Figure 12. 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow

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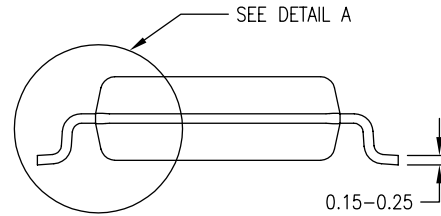
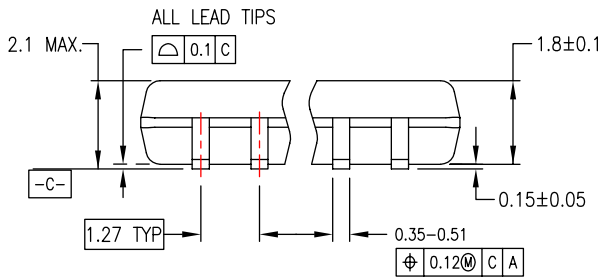
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Physical Dimensions (Continued)



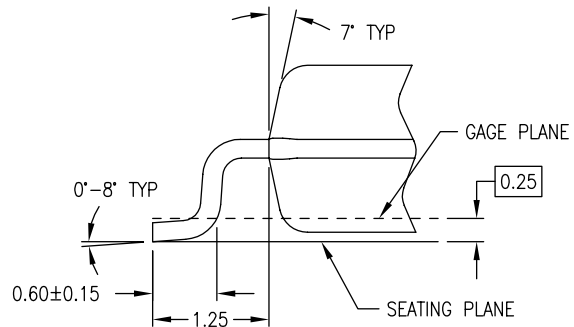
LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS

NOTES:

- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.



DETAIL A

M14DREVC

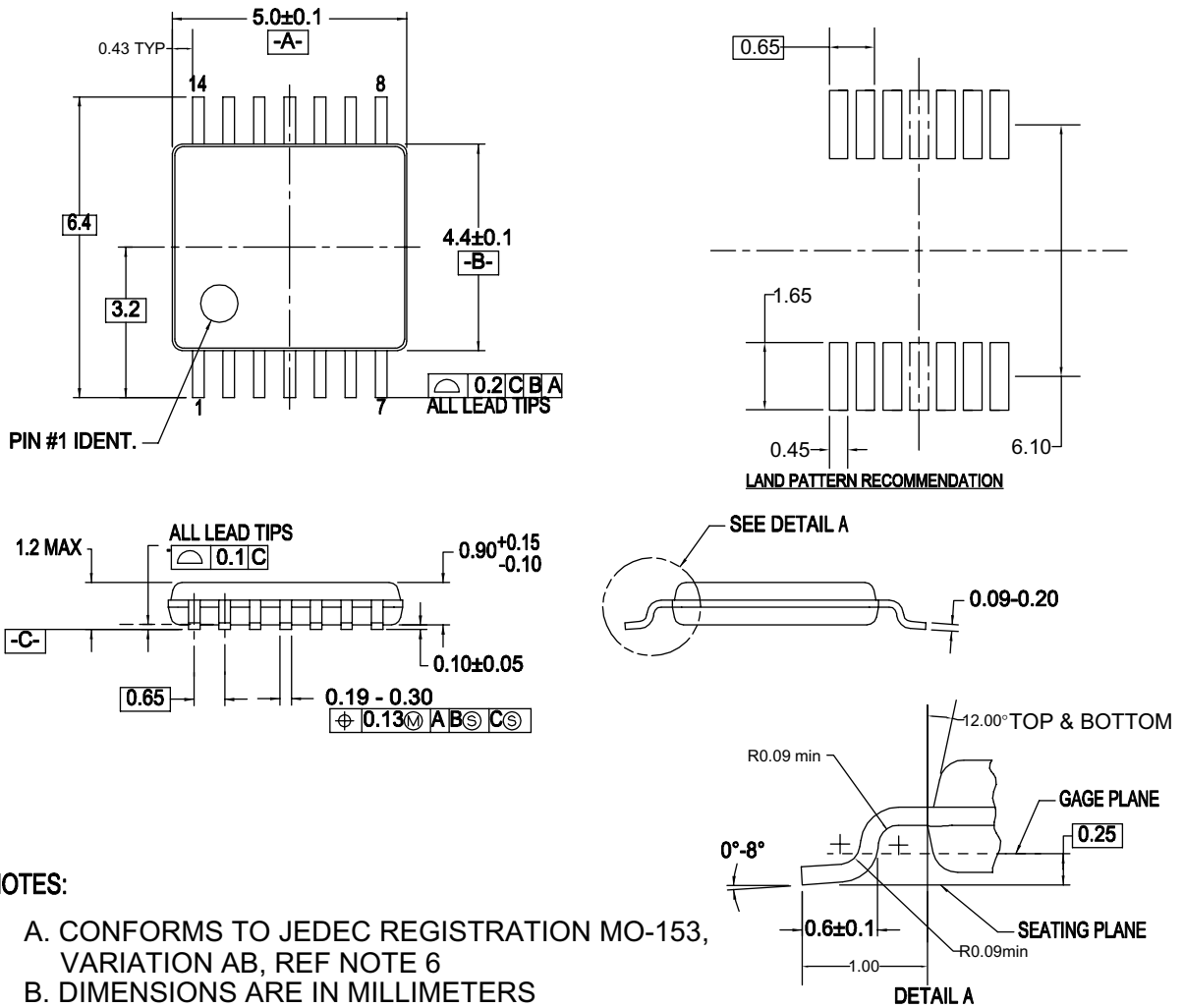
Figure 13. 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide

