

THUNDER | CORE

AX64

**Thunderbolt 3, DANTE, MADI and
ADAT Modular Audio Interface**

Installation Guide



IMPORTANT SAFETY INSTRUCTIONS

READ AND KEEP THESE INSTRUCTIONS



The lightning flash with arrowhead symbol, within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance (servicing) instructions in the literature accompanying the product.



The garbage bin with a cross is intended to alert the user that the product may not be disposed of by regular garbage, but as electronic equipment.

WARNING – when using electric products, basic precautions should be followed, including the following:

Read all of the safety and installations instructions and explanation of graphic symbols before using the product.

1. Do not use this apparatus near water.
2. Clean only with dry cloth.
3. Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
4. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.
5. Do not defeat the safety purpose of the polarized or grounding-110 to 125V type plug according to UL 817 and CSA C22.2 no. 42. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong are provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
6. Protect the power cord from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.
7. Only use attachments/accessories specified by the manufacturer.
8. Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
9. Unplug this apparatus during lightning storms or when unused for long periods of time.
10. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

DANGER

Improper connection of the equipment-grounding can result in a risk of electric shock. Do not modify the plug provided with the product – if it will not fit the outlet have a proper outlet installed by a qualified electrician. Do not use an adapter which defeats the function of the equipment-grounding conductor. If you are in doubt as to whether the product is properly grounded, check with a qualified serviceman or electrician.

The product must be grounded. If it should malfunction or breakdown, grounding provides a path of least resistance for electric current to reduce the risk of electric shock. This product is equipped with a power supply cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into an appropriate outlet which is properly installed and grounded in accordance with all local codes and ordinances.

WARNING

- This product, either alone or in combination with an amplifier and speakers or headphones, may be capable of producing sound levels that could cause permanent hearing loss. Do not operate at a high volume level or at a level that is uncomfortable. If you experience any hearing loss or ringing in the ears, you should consult an audiologist.
- The product should be located so that its location or position does not interfere with its proper ventilation.
- The power-supply cord of the product should be unplugged from the outlet when left unused for a long period of time. When unplugging the power supply, do not pull on the cord, but grasp it by the plug.
- Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.

SERVICE

- Do not attempt to service the product beyond that described in the user maintenance instructions. All other servicing should be referred to qualified service personnel.
- The product should be serviced by qualified service personnel when:
 1. The power supply cord or plug has been damaged, or
 2. Objects have fallen, or liquid has spilled into the product, or
 3. The product has been exposed to rain, or
 4. The product does not appear to be operating normally or exhibits a marked change in performance,
or
 5. The product has been dropped, or the enclosure damaged.

WARNING – Hazardous moving parts inside the unit. Keep fingers and other body parts away.

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Doc No. AX64-8001-A-4 rev.2

General description.

Congratulations, and thank you for purchasing the Thunder|Core-enabled AX64 Modular Audio Interface. AX64 is an extremely capable multi-channel audio converter and digital audio interface which is ideal in your sound studio as a pristine and versatile multi-format, multi-channel audio interface.

AX64 has eight slots for optional DAD I/O cards, providing interface for MADI and Dante with SRC, 3G SDI, AES/EBU, and pristine 8 channel analogue line and microphone input and 8 channel analogue line as installable card options.

AX64 has built-in Thunderbolt 3 interface w. 256 bidirectional channels for connection to a computer and can also provide 15W power on each port for powering peripheral devices. Digital I/O provided for 256 channels of Dante™, 64 channels of MADI, 16 channels of ADAT and 4 channels of S/PDIF. Sample rates are supported from 44.1 to 348 kHz and a resolution of 28-bit floating point. As options a 128-channel mini MADI I/O module can be installed supporting MADI or 256 channels DADLink.

AX64 has the DAD routing engine provides a 1872x1872 matrix where all inputs and outputs can be patched in any combination. In addition a 512x64 channel summing processor and a 1024 filter SPQ equalizer is also available.



Note. The AX64 is operated via the DADman software. The control is done via the Thunderbolt connection or Ethernet if Thunderbolt is not connected to the unit.

Below is a diagram of the overall functionality.

