HPPR/2

Technical Manual

Version 003

Bruker BioSpin

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Figure 1.1. HPPR/2 Standard Configuration with QNP Module

Overview *1.2*

The High Performance Preamplifier version 2 (hereafter referred as HPPR/2) consists, in the basic configuration, of a 1H module, a X-BB module, a 2H module and a Cover/Display module. The basic configuration may later be updated to a maximum of nine modules or even more with two HPPR/2 assemblies.

The preamplifier modules contain a Transmitter/Receiver switch including necessary high performance filters in the transmitter and probehead paths, a rf preamplifier and an interface logic including a power supply and BIS (Bruker Information System). All preamplifier modules are ‘Fourier capable’.

The display indicates on a LCD the operating status of the HPPR/2, eg. what kind of modules are connected, what are there operating modes (observe, lock, wobble, decouple) and other information.

The status LEDs “ERROR”, “READY”, “SLEEP” and “COM” indicate the current state of the Cover module. The “COM” LED shows real data communication with the HPPR/2. When the “SLEEP” LED is on, the microcontroller and oscillator in the Cover module are switched off. This power down state is activated by the console during the acquisition phase, thus the Cover Module is not able to disturbe the measurement.

The T-junction LEDs indicate during operation of the wobble mode the accuracy of probehead tuning and matching and whether this must be corrected.

The individual modules, the power transmitter and the probehead are connected with N-plugs and shielded cables. The BNC cable for the receiver signal leads from the rear Cover/Display unit to the FT and lock receiver in the console. A 36 wire MDR cable supplies all DC voltages for a maxium of three preamplifier modules. The cable also contains the required real time pulses (RGP_PA, LOCK_PP, INTERLEAVE_INCR) and a SBS-Bus (tty10) for command and data transfer between the console and the HPPR/2.

If there are used more than three preamplifier modules an additional power supply cable is needed.

Features *1.3*

Same RF technology as the classic HPPR

Ease of operation

Self configuration

Multiple HPPR/2 configuration, up to 2 HPPR/2

Modular arrangement, up to 9 modules per HPPR/2, even identical ones

Enhanced noise immunity (also Cover Module)

Enhanced display informations

Integration of external functional modules as ATMA, Cryoprobe and QNP

Installation 1.4

Connection Preamplifier/QNP Modules 1.4.1

Figure 1.2. Right/ Wrong Module Connection

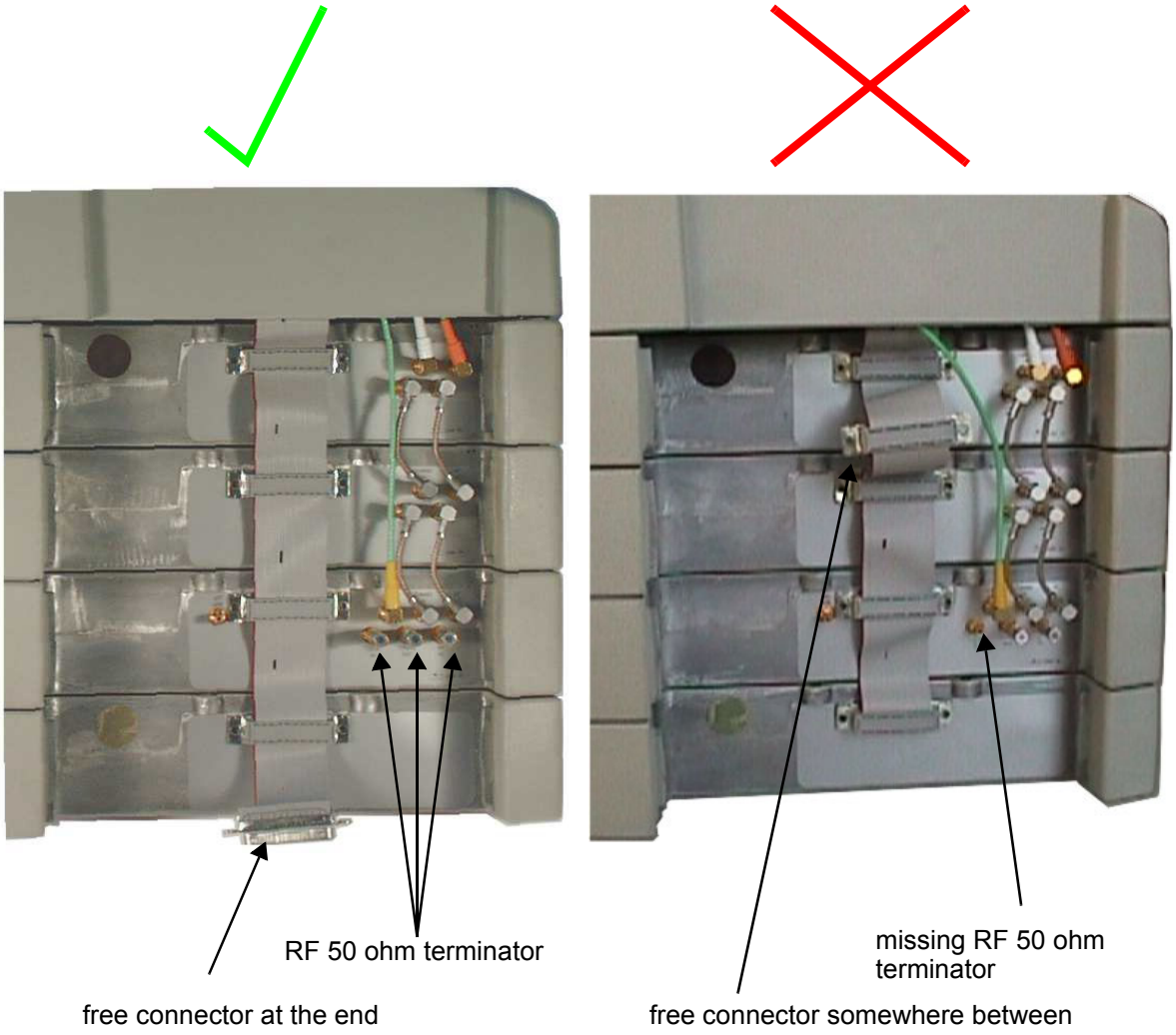
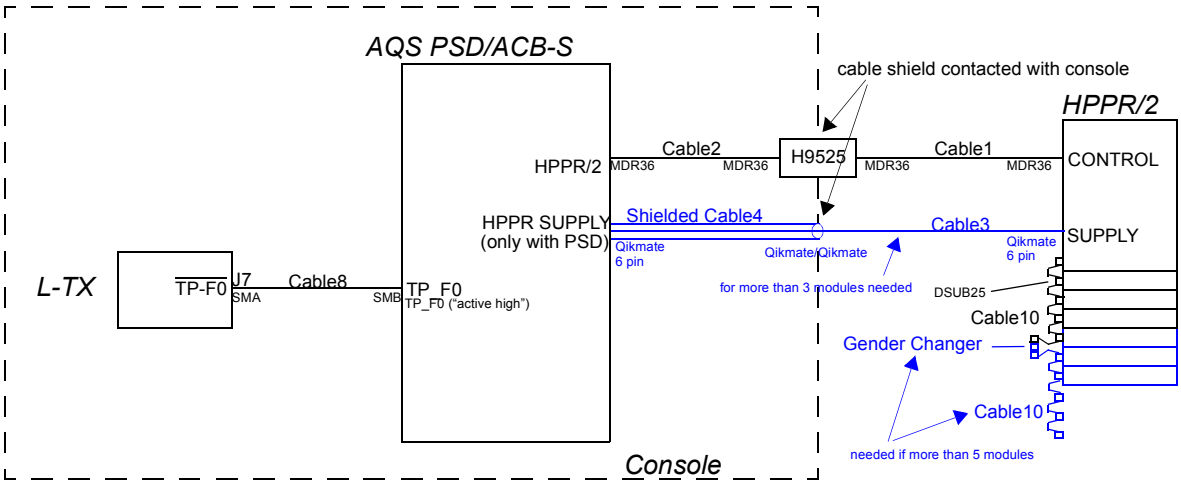


Figure 1.3. Overview DC Wiring Standard and extended

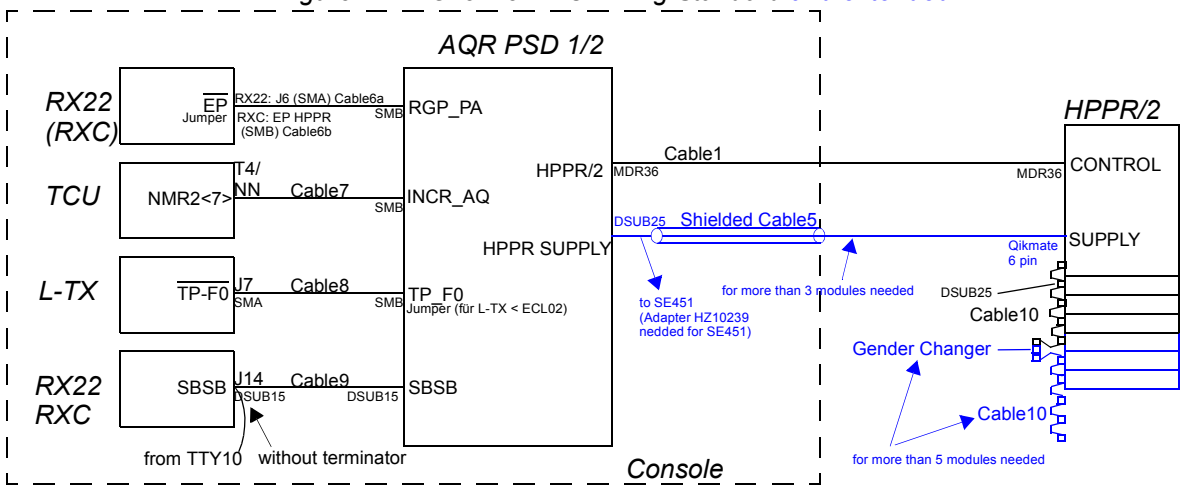


Remark:

- The Extended version (more than three preamplifier modules) is only possible in conjunction with a AQS PSD board, because there is no supply plug (6 pin Qikmate plug) on the ACB-S board.
- The polarity of TP_F0 cannot be configured on the AQS PSD/ACB-S board. Since it is adjusted to "active high", all L-TX can be operated.

DC-Wiring DRX, DPX and DMX with RXC or RX22 1.5.2

Figure 1.4. Overview DC Wiring Standard and extended



Remarks:

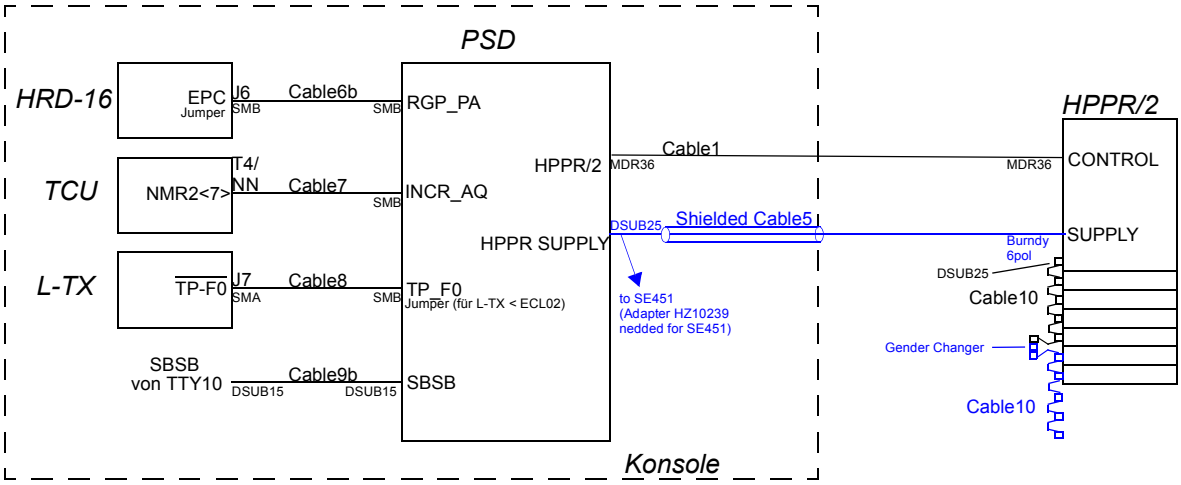
- The AQR PSD basically expects low active pulses (RGP_PA, INCR_AQ, TP_F0). Therefore it can only be operated with RXC starting from ECL01.
- The default setting for the TP_F0 pulse is set to “high active” in all BSMS L-TX boards and set to “low active” in all AQR PSD boards.
  With BSMS L-TX ECL02 and later, the TP_F0 pulse polarity can be set using the BSMS Service Tool. With AQR PSD the TP_F0 pulse polarity can be set with the jumper JU1.
  Therefore the TP_F0 polarity has to be set to “high active” on the AQR PSD board or has to be changed to “low active” on the BSMS L-TX board (only possible with BSMS L-TX ECL02 and later).
- It is an AQR PSD needed (1 or 2 depending on AQR type ,AQR PSD/1 for AQR Chassis and AQR PSD/2 for AQR/P Chassis) with ECL01 or later.
- The cableset H9714 contains all the necessary cables For an upgrade of a DRX, DMX, or DPX to HPPR/2.
- The cableset H9714/1 contains all the necessary cables For an upgrade of a DRX or DMX with RXC (and SE451) to HPPR/2.
- For more than 5modules, the HPPR+9V fuse on the AQR (PSB1) must be increased to 2.5A (Part no. 2255).

Tuning with DRX, DPX and DMX 1.5.3

The tuning signal from a DRX or DPX console is too strong for the HPPR/2. To prevent saturation a 10dB attenuator must be fixed at the HPPR/2 tuning signal input. The attenuator (part no. 90289) is part of the cable set AQR-HPPR/2 RX22 (H9714). For a DMX console with SE451 a 13dB attenuator (85435) is necessary which is part of H9714 var1.

DC-Wiring DMX with HRD-16 1.5.4

Figur 1.5. Overview DC Wiring Standard and Extended



- The cableset H9714/2 contains all the necessary cables For an upgrade of a DRX or DMX with HRD-16 to HPPR/2.

Accessories 1.5.5

Figure 1.6. Overview Cable Accessories for HPPR/2 DC Wiring

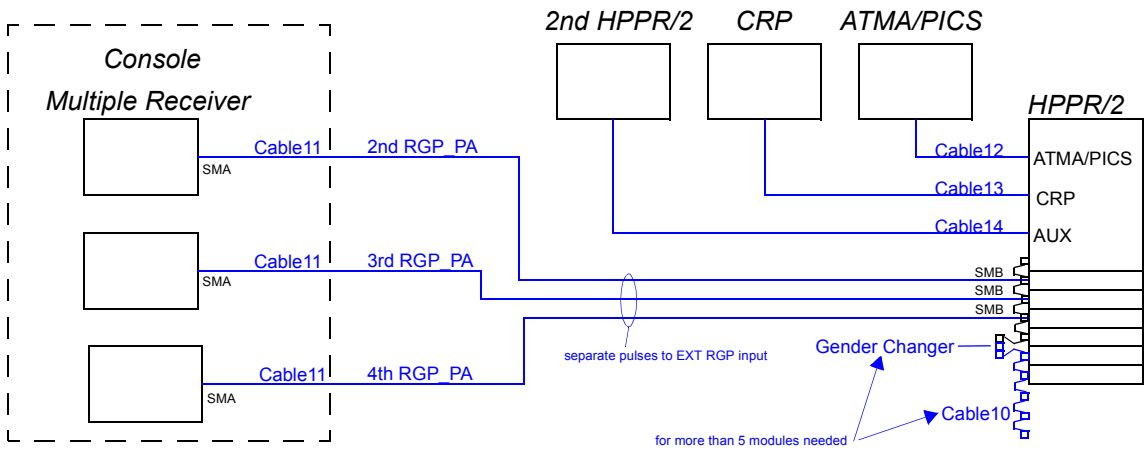


Table 1.1. Cable List

Id	P/N	Len	Description
Cable1	HZ10174	7m	IEEE1284 C-C (MDR 36 pin 1:1), AWG28
Cable2	HZ10175	2m	IEEE1284 C-C (MDR 36 pin 1:1), AWG28
Cable3	HZ10110/A	7m	Qikmate 6 pin / Qikmate 6 pin, shielded, 1.5mm2
Cable4	HZ10109/A	1m	Qikmate 6 pin / Qikmate 6 pin, shielded, 1.5mm2
Cable5	HZ10197	8.5m	Qikmate 6 pin / DSUB25, shielded, 1.5mm2
Cable6a	HZ10195	1.5m	RG316 or RG178, SMA/SMB (for RX22)
Cable6b	HZ10193	1.5m	RG316 or RG178, SMB/SMB (for RXC)
Cable7	HZ10196	2.2m	RG316 or RG178, BY /SMB
Cable8	HZ10194	2.2m	RG316 or RG178, SMA/SMB
Cable9a	HZ04459	0.45m	DSUB25m/DSUB25f, shielded, 1:1
Cable9b	HZ04460	2m	DSUB25m/DSUB25f, shielded, 1:1
Cable10	Z14091	0.29m	CABLE FLK 25P Preamp-Bus
Cable11	tbd	7.5m	RG316 or RG178, SMA/SMB
Cable12	Z14361	2.2m	CABLE RD 5P HPPR/2 <-> ATMA/PICS
Cable13	Z14362	1.8m	CABLE RD 10P HPPR/2 <-> CRP
Cable14	tbd	1.5m	RJ45 Kabel 1:1, shielded

Table 1.2. Various Parts

Id	P/N	Description
Gender Changer	47020	GENDER CHANGER M/M 25 POL
Adapter for SE451	HZ10239	CABLE 25P ADAP AQR PSD HPPR/2

Abbreviations *1.6*

ATMA	Automatic Tuning and Matching Accessory
BIS	Bruker Information System
CRP	Cryo Probe
HPPR/2	High Performance Preamplifier version 2
IFB	HPPR/2 Interface Board (interface from the module to the Preamp-Bus)
INCR_AQ	see INTERLEAVE_INCR
INTERLEAVE_INCR	Interleave Increment Pulse
I2C	I2C bus (two wire single master bus)
PLD	Programmable Logic Device
LCD	Liquid Crystal Display
LOCK_PP	Lock Protection Pulse
MDR	Mini Delta Ribbon connector (e.g. from 3M)
PICS	Probehead Identification System
QNP	Quadro Nucleus Probe
RGP_HPPR	Receiver Gating Pulse for HPPR
RGP_PA	see RGP_HPPR
SBSB	Serial Bruker Spectrospin Bus (RS485 Bus)
TP_F0	see LOCK_PP

Cover Module 2

Top Side 2.1

Figure 2.1. Cover Module top view

LED Description *2.1.1*

The LEDs indicate the current state of the HPPR/2 and the tuning/matching information from the probehead (see also ***2.5.4***).

