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ComputerBoards, INC.

CIO-DAS1600/12 & CIO-DAS1600/16

High Speed 16 Channel 12 or 16 Bit Analog Input, 2 Channel 12 Bit Analog Output with 32 Digital I/O & 3, 16 Bit Counters.

Ordering Information

DESCRIPTION

The CIO-DAS1600 multifunction analog and digital I/O board is designed to be compatible with MetraByte's popular DAS-1600 and provide additional features.

Installed in any IBM compatible personal computer the CIO-DAS1600 turns your personal computer into a high speed data acquisition and control station suitable for laboratory data collection, instrumentation, production test, or industrial monitoring.

The CIO-DAS1600 is supported by the Universal Library software to allow programmed control in BASIC, C and PASCAL in DOS or Windows languages. Many menu controlled data logging, analysis and control programs are available from a number of third party developers. In fact, any software designed for the DAS-16 will work with the CIO-DAS1600; we guarantee it!

MORE THAN A CLONE

The CIO-DAS1600 is much more than a clone. Extra features include:

1K sample FIFO Buffer.
Allows high speed A/D.DT-Connect, for high speed inter-board communication.
12 or 16 bit A/D converter, 1 part in 65,535 resolution.
Corrected A/D triggering.

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 transfer requests, then service the requests 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 the DAS-1600 or CIO-DAS16 will run a CIO-DAS1600 at higher speed without modification. And you won't miss a sample.

SIXTEEN BIT RESOLUTION & COMPATIBLE

The CIO-DAS1602/16 provides a full 16 bits of A/D resolution (1 part in 65,536). In addition, it is fully compatible with the CIO-DAS1602/12 (KM DAS-1602), including burst mode and gain codes. Because it is a natural extension of the DAS-16 family architecture, the CIO-DAS1602/16 is also register compatible with the KM DAS-HRES.

The only difference between a the 12 and 16 bit board is one register; the A/D least significant byte. Shown here is the LSB register for both the 1600/12 and 1600/16. In the 16 bit board, the additional 4 A/D bits are located in the 4 bits allocated to the channel tag in the 12 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

ANALOG INPUTS

The analog input section of the CIO-DAS1600 has been re-designed and is a considerable improvement over the DAS-16.

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Both speed and resolution have been enhanced.

HIGHER SPEED
The CIO-DAS1600/12 boasts speeds greater than 3 times that attainable with the DAS-16. The speed has been improved by changing to a faster (3.3uS) A/D converter with integral sample & hold vs. the AD774 (8 uS and external sample & hold (2uS). Both paced and burst mode are faster!

A/D converter throughput is not the only impediment to A/D board throughput. Data transfer method has a dramatic effect on board speed. The CIO-DAS1600/12 and CIO-DAS1600/16 have a FIFO buffer that stores A/D samples and unloads them to the PC bus asynchronously. This method is faster than forced synchronous which the DAS-16 boards use.

FINER RESOLUTION
The CIO-DAS1600/16 employs a 16 bit A/D converter providing 1 part in 65,536 resolution of the full scale range. Operating at +/-5V range, the CIO-DAS1600/16 resolves to 0.0001526 volts per bit. That is *16 times the resolution* of a 12 bit converter. Higher resolution is slightly more expensive and is limited to 100KHz.

DT-Connect
The CIO-DAS1600 boards can transfer A/D conversions to the PC via the ISA bus, or to other boards via DT-Connect. The DT-Connect board-to-board interface is a standard employed by a number of data acquisition, array and signal processing companies. ComputerBoards makes the MEGA-FIFO sample buffer board which holds up 128MegaSamples of memory completely freeing the PC bus from data transfer overhead. Great for Windows.

Three major improvements to the analog input of the DAS1600!

Of course compatibility with the entire DAS-16 family is maintained. Software designed for the DAS-16, DAS-16G, DAS-HRES, or DAS1600 boards will operate the CIO-DAS1600 family without modification. Often with great improvements in speed even with existing routines!

The speed of data gathering is dependent on the method of triggering and data transfer, as the table below illustrates.

A/D TRIGGER TRANSFER METHOD	MAX A/D RATE >=386/20 MHz
CIO-DAS1600-12	
Interrupt to variable or Array	20,000
Direct Memory Access (DMA)	160,000
DT-Connect, multi channel	250,000
DT-Connect, single channel	330,000
CIO-DAS1600/16	
Interrupt to variable or Array	20,000
DMA or DT-Connect	100,000

CONNECTOR
The analog signals are brought on board by a standard 37 pin D 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).

