



# 16-/32- Channel, Serially Controlled 4 $\Omega$ 1.8 V to 5.5 V, $\pm 2.5$ V, Analog Multiplexers

## Preliminary Technical Data

## ADG725/ADG731

### FEATURES

**3-Wire SPI Serial Interface**  
**1.8 V to 5.5 V Single Supply**  
 **$\pm 2.5$  V Dual Supply Operation**  
**4  $\Omega$  On Resistance**  
**0.5  $\Omega$  On Resistance Flatness**  
**7mm x 7mm 48 lead Chip Scale Package (CSP)**  
**or 48 lead TQFP package.**  
**Rail to Rail Operation**  
**Power On Reset**  
**Fast Switching Times**  
**Single 32 to 1 Channel Multiplexer**  
**Dual/Differential 16 to 1 Channel Multiplexer**  
**TTL/CMOS Compatible Inputs**  
**For Functionally Equivalent devices with Parallel Interface**  
**See ADG726/ADG732**

### APPLICATIONS

**Optical Applications**  
**Data Acquisition Systems**  
**Communication Systems**  
**Relay replacement**  
**Audio and Video Switching**  
**Battery Powered Systems**  
**Medical Instrumentation**  
**Automatic Test Equipment**

### GENERAL DESCRIPTION

The ADG725/ADG731 are monolithic CMOS 32 channel/dual 16 channel analog multiplexers with a serially controlled 3-wire interface. The ADG731 switches one of thirty-two inputs (S1-S32) to a common output, D. The ADG725 can be configured as a dual mux switching one of sixteen inputs to one output or a differential mux switching one of sixteen inputs to a differential output.

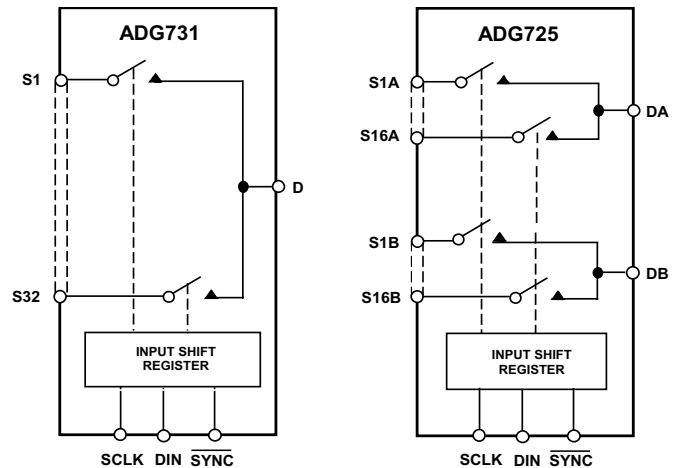
These multiplexers utilize a 3-wire serial interface that is compatible with SPI<sup>TM</sup>, QSPI<sup>TM</sup>, MICROWIRE<sup>TM</sup> and some DSP interface standards. On power-up, the internal shift register contains all zeros and all switches are in the OFF state.

These multiplexers are designed on an enhanced submicron process that provides low power dissipation yet gives high switching speed, very low on resistance and leakage currents. They operate from single supply of 1.8V to 5.5V and  $\pm 2.5$  V dual supply, making them ideally suited to a variety of applications. On resistance is in the region of a few Ohms and is closely matched between switches and very flat over the full signal range. These parts can operate equally well as either Multiplexers or De-Multiplexers

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### FUNCTIONAL BLOCK DIAGRAMS



and have an input signal range which extends to the supplies. In the OFF condition, signal levels up to the supplies are blocked. All channels exhibit break before make switching action preventing momentary shorting when switching channels.

They are available in either 48 lead CSP or TQFP package.

### PRODUCT HIGHLIGHTS

- 3-Wire Serial Interface.
- +1.8 V to +5.5 V Single or  $\pm 2.5$  V Dual Supply operation. These parts are specified and guaranteed with +5 V  $\pm 10\%$ , +3 V  $\pm 10\%$  single supply and  $\pm 2.5$  V  $\pm 10\%$  dual supply rails.
- On Resistance of 4  $\Omega$ .
- Guaranteed Break-Before-Make Switching Action.
- 7mm x 7mm 48 lead Chip Scale Package (CSP) or 48 lead TQFP package.

# PRELIMINARY TECHNICAL DATA

## ADG725/ADG731—SPECIFICATIONS<sup>1</sup> ( $V_{DD} = 5V \pm 10\%$ , $V_{SS} = 0V$ , $GND = 0V$ , unless otherwise noted)

