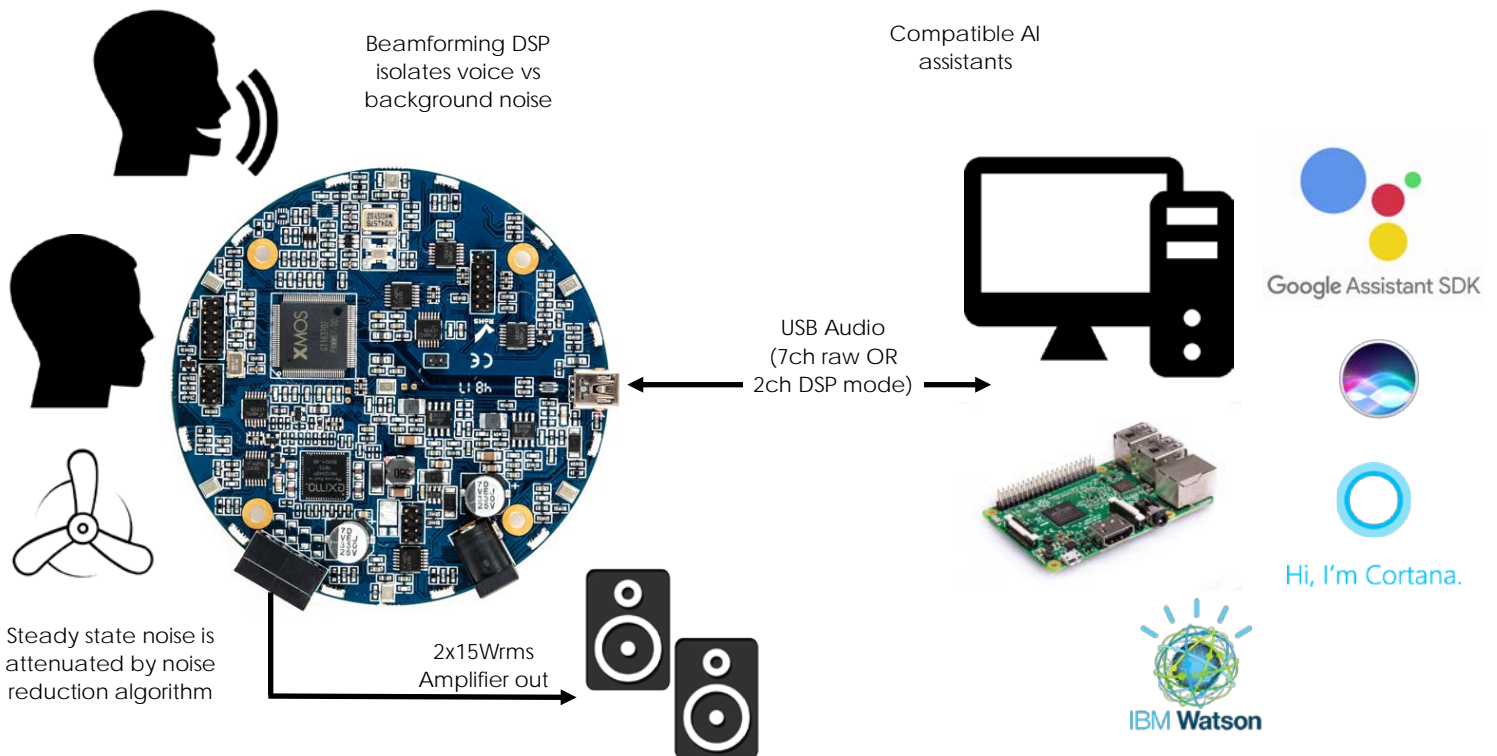


# UMA-8-SP

## USB MICROPHONE ARRAY WITH EMBEDDED DSP AND STEREO DIGITAL AMPLIFIER

### User Manual





## Revision history

| Revision | Description          | Date              |
|----------|----------------------|-------------------|
| 1.0      | First public release | 12 June 2018      |
| 1.1      | Adding DOA USB API   | 14 September 2018 |

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## IMPORTANT INFORMATION

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Please read the following information before use. In case of any questions, please contact miniDSP via the support portal at [minidsp.desk.com](http://minidsp.desk.com).

### SYSTEM REQUIREMENTS – WINDOWS

- 1GHz or higher processor clock speed recommended / Intel® Pentium®/Celeron® family, or AMD K6®/AMD Athlon®/AMD Duron® family, or compatible processor recommended.
- 512 megabytes (MB) of RAM or higher recommended
- One free USB 2.0 port
- Microsoft® Windows® Win7/Win8/Win10

### SYSTEM REQUIREMENTS – MAC OS X

- Intel Core Duo processor or greater
- 256 megabytes (MB) of RAM or higher recommended
- One free USB 2.0 port

### DISCLAIMER/WARNING

miniDSP cannot be held responsible for any damage that may result from the improper use or incorrect configuration of this product. Please read this manual carefully to ensure that you fully understand how to operate and use this product, as incorrect use or use beyond the parameters and ways recommended in this manual have the potential to cause damage to your audio system.

Please also note that many of the questions we receive at the technical support department are already answered in this User Manual and in the online [application notes](#) on the miniDSP.com website. So please take the time to carefully read this user manual and the online technical documentation. Thank you for your understanding!

### WARRANTY TERMS

miniDSP Ltd warrants this product to be free from defects in materials and workmanship for a period of one year from the invoice date. Our warranty does not cover failure of the product due to incorrect connection or installation, improper or undocumented use, unauthorized servicing, modification or alteration of the unit in any way, or any usage outside of that recommended in this manual. If in doubt, contact miniDSP prior to use.

### FCC CLASS B STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- This device may not cause harmful interference.



- This device must accept any interference received, including interference that may cause undesired operation.

**Warning:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

**Notice:** Shielded interface cable must be used in order to comply with emission limits.

**Notice:** Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## CE MARK STATEMENT

The UMA-8-SP has passed the test performed according to European Standard EN 55022 Class B.

