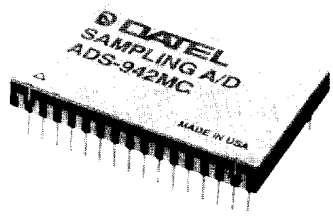
DATEL®
INNOVATION and EXCELLENCE

ADS-942
14-Bit, 2MHz Sampling A/D Converter

FEATURES

- 14-Bit resolution
- 2MHz minimum throughput
- Functionally complete
- Internal reference and Sample/Hold
- –85dB total harmonic distortion
- –78dB signal-to-noise ratio
- Full Nyquist-rate sampling
- Small 32-pin DIP
- Low-power, 2.9 Watts



GENERAL DESCRIPTION

DATEL's ADS-942 is a functionally complete, 14-bit, 2MHz, sampling A/D converter. Its standard, 32-pin, triple-wide ceramic DIP contains a fast-settling sample/hold amplifier, a 14-bit subranging (two-pass) A/D converter, a precision reference, three-state output register and all the timing and control logic necessary to operate from a single start convert pulse.

The ADS-942, is optimized for wideband frequency-domain applications, and is fully FFT tested. The ADS-942 requires ±15V and +5V supplies and typically consumes 2.9 Watts.

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	CODING SELECT	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	ANALOG GROUND	30	BIT 1 OUT (MSB)
15	ANALOG GROUND	31	BIT 1 OUT (MSB)
16	EOC	32	START CONVERT

