RME AVB Tool User's Guide

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1. Safety Precautions

! WARNING	
	DO NOT OPEN DEVICE - RISK OF ELECTRIC SHOCK The unit has non-isolated live parts inside. No user serviceable parts inside. Refer service to qualified service personnel.

! CAUTION	
	General Safety Information Read read the following safety information thoroughly and keep it in a safe place for later reference. KEEP AWAY FROM WATER AND MOISTURE Prevent moisture and water from entering the device. Never leave objects containing liquid on top or near the device. Do not use this product near water, i. e. swimming pool, bathtub or wet basement. Danger of condensation inside - do not turn on before the device has reached room temperature. ENSURE PROPER VENTILATION Do not cover the vents on the side of the unit. Ensure proper ventilation to avoid overheating. Operation of the device is limited to the description in this manual.

NOTICE	
	Read the User Manual Read the manual completely. It includes all information necessary to use and operate this device.

2. Introduction

Thank you for purchasing the AVB Tool.

The AVB Tool combines four instrument, line and microphone inputs, two line outputs, and a headphone output with MADI and AVB routing capabilities. Among its outstanding features: digital no-compromise studio quality converters, remote control, and a user interface optimized for rapid configuration and control.

All device states and controls can be operated directly on the front panel with an encoder and four buttons that change their function depending on selected feature. This allows to rapidly create gain groups, switch phantom power and route signals to the headphone.

The RME AVB Core has implemented the IEEE standards for audio streaming, discovery and control meticulously, allowing the devices to be discovered and fully controlled by any AVB controller and making vendor-specific control protocols a thing of the past. Any signal reaching the 12Mic can be routed and streamed over deterministic networks with fixed latency and guaranteed bandwidth - no switch configuration required!

The coaxial MADI port and a slot for a second, independent or redundant optical MADI port (SFP module) can be used for daisy chaining, merging and converting MADI signals with lowest latencies.

A web frontend offers convenient access to the device controls and its integrated routing matrix. The integrated matrix allows free routing between analog inputs and headphone outputs, as well as all channels of both MADI ports, the AVB streams, and the analog line outputs.

2.1. About This Manual

This printed document was created for firmware 1.0.5b on 2020-04-29. For an updated version, please check https://www.rme-audio.com.

The following manual provides a detailed explanation of features and their proper use. Please read the safety instructions carefully.

> Features described in this manual may change when the device firmware is updated. It is therefore recommended to refer to the latest version of the manual available online.

Although the contents of this manual have been thoroughly checked for errors, RME cannot guarantee that it is correct throughout. RME does not accept responsibility for any misleading or incorrect information within this guide. RME reserves the right to change specifications at any time without notice.

2.2. Firmware Update

New and improved features for this device, as well as bug fixes, are published on the RME website in the download section as a firmware update. The update is provided as a compressed file with a .swu extension and can be uploaded via web remote over USB or network.

To update the AVB Tool:

1. Connect the device by USB or network cable and open the Web Remote.

   See: Section 8.4.1, 'Finding the Device on a Network'

2. Download the current firmware from the RME website.

3. Unpack the compressed file.
4. Open the # Settings in the Web Remote.
5. Within the Firmware Update section, press the Select .swu Firmware File button and locate the unpacked file.
6. Press Start Firmware Update.

> ! The unit retains all settings, including presets, when the firmware is upgraded.

2.3. Controlling the device

The AVB Tool can be controlled directly at the unit. For this purpose, a display, buttons, and an encoder provide access to all features. From the main screen, the encoder knob is used to access the main menu. It also controls the gain of the headphone output if turned, and puts the device into standby mode if pushed for several seconds.

2.3.1. Sections

The main menu separates all controls into one of four sections:

- STATE for general settings
- CLOCK for digital clock related settings
- INPUT for audio input related settings
- OUTPUT for audio output related settings and routing

To access the INPUT section:

1. Push the encoder to open the menu

2. Rotate the encoder to highlight the "INPUT" section
3. Push the encoder to open the "INPUT" section.

2.3.2. Tabs

The STATE, INPUT and OUTPUT sections are further divided into tabs, which are shown when the section is opened. Upon opening one of these sections, a cursor is shown to navigate between tabs and settings.

To leave a tab or the section, use the return key .

Tabs can generate a warning whenever a configured signal path cannot be established. This is then indicated on the main screen as a red highlight of the corresponding section and in the main menu. Warnings occur for example when a clock reference signal does not match the internal sample rate. They also cause the standby LED to flash in white and red.

Tabs in the main menu can also show a 'caution notification', for example if loaded preset was not saved. To see these notifications, open the main menu by pushing the encoder.

2.4. Status Indicator Color Chart

Notifications on this device have been optimized for different screen sizes. They are unified across the device display and the web remote and include a color bar that indicates the current state at a glance.

The following table shows the possible status indicator colors for reference.

Status	Color	Description
Warning	red	Requires a configuration change or matching external signal.
Notice	yellow	There is a potential issue.
Notice (in progress)	yellow with dots	There is a temporary issue that should resolve automatically.
No Routing	light green	*In output section:* Output is sending an empty signal.
Issues with Input	light green	*On standby screen in output section:* Output is working, but issues with input.
Good	green	Everything is working as expected.
Inactive	grey	Feature is not monitored or disabled.

3. Hardware

Section 3.6, ‘Analog Input Connectors’
Section 3.10, ‘Control Section’
Section 3.11, ‘Headphone Output’
Section 3.4, ‘Standby Switch’
Section 3.16, ‘USB 2.0 Type B Jack’
Section 3.18, ‘Security Lock Slot’
Section 3.15, ‘Word Clock’
Section 3.13, ‘MADI Coaxial and SFP’
Section 3.14, ‘Network Connection’
Section 3.17, ‘Analog Line Level Outputs’
Section 3.12, ‘Power supply’

3.1. Hardware Specifications

	RME AVB Tool
EAN	42 6012336 330 7
Dimensions	215 x 44 x 130 mm (8.5 x 1.7 x 5.1 inches)
Weight	1.0 kg (2.2 lbs)
Package	347 x 216 x 83 mm (13.7 x 8.5 x 3.3 inches)
Conformity	CE, FCC, WEEE, RoHS
Power supply	external 2 A 100-240 V AC
Power consumption	typ. 13W, standby 0.5W

3.2. Package Contents

The package of the AVB Tool contains the following items:

- AVB Tool
- external power supply
- one power cord
- one Cat5e network cable
- printed manual

> If any item is missing from a factory-sealed package, please contact support immediately.

3.3. Power On

The AVB Tool has a standby switch at the front.

Perform the following steps to power on the AVB Tool:

1. Ensure that the power inlet is properly connected to a power source.
2. The power indicator will light up in red (Standby) or white (On). This depends on the state of the device before it was disconnected from a power source.
3. If the device is in standby mode, hold the encoder for two seconds to boot the device.

> The AVB Tool features a dark mode which deactivates some or all lights of the front panel. This can be used to let the device appear powered off when it is in fact powered on. A short push on the encoder or any button deactivates this mode temporarily.

3.4. Standby Switch

The front panel encoder acts as a standby switch. While in standby mode, the device is completely powered down except for a red LED. No signals are processed or passed on.

Possible actions:

- When the device is in standby mode, pushing the encoder for two seconds will boot the device.
- When the device is powered on, push and hold the encoder for several seconds in order to power down the device. A red progress bar is shown while the encoder is pushed.

3.5. Standby Indicator

The following illumination patterns are possible:

No illumination

- There is no power at the DC input.
- Dark mode has been activated.

Permanent red illumination

- The device is powered off but is receiving power at either one of the power inlets.

Permanent white illumination

- The device is powered on and all systems are working without warning.

Alternating red/white illumination

- Something is not working properly. This is triggered when one of the four display sections: STATE, INPUT, OUTPUT, or CLOCK signals a warning.

3.6. Analog Input Connectors

XLR/TRS combo jacks 1-4

On the front of the device, four combined XLR/TRS inputs labeled "1" to "4" can be used for microphone, line and instrument signals. Phantom power (48 V) for microphones can be activated on each XLR input, high impedance ("Hi-Z") can be activated when using unbalanced TS connectors. Both XLR and TRS jacks accept balanced signals and maintain full symmetry internally all the way to the A/D converter. Phantom power is not applied at the TRS inputs.

