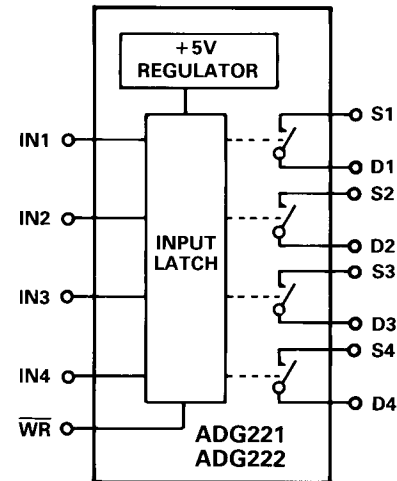


### ADG221/ADG222

#### FEATURES

- 44V Supply Maximum Rating
- ±15V Analog Signal Range
- Low R<sub>ON</sub> (60Ω)
- Low Leakage (0.5nA)
- Break-Before-Make Switching
- Extended Plastic Temperature Range  
(-40°C to +85°C)
- Low Power Dissipation (25.5mW)
- μP, TTL, CMOS Compatible
- Available in 16-Lead DIP/SOIC and  
20-Lead PLCC/LCCC Packages
- Surface Mount Packages
- Superior DG221 Replacement

#### FUNCTIONAL BLOCK DIAGRAM



#### GENERAL DESCRIPTION

The ADG221 and ADG222 are monolithic CMOS devices comprising four independently selectable switches. On-chip latches facilitate microprocessor interfacing. They are designed on an enhanced LC<sup>2</sup>MOS process which gives an increased signal handling capability of ±15V. These switches also feature high switching speeds and low R<sub>ON</sub>.

The ADG221 and ADG222 consist of four SPST switches. They differ only in that the digital control logic is inverted. All devices exhibit break before make switching action. Inherent in the design is low charge injection for minimum transients when switching the digital inputs.

#### PRODUCT HIGHLIGHTS

1. Easily Interfaced:  
Digital inputs are latched with a  $\overline{WR}$  signal for microprocessor interfacing. A 5V regulated supply is internally generated permitting wider tolerances on the supplies without affecting the TTL digital input switching levels.
2. Single Supply Operation:  
For applications where the analog signal is unipolar (0V to 15V), the switches can be operated from a single +15V supply.
3. Low Leakage:  
Leakage currents in the range of 500pA make these switches suitable for high precision circuits. The added feature of Break-before-Make switching allows for multiple outputs to be tied together for multiplexer applications while keeping leakage errors to a minimum.

$\overline{WR}$	ADG221 IN	ADG222 IN	SWITCH CONDITION
0	0	1	ON
0	1	0	OFF
1	X	X	Retains Previous Switch Condition

Table 1. Truth Table

#### REV. B

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# ADG221/ADG222—SPECIFICATIONS (V<sub>DD</sub> = +15V, V<sub>SS</sub> = -15V, unless otherwise specified)