The signal levels, functions and pin assignments are identical to the DAS-16 series of boards so applications may be upgraded to CIO-DAS1600 without changes to connector or cable.

TRIGGERING
A Trigger is the event that begins an acquisition/transfer cycle. There are three ways to trigger a CIO-DAS1600; software, internal or external. There are also three ways to transfer data from the CIO-DAS1600; 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.

The KM DAS16 and ComputerBoards CIO-DAS16 series of boards all trigger A/D conversions on the rising edge of the TTL trigger signal. Surprisingly, KM departed from this standard with the DAS-1600. The DAS1600 is triggered on the falling edge of the trigger signal. The KM DAS-1600 is the only A/D board we know of with a falling edge trigger. Using a DAS-1600 with software written for the DAS-16 may result in timing errors due to the change in triggering methods.

The trigger edge, rising or falling, is jumper selected on the CIO-DAS1600, to maintain compatibility with KM and with the DAS-16 standard. We ship the board in the standard rising edge mode.

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MINIMIZING CHANNEL-CHANNEL SKEW (BURST MODE)

A/D converter board design begins with a single A/D converter, the most expensive part on the board. An A/D converter chip has only a single input. In many applications, multiple channels of A/D input are desired and so the board's analog inputs are multiplexed one at a time into the A/D chip for conversion.

Channel to channel skew is the result of multiplexing the A/D inputs and is nothing more than the time between consecutive samples. For example, if four channels are sampled at a rate of 1Khz per channel, the channel skew is 250uS (1mS / 4).

Burst mode minimizes channel to channel skew by clocking the A/D at the maximum rate between successive channels. For example, at the 1mS pulse channel 0 is sampled, then channel 1 is sampled 4uS later, then channel 2, 4uS after that and channel 3, 4 uS after that. Then no samples are taken until the next 1mS pulse when channel 0 is sampled again. In this scheme the rate for all channels is 1KHz but the channel to channel skew (delay) is now 4uS between channels or 12uS total.

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 CIO-DAS1600 can trigger an external CIO-SSH16 via the unused D/A REF1 input (pin 26, see block diagram). The CIO-SSH16 reduces CIO-DAS1600/12 channel to channel skew from a minimum of 4 uS in burst mode, to zero, with less than 50 nS aperture uncertainty.

COUNTER TIMER

The 8254 counter/timer chip has 3 counters of 16 bits each. Much of the 8254 is used by the CIO-DAS1600 as a pacer clock to synchronize A/D conversions. One full counter, 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. If you desire additional counters, a 5 channel CIO-CTR05 is available.
CLK Input Freq. . . . . .10 MHz Max
TTL Loads . . . . . .Source 1, Sink 4

GAIN & RANGE SELECTION

Gain and range selection on the CIO-DAS1600 is accomplished by a combination of bipolar/unipolar switch and a programmable gain amplifier. The ranges available are:

BOARD	Prog.Gain CODE	Bipolar RANGE	Unipolar RANGE
DAS1601/12	0	+\-10V	0-10V
	1	+\-1V	0-1V
	2	+\-.1V	0-.1V
	3	+\-.01V	0-.01V
DAS1602/12 &	0	+\-10V	0-10V
DAS1602/16	1	+\-5V	0-5V
	2	+\-2.5V	0-2.5V
	3	+\-1.25V	0-1.25V

The bipolar/unipolar switch must be set.

Why is the gain and range only half programmable? Only the designer of the KM DAS-1600 knows... By the way, the BIP\UNI switch has been flipped on the KM DAS-1600. It is a UNI/BIP switch on the DAS-16.

The CIO-DAS1600/16 is not made available in a 1601 version because of the gains of 100 and 1000. A 16 bit converter at a gain of 100 resolves each bit to 1.5uV. At that low level we determined the signal to noise made the measurement meaningless. For those with special range requirements, please call the factory to explore other options or custom configurations.

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16 / 8 CHANNEL SWITCH

A switch on the CIO-DAS1600 configures the analog inputs as either 8 channels of differential input or 16 channels of single ended input.

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.

