A__line

User Guide

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www.lawo.com/downloads

Table of Contents

1. Introduction

Welcome to **A__line**.

About this Manual

This document describes how to install, configure and operate each of the **A__stage** devices, the **A__digital64** and **A__madi6**.

Look out for the following which indicate:

Notes - points of clarification.

Tips - useful tips and short cuts.

Attention: Alert you when an action should *always* be observed.

Utility Software

Each device is configured via a HTML-based user interface. No specific software is required other than a suitable web browser.

Further Information

Mechanical drawings and data sheets are available from the **Download-Center** (after login).

Lawo User Registration

For access to the **Download-Center** and to receive regular product updates, please register at:

www.lawo.com/user-registration.

2. Important Safety Instructions

Please observe all of the instructions provided in the "General Safety Information for Lawo Equipment" booklet delivered with your devices. Double-click here to open the same information (as a pdf).

3. A__line Overview

The **A__line** product family contains a range of WAN-capable Audio-over-IP nodes.

Each device provides a range of local inputs and outputs plus dual-redundant streaming ports for transferring audio over IP. By networking multiple nodes, signals can be easily distributed between device locations.

The following products are described in this manual:

	Local IO	Network Interfaces
A__stage48 (3RU) 	16 x MIC/LINE in (Sub-D) 16 x LINE out (Sub-D) 8 x AES3 in, 8 x AES3 out (Sub-D) 1 x MADI, redundant pair (SFP) 8 x GPI, 8 x GPO (Sub-D)	2 x AoIP dual media (SFP/RJ45) 1 x Management (RJ45)
A__stage64 (4RU) 	32 x MIC/LINE in (XLR) 16 x LINE out (XLR) 8 x AES3 in, 8 x AES3 out (Sub-D)) 1 x MADI, redundant pair (SFP) 8 x GPI, 8 x GPO (Sub-D)	2 x AoIP dual media (SFP/RJ45) 1 x Management (RJ45)
A__stage80 (3RU) 	32 x MIC/LINE in (Sub-D) 32 x LINE out (Sub-D) 8 x AES3 in, 8 x AES3 out (Sub-D) 1 x MADI, redundant pair (SFP) 8 x GPI, 8 x GPO (Sub-D)	2 x AoIP dual media (SFP/RJ45) 1 x Management (RJ45)
A__digital64 (3RU) 	32 x AES3 in, 32 x AES3 out (Sub-D) 1 x MADI, redundant pair (SFP) 8 x GPI, 8 x GPO (Sub-D)	2 x AoIP dual media (SFP/RJ45) 1 x Management (RJ45)
A__madi6 (1RU) 	6 x MADI (SFP) A__madi6 provides three independent bridging modules, each capable of converting audio formats between MADI and AES67/RAVENNA.	3 x AoIP dual media (SFP/RJ45)

Network Interfaces

The dual media RAVENNA/AES67 interfaces stream the device's local IO signals to and from the IP network. The interfaces support the SMPTE ST2110-30/31, AES67 and RAVENNA standards. By connecting both interfaces (PRIMARY and SECONDARY) to discrete network paths, redundant streaming can be configured via SMPTE ST2022-7 Seamless Protection Switching.

The MGMT port provides a connection to the device's control system. It can be used either as a local service port, or to connect the device to a dedicated management network.

Power & Cooling

Each device is fitted with dual redundant power supplies. A single PSU is required for the system to operate. The second PSU provides redundancy. The mains connectors are located on the rear panel. The unit is cooled by a single low-noise fan which is temperature-controlled.

Control

All settings are adjusted using a HTML-based user interface, known as the Web UI. These include system settings, local IO parameters and the configuration of the transmit (TX) and receive (RX) streams.

Once the device is configured, all parameters are accessible via Ember+. This allows an external control system, such as a Lawo console or VSM, to remotely control or respond to parameter changes within the device. For example, to adjust an IO parameter, or change the mapping of local IO signals to TX and RX streams.

4. Controls, Connectors & Indicators

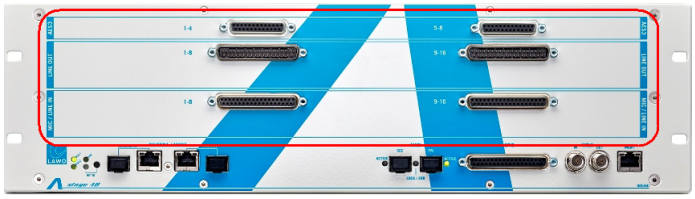
The A__stage and A__digital64 variants differ in their digital and analog IO (and respective mechanical data). In all other respects they are identical.

The A__madi6 differs in several respects and is described separately.

4.1 Front View

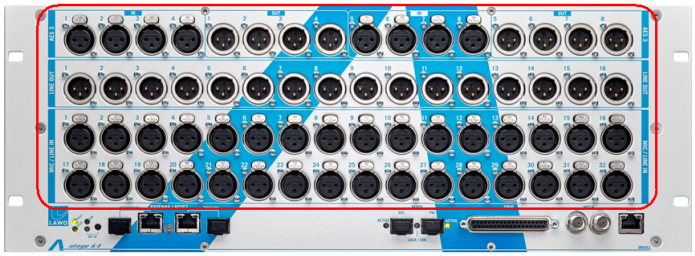
4.1.1 Digital & Analog IO

A__stage48



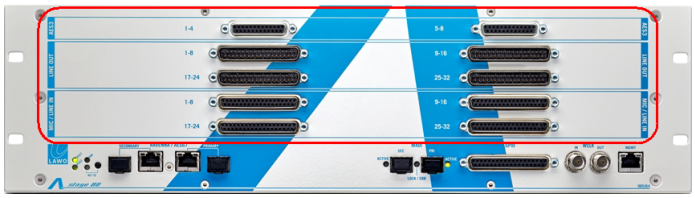
- AES3 - 8 x AES3 inputs + 8 x AES3 outputs.
- LINE OUT - 16 x line level outputs.
- MIC/LINE IN - 16 x mic/line inputs.
- All connectors are Sub-D.

A__stage64



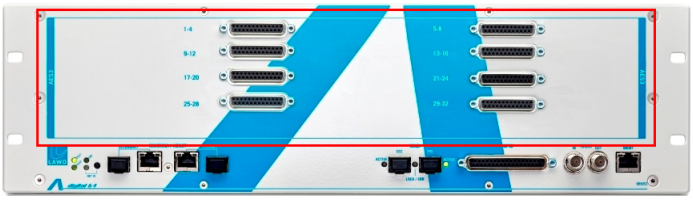
- AES3 - 8 x AES3 inputs + 8 x AES3 outputs.
- LINE OUT - 16 x line level outputs.
- MIC/LINE IN - 32 x mic/line inputs.
- All connectors are XLR.

A__stage80



- AES3 - 8 x AES3 inputs + 8 x AES3 outputs.
- LINE OUT - 32 x line level outputs.
- MIC/LINE IN - 32 x mic/line inputs.
- All connectors are Sub-D.

A__digital64



- AES3 - 32 x AES3 inputs + 32 x AES3 outputs.
- All connectors are Sub-D.

4.1.2 Lower Connector Panel

A__stage, A__digital64

1 STATUS LEDs & NET ID Button

The first three LEDs indicate the status of the two internal power supplies and cooling fan.

- **PSU** LEDs: green = power supply is working properly; off = no power or low DC voltage to the main circuit board.
- **FAN** LED: off = fan is working properly; red = fan error.

The **NET ID** button and LED can be used to reset the MGMT port to its default network settings or perform a factory reset. To prevent accidental operation, a press and hold is required.

➢ **To reset the Network Settings of the MGMT port:**

First, make sure that the device is booted and operating normally - the **NET ID** LED should be blinking yellow. Then, using a pointed object, press and hold the recessed **NET ID** button until the LED lights continuously. When the LED switches off, the reset is complete.

➢ **To perform a factory reset:**

First, power cycle the device and, while the unit is booting, press and hold the recessed **NET ID** button - the LED blinks red to acknowledge the reset and then lights continuously until boot-up is complete. When the LED switches off, the reset is complete.

A factory reset deletes all of the configuration files, resets the RAVENNA/AES67 interfaces to their default network settings AND resets the MGMT port.

2 RAVENNA/AES67 - AoIP Streaming

The two RAVENNA/AES67 interfaces connect the audio streams to the IP network. They also provide access to the control data (for the Web UI and Ember+). In each case, the connection can be made using either copper or optical fibre (via SFP).

The interfaces support the SMPTE ST2110-30/31, AES67 and RAVENNA standards. By connecting both interfaces (PRIMARY and SECONDARY) to discrete network paths, redundant streaming can be configured via SMPTE ST2022-7 Seamless Protection Switching.

The total AoIP capacity of one device is 128 IO channels. This can be split into up to 128 streams, where each stream can be mono, stereo or multi-channel. For each stream you can decide whether it will be transmitted or received via the PRIMARY, SECONDARY or both interfaces. The streaming configuration is handled by the Web UI.

Default Network Settings	PRIMARY Streaming Interface	SECONDARY Streaming Interface
Connection Type	DHCP	DHCP
IP Address & Netmask	defined by DHCP server	defined by DHCP server
Gateway	0.0.0.0	0.0.0.0

3 MADI (AES10) via SFP

The two MADI ports can be used to connect multi-channel digital audio to the device (1 x 64-channels).

The two ports operate as a main and redundant connection: PRI and SEC. If both ports are receiving signal, then the primary port is active. If the primary signal fails, then the secondary port becomes active until the primary signal returns. If redundancy is not required, then it is recommended to connect your device to the primary port and leave the secondary port unconnected. In each case, you must fit a Lawo-certified SFP module to use a MADI port.

The **ACTIVE** LEDs indicate which port is active according to the table below. The **LOCK/ERR** LED indicates the status of the incoming MADI signal: green = ok; red = link error; off = no signal detected.

ACTIVE LED (PRI)	ACTIVE LED (SEC)	Result
OFF	OFF	no signal on either port
ON (green)	OFF	signal on port 1 and port 1 is active; no signal on port 2
ON (green)	ON (yellow)	signal on port 1 and port 1 is active; standby signal available on port 2
OFF	ON (green)	no signal on port 1; signal on port 2 and port 2 is active

4 GPIO

This connector provides 8 x GPI (optocouplers) and 8 x GPO (silent CMOS relays) for local signaling and switched functions.

5 WCLK IN & OUT

WCLK IN can be used to connect an external Wordclock sync reference. Other reference options are PTP, MADI or Internal.

WCLK OUT always provides an output of the current system reference.

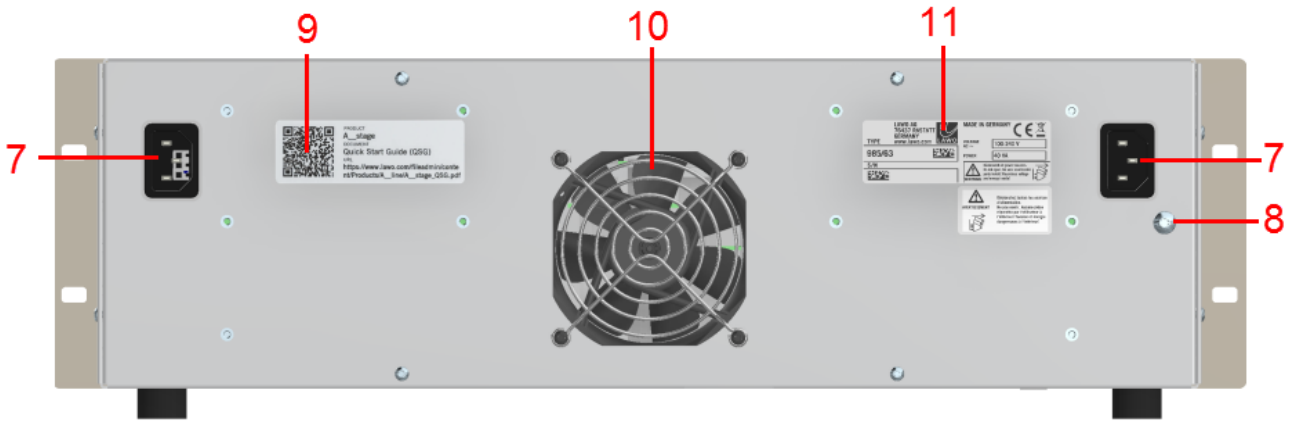
6 MGMT - Management Network (Control)

The MGMT port provides a connection to the device's control system (for the Web UI and Ember+). It can be used either as a local service port, or to connect the device to a dedicated management network. The latter should be installed if you wish to separate the control data from the streaming network. Note that this is optional, as all control data can be accessed via the RAVENNA/AES67 ports.

Default Network Settings	MGMT Interface
Connection Type	Static
IP Address	192.168.110.253
Netmask	255.255.255.0
Gateway	192.168.110.1

4.2 Rear View

A__stage, A__digital64



7 PSU 1 & PSU 2

The PSU 1 and PSU 2 connectors supply AC mains power to the device. The AC mains requirements are summarized above each connector.

Only one input is required for the system to operate; the second provides redundancy.

> The device *MUST* be connected to the mains using the power cables supplied with the system.

8 CASE

The CASE grounding screw should be used to ground the frame.

9 QR Code

The QR code will take you to the latest version of the manual.

10 Fan

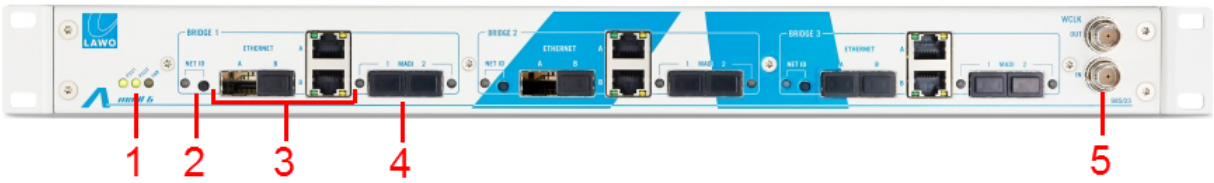
The device is fitted with a slow turning, low noise fan which is temperature controlled. Ventilation holes are provided on both sides and at the rear of the unit.

> Take care that no devices or cables obstruct the flow of air and, thereby, hinder cooling.

11 Device Information

This sticker shows the type, part number and serial number of the device, and states the compliance information.

4.3 Front View (A__madi6)



There is one set of status LEDs (1) and WCLK connectors (5) for the device. The remaining controls (2, 3, 4) are repeated for each of the three bridging modules.

1 STATUS LEDs

The three LEDs indicate the status of the two internal power supplies and cooling fan.

- **PSU** LEDs: green = power supply is working properly; off = no power or low DC voltage to the main circuit board.
- **FAN** LED: off = fan is working properly; red = fan error.

2 NET ID Button

The **NET ID** button and LED can be used to reset the ETHERNET A port to its default network settings or perform a factory reset. To prevent accidental operation, a press and hold is required. The ETHERNET B port is unaffected.

➢ **To reset the Network Settings of the ETHERNET A port:**

First, make sure that the device is booted and operating normally - the **NET ID** LED should be blinking yellow. Then, using a pointed object, press and hold the recessed **NET ID** button until the LED lights continuously. When the LED switches off, the reset is complete.

➢ **To perform a factory reset:**

First, power cycle the device and, while the unit is booting, press and hold the recessed **NET ID** button - the LED blinks red to acknowledge the reset and then lights continuously until boot-up is complete. When the LED switches off, the reset is complete.

A factory reset deletes all of the configuration files AND resets the ETHERNET A interface to its default network settings.

3 ETHERNET A & B - AoIP Streaming

The two ETHERNET interfaces connect the audio streams to the IP network. They also provide access to the control data (for the Web UI and Ember+). In each case, the connection can be made using either copper or optical fibre (via SFP).

The interfaces support the SMPTE ST2110-30/31, AES67 and RAVENNA standards. By connecting both interfaces (A and B) to discrete network paths, redundant streaming can be configured via SMPTE ST2022-7 Seamless Protection Switching.

The total AoIP capacity of one device is 128 IO channels. Depending on the number of channels per stream, up to 128 streams can be transmitted and received in parallel. Using 128 RX/TX streams requires all streams to be mono or 1-channel only. For each stream you can decide whether it will be transmitted or received via the A, B or both interfaces. The streaming configuration is handled by the Web UI.

Default Network Settings	ETHERNET A	ETHERNET B
Connection Type	Static	DHCP
IP Address	192.168.110.253	defined by DHCP server
Netmask	255.255.255.0	defined by DHCP server
Gateway	192.168.110.1	0.0.0.0

4 MADI (AES10) via SFP

Each BRIDGE module provides two MADI ports: 1 & 2. The connections conform to AES 10-2008 (64-channel mode), and carry up to 64 input and 64 output channels.

Both ports use SFP modules to support a variety of connections.

Each port is accompanied by a Lock/Error LED which indicates the status of the incoming MADI signal: green = ok; red = link error; off = no signal detected.

5 WCLK IN & OUT

WCLK IN can be used to connect an external Wordclock sync reference. Other reference options are PTP, MADI or Internal. Providing Wordclock is selected as the sync input in the RAVENNA Web UI, then all three BRIDGE modules will sync to this input.

WCLK OUT provides an output of the active sync source for BRIDGE 1. Note that sync outputs from BRIDGE 2 and 3 are not accessible.

Both ports use a standard BNC video connector.

4.4 Rear View (A__madi6)

6 PSU 1 & PSU 2

The PSU 1 and PSU 2 connectors supply AC mains power to the device. The AC mains requirements are summarized above each connector.

Only one input is required for the system to operate; the second provides redundancy.

The device *MUST* be connected to the mains using the power cables supplied with the system.

7 CASE

The CASE grounding screw should be used to ground the frame.

8 Fan

The device is fitted with a slow turning, low noise fan which is temperature controlled. Ventilation holes are provided on both sides and at the rear of the unit.

Take care that no devices or cables obstruct the flow of air and, thereby, hinder cooling.

9 Device Information

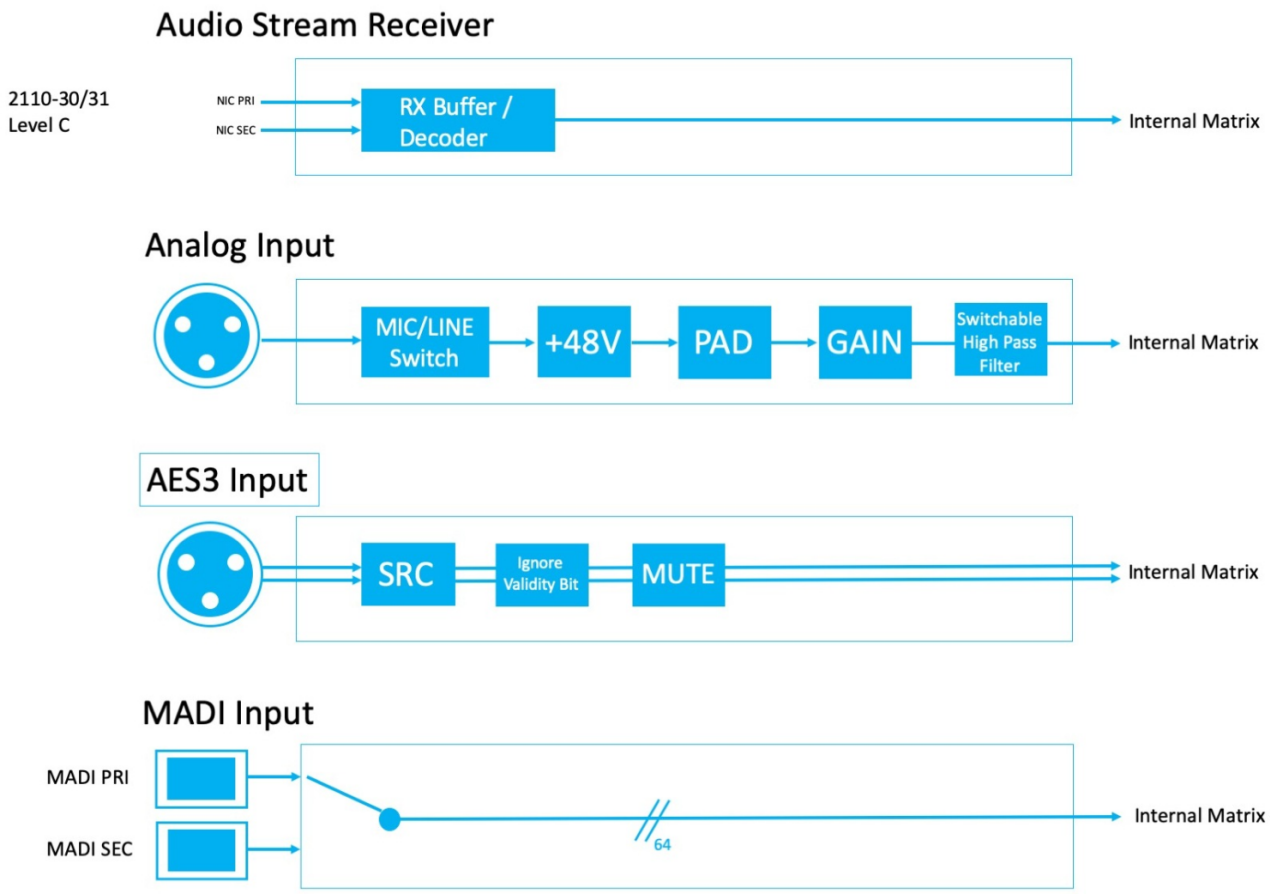
This sticker shows the type, part number and serial number of the device, and states the compliance information.

The QR code will take you to the latest version of the manual.

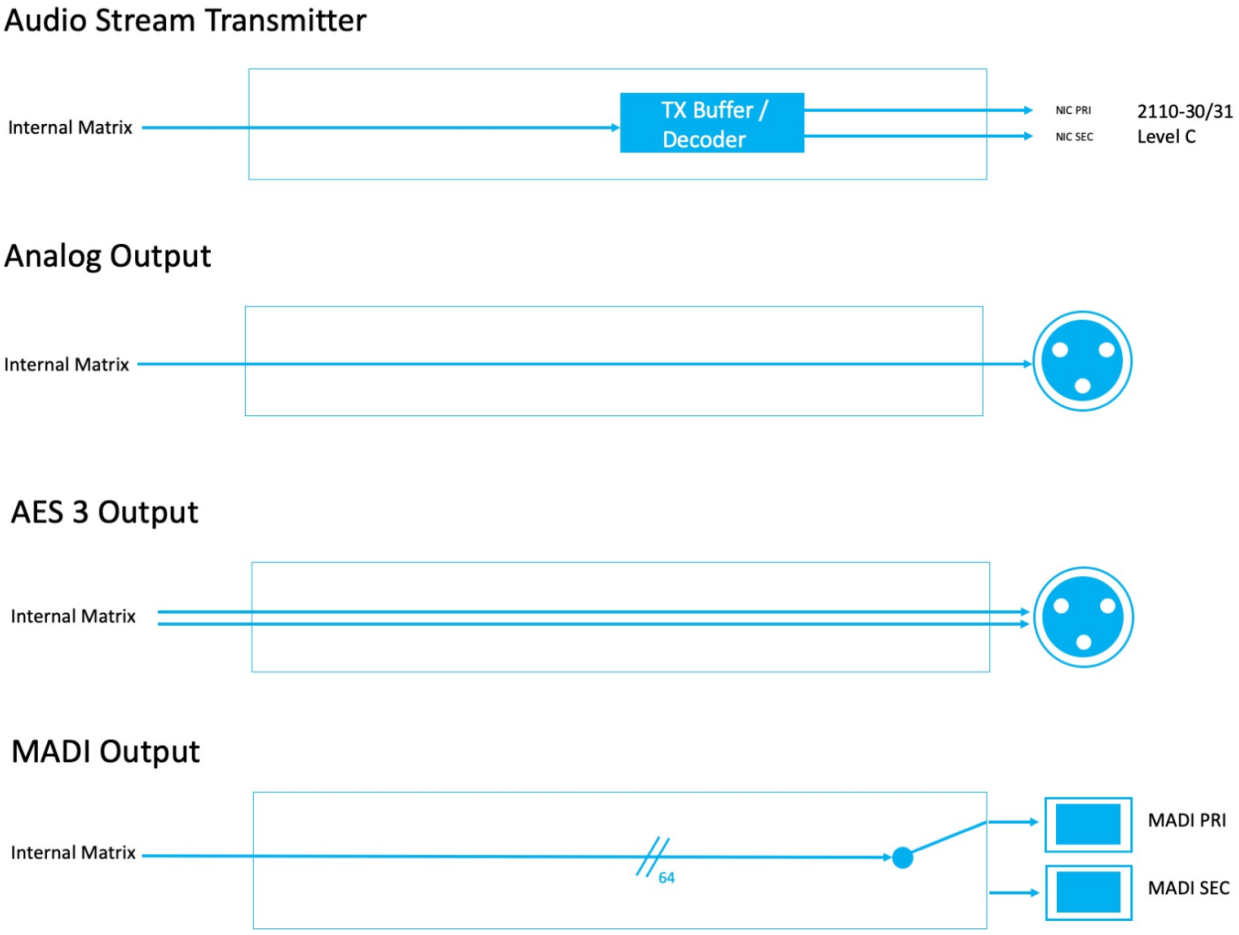
5. Signal Flow

This chapter describes the signal flow through each A__line device.

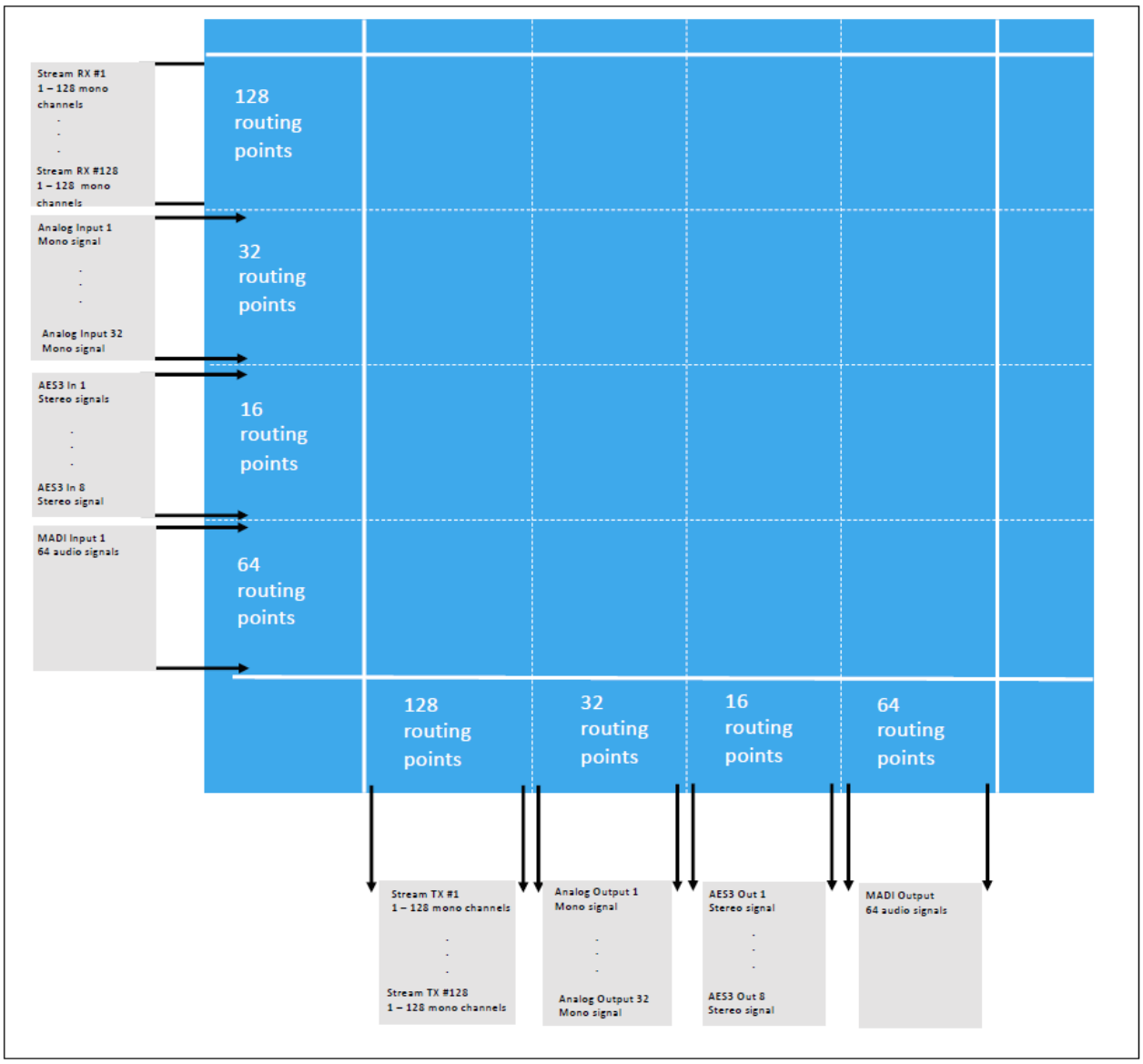
5.1 Audio Input Anatomy (A__stage, A__digital64)



5.2 Audio Output Anatomy (A__stage, A__digital64)



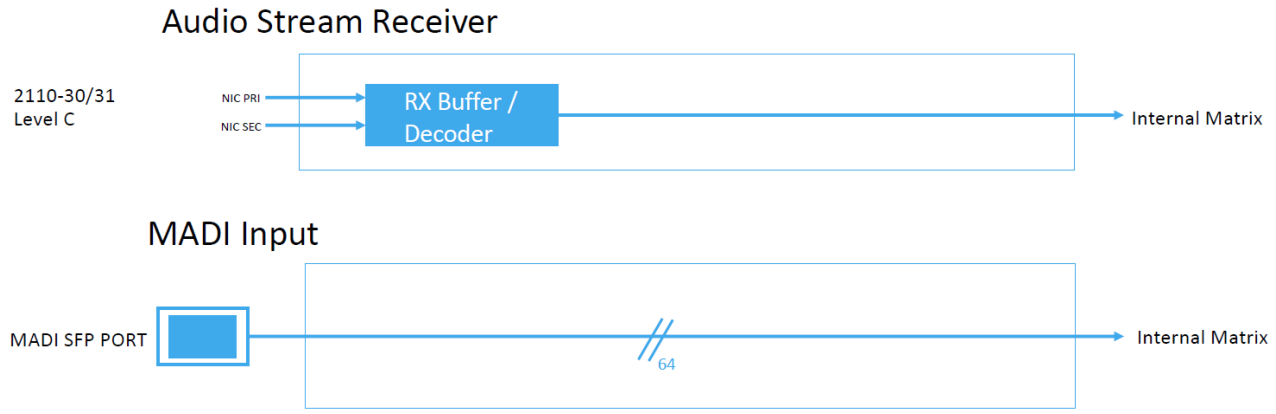
5.3 Audio Matrix Anatomy (A__stage, A__digital64)



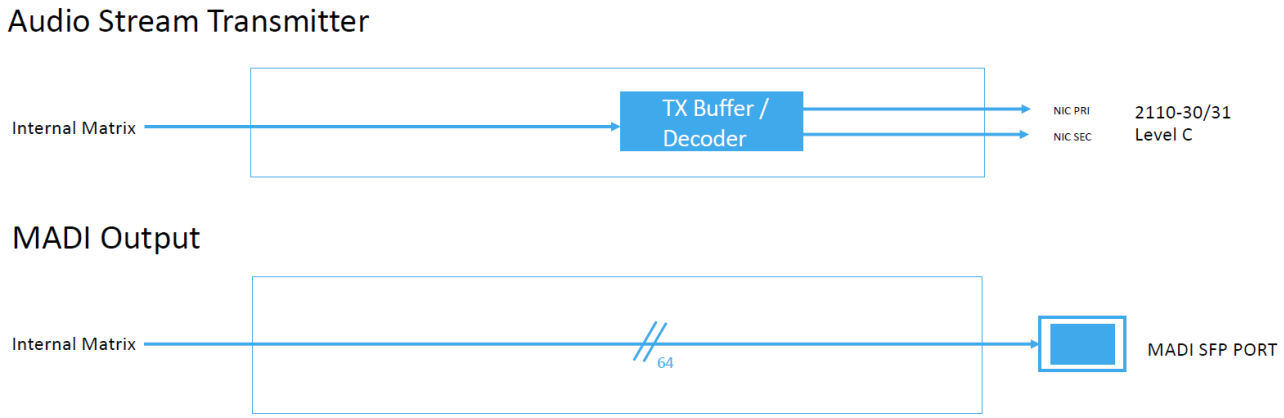
5.4 System Level

A__line devices use an audio system level of +24 dBu.

