

# PC104-DAS16Jr/12 & PC104-DAS16Jr/16

High Speed 16 Channel, 12 or 16 Bit Analog Input with  
4 Digital In, 4 Digital Out & 3, 16 Bit Counters



## Features

- 12 Bit or 16 Bit Resolution A/D
- 16 Single Ended Inputs, or
- 8 Differential Inputs
- 160,000 Sample per Second Convert & Transfer (12 bit)
- 100,000 Sample per Second Convert & Transfer (16 bit)
- Three 16 Bit Counters
- 4 Digital Inputs
- 4 Digital Outputs

PC104 Compliant. Install in any PC104 system.

- 100% Register compatible with CIO-DAS16/Jr
- No changes to any programs
- 100% Connector compatible with DAS16 family
- No changes to field wiring
- Accepts many standard accessories

## DESCRIPTION

The PC104-DAS16Jr/12 provides all the functionality of our ISA bus version, the CIO-DAS16/Jr, in a PC104 form factor. The PC104 form factor is the new standard for compact embedded applications. Running standard DOS and Windows operating systems and the programs that go with them, a PC104 system can be packed into a smaller space than any ISA based computer.

The PC104-DAS16Jr/12 is 100% compatible with the CIO-DAS16/Jr to the register and connector level. That means you do not have to modify a single line of code or rework your field wiring! The PC104-DAS16Jr/16 provides the same level of compatibility with the addi-

tional resolution of a sixteen bit analog to digital converter. An improvement in resolution from 1 part in 4096 to 1 part in 65,536.

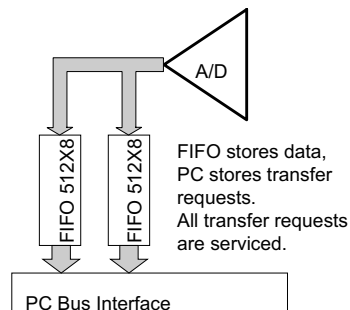
Analog signals may be sampled on 16 single ended or 8 differential channels (switch selectable) at up to 100,000(16-bit) or 160,000(12-bit) samples per second. Samples may be paced via software poll, external event or paced via the counters of an on-board 82C54 counter timer and precision XTAL.

Discrete events, such as contact closures, and discrete devices, such as relays, may be sensed and controlled via 4 dedicated digital inputs, and 4 dedicated digital outputs.

## FIFO Buffer = Windows Ready

The FIFO Buffer collects the results of A/D conversions and stores them until the personal computer CPU is able to transfer the data into PC memory. A FIFO buffer allows the PC to store up the A/D data, then transfer the data in batches. Under Windows, many demanding resources employ block transfers. Your A/D board should work in concert rather than conflict with your high performance PC.

The best part about the FIFO buffer is transparency; software you have written for any DAS-16 family board will run a PC104-DAS16Jr at higher speed without modification. And you won't miss a sample.



## 12 or 16 BIT RESOLUTION

The PC104-DAS16Jr/16 provides a full 16 bits of A/D resolution (1 part in 65,536). Sixteen bit resolution is a natural extension of the DAS-16 family architecture which provides greater accuracy and dynamic range.

The only register difference between the 12 and 16 bit board is 4 bits in the A/D least significant byte. Shown here is the LSB register for both the PC104-DAS16Jr/12 and the PC104-DAS16Jr/16. In the 16 bit board the additional 4 A/D bits come from the 4 bits allocated to channel number in a 12 bit board. To use the additional A/D resolution be sure to use software drivers for this 16 bit board.

