


AQS System

- for AVANCE NEO
User Manual
Version 001



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1 Introduction

1.1 Overview

This manual enables safe and efficient handling of the device.

This manual is an integral part of the device, and must be kept in close proximity to the device where it is permanently accessible to personnel. In addition, instructions concerning labor protection laws, operator regulations tools and supplies must be available and adhered to.

Before starting any work, personnel must read the manual thoroughly and understand its contents. Compliance with all specified safety and operating instructions, as well as local work safety regulations, are vital to ensure safe operation.

The figures shown in this manual are designed to be general and informative and may not represent the specific Bruker model, component or software/firmware version you are working with. Options and accessories may or may not be illustrated in each figure.

1.2 Intended Use

The device has been designed and constructed solely for the intended use as the acquisition system of AVANCE NEO spectrometers series of Bruker.

Intended use also includes compliance with all specifications within this manual.

- Any use which exceeds or differs from the intended use shall be considered improper use.
- No claims of any kind for damage will be entertained if such claims result from improper use.

1.3 Policy Statement

It is Bruker's policy to improve products as new techniques and components become available. Bruker reserves the right to change specifications at any time.

Every effort has been made to avoid errors in text and figure presentation in this publication. In order to produce useful and appropriate documentation, we welcome your comments on this publication. Field Service Engineers are advised to check regularly with Bruker for updated information.

Bruker is committed to providing customers with inventive, high-quality, environmentally-sound products and services.

1.4 Installation and Initial Commissioning



Installation, initial commissioning, retrofitting, repairs, adjustments or dismantling of the device must only be carried out by Bruker Service or personnel authorized by Bruker. Damage due to servicing that is not authorized by Bruker is not covered by your warranty.

1.5 Limitation of Liability

All specifications and instructions in this manual have been compiled taking account of applicable standards and regulations, the current state of technology and the experience and insights we have gained over the years.

The manufacturer accepts no liability for damage due to:

- Failure to observe this manual
- Improper use
- Deployment of untrained personnel
- Unauthorized modifications
- Technical modifications
- Use of unauthorized spare parts

The actual scope of supply may differ from the explanations and depictions in this manual in the case of special designs, take-up of additional ordering options, or as a result of the latest technical modifications.

The undertakings agreed in the supply contract as well as the manufacturer's Terms and Conditions and Terms of Delivery and the legal regulations applicable at the time of conclusion of the contract shall apply.

1.6 Warranty Terms

The warranty terms are included in the manufacturer's Terms and Conditions.

1.7 Customer Service

Our customer service division is available to provide technical information. See the chapter Contact for contact information.

In addition, our employees are always interested in acquiring new information and experience gained from practical application; such information and experience may help improve our products.

1.8 Product Safety and Electromagnetic Compatibility

The device complies with the following safety requirements:

- IEC 61010-1:2010+AMD1:2016
- EN 61010-1:2010
- UL 61010-1 3rd edition (2012-05-11)
- CAN/CSA-C22.2 NO. 61010-1-12 (R2017)

2 Safety

This section provides an overview of all the main safety aspects involved in ensuring optimal personnel protection and safe and smooth operation.

Non-compliance with the action guidelines and safety instructions contained in this manual may result in serious hazards.

2.1 General

Before you start any repair inside of the device, be aware of the high 230/115V voltages. Even if these voltages are protected by security features to avoid any physical contact, it is still possible that the voltage sources can be unintentionally touched with a tool, object, etc.

Therefore, always check if you really need the power supply to be switched on during your work. Otherwise turn the device off and disconnect the power cable from the wall socket to the device. Safeguard that no one is able to re-power the system without your approval.

2.2 System Owner's Responsibility

System Owner

The term *system owner* refers to the person who operates the device for trade or commercial purposes, or who surrenders the device to a third party for use/application, and who bears the legal product liability for protecting the user, the personnel or third parties during the operation.

System Owner's Obligations

The device is used in the industrial sector, universities and research laboratories. The system owner of the device must therefore comply with statutory occupational safety requirements.

In addition to the safety instructions in this manual, the safety, accident prevention and environmental protection regulations governing the operating area of the device must be observed.

In this regard, the following requirements should be particularly observed:

- The system owner must obtain information about the applicable occupational safety regulations, and - in the context of a risk assessment - must determine any additional dangers resulting from the specific working conditions at the usage location of the device. The system owner must then implement this information in a set of operating instructions governing operation of the device.
- During the complete operating time of the device, the system owner must assess whether the operating instructions issued comply with the current status of regulations, and must update the operating instructions if necessary.
- The system owner must clearly lay down and specify responsibilities with respect to installation, operation, troubleshooting, maintenance and cleaning.
- The system owner must ensure that all personnel dealing with the device have read and understood this manual. In addition, the system owner must provide personnel with training and hazards information at regular intervals.
- The system owner must provide the personnel with the necessary protective equipment.

- The system owner must warrant that the device is operated by trained and authorized personnel as well as all other work, such as transportation, mounting, start-up, the installation, maintenance, cleaning, service, repair and shutdown, that is carried out on the device.
- All personnel who work with, or in the close proximity of the device, need to be informed of all safety issues and emergency procedures as outlined in this user manual.
- The system owner must document the information about all safety issues and emergency procedures in a laboratory SOP (Standard Operating Procedure). Routine briefings and briefings for new personnel must take place.
- The system owner must ensure that new personnel are supervised by experienced personnel. It is highly recommended to implement a company training program for new personnel on all aspects of product safety and operation.
- The system owner must ensure that personnel are regularly informed of the potential hazards within the laboratory. This is all personnel that work in the area, but in particular laboratory personnel and external personnel such as cleaning and service personnel.
- The system owner is responsible for taking measures to avoid inherent risks in the handling of dangerous substances, preventing industrial disease, and providing medical first aid in emergencies.
- The system owner is responsible for providing facilities according to the local regulations for the prevention of industrial accidents and generally accepted safety regulations according to the rules of occupational medicine.
- All substances needed for operating and cleaning the device samples, solvents, cleaning agents, gases, etc. have to be handled with care and disposed of appropriately. All hints and warnings on storage containers must be read and adhered to.
- The system owner must ensure that the work area is sufficiently illuminated to avoid reading errors and faulty operation.
- The system owner must ensure that the laboratory is equipped with an oxygen warning device, in case the device is operated with nitrogen.

Furthermore, the system owner is responsible for ensuring that the device is always in a technically faultless condition. Therefore, the following applies:

- The system owner must ensure that the maintenance intervals described in this manual are observed.
- The system owner must ensure that all (electrical, mechanical, etc.) safety devices are regularly checked to ensure full safety functionality and completeness.

2.3 Personnel Requirements



Only trained Bruker personnel are allowed to install, mount, retrofit, repair, adjust and dismantle the unit!

2.3.1 Qualifications

This manual specifies the personnel qualifications required for the different areas of work, listed below:

Laboratory Personnel

Laboratory personnel are health care professionals, technicians, and assistants staffing a research or health care facility where specimens are grown, tested, or evaluated and the results of such measurements are recorded. Laboratory personnel are able to carry out assigned work and to recognize and prevent possible dangers self-reliant due to their professional training, knowledge and experience as well as profound knowledge of applicable regulations.

The workforce must only consist of persons who can be expected to carry out their work reliably. Persons with impaired reactions due to, for example, the consumption of drugs, alcohol, or medication are prohibited from carrying out work on the device.

When selecting personnel, the age-related and occupation-related regulations governing the usage location must be observed.

2.3.2 Unauthorized Persons

WARNING

Risk to life for unauthorized personnel due to hazards in the danger and working zone!



Unauthorized personnel who do not meet the requirements described in this manual will not be familiar with the dangers in the working zone. Therefore, unauthorized persons face the risk of serious injury or death.

- ▶ Unauthorized persons must be kept away from the danger and working zone.
- ▶ If in doubt, address the persons in question and ask them to leave the danger and working zone.
- ▶ Cease work while unauthorized persons are in the danger and working zone.

2.3.3 Instruction

Personnel must receive regular instruction from the owner. The instruction must be documented to facilitate improved verification.

Date	Name	Type of Instruction	Instruction Provided By	Signature

2.4 Personal Protective Equipment

Personal protective equipment is used to protect the personnel from dangers which could affect their safety or health while working.

Personnel must wear personal protective equipment while carrying out the different operations at and with the device.

This equipment will be defined by the head of the laboratory. Always comply with the instructions governing personal protective equipment posted in the work area.

2.5 Position of the Emergency Stop Button



The AQS system is a subunit of the spectrometer electronics cabinet. As such it has no mains switch or emergency stop button.

In case of an emergency use the mains power switch at the back of the electronics cabinet.

2.6 Location of the Safety Label



The laboratory supervisor is responsible for ensuring that all the warning labels are maintained in their proper place any time that the device is used.

2.7 Basic Dangers

The following section specifies residual risks which may result from using the device and have been established by means of a risk assessment.

In order to minimize health hazards and avoid dangerous situations, follow the safety instructions specified here as well as in the following chapters of this manual.

2.7.1 General Workplace Dangers

WARNING



Risk to life from nonfunctional or insufficient safety devices!

If safety devices are not functioning or are disabled, there is a danger of serious injury or death.

- ▶ Check that all safety devices are fully functional and correctly installed before starting work.
- ▶ Never disable or bypass safety devices.
- ▶ Ensure that all safety devices are always accessible.

CAUTION



Risk of injury from tripping over dirt and scattered objects!

Dirt and scattered objects may cause people to slip or trip, resulting in personal injuries.

- ▶ Always keep the work area clean.
- ▶ Remove objects which are no longer required from the work area and particularly from the floor.
- ▶ Indicate unavoidable hazards using marking tape.

CAUTION



Accident hazard from falling from ladder!

It is possible to fall from a ladder when it is used to reach the device on some magnets.

- ▶ Do not use a ladder.
- ▶ Use an approved platform to reach the device on the magnet.
- ▶ Wear non-slip shoes.

NOTICE

Material damage due to a software error!

Samples or the device may be damaged due to a software error causing malfunction of the control system. Users may also be shocked by abrupt malfunction or unexpected system start.

- ▶ Dummy samples must be used during installation and service.
- ▶ Personnel should be alerted to unexpected malfunctions.

NOTICE

Material damage due to the use of genuine samples during installation and maintenance!

Using genuine samples during installation and maintenance may result in material damage.

- ▶ Use only dummy samples during installation and maintenance.

2.7.2 Dangers from Electric Power

DANGER

Danger to life from stored charges!

Electric charges may be stored in electrical components even after the system has been switched off and disconnected from the power supply. Contact with these components may result in serious or fatal injury.

- ▶ Before working on the specified components, ensure that they have been completely disconnected from the power supply.
- ▶ Allow 10 minutes to elapse in order to ensure that the internal capacitors have been fully discharged.

WARNING

Danger of injury from electrical shock!

A life threatening shock may result when the housing is open during operation.

- ▶ Only qualified personnel should open the housing.
- ▶ Disconnect the device from the electrical power supply before opening the device. Use a voltmeter to verify that the device is not under power!
- ▶ Be sure that the power supply cannot be reconnected without notice.

WARNING

Danger to life from residual electrostatic potentials!

Friction between material being conveyed may result in significant development of electrostatic potential. Therefore, contact with parts immediately following the conveying operation may be life-threatening.

- ▶ Potential equalisation must be ensured before making contact with parts, unless such equalisation is provided by the customer.



Electrostatic discharge from friction may occur, resulting in an electric spark and loud bang. Use ESD flooring and wear ESD shoes.

WARNING

Danger to life from contact voltage!

Absent or faulty protective earth conductor may result in contact voltage. This may pose a risk of injury or death.

- ▶ Before the initial commissioning of the device, connect the main power supply to the socket and verify the complete functionality of the protective earth conductor.



2.7.3 Mechanical Dangers

CAUTION



Accident and material damage hazard from falling objects!

Equipment may fall down during assembly, retrofitting, or dismantling. This may result in personal injury or equipment damage.

- ▶ If necessary, assemble/disassemble the device in multiple parts.
- ▶ Use a platform with railings instead of a ladder to reach the assembly area.
- ▶ Avoid working over the head. When this can not be avoided, wear a protective hard hat.
- ▶ Follow the mounting instructions in the installation manual.

2.8 Environmental Protection

NOTICE

Potential environmental damage from incorrect handling of pollutants!

Incorrect handling of pollutants, particularly incorrect waste disposal, may cause serious damage to the environment.

- ▶ Always observe local environmental regulations regarding handling and disposal of pollutants.
- ▶ Take the appropriate actions immediately if pollutants escape accidentally into the environment. If in doubt, inform the responsible municipal authorities about the damage and ask about the appropriate actions to be taken.

The following pollutants are used:

Cleaning liquids	Cleaning liquids incorporating solvents contain toxic substances. They must not be allowed to escape into the environment. Disposal must be carried out by a specialist disposal company.
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2.9 Signs and Labels



The identification and placement of warning labels are included in the manual. The laboratory supervisor is responsible for ensuring that all the warning labels are maintained in their proper place any time that the device is used. New signs and labels can be obtained from Bruker Service.

The following symbols and information signs can be found in the work area. They refer to their immediate surroundings.

Electrical Voltage



Only qualified electricians are permitted to work in a work room marked by this sign. Unauthorized persons must not enter the workplaces thus marked and must not open the marked cabinet. The warning label may be ordered using Bruker Part Number 23948.

Danger Spot



Warning indicating a danger spot in work rooms.
The warning label may be ordered using Bruker Part Number 23944.

Cold spot



Warning indicating a cold spot in work rooms.
The warning label may be ordered using Bruker Part Number 23943.

Hot spot



Warning indicating a hot spot in work rooms.
The warning label may be ordered using Bruker Part Number 23945.

Protection

Never Open!

Warning indicating.

The warning label may be ordered using Bruker Part Number Z129088.

Personal Protective Equipment



Protective Goggles (DIN EN 166, 170 & 172)

Protect the eyes from injury due to flying cold gases, liquids and parts. The safety label may be ordered using Bruker Part Number 23946.



Protective Gloves (DIN EN 388, 420 & 511)

Protect the hands from injury caused by contact with extremely cold gases, liquids or surfaces and for protection from injury caused by rough edges. The safety label may be ordered using Bruker Part Number 23947.







3 Transport, Packaging and Storage



Installation, initial commissioning, retrofitting, repairs, adjustments or dismantling of the device must only be carried out by Bruker Service or personnel authorized by Bruker. Damage due to servicing that is not authorized by Bruker is not covered by your warranty.

3.1 Symbols on the Packaging

The following symbols are affixed to the packaging material. Always observe the symbols during transport and handling.

Top		The arrow tips on the sign mark the top of the package. They must always point upwards; otherwise the content may be damaged.
Fragile		Marks packages with fragile or sensitive contents. Handle the package with care; do not allow the package to fall and do not allow it to be impacted.
Protect Against Moisture		Protect packages against moisture and keep dry.
Attach Here		Lifting gear (lifting chain, lifting strap) must only be attached to points bearing this symbol.
Center of Gravity		Marks the center of gravity of packages. Note the location of the center of gravity when lifting and transporting.
Weight, Attached Load		Indicates the weight of packages. Handle the marked package in accordance with its weight.






Permitted Stacking Load		<p>Indicates packages which are partially stackable.</p> <p>Do not exceed the maximum load-bearing capacity specified on the symbol in order to avoid damaging or destroying the content.</p>
Do not Damage Air-tight Packaging		<p>The packaging is air-tight. Damage to the barrier layer may render the contents unusable.</p> <p>Do not pierce.</p> <p>Do not use sharp objects to open.</p>
Component Sensitive to Electrostatic Discharge		<p>The packaging contains components which are sensitive to an electrostatic discharge.</p> <p>Only allow packaging to be opened by trained personnel.</p> <p>Establish potential equalization before opening.</p>
Protect from Heat		<p>Protect packages against heat and direct sunlight.</p>
Protect from Radioactive Sources		<p>Protect packages against radioactive sources.</p>

Table 3.1: Symbols on the Packaging

3.2 Inspection at Delivery

Upon receipt, immediately inspect the delivery for completeness and transport damage.

Proceed as follows in the event of externally apparent transport damage:

- Do not accept the delivery, or only accept it subject to reservation.
- Note the extent of the damage on the transport documentation or the shipper's delivery note.
- Initiate complaint procedures.



Issue a complaint in respect to each defect immediately following detection. Damage compensation claims can only be asserted within the applicable complaint deadlines.

3.3 Packaging

About Packaging

The individual packages are packaged in accordance with anticipated transport conditions. Only environmentally friendly materials have been used in the packaging.

The packaging is intended to protect the individual components from transport damage, corrosion and other damage prior to assembly. Therefore do not destroy the packaging and only remove it shortly before assembly.

Handling Packaging Materials

Keep the original container and packing assembly, at least as long as the warranty is valid, in case the unit has to be returned to the factory. When the packaging material is no longer needed dispose of it in accordance with the relevant applicable legal requirements and local regulations.

3.4 Storage

Storage of the Packages

Store the packages under the following conditions:

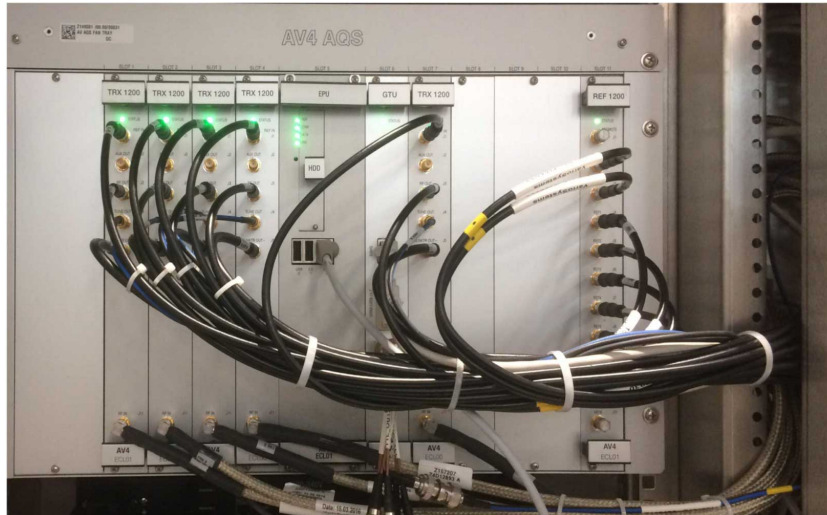
- Do not store outdoors.
- Store in dry and dust-free conditions.
- Do not expose to aggressive media.
- Protect against direct sunlight.
- Avoid mechanical shocks.
- Storage temperature: 15 to 35 °C.
- Relative humidity: max. 60%.
- If stored for longer than 3 months, regularly check the general condition of all parts and the packaging. If necessary, top-up or replace preservatives.



Under certain circumstances, storage instructions may be affixed to packages which expand the requirements specified here. Comply with these accordingly.

4 Design and Function

4.1 AVANCE History



The first Acquisition System (named AQS) was introduced into the market in 1999 in the **AVANCE** Spectrometer. The main reason was the development of a BRUKER own synthesizer (SGU) based on a novel channel concept. The architecture of the former AQR and AQX (parts of the D*X spectrometer family) units have been unified, higher integrated and more standardized. During the last years the architecture has been completed with additional and more diversified configurations still based on a unified hardware and software concept. This allowed i.e. to enhance Solids configurations (RX-BB instead of SE451), to develop higher integrated High Resolution spectrometer electronics (AQS integrated LNA preamplifiers instead of HPPR), to offer new MRI solutions (Pharmascan and Biospec with multiple RX) and standardize the FTMS platforms (SGU FTMS).

