

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.

- 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

MAXIMUM RATINGS (Voltages Referenced to V_{SS}) (Note 2.)

| 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 | ± 10 | mA |
| I_{SW} | Switch Through Current | ± 25 | mA |
| P_D | Power Dissipation, per Package (Note 3.) | 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 | $^{\circ}\text{C}$ |

2. Maximum Ratings are those values beyond which damage to the device may occur.
3. Temperature Derating:
Plastic "P and 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 $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

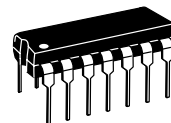
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.



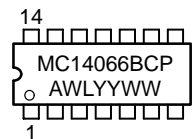
ON Semiconductor

<http://onsemi.com>

MARKING DIAGRAMS



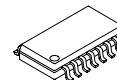
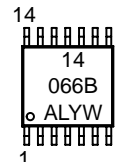
PDIP-14
P SUFFIX
CASE 646



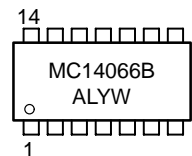
SOIC-14
D SUFFIX
CASE 751A



TSSOP-14
DT SUFFIX
CASE 948G



SOEIAJ-14
F SUFFIX
CASE 965



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week

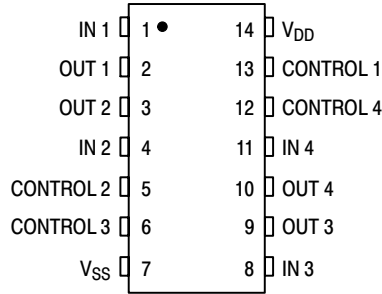
ORDERING INFORMATION

| Device | Package | Shipping |
|--------------|-----------|------------------|
| MC14066BCP | PDIP-14 | 2000/Box |
| MC14066BD | SOIC-14 | 55/Rail |
| MC14066BDR2 | SOIC-14 | 2500/Tape & Reel |
| MC14066BDT | TSSOP-14 | 96/Rail |
| MC14066BDTEL | TSSOP-14 | 2000/Tape & Reel |
| MC14066BDTR2 | TSSOP-14 | 2500/Tape & Reel |
| MC14066BF | SOEIAJ-14 | See Note 1. |
| MC14066BFEL | SOEIAJ-14 | See Note 1. |

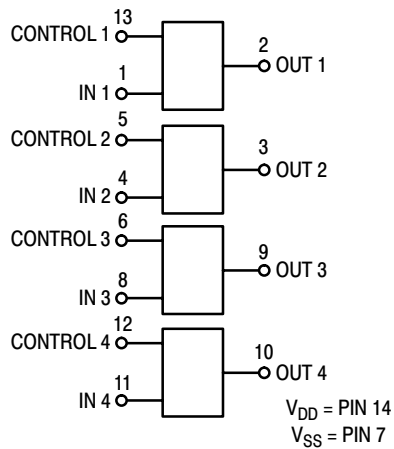
1. For ordering information on the EIAJ version of the SOIC packages, please contact your local ON Semiconductor representative.

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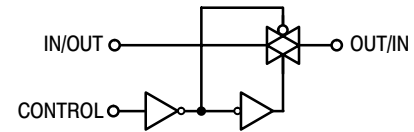
PIN ASSIGNMENT



BLOCK DIAGRAM



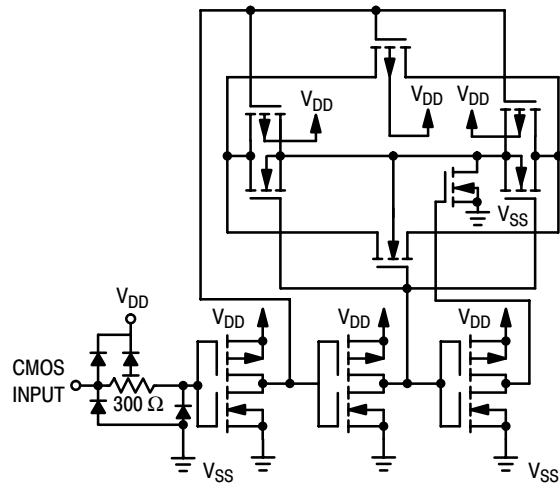
LOGIC DIAGRAM AND TRUTH TABLE (1/4 OF DEVICE SHOWN)



| 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 _{DD} | Test Conditions | - 55°C | | 25°C | | | 125°C | | Unit |
|----------------|--------|-----------------|-----------------|--------|-----|------|---------|-----|-------|-----|------|
| | | | | Min | Max | Min | Typ (4) | Max | Min | Max | |