### 12 Bit Board A/D LSB

**D7 D6 D5 D4 D3 D2 D1 D0**  
A8 A9 A10 LSb CH3 CH2 CH1 CH0

### 16 Bit Board A/D LSB

**D7 D6 D5 D4 D3 D2 D1 D0**  
A8 A9 A10 A11 A12 A13 A14 LSb

## DAS16 FAMILY COMPATIBILITY

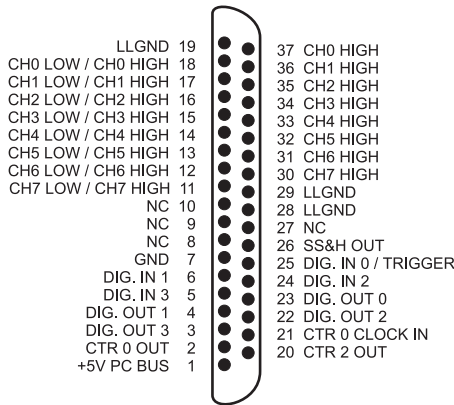
ComputerBoards designed the PC104-DAS16Jr to be register and connector compatible with the most popular family of data acquisition boards available; the DAS-16 family. Currently ComputerBoards offers 15 different configurations of DAS-16 and virtually every data acquisition software package supports the DAS-16 register set.

If you have applications designed for the DAS-16 and are ready to propagate those either within your facility or as a commercial product, these smaller, less expensive PC104-DAS16Jrs may be just what you need. As the following diagram shows, connector compatibility is assured.

The 40 pin header connector on the PC104-DAS16Jr maps directly into a 37 pin D connector that is identical to that of the CIO-DAS16. Simply order a C40-37F-2.

Of course, the pins which carry analog output signals on the CIO-DAS16 are no-connect (NC) on the Jr. boards. These pins are left floating rather than tied to ground or some other signal. That way an existing cable with a signal on it is not a problem.

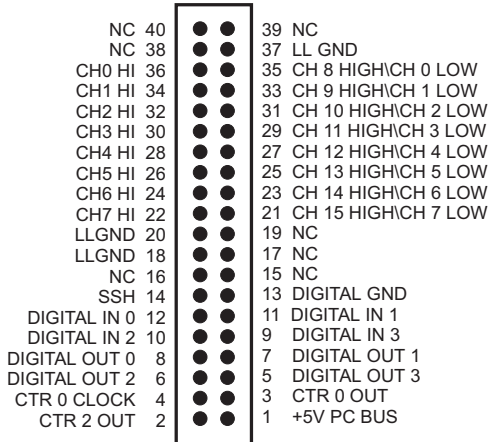
Because of Computer Boards' strict adherence to standards, accessory boards, cables and all of your existing hookups are 100% compatible with the PC104-DAS16Jr connector



## 40 PIN CONNECTOR

The PC104-DAS16Jr uses the standard PC-104 header connector for I/O signal interconnection. Here is the connector pin number to signal diagram.

Because of our desire to maintain compatibility with the DAS16 family, you will notice a number of NC (no connect) pins. These pins have other functions on some DAS16 family boards. By not using these pins for another function, we have assured compatibility to existing field wiring.



## ANALOG INPUTS

The analog input section of the PC104-DAS16Jr has been designed for flexibility and accuracy in a number of configurations and ranges. The analog signals are brought on board by a standard 40 pin header connector directly to two multiplexors. The two multiplexors may be configured as 16 channels of single ended input or 8 channels of differential input. Differential inputs can reject noise and ground loops (common mode voltages) but require a 3 wire hookup as opposed to 2.

Signals are amplified by a programmable gain amplifier prior to conversion by the A/D converter. The programmable gain and range of the PC104-DAS16Jr provides complete unipolar and bipolar signal to input matching.

An integral sample & hold captures the signal which is then converted by the A/D converter. The 12 bit A/D converter provides a resolution of 1/4096 parts of full scale with +/- 1LSB of accuracy.

The 16 bit converter provides a resolution of 1/65,536 parts of full scale with +/- 1.5 Lsb of accuracy (+/-3LSB on 1.25 scales).

The speed of data gathering is dependent on the method of triggering and data transfer, as the table below illustrates. Direct Memory Access (D.M.A.) provides the fastest convert & transfer rate but sample sets are limited to the 64KB (32K Samples) memory segment size of the personal computer. Interrupt routines are slower, but may handle larger sample sets.

