8 MHz 16-bit Analog Output USB Module

Hardware Manual

Model USB-AO-ARB1

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MADE IN THE USA

Chapter 1: Quick Start

It is recommended that you install the software package before connecting the USB module to your computer. You can install the software[1] using either a stand-alone installer downloaded from the website or an optional Software Master CD.

Run the installer you downloaded (or autorun.exe on the Software Master CD) and follow the prompts to install the software for your device.

Once the software has been installed: If your device is configured to use external power, connect the voltage source to the device, then turn on the power. Plug the USB cable into both the USB module and your system.

As soon as the green Power/Activity LED lights, your new analog output is ready to use; you can run any of the provided sample programs to begin using the device.

If, for any reason, the Power/Activity LED does not light, launch Device Manager and look under the "Data Acquisition" section. If the USB device displays a warning triangle, right-click and select "Update Driver".

Please note: during the installation you may be prompted regarding the installation of non-WHQL-certified drivers; please carefully confirm the digitally signed source of the drivers and accept the installation.

[1] In Linux or OSX please refer to the instructions in those directories.

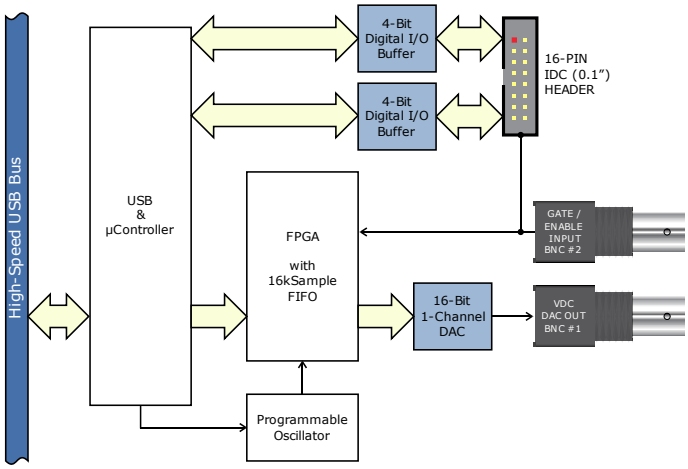
Chapter 2: Introduction

USB, the world's most popular peripheral interconnect bus, provides an easy way to add capabilities of all kinds to your system. Although originally intended for Human Interface Devices like mice and keyboards, advances to the specification enabled reliable and high speed connectivity for everything from audio devices to frame grabbers.

FEATURES

- High-speed USB 2.0 device (USB 3.0+ compatible), w/High-retention USB connector
- Fast waveform output; up to 8M samples/sec
- Small, portable digital to analog single-ended output at 16-bit resolution
- 16 k sample FIFO buffer on-board
- Jumper selectable analog output ranges of 0-2.5V, 0-5V, 0-10V, ±2.5V, ±5V, ±10V
- Two 4-bit I/O ports independently selectable for inputs or outputs
- All 8 DIO lines buffered with Sink 32mA / Source 32mA current capabilities
- Jumper selectable 10k ohm Pull-up/Pull-down resistors on DIO lines
- Standard 16-pin IDC connector for DIO and GATE
- BNC connectors for DAC output *and* Gate Control
- PC/104 module size and mounting compatibility
- Alternate embedded USB connector
- Small, rugged, industrial enclosure

The USB-AO-ARB1 features one single-ended analog output on a type BNC connector running at up to 8MHz of continuous conversions. The board includes a programmable clock capable of 1K - 8MHz transfers through a 16k word FIFO.



In addition to the one analog output, there are eight standard digital I/O channels software configurable as two separate ports for input or output (see block diagram).

All required power is normally supplied to the board via the USB cable, however for higher current sourcing capabilities, optional external power may be used. Pull-ups or pull-downs on the board assure that I/O lines are at a known state at power-up until the board is initialized by system software. The I/O wiring connections for the digital I/O lines on the USB-AO-ARB1 are via a 16-position industry standard IDC connector.

The USB-AO-ARB1 is designed to be used in rugged industrial environments but is small enough to fit nicely onto any desk or testing station. The board itself is PC/104 sized (3.550 by 3.775 inches) and ships inside a steel powder-coated enclosure with an anti-skid bottom.