Parameter	K Version		B Version		T Version		Units	Test Conditions	
	25°C	-40°C to +85°C	25°C	-40°C to +85°C	25°C	-55°C to +125°C			
<b>ANALOG SWITCH</b>									
Analog Signal Range	± 15	± 15	± 15	± 15	± 15	± 15	Volts	- 10V ≤ V <sub>S</sub> ≤ + 10V I <sub>DS</sub> = 1.0mA Test Circuit 1	
R <sub>ON</sub>	60		60		60		Ω typ		
	90	145	90	145	90	145	Ω max		
R <sub>ON</sub> vs. V <sub>D</sub> (V <sub>S</sub> )	20		20		20		% typ	V <sub>S</sub> = 0V, I <sub>DS</sub> = 1mA	
R <sub>ON</sub> Drift	0.5		0.5		0.5		%/°C typ		
R <sub>ON</sub> Match	5		5		5		% typ		
I <sub>S</sub> (OFF)	0.5		0.5		0.5		nA typ	V <sub>D</sub> = ± 14V; V <sub>S</sub> = ± 14V; Test Circuit 2	
OFF Input Leakage	2	100	2	100	1	100	nA max		
I <sub>D</sub> (OFF)	0.5		0.5		0.5		nA typ	V <sub>D</sub> = ± 14V; V <sub>S</sub> = ± 14V; Test Circuit 2	
OFF Output Leakage	2	100	2	100	1	100	nA max		
I <sub>D</sub> (ON)	0.5		0.5		0.5		nA typ	V <sub>D</sub> = ± 14V; Test Circuit 3	
ON Channel Leakage	2	200	2	200	1	200	nA max		
<b>DIGITAL CONTROL</b>									
V <sub>INH</sub> , Input High Voltage		2.4		2.4		2.4	V min		
V <sub>INL</sub> , Input Low Voltage		0.8		0.8		0.8	V max		
I <sub>INL</sub> or I <sub>INH</sub>		1		1		1	μA max		
<b>DYNAMIC CHARACTERISTICS</b>									
t <sub>OPEN</sub>	30		30		30		ns typ	Test Circuit 4 Test Circuit 4 See Figure 2 See Figure 2 See Figure 2 V <sub>S</sub> = 10V (p-p); f = 100kHz R <sub>L</sub> = 75Ω; Test Circuit 6 Test Circuit 7	
t <sub>ON</sub> <sup>1</sup>	300		300		300		ns max		
t <sub>OFF</sub> <sup>1</sup>	250		250		250		ns max		
t <sub>w</sub> <sup>1</sup> Write Pulse Width		100		100	100	120	ns min		
t <sub>S</sub> <sup>1</sup> Digital Input Setup Time		100		100	100	120	ns min		
t <sub>H</sub> <sup>1</sup> Digital Input Hold Time		20		20	20	20	ns min		
OFF Isolation	80		80		80		dB typ		
Channel-to-Channel Crosstalk	80		80		80		dB typ	R <sub>S</sub> = 0Ω; C <sub>L</sub> = 1000pF; V <sub>S</sub> = 0V Test Circuit 5	
C <sub>S</sub> (OFF)	5		5		5		pF typ		
C <sub>D</sub> (OFF)	5		5		5		pF typ		
C <sub>D</sub> , C <sub>S</sub> (ON)	16		16		16		pF typ		
C <sub>IN</sub> Digital Input Capacitance	5		5		5		pF typ		
Q <sub>INJ</sub> Charge Injection	20		20		20		pC typ		
<b>POWER SUPPLY</b>									
I <sub>DD</sub>	0.6		0.6		0.6		mA typ		Digital Inputs = V <sub>INL</sub> or V <sub>INH</sub>
I <sub>DD</sub>		1.5		1.5		1.5	mA max		
I <sub>SS</sub>	0.1		0.1		0.1		mA typ		
I <sub>SS</sub>		0.2		0.2		0.2	mA max		
Power Dissipation		25.5		25.5		25.5	mW max		

**NOTE**

<sup>1</sup>Sample tested at 25°C to ensure compliance.  
t<sub>ON</sub>, t<sub>OFF</sub> are the same for both IN and WR digital input changes.  
Specifications subject to change without notice.

**ABSOLUTE MAXIMUM RATINGS\***

(T<sub>A</sub> = +25°C unless otherwise stated)

V <sub>DD</sub> to V <sub>SS</sub>	44V
V <sub>DD</sub> to GND	25V
V <sub>SS</sub> to GND	-25V
Analog Inputs <sup>1</sup>	
Voltage at S, D	V <sub>SS</sub> - 0.3V to V <sub>DD</sub> + 0.3V
Continuous Current, S or D	30mA
Pulsed Current S or D	
1ms Duration, 10% Duty Cycle	70mA
Digital Inputs <sup>1</sup>	
Voltage at IN, WR	V <sub>SS</sub> - 2V to V <sub>DD</sub> + 2V or 20mA, Whichever Occurs First

**Power Dissipation (Any Package)**

Up to +75°C	470mW
Derates above +75°C by	6mW/°C
<b>Operating Temperature</b>	
Commercial (K Version)	-40°C to +85°C
Industrial (B Version)	-40°C to +85°C
Extended (T Version)	-55°C to +125°C
<b>Storage Temperature</b>	
	-65°C to +150°C
<b>Lead Temperature (Soldering 10sec)</b>	
	+300°C

**NOTE**

<sup>1</sup>Overvoltage at IN, WR, S or D will be clamped by diodes. Current should be limited to the Maximum Rating above.

\*COMMENT: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Only one Absolute Maximum Rating may be applied at any one time.

