PMC-16AIO
16-Bit Analog Input/Output PMC Board
With 32 Input Channels, 4 Output Channels and 16-Bit Digital I/O Port

Features Include:

- 32 Single-Ended or 16 Differential 16-Bit Scanned Analog Input Channels
- 4 Analog Output Channels, 16-Bit D/A Converter per Channel
- 16-Bit Bi-directional Digital Port with Two Auxiliary I/O Lines
- Software-Selectable Analog Input/Output Ranges of ±10V, ±5V or ±2.5V
- Independent 32K-Sample Analog Input and Output FIFO Buffers
- 300K Samples per Second Aggregate Analog Input Sample Rate
- Multiple-Channel and Single-Channel Input Scanning Modes
- Low Crosstalk, Noise and Input Bias Current; Buffer Amplifiers on all Analog Input Lines
- 300K Samples per Second per Channel Analog Output Clocking Rate (1200 KSPS Aggregate Rate)
- Supports Waveform and Arbitrary Function Generation; Continuous and One-shot Modes
- Internal Rate Generator Controls Input Sampling, Output Sampling, or Both Simultaneously
- Supports Multiboard Synchronization of Analog Inputs and Outputs
- Internal Auto calibration of Analog Input and Output Channels
- Continuous and Burst (One-Shot) Input and Output Modes
- DMA Engine Minimizes Host I/O Overhead

Applications:
- Data Acquisition Systems
- Industrial Robotics
- Precision Voltage Sourcing and Measurement
- Automatic Test Equipment
- Function and Waveform Generation
- Research Instrumentation
**Functional Description:**

The PMC-16AIO board provides cost effective high-speed 16-bit analog input/output resources on a standard single-width PMC module. Four analog output channels can be updated either synchronously or asynchronously, and support waveform generation. Internal autocalibration networks permit calibration to be performed without removing the board from the system. Software-controlled test configurations include a loopback mode for monitoring all analog output channels. Gain and offset correction of the analog input and output channels is performed by calibration DAC's that are loaded with channel correction values during autocalibration. A digital I/O port provides 16 bidirectional data lines and two auxiliary I/O lines.

The analog inputs are software-configurable either as 32 single-ended channels or as 16 differential signal pairs. Buffer amplifiers on all input lines eliminate multiplexer input switching noise, and minimize crosstalk and input bias currents. Analog input data accumulates in a 32K-sample buffer until retrieved by the PCI bus. Each of the four analog output channels contains a dedicated 16-bit D/A converter and an output range control network. The board receives analog output data from the PCI bus through a 32K-sample FIFO buffer.

![Functional Organization](image)

Figure 1. PMC-16AIO; Functional Organization

The board is functionally compatible with the IEEE PCI local bus specification Revision 2.2, and supports the "plug-n-play" initialization concept. System input/output connections are made at the panel bracket through a high-density 68-pin connector. Power requirements consist of +5 VDC, in compliance with the PCI specification, and operation over the specified temperature range is achieved with conventional convection cooling.
ELECTRICAL SPECIFICATIONS

At +25 °C, with specified operating voltages

ANALOG INPUT CHANNELS

- **Input Characteristics:**
  - Configuration: 32 input lines, configurable as 32 single-ended or 16 differential channels
  - Voltage Ranges: Software configurable as ±10, ±5 or ±2.5 Volts
  - Input Impedance: 1.0 Megohms line-to-ground, 2.0 Megohms line-to-line, in parallel with 100Pfd. Independent of scan rate.
  - Bias Current: 80 nanoamps maximum
  - Signal to Noise (SNR): 80 dB typical
  - Common Mode Rejection: 60 dB typical, DC-60 Hz, differential input mode
  - Common Mode Range: ±10 Volts; differential input configuration
  - Overvoltage Protection: Standard: ±30 Volts with power applied; ±15 Volts with power removed

- **Transfer Characteristics:**
  - Resolution: 16 Bits; 0.0015 percent of FSR
  - Maximum Conversion Rate: 300K conversions per second, minimum
  - Channels per scan: 2, 4, 8, 16, or 32 Channels per scan (32 channels available only in single-ended mode)
  - Maximum Scan Rate: 75K scans per second in multiple-channel mode. 150 KSPS in 2-Channel mode. 300KSPS in single-channel mode. Scan rate equals the conversion rate divided by the number of channels per scan.
  - Minimum Scan Rate: 400 scans per second, using a single internal rate generator; 0.007SPS using both generators. Zero, using a software sync flag or an externally supplied sync input.
  - DC Accuracy: (Maximum composite error, referred to inputs) ±10V ±3.2mV ±4.2mV ±5V ±2.3mV ±2.8mV ±2.5V ±1.6mV ±2.0mV
  - Crosstalk Rejection: 85dB, DC-10kHz
  - Integral Nonlinearity: ±0.003 percent of FSR, maximum
  - Differential Nonlinearity: ±0.0015 percent of FSR, maximum

