AD16

Analog Input Interface for the Persistor CF-1

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Introduction

The AD16 is a peripheral interface for the Persistor CF-1 that provides four channels of analog input with 16-bit resolution. The interface card contains a 5-Volt regulated supply for the Analog-to-Digital Converter (ADC), two buffered output bits, access to a prototyping area and test pad connections to a number of the CF-1 I/O pins. The interface card also provides a 3V lithium coin cell to provide backup power for the CF-1 real-time clock and a 10-pin ribbon cable connector for serial I/O.

Setup and Testing

Setting up the AD16 is as simple as plugging the CF-1 into the AD16, connecting power, serial I/O and analog inputs, then running one of the test programs.

Serial Port Connections

The serial I/O connector provides the same RS-232 signals implemented on the Recipe cards from Persistor. The header is compatible with the IDC-10 to DB9F connector also provided by Persistor. The pin connections of this cable are shown in figure 1.

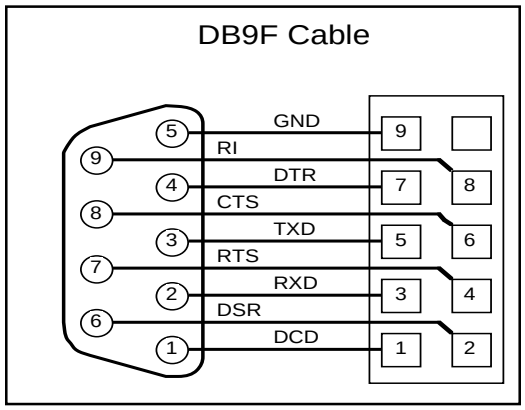


Figure 1. IDC10 to DB9F Cable

Analog Input Connections

(The 20-pin analog filter header is present only on the Rev 2. PCB)

The AD16 can accept analog inputs either through the 8-position screw terminal connector or the 20-pin header. The AD16 is shipped with jumpers on the 20-pin header so that inputs are carried through the header to the A/D. Figure XX shows the pin assignments for the 20-pin header. The header has connections to the switched 5V supply, Vbattery, VLIN(3.3V), the A/D Powerdown signal and Test point TP1 and TP2. These power and signal pins make it possible to plug in an external card containing either active filters for the inputs, low-power sensors, or multiplexers to add additional input channels.

Power Supply Input

Power is provided to the AD16 and the CF-1 through a 2-pin screw-terminal connector, J1. Although the CF-1 and the +5V regulator will block reversed voltages at their inputs, the input filter capacitor, C13, will explode messily if exposed to a high-current, reversed supply.

NOTE: The +Voltage input is nearest the center of the board. Don't be misled by the ground trace from the prototyping area which only APPEARS to go to that pin. The ground lead is nearest the edge of the board.

When operating at full speed, the CF-1 and can draw up to 50mA. the AD16 adds only about 10mA. You should use a current-limited supply set to about 100mA when developing and testing a new system.

The AD16 and CF-1 can accept input voltages to 20Volts without damage. However, if you have a power supply of greater than 11 Volts, it would probably be best to implement a step-down switching converter to provide about 7 volts to the CF-1 and AD-16. A reasonably efficient converter will reduce the current drain on the supply—which can greatly extend the life of a battery supply. Please contact OES if you have a supply of greater than 12Volts where current drain is important.

Test Software

The diskette provided with the AD16 includes a number of compiled applications that you may use to test your AD16 and CF-1. You may also download this software, and other example programs as they are developed, from the OES web page (www.oes.to)

Hardware

The AD16 is assembled on two-sided printed circuit board using both surface-mount and through-hole components. The arrangement on the components on the board is shown in figure 2.

