

HPPR

HP-Preamplifier

Technical Manual

Version 007



The information in this manual may be altered without notice.

Spectrospin AG accepts no responsibility for actions taken as a result of use of this manual. Spectrospin AG accepts no liability for any mistakes contained in the manual, leading to coincidental damage, whether during installation or operation of the instrument. Unauthorised reproduction of manual contents, without written permission from the publishers, or translation into another language, either in full or in part, is forbidden.

This Manual was written by

W. Roeck, R. Malacarne and R. Koch

Spectrospin AG, CH-8117 Fällanden

© November 25, 1994: Spectrospin AG
Fällanden, Switzerland

Updated for BASH 2.0 by U. Roos - December 1996

P/N: Z 31075
DWG-Nr.: 755007

Contents

	List of Index	7
1	Assembly	11
1.1	Overview	12
1.2	Features	12
2	Cover / Display Module	15
2.1	Controller	16
	Function description	17
	Gate Pulse Inverter	22
2.2	Display	24
	Functional description	25
2.3	Preamplifier Selector / Tuning Splitter	26
	Function description	27
3	HPPR - Interface	29
3.1	Message syntax	30
	Power up	30
	Error accepted	30
	Set 19F	31
	Gain plus	31
	Configuration	31
	Lock select	32
	Observe select	32
	Preamplifier Enable on/off	33
3.2	Command-sequences	34
	Multinuclear Mode	34
	QNP Mode	34
	X - Decoupling	35
	Triple Resonance Mode Inverse	35
	Triple Resonance Mode 13C	35
	Deuterium with 19F Lock	36
	19F Lock over USER-Box	36
	19F Observe Mode	36
3.3	Conclusion	37
4	1H Module	39
4.1	Preamplifier Board	41
	The Preamplifier	41
	The Bandpass filter	42
	The Blanking	43
	The Tuning Mode	44
4.2	Lambda/4 T/R-Hotswitch Box	46
	Functional description	46
	Power handling capability	46

4.3	Probehead Filter	49
4.4	Transmitter Filter	49
5	19F/1H/3H HP-Module	51
5.1	Preamplifier Board	53
	The Bandpass filter	53
6	X-BB Module	55
6.1	Preamplifier Board	57
	The Preamplifier	57
	The Blanking	58
	The Tuning Mode	59
6.2	X-BB T/R-Hotswitch Box	60
6.3	Probehead Filter	60
6.4	Transmitter Filter	60
7	2H Module	61
7.1	Preamplifier Board	63
	The Preamplifier	63
	The Tuning Mode	64
	The Blanking	64
7.2	2H T/R-Hotswitch Box	65
7.3	Probehead Filter	65
7.4	Transmitter Filter	65
8	19F Selective Module	67
8.1	Preamplifier Board	69
	Functional description	69
	The Bandpass filter	70
	The Blanking	70
	The Tuning Mode	71
8.2	Lambda/4 T/R-Hotswitch Box	72
8.3	Probehead Filter	72
8.4	Transmitter Filter	72
9	3H Module	73
9.1	Preamplifier Board	75
	Function description	75
	The Bandpass filter	76
	The Blanking	76
	The Tuning Mode	77
9.2	Lambda/4 T/R-Hotswitch Box	78
9.3	Probehead Filter	78
9.4	Transmitter Filter	78
10	QNP Control Module	79
10.1	QNP Functional Description	81
	Installation of the QNP Control Module	81
11	HPPR Configuration	83
11.1	CPMAS	84

11.2	Multinuclear Mode	85
11.3	QNP Mode 1	86
11.4	QNP Mode 2	87
11.5	X - Decoupling	88
11.6	Triple Resonance Mode Inverse	89
11.7	Triple Resonance Mode 13C	90
11.8	Deuterium with 19F Lock	91
11.9	19F Observe Mode	92
11.10	Selective Heteronuclear Mode	93
11.11	Reverse Mode	94
11.12	3H Observe Mode	95
12	Commonly used Circuits	97
12.1	Introduction	98
12.2	Power Supply Board	98
12.3	Junction Board	102
A	Technical Data	105
A.1	1H Module	106
A.2	High Power HPHP_19F/1H/3H Module	107
A.3	X-BB_31P_2HS Module	108
A.4	2H Module	109
A.5	19F Selektive Module	110
A.6	X-BB 19F 2HP Module	111
A.7	3H Module	112
A.8	Deadtimes	113
A.9	Power Consumption	113
B	Schematics	115
B.1	Assembly	116
B.2	Cover / Display Module	117
B.5	Common Circuits	126
	List of Figures	131
	List of Tables	135

List of Index

Numerics

19F	31
19F Lock over USER-Box.....	36
19F Observe Mode	36, 92
2H T/R-Hotswitch Box	65

B

Bismuth (209Bi)	60
Blanking	43, 58, 64, 70, 76

C

Channel Selector	25
Command-sequences	34
Configuration	31
Controller	
Setup	18
CPMAS.....	46, 84

D

Deuterium with 19F Lock	36, 91
DISPBRIGHT signal	25
Display	
Channel Selector button.....	25
Intensity Sensor	25
Observe- and Lock channel	25
Status	
COMPUTER-LED	25
ERROR-LED	25
READY-LED	25
Tuning/Matching-Indicator	25
Display Test button	25

E

EPROM.....	17
------------	----

G

Gain plus.....	31
Gate Pulse Inverter	22
Gate Pulse Logic	
Transmitter.....	20

H

HCL.....	98
High	12
HIGH POWER MODES.....	84
Hotswitch	46, 84
Hotswitch Box	46, 84

I

Indicators	25
Intensity Sensor	25

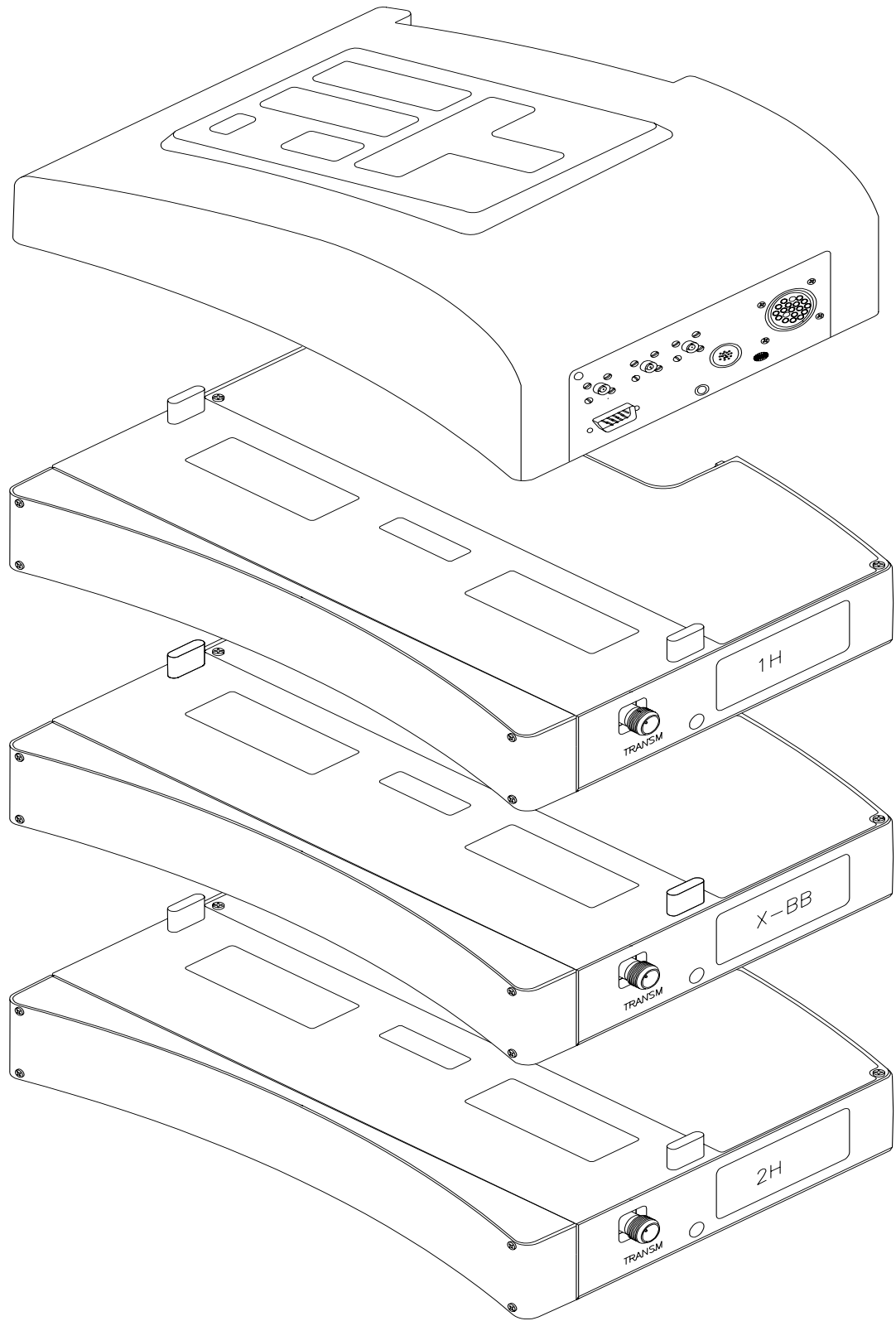
J

Jumper Settings.....	102
Junction board	102

L	Lambda/4 T/R-Hotswitch Box	43, 46, 72, 78, 84
	LED Indicators	25
	Light Intensity Sensor	25
	Lithium (6Li)	60
	Lock select	32
M	Matching see Tuning/Matching	25
	Microcontroller center	
	80C535	17
	EPROM	17
	Flash-Memory	17
	SRAM	17
	MMIC	42
	MSA1105	42
	Multinuclear Mode	34, 84, 85
N	Normal Mode	18
O	Observe select	32
	Observe Signal	
	19F Observe	20
	1H Observe	20
	2H Observe	20
	USER-Box Observe	20
	X-BB Observe	20
	operating	12
P	PCODE	98
	Performance	12
	Power handling capability	46
	Power Supply Board	98
	Power up	30
	Preamplifier En-/Disable	98
	Preamplifier Selector	27
	Probehead filter	49, 60, 65, 72, 78
Q	QNP Mode	34
	QNP Mode 1	86
	QNP Mode 2	87
R	RCPI-Logic	19
	REF ON/OFF	59
	Reference Resistor	45, 59
	Reset- and Wakeup -Logic	18
	Reverse Mode	94
	RS232	17
S	Selective Heteronuclear Mode	93
	Serial Port	
	RS232	17
	Sleep- and Normal -Mode	18
	Solids	53
	SP	

	Transmitter Pulse (Senderpuls).....	20
	Status Indicator	25
	COMPUTER-LED	25
	ERROR-LED.....	25
	READY-LED	25
T		
	T/R switch.....	43, 60, 65
	Transmitter filter	49, 60, 65, 72, 78
	Transmitter gate pulse	
	SP-F0	20
	SPP-AF19	20
	SPP-AH	20
	SPP-AX	20
	Triple Resonance Mode 13C.....	35, 90
	Triple Resonance Mode Inverse	35, 89
	TUNE ON/OFF	59
	Tuning Mode	44, 59, 64, 71, 77
	Tuning Splitte	27
	Tuning/Matching-Indicator.....	25
V		
	VCC	98
	VCTRL line.....	98
	VDD	98
	VDD_SW	98
	VSS	98
W		
	Wakeup Logic.....	18
X		
	X - Decoupling	35, 88
	X-BB T/R-Hotswitch Box	60

Figure 1: Exploded View



The High Performance Preamplifier Assembly (hereafter referred as HP Preamp) consists, in the basic configuration, of a ¹H module, a X-BB module, a ²H module and a Cover/Display unit. All modules are 'Fourier capable' and are intended for use with up to 400 W transmission power. The basic configuration may later be updated with a maximum of two extra modules.

The modules, with identical casts, contain a preamplifier, and a Transmitter/Receiver switch including necessary high performance filters in the transmitter and probehead paths.

The display indicates the operating status of the HP Preamp. The observe channel, the lock channel, and other information, are indicated on the large format LED. When in progress, data communication is indicated. The T-junction LED indicates - during the operation of the tuning 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 19 core cable supplies all DC voltages and required transmission pulses. A RS 232C connection is used for command and data transfer between the Console and the HP Preamp.

Ease of Operation

Cast aluminium housing for enhanced noise immunity

Improved lock stability through integrated lock preamplifier

FFT capable lock

Integrated filter in Transmitter and Probehead path (400 W pulse power)

Automatic routing of the Receiver and Lock channel

Modular arrangement , up to 5 modules maximum

No magnetic switches (Relays)

Communication via RS 232C with X 32

Probehead tuning (Wobblefunction)

Figure 2: HP Preamp - Block Diagram -

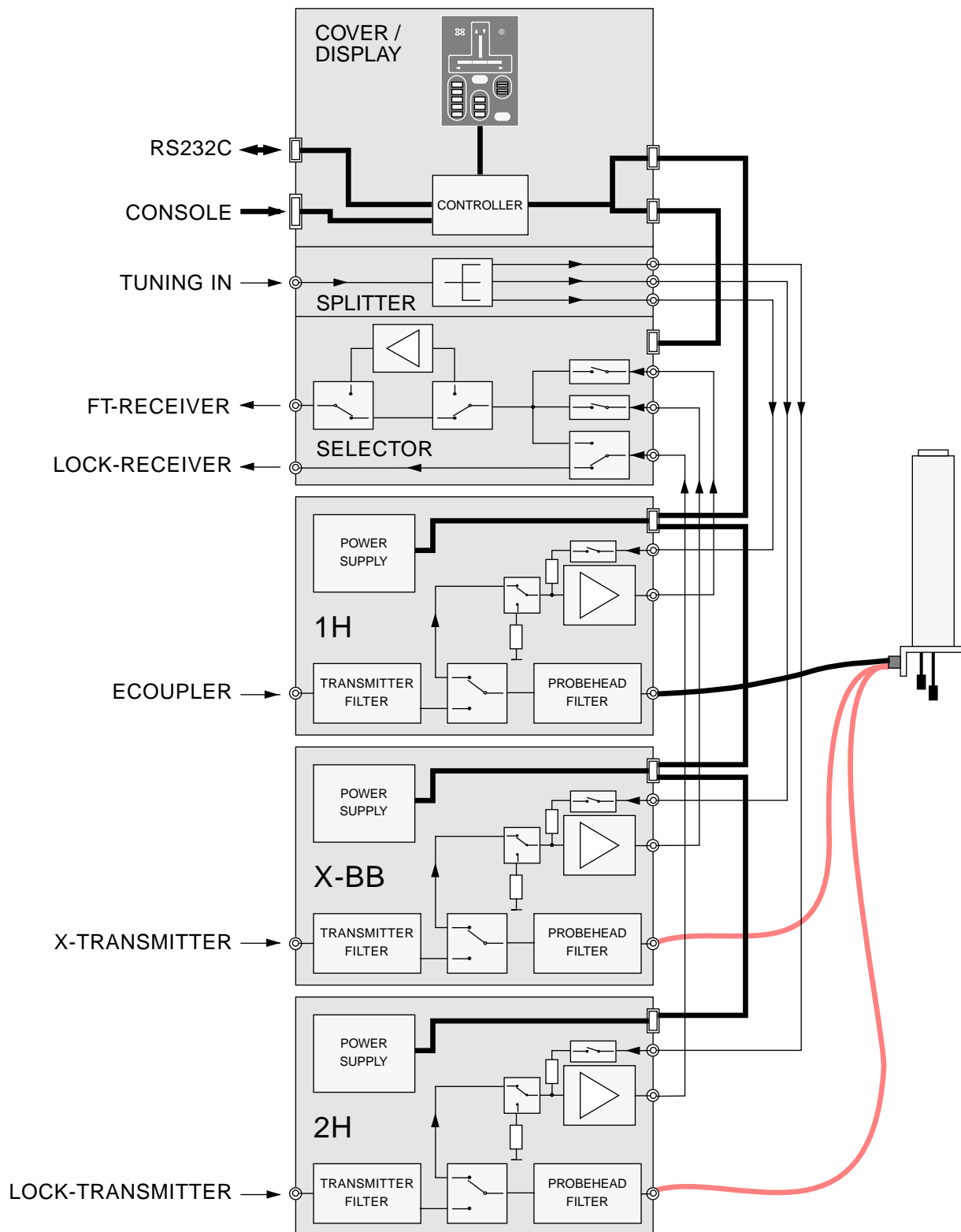
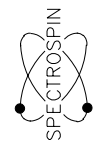
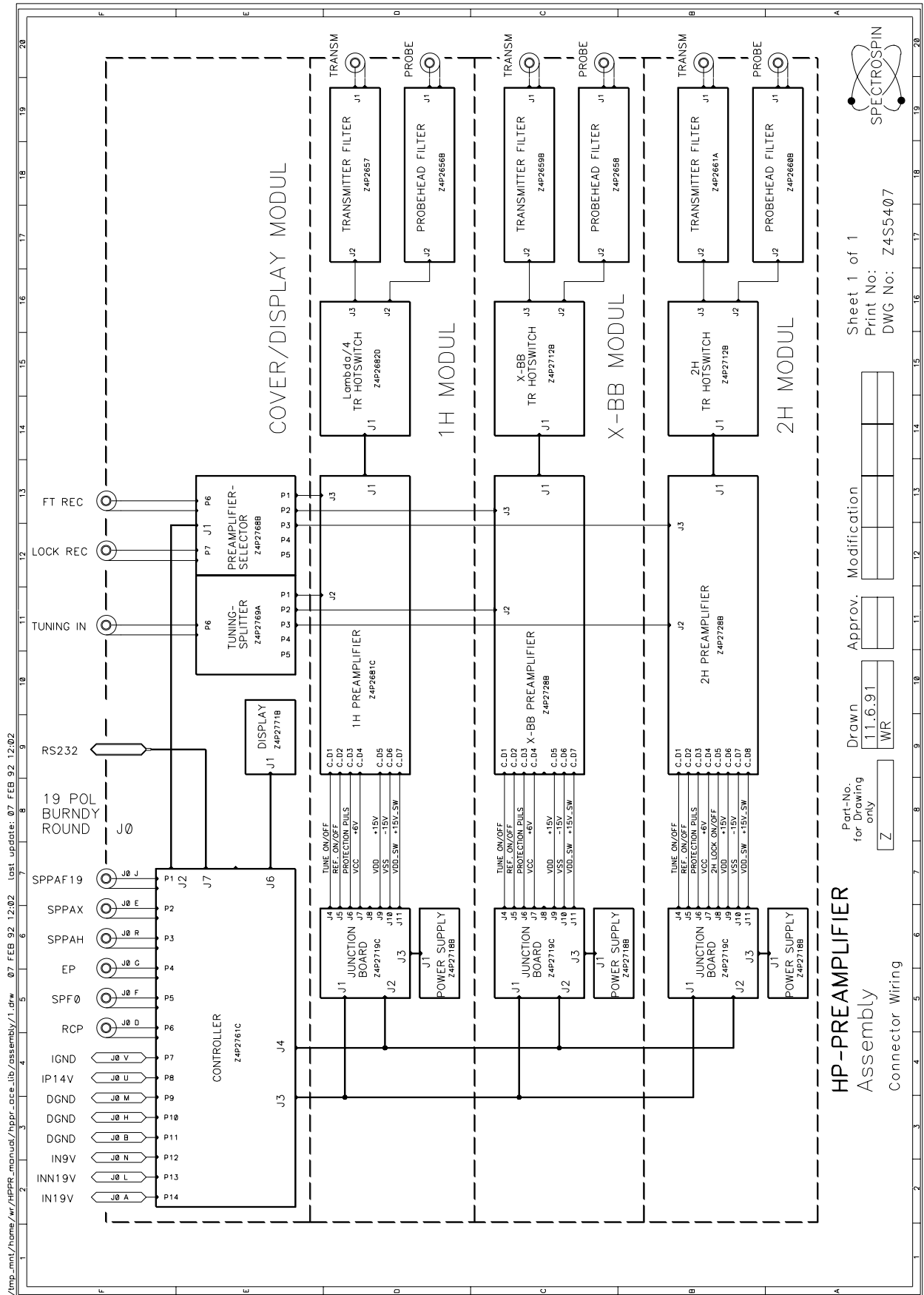


Figure 3: Connector Wiring - Block Diagram -



Sheet 1 of 1
Print No:
DWG No: Z4S5407

Part-No. for Drawing only	Drawn	Approx.	Modification
Z	11.6.91 WR		

HP-PREAMPLIFIER
Assembly
Connector Wiring

Figure 4: Cover / Display Module - Exploded View -

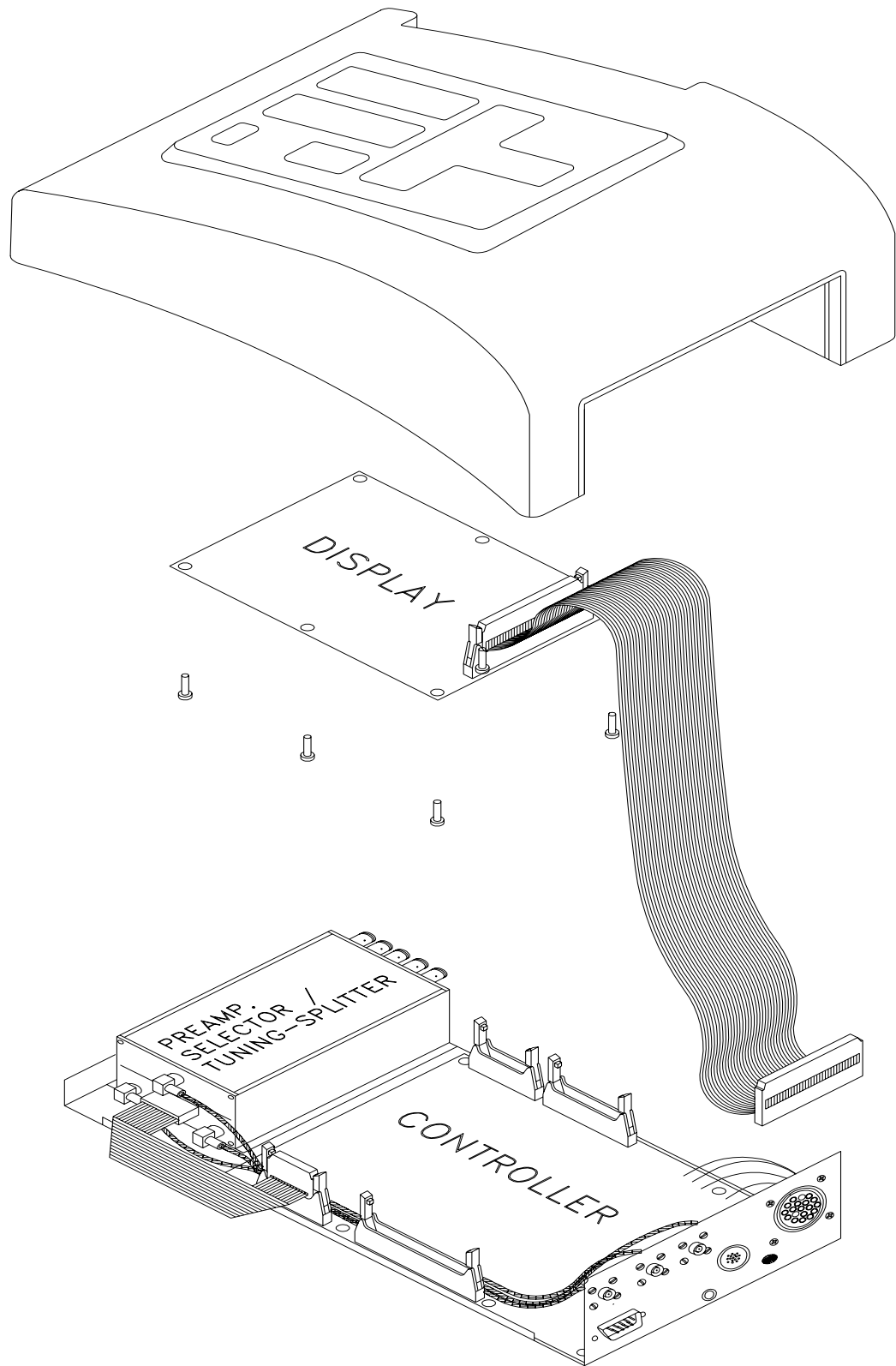
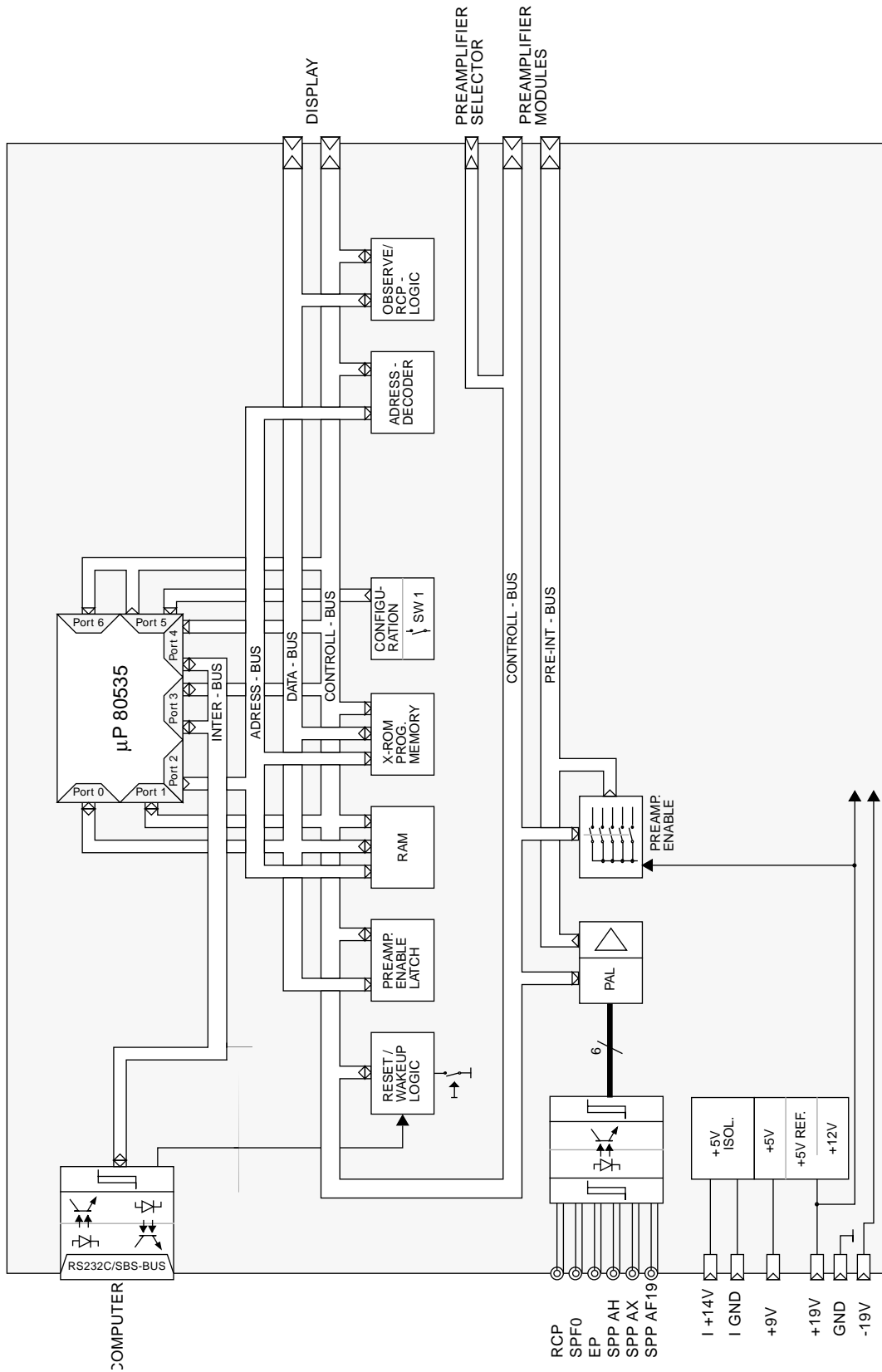


Figure 5: Controller - Block Diagram -



General

The Controller is responsible for the HF electronics in the HP Preamp. The display indicates the current status of the HP Preamp.

Microcontroller

The heart of the Controller consists of a 80C535 (12 MHz) Microcontroller, a 32k*8 SRAM, a 32k*8 EPROM, a 32k*8 or 64k*8 Flash-Memory and an address decoder. The startup and download software is found in the EPROM. The Flash memory contains the application software. The operating software can be updated to the Flash memory by downloading through the serial port.

Serial Port RS232

All commands between the X32 and the HP Preamp are transferred via the RS 232. The port is galvanically isolated. A handshake system (RTS, DTR) which is controlled by the X32 - RS232 drivers must, in the case of the RTS and DTR lines, operate on a 12 V level. The HP Preamp communication system requires no other handshake connections (pure software handshake).

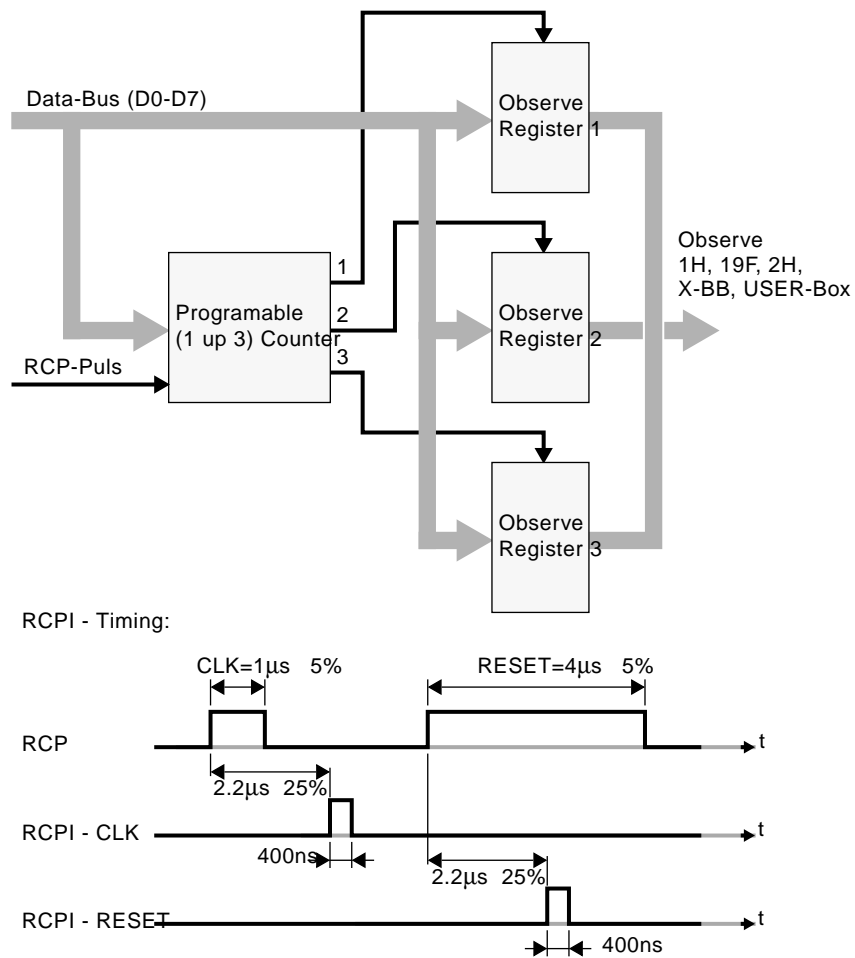
Table 1: RS232: 9-pol D-Sub connector (male)

Pin	Signal	Remark
1	CD	connected with RTS, DSR
2	TXD	
3	RXD	
4	DTR	connected with CTS
5	GND	
6	DSR	connected with CD, RTS
7	RTS	connected with CD, DSR
8	CTS	connected with DTR
9	RI	not connected

RCPI-Logic

The Preamp controller operates either in normal mode or in sleep mode. In the first case all commands are received from the serial port. To ensure that an experiment is not disturbed by the oscillator clock, the data communication unit sets the controller to sleep mode during measurements. For certain measurements it is necessary to change the observe channel. The RCPI logic allows a fast channel change during sleep mode. The logic consists of three registers and a programmable counter. An observe channel can be activated via the serial port in the register. The number of the observe channel change is programmed in the counter (1 ... 3). The counter is incremented (modulo channel change number) with a pulse of $1 \mu\text{s}$ ($\pm 5\%$) on the RCP input. With a pulse of $4 \mu\text{s}$ ($\pm 5\%$) at the RCP input, the counter returns to the reset position (the configuration of register 1 is active). In the normal mode the RCPI logic is switched back. The RCP input is disabled.

Figure 7: RCPI Interface



Transmitter Gate Pulse Logic

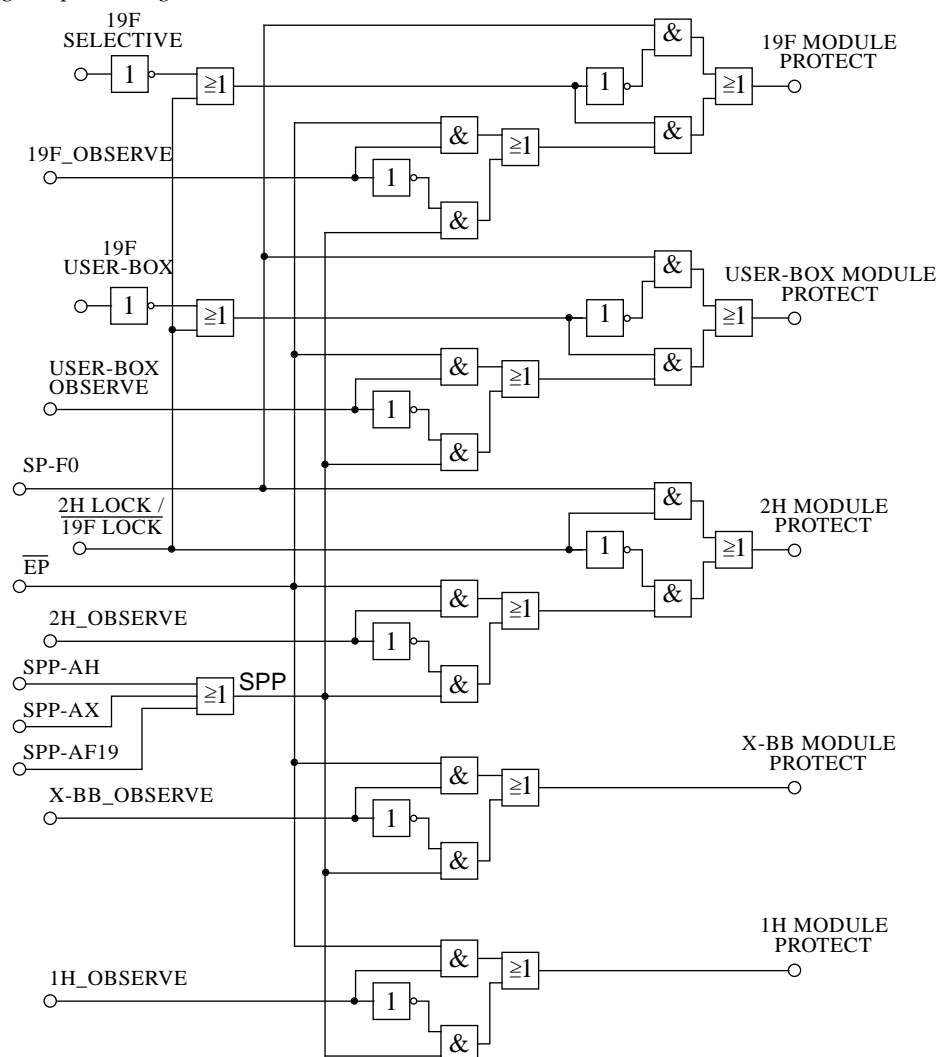
The four transmitter gate pulses: SP-F0, SPP-AH, SPP-AX and SPP-AF19 are allocated to a maximum of five Preamp modules. The ^2H Module, the ^{19}F Module or the corresponding USER Box Module can operate in either Fourier- or Lock mode. Depending on the system, either the SP-F0 or another gate pulse is used. In addition, ^{19}F measurements with a ^{19}F selective module or with an appropriately equipped USER-Box (QNP) may be completed.

At certain times the correct setting for the transmitter gate pulse in the module will be set by a command from the controller. The OBSERVE-Signal and the ^2H -Lock / ^{19}F -Lock signal control the switching.

For example: A ^1H experiment with BB-decoupling uses an inverted EP pulse to protect the ^1H Module whereas the X-BB Module is protected by the OR-transmitter gate pulse.

The principle illustrated by this example may be applied to all known experiments. The transmitter gate pulse logic is found on the controller print.

Figure 8: Transmitter gate pulse logic



PAL-Equations for the Transmitter gat pulse logic

Standard declarations

= OR
& = AND
SPP = (SPPAH # SPPAX # SPPAF19);

Transmitter Gate Pulse Equations

19FPROTECT = ((2HLOCK # !SEL19F) & ((EPFTn & OBS19F) # (!OBS19F & SPP)))
 # (SPF0 & !(2HLOCK # !SEL19F)) ;

UBPROTECT = ((2HLOCK # !UB19F) & ((EPFTn & OBSUB) # (!OBSUB & SPP)))
 # (SPF0 & !(2HLOCK # !UB19F)) ;

2HPROTECT = (!2HLOCK & ((!OBS2H & SPP) # (OBS2H & EPFTn)))
 # (SPF0 & 2HLOCK) ;

XBBPROTECT = (!OBSXBB & SPP) # (OBSXBB & EPFTn) ;

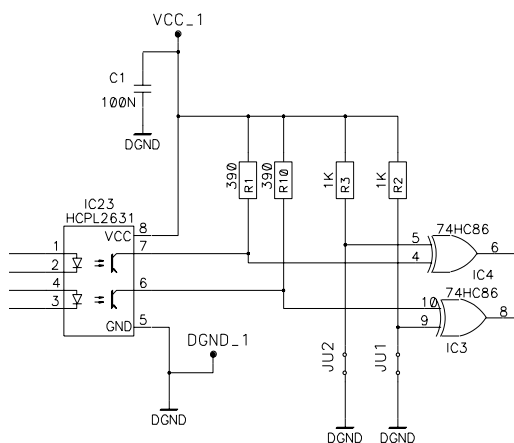
1HPROTECT = (!OBS1H & SPP) # (OBS1H & EPFTn) ;

General

In the new spectrometer series DMX, DSX, DRX,DPX and D.. the gate pulses SP-PAH, SPPAX, SPPAF19 and RCP change from positive logic (active High) to negative logic (active Low). The SPF0 and EP pulses remain in their old positive-active state.

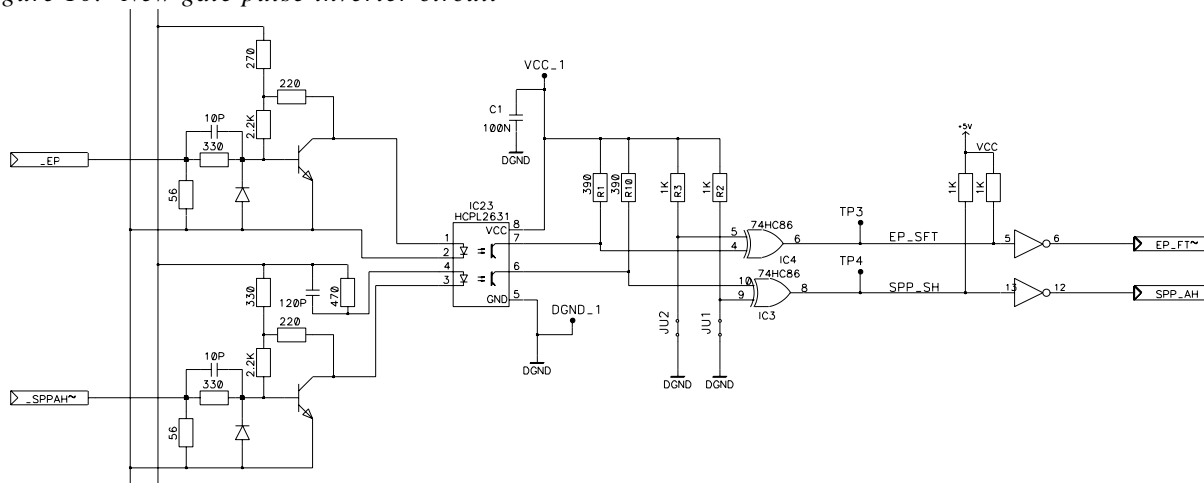
Function description

Figure 9: Puls inverter subprint (1 of 3 circuits)



The optocouplers IC14, IC23 and IC26 on the controller board have been replaced by sockets. The subprint plugged into these sockets contains the new circuits shown above.

Figure 10: New gate pulse inverter circuit



It is possible to select negative- or positive-active pulses by jumpers. Each open jumper provides an additional inverter in the designated signal path. The schematic above shows the EP and SPPAH gate pulse path. Note that the EP pulse channel of the optocoupler IC23 is different to all other optocoupler circuits. It is designed as an inverter.