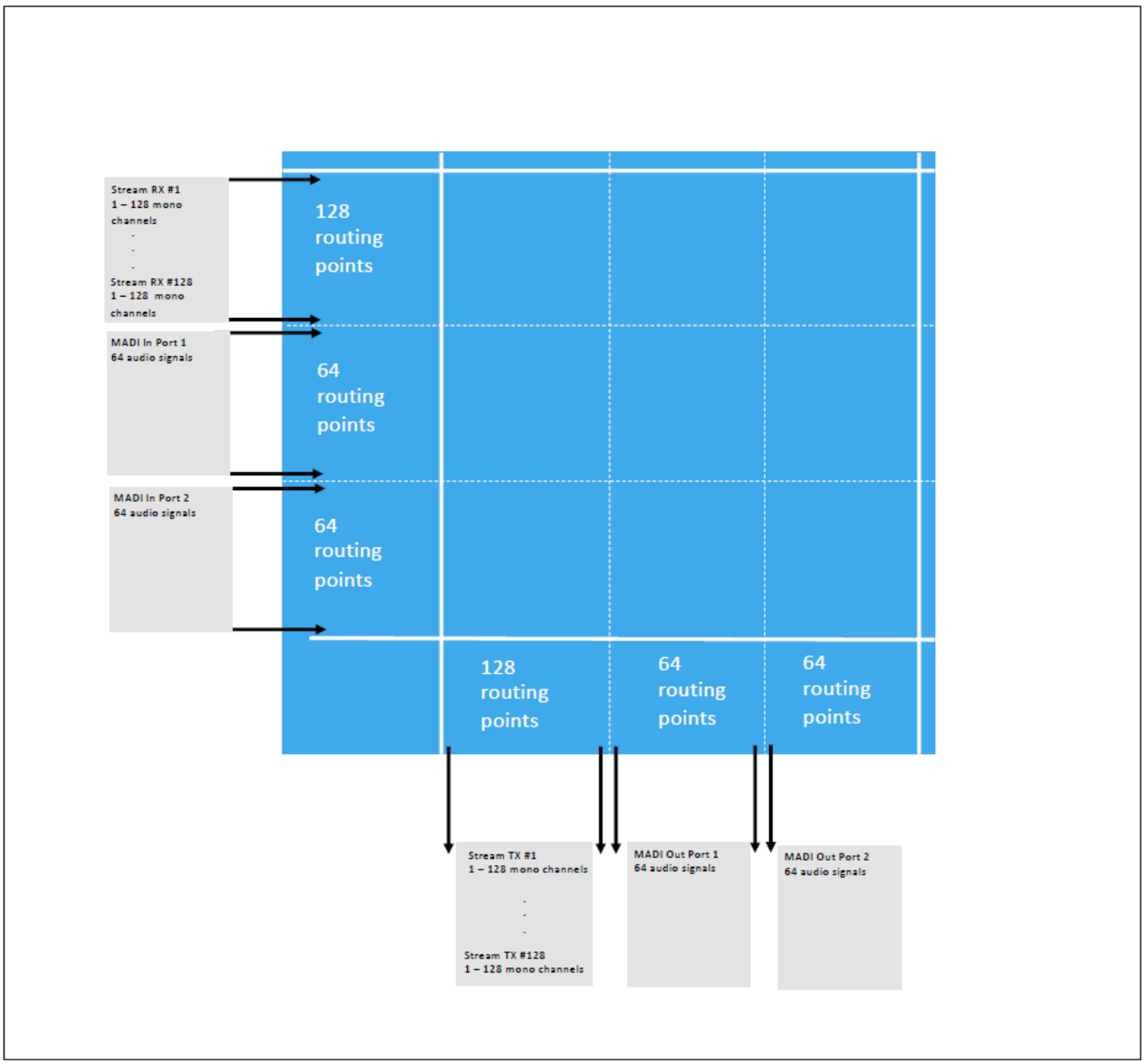
5.5 Audio Input Anatomy (A__madi6)



5.6 Audio Output Anatomy (A__madi6)



5.7 Audio Matrix Anatomy (A__madi6)



6. Installation

This chapter describes how to install the device.

6.1 Packing List

Included

Each A__line device ships with the following accessories:

- 2 x 2m IEC power cables (country-specific) - to connect AC mains to the frame.
- Dust caps for the RAVENNA/AES67 SFP cages - these will be mounted in the frame.
- Dust caps for the MADI SFP cages - these will be mounted in the frame.

Optional

The following items must be ordered separately:

- SFP modules for the MADI and optical fibre RAVENNA/AES67 ports.

6.2 Preparation

Unpacking

Each device is delivered in its own box with all included accessories.

Please check the contents of the shipping boxes, and in the event of any transport damage, contact your local Lawo representative or email support@lawo.com.

Rack-Mounting

A__line devices are designed to be mounted in a 19-inch rack. Please install supporting slide bars to hold the weight of the unit, and use the locking devices provided.

Connectors are located at the front and rear of the unit. Therefore, when using 19-inch racks with doors please leave enough room for the cables.

Dimensions & Weights

	Height	Width	Depth	Weight
A__stage48	132.5mm (3RU)	481mm (19”)	230mm (9.05”)	5.2kg (11.5lbs)
A__stage64	177 mm (4RU)	481mm (19”)	230mm (9.05”)	5.9kg (13 lbs)
A__stage80	132.5mm (3RU)	481mm (19”)	230mm (9.05”)	6 kg (13.2 lbs)
A__digital64	132.5mm (3RU)	481mm (19”)	230mm (9.05”)	5.2kg (11.5lbs)
A__madi6	44 mm (1RU)	448mm (19”)	266mm (10.4")	3.1kg (6.83 lbs)

A dimension drawing for each device is included in the Appendices.

Temperature and Cooling

The device is equipped with a temperature-controlled fan for minimum noise emission. Ventilation holes are provided on the sides and rear of the unit. There must be sufficient airflow around the device for cooling. The recommended tolerances can be found in the data sheet for the A__stage device.

DO NOT obstruct the side or rear ventilation holes as to do so will prevent efficient cooling.

Power Consumption & Electrical Voltage

Please refer to the device's data sheet for details on power consumption and electrical voltage. The requirements for the AC mains supply are written above the **PSU 1** and **PSU 2** connectors on the rear panel.

6.3 SFP Modules

To use a MADI or optical fiber RAVENNA/AES67 port, you must fit a Lawo-certified SFP module. SFPs are not included and must be ordered separately. You will need one SFP for each port.

If fitting SFPs to both MADI and RAVENNA ports, take care not to mix up the SFP types.

➢ **MADI Interface SFP Modules**

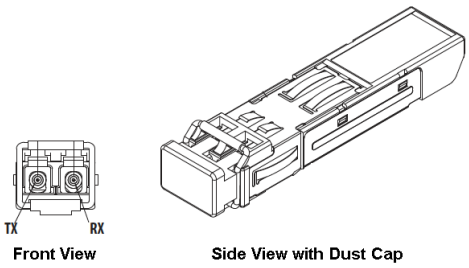
SFP Module Description	Part Number
MADI, 1310nm, multi-mode fibre, 2km	981/60-80
MADI, 1310nm, single-mode fibre, 20km	981/60-81
MADI, HD-BNC (75 ohm), copper, 100m	981/60-82

➢ **RAVENNA/AES67 Interface SFP Modules**

SFP Module Description	Part Number
MADI, 1310nm, multi-mode fibre, 2km	981/60-80
MADI, 1310nm, single-mode fibre, 20km	981/60-81
MADI, HD-BNC (75 ohm), copper, 100m	981/60-82

Installing the SFPs

The SFP modules are hot-pluggable, and so they can be fitted or exchanged while the device is powered.



Front View

Side View with Dust Cap

1. Remove the dust caps from both the port and SFP module.

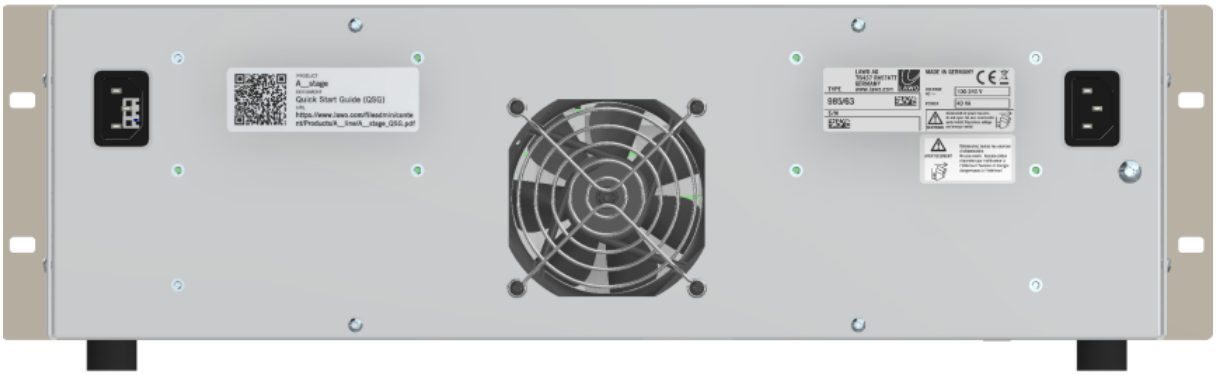
Store these carefully so that they can be replaced if a module is removed.

2. Push the SFP module into the rectangular slot.
3. Press gently and firmly until the module locks into position.

Attention: Before removal, please unlock SFP modules to avoid mechanical damage to the slots.
If a module is removed, please refit the port's dust cap to protect the internal components.
You *must* use the correct fiber type for your remote device. Using the wrong fiber type or exceeding the maximum optical input power can result in malfunction of, or damage to, the optical device.

6.4 Grounding & Power

Rear View (A__stage, A__digital64)



Rear View (A__madi6)

6.4.1 Grounding

Although operator protection is guaranteed, it is best to establish an additional ground for EMC reasons.

A grounding screw is provided below the **PSU 1** connector on the rear of the frame.

1. Use the M4x8 **CASE** screw to fasten the grounding cable to the housing.

The A__line device must be on the same potential as all other system devices.
For Scandinavian countries, ALWAYS use a grounded mains connection, to prevent the device from being grounded through Ethernet or other signal connections.

Grounding of Audio Interfaces

For compliance with AES3, digital interfaces should be connected to a field ground.

For microphones, the ground from the device should connect directly to the microphone via the cable shielding, otherwise phantom power cannot be transferred. Take care that the shielding does not connect to the field ground, to prevent interference and loss of signal quality.

6.4.2 Power

Each device is fitted with two integrated wide-ranging AC power supplies. A single PSU is required for the system to operate. The second PSU provides redundancy.

The status of the PSUs can be monitored from the LEDs on the front of the device.

The mains connectors are located on the rear panel and include a locking mechanism for security. Please unlock before removing a connector. Be sure to turn the mains power off BEFORE connecting or disconnecting a cable.

The unit is delivered with two 2m IEC power cables which are country-specific.

1. Using the IEC cables provided, connect your AC mains supply to the **PSU 1** and, optionally, the **PSU 2** inputs.

For redundancy, it is recommended to connect both inputs, each to a separate phase of the AC mains circuit.

There is no on/off switch, and so the device will boot as soon as mains power is supplied to either of the inputs.

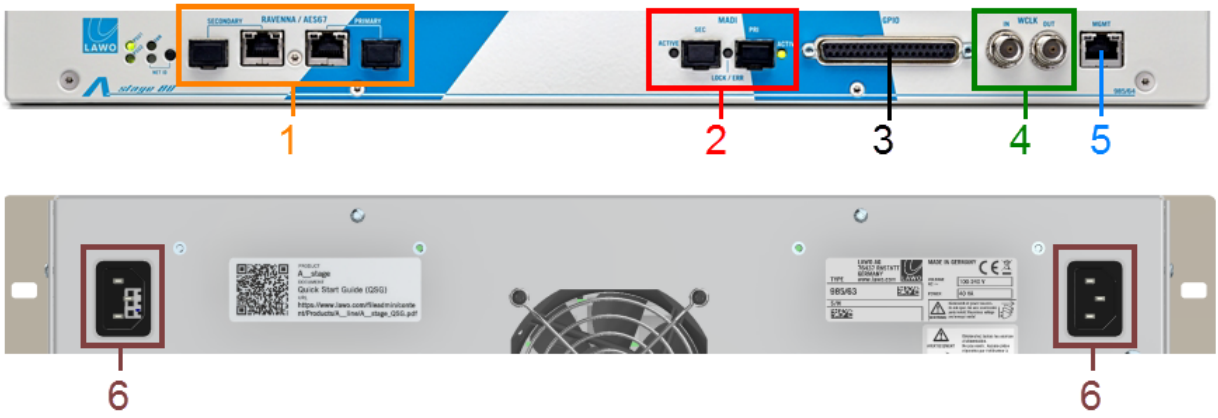
The device *MUST* be connected to the mains using the power cables supplied with the system.
When running with two mains supplies, make sure that both circuits lie on the same ground potential. Otherwise, an internal bridge of two grounding wires can lead to a ground loop!

6.5 Wiring (A__stage, A__digital64)

Each of the A__stage variants and A__digital64 should be wired as follows. For the initial setup, only the MGMT port (5) and Power (6) are required.

Please also see Connector Pin-Outs for wiring information.

A__stage, A__digital64



1 AoIP Streaming (CAT 5/6/7)

The two RAVENNA/AES67 interfaces connect the audio streams to the IP network. They also provide access to the control data (for the Web UI and Ember+).

The interfaces support the SMPTE ST2110-30/31, AES67 and RAVENNA standards. To achieve redundant streaming (via SMPTE ST2022-7), you must connect both interfaces (PRIMARY and SECONDARY) to discrete network paths.

The connections *must* be made via a network switch (and not directly to another streaming port). You can find more details about the data network requirements and suitable components in the Lawo IP Networking Guide.

> The streaming network *must* be properly configured and managed. i.e. it must use a suitable network architecture; all components must support multicast (as opposed to unicast); a proper Quality of Service (QoS) must be configured; and so on.
>
> Please *DO NOT* attempt to connect the streaming ports using an unqualifying IP network, as correct operation cannot be guaranteed.

For each interface, the connection is available on dual media: either copper (Gigabit Ethernet:1000 Base-T) or optical fiber (via SFP):

- Copper - use a straight (or crossed) STP-CAT5 (or better) network cable with RJ45 connectors. The maximum distance to the network switch must not exceed 80m.
- Optical Fiber - you must fit a Lawo-certified RAVENNA SFP module (as described earlier). The SFP determines the cable type, maximum distance and connector.

> The streaming ports will auto-negotiate their link speeds with the connected switch ports. If auto-negotiation is disabled (for the switch port), then a working link cannot be established to the A__line device.

2 MADI (via SFP)

The two MADI ports can be used to connect multi-channel digital audio to the device. The ports conform to AES 10-2008 and carry up to 64 bi-directional channels (at 48kHz).

The two ports operate as a main and redundant connection: PRI and SEC. If redundancy is not required, then it is recommended to connect your device to the primary port and leave the secondary port unconnected.

All MADI connections must be point-to-point. To use the ports, you must fit a Lawo-certified MADI SFP module (as described earlier). The SFP determines the cable and connector type, and the maximum distance.

3 GPIO (SUB-D37)

The GPIO connector provides 8 x GPI (optocouplers) and 8 x GPO (silent CMOS relays) for local signaling and switched functions:

- GPI = 8 x optocouplers (3-36 VDC / 8mA @ 36V)
- GPO = 8 x silent CMOS relays (50V AD/DC / 0.5A AC; 1.0A DC).

The connector is a 37-pin D-type.

4 WCLK IN & OUT (BNC)

The system can sync to external wordclock by connecting the clock signal to **WCLK IN**.

The **WCLK OUT** provides an output of the current system reference: PTP, WCLK IN, MADI or internal clock.

In both cases, connections are made using standard 75 ohm BNC connectors. The maximum cable length depends on the equipment you are connecting to.

5 Management Network (CAT 5e or better)

The MGMT port provides a connection to the device's control system (for the Web UI and Ember+). It can be used as a local service port or to connect the device to a dedicated management network.

When connecting via a network, then this can be shared with other devices, such as in the regular "house network" of a typical broadcast facility. Routers are permitted as long as the minimum requirements below are met. By using routers, or similar devices, the latency of the communication will increase. The management network *MUST* meet or exceed the following requirements:

- At least 100MBit/s; 1 GBit/s preferred
- Full Duplex

> It is important to keep the management network separate from the streaming network connected to the AoIP ports (1).

For a direct connection, you will need a crossover network cable. For connection via a network switch, use a straight (1:1) network cable. The cable should be STP-CAT 5e or better with RJ45 connectors. The maximum distance must not exceed 100m.

6 Grounding & Power

See Grounding & Power.

7 DIGITAL & ANALOG IO

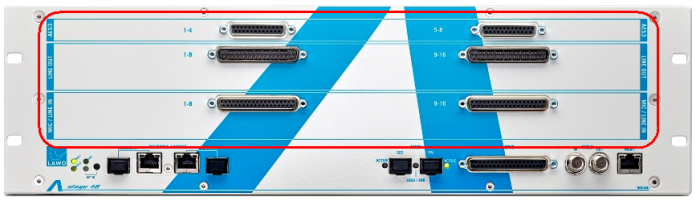
All AES inputs and outputs conform to the stereo AES3 standard. The AES3 inputs have sample rate conversion (SRC).

All LINE OUT connections are electronically balanced and floating (suitable for balanced or unbalanced use). The maximum analog output level can be adjusted to +12, +15, +18, +21 or +24 dBu relative to digital full scale (dBFS). This is a factory-configured setting; +24dBu is recommended.

All MIC/LINE INs are electronically balanced and floating (suitable for balanced or unbalanced use). They feature a discrete class-A preamplifier with superb performance at both low (mic) and high (line) levels. In addition to variable microphone pre-amp gain, each input comes with switchable 48V phantom power, a high-pass filter and 20dB PAD. The maximum analog input level (with the PAD enabled) is +24dBu.

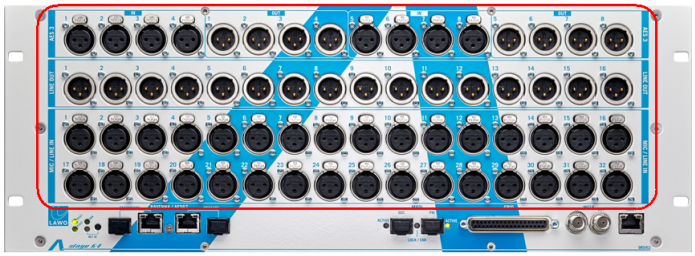
The connector types are as follows:

A__stage48



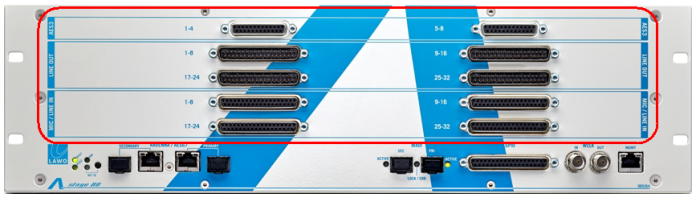
- AES3 IN/OUT - 2 x SUB-D25 female.
- LINE OUT - 2 x SUB-D37 male.
- MIC/LINE IN - 2 x SUB-D37 female.

A__stage64



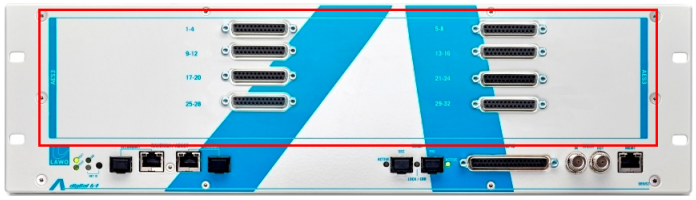
- AES3 IN/OUT - 8 x XLR female + 8 x XLR male.
- LINE OUT - 16 x XLR male.
- MIC/LINE IN - 32 x XLR female.

A__stage80



- AES3 IN/OUT - 2 x SUB-D25 female.
- LINE OUT - 4 x SUB-D37 male.
- MIC/LINE IN - 4 x SUB-D37 female.

A__digital64



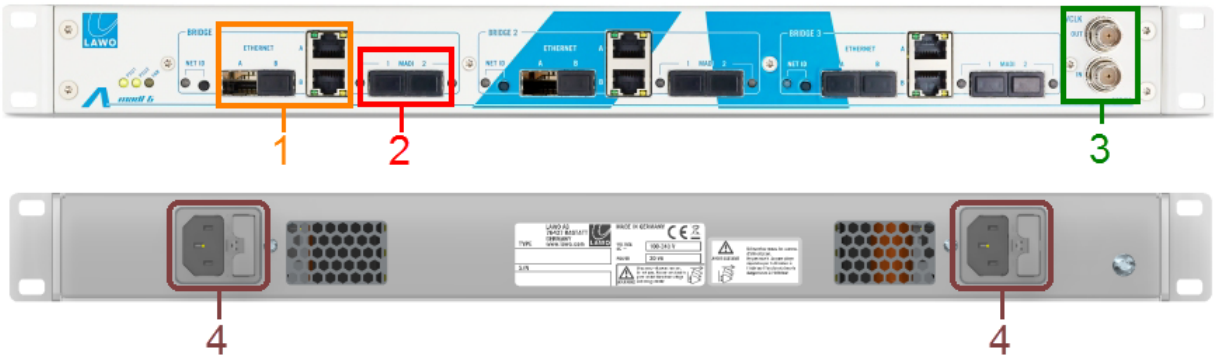
- AES3 IN/OUT - 8 x SUB-D25 female.

6.6 Wiring (A__madi6)

The A__madi6 should be wired as follows. The AoIP (1) and MADI (2) connectors are repeated for each of the three bridging modules. For the initial setup, only the ETHERNET A port (1) and Power (4) are required.

Please also see Connector Pin-Outs for wiring information.

A__madi6



1 AoIP Streaming (CAT 5/6/7)

The two ETHERNET interfaces connect the audio streams to the IP network. They also provide access to the control data (for the Web UI and Ember+).

The interfaces support the SMPTE ST2110-30/31, AES67 and RAVENNA standards. To achieve redundant streaming (via SMPTE ST2022-7), you must connect both interfaces to discrete network paths.

The connections *must* be made via a network switch (and not directly to another streaming port). You can find more details about the data network requirements and suitable components in the Lawo IP Networking Guide.

The streaming network *must* be properly configured and managed. i.e. it must use a suitable network architecture; all components must support multicast (as opposed to unicast); a proper Quality of Service (QoS) must be configured; and so on.

Please *DO NOT* attempt to connect the streaming ports using an unqualifying IP network, as correct operation cannot be guaranteed.

For each interface, the connection is available on dual media: either copper (Gigabit Ethernet:1000 Base-T) or optical fiber (via SFP):

- Copper - use a straight (or crossed) STP-CAT5 (or better) network cable with RJ45 connectors. The maximum distance to the network switch must not exceed 80m.
- Optical Fiber - you must fit a Lawo-certified RAVENNA SFP module (as described earlier). The SFP determines the cable type, maximum distance and connector.

The streaming ports will auto-negotiate their link speeds with the connected switch ports. If auto-negotiation is disabled (for the switch port), then a working link cannot be established to the A__line device.

2 MADI (via SFP)

The two MADI ports can be used to connect multi-channel digital audio to the device. The ports conform to AES 10-2008 and carry up to 64 bi-directional channels (at 48kHz).

All MADI connections must be point-to-point. To use the ports, you must fit a Lawo-certified MADI SFP module (as described earlier). The SFP determines the cable and connector type, and the maximum distance.

3 WCLK IN & OUT (BNC)

The system can sync to external wordclock by connecting the clock signal to **WCLK IN**. Providing Wordclock is selected as the sync input in the RAVENNA Web UI, then all three BRIDGE modules will sync to this input.

The **WCLK OUT** provides an output of the active sync source for BRIDGE 1: PTP, WCLK IN, MADI or internal clock. Note that sync outputs from BRIDGE 2 and 3 are not accessible.

In both cases, connections are made using standard 75 ohm BNC connectors. The maximum cable length depends on the equipment you are connecting to.

4 Grounding & Power

See Grounding & Power.

6.7 Synchronization

6.7.1 Sync Reference Options

The active sync source is selected using the Web UI. The options are:

- **PTP** – arriving from/sending to the streaming network (via the PRIMARY or SECONDARY interface). This is the default setting.
- **WCLK In** – external wordclock connected to the WCLK IN.
- **MADI** – incoming MADI from the PRI port (or SEC port if the redundant port is active).
- **Internal Clock** – the device's own internal sync generator (set to 48 or 44.1kHz).

To sync to an external reference, the clocking signal *MUST* match the internal sample rate of the device.

6.7.2 Sync Output

On all devices except the A__madi6, the WCLK OUT connector provides an output of the current system reference.

On A__madi6, WCLK OUT provides an output of the active reference for BRIDGE 1.

6.7.3 Using PTP

For correct synchronization via PTP, the streaming network requires a PTP master clock source. This can be achieved by using a streaming node or installing a separate grandmaster device. A PTP master should be capable of taking an incoming sync signal and generating PTP clock. Please note:

- PTP uses a master-slave approach in which all master-capable devices elect the best master, called the grandmaster, according to a common algorithm known as the “Best Master Clock Algorithm”.
- At any moment in time, there can be only one PTP master operating on the network.

All A__line devices operate as PTP slaves. Thus, the device will lock to PTP received *from* the streaming network via either RAVENNA/AES67 interface: PRIMARY or SECONDARY. The PTP slave parameters can be adjusted from the Web UI.

More information on PTP and its use can be found in the Lawo IP Networking Guide.

6.7.4 Non-PTP Installations

If PTP is not available and all devices support syntonised streaming, then you can use external Wordclock as the sync reference for all streaming nodes.

To support this option, you must have a Wordclock signal (referenced to a single common master) that can be distributed to all nodes on the network. If multiple Wordclock masters are used, then they must be referenced to a single common basis (e.g. GPS).

