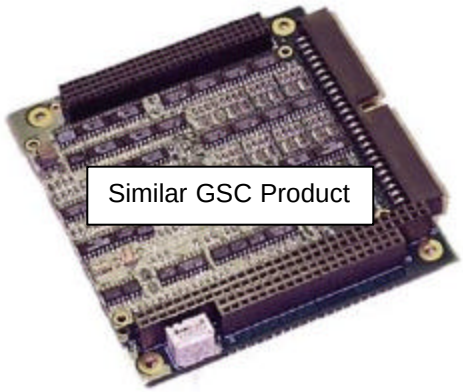
General Standards Corporation

High Performance Bus Interface Solutions

PC104P-ADADIO

12-Channel 16-Bit Analog I/O PMC Card With 8 Simultaneous Input Channels at 200K Samples per Second per Channel, 4 Output Channels, and Byte-Wide Digital I/O Port



Features Include:

- 8 Analog Input Channels, 4 Analog Output Channels
- 16-Bit Resolution; Analog Inputs and Outputs
- 8-Bit Bi-directional Digital Port with Two Control Lines
- Auto calibration of all Analog Channels; Internally Controlled
- Simultaneous Analog Input Sampling; 16-Bit A/D Converter per Channel
- Analog Input Sample Rates adjustable up to 200,000 Samples per Second per Channel
- 32K-Sample Analog Input FIFO Buffer
- Continuous and Triggered-Burst Input Modes. Supports Multiboard Synchronization.
- 16-Bit D/A Converter per Analog Output Channel
- Analog Outputs Disconnect from System Under Software Control
- Simultaneous Updating of Outputs with Hardware or Software Strobe
- Analog Output Aggregate Data Rates to 250K Samples per Second, host dependent
- Loopback Feature for Built-in-Test Support and Auto calibration
- Single-width PMC Form Factor
- VxWorks™ Driver available

Applications:

- ✓ Acoustics Analysis
- ✓ Analog Inputs
- ✓ Data Acquisition Systems
- ✓ Voltage Measurement
- ✓ Process Monitoring
- ✓ Industrial Robotics
- ✓ Automatic Test Equipment
- ✓ Audio Waveform Analysis
- ✓ Environmental Test Systems

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8302A Whitesburg Drive · Huntsville, AL 35802
Phone: (256) 880-8787 or (800) 653-9970
FAX: (256) 880-8788

Overview:

The 12-channel PMC-ADADIO analog I/O board provides high resolution 16-bit analog input and output resources in a high-density single-width PMC module. Eight analog input channels are sampled simultaneously (up to 200 KHz each channel), and are software-configurable as either differential or single-ended inputs. The inputs can be sampled continuously or can be burst-sampled, and are supported by a FIFO buffer. The four analog output channels are accessed through independent registers, and can be updated either synchronously or asynchronously. Inputs and outputs have a factory-configured range of ±10V, ±5V or ±2.5V. A digital port provides eight bi-directional data lines and two control lines.

Internal Autocalibration networks permit periodic calibration to be performed without removing the board or host from the system. All input and output channels are calibrated with a single internal voltage reference. This feature produces the optimum calibration situation, in which the board is calibrated in its actual operating environment. Software-controlled test configurations include a loopback mode for monitoring all analog output channels.

Functional Description:

The PMC-ADADIO board is a single-width PMC module which contains eight 16-Bit A/D converters, four 16-bit D/A converters, and all supporting functions necessary for adding flexible analog I/O capability to a PMC host. The board is designed for minimum off-line maintenance, and includes internal monitoring and loopback features that eliminate the need for disconnecting or removing the module from the system for calibration. All analog input and output system connections are made through a single 68-pin subminiature-D front-access I/O connector. The analog outputs can be internally disconnected from the system I/O connector under software control.