Control is possible either with custom application software, with off-the-shelf applications (such as LabVIEW), or with provided samples and utilities, including samples in Windows XP through 8.1, and Linux.

The analog output and gate input signals are accessed using industry standard BNC connectors for assured signal integrity. The

8 digital I/O signals are connected via a right-angle IDC 16-pin (0.1" spacing) boxed and keyed header.

Refer to Chapter 4 for additional information regarding user-selectable option settings for this device including analog output range, polarity, and digital I/O bias selection.

Chapter 3: Hardware

This manual applies to the following model:	
USB-AO-ARB1	One 16-bit 8MHz Analog Output on USB

This unit is PC/104 sized and mounting-compatible (3.55" x 3.775") with a standard steel powder-coated enclosure (4" x 4.08" x 1.05"). This device is available RoHS compliant, and supports Industrial temperature environments (-40°C to 85°C operating, -65°C to 150°C storage) as an option. Additional options include 3.3V compatible digital I/O and screw-terminal connectivity for positive external power retention (replaces the DC input jack).

A green LED provides Power and Activity status. A solid green light means the firmware has been successfully loaded and executed; a flickering light indicates activity.

INCLUDED IN YOUR PACKAGE

USB module (installed in labeled enclosure)
6' USB cable

Available accessories include:	
UTBK-16	Direct-connect 16-pin Screw Terminal board
CAB-BNC-6	Standard 6-foot co-axial cable, male BNC connectors
CAB-BNC-CLIP	3-foot co-axial BNC to mini-grabber test clip cable
MP104-DIN	DIN-rail mounting kit

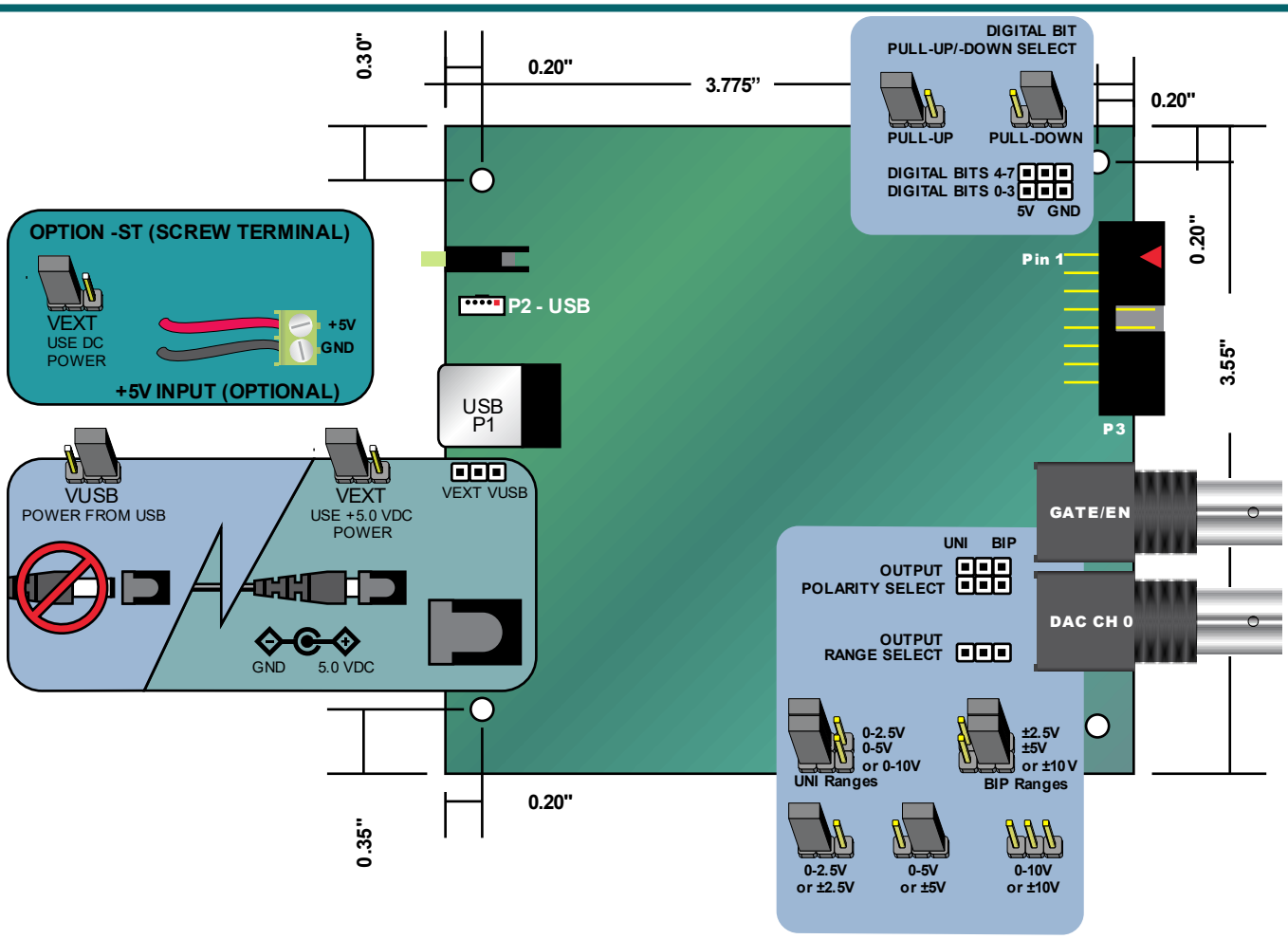
Contact the factory for information regarding additional accessories, options, and specials that may be available to best fit your specific application requirements.

