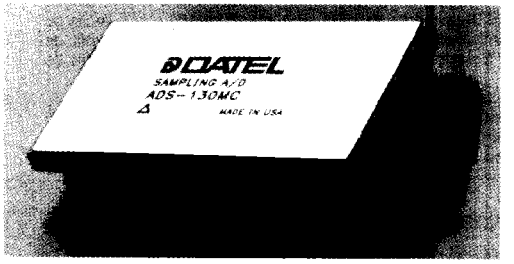
ADS-130
12-Bit, 10 MHz Sampling A/D Converter

FEATURES

- **12-Bit resolution**
- **Internal Sample/Hold amplifier**
- **10 MHz minimum throughput**
- **Samples up to Nyquist**
- **Functionally Complete**
- **Small 40-pin DIP**
- **Low-power, 3.85 Watts**
- **Three-State output buffers**
- **High input bandwidth**
- **Overflow pin**
- **No missing codes**

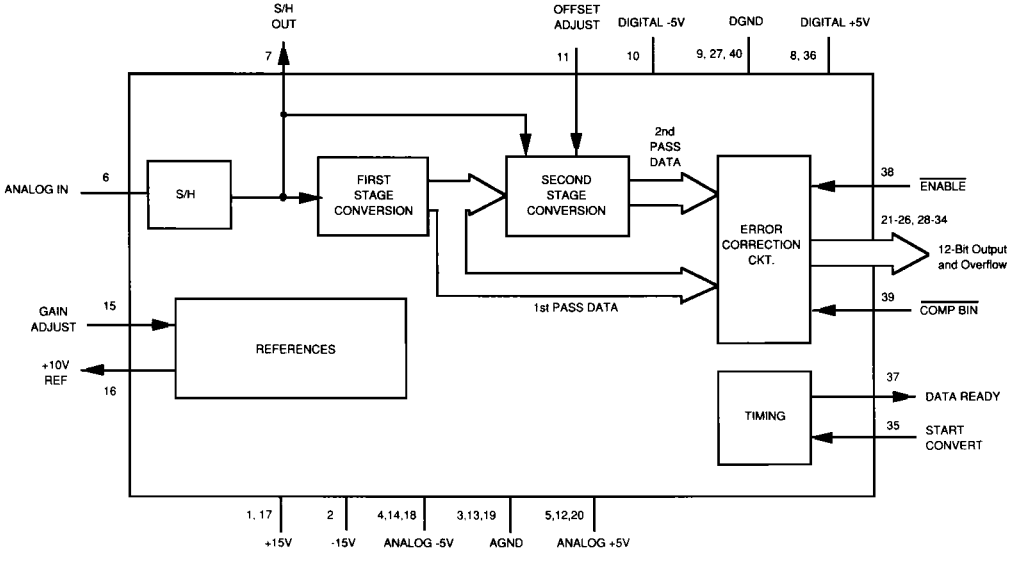


GENERAL DESCRIPTION

DATEL's ADS-130 is a 12-bit, functionally complete, sampling A/D converter packaged in a small 40-pin DIP. A 10 MHz minimum throughput rate in digitizing sinusoidal signals is achieved while only dissipating 3.85 Watts.

INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	+15V	40	DIGITAL GROUND
2	-15V	39	COMP BIN
3	ANALOG GROUND	38	ENABLE
4	ANALOG -5V	37	DATA READY
5	ANALOG +5V	36	DIGITAL +5V
6	ANALOG INPUT	35	START CONVERT
7	S/H OUT	34	OVERFLOW
8	DIGITAL +5V	33	BIT 1 (MSB)
9	DIGITAL GROUND	32	BIT 2 OUT
10	DIGITAL -5V	31	BIT 3 OUT
11	OFFSET ADJUST	30	BIT 4 OUT
12	ANALOG +5V	29	BIT 5 OUT
13	ANALOG GROUND	28	BIT 6 OUT
14	ANALOG -5V	27	DIGITAL GROUND
15	GAIN ADJUST	26	BIT 7 OUT
16	+10V REFERENCE	25	BIT 8 OUT
17	+15V SUPPLY	24	BIT 9 OUT
18	ANALOG -5V	23	BIT 10 OUT
19	ANALOG GROUND	22	BIT 11 OUT
20	ANALOG +5V	21	BIT 12 OUT (LSB)