Table 2.1. LED description

Label	Description
MATCHING LED TUNING LED	This display only becomes active when the HPPR/2 is in Tuning/Matching mode and indicates the quality of the Tuning/Matching balance.
ERROR LED	Monitors HPPR/2 error state.
READY LED	Monitors microcontroller ready state.
SLEEP LED	Monitors microcontroller power down state.
COM LED	Monitors HPPR/2 communication on SBS or AUX bus.

LCD and KEY Description *2.1.2*

Table 2.2. LCD and KEY description

Label	Description
LCD	The LCD is used to show user menus and some other useful information (e.g. module list, tuning/matching channel, error message).
KEY ***[F1]*** ... ***[F3]***	This keys are used to navigate in menu and to execute user functions. Key function during menu handling: ***[F1]*** : scroll clockwise through the menu. (see figure ...) ***[F2]*** : scroll counter clockwise through the menu. ***[F3]*** : select this menu (***'ok'***).
KEY ***[F4]***	Pressing this key always quits the current menu or function. *NOTE*: Pressing ***[F1]*** and ***[F4]*** simultaneously will always result in returning to the idle menu.

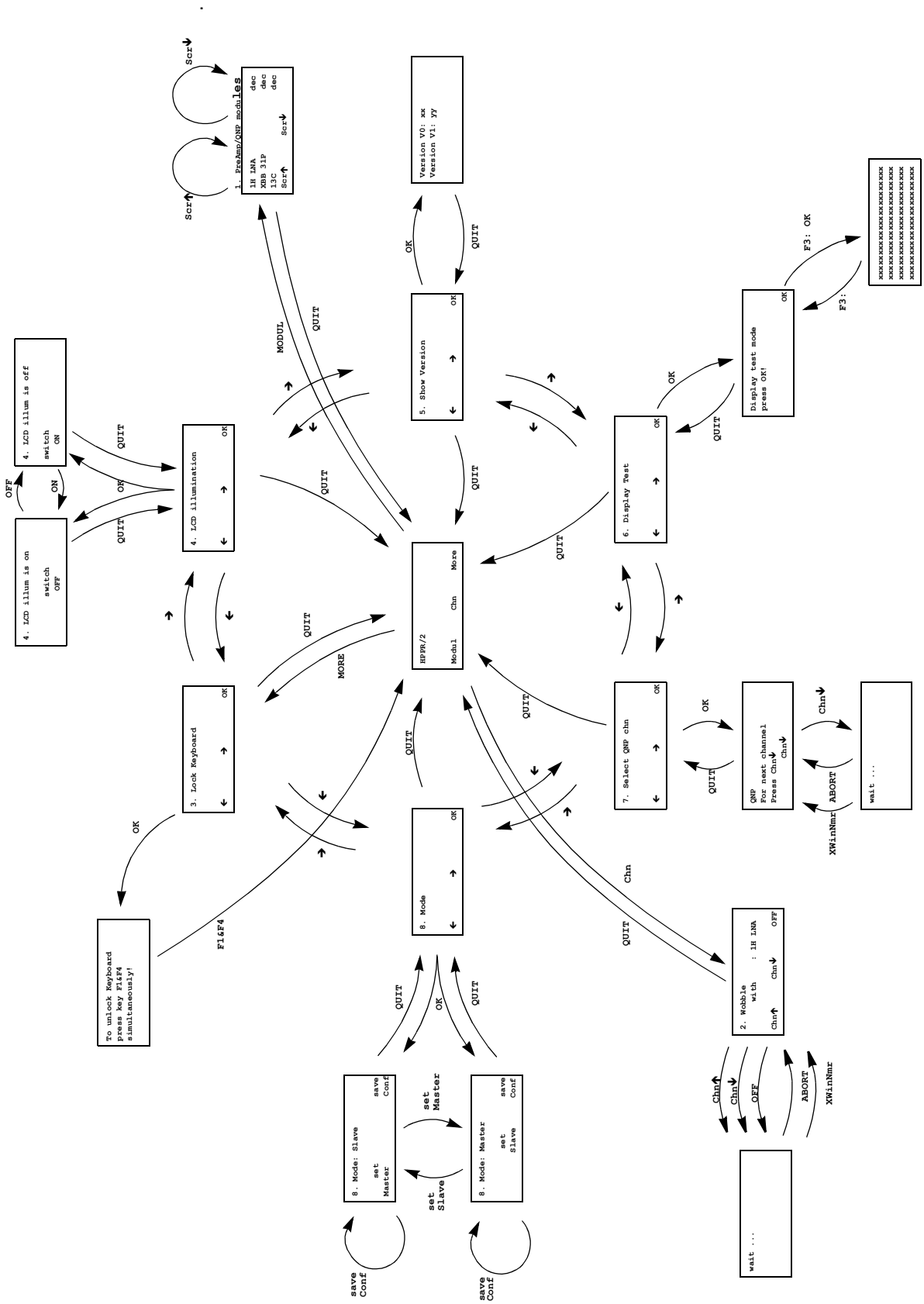
Menu mode *2.1.3*

Notation

Expressions in quotation marks and in bold italic letters (e.g., ***'4. LCD illumination'***) represent what is shown on the HPPR/2 display. Expressions in square brackets and in bold capital italic letters (e.g., ***[F1]***) indicate keys.

General

The menu mode of the HPPR/2 gives a direct access to different HPPR/2 functions.


HPPR/2
Modul
Chn
More
1. PreAmp/QNP modules
1H LNA
XBB 31P
13C
Scr
dec
4. LCD illum is on
switch
OFF
4. LCD illum is off
switch
ON
4. LCD illumination
3. Lock Keyboard
To unlock Keyboard
press key F1&F4
simultaneously!
5. Show Version
Version V0: xx
Version V1: yy
6. Display Test
Display test mode
press OK!
F3: OK
F3:
7. Select QNP chn
QNP
For next channel
Press Chn
wait ...
8. Mode
8. Mode: Slave
set
Master
save
Conf
8. Mode: Master
set
Slave
2. Wobble
with
Chn
OFF
ABORT
XWinNmr
OK
QUIT
MODUL
MORE
F1&F4
ON
OFF
Scr
save
Conf
set
Master
set
Slave

The menu navigation works very easy and is similar to other already known user interfaces like the BSMS keyboard. Therefore it won't be further explained than in ***Table 2.2.***

The main menu is composed of the following submenus: ***'1. MODUL'*** (list of all preamp modules), ***'2. CHN'*** (Channel) and ***'MORE'***. 'More' is sub-divided into six further menu points: ***'3. Lock Keyboard'*** , ***'4. LCD illumination'*** , ***'5. Show Version'*** , ***'6. Display Test'*** , ***'7. Select QNP chn'*** , ***'8. Mode'***.

Each of these submenus has several functions, which are described below for HPPR firmware version "AE" or later (file: e.g. hpprag.hex).

Menu Description *2.1.4*

Idle Menu

After power-up and confirming 'power fail' the HPPR/2 display shows the idle menu.

Pressing ***[F1]*** or ***[F2]*** leads directly to the menu function ***"'1. MODUL'"*** or ***"'2. CHN'"***. Pressing ***[F3] 'MORE'*** leads to further menu points (3 ... 8).

*'1. **MODUL'***

This function lists all preamp modules and their actual states actually connected to the current HPPR/2 . The following states are possible:

Table 2.3. Module state

state	Description
'dec'	Decouple mode (default), module is not used for observe or lock and is therefore always protected from transmitting pulses.
'obs'	Observe mode, this module is used as observe channel. The protection of the module is dependent on the real time pulse "RGP_HPPR".
'lock'	Lock mode, this module is used as lock channel. The protection of the module is dependent on the real time pulse "LOCK_PP".
'wobb'	Tuning/Matching mode, this channel can be tuned and matched.
'crp ...'	Cryo probe mode, can be combined with all states decribed above (dec, obs, lock or wobb).
'pwr err'	Power error, a power error has occured on this module. Check the connection to the module and the preamplifier module itself.
'stop'	Emergency stop, an emergency stop signal has occurred on this module.

*'2. **CHN'***

This menu point shows the current wobble channel if available. It allows to change the channel for Tuning/Matching.

'MORE'

This menu point leads to the following menu points:

'3. Lock Keyboard'

Entering this function locks the keys on the HPPR/2 display (useful during a long experiment). ***'To unlock press key F1&F4 simultaneously'*** appears on the display and all other key-compinations are disabled. To exit this mode, press ***[F1]*** and ***[F4]*** simultaneously.

'4. LCD Illumination"

Enables the user to switch on or off the LCD illumination. After power-up the illumination is always switched on.

'5. Show Version'

'V0 = ...' shows the current hardware version of the Preamplifier Control Board. This is the control board with the microcontroller (see ***2.3.1***) which is a part of the Cover Module.

'V1 = ...' shows the current hardware version of the Display Board which is another part of the Cover Module.

'6. Display Test'

Tests the LCD and all LED's.

'7. Select QNP channel'

Allows to change the QNP channel if QNP module is connected.

'8. Mode'

The current HPPR/2 Mode is shown: Master or Slave. Master Mode is the default setting from the factory. The other mode can be set with ***[F2] 'set ...'*** and saved with ***[F3] 'save Conf'***. Saving the Mode will take a few seconds.

In standard configuration (one HPPR/2) the HPPR/2 has always to be set in master mode. In configuration with two HPPR/2 only the master HPPR/2 has to be set in master mode. The other/second HPPR/2 has to be set in slave mode.

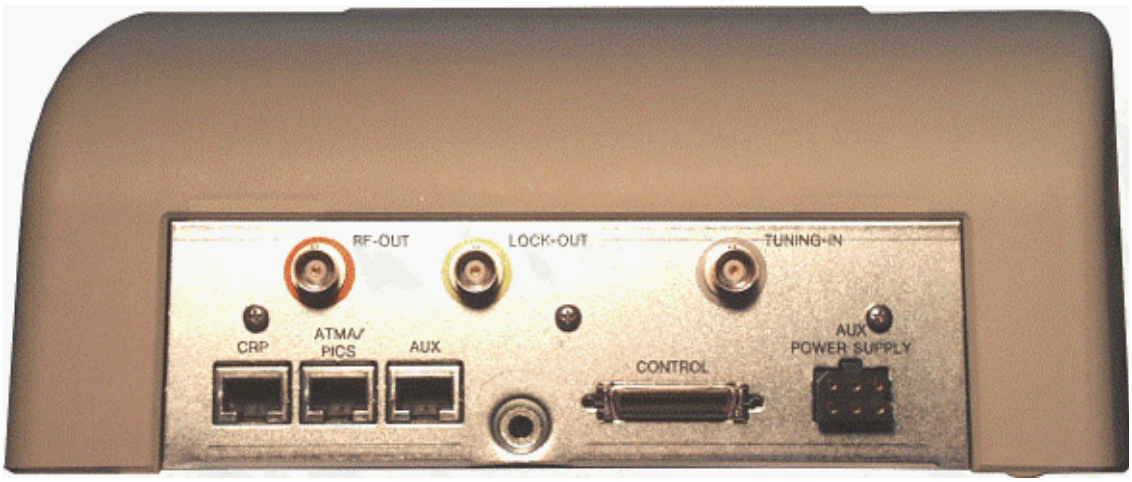
After changing the mode, the new configuration has to be saved with the function ***'save Conf'***. After that the HPPR/2 has to be re-initalized (power-up or init command with unitool). From now on the HPPR/2 is working in the selected mode.

'save Conf' saves the configuration to the FLASH PROM in the HPPR/2 Cover Module.

The HPPR/2 mode can also be set by unitool. Note that the unitool address will change when changing the mode. Therefore unitool has to be restarted with the new address.

Rear Side 2.2

Figure 2.2. Cover Module rear view



Connector Rear Side 2.2.1

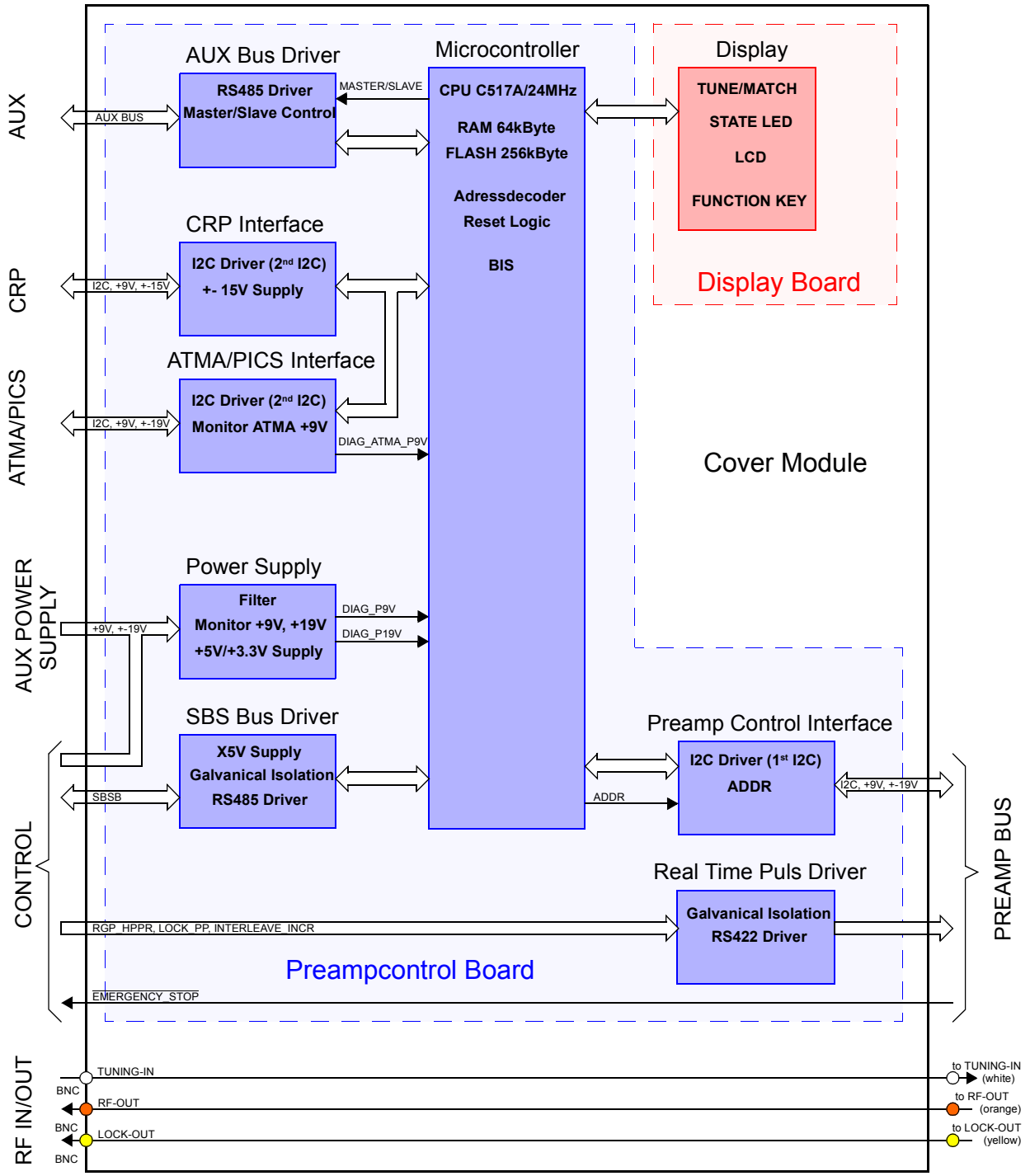
Table 2.4. Connectors on the rear side

Label	Connector Type	Description
CONTROL	MDR 36 pin	Control signals (SBSB, real time pulses, emergency stop) and power supply for three preamplifier modules.
AUX POWER SUPPLY	Qikmate 6 pin	Auxiliary power supply for more than three preamplifier modules.
CRP	RJ45	Connection to Cryo Probe.
ATMA/PICS	RJ45	Connection to ATMA or PICS.
AUX	RJ45	Auxiliary connection to another HPPR/2.

