DATEL®

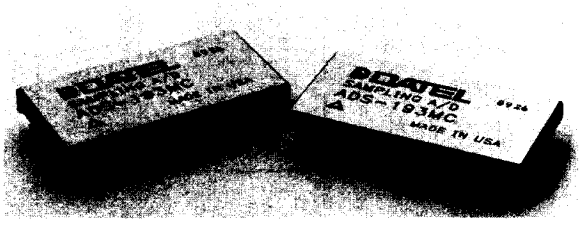
PRODUCT DATA

ADS-193

12-Bit, 1.0 MHz, Low-Power Sampling A/D Converter

FEATURES

- **12-Bit resolution**
- **Internal Sample/Hold**
- **1.0 MHz minimum throughput**
- **Functionally complete**
- **Low-power, 1.3 Watts**
- **Samples to Nyquist**



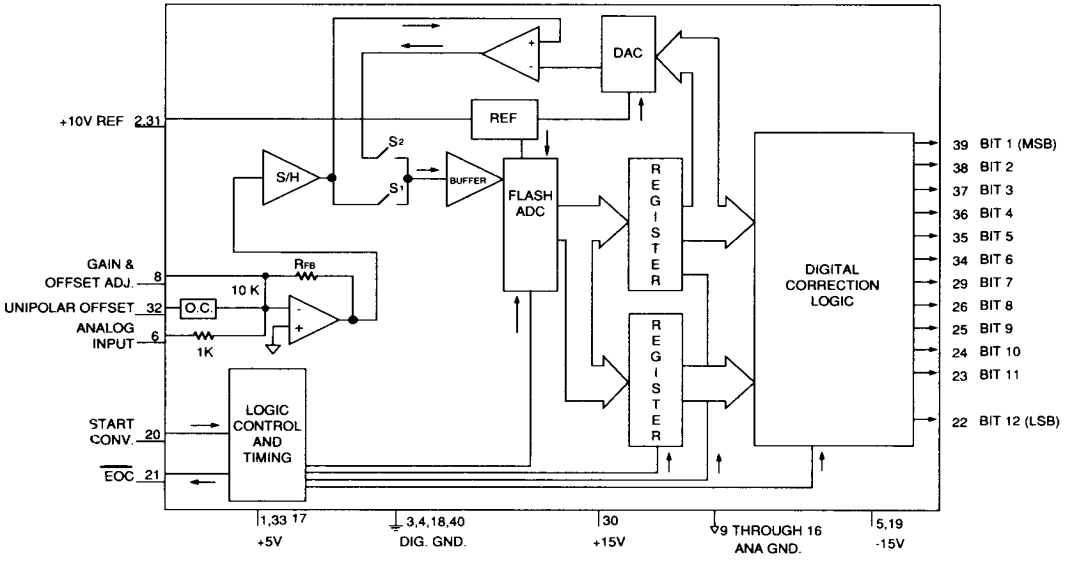
GENERAL DESCRIPTION

DATEL's ADS-193 is a 12-bit, functionally complete, sampling A/D converter that is packaged in a 40-pin ceramic DIP. A minimum throughput rate of 1.0 MHz is achieved while only dissipating 1.3 Watts. The ADS-193 digitizes signals up to Nyquist.

Typical applications include spectrum, transient, vibration and waveform analysis. This device is also ideally suited for radar, sonar, video digitization, medical instrumentation and high-speed data acquisition systems. For information on high reliability screening, contact DATEL.

INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	+5V	40	DIGITAL GROUND
2	+10 V REFERENCE	39	BIT 1 OUT (MSB)
3	DIGITAL GROUND	38	BIT 2 OUT
4	DIGITAL GROUND	37	BIT 3 OUT
5	-15V	36	BIT 4 OUT
6	ANALOG INPUT	35	BIT 5 OUT
7	DO NOT CONNECT	34	BIT 6 OUT
8	GAIN OFFSET ADJ.	33	+5V
9	ANALOG GROUND	32	UNIPOLAR OFFSET
10	ANALOG GROUND	31	+10V REFERENCE
11	ANALOG GROUND	30	+15V
12	ANALOG GROUND	29	BIT 7 OUT
13	ANALOG GROUND	28	NO CONNECTION
14	ANALOG GROUND	27	NO CONNECTION
15	ANALOG GROUND	26	BIT 8 OUT
16	ANALOG GROUND	25	BIT 9 OUT
17	+5V	24	BIT 10 OUT
18	DIGITAL GROUND	23	BIT 11 OUT
19	-15V	22	BIT 12 OUT (LSB)
20	START CONVERT	21	$\overline{EOC}$



