

## MM74HC4066 Quad Analog Switch

### 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.

### Features

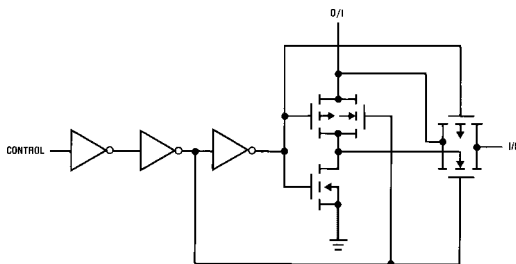
- Typical switch enable time: 15 ns
- Wide analog input voltage range: 0–12V
- Low "ON" resistance: 30  $\Omega$  typ. (MM74HC4066)
- Low quiescent current: 80  $\mu$ A maximum (74HC)
- Matched switch characteristics
- Individual switch controls

### Ordering Code:

| Order Number    | Package Number | Package Description                                                                  |
|-----------------|----------------|--------------------------------------------------------------------------------------|
| MM74HC4066M     | M14A           | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow         |
| MM74HC4066MX_NL | M14A           | Pb-Free 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| MM74HC4066SJ    | M14D           | Pb-Free 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               |

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.  
Pb-Free package per JEDEC J-STD-020B.

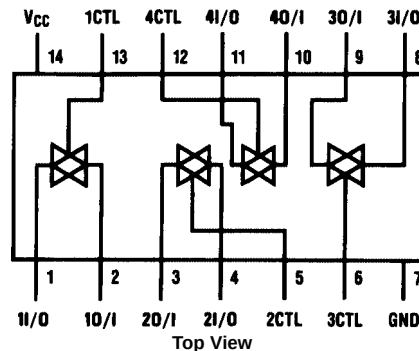
### Schematic Diagram



### Truth Table

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

### Connection Diagram



**Absolute Maximum Ratings** (Note 1)

(Note 2)

|                                                  |                                   |
|--------------------------------------------------|-----------------------------------|
| Supply Voltage ( $V_{CC}$ )                      | −0.5 to +15V                      |
| DC Control Input Voltage ( $V_{IN}$ )            | −1.5 to $V_{CC} + 1.5V$           |
| DC Switch I/O Voltage ( $V_{IO}$ )               | $V_{EE} - 0.5$ to $V_{CC} + 0.5V$ |
| Clamp Diode Current ( $I_{IK}, I_{OK}$ )         | ±20 mA                            |
| DC Output Current, per pin ( $I_{OUT}$ )         | ±25 mA                            |
| DC $V_{CC}$ or GND Current, per pin ( $I_{CC}$ ) | ±50 mA                            |
| Storage Temperature Range ( $T_{STG}$ )          | −65°C to +150°C                   |
| Power Dissipation ( $P_D$ )                      |                                   |
| (Note 3)                                         | 600 mW                            |
| S.O. Package only                                | 500 mW                            |
| Lead Temperature ( $T_L$ )                       |                                   |
| (Soldering 10 seconds)                           | 260°C                             |

**Recommended Operating Conditions**

|                                                         | Min | Max      | Units |
|---------------------------------------------------------|-----|----------|-------|
| Supply Voltage ( $V_{CC}$ )                             | 2   | 12       | V     |
| DC Input or Output Voltage ( $V_{IN}, V_{OUT}$ )        | 0   | $V_{CC}$ | V     |
| Operating Temperature Range ( $T_A$ )                   | −40 | +85      | °C    |
| Input Rise or Fall Times ( $t_r, t_f$ ) $V_{CC} = 2.0V$ |     | 1000     | ns    |
| $V_{CC} = 4.5V$                                         |     | 500      | ns    |
| $V_{CC} = 9.0V$                                         |     | 400      | ns    |

