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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 understood
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

<table>
<thead>
<tr>
<th>Type of Information</th>
<th>Font</th>
<th>Examples</th>
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<td><strong>Shell Command, Commands,</strong> &quot;All what you can enter&quot;</td>
<td>Arial bold</td>
<td>Type or enter <code>fromjdx zg</code></td>
</tr>
<tr>
<td><strong>Button, Tab, Pane and Menu Names</strong></td>
<td>Arial bold, initial letters capitalized</td>
<td>Use the <strong>Export To File</strong> button. Click <strong>OK</strong>. Click <strong>Processing</strong>…</td>
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<td>&quot;All what you can click&quot;</td>
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<td><strong>Windows, Dialog Windows, Pop-up Windows Names</strong></td>
<td>Arial, initial letters capitalized</td>
<td>The Stacked Plot Edit dialog will be displayed.</td>
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<tr>
<td><strong>Path, File, Dataset and Experiment Names</strong></td>
<td>Arial Italic</td>
<td><code>$tshome/exp/stan/nmr/lists</code> expno, procno, IconNMR™, TopSpin™, XWIN-NMR™</td>
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<td>Courier</td>
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<td><strong>Pulse and AU Program Names</strong></td>
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*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.

<table>
<thead>
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<th>Title</th>
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<td>SB-MAS Operation Manual</td>
<td>Z31401</td>
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<tr>
<td>MAS II Pneumatic Unit</td>
<td>Z31701E</td>
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<tr>
<td>High Resolution Magic Angle Spinning Spectroscopy</td>
<td>Z31437</td>
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<tr>
<td>AVANCE DMX/DSX Spectrometers, Solids Experiments User Manual</td>
<td>H9321</td>
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<td>MAS Spinning Guide</td>
<td>B3940</td>
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<tr>
<td>Variable Temperature Control for NMR Probes</td>
<td>Z33073</td>
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</tbody>
</table>

*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
Déclaration 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... / hereewith declares that... / déclare par la présente que le...

Produkt Serie / Product Series / Série de Produit:
MAS III / NMR
Produkt ID / Product ID / ID de Produit:
H139280

...in Übereinstimmung mit den Bestimmungen der nachstehenden EG-Richtlinien (einschließlich aller zutreffenden Änderungen) ist.
...is in conformity with the provisions of the following EC directives (including all applicable amendments).
...est conforme aux dispositions des directives européennes suivantes (y compris tous les amendements applicables).

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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.

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.

<table>
<thead>
<tr>
<th>Date</th>
<th>Name</th>
<th>Type of Instruction</th>
<th>Instruction Provided By</th>
<th>Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Safety

**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.
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 cryogens.
Material damage may result from the overflow of cryogens.

► 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 cryogens 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

<table>
<thead>
<tr>
<th>Table 4.1: Input Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input pressure to the Gas Tank:</strong></td>
</tr>
<tr>
<td>Min.: 0.4 MPa (4 bar / 60 psi)</td>
</tr>
<tr>
<td>Ideal: 0.6-0.8 MPa (6-8 bar / 87-115 psi)</td>
</tr>
<tr>
<td><strong>Input pressure to the MAS III Unit:</strong></td>
</tr>
<tr>
<td><strong>Particulates:</strong></td>
</tr>
<tr>
<td><strong>Dew point:</strong></td>
</tr>
<tr>
<td><strong>Flow rate:</strong></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Data</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage</td>
<td>110 – 230 VAC</td>
<td></td>
</tr>
<tr>
<td>Apparent power consumption, maximum</td>
<td>75 VA</td>
<td></td>
</tr>
<tr>
<td>Circuit protection</td>
<td>2x 0.8 A 250 V slow blow</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>50 / 60 Hz</td>
<td></td>
</tr>
</tbody>
</table>

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 for detail information.

