



T-51-10-90

**ADS-942**

# 14-Bit, 2.0 MHz, High Resolution Sampling A/D Converter

## PRELIMINARY PRODUCT DATA

### FEATURES

- 14-Bit resolution
- Internal Sample/Hold
- 2.0 MHz minimum throughput
- Functionally complete
- Small 32-pin DIP
- Low-power 2.9 Watts
- Three-state output buffers
- Samples up to Nyquist



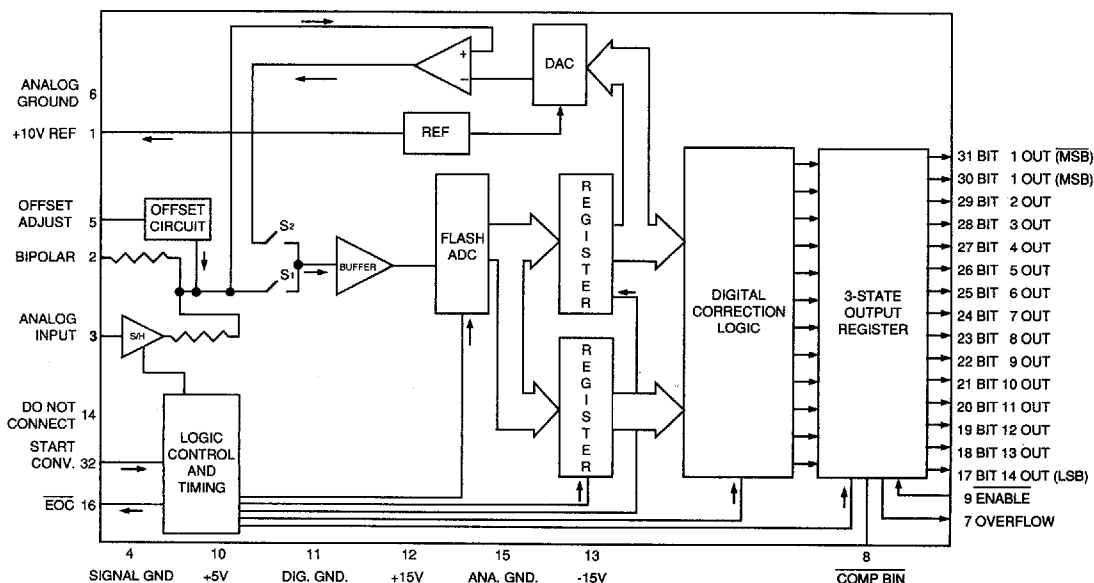
### GENERAL DESCRIPTION

DATEL's ADS-942 is a 14-bit, 2.0 MHz sampling rate, functionally complete A/D converter. The ADS-942 samples up to Nyquist with no missing codes.

Packaged in a small 32-pin DIP, power requirements are  $\pm 15$  volts and +5 volts with 2.9 Watts power dissipation.

### INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	+10V REF. OUT	17	BIT 14 OUT (LSB)
2	BIPOLAR	18	BIT 13 OUT
3	ANALOG INPUT	19	BIT 12 OUT
4	SIGNAL GROUND	20	BIT 11 OUT
5	OFFSET ADJUST	21	BIT 10 OUT
6	ANALOG GROUND	22	BIT 9 OUT
7	OVERFLOW	23	BIT 8 OUT
8	COMP. BIN	24	BIT 7 OUT
9	ENABLE	25	BIT 6 OUT
10	+5V	26	BIT 5 OUT
11	DIGITAL GROUND	27	BIT 4 OUT
12	+15V	28	BIT 3 OUT
13	-15V	29	BIT 2 OUT
14	DO NOT CONNECT	30	BIT 1 OUT (MSB)
15	ANALOG GROUND	31	BIT 1 OUT (MSB)
16	EOC	32	START CONVERT



