CPCI-DAS6402/16 & CPCI-DAS6402/16/JR

High-Speed CompactPCI-bus Compatible, 16-bit, 64-Channel Analog Input Board with Dual Analog Output Channels & 32 Digital I/O bits

Features

- 64 channel single-ended / 32 chan diff
- 16-bit A/D resolution
- 200 kHz sample rate
- 8192 sample gain/channel queue
- Bus-master & scatter-gather support
- Analog trigger input (not avail on /JR)
- Burst-Mode SS&H emulation
- 8192 sample A/D FIFO
- Dual 16-bit D/As (not avail on /JR)
- 100 kHz D/A update rate (16-k FIFO)
- Provides arbitrary waveform generation
- One 16-bit counter/ 32-bits, digital I/O
- Fully Plug-and-Play & Autocalibrating

Block Diagram

cPCI-DAS6402/M2/16
Block Diagram
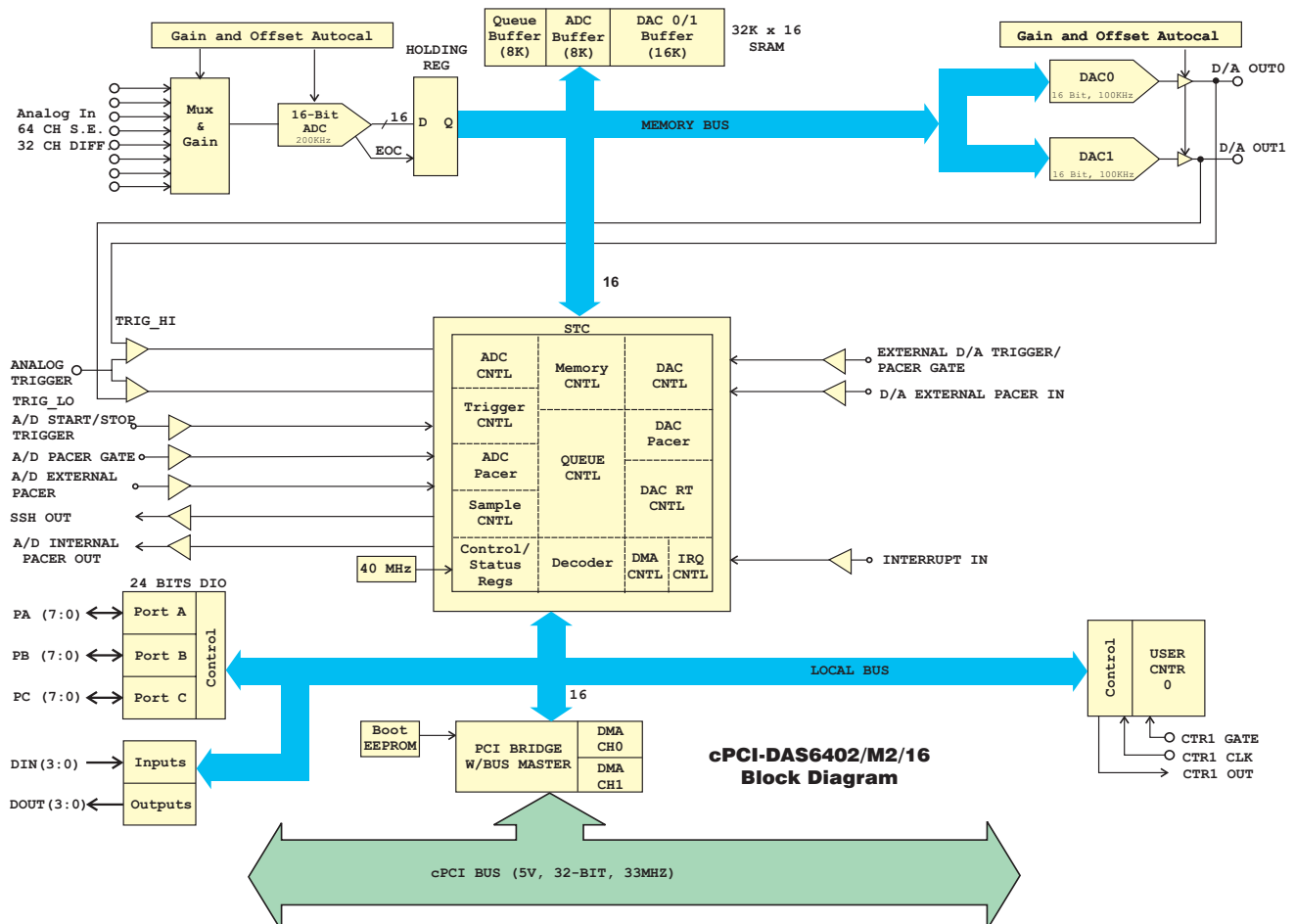
Functional Description