ABSOLUTE MAXIMUM RATINGS

PARAMETERS	LIMITS	UNITS
+15V Supply (Pin 1,17)	0 to +18	Volts dc
-15V Supply (Pin 2)	0 to -18	Volts dc
+5V Supply (Pin 5, 8,12,20,36)	-0.5 to +7.0	Volts dc
-5V Supply (Pin 4,10,14,18)	+0.5 to -7.0	Volts dc
Digital Inputs (Pins 35,38,39)	-0.3 to +5.5	Volts dc
Analog Input (Pin 6)	±5	Volts dc
Lead Temp. (10 Sec.)	300	°C

FUNCTIONAL SPECIFICATIONS

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

INPUTS	MIN	TYP	MAX	UNITS
ANALOG				
Input Voltage Range	–	±1.25	–	V dc
Input Impedance	50	160	–	KOhm
Input Capacitance	–	2.5	10	pF
DIGITAL				
Logic Level "1"	2.0	–	–	V dc
Logic Level "0"	–	–	0.8	V dc
Logic Loading "1"	–	–	5.0	µA
Logic Loading "0"	–	–	-200	µA
OUTPUTS				
Resolution	12 Bits			
Output Coding	Offset Binary			
(Pin 39 HI)	Complementary Offset Binary			
(Pin 39 Low)				
Logic Level "1"	2.4	–	–	V dc
Logic Level "0"	–	–	0.4	V dc
Logic Loading "1"	–	–	-160	µA
Logic Loading "0"	–	–	6.4	mA
Internal VREF, (pin 16)				
+25 °C	+9.9	+10.0	+10.1	V dc
0 to +70 °C	+9.9	+10.0	+10.1	V dc
-55 to +125 °C	+9.8	+10.0	+10.2	V dc
External Current	–	–	2	mA
PERFORMANCE				
Int. Non-Lin., fIN= 5.0 MHz				
+25 °C	–	–	±1	LSB
0 to +70 °C	–	–	±1	LSB
-55 to +125 °C	–	–	±2	LSB
Diff. Non-Lin., fIN = 5.0 MHz				
+25 °C	–	–	±1	LSB
0 to +70 °C	–	–	±1	LSB
-55 to +125 °C	–	–	±2	LSB
Full Scale Absolute Accuracy				
+25 °C (Tech note 1)	–	±0.2	±0.4	%FSR
0 to +70 °C	–	±0.4	±0.8	%FSR
-55 to +125 °C	–	±0.8	±1.6	%FSR
Bipolar Zero Error,				
+25 °C (Tech note 1)	–	±0.15	±0.2	%FSR
0 to +70 °C	–	±0.2	±0.4	%FSR
-55 to +125 °C	–	±0.4	±0.8	%FSR
Bipolar Offset Error,				
+25 °C (Tech Note 1)	–	±0.15	±0.2	%FSR
0 to +70 °C	–	±0.2	±0.4	%FSR
-55 to +125 °C	–	±0.4	±0.8	%FSR
Gain Error, +25 °C				
(Tech Note 1)	–	±0.15	±0.2	%FSR
0 to +70 °C	–	±0.2	±0.4	%FSR
-55 to +125 °C	–	±0.4	±0.8	%FSR
No Missing Codes				
(12 Bits, at fIN = 2.5 MHz)				