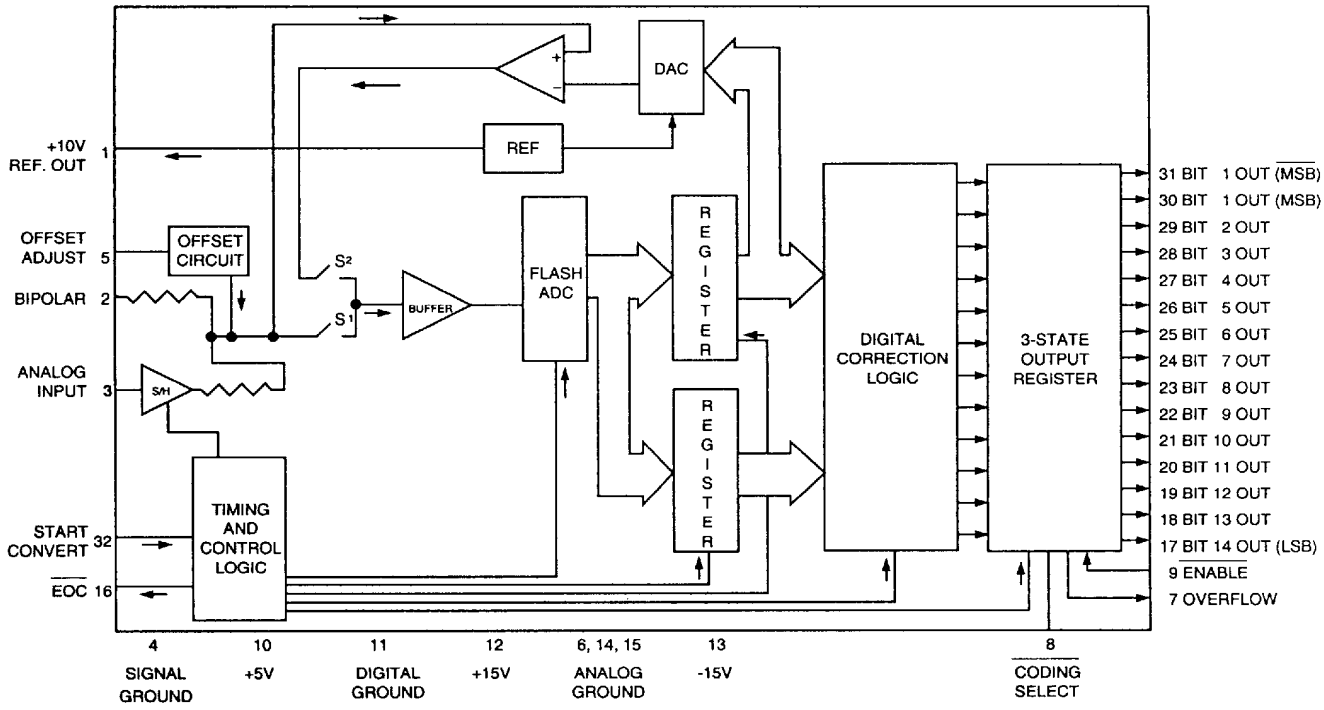


Figure 1. ADS-942 Simplified Block Diagram

ABSOLUTE MAXIMUM RATINGS

PARAMETERS	LIMITS	UNITS
+15V Supply (Pin 12)	0 to +16	Volts
–15V Supply (Pin 13)	0 to –16	Volts
+5V Supply (Pin 10)	0 to +6	Volts
Digital Inputs (Pins 8, 9, 32)	–0.3 to $+V_{DD}$ +0.3	Volts
Analog Input (Pin 3)	±15	Volts
Lead Temp. (10 seconds)	300	°C

FUNCTIONAL SPECIFICATIONS

(T_A = +25°C, $\pm V_{CC}$ = ±15V, $\pm V_{DD}$ = ±5V, 2MHz sampling rate, 7 minute warmup, unless otherwise specified.)

ANALOG INPUTS	MIN.	TYP.	MAX.	UNITS
Input Voltage Range				
Unipolar	—	0 to +10	—	Volts
Bipolar	—	±5	—	Volts
Input Impedance	4.9	5	—	kΩ
Input Capacitance	—	7	15	pF
DIGITAL INPUTS				
Logic Levels				
Logic "1"	+2.0	—	—	Volts
Logic "0"	—	—	+0.8	Volts
Logic Loading "1"	—	—	+5.0	µA
Logic Loading "0"	—	—	–600	µA
PERFORMANCE				
Integral Non–Linearity (f_{in} = 1MHz)				
+25°C	—	±1	±2	LSB
0 to +70°C	—	±1	±2	LSB
–40 to +85°C	—	±2	±3	LSB
Differential Non–Linearity (f_{in} = 1MHz)				
+25°C	–0.75	±0.5	+0.75	LSB
0 to +70°C	–0.95	±0.75	+1.25	LSB
–40 to +85°C	–1	±1	+2.5	LSB
Full Scale Absolute Accuracy				
+25°C (see Figure 3)	—	±0.1	±0.122	%FSR
0 to +70°C	—	±0.12	±0.36	%FSR
–40 to +85°C	—	±0.45	±0.85	%FSR
Unipolar Zero Error				
+25°C (see Figure 3)	—	±0.012	±0.122	%FSR
0 to +70°C	—	±0.1	±0.2	%FSR
–40 to +85°C	—	±0.2	±0.3	%FSR
Bipolar Zero Error				
+25°C (see Figure 3)	—	±0.05	±0.122	%FSR
0 to +70°C	—	±0.1	±0.2	%FSR
–40 to +85°C	—	±0.2	±0.3	%FSR
Bipolar Offset Error				
+25°C (see Figure 3)	—	±0.1	±0.2	%FSR
0 to +70°C	—	±0.12	±0.3	%FSR
–40 to +85°C	—	±0.5	±0.8	%FSR
Gain Error				
+25°C (see Figure 3)	—	±0.018	±0.122	%
0 to +70°C	—	±0.12	±0.3	%
–40 to +85°C	—	±0.6	±0.8	%
No Missing Codes (f_{in} = 500kHz)	0 to +70°C			
14 Bits	–40 to +85°C			
13 Bits	14 Bits			
Resolution				

① Same specification as In–Band Harmonics and Peak Harmonics.