The CPCI-DAS6402/16 analog and digital I/O board sets a new standard for high channel count, high resolution data acquisition on the CompactPCI-bus. Offering 64 single-ended or 32 differential 16-bit analog inputs with sample rates up to 200 kHz (single-channel or multi-channel sampling), two 16-bit analog outputs (no analog outputs on /JR version), 32 bits of digital I/O and one 16-bit down counter. The board offers a variety of analog and digital trigger modes with trigger levels and direction selectable by software.

At the heart of the board is ComputerBoards' powerful System Timing Controller (STC) chip. The STC chip controls all A/D sampling and D/A update rates as well as controlling the 8K A/D FIFO, the 8-k gain/channel queue and the 16-k D/A FIFO. This functionality is based on the STC chip's use of an on-board 32K x 16 SRAM. The STC chip assigns functions to various parts of the SRAM (e.g. A/D FIFO) and then provides full speed control and arbitration among the various functions using the various sections of the SRAM buffer.

The STC allows simultaneous full speed A/D sampling, D/A updating and gain/channel queue sequencing (with variable intersample timing if desired). *The STC chip performs these functions up to 5 MHz, and is available as an OEM component for use in your own designs*. The board provides bus-mastering and scatter-gather functionality to assure the desired system timing is maintained.

The CPCI-DAS6402/16 is completely plug-and-play. There are no switches, jumpers or potentiometers on the board. All board addresses, interrupt channels etc. are set by your computers plug-and-play software. Even calibration is performed via software by using on-board trim D/A converters. (For more details on our digital calibration techniques, please see our calibration tutorial on page 270).

Analog Inputs

The CPCI-DAS6402/16 provides 32 fully differential or 64 single-ended analog inputs. The input mode is software selectable, with no switches or jumpers to set. The board offers a 200 kHz maximum sample rate in single and multichannel scans at any gain setting. An 8 kilosample gain/channel queue is available making long, complex sample sequencing simple. An 8-k sample FIFO assures data taken from the board is transferred into computer memory without the possibility of missed samples.

Software or the gain/channel queue selects the bipolar/unipolar input configuration as well as selecting among the input ranges. The table below details the input ranges and resolutions for the available input configurations and gains.

Bipolar Range	Resolution	Unipolar Range	Resolution
±10V	305 uV	0 - 10V	153 uV
±5V	153 uV	0 - 5V	76.3 uV
±2.5V	76.3 uV	0-2.5V	38.1 uV
±1.25V	38.1 uV	0-1.25V	19.1 uV

Burst Mode

Channel-to-channel skew is the result of multiplexing the A/D inputs and is defined as the time between consecutive samples. Burst mode minimizes channel-to-channel skew by clocking the A/D at a high rate between successive samples within a scan, and then waiting a specified time before starting an new scan. The CPCI-DAS6402/16 provides burst mode with a 5 uS minimum sample skew/delay.

