

AO-16 Instuction Manual

Introduction

Thank you for purchasing the AO-16 Midi controlled Analog I/O unit. The AO-16 is part of our BB-200 series of 1/4 rack space, Midi based controllers. It responds to either 16 consecutive Midi Continuos Controller messages or Midi Pitchbend messages on each of the 16 Midi channels to produce 16 separate 0-10 or 0-5 volt outputs (internal jumper setting) at resolutions up to 12 bit (4096 discreet steps). If you ordered your unit with the digital output option, then instead of 16 analog outputs, it will provide 8 analog outputs and 8 open collector, 500ma drive, digital On/Off only outputs that respond to Midi Note On/Off commands.

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SETUP

The AO-16 is very simple to setup. No software or special program is required. The front panel DIP switches provide all the basic functions. With these switches, you can set the Midi Channel and starting Offset of the first output (Controller mode only), or put the unit into high resolution Pitchbend mode.

Midi Tutorial:

Every Midi cable can carry multiple types of Midi commands. These commands are broken up further into 16 separate Midi channels, each channel having access to all the same Midi commands. For example, you can have a Note On command on channel 1, and another Note On command on channel 2 on the same cable and they won't interfere with each other.

Most Midi commands have a maximum resolution of 7 bits, or 128 discreet values. Most commands have 128 "values" with each value having 128 variations. The commands that we are concerned with typically are Note On/Off and Controller commands.

Note On/Off:

We use Midi Note On/Off commands to control digital On/Off outputs in our BB-200 series units. Each Note command has 3 values that are transmitted with it; Midi Channel (1-16), Note number (0-127), and velocity (0-127). To activate a particular digital output on a BB-200 unit such as our DO-16 or AO-16 with digital option, you must transmit the Note On or Off command on the proper Midi channel, with the proper Note number, and the proper velocity (velocities greater than 0 are on, 0 is off). Each BB-200 can be assigned to any 1 of the 16 Midi channels via the front panel DIP switches. The number that each output responds to is set with the Offset DIP switches. Whatever offset the unit is set to, the first output will respond to that number, and the next 15 outputs will respond to consecutively higher numbers. For example, with an offset of "0" and a Midi Channel setting of "1" (default setting), the first output will respond to Note On/Off commands on Midi channel 1, note number "0", the next output will respond to Ch 1, number 1, etc.

Controllers:

Midi Continuous Controllers are used to activate the 16 analog outputs on our AO-16 when it is in controller mode. Each Controller message has 3 parts to it; Midi Channel (1-16), Controller Number (0-127), and value (0-127). Each output on the AO-16 can thus be set to any voltage between 0-10 volts with a resolution of 128 steps. For example, the first output of a unit with a Midi Channel setting of 2 and an offset of 16 would respond to Midi Controller messages on Ch2, Controller number 16. A value of "0" in this message would set the voltage to 0 volts, a value of 64 would set the voltage to 5 volts, and a value of 127 would set the voltage to 10 volts.

Pitchbend:

A special case in the Midi command set is Pitchbend. Each Midi channel has only 1 pitchbend command. Thus we can have a maximum of 16 Pitchbend commands on a single Midi cable, each on one of the 16 Midi channels. The advantage of Pitchbend commands is that they are a high resolution command. They have 128 X 128 or 16384 discreet steps that they can set an output to instead of only 128 discreet steps that we can achieve with a controller command. When the AO-16 is set to Pitchbend Mode, It ignores the Midi channel setting and the Offset setting and reassigns each of the 16 analog output to a Pitchbend command on the 16 Midi channels. Even though each Pitchbend command has a resolution of 16384 steps, the Maximum resolution of the AO-16 is 4096 (12 bit) steps. This is quite sufficient for almost any application. The unit automatically “rounds down” the higher resolution Pitchbend command to the nearest 12 bit value and sets the output voltage accordingly. This mode is preferable to the Controller mode as it gives you more control over the voltage and a smoother output. [Please note: Most Midi devices do not generate high resolution Pitchbend. Although they do generate Pitchbend, they typically only send 128 discreet values and simply skip all the in between values. Most sequencers though, will record the higher resolution commands if you can generate them . Contact MediaMationa for more information about our high resolution Pitchbend generators and other options.]

