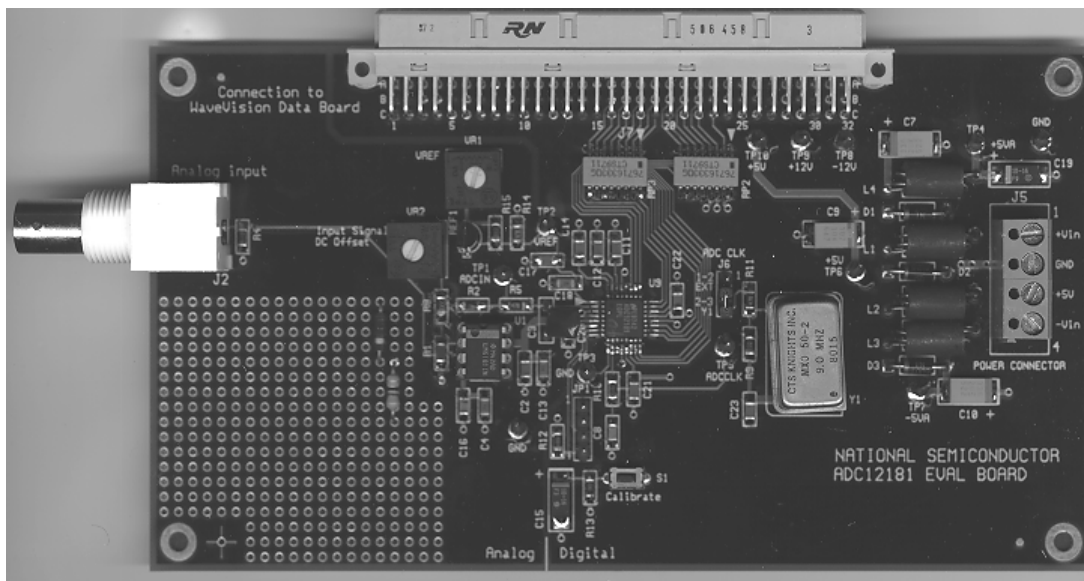


Evaluation Board Instruction Manual

ADC12081, ADC12181 and ADC12281

12-Bit, 5, 10 and 20 MSPS, Self-Calibrating, Pipelined
Analog-to-Digital Converters with Internal Sample & Hold



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Table of Contents

1.0 Introduction	5
2.0 Board Assembly	5
3.0 Quick Start.....	6
4.0 Functional Description	6
4.1 Input (signal conditioning) circuitry	6
4.2 ADC reference circuitry.....	6
4.3 ADC clock circuit.....	6
4.4 ADC control signals	6
4.5 Digital Data Output.....	7
4.6 Power Supply Connections	7
4.7 Power Requirements.....	7
5.0 Installing the ADC12181 Evaluation Board	7
6.0 Evaluation Board Specifications	7
7.0 Hardware Schematic	8
8.0 Evaluation Board Bill of Materials	9
A1.0 Operating in the Computer Mode	10
A2.0 Summary Tables of Test Points and Connectors.....	10

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1.0 Introduction

The ADC12181EVAL Design Kit (consisting of the ADC12181 Evaluation Board, National's WaveVision™ software and this manual) is designed to ease evaluation and design-in of National's ADC12081, ADC12181 and ADC12281 12-bit Analog-to-Digital Converters, which operate at speeds up to 5 MSPS, 10 MSPS and 20 MSPS, respectively. Whenever the ADC12181 is mentioned in this manual, the ADC12081 and the ADC12281 are also included.

The WaveVision™ software can be operated under Microsoft Windows 3.1 or later. The signal at the Analog Input is digitized and can be captured and displayed on the computer monitor as dynamic waveforms. The digitized output is also available at Euro connector J7.

The software can perform an FFT on the captured data upon command. The FFT display also shows dynamic performance in the form of SNR, SINAD, THD and SFDR.