Functionality 2.3

Topology 2.3.1

Figure 2.3. HPPR/2 Cover Module Blockdiagram



Busses 2.3.2

Each HPPR/2 Cover Module has 4 independent busses :

- SBSB, controlling HPPR/2 in master mode
- AUX bus, controlling HPPR/2 in slave mode
- I2C bus 1, controlling external devices as ATMA/PICS and CRP
- I2C bus 2, controlling internal devices (preamplifier modules, QNP Module)

Power Supply and Monitoring 2.3.3

All voltages supplied from the console are filtered on the HPPR/2 Cover Module.

The HPPR/2 Cover Module with ECL 01 or later is monitoring the +19V, +9V and ATMA/PICS +9V. In following case the HPPR/2 will display an error message:

Table 2.5. Power Supply Error Cause

Error Cause	Error Code	Description
+9V < 7.8V or +19V < 17.8V	90	The power supply +9V or +19V is too low. Check the power supply in the console (AQR or AQS) and use a special power supply cable to HPPR/2.
+9V > 10V or +19V > 20.5V	91	The power supply +9V or +19V is too high. Check the power supply in the console (AQR or AQS).
ATMA +9V < 7.6V	93	The connected ATMA or PICS might be defect or there is a wrong device connected to the ATMA/PICS connector.

Fuses 2.3.4

The connectors “AUX”, “ATMA/PCIS” and “CRP” are protected against short circuit. There are resetable fuses (“Multifuse”) built in for this protection. In case of a fault condition (e.g. short circuit at the ATMA/PICS connector), excessive current flows through the “Multifuse” and heats the fuse material. As the fuse has a very large non-linear Positive Temperature Coefficient (PTC) this will increase the fuse resistance sharply.

The fuse will stay “hot”, remaining in this high resistance a long as the power is applied. The fuse will remain latched, providing continuous protection, until the fault is cleared and the power is removed.

! ***All power supplies contained in the Preamp-Bus are only protected with the HPPR/2 power supply fuses (see PSM1-3 or PSB1-3 depending on the console type).***

Real-Time Pulse *2.3.5*

All pulses are galvanically isolated by fast opto couplers on the HPPR/2. After that, they are driven by a RS422 driver to the preamlifier modules. The pulse delay from the pulse driver, opto couplers and transmission line to the preamplifier module is less than 300 ns.

The polarity of the real time pulses can't be modified on the HPPR/2 Cover Module.

There are following three real time pulses:

1. RGP_HPPR, Receiver Gating Pulse HPPR (also known as RGP_PA)
2. LOCK_PP, Lock Protection Pulse (also known as TP_F0)
3. INTERLEAVE_INCR, Interleave Increment (also known as INCR_AQ)

Microcontroller *2.3.6*

Before an experiment starts the microcontroller is set into power down state. After a successful processing and acquisition the controller can be woken up by the SBSB_WUP~ signal to handle system requests or new instrument initialization.

The microcontroller system boots after each reset. While the controller boots, the HPPR/2 does not serve the serial interface. Any data received on the SBS bus is ignored. The boot time must be considered by any application and testing software.

The microcontroller system consists of a Infineon C517A / 24 MHz microcontroller, a 128K * 8 Bit Static RAM, a 4MB paged FLASH PROM and a 24 MHz clock generator. The external bus interface of the controller consists of an 8-bit data bus, a 16-bit address bus and several control lines. The address latch enable signal (ALE) is used to demultiplex address and data of port 0. The program memory is accessed by the program store enable signal (PSEN~) every second machine cycle. The read or write strobe (RD~, WR~) is used to access the external data memory.

An address decoder controls the microcontroller program and data memory accesses. It enables/disables (depending on the address and control signals) different devices. The controller boots normally from one page of the FLASH memory and runs its application software from other pages. The PSEC~ control signal is asserted by the controller while it downloads later application software or stores later BIS or configuration data. This maps the FLASH memory into the data segment and the RAM into code segment. The controller accesses now the RAM as if it was a nonvolatile code memory. Therefore program instructions are copied from the boot partition of the FLASH memory to the RAM before starting the download procedure.

A special mode allows the download of the boot software into the lower page of the FLASH memory. The boot software programmed in the test department is not field programmable in normal operation mode and is protected from unwanted program and erase operations.

Later application software can be loaded using the BRUKER UniTool.

BIS *2.3.7*

The HPPR/2 Cover Module BIS data contains information about production data, ECL, hardware type and display type.

BIS information is provided by the internal microcontroller and can be read using UniTool commands.

Connector Pinout *2.4*

Table 2.6. CONTROL connector: Mini Delta Ribbon 36 pin (female)

Signal Name	Pin No.	Remark
HPPR +19V	1,2	HPPR power supply
HPPR -19V	19,20	
HPPR +9V	3 - 8	
GND	13, 14, 21-26, 31, 33	
EMERGENCY_STOP	32	Emergency Stop signal
$\overline{\text{EMERGENCY\_STOP}}$	14	
RGP_HPPR	18	Gating Pulse for HPPR
$\overline{\text{RGP\_HPPR}}$	36	
LOCK_PP	17	Lock Protection Pulse
$\overline{\text{LOCK\_PP}}$	35	
INTERLEAVE_INCR	16	Interlave Increment Pulse
$\overline{\text{INTERLEAVE\_INCR}}$	34	
RxD+	10	SBSB signals and power supply
RxD-	28	
TxD+	11	
TxD-	29	
$\overline{\text{WUP}}$	12	
VRS	9	
XGND	27, 30	

Table 2.7. AUX Power Supply connector: Qikmate 6 pin (female)

Signal Name	Pin No.	Remark
HPPR +19V	6[a]	HPPR/2 power supply
HPPR -19V	3	
HPPR +9V	2	
GND	1, 4, 5	

a) In an older manaul version, pin 2 and 6 were wrong

Table 2.8. AUX connector: RJ45 8 pin (female)

Signal Name	Pin No.	Remark
AUX TxD+	1	AUX bus RS485 transmitter (master mode) or receiver (slave mode) signals.
AUX TxD-	2	
AUX RxD+	3	AUX bus RS485 receiver (master mode) or transmitter (slave mode) signals.
AUX RxD-	4	
reserved	5	Reserved for power supply, not connected.
$\overline{\text{AUX WUP}}$	6	Wake up signal (master mode = out; slave mode = in)
GND	7, 8	Ground

Table 2.9. CRP connector: RJ45 8 pin (female)

Signal Name	Pin No.	Remark
EN I2C	2	I2C bus clock, data and enable signal.
SCL	3	
SDA	4	
CRP P15V	1	Power supply for Cryo Probe.
CRP N15V	5	
GND	6, 7, 8	

Table 2.10. ATMA/PICS connector: RJ45 8 pin (female)

Signal Name	Pin No.	Remark
EN I2C	2	I2C bus clock, data and enable signal.
SCL	3	
SDA	4	
ATMA/PICS +19V	1	Power supply for ATMA or PICS.
ATMA/PICS -19V	5	
ATMA/PICS +9V	6	
GND	7, 8	

Table 2.11. PREAMP BUS connector: DSUB 25 pin

Signal Name	Pin No.	Remark
HPPR +19V	11	HPPR/2 power supply
HPPR -19V	1	
HPPR +9V	5, 6, 7	
GND	2, 3, 9, 16, 19, 20, 22	
EMERGENCY_STOP	4	Emergency Stop signal
RGP_HPPR	23	Receiver Gating Pulse
$\overline{\text{RGP\_HPPR}}$	10	
LOCK_PP	8	Lock Protection Pulse
$\overline{\text{LOCK\_PP}}$	21	
INTERLEAVE_INCR	24	Interlave Increment Pulse
$\overline{\text{INTERLEAVE\_INCR}}$	12	
SCL	15	I2C bus clock and data signal
SDA	14	
ADDR1	17	Daisy chain for addressing the modules.
ADDR2	18	

Test Issues 2.5

General 2.5.1

To avoid damage to the electronics the HPPR/2 Cover Module must not be opened in the field. The internal microcontroller supervises the operation of the board and detects serious malfunction. All fuses applied in HPPR/2 Cover Module are resetable and therefore have not to be changed.

Status information and error messages are sent to the workstation and displayed on the HPPR/2 Cover Module LCD.

Power Fail Error 2.5.2

After an ordinary power-up, a firmware download or a power breakdown the HPPR/2 creates a ***"power fail error"*** with error code 13. This informs the spectrometer, that the system has not yet been initialized. The error code has no further meaning for the user of the spectrometer.

Power supply protection / Fuse 2.5.3

The power supply for the "ATMA/PICS", "CRP" and "AUX" connector are protected against short circuit with resetable fuses or short circuit resistant power supplies. In case of a fault, the fault has to be cleared and the power supply has to be removed (see also ***2.3.4***).

LED States 2.5.4

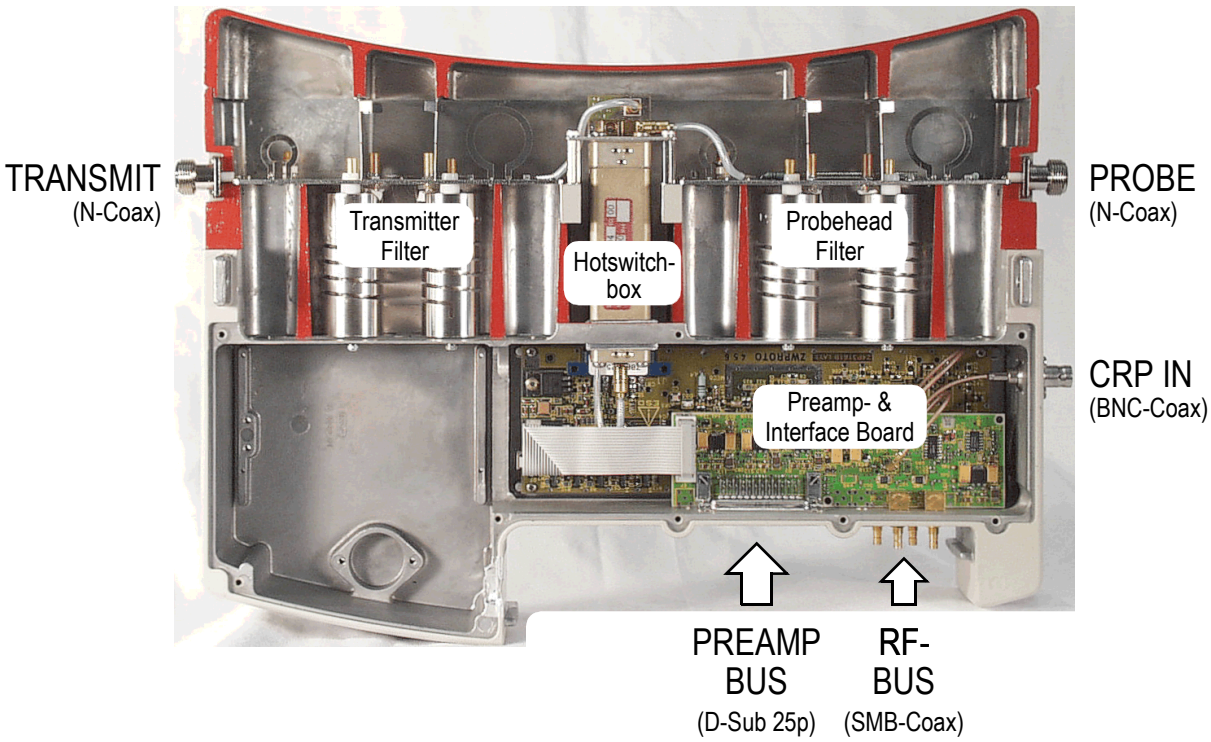
Table 2.12. LED States

ERROR	READY	SLEEP	Description
off	off	off	Power supply not on or HPPR/2 is still booting
off	off	on	Sleep mode (oscillator switched off)
blinking	on	off	HPPR/2 is in boot mode, no application software is running or a download is in process.
on	on	off	Error state, the error must be acknowledged by the master or user.
off	on	off	Normal operation mode

Preamplifier Modules 3

View 3.1

Figure 3.1. Preamp Module Connectors (open module)



