Filter Configurations.

for High Resolution NMR (and HR MAS)

Service Manual

Version 009

NMR Spectroscopy

Innovation with Integrity

This manual was written by

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Fällanden, Switzerland

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For further technical assistance on the Filter Configurations unit, please do not hesitate to contact your nearest BRUKER dealer or contact us directly at:

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Contact

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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-biospin.com/hotlines_nmr.html

1 About

1.1 This Manual

This manual is intended to be a reference guide for operators and service technicians. It provides detailed information about the user level maintenance and service and overall use of the Bruker device.

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.

Carefully read all relevant chapters before working on the device!

This manual describes parts and procedures relevant to the device version it is delivered with. For older hardware, please refer to the manual supplied at the time.

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 harzard.

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

DANGER

This combination of symbol and signal word indicates an immediately hazardous situation which could result in death or serious injury unless avoided.

⚠ WARNING

This combination of symbol and signal word indicates a potentially hazardous situation which could result in death or serious injury unless avoided.

⚠ CAUTION

This combination of symbol and signal word indicates a possibly hazardous situation which could result in minor or slight injury unless avoided.

NOTICE

This combination of symbol and signal word indicates a possibly hazardous situation which could result in damage to property or the environment unless avoided.

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

2 Introduction

This manual is intended to be used by trained device users. It contains information about the device: operation, safety, maintenance, etc..

2.1 Concept

2.2 Limitation of Liability

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

The manufacturer accepts no liability for damage due to:

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

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

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

2.3 Before You Begin

This user manual contains information and safety information that are necessary for the safe operation of the device.

Any user maintenance and repairs are to be accomplished using the information in this manual.

Consider all safety references!

Information for ordering spare parts is available in the spare parts section for from the Bruker Service Center (see contacts).

2.4 Minimum Qualifications for Operating Personnel

EXAMPLE:

Type of Task	Personnel	Training and Experience
Transportation	No speical requirements.	No special.
Installation	Bruker certified personnel only.	Technically skilled, with a good knowledge of the application field.
Routine Use Daily Maintenance	Appropriately certified and experienced personnel, familiar with use of computers and automation in general	Laboratory technicians or equivalent. Training is usually done in-house. Familiar with MS Windows® environment.
Setup and optimization of program	Bruker certified personnel only.	Experienced laboratory technician. High degree of knowledge of the relevant application field.
Preventive Maintenance	Bruker certified personnel only.	Technically skilled with a basic understanding of the application.
Servicing	Bruker certified personnel only.	Background and experience in electronics/mechanics with computer knowledge.

Table 2.1 Overview Installation and Operation Requirements for Personnel

2.5 The Bruker Service

Our customer service division is available to provide technical information. See "Contact" on page 5 for contact details.

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.

2.6 Transport to Manufacturer

When the filter must be returned to the manufacturer for a major repair, use the original packaging for transportation.

Include a good description of the problem.

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 Intended Use

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

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

Any use which exceeds or differs from the intended use shall be considered improper use.

No claims of any kind for damage will be entertained if such claims result from improper use.

3.2 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 PRODUCTNAME is operated by trained and authorised personnel as well as all other work, 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 PRODUCTNAME 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 must be 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 is 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.

3.3 Personnel Requirements

3.3.1 Qualifications

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

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.

3.3.2 Unauthorized Persons

⚠ WARNING

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

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

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

3.3.3 Instruction

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

Date	Name	Type of Instruction	Instruction Provided By	Signature

3.4 Personal Protective Equipment

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

The 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 laboratory. Always comply with the instructions governing personal protective equipment posted in the work area.

3.5 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.

3.5.1 Position of the Safety Devices

Installed filters must always be connected on both side to the corresponding cables or HPPR/2 modules

3.5.2 General Workplace Dangers

Never touch an open RF connector on a running spectrometer.

4 Filter Configurations for HR-NMR and HR-MAS

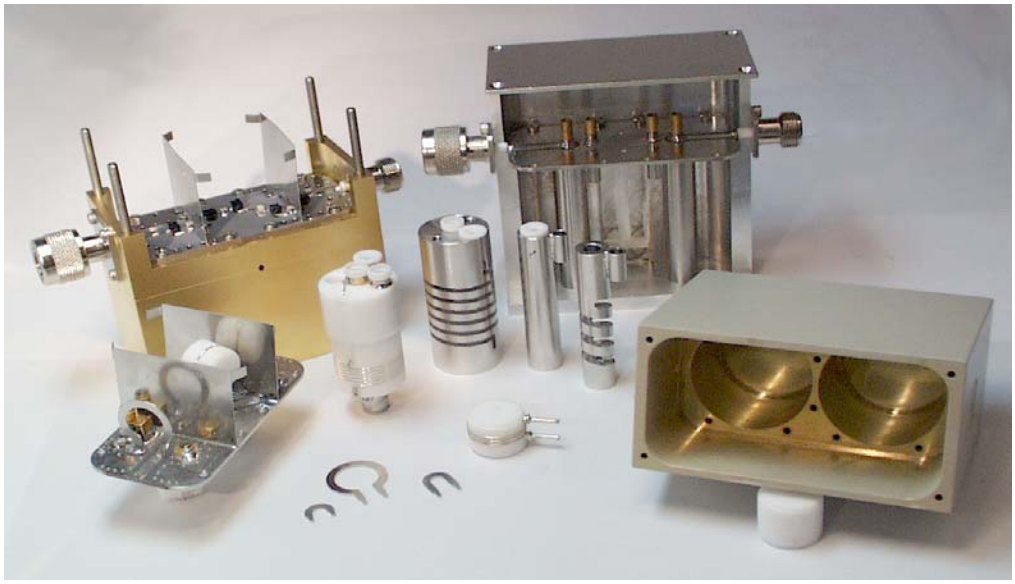


Figure 4.1 High Resolution NMR Filters and Filtercomponents

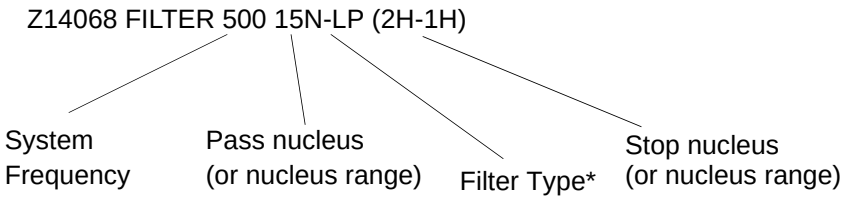
4.1 Introduction

For use of phased-out filters (not mentioned in Table page 51) or old HPPR modules see previous manual versions.

