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ADVANCED ANALOG

ADC1140

16-BIT A/D CONVERTER

DESCRIPTION

The ADC1140 is a low cost 16-bit successive approximation A/D converter that has fast, 35 μsec conversion time. Integral and differential nonlinearity of ±0.003% FSR assures high accuracy performance.

The economical ADC1140 is packaged into a small, 2x2x0.4 inch package and weighs only 1.2 oz.

CMOS manufacturing means the ADC1140 consumes only 1.6W from a ±12V to ±17V power supply.

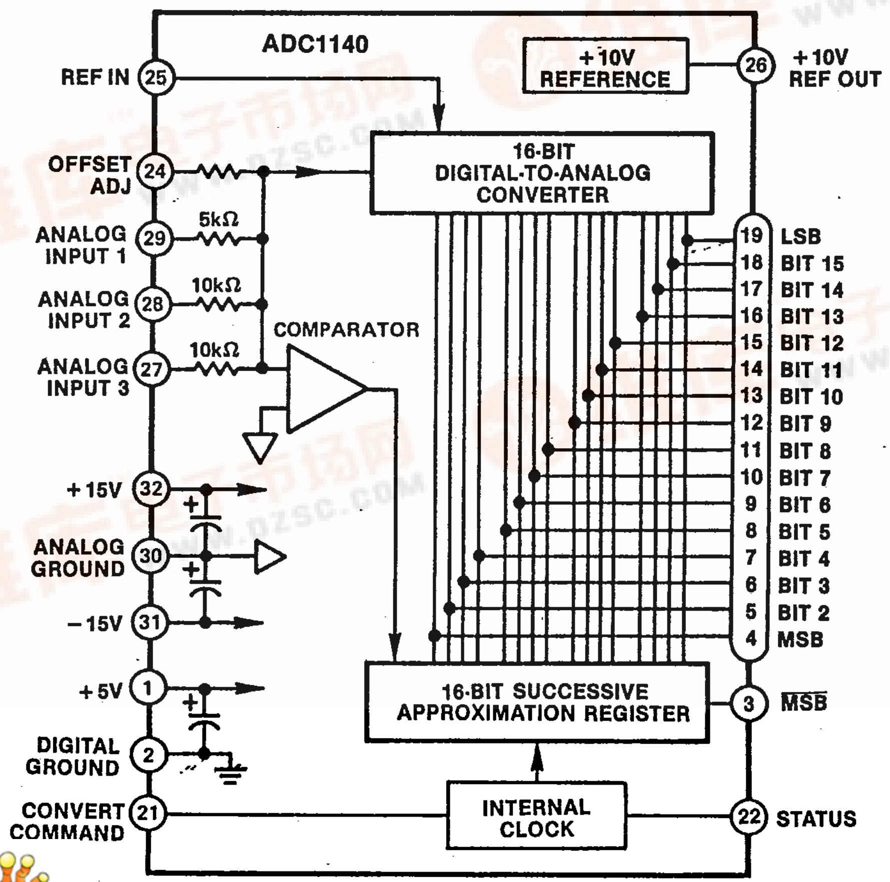
This unit will accept an analog input signal either unipolar from 0 to +10V and/or bipolar from +5V to ±10V. When configured as a bipolar device, it will give a corresponding binary, offset binary or two's complement output coding, as fast as 35 μsec.

It is ideal for applications in robotics, process control and seismic data acquisition, and precision instrumentation.

FEATURES

- Low cost-small size
- 16-bit resolution
- 35 μsec conversion time
- High stability
- Low power consumption
- CMOS/TTL compatible

FUNCTIONAL BLOCK DIAGRAM



SPECIFICATIONS

(Typical @ +25°C, $\pm V_S$ = ±15V, V_{CC} = +5V, V_{Ref} = +10.0V unless otherwise noted.)

