

## Quad Bilateral Switch

**IW4016B**

### General Description

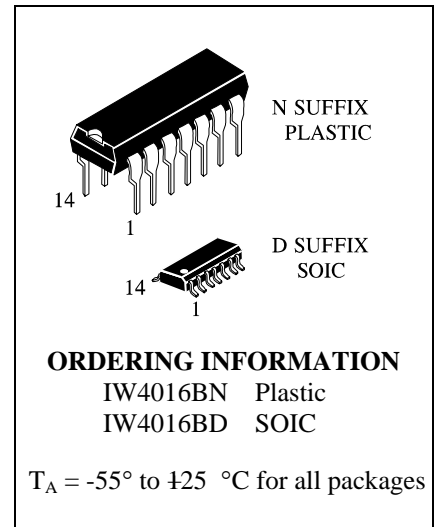
The IW4016B is a quad bilateral switch intended for the transmission or multiplexing of analog or digital signals.

### Features

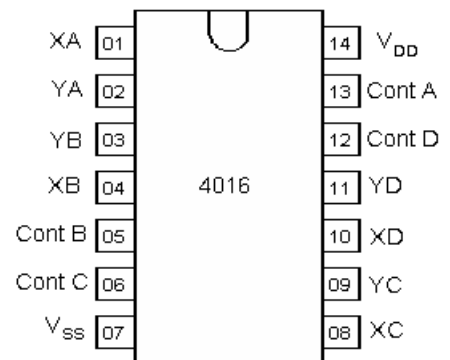
- Wide supply voltage range: 3V to 15V
- Wide range of digital and analog switching:  $\pm 7.5 V_{PEAK}$
- "ON" resistance for 15V operation:  $400 \Omega$  (typ.)
- Matched "ON" resistance over 15V signal input:  $\Delta R_{ON} = 10 \Omega$  (typ.)
- High degree of linearity:  
0.4% distortion (typ.)  
@  $f_{IS} = 1 \text{ kHz}$ ,  $V_{IS} = 5 V_{p-p}$   
 $V_{DD} - V_{SS} = 10V$ ,  $R_L = 10 \text{ k}\Omega$
- Extremely low "OFF" switch leakage:  
0.1 nA (typ.)  
@  $V_{DD} - V_{SS} = 10V$   
 $T_A = 25^\circ \text{C}$
- Extremely high control input impedance:  $10^{12}$  (typ.)
- Low crosstalk between switches:  
-50 dB (typ.)  
@  $f_{IS} = 0.9 \text{ MHz}$ ,  $R_L = 1 \text{ k}\Omega$
- Frequency response, switch "ON": 40 MHz (typ.)

### Applications

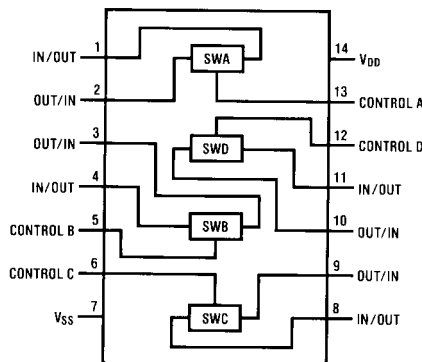
- Analog signal switching/multiplexing  
Signal gating  
Squelch control  
Chopper  
Modulator/Demodulator  
Commutating switch
- Digital signal switching/multiplexing
- CMOS logic implementation
- Analog-to-digital/digital-to-analog conversion
- Digital control of frequency, impedance, phase, and analog-signal gain



### Pin Assignment



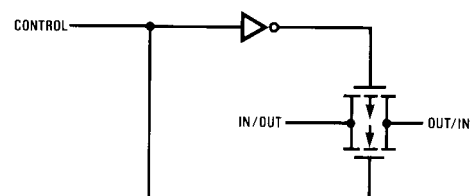
### Functional Diagram



### FUNCTION TABLE

INPUT of Control	Analog Switch Mode
L	Close
H	Open

### Schematic Diagram



**Absolute Maximum Ratings** (Note 1)

(Note 2)

V <sub>DD</sub> Supply Voltage	-0.5V to +18V
V <sub>IN</sub> Input Voltage	-0.5V to V <sub>DD</sub> + 0.5V
T <sub>S</sub> Storage Temperature Range	-65°C to + 150°C
Power Dissipation (P <sub>D</sub> )	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature	
(Soldering, 10 seconds)	260°C