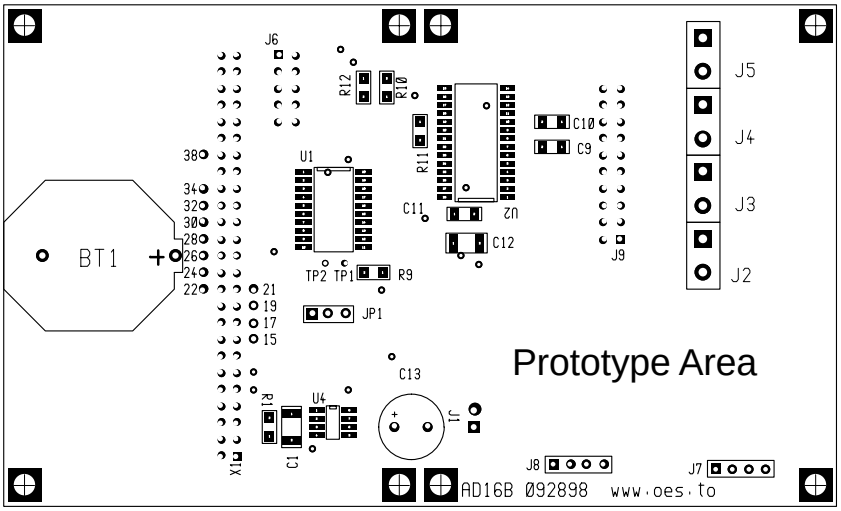


Figure 2. PCB Layout

Analog-to-Digital Converter and Interface

The AD16 uses the Burr-Brown ADS7825 4-channel, 16-bit ADC. This converter provides a combination of low power, wide input range, and convenient serial interface. It also has an internal reference voltage and runs of a single +5V supply. The channel selection bits, serial data and clock, and start conversion signal are buffered by a 74LPT245 tri-state bus interface circuit. This IC provides I/O signals which are compatible with the 5V TTL levels of the ADC

while operating from the 3.3V linear supply of the Persistor CF-1. The outputs of the 74LPT245 can be switched into a high-impedance mode when the +5V supply power to the ADC is shut down. Two spare TTL-level outputs are also routed to test points and the analog filter header

Input Connections and Filter Header

The AD16 provides four sets of screw terminal connectors for analog input. Pin 1 of each set is connected to the analog ground plane. The analog inputs on pin 2 are routed to a 20-pin header strip. In the default configuration, the inputs are connected directly to the ADC inputs with shorting jumpers. The pin assignments for the filter header are shown in figure 3.

If you require input filtering or other signal conditioning, you may implement a mezzanine plug-in card to connect to the 20-pin header strip that provides the circuitry required for your application. The header also provides raw battery and +5V power, a shutdown signal and two TTL-level outputs. These outputs may be used to control additional multiplexers to expand the input capacity of the AD16.

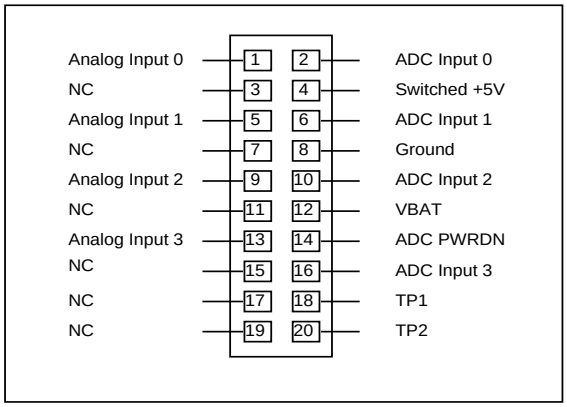


Figure 3. Analog Filter Connector

+5V Supply and Low-Power Jumper

The +5V supply utilizes a Linear Technology LT1521-5 linear voltage regulator. This regulator will handle input voltages to 20 volts and is protected against reversed input polarity. The +5V output can be turned off with the Shutdown signal

The Shutdown signal for the +5V supply can be derived from either of two sources—selected by the position of the jumper on 3-pin header JP1. If the jumper connects the two pins nearest the CF-1 connector, the Shutdown signal comes from the /SHDN of the CF-1 on Pin 12 The "/" character indicates that the SHDN signal is active when low—when it is high, the power is turned on.

When the jumper on JP1 connects the two pins farthest from the CF-1, the Shutdown signal is supplied by Pin 23 of the CF-1. This signal is named PSHDN on the schematic diagram. This signal is used in the demonstration programs to control the power to the A/D converter.