A prototype area is available for building customized input conditioning circuitry.

The evaluation board can be used in either of two modes. The first mode is the Manual or Stand-Alone mode where suitable test equipment can be used with the board to evaluate the ADC12181 performance.

The second mode is the Computer mode. In this mode, evaluation is simplified by connecting the board to the Wavevision™ Digital Interface Board (order number WAVEVISION BRD), which is connected to a personal computer through a serial communication port and running WaveVision™ software, operating under Microsoft Windows 3.1 or later.

The signal at the Analog Input to the board is digitized and is available at pins B16 through B21 and C16 through C21 of J7. Pins A16 through A21 of J7 are ground pins.

Provision is made for adjustment of the Reference Voltage V_{REF} and of the Input Signal DC Offset voltage.

2.0 Board Assembly

The ADC12181 Evaluation Board may come preassembled or as a bare board with a surface mounted ADC12181 that must be assembled. Refer to the Bill of Materials for a description of components, to Figure 1 for major component placement and to Figure 2 for the Evaluation Board schematic.

A breadboard area is provided for building customized circuitry. For best performance, keep circuitry neat and arrange components to provide short, direct connections.

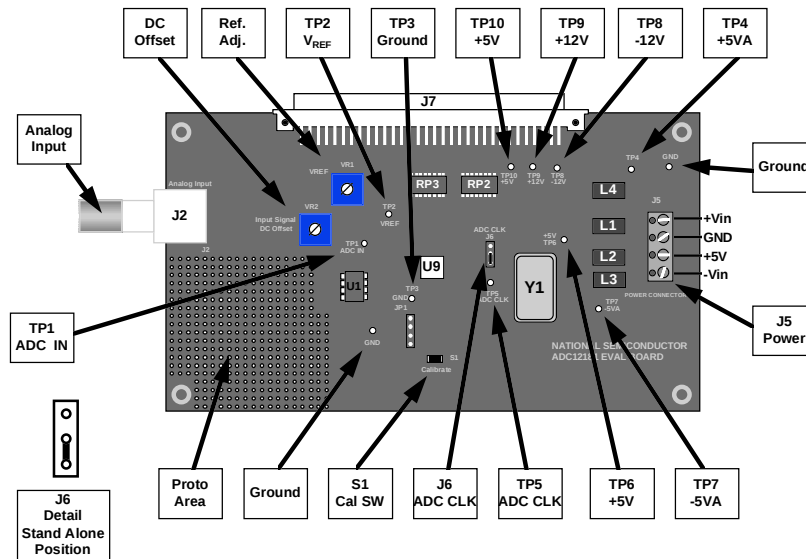


Figure 1. Component and Test Point Locations

3.0 Quick Start

Refer to Figure 1 for locations of test points and major components. For Stand-Alone operation:

1. Install a 5, 10 or 20 MHz crystal into socket Y1, depending upon the particular ADC on the board. While the oscillator may be soldered to the board, using a socket will allow you to easily change clock frequencies.
2. Connect pin C12 of J7 to GND to enable the ADC output buffers.
3. Connect a clean power supply to +Vin, -Vin and GND at connector J5. Adjust power supplies +Vin and -Vin to +5.5V and -5.5V, respectively, before connecting to the board. When power is applied to the board, adjust the power supplies so that +5V appears at either end of L4 and -5V appears at pin 4 of op-amp U1 (LM6181 or CLC409, depending upon the ADC used).
4. Use VR1 to set the reference voltage (V_{REF}) for the ADC to 2.0V. V_{REF} can be measured at TP2.
5. To use the crystal oscillator located at Y1 to clock the ADC, connect the jumper at J6 to pins 2 and 3. The ADC clock signal may be monitored at TP5.
6. Connect a signal of 1Vp-p amplitude from a 50-Ohm source to Analog Input BNC J2. The ADC input signal can be observed at TP1.
7. Adjust the input signal amplitude (at the source or with VR2) and the DC offset using VR2 as needed to ensure that the signal at TP1 remains within the valid signal range of 0V to V_{REF} .
8. Push switch S1 to calibrate the ADC.
9. The digitized signal is available at pin B16 through B21 and C16 through C21 of J7.