OUTPUTS	MIN.	TYP.	MAX.	UNITS
Output Coding	Straight Bin./Offset Bin./2's Comp. Comp. Bin./Comp. Offset Bin.,C2C			
Logic Levels				
Logic "1"	+2.4	—	—	Volts
Logic "0"	—	—	+0.4	Volts
Logic Loading "1"	—	—	–160	µA
Logic Loading "0"	—	—	+6.4	mA
Internal Reference				
Voltage, +25°C	+9.98	+10.0	+10.02	Volts
Drift	—	±13	±30	ppm/°C
External Current	—	—	5	mA
DYNAMIC PERFORMANCE				
Total Harm. Distort. (–0.5 dB)				
dc to 100kHz	—	–85	–76	dB
100kHz to 500kHz	—	–80	–75	dB
500kHz to 1MHz	—	–77	—	dB
Signal–to–Noise Ratio (w/o distortion, –0.5 dB)				
dc to 100kHz	74	78	—	dB
100kHz to 500kHz	73	75	—	dB
500kHz to 1MHz	—	73	—	dB
Signal–to–Noise Ratio (and distortion, –0.5 dB)				
dc to 100kHz	73	78	—	dB
100kHz to 500kHz	72	75	—	dB
500kHz to 1MHz	—	72	—	dB
Spurious Free Dyn. Range ①				
dc to 100kHz	—	–86	–77	dB
100 to 500kHz	—	–81	–75	dB
500kHz to 1MHz	—	–78	—	dB
Two–tone Intermodulation Distortion (f_{in} = 100kHz, 240kHz, f_s = 2.0MHz, –0.5dB)	–92	—	—	dB
Input Bandwidth (–0.3dB)				
Small Signal (–20dB input)	—	6	—	MHz
Large Signal (–0.5dB input)	—	1.75	—	MHz
Slew Rate	—	±250	—	V/µs
Aperture Delay Time	—	—	±10	ns
Aperture Uncertainty	—	—	5	ps rms
S/H Acq. Time, (0.003% FSR)				
sinusoidal (f_{in} = 1MHz)	—	—	150	ns
step input	—	250	450	ns
Conversion Rate				
sinusoidal (f_{in} = 1MHz)	2	—	—	MHz
step input	1.3	—	—	MHz
Feedthrough Rejection				
f_{in} = 1MHz	—	–85	—	dB
Overvoltage Recovery, ±12V	—	1000	2000	ns
Noise	—	250	—	µV, rms
POWER REQUIREMENTS				
Power Supply Ranges				
+15V Supply	+14.25	+15.0	+15.75	Volts
–15V Supply	–14.25	–15.0	–15.75	Volts
+5V Supply	+4.75	+5.0	+5.25	Volts
Power Supply Currents				
+15V Supply	—	+65	+87	mA
–15V Supply	—	–80	–98	mA
+5V Supply	—	+150	+165	mA
Power Dissipation	—	2.9	3.4	Watts
Power Supply Rejection	—	—	±0.02	%FSR/%V
PHYSICAL/ENVIRONMENTAL				
Operating Temp. Range, Case				
ADS-942MC	0	—	+70	°C
ADS-942ME	–40	—	+85	°C
Storage Temperature Range	–65	—	+150	°C
Package Type	32–pin hermetic sealed, ceramic DDIP			
Weight	0.46 ounces (13 grams)			

TECHNICAL NOTES

1. 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.

2. Bypass the analog and digital supplies and the +10V REF. OUT (pin 1) to ground with a 4.7µF, 25V tantalum electrolytic capacitor in parallel with a 0.1 µF ceramic capacitor.

3. CODING SELECT(pin 8) is compatible with CMOS/TTL logic levels for those users desiring logic control of this function. The device has an internal pull-up resistor on this pin, allowing pin 8 to be connected to +5V or left open when a logic 1 is needed. See the Calibration Procedure for applicable connections for a particular coding.

4. To enable the three-state outputs, connect $\overline{\text{ENABLE}}$ (pin 9) to a logic "0" (low). To disable, connect pin 9 to a logic "1" (high).

Table 1. Input Connections

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

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 START CONVERT (pin 32) at a rate of 200kHz. This rate is chosen to reduce flicker if LED's are used on the outputs for calibration purposes.

2. Zero Adjustments
   Apply a precision voltage reference source between ANALOG INPUT (pin 3) and SIGNAL GROUND (pin 4), then adjust the reference source output per Table 2.