**Note 1:** Absolute Maximum Ratings are those values beyond which damage to the device may occur.**Note 2:** Unless otherwise specified all voltages are referenced to ground.**Note 3:** Power Dissipation temperature derating — plastic "N" package: −12 mW/°C from 65°C to 85°C.**DC Electrical Characteristics** (Note 4)

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

**Note 4:** For a power supply of 5V ±10% the worst case on resistance ( $R_{ON}$ ) occurs for HC at 4.5V. Thus the 4.5V values should be used when designing with this supply. Worst case  $V_{IH}$  and  $V_{IL}$  occur at  $V_{CC} = 5.5V$  and 4.5V respectively. (The  $V_{IH}$  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.**Note 5:** At supply voltages ( $V_{CC}-GND$ ) 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

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

| Symbol                              | Parameter                                                                                 | Conditions                                                                                                                                 | V <sub>CC</sub> | T <sub>A</sub> = 25°C |                   | T <sub>A</sub> = -40 to 85°C | T <sub>A</sub> = -55 to 125°C | Units |
|-------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------|-----------------------|-------------------|------------------------------|-------------------------------|-------|
|                                     |                                                                                           |                                                                                                                                            |                 | Typ                   | Guaranteed Limits |                              |                               |       |
| t <sub>PHL</sub> , t <sub>PLH</sub> | Maximum Propagation Delay Switch In to Out                                                |                                                                                                                                            | 2.0V            | 25                    | 50                | 30                           | 75                            | ns    |
|                                     |                                                                                           |                                                                                                                                            | 4.5V            | 5                     | 10                | 13                           | 15                            | ns    |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | 4                     | 8                 | 10                           | 12                            | ns    |
|                                     |                                                                                           |                                                                                                                                            | 12.0V           | 3                     | 7                 | 11                           | 13                            | ns    |
| t <sub>PZL</sub> , t <sub>PZH</sub> | Maximum Switch Turn "ON" Delay                                                            | R <sub>L</sub> = 1 kΩ                                                                                                                      | 2.0V            | 30                    | 100               | 125                          | 150                           | ns    |
|                                     |                                                                                           |                                                                                                                                            | 4.5V            | 12                    | 20                | 25                           | 30                            | ns    |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | 6                     | 12                | 15                           | 18                            | ns    |
|                                     |                                                                                           |                                                                                                                                            | 12.0V           | 5                     | 10                | 13                           | 15                            | ns    |
| t <sub>PHZ</sub> , t <sub>PLZ</sub> | Maximum Switch Turn "OFF" Delay                                                           | R <sub>L</sub> = 1 kΩ                                                                                                                      | 2.0V            | 60                    | 168               | 210                          | 252                           | ns    |
|                                     |                                                                                           |                                                                                                                                            | 4.5V            | 25                    | 36                | 45                           | 54                            | ns    |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | 20                    | 32                | 40                           | 48                            | ns    |