SUPPLY REQUIREMENTS (Voltages Referenced to V_{EE})

| | | | | | | | | | | | |
|--|--------------------|-----------------|--|---|------|-----|-------|------|-----|-----|----|
| Power Supply Voltage Range | V _{DD} | — | | 3.0 | 18 | 3.0 | — | 18 | 3.0 | 18 | V |
| Quiescent Current Per Package | I _{DD} | 5.0 | Control Inputs: V _{in} = V _{SS} or V _{DD} , Switch I/O: V _{SS} ≤ V _{I/O} ≤ V _{DD} , and ΔV _{switch} ≤ 500 mV (5.) | — | 0.25 | — | 0.005 | 0.25 | — | 7.5 | μA |
| | | 10 | | — | 0.5 | — | 0.010 | 0.5 | — | 15 | |
| | | 15 | | — | 1.0 | — | 0.015 | 1.0 | — | 30 | |
| Total Supply Current (Dynamic Plus Quiescent, Per Package) | I _{D(AV)} | 5.0 10 15 | T _A = 25°C only The channel component, (V _{in} - V _{out})/R _{on} , is not included.) | Typical (0.07 μA/kHz) f + I _{DD} (0.20 μA/kHz) f + I _{DD} (0.36 μA/kHz) f + I _{DD} | | | | | | μA | |

CONTROL INPUTS (Voltages Referenced to V_{SS})

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

SWITCHES IN AND OUT (Voltages Referenced to V_{SS})

| | | | | | | | | | | | |
|---|----------------------|-----|--|---|-----------------|---|--------|-----------------|---|-----------------|------------------|
| Recommended Peak-to-Peak Voltage Into or Out of the Switch | V _{I/O} | — | Channel On or Off | 0 | V _{DD} | 0 | — | V _{DD} | 0 | V _{DD} | V _{p-p} |
| Recommended Static or Dynamic Voltage Across the Switch (5.) (Figure 1) | ΔV _{switch} | — | Channel On | 0 | 600 | 0 | — | 600 | 0 | 300 | mV |
| Output Offset Voltage | V _{OO} | — | V _{in} = 0 V, No Load | — | — | — | 10 | — | — | — | μV |
| ON Resistance | R _{on} | 5.0 | ΔV _{switch} ≤ 500 mV (5.), V _{in} = V _{IL} or V _{IH} (Control), and V _{in} = 0 to V _{DD} (Switch) | — | 800 | — | 250 | 1050 | — | 1200 | Ω |
| | | 10 | | — | 400 | — | 120 | 500 | — | 520 | |
| | | 15 | | — | 220 | — | 80 | 280 | — | 300 | |
| ΔON Resistance Between Any Two Channels in the Same Package | ΔR _{on} | 5.0 | | — | 70 | — | 25 | 70 | — | 135 | Ω |
| | | 10 | | — | 50 | — | 10 | 50 | — | 95 | |
| | | 15 | | — | 45 | — | 10 | 45 | — | 65 | |
| Off-Channel Leakage Current (Figure 6) | I _{off} | 15 | V _{in} = V _{IL} or V _{IH} (Control) Channel to Channel or Any One Channel | — | ±100 | — | ± 0.05 | ±100 | — | ±1000 | nA |
| Capacitance, Switch I/O | C _{I/O} | — | Switch Off | — | — | — | 10 | 15 | — | — | pF |
| Capacitance, Feedthrough (Switch Off) | C _{I/O} | — | | — | — | — | 0.47 | — | — | — | pF |

- Data labeled "Typ" is not to be used for design purposes, but is intended as an indication of the IC's potential performance.
- For voltage drops across the switch (ΔV_{switch}) > 600 mV (> 300 mV at high temperature), excessive V_{DD} current may be drawn; i.e. the current out of the switch may contain both V_{DD} 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.)