- The following chapter helps to select the necessary filter type dependent on the pre-amplifier and the probe.
- System orders with multiple probes require only the combined minimum set of filters.
- Only standard operation is guaranteed with the recommended filter configuration. Non-standard operation (observe on outer coil and decoupling on inner coil) may also be possible with the recommended filter configuration.
- With individual probe orders the current configuration at the customer‘s labs should be obtained to avoid ordering filters which are already at the site.

- If your probe is not included in this list, please fill in the filter requirements questionnaire on page 20 and send it to BBIO-CH, Production Department.
- The exact order number for the corresponding magnet frequency can be taken from the chapter "Available Filters, February 2012" on page 57.
- No additional filters are necessary in the lock channel.
- No additional filters are necessary for cryoprobe operation.
- For HR MAS are exactly the same filters required as for high resolution NMR (for the corresponding probe).
- All filters should be mounted on the HPPR/2 and not on the probe
- In cause of more than one filter, the 2H stop should be mounted closer to the HPPR
- For filters with increased EMC and shielding requirements see the corresponding EC.

Explanation of the filter nomenclature:



*) LP=low pass, HP= high pass, BP=band pass

- Special“ non reflective” (NR) filters are available for 15N (e.g. FILTER 900 15N-NR (2H,F-H). The second harmonic of 15N is being terminated and not reflected by the filter.

4.1.1 HPPR/2 Overview

Preamplifier	
HPPR/2 1H MODULE 200-250	
AQS 1H2H PREAMP 300-400	
HPPR/2 1H2H MODULE 300-400	
HPPR/2 1H LNA MODULE 500-900	
HPPR/2 1H[a] HPLNA MODULE 200-1000	

Table 4.1 Currently used preamplifiers for 1H (HR)

a. with 19F capability, depending on ECL (see ECH3791)

Preamplifier	
HPPR/2 XBB19F 2HS MODULE 200-250, 500-700	
HPPR/2 XBB31P 2HS MODULE 750-1000	
AQS XBB19F 2HS PREAMP 300-400	
HPPR/2 XBB19F 2HS MODULE 300-400	

Table 4.2 Currently used preamplifiers for X (HR)

4.2 Filter Requirements Questionnaire

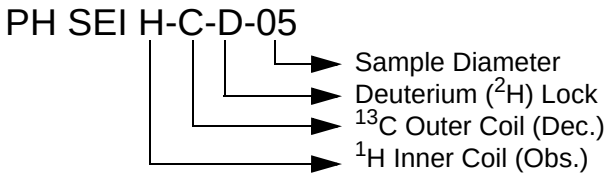
Please fill in the following questionnaire for each probe.

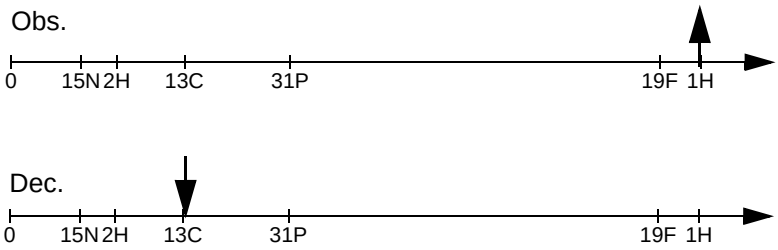
		(Part. Nr. / Ser. Nr.)
Bruker Order Number		
Spectrometer Type		
Probe		
Transmitter Configuration	1H	
	19F	
	X	
	Y	
	Z	
HPPR/2 Configuration	1H	
	19F	
	XBB	
	...	
Lock	2H	
	19F	
	2H Lockswitch	
Existing Filter 1		
Existing Filter 2		
...		
Experiment 1	Obs1 {Dec1}	
Experiment 2	Obs2 {Dec2}	
...		

Table 4.3 Questionnaire

4.3 SEI (Selective Inverse)

Example:





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-
Decoupling Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	-
	HPPR/2 XBB19F 2HS MODULE 300-400 	-

Table 4.4 Required Filters PH SEI H-C-D

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

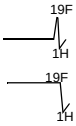
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass/19F-Stop 
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 
Decoupling Path 19F	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P,19F-LP (1H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	not possible
	AQS XBB19F 2HS PREAMP 300-400 	-[a]
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
	HPPR/2 1H HPLNA MODULE 200-1000 	19F-BP(1H) or 0-31P,19F-LP(1H) 

Table 4.5 Required Filters PH SEI H-F-D

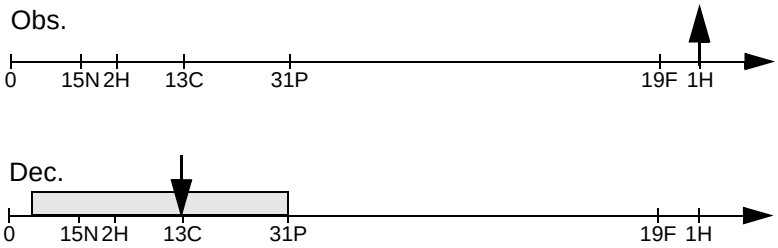
a. only for ECL<=1: Filter 0-31P,19F-LP(1H) is required for 19F Observe and 1H Decoupling

4.4 BBI (Broad Band Inverse)

Example:

PH BBI H-BB-D-05

- Sample Diameter
- Deuterium (^{2}H) Lock
- BB (^{107}Ag...^{31}P) Outer Coil (Dec.)
- ^{1}H Inner Coil (Obs.)



