

NMR-DAC-UM-099E - April 2013



EDEL Network Audio DAC

NMR-DAC

Evaluation Board User Manual

April 2013

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About This Manual

This document provides the information needed to design and integrate the Edel Ethernet Media Renderer Module into your product. For more information, please refer to the product description available from the ABC PCB web site at <http://www.abc-pcb.com>.

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1. Introduction

The Edel NMR-DAC is a very high quality audio DAC for music rendering over an Ethernet network. It is based on the Edel Media Renderer Module (MR-MOD), developed by ABC PCB to provide an optimal solution for high end network audio playback systems.

The MR-MOD plays music from streams, from a file server or an Internet radio, acting as a UPnP™ AV/DLNA Media Renderer device. Common audio formats are supported, including lossless FLAC at 192kHz 24-bit.

The Ethernet stream is asynchronous and the audio data are extracted at the rate of the local clocks. Thus, for optimal performances, the digital audio output port of the MR-MOD works in slave mode and assures bit-perfect data transfer and jitter-free clocking.

Great care has been taken on the electronic design and board layout. Digital and analog circuits have been precisely designed, simulated, measured and fine tuned for the best sonic performances.

Our team truly hope that you will enjoy using this DAC board for evaluating our technology, and simply listening to great music with a very high quality streaming concept!

1.1 Highlights

- Digital Media Renderer
- UPnP™ AV 2.0 / DLNA
- Plays and decode common audio formats (*) from HTTP streams
- Resolution up to 24-bits, sampling rate up to 192kHz (**)
- Bit-perfect data transmission
- 2-channel asynchronous endpoint for jitter-free stereo playback
- 32-bit digital volume attenuator
- Low jitter local oscillators, located close to the D/A section for optimal clock distribution
- WM8740 D/A converters in dual differential mode
- High performance analog filtering
- Discrete, high current and high bandwidth analog output stage
- High quality headphone output
- Configurable local volume control
- Low noise local voltage regulation and extensive power supply filtering
- High grade electronic parts
- Auxiliary S/PDIF input

(*) Subject to licensing by the final product manufacturer for the various audio decoders.

(**) DSD playback is not supported.

1.2 Functional Block Diagram

The NMR-DAC is designed to illustrate the performances of the Edel MR-MOD Media Renderer Module. Thanks to the asynchronous streaming mode, the digital audio clock is provided by the local oscillators. There are two on-board low-jitter oscillators, selected according to the native sampling rate of the audio file currently playing.

This concept allows for true bit-perfect data transfer. No sample-rate conversion or other processing is performed on the audio data. The oscillators are located close to the DACs for better jitter performances.

The NMR-DAC board features a digital audio input according to the S/PDIF standard. When this input is selected, the master clock is extracted from the biphasic mark code. In this case, the recovered master clock is used for the DACs and the local oscillators are not used. The S/PDIF input is galvanically isolated with a high bandwidth transformer.

D/A conversion is based on two WM8740 DACs from Wolfson Microelectronics, configured in mono mode. A third order low pass filter rejects high-frequency noise produced by the delta-sigma modulator. The output stage uses high quality op-amps as well as a discrete output buffer.