RESOLUTION	16 bits
CONVERSION TIME	35μs max
ACCURACY	
Nonlinearity	±0.003% FSR max
Differential	±0.003% FSR max
STABILITY	
Differential nonlinearity	±2ppm/°C max
Gain	
(with internal reference)	±12ppm/°C max
(without internal reference)	±4ppm/°C max
Unipolar offset	±30μV/°C max
Bipolar offset	±7ppm/°C max
POWER SUPPLY SENSITIVITY	±0.002% FSR/%V_S
ANALOG INPUT	
Bipolar	±5V, ±10V
Unipolar	0 to +5V, 0 to +10V
Input resistance	
0 to +5V	2.5kΩ
0 to +10V, ±5V	5.0KΩ
±10V	10.0KΩ
External reference input	
Voltage range	0 to +12V
Input resistance	2.5KΩ
DIGITAL INPUT	
Convert command	positive pulse, 100 ns min negative edge triggered
Logic loading	1 TTL load
DIGITAL OUTPUT	
Parallel output data	
Unipolar	binary
Bipolar	offset binary
Output drive	1 TTL load
Status	logic "1" during conversion
INTERNAL REFERENCE VOLTAGE	+10V, ±0.3%
External load current	2mA max
Temperature stability	±8.5ppm/°C
POWER REQUIREMENTS	
Voltage	±15V ±3% +5V ±3%
Current	±15V ±30mA +5V 150mA
TEMPERATURE RANGE	
Operating	−25°C to 85°C
Storage	−55°C to 85°C

OPERATION

The power supplies, internal or external reference, input voltage programming, convert command and digital output are the only connections needed to operate the ADC1140.

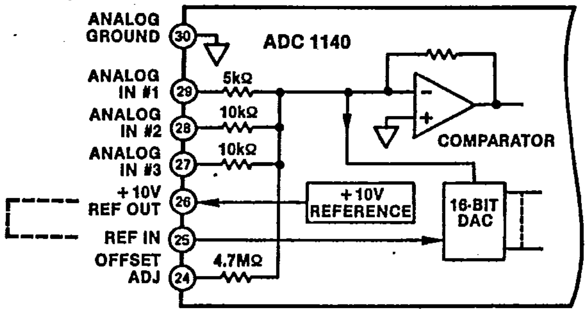
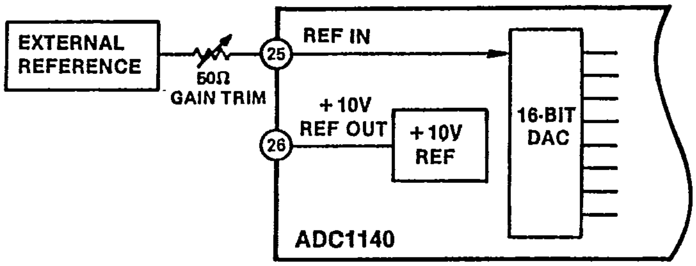


Figure 1 Analog Input Diagram

EXTERNAL REFERENCE

For operation with an external ±10.0V reference, disconnect the gain trim potentiometer from pin 26 and reconnect to the external reference, pin 25.