**Recommended Operating**

**Conditions** (Note 2)

V <sub>DD</sub> Supply Voltage	3V to 15V
V <sub>IN</sub> Input Voltage	0V to V <sub>DD</sub>
T <sub>A</sub> Operating Temperature Range	-40°C to +85°C

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

**Note 2:** V<sub>SS</sub> = 0V unless otherwise specified.

**DC Electrical Characteristics** (Note 2)

Parameter, Units	Symbol	Conditions, Units				Limits					
						-55°C		125°C		25°C	
		V <sub>IL</sub> , V	V <sub>IH</sub> , V	I <sub>O</sub> , mA	V <sub>DD</sub> , V	Min	Max	Min	Max	Min	Max
Low Level Input Voltage, V	V <sub>ILC</sub>		-	-	5.0	-	0.9	-	0.4	-	0.7
					10	-	0.9	-	0.4	-	0.7
					15	-	0.9	-	0.4	-	0.7
High Level Input Voltage, V	V <sub>IHC</sub>		-	-	5.0	3.5	-	3.5	-	3.5	-
			-	-	10	7	-	7	-	7	-
			-	-	15	11	-	11	-	11	-
Switch Output Voltage, V	V <sub>OS</sub>	V <sub>IS</sub> =0 B		0.25	5.0	0.4	-	-	-	-	-
				0.14	5.0	-	-	0.4	-	-	-
				0.2	5.0	-	-	-	-	0.4	-
				0.62	10	0.5	-	-	-	-	-
				0.36	10	-	-	0.5	-	-	-
				0.5	10	-	-	-	-	0.5	-
		V <sub>IS</sub> =5.0 V		1.8	15	1.5	-	-	-	-	-
				1.1	15	-	-	1.5	-	-	-
				1.5	15	-	-	-	-	1.5	-
		V <sub>IS</sub> =10 V		-0.25	5.0	4.6	-	-	-	-	-
				-0.14	5.0	-	-	4.6	-	-	-
				-0.2	5.0	-	-	-	-	4.6	-
		V <sub>IS</sub> =15 V		-0.62	10	9.5	-	-	-	-	-
				-0.36	10	-	-	9.5	-	-	-
				-0.5	10	-	-	-	-	9.5	-
V <sub>IS</sub> =15 V		-1.8	15	13.5	-	-	-	-	-		
		-1.1	15	-	-	13.5	-	-	-		
		-1.5	15	-	-	-	-	13.5	-		

## DC Electrical Characteristics (continue)

Parameter, Units	Symbol	Conditions, Units				Limits						
		V <sub>IL</sub> , V	V <sub>IH</sub> , V	I <sub>O</sub> , mA	V <sub>DD</sub> , V	-55°C		125°C		25°C		
						Min	Max	Min	Max	Min	Max	
Input/Output Overshoot Voltage Amplitude, mV	V <sub>AIO</sub>	V <sub>C</sub> =10 V,  R <sub>L</sub> =10 kOhm, t <sub>LH</sub> =t <sub>HL</sub> ≤20 nsec			10	-	-	-	-	-	50*	
Quiescent Device Current, uA	I <sub>DD</sub>		-	-	5.0	-	0.25	-	7.5	-	0.25	
			-	-	10	-	0.5	-	15	-	0.5	
			-	-	15	-	1.0	-	30	-	1.0	
			-	-	20	-	5.0	-	150	-	5.0	
Input/Output Leakage, uA	I <sub>LIO</sub>	0	18	-	18	-	±0.1	-	±1.0	-	±0.1	
Low Level Input Current, uA	I <sub>IL</sub>	0	-	-	18	-	-0.1	-	-1.0	-	-0.1	
High Level Input Current, uA	I <sub>IH</sub>		18	-	18	-	0.1	-	1.0	-	0.1	

**Note 3:** If the switch input is held at V<sub>DD</sub>, V<sub>IHC</sub> is the control input level that will cause the switch output to meet the standard "B" series V<sub>OH</sub> and I<sub>OH</sub> output levels. If the analog switch input is connected to V<sub>SS</sub>, V<sub>IHC</sub> is the control input level — which allows the switch to sink standard "B" series |I<sub>OH</sub>|, high level current, and still maintain a V<sub>OL</sub> ≤ "B" series. These currents are shown in Figure 8.

