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# MC14066B

## Quad Analog Switch/Quad Multiplexer

The MC14066B consists of four independent switches capable of controlling either digital or analog signals. This quad bilateral switch is useful in signal gating, chopper, modulator, demodulator and CMOS logic implementation.

The MC14066B is designed to be pin-for-pin compatible with the MC14016B, but has much lower ON resistance. Input voltage swings as large as the full supply voltage can be controlled via each independent control input.

### Features

- Triple Diode Protection on All Control Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Linearized Transfer Characteristics
- Low Noise –  $12 \text{ nV}/\sqrt{\text{Cycle}}$ ,  $f \geq 1.0 \text{ kHz}$  typical
- Pin-for-Pin Replacement for CD4016, MC14016B
- For Lower  $R_{ON}$ , Use The HC4066 High-Speed CMOS Device
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free and are RoHS Compliant

### MAXIMUM RATINGS (Voltages Referenced to $V_{SS}$ )

| Symbol            | Parameter                                       | Value                  | Unit               |
|-------------------|---|------------------------|--------------------|
| $V_{DD}$          | DC Supply Voltage Range                         | -0.5 to +18.0          | V                  |
| $V_{in}, V_{out}$ | Input or Output Voltage Range (DC or Transient) | -0.5 to $V_{DD} + 0.5$ | V                  |
| $I_{in}$          | Input Current (DC or Transient) per Control Pin | $\pm 10$               | mA                 |
| $I_{SW}$          | Switch Through Current                          | $\pm 25$               | mA                 |
| $P_D$             | Power Dissipation, per Package (Note 1)         | 500                    | mW                 |
| $T_A$             | Ambient Temperature Range                       | -55 to +125            | $^{\circ}\text{C}$ |
| $T_{stg}$         | Storage Temperature Range                       | -65 to +150            | $^{\circ}\text{C}$ |
| $T_L$             | Lead Temperature (8-Second Soldering)           | 260                    | $^{\circ}\text{C}$ |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Temperature Derating: "D/DW" Packages: -7.0 mW/ $^{\circ}\text{C}$  From 65 $^{\circ}\text{C}$  To 125 $^{\circ}\text{C}$

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either  $V_{SS}$  or  $V_{DD}$ ). Unused outputs must be left open.

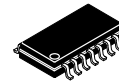


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SOIC-14  
D SUFFIX  
CASE 751A

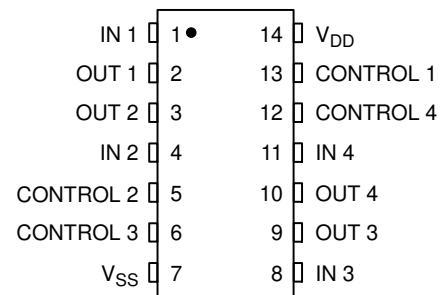


SOEIAJ-14  
F SUFFIX  
CASE 965

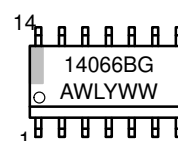


TSSOP-14  
DT SUFFIX  
CASE 948G

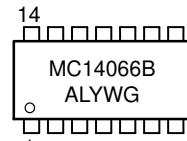
### PIN ASSIGNMENT



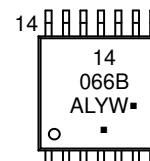
### MARKING DIAGRAMS



SOIC-14



SOEIAJ-14



TSSOP-14

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

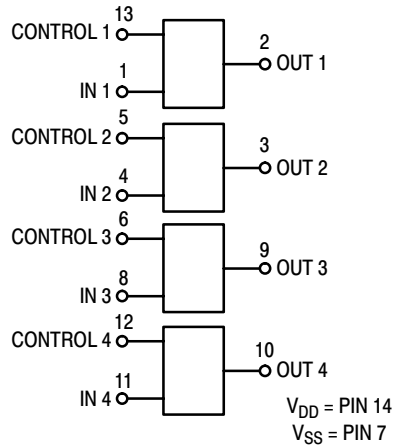
(Note: Microdot may be in either location)

### ORDERING INFORMATION

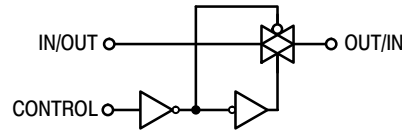
See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

# MC14066B

## BLOCK DIAGRAM



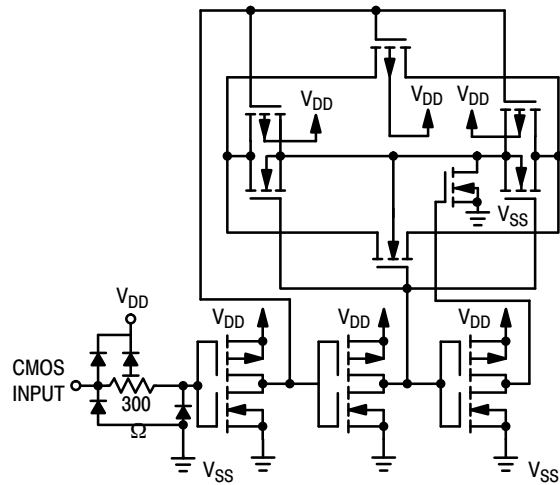
## LOGIC DIAGRAM AND TRUTH TABLE (1/4 OF DEVICE SHOWN)



| Control      | Switch |
|--------------|--------|
| 0 = $V_{SS}$ | OFF    |
| 1 = $V_{DD}$ | ON     |