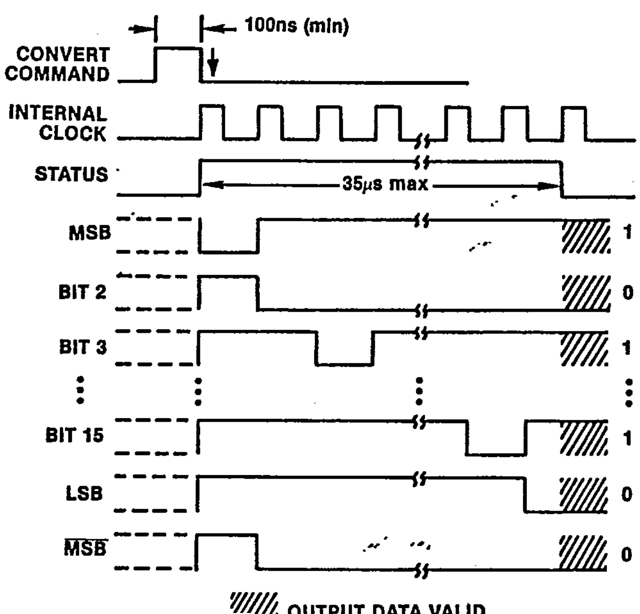


$$\text{DIGITAL OUTPUT CODING} = K\frac{V_{IN}}{V_{REF}}$$

K = 0.5 FOR ±10V RANGE
K = 1 FOR ±5V, AND 0 TO +10V RANGES
K = 2 FOR 0 TO +5V RANGES

Figure 6 External Reference

TIMING



OFFSET AND GAIN CALIBRATION (Optional)

Refer to Figure 2 and adjust offset and gain errors to zero by using potentiometers. It should be noted that this is a highly accurate converter and requires the use of a clean, accurate input voltage source and must be stable. The required value at either end is within 1μV. Good quality cermet potentiometers having 10 to 15 turns with 100ppm/°C temperature coefficients should be utilized. It is recommended that the offset be adjusted first, ensuring that gain and offset adjustment remain separate from each other.

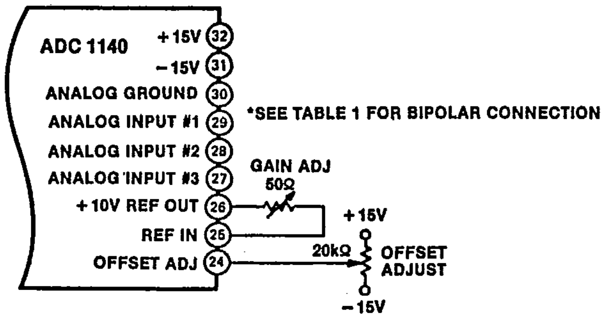


Figure 2 Offset and Gain Calibration

OFFSET CALIBRATION

0 to +10V: Set input voltage to exactly +76μV.
0 to +5V: Set input voltage to exactly +38μV.
Adjust the zero potentiometer until the digital output code specified in Table 1 is obtained.

±5V: Set input voltage to exactly −4.999924V.
±10V: Set input voltage to exactly −9.999847V.
Adjust the zero potentiometer until the digital output code specified in Table 2 is obtained.

GAIN CALIBRATION

0 to 10V: Set input voltage exactly at +9.99977V.
0 to +5V: Set input voltage exactly at +4.99988V.
+5V: Set input voltage exactly at 4.99977V.
+10V: Set input voltage exactly at +9.99954V.
Adjust gain potentiometer until binary and offset binary coded units reach values shown in Tables 1 and 2.

POWER SUPPLY AND GROUNDING CONNECTION

Pin 30 (analog ground) and pin 2 (digital ground) must be externally connected. To avoid ground loops and minimize coupling between the analog and digital sections, an optimum common point must be utilized.

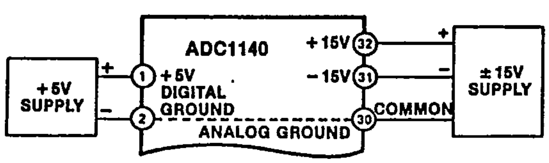


Figure 4 Power Supply and Grounding

ANALOG INPUT/OUTPUT RELATIONSHIPS

Unipolar: Gives true binary coded output. MSB is displayed on pin 4.

Bipolar: Produces either offset binary or two's complement output codes. MSB is displayed on pin 3.