Analog Outputs *(there are no analog outputs on the/JR version)*

The CPCI-DAS6402/16 provides two high speed 16-bit analog outputs. The analog outputs are updated via on-board 16-k FIFO and provide a 100 kHz max. update rate. Repetitive D/A-based waveforms can be stored in on-board memory and generated without requiring ongoing CompactPCI bus transfers. Software selectable ranges of 0-10V, 0-5V, ±10V and ±5V are provided, and channels may be set at different ranges. The outputs provide rated accuracy to ±5 mA, are short circuit protected (35 mA limit) and are cleared to 0 volts on power up or reset. The board supports simultaneous full speed operation of both the A/D and D/A.

Parallel Digital I/O

The CPCI-DAS6402/16 provide 32 bits of digital I/O. An 82C55 chip provides 24 bits of CMOS compatible I/O at the board's 40-pin auxilliary connector. Four LSTTL compatible digital inputs and four outputs are also provided on the main 100-pin connector. On power up or reset, all I/O ports default to the input state (high impedance).

Counter/Timer I/O

The CPCI-DAS6402/16 provides one 16-bit down counter (1/3 of an 82C54). The counter provides clock, gate and output connections at the user I/O connector.

Installed in any CompactPCI-bus compatible personal computer the CPCI-DAS6402/16 turns your personal computer into a high speed, high resolution data acquisition and control station.

Software

All CPCI-DAS6402/16 boards come complete with ComputerBoards' powerful *InstaCal*™ software package. *InstaCal* is a complete installation, calibration and test program for ComputerBoards data acquisition and control boards. Complete with extensive error checking, *Insta*Cal guides you through installation and setup of your data acquisition board and creates the board configuration file for use by your program or application software package. *Insta*Cal is described in detail within the software section of this website.

The CPCI-DAS6402/16 boards are fully supported by ComputerBoards' powerful Universal Library. Universal Library is a complete set of I/O libraries and drivers for all of our boards, in all Windows based languages. When using the Universal Library you can switch boards or even programming languages and the syntax remains constant. For details on Universal Library, please refer to the software section of this website.

The CPCI-DAS-6402/16 boards are fully supported by a wide variety of applications software packages including SoftWIRE™, DAS-Wizard™, (and DAS-Wizard Pro™), HP VEE®, HP VEE Lab and LabVIEW™. For further details on these, as well as a variety of other software packages, please refer to the software section of this website.

SoftWIRE for Visual Basic combines the simplicity of graphical programming with the power and flexibility of programming in VB!

CPCI-DAS6402/16 Specifications

Analog input section

Resolution	16-bits
Number of channels	32 diff/64 SE, Software selectable
A/D conversion time	5µs
Sample rate	200 kHz (single or multiple channel)

Sample rates with gain/channel queue

Single channel, single input range	200 kHz
Multiple channels, same input range	200 kHz
Single or multiple channels, changing input ranges, all channels in the same unipolar or bipolar mode	200 kHz
Single or multiple channel, changing input ranges, channels in both unipolar and bipolar modes	200 kHz
Data transfer modes	via 8192 sample FIFO and Bus master DMA, interrupt, or software polled
Programmable ranges	±10V, ±5V, ±2.5V, ±1.25V, 0 - 10V, 0 - 5V, 0 - 2.5V, 0 - 1.25V
A/D pacing	Programmable: internal counter or external source or software polled
Channel/gain queue	8192 samples.
Burstmode	Software selectable option, skew = 5µs
A/D Trigger sources	External: analog or digital

A/D Triggering Modes

Digital: SW configurable for Edge (triggered) or level-activated (gated). Programmable polarity (rising/falling edge, high/low gate).

Analog: SW configurable for above/below reference, in/out window and hysteresis. Programmable polarity (rising/falling edge trigger, high/low gate). Trigger levels set by DAC0 and/or DAC1. (Analog triggering is not available on the /JR version)

Pre-trigger: Unlimited pre- and post-trigger sample sizes. Compatible with Digital and Analog trigger modes

Diff. Linearity error	±1.25V range	±3 LSB
	all other ranges	±1 LSB
Integral Linearity error	±1.25V	±3 LSB
	all other ranges	±1.5 LSB
Gain Error	±1.25V, 0-1.25V	22.5 ppm typ, 45 max
	all other ranges	22.5ppm max

