ADC-810, ADC-811
12-Bit, High-Speed Hybrid A/D Converter

DATEL

FEATURES

- 2 Microsecond maximum conversion time
- 12-Bit resolution
- Industry-standard pinout
- −55°C to +125°C Operation

GENERAL DESCRIPTION

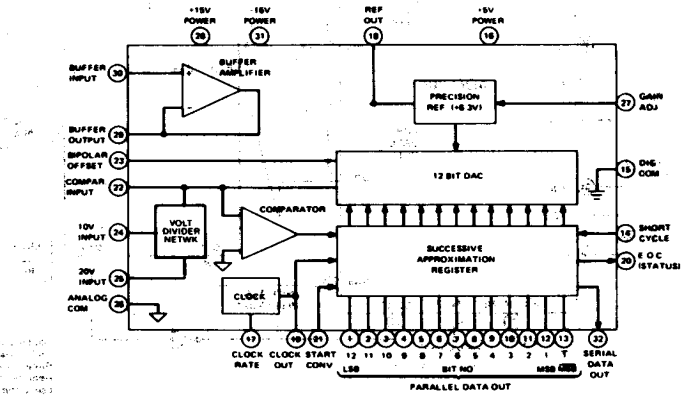
DATEL's ADC-810 and ADC-811 are high speed, high performance 12-bit analog-to-digital converters manufactured with thick- and thin-film hybrid technology. Utilizing the successive approximation conversion technique, the ADC-810 achieves a 12-bit conversion in a maximum of only 2 microseconds. Conversion time for the ADC-811 is 3 microseconds maximum, this being the only difference between the two units. Both models are pin-compatible with industry standard ADC-85/87 converters, offering increased speed, high accuracy and reliability over the full military temperature range.

These converters feature four pin-programmable input voltage ranges: 0 to +10V dc, 0 to +20V dc, ±5V dc, and ±10V dc. A user selectable input buffer amplifier is included for applications where 100 MΩ input impedance is required. Other specifications include a maximum nonlinearity of ±1 LSB, and a gain tempco of 20 ppm/°C maximum. The differential nonlinearity tempco is ±5 ppm/°C maximum.

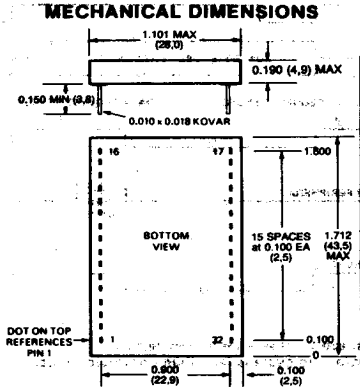
Output data is available in parallel or serial form. Output coding is complementary binary, complementary offset binary or complementary two's complement. All digital outputs are TTL-compatible.

The ADC-810 and ADC-811 are a good choice for numerous commercial, industrial and military applications requiring high speed, hybrid reliability, low cost and small size. Such applications include FFT analysis, radar digitization, medical instrumentation, and high speed multiplexed data acquisition systems.

Power requirement for both converters is ±15V and +5V. Models are available for operation over the commercial, 0°C to +70°C, and military −55°C to +125°C temperature ranges. All devices are packaged in a 32-pin, hermetically sealed, ceramic case.



MECHANICAL DIMENSIONS



*NOTE: PINS HAVE 0.025 INCH STANDOFF FROM CASE, ±0.01"

INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	BIT 12 OUT (LSB)	17	CLOCK RATE
2	BIT 11 OUT	18	REF. OUT
3	BIT 10 OUT	19	CLOCK OUT
4	BIT 9 OUT	20	E.O.C. (STATUS)
5	BIT 8 OUT	21	START CONVERT
6	BIT 7 OUT	22	COMPAR. INPUT
7	BIT 6 OUT	23	BIPOLAR OFFSET
8	BIT 5 OUT	24	10V INPUT
9	BIT 4 OUT	25	20V INPUT
10	BIT 3 OUT	26	ANALOG COM
11	BIT 2 OUT	27	GAIN ADJUST
12	BIT 1 OUT (MSB)	28	+15V POWER
13	BIT T OUT (MSB)	29	BUFFER OUTPUT
14	SHORT CYCLE	30	BUFFER INPUT
15	DIGITAL COM.	31	-15V POWER
16	+5V POWER	32	SERIAL OUTPUT

