



Is Now Part of



ON Semiconductor®

To learn more about ON Semiconductor, please visit our website at
www.onsemi.com

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

CD4016BC Quad Bilateral Switch

General Description

The CD4016BC is a quad bilateral switch intended for the transmission or multiplexing of analog or digital signals. It is pin-for-pin compatible with CD4066BC.

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 Ω (typ)
- Matched "ON" Resistance over 15V signal input:
 $\Delta R_{ON} = 10\Omega$ (typ)
- High degree of linearity:
0.4% distortion (typ)
@ $f_{IS} = 1$ kHz, $V_{IS} = 5 V_{p-p}$,
 $V_{DD} - V_{SS} = 10V$, $R_L = 10$ k Ω
- Extremely low "OFF" switch leakage:
0.1 nA (typ.)
@ $V_{DD} - V_{SS} = 10V$
 $T_A = 25^\circ C$

- Extremely high control input impedance: $10^{12}\Omega$ (typ)
- Low crosstalk between switches:
-50 dB (typ.)
@ $f_{IS} = 0.9$ MHz, $R_L = 1$ k Ω
- Frequency response, switch "ON": 40 MHz (typ)

Applications

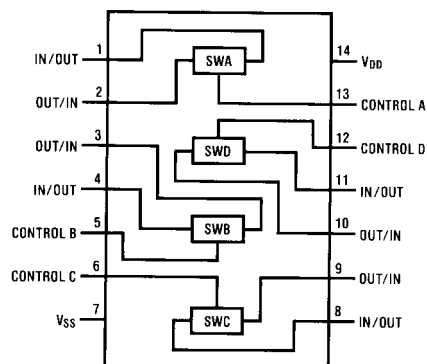
- Analog signal switching/multiplexing
 - Signal gating
 - Squelch control
 - Chopper
 - Modulator/Demodulator
 - Commutating switch
- Digital signal switching/multiplexing
- CMOS logic implementation
- Analog-to-digital/digital-to-analog conversion
- Digital control of frequency, impedance, phase, and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

Ordering Code:

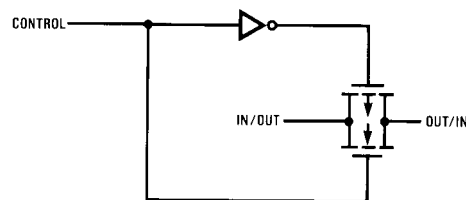
Order Number	Package Number	Package Description
CD4016BCM	M14A	14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
CD4016BCN	N14A	14-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending the letter suffix "X" to the ordering code.

Connection Diagram



Schematic Diagram



Absolute Maximum Ratings(Note 1)

(Note 2)

V _{DD} Supply Voltage	-0.5V to +18V
V _{IN} Input Voltage	-0.5V to V _{DD} + 0.5V
T _S Storage Temperature Range	-65°C to +150°C
Power Dissipation (P _D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

V _{DD} Supply Voltage	3V to 15V
V _{IN} Input Voltage	0V to V _{DD}
T _A Operating Temperature Range	-55°C to +125°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_{SS} = 0V unless otherwise specified.

DC Electrical Characteristics (Note 2)