ABSOLUTE MAXIMUM RATINGS

PARAMETERS	LIMITS	UNITS
+15V Supply (Pin 30)	0 to +18	Volts dc
-15V Supply (Pin 5,19)	0 to -18	Volts dc
+5V Supply (Pin 1,33)	-0.5 to +7.0	Volts dc
Digital Inputs (Pins 20)	-0.3 to +6.0	Volts dc
Analog Input (Pin 6)	-15 to +15	Volts dc
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 -5	–	Volts dc
	–	±2.5	–	Volts dc
Input Impedance	950	1,000	1,050	Ohms
Input Capacitance	–	6	15	pf
DIGITAL INPUTS				
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
A/D PERFORMANCE				
No Missing Codes (12 Bits; fin=500 KHz)	Over the Operating Temp. Range.			
Integral Non-Linearity				
+25 °C	–	±1/4	±3/4	LSB
0 °C to +70 °C	–	±1/4	±3/4	LSB
-55 C to +125 °C	–	–	±1.5	LSB
Differential Non-Linearity				
+25 °C	–	–	±3/4	LSB
0 °C to +70 °C	–	–	±3/4	LSB
-55 C to +125 °C	–	–	±1	LSB
Full Scale Absolute Accuracy				
+25 °C	–	±0.13	±0.25	% FSR
0 °C to +70 °C	–	±0.15	±0.44	% FSR
-55 C to +125 °C	–	±0.25	±0.78	% FSR
Unipolar Zero Error,				
+25 °C (See Tech Note 1)	–	±0.074	±0.13	% FSR
Unipolar Zero Tempco	–	±15	±30	ppm/ ° C
Bipolar Zero Error,				
+25 °C (See Tech Note 1)	–	±0.074	±0.13	% FSR
Bipolar Zero Tempco	–	±5	±8	ppm/ ° C
Bipolar Offset Error,				
+25 °C (See Tech Note 1)	–	±0.1	±0.2	% FSR
Bipolar Offset Tempco	–	±20	±40	ppm/ ° C
Gain Error, +25 °C	–	±0.1	±0.2	% FSR
(See Tech Note 1)				
Gain Tempco	–	±20	±40	ppm/ ° C
Logic Levels				
Logic "1"	2.4	–	–	Volts dc
Logic "0"	–	–	0.4	Volts dc
Logic Loading "1"	–	–	-160	µA
Logic Loading "0"	–	–	4.8	mA
Internal Reference				
Voltage, +25 °C	+9.98	+10.0	+10.02	Volts dc
Drift.	–	±5	±30	ppm/ ° C
External Current	–	–	1.5	mA