**AC Electrical Characteristics** (Note 4)

$T_A = 25^\circ\text{C}$ ,  $t_r = t_f = 20\text{ ns}$  and  $V_{SS} = 0\text{V}$  unless otherwise specified

Parameter, Units	Symbol	Conditions,				Limits					
		Units				-55°C		+125°C		+25°C	
		$V_{IL}$ , V	$V_{IH}$ , V	$I_O$ , mA	$V_{DD}$ , V	Min	Max	Min	Max	Min	Max
Propagation Delay Time Control Input to Signal Output Logical Level to High Impedance (Propagation Delay Time Control Input to Signal Output High Impedance to Logical Level), nsec	$t_{PHZ}$ ( $t_{PZH}$ ) $t_{PLZ}$ ( $t_{PZL}$ )	$t_{LH}=t_{HL}\leq 20\text{ nsec}$ , $C_L=50\text{ pF}$ $R_L=1\text{ kOhm}$		5.0	-	70	-	140	-	70	
				10	-	40	-	80	-	40	
				15	-	30	-	60	-	30	
Capacitance, pF - Signal Input - Signal Output	$C_{IS}$ $C_{OS}$	$V_C=V_{SS}=-5\text{V}$		5.0	-	-	-	-	4*		
- Feedthrough Capacitance	$C_{IOS}$				-	-	-	-	0.2*		
- Control Input Capacitance	$C_{IN}$			5.0	-	-	-	-		7.5	

\* Typical value

**Note 4:** AC Parameters are guaranteed by DC correlated testing.

**Note 5:** These devices should not be connected to circuits with the power "ON".

**Note 6:** In all cases, there is approximately 5 pF of probe and jig capacitance on the output; however, this capacitance is included in  $C_L$  wherever it is specified.

**Note 7:**  $V_{IS}$  is the voltage at the in/out pin and  $V_{OS}$  is the voltage at the out/in pin.  $V_C$  is the voltage at the control input.

## AC Electrical Characteristics (continue)

$T_A = 25^\circ\text{C}$ ,  $t_r = t_f = 20\text{ ns}$  and  $V_{SS} = 0\text{V}$  unless otherwise specified

Parameter, Units	Symbol	Conditions,				Limits					
		Units				-55°C		+125°C		+25°C	
		$V_{IL}$ , V	$V_{IH}$ , V	$I_O$ , mA	$V_{DD}$ , V	Min	Max	Min	Max	Min	Max
Harmonic Factor, %	Kh	$V_C=5\text{ V}$ , $V_{SS}=-5\text{ V}$ , $V_{IS}=5\text{ V}$ , $R_L=10\text{ k}\Omega$ , $f_{IS}=1\text{ kHz}$			5.0	-	-	-	-	0.4*	
Frequency Response – Switch “ON” (Frequency at -3dB), MHz	BW	$V_C=5\text{ V}$ , $V_{SS}=-5\text{ V}$ , $V_{IS}=5\text{ V}$ , $R_L=1\text{ k}\Omega$ , $C_L=50\text{ pF}$ , $t_{LH}=t_{HL}\leq 20\text{ nsec}$ (Figure 4)			5.0	-	-	-	-	40*	
Frequency Response – Switch “OFF” (Frequency at -50dB), MHz	$f_1$	$V_C=5\text{ V}$ , $V_{SS}=-5\text{ V}$ , $V_{IS}=5\text{ V}$ , $R_L=1\text{ k}\Omega$ , $C_L=50\text{ pF}$ , $t_{LH}=t_{HL}\leq 20\text{ nsec}$ (Figure 4)			5.0	-	-	-	-	1.25*	
Crosstalk Between Any Two Swithes (Frequency at -50dB), MHz	$f_2$	(Figure 5)			5.0	-	-	-	-	0.9*	
Switching Frequency, MHz	$f_S$	$V_C=10\text{ V}$ , $V_{SS}=\text{GND}$ , $V_{IS}=10\text{ V}$ , $R_L=1\text{ k}\Omega$ , $C_L=50\text{ pF}$ , $t_{LH}=t_{HL}\leq 20\text{ nsec}$ $V_{OS}=1/2 V_{OS}$ under frequency 1 kHz			10	-	-	-	-	10*	
Propagation Delay Time Signal Input to Signal Output, nsec	$t_{PHL}$ ( $t_{PLH}$ )	$t_{LH}=t_{HL}\leq 20\text{ nsec}$ ,			5.0	-	70	-	200	-	100
		$C_L=50\text{ pF}$			10	-	40	-	80	-	40
		$R_L=200\text{ k}\Omega$			15	-	30	-	60	-	30

\* Typical value

**Note 4:** AC Parameters are guaranteed by DC correlated testing.

**Note 5:** These devices should not be connected to circuits with the power “ON”.

**Note 6:** In all cases, there is approximately 5 pF of probe and jig capacitance on the output; however, this capacitance is included in  $C_L$  wherever it is specified.

