Formula xHD
D / A converter

Owner's Manual

Rev 6.1

IMPORTANT SAFETY NOTICES

CAUTION
RISK OF ELECTRIC SHOCK
DO NOT OPEN

The triangle with the lightning flash symbol displayed on the unit advises the user of dangerous uninsulated voltage inside the product's enclosure.
To reduce the risk of electric shock, do not remove the cover.
The triangle with the exclamation point symbol on the component suggests that the owner refer to important operating and maintenance instructions in the owner's manual.

WARNING

Modifications and alterations not approved by the manufacturer may violate adherence to EC regulations and make the appliance no longer suitable for use. The manufacturer declines all responsibility for damage caused to persons or property due to the misuse or malfunction of device subject to unauthorized change.

CAUTION

In order to make changes that improve the already excellent quality of its products, aqua - acoustic quality reserves the right to modify the information or the contents of this manual at any time and without notice.

WARRANTY STATEMENT

Aqua Acoustic Quality (Aqua) equipment is supported, and serviced through the worldwide network of distributors and dealers listed within a section of the website.

The authorized retailer provides the end customer with the dealer's warranty, the terms of which vary according to the country's rules, within European Union generally two (2) or more years.

Warranty service should normally be obtained from the importing distributor or retailer from whom you purchased the product. The authorized importing distributor or retailer accepts the responsibility for the warranty of products sold by that distributor or dealer.

In the unlikely event of service required beyond the capability of the importing distributor or retailer, the customer can contact the manufacturer directly and Aqua will provide the manufacturer's warranty. The manufacturer's warranty for a term of one (1) year from the date the unit was originally shipped from aqua, in order to protect our customers from illegitimate resellers.
This manufacturer's warranty is subject to the following terms and conditions:
- in case of a defect covered by this warranty, Aqua will provide without charge the materials and labor necessary to restore the product to its original specifications. In the alternative Aqua may at its sole option either replace the product with a new one of the same or equivalent model in the Aqua production, or refund the purchase price of the product.

The warranty does not apply:
- if the product has not been purchased from an authorized Aqua Dealer
- to damage caused by accident, abuse, misuse or misapplication
- if the product presents changes, modifications or repairs not expressly approved by the manufacturer
- if the Serial Number of the product is absent or altered
- if the product is shipped to Aqua without an adequate package
If vacuum tubes are contained in the product, they are warranted for 90 days from the date of purchase of the original purchaser.
NOS (New Old Stock) components are excluded from the warranty.

The warranty is provided to the original purchaser only, that must provide the original sales receipt containing product name and purchase date. If during the warranty period the product ownership is transferred, the warranty will terminate at the date of the ownership transfer.
The warranty does not cover shipping charges or tax/duty: shipments of the product to Aqua for repair, and shipments to the owner of the serviced product are at the owner's expense

Aqua reserves the right to apply a service charge if the product returned for warranty repair is found to be operating correctly.

Recommended procedure to obtain the repair service (during warranty period and outside)
Contact Aqua, preferably via e-mail at support@aquahifi.com, and briefly describe the problem. In case it is necessary to send the product for repair, Aqua will provide you an RMA number (Return Merchandise Authorization) to return your unit.
This number is required to obtain the repair service: any unit received without an RMA number will be returned to the sender.
The RMA number can be issued only by Aqua staff, you will receive it via e-mail or other means indicated by you.
Please write the RMA number clearly visible on the outside of the package.

THIRD PARTY CONTENT AND TECHNOLOGIES

In its operation, the device uses or may use some services or technologies provided by third parties (e.g. streaming services, software applications/libraries and similar).
These services, software applications or products are outside the control of aqua.
Consequently, these services or products are not covered by the warranty. aqua disclaims any liability relating to them, in particular those related to service interruptions or malfunctions of the services/products provided by third parties.

GENERAL SAFETY INFORMATION

The following general safety precautions must be observed during all phases of operation of this equipment. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment. aqua - acoustic quality assumes no liability for the customer's failure to comply with these requirements.

• DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes. For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type. DO NOT use repaired fuses or short-circuited fuse holders.
• Keep away from live circuits. Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with

the equipment switched off. To avoid dangerous electric shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

• DO NOT operate damaged equipment. If the built-in safety protection features have been impaired through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use product until safe operation is verified by service-trained personnel. If necessary, return the product to aqua - acoustic quality for service and repair to ensure that the safety features are maintained.

