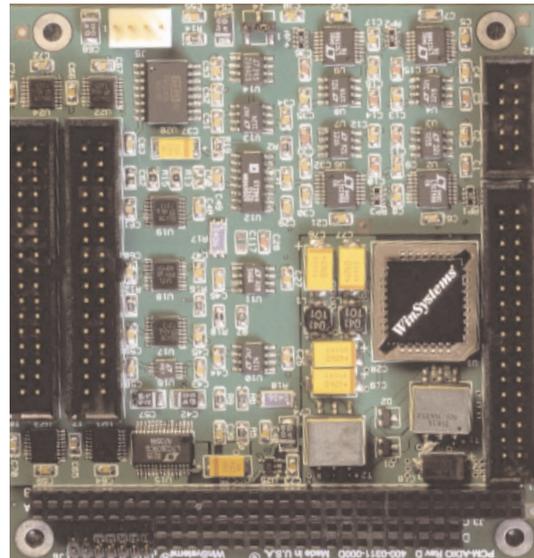


### FEATURES

- Command-based intelligent data acquisition system
- Onboard processor handles all scheduling, mode selection, calibration control, and data buffer management
- Eight Analog Input Ranges: 0-1.25V, 0-2.5V, 0-5V, 0-10V,  $\pm 1.25V$ ,  $\pm 2.5V$ ,  $\pm 5V$ , and  $\pm 10V$
- 16-bit Analog-to-Digital (A/D) converter
  - Any combination of up to 32 single-ended input channels and up to 16 differential input channels
  - Each channel independently software programmable for input range, type and polarity
  - 32Kbyte FIFO can be assigned in 256 byte blocks to any or all channels
  - Conversion rate selectable for each channel
  - No missing codes over full range
- Ultra low noise DC/DC converter
- High-precision, ultra low drift reference
- Buffered reference output for ratiometric applications
- External reference input supported
- External event sense or clock for conversion control
- Four 12-bit Digital-to-Analog (D/A) converters
  - Output Ranges: 0-5V, 0-10V,  $\pm 2.5V$ ,  $\pm 5V$ ,  $\pm 10V$
  - Each individual channel independently software programmable
  - Output channels can be updated and cleared individually or simultaneously
- 16 bits of TTL-compatible general purpose digital I/O
- No adjustment potentiometers or calibration needed
- Software programmable interrupt configuration
- +5 volt only operation
- Small size: 3.6" x 3.8" (90mm x 96mm)
- Operating temperature:  $-40^{\circ}C$  to  $+85^{\circ}C$

The PCM-ADIO is an intelligent PC/104-based analog input, analog output, and digital I/O board designed to meet customer demands for high-accuracy and high channel count analog I/O. Based on 16-bit analog-to-digital and 12-bit digital-to-analog converters, the PCM-ADIO includes unique features such as advanced automatic conversion control and buffers, automatic calibration for all input modes of operation, and jumperless selection for all analog input/output ranges.

Automated input configurations provide designers the flexibility to digitize inputs from many different sources with little or no external input signal conditioning. Input range selection, mode, calibration, and conversion rates are handled automatically on a channel-by-channel basis through a simple command structure.