Measurement Modes 3.2

1H, 3H, X-BB, 13C, 15N Module 3.2.1

Figure 3.2. Measurement modes 1H,3H, X-BB, 13C, 15N- Module

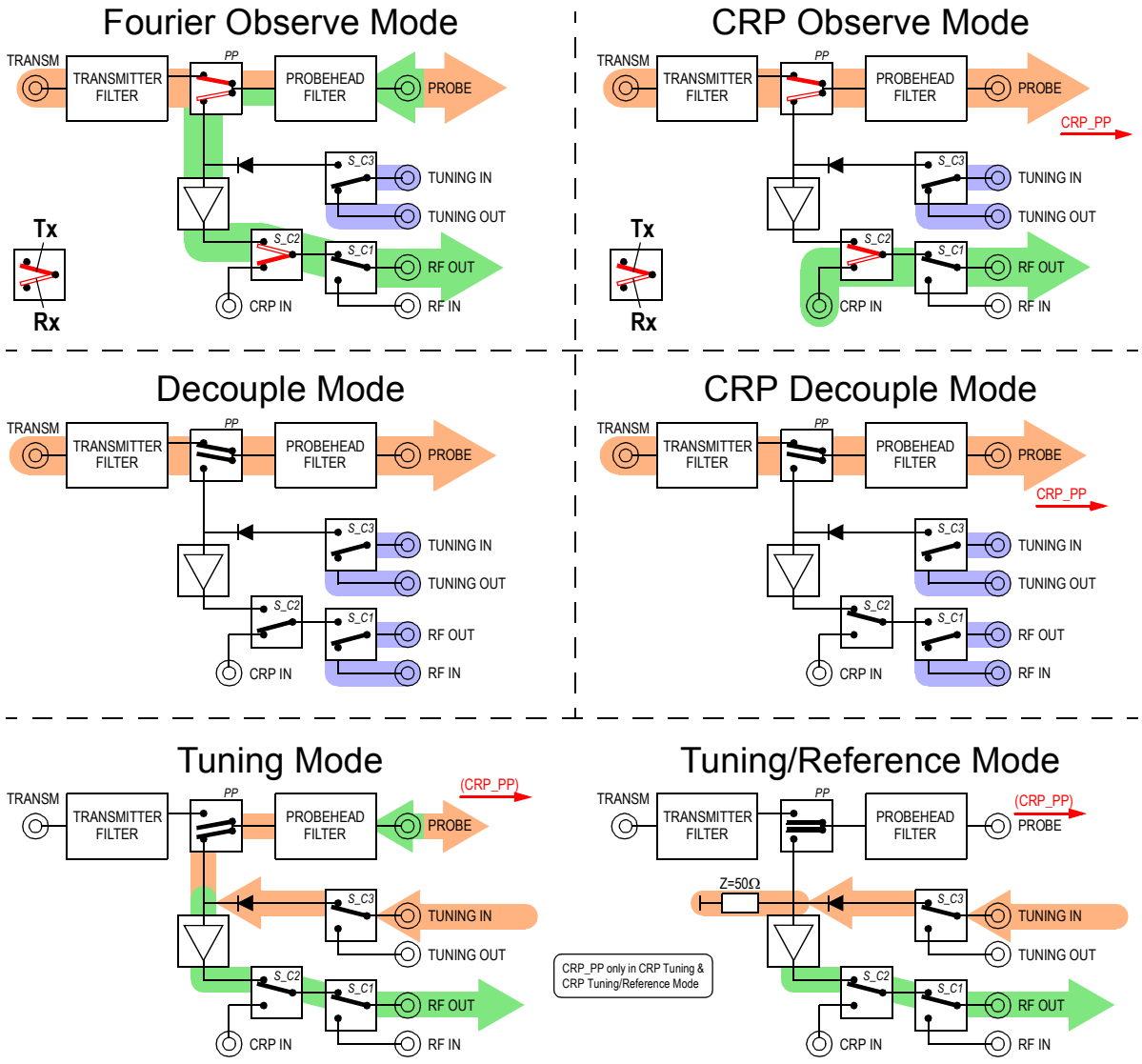


Figure 3.3. Measurement modes 2H, 19F Module

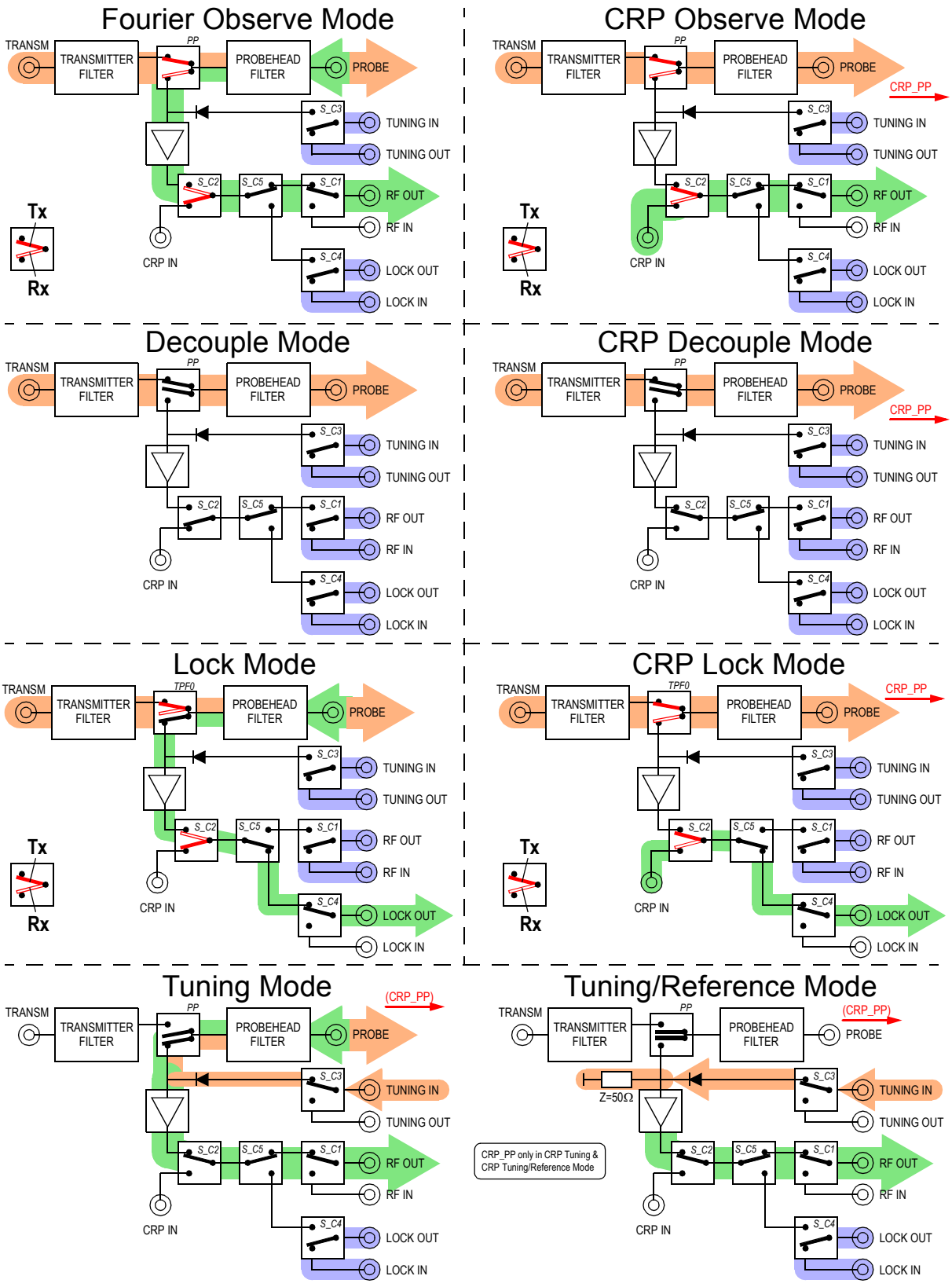


Figure 3.4. Measurement modes 1H2H Module (OBS, DEC, LOCK)

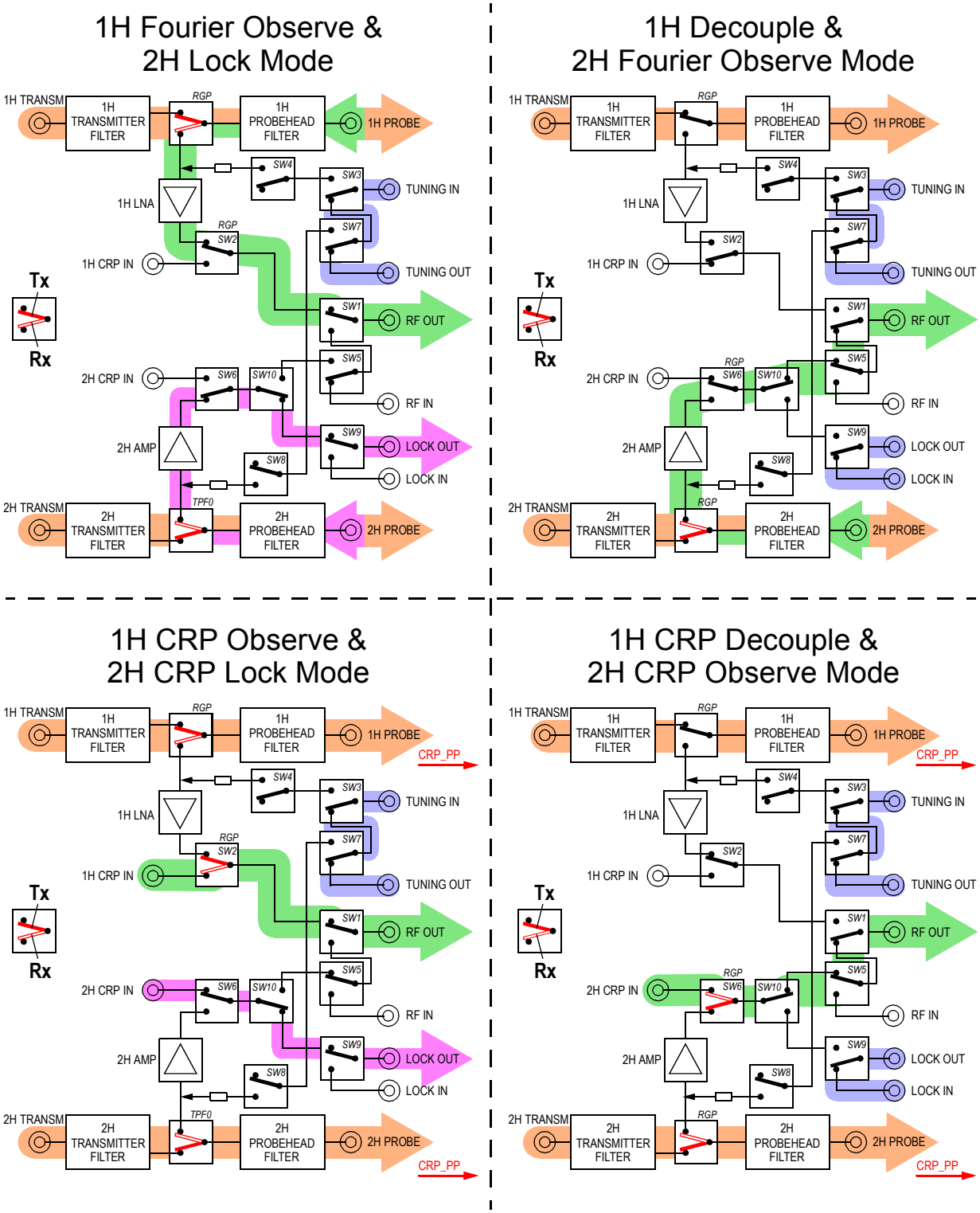


Figure 3.5. Measurement modes 1H2H Module (TUN, TUN/REF)

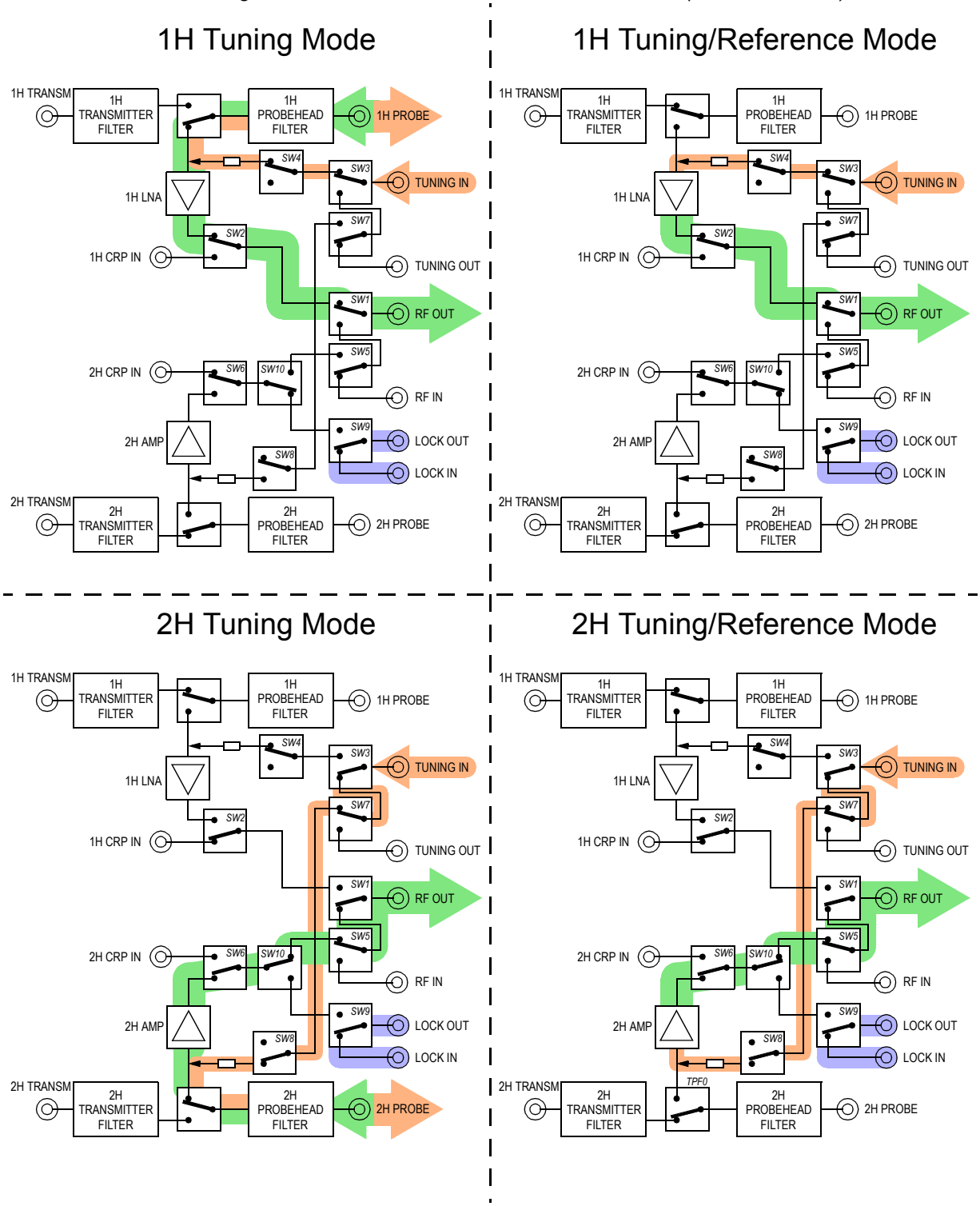
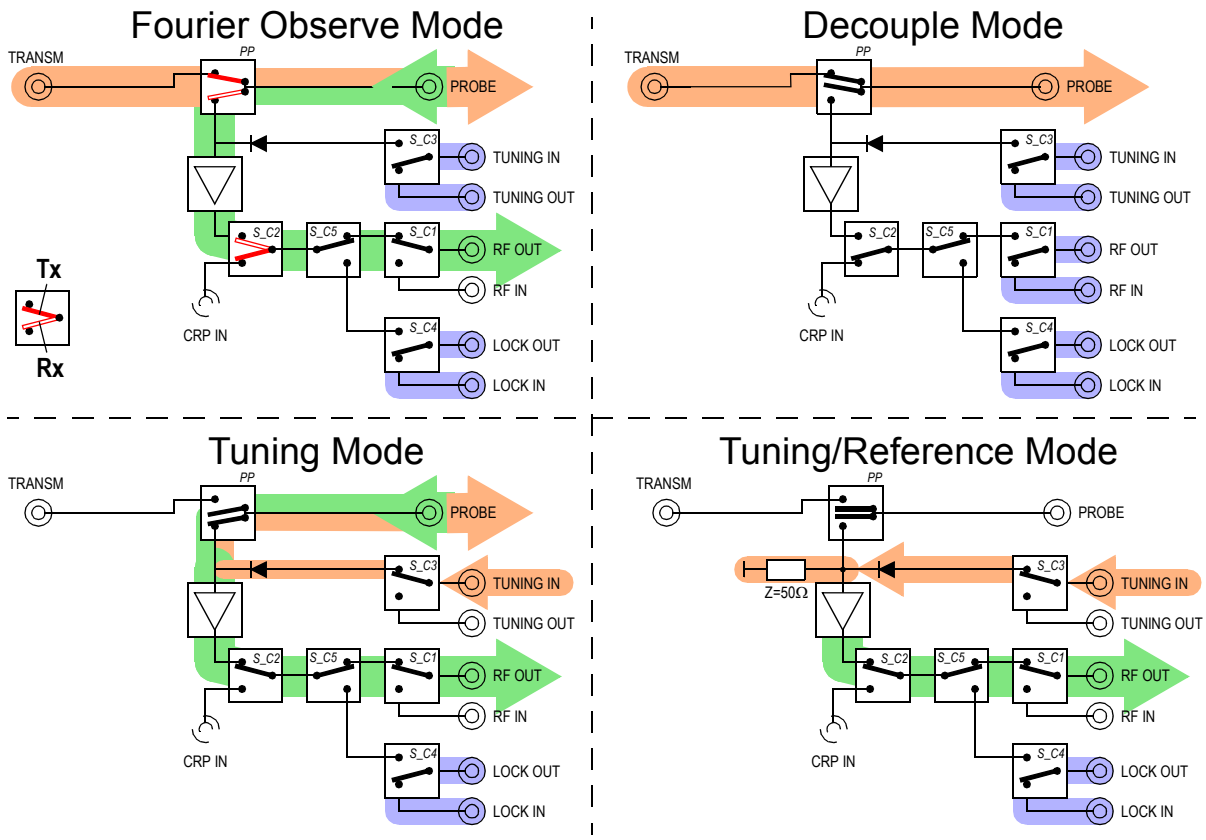


Figure 3.6. Measurement modes HPHP 19F/1H and HPHP XBB31P



Control Signals & RF-Switch Setting 3.3

Standart Modules (Single Channel Interface) 3.3.1

Table 3.1. Control Signals & RF-Switch Setting Single Channel Modules

Measurement Mode RGP = Receiver Gating Pulse (inverted) TPF0 = Lock Transmitter Gating Pulse [a]		HPPR/2 Interface OUTPUT					HPPR/2 Interface RF-Switch				
		Protection Pulse (HPPR_PP)	CRP TXSW Pulse (CRP_PP)	TUNE_ON_OFF	REF_ON_OFF	LOCK_ON_OFF	SEL_C1 (SW1)	SEL_C2 (SW2) [b]	SEL_C3 (SW3)	SEL_C4 (SW4, 5)	
Fourier Decouple	*DEC*	1	0	0	0	0	1	0	1	1	
Fourier Observe	*OBS Rx/Tx*	$\overline{\text{RGP}}$	0	0	0	0	0	RGP	1	1	
Lock [c]	*LOCK*	TPF0	0	0	0	1	1	$\overline{\text{TPF0}}$	1	0	
Tuning Tuning / Reference	*TUN* *TUN / REF*	0 0	0 0	1 1	0 1	0 0	0 0	1 1	0 0	1 1	
CRP Decouple	*CRP DEC*	1	1	0	0	0	1	1	1	1	Force Cold
CRP Observe	*CRP OBS Rx/Tx*	$\overline{\text{RGP}}$	$\overline{\text{RGP}}$	0	0	0	0	$\overline{\text{RGP}}$	1	1	
CRP Lock [c]	*CRP LOCK*	TPF0	TPF0	0	0	0	1	TPF0	1	0	
CRP Tuning CRP Tuning / Reference	*CRP TUN* *CRP TUN / REF*	0 0	1 1	1 1	0 1	0 0	0 0	1 1	0 0	1 1	

a TPF0 = LOCK_PP (Lock Protection Pulse)

b SW2 used as receiver gating switch in Observe and Lock mode.

c Lock and CRP Lock Mode only for 2H Modules

Activation by UniTool: 'Force Cold' routes all 'normal'- modes to 'CRP'- modes.

Activation by UniTool: 'Force CrpBypass' routes all 'CRP'- modes to 'normal'- modes in addition to setting bit 'CRP_PP'.

