General Standards Corporation
High Performance Bus Interface Solutions

PCIe-16AOF64

16-Bit, 64/32-Channel, 500KSPS PCI Express Analog Output Board

With Reconstruction Output Filters

Features Include:

- **Precision 16-Bit simultaneously-clocked analog outputs: R-2R DAC per channel**
- **Available with either *64 single-ended* outputs, or *32 balanced-differential* outputs**
- **Software-selectable ranges of ±10V, ±5V. Optionally 0 to +10V, or 0 to +5V.**
- **Output clocking rates from zero to 500K samples per second per channel.**
- **Reconstruction filter in each output channel: 6th order Lowpass, 300Hz-100kHz.**
- **Optional Outputs-Disconnect feature supports multiple-board redundancy, and eliminates outputs activity during autocalibration**
- **Remote ground-sense input minimizes the effects of interground potentials**
- Supports both Block-mode and Demand-mode DMA transactions
- 256K-Sample output data FIFO buffer; Configurable as open or closed (circular)
- Simultaneous output clocking, with emulated sequential outputs also supported
- Multiboard synchronization supported
- Continuous and Triggered-Burst output modes support seamless waveform sequencing
- Data clocking rate controlled internally or externally
- High accuracy ensured by on-demand Autocalibration of all channels
- x1 Link PCI Express Port operating at 2.5Gbps
- Available on multiple form factors, including PCI, and cPCI, as well as PC104-*Plus*, PMC, PCIX and cPCIX with reduced channel count. Contact Sales for availability

Applications Include:

- ✓ Precision Voltage Array
- ✓ High Density Outputs
- ✓ Servo Control
- ✓ Sonar
- ✓ Waveform Synthesis
- ✓ Industrial Robotics

***** Preliminary Advance Information ****

REV: 111717DRFT

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FUNCTIONAL DESCRIPTION

The PCIe-16AOF64 is a precision 16-Bit analog output product that provides 64 simultaneously clocked output channels in a PCI Express form factor. Outputs can be clocked at rates up to 500 KSPS per channel, and are supported by a 256K-Sample FIFO data buffer. Both continuous and burst clocking modes are supported, and voltage ranges are software-selectable as ±10V or ±5V; or optionally as 0 to +10V or 0 to +5V. Clocking and triggering rates can be derived from an internal rate generator, or from external clock and trigger sources to support the synchronous operation of multiple boards. When equipped with the optional outputs-disconnect feature, the outputs can be disconnected from the system I/O connector under software control.

All outputs can be operated with or without 6th order lowpass reconstruction filters, under software control. Filter corner frequency can be specfied from 300Hz to 100kHz, with Butterworth or Chebyshev characterstics.

Each analog output channel implements an R-2R DAC, which minimizes latency and has no minimum clocking rate. The outputs can be factory-configured for single-ended operation or for 3-wire balanced differential operation.

On-demand autocalibration determines and applies error correction for all output channels.