Parameter	B Version		Units	Test Conditions/Comments
	+25°C	-40°C to +85°C		
<b>ANALOG SWITCH</b>				
Analog Signal Range	0 V to $V_{DD}$		V	
On-Resistance ( $R_{ON}$ )	4		$\Omega$ typ	$V_S = 0V$ to $V_{DD}$ , $I_{DS} = 10mA$ ; Test Circuit 1
	5.5	6	$\Omega$ max	
On-Resistance Match Between Channels ( $\Delta R_{ON}$ )		0.3	$\Omega$ typ	$V_S = 0V$ to $V_{DD}$ , $I_{DS} = 10mA$
		0.8	$\Omega$ max	
On-Resistance Flatness ( $R_{FLAT(ON)}$ )	0.5		$\Omega$ typ	$V_S = 0V$ to $V_{DD}$ , $I_{DS} = 10mA$
		1	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>				
Source OFF Leakage $I_S$ (OFF)	$\pm 0.01$		nA typ	$V_{DD} = 5.5V$ $V_D = 4.5V/1V$ , $V_S = 1V/4.5V$ ; Test Circuit 2
	$\pm 0.25$	$\pm 0.5$	nA max	
Drain OFF Leakage $I_D$ (OFF)	$\pm 0.05$		nA typ	$V_D = 4.5V/1V$ , $V_S = 1V/4.5V$ ; Test Circuit 3
ADG725	$\pm 0.5$	$\pm 2.5$	nA max	
ADG731	$\pm 1$	$\pm 5$	nA max	
Channel ON Leakage $I_D$ , $I_S$ (ON)	$\pm 0.05$		nA typ	$V_D = V_S = 1V$ , or $4.5V$ ; Test Circuit 4
ADG725	$\pm 0.5$	$\pm 2.5$	nA max	
ADG726	$\pm 1$	$\pm 5$	nA max	
<b>DIGITAL INPUTS</b>				
Input High Voltage, $V_{INH}$		2.4	V min	
Input Low Voltage, $V_{INL}$		0.8	V max	
Input Current				
$I_{INL}$ or $I_{INH}$	0.005		$\mu A$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
		$\pm 0.1$	$\mu A$ max	
$C_{IN}$ , Digital Input Capacitance	5		pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>				
$t_{TRANSITION}$	40		ns typ	$R_L = 300\Omega$ , $C_L = 35pF$ , Test Circuit 5; $V_{S1} = 3V/0V$ , $V_{S32} = 0V/3V$
		60	ns max	
Break-Before-Make Time Delay, $t_D$	30		ns typ	$R_L = 300\Omega$ , $C_L = 35pF$ ; $V_S = 3V$ , Test Circuit 6
		1	ns min	
Charge Injection	$\pm 5$		pC typ	$V_S = 0V$ , $R_S = 0\Omega$ , $C_L = 1nF$ ; Test Circuit 7
Off Isolation	-60		dB typ	$R_L = 50\Omega$ , $C_L = 5pF$ , $f = 100kHz$ ; Test Circuit 8
Channel to Channel Crosstalk	-60		dB typ	$R_L = 50\Omega$ , $C_L = 5pF$ , $f = 100kHz$ ; Test Circuit 9
-3 dB Bandwidth				
ADG725	34		MHz typ	$R_L = 50\Omega$ , $C_L = 5pF$ , Test Circuit 10
ADG731	18		MHz typ	
$C_S$ (OFF)	13		pF typ	$f = 1MHz$
$C_D$ (OFF)				
ADG725	180		pF typ	$f = 1MHz$
ADG731	360		pF typ	$f = 1MHz$
$C_D$ , $C_S$ (ON)				
ADG725	200		pF typ	$f = 1MHz$
ADG731	400		pF typ	$f = 1MHz$
<b>POWER REQUIREMENTS</b>				
$I_{DD}$	10		$\mu A$ typ	$V_{DD} = +5.5V$ Digital Inputs = $0V$ or $+5.5V$
		20	$\mu A$ max	

### NOTES

<sup>1</sup>Temperature range is as follows: B Version: -40°C to +85°C.

<sup>2</sup>Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

# SPECIFICATIONS<sup>1</sup> ( $V_{DD} = 3V \pm 10\%$ , $V_{SS} = 0V$ , $GND = 0V$ , unless otherwise noted)

Parameter	B Version		Units	Test Conditions/Comments
	+25°C	-40°C to +85°C		
<b>ANALOG SWITCH</b>				
Analog Signal Range		0 V to $V_{DD}$	V	
On-Resistance ( $R_{ON}$ )	7		$\Omega$ typ	$V_S = 0V$ to $V_{DD}$ , $I_{DS} = 10$ mA;
	11	12	$\Omega$ max	Test Circuit 1
On-Resistance Match Between Channels ( $\Delta R_{ON}$ )		0.4	$\Omega$ typ	$V_S = 0V$ to $V_{DD}$ , $I_{DS} = 10$ mA
On-Resistance Flatness ( $R_{FLAT(ON)}$ )		1	$\Omega$ max	
		3	$\Omega$ max	$V_S = 0V$ to $V_{DD}$ , $I_{DS} = 10$ mA
<b>LEAKAGE CURRENTS</b>				
Source OFF Leakage $I_S$ (OFF)	$\pm 0.01$		nA typ	$V_{DD} = 3.3V$
	$\pm 0.25$	$\pm 0.5$	nA max	$V_S = 3V/1V$ , $V_D = 1V/3V$ ;
Drain OFF Leakage $I_D$ (OFF)	$\pm 0.05$		nA typ	Test Circuit 2
ADG725	$\pm 0.5$	$\pm 2.5$	nA max	$V_S = 1V/3V$ , $V_D = 3V/1V$ ;
ADG731	$\pm 1$	$\pm 5$	nA max	Test Circuit 3
Channel ON Leakage $I_D$ , $I_S$ (ON)	$\pm 0.05$		nA typ	$V_S = V_D = +1V$ or $+3V$ ;
ADG725	$\pm 0.5$	$\pm 2.5$	nA max	Test Circuit 4
ADG731	$\pm 1$	$\pm 5$	nA max	
<b>DIGITAL INPUTS</b>				
Input High Voltage, $V_{INH}$		2.0	V min	
Input Low Voltage, $V_{INL}$		0.8	V max	
Input Current				
$I_{INL}$ or $I_{INH}$	0.005		$\mu A$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
		$\pm 0.1$	$\mu A$ max	
$C_{IN}$ , Digital Input Capacitance	5		pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>				
$t_{TRANSITION}$	45		ns typ	$R_L = 300\Omega$ , $C_L = 35$ pF Test Circuit 5
		75	ns max	$V_{S1} = 2V/0V$ , $V_{S32} = 0V/2V$
Break-Before-Make Time Delay, $t_D$	30		ns typ	$R_L = 300\Omega$ , $C_L = 35$ pF;
		1	ns min	$V_S = 2V$ , Test Circuit 6
Charge Injection	$\pm 5$		pC typ	$V_S = 0V$ , $R_S = 0\Omega$ , $C_L = 1$ nF;
				Test Circuit 7
Off Isolation	-60		dB typ	$R_L = 50\Omega$ , $C_L = 5$ pF, $f = 1$ MHz;
				Test Circuit 8
Channel to Channel Crosstalk	-60		dB typ	$R_L = 50\Omega$ , $C_L = 5$ pF, $f = 1$ MHz;
				Test Circuit 9
-3 dB Bandwidth				
ADG725	34		MHz typ	$R_L = 50\Omega$ , $C_L = 5$ pF, Test Circuit 10
ADG731	18		MHz typ	
$C_S$ (OFF)	13		pF typ	$f = 1$ MHz
$C_D$ (OFF)				
ADG725	180		pF typ	$f = 1$ MHz
ADG731	360		pF typ	$f = 1$ MHz
$C_D$ , $C_S$ (ON)				
ADG725	200		pF typ	$f = 1$ MHz
ADG731	400		pF typ	$f = 1$ MHz
<b>POWER REQUIREMENTS</b>				
$I_{DD}$	10		$\mu A$ typ	$V_{DD} = +3.3V$
		20	$\mu A$ max	Digital Inputs = 0 V or +3.3 V