ANALOG INPUTS	MIN.	TYP.	MAX.	UNITS
Resolution	12 Bits			
Output Coding	Complementary binary Complementary offset binary			
PERFORMANCE				
Conversion Rate	1.0	–	–	MHz
In-Band Harmonics (-0.5dB)				
DC to 100 KHz	-76	-81	–	FS-dB
100 KHz to 500 KHz	-70	-75	–	FS-dB
Total Harm. Distort. (-0.5dB)				
DC to 100 KHz	-75	-78	–	FS-dB
100 KHz to 500 KHz	-68	-73	–	FS-dB
Signal-to-Noise Ratio (w/o distortion, -0.5dB)				
DC to 100 KHz	-68	-72	–	FS-dB
100 KHz to 500 KHz	-67	-71	–	FS-dB
Signal-to-Noise Ratio & distortion, -0.5dB				
DC to 100 KHz	-66	-70	–	FS-dB
100 KHz to 500 KHz	-66	-70	–	FS-dB
Effective Bits, -0.5dB				
DC to 100 KHz	11.0	11.25	–	Bits
100 KHz to 500 KHz	10.6	11.0	–	Bits
Two-Tone Intermodulation Distortion (*f*IN=75, 105 KHz				
Fs=1 MHz, -7dB	-80	-88	–	FS-dB
Two-Tone Intermodulation Dist. (*f*IN=480 KHz, 490				
KHz, Fs=1 MHz, (-0.5dB)	-65	-68	–	FS-dB
Input Bandwidth				
Small Signal (-20dB)	7.5	10	–	MHz
Full Power (0dB)	5	8	–	MHz
Slew Rate	–	150	–	V/µSec.
Aperture Delay Time	–	–	20	nSec.
Effect. Aperture Delay Time	–	–	16	nSec.
Aperture Uncertainty (Jitter)				
(rms)	–	–	±15	pSec.
(peak)	–	–	±50	pSec.
S/H Acquisition Time to 0.01% (Transient Recovery)	–	–	180	nSec.
Overvoltage Recovery Time	–	–	1000	nSec.
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	–	+24	+35	mA
-15V dc Supply	–	-40	-48	mA
+5V dc Supply ①	–	+95	+115	mA
Power Dissipation	–	1.3	1.7	Watts
Power Supply Rejection	–	–	0.05	%FSR/%V
PHYSICAL/ENVIRONMENTAL				
Operating Temp. Range				
-MC	0	–	+70	° C
-MM	-55	–	+125	° C
Storage Temperature Range	-65	–	+150	° C
Package Type	40-pin hermetic sealed, ceramic DIP			
Weight	0.56 ounces (16 grams), maximum			

① +5V power usage at 1 TTL logic loading per data output bit.
Specifications subject to change without notice.

TECHNICAL NOTES

1. Use external potentiometers as shown in Figure 3 to adjust the offset and gain errors to zero. For operation without adjustment, leave pin 8 open.

2. Rated performance requires using good high-frequency circuit board layout techniques. The analog and digital grounds are connected internally. Avoid ground-related problems by connecting the digital 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 to ground with a 10 µF, 25V tantalum electrolytic capacitor. Bypass the +10V reference (pin 2 and 31) to analog ground (pin 16) with a 0.1 µF ceramic capacitor.

4. For unipolar, 0 to -5V FSR, connect pins 31 and 32. For bipolar, ±2.5V FSR, connect pin 32 to analog ground and connect pin 31 to a 0.1 µF ceramic capacitor only.

5. Pins 27 and 28 are no connection pins. Connecting pins 27 and 28 together is acceptable.

TIMING

Figure 2 shows the relationship between the various input signals. The timing shown applies over the operating temperature range and over the operating power supply range. These times are guaranteed by design.

CALIBRATION PROCEDURE

1. Connect the converter per Figure 3 for the appropriate full-scale range (FSR). Apply a pulse of 200 nanoseconds minimum to the START CONVERT input (pin 20) at a rate of 250 KHz. 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 the amplifier's analog input and ground. Adjust the output of the reference source per Table 2. Adjust the zero trimming potentiometer so that the output code flickers equally between 0000 0000 0000 and 0000 0000 0001 for unipolar.

   For bipolar operation, adjust the potentiometer such that the code flickers equally between 1000 0000 0000 and 1000 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 1111 1111 1110 and 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.

Table 2. Zero and Gain Adjust

FSR	ZERO ADJUST + 1/2 LSB	GAIN ADJUST +FS - 1 1/2 LSB
0 to -5V dc	-0.61mV dc	-4.9982V
±2.5V dc	+0.61 mV	-2.4982V