The 2nd generation (named **AVANCE II**) was the introduction of a new receiver system. The former RCU, RX-22 and the HADC/2 and SADC were replaced by the new DRU and RXAD (equipped in the also new AQS/2 chassis) which brought a much higher integration and increased performance.

The 3rd step (**AVANCE III**) was the replacement of the VME boards, such as CCU, FCU, TCU and GCU by the IPSO (intelligent pulse sequence organizer). The AQS/3 chassis can be equipped with an IPSO AQS Unit for systems up to three channels. Systems with more than three channels need the extended IPSO 19" Unit. The IPSO compatible SGU/2 was the successor of the former SGU with a higher bandwidth digital interface for setting all relevant pulse program parameters such as frequency, phase and amplitude at the same time. A package of frequency, phase- and amplitude-words together with some relevant real time pulses can be set synchronously every 25ns via the 80MHz and 48bit wide LVDS link. The setting via the synchronous and differential LVDS link guarantees an excellent isolation between digital computer electronics and purest RF signals.

With the introduction of **AVANCE III HD** a new and higher integrated digital RF synthesizer SGU/3 was being used for signal generation. It was based on latest digital RF components running at higher clock rates. This new synthesizer was fully compliant with the AVANCE III IPSO but requires different infrastructure (chassis, reference signals, power supply). At the same time a unification of frequency variants has taken place. There are no specific 400 MHz versions anymore.

The AQS/3+ chassis offers one central 48V AC/DC power supply. All local voltages are derived from this central supply. The SGU/3 incorporates two highly integrated and independent RF channels with increased performance compared to the former SGU/2. The REF/3 generates all the necessary fix-frequencies for the SGU/3 and also synchronizes via a global reset all SGU/3. Therefore, even in a complex multi chassis system, only one REF/3 is required.

With the recently introduced **AVANCE NEO** a new level in NMR electronics-integration has been reached. All the important NMR main-functional blocks, such as pulse-program executor, sequencer, synthesizer, receiver, digital down converting and data decimation are now implemented on a single unit, the so called Transceiver 1200 (AV4 TRX 1200). Or in other words, the entire low power electronics of a full NMR channel is located on a single board. A high speed PCIe data link connects all AV4 TRX to the AV4 EPU (Embedded Processing Unit), which controls the acquisition and acts as a local NMR data server and storage.

A single **AV4 AQS** chassis can be equipped with up to maximal eight AV4 TRX 1200 (eight fully independent transceiver channels). Other necessary support functions such as a new reference board and power supply modules, do also well suit into the AV4 AQS chassis. Special MRI-configurations do allow operating of up to 24 independent, but fully synchronous channels.

4.2 Features of the AVANCE NEO Acquisition System (AV4 AQS Chassis)

- Unified low power NMR electronics for liquids, solids and (micro-)imaging.
- Prepared for up to 8 NMR channels in one chassis (low power RF electronics).
- Each channel incorporates a full and independent pulse-program-sequencer, receiver and transmitter.
- Only one frequency version up to 1200 MHz (system frequency).
- Expandable up to 24 channels (additional chassis may be needed).
- 12.5 ns timing resolution and synchronization of each channel.
- Software controlled mains cycling (power up and down).



Figure 4.1: Typical AV4 AQS Chassis configuration for 4-Channel AV NEO.

4.3 The Channel Concept

With the introduction of the AVANCE NEO, the well proven acquisition channel concept has been further extended by the integration of the pulse-program-sequencer, receiver and synthesizer into a single unit. Therefore, multi receive will become a standard.

It was possible to further reduce control and routing of important channel related real time events and analog signals to only a few dedicated units.

The following diagram shows the consequent implementation of this concept. The number of analog interconnections is reduced to a few dedicated units. All important RF signals, blanking pulses and dwell clock are channel related and follow a straightforward channel philosophy. In this way, extended and independent multi-channel operation can be performed in a much more transparent way. Less interfaces and units allow a general guaranteed stability and reliability.

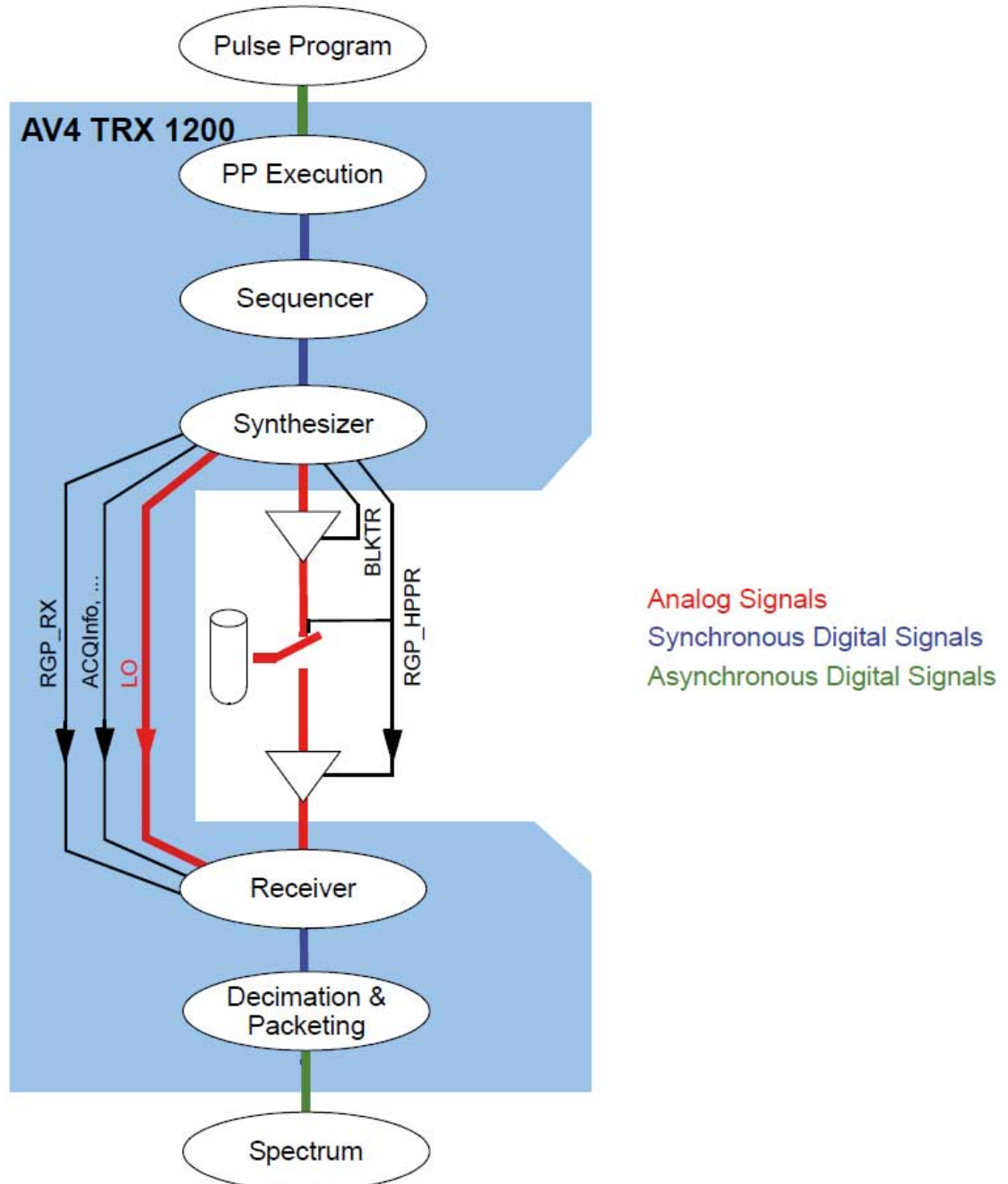


Figure 4.2: AQS Channel Concept

5 AV4 AQS Chassis (Mainframe)

5.1 Overview

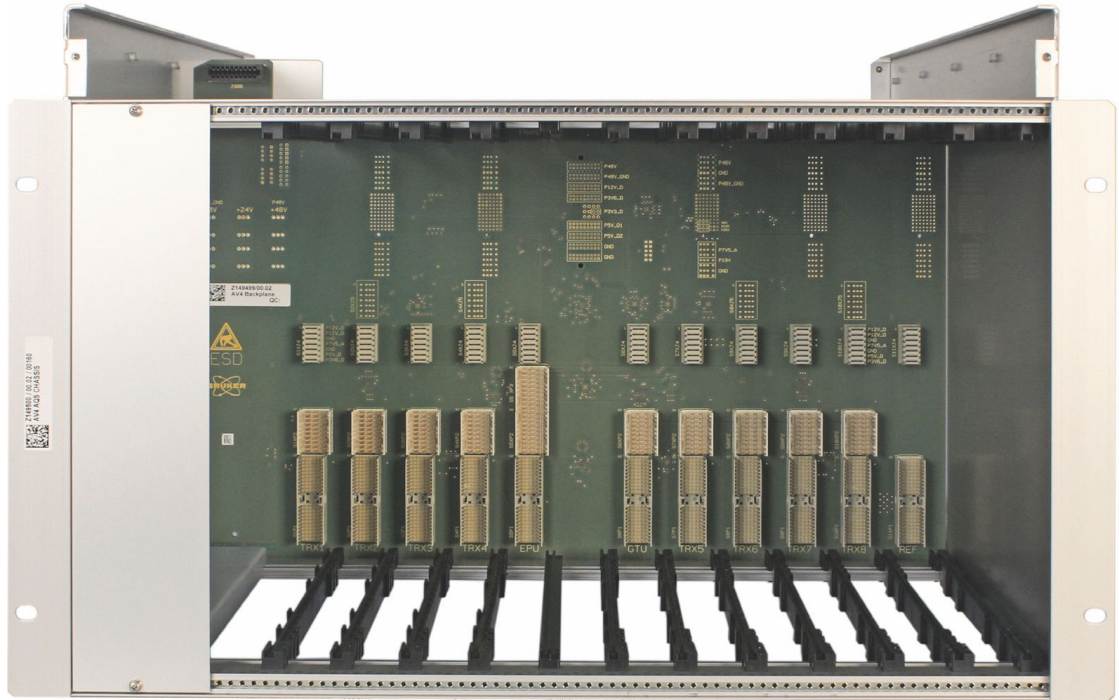


Figure 5.1: Front View AV4 AQS Chassis

5.2 Description

The AV4 AQS Chassis is the mainframe for the AV NEO AQS system. It contains a backplane with slots for all necessary acquisition units and power supplies. These include:

- AV4 TRX 1200 Transceiver Unit
- AV4 EPU Embedded Processing Unit
- AV4 GTU GT-Controller Unit
- AV4 REF 1200 Reference Unit
- AV4 PSM-48V, AV4 PSM-A, AV4 PSM-D, AQS PSM-HPLNA, and AQS PSM-ADM Power Supply Modules



Units of previous AQS generations are not compatible to the AV4 AQS Chassis! Exceptions are AQS PSM HPLNA and AQS PSM ADM.

Cooling is provided by nine fans in the AV4 AQS Fan Tray inserted on the top. For more information about the fan tray see [AV4 AQS Fan Tray \[33\]](#).

5.2.1 Power On/Off



The AV4 AQS Chassis has no power On/Off switch!

The AV4 AQS Chassis has neither a mains power inlet nor a mains distribution.

The mains power is routed via the Power Distribution Unit (AV4 PDU 8/16A) of the cabinet directly to each AC/DC power supply module of the chassis. The AV4 PDU 8/16A controls the power-up/down cycle of the individual PSMs and thus the chassis.

For more information on mains power supply and the power supply modules refer to [AV4 Mains Power Distribution Unit \[85\]](#) and [AV4 Power Supply Modules \[35\]](#).



No operation without AV4 AQS Fan Tray!

The AV4 AQS chassis power supply does not power up if no fan tray is present. It automatically turns off (without warning) when the fan tray is removed during operation.

5.2.2 AV4 AQS Chassis Backplane Functions

The backplane (user bus) incorporates various functions:

- DC power distribution.
- I²C bus distribution with active bus switches.
- Reference clock and PCIe clock distribution (see page 96).
- PCIe clock generation.
- PCIe- and AQ-bus distribution including termination.
- Auxiliary control signal and gating pulse distribution.
- Slot and System-ID (chassis code) signals including chassis code setting switch.

5.2.3 Part Numbers

Bruker Part Number	Description
Z149500	AV4 AQS CHASSIS

Table 5.1: Part Numbers: AV4 AQS Chassis

5.2.4 Technical Data

Technical

Number of front slots: 8x TRX, 1x EPU, 1x GTU, 1x REF	11	Slot
Number of rear slots: 3x standard PSM (48V/A/D), 4x auxiliary PSM	7	Slot
Reference clock: +3,3V LVECL, differential	20	MHz
PCIe clock: +3,3V LVECL, differential	100	MHz

Mechanical

Length	58.0	cm
Width 19 inch	48.3	cm
Height 6 HU + 1 HU	31.1	cm
Weight	5.1	kg

5.3 Troubleshooting

The AV4 AQS Chassis can only be replaced as a whole field replaceable unit (FRU). There are no serviceable parts.

Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages.

General information on troubleshooting, error handling and failure reporting is available in chapter [Troubleshooting \[97 \]](#).

5.3.1 Diagnostics

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems.

One can connect to the Service Web page on the AV4 EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

6 AV4 AQS Fan Tray

6.1 Overview

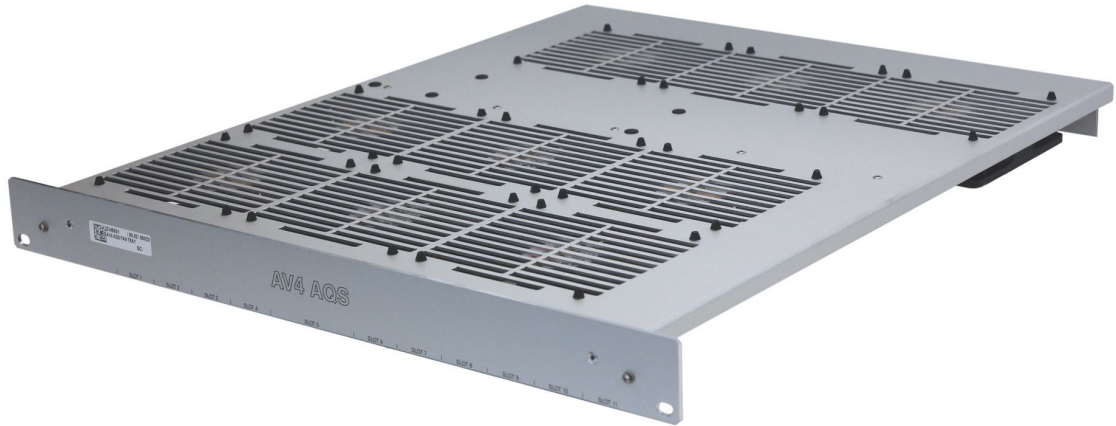


Figure 6.1: View of the AV4 AQS Fan Tray

6.2 Description

The AV4 AQS Fan Tray is located on top of the AV4 AQS Chassis mainframe as a separate field replaceable unit. It contains nine dc cooling fan. The fan are controlled and supervised by an on board control print connected to the I2C bus interface. It connects directly to the AV4 AQS Chassis backplane. The monitoring is done via the host rack controller software in the EPU/2.

Control Functions

- Fan speed control: full speed / reduced speed
- Supervision of each individual fan: On/Off check

6.3 Part Numbers

Bruker Part Number	Description
Z149501	AV4 AQS FAN TRAY

Table 6.1: Part Number: AV4 AQS Fan Tray

6.4 Technical Data

Technical

Number of fan	9	
Fan supply voltage	12	Vdc
Fan supply current	Max. 3	Adc

Mechanical

Length	57.0	cm
Width	48.3	cm
Height 1 HU	4.5	cm
Weight	2.8	kg

6.5 Troubleshooting

The AV4 AQS Fan Tray can be replaced by Bruker Service as a whole Field Replaceable Unit (FRU).

Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages.

General information on troubleshooting, error handling and failure reporting is available in chapter [Troubleshooting \[97\]](#).

6.5.1 Diagnostics

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems.

One can connect to the Service Web page on the AV4 EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

7 AV4 Power Supply Modules

7.1 System Overview



Figure 7.1: Overview AV4 Power Supply Modules

7.2 System Description

The basic power supply system of the AV4 AQS Chassis consists of one ac/dc and two dc/dc power supply modules (PSM). Depending on the configuration up to four auxiliary PSM may be used.

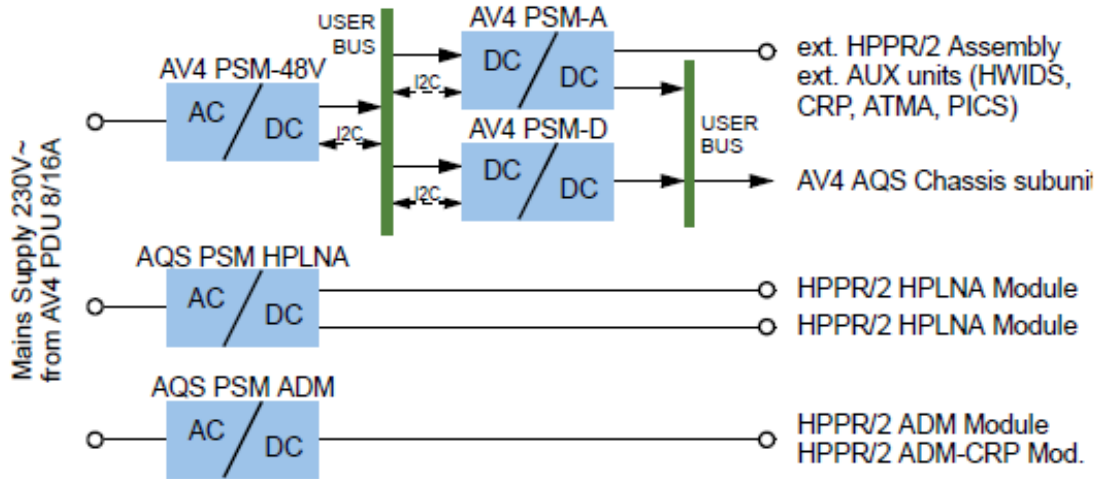


Figure 7.2: Block Diagram: Power Supply System

7.3 Unit Description

7.3.1 AV4 PSM-48V Power Supply Module

The PSM-48V unit consists of an ac-input filter and two compact switched mode AC/DC power supply modules with $\pm 24V$ output. The ac-input is internally fused (L+N, not user accessible).

The ac-input connector is on the front panel, the dc-output connects to the backplane.

The supply status is indicated on the front panel (Power LED).

The unit has no serviceable parts or fuses.



Figure 7.3: View AV4 PSM-48V



Mains input specifications see [Connection Values \[105\]](#).
 Rating plate information see [Rating Plates \[107\]](#).

7.3.2 AV4 PSM-A Power Supply Module

The AV4 PSM-A module consists of several hybrid DC/DC power supplies on a printed circuit board. The 48V input and most outputs connect to the backplane.