## PACKAGE CONTENTS

Your *UMA-8-SP* package includes:

- One *UMA-8-SP* USB far field microphone array module
- One USB cable for computer connectivity (1.5m)

## A NOTE ON THIS MANUAL

This User Manual is designed for reading in both print and on the computer. If printing the manual, please print double-sided. The embedded page size is 8 ½" x 11". Printing on A4 paper will result in a slightly reduced size.

For reading on the computer, we have included hyperlinked cross-references throughout the manual. In addition, a table of contents is embedded in the PDF file. Displaying this table of contents will make navigation much easier:

- In Adobe Reader on Windows, click on the "bookmarks" icon at the left. The table of contents will appear on the left and can be unfolded at each level by clicking on the "+" icons.
- In Preview on the Mac, click on the **View** menu and select **Table of Contents**. The table of contents will appear on the left and can be unfolded at each level by clicking on the triangle icons.



## 1 PRODUCT OVERVIEW

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Thank you for purchasing a miniDSP UMA-8-SP USB microphone array. The UMA-8-SP is a high-performance USB microphone array paired with a digital audio amplifier. Seven high-performance MEMS microphones are configured in a circular arrangement to provide high-quality voice capture in farfield microphone applications such as AI assistants, conferencing, robotics...

Leveraging the onboard DSP processing from XMOS XVSM3000, the UMA-8-SP supports voice algorithms including beamforming, noise reduction, acoustic echo cancellation and de-reverb. The UMA-8-SP is a fully compliant UAC2 audio interface with driverless support for Mac/Linux and ASIO drivers for Windows. An onboard 2x15Wrms digital amplifier provides an all-in-one microphone array + amplifier integration. The perfect fit to build your own AI assistant or conferencing unit.

From DIYers to OEM, this pocket-size platform is engineered for flexibility in firmware, software and hardware. Feel free to contact miniDSP on how we can help kickstart your new project!

The UMA-8-SP is a fully compliant UAC2 audio interface with driverless support for Mac/Linux and ASIO drivers for Windows. Depending on the loaded firmware, the UMA-8-SP has different modes of operation.

**DSP mode:** the interface is running as a 2xIN (2ch Beamforming), Mono audio output on stereo audio amplifier. Note that the embedded XMOS library can only output mono signal. Both outputs of the onboard amplifier will therefore carry the same mono signal.

**RAW audio mode:** the unit is streaming all raw audio from the MEMS (7 x MEMS + 1 x spare PDM input), 2 x OUTPUTS on digital audio amplifier. Note that in RAW mode, no processing is enabled and signal may be small as it's the RAW audio from the MEMS microphones. You may need to perform a bit shift to increase the sensitivity of your signal.

The below sections will hopefully clarify how to install and configure the UMA-8-SP. If any doubt/questions, feel free to contact our technical support team.

## 2 HARDWARE CONNECTIVITY

### 2.1 BOARD OVERVIEW

The UMA-8-SP has few exposed headers to help for customization of the product.

Note that MEMS are up-firing( through the board) and SW1/2/3/4 must be at the top for correct microphone pickup.

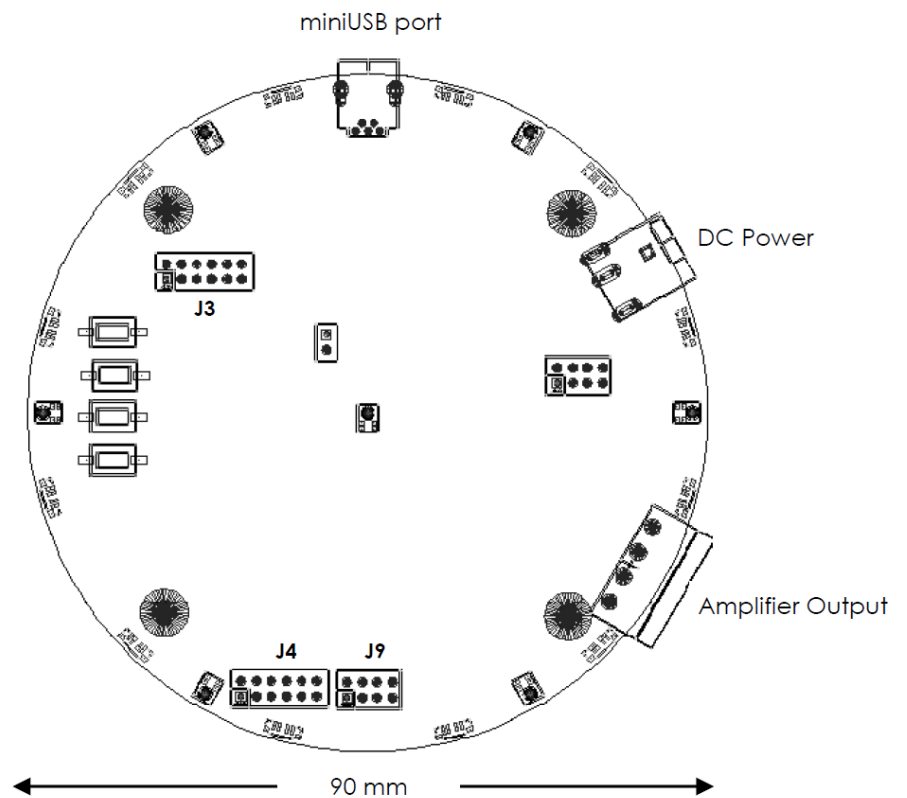
#### J3 / Audio data & clocks (Future)

|                  |                   |
|------------------|-------------------|
| J3.1 - I2S_OUT_0 | J3.2 - I2S_IN_0   |
| J3.3 - I2S_OUT_1 | J3.4 - I2S_IN_1   |
| J3.5 - I2S_OUT_2 | J3.6 - I2S_IN_2   |
| J3.7 - I2S_OUT_3 | J3.8 - I2S_OUT_4  |
| J3.9 - MCLK      | J3.10 - I2S_BCLK  |
| J3.11 - GND      | J3.12 - I2S_LRCLK |

#### J2 / Control IO pins (Future)

|                  |                  |
|------------------|------------------|
| J2.1 - GND       | J2.2 - 3.3V      |
| J2.3 - GND       | J2.4 - 3.3V      |
| J2.5 - N/A       | J2.6 - UART_TX   |
| J2.7 - UART_RX   | J2.8 - XMOS_RST  |
| J2.9 - I2C_SDATA | J2.10 - I2C_SCLK |
| J2.11 - N/A      | J2.12 - N/A      |

#### Bottom VIEW



## 2.2 DC POWER SCHEMES

The UMA-8-SP has 2 modes of operations when it comes to powering schemes:

**USB self-powered:** A single USB connection to your PC/Mac suffices to provide power to the unit and stream bidirectional audio simultaneously. In this mode, the UMA-8-SP will disable the amplifier due to the limited current capabilities of USB power.