## ADS-942



## ABSOLUTE MAXIMUM RATINGS

PARAMETERS	LIMITS	UNITS
+15V Supply (Pin 12)	-0.3 to +18	Volts dc
-15V Supply (Pin 13)	+0.3 to -18	Volts dc
+5V Supply (Pin 10)	-0.3 to +7.0	Volts dc
Digital Inputs (Pins 8, 9, 32)	-0.3 to +7.0	Volts dc
Analog Input (Pin 3)	±25	Volts
Lead Temp. (10 Sec.)	300 max	°C

## FUNCTIONAL SPECIFICATIONS

Apply over the operating temperature range and at ±15V dc and +5V dc unless otherwise specified.Ⓢ

ANALOG INPUTS	MIN.	TYP.	MAX.	UNITS
Input Voltage Range	-	0 to +10	-	Volts
	-	±5	-	Volts
Input Impedance	2.2	2.5	-	K Ohms
Input Capacitance	-	7	15	pf
<b>DIGITAL INPUTS</b>				
Logic Levels				
Logic "1"	2.0	-	-	Volts dc
Logic "0"	-	-	0.8	Volts dc
Logic Loading "1"	-	-	5.0	μA
Logic Loading "0"	-	-	-200	μA
<b>PERFORMANCE</b>				
Int. Non-Lin. @ $f_{IN} = 1$ MHz				
+25 °C	-	±1/2	±1	LSB
0 to +70 °C	-	±3/4	±1.5	LSB
-55 to +125 °C	-	±1	±2.5	LSB
Diff. Non-Lin. @ $f_{IN} = 1$ MHz				
+25 °C	-	±1/2	±1	LSB
0 to +70 °C	-	±3/4	±1.25	LSB
-55 to +125 °C	-	±1	±2.5	LSB
Full Scale Absolute Accuracy				
+25 °C	-	±0.08	±0.122	%FSR
0 to +70 °C	-	±0.18	±0.36	%FSR
-55 to +125 °C	-	±0.61	±0.85	%FSR
Unipolar Zero Error,				
+25 °C	-	±0.012	±0.04	%FSR
0 to +70 °C	-	±0.07	±0.13	%FSR
-55 to +125 °C	-	±0.1	±0.17	%FSR
Bipolar Zero Error,				
+25 °C (Tech Note 1)	-	±0.04	±0.122	%FSR
0 to +70 °C	-	±0.07	±0.18	%FSR
-55 to +125 °C	-	±0.1	±0.3	%FSR
Bipolar Offset Error,				
+25 °C (Tech Note 1)	-	±0.018	±0.061	%FSR
0 to +70 °C	-	±0.12	±0.3	%FSR
-55 to +125 °C	-	±0.53	±0.73	%FSR
Gain Error, +25 °C	-	±0.018	±0.122	%FSR
(See Tech Note 1)				
0 to +70 °C	-	±0.12	±0.3	%FSR
-55 to +125 °C	-	±0.53	±0.73	%FSR
No Missing Codes				
14 Bits @ 1 MHz $f_{IN}$	Over 0 to 70°C			
13 Bits @ 1 MHz $f_{IN}$	Over -55 to +125°C			
Resolution	14 Bits			

OUTPUTS	MIN.	TYP.	MAX.	UNITS
Output Coding (Pin 8 Hi) (Pin 8 Low)	Straight binary/offset binary Complementary binary			
Logic Levels				
Logic "1"	2.4	-	-	Volts dc
Logic "0"	-	-	0.4	Volts dc
Logic Loading "1"	-	-	-160	μA
Logic Loading "0"	-	-	6.4	mA
Internal Reference Voltage, +25 °C	+9.98	+10.0	+10.02	Volts dc
Drift	-	±13	±30	ppm/°C
External Current	-	-	5	mA