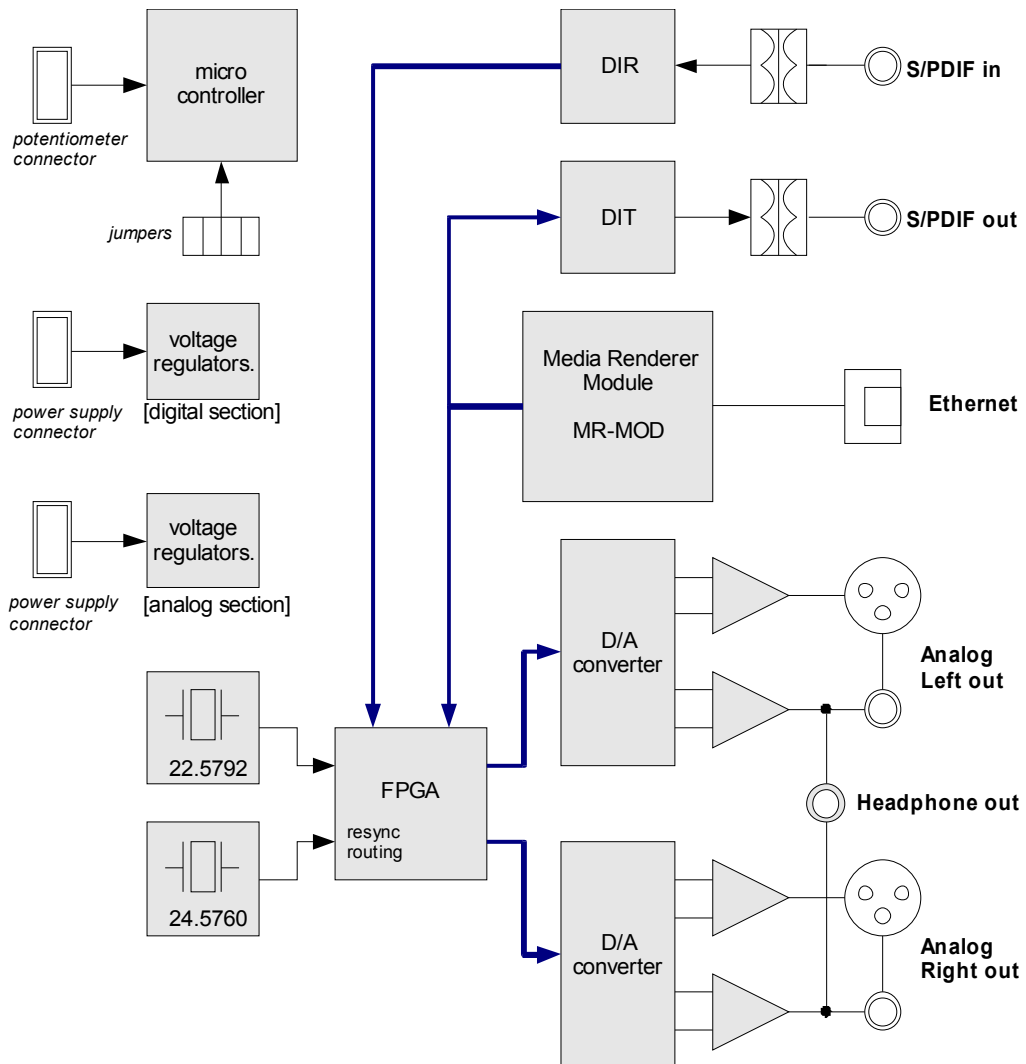



Fig. 1: Edel NMR-DAC functional block diagram

2. Characteristics and Specifications

2.1 Electrostatic Discharge Warning

Many of the components in this product are subject to be damaged by electrostatic discharge (ESD). Customers are advised to observe proper ESD precautions when unpacking and handling the board, including the use of a grounded wrist strap at an approved ESD workstation.

Caution	
	<i>Failure to observe ESD handling procedures may result in damage to the product.</i>

2.2 Recommended Operating Conditions

Table 1 indicates the recommended conditions under which the board should run properly.

Parameter	Recommended Condition
<i>Digital section Power Supply</i>	<i>5.0V DC</i>
<i>Analog section Power Supply, positive rail</i>	<i>+12.0V DC</i>
<i>Analog section Power Supply, negative rail</i>	<i>-12.0V DC</i>


Table 1: Recommended operating conditions

2.3 Absolute Maximum Ratings

The user should be aware of the absolute maximum operating ratings for the Edel NMR-DAC board. Failure to comply with these conditions may result in damage to the product. The minimum and maximum values are indicated in Table 2.

Parameter	Maximum Condition
<i>Digital section Power Supply</i>	<i>-0.3V to 5.5V</i>
<i>Analog section Power Supply, positive rail</i>	<i>-0.3V to +15.0V</i>
<i>Analog section Power Supply, negative rail</i>	<i>+0.3V to -15.0V</i>
<i>Peak-to-peak S/PDIF input voltage</i>	<i>0.0V to 3.6V</i>

Table 2: Absolute maximum ratings

Caution	
	Failure to respect the absolute maximum ratings may result in damage to the components.

2.4 Electrical Specifications

Parameter	Min	Typ	Max	Units
Power Supply				
External DC supply voltage, Digital section	4.75	5.0	5.25	V
External DC supply current, Digital section		600	800	mA
External DC supply voltage, Analog section positive rail	11.4	12.0	12.6	V
External DC supply current, Analog section positive rail		180.0		mA
External DC supply voltage, Analog section negative rail	-12.6	-12.0	-11.4	V
External DC supply current, Analog section negative rail		150.0		mA
Digital Audio				
Peak-to-peak S/PDIF output voltage (with $R_L=75\Omega$)		0.5		V
S/PDIF output impedance		75		Ω
Peak-to-peak S/PDIF input voltage	0.3	0.5	1.0	V
S/PDIF input impedance		75		Ω
Analog Audio				
Unbalanced output voltage (0dB FS)		2.0		V _{rms}
Unbalanced output impedance		75.0		Ω
Balanced output voltage (0dB FS)		4.0		V _{rms}
Balanced output impedance		150.0		Ω

Table 3: Electrical specifications

2.5 Performance Specifications

Parameter	Min	Typ	Max	Units
Digital Audio				
Input Resolution	16	-	24	bit
Input Frequency (Network streaming)	44.1	-	192	kHz
Input Frequency (S/DPIF input)	44.1	-	96	kHz
Dynamic Range	-	24	-	bit
Typical DAC performance (Note 1)				
Unbalanced output Noise Level (unweighted)		4.0		μV
Unbalanced output Signal-to-Noise Ratio (A-weighted, Note 2)		116		dB
Unbalanced output Total Harmonic Distortion (Note 2)		-104		dB
Balanced output Noise Level (unweighted)		7.0		μV
Balanced output Signal-to-Noise Ratio (A-weighted, Note 2)		118		dB
Balanced output Total Harmonic Distortion (Note 3)		-104		dB

Table 4: Performance Specifications

Notes:

1. All performance measurements done with a 22Hz – 22kHz bandpass filter.
2. SNR measured with 1kHz full scale (0dB FS) signal.
3. THD measured with 1kHz full scale (0dB FS) signal.