**External 12V power supply:** In this mode, the UMA-8-SP will have the digital audio amplifier for up to 2x15Wrms.

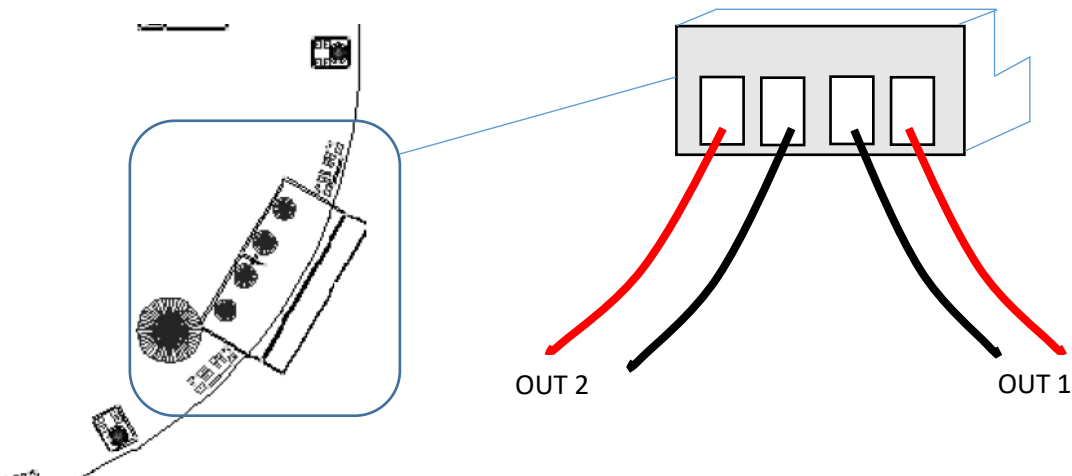
## 2.3 I2S EXPANSION HEADER PINOUTS

Header J3 is provided for connection of I/O circuitry via I2S. The pinouts are shown in Table 1.

In the current firmware, none of the I2S in/out are enabled.

## 2.4 DIGITAL AUDIO AMPLIFIER OUTPUTS

The onboard stereo digital audio amplifier outputs are available on a 3.81mm pitch removable Phoenix terminal block. The below diagram shows the typical configuration (OUT 1 +, OUT1-, OUT2-, OUT2+)



## 2.5 ADDITIONAL I2S USAGE NOTES

Note that I2S is not a “plug and play” protocol. It requires attention to technical details such as clocking and wire layout. It is a solution for OEMs and *advanced* DIYers (or professionals) with suitable knowledge, skills and measurement equipment.

Be sure to take the following precautions when designing your I2S interface and wiring:

### General I2S usage notes

- Unbuffered I2S lines must be kept short to ensure clock and data integrity.



- If driving longer lines, buffers may be required for the clock signals (MCLK, LRCLK, and BLCK).
- Observe correct grounding and shielding, and keep analog and digital grounds separated.
- Ensure that the clock ratios (as listed in Table 2) are compatible with connected circuits.

### 3.3V logic level

All lines use a 3.3V logic level. Ensure that connected circuits use a compatible level (1.8V, for example, will not work).

## 2.6 DSP SETTINGS PARAMETERS

The below settings are the default parameters of the internal DSP library. We hope in the near future to provide an easy to use GUI to control these parameters. Stay tuned.

| parameter       | type        | range            | description   |
|-----------------|-------------|------------------|---|
| HPFONOFF        | APES_INT    | [0..3]           | High-pass Filter on microphone signals (read-write).<br>0 = OFF<br>1 = ON - 70 Hz cut-off (default)<br>2 = ON - 125 Hz cut-off<br>3 = ON - 180 Hz cut-off |
| AECFREEZEONOFF  | APES_INT    | [0,1]            | Adaptive Echo Canceller updates inhibit (read-write).<br>0 = Adaptation enabled (default)<br>1 = Freeze adaptation, filter only                           |
| RT60ONOFF       | APES_INT    | 0,1]             | RT60 Estimation for AES (read-write).<br>0 = OFF<br>1 = ON (default)  |
| AECNORM         | APES_FLOAT1 | [0.25 .. 16.0]   | Limit on norm of AEC filter coefficients (read-write).<br>(default: 2.0)  |
| AECSILENCELEVEL | APES_FLOAT1 | [0.0 .. 1.0]     | Threshold for signal detection in AEC (read-write). $[-\infty .. 0]$ dBov<br>(default: $-80\text{dBov} \approx 10\log_{10}(1 \cdot 10^{-8})$ )            |
| RT60            | APES_FLOAT1 | [0.250 .. 0.900] | Current RT60 estimate in seconds (read-only).<br>(default: 0.500)   |
| AECSILENCEMODE  | APES_INT    | 0,1]             | AEC far-end silence detection status (read-only).<br>0 = false (signal detected)<br>1 = true (silence detected)   |
| PROFILINGONOFF  | APES_INT    | 0,1]             | Profiling mode option (read-write).<br>0 = Normal operating mode (default)<br>1 = Profiling mode (maximize CPU load)                                      |