### CAUTION

ESD (electrostatic discharge) sensitive device. The digital control inputs are diode protected; however, permanent damage may occur on unconnected devices subject to high energy electrostatic fields. Unused devices must be stored in conductive foam or shunts. The protective foam should be discharged to the destination socket before devices are removed.



### ORDERING GUIDE

Model <sup>1</sup>	Temperature Range	Package Option <sup>2</sup>
ADG221KN	-40°C to +85°C	N-16
ADG221KR	-40°C to +85°C	R-16A
ADG221KP	-40°C to +85°C	P-20A
ADG221BQ	-40°C to +85°C	Q-16
ADG221TQ	-55°C to +125°C	Q-16
ADG221TE	-55°C to +125°C	E-20A
ADG222KN	-40°C to +85°C	N-16
ADG222KR	-40°C to +85°C	R-16A
ADG222KP	-40°C to +85°C	P-20A
ADG222BQ	-40°C to +85°C	Q-16
ADG222TQ	-55°C to +125°C	Q-16
ADG222TE	-55°C to +125°C	E-20A

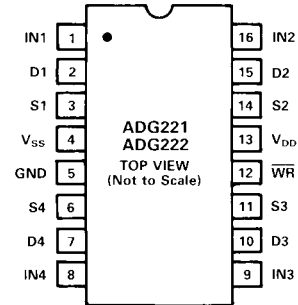
### NOTES

<sup>1</sup>To order MIL-STD-883, Class B processed parts, add /883B to T grade part numbers. See Analog Devices Military Products Databook (1990) for military data sheet.

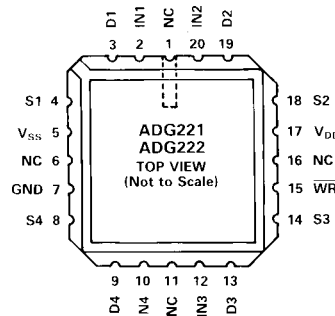
<sup>2</sup>N = Plastic DIP; R = 0.15" Small Outline IC (SOIC); P = Plastic Leaded Chip Carrier (PLCC); Q = Cerdip; E = Leadless Ceramic Chip Carrier (LCCC).

### PIN CONFIGURATIONS

#### DIP, SOIC

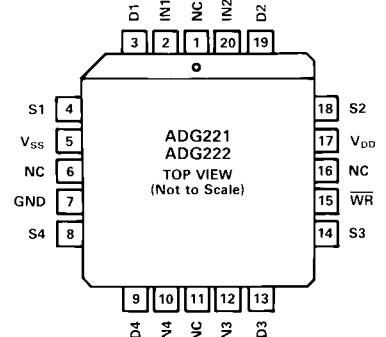


#### LCCC



NC = NO CONNECT

#### PLCC



NC = NO CONNECT

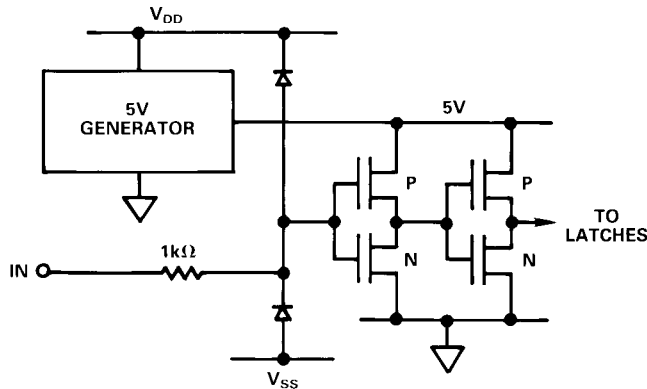
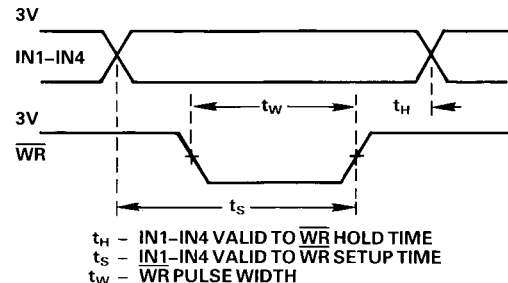


Figure 1. Typical Digital Input Cell

### TIMING AND CONTROL SEQUENCE

Figure 2 shows the timing sequence for latching the switch digital inputs (IN1 – IN4). The latches are level sensitive and, therefore, while  $\overline{WR}$  is held low the latches are transparent and the switches respond to the digital inputs. The digital inputs are latched on the rising edge of  $\overline{WR}$ .