## NOTES

<sup>1</sup>Temperature ranges are as follows: B Version: -40°C to +85°C.<sup>2</sup>Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

PRELIMINARY TECHNICAL DATA

# ADG725/ADG731—SPECIFICATIONS<sup>1</sup> Dual Supply

( $V_{DD} = +2.5\text{ V} \pm 10\%$ ,  $V_{SS} = -2.5\text{ V} \pm 10\%$ ,  $GND = 0\text{ V}$ , unless otherwise noted)

Parameter	B Version		Units	Test Conditions/Comments
	+25°C	-40°C to +85°C		
<b>ANALOG SWITCH</b>				
Analog Signal Range		$V_{SS}$ to $V_{DD}$	V	
On-Resistance ( $R_{ON}$ )	4		$\Omega$ typ	$V_S = V_{SS}$ to $V_{DD}$ , $I_{DS} = 10\text{ mA}$ ; Test Circuit 1
	5.5	6	$\Omega$ max	
On-Resistance Match Between Channels ( $\Delta R_{ON}$ )		0.3	$\Omega$ typ	$V_S = V_{SS}$ to $V_{DD}$ , $I_{DS} = 10\text{ mA}$
		0.8	$\Omega$ max	
On-Resistance Flatness ( $R_{FLAT(ON)}$ )	0.5		$\Omega$ typ	$V_S = V_{SS}$ to $V_{DD}$ , $I_{DS} = 10\text{ mA}$
		1	$\Omega$ max	
<b>LEAKAGE CURRENTS</b>				
Source OFF Leakage $I_S$ (OFF)	$\pm 0.01$		nA typ	$V_{DD} = +2.75\text{ V}$ , $V_{SS} = -2.75\text{ V}$ $V_S = +2.25\text{ V}/-1.25\text{ V}$ , $V_D = -1.25\text{ V}/+2.25\text{ V}$ ; Test Circuit 2
	$\pm 0.25$	$\pm 0.5$	nA max	
Drain OFF Leakage $I_D$ (OFF)	$\pm 0.05$		nA typ	$V_S = +2.25\text{ V}/-1.25\text{ V}$ , $V_D = -1.25\text{ V}/+2.25\text{ V}$ ; Test Circuit 3
	$\pm 0.5$	$\pm 2.5$	nA max	
	$\pm 1$	$\pm 5$	nA max	
Channel ON Leakage $I_D$ , $I_S$ (ON)	$\pm 0.01$		nA typ	$V_S = V_D = +2.25\text{ V}/-1.25\text{ V}$ , Test Circuit 4
	$\pm 0.5$	$\pm 2.5$	nA max	
	$\pm 1$	$\pm 5$	nA max	
<b>DIGITAL INPUTS</b>				
Input High Voltage, $V_{INH}$		1.7	V min	
Input Low Voltage, $V_{INL}$		0.7	V max	
Input Current $I_{INL}$ or $I_{INH}$	0.005		$\mu\text{A}$ typ	$V_{IN} = V_{INL}$ or $V_{INH}$
		$\pm 0.1$	$\mu\text{A}$ max	
$C_{IN}$ , Digital Input Capacitance	5		pF typ	
<b>DYNAMIC CHARACTERISTICS<sup>2</sup></b>				
$t_{TRANSITION}$	40		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ Test Circuit 5
		60	ns max	$V_{S1} = 1.5\text{ V}/0\text{ V}$ , $V_{S32} = 0\text{ V}/1.5\text{ V}$
Break-Before-Make Time Delay, $t_D$	15		ns typ	$R_L = 300\ \Omega$ , $C_L = 35\text{ pF}$ ;
		1	ns min	$V_S = 1.5\text{ V}$ , Test Circuit 6
Charge Injection	$\pm 8$		pC typ	$V_S = 0\text{ V}$ , $R_S = 0\ \Omega$ , $C_L = 1\text{ nF}$ ; Test 7
Off Isolation	-60		dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; Test Circuit 8
Channel to Channel Crosstalk	-60		dB typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , $f = 1\text{ MHz}$ ; Test Circuit 9
-3 dB Bandwidth				
ADG725	34		MHz typ	$R_L = 50\ \Omega$ , $C_L = 5\text{ pF}$ , Test Circuit 10
ADG731	18		MHz typ	
$C_S$ (OFF)	13		pF typ	
$C_D$ (OFF)				
ADG725	180		pF typ	$f = 1\text{ MHz}$
ADG731	360		pF typ	$f = 1\text{ MHz}$
$C_D$ , $C_S$ (ON)				
ADG725	200		pF typ	$f = 1\text{ MHz}$
ADG731	400		pF typ	$f = 1\text{ MHz}$
<b>POWER REQUIREMENTS</b>				
$I_{DD}$	10		$\mu\text{A}$ typ	$V_{DD} = +2.75\text{ V}$ Digital Inputs = 0 V or +2.75 V
		20	$\mu\text{A}$ max	
$I_{SS}$	10		$\mu\text{A}$ typ	$V_{SS} = -2.75\text{ V}$ Digital Inputs = 0 V or +2.75 V
		20	$\mu\text{A}$ max	

NOTES

<sup>1</sup>Temperature range is as follows: B Version: -40°C to +85°C.

<sup>2</sup>Guaranteed by design, not subject to production test.

Specifications subject to change without notice.