Symbol	Parameter	Conditions	-55°C		25°C			+125°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I _{DD}	Quiescent Device Current	V _{DD} = 5V, V _{IN} = V _{DD} or V _{SS}		0.25		0.01	0.25		7.5	μA
		V _{DD} = 10V, V _{IN} = V _{DD} or V _{SS}		0.5		0.01	0.5		15	μA
		V _{DD} = 15V, V _{IN} = V _{DD} or V _{SS}		1.0		0.01	1.0		30	μA
Signal Inputs and Outputs										
R _{ON}	"ON" Resistance	R _L = 10kΩ to (V _{DD} - V _{SS})/2								
		V _C = V _{DD} , V _{IS} = V _{SS} or V _{DD}								
		V _{DD} = 10V		600		250	660		960	Ω
		V _{DD} = 15V		360		200	400		600	Ω
		R _L = 10kΩ to (V _{DD} - V _{SS})/2								
		V _C = V _{DD}								
		V _{DD} = 10V, V _{IS} = 4.75 to 5.25V		1870		850	2000		2600	Ω
		V _{DD} = 15V, V _{IS} = 7.25 to 7.75V		775		400	850		1230	Ω
ΔR _{ON}	Δ"ON" Resistance Between any 2 of 4 Switches (In Same Package)	R _L = 10kΩ to (V _{DD} - V _{SS})/2								
		V _C = V _{DD} , V _{IS} = V _{SS} to V _{DD}								
		V _{DD} = 10V				15				Ω
		V _{DD} = 15V				10				Ω
I _{IS}	Input or Output Leakage Switch "OFF"	V _C = 0, V _{DD} = 15V		±50		±0.1	±50		±500	nA
		V _{IS} = 0V or 15V, V _{OS} = 15V or 0V								
Control Inputs										
V _{ILC}	LOW Level Input Voltage	V _{IS} = V _{SS} and V _{DD}								
		V _{OS} = V _{DD} and V _{SS}								
		I _{IS} = ±10 μA								
		V _{DD} = 5V		0.9			0.7		0.5	V
		V _{DD} = 10V		0.9			0.7		0.5	V
		V _{DD} = 15V		0.9			0.7		0.5	V
V _{IHC}	HIGH Level Input Voltage	V _{DD} = 5V	3.5		3.5			3.5		V
		V _{DD} = 10V	7.0		7.0			7.0		V
		V _{DD} = 15V	11.0		11.0			11.0		V
		(Note 3) and Table 1								
I _{IN}	Input Current	V _{CC} - V _{SS} = 15V		±0.1		±10 ⁻⁵	±0.1		±1.0	μA
		V _{DD} ≥ V _{IS} ≥ V _{SS}								
		V _{DD} ≥ V _C ≥ V _{SS}								

Note 3: If the switch input is held at V_{DD}, V_{IHC} is the control input level that will cause the switch output to meet the standard "B" series V_{OH} and I_{OH} output levels. If the analog switch input is connected to V_{SS}, V_{IHC} is the control input level — which allows the switch to sink standard "B" series |I_{OH}|, HIGH level current, and still maintain a V_{OL} ≤ "B" series. These currents are shown in Table 1.

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						
Symbol	Parameter	Conditions	Min	Typ	Max	Units
t_{PHL} , t_{PLH}	Propagation Delay Time Signal Input to Signal Output	$V_C = V_{DD}$, $C_L = 50\text{ pF}$, (Figure 1) $R_L = 200\text{ k}\Omega$ $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$		58 27 20	100 50 40	ns ns ns
t_{PZH} , t_{PZL}	Propagation Delay Time Control Input to Signal Output HIGH Impedance to Logical Level	$R_L = 1.0\text{ k}\Omega$, $C_L = 50\text{ pF}$, (Figure 2, Figure 3) $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$		20 18 17	50 40 35	ns ns ns
t_{PHZ} , t_{PLZ}	Propagation Delay Time Control Input to Signal Output Logical Level to HIGH Impedance Sine Wave Distortion	$R_L = 1.0\text{ k}\Omega$, $C_L = 50\text{ pF}$, (Figure 2, Figure 3) $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$ $V_C = V_{DD} = 5\text{V}$, $V_{SS} = -5$ $R_L = 10\text{ k}\Omega$, $V_{IS} = 5\text{ V}_{P-P}$, $f = 1\text{ kHz}$, (Figure 4)		15 11 10 0.4	40 25 22	ns ns ns %
	Frequency Response — Switch "ON" (Frequency at -3 dB)	$V_C = V_{DD} = 5\text{V}$, $V_{SS} = -5\text{V}$, $R_L = 1\text{ k}\Omega$, $V_{IS} = 5\text{ V}_{P-P}$, $20\text{ Log}_{10} V_{OS}/V_{OS} (1\text{ kHz}) -\text{dB}$, (Figure 4)		40		MHz
	Feedthrough — Switch "OFF" (Frequency at -50 dB)	$V_{DD} = 5\text{V}$, $V_C = V_{SS} = -5\text{V}$, $R_L = 1\text{ k}\Omega$, $V_{IS} = 5\text{ V}_{P-P}$, $20\text{ Log}_{10} (V_{OS}/V_{IS}) = -50\text{ dB}$, (Figure 4)		1.25		MHz
	Crosstalk Between Any Two Switches (Frequency at -50 dB)	$V_{DD} = V_{C(A)} = 5\text{V}$; $V_{SS} = V_{C(B)} = -5\text{V}$, $R_L = 1\text{ k}\Omega$, $V_{IS(A)} = 5\text{ V}_{P-P}$, $20\text{ Log}_{10} (V_{OS(B)}/V_{OS(A)}) = -50\text{ dB}$, (Figure 5)		0.9		MHz
	Crosstalk; Control Input to Signal Output	$V_{DD} = 10\text{V}$, $R_L = 10\text{ k}\Omega$ $R_{IN} = 1\text{ k}\Omega$, $V_{CC} = 10\text{V}$ Square Wave, $C_L = 50\text{ pF}$ (Figure 6)		150		mV _{P-P}
	Maximum Control Input	$R_L = 1\text{ k}\Omega$, $C_L = 50\text{ pF}$, (Figure 7) $V_{OS(f)} = \frac{1}{2} V_{OS}(1\text{ kHz})$ $V_{DD} = 5\text{V}$ $V_{DD} = 10\text{V}$ $V_{DD} = 15\text{V}$		6.5 8.0 9.0		MHz MHz MHz
C_{IS}	Signal Input Capacitance			4		pF
C_{OS}	Signal Output Capacitance	$V_{DD} = 10\text{V}$		4		pF
C_{IOS}	Feedthrough Capacitance	$V_C = 0\text{V}$		0.2		pF
C_{IN}	Control Input Capacitance			5	7.5	pF
<p>Note 4: AC Parameters are guaranteed by DC correlated testing.</p> <p>Note 5: These devices should not be connected to circuits with the power "ON".</p> <p>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.</p> <p>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.</p>						