Table 3.2. HPPR/2 Interface Board RF-Switch Debug Information

Switch Setting (alt. name)		aktive Port	Signalflow 1H, X-BB, 13C, 15N Module	Signalflow 2H Module
SW1 (SC_1)	0 1	RF1 RF2	HPPR/CRP IN → RF OUT: SW2 OUT → J2 RF IN → RF OUT: J8 → J2	HPPR/CRP IN → RF OUT: SW5 RF2 → J2 RF IN → RF OUT: J8 → J2
SW2 (SC_2)	0 1	RF1 RF2	CRP_IN → RF OUT: RFCON7 → SW1 RF1 HPPR_IN → RF OUT: RFCON8 → SW1 RF1	CRP IN → RF OUT: RFCON7 → SW5 IN HPPR IN → RF OUT: RFCON8 → SW5 IN
SW3 (SC_3)	0 1	RF1 RF2	TUNING IN → TUNE RF OUT: J4 → RFCON9 TUNING IN → TUNING OUT: J4 → J7	TUNING IN → TUNE RF OUT: J4 → RFCON9 TUNING IN → TUNING OUT: J4 → J7
SW4 (SC_4)	0 1	RF1 RF2	*Switch SW4 not placed*	HPPR IN→ LOCK OUT: SW5 RF1 → J5 LOCK IN → LOCK OUT: J6 → J5
SW5 (SC_4)	0 1	RF1 RF2	*Switch SW5 not placed*	HPPR/CRP IN → LOCK OUT: SW2 OUT → SW4 RF1 HPPR/CRP IN → RF OUT: SW2 OUT → SW1 RF1

1H2H Module (double channel interface) *3.3.2*

Table 3.3. Control Signals & RF-Switch Setting 1H2H Module

Measurement Mode Signalname in 1H section → *Signalname in 2H section →* RGP = Receiver Gating Pulse (inverted) TPF0 = Lock Transmitter Gating Pulse [a]		TXSW_1H (HPPR_PP) *TXSW_2H*	CRP_TXSW_1H (CRP_PP) *CRP_TXSW_2H*	SEL_1H_C0 (SW1) *SEL_2H_C0 (SW5)*	SEL_1H_C1 (SW2) [b] *SEL_2H_C1 (SW6)*	SEL_1H_C2 (SW3,4) [c] *SEL_2H_C2 (SW7,8)*	*SEL_2H_C3 (SW7,9,10)*	Force Cold [d] Force CrpBypass [e]
Fourier Decouple	*DEC*	1	0	1	0	1	1	Force Cold
Fourier Observe	*OBS Rx/Tx*	$\overline{RGP}$	0	0	1	1	1	
Lock [f]	*LOCK*	TPF0	0	1	1	1	0	
Tuning [g] Tuning / Reference	*TUN* *TUN / REF*	0 1	0	0	1	0	1	
CRP Decouple	*CRP DEC*	1	1	1	1	1	1	
CRP Observe	*CRP OBS Rx/Tx*	$\overline{RGP}$	$\overline{RGP}$	0	$\overline{RGP}$	1	1	
CRP Lock [c]	*CRP LOCK*	TPF0	TPF0	1	0	1	0	
CRP Tuning [g] CRP Tuning / Reference	*CRP TUN* *CRP TUN / REF*	0 1	1	0	1	0	1	

a TPF0 = LOCK_PP (Lock Protection Pulse)
b SW2 and SW6 used as receiver gating switch in and Lock mode.
c Tuning $\overline{ON}$/OFF
d Activation by UniTool: ‘Force Cold’ routes all ‘normal’- modes to ‘CRP’- modes.
e Activation by UniTool: ‘Force CrpBypass’ routes all ‘CRP’- modes to ‘normal’- modes in addition to setting bit ‘CRP_PP’.
f Lock and CRP Lock Mode in 2H section only
g in Tuning and Tuning/Reference Mode LOW_GAIN is set to ‘1’ (normal Gain) regardless of it’s prior setting

Table 3.4. RF Interface Switch Debug Information 1H2H Module

	Switch	Controlsignal	Signalpath	
			“0” = RF1 Port activ	“1” = RF2 Port activ
1H	SW1	SEL_1H_C(0)	HPPR/CRP IN → RF OUT	RF IN → RF OUT
	SW2	SEL_1H_C(1)	CRP IN → RF OUT	HPPR IN → RF OUT
	SW3,4	SEL_1H_C(2)	TUNING IN → TUNE RF OUT	TUNING IN → TUNING OUT
2H	SW5	SEL_2H_C(0)	HPPR/CRP IN → RF OUT	RF IN → RF OUT
	SW6	SEL_2H_C(1)	CRP IN → RF OUT	HPPR IN → RF OUT
	SW7,8	SEL_2H_C(2)	TUNING IN → TUNE RF OUT	TUNING IN → TUNING OUT
	SW9 SW10	SEL_2H_C(3)	HPPR/CRP IN→ LOCK OUT HPPR/CRP IN → LOCK OUT	LOCK IN → LOCK OUT HPPR/CRP IN → RF OUT

Blockdiagrams *3.4*

The figures in this section contain the blockdiagrams of the following modules:

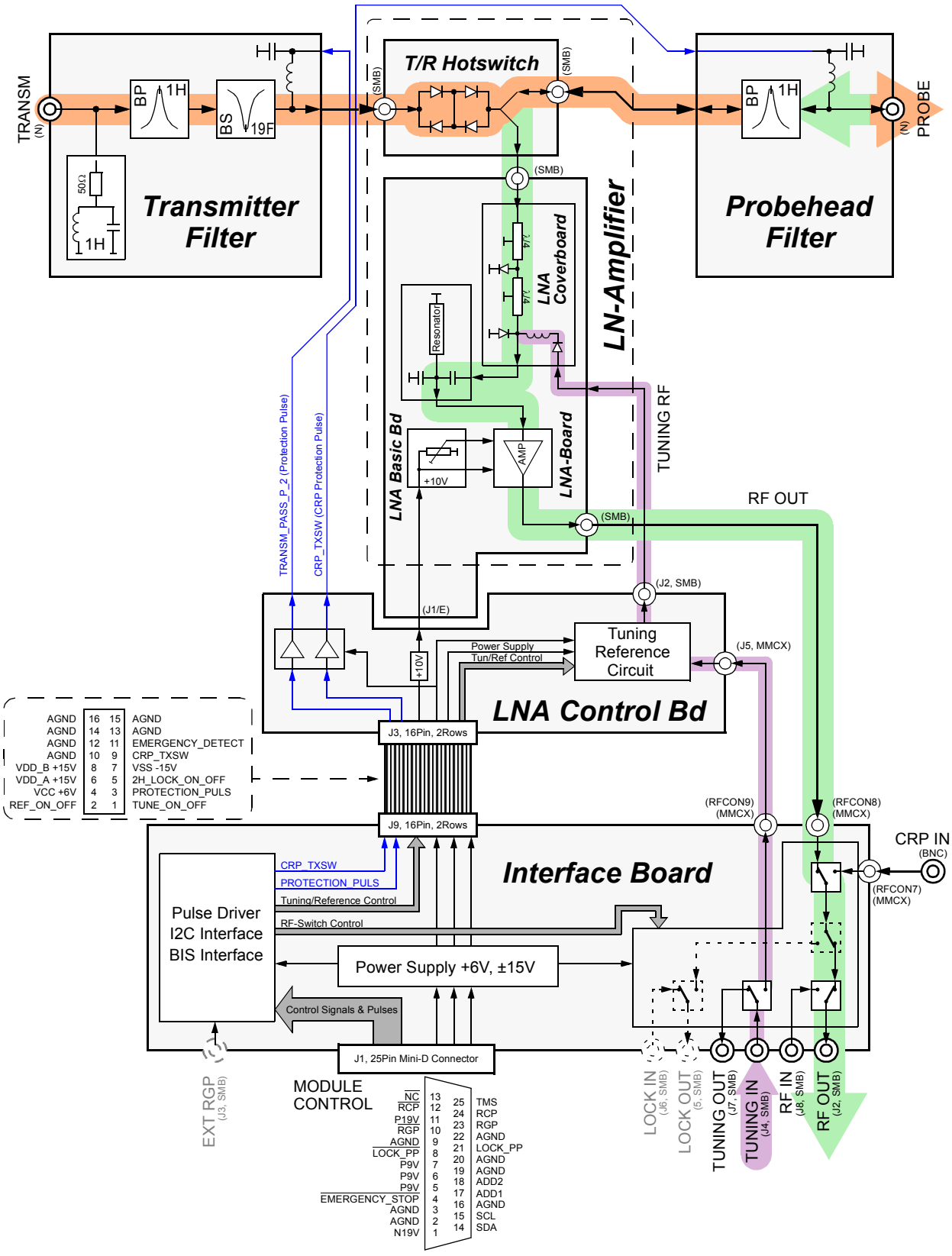
- HPPR/2 1H-LNA Module
- HPPR/2 2H Module
- HPPR/2 1H2H Module
- HPPR/2 13C Module
- HPPR/2 15N Module
- HPPR/2 XBB-19F 2HS Module
- HPPR/2 XBB-31P 2HS Module
- HPHP/2 19F/1H Module
- HPHP/2 XBB31P Module

The figures show all internal subsections and individual boards with their interconnections. Signal names, connector pin numbers and connector types are also noted.

For the states of the specific control signals in different measurement modes please refer to the section ***"Control Signals & RF-Switch Setting" on page 33***.

1H-LNA Module 3.4.1

Figure 3.7. 1H-LNA Module Blockdiagram



2H Module 3.4.2

Figure 3.8. 2H Module Blockdiagram

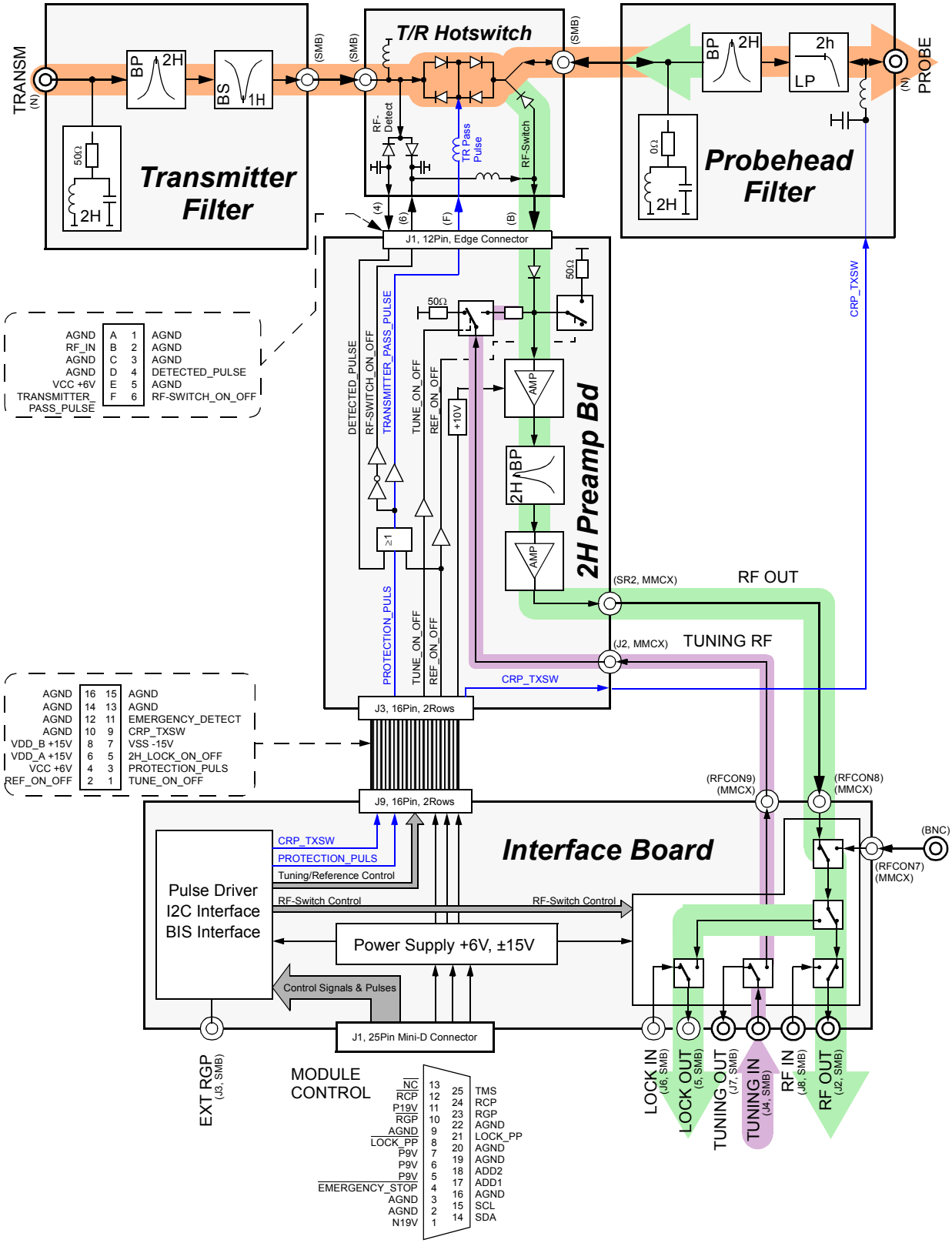


Figure 3.9. 1H/2H Module Blockdiagram

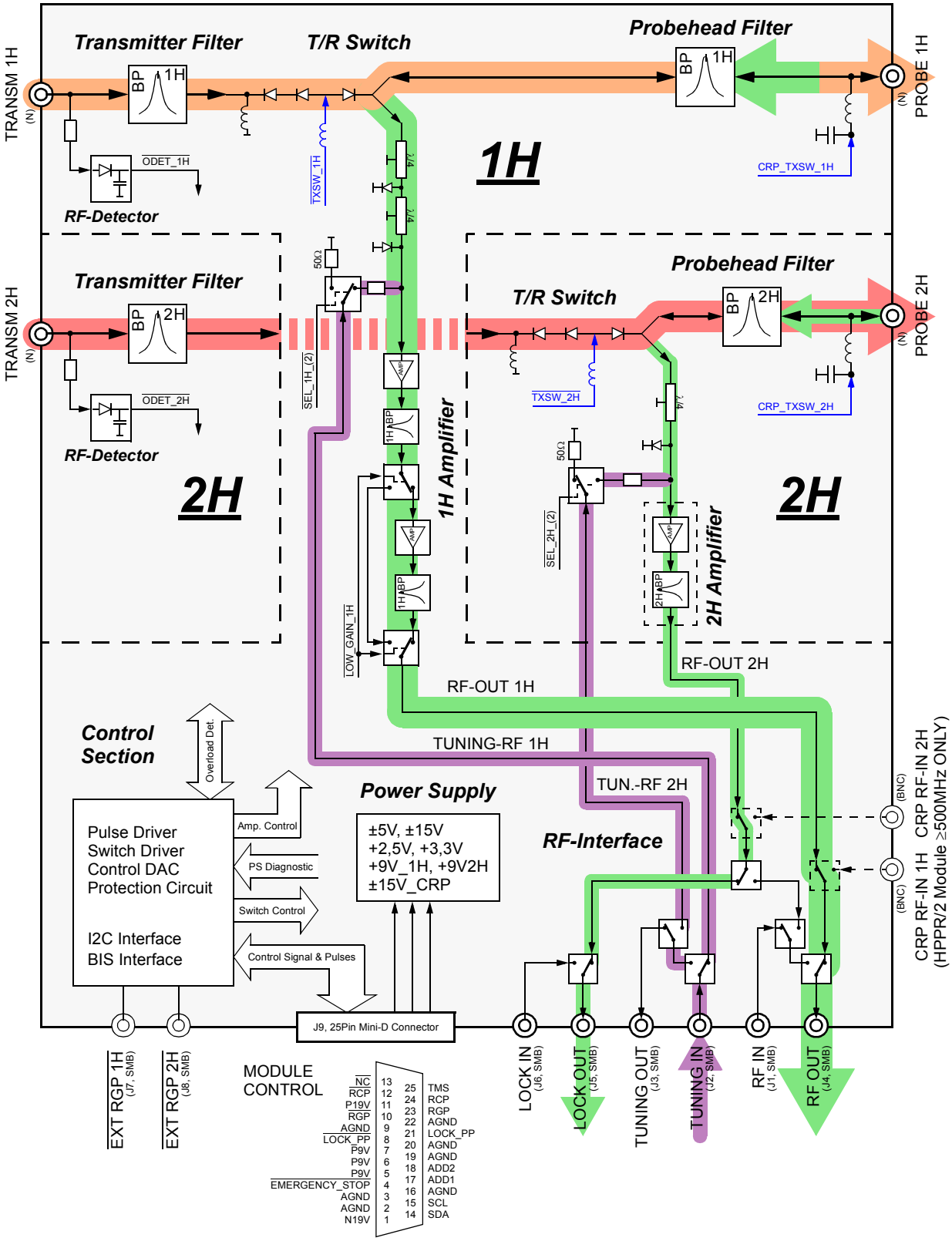
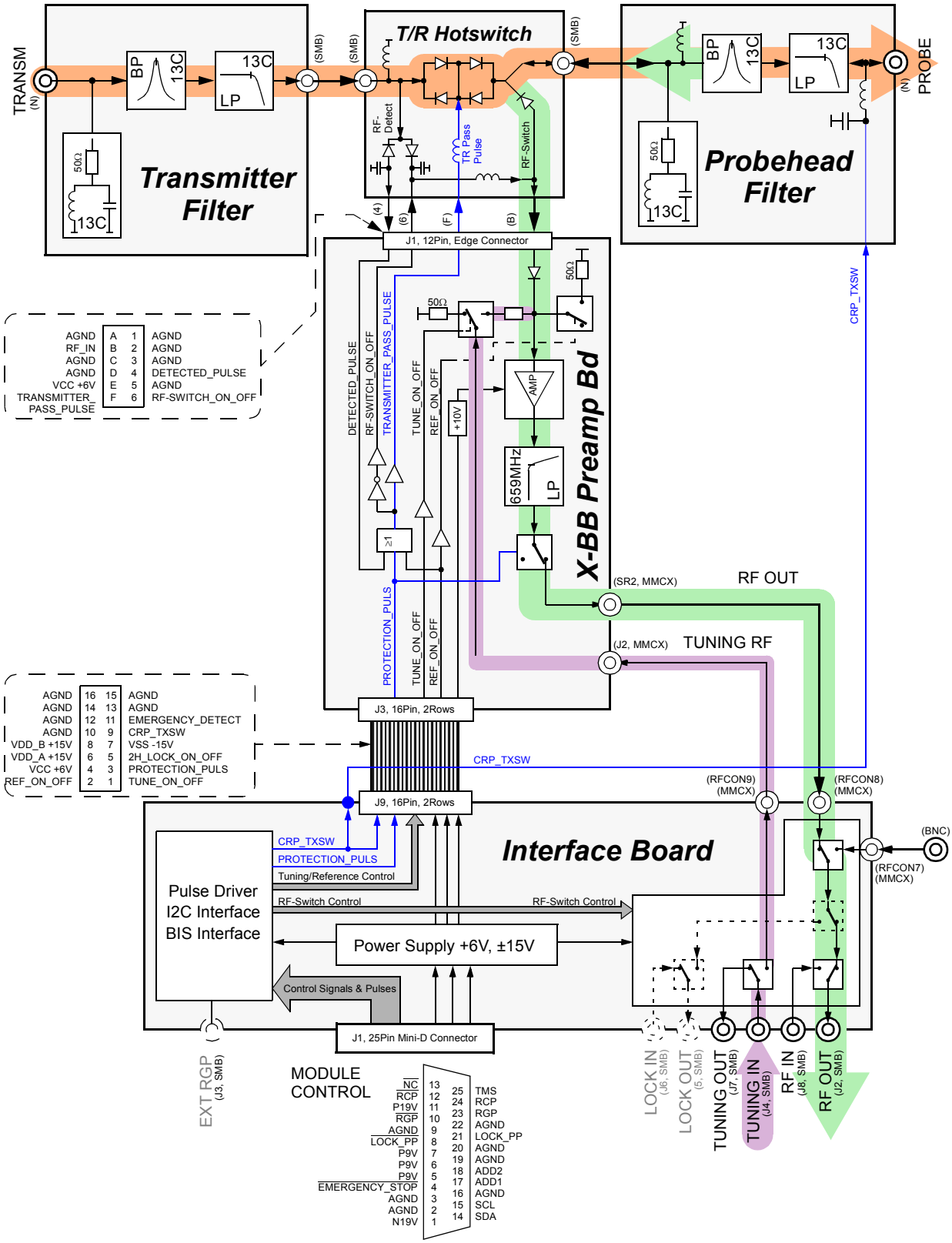