2.6 FFT Plots, 1kHz sine wave

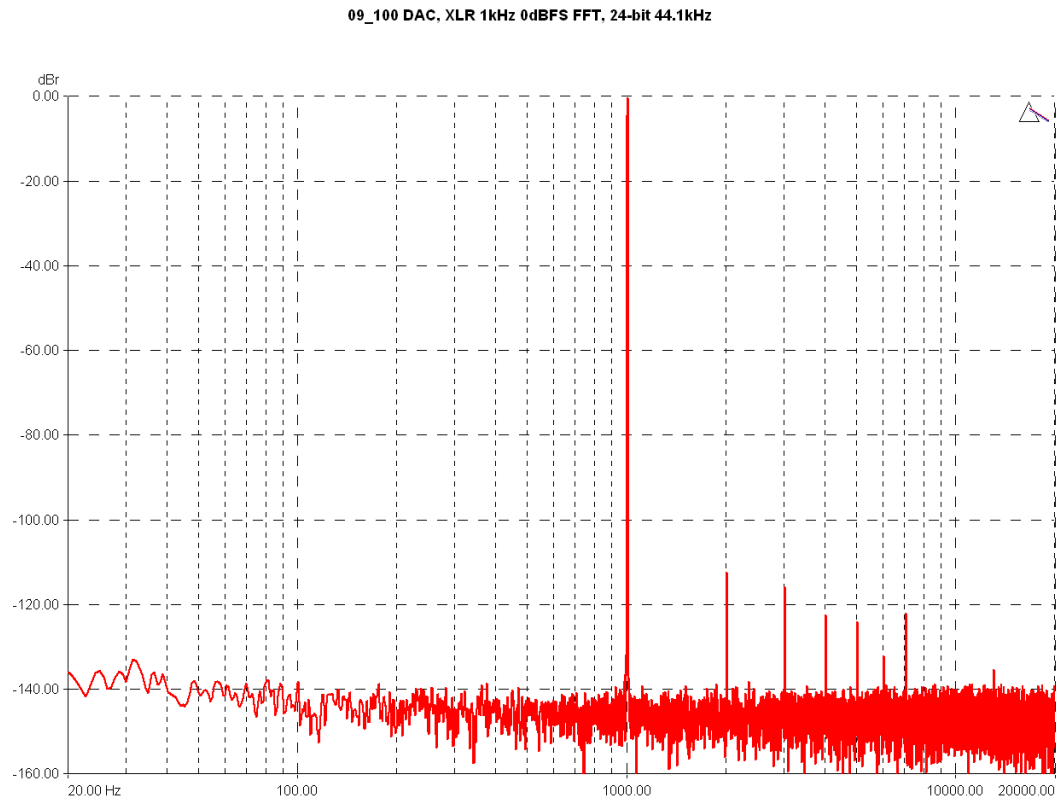


Fig. 2: FFT Plot, 24-bit 44.1kHz file

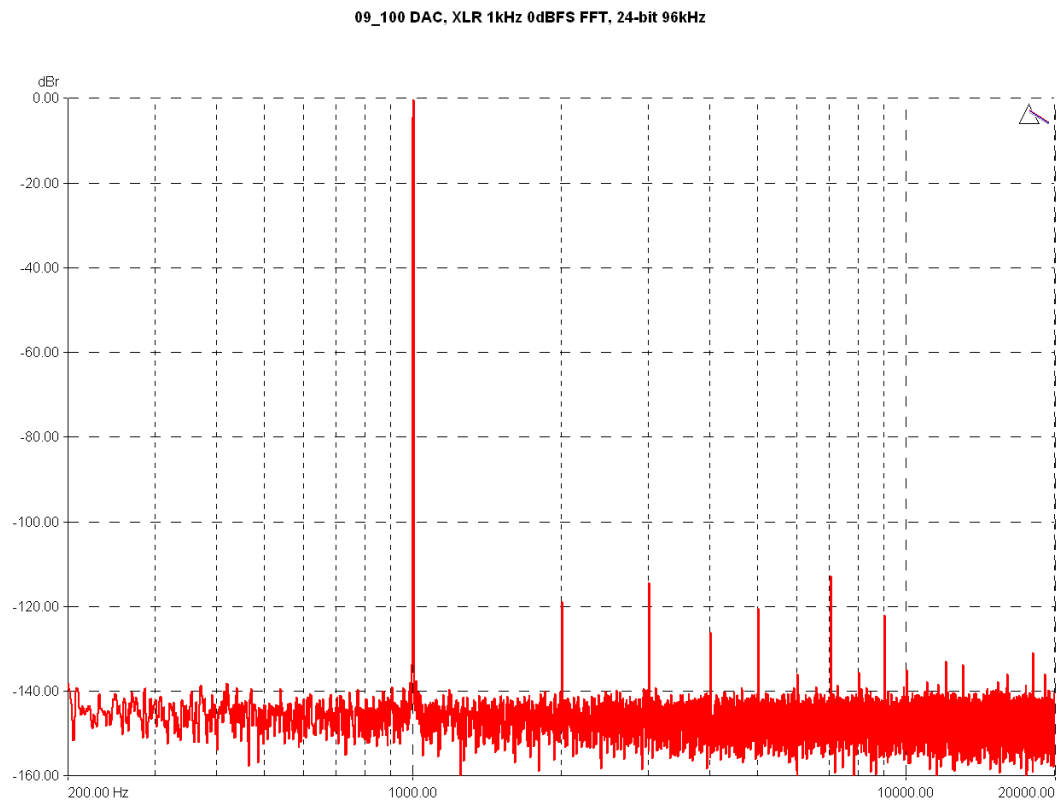


Fig. 3: FFT Plot, 24-bit 96kHz file

3. Application information

3.1 Typical Network Audio System

The NMR-DAC is easy to integrate into a home network thanks to the MR-MOD compatibility with the UPnP™ AV 2.0 standard.

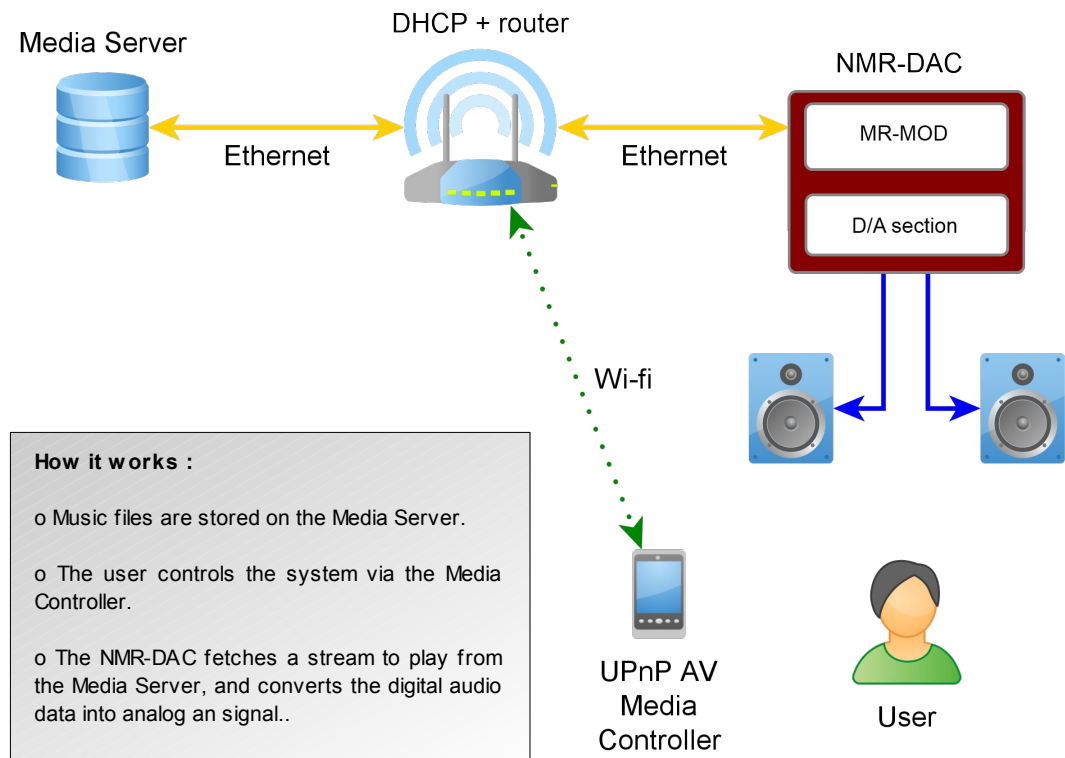


Fig. 4: Typical setup of a network audio system

3.2 Home Network Devices

Digital Media Server (DMS)

Multimedia files are stored on this device and are made available to the network Digital Media Renderers (DMR). Ex. : computer, network-attached storage (NAS) device.

Digital Media Renderer (DMR)

This device is controlled by a Digital Media Controller (DMC) and can play the content of a Digital Media Server (DMS). Ex. : network audio player based on the Edel MR-MOD, audio/video receiver, TV, remote speakers.

Digital Media Controller (DMC)

This device can browse the content on a Digital Media Server (DMS) and control a Digital Media Renderer (DMR) to play these files. Ex. : smart-phone, tablet computer, laptop or personal computer with a standard UPnP controller application.