Please see the accompanying diagrams and charts for the settings of the DIP switches.

Rear Panel Connectors

Power Options

NOTE: The AO-16 can receive its power from 2 different methods. **It is important that you only use one of these methods at a time.**

Rear Panel Power Jack:

This jack will supply power to AO-16's internal electronics directly.. It requires any supply of AC or DC between 12-24 volts in order to function properly. Polarity (+ and - of the supply) does not matter as the unit has a full bridge rectifier inside.

Midi In or Out/Thru Phantom Power:

Although a Midi jack has 5 connections, only 3 are used for the actual Midi signal. It is a fairly common practice to use the other 2 connections to provide “phantom power” to other devices. Our BB-200 units take advantage of this. On the AO-16, you can receive or transmit power via either or both of the rear panel Midi jacks. A jumper near each of these jacks inside the unit determines whether the unused pins on each of the Midi jacks are connected to the AO-16 power circuit or not. Typically, you can power several BB-200 units from a single source using this method. If you are receiving or sending power from the Midi In jack, put jumper JMP5 in the enable position. If you are receiving or sending power from the Midi Out/Thru jack, put jumper JMP4 in the enable position.

Notes:

Remember, if you are using the Power in Jack to supply power to the AO-16, you can then transmit that power to other BB-200 units via the Midi jacks, but make sure that none of them are also trying to transmit Power back to your unit. By removing both of the jumpers, or placing them in the Disable position, you are isolating the AO-16 power circuit and you *must* use the Power In jack to supply power to the unit.

Also, check your Midi cables before you use Phantom Power. Many Midi cables are only “3 wire” type and have no connections to the 2 unused pins. In order to utilize the Phantom Power option, you must use Midi cables with all 5 pins wired through.

Midi In Jack

The Midi In jack receives Midi information from your Midi source. This can be a sequencer, an RP-16 unit, a control console such as the PC-1600, or any other Midi source. This input jack follows the full Midi specification and is opto-isolated

Midi Out/Thru

The Midi Out/Thru jack re-transmits any Midi data that is received in the Midi In jack to send to other units in the Midi chain. The AO-16 does not generate any Midi data on its own, so this jack operates strictly as a Midi Thru jack and provides an exact reflection of the Midi data that is received at the Midi In jack. A unique feature of all of the BB-200 units is that any data coming out of the Midi Out/Thru jack is totally processed and re-generated. This means that there is no signal degradation at all and the Midi signal emanating from this jack is brand new “fresh” data. As such, there is a small timing delay (less than 1 millisecond), but you can daisy chain as many BB-200 units together as you wish without having to worry about the typical signal limitations of only 3 devices on a Midi chain that most Midi devices have. You can have 25 BB-200 series units daisy chained together and the last unit in the chain will have just as solid and undistorted a data signal as the first unit in the chain. In fact, an incoming Midi signal that has some distortion on it is actually re-transmitted out the Midi Thru jack as a new, undistorted signal in better shape than when it arrived.

DB-25 I/O Connector

This connector carries all the output signals to your external equipment. It is a standard DB-25 connector socket. Mating connectors are readily available at most electronic, computer, or Radio Shack stores. Please see accompanying diagram for the specific signals at each pin on this connector.

FRONT PANEL INDICATORS

DIP Switches

These are used to set the Mode (Controller or Pitchbend), Midi channel, and starting Offset. Please refer to the accompanying diagrams for the different settings.

Power LED

This LED will illuminate whenever the unit is powered up.