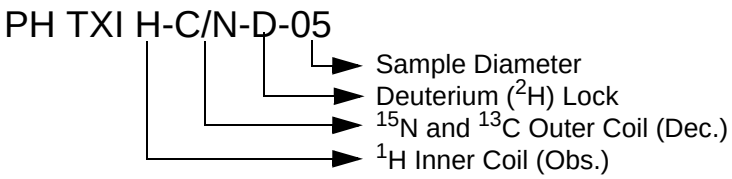
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-
Decoupling Path BB	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	-
	HPPR/2 XBB19F 2HS MODULE 300-400 	-

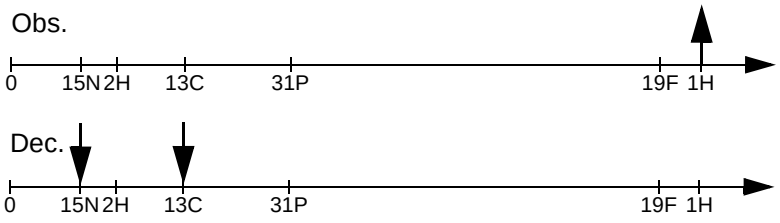
Table 4.6 Required Filters PH BBI H-BB-D

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

4.5 TXI (Triple X-Nuclei Inverse)

Example:





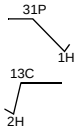
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-
Decoupling Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) and 13C-Pass / 2H-Stop 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	13C-Pass / 2H-Stop 
	AQS XBB19F 2HS PREAMP 300-400 	13C-Pass / 2H-Stop 
	HPPR/2 XBB19F 2HS MODULE 300-400 	13C-Pass / 2H-Stop 
Decoupling Path 15N	some X-BB Preamplifier	15N-Pass / 2H-Stop 

Table 4.7 Required Filters PH TXI H-C/N-D

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-
Decoupling Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	13C-Pass / 31P-Stop 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	13C-Pass / 31P-Stop 
	AQS XBB19F 2HS PREAMP 300-400 	13C-Pass / 31P-Stop 
	HPPR/2 XBB19F 2HS MODULE 300-400 	13C-Pass / 31P-Stop 
Decoupling Path 31P	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	31-P-Pass /13C-Stop 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	31-P-Pass /13C-Stop 
	AQS XBB19F 2HS PREAMP 300-400 	31-P-Pass /13C-Stop 
	HPPR/2 XBB19F 2HS MODULE 300-400 	31-P-Pass /13C-Stop 

Table 4.8 Required Filters PH TXI H-C/P-D

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

13C Observe/ 1H Decoupling might be possible with this configuration.

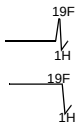
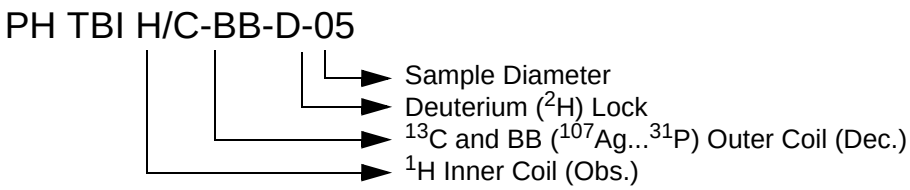
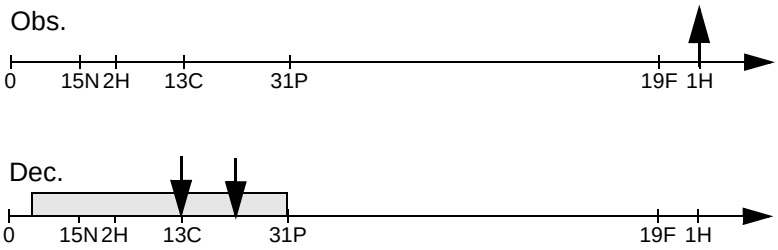
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass/19F-Stop 
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 
Decoupling Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	0-31P-LP (19F-3H) 
	AQS XBB19F 2HS PREAMP 300-400 	0-31P-LP (19F-3H) 
	HPPR/2 XBB19F 2HS MODULE 300-400 	0-31P-LP (19F-3H) 
Decoupling Path 19F	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	19F-BANDPASS 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	not possible
	AQS XBB19F 2HS PREAMP 300-400 	19F-BANDPASS 
	HPPR/2 XBB19F 2HS MODULE 300-400 	19F-BANDPASS 
	HPPR/2 1H HPLNA MODULE 200-1000 	19F-BP(1H) or 0-31P,19F-LP(1H) 

Table 4.9 Required Filters PH TXI H/C-F-D

4.6 TBI (Triple Broad Band Inverse)

Example:





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-
Decoupling Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	b c
	HPPR/2 XBB31P 2HS MODULE 750-1000 	b c
	AQS XBB19F 2HS PREAMP 300-400 	b c
	HPPR/2 XBB19F 2HS MODULE 300-400 	b c
Decoupling Path BB	some X-BB Preamplifier	b c

Table 4.10 Required Filters PH TBI H-C/BB-D

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

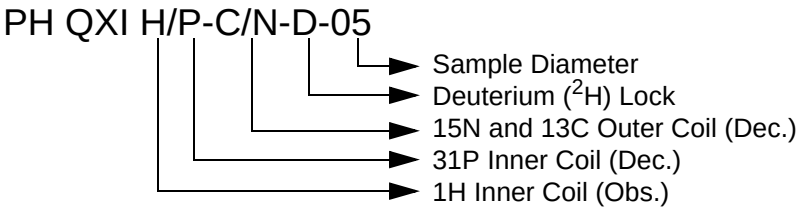
b. For 13C and 15N decoupling filter requirements is the same as "Required Filters PH TXI H-C/N-D" on page 27

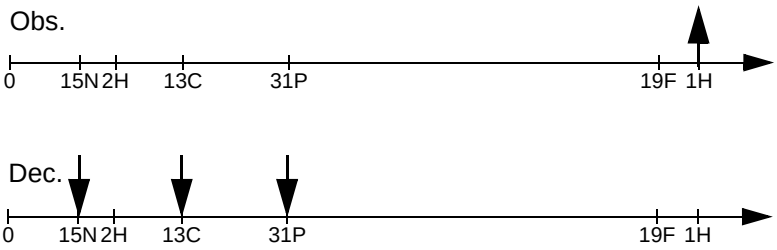
c. For 13C and 31P decoupling filter requirements is the same as "Required Filters PH TXI H-C/P-D" on page 28

For additional decoupling nuclei please contact the nearest local Bruker office.