The module also incorporates the following functions:

- External and internal HPPR/2 assembly supply and interface including BFB bus
- RGP HPPR pulse output to external HPPR/2 assembly
- External AUX unit supply and interface: HWIDS, CRP, ATMA, PICS
- TPF0 signal input from BSMS/2 L-TRX
- Internal I2C bus master

The supply status is indicated on the front panel.

The unit has no serviceable parts except fuses.

AV4 Power Supply Modules

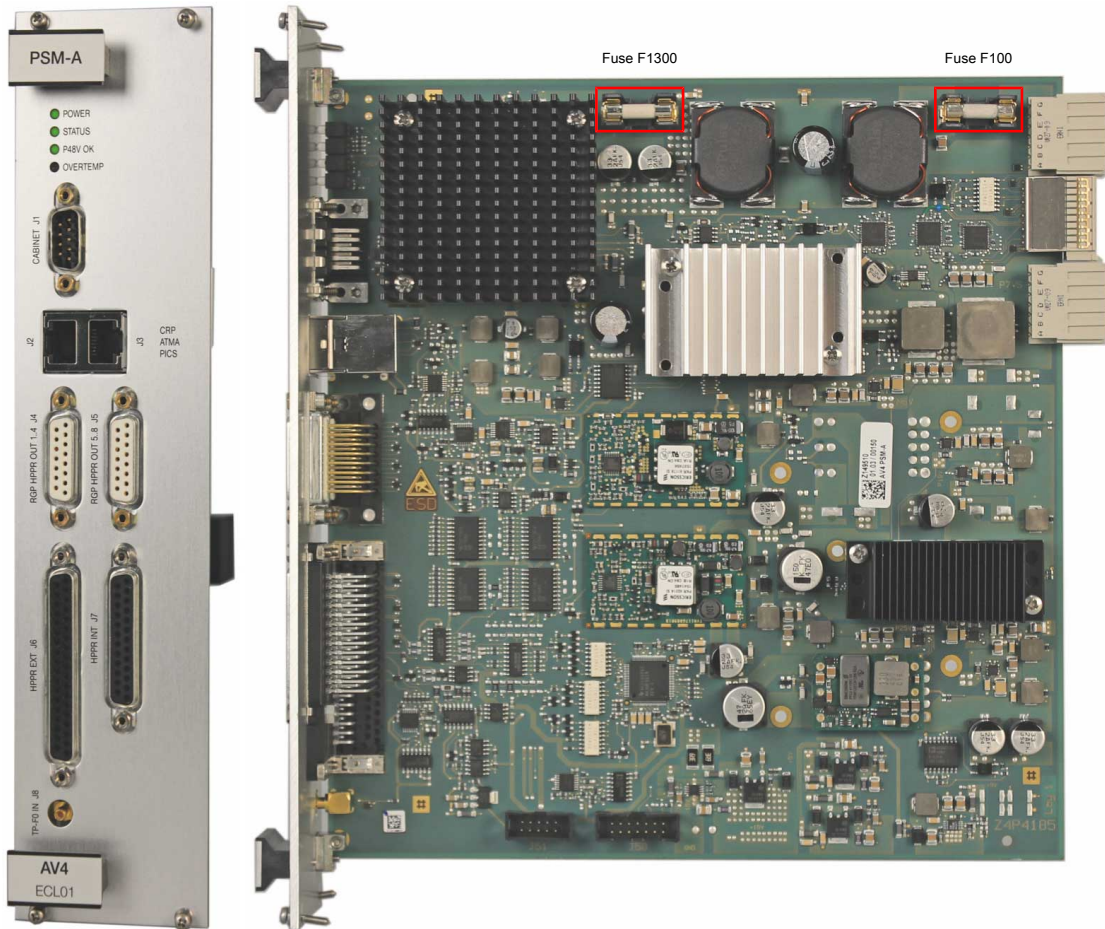

















Figure 7.4: View AV4 PSM-A

Supply	Fuse	Mat. Nb.	Value
+48V Input	F100	1808981	10 AT H
+9V HPPR Output	F1300	1801422	5 AT H

Table 7.1: Fuses PSM-A2

7.3.2.1 LED Display

LED	LED Status		Description
POWER		off	Power off / Power supply output error
		green	Power on, all power supply output ok
STATUS		off	Power off
		white	Configuration error / Reset / Init in progress
		blue	Communication error: no USB connection to EPU/2
		Heartbeat flicker	Power on, unit ready for operation
		red	Error
P48V OK & OVERTEMP		P48V OK OVERTEMP	Power off / P48V input supply failure (from AV4 PSM-48V)
			
		P48V OK OVERTEMP	Power on, P48V input supply ok
			
		P48V OK OVERTEMP	Over temperature error: Fan tray not installed properly ^a
			
	P48V OK OVERTEMP	PSM-A ECL≤02 only: PSM-48V error: -24V supply failure ^b	
			

^a Only a missing or incorrectly installed fan tray is detected. Actual over temperature detection followed by a power supply shutdown is not implemented.

^b An -24V power supply failure inside the AV4 PSM-48V may falsely trigger the OVERTEMP LED

Table 7.2: LED colors: AV4 PSM-A

7.3.3 AV4 PSM-D Power Supply Module

The AV4 PSM-D module consists of several hybrid DC/DC power supplies on a printed circuit board. The 48V input and all outputs connect to the backplane.

The supply status is indicated on the front panel (Power LED).

The unit has no serviceable parts except fuses.

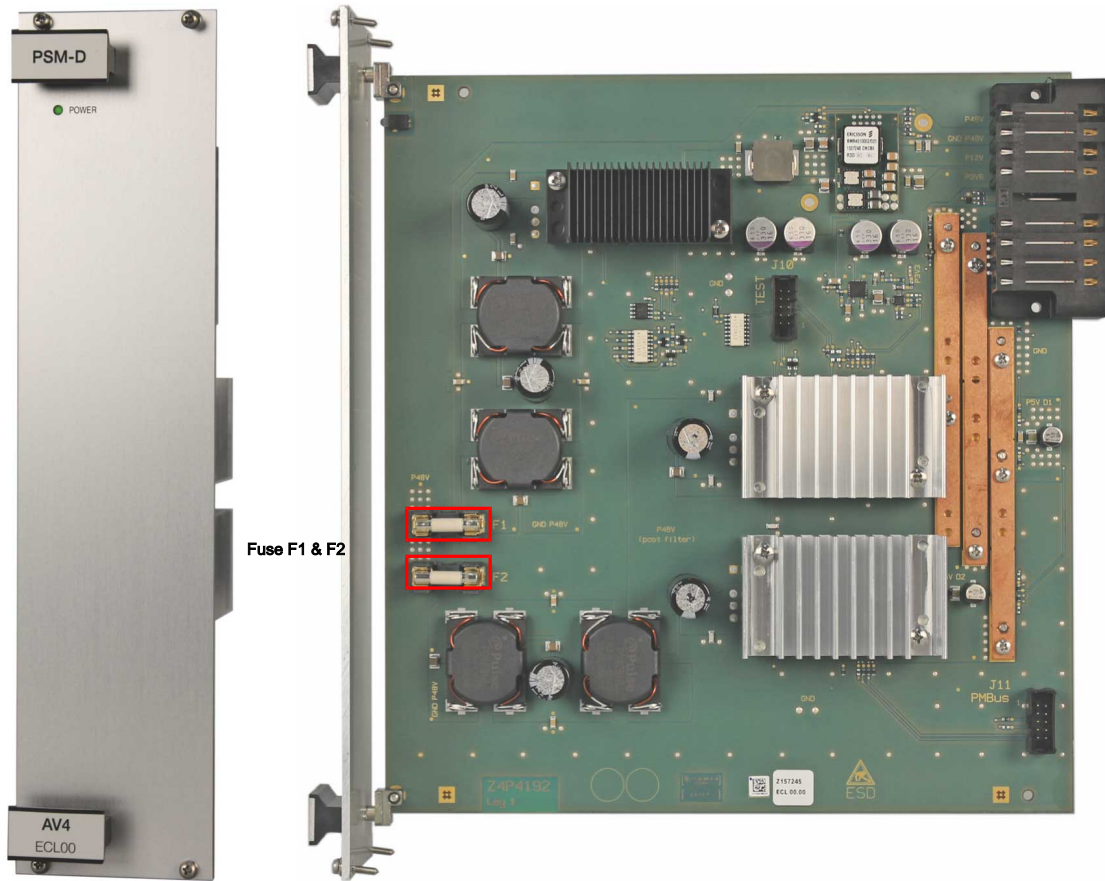


Figure 7.5: View AV4 PSM-D

Supply	Fuse	Mat. Nb.	Value
+48V Input	F1	49216	8.0 AT H
+48V Input	F2	49216	8.0 AT H

Table 7.3: Fuses AV4 PSM-D

7.3.4 AQS PSM HPLNA

The AQS PSM HPLNA is a compact switched mode AC/DC power supply module with multiple outputs. The input cable connects directly to a AV4 PDU 8/16A mains power outlet. The DC-outputs connect to two D-SUB connectors with high-voltage pins on the front panel. There are no connections to the AV4 AQS Chassis backplane or other units within the chassis.

The supply status is indicated with LED's on the front panel.

The unit has no serviceable parts or fuses.

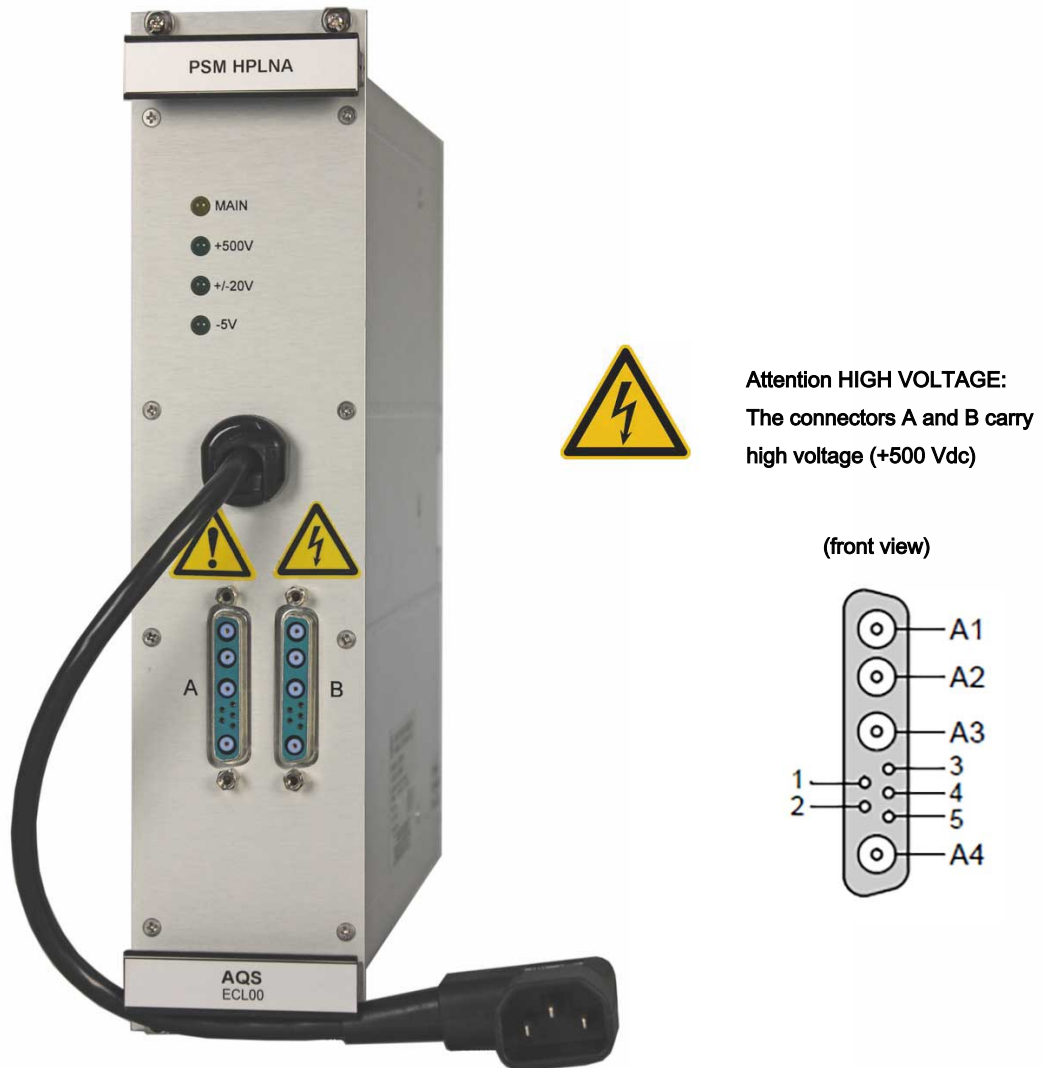


Figure 7.6: View AQS PSM HPLNA



Mains input specifications see [Connection Values \[105\]](#).

Rating plate information see [Rating Plates \[107\]](#).

7.3.5 AQS PSM ADM

The AQS PSM ADM is a compact switched mode AC/DC power supply module with multiple outputs. The input cable connects directly to a AV4 PDU 8/16A mains power outlet. The DC-outputs connect to an UT0 connector with 12 DC pins on the front panel.

There are no connections to the AV4 AQS Chassis backplane or other units within the chassis.

The supply status is indicated with LED's on the front panel.

The unit has no serviceable parts except fuses.

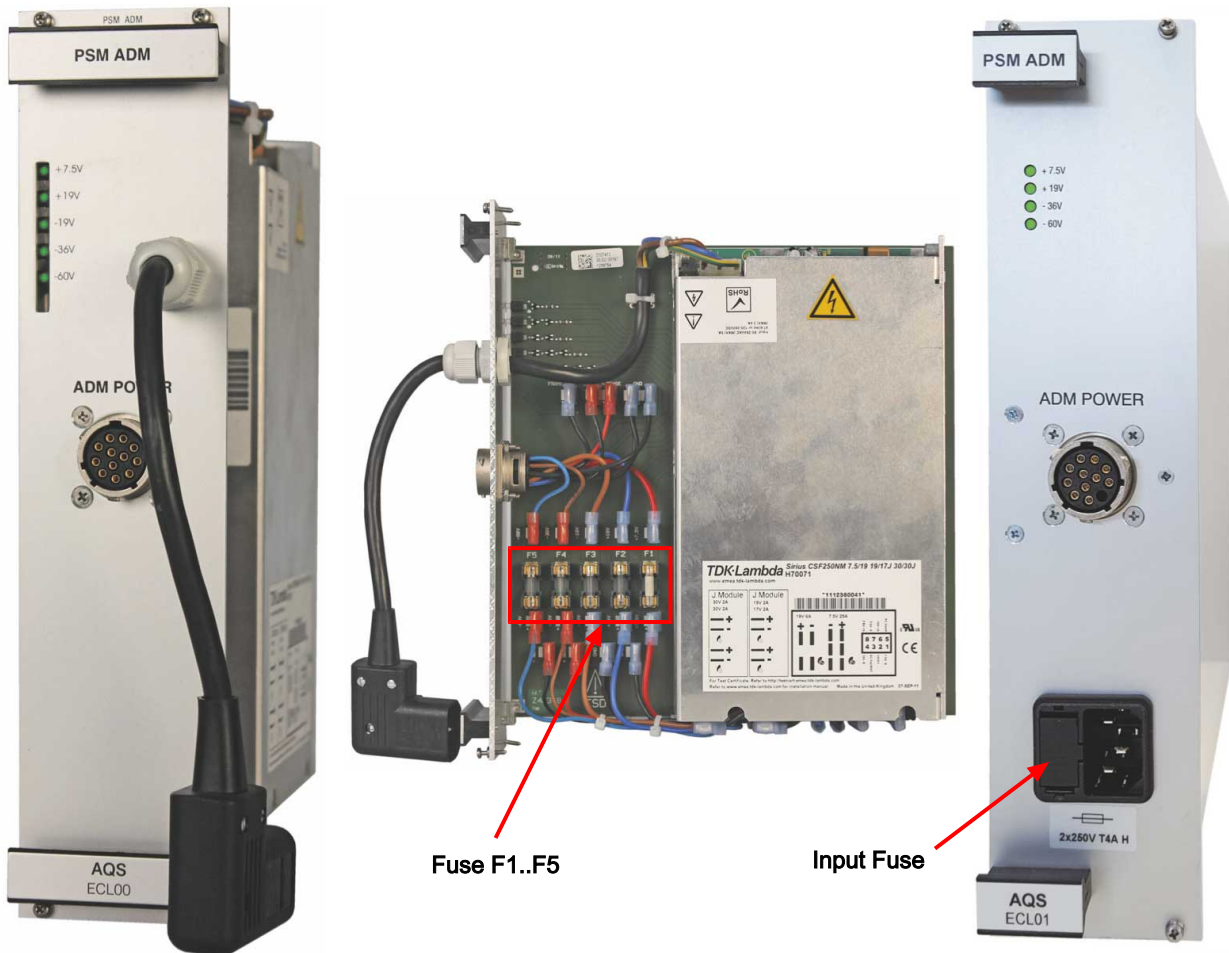


Figure 7.7: View AQS PSM ADM: ECL00 & ECL01



Mains input specifications see [Connection Values](#) [▶ 105].

Rating plate information see [Rating Plates](#) [▶ 107].

7.3.6 Part Numbers

Type	Bruker Part Number	Description
AC/DC	Z149850	AV4 PSM-48V POWER SUPPLY MODULE
DC/DC	Z149510	AV4 PSM-A POWER SUPPLY MODULE
	Z149520	AV4 PSM-D POWER SUPPLY MODULE
Auxiliary AC/DC	Z104783	AQS PSM HPLNA
	Z107413	AQS PSM ADM

Table 7.4: Part Numbers: AQS Power Supply



AVIII HD AQS chassis PSM are not compatible to the AV4 AQS chassis!
Only auxiliary PSM without backplane connectors can still be used.

7.3.7 Troubleshooting

Some PSM contain fuses accessible for service personnel. See description of the individual PSM. Other than that there are no serviceable parts.

WARNING



Risk to life from electrical shock

A life threatening shock may result when the housing is open during operation.

- ▶ Only qualified personnel should open the housing.
- ▶ Disconnect the device from the electrical power supply before opening the device. Use a voltmeter to verify that the device is not under power!
- ▶ Be sure that the power supply cannot be reconnected without notice.

Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages.

General information on troubleshooting, error handling and failure reporting is available in chapter [Troubleshooting \[97\]](#).

7.3.7.1 Diagnostics

The supply status is indicated either with one POWER LED for all output voltages or one LED per output voltage.

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems, depending on the capabilities of the individual PSM.

One can connect to the Service Web page on the EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

8 AV4 Transceiver 1200

8.1 Overview

The Transceiver (AV4 TRX) concentrates all the important NMR main-functional blocks, such as pulse-program executor, sequencer, synthesizer, receiver, digital down converting and data decimation, on a single unit. Or in other words, the entire low power electronics of a full NMR channel is located on the AV4 TRX.

There is only one version for all NMR systems up to 1200 MHz.