DYNAMIC PERFORMANCE	MIN	TYP	MAX	UNITS
Conversion Rate				
(Changing Inputs),+25 °C	10	–	–	MHz
0 to +70 °C	10	–	–	MHz
-55 to +125 °C	10	–	–	MHz
Total Harm. Distort.(-0.5 dB)				
DC to 500 KHz	-68	-70	–	FS, -dB
500 KHz to 2.5 MHz	-65	-67	–	FS, -dB
2.5 MHz to 5 Mhz	-65	-67	–	FS, -dB
Signal-to-Noise Ratio				
(w/o distortion, -0.5 dB)				
DC to 500 KHz	-67	-70	–	FS, -dB
500 KHz to 2.5 MHz	-65	-69	–	FS, -dB
2.5 MHz to 5 Mhz	-65	-69	–	FS, -dB
Signal-to-Noise Ratio				
and Distortion (-0.5 dB)				
DC to 500 KHz	-65	-66	–	FS, -dB
500 KHz to 2.5 MHz	-63	-65	–	FS, -dB
2.5 MHz to 5 Mhz	-63	-65	–	FS, -dB
Spurious Free Dynamic Range				
DC to 500 KHz (-0.5 dB)②	-69	-70	–	FS, -dB
500 KHz to 2.5 MHz	-66	-67	–	FS, -dB
2.5 MHz to 5 Mhz	-66	-67	–	FS, -dB
Effective Bits				
DC to 500 KHz	10.6	11.0	–	Bits
500 KHz to 2.5 MHz	10.2	10.5	–	Bits
2.5 MHz to 5 Mhz	10.0	10.2	–	Bits
Two-tone Intermodulation Distortion (fIN =2.2 MHz,				
2.3 MHz, Fs = 8 MHz)	-72	-75	–	dB
Input Bandwidth				
Small Signal (-20 dB input)	50	65	–	MHz
Full Power (0 dB input)	30	40	–	MHz
Slew Rate	175	200	–	V/µSec
Aperture Delay Time	–	5	7	nSec
Aperture Uncertainty	–	5	7	psec
S/H Acquisition Time				
to 0.01% FS (2.5V step)				
+25 °C	–	30	50	nSec
0 to +70 °C	–	30	50	nSec
-55 to +125 °C	–	50	70	nSec
Feedthrough Rejection				
2.5V step	-62	-66	–	dB
Overvoltage Recovery, ±2.5 V	–	50	100	nSec
POWER REQUIREMENTS				
Power Supply Range				
+15V dc Supply (Vcc)	+14.25	+15.0	+15.75	V dc
-15V dc Supply (VEE)	-14.25	-15.0	-15.75	V dc
+5V dc Supply (VDD)	+4.75	+5.0	+5.25	V dc
-5V dc Supppy (Vss)	-4.75	-5.0	-5.25	V dc
Power Supply Current				
+15V dc Supply	–	+26	+28	mA
-15V dc Supply	–	-30	-33	mA
+5V dc Supply①	–	+347	+372	mA
-5V dc Supply	–	-255	-285	mA
Power Dissipation	–	3.85	4.2	Watts
Power Supply Rejection	–	0.05	0.1	%FSR/%V
PHYSICAL/ENVIRONMENTAL				
Operating Temp. Range (Case)				
-MC	0	–	+70	°C
-MM	-55	–	+125	°C
Storage Temperature Range	-65	–	+150	°C
Weight	0.56 oz. (16 grams) Max.			
Package Type	40-Pin hermetic sealed, ceramic TDIP			

① +5V power usage at 1 TTL logic loading per data output bit.
② The same specifications apply to Inband Harmonics.

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

TECHNICAL NOTES

1. Use external potentiometers to remove system errors or to reduce the small initial errors to zero. Use a 20K trimming potentiometer for gain adjustment with the wiper tied to pin 15 (tie pin 15 to ANALOG GROUND for operation without adjustments). Use a 20K trimming potentiometer with the wiper tied to pin 11 for zero/offset adjustment (tie pin 11 to ANALOG GROUND for operation without adjustment).

2. Rated performance requires using good high-frequency circuit board layout techniques. Avoid ground-related problems by connecting the digital and analog grounds to one point, the ground plane beneath the converter.

   In most cases, users will use a single +5V supply for both analog +5V and digital +5V (applicable for the -5V supply also). Should users have separate supplies the difference between the analog and digital supply should be within ±100 mV to avoid performance degradation.

   Due to the inductance and resistance of the power supply return paths, return the analog and digital ground separately to the power supplies. This prevents contamination of the analog ground by noisy digital ground currents.

3. Bypass all the analog and digital power supply pins with a 2.2 µF, 25V tantalum electrolytic capacitor in parallel with a 0.1 µF ceramic capacitor to their respective analog and digital grounds. Use of chip capacitors is recommended.

4. Obtain offset binary output coding by tying $\overline{\text{COMP BIN}}$ (pin 39) to +5V dc. To obtain complementary offset binary output coding, tie pin 39 to ground. The pin 39 signal is compatible to CMOS/TTL logic levels for those users desiring logic control of this function.

5. To obtain three-state outputs, connect the $\overline{\text{ENABLE}}$ pin (pin 38) to a logic "1" (high). Otherwise, connect pin 38 to a logic "0" (low).

6. The ADS-130 guarantees it's specified throughput rate over the temperature range when the START CONVERT pulse of 10 nS minimum, 90 nS maximum is provided at the specified rate. Start convert pulses greater than 90 nanoseconds will result in slower throughput rates.

7. The ADS-130 is capable of digitizing sinusoidal input frequencies up to the Nyquist frequency. The acquisition time for pulse or dc level signals is 50 nS maximum over the 0 to +70 °C temperature range. Acquisition time is 70 nSec. maximum from -55 °C to +125 °C.