4.7 QXI (Quadruple X-Nuclei Inverse)

Example:





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	-
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-
Decoupling Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	13C-BP (0-SI,11B-H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	13C-BP (0-SI,11B-H) 
	AQS XBB19F 2HS PREAMP 300-400 	13C-BP (0-SI,11B-H) 
	HPPR/2 XBB19F 2HS MODULE 300-400 	13C-BP (0-SI,11B-H) 
Decoupling Path 15N	some X-BB Preamplifier	15N-Pass / 2H-Stop 
Decoupling Path 31P	some X-BB Preamplifier	31P-BP(0-11B,19F-H) 

Table 4.11 Required Filters PH QXI H/P-C/N-D

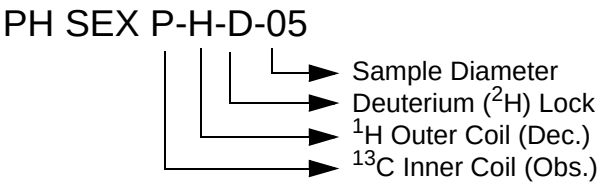
Filter Configurations for HR-NMR and HR-MAS

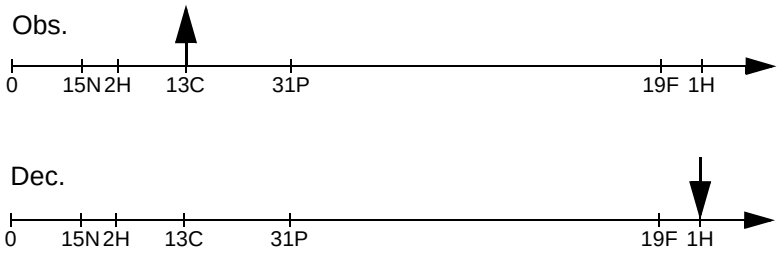
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass/19F-Stop 
	AQS 1H2H PREAMP 300-400 	1H-Pass/19F-Stop 
	HPPR/2 1H2H MODULE 300-400 	1H-Pass/19F-Stop 
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 
Decoupling Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	13C-BP (0-SI,11B-H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	13C-BP (0-SI,11B-H) 
	AQS XBB19F 2HS PREAMP 300-400 	13C-BP (0-SI,11B-H) 
	HPPR/2 XBB19F 2HS MODULE 300-400 	13C-BP (0-SI,11B-H) 
Decoupling Path 15N	some X-BB Preamplifier	15N-Pass / 2H-Stop 
Decoupling Path 19F	some X-BB Preamplifier	0-31P,19F-LP (1H) and 19F-BANDPASS   or 19F-BP(1H) 
	HPPR/2 1H HPLNA MODULE 200-1000 	19F-BP(1H) or 0-31P,19F-LP(1H)  

Table 4.12 Required Filters PH QXI H/F-C/N-D

4.8 SEX, Dual (Selective X-Nuclei)

Example:





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	-
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 

Table 4.13 Required Filters PH SEX C-H-D

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 3H	HPPR/2 3H MODULE 	3H-HP(1H) 
	HPPR/2 3H HPLNA MODULE 200-1000 	3H-HP(1H) 
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-LP(3H) 
	HPPR/2 1H MODULE 200-250 	1H-LP(3H) 
	AQS 1H2H PREAMP 300-400 	1H-LP(3H) 
	HPPR/2 1H2H MODULE 300-400 	1H-LP(3H) 
	HPPR/2 1H LNA MODULE 500-900 	1H-LP(3H) 

Table 4.14 Required Filters PH SEX 3H-H-D

1H Observe/ 3H Decoupling might be possible with this configuration.

Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 2H	HPPR/2 2H MODULE 200-250, 500-900 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass / 19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass / 19F-Stop 
	AQS 1H2H PREAMP 300-400 	
	HPPR/2 1H2H MODULE 300-400 	
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass / 19F-Stop 

Table 4.15 Required Filters PH SEX 2H-H-F

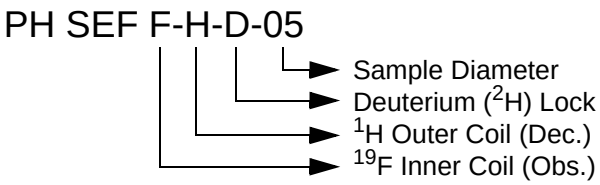
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path BB	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	-
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	-
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-

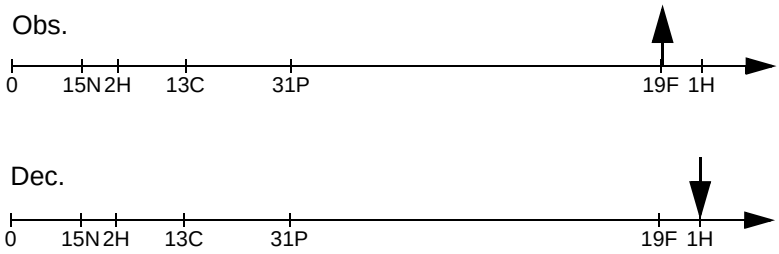
Table 4.16 Required Filters for PH SEX X-H-D (x=all X-nuclei except 2H, 3H, 13C)

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

4.9 SEF (Selective 19F)

Example:





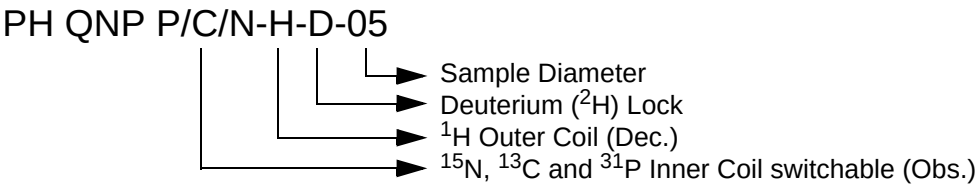
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 19F	HPPR/2 19F MODULE 200-1000 	0-31P,19F-LP (1H) 
	HPPR/2 1H HPLNA MODULE 200-1000 	19F-BP(1H)  or 0-31P,19F-LP (1H) 
	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P,19F-LP (1H) 
	AQS XBB19F 2HS PREAMP 300-400 	-[a]
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass/19F-Stop 
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 

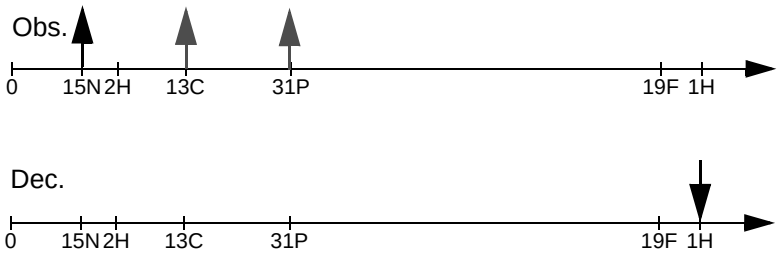
Table 4.17 Required Filters for PH SEF F-H-D

a. only for ECL <=1 Filter 0-31P,19F-LP(1H) is required

4.10 QNP (Quadruple Nuclei Probe)

Example:





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 31P/13C/15N	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	-
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-

Table 4.18 Required Filters for PH QNP P/C/N-H-D

a. This filter is only required in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