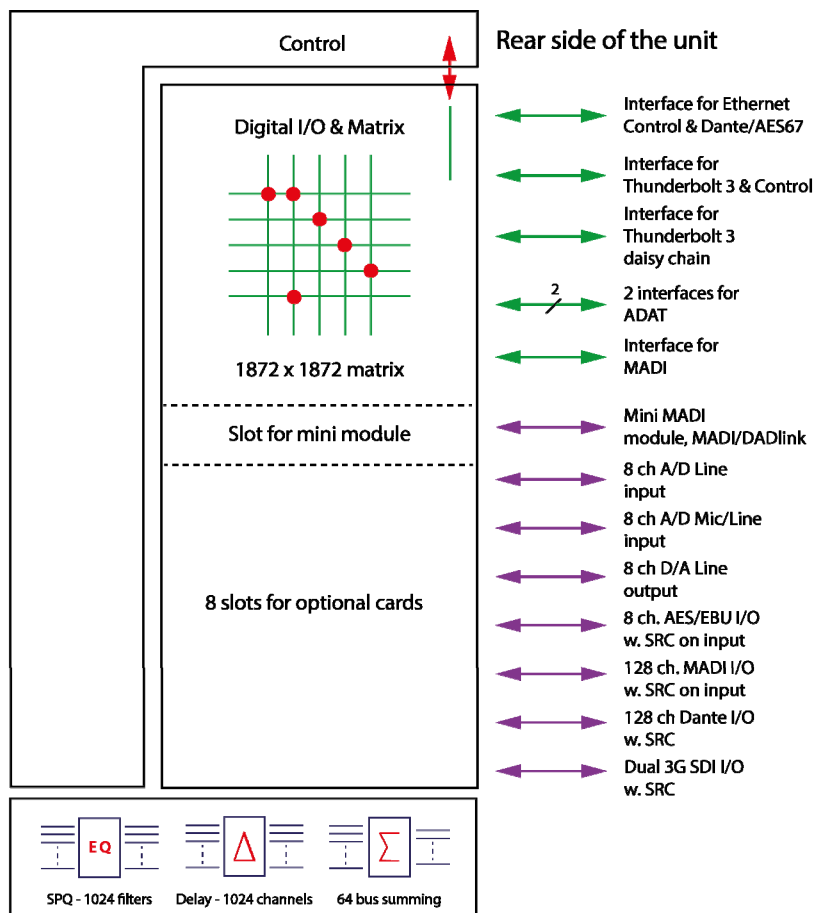


Figure 1, Block diagram of the unit

Before you start

Place your AX64 on a hard and dry surface or mount it into a 19" rack, and leave plenty of room for ventilation.

In order to meet the EMC requirements of directives EN 55032 and FCC 47 CFR part 15, and in order to obtain the highest performance of the AX64, you must use good quality correctly shielded cables for all external connections when installing AX64. For the power connection, a normal unshielded power cable with a proper protective earth conductor can be used.

Make sure that your sound system is at a safe volume level.

Mechanical installation and low fan noise

AX64 is fitted with two very quiet fans to ensure optimum operating temperature. The fans are temperature-controlled, i.e. the rotation speed, and thereby noise, is dependent on the temperature inside the AX64. The fan is hardly audible during normal operation, assuming the MTRX II is installed correctly.

The optimal air flow is through the ventilation openings in the front panel to the rear of the unit. When the unit is installed, considerations have to be made to ensure proper air circulation for the air leaving the rear of the unit. The speed of the low noise fan will be increased automatically to keep the internal temperature low if there is insufficient airflow. If the internal temperature exceeds 60°C / 140°F a temperature alarm will appear in DADman and is indicated via the red error LED on the front panel.

Accessing the AX64 cards.

It is not necessary to open the AX64 during installation, unless you need to add DAD expansion cards or module.

The AX64 cards and module options can be installed by removing the lid of the chassis. The chassis provides 8 card slot positions where cards can be installed. The mini I/O module is mounted on the Main board of the converter. Cards and modules should not be removed or changed without consulting either NTP Technology or an authorised DAD representative.

Network configuration

AX64 is equipped with two Giga Bit Ethernet connectors and internally an Ethernet switch, a controller part and a part for the IP Audio option powered by Dante™. The network connectors can operate as two "parallel" connectors for the internal switch, or as dual connectors for redundant IP audio operation. In this case controlling the unit is done via Net port 1. AX64 has two to three different IP addresses. One for the unit control via DADman and one or two for the IP audio in respectively single or redundant mode. The network configuration is managed separately for the controlling interface and for the IP audio interface, and can have a different configuration from the controlling interface. The controlling interface is used for controlling AX64 from DADman and the IP audio interface is used for interfacing Dante IP audio in a network. The factory default setting of the IP address of the controller port of the AX64 is 10.0.7.20. The IP address can be changed manually via DADman or it can be set to be automatically assigned by a DHCP server/router in the network. If needed AX64 can be set in recovery mode with a the fixed factory defined IP address 10.0.7.20 and IP discovery via DHCP. This is described in the Reconfig section of this manual.