| parameter         | type        | range           | description   |
|-------------------|-------------|-----------------|---|
| AGCONOFF          | APES_INT    | [0,1]           | Automatic Gain Control (read-write).<br>0 = OFF<br>1 = ON (default)   |
| AGCMAXGAIN        | APES_FLOAT1 | [1.0 .. 1000.0] | Maximum AGC gain factor (read-write).<br>[0 .. 60] dB<br>(default 30 dB $\approx 20\log_{10}(31.6)$ )                                 |
| AGCDESIREDLEVEL   | APES_FLOAT1 | [0.0 .. 1.0]    | Target power level of the output signal (read-write). $[-\infty .. 0]$ dBov<br>(default: -23 dBov $\approx 10\log_{10}(0.005)$ )      |
| AGCGAIN           | APES_FLOAT1 | [1.0 .. 1000.0] | Current AGC gain factor (read-write).<br>[0 .. 60] dB<br>(default: 0.0 dB = $20\log_{10}(1.0)$ )                                      |
| AGCTIME           | APES_FLOAT1 | [0.1 .. 1.0]    | Ramp-up/down time-constant in seconds(read-write). [0.1 .. 1.0]<br>(default: 0.9 s)   |
| CNIONOFF          | APES_INT    | [0,1]           | Comfort Noise Insertion (read-write).<br>0 = OFF<br>1 = ON (default)  |
| FREEZEONOFF       | APES_INT    | [0,1]           | Adaptive beamformer and postprocessor updates (read-write).<br>0 = Adaptation enabled (default)<br>1 = Freeze adaptation, filter only |
| TRANSIENTONOFF    | APES_INT    | [0,1]           | Transient echo suppression (read-write).<br>0 = OFF<br>1 = ON (default)   |
| STATNOISEONOFF    | APES_INT    | [0,1]           | Stationary noise suppression (read-write).<br>0 = OFF<br>1 = ON (default)   |
| GAMMA_NS          | APES_FLOAT1 | [0.0 .. 3.0]    | Over-subtraction factor of stationary noise (read-write).<br>min .. max attenuation (default: 1.0)                                    |
| MIN_NS            | APES_FLOAT1 | [0.0 .. 1.0]    | Gain-floor for stationary noise suppression (read-write). $[-\infty .. 0]$ dB<br>(default: -16 dB $\approx 20\log_{10}(0.15)$ )       |
| NONSTATNOISEONOFF | APES_INT    | [0,1]           | Non-stationary noise suppression (read-write).<br>0 = OFF<br>1 = ON (default)   |
| GAMMA_NN          | APES_FLOAT1 | [0.0 .. 3.0]    | Over-subtraction factor of non-stationary noise (read-write).<br>min .. max attenuation (default: 1.1)                                |
| MIN_NN            | APES_FLOAT1 | [0.0 .. 1.0]    | Gain-floor for non-stationary noise suppression (read-write). $[-\infty .. 0]$ dB<br>(default: -10 dB $\approx 20\log_{10}(0.3)$ )    |
| ECHOONOFF         | APES_INT    | [0,1]           | Echo suppression (read-write).<br>0 = OFF<br>1 = ON (default)   |

| parameter      | type        | range        | description  |
|----------------|-------------|--------------|--|
| GAMMA_E        | APES_FLOAT1 | [0.0 .. 3.0] | Over-subtraction factor of echo (direct and early components) (read-write).<br>min .. max attenuation (default: 1.0) |
| GAMMA_ETAIL    | APES_FLOAT1 | [0.0 .. 3.0] | Over-subtraction factor of echo (tail components) (read-write).<br>min .. max attenuation (default: 1.0)             |
| GAMMA_ENL      | APES_FLOAT1 | [0.0 .. 5.0] | Over-subtraction factor of non-linear echo (read-write).<br>min .. max attenuation (default: 1.0)                    |
| NLATTENONOFF   | APES_INT    | [0,1]        | Non-Linear echo attenuation (read-write).<br>0 = OFF (default)<br>1 = ON   |
| NLAEC_MODE     | APES_INT    | [0..2]       | Non-Linear AEC training mode (read-write).<br>0 = OFF (default)<br>1 = ON - phase 1<br>2 = ON - phase 2              |
| PROFILINGONOFF | APES_INT    | [0,1]        | Profiling mode option (read-write).<br>0 = Normal operating mode (default)<br>1 = Profiling mode (maximize CPU load) |
| FSBUPDATED     | APES_INT    | [0,1]        | FSB Update Decision (read-only).<br>0 = false (FSB was not updated)<br>1 = true (FSB was updated)                    |
| FSBPATHCHANGE  | APES_INT    | [0,1]        | FSB Path Change Detection (read-only).<br>0 = false (no path change detected)<br>1 = true (path change detected)     |
| VOICEACTIVITY  | APES_INT    | [0,1]        | VAD voice activity status (read-only).<br>0 = false (no voice activity)<br>1 = true (voice activity)                 |



## 3 DRIVER INSTALLATION AND CONFIGURATION – WINDOWS

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### 3.1 INSTALLATION

The UMA-8-SP is a USB Audio Class 2.0 device. For use with Microsoft Windows, driver installation is required.

#### 3.1.1 Download the latest driver

When you receive notification that your order has shipped, your installation software download will be available at the *User Downloads* section of the miniDSP website:

<http://www.minidsp.com/userdownloads>

(If you are unable to access this section of the website, please login first.)

Download the installation zip file under the **USB Microphone array series** heading and unzip the folder on your PC.

NOTE: If you purchased this item from a dealer or someone else purchased the product for you and you currently don't have access to the userdownloads section, simply get in touch with [our customer team](#). We're here to help.

#### 3.1.2 Connect your UMA-8-SP

In order to automatically detect the UMA-8-SP during driver installation, connect the UMA-8-SP to your PC and power it on before going to the following step.