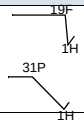
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 19F/31P/13C	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P,19F-LP (1H) or 0-31P-LP (19F-3H)[a] 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	19F observe not possible
	AQS XBB19F 2HS PREAMP 300-400 	-[b]
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass/19F-Stop 
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 

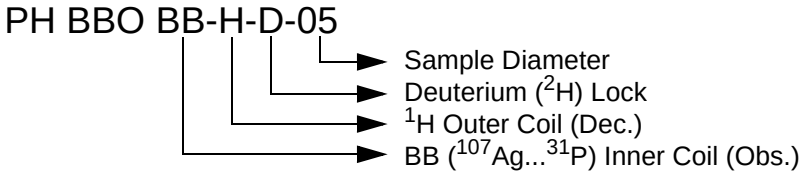
Table 4.19 Required Filters for PH QNP F/P/C-H-D

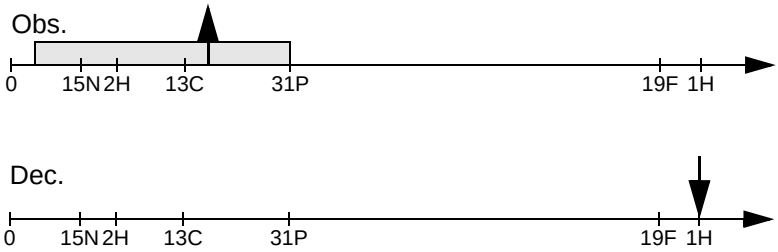
a. This filter is only necessary for 13C decoupling and must be removed for 19F decoupling or observe

b. only for ECL <=1 Filter 0-31P,19F-LP(1H) is required

4.11 BBO (Broad Band Observe)

Example:





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path BB	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	-
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-

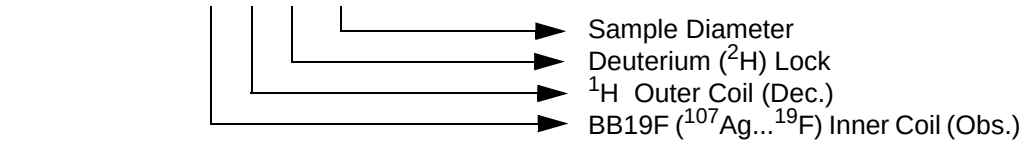
Table 4.20 Required Filters for PH BBO-H-D

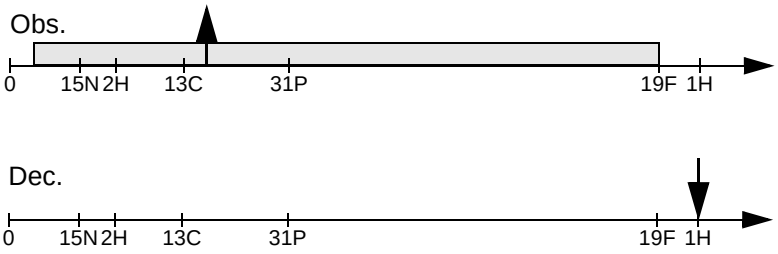
a. This filter is only in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter) required

4.12 BBO BBF-H (Broad Band Observe)

Example:

PA BBO BBF-H-D-05 Z





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path BB	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P,19F-LP (1H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	19F observe not possible
	AQS XBB19F 2HS PREAMP 300-400 	-[a]
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass/19F-Stop 
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 

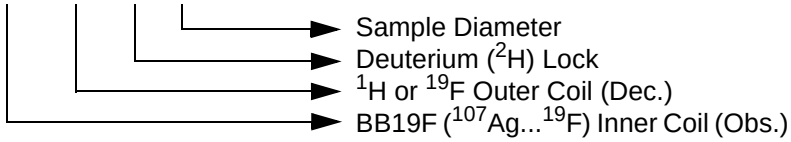
Table 4.21 Required Filters for PH BBO BBF-H (valid for Standard-, Plus- and Smart-Probes)

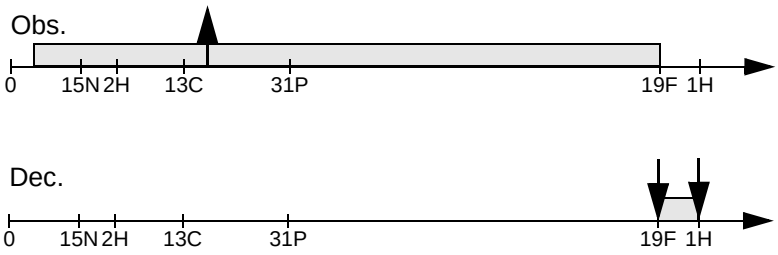
a. only for ECL <=1 Filter 0-31P,19F-LP(1H) is required

4.13 BBO BBF-H&F (Broad Band Observe)

Example:

PA BBO BBF-H&F-D-05 Z





Depending on the decoupling nucleus, different filter configurations are required.

Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path BB	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P,19F-LP (1H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	19F observe not possible
	AQS XBB19F 2HS PREAMP 300-400 	-[a]
	HPPR/2 XBB19F 2HS MODULE 300-400 	-
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass/19F-Stop 
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass/19F-Stop 

Table 4.22 Required Filters for PH BBO BBF-H&F (Valid for Standard-, Plus and Smart-Probes) for 1H Decoupling

a. only for ECL <=1 Filter 0-31P,19F-LP(1H) is required

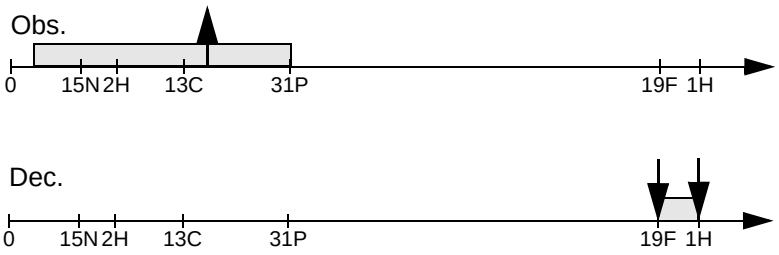
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path BB	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	0-31P-LP (19F-3H) 
	HPPR/2 XBB19F 2HS MODULE 300-400 	0-31P-LP (19F-3H) 
Decoupling Path 19F	no preamplifier (1H preamplifier must be bypassed for 19F decoupling)	19F-BANDPASS 
	HPPR/2 1H HPLNA MODULE 200-1000 	

Table 4.23 Required Filters for PH BBO BBF-H&F (Valid for Standard-, Plus and SmartProbes) for 19F decoupling and 107Ag-31P Observe.