To reduce power consumption to the absolute minimum, the CF-1 implements a suspend mode in which the /SHDN signal is pulled low. This shuts down the +3.3V supply while providing backup power to the RAM and Real-Time Clock.

If the Shutdown jumper is positioned properly, will also shut down the +5V supply. If you plan to use the suspend mode, you should position the jumper on JP1 to control the 5V supply also. Otherwise, you may end up in a situation where the ADC is sourcing current to the 74LPT245, which is receiving no 3.3V VCC.

Prototype Area and I/O Pads

The prototype area provides a matrix of pads suitable for mounting several 8, 14, or 16-pin DIP integrated circuits or discrete components. This area can be used to construct simple input filters, signal conditioning circuits or sensor power switches. Nearby pads provide ground, +3.3V and switched +5V power.

Serial I/O Connector

The serial port header has the same pinout as the header on the hasty-pudding recipe card. It is compatible with the ribbon-cable and 9-pin connector provided with that interface.

Backup Battery

The AD16 provides a 2032 Lithium coin cell backup battery for the CF-1. If you are stacking a Recipe Card® or other interface along with the AD16, only one of the cards should provide a backup battery. Otherwise a dead or defective battery on one card could drain a battery on another card.

Stacking CF-1 Connector Option

The AD16 can optionally be provided with stacking connectors for the CF-1. These connectors allow the CF-1 to be used with other Recipe Cards® or interfaces from OES. If you decide to stack multiple cards on the CF-1 it becomes your responsibility to ensure that there are no conflicts in the pin usage on the CF-1.

Software

AD16 Library

A library of software routines for the AD16 is provided in C-Language source code format for the MetroWerks CodeWarrior development system. The library files (ad16.c and ad16.h) provide routines to initialize the A/D interface, control the +5V power and ADC shutdown, and collect data from the ADC.

Sample Programs

The diskette provided with AD16 provides source and compiled .RUN code for several sample programs illustrating the use of the AD16. These must be loaded into the CF-1 using the MotoCross loader from Persistor.