|                                     |                                                                                           |                                                                                                                                            | 12.0V           | 15                    | 30                | 38                           | 45                            | ns    |
| f <sub>MAX</sub>                    | Minimum Frequency Response (Figure 7)<br>20 log (V <sub>O</sub> /V <sub>I</sub> ) = -3 dB | R <sub>L</sub> = 600Ω<br>V <sub>IS</sub> = 2 V <sub>PP</sub> at (V <sub>CC</sub> /2)<br>(Note 6) (Note 7)                                  | 4.5V            | 40                    |                   |                              |                               | MHz   |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | 100                   |                   |                              |                               | MHz   |
|                                     | Crosstalk Between any Two Switches (Figure 8)                                             | R <sub>L</sub> = 600Ω, F = 1 MHz<br>(Note 7) (Note 8)                                                                                      | 4.5V            | -52                   |                   |                              |                               | dB    |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | -50                   |                   |                              |                               | dB    |
|                                     | Peak Control to Switch Feedthrough Noise (Figure 9)                                       | R <sub>L</sub> = 600Ω, F = 1 MHz<br>C <sub>L</sub> = 50 pF                                                                                 | 4.5V            | 100                   |                   |                              |                               | mV    |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | 250                   |                   |                              |                               | mV    |
|                                     | Switch OFF Signal Feedthrough Isolation (Figure 10)                                       | R <sub>L</sub> = 600Ω, F = 1 MHz<br>V <sub>(CT)</sub> V <sub>IL</sub><br>(Note 7) (Note 8)                                                 | 4.5V            | -42                   |                   |                              |                               | dB    |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | -44                   |                   |                              |                               | dB    |
| THD                                 | Total Harmonic Distortion (Figure 11)                                                     | R <sub>L</sub> = 10 kΩ, C <sub>L</sub> = 50 pF,<br>F = 1 kHz<br>V <sub>IS</sub> = 4 V <sub>PP</sub><br>V <sub>IS</sub> = 8 V <sub>PP</sub> | 4.5V            | .013                  |                   |                              |                               | %     |
|                                     |                                                                                           |                                                                                                                                            | 9.0V            | .008                  |                   |                              |                               | %     |
| C <sub>IN</sub>                     | Maximum Control Input Capacitance                                                         |                                                                                                                                            |                 | 5                     | 10                | 10                           | 10                            | pF    |
| C <sub>IN</sub>                     | Maximum Switch Input Capacitance                                                          |                                                                                                                                            |                 | 20                    |                   |                              |                               | pF    |
| C <sub>IN</sub>                     | Maximum Feedthrough Capacitance                                                           | V <sub>CTL</sub> = GND                                                                                                                     |                 | 0.5                   |                   |                              |                               | pF    |
| C <sub>PD</sub>                     | Power Dissipation Capacitance                                                             |                                                                                                                                            |                 | 15                    |                   |                              |                               | pF    |