8.2 Description

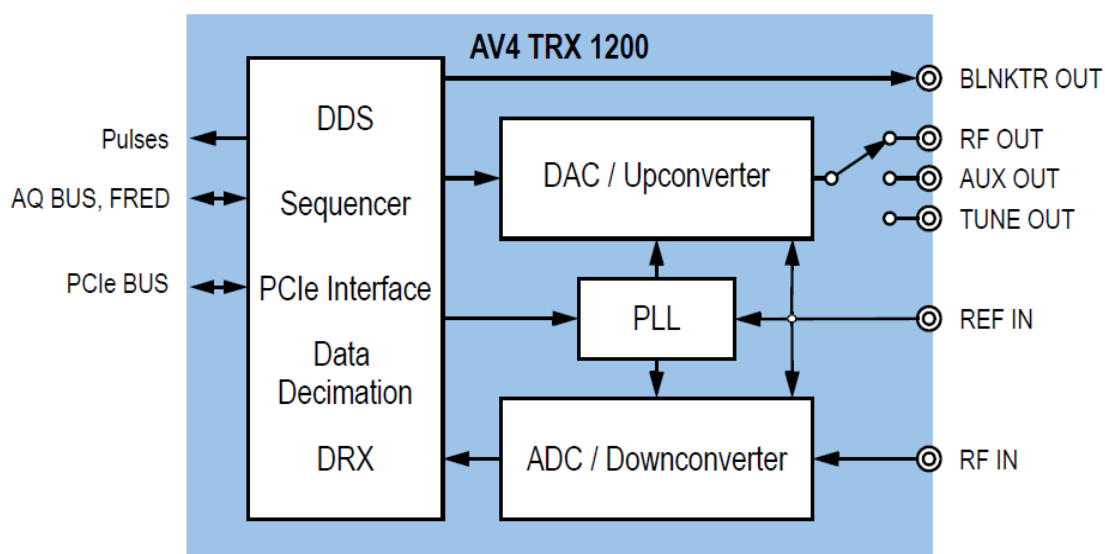


Figure 8.1: Block Diagram: AV4 TRX 1200

8.2.1 Front Panel Wiring/Display



Figure 8.2: View AV4 TRX 1200

8.2.2 LED Display








LED Status		Description
	off	Power off/Power supply error
	white	Configuration error/Reset/Init in progress
	magenta	Diagnostic mode
	blue	Error: REF IN or clock signal missing Short pulse (<1s) during „Synchro Reset“
	green	Power on, unit ready for operation
	red	Error
	yellow	Warning

Table 8.1: LED Colors: AV4 TRX 1200

8.2.3 Front Panel Connectors

J1 REF IN

Reference signal input from AV4 REF unit.

J2 AUX OUT

Auxiliary transmitter signal output.

J3 RF OUT

RF transmitter signal output.

J4 TUNE OUT

Tune signal output.

J5 BLNKTR OUT~

Transmitter blanking pulse output.

J11 RF IN

Receiver signal input from PREAMP module.

8.2.4 Part Numbers

Bruker Part Number	Description
Z148391	AV4 TRANSCEIVER 1200

Table 8.2: Part Number: AV4 TRX 1200

8.2.5 Technical Data

Frequency range:	5 - 1280	MHz
Frequency resolution:	< 0.005	Hz
Phase resolution:	< 0.006	°
Attenuation resolution:	< 0.1	dB
Attenuation range:	90	dB
Amplitude modulation:	> 90	dB
Min. time for simultaneous setting of frequency, phase and amplitude:	12.5	ns
Monotony amplitude:	< ± 0.1	dB
Monotony phase:	< ± 0.5	°
Waveform / Pulse program memory:	1	GB
RF intermediate frequency:	1.852	GHz
NMR signal generation: (digital up converter, DUC)	960	MSPS
NMR signal detection: (digital down converter, DDC)	240	MSPS
Spectral width:	50 - 7'500'000	Hz
Effective dynamic range (SW < 7.5 MHz):	> 17	Bit
Effective dynamic range (SW < 1 MHz):	> 19	Bit
Effective dynamic range (SW < 6 kHz):	> 23	Bit

8.3 Troubleshooting

The AV4 TRX 1200 can only be replaced as a whole unit (FRU). There are no serviceable parts.

Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages.

General information on troubleshooting, error handling and failure reporting is available in chapter [Troubleshooting \[▶ 97\]](#).

8.3.1 Diagnostics

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems.

One can connect to the Service Web page on the AV4 EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

9 AV4 Embedded Processing Unit

9.1 Overview

The Embedded Processing Unit (AV4 EPU/2) and the Embedded Processing Unit Replacer (AV4 EPU/2 R) connect the AV4 chassis to the TopSpin station PC.

Both units are based on the same design, but differently populated for two intended applications. The variant placement results in two distinct units, the AV4 EPU/2 resp. the AV4 EPU/2 R.

- Single Chassis operation: AV4 EPU/2 equipped with an onboard CPU.
- Single or Multi Chassis operation: AV4 EPUR/2 linked up by cable PCIe to the external CPU PCIe expansion card interface.



The AV4 EPU/2 and AV4 EPU/2 R units are successors of the original EPU unit. The versions are functionally identical, the difference is mainly in the housing design and hard drive ejection mechanism.

For ease of understanding, the acronyms AV4 EPU/2 and AV4 EPU/2 R are used in this manual, while the term AV4 EPU/2 covers both hardware revisions, AV4 EPU and AV4 EPU/2.



The manual contains no documentation for the AV4 EPU/2 R unit.

The unit will be documented upon availability of AV4 EPU/2 R information.

9.2 Description

The AV4 EPU/2 design incorporates a COM (Computer On Module) compact PC. The COM PCIe expansion bus is the root port for the PCIe distribution within the AV4. The root port, called upstream port, communicates with a 10-Port PCIe switch. The switch drives 9 downstream ports which are point-to-point connected to the AV4 endpoints such as AV4 TRX and AV4 GTU.

An AV4 internally routed USB bus connects the COM compact PC to the AV4 PSM-A. The USB bus serves as slow, asynchronous chassis control bus for AV4 configuration and administering tasks.

Programmable logic in the AV4 EPU/2 design supervises the chassis internal power-up and power-down sequence. The logic monitors the AV4 EPU/2 power supplies, the AV4 clock distribution status, the AV4 TRX/GTU status and the COM compact PC ACPI state and performs the power-on sequencing of the chassis.

Except the LAN Ethernet connection, all relevant AV4 EPU/2 interconnects are routed to the AV4 backplane and distributed internally within the chassis.

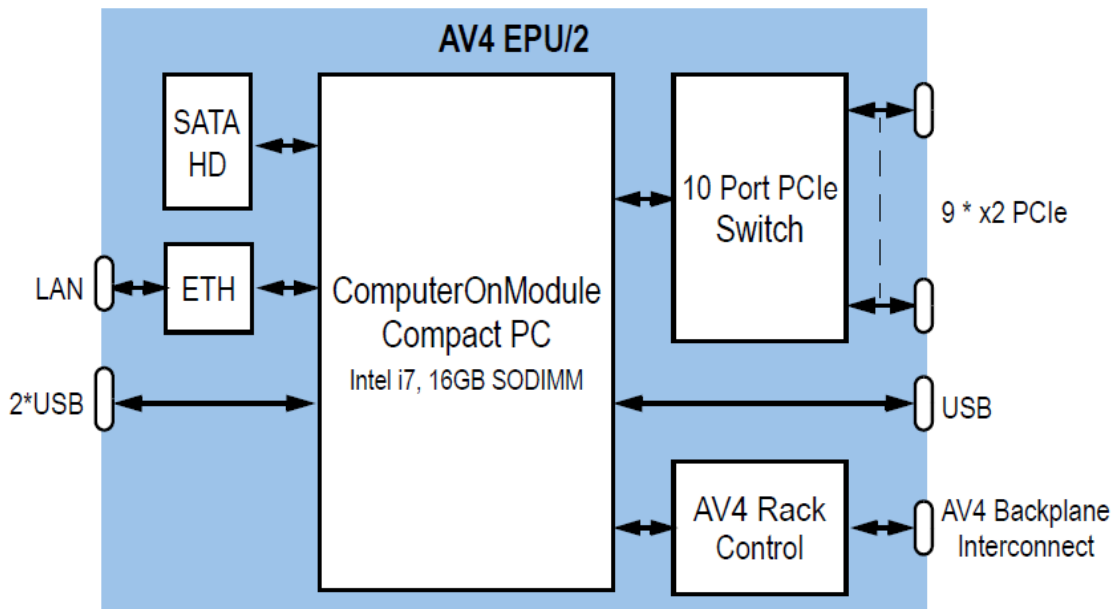


Figure 9.1: Block Diagram: AV4 EPU/2

9.2.1 Front Panel Wiring/Display



Figure 9.2: View AV4 EPU/2 (with mounted hard disk)

9.2.2 LED Display

The AV4 EPU/2 incorporates four LEDs as status and power monitor indicators.













LED	LED Status		Description
PWR		off	CPU in ACPI hibernate Soft Off mode (shutdown -r, shutdown -h).
		Red	Power Fail Condition (Chassis- or Onboard Supply).
		green	Power ON, unit in power-up sequence.
		heartbeat flicker	Power ON and BrukerAqRackControl Server alive, unit ready for operation.
CONF		off	One or several RF and gradient channels not ready for initialization.
		green	All RF and Gradient channels are ready for configuration or have been configured.
SATA		off	Intel CPU Serial ATA activity LED, presently no SATA drive activity.
		green flicker	Intel CPU serial ATA activity LED, ongoing SATA drive activity.
Link		blinking slow	Power-up and PCIe enumeration sequence ongoing. Ceaseless blinking: Unrecoverable error in PCIe bus interface, contact Bruker Service.
		red	Unrecoverable error in PCIe bus interface. Power Cycle Chassis, if status permanently ON contact Bruker Service.
		green	Power ON, unit in power-up sequence.
		heartbeat flicker	PCIe upstream and downstream ports configured and operating. Number of flickers indicates the downstream port count (up to 7 ports).

Table 9.1: LED Colors: AV4 EPU/2

Two additional LEDs are incorporated into the ETH LAN connector. Whereat the upper LED indicates a 1000Mbit/sec Ethernet link-up and the lower LED indicates LAN traffic (lighted / flickering).

9.2.3 Front Panel Connectors

ETH

Ethernet uplink to router.

USB0, USB1

USB ports, for internal use only.

9.2.4 Part Numbers

Bruker Part Number	Description
H153448	AV4 EPU EMBEDDED PROCESSING UNIT
H153455	AV4 EPU HARD DISK
H153448F1	AV4 EPU/2 EMBEDDED PROCESSING UNIT
H153455F1	AV4 EPU/2 HARD DISK

Table 9.2: Part Numbers: AV4 EPU



Due to different AV4 EPU vs. AV4 EPU/2 housing styles, the H153455 and H153455F1 hard disk assemblies are mechanically not compatible and won't fit into the opposite HDD slot.

An H153454 AV4 EPU Unit integrates a H153455 hard disk assembly and consequently an H153448F1 AV4 EPU/2 unit integrates a H153455F1 hard disk assembly.

9.2.5 Technical Data

COM (Computer On Module), revision dependent, EPU ECL 01 listed:

CPU	4-th generation Intel® Core™ i7 Quad Core™
Peripherals front panel accessible	2 * USB 2.0 1 * 1GbE
Memory	16GB DDR3L SO-DIMM

H153455 / H153455F1 Hard Disk:

Serial ATA™ (SATA)	1TB , SATA rev. 3.0, 6.0Gb/s
Operating System	Included in TopSpin distribution, Linux based

PCIe Distribution:

Root Complex	1 * x4 Gen2/3 20/32 GT/s up/down
End-Points	9 * x2 Gen2 10GT/s up/down

Board support, system integration:

Peripherals non-accessible	1 * USB 2.0 I2c
Run-time diagnostics	Various

9.3 Troubleshooting

The AV4 EPU/2 can only be replaced as a whole unit (FRU). There are no serviceable parts. The hard disk serves as a TopSpin experiment data storage device. If sensitive user data (experiment data) is stored on the disk:

- Remove the hard disk before replacing or returning the AV4 EPU/2 to Bruker.
- Keep and store the disk for security purposes at your site.

In the event of a repair or unit replacement of an AV4 EPU/2 with inserted AV4 EPU/2 Hard Disk, Bruker cannot guarantee the security of any user data on the hard disk, nor can Bruker guarantee that the hard disk will be returned to the same customer.

Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages.

General information on trouble shooting, error handling and failure reporting is available in chapter [Troubleshooting \[97\]](#).

9.3.1 Diagnostics

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems.

One can connect to the Service Web page on the AV4 EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

10 AV4 GT Controller Unit

10.1 Overview

Communication with a GTU is via PCIe. A GTU is also master of the AQ bus and sends real time control signals to all AQ bus slaves (TRX).

A GTU MRI performs the function of a GTU in AV4 systems with multiple chassis. Communication with a GTU MRI is via PCIe. The GTU MRI in the first chassis is master over all other GTU MRI

10.2 Description

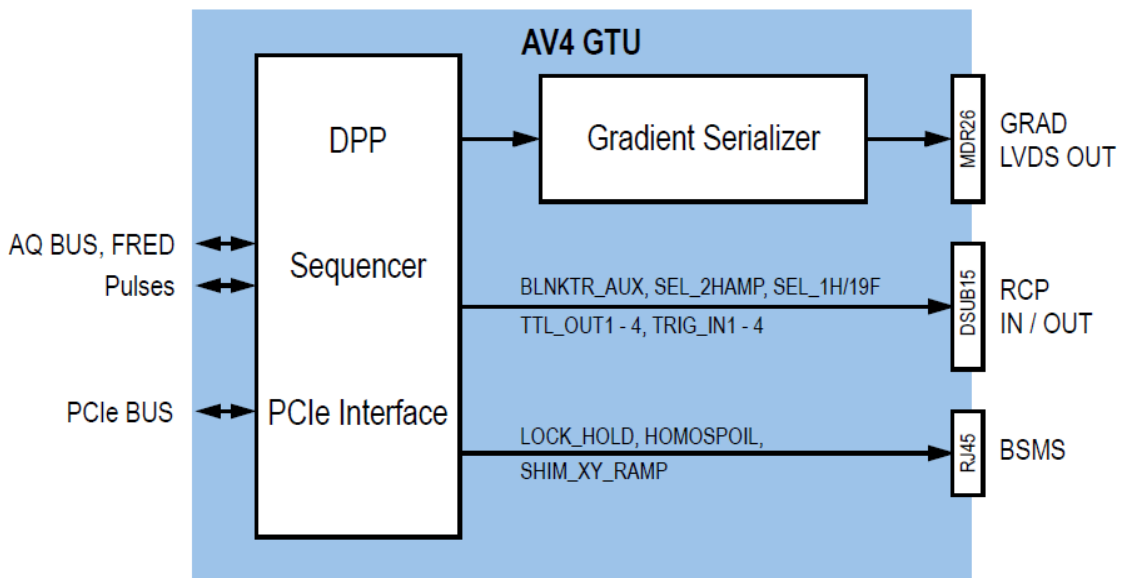


Figure 10.1: Block Diagram: AV4 GTU

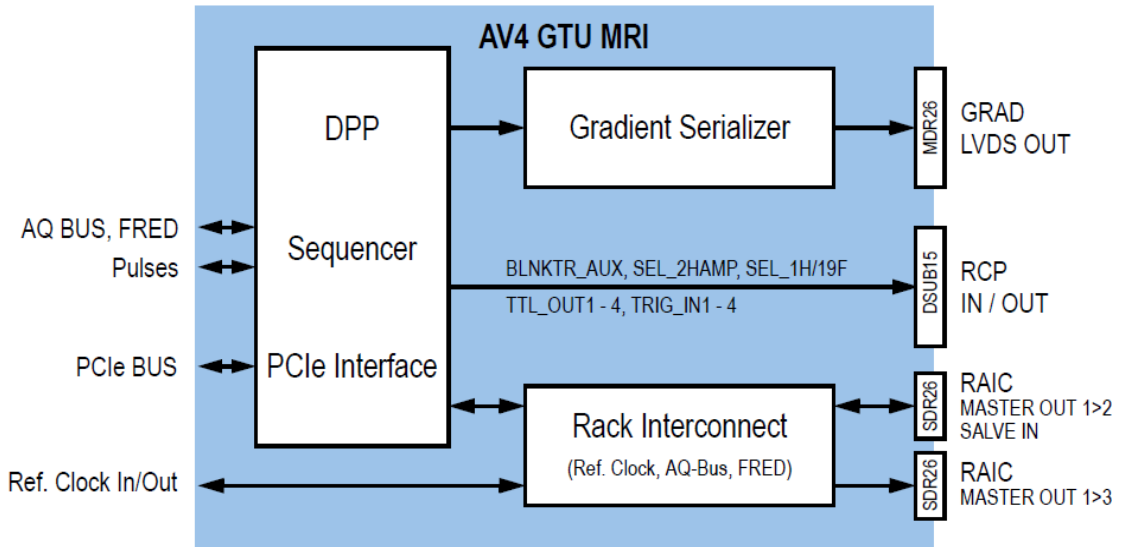


Figure 10.2: Block Diagram: AV4 GTU MRI

10.2.1 RCP Real Time Pulses

The front panel connectors BSMS (J6) and RCP IN/OUT (J9) host a total of four input and 14 output real time pulses. Only the pulses on J9 are user accessible.

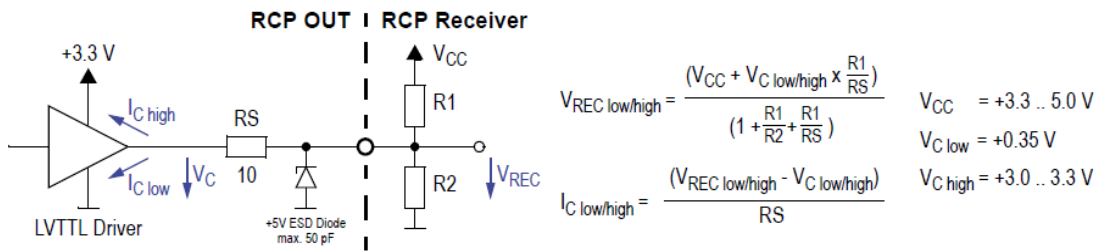


Figure 10.3: RCP Output Driver Circuit

Parameter	Combination of Receiver Circuits								Unit
	+5.0				+3.3				
V_{CC}									V
R1	100	100	100	200	100	100	100	200	Ohm
R2	68	∞	100	200	68	∞	100	200	Ohm
V_{REC} if $I_C = 0$	2.0	5.0	2.5	2.5	1.34	3.30	1.65	1.65	V
$V_{REC\ low}$	0.68	0.77	0.71	0.55	0.55	0.62	0.57	0.47	V
$V_{REC\ high}$	2.9	3.3	3.0	3.1	2.8	3.2	2.9	3.0	V
$I_{C\ low}$	33	42	36	20	20	27	22	12	mA
$I_{C\ high}$	-22	17	-11	-6	-36	1	-25	-14	mA

Table 10.1: Typical RCP Output Voltages and Currents

10.2.2 Front Panel Wiring/Display



Figure 10.4: View AV4 GTU and AV4 GTU MRI

10.2.3 LED Display

Status LED








POWER LED		Description
	off	Power off / Power supply error.
	white	Configuration error / Reset / Init in progress.
	magenta	Diagnostic mode.
	blue	Error: Clock signal missing. Short pulse (<1s) during „Synchro Reset“.
	green	Power on, unit ready for operation.
	red	Error.
	yellow	Warning.