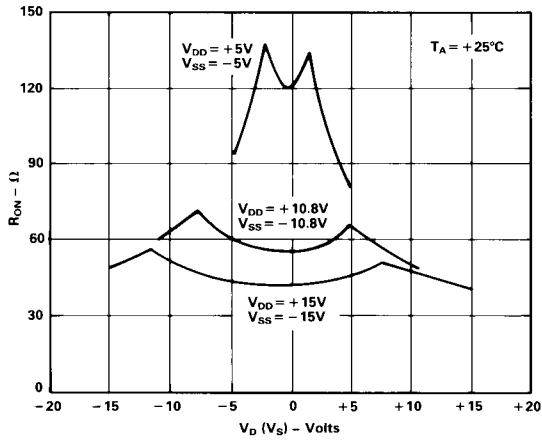


$t_H$  – IN1-IN4 VALID TO  $\overline{WR}$  HOLD TIME  
 $t_S$  – IN1-IN4 VALID TO  $\overline{WR}$  SETUP TIME  
 $t_w$  –  $\overline{WR}$  PULSE WIDTH

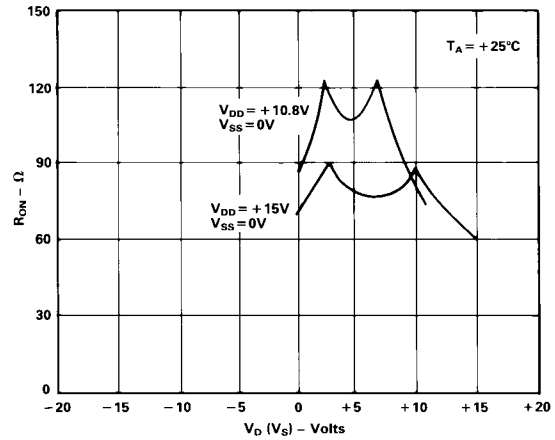
Figure 2. Timing and Control Sequence

# ADG221/ADG222—Typical Performance Characteristics

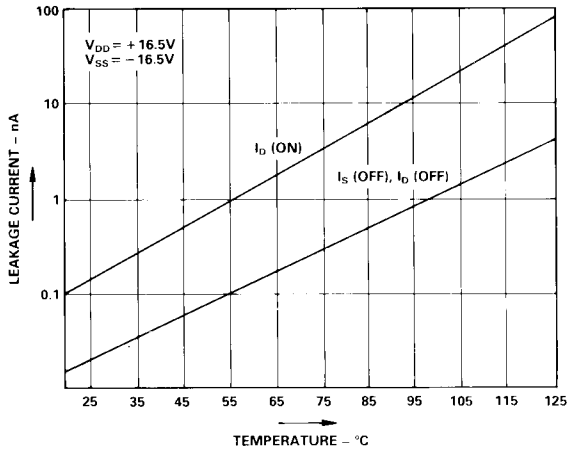
The switches are guaranteed functional with reduced single or dual supplies down to 4.5V.



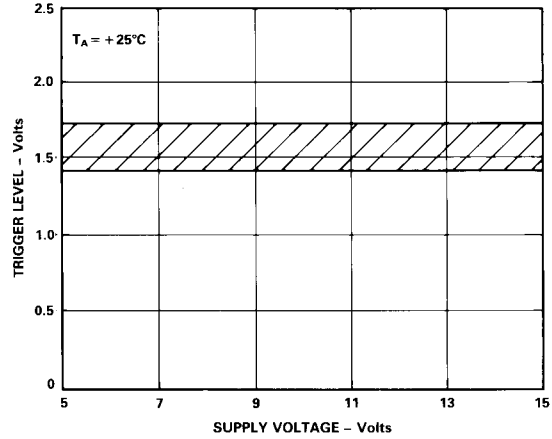
$R_{ON}$  as a Function of  $V_D$  ( $V_S$ ): Dual Supply Voltage