No missing codes	16- bits guaranteed
Gain drift / Zero drift	±7ppm/°C / ±2ppm/°C
Input leakage current	200 nA (25 Deg C)
Input impedance	10 Megohms, Min
Maximum input voltage	±35V

Counter section

Configuration	Single 16-Bit down counters1/3 82C54
User connections	Clock in, Gate and Output all available at I/O connector

Clock input frequency	10Mhz max
High pulse width (clk input)	30ns min
Low pulse width (clk input)	50ns min
Gate width high or low	50ns min
Input low voltage	0.8V max
Input high voltage	2.0V min
Output low voltage	0.4V max
Output high voltage	3.0V min

Analog Output:

Resolution	16-bits
Number of channels	2 (not available on /JR version)
Voltage Ranges	±10V, ±5V, 0-5V, 0-10V. Each channel independently programmable
D/A update rate	100 kHz on each D/A operating in single channel or simultaneous update mode
Data transfer modes	via 16384 sample FIFO and Bus Master DMA or through programmed I/O.
Arbitrary waveform mode	Supports repetitive waveforms to 16 ksample
D/A pacing	Internal or external clock or software paced
D/A trigger modes	Software or external gate.

Offset error	±100uV max, all ranges
Gain error	±30.5ppm max
Differential nonlinearity	±1LSB max
Integral nonlinearity	±1LSB max
Monotonicity	16-bits at 25 °C
D/A Gain drift	±15 ppm/°C max
D/A Bipolar offset drift	±5 ppm/°C max
D/A Unipolar offset drift	±3 ppm/°C max

Throughput	100kHz, 2 channels simultaneous.	
Settling time (20V step to .0008%)	13 µs max	
Settling time (10V step to .0008%)	6µs typ	
Slew Rate	10V Ranges	6 V/uS
	5V Ranges	3 V/uS

Current Drive	±5 mA min
Short-circuit current	± 35 mA indefinite
Output Coupling / impedance	DC / 0.1 ohms max
Miscellaneous	Power up/reset, all DAC's set to 0 volts

Digital Input / Output

Digital Bits	32
Configuration	24-bit, 82C55 at Aux 40-pin connector 4 dedicated input & 4 dedicated output bits on 100-pin main connector

82C55 Specifications

Configuration	2 banks of 8, 2 banks of 4, programmable by bank as input or output
Default/Reset State	Input, High Impedance
Output High	2.4 volts @ -2.5 mA min
Output Low	0.5 volts @ 2.5 mA min
Input High	2.0 volts min, 7 volts absolute max
Input Low	0.8 volts max, -0.5 volts absolute min

Dedicated I/O bits (4 input, 4 output)

Input / Output device:	74LS175
Default/Reset State	All 4 outputs to logic low
Output High	2.4 volts @ -0.4 mA min
Output Low	0.5 volts @ 8.0 mA min
Input High	2.0 volts min, 7 volts absolute max
Input Low	0.8 volts max, -0.5 volts absolute min

Interrupts	INTA# - mapped to IRQn via cPCI BIOS at boot-time
Interrupt enable	Software programmable
Interrupt sources	External (rising TTL edge event) or a variety of internal FIFO status sources

Power consumption

+5V Operating	2.7A typical, 3.1A max

Environmental

Operating temperature range	0 to 70°C
Storage temperature range	-40 to 100°C
Humidity	0 to 90% non-condensing

Digital Signal Conditioning *(requires C40-37F-X or BP40-37)*

CIO-ERB08[*]	8 channel relay rack with 6 Amp, Form C relays
CIO-ERB24[*]	24 channel relay rack with 6 Amp, Form C relays
CIO-SERB24[*]	24 channel relay rack with 10 Amp, socketed and field replaceable Form C relays.
SSR-RACK08[*]	8 channel solid state I/O module rack.
SSR-RACK24[*]	24 channel solid state I/O module rack.

BNC Connector Interface Boxes

BNC-16SE	BNC interface box for single-ended mode. Four are required to connect all 64 channels.
BNC-16DI	BNC interface box for differential mode. Four are required to connect to all 32 channels.