Midi LED

This LED is used to indicate incoming Midi messages received at the Midi In jack. Whenever a Midi message is received, this LED will blink.

I/O Indicator LED's

These LED's indicate the current voltage levels of each of the 16 outputs. When the voltage is at 0 volts, they are off. As the voltage increases, they will get brighter until they are at full brightness when the voltage reaches maximum. If you have the internal jumper set for 0-5 volt range, these LEDs will not glow as brightly at maximum voltage as they do in the 0-10 volt range. They are connected directly to the same outputs as the rear panel DB-25 connector so they are an accurate display of the voltages on that connector. If you have the digital output option installed in your unit, the last 8 LEDs indicate the On or Off state of those 8 outputs and will glow with a brightness approximately 1/2 that of an analog output when on.

MIDI COMMANDS

The AO-16 responds to Midi Controllers, Pitchbend, Note On/Off, and System/Channel Mode Messages as described below:

Midi Continuous Controllers:

If the AO-16 is in controller mode (DIP Switch #4 down), the unit will adjust the output voltage for each of its 16 outputs based on the last valid controller value received for that output. Values can range anywhere between 0-127 with 0 producing a 0 voltage output, and 127 producing either a 5 volt or 10 volt output depending upon the position of JMP1 inside the unit. A 0-10 volt range is the default. Midi channel is determined by DIP Switches 5-8, while first output offset is determined by switches 1-3. See accompanying diagrams and charts for specifics.

Midi Pitchbend:

If the AO-16 is in Pitchbend mode (DIP Switch #4 up), the unit will adjust the output voltage for each of its 16 outputs based on the last valid Pitchbend value received for that output. Values can range anywhere between -8192 and +8192 (some Midi devices use a range of 0-16384) with -8192 producing a 0 voltage output, and +8192 producing either a 5 volt or 10 volt output depending upon the position of JMP1 inside the unit. A 0-10 volt range is the default. All commands are rounded down to the closest 12 bit value (+/- 2048) before being converted to a voltage output. As each output responds to pitchbend on its corresponding Midi channel 1-16, Midi channel and Offset settings are ignored. See accompanying diagrams and charts for specifics.

Note On/Off

If your AO-16 has the Digital Output option installed, the last 8 outputs will respond to Midi Note On/Off messages to turn on or off the corresponding open collector drive outputs rather than generate analog voltages. These outputs response will depend on the Midi Channel and Offset settings exactly like the Controller mode described above, except that they will respond to Note commands. For example, if the Midi channel is 5 and the Offset is set to 16, these output will respond to Note On/Off commands for note numbers 16-23, on Midi channel 5. These outputs will turn on with a valid Note On command with a velocity greater than 0. They will turn off with a valid Note Off command (any velocity) or via a Note On command with a velocity of 0.

System and Channel Mode Messages

The AO-16 will respond to the following System and Channel Mode messages as follows:

Midi Channel Independent (Ignores DIP switches 5-8 settings)

System Reset (Hex FF) All outputs set to 0 volts or Off

Midi Channel Dependent (Only responds to channel set by DIP switches 5-8)

Reset All Controllers (Controller #121, value 0) All analog outputs set to 0 volts

All Notes Off (Controller #123, value 0) All digital outputs Off

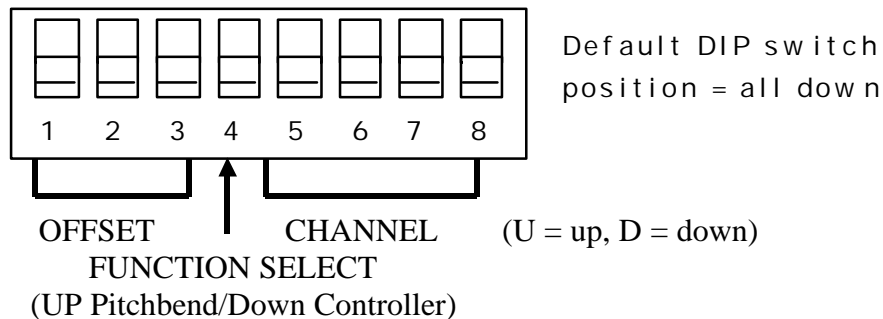
Omni Off (Controller #124, value 0) All digital outputs Off