Please note:

- For correct synchronization without PTP, the same sync source *must* be selected at all streaming nodes!
- All nodes *must* support syntonised streaming. This is true for all Lawo RAVENNA interfaces, but must be checked for third-party devices.

7. System Setup

This chapter describes how to set up the device for the first time.

7.1 Introduction

The "Device Initial Setup" page appears whenever you open a web browser connection to an A__line device following a factory reset.

The page guides you through the initial setup so that the device is ready for operation in just a few small steps. Once the settings are applied, the page closes and the device is ready for operation[1,2]. From here on, the Web UI home page will appear whenever you open a new browser connection.

The same settings can be accessed from other Web UI pages if changes need to be made later.

[1] If you are using an A__stage device with a mc^2/Nova system (as a remote IO node / stagebox), then the initial setup is all that is required to prepare the device. The mc^2 system must be running Version 6.2 or later.

[2] For other applications, there are some additional steps to create the streams and define the IO parameters. These are described later (in the Configuration chapter).

7.2 Opening the Browser Connection

For the initial setup, you should connect your computer *directly* to the device's MGMT port.

At this stage do NOT connect the device to the network switch (if installing a management network), as first you must assign the port a unique IP address.

1. Power on the device.
2. Connect your computer's LAN port directly to the MGMT port of the A__line device.

Take care to connect to the MGMT port and not one of the RAVENNA/AES67 streaming ports!

3. Configure the network settings for your computer's LAN port. The exact steps vary depending on your OS version.

The IP address must be unique, and set within the same range as that of the port you are connecting to. The subnet masks should be identical.

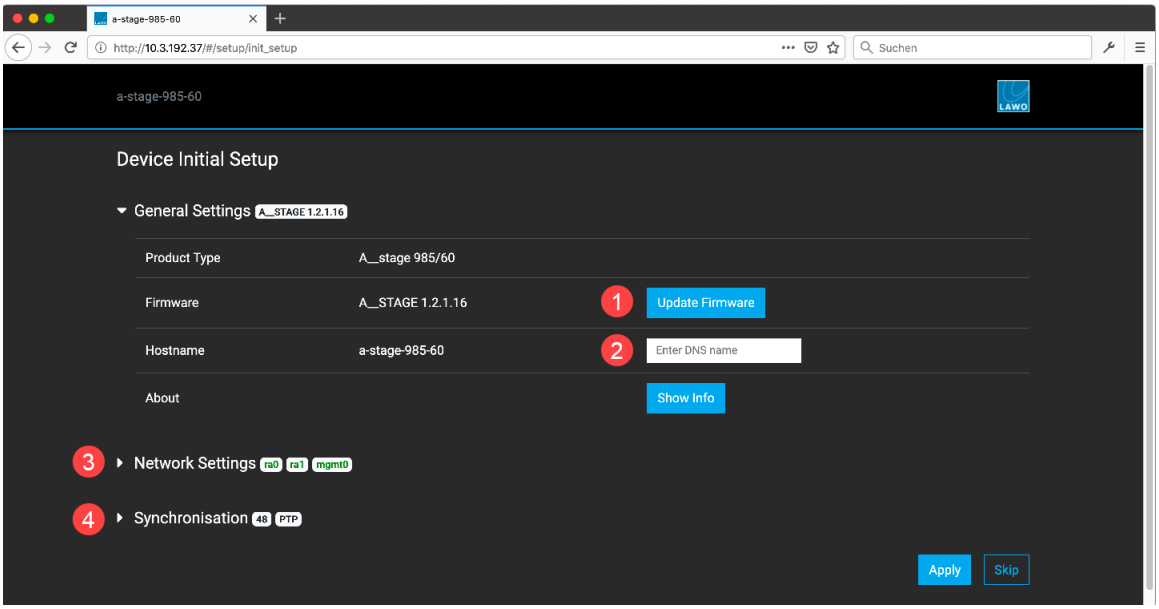
The default settings for the A__line MGMT port are listed below. At any time, you can reset the MGMT port to these settings using the NET-ID button on the front panel.

Default Network Settings	MGMT Interface
Connection type	Static
IP address	192.168.110.253
Netmask	255.255.255.0
Gateway	192.168.110.1

4. Test the connection by opening a web browser application and typing in the MGMT port IP address = 192.168.110.253
5. Press Enter - if the connection is successful, then the "Device Initial Setup" page appears.

If there is a problem opening the page, check your web browser (see Prerequisites for the requirements). Then check the network cabling and IP settings of the control computer and A__line device.

7.3 Device Initial Setup



The "Device Initial Setup" page opens as shown above. Use the on-screen prompts to work through the setup procedures:

1. Update Firmware - check and, if necessary, update the firmware running on the device.
2. Enter a DNS hostname - to identify the device to the rest of the network.
3. Network Settings - define the IP settings for the two RAVENNA/AES67 interfaces (ra0 and ra1) and MGMT port (mgmt0).
4. Synchronisation - define the sync source and sample rate.

Once all fields have been edited, select **Apply** to confirm the changes. The settings are saved and the "Device Initial Setup" page closes. The Web UI home page ("Health") will now appear.

Alternatively, select **Skip** to cancel out of the "Device Initial Setup" without making any changes. You will be asked if you wish the page to appear on the next browser connection - select **Yes** (recommended) or **No** (to skip the initial setup). If you select **No**, then to return to the "Device Initial Setup" page you must perform a factory reset (using the NET-ID button).

The rest of this chapter describes each of the initial steps in more detail.

7.3.1 Updating the Firmware

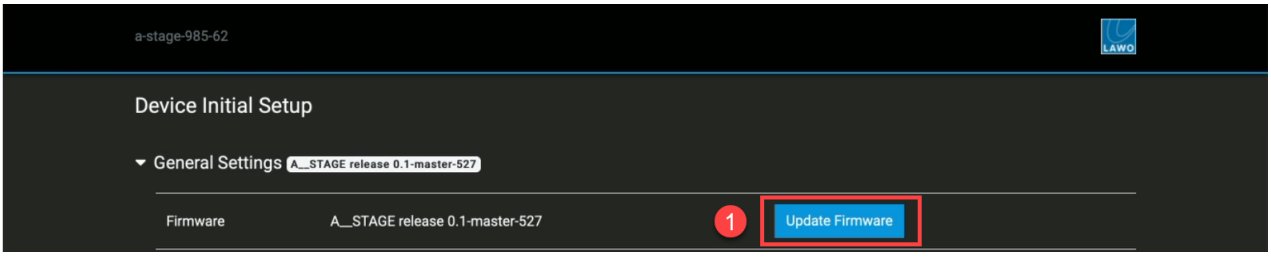
Under "General Settings" you will see the current **Firmware** version running on the device.

Whenever a new software release is issued, all necessary files are available from the **Downloads** area at www.lawo.com (after **Login**).

Start by downloading the update file onto your computer and check that the file ends with ".tar.gz". Some browsers, such as Safari, tend to unzip the file automatically after download which makes the file invalid. If this is the case, choose "Download as..." in your browser to bypass the automatic unzip function. Then read the accompanying "Release Notes" for any additional steps or advice.

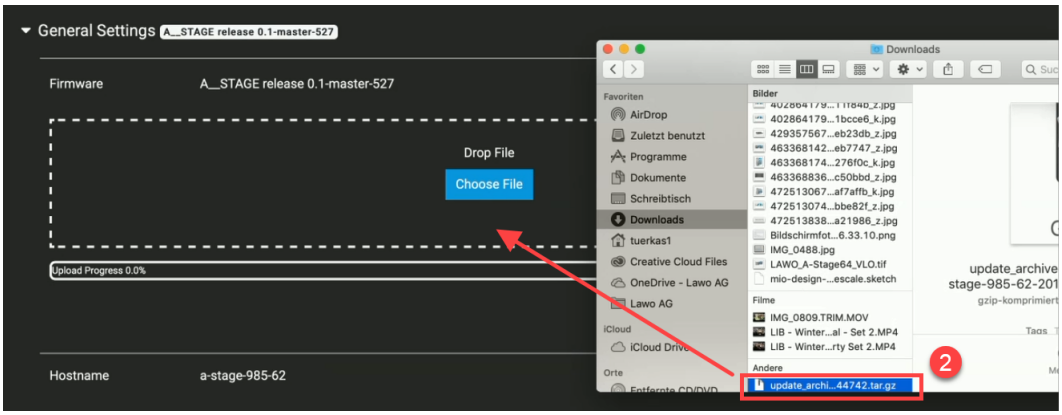
To perform the update:

1. Select **Update Firmware**.

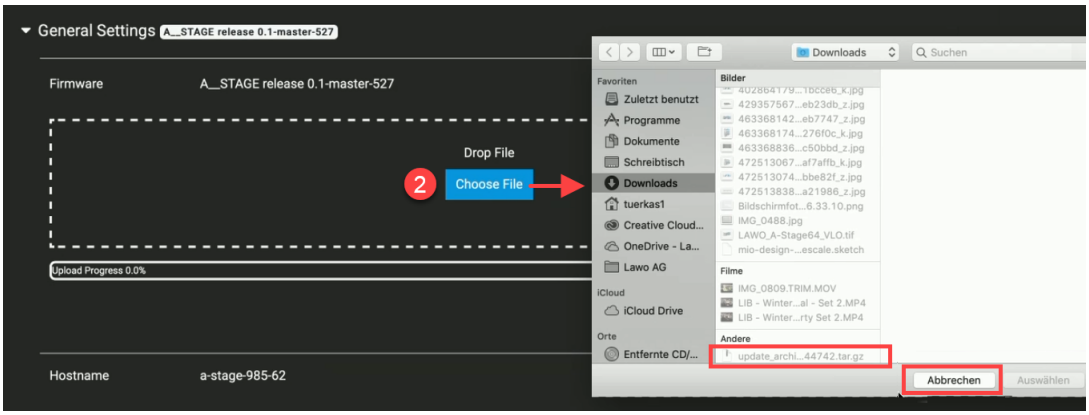


2. Either drag and drop the update file into the "Drop File" area (inside the dotted line), or use **Choose File** to open a "File Explorer" window and make a selection.

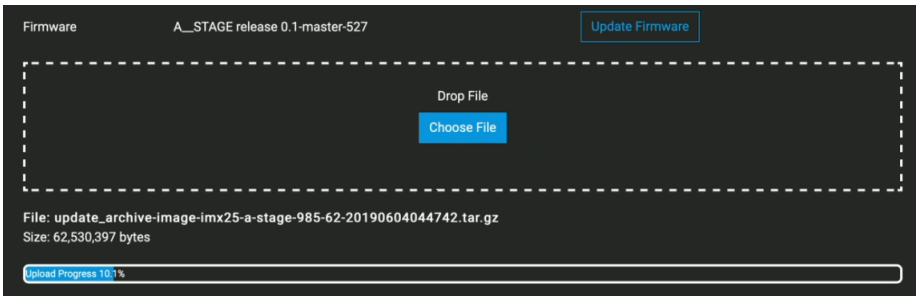
Drag & Drop



Choose File



The update starts automatically once you have selected a file.



The update may take a while. Its progress is shown in blue on the "Progress" bar. After a successful update, the device will automatically reboot (which means that you will lose your browser connection).

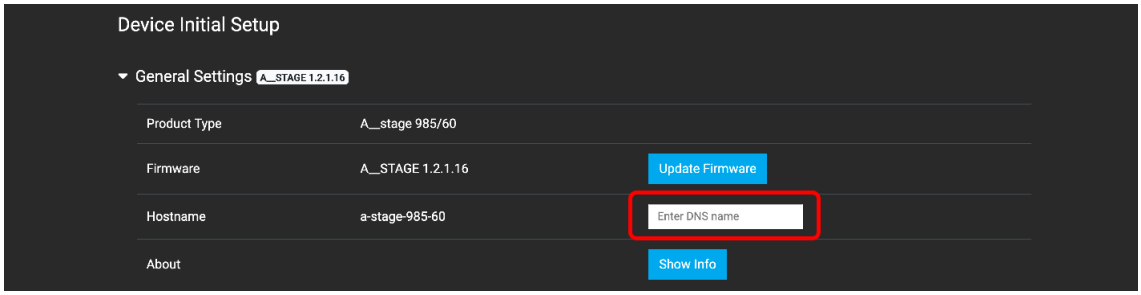
Once the reboot is complete, the device reconnects automatically and you can continue with the setup.

7.3.2 Entering a DNS Hostname

Under "General Settings" you will see the current **Hostname** of the device. This name identifies the device to the rest of the network (via the DNS announcement service). It is displayed at the top of every Web UI page and in the Ember+ Tree.

To edit the name:

1. Type a name into the "DNS name" field.



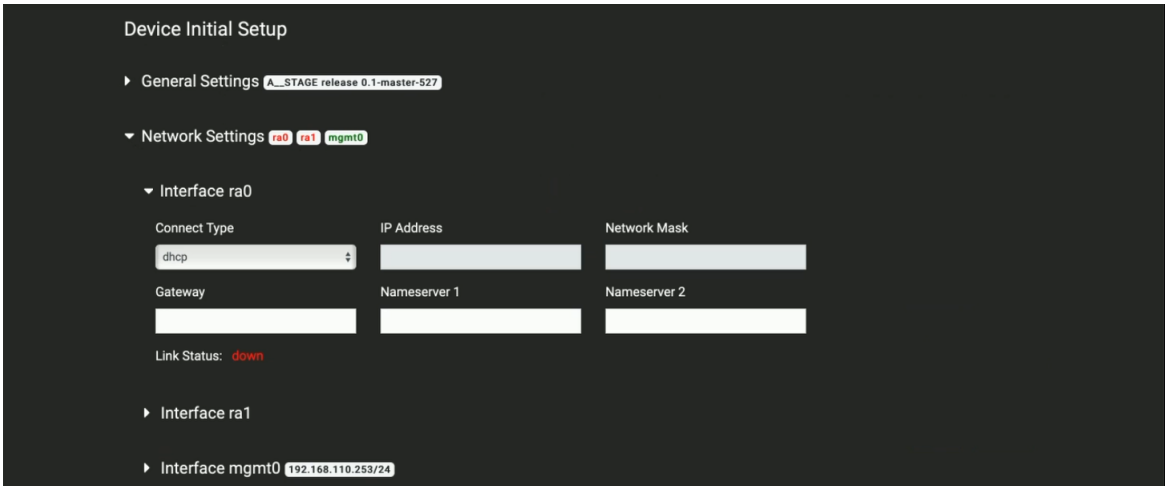
Special characters and spaces are not permitted. If an invalid name is entered, then you will see an error message (in magenta).

2. Close the "General Settings" and move onto the next step.

Note that the new DNS hostname will only become active once you have selected **Apply** (at the end of the setup).

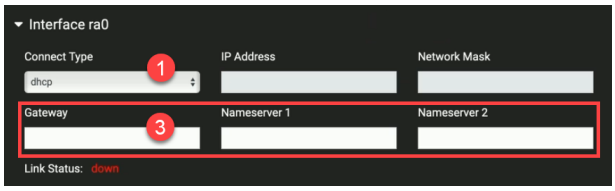
7.3.3 Defining the Network Settings

Open "Network Settings" and then an interface to define the IP settings for the two RAVENNA/AES67 ports (ra0 and ra1) and MGMT port (mgmt0).

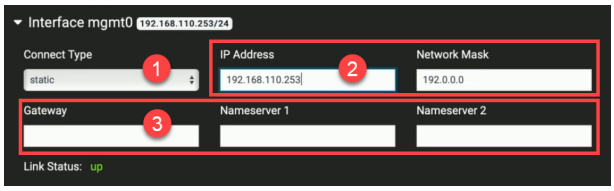


Each interface is configured as follows.

Connection Type = dhcp



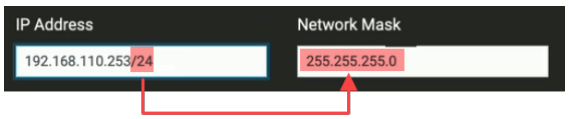
Connection Type = static



1. Select the connection type from the drop-down menu:
   - **static** - choose this option to enter a fixed IP Address and Network Mask manually.
   - **dhcp** - choose this option to receive an IP Address automatically from the network's DHCP server.
   - **zeroconf** - in this mode, the unit will automatically assign its own IP address.
2. If the connection type is **static**, then enter the **IP Address** and **Network Mask** into the corresponding fields. Note that these cannot be edited for **dhcp** or **zeroconf**.

The **IP Address** *must* be unique, and lie within the same IP address range as all other streaming nodes (i.e. the first three fields must match). The **Network Mask** *must* match the Subnet Mask of all other streaming nodes.

When entering the **IP Address** you can define the **Network Mask** automatically by typing "/xx" at the end of the field - for example:

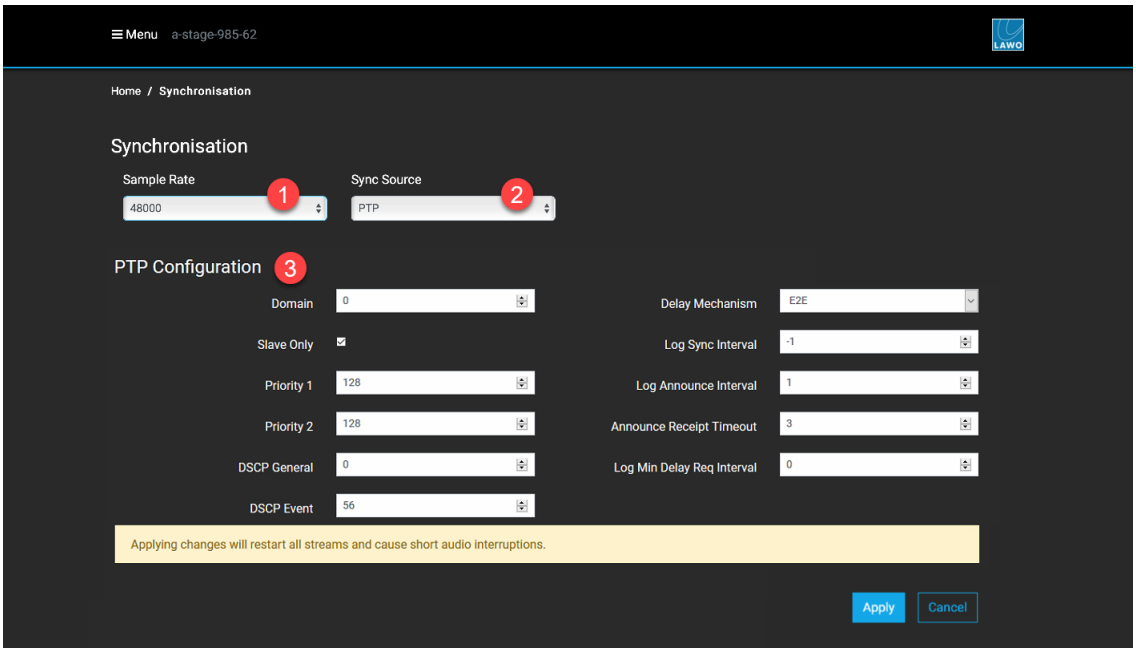


3. If data packets are to be redirected via a network switch with Layer 3 routing capability, then enter a **Gateway** and up to two **Nameservers**. If redirection is not required, then these fields can be left blank.
4. Repeat steps 1 to 3 for each network interface.
5. Close the "Network Settings" and move onto the next step.

Note that the new settings will only become active once you have selected **Apply** (at the end of the setup).

7.3.4 Defining the Sync Options

Open "Synchronization" to define the sync options for the device.



1. Start by selecting the sample rate: either **48000** (48kHz) or **44100** (44.1kHz). The default setting is 48kHz.
2. Then select the sync source: **WCLK In**, **MADI**, **PTP** or **Internal**. The default setting is PTP.

The sync reference must be connected as follows:

- **WCLK In** – external wordclock connected to the WCLK IN.
- **MADI** – external MADI connected to the active MADI port.
- **PTP** – arriving from/sending to the streaming network (via either the PRIMARY or SECONDARY interface).
- **Internal** – the device's own internal sync generator.

To synchronize to an external reference, the clocking signal *MUST* match the sample rate of the device.

3. If the sync source = PTP, then the "PTP Configuration" applies.

These fields are described later. As a first step, they can be left at their default values.

Note that the new settings will only become active once you have selected **Apply** (at the end of the setup).

7.3.5 Completing the Initial Setup

Once all fields have been edited, select **Apply** to confirm the changes. The settings are saved and the "Device Initial Setup" page closes. The Web UI Home page ("Health") will now appear.

8. Configuration (via the Web UI)

This chapter describes how to use the Web UI to configure your A__line device.

8.1 Introduction

Following the initial setup, there are two main tasks:

- Streams - create and manage the TX and RX streams.
- I/O Parameters (A__stage & A__digital64) - adjust the local audio parameters.

The Web UI also provides access to the General Settings, Network Settings and Synchronization options defined during the initial setup. In addition, the Health, Alarms and Log Viewer pages can be used for diagnostics.

All settings are stored locally on the device and are re-instated following a power cycle or reboot.

8.2 Prerequisites

To run the Web UI, your computer *MUST* meet or exceed the following requirements:

- **Processor:** Pentium 166 or higher
- **RAM:** 64 MB
- **Network Interface Card**: operating at 100 or 1000 Base-T
- **Screen Resolution:** >= 1024 x 786
- **Web Browser**: Microsoft Internet Explorer, Mozilla Firefox, Apple Safari or Google Chrome. Please install the latest version of the browser for best performance.

8.3 Opening the Web UI

The Web UI can be accessed via the management network port (MGMT) or one of the streaming network ports (RAVENNA/AES67: PRIMARY or SECONDARY).

If you are installing a dedicated management network, then it is recommended to assign a unique static IP address to the MGMT port during the initial setup. Once this is in place, you can connect both the device and your computer to the network, and open the Web UI from any access point.

Alternatively, to access the Web UI via the streaming network, you will need to know the IP settings of one of your RAVENNA/AES67 interfaces: PRIMARY or SECONDARY. By default, these are assigned automatically via DHCP, but can be changed to static IP settings if you wish. Using static IPs will allow you to access the Web UI by connecting your computer to the streaming network and entering the intreface's fixed IP address.

In all instances, the Web UI can be opened by making a direct connection to the MGMT port (as described earlier). Once the Web UI is open, the current network settings can be edited from the "Network Settings" page.

➢ **To open the Browser Connection:**

1. Power on the device.
2. Connect your computer's LAN port to your network access point (as described above).
3. Configure the network settings for your computer's LAN port. The exact steps vary depending on your OS version.

The IP address must be unique, and set within the same range as that of the port you are connecting to. The subnet masks should be identical.

Note that, at any time, you can reset the MGMT port to its default network settings using the NET-ID button on the front panel.

4. Open your web browser application and type in the IP address of the port you are connecting to.

For example, you would type 192.168.110.253 if connecting via the management network to an A__line device with its default MGMT port IP address.

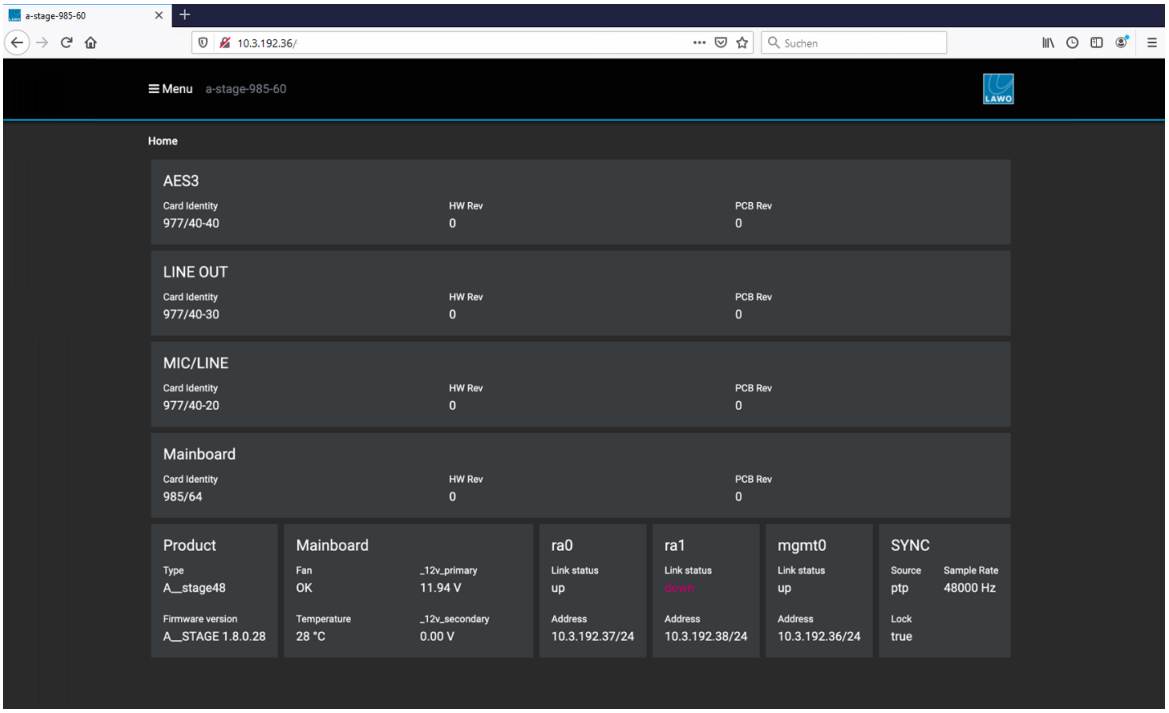
5. Press Enter - if the connection is successful, then the Web UI Home page appears.

If there is a problem opening the page, check your web browser (see Prerequisites). Then check the network cabling and IP settings of the control computer and A__line device.

8.4 Using the Web UI

The Web UI always opens with its Home page ("Health"), unless you are connecting for the first time (when you will see the Device Initial Setup).

Home page (Health)



All pages use the same operating principles, and are divided into two: the top headline bar and main working area.

Headline

At the top of each page are the **Menu** button, device name (DNS name) and LAWO logo.

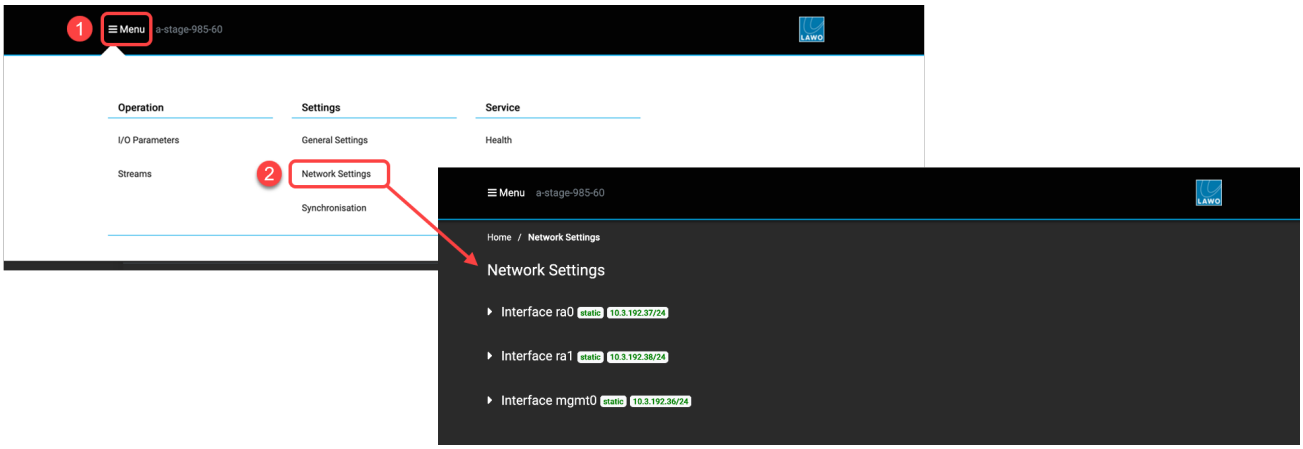
A small warning triangle may also appear if the device's global alarm is active. If you click on the triangle, then this will open the "Alarms" page.

Working Area

The rest of the page displays the menu path and title at the top (e.g. Home), followed by the topics and their content.

8.4.1 Page Navigation

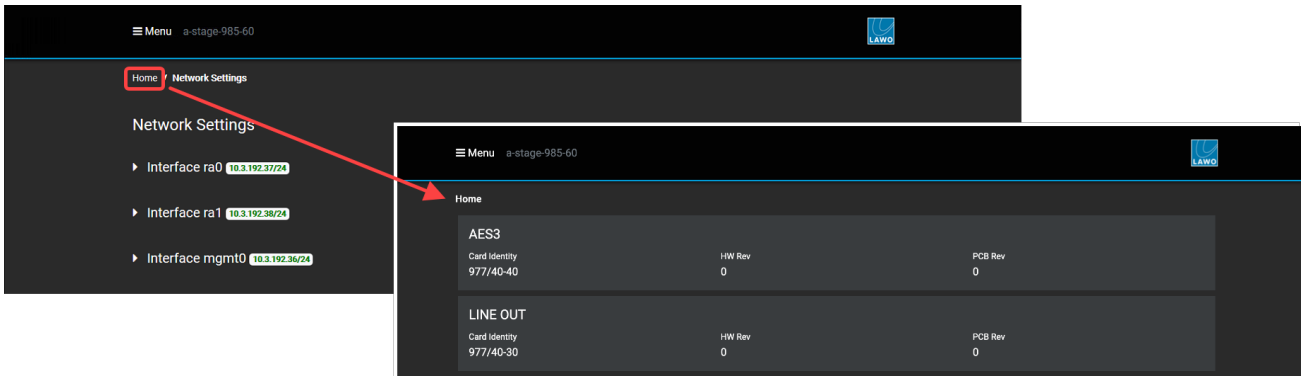
You can navigate to any page from the main menu as follows.