Logic Diagram Restrictions  
 $V_{SS} \leq V_{in} \leq V_{DD}$   
 $V_{SS} \leq V_{out} \leq V_{DD}$

## CIRCUIT SCHEMATIC (1/4 OF CIRCUIT SHOWN)



# MC14066B

## ELECTRICAL CHARACTERISTICS

| Characteristic | Symbol | V <sub>DD</sub> | Test Conditions | -55°C |     | 25°C |                 |     | 125°C |     | Unit |
|----------------|--------|-----------------|-----------------|-------|-----|------|-----------------|-----|-------|-----|------|
|                |        |                 |                 | Min   | Max | Min  | Typ<br>(Note 2) | Max | Min   | Max |      |

### SUPPLY REQUIREMENTS (Voltages Referenced to V<sub>EE</sub>)

|  |                    |                 |   |   |                    |             |                         |                    |             |                 |    |
|--|--------------------|-----------------|---|---|--------------------|-------------|-------------------------|--------------------|-------------|-----------------|----|
| Power Supply Voltage Range                                 | V <sub>DD</sub>    | —               |   | 3.0   | 18                 | 3.0         | —                       | 18                 | 3.0         | 18              | V  |
| Quiescent Current Per Package                              | I <sub>DD</sub>    | 5.0<br>10<br>15 | Control Inputs:<br>V <sub>in</sub> = V <sub>SS</sub> or V <sub>DD</sub> ,<br>Switch I/O: V <sub>SS</sub> ≤ V <sub>I/O</sub> ≤ V <sub>DD</sub> , and<br>ΔV <sub>switch</sub> ≤ 500 mV <sup>(3)</sup> | —<br>—<br>—   | 0.25<br>0.5<br>1.0 | —<br>—<br>— | 0.005<br>0.010<br>0.015 | 0.25<br>0.5<br>1.0 | —<br>—<br>— | 7.5<br>15<br>30 | μA |
| Total Supply Current (Dynamic Plus Quiescent, Per Package) | I <sub>D(AV)</sub> | 5.0<br>10<br>15 | T <sub>A</sub> = 25°C only The channel component, (V <sub>in</sub> - V <sub>out</sub> )/R <sub>on</sub> , is not included.)   | Typical (0.07 μA/kHz) f + I <sub>DD</sub><br>(0.20 μA/kHz) f + I <sub>DD</sub><br>(0.36 μA/kHz) f + I <sub>DD</sub> |                    |             |                         |                    |             |                 | μA |

### CONTROL INPUTS (Voltages Referenced to V<sub>SS</sub>)

|                          |                 |                 |  |                  |                   |                  |                      |                   |                  |                   |    |
|--------------------------|-----------------|-----------------|--|------------------|-------------------|------------------|----------------------|-------------------|------------------|-------------------|----|
| Low-Level Input Voltage  | V <sub>IL</sub> | 5.0<br>10<br>15 | R <sub>on</sub> = per spec,<br>I <sub>off</sub> = per spec | —<br>—<br>—      | 1.5<br>3.0<br>4.0 | —<br>—<br>—      | 2.25<br>4.50<br>6.75 | 1.5<br>3.0<br>4.0 | —<br>—<br>—      | 1.5<br>3.0<br>4.0 | V  |
| High-Level Input Voltage | V <sub>IH</sub> | 5.0<br>10<br>15 | R <sub>on</sub> = per spec,<br>I <sub>off</sub> = per spec | 3.5<br>7.0<br>11 | —<br>—<br>—       | 3.5<br>7.0<br>11 | 2.75<br>5.50<br>8.25 | —<br>—<br>—       | 3.5<br>7.0<br>11 | —<br>—<br>—       | V  |
| Input Leakage Current    | I <sub>in</sub> | 15              | V <sub>in</sub> = 0 or V <sub>DD</sub>                     | —                | ±0.1              | —                | ±0.00001             | ±0.1              | —                | ±1.0              | μA |
| Input Capacitance        | C <sub>in</sub> | —               |  | —                | —                 | —                | 5.0                  | 7.5               | —                | —                 | pF |