For Computer mode operation:

1. Connect the evaluation board to the Digital Interface Board. See the Digital Interface Board Manual for operation of that board.
2. Perform steps 3 through 4 of the Stand-Alone operating quick start, above.
3. Connect the jumper at J6 to pins 1 and 2. The ADC clock signal may be monitored at TP5 after application of power.
4. Perform steps 6 through 8 of the Stand-Alone operating quick start, above.
5. See the Digital Interface Board Manual for instructions for gathering data.

4.0 Functional Description

The ADC12181 Evaluation Board schematic is shown in Figure 2.

4.1 Input (signal conditioning) circuitry

The input signal to be digitized should be applied to BNC connector J2. This 50 Ohm input is intended to accept a low-noise sine wave signal centered at ground with amplitude up to 1V peak-to-peak. To accurately evaluate the ADC12181 dynamic performance, the input test signal will have to be passed through a high-quality bandpass filter with better than 12-bit equivalent noise and distortion characteristics.

The input amplifier, U1 (an LM6181 or a CLC409, depending upon the ADC used), provides a gain of approximately +1.35 for the ADC12081 and the ADC12181 circuits and about +1.95 for the ADC12281 circuit. The output of the amplifier is applied to the ADC and can be monitored at test point TP1. The d.c. level of the amplifier output is controlled by VR2. The analog input signal applied to the ADC should be checked (at TP1) and adjusted to ensure that it remains between GND and the reference voltage applied to the ADC12181.

No scope or other test equipment should be connected to TP1 to TP5 while gathering data or the results could be worse than expected.

4.2 ADC reference circuitry

An adjustable reference circuit based on the LM4041-ADJ is provided. When using the resistor values shown in Fig. 1 the reference circuit will generate a reference voltage in the range of approximately 1.2 to 2.4 volts. The ADC12181 is specified to operate with V_{REF} in the range of 1.8 to 2.2 V, with a nominal value of 2.0V.

The reference voltage for the ADC12181 can be monitored at test point TP2 and is set with VR1.

4.3 ADC clock circuit

The clock signal applied to the ADC is selected with jumper JP6. A standard 5, 10 or 20 MHz crystal oscillator can be installed at Y1 and selected with jumper J6 pins 2-3. To use a different clock source, connect the signal to pin B23 of J7 and select pins 1-2 of jumper J6. The ADC clock signal can be monitored at test point TP5. R10 and C8 are used for high frequency termination of the clock line. In the Computer mode of operation using the Digital Interface Board, JP6 should be set to connect pins 1 and 2 together to use the clock from the Digital Interface Board used.

4.4 ADC control signals

The input and output control signals are at JP1. The status signals Ready and Over-Range are available at pins 1 and 2 respectively. The active high Calibration command is activated by pushing switch S1 and is available at JP1 pin 3. The ADC12181 should be calibrated after power is applied to the board. The active high Power-Down command is

connected to JP1 pin 4. The default level of the Power-down command is LOW, which places the ADC12181 in normal operating mode.

4.5 Digital Data Output.

The digital output data from the ADC12181 is available at the 96-pin Euro connector J7. If the board is used in Stand-Alone mode, J7 pin C12 must be connected to GND in order to enable the ADC output buffer drivers. Series resistors RP2 and RP3 isolate the ADC from the load circuit in order to reduce noise coupling into the ADC.