# TIMING CHARACTERISTICS<sup>1,2</sup>

Parameter	Limit at T <sub>MIN</sub> , T <sub>MAX</sub>	Units	Conditions/Comments
t <sub>1</sub>	33	ns min	SCLK Cycle time
t <sub>2</sub>	13	ns min	SCLK High Time
t <sub>3</sub>	13	ns min	SCLK Low Time
t <sub>4</sub>	13	ns min	$\overline{\text{SYNC}}$ to SCLK falling edge setup time
t <sub>5</sub>	40	ns min	Minimum $\overline{\text{SYNC}}$ low time
t <sub>6</sub>	5	ns min	Data Setup Time
t <sub>7</sub>	4.5	ns min	Data Hold Time
t <sub>8</sub>	33	ns min	Minimum $\overline{\text{SYNC}}$ high time

NOTES

<sup>1</sup>See Figure 1.

<sup>2</sup>All input signals are specified with tr = tf = 5ns (10% to 90% of V<sub>DD</sub>) and timed from a voltage level of (V<sub>IL</sub> + V<sub>IH</sub>)/2.

Specifications subject to change without notice.

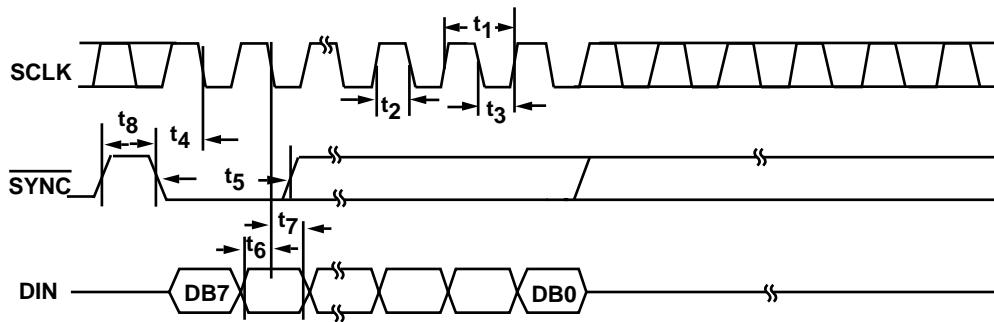


Figure 1. 3-Wire Serial Interface Timing Diagram.

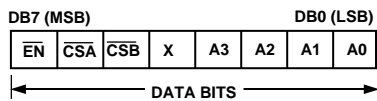


Figure 2. ADG725 Input Shift Register Contents

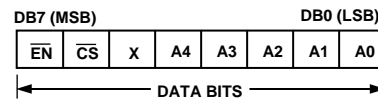


Figure 3. ADG731 Input Shift Register Contents

# PRELIMINARY TECHNICAL DATA

## ADG725/ADG731

### ABSOLUTE MAXIMUM RATINGS<sup>1</sup>

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

V <sub>DD</sub> to V <sub>SS</sub>	+7 V
V <sub>DD</sub> to GND	-0.3 V to +7 V
V <sub>SS</sub> to GND	+0.3 V to -7 V
Analog Inputs <sup>2</sup>	V <sub>SS</sub> - 0.3 V to V <sub>DD</sub> +0.3 V or 30 mA, Whichever Occurs First
Digital Inputs <sup>2</sup>	-0.3V to V <sub>DD</sub> +0.3 V or 30 mA, Whichever Occurs First
Peak Current, S or D	60mA (Pulsed at 1 ms, 10% Duty Cycle max)
Continuous Current, S or D	30mA
Operating Temperature Range	
Industrial (B Version)	-40°C to +85°C

Storage Temperature Range	-65°C to +150°C
Junction Temperature	+150°C
48 lead CSP θ <sub>JA</sub> Thermal Impedance	TBD°C/W
48 lead TQFP θ <sub>JA</sub> Thermal Impedance	TBD°C/W
Lead Temperature, Soldering (10seconds)	300°C
IR Reflow, Peak Temperature	+220°C

### NOTES

<sup>1</sup>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 listed 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.

<sup>2</sup>Overvoltages at SCLK, SYNC, DIN, RS, S or D will be clamped by internal diodes. Current should be limited to the maximum ratings given.

### CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the ADG725/ADG731 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.



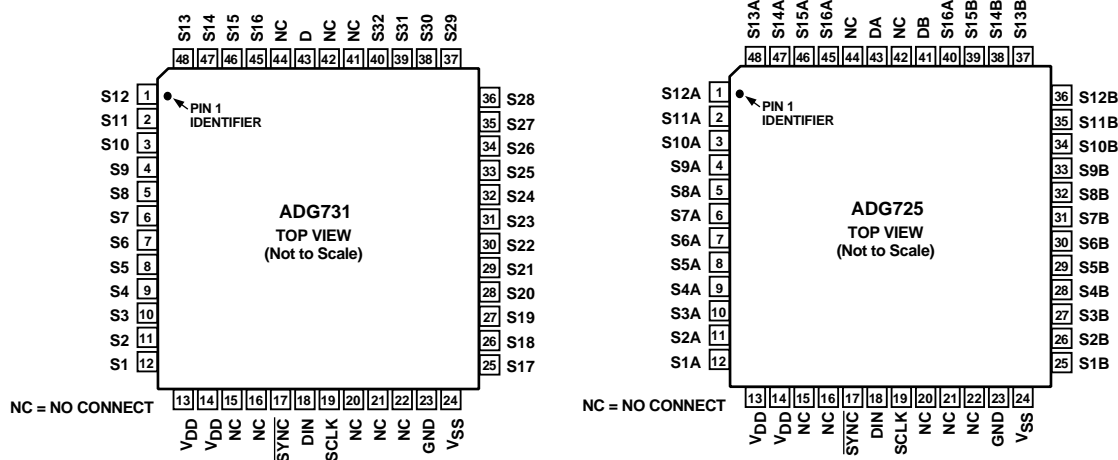
### ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADG725BCP	-40 °C to +85 °C	Chip Scale Package (CSP)	CP-48
ADG725BSU	-40 °C to +85 °C	Thin Quad Flatpack	SU-48
ADG731BCP	-40 °C to +85 °C	Chip Scale Package (CSP)	CP-48
ADG731BSU	-40 °C to +85 °C	Thin Quad Flatpack	SU-48