Omni On (Controller #125, value 0) All digital outputs Off

Poly On / Mono Off (Controller #127, value 0) All digital outputs Off

Switches and Jumper Settings:

AO-16 DIP SWITCH



Controller Mode (Function Select Switch Down)

The three DIP switches, (1-3), designate the MIDI controller number offset that the AO-16 unit will respond to. It follows a binary sequence, as follows:

Starting Offset	DIP Settings	Controller Numbers	
0	DDD	0-15	
16	DDU	16-31	
32	DUD	32-47	
48	DUU	48-63	
64	UDD	64-79	
80	UDU	80-95	
96	UUD	96-111	

112	UUU	96-111	
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Controller numbers from 120 to 127 are reserved. If offset is set to “112”, it will convert to “96” inside the AO-16

The four DIP switches, (5-8), designate the MIDI channel that the AO-16 unit will respond to as follows:

MIDI Channel	DIP Settings	MIDI Channel	DIP Settings
1	DDDD	9	UDDD
2	DDDU	10	UDDU
3	DDUD	11	UDUD
4	DDUU	12	UDUU
5	DUDD	13	UUDD
6	DUDU	14	UUDU
7	DUUD	15	UUUD
8	DUUU	16	UUUU

Pitch bend Mode (Function Select Switch Up)

The offset (1-3), MIDI channel (5-8) DIP switches are not available in this mode.

Pitch bend channel 1 : Analog Output 1

Pitch bend channel 2 : Analog Output 2

Pitch bend channel 3 : Analog Output 3

:

Pitch bend channel 15 : Analog Output 15

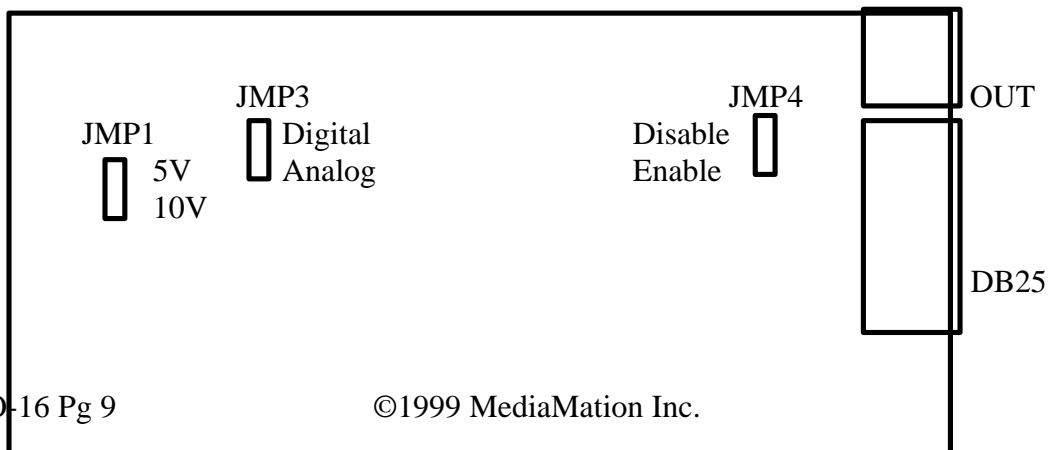
Pitch bend channel 16 : Analog Output 16

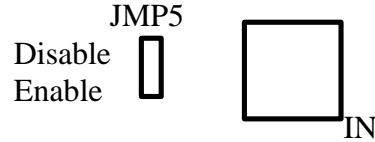
Pitch bend data consists of 14 bit data. The AO-16 has 12bit resolution DAC, Pitch bend data is converted to 12 bit automatically.