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FUNCTIONAL SPECIFICATIONS, ADC-810, ADC-811

Typical at 25°C, ±15V and +5V supplies unless otherwise noted

DESCRIPTION		
INPUTS		
Analog Input Ranges, unipolar[1]	0 to +10V FS, 0 to +20V FS	
Analog Input Ranges, bipolar[1]	±5V, ±10V FS	
Input Impedance	1.05 kΩ (0 to +10V, ±5V) 4.2 kΩ (0 to +20V, ±10V)	
Input Impedance with Buffer	100 Megohms	
Input Bias Current of Buffer	125 nA typical, 250 nA max.	
Input Overvoltage[2]	±15V	
Start Conversion	2V min. to 5.5V max. positive pulse with duration of 50 nsec. min. Rise and fall times <30 nsec. Logic "1" to "0" transition resets converter and initiates next conversion. Loading: 1 TTL load	
OUTPUTS[3]		
Parallel Output Data	12 parallel lines of data held until next conversion command. V_{OUT} ("0") ≤ +0.4V V_{OUT} ("1") ≥ +2.4V	
Coding, unipolar	Complementary Binary	
Coding, bipolar	Complementary Offset Binary Complementary Two's Complement	
Serial Output Data	NRZ successive decision pulses out, MSB first. Complementary Binary or Complementary Offset Binary Coding.	
End of Conversion (Status)	Conversion status signal. Output is logic "1" during reset and conversion and logic "0" when conversion complete.	
Clock Output	Train of positive going +5V, 70 nsec. pulses. 6.5 MHz for ADC-810, and 4.3 MHz for ADC-811 (Pin 17 grounded).	
PERFORMANCE		
Resolution	12-bits (1 part in 4096)	
Nonlinearity, max.	±1 LSB	
Differential Nonlinearity, max.	±1 LSB	
Gain Error, max., before adj.	±0.1%	
Zero Error, max., unipolar, before adj.	±0.15% of FSR[4]	
Offset Error, max., bipolar, before adj.	±0.15% of FSR[4]	
Temp. Coeff. of Gain, max.	±20 ppm/°C	
Temp. Coeff. of Zero, unipolar, max.	±10 ppm/°C of FSR[5]	
Temp. Coeff. of Offset, bipolar, max.	±10 ppm/°C of FSR[5]	
Diff. Nonlinearity Tempco, max.	±5 ppm/°C of FSR	
		ADC-811 only
Conversion Time[4]**, 12 bits**	2.0 μsec. max.	3.0 μsec. max.
10 bits[6]	1.7 μsec. max.	2.6 μsec. max.
8 bits[6]	1.4 μsec. max.	2.1 μsec. max.
Buffer Settling Time, 10V step	500 nsec. to 0.01%	
Power Supply Rejection max.	0.01%/% Supply max.	
POWER REQUIREMENTS		
Analog Supply, positive	+15V dc ±0.5V at 70 mA max.	
negative	−15V dc ±0.5V at 30 mA max.	
Logic Supply	+5V dc ±0.25V at 240 mA max.	
PHYSICAL/ENVIRONMENTAL		
Operating Temperature Range, MC	0°C to +70°C	
MM	−55°C to +125°C	
Storage Temperature Range	−65°C to +150°C	
Package Size	1.700 x 1.100 x 0.160 inches	
Package Type	32 pin ceramic	
Pins	0.010 x 0.018 inch Kovar	
Weight	0.5 ounces (14 grams)	