4.6 Power Supply Connections

Power to this board is supplied through power connector J5. The analog supplies are labeled +5VA and -5VA and can be measured at TP4 (+5VA) and TP7 (-5VA). Because of the series protection diodes, the voltages input at J5 should be slightly higher than 5V in absolute magnitude. The recommended power supply connection procedure is to adjust a low-noise power supply to +5.5V and -5.5V before connecting to J5. Then, with the power supplies turned off, connect the positive supply to J5-1 (+Vin label), connect the common GND to J5-2, connect the negative supply to J5-4 (-Vin label) and a +5V supply to J5-3(+5V label). Turn on the power supplies and adjust the voltages measured at TP4 and TP7 to +5V and -5V, respectively.

When using the ADC12181 Evaluation Board with the Digital Interface Board, the 5V logic power supply for the interface board is passed through the evaluation board. The connection to the 5V logic power source is at J5-3 (+5V label) and the common GND is connected at J5-2. This supply is protected by shunt diode D2 and can be measured at TP6 or TP10. If a circuit on the interface board requires voltages greater than 5V, there are pins on connector J7 reserved for this purpose. These pins can be contacted at TP8 and TP9 on the ADC12181 Evaluation Board and are labeled -12V and +12V, respectively.

4.7 Power Requirements

Voltage and current requirements for the ADC12181 Evaluation Board in Stand-Alone mode are:

- +5.7V at 100 mA
- - 5.7V at 50 mA
- +5.0V at 30mA (1A when connected to the Digital Interface Board).

5.0 Installing the ADC12181 Evaluation Board

The evaluation board requires power supplies as described in Section 4.7. An appropriate signal generator (such as the HP3325B, HP4662A or the Tektronix TSG130A) with 50 Ohm source impedance should be connected to the Analog Input BNC, J2.

If this board is used in conjunction with the Digital Interface Board and WaveVision™ software, a cable with a DB-9 connector must be connected between the Digital Interface Board and the host computer. See the Digital Interface Board manual for details.

6.0 Evaluation Board Specifications

Board Size:	6.5" x 3.5" (16.5cm x 8.9 cm)
Power Requirements:	+5.7V @ 100 mA - 5.7V @ 50 mA + 5.0V @ 30 mA / 1A (see section 4.7)
Clock Frequency Range:	1 MHz to 20 MHz
Analog Input	
Nominal Voltage:	1V _{P-P}
Impedance:	50 Ohms