4.2 General Information

<table>
<thead>
<tr>
<th>Data</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight*</td>
<td>16 kg</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>35,5 cm</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>27 cm</td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>24 cm</td>
<td></td>
</tr>
</tbody>
</table>

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):

<table>
<thead>
<tr>
<th>Manual</th>
<th>Bruker Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site Planning for AVANCE Systems 300-750 MHz</td>
<td>Z31276</td>
</tr>
<tr>
<td>Site Planning for AVANCE Systems 800-950 MHz</td>
<td>Z31686</td>
</tr>
</tbody>
</table>

*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](image)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TRIGGER</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>AUXILIARY TRIGGER</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>ETHERNET</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>CAN BUS</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>USB</td>
<td>18</td>
</tr>
<tr>
<td>6</td>
<td>SPIN RATE</td>
<td>19</td>
</tr>
<tr>
<td>7</td>
<td>LINE IN UNIT (Main Switch, Fuse Holder, Line In)</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>PRESSURE MONITOR</td>
<td>21</td>
</tr>
<tr>
<td>9</td>
<td>SPIN RATE MONITOR</td>
<td>22</td>
</tr>
<tr>
<td>10</td>
<td>BEARING SENSE</td>
<td>23</td>
</tr>
<tr>
<td>11</td>
<td>EJECT</td>
<td>24</td>
</tr>
<tr>
<td>12</td>
<td>INSERT</td>
<td>25</td>
</tr>
<tr>
<td>13</td>
<td>FRAME COOLING</td>
<td>26</td>
</tr>
</tbody>
</table>
### 5.3 Connections

#### 5.3.1 Electrical Connections

![Back Panel - Electrical Connections](image)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>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.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TRIGGER</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AUXILIARY TRIGGER</td>
<td>Additional electrical output to the TCU. This 5V TTL signal is high when the spin lock is reached. Otherwise the output level is low.</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>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).</td>
</tr>
<tr>
<td>3</td>
<td>ETHERNET</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CAN BUS</td>
<td>Input/output, to control external units from the MAS III. No application available at the moment.</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>USB-Device connector for a USB memory device e.g. USB stick for Firmware update, logging and service purposes.</td>
</tr>
<tr>
<td>5</td>
<td>USB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPINRATE</td>
<td>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).</td>
</tr>
<tr>
<td>6</td>
<td>SPINRATE</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LINE IN</td>
<td>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.</td>
</tr>
<tr>
<td>7</td>
<td>LINE IN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PRESSURE MONITOR</td>
<td>Electrical input, used to measure the gas supply of the lab (measured before the gas tank).</td>
</tr>
<tr>
<td>8</td>
<td>PRESSURE MONITOR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPINRATE MONITOR</td>
<td>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.</td>
</tr>
<tr>
<td>9</td>
<td>SPINRATE MONITOR</td>
<td></td>
</tr>
</tbody>
</table>
### 5.3.2 Pneumatic Connections

![Figure 5.4: Pneumatic Connections (pink)](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>BEARING SENSE</td>
<td>This <strong>input</strong> 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.</td>
</tr>
<tr>
<td>11</td>
<td>EJECT</td>
<td>Pressure <strong>output</strong> which ejects the rotor from the stator.</td>
</tr>
<tr>
<td>12</td>
<td>INSERT</td>
<td>This pressure <strong>output</strong> 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.</td>
</tr>
<tr>
<td>13</td>
<td>FRAME COOLING</td>
<td>Pressure <strong>output</strong> for cooling the probe assembly.</td>
</tr>
<tr>
<td>14</td>
<td>OPTION</td>
<td>An optional pressure <strong>output</strong> 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 <em>Installation</em> [39].</td>
</tr>
<tr>
<td>15</td>
<td>DRIVE OUT</td>
<td>Pressure <strong>output</strong> used to drive the rotor.</td>
</tr>
<tr>
<td>16</td>
<td>BEARING OUT</td>
<td>The pneumatic <strong>output</strong> will be connected to either a heat exchanger or directly to the probe and serves the bearings from the probe.</td>
</tr>
<tr>
<td>17</td>
<td>VERTICAL</td>
<td><strong>Output</strong> 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).</td>
</tr>
</tbody>
</table>
### 5.3.3 Optical Connections (for Future Use)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Connection Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>SPIN OPTIC, blue</td>
<td>Optical <strong>output</strong> for spin rate measurement.</td>
</tr>
<tr>
<td>23</td>
<td>SPIN OPTIC, black</td>
<td>Optical <strong>input</strong> for spin rate measurement.</td>
</tr>
</tbody>
</table>