3.6.1. Analog Input Specifications

XLR In 1-4

- ¥ Input: XLR, electronically balanced
- ¥ Input impedance: 3.4 kOhm
- ¥ Gain range: 75 dB, 1 dB steps
- ¥ Resolution AD: 24 bit
- ¥ Frequency response @ 44.1 kHz, -0.1 dB: 8 Hz Ð 20.8 kHz
- ¥ Frequency response @ 96 kHz, -0.5 dB: 4 Hz Ð 29.2[1]
- ¥ Frequency response @ 192 kHz, -1 dB: 3 Hz Ð 43.7[1]
- ¥ THD @ 30 dB gain: < -110 dB, < 0.00032 %
- ¥ THD+N @ 30 dB gain: < -104 dB, < 0.00063 %
- ¥ Channel separation: > 110 dB
- ¥ Signal to Noise ratio (SNR): 118 dB RMS unweighted, 121 dBA
- ¥ Maximum input level, Gain 0 dB: +18 dBu
- ¥ Maximum input level, Gain 75 dB: -57 dBu

[1] *optimized impulse response filter, see Section 3.7, ÒFrequency and Impulse ResponseÓ*

TRS In 1-4

As above, but:

- TRS jack, balanced
- Gain range: 42 dB, 1 dB steps
- Maximum input level, Gain 8 dB: +21 dBu
- Maximum input level, Gain 50 dB: -21 dBu
- Switchable high impedance (unbalanced TS): 1 MOhm

3.7. Frequency and Impulse Response

The AD converters of the AVB Tool are optimized for extremely low latencies (Short Delay IIR filters). At single speed, the conversion prioritizes frequency response to ensure linear conversion across the entire frequency band.

At double and quad speed (88.2 kHz and higher), the conversion has been optimized to deliver a near-perfect impulse response. This is achieved by allowing a lower cutoff frequency and a slower roll-off of the anti-aliasing filter. It shifts from around 44 kHz to 25 kHz at 96 kHz (84 kHz to 32 kHz at 192 kHz) and attenuates higher signals less steeply. The resulting impulse response shows significantly less ringing artifacts than steep filters at at a higher cutoff frequency. Since even the lower cutoff frequencies are located well above the audible range, the advantage of the improved impulse response outweighs the benefit of a higher cutoff frequency.

> If the AVB Tool is used for scientific research (ultrasonic signals) with measurement microphones that maintain a linear frequency response above 25 kHz, please contact your support for a solution.

3.8. Analog input LEDs with Integrated Metering

Each analog input is accompanied by an LED. Shades of green, yellow, and red represent the current level for each channel. Additionally, each LED shows the active state of phantom power (yellow), active TRS inputs (white), and active High-Z impedance on TRS inputs (blue) while pressing the corresponding quick access buttons.

3.9. Meter Backlight Color and Intensity Reference

The following table describes the signal level represented by the backlight color. Each value corresponds to full scale, which is equivalent to the reference level of the corresponding input.

Color	Color name	dBFS
	Green	-54 (barely visible in low light) -40 (barely visible in daylight) -20 (bright green)
	Yellow	-5 (strong yellow)
	Orange	-4

Color	Color name	dBFS
	Red	-1
	Red flashing fast	0 (at least three consecutive samples)
	Red flashing slow	input muted

3.10. Control Section

Section 3.8, 'Analog input LEDs with Integrated Metering'

Section 9.1.1, 'Analog Input User Interfaces'

Display buttons

Toggle P48/Hi-Z/TRS

Section 3.10, 'Control Section'

Phones output with routing

Input tab with warning

Section 3.4, 'Standby Switch', Encoder

The AVB Tool can be configured completely at the device. To do so, the a TFT display shows a menu. The adjacent encoder knob and buttons are used to navigate and change settings. In addition, each input channel has a dedicated button to access its controls.

The encoder can be pushed in order to activate an item,

and rotated left and right in order to select an item.

! If the device is powered on but the display shows no content, dark mode may be active. Rotate the encoder to temporarily bypass this mode and show the display.

3.11. Headphone Output

The AVB Tool features a stereo headphone output, 1/4" (6.3mm) TRS on the front panel. It can also function as a dual mono unbalanced output (13 dBu) and as a mono balanced line level output (19 dBu). Any digital or analog input signal can be monitored.

3.11.1. Analog Output Specifications

Phones 1/2:

- Resolution: 24 Bit
- Noise (DR): 115 dB RMS unweighted, 118 dBA
- Frequency response @ 44.1 kHz, -0.5 dB: 9 Hz Ð 22 kHz
- Frequency response @ 96 kHz, -0.5 dB: 9 Hz Ð 45 kHz
- Frequency response @ 192 kHz, -1 dB: 8 Hz - 75 kHz
- THD+N: < -100 dB, < 0.001 %
- Channel separation: > 110 dB
- Output: 6.3 mm TRS stereo (unbalanced) or mono (balanced) jack
- Maximum output level at 0 dBFS: +13 dBu (unbalanced), +19 dBu (balanced)

Analog Out 3/4:

- Output: two 6.3 mm TRS mono (balanced) jacks
- Maximum output level at 0 dBFS: +4 dBu or +19 dBu

3.12. Power supply

The AVB Tool comes with an external 12 V 2.0 A power supply with a locking connector (5.5 mm positive polarity) and detachable power cord (C7).

Insert the connector fully with the lock tabs facing sideways, then gently turn 30 degrees clockwise to secure the connector in place. Reverse this process to unlock and unplug the connector.

! Do not push and turn the connector at the same time as this may damage the DC socket.

3.13. MADI Coaxial and SFP

The rear of the AVB Tool features coaxial and SFP MADI (AES10-2003) I/O.

Each input receives up to 64 audio channels. Auto Input (see Section 9.2.2, 'Connecting Two Identical MADI Signals for Redundancy') can be activated to treat both inputs as one.

The coaxial BNC connector accepts coaxial cables with 75 ! impedance.

The *"small form-factor pluggable"* connector (SFP) accepts 125 MBit/s transceivers with LC connectors and multi-mode (MM) and single-mode (SM) cable support. These must be purchased separately (see Section 4, 'Accessories').

An SFP module has indicators to distinguish transmitter (!) and receiver ("). It can be inserted and removed while the device is powered on (hot plugging). Any plugged in connector must be removed before unlocking the SFP. Unlock and remove by pulling its integrated wire latch outward.

! The wire latch of the SFP module is color coded. Black stands for the most common multimode module, blue stands for single mode which allows longer distance transmissions. It is possible, but not reliable to connect single mode transceivers with multi mode transceivers. Avoid this by always confirming that connected devices match the specification of the fiber optic cable.

On the device, the characteristics and state of the signal at either input can be inspected in the INPUT section.

The presence or loss of a signal at either port is indicated on the standby screen and main menu if

- the input port is selected as clock master, or

- its audio channels are routed in the OUTPUT section.

3.14. Network Connection

On the rear of the AVB Tool, a ruggetized RJ45 connector labeled NETWORK provides ethernet connectivity. The supported link speed is 1 Gb/s for AVB.

A green LED (left) signals network traffic (blinking). A yellow LED (right) signals a successful link.

Both straight and crossover cables can be used (*Auto MDI-X*). Cable lengths of up to 100m are supported when using Cat 5e or higher classification.

The network port is used to send and receive:

- up to eight AVB audio streams when connected to AVB switches and endpoints,
- remote status/control with AVDECC, and
- remote status/control with HTTP over IP routed networks.

The current link state is also shown on the display of the AVB Tool.

A network port icon in the menu reveal the following states:

Icon	*Description*
	No link - cable not connected
	Negotiating link with other endpoint
	Link with speed of 100 MBit/s (not supported for audio streams)
	Successful link with speed of 1 GBit/s

3.15. Word Clock

Word clock can be sent and received via 75 ! coaxial cabling at the corresponding BNC connectors. The cable length should not exceed 100 m (330 ft).

! The input is terminated with 75 ! internally. To pass on the word clock to other devices, use the word clock output. Do not connect a T-adapter to the word clock input.

The state of an incoming word clock signal can be accessed in the CLOCK section.

Possible States:

- A green indicator shows that the signal is currently in sync with the chosen clock master.
- An orange indicator means that a word clock is received but is not in sync.
- A red indicator means that word clock is chosen as master, but a signal is not present or has a different sample rate than the chosen one.