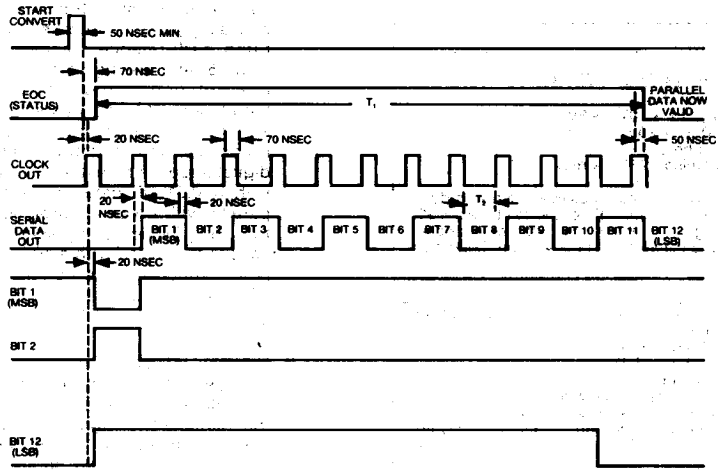
FOOTNOTES:

1. For information on models with 0 to +5V dc and ± 2.5V dc input voltage ranges, please contact the factory.
2. The input buffer cannot be used with the 0 to +20V dc input range.
3. All digital outputs can drive 5 TTL loads.
4. Without buffer amplifier used. ADC-810/811 may require external adjustment of clock rate using the buffer amplifier.
5. FSR is full scale range and is 10V dc for 0 to +10V dc or ±5V dc input and 20V dc for ±10V dc input.
6. Short cycled operation.

TECHNICAL NOTES

1. Use of good high frequency circuit board layout techniques is required for rated performance. Digital common (Pin 15) and analog common (Pin 26) are not connected internally and therefore must be connected as directly as possible externally. Also, it is recommended that the analog and digital supplies be externally bypassed with a 0.01 μF ceramic capacitor in parallel with a 1 μF electrolytic capacitor. The ±5V dc supply should be bypassed to ground with a 10 μF electrolytic capacitor. Additionally, Pin 27 (Gain Adjust) should be bypassed to ground with a 0.01 μF ceramic capacitor.
2. External adjustment of zero or offset and gain are provided for by trimming potentiometers connected as shown in the connection diagrams. The potentiometer values can be between 10 k and 100 k ohms and should be 100 ppm/°C cermet types (such as DATEL's TP Series). The adjustment range is ±0.2% of FSR for zero or offset and ±0.3% for gain. The trimming pots should be located as close as possible to the converter to avoid noise.
3. Short cycled operation results in shorter conversion times where the conversion can be truncated to less than 12 bits. This is done by connecting Pin 14 to the output bit following the last bit desired. For example, for an 8-bit conversion, Pin 14 is connected to bit 9 output. Maximum conversion times are given for short-cycled conversions of 8 or 10 bits. In these two cases, the clock rate is also speeded up by connecting the clock rate adjust (Pin 17) to +5V (10 bits) or +15V (8 bits). The clock rate should not be arbitrarily speeded up to exceed the maximum conversion rate at a given resolution, however, or missing codes will result.
4. These converters dissipate 2.8 watts of power. The case to ambient thermal resistance is approximately 20°C per watt. For ambient temperatures above 50°C, care should be taken not to restrict air circulation in the vicinity of the converter. Also, it is recommended that the converter be mounted directly to the circuit board (without the use of a mounting socket) and that good thermal contact be established between the case bottom and the circuit board grounded plane by use of a silicone thermal joint compound such as Wakefield type 120 or equivalent. For operation in ambient temperatures exceeding 85°C, air flow of at least 400 linear feet per minute is recommended.

TIMING DIAGRAM FOR ADC-810, ADC-811

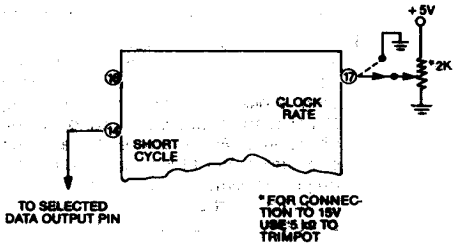


TIMING DIAGRAM OPERATING PERIODS

	ADC-810	ADC-811
T_1	2.0 µsec.	3.0 µsec.
T_2	98 nsec.	258 nsec.

