

General Standards Corporation

High Performance Bus Interface Solutions

PCI66-16AO16FLV

16-Channel 16-Bit Differential High-Speed PCI Analog Output Board
*With 450,000 Samples per Second per Channel, 66 MHz PCI Support, and
Selectable Reconstruction Filters*

Features:

- **16 Precision 3-Wire Balanced Differential High-Speed Analog Output Channels**
- **16-Bit Resolution; D/A Converter per Channel**
- **Dual Selectable 8th-Order Continuous-Time Reconstruction Filters on All Outputs**
- **66MHz PCI Bus Support**
- **Data Rates to 450K Samples per Second per Channel; 7.2 MSPS Aggregate Rate**
- **Software-Selectable Output Ranges of $\pm 10V$ or $\pm 5V$ Full Scale at 5mA with High-Level Option, or $\pm 2.5V$ or $\pm 1.5V$ at 30mA with High-Current Option**
- **Supports 50-Ohms Loads on $\pm 1.5V$ Output Range**
- **Optional 2-Wire Single-Ended Analog Outputs**
- **256K-Sample Output Data FIFO Buffer; Configurable as Open or Circular**
- **Simultaneous or Sequential Output Clocking**
- **Multiboard Synchronization Compatibility with Other GSC I/O Products**
- **Continuous and Burst (One-Shot) Output Modes Support Seamless Waveform Sequencing**
- **Data Rate Controlled Internally or Externally**
- **Software-Selectable Differential Clock I/O for Synchronizing Sigma-Delta A/D Boards**
- **High Accuracy Ensured by On-Demand Autocalibration of all Channels**
- **Remote Ground Sensing**

Applications:

- ✓ Precision Voltage Source
- ✓ Acoustic Research
- ✓ Waveform Synthesis
- ✓ Audio Synthesis
- ✓ Process Control
- ✓ Industrial Robotics

REV: 091117

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Overview:

The PCI66-16AO16FLV contains sixteen 16-bit D/A converters (DAC's), and all supporting functions necessary for providing precision high-speed differential or single-ended analog output capability in a PCI application. Output ranges are software-selectable as ± 10 Volts or ± 5 Volts at 5mA with the High-Level ordering option, or as ± 2.5 V or ± 1.5 V at 30mA with the High-Current option. The outputs can be software-configured with no filtering for minimum response time, or with either of two 8th order reconstruction filters selected.

Unique FIFO buffer controls support the seamless sequencing of successive waveforms through a single buffer port. In less demanding applications, the outputs can be updated individually. Hardware clock I/O provisions support synchronization with a variety of GSC products, including Sigma-Delta ADC boards.

Sixteen output channels are controlled through an analog output FIFO buffer, and can be updated either simultaneously or sequentially. The output sample rate can be controlled by an internal rate generator or by an external clock. The local controller manages all input/output configuration and data manipulation functions, including autocalibration. Analog output levels are initialized to zero (midrange). Multiboard synchronization is supported.

A PCI interface adapter provides the interface between the controlling PCI bus and the internal local controller (Figure 1). The control interface conforms to IEEE PCI local bus specification Revision 2.3, and supports both 66MHz and 33MHz PCI bus speeds with universal signaling.