Table 2: Default jumper settings for positive-active gate pulses

Input pulse		Jumper settings			Output pulse	
Name	+/- activity	JU# ¹	closed (Puls)	open (Puls)	Name	+/- activity
_RCP	positive	JU4	X		RCP	positive
_SPF0	positive	JU3	X		SP_F0	positive
_EP ²	positive	JU2	X		EP_FT ~	negative
_SPPAH	positive	JU1	X		SPP_AH	positive
_SPPAX	positive	JU6	X		SPP_AX	positive
_SPPAF19	positive	JU5	X		SPP_AF19	positive

¹ Jumper JU7 is not used (reserve)

Table 3: New jumper settings for negative-active gate pulses

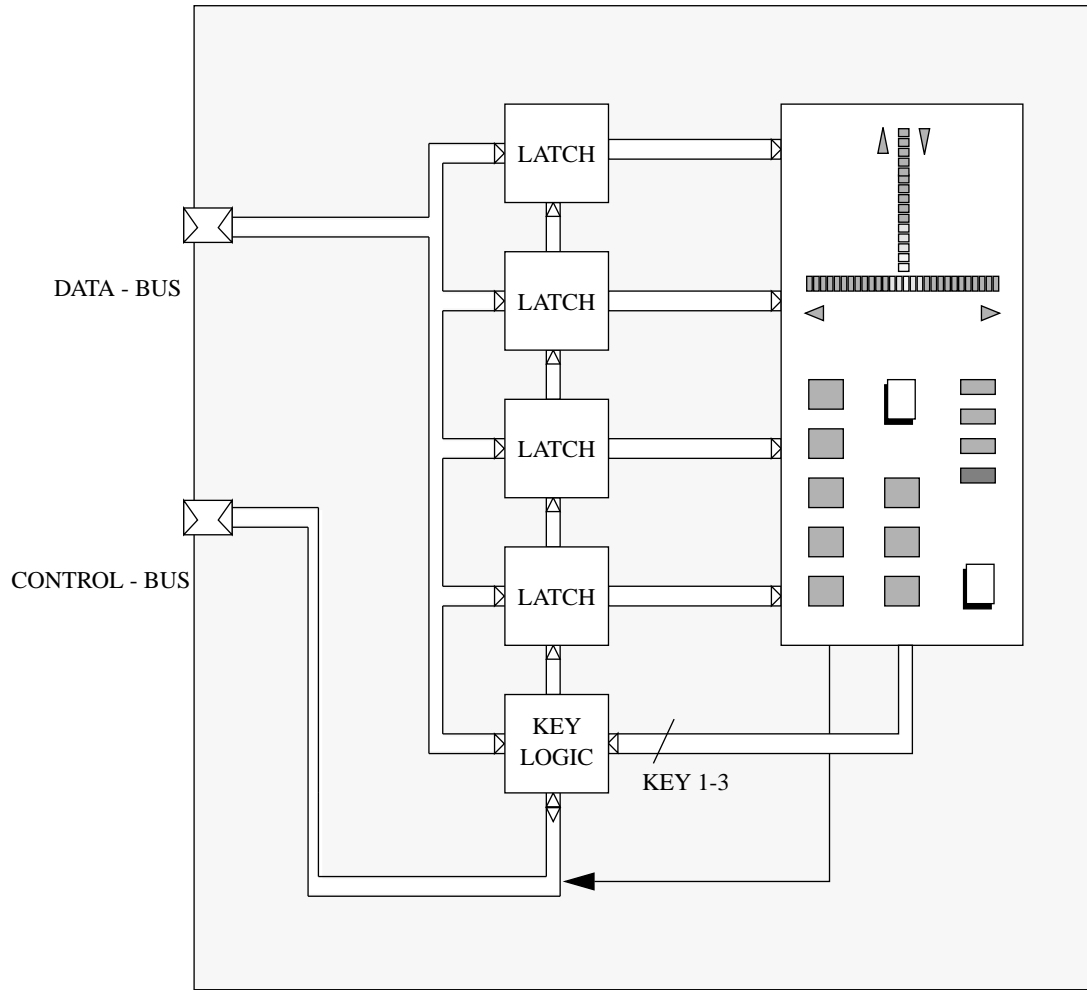
(For spectrometer series DMX, DSX, DRX and D..)

Input pulse		Jumper settings			Output pulse	
Name	+/- activity	JU# ¹	closed (Puls)	open (Puls)	Name	+/- activity
_RCP ~	negative	JU4		X	RCP	positive
_SPF0	positive	JU3	X		SP_F0	positive
_EP ²	positive	JU2	X		EP_FT ~	negative
_SPPAH ~	negative	JU1		X	SPP_AH	positive
_SPPAX ~	negative	JU6		X	SPP_AX	positive
_SPPAF19 ~	negative	JU5		X	SPP_AF19	positive

¹ Jumper JU7 is not used (reserve)

² The optocouplers IC23 EP pulse channel is different to the other optocoupler circuits. It is designed as an inverter. Thus the jumper JU2 has to be closed to get a negative-active pulse (EP_FT ~) at the output.

Figure 11: Display - Block Diagram -



The display indicates the current status of the HP Preamp. It is divided into 6 parts:

1. Observe- and Lock channel indicator:

Denotes the Lock- and the Observe channel (green LED)

2. Status Indicator:

COMPUTER-LED:	Data transfer via RS232
READY-LED:	Stand by for further commands
ERROR-LED:	Indicates Preamp problems

3. Tuning/Matching Indicator:

This display only becomes active when the HP Preamp is in Tuning/Matching mode.

4. Channel Selector button:

Allows to change channels for multiple channel Tuning/Matching.

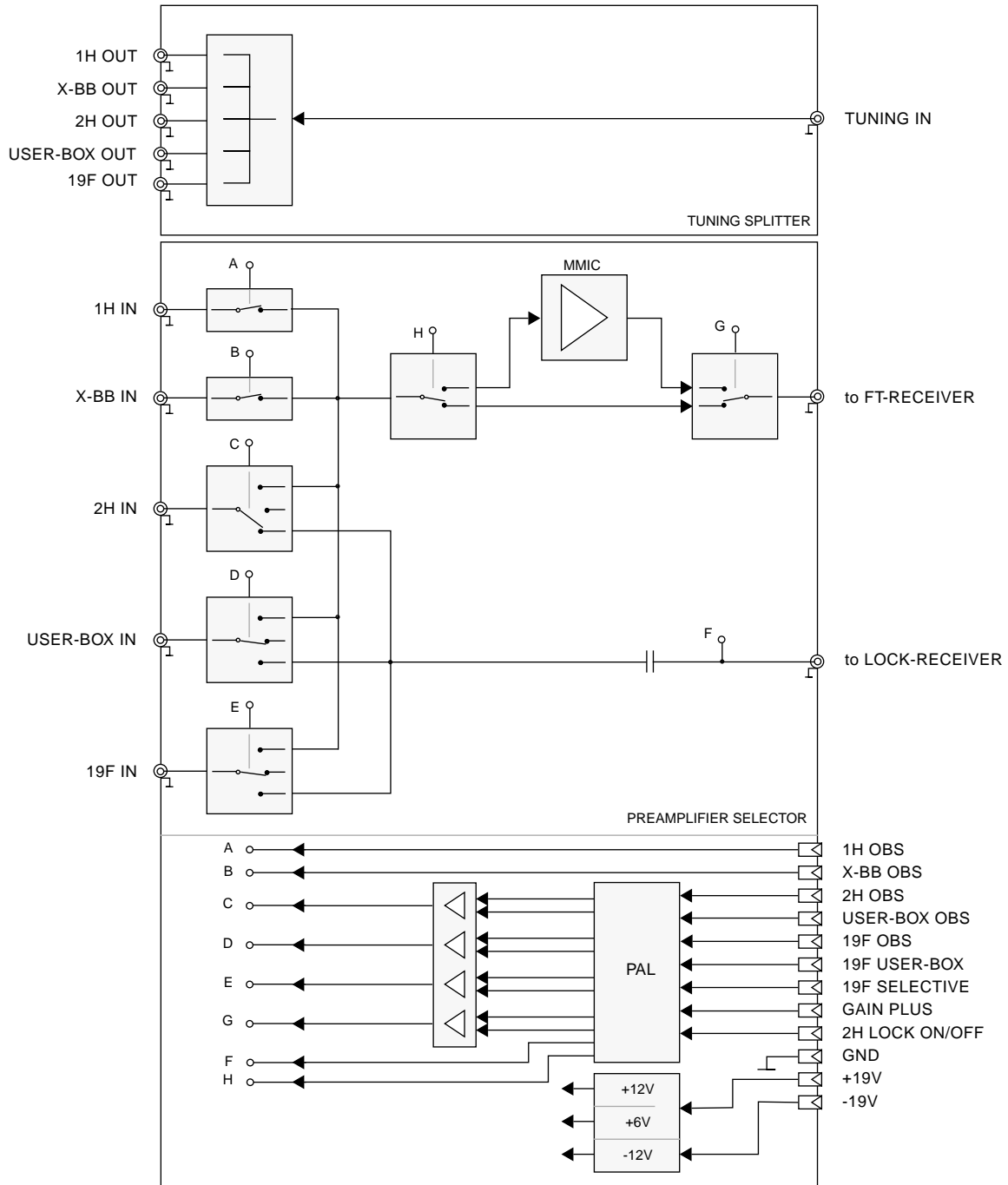
5. Display Test button:

All display elements light up whilst pressing this button. When pressing both the Channel selector and Display test buttons the OBSERVE LED's will indicate which modules are available.

6. Light Intensity Sensor: (Valid for Covermodules delivered until Q4/1994)

Measures the ambient light intensity and adjusts the display brightness accordingly. The voltage drop over the LDR is periodically measured. This value determines the differences in the ON/OFF ratio from the DISP-BRIGHT signal. The DISP-BRIGHT signal switches the indicator latches on and off and therefore also the LED.

Figure 12: Preamp Selector / Tuning Splitter - Block Diagram -



The Preamplifier Selector

The Preamplifier Selector and the Tuning Splitter are situated in the same housing, but are electrically isolated. The selector links the outputs of the following units:

¹H-Module
X-BB- Module
²H-Module
¹⁹F-Module
User-Box

It distributes the Observe signal and the Lock signal, depending on software settings, to the two outputs for the FT- and the Lock receiver.

The ²H-, the User-Box- and the ¹⁹F Preamp can be switched either to the

LOCK channel,

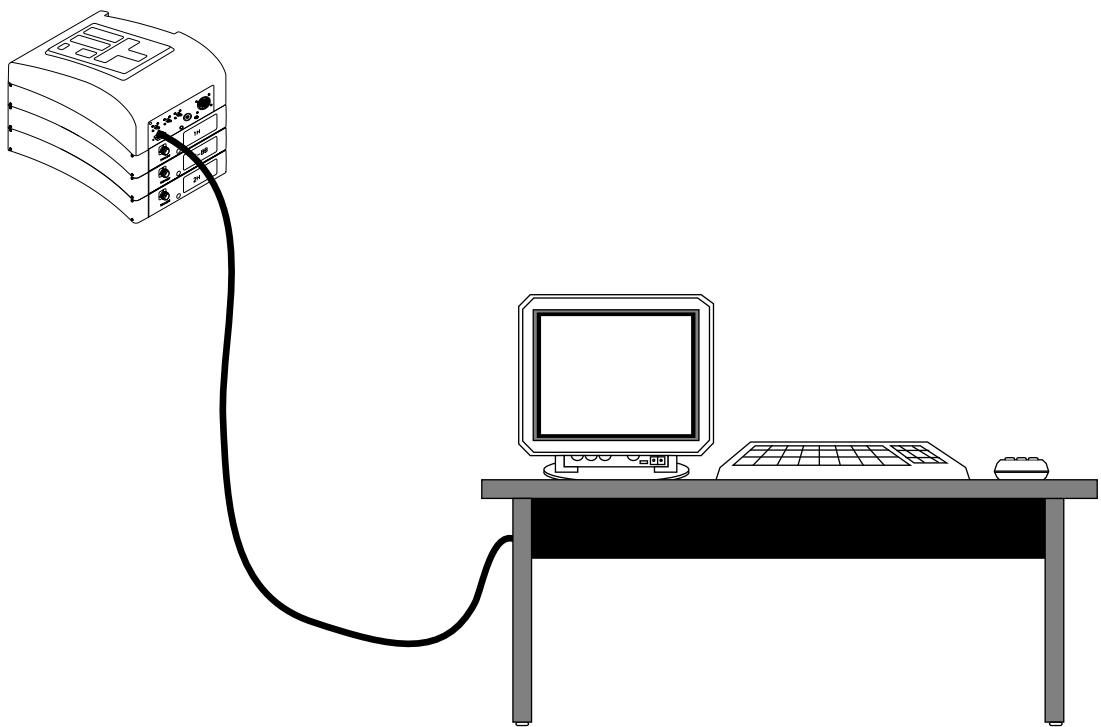
or to the FT channel.

The ¹H- and the X-BB Preamps may only be used with the FT channel. The HF switch matrix consists of 16 PIN diodes, two for each path. The HF switch and its controller are placed on a single multilayer print. The control signals for the HF parts are generated by a PAL (Type 18CV8) and a quad op-amp in SMD technology. Two 100 mA voltage regulators are used to stabilise the voltage from 19 V to 12 V DC.

An additional command (Gain Plus) increases the Gain for the signal to the FT receiver by about 8 - 15 dB depending on the frequency. The additional gain is mainly used in the X range for nuclei like ¹⁵N, that have a low level signal.

The Tuning Splitter

The Tuning Splitter consists a broadband resistor divider. The splitting loss is about 14 dB.



Overview

- Command name transmitted character-string
- Command-description
- Back-message if the command executed without errors
- Example

Legend:

A - Z :	ASCII-Character 'A' - 'Z'
a - z :	ASCII-Character 'a' - 'z'
00 - ff :	Hex letter
ch :	checksum = sum of the seven characters before the checksum
x :	no significance
Xi :	actual value of bytes (for example: -1 = ffh, 1 = 01h)
Module-number:	2H 0
	X-BB 1
	1H 2
	USER-Box 3
	19F 4
	No module 5
on :	01h
off :	00h

Power up

3.1.1

Power up A x x x x x ch

This command sets the HPPR into a reset-state; like a hardware-reset. Additionally, this command serves for the detection of a power-supply break. As back-message, a short identify-string „HPPA“ will be transmitted.

Back-message:

X1, X2 = 00h

A X1 X2 H P P A ch

Error accepted

3.1.2

Error accepted E x x x x x ch

Set error-flag back in HPPR. New commands will be accepted

Back-message: E X1 x x x x x ch

X1: Error-code

Set 19F F X1 x x x x x ch

X1: Module-number

Configure the HPPR for 19F measurements by the 19F selective-module or the USER-Box module with QNP(19F) contents. (default: X1 = no module)

Back-message: F X1 x x x x x ch

Example:

for QNP(19F) F 3 x x x x x ch

for 19F-Selective F 4 x x x x x ch

Remark:

Even for 19F-Lock has to be set the 19F-selective command

Gain plus

3.1.4

Gain plus on/off G X1 x x x x x ch

X1: on/off

Switch the additional gain stage in the preamplifier-selector

Back-message: G X1 x x x x x ch

Example:	G 01 x x x x x ch	Gain on
	G 00 x x x x x ch	Gain off

Configuration

3.1.5

Configuration K x x x x x x ch

Read module-code of the available preamplifier-modules

Back-message:

Xi: Preamplifier-Code of Module-number i. Code=0 means: No module available

K X0 X1 X2 X3 X4 x ch

Example: K 63 5D 1B 0 0 x ch

X0 = 63h means: 2H Module available, HCL C^I

X1 = 5Dh means: X-BB Module available, HCL E

X2 = 1Bh means: 1H Module available, HCL C

X3 = 0 means: no preamplifier available

X4 = 0 means: no preamplifier available

I. HCL = Hardware Change Level. Used for software-configuration and not correlated with ECL

Lock select L X1 X2 x x x ch
 X1: W: Write-operation, R: Read-operation (X2 is ignored)
 X2: Module-number of the lock-channel (no lock is 5)

Set the lock-channel (X1=W) or read the actual settings (X1=R). The corresponding preamplifier enable will be automatically activated. 2H, 19F or USER-Box are the only possible lock-channel! It is not possible to be lock-channel and observe-channel at the same time (otherwise error-message).

Back-message:
 X3: Module-number of the active observe-channel
 L X1 X2 X3 x x x ch

Examples:
 for 2H L W 0 x x x x ch
 for 19F L W 4 x x x x ch
 for USER-Box L W 3 x x x x ch

Observe select O X1 X2 x x x ch
 X1: W: Write-operation, R: Read-operation (X2 is ignored)
 X2: Module-number of the observe-channel (no module is 5)

Set the observe-channel (X1=W) or read the actual settings (X1=R). The corresponding preamplifier enable will be automatically activated. It is not possible to be observe-channel and lock-channel at the same time (otherwise error-message).

Back-message:
 X3: Module-number of the active observe-channel
 O X1 X2 X3 x x x ch

Examples:
 for 2H O W 0 x x x x ch
 for X-BB O W 1 x x x x ch
 for 1H O W 2 x x x x ch
 for USER-Box O W 3 x x x x ch
 for 19F O W 4 x x x x ch

Preamplifier enable on/off P X1 X2 X3 x x x ch

X1: W: Write-operation, R: Read-operation (X2 and X3 are ignored)

X2: Module-number: Module-number = no module and X3 = on
means all preamplifier on

Module-number = no module and X3 = off
means all preamplifier off, without the active observe-
and lock-channel

X3: Preamplifier enable on/off

Set the preamplifier enable (X1 = W, switch the preamplifier-gain-modul power-supply) or read the actual settings (X1 = R).

It is not allowed to set the preamplifier enable off on a lock- or observe-channel (otherwise error-message).

Back-message:

Xi: Module-number i on/off
P X0 X1 X2 X3 X4 x ch

Example:

for 1H off P W 2 00 x x x ch

Command-sequences

3.2

Multinuclear Mode

3.2.1

			OBS	
observe nucleus :	X		<input type="text" value="1H"/>	
decoupling :	1H		<input type="text" value="X-BB"/>	LOCK
lock :	2H		<input type="text" value="2H"/>	<input type="text" value="2H"/>
			<input type="text" value="19F"/>	<input type="text" value="19F"/>
set 2H lock:	L W 0 x x x x ch		<input type="text" value="UB"/>	<input type="text" value="UB"/>
set observe channel X:	O W 1 x x x x ch			

QNP Mode

3.2.2

observe nucleus : 13C, 31P, 19F
 decoupling : 1H
 lock : 2H

For USER-Box with X-BB19F 2HP contents

			OBS	
set 2H lock:	L W 0 x x x x ch		<input type="text" value="1H"/>	
set observe channel UB:	O W 3 x x x x ch		<input type="text" value="X-BB"/>	LOCK
			<input type="text" value="2H"/>	<input type="text" value="2H"/>
			<input type="text" value="19F"/>	<input type="text" value="19F"/>
			<input type="text" value="UB"/>	<input type="text" value="UB"/>

For a standard X-BB19F 2HS

			OBS	
set 2H lock:	L W 0 x x x x ch		<input type="text" value="1H"/>	
set observe channel X:	O W 1 x x x x ch		<input type="text" value="X-BB"/>	LOCK
			<input type="text" value="2H"/>	<input type="text" value="2H"/>
			<input type="text" value="19F"/>	<input type="text" value="19F"/>
			<input type="text" value="UB"/>	<input type="text" value="UB"/>

X - Decoupling

3.2.3

observe nucleus :	1H	OBS	
decoupling :	X	<input type="text" value="1H"/>	
lock :	2H	<input type="text" value="X-BB"/>	LOCK
		<input type="text" value="2H"/>	<input type="text" value="2H"/>
		<input type="text" value="19F"/>	<input type="text" value="19F"/>
set 2H lock:	L W 0 x x x x ch	<input type="text" value="UB"/>	<input type="text" value="UB"/>
set observe channel 1H:	O W 2 x x x x ch		

Triple Resonance Mode Inverse

3.2.4

observe nucleus :	1H	OBS	
decoupling 1 :	13C	<input type="text" value="1H"/>	
lock :	2H	<input type="text" value="X-BB"/>	LOCK
decoupling 2 :	15N	<input type="text" value="2H"/>	<input type="text" value="2H"/>
		<input type="text" value="19F"/>	<input type="text" value="19F"/>
set 2H lock:	L W 0 x x x x ch	<input type="text" value="UB"/>	<input type="text" value="UB"/>
set observe channel 1H:	O W 2 x x x x ch		

Triple Resonance Mode 13C

3.2.5

observe nucleus :	13C	OBS	
decoupling 1 :	1H	<input type="text" value="1H"/>	
lock :	2H	<input type="text" value="X-BB"/>	LOCK
decoupling 2 :	15N	<input type="text" value="2H"/>	<input type="text" value="2H"/>
		<input type="text" value="19F"/>	<input type="text" value="19F"/>
set 2H lock:	L W 0 x x x x ch	<input type="text" value="UB"/>	<input type="text" value="UB"/>
set observe channel X:	O W 1 x x x x ch		

Deuterium with 19F Lock

3.2.6

observe nucleus :	2H	OBS	
decoupling :	1H	1H	
lock :	19F	X-BB	LOCK
		2H	2H
		19F	19F
set 19F lock:	L W 4 x x x x ch	UB	UB
set observe channel 2H:	O W 0 x x x x ch		
set 19F by 19F-Selective:	F 4 x x x x x ch		

19F Lock over USER-Box

3.2.7

only possible for USER-box with X-BB19F 2HP contents		OBS	
lock :	19F	1H	
		X-BB	LOCK
		2H	2H
set UB lock:	L W 3 x x x x ch	19F	19F
set 19F by USER-Box:	F 3 x x x x x ch	UB	UB

19F Observe Mode

3.2.8

observe nucleus :	19F	OBS	
decoupling :	1H	1H	
lock :	2H	X-BB	LOCK
		2H	2H
		19F	19F
set 2H lock:	L W 0 x x x x ch	UB	UB
set observe channel 19F:	O W 4 x x x x ch		

		OBS		
1H:	O W 2 x x x x ch	1H		
X-BB:	O W 1 x x x x ch	X-BB	LOCK	
2H:	O W 0 x x x x ch	2H	2H	L W 0 x x x x ch
19F:	O W 4 x x x x ch	19F	19F	L W 4 x x x x ch
UB:	O W 3 x x x x ch	UB	UB	L W 3 x x x x ch

Figure 13: 1H Module - Exploded View -

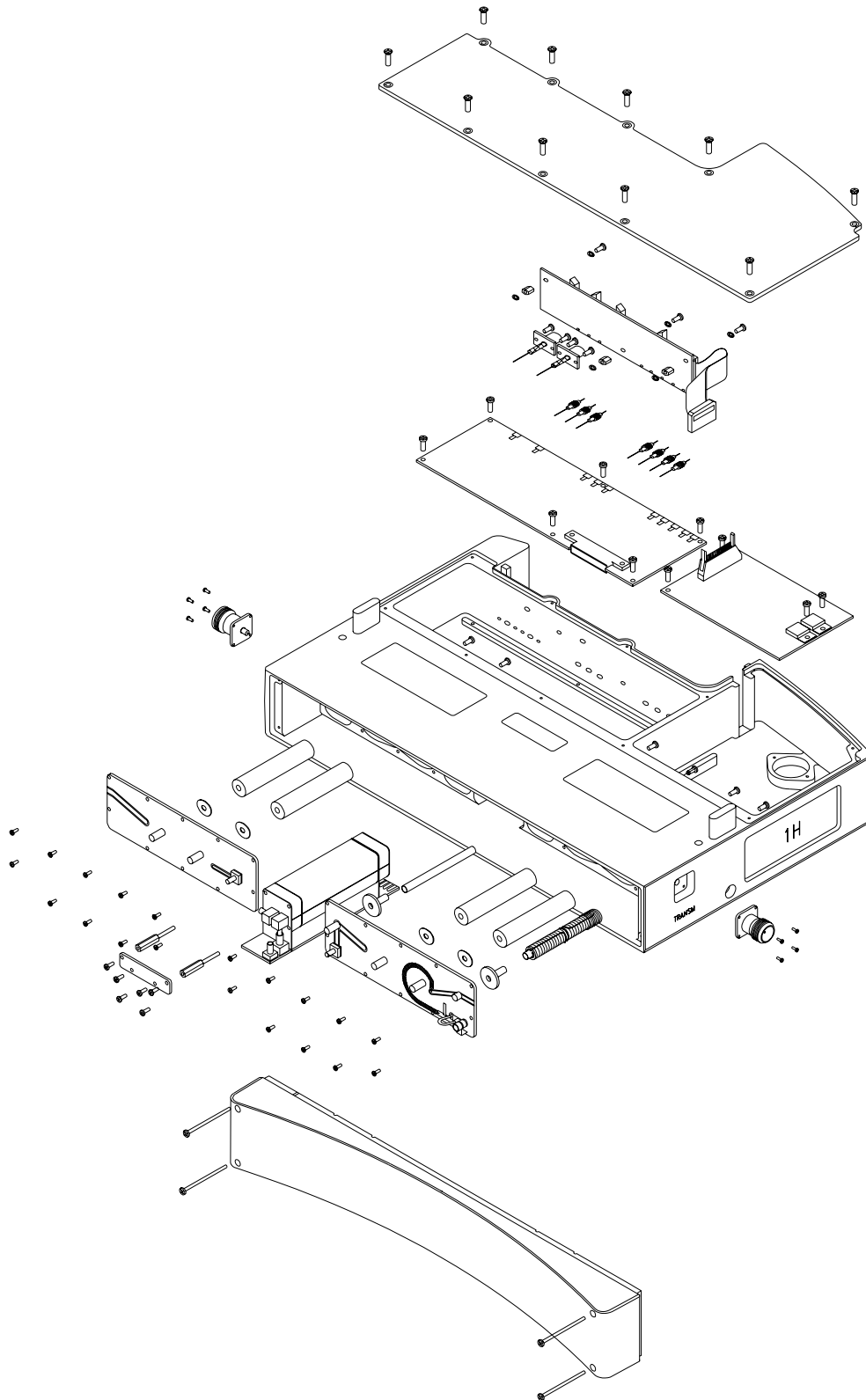
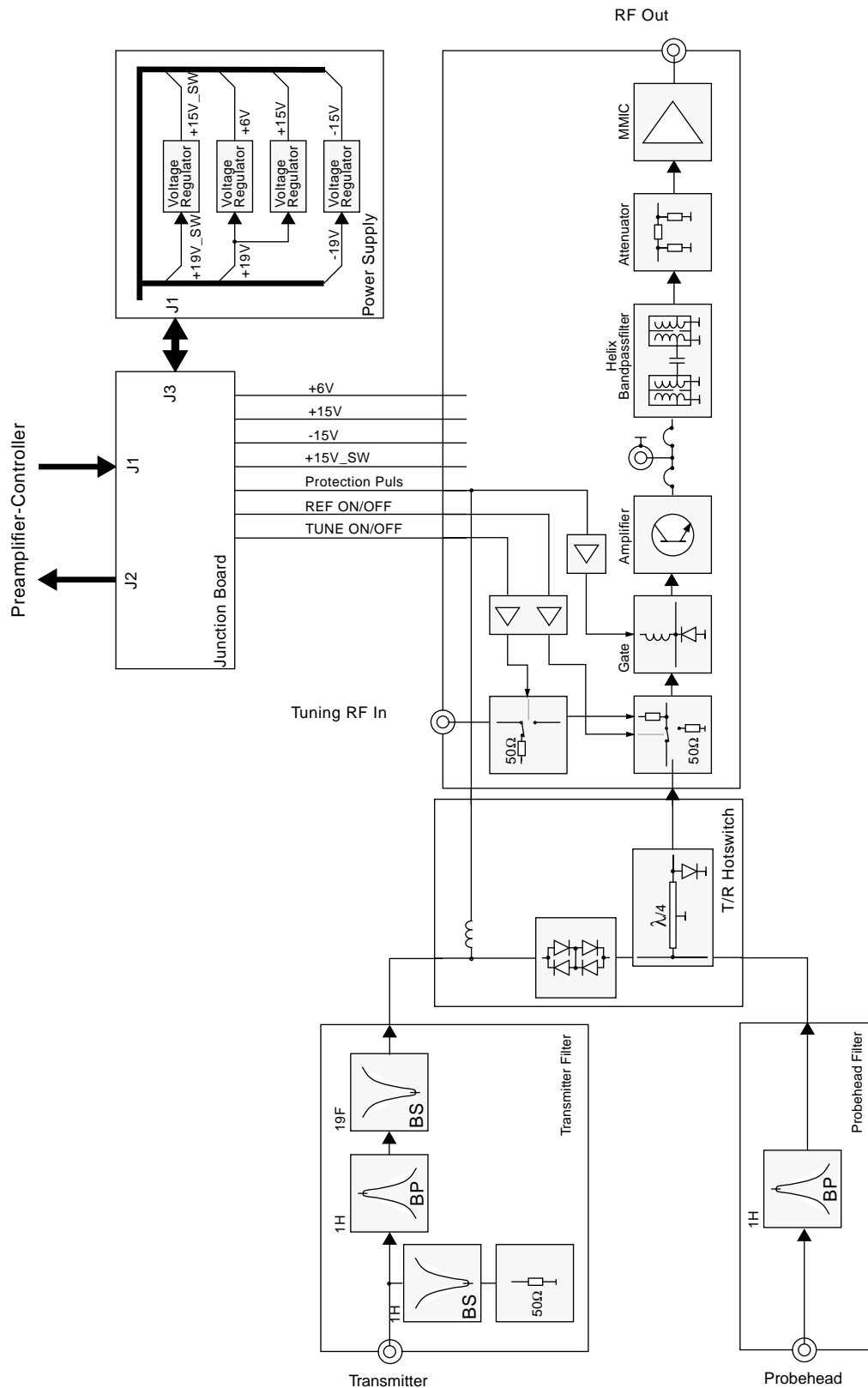


Figure 14: 1H Module - Block Diagram -



The Preamplifier

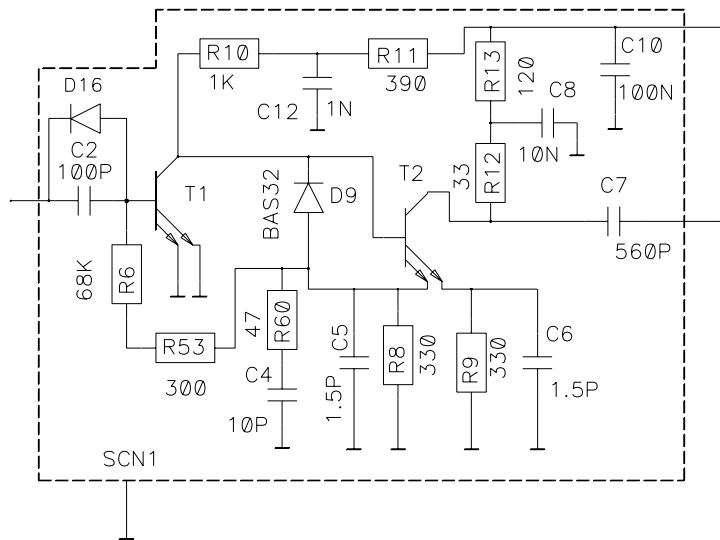
4.1.1

The newest possible components and an embrace of modern technology characterise this Preamplifier. Optimal assembly of the unit is only possible through computerised, automated, high-tech testing stations.

The HP Preamplifier is extremely sensitive to replacement and readjustment of faulty parts. Therefore we strongly recommend that necessary work be completed in service stations or at the originating plant: Spectrospin/Switzerland.

A broad or entire exchange is, however, possible for service engineers and will lead to re-establishment of HP Preamp specifications.

Figure 15: Scheme extract - Preamplifier -



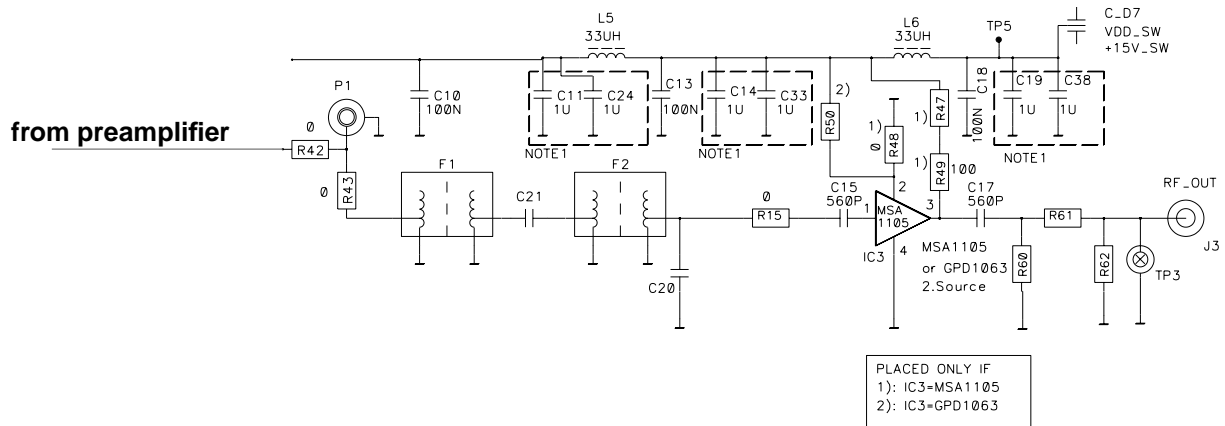
Between the Preamp and the bandpass filter there is a SMB pin plug (P1) built in parallel to the signal path. By removing the appropriate zero ohm resistors the preamplifier resp. the bandpass filter can be tested separately.

The attenuator between the bandpass filter and the MMIC matches the input impedance of the MMIC MSA1105.

The MMIC MSA1105

This is a high performance bipolar silicon Monolithic Microwave Integrated Circuit (MMIC) mounted in a SMD plastic housing. It exhibits extremely good noise performance and compensates loss through the bandfilter and the attenuator. The total gain of the ¹H Preamp is approx. 28 dB.

Figure 16: Scheme extract - Bandpass filter -

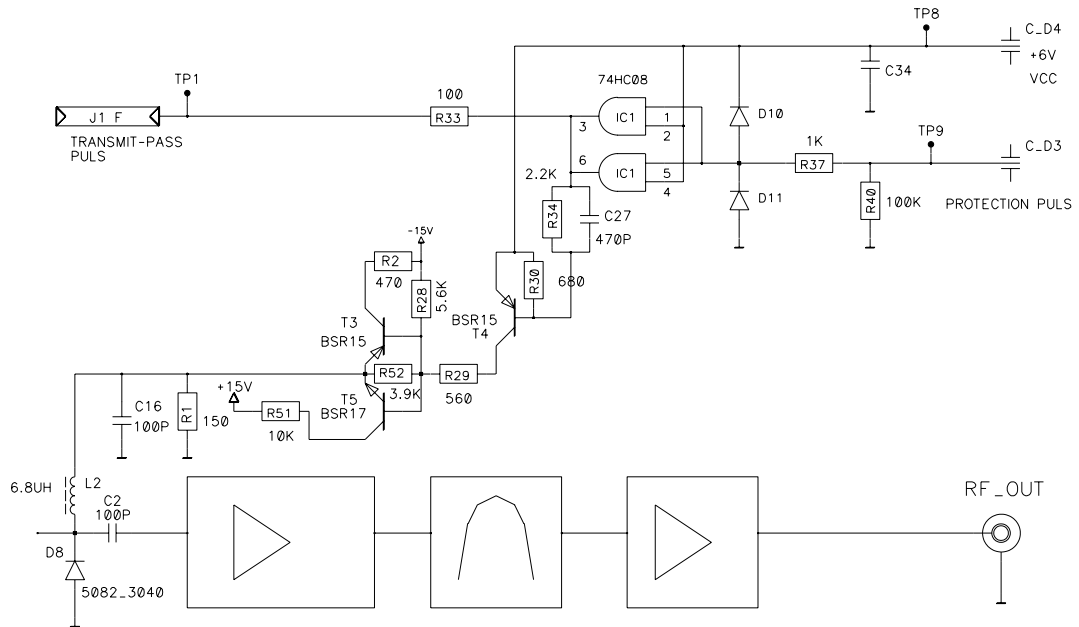


In addition to the **Transmitter/Receiver switch (T/R switch)** - mounted in the $\lambda/4$ T/R-Hotswitch Box - the Preamp has another protection switched in the transmitting phase. The protection, which is completed with a PIN diode parallel to the input, in comparison to a $\lambda/4$ power switch in the Hotswitch box, delivers a broadband protection from HF power from neighbouring frequencies.

Circuit description

The transmitter blanking switch signal PROT_1H originates from the transmitter switch logic of the Preamp controller and comes via the connector J 1 in the Junction board, to the switch input. IC 1 contains two dual parallel switching AND gates. This allows the necessary driver current of approx. 30 mA (for the transmitter switch) in the T/R Hotswitch box to be delivered (Transmitter Pass Pulse: Check point 1). A signal to the driver switch diode D 8 runs parallel to the output pins 3 and 6 of IC 1. The driver consists of the transistors T 3, 4, 5 and the necessary resistors for biasing. A push pull amplifier uses the transistors T 3 and T 5. The strip line PIN diode D 8 is one of the NIP diodes with an anode heat sink.

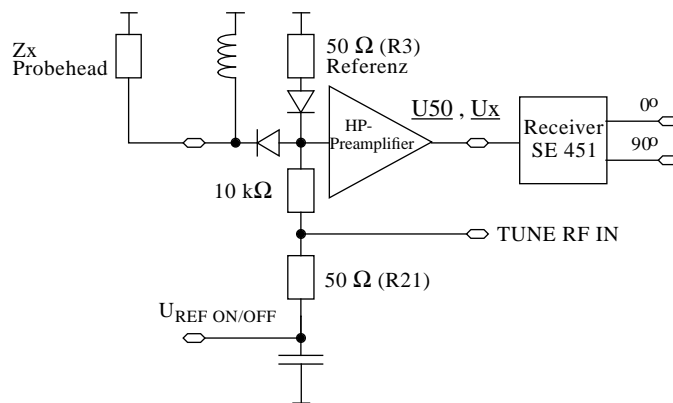
Figure 17: Scheme extract - Blanking -



A great advantage of the HP Preamp is its possibility to tune and match probeheads without additional instruments.

A HF bridge circuit will be completed with support from a PIN diode switch in the signal path to the Preamp, as is usual at any wobble testing station. During Tuning operation a sweeping HF is fed to the Preamp input via a high impedance resistor. The input is first connected to a 50 Ω reference resistor and then compared to the probehead via the connecting cable. The X32 computer, using tuning software, calculates the result of the impedance measurements. The resulting information will be displayed on both the console monitor (wobble curve) and the HP Preamp display (T-display).

Figure 18: Tuning Principle



Circuit description (see Figure 19:)

The Tuning command TUNE ON/OFF is sent from the Preamp controller via the J 1 plug on the Junction board to IC 1, which controls an op amp. This amplifier converts the Low/High information at the input into a Plus/Minus control voltage for the tuning switch. The tuning switch consists of PIN diodes D 1, 2, 3. It switches the HF during tuning operation to the high-resistive resistors R 41 and R 5. Should a positive charge be present at output (Pin 1) of IC 2 (+13 V, TUNE OFF), then D 2 and D 3 are off and D 1 is active. D 1 combines with R 24 (47 Ω), in this instance, to provide a 50 Ω terminal resistance.

If, during TUNE ON mode, Pin 1 has a negative voltage (approx. -13 V) D 1 will be off, and the diodes D 2 and D 3 will be active. The second input, called REF ON/OFF is only used during Tuning mode.

The circuitry, including the op amp, is identical with that found at the TUNE ON/OFF input. Pin 7 of IC 2 controls, via a R, C, L network, the PIN diodes D 6 and D 7.

Should the output of Pin 7 from IC 2 have a positive voltage (approx. +13 V, REF OFF), then D 6 is active. The probehead is connected parallel to the Preamp via the filter and the feeder cable. Alternatively, if D 6 is off and D 7 is active (negative voltage on Pin 7) then the 50 Ω Reference resistor R 3, R 4 is parallel to the Preamp.