### PIN FUNCTION DESCRIPTION

ADG725	ADG731	Mnemonic	Function
		SCLK	Serial Clock Input. Data is clocked into the input shift register on the falling edge of the serial clock input. These devices can accommodate serial input rates of up to 30MHz.
		$\overline{RS}$	Active low control input that clears the input register and turns all switches to the OFF condition.
		DIN	Serial Data Input. Data is clocked into the 8-bit input register on the falling edge of the serial clock input.
		SXX	Source. May be an input or output.
		DX	Drain. May be an input or output.
		V <sub>DD</sub>	Power Supply Input. These parts can be operated from a supply of +1.8V to +5.5V and dual supply of +/-2.5V.
		GND	Ground reference.
		$\overline{SYNC}$	Active Low Control Input. This is the frame synchronization signal for the input data. When $\overline{SYNC}$ goes low, it powers on the SCLK and DIN buffers and the input shift register is enabled. An 8-bit counter is also enabled. Data is transferred on the falling edges of the following clocks. After 8 falling clock edges, switch conditions are automatically updated. $\overline{SYNC}$ may be used to frame the signal, or just pulled low for a short period of time to enable the counter and input buffers.

### PIN CONFIGURATIONS CSP & TQFP



# PRELIMINARY TECHNICAL DATA

## ADG725/ADG731

**Table 1. ADG725 Truth Table**

A3	A2	A1	A0	$\bar{E} \bar{N}$	$\bar{C} \bar{S} \bar{A}$	$\bar{C} \bar{S} \bar{B}$	Switch Condition
X	X	X	X	X	1	1	Retains previous switch condition
X	X	X	X	1	1	1	All Switches OFF
0	0	0	0	0	0	0	S1A - DA, S1B - DB
0	0	0	1	0	0	0	S2A - DA, S2B - DB
0	0	1	0	0	0	0	S3A - DA, S3B - DB
0	0	1	1	0	0	0	S4A - DA, S4B - DB
0	1	0	0	0	0	0	S5A - DA, S5B - DB
0	1	0	1	0	0	0	S6A - DA, S6B - DB
0	1	1	0	0	0	0	S7A - DA, S7B - DB
0	1	1	1	0	0	0	S8A - DA, S8B - DB
1	0	0	0	0	0	0	S9A - DA, S9B - DB
1	0	0	1	0	0	0	S10A - DA, S10B - DB
1	0	1	0	0	0	0	S11A - DA, S11B - DB
1	0	1	1	0	0	0	S12A - DA, S12B - DB
1	1	0	0	0	0	0	S13A - DA, S13B - DB
1	1	0	1	0	0	0	S14A - DA, S14B - DB
1	1	1	0	0	0	0	S15A - DA, S15B - DB
1	1	1	1	0	0	0	S16A - DA, S16B - DB

**Table 2. ADG731 Truth Table**

A4	A3	A2	A1	A0	$\bar{E} \bar{N}$	$\bar{C} \bar{S}$	Switch Condition
X	X	X	X	X	X	1	Retains previous switch condition
X	X	X	X	X	1	1	All Switches OFF
0	0	0	0	0	0	0	1
0	0	0	0	1	0	0	2
0	0	0	1	0	0	0	3
0	0	0	1	1	0	0	4
0	0	1	0	0	0	0	5
0	0	1	0	1	0	0	6
0	0	1	1	0	0	0	7
0	0	1	1	1	0	0	8
0	1	0	0	0	0	0	9
0	1	0	0	1	0	0	10
0	1	0	1	0	0	0	11
0	1	0	1	1	0	0	12
0	1	1	0	0	0	0	13
0	1	1	0	1	0	0	14
0	1	1	1	0	0	0	15
0	1	1	1	1	0	0	16
1	0	0	0	0	0	0	17
1	0	0	0	1	0	0	18
1	0	0	1	0	0	0	19
1	0	0	1	1	0	0	20
1	0	1	0	0	0	0	21
1	0	1	0	1	0	0	22
1	0	1	1	0	0	0	23
1	0	1	1	1	0	0	24
1	1	0	0	0	0	0	25
1	1	0	0	1	0	0	26
1	1	0	1	0	0	0	27
1	1	0	1	1	0	0	28
1	1	1	0	0	0	0	29
1	1	1	0	1	0	0	30
1	1	1	1	0	0	0	31
1	1	1	1	1	0	0	32

X = Don't Care

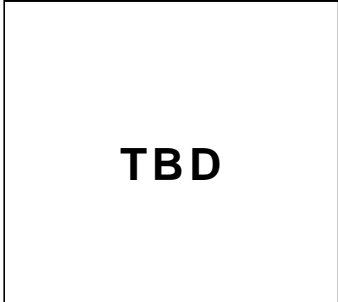


## TERMINOLOGY

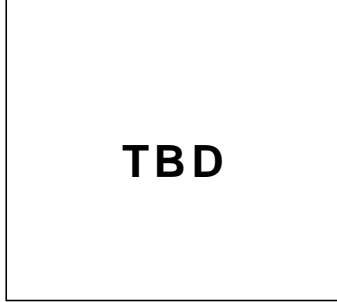
$V_{DD}$	Most positive power supply potential.
$V_{SS}$	Most Negative power supply in a dual supply application. In single supply applications, connect to GND.
$I_{DD}$	Positive supply current.
$I_{SS}$	Negative supply current.
GND	Ground (0 V) reference.
S	Source terminal. May be an input or output.
D	Drain terminal. May be an input or output.
IN	Logic control input.
$V_D (V_S)$	Analog voltage on terminals D, S
$R_{ON}$	Ohmic resistance between D and S.
$\Delta R_{ON}$	On resistance match between any two channels, i.e. $R_{ONmax} - R_{ONmin}$
$R_{FLAT(ON)}$	Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured over the specified analog signal range.
$I_S (OFF)$	Source leakage current with the switch "OFF."
$I_D (OFF)$	Drain leakage current with the switch "OFF."
$I_D, I_S (ON)$	Channel leakage current with the switch "ON."
$V_{INL}$	Maximum input voltage for logic "0".
$V_{INH}$	Minimum input voltage for logic "1".
$I_{INL}(I_{INH})$	Input current of the digital input.
$C_S (OFF)$	"OFF" switch source capacitance. Measured with reference to ground.
$C_D (OFF)$	"OFF" switch drain capacitance. Measured with reference to ground.
$C_D, C_S (ON)$	"ON" switch capacitance. Measured with reference to ground.
$C_{IN}$	Digital input capacitance.
$t_{TRANSITION}$	Delay time measured between the 50% and 90% points of the SYNC and the switch "ON" condition when switching from one address state to another.
$t_{OPEN}$	"OFF" time measured between the 80% points of both switches when switching from one address state to another.
Charge Injection	A measure of the glitch impulse transferred from the digital input to the analog output during switching.
Off Isolation	A measure of unwanted signal coupling through an "OFF" switch.
Crosstalk	A measure of unwanted signal is coupled through from one channel to another as a result of parasitic capacitance.
On Response	The Frequency response of the "ON" switch.
Insertion Loss	The loss due to the ON resistance of the switch.