Factory Options include:	
-OEM	Board only, without enclosure, features PC/104 module size and mounting compatibility
-T	Extended Temperature (-40°C to 85°C)
-PR	+5VDC regulated AC/DC supply and onboard DC-power input jack
-ST	Screw terminals installed for DC-power input (no jack, no wall-wart)
-LV	Replaces +5VDC digital logic with +3.3V compatible I/O

Chapter 4: Configuration Settings

This product has several physical settings you should configure before connecting it to the computer. You can run the provided Windows Settings Program for a visual walk-through while configuring the settings, or refer to the image above and instructions below. You will need a Philips screw-driver to open the enclosure. Please follow ESD precautions while configuring settings.

- Digital I/O:
  - For each 4-bit port select between Pull-Up (to Vcc[1] via 10kΩ) or Pull-down (to GND via 10kΩ). You may also configure a DIO port for neither pull-up nor pull-down (unbiased) by removing the option selection jumper entirely. Note 1: Vcc is 5VDC (or 3.3VDC if the –LV option was specified)
- Analog Output:
  - Choose the full-scale output voltage from 2.5, 5, or 10VDC.
  - Choose Unipolar or Bipolar output range (Unipolar goes from 0 to full-scale while Bipolar is from negative to positive full-scale). Please ensure you move *both* Polarity Select jumpers to the same "left" or "right" pair of posts as shown in the drawing, above.
- Power Input:
  - Choose to use power as provided by the USB cable, or to use external power (as provided to the DC Jack or screw terminals (-ST option)).



Option Selection Map & Dimension Drawing

Chapter 5: PC Interface

The USB-AO-ARB1 is a USB 2.0 High-Speed device compatible with 2.0 and 3.0 USB ports.

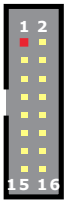
The ubiquitous USB port provides a convenient and hot-pluggable interface for adding this high-speed waveform output DAC board to most any existing system.

In addition to the industry standard type-B USB connector an alternate micro-fit embedded USB header connector is provided. This connector provides a very small footprint, latching signal interface that avoids the stiff and bulky USB cable.

The USB-AO-ARB1 can be powered via the USB cable (a powered USB port is required), or from external +5VDC power supplied via either a DC-jack (option -PR) or screw terminals (option -ST).

Chapter 6: I/O Interface

A total of three I/O connectors are provided on this device. A 16-pin right-angle shrouded and keyed male 0.1" spacing IDC header contains the digital I/O bits and a digital input dedicated for use as a waveform GATE signal. A pair of BNC connectors provide the analog waveform output, and an alternate method of connecting the GATE signal.