3.3 Volume control

There are two options to control the NMR-DAC analog output level, both using digital attenuators.

Remote volume control

The volume is controlled by the Media Controller and is transmitted to the Edel MR-MOD via the Ethernet connection. The corresponding attenuation is computed inside the DSP and applied to the serial audio data output. Please note that there may be a short latency on volume changes due to the renderer's buffering system.

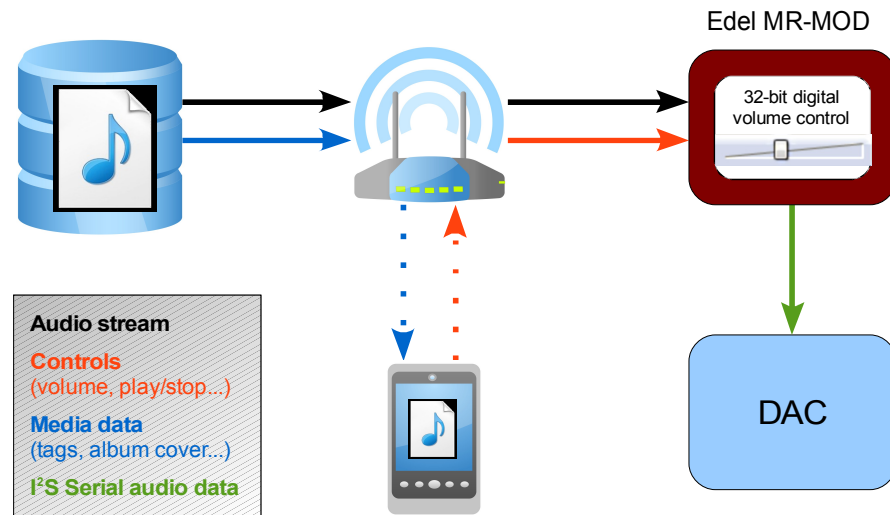


Fig. 5: Remote volume control description

Local volume control

This control uses the Wolfson DAC embedded attenuator. The wiper position of an external potentiometer is measured by the micro-controller to set the DACs digital attenuator. Please refer to chapter 4 Hardware set-up for information about this configuration.

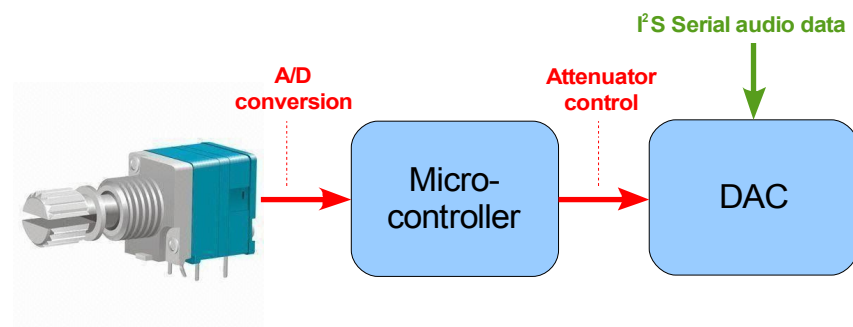


Fig. 6: Local volume control description

Please note that the remote volume control does not work when the S/PDIF input is selected.

4. Hardware set-up

4.1 Board overview

The following picture shows the location of some key circuits of and connectors on the NMR-DAC board.