OUTPUT: 101010101010

CLOCK RATE ADJUSTMENT



SHORT CYCLE OPERATION

Refer to Technical Note 3 for methods of reducing the overall ADC-810 or ADC-811 conversion time.

PIN 14 CONNECTION

RES. (BITS)	PIN 14 TO	RES. (BITS)	PIN 14 TO
1	PIN 11	7	PIN 5
2	PIN 10	8	PIN 4
3	PIN 9	9	PIN 3
4	PIN 8	10	PIN 2
5	PIN 7	11	PIN 1
6	PIN 6	12	PIN 16

CLOCK RATE VS. VOLTAGE

PIN 17 VOLTAGE	CLOCK RATE	
	ADC-811	ADC-810
0V	4.3 MHz	6.5 MHz
+5V	5.2 MHz	7.8 MHz
+15V	5.4 MHz	8.1 MHz

CLOCK RATE ADJUSTMENT RANGE

5V, 2kΩ Trim Pot
6.5 MHz to 7.8 MHz (ADC-810)
3.2 MHz to 3.6 MHz (ADC-811)

15V, 5KΩ Trim Pot
6.5 MHz to 8.1 MHz (ADC-810)
3.2 MHz to 4 MHz (ADC-811)

8, 10, & 12 BIT CONVERSION

RESOLUTION	12 BITS	10 BITS	8 BITS
ADC-810 CONV. TIME	2 µsec	1.7 µsec	1.4 µsec
ADC-811 CONV. TIME	3 µsec	2.6 µsec	2.1 µsec
CONNECT THESE PINS TOGETHER	17 & 15	17 & 16	17 & 28
	14 & 16	14 & 2	14 & 4

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INPUT CONNECTIONS

INPUT VOLT. RANGE	WITHOUT BUFFER			WITH BUFFER			
	INPUT PIN	CONNECT THESE PINS TOGETHER		INPUT PIN	CONNECT THESE PINS TOGETHER		
0V to + 10V	24	—	23 & 26	30	—	23 & 26	29 & 24
0V to + 20V	25	—	23 & 26	30	—	NA	NA
± 5V	24	—	23 & 22	30	—	23 & 22	29 & 24
± 10V	25	—	23 & 22	30	—	23 & 22	29 & 25

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OUTPUT CODING TABLES

BIPOLAR OPERATION

INPUT VOLTAGE RANGE		COMP. OFFSET BINARY			COMP. TWO'S COMPLEMENT		
± 10V	± 5V	MSB		LSB	MSB		LSB
+ 9.9951V	+ 4.9976V	0000	0000	0000	1000	0000	0000
+ 7.5000	+ 3.7500	0001	1111	1111	1001	1111	1111
+ 5.500	+ 2.5000	0011	1111	1111	1011	1111	1111
0.0000	0.0000	0111	1111	1111	1111	1111	1111
− 5.0000	− 2.5000	1011	1111	1111	0011	1111	1111
− 7.5000	− 3.7500	1101	1111	1111	0101	1111	1111
− 10.000	− 5.0000	1111	1111	1111	0111	1111	1111