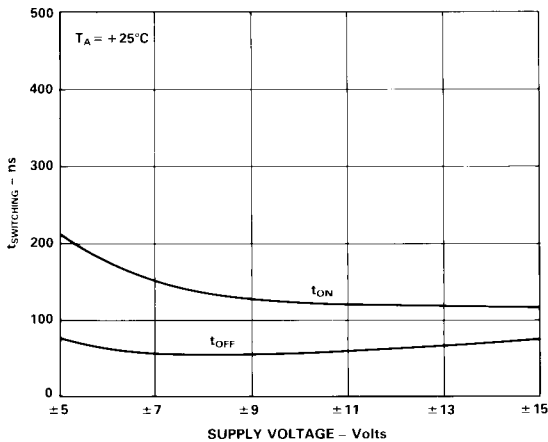
$R_{ON}$  as a Function of  $V_D$  ( $V_S$ ): Single Supply Voltage



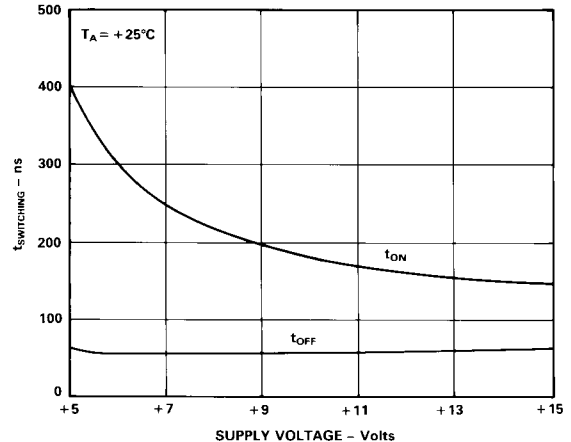
Leakage Current as a Function of Temperature (Note: Leakage Currents Reduce as the Supply Voltages Reduce)



Trigger Level vs. Power Supply Voltage: Dual or Single Supply Voltage

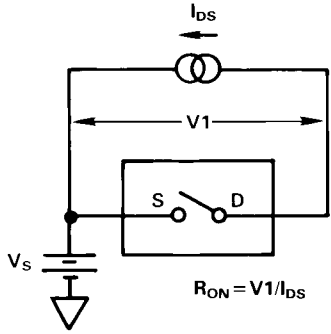


Switching Times vs. Supply Voltage (Dual Supply)

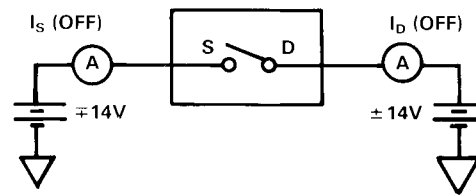


Switching Times vs. Supply Voltage (Single Supply)