AC Test Circuits and Switching Time Waveforms

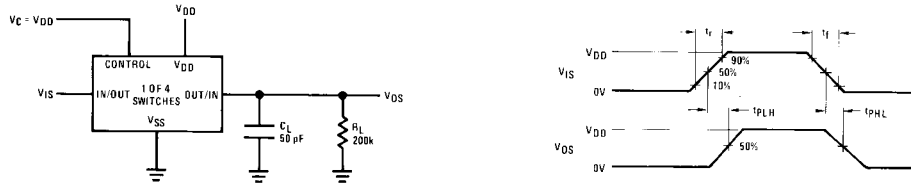


FIGURE 1. t_{PLH} , t_{PLL} Propagation Delay Time Control to Signal Output

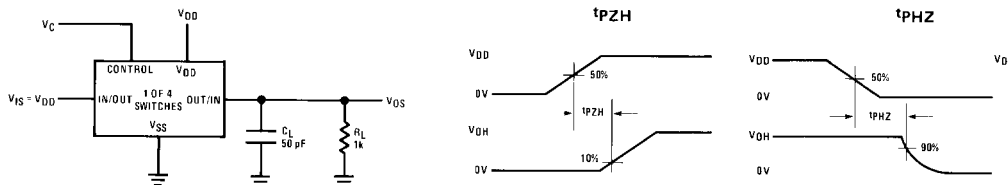


FIGURE 2. t_{PZH} , t_{PHZ} Propagation Delay Time Control to Signal Output

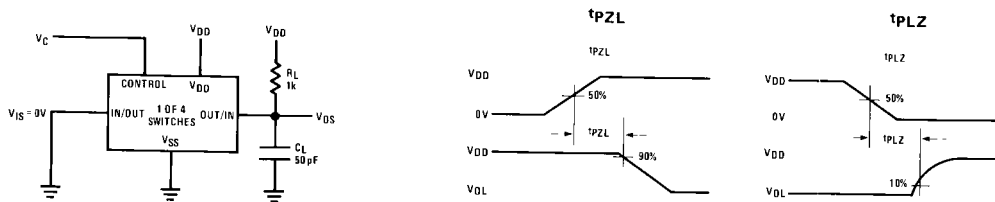
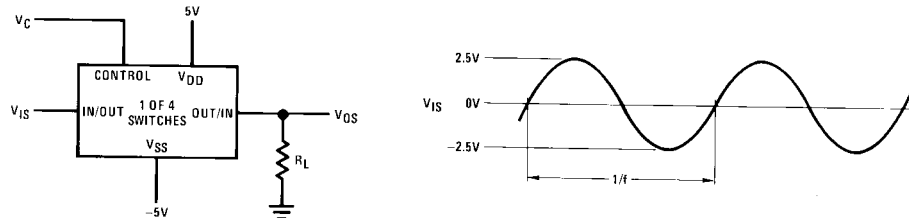