AO-16 DB25 Pin Output Layout

Output	DB25 Pin #	Function	Comments
Out 1	1		
Out 2	2		
Out 3	3		
Out 4	4		
Out 5	5		
Out 6	6		
Out 7	7		
Out 8	8		
Out 9	9	(Digital out 1 if installed)	
Out 10	10	(Digital out 2 if installed)	
Out 11	11	(Digital out 3 if installed)	
Out 12	12	(Digital out 4 if installed)	
Out 13	13	(Digital out 5 if installed)	
Out 14	14	(Digital out 6 if installed)	
Out 15	15	(Digital out 7 if installed)	
Out 16	16	(Digital out 8 if installed)	
	17	Not Used	No Connection
	18	Not Used	No Connection
Common	19	Analog common	
Common	20	Analog common	
Common	21	Analog common	
Digital Ground	22		
Digital Ground	23		
Digital Kickback	24	Connect to +V for Digital outs	
Digital Kickback	25	Connect to +V for Digital outs	

JUMPER Settings





JMP1 : 5V/10V output select (Default 10V) JMP3 : Output select Analog/Digital
 JMP4, JMP5 : Power daisy chain thru MIDI cable (Default Disable)

Specifications:

ENVIRONMENTAL

Operating Temperature: 0°C to +59°C (+32°F to +138°F)
 Storage Temperature: -40°C to +85°C (-40°F to +185°F)
 Humidity: 130/85% (non-condensing)

PHYSICAL

Weight: 1lb., 11.3oz.
 Dimensions: 6-1/8" x 4-3/8" x 1-5/16"
 Color: Black

ELECTRICAL

Power Requirement: 12 to 24 Volts DC/AC, @ 500mA

AO-16 Analog Output Specifications:

(LM324 QUAD INTEGRATED AMPLIFIER DRIVER ON OUTPUTS)

D/A Resolution 12 bit (Pitchbend Commands), 7 bit (Controller commands)
 Output Sampling Rate > 600 Hz each output
 Duration of output short circuit to ground or below unlimited
 Output Current (typical) 20 ma

AO-16 Digital Option Specifications:

ULN2803A DRIVER SPECIFICATIONS (REPRINTED FROM MANUFACTURING DATA SHEET)

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	VALUE	UNIT
V_o	Output Voltage	50	V
I_c	Continuous Collector Current	500	mA
P_{tot}	Power Dissipation (one Darlington pair) (total package)	1.0 2.25	W W
T_{amb}	Operating Ambient Temperature Range	-20 to 85	°C
T_{stg}	Storage Temperature Range	-55 to 150	°C

THERMAL DATA

SYMBOL	PARAMETER	VALUE	UNIT
$R_{TH J-amb}$	Thermal Resistance Junction-Ambient	55	°C/W

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ °C}$ unless otherwise specified)

SYMBOL	PARAMETER	TEST CONDITIONS	TYP.	MAX.	UNIT
I_{CEX}	Output Leakage Current	$V_{CE} = 50V$ $T_{amb} = 70\text{ °C}, V_{CE} = 50V$		50	μA μA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 100mA, I_B = 250\mu A$ $I_C = 200mA, I_B = 350\mu A$ $I_C = 350mA, I_B = 500\mu A$	0.9 1.1 1.3	1.1 1.3 1.6	V V V
t_{PLH}	Turn-On Delay Time	$0.5 V_i$ to $0.5 V_o$	0.25	1	μS
t_{PHL}	Turn-Off Delay Time	$0.5 V_i$ to $0.5 V_o$	0.25	1	μS
I_R	Clamp Diode Leakage Current	$V_R = 50V$ $T_{amb} = 70\text{ °C}, V_R = 50V$		50 100	μA μA
V_F	Clamp Diode Forward Voltage	$I_F = 350mA$	1.7	2	V

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