Figure 19: Scheme extract - Tuning -

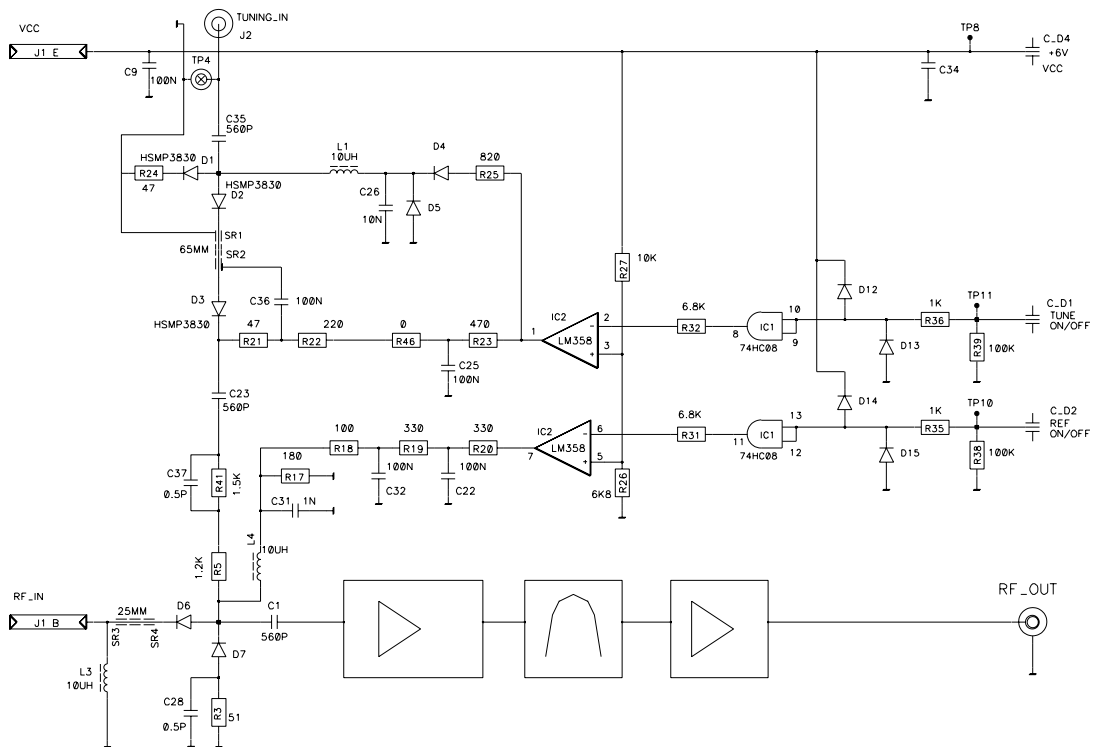
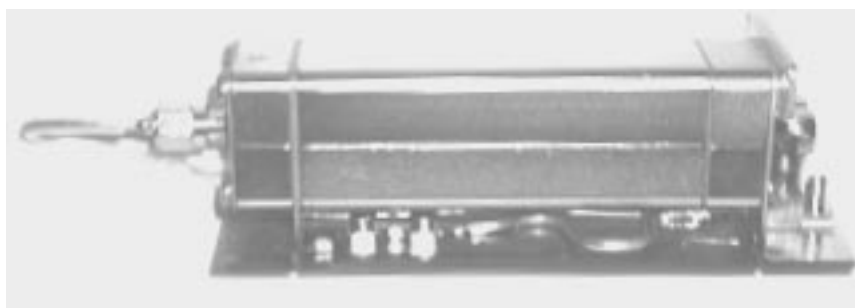


Figure 20: Lambda/4 T/R-Hotswitchbox used in the 1H-Module



Functional description

4.2.1

The T/R switch reacts during the transmission phase to designate the probehead as the load of the power transmitter. During the receiver phase the probehead becomes the source of the signals for the Preamp. High transmission efficiency and minimal insertion loss, with an extremely good suppression, represents the advances achieved with the two switches.

The transmitter switch is constructed with two serial pairs of PIN diodes. In order to be able to transmit using high power, the diodes are well cooled.

The receiver switch is constructed as a $\lambda/4$ switch. A $\lambda/4$ line and two Stripline-PIN diode (D 5 and D6) are activated (40 mA DC) approx. 1 μ s in advance of the HF transmission pulse. D 5 short circuits the $\lambda/4$ line at the output and therefore converts the input to a high impedance load, like an open switch.

Power handling capability

4.2.2

In NMR-applications there are a great number of possible pulse strings, that means, it isn't easy to define how much power can be handled by the T/R-Hotswitchbox without an instant failure. The junction temperature of a diode is dependent on peak and average power dissipated, thermal impedance of the chip, heat sink interface and the ambient temperature. Data of the transient thermal impedance rising with pulse length, are usually given by the manufacturers. So it is quite possible to give the maximal handling power for a single HF pulse with a definite duty cycle as follows.

The *Hotswitchbox* can not handle experiments with high power and long time pulses (E.g.: decoupling pulses during CPMAS).

Figure 21: Power handling capability without Probehead

Single pulse, worst case for maximum mismatch (no probehead connected) for a maximum junction temperature of 125°C and an ambient temperature of 25° C

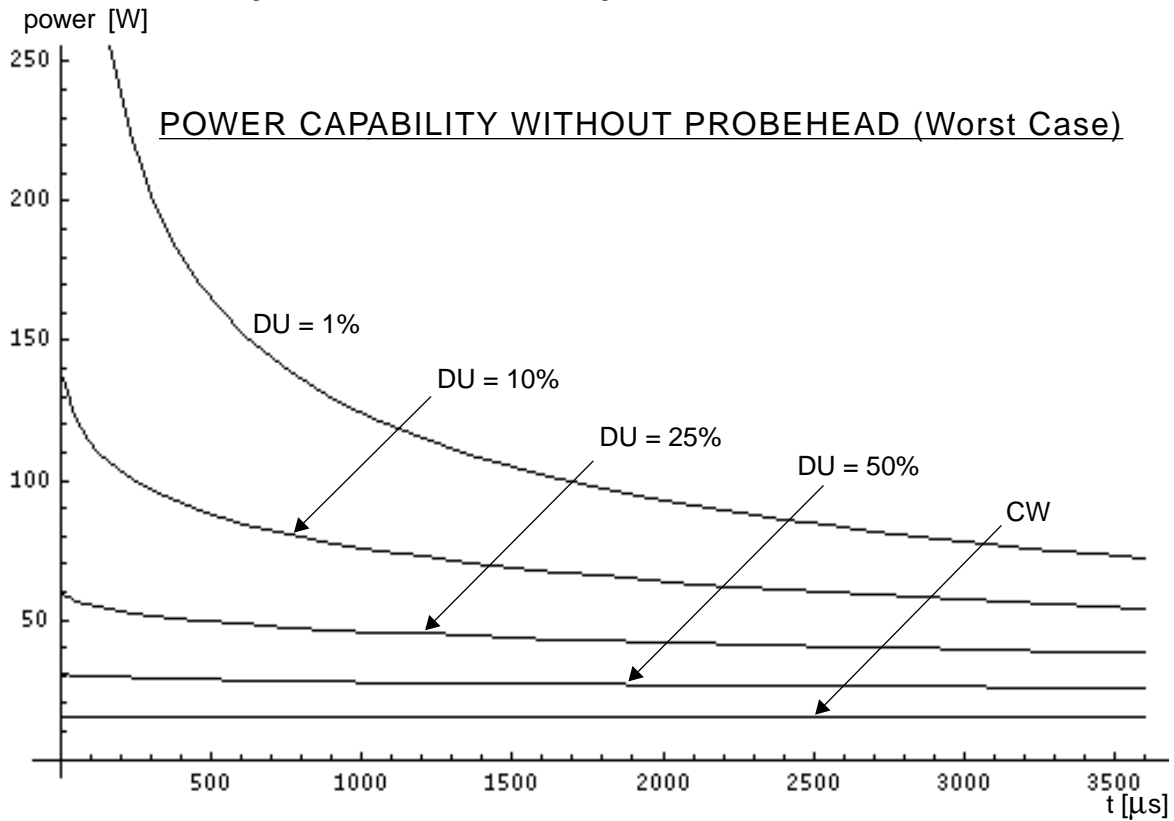


Table 4: Power handling capability: single pulse, worst case for maximum mismatch

Pulse length	Maximum RF power for maximum mismatch				
	DU = 1%	DU = 10%	DU = 25%	DU = 50%	CW*
100 μ s	250 W	110 W	55 W	30 W	15 W
500 μ s	160 W	88 W	50 W	28 W	
1 ms	120 W	75 W	45 W	27 W	
3 ms up to 10 sec.	75 W	55 W	40 W	26 W	

* for an infinite operation time

We recommend to use no more power than listed in the figures and tables above! Especially with CPMAS-Experiments.

Figure 22: Power handling capability with matched Probehead

Single pulse, standard case for best matching between probehead and transmitter and a maximum junction temperature of 125°C and an ambient temperature of 25°C

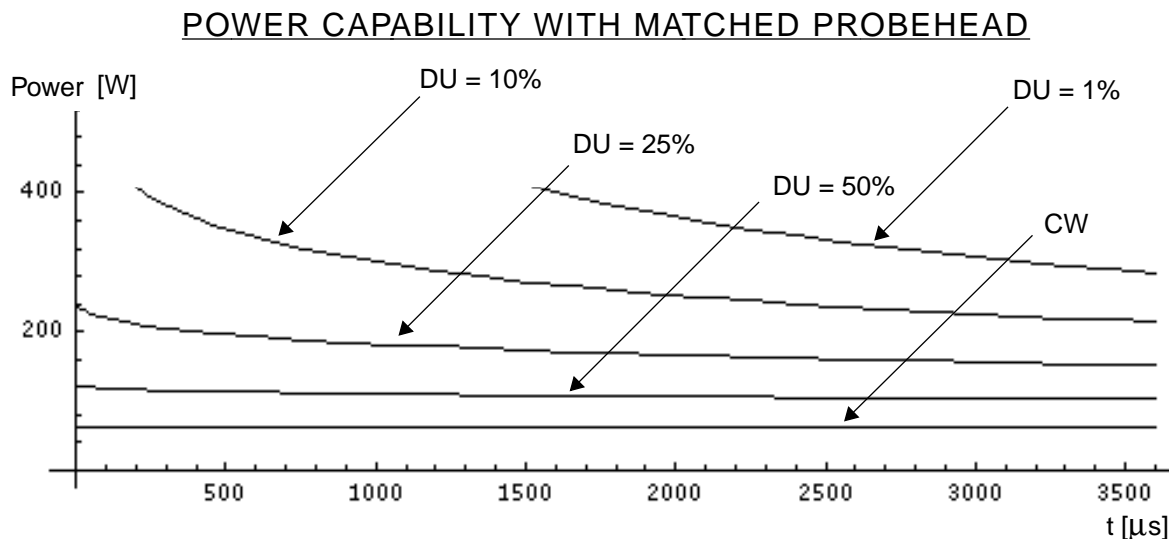


Table 5: Power handling capability: single pulse, for best matching

Pulse length	Maximum RF power for best matching				
	DU = 1%	DU = 10%	DU = 25%	DU = 50%	CW*
100 μs	400 W	400 W	220 W	115 W	60 W
500 μs	400 W	350 W	200 W	115 W	
1 ms	400 W	300 W	180 W	110 W	
3 ms up to 10 sec	300 W	220 W	160 W	100 W	

* for an infinite operation time

Now, for a pulse string you can do an estimation whether there is a risk or not. For example: For a string of five 10 μs pulses of each 100 W in a shape of about 100 μs and a duty cycle of 10 % there should be no risk.

We recommend to use no more power than listed in the figures and tables above! Never start the spectrometer or UXNMR without a Probehead connected to the Preamplifier.

Connect the PowerAmplifier directly to the probehead during CP-MAS-Decoupling or other HIGH POWER experiments exceeding the values listed above.

The probehead filter is designed as a dual circuit comb band pass filter. The capacitive coupling occurs at the high point of the resonator. The coupling between the resonators functions as a band pass filter with an inductive high point coupling.

The transmitter filter is designed as a dual circuit comb band pass filter, suppressing ^{19}F . The capacitive coupling occurs at the high point of the resonator. The coupling between the resonators functions as a band pass filter with an inductive high point coupling. At the filter input there is a special circuit for the $50\ \Omega$ matching of the higher harmonics caused by the ^1H transmitter.

Figure 23: High-Power 19F/1H/3F Module - Exploded View -

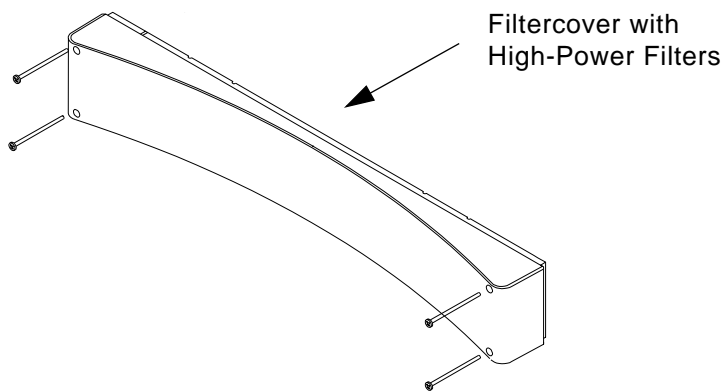
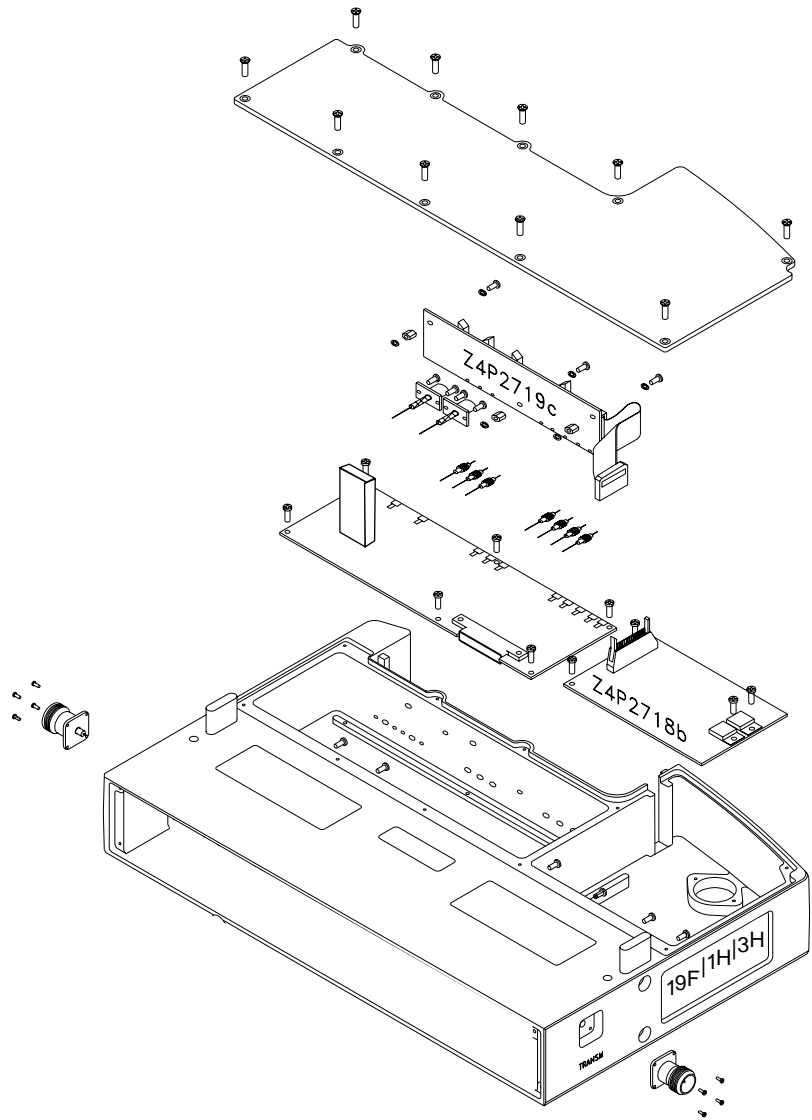
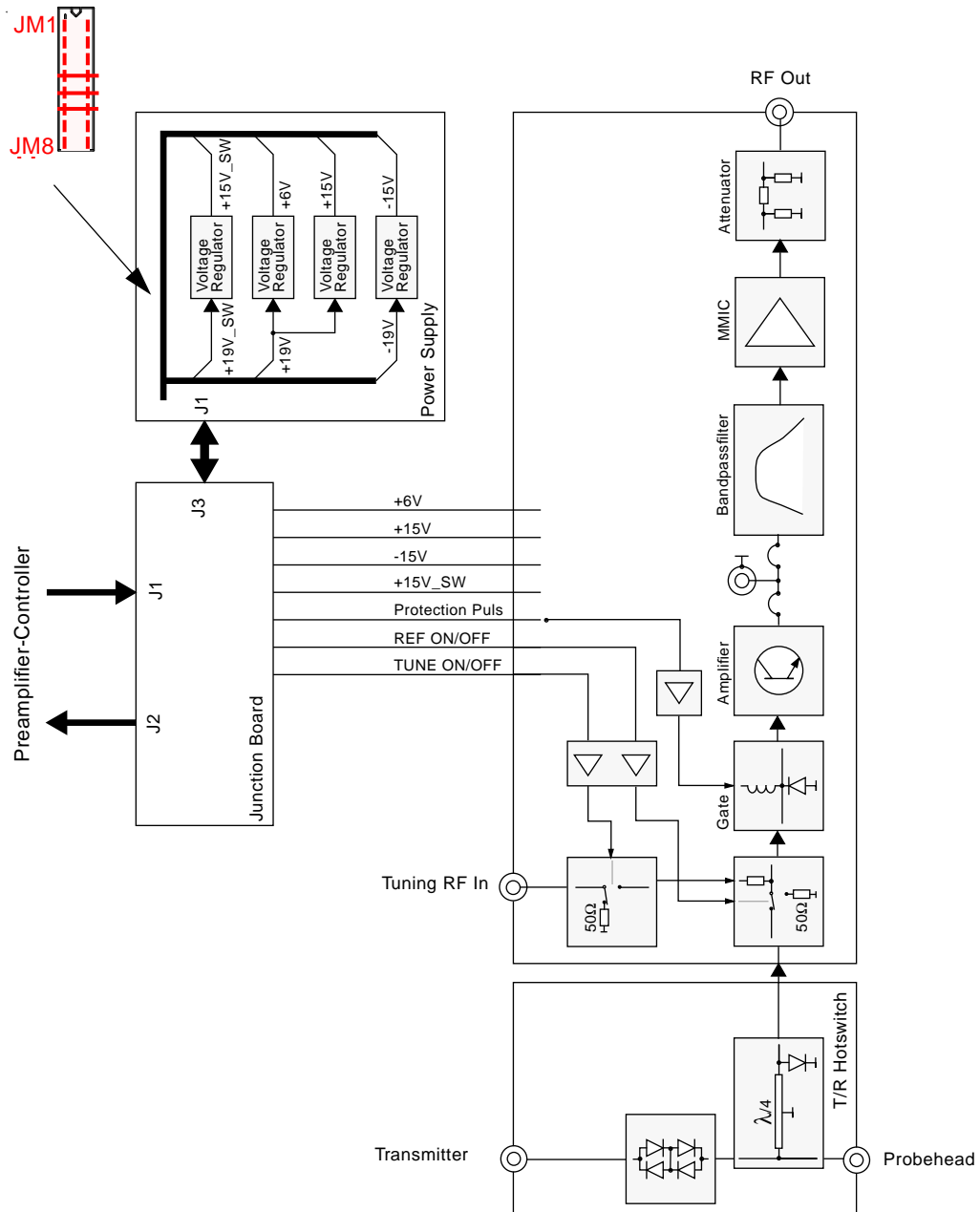


Figure 24: 19F/1H/3H Module - Block Diagram -



This modul is normally used in HIGH-POWER-Applications (Solids).

For more information about the circuits see Chapter „1H Module on page 39“.

The 19F/1H/3H-Module uses the same preamplifier circuit as the 1H Module. The component values differ from those of the 1H Module. Please refer to the corresponding section within the chapter „1H Module on page 39“ for further information. (E.g. Tuning and/or Blanking Mode).

The Bandpass filter

5.1.1

Between the Preamplifier and the bandpass filter there is a SMB pin plug (P1) built in parallel to the signal path. By removing the appropriate zero ohm resistors the preamplifier resp. the bandpass filter can be tested separately.

The bandpass filter is responsible for the selectivity of the HPHP-Preamplifier. It is not tuneable. The pass range starts at ¹⁹F and ends at ³H. The stop range suppresses DC until ³¹P.

Figure 25: Scheme extract - Bandpass filter -

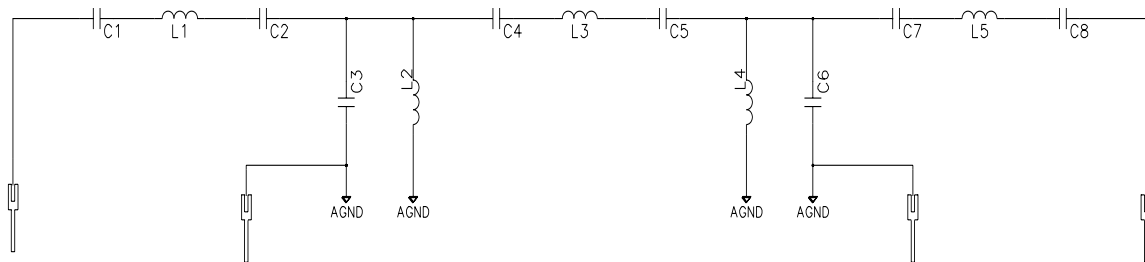
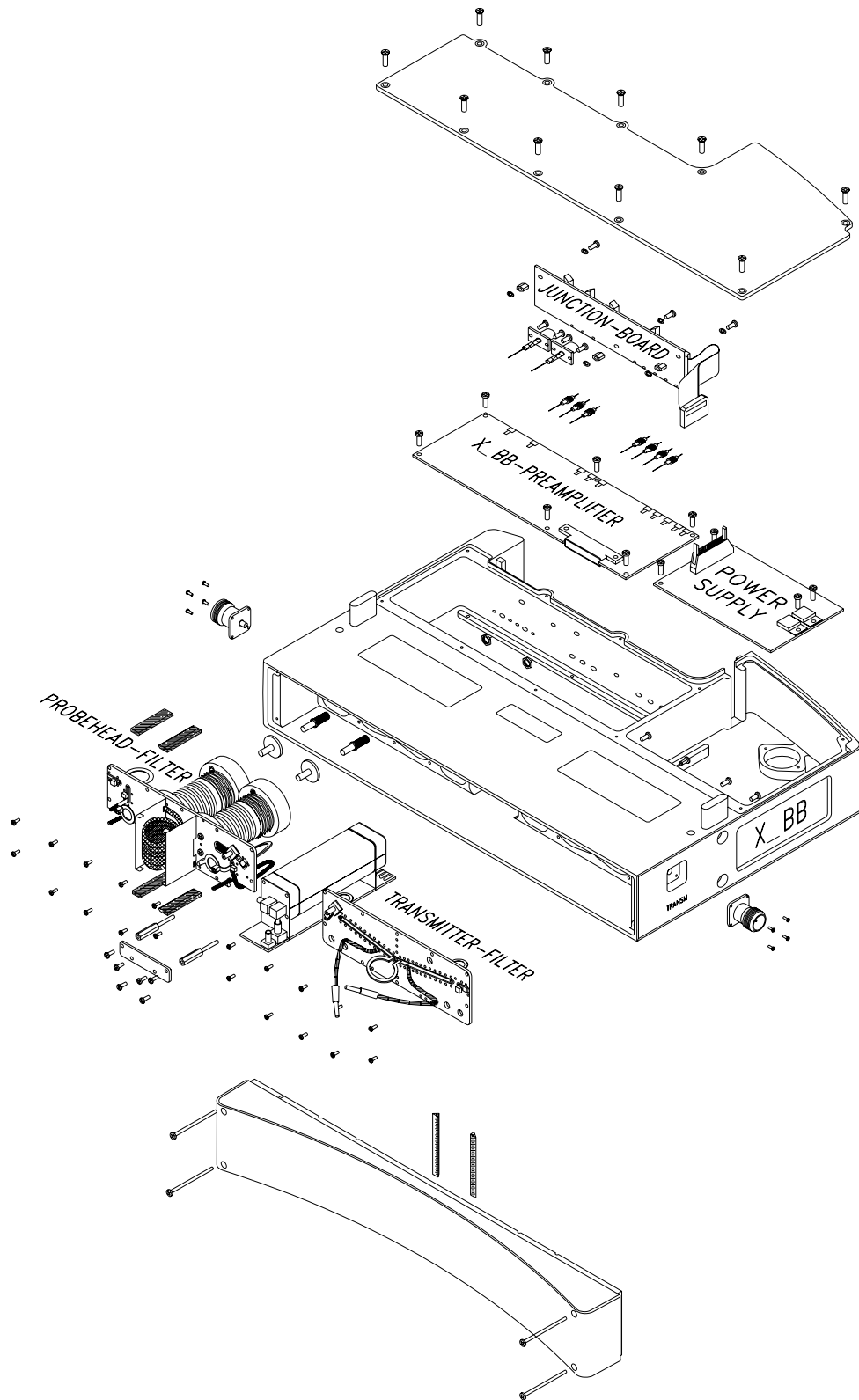
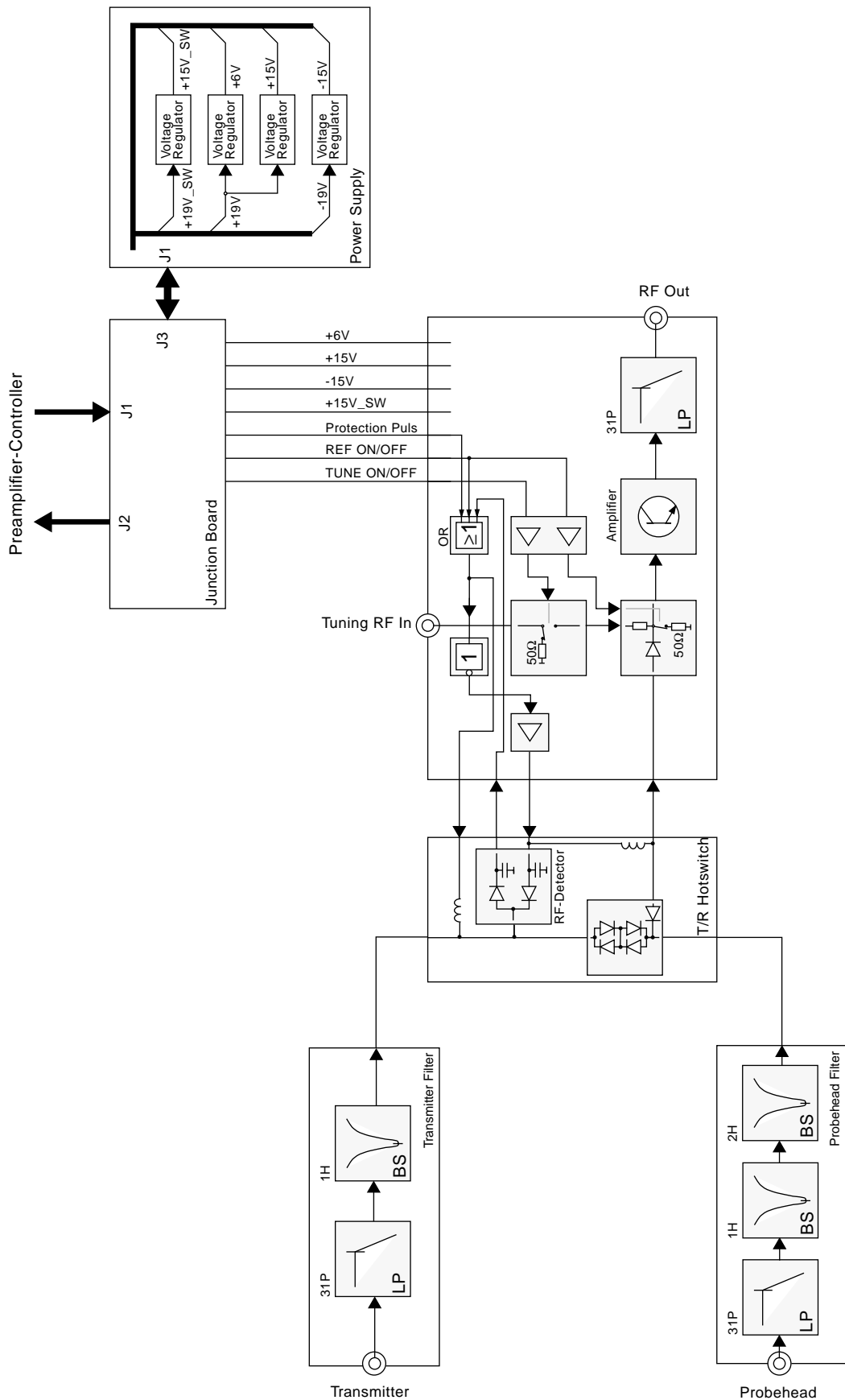


Figure 26: X-BB Module - Exploded View -



X-BB Module

Figure 27: X-BB Module - Block Diagram -



The Preamplifier

6.1.1

The Preamplifier illustrated below operates in a frequency range of 5 - 250 MHz.

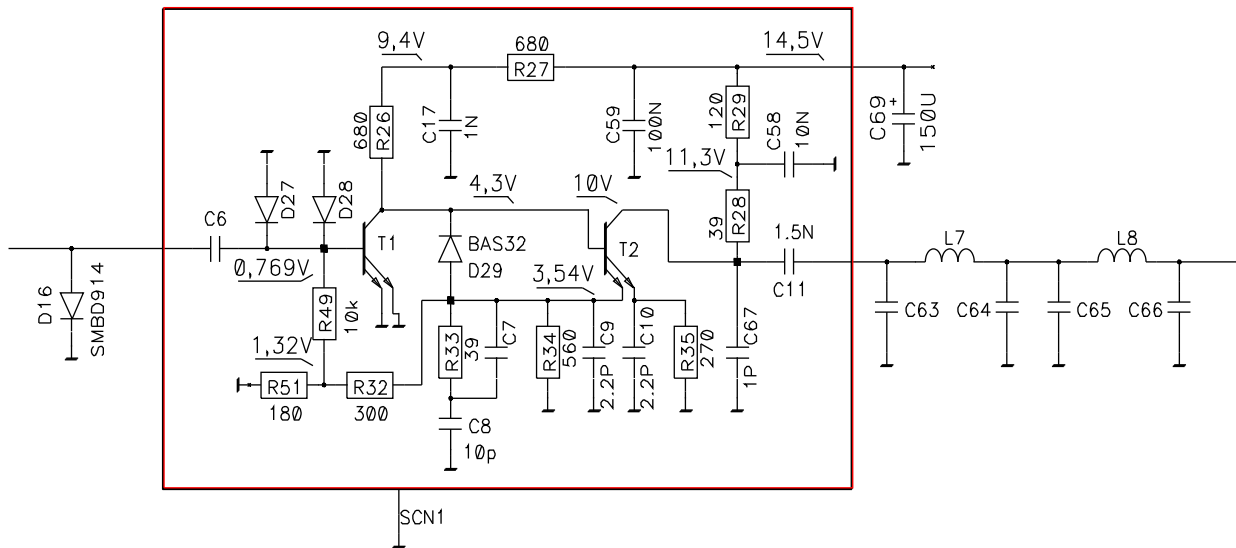
A ³¹P low pass filter system which suppresses ¹H is attached to the Preamplifier. Depending on the ¹H frequency different low-passes are used.

The range is divided as follows:

200 MHz - 360 MHz : $f_{limit} = 150 \text{ MHz}$

400 MHz - 600 MHz : $f_{limit} = 250 \text{ MHz}$

Figure 28: Scheme extract - Preamplifier -



FOR XBB31P 2HS
2H-PREAMPLIFIER

FOR XBB19F 2HS / XBB19F 2HP-PREAMPLIFIER

1H-Frequency	-750-/-600-	-360-/-300-	-750-/-600-	-500-/-400-	-360-/-300-
Component:	-500-/-400-	-250-/-200-			-250-/-200-
L7/L8	47NH	68NH	10NH	12NH	33UH
C63/C66	5.6P	27P	1.0P	1.0P	6.8P
C64	15P	39P	3.9P	3.9P	6.8P
C65	---	4.7P	---	2.7P	6.8P
C6	270P	1.5N	270P	270P	1.5N
C7	---	---	1.2P	---	---
D16	---	SMBD914	---	---	SMBD914

It uses the same Tuning circuit as the 1H Module. Please refer to the corresponding section for further information.

Circuit description

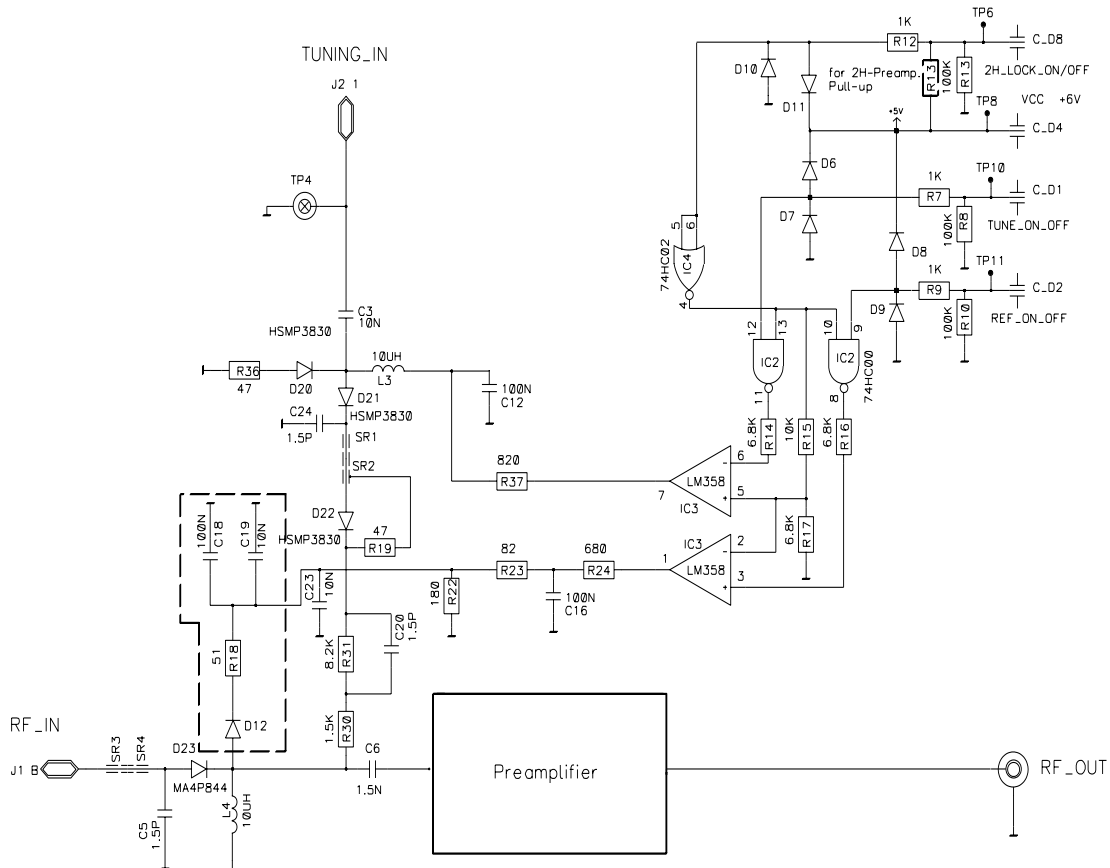
The tuning command TUNE ON/OFF is sent from the Preamp controller, via the J 1 plug on the Junction board, to IC 2, which controls an operation amplifier. This amplifier converts the Low/High information at the input into a Plus/Minus control voltage for the tuning switch. The tuning switch, which consists of PIN diodes D 20, 21, 22, switches the HF during tuning operation to the high impedance resistors R 31 and R 30. Should a positive voltage be present at Pin 7 output on IC 3 (+13 V, TUNE OFF), then D 21 and D 22 are off and D 20 is active. D 20 combines with R 36 (47 Ω), in this instance, to provide a 50 Ω terminal resistance.

If, during TUNE ON mode, Pin 7 has a negative voltage (approx. -13 V) D 20 will be off, and the diodes D 21 and D 22 will be active. The second input, called REF ON/OFF is only used during tuning mode.

The circuitry including the OP is identical to the one found at the TUNE ON/OFF input. Pin 1 of IC 3 controls, via a R, C, L network, the PIN diode D 12.

Should the output of Pin 1 from IC 3 have a positive voltage (approx. +13 V, REF OFF, Receiver switch closed), then D 12 is off. The probehead is connected parallel to the Preamp via the filter and the feeder cable. Alternatively, if D 12 is active then the 50 Ω Reference resistor R 18, R 48 is parallel to the Preamp.

Figure 30: Scheme extract - Tuning -



The T/R switch reacts during the transmission phase to designate the probehead as the target of the power transmitter. During the receiver phase the probehead becomes the source of signals for the Preamp. High transmission efficiency and minimal insertion loss, with an extremely good suppression, represents the advances achieved with the two switches.

The transmitter switch is constructed with two serial pairs of PIN diodes. In order to be able to transmit using high power, the diodes are well cooled.

To achieve a broad band solution the receiver switch is constructed with two serial PIN diodes. One of the two PIN diodes (D 20) is found in a SMB board plug cable inlet, which is soldered directly to the aluminium box star point. The other PIN diode (D 23) is located on the X-BB Preamp board. The receiver switch is opened from the connector 6 of board plug J 1 during the receiver mode. In transmission mode the PIN diodes are biased through the unidirectional negative half-wave in the reverse direction. The electronic control on the X-BB Preamp board includes an extra protection-circuit. In case the console gating pulse fails, a gate pulse is generated by the diodes D 2, 4, 5, 6, by rectifying the HF transmitter pulse (Pin 4 of the board plug J 1).

Probehead Filter**6.3**

The probehead filter is a ^{31}P low pass filter, including ^2H and ^1H stop filters, using $\lambda/4$ lines. The design of the filter has the advantage that neighbouring nuclei from ^2H , e.g. Lithium (^6Li) and Bismuth (^{209}Bi) have a band pass attenuation less than 1 dB.

Transmitter Filter**6.4**

The transmitter filter is a ^{31}P low pass filter including a ^1H stop filter, using $\lambda/4$ -lines.