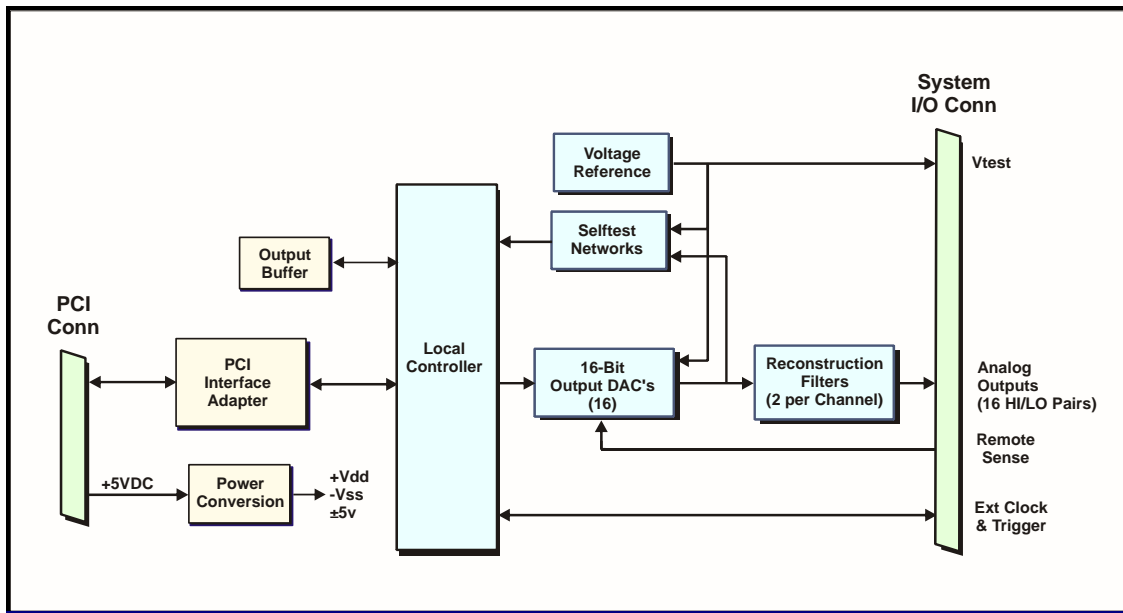


Figure 1. PCI66-16AO16FLV Functional Organization

This product is designed for minimum off-line maintenance. On-demand autocalibration eliminates the need for disconnecting or removing the module from the system for calibration. All analog input and output system connections are made through a single 68-pin I/O connector. Power requirements consist of +5 VDC, in compliance with the PCI specification, and operation over the specified temperature range is achieved with conventional convection cooling.

Electrical Specifications

(At +25 °C, with specified operating conditions)

Analog Output Channels

Output Characteristics:

Configuration:	Sixteen 3-wire balanced differential analog output channels, with a dedicated 16-Bit DAC per channel. Each 3-Wire output consists of complementary 'HI' and 'LO' signal lines, with 'output return' as the center (balance) reference. All output returns are electrically common internally. Optional 12-channel and 8-Channel configurations are available, as well as 2-wire single-ended analog outputs.
Voltage Ranges:	Software-selectable as $\pm 10V$ or $\pm 5V$ with the High-Level ordering option, or as $\pm 2.5V$ or $\pm 1.5V$ with the High-Current option. Measured Line-to-Line for differential configuration; Line-to-Ground with Single-Ended option (Output-HI relative to output return). See Ordering information.
Output Resistance:	1.0 Ohm maximum, line-line, line-return.
Protection:	Withstands sustained short-circuiting to ground without damage
Maximum Load Current:	± 5 ma on Hi-Level ranges; $\pm 30mA$ on High-Current ranges.
Load Capacitance:	Stable with zero to 10,000 pF shunt capacitance; all ranges, all rated loads.
Settling Time:	3 us to 0.1%, 5 us to 0.01%. Typical for 5-Volt step with no filter selected.
Noise:	-85dB typical. Re: Fullscale RMS. Constant midrange output at 150KSPS.
Glitch Impulse (No filter):	$\pm 2.5V$ Range: 3 nV-Sec max.. $\pm 10V$ Range: 8 nV-Sec
Remote Sensing:	Single input pin compensates for ground potential at load. Max range $\pm 1.0V$. Enabled or disabled through application software. Correction ± 1 percent. Input resistance: 15K typical.

Transfer Characteristics:

Resolution:	16 Bits (0.0015 percent of FSR)															
Sample Clocking Rate:	Internal Rate Clock: 100 to 450,000 samples per second per channel External Rate Clock: 0 to 450,000 samples per second per channel															
DC Accuracy, Line-Line: (Max error, no-load)	<table><thead><tr><th>Range</th><th>Midscale Accuracy</th><th>\pmFullscale Accuracy</th></tr></thead><tbody><tr><td>$\pm 10V$</td><td>$\pm 2.4mv$</td><td>$\pm 3.3mv$</td></tr><tr><td>$\pm 5V$</td><td>$\pm 1.7mv$</td><td>$\pm 2.2mv$</td></tr><tr><td>$\pm 2.5V$</td><td>$\pm 1.4mv$</td><td>$\pm 4.0mv$ (High current range)</td></tr><tr><td>$\pm 1.5V$</td><td>$\pm 1.2mv$</td><td>$\pm 3.0mv$ (High current range)</td></tr></tbody></table>	Range	Midscale Accuracy	\pm Fullscale Accuracy	$\pm 10V$	$\pm 2.4mv$	$\pm 3.3mv$	$\pm 5V$	$\pm 1.7mv$	$\pm 2.2mv$	$\pm 2.5V$	$\pm 1.4mv$	$\pm 4.0mv$ (High current range)	$\pm 1.5V$	$\pm 1.2mv$	$\pm 3.0mv$ (High current range)
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$\pm 1.5V$	$\pm 1.2mv$	$\pm 3.0mv$ (High current range)														
Output Balance:	10mV maximum HI/LO unbalance; differential configuration.															
Bandwidth:	DC to selected filter corner frequency, or to 350kHz with no filter selected.															
Output Filters:	Selectable as Filter-A, Filter-B; or no filter. The filters are 8th Order continuous-time lowpass, with 75dB typical stopband attenuation at $1.5F_c$ for elliptic response. and are available with corner frequencies up to 250kHz. See "Ordering Options" for details.															
Crosstalk Rejection:	80 dB minimum, DC-50 kHz															
Integral Nonlinearity:	± 0.007 percent of FSR, maximum															
Differential Nonlinearity:	± 0.003 percent of FSR, maximum															