### SWITCHES IN AND OUT (Voltages Referenced to V<sub>SS</sub>)

|   |                      |                 |   |             |                   |             |                  |                    |             |                    |                  |
|---|----------------------|-----------------|---|-------------|-------------------|-------------|------------------|--------------------|-------------|--------------------|------------------|
| Recommended Peak-to-Peak Voltage Into or Out of the Switch                  | V <sub>I/O</sub>     | —               | Channel On or Off   | 0           | V <sub>DD</sub>   | 0           | —                | V <sub>DD</sub>    | 0           | V <sub>DD</sub>    | V <sub>p-p</sub> |
| Recommended Static or Dynamic Voltage Across the Switch (Note 3) (Figure 1) | ΔV <sub>switch</sub> | —               | Channel On  | 0           | 600               | 0           | —                | 600                | 0           | 300                | mV               |
| Output Offset Voltage   | V <sub>OO</sub>      | —               | V <sub>in</sub> = 0 V, No Load  | —           | —                 | —           | 10               | —                  | —           | —                  | μV               |
| ON Resistance   | R <sub>on</sub>      | 5.0<br>10<br>15 | ΔV <sub>switch</sub> ≤ 500 mV <sup>(3)</sup> ,<br>V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>(Control), and V <sub>in</sub> =<br>0 to V <sub>DD</sub> (Switch) | —<br>—<br>— | 800<br>400<br>220 | —<br>—<br>— | 250<br>120<br>80 | 1050<br>500<br>280 | —<br>—<br>— | 1200<br>520<br>300 | Ω                |
| ΔON Resistance Between Any Two Channels in the Same Package                 | ΔR <sub>on</sub>     | 5.0<br>10<br>15 |   | —<br>—<br>— | 70<br>50<br>45    | —<br>—<br>— | 25<br>10<br>10   | 70<br>50<br>45     | —<br>—<br>— | 135<br>95<br>65    | Ω                |
| Off-Channel Leakage Current (Figure 6)                                      | I <sub>off</sub>     | 15              | V <sub>in</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>(Control) Channel to<br>Channel or Any One<br>Channel   | —           | ±100              | —           | ±0.05            | ±100               | —           | ±1000              | nA               |
| Capacitance, Switch I/O   | C <sub>I/O</sub>     | —               | Switch Off  | —           | —                 | —           | 10               | 15                 | —           | —                  | pF               |
| Capacitance, Feedthrough (Switch Off)                                       | C <sub>I/O</sub>     | —               |   | —           | —                 | —           | 0.47             | —                  | —           | —                  | pF               |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Data labeled "Typ" is not to be used for design purposes, but is intended as an indication of the IC's potential performance.

3. For voltage drops across the switch (ΔV<sub>switch</sub>) > 600 mV (> 300 mV at high temperature), excessive V<sub>DD</sub> current may be drawn; i.e. the current out of the switch may contain both V<sub>DD</sub> and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded. (See first page of this data sheet.)

# MC14066B

## ELECTRICAL CHARACTERISTICS (Note 4) ( $C_L = 50$ pF, $T_A = 25^\circ\text{C}$ unless otherwise noted.)

| Characteristic  | Symbol             | V <sub>DD</sub><br>Vdc | Min         | Typ<br>(Note 5) | Max             | Unit              |
|---|--------------------|------------------------|-------------|-----------------|-----------------|-------------------|
| Propagation Delay Times<br>Input to Output ( $R_L = 10$ k $\Omega$ )<br>$t_{PLH}, t_{PHL} = (0.17 \text{ ns/pF}) C_L + 15.5 \text{ ns}$<br>$t_{PLH}, t_{PHL} = (0.08 \text{ ns/pF}) C_L + 6.0 \text{ ns}$<br>$t_{PLH}, t_{PHL} = (0.06 \text{ ns/pF}) C_L + 4.0 \text{ ns}$ | $t_{PLH}, t_{PHL}$ | 5.0<br>10<br>15        | –<br>–<br>– | 20<br>10<br>7.0 | 40<br>20<br>15  | ns                |
| Control to Output ( $R_L = 1$ k $\Omega$ ) (Figure 2)<br>Output "1" to High Impedance   | $t_{PHZ}$          | 5.0<br>10<br>15        | –<br>–<br>– | 40<br>35<br>30  | 80<br>70<br>60  | ns                |
| Output "0" to High Impedance  | $t_{PLZ}$          | 5.0<br>10<br>15        | –<br>–<br>– | 40<br>35<br>30  | 80<br>70<br>60  | ns                |
| High Impedance to Output "1"  | $t_{PZH}$          | 5.0<br>10<br>15        | –<br>–<br>– | 60<br>20<br>15  | 120<br>40<br>30 | ns                |
| High Impedance to Output "0"  | $t_{PZL}$          | 5.0<br>10<br>15        | –<br>–<br>– | 60<br>20<br>15  | 120<br>40<br>30 | ns                |
| Second Harmonic Distortion<br>( $V_{in} = 1.77$ Vdc, RMS Centered @ 0.0 Vdc,<br>$R_L = 10$ k $\Omega$ , $f = 1.0$ kHz)  | –                  | 5.0                    | –           | 0.1             | –               | %                 |
| Bandwidth (Switch ON) (Figure 3)<br>( $R_L = 1$ k $\Omega$ , 20 Log ( $V_{out}/V_{in}$ ) = – 3 dB, $C_L = 50$ pF,<br>$V_{in} = 5$ V <sub>p-p</sub> )  | –                  | 5.0                    | –           | 65              | –               | MHz               |
| Feedthrough Attenuation (Switch OFF)<br>( $V_{in} = 5$ V <sub>p-p</sub> , $R_L = 1$ k $\Omega$ , $f_{in} = 1.0$ MHz) (Figure 3)   | –                  | 5.0                    | –           | – 50            | –               | dB                |
| Channel Separation (Figure 4)<br>( $V_{in} = 5$ V <sub>p-p</sub> , $R_L = 1$ k $\Omega$ , $f_{in} = 8.0$ MHz)<br>(Switch A ON, Switch B OFF)  | –                  | 5.0                    | –           | – 50            | –               | dB                |
| Crosstalk, Control Input to Signal Output (Figure 5)<br>( $R_1 = 1$ k $\Omega$ , $R_L = 10$ k $\Omega$ , Control $t_{TLH} = t_{THL} = 20$ ns)   | –                  | 5.0                    | –           | 300             | –               | mV <sub>p-p</sub> |