Table 10.2: LED Colors: AV4 GTU and AV4 GTU MRI Status LED

RAIC LED (GTU MRI only)




POWER LED		Description
	off	Power off / Power supply error.
	green	GTU MRI in Chassis 1: Internal and RAIC clock locked to Reference Board RefClock, RAIC clock and AQ_Bus distribution ON.
		GTU MRI in Chassis 2 / 3: Internal clocks locked to RAIC clock, AQ_Bus interconnect ON.
	red	GTU MRI in Chassis 1: Error in RAIC clock generation. Possible source wrong Chassis Code.
		GTU MRI in Chassis 2/3: Clock circuits not locked to RAIC clock. Possible source: RAIC cable not/incorrect connected (Front Panel Connectors ▶ 59) or wrong Chassis Code.

Table 10.3: LED Colors: AV4 GTU MRI RAIC LED

10.2.4 Front Panel Connectors

J2 RAIC MASTER OUT 1 > 2, SLAVE IN (AV4 GTU MRI only)

Rack interconnect output to chassis 2 or input from chassis 1.

LVDS clock and data output to chassis 2 containing reference clock, AQ bus and FRED data. In chassis 2 and 3 this connector serves as slave input from the master MRI GTU in chassis 1.

J3 RAIC MASTER OUT 1 > 3 (AV4 GTU MRI only)

Rack interconnect output to chassis 3.

LVDS clock and data output to chassis 3 containing reference clock, AQ bus and FRED data.

J6 BSMS (AV4 GTU only)

Pulse output to BSMS ELCB.

LVTTL output pulses, connector pinout (see Pinout RCP IN/OUT Connector J9).

J7 GRAD LVDS OUT

Gradient signal output to GREAT, BSMS GAB/2.

Serialized LVDS data stream, 48 bit / 80 MHz.

J9 RCP IN / OUT

RCP pulse input and output.

LVTTL output pulses, +5V TTL compatible inputs, connector pinout (see Pinout RCP IN/OUT Connector J9).

10.2.5 RCP Pulses

Standard pulse programs in `../exp/stan/nmr/lists/pp` may include keywords for the control of experiment synchronous Real Time Pulses (RTP) such as the `LOCK_HOLD~` pulse.

The keywords reference macros which are defined in include files, i.a. `../lists/pp/Avance.incl` and `Grad.incl` or similar includes.

Custom user pulse programs shall use the keywords for pulse program maintenance and generic style reasons.

Although not suggested, customized pulse programs may control RTP levels with the appropriate pulse program `setrtp0xy` syntax, whereat

- **x**: denotes the channel within the control word 0 register (Pinout BSMS Connector J6 (RJ45), Pinout RCP IN/OUT Connector J9 (DSUB 15)).
- **y**: indicates the requested action. pipe `'|'` Control ON, caret `'^'` Control OFF.

All RTP pulses are active low defined (`~` appendix in signal name). Thus, turning on a RTP forces a TTL "0", turning OFF a TTL "1" state.

The RTP default state is OFF for all pulses (TTL high / "1").

Examples

1u setrtp0|10: RES_TTL_OUT(1)~ switches to active state (TTL Low), 1u delay
 2u setrtp0^12: RES_TTL_OUT(3)~ switches to inactive state (TTL high), 2u delay

See the Bruker TopSpin Pulse Programming Manual for detailed information.

Pin	Signal	Keyword *.incl macro (may vary)	setrtp0 channel
2	LOCK_HOLD~	LOCKH_ON, LOCKH_OFF / BLKGRAD, UNBLKGRAD	0
4	SHIM_XY_RAMP~	SHIM_XY_RAMP_ON, SHIM_XY_RAMP_OFF	1
6	HOMOSPOIL~	HOMOSPOIL_ON, HS_ON / HOMOSPOIL_OFF, HS_OFF	2
8	SEL_2H/AMP~	Not defined yet.	3

Table 10.4: Pulse Program setrtp assignments BSMS Connector J6 (RJ45)

Pin	Signal	Keyword *.incl macro (may vary)	setrtp0 channel
4	TTL_OUT(1)~	TTL1_LOW, TTL1_HIGH	6
5	TTL_OUT(2)~	TTL2_LOW, TTL2_HIGH	7
6	TTL_OUT(3)~	TTL3_LOW, TTL3_HIGH	8
7	TTL_OUT(4)~	TTL4_LOW, TTL4_HIGH	9
10	SEL_2H/AMP~	Not defined yet.	4
3	SEL_1H/19F~	Not defined yet.	5
1	RES_TTL_OUT(1)~	Not defined yet.	10
9	RES_TTL_OUT(2)~	Not defined yet.	11
8	RES_TTL_OUT(3)~	Not defined yet.	12
15	RES_TTL_OUT(4)~	Not defined yet.	13

Table 10.5: Pulse Program setrtp assign. RCP IN / OUT Connector J9 (DSUB 15)

10.2.5.1 External Trigger Pulses

The signal status of the four external trigger signals labeled TRIG_IN(4..1) in Pinout RCP IN/OUT Connector J9 may be included in the pulse program for conditional pulse program executions.

The TRIG_IN(4..1) inputs are considered asynchronous to the 12.5ns pulse program event resolution. The triggers are internally synchronized to the 12.5ns resolution and further processed in the pulse programs.

Trigger pulse program syntax trigXYZ

Whereas:

- **X**: Denotes the polarity, n for negative, p for positive
- **Y**: Denotes the event type, l for level, e for edge
- **Z**: Denotes the trigger channel

Example

trigpe2: Pulse program waits for / evaluates TRIG_IN(2) for a positive edge condition.

See the Bruker TopSpin Pulse Programming Manual for detailed information.

The pulse program polarity notation (trigXyz) follows the signal level on the input pin.

Thus a `trigpp` syntax waits for / evaluates a high “1” TTL level and a `trign` syntax waits for / evaluates a low “0” TTL level.

The TRIG_IN signals are pulled-up on the GTU / GTU MRI which results in positive level default signal state for all TRIG_IN.

10.2.6 Part Numbers

Bruker Part Number	Description
Z148393	AV4 GT-CONTROLLER UNIT
Z148394	AV4 MRI GT-CONTROLLER UNIT

Table 10.6: Part Numbers: AV4 GTU and AV4 GTU MRI

10.2.7 Technical Data

AV4 GTU

Timing Controller

Timing resolution	12.5	ns
Channel synchronicity: (for all channels)	12.5	ns

RCP IN (TRIG_IN): Real Time Pulse Input

Number of asynchronous, trigger inputs (internally synchronized to 12.5ns)	4	
V_{IH} (+5 V TTL compatibel)	2.0..5.5	V
V_{IL}	< 0.8	V

RCP OUT: Real Time Pulse Output

Number of real time control outputs: (12.5 ns synchronized) 4 + 11
 Further specifications see [RCP Real Time Pulses \[56\]](#).

AV4 GTU MRI

Timing Controller

Timing resolution	12.5	ns
Channel synchronicity: (for all channels)	12.5	ns

RCP IN (TRIG_IN): Real Time Pulse Input

Number of asynchronous, trigger inputs (internally synchronized to 12.5ns)	4	
V_{IH} (+5 V TTL compatibel)	2.0..5.5	V
V_{IL}	< 0.8	V

RCP OUT: Real Time Pulse Output

Number of real time control outputs: (12.5 ns synchronized) 11
 Further specifications see [RCP Real Time Pulses \[56\]](#).

Rack Interconnect (RAIC)

Number of RAIC interfaces (additional racks)	2
RAIC operation modes (auto identification)	master/slave
Distributed clock	20MHz RefClk or onboard fail-save clock

Distributed AQ Bus and FRED signals (12.5ns synchronous)	20	
AQ Bus input signals (12.5ns synchronous)	3	
RAIC cable assembly length	2	m

10.3 Troubleshooting

The AV4 GTU can only be replaced as a whole unit (FRU). There are no serviceable parts. Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages. General information on troubleshooting, error handling and failure reporting is available in chapter [Troubleshooting \[▶ 97\]](#).

10.3.1 Diagnostics

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems. One can connect to the Service Web page on the AV4 EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

11 AV Reference 1200

11.1 Overview

The AV4 REFERENCE 1200 board (AV4 REF) generates the necessary reference clocks and frequencies for all units in the AVANCE NEO system. It is not compatible to any former AVANCE generation.

One AV4 REF can supply and synchronize up to 8 AV4 TRX channels in one chassis or (with external splitters) up to 24 AV4 TRX channels in three chassis.

The source of all frequencies is a single 10 MHz OCXO (oven controlled crystal oscillator).

11.2 Description

All NMR frequencies and timings are generated by the AV4 REF or derived from it.

- 10 MHz signal for BSMS/2 ELCB.
- 160 MHz and 320 MHz for BSMS/2 Lock Transceiver.
- Frequency mix for all AV4 TRX 1200.
- Synchro Reset for all AV4 TRX 1200.

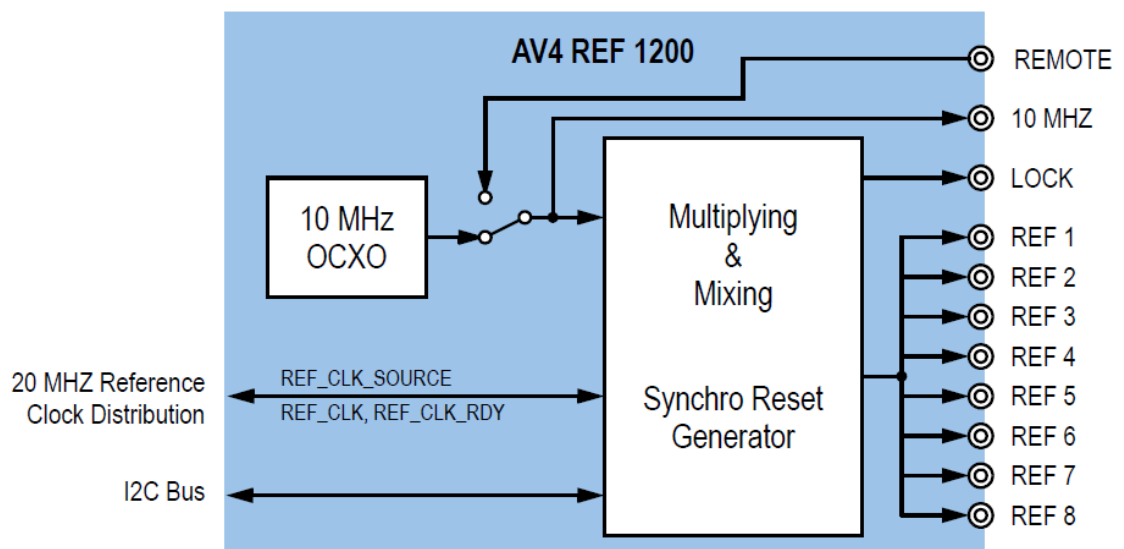


Figure 11.1: Block Diagram: AV4 REF

11.2.1 Synchro Reset

The Synchro Reset is a 150 ns gap in the 960 MHz signal at the REF 1-8 output. It is used to assure phase coherence of all NMR signals generated by the AV4 TRX, even if they are distributed in up to three chassis.

11.2.2 Overall Reference Clock Synchronisation

The 20 MHz reference clock generated by AV4 REF is routed to the backplane where it is distributed synchronously to all front slots of the chassis as well as the PCIe clock generator and distribution on the backplane.

In multi chassis configurations the reference clock signal is routed via the cross switch on the backplane to the AV4 GTU MRI. From there it is distributed synchronously to the other chassis and back to the clock distribution on the backplane.

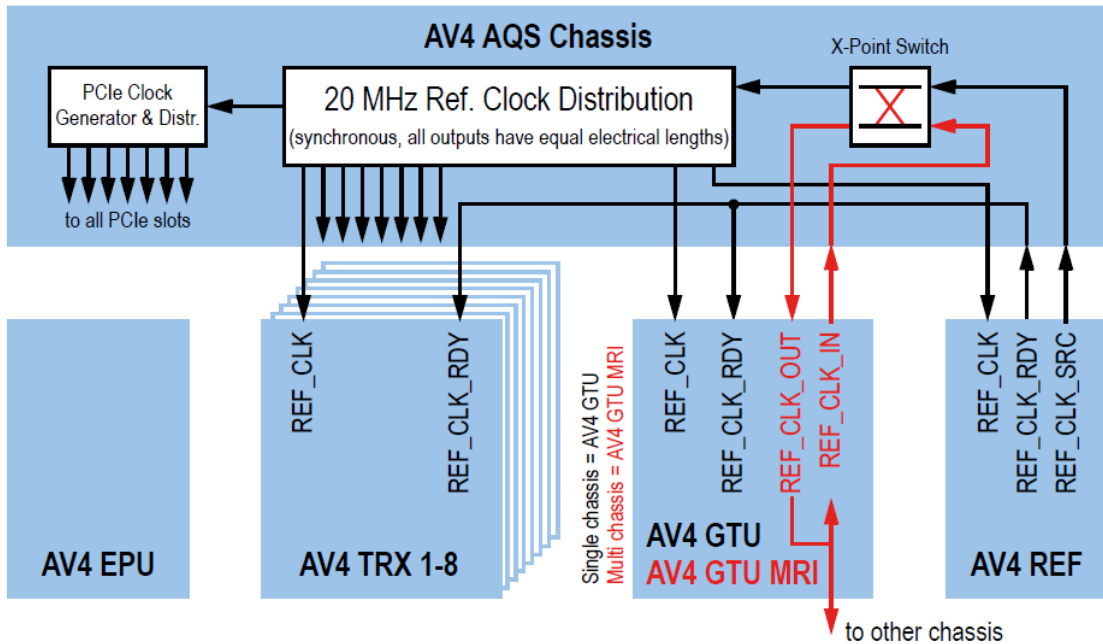


Figure 11.2: 20 MHz Reference Clock Distribution

Reference Clock Ready

When the AV4 REF receives back the reference clock from the backplane and after a time out of approx. 5s it generates the REF_CLK_RDY signal. The signal indicates to all users that the reference clock is stable and ready to use.

11.2.3 REF Distribution in Multi Chassis Configurations

In such configurations AV4 BB SPLITTER 3-WAY (Z154809) must be used for REF signal distribution.

11.2.4 Front Panel Wiring/Display



Figure 11.3: View AV4 REF 1200

11.2.5 LED Display

Status LED







POWER LED		Description
	off	Power off/Power supply error
	white	Power up ok, waiting for init
	blue	Error: 20 MHz clock missing Short pulse (<1s) during „Synchro Reset“
	green	Power on, unit ready for operation
	red	Error
	yellow	Startup in progress (delay 5 s)

Table 11.1: LED Colors: AV4 REF

11.2.6 Front Panel Connectors

J1 REMOTE

10 MHz remote input.

A 10 MHz sine wave clock signal applied to this input with a power of +8.5...14 dBm overrides the oscillator for the internal frequency generation.

J2 10MHZ

10 MHz output.

Phase locked sine wave +7 dBm (1.4 Vpp @ 50 Ω).

J3 LOCK

Clock signal output for LOCK system (L-TRX unit).

Phase locked mix of two sine wave signals:

- 160 MHz: -0.5 dBm (0.6 Vpp @ 50 Ω).
- 320 MHz: -3.5 dBm (0.42 Vpp @ 50 Ω).

J4 - J11 REF1 - REF8

Reference signal output for frequency generation in AV4 TRX unit.

Phase locked mix of five sine wave signals:

- 960 MHz: -4 dBm (0.4 Vpp @ 50 Ω)¹
- The reference signal distribution with AV4 BB SPLITTER 3-WAY.
- 1920 MHz: -6 dBm (0.32 Vpp @ 50 Ω)
- 2240 MHz: -6 dBm (0.32 Vpp @ 50 Ω)
- 2560 MHz: -6 dBm (0.32 Vpp @ 50 Ω)
- 2880 MHz: -6 dBm (0.32 Vpp @ 50 Ω)

Additional feature: Synchro Reset gap in 960 MHz output signal used to synchronize all AV4 TRX units in the chassis.

11.2.7 Part Numbers

Bruker Part Number	Description
Z148270	AV4 REFERENCE 1200

Table 11.2: Part Numbers: AV4 REF

11.2.8 Technical Data

Phase Noise @ 1920 MHz; REF1 - REF8 (J4 - J11)

Offset 10 Hz	Max. -82	dBc/Hz
Offset 100 Hz	Max. -95	dBc/Hz
Offset 1 kHz	Max. -110	dBc/Hz
Offset 10 kHz	Max. -120	dBc/Hz
Offset 100 kHz	Max. -120	dBc/Hz
Output power level accuracy	±0.5	dB

11.3 Troubleshooting

Unused ports



Unused REF outputs must be terminated with 50 Ω. All other ports may be left open.

¹ In MRI configurations the output power of the signal mix is automatically raised to compensate for loss in the reference signal distribution with AV4 BB SPLITTER 3-WAY.

OCXO Failure

In the event of a suspected OCXO failure try to apply a 10 MHz sine wave source with +8.5..14 dBm power to REMOTE input J1.

General Troubleshooting

The AV4 REF can only be replaced as a whole unit (FRU). There are no serviceable parts.

Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages.

General information on troubleshooting, error handling and failure reporting is available in chapter [Troubleshooting \[97\]](#).

11.3.1 Diagnostics

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems.

One can connect to the Service Web page on the AV4 EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

12 AV4 MRI AD Controller

12.1 Overview

The AV4 MRI AD-Controller Module (AV4 AD-CTRL) bundles the individual RGP HPPR and BLNKTR pulses from a maximum of 24 transceiver (AV4 TRX) channels in three racks and passes them on to the HPPR/2 preamplifier assemblies.

To reduce the wiring eight AD-CTRL output pulses can be configured individually as a combination of all 48 input pulses. They are wired to the HPPR/2 MRI Active Detuning Module (HPPR/2 ADM) and HPPR/2 MRI ADM-CRP Module (HPPR/2 ADM-CRP).

Additionally the RGP HPPR output pulses are bundled and wired to the baseplates of the HPPR/2 assembly stacks.