1. Click on **Menu** to open the main menu pop-up.

The pages are divided into three branches: **Operation** (for use during runtime), **Settings** (for device setup) and **Service** (for diagnostics).

2. Select a page (e.g. **Network Settings**) - the working area updates accordingly.
3. To switch to another page, either repeat the steps above or click on "Home" to return to the "Health" page overview.



4. To close the main menu, either click again on **Menu** or select the **Close** button (top right).

8.4.2 Available Pages

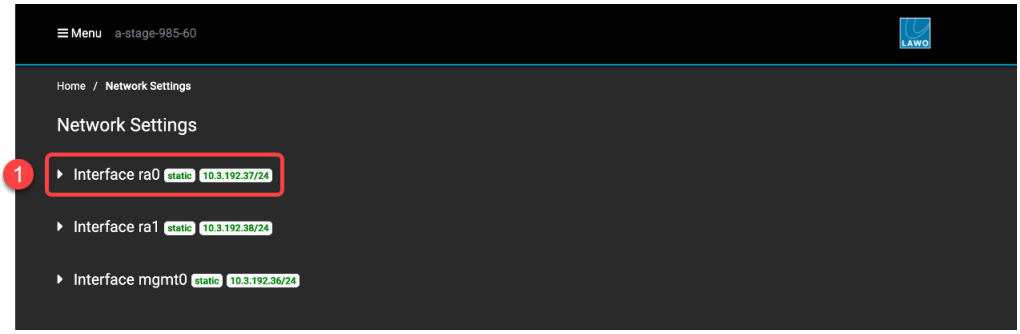
There are eight pages in total. They provide the following functions.

- **I/O Parameters** - remote control of the local audio parameters.
- **Streams** - configuration of the TX and RX streams.
- **General Settings** - update firmware and edit the device (DNS) name.
- **Network Settings** - define network settings for the RAVENNA/AES67 and MGMT interfaces.
- **Synchronzation** - define the sample rate and sync source.
- **Health** (Home page) - show device information and statuses.
- **Alarms** - show system alarms.
- **Log Viewer** - show and download log messages.

8.4.3 Accessing Topics & Sub Topics

Each page uses accordions (marked by the arrows) to organise its topics and sub topics.

1. Click on an accordion (e.g. "Interface ra0") to show or hide the associated content.



2. Scroll down to access all available fields and the other accordions.

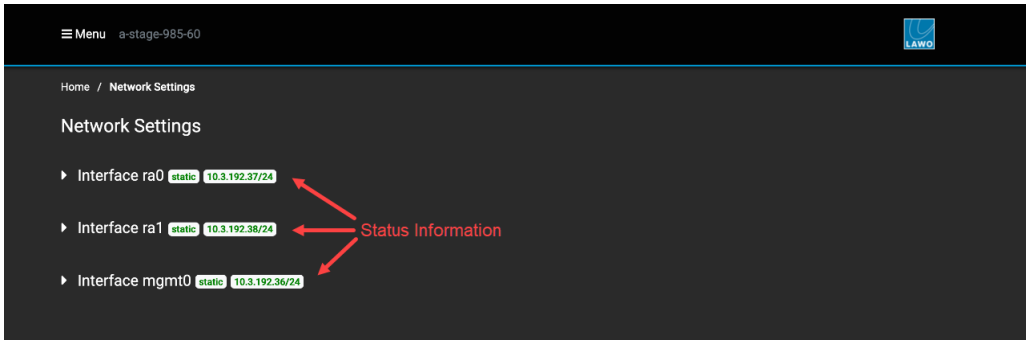
You can have multiple accordions open at the same time. However, it is best to close them, once you have finished editing, to reduce the amount of page scrolling.

8.4.4 Status Badges

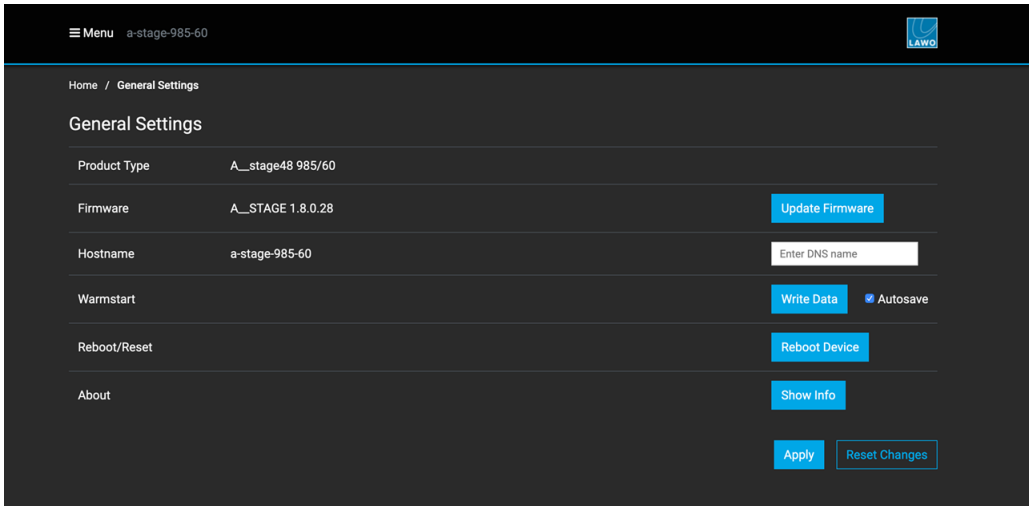
To the right of each accordion, you will see the most important status information.

For example, in the "Network Settings" page, the badges show the type of link and IP address of each interface.

Sometimes the badges are color-coded; in this instance, the text color shows whether the links are up (green) or down (red).



8.4.5 Editing & Saving Settings



To edit parameters or perform actions, a number of conventions are used:

- Buttons - all on-screen buttons are colored blue: either white text on a blue background for positive actions (e.g. **Apply**); or blue text on a dark background for negative actions (e.g. **Reset Changes**). If a button is dimmed, then its action cannot be completed (e.g. if a required field has been left blank).
- Editable Fields - if a field can be edited, then its background is white; if a field cannot be edited, then its background is grey. For text entries, use the on-screen messages to guide you (e.g. "Enter DNS name").
- Error messages and guidance text appear in magenta. This makes it easy to spot mistakes or incomplete fields.
- Option Boxes - can be either ticked (on) or unticked (off).

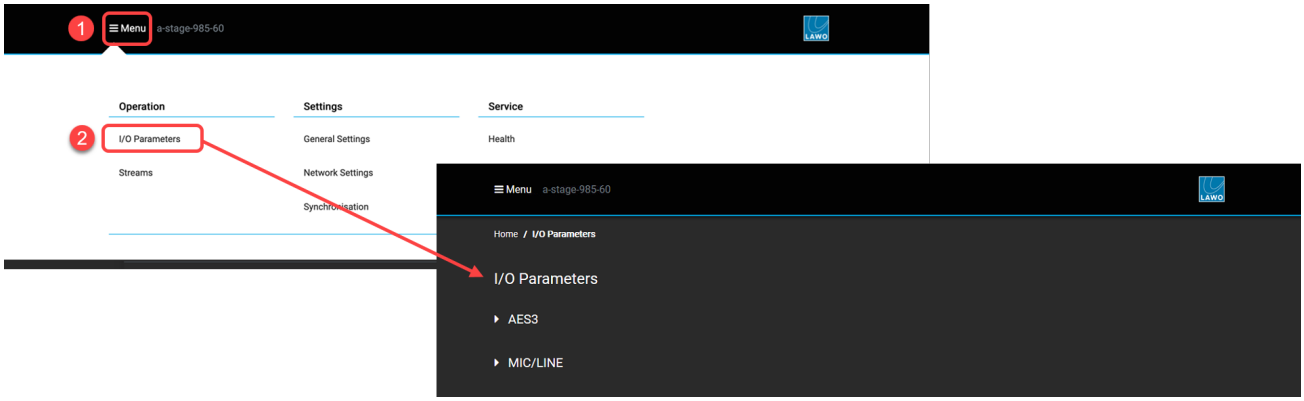
In all cases, you will need to select **Apply** to save your changes. All settings are stored locally on the device and are re-instated following a power cycle or reboot.

The rest of this chapter describes the functionality of each page.

8.5 I/O Parameters (A__stage, A__digital64)

From this page you can remotely control local audio parameters such as mic input gain or SRC (Sample Rate Conversion) on/off. Note that this page is not available (or necessary) for A__madi6.

The screenshot below shows how to open the page.



8.5.1 AES3 Parameters

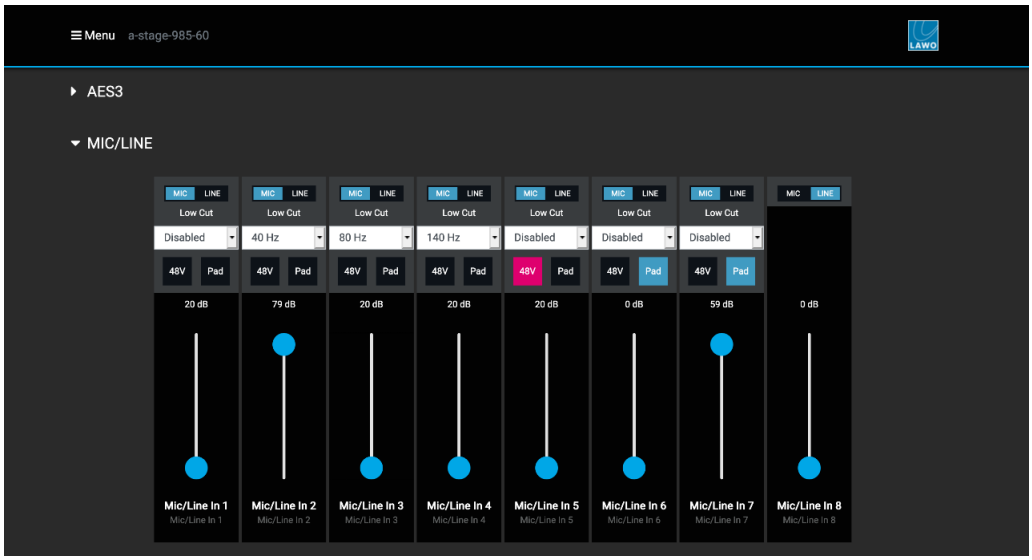
Open "AES3" to access parameters for the digital inputs. Each input is represented by a column in the table.

Use the SRC **ON** / **OFF** buttons to enable or disable the sample rate conversion. The factory default is SRC ON.

8.5.2 MIC/LINE Parameters (A__stage)

Open "MIC/LINE" to access parameters for the mic/line inputs. Note that this page is not available (or necessary) for A__digital64.

Each input is represented by a vertical channel strip.



Use the **MIC** / **LINE** buttons to change the input selection. The factory default is LINE.

When switched to **MIC**, each input provides:

- **Low Cut** filtering, with a choice of roll-off frequencies: **Disabled** (off), **40Hz**, **80Hz** or **140Hz**. The default is off.
- **48V** phantom power (**on**/**off**). The default is off.
- -20 dB **Pad** (**on**/**off**). The default is off.
- **Analog input gain**: from +20 to 79dB (no PAD).

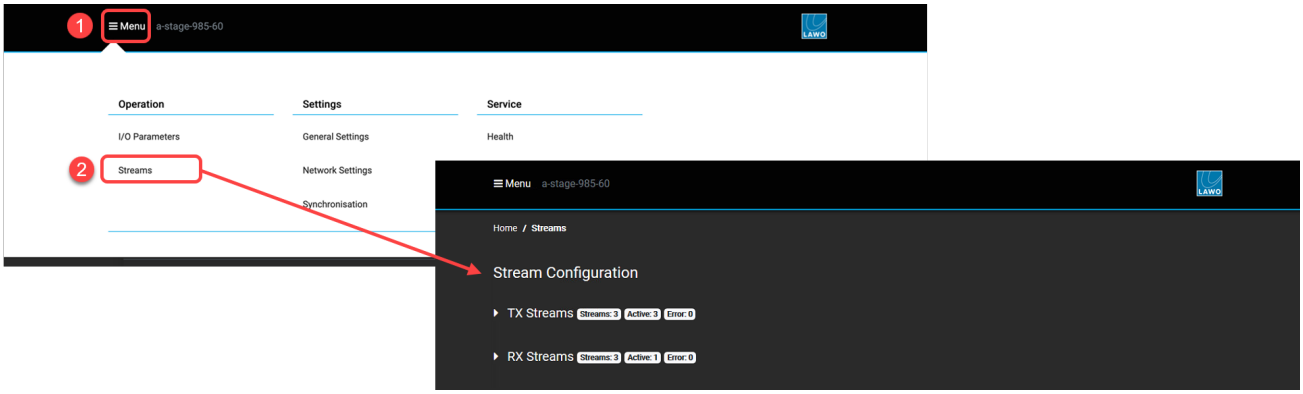
When switched to **LINE**, there is no Low Cut filter, 48V or 20dB Pad. The line input gain range = 0 to 59dB.

Click and drag on the slider to adjust the input gain - the current value is displayed above the slider.

8.6 Streams

This page is used to create and manage the streams. TX streams publish audio from the device to the network. RX streams receive audio from the network.

The screenshot below shows how to open the page.

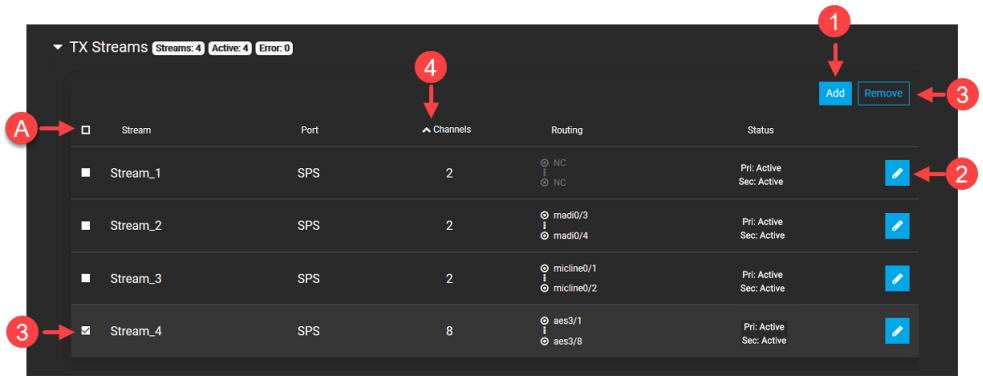


The status badges beside "TX Streams" and "RX Streams" show how many streams have been added, the number which are active and the number in error. If a stream is configured for SPS, then both paths must be in error before this is indicated in the status badges.

8.6.1 TX Stream Operations

Open "TX Streams" to reveal all existing TX streams (in table form). If no TX streams have been created, then the table will be empty. In the example below, there are four TX streams.

The table shows the Stream name; the Port used to transmit the stream (Primary, Secondary or SPS); the number of Channels carried by the stream; the Routing to those channels from the local IO; and the Status of the outgoing stream.



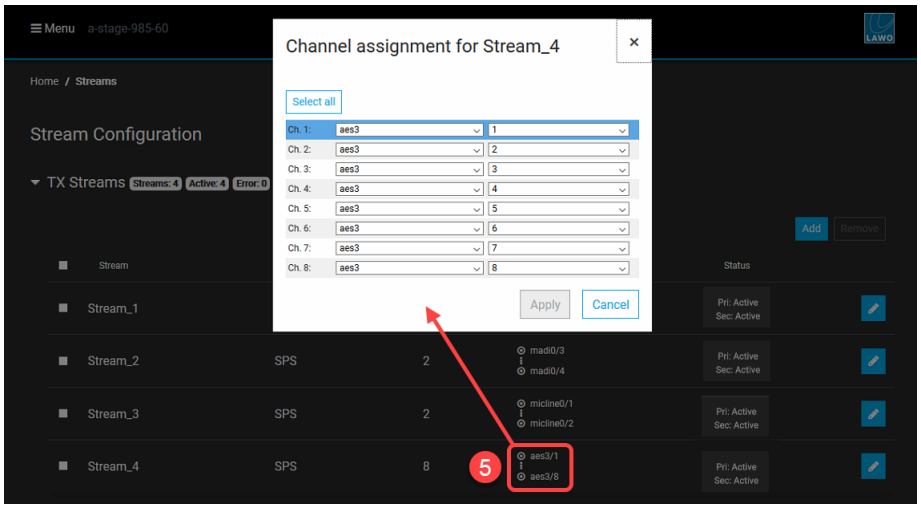
The following operations are possible:

1. Click on **Add** to create a new TX stream.
2. Click on the pencil icon to edit the TX stream properties.
3. Select an entry (or entries) and click on **Remove** to delete the selected stream(s). Select **Yes** to confirm or **No** to cancel.

You can use the select all button (**A**) to select all entries.

4. Click on a column heading to sort the list by Stream name, Port type, number of Channels, etc.

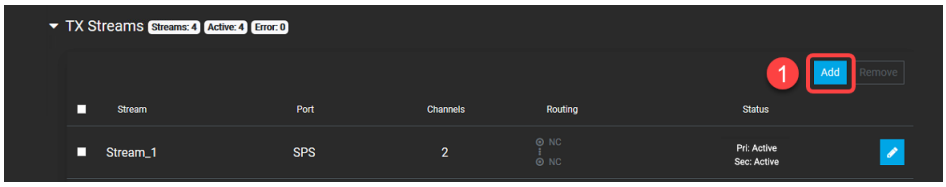
When sorting is active, an arrow appears beside the column heading. Each click cycles through the sorting options: ascending, descending and off. When column sorting is off, the list is sorted by Stream name alphabetically.



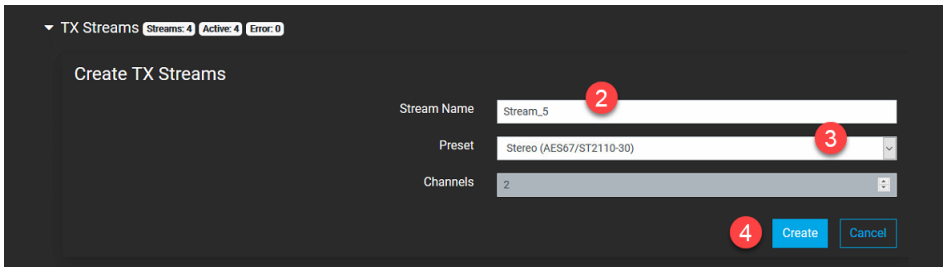
5. Click on the Routing summary to edit the IO assignments for the stream. Use the **x** button (top right) to close the pop-up.

8.6.2 Creating a TX Stream

To publish audio from the device to the network, you will need to create a TX stream as follows.



1. Open "TX Streams" and click on **Add** to open the "Create TX Streams" settings.



2. Enter a **Stream Name**.

> This field MUST be completed. It cannot be left blank and cannot be edited once you have created the stream.

➢ **Stream Name**

The **Stream Name** identifies the stream to other network users.

The identifier string must not contain the character “/” (ASCII/UTF-8: 47) and must begin with a letter or the lower line character “a”-“z”, “A”-“Z”, “_” (ASCII/UTF-8: 65-90, 97-122 ,95).

TX stream names must not exceed 28 characters.

3. Choose a **Preset**.

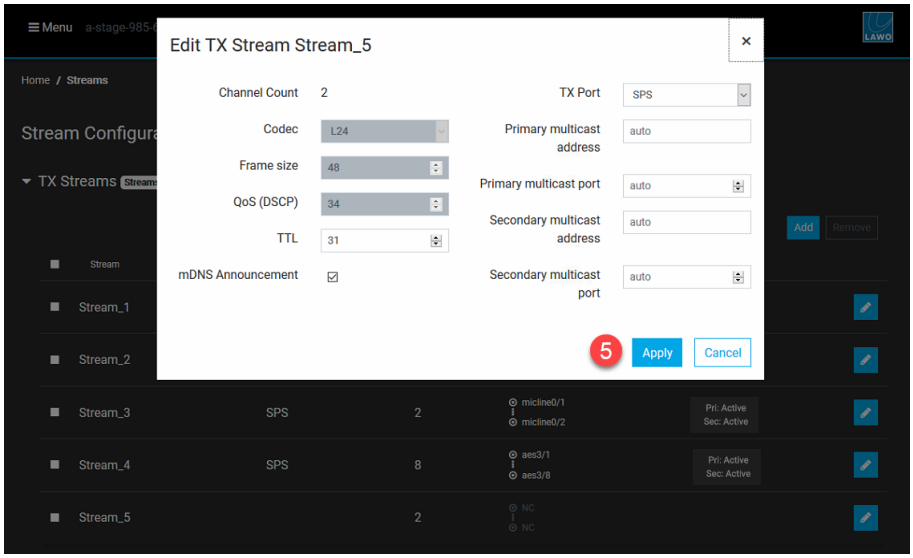
By default, the **Stereo (AES67/ST2110-30)** preset is selected. Use the drop-down menu to choose another named preset or **Custom**.

The named presets ensure compliance with the corresponding standard: AES67/ST2110-30, ST2110-31, etc. Select **Custom** if you wish to edit the payload parameters (Channels, Codec, Frame size) or QoS (DSCP) manually. The **Custom** option is described in more detail later. For all named presets, the number of **Channels** is completed automatically.

4. Click on **Create** to create the stream (or **Cancel** to exit).

The TX stream is published to the network and the "Edit TX Stream" window appears.

Edit TX Stream

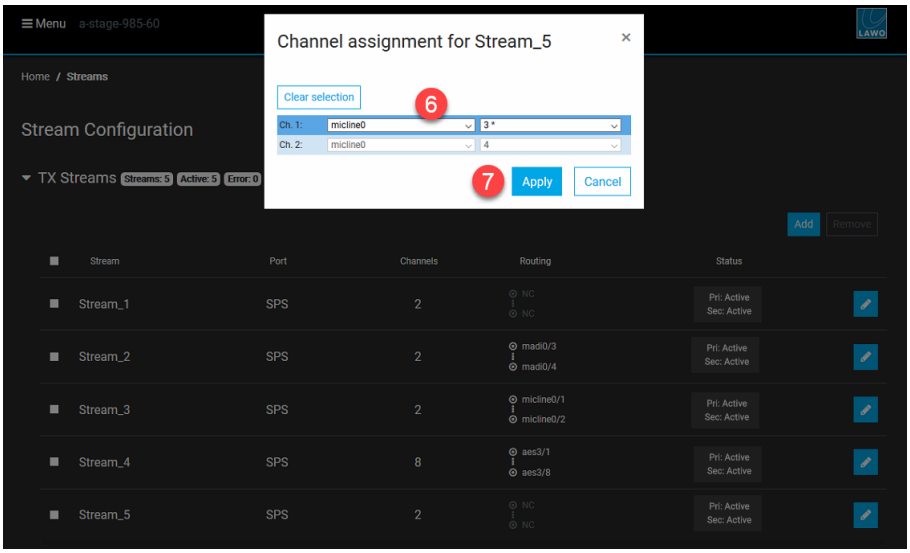


This is used to edit the TX stream properties (described later). By default, the **TX Port** is set to **SPS** (for redundant streaming); the multicast addresses are set to **auto** (automatic); the **TTL** = **31**; and **mDNS Announcement** is enabled.

5. Once you are happy with the stream properties, select **Apply** to continue (or **Cancel** to exit).

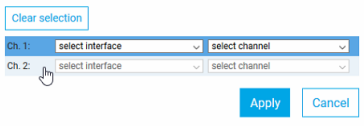
6. Next, the "Channel Assignment" window appears. This is used to assign local audio from the device to the stream's channels.

Channel Assignment

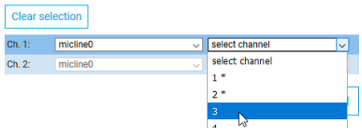


First, select a streaming channel or range of channels by clicking on the first and last entry. Then select an audio interface and the first IO number. An asterisk (*) will appear if the IO is already assigned to another stream or a different channel on the same stream. Whenever a range of streaming channels are selected, the IO assignments are made incrementally.

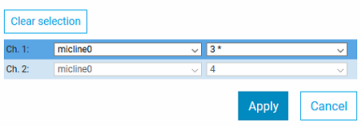
Channels 1 & 2 selected



Select first IO channel



Assignment Completed

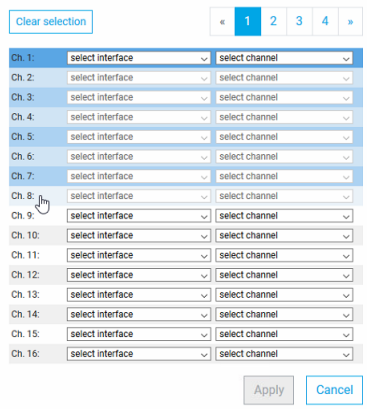


Use **Select all** to select all streaming channels, or **Clear Selection** to clear the current range.

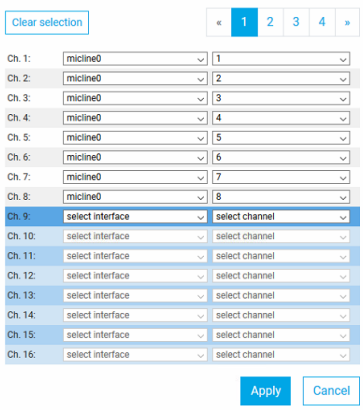
If a stream has more than 16 channels, then the channels are divided into pages.

To assign audio from different interfaces or to non-consecutive channels, simply make the assignments in several stages. For example:

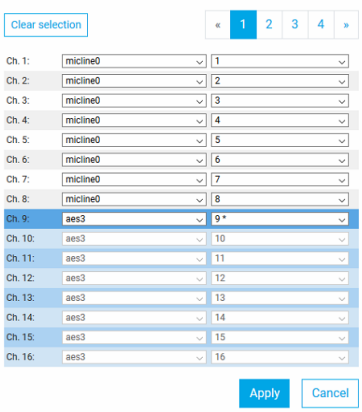
Channels 1 to 8 selected



Channels 9 to 16 selected



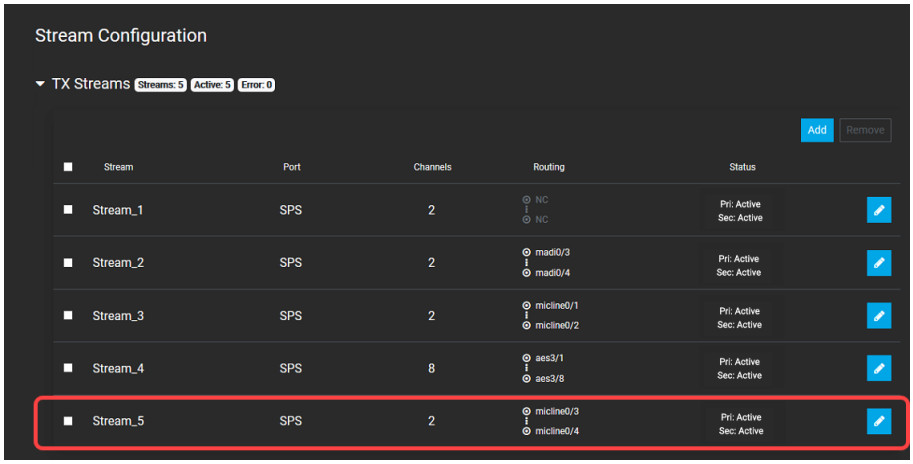
Assignment Completed



7. Once you are happy with the audio assignments, click on **Apply** to continue (or **Cancel** to exit).

You can now check all of the details for the stream in the "TX Streams" table.

TX Streams (published)

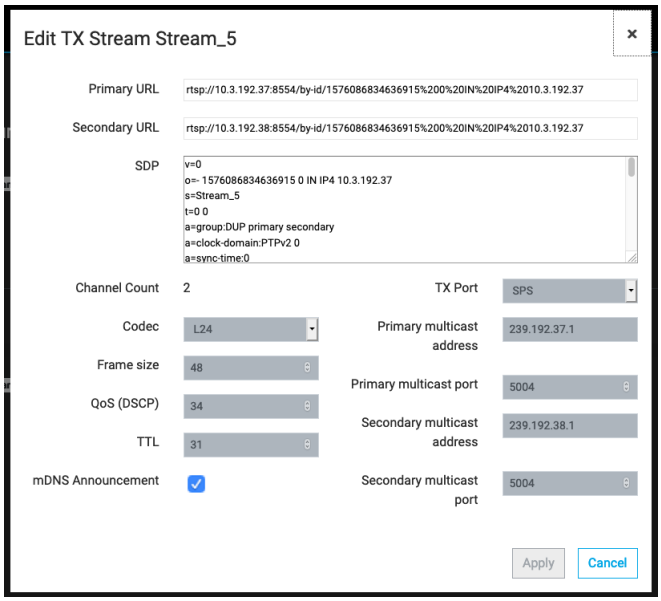


8.6.3 Editing a TX Stream

The "Edit TX Stream" window can be opened by clicking on the pencil icon, and the "Channel Assignment" window can be opened by clicking on the Routing summary. This allows you to modify the editable stream properties and audio assignments later. In both cases, remember to select **Apply** to save any changes (or **Cancel** to exit without saving).