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

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

   Two's complement coding requires using BIT 1 OUT (MSB) (pin 31). With pin 8 tied low, adjust the trimpot until 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.

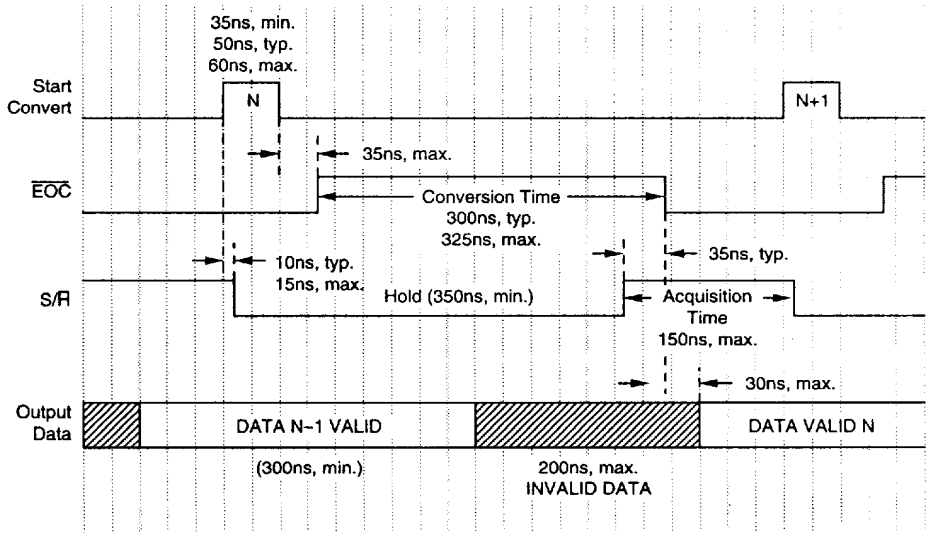
Table 2. Zero and Gain Adjust

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

   Adjust the gain trimpot until the output code flickers equally between 11 1111 1111 1110 and 11 1111 1111 1111 with pin 8 tied low for straight binary / offset binary or between 00 0000 0000 0000 and 00 0000 0000 0001 with pin 8 tied high complementary binary / complementary offset binary.

   Two's complement coding requires using pin 31. With pin 8 tied low, adjust the gain trimpot until 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.