ADG725/ADG731

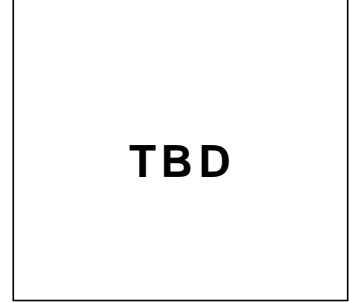
TYPICAL PERFORMANCE CHARACTERISTICS



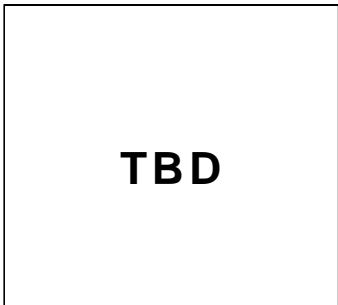
TPC 1. On Resistance vs.  $V_D(V_S)$  for Single Supply



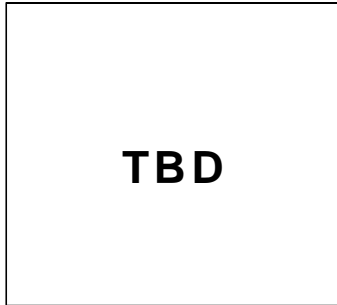
TPC 4. On Resistance vs.  $V_D(V_S)$  for Different Temperatures, Single Supply



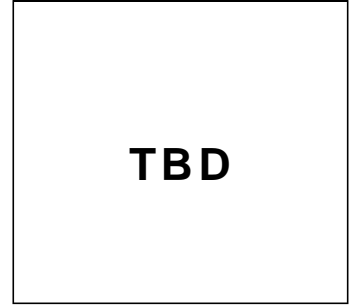
TPC 7. Leakage Currents vs.  $V_D(V_S)$



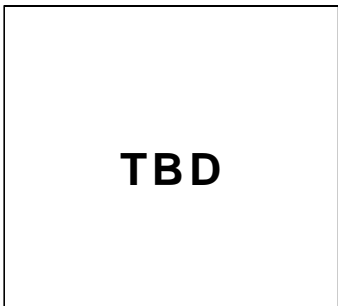
TPC 2. On Resistance vs.  $V_D(V_S)$  for Dual Supply



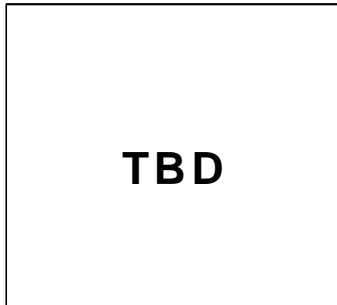
TPC 5. On Resistance vs.  $V_D(V_S)$  for Different Temperatures, Dual Supply



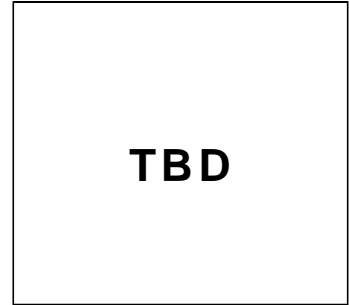
TPC 8. Leakage Currents vs.  $V_D(V_S)$



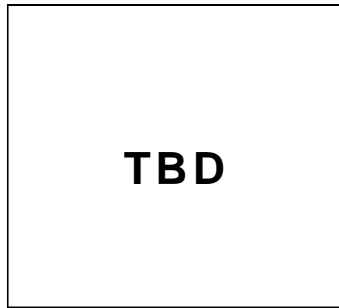
TPC 3. On Resistance vs.  $V_D(V_S)$  for Different Temperatures, Single Supply



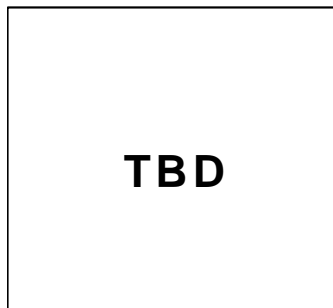
TPC 6. Leakage Currents vs.  $V_D(V_S)$



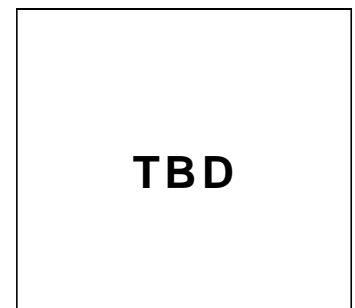
TPC 9. Leakage Currents vs. Temperature



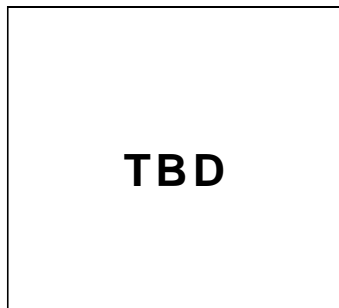
*TPC 10. Leakage Currents vs. Temperature*