• DO NOT service or adjust alone. Do not attempt any internal service or adjustment unless a person capable of rendering first aid and resuscitation is present.

• DO NOT substitute parts or modify equipment. To avoid the occurrence of additional hazards, do not install substitute parts or perform any unauthorized modification to the product. Return the product to aqua - acoustic quality for service or repair to ensure that the safety features are maintained.

In This Guide…

1. **Operation and Features**

Make sure the supplied voltage is the one required by the device. Please ensure the quality of the connecting cables, paying particular attention to the coaxial digital cable. Often, numerous tests have revealed the importance of this cable for obtaining the best sound quality. The transport unit which is responsible for the extraction of numeric data, is affected by jitter, which is non-temporal coherence. In more recent years, this issue has been taken seriously by some manufacturers, significantly improving the results in terms of sound quality. aqua - acoustic quality counsels that this quality should be carefully assessed in order to achieve the desired result.

The Optologic R2R conversion system

aqua believes that the more musical D/A conversion system is based on the circuit usually identified as "resistor ladder".
This technology has been substituted in the mass-market by the so-called sigma-delta converters.
The sigma-delta converter is a near-completely digital circuit and for this reason it can be can be integrated on silicon and produced at low-cost.
A quality resistor ladder DAC instead uses a circuit based on a set of high precision discrete resistors: at least 2 resistor banks, one for each stereo channel.
The Formula DAC is the first in the aqua's production to show a proprietary D/A conversion system, that we name Optologic.
The signals sent to the resistor ladders are generated by a proprietary digital circuit, implemented inside an FPGA (Field Programmable Gate Array).
Formula has a sign-magnitude converter structure, and this requires not two but four 24 bit resistors banks, each one made of very low tolerance discrete resistors.
In order to separate the digital section from the sensitive analog circuits, galvanic and magnetic isolations are implemented between the FPGA and the four branches of the R2R ladder converter.
This creates complete isolation of all digital circuitry - including the clock - from the analogue section, for a clean, noiseless ground plane. It also plays the main role in the differential management of the R2R ladders, achieving perfect symmetry between the counter-phase halves. The result is the highest tonal contrast and naturalness.

Pure 1x native sample rate DAC

The Formula, like the other aqua models, is a digital filter-less DAC.
Our conviction is that in spite of the instrumental measurements showed by upsampling / oversampling DACs, they rarely are able to produce the same emotional and realistic results. reliability. With the exception of six superior quality electrolytics, all other caps are Tantalum, solid-polymer OS-CON and double-metalized MJP. The signal path itself is direct-coupled and free of all capacitors. The two output stages (one single-ended, one transformer-coupled balanced) use discrete BJT and JFet with metal-film resistors. All the electronics parts show an ultra low RF noise.

Modularity

A third important aspect in the aqua production is the modularity of the various electronic circuits.

aqua equipment are not short life products: as modular, they are open to future improvements and to follow the evolution of the technology.

Formula is made of a set of circuits every one developed on a separate printed circuit board easily interchangeable.

As an example, each of the four resistors banks of the converter is separate and mounted on connectors.

State of the art digital and analog electronics

As explained before, the Formula DAC uses no digital filter or any other compensation, relying instead on maniacal attention to each sub-circuit.

The separate analog and digital power supplies are executed purely by extensive use of discrete BJT, Mosfet, J-Fet and ultra-fast diodes.

Passive parts were selected not just for the best sonic result but also for their top quality, longevity and reliability. With the exception of six superior electrolytic capacitors, all other caps are Tantalum, solid-polymer OS-CON and double-metalized MKP.

The signal path itself is direct-coupled and completely capacitor-free.

The two output stages (one single-ended, one transformer-coupled balanced) use discrete BJT and J-Fet with metal-film resistors. All the electronics parts show an ultra-low RF noise.

An advanced ARM microcontroller manages the user interface on the front panel, the IR remote command and the communication port (serial, RS232 standard).

The xHD update

This update has required significant optimization of code for the main FPGA of R2R ladder DAC which has improved sound quality.