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ELECTRICAL CHARACTERISTICS ^(6.) ($C_L = 50 \text{ pF}$, $T_A = 25^\circ\text{C}$ unless otherwise noted.)

| Characteristic | Symbol | V _{DD} Vdc | Min | Typ ^(7.) | Max | Unit |
|---|-----------------------|------------------------|-------------|---------------------|-----------------|-------------------|
| Propagation Delay Times Input to Output ($R_L = 10 \text{ k}\Omega$) t_{PLH} , $t_{PHL} = (0.17 \text{ ns/pF}) C_L + 15.5 \text{ ns}$ t_{PLH} , $t_{PHL} = (0.08 \text{ ns/pF}) C_L + 6.0 \text{ ns}$ t_{PLH} , $t_{PHL} = (0.06 \text{ ns/pF}) C_L + 4.0 \text{ ns}$ | t_{PLH} , t_{PHL} | 5.0 10 15 | — — — | 20 10 7.0 | 40 20 15 | ns |
| Control to Output ($R_L = 1 \text{ k}\Omega$) (Figure 2) Output "1" to High Impedance | t_{PHZ} | 5.0 10 15 | — — — | 40 35 30 | 80 70 60 | ns |
| Output "0" to High Impedance | t_{PLZ} | 5.0 10 15 | — — — | 40 35 30 | 80 70 60 | ns |
| High Impedance to Output "1" | t_{PZH} | 5.0 10 15 | — — — | 60 20 15 | 120 40 30 | ns |
| High Impedance to Output "0" | t_{PZL} | 5.0 10 15 | — — — | 60 20 15 | 120 40 30 | ns |
| Second Harmonic Distortion ($V_{in} = 1.77 \text{ Vdc}$, RMS Centered @ 0.0 Vdc, $R_L = 10 \text{ k}\Omega$, $f = 1.0 \text{ kHz}$) | — | 5.0 | — | 0.1 | — | % |
| Bandwidth (Switch ON) (Figure 3) ($R_L = 1 \text{ k}\Omega$, 20 Log (V_{out}/V_{in}) = -3 dB, $C_L = 50 \text{ pF}$, $V_{in} = 5 \text{ V}_{p-p}$) | — | 5.0 | — | 65 | — | MHz |
| Feedthrough Attenuation (Switch OFF) ($V_{in} = 5 \text{ V}_{p-p}$, $R_L = 1 \text{ k}\Omega$, $f_{in} = 1.0 \text{ MHz}$) (Figure 3) | — | 5.0 | — | -50 | — | dB |
| Channel Separation (Figure 4) ($V_{in} = 5 \text{ V}_{p-p}$, $R_L = 1 \text{ k}\Omega$, $f_{in} = 8.0 \text{ MHz}$) (Switch A ON, Switch B OFF) | — | 5.0 | — | -50 | — | dB |
| Crosstalk, Control Input to Signal Output (Figure 5) ($R_1 = 1 \text{ k}\Omega$, $R_L = 10 \text{ k}\Omega$, Control $t_{TLH} = t_{THL} = 20 \text{ ns}$) | — | 5.0 | — | 300 | — | mV _{p-p} |