Figure 31: 2H Module - Exploded View -

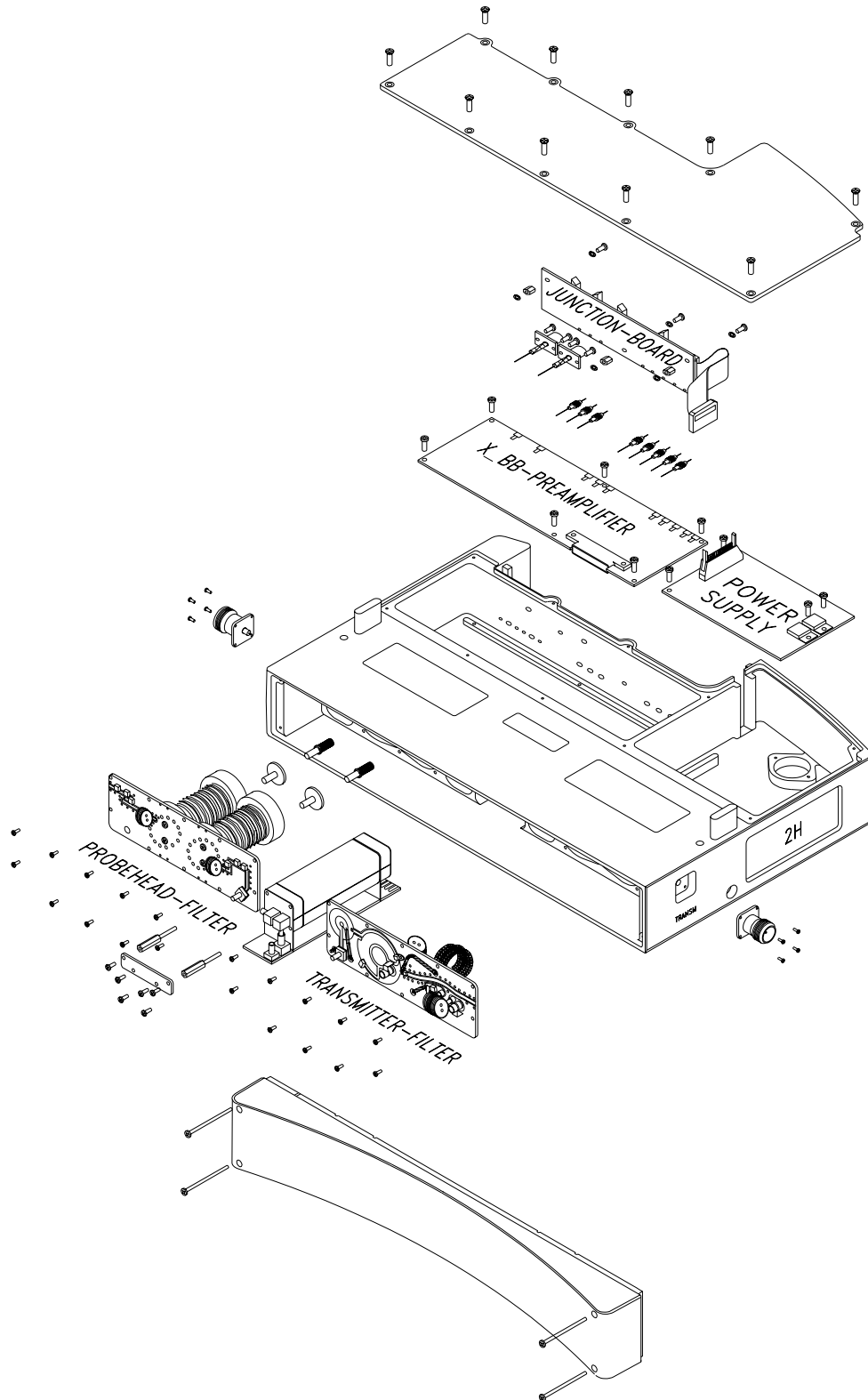
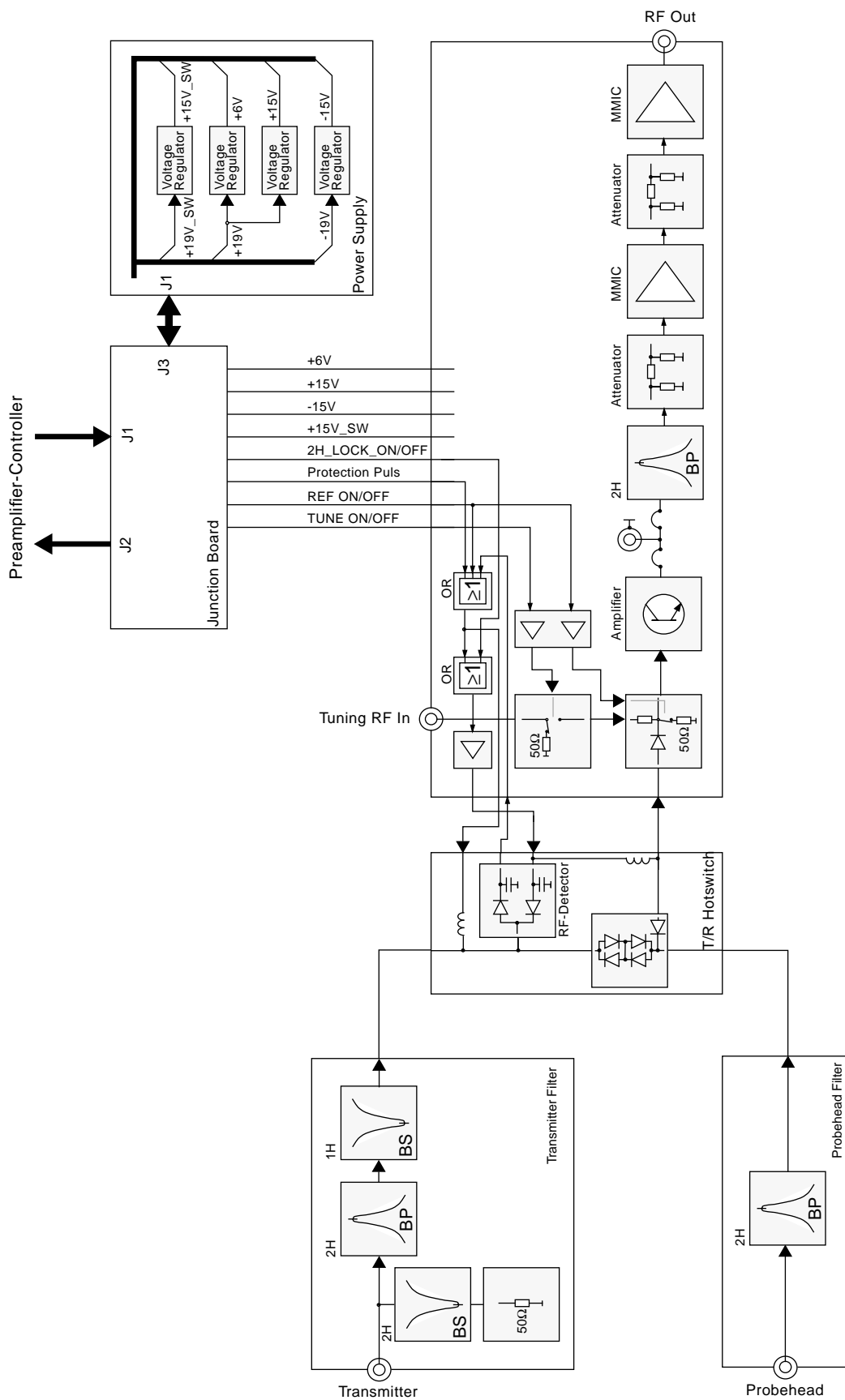


Figure 32: 2H Module - Block diagram -



The Preamplifier

7.1.1

For the first time the 2H Lock and its module may also be used for Fourier measurements and decoupling. A ¹⁹F Lock is a prerequisite.

The same board as for the X-BB Preamp is used, but with additional components for a band pass and more amplification. Please refer to the corresponding section for further information.

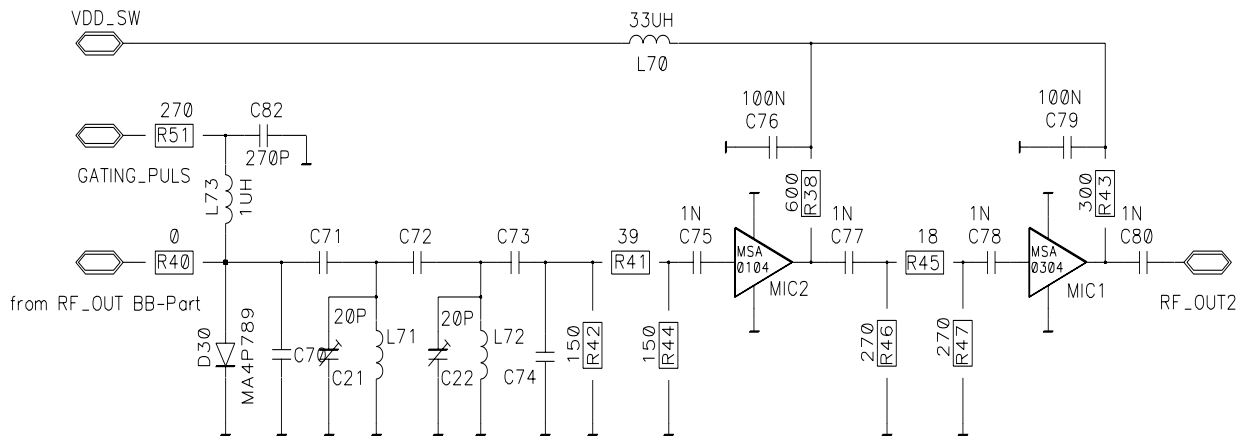
The Band pass filter

Between the Preamp and the bandpass filter there is a SMB pin plug (P1) built in parallel to the signal path. By removing the appropriate zero ohm resistors the preamplifier resp. the bandpass filter can be tested separately.

The Postamplifiers

The higher gain (typically 46 dB) of the ²H Preamp is reached by using two additional MMIC.

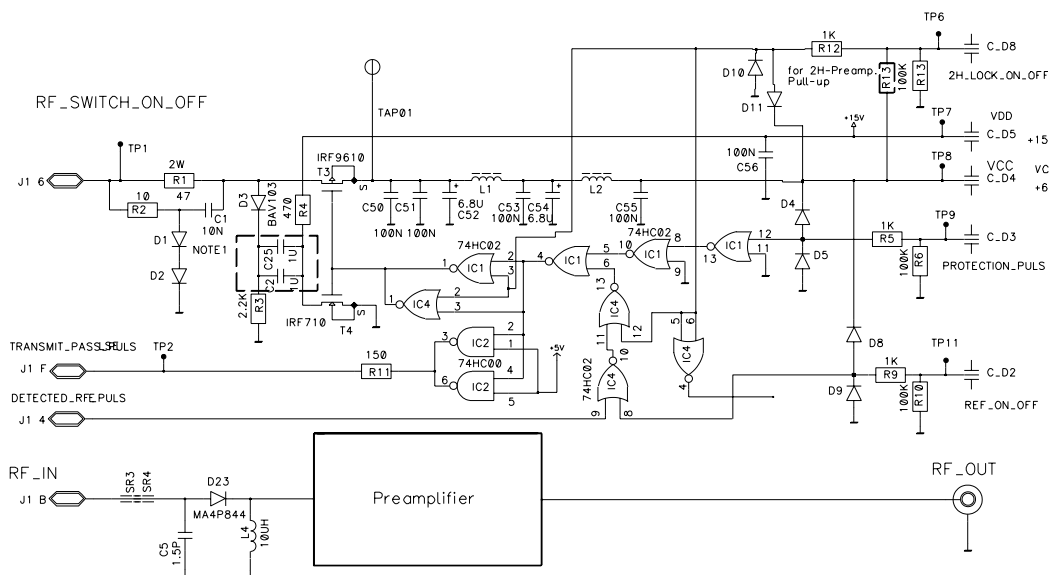
Figure 33: Schematic extract - Band pass filter -



The ²H Preamp can be used for tuning in the same way as the X-BB Preamp. However, only if its not used as a Lock preamplifier (2H LOCK OFF). Further information about the Tuning can be found in the function description for the X-BB Preamp.

In comparison to the X-BB Preamp the ²H Preamp board has one important difference - the Receiver switch in the T/R switch box is always enabled. This suppresses spikes in the region of the Lock frequency when measuring with the X-BB module. When the 2H Preamp is being used for NMR measurements the switch operates as in the X-BB Preamp. The switch command originates from the Preamp controller. Two parallel NAND gates from IC 2 supply the necessary driver current of approx. 30 mA for the transmitter switch in the T/R hot switch box (transmitter pass pulse: checkpoint 2).

Figure 34: Scheme extract - Blanking -



The ²H T/R-Hotswitch Box is identical to the one used in the X-BB Module. Please refer to the corresponding section for further information.

Probehead Filter

The probehead filter consists of two low pass filters with a band pass filter in between. The low pass filter improves the suppression of frequencies above ²H.

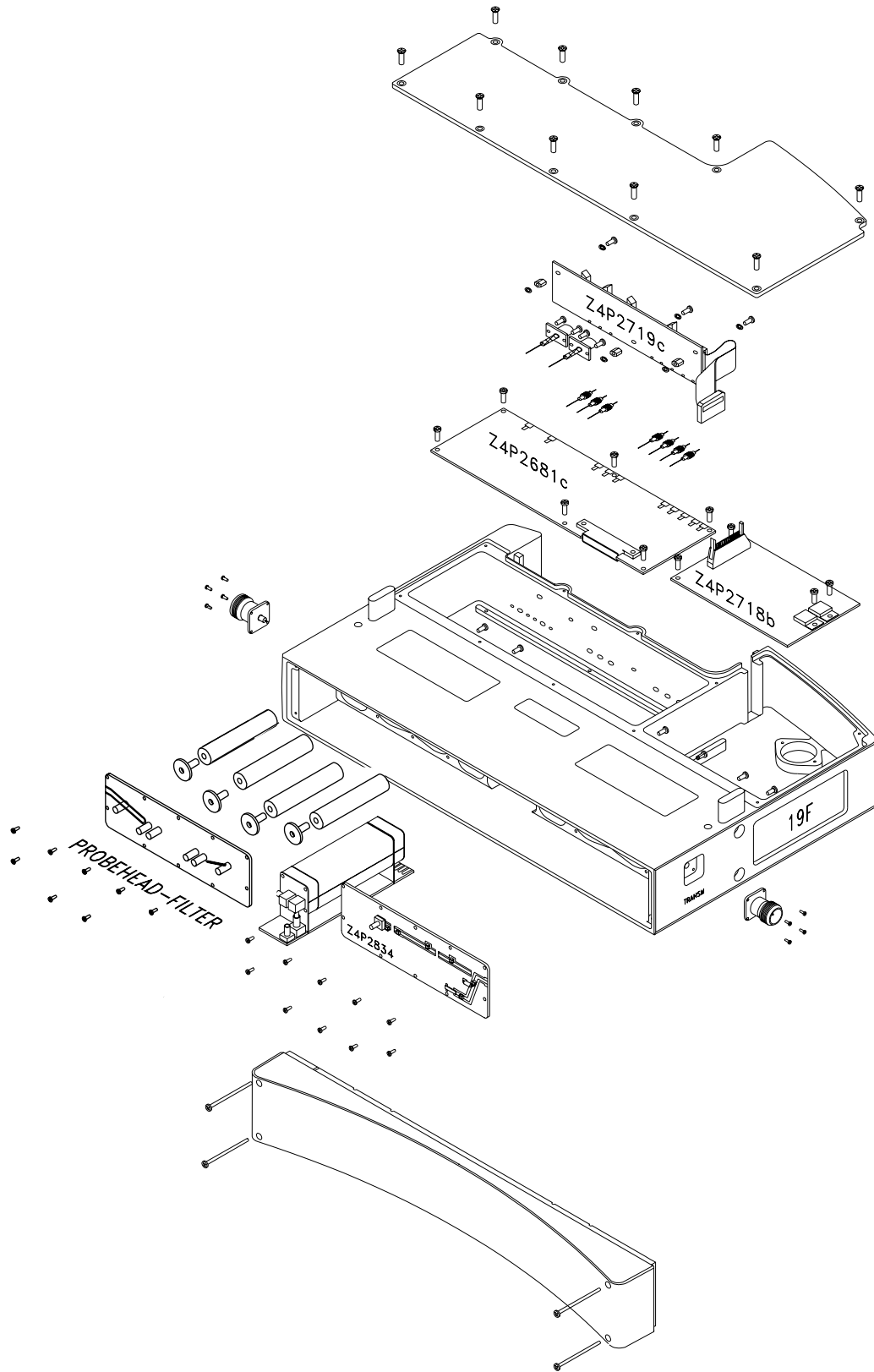
Transmitter Filter

The Transmitter filter consists of a band pass filter followed by a low pass filter connected to a ¹H stop filter. An open $\lambda/4$ line is used as ¹H stop filter.

The low pass filter is formed by the cable capacity and the coils L 1 and L 2 which are etched onto the pc board. The capacitors C 1 to C 5, together with the coils L 3 to L 6, form the band pass filter.

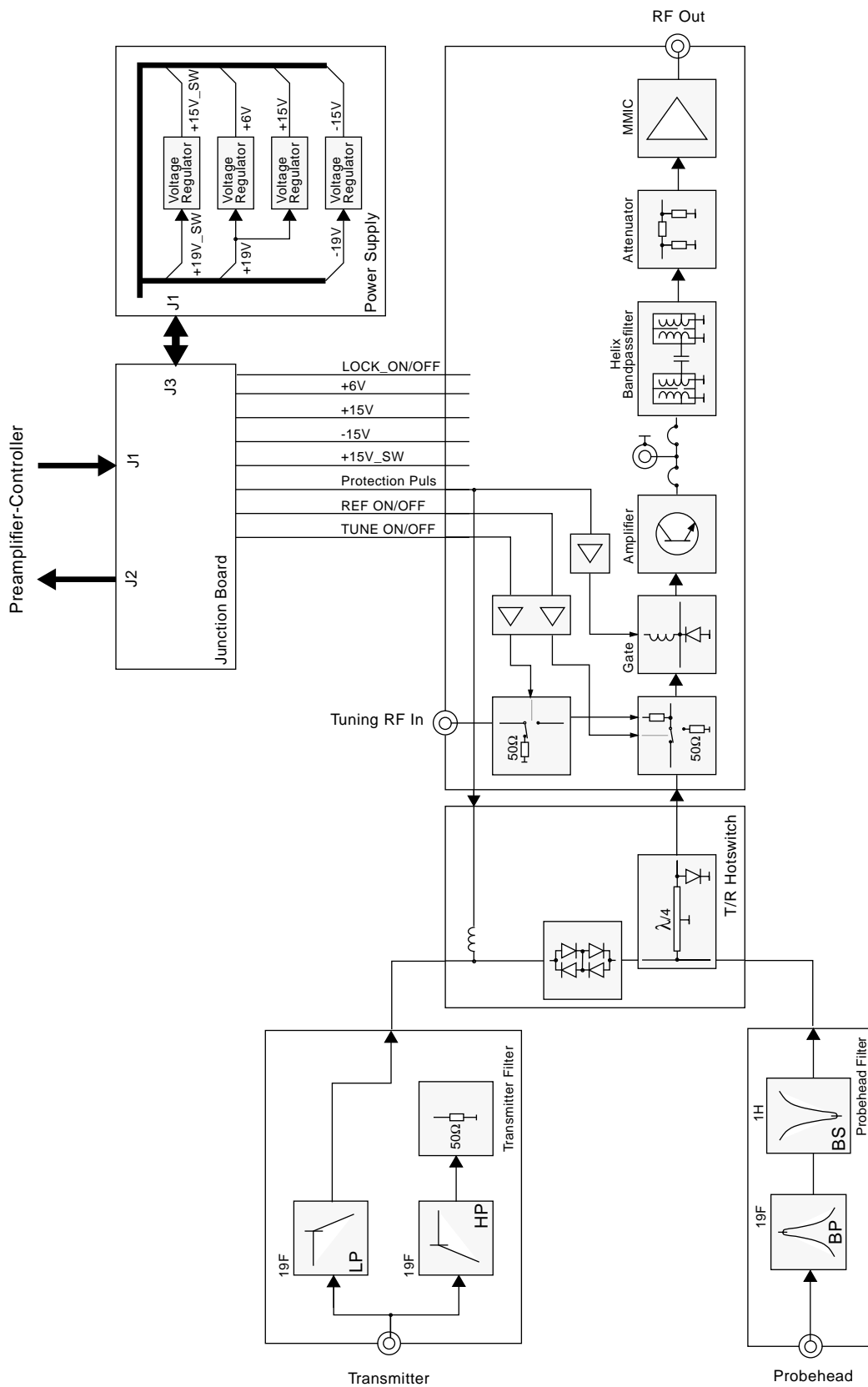
19F Selective Module

Figure 35: 19F Selectiv Module - Exploded View -



19F Selective Module

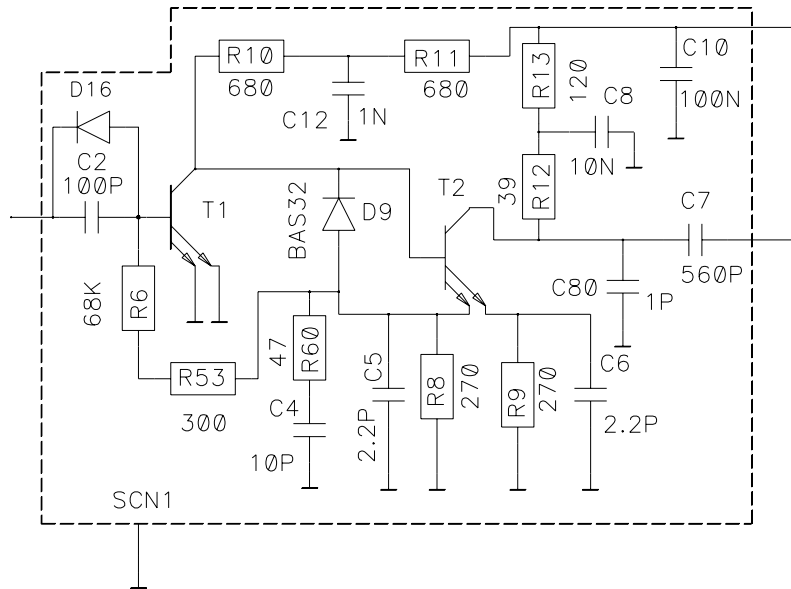
Figure 36: 19F Selective Module - Block Diagram -



The Preamplifier

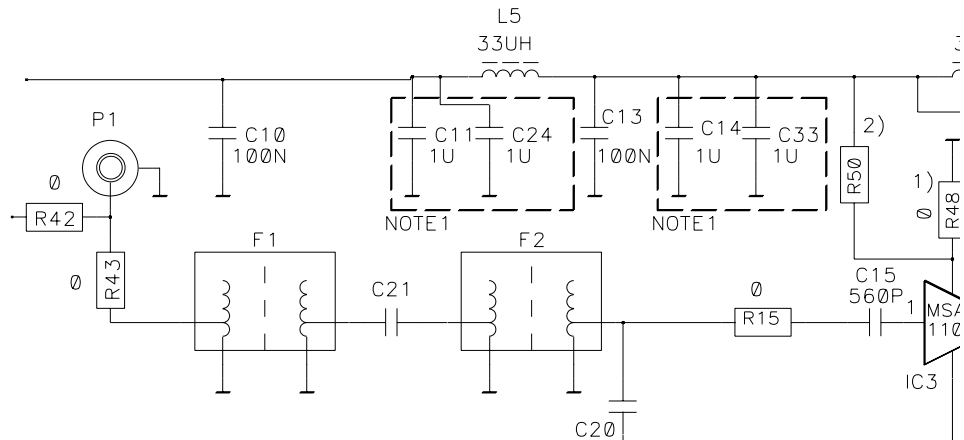
The 19F Selective Module uses the same preamplifier as the 1H Module. Please refer to the corresponding section for further information.

Figure 37: Scheme extract - Preamplifier -



The bandpass-filter and the attenuator are the same as used in the 1H - Module. Please refer to the corresponding section for further information.

Figure 38: Scheme extract - Bandpass filter -

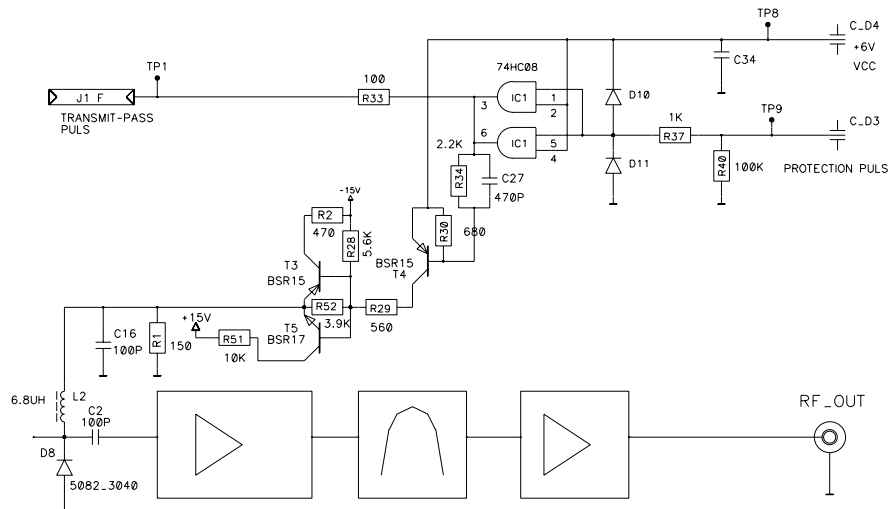


The Blanking circuit works in the same way as described in the 1H Module section.

Circuit description

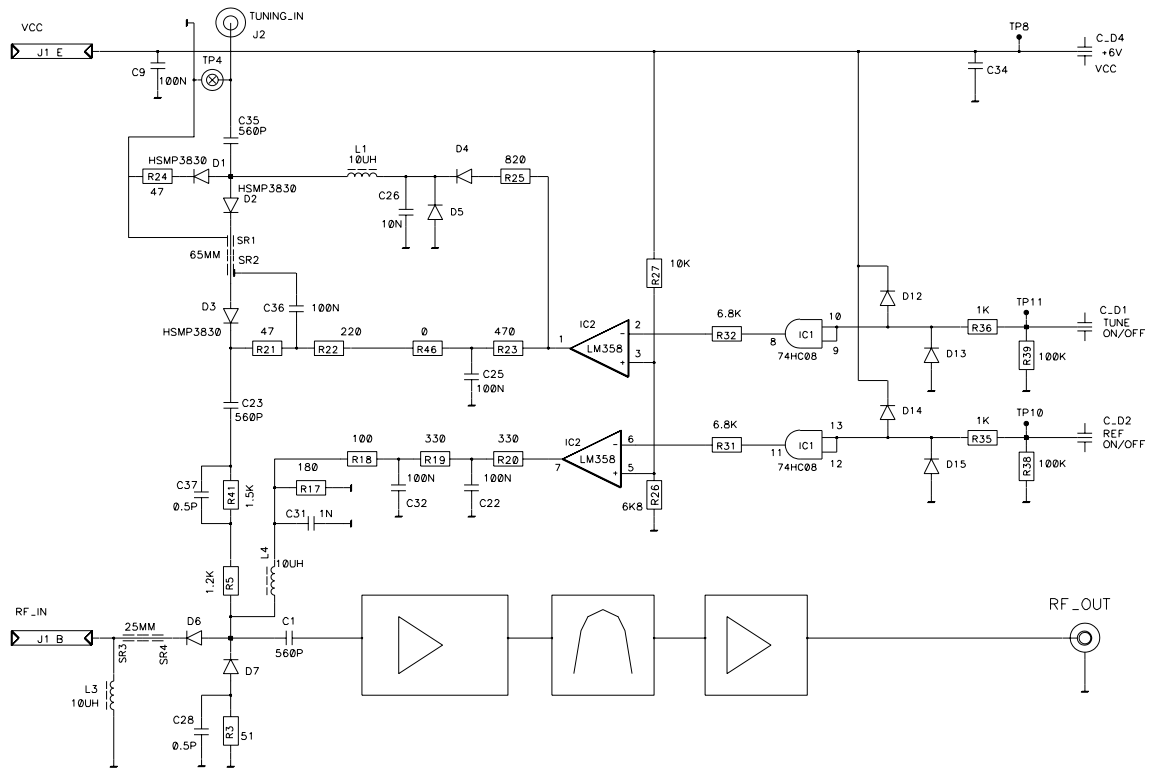
The transmitter blanking switch PROT_19F originates from the transmitter switch logic of the Preamp controller and comes via the connector J 1 in the Junction board, to the switch input. IC 1 contains two dual parallel switching AND gates. This allows for the necessary driver current of approx. 30 mA (for the transmitter switch) in the T/R Hotswitch box to be delivered (Transmitter Pass Pulse: Check point 1). A signal to the driver switch diode D 8 runs parallel to the output pins 3 and 6 of IC 1. The driver consists of the transistors T 3, 4, 5 and the necessary resistors for biasing. A push pull amplifier uses the transistors T 3 and T 5. The strip line PIN diode D 8 is one of the NIP diodes with an anode heat sink.

Figure 39: Scheme extract - Blanking -



The same Tuning circuit as in the 1H Module is used. Please refer to the corresponding section for further information.

Figure 40: Scheme extract - Tuning-



Lambda/4 T/R-Hotswitch Box

8.2

The same Lambda/4 T/R-Hotswitch Box as in the 1H Module is used. Please refer to the corresponding section for further information.

Probehead Filter

8.3

The probehead filter is designed as a dual circuit comb band pass filter. The capacitive coupling occurs at the high point of the resonator. The coupling between the resonators functions as a band pass filter with an inductive high point coupling.

Transmitter Filter

8.4

The transmitter filter is designed as a combined ^{19}F low pass filter and a ^{19}F high pass filter. The high pass filter is connected with a special circuit for the $50\ \Omega$ matching of the higher harmonics caused by the ^{19}F transmitter.

Figure 41: 3H Module - Exploded View -

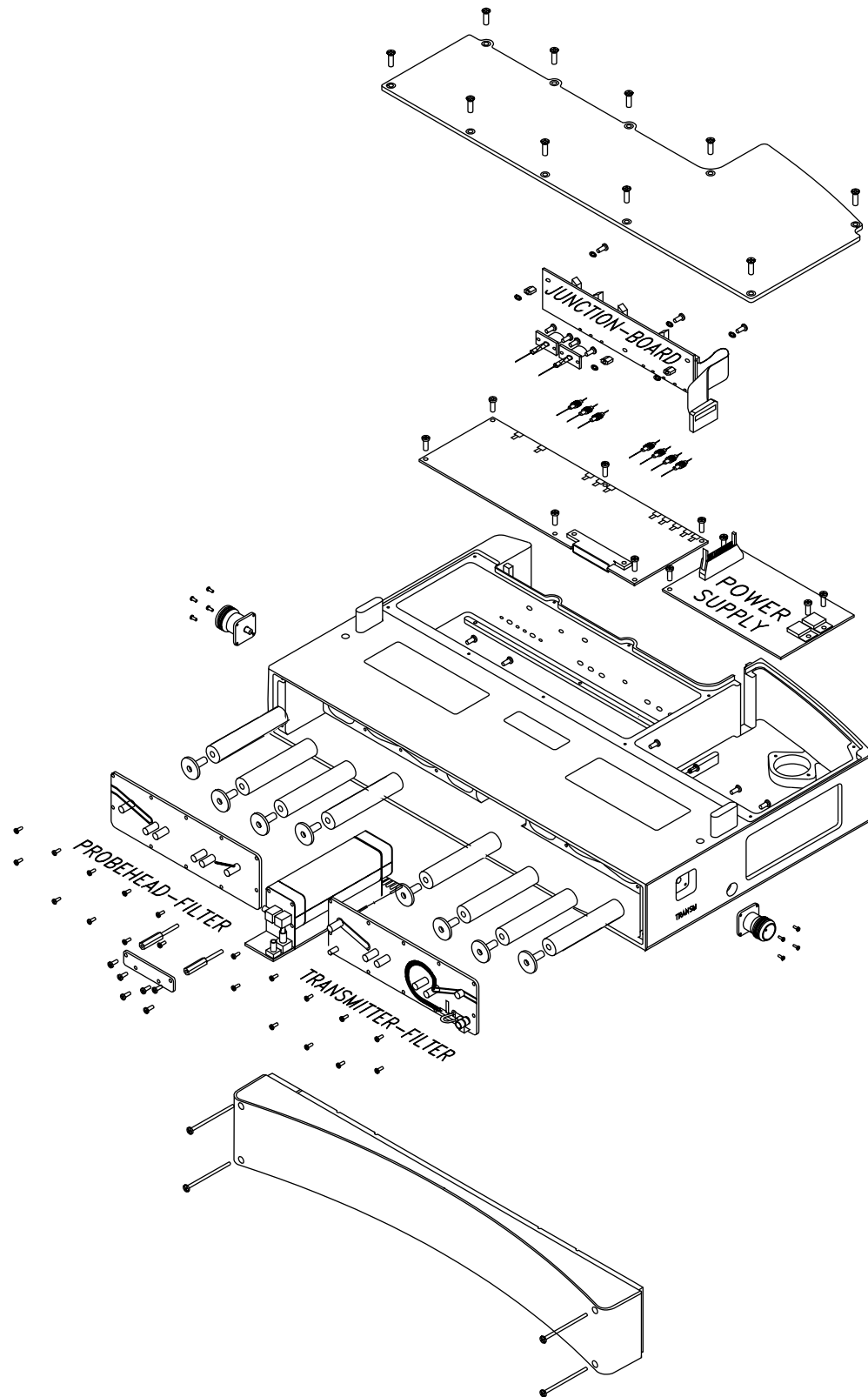
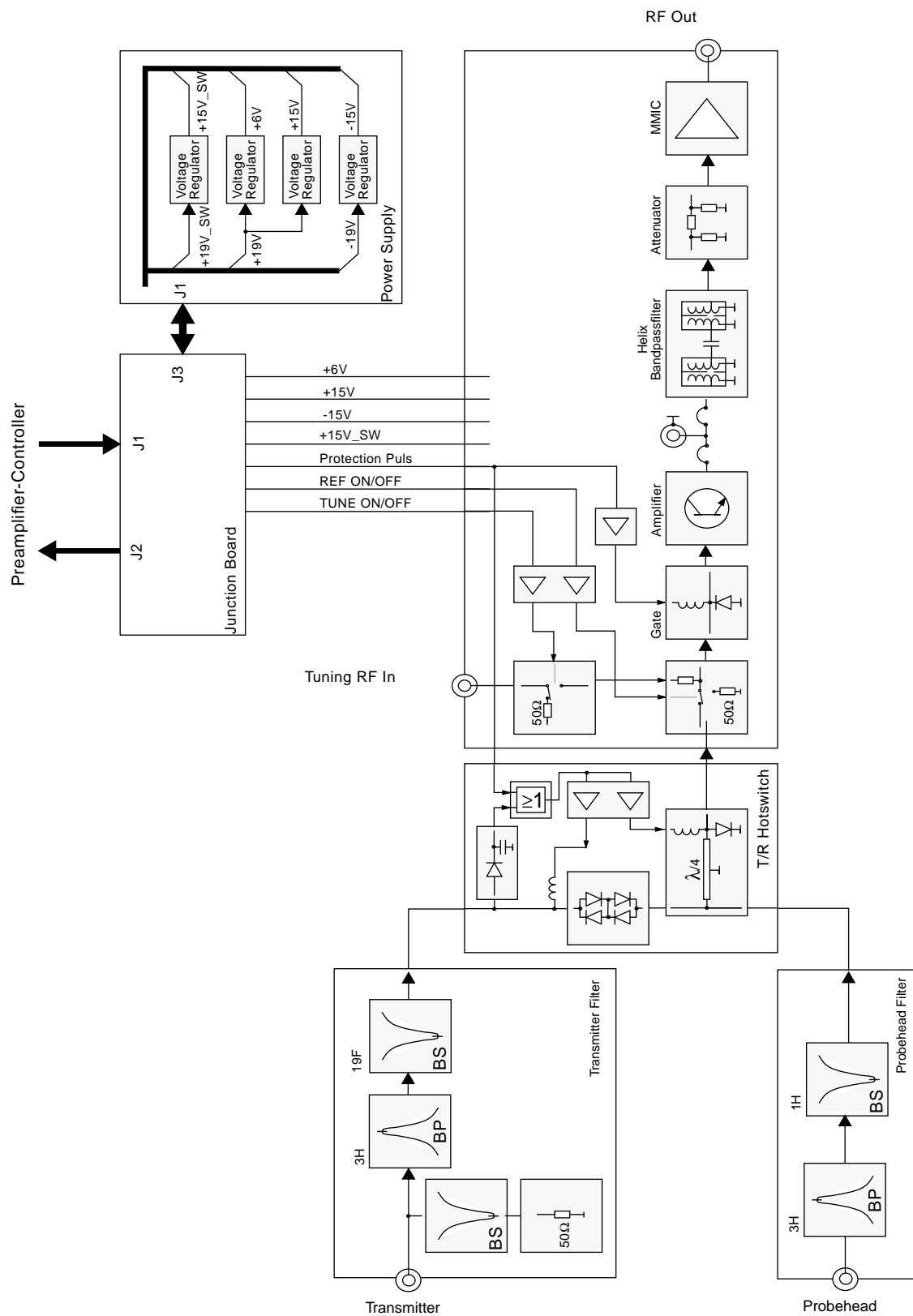


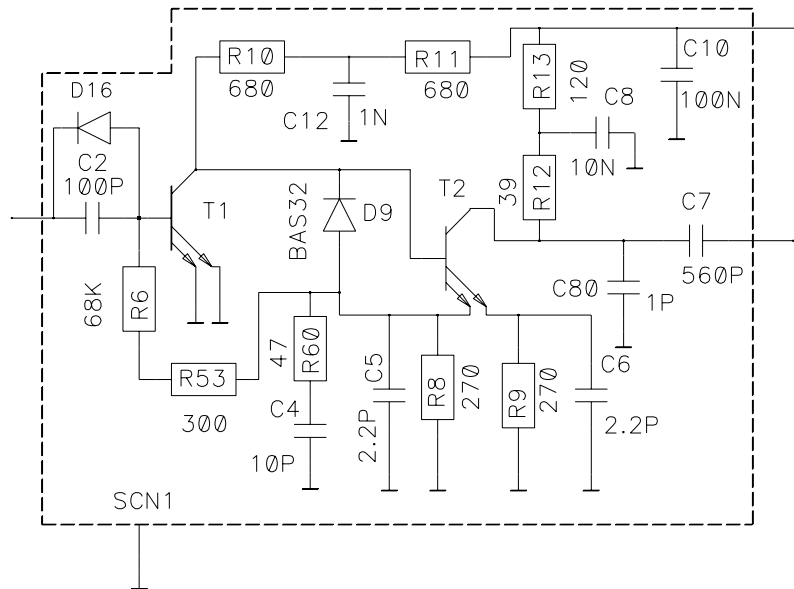
Figure 42: 3H Module - Block Diagram -



The Preamplifier

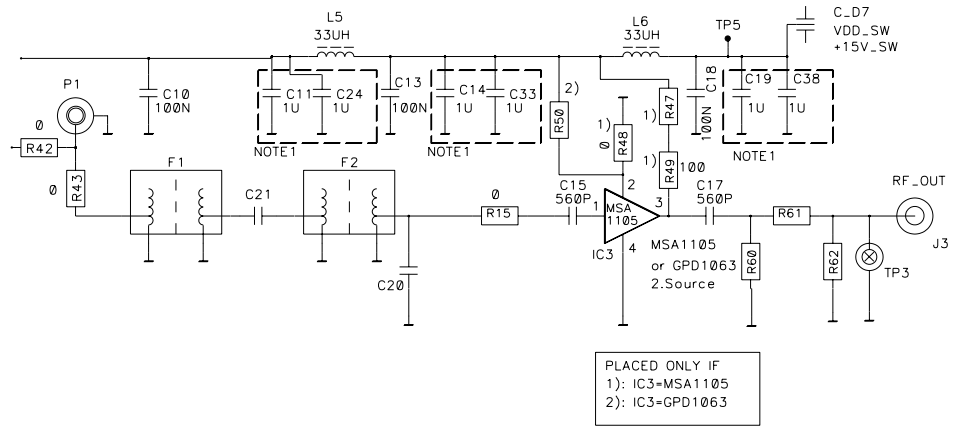
The 3H Module uses the same preamplifier as the 1H Module. Please refer to the corresponding section for further information.

Figure 43: Scheme extract - Preamplifier -



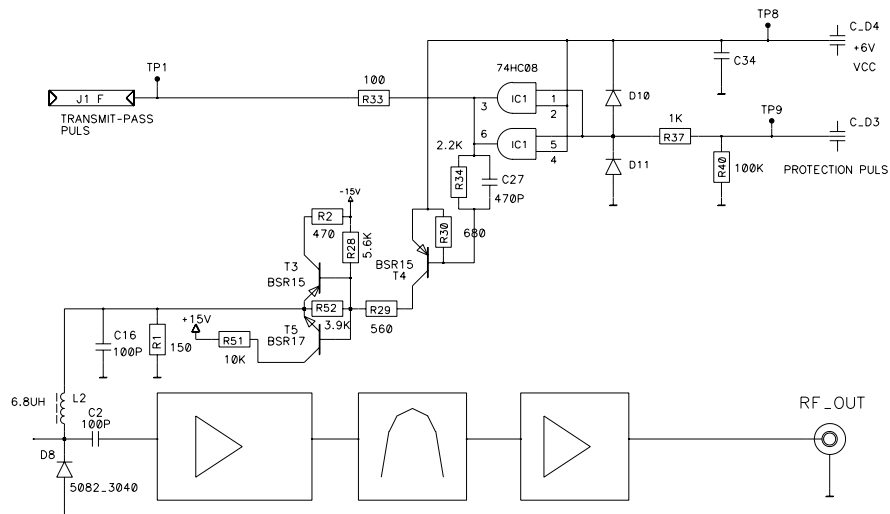
The bandpass-filter and the attenuator are the same as used in the 1H - Module. Please refer to the corresponding section for further information.

Figure 44: Scheme extract - Bandpass filter -



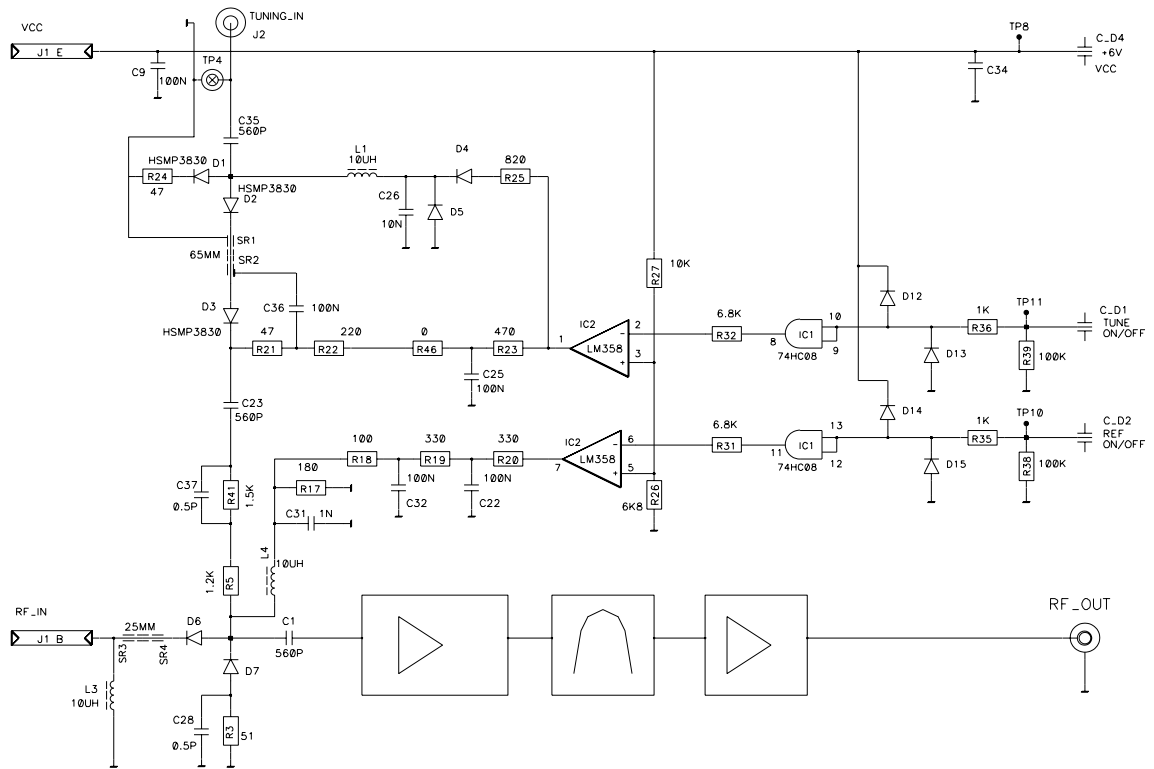
The Blanking circuit works in the same way as described in the 1H Module section.