Control software installation



Computer recommendation

The DADman control program operates on any Windows or MacOS based computer, and is frequently maintained for interoperability with the latest OS versions.

Program installation

This section will take you through the installation procedure for the DADman computer control program.

The AX64 is controlled from a PC or MAC via the Thunderbolt 3 connection or by a network connection. The PC/MAC and the AX64 units must be connected on the same subnet.



Note. In order to control the unit via Thunderbolt 3 the DAD Thunderbolt 3 driver has to be installed.

The DADman remote control program installation

1. Install the DADman program by downloading the application from DAD support website www.digitalaudiosupport.com. Follow the instructions of the install program. Please note that there are two different program downloads; One for Windows and one for MacOS.
2. Create a shortcut for the DADman program on the desktop.
3. Double-click on the DADman icon and start the DADman application.

Connect your AX64 to DADman

AX64 can be controlled via Thunderbolt or Ethernet. In the top menu bar select Tools/Device List and the window will show a list of the discovered units. If the unit is connected via Thunderbolt this will appear in the list. If there is no Thunderbolt connection, the units can be connected via Ethernet. If a unit on the Ethernet not appear in the list apply 'Refresh' when using a Windows PC, in order to discover the AX64 over Ethernet. On MacOS, 'Action' is used to select 'Refresh IP list' The Device List window is shown in figure 1. A unit will always be discovered, but depending on your network configuration will have to be set to DHCP or Manual IP addressing.

In order to attach the unit to DADman the connect box has to be checked.

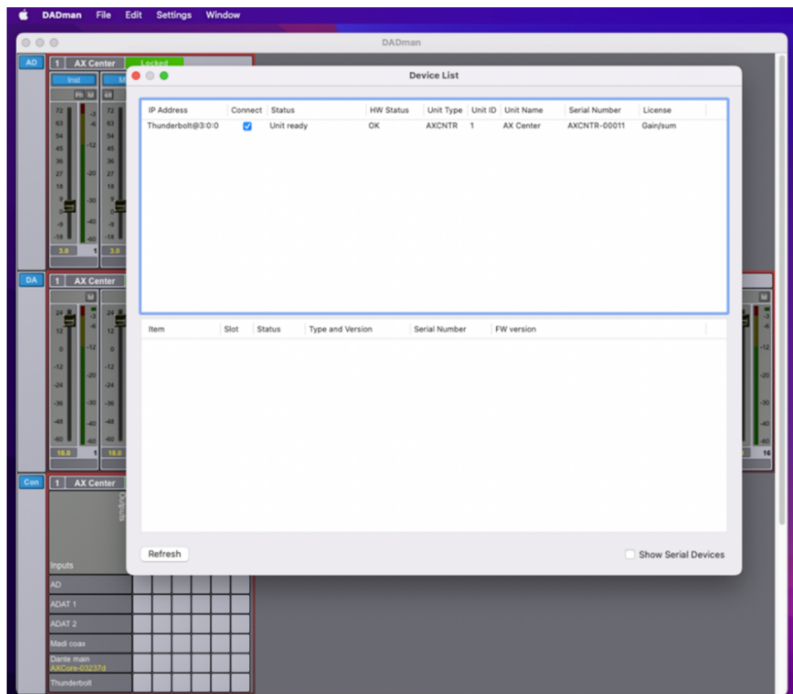


Figure 2, DADman Device list



Note. If the DAD Thunder|Core Thunderbolt driver is installed on the computer where DADman is running DADman will automatically connect via Thunderbolt to AX64 and not via Ethernet.

Assigning the IP address for the computer and the AX64

When the DADman program is installed, you are able to finalise the network configuration of the AX64. You have the option of using fixed IP addresses or IP addresses assigned via DHCP. DHCP can be auto assigned via the Ethernet by it self or via an external DHCP server providing IP address for all units on your network.

Fixed IP address

You must have a preferred range of IP addresses, and a network mask for the computer network and the connected AX64 units.

1. Configure your computer IP address and network mask via the computer control panel to e.g. 10.0.7.25 | 255.255.255.0

Select the AX64 in the DADman Settings/ Device List menu by right clicking the unit line and select 'Network settings' when using a Windows PC. On MAC-OSX you use the 'Action' button to select 'Network Settings'.

Configure via DADman each AX64 in turn with a unique IP address and the preferred network mask e.g. 10.0.7.21 | 255.255.255.0. In this window you can also configure the IP audio network settings

When you are done you can connect more than one AX64 to the network, and they will appear in the DADman Device List.

Automatic IP address

You must have a network with a DHCP server which will allocate the IP addresses, or the IP address will self-assigned.