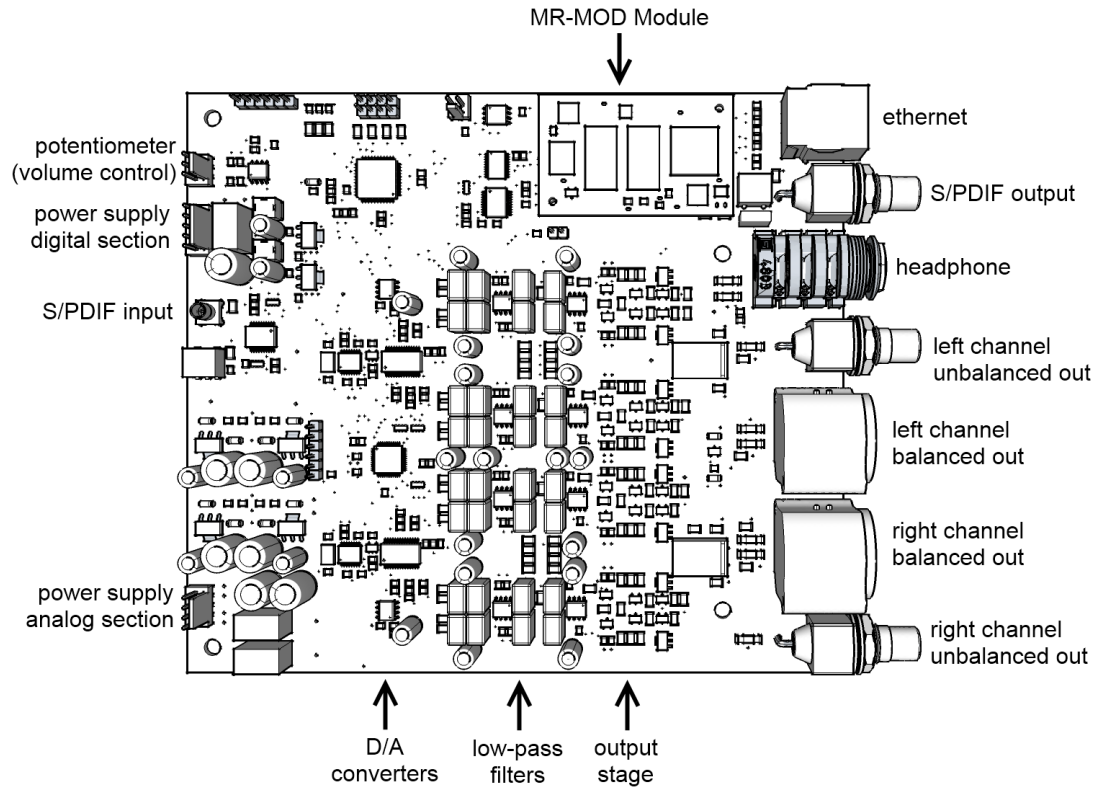


Fig. 7: NMR-DAC board overview

4.2 Digital section power supply

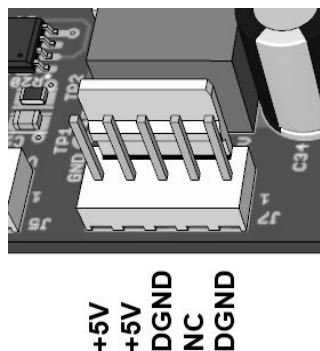


Fig. 8: J7 overview

Connector: J7. Industry standard 5-pin Molex KK-series 2.54mm connector. Corresponding housing for contacts: Molex ref. 22-01-2055.

PIN#	Name	I/O	Description
1	DGND	ground	Ground for the digital section
2	NC	output	Do not connect
3	DGND	ground	Ground for the digital section
4	+5V	power	+5V Power Supply - power supply input for the digital section , +5.0V
5	+5V	power	+5V Power Supply - power supply input for the digital section , +5.0V

Table 5: Digital section power supply connector description.

4.3 Analog section power supply

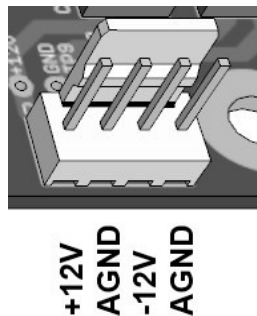


Fig. 9: J15 overview

Connector: J15. Industry standard 4-pin Molex KK-series 2.54mm connector. Corresponding housing for contacts: Molex ref. 22-01-2045.

PIN#	Name	I/O	Description
1	AGND	ground	Ground for the analog section
2	-12V	power	-12V Power Supply - power supply input for the analog section , -12.0V
3	AGND	ground	Ground for the analog section
4	+12V	power	+12V Power Supply - power supply input for the analog section , -12.0V

Table 6: Analog section power supply connector description.

4.4 Local volume control

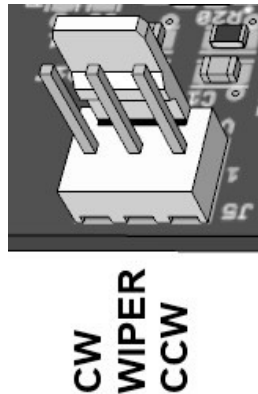


Fig. 10: J5 overview

Connector: J5. Industry standard 3-pin Molex KK-series 2.54mm connector. Corresponding housing for contacts: Molex ref. 22-01-2035.

PIN#	Name	I/O	Description
1	CCW	ground	Ground for potentiometer connexion
2	WIPER	input	Wiper input for potentiometer connexion
3	CW	output	+5V output for potentiometer connexion

Table 7: Potentiometer connector description.

Connect a 100k linear potentiometer to J5 for local volume control. The Wiper position is measured via an A/D conversion process by the on board micro-controller. The DAC's embedded digital attenuator is set accordingly.

Please not that the local volume control does not override the remote volume control processed by the MR-MOD. Both volume controls can be activated and work simultaneously.

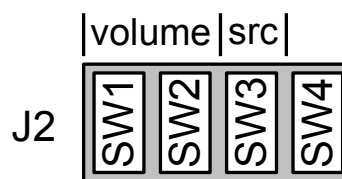


Fig. 11: Jumpers overview

The local volume control is set by two jumpers on the left side of J2 header, SW1 and SW2. Please refer to table 8 for more information. When set to *OFF*, no volume control is applied and the the potentiometer has no effect. When set to *ON*, the DACs digital attenuators are configured accordingly to the potentiometer position.