	Pin	Signal Names	Description	Pin	Signal Names	Description
Direction group 0	1	DIO #0	Digital I/O bit 0	2	GND	Ground
	3	DIO #1	Digital I/O bit 1	4	GND	Ground
	5	DIO #2	Digital I/O bit 2	6	GND	Ground
	7	DIO #3	Digital I/O bit 3	8	GND	Ground
Direction group 1	9	DIO #4	Digital I/O bit 4	10	GND	Ground
	11	DIO #5	Digital I/O bit 5	12	GND	Ground
	13	DIO #6	Digital I/O bit 6	14	GND	Ground
	15	DIO #7	Digital I/O bit 7	16	/TX_EN	GATE Input

The pair of BNC connectors are industry standard "female" identical to those you would find on test equipment anywhere.

All DIO bits can be pulled up or down via jumper selection (in two groups of four bits each). Pull-ups are generally used with input mode (to make contact-closure monitoring easy), while outputs are best configured for pull-downs (so external devices don't activate while the computer is booting).

The /TX_EN signal is available on both the 16-pin header and on a BNC connector. It is an active low GATE signal and is pulled down at the factory: to inhibit output bring the /TX_EN pin high.

All pull-up/pull-down resistors are 10kΩ.

Chapter 7: Software Interface

The USB-AO-ARB1 utilizes a high-speed custom function driver optimized for maximum continuous data throughput of up to 16MB/s that is hundreds to thousands of times faster than the USB human interface device (HID) driver used by many competing products.

This approach maximizes the full functionality of the hardware along with capitalizing on the advantage of high-speed USB 2.0.

The boards are supported for use in most USB supported operating systems and includes a free Windows and Linux compatible software package. This package contains sample programs and source code in C# (.NET), Delphi, and Visual C++, for Windows.

Third party support includes a Windows standard DLL interface usable from the most popular application programs and includes example LabVIEW VIs. Embedded OS support includes XP Embedded and Windows Embedded Standard. Full driver source code is provided to assist supporting any and all Operating Systems.

Numerous sample programs are provided to demonstrate using the API. Some example functions are shown, below:

```
UInt32 GetDeviceByEEPROMByte(); // Find an installed
        device with a specific BoardID stored in the
        first byte of onboard "user" EEPROM.

UInt64 DACOutputProcess(UInt32 DeviceIndex, ref double
        ClockHz, UInt32 NumSamples, UInt16[]
        SampleData); // Output a waveform dataset one
        time

UInt64 DACOutputFrameRaw(UInt32 DeviceIndex, UInt32
        FramePoints, UInt16[] FrameData); // add data to
        the current waveform buffer for output

UInt64 DACDirect(UInt32 DeviceIndex, UInt16 Channel,
        UInt16 Counts); // update the DAC output in
        "immediate" mode; i.e., changes the voltage
        being output
```

Our drivers and DLLs usually shield you from needing to know these details, but for advanced use the following information may be helpful:

Before the firmware has been loaded and initialized the device appears to your system as a VID/PID pair of 1605/0068.

Once the firmware has been successfully loaded and is running the device appears as a VID/PID of 1605/8068.

This information is primarily useful if you'll be using more than one board in the same computer, all using the same AIOUSB driver.

The latest information can always be found on the product page on the website. Here are some useful links:

Links to useful downloads	
Main web site	http://acces.io
Product web page	acces.io/USB-AO-ARB1
This manual	acces.io/MANUALS/USB-AO-ARB1.pdf
Windows Software	acces.io/files/packages/USB-AO-ARB1
Install Package	Install.exe

Chapter 8: Specifications

PC Interface

USB	USB 2.0 or 3.0+, High-Speed
Connector	High-retention type USB-B, complies with the class 1, Div II, minimum withdrawal requirement of over 3 pounds of force (15 Newtons)
Alternate, Embedded Connector	Latching small-form-factor "UP" connector Molex 53047-0510. The mating connector is Molex 51021-0500.