4. The formulas given are for the typical characteristics only at 25°C.

5. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

TEST CIRCUITS

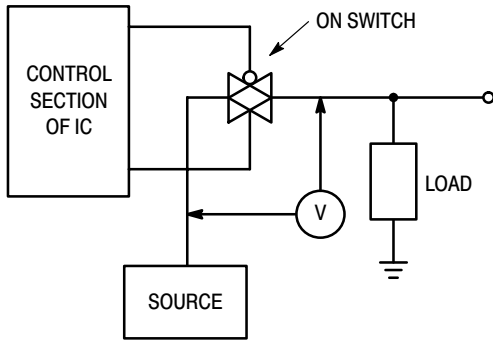


Figure 1.  $\Delta V$  Across Switch

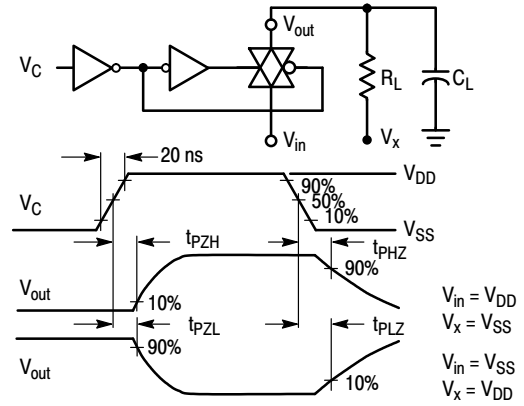


Figure 2. Turn-On Delay Time Test Circuit and Waveforms

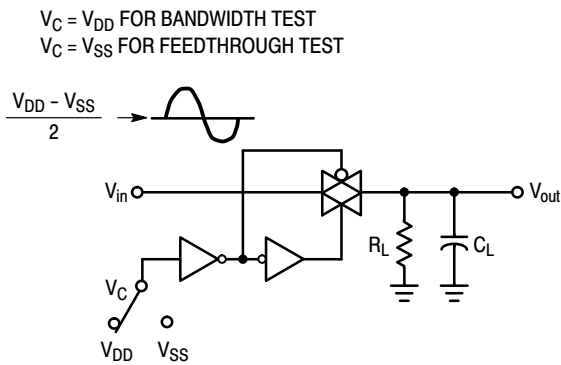


Figure 3. Bandwidth and Feedthrough Attenuation

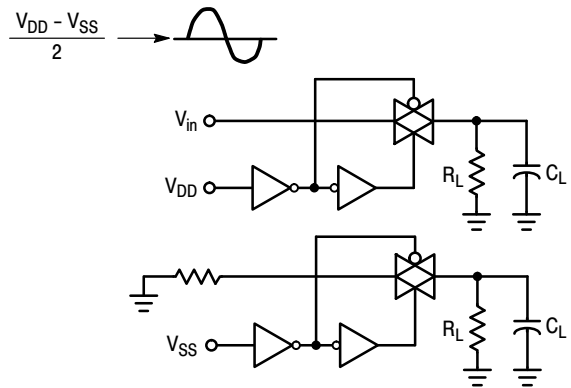


Figure 4. Channel Separation

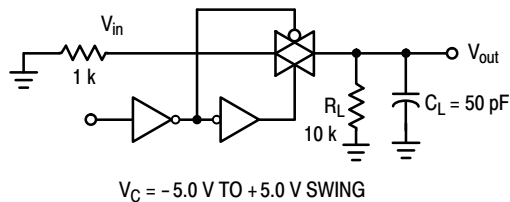


Figure 5. Crosstalk, Control to Output

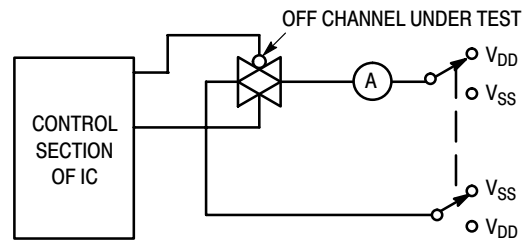


Figure 6. Off Channel Leakage

# MC14066B

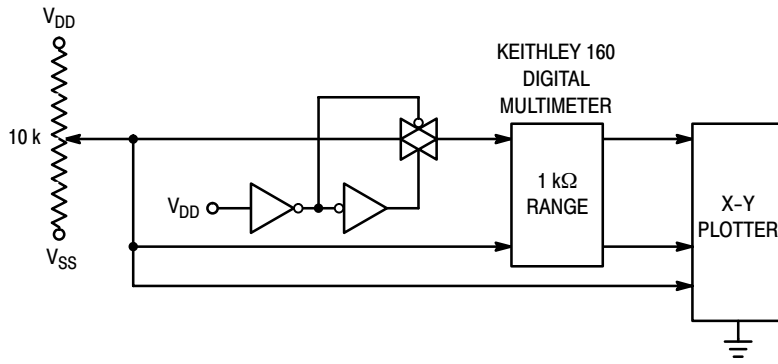