*Figure 5.5: Optical Connections (green)*
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

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Status light with three LEDs: red, green, blue</td>
</tr>
<tr>
<td>2</td>
<td>Bottom LEDs</td>
</tr>
</tbody>
</table>
**Status Light**

<table>
<thead>
<tr>
<th>Color</th>
<th>Status Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Error: Look for messages in <em>TopSpin</em> or on the embedded web pages.</td>
</tr>
<tr>
<td>Green</td>
<td>Ready.</td>
</tr>
<tr>
<td>Green Blinking</td>
<td>Activity e.g. initializing.</td>
</tr>
<tr>
<td>Blue</td>
<td>User interaction is required: Look for messages in <em>TopSpin</em> or on the embedded web pages.</td>
</tr>
</tbody>
</table>

*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.

<table>
<thead>
<tr>
<th>Status</th>
<th>Status Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Off</td>
<td>No rotation.</td>
</tr>
<tr>
<td>Increasing intensity</td>
<td>Rotation speed incrementing.</td>
</tr>
<tr>
<td>On</td>
<td>Rotation running and target frequency is locked.</td>
</tr>
<tr>
<td>Decreasing intensity</td>
<td>Rotation speed decrementing.</td>
</tr>
<tr>
<td>Fast Blinking at constant intensity</td>
<td>Waiting for spin lock.</td>
</tr>
</tbody>
</table>

*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:

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

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](image)

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](image)
• Fix the protective ground cable between the two chopper discs with two nuts:

![Figure 6.4: Connected Protective Ground Cable](image)

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](image)

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

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

| 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:
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.
Installation

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

**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* (p. 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.
Installation

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` 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 Vespel 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.
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.

![Figure 7.1: The Main Tab of the TopSpin MAS User Interface.](image)
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.

![Image of TopSpin interface](image)

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

**See also**
- Spinning and Stopping [p. 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*[p. 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.
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.

![Recording Tab of the TopSpin MAS User Interface](image)

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

![Help Tab](image)

**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.

![Image of web interface](image)

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.

Click the Exchange Probe button when the probe is already installed.
In the **Settings** tab click **Probe** in the left navigation pane.
Click the **Edit** button. Now the settings can be edited or modified:

**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.
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.
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.

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

<table>
<thead>
<tr>
<th>DANGER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger of injury from rotor breakage!</td>
</tr>
<tr>
<td>Broken rotors may cause minor injuries or material damage, but may also result in a life threatening situation if hazardous substances are used.</td>
</tr>
<tr>
<td>▶ If a rotor breaks, refer to the corresponding precautions and cleaning/disinfection instructions.</td>
</tr>
<tr>
<td>▶ Wear protective equipment.</td>
</tr>
<tr>
<td>▶ Perform all tasks with samples and rotors carefully.</td>
</tr>
<tr>
<td>▶ Before carrying out any maintenance work, remove the samples if necessary.</td>
</tr>
<tr>
<td>▶ Strictly observe the correct diameter of the rotors.</td>
</tr>
<tr>
<td>▶ The laboratory supervisor is responsible for:</td>
</tr>
<tr>
<td>☰ Establishing and enforcing standard sample handling and cleaning procedures.</td>
</tr>
<tr>
<td>☰ Establishing and enforcing the use of protective clothing and equipment.</td>
</tr>
<tr>
<td>☰ Training laboratory personnel.</td>
</tr>
<tr>
<td>☰ Preparing an emergency plan.</td>
</tr>
</tbody>
</table>

Electrical System

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Danger of injury from electrical shock!</td>
</tr>
<tr>
<td>A life threatening shock may result when the housing is open during operation.</td>
</tr>
<tr>
<td>▶ Only qualified personnel should open the housing.</td>
</tr>
<tr>
<td>▶ Disconnect the device from the electrical power supply before opening the device. Use a voltmeter to verify that the device is not under power!</td>
</tr>
<tr>
<td>▶ Be sure that the power supply cannot be reconnected without notice.</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2254</td>
<td>Fuse 5X20MM 2.0A / 250V slow blow</td>
</tr>
</tbody>
</table>