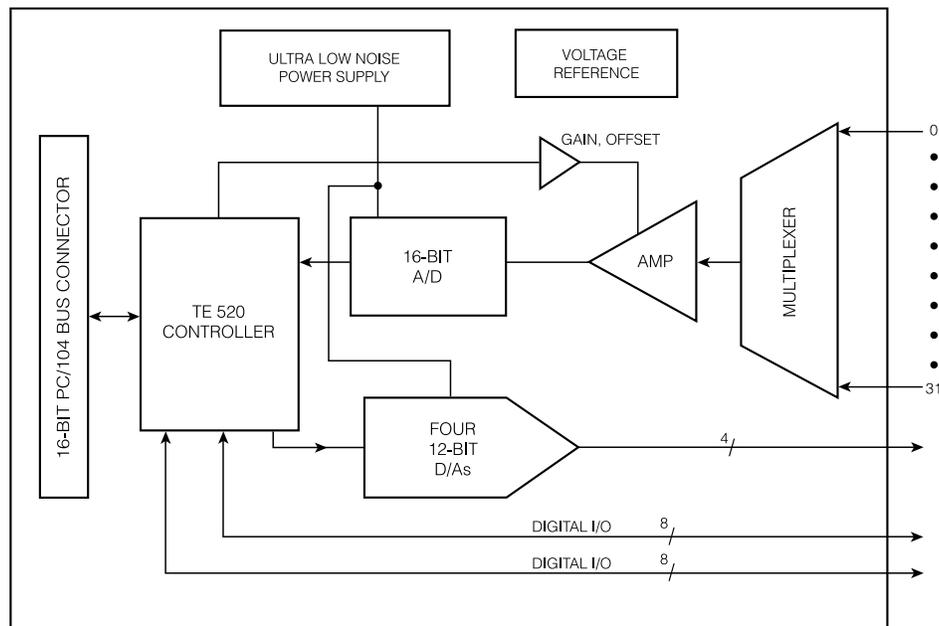


This board targets industrial applications that require a variety of inputs from thermocouples, amplified bridges and monitored system voltages representing parameters such as temperature, pressure, acceleration, humidity, frequency, vibration, weight, flow rates and current. The PCM-ADIO operates over the industrial temperature range of  $-40^{\circ}$  to  $+85^{\circ}$  Centigrade.

### FUNCTIONAL CAPABILITY

**Controller** - The key to the intelligence of the PCM-ADIO is the onboard TE520 Configurable System-on-Chip. The TE520 includes a built-in 8051/52 operating at 40 MHz with 40Kbytes of system RAM. Its internal 3,200 system logic cells allows great flexibility in system configuration and multiple command mode options. Programming of the controller is stored in a Flash memory device.

The onboard processor and logic handles all scheduling, mode selection, calibration control, and data buffer management to minimize host processor overhead. Under user commands, the TE520 controls the input ranges, input configurations, conversion rates, FIFO depth per channel, output ranges, calibration, and digital I/O without the need of clumsy jumpers or potentiometers. The result is that the PCM-ADIO is a highly integrated, command-based intelligent data acquisition system.



**PCM-ADIO BLOCK DIAGRAM**

**Analog Input** - The PCM-ADIO supports 8 input voltage ranges. Any input range is independently software selectable for each channel. No jumpers are required. Also, any of the inputs can be inverted for resolution enhancement or for auto-ranging applications. There is overvoltage protection up to  $\pm 20V$  on each channel.

Unipolar	Bipolar
0 - 1.25V	$\pm 1.25V$
0 - 2.5V	$\pm 2.5V$
0 - 5V	$\pm 5V$
0 - 10V	$\pm 10V$

**Input Voltage Ranges for PCM-ADIO**

A sophisticated input multiplexer and signal conditioning circuit provides unparalleled configuration flexibility. The board will support up to 32 single-ended input channels, 16 differential input channels or various combinations of both. This means that under software control, any channel can be set for either single ended or differential along with its input voltage range. For example, Channels 0 and 1 could be set as 0-10V single ended, Channel 2 set as  $\pm 5V$  differential, Channels 4 and 5 set as 0-1.25V single ended, Channel 6 set as  $\pm 10V$  differential, etc. In the differential input mode, only the even channel numbers are used. The input signal is applied between the even channel number and the next odd channel input pin.

The entire input channel configuration is done under software control using a command protocol. Software drivers are available in C, Windows and Linux. Contact an applications engineer or visit the web site for details.

The analog-to-digital converter is a Linear Technology LTC1609. The device includes a sample-and-hold, a precision reference, a switched capacitor successive approximation A/D and trimmed internal clock. It is a 16-bit A/D that draws only 65mW (typical) from a single 5V supply. The PCM-ADIO uses an LT1236A external reference for even better accuracy. The serial digitized output data is routed to the TE520 where it stored, formatted, and presented to the host computer through the PC/104 bus.