Figure 7. Channel Resistance ( $R_{ON}$ ) Test Circuit

## TYPICAL RESISTANCE CHARACTERISTICS

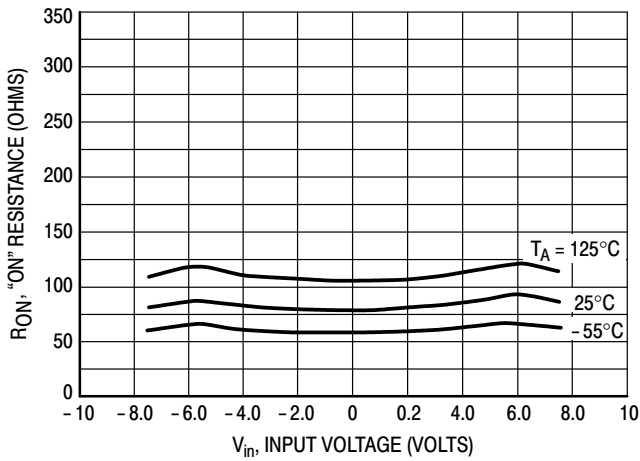


Figure 8.  $V_{DD} = 7.5 \text{ V}$ ,  $V_{SS} = -7.5 \text{ V}$

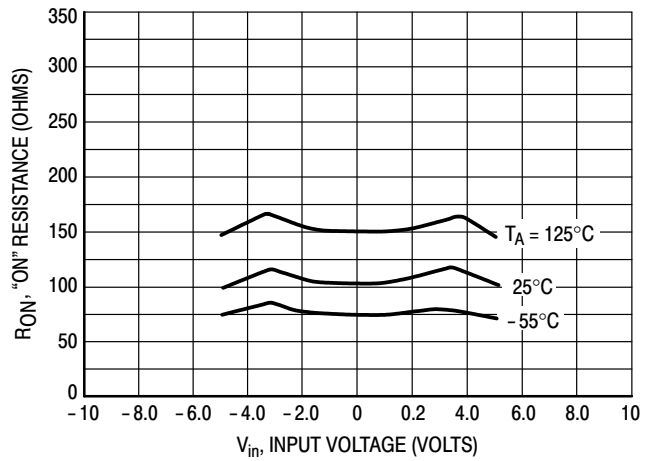


Figure 9.  $V_{DD} = 5.0 \text{ V}$ ,  $V_{SS} = -5.0 \text{ V}$

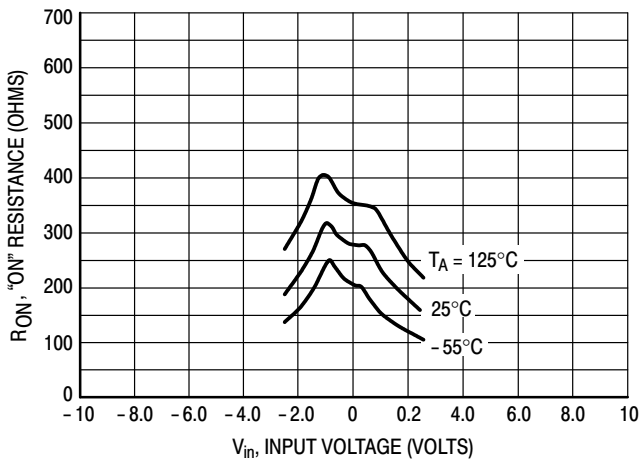


Figure 10.  $V_{DD} = 2.5 \text{ V}$ ,  $V_{SS} = -2.5 \text{ V}$

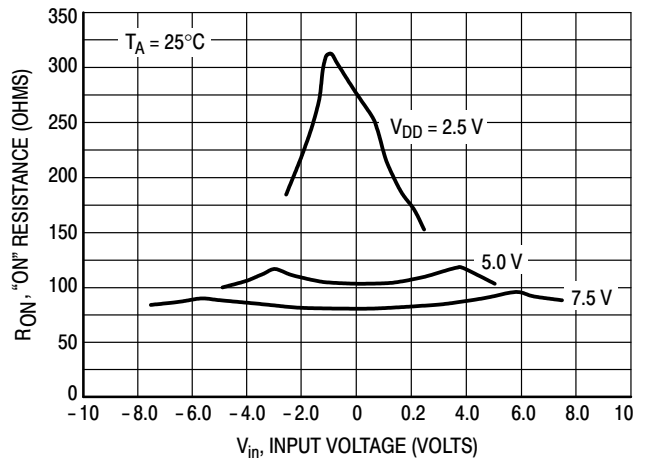


Figure 11. Comparison at  $25^\circ\text{C}$ ,  $V_{DD} = -V_{SS}$

# MC14066B

## APPLICATIONS INFORMATION

Figure A illustrates use of the Analog Switch. The 0-to-5 V digital control signal is used to directly control a 5 V peak-to-peak analog signal.