3.16. USB 2.0 Type B Jack

The USB jack at the rear of the AVB Tool provides an alternative connection method for web remote control when a network connection is not available.

When connecting the AVB Tool with a standard ("printer") USB 2.0 cable to a current Microsoft® Windows® or Apple® macOS® operating system, a network adapter will be automatically installed. This does not require additional drivers. The device can then be remotely controlled by opening the URL http://172.20.0.1.

" The USB port cannot be used to stream audio signals.

3.17. Analog Line Level Outputs

Two 1/4" (6.3mm) TRS balanced line level outputs (labelled 3 and 4) are located on the rear panel. They support +4 dBu and +19 dBu line level.

Any digital or analog input signal can be sent to these outputs. The outputs are servo balanced, therefore unbalanced cables with TS plugs can be used and deliver the same output level as balanced connections.

3.18. Security Lock Slot

A slot marked "Lock" can be used to secure the device physically. The size of the slot follows industry standards and can be used with Kensington ¨ standard security slot locks.

4. Accessories

RME offers optional accessories for the AVB Tool:

Part Number	Description
SFP Modules	
MADI-SFP-MM	MADI optical multi-mode module, 2 km, LC
MADI-SFP-SM	MADI optical single-mode module, 20 km, LC

5. AVB Connectivity

Network Control

The AVB Tool is an AVB endpoint device that can be configured with the IEEE Standard for Device Discovery, Connection Management, and Control Protocol for IEEE 1722ª Based Devices, in short: AVDECC.

> This device does not provide an AVDECC controller for other devices on a network. To establish an AVB connection between devices, a separate controller is required.

There are several AVDECC controllers available for download from different manufacturers that support the commands required to

- identify the device,
- adjust its sample rate and clock source, and
- create connections to or from it.

The RME Digiface AVB includes an AVDECC controller.

Many other configuration options of the AVB Tool are at this time not implemented in generic AVDECC controllers. Both the control on the device and its web remote can be used to configure additional options.

> An AVDECC controller can optionally acquire the device. This means that the AVB Tool is no longer configurable by display or web remote until the acquisition is released.

Audio Streaming

The AVB Tool has eight outgoing and eight incoming stream ports. Each one can be configured to contain 1-8, 12 or 16 audio channels in AAF or AM824 format, or 0 audio channels in CRF format.

In order to establish a connection (*stream*) between two AVB devices, the following conditions must be fulfilled:

1. There must be a *physical* connection between the devices.
2. All switches between the devices must be certified AVB switches (or compatible).
3. An *AVDECC Controller* is required to find the devices and to connect them.
4. Talker and listener must support the stream format and channel count.

> A stream between two AVB devices is deterministic, has a fixed latency, and reserved bandwidth.

5.1. Identifying a Device Remotely

When several AVB Tools are connected to the same network, each device has its own remote control. To quickly reveal which device is currently being controlled, the web remote and any AVDECC controller can send an Identify command. This triggers an animation of the front panel level meters of the corresponding device.

To start device identification with the web remote:

1. Open an AVB Tool web remote in a browser (see *Section 2.3, "Controlling the device"*)
2. Press the identify ! icon. The front panel level meters of the controlled device will show an animation.

! Depending on the controller, the animation may persist infinitely or stop after a short period of time.

5.2. Changing the Device Name

A custom name can be assigned to the device. It is used to identify the AVB entity with AVDECC controllers. It also allows the access to the web remote without using the IP address on Apple macOS computers.

$ The device name is stored to and recalled from presets. Loading a preset can therefore change the device name. It is not affected by firmware updates.

Changing the device name is only possible via web remote or AVDECC controller.

5.3. AVB Stream Size and Format

In an AVB network, a stream describes a connection between a talker and one or more listeners. It consists of a fixed number of audio channels at a fixed sample rate. The *stream port* of the talker and the listener must be configured to have the same amount of channels and stream format. Once a stream is connected, each AVB switch along its way ensures that the audio channels can pass in time, with a higher priority than other network traffic.

For audio transport, AVB audio endpoints support the AM824 Stream Format or the more efficient AVTP Audio Format (AAF). Additionally, they may support the Clock Reference Format (CRF), which contains only clock information, but no audio.

The AVB Tool supports a total of eight incoming streams and eight outgoing streams. Each stream port can be individually configured to contain 1-8, 12 or 16 channels in AM824 or AAF format. Additionally, a stream port may be configured for 0 channel CRF streams.

5.4. AVB Network Latency

All devices in an AVB network share the same time. This allows the sending device (*talker*) to specify the precise point of time when its audio samples should be played out at the receiver side (*listener*). This is achieved by adding an offset to the current time and sending the resulting timestamp with each sample transmitted. The timestamp is called "presentation time" and has nanosecond precision. For comparison, a single sample at 48 kHz has a duration of over 20800 ns.

The receiver compares the incoming presentation time of each sample to the current time and buffers the sample until the presentation time is has come.

The offset (*maximum transit time*) is specified by the AVB standard as 2 ms for class A traffic, which is enough time for the signal to pass through a very large network under full load with up to seven 100 MBit/s switches along the way. By default, most AVB products will use this offset. In smaller networks with less hops or 1 GBit/s link speed, the offset can be adjusted to lower values, such as 0.3 ms, 0.6 ms or 1 ms. In the event that the chosen offset is too low, the listener detects that the requested presentation time has already passed and the audio data is discarded.

The AVB Tool acts both as a talker with a specified offset of 2 ms, adjustable down to 0.3 ms, and as a

listener - where the latency is configured by the talker.

! In AVB networks, the latency is always specified by the talker and guaranteed by the listener. This behavior is *plug and play* and does not require any user interaction or monitoring.

5.4.1. Adjusting the network latency

The default presentation time offset of 2 ms for outgoing streams can be changed when lower latencies are required.

" Reducing the offset to a lower value can prevent audio to be played out depending on the network.

This setting can only be accessed on the web remote (see Section 2.3, ÒControlling the deviceÓ), where it can be found in the outgoing stream settings.

! Changing the presentation time offset briefly interrupts all incoming and outgoing AVB streams.

6. Quick Start (MADI)

Follow this procedure to send microphone input signals to the digital outputs.

1. Load Preset 1 from the STATE>Preset tab. If Preset 1 has been modified, load the Factory preset and create a routing first Section 10.1, ÒRouting Signals to the OutputsÓ.

2. In the CLOCK section, choose a sample rate and verify that the device is clock master or that the chosen clock source is in sync.

3. After connecting an analog signal, adjust its gain level as needed: press the button next to the input.

4. Then, use the buttons and encoder next to the display to adjust settings as needed.

" done! The channel is sent to the MADI and AVB outputs.

7. Warranty and Support

7.1. Warranty

Each individual AVB Tool undergoes comprehensive quality control and a complete test before shipping. The usage of high grade components should guarantee a long and trouble-free operation of the unit.

If you suspect that your product is faulty, please contact your local retailer. Do not disassemble the device by yourself as it may get damaged. It has been sealed with tamper-evident material, and your warranty is void if those seals have been damaged.

The distributor grants a limited manufacturer warranty of 6 months from the day of invoice showing the date of sale. The length of the warranty period is different per country. Please contact your local distributor for extended warranty information and service. Note that each country may have regional specific warranty implications.

In any case warranty does not cover damage caused by improper installation or maltreatment - replacement or repair in such cases can only be carried out at the owner's expense.

No warranty service is provided when the product is not returned to the local distributor in the region where the product had been originally shipped.

The distributor does not accept claims for damages of any kind, especially consequential damage. Liability is limited to the value of the AVB Tool. The general terms of business drawn up by the distributor apply at all times.

7.2. Support

Please ensure that you are using the latest firmware before contacting support.

In many cases, the user forum at https://forum.rme-audio.de provides help with a simple search for relevant keywords.

If the problem cannot be solved by any of the aforementioned methods, please have your serial number at hand and contact and your local dealer or distributor. A complete list of distributors can be found on the RME website.