Figure 45: Scheme extract - Blanking -



The same Tuning circuit as in the 1H Module is used. Please refer to the corresponding section for further information.

Figure 46: Scheme extract - Tuning-



Lambda/4 T/R-Hotswitch Box

9.2

The same Lambda/4 T/R-Hotswitch Box as in the 1H Module is used. Please refer to the corresponding section for further information.

Probehead Filter

9.3

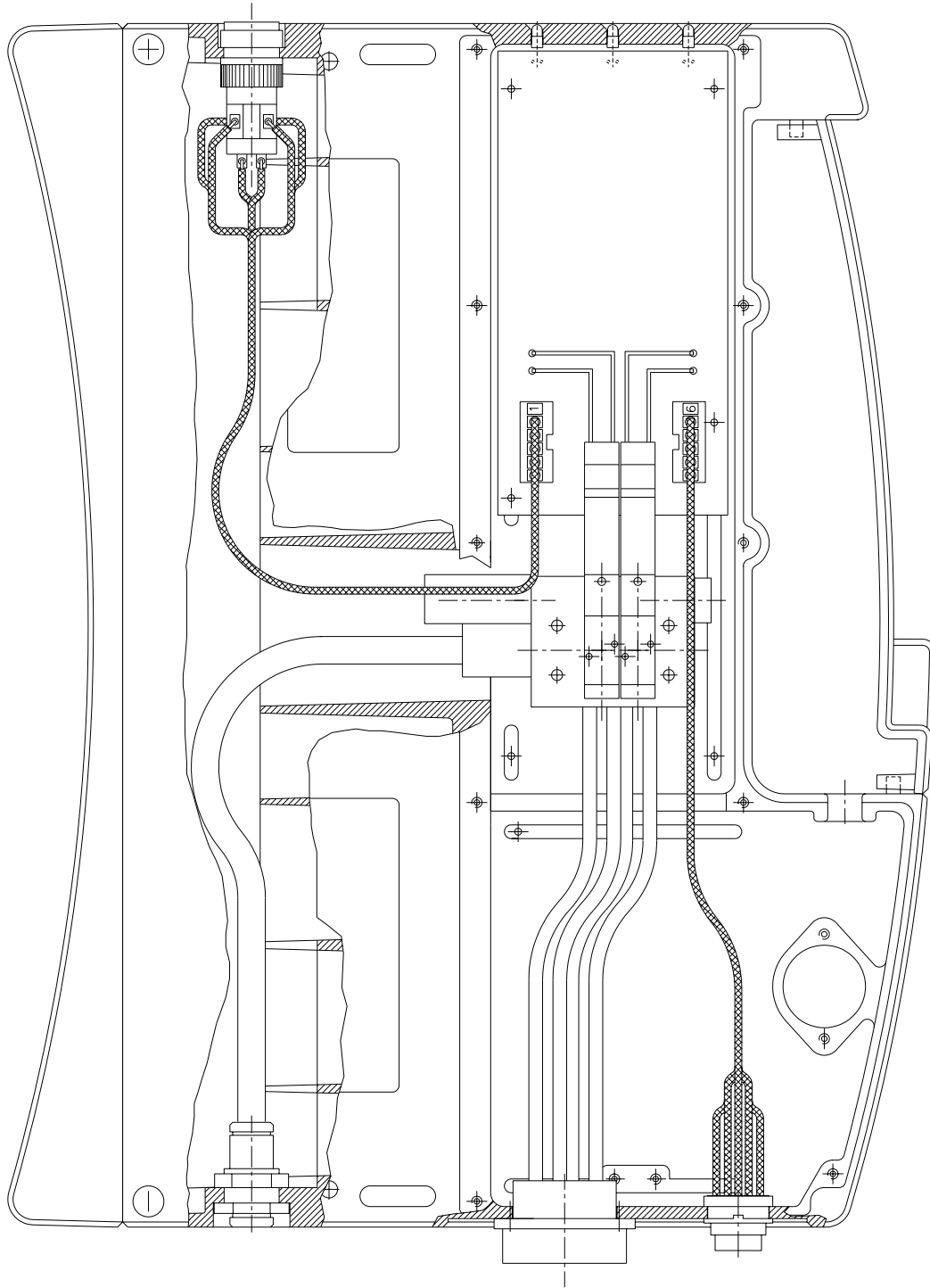
The probehead filter is designed as a dual circuit comb band pass filter. The capacitive coupling occurs at the high point of the resonator. The coupling between the resonators functions as a band pass filter with an inductive high point coupling.

Transmitter Filter

9.4

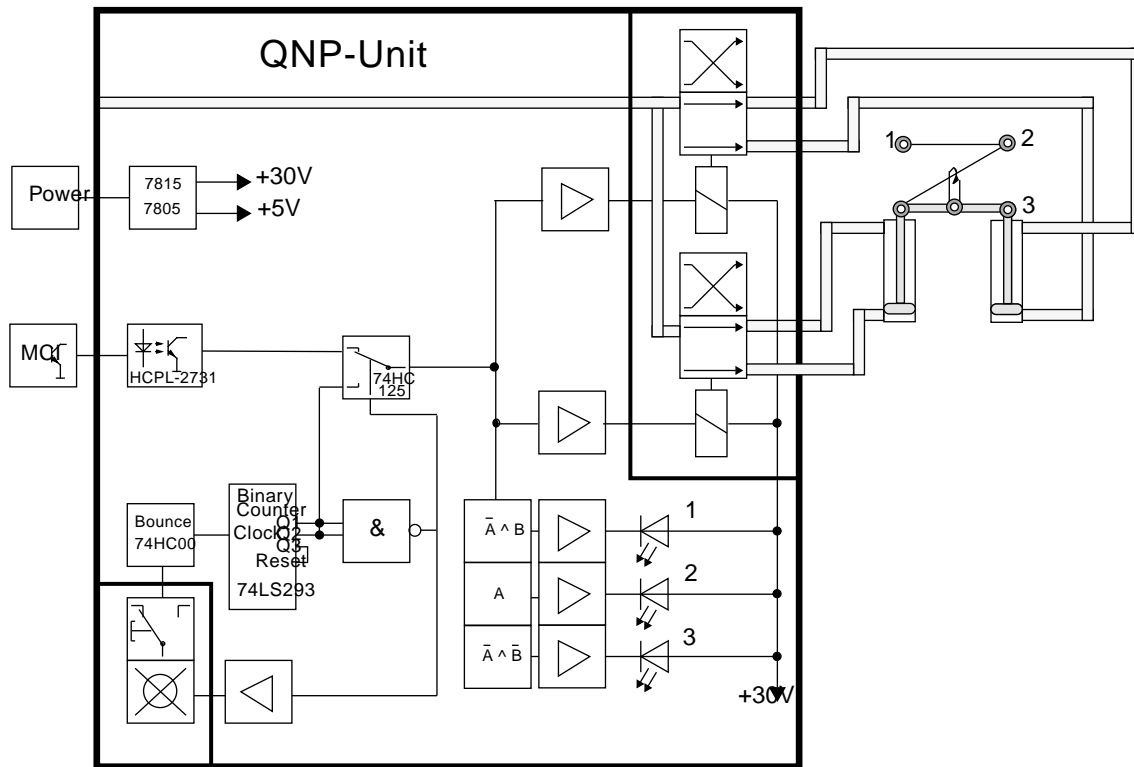
The transmitter filter is designed as a dual circuit comb band pass filter, suppressing ^{19}F . The capacitive coupling occurs at the high point of the resonator. The coupling between the resonators functions as a band pass filter with an inductive high point coupling. At the filter input there is a special circuit for the $50\ \Omega$ matching of the higher harmonics caused by the ^3H transmitter.

Figure 47: QNP Control Module - Top View -



QNP Control Module

Figure 48: QNP Control Module - Block Diagram -



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. ^{19}F , ^{13}C and ^{31}P . This is made possible by the triple-switchable measure-channel in the Probehead.

The QNP Control Module is the interface between the electronics and pneumatics. It is controlled manually or by the MCI via the signals Fxa and Fxb. Manual or MCI control can be chosen by a switch. The three indication LED's on the front panel show the operation state of the probehead switch. The three-level operation of the tuning-rod is controlled by two pneumatic cylinders in the Pneumatic Switch Drive. The associated control valve is positioned in the QNP Control Module.

Installation of the QNP Control Module

10.1.1

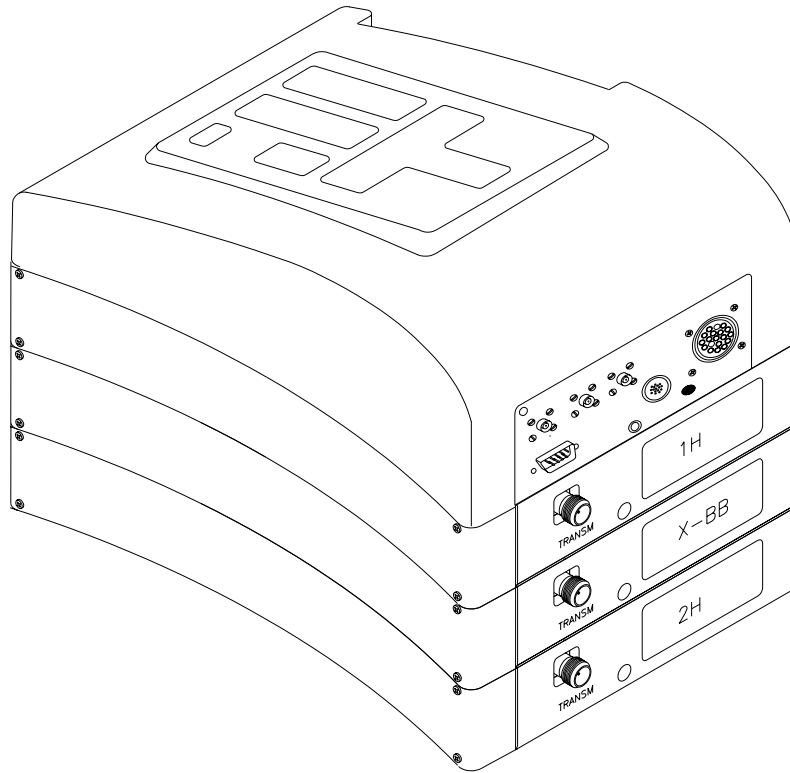
On the Multi Channel NMR Interface Board 3 C NMR I/F (H3500 or H3624), remove pins D and J on connector N1 and replace them with pins D1 (black) and J1 (violet/black). If BP2 is already occupied, the QNP cable pins must be removed and inserted in the already available connector. The QNP cable is labelled correspondingly.

Table 6: Console Connector BP2 pins

Pin	Signal
BB	Fxa
FF	Fxb
HH	DGND
KK	+30V
CC	GND

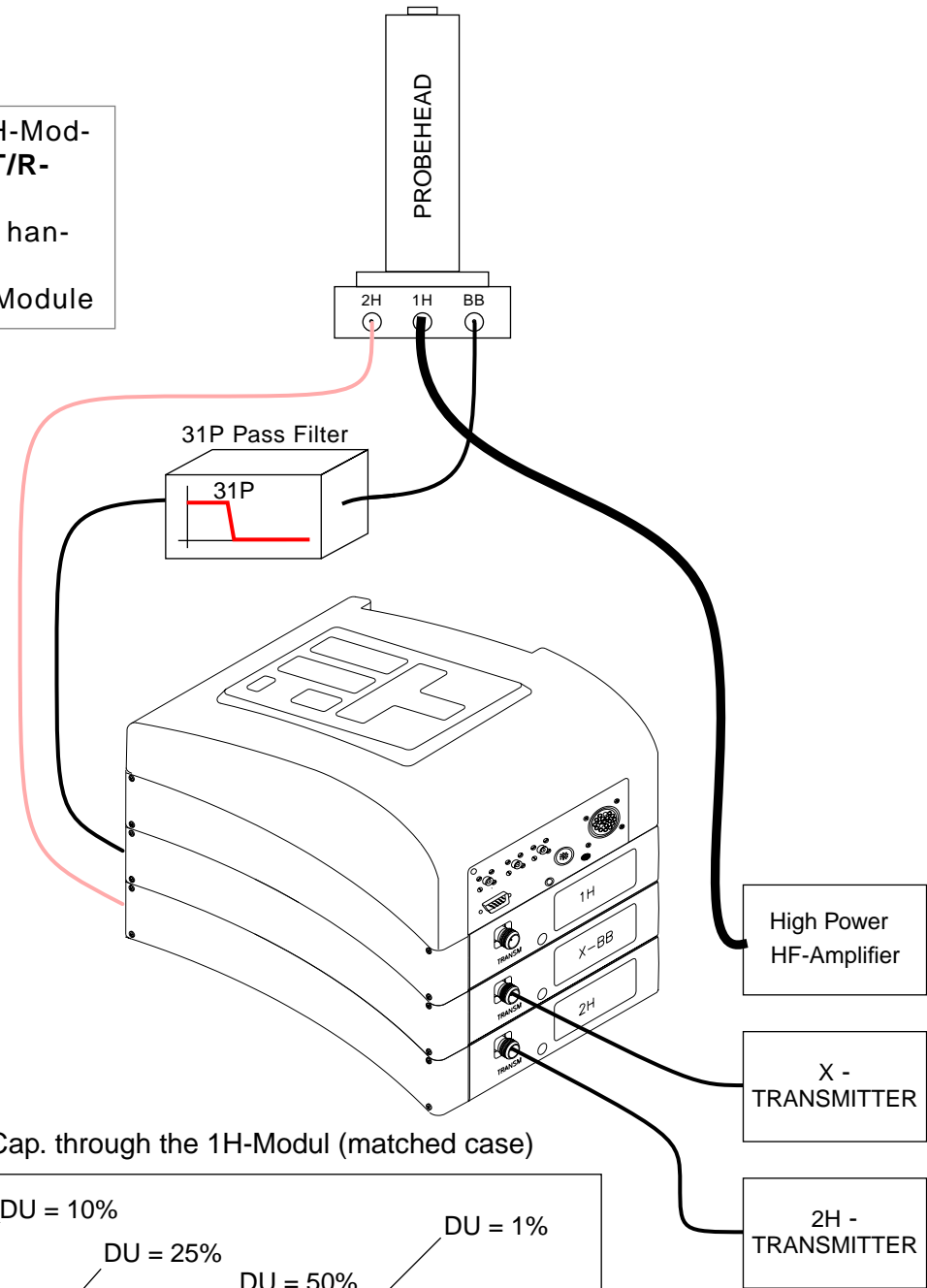
Table 7: QNP Control Signals

	Fxa	Fxb	Probehead Switch	Pneumatic Switch	Frequency
1	H	H	3	bottom	max.
2	L	H	2	middle	mid.
3	H	L	1	top	min.

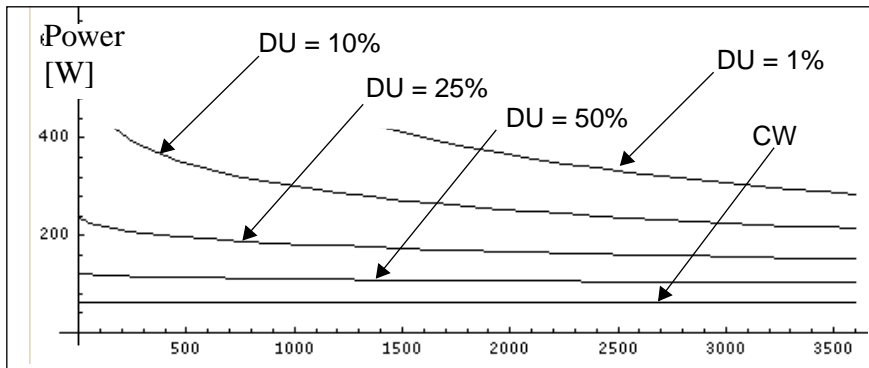


observe nucleus:X
 decoupling:1H, Pulses with more than 500mS @ 150 Watt and > 10 % Duty Cycle
 (external lock:2H)

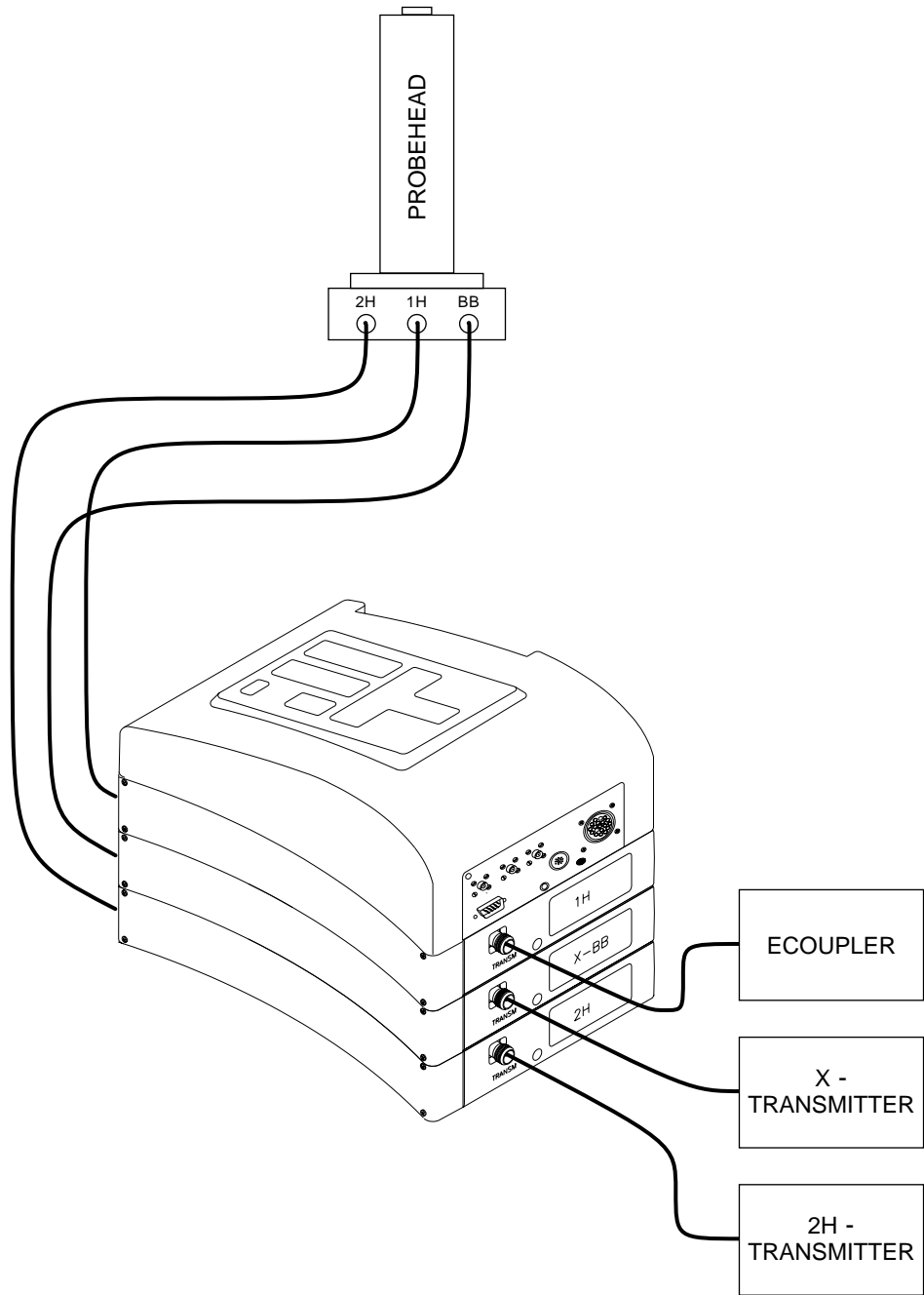
Read chapter 1H-Module (Lambda/4 T/R-Hotswitch Box) about the power handling capability through the 1H-Module



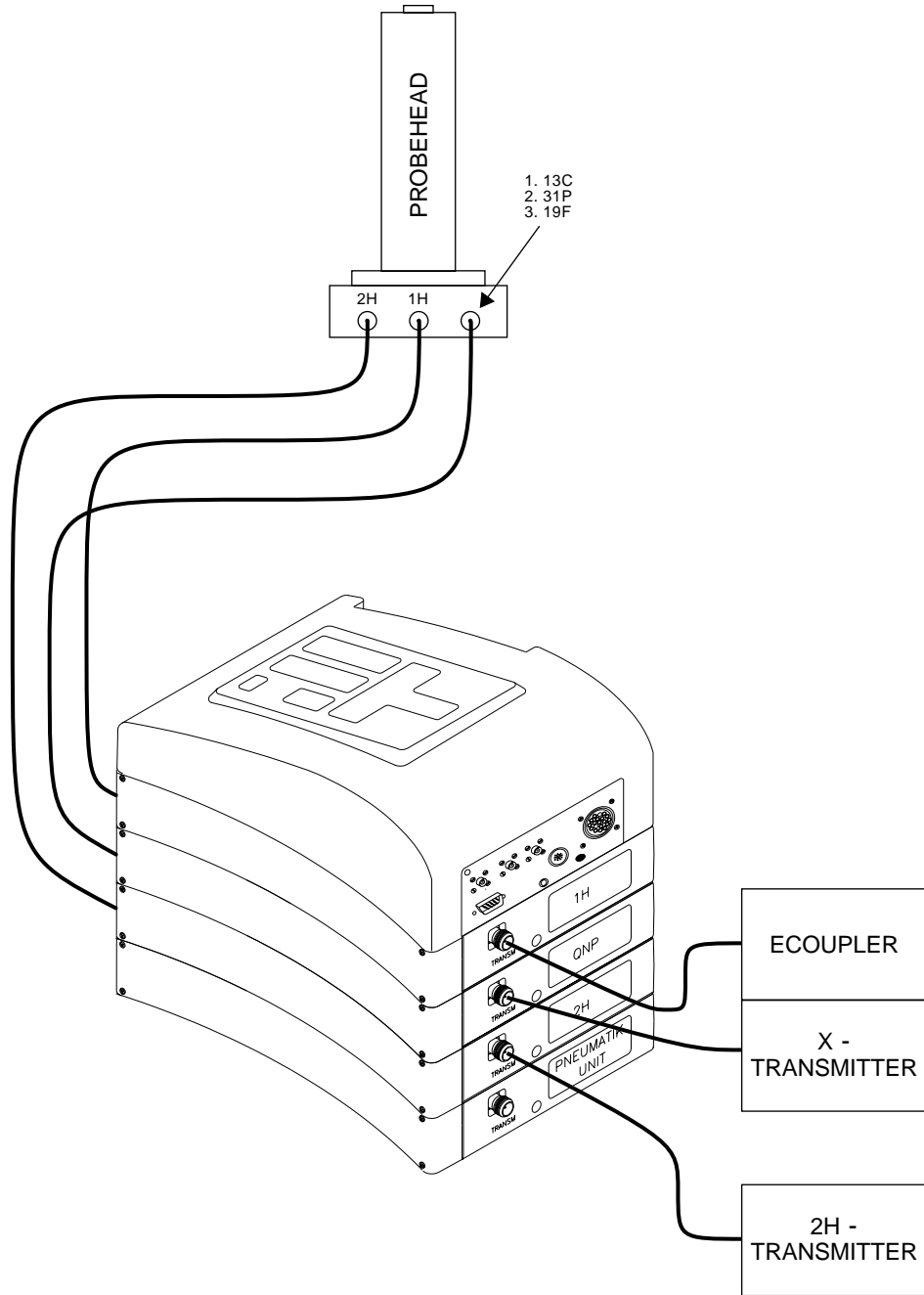
Power Handling Cap. through the 1H-Modul (matched case)



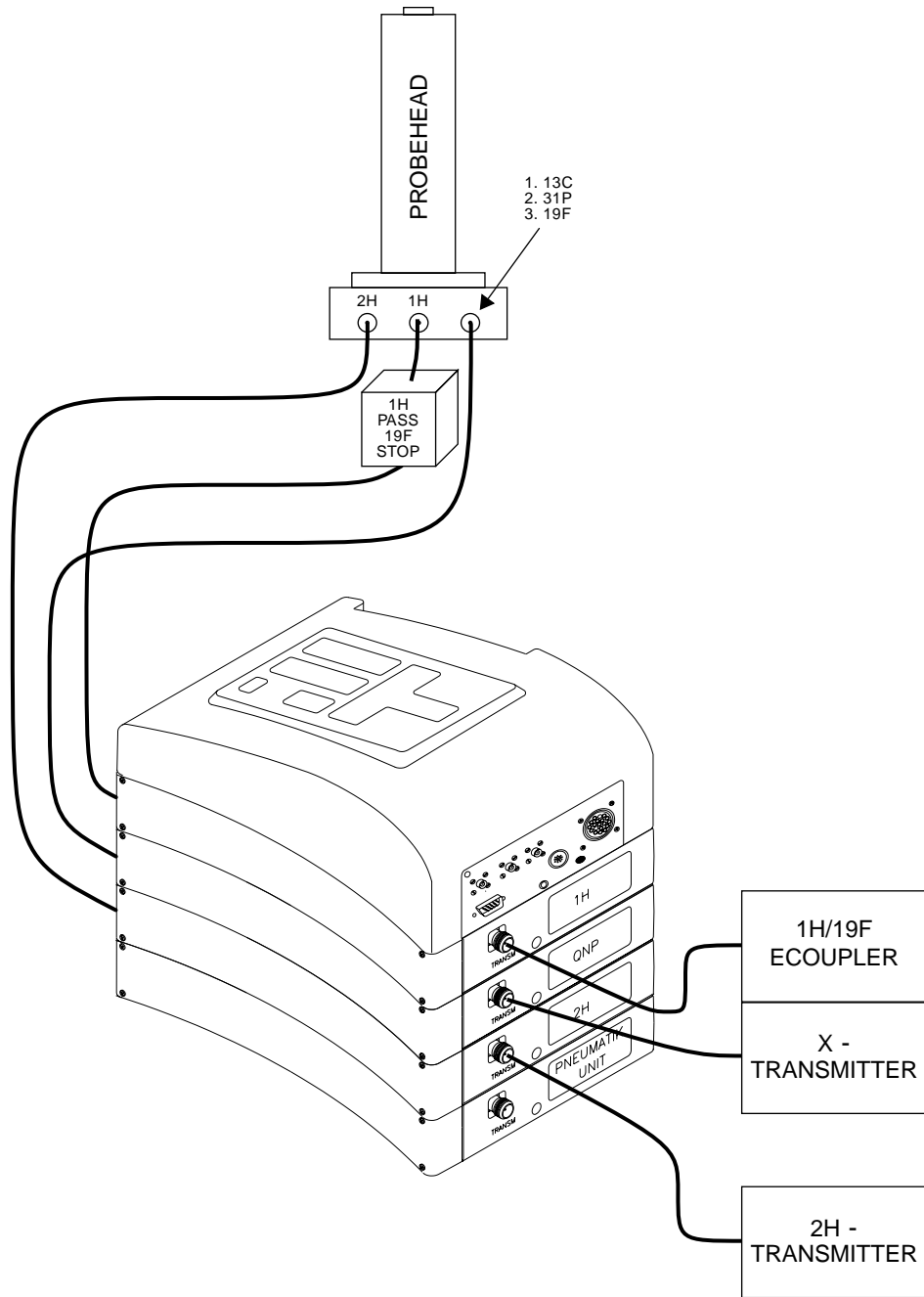
observe nucleus:X
decoupling:1H
lock:2H



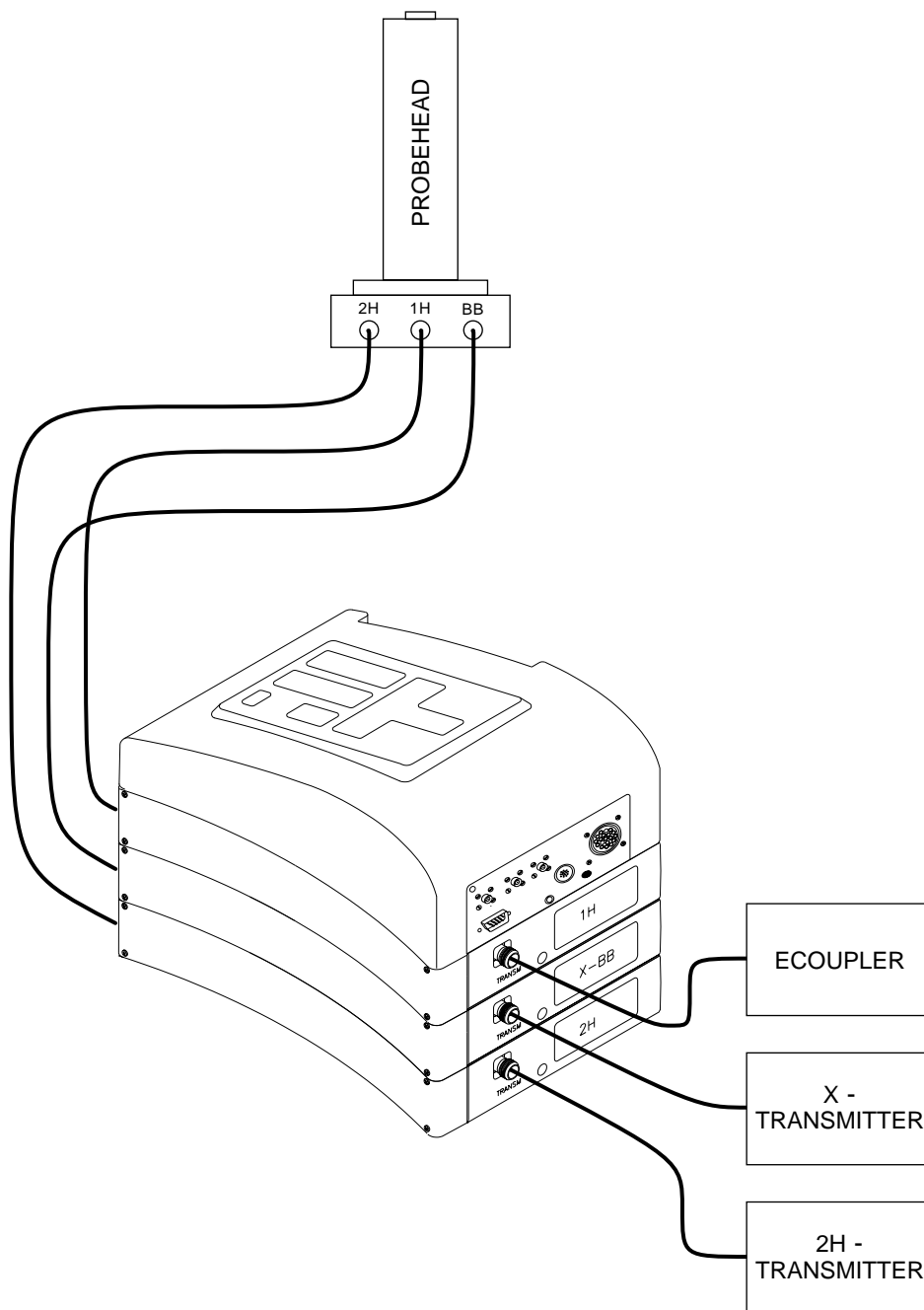
observe nucleus:13C, 31P, 19F
decoupling:1H
lock:2H



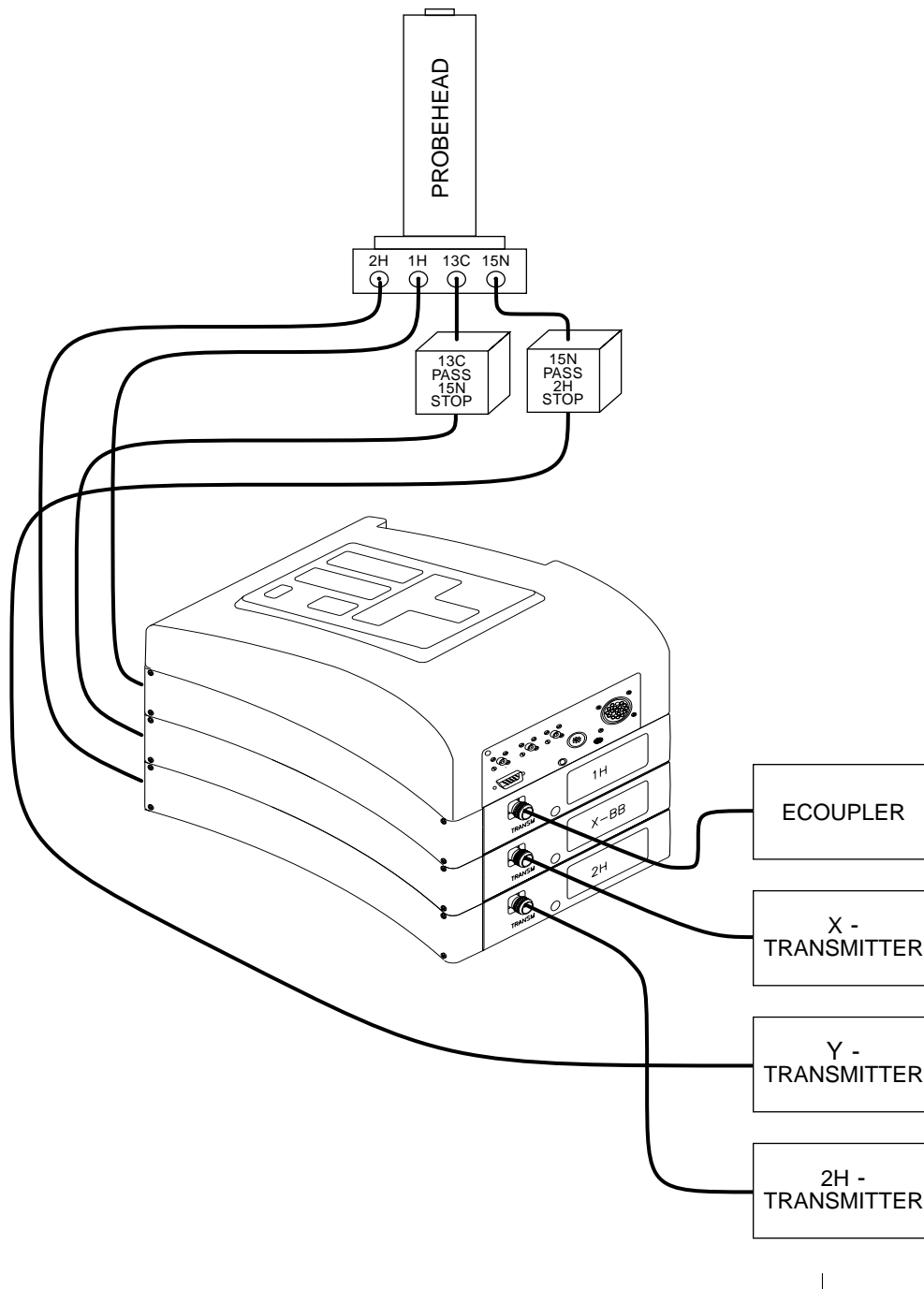
observe nucleus:13C, 31P, 1H
decoupling:19F
lock:2H



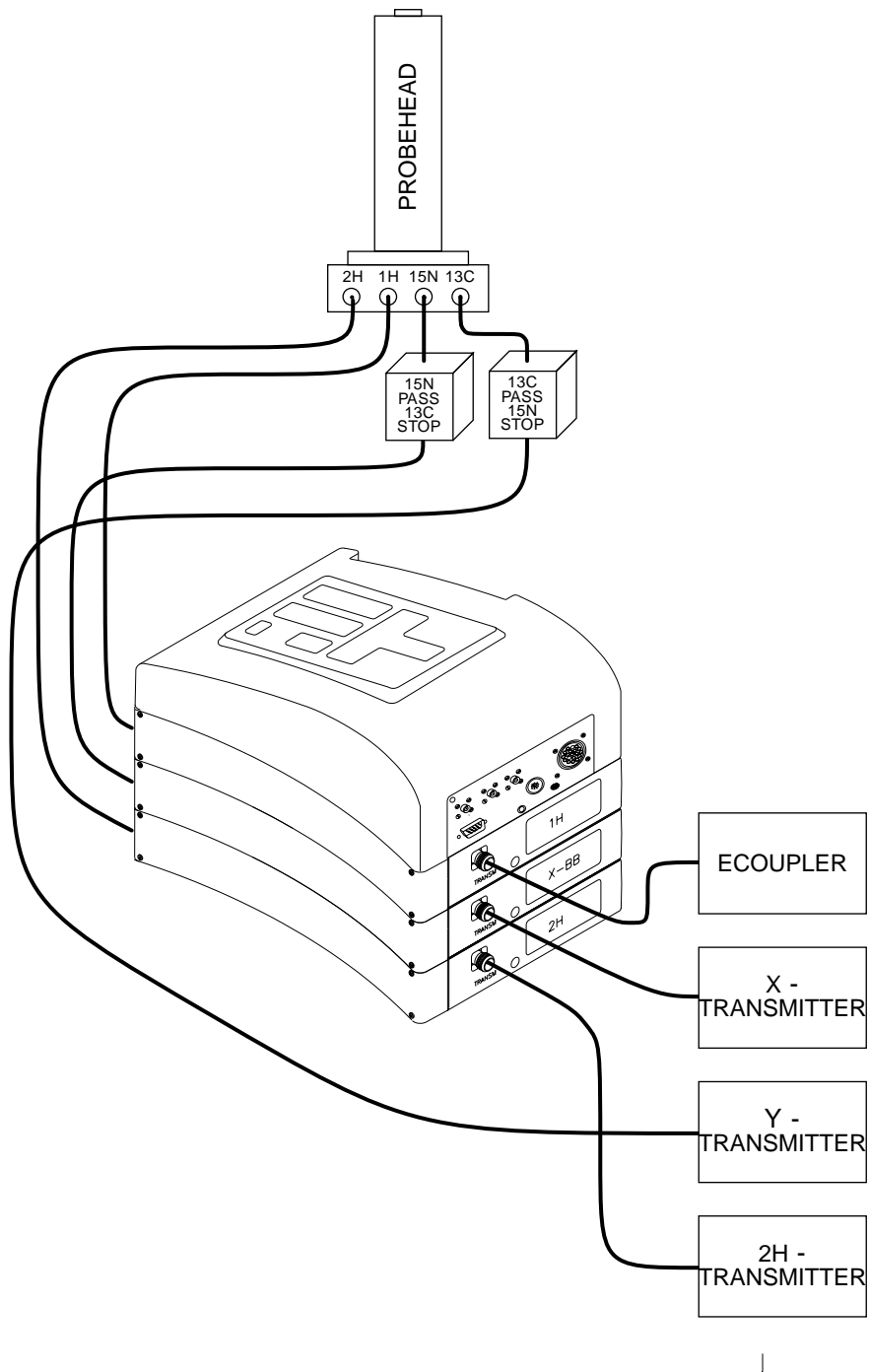
observe nucleus:1H
decoupling:X
lock:2H



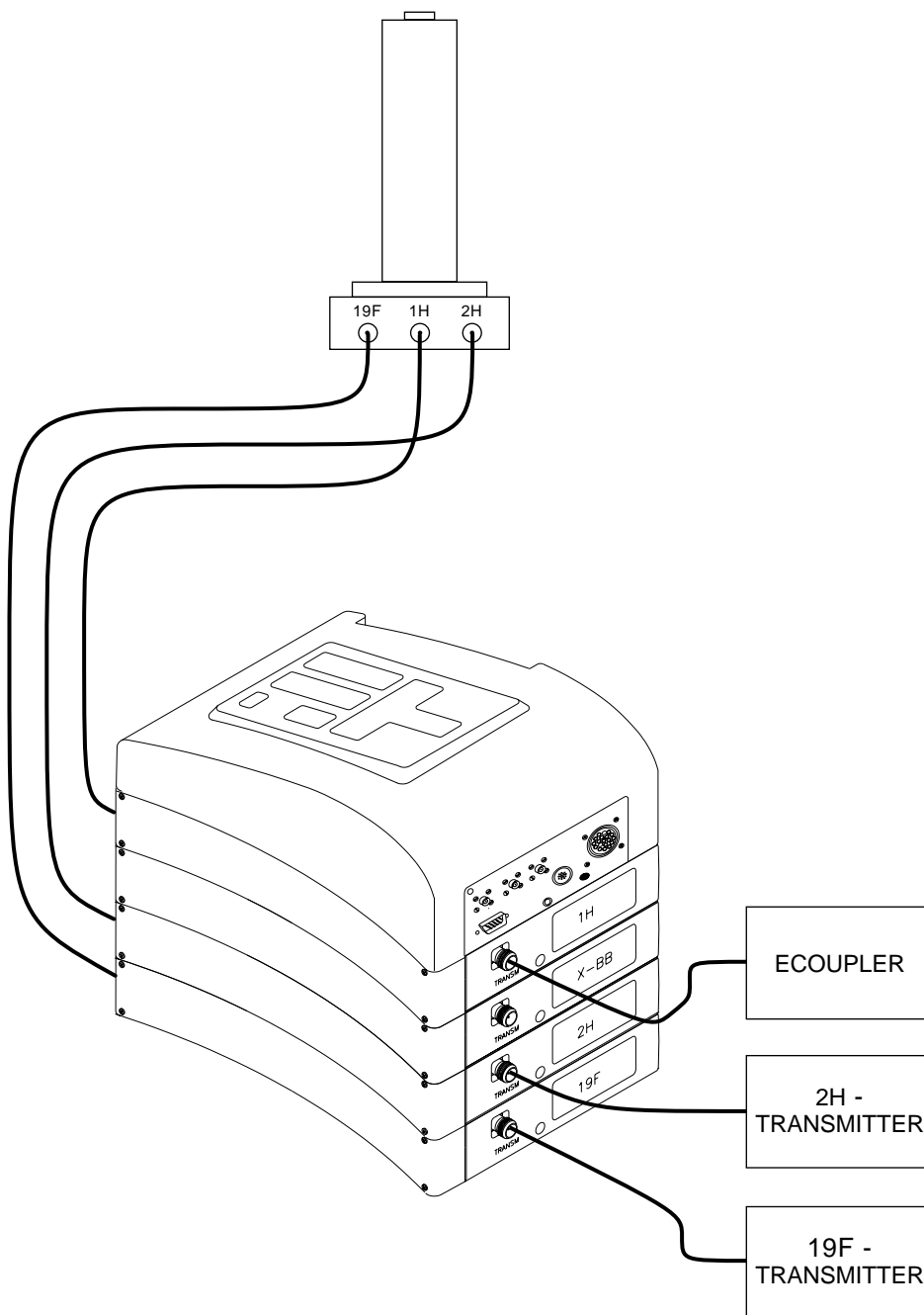
observe nucleus:1H
 decoupling 1:13C
 lock:2H
 decoupling 2:15N