#### 3.1.3 USB Driver installation

1. Connect the UMA-8-SP to the computer using the supplied USB cable, and power it on.
2. Navigate to the **WinDrivers** folder of the software download and double-click on the appropriate installer:
  - **miniDSP\_UAC2\_v3.34.0\_ForWin7\_8\_10.exe** for Windows 7, 8, and 10

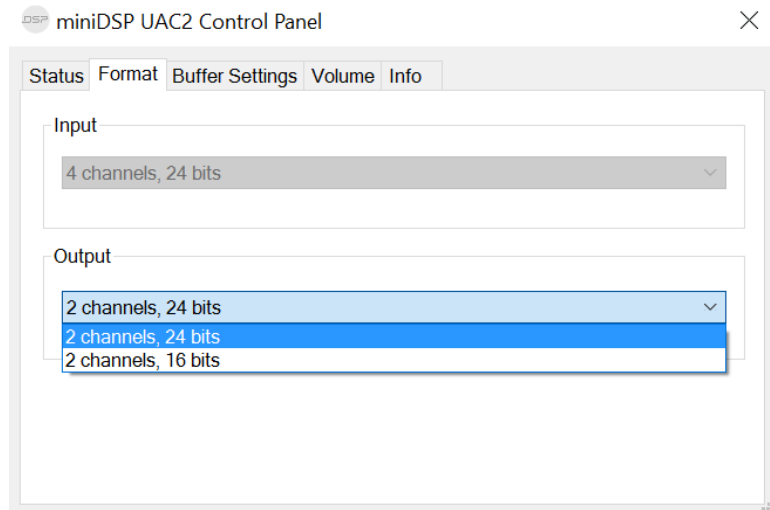
We recommend accepting the default installation location. Once the driver installation completes, click the **Finish** button.

## 3.2 CONFIGURATION

To configure the UMA-8-SP, open the **USB Audio Control Panel** (from Start Menu -> miniDSP Ltd -> UAC2 Control Panel). It has several panes, described below.

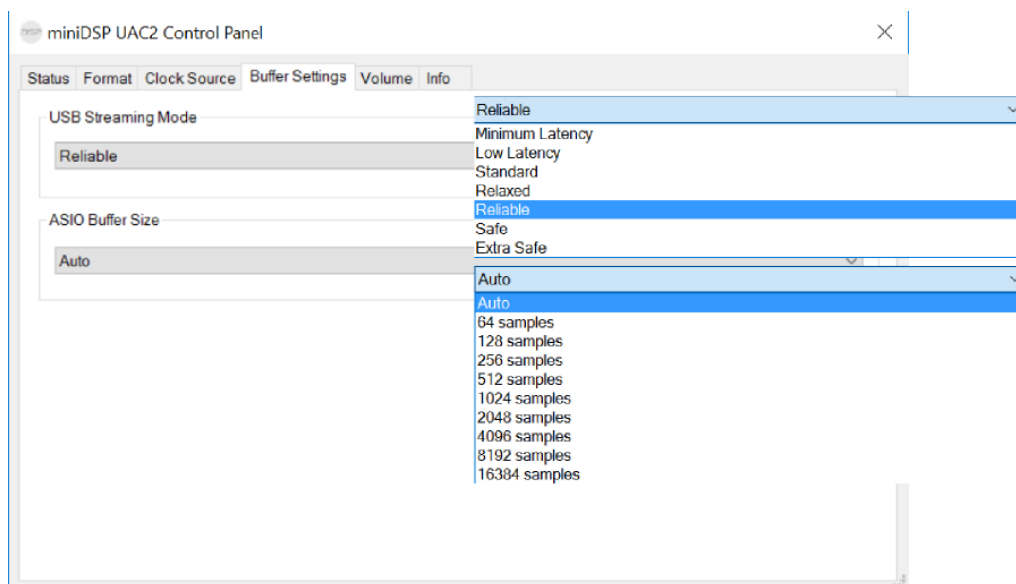
### 3.2.1 Format

This panel selects the input and output data format.



### 3.2.2 Buffer settings

The buffer settings are for those looking to optimize buffering and latency settings. Note that changing these settings may result in unstable operation. For example, the lowest latency settings require high amounts of CPU and memory, and may not work on some machines. If you do not require lowest latency, we recommend that you do not depart from the default safe settings.



