


MAS III

- Pneumatic Unit
User Manual
Version 001



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1 About

1.1 This Manual

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 accident prevention 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 Policy Statement

It is the policy of Bruker 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. Support engineers are advised to regularly check with Bruker for updated information.

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

1.3 Symbols and Conventions

Safety instructions in this manual are marked with symbols. The safety instructions are introduced using indicative words which express the extent of the hazard.

In order to avoid accidents, personal injury or damage to property, always observe safety instructions and proceed with care.

DANGER



DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

This is the consequence of not following the warning.

1. This is the safety condition.

▶ This is the safety instruction.

WARNING



WARNING indicates a hazardous situation, which, if not avoided, could result in death or serious injury.

This is the consequence of not following the warning.

1. This is the safety condition.
 - ▶ This is the safety instruction.

CAUTION



CAUTION indicates a hazardous situation, which, if not avoided, may result in minor or moderate injury.

This is the consequence of not following the warning.

1. This is the safety condition.
 - ▶ This is the safety instruction.

NOTICE

NOTICE indicates a property damage message.

This is the consequence of not following the notice.

1. This is a safety condition.
 - ▶ This is a safety instruction.

SAFETY INSTRUCTIONS

SAFETY INSTRUCTIONS are used for control flow and shutdowns in the event of an error or emergency.

This is the consequence of not following the safety instructions.

1. This is a safety condition.
 - ▶ This is a safety instruction.



This symbol highlights useful tips and recommendations as well as information designed to ensure efficient and smooth operation.

1.4 Font and Format Conventions

Type of Information	Font	Examples
Shell Command, Commands, “All what you can enter”	Arial bold	Type or enter fromjdx zg
Button, Tab, Pane and Menu Names “All what you can click”	Arial bold, initial letters capitalized	Use the Export To File button. Click OK . Click Processing...
Windows, Dialog Windows, Pop-up Windows Names	Arial, initial letters capitalized	The Stacked Plot Edit dialog will be displayed.
Path, File, Dataset and Experiment Names Data Path Variables Bruker Trademarks Table Column Names Field Names (within Dialog Windows)	Arial Italics	<i>\$tshome/exp/stan/nmr/</i> <i>lists</i> <i>expno, procno,</i> <i>IconNMR™,</i> <i>TopSpin™,</i> <i>XWIN-NMR™</i>
Parameters	Arial in Capital Letters	VCLIST
Program Code Pulse and AU Program Names Macros Functions Arguments Variables	Courier	go=2 au_zgte edmac CalcExpTime() XAU(prog, arg) disk2, user2
AU Macro	Courier in Capital Letters	REX PNO

Table 1.1: Font and Format Conventions

2 Introduction



Figure 2.1: MAS III

This manual describes the operation of the *MAS III* unit for MAS type NMR experiments. Two different software interfaces are available: The *TopSpin* user interface and the MAS units webpage, their corresponding usage is explained in the section [MAS Unit Web Interface \[▶ 64\]](#) and [MasDisp \[▶ 54\]](#), respectively. The user interface is part of *TopSpin* 3.5 and higher and is intended for routine use. The web interface provides the same functionality but adds access to advanced settings. It can be operated independently from *TopSpin*. For routine operation use *TopSpin*.

2.1 Concept

This manual is intended to assist operators who have recently acquired a MAS III Pneumatic Unit (P/N H139288). After reading the manual the operator should be able:

- To install the unit.
- To understand the basic functions of the hardware.
- To setup the unit.
- To operate the unit via *TopSpin* and the internal webpages.

This manual is **not** intended to describe:

- Solid NMR or specifically MAS applications.
- Sample preparation.
- MAS data analysis.
- Variable temperature work.
- MAS probes.

2.1.1 Useful Manuals on the Subject of MAS

This manual concentrates on describing the operation of the MAS Pneumatic Unit from a user's perspective. Other manuals that may be of interest to a user are listed in the table below.

Title	Part Number
SB-MAS Operation Manual	Z31401
MAS II Pneumatic Unit	Z31701E
High Resolution Magic Angle Spinning Spectroscopy	Z31437
AVANCE DMX/DSX Spectrometers, Solids Experiments User Manual	H9321
Solid State NMR AVANCE Solids User Manual	Z31848
High Resolution MAS Probes	Z31391
MAS Spinning Guide	B3940
Variable Temperature Control for NMR Probes	Z33073

Table 2.1: Other Manuals

2.2 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.

You must use an adequate mains cable rated to at least 250V and which meets any local safety requirements. A suitable UL listed detachable mains cable is available in the accessory kit supplied with the unit.

2.3 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, Terms of Delivery, and the legal regulations applicable at the time of the conclusion of the contract shall apply.

2.4 Copyright

This manual is protected by copyright and intended solely for internal use.

This manual must not be made available to third parties, duplicated in any manner or form – whether in whole or in part – and the content must not be used and/or communicated, except for internal purposes, without the written consent of the manufacturer.

Violation of the copyright will result in legal action for damages. We reserve the right to assert further claims.

2.5 Warranty Terms

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

2.6 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.

2.7 EC Declaration of Conformity

EG Konformitätserklärung
EC-Declaration of Conformity
Declaration de Conformité – CE
 Bruker BioSpin Group



Der Unterzeichner, der den nachstehenden Hersteller vertritt:
 The undersigned, representing the following manufacturer:
 Le signataire, qui représente le producteur suivant:

Hersteller / Manufacturer / Producteur: **Bruker BioSpin GmbH**
 Anschrift / Address / Adresse: Silberstreifen 4, 76287 Rheinstetten, Germany

erklärt hiermit, dass die... / herewith declares that... / déclare par la présente que le ...

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 ...est conforme aux dispositions des directives européennes suivantes (y compris tous les amendements applicables).

2006/95/EG Niederspannungsrichtlinie (NS-RL)	2006/95/EC Low Voltage Directive (LVD)	2006/95/CE Directive Basse Tension (DBT)
Europäische Richtlinie betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen European Directive to electrical equipment designed for use within certain voltage limits LVD - Low Voltage Directive Directive européen au matériel électrique destiné à être employé dans certaines limites de tension		(früher: 73/23/EWG) (former: 73/23/EEC) (avant: 73/23/CEE)
Angewendet harmonisierte / Applied harmonized standards / Suite à des normes harmonisées applicables:		
EN 61010-1:2010		

2004/108/EG Elektromagnetische Verträglichkeit (EMV)	2004/108/EC Electromagnetic Compatibility (EMC)	2004/108/CE Compatibilité Electromagnétique (CEM)
Europäische Richtlinie über die elektromagnetische Verträglichkeit Directive relating to electromagnetic compatibility Directive Européen concernant la Compatibilité Électromagnétique		(früher: 89/336/EWG) (former: 89/336/EEC) (avant: 89/336/CEE)
Angewandte harmonisierte Normen / Applied harmonized standards / Suite à des normes harmonisées applicables:		
EN 61326-1:2013	EN 61000-3-2:2006 + A1:2009 + A2:2009	EN61000-3-3:2008

Rheinstetten, 01.07.2014
 Deutschland / Germany / Allemagne

Dr. Frank Decker
 Produktmanager / Product Manager / Chef de Produit

3 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.

3.1 General

Before you start any repair inside of the device, be aware of the high 230/110V 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.

3.2 Intended Use

The device has been designed and constructed solely for the intended use described here.

The MAS III pneumatic unit is designed to control Bruker MAS NMR Probes using *TopSpin* or the Manual Control Panel on the MAS III pneumatic unit web pages.

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

Any use which exceeds or differs from the intended use and the instructions of this manual shall be considered improper use and may impair the safety of operation. No claims of any kind for damage will be entertained if such claims result from improper use.

3.3 Owner's Responsibility

Owner

The term *owner* refers to the person who himself 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.

Owner's Obligations

The device is used in the industrial sector, universities and research laboratories. The 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 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 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 owner must assess whether the operating instructions issued comply with the current status of regulations, and must update the operating instructions if necessary.
- The owner must clearly lay down and specify responsibilities with respect to installation, operation, troubleshooting, maintenance and cleaning.
- The owner must ensure that all personnel dealing with the device have read and understood this manual. In addition, the owner must provide personnel with training and hazards information at regular intervals.
- The owner must provide the personnel with the necessary protective equipment.
- The 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 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 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 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 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 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 owner must ensure that the work area is sufficiently illuminated to avoid reading errors and faulty operation.
- The owner must ensure that the laboratory is equipped with an oxygen warning device, in case the device is operated with nitrogen.

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

- The owner must ensure that the maintenance intervals described in this manual are observed.
- The owner must ensure that all safety devices are regularly checked to ensure full functionality and completeness.

3.4 Personnel Requirements



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

3.4.1 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 measures 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.

3.4.2 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.

3.4.3 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

3.5 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.

3.6 Position of the Rotor Quick Stop Button

The location of the **Rotor Quick Stop** button is on the MAS III back panel.

Pressing the **Rotor Quick Stop** button causes a stop procedure, either for standard or for toxic samples.

NOTICE

Damage to the Rotor or the Probe

If the device is configured for toxic samples, pressing the **Rotor Quick Stop** Button can result in damage to the rotor and the probe.

- ▶ When configured for toxic samples all valves will automatically close.
- ▶ Press the **Rotor Quick Stop** button **only** in case of malfunction.



Figure 3.1: **Rotor Quick Stop** Button on the MAS III Back Panel

3.7 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.

3.7.1 General Workplace Dangers

DANGER



Danger of Suffocation from Nitrogen Gas

If excessive amounts of N₂ gas is released in an enclosed space, nitrogen will decrease the amount of available oxygen and may cause suffocation.

- ▶ The device should be installed in a sufficiently spacious, well ventilated room equipped with a permanent O₂ alarm.

WARNING



Danger 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



Danger 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.

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.

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

NOTICE

Material damage hazard due to impacting the magnet!

Impacting the magnet may result in a quench.

- ▶ Avoid banging the magnet during installation.

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 empty samples during installation and maintenance.

3.7.2 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.

3.7.3 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.
- ▶ Avoid working over the head. When this cannot be avoided, wear a protective hard hat.
- ▶ Follow the mounting instructions in the section Installation.

3.7.4 Dangers from Gases Under Pressure**⚠ WARNING****Danger of injury due to movements caused by stored pneumatic forces!**

Pneumatically driven components may move unexpectedly due to stored residual forces, causing serious injuries.

- ▶ Work on the pneumatics system must only be carried out by trained pneumatics technicians.
- ▶ Before starting work on the pneumatics system, ensure that it has been completely depressurized. The pressure accumulator must be completely relieved.

⚠ WARNING**Accident hazard from asphyxiation!**

A break in the pneumatic hose may result in the uncontrolled exit of nitrogen into the laboratory.

- ▶ An oxygen warning device should be present in the laboratory if the device is operated with nitrogen.
- ▶ Note that leakage from the main supply line cannot be stopped by the device!

Overpressure Valve

The high pressure system includes an overpressure valve which safely reduces the excess pressure in the event of inadmissible pressure conditions developing as a result of faulty operation, component failure or other irregular events.

3.7.5 Dangers from Magnetic Fields

WARNING

Risk to life due to high magnetic fields

A magnetic field of more than 0.5 mT (5 Gauss) is life-threatening for people with pacemakers or active metal implants. Exposure to more than 8 T can cause damage to health. Duration of exposure (8 h/day) above the limit of 200 mT can cause damage to health. Ferromagnetic tools in the magnetic field are significantly hazardous. Disks and electronic devices may be damaged.



- ▶ Mark the magnetic field of more than 0.5 mT (5 Gauss) before start up.
- ▶ Keep people with active medical implants or heart pacemakers away from the 0.5 mT (5 Gauss) area.
- ▶ The permanent workplace of employees must be outside the 0.5 mT (5 Gauss) area.
- ▶ Do not stay or work at magnetic fields of more than 8 T.
- ▶ Prevent exposure of more than 200 mT for more than 8 h/day.
- ▶ Keep disks, credit cards and electronic devices away from the identified area.
- ▶ Do not use ferromagnetic tools or items within the identified area.
- ▶ Only use non-ferromagnetic transportation dewars or pressure cylinders for the cryogenic agents.
- ▶ Only use non-ferromagnetic ladders or steps.
- ▶ Remove magnetic items (jewelry, watches, pens etc.) before carrying out maintenance work.



The magnetic field of the device does not cause any personal injuries or property damage. For further information see the manual of the magnet used.

3.7.6 Dangers from LED or Laser Light

CAUTION



Accident hazard from bright LED or laser light!

Peering into the lighting system of optical sensors, may result in temporary blinding of the eyes due to the bright light.

- ▶ Do not look into the ray of light.
- ▶ Switch off the equipment before maintenance work.

3.7.7 Dangers Due to High or Low Temperatures

CAUTION



Accident hazard from hot or cold air escaping out of the unit.

When the cassette is removed, hot or cold air may exit the unit or BST, which may result in serious burns.

- ▶ Ensure that personnel are aware of this risk.
- ▶ Refer to the unit manual for more information.

NOTICE

Material damage hazard from overflow of cryogenes.

Material damage may result from the overflow of cryogenes.

- ▶ Turn off the device during magnet servicing.
- ▶ Cover the device with a protective cover to avoid contact with cold gases.
- ▶ Be sure to use sufficient transfer line and Teflon evacuation hose for nitrogen and helium refills based on recommendations in the magnet manual.
- ▶ After refilling cryogenes some parts of the magnet may be icy. Be sure to remove the ice to avoid its melting onto the device.

3.7.8 Danger from Chemical Substances

DANGER



Danger of injury from rotor breakage!

Broken rotors may cause minor injuries or material damage, but may also result in a life threatening situation if hazardous substances are used.

- ▶ If a rotor breaks, refer to the corresponding precautions and cleaning/disinfection instructions.
- ▶ Wear protective equipment.
- ▶ Perform all tasks with samples and rotors carefully.
- ▶ Before carrying out any maintenance work, remove the samples if necessary.
- ▶ Strictly observe the correct diameter of the rotors.
- ▶ **The laboratory supervisor is responsible for:**
 - ⇒ Establishing and enforcing standard sample handling and cleaning procedures.
 - ⇒ Establishing and enforcing the use of protective clothing and equipment.
 - ⇒ Training laboratory personnel.
 - ⇒ Preparing an emergency plan.

WARNING



Danger of injury from vapor formation!

During the work process, vapors may form which cause serious injury if inhaled.

- ▶ Only install the device in a well-ventilated room or ensure that an extractor is fitted.

NOTICE

Material damage hazard from material contact with NMR solvents!

Material damage may result when the device comes in contact with NMR solvents.

- ▶ Follow instructions provided in the manual for correct handling of solvents.
- ▶ Follow the sensor cleaning procedures described in this manual.
- ▶ If surface damage should occur, contact Bruker for repair of damaged parts.

NOTICE

Material damage hazard from samples!

Samples may be damaged due to incorrect pressure adjustment.

- ▶ Adjustment is valid only for 1 sample configuration and weight.
- ▶ Personnel must be trained.

3.8 Environmental Protection

NOTICE

Danger to the environment 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:

Nitrogen gas	Nitrogen gas may cause suffocation at high concentrations. Disposal of the empty gas cylinders must be performed by a specialist disposal company.
---------------------	--

3.9 Signage

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



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.

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.

Danger Spot



Warning indicating a danger spot in work rooms. The warning label may be ordered using Bruker Part Number 67470.

4 Technical Data

4.1 Facility Requirements

4.1.1 Main Air Supply

Input pressure to the Gas Tank:	Max.: 1 MPa (10 bar / 145 psi)
	Min.: 0.4 MPa (4 bar / 60 psi)
	Ideal: 0.6-0.8 MPa (6-8 bar / 87-115 psi)
Input pressure to the MAS III Unit:	Max.: 0.7 MPa (7 bar / 100 psi)
Particulates:	Oil free air with particle size not greater than 0.01 microns.
Dew point:	< -30°C
Flow rate:	This will depend to some extent on spin rates etc., but typically a flow of 300 l/min (2.35 cu.ft./min.) flowing at greater than 0.6 MPa (6 bar / 90 psi) will suffice.