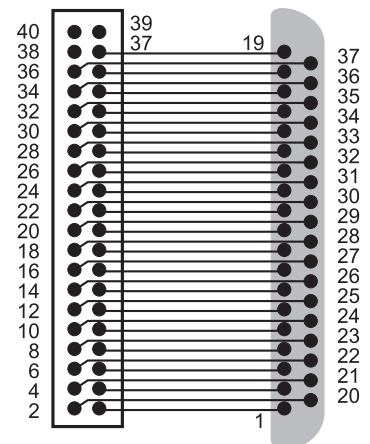
The FIFO buffer ensures that data transfers will continue to be performed at the maximum rate regardless of other higher priority system function which the operating system may allocate CPU time to.

A/D CONVERSION SPEED	386/20MHz
Polled/ Transfer to variable	2,200
Interrupt/ Variable or array	20,000
D.M.A. (12 bit)	160,000
D.M.A. (16 bit)	100,000

## C40-37F-2 Cable

If you have standard DAS16 37 pin connections to your field wiring, you can use the C40-37F-2 cable to convert this 40 pin header connector to a 37 pin D type connector.

The C40-37 cable may be ordered with a female 37 pin connector (F), the standard connector to mate with accessory boards, or with a male connector (M), to mate with another cable. Custom lengths are available also.

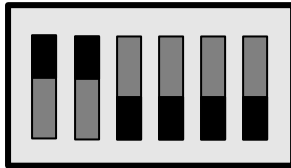


C40-37F-2 Cable Schematic  
Signals are aligned for standard 37 pin out.

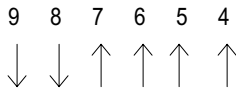
## BASE ADDRESS SELECTION

The PC104-DAS16Jr is addressed through software at an I/O address set by the switch shown here. The switch selects the first or BASE address. Switches have values in the down position. Values are added together to create an address.

Address 300H shown



SW	HEX
A9	200
A8	100
A7	80
A6	40
A5	20
A4	10



## I/O & CONTROL REGISTER MAP

The PC104-DAS16Jr and CIO-DAS16Jr are 100% software compatible because the I/O registers have identical functions on each board. I/O registers are the locations to which the computer writes and reads commands and data.

In most cases you will not interact with the registers on the board as that is handled by either language libraries or application programs. With today's very complex real time operating systems, it is not advisable to write directly to I/O registers, but rather to work through a DLL or a VxD. All software libraries written for DAS16 family will work with the PC104-DAS16Jr.

I/O ADDR.	PC104-DAS16Jr FUNCTION R-W
BASE + 0	A/D Low Byte - Start A/D
BASE + 1	A/D High Byte - NA
BASE + 2	Mux Settings - Mux Scan Control
BASE + 3	Digital 4 In - Digital 4 Out
BASE + 4	Not Used: These 4 registers are the DAS-16 D/A control registers, and are not used so that existing DAS-16 software will be compatible.
BASE + 5	A/D Status - NA
BASE + 6	Control Settings - Control
BASE + 7	NA - Counter Source Control
BASE + 8	Programmable Gain Set
BASE + 9	Counter 0 - Counter 0 Load
BASE + A	Counter 1 - Counter 1 Load
BASE + B	Counter 2 - Counter 2 Load
BASE + C	NA - 8254 Counter Control
BASE + D	
BASE + E	
BASE + F	

## DMA LEVEL SELECT

The PC104-DAS16Jr can use DMA levels 1 or 3, providing full compatibility with PC/XT/AT/PS30.



## GAIN & RANGE SELECTION

On the PC104-DAS16Jr/12 the analog input range is fully programmable. A single write to Base + 11 controls both the unipolar/bipolar setting and the amplification of the analog input signal. The gain register, located at the board's Base + 11 address, is an eight bit register. The lower four bits control the gain and range.