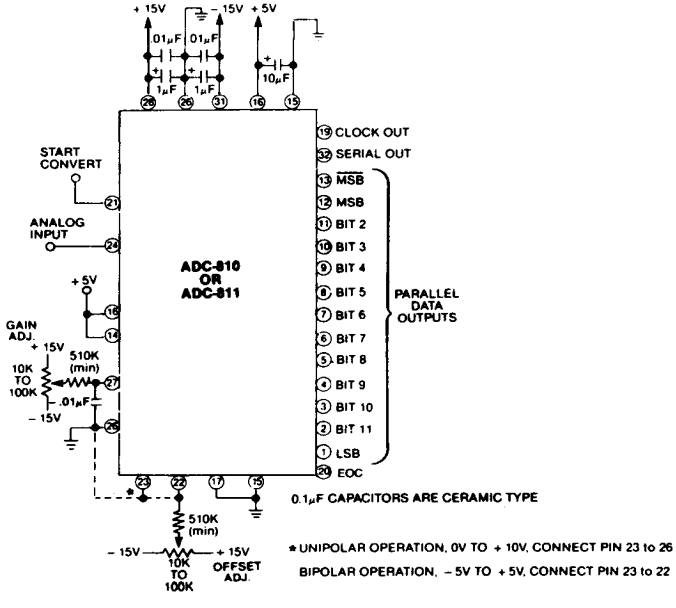
UNIPOLAR OPERATION

INPUT RANGE		COMP. BINARY CODING		
0 TO + 10V	0 TO + 20V	MSB		LSB
+ 9.9976V	+ 19.9952V	0000	0000	0000
+ 8.7500	+ 17.5000V	0001	1111	1111
+ 7.5000	+ 15.0000V	0011	1111	1111
+ 5.0000	+ 10.0000V	0111	1111	1111
+ 2.50000	+ 5.0000V	1011	1111	1111
+ 0.0024	+ 0.0049V	1111	1111	1110
0.0000	+ 0.0000V	1111	1111	1111

CALIBRATION PROCEDURE

1. **Connect the converter** as shown in the applicable connections diagram. A trigger pulse of 50 nanoseconds minimum is applied to the start conversion input (pin 21) at a rate of 200 kHz.
2. **Zero and Offset Adjustments**
   Apply a precision voltage reference source between the appropriate input for the selected full scale range and ground. Adjust the output of the reference source to the value shown in the Calibration Table for the unipolar zero adjustment (0 + ½ LSB) or the bipolar offset adjustment (0 − ½ LSB). Adjust the offset trimming potentiometer so that the output code flickers equally between 1111 1111 1111 and 1111 1111 1110 for the unipolar range and between 0111 1111 1111 and 1000 0000 0000 for the bipolar range.
3. **Full Scale Adjustment**
   Set the output of the voltage reference source used in step 2 to the value shown in the Calibration Table for the unipolar or bipolar gain adjustment (+ FS − 1½ LSB). Adjust the gain trimming potentiometer so that the output code flickers equally between 0000 0000 0000 and 0000 0000 0001.

TYPICAL CONNECTIONS



*UNIPOLAR OPERATION, 0V TO + 10V, CONNECT PIN 23 to 26
BIPOLAR OPERATION, − 5V TO + 5V, CONNECT PIN 23 to 22

CALIBRATION TABLE

UNIPOLAR RANGE	+ ½ LSB	+ F.S.-1½ LSB
0 to + 10V 0 to + 20V	+ 1.22 mV + 2.44 mV	+ 9.9963 V + 19.9927V
BIPOLAR RANGE	**− ½ LSB**	**+ F.S.-1½ LSB**
± 5V ± 10V	− 1.22 mV − 2.44 mV	+ 4.9963 V + 9.9927 V

For information on models with 0 to + 5V and ± 2.5V input voltage ranges please contact the factory.

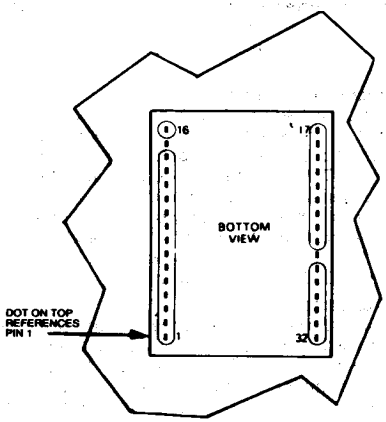
NOTE

In any application using the ADC-810 or the ADC-811, signal integrity and noise isolation are a function of grounding. The suggested ground plane shown should be used whenever possible.