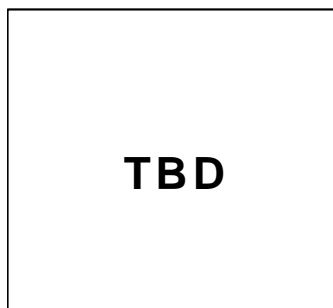
*TPC 13. T<sub>ON</sub>/T<sub>OFF</sub> Times vs. Temperature*



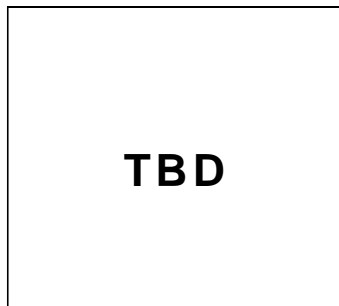
*TPC 16. On Response vs. Frequency*



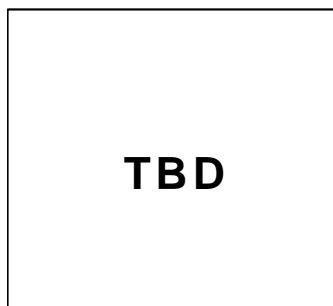
*TPC 11. Supply Currents vs. Input Switching Frequency*



*TPC 14. Off Isolation vs. Frequency*



*TPC 12. Charge Injection vs. Source Voltage*



*TPC 15. Crosstalk vs. Frequency*

## ADG725/ADG731

### GENERAL DESCRIPTION

The ADG725 and ADG731 are serially controlled, 32 channel and dual/differential 16 channel multiplexers respectively.

### POWER ON RESET

On power up of the device, all switches will be in the OFF condition and the internal shift register is filled with zeros and will remain so until a valid write takes place.

### SERIAL INTERFACE

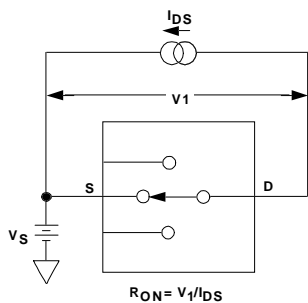
The ADG725 and ADG731 have a three wire serial interface ( $\overline{\text{SYNC}}$ , SCLK, and DIN), which is compatible with SPI, QSPI, MICROWIRE interface standards and most DSP's. Figure 1 shows the timing diagram of a typical write sequence.

Data is written to the 8-bit shift register via DIN under the control of the  $\overline{\text{SYNC}}$  and SCLK signals.

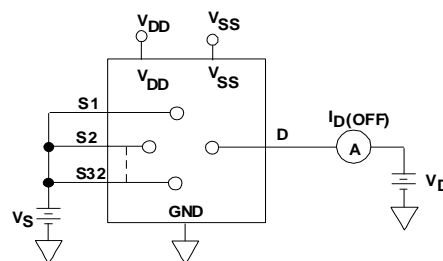
When  $\overline{\text{SYNC}}$  goes low, the input shift register is enabled. An 8-bit counter is also enabled. Data from DIN is clocked into the shift register on the falling edge of SCLK. Figures 2 & 3 show the contents of the input shift registers for these devices. When the part has received eight clock cycles after  $\overline{\text{SYNC}}$  has been pulled low, the switches are automatically updated with the new configuration and the input shift register is disabled. With  $\overline{\text{SYNC}}$  held high, any further data or noise on the DIN line will have no effect on the shift register.

The ADG725  $\overline{\text{CSA}}$  and  $\overline{\text{CSB}}$  data bits allow the user the flexibility to change the configuration of either or both banks of the multiplexer.

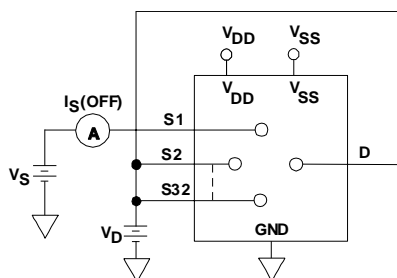
Test Circuits



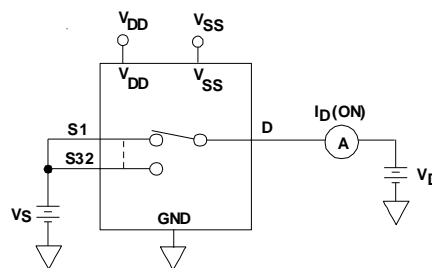
Test Circuit 1. On Resistance.



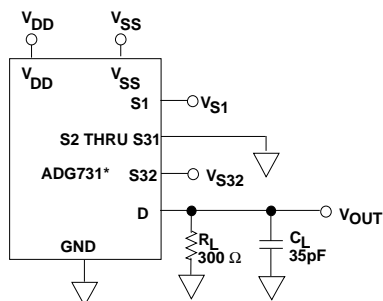
Test Circuit 3.  $I_D$  (OFF)



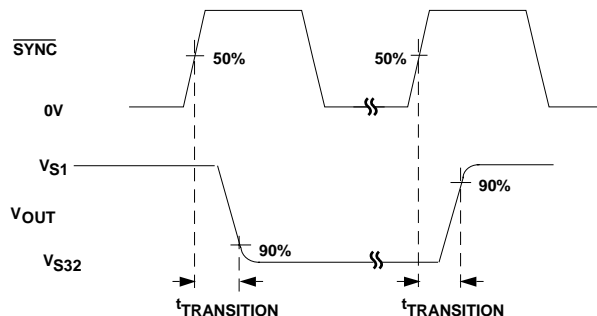
Test Circuit 2.  $I_S$  (OFF).



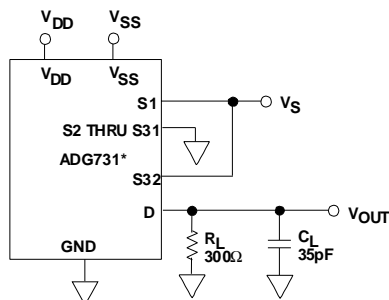
Test Circuit 4.  $I_D$  (ON)



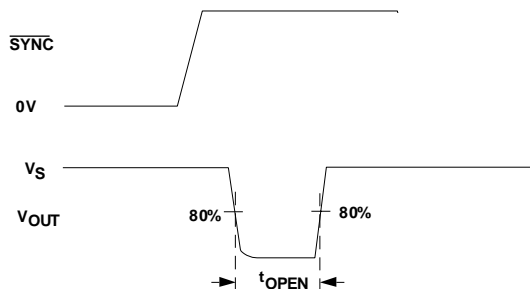
\* SIMILAR CONNECTION FOR ADG725



Test Circuit 5. Switching Time of Multiplexer,  $t_{TRANSITION}$ .