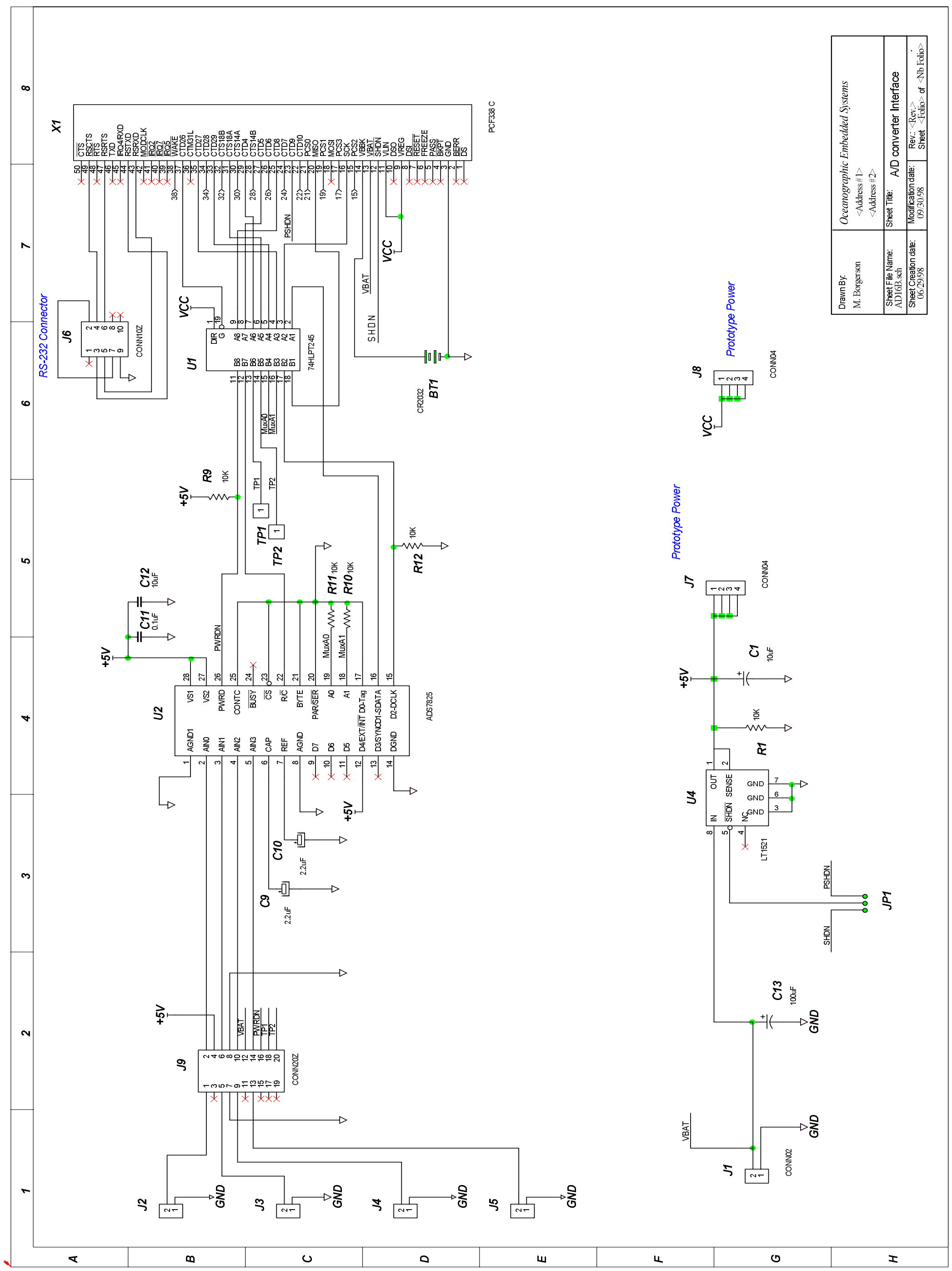
AD16Slow.run is a low-power data collection test that collects and transmits the voltage at the four inputs once each 5 seconds. Between samples, the CF-1 and AD16 drop to a low-power mode that draws approximately 1mA. This is the lowest power consumption that can be achieved while the CF-1 receives +3.3V power. An interrupt from the programmable timer is

used to keep track of the time while the system sleeps. The CF-1 also supports an even lower-power suspend mode, which should reduce power consumption to under 100 microamperes. However, that mode was not supported in the CF-1 BIOS at the time the demonstration programs were written. The program stops automatically after 6 samples have been collected and displayed.

AD16Fast.run collects 100 data points from four channels at a 100Hz rate under interrupt control. The program displays the mean and standard deviation of the samples. This program uses the Queued PicoBus system calls to illustrate their use with the AD16. These system functions would allow you to use the AD16 and other QSPI peripherals together without conflict.

AD16Xtra.run directly addresses the QSPI hardware and uses more tightly optimized code (including some global variables). It is able to collect and store samples at a 2500Hz rate from each of the four input channels. The program collects and displays the mean and standard deviation of 100 samples.

AD16Pkt.run collects data from four channels ten times per second and stores the data in a file on the Compact Flash Disk. The firmware communicates with a host program using binary data packets. You are allowed to collect the data, upload it to your computer and save it in a text file (compatible with Excel or other data display software). The host software runs only on the IBM PC under WIN95, 98 or NT (the latter two have not been tested, however). This example illustrates the type of data collection and host system that you can implement with the CF-1, AD16, and the current generation of Rapid Application Development (RAD) systems now available on the PC. The host application was developed in just a few days with Borland's C++ builder.


RS-232 Connector
Prototype Power
Prototype Power
Oceanographic Embedded Systems
Drawn By:
M. Borgerson
Sheet Title:
A/D converter Interface
PCF338 C
ADS7825
74HLPT245
LT1521
CONN10Z
CONN20Z
CONN04
CONN02
CR2032
+5V
VCC
GND
VBAT
SHDN
PSHDN