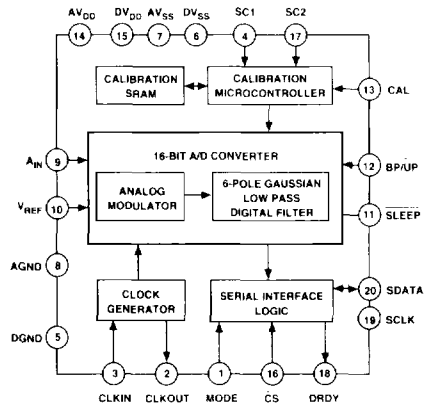


**FEATURES**

- Monolithic 16-Bit ADC**
- 0.0015% Linearity Error**
- On-Chip Self-Calibration Circuitry**
- Programmable Low Pass Filter**
- 0.1 Hz to 10 Hz Corner Frequency**
- 0 V to +2.5 V or ±2.5 V Analog Input Range**
- 4 kSPS Output Data Rate**
- Flexible Serial Interface**
- Ultralow Power**

**APPLICATIONS**

- Industrial Process Control**
- Weigh Scales**
- Portable Instrumentation**
- Remote Data Acquisition**

**FUNCTIONAL BLOCK DIAGRAM**

**GENERAL DESCRIPTION**

The AD7701 is a 16-bit ADC which uses a sigma-delta conversion technique. The analog input is continuously sampled by an analog modulator whose mean output duty cycle is proportional to the input signal. The modulator output is processed by an on-chip digital filter with a six-pole Gaussian response, which updates the output data register with 16-bit binary words at word rates up to 4 kHz. The sampling rate, filter corner frequency and output word rate are set by a master clock input that may be supplied externally, or by a crystal-controlled on-chip clock oscillator.

The inherent linearity of the ADC is excellent, and end-point accuracy is ensured by self-calibration of zero and full scale which may be initiated at any time. The self-calibration scheme can also be extended to null system offset and gain errors in the input channel.

The output data is accessed through a flexible serial port, which has an asynchronous mode compatible with UARTs and two synchronous modes suitable for interfacing to shift registers or the serial ports of industry-standard microcontrollers.

CMOS construction insures low power dissipation, and a power down mode reduces the idle power consumption to only 10  $\mu$ W.

**PRODUCT HIGHLIGHTS**

1. The AD7701 offers 16-bit resolution coupled with outstanding 0.0015% accuracy.
2. No missing codes ensures true, usable, 16-bit dynamic range, removing the need for programmable gain and level-setting circuitry.

3. The effects of temperature drift are eliminated by on-chip self-calibration, which removes zero and gain error. External circuits can also be included in the calibration loop to remove system offsets and gain errors.
4. A flexible synchronous/asynchronous interface allows the AD7701 to interface directly to UARTs or to the serial ports of industry-standard microcontrollers.
5. Low operating power consumption and an ultralow power standby mode make the AD7701 ideal for loop-powered remote sensing applications, or battery-powered portable instruments.

**ORDERING GUIDE**

Model	Temperature Range	Linearity Error (% FSR)	Package Options*
AD7701AN	40°C to +85°C	0.003	N-20
AD7701BN	40°C to +85°C	0.0015	N-20
AD7701AR	40°C to +85°C	0.003	R-20
AD7701BR	40°C to +85°C	0.0015	R-20
AD7701ARS	40°C to +85°C	0.003	RS-28
AD7701AQ	40°C to +85°C	0.003	Q-20
AD7701BQ	40°C to +85°C	0.0015	Q-20
AD7701SQ	55°C to +125°C	0.003	Q-20
AD7701TQ	55°C to +125°C	0.0015	Q-20

\*N = Plastic DIP; Q = Cerdp; R = SOIC. For outline information see Package Information section.

To obtain the most recent version or complete data sheet, call our fax retrieval system at 1-800-446-6212 or visit our World Wide Web site at <http://www.analog.com>.

( $T_A = +25^\circ\text{C}$ ;  $AV_{DD} = DV_{DD} = +5\text{ V}$ ;  $AV_{SS} = DV_{SS} = -5\text{ V}$ ;  $V_{REF} = +2.5\text{ V}$ ;  
 $f_{CLKIN} = 4.096\text{ MHz}$ ; Bipolar Mode:  $MODE = +5\text{ V}$ ;  $A_{IN}$  Source Resistance =  $750\ \Omega$ <sup>1</sup>  
 with  $1\text{ nF}$  to  $AGND$  at  $A_{IN}$ , unless otherwise noted.)