1. Configure your computer IP address via the computer control panel to DHCP.

Select the AX64 in the DADman Tools / Device List menu by right clicking the unit line and select 'Network settings'.

If you have more AX64 units connected they will all be configured with IP address via DCHP.

2. Once the DHCP system has allocated an IP address to the unit it will appear in will appear in the DADman Device List with the name MTRXII.

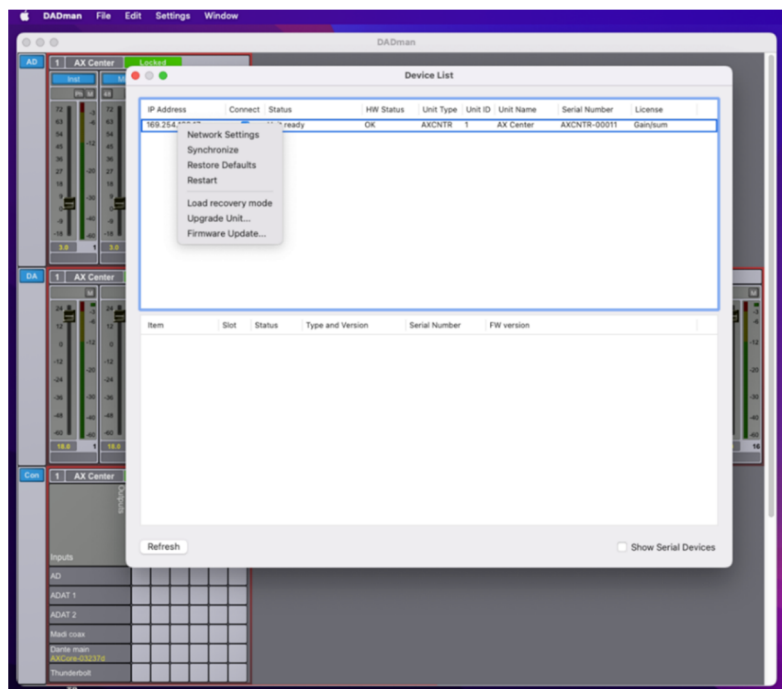


Figure 3, DADman Device list w. settings



Note. In order to have proper function of the AX64 the routing and sample rate configuration has to be set correctly via DADman.

Installation of DAD Thunderbolt 3 driver for MacOS



The driver software has to be installed completely before it can work properly.

When you install the driver it is of no importance if you have units or other peripheral devices connected to the Thunderbolt 3 / USB-C port on the computer. In the process described below there are no devices connected before installation.

The installation sequence is the following:

1. Copy the driver .pkg file to the computer desk top and double click in order to start installation
2. Follow the installation instructions click *Next* and then *Install*.
3. Enter Administrator password and click *Install*
4. If the driver has not been installed before on the computer you get the message "System extension blocked". Click on *Open Security Preferences*.
5. In the "Security and Privacy" window you have to click on the lock symbol in the bottom left corner and unlock settings and click *Allow*.
6. Restart the Computer and open the Thunderbolt 3 driver application, and connect the DAD Thunder|Core interface to the USB-C/Thunderbolt 3 port on the Computer. Make sure that you are using a high-speed (20Gbps) Thunderbolt 3 USB-C cable.

For mor information how to install and configure the Thunderbolt 3 driver please refer to the Thunder|Core installation guide on www.digitalaudiosupport.com.

Once the driver is installed the device can be attached to via the setup window

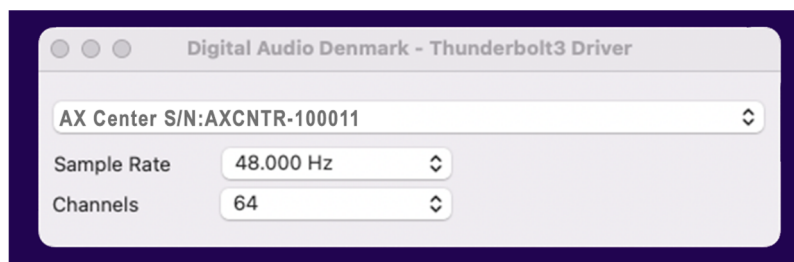


Figure 4, DADDriver setup window

Installation of DAD Thunderbolt 3 driver on Windows PC

The driver software has to be installed completely before it can work properly.

When you install the driver, it is of no importance if you have units or other peripheral devices connected to the Thunderbolt 3 / USB-C port on the computer. In the process described below there are no devices connected before installation.