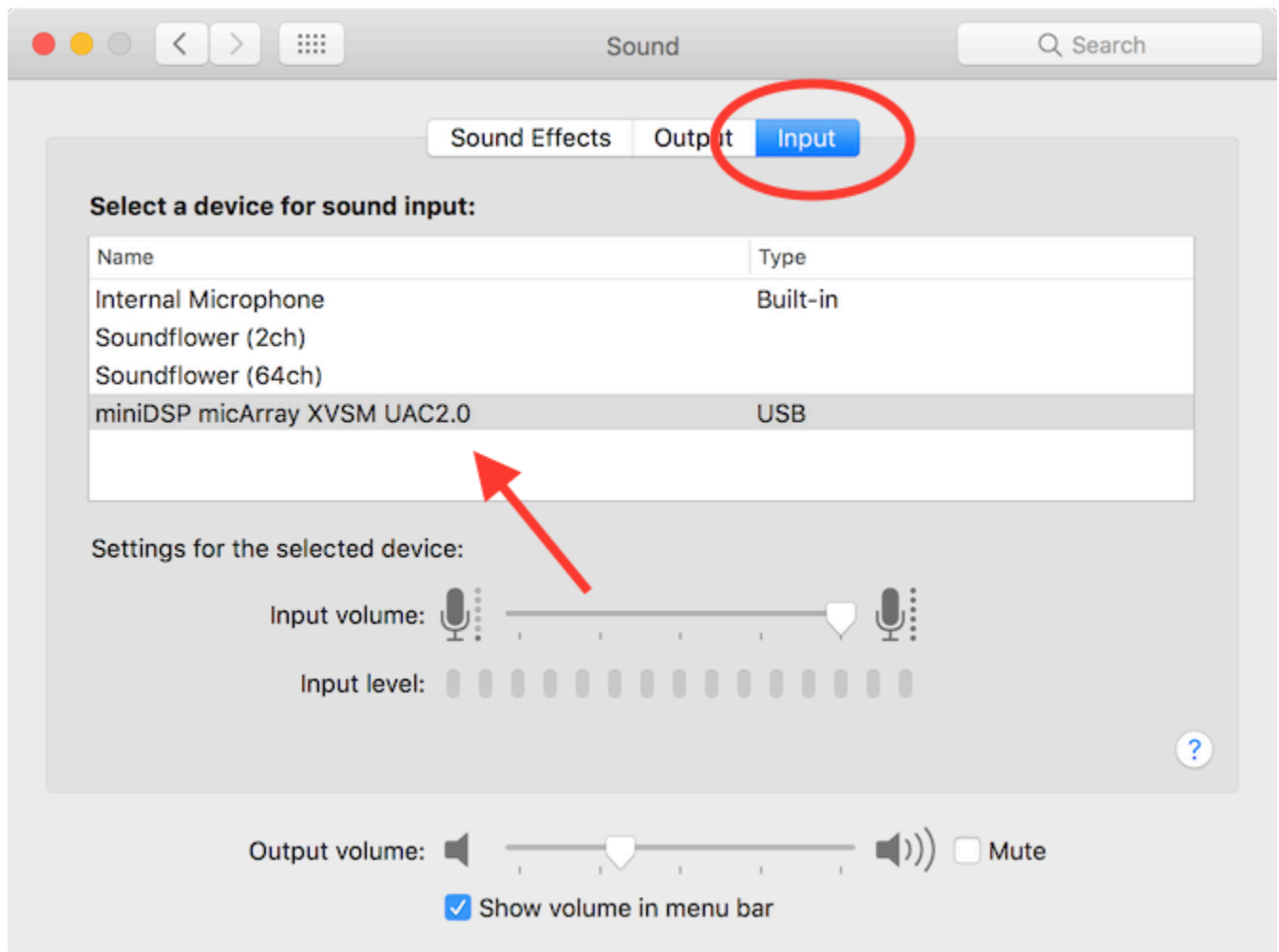
## 4 DRIVER INSTALLATION AND CONFIGURATION – MAC OS X

### 4.1 INSTALLATION

Mac OS X has native support for USB Audio class 2.0 devices, so no driver installation is required. The UMA-8-SP will automatically be detected by Mac OS X as a compliant multichannel USB audio interface.

### 4.2 CONFIGURATION

Open the program **Audio MIDI Setup** (in **Applications->Utilities**). The UMA-8-SP will appear automatically in the list on the left hand side, as a **miniDSP micArray XVSM UAC2.0**



## 5 DRIVER INSTALLATION AND CONFIGURATION – LINUX

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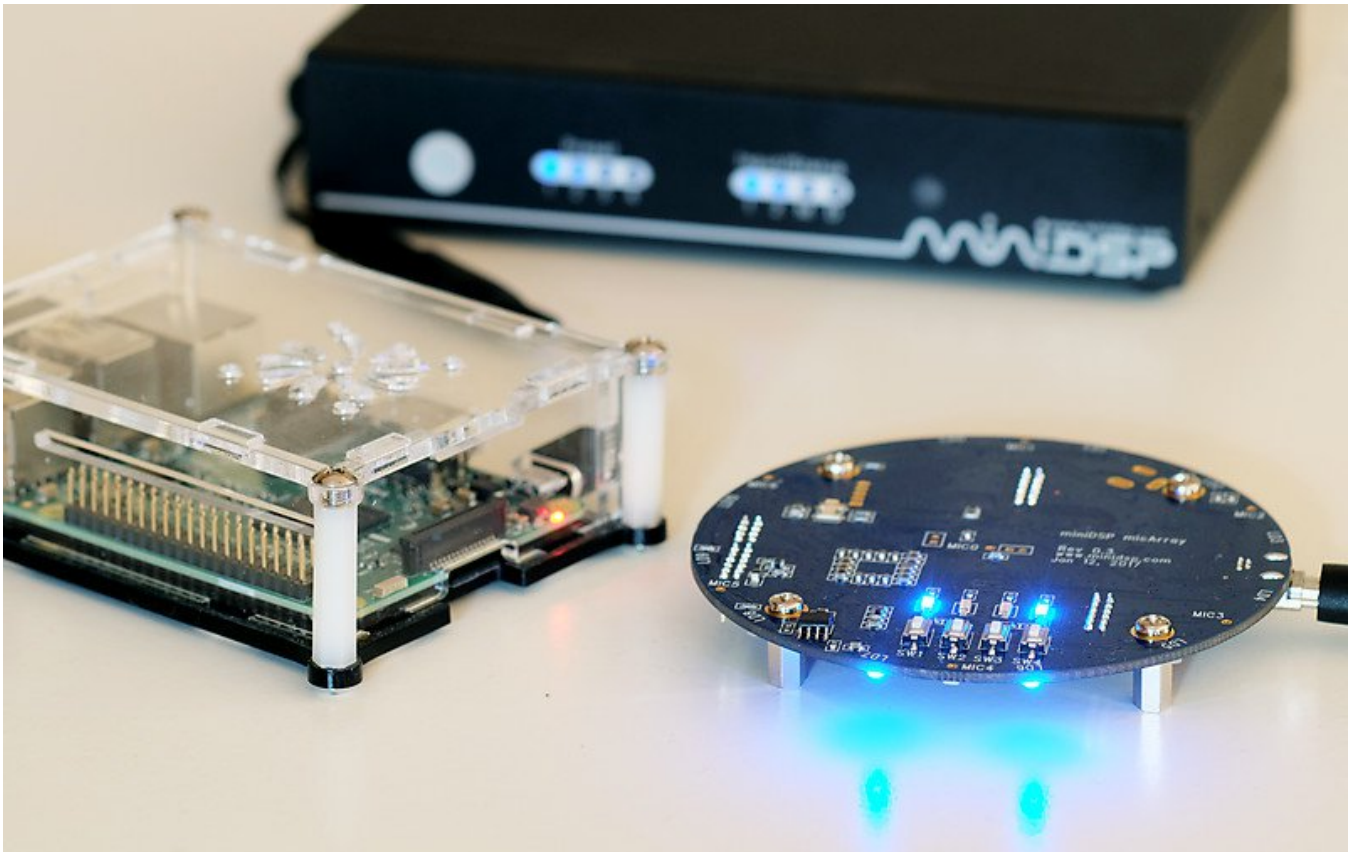
### 5.1 ALSA INSTALLATION

The UMA-8-SP is a fully compliant UAC 2 (USB Audio Class) device. While miniDSP's technical support team unfortunately can't provide email/phone support for Linux due to the large number of distributions, we know from experience that the UMA-8-SP is Plug&Play with Alsa 2.0 drivers. For more information/support on ALSA driver, please consult [ALSA project](#).