Once a TX stream is Active, the "Edit TX Stream" window includes the RTSP-URLs (for the Primary and Secondary interface) and SDP information. From here they can be copied so that they may be used to receive the stream on other devices.

Edit TX Stream (once stream is Active)

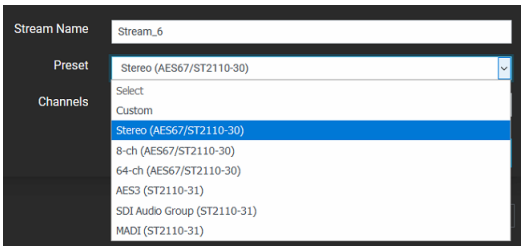


8.6.4 TX Stream Properties

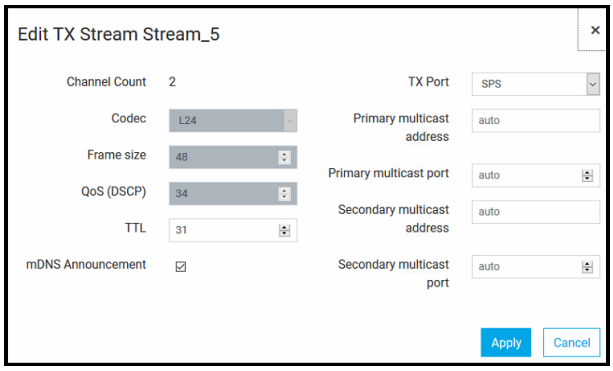
➢ **Channels, Codec, Frame Size & QoS (DSCP)**

Whenever you choose a named preset, the payload parameters (Channels, Codec, Frame size) and QoS (DSCP) are completed automatically (and cannot be edited). This ensures compliance with the corresponding standard.

Preset Selection



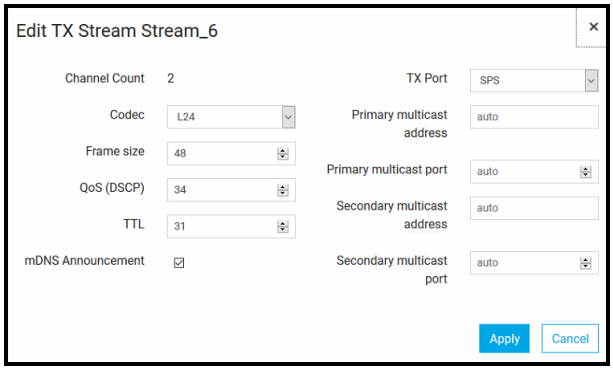
Properties for Preset = Stereo (AES67/ST2110-30)



To enter the values manually, choose the **Custom** preset when you create the stream, and enter the number of Channels to be encoded (e.g. **2**). The Codec, Frame size and QoS (DSCP) can then be edited from the "Edit TX Stream" window.

Preset = Custom

Properties for Preset = Custom



The first three fields determine the payload of the stream as follows:

- **Channels** = the number of channels to be encoded: mono, stereo, 8-channel, etc.
- **Codec** = the encoding method used for the digital audio. For example: **L16** = 16-bit Linear PCM; **L24** = 24-bit Linear PCM; **AM824** = 24-bit Linear PCM + 8-bit metadata, a non-standard format commonly used in AES/EBU.
- **Frame Size** = the number of samples per channel per network packet. The smaller the frame size, the more often the sender transmits packets. This results in a lower sending latency, but also a higher demand on the network's bandwidth. In Lawo devices, the Frame Size limits the number of TX streams which can be created by each device.

Note that it is the payload which forms the bulk of the stream's network packet size. In short, the more channels per stream, the bigger the payload.

The **QoS (DSCP)** field assigns a DSCP (differentiated services code point) or quality class to the stream. The default value = **34**.

➢ **TTL (Time To Live)**

The TTL value can be used to prevent data packets from circulating indefinitely. The default value = **31**.

You may need to increase the value if your network includes several Layer 3 network switches (Gateways).

➢ **mDNS Announcement**

By default this option is enabled. It determines how the stream will be announced to the network:

- **mDNS Announcement** - multicast Domain Name System (defined in IETF RFC 6762).

➢ **TX Port**

This field determines which interface, or interfaces, will be used to transmit the stream to the network. To create SMPTE ST2022-7 compatible streams, you should choose **SPS** to activate both interfaces. If redundant streaming is not required, then you can choose to issue the stream from either the **Primary** or **Secondary** interface. In this instance, the **multicast address** and **multicast port** fields update accordingly.

➢ **Primary & Secondary multicast address & port**

For each interface **(Primary** and **Secondary**), the multicast address and port fields determine how the multicast addresses will be created. There are two possibilities: either automatic or manual.

If you leave the fields blank (the default), then the stream will be allocated an automatic multicast IP address and port, and you will see "**auto**" as there is nothing further to do.

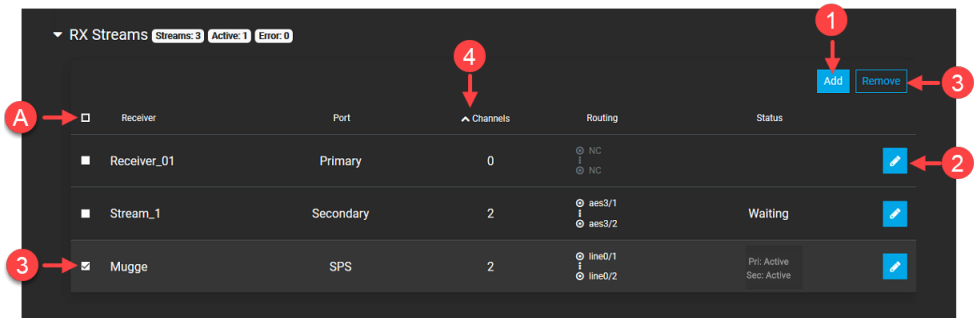
To assign a multicast IP address and port manually, type the values into the corresponding input fields. Use this method if your network supports a limited IP range.

8.6.5 RX Stream Operations

Open "RX Streams" to reveal all existing RX streams (in table form). If no RX streams have been created, then the table will be empty.

The table shows the Receiver (or incoming Stream) name; the Port used to receive the stream (Primary, Secondary or SPS); the number of Channels carried by the stream; the Routing from those channels to the local IO; and the Status of the incoming stream.

Note that the Receiver column shows the Receiver name until a stream is assigned from the network. Once an assignment has been made, the Stream name (announced to the network) is displayed. Thus, in the example below, there are three RX streams: one empty receiver (Receiver_01) and two incoming streams (Stream_1 and Mugge).



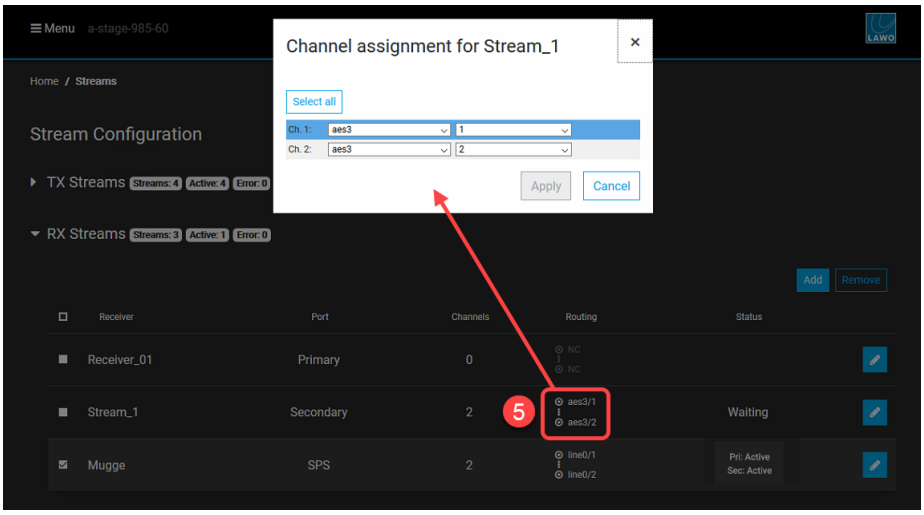
The following operations are possible:

1. Click on **Add** to create a new receiver.
2. Click on the pencil icon to edit the RX stream properties.
3. Select an entry (or entries) and click on **Remove** to delete the selected stream(s). Select **Yes** to confirm or **No** to cancel.

You can use the select all button (**A**) to select all entries.

4. Click on a column heading to sort the list by Receiver (or Stream) name, Port type, number of Channels, etc.

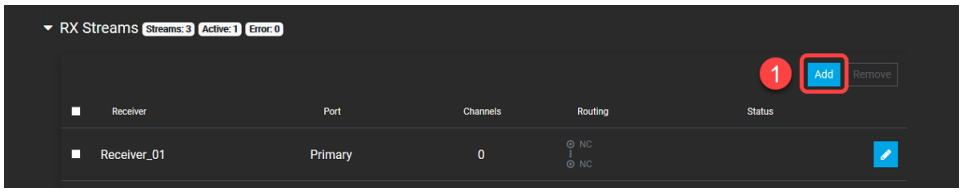
When sorting is active, an arrow appears beside the column heading. Each click cycles through the sorting options: ascending, descending and off. When column sorting is off, the list is sorted by the Receiver (or Stream) name alphabetically.



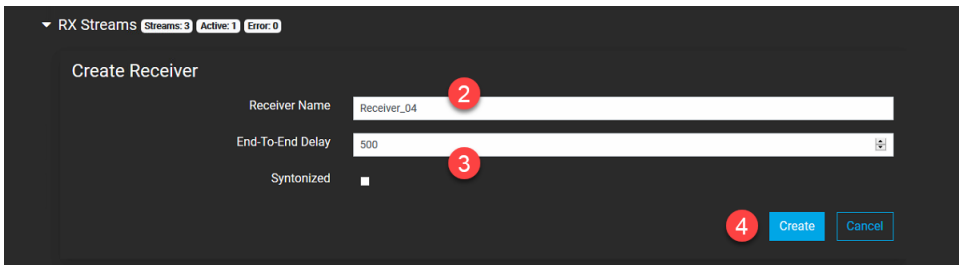
5. Click on the Routing summary to edit the IO assignments for the stream. Use the **x** button (top right) to close the pop-up.

8.6.6 Creating a RX Stream

To use audio from the network, you will need to create a RX stream as follows.



1. Open "RX Streams" and click on **Add** to open the "Create Receiver" settings.



2. The **Receiver Name** comes pre-filled with the next available receiver number. For simplicity, accept the default name and move on to step 3. Alternatively, you can edit the name using the instructions below.

> This field MUST be completed. It cannot be left blank and cannot be edited once you have created the receiver.

➢ **Receiver Name**

The **Receiver Name** is used to identify the RX stream within the Web UI until an incoming stream is assigned.

The identifier string must not contain the character “/” (ASCII/UTF-8: 47) and must begin with a letter or the lower line character “a”-“z”, “A”-“Z”, “_” (ASCII/UTF-8: 65-90, 97-122 ,95).

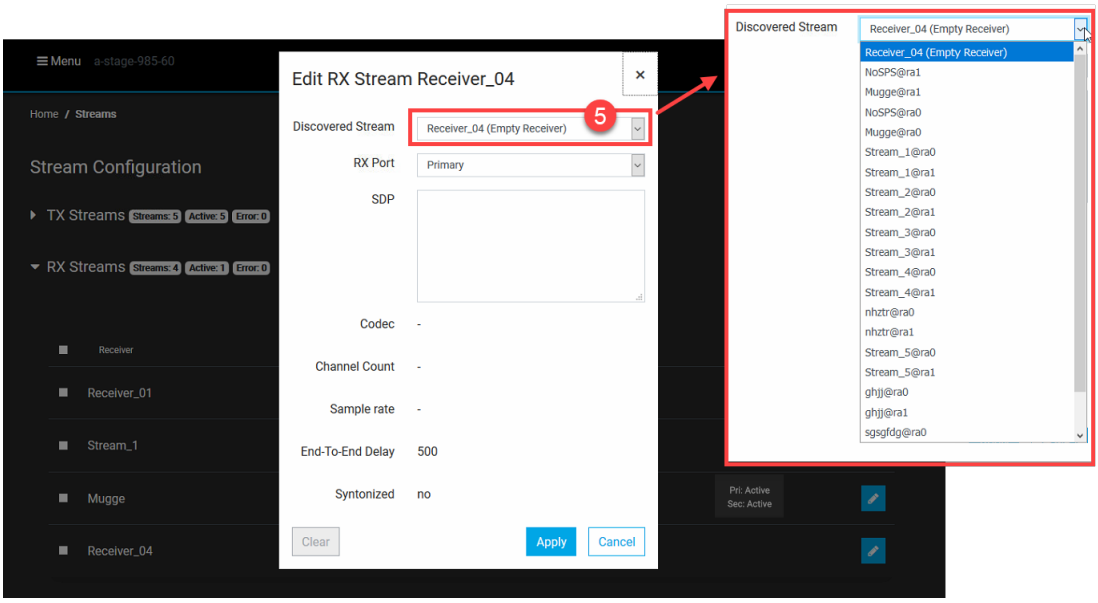
Receiver names must not exceed 28 characters.

3. Check the **End-To-End Delay** and **Syntonized** mode properties (described later).

By default, **Syntonized** mode is disabled and the **End-To-End Delay** = 500 samples.

4. Click on **Create** to create the receiver (or **Cancel** to exit).

The RX stream is created and the "Edit RX Stream Receiver" window appears. At this stage, the RX stream is configured as an empty receiver.

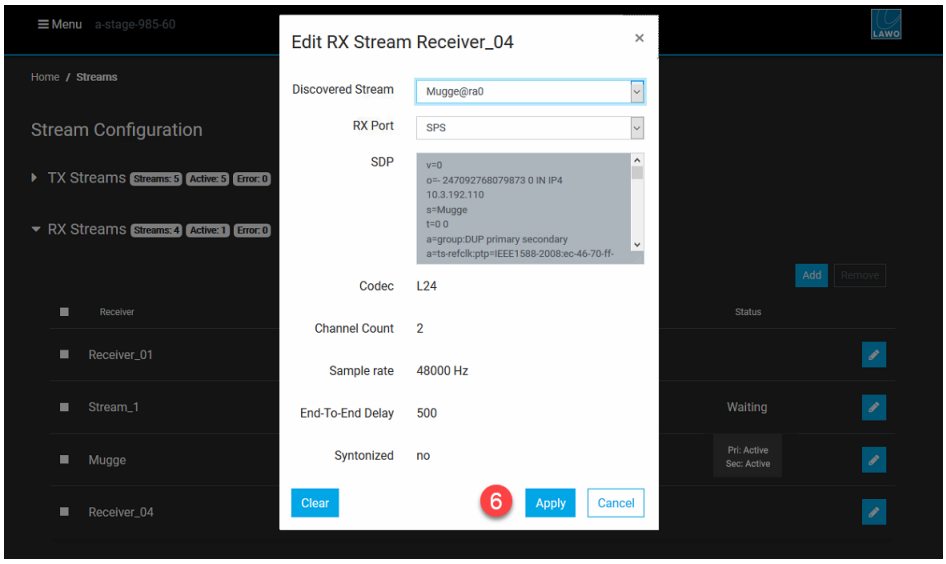


5. Use the **Discovered Stream** menu to choose an incoming stream from the network.

The list of incoming streams is dependent on TX streams being announced to the network via their SDP information. Not all devices support network announcement, and so you can select **Empty Receiver** to create a placeholder. This allows you to copy and paste in the SDP information later. You should also create an **Empty Receiver** if the stream assignment will be handled dynamically (by VSM).

If you choose an incoming stream, then the **SDP**, **Codec** and **Sample rate** fields are completed automatically from the stream's SDP information.

Discovered Stream (from network)



If the **Discovered Stream** field is set to **Empty Receiver**, then the SDP information must be entered manually, either now or later. See Copying & Pasting an SDP.

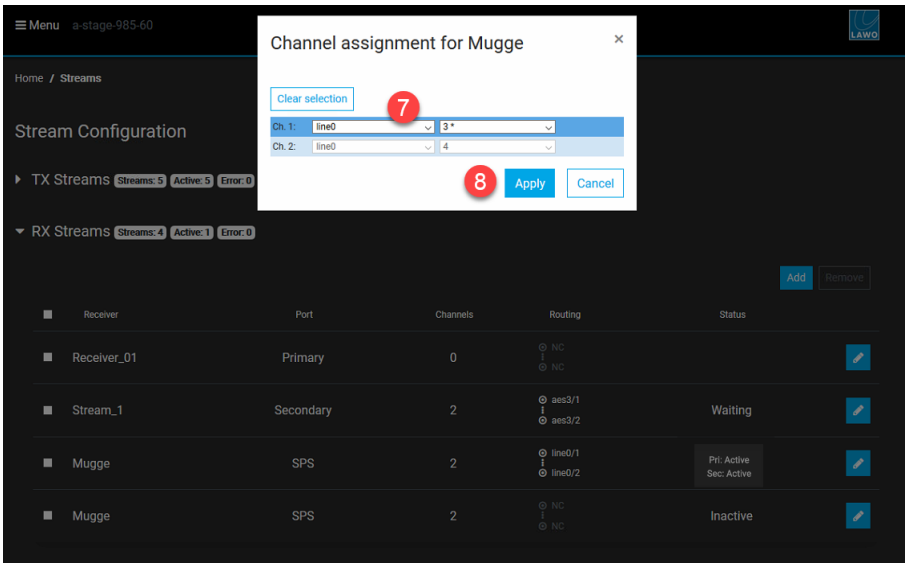
In both cases, check the RX stream properties (described later). By default, the **RX Port** is set to **SPS** (for redundant streaming).

6. Once you are happy with the stream properties, select **Apply** to continue (or **Cancel** to exit).

You can use the **Clear** button to clear the SDP information and return the RX stream to an empty receiver.

7. Next, the "Channel Assignment" window appears. This is used to assign the stream's channels to the local audio outputs of the device.

Channel Assignment



The assignments are made in the same way as for TX streams (described earlier).

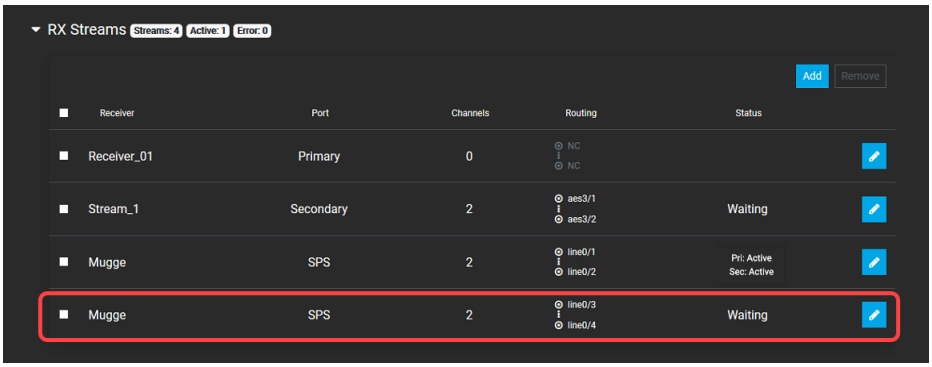
The number of streaming channels available is defined by the SDP information.

For an Empty Receiver, the window provides access to all 128 possible streaming channels. This allows you to pre-configure the IO before entering the stream's SDP information. If there is a mismatch once the SDP is entered, then the available streaming channels will be configured.

8. Once you are happy with the audio assignments, click on **Apply** to continue (or **Cancel** to exit).

You can now check all of the details for the stream in the "RX Streams" table.

RX Streams (completed)



8.6.7 Editing a RX Stream

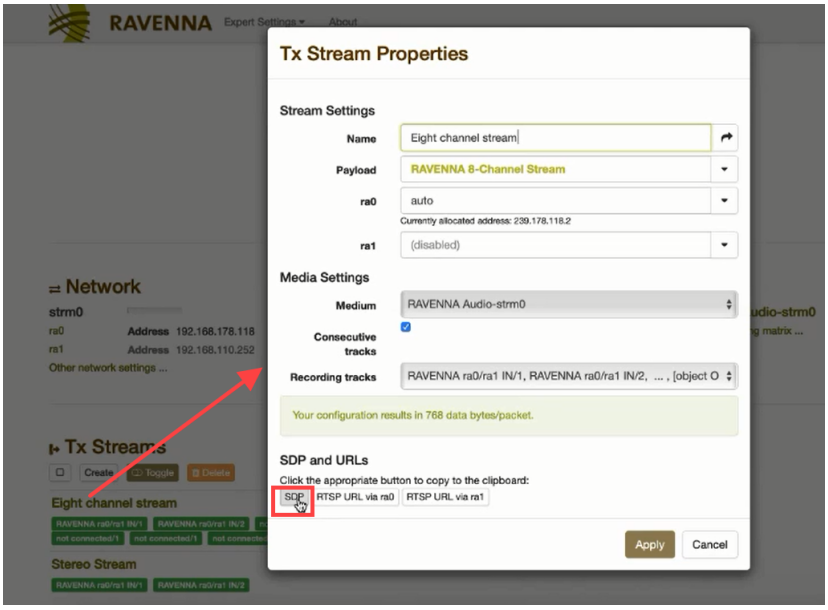
The "Edit RX Stream Receiver" window can be opened by clicking on the pencil icon, and the "Channel Assignment" window can be opened by clicking on the Routing summary. This allows you to modify the editable stream properties and audio assignments later. In both cases, remember to select **Apply** to save any changes (or **Cancel** to exit without saving).

8.6.8 Copying & Pasting an SDP

The steps below show how to create a RX stream using the sender's SDP information. Note that if the stream is redundant, the SDP contains information about both network paths.

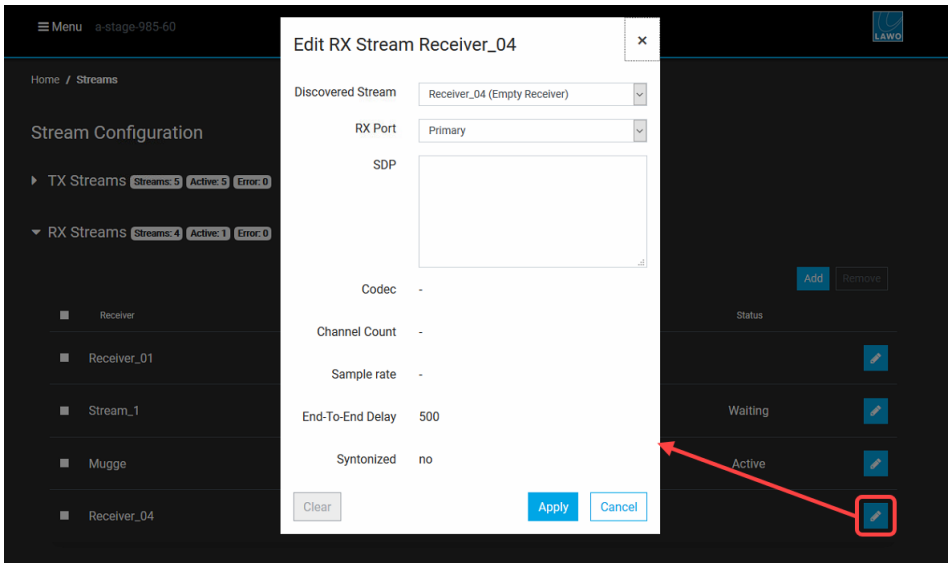
1. From the A__line Web UI, create an Empty Receiver (as described earlier).
2. Open a Web UI connection to the sending device and copy its SDP information.

A__digital8: Copy SDP



3. Return to the A__line Web UI and click on the pencil icon beside the Empty Receiver to edit its properties.

A__line: Edit RX Stream Receiver



4. Paste the contents of the clipboard into the **SDP** field and then select **Apply**.

The RX streams table updates accordingly.

If you need to modify the local IO assignments, then click on the Routing summary to open the "Channel Assignment" window (described earlier).

8.6.9 RX Stream Properties

➢ **End-To-End Delay / RX Buffer**

This value changes meaning depending on the status of **Syntonized** mode: **End-to-End Delay** (Syntonized off) or **RX Buffer** (Syntonized on).

End-To-End Delay - the value adjusts the end to end latency (in samples) for the whole streaming path when synchronous (PTP time-aligned) streaming is possible. It should be large enough to deal with delays along the network path such as packetization latency and jitter. The value must always be larger than the frame size (in samples) specified at the sender. As a general rule, set the **End-to-End Delay** to 2 x the sender's **Frame Size**. If you experience drop-outs during playback, then increase the **End-to-End Delay** time.

RX Buffer - if syntonous streaming is required, the value directly specifies the size of the receive jitter compensation buffer (in samples). End-to-end latency is unpredictable; the typical minimum latency = the sender's **Frame Size** + **RX Buffer** size (in samples). To provide a safe margin, set the **RX Buffer** size to 2 x the expected peak jitter value. In syntonized mode, the receiver will self-adjust the buffer when network conditions cause a buffer under run.

The **End-To-End Delay** / **RX Buffer** values cannot be edited once you have created a receiver.

➢ **Syntonized Mode**

By default this option is disabled, which means that the receiver is running in synchronized mode. Tick the option to enable syntonized mode, which means that the stream will be free running.

Syntonized mode should be enabled if the clock signal is missing from the SDP information, or if you have a different clock source selected at the sender and receiver.

> Syntonized mode should always be enabled for connections between Lawo audio and V__line devices.
> Syntonized mode should be disabled for AES67 or SMPTE ST2110-30 compliance.

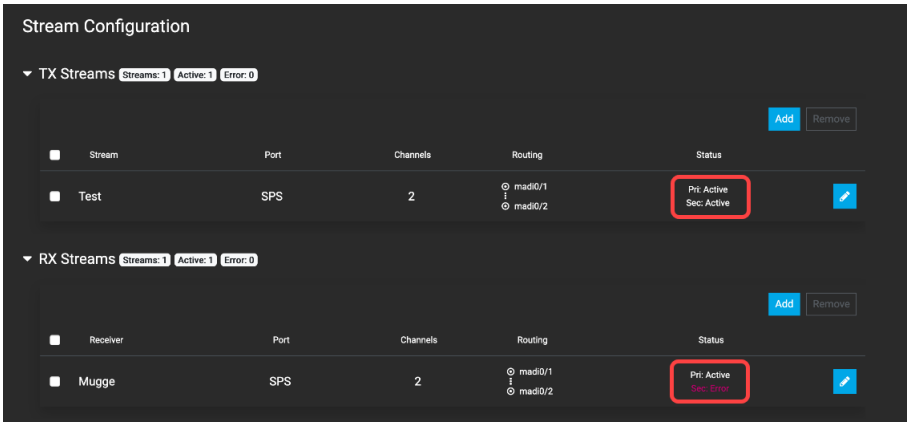
➢ **RX Port**

This field determines which interface, or interfaces, will be used to receive the stream from the network.

If the stream's SDP information contains two SMPTE ST2022-7 compatible streams, then you can receive the stream redundantly by selecting the **SPS** option (default). You may also choose to receive it non-redundantly by choosing either **Primary** or **Secondary**.

If the stream's SDP is not SMPTE ST2022-7 compatible, then the field is set to **Primary** (by default). In this instance, you can change the RX Port to **Secondary** if needed.

8.6.10 Stream Statuses



The status of each stream is displayed in the TX Stream and RX Stream tables.

If a stream is configured for SPS, then you will see the status of both paths: primary and secondary. Note that both paths must be in error before this is indicated in the status badges (beside the "TX Streams" and "RX Streams" accordions).

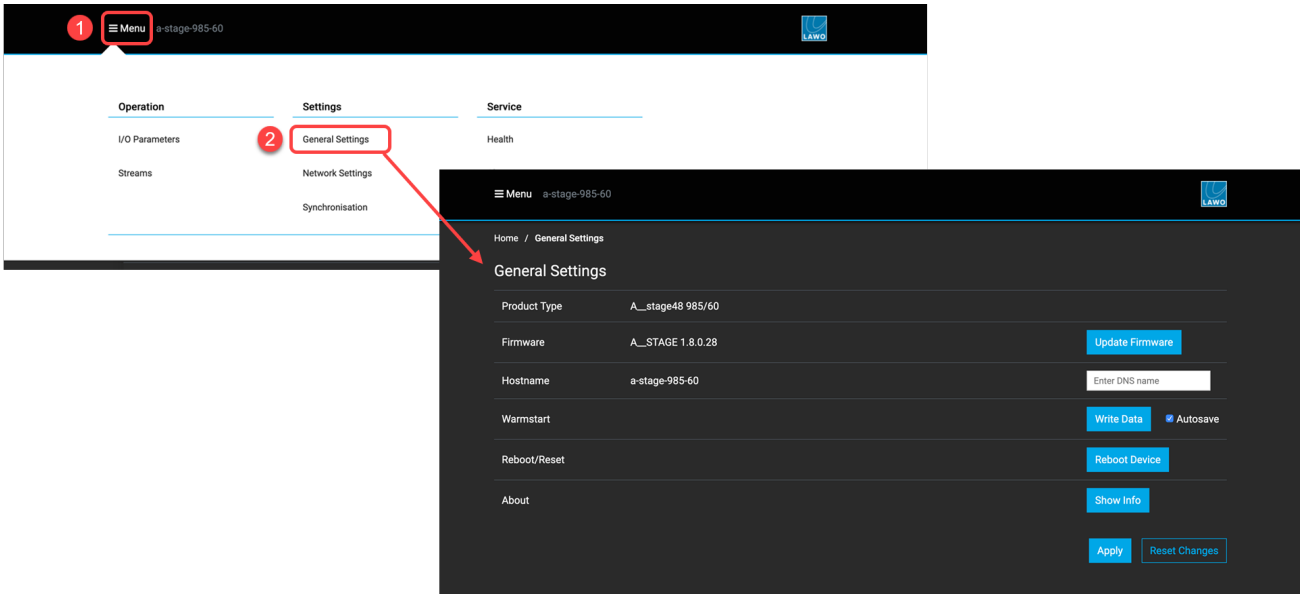
The status messages can also be found in the Ember+ tree or in the Log (via the Log Viewer). The table below describes how to interpret each message.