**Note 6:** Adjust 0 dBm for  $F = 1$  kHz (Null  $R_L/R_{ON}$  Attenuation).

**Note 7:**  $V_{IS}$  is centered at  $V_{CC}/2$ .

**Note 8:** Adjust input for 0 dBm.

## AC Test Circuits and Switching Time Waveforms

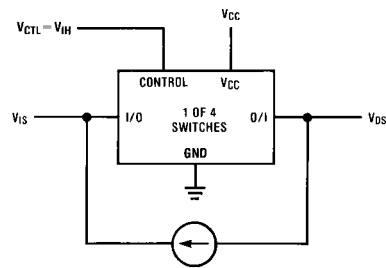


FIGURE 1. "ON" Resistance

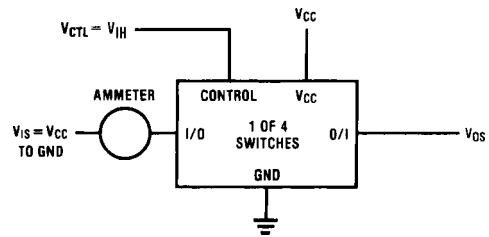


FIGURE 2. "ON" Channel Leakage Current

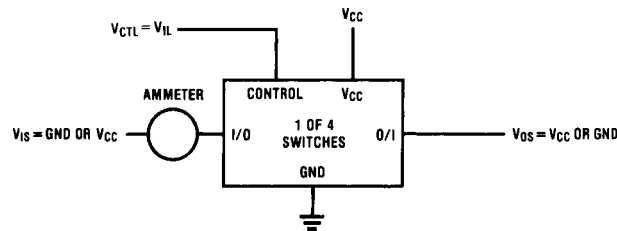
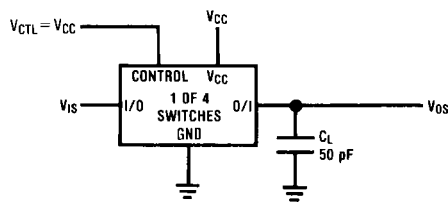
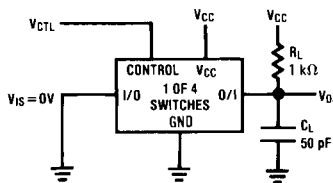
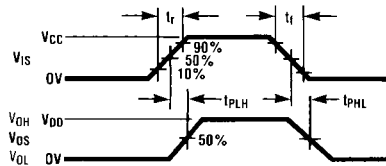
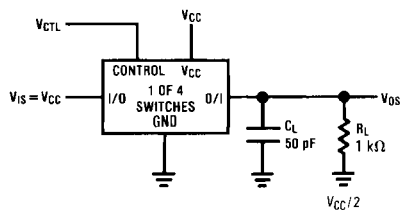
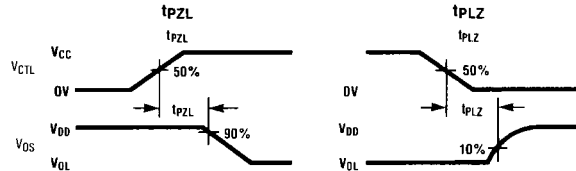
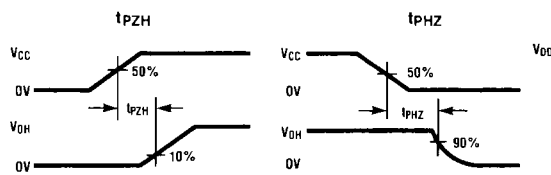


FIGURE 3. "OFF" Channel Leakage Current

FIGURE 4.  $t_{PHL}$ ,  $t_{PLH}$  Propagation Delay Time Signal Input to Signal OutputFIGURE 5.  $t_{PZL}$ ,  $t_{PLZ}$  Propagation Delay Time Control to Signal OutputFIGURE 6.  $t_{PZH}$ ,  $t_{PHZ}$  Propagation Delay Time Control to Signal Output