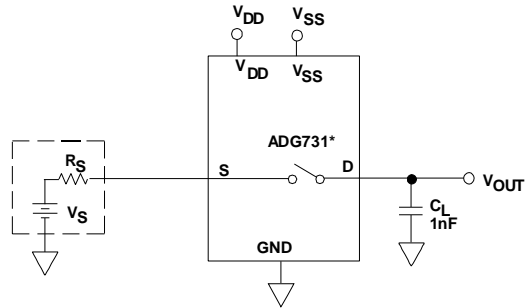


\*SIMILAR CONNECTION FOR ADG725



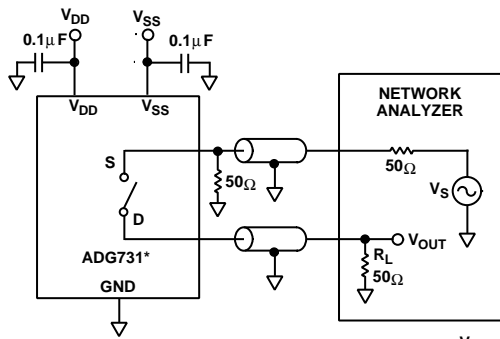
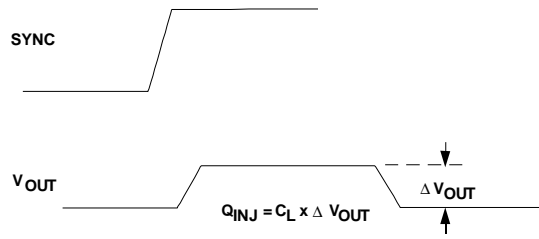
Test Circuit 6. Break Before Make Delay,  $t_{OPEN}$ .

ADG725/ADG731



\*SIMILAR CONNECTION FOR ADG725

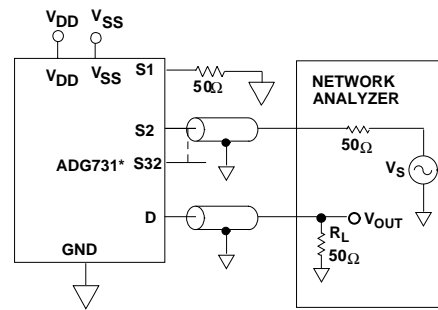
Test Circuit 7. Charge Injection.



$$\text{OFF ISOLATION} = 20 \text{ LOG } \frac{V_{\text{OUT}}}{V_{\text{S}}}$$

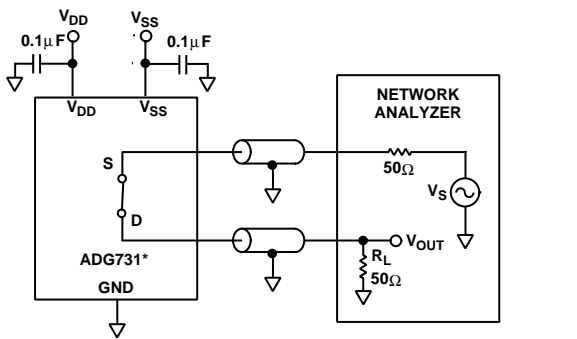
\*SIMILAR CONNECTION FOR ADG725

Test Circuit 8. OFF Isolation



\*SIMILAR CONNECTION FOR ADG725  
CHANNEL TO CHANNEL CROSSTALK =  
 $20 \text{ LOG}_{10} (V_{\text{OUT}}/V_{\text{S}})$

Test Circuit 9. Channel-to-Channel Crosstalk.



$$\text{INSERTION LOSS} = 20 \text{ LOG } \frac{V_{\text{OUT WITH SWITCH}}}{V_{\text{OUT WITHOUT SWITCH}}}$$

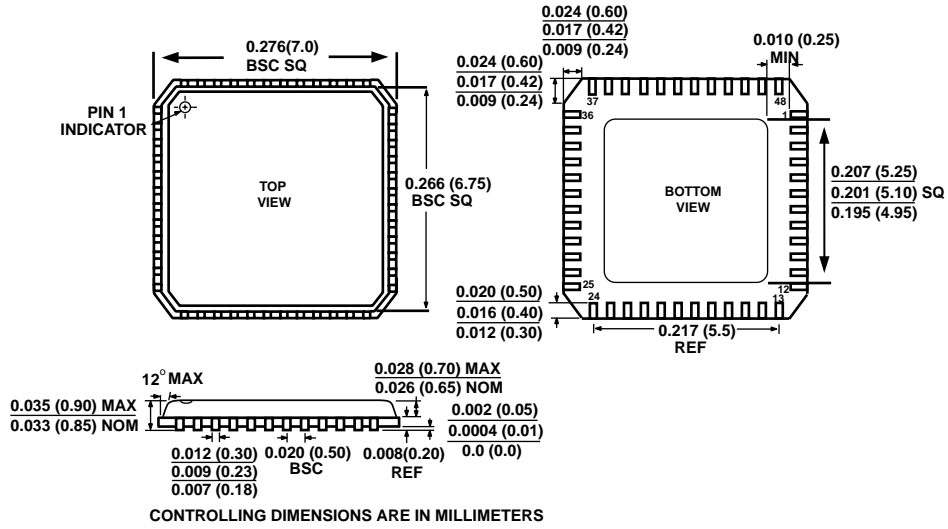
\*SIMILAR CONNECTION FOR ADG725

Test Circuit 10. Bandwidth

### OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).

#### 48-Lead CSP (CP-48)



#### 48-Lead TQFP (SU-48)