12.2 Description

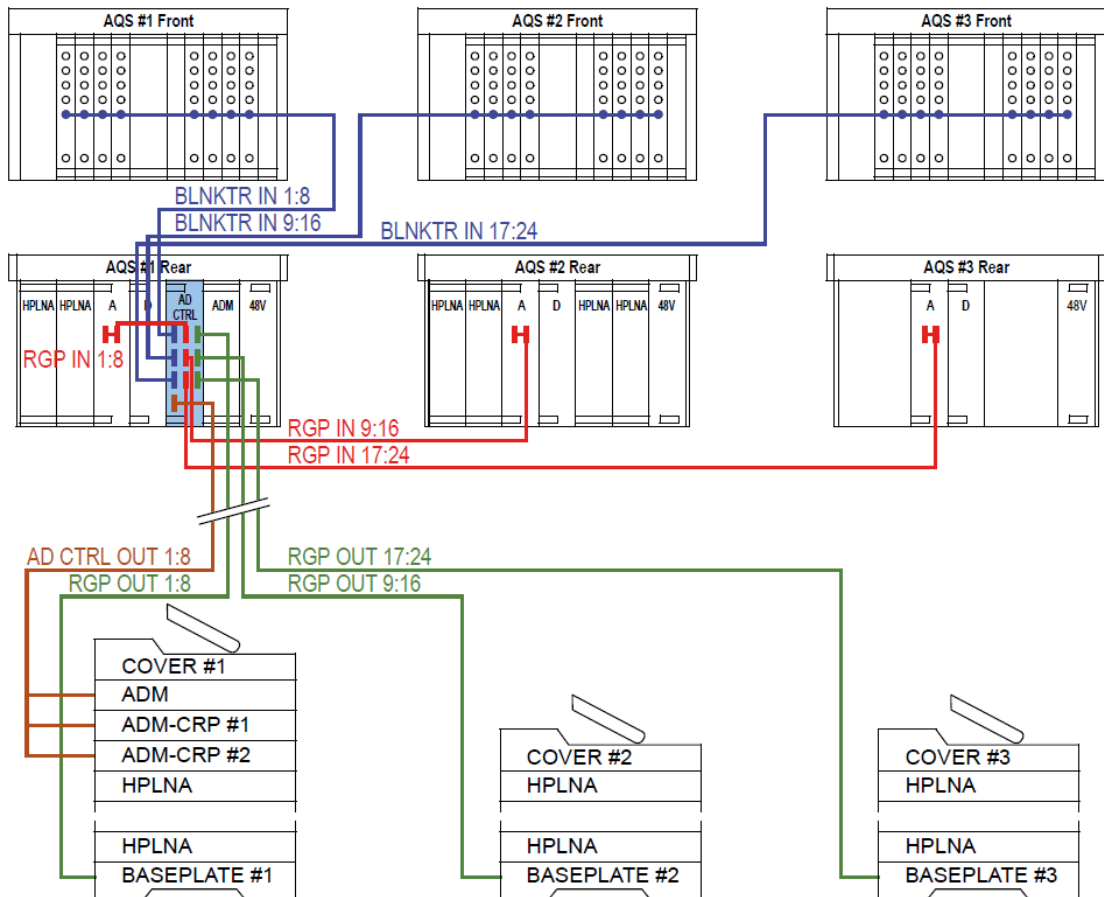


Figure 12.1: Wiring Diagram: MRI System with AV4 AD-CTRL

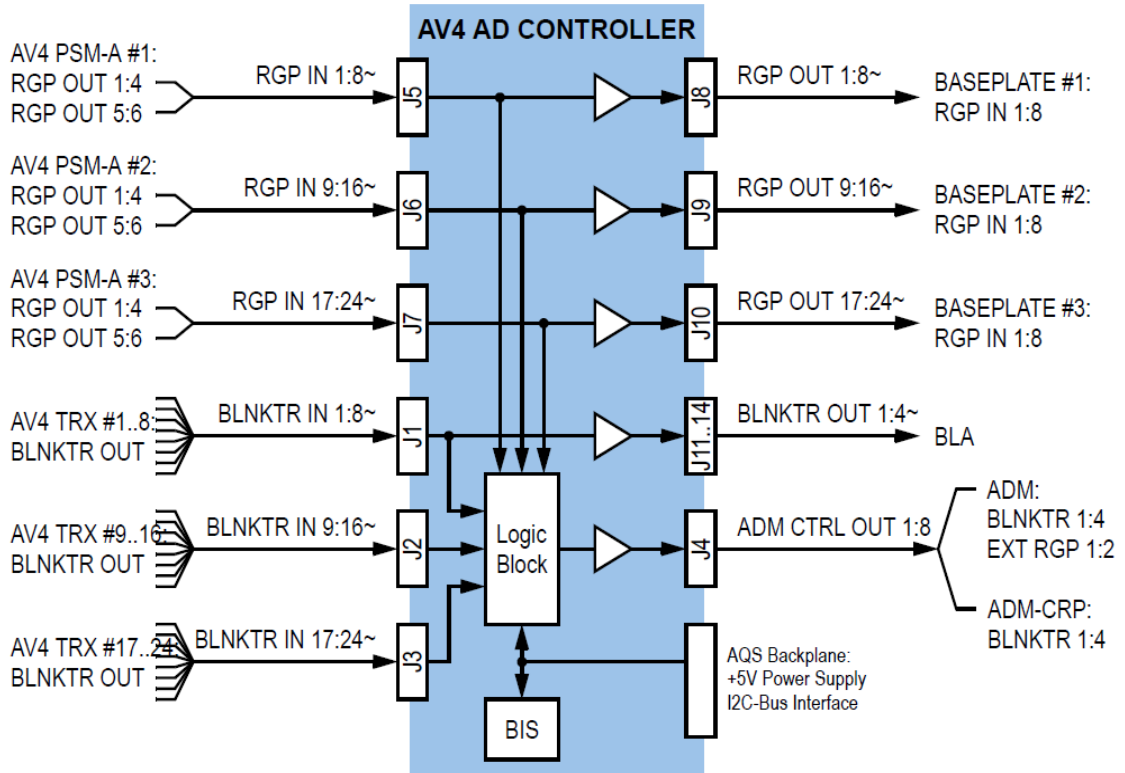


Figure 12.2: Block Diagram: AV4 AD-CTRL

12.2.1 AV4 AD-CTRL OUT 1:8

The AV4 AD-CTRL output is a combined and buffered control pulse for to the MRI active detuning modules HPPR/2 ADM and HPPR/2 ADM-CRP in the external HPPR/2 PREAMP assembly stack.

Each of the eight outputs can be individually configured as:

- OR or AND combination of any number of RGP and BLKTR inputs (maximum of 48 inputs per output)
- Positive or negative active pulse polarity

These settings are not stored in the unit. Upon power-up all combinatory logic is reset (no pulse selected) and the pulse polarity set to negative (default).

12.2.2 Front Panel Wiring / Display



Figure 12.3: View AV4 AD-CTRL

12.2.3 LED Display






POWER LED		Description
	off	Power off/Power supply error
	white	Configuration error/Reset/Init in progress
	green	Power on, unit ready for operation
	red	Error
	yellow	Warning/I2C data transfer

Table 12.1: LED Colors: AV4 AD-CTRL

12.2.4 Front Panel Connectors

J1 - J3 BLNKTR IN 1:24~

Transmitter blanking pulse input from transceiver AV4 TRX 1:24 out of three racks.

J4 AD-CTRL OUT 1:8

Combined and buffered control pulse output to the MRI Active Detuning Module in the external HPPR/2 PREAMP assembly stack.

J5 - J7 RGP HPPR IN 1:24~

Preamplifier receiver gating pulse input from transceiver AV4 TRX 1:24 out of three racks. Routed and buffered from AV4 PSM-A.

J9 - J10 RGP HPPR OUT 1:24~

Preamplifier receiver gating pulse output to a maximum of three external HPPR/2 PREAMP assembly stacks. Routed from RGP HPPR IN 1:24~ without buffer.

J11 - J14 BLNKTR OUT 1:4~

Coaxial transmitter blanking pulse output to local power transmitters. Routed and buffered from BLNKTR IN 1:4~.

12.2.5 Part Numbers

Bruker Part Number	Description
Z161580	AV4 MRI AD-CONTROLLER

Table 12.2: Part Numbers: AV4 AD-CTRL

12.2.6 Technical Data

RGP HPPR IN: from AV4 PSM-A	TTL +5	V
RGP HPPR OUT	TTL +5	V
BLNKTR IN: from AV4 TRX	LVTTL +3.3	V
BLNKTR OUT	LVTTL +3.3	V
AD CTRL OUT	TTL +5	V

12.3 Troubleshooting

The AV4 AD-CRTL can only be replaced as a whole unit (FRU). There are no serviceable parts.



ECL00 are not suitable for use in MRI systems.

The pinout of connectors J8..J10 are wrong. Units must be upgraded to ECL > 01.

Detected failures are reported with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the Service Web pages.

General information on troubleshooting, error handling and failure reporting is available in chapter [Troubleshooting \[97\]](#).

12.3.1 Diagnostics

Service Web pages provide some low level access to the hardware that may help to diagnose hardware problems.

One can connect to the Service Web page on the AV4 EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

13 AV4 Ethernet Router

13.1 Overview/Description

The AV4 ETHERNET ROUTER RM 14-PORT consists of a consumer/SOHO router mounted together with an industrial power supply on a 19" frame.



The router is factory configured. Part number and ECL define its configuration. The configuration cannot be changed in the field.

13.1.1 Front Panel Wiring / Display



Figure 13.1: View AV4 ROUTER 14-Port

13.1.2 Wiring

Port Nr.	Dev. Type	AV NEO OneBay Console (H03128OB(X))	AV NEO TwoBay Console (H03128T2)
1	External	Back Panel: Port 1 MAS3	Back Panel: Port 1 MAS3
2		Back Panel: Port 2	Back Panel: Port 2
3		Back Panel: Port 3	Back Panel: Port 3
4		Back Panel: Port 4 Sample Changer	Back Panel: Port 4 Sample Changer
5		Back Panel: Port 5 Cryo Platform	Back Panel: Port 5 Cryo Platform
6	Internal	PDU1	PDU1
7		Not connected	PDU2
8		AV4 AQS Chassis: EPU/2	AV4 AQS Chassis: EPU/2
9		AV4 BSMS Chassis: ELCB	AV4 BSMS Chassis: ELCB
10		BLA1	BLA1
11		BLA2	BLA2
12		BLA3	BLA3
13		BLA4	BLA4
14		ETHERNET SWITCH 1: ^a SPECT NET Port 8	ETHERNET SWITCH 1: ^a SPECT NET Port 8
WAN		Back Panel: Workstation	
DMZ		Not connected	Not connected

^a ETHERNET SWITCH in AV NEO 1BAY Microimaging console or AV NEO 2BAY HP-Diffusion console.

Table 13.1: AV4 Router 14-Port Wiring: AVANCE NEO OneBay and TwoBay Console

Wirings for other router variants

The wirings for the AV4 MRI ROUTER 14P and AV4 NB ETHERNET ROUTER RM 14P are not part of this manual.

13.1.3 Part Numbers

Bruker Part Number	Description
Z156496	AV4 ETHERNET ROUTER RM 14-PORT Standard HR-NMR router for AV4.
Z163216	AV4 MRI ETHERNET ROUTER RM 14P Different configuration for PCI. Mechanically identical to Z156496.
Z163447	AV4 NB ETHERNET ROUTER RM 14P Different mounting for NanoBay. Configuration identical to Z156496.

Table 13.2: Part Numbers: AV4 ROUTER 14-Port

13.1.4 Technical Data

LAN ports	14	
WAN Ports (2nd WAN or DMZ port unused, do not connect)	1	
USB Ports (unused, do not connect)	2	
NAT throughput	900	Mbit/s
VPN throughput (IPSec)	100	Mbps
VPN throughput (SSL)	20	Mbps
Power supply input voltage	12	V
Power supply input current	Max. 2	A

NOTICE

Mains input specifications see [Connection Values](#) [▶ 105].

Rating plate information see [Rating Plates](#) [▶ 107].

13.2 Troubleshooting

The router has no power/no LED is lit.

- The power cord is not connected to PDU1 outlet #1 (see [Wiring \[▶ 87\]](#)).
- PDU1 outlet #1 has no mains power (LED on PDU1).
- The tiny switch in the rear of RV325 is in the off position.
- The DC connector in the rear of RV325 has been loosened.
- Check the Power LED of the embedded power supply.

No connection to device

- The green router LED **PWR** must be steady on.
- The red router LED **DIAG** must be off.
- Check the Device Port Number on RV325 (see [Wiring \[▶ 78\]](#)).
- Check the link LEDs of WAN and device port.
- Check the patch cables.
- Ping the router (149.236.99.9).

The red DIAG LED on the Router is ON

- The router is booting - this can take two minutes (**PWR** is blinking).
- If the **DIAG** LED doesn't go off after five minutes, power-cycle the router.

Software Configuration

The router is factory configured. Part number and ECL define its configuration.



The configuration cannot be changed in the field.

NOTICE

Loss of router configuration

If the **RESET** button is pressed for more than 10s the router loses its configuration and reverts to the CISCO factory settings. Router access is no longer possible.

- ▶ If the router has lost its configuration, it must be sent to Bruker for repair.

General Troubleshooting

The router can only be replaced as a whole unit (FRU). There are no serviceable parts.

13.2.1 Diagnostics

Further diagnostics than described above is not available. There is no access to a service web page.

14 Ethernet Switch 24-Port

14.1 Overview/Description

- ▶ The ETHERNET SWITCH FAST 24-PORT 10/100/1000 consists of a consumer switch mounted on a 19" frame.

14.1.1 Front Panel Wiring/Display



Figure 14.1: View ETHERNET SWITCH 24-Port

14.1.2 Wiring

Console	AV NEO 2BAY HP-Diffusion H03128T2	AV NEO 1BAY Microimaging W156129	AV NEO 1BAY SWB Driver W156129
Port Number	ETHERNET SWITCH 1 O10293	ETHERNET SWITCH 1 O10293	ETHERNET SWITCH 2 O10293
1	SAFETY CONTROLLER	SAFETY CONTROLLER	SAFETY CONTROLLER
2	GREAT Z	GREAT Z	GREAT Z
3	Not connected	GREAT Y	GREAT Y
4	Not connected	GREAT X	GREAT X
5	Not connected	Not connected	Not connected
6	Not connected	Not connected	SHIM INTERFACE
7	Not connected	PDU 3	PDU 3
8	AV4 ROUTER 14-Port: SPECT NET Port 14 ^a	AV4 ROUTER 14-Port: SPECT NET Port 14 ^a	AV4 ROUTER 14-Port: SPECT NET Port 9 ^b
9	AV4 ROUTER 14-Port: SPECT NET Port 8 ^c	AV4 ROUTER 14-Port: SPECT NET Port 8 ^c	GRADIENT INTERFACE X
10	Not connected (reserved)	Not connected (reserved)	GRADIENT INTERFACE Y
11	Not connected (reserved)	Not connected (reserved)	GRADIENT INTERFACE Z

Console	AV NEO 2BAY HP-Diffusion H03128T2	AV NEO 1BAY Microimaging W156129	AV NEO 1BAY SWB Driver W156129
Port Number	ETHERNET SWITCH 1 O10293	ETHERNET SWITCH 1 O10293	ETHERNET SWITCH 2 O10293
12	Not connected (reserved)	Not connected (reserved)	IECO PS
13-24	Not connected (reserved)	Not connected (reserved)	Not connected (reserved)
^a SPECT NET input from router (upstream) ^b SPECT NET input from Ethernet Switch 1 (upstream) ^c SPECT NET output to Ethernet Switch 2 (downstream)			

Table 14.1: Wiring Ethernet Switch 24-Port

14.1.3 LED Display

- LED Power: Switch power on status
- LED's 1 thru 24: Ethernet link status and speed

14.1.4 Part Numbers

Bruker Part Number	Description
O10293	ETHERNET SWITCH FAST 24-PORT 10/100

Table 14.2: Part Numbers: ETHERNET SWITCH 24-Port

14.1.5 Technical Data

Specification Switch NETGEAR JGS524E

LAN ports	24	
PoE ports	0	
VLAN supported ports	all	
LAN port speed	10 / 100 / 1000	Mbps
Bandwidth	48	Gbps



Mains input specifications see [Connection Values \[▶ 105\]](#).
 Rating plate information see [Rating Plates \[▶ 107\]](#).

14.2 Troubleshooting

The switch has no power/no LED is lit.

- The power cord is not connected to the PDU outlet (see [Wiring \[▶ 87\]](#)).
- PDU outlet has no mains power (LED on PDU is off).

No connection to device

- The green switch LED **Power** must be steady on.
- The green switch upper Port LEDs **Link/Act** of the connected ports must be either steady on (link) or blinking (activity).
- Check the switch **Link** LEDs of the connected device port.
- Check the patch cables.

Software Configuration

The switch is factory configured. It needs no customer configuration.



The configuration cannot be changed in the field.

General Troubleshooting

The switch can only be replaced as a whole unit (FRU). There are no serviceable parts.

14.2.1 Diagnostics

Port Speed

The switch lower Port LEDs indicate the speed of the connected port.

- green = 1000 Mbps
- yellow = 100 Mbps
- off = 10 Mbps

Further diagnostics than described above is not available. There is no access to a service web page.

15 AV4 Mains Power Distribution Unit

15.1 Overview

The AV4 Mains Power Distribution Unit (AV4 PDU 8/16A) enables software controlled mains cycling of all units within the electronics cabinet. It allows the operator to remotely power up and power down the cabinet from the workstation.

There are several versions for different cabinets.

15.2 Description

The AV4 PDU 8/16A consists of a commercially available power distribution unit with individually preprogrammed power-up settings.

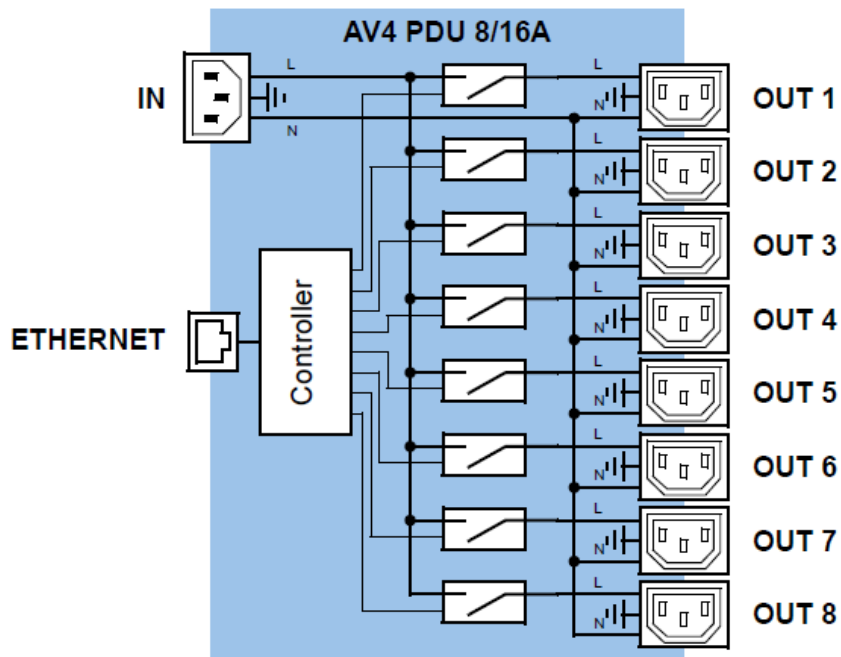


Figure 15.1: Block Diagram: AV4 PDU 8/16A

15.2.1 Power Cycling

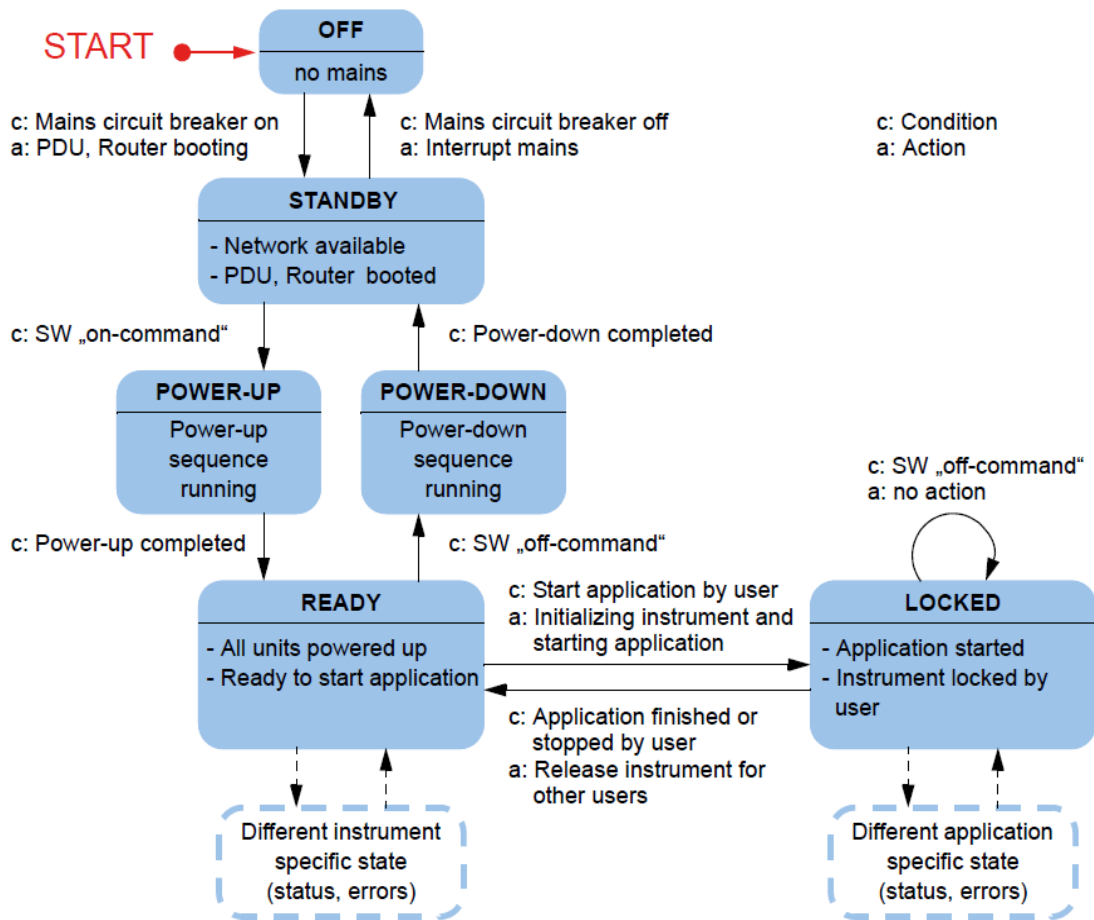


Figure 15.2: State Diagram AV NEO Power Cycling

Mains Power Switch On > Standby

AV4 PDU 8/16A #1 (Z156566) is always in the first cabinet. PDU1 boots up and turns on outlet 1 connected to the Router. The spectrometer is in standby mode.