7.3. Support Contacts

Additionally, the following global service centers can provide support assistance:

Europe

Audio AG, Germany
support@rme-audio.de

Synthax U.K.
info@synthax.co.uk

Asia/Australia

RME Trading Ltd., Hong Kong
support@rme-trading.hk

Americas

Synthax Inc., U.S.A.
tech.support@synthax.com

Global

support@rme-audio.de

8. STATE Section

The STATE section contains states and settings that are unrelated to audio I/O and clock. It can be used to configure presets, dark mode, level meters, and remote control.

A notification (orange) is shown when a preset is modified, no IP address was assigned to the web remote or any dark mode is active.

8.1. Presets

Any change in the device configuration is persistent. After a power loss, the device will revert back to its last state. Additionally, the AVB Tool can save fifteen states in presets numbered 1-15. After a preset is loaded, any change in the configuration will result in an *unsaved changes* state.

Representation of an unsaved preset on the device.

> The internal preset storage is not affected when the device firmware is updated. Moreover, recalling the factory default preset does not delete any other saved preset.

Settings that are not saved in a Preset

The following settings are not saved *in a preset:*

- Auto-lock
- Lock code
- Remote control

8.1.1. Saving Presets

Up to 15 presets can be saved in the internal storage of the AVB Tool.

To save a preset on the device:

1. Open the preset tab in the STATE section. The currently loaded preset is shown.
2. *(optional)* Rotate the encoder to choose a preset that should be overwritten.

3. Push Save to save the preset.

8.1.2. Loading Presets

Up to 15 custom presets can be loaded from the internal storage of the AVB Tool.

! Loading a preset cannot be undone. Ensure that any important configuration has been saved to another preset before proceeding.

$ The device name is part of the preset. When a preset is loaded, the device name is changed to the value stored in the preset.

To load a preset on the device:

1. Open the preset tab in the STATE section *(see: Section 2.3, ‟Controlling the device”)*.
2. Rotate the encoder to choose a preset.

3. Select Load to load the preset.

8.1.3. Loading Factory Default Settings

The factory default settings are saved internally as Factory Preset and cannot be overwritten.

To load the factory defaults, load the 16th preset labelled Factory Preset.

" Loading the factory defaults does not delete any saved presets. It also does not affect the lock settings in the STATE section.

8.2. Device Lock

The AVB Tool can be secured against both accidental and intentional changes to its configuration. Locking the device, with or without code, protects against changes on the device itself. When locked, the display shows a lock symbol.

The device lock does not protect against changes over network or MIDI remote control protocols. The lock configuration is not stored within a preset.

! A four to six digit code can be configured on the device. If this code is lost or forgotten, it is not possible for the user to unlock the device. Contact your support for assistance.

8.2.1. Locking the Device

In order to lock the device, proceed with the following steps:

1. Open the lock tab in the STATE section (*see Section 2.3, "Controlling the device"*).
2. *(optional)* Set Code: enter a four to six digit code with the encoder.
3. *(optional)* Activate the Auto Lock toggle to lock after one minute.
4. *(optional)* Select Lock Device Now to lock immediately.

! Remember or write down the code shown in SET CODE. It is not possible to unlock the device without this code. A unique secondary code (PUK) can be obtained from RME Support upon request with a proof of purchase and device serial number.

To delete the code, move the cursor on the code and push the encoder. "No code" will be displayed.

8.2.2. Unlocking the Device

To unlock the device temporarily*:*

1. Push and hold the encoder button for four seconds.
2. (if a code was set) Enter the code using the encoder and choose "Done".

The device will lock again after a timeout of one minute.

To unlock the device permanently:

1. Proceed as above, then
2. Open the lock tab in the STATE section

3. Deactivate the lock by toggling the switch to: OFF
4. *(optional)* Move the encoder onto the lock code (if any), and push the encoder to delete it.

8.3. Front Panel Illumination

The AVB Tool front panel illumination reveals the current device state at a glance. It combines:

- full color LEDs at each input
- a standby indicator with integrated status warning
- a display with level meters and status feedback

Each of these three elements can be individually switched off (*dark mode*).

8.3.1. Dark Mode

Each of the three front panel illumination sections can be switched off if they are not required.

To turn off illumination on the device:

1. Open the visual feedback tab in the STATE section.

2. Change any of the following:
   a. Display to off to turn off the display.
   b. Status indicator to off to turn off the standby/status indicator .
   c. LED Meters to off or Dimmed to turn off or dim channel LEDs.

When any item is turned off, a notification (orange) is shown in the STATE section.

To turn panel illumination back on:

1. Open the same menu and set the corresponding switches to to On.

! To turn the front panel lighting on temporarily, just rotate or push the encoder. The panel will turn back off after five seconds.

8.3.2. Changing the Meters to Peak or RMS Mode

Depending on the application, instantaneous peak level metering or a slower, averaged RMS metering may be preferred.

To change the metering mode on the device:

1. Open the visual feedback tab in the STATE section.

2. Open "Global Meters" using the corresponding button.

3. Press the first button to toggle between Peak and RMS metering.

> This is a global setting which affects both the front panel level meters and the remote control interface.

8.3.3. Persistent Clipping Notifications and Peak Hold

The maximum level of signals can be saved and shown on the front panel and web remote. Clipping is detected when three consecutive samples reach digital full scale (0 dBFS). The duration of how long the maximum level or clipping is shown can be manually changed to either five seconds or until they are manually reset.

> This is a global setting which affects both the remote control and the device.

On the device, an over notification is signaled as a fast flashing (red) of the channel LED.

To switch over notifications on or off:

1. Open the visual feedback tab in the STATE section

2. Change Peak Hold to either:
   - 5s to notify for five seconds
   - On to notify until manually reset
   - Off to deactivate over notifications

To reset infinite full scale notifications:

1. Open either the INFO menu from the standby screen or the visual feedback - Global Meters tab in the STATE section.

2. Push the Peak Reset button.

8.3.4. Metering of Digital Signals

The incoming and outgoing digital signals can be visually inspected to ensure that signals are properly connected and routed. Level meters are included for each port in the corresponding input and output sections, but they can also be inspected quickly from the main window without using the main menu:

To show the digital level meters on the display:

1. Open the info section on the main screen.

2. Open the tab "Levelmeters".

3. Turn the encoder knob to step through the input and output signals.

8.4. Remote Control Overview

The AVB Tool can be remotely controlled. Remote control is activated by default and is not affected by preset changes or device lock.

The network controls over HTTP and AVDECC operate simultaneously. Two or more controller instances are synchronized. The MIDI control works either via DIN or is embedded into either MADI signals. Both network and MIDI control can be operated at the same time.

> **!** The remote control protocols are not protected against malicious use. When activated, the remote control server allows anyone on the network to make changes to the configuration of the device. To limit access, secure the network that the device is connected to.

8.4.1. Finding the Device on a Network

The AVB Tool has two integrated network adapters (USB 2.0 and ethernet). The adapters can be used, individually or simultaneously, to control the device with HTTP ("web remote"). The web remote control works on any IP-based network, including wireless networks.

The ethernet connection additionally supports AVDECC 1722.1 remote protocol, which requires a physical connection (cables), but does not require AVB switches. Wireless routers are not supported for AVDECC.

To enable web remote functionality over HTTP:

1. Open the remote tab in the STATE section.

2. Ensure that the HTTP Remote setting is switched to ON.

USB

When the device is connected with a USB 2.0 cable to a Apple macOS or Microsoft Windows computer, a network device is automatically installed in the background that assigns the AVB Tool the following IP address:

http://172.20.0.1

$ Only one of the following products can be connected to the host computer via USB at a time: RME M-32 AD Pro, M-32 DA Pro, 12Mic, AVB Tool, M-1610 Pro.

Ethernet

The integrated ethernet adapter will join an IP network when connected. If no DHCP server is found, for example when connecting the AVB Tool directly to a computer, an address is automatically self-assigned (in the 169.254.0.0/16 subnet).

To find out the current IP address:

1. Open the remote tab in the STATE section.
2. The current IP address is displayed.
3. Enter the IP address in the address bar.

Connecting to the Remote Interface without IP address

Instead of using the IP address, the device name can be entered in the browser window, followed by .local./.

By default, the name is avb-tool, and the corresponding URL is therefore:

http://avb-tool.local./

" The length of the custom name should not exceed 63 characters. Spaces in the device name should be written as hyphens ("-") when entering the URL.

! The device name is stored in a preset. Loading a preset can therefore change the device name and require a different address.

