

Probes

- **Configuring CMAS Triple Resonance Probes**
User Manual
Version 001



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1 Introduction

With this manual you learn how to configure your CMAS probe (PH) in order to access certain nuclei. There are different possibilities to adjust the frequency range of your PH e.g. changing inserts, capacitors and coils.

In [Options for Modifying the Tuning Range \[17\]](#) you learn how to change the different elements and in [Probe Tuning Table \[22\]](#) you find the table you need to adjust your probe for the different frequency ranges.

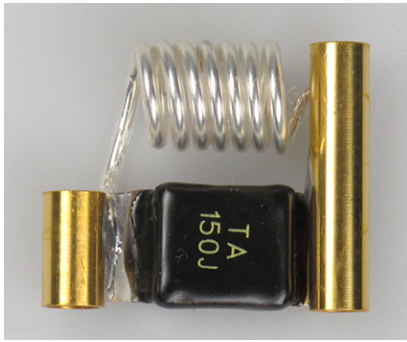


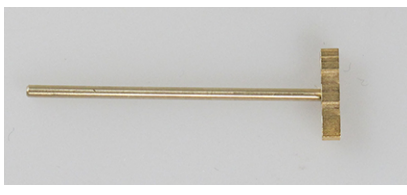

For further information about the magnet or the amplifiers please check the corresponding documentation.



Important!

The probe must only be used inside the magnet.

2 Tuning Accessory

XY-Insert	 A photograph of an XY-Insert component. It consists of a black rectangular capacitor with 'TA 150J' printed on it, a silver metal spring, and two gold-colored cylindrical metal tubes. The spring is attached to one of the tubes.
Short circuit insert	 A photograph of a short circuit insert. It features two gold-colored cylindrical metal tubes connected by a flat, silver metal strip.
Double mode adapter	 A photograph of a double mode adapter, which is a single, solid gold-colored cylindrical metal tube.
Jumper for serial capacitor and tool	 A photograph of a jumper for serial capacitor and tool. It is a thin gold-colored metal rod with a T-shaped cross-section at one end.
Shunt capacitors for extending the Y-channel tuning range	 A photograph of shunt capacitors for extending the Y-channel tuning range. It shows a black capacitor with 'TA 150J' printed on it, mounted on a silver metal strip with two circular terminals at the ends.

Range coils for increasing X frequency up to ^{31}P

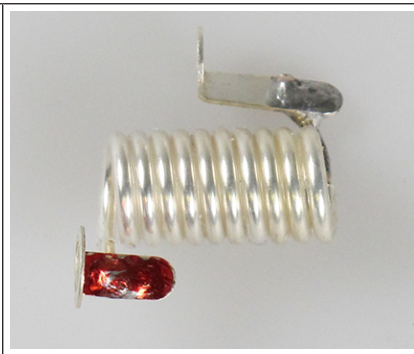


Table 2.1: Tuning Accessory Parts

3 Probe Interfaces



Figure 3.1: HF Connectors

1	¹ H RF Connector	4	Spin Rate
2	X RF Connector	5	Base Heater
3	Y RF Connector (triple resonance probes only)		