Figure 3.10. 13C Module Blockdiagram



15N Module 3.4.5

Figure 3.11. 15N Module Blockdiagram

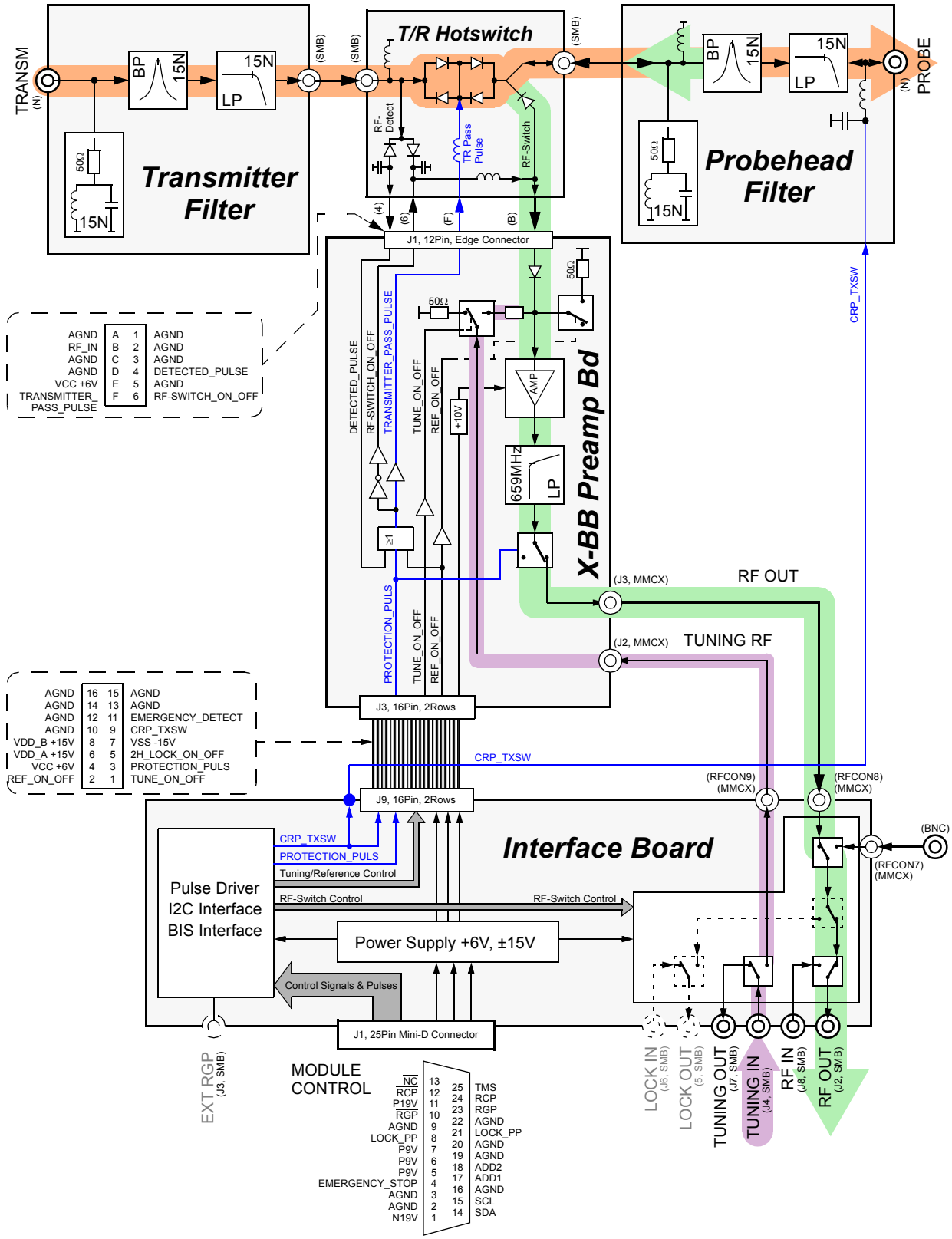
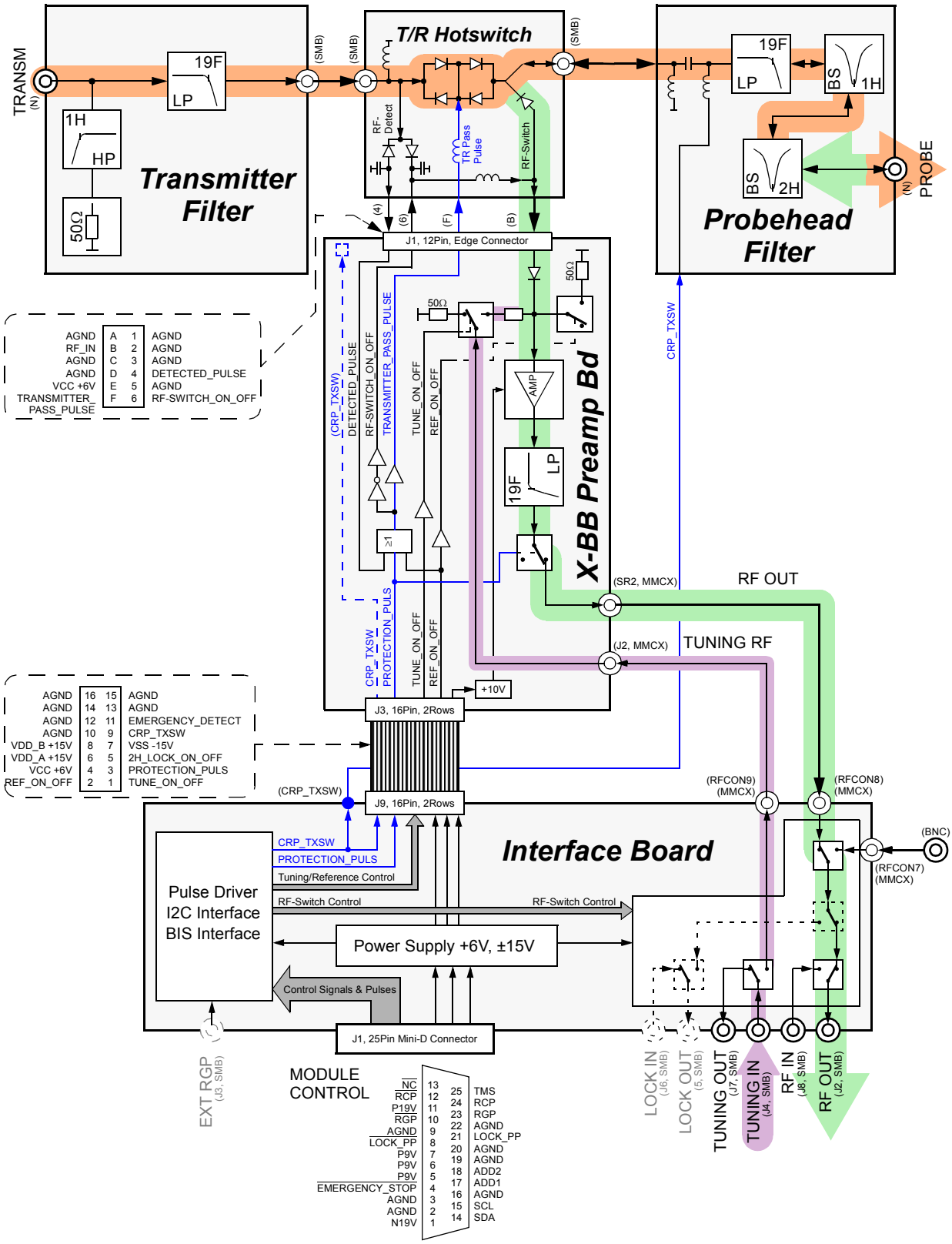


Figure 3.12. XBB-19F 2HS Module Blockdiagram



XBB-31P 2HS Module 3.4.7

Figure 3.13. XBB-31P 2HS Module Blockdiagram

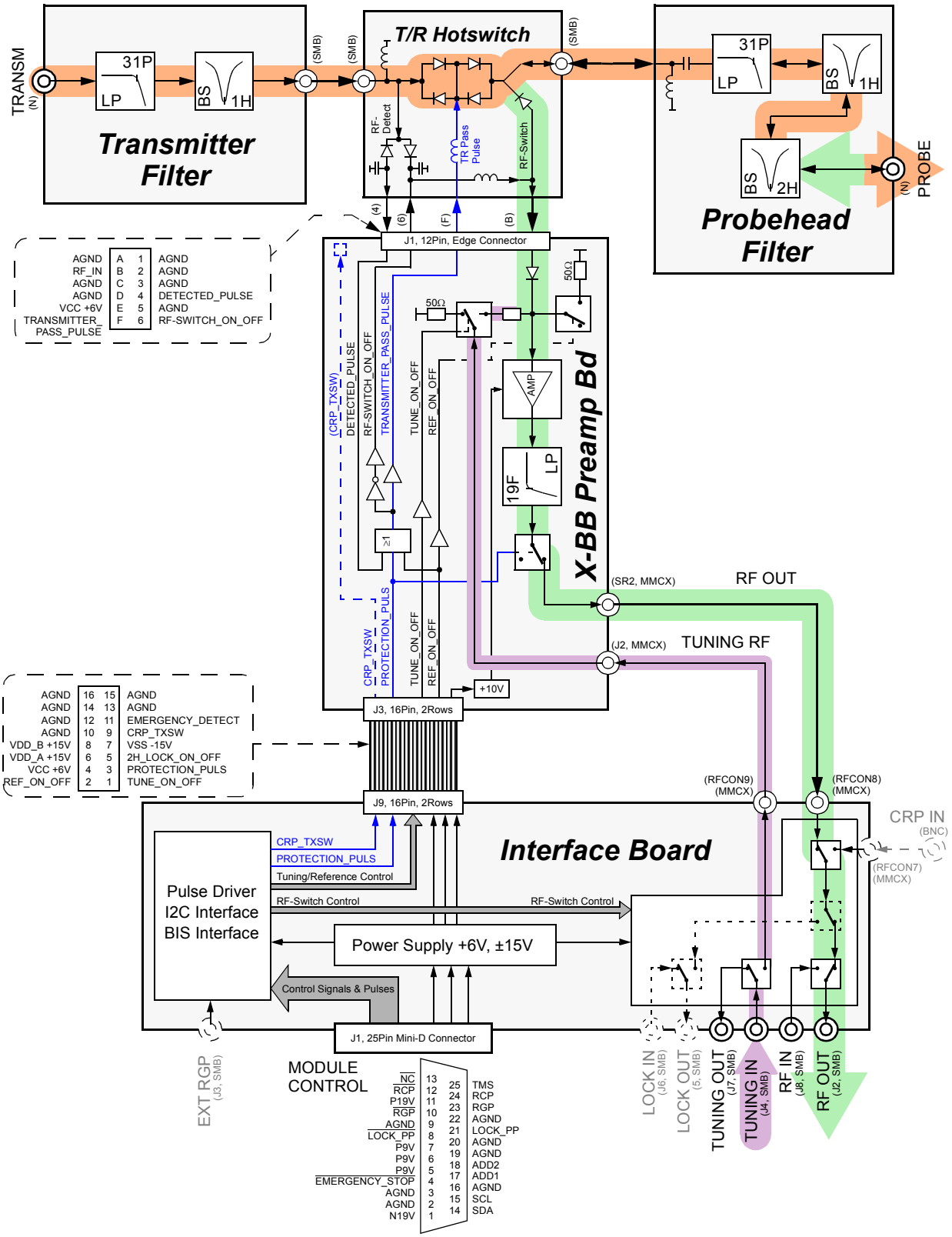
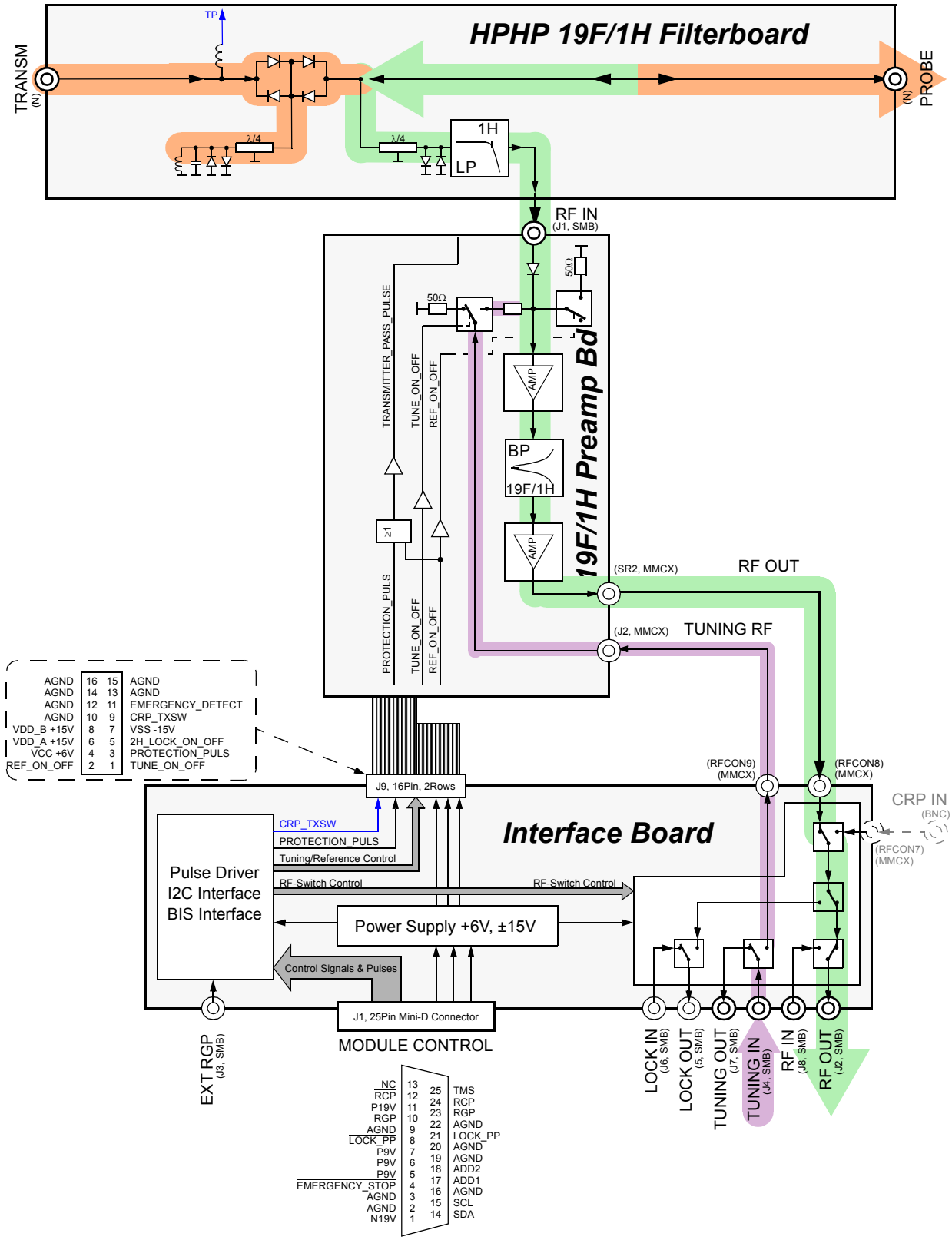
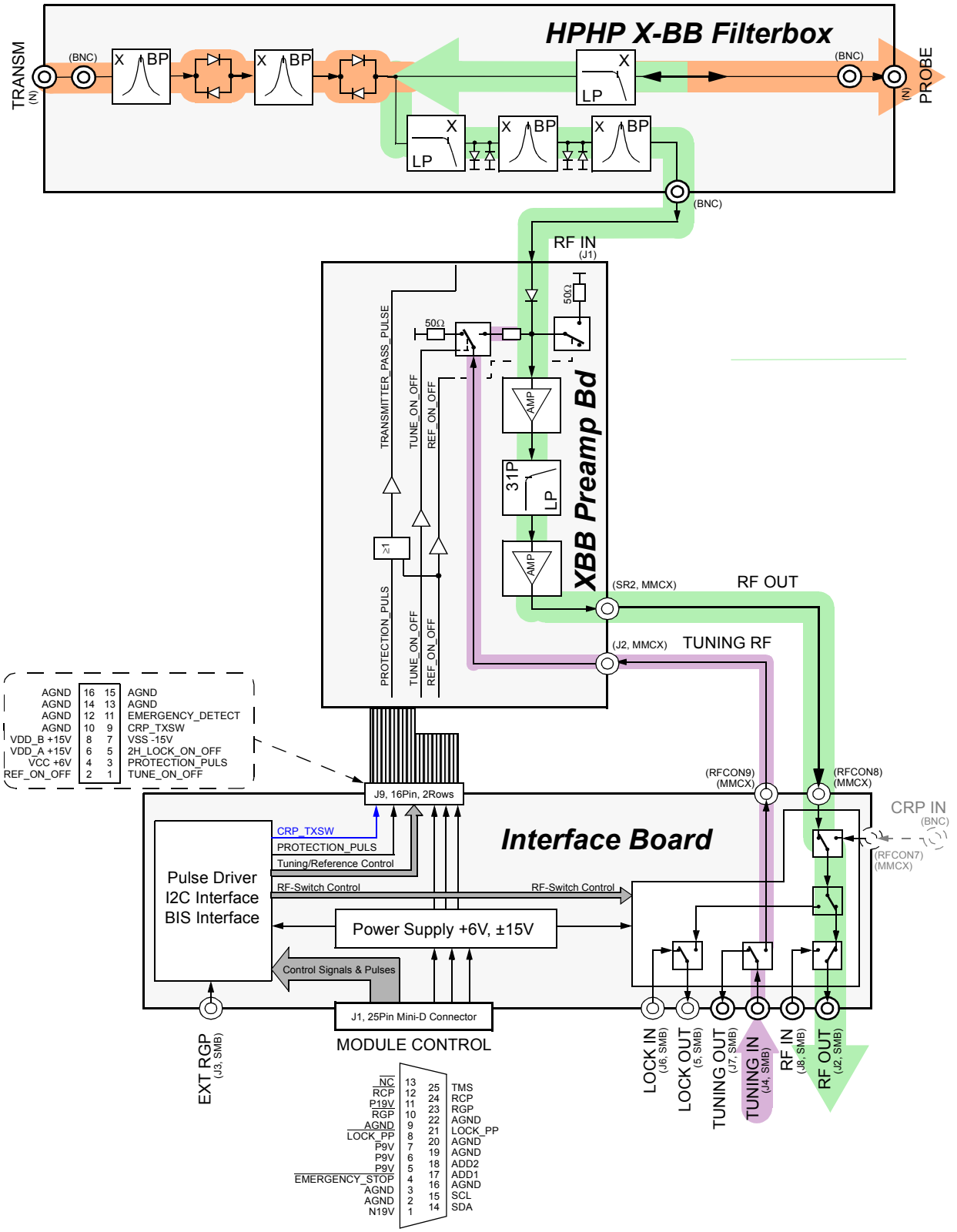