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
Maintenance

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](image)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bleed valves</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Filter housings</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>Gas inlet</td>
<td>6</td>
</tr>
</tbody>
</table>
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

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

<table>
<thead>
<tr>
<th>Part number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2250</td>
<td>Fuse 5X20MM 0.8A / 250V slow blow</td>
</tr>
</tbody>
</table>

Table 8.2: Part Number and Description of the Main Fuse

8.5 Replacement Parts

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>2250</td>
<td>Mains fuse</td>
</tr>
<tr>
<td>2254</td>
<td>Accumulator fuse</td>
</tr>
<tr>
<td>1813295</td>
<td>Accumulator</td>
</tr>
</tbody>
</table>

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).

<table>
<thead>
<tr>
<th>Interval</th>
<th>Maintenance Work</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily</td>
<td>Clean the working area.</td>
<td>Laboratory SOP.</td>
</tr>
<tr>
<td>Weekly</td>
<td>Clean the machine compartment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Check air maintenance unit.</td>
<td></td>
</tr>
<tr>
<td>Annually</td>
<td>Clean the carousel Light Barrier</td>
<td></td>
</tr>
<tr>
<td>As needed</td>
<td>Clean Outer Shell of the Device.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Update Firmware.</td>
<td></td>
</tr>
</tbody>
</table>

*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 disassemble 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 [p. 95].
9 Troubleshooting

To access the Web pages refer to the section Accessing the Webpages [p. 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 [p. 82].
- A TopSpin Log File [p. 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 [p. 64]
Troubleshooting

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:

![Execute Savelogs](image)

  - 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.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top</td>
<td>The arrow tips on the sign mark the top of the package. They must always point upwards; otherwise the content may be damaged.</td>
</tr>
<tr>
<td>Fragile</td>
<td>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.</td>
</tr>
<tr>
<td>Protect Against Moisture</td>
<td>Protect packages against moisture and keep dry.</td>
</tr>
<tr>
<td>Attach Here</td>
<td>Lifting gear (lifting chain, lifting strap) must only be attached to points bearing this symbol.</td>
</tr>
<tr>
<td>Center of Gravity</td>
<td>Marks the center of gravity of packages. Note the location of the center of gravity when lifting and transporting.</td>
</tr>
<tr>
<td>Weight, Attached Load</td>
<td>Indicates the weight of packages. Handle the marked package in accordance with its weight.</td>
</tr>
<tr>
<td>Permitted Stacking Load</td>
<td>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.</td>
</tr>
</tbody>
</table>
Do not Damage Air-tight Packaging

- The packaging is air-tight. Damage to the barrier layer may render the contents unusable.
- Do not pierce.
- Do not use sharp objects to open.

Component Sensitive to Electrostatic Charge

- The packaging contains components which are sensitive to an electrostatic charge.
- Only allow packaging to be opened by trained personnel.
- Establish potential equalisation before opening.

Protect from Heat

- Protect packages against heat and direct sunlight.

Protect from Heat and Radioactive Sources

- Protect packages against heat, direct sunlight and radioactive sources.

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

<table>
<thead>
<tr>
<th>PRODUCT PART NO:</th>
<th>SERIAL NO:</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAULT DESCRIPTION (reason for return):</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DATE FAILURE OCCURRED:</th>
<th>SYSTEM ORDER NO.</th>
<th>DISPATCH NO.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPANY/INSTITUTE:</td>
<td>SIGNATURE:</td>
<td></td>
</tr>
<tr>
<td>NAME:</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>MAILING ADDRESS:</td>
<td>DATE:</td>
<td></td>
</tr>
<tr>
<td>CITY/POSTAL CODE/COUNTRY:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMAIL:</td>
<td>------------------</td>
<td></td>
</tr>
</tbody>
</table>

---

H146901_2_001
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