When set to *Automatic*, the volume control is applied only when a headphone jack is plugged. This option is convenient for using the DAC at line Level with an integrated amplifier connected to the RCAs or XLRs, and use the local volume control only when listening to with headphones.

SW1	SW2	Description
Open	Open	OFF
Open	Closed	ON
Closed	Open	Automatic

Table 8: Local volume control setting.

4.5 S/PDIF input

Connector: J10. SMB Mini receptacle. Corresponding connector: Emerson Network Power ref. 131-8403-101.

The S/DPIF input is selected by removing the jumper SW3. Please refer to Fig. 11 for an overview of the jumpers position.

SW3	Description
Open	S/PDIF input is selected
Close	Network Streaming input is selected

Table 9: Local volume control setting.

4.6 MR-MOD Firmware Upgrade

The firmware update requires a computer connected on the same network as the MR-MOD. Once the device has booted and is registered on the network, its information web page can be accessed with an Internet browser. This page contains the firmware update interface.

On MS Windows-based computers, browsing the network gives easy access to the media renderer, displayed in the Network window under the label "Media Devices". A double-click on the "Audio Renderer-XX" icon shows the information web page.

On other operating systems, it may be required to access the router's DHCP table to get the renderer's IP address. Then simply enter the IP address in your web browser to access it.

The information page contains the firmware update interface.

Fig. 12: Firmware Update dialogue

Download the latest firmware from our web site and save the file on your computer, then extract the ZIP archive. Select the "nmr-abc_vX.XX-...bin" file and click on the "Flash Firmware" button.