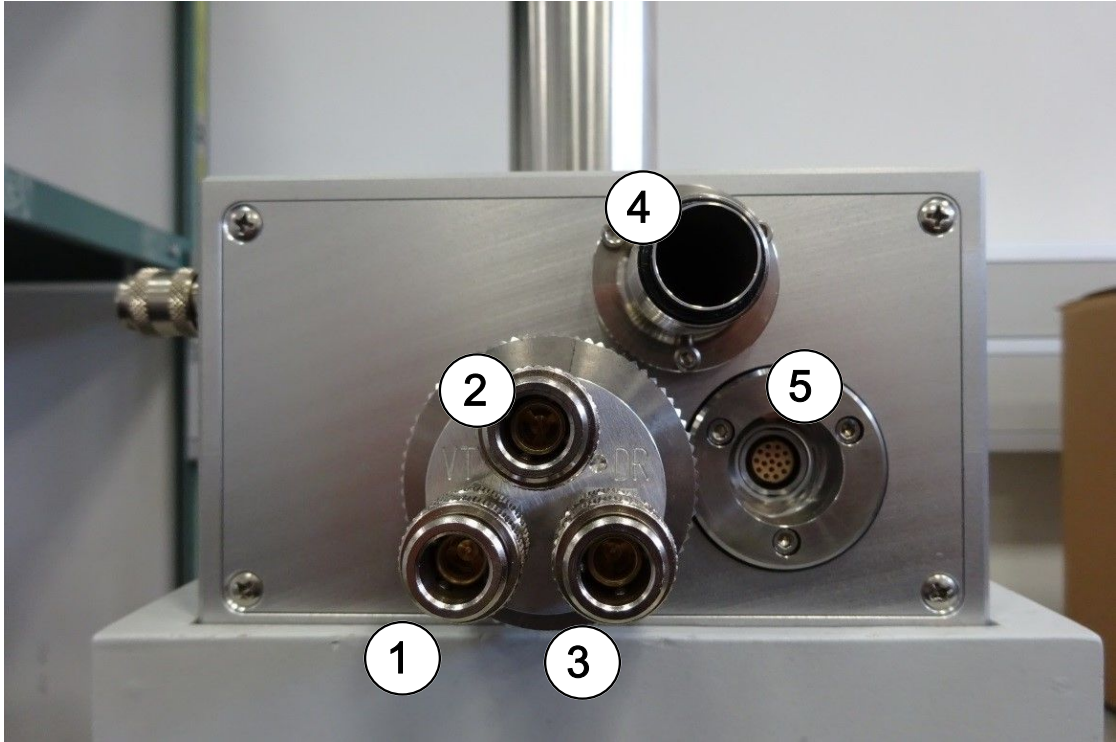


Figure 3.2: ITL Connector

1	Variable Temperature	4	Gas Return Line
2	Bearing	5	ITL Connector
3	Drive		
1-3: Room temperature adapter mounted on the MAS gas interface.			