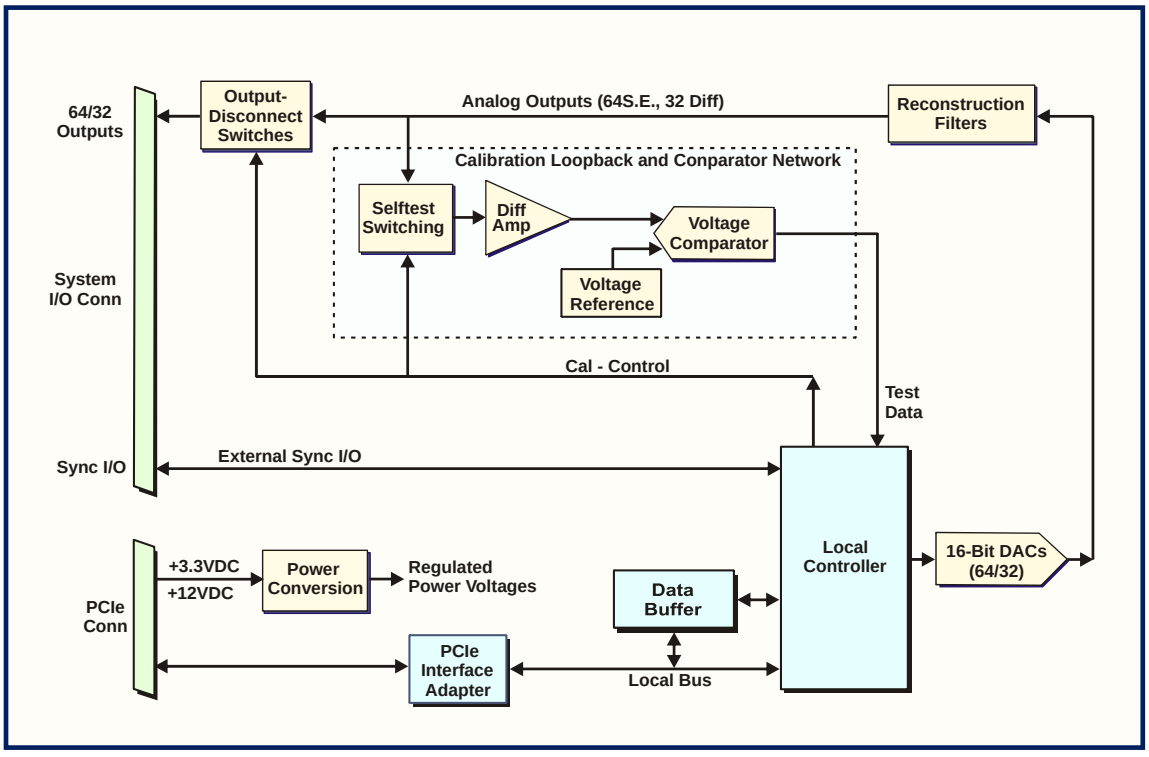

Figure 1. PCIe-16AOF64; Functional Organization

Power requirements consist of +12VDC and +3.3VDC in compliance with the PCI Express specification, and analog power voltages are generated internally. Operation over the specified temperature range is achieved with conventional air cooling.

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PERFORMANCE SPECIFICATIONS

At +25 ^{O}C, with specified operating conditions

Analog Output Characteristics:

Configuration:	64 simultaneously clocked single-ended output channels with a dedicated 16-Bit R-2R DAC per channel. Optionally available as 32-Channel 3-wire balanced differential. 32SE and 16Diff versions also available
Voltage Ranges:	Software-selectable as ±10V or ±5V. Optionally as 0 to +10V or 0 to +5V. (Contact Sales for other, custom ranges)
Output Resistance:	1.0-Ohm maximum at I/O connector pins, without outputs-disconnect option; or 2.5-Ohm maximum with outputs-disconnect. (Greater than 50 K-Ohms if the outputs-disconnect feature is installed and enabled).
Output protection:	Withstands sustained short-circuiting to ground
Loading:	Zero to ±5ma, any single channel. *Maximum total of 64mA on all outputs.* Stable with any load capacitance up to 20,000 PFD.
Line Imbalance:	(With optional 3-Wire differential output configuration) ±10mV max.
Signal/Noise Ratio (SNR):	Filters Disabled: 85dB typical on ±10V range; 10Hz - 250kHz. Filters Enabled: Determined by output filter; See ordering options.
Glitch Impulse:	10 nV-s, typical on the ±10V range

Analog Output Transfer Characteristics:

Resolution:	16 Bits (0.0015 percent of FSR)		
Output Access:	256 K-Sample FIFO buffer.		
DC Accuracy: (Max error, no-load)	S.E. Range	S.E. Zero Accuracy	S.E. ±Fullscale Accuracy
	±10V	±2.4mV	±3.3mV
	±5V	±1.7mV	±2.5mV
	0 to +10V	±2.2mV	±3.1mV
	0 to +5V	±1.5mV	±2.3mV
	Diff Range*	Diff Zero Accuracy	Diff +Fullscale Accuracy
	±10V	±2.4mV	±5.0mV
	±5V	±1.7mV	±3.0mV
	0 to +10V	±2.2mV	±4.5mV
	0 to +5V	±1.5mV	±2.6mV
	* Differential output is measured between the even (HI) and odd (LO) outputs in each even-odd channel pair.		
Output Clocking Rate:	0-500KSPS		
Bandwidth (-3dB):	Output Filters disabled. Greater than 200kHz. Filters Enabled: Determined by output filter; See ordering options.		
Settling Time:	Filters Disabled: 4us to 0.1 percent of step, typical with halfscale step. Filters Enabled: Determined by output filter; See ordering options.		
Crosstalk Rejection:	90 dB minimum, DC-100 kHz		
Integral Nonlinearity:	±0.008 percent of FSR, maximum		
Differential Nonlinearity:	±0.0035 percent of FSR, maximum (15 Bits DNL). Monotonic to 16 Bits.		
Remote Ground Sense	Input resistance approx 30KOhm when enabled, >1 Megohm when disabled. Input range: ±2.0V; Protected to ±25V Correction accuracy: ±1-percent. Bandwidth: DC-10kHz.		