Screw Terminal Accessory Boards and Boxes

SCB-Series & CIO-MINI-Series

The main 100-pin connector is compatible with C100FF-03 series cables and the SCB-50 screw connection box (1 required for all 100 connections) or CIO-MINI50 screw terminal board (2 required).

The auxilliary digital connector is compatible with the SCB-37 using C40-37F-X series cables or the CIO-MINI40 using C40FF-X series cables.

[*] Items denoted with an asterisk are available with detachable screw terminals.

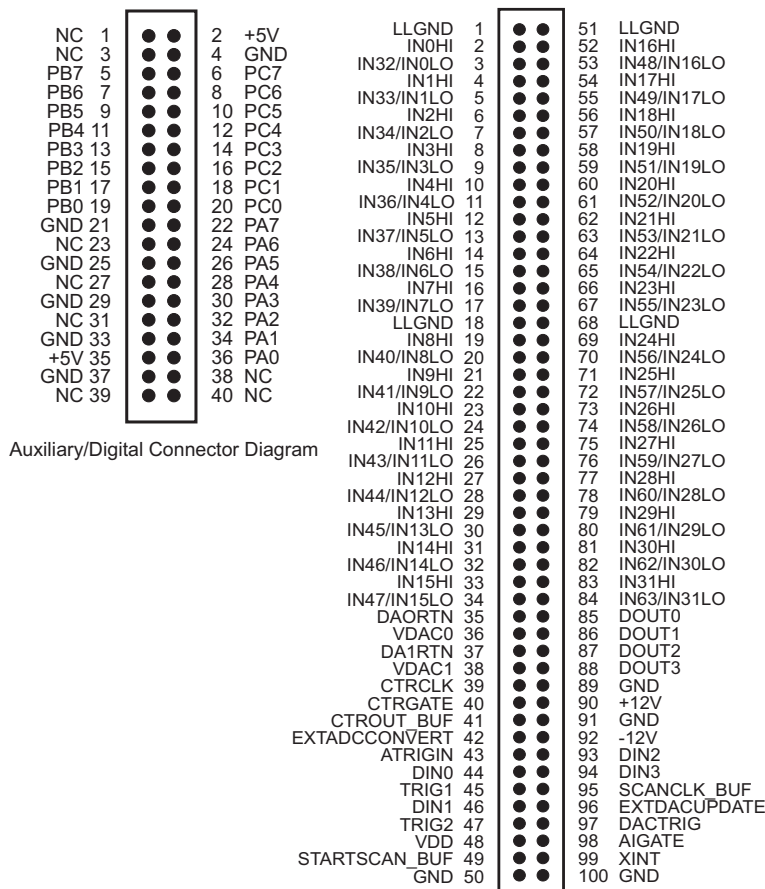## Auto-Calibration / Self-Calibration

In keeping with general plug-and-play standards, the CPCI-DAS6402/16 board has no switches, jumpers or potentiometers. *Auto-calibration* is performed with digital potentiometers and/or trim D/A converters. Unlike some boards that use software lookup tables for post-acquisition error correction, the CPCI-DAS6402/16 board's data is accurate when written into your computer's memory. The calibration factors that control the digital trim components are stored in EEPROM on the board. You can remove the board from one computer, install it in another, and it will still provide calibrated data.

In addition to being auto-calibrating, the CPCI-DAS6402/16 board is self calibrating. The CPCI-DAS6402/16 provides on-board circuitry that grounds the inputs for offset calibration, and connects the inputs to an ultra-stable, on-board voltage reference for gain calibration. A complete calibration is as simple as issuing a single software command.

All analog, triggering and counter/timer connections are through a 100-pin connector. The C100FF-XX series cable splits the 100 pins into separate 50-pin cables. The first 50-pin cable contains the signals from pins 1-50, while the second carries pins 51-100. These 50-pin connectors are compatible with the SCB-50 screw connection box (one required), the CIO-MINI50 screw terminal board (two required), and the BNC-16 series (one required for each 16 SE or 8 DIFF channels).