**Note 7:**  $V_{IS}$  is the voltage at the in/out pin and  $V_{OS}$  is the voltage at the out/in pin.  $V_C$  is the voltage at the control input.

AC Test Circuits and Switching Time Waveforms

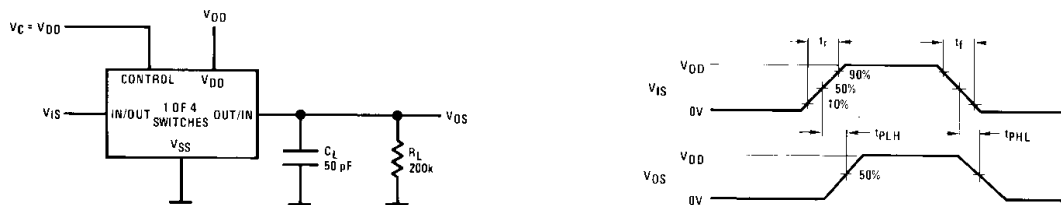


FIGURE 1.  $t_{PLH}$ ,  $t_{PHL}$  Propagation Delay Time Control to Signal Output

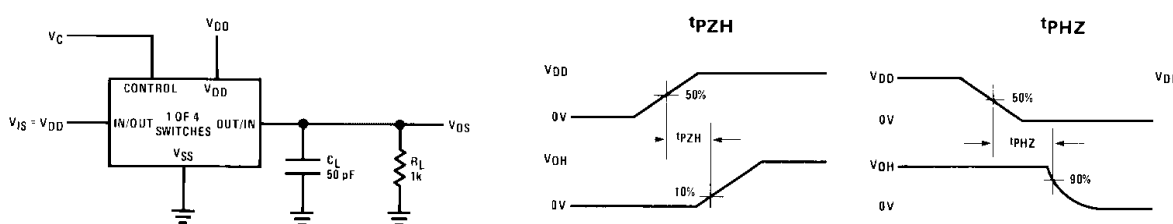


FIGURE 2.  $t_{PZH}$ ,  $t_{PHZ}$  Propagation Delay Time Control to Signal Output

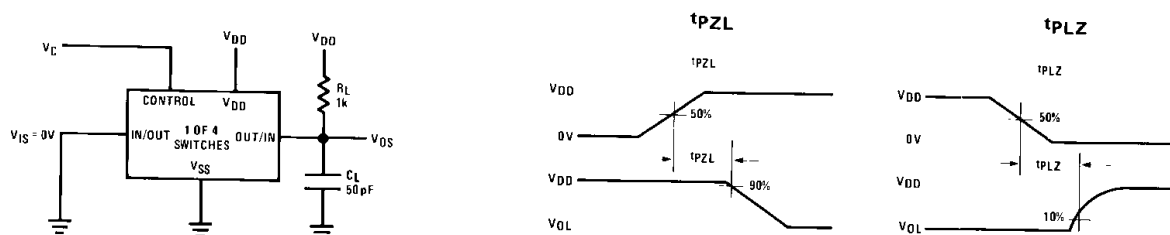
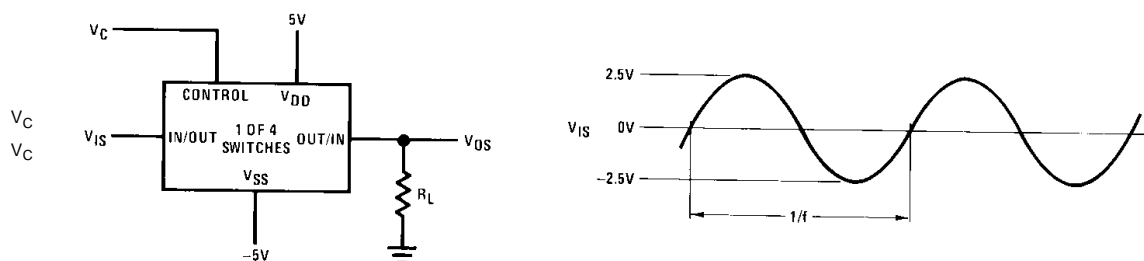