D7	D6	D5	D4	D3	D2	D1	D0
X	X	X	X	Range	U/B	G1	G0

**RANGE** = The A/D chip input range, either 10V full scale or 20V full scale. 0 = 10V, 1 = 20V.

**U/B** = Unipolar or Bipolar ranges. 0 = Bipolar, 1 = Unipolar.

**G1 G0** = the gain of the input amplifier. 0,0 = X1. 0,1 = X2. 1,0 = X4. 1,1 = X8.

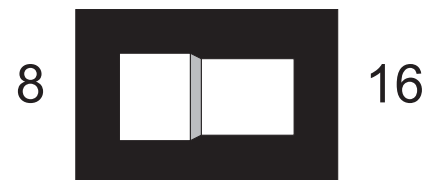
Ranges are: 0-10V, 0-5V, 0-2.5V, 0-1.25V  
and +/-10V, +/-5V, +/-2.5V, +/-1.25V, (+/-0.625V for PC104-DAS16Jr/12 only)

On the PC104-DAS16Jr/16, a switch controls the polarity (unipolar or bipolar) and only D0 and D1 are used to control the gain. The ranges available are nearly the same for both the PC104-DAS16Jr/12 and PC104-DAS16Jr/16, but there is a very great difference in the precision of the measurement that may be made. For example, in the range +/-5V, the 12 bit board can make a reading as fine as 10V divided by 4096, or 2.44 millivolts. A 16 bit board will measure a signal as small as 10V divided by 65,536, or 0.152 millivolts. Although the range is the same for each board, the resolution of the measurements differ considerably.

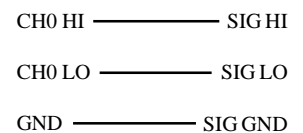
## 16 / 8 CHANNEL SWITCH

A switch on the PC104-DAS16Jr configures the analog inputs as either 8 channels of differential input or 16 channels of single ended input. The ability to choose is a real plus. If you need many channels and need not worry about common mode voltages, choose 16 channels of single ended input. If you prefer a more noise immune analog connection, choose 8 channels of differential input.

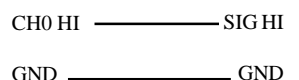
If you have questions about the choice of input, you will find a complete technical note in the hardware manual, which you can have in advance of your order by calling Technical Support and requesting one.



**DIFFERENTIAL INPUT** IS A 3 WIRE ANALOG CONNECTION WHICH IS LESS SUSCEPTIBLE TO NOISE AND GROUND LOOPS.

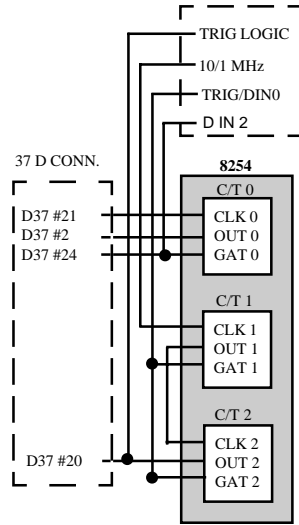


**SINGLE ENDED INPUT** IS A 2 WIRE ANALOG CONNECTION WHICH IS FINE FOR MOST APPLICATIONS.



## COUNTER TIMER

The 82C54 counter/timer chip has 3 counters of 16 bits each. The counters are fully programmable and may terminate or repeat on terminal count. The maximum input frequency of each counter is 10MHz. Much of the 8254 is used by the PC104-DAS16Jr as a pacer clock to synchronize A/D conversions. Counter 0, is available for counting, pulse generation or frequency measurement. The output of counter 2 is available to provide external synchronization to the A/D converter or as a programmable rate source.



## TRIGGERING

A Trigger is the event that begins an acquisition/transfer cycle. There are three ways to trigger a PC104-DAS16Jr; software, internal or external. There are also three ways to transfer data from the PC104-DAS16Jr; program, interrupt service routine or DMA.