The new hybrid USB XMOS xCore 200 (dual core) + FPGA circuitry enables the high-resolution file playback up to 768kHz PCM and native DSD512

xHD improvements:
• Proprietary hybrid 2-stage XMOS xCore XE216 + FPGA
• Fully-floating (isolated) USB decoding and clock generation by FPGA with proprietary code
• High quality, long life, low noise parts and modular design that distinguish aqua - acoustic quality equipment
• Sample rate in "Bit Perfect" up to 768 kHz PCM and DSD512
• Latest version of customized XMOS X Core Driver on Windows OS (W7, W10)
• Native X Core Audio on Mac OS (Bit Perfect)
• USB Audio 2.0 operation on Linux (Bit Perfect)

FEATURES

• Proprietary Optologic D/A conversion system. Pure R2R ladder - FPGA (Field Programmable Gate Arrays) based without digital filter

• Galvanic and magnetic isolations between the FPGA and the four branches of the R2R ladder converter

• Jitter free digital interface AQlink PRO (I2S protocol), uncompromising digital connection to La Diva cd transport

• Discrete R2R ladder DACs with low noise precision resistors

• Zero S/PDIF Jitter design, digital receiver stage PLL (phase locked loop) technology

• High-performance AQ Discrete Regulator (MOSFET, J-FET, BJT) for analog and digital DAC's power supply

• 2 separate low noise C-Core power transformers, one for the analog and one for the digital section

• MODULAR DESIGN with upgradeable multi board platform

• Transformer-based true balanced audio output stage

• Fully upgradeable high-speed USB hybrid 2-stage XMOS xCore XE216 + FPGA, Fully-floating (isolated) USB decoding and clock generation by FPGA with proprietary code

• Proprietary USB Firmware / driver :
Apple MAC OS - Linux OS : USB asynchronous native support, no need to install drivers software

• Digital phase selector on front panel

• High-quality parts selected for sound quality:
- Tantalum, solid-polymer OS-CON and double-metalized MJP capacitors
- low noise Metal Foil ultra-precision resistors
- double metallized film pulse capacitor
- ultra-fast diodes
- halogen free cables

• Aluminium anti-resonant cabinet with Nextel

• RC5 IR remote controller (optional)

• Designed and handmade in Italy

2. Specifications

Digital to analog conversion type	Proprietary Optologic DAC Pure R2R ladder - FPGA (Field Programmable Gate Arrays) based without digital filter
Supported Native Sample Rates	AQlink / I2S serial bus - USB PC Audio : 44.1kHz to 768kHz PCM up to 24 bits Native DSD512 Supports DSD via DoP on all inputs
DAC architecture	Multibit sign magnitude R2R ladder (upgradable)
Asynchronous USB (High Speed)	USB Audio Class 2 with Type B connector
Digital Receiver	PLL (phase locked loop) technology 128 or 256 FS selectable
AQlink (I2S bus)	LVCMOS level
Oversampling factor	1x
Analog Conversion method	Pure R2R ladder - FPGA (Field Programmable Gate Arrays) based digital decoding without digital filter
Digital inputs	- RJ45 AQlink (I2S serial bus) - PCM 24 bit / 768kHz - DSD64, DSD256 via DoP - BNC coax (S/PDIF) 75 ohm - PCM 24 bit / 192kHz - DSD64 via DoP - RCA coax (S/PDIF) 75 ohm - PCM 24 bit / 192kHz - DSD64 via DoP - AES/EBU balanced 110 ohm - PCM 24 bit / 192kHz - DSD64 via DoP - USB port - PCM 24 bit / 768kHz - DSD64, native DSD512 Modular input: - AES/EBU balanced 110 Ohm - 24 bit / 192kHz - DSD64 - RCA coax (S/PDIF) 75 Ohm - 24 bit / 192kHz - DSD64 - AT&T (ST Fiber) - 24 bit / 192kHz - DSD64 - Optical TOSLINK - 24 bit / 96kHz
Analogue Outputs	UNBAL 2 RCA Output 2.4 V RMS BALANCED (passive transformer's symmetrical) 2 XLR Output : 3.8V RMS
Output Impedance	10 Ω RCA - 600 Ω XLR
Load Impedance	10 k Ω (min.) RCA - 600 Ω XLR
Frequency Response	20Hz to 22kHz +0.5dB/-0.5dB
THD + N	<0,016% 1KHz -10dB
Main processor	STM-ARM microcontroller
Controls	9 Button on front panel, IR Remote, Isolated RS-232 D-SUB 9-pin connector
Front Panel	Power, phase invert, mute, input switch, RC5 remote sensor
Power Consumption	100-115V / 220-240V; 50 or 60Hz - 82VA
Dimensions	(W x D x H) 450 x 380 x 100 mm
Weight	9 kg
Front finish	Satin Alu Silver or Satin Black
Case finish	Grey Nextel powder coated

3. DAC Configuration

The Formula DAC is a modular equipment. More info at www.aquahifi.com.