The installation sequence is the following:

1. Copy the driver .msi windows installer file to the computer desk top and double click in order to start installation
2. Follow the installation instructions click Next and then Install.
3. Once the driver is installed open your audio application and chose the Digital Audio Denmark ASIO driver
4. In order to configure the ASIO driver open the ASIO dialogue window in the audio configuration section of your audio application
5. Configuration can be done on the parameters shown in figure 6

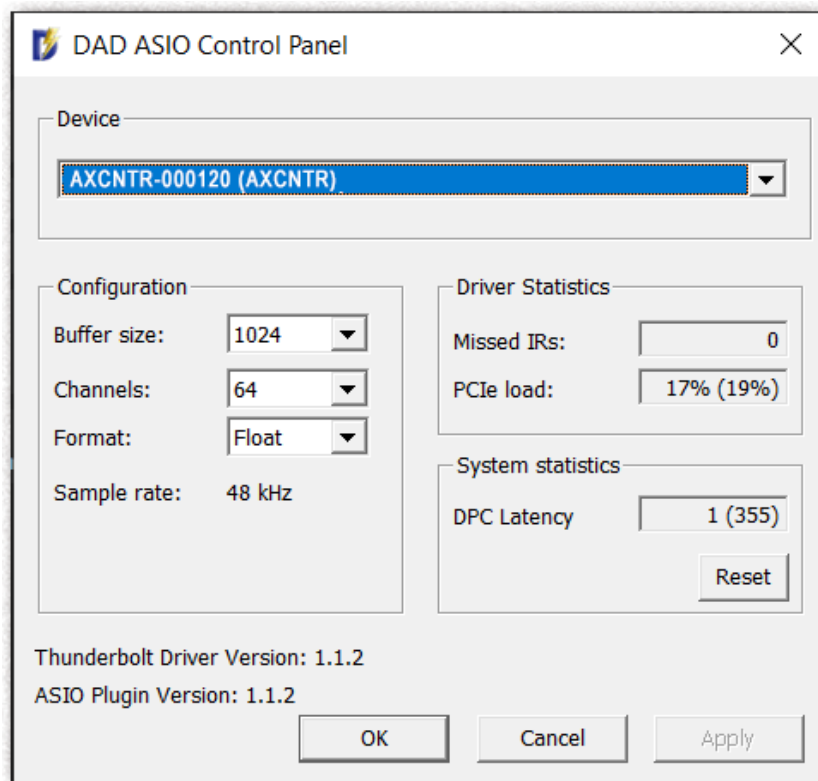


Figure 5, ASIO driver configuration window.



Note. The DAD ASIO control panel is accessible as a stand-alone configuration window or if your DAW audio application supports this, from inside the audio configuration dialogue.

Operation

The AX64 is controlled from a Mac or Windows computer via the Thunderbolt Connection or the Ethernet port on the rear panel and configured by the DADman software running on the computer. On the front panel status viewing can be made on some of the primary settings.

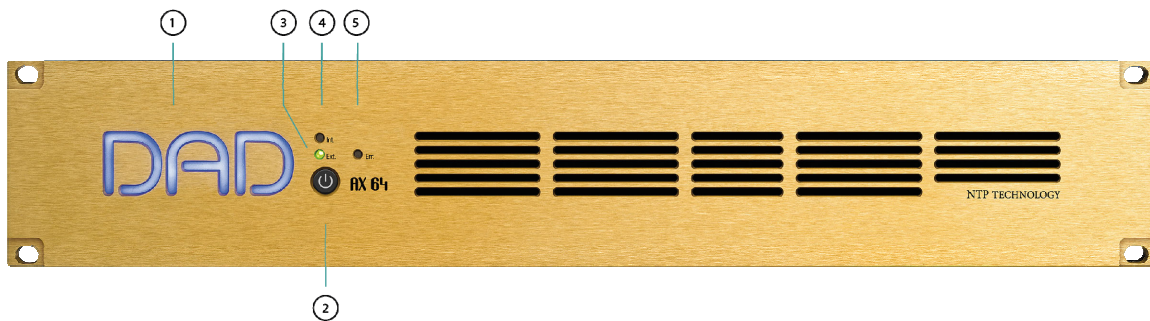


Figure 6, Front panel layout

Front panel layout

1. DAD Logo. Indicates that the unit is turned on, Blinks while the unit is set in standby (off)
2. On/Standby button. Note that the unit automatically returns to the last power state (on or standby) if it is power cycled via the mains power
3. External sync source two-color indicator. Green LEDs shows external sync source OK, red LED indicate that no or bad sync signal.
4. Internal sync indicator. Green LEDs shows internal or external sync source
5. Error indicator, Red LED. Indication in related to hardware performance and can be temperature overload, Fan error, DAD I/O card failure or general internal boot error. A more specific error indication will be visible in DADman.