Table 4.1: Input Pressure

4.1.2 Nitrogen Supply for Low Temperature Work



DANGER

Danger of Suffocation from Nitrogen Gas

If excessive amounts of N₂ gas is released in an enclosed space, nitrogen will decrease the amount of available oxygen and may cause suffocation.

- ▶ The device should be installed in a sufficiently spacious, well ventilated room equipped with a permanent O₂ alarm.

For low temperature work the most common arrangement is to use a pressurized liquid nitrogen tank with a nitrogen boil-off device. A 60l (2.11 cu.ft.) gas cylinder (20 MPa / 200 bar / 2900 psi) will typically last for 1 hour.

The various configurations for low temperature work are dealt with extensively in the corresponding spectrometer manual, e.g. P/N H9321 or B92999.

4.1.3 Ambient Laboratory Environment

No special requirements in respect to temperature and humidity are required. The MAS III Unit will operate under standard laboratory conditions suitable for NMR spectrometer.

4.1.4 Electrical Supply

Data	Value	Unit
Voltage	110 – 230	VAC
Apparent power consumption, maximum	75	VA
Circuit protection	2x 0.8	A
	250	V
	slow blow	
Frequency	50 / 60	Hz

Table 4.2: Electrical Connection Values

4.1.5 Maintenance

A well-controlled temperature and humidity environment in the laboratory will extend the life cycle of all parts. The quality of the gas input into the MAS III unit is particularly important in preventing problems arising from impurities / particles etc.

The MAS III pneumatic unit requires special maintenance procedures due to the battery inside the MAS and the particle filter on the maintenance unit on the gas buffer. Refer to the section [Troubleshooting \[▶ 81\]](#) for detail information.

4.2 General Information

Data	Value	Unit
Weight*	16	kg
Length	35,5	cm
Width	27	cm
Height	24	cm

Table 4.3: Technical Data: General Information

*Weight without accessories (e.g. gas tank)

4.3 Operating Conditions

Environment

Normal environmental conditions (CAN/CSA 61010-1-12; IEC 61010-1: 2010; ANSI/UL 61010-1)

- Indoor use only.
- Maximum operation altitude: 2000 m.
- Working temperature 5 °C to 35 °C.
- Maximum relative humidity 80% for temperatures up to 31 or decreasing linearly to 50% relative humidity at 40 °C.
- MAINS supply voltage fluctuations within the stated voltage range.
- Transient overvoltage's up to the levels of overvoltage category II.

- Pollution degree 2.
- Protection class IP20.

For the appropriate temperature see also the Bruker site planning guides on the BASH DVD (Bruker Advanced Service Handbook):

Manual	Bruker Part Number
Site Planning for AVANCE Systems 300-750 MHz	Z31276
Site Planning for AVANCE Systems 800-950 MHz	Z31686

Table 4.4: Bruker Site Planning Guides

4.4 Rating Plate

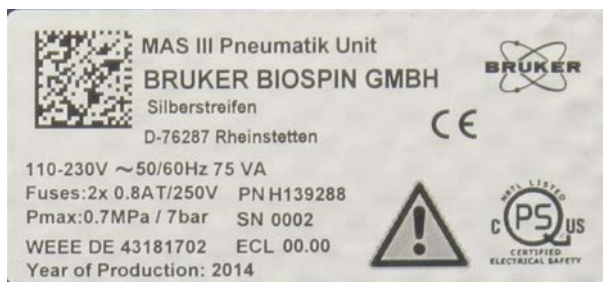


Figure 4.1: Rating Plate

The rating plate is located at the power input and includes the following information:

- Name of product
- Manufacturer
- Voltage
- Frequency
- Apparent power consumption, maximum
- Fuses
- Input pressure, maximum
- ElektroG Registration Number
- Year of Production
- PN: Part Number
- SN: Serial Number
- ECL: Engineering Change Level

5 Design and Function

5.1 Overview

Magic Angle Spinning (MAS) is a technique often used to obtain high-resolution NMR spectra from solid samples. It is implemented in the NMR experiment by rotating the sample about an axis oriented at an angle of about 54.7 degrees, with respect to the applied static magnetic field.



Figure 5.1: MAS III Unit

5.2 Back Panel

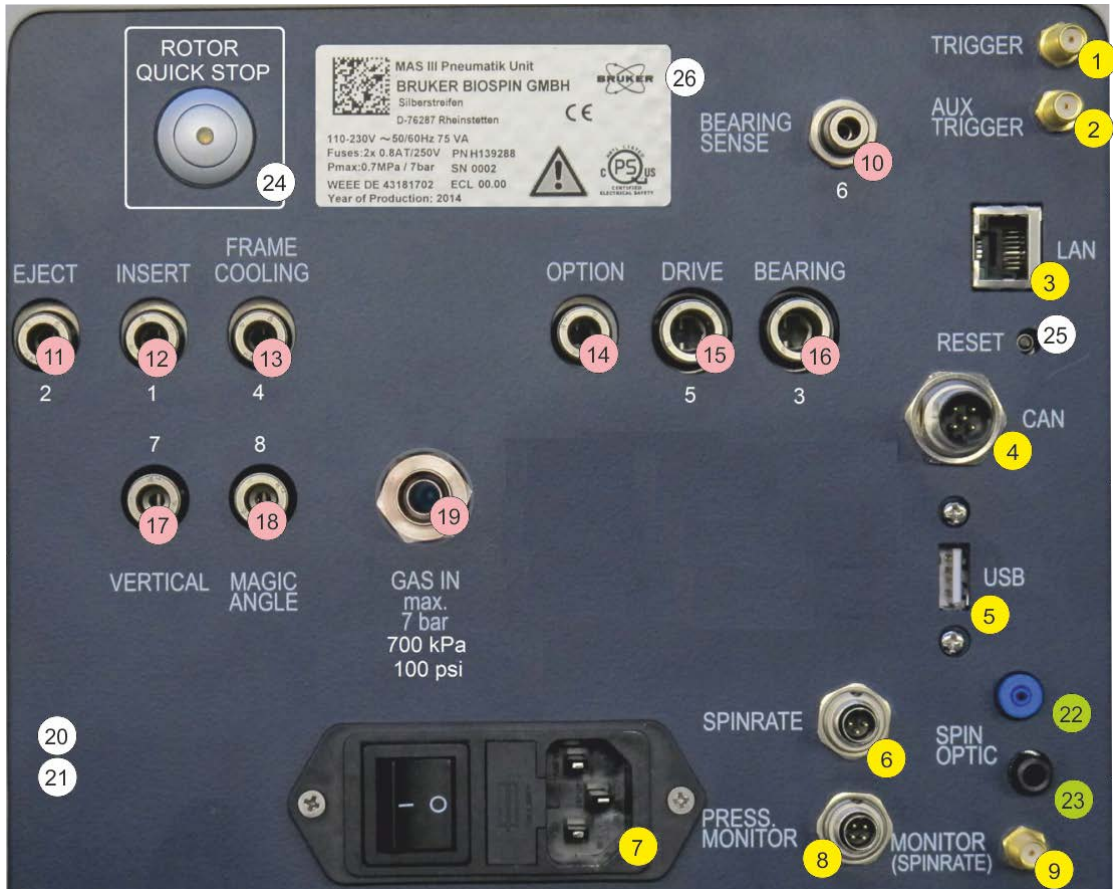


Figure 5.2: MAS Back Panel

1	TRIGGER	14	OPTION
2	AUXILIARY TRIGGER	15	DRIVE OUT
3	ETHERNET	16	BEARING OUT
4	CAN BUS	17	VERTICAL
5	USB	18	MAGIC ANGLE
6	SPINRATE	19	GAS IN
7	LINE IN UNIT (Main Switch, Fuse Holder, Line In)	20	Placeholder
8	PRESSURE MONITOR	21	Placeholder
9	SPINRATE MONITOR	22	SPIN OPTIC, blue
10	BEARING SENSE	23	SPIN OPTIC, black
11	EJECT	24	Emergency Stop Button, see chapter <i>Position of the Rotor Quick Stop Button</i> [▶ 18]
12	INSERT	25	Reset Button
13	FRAME COOLING	26	Rating Plate see chapter <i>Rating Plate</i> [▶ 29]

5.3 Connections

5.3.1 Electrical Connections

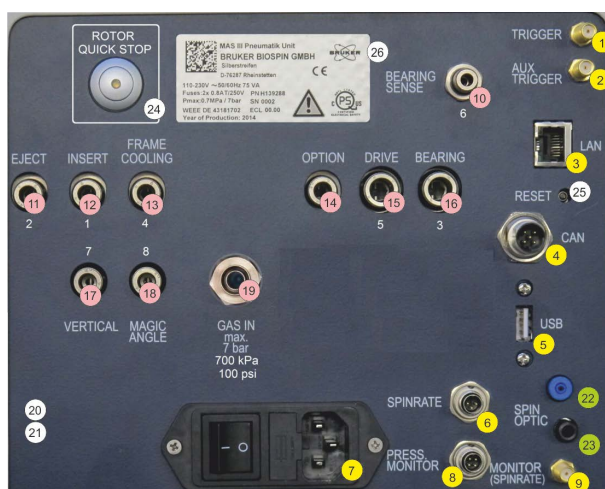


Figure 5.3: Back Panel - Electrical Connections (yellow)

1	TRIGGER	Electrical output to the Timing Control Unit (TCU). This is a TTL 5V signal that replicates the spinning of the rotor and can be used to synchronize the phase of the rotation with specific NMR pulse sequences.
2	AUXILIARY TRIGGER	Additional electrical output to the TCU. This 5V TTL signal is high when the spin lock is reached. Otherwise the output level is low.
3	ETHERNET	Communication interface which must be connected to the Ethernet switch of the NMR spectrometer or a PC by using the unit in manual mode. Connect this using a suitably certified Ethernet cable (supplied in the accessory kit).
4	CAN BUS	Input/output , to control external units from the MAS III. No application available at the moment.
5	USB	USB-Device connector for a USB memory device e.g. USB stick for Firmware update, logging and service purposes.
6	SPINRATE	This is the electrical spin rate readout input , which must be connected to the spin rate assembly on the probe via the spin rate cable (P/N HZ16808).
7	LINE IN	See specification in chapter Electrical Supply [28] . You must use an adequate mains cable rated to at least 250 V and which meets any local safety requirements. A suitable UL listed detachable mains cable is available in the accessory kit supplied with the unit.
8	PRESSURE MONITOR	Electrical input , used to measure the gas supply of the lab (measured before the gas tank).
9	SPINRATE MONITOR	Electrical output , used to monitor the preamplified analog spinning rate signal. This signal is in the range of 0 to 5 V. Not 50 Ohms stable! Connect only high-impedance devices.

5.3.2 Pneumatic Connections



Figure 5.4: Pneumatic Connections (pink)

10	BEARING SENSE	This input ensures that the pressure elevating the rotor (the BP) as detected at the probe base is sufficient. This ensures that abnormal pressure losses can be detected in the bearing path.
11	EJECT	Pressure output which ejects the rotor from the stator.
12	INSERT	This pressure output inserts the rotor into the stator. This output is not always connected. If you are not sure if this output is needed, please refer to your probe manual.
13	FRAME COOLING	Pressure output for cooling the probe assembly.
14	OPTION	An optional pressure output which is actually needed to operate the old Solids Sample Changer which fits on the transfer tube in top of the BST (e.g. P/N B0525). For detailed information refer to the chapter Installation [39].
15	DRIVE OUT	Pressure output used to drive the rotor.
16	BEARING OUT	The pneumatic output will be connected to either a heat exchanger or directly to the probe and serves the bearings from the probe.
17	VERTICAL	Output that switches the stator back to the vertical position to enable the rotor to be ejected or a new rotor to be inserted. This output is required for all probes using Flip mechanics (mostly used for standard bore magnets).

18	MAGIC ANGLE	Output that tilts the stator to the desired angle. This output is required for all probes using Flip mechanics (mostly used for standard bore magnets).
19	GAS IN	This is the main pneumatic pressure input to the MAS III and is the source of all other pressures that are used. This supply must be buffered by a gas tank with a volume of at least 7 liters (0.25 cu.ft.) and filtered by a sub-micro filter inside the maintenance unit. See specification in Main Air Supply [27] .
20	Placeholder	
21	Placeholder	

5.3.3 Optical Connections (for Future Use)



Figure 5.5: Optical Connections (green)

22	SPIN OPTIC, blue	Optical output for spin rate measurement.
23	SPIN OPTIC, black	Optical input for spin rate measurement.

5.4 Control and Display Elements



Figure 5.6: **Rotor Quick Stop** Button on the Back Panel of the MAS III



Figure 5.7: Mains Switch

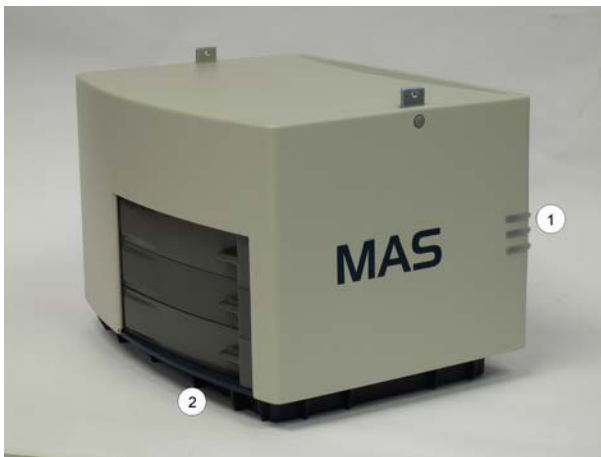


Figure 5.8: MAS III with LEDs

1	Status light with three LEDs: red, green, blue
2	Bottom LEDs

Status Light

Color	Status Description
Red	Error: Look for messages in <i>TopSpin</i> or on the embedded web pages.
Green	Ready.
Green Blinking	Activity e.g. initializing.
Blue	User interaction is required: Look for messages in <i>TopSpin</i> or on the embedded webpages.

Table 5.1: Status Light

Bottom LEDs

Used to indicate the state of the rotor rotation. The LED is blue, but with different blinking states.

Status	Status Description
Off	No rotation.
Increasing intensity	Rotation speed incrementing.
On	Rotation running and target frequency is locked.
Decreasing intensity	Rotation speed decrementing.
Fast Blinking at constant intensity	Waiting for spin lock.

Table 5.2: Bottom LEDs

6 Installation



Only trained Bruker personnel are allowed to retrofit, repair, adjust and dismantle the unit.

There are several steps that must be carried out to safely install the MAS III Pneumatic Unit in the spectrometer environment:

- [Verifying the Shipping List \[▶ 39\]](#)
- [Preparing the MAS III Unit for Installation \[▶ 40\]](#)
- [Gas Buffer Connections \[▶ 43\]](#)
- [Mains and Spectrometer Connections \[▶ 46\]](#)
- [NMR Probe Connections \[▶ 47\]](#)
- [TopSpin Configuration \[▶ 48\]](#)
- [Final Configuration \[▶ 49\]](#)

6.1 Verifying the Shipping List

Before connecting the MAS III to a spectrometer system, verify that all parts on the shipping list have been received:

Description	Part Number
MAS Unit	H139288
Trigger, Ethernet and power cable set	H139646
Trigger Adapter SMA / Twin-BNC	H146795
Accumulator	1813295
Buffer tank connection set	H139673
HPPR Mounting set	H146662
Protective ground adapter set	H143014
Packing	H143709
This manual	H146901
Gas buffer or maintenance unit including wiring and tubing	e.g. H138874 or H138875

Table 6.1: Shipping List

6.2 Preparing the MAS III Unit for Installation

There are several configurations that can be used to include the MAS III Pneumatic Unit in the spectrometer environment, based on the spectrometer configuration available:

- [MAS III as a Standalone Unit \[▶ 40\]](#)
- [MAS III with HPPR Preamplifiers \[▶ 41\]](#)
- [MAS III with HPPR Preamplifiers and Multiple Receiver Adapter \[▶ 42\]](#)

Follow the instructions pertaining to your spectrometer configuration to prepare the unit for installation.