## DYNAMIC PERFORMANCE

Total Harm. Distort. (-0.5 dB)				
DC to 100 KHz	-79	-85	-	FS - dB
100 KHz to 1 MHz	-73	-79	-	FS - dB
Signal-to-Noise Ratio (w/o distortion, -0.5 dB)				
DC to 100 KHz	-78	-85	-	FS - dB
100 KHz to 1 MHz	-73	-79	-	FS - dB
Signal-to-Noise Ratio & distortion, -0.5 dB				
DC to 100 KHz	-72	-77	-	FS - dB
100 KHz to 1 MHz	-68	-71	-	FS - dB
Effective Bits, -0.5 dB				
DC to 100 KHz	12.3	13.0	-	Bits
100 KHz to 1 MHz	11.7	12.3	-	Bits
Two-tone Intermodulation Distortion ( $f_{IN} = 100$ KHz, 240 KHz, $F_s = 2.0$ MHz, -0.5 dB)	-92	-	-	FS - dB
Input Bandwidth				
Small Signal (-20 dB input)	6	-	-	MHz
Full Power (0 dB input)	1.75	-	-	MHz
Slew Rate	210	250	-	V/μSec.
Aperture Delay Time	-	-	±10	nSec.
Aperture Uncertainty, Rms	-	-	±10	pSec.
S/H Acquisition Time (to 0.006%FS (10V step))	-	120	150	nSec.
Feedthrough Rejection @ $f_{IN} = 1$ MHz	-85	-	-	dB
Overvoltage Recovery, ±12V	-	1000	2000	nSec.
A/D Conversion Rate				
+25 °C	2.0	2.1	-	MHz
0 to +70 °C	2.0	2.1	-	MHz
-55 to +125 °C	2.0	2.05	-	MHz

## POWER REQUIREMENTS

Power Supply Range				
+15V dc Supply	+14.25	+15.0	+15.75	Volts dc
-15V dc Supply	-14.25	-15.0	-15.75	Volts dc
+5V dc Supply	+4.75	+5.0	+5.25	Volts dc
Power Supply Current				
+15V dc Supply	-	+70	+87	mA
-15V dc Supply	-	-80	-98	mA
+5V dc Supply Ⓢ	-	+155	+165	mA
Power Dissipation	-	2.9	3.4	Watts
Power Supply Rejection	-	-	0.02	%FSR/%V

## PHYSICAL/ENVIRONMENTAL

Operating Temp. Range				
-MC	0	-	+70	°C
-MM	-55	-	+125	°C
Storage Temperature Range	-65	-	+150	°C
Package Type	32-pin hermetic sealed, ceramic DIP			
Weight	0.42 ounces (12 grams)			

Ⓢ +5V power usage at 1 TTL logic loading per data output bit.

Ⓢ Warm-up time to full specification: 20 minutes.

TECHNICAL NOTES

1. Use external potentiometers to remove system errors or the small initial errors to zero. Use a 200 Ω trimming potentiometer in series with the analog input for gain adjustment. Use a short in place of the gain adjustment trim pot for operation without adjustments. Use a 20K trimming potentiometer with the wiper tied to pin 5 for zero/offset adjustment (connect pin 5 to pin 15, analog ground for operation without adjustment).
2. Rated performance requires using good high-frequency circuit board layout techniques. The analog and digital grounds are not connected internally. Avoid ground-related problems by connecting the digital and analog grounds to one point, the ground plane beneath the converter. Due to the inductance and resistance of the power supply return paths, return the analog and digital ground separately to the power supplies.
3. Bypass the analog and digital supplies and the +10V reference (pin 1) to ground with a 4.7 μF, 25V tantalum electrolytic capacitor in parallel with a 0.1 μF ceramic capacitor. Bypass the +10V reference (pin 1) to analog ground (pin 15).
4. Obtain straight binary/offset binary output coding by tying COMP BIN (pin 8) to +5V dc or leaving it open. The device has an internal pull-up resistor on this pin. To obtain complementary binary or complementary offset binary output coding, tie pin 18 to ground. The pin 18 signal is compatible to CMOS/TTL logic levels for those users desiring logic control of this function.
5. To enable the three-state outputs, connect ENABLE (pin 9) to a logic "0" (low). To disable, connect pin 9 to a logic "1" (high).