Rear panel connections.

Below is the layout of the rear panel of the AX64

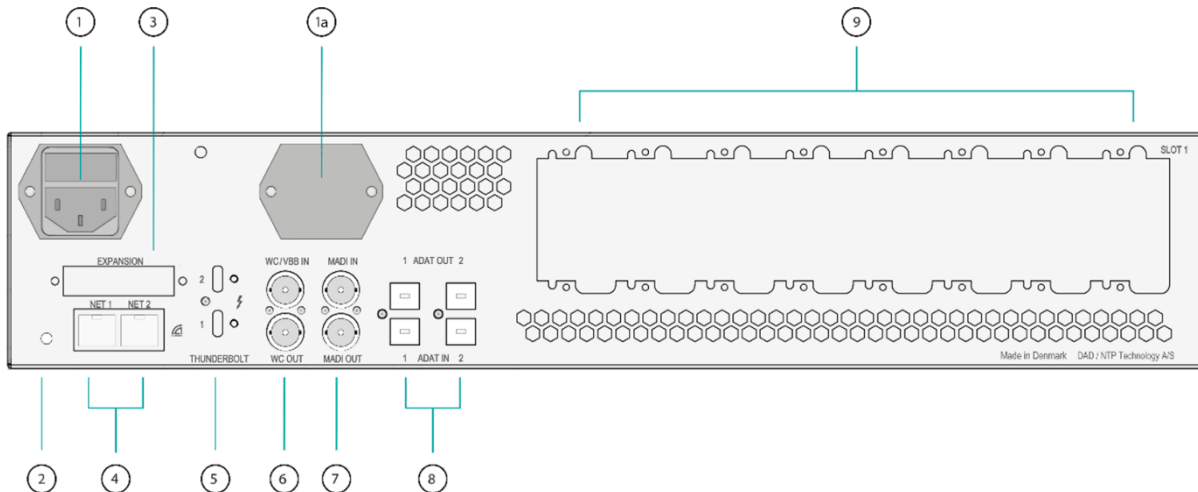
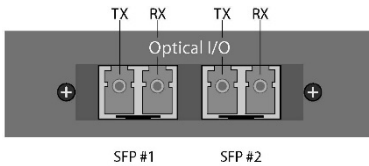


Figure 7, Rear panel layout

Rear panel layout

1. Mains power connector. 1a Slot for installation of dual power connector option.
2. "Reconfig" button. Please refer to section below for further description
3. Expansion slot for optional dual MADI I/O mini module via optical or coaxial SFP modules.
4. RJ45 Ethernet connectors. Two ports for Control and Dante AoIP. Connectors can be set in switched or redundant mode for Dante. In redundant mode the control network has to be connected to port 1.
5. Thunderbolt 3 interface for connection to a computer, and for an expansion unit or other peripheral interface.
6. Word Clock or Video Black Burst synchronization input (configurable), BNC connector, and Word Clock output.
7. MADI I/O BNC connectors.
8. Two set of TOSLINK optical ADAT input and output connectors. Input can also be set to S/PDIF
9. 8 Slots for Optional multi-format DAD I/O Cards

Digital I/O and Network Connections



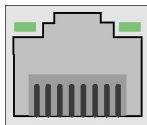
Dual MADI SFP I/O mini-module

The Dual SFP module can operate as a MADI interface or as DADlink.

The Dual SFP module, can be installed with one or two “Small form-factor pluggable” (SFP) transceiver modules supporting Optical LC connection or mini coax HD-BNC electrical connection.

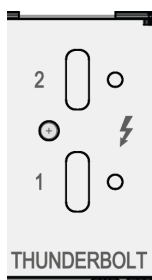
The mini coax HD-BNC electrical SFP connection works only with MADI. The optical SFP modules are standard types, which can support single mode or multimode optical fibres of various types as well as different wavelengths. For MADI typically 1300nm types are used. Each SFP module has a receiver and a transmitter part and can be used for MADI audio I/O or DADlink or a combination. When using DADlink optical SFP modules must be Gigabit/1000base types. For MADI optical SFP modules can be both 1000base and 100base types.

The right part of the SFP connector is the receiver and the left part is the transmitter.



Dual Ethernet, RJ45 connector, Gigabit

Pin 1.	BI_DA+
Pin 2.	BI_DA-
Pin 3.	BI_DB+
Pin 4.	BI_DC+
Pin 5.	BI_DC-
Pin 6.	BI_DB-
Pin 7.	BI_DD+
Pin 8.	BI_DD-



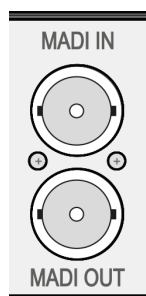
Thunderbolt 3 connectors

Two USB-C type connectors for connecting via Thunderbolt 3. The two connectors 1 and 2 have the same functionality. One can be connected to the computer and the other to an additional audio interface for expansion or to a standard USB-C peripheral device providing non-audio functionality.