FIGURE 3.  $t_{PZH}$ ,  $t_{PHZ}$  Propagation Delay Time Control to Signal Output



=  $V_{DD}$  for distortion and frequency response tests  
 =  $V_{SS}$  for feedthrough test

FIGURE 4. Sine Wave Distortion, Frequency Response and Feedthrough

AC Test Circuits and Switching Time Waveforms (Continued)

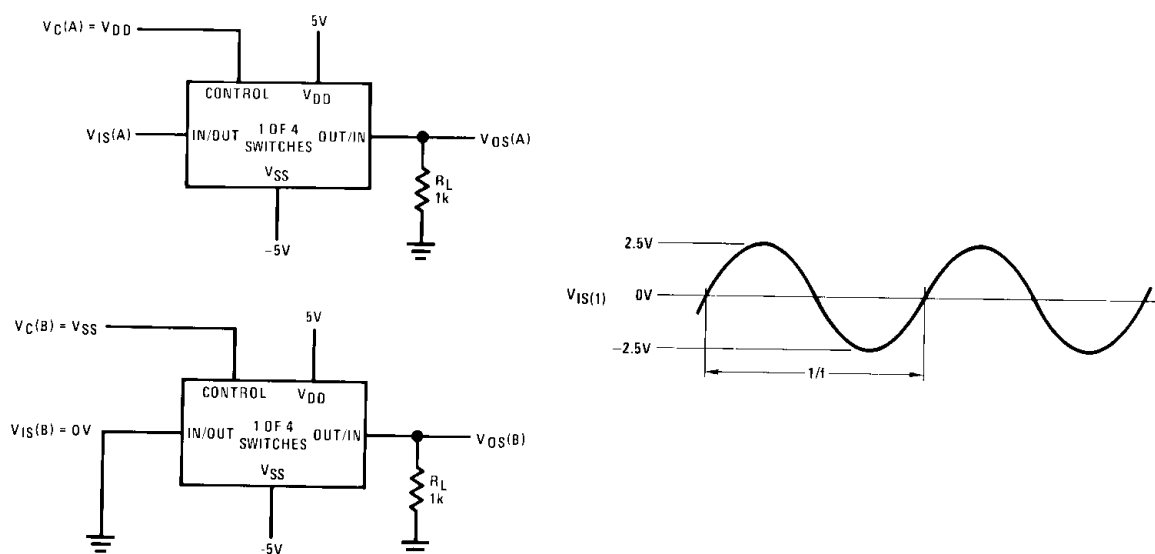


FIGURE 5. Crosstalk Between Any Two Switches