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Analog Output Operating Modes and Controls

Output Data Buffer:	256 K-sample FIFO
Sample Clock Sources:	Internal rate generator; External Clock I/O, Software clock. 500kHz max.
Triggering Sources:	Internal rate generator, TTL external trigger I/O, Software trigger.
Clocking Modes:	Continuous or periodic. Supports triggered functions.
Internal Rate Generator:	Programmable from 3 to 500,000 output clocks per second. Divides Master Clock frequency to clocking rate using a 24-bit divider.
Output Filters:	Selectable as 6th order lowpass output filters, or as no output filters.
External Sync I/O:	Bidirectional Clock and trigger, TTL
Output Data Format:	16 Bits, selectable as offset binary or two's complement coding, with attached end-of-function flag and channel number.
Outputs Disconnect: (Optional)	A single control bit disconnects all outputs from the system I/O connector.

PCIe Compatibility:

Conforms to PCI Express Specification revision 1.0a.
DMA transfers as bus master with two DMA channels.

Power Requirements:

+3.3VDC ±0.2 VDC from the PCIe bus, 0.9 Amps typical, 1.0 Amps maximum.
+12VDC ±0.4 VDC from the PCIe bus, 1.2 Amps typical, 1.4 Amps maximum.
Total power consumption: 14 Watts typical, 16 Watts maximum.
All outputs loaded with 1.0mA:

Physical Dimensions::

Height: 110.1 mm (4.37 in)
Width: 18.7mm (0,74 in) not including bracket..21.6 mm (0.85 in) with Bracket.
Depth: 312.0 mm (12.28 in)

Environmental Specifications:

Ambient Temperature Range:	
Standard Temperature:	Operating: 0 to +70 Degrees Celsius * Storage: -40 to +85 Degrees Celsius
Extended Temperature:	Operating: -40 to +80 Degrees Celsius * Storage: -40 to +85 Degrees Celsius
	* Air temperature at board surface.
Relative Humidity:	0 to 95%, non-condensing
Altitude:	Operation to 10,000 ft.
Cooling:	Conventional air cooling; 150 LFPM

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Ordering Information:

Specify the basic product model number followed by an option suffix "-A-B-C-D-E-F", as indicated below. For example, model number **PCIe-16AOF64-64S-BP-F1-49.152M-OD-0** describes a module with 64 single-ended output channels, bipolar output ranges, 800Hz Butterworth output filters, standard 49.152MHz master clock, Outputs-Disconnect feature installed, and no special features

Table 1. Ordering Options

Optional Parameter	Value	Specify Option As:
Number of Channels:	64 Single-ended output channels	A = 64S
	32 Differential output channels	A = 32D
	32 Single-ended output channels	A = 32S
	16 Differential output channels	A = 16D
Output Ranges:	Bipolar: Software-selectable ±10V, ±5V.	B = BP
	Unipolar: Software-selectable 0 to +10V, 0 to +5V.	B = UP
Output Filters	800Hz Butterworth, 6th Order	C= F1
	(TBD)	C= F2
	---	C= Fx
Master Clock Frequency [1]	49.152MHz	D= 49.152M
	(TBD)	D= (TBD)
Outputs Disconnect Feature	No Outputs Disconnect	E = 0
	Outputs-Disconnect Feature Installed	E = OD
Special Features:	---	F = 0 or blank

[1] ±0.005% typical. Call Sales for availability of optional master clock frequencies from 49MHz to 51MHz.

Table 2. Output Filter Characteristics

		Passband		Stopband [2]	
Option	**Type** [3]	**Frequency** [4] (300Hz to 100kHz)	**Attenuation at Corner Frequency**	**Frequency (Typ)**	**Attenuation, (Min)**
F1	Butterworth	DC - 800Hz	3dB	2.7kHz	60dB
F2	---	---	---	---	---
F3	---	---	---	---	---
F4	---	---	---	---	---

[2] Extends beyond 1.0 MHz.
[3] Specify **Butterworth or Chebyshev Elliptic**; 6th order lowpass; 200Hz to 100kHz.
[4] ±4% typical.