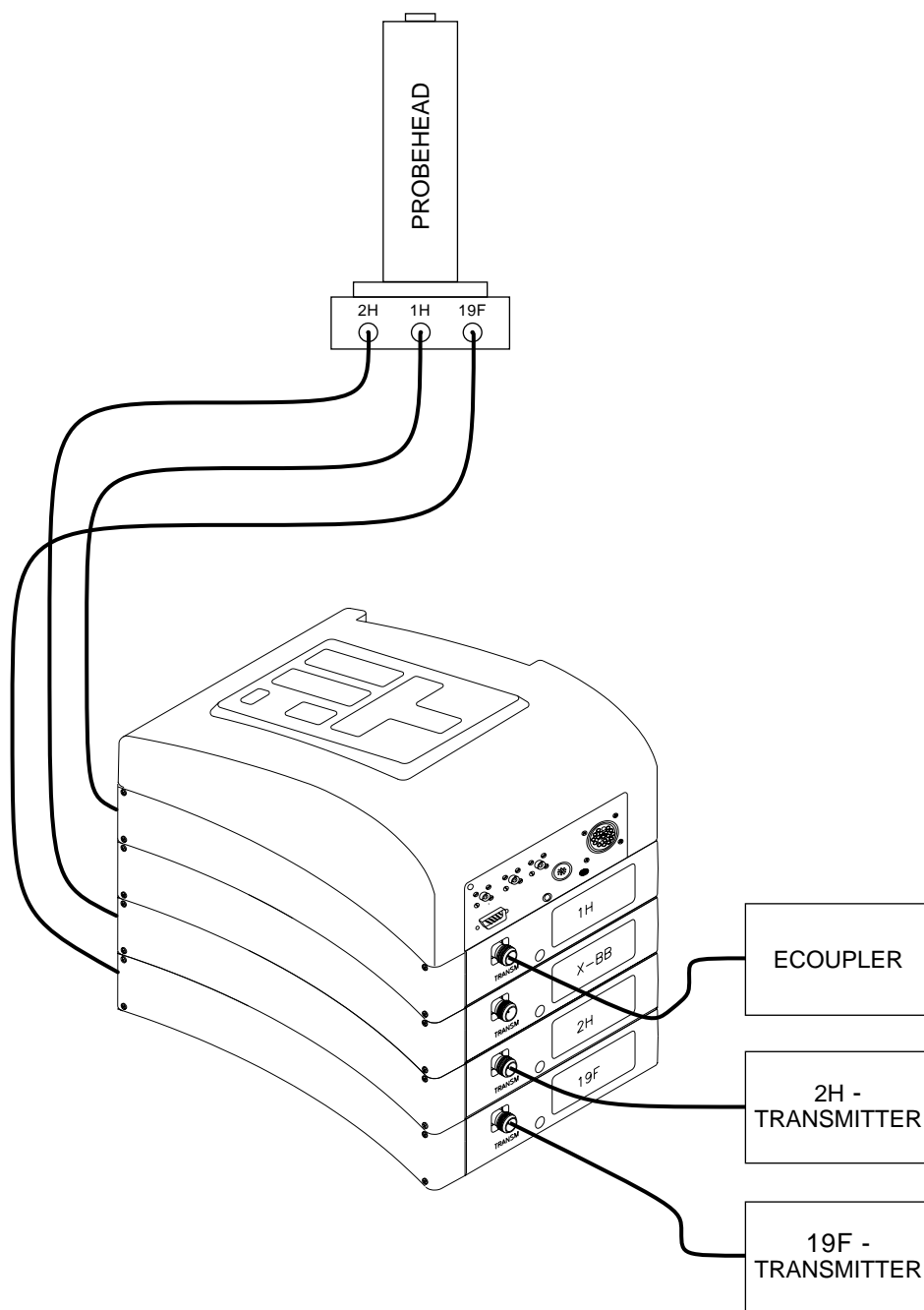
observe nucleus:13C
decoupling 1:1H
lock:2H
decoupling 2:15N



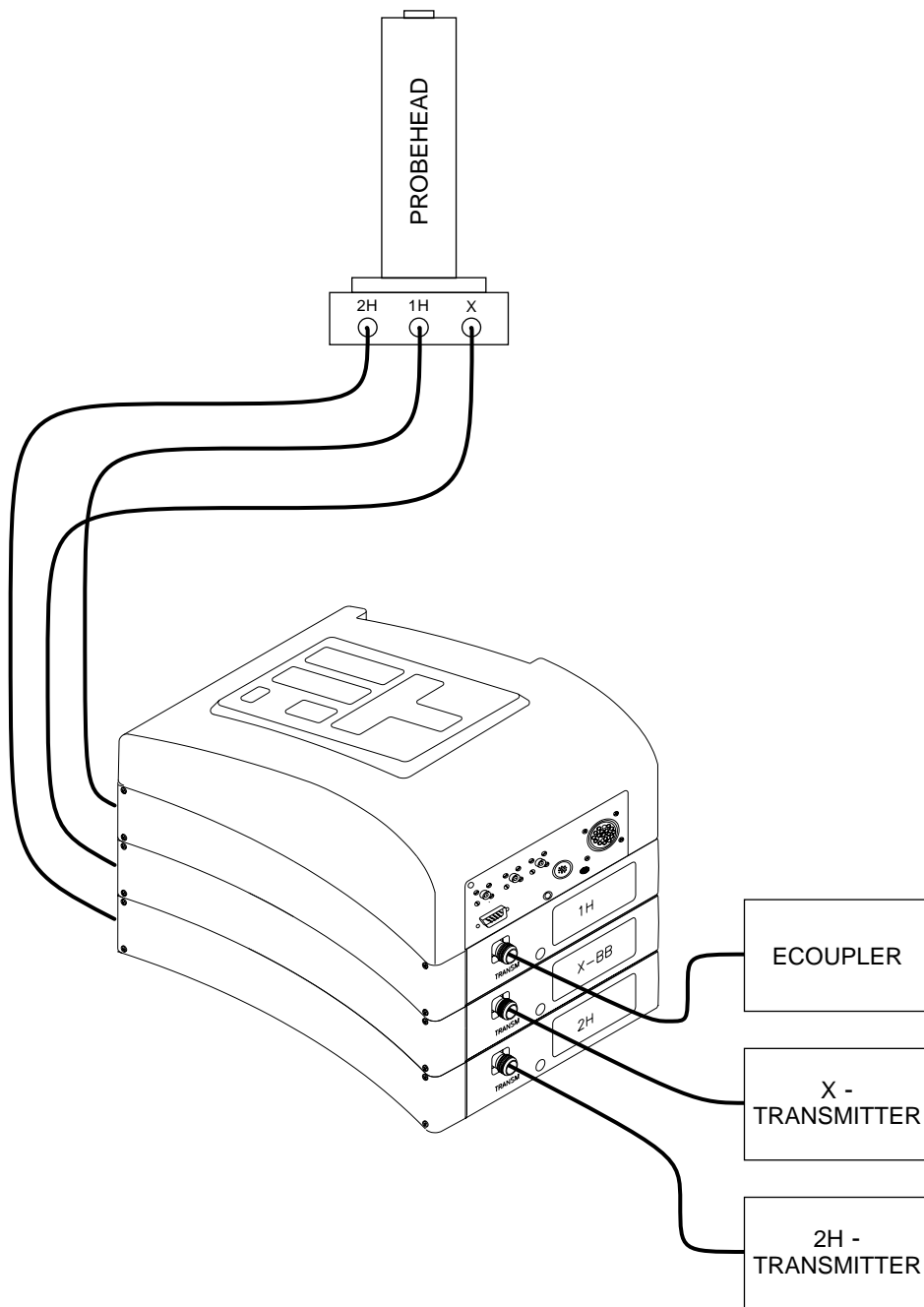
observe nucleus:2H
decoupling:1H
lock:19F



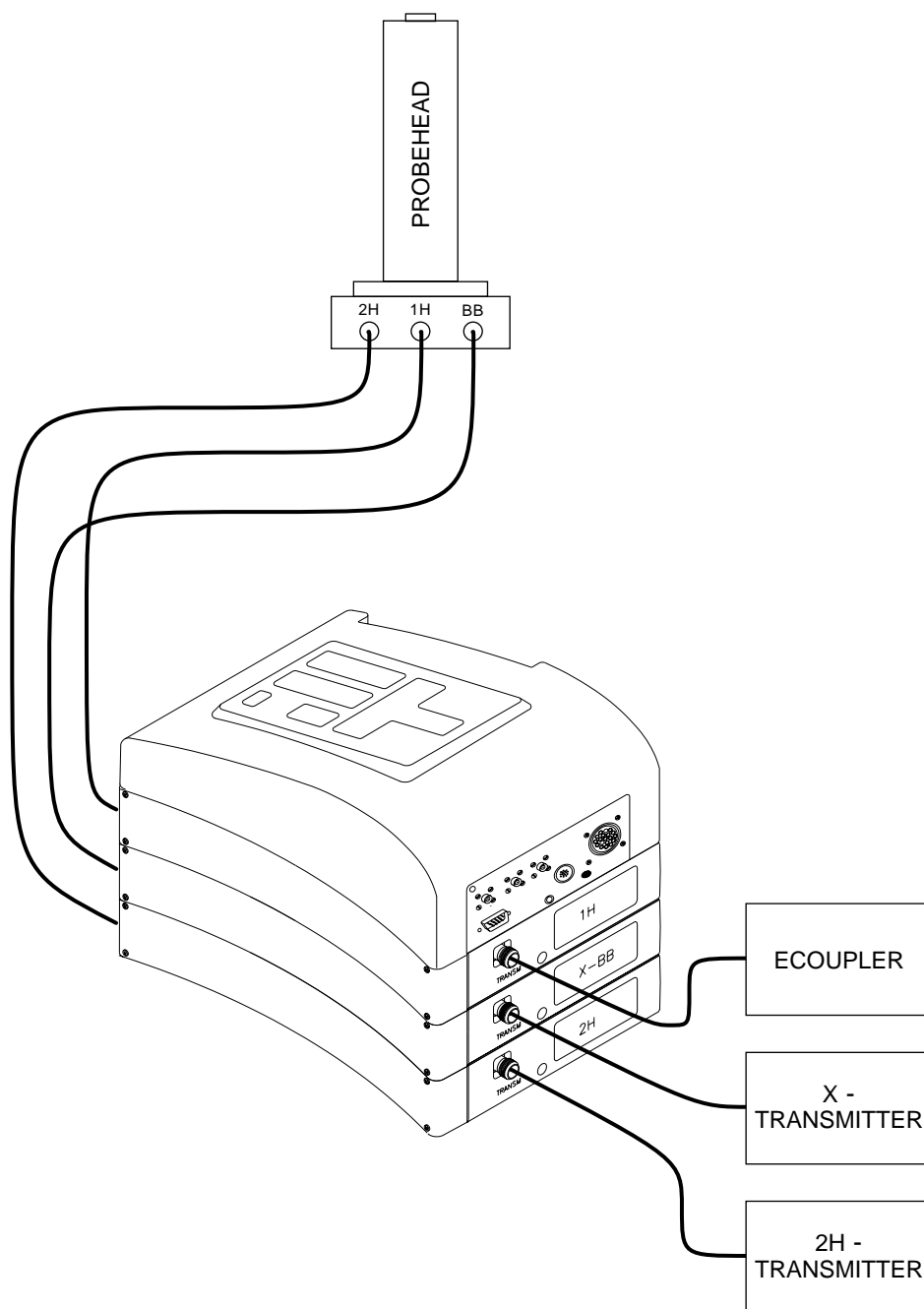
observe nucleus:19F
decoupling:1H
lock:2H



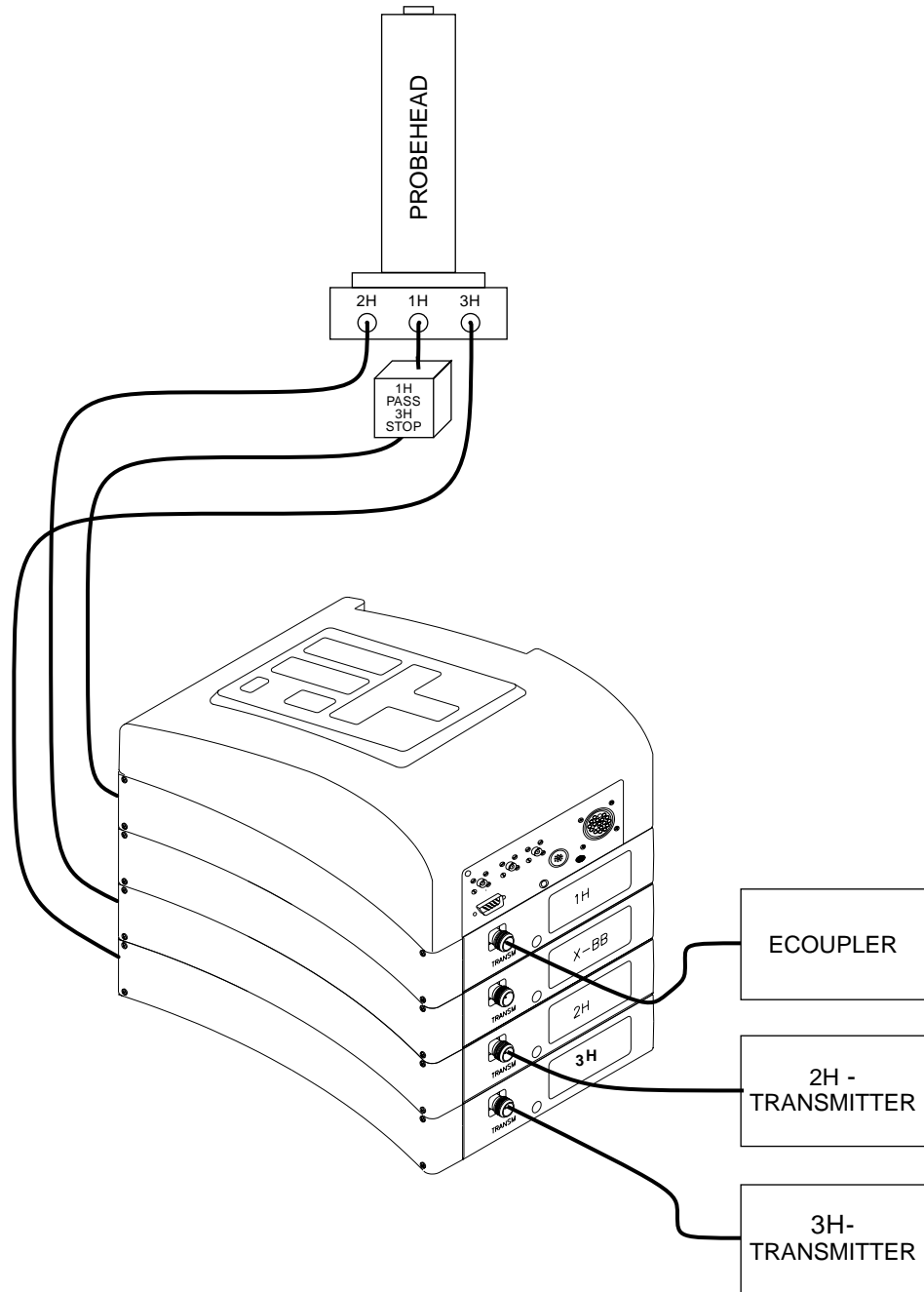
observe nucleus:X
decoupling:1H
lock:2H



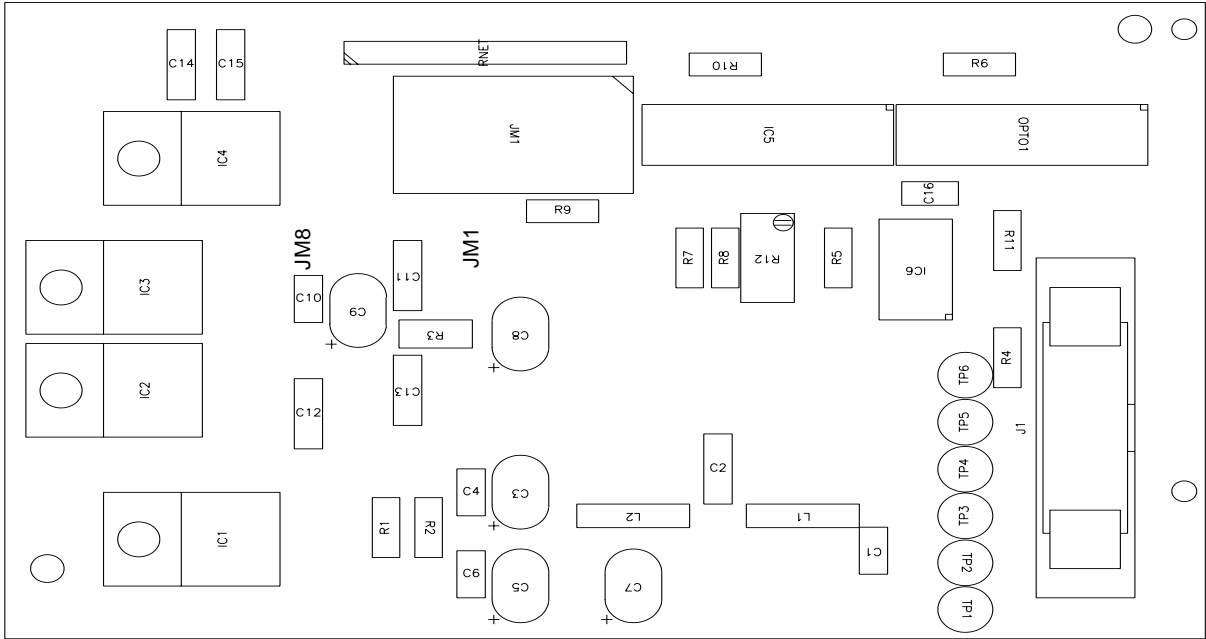
observe nucleus:1H
decoupling:X
lock:2H



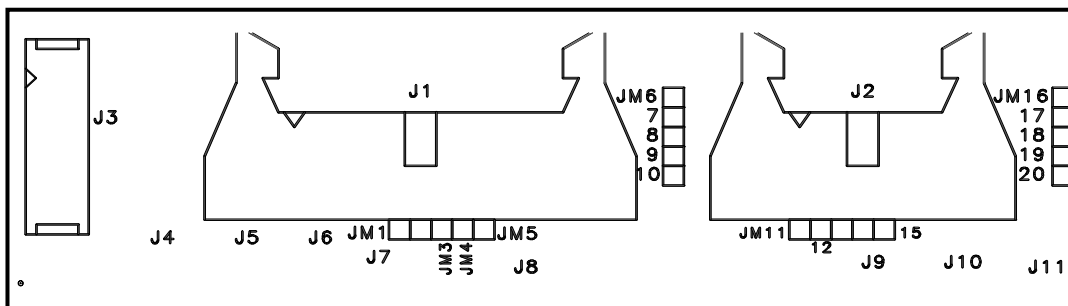
observe nucleus : 3H
decoupling : 1H
lock : 2H



Power Supply



Junction Board



A major goal while designing each one of the various Preamplifier-Modules was to keep the number of supporting circuits as low as possible. Therefore identical Power Supply and the Junction Boards are found in all Preamplifier Modules.

Each preamplifier-module has its own Power Supply board. It is fed from the console with ± 19 V. The Power Supply delivers three stabilized voltages.

- 15 V	VDD	IC 2	TP 3
- 15 V	VSS	IC 4	TP 4
+ 6 V	VCC	IC 3	TP 2

The supply voltage for the Preamp (19 V_SW -> VDD_SW, TP 1) which is found on the controller board may be switched via software (Preamplifier En-/Disable). It is connected to the Power Supply via an additional connection other than ± 19 V.

All supplied voltages are monitored (OPTO 1 /PC 847). Should one of the three voltages above fail, the corresponding optical coupler will shut and the change of conditions will be reported to Preamp control via the VCTRL line.

The X32 computer is able to read up to 5 module information codes from the HP Preamp. A module modification index is read by the controller and sent to the X32 computer on request.

If a ¹H, ²H, X-BB or ¹⁹F preamplifier module requires an update, the **Hardware-Code-Level (HCL**)** index will be altered at a BRUKER facility. All of the named modules are connected to the Preamp controller via a line (PCODE, TP 5 on the Power Supply) which carries a corresponding voltage for the modification index. The identifying voltage is generated on the Power Supply board using an 8-Bit DAC (IC 5) followed by a OP stage (IC 6). The coding of the Preamp module can be achieved with solderable jumpers (JM1 - JM8).

The following tables show the Power Supply Jumper Settings for the Preamplifier Modules.

Note!

Table 8 on page 99: Hardware Code Level Detection HCL A and B for 1H, 2H, X-BB, 19F Modules only!

Table 9 on page 99: Hardware Code Level Detection HCL C and higher for all Modules!

Table 8: *Hardware Code Level Detection - HCL A and B only -*

Pos.	Jumper								Hardware Code Level Detection for 1H, 2H, X-BB, 19F Modules - HCL A and B only -
	7	6	5	4	3	2	1	0	
	JM_ 8	JM_ 7	JM_ 6	JM_ 5	JM_ 4	JM_ 3	JM_ 2	JM_ 1	
1H, 2H, X-BB, 19F MODULE									
									MODIFICATION INDEX
1	0	0	0	0	0	0	0	0	no Preamplifier available
2	X	X	X	X	0	0	0	1	Module HCL A
3	X	X	X	X	0	0	1	0	Module HCL B
									FREQUENCY IDENTIFICATION
4	X	0	1	0	X	X	X	X	- 300 -
5	X	0	1	1	X	X	X	X	- 360 -
6	X	1	0	0	X	X	X	X	- 400 -
7	X	1	0	1	X	X	X	X	- 500 -
8	X	1	1	0	X	X	X	X	- 600 -
USER-BOX									
9	0	0	0	0	0	0	0	0	no Preamplifier available
10	0	0	0	0	0	0	1	0	X-BB_19F_2HP [former QNP(19F)]

Table 9: *Hardware Code Level Detection - HCL C and higher -*

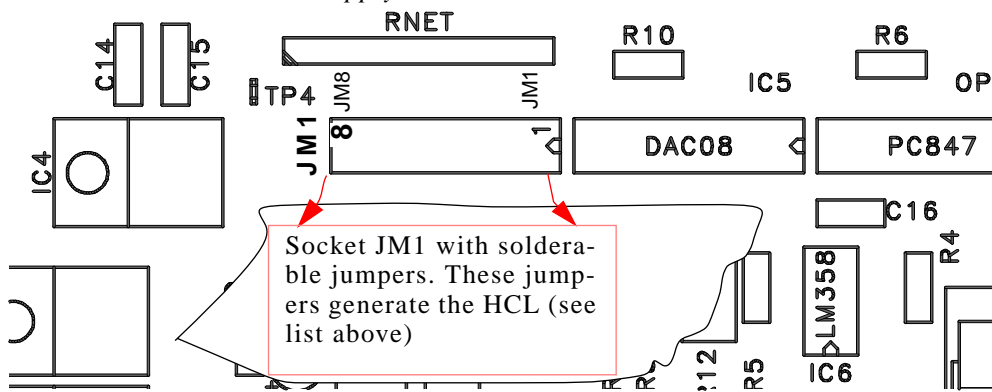
Pos.	Jumper								Hardware Code Level Detection for all Modules - HCL C and higher -
	7	6	5	4	3	2	1	0	
	JM_ 8	JM_ 7	JM_ 6	JM_ 5	JM_ 4	JM_ 3	JM_ 2	JM_ 1	
1	0	0	0	0	0	0	0	0	no Preamplifier available
2	X	X	X	X	X	0	1	1	Module HCL C
3	X	X	X	X	X	1	0	0	Module HCL D
4	X	X	X	X	X	1	0	1	Module HCL E
5	X	X	X	X	X	1	1	0	Module HCL F

Commonly used Circuits

Pos.	Jumper								Hardware Code Level Detection for all Modules - HCL C and higher -
	7	6	5	4	3	2	1	0	
	JM_ 8	JM_ 7	JM_ 6	JM_ 5	JM_ 4	JM_ 3	JM_ 2	JM_ 1	
6	X	X	X	X	X	1	1	1	Module HCL G
7	0	0	0	0	1	X	X	X	3H Module
8	0	0	0	1	0	X	X	X	3H Module HP (High Power)
9	0	0	0	1	1	X	X	X	1H Module
10	0	0	1	0	0	X	X	X	1H Module HP
11	0	0	1	0	1	X	X	X	19F Sel. Module
12	0	0	1	1	0	X	X	X	19F Sel. Module HP
13	0	0	1	1	1	X	X	X	19F/1H/3H Module HP
14	0	1	0	0	0	X	X	X	X-BB_19F_2HS Module
15	0	1	0	0	1	X	X	X	X-BB_19F Module HP
16	0	1	0	1	0	X	X	X	X-BB_31P_2HS Module
17	0	1	0	1	1	X	X	X	X-BB_31P Module HP
18	0	1	1	0	0	X	X	X	2H Module
19	0	1	1	0	1	X	X	X	2H Module HP
20	0	1	1	1	0	X	X	X	Reserve
21	0	1	1	1	1	X	X	X	Reserve
22	1	0	0	0	0	X	X	X	Reserve
23	1	0	0	0	1	X	X	X	Reserve
24	1	0	0	1	0	X	X	X	Reserve
25	1	0	0	1	1	X	X	X	Reserve
26	1	0	1	0	0	X	X	X	Reserve
27	1	0	1	0	1	X	X	X	Reserve
28	1	0	1	1	0	X	X	X	Reserve
29	1	0	1	1	1	X	X	X	Reserve
30	1	1	0	0	0	X	X	X	Reserve
31	1	1	0	0	1	X	X	X	Reserve
32	1	1	0	1	0	X	X	X	Reserve

Pos.	Jumper								Hardware Code Level Detection for all Modules - HCL C and higher -
	7	6	5	4	3	2	1	0	
	JM_8	JM_7	JM_6	JM_5	JM_4	JM_3	JM_2	JM_1	
33	1	1	0	1	1	X	X	X	Reserve
34	1	1	1	0	0	X	X	X	Reserve
35	1	1	1	0	1	X	X	X	Reserve
36	1	1	1	1	0	X	X	X	Reserve
37	1	1	1	1	1	X	X	X	Reserve

Figure 49: Scheme extract - Power Supply Board - with HCL socket.



The Junction board is located in the ‘cable channel’ (covered with a plastic shield) of the module. It connects the Pre-amplifier Controller with the Power Supply- and Pre-amplifier board. All pre-amplifier-modules use the same Junction Board with a specific jumper-setting (JM1 - JM20) for each module.

Caution

Tampering with the jumpers will lead to module identification problems!

The following tables show the Junction Board Jumper Settings for the most often used Pre-amplifier Configurations.

Table 10: Jumper Settings for Standard Pre-amplifiers Configurations

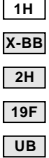
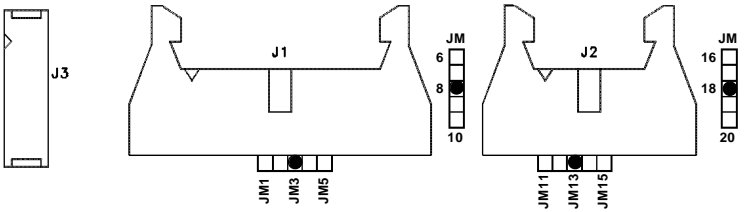
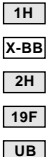
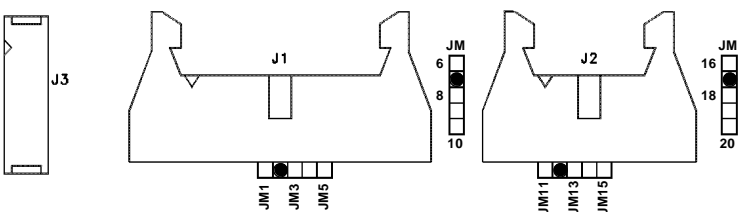
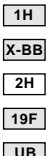
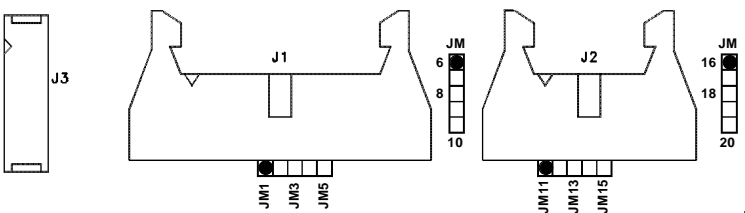
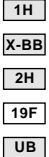
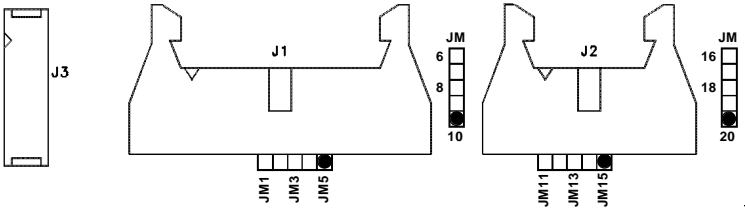
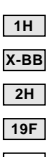
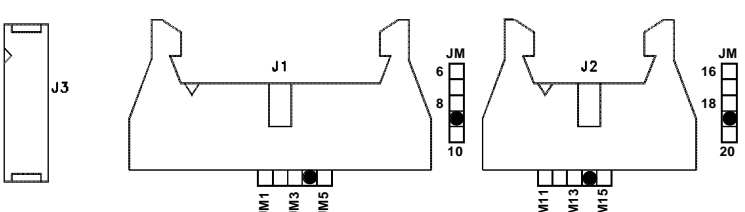
Module	Jumper	Preamp. - Position	Remarks
1H Module	JM_3, JM_8, JM_13, JM_18	1 	
X-BB_31P_2HS or X-BB_19F_2HS Module (X-Range up to 31P/19F with 2H-Stop; internal or external)	JM_2, JM_7, JM_12, JM_17	2 	
2H Module Lock/ HR	JM_1, JM_6, JM_11, JM_16	3 	
USER-Box Position 1: E.g.: - 19F-Sel. Module HR/Lock - 3H-Sel. Module	JM_5, JM_10, JM_15, JM_20	4 	
USER-Box Position 2: E.g.: - X-BB_19F_2HP Module - (special content)	JM_4, JM_9, JM_14, JM_19	5 	

Table 11: 1H, X-BB_31P_2HS, 2H, X-BB_19F_2HP Module

Modules	Jumper	Remarks
1H Module	JM_3, 8, 13, 18	
X-BB_31P_2HS Module (X-Range up to 31P with 2H-Stop; internal or external)	JM_2, 7, 12, 17	
2H Module Lock/HR	JM_1, 6, 11, 16	
X-BB_19F_2HP Module	JM_4, 9, 14, 19	USER-Box Position 2

Table 12: HR/HP combined Assembly

Module	Jumper	Remarks
1H Module	JM_3, 8, 13, 18	
X-BB19F_2HS Module (X-Range up to 19F with 2H-Stop; internal or external)	JM_2, 7, 12, 17	
2H Module Lock/HR	JM_1, 6, 11, 16	
19F/1H/3H Module HP	JM_5, 10, 15, 20	USER-Box Position 1
X-BB Module HP	JM_4, 9, 14, 19	USER-Box Position 2

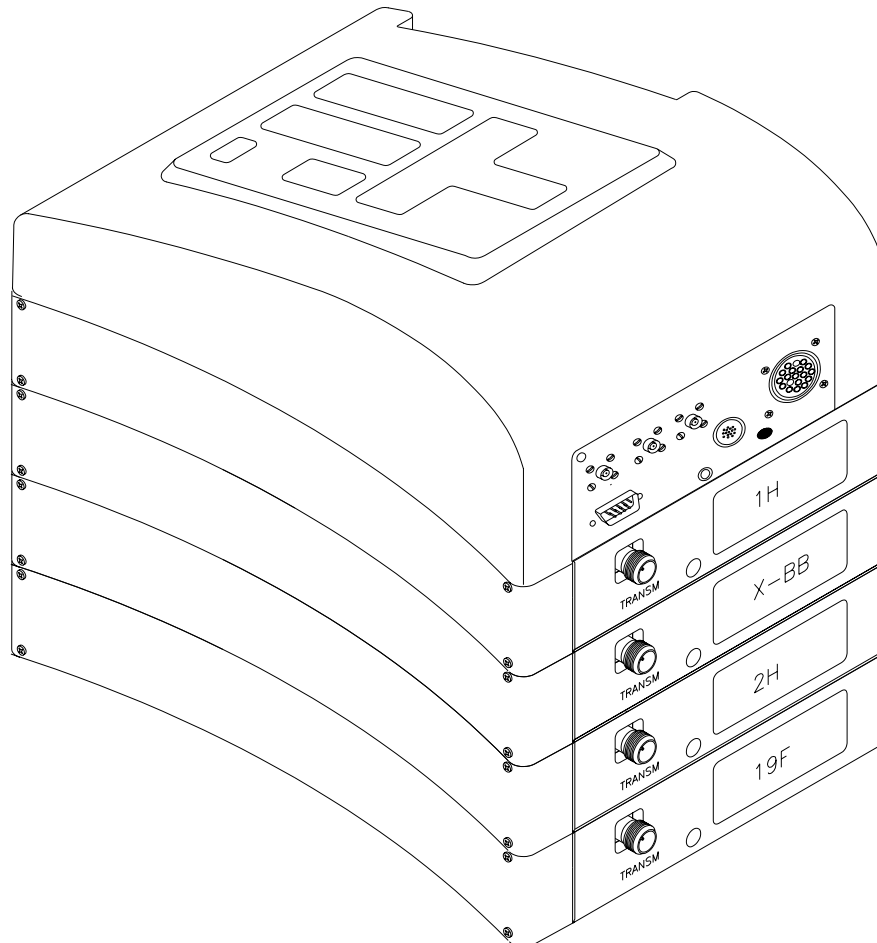


Table 13: 1H Preamplifier

Typical Data	- 750 -	- 600 -	- 500 -	- 400 -	- 360 -	- 300 -	- 250 -	- 200 -
Max. Noise Figure @ 1H, 50Ω Source	2.4 dB	2.3 dB	2.35 dB	2.2 dB	2.2 dB	2.2 dB	2.2 dB	2.2 dB
Gain, ± 1.5 dB at 1H	26 dB	26 dB	27 dB	27.5 dB	28.5 dB	29 dB	30 dB	30.5 dB
Output Power, 1 dB Compression	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm
Max. Power (Probe 50 Ω matched)	400 W, 100 us 10 % duty cycle or 60 W CW							
Third Order Intercept	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm
Filter Performance:								
Transmitter Path: 3 dB BW	35MHz	35 MHz	30 MHz	25 MHz	21 MHz	16 MHz	>10 MHz	>10 MHz
Transmitter Path: 19 F Suppression	>80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB
Probehead Path: 3 dB BW	16 MHz	13 MHz	14 MHz	13 MHz	>8 MHz	>4 MHz	>10 MHz	>10 MHz
Probehead Path: 60 dB BW	<80 MHz	<70 MHz	<62 MHz	<55 MHz	<44 MHz	<32 MHz	<60 MHz	<60 MHz

Figure 50: 1H -400- : Probehead Path

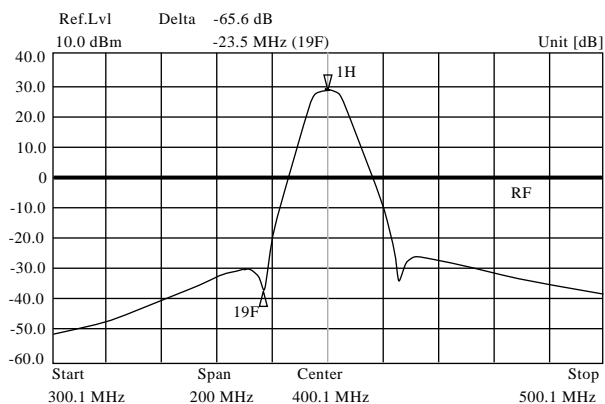


Figure 52: 1H -400- : Transmitter Path

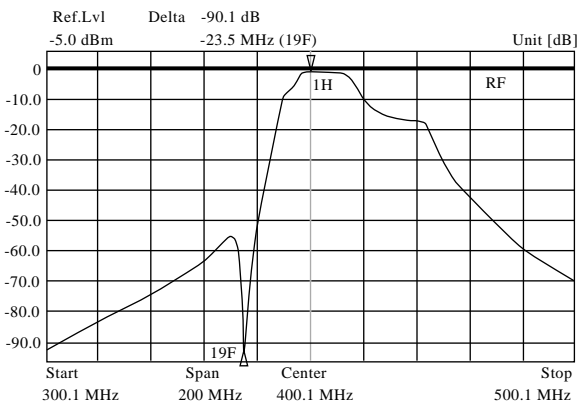


Figure 51: 1H -400- : Gain and NoiseFigure

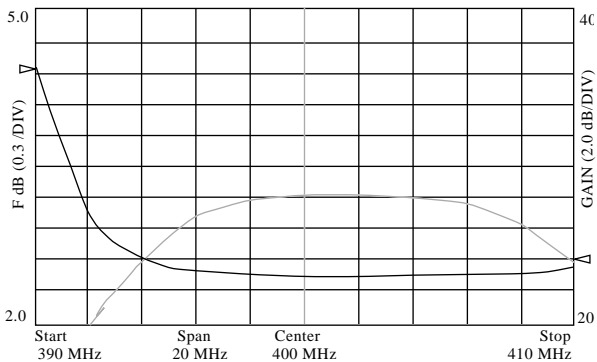


Table 14: 19F/1H/3H Preamplifier

Typical Data	- 600 -	- 500 -	- 400 -	- 360 -	- 300 -	- 200 -
Max. Noise Figure 1H, 50Ω Source	2.3 dB	2.2 dB	2.2 dB	2.2 dB	2.2 dB	2.2 dB
Max. Noise Figure 19F, 50Ω Source	2.2 dB	2.1 dB	2.1 dB	2.1 dB	2.1 dB	2.1 dB
Max. Noise Figure 3H, 50Ω Source	2.3 dB	2.2 dB	2.2 dB	2.2 dB	2.2 dB	2.2 dB
Gain, ± 1.5 dB at 1H	26 dB	27 dB	27.5 dB	28.5 dB	29 dB	30.5 dB
Gain, ± 1.5 dB at 19F	26 dB	26.5 dB	27.5 dB	27.5 dB	29 dB	30.5 dB
Gain, ± 1.5 dB at 3H	24.5 dB	26.5 dB	27.5 dB	27.5 dB	29 dB	30.5 dB
Output Power, 1 dB Compression	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm
Max. Power (Probe 50 Ω matched)	1 kW, 50 ms 10 % duty cycle or 50 W CW					
Third Order Intercept	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm
Filter Performance:						
Transmitter Path: Insertion Loss	< 2 dB	< 2 dB	< 2 dB	< 2 dB	< 2 dB	< 2 dB
Probehead Path: DC to 31P Suppression	> 40 dB	> 40 dB	> 50 dB	> 60 dB	> 60 dB	> 50 dB
Probehead Path: 2nd Harmonic Suppresion	> 40 dB	> 40 dB	> 40 dB	> 40 dB	> 40 dB	> 40 dB
Probehead Path: 1 dB BW Flatness 1H	> 24 MHz	> 20 MHz	> 16 MHz	> 14 MHz	> 12 MHz	> 8 MHz
Probehead Path: 1 dB BW Flatness 19F	> 24 MHz	> 20 MHz	> 16 MHz	> 14 MHz	> 12 MHz	> 8 MHz
Probehead Path: 1 dB BW Flatness 3H	> 24 MHz	> 20 MHz	> 16 MHz	> 14 MHz	> 12 MHz	> 8 MHz