2. Zero Adjustments

Apply a precision voltage reference source between the analog input (pin 3) and signal ground (pin 4). Adjust the output of the reference source per Table 2.

For unipolar, adjust the zero trimming potentiometer so that the output code flickers equally between 00 0000 0000 0000 and 00 0000 0000 0001 with the COMP BIN (pin 8) tied low (straight binary) or between 11 1111 1111 1111 and 11 1111 1111 1110 with the pin 8 tied high (complementary binary).

For bipolar operation, adjust the potentiometer such that the code flickers equally between 10 0000 0000 0000 and 10 0000 0000 0001 with pin 8 tied high (offset binary) or between 01 1111 1111 1111 and 01 1111 1111 1110 with pin 8 tied low (complementary offset binary).

Two's complement coding requires use of the MSB (pin 31) with COMP BIN (pin 8) tied high, adjusting the potentiometer such that the code flickers between 00 0000 0000 0000 and 00 0000 0000 0001.

3. Full-Scale Adjustment

Set the output of the voltage reference used in step 2 to the value shown in Table 2.

Adjust the gain trimming potentiometer so that the output code flickers equally between 11 1111 1111 1110 and 11 1111 1111 1111 for COMP BIN (pin 8) tied low for unipolar operation or tied high for bipolar operation (straight binary/offset binary) or between 00 0000 0000 0000 and 00 0000 0000 0001 for COMP BIN tied high for unipolar operation or tied low for bipolar operation (complementary binary/complementary offset binary).

Two's complement coding requires use of the MSB (pin 31) with the COMP BIN (pin 8) tied high, adjusting the gain trimming potentiometer so that the output code flickers equally between 01 1111 1111 1110 and 01 1111 1111 1111.

4. To confirm proper operation of the device, vary the precision reference voltage source to obtain the output coding listed in Table 3.

CALIBRATION PROCEDURE

1. Connect the converter per Figure 3, and Table 1 for the appropriate full-scale range (FSR). Apply a pulse of 35 nanoseconds minimum to the START CONVERT input (pin 32) at a rate of 200 KHz. This rate is chosen to reduce flicker if LED's are used on the outputs for calibration purposes.

Table 1. Input Connections

INPUT RANGE	INPUT PIN	TIE TOGETHER
0 to +10V ±5V	Pin 3 Pin 3	Pins 2 and 4 Pins 1 and 2

Table 2. Zero and Gain Adjust

FSR	ZERO ADJUST +1/2 LSB	GAIN ADJUST FS - 1/2 LSB
0 to +10V ±5V	-305 μV -305 μV	+9.999085V -4.999085V

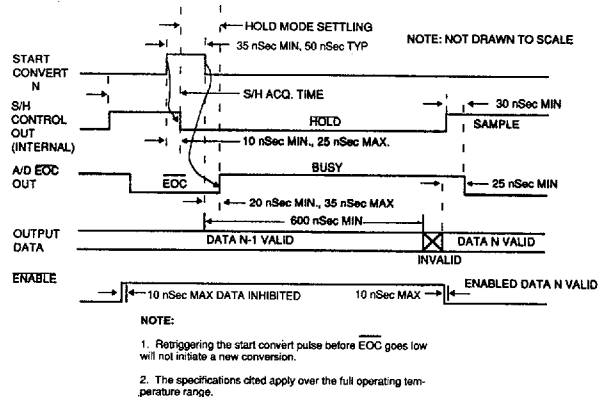
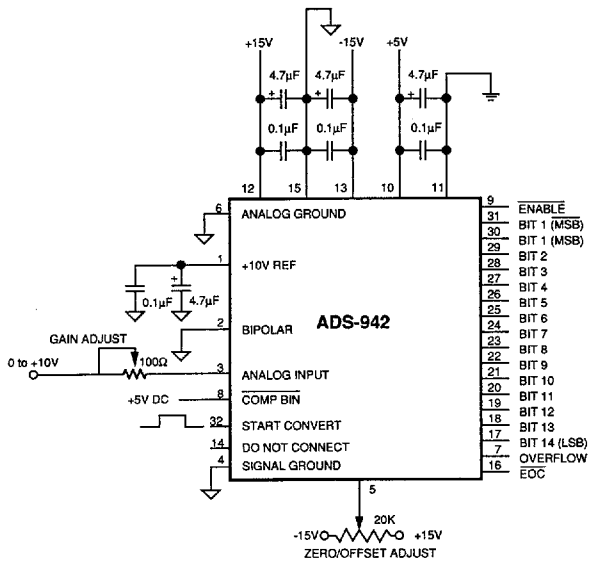