Status	Meaning	Description
0	Undefined	The streamer has received a request to create the stream, but no further action has been taken.
1	Invalid	One or more of the stream parameters are invalid (i.e. wrong sample rate, invalid streaming interface, etc.). Please check the "error"-Object for further information.
2	Initializing	The streamer is initializing the stream (i.e. creating all internal structures, writing FPGA registers, etc.).
3	Inactive	The stream is completely initialized but not started in the FPGA (i.e. it has been actively stopped or is waiting for track mapping).
4	Error	There are one or more errors on a running stream (i.e. no data, wrong RTP-Payload, etc.). Please check the "error"-Object for further information.
5	Waiting	Applies only to RX-streams. The stream has been successfully setup and is running, but has not yet received any data.
6	Active	The stream has been successfully setup and is running. For TX-streams this means that at least the FPGA is producing RTP-Frames.

8.7 General Settings

This page defines the general settings for the device. These include the **Firmware** and **Hostname** defined earlier during the Device Initial Setup.

The screenshot below shows how to open the page.



8.7.1 Product Type

Beside **Product Type** you will see the part number of the device. This is provided for information purposes only.

8.7.2 Firmware

Beside **Firmware** you will see the name of the current firmware version running on the device. You can use the **Update Firmware** button to update the device.

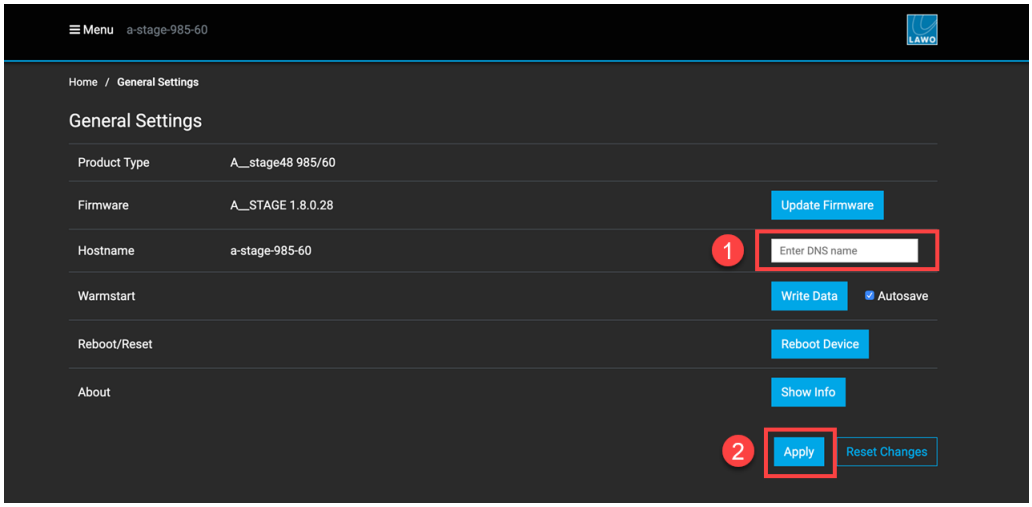
The update procedure is the same as described earlier.

Once a device is configured, it is strongly recommended that you export your configuration and/or take screenshots so that the current settings can be re-instated once the upgrade/downgrade is complete.

8.7.3 Hostname

Beside **Hostname** you will see the current DNS hostname of the device. This name identifies the device to the rest of the network (via the DNS announcement service). It is displayed at the top of every Web UI page and in the Ember+ Tree.

To edit the name:



1. Type into the "Enter DNS name" field.

Special characters and spaces are not permitted. Short names (6 characters or less) are recommended. If an invalid name is entered, then you will see an error message (in magenta).

2. Select **Apply** to confirm the change (or **Reset Changes** to cancel).

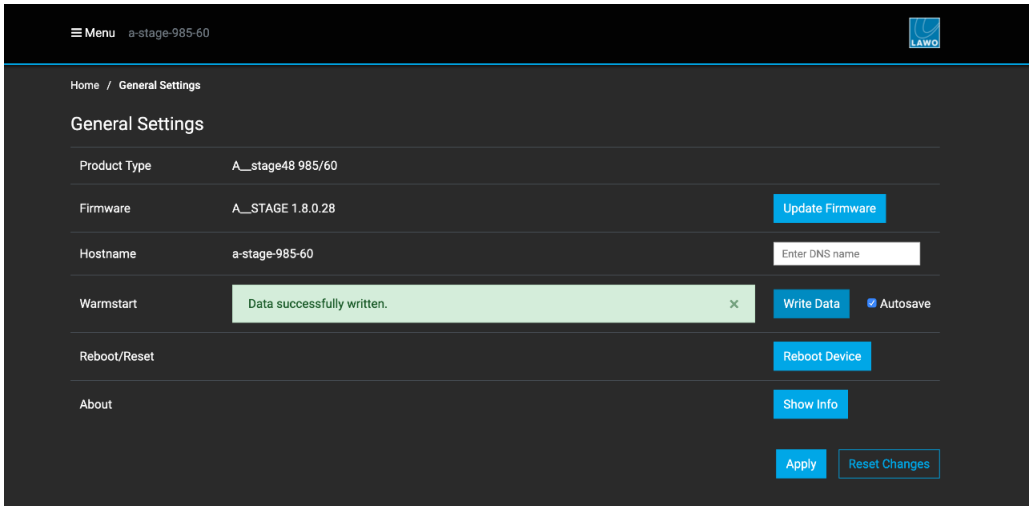
8.7.4 Warmstart

This row determines how the device writes its warm start data. This is the data which will be re-instated following a power cycle or reboot.

By default, the **Autosave** option is turned on (and the auto save interval is set to 60 seconds[1]). Thus, the device will automatically save the current settings every minute.

To disable this feature, turn the **Autosave** option off. This prevents the current warm start data from being overwritten until either you click on **Write Data** (to force a manual save), or turn the **Autosave** option back on. This can be useful if you need to make a temporary change to the configuration.

Regardless of whether **Autosave** is on or off, you can force a manual save by clicking on **Write Data** - the device stores its current settings and you will see the following confirmation message.



[1] The auto save interval can be changed from an external device via Ember+. Note that the interval is reset to 60 seconds whenever you disable and enable the **Autosave** option in the Web UI.

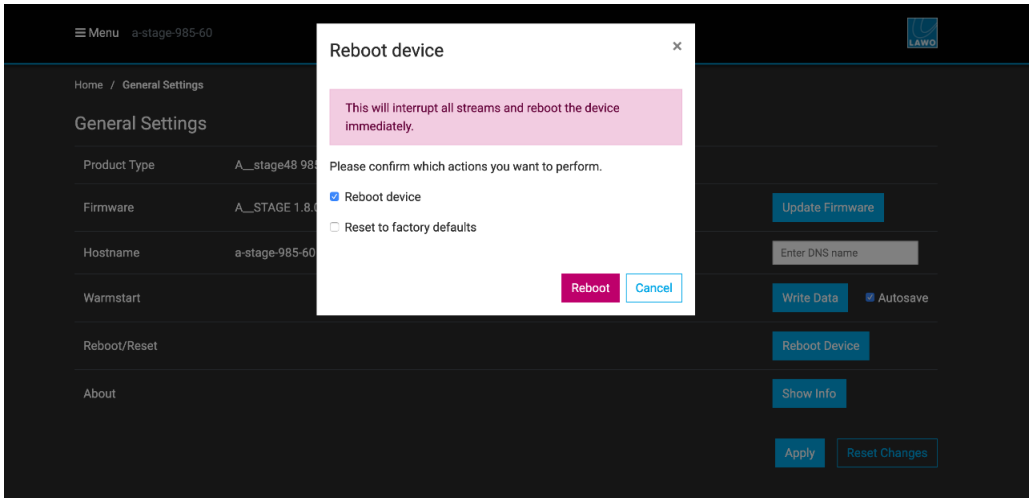
8.7.5 Reboot/Reset

The **Reboot Device** button can be used to reboot or reset the device.

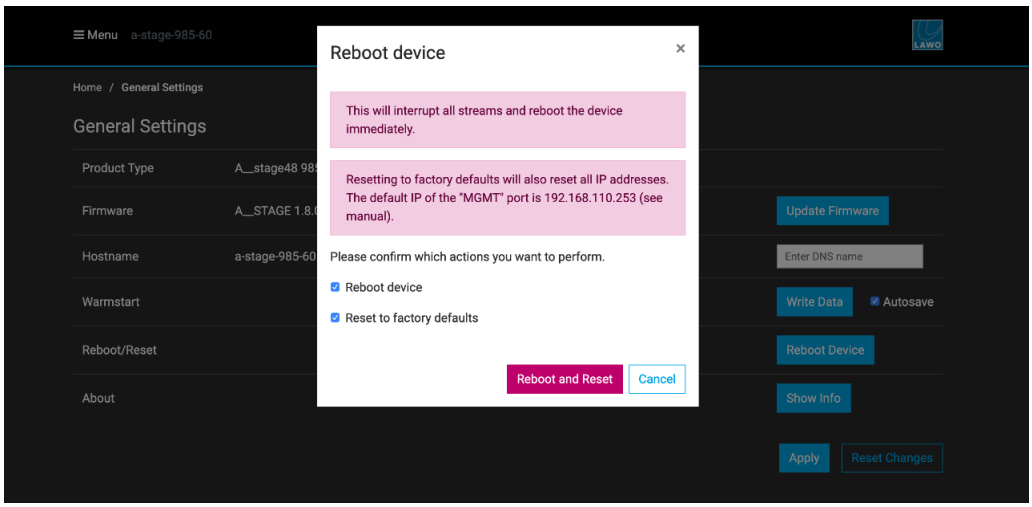
In the first instance, the device will reboot and load its warm start data. In the second instance, the device will reboot and reset to the factory default settings. The reset option should be used with caution as all user settings will be lost, including changes to the IP settings and the streaming setup.

In both cases, select **Reboot Device** to start the operation - the "Reboot Device" window appears.

To reboot the device (and load the warm start data), select the **Reboot device** option and then click on **Reboot** (or **Cancel** to exit). Any existing streams will be interrupted while the reboot takes place.



Alternatively, to reset the device (to the factory configuration), select both options and then click on **Reboot and Reset** (or **Cancel** to exit).



In this instance, the streaming setup and all other user settings are cleared. This means that you may need to edit your computer's IP settings to re-open a Web UI connection to the default MGMT port address.

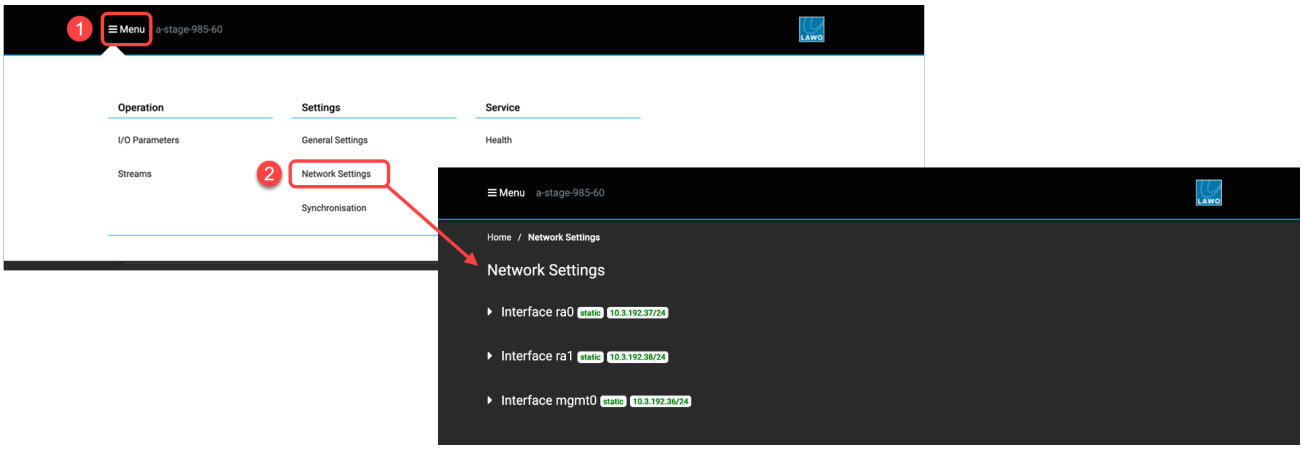
8.7.6 About

Select **Show Info** to display information about the Open Source software used by the program. The licenses can be downloaded (as a zipped file) by selecting **Download licenses**.

8.8 Network Settings

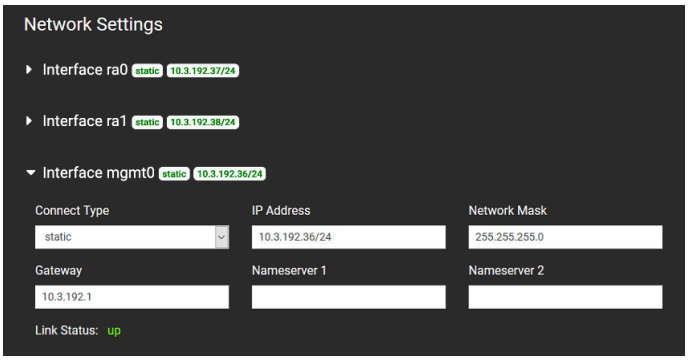
This page defines the network settings for the two RAVENNA/AES67 interfaces (ra0 and ra1) and MGMT port (mgmt0). The same settings were defined earlier during the Device Initial Setup. You can use this page to modify the settings at a later stage.

The screenshot below shows how to open the page.



The current link type and IP address are shown beside each interface - the text color shows whether the links are up (green) or down (red).

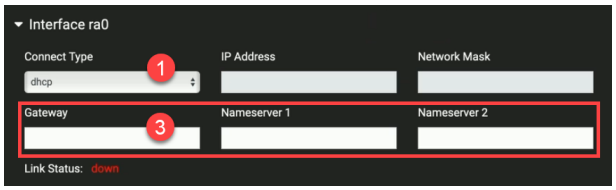
Open an interface to view its settings:



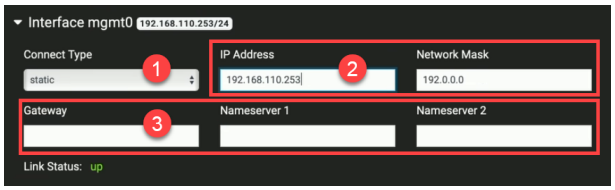
8.8.1 Editing the Network Settings

Each interface is configured as follows.

Connection Type = dhcp



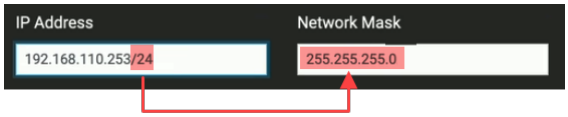
Connection Type = static



1. Select the connection type from the drop-down menu:
   - **static** - choose this option to enter a fixed IP Address and Network Mask manually.
   - **dhcp** - choose this option to receive an IP Address automatically from the network's DHCP server.
   - **zeroconf** - in this mode, the unit will automatically assign its own IP address.
2. If the connection type is **static**, then enter the **IP Address** and **Network Mask** into the corresponding fields. Note that these cannot be edited for **dhcp** or **zeroconf**.

The **IP Address** *must* be unique, and lie within the same IP address range as all other streaming nodes (i.e. the first three fields must match). The **Network Mask** *must* match the Subnet Mask of all other streaming nodes.

When entering the **IP Address** you can define the **Network Mask** automatically by typing "/xx" at the end of the field - for example:



3. If data packets are to be redirected via a network switch with Layer 3 routing capability, then enter a **Gateway** and up to two **Nameservers**. If redirection is not required, then these fields can be left blank.
4. Repeat steps 1 to 3 for each network interface.
5. Select **Apply** to confirm the changes (or **Cancel** to exit).

Once applied, you can check the current link status:

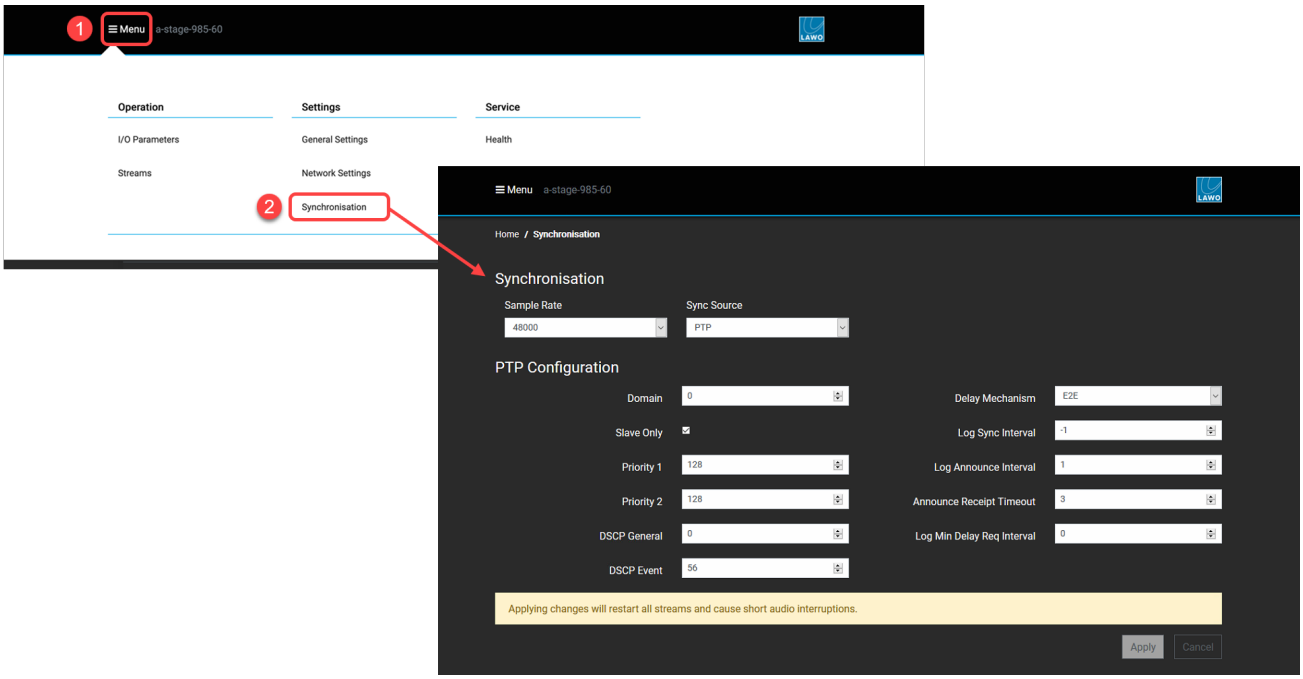
- **Link up** (green) = correct operation
- **Link down** (red) = the Ethernet link is not connected or invalid.

> The streaming ports will auto-negotiate their link speeds with the connected switch ports. If the link speed cannot be auto-negotiated, then a working link cannot be established to the A__line device.

8.9 Synchronisation

This page defines the sample rate and sync source for the device, and the PTP configuration. The same settings were defined earlier during the Device Initial Setup. You can use this page to modify the settings at a later stage.

The screenshot below shows how to open the page.



Note that if you make any changes and select **Apply**, then audio will be interrupted for a short period while the streams restart.

8.9.1 Sample Rate & Sync Source

There are two top level settings: sample rate and sync source.

The sample rate can be set to either **48000** (48kHz) or **44100** (44.1kHz). The default setting is 48kHz.

The sync source can be set to one of four options:

- **PTP** – arriving from/sending to the streaming network (via the PRIMARY or SECONDARY interface). This is the default setting.
- **WCLK In** – external wordclock connected to the WCLK IN.
- **MADI** – incoming MADI from the PRI port (or SEC port if the redundant port is active).
- **Internal Osc.** – the device's own internal sync generator.

To sync to an external reference, the clocking signal *MUST* match the sample rate of the device.

8.9.2 PTP Configuration

If the sync source = PTP, then the "PTP Configuration" applies. Use the fields to type in a value or select a menu option.

More information on PTP and its use can be found in the Lawo IP Networking Guide. The information below provides a general description.

➢ **Slave only**

For A__line devices, the **Slave only** option is always enabled. This forces the device to operate as a PTP slave at all times.

➢ **Priority 1 and Priority 2**

PTP uses a master-slave approach in which all master-capable devices elect the best master, called the grandmaster, according to a common algorithm known as the “Best Master Clock Algorithm”. The algorithm compares the following parameters in turn:

- **Priority 1** - the lower the number, the higher the priority of the device.
- **Clock Class**
- **Priority 2** - as for Priority 1.
- **MAC Address**

For example, if there is no **Priority 1** available, then all devices on the network look at the **Clock Class**, then **Priority 2** and finally the **MAC address**. Note that only the **Priority 1** and **Priority 2** values can be adjusted from the Web UI. The **Clock Class** is not available but may be used by a third-party grandmaster if one is installed.

In order to sync properly, the **Priority** values must be setup according to the system design. Although the device is set to **Slave only**, it will not sync unless its priority is lower than the one of the desired grandmaster device.

➢ **DSCP**

The **DSCP** fields assign a DSCP (differentiated services code point) or quality class to the PTP clock stream. The default setting is **56**.

➢ **Other Properties**

The values within the remaining fields - **Domain**, **Delay Mechanism**, **Sync Interval** and **Announce Interval** - vary depending on the PTP profile in use.

Please refer to the Lawo IP Networking Guide for more details.

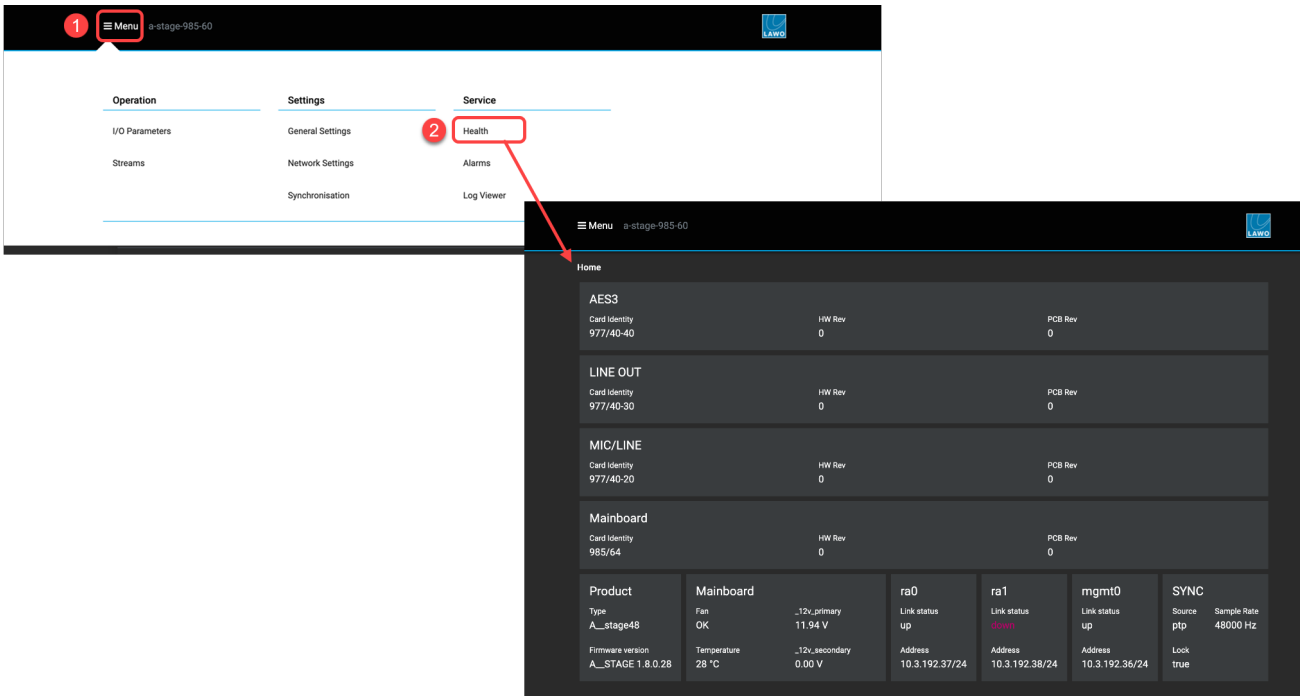
The AES-R16-2016 (5.1.3) interoperability settings are as follows.

Parameter	Value	Remark
Domain	0	
logAnnounceInterval	1	0.5 per second
AnnouceReceiptTimeout	3	timeout after 6 seconds
logSyncInterval	-1	2 per second
logMinDlyReqInterval	0	1 per second

8.10 Health

This page provides an overview of the health of the device. It is also called the Home page and appears automatically after a reboot (unless you are connecting for the first time when you will see the Device Initial Setup).

The screenshot below shows how to open the page from the main menu.



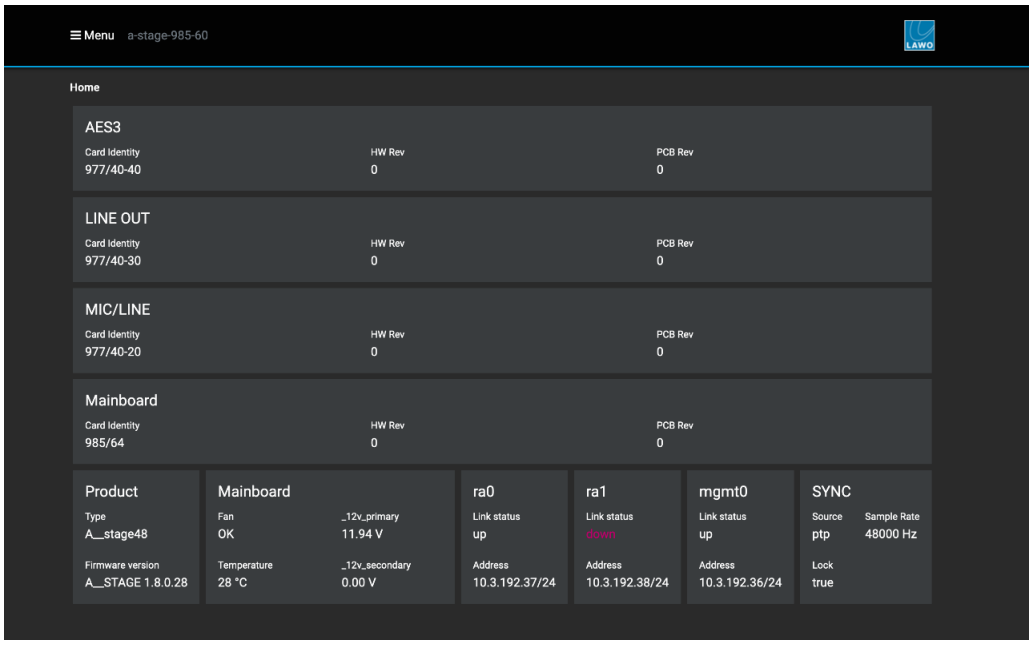
The layout of the page matches that of the physical components as viewed from the front of the device. The upper rows show information about the IO boards and Mainboard. The bottom row shows information about the system and its connections.

In each case, the color of the text indicates the current status: white text = correct operation; magenta text = there is an error. In the example above, everything is operating correctly except for the secondary streaming interface (ra1).

If you click anywhere inside an area, then this will open more information or navigate to the related page. For example:

- Click on Product to open the General Settings page.
- Click on Mainboard to view more details about the PSU voltages and fan speed.
- Click on a network interface (ra0, ra1 or mgmt0) to open the Network Settings page.
- Click on SYNC to open the Synchronisation page.

8.10.1 Health Page Information



IO Boards & Mainboard

- Card Identity - shows the part number.
- H/W Rev - shows the hardware revision.
- PCB Rev - shows the PCB revision.

Product

- Type - shows the A__stage model.
- Firmware version - shows the current firmware version.

Mainboard

- Fan - shows the status of the cooling fan.
- Temperature - shows the operating temperature of the mainboard.
- _12v_primary - shows the DC voltage supplied to the mainboard by PSU 1.
- _12v_secondary - shows the DC voltage supplied to the mainboard by PSU 2.

ra0, ra1, mgmt0

Shows information for each of the network interfaces: ra0 = the primary streaming interface; ra1 = the secondary streaming interface; mgmt0 = the management interface.

- Link status - can be either up (for correct operation) or down (if there is a problem with the link).
- Address - shows the IP address of the network interface.