Channel 0	1	2	GND
Channel 1	3	4	GND
Channel 2	5	6	GND
Channel 3	7	8	GND
Channel 4	9	10	GND
Channel 5	11	12	GND
Channel 6	13	14	GND
Channel 7	15	16	GND
Channel 8	17	18	GND
Channel 9	19	20	GND
Channel 10	21	22	GND
Channel 11	23	24	GND
Channel 12	25	26	GND
Channel 13	27	28	GND
Channel 14	29	30	GND
Channel 15	31	32	GND
GND	33	34	GND

**Channel 0 - 15 Analog Input Pinout**

**FIFO** - A 32Kbyte first-in, first-out (FIFO) buffer in the TE520 allows data from a signal to be acquired and stored before transferring it to the host computer. This

eliminates critical timing concerns and allows application code to be written more quickly and efficiently. The entire buffer is available to any or all of the A/D channels and can be allocated independently to any channel in segments of 256 bytes. This is done in software by writing the appropriate command sequence to the module.

Channel 16	1	2	GND
Channel 17	3	4	GND
Channel 18	5	6	GND
Channel 19	7	8	GND
Channel 20	9	10	GND
Channel 21	11	12	GND
Channel 22	13	14	GND
Channel 23	15	16	GND
Channel 24	17	18	GND
Channel 25	19	20	GND
Channel 26	21	22	GND
Channel 27	23	24	GND
Channel 28	25	26	GND
Channel 29	27	28	GND
Channel 30	29	30	GND
Channel 31	31	32	GND
GND	33	34	GND

**Channel 16 - 31 Analog Input Pinout**

**Auto-Sampling Rate and Trigger Source** - The PCM-ADIO has a flexible method of automatically initiating A/D conversion cycles for each channel. The time period ranges from about once every 50 microseconds to over 1 minute. Each channel can be individually programmed for its specific automatic sample rate. The base clock rate can be selected from an onboard source that ranges from 0 to 20KHz in increments of 1KHz. An external clock can be used for event synchronization or to employ an external conversion clock. This allows an extremely low sample interval if desired. Each A/D channel has an individual software programmable up-counter that can increment from 0 to 65535. The counter is incremented at the rate set by either the internal or external clock. Presetting the counter allows the application program to select the specific sample rate for the channel. Auto sampling can be enabled or disabled on a channel-by-channel basis.

**Interrupts** - Interrupts are generated at the end of conversion for each A/D channel. They can be individually enabled or disabled. Under program control, the PCM-ADIO sets the IRQ on the PC/104 Bus assignments as Channels 2, 3, 4, 5, 6, 7, 10, 11, 12, 14, or 15.

**Analog Output** - The PCM-ADIO uses the LTC1588 SoftSpan™ DAC. It is software programmable for either unipolar or bipolar modes. INL and DNL are

accurate to 1 LSB over the industrial temperature range in both unipolar and bipolar modes. The device includes an internal deglitcher circuit that reduces the glitch impulse to less than 2nV-s (typ).

There are 4 independent 12-bit, D/A channels that each have 5 programmable output voltage ranges. They are asynchronously cleared to 0V for all ranges when reset.

Unipolar	Bipolar
--	±2.25V
0 - 5V	±5V
0 - 10V	±10V

**Output Voltage Ranges for the DAC Channels**

All four output channels are wired to a 10-pin connector. The pin-out is shown in the chart below.

Channel 0	1	2	GND
Channel 1	3	4	GND
Channel 2	5	6	GND
Channel 3	7	8	GND
GND	9	10	GND

**D/A Output Channels 0-3 Pinout**

**Voltage Reference** - The single most important component in any analog converter design is the analog voltage reference. The PCM-ADIO uses the LT1236 precision reference that provides both superior accuracy and temperature coefficient specifications. It combines ultra-low drift and noise with excellent long-term stability and high output accuracy. Reference voltage drift directly affects analog conversion accuracy, expressed as full-scale (gain) error. Also special care has been taken to minimize thermal regulation effects and temperature-induced hysteresis.

A buffered reference output is available for ratiometric applications. An external reference input is also provided. If used, the board must be recalibrated to the external reference.

**Calibration** - Calibration is accomplished through a factory calibration sequence that stores the calibration data for each mode of operation in non-volatile EEPROM memory on board. The data is recalled and applied to the input signal conditioning circuitry for the selected mode and channel. This supports multiple input configurations and ranges on a single board without the time and expense of additional boards or manually reconfiguring and recalibrating for the new range.