4.14 BBO BB-H&F (Broad Band Observe)

Example:

PA BBO BB-H&F-D-05 Z



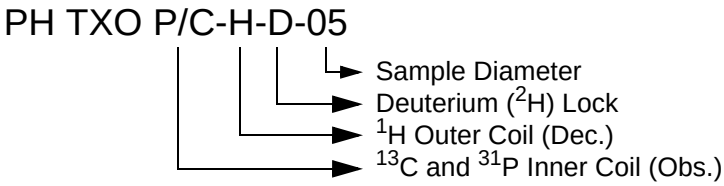
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path BB	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	-
	HPPR/2 XBB19F 2HS MODULE 300-400 	0-31P-LP (19F-3H)[a] 
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass/19F-Stop
	HPPR/2 1H MODULE 200-250 	19F decoupling not possible
	AQS 1H2H PREAMP 300-400 	19F decoupling not possible
	HPPR/2 1H2H MODULE 300-400 	19F decoupling not possible
	HPPR/2 1H LNA MODULE 500-900 	19F decoupling not possible

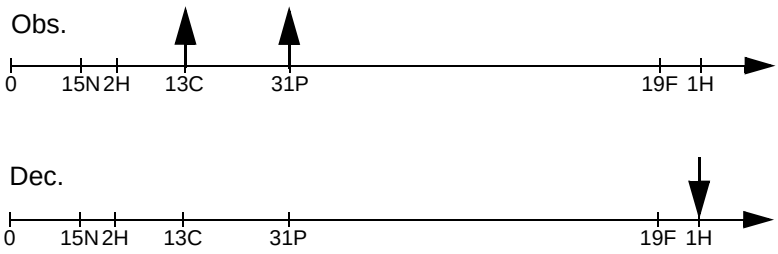
Table 4.24 Required Filters for PH BBO BB-H&F (Valid for Standard-, and SmartProbes)

a. Lowpass only required in combination with HPLNA 1H

4.15 TXO (Triple X-Nuclei Observe)

Example:





Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path X	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	X-Pass / Y-Stop 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	X-Pass / Y-Stop 
	AQS XBB19F 2HS PREAMP 300-400 	X-Pass / Y-Stop 
	HPPR/2 XBB19F 2HS MODULE 300-400 	X-Pass / Y-Stop 
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass /19F-Stop[a] 
	HPPR/2 1H MODULE 200-250 	-
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	-
Decoupling Path Y	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	Y-Pass / X-Stop 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	Y-Pass / X-Stop 
	AQS XBB19F 2HS PREAMP 300-400 	Y-Pass / X-Stop 
	HPPR/2 XBB19F 2HS MODULE 300-400 	Y-Pass / X-Stop 

Table 4.25 Required Filters for PH TXO X/Y-H-D (without 19F)

a. This filter is only requred in configurations with a XBB19F 2HS preamplifier (without any additonal low-pass filter)

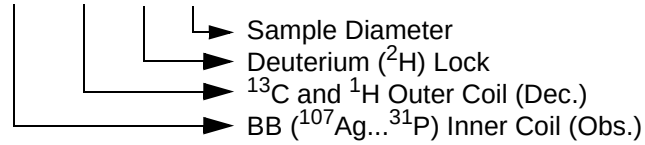
Channel (Obs/Dec)	Preamplifier Module Type	Required Filters
Observe Path 19F	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	19F-Bandpass 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-not possible 
	AQS XBB19F 2HS PREAMP 300-400 	19F-Bandpass 
	HPPR/2 XBB19F 2HS MODULE 300-400 	19F-Bandpass 
Decoupling Path 1H	HPPR/2 1H HPLNA MODULE 200-1000 	1H-Pass / 19F-Stop 
	HPPR/2 1H MODULE 200-250 	1H-Pass / 19F-Stop 
	AQS 1H2H PREAMP 300-400 	-
	HPPR/2 1H2H MODULE 300-400 	-
	HPPR/2 1H LNA MODULE 500-900 	1H-Pass / 19F-Stop 
Decoupling Path Y	HPPR/2 XBB19F 2HS MODULE 200-250, 500-700 	0-31P-LP (19F-3H) 
	HPPR/2 XBB31P 2HS MODULE 750-1000 	-
	AQS XBB19F 2HS PREAMP 300-400 	0-31P-LP (19F-3H) 
	HPPR/2 XBB19F 2HS MODULE 300-400 	0-31P-LP (19F-3H) 

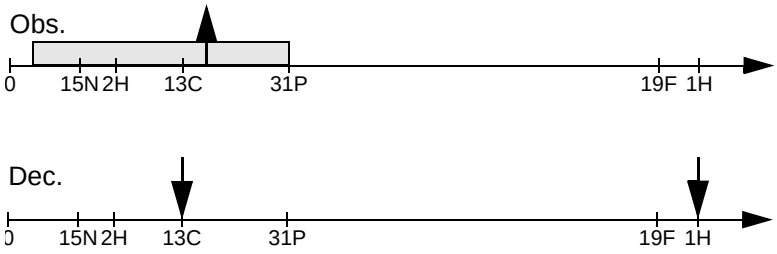
Table 4.26 Required Filters for PH TXO F/Y-H-D (with X=19F)

4.16 TBO (Triple Broad Band Observe)

Example:

PH TBO BB-H/C-D-05





Required Filters:

Please contact the nearest Bruker head office for TBO filter requirements.