Two chassis holes enables the use of ThunderLok 3L Thunderbolt Connector Retention clips.

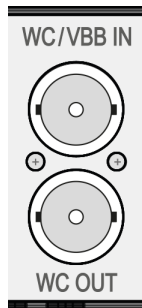
Note that a high-speed Thunderbolt 3 cable has to be used for interconnection. The cable should be the following type:

Thunderbolt 3 20 Gbps or 40 Gbps USB-C cable and preferably Intel Certified.



MADI connectors

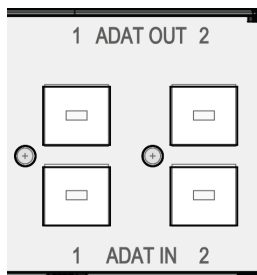
Coaxial BNC connector for input and output of MADI signals via 75Ohm Coax cables.



Sync connectors

Coaxial BNC connector for Clock input synchronization, and Word Clock output

The input clock format can be Word Clock or Video Black and Burst (VBB)



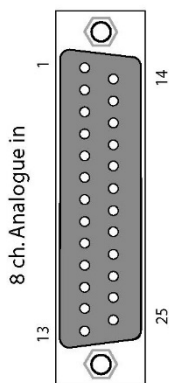
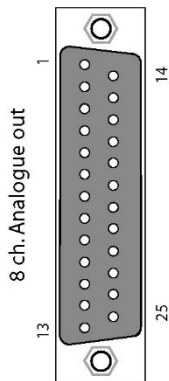
ADAT Connectors

Two TOSLINK Inputs and two outputs. Input and output connectors support ADAT.

S/PDIF is supported on input only.

Analogue I/O Connections on optional DAD I/O Cards

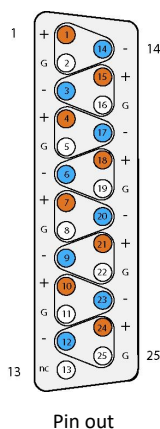
Analogue I/O 25 pole female D-sub connectors.



These are interfaced via a 25 pole D-sub connectors on the card which is accessible from the rear panel of the AX64 chassis.

This connector type is used both for the analogue Line input card and the analogue Line output.

Below is listed the connection for the 25 pole D-sub connector. The pinning is according to the proprietary standard by the company **Tascam**. The pinning is for each group of 8 channels



Connections channel 1-8

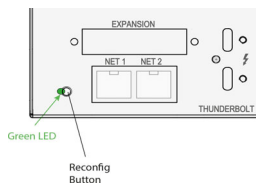
Pin no	Func.	Pin no	Func.
1	AIN/OUT 8 +	14	AIN/OUT 8 -
2	GND	15	A/IN/OUT 7 +
3	AIN/OUT 7 -	16	GND
4	AIN/OUT 6 +	17	AIN/OUT 6 -
5	GND	18	AIN/OUT 5 +
6	AIN/OUT 5 -	19	GND
7	AIN/OUT 4 +	20	AIN/OUT 4 -
8	GND	21	AIN/OUT 3 +
9	AIN/OUT 3 -	22	GND
10	AIN/OUT 2 +	23	AIN/OUT 2 -
11	GND	24	AIN/OUT 1 +
12	AIN/OUT 1 -	25	GND
13	N.C.		

Reconfig button

The “Reconfig” button on the back of the AX64 should not be used during normal installation. It is generally intended as an ultimate recovery function in case something goes wrong during programming of IP addresses or a software upgrade, e.g. an unintended power loss. It allows the AX64 to start in various “basic” modes so it can be restored without having to be returned to the factory.

The “Reconfig” button is accessed via a hole in the rear panel using a pen or a similar pointed item. A green LED is visible through the hole. When the “Reconfig” button is activated, the LED will light up indicating the two reconfig modes of the AX64.

Recovery mode



“Reconfig”
pushed while the
unit is powering
up

Green LED
turns **ON**

The AX64 enters a recovery mode. In this mode only a basic boot software is operative in the unit, and new software can be downloaded via the DADman software. This mode is used if the software in the AX64 for some reason is not operative or broken.

The IP address settings of the unit are the last setting used in the unit.

“Reconfig”
short push
while the unit is in
reconfig mode and
Green LED is on

Green LED
turns **OFF**

The AX64 remains in reconfig mode as described above.