Operating Modes and Control

DAC Clocking Source:	Internal rate generator, external hardware input, or software clock. The internal rate generator is software-controlled with ± 5 PPM accuracy. Supported sample rates include integer multiples of 44.100KSPS, including 352.800KSPS. Custom sample rate scaling is available.
Multiboard Clocking Configurations:	To support the simultaneous clocking of DAC outputs on multiple boards, the 16AO16 is software-selectable as either a clock initiator or a clock target. Initiators provide an output clock for target boards, each of which can retransmit the clock signal to subsequent boards connected in a daisy-chain configuration.
Burst Trigger:	Software control bit, or external TTL/LVDS trigger input (Same as clock I/O option). Burst triggering also can be obtained from an external source.
Update Mode:	Simultaneous or channel-sequential output updating
Active Buffer Size:	From 8 output values to 256K-values, in 2:1 steps, software-selectable.
Buffer Mode:	Selected as Circular for periodic waveforms, or as Open for one-shot functions
Data Format:	Software selected as Offset Binary or Two's complement

PCI Compatibility

Conforms to PCI Specification 2.3, with 66 MHz or 33 MHz bus, and D32 read/write transactions.
Universal I/O supports both 3.3V and 5V signaling.
Multifunction interrupt.
Supports block-mode and demand-mode DMA transfers as bus master.

Power, Mechanical and Environmental Specifications

Power Requirements:

+5.0 VDC ± 0.20 VDC at 4.5 Amps, maximum; 3.8 Amps typical.

Mechanical Characteristics:

Height: 106.7 mm (4.20 in)
Depth: 312.0 mm (12.28 00 in)
Width: 19.0 mm (0.75 in)

Environmental Requirements:

Ambient Temperature Range :	Operating: 0 to +65 degrees Celsius inlet air Storage: -40 to +85 degrees Celsius
Relative Humidity:	Operating: 0 to 80%, non-condensing Storage: 0 to 95%, non-condensing
Altitude:	Operation to 10,000 ft.
Cooling:	Conventional convection cooling.

Ordering Information

Specify the basic model number followed by an option suffix "-A-B-C-D", as indicated below. For example, model number **PCI66-16A016FLV-12-F1-HC-S** describes a PCI module with 12 channels, F1 filters, and High-Current ($\pm 2.5V$, $\pm 1.5V$) single-ended outputs.

Table 1. Ordering Options

Optional Parameter	Value	Specify Option As:
Number of Output Channels:	8 Channels	A = 8
	12 Channels	A = 12
	16 Channels	A = 16
Lowpass Output Filters: *	See Filter Characteristics table	B = F1
		B = F2
		B = F3
Output Range:	High Level ($\pm 10V$, $\pm 5V$)	C = HL
	High-Current ($\pm 2.5V$, $\pm 1.5V$)	C = HC
Output Configuration:	3-Wire Differential	D = D
	2-Wire Single-Ended	D = S

* See Filter Characteristics table. Custom frequencies available from 10kHz to 250kHz. Available characteristics include Butterworth, Elliptic, Bessel and Chebyshev. Contact GSC Solutions for custom requirements.

Table 2. Filter Characteristics

OPTION	FILTER	TYPE *	PASSBAND		STOPBAND **	
			FREQ	ATTEN	FREQ	ATTEN
F1	A	Elliptic	DC - 18.2kHz	$\pm 1dB$	25.9kHz	75dB
	B	Elliptic	DC - 145.6kHz	$\pm 1dB$	207.2kHz	75dB
F2	A	Butterworth	DC - 18.2kHz	$\pm 1dB$ (-3dB at corner)	25.9kHz	72dB
	B	Butterworth	DC - 145.6kHz	$\pm 1dB$ (-3dB at corner)	207.2kHz	72dB
F3	A	Elliptic	DC - 55.0kHz	$\pm 1dB$	78.3kHz	75dB
	B	Elliptic	DC - 145.6kHz	$\pm 1dB$	207.2kHz	75dB
F4						

* 8th order.