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

7. 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

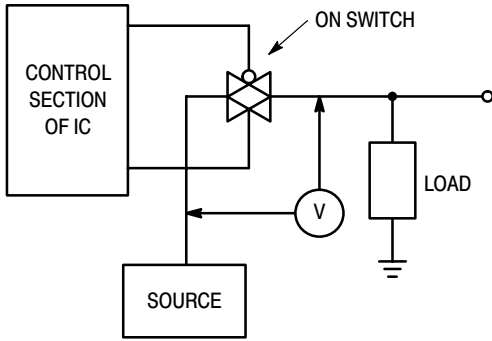


Figure 1. ΔV Across Switch

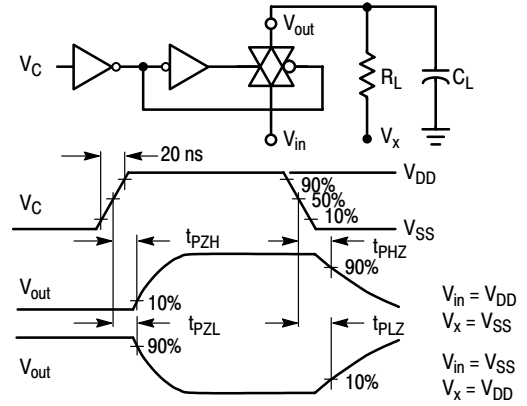


Figure 2. Turn-On Delay Time Test Circuit and Waveforms

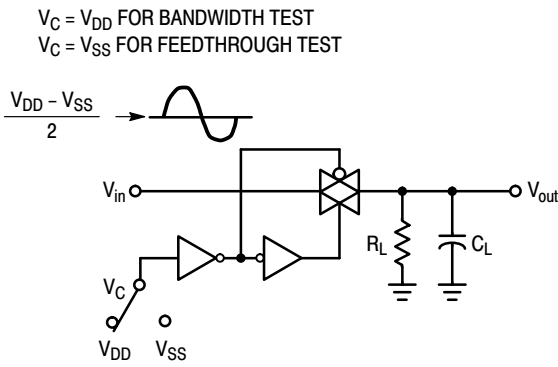


Figure 3. Bandwidth and Feedthrough Attenuation

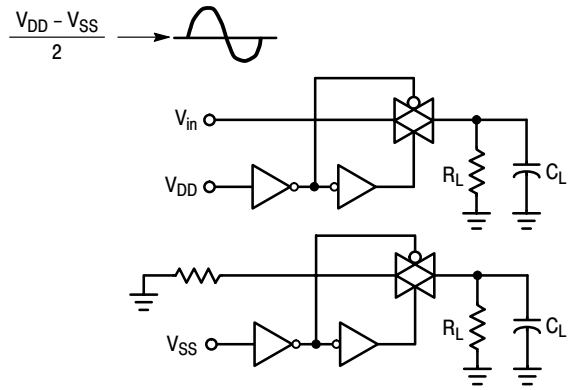


Figure 4. Channel Separation

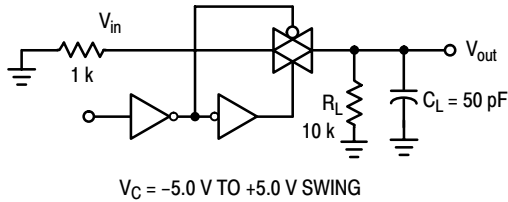


Figure 5. Crosstalk, Control to Output

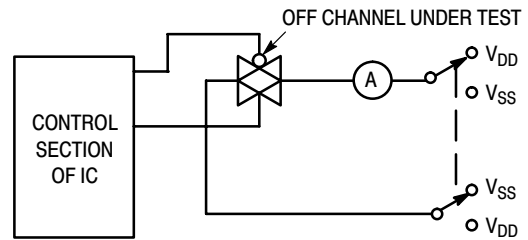


Figure 6. Off Channel Leakage

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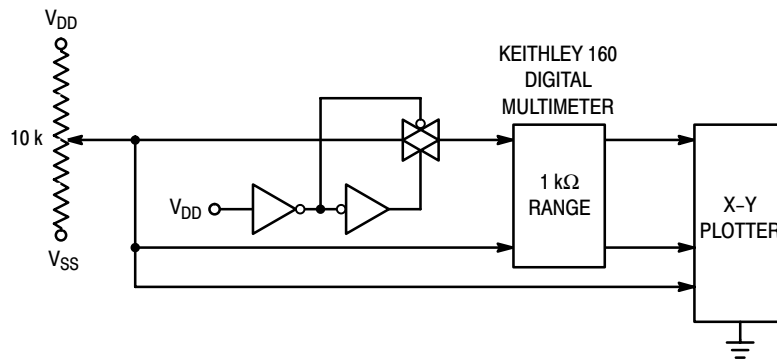