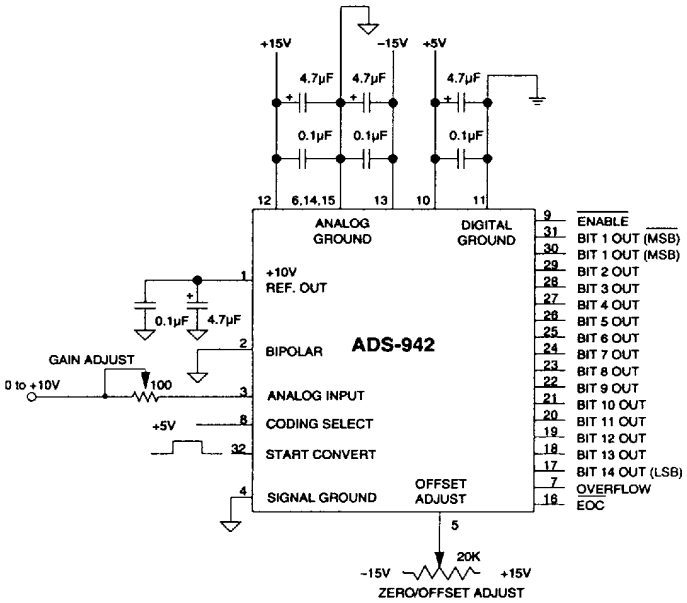


25ns per division

Figure 2. ADS-942 Timing Diagram

Table 3. Output Coding

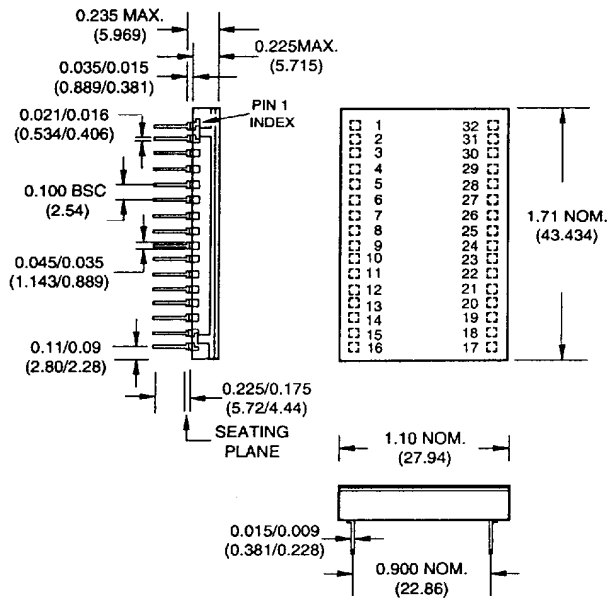
		STRAIGHT BIN.		COMP. BINARY					
UNIPOLAR SCALE	INPUT RANGE 0 to +10V	OUTPUT CODING MSB	LSB	MSB	LSB	MSB	LSB	INPUT RANGE ±5V	BIPOLAR SCALE
FS -1 LSB	+9.999390	11 1111 1111 1111		00 0000 0000 0000		01 1111 1111 1111		+4.999390	+FS -1 LSB
7/8 FS	+8.750000	11 1000 0000 0000		00 0111 1111 1111		01 1000 0000 0000		+3.750000	+3/4 FS
3/4 FS	+7.500000	11 0000 0000 0000		00 1111 1111 1111		01 0000 0000 0000		+2.500000	+1/2 FS
1/2 FS	+5.000000	10 0000 0000 0000		01 1111 1111 1111		00 0000 0000 0000		0.000000	0
1/4 FS	+2.500000	01 0000 0000 0000		10 1111 1111 1111		11 0000 0000 0000		-2.500000	-1/2 FS
1/8 FS	+1.250000	00 1000 0000 0000		11 0111 1111 1111		10 1000 0000 0000		-3.750000	-3/4 FS
1 LSB	+0.000610	00 0000 0000 0001		11 1111 1111 1110		10 0000 0000 0001		-4.999390	-FS +1 LSB
0	0.000000	00 0000 0000 0000		11 1111 1111 1111		10 0000 0000 0000		-5.000000	-FS
		OFF. BINARY		COMP. OFF. BIN.		TWO'S COMP.			



NOTE: Use external potentiometers to remove system errors or to reduce small initial errors to zero. Use a 100Ω trimpot in series with the analog input for gain adjustment; otherwise, use a fixed 50Ω resistor in its place for operation without adjustment. Use a 20k trimpot with the wiper tied to OFFSET ADJUST (pin 5) for zero/offset adjustment. Connect pin 5 to ANALOG GROUND (pin 6) for operation without zero/offset adjustment.

Figure 3. Typical ADS-942 Connection Diagram

MECHANICAL DIMENSIONS
INCHES (mm)



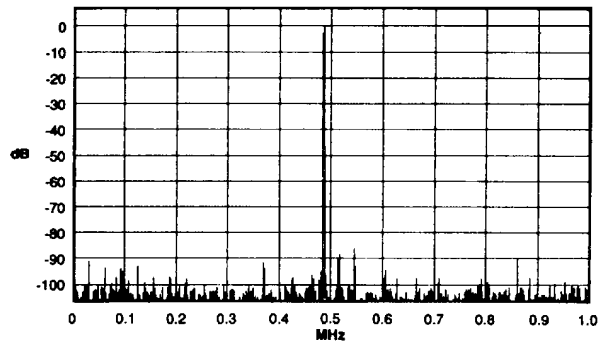


Figure 4. FFT Analysis of ADS-942
(f_S = 2MHz, f_{in} = 490kHz, V_{in} = –0.5dB, 4096 points)

ORDERING INFORMATION

MODEL NUMBER	OPERATING TEMP. RANGE
ADS-942MC	0 °C to +70 °C
ADS-942ME	-40 °C to +125 °C
ACCESSORY	ADS-EVAL4 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.

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