Analog Output Interface

Output Connector	BNC, female
Analog Output	1, Single-Ended
Resolution	16-bit
Unipolar Ranges	2.5V, 5V, 10V
Bipolar Ranges	±2.5V, ±5V, ±10V
Waveform Output Rate	1kHz to ≥8MHz via onboard oscillator
Relative Accuracy	±4 LSB, typical
Differential Non-Linearity	±2 LSB, typical
Settling Time	70ns, typical
Output Current	±6mA
Waveform Features	16kSample FIFO (32kBytes) GATE input Onboard intelligence

Digital Input / Output Interface

I/O Connector	Right-angle IDC 16-pin (0.1") boxed and keyed header
Gate Connector	BNC, female; also on IDC pin 16

Digital Outputs	**5V Logic**
High-output Voltage	3.8VDC, min
Low-output Voltage	0.55VDC max
Sink Current	32mA
Source Current	32mA
	3.3V Logic
High-output Voltage	2.4VDC, min
Low-output Voltage	0.55VDC max
Sink Current	24mA
Source Current	24mA
Digital Inputs	**5V Logic**
High-input Voltage	3.5VDC min, 5.5VDC max
Low-input Voltage	1.5VDC max, -0.5VDC min
	3.3V Logic
High-input Voltage	2.0VDC min, 5.5VDC max
Low-input Voltage	0.8VDC max, -0.5VDC min

Environmental	
Operating temperature	
Commercial (Standard)	0° to 70°C
Industrial (-T)	-40° to 85°C
Storage temperature	-50° to 125°C
Humidity	5% to 95%, non-condensing
Power required	370 mA typical (no load) +5VDC, regulated

If using more than 500mA, or your USB port/hub has less than the 500mA normally available, use optional 5VDC external power supply (-PR option) and move the Vusb jumper to the Vext position. Connect external power before plugging in the USB cable.

Physical	
Size	3.550 x 3.775 inches *PC/104-size*
Enclosure Size	3.990 x 4.075 x 1.045 inches
Weight	75.5 grams

CHAPTER 9: CERTIFICATIONS

CE & FCC

These devices are designed to meet all applicable EM interference and emission standards.

ROHS / LEAD-FREE STATEMENT

All models are available in compliance with RoHS and various other lead-free initiatives. Make sure to specify "–RoHS" when placing your orders.

WARNING

A SINGLE STATIC DISCHARGE CAN DAMAGE YOUR CARD AND/OR CAUSE PREMATURE FAILURE! PLEASE FOLLOW ALL REASONABLE PRECAUTIONS TO PREVENT A STATIC DISCHARGE.

ALWAYS CONNECT AND DISCONNECT YOUR FIELD CABLING WITH THE POWER TO THE DEVICE OFF. CONNECTING CABLES TO A DEVICE WITH THE DEVICE OR FIELD POWER ON MAY CAUSE DAMAGE TO THE I/O CARD AND WILL VOID ALL WARRANTIES, IMPLIED OR EXPRESSED.

WARRANTY

Prior to shipment, ACCES equipment is thoroughly inspected and tested to applicable specifications. However, should equipment failure occur, ACCES assures its customers that prompt service and support will be available. All equipment originally manufactured by ACCES which is found to be defective will be repaired or replaced subject to the following considerations

TERMS AND CONDITIONS

If a unit is suspected of failure, contact ACCES' Customer Service department. Be prepared to give the unit model number, serial number, and a description of the failure symptom(s). We may suggest some simple tests to confirm the failure. We will assign a Return Material Authorization (RMA) number which must appear on the outer label of the return package. All units/components should be properly packed for handling and returned with freight prepaid to the ACCES designated Service Center, and will be returned to the customer's/user's domestic site freight prepaid and invoiced.

COVERAGE

FIRST THREE YEARS: Returned unit/part will be repaired and/or replaced at ACCES option with no charge for labor or parts not excluded by warranty. Warranty commences with equipment shipment.

FOLLOWING YEARS: Throughout your equipment's lifetime, ACCES stands ready to provide on-site or in-plant service at reasonable rates similar to those of other manufacturers in the industry.

EQUIPMENT NOT MANUFACTURED BY ACCES

Equipment provided but not manufactured by ACCES is warranted and will be repaired according to the terms and conditions of the respective equipment manufacturer's warranty.

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