Figure 53: 19F/1H/3H -500- : Probehead Path

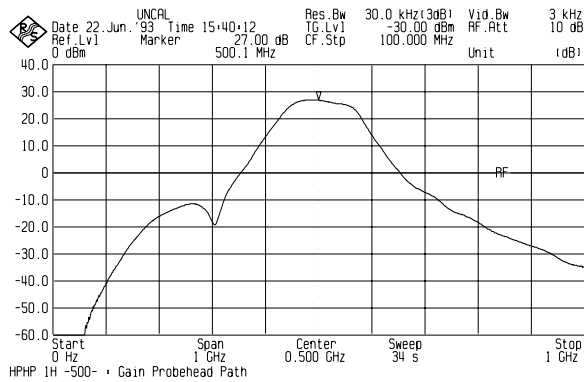


Figure 55: 19F/1H/3H -500- : Transmitter Path

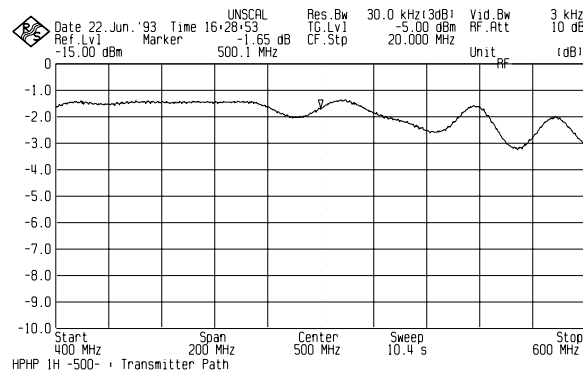


Figure 54: 19F/1H/3H -500- : Gain and Noise Figure

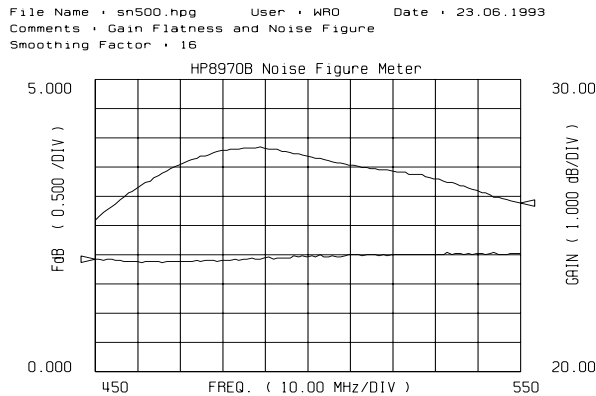


Table 15: X-BB 31P 2HS Preamplifier

Typical Data	- 750 -	- 600 -	- 500 -	- 400 -	- 360 -	- 300 -		
Max. Noise Figure 13C, 50Ω Source	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB	1.8 dB		
Gain, ± 1.5 dB	30.5 dB	30.5 dB	30.5 dB	30.5 dB	30.5 dB	30.5 dB		
Output Power, 1 dB Compression	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm		
Max. Power (Probe 50 Ω matched)	400 W, 5 us 5 % duty cycle or 50 W CW							
Third Order Intercept	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm		
Filter Performance:								
Transmitter Path: 1H Suppression	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB		
Transmitter Path: 2H Suppression	> 70 dB	> 70 dB	> 70 dB	> 70 dB	> 70 dB	> 70 dB		
Probehead Path: 1H Suppression	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB		
Probehead Path: 2H Suppression	> 70 dB	> 70 dB	> 70 dB	> 70 dB	> 70 dB	> 70 dB		
Probehead Path: Insertion Loss: 6Li	< 1 dB	< 1 dB	< 1 dB	< 1 dB	< 1 dB	< 1 dB		
Probehead Path: Insertion Loss: 209Bi	< 1 dB	< 1 dB	< 1 dB	< 1 dB	< 1 dB	< 1 dB		

Figure 56: X-BB 31P -400- : Probehead Path

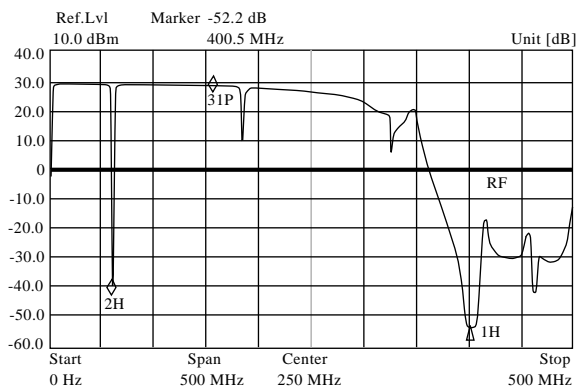


Figure 58: X-BB 31P -400- : Transmitter Path

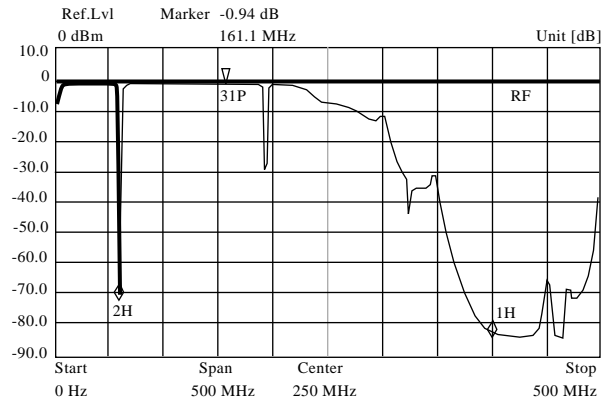


Figure 57: X-BB 31P -400- : 2H Stop Probehead Path Figure 59: X-BB 31P -400- : Gain and Noise Figure

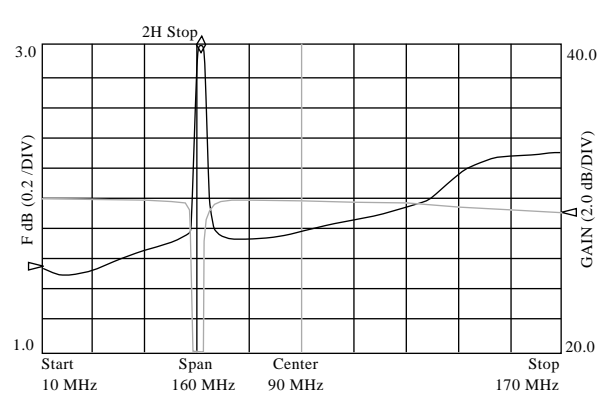
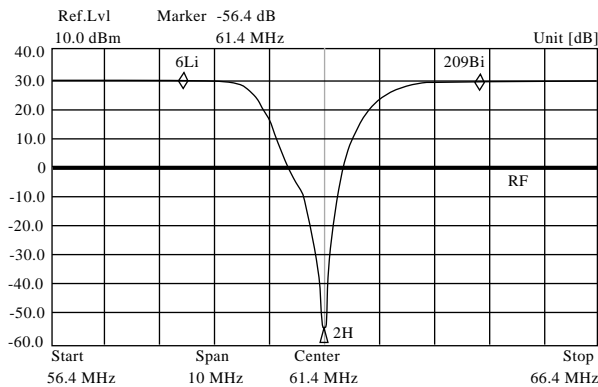


Table 16: 2H Preamplifier

Typical Data	- 750 -	- 600 -	- 500 -	- 400 -	- 360 -	- 300 -	-250-	- 200 -	
Max. Noise Figure 2H, 50Ω Source	2.6 dB	2.6 dB	2.6 dB	2.6 dB	2.6 dB	2.6 dB	2.5 dB	2.5 dB	
Gain, ± 1.5 dB	45.5 dB	45.5 dB	45.5 dB	45.0 dB	45.0 dB	45.0 dB	46.5 dB	46.5 dB	
Output Power, 1 dB Compression	5 dBm	5 dBm	5 dBm	5 dBm	5 dBm	5 dBm	5 dBm	5 dBm	
Max. Power (Probe 50 Ω matched)	400 W, 5 us 5 % duty cycle or 50 W CW							1)	
Filter Performance:									
TransmitterPath: 3 dB BW	> 5 MHz	> 5 MHz	> 4 MHz	> 3 MHz	>2 MHz	> 2 MHz	> 2 MHz	> 2 MHz	
TransmitterPath: 60 dB BW	<60 MHz	<45 MHz	<37 MHz	<30 MHz	<30 MHz	<30 MHz	<18 MHz	<18 MHz	
Probehead Path: 3 dB BW	> 5 MHz	> 3 MHz	> 2 MHz	> 2 MHz	> 2 MHz	> 1 MHz	> 1 MHz	> 1 MHz	
Probehead Path: 60 dB BW	< 45 MHz	< 35 MHz	< 29 MHz	< 22 MHz	< 20 MHz	< 17 MHz	<14 MHz	<12 MHz	

1): 180 W, 5 us 5 % duty cycle or 50 W CW

Figure 60: 2H -400- : Probehead Path

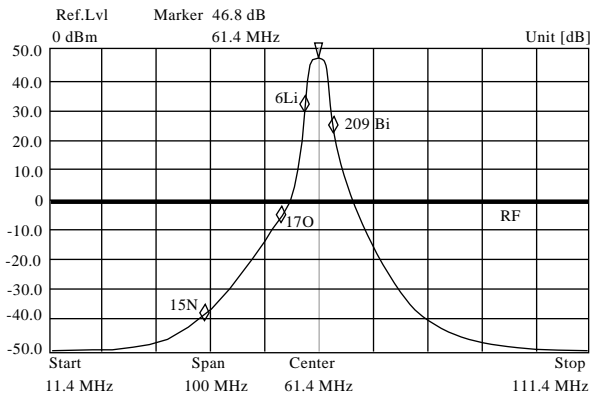


Figure 62: 2H -400- : Transmitter Path

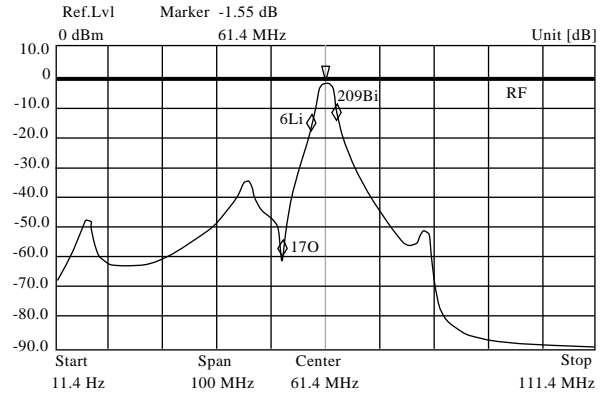


Figure 61: 2H -400- : Gain and Noise Figure

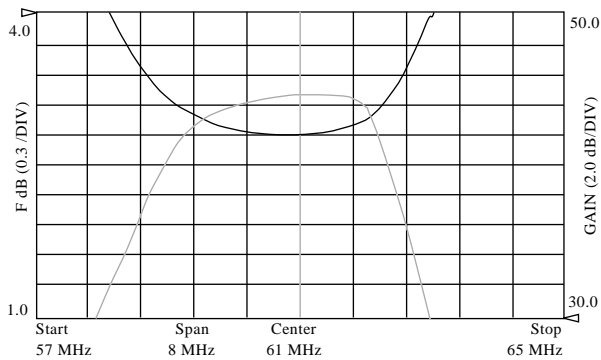


Table 17: 19F Selective Preamplifier

Typical Data	- 600 -	- 500 -	- 400 -	- 360 -	- 300 -	- 250 -	- 200 -
Max. Noise Figure 19F, 50Ω Source	2.3 dB	2.2 dB	2.2 dB	2.2 dB	2.2 dB	2.4 dB	2.6 dB
Gain, ± 1.5 dB	26.0 dB	27.0 dB	28.0 dB	28.5 dB	29.0 dB	30.0 dB	30.5 dB
Output Power, 1 dB Compression	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm
Max. Power (Probe 50 Ω matched)	400 W, 100 us 10 % duty cycle or 60 W CW						
Third Order Intercept	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm
Filter Performance:							
TransmitterPath: 1H Suppression	> 60 dB	> 60 dB	> 60 dB	> 60 dB	> 60 dB	> 60 d	> 60 d
Probehead Path: 1H Suppression	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 80 dB
Probehead Path: 3 dB BW	>11 MHz	>12 MHz	>11 MHz	> 6 MHz	> 3 MHz	>10 MHz	> 8 MHz
Probehead Path: 60 dB BW	< 66 MHz	< 55 MHz	< 38 MHz	< 36 MHz	< 38 MHz	< 43 MHz	< 32 MHz

Figure 63: 19F Selective -400- : Probehead Path

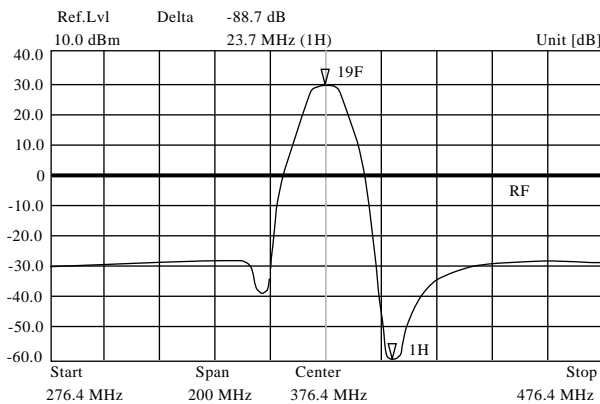


Figure 65: 19F Selective -400- : Transmitter Path

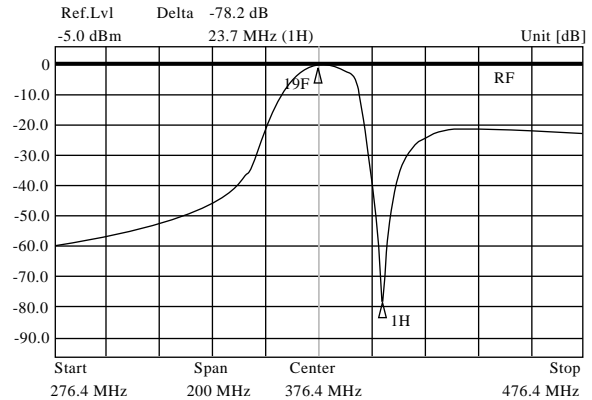


Figure 64: 19F Selective -400- : Gain a. Noise Figure

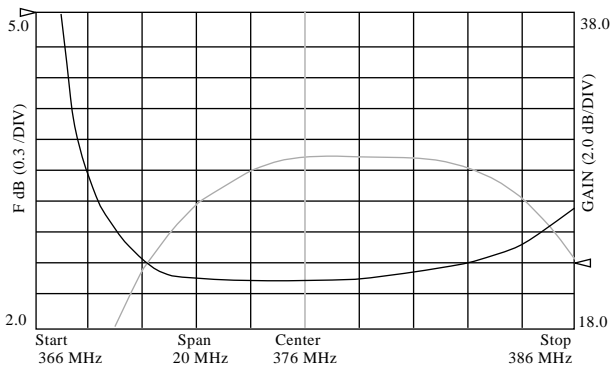


Table 18: X-BB_19F_2HP Preamplifier

Typical Data	- 600 -	- 500 -	- 400 -	- 360 -	- 300 -
Max. Noise Figure @ 13C, 50Ω Source	1.9 dB	1.9 dB	1.9 dB	1.9dB	1.9 dB
Gain, ± 1.5 dB	30.5 dB	30.5 dB	30.5 dB	30.5 dB	30.5 dB
Output Power, 1 dB Compression	7 dBm	7 dBm	7 dBm	7 dBm	7 dBm
Max. Power (Probe 50 Ω matched)	400 W, 5 us 5 % duty cycle or 50 W CW				
Third Order Intercept	15 dBm	15 dBm	15 dBm	15 dBm	15 dBm
Filter Performance:					
Transmitter Path: 1H Suppression	> 60 dB	> 60 dB	> 60 dB	> 60 dB	> 60 dB
Probehead Path: 1H Suppression	> 60 dB	> 60 dB	> 60 dB	> 60 dB	> 60 dB

Figure 66: X-BB 19F 2HP -400-: Probehead Path

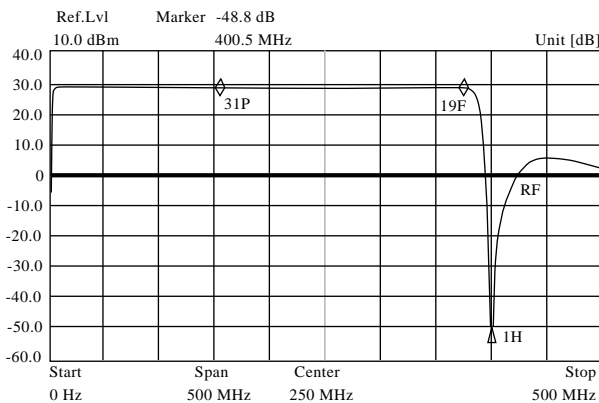


Figure 68: X-BB 19F 2HP -400-: Transmitter Path

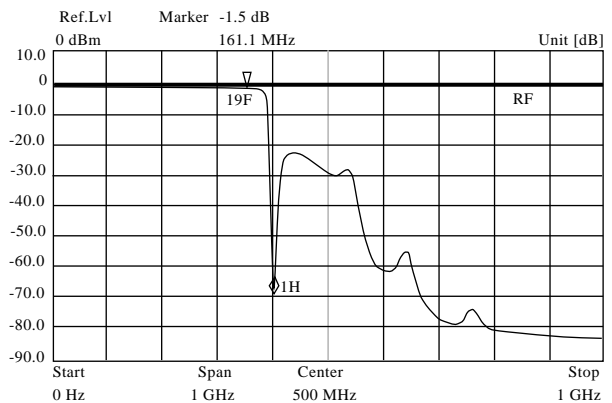


Figure 67: X-BB 19F 2HP -400-: Gain a. Noise Figure

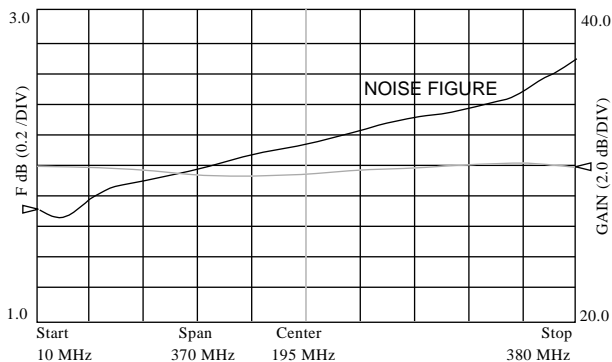


Table 19: 3H Preamplifier

Typical Data	- 600 -	- 500 -	- 400 -				
Max. Noise Figure 3H, 50Ω Source	2.5 dB	2.5 dB	2.5 dB				
Gain, ± 1.5 dB at 3H	26 dB	27 dB	28 dB				
Output Power, 1 dB Compression	7 dBm	7 dBm	7 dBm				
Max. Power (Probe 50 Ω matched)	400 W, 100 us 10 % duty cycle or 60 W CW						
Third Order Intercept	15 dBm	15 dBm	15 dBm				
Filter Performance:							
Transmitter Path: 1H Suppression	> 75 dB	> 75 dB	> 75 dB				
Transmitter Path: 19F Suppression	> 80 dB	> 80 dB	> 80 dB				
Transmitter Path: 3 dB BW	>30 MHz	>35 MHz	>20 MHz				
Probehead Path: 1H Suppression	> 80 dB	> 80 dB	> 80 dB				
Probehead Path: 3 dB BW	>17 MHz	>24 MHz	>17 MHz				
Probehead Path: 60 dB BW	<70 MHz	<80 MHz	<60 MHz				

Figure 69: 3H -500- : Probehead Path

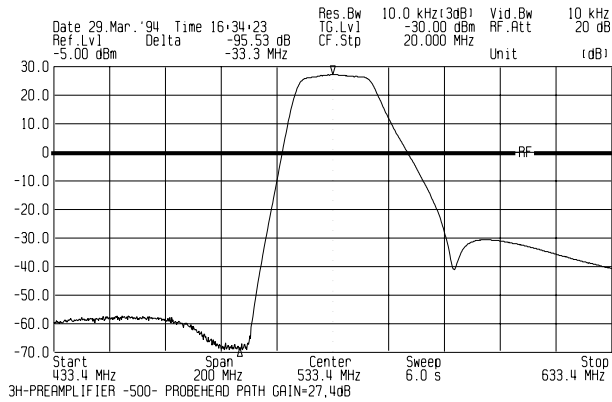


Figure 71: 3H -500- : Transmitter Path

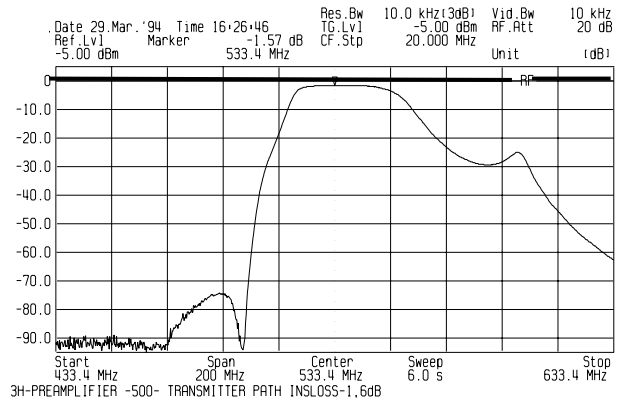


Figure 70: 3H -500- : Gain and Noise Figure

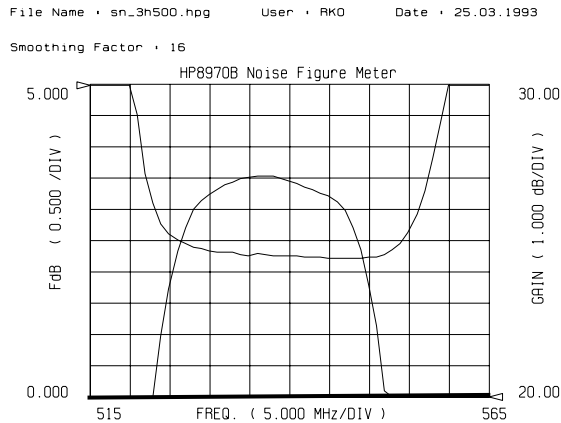


Table 20: Deadtimes (Beginning of pulse [#] to settled Phase @ 1Degree [°])

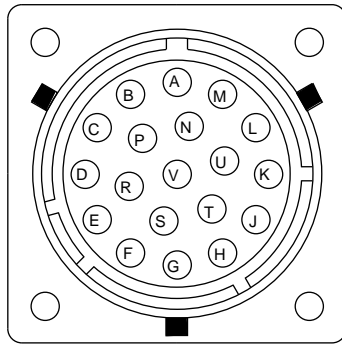
	-750-	-600-	-500-	-400-	-360-	-300-	-250-	-200-
XBB31P 2HS	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$
XBB19F 2HS	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$
XBB19F 2HP	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$
2H	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<5us # <8us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$	<12us # <20us \$

Power Consumption

Table 21: Power Consumption

	+19V [mA]	-19V [mA]	+9V [mA]	X9V (or +14V) [mA]
COVER / DISPLAY MODULE	140	20	350	120
1H-PREAMPLIFIER MODULE	170	50		
X-BB-PREAMPLIFIER MODULE	250	50		
2H-PREAMPLIFIER MODULE	300	50		
1. USER MODULE	250	50		
2. USER MODULE	250	50		
MAX. TOTAL CURRENT	1360	270	350	120
BURNDY-CONNECTOR PIN	A / C	L	N	U

Figure 72: Cover module PS & Interface Connector



- A IN 19V (+19V)
- B DGND
- C IN 19V (+19V)
- H DGND
- L INN 19V (-19V)
- M DGND
- N IN 9V (+9V)
- U IP 14V (+14V floating)
- V IGND (GND floating)

See List of Figures for page numbers

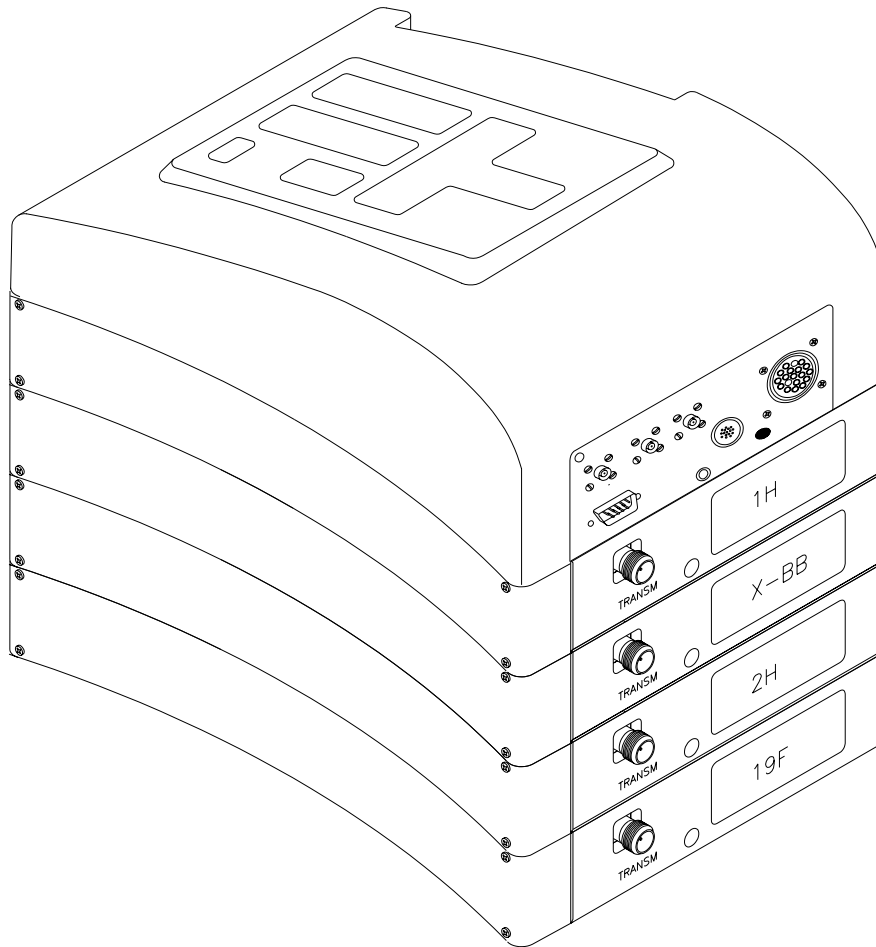
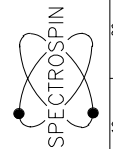
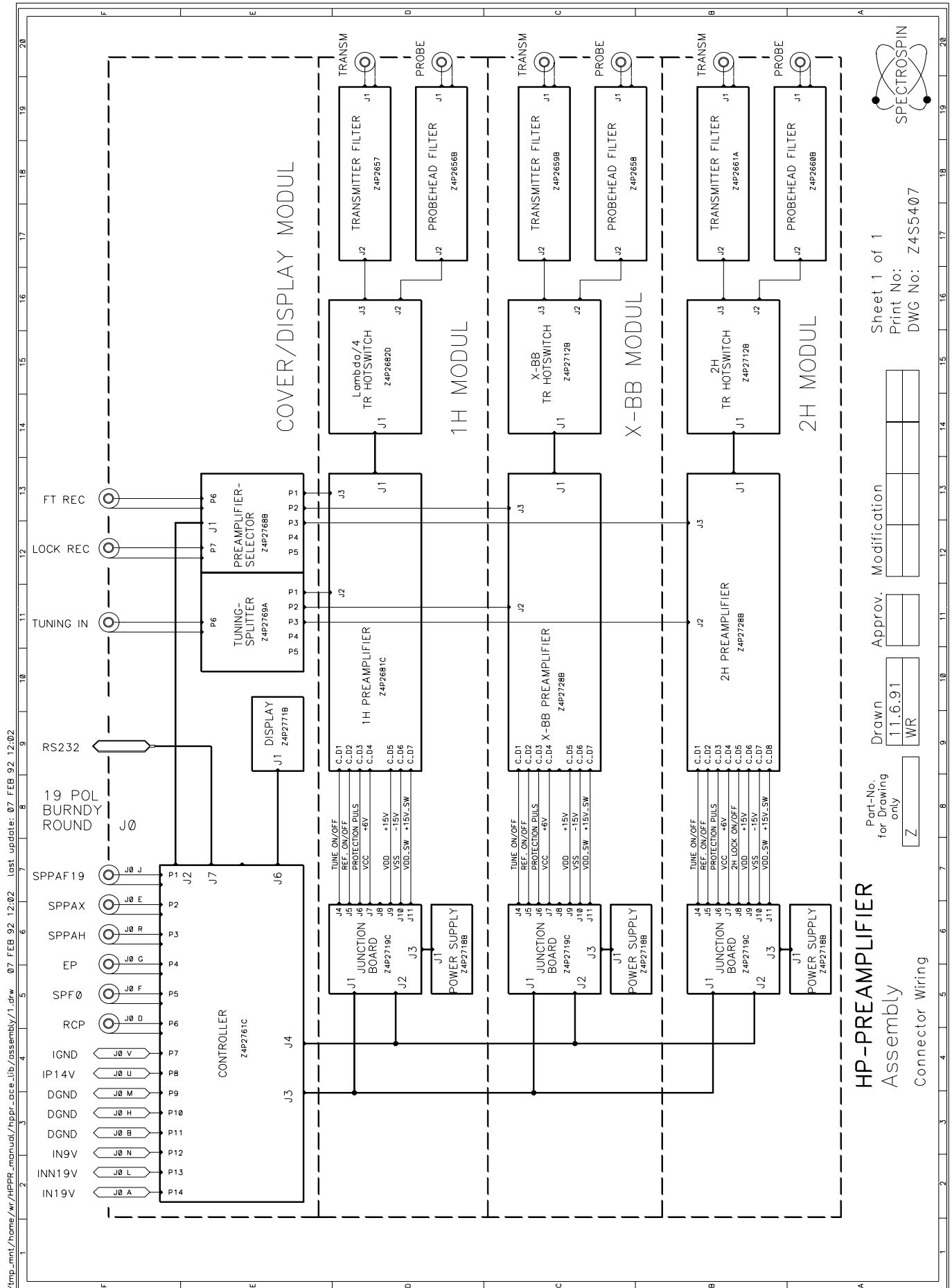


Figure 73: Connector Wiring - Block Diagram -



Sheet 1 of 1
Print No:
DWG No: Z4S5407

Part-No.	Drawn	Approv.	Modification
Z	11.6.91	WR	

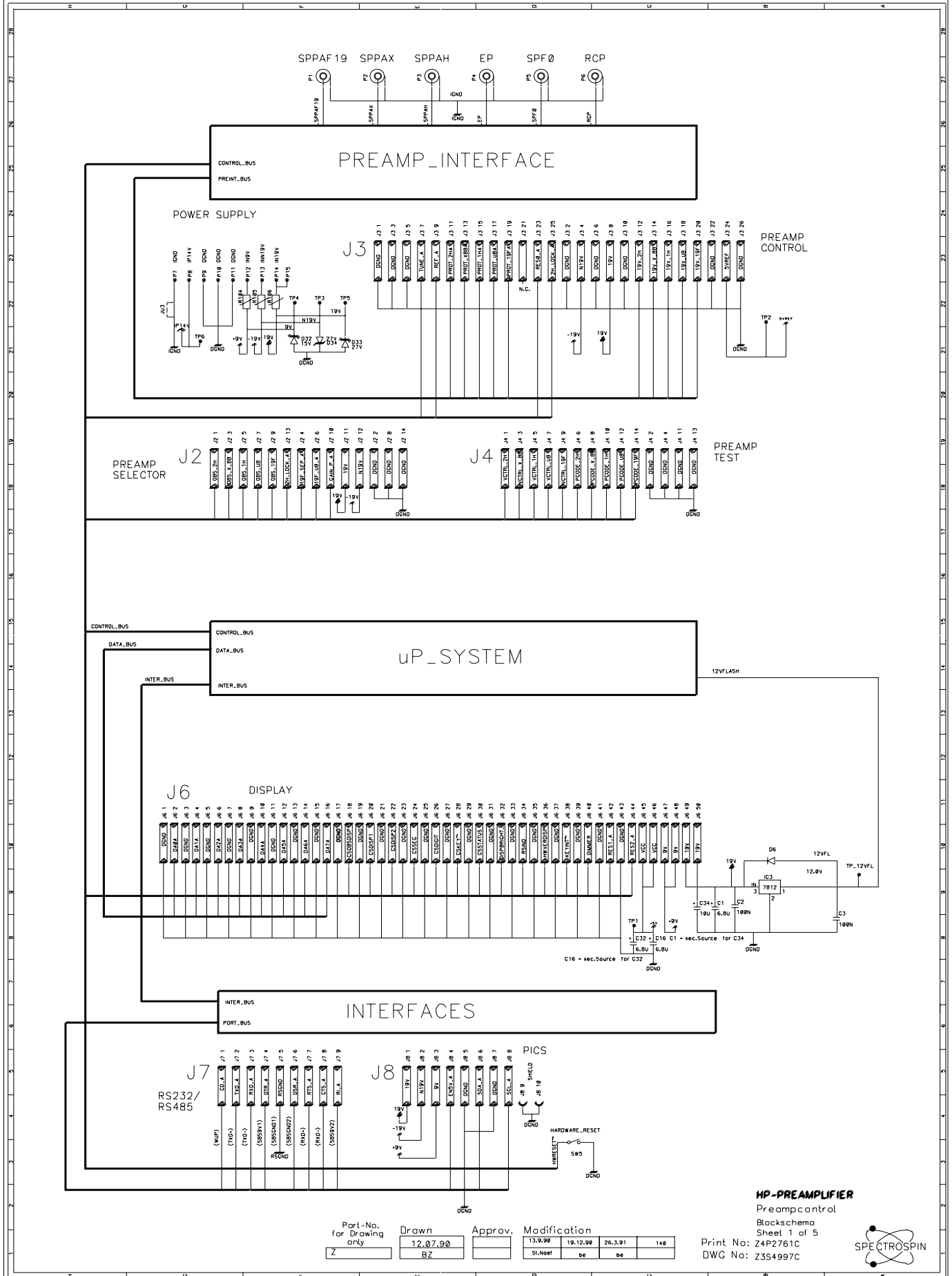
Part-No. for Drawing only
Z

HP-PREAMPLIFIER
Assembly
Connector Wiring

/tmp_mnt/home/wr/HPPR_manual/hppr_ose-lib/assembly/1.dwg 07 FEB 92 12:02 Last update: 07 FEB 92 12:02

Figure 74: Block Diagram - Scheme 1 of 5 -

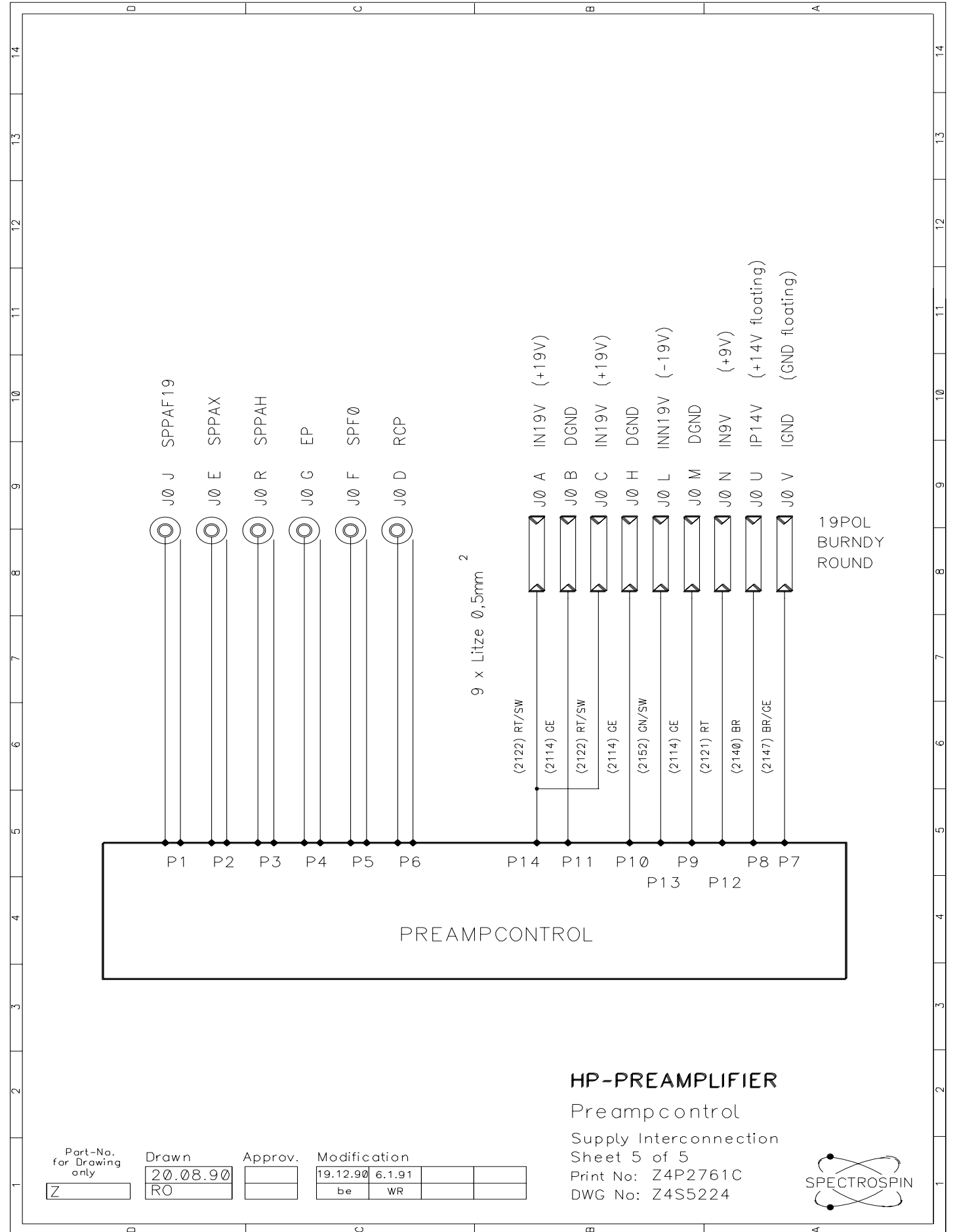
\\lex/home/users/af/hppr_manud/hppr_0ce/job/covers/controller/schema_1.dra 07 JUN 91 09:46 last update: 02 APR 91 14:36



Part-No. for Drawing only	Drawn 12.07.90 BZ	Approv.	Modification								
Z			<table border="1"> <tr> <td>13.9.90</td> <td>19.12.90</td> <td>26.3.91</td> <td>148</td> </tr> <tr> <td>St.Noef</td> <td>be</td> <td>be</td> <td></td> </tr> </table>	13.9.90	19.12.90	26.3.91	148	St.Noef	be	be	
13.9.90	19.12.90	26.3.91	148								
St.Noef	be	be									

HP-PREAMPLIFIER
Preampcontrol
Blockschema
Sheet 1 of 5
Print No: Z4P2761C
DWG No: Z3S4997C





PREAMPCONTROL

HP-PREAMPLIFIER

Preampcontrol

Supply Interconnection

Sheet 5 of 5

Print No: Z4P2761C

DWG No: Z4S5224



Part-No.
for Drawing
only

Z

Drawn

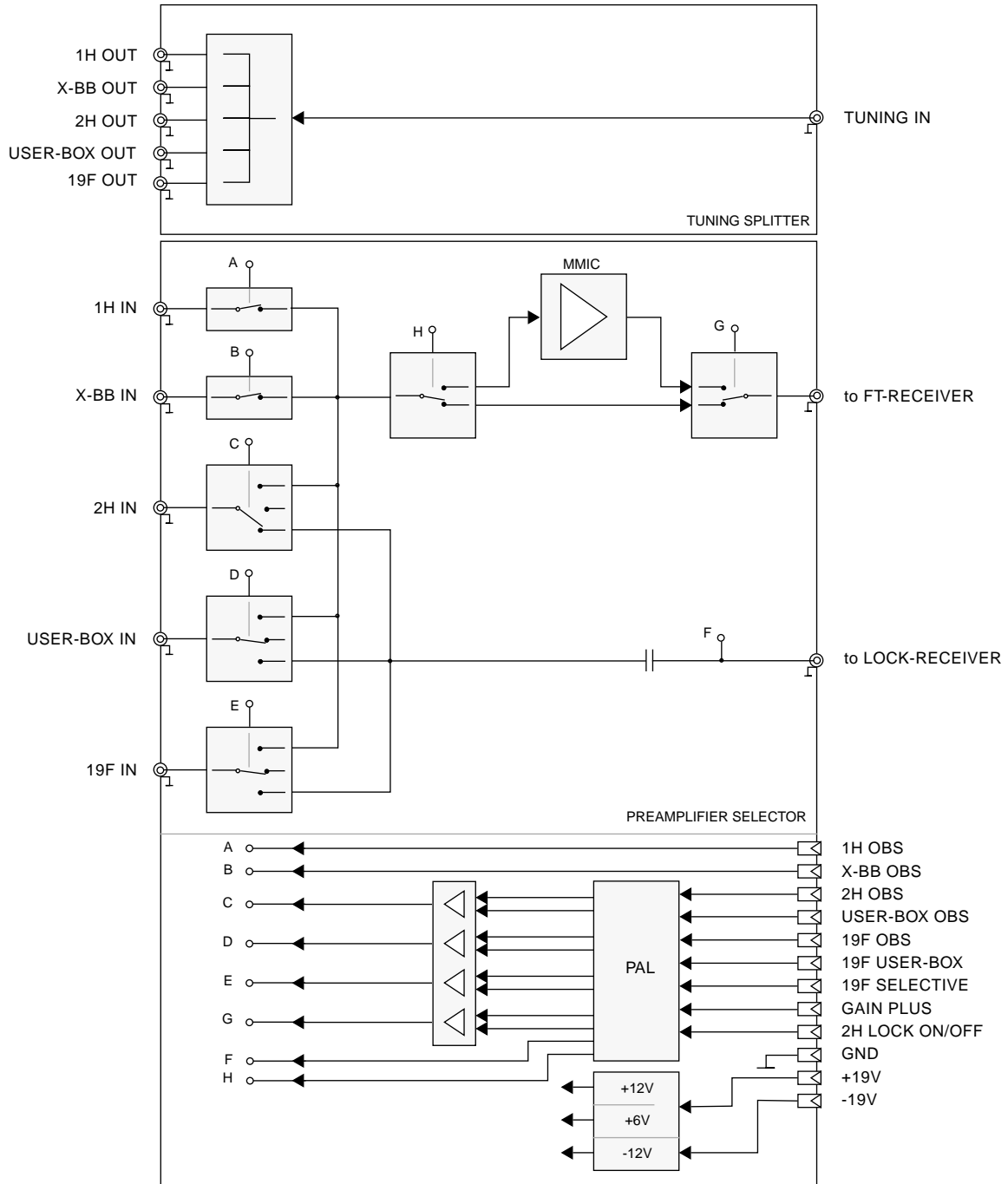
20.08.90
RO

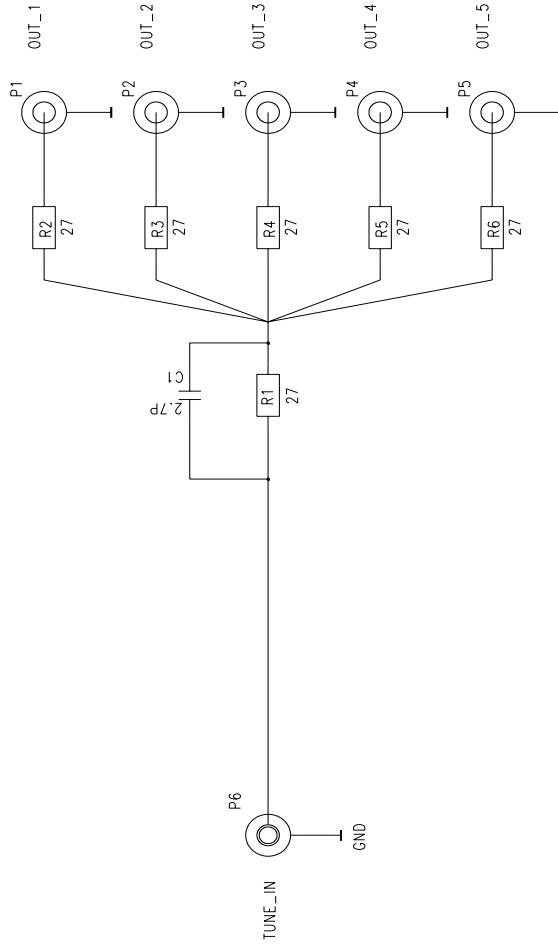
Approv.