### 5.2 RASPBERRY PI OR LINUX INSTALLATIONS

The UMA-8-SP was tested to be plug&play with AlexaPi. A complete app note with step by step instructions to build your DIY Alexa speaker is provided at the [following link](#).

We also tested the unit with Google Home, Watson SDK and others. Please check [our application section](#) for more information





## 6 USB API / CUSTOMIZATION

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For advanced DIYers, the UMA-8 may be controlled directly using a basic USB API. Note that the below sections assumes you have basic knowledge of USB HID libraries. miniDSP unfortunately won't be able to provide support to debug/test your code or provide support on basics of HID control. The good news is that there isn't shortage of USB API libraries online.

### 6.1.1 Discovery of UMA-8

On power up, Mic-Array will be recognized by the computer as an HID device with Vendor ID=0x2752. Product ID=0x1C, some USB library can be used to connect to this device and send / receive commands to / from it.

### 6.1.2 Voice Activated Detection (VAD) + Direction Of Arrival (DOA)

When voice is detected (VAD active) or the direction of arrival (DOA) changed, the microphone array will send a command to the USB host through USB interrupt. The command format is shown below:

| Byte 1 | Byte 2 | Byte 3 | Byte 4   | Byte 5   | Byte 6 |
|--------|--------|--------|----------|----------|--------|
| 0x06   | 0x36   | VAD    | Angle.HB | Angle.LB | Dir    |

VAD = 1 / Voice is detected, the Dir byte has to be read to determine the Direction of Arrival.

VAD = 0 / No more voice signal detected

Dir = Direction of Arrival, represented by a number correspond to mic position. Can range from 1 ~ 6 for Mic1~6 as per below diagram. .

Angle = angle of the direction number as specified by Dir, in degrees. Range from 0 ~ 360

Angle.HB = high byte of the angle

Angle.LB = low byte of the angle



## 7 ADDITIONAL INFORMATION

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### 7.1 SPECIFICATIONS

| Item                               | Description   |
|------------------------------------|---|
| USB streaming engine               | XMOS XSVM 3000 - Multicore USB audio processor with embedded DSP  |
| USB audio capabilities             | USB audio recording in 2 possible modes depending on firmware:<br>- 8-channel mode (7 x MEMS installed + 1 x spare PDM port in the center)<br>- Stereo recording with DSP processing enabled<br>USB audio playback: 2ch fed to stereo amplifier   |
| DSP processing (prebuilt firmware) | <ul style="list-style-type: none"> <li>• Beamforming with configurable beam width (up to 20dB attenuation)</li> <li>• Perceptual acoustic echo cancellation (up to 80dB attenuation)</li> <li>• Noise suppression (up to 20dB attenuation)</li> <li>• De-reverb ( up to 20dB attenuation)</li> </ul>                            |
| UAC2.0 drivers                     | Driverless interface for Mac OS X v10.6.4 and up<br><br>Thesycon Windows ASIO driver (All versions)<br>Linux Alsa 2.0 compliant   |
| Resolution / Sample rate           | 24bit @ 11/16/32/44.1/48 kHz  |
| Amplifier output                   | Stereo class D amplifier / 2x15Wrms amplifier output (Mono Audio Output)<br>>90% efficiency at full power.  |
| MEMS microphones                   | 7 x Knowles SPH1668LM4H with low noise buffer and high performance modulator<br><br><ul style="list-style-type: none"> <li>• Low distortion: 1.6% @ 120 dB SPL</li> <li>• High SNR: 65 dB and flat frequency response</li> <li>• RF shielded against mobile interference</li> <li>• Ominidirectional pick-up pattern</li> </ul> |
| LED                                | 12 x RGB LED / Bottom mounted   |
| Expansion connector                | 2 x 12-pin, 2 mm pitch expansion connector for connectivity to hardware.  |
| Power supply                       | USB powered (Amplifier disabled) or +12VDC (Amplifier enabled)  |
| Dimensions (diameter) mm           | 90 mm diameter / 20mm height with LED ring, 14mm height without LED ring  |

## 7.2 FIRMWARE UPGRADE

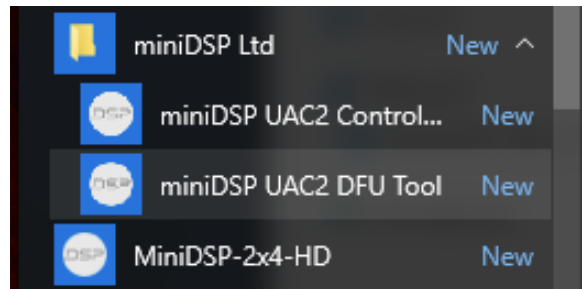
miniDSP may occasionally provide an upgrade to the UMA-8-SP MCU firmware to enable new features. To upgrade the MCU firmware, first download and install the latest version of the Mic Array plugin from the **User Downloads** section of the miniDSP website.