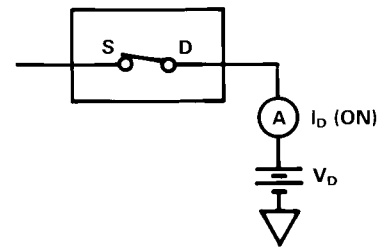
# Test Circuits—ADG221/ADG222



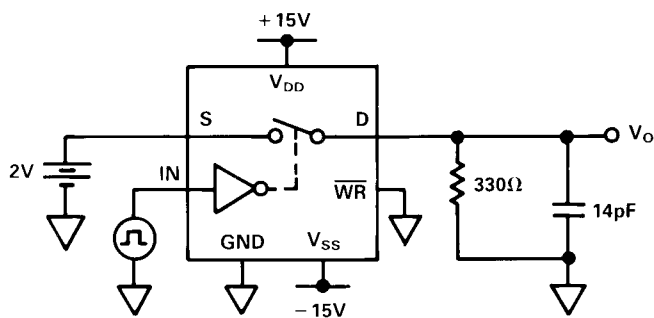
Test Circuit 1



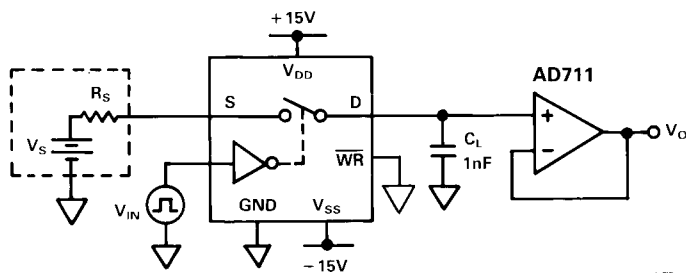
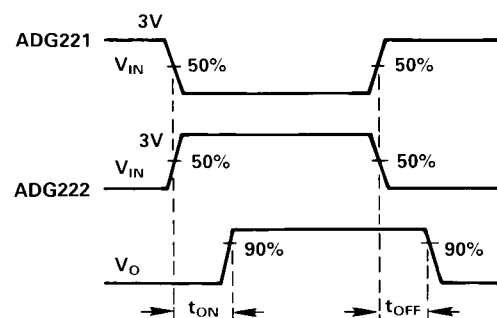
Test Circuit 2



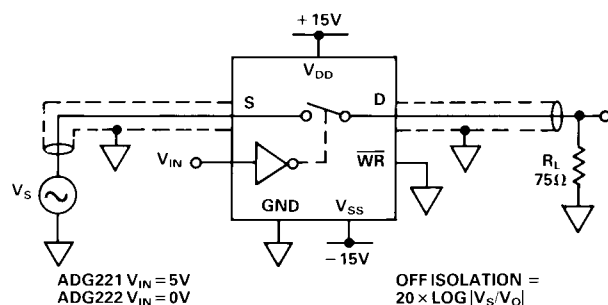
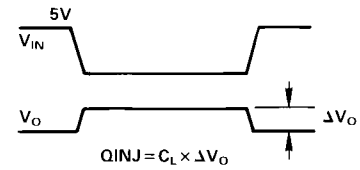
Test Circuit 3



Test Circuit 4



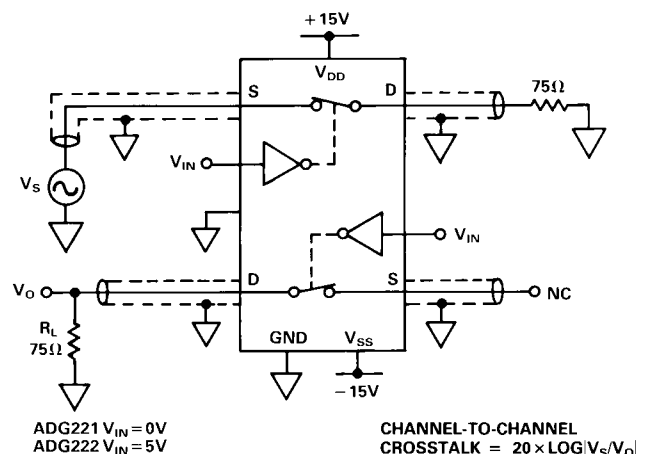
Test Circuit 5. Charge Injection



Test Circuit 6. Off Isolation

ADG221  $V_{IN} = 5V$   
ADG222  $V_{IN} = 0V$

OFF ISOLATION =  
 $20 \times \text{LOG} |V_S/V_O|$



Test Circuit 7. Channel-to-Channel Crosstalk

CHANNEL-TO-CHANNEL  
CROSSTALK =  $20 \times \text{LOG} |V_S/V_O|$

# ADG221/ADG222

## TERMINOLOGY

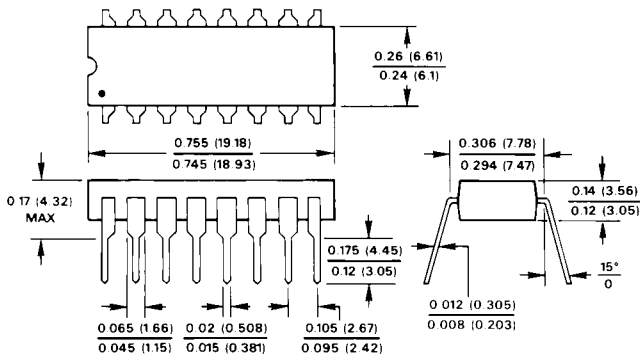
$R_{ON}$	Ohmic resistance between terminals OUT and S
$R_{ON}$ Match	Difference between the $R_{ON}$ of any two channels
$I_S$ (OFF)	Source terminal leakage current when the switch is off
$I_D$ (OFF)	Drain terminal leakage current when the switch is off
$I_D$ (ON)	Leakage current that flows from the closed switch into the body
$V_D$ ( $V_S$ )	Analog voltage on terminal D, S
$C_S$ (OFF)	Switch input capacitance "OFF" condition
$C_D$ (OFF)	Switch output capacitance "OFF" condition
$C_{IN}$	Digital input capacitance
$C_D, C_S$ (ON)	Input or output capacitance when the switch is on