Analog Input 0 to +5V Range	Analog Input 0 to +10V Range	Digital Output Binary Code
+4.999924V	+9.99985V	1111 1111 1111 1111
+2.50000V	+5.00000V	1000 0000 0000 0000
+1.25000V	+2.50000V	0100 0000 0000 0000
+0.62500V	+1.25000V	0010 0000 0000 0000
+0.000076V	+0.000153V	0000 0000 0000 0001
+0.00000V	+0.00000V	0000 0000 0000 0000

Table 1 Unipolar Input/Output Relationships

PIN DESIGNATIONS

PIN	FUNCTION	PIN	FUNCTION
1	+5V	32	+15V
2	DIGITAL GROUND	31	−15V
3	$\overline{\text{MSB}}$	30	ANALOG GROUND
4	MSB	29	ANALOG IN 1
5	BIT 2	28	ANALOG IN 2
6	BIT 3	27	ANALOG IN 3
7	BIT 4	26	+10V REF OUT
8	BIT 5	25	REFERENCE IN
9	BIT 6	24	OFFSET ADJUST
10	BIT 7	23	N/C
11	BIT 8	22	STATUS
12	BIT 9	21	CONVERT COMMAND
13	BIT 10	20	N/C
14	BIT 11	19	LSB
15	BIT 12	18	BIT 15
16	BIT 13	17	BIT 14

Analog Input ±5V Range	Analog Input ±10V Range	Digital Output Offset Binary Code	Digital Output 2's Complement Code
+4.99985V	+9.99985V	1111 1111 1111 1111	0111 1111 1111 1111
+2.50000V	+5.00000V	1000 0000 0000 0000	0100 0000 0000 0000
+0.000153V	+2.50000V	0100 0000 0000 0000	0000 0000 0000 0001
+0.00000V	+1.25000V	0010 0000 0000 0000	0000 0000 0000 0000
−5.00000V	+0.000153V	0000 0000 0000 0001	1000 0000 0000 0000

Table 2 Bipolar Input/Output Relationships

ANALOG INPUT RANGE SELECTION

There are three analog input terminals: pin 29, pin 28 and pin 27.

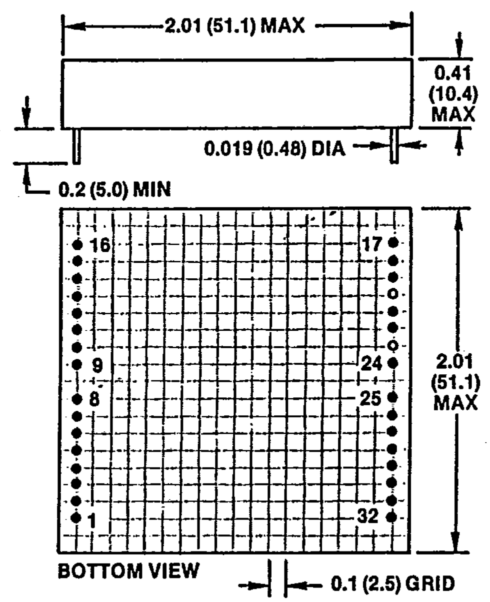
Unipolar: 0 to +10V or 0 to +5V input signal produces 0 to +mA current that is compared to the 0 to −2mA current output of the DAC. Refer Analog Input Diagram.

Bipolar: +1mA offset current from the reference is channeled to the comparator input via pin 29. The device is thus enabled to accept either ±5V or ±10V inputs. Input comparison to output current occurs again. Refer to Figure 2 and Gain Calibration section.

Input Range	Coding	Connect Input Signal To Pin(s)	Connect Pin 26 To Pin	Connect Pin 30 To Pin(s)
±10V	OBIN, Two's Comp	28	27	29, 2
±5V	OBIN, Two's Comp	29	27	28, 2
0 to +5V	BIN	27, 28, 29	Open	2
0 to +10V	BIN	27, 28	Open	29, 2

Note 1: When internal reference is used, pins 25 and 26 must be connected together. Refer gain and offset calibration.

MECHANICAL OUTLINE



TERMINAL PINS INSTALLED ONLY IN SHADED HOLE LOCATIONS.

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