Figure 7. Channel Resistance (R_{ON}) Test Circuit

TYPICAL RESISTANCE CHARACTERISTICS

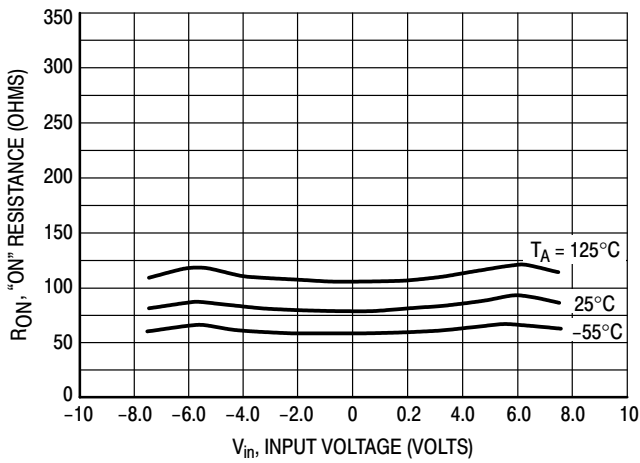


Figure 8. $V_{DD} = 7.5\text{ V}$, $V_{SS} = -7.5\text{ V}$

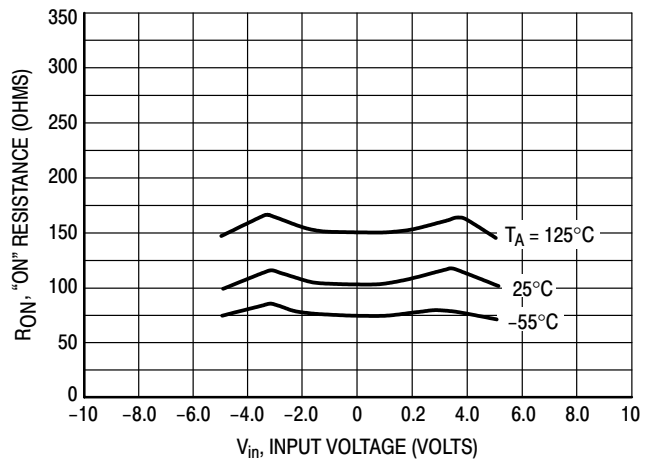


Figure 9. $V_{DD} = 5.0\text{ V}$, $V_{SS} = -5.0\text{ V}$

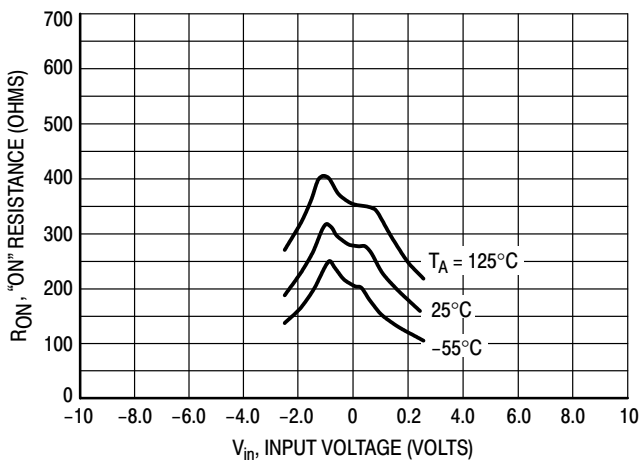


Figure 10. $V_{DD} = 2.5\text{ V}$, $V_{SS} = -2.5\text{ V}$

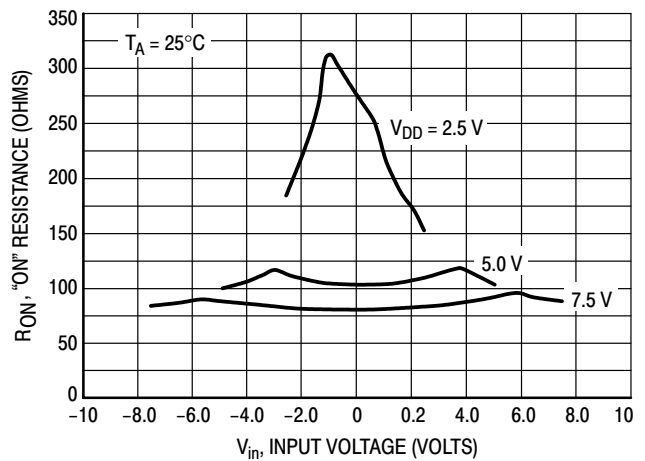


Figure 11. Comparison at 25°C , $V_{DD} = -V_{SS}$

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APPLICATIONS INFORMATION

Figure A illustrates use of the Analog Switch. The 0–5 volt digital control signal is used to directly control a 5 volt 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 volt 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 18.0 volts. Most parameters are specified up to 15 volts which is the *recommended* maximum difference between V_{DD} and V_{SS} .