FIGURE 3. t_{PZH} , t_{PHZ} Propagation Delay Time Control to Signal Output



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

FIGURE 4. Sine Wave Distortion, Frequency Response and Feedthrough

AC Test Circuits and Switching Time Waveforms (Continued)

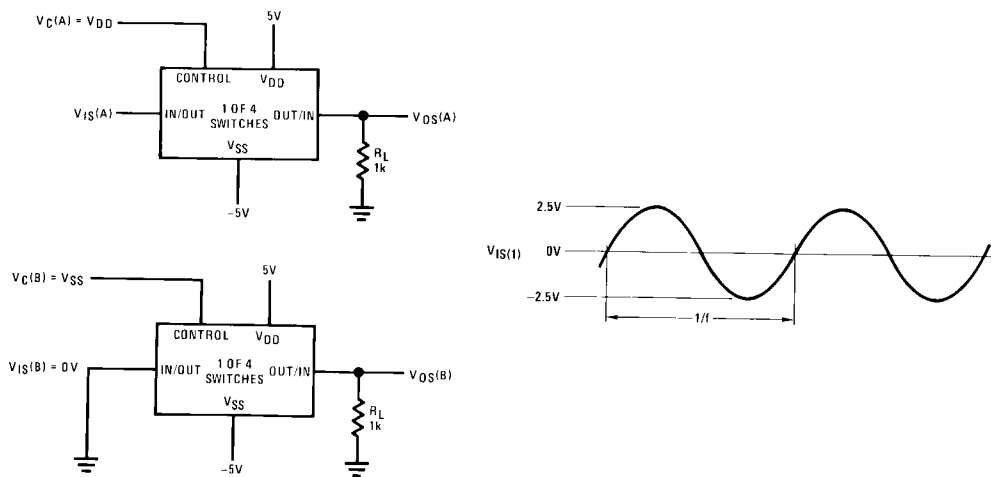


FIGURE 5. Crosstalk Between Any Two Switches

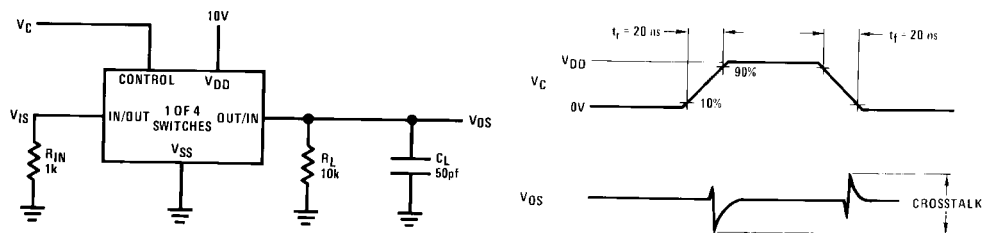


FIGURE 6. Crosstalk — Control to Input Signal Output

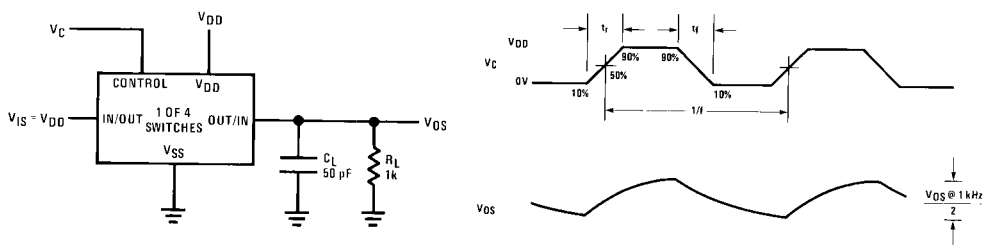


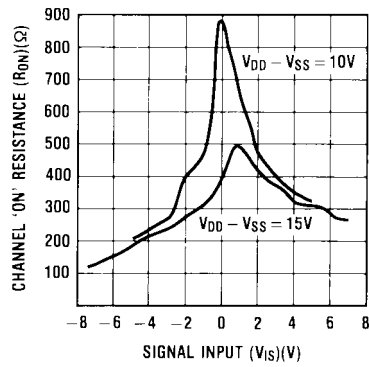
FIGURE 7. Maximum Control Input Frequency