4. Front panel

On the front panel, you find:
- power on/off switch
- mute
- phase invert
- switches for the selection of digital input
- LEDs for: power indicator, mute, phase invert, sample rate from 44.1 kHz to 384 kHz.
  For other sample rate and DSD:
  PCM 705.6 kHz   (176.4 together 352.8 led)
  PCM 768 kHz   (192 together 384 led)
  DSD64   (44.1 together 48 led)
  DSD128   (88.2 together 96 led)
  DSD256   (176.4 together 192 led)
  DSD512   (352.8 together 384 led)

5. Back panel

On the rear panel, you find:

- IEC connector of the power supply (220-240V or 100-120V).
- RS-232 D-SUB 9-pin connector
- Digital inputs :
- RJ45 AQlink (I2S serial bus)
- BNC coax (S/PDIF) 75 ohm
- RCA coax (S/PDIF) 75
- AES/EBU balanced 110 ohm
- USB port
Modular input:
- AES/EBU balanced 110 ohm
- RCA coax (S/PDIF) 75 ohm
- AT&T (ST Fiber)
- Optical TOSLINK
- analog outputs :
- RCA single-ended
- XLR balanced symmetrical

PIN ASSIGNMENT

The pin assignments of all of the XLR-type male analog outputs, the XLR-type female digital inputs are as follows:
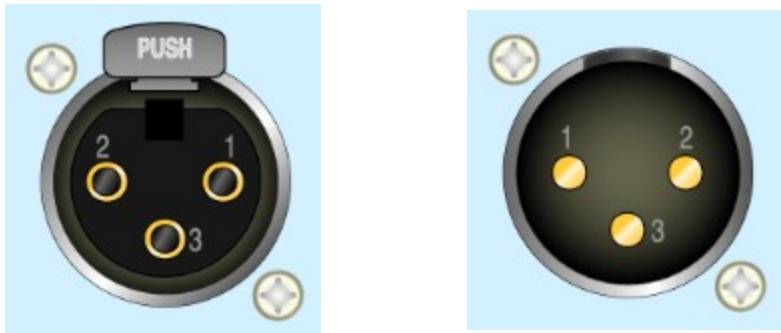
Pin 1: Signal ground
Pin 2: Signal + (non-inverting)
Pin 3: Signal - (inverting)
Connector ground lug: chassis free

6. PC connection

ADVICE: Windows users must install the driver prior to connecting the USB cable to the PC (please refer to download section http://www.aquahifi.com/download.html).

The USB cable that connects to a PC, must conform to the 2.0 specifications, and should be of adequate quality. Please avoid using cable more than 2m, to avoid invalidating the bus performance

True plug'n'play operation with Mac

Mac computers with OSX 10.6.4 and later have a native support for audio devices compliant with **USB Audio Class 2.0**. This means that the driver is already included in the operating system and the user needs not to install anything. Just connect the Formula DAC to your Mac and it will be immediately recognized by the OS and ready to use. Macs with older OS need update.
To use aqua USB as output device for your Mac, you need to select it as default output device from the **Audio Control Panel (Preferences -> Sound).**
After selecting aqua USB, please check settings, you can select the sampling frequency fixed for Formula DAC, regardless the native sampling frequency of all audio tracks.

For the best sonic results, you may want to use a player which follows the native frequency of the tracks, like **Sonic Studio Amarra** or **Channel D Pure Music**.

True plug'n'play operation with Linux

PC with Linux 1.0.24 and later have a native support for audio devices compliant with **USB Audio Class 2.0** This means that the driver is already included in the operating system and the user needs not to install anything. Just connect the Formula DAC to your PC with Linux and it will be immediately recognized by the OS and ready to use.

Windows XP, VISTA, 7, 8, 10 O.S.

For the best sonic results, you may want to use a player which support **ASIO***, like **Foobar** or **JRiver Media Center**

*ASIO is a trademark of Steinberg Media Technologies GmbH

Handcrafted in Italy

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