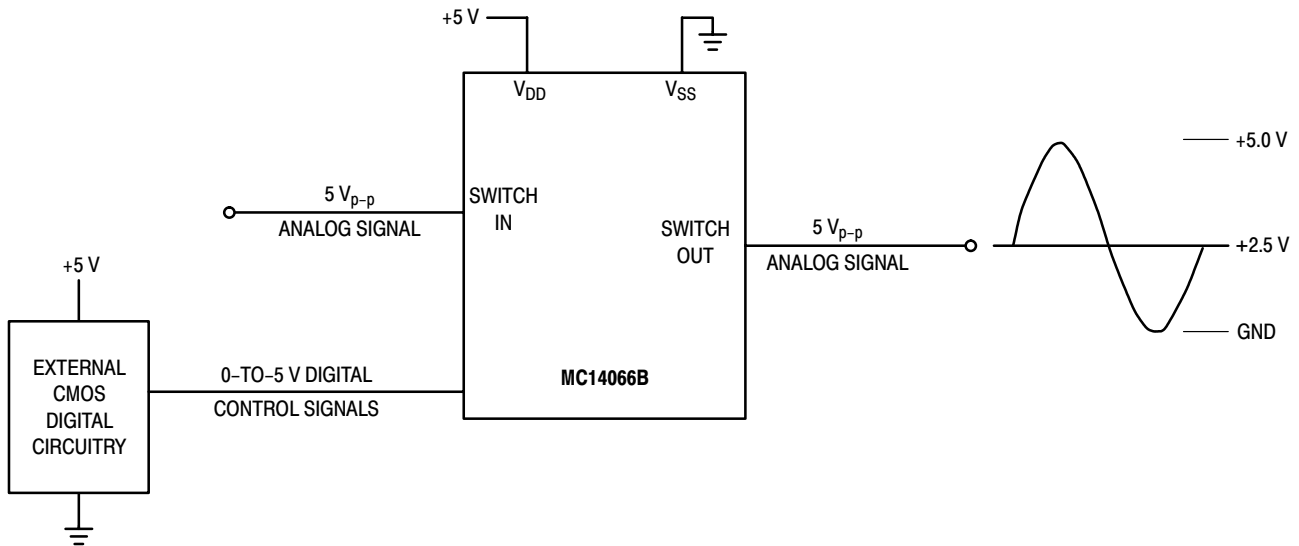


Figure A. Application Example

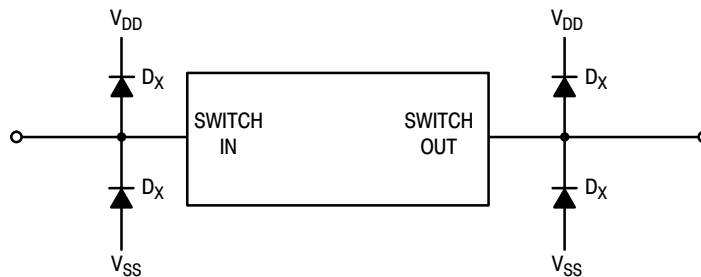
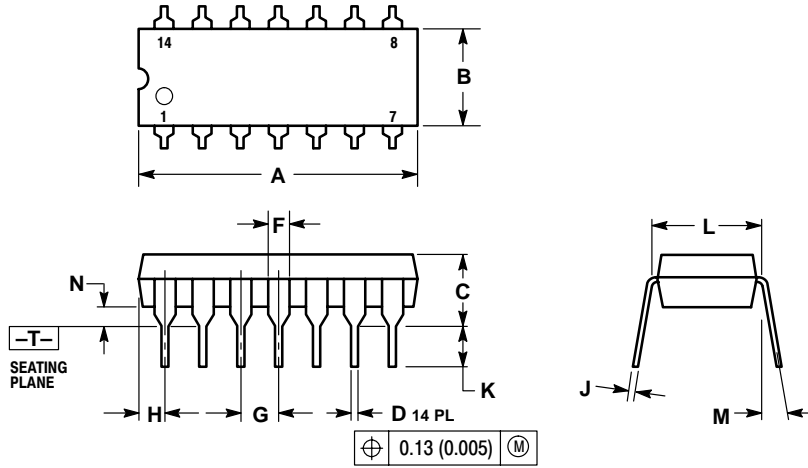


Figure B. External Germanium or Schottky Clipping Diodes

MC14066B

PACKAGE DIMENSIONS

P SUFFIX
PLASTIC DIP PACKAGE
CASE 646-06
ISSUE M



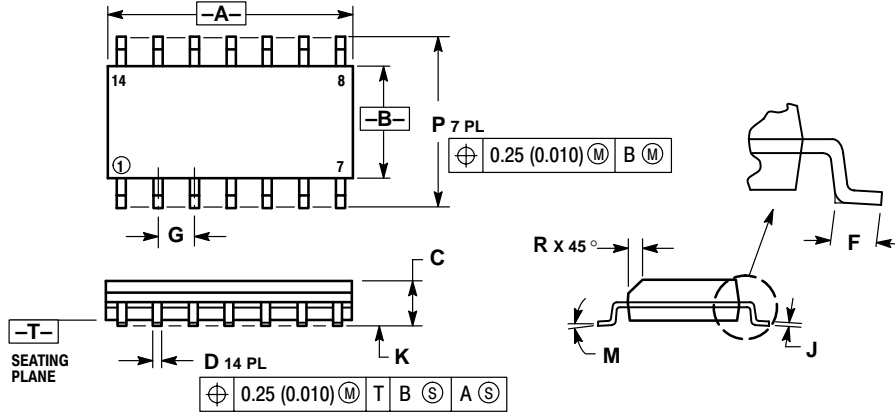
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
 4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
 5. ROUNDED CORNERS OPTIONAL.

| DIM | INCHES | | MILLIMETERS | |
|-----|-----------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.715 | 0.770 | 18.16 | 18.80 |
| B | 0.240 | 0.260 | 6.10 | 6.60 |
| C | 0.145 | 0.185 | 3.69 | 4.69 |
| D | 0.015 | 0.021 | 0.38 | 0.53 |
| F | 0.040 | 0.070 | 1.02 | 1.78 |
| G | 0.100 BSC | | 2.54 BSC | |
| H | 0.052 | 0.095 | 1.32 | 2.41 |
| J | 0.008 | 0.015 | 0.20 | 0.38 |
| K | 0.115 | 0.135 | 2.92 | 3.43 |
| L | 0.290 | 0.310 | 7.37 | 7.87 |
| M | --- | 10° | --- | 10° |
| N | 0.015 | 0.039 | 0.38 | 1.01 |

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PACKAGE DIMENSIONS

D SUFFIX PLASTIC SOIC PACKAGE CASE 751A-03 ISSUE F



NOTES:

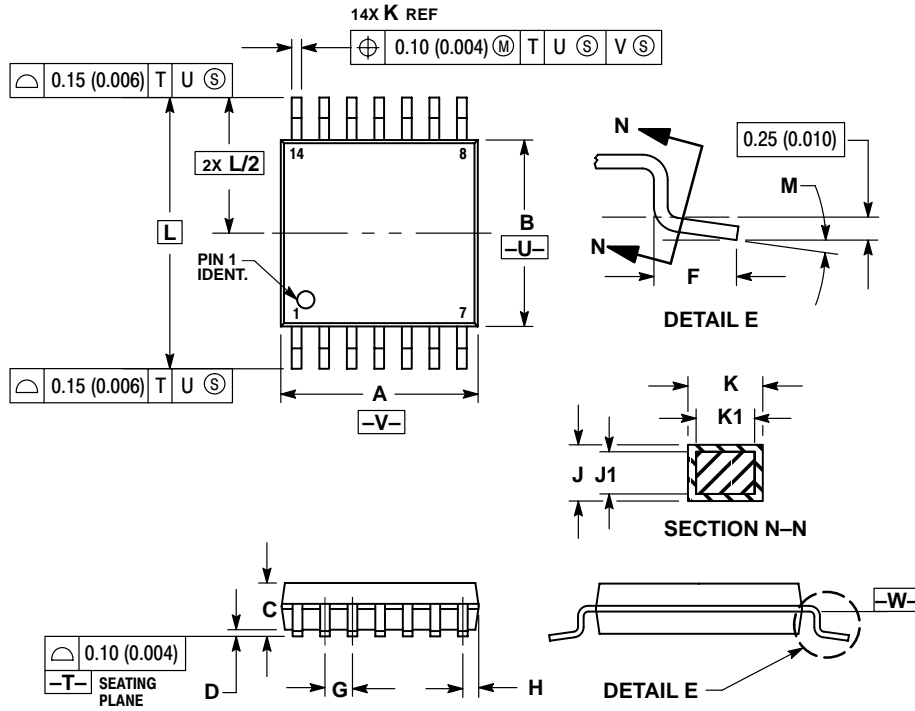
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 8.55 | 8.75 | 0.337 | 0.344 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.228 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

MC14066B

PACKAGE DIMENSIONS

DT SUFFIX
 PLASTIC TSSOP PACKAGE
 CASE 948G-01
 ISSUE O



NOTES:

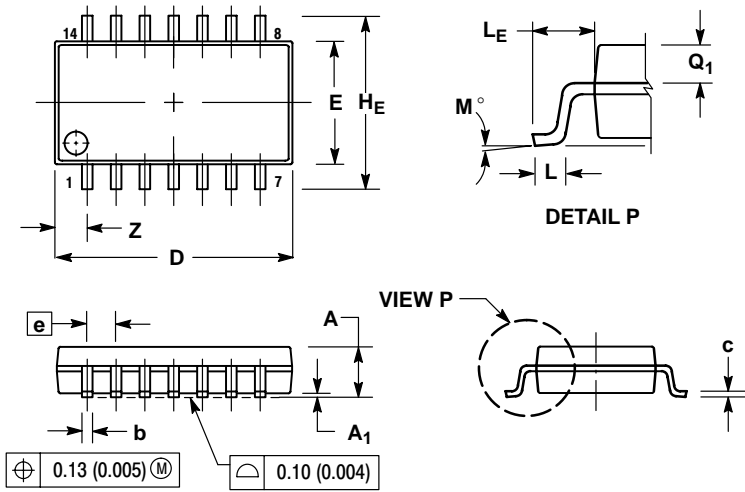
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE W.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.90 | 5.10 | 0.193 | 0.200 |
| B | 4.30 | 4.50 | 0.169 | 0.177 |
| C | --- | 1.20 | --- | 0.047 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.65 BSC | | 0.026 BSC | |
| H | 0.50 | 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° |

MC14066B

PACKAGE DIMENSIONS

F SUFFIX PLASTIC EIAJ SOIC PACKAGE CASE 965-01 ISSUE O



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 ₁ | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 0.35 | 0.50 | 0.014 | 0.020 |
| c | 0.18 | 0.27 | 0.007 | 0.011 |
| 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 | |
| H _E | 7.40 | 8.20 | 0.291 | 0.323 |
| 0.50 | 0.50 | 0.85 | 0.020 | 0.033 |
| L _E | 1.10 | 1.50 | 0.043 | 0.059 |
| M | 0° 10° | | 0° 10° | |
| Q ₁ | 0.70 | 0.90 | 0.028 | 0.035 |
| Z | --- | 1.42 | --- | 0.056 |

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