Special attention has been given to the calibration and front-end circuitry to minimize error caused by drift

over time and temperature which eliminates the need for "auto-calibration" sequences. Drift errors are predominantly functions of component drift over time and how changes in temperature affect components in the system. From the  $\pm 2$  ppm per degree Centigrade drift precision reference to the ultra low drift custom resistor networks and active components in the signal conditioning paths, the PCM-ADIO maximizes converter accuracy over time and temperature.

**Power Supplies** - There is an ultra low noise,  $\pm 15V$ -power supply on board. It is based upon an LT1533 switching regulator designed to reduce both conducted and radiated EMI. This is achieved by independent control of voltage and slew rates for both the positive and negative voltages plus careful layout techniques. A separate regulator is used to generate an analog +5V supply for the converters. This is done to minimize digital switching noise since converters inherently have low power supply rejection (PSRR). The result is less than 200 $\mu$ V p-p (typ.) from DC to 1 MHz on all analog supply voltages.

**Digital Input/Output** - There are 16 bits of TTL compatible digital I/O organized into two, 8-bit bytes. They can be configured as either input or output.

Port A Bit 0	1	2	GND
Port A Bit 1	3	4	GND
Port A Bit 2	5	6	GND
Port A Bit 3	7	8	GND
Port A Bit 4	9	10	GND
Port A Bit 5	11	12	GND
Port A Bit 6	13	14	GND
Port A Bit 7	15	16	GND
Port B Bit 0	17	18	GND
Port B Bit 1	19	20	GND
Port B Bit 2	21	22	GND
Port B Bit 3	23	24	GND
Port B Bit 4	25	26	GND
Port B Bit 5	27	28	GND
Port B Bit 6	29	30	GND
Port B Bit 7	31	32	GND
GND	33	34	GND

**Digital I/O Connector Pinout**

**PC/104 Interface** - The PCM-ADIO supports 10-bit I/O address decoding. Each board requires 8 contiguous port addresses based on an even 8-port boundary. The control, data, and power signals are wired to a 16-bit stackthrough PC/104 connector.



## SPECIFICATIONS

### Electrical

PC/104 Bus: 16-bit, stackthrough  
Voltage: +5V  $\pm 5\%$  @ 850mA (Typ.)

### A/D Section

Input: 32 channels single ended, 16 channels differential or combination thereof.  
Range: 0-1.25V, 0-2.5V, 0-5V, 0-10V,  $\pm 1.25V$ ,  $\pm 2.5V$ ,  $\pm 5V$ , and  $\pm 10V$   
Resolution: 16-bits  
Monotonicity: Guaranteed over temperature range  
Differential Non-linearity: No missing codes to 15-bits  
Trigger Source: Programmable timer, external trigger or program command  
Reference Buffer Output: 10mA source capability  
External Reference Input: 5.0 volt typ., 5.5V max.

### D/A Section

Output: 4 channels  
Range: 0-5V, 0-10V,  $\pm 2.5V$ ,  $\pm 5V$ ,  $\pm 10V$   
Resolution: 12-bits, no missing codes  
Settling time: 2 $\mu$ S to 1% full scale  
Output Current:  $\pm 10mA$  per output typical with  $\pm 30mA$  maximum per board

### Digital I/O

Type: 16 bits organized in two, 8-byte segments  
Logic: TTL-compatible with 12mA source and sink for each pin

### Mechanical

Dimensions: 3.6" x 3.8" (90mm x 96mm)

### Connectors

A/D: Two, 34-pin on 0.100" grid  
D/A: 10-pin on 0.100" grid  
Digital I/O: 34-pin on 0.100" grid  
Voltage Reference: 4-pin, 0.100"  
PC/104: 64-pin, 0.100" (32-pin double row)  
40-pin, 0.100" (20-pin double row)  
Jumpers: 0.020" square posts on 2mm centers

### Environmental

Operating Temperature: -40° to +85° Celsius  
Non-condensing relative humidity: 5% to 95%

## ORDERING INFORMATION

PCM-ADIO PC/104 command-based data acquisition board

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