5. Mechanical data

5.1 Board dimensions

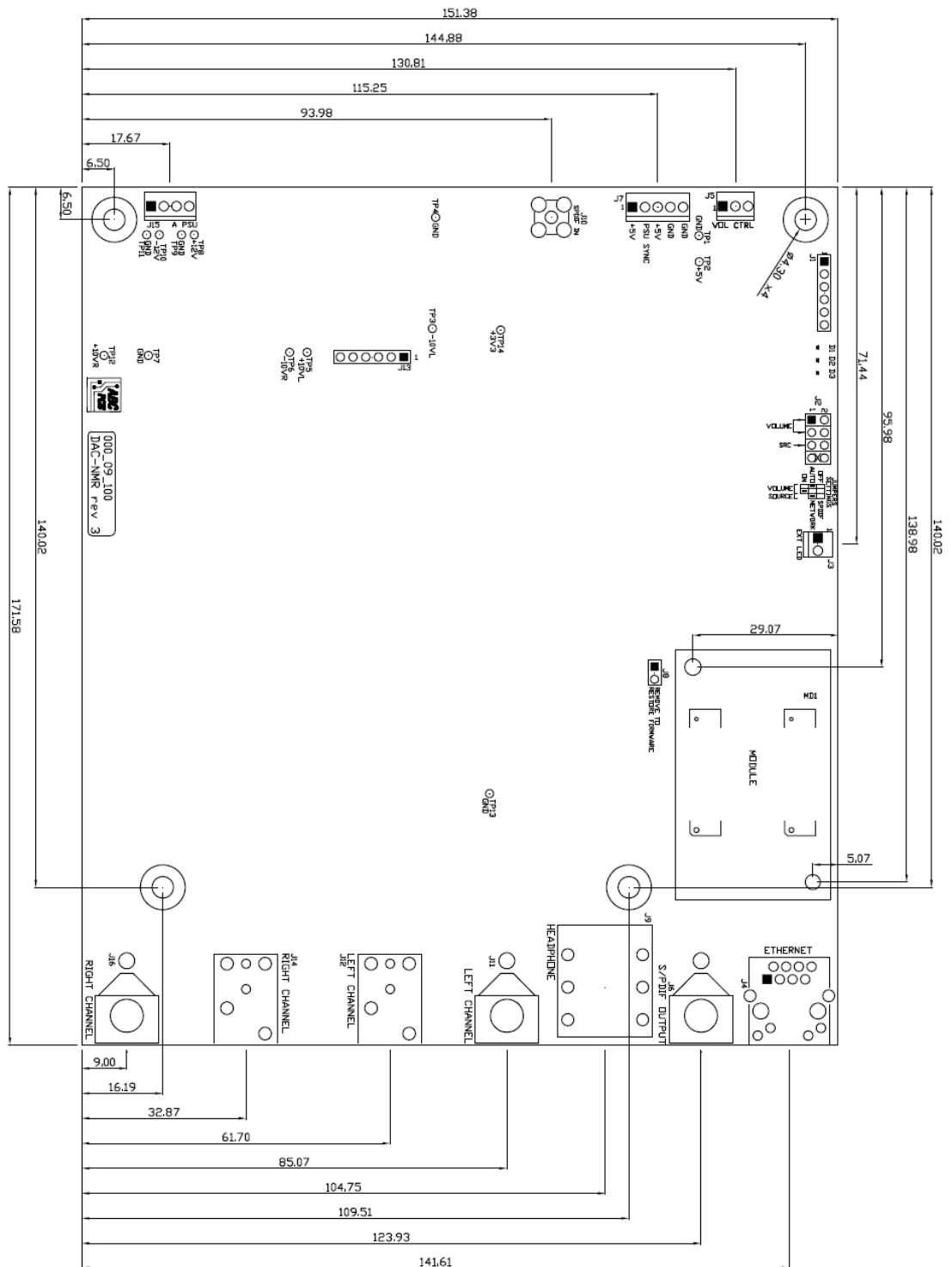


Fig. 13: NMR-DAC board dimensions

The drawing here below shows the NMR-DAC connectors position, holes shape and size for rear panel milling. This information is useful for mounting the NMR-DAC into a chassis.

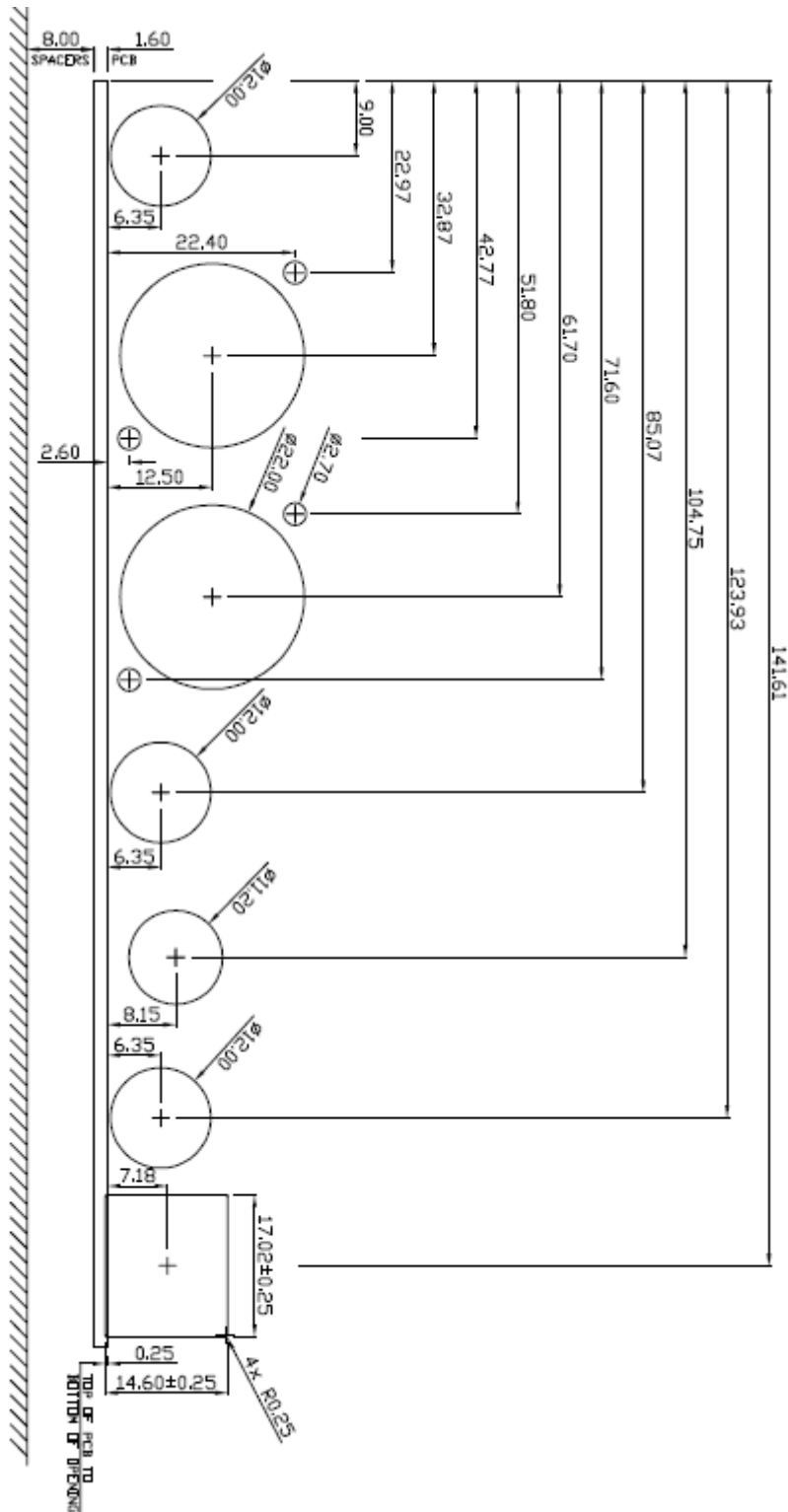


Fig. 14: NMR-DAC connectors position

6. Ordering information

6.1 Part Number

Part Number	Description
<i>NMR-DAC</i>	<i>EDEL Network Audio DAC</i>

6.2 Company address

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Product specifications are subject to change without notice.