Power-Up > Ready

The On command is sent by TopSpin via Router to PDU1. This turns on outlet 2 connected to the AV4 AQS Chassis PSM. After booting the EPU takes control of the powerup cycle and turns on other AV4 PDU 8/16A outlets / units within the cabinet(s) in a predefined order. When all units have finished their booting process the spectrometer is ready for operation.

Power-Down > Standby

The Off command is sent by TopSpin to the EPU. It starts turning off all AV4 PDU 8/16A outlets / units within the cabinet(s) in a predefined order (reverse order of power-up). At the end the EPU goes into shutdown and (after a time-out) PDU1 turns of the AV4 AQS Chassis PSM. The spectrometer reverts to standby mode.

Mains Power Switch Off > OFF

To turn off all power within the cabinet the mains power switch must be turned off manually.

15.2.2 Front Panel Wiring/Display



Figure 15.3: View AV4 PDU 8/16A

15.2.3 Wiring

Console	AV NEO ONEBAY Console (H03128OB(X))
Outlet Number	AV4 PDU 8/16A Cabinet 1 (Z156566)
1	AV4 Router + Fan OBX ^{a b}
2	AV4 AQS Chassis: PSM-48V
3	AQS PSM HPLNA (max. 2) ^b
4	AV4 BSMS Chassis: 1st PSM-48V
5	AV4 BSMS Chassis: 2nd PSM-48V
6	BLA 1
7	BLA 2
8	BLA 3 ^a

^a Fan OBX and BLA 3 can be field upgrades
^b For two units use two-way adapter delivered with AV4 PDU 8/16A (Bruker Nr. 1843057)

Table 15.1: Wiring AV4 PDU 8/16A: AV NEO OneBay Console

Console	AV NEO TWOBAY Standard and HP-Diffusion H03128T2		AV NEO ONEBAY Microimaging W156129
Outlet Number	AV4 PDU 8/16A Cabinet 1 Z156566	AV4 PDU 8/16A Cabinet 2 Z158203	AV4 PDU 8/16A Cabinet 3 Z158204
1	AV4 Router + Ethernet Switch ^a	FAN TB	Ethernet Switch
2	AV4 AQS Chassis: PSM-48V	BLA 1	Safety Controller
3	AV4 AQS Chassis: AQS PSM HPLNA ^a	BLA 2	GREAT Z (via PDU Booster ^b)
4	AV4 BSMS Chassis: 1st PSM-48V	BLA 3	GREAT Y via PDU Booster
5	AV4 BSMS Chassis: 2nd PSM-48V	BLA 4	GREAT X via PDU Booster
6	UPS	BLA 5	Not connected
7	Not connected	Safety Controller	Not connected
8	Not connected	GREAT Z	Not connected

^a For two units use two-way adapter delivered with AV4 PDU 8/16A (Bruker Nr. 1843057)
^b Only with GREAT Y and GREAT X

Table 15.2: Wiring AV4 PDU 8/16A: AV NEO TwoBay and Microimaging console

15.2.4 LED Display

- LED next to power outlet: indicates active power outlet.
- LED and displays front right: energy metering display (test use only).

15.2.5 Front Panel Connectors

Power Outlet 1-8 (IEC appliance outlet C13)

Mains power output to console units.

USB-A, USB-B, CONSOLE/MODEM

Unused ports (do not connect).

15.2.6 Rear Panel Connectors

Power Inlet (IEC appliance inlet C20)

Mains power inlet. Connect to console internal mains power cable.

ETHERNET (RJ45)

Ethernet uplink. Connect to router.

FEATURE, SENSOR1, SENSOR2

Unused ports (do not connect).

15.2.7 Part Numbers

Brüker Part Number	Description
Z156566	AV4 MAINS PDU RM 8/16A CABINET 1
Z158203	AV4 MAINS PDU RM 8/16A CABINET 2
Z158204	AV4 MAINS PDU RM 8/16A CABINET 3

Table 15.3: Part Numbers: AV4 PDU 8/16A

15.2.8 Technical Data

Input / output voltage	208-230 ¹	Vac
Input / output frequency	50/60	Hz
Input / total output current	≤ 16	Aac
Individual output current (continuous current)	≤ 12	Aac
Individual pulsed output current (calculated rms value of the pulse current)	≤ 12	Arms

¹ Not all units within the console allow input voltages as low as 100 Vac. The input voltage range is therefore limited to a useful range.



Rating plate information see [Rating Plates \[107\]](#).

15.3 Troubleshooting

The AV4 PDU 8/16A can only be replaced as a whole unit (FRU). There are no serviceable parts.

Software Configuration

The AV4 PDU 8/16As are factory configured. Part number and ECL define its configuration.



The configuration cannot be changed in the field.

15.3.1 Diagnostics

Further diagnostics than described above is not available. There is no access to a service web page.

16 AV4 PDU Booster Triple

16.1 Overview

The AV4 PDU BOOSTER TRIPLE unit (AV4 PDU Booster) is an extension of the standard AV4 PDU 8/16A. It enables the independent switching of three separate power connections which are loaded with up to 10 A simultaneously.

16.2 Description

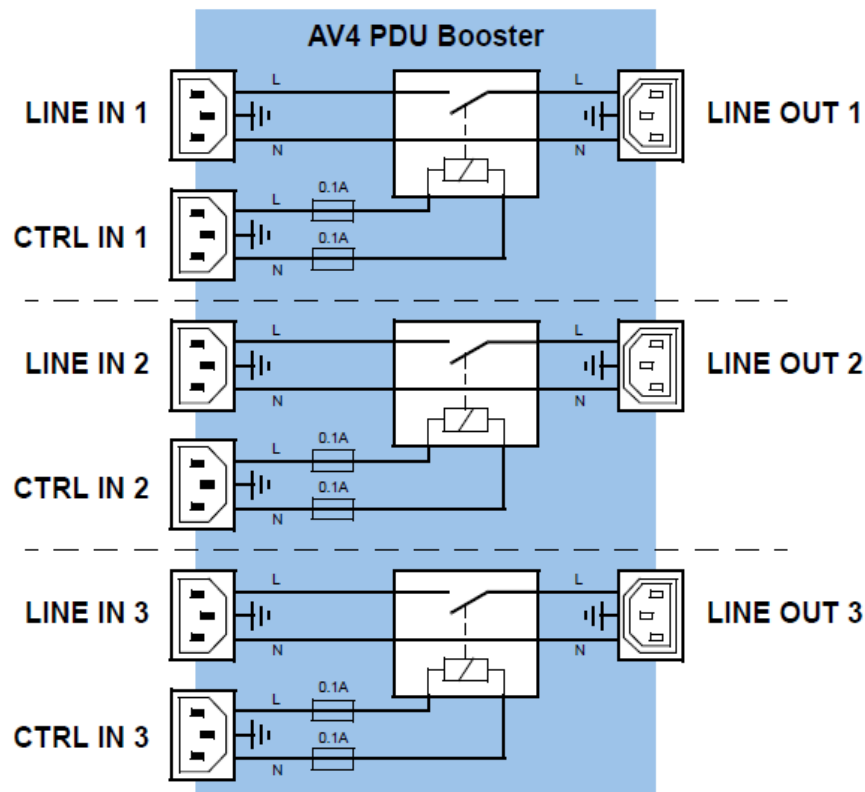


Figure 16.1: Block Diagram: AV4 PDU Booster

The LINE inputs are separately connected to the mains input of the console. The LINE outputs connect to the high-power units in the console. Load currents must be limited by these units to 10 A each. The AV4 PDU Booster contains fuses at the CTRL IN inlets but none in the load path.

The CTRL inputs connect directly to AV4 PDU 8/16A outputs. Thus, the AV4 PDU 8/16A effectively controls the switching of the AV4 PDU Booster.

16.2.1 Front/Rear Panel Wiring



Figure 16.2: View AV4 PDU Booster

Location	Fuse	Part Number	Value
CTRL IN 1-3	L + N	2241	0.1 AT

Table 16.1: Fuses AV4 PAV4 PDU Booster

16.2.2 Wiring



All units must be connected to the AV4 PDU Booster in-/outlets as shown in the following table. Otherwise the power-up sequence is not in the correct order.

Console	AV NEO ONEBAY Microimaging W156129	
Outlet Nr.	AV4 PDU 8/16A CABINET 3 Z158204	AV4 PDU BOOSTER Z167825
1	ETHERNET SWITCH	GREAT Z
2	SAFETY CONTROLLER	GREAT Y
3	AV4 PDU BOOSTER CTRL IN 1	GREAT X
4	AV4 PDU BOOSTER CTRL IN 2	
5	AV4 PDU BOOSTER CTRL IN 3	
6	Not connected	
7	Not connected	
8	Not connected	

Table 16.2: Wiring AV4 PDU Booster: Console 3 Microimaging + SWB

16.2.3 Front Panel Connectors

CTRL IN 1-3 (IEC appliance inlet C14)

Control input from AV4 PDU 8/16A.

LINE OUT 1-3 (IEC appliance outlet C13)

Mains power output to cabinet units.

16.2.4 Rear Panel Connectors

LINE IN 1-3 (IEC appliance inlet C14)

Mains power inlet.

16.2.5 Part Numbers

Bruker Part Numbers	Description
Z167825	AV4 PDU BOOSTER TRIPLE

Table 16.3: Part Numbers: AV4 PDU Booster

16.2.6 Technical Data

Voltage range: (all connections)	208-230	Vac
Frequency	50/60	Hz
Individual continuous current	3 x 10	Aac
Individual pulsed current (calculated rms value of the pulse current)	3 x 10	Aac
CTRL IN fuses 2x, 250 Vac, time lag T	0.1	Aac



Rating plate information see [Rating Plates \[107\]](#).

16.3 Troubleshooting

The AV4 PDU Booster can only be replaced as a whole unit (FRU). There are no serviceable parts, except of the CTRL IN fuses.

16.3.1 Diagnostics

None.

17 Maintenance

The sections below describe the maintenance work required to ensure optimal and smooth operation of the device.

If increased wear is found during regular checks, the required maintenance intervals should be shortened in accordance with the actual wear occurrences. Contact Bruker in the event of questions regarding maintenance work and intervals (see [Contact \[▶ 109\]](#)).

Interval	Maintenance Work	Reference
Daily	Clean the working area.	Laboratory SOP
Annually	Clean or replace air intake filters in the cabinet.	
As needed	Clean outer shell of the device.	
	Update firmware.	

Table 17.1: Maintenance Schedule for Laboratory Personnel

17.1 Cleaning

Before Cleaning

- Stop all experiments.
- Power down the electronics cabinet (see [Power Cycling \[▶ 86\]](#)).
- Disconnect the mains power cable.

Cleaning the Outside of the Chassis Units

Do not use any detergent or other cleaning solvents. Use only water or neutral cleaning fluids. Usage of volatile cleaners like thinner or benzine may damage the surface of the units.

- Clean the outside of the units with a soft, lint-free cloth dampened in water.
- Wait until the unit is completely dry before you reconnect the power cable!

Other Cleaning Operations

For all other cleaning operations contact Bruker service for advice and support. It may be necessary to send in the device for a cleaning service.

No special precautions have been taken in the device to avoid contamination from leaking samples. Bruker accepts no responsibility for any damage which may occur when samples are used containing radioactive or other hazardous materials.

In case of an accident with toxic, radioactive, explosive, or biologically active substances, the device and associated equipment must be cleaned in such a way that no danger emanates from the device and associated equipment, especially for all uninformed personnel. If a device must be cleaned of all remains of a substance for safety reasons, contact Bruker service for advice and support.

Note that in serious cases it may be necessary for the owner to exchange the device with a new one, contact Bruker service for details.

17.2 Preventative Maintenance

All parts in the device have been designed to work reliably without preventative maintenance with the exception of the AV4 AQS Fan Tray. The life expectancy of DC-fans is usually lower than that of other electronic parts. Therefore, preventive maintenance may be useful.

Refer to the chapter [AV4 AQS Fan Tray \[▶ 33\]](#) or contact Bruker customer service for more information.

17.3 Bruker Service Maintenance

Bruker offers various maintenance options and packages. Contact Bruker customer service for more information.

17.3.1 Device Report File

The device logs all information in a file. With the help of this file Bruker customer service can diagnose the system. In case of troubleshooting as a result of an unknown error, Bruker customer service may ask you to send the log files and the system data. From these files the customer service can obtain additional debugging information. These files do not contain any information about your company, samples or spectra. Bruker will not give any information to a third party.

For information on how to acquire the log files refer to [Troubleshooting \[▶ 97\]](#).

17.3.2 Firmware Update

Firmware updates of all AQS components are handled exclusively by TopSpin.

18 Troubleshooting

The following sections describe how failures are reported and what can be done to simplify the troubleshooting for customer service.

18.1 Operation Failure

When an error occurs during program execution, an exception will be displayed on the TopSpin screen. If the exception occurs in a low level AQS or HPPR configuration routine, the exception information may also be saved in the AqRackServer log.

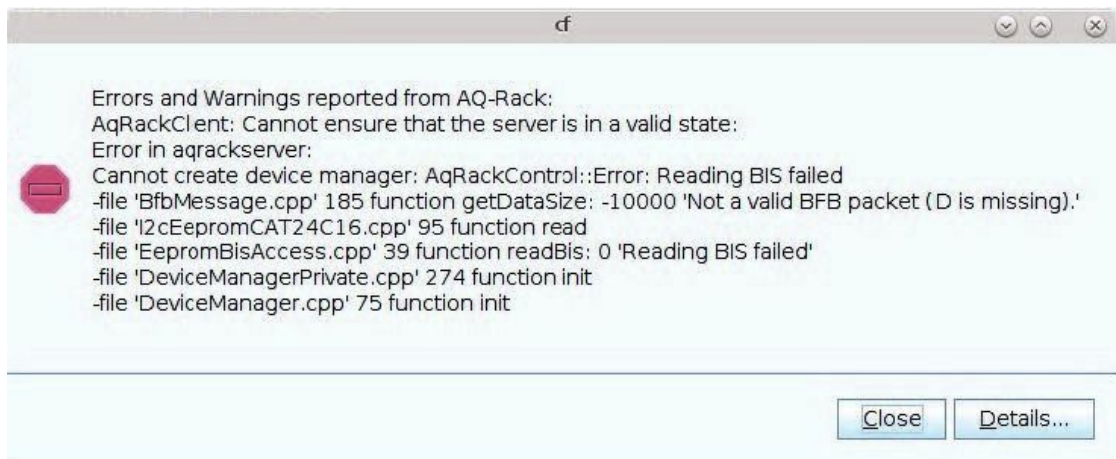


Figure 18.1: Troubleshooting: Operation Failure

18.2 Hardware Warnings or Errors

The hardware reports detected failures with event messages. Event messages are displayed on the TopSpin screen and can be viewed on the ServiceWeb pages:



Figure 18.2: Troubleshooting: TopSpin Event Messages

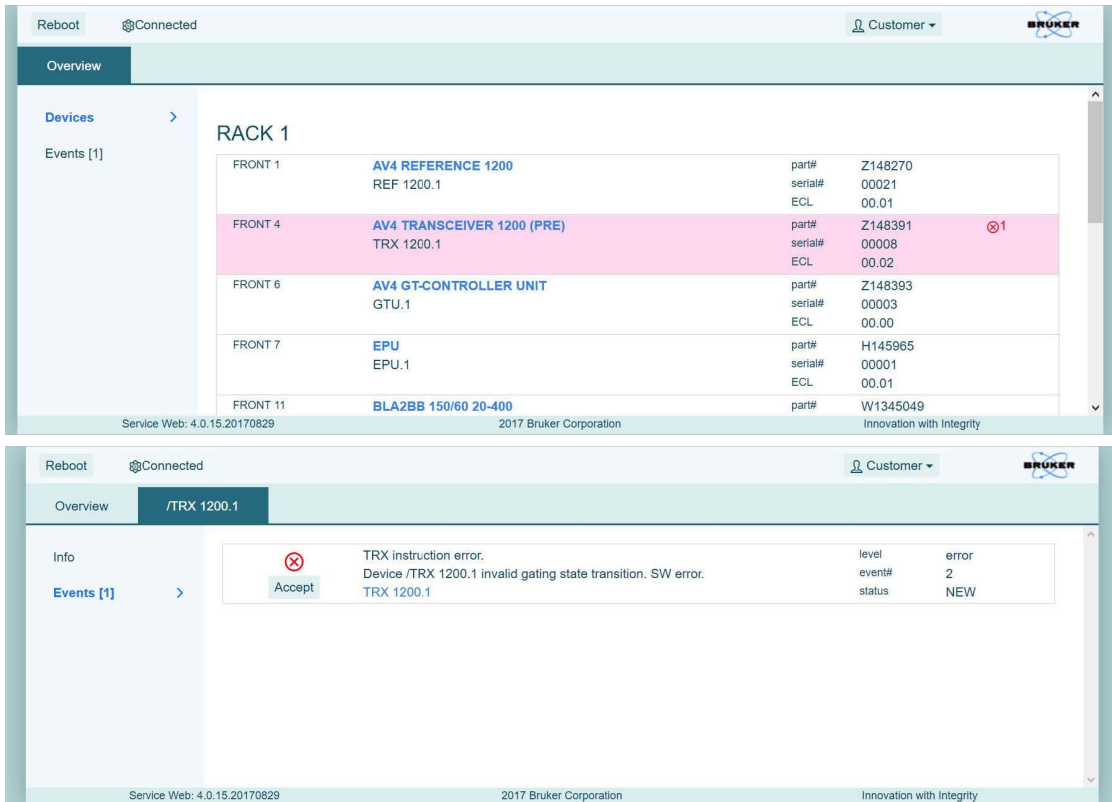


Figure 18.3: Troubleshooting: ServiceWeb Event Messages

Multiple events may be reported almost simultaneously. It is not guaranteed that the main cause for the hardware failure is reported in the first event message. Therefore, read carefully all event messages when troubleshooting.