7.0 Hardware Schematic

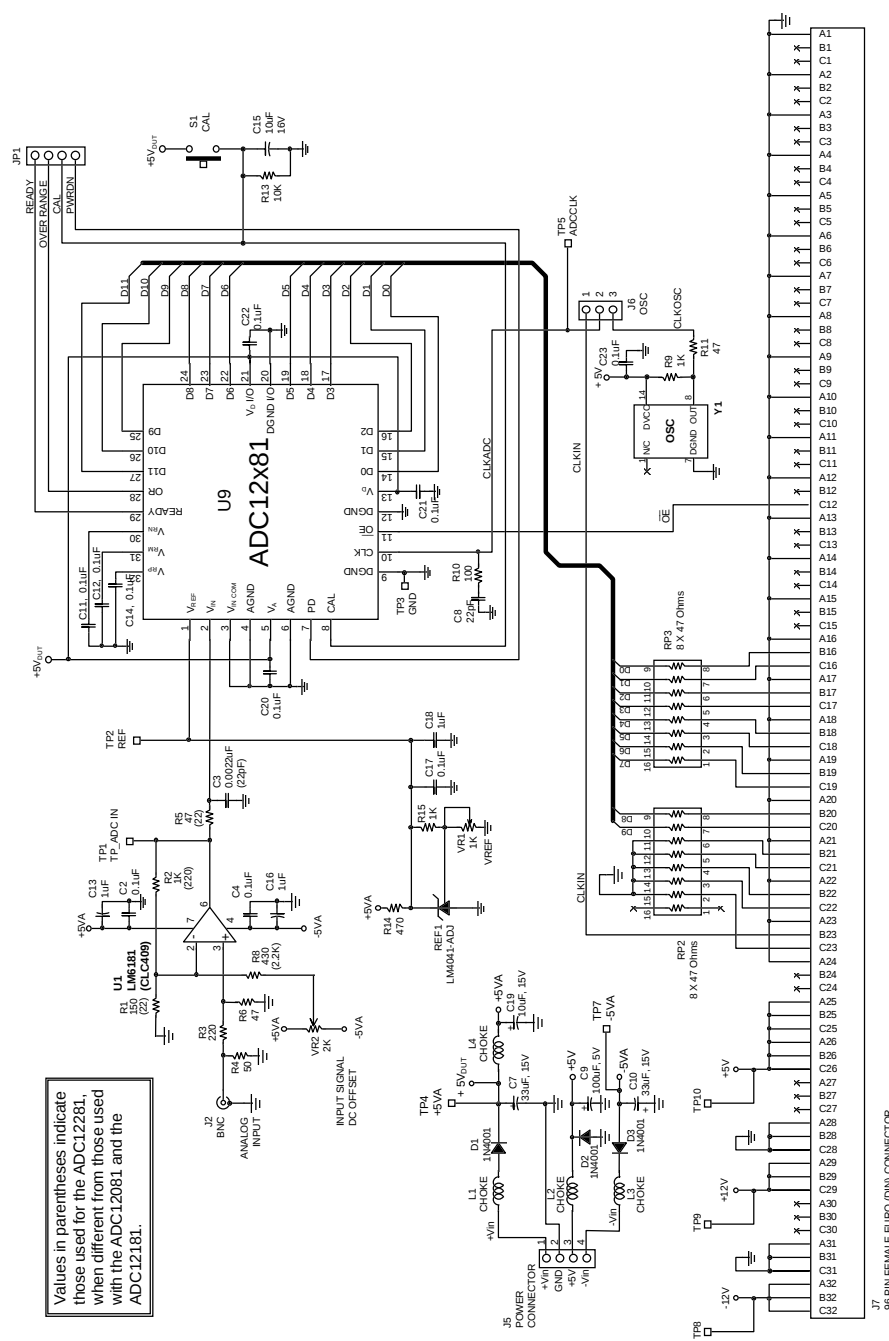


Figure 2. ADC12081 / ACD12181 / ADC12281 Evaluation Board Hardware Schematic

8.0 Evaluation Board Bill of Materials

(ADC12281 board components in parentheses, where different)

C1, C5, C6	- not used -	--
C3	0.0022uF (22pF)	DigiKey # P4574ND (TBD)
C8	22pF	SMT type 1206
C2, C4, C11, C12, C14, C17, C20, C21, C22, C23	0.1uF	SMT type 0805
C13, C16, C18	1uF	SMT type 1206
C15, C19	10uF, 16V	SMT type 7343
C7, C10	33uF, 16V	SMT type 7343
C9	100uF, 5V	SMT type 7343
D1, D2, D3	1N400x	Axial lead
J1, J3, J4	(not used)	--
J2	BNC, right angle	DigiKey # ARF1178-ND
J5	4-pin Terminal Block	DigiKey # ED1609-ND
J6	3-pin Header, 0.1"	(same as TP)
--	Shorting Jumper (one needed)	DigiKey # S9001-ND
J7	96 Pin Female DIN Connector	DigiKey # H7096-ND
JP1	4-pin Header, 0.1"	(same as TP)
L1, L2, L3, L4	Choke	DigiKey # M2204-ND
R7, R12	- not used -	--
R1	150 Ω (22 Ω)	SMT type 1206
R5	47 Ω (22 Ω)	SMT type 1206
R4	50 Ω	SMT type 1206
R6, R11	47 Ω	SMT type 1206
R10	100 Ω	SMT type 1206
R2	1k Ω (220 Ω)	SMT type 1206
R3	220 Ω	SMT type 1206
R9, R15	1 k Ω	SMT type 1206
R13	10 k Ω	SMT type 1206
R8	430 Ω (2.2 k Ω)	SMT type 1206
R14	470 Ω	SMT type 1206
RP1	- not used -	--
RP2, RP3	8 X 47 Ω (33 Ω is O.K.)	SMT dual-in-line
REF1	Voltage Reference	National LM4041CIZ-ADJ
S1	Push-button switch, SPST- NO	DigiKey # P8026S-ND
Socket	for U1	DIP 8 socket
TP1 - 5, 7 - 10, GND (2)	Breakable Header, single row	DigiKey # S1012-36-ND
TP6	- not used -	--
--	2 additional TP's used for GND(same as TP)	
U2 - 8	(not used)	--
U1	Op-Amp	National LM6181AIN (CLC409AJP)
U9	DUT	National ADC12x81CIVT
VR1	1 k Ω	DigiKey # 3386F-102-ND
VR2	2 k Ω	DigiKey # 3386F-202-ND
Y1	10 MHz Full-size XTAL Oscillator	DigiKey # CTX-114-ND
Socket	4-pin full-size XTAL osc. socket for Y1	DigiKey # A462-ND
Standoffs or rubber feet	1 @ each corner of board	--