8.4.2. Web Remote

An integrated web server provides an easy-to-use remote control interface for the AVB Tool. It requires a network connection from a desktop or tablet computer with a current browser version.

" Due to the amount of features, the web remote manual has been separated from this manual. A link to download the current manual can be found on the RME website and in the # Settings section of the web remote.

Compatible browsers:

- ¥ Chrome 68
- ¥ Safari 11.1
- ¥ Firefox 61

or newer

Section 2.2, ÒFirmware UpdateÓ
Section 5.1, ÒIdentifying a Device RemotelyÓ
Section 8.1, ÒPresetsÓ
Section 8.3, ÒFront Panel IlluminationÓ
Section 10.1, ÒRouting Signals to the OutputsÓ
Section 11, ÒCLOCK SectionÓ
Section 9, ÒINPUT SectionÓ
Section 9.1, ÒAnalog InputsÓ
Section 10, ÒOUTPUT SectionÓ

8.5. Device Information

The information tab is located in the STATE section.

It shows the current device name, firmware version and gPTP Grandmaster ID.

9. INPUT Section

The input section is used to inspect and configure the audio inputs of the device. A warning is displayed when a digital input is not present but selected as clock master, or routed to an output and is either not present or not in sync to the clock master. Related input settings, such as AVB stream size or MADI auto input, can be configured here.

9.1. Analog Inputs

The analog inputs of the AVB Tool can be configured at the device or remotely. Gain, phase, phantom power (48V) and TRS can be set on all inputs. While switched to TRS, the impedance can be set to High-Z for instrument signals.

" Phantom power is only available at the XLR input, high impedance only at the TRS input. When toggling from TRS to XLR, the current High-Z setting is stored and recalled to its previous state when toggled back. The phantom power setting is not stored and will be switched off when toggling the channel to TRS.

! To protect the input stage, only switch on phantom power after connecting a compatible condenser microphone or accessory. Remember to switch off phantom power when unplugging a microphone and before saving a preset.

" The gain and phase settings are not affected when toggling between XLR and TRS inputs.

Latency and default routing

At single speed sample rates, the converters are configured with short delay 'sharp' IIR filters with extremely low latencies (5 samples) and flat frequency response over the entire audible range. At higher sample rates, a short delay 'slow' filter is used to additionally optimize the impulse response. The latency increases to six samples at quad speed (176.4 kHz, 192 kHz).

A new device has a user-writeable preset 1 with the following default routing. While the factory default preset (16) does not contain any routings, preset 1 is convenient for plug'n'play operation.

! save preset 1 to any other preset for backup if it appears to be useful.

The default setting in preset 1 routes the analog inputs 1-4 to:

- both MADI coaxial and optional MADI SFP (channel 1-4),
- AVB stream 1 (AAF, 4 channels)
- AVB stream 2 (AM824, 4 channels)

9.1.1. Analog Input User Interfaces

Each analog input channel at the device has its own button. The button activates a settings dialog on the screen.

Activate channel controls
Monitor to phones
Gain Groups and Phase
Phantom Power
XLR/TRS Toggle
Current Input Level
Current Gain
Encoder

9.1.2. Adjusting the Input Gain

To adjust the input gain on the device:

1. Press the button next to the input. The current gain will be shown on the screen.

2. Rotate the encoder to adjust the gain.

9.1.3. Enabling Phantom Power (P48)

Channels with active phantom power are shown on the standby-screen with a yellow square indicator.

To activate phantom power on several channels:

1. While the standby screen shows the input level meters, press and hold the first button next to the yellow indicator. An instruction is shown on the display and the LEDs next to the input channels change to off (no phantom power) or yellow (phantom power active).

2. While holding down the button, press the channel buttons next to each input where the phantom power should be toggled on or off. A yellow LED at the input represents active phantom power.

To activate phantom power on a single channel:

1. Use the button next to the analog input to access its settings.

2. Use the P48 button to toggle phantom power.

> " Phantom power settings are not shown when the channel is switched to TRS input.

9.1.4. Switching Between XLR and TRS Inputs

The input channels 1-4 have "combo-jacks" that support both XLR and TRS connectors. When a plug is inserted, the corresponding input must be selected in the input settings. XLR is the default choice in the factory preset.

The current input mode is shown on the standby screen:

To toggle between XLR and TRS inputs on several channels:

1. While the standby screen shows the input level meters, press and hold the second button next to the X|T indicator. An instruction is shown on the display and the LEDs next to the input channels change to off (XLR) or white (TRS).

2. While holding down the button, press the channel buttons next to each input where the TRS input should be activated. A white LED at the input represents TRS.

To toggle XLR/TRS on a single channel:

1. Use the button next to the corresponding analog input to access its settings.

2. Use the XLR|TRS button to toggle the change the corresponding input. The active setting will be highlighted in blue.

9.1.5. Activating High Impedance (Hi-Z) on TRS Inputs

A high input impedance can be activated manually for unbalanced TS connectors on inputs 1-4. The current input mode is shown on the standby screen:

To activate high impedance on several channels:

1. While the standby screen shows the input level meters, press then hold down the first button. An instruction is shown on the display and the LEDs next to the TRS input channels change to white (low impedance) or blue (high impedance).

2. While holding down the button, press the channel buttons next to each TRS input where high impedance should be activated. A blue LED at the input represents high impedance.

To activate high impedance on a single TRS input channel:

1. Use the button next to the corresponding TRS input to access its settings.
2. Use the Hi-Z button to toggle high impedance. The active setting will be highlighted in blue.

" High impedance settings are not shown when the channel is switched to XLR input.

9.1.6. Inverting the Phase of an Analog Input Signal

The phase of analog input signals can be inverted at the input.

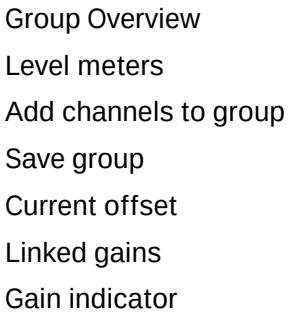
To toggle the phase of an input signal

1. Use the button next to the corresponding input to access its settings.
2. Press the third button two times in quick succession (double press). The phase button ¯ will become yellow.

" The setting persists even if the input source is toggled between XLR and TRS.

9.1.7. Gain Groups

The gain level of two or more channels can be linked temporarily or permanently. When part of a group, gain is increased or decreased as an *offset (in dB)* to the previously set individual gain levels. The offset is not stored itself - the adjustment is immediately applied to all member channels. Each time a gain group is accessed, the offset starts at 0 dB. If a gain of a channel is at its lowest setting (0 dBu) and a negative offset is created in a group that comprises the channel, the offset is ignored.



! All channels in a gain group will reach the same gain value when the offset reaches its maximum/minimum value. Any previously created gain differences between the channels will be lost.

" It is possible to adjust the gain of individual channels even when they are part of a gain group.

! In order to create an equal gain for all channels in a group, first set the offset of the group to its lowest (negative) value. Then, increase the offset to the preferred gain.

9.1.8. Creating a Gain Group

Gains can be linked directly at the device using the following methods.

To link the gain of two or more consecutive input channels while the device is idle (main screen):

1. Press and hold the first button at the first input. The channel is selected as the first channel in a group.

2. While holding down the first button, press a second button at another input. All inputs in-between will be added to the group. Release the buttons and adjust gain as required.

> Channels that participate in the current group are shown with colored level meters and a connecting line towards the encoder. Channels that do not participate in the group have grey level meters.

3. Hold down the third button (+) to add or remove individual channels from the group.

To link the gain of a selected channel to additional channels:

1. Press and hold the third button "+". The button turns green and an instruction will be shown.

2. Press a second button at another input. The new gain group is shown.

9.1.9. Saving a Gain Group

A temporary gain group can be saved. The gain group can then be opened anytime by pressing the channel button of a participating group once. Individual channel settings, such as phantom power, can still be accessed by pressing the channel button a second time.

To save the current gain group:

1. Create a temporary gain group. The selected channels will be shown on the screen, connected by a line attached to the bottom of their level meter.

2. Press the fourth button next to the display. The "link" indicator turns green, indicating a saved group.

" Groups will be saved in presets and appear always on both the device and its web interface. The gain of individual channels remains fully independent.