# AD7701—SPECIFICATIONS

Parameter	A, S Versions <sup>2</sup>	B, T Versions <sup>2</sup>	Units	Test Conditions/Comments
<b>STATIC PERFORMANCE</b>				
Resolution	16	16	Bits	
Integral Nonlinearity $T_{MIN}$ to $T_{MAX}$	$\pm 0.003$	$\pm 0.0007$ $\pm 0.0015$	% FSR typ % FSR max	
Differential Nonlinearity $T_{MIN}$ to $T_{MAX}$	$\pm 0.125$ $\pm 0.5$	$\pm 0.125$ $\pm 0.5$	LSB typ LSB max	Guaranteed No Missing Codes
Positive Full-Scale Error <sup>3</sup>	$\pm 0.13$ $\pm 0.5$	$\pm 0.13$ $\pm 0.5$	LSB typ LSB max	
Full-Scale Drift <sup>4</sup>	$\pm 1.2$ (+2.3 S Version)	$\pm 1.2$ (+2.3 T Version)	LSB typ	
Unipolar Offset Error <sup>5</sup>	$\pm 0.25$ $\pm 1$	$\pm 0.25$ $\pm 1$	LSB typ LSB max	
Unipolar Offset Drift <sup>4</sup>	$\pm 1.6$ (+3/ 25 S Version)	$\pm 1.6$ (+3/ 25 T Version)	LSB typ	
Bipolar Zero Error <sup>5</sup>	$\pm 0.25$ $\pm 1$	$\pm 0.25$ $\pm 1$	LSB typ LSB max	
Bipolar Zero Drift <sup>4</sup>	$\pm 0.8$ (+1.5/ 12.5 S Version)	$\pm 0.8$ (+1.5/ 12.5 T Version)	LSB typ	
Bipolar Negative Full-Scale Error <sup>3</sup>	$\pm 0.5$ $\pm 2$	$\pm 0.5$ $\pm 2$	LSB typ LSB max	
Bipolar Negative Full-Scale Drift <sup>4</sup>	$\pm 0.6$ ( $\pm 1.2$ S Version)	$\pm 0.6$ ( $\pm 1.2$ T Version)	LSB typ	
Noise (Referred to Output)	0.1	0.1	LSB rms typ	
<b>DYNAMIC PERFORMANCE</b>				
Sampling Frequency, $f_s$	$f_{CLKIN}/256$	$f_{CLKIN}/256$	Hz	
Output Update Rate, $f_{OUT}$	$f_{CLKIN}/1024$	$f_{CLKIN}/1024$	Hz	
Filter Corner Frequency, $f_{-3dB}$	$f_{CLKIN}/409,600$	$f_{CLKIN}/409,600$	Hz	
Settling Time to $\pm 0.0007\%$ FS	$507904/f_{CLKIN}$	$507904/f_{CLKIN}$	sec	For Full-Scale Input Step
<b>SYSTEM CALIBRATION</b>				
Positive Full-Scale Overrange	$V_{REF} + 0.1$	$V_{REF} + 0.1$	V max	Applies to Unipolar and Bipolar Ranges. After Calibration, If $A_{IN} > V_{REF}$ , the Device Will Output All 1s. If $A_{IN} < 0$ (Unipolar) or $V_{REF}$ (Bipolar), the Device Will Output All 0s.
Positive Full-Scale Overrange	$V_{REF} + 0.1$	$V_{REF} + 0.1$	V max	
Negative Full-Scale Overrange	$(V_{REF} + 0.1)$	$(V_{REF} + 0.1)$	V max	
Maximum Offset Calibration Range <sup>5, 6</sup> Unipolar Input Range	$(V_{REF} + 0.1)$	$(V_{REF} + 0.1)$	V max	
Bipolar Input Range	$0.4 V_{REF}$ to $+0.4 V_{REF}$	$0.4 V_{REF}$ to $+0.4 V_{REF}$	V max	
Input Span <sup>7</sup>	$0.8 V_{REF}$ $2 V_{REF} + 0.2$	$0.8 V_{REF}$ $2 V_{REF} + 0.2$	V min V max	
<b>ANALOG INPUT</b>				
Unipolar Input Range	0 to $+2.5$	0 to $+2.5$	Volts	
Bipolar Input Range	$\pm 2.5$	$\pm 2.5$	Volts	
Input Capacitance	10	10	pF typ	
Input Bias Current <sup>1</sup>	1	1	nA typ	
<b>LOGIC INPUTS</b>				
All Inputs Except CLKIN				
$V_{INL}$ Input Low Voltage	0.8	0.8	V max	
$V_{INH}$ Input High Voltage	2.0	2.0	V min	
CLKIN				
$V_{INL}$ Input Low Voltage	0.8	0.8	V max	
$V_{INH}$ Input High Voltage	3.5	3.5	V min	
$I_{IN}$ Input Current	10	10	$\mu\text{A}$ max	
<b>LOGIC OUTPUTS</b>				
$V_{OL}$ Output Low Voltage	0.4	0.4	V max	$I_{SINK} = 1.6\text{ mA}$ $I_{SOURCE} = 100\ \mu\text{A}$
$V_{OH}$ Output High Voltage	$DV_{DD} - 1$	$DV_{DD} - 1$	V min	
Floating State Leakage Current	$\pm 10$	$\pm 10$	$\mu\text{A}$ max	
Floating State Output Capacitance	9	9	pF typ	

Specifications subject to change without notice.