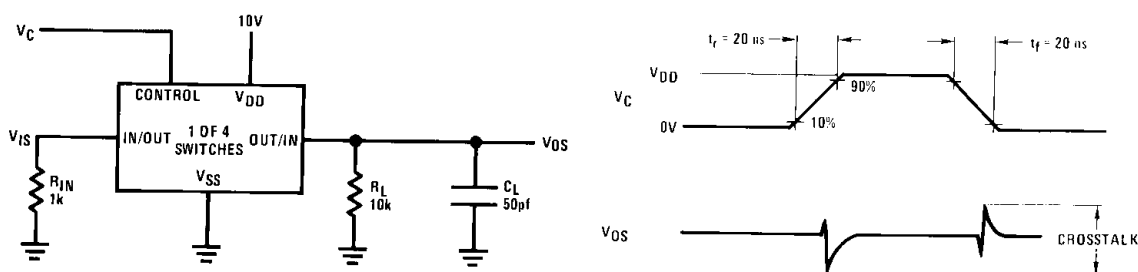


FIGURE 6. Crosstalk — Control to Input Signal Output

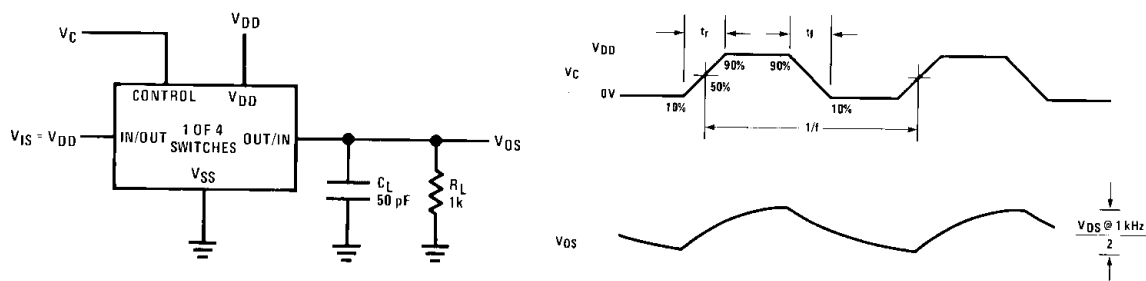
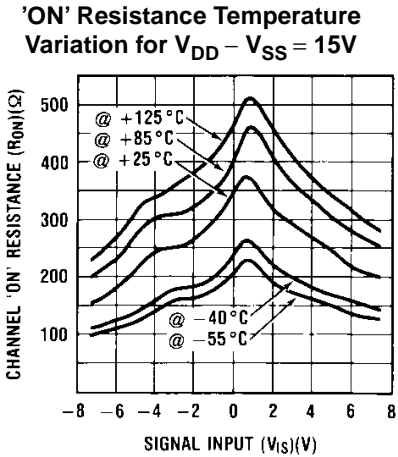
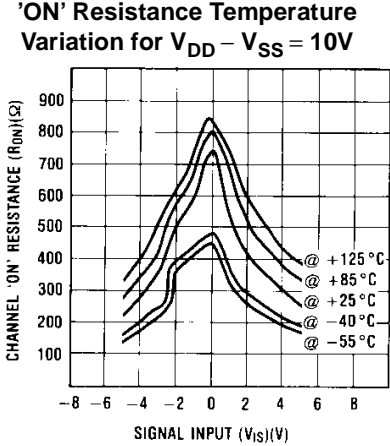
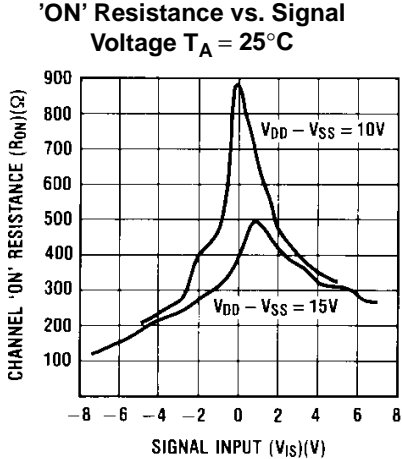


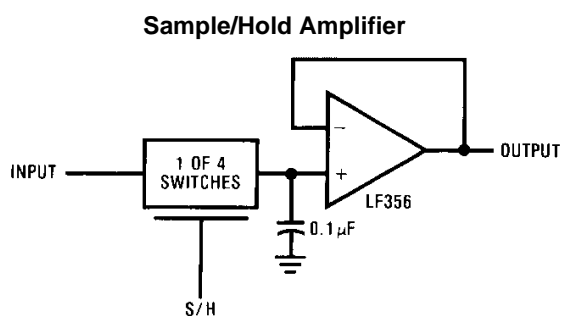
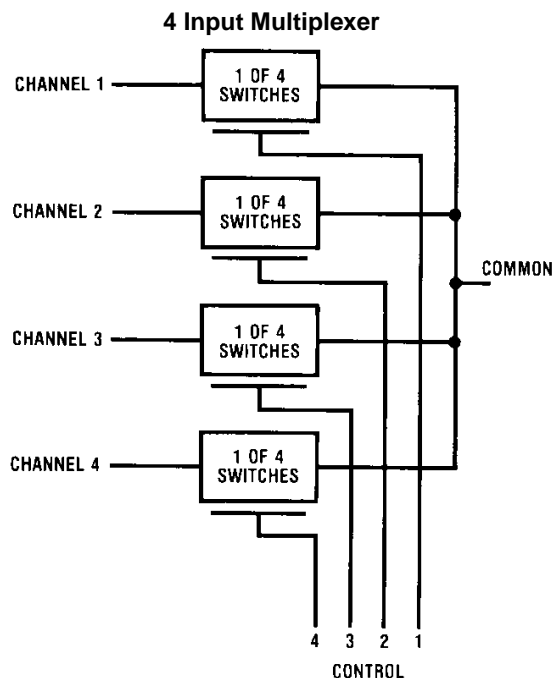
FIGURE 7. Maximum Control Input Frequency