## AC Test Circuits and Switching Time Waveforms (Continued)

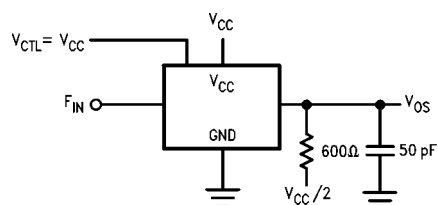


FIGURE 7. Frequency Response

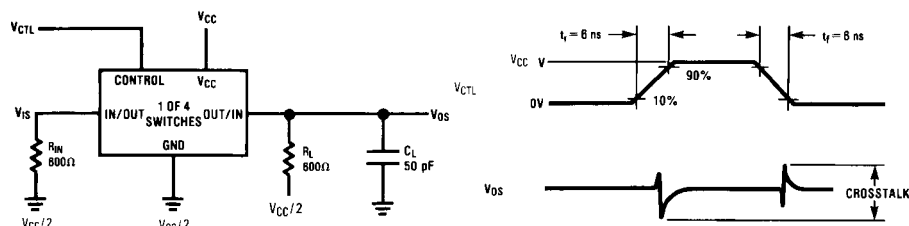


FIGURE 8. Crosstalk: Control Input to Signal Output

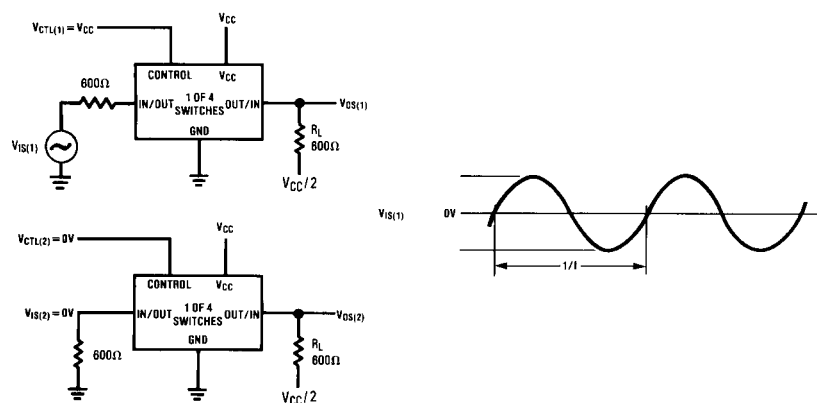


FIGURE 9. Crosstalk Between Any Two Switches

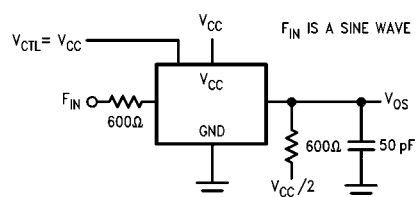


FIGURE 10. Switch OFF Signal Feedthrough Isolation

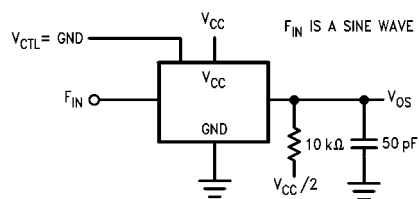
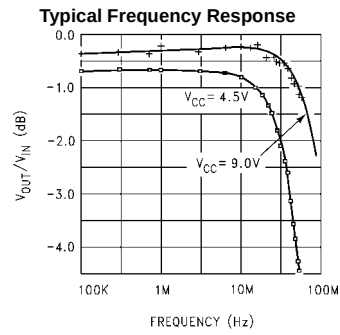
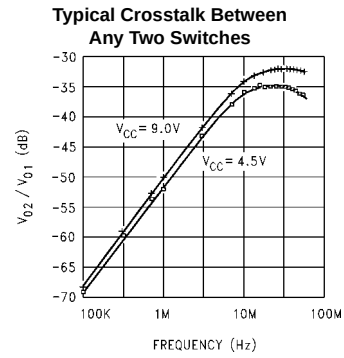
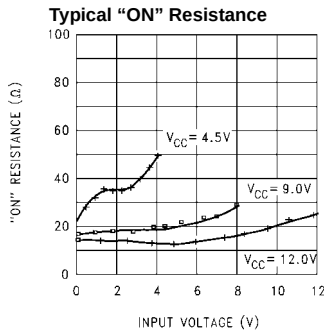