A/D SPECIFICATIONS

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Channels.....16 SE or 8 Differential
A/D Type.....Successive Approx.
Conversion Time.....3.3uS (12 bit) 10uS (16 bit)
A/D Convert & Transfer Speed (DMA).....160KHz (12 bit), 100KHz (16 bit)
Accuracy .....0.01% +/- 1 LSB
Integral Linearity.....+/- 1 LSB
No missing codes guaranteed over temp. range.
Maximum Overvoltage.....+/- 35V Continuous
Input Leakage Current.....250 nA Max @ 25oC
Gain Drift.....+/- 25 ppm/Deg C Max
Zero Drift.....+/- 10 ppm/Deg C Max

ANALOG OUTPUT
Analog voltage output is provided by two 12 bit multiplying D/A converters. This type of converter accepts a reference voltage and provides an output proportional to that. A precision -5V and -10V reference provide on-board D/A ranges of 0-5V, 0-10V, +/-5V, and +/-10V.

Other ranges between +/-10V are possible if you supply a +/-10V external reference at pin #10 or #26 of the 37 pin D connector.

The D/A converters do have program and interrupt transfer capability. Interrupts may be initiated by the on-board pacer clock or by external trigger.

If the DAC 0 reference is supplied on board, the external reference input pin of the 37 pin connector may be converted to a simultaneous sample & hold output sync pulse by installing the jumper labeled SH.

D/A SPECIFICATIONS .....12 BIT
Channels.....2
D/A Type.....Multiplying 4 Quadrant
Conversion Time.....30nS to 0.01%
Integral Linearity.....+/- 1 LSB
Differential Linearity.....+/- 1 LSB
Reference Range.....+/- 10V
Output Range.....+/- 10V, Reference dependent
Jumper selectable ranges.....0-5V, 0-10V, +/-5V, +/-10V
R Out.....0.1 Ohm Max
I Out.....+/- 5mA Min

BASE ADDRESS SELECTION
The CIO-DAS1600 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.

A wait state may be implemented by placing the WAIT EN switch in the down position. The KM-DAS1600 has an additional switch for 1/10MHz XTAL rate to the 8255. The CIO-DAS1600 offers the same choice via jumper selection.

DMA LEVEL SELECT
The CIO-DAS1600 can use DMA levels 1 or 3, providing full compatibility with PC/XT/AT/PS30.

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24 BIT DIGITAL I/O CONNECTOR
A 40 pin connector, mounted on the CIO-DAS1600 board is the connector for a 24 line bi-directional digital I/O port. The 8255 on board raises the digital I/O count to 32 lines. The 8255 BASE address is located at CIO-DAS1600 BASE address + 400H.

The CIO-DAS1600 takes advantage of the IBM's choice to only decode I/O address 0-3FF (A0-A9). By decoding A10, a bank of 16 additional I/O locations beginning at Base Address + 400H open up. It is at these address that the 8255 control and port registers, and DAS-1600 mode and burst control registers are located.

The 40 pin digital connector on the CIO-DAS1600 is mapped to a standard 37 pin D connector mounted to a backplate via the BP40-37 cable and connector kit. Once brought to the 37 pin connector, the pin assignments are those of a CIO-DIO24.

ORDERING GUIDE
CIO-DAS1600/12 comes in two gain ranges.
16 Channel, 12 bit, gains of 1,10,100,1000.....CIO-DAS1601/12

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16 Channel, 12 bit, gains of 1,2,4,8.....CIO-DAS1602/12

16 Channel, 16 bit, gains of 1,2,4,8.....CIO-DAS1602/16
Universal Driver Language Programming Library.....UNIV-LIBRARY

Sample & Hold Accessory
16 Ch. S&H Diff. Amp accessory board, 4 Ch. installed.....CIO-SSH16
Additional S&H + Amps installed. Up to 12 additional.....CIO-SSH-AMP

Screw Terminal Boards
16" X 4" all signals from one 37 D plus proto area.....CIO-TERMINAL
4" X 4" all signals from one 37 D connector.....CIO-MINI37
16" X 4" all signals from one 37D, Spade Lug Terminals.....CIO-SPADE50

Cables
2 foot ribbon cable, 37 conductor, female connectors.....C37FF-2
'N' foot ribbon cable, 37 conductor, female connectors.....C37FF-N
5 foot shielded cable, molded female connectors, 37 cond.....C37FFS-5
10 foot shielded cable, molded female connectors, 37 cond.....C37FFS-10

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