Offset and gain trimming of the 16-bit ADC and output DAC's is performed by 24 12-bit DAC's (Figure 1). System analog inputs pass through a selftest network which can replace the system signals either with a precision voltage standard or with the four analog output channels, under software control. This arrangement is used during autocalibration to determine the offset and gain correction parameters for the ADC, and for each of the output D/A converters. The correction parameters are stored in a calibration EEPROM for subsequent transfer to the calibration DAC's during board initialization. Autocalibration can be invoked at any time from the PCI bus.

Each analog output channel is accessed through an independent 16-bit data register in PCI memory space. ADC conversion data are read by the bus through an analog input FIFO buffer. An auxiliary digital port contains eight bits of bidirectional data and two control lines, and is controlled through a single register.

Communication with the host PCI bus is provided by a PCI Interface Adapter which furnishes a 32-bit local bus for exchanging information between the FIFO buffers, the adapter, and the Local Controller. All internal operations are managed by the Local Controller.

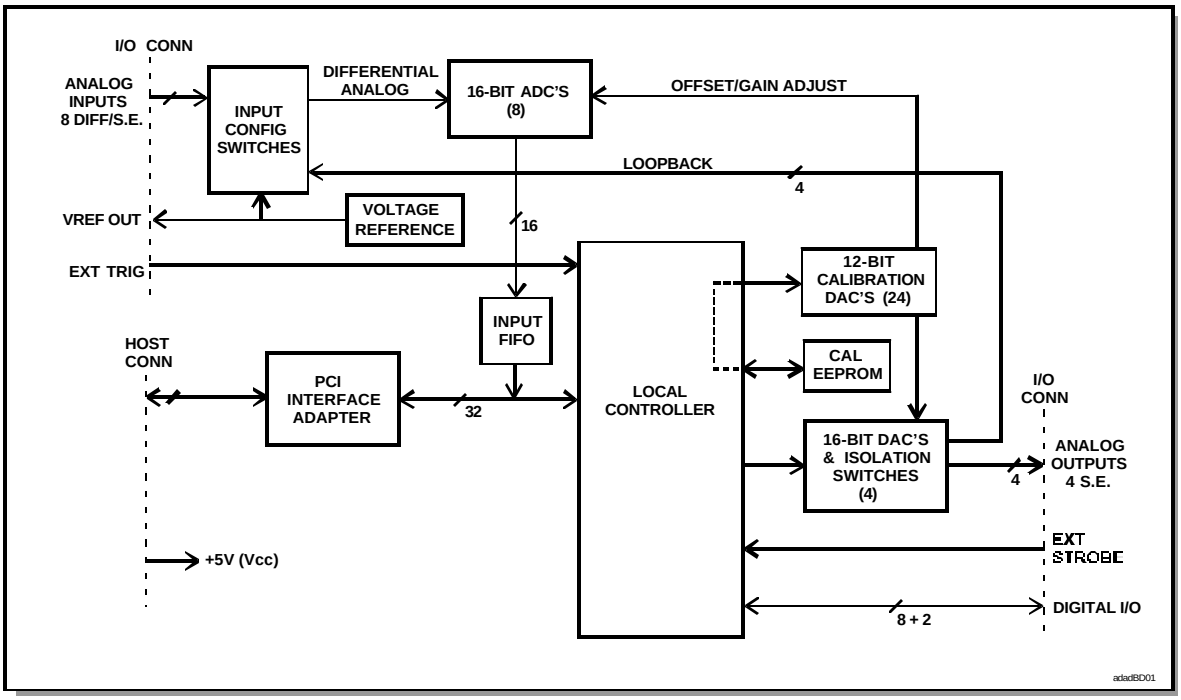

Figure 1. PMC-ADADIO Analog I/O Board, Simplified Functional Diagram

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ELECTRICAL SPECIFICATIONS

At +25 ^{O}C, with specified operating voltages

ANALOG INPUT CHANNELS

Input Characteristics:

Configuration:	8 differential or single-ended input channels; software selected
Voltage Ranges:	Factory configured as ±10 Volts, ±5 Volts or ±2.5 Volts
Input Impedance:	1.0 Megohms in parallel with 20 pF; 2.0 Megohms line-to-line
Common Mode Rejection:	75 dB minimum, DC-60 Hz (Differential mode)
Common Mode Range:	±11.0 Volts; with zero input signal level
Offset Voltage:	±1.0 millivolts, maximum
Noise:	1.5 mVrms, 10Hz-10KHz; Differential Mode, inputs shorted
Remote Ground Sensing:	All single-ended inputs are measured relative to the external return, which is isolated from the internal analog return by approximately 200 Ohms.
Overvoltage Protection:	±30 Volts with power applied; ±15 Volts with power removed
External Trigger Input:	TTL level, active LOW

Transfer Characteristics:

Resolution:	16 Bits (0.0015 percent of FSR)
Conversion Rate	305 Hz to 200 kHz (Optional 100 kHz) per channel, controlled with 16-bit integer. (170-200KSPS in burst and multiboard sync modes). At very low rates (below 150SPS) the conversion cycle time is 9 us.
Accuracy:	±0.007 percent of reading, ±0.006 percent of Full-Scale-Range, ±1.0 mV. e.g.: ± 2.8 mV, while reading +8 Volts on the ±10V range (20V FSR).
Crosstalk Rejection:	80dB minimum; DC-1000Hz
Integral Nonlinearity:	±0.006 percent of FSR, maximum
Differential Nonlinearity:	±0.003 percent of FSR, maximum
External Trigger Latency:	Single card: 0.25µs maximum; Multiboard synchronization: 0.35µs

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❑ Analog Input Operating Modes and Controls

Input Sampling Mode:

Continuous Conversion Mode (Default): Analog inputs are converted continuously at the selected conversion rate. Inputs are software selected as differential or single-ended.

Burst Scan Mode: A single conversion of selected channels is initiated by a external hardware trigger or by a software trigger. Applies in both differential or single-ended modes.

Loopback Mode: Connects a selected analog output channel to all input channels.

Reference Modes: Used during calibration verification. Replace system inputs with an internal reference voltage or with signal return

Active Channels:	Software selected as from 1 to 8 channels. Conversion data from active channels appear in the analog input buffer. Active channels are contiguous, beginning with Channel-0 and proceeding upward to the highest active channel number.
Data Buffer:	FIFO buffer with a capacity of 1 to 32,768 samples. Buffer size is software selected in 2:1 ratios with a 4-bit register field.
Buffer Flags:	Buffer empty, buffer half full and buffer full. Corresponding interrupts supported.
Data Format:	Software selected as offset binary or two's complement format
Multiboard Synchronization:	One card can be used to trigger synchronized conversions in up to three other cards.

ANALOG OUTPUT CHANNELS

❑ Output Characteristics:

Configuration:	Four single-ended output channels
Voltage Ranges:	Factory configured as ±10 Volts, ±5 Volts or ±2.5 Volts
Output Resistance:	1.0 Ohm, maximum if outputs are enabled; 22 kohms to ground if outputs are disabled
Output protection:	Withstands sustained short-circuiting to ground. Also withstands overvoltage transients to ±40 Volts through 80 Ohms for 10 milliseconds.
Load Current:	±5 mA maximum; ±2 mA recommended for minimum crosstalk and line loss
Load Capacitance:	Stable with zero to 2000 pF shunt capacitance
Noise:	1.2 kHz Filter: 2 mVrms, 10Hz-10KHz 4 kHz Filter: 4 mVrms, 10Hz-10KHz No Filter (75 kHz): 10 mVrms, 10Hz-10KHz

Transfer Characteristics:

Resolution:	16 Bits (0.0015 percent of FSR)
Maximum Sample Rate:	250K channels per second, typical aggregate rate. Useable rate is host-dependent.
Accuracy (No load):	±0.007 percent of reading, ±0.005 percent of Full-Scale-Range, ±1.0 mV. e.g.: ±2.3mV, while generating +4 Volts on the ±5V range (10V FSR). Add ±1.0 mV per milliamp of loading.
Settling Time (0.01%):	No output filter: 25 us 4 kHz Filter: 0.40 ms 1.2 kHz Filter: 1.50 ms
Crosstalk Rejection:	75 dB minimum, DC-1000Hz
Integral Nonlinearity:	±0.007 percent of FSR, maximum
Differential Nonlinearity:	±0.003 percent of FSR, maximum
External Strobe Input:	TTL level, active LOW

Analog Output Operating Modes and Controls

Output Strobing:	When software configured for output strobing, all outputs are updated simultaneously in response to a software strobe or to an external hardware strobe.
Output Enabling:	Analog outputs are connected to the system I/O connector if analog outputs are enabled, or are disconnected if analog outputs are disabled.
Data Registers:	16-bit data register per output channel
Data Format:	Software selected as offset binary or two's complement format

DIGITAL I/O PORT

Configuration:	8 bidirectional data lines and two control lines. One control line is a dedicated output, the other control line is a dedicated input. All lines use standard TTL logic levels.
Data and Control Register:	Single 16-bit register
Transfer Rate:	Typically 10^6 transfers per second, host-dependent

CALIBRATION

During autocalibration, all analog channels are calibrated against a single precision internal voltage reference. The reference is adjustable with a single internal trimmer, or by an external remote trimmer. Analog outputs are disabled during autocalibration, which has a typical duration of four seconds.

PCI INTERFACE

- **Compatibility:** Conforms to PMC Specification 2.1.
  Supports "plug-n-play" initialization.
  Provides one multifunction interrupt.
  Supports DMA transfers as bus master.

- **Board Control and Data Registers**

Board Control Register:	32-bit register. Determines the operating mode of the board
Analog Input Buffer:	32-bit register. Data path to 32K-sample buffer for analog input data
Analog Output Registers:	Four 32-bit registers; 16 active bits
Digital I/O Register:	Single 32-bit register, 11 active bits.

- **Analog Input FIFO Buffer**

  Analog input data is read from the PMC-ADADIO card by the host PCI bus through a single 32-bit register which serves as a FIFO buffer port. The buffer is 16 bits wide, has a capacity of 32K input samples, and is justified to the LSB in the D32 data register. Analog input data is software-configurable in either Two's complement or offset binary format. The Two's complement sign bit is extended to the MSB.

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MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

❑ Power Requirements

+5VDC ±0.2 VDC at 1.0 Amps, maximum, 1.1 Amps typical
Power Dissipation: 7.0 Watts maximum; 5.5 Watts typical

❑ Physical Characteristics (Overall, excluding spacers):

Height: 23.3 mm (0.92 in)
Width: 94.0 mm (3.78 in)
Depth: 95.9 mm (3.70 in)

❑ Environmental Specifications

Ambient Temperature Range:	Operating: 0 to +70 degrees Celsius * Storage: -40 to +85 degrees Celsius
	*Temperature of inlet cooling air.
Relative Humidity:	Operating: 0 to 80%, non-condensing Storage: 0 to 95%, non-condensing
Altitude:	Operation to 10,000 ft.
Cooling:	Conventional convection cooling

❑ Cooling Requirements

Conventional air cooling; 200 LPFM (typical mezzanine environment).

ORDERING INFORMATION

Specify the basic product model number followed by an option suffix "-ABC", as indicated below. For example, model number PMC-ADADIO-321 describes a card with ±10 Volt input/output ranges, 1.2 kHz output filters, and a 100 kHz sample rate per channel.

Optional Parameter	Value	Specify Option As:
Input/output Range	±2.5 Volts	A = 1
	±5 Volts	A = 2
	±10 Volts	A = 3
Output Lowpass Filter	No output Filter *	B = 1
	1.2 kHz Output Filter	B = 2
	4 kHz Output Filter	B = 3
Max Sample Rate	100 kHz per Channel	C = 1
	200 kHz per Channel	C = 2

* Output frequency response with no output filter is approximately 75 kHz.

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