Modification

19.12.90	6.1.91		
be	WR		

Figure 76: Preamplifier Selector / Tuning Splitter - Block Diagram -





HP-PREAMPLIFIER
Tuning Splitter Board

Splitter

Sheet 1 of 1

Print No: Z4P2769A

DWG No: Z4S4994A



Part-No. for Drawing only	Drawn	Approv.	Modification
Z	13.3.90 WR		4.3.91 be

HP-PREAMPLIFIER
Preamp Selector
PIN-Diode Mux

Sheet 1 of 2

Print No: Z4P2768D

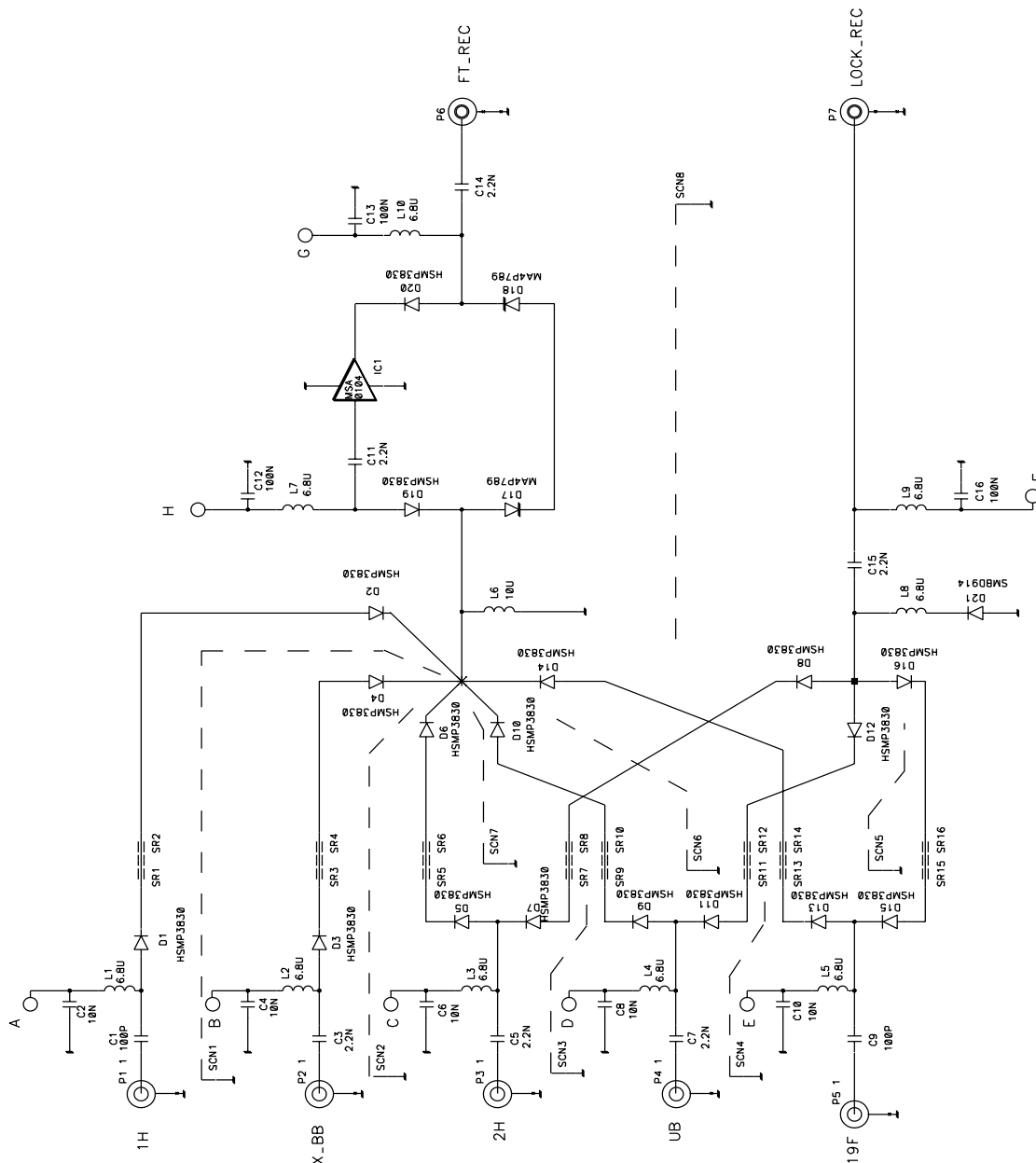
DWG No: Z4S4991C

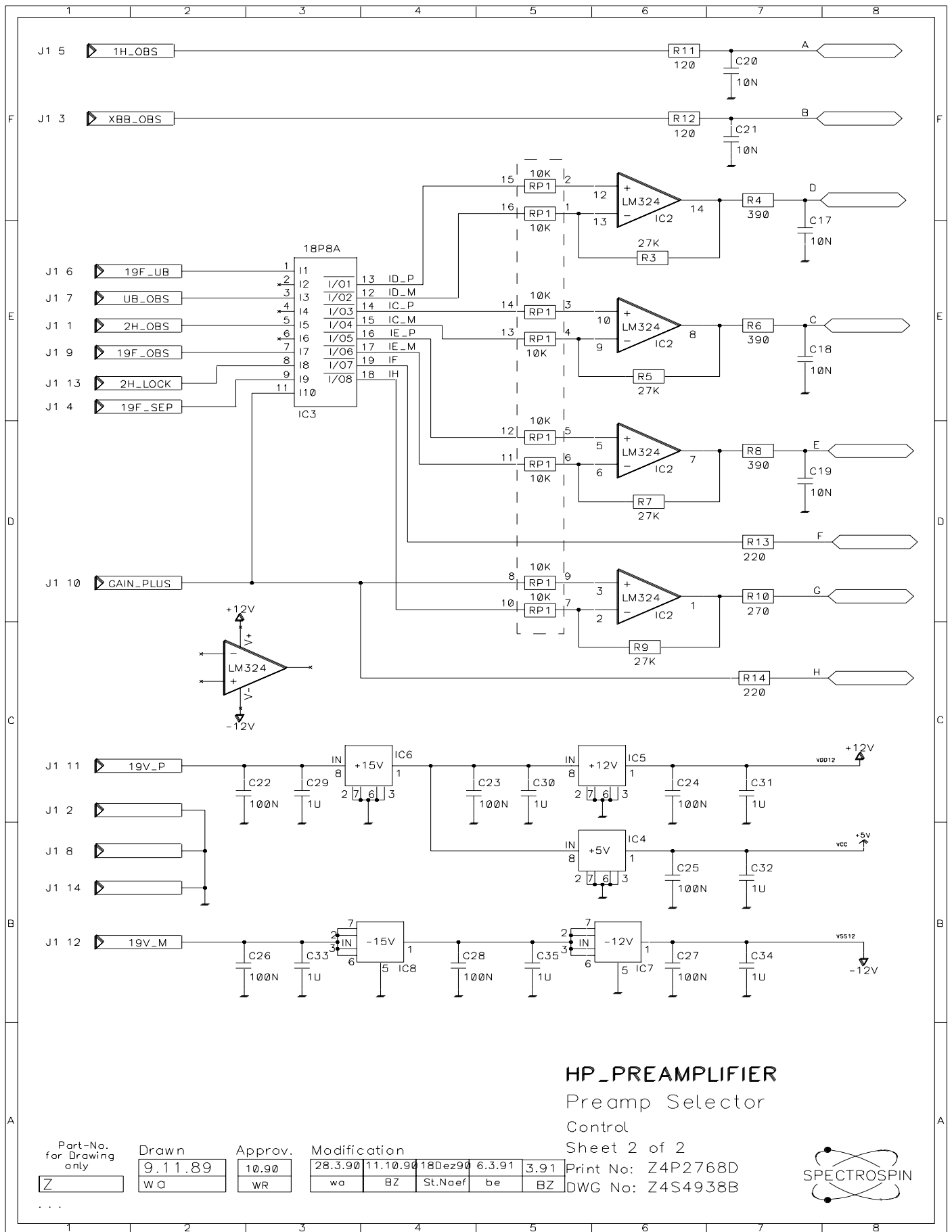
Part-No. for Drawing only: Z

Drawn: 13.3.90 WR

Apprv: 10.90 WR

Modification: 8.3.91 3.7.91 15.7.93
SL:Noel be bz uba





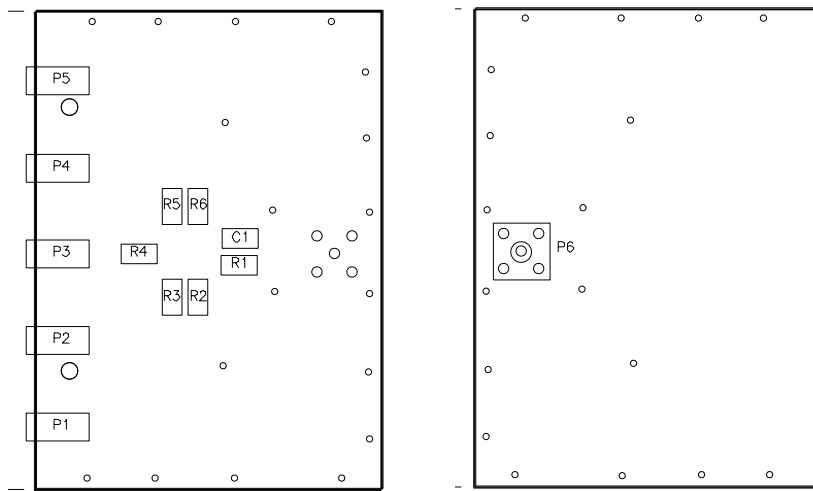
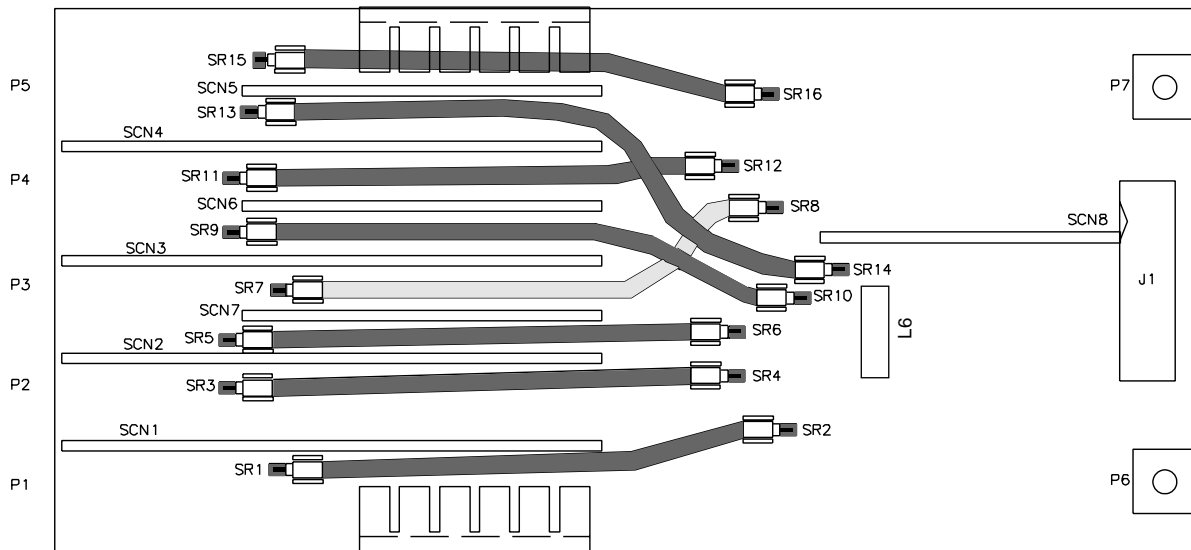


Figure 81: Selector Component plan :HF-side - Wired Components -



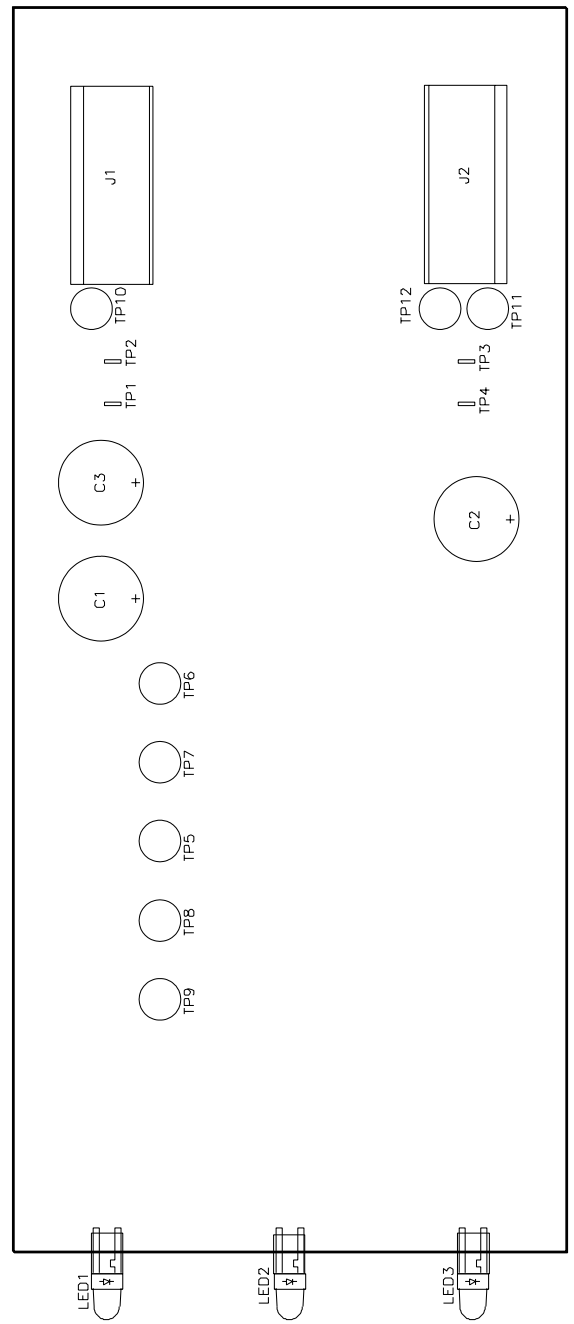
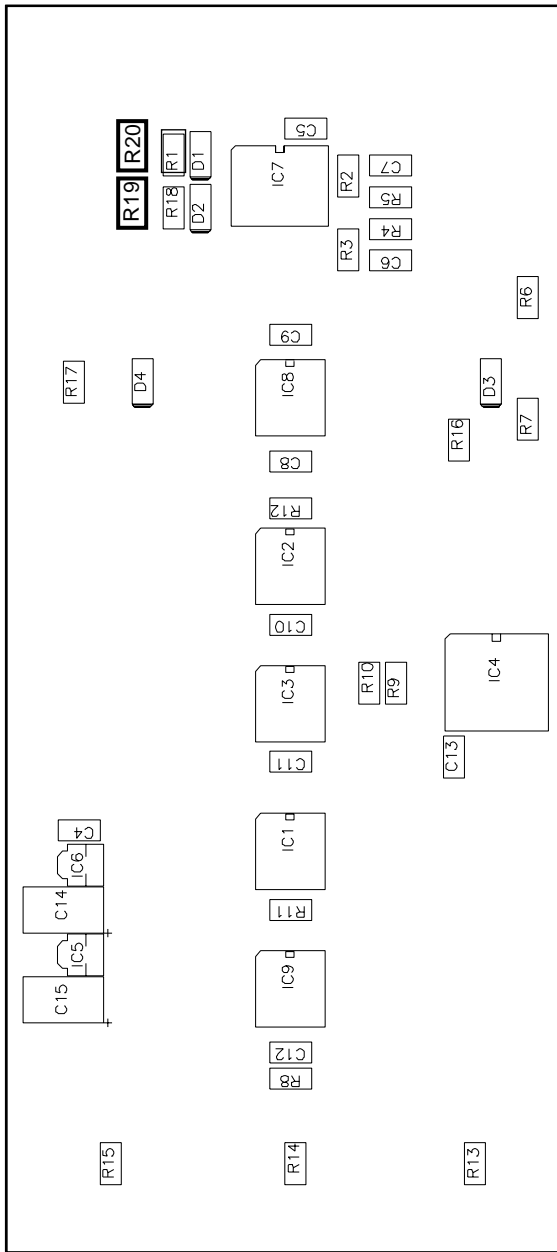
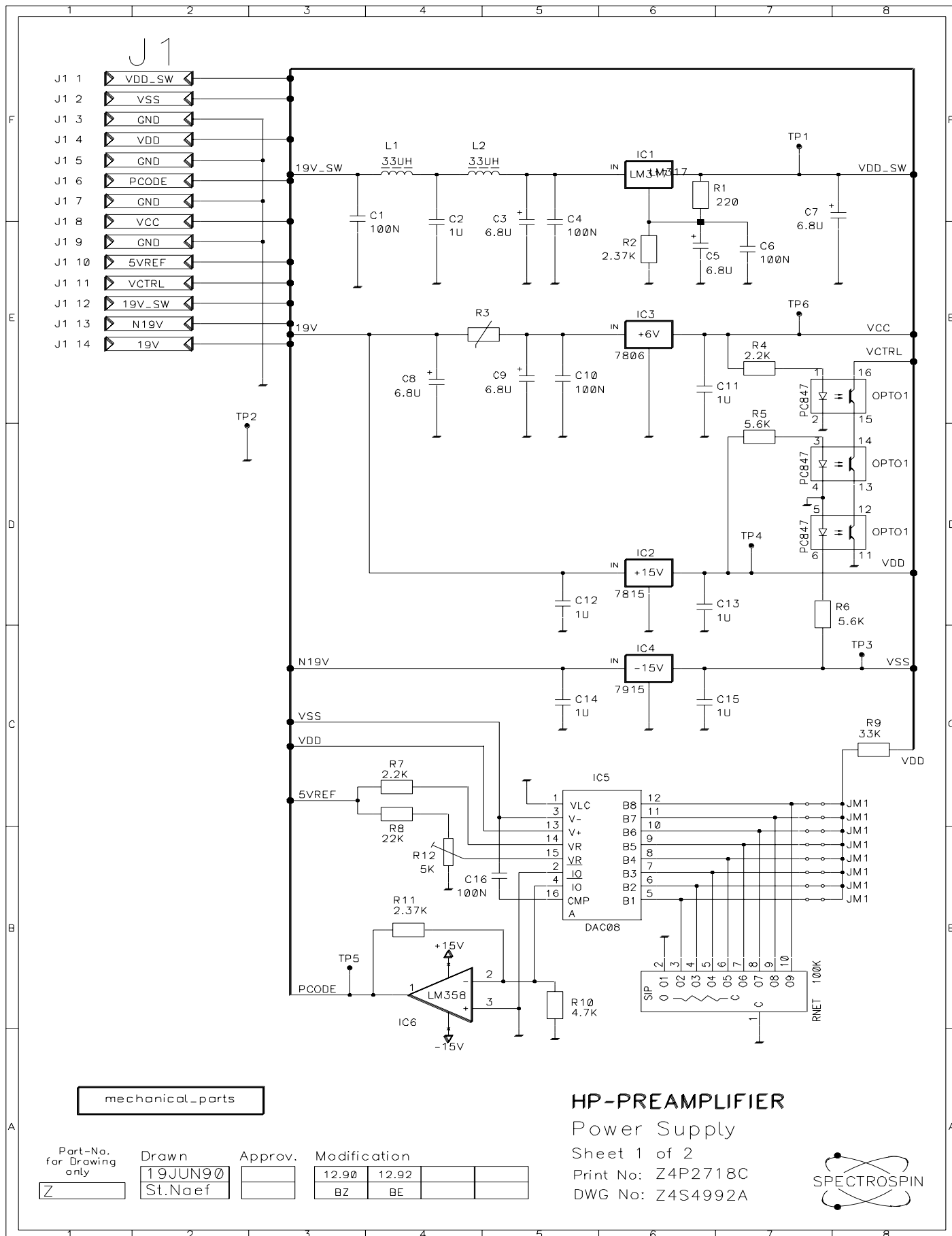


Figure 84: Power Supply



mechanical_parts

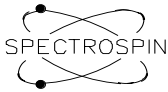
HP-PREAMPLIFIER

Power Supply

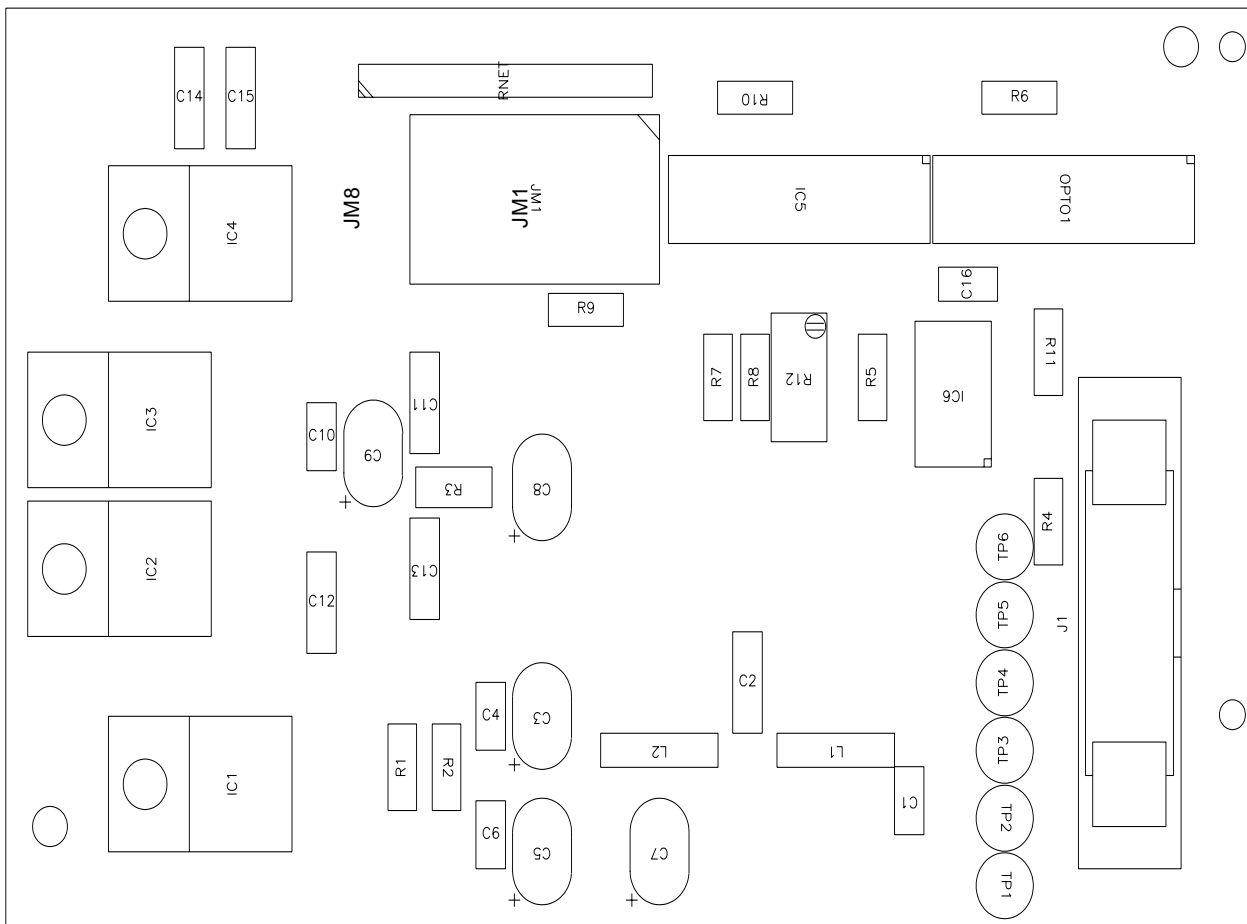
Sheet 1 of 2

Print No: Z4P2718C

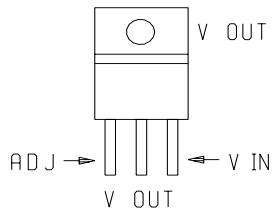
DWG No: Z4S4992A



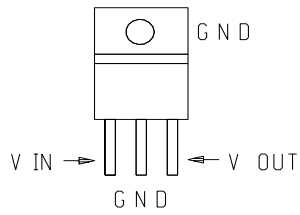
Part-No. for Drawing only	Drawn	Approv.	Modification	
Z	19JUN90 St.Naef		12.90 BZ	12.92 BE



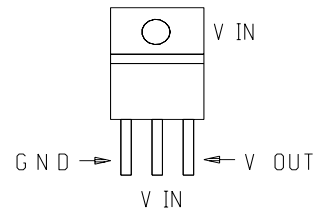
VOLTAGE REGULATORS



LM317T

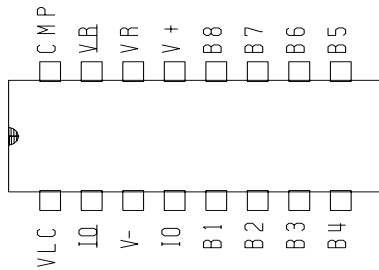


LM78XX

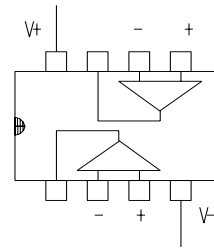


LM79XX

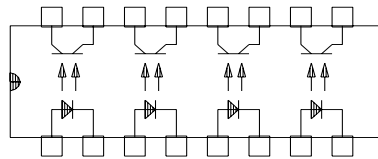
DIGITAL + LINEAR



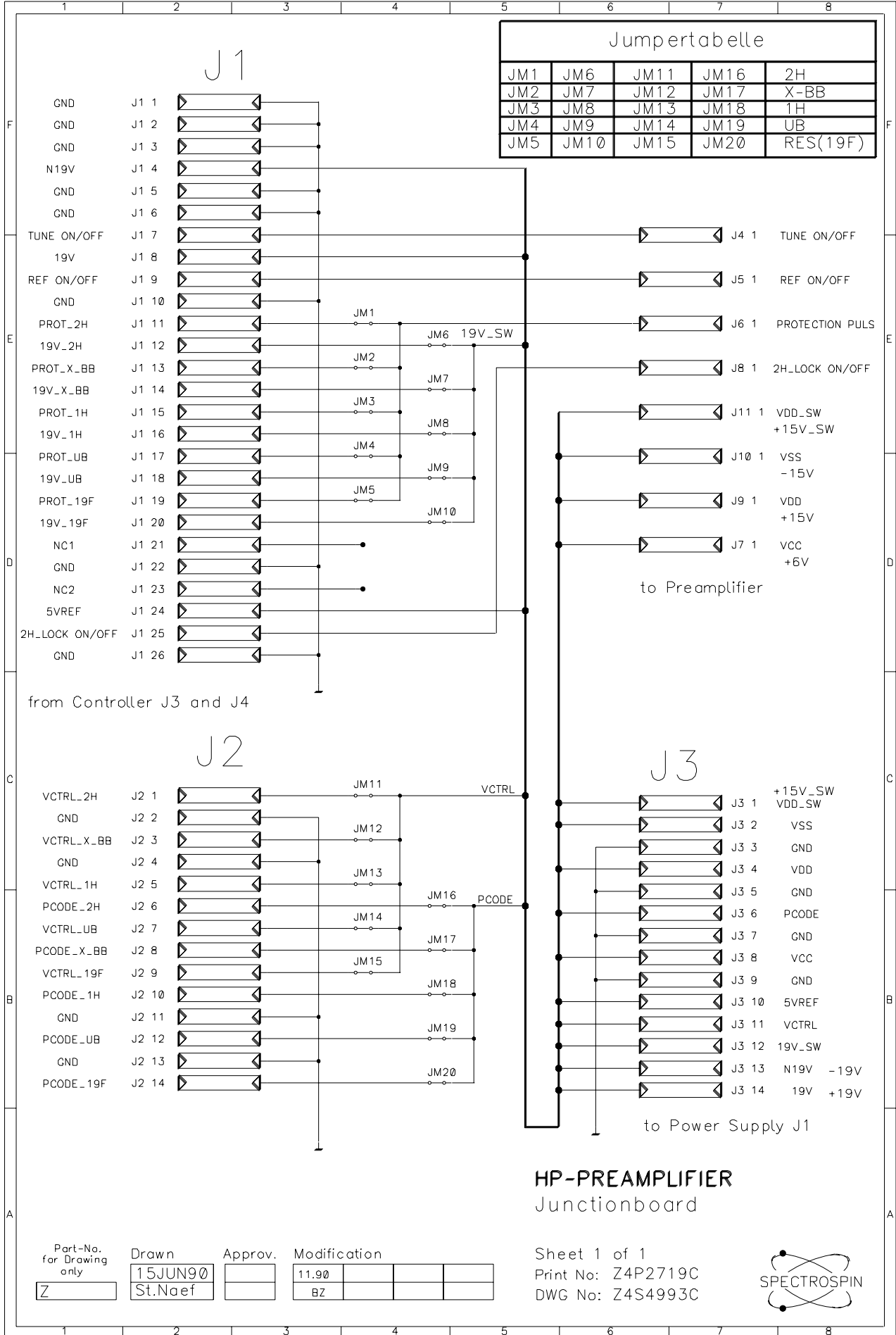
DAC-08
8-BIT D/A CONVERTER

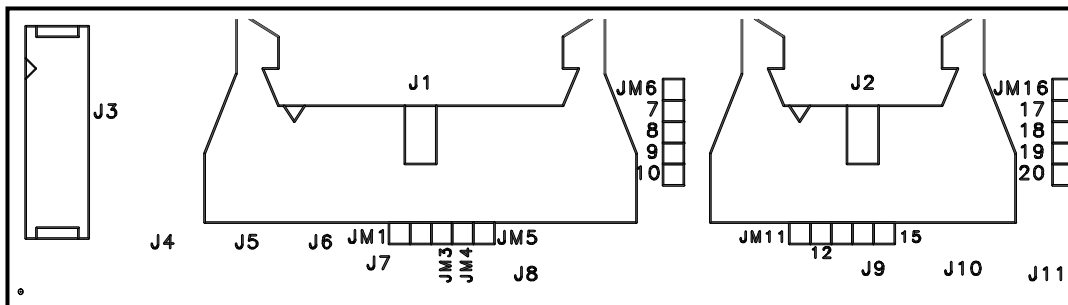


LM 358
Dual / 1 Supply OP



PC847
OPTO COUPLER





TUNE ON/OFF

REF ON/OFF

PROTECTION PULS

VCC +6V

2H_LOCK ON/OFF

VDD_SW +15V_SW

VSS -15V

VDD +15V

.List of Index	7
1.Assembly	11
Figure 1: Exploded View.....	11
Figure 2: HP Preamp - Block Diagram -	13
Figure 3: Connector Wiring - Block Diagram -	14
2.Cover / Display Module	15
Figure 4: Cover / Display Module - Exploded View -	15
Figure 5: Controller - Block Diagram -	16
Figure 6: Reset/ Wakeup Logic	18
Figure 7: RCPI Interface	19
Figure 8: Transmitter gate pulse logic	20
Figure 9: Puls inverter subprint (1 of 3 circuits)	22
Figure 10: New gate pulse inverter circuit	22
Figure 11: Display - Block Diagram -	24
Figure 12: Preamplifier Selector / Tuning Splitter - Block Diagram -	26
3.HPPR - Interface	29
4.1H Module	39
Figure 13: 1H Module - Exploded View -	39
Figure 14: 1H Module - Block Diagram -	40
Figure 15: Scheme extract - Preamplifier -	41
Figure 16: Scheme extract - Bandpass filter -	42
Figure 17: Scheme extract - Blanking -	43
Figure 18: Tuning Principle	44
Figure 19: Scheme extract - Tuning -	45
Figure 20: Lambda/4 T/R-Hotswitchbox used in the 1H-Module	46
Figure 21: Power handling capability without Probehead	47
Figure 22: Power handling capability with matched Probehead	48
5.19F/1H/3H HP-Module	51
Figure 23: High-Power 19F/1H/3F Module - Exploded View -	51
Figure 24: 19F/1H/3H Module - Block Diagram -	52
Figure 25: Scheme extract - Bandpass filter -	53
6.X-BB Module	55
Figure 26: X-BB Module - Exploded View -	55
Figure 27: X-BB Module - Block Diagram -	56
Figure 28: Scheme extract - Preamplifier -	57
Figure 29: Scheme extract - Blanking -	58
Figure 30: Scheme extract - Tuning -	59

7.2H Module	61
Figure 31: 2H Module - Exploded View -	61
Figure 32: 2H Module - Block diagram -	62
Figure 33: Schematic extract - Band pass filter -	63
Figure 34: Scheme extract - Blanking -	64
8.19F Selective Module	67
Figure 35: 19F Selectiv Module - Exploded View -	67
Figure 36: 19F Selectiv Module - Block Diagram -	68
Figure 37: Scheme extract - Preamplifier -	69
Figure 38: Scheme extract - Bandpass filter -	70
Figure 39: Scheme extract - Blanking -	70
Figure 40: Scheme extract - Tuning-	71
9.3H Module	73
Figure 41: 3H Module - Exploded View -	73
Figure 42: 3H Module - Block Diagram -	74
Figure 43: Scheme extract - Preamplifier -	75
Figure 44: Scheme extract - Bandpass filter -	76
Figure 45: Scheme extract - Blanking -	76
Figure 46: Scheme extract - Tuning-	77
10.QNP Control Module	79
Figure 47: QNP Control Module - Top View -	79
Figure 48: QNP Control Module - Block Diagram -	80
11.HPPR Configuration	83
12.Commonly used Circuits	97
Figure 49: Scheme extract - Power Supply Board - with HCL socket.....	101
A.Technical Data	105
Figure 50: 1H -400- : Probehead Path	106
Figure 51: 1H -400- : Gain and NoiseFigure	106
Figure 52: 1H -400- : Transmitter Path.....	106
Figure 53: 19F/1H/3H -500- : Probehead Path.....	107
Figure 54: 19F/1H/3H -500- : Gain and Noise Figure.....	107
Figure 55: 19F/1H/3H -500- : Transmitter Path	107
Figure 56: X-BB 31P -400- : Probehead Path	108
Figure 57: X-BB 31P -400- : 2H Stop Probehead Path.....	108
Figure 58: X-BB 31P -400- : Transmitter Path	108
Figure 59: X-BB 31P -400- : Gain and Noise Figure	108
Figure 60: 2H -400- : Probehead Path	109
Figure 61: 2H -400- : Gain and Noise Figure	109
Figure 62: 2H -400- : Transmitter Path.....	109
Figure 63: 19F Selective -400- : Probehead Path	110
Figure 64: 19F Selective -400- : Gain a. Noise Figure	110
Figure 65: 19F Selective -400- : Transmitter Path	110
Figure 66: X-BB 19F 2HP -400-: Probehead Path	111
Figure 67: X-BB 19F 2HP -400-: Gain a. Noise Figure	111
Figure 68: X-BB 19F 2HP -400-: Transmitter Path.....	111

Figure 69:	3H -500- : Probehead Path	112
Figure 70:	3H -500- : Gain and Noise Figure	112
Figure 71:	3H -500- : Transmitter Path.....	112
Figure 72:	Cover module PS & Interface Connector	114

B.Schematics 115

Figure 73:	Connector Wiring - Block Diagram -	116
Figure 74:	Block Diagram - Scheme 1 of 5 -	117
Figure 75:	Supply Interconnection - Scheme 5 of 5 -	118
Figure 76:	Preamplifier Selector / Tuning Splitter - Block Diagram -	119
Figure 77:	Splitter.....	120
Figure 78:	Selector: PIN Diodes Matrix - Scheme 1 of 2 -	121
Figure 79:	Selector: Control Side - Scheme 2 of 2 -	122
Figure 80:	Splitter Component plan - Top and Bottom Views -	123
Figure 81:	Selector Component plan :HF-side - Wired Components -	123
Figure 82:	QNP Control Module	124
Figure 83:	QNP Control Modul Component plan.....	125
Figure 84:	Power Supply.....	126
Figure 85:	Power Supply Component plan - Top View -	127
Figure 86:	Power Supply Special Parts - Top View -	128
Figure 87:	Junction Board.....	129
Figure 88:	Junction Board Component plan - Top View -	130

.List of Index	7
1.Assembly.....	11
2.Cover / Display Module.....	15
Table 1: RS232: 9-pol D-Sub connector (male)	17
Table 2: Default jumper settings for positive-active gate pulses	23
Table 3: New jumper settings for negative-active gate pulses	23
3.HPPR - Interface.....	29
4.1H Module	39
Table 4: Power handling capability: single pulse, worst case for maximum mismatch 47	
Table 5: Power handling capability: single pulse, for best matching	48
5.19F/1H/3H HP-Module.....	51
6.X-BB Module.....	55
7.2H Module	61
8.19F Selective Module.....	67
9.3H Module	73
10.QNP Control Module	79
Table 6: Console Connector BP2 pins	81
Table 7: QNP Control Signals	81
11.HPPR Configuration	83
12.Commonly used Circuits	97
Table 8: Hardware Code Level Detection - HCL A and B only -	99
Table 9: Hardware Code Level Detection - HCL C and higher -	99
Table 10: Jumper Settings for Standard Preamplifiers Configurations	102
Table 11: 1H, X-BB_31P_2HS, 2H, X-BB_19F_2HP Module	103
Table 12: HR/HP combined Assembly	103
A.Technical Data	105
Table 13: 1H Preamplifier	106
Table 14: 19F/1H/3H Preamplifier	107

Table 15:	X-BB 31P 2HS Preamplifier	108
Table 16:	2H Preamplifier	109
Table 17:	19F Selective Preamplifier	110
Table 18:	X-BB_19F_2HP Preamplifier	111
Table 19:	3H Preamplifier	112
Table 21:	Power Consumption	113
Table 20:	Deadtimes (Beginning of pulse [#] to settled Phase @ 1Degree [\$]) 113	
B.Schematics		115