6.2.1 MAS III as a Standalone Unit

When using the MAS III as a standalone unit:

- Close the mounting gaps for the HPPR, using:
 - The two plastic bricks (P/N H142758)
 - Screws (P/N 1672)
 - Caps (P/N 88399)



Figure 6.1: MAS Standalone Operation with Closing Caps

6.2.2 MAS III with HPPR Preamplifiers

To integrate the MAS III into the HPPR preamplifiers:

- Mount the holding plate (P/N Z100048) on the front end side of the MAS III unit, using:
 - Screw (P/N 1672)
 - Caps (P/N 88399)



Figure 6.2: HPPR Stack Adapter

The MAS III unit is now ready for mounting to the HPPR preamplifier and the protective earth connector on the back end side.

- Mount the holding plate (P/N Z100048) together with the protective ground connection set (P/N H143014).
 - Mount the preamplifier on the MAS III.
 - Fix the grub screw into the holding plate.
 - Tighten the nut using the enclosed washer.



Figure 6.3: Grub Screw

1	Protective ground connector screw
---	-----------------------------------

- Fix the protective ground cable between the two chopper discs with two nuts:



Figure 6.4: Connected Protective Ground Cable

6.2.3 MAS III with HPPR Preamplifiers and Multiple Receiver Adapter

To use the MAS III with HPPR Preamplifiers and the Multiple Receiver Adapter

- Prepare the Multi-RX Adapter (P/N Z100583) with the two assembly bricks (P/N H142755 and H142756) as with the geometrical filling part (P/N H138128).
- Assemble the Multi-RX-Adapter on top of the MAS unit, ensuring that there is a straight alignment.



Figure 6.5: Multiple Receive Adapter Prepared for MAS III

Mount the prepared Multi-RX Adapter on the MAS III unit using:

- Mounting screws (P/N 1672)
- Caps (P/N 88399)



Figure 6.6: Multiple Receiver Adapter Mounted on the MAS III



Figure 6.7: Multiple Receiver Adapter Mounted on the MAS III (top view)

6.3 Gas Buffer Connections



The external gas tubing must be handled with care. The tubing should be regularly examined for damage and a replacement must be ordered as required.

There are two gas tank versions available:

- Wall-mountable (P/N H138875)
- Floor-standing (P/N H138874)

The handling and installation of these buffers to the MAS III unit are identical. For security reasons the system pressure is monitored at these buffers.

Connect the electrical cable included in the tube set with:

- The correspondent gas buffer connector.
- The PRESSURE MONITOR connector on the MAS III.

The output of the gas tank, which is located at the end of the right hand side of the maintenance unit, must be connected to the MAS III units GAS IN fitting as follows:



This connection must be carried out by trained personnel only.

1. Remove the lock nut from the fitting of the gas outlet on the tank.
2. Move this lock nut above the air hose.
3. Stick in the air hose as far as it will go.
4. Tighten the lock nut using a 17 mm spanner.
5. Repeat steps 1 to 4 for the GAS IN connection on the MAS unit.

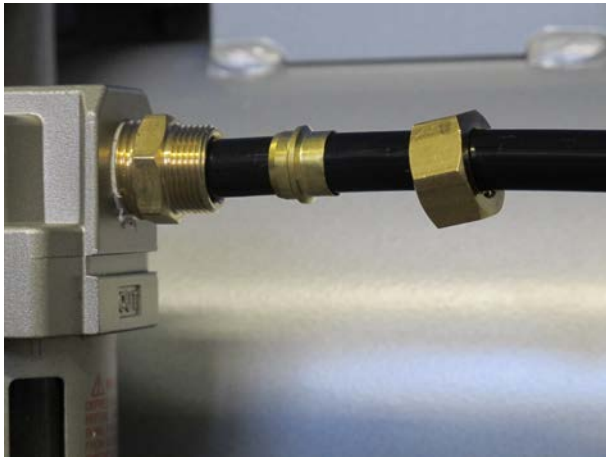


Figure 6.8: Maintenance Unit Order of Output Connector Components.



Figure 6.9: Maintenance Unit Output Connected.

- Turn off the system pressure.
- Join the pneumatic tube of the wall socket to the input of the gas buffer.
- Ensure that the input pressure does not exceed the maximum values 1 MPa / 10 bar / 145 psi.
- Turn on the system pressure.

Ideally, the internal pressure of the MAS III unit has to be adjusted in accordance to your local pressure supply.

To adjust the internal pressure

- Pull out the pressure adjustment knob on the maintenance unit of the gas buffer. In this position the internal pressure can be adjusted.

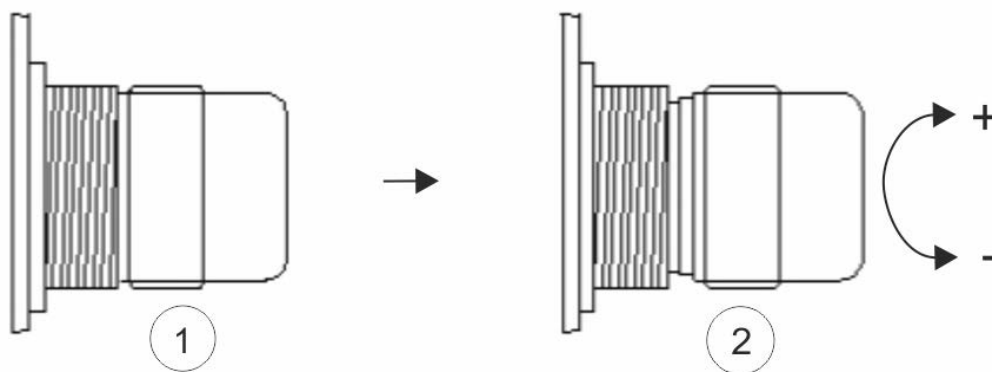


Figure 6.10: Adjusting the Internal Pressure

1	Pull out the knob until it stops.	2	Turn the knob for adjustment.
---	-----------------------------------	---	-------------------------------

To increase the internal pressure:

- Turn the pressure adjustment knob clockwise (+).

To decrease the internal pressure:

- Turn the knob counterclockwise (-).

Adjust the MAS III unit pressure using the pressure gauge in front of the maintenance unit.

Verify the amount of the MAS III unit pressure on the MAS III service web pages.

The following figure illustrates a maintenance unit and its components. The yellow arrows indicate the direction of the gas flow:

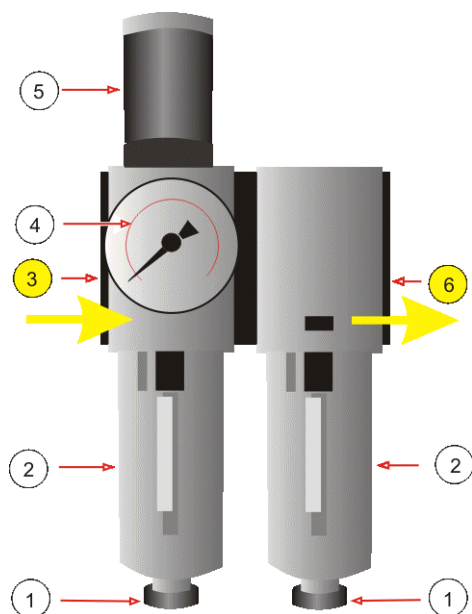


Figure 6.11: Schematically Presentation of a Pneumatically Maintenance Unit

1	Bleed valves	4	Pressure gauge
2	Filter housings	5	Pressure adjustment knob
3	Gas inlet	6	Gas outlet

6.4 Mains and Spectrometer Connections

Power Line

Before connecting the power cable to the mains supply, ensure that the MAS III is switched off.

Connect the power cable between the MAS III LINE IN connector and a 10 A wall outlet, or to a free socket of the spectrometer safety box. The electrical supply must be 110-230 V 50/60 Hz single phase, A.C.

Ethernet

Connect the Ethernet cable between the ETHERNET connector from the MAS III and the Ethernet switch of the spectrometer.

Trigger

If synchronization with specific NMR pulse sequences and rotation phase is required:

- Connect the MAS III TRIGGER output cable with the spectrometer TCU input.

6.5 NMR Probe Connections

Spin Rate

Connect the spin rate measurement cable HZ16808 between the MAS III SPINRATE input and the probe spin rate assembly (e.g. H116432).

Bearing / Ambient

The bearing output is usually connected directly with the probe base input labeled with **BEARING** or **AMBIENT**.

For low temperature mode connect the bearing output with a heat exchanger and then apply it to the probe base. Temperature experiments need special equipment and will be described separately in another manual.

Bearing Sense

The SENSE of BEARING channel monitors the bearing pressure at the probe.

To prevent a crash of a rotor it is necessary to connect this channel!

Drive

Connect the DRIVE channel with the DRIVE input of the probe.

Insert

The INSERT channel is used:

- To insert the rotor in the stator
 - Connect the INSERT fitting of the probe with the MAS III INSERT output.
- To control the old MAS sample changer e.g. P/N B0525.
 - Connect the MAS III INSERT and OPTION channels with a T-Connector (P/N 88555).
 - This bypass has to be connected with the INSERT fitting of the old MAS sample changer.

If needed:

Use a second T-Connector to connect also the INSERT fitting of the probe.

For further information read the manual of the MAS sample changer and the Service-Information Number **SIH0398**.

Eject

The EJECT channel has the same two applications as the INSERT channel:

- Ejecting the rotor out of the stator of almost every probe.
 - Connect the EJECT fitting of the probe with correspondent fitting of the MAS III using the Bruker hose set.
- Control of the old MAS sample changer (e.g. P/N B0525).
 - Connect the EJECT channel of the MAS III to the EJECT fitting of the old MAS sample changer and if needed, to the EJECT connector from the probe. For further information refer to the MAS Sample Changer manual.

Magic Angle and Vertical

These two pneumatic channels are needed for Flip-type probes with a switching mechanism for Magic Angle and Vertical position. These probes are mostly used together with standard bore magnets and greater rotor diameters. Connect the hoses between the MAS III and the probe fittings of the same name.

Frame Cooling / Frame Flushing

For special NMR temperature experiments, it is necessary to flush or cool the frame of the probe. In that case, connect the probe with the correspondent connections of the MAS III and refer to the special manual (e.g. Probe, Experiment, etc.).

Loading Bay

Connect this pneumatic channel with the corresponding channel on your probe.

Option

The option channel is used to operate the old MAS III Sample Changer (e.g. P/N B0525).



For all pneumatic connections use the original air hoses delivered from Bruker. These hoses are either part of the MAS III unit or the probe accessory.

6.6 TopSpin Configuration

The MAS III can only be used with *TopSpin* 3.5 or newer, controlling the unit with older *TopSpin* versions is not possible. When using an older version please consider upgrading. If upgrading is not possible you can still control the unit from the units webpages (see [MAS Unit Web Interface \[▶ 64\]](#)).

1. Ensure that the unit has been installed correctly.
2. Power on the unit and wait for the status lamp to switch to green, blue, or red.
3. In *TopSpin* enter the **cf** command and follow the steps in the wizard.
4. The MAS III unit will be automatically detected by *TopSpin*.
5. In the last wizard screen you can verify that the MAS III has been detected by looking for MAS III Control Unit in the summary.


```

Summary
-----
 8 0x26 0x5 0 A 5.0 BLA-1 BLA2BB 150/60 20-400 W1345049/1435 ECL 5
-- 0x20 0xd0 0 B 2.2 MASTER AQS NanoBay / INES
 1 0x20 0x7 0 B MASTER AQS Rack Master

Logical Receiver/SGU configuration:

Router: 1 AQS-Minirouter

Amplifiers (AQS configuration):
RO Amplifier Module Nucleus Power/W Switchbox Name FN/SN/FW
 1 1 1 B 150 N BLA2BB 150/60 20-400 W1345049/1435/-
 2 1 2 B 60 N BLA2BB 150/60 20-400 W1345049/1435/-

Transmitters at the spectrometer subnet:
-----
LTRX Z109887/00072 ECL 02.02:
- TCP/IP address = 149.236.99.21
- Amplifier = BSMS/2 LOCK TRANSCEIVER 300: Z109887/00072 ECL 02.02

BSMS: BSMS/2 connected to ethernet
- TCP/IP address = 149.236.99.21
- ELCB firmware version = 20130627
- GAB current limits = 0.0/X, 0.0/Y, 10.0/Z (in A)
- SCB channels = 20
- Shim System = BOSS1-SB
- L-TRX = BSMS/2 LOCK TRANSCEIVER 300: Z109887/00072 ECL 02.02
- Lock: on L-TRX board

MAS Control Unit: MAS_H139288_0013
- TCP/IP address = 149.236.99.189

Sample Changers at the spectrometer subnet:
-----
Sample Changer 1: SAMCHG_H121100 NONE
- TCP/IP address = 149.236.99.248

Preamplifiers :
HPFR2: - HPFR/2 preamplifier connected to 149.236.99.89:/dev/tty10
Type : HPFR/2
Controller: no Cover, with Application firmware = aQ
no LED display for tuning and matching

```

Figure 6.12: The Summary Window



Using the MAS II and the MAS III on one Spectrometer

While an MAS III is available in the spectrometer network, a **MAS II is not configurable**. To configure an MAS II switch off the MAS III before running the **cf** command.

6.7 Final Configuration

To enter the advanced configuration setting:

- Go to the embedded web page. See also [Accessing the Webpages \[64\]](#).
- Log in with User Name **Administrator** and Password **admin**.

Bruker Embedded Web Pages

MAS Help BRUKER Web Site

Main Settings Service

System Overview

Sample Down: Unknown [Insert] [Eject] [Re-Flip]

Spin Rate (Hz): 0

Target Spin Rate (Hz): 5000 [Set]

Rotation State: Off
No sample

Frame cooling is: Off [Switch on]

Frame cooling pressure (mbar): 0 [Set]

Settings

Probe: BL4hr (4.00 mm)

Profile: Generic [Set]

Cap: KEL-F [Set]

Ready for sample
insert
Spin Rate (Hz)
0
User Name:
[]
Password:
[]
[Log in]
The data on this page is updated every 2 seconds.

Innovation with Integrity
© 2014 Bruker Corporation MAS / Part No. H139288 / Serial No. 0013 / Software 20141017_1540 Print this page

- Click the **Edit** button in the **Settings** tab.

Bruker Embedded Web Pages

MAS Help BRUKER Web Site

Main Settings Service

System

[Edit]

Air

Minimum Main Pressure (mbar)	4500
Spin Lock Tolerance (Hz)	5
Bearing Hold Pressure (mbar)	0
Insert Hold Pressure (mbar)	0
Insert Pressure (mbar)	2000
Insert Time (ms)	1000
Eject Pressure (mbar)	2000
Eject Time (ms)	5000
Bearing Sense Timeout (ms)	1000

Miscellaneous

Option pressure for mechanical sample changer (not SamplePro hr-MAS)	No
--	----

Ready for sample
insert
Spin Rate (Hz)
0
User Name:
Administrator
[Log out]

Innovation with Integrity
© 2014 Bruker Corporation MAS / Part No. H139288 / Serial No. 0000 / Software 1.2.2.17491 Print this page

Figure 6.13: The System **Settings** Tab.

Air Group Fields:**Minimum Main Pressure**

To guarantee proper operation the minimum main pressure value must be 4000 mbar. The maximum output pressure can be driven up to 5000 mbar. When a higher value as 4000 mbar is needed e.g. for Insert, Eject or Frame Cooling, the minimum main pressure value must be raised.

During operation the supply pressure will drop because of the consumption. If the pressure supply is not sufficiently dimensioned, the minimum main pressure value can be undercut and the unit performs a safety stop.

Spin Lock Tolerance

The Spin Lock window is sizeable in the range of ± 1 Hz to ± 100 Hz. In automation mode the size of the Spin Lock window defines the starting point of the data acquisition. When the spinning rate reaches the Spin Lock window the NMR data acquisition will start. These settings also control the Auxiliary Trigger output. See also [Electrical Connections \[33\] \(2\)](#).

Bearing Hold Pressure

The bearing pressure remains available even when the rotation has stopped, e.g. with hr-MAS experiments to guarantee a static gas flow around the heater.

Insert Hold Pressure

The insert pressure remains available during a rotation, e.g. for low temperature experiments.

Insert Pressure

The insert gas is needed to insert the rotor into the stator assembly. This flow must be adjusted according to the probe type.

Insert Time

This setting determines the time for the insert procedure.