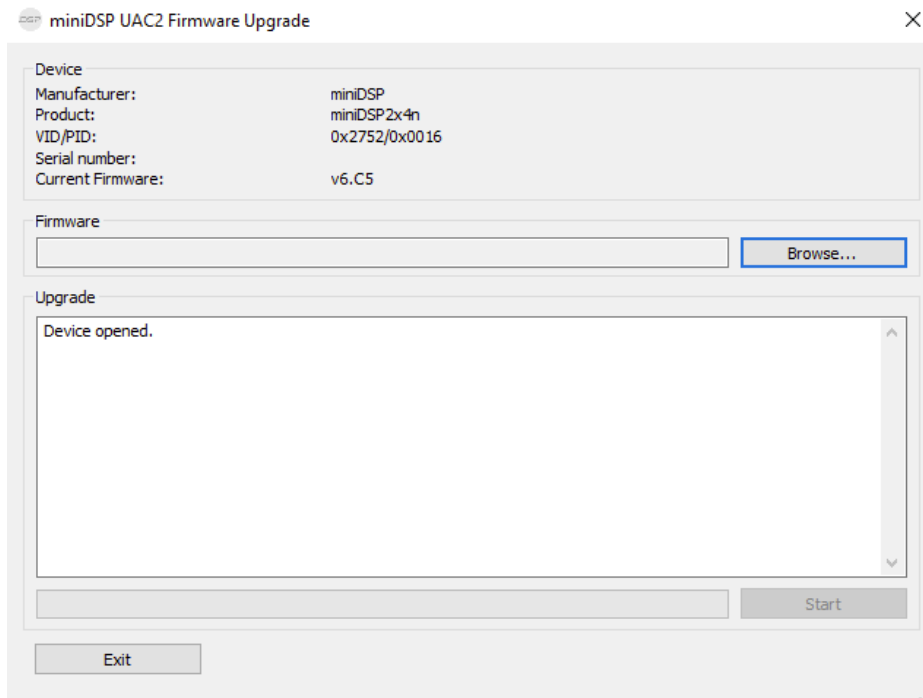
DO NOT DISCONNECT THE USB CABLE OR POWER FROM THE *UMA-8-SP* WHILE FIRMWARE UPGRADE IS IN PROGRESS. DOING SO MAY “BRICK” YOUR *UMA-8-SP*

### 7.2.1 Windows

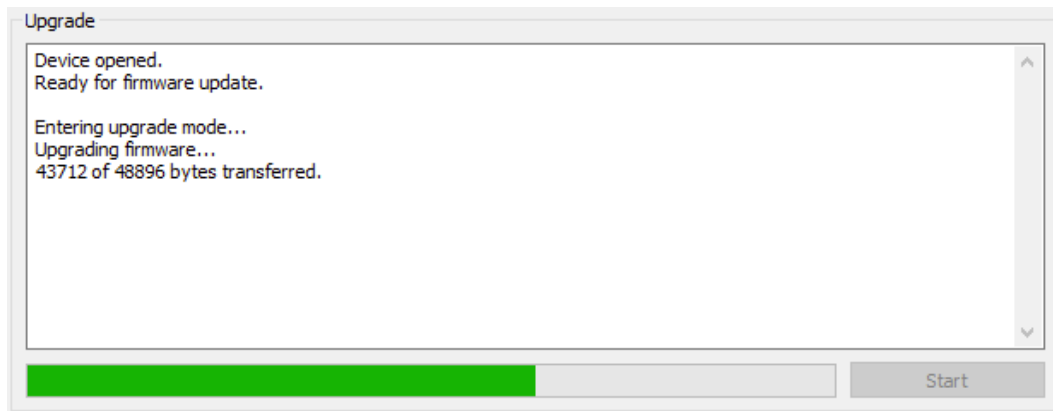
1. Connect the UMA-8-SP to your computer via USB (if not already connected) and power it on.
2. Start the **miniDSP UAC2 DFU Tool** located under the ZIP file from our userdownloads.



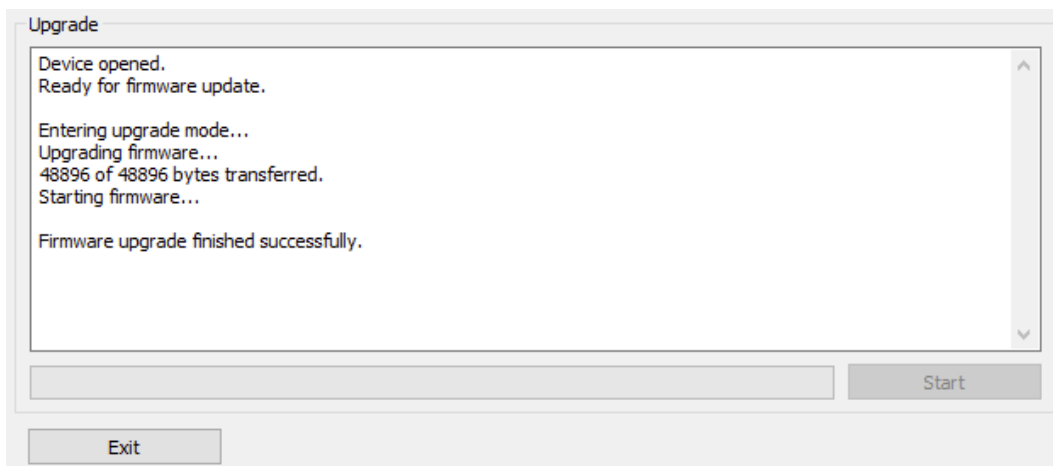
3. The upgrade program will start:



4. Click on the **Browse** button, navigate to the folder **XMOS\_Firmware** in the plugin download folder, and select the firmware file.
5. Click on the **Start** button.
6. You will get a progress bar as upgrade proceeds:



7. Once the firmware upgrade completes, you will see a message that the upgrade completed successfully:



8. Click on **Exit**.
9. That's it! You're done. You can now use your UMA8SP with the new functionality.

### 7.3 OBTAINING SUPPORT

1. Check the forums on [minidsp.com](http://minidsp.com) to see if this issue has already been raised and a solution or solutions provided.
2. Contact miniDSP via the support portal at [support.minidsp.com](http://support.minidsp.com) with:
  - a. The product information including OS version and version of driver installed (for Windows).
  - b. A clear explanation of the symptoms you are seeing.
  - c. A description of the troubleshooting steps you performed and the results obtained.