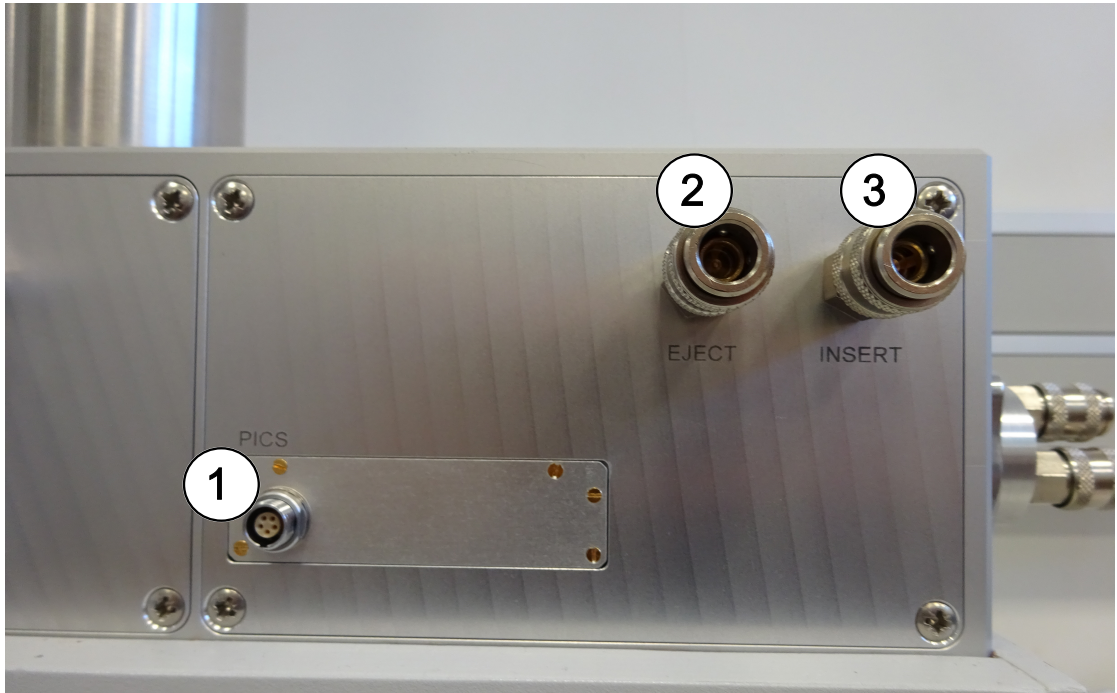


Figure 3.3: PICS and Eject_Insert

1	PICS	3	Insert
2	Eject		

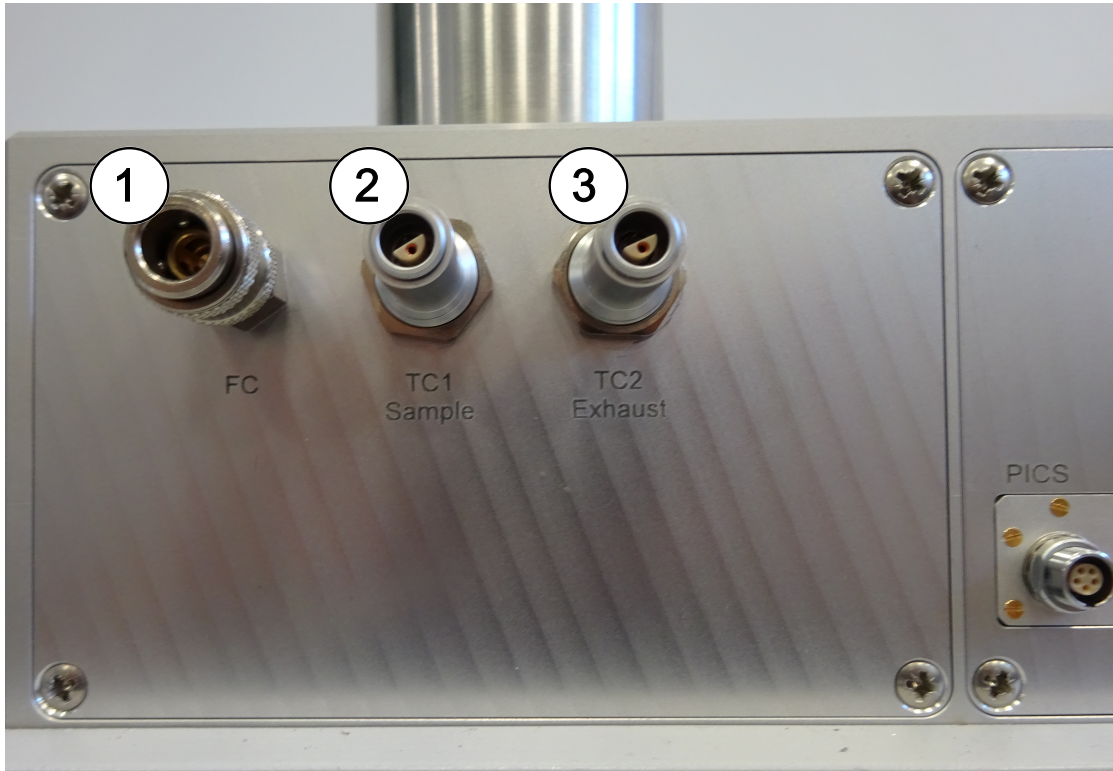


Figure 3.4: Frame Flush and Temperatur Sensors

1	Frame cooling (flush) Venturi*	3	Thermocouple Exhaust
2	Thermocouple Sample		
* Venturi is only for probes with BL 1.9 mm and smaller.			

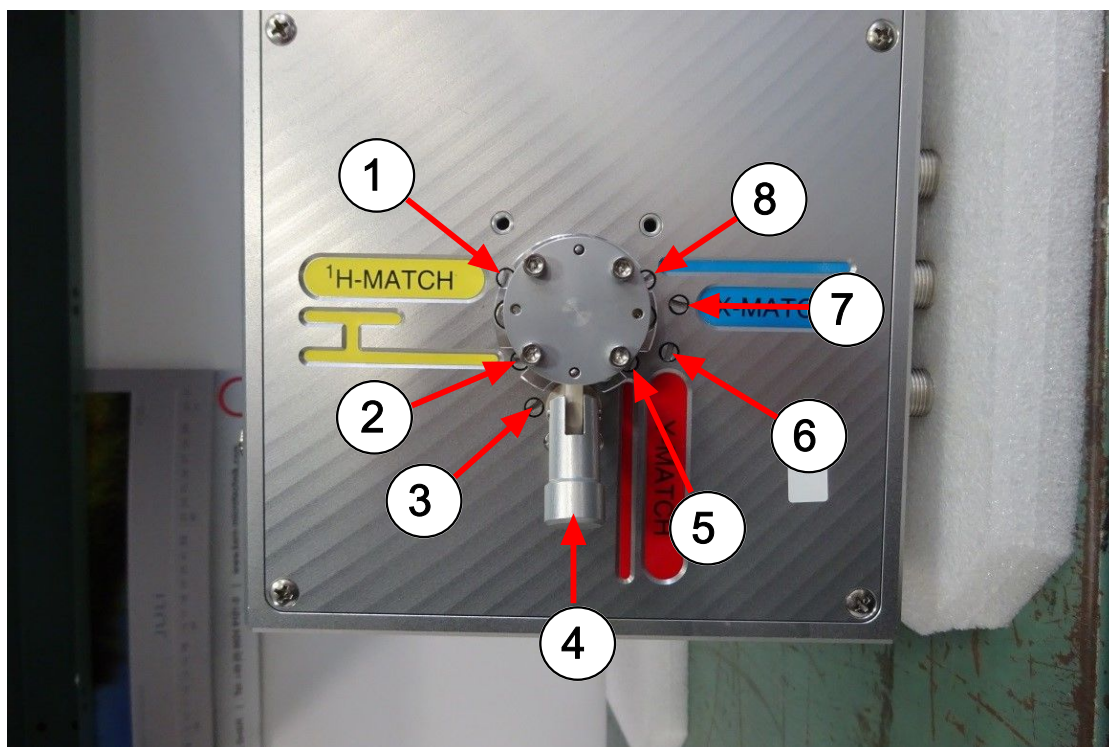


Figure 3.5: Tuning and Matching Elements

1	^1H Matching	5	Y Tuning (triple resonance probes only)
2	^1H Tuning	6	Y