A device that reports a hardware error event may also indicate that by changing the color of its status LED. For more information on LED colors, see the chapter on the corresponding unit.

18.3 Troubleshooting Hardware Problems

ServiceWeb

ServiceWeb pages on the EPU provide some low level access to the hardware that may help to track down a hardware problem. ServiceWeb provides amongst other things:

- Overview of detected AQS and HPPR devices
- Failure report generation for customer service
- Ability to change some HPPR settings for debug purposes
- Low level device diagnostic

You can connect to the ServiceWeb page on the EPU via **ha** (Hardware Access) command in TopSpin. Direct connection via a browser is also possible if the system IP is known (e.g. <http://149.236.99.9/serviceweb/>).

Savelogs

Savelogs is a TopSpin command that simplifies the collection of all information needed by the customer service.

Read the TopSpin User Manual chapter **Store Complete Log with => savelogs** for more information.

AqRackServer Log

The AqRackServer is responsible for low level AQS and HPPR device initialization and configuration. It also handles hardware event reporting. The log files of AqRackServer contain useful information for AQS and HPPR troubleshooting. They are located on the EPU and will be saved with savelogs.

The verbosity of AqRackServer logs can be configured with the two parameter Log-Level and Log-Mask.

Log-Level

The Log-Level is a number. Larger values lead to more detailed log files. A reasonable Log-Level for hardware troubleshooting is 20. Values >99 are not recommended.

The Log-Level of a running system can be changed via ServiceWeb.

Log-Mask

The Log-Mask determines what kind of information will be written to the log. Each device has its own Log-Mask that can be configured via Service Web. Changing the Log-Mask is only recommended when the default values lead to unreadable big log files, or when you are troubleshooting AqRackServer internals.

18.4 How to Report a System Error

When contacting the customer service to report a system error do provide a short description of the problem. Additionally, use the following tools or methods to get more information from your system.

When TopSpin is running:

- Use [SaveLogs \[99\]](#) to automatically compile necessary information from your system
- Sometimes additional [ServiceWeb \[98\]](#) reports may be useful

When TopSpin is not running:

- Use [ServiceWeb \[98\]](#) reports for additional information

When TopSpin, ServiceWeb and EPU are not running:

- Write a description of your hardware by hand. The description should contain:
 - Spectrometer type (e.g. AV Neo 500) and order number
 - Part number and ECL (engineering change level) of all units
 - Position (Slot nb.) of the units within the chassis (rack) or cabinet
 - Color and state of unit LEDs
 - Magnet type
- With this information contact the customer service. See [Contact \[109\]](#) for contact details.

19 Replacement of Parts



Only Bruker trained or qualified personnel are allowed to install, mount, retrofit, repair, adjust and dismantle the unit!

Loss of Guarantee

The use of non-approved spare parts will invalidate the manufacturer's guarantee.

Purchase spare parts from authorized dealers or directly from the manufacturer. See [Contact \[109\]](#) for manufacturer's address.

19.1 Returning the Unit for Repair

If the Bruker Hotline diagnoses an instrument failure that requires a part to be returned for repair, please follow the procedure listed here:

1. Contact your local Bruker office to start the repair process (see [Contact](#)). Repair is always handled by your local Bruker office. Their reply will contain all necessary information for the subsequent repair process steps.
2. They will provide you with details on the shipping address, and also in most cases a "Return Merchandise Authorization" number (RMA number) that allows references to the repair case. Always refer to this RMA number in case of questions.
3. Send the defective part to the local Bruker office and include the following documents:
 - RMA sheet (if RMA number was assigned).
 - Signed Equipment Clearance Form (BBIOF002/H152631). The Equipment Clearance Form will be sent to you as part of step 1 (see above) with information about the returned part (part number, serial number, your contact details) already filled in.
4. Attach the relevant papers to the *outside* of the packaging, for instance in a transparent polybag.



The unit should be returned using the original container and packing assembly. If this packaging is no longer available, contact your local Bruker office for further instructions.

20 Dismantling and Disposal

Following the end of its operational life, the device must be dismantled and disposed of in accordance with the environmental regulations.



Installation, initial commissioning, retrofitting, repairs, adjustments or dismantling of the device must only be carried out by Bruker Service or personnel authorized by Bruker. Damage due to servicing that is not authorized by Bruker is not covered by your warranty.

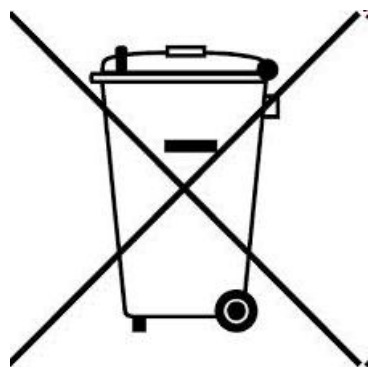
20.1 Dismantling

Before starting dismantling:

1. Shut down the device and secure to prevent restarting.
2. Disconnect the power supply from the device; discharge stored residual energy.
3. Remove consumables, auxiliary materials and other processing materials and dispose of them in accordance with the environmental regulations.
4. Clean assemblies and parts properly and dismantle in compliance with applicable local occupational safety and environmental protection regulations.

20.2 Disposal Europe

Environmental information for laboratory and industrial customers within the EU (European Union)



This laboratory product is developed and marketed for Business-to-Business (B2B), so does not fall under article 6 clause 3 of the German Act ElectroG. To meet the demands of the European Directive 2012/19/EU WEEE 2 (Waste of Electrical and Electronic Equipment) and the national Equipment Safety Act, electrical and electronic equipment that is marked with this symbol directly on or with the equipment and/or its packaging must not be disposed of together with unsorted municipal waste or at local municipal waste collecting points. The symbol indicates that the equipment should be disposed of separately from regular industrial/domestic waste.

Correct disposal and recycling will help prevent potential negative consequences for the environment and risk to personal health. It is your responsibility to dispose of this equipment using only legally prescribed methods of disposal and at collection points defined by government or local authorities in your area.

The WEEE register number can be found on the product label of the equipment. If you need further information on the disposal of equipment or collection and recovery programs available, contact your local Bruker BioSpin sales representative. Local authorities or professional waste management companies may also provide information on specific waste disposal services available in your area.

Disposal - End of Life (EoL) information: the common procedure as defined in the sales contract with Bruker BioSpin

After the lifespan of an electrical and electronic product, Bruker BioSpin takes responsibility for final disassembly and correct disposal in accordance with the European directive 2012/19/EU WEEE 2.

Bruker BioSpin offers to take back the equipment (only for deliveries after 23.03.2006) after termination of use at the customer site upon request by the customer. This request must be affirmed when the equipment is ordered from Bruker BioSpin. Additional costs for dismantling and transport service will apply!

Only 100% pre-decontaminated equipment can and will be accepted by Bruker BioSpin. A release document for decontamination can be inquired from your nearest Bruker BioSpin contact site, also to be used when repairs, going back to Bruker sites, are requested.

In compliance with WEEE II directive: **2012/19/EU**

20.3 Disposal USA and Other Countries

Disposal of these materials may be regulated due to environmental considerations. For disposal or recycling information, please contact our local office or your local authorities, or in the U.S.A., contact the Electronics Industry Alliance web site at www.eiae.org.

21 Technical Data

21.1 General Information

Data	Value	Unit
Weight without subunits or fan tray	5,1	kg
Weight with all subunits (approximately)	45	kg
Length	57,0	cm
Width	48,3	cm
Height	31,0	cm
Sound Pressure Level ^a , maximum	63	dBA
^a Measured stand-alone, outside of the cabinet. For SPL including the cabinet and protection instructions see the applicable manuals.		

Table 21.1: Technical Data: General Information

21.2 Connection Values

The AV NEO AQS system has no single power inlet with mains distribution within the chassis. Each power supply module or unit with mains input is connected individually to the AV4 MAINS PDU 8/16A (power distribution unit) of the cabinet.

Bruker Part No.	Description	Input Voltage Range	Input Current, rated max.	App. power cons. rated max.	Frequency Range	Circuit protection Input Fuse	Notes
		V ac	A ac	VA	Hz	A ac	-
Z156566	AV4 PDU RM 8/16A CAB.1	208-230	16	3840	50-60	none	1
Z158203	AV4 PDU RM 8/16A CAB.2						2
Z158204	AV4 PDU RM 8/16A CAB.2						5
Z177825	AV4 PDU Booster	208-230	3x 10	-	50/60	3x 0,1	1 2 3 4
Z149850	AV4 PSM-48V	208-230	8	1840	50/60	10	5 6
Z104783	AQS PSM HPLNA	100-240	2	117	50/60	3,15	6
Z107413	AQS PSM ADM ECL00	100-240	5	-	47-63	6,3	6
	AQS PSM ADM ≥ ECL01	100-240	2,7	-	47-63	4,0	7
Z156496	AV4 Router 14-PORT	100-240	0,4	96	50-60	internal	8
Z163216	AV4 MRI Router 14-PORT						

Bruker Part No.	Description	Input Voltage Range	Input Current, rated max.	App. power cons. rated max.	Frequency Range	Circuit protection Input Fuse	Notes
		V ac	A ac	VA	Hz	A ac	-
	(including ac/dc power supply adapter)						
O10293	Ethernet Switch 24-PORT	100-240	1,0	-	50/60	internal	-

Table 21.2: Electrical Connection Values: Summary of all Units

Notes:

1. No LINE IN input protection. The LINE IN input current is limited in the AV4 OB LINE IN MODULE of the console.
2. LINE OUT load currents must be limited to 10 A per output by the connected device
3. Three LINE IN to LINE OUT channels per unit
4. Three CTRL-IN input per unit, two replaceable fuses per input (L+N, time-lag T)
5. The input voltage range is limited to a useful range to allow load units without wide range ac-inputs. It is smaller than the one on the rating plate of the actual unit.
6. Two not replaceable internal fuses per input (L+N)
7. Two replaceable fuses per input (L+N, time-lag T, type H)
8. Internal protection against overload, over voltage and over temperature with auto recovery

21.3 Environmental Conditions

Data	Value	Unit
Temperature range	+5 - 40	°C
Relative humidity at 31 °C, maximum ^a	max. 80	%
Working altitude above sea level	max. 2000	m
Supply voltage variation	max.-10 .. +10	%
Overvoltage category	II	
Temporary overvoltage	1440	V
Pollution degree	2	
^a Decreasing linear till relative humidity < 50% at 40 °C		



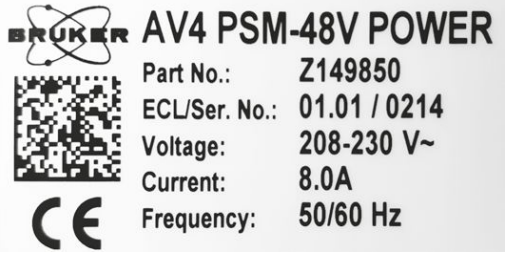

Table 21.3: Operating Environment

For the appropriate temperature see also Bruker site planning guides.

21.4 Rating Plates

The rating plates are located near the power input of each power supply module and includes the following information:

- Manufacturer
- Type
- Voltage
- Frequency
- Apparent power consumption or input current, maximum
- PN: Part Number
- SN: Serial Number
- ECL: Engineering Change Level

Bruker Part No.	Description	Rating Plate
Z156566 Z158203 Z158204	AV4 PDU RM 8/16A CAB.1 AV4 PDU RM 8/16A CAB.2 AV4 PDU RM 8/16A CAB.2	 <p>Raritan Raritan, Inc. 400 Cottontail Lane Somerset, NJ 08873 www.raritan.com</p> <p>P/N: PX2-2180CR</p> <p>Input: 100-240Vac, 50-60Hz, 16A Total Output: 100-240Vac, 50-60Hz, ≤ 16A Individual Outlet: 8x C13 ≤ 12A, each H/W: V.AL, Ctrl-V6-AK, Con-AB, Led-0A, Outlet-AB Relay-AM, ILM-AJ F/W: PX2-3.2.30.5.43188, RELAY 0x185, METER 0x383</p> <p>Serial #: PFL6C00011</p> <p>Model: PX2-2180CR</p> <p>This device complies with Canada ICES-003, Class A This device complies with Part 15 Class A of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.</p> <p>この装置は、クラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。</p> <p>UL LISTED I.T.E. E149920 10510271 RoHS N14663 Made in Taiwan</p>
Z177825	AV4 PDU BOOSTER	<p>Z167825 AV4 PDU BOOSTER TRIPLE ECL 00.00 S-Nr. 0004 Procadesign AG / 8610 Uster Art. Nr. 8E1024500</p> <p>Input voltage range: 208-230 Vac Input current: 3 x 10Aac Input frequency: 50/60 Hz</p> 
Z149850	AV4 PSM-48V	 <p>BRUKER AV4 PSM-48V POWER</p> <p>Part No.: Z149850 ECL/Ser. No.: 01.01 / 0214 Voltage: 208-230 V~ Current: 8.0A Frequency: 50/60 Hz</p> 

Bruker Part No.	Description	Rating Plate
Z104783	AQS PSM HPLNA	
Z107413	AQS PSM ADM ECL00	
	AQS PSM ADM ≥ ECL01	<p style="text-align: center;">AQS PSM ADM</p> <p>In: 100-240VAC I/Art-Nr: Z107413 2,7A / 47- 63Hz ECL01.00 Out1: + 7,5 VDC / 10A U/Art-Nr: 123416 B Out2: +19 VDC / 2A S/N: Z107413 / 01.00 / 01008 Out3: - 36 VDC / 1A Out4: - 60 VDC / 1A</p> <p style="text-align: center;">Made in Switzerland</p> <p style="text-align: center;">ELMA Your Solution Partner</p> <p style="text-align: right;">www.elma.ch</p>
Z156496 Z163216	AV4 ROUTER 14-PORT AV4 MRI ROUTER 14-PORT (including ac/dc power supply adapter)	
O10293	ETHERNET SWITCH 24-PORT	<p style="text-align: center;">NETGEAR</p> <p style="text-align: center;">ProSafe® Plus Switch 24-Port Gigabit Switch JG5524Ev2</p> <p>This device complies with part 15 of the FCC Rules and Canada ICES-003. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.</p> <p>この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。</p> <p style="text-align: right;">VCCI-A</p> <p>DEFAULT ACCESS: C UL US LISTED I.T.E. E212778 password: password</p> <p>Input Rating: AC 100-240V~, 50/60Hz, 1.0 A max.</p> <p>MAC: DCEF09C82191 SERIAL: 3KH55A5Y0065B</p> <p style="text-align: center;">NETGEAR, INC. Made in China 272-11987-03</p>

Table 21.4: Technical Data: Rating Plate Examples

22 Contact

Manufacturer

Bruker BioSpin GmbH
Silberstreifen 4
D-76287 Rheinstetten
Germany
<http://www.bruker.com>

WEEE DE43181702

NMR Hotlines

Contact our NMR service centers.

Bruker BioSpin NMR provides dedicated hotlines and service centers, so that our specialists can respond as quickly as possible to all your service requests, applications questions, software or technical needs.

Please select the NMR service center or hotline you wish to contact from our list available at:

<https://www.bruker.com/service/information-communication/helpdesk.html>

Phone: +49 721-5161-6155

E-mail: nmr-support@bruker.com

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23 Glossary

AC/DC PSM	DC power supply with ac-input
AQ-bus	Acquisition control signal bus
AqRackServer	Host rack controller software
AQS	Acquisition System
AQS PSM ADM	AQS PSM ADM Power Supply Module
AQS PSM HPLNA	AQS PSM HPLNA Power Supply Module
ATMA	Automatic Tuning and Matching, motor unit in probes
AV4 AD-CTRL	AV4 MRI AD-Controller
AV4 AQS Chassis	AV4 AQS Chassis Mainframe
AV4 AQS Fan Tray	AV4 AQS Chassis Cooling Unit
AV4 EPU/2	AV4 Embedded Processing Unit 2nd generation
AV4 EPU/2 R	AV4 Embedded Processing Unit Replacer 2nd generation
AV4 GTU	AV4 GT-Controller Unit
AV4 PDU 8/16A	AV4 Mains Power Distribution Unit
AV4 PDU BOOSTER	AV4 PDU Booster Triple
AV4 PSM-48V	AV4 PSM-48V Power Supply Module
AV4 PSM-A	AV4 PSM-A Power Supply Module
AV4 PSM-D	AV4 PSM-D Power Supply Module
AV4 REF	AV4 Reference 1200
AV4 ROUTER 14-PORT	AV4 Ethernet Router RM 14-Port
AV4 TRX	AV4 Transceiver 1200
AVANCE	Bruker spectrometer brand name
Backplane	Connection board within the chassis mainframe
BFB bus	Bruker Field Bus, serial communication bus
BLNKTR	Transmitter Blanking Pulse
BSMS/2	Bruker Smart Magnet Control System 2nd generation
BSMS/2 ELCB	BSMS/2 ELCB Extended Lock Control Board
BSMS/2 L-TRX	BSMS Lock Transceiver
COM	ComputerOnModule compact PC
CRP	Cryoprobe
DC/DC PSM	DC power supply with dc-Input
Ethernet Switch 24-Port	Ethernet Switch Fast 24-Port 10/100
FRU	Field Replaceable Unit

FTMS	Fourier-transformation ion cyclotron resonance mass spectroscopy
HPPR/2	High Performance Preamplifier 2nd generation
HPPR/2 ADM	HPPR/2 MRI Active Detuning Module
HPPR/2 ADM-CRP	HPPR/2 MRI ADM-CRP Module
HWIDS	Hardware Identification System (MRI only)
I2C bus	Low-speed serial communication bus
IPSO	Intelligent Pulse Sequence Organizer
LED	Light Emitting Diode
LNA	Low Noise Amplifier
LVDS	Low Voltage Differential Signaling
MRI	Magnetic Resonance Imaging
NMR	Nuclear Magnetic Resonance spectroscopy
OCXO	Oven Controlled Cristal Oscillator
PCIe-bus	High-speed serial communication bus
PICS	Probe Identification System
PSM	Power Supply Module (generic term)
RCP	Realtime Control Pulse
RF electronics	Radio frequency electronics
RGP HPPR	Preamplifier Receiver Gating Pulse
SGU	Signal Generation Unit, predecessor of TRX unit
SOHO Router	Small Office, Home Office Router
TopSpin	Spectrometer control, data acquisition and processing software
TPF0	Lock Transmitter Gating Pulse
Transceiver	Combined transmitter and receiver unit
USB bus	Universal Serial Bus
UT0 connector	UT0 series round connector (brand name)





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