Typical Performance Characteristics





Typical Applications

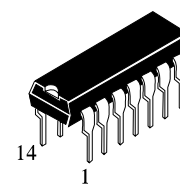
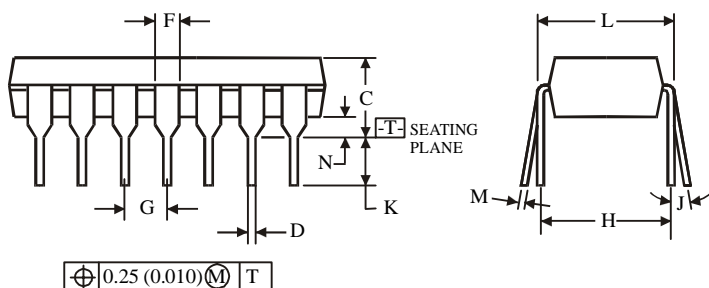
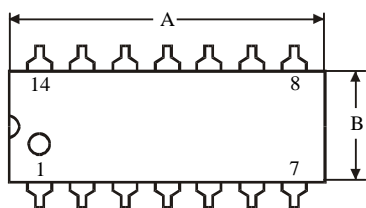


**Special Considerations**

The IW4016B is composed of 4, two-transistor analog switches. These switches do not have any linearization or compensation circuitry for “ $R_{ON}$ ” as do the IW4066B’s. Because of this, the special operating considerations for the IW4066B do not apply to the IW4016B, but at low supply voltages,  $\leq 5V$ , the IW4016B’s on resistance becomes

non-linear. It is recommended that at 5V, voltages on the in/out pins be maintained within about 1V of either  $V_{DD}$  or  $V_{SS}$ ; and that at 3V the voltages on the in/out pins should be at  $V_{DD}$  or  $V_{SS}$  for reliable operation.

**N SUFFIX PLASTIC DIP  
(MS - 001AA)**

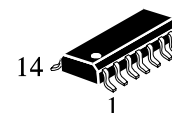
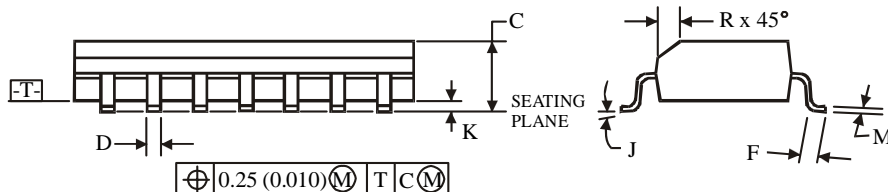
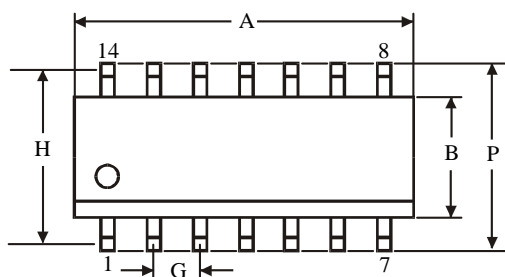


Symbol	Dimensions, mm	
	MIN	MAX
A	18.67	19.69
B	6.10	7.11
C		5.33
D	0.36	0.56
F	1.14	1.78
G	2.54	
H	7.62	
J	0°	10°
K	2.92	3.81
L	7.62	8.26
M	0.20	0.36
N	0.38	

**NOTES:**

- Dimensions "A", "B" do not include mold flash or protrusions. Maximum mold flash or protrusions 0.25 mm (0.010) per side.

**D SUFFIX SOIC  
(MS - 012AB)**



Symbol.	Dimensions, mm	
	MIN	MAX
A	8.55	8.75
B	3.80	4.00
C	1.35	1.75
D	0.33	0.51
F	0.40	1.27
G	1.27	
H	5.72	
J	0°	8°
K	0.10	0.25
M	0.19	0.25
P	5.80	6.20
R	0.25	0.50

**NOTES:**

- Dimensions A and B do not include mold flash or protrusion.
- Maximum mold flash or protrusion 0.15 mm (0.006) per side for A; for B - 0.25 mm (0.010) per side.