9.1.10. Monitor Analog Inputs at Phones Output

The phones output at the front of the AVB Tool can receive any input signal. Permanent routings are configured in the Phones Output settings (see *Section 10.1, 'Routing Signals to the Outputs'* and *Section 10.2, 'Phones Output'*). Additionally, the analog input screens provide a quick and convenient method to temporarily send their signal to the phones output.

To listen to an analog input on the phones output:

1. Ensure that the output volume is adequate (see *Section 10.2.1, 'Adjusting the Headphone Volume'*)
2. Press the button next to the corresponding channel to open the channel settings.

3. Use the fourth button to send this channel to the Phones Output (left and right) The button turns green, indicating that temporary routing has been established. The green button is also shown on the main screen and in the phones output settings.

To remove the temporary phones routing:

- Deactivate the routing by either pressing its button in the corresponding input channel, or
- by opening the phones output and deactivating the mode there. If there was a previous routing, it will be re-established immediately.

! when changing the routing, always ensure that the headphone volume is low to avoid damage to headphones and hearing.

9.2. MADI Input

The AVB Tool accepts up to two MADI signals, one electrical (BNC input) and one optical via SFP option (LC input).

To connect a MADI signal:

1. Ensure that you have set the correct sample rate and clock source in the CLOCK section.
2. Connect the cable to the corresponding input.
3. Open a MADI tab in the input section to see the current LOCK and SYNC state.
4. *(optional)* Use the device level meters to inspect the audio channels from the incoming MADI signal (*see: Section 8.3.4, 'Metering of Digital Signals'*).

! It is best to create a routing for the MADI signal right away, before connecting the cable to the device. This activates monitoring of the corresponding input for signal loss or clock issues. If no routing exists and the signal is not set as clock reference, plugging in a MADI signal will not lead to any visible change on the device standby screen.

9.2.1. MADI at High Sample Rates

The MADI standard (AES10) allows transport of audio at sample rates beyond 48 kHz by reducing the number of available channels.

Double speed (88.2 kHz, 96 kHz)

Double speed audio signals can be transmitted and received in two different ways. Manufacturers can implement one or both modes, usually referred to as "96k frame" and "S/MUX 2" or "legacy" mode. It is important to use the same mode on both sender and receiver side because S/MUX 2 and legacy mode are not compatible. Both modes transport the audio signal transparently.

96k frame

The so-called "96k frame pattern" (AES10) can be detected at the receiver side automatically. In this mode, the frame numbers and corresponding user bits equal the number of channels submitted. The "56 Ch." setting corresponds to 28 audio channels at 88.2 kHz and 96 kHz sample rates. The "64 Ch." setting corresponds to 32 audio channels at 88.2 kHz and 96 kHz sample rates.

S/MUX 2

Sample multiplexing (or S/MUX 2) describes a method to distribute two consecutive samples onto neighboring channels. The MADI signal remains exactly the same as in single speed with 56 or 64 channels including its user-bits. The receiver decodes the audio signal by passing the samples of channel 1+2 as two consecutive samples for channel 1, samples of channel 3+4 as two consecutive samples for channel 2, and so forth. The amount of channels corresponds to the same as the 96k frame. This format cannot be automatically detected at the receiver side.

Quad Speed (176.4 kHz, 196 kHz)

Quad speed MADI does not have a standardized frame format. Therefore S/MUX 4 is used. The encoding works the same way as S/MUX 2, except that four consecutive channels are used to transport one audio channel. This reduces the available number of channels to 14 ("56 Ch." setting) or 16 ("64 Ch." setting).

" When using MADI, the sample rate of the incoming MADI signal and the expected frame format of the outgoing MADI signal must be set in the device.

9.2.2. Connecting Two Identical MADI Signals for Redundancy

The coaxial MADI input can be configured to automatically switch to an existing MADI optical signal in case the coaxial signal fails. While existing routing and clock settings from the coaxial MADI input are kept, the port's name is changed to MADI Auto Input and its icon changes to reflect the feature. The failover is seamless if the active input loses lock abruptly (e.g. one of the cables is unplugged).

The user is notified of the lost signal with a warning and redundancy can be re-established.

" For a seamless failover, the two MADI signals must be identical. However, only the SYNC and LOCK states are evaluated to confirm the current input state. It is therefore possible to send two different signals to the AVB Tool as long as they are in sync.

To create MADI redundancy:

1. Switch on "enable MADI redundancy" in the coaxial tab of the INPUT section. The port will be renamed to MADI Auto Input.
2. Create a routing from MADI Auto Input to any output.
3. If the device should also slave to MADI Auto Input, choose it as clock master in the CLOCK section.
4. Connect both MADI signals with identical audio.

9.3. AVB Input Streams

The AVB streams *received* by the AVB Tool are referred to as "input streams". For these streams, the device acts as an AVB Listener.

To establish a connection between a talker and a listener, an AVDECC Controller is required. The AVB Tool does not include an AVDECC Controller.

AVB input streams are monitored as follows:

Description	Indicator	Possible solution
Disabled	grey	Create connection with AVDECC controller
Streaming/Receiving	green	
No Data	red	Verify proper talker configuration
SR Mismatch	red	Verify that the sample rates of talker and listener are identical
Waiting	yellow É	Waiting for talker to be ready
Talker Fail	red	Verify proper talker configuration
No Bandwidth	red	Use faster network speed (1 GBit/s instead of 100 MBit/s)
Domain Boundary	red	Reconnect all devices and reboot switch, ensure only AVB switches are used
Internal Error	red	Reboot device

9.3.1. Change AVB Input Stream Size

Each of the eight AVB streams can have a size of 1-8, 12 or 16 channels in AM824 and AAF stream formats, or 0 channels in CRF Media Clock stream format.

To change the amount of channels and format of incoming AVB streams on the device:

1. Open the AVB tab in the INPUT section.
2. Use the first button and encoder to select an incoming stream.

3. Use the second button and encoder to change the stream size and format.

! Changing a stream size briefly interrupts all incoming and outgoing AVB streams.

10. OUTPUT Section

The output section represents the internal routing matrix and state of the outputs. Routing is performed by selecting an output and assigning any input to it. When a routing is active, its input is automatically monitored for lock and sync in the input section. For AVB stream outputs, their states are additionally monitored in the output section.

Example:

In the OUTPUT section, MADI Optical 1-12 is chosen as source for AVB Stream 2. The AVB Tool is clock master, but the incoming MADI signal is not correctly synchronized. This causes a warning in the INPUT section. If MADI Optical is not routed to any output, an invalid or missing signal does not cause a warning.

> **!** Use the web remote to find out quickly which outputs are receiving a specific input signal. The web remote provides a thorough representation of all active routing connections at a glance.

Device Output Section

The device allows full inspection and configuration of outgoing signals including routing in four channel blocks.

10.1. Routing Signals to the Outputs

Each output channel of the AVB Tool can receive any input signal. If preset 1 has not been modified, it contains a routing of all analog inputs to all digital outputs. However, this can be adjusted and changed easily. The factory default preset does not contain any routing.

> **"** A routing immediately activates input monitoring for a corresponding digital input and raises a warning in the input state if the source signal is not available or out of sync.

The following example shows the procedure to route to MADI Coaxial output channels. Other outputs follow the same principle.

To create a routing to a MADI Coaxial output on the device:

1. Open the routing tab of the MADI Coaxial output in the OUTPUT section (*see Section 2.3, ‛Controlling the device'*).
2. Activate the routing destination and choose an output channel with the encoder (1, 2).
3. Activate the routing source and choose an input channel with the encoder (3, 4).

To remove a routing on the device:

1. Navigate to the corresponding output channel (1, 2).
2. Double click on "Increment routing". The routing source will be changed to "not routed".
3. *(optional)* Hold "increment routing" while turning the encoder to remove routings to the following output channels.

To route consecutive channels:

1. Navigate to the first output channel (1, 2) and create a routing as described above.
2. Hold "increment routing" while turning the encoder clockwise to increment input channel and output channel at the same time.

10.2. Phones Output

The front TRS connector can be used for phones or as a balanced mono output. Any incoming signal can be routed to the phones output. Analog input signals can be temporarily routed to the phones output while the original routing remains saved. A button on the standby screen gives access to all features of the output.

! The analog output level meters show the routed input signal relative to 0 dBFS (pre gain) in grey color in the background, and additionally the calculated output level post gain in green color in the foreground.