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Physical Dimensions (Continued)



NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6
- B. DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982
- E. LANDPATTERN STANDARD: SOP65P640X110-14M
- F. DRAWING FILE NAME: MTC14REV6

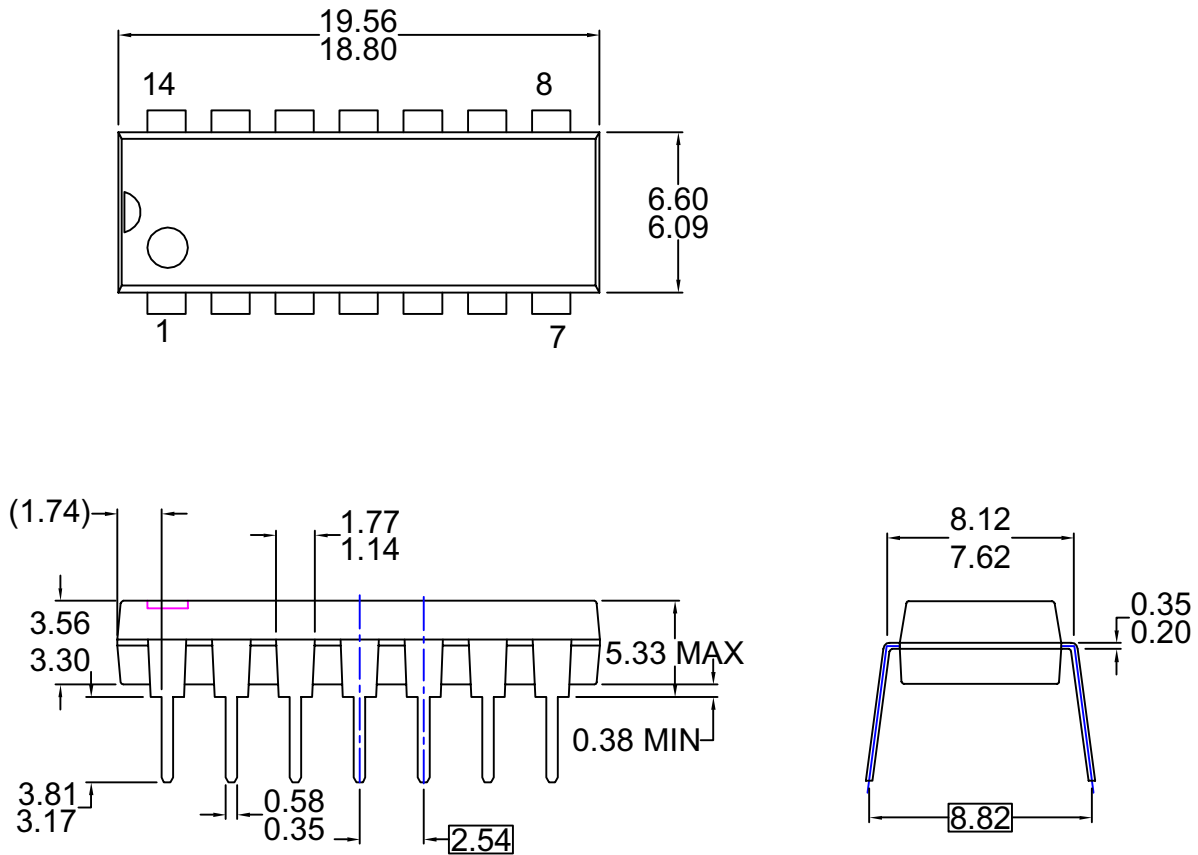
Figure 14. 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

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## Physical Dimensions (Continued)



- NOTES: UNLESS OTHERWISE SPECIFIED**
- THIS PACKAGE CONFORMS TO
  - A) JEDEC MS-001 VARIATION BA
  - B) ALL DIMENSIONS ARE IN MILLIMETERS.
  - C) DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
  - D) DIMENSIONS AND TOLERANCES PER ASME Y14.5-1994
  - E) DRAWING FILE NAME: MKT-N14AREV7

**Figure 15. 14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide**

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| ACEx <sup>®</sup>   | FPS <sup>™</sup>                             | PDP-SPM <sup>™</sup>                   | SupreMOS <sup>™</sup>            |
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