TABLE 1. CD4016B Switch Test Conditions for V_{IHC}

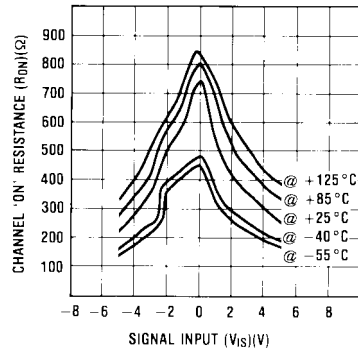
Temperature Range	V_{DD}	Switch Input				Switch Output	
		V_{IS}	I_{IS} (mA)			$V_{OS}(V)$	
			-40°C	25°C	+85°C	Min	Max
COMMERCIAL	5	0	0.2	0.16	0.12		0.4
	5	5	-0.2	-0.16	-0.12	4.6	
	10	0	0.5	0.4	0.3		0.5
	10	10	-0.5	-0.4	-0.3	9.5	
	15	0	1.4	1.2	1.0		1.5
	15	15	-1.4	-1.2	-1.0	13.5	

Typical Performance Characteristics

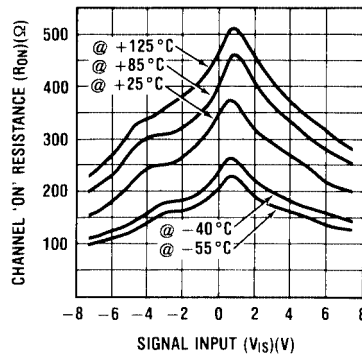
'ON' Resistance vs. Signal Voltage $T_A = 25^\circ C$



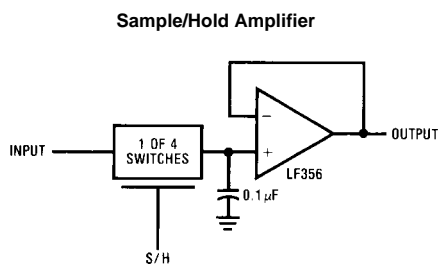
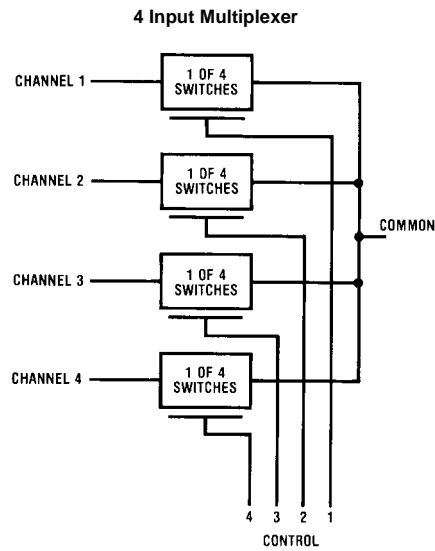
'ON' Resistance Temperature Variation for $V_{DD} - V_{SS} = 10V$