The digital control logic levels are determined by  $V_{DD}$  and  $V_{SS}$ . The  $V_{DD}$  voltage is the logic high voltage, the  $V_{SS}$  voltage is logic low. For the example,  $V_{DD} = +5\text{ V} =$  logic high at the control inputs;  $V_{SS} = \text{GND} = 0\text{ V} =$  logic low.

The maximum analog signal level is determined by  $V_{DD}$  and  $V_{SS}$ . The analog voltage must not swing higher than  $V_{DD}$  or lower than  $V_{SS}$ .

The example shows a 5 V peak-to-peak signal which allows no margin at either peak. If voltage transients above

$V_{DD}$  and/or below  $V_{SS}$  are anticipated on the analog channels, external diodes ( $D_x$ ) are recommended as shown in Figure B. These diodes should be small signal types able to absorb the maximum anticipated current surges during clipping.

The *absolute* maximum potential difference between  $V_{DD}$  and  $V_{SS}$  is 18 V. Most parameters are specified up to 15 V which is the *recommended* maximum difference between  $V_{DD}$  and  $V_{SS}$ .

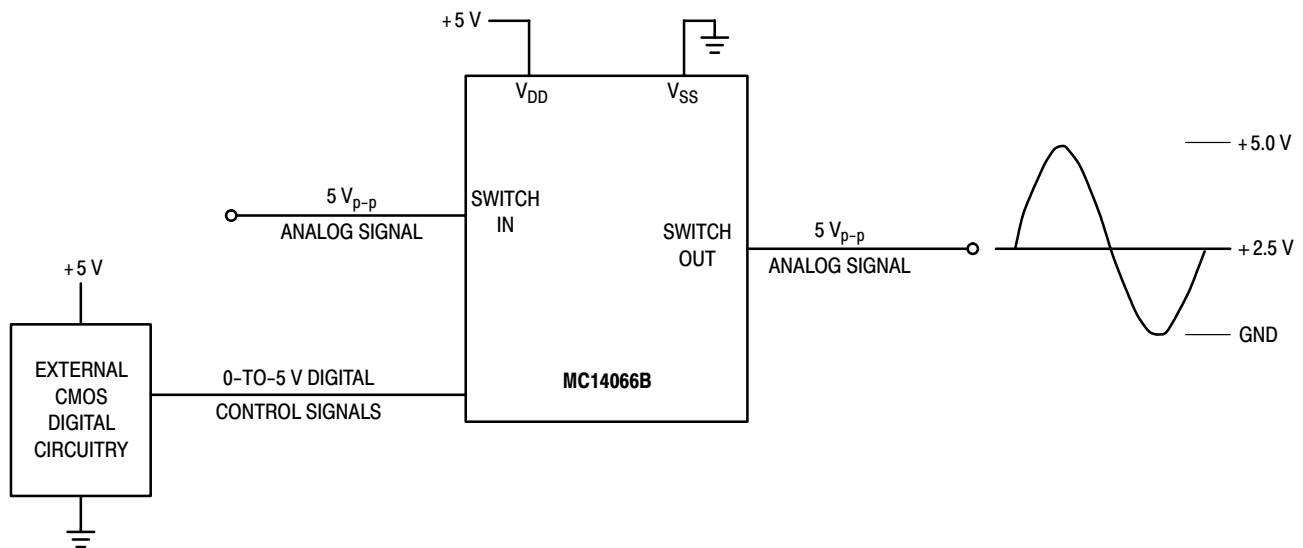


Figure A. Application Example

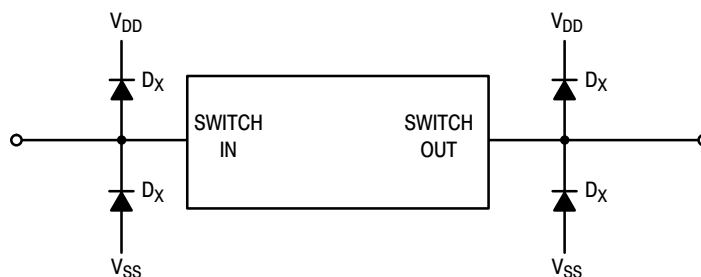


Figure B. External Germanium or Schottky Clipping Diodes



## MC14066B

### ORDERING INFORMATION

| Device          | Package                | Shipping†          |
|-----------------|------------------------|--------------------|