$t_{ON}$	Delay time between the 50% and 90% points of the digital input and switch "ON" condition
$t_{OFF}$	Delay time between the 50% and 90% points of the digital input and switch "OFF" condition
$t_{OPEN}$	"OFF" time measured between 50% points of both switches, which are connected as a multiplexer, when switching from one address state to another
$V_{INL}$	Maximum Input Voltage for a Logic Low
$V_{INH}$	Minimum Input Voltage for a Logic High
$I_{INL}$ ( $I_{INH}$ )	Input current of the digital input
$V_{DD}$	Most positive voltage supply
$V_{SS}$	Most negative voltage supply
$I_{DD}$	Positive supply current
$I_{SS}$	Negative supply current

## OUTLINE DIMENSIONS

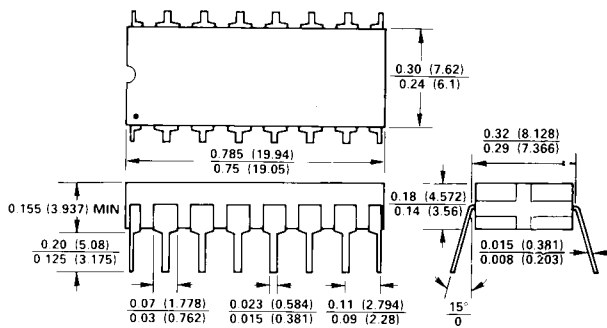
Dimensions shown in inches and (mm).

### 16-Pin Plastic (N-16)

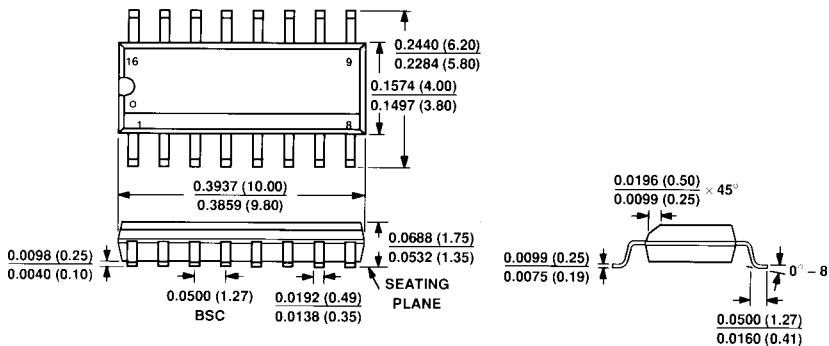


LEAD NO. 1 IDENTIFIED BY DOT OR NOTCH  
LEADS ARE SOLDER OR TIN-PLATED KOVAR OR ALLOY 42

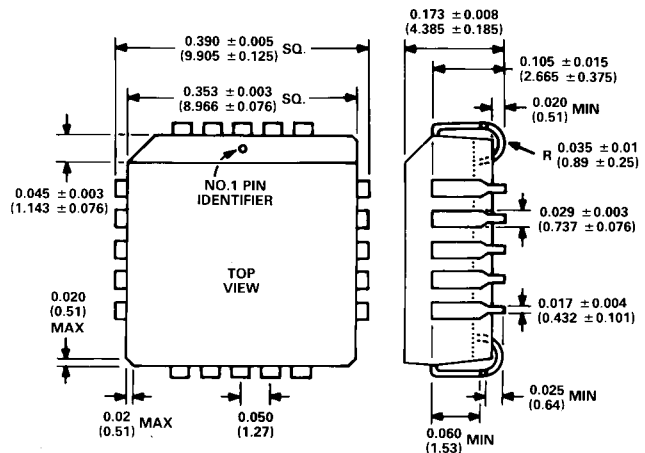
### 16-Pin Cerdip (Q-16)



### 16-Lead Narrow Body SOIC (R-16A)



### 20-Terminal Plastic Leaded Chip Carrier (P-20A)



### 20-Terminal Leadless Ceramic Chip Carrier (E-20A)