Eject Pressure

The eject gas is needed to eject the rotor from the stator assembly. This flow must be adjusted according to the probe type.



The eject gas flow depends on the transfer system length!

When the rotor is not ejected the setting for the eject gas flow must be increased.

When the gas flow is too high it must be decreased to avoid rotor damage.

Eject Time

This setting determines the time for the eject procedure.

Bearing Sense Timeout

This is the time to match the bearing pressure.

If the difference between the bearing pressure and the bearing sense pressure is too high for longer than the length of this Timeout, the unit will perform a safety rotation stop. The allowed difference between the bearing pressure and the bearing sense pressure depends on the system and is not configurable.

Miscellaneous

Mechanical Sample Changer

Option for mechanical sample changers like B0240, B0525 or B4469.

Do not use this option to operate a SamplePro hr-MAS.

7 Operation with TopSpin and Web Interface

There are several general rules and procedures that should be observed while operating the device.

Temperature Changes

When the ambient temperature changes significantly wait at least 1 hour until the device has achieved room temperature before turning on the device.

Contamination of Samples

Reusing NMR MAS rotors may result in contamination of a new NMR sample from the contents of the previous sample.

Improper Operation

WARNING



Danger of injury from improper operation!

Improper operation can result in serious injury and significant damage to property.

- ▶ Carry out all operating steps in accordance with the specifications and instructions in this manual.
- ▶ Before starting work, ensure that
 - All covers and safety devices are installed and functioning properly.
 - No persons are in the danger zone.
- ▶ Never disable or bypass safety devices during operation.

Modes of Operation

The MAS unit has to be operated in a dedicated window in *TopSpin* (version 3.5 and later) called *MasDisp*. All routine operations and configuration as well as monitoring can be performed from *TopSpin*.

Refer to [MasDisp \[▶ 54\]](#).

A web user Interface is also available. It provides basic rotation control and some advanced configuration. Controlling the unit from the webpages is not recommended and should only be done if it is not possible to use *TopSpin* 3.5 or later.

Refer to [MAS Unit Web Interface \[▶ 64\]](#)

7.1 MasDisp

7.1.1 Accessing the User Interface

The user interface can be accessed in different ways:

- Enter **masdisp** at the *TopSpin* prompt.
- Click **mas** in the *TopSpin Acquisition* tab.
- Click the **MAS spin rate** icon on the *TopSpin* acquisition status bar at the bottom of the *TopSpin* window.

7.1.2 Masdisp Overview

The user interface supplies the following tabs:

- **Main:** Main window for routine operation.
- **Monitoring:** Display of spin rate and pressure settings or readings.
- **Recording:** Writing and (graphical) inspection of record files.
- **Configuration:** Settings for displaying stability information and for window handling.
- **Log:** Display of MAS unit notifications and error messages.
- **Help:** Display of information about setting up and using the MAS unit.

A status line is located at the bottom of the window. It displays the current state (rotation on/off), the spinning stability, the current spinning speed, the system pressure, and the probe temperature as monitored and controlled by the variable temperature control unit.

7.1.3 The Main Tab of the TopSpin User Interface

7.1.3.1 Overview

Most of the MAS operation is controlled from the **Main** menu. It shows the following information (see the figure in section [Temperature Limits and Spin Rate Limits \[55\]](#)) from top to down:

- Current and desired spin rate.
- Buttons for insert, eject, spinning, and stopping the rotor.
- Supply pressure and internal operation pressure readings of the MAS unit.
- Actual pressure settings for bearing, sense of bearing, and drive.
- Frame cooling state and pressure setting.
- Settings for probe, profile, rotor type, cap material, temperature limits, and spin rate limits.

At startup the following settings are displayed: probe, profile (this defines the regulation parameters and others), rotor type, cap material, temperature limits, and lower and upper spinning frequency limits. Except for the cap material usually no user input is required because the probe is set according to the *current probe* as defined by the **edprobe** command. The profile and rotor type are automatically chosen according to the probe. Temperature limits and frequency limits are defined by the cap material, the profile and the current probe, respectively and cannot be changed independently.

7.1.3.2 Probe and Profile Selection

For standard operation the user does not need to select the probe and corresponding profile. At startup the main tab will show the current probe as set by **edprobe**. A suitable profile (this defines the regulation parameters as well as maximum and minimum spinning frequencies) is automatically loaded. The user may change the probe by clicking on the **Exchange probe** button – the NMR super-user password is required for this. The probe cannot be changed while a rotor is spinning. The profile may be changed as well by choosing one of the available profiles from a drop-down list. Usually, the default profile will be the correct one, special profiles may be set for dedicated applications like slow spinning. Details of the current profile may be inspected by clicking the **Show profile** button.

7.1.3.3 Rotor and Cap Type Selection

The rotor is set according to the selected probe, this cannot be changed. The cap type may be selected from a drop-down menu, the default setting is *Kel-F* for 4 mm and 7 mm rotors and *Vespe* for smaller diameter ones. The cap material defines the allowed temperature range and maximum spinning speed.

7.1.3.4 Temperature Limits and Spin Rate Limits

The displayed temperature limits are set according to the probe and cap material settings. The display is for information only, the limits cannot be changed on their own. The same holds true for the spin rate limits, which are set according to the probe, profile, and cap material. If, e. g., a lower temperature limit is required the rotor must be equipped with suitable cap. If, e. g., slower spinning is desired a suitable profile needs to be chosen.

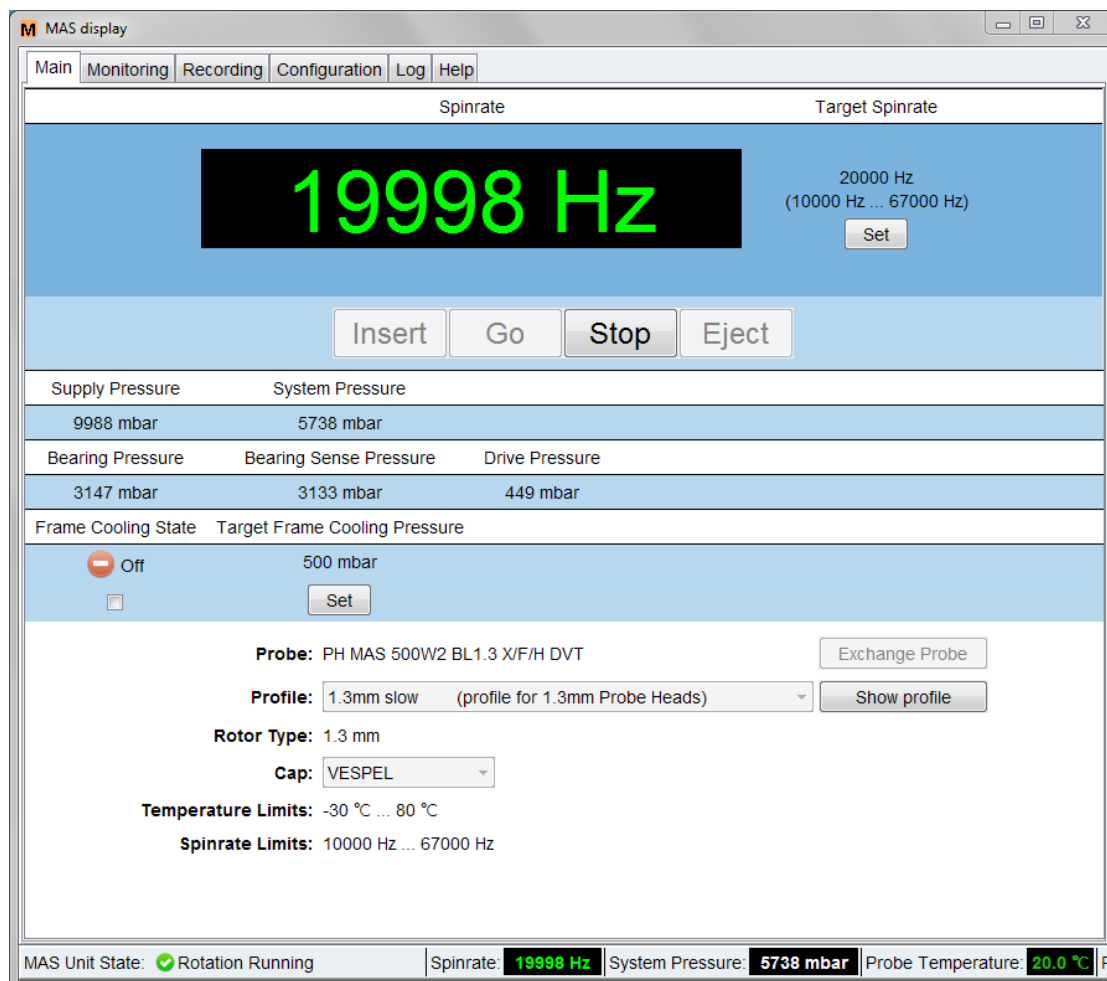


Figure 7.1: The **Main** Tab of the TopSpin MAS User Interface.

7.1.3.5 Rotor Handling

Rotor insertion and removal are performed by clicking the **Insert** or **Eject** button, respectively. The unit will perform the necessary steps according to the probe type like applying insert and eject air, stator flipping for probes equipped with a flip type stator etc. The **Eject** button is enabled as long as no rotation is running even when no sample is in the system. Both the **Insert** and the **Eject** button are inactive during sample spinning.

The target spin rate is shown on the top right side of the **Main** window together with the allowed spin rate range. The user may set the spin rate by clicking the **Set** button, this will open a small window in which the desired value may be typed. Changing the target frequency is always possible but not during the start and stop rotation phases. Entries outside of the allowed range cannot be set. Spinning is started or stopped by clicking the **Go** button or **Stop** button, respectively. The **Go** button is inactive before **Insert** is applied at least once. The **Stop** button is inactive if the rotor does not spin. The current spin rate is shown on the upper left side of the **Main** window, a color code is used to indicate regulation status:

- Green color indicates that the rotor is spinning at the desired spinning speed with a defined tolerance (this is set in the **Configuration** tab, see [The Configuration Tab of the TopSpin User Interface \[61\]](#)).
- Red color indicates deviations from the desired spin rate.

Such deviations occur during normal operation when the rotor is spun up or down, or the spinning speed is changed. They may as well indicate a problem like instable spinning due to an imbalanced rotor or strong fluctuations of the supply pressure. In case the spinning stability is lost a corresponding message will be displayed just below the display of the current spin rate. The user may delete this message by clicking the **Reset** button on its right side, see the next figure. The color code may be changed by the user in the **Configuration** tab of the *TopSpin* user interface.

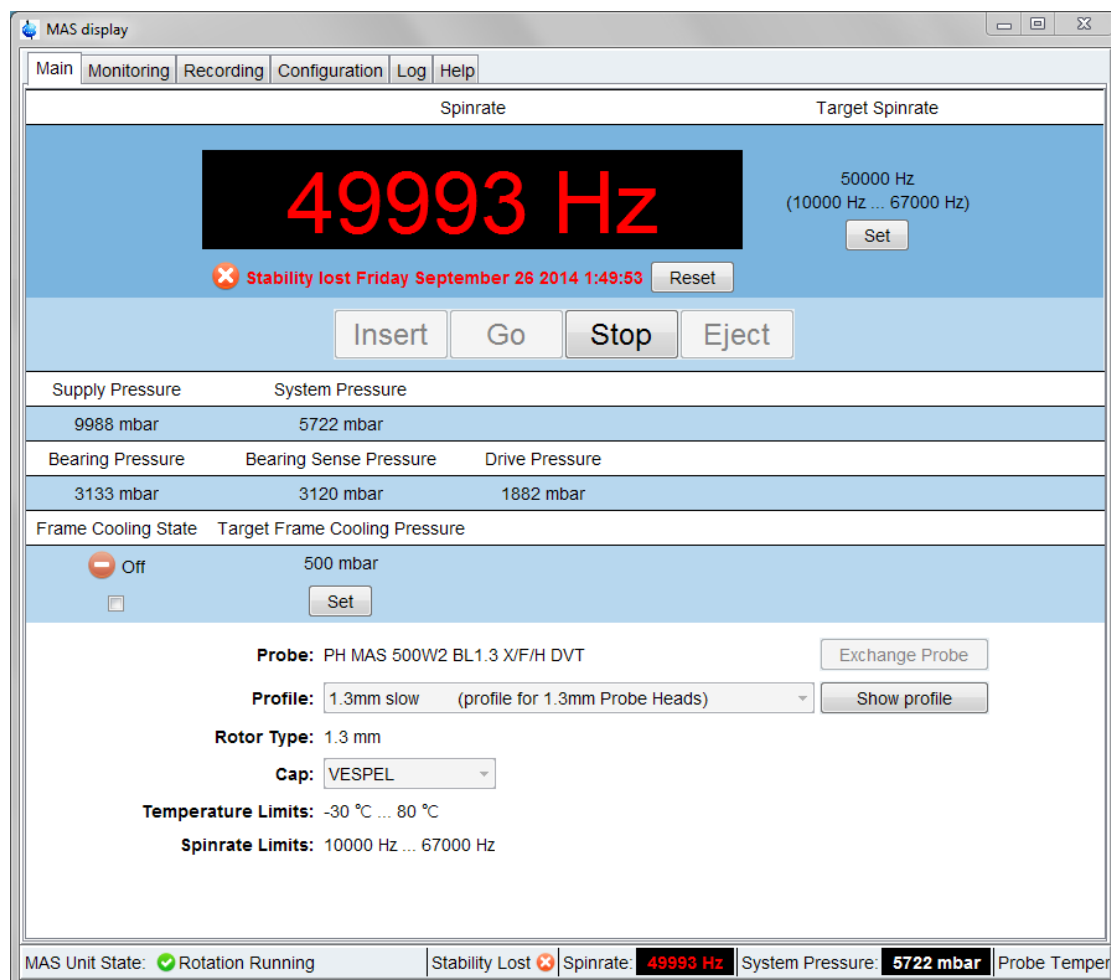


Figure 7.2: The **Main** Tab of the *TopSpin* MAS User Interface in Case of Instable Spinning.

See also

📖 Spinning and Stopping [▶ 56]

7.1.3.6 Pressure Display

The supply pressure is the pressure of the gas supply for the MAS unit. This pressure is reduced to the system pressure in the unit which in turn is used to set bearing, drive, etc. The internal pressure has to be adjusted on the pressure regulator near the gas tank (refer to chapter [Gas Buffer Connections](#) [▶ 43]).

The bearing and drive pressures are set by the MAS unit according to the probe, profile, and desired spinning speed. Both pressures are set by the MAS unit and displayed in the main window. The display is for information only, the values cannot be changed. The bearing sense pressure is measured at the probe directly for safety purposes: The MAS unit supervises the bearing sense pressure constantly and stops the spinning if its value drops

below a certain cutoff limit. This is intended to prevent a rotor damage caused by a loss of bearing pressure between MAS unit and probe. Such a loss may, e. g., occur if the MAS hoses or joints are not tight or damaged.

7.1.3.7 Frame Cooling

The frame cooling is a stream of ambient temperature gas which is applied to the probe's frame. This is intended as a cooling of the electric parts in high RF and high duty cycle experiments. It is as well used to keep the probe's electric parts at ambient temperature in high or low temperature experiments. Frame cooling is switched on by ticking the corresponding check box. The target frame cooling pressure may be set by clicking the **Set** button and typing in the desired value.

The frame cooling may be used for other purposes, e. g. for transfer line cooling.

7.1.4 The Monitoring Tab of the TopSpin User Interface

7.1.4.1 Purpose

This tab is provided for information purposes. It supplies a graphical display of the spin rate and pressure settings or readings as a function of time, see the figure in section [Graphical Display \[▶ 58\]](#).

7.1.4.2 Configuration

The user may define the displayed parameters by ticking the corresponding checkboxes in the **Configure** section of the tab. The parameter list may be shown or hidden by clicking the **Down arrow / Up arrow** button, respectively, on top of window (left to **Configure**). The following settings can be made.

- General: Update interval in seconds.
- Parameters.
- Spin rate: Target and actual spin rate.
- Pressures: Supply pressure and system pressure.
- Bearing/Drive pressure

If the **Auto scale** check box is marked the vertical and horizontal axes will constantly be rescaled to fit to the actual spin rate and pressure settings or readings. The **Overview** mode is similar to the *TopSpin* overview mode for spectra display, if the corresponding box is checked the full curve will always be shown on top of the actual display.