| MC14066BDG      | SOIC-14<br>(Pb-Free)   | 55 Units / Rail    |
| NLV14066BDG*    | SOIC-14<br>(Pb-Free)   | 55 Units / Rail    |
| MC14066BDR2G    | SOIC-14<br>(Pb-Free)   | 2500 / Tape & Reel |
| NLV14066BDR2G*  | SOIC-14<br>(Pb-Free)   | 2500 / Tape & Reel |
| MC14066BDTR2G   | TSSOP-14<br>(Pb-Free)  | 2500 / Tape & Reel |
| NLV14066BDTR2G* | TSSOP-14<br>(Pb-Free)  | 2500 / Tape & Reel |
| MC14066BFELG    | SOEIAJ-14<br>(Pb-Free) | 2000 / Tape & Reel |

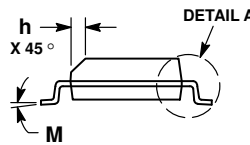
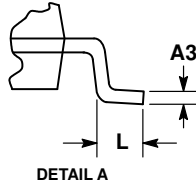
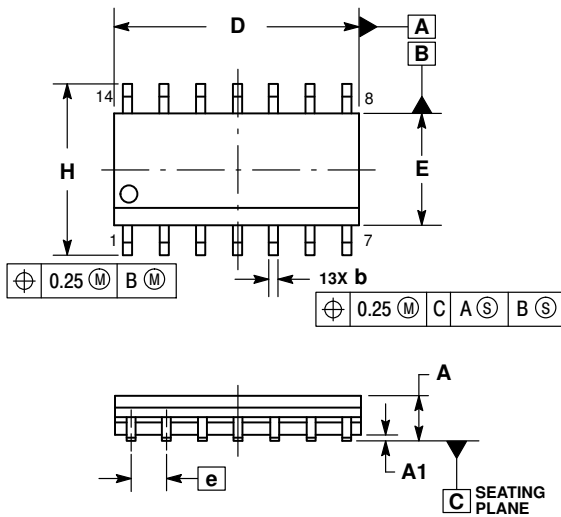
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

# MC14066B

## PACKAGE DIMENSIONS

SOIC-14 NB  
CASE 751A-03  
ISSUE K

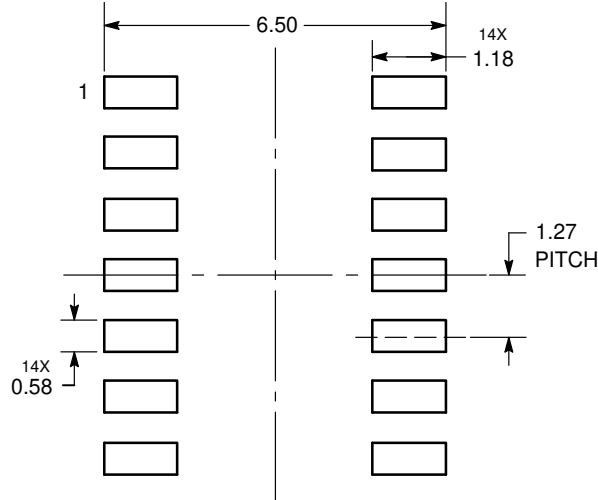


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.35        | 1.75 | 0.054     | 0.068 |
| A1  | 0.10        | 0.25 | 0.004     | 0.010 |
| A3  | 0.19        | 0.25 | 0.008     | 0.010 |
| b   | 0.35        | 0.49 | 0.014     | 0.019 |
| D   | 8.55        | 8.75 | 0.337     | 0.344 |
| E   | 3.80        | 4.00 | 0.150     | 0.157 |
| e   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 5.80        | 6.20 | 0.228     | 0.244 |
| h   | 0.25        | 0.50 | 0.010     | 0.019 |
| L   | 0.40        | 1.25 | 0.016     | 0.049 |
| M   | 0°          | 7°   | 0°        | 7°    |