8. The specifications listed in Figure 2 (timing diagram) apply over the full operating temperature range unless otherwise specified.

9. The OVERFLOW pin goes high for signals greater than +full scale (no overflow flag given for signals greater than -FS). The OVERFLOW pin is a three-state output and is enabled by pin 38.

10. The ADS-130 has a one pipeline delay in obtaining output data. Refer to the Timing Diagram in Figure 3.

11. The ADS-130 goes into the hold mode on the rising edge of the start convert pulse.

CALIBRATION PROCEDURE

1. Connect the converter per Figure 2.
Apply a pulse of 10 nS typical to the START CONVERT input (pin 35) at a rate of 500 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 analog input (pin 6) and analog ground. Adjust the output of the reference source per Table 2 for the bipolar zero adjustment (zero +1/2 LSB). Adjust the potentiometer such that the code flickers equally between 1000 0000 0000 and 1000 0000 0001 with $\overline{\text{COMP BIN}}$ (pin 39) tied high (offset binary) or between 0111 1111 1111 and 0111 1111 1110 with pin 39 tied low (complementary offset binary).

3. Full-Scale Adjustment
Set the output of the voltage reference used in step 2 to the value shown in Table 2 for the bipolar gain adjustment (+FS -1 1/2 LSB). Adjust the gain trimming potentiometer so that the output code flickers equally between 1111 1111 1110 and 1111 1111 1111 with pin 39 tied high or between 0000 0000 0000 and 0000 0000 0001 with pin 39 tied low.

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

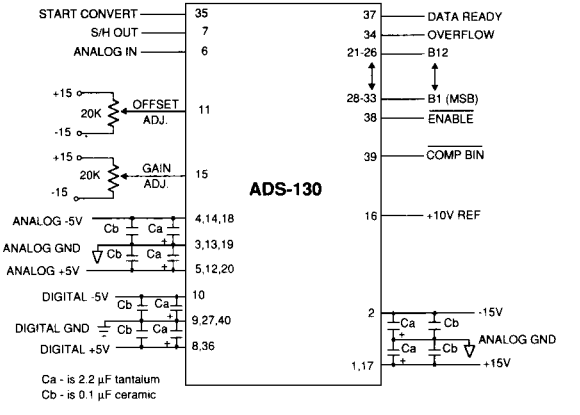


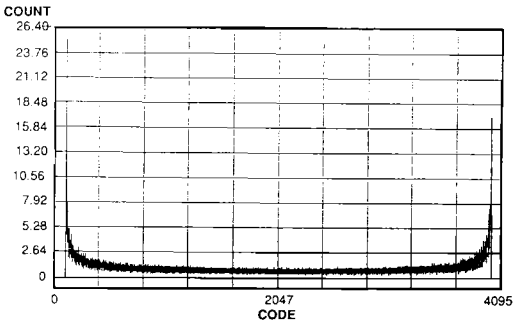
Figure 2. Typical ADS-130 Connection Diagram

Table 2. Zero and Gain Adjust

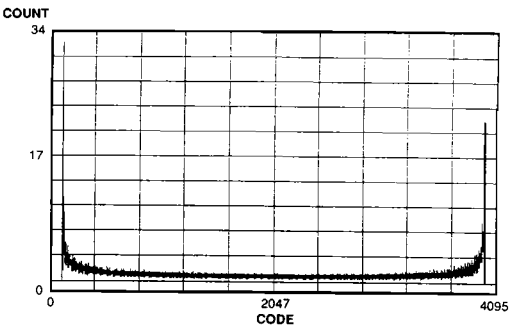
FSR	ZERO ADJUST 0 + 1/2 LSB	GAIN ADJUST +FS - 1 1/2 LSB
±1.25Vdc	+305 µV dc	+1.249085V dc