7.1.4.3 Graphical Display

For each of the parameter groups described above a separate graph will be shown (if no parameter of the corresponding group is selected, no graph will be shown). Each display has got icons similar to the *TopSpin* icons for expanding/compressing the horizontal or vertical scales. If the **Overview** mode is set (see above) the full curve will always be shown on top of the current display.

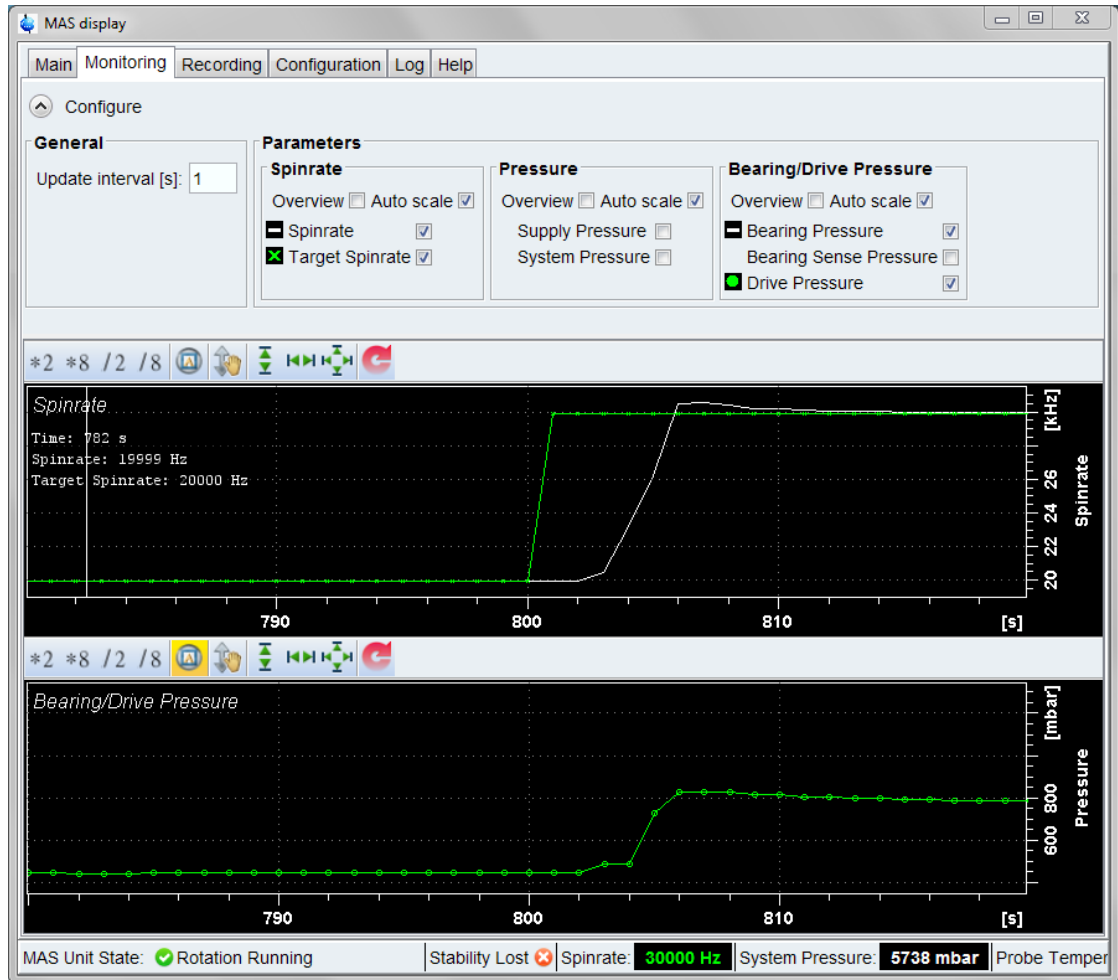


Figure 7.3: The **Monitoring** Tab of the TopSpin MAS User Interface.

7.1.5 The Recording Tab of the TopSpin User Interface

7.1.5.1 Purpose

The user may write and inspect record files in which spin rate and pressures settings and readings of the MAS unit are stored at defined time steps. The figure in section [Monitoring of the Recorded Parameters \[60\]](#) shows the **Recording** tab.

7.1.5.2 Defining the Recorded Parameters

The left side of the **Recording** tab is for user input and for the start of stop of the recording. The following sections are given:

- Start/Stop Recording: The user may start or stop the recording by clicking the appropriate button.
- Record files: This shows a list of previously written record files. The file content may be displayed graphically (button **Show graph**) or edited (button **Show file content**). The user may delete files by clicking the **Delete** button. The user will be prompted to confirm the deletion.
- Options. Here the recording interval and the time format are set and the user may define a suitable record file name. Record files are stored in the XXX directory.

7.1.5.3 Monitoring of the Recorded Parameters

On the right side of the **Recording** window the last record lines written to file are displayed. The user may inspect these lines e. g. to check the proper choice of parameters and time interval. The display may be cleared by clicking the **Clear** button.

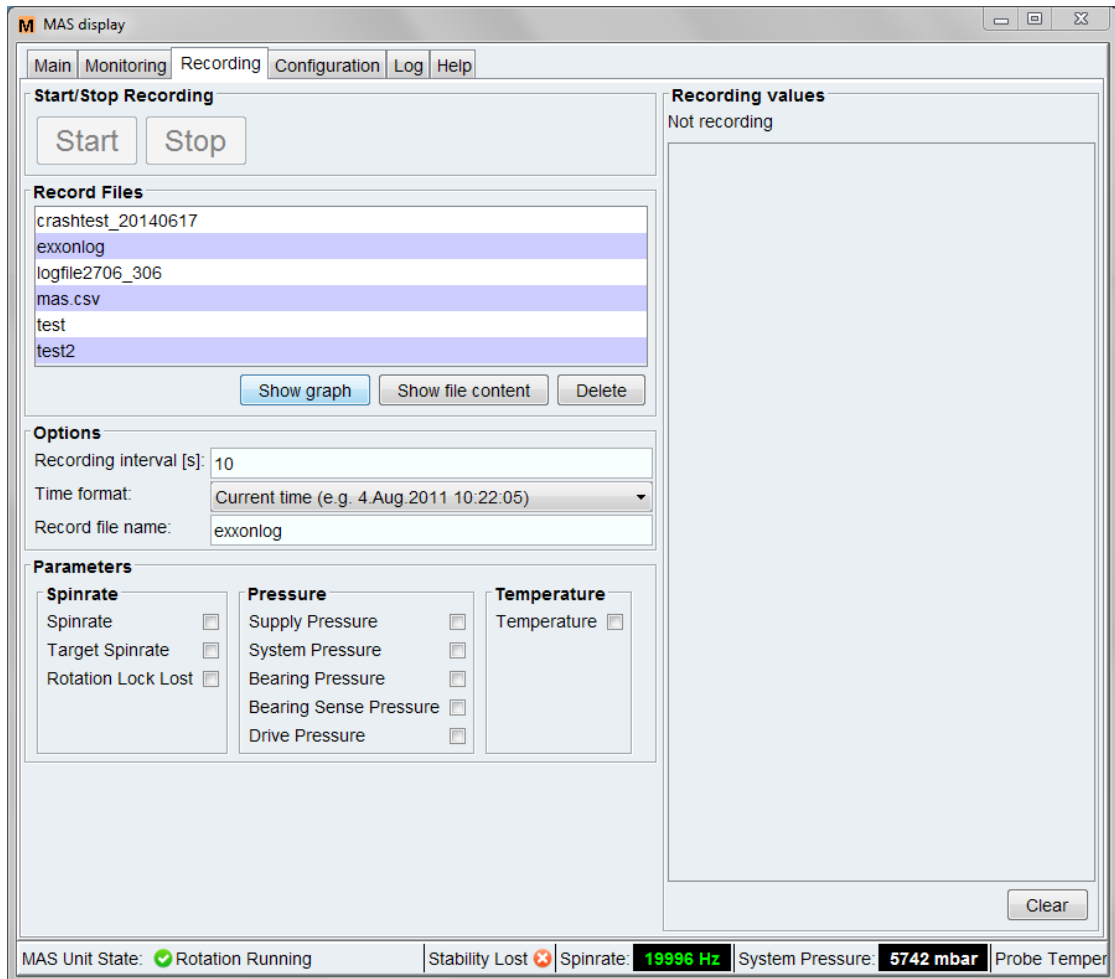


Figure 7.4: The **Recording** Tab of the TopSpin MAS User Interface.

7.1.6 The Configuration Tab of the TopSpin User Interface

7.1.6.1 Purpose

This tab allows some settings for the graphical appearance of the *TopSpin* MAS interface. It is not intended to configure the MAS unit. For the latter purpose, however, a link to the MAS unit's web page is supplied.

7.1.6.2 Settings

The following sections are available:

Stability Configuration:

- Lock tolerance: the *lock tolerance interval* defines the maximum deviation of the actual spin rate from the target spin rate which is regarded as acceptable for stable spinning. The default value is ± 5 Hz, the user may change this to smaller or larger figures. It cannot be changed while a rotation is starting or stopping.



The spin lock tolerance limit is only a monitoring parameter, it has no impact on the spinning regulation. It is used for the spinning speed color code, the stability indicator in the *TopSpin* MAS interface status bar, and the *Rotation Lock Lost* entry of the record files.

Color

- Color for stable rotation: This is the color for the spin rate display for stable spinning, the default color is green, the user may choose a different color by clicking the **Select** button.
- Color for unstable rotation: This is the color for the spin rate display if spinning is unstable, the default color is red, the user may choose a different color by clicking the **Select** button.
- Use default colors: This button may be clicked to undo any user choices and return to the default color scheme.

Location

- External *TopSpin* window: The MAS user interface will show up in a separate window which may be handled independently of the main *TopSpin* window.
- Internal *TopSpin* window: The MAS interface will be incorporated into the main *TopSpin* window.

MAS Webpage

- MAS main webpage: Clicking the **Show** button will open a web browser and display the main MAS unit webpage.
- MAS firmware update: Clicking the **Show** button will open a web browser and display the MAS unit webpage for firmware update.

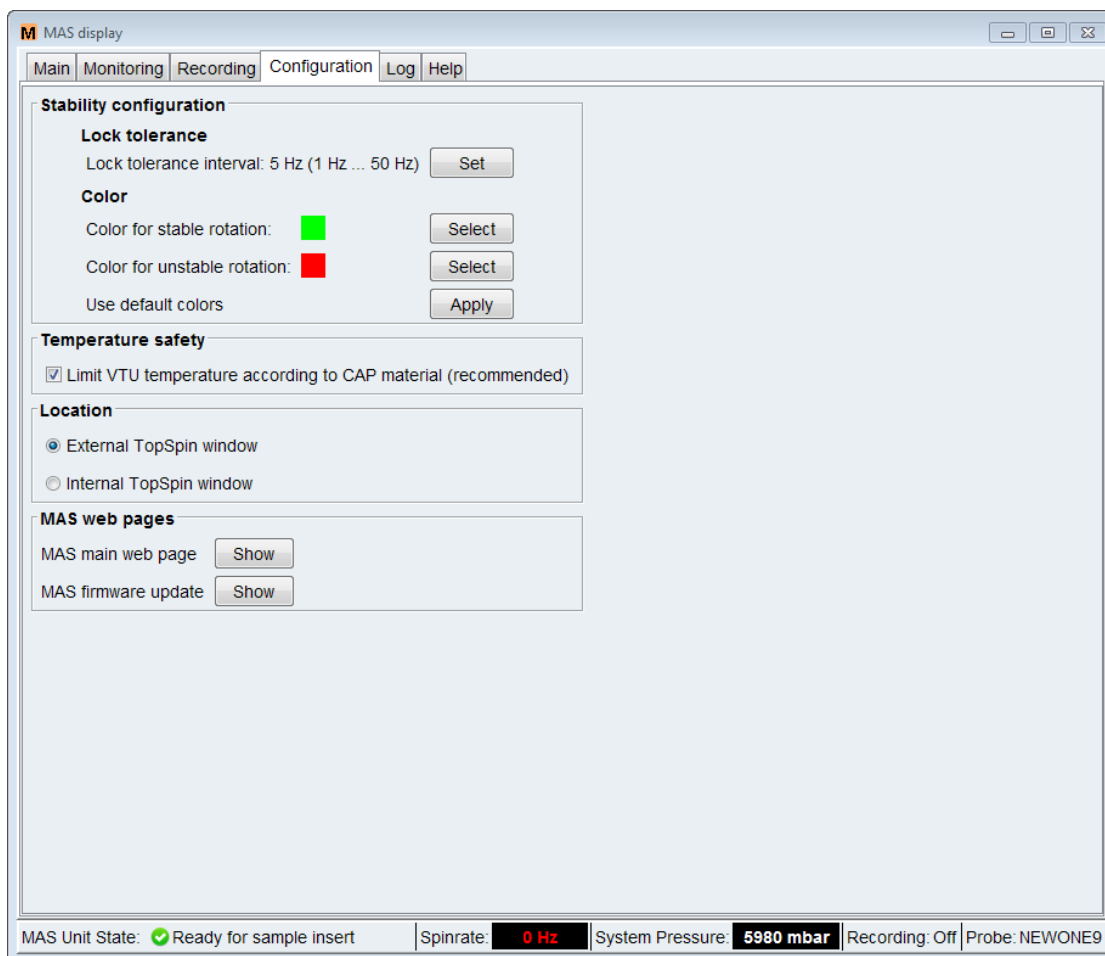


Figure 7.5: The **Configuration** Tab of the TopSpin MAS Unit Interface.

7.1.7 The Log Tab of the TopSpin User Interface

7.1.7.1 Purpose

This tab allows to inspect, print, or clear notifications, error messages and information supplied by the MAS unit.

7.1.7.2 Categories

The following categories are displayed:

- MAS Unit Notifications.
- Current error messages.
- Error message history: The **Reload** button updates the display to include the most recent entries.
- Info messages.

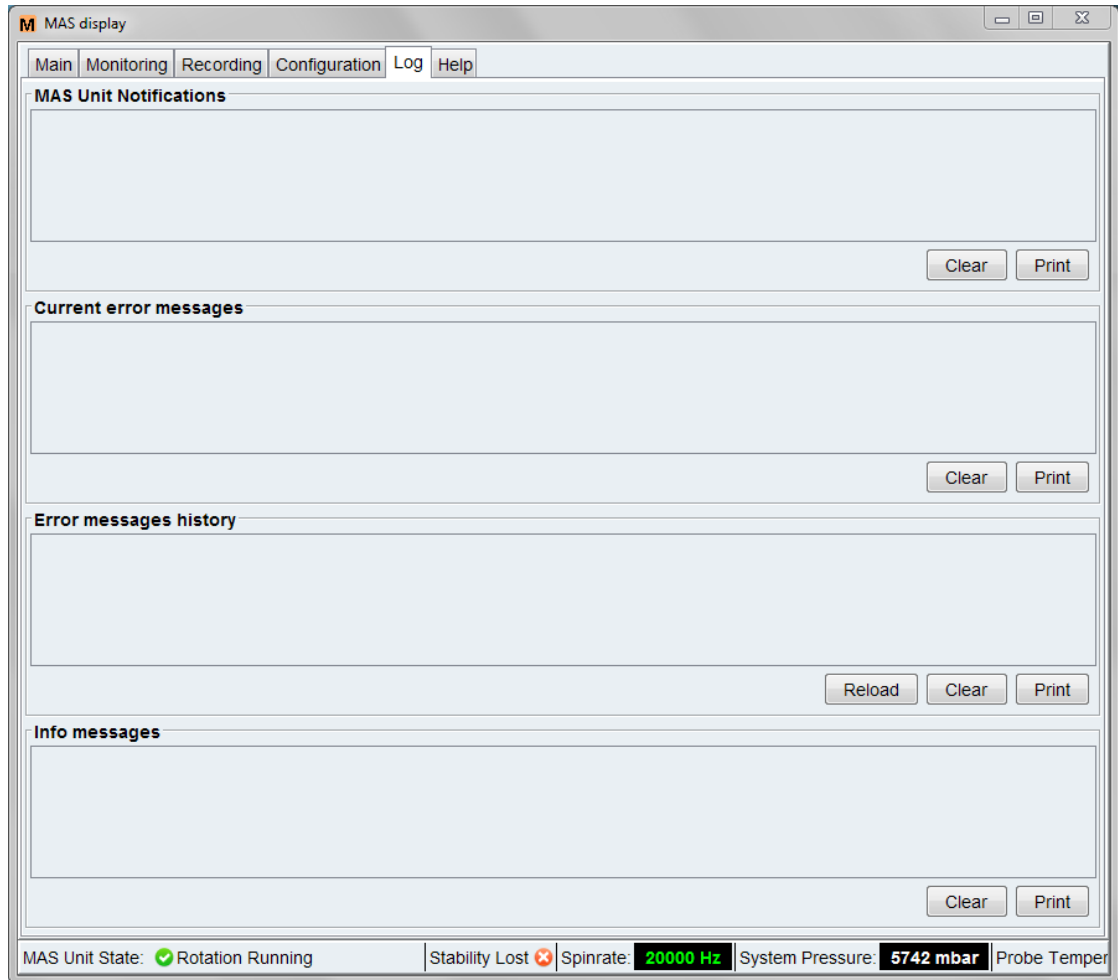


Figure 7.6: The **Log** Tab

To print a message category:

- Click the **Print** button.