** Extends beyond 1.0 MHz.

System I/O Connections

I/O CONNECTOR PIN ASSIGNMENTS

ROW-A		ROW-B	
PIN	FUNCTION	PIN	FUNCTION
1	OUTPUT 00 LO *	1	OUTPUT 09 LO *
2	OUTPUT 00 HI	2	OUTPUT 09 HI
3	OUTPUT RTN 00 ****	3	OUTPUT 10 LO *
4	OUTPUT RTN 01	4	OUTPUT 10 HI
5	OUTPUT 01 LO *	5	OUTPUT RTN 09
6	OUTPUT 01 HI	6	OUTPUT RTN 10
7	OUTPUT RTN 01	7	OUTPUT 11 LO *
8	OUTPUT RTN 02	8	OUTPUT 11 HI
9	OUTPUT 02 LO *	9	OUTPUT 12 LO *
10	OUTPUT 02 HI	10	OUTPUT 12 HI
11	OUTPUT RTN 02	11	OUTPUT RTN 11
12	OUTPUT RTN 03	12	OUTPUT RTN 12
13	OUTPUT 03 LO *	13	OUTPUT 13 LO *
14	OUTPUT 03 HI	14	OUTPUT 13 HI
15	OUTPUT RTN 03	15	OUTPUT 14 LO *
16	OUTPUT RTN 04	16	OUTPUT 14 HI
17	OUTPUT 04 LO *	17	OUTPUT RTN 13
18	OUTPUT 04 HI	18	OUTPUT RTN 14
19	OUTPUT RTN 04	19	OUTPUT 15 LO *
20	OUTPUT RTN 05	20	OUTPUT 15 HI
21	OUTPUT 05 LO *	21	OUTPUT RTN 15
22	OUTPUT 05 HI	22	REM GND SENSE
23	OUTPUT RTN 05	23	OUTPUT RTN 15
24	OUTPUT RTN 06	24	VTEST OUT
25	OUTPUT 06 LO *	25	VTEST RETURN
26	OUTPUT 06 HI	26	DIGITAL RETURN
27	OUTPUT RTN 06	27	TRIG IN HI **
28	OUTPUT RTN 07	28	TRIG IN LO **
29	OUTPUT 07 LO *	29	TRIG OUT HI **
30	OUTPUT 07 HI	30	TRIG OUT LO **
31	OUTPUT RTN 07	31	DAC CLK OUT HI **
32	OUTPUT RTN 08	32	DAC CLK OUT LO **
33	OUTPUT 08 LO *	33	CLOCK I/O HI ***
34	OUTPUT 08 HI	34	CLOCK I/O LO ***

The differential analog output configuration is shown. For optional single-ended outputs, OUTPUT XX HI is an output, and OUTPUT XX LO is not used.

* "No-connect" for the 2-Wire single-ended configuration.

** Software-selectable as LVDS differential pairs. In TTL mode, 'HI' pins are signal pins, and 'LO' inputs should be connected to digital return.

*** Bidirectional synchronization signal.

**** All OUTPUT RTN XX pins are connected together internally

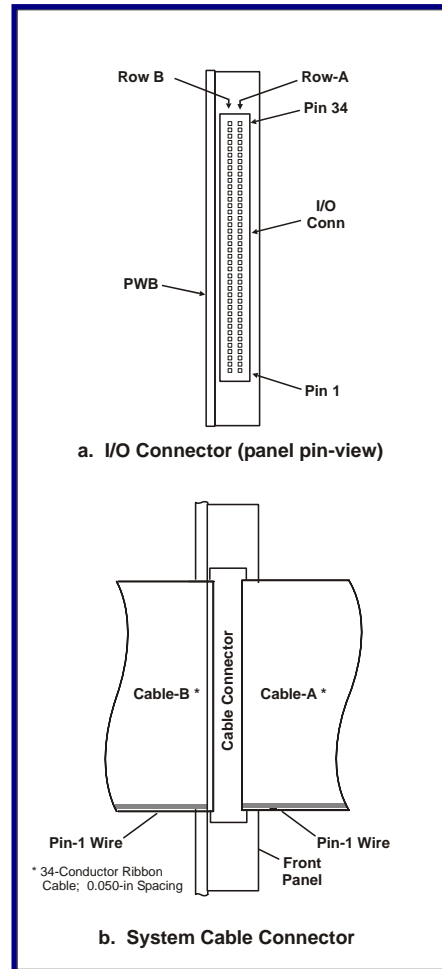


Figure 2. System I/O Connector

System Cable Mating Connector:

68-pin 0.050" Subminiature connector: with metal shield:
AMP #749621-7 or equivalent.

I/O Connector Installed on Board (Ref):

Amp # 787170-7

Channels available in 8-Channel and 12-Channel configurations:

8-Channel Board: Channels 00-07,
12-Channel board: Channels 00-11.

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