Figure 2. ADS-942 Timing Diagram

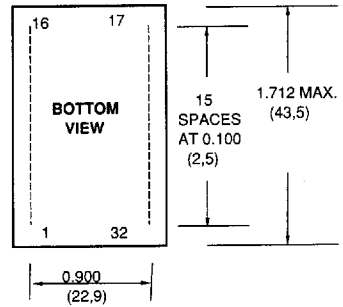
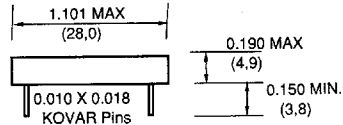
**Table 3. Output Coding**

UNIPOLAR SCALE	INPUT RANGES, V dc	STRAIGHT BIN. COMP. BINARY				INPUT RANGE	BI POLAR SCALE
		MSB	LSB	MSB	LSB		
FS -1 LSB	+9.999390	11 1111 1111 1111	1111	00 0000 0000 0000	0000	+10V dc	+FS -1 LSB
7/8 FS	+8.750000	11 1000 0000 0000	1111	00 0111 1111 1111	0000	-4.99939	+FS -1 LSB
3/4 FS	+7.500000	11 0000 0000 0000	1111	00 1111 1111 1111	0000	-3.75000	+3/4 FS
1/2 FS	+5.000000	10 0000 0000 0000	1111	00 0000 0000 0000	0000	-2.50000	+1/2 FS
1/4 FS	+2.500000	01 0000 0000 0000	1111	00 1111 1111 1111	0000	0.00000	0
1/8 FS	+1.250000	00 1000 0000 0000	1111	10 1111 1111 1111	0000	+2.50000	-1/2 FS
1 LSB	+0.000610	00 0000 0000 0001	1111	10 1000 0000 0000	0000	+3.75000	-3/4 FS
0	0.000000	00 0000 0000 0000	1111	10 0000 0000 0001	0000	+4.99939	-FS +1 LSB
		00 0000 0000 0000	1111	10 00000000 0000	0000	+5.00000	-FS

OFF. BINARY COMP OFF BIN. TWO'S COMP.

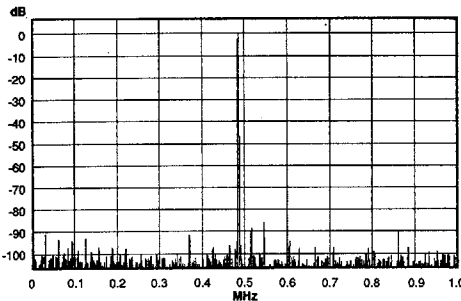


**MECHANICAL DIMENSIONS**  
**INCHES (MM)**



NOTE: Pins have a 0.025 inch, ±0.01 stand-off from case.

**Figure 3. Typical ADS-942 Connection Diagram**



**Figure 4. FFT Analysis of ADS-942**

**ORDERING INFORMATION**

MODEL NUMBER	OPERATING TEMP. RANGE	SEAL
ADS-942MC	0 °C to +70 °C	Hermetic
ADS-942MM	-55 °C to +125 °C	Hermetic
<b>ACCESSORY</b>	ADS-EVAL1	Evaluation Board (without ADS-942)

Receptacle for PC board mounting can be ordered through AMP Inc., Part # 3-331272-8 (Component Lead Socket), 32 required.

For availability of MIL-STD-883B versions, contact DATEL.