10.2.1. Adjusting the Headphone Volume

The volume of the unbalanced phone outputs can be adjusted separately or as a stereo pair.

To adjust the headphone volume on the device:

1. While on the main screen, rotate the encoder. The current volume will be shown below the encoder on the screen.

To separate the left and right headphone channels:

1. Open the headphone configuration by clicking the phones icon on the main screen.
2. Open the additional settings # by pressing the encoder.

3. Press the "Stereo" button to separate the left and right channel. Each channel now has its own volume control which can be accessed by toggling the following button on the phones screen:

Follow the same procedure to join the two channels as a Stereo channel.

10.2.2. Muting the Phones Output

To mute the phones output

1. While on the main screen, press the headphone button. The phones settings opens.

2. Press the mute button. It turns red to symbolize that the phones are muted.

10.2.3. Using Phones Out as a Balanced Line Output

The headphone output can operate as a mono balanced line level output. This may for example be useful when an active talkback speaker with symmetrical input is connected to the 12Mic.

To toggle balanced output mode on the Phones output:

1. On the main screen, press the Phones button to access phones output settings.
2. Press the encoder to open additional settings # .

3. Press the "BAL" button to switch the channel to balanced out. The channel that was routed to the left phones output will now be applied to both tip and ring of a TRS connector, the phase being inverted on the ring.

10.2.4. Line Level Outputs

The rear analog TRS connectors can be configured as individual channels or a stereo pair and their level adjusted to +4 dBu or +19 dBu. Any incoming signal can be routed to the analog outputs. To access these channels from the standby screen, open the phones settings first and then use the '3|4' button to open the line outputs.

10.2.5. Changing Analog Output Volume

The level of the balanced line level outputs can be adjusted separately or as a stereo group.

To adjust the volume of both channels as a stereo pair (default):

1. On the main screen, press the Phones button to access phones output settings.
2. Press the '3|4' selection button to access output channel 3 and 4.

3. Adjust the volume using the encoder.

To separate Output Channels 3 and 4

1. Open output channel 3|4 as above.
2. Press the encoder to open # additional settings.
3. Click the "Stereo" button to separate the channels.

10.3. MADI Outputs

The MADI outputs of the AVB Tool are always active. If no routing is configured, an empty stream is sent that can be used for clocking. This state is represented with a light-green Status Indicator.

10.3.1. Setting the Output Channel Format and Frame Pattern

Depending on the requirements of the receiver, it is possible to change the channel format and frame pattern of the outgoing MADI streams.

To change the channel format of both MADI outputs on the device:

1. Go to one of the MADI tabs in the OUTPUT section.
2. Toggle the switch to 56Ch or 64Ch to adjust number of output channels.

" 56Ch and 64Ch format correspond to 28/32 channels at double speed, and to 14/16 channels at quad speed.

To change the frame pattern of both MADI outputs on the device:

1. Go to one of the MADI tabs in the OUTPUT section.
2. Toggle the switch for 96k to use the 96k frame at 88.2 kHz and 96 kHz.

" 96k frame setting is only used at sample rates 88.2 kHz and 96 kHz and is otherwise ignored.

$ It is not possible to select separate settings for each MADI port. Both ports will be affected regardless which output tab is used to change the setting.

10.3.2. MADI Daisy Chains

MADI is a uni-directional protocol with a fixed number of channels. When more than two MADI devices are connected, a serial connection is required. This is also referred to as a "daisy chain". The output of the first device is connected to the input of the second device, the output of the second device to the input of third device, and so on, until the signal is plugged into the input of the first device.

It is important to understand that each device must be programmed to pass on audio from its MADI input to the MADI output. Otherwise, the last device would only receive the channels of one device.

$ While many RME devices pass on MADI signals automatically, the AVB Tool must be explicitly configured to do so.

In order to pass on signals, configure the output routing of the required output port to pass on the signal from the MADI input port.

" The latency of the MADI I/O is four samples.

10.3.3. MADI Port Mirroring

A redundant MADI connection protects from loss of audio in case of a single cable failure. To achieve redundancy, the receiver must support MADI redundancy. The sender must send two identical MADI signals on two outputs, usually the coaxial and optical ports.

The AVB Tool features independent routing for both MADI output ports. For this reason, a "mirroring" of the signal must be manually created. In order to do this, the routing of the two MADI outputs should be configured to contain the same routing.

$ The receiving device usually ignores the audio contents of the two MADI signals. Therefore, the redundancy may appear to be set up even though the AVB Tool sends different audio signals on both ports.

10.4. AVB Output Streams

The AVB streams *leaving* the AVB Tool are described as "output streams". In this case, the device acts as a talker. The talker defines the *presentation time* and therefore the latency across the network. This is set per default to 2 ms.

The output streams of the AVB Tool are by default empty, containing a clock signal but no audio signal. To send audio with AVB, a routing must be created for each outgoing stream.

To establish a connection between a talker and a listener, an AVDECC controller is required. The AVB Tool does not include an AVDECC controller.

Outgoing AVB streams are monitored by the device as follows:

Description	Indicator	Possible solution
Disabled	grey	Create routing
Disabled	orange	Create connection with AVDECC controller
Streaming/Transmitting	green	

Description	Indicator	Possible solution
SR mismatch	red	Verify that the sample rates of talker and listener are identical
Waiting	yellow É	Wait for listener to be ready
Listener Fail	red	Verify proper listener configuration
No Bandwidth	red	Use faster network speed (1 GBit/s instead of 100 MBit/s)
Domain Boundary	red	Reconnect all devices and reboot switch
Internal Error	red	Reboot device

10.4.1. Change AVB Output Stream Size and Format

Each of the eight outgoing AVB streams can have a size of 1-8, 12 or 16 channels in AM824 and AAF stream formats, or 0 channels in CRF Media Clock stream format.

To change the amount of channels and its format in the outgoing AVB stream on the device:

1. Select the configuration # of the corresponding AVB Stream tab in the OUTPUT section.

2. Use the button next to Stream format

3. Rotate the encoder to configure a new stream size and stream format and confirm by pressing the encoder again.

! Changing a stream size briefly interrupts all incoming and outgoing AVB streams.

" Changing stream sizes is not possible when streams are connected.

11. CLOCK Section

The CLOCK section is used to inspect and configure the clock source and sample rate of the AVB Tool.

11.1. Clock status

The clock of all digital inputs is continuously monitored with SyncCheck™ and shown in the CLOCK section. A warning occurs when the chosen clock master fails. A caution is displayed when a routed signal is out of sync. A caution notification is displayed when a signal is present, but not in sync and not routed. A good notification is displayed when a signal is present and in sync, but not routed or chosen as clock master. A confirmation is shown when the signal is present and either chosen as master or routed and in sync.

" On the standby screen, the two possible notifications are not shown. Those signals are not relevant to the current device state.

11.2. Master Clock

In its the default state, the AVB Tool uses an internal clock signal (*master*). This means that any connected device must synchronize to it (*slave*).

Alternatively, one of the digital inputs (word clock, MADI optical, MADI coaxial, and each of the four AVB streams) can be chosen as clock reference. This activates SteadyClock™ FS, a technology that extracts a low jitter clock signal from the incoming signal.

Intelligent Clock Control (ICC) automatically changes the clock source when the chosen master clock fails. Using the feedback of SyncCheck™, the AVB Tool will change to another source signal that is in sync, maintaining the slave mode and current sample rate. If no other source is available, the device will fall back to its internal clock until the chosen master has recovered. Due to the excellent performance of RME's clock technology, disconnection and re-connection of a master clock is likely to be performed without losing a sample in the outgoing audio signal.

" ICC switches the clock source between word clock, MADI optical, MADI coaxial, and internal, seamlessly, when the MADI optical, coaxial or word clock inputs fail and the other port is locked - or to internal. ICC will not fall back to an AVB sync source and also will not affect a chosen AVB master clock.

11.2.1. Selecting a Master Clock

To configure the clock master on the device:

1. Enter the CLOCK section (*see Section 2.3, 'Controlling the device'*).

2. Push first button. Two blue arrows are shown to indicate that the encoder can now be used to change the current setting.
3. Rotate the encoder until the preferred clock source is shown.
4. Push the encoder again to activate the setting.