HISTOGRAM TESTS

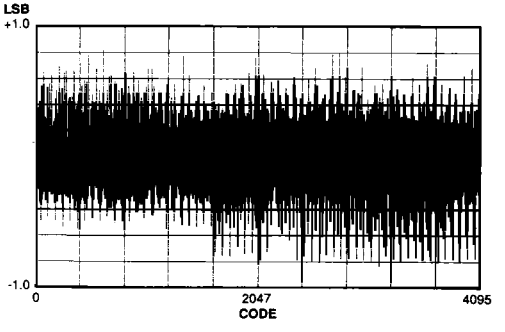
FIN = 180 KHz

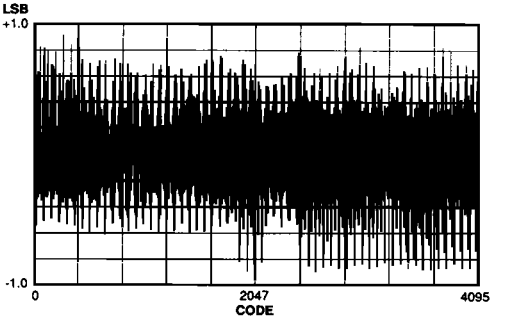


FIN = 949 KHz

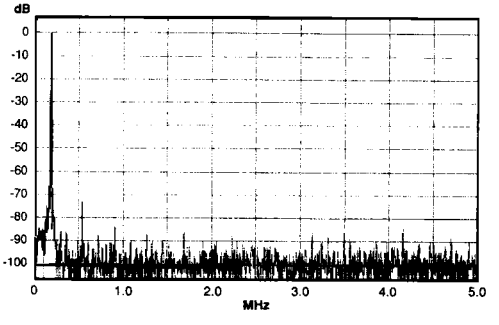


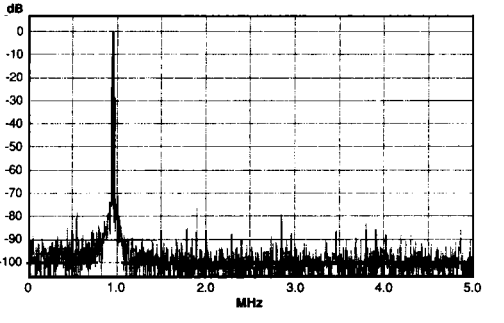
DIFF LINEARITY





FFT TESTS



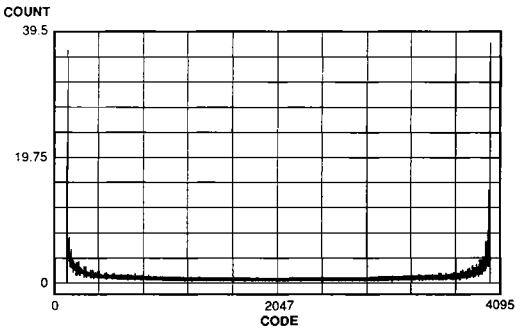


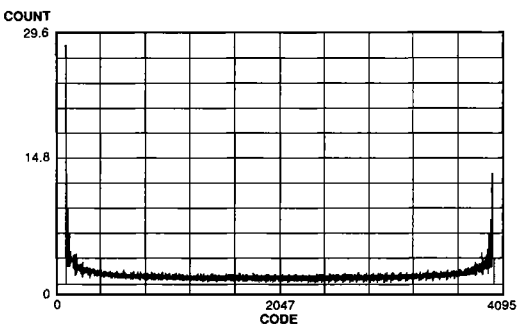
NOTE: FCLOCK = 10 MHz for all presentations