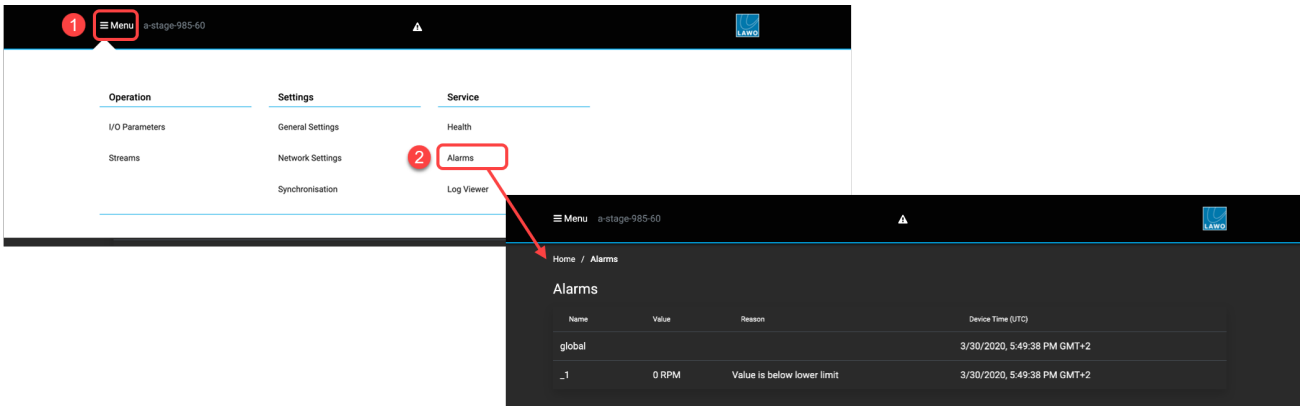
SYNC

- Source - shows the active sync source.
- Sample Rate - shows the internal operating frequency of the device.
- Lock - can be either true (if the sync source is stable) or false (if there is a problem with the sync).

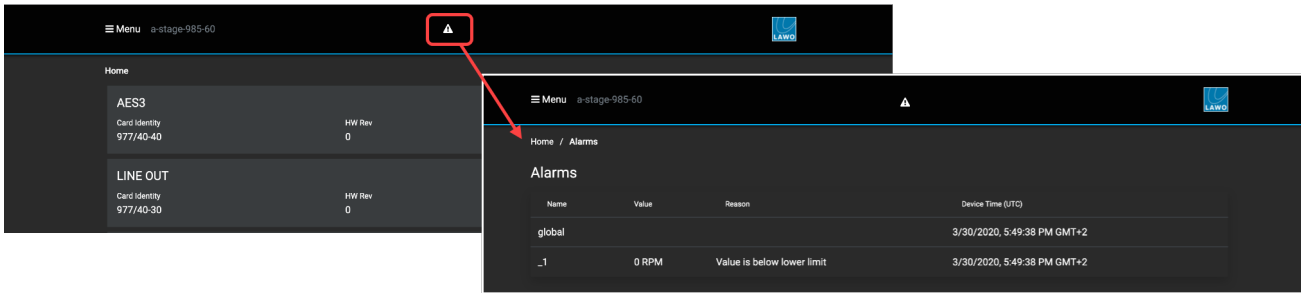
8.11 Alarms

This page can be used to interrogate the system's alarms.

The screenshot below shows how to open the page from the main menu.



The page can also be opened by clicking on the small warning triangle (which appears in the headline area whenever the global alarm is active):



8.11.1 Alarm States

If no alarms have been triggered, then the list will be empty.

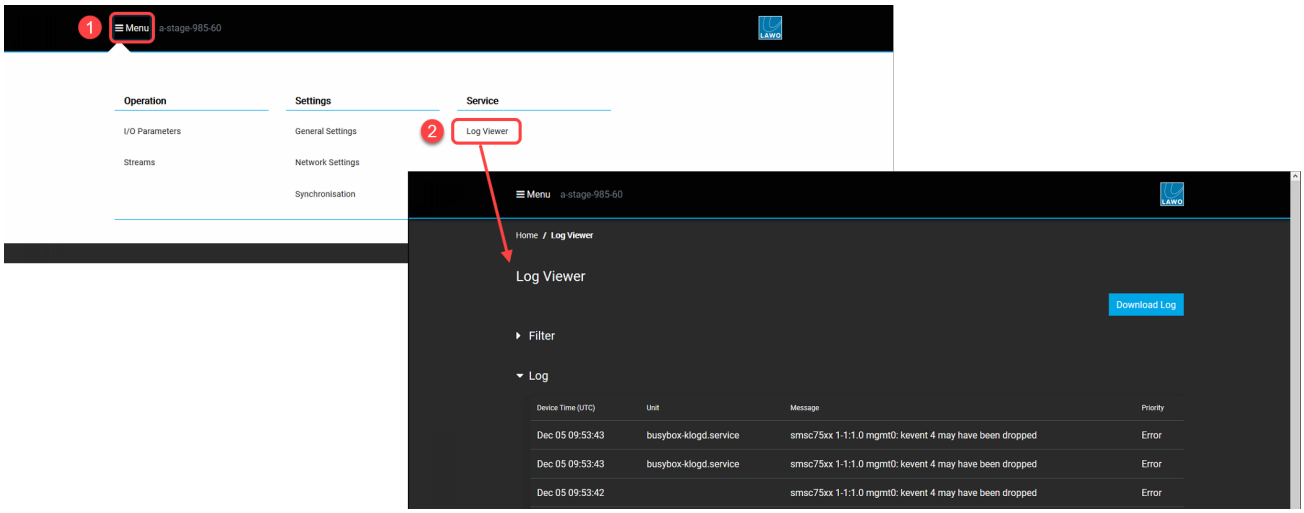
If one or more alarms are active, then the list shows the name, value, revision and date/time (when the alarm became active). There are two possible alarms which may appear:

- **global** - becomes active when any other critical alarm state is triggered.
- **_1** - becomes active if the internal fan speed drops below 5 RPM (Revolutions Per Minute).

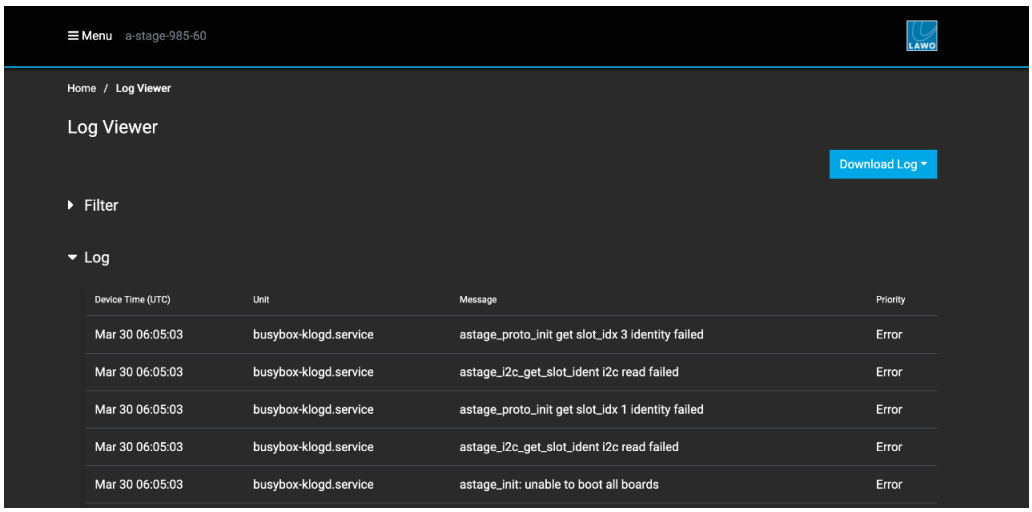
8.12 Log Viewer

This page can be used to view and download the system's log messages.

The screenshot below shows how to open the page.



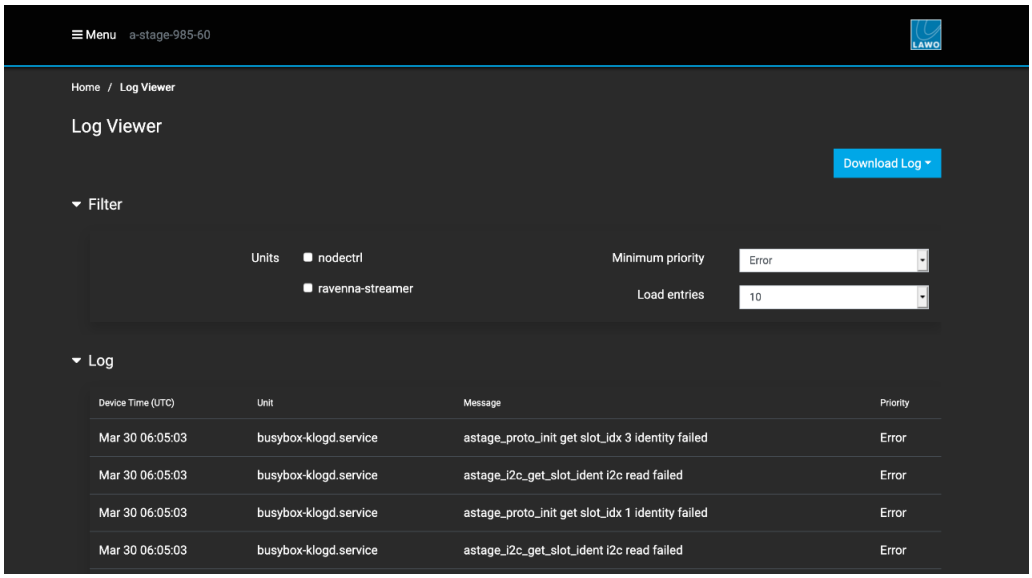
8.12.1 Viewing All Log Messages



1. By default, the "Log" area is open and shows the last 10 messages.
2. Scroll down and click on **Load More** (at the bottom of the list) to load another 10 messages to the page.

The number of messages loaded can be adjusted by opening the "Filter" accordion and adjusting the **Load entries** field.

8.12.2 Filtering the Log



1. Open the "Filter" accordion to filter the log messages.

You can filter by the unit type: either **nodectrl** or **ravenna streamer**. Or by the minimum priority: the log shows all messages with the selected priority or higher.

In each case, the "Log" area updates accordingly.

2. As before, click on **Load More** (at the bottom of the list) to load more messages to the page.

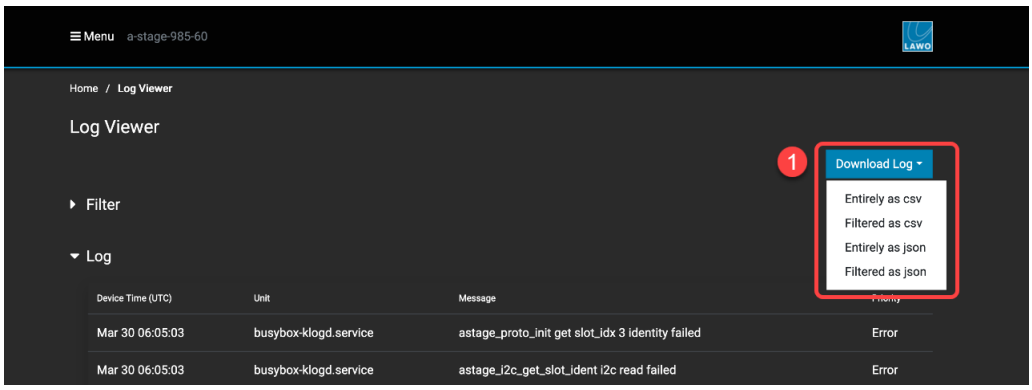
The number of messages loaded is defined by the **Load entries** field.

8.12.3 Downloading the Log

The contents of the log can be downloaded as either a ".csv" or ".json" file.

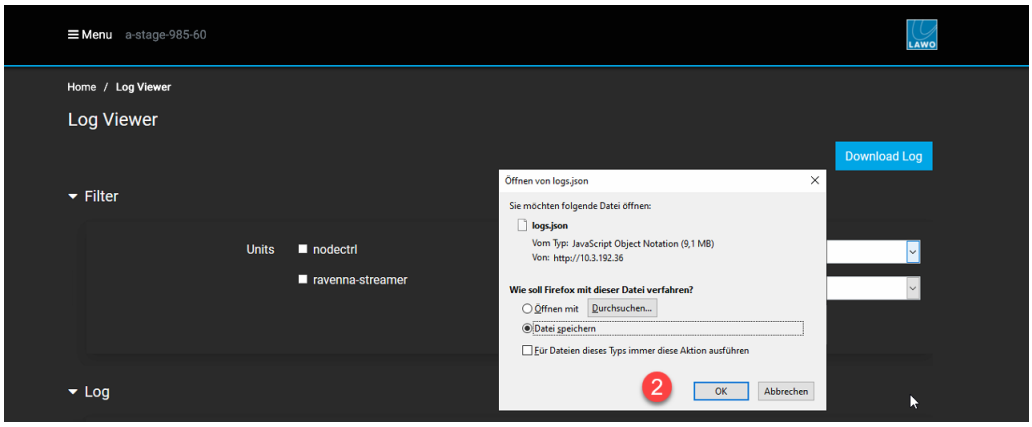
In each case, you can download the complete log in its entirety, or a filtered version if filtering has been applied.

1. Click on **Download Log** and choose one of the available options:



The log file is prepared and then the "Download File" dialog box appears. It may take a while to prepare the log depending on the size of the file.

2. Check the options and select **OK** to start the download.



Once the download is complete, a confirmation message appears.

9. Remote Control (via Ember+)

This chapter describes the Ember+ implementation.

9.1 Introduction

All parameters within A__line devices are accessible via Ember+. This allows an external control system, such as a Lawo console or VSM, to remotely control or respond to parameter changes within the device. For example, to adjust an IO parameter or change the mapping of local IO signals to the TX/RX streams.

Ember+ is a non-proprietery TCP/IP protocol supported by a wide range of Lawo products. More details about the Ember+ protocol can be found at https://github.com/Lawo/ember-plus/wiki.

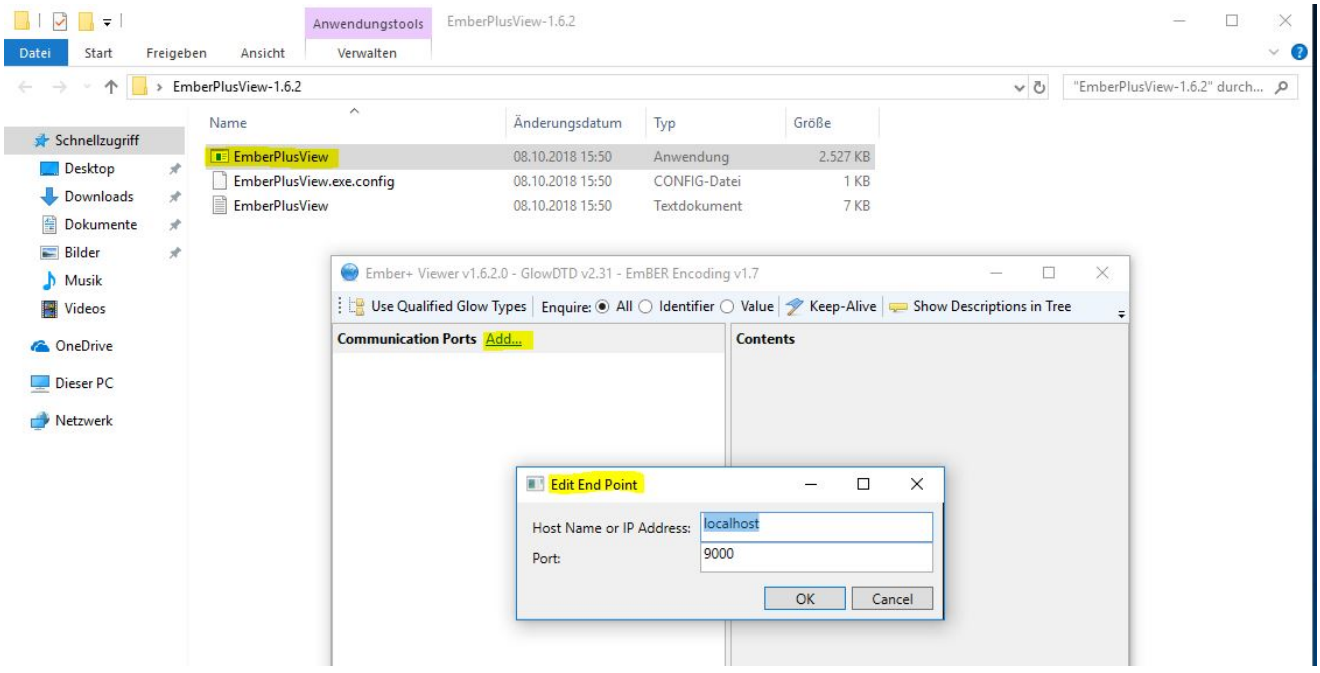
The rest of this chapter describes the Ember+ parameters and how they can be viewed.

9.2 Ember+ Tree Viewer

The Ember+ Tree Viewer can be used to check the status of Ember+ parameters and/or switch a parameter manually. This can be useful when configuring and testing an Ember+ controlled device.

To use the application:

1. Download the ".bz2" or ".xz" archive from the location https://github.com/Lawo/ember-plus/releases and unzip it.
2. Navigate to the folder "tools" and unzip the file "EmberPlusView-X.X.X.zip"
3. Double-click on the file "EmberPlusView.exe" to start the Ember+ Tree Viewer.
4. Once the application is open, click on "Add.." to add a new communication port:



5. Enter the IP Address and Port number of your device.

For devices with a MGMT port, you can use any of the network interfaces: RAVENNA/AES67 or MGMT.

The port number should always be 9000.

6. Select **OK** to add the device to the Ember+ Viewer - the virtual status LED will turn green once the tree has been fully read.
7. You can now open the branches of the tree and select a parameter to interrogate or alter its status.

9.3 Ember+ Tree Structure

/system

Root node of the System module. It covers:

- Network settings
- Audio levels

/identity

Implements the de.l-s-b.emberplus.identity schema:

- product
- version
- role
- company
- serial

/log/severityFilter

Controls the verbosity of log output in NodeCtrl. 0 (trace) to 5 (fatal)

/sync

Root node for the sample rate and audio sync settings. The actual tree structure depends on the available sync sources of the system.

/ravenna

Root node for internal signal routing and streaming.

/ravenna/discovery

Root node for the discovery module, which collects available streams from the network.

/ravenna/discovery/interfaces

A list of available audio interfaces, under which the available sessions/streams are being shown.

Example:

```
{
    "discovery":
    {
        "interfaces":
        {
            "strm0":
            {
                "streams":
                {
                    "RemoteStream1":
                    {
                        "sdp": [string, SDP of the remote stream],
                        "primarySource": [string, URL of the remote stream, or its primary URL in
case of redundancy],
                        "secondarySource": [string, secondary URL, empty for non-redundant streams],
                    }
                }
            }
        }
    }
}
```

/ravenna/routing

Root node for the internal (assumed) mono signal matrix and streaming.

/ravenna/routing/functions

A collection of functions for stream and matrix configuration/manipulation.

/ravenna/routing/functions/settings

Contains some default settings that will be used by the functions.

/ravenna/routing/functions/createInputStream

Creates an internal handle for Rx streams.

Arguments:

```
{
    "interface": [string, audio interface to receive the stream],
    "id": [string, internal identifier of this stream, must be unique for this audio interface],
    "delay": [int, size of the jitter buffer for one channel of this stream in samples],
    "syntonized": [bool, syntonized or synchronized mode]
}
```

Return Values:

```
{
    "errorText": [string, empty on success]
}
```

/ravenna/routing/functions/deleteInputStream

Deletes an internal Rx stream handle.

Arguments:

```
{
    "interface": [string, audio interface the stream was received from],
    "id": [string, internal identification of the stream],
}
```

Return Values:

```
{
    "errorText": [string, empty on success]
}
```

/ravenna/routing/functions/resetInputStatistics

Resets accumulated statistics. The path can be of length 0, 1 or 2 in order to address all inputs, an audio interface or a stream.

Arguments:

```
{
    "inputPath": [string, "", "[interface]" oder "[interface]/[id]"]
}
```

Return Values:

```
{
    "errorText": [guess what]
}
```

/ravenna/routing/functions/createOutputStream

Creates a new Tx stream. 'Stream' in this context solely reserves outputs of the internal mono matrix. In order to actually stream to the network, 'senders' must be added to the stream ('createOutputStreamSender').

Arguments:

```
{
    "interface": [string, audio interface],
    "streamId": [string, internal key of this stream],
    "channelCount": [int, number of channels in this stream]
}
```

Return Values:

```
{
    "errorText": [.]
}
```

/ravenna/routing/functions/createOutputStreamSender

Creates a Rx sender for an existing stream.

Arguments:

```
{
    "interface": [string, audio interface of the stream],
    "streamId": [string, internal key of the stream],
    "senderId": [string, internal key of the sender, must be unique within this stream],
    "primaryAddress": [string, ip address, or empty for ' multicast auto', the address range implies
the distinction between unicast and multicast],
    "primaryPort": [int, port number, only relevant for unicast],
    "usePrimary": [bool, true if primaryAddress/-Port should be used]
    "secondaryAddress": [string, must logically correspond to 'primaryAddress'],
    "secondaryPort": [int],
    "useSecondary": [bool, true if secondaryAddress/-Port should be used]
    "dscp": [int],
    "codec": [int, 0=L16, 1=L24, 2=L32, 3=AM824],
    "frameSize": [int, number of samples per channel and frame],
    "ttl": [int, "time to live"]
}
```

Return Values:

```
{
    "errorText": [string]
}
```

/ravenna/routing/functions/deleteOutputStreamSender

Deletes a Tx sender.

Arguments:

```
{
    "interface": [string, audio interface],
    "streamId": [string, internal key of the Tx stream of the sender to delete],
    "senderId": [string, internal key of the sender to be deleted]
}
```

Return Values:

```
{
    "errorText": [string]
}
```

/ravenna/routing/functions/deleteOutputStream

Deletes a Tx stream and all its senders.

Arguments:

```
{
    "interface": [string, audio interface],
    "streamId": [string]
}
```

Return Values:

```
{
    "errorText": [string]
}
```

/ravenna/routing/functions/connectChannel

Sets or clears one mono connection in the internal matrix. If the destination was already connected, that connection will be discarded.

Arguments:

```
{
    "outputPath": [string, "[medium]/[channel]" oder "[audio interface]/[stream]/[channel]"],
    "inputPath": [string, "[medium]/[channel]" oder "[audio interface]/[stream]/[channel]"]
}
```

Return Values:

```
{
    "errorText": [string]
}
```

Example:

```
{
    "outputPath": "strm0/myTxStream0/3",
    "inputPath": "madi0/63"
}
```

/ravenna/routing/functions/subscribeURLs

Allows both redundant RTSP-URLs to be automatically set for an existing Rx stream.

Arguments:

```
{
    "interface": [string, audio interface],
    "streamId": [string],
    "primary": [string, primary URL],
    "secondary" [string, secondary URL]
}
```

Return Values:

```
{
    "errorText": [string]
}
```

/ravenna/routing/functions/saveRouting

Experimental.

/ravenna/routing/inputs

Hierarchical representation of the input axis of the internal mono matrix. Streaming and non-streaming devices can be distinguished by their device root node's schema identifiers.

Schema-Identifiers are one of:

- com.lawo.ravenna.inputs.streaming
- com.lawo.ravenna.inputs.medium

Example:

```
{
    "inputs":
    {
        [Example of a streaming device]
        "strm0":
        {
            "streams": [list of Rx stream representations]
            {
                "MyRxStream1":
                {
                    [TBD]
                }
            }
        },
        [Example of a non-streaming device]
        "madi0":
        {
            "channelCount": 64
        }
    }
}
```

The matrix inputs serve solely as a reference for what exists. Connections are being established at the outputs.

/ravenna/routing/outputs

Hierarchical representation of the output axis of the internal mono matrix. Streaming and non-streaming devices can be distinguished by their device root node's schema identifiers.

Schema-Identifiers are one of:

- com.lawo.ravenna.inputs.streaming
- com.lawo.ravenna.inputs.medium

Example:

```
{
    "outputs":
    {
        [example of a streaming device]
        "strm0":
        {
            "streams": [List of existing Tx streams]
            {
                [Example of a 2-channel Tx stream]
                "MyTxStream1":
                {
                    "channels":
                    {
                        "_0":
                        {
                            "track": 0, [internal information]
```

```
                            "input": "strm0/MyRxStream1/0" [Channel 0 of "MyRxStream1" at "strm0" is
routed to this output channel]
                        },
                        "_1":
                        {
                            "track": 1, [interne Information]
                            "input": "madi/0" [Channel 0 of "madi0" is routed to this output channel]
                        }
                    },
                    "senders": [A stream can be streamed from any number of senders with differing
settings]
                    {
                        "Sender1":
                        {
                            [TBD]
                        }
                    }
                }
            }
        },
        [Example for a non-streaming device]
        "madi0":
        {
            "_0":
            {
                "input": "strm0/MyRxStream1/0" [Channel 0 of "MyRxStream1" at "strm0" is routed to
this output channel]
            },
            "_1":
            {
                "input": "madi/0" [Channel 0 of "madi0" is routed to this output channel]
            },
            [62 more MADI output channels]
        }
    }
}
```

/ravenna/facades

Root node for alternative views of the data.

/IoControl/Facades/UnifiedNumbering/

This facade provides a reduced view/access to the A__stage IoControl part of the ember+ tree. The node numbers in this facade are fixed and do not change between systems starts. Control of the resources remains the same as described in the respective ember+ schema.

/warmstart

Settings that control nodectrl's behaviour while restarting.

/warmstart/writeData

Writes the data tree's current state to a file so that it can be restored at the next start.

/warmstart/autoSaveInterval

Controls periodic storage of Warmstart data, in seconds. 0 means 'off'.

Please use with care, as this may take a significant time and cause the system to slow down periodically.

/warmstart/forceColdstart

Forces a cold start of the system by deleting warmstart data.

/config

Root node of an experimental system configuration module.

/IoControl/Boards

Base node for control of I/O (-board) parameters

/IoControl/Boards/_<board_index>

Sub node with control parameters of one board.

/IoControl/Boards/_<board_index>/General

Contains read only common information about the I/O board.

- Available: avaliable state; True: communication with I/O board is active; False: communication with I/O board is disturbed or impossible.
- ResetFlags: representation of internal reset flags. For development purposes only.
- Clock/Config: system clock configuration (0: 44100, 1:48000, 2: 88200, 3: 96000)
- Clock/State: internal clock state flags. For development purposes only.
- Fpga/Done: FPGA state; True: FPGA is booted; False: FPGA not booted.
- Fpga/Identity: internal code of FPGA file type
- HwInfo/IdentityRegister: representation of internal identity data. For development purposes only.
- HwInfo/CardIdentity: identification number of I/O board.
- HwInfo/HwRev: hardware revision.
- HwInfo/PcbRev: printed circuit board revision.

/IoControl/Boards/_<board_index>/GpIn

If an I/O board provides general purpose inputs, this node is present. If GPI is not provided, this node is not present.

- _<GpIn_index>: index of the input.

For I/O boards with GPI resources, an additional control may be provided:

/IoControl/Boards/_<board_index>/GpIn/Run: activate (true) or deactivate (false) monitoring of inputs

Schema-Identifier:

- com.lawo.emberplus.gpin.v1.0

Ember+ schema documentation of this resource can be found on
https://github.com/Lawo/ember-plus/wiki/Schema-Definition:-com.lawo.emberplus.gpin-(Version-1)

/IoControl/Boards/_<board_index>/GpOut

If an I/O board provides general purpose outputs, this node is present. If GPO is not provided, this node is not present.

- _<GpOut_index>: index of the output.

Schema-Identifier:

- com.lawo.emberplus.gpout.v1.0

Ember+ schema documentation of this resource can be found at
https://github.com/Lawo/ember-plus/wiki/Schema-Definition:-com.lawo.emberplus.gpout-(Version-1)

/IoControl/Boards/_<board_index>/InputChannels/_<channel_index>

If an I/O board provides parameters for input channels, this node is present. If there are no input channels or no parameters for provided input channels, this node is not present.

The following input resource types may be found if the board provides them:

/IoControl/Boards/_<board_index>/InputChannels/_<channel_index>/MicLineSchema-Identifier:

- com.lawo.emberplus.micline.v2.0

Ember+ schema documentation of this resource can be found at
https://github.com/Lawo/ember-plus/wiki/Schema-Definition:-com.lawo.emberplus.micline-(Version-2)

For I/O boards with MicLine resources, an additional state information may be provided:

/IoControl/Boards/_<board_index>/InputChannels/P48Generator: board wide 48V phantom power generator is active (true) or not (false)

The active state here is a prerequisite for the activation of phantom power on individual channels as described in the schema identifier.

/IoControl/Boards/_<board_index>/InputChannelPairs/_<channel_pair_index>

If an I/O board provides control parameters valid for a pair of input channels simultaneously (e.g. AES3In), this node is present. If not, this node is not present.

The following input resource types may be found if the board provides them:

/IoControl/Boards/_<board_index>/InputChannels/_<channel_pair_index>/Aes3Schema-Identifier:

- com.lawo.emberplus.aes3in.v1.0

Ember+ schema documentation of this resource can be found at
https://github.com/Lawo/ember-plus/wiki/Schema-Definition:-com.lawo.emberplus.aes3in-(Version-1)

/IoControl/Boards/_<board_index>/OutputChannels/_<channel_index>

If an I/O board provides parameters for output channels, this node is present. If there are no output channels or no parameters for provided output channels, this node is not present.