FIGURE 11. Sinewave Distortion

## Typical Performance Characteristics

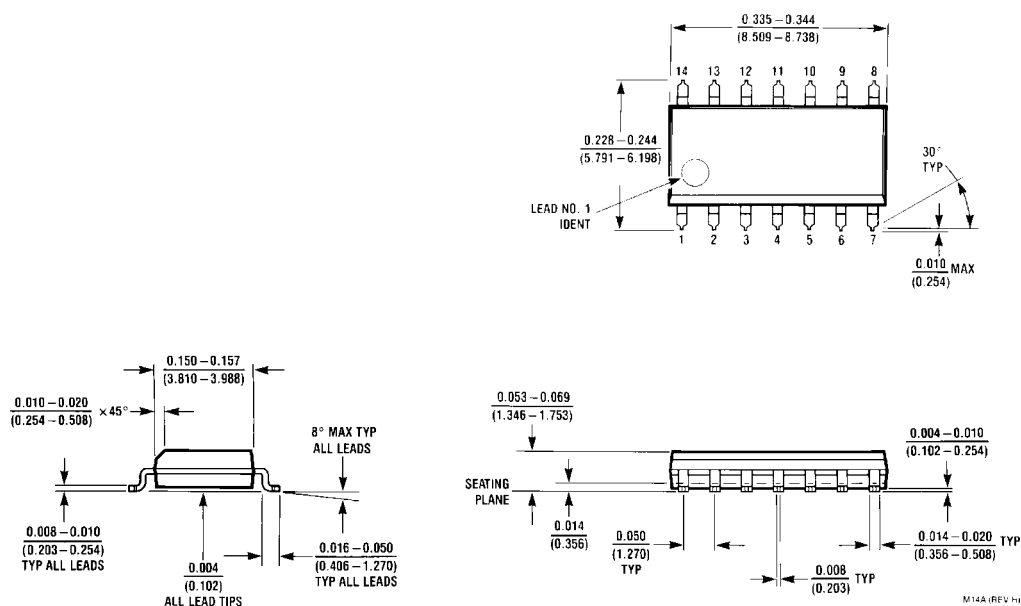


## Special Considerations

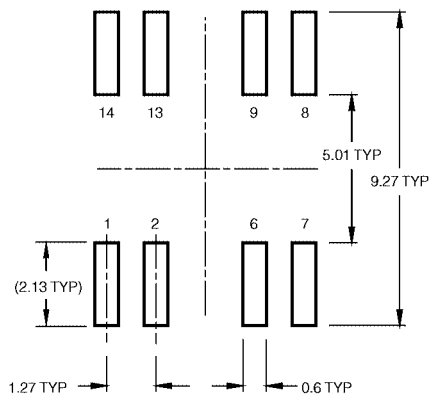
In certain applications the external load-resistor current may include both  $V_{CC}$  and signal line components. To avoid drawing  $V_{CC}$  current when switch current flows into

the analog switch input pins, the voltage drop across the switch must not exceed 0.6V (calculated from the ON resistance).

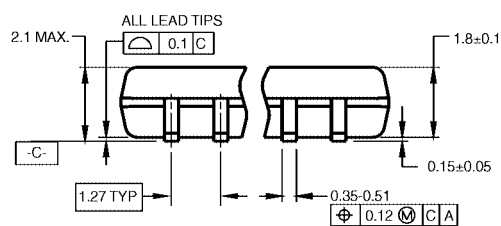
**Physical Dimensions** inches (millimeters) unless otherwise noted



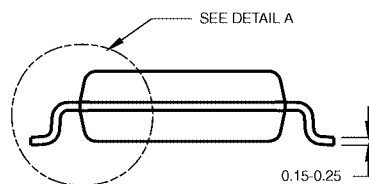
**14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow  
Package Number M14A**



### LAND PATTERN RECOMMENDATION



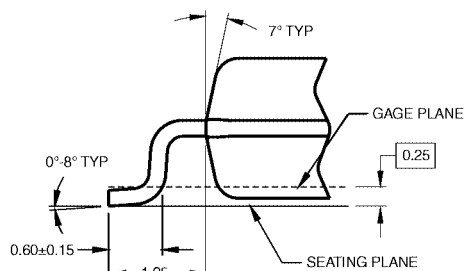
DIMENSIONS ARE IN MILLIMETERS



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.