5 Available Filters, February 2012

Z002054	FILTER BIOSPEC-200 1H+19F PASS
Z13381	FILTER 200 1H-BANDPASS
Z13281	FILTER 200 1H-PASS / 19F-STOP
Z00114	FILTER 200 2H STOP
Z107721	FILTER 200 2H-LP(13C)
Z13327	FILTER 200 0-31P,19F-LP (1H)
Z14329	FILTER 200 0-31P-LP (19F-3H)
Z13088	FILTER 200 11B-PASS / 13C-STOP
Z41000	FILTER 200 11B-PASS / 31P-STOP
Z13087	FILTER 200 13C-PASS / 11B-STOP
Z13083	FILTER 200 13C-PASS / 2H-STOP
Z6842	FILTER 200 13C-PASS / 31P-STOP
Z13908	FILTER 200 19F-BANDPASS
Z12967	FILTER 200 23NA-PASS /31P-STOP
Z13015	FILTER 200 27AL-PASS /31P-STOP
Z41001	FILTER 200 31P-PASS / 11B-STOP
Z6843	FILTER 200 31P-PASS / 13C-STOP
Z12968	FILTER 200 31P-PASS /23NA-STOP

Z13382	FILTER 250 1H-BANDPASS
Z13279	FILTER 250 1H-PASS / 19F-STOP
Z00115	FILTER 250 2H STOP
Z13439	FILTER 250 3H-PASS / 1H-STOP
Z13328	FILTER 250 0-31P,19F-LP (1H)
Z14330	FILTER 250 0-31P-LP (19F-3H)
Z12810	FILTER 250 103RH-PASS/31P-STOP
Z9146	FILTER 250 13C-PASS / 2H-STOP
Z6818	FILTER 250 13C-PASS / 31P-STOP
Z13375	FILTER 250 14N-PASS/195PT-STOP
Z42386	FILTER 250 15N-PASS / 2H-STOP
Z13376	FILTER 250 195PT-PASS/14N-STOP
Z13902	FILTER 250 19F-BANDPASS

Z110651 FILTER 250 1H-HP(0-13C)
Z9774 FILTER 250 205TL-PASS/ 1H-STOP
Z6819 FILTER 250 31P-PASS / 13C-STOP
Z12811 FILTER 250 31P-PASS/103RH-STOP

Z002084 FILTER BIOSPEC-300 1H+19F PASS
Z13383 FILTER 300 1H-BANDPASS
Z13763 FILTER 300 1H-LP (3H)
Z13270 FILTER 300 1H-PASS / 19F-STOP
Z00116 FILTER 300 2H STOP
Z9327 FILTER 300 2H-PASS / 13C-STOP
Z9330 FILTER 300 2H-PASS / 15N-STOP
Z7781 FILTER 300 2H-PASS / 19F-STOP
Z13764 FILTER 300 3H-HP (1H)
Z13329 FILTER 300 0-31P,19F-LP (1H)
Z14331 FILTER 300 0-31P-LP (19F-3H)
Z100288 FILTER 300 0-195PT-LP(13C)
Z13029 FILTER 300 119SN-P 13C-29SI-ST
Z8742 FILTER 300 119SN-PASS/31P-STOP
Z9229 FILTER 300 11B-PASS / 31P-STOP
Z13972 FILTER 300 13C-BP (0-SI,11B-H)
Z9328 FILTER 300 13C-PASS / 2H-STOP
Z12853 FILTER 300 13C-PASS / 14N-STOP
Z8955 FILTER 300 13C-PASS / 15N-STOP
Z6845 FILTER 300 13C-PASS / 31P-STOP
Z9329 FILTER 300 15N-PASS / 2H-STOP
Z8954 FILTER 300 15N-PASS / 13C-STOP
Z13773 FILTER 300 19F-BANDPASS
Z42428 FILTER 300 27A-PASS / 31P-STOP
Z15174 FILTER 300 31P-BP(0-11B,19F-H)
Z9228 FILTER 300 31P-PASS / 11B-STOP
Z6844 FILTER 300 31P-PASS / 13C-STOP
Z42427 FILTER 300 31P-PASS / 27A-STOP
Z8741 FILTER 300 31P-PASS /119S-STOP
Z13373 FILTER 300 31P-PASS/195PT-STOP
Z9244 FILTER 300 6LI-PASS / 2H-STOP

Z7779	FILTER 300 6LI-PASS / 15N-STOP
Z102690	FILTER 300 7LI - 1H-HP (13C)

Z13385	FILTER 400 1H-BANDPASS
Z13271	FILTER 400 1H-PASS / 19F-STOP
Z103107	FILTER 400 1H-LP (3H)
Z6850	FILTER 400 1H-PASS/205TL-STOP
Z00118	FILTER 400 2H STOP
Z9032	FILTER 400 2H-PASS / 13C-STOP
Z9093	FILTER 400 2H-PASS / 15N-STOP
Z12805	FILTER 400 2H-PASS / 171YB-ST
Z5785	FILTER 400 2H-PASS / 31P-STOP
Z14181	FILTER 400 3H-HP (1H)
Z104117	FILTER 400 0-13C LP (119SN)
Z13331	FILTER 400 0-31P,19F-LP (1H)
Z14333	FILTER 400 0-31P-LP (19F-3H)
Z13148	FILTER 400 10B-PASS / 11B-STOP
Z104116	FILTER 400 119SN BP(0-24NA,19F-1H)
Z14324	FILTER 400 11B-BP (0-23NA,P-H)
Z13149	FILTER 400 11B-PASS / 10B-STOP
Z14107	FILTER 400 13C-BP (0-SI,11B-H)
Z9095	FILTER 400 13C-PASS / 2H-STOP
Z13432	FILTER 400 13C-PASS / 11B-STOP
Z8831	FILTER 400 13C-PASS / 15N-STOP
Z107715	FILTER 400 13C-LP(31P)
Z107713	FILTER 400 15N-NR(2H,F-H)
Z8832	FILTER 400 15N-PASS / 13C-STOP
Z12806	FILTER 400 171YB-PASS / 2H-STO
Z104194	FILTER 400 19F-1H HP(0-31P)
Z13774	FILTER 400 19F-BANDPASS
Z14180	FILTER 400 1H-LP (3H)
Z6849	FILTER 400 205TL-PASS/ 1H-STOP
Z13202	FILTER 400 23NA-PASS /31P-STOP
Z13322	FILTER 400 27AL-PASS /31P-STOP
Z15309	FILTER 400 29SI-BP(0-2H,13C-H)
Z13976	FILTER 400 31P-BP(0-11B,19F-H)

Z6840 FILTER 400 31P-PASS / 13C-STOP
Z13323 FILTER 400 31P-PASS /27AL-STOP
Z7785 FILTER 400 57FE PASS / 1H-STOP
Z42408 FILTER 400 6LI-PASS / 2H-STOP