To empty a message category:

- Click the **Clear** button.

7.1.8 The Help Tab of the TopSpin User Interface

This tab provides access to the MAS unit manual.

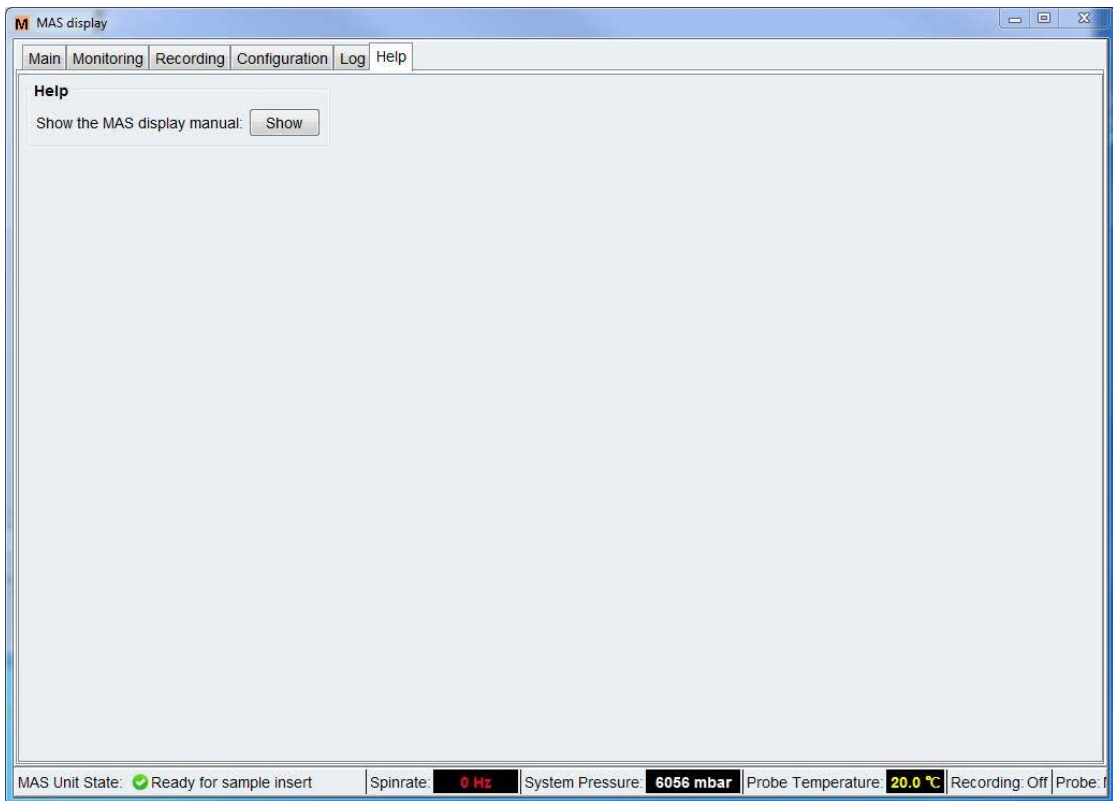


Figure 7.7: The *Help* Tab

7.2 MAS Unit Web Interface

7.2.1 Accessing the Webpages

The user interface can be accessed in different ways:

- By clicking the corresponding button in the **Configuration** tab of the *TopSpin* MAS user interface, see section [The Configuration Tab of the TopSpin User Interface \[61\]](#).
- By typing **ha** (for hardware address) at the *TopSpin* prompt and clicking the **MAS unit** button in the pop-up window. The **ha** command shows a list of all units connected via Ethernet and their corresponding addresses.
- By opening a web browser and typing in the proper IP address.

7.2.2 Look and Feel of the Webpages

The user interface supplies the following main tabs, see the next figure:

- **Main:** This tab may be used for operating the MAS unit.
- **Settings:** This tab displays the current settings and allows them to be changed.
- **Service:** This tab gives access to advanced settings for monitoring, diagnosis, and calibration.
- **Left navigation pane:** According to the main tab a vertical list of available submenus is shown in the navigation pane on the left side of the page.
- **Center pane:** The information of the selected submenu is displayed in the center part of the page.
- **Right pane:** On the right pane a status field indicates the current rotation state and spinning speed. Log in with user name and password. If a user is logged in the user name is displayed and the **Login** button changes to a **Log out** button.

The screenshot displays the Bruker Embedded Web Pages interface for the MAS unit. At the top right is the Bruker logo. Below it, the text 'Bruker Embedded Web Pages' is visible. The main navigation bar includes 'MAS', 'Help', and 'BRUKER Web Site'. Underneath, there are sub-tabs for 'Main', 'Settings', and 'Service'. On the left, a blue navigation pane lists 'System Overview' (selected), 'Notifications', and 'System Information'. The central 'System Overview' section contains several controls: 'Sample Down' with 'Insert' and 'Eject' buttons; 'Spin Rate (Hz)' set to 67000; 'Target Spin Rate (Hz)' with a text input '67000' and a 'Set' button; 'Rotation State' set to 'On' with 'Go' and 'Stop' buttons; 'Frame cooling is' set to 'Off' with a 'Switch on' button; and 'Frame cooling pressure (mbar)' set to '500' with a 'Set' button. Below this is a 'Settings' table:

Settings	
Probe	PH MAS 500W2 BL1.3 X/F/H DVT (1.30 mm)
Profile	1.3mm slow
Cap	VESPEL

On the right side, a 'Rotation Running' status box shows 'Spin Rate (Hz) 67000.2', a 'User Name:' field, a 'Password:' field, and a 'Log in' button. A note at the bottom of this box states: 'The data on this page is updated every 2 seconds.'

Figure 7.8: Start Page of the MAS Web Interface.

7.2.3 Operating the MAS Unit

7.2.3.1 Introduction

This section describes how the MAS webpage may be used for rotor insertion or ejection and sample spinning, this is similar to operating the MAS by the *TopSpin* MAS user interface and much of the description given above in section [MasDisp \[54\]](#) applies here as well.

7.2.3.2 The System Overview Sub-menu

7.2.3.3 Setting up a Probe

Exchanging and editing the probe settings after Log In

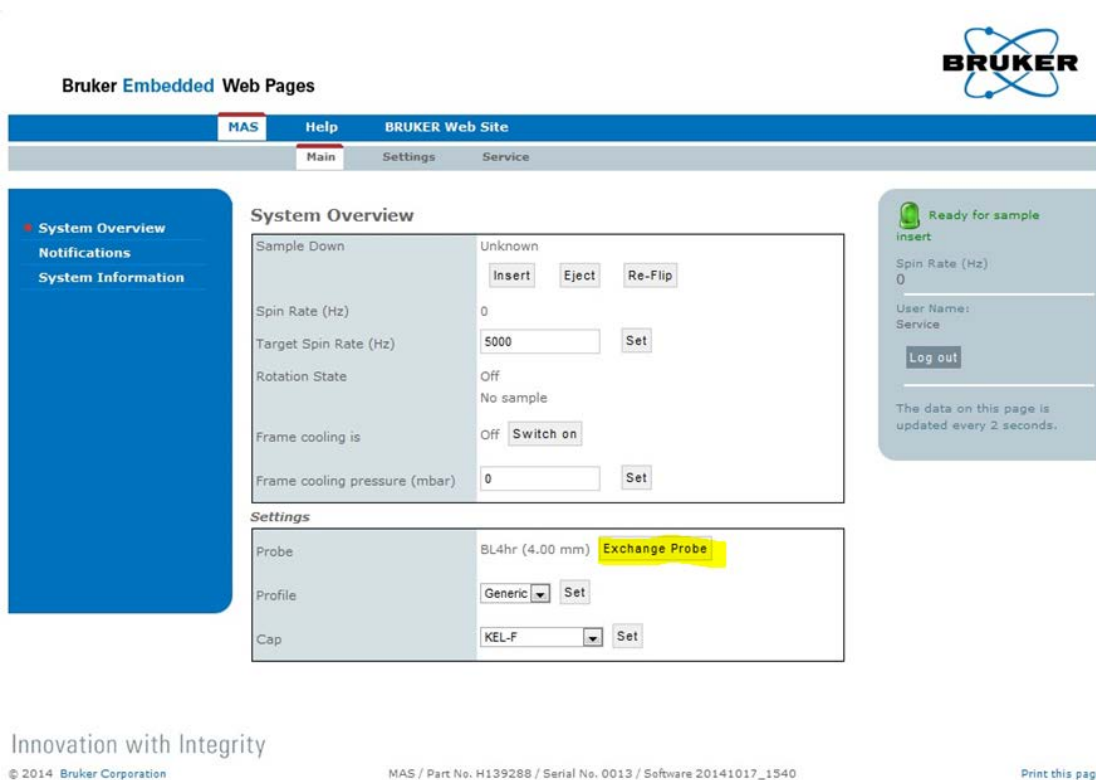
Log in with User Name *Administrator* and Password *admin*.

The screenshot displays the Bruker Embedded Web Pages interface. At the top, there is a navigation bar with 'MAS', 'Help', and 'BRUKER Web Site'. Below this is a sub-menu with 'Main', 'Settings', and 'Service'. The main content area is divided into three sections:

- System Overview:** This section contains several parameters and controls:
 - Sample Down: Unknown, with buttons for 'Insert', 'Eject', and 'Re-Flip'.
 - Spin Rate (Hz): 0
 - Target Spin Rate (Hz): 5000, with a 'Set' button.
 - Rotation State: Off, with the text 'No sample' below it.
 - Frame cooling is: Off, with a 'Switch on' button.
 - Frame cooling pressure (mbar): 0, with a 'Set' button.
- Settings:** This section contains:
 - Probe: BL4hr (4.00 mm)
 - Profile: Generic, with a 'Set' button.
 - Cap: KEL-F, with a 'Set' button.
- Ready for sample:** A status box on the right with a green 'Ready for sample' indicator, an 'insert' button, 'Spin Rate (Hz): 0', 'User Name:' and 'Password:' input fields, and a 'Log in' button. Below this is a note: 'The data on this page is updated every 2 seconds.'

At the bottom of the page, there is a footer with the text 'Innovation with Integrity', '© 2014 Bruker Corporation', 'MAS / Part No. H139288 / Serial No. 0013 / Software 20141017_1540', and a 'Print this page' link.

Click the **Exchange Probe** button when the probe is already installed.



Bruker Embedded Web Pages

MAS Help BRUKER Web Site

Main Settings Service

System Overview

Sample Down: Unknown

Spin Rate (Hz): 0

Target Spin Rate (Hz):

Rotation State: Off
No sample

Frame cooling is: Off

Frame cooling pressure (mbar):

Settings

Probe: BL4hr (4.00 mm)

Profile:

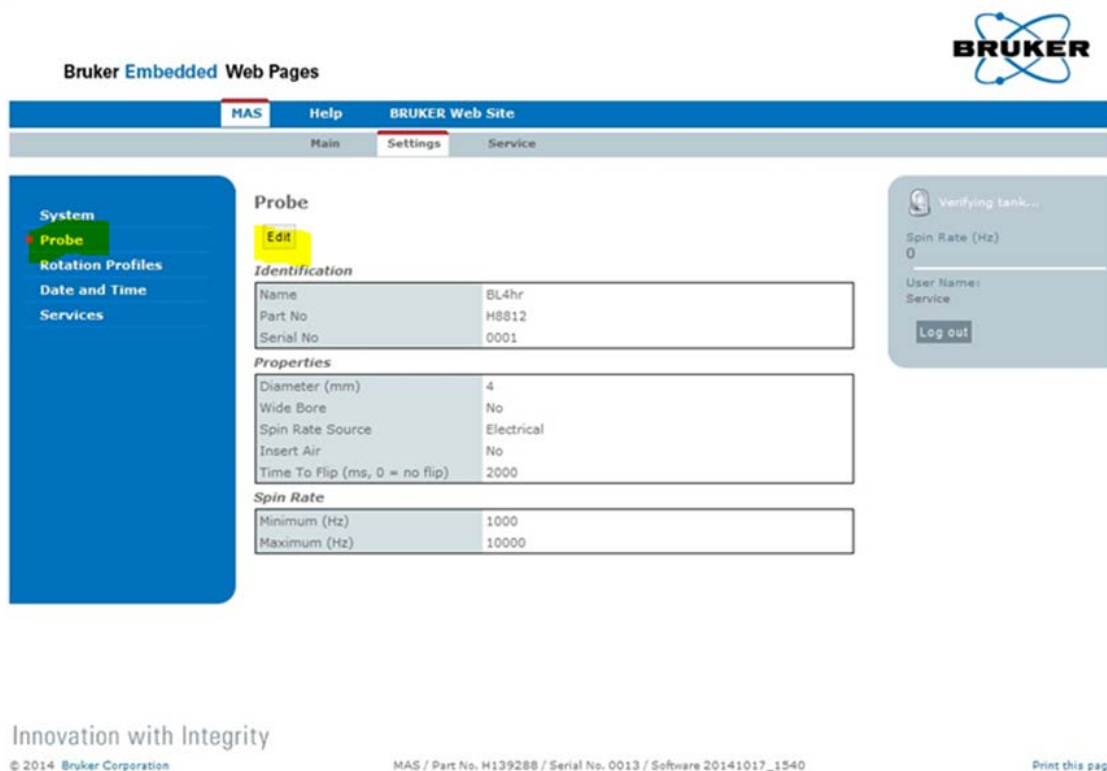
Cap:

Ready for sample insert
 Spin Rate (Hz): 0
 User Name: Service

The data on this page is updated every 2 seconds.

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In the **Settings** tab click **Probe** in the left navigation pane.



Bruker Embedded Web Pages

MAS Help BRUKER Web Site

Main Settings Service

Probe

Identification

Name	BL4hr
Part No	H8812
Serial No	0001

Properties

Diameter (mm)	4
Wide Bore	No
Spin Rate Source	Electrical
Insert Air	No
Time To Flip (ms, 0 = no flip)	2000

Spin Rate

Minimum (Hz)	1000
Maximum (Hz)	10000

Verifying tank...
 Spin Rate (Hz): 0
 User Name: Service

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Click the **Edit** button. Now the settings can be edited or modified:

Bruker Embedded Web Pages

MAS Help BRUKER Web Site

Main Settings Service

System

- Probe
- Rotation Profiles
- Date and Time
- Services

Probe

Identification

Name	BL4hr
Part No	H8812
Serial No	0001

Properties

Diameter (mm)	4.0
Wide Bore	<input type="checkbox"/>
Spin Rate Source	Electrical
Insert Air	<input type="checkbox"/>
Time To Flip (ms, 0 = no flip)	2000

Spin Rate

Minimum (Hz)	1000
Maximum (Hz)	10000

Save

Cancel

Ready for sample insert

Spin Rate (Hz)
0

User Name:
Service

Log out

Innovation with Integrity

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MAS / Part No. H139288 / Serial No. 0013 / Software 20141017_1540

Print this page

Identification Group

Name

Name of the probe.