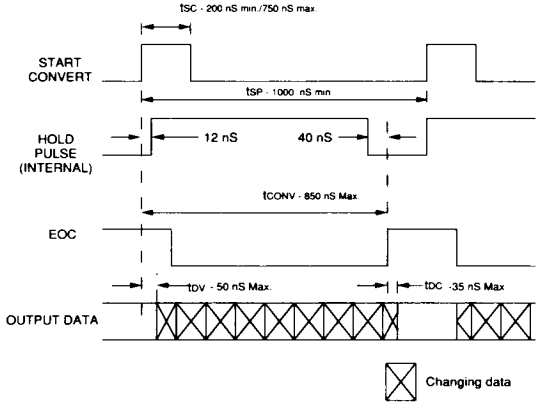


Figure 2. ADS-193 Timing Diagram

Table 3. Output Coding

		COMP BINARY		
UNIPOLAR SCALE	INPUT RANGE, V dc 0 to -5V	OUTPUT CODING MSB LSB	INPUT RANGE ±2.5V dc	BIPOLAR SCALE
+FS -1 LSB	-4.998V	1111 1111 1111	-2.4988V	+FS -1 LSB
7/8 FS	-4.375V	1110 0000 0000	-1.8750V	+3/4 FS
3/4 FS	-3.750V	1100 0000 0000	-1.2500V	+1/2 FS
1/2 FS	-2.500V	1000 0000 0000	0.0000V	0
1/4 FS	-1.250V	0100 0000 0000	+1.2500V	-1/2 FS
1/8 FS	-0.625V	0010 0000 0000	+1.8750V	-3/4 FS
1 LSB	-0.0012V	0000 0000 0001	+2.4988V	-FS +1 LSB
0	0.000V	0000 0000 0000	+2.5000V	-FS
		COMP OFF BIN		

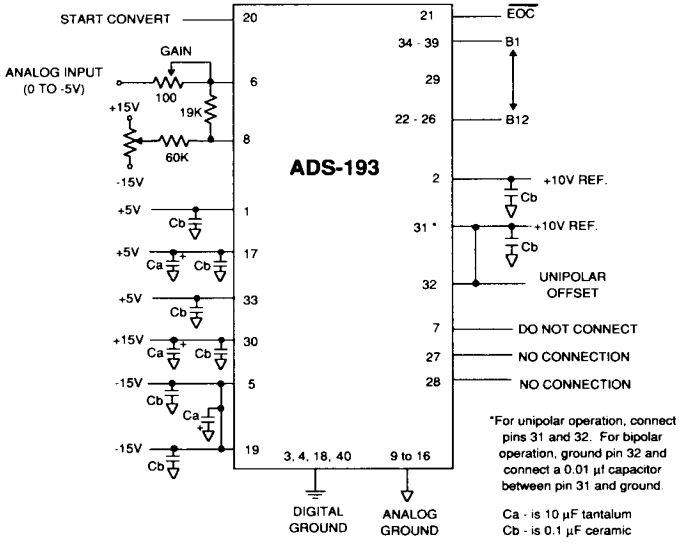
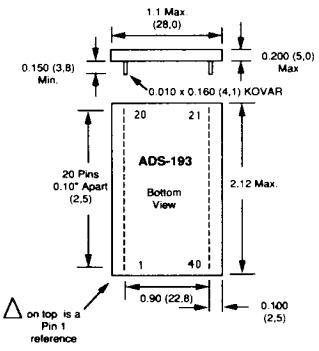
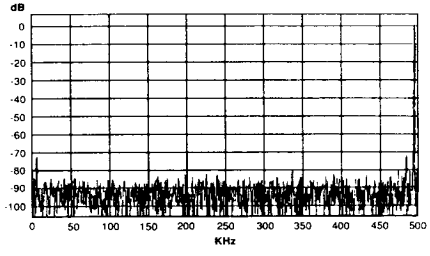


Figure 3. Typical ADS-193 Connection Diagram

MECHANICAL DIMENSIONS INCHES (MM)





FFT Analysis of ADS-193

ORDERING INFORMATION

MODEL NUMBER	OPERATING TEMP. RANGE	SEAL
ADS-193MC	0 °C to +70 °C	Hermetic
ADS-193MM	-55 °C to +125 °C	Hermetic
ADS-EVAL1	Evaluation board (without ADS-193)	

Receptacle for PC board mounting can be ordered through AMP Inc., Part # 3-331272-8 (Component Lead Socket), 40 required.

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

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