11.3. Sample Rates Overview

The AVB Tool supports the following sample rates:

Supported sample rates

Single speed	44.1 kHz, 48 kHz
Double speed	88.2 kHz, 96 kHz
Quad speed	176.4 kHz, 192 kHz

If the device is clock master, these rates always correspond to the actual sample rate used.

11.3.1. Slave Mode

When the device is slave, certain deviations are automatically accepted to avoid interruption of the outgoing audio signal when the sample rate changes. This is called Intelligent Clock Control (ICC). It also handles deriving a sample rate of double or quad speed based on an incoming rate.

Intelligent Clock Control (ICC)

Input	Clock at input	Selected Sample Rate	Resulting Sample Rate
MADI	44.1	44.1	44.1
MADI	44.1	48	44.1 with warning
MADI	44.1	88.2	88.2
MADI	44.1	96	88.2 with warning
MADI	44.1	176.4	176.4
MADI	44.1	192	176.4 with warning
MADI	48	44.1	48 with warning
MADI	48	48	48
MADI	48	88.2	96 with warning
MADI	48	96	96
MADI	48	176.4	192 with warning
MADI	48	192	192
MADI 96k	88.2	44.1	warning (no sync)
MADI 96k	88.2	48	warning (no sync)
MADI 96k	88.2	88.2	88.2
MADI 96k	88.2	96	88.2 with warning
MADI 96k	88.2	176.4	warning (no sync)
MADI 96k	88.2	192	warning (no sync)
MADI 96k	96	44.1	warning (no sync)
MADI 96k	96	48	warning (no sync)
MADI 96k	96	88.2	96 with warning

MADI 96k	96	96	96
MADI 96k	96	176.4	warning (no sync)
MADI 96k	96	192	warning (no sync)
Word Clock	44.1	44.1	44.1
Word Clock	44.1	48	44.1 (with warning)
Word Clock	44.1, 88.2	88.2	88.2
Word Clock	44.1, 88.2	96	88.2 with warning
Word Clock	44.1, 88.2, 176.4	176.4	176.4
Word Clock	44.1, 88.2, 176.4	192	176.4 with warning
Word Clock	48	44.1	48 with warning
Word Clock	48	48	48
Word Clock	48, 96	88.2	96 with warning
Word Clock	48, 96	96	96
Word Clock	48, 96, 192	176.4	192 with warning
Word Clock	48, 96, 192	192	192

There is no ICC mechanism necessary for AVB; the device will always use the exact clock from the corresponding AVB stream.

" It is not recommended to sync devices with a higher sample rate than the current sample rate, because two devices could choose different edges of the incoming clock signal.

$ ICC does not affect outgoing AVB streams. Outgoing AVB streams will always correspond to the sample rate set in the CLOCK section. If the reference clock changes its frequency, outgoing AVB streams will be interrupted.

11.3.2. Number of Channels

The supported number of channels per port or stream at different sample rates is shown in the following table.

Supported number of audio channels per stream/port and direction at different sample rates

	44.1 kHz	48 kHz	88.2 kHz	96 kHz	176.4 kHz	192 kHz
MADI 56 Ch	56	56	28	28	14	14
MADI 64 Ch	64	64	32	32	16	16
MADI 56 Ch + 96k	---	---	28	28	---	---
MADI 64 Ch + 96k	---	---	32	32	---	---
AVB 1-8 Ch stream	1-8	1-8	1-8	1-8	1-8	1-8
AVB 12 Ch stream	12	12	12	12	---	---
AVB 16 Ch stream	16	16	---	---	---	---

" Since there are two independent MADI ports, the total supported number of channels can be multiplied by two. Since there are eight independent AVB streams, the total supported number of channels can be multiplied by eight. The analog channel count remains identical at all sample rates.

11.3.3. Selecting a Sample Rate

To configure the sample rate on the device:

1. Enter the CLOCK section (*see Section 2.3, 'Controlling the device'*).

2. Use the button next to the current sample rate. Two blue arrows will appear to indicate that the encoder can now be used to change the rate.
3. Rotate the encoder until the preferred sample rate is shown.
4. Push the encoder again to activate the setting.

11.3.4. Effects of Sample Rate Changes on Existing Routing

The AVB Tool saves one routing table per preset, regardless of sample rate. A change of sample rate or MADI frame mode can reduce the number of input and output channels available for routing. This does not alter the routing table. Any existing routing is hidden until another change of sample rate re-enables the channels.

Example:

A routing is created at 96 kHz with 32 channels, sending the MADI coaxial Input 1-32 to optical MADI Output 1-32. If the sample rate is now changed to 176.4 kHz and the 56 Ch frame is activated, only the first 14 channels of MADI coaxial input are routed to the optical output. Switching the sample rate to 44.1 or 48 kHz will reveal the previous routing for 32 channels.

11.4. Set Word Clock Output to Single Speed

At sample rates > 48 kHz, it may be necessary to synchronize two devices with a fraction of the actual sample rate:

Sample Rate	Word Clock Full Speed (default)	Word Clock Single Speed (option)
88.2 kHz	88.2 kHz	44.1 kHz
96 kHz	96 kHz	48 kHz
176.4 kHz	176.4 kHz	44.1 kHz
192 kHz	192 kHz	48 kHz

To set the Word Clock output to single speed on the device:

1. Open the CLOCK section (*see Section 2.3, 'Controlling the device'*).

2. Use the third button to toggle WCL 1x.

12. Annex

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Glossary

96k frame

MADI sources with a sample rate of 88.2kHz or 96kHz can be configured to use the so-called 96k frame. If this frame is used, a sample rate of 88.2 or 96 kHz can be detected on the receiver side automatically. When it is not used, or when higher sample rates are used, the receiver must always be configured to the correct factor (x2, x4) since there is no other mechanism in MADI that allows automatic detection.

AVB

Audio Video Bridging (AVB) is a common name for the set of technical standards developed by the Institute of Electrical and Electronics Engineers (IEEE) Audio Video Bridging Task Group of the IEEE 802.1 standards committee.

AVDECC

IEEE standard for device discovery and control. A protocol that is used by manufacturers to control various settings of AVB endpoints.

AVDECC Controller

A software that discovers AVB entities and allows the user to access their settings and connect them. Different AVDECC Controllers from different vendors can be used at the same time in the same network.

AVB talker

An AVB endpoint that streams audio to one or more listeners.

AVB listener

An AVB endpoint that receives an audio stream from a talker.

DHCP server

A DHCP Server hands out IP addresses to network devices. Every consumer oriented WiFi Router has a default DHCP Server handing out private addresses, usually 192.168.0.x. The IP address of a network device must be known in order to communicate with it on Layer 3.

MADI

Multichannel Digital Audio Interface as defined in the AES 10 standard. Used to receive and transmit up to 64 uncompressed audio channels over coaxial or fibre optic connection.

Master clock

Every digital audio transmission requires a clock which allows sender and receiver to be synchronized. When two or more devices are connected, one device is configured to be the 'clock master' (clock source: internal). All other devices are configured to be be 'slaves'. Synchronization can either be established by dedicated cabling (word clock, 75 ohms coaxial cable), or by recreating the clock from an incoming digital audio signal such as MADI or an AVB stream.

Word Clock

An electrical square wave signal transported over coaxial 75 Ohm terminated cables. It is used to synchronize the receiving device (slave, word clock input) to the sending device (master, word clock output).

CE Compliance

This device has been tested and found to comply with the limits of the European Council Directive on the approximation of the laws of the member states relating to electromagnetic compatibility according to RL2014/30/EU, and European Low Voltage Directive RL2014/35/EU.

FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful 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.

Shielded cables must be used with this unit to ensure compliance with the Class B FCC limits.

Responsible Party in USA: Synthax United States, 6600 NW 16th Street, Suite 10, Ft Lauderdale, FL 33313 T.:754.206.4220

Trade Name: RME, Model Number: AVB Tool

Note on Disposal

According to the guide line RL2002/96/EG (WEEE Ð Directive on Waste Electrical and Electronic Equipment), valid for all european countries, this product has to be recycled at the end of its lifetime. In case a disposal of electronic waste is not possible, the recycling can also be done by Scheck Audio GmbH, the manufacturer of this device.

For this the device has to be sent free to the door to:

Scheck Audio GmbH, 3. Industriestr. 5, 68804 Altlussheim, Germany.

Shipments not prepaid will be rejected and returned on the original sender's costs.