APPENDIX

A1.0 Operating in the Computer Mode

The ADC12181 Evaluation Board is compatible with the WaveVision™ Digital Interface Board and WaveVision™ software. When connected to the Digital Interface Board data capture is easily controlled from a personal computer operating in the Windows™ environment. The data samples captured can be observed on the video monitor in the time and frequency domains. An FFT plot of the data sample can be immediately calculated and displayed. The FFT analysis of the captured data yields insight into system noise and distortion sources and estimates of ADC dynamic performance such as SINAD, SNR and THD.

See the Digital Interface Board manual for more information.

A2.0 Summary Tables of Test Points and Connectors

Test Points on the ADC12181 Evaluation Board

TP 1	Analog input to the ADC, measured at output pin of op-amp U1
TP 2	ADC reference voltage
TP 3	Ground
TP 4	+5V power supply for ADC12181 Eval Board
TP 5	ADC clock
TP 6	Not used
TP 7	-5V power supply for ADC12181 Eval Board
TP 8	Optional -12V power supply for Digital Interface Board
TP 9	Optional +12V power supply for Digital Interface Board
TP 10	+5V power supply for Digital Interface Board
JP1-1	ADC Ready output (High indicates valid data output on D0...D11)
JP1-2	ADC Out of Range output (High indicates ADC analog input is Out of Range)
JP1-3	ADC Calibrate command (Active High, connected to switch S1)
JP1-4	ADC Power Down command (Active High, connected to GND through R12)

J5 Connector - Power Supply Connections

J5-1	+V _{IN}	+5.5V Power Supply for ADC12181 Eval Board
J5-2	GND	Power Supply Ground
J5-3	+5V	+5.0V Logic Power Supply for Digital Interface Board
J5-4	-V _{IN}	-5.5V Power Supply for ADC12181 Eval Board

J6 Connector - ADC Clock selection jumper settings

Connect 1-2	Use external clock signal from J7 pin B23
Connect 2-3	Use crystal oscillator Y1

J7 Connector - ADC Data Outputs - Connection to WaveVision™ Digital Interface Board

Signal	J7 pin number
ADC output D0	B16
ADC output D1	C16
ADC output D2	B17
ADC output D3	C17
ADC output D4	B18
ADC output D5	C18
ADC output D6	B19
ADC output D7	C19
ADC output D8	B20
ADC output D9	C20
ADC output D10	B21
ADC output D11	C21
GND	A1 thru A24, A28, B28, C28, A31, B31, C31
ADC Output Enable	C12
External clock input	B23
Reserved, signal	B22, C22, C23
Reserved, power	A25, A26, B25, B26, C25, C26 (+5V Logic Power Supply to Digital Interface Board)
Reserved, power	A29, B29, C29
Reserved, power	A32, B32, C32

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