The following output resource types may be found if the board provides them:

/IoControl/Boards/_<board_index>/OutputChannels/_<channel_index>/LineSchema-Identifier:

- com.lawo.emberplus.lineout.v1.0

Ember+ schema documentation of this resource can be found at
https://github.com/Lawo/ember-plus/wiki/Schema-Definition:-com.lawo.emberplus.lineout-(Version-1)

/IoControl/Boards/_<board_index>/OutputChannelPairs/_<channel_pair_index>

If an I/O board provides control parameters valid for a pair of output channels simultaneously (e.g. AES3Out), this node is present. If not, this node is not present.

The following input resource types may be found if the board provides them:

/IoControl/Boards/_<board_index>/OutputChannelPairs/_<channel_pair_index>/Aes3Schema-Identifier:

- com.lawo.emberplus.aes3out.v1.0

Ember+ schema documentation of this resource can be found at
https://github.com/Lawo/ember-plus/wiki/Schema-Definition:-com.lawo.emberplus.aes3out-(Version-1)

9.4 Working with the Ember+ Tree

9.4.1 Receiving a Stream

Receiving a stream in nodectrl has two parts:

- Creating an input stream representation.
- Subscribing to a session.

In some applications, the stream representation can be reused by subscribing to a different session.

Create an input stream

In order to create a synchronized input stream (representation) called 'MyIn0' at audio interface 'strm0' with a sample buffer of 32 samples per channel, call:

```
ravenna/routing/functions/createInputStream ("strm0", "MyIn0", 32, false)
```

Subscribe by SDP

Set:

```
/ravenna/routing/inputs/strm0/streams/MyIn0/sourceSDP
```

to your desired source session SDP.

➢ To choose a (non-redundant) stream from the session, set:

```
/ravenna/routing/inputs/strm0/streams/MyIn0/primaryStreamIndex
```

to the desired stream index of the session. 0 by default.

➢ To choose a redundant stream from the session, set:

```
/ravenna/routing/inputs/strm0/streams/MyIn0/primaryStreamIndex
/ravenna/routing/inputs/strm0/streams/MyIn0/secondaryStreamIndex
```

to the desired stream indices of the session. 0 and -1 by default.

Subscribe by RTSP-URL

Call:

```
/ravenna/routing/functions/subscribeURLs ("strm0", "MyIn0", [primary], [secondary])
```

to set your desired SDP sources. [secondary] may be an empty string for a non-redundant RTSP-URL, or a secondary source URL.

Unsubscribe from a stream

It is recommended (but not enforced) that you unsubscribe in the same fashion you subscribed.

➢ To unsubscribe by SDP, set:

```
/ravenna/routing/inputs/strm0/MyIn0/sourceSDP
```

to "".

➢ To unsubscribe by RTSP, call:

```
/ravenna/routing/functions/subscribeURLs ("strm0", "MyIn0", "", "")
```

Delete an input stream

Call:

```
/ravenna/routing/functions/deleteInputStream ("strm0", "MyIn0")
```

Any ongoing subscription will be implicitly unsubscribed.

9.4.2 Sending a Stream

Sending a stream in nodectrl has two parts:

- Creating an output stream representation.
- Adding sender(s) to the stream representation.

In some applications, multiple senders with differing parameters might be added to a stream, using matrix resources only once.

Create an output stream

In order to create an output stream with 2 channels called "MyOut0" at audio interface "strm0", call:

```
ravenna/routing/functions/createOutputStream ("strm0", "MyOut0", 2)
```

Add a sender

In order to add a sender called "theSender" to "MyOut0" at "strm0", call:

```
/ravenna/routing/functions/createOutputStreamSender ("strm0", "MyOut0", "theSender", ...)
```

with the desired sender-specific parameters.

Remove a sender

Call:

```
/ravenna/routing/functions/deleteOutputStreamSender ("strm0", "MyOut0", "theSender")
```

Delete an output stream

Call:

```
/ravenna/routing/functions/deleteOutputStream ("strm0", "MyOut0")
```

All remaining senders will be implicitly removed.

9.4.3 Connecting Inputs to Outputs

In order to connect channel 0 of input medium "madi0" to channel 0 in output stream "MyOut0" at audio interface "strm0", call:

```
/ravenna/routing/functions/connectChannel ("strm0/MyOut0/0", "madi0/0")
```

You can also connect the following devices: streaming to non-streaming, non-streaming to non-streaming or streaming to streaming.

9.4.4 Disconnecting Outputs

In order to disconnect channel 0 in output stream "MyOut0" at audio interface "strm0", call:

```
/ravenna/routing/functions/connectChannel ("strm0/MyOut0/0", "")
```

9.4.5 Manipulating IO Parameters

This section describes how state values and control parameters of audio IO and GPIO resources are represented in the Ember+ tree.

Locating IO Parameters

On devices with audio IO and/or GPIO resources, the Ember+ tree structure represents the physical appearance of the device.

Resource controls are grouped in nodes which represent the IO boards, each having an index node in the tree. Index _0 is typically the main board.

"root" node of state and control parameters of mainboard resources:

```
/IoControl/Boards/_0
```

The other indices enumerate the IO boards which are physically present in a unit from the board at the top (index _1) to the bottom.

The resource parameters of an IO board are grouped in the nodes InputChannels, OutputChannels, GpIn and GpOut with channel or channel pair indices.

The tree contains only nodes for resources which are present on a board AND have state data or controllable parameters.

Example

Abstract of the IoControl tree from a unit with a main board containing GPIO, one AES3 board, one LineOut board and one MicLine board:

```
{
    "IoControl":
    {
        "Boards":
        {
            "_0":
            {
                "GpIn":
                {
                    "_0":
                    {
                        [GP In state]
                    },
                    "_1":
                    {
                        [GP In state]
                    },
                    [more general purpose inputs]
                },
                "GpOut":
                {
                    "_0":
                    {
                        [GP Out state/control parameters]
                    },
                    "_1":
                    {
                        [GP Out state/control parameters]
                    },
                    [more general purpose outputs]
                }
            },
            "_1":
            {
                "InputChannelPairs":
                {
                    "_0":
                    {
                        "Aes3":
                        {
                            [AES3In channel pair state/control parameters]
                        }
                    },
                    "_1":
                    {
                        "Aes3":
                        {
                            [AES3In channel pair state/control parameters]
                        }
                    },
                    [more AES3 input channel pairs]
```

```
                }
            },
            "_2":
            {
                "OutputChannels":
                {
                    "_0":
                    {
                        "Line":
                        {
                            [LineOut channel state/control parameters]
                        }
                    },
                    "_1":
                    {
                        "Line":
                        {
                            [LineOut channel state/control parameters]
                        }
                    },
                    [more LineOut channels]
                }
            },
            "_3":
            {
                "InputChannels":
                {
                    "_0":
                    {
                        "MicLine":
                        {
                            [MicLine channel state/control parameters]
                        }
                    },
                    "_1":
                    {
                        "MicLine":
                        {
                            [MicLine channel state/control parameters]
                        }
                    },
                    [more MicLine channels]
                }
            }
        }
    }
}
```

10. Appendices

This chapter includes further information which you may find useful.

10.1 Part Numbers

System Component		Part Number
A__stage48	3RU, 16 mic/line, 16 line out, 8 AES3 IO, 1 red. MADI, 8 GPIO	985/60
A__stage64	4RU, 32 mic/line, 16 line out, 8 AES3 IO, 1 red. MADI, 8 GPIO	985/62
A__stage80	3RU, 32 mic/line, 32 line out, 8 AES3 IO, 1 red. MADI, 8 GPIO	985/64
A__digital64	3RU, 32 AES3 IO, 1 red. MADI, 8 GPIO	985/63
A__madi6	1RU, 3 x AoIP to MADI converter.	985/23
SFPs (RAVENNA & MADI)	Please see the optional accessories.	981/60-xx
Spare Parts	Internal PSU Block	436-7310-000
	Internal Fan	350-3288-000

10.1.1 Data Sheets

Further technical information can be found in the product data sheets. The system part numbers will help you locate the data sheets for the main system components.

All documentation is available from the **Downloads** area at www.lawo.com (after **Login**).

10.2 Dimension Drawings

Please double-click on the links below to open the dimension drawings (as a pdf):

- A__stage48 Dimension Drawing
- A__stage64 Dimension Drawing
- A__stage80 Dimension Drawing
- A__digital64 Dimension Drawing
- A__madi6 Dimension Drawing

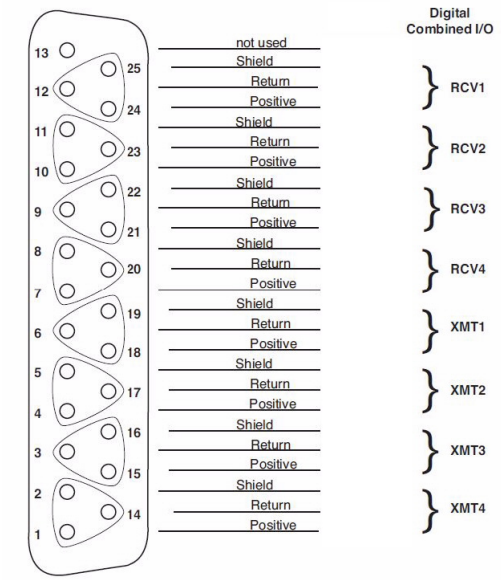
10.3 Connector Pin-Outs

10.3.1 A__stage48

AES3 IO (SUB-D25)

2 x 25-pin D-type connectors, female. Pinning and gender according to AES59.

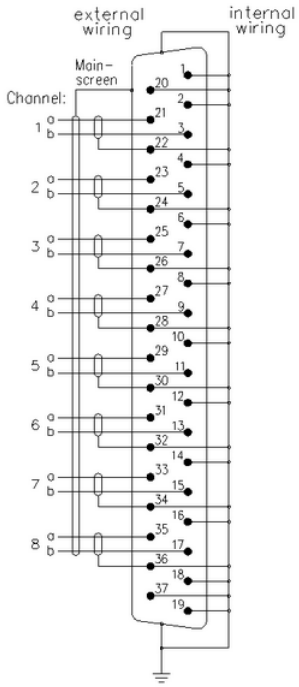
AES3 inputs 1..4 (RCV1..4), AES3 outputs 1..4 (XMT1..4).



All shields are internally connected to system ground.

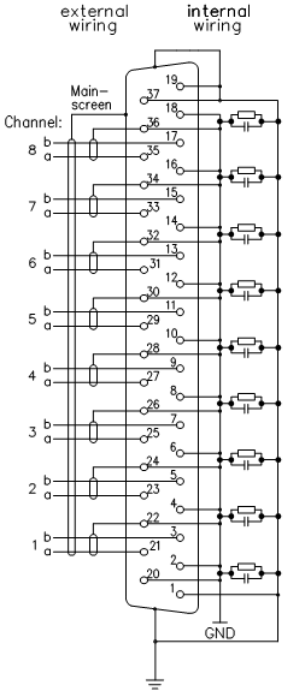
LINE OUT (SUB-D37)

2 x 37-pin D-type connectors, male.



MIC/LINE IN (SUB-D37)

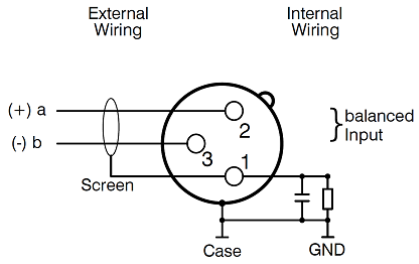
2 x 37-pin D-type connectors, female.



10.3.2 A__stage64

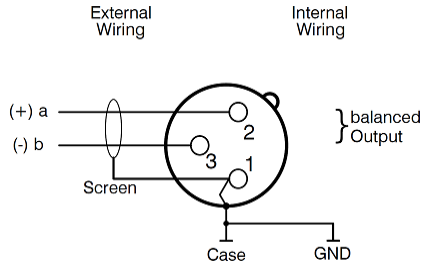
AES3 IN (XLR)

8 x XLR connectors, female.



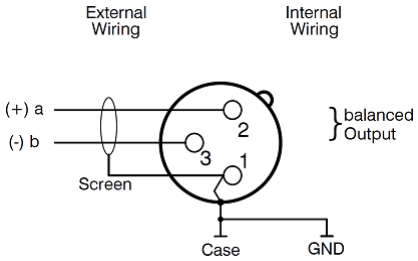
AES3 OUT (XLR)

8 x XLR connectors, male.



LINE OUT (XLR)

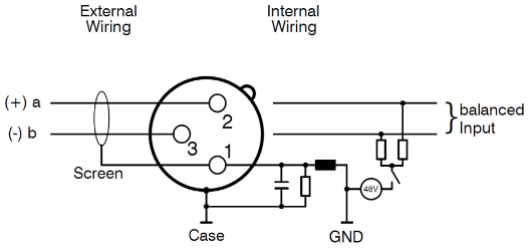
16 x XLR connectors, male.



For connection to an unbalanced input stage, one line needs to be shorted to ground (hot or cold), like with a transformer-coupled output stage. The level will remain the same as with a balanced load.

MIC/LINE IN (XLR)

32 x XLR connectors, female.

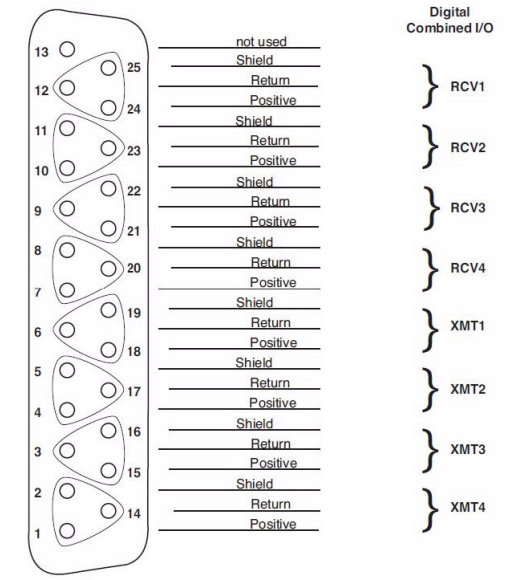


10.3.3 A__stage80

AES3 IO (SUB-D25)

2 x 25-pin D-type connectors, female. Pinning and gender according to AES59.

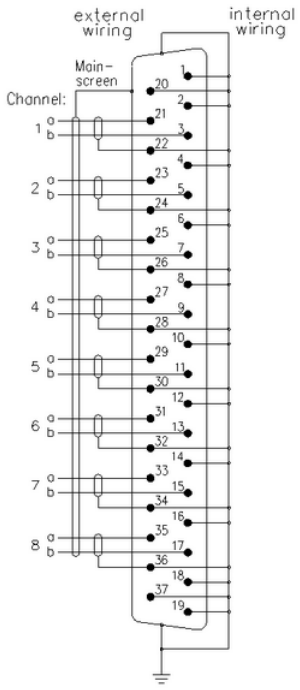
AES3 inputs 1..4 (RCV1..4), AES3 outputs 1..4 (XMT1..4).



All shields are internally connected to system ground.

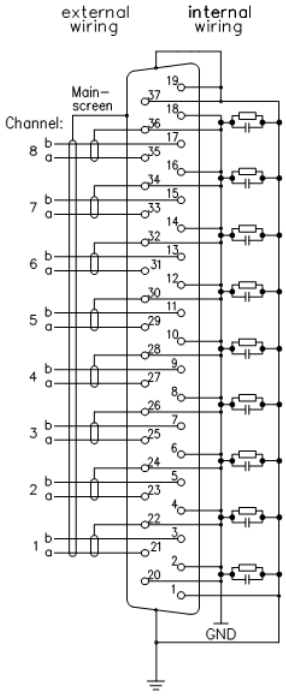
LINE OUT (SUB-D37)

4 x 37-pin D-type connectors, male.



MIC/LINE IN (SUB-D37)

4 x 37-pin D-type connectors, female.

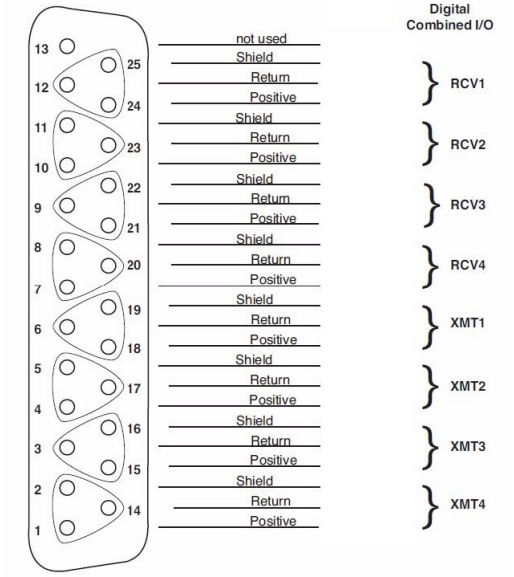


10.3.4 A__digital64

AES3 IO (SUB-D25)

8 x 25-pin D-type connectors, female. Pinning and gender according to AES59.

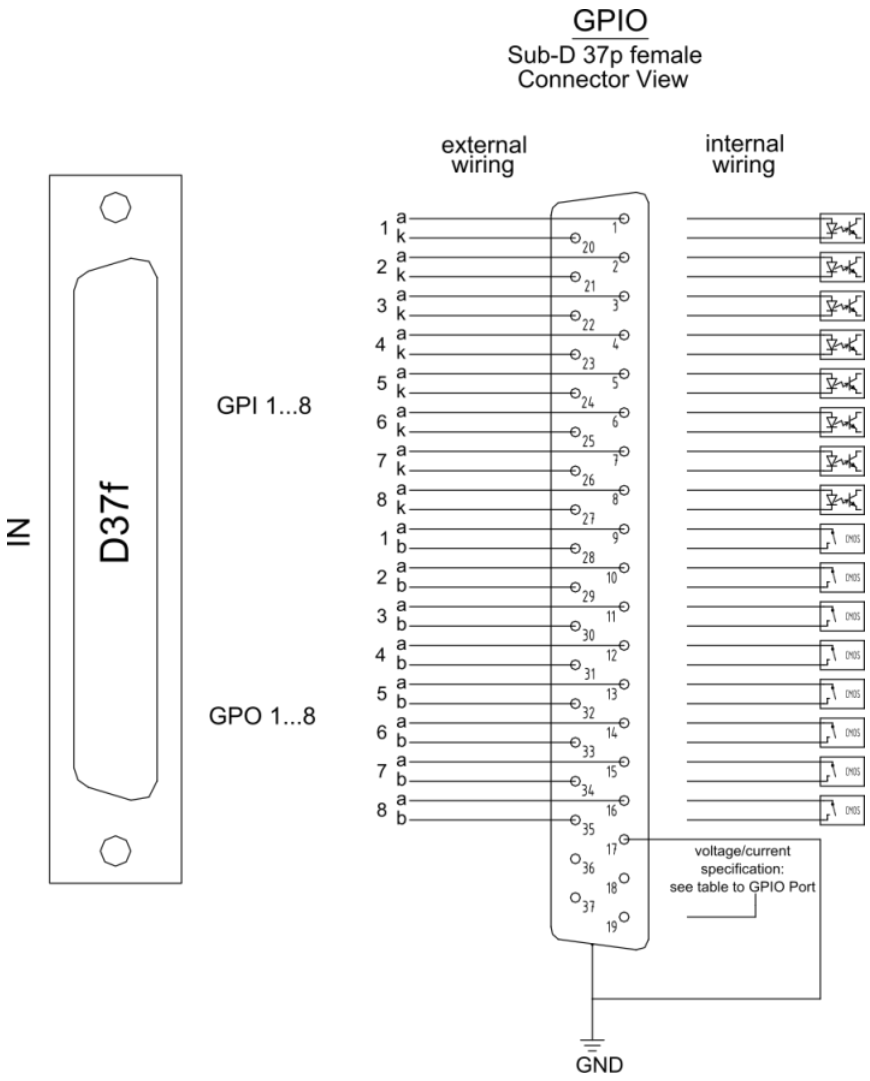
AES3 inputs 1..4 (RCV1..4), AES3 outputs 1..4 (XMT1..4).



All shields are internally connected to system ground.

10.3.5 GPIO (SUB-D37)

1 x 37-pin D-type connector, female.



Parameter	Conditions	Min.	Typ.	Max.	Unit
GPI					
Input type		opto coupler			
Input voltage	DC	3.0		36	V
Input current	V_m=36V		8		mA
Reverse voltage				36	V
Impulse width	positive or negative impulse	5			ms
Cycle time between 2 successive events		30			ms
Allowable duration of contact bounce per event				40	ms

Parameter	Conditions	Min.	Typ.	Max.	Unit
GPO					
Output type		mechanical relays			
Switching voltage	AC/DC			50	V
Switching current	AC			0.5	A
	DC			1	A

Parameter	Conditions		Min.	Typ.	Max.	Unit
Auxililary voltage supply						
Output voltage	DC	no load		11.3		V
		load 0.1A		10.7		V
		load 0.2A		9.9		V
		load 0.3A		8.4		V
Output current	DC, foldback current limit				0.3	A

11. Glossary

1000 Base-T
1000 Base-SX
1000 Base-LX

Used in data networks to describe the Ethernet standard. The standard defines the network speed, cable type and length.

For example, 1000 Base-T is a standard for Gigabit Ethernet over copper wiring. The 1000 refers to the network speed (1000 Mbit/s), while the Base-T refers to the cable type and length of connection (e.g. twisted pair CAT5, CAT5e, CAT6, CAT7, up to 100m).

Other common Ethernet standards include 100 Base-TX (Fast Ethernet, twisted pair CAT 5, up to 100m), 1000 Base-SX (Gigabit Ethernet, multi-mode fibre, 220-550 metres), 1000 Base-LX10 (Gigabit Ethernet, single-mode fibre, up to 10km), etc.

AoIP

Audio-over-IP

Buffer Size

The buffer size sets the amount of data stored (in memory) before each data packet is transmitted or played out. In an audio system, the smaller the buffer size, the lower the latency, but the more susceptible to drop-outs.

COMi.MX

The name of Lawo's RAVENNA processing hardware device. The COMi.MX forms a sub component of most of Lawo's RAVENNA IO cards.

DALLIS

Digital and Line Level Interface System.

The name of Lawo's configurable IO device. Each DALLIS frame can be fitted with a combination of plug-in IO cards.

DHCP

Dynamic Host Configuration Protocol

Commonly used in data networks to dynamically allocate IP addresses from a central server.

DSCP

Differentiated Services Code Point

DSCP values are used within computer networks to classify and manage different types of network traffic. For example, to provide low-latency for critical network traffic such as media streaming, while providing best-effort services to non-critical services such as web traffic or file transfers. The default DSCP value for RAVENNA streams is 46 (=EF); and for PTP is 56 (=CS7).

Ember+

A non-proprietary TCP/IP interface protocol. An Ember+ provider can "publish" parameters which may then be used by an Ember+ consumer. For example, to display information or enable control from a remote device.

Fast Leave

An option often supported by IGMP network switches, which allows the switch to determine when an output port has left a Multicast group. If this option is not enabled, then Multicast traffic can flood the output port continuously. See IGMP.

HPET

High Precision Event Timer

A high precision clock reference provided by your PC. It is required for proper RAVENNA timing.

HTTP

Hypertext Transfer Protocol

A networking protocol/URL address, commonly used to exchange or transfer web pages, email, etc.

IGMP

Internet Group Management Protocol

A communications protocol used by adjacent switches/routers on a network to establish Multicast group memberships.

IGMP Querying/Snooping is a technique used by network switches to control the forwarding of Multicast data packets. A switch with IGMP Querying/Snooping will forward Multicast data packets only to the ports that are members of the Multicast group. Whereas, a switch without IGMP Querying/Snooping will broadcast Multicast data to all of its output ports. As a result, the volume of Multicast traffic will be significantly reduced if a network switch supports IGMP Querying/Snooping.

IP Address

Internet Protocol address.

	All devices connected to a data network must have a unique IP address. In IPv4, a 32-bit number is used and a typical address looks like this: **192.168.101.240**. In IPv6, a 128-bit number is used. In IPv4, subnets are used to divide the IP address range. For example, a subnet mask of **255.255.255.0** effectively filters the first three fields of the address. So, providing the subnet masks match, a device with an IP address = **192.168.101.xxx** can communicate with another device using an IP address = **192.168.101.xxx** (where **xxx** is a unique number between **1** and **254**) without any further configuration or routing. A Class C IPv4 address range runs from **0** to **255**. However, **.0** is usually reserved for use as a gateway and **.255** as a broadcast address (by network switches). Therefore, this type of network supports 254 clients/nodes. If communication is required outside of the broadcast domain - for example, to a device with an IP address = **192.168.102.xxx -** then the data packets must be redirected using a network switch with Layer 3 routing capability.
IPv4	Internet Protocol Version 4 - see IP Address.
IPv6	Internet Protocol Version 6 - see IP Address.
LAN	Local Area Network A data network that interconnects devices within a small geographic area (e.g. a home, school or office building). LANs differ from WANs (Wide Area Networks) in that they do not require leased telecommunications lines (i.e. there is no need for an external service provider).
Latency	The amount of time delay between an audio signal entering and emerging from a system.
Layer 2/3	See Network Switch.
Multicast	In a multicast data network, data is copied and distributed by the network switch/router. This means that packets sent from a single device can be received by multiple nodes at the same time (i.e. one to many). This differs from a unicast data network where data packets are addressed to a single receiving node (i.e. one to one).
Network Router	See Network Switch.
Network Switch	A device used in data networks to interconnect multiple nodes. A Layer 2 network switch conforms to the OSI Layer 2 model, meaning that they can handle the physical and data link layers (i.e. cabling and basic packet transmission). This differs from a Layer 3 network router which also handles the network layer (i.e. it can redirect network packets).
NIC	Network Interface Card A computer interface that connects to external network devices.
Nova73	A stand alone routing matrix with networking capabilities; this is a large matrix related to the mc^2 series of Lawo consoles.
PTP	Precision Time Protocol. An ultra-precise, Synchronization method used in data networks. The PTPv2 protocol can be used as the sync reference for all RAVENNA devices in a network.
QoS	Quality of Service The QoS defines the overall performance of a computer network. Several factors are considered: error rates, bandwidth, throughput, transmission delay, availability, jitter, etc. See also DSCP.
RAVENNA	A real-time, network-synchronised Audio over IP protocol. RAVENNA offers real-time distribution of audio and other media content within IP-based network environments.
Remote MNOPL	The remote control protocol RemoteMNOPL is a LAN based client-server network byte order protocol to enable third party systems to control Lawo's digital mixing consoles or standalone routers.

RTP	Real-time Transport Protocol A networking protocol that defines a standard packet format for delivering audio and video over data networks.
RTCP	Real-time Transport Control Protocol Works in conjunction with RTP. While RTP carries the media streams (audio and video), RTCP is used to monitor the transmission statistics and Quality of Service (QoS).
RTSP	Real-time Transport Streaming Protocol A networking protocol/URL address, commonly used in establishing point-to-point media sessions.
Sample Rate	The speed at which the Processing of the system takes samples respective to values from a continuous, analogue audio signal to make a discrete, digital one. For example, when running at 48kHz, incoming analogue audio is sampled at a rate of 48000 values per second.
SDP	Session Description Protocol A format for describing streaming media communications parameters.
SFP	Small Form-factor Pluggable transceiver. A hot-pluggable device which can be used to offer a choice of connection methods - e.g. multi-mode fibre, single-mode fibre, etc.
SIP	Session Initiation Protocol A networking protocol/URL address, commonly used within Voice-over-IP systems.
SMPTE 2022-7	SMPTE 2022 is a standard from the Society of Motion Picture and Television Engineers (SMPTE) that describes how to send digital video over an IP network. The standard is published in seven parts. The seventh part (SMPTE 2022-7) describes the Seamless Protection Switching of SMPTE ST 2022 IP datagrams. Within a RAVENNA streaming network, the technology is used to provide redundant streaming between two nodes.
SPS	Seamless Protection Switching. See SMPTE 2022-7.
Subnet	See IP Address.
TCP	Transmission Control Protocol A protocol that provides reliable, ordered, and error-checked delivery of a stream of octets (bytes) between applications running on hosts communicating via an IP network.
TCP/IP	The Internet protocol suite - Transmission Control Protocol (TCP) and the Internet Protocol (IP) - provides end-to-end data communication specifying how data should be packetized, addressed, transmitted, routed, and received.
TDM	Time-Division Multiplexing A common method of transporting signals via a point-to-point connection. In Lawo devices, TDM is used internally to transport audio along the backplane - e.g. from a IO or DSP card to the routing matrix, and vice versa.
TTL	Time to Live A mechanism that limits the lifespan of data within a computer network, in order to prevent data packets from circulating indefinitely.
UDP	User Datagram Protocol A simple connection-less networking protocol which is often used in real-time applications due to its low latency. UDP is suitable for purposes where error checking and correction are either not necessary or performed in the application.
URL	Uniform Resource Locator A networking term for specifying the location of a resource on a computer network. URL types include http, rtsp and sip.

VLAN	Virtual Local Area Network A tool supported by some network switches/routers to separate network traffic "virtually" when connected to the same physical LAN.
WAN	Wide Area Network A data network that covers a broad area (e.g. linking regional, national or international boundaries) using leased telecommunications lines (i.e. supported by a service contract from an external provider).