Figure 3.14. HPHP/2 19F/1H Module Blockdiagram



HPHP/2 XBB31P Module *3.4.9*

Figure 3.15. HPHP/2 XBB31P Module Blockdiagram



Technical Specifications *3.5*

Table 3.5. Technical Data HPPR/2 1H LNA MODULE

	500	600	700	750	800	900
Receive Path Performance						
Gain (typ)	28dB					
Noise Figure (typ)	1dB[a]				1.15dB[a]	
Transmit Path Performance						
Max. Power Rating	100W, 20us, 2% Duty Cycle					
Insertion Loss 1H	<=1.9dB[a]					

a without additional external filters

Table 3.6. Technical Data HPPR/2 and AQS 1H2H MODULE

	300	400
1H Receive Path Performance		
Gain (typ)	30dB	
Noise Figure (typ)	1.4dB[a]	
1H Transmit Path Performance		
Max. Power Rating	100W, 20us, 2% Duty Cycle	
Insertion Loss 1H (typ)	2.5dB[a]	
2H Receive Path Performance		
Gain (typ)	48dB	
Noise Figure (typ)	1.5dB	
2H Transmit Path Performance		
Max. Power Rating	300W, 20us, 2% Duty Cycle	
Insertion Loss 2H (typ)	2.2dB	

a all filters included

Table 3.7. Technical Data HPPR/2 2H MODULE

	500	600	700	750	800	900
Receive Path Performance						
Gain (typ)	45dB					
Noise Figure (typ)	2.8dB					
Transmit Path Performance						
Max. Power Rating	500W, 100us, 2% Duty Cycle					
Insertion Loss 2H	<=2dB					

Table 3.8. Technical Data HPPR/2 13C MODULE

	500	600	700	750	800	900
Receive Path Performance						
Gain (typ)	28dB					
Noise Figure (typ)	2.8dB					
Transmit Path Performance						
Max. Power Rating	500W, 100us, 2% Duty Cycle					
Insertion Loss 13C	<=2dB					

Table 3.9. Technical Data HPPR/2 15N MODULE

	500	600	700	750	800	900
Receive Path Performance						
Gain (typ)	28dB					
Noise Figure (typ)	2.8dB					
Transmit Path Performance						
Max. Power Rating	500W, 100us, 2% Duty Cycle					
Insertion Loss 15N	<=2dB					

Table 3.10. Technical Data HPPR/2 and AQS[a] XBB19F 2HS MODULE

	300	400	500	600	700
Receive Path Performance					
Gain (typ)	28dB				
Noise Figure 13C (typ)	2dB[b]				
Transmit Path Performance					
Max. Power Rating	500W, 100us, 2% Duty Cycle				
Insertion Loss 13C	<=1dB				<=1.1

a for 300 and 400MHz only

b all filters are included for 300 and 400MHz preamplifiers (AQS and HPPR/2)

Table 3.11. Technical Data HPPR/2 XBB31P 2HS MODULE

	750	800	900
Receive Path Performance			
Gain (typ)	28dB		
Noise Figure 13C (typ)	2dB		
Transmit Path Performance			
Max. Power Rating	500W, 100us, 2% Duty Cycle		1000W, 100us, 2% Duty Cycle
Insertion Loss 13C	<=1.2dB		

Table 3.12. Technical Data HPHP/2 19F/1H MODULE

	200	300	360	400	500	600	700	750	800	900
Receive Path Performance										
Gain 1H (typ)	28dB									
Noise Figure 1H (typ)	2.2dB						2.4dB			2.7dB
Transmit Path Performance										
Max. Power Rating	1000W, 50ms, 10% Duty Cycle									
Insertion Loss 1H	<=2dB						<=2.3dB			

Table 3.13. Technical Data HPHP/2 XBB31P MODULE

	100-360	400-750	800-900
Receive Path Performance			
Gain 1H (typ)	32dB		
Noise Figure[a] (typ)	1.6dB		
Transmit Path Performance			
Max. Power Rating	1000W, 50ms, 10% Duty Cycle		

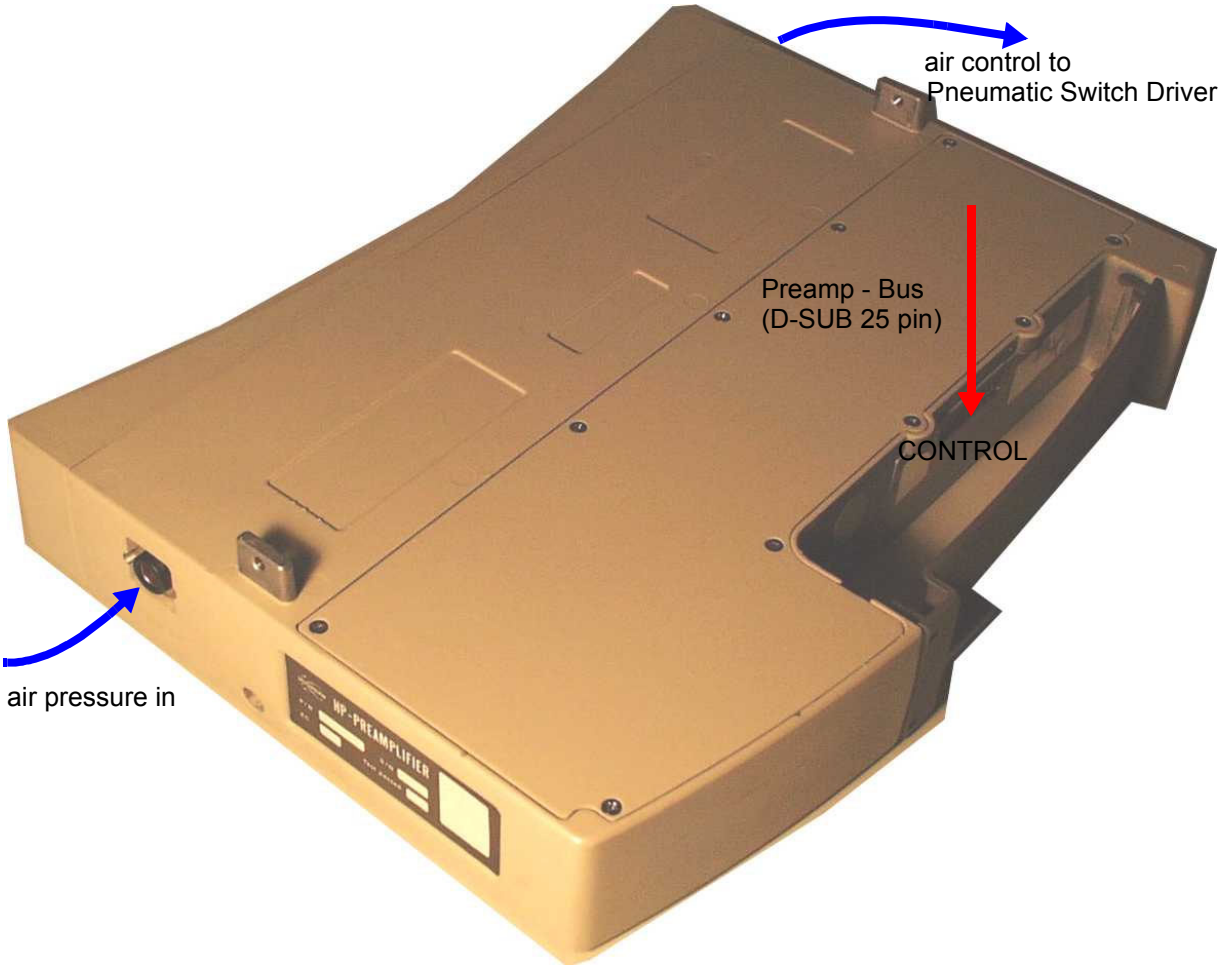
a e.g. with Filterbox Z002696 120-210MHz

QNP Module

4

General 4.1

Figure 4.1. View

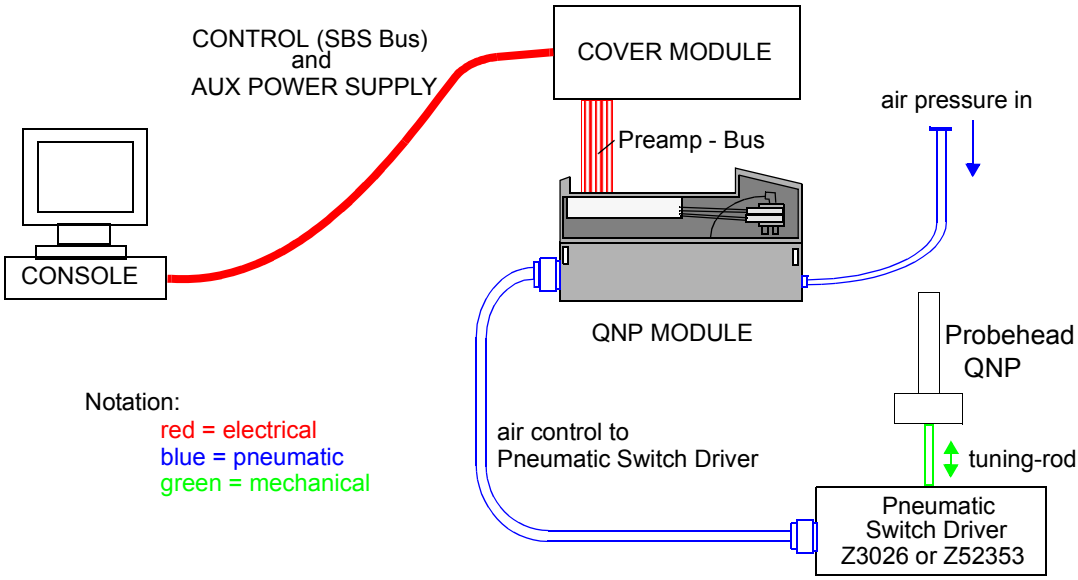


QNP Functional Description 4.1.1

Using only one Probehead, the QNP System (Quadro Nucleus Probe) allows the measurement of four different nuclei, 1H and three user determined nuclei, e.g. 19F / 31P / 13C or 31P / 13C / 15N. This is enabled by the triple-switchable measurement-channel in the QNP Probehead.

The QNP Module is the interface between the electronics and pneumatics. It is controlled electrically via the SBS bus (Console to Cover Module) and the Preamp - Bus (Cover Module to QNP Module). The LCD on the Cover Module shows the actual status. The three-level operation of the tuning-rod is controlled by two pneumatic cyclinders in the Pneumatic Switch Drive. The associated control valve is positioned in the QNP Module.