- **Analog Input Operating Modes and Controls**
  - Analog Input Modes: Single Scan: A software or hardware sync initiates a single scan of all active channels at the maximum conversion rate. As many as three target boards can be synchronized to a single initiator board.
Continuous Scan: Inputs are scanned continuously at the selected scan rate.
Selftest: Reference and loopback tests; autocalibration
Multiple-Channel: 4, 8, 16 or 32 channels per scan
Single-Channel: Any single channel can be selected for digitizing at the maximum conversion rate.
Two-Channel: 2-Channel scan size.
Input Data Buffer: 32K-sample FIFO with 0000h-7FFEh adjustable threshold flag; DMA is supported

ANALOG OUTPUT CHANNELS

- **Output Characteristics:**
  - Configuration: Four single-ended output channels. (Ordering option)
  - Voltage Ranges: Same as selected for analog inputs; ±10, ±5 or ±2.5 Volts
  - Output Resistance: 1.0 Ohm, maximum
  - Output protection: Withstands sustained short-circuiting to ground
  - Load Current: Zero to ±3ma per individual channel
  - Load Capacitance: Stable with zero to 2000 pF shunt capacitance
  - Noise: 2.0mV-RMS, 10Hz-100KHz typical
  - Glitch Impulse: 5 nV-Sec typical, ±2.5V range

- **Transfer Characteristics:**
  - Resolution: 16 Bits (0.0015 percent of FSR)
  - Output Sample Rate: Software adjustable from 400SPS to 300KSPS per channel; 0.006SPS to 300KSPS using both internal rate generators. DC to 300KSPS with hardware or software sync.
  - DC Accuracy: (Maximum composite error, no-load)
    - ±10V: ±2.7mV, ±3.0mV
    - ±5V: ±1.9mV, ±2.2mV
    - ±2.5V: ±1.3mV, ±1.7mV
  - Settling Time: 8us to 1LSB, typical with 50-percent fullscale step
  - Crosstalk Rejection: 85 dB minimum, DC-1000Hz
  - Integral Nonlinearity: ±0.004 percent of FSR, maximum
  - Differential Nonlinearity: ±0.0015 percent of FSR, maximum

- **Analog Output Operating Modes and Controls**
  - Clocking Modes: Simultaneous Continuous Mode: Channel values in a designated channel group are stored in an intermediate buffer, and then are transferred to the output DAC’s when an output clock occurs. The clock can be generated either by the internal rate generator, by a software flag, or by an external hardware trigger. As many as three target boards can be clock-synchronized to a single initiator board.
    Simultaneous Burst Mode: A single function (i.e.: burst) is initiated by a software or hardware sync. During a burst, channel values in a designated channel group are...
stored in a transfer buffer, and then are transferred to the output DAC's each time a clock pulse is generated by the internal rate generator. The burst terminates when a Burst End flag is encountered.

Channel-Sequential Modes: Same as simultaneous modes, except each value in the data buffer is written immediately to the associated output DAC. The group-end flag is ignored in this mode.

Channel Assignment: A 2-bit field in the output buffer assigns the associated data field to a specific output channel.
Group End: A single bit in the output buffer indicates the last value in a channel group.
Burst End: A single bit in the output buffer indicates the last value in an output burst sequence.
Output Data Buffer: 32K-sample FIFO with 0000h-7FFEh adjustable threshold flag; DMA is supported.

RATE GENERATORS

Analog outputs and inputs can be clocked from either of two independent rate generators, or both inputs and outputs can be synchronized to a single generator. Each rate generator uses a 16-bit adjustable frequency divider, and the two generators can be operated in series to provide very low clocking rates.

DIGITAL I/O PORT

The digital I/O port consists of 16 bidirectional data lines, one auxiliary input line and one auxiliary output line. An interrupt request can be generated in response to the auxiliary input. The data lines are organized as two data bytes, each of which can be configured independently as either an input or output byte. Standard TTL logic levels apply, with 20 ma source/sink capability per output line.

PCI INTERFACE

- **Compatibility:** Conforms to PCI Specification 2.2, with D32 read/write transactions.
  - Supports "plug-n-play" initialization.
  - Provides one multifunction interrupt.
  - Supports DMA transfers as bus master.

MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

- **Power Requirements**
  - +5VDC ±0.2 VDC at 1.5 Amps, maximum
  - Maximum Power Dissipation: 6.5 Watts, Side 1; 1.0 Watt, Side 2

- **Physical Characteristics**
  - Height: 13.5 mm (0.53 in)
  - Depth: 149.0 mm (5.87 in)
  - Width: 74.0 mm (2.91 in)
  - Shield: Optional EMI shield available for Side 1.