Z13794 FILTER 500 1H-LP (3H)
Z13272 FILTER 500 1H-PASS / 19F-STOP
Z00119 FILTER 500 2H STOP
Z9031 FILTER 500 2H-PASS / 13C-STOP
Z9033 FILTER 500 2H-PASS / 15N-STOP
Z4637 FILTER 500 2H-PASS / 31P-STOP
Z13795 FILTER 500 3H-HP (1H)
Z102949 FILTER 500 0-13C LP (119SN)
Z13332 FILTER 500 0-31P,19F-LP (1H)
Z14334 FILTER 500 0-31P-LP (19F-3H)
Z14299 FILTER 500 117SN-LP (119SN)
Z14300 FILTER 500 119SN-HP (117SN)
Z13114 FILTER 500 11B-PASS / 13C-STOP
Z14067 FILTER 500 13C-BP (0-SI,11B-H)
Z8917 FILTER 500 13C-PASS / 2H-STOP
Z13113 FILTER 500 13C-PASS / 11B-STOP
Z8745 FILTER 500 13C-PASS / 15N-STOP
Z107716 FILTER 500 13C-LP(31P)
Z42638 FILTER 500 13C-PASS /203TL-STP
Z8916 FILTER 500 15N-NR(2H,F-H)
Z8744 FILTER 500 15N-PASS / 13C-STOP
Z13597 FILTER 500 19F-BANDPASS
Z12866 FILTER 500 19F-PASS / 31P-STOP
Z13346 FILTER 500 19F-PASS /205TL-STP
Z42639 FILTER 500 203T-PASS / 13C-STP
Z13345 FILTER 500 205TL-PASS /19F-STP
Z104159 FILTER 500 31P-1H HP(13C)
Z14071 FILTER 500 31P-BP(0-11B,19F-H)
Z14973 FILTER 500 31P-HP (2H)
Z6808 FILTER 500 31P-PASS / 13C-STOP
Z13145 FILTER 500 31P-PASS/29SI-STOP

Z118480 FILTER 500 57FE-NR(2H-1H)
Z13697 FILTER 500 6LI-PASS / 2H-STOP

Z14042 FILTER 600 1H-LP (3H)
Z13273 FILTER 600 1H-PASS / 19F-STOP
Z6685 FILTER 600 2H STOP
Z9087 FILTER 600 2H-PASS / 13C-STOP
Z9089 FILTER 600 2H-PASS / 15N-STOP
Z8753 FILTER 600 2H-PASS / 19F-STOP
Z14260 FILTER 600 3H-HP (1H)
Z105097 FILTER 600 6Li-LP (2H)
Z13333 FILTER 600 0-31P,19F-LP (1H)
Z14335 FILTER 600 0-31P-LP (19F-3H)
Z100315 FILTER 600 101RU-LP (15N-H)
Z14631 FILTER 600 13C-BP(0-SI,11B-H)
Z9086 FILTER 600 13C-PASS / 2H-STOP
Z4132 FILTER 600 13C-PASS / 15N-STOP
Z107714 FILTER 600 13C-LP(31P)
Z9088 FILTER 600 15N-NR(2H,F-H)
Z4131 FILTER 600 15N-PASS / 13C-STOP
Z13904 FILTER 600 19F-BANDPASS
Z14632 FILTER 600 31P-BP(0-11B,19F-H)
Z15088 FILTER 600 31P-HP (2H)
Z6900 FILTER 600 31P-PASS / 13C-STOP

Z13900 FILTER 700 1H-BANDPASS
Z14841 FILTER 700 0-13C-LP (31P)
Z13501 FILTER 700 0-31P-LP (19F-3H)
Z14711 FILTER 700 13C-1H-HP(15N)
Z15283 FILTER 700 13C-BP (0-29SI,P-H)
Z13500 FILTER 700 13C-PASS / 2H-STOP
Z13498 FILTER 700 15N-NR(2H,F-H)
Z13905 FILTER 700 19F-BANDPASS
Z14993 FILTER 700 19F-BP (0-31P,1H)
Z14842 FILTER 700 31P-1H-HP (2H)
Z15105 FILTER 700 31P-BP(0-11B,19F-H)

Z112898 FILTER 750 1H-BP (0-31P,3H)
Z12935 FILTER 750 2H STOP
Z13099 FILTER 750 2H-PASS / 15N-STOP
Z112897 FILTER 750 3H-BP (0-31P,1H)
Z14336 FILTER 750 0-31P-LP (19F-3H)
Z14216 FILTER 750 13C-BP (0-29SI,P-H)
Z41122 FILTER 750 13C-PASS / 2H-STOP
Z12864 FILTER 750 13C-PASS / 15N-STOP
Z12812 FILTER 750 13C-PASS / 31P-STOP
Z41123 FILTER 750 15N-NR(2H,F-H)
Z12865 FILTER 750 15N-PASS / 13C-STOP
Z13906 FILTER 750 19F-BANDPASS
Z15033 FILTER 750 31P-1H HP(2H)
Z12813 FILTER 750 31P-PASS / 13C-STOP

Z7839 FILTER 800 2H-PASS / 15N-STOP
Z13936 FILTER 800 0-13C LP (31P)
Z13937 FILTER 800 0-31P-LP (19F-3H)
Z103187 FILTER 800 13C-BP(0-Si,11B-H)
Z7837 FILTER 800 13C-PASS / 2H-STOP
Z7838 FILTER 800 15N-NR(2H,F-H)
Z13909 FILTER 800 19F-BANDPASS
Z13288 FILTER 800 1H-BP (0-31P,19F)
Z13938 FILTER 800 31P-1H HP (2H)
Z103105 FILTER 800 31P-BP(0-11B, 19F-1H)

Z122536 FILTER 850 1H-BP (0-31P,19F)
Z117428 FILTER 850 13C-BP(0-Si,11B-H)
Z117430 FILTER 850 15N-NR(2H,F-H)
Z122535 FILTER 850 19F-BP (0-31P,1H)
Z117429 FILTER 850 31P-BP(0-11B,19F-1H)
Z104178 FILTER 850 0-31P-LP (19F-3H)

Z13901 FILTER 900 1H-BANDPASS
Z14645 FILTER 900 0-13C-LP (31P)

Z14123 FILTER 900 0-31P-LP (19F-3H)

Z13550 FILTER 900 13C-1H-HP (2H)

Z13551 FILTER 900 15N-NR(2H,F-H)

Z13907 FILTER 900 19F-BANDPASS

Z103107 FILTER 900 31P-BP(0-11B, 19F-1H)

Z106115 FILTER 950 0-31P-LP (19F-3H)

Z106131 FILTER 950 13C-1H-HP (2H)

Z106130 FILTER 950 15N-NR(2H,F-H)

Z109597 FILTER 1000 0-31P-LP (19F-3H)

Z109596 FILTER 1000 13C-1H-HP (2H)

Z109595 FILTER 1000 15N-NR(2H,F-H)

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Appendix

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