Part No

Part number of the probe.

Serial No

Serial number of the probe.

Properties Group

Diameter

Diameter of the rotor.

Wide Bore

Click the checkbox for Widebore magnet systems.

Spin Rate Source

Select *Electrical* only for the MAS III unit.

Optical is needed for future applications.

Insert Air

Click this checkbox when the probe requires Insert air. See also the section [Final Configuration \[▶ 49\]](#).

Time To Flip

Some probes mechanically flip the Stator between the Magic Angle position and the Vertical position.

Enter a value to set the flip time.

NOTICE

Rotor or probe damage

When the flip time is too short the probe or the rotor can be damaged or the rotor might drop into the probe.

Spin rate group

Here the laboratory admin defines the spinning speed minimum and maximum range.

When the values entered here are out of range the system will limit the range depending on the probe type, rotor type and rotor cap.

Minimum

Lower limit of the spinning speed.

Maximum

Upper limit of the spinning speed.

Click **Save** to store the settings.

7.2.3.4 Inserting a Rotor

Place the rotor into the transfer system or the sample changer e.g. SamplePro hrMAS and click the **Insert** button. For operating the MAS III with a sample changer refer to the corresponding manual.

Perform an eject function before inserting a new rotor:

- When it is not sure if there is still a rotor in the stator.
- When using a flip-type probe.
 - This brings the stator in the vertical position enabling the insert of a rotor.

After pressing the **Insert** button, the Sample Down status changes.



Bruker Embedded Web Pages

MAS Help BRUKER Web Site

Main Settings Service

System Overview

Notifications

System Overview

Sample Down No Sample

Spin Rate (Hz) 0

Target Spin Rate (Hz) 1200

Rotation State Off
No sample

Frame cooling is Off

Frame cooling pressure (mbar) 0

Settings

Probe Test7 (7.00 mm)

Profile Generic

Cap VESPEL

Ready for sample
insert

Spin Rate (Hz)
0

User Name:

Password:

The data on this page is updated every 2 seconds.

Figure 7.9: Inserting a Rotor

7.2.3.5 Start and Stop Spinning a Rotor

Start Rotation

Enter the target spin rate for the NMR experiment e.g. 5000 Hz and click the **Set** button. The allowed minimum and maximum values depend on the current probe profile and cap material.

To start the rotor rotation:

- Click the **Go** button.
 - The MAS III unit performs a start procedure optimized for the current probe bringing the rotor up to speed.
 - The spin rate will be stabilized at the demanded value.



Bruker Embedded Web Pages

MAS Help BRUKER Web Site

Main Settings Service

System Overview

Notifications

System Overview

Sample Down Sample Down

Spin Rate (Hz) 1200

Target Spin Rate (Hz) 1200

Rotation State On

Frame cooling is Off

Frame cooling pressure (mbar) 0

Settings

Probe Test7 (7.00 mm)

Profile Generic

Cap VESPEL

Rotation Running

Spin Rate (Hz)
1200

User Name:

Password:

The data on this page is updated every 2 seconds.

Figure 7.10: Changing the Spin Rate

Changing the Spin Rate

While in the regulation mode you can change the target spin rate at any time after typing in and confirming by pressing the **Set** button.

Stop Rotation

To stop spinning the rotor:

- Click the **Stop** button.
 - When the rotation has stopped the **Go** button changes from disabled to enabled.
 - The MAS unit is ready for another spin or for rotor ejection.

The screenshot displays the Bruker Embedded Web Pages interface. At the top, there is a navigation bar with 'MAS', 'Help', and 'BRUKER Web Site'. Below this is a secondary navigation bar with 'Main', 'Settings', and 'Service'. The main content area is titled 'System Overview' and contains several control panels. On the left, a blue sidebar menu shows 'System Overview' and 'Notifications'. The 'System Overview' panel includes:

- 'Sample Down' section with 'Insert' and 'Eject' buttons.
- 'Spin Rate (Hz)' field.
- 'Target Spin Rate (Hz)' field set to 1200, with a 'Set' button.
- 'Rotation State' field set to 'Off', with 'Go' and 'Stop' buttons.
- 'Frame cooling is' field set to 'Off', with a 'Switch on' button.
- 'Frame cooling pressure (mbar)' field set to 0, with a 'Set' button.

 Below this is a 'Settings' section with:

- 'Probe' field set to 'Test7 (7.00 mm)'.
- 'Profile' dropdown menu set to 'Generic', with a 'Set' button.
- 'Cap' dropdown menu set to 'VESPEL', with a 'Set' button.

 On the right side, there is a 'Ready' status indicator, 'Spin Rate (Hz)' field set to 0, 'User Name' and 'Password' input fields, and a 'Log in' button. A note at the bottom right states 'The data on this page is updated every 2 seconds.'

Figure 7.11: Start and Stop a Rotation

7.2.3.6 Ejecting a Rotor

The Eject function ejects the rotor from the stator:

- To be taken manually from the transfer system.
- Into a MAS sample changer e.g. SamplePro hrMAS.

The Eject function works similarly to the Insert function.

8 Maintenance

8.1 Safety

Samples

DANGER

Danger of injury from rotor breakage!

Broken rotors may cause minor injuries or material damage, but may also result in a life threatening situation if hazardous substances are used.



- ▶ If a rotor breaks, refer to the corresponding precautions and cleaning/disinfection instructions.
- ▶ Wear protective equipment.
- ▶ Perform all tasks with samples and rotors carefully.
- ▶ Before carrying out any maintenance work, remove the samples if necessary.
- ▶ Strictly observe the correct diameter of the rotors.
- ▶ **The laboratory supervisor is responsible for:**
 - ⇒ Establishing and enforcing standard sample handling and cleaning procedures.
 - ⇒ Establishing and enforcing the use of protective clothing and equipment.
 - ⇒ Training laboratory personnel.
 - ⇒ Preparing an emergency plan.

Electrical System

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.

Improperly Performed Maintenance

WARNING

Danger of injury due to improperly performed maintenance!

Improperly performed maintenance may lead to serious injury and significant material damage.



- ▶ Provide for sufficient mounting clearance before starting to work.
- ▶ Keep the assembly area tidy and clean! Loose components and tools lying around or on top of each other may lead to accidents.
- ▶ When reinstalling previously removed components, make sure that the components are mounted properly, all fixing elements are reinstalled, and all screws are tightened to torque.
- ▶ Before putting the device back into operation:
 - ⇒ Make sure that all maintenance work has been performed and completed following the instructions and information provided in this manual.
 - ⇒ Make sure that no persons are still in the danger zone of the device.
 - ⇒ Make sure that all covers and safety devices have been installed and function properly.

Securing to Prevent Restart

WARNING



Danger to life from an unauthorized restart!

In the event of an unauthorized restart of the power supply during maintenance, there is a danger of serious injuries or death for persons in the danger zone.

- ▶ Switch off all power supplies before starting work and make sure they cannot be switched on again.

Moving Parts

Environmental protection

Observe the following environmental protection instructions during maintenance work:

- In respect to all lubrication points supplied manually with lubricant, remove any escaping, used or surplus grease and dispose of in accordance with applicable local regulations.

8.2 Accumulator inside the MAS III Unit

To avoid any rotor and/or probe damage in case of a power outage, the MAS III unit is equipped with an uninterruptible power supply (UPS). This power supply uses a lead acid accumulator with a voltage of 12V and a power of 1.2Ah. This accumulator has a very long life. It is usual, that the accumulator gets weak over the time. To ensure safe operation of the MAS III unit, weak accumulators must be replaced.

The power-on hours from the accumulator are counted. Depending on that, the accumulator has to be maintenance within a special period of time to increase the lifetime and to get the health-state. The user will be instructed about the maintenance procedure. If a service is necessary, the MAS III unit will notify the user by the blinking GREEN LED, see chapter [Control and Display Elements \[▶ 36\]](#).

Accumulator Fuse

Inside the MAS III unit there is an additional fuse to protect the accumulator.

To change this fuse you first have to remove the mains connector from the MAS III unit, then open the upper case cover. The position of the fuse is shown in the next figure.

You need a fuse type 5x20mm for a current of 2 A with characteristic slow blow.

Part number	Description
2254	Fuse 5X20MM 2.0A / 250V slow blow

Table 8.1: Part number and description for accumulator fuse

Before changing the fuse you have to disconnect the cable from the ST1 connector. After replacing the fuse you must reconnect this connector.

Position of the Accumulator Fuse

The accumulator fuse is located near the accumulator in the accumulator bay at the left side of the unit.



Figure 8.1: Accumulator bay with fuse



Figure 8.2: Connected accumulator with fuse

- Always remove the mains cable before carrying out any maintenance!
- Line voltage is present even with the mains switch in the **Off** position.



Figure 8.3: Accumulator Fuse Holder

Accumulators

CAUTION

Device Damage Hazard by Accumulators

The electronics of the device can be damaged when using improper or polarity-reversed connected accumulators.

- ▶ Only use rechargeable accumulators specified by the manual.
- ▶ Assure to connect the battery in right polarity.
- ▶ Weak accumulators must be replaced.

To avoid any rotor and/or probe damage when a power outage occurs, the MAS III unit is equipped with an uninterruptible power supply (UPS). This power supply uses 2 lead acid accumulators, each with a voltage of 12 V and a power of 1.2 Ah. These accumulators have a very long life, however it is possible that the accumulators weaken over time.

When a replacement accumulator is needed, use part number 1813295. (AKKU BLEIGEL 12V 1.2AH) or part number 86594.

To replace the accumulators:

- Remove the power cable from the MAS III unit.
- Open the side cover.

Always remove the mains cable before carrying out any maintenance! Line voltage is present even with the mains switch in the “off” position!

8.3 Particle Filter on the Maintenance Unit

The maintenance unit is located on the gas buffer. The unit should be checked using the following procedure, incorrect handling of the unit may cause breakage or malfunction of the equipment or device:

- Perform periodical checks to locate any cracks, flaws or other deterioration on the filter housing, see (2) on the figure below. If any cracks or flaws exist, or a malfunction occurs, replace with a new housing.
- Check periodically for a dirty filter housing (2). If any dirt is seen, replace with new housing.
- The drain cock should only be opened and closed manually (1). Use of a tool to open and close the drain cock may cause damage.
- Replace the filter elements, which appear when removing the filter housings (2), every two years. Using the filter elements past this replacement period may damage the system.

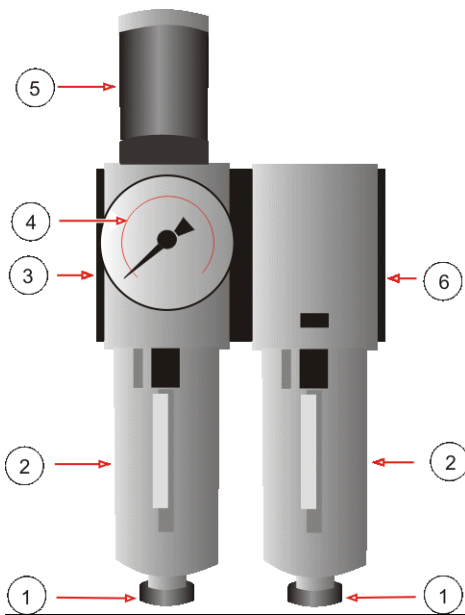


Figure 8.4: Particle Filter

1	Bleed valves	4	Pressure gauge
2	Filter housings	5	Pressure adjustment knob
3	Gas inlet	6	Gas outlet

8.4 Mains Fuse

Fuses

If the MAS III unit does not switch on, a fuse may be blown.

Main Fuse

There are 2 input fuses at the 230 V AC mains inlet of the MAS III unit.

As a replacement only use fuses of the type 5 x 20 mm for a maximal current of 800 mA, of the type slow blow that is rated with 250 V.

To change the fuses, remove the mains connector from the MAS III unit and open the fuse holder on the rear side of the unit.

Fuse Holder Main Fuse



Figure 8.5: Main Fuse

Use a screwdriver to withdraw the fuse holder. Change the blown fuse(s) and move the fuse holder back to its initial position.

Part number	Description
2250	Fuse 5X20MM 0.8A / 250V slow blow

Table 8.2: Part Number and Description of the Main Fuse

8.5 Replacement Parts

Part Number	Destination
2250	Mains fuse
2254	Accumulator fuse
1813295	Accumulator

Table 8.3: Bruker Replacement Parts

Replacement parts must be exchanged by Bruker Service personnel!

Only original parts from Bruker are to be used for the device. Use of any parts other than from Bruker invalidates all warranty.

Parts which are returned to Bruker for repair or disposal must be accompanied by a repair declaration (see [Repair Declaration \[p. 95\]](#)).

8.6 Preventive Maintenance

All parts in the device have been designed to work reliably without routine preventative maintenance.

8.7 Maintenance Schedule

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).

Interval	Maintenance Work	Reference
Daily	Clean the working area.	Laboratory SOP.
Weekly	Clean the machine compartment.	
	Check air maintenance unit.	
Annually	Clean the carousel Light Barrier	
As needed	Clean Outer Shell of the Device.	
	Update Firmware.	

Table 8.4: Maintenance Schedule for Laboratory Personnel

8.8 Cleaning

8.8.1 Before Cleaning

1. Stop the jobs submitted in the IconNMR automation mode.
2. Stop the device from doing any actions.
3. Switch the power off (see [Control and Display Elements \[▶ 36\]](#)).
4. Disconnect the power supply (see [Electrical Connections \[▶ 33\]](#)).

8.8.2 Cleaning the Outside of the Device Chassis and 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 unit.

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

8.8.3 Cleaning the Outer Shell of the Device

- Use only water as a cleaning fluid.
- Do not disassembly the device for cleaning.
- Do not use acetone for cleaning.
- Clean only the outer shell of the device with a lint-free cloth dampened in water.

8.8.4 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.

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 has to 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.

Repair Declaration Form

Use the Repair Declaration Form, whenever a device might be exposed to hazardous substances by customers, when it is to be returned to Bruker.

You will find the Repair Declaration Form in the appendix [Repair Declaration \[▶ 95\]](#).

9 Troubleshooting



To access the Web pages refer to the section [Accessing the Webpages \[▶ 64\]](#).

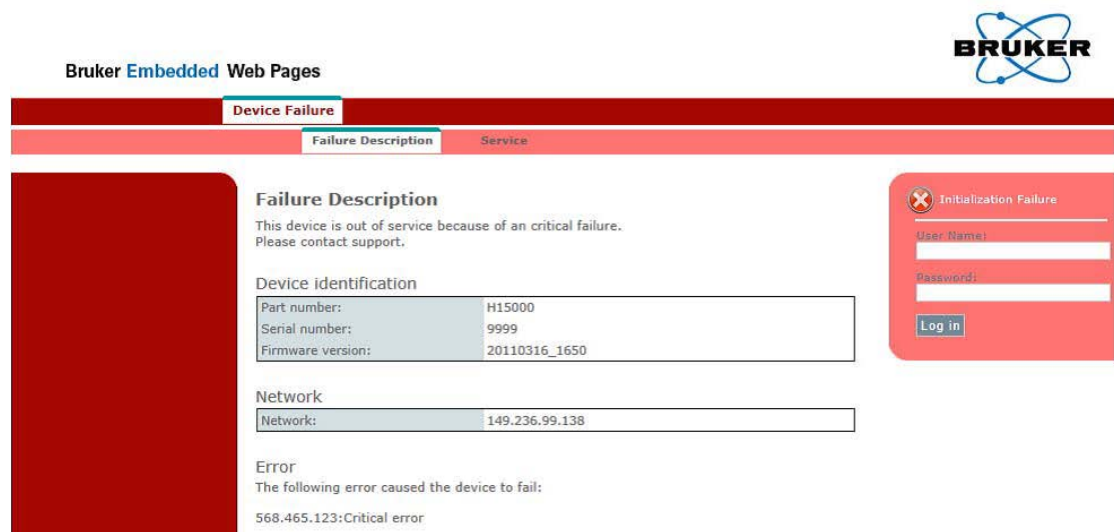
9.1 Device Failure

In case of a fatal error the indicator lamp turns red. Should the fatal error occur during startup, the indicator lamp will stay red + green for more than two minutes.