M14DRevB1

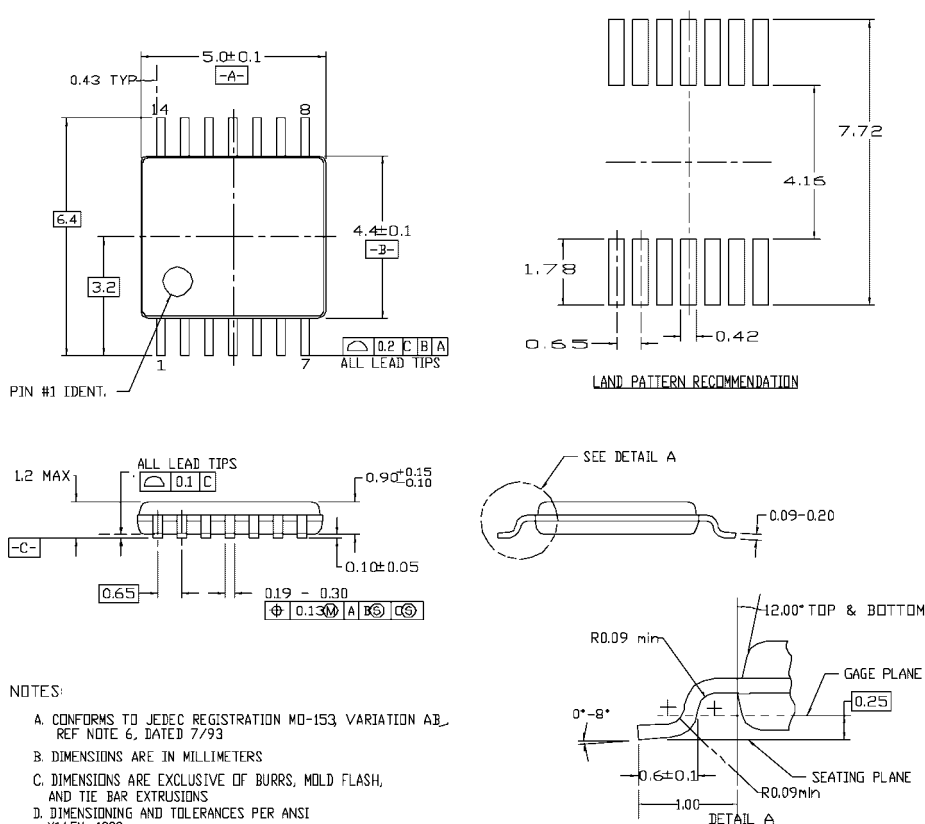


DETAIL A

**Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M14D**



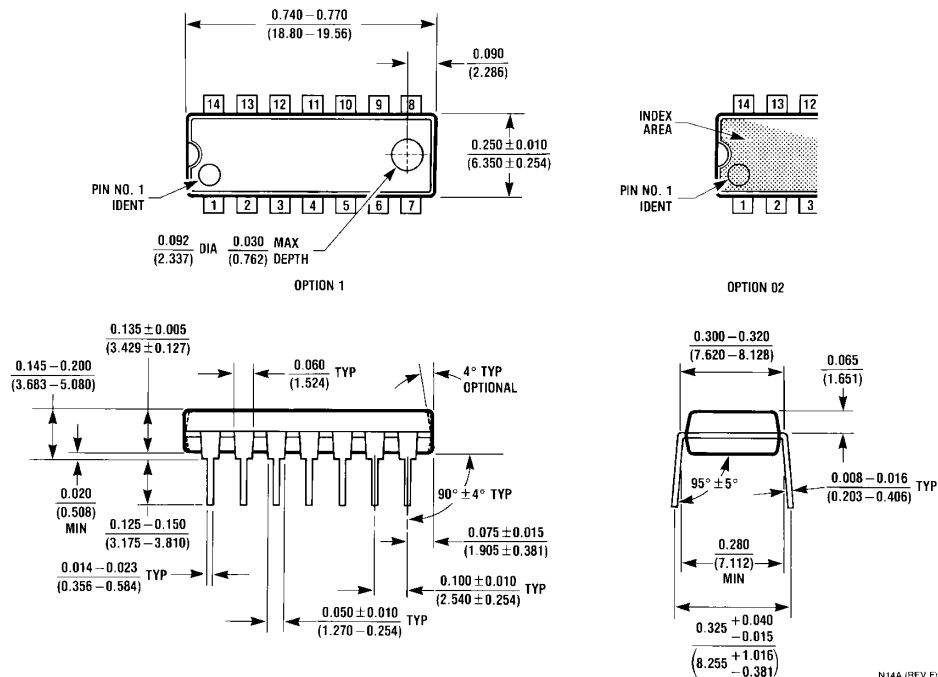
# Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



MTC14revD

14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC14

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide  
Package Number N14A

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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