Figure 4.2. Interfaces of QNP Module



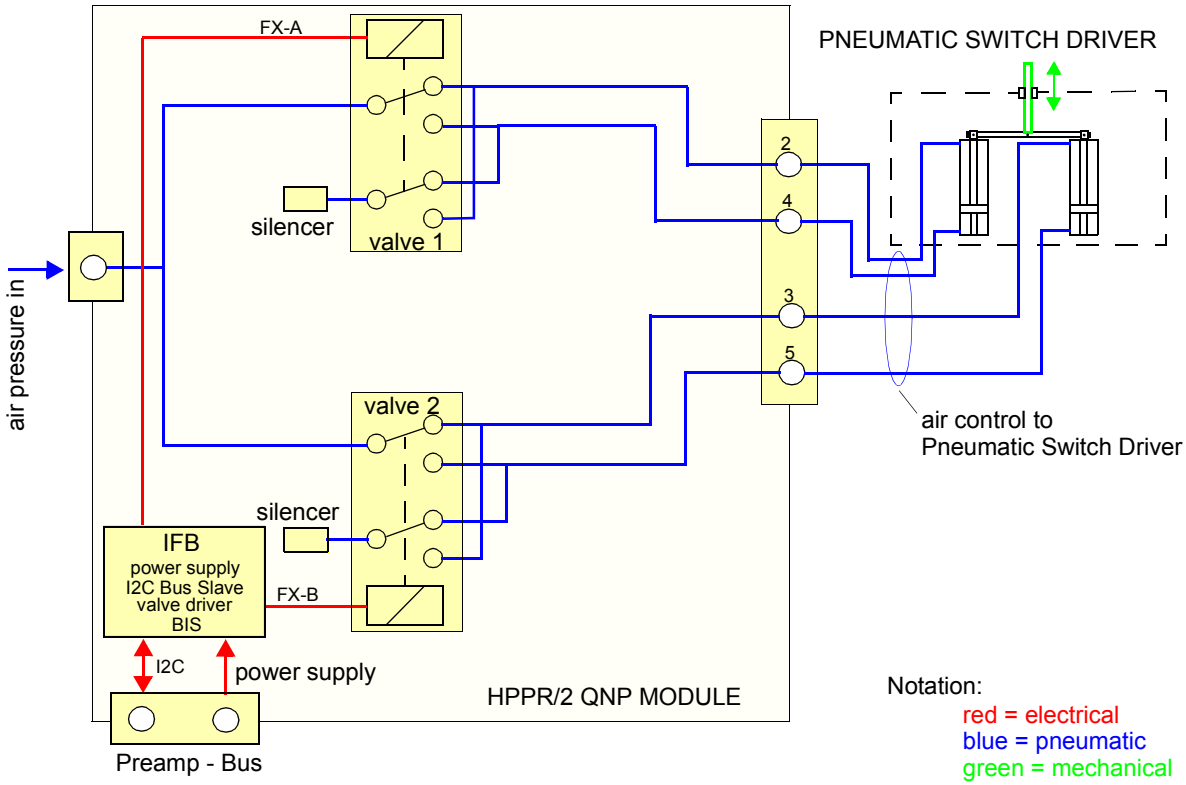
Installation of the QNP Module 4.1.2

There is nothing special to know about the installation of the QNP Module. Just connect the QNP Module as bottom module and init the system with XWINNMR (“cf”). Now the XWINNMR should have found the QNP Module and you will be able to control the QNP Probehead by switching the air current with the connected QNP Module.

Functionality 4.2

Topology 4.2.1

Figure 4.3. Blockdiagram HPPR/2 QNP Module



IFB (Interface Board) 4.2.2

The Interface Board (IFB) is the central control board in the QNP Module. It contains following parts:

1. power supply and monitoring for internal and valve control voltage
2. I2C Bus slave interface
3. valve control driver
4. BIS (Bruker Information System)

This function blocks will be described in the following chapters.

Power Supply and Monitoring

The QNP Module uses the HPPR +9V voltage for supplying the control logic on the IFB and the HPPR +19V for controlling the pneumatic valve.

Both voltages are supplied via Preamp-Bus from Cover Module and are filtered and stabilized on the IFB. The operation of the on-board power stabilization is monitored. In case of failure, the HPPR/2 Cover Module will create an error and will display the corresponding error message on its LCD.

I2C Bus and Addressing

The QNP Control Module is an I2C slave device. The Cover Module is the master device which controls all slave devices on the Preamp-Bus. The addressing of the device is made by a daisy chain automatically. Therefore there mustn't be left any gaps in the Preamp-Bus connector and unused connections from the Preamp-Bus cable have to be after the last connected module.

Valve Control Driver

The pneumatic valve are driven by a 12 volt totem pole high current driver which is placed on the IFB.

BIS

The HPPR/2 QNP Module BIS data contains information about production data, ECL, hardware type, name and type of the module.

BIS information is provided via I2C bus to the Cover Module and can be read using UniTool commands.

Valve *4.2.3*

There are used customer specified pneumatic valves for switching the air to the Pneumatic Switch Driver (for blockdiagram see ***Figure 4.3.***). The valves are controlled by a 12 volt signal.

With these two valves it is possible to drive three different QNP Probehead positions. There are following rules:

Table 4.1. True Table Pneumatic Valve

Pos.	Valve 2	Valve 1	Switch Drive Position	Frequency
1[a]	off	off	bottom	maximum
2[b]	off	on	middle	medium
2	on	off	middle	medium
3	on	on	top	minimum

a default after power-up
b not used since identical with next status

Connectors *4.2.4*

air pressure in

The air pressure is supplied at the "TRANSM" connector. There is a maximum pressure of 600 kPa (= 6 bar = 87 psi) allowed.

air control to Pneumatic Switch Drive

There are four air hoses leading to the Pneumatic Switch Drive to control the QNP Probehead position.

The ***Table 4.1.*** shows how the position of the Pneumatic Switch Drive is controlled through the pneumatic valves and the corresponding air hoses.

Preamp-Bus

The QNP Module is fully electrically controlled via the Preamp-Bus. This is the same bus which is also connected to the HPPR/2 preamplifier modules.

The Preamp-Bus contains a I2C bus for controlling the module and a +9V / +19V for supplying the module. The Power Supply -19V, the Emergency Stop and real time pulse signals are not used for the QNP Module.

Table 4.2. Preamp-Bus connector: DSUB 25 pin

Signal Name	Pin No.	Remark
HPPR +19V	11	HPPR/2 power supply
HPPR -19V	1	
HPPR +9V	5, 6, 7	
GND	2, 3, 9, 16, 19, 20, 22	
EMERGENCY_STOP	4	Emergency Stop signal
RGP_HPPR	23	Real time pulse singals
$\overline{\text{RGP\_HPPR}}$	10	
LOCK_PP	8	
$\overline{\text{LOCK\_PP}}$	21	
INTERLEAVE_INCR	24	
$\overline{\text{INTERLEAVE\_INCR}}$	12	
SCL	15	I2C bus clock and data signal
SDA	14	
ADDR1	17	Daisy chain for addressing the modules.
ADDR2	18	

HPPR/2 Module Configurations 5

Introduction 5.1

The following chapter gives an introduction to commonly used HPPR/2 module configurations.

Other configurations are principally possible, then to the following rule should be paid attention: the QNP module is always the lowest followed by the high power modules (HPHP/2). The high resolution modules are always on the very top.

For standard wiring (no multiple RX) see chapter ***"Installation" on page 7***.

HPPR/2 Configurations for High Resolution 5.2

Figure 5.1. HPPR/2 Configuration for High Resolution

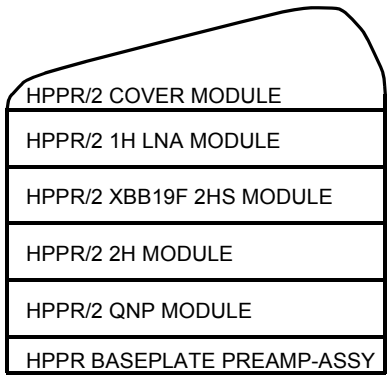


Figure 5.2. HPPR/2 Configuration with 1H2H Module

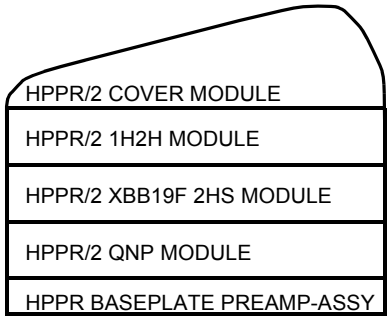


Figure 5.3. HPPR/2 Configuration with two XBB Module

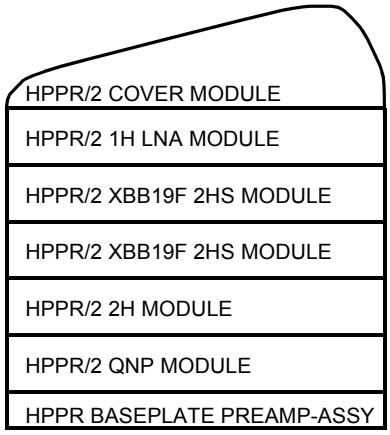


Figure 5.4. HPPR/2 Configuration with 1H2H Module and two XBB Module

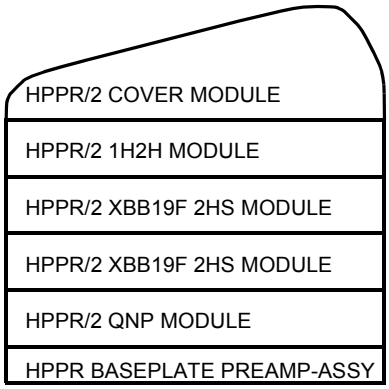


Figure 5.5. HPPR/2 Configuration with selective 19F Module or 3H Module

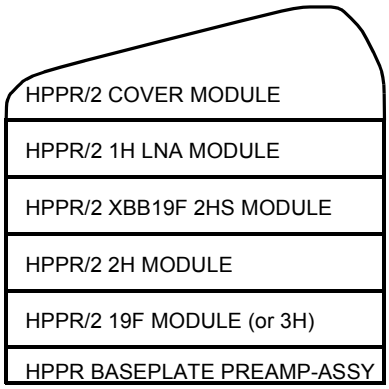
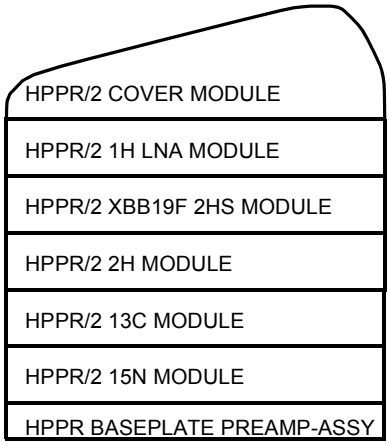


Figure 5.6. HPPR/2 Configuration for Cryoprobe



HPPR/2 Configurations for High Power *5.3*

Figure 5.7. HPPR/2 Configuration with HPHP/2 Modules

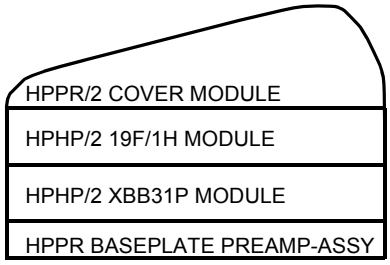


Figure 5.8. HPPR/2 Configuration for High Resolution and High Power

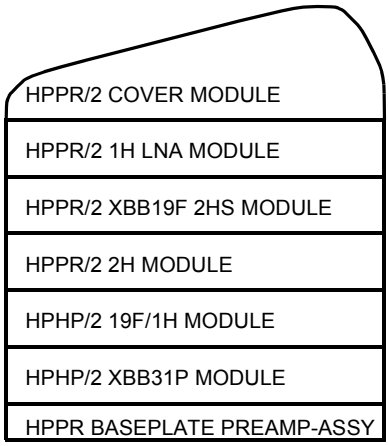
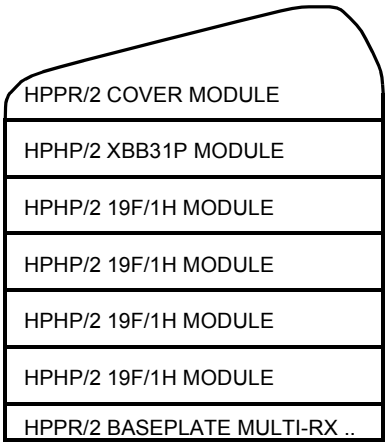
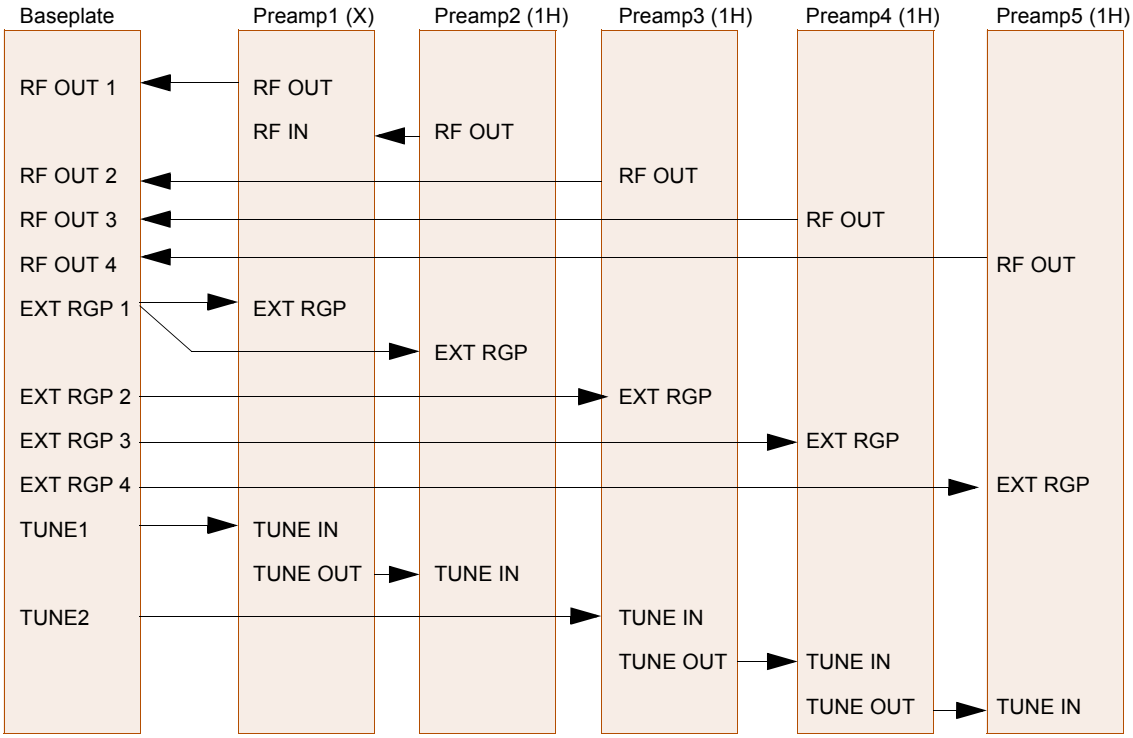


Figure 5.9. HPPR/2 Configuration for Multiple Receiver Systems



HPPR/2 Multiple RX Wiring:



HPPR/2 UniTool 6

Introduction 6.1

For service purpose BRUKER has developed an universal tool that allows access to boards with UniTool support for diagnostic, check and firmware upgrade over the RS485 serial bus.

UniTool acts as a browser, all menus are provided by the units themselves. Board specific Unitool access can be achieved by starting the UniTool with the matching SBSB address.

Identification of the firmware release 6.2

1. Open a UNIX shell or a command prompt window in the BRUKER Utilities folder when using Windows NT.
2. Start the UniTool: `xwinnmr -e UniTool`
3. -> `hppr`, confirm
4. -> decimal address for master HPPR/2 is **`80`**, (slave **`81`**), confirm
5. Choose -> `[2] Show Version`, confirm

You will be given the details of firmware and boot software version.

Download a new HPPR/2 firmware 6.3

Please refer to the BRUKER Service Information to check out if a download is necessary.

! ***The download of the newest firmware is not always necessary. However, in case of trouble it is always recommended to download the newest available firmware on the BBIO-CH ftp server.***

Further information about the demand of new firmware can also be found on the FTP server of BBIO-CH:

ftp://ftp.bruker.ch/pub/NMR/download/servtools/firmware/hppr/

Download 6.3.1

Follow these instructions:

1. Check if the directory (/Bruker/<xwinnmr release>/conf/instr/servtool/UniTool/files/hppr) exists. Otherwise create it.

2. Copy the newest version available on the BBIO-CH ftp server (hppr__.hex) into the directory /Bruker/<xwinnmr release>/conf/instr/servtool/UniTool/files/hppr

3. Start the UniTool in a Shell: `xwinnmr -e UniTool`

4. -> `hppr`, confirm

5. -> decimal address for master HPPR/2 is **80**, (slave **81**), confirm

6. When the UniTool Menu is loaded, enter `[4] Check Download` -> download is started. The download takes about 20..25 min

7. When download has finished, an error message like 'Communication error detected' may appear. This is an UniTool internal message and does not affect the download. Exit and restart UniTool. The HPPR/2 has to be accessible.

Error handling *6.3.2*

If a serious malfunction occurs during download (e.g. network failures), the download can be restarted. The HPPR/2 automatically starts in the **boot mode**, but UniTool operation is still provided.

```
host:user 1% xwinnmr -e UniTool hppr
Enter decimal SBSB address for hppr (80) > 80
device name taken from already existing configfile: /dev/tty10
B r u k e r  U n i T o o l
   Version: 1.0
   Compilation date: 010404
W A R N I N G:
   This is a hardware level debug tool.
   Improper operation may damage your hardware.
Connecting SBSB address 80 (0x50).

HPPR/2 ROM Menu
================
[1] Init HPPR/2
[2] Show Version
[3] Auto Download HPPR/2
[4] Manual Download HPPR/2
[5] Service...
[X] Exit       your choice:
```

If a *power dow*n occurred while loading new firmware the restart of the download is different. The red LED of the HPPR/2 in boot mode is blinking *fast*.

The download can be restarted with `[1] Init HPPR/2` and `[3] Auto Download HPPR/2`.

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Remarks	Date	Signature