### SOLDERING FOOTPRINT\*



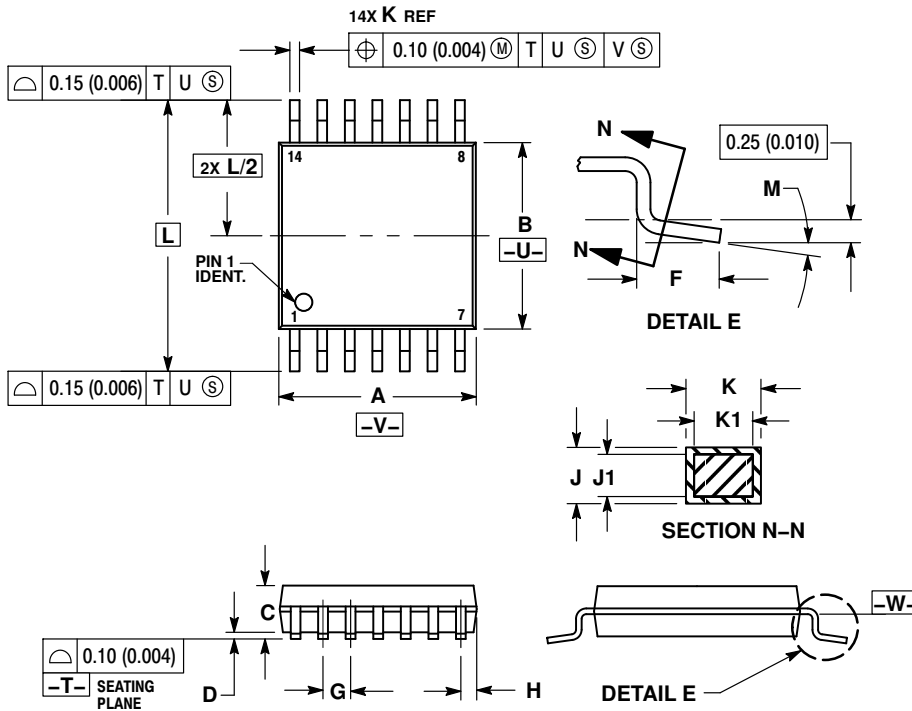
DIMENSIONS: MILLIMETERS

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

# MC14066B

## PACKAGE DIMENSIONS

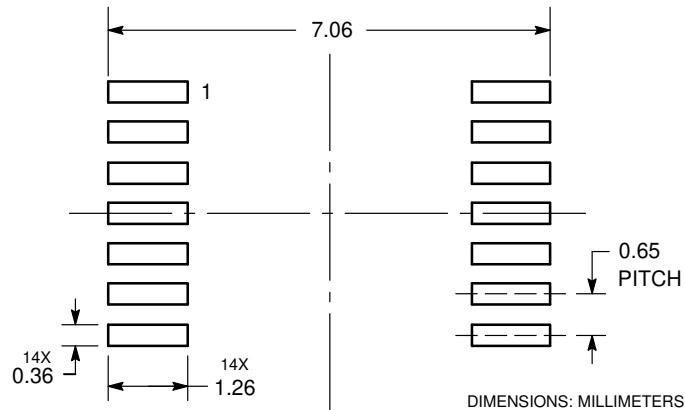
TSSOP-14  
CASE 948G  
ISSUE B



- 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   | 0.50        | 0.60 | 0.020     | 0.024 |
| J   | 0.09        | 0.20 | 0.004     | 0.008 |
| J1  | 0.09        | 0.16 | 0.004     | 0.006 |
| K   | 0.19        | 0.30 | 0.007     | 0.012 |
| K1  | 0.19        | 0.25 | 0.007     | 0.010 |
| L   | 6.40 BSC    |      | 0.252 BSC |       |
| M   | 0°          | 8°   | 0°        | 8°    |

### SOLDERING FOOTPRINT\*

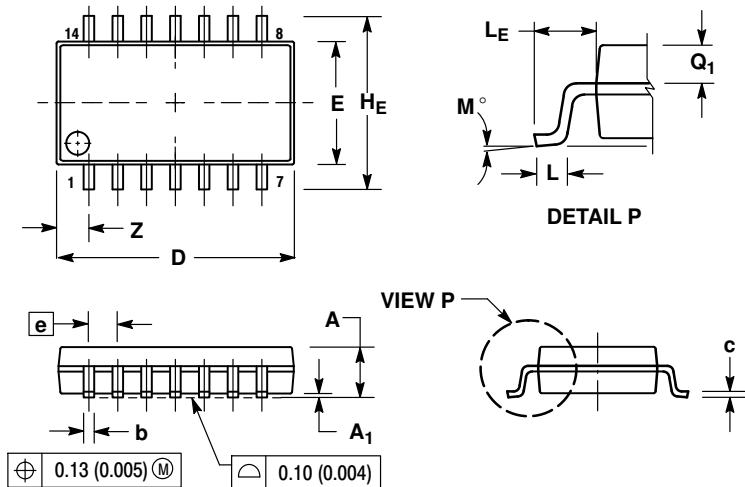


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# MC14066B

## PACKAGE DIMENSIONS


SOEIAJ-14  
CASE 965  
ISSUE B



### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

| DIM            | MILLIMETERS |       | INCHES    |       |
|----------------|-------------|-------|-----------|-------|
|                | MIN         | MAX   | MIN       | MAX   |
| A              | ---         | 2.05  | ---       | 0.081 |
| A <sub>1</sub> | 0.05        | 0.20  | 0.002     | 0.008 |
| b              | 0.35        | 0.50  | 0.014     | 0.020 |
| c              | 0.10        | 0.20  | 0.004     | 0.008 |
| D              | 9.90        | 10.50 | 0.390     | 0.413 |
| E              | 5.10        | 5.45  | 0.201     | 0.215 |
| e              | 1.27 BSC    |       | 0.050 BSC |       |
| HE             | 7.40        | 8.20  | 0.291     | 0.323 |
| L              | 0.50        | 0.85  | 0.020     | 0.033 |
| LE             | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0°          | 10°   | 0°        | 10°   |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 1.42  | ---       | 0.056 |

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