'ON' Resistance Temperature Variation for $V_{DD} - V_{SS} = 15V$



Typical Applications

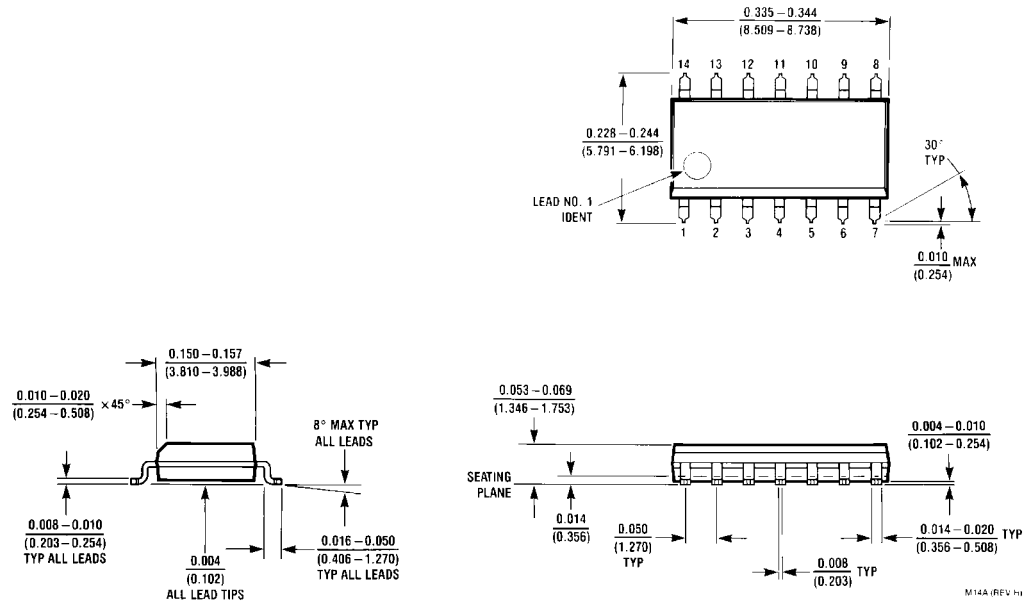


Special Considerations

The CD4016B is composed of 4, two-transistor analog switches. These switches do not have any linearization or compensation circuitry for "R_{ON}" as do the CD4066B's. Because of this, the special operating considerations for the CD4066B do not apply to the CD4016B, but at low supply voltages, $\leq 5V$, the CD4016B's On Resistance becomes

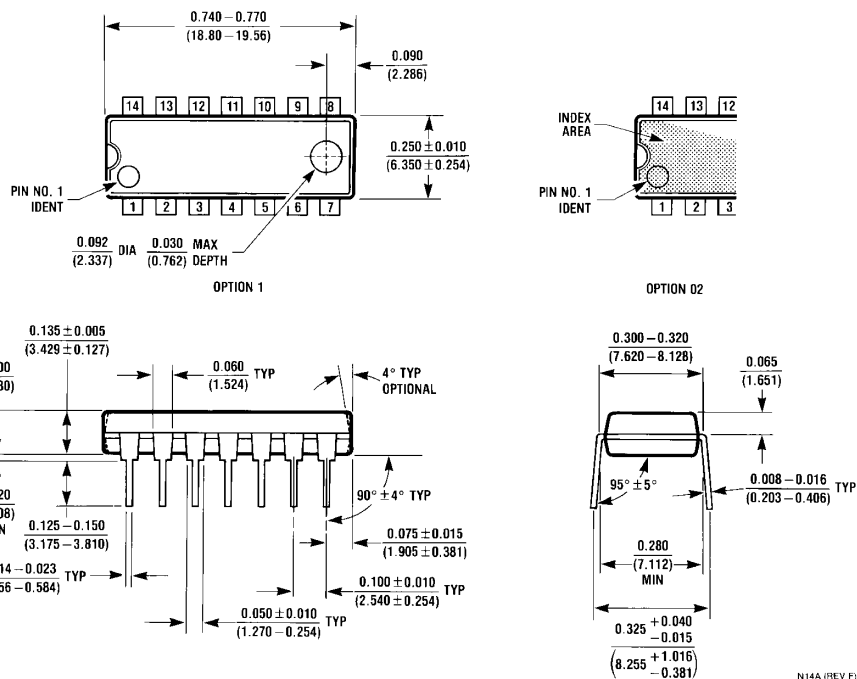
non-linear. It is recommended that at 5V, voltages on the in/out pins be maintained within about 1V of either V_{DD} or V_{SS} ; and that at 3V the voltages on the in/out pins should be at V_{DD} or V_{SS} for reliable operation.

Physical Dimensions inches (millimeters) unless otherwise noted



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

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

Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
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.

www.fairchildsemi.com

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800-282-9855 Toll Free
USA/Canada
Europe, Middle East and Africa Technical Support:
Phone: 421 33 790 2910
Japan Customer Focus Center
Phone: 81-3-5817-1050

ON Semiconductor Website: www.onsemi.com
Order Literature: <http://www.onsemi.com/orderlit>
For additional information, please contact your local
Sales Representative