In such a case you need to contact Bruker Service (see Contact) and provide the following information:

- The [Device Report File \[▶ 82\]](#).
- A [TopSpin Log File \[▶ 84\]](#).
- The information displayed on the webpage shown in the figure below (a screen shot is very useful).

In failure mode the embedded webpages will be shown in red:



See also

- 📄 [Accessing the Webpages \[▶ 64\]](#)

9.2 Device Report File

The device report file provides Bruker service with important information used for troubleshooting.

To create a device report file either:

- Download it to the spectrometer computer using the device webpages.
- Use the **savelogs** command in *TopSpin* 3.5 or later.
- Use a USB memory stick.

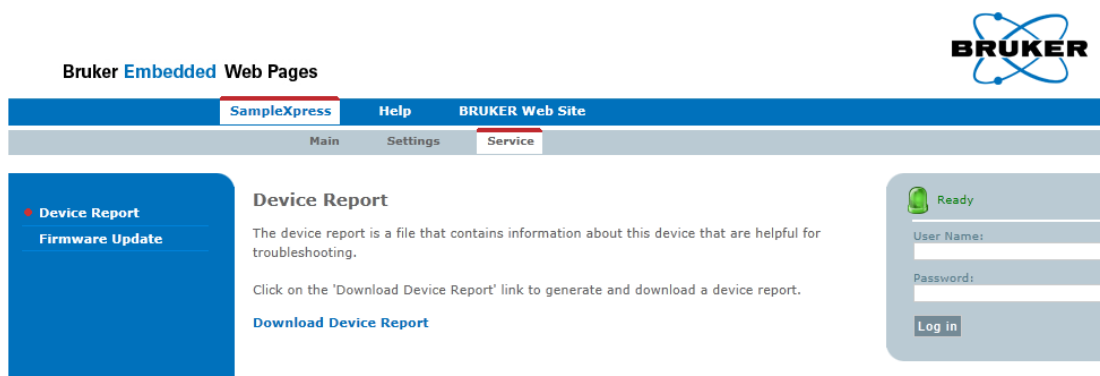


Note: In failure mode the generation of the device report can be much slower than in normal operation.

9.2.1 Downloading the Device Report File from the Webpages

To download the Device Report File from the webpages:

1. Open the webpages as described in the chapter Accessing the Web Pages.
2. Click on **Service** in the main menu (gray horizontal bar).
 - The Device Report page will be displayed:



3. Click the link **Download Device Report**.
 - After a short pause you will be queried on where to save the file.
4. Select the path where you want the file to be saved.

9.2.2 Saving the Device Report File on a USB Memory Stick

For all USB memory stick based operations a FAT32 formatted USB memory stick is needed.

1. Plug the USB memory stick into the USB port on the rear side of the device.
 - ▶ Unless the unit is in failure mode, the status lamp will start blinking blue.
 - ▶ The application software searches service files on the USB memory stick. This may take several minutes. Normally there is no service file available (see [Service File \[▶ 83\]](#)).
 - ▶ If no service file is found, a report file is generated and copied to the memory stick.
 - ▶ When completed, the blue status lamp stops blinking.
2. Disconnect the USB memory stick from the device.
3. Send the file to Bruker customer service.

Note: The file is saved in the directory \Bruker\Automation\logs on the USB stick. The file name consists of device name, model number, serial number, date (YYYYMMDD) and time (hhmmss),

e.g. X:\Bruker\Automation\logs\MAS_H139288_1234_20141117_103745.brukreport

The log file is written only if no service file is available for this device on the USB memory stick (see [Service File \[▶ 83\]](#)).

9.3 Service File

Bruker customer service can send a service file to carry out maintenance automatically. The service file is valid only once for a specific device (based on the part and serial numbers).

Always follow the instructions provided by Bruker Customer Service to apply a service file on your device. The general procedure is:

1. Copy the Service file to a FAT32 formatted USB memory stick.
2. Stop the rotation.
3. Plug the USB memory stick into the USB port on the rear side of the device.
 - ▶ Unless the unit is in failure mode, the status lamp will start blinking blue.
 - ▶ The application software searches service files on the USB memory stick. This may take several minutes.
 - ▶ When the device has processed the service files and is ready, the blue status lamp stops blinking.
4. Disconnect the USB memory stick from the device.
5. Send the service file that is on the memory stick back to Bruker Customer Service.

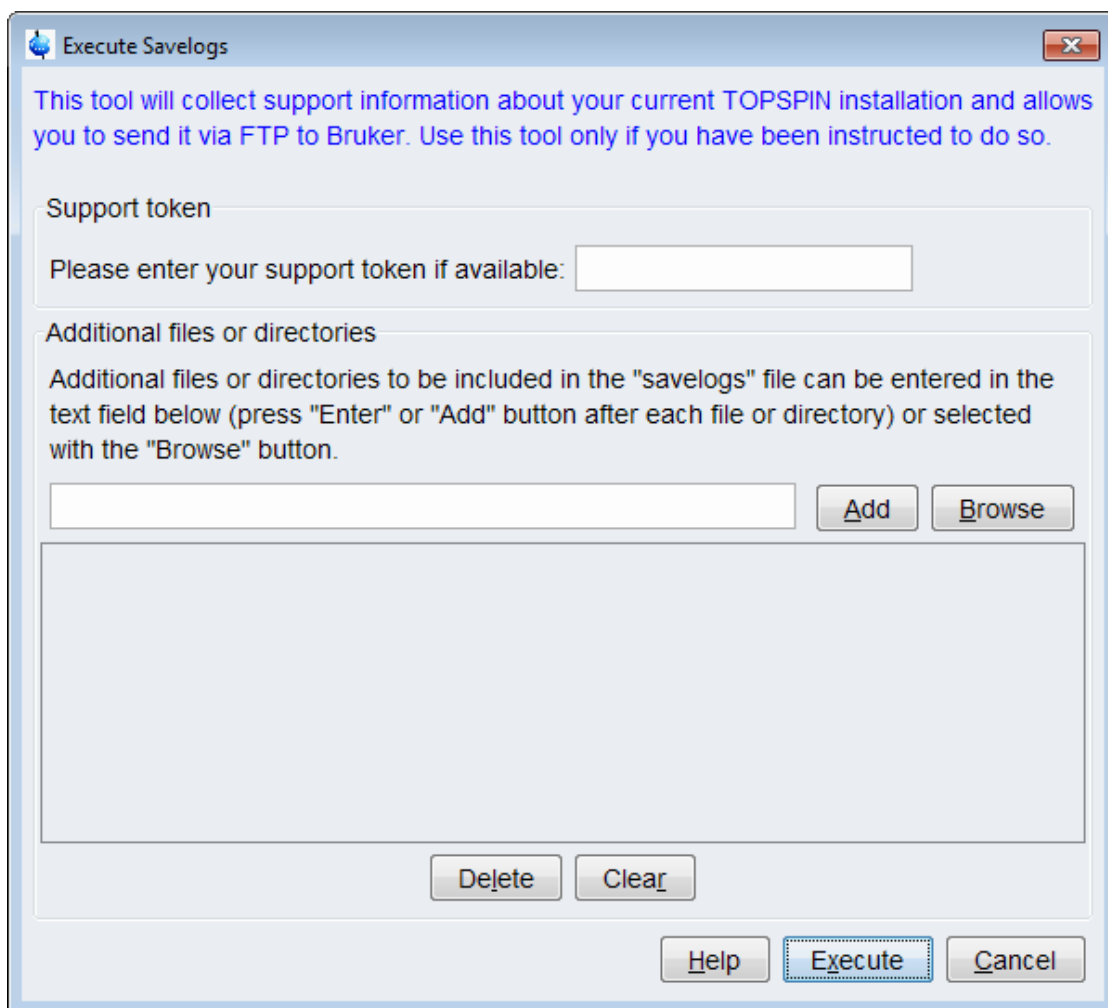
9.4 TopSpin Log File



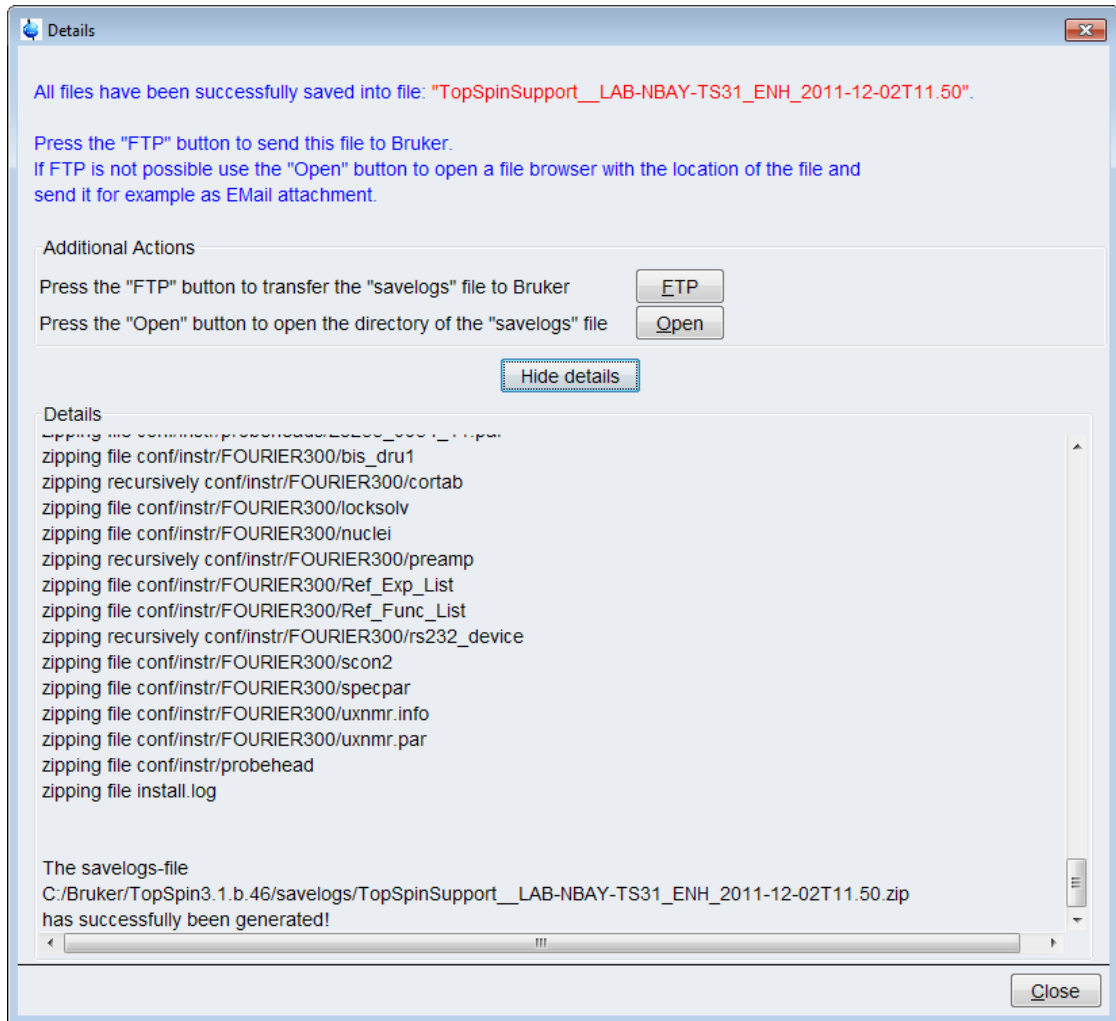
Starting with TopSpin version 3.5 the generated log file also includes the MAS III log file.

The TopSpin log files are also required to troubleshoot errors that occur, especially when the device was controlled by TopSpin. This section provides a brief description on how to obtain the TopSpin log files, for more detailed information refer to the TopSpin User Manual:

- Enter **savelogs** on the TopSpin command line.
 - The Execute Savelogs window will appear:



- When Bruker service has provided a support token enter the support token text.
- Click **Execute**.
 - The TopSpin log file will be prepared, when completed the following window will appear:



- To send this file to Bruker **click** the **FTP** button and inform Bruker about the file name.








10 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.

10.1 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		Indicates packages which are partially stackable. 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>		<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>
<p>Component Sensitive to Electrostatic Charge</p>		<p>The packaging contains components which are sensitive to an electrostatic charge.</p> <p>Only allow packaging to be opened by trained personnel.</p> <p>Establish potential equalisation before opening.</p>
<p>Protect from Heat</p>		<p>Protect packages against heat and direct sunlight.</p>
<p>Protect from Heat and Radioactive Sources</p>		<p>Protect packages against heat, direct sunlight and radioactive sources.</p>

Table 10.1: Symbols on the Packaging

10.2 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.



Note:

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

10.3 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

Dispose of packaging material in accordance with the relevant applicable legal requirements and local regulations.

10.4 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.



Note:

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

11 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.

11.1 Safety

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 of injury due to improper dismantling!

Stored residual energy, angular components, points and edges on and in the device or on the tools needed can cause injuries.

- ▶ Ensure sufficient space before starting work.
- ▶ Handle exposed, sharp-edged components with care.
- ▶ Dismantle the components properly.
- ▶ Secure components so that they cannot fall down or topple over.
- ▶ Consult the manufacturer if in doubt.

11.2 Dismantling

Before starting dismantling:

1. Shut down the device and secure to prevent restarting.
2. Physically disconnect the power supply from the device; discharge stored residual energy.
3. Remove consumables, auxiliary materials and other processing materials and dispose of 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.

11.3 Disposal

If no return or disposal agreement has been made, send the dismantled components for recycling.

- Scrap metals.
- Send plastic elements for recycling.
- Sort and dispose of other components in accordance with their material composition.

NOTICE

Danger to the environment 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.

12 Contact

Manufacturer:

Bruker BioSpin NMR
Silberstreifen
D-76287 Rheinstetten
Germany
Phone: +49 721-5161-6155

<http://www.bruker.com>

WEEE DE43181702

NMR Hotlines

Contact our NMR service centers.

Bruker BioSpin NMR provide 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:

<http://www.bruker.com/service/information-communication/helpdesk/magnetic-resonance.html>

13 Appendix A

13.1 Repair Declaration

The Equipment Clearance Form on the following page needs to be used for Service, Repair, Disposal or Transfer of the device.

• Safety and Repair Declaration

Equipment Clearance Form for Service, Repair, Disposal or Transfer



Use this form, whenever a probe or another unit situated in a magnet room or an analytical instrument might be exposed to hazardous substances by customers, when it is to be returned to Bruker.

Whenever a customer returns a system or its components to Bruker, e.g. for repair, upgrade, loan returns, exchange, etc., the customer accepts the following obligation:

It is the explicit responsibility of the customer to make sure that the returned products are absolutely free of any hazardous substances. In case of omission to do so, Bruker will hold the customer liable for any resulting injuries and/or damages, caused to employees of Bruker and/or to other persons exposed to the hazardous substances. The customer is further liable for all damage caused to Bruker, e.g. decontamination, security measures, etc. The customer is finally liable for all other direct and/or indirect damages caused to Bruker by the hazardous substances.

I ACCEPT THIS OBLIGATION

The repair declaration, completed and signed by the **safety representative**, has to be attached to the returned product. The declaration must be attached to the delivery note on the package exterior. Any returned product without a properly completed and duly signed declaration cannot be repaired. If we think that there is a risk of damage because of a contaminated returned product, we must dispose the hazardous material at the expense of the customer.

The safety & repair declaration form may be signed by a Bruker service engineer if the system was never operated by the customer (e.g. prior to completion of the installation).

The customer/signatory confirms that the returned product is absolutely free of any hazardous substances (e.g. toxic, corrosive, explosive, biologically dangerous or radioactive).

PRODUCT PART NO.:	SERIAL NO.:
FAULT DESCRIPTION (reason for return) :	
DATE FAILURE OCCURRED:	SYSTEM ORDER NO./ DISPATCH NO.:
COMPANY/INSTITUTE:	SIGNATURE: DATE:
NAME:	
MAILING ADDRESS:	
CITY/POSTAL CODE/COUNTRY:	
EMAIL:	

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