- **Environmental Specifications**
  - Ambient Temperature Range:
    - Operating: 0 to +55 degrees Celsius
    - Storage: -40 to +85 degrees Celsius
  - Relative Humidity:
    - Operating: 0 to 80%, non-condensing
    - Storage: 0 to 95%, non-condensing
Altitude: Operation to 10,000 ft.
Cooling: Conventional convection cooling

ORDERING INFORMATION

Specify the basic product model number followed by an option suffix "-AB", as indicated below. For example, model number PMC-16AIO-41 describes a board with 4 output channels, and with a bezel and EMI shield installed.

<table>
<thead>
<tr>
<th>Optional Parameter</th>
<th>Value</th>
<th>Specify Option As:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Analog Outputs</td>
<td>No Output Channels</td>
<td>A = 0</td>
</tr>
<tr>
<td></td>
<td>4 Output Channels</td>
<td>A = 4</td>
</tr>
<tr>
<td>EMI Shield (Recommended in high-noise environments)</td>
<td>No bezel or shield</td>
<td>B = 0</td>
</tr>
<tr>
<td></td>
<td>Bezel &amp; shield installed</td>
<td>B = 1</td>
</tr>
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SYSTEM I/O CONNECTIONS

Table 1. System Connector Pin Functions

<table>
<thead>
<tr>
<th>PIN</th>
<th>SIGNAL</th>
<th>PIN</th>
<th>SIGNAL</th>
</tr>
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<tbody>
<tr>
<td>34</td>
<td>ANA INP00 HI</td>
<td>34</td>
<td>ANA OUT00</td>
</tr>
<tr>
<td>33</td>
<td>ANA INP00 LO *</td>
<td>33</td>
<td>OUTPUT RTN</td>
</tr>
<tr>
<td>32</td>
<td>ANA INP02 HI</td>
<td>32</td>
<td>ANA OUT01</td>
</tr>
<tr>
<td>31</td>
<td>ANA INP02 LO</td>
<td>31</td>
<td>OUTPUT RTN</td>
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<tr>
<td>30</td>
<td>ANA INP04 HI</td>
<td>30</td>
<td>ANA OUT02</td>
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<td>ANA INP04 LO</td>
<td>29</td>
<td>OUTPUT RTN</td>
</tr>
<tr>
<td>28</td>
<td>ANA INP06 HI</td>
<td>28</td>
<td>ANA OUT03</td>
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<td>27</td>
<td>ANA INP06 LO</td>
<td>27</td>
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<tr>
<td>26</td>
<td>ANA INP08 HI</td>
<td>26</td>
<td>VTEST</td>
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<td>25</td>
<td>ANA INP08 LO</td>
<td>25</td>
<td>VTEST RTN</td>
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<td>24</td>
<td>ANA INP10 HI</td>
<td>24</td>
<td>DIGITAL RTN</td>
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<tr>
<td>23</td>
<td>ANA INP10 LO</td>
<td>23</td>
<td>AUX DIGITAL IN</td>
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<td>22</td>
<td>ANA INP12 HI</td>
<td>22</td>
<td>AUX DIGITAL OUT</td>
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<td>DIG IO 06</td>
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<td>ANA INP14 HI</td>
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<td>ANA INP14 LO</td>
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<td>DIG IO 02</td>
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<td>INPUT RTN</td>
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<td>DIG IO 08</td>
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<td>ANA INP20 HI</td>
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<td>DIG IO 09</td>
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<td>ANA INP20 LO</td>
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<td>DIG IO 15</td>
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<td>ANA INP26 LO</td>
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<td>DIGITAL RTN</td>
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<td>ANA INP28 HI</td>
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<td>SYNC OUTPUT</td>
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<td>ANA INP28 LO</td>
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<td>DIGITAL RTN</td>
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<td>ANA INP30 HI</td>
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<td>SYNC INPUT</td>
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<tr>
<td>1</td>
<td>ANA INP30 LO</td>
<td>1</td>
<td>DIGITAL RTN</td>
</tr>
</tbody>
</table>

* Analog inputs are shown for the differential input mode. In single-ended mode, LO inputs become consecutive odd-numbered channels, beginning with ANA INP 01 replacing ANA INP 00 LO.

Figure 2. System Input/Output Connector

System Mating Connector:
68-Pin 2-row 0.050" dual-ribbon cable socket connector: Robinson Nugent #P50E-068-S-TG, or equivalent.

Contact factory for availability of the 68-pin AMP SCSI-3 connector.

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