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356

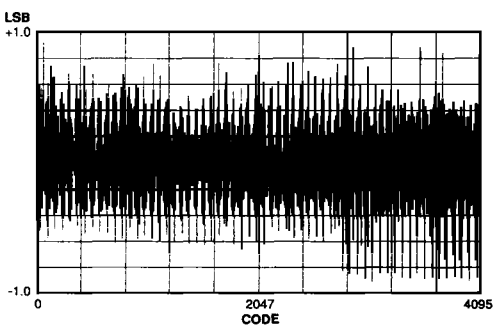
FIN = 1.89 MHz **FIN = 4.85 MHz**

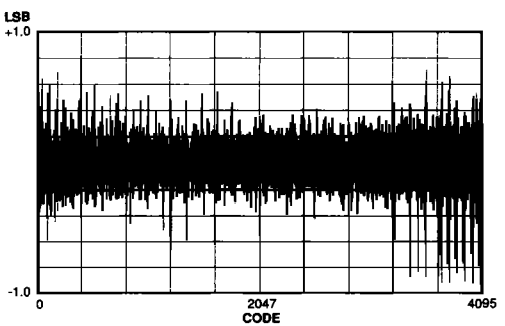
HISTOGRAM TESTS



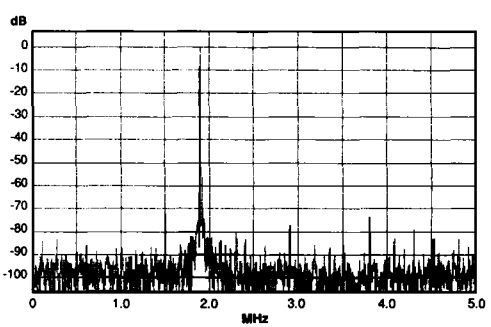


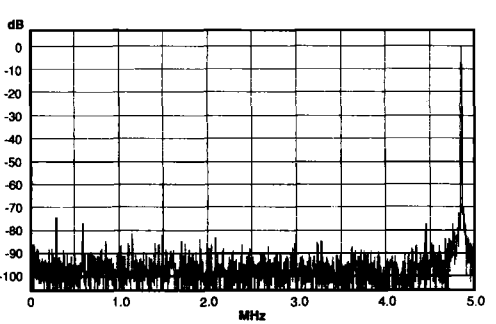
DIFF LINEARITY





FFT TESTS





NOTE: FCLOCK = 10 MHz for all presentations

Table 3. Output Coding for Bipolar Operation

BIPOLAR SCALE	INPUT RANGE (Volts dc) ±1.25V	OUTPUT CODING OFFSET BINARY MSB LSB	COMP OFF. BINARY MSB LSB
+FS -1 LSB	+1.24939V	1111 1111 1111	0000 0000 0000
+3/4 FS	+0.9375V	1110 0000 0000	0001 1111 1111
+1/2 FS	+0.625V	1100 0000 0000	0011 1111 1111
0	0.0000V	1000 0000 0000	0111 1111 1111
-1/2 FS	-0.625V	0100 0000 0000	1011 1111 1111
-3/4 FS	-0.9375V	0010 0000 0000	1101 1111 1111
-FS +1 LSB	-1.24939V	0000 0000 0001	1111 1111 1110
-FS	-1.2500V	0000 0000 0000	1111 1111 1111

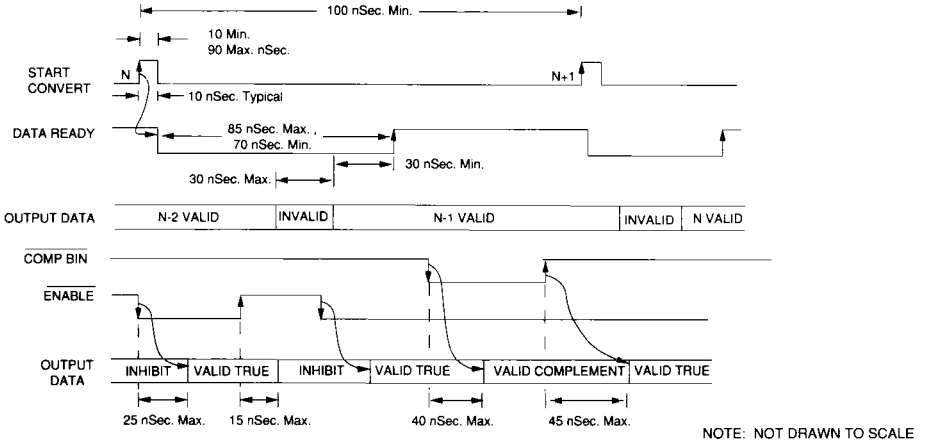
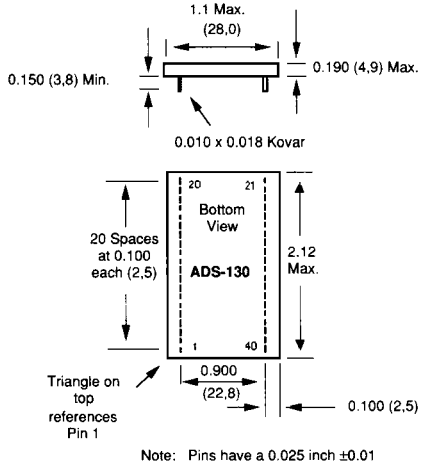


Figure 3. ADS-130 Output Data Timing

MECHANICAL DIMENSIONS INCHES (mm)



Note: Pins have a 0.025 inch ±0.01 standoff from case

ORDERING INFORMATION

MODEL NUMBER	OPERATING TEMP. RANGE	SEAL
ADS-130MC	0 to +70 °C	Hermetic
ADS-130MM	-55 to +125 °C	Hermetic
ADS-B130/131	Evaluation Board (without ADS-130)	

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-883B versions, contact DATEL.

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194/TEL (508) 339-3000/TLX 174388/FAX (508) 339-6356