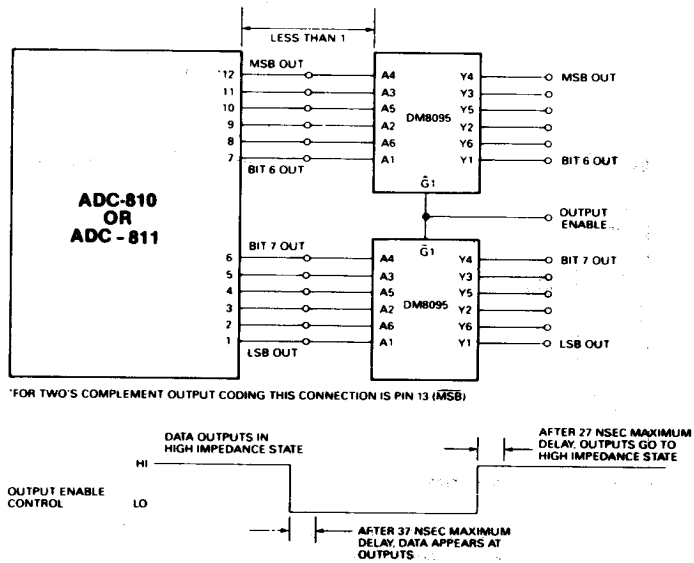
Providing Three-State Outputs

For applications where the coverted input must interface to tri-state TTL or CMOS logic, the ADC-810 or ADC-811 outputs are easily converted using buffers such as the DM8095's shown in the diagram. Signal length must be less than one inch between devices to ensure signal integrity. Also note that two's complement outputs are available from the ADC-810 and ADC-811 by using pin 13 instead of Pin 12 as the MSB output. The timing diagram shows the delays incurred as the signal passes through the buffers.

GROUND PLANE LAYOUT



HIGH SPEED THREE-STATE OUTPUT BUFFER



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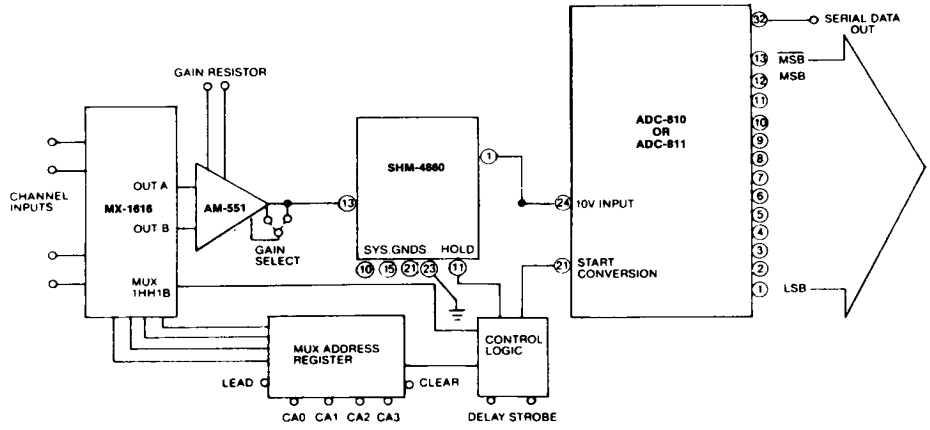
HIGH SPEED DATA ACQUISITION SYSTEM



The four DATEL components shown in the diagram make up a 12-bit, high-speed data acquisition system capable of throughput rates of 200 kHz. The system can accept up to 16 single-ended input channels using DATEL's MX-1616 CMOS multiplexer or up to eight differential channels using the MX-808.

Other DATEL components in the system are the AM-551, a hybrid precision programmable gain instrumentation amplifier and the SHM-4860, a 200 nanosecond, 0.01% hybrid sample-and-hold device.

ORDERING INFORMATION

MODEL	TEMP. RANGE
ADC-810MC	0° C to + 70° C
ADC-810MM	-55° C to + 125° C
ADC-811MC	0° C to + 70° C
ADC-811MM	-55° C to + 125° C

ACCESSORIES

Part Number	Description
TP10K or TP100K	Trimming Potentiometers