An internal trigger is useful for synchronizing samples to a known time base; the on board XTAL and 8254 programmable divider. Using an external trigger allows you to synchronize samples to an external event.

## SIMULTANEOUS SAMPLE & HOLD

Simultaneous Sample & Hold is an option which allows 16 analog input channels to be triggered simultaneously. This option is important to applications where even the minimized burst mode channel to channel skew is not acceptable, such as audio digitization.

The PC104-DAS16Jr can trigger an external CIO-SSH16 via the SSH Trigger signal on pin 26. The CIO-SSH16 reduces PC104-DAS16Jr channel to channel skew from a minimum of 3 uS, to zero, with less than 50 nS aperture uncertainty.

Although the CIO-SSH16 is not in the PC104 form factor, this is also true of many signal conditioning and screw termination products. It would be impossible to place solid state relay modules on a PC104 board for example. If you need a smaller footprint on any signal conditioning circuit, please call us and we will build it for you.



## SPECIFICATIONS - PC104-DAS16Jr/12

### Analog Inputs

Analog to Digital Resolution	12 Bit, 1 part in 4096
Channels	16 SE or 8 Differential
A/D Type	Successive Approx. ADS 7800
Conversion Time	3uS
A/D Convert & Transfer Speed	160KHz
Accuracy	0.01% +/- 1 LSB
Integral Linearity	+/- 1 LSB
No missing codes over temp. range.	
Maximum Overvoltage	+/- 35V Continuous
Input Leakage Current	300nA Max @ 25°C
Gain Drift	+/- 25 ppm/Deg C Max
Zero Drift	+/- 10 ppm/ Deg C Max
Unipolar Ranges	0-10, 0-5, 0-1.25, 0-2.5
Bipolar Ranges	+/-10, +/-5, +/-2.5, +/-1.25, +/-0.625

Counter/Timer	82C54
Number of Counters	3
Resolution	16 Bit
Max input frequency	10 MHz
Configuration	Input, Gate, Output

Digital I/O Configuration	Two 4 Bit Ports 4 Inputs, not latched 4 Outputs, latched
Max Sink/Source current	4 milli Amps

Environmental	
Power Consumption	+5 @ 250mA Typ, 375 mA Max
Operating Temperature	0-50 C
Storage Temperature	-20 to 70 C

## SPECIFICATIONS - PC104-DAS16Jr/16

### Analog Inputs

Analog to Digital Resolution	16 Bit, 1 part in 65,536
Channels	16 SE or 8 Differential
A/D Type	Successive Approx. ADS 7805
Conversion Time	10uS
A/D Convert & Transfer Speed	100KHz
Accuracy	0.003% +/- 1 LSB
Integral Linearity	+/- 1.5 LSB(+/-3LSB @ 1.25V BIP or UNI ranges)
No missing codes over temp. range.	
Maximum Overvoltage	+/- 35V Continuous
Input Leakage Current	300nA Max @ 25°C
Gain Drift	+/- 20 ppm/Deg C Max
Zero Drift	+/- 10 ppm/ Deg C Max
Unipolar Ranges	0-10, 0-5, 0-1.25, 0-2.5
Bipolar Ranges	+/-10, +/-5, +/-2.5, +/-1.25,

Environmental	
Power Consumption	+5 @ 250mA Typ, 375 mA Max
Operating Temperature	0-50 C
Storage Temperature	-20 to 70 C

## Ordering Guide

## Part No.

16 Bit, 16/8 channel A/D, 3 CTR, 4/4 DIO	PC104-DAS16Jr/16
12 Bit, 16/8 channel A/D, 3 CTR, 4/4 DIO	PC104-DAS16Jr/12
Cable, 40 pin header to 37 D female, 2'	C40-37F-2
Cable, 40 pin header to 37 D male, 2'	C40-37M-2
Programmers Library for Windows & DOS	Universal Library
Graphical Programming Tools for Windows C	VI Components