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Table 2. System I/O Connector

Single-Ended Signal *		
Pin	Row-A	Row-B
1	OUT00	OUT34
2	OUT01	OUT35
3	OUT02	OUT36
4	OUT03	OUT37
5	OUT04	OUT38
6	OUT05	OUT39
7	OUT06	OUT40
8	OUT07	OUT41
9	OUT08	OUT42
10	OUT09	OUT43
11	OUT10	OUT44
12	OUT11	OUT45
13	OUT RTN	OUT RTN
14	OUT RTN	OUT RTN
15	OUT12	OUT46
16	OUT13	OUT47
17	OUT14	OUT48
18	OUT15	OUT49
19	OUT16	OUT50
20	OUT17	OUT51
21	OUT18	OUT52
22	OUT19	OUT53
23	OUT20	OUT54
24	OUT21	OUT55
25	OUT22	OUT56
26	OUT23	OUT57
27	OUT RTN	OUT RTN
28	OUT RTN	OUT RTN
29	OUT24	OUT58
30	OUT25	OUT59
31	OUT26	OUT60
32	OUT27	OUT61
33	OUT28	OUT62
34	OUT29	OUT63
35	OUT30	OUT RTN
36	OUT31	OUT RTN
37	OUT32	DIG RTN
38	OUT33	CLK I/O
39	OUT RTN	DIG RTN
40	REM GND	TRIG I/O

Differential Signal *		
Pin	Row-A	Row-B
1	OUT00 HI	OUT17 HI
2	OUT00 LO	OUT17 LO
3	OUT01 HI	OUT18 HI
4	OUT01 LO	OUT18 LO
5	OUT02 HI	OUT19 HI
6	OUT02 LO	OUT19 LO
7	OUT03 HI	OUT20 HI
8	OUT03 LO	OUT20 LO
9	OUT04 HI	OUT21 HI
10	OUT04 LO	OUT21 LO
11	OUT05 HI	OUT22 HI
12	OUT05 LO	OUT22 LO
13	OUT RTN	OUT RTN
14	OUT RTN	OUT RTN
15	OUT06 HI	OUT23 HI
16	OUT06 LO	OUT23 LO
17	OUT07 HI	OUT24 HI
18	OUT07 LO	OUT24 LO
19	OUT08 HI	OUT25 HI
20	OUT08 LO	OUT25 LO
21	OUT09 HI	OUT26 HI
22	OUT09 LO	OUT26 LO
23	OUT10 HI	OUT27 HI
24	OUT10 LO	OUT27 LO
25	OUT11 HI	OUT28 HI
26	OUT11 LO	OUT28 LO
27	OUT RTN	OUT RTN
28	OUT RTN	OUT RTN
29	OUT12 HI	OUT29 HI
30	OUT12 LO	OUT29 LO
31	OUT13 HI	OUT30 HI
32	OUT13 LO	OUT30 LO
33	OUT14 HI	OUT31 HI
34	OUT14 LO	OUT31 LO
35	OUT15 HI	OUT RTN
36	OUT15 LO	OUT RTN
37	OUT16 HI	DIG RTN
38	OUT16 LO	CLK I/O
39	OUT RTN	DIG RTN
40	REM GND **	TRIG I/O

* Outputs can be factory-configured for either single-ended or differential operation. In the differential configuration, odd-numbered channels become the 'LO' inputs of differential channel pairs.

** Ground or leave disconnected for the differential configuration.

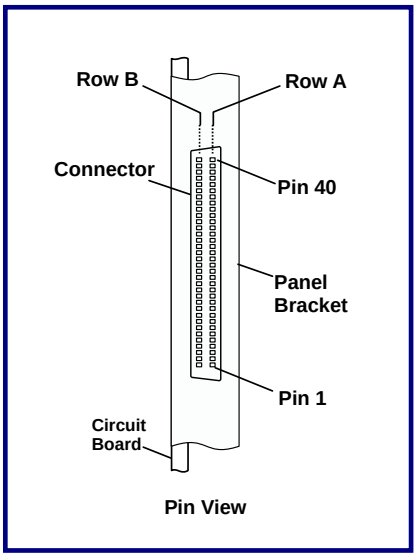

Figure 2. System I/O Connector

System Mating Connector:

Standard 80-pin 0.050" dual-ribbon socket connector:

Robinson Nugent **P50E-080S-TG** or equivalent.

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