The IP address settings of the unit is however set to DHCP. In case there is no DHCP server on the network, the AX64 will default to IP address 10.0.7.20 / 255.255.0.0 after approx. 2 minutes.

The selection of either of the two recovery modes are fixed after selection. The AX64 will start with a basic boot software and IP configuration. The AX64 will not be operational until a proper firmware has been downloaded via the DADman software and it has been restarted. By enabling recovery mode with default IP address and network configuration the unit can always be identified on a network via the default setup.



Note that the IP address referred to is the IP address of the controller/management interface of the unit. This is not the IP address of the IP audio interface if a such is installed. This IP address can not be accessed in recovery or restore defaults mode.

Specifications

Audio Specifications

	Analogue input for optional A/D card
Sampling, resolution	5bit sigma/delta@5.645 or 6.144 MHz, 24 bit PCM
PCM (DXD) sample rates	44,1, 48, 88.2, 96, 174.4, 192, 352.8, 384 kHz
DSD sample rates	2.8224 & 5.6448 Mhz (64 & 128 fs)
Dynamic range (A)	> 123 dB
THD+N(A)	< -117 dB@-3dB FS / 0,00014%
Cross talk	< -120 dB
Input Impedance (differential)	> 10 k Ohm
Max input level	Adjustable from 9 dBu to 30 dBu in steps of 0.1 dB
Microphone input gain range/accuracy	Adjustable from -18 to +70 dB, in steps of 0.1 dB, ± 0.25 dB accuracy
Microphone equivalent input noise (A)	< -133dB
	Analogue output optional D/A card
Modulator resolution, format	32 x oversampling, 1 bit DSD, 24 bit PCM
PCM (DXD) sample rates	44,1, 48, 88.2, 96, 174.4, 192, 352.8, 384 kHz
DSD sample rates	2.8224 & 5.6448 Mhz (64 & 128 fs)
Dynamic range (A)	> 128 dB
THD+N(A)	< -110 dB@-3dB FS / 0,00031%
Cross talk	< 120 dB
Max output level	Adjustable from -60 dBu to 24 dBu in steps of 0.1 dB
	Digital I/O and Synchronisation
Digital I/O formats/ Supported sample rate	Dante™ IP audio and ADAT/SMUX up to 192 kHz Thunderbolt 3 and MADI up to 384 kHz
Synchronisation	Word Clock, Video Blac Burst, Dante, ADAT and MADI
	Network Interface
Interface	1000BASE-T, RJ45 connector, 4-pair connection
	Thunderbolt 3 Interface
	2 x USB-C type connectors, supporting link functionality and 15w power on each port
	DADLink Interface
Interfaces	2 x SFP connectors for Gigabit SFP modules for multi-mode LC optical fibre connection.

Latency	Below 1 microsecond latency between interconnected units. The overall latency is defined by the system delay set for all the units which is normally 7 samples. All I/O connections across units are 100% aligned in phase.
Channels and Sample rates per link	128 channels @44.1 and 48 kHz 64 channels @88.2 and 96 kHz 32 channels @176.4 and 192 kHz 16 channels @352.8 and 384 kHz Double channel count by using two fibre links.

Electrical Specifications:

Power consumption	Digital section 15W DAD I/O Options max 75W Thunderbolt power max 2x15W Mains 120 VA max.
Input voltage	90 – 260 VAC 100 – 240 VAC Nominal, 47 - 63 Hz
Mains fuse, mounted in IEC connector	1.5 A, T1.5AH/250V
Safety compliance	IEC 62368-1:2020+A11 2020

Power supply cord must be min. light sheathed flexible cord according to IEC60227 (designation 60227 IEC 52) and include a protective earth conductor having a green-and-yellow insulation. Cross-sectional areas min. 3x0.75mm²

<u>Mains line plug type</u>	<u>Correct type acc. to standard</u>
110-125V	UL817 and CSA C22.2 no 42
220-230V	CEE 7 page VII, SR section 107-2-D1/IEC 83 page C4.
240V	BS 1363 of 1984.Specification for 13A fused plugs and switched and unswitched socket outlets

Mechanical specifications

Chassis standard	19", 2 RU
Chassis depth, without connectors mounted	34.5 cm / 14.0"
Chassis body width	43.5 cm / 17.2"
Weight	5.6 kg / 12.3 lbs.

Environmental specifications.

Operating Temperature 0 – 45 °C / 32 - 113°F

Humidity

EMC compliance

EN 55032:2015: emission

EN 55103-2, part 2: Immunity

EN 55035:2017: Immunity

FCC 47 CFR part 15 (B): emission