The 24-bits of high current digital I/O are available on an 40 pin header. From the 40-pin header the user connect to the optional BP40-37 which brings these pins out to the standard 37-pin connector and installs in any unused slot. This 37-pin connector is then pin compatible with all DIO24 series boards (and all of our 8 and 24-bit digital signal conditioning boards). Alternatively, the 40-pin header may be brought out directly with the C40FF-2 cable and connected directly to a CIO-MINI40 screw terminal board.

NC	1	2	+5V		
NC	3	4	GND		
PB7	5	6	PC7		
PB6	7	8	PC6		
PB5	9	10	PC5		
PB4	11	12	PC4		
PB3	13	14	PC3		
PB2	15	16	PC2		
PB1	17	18	PC1		
PB0	19	20	PC0		
GND	21	22	PA7		
NC	23	24	PA6		
GND	25	26	PA5		
NC	27	28	PA4		
GND	29	30	PA3		
NC	31	32	PA2		
GND	33	34	PA1		
+5V	35	36	PA0		
GND	37	38	NC		
NC	39	40	NC		

Auxiliary/Digital Connector Diagram

LLGND	1	51	LLGND	
IN0HI	2	52	IN16HI	
IN32/IN0LO	3	53	IN48/IN16LO	
IN1HI	4	54	IN17HI	
IN33/IN1LO	5	55	IN49/IN17LO	
IN2HI	6	56	IN18HI	
IN34/IN2LO	7	57	IN50/IN18LO	
IN3HI	8	58	IN19HI	
IN35/IN3LO	9	59	IN51/IN19LO	
IN4HI	10	60	IN20HI	
IN36/IN4LO	11	61	IN52/IN20LO	
IN5HI	12	62	IN21HI	
IN37/IN5LO	13	63	IN53/IN21LO	
IN6HI	14	64	IN22HI	
IN38/IN6LO	15	65	IN54/IN22LO	
IN7HI	16	66	IN23HI	
IN39/IN7LO	17	67	IN55/IN23LO	
LLGND	18	68	LLGND	
IN8HI	19	69	IN24HI	
IN40/IN8LO	20	70	IN56/IN24LO	
IN9HI	21	71	IN25HI	
IN41/IN9LO	22	72	IN57/IN25LO	
IN10HI	23	73	IN26HI	
IN42/IN10LO	24	74	IN58/IN26LO	
IN11HI	25	75	IN27HI	
IN43/IN11LO	26	76	IN59/IN27LO	
IN12HI	27	77	IN28HI	
IN44/IN12LO	28	78	IN60/IN28LO	
IN13HI	29	79	IN29HI	
IN45/IN13LO	30	80	IN61/IN29LO	
IN14HI	31	81	IN30HI	
IN46/IN14LO	32	82	IN62/IN30LO	
IN15HI	33	83	IN31HI	
IN47/IN15LO	34	84	IN63/IN31LO	
DAORTN	35	85	DOUT0	
VDAC0	36	86	DOUT1	
DA1RTN	37	87	DOUT2	
VDAC1	38	88	DOUT3	
CTRCLK	39	89	GND	
CTRGATE	40	90	+12V	
CTROUT_BUF	41	91	GND	
EXTADCCONVERT	42	92	-12V	
ATRIGIN	43	93	DIN2	
DIN0	44	94	DIN3	
TRIG1	45	95	SCANCLK_BUF	
DIN1	46	96	EXTDACUPDATE	
TRIG2	47	97	DACTRIG	
VDD	48	98	AIGATE	
STARTSCAN_BUF	49	99	XINT	
GND	50	100	GND	

MAIN CONNECTOR

Ordering Guide

CPCI-DAS6402/16	64-channel, 200 kHz, 16-bit analog & digital I/O board for PCI-bus computers.
CPCI-DAS6402/16/JR	64-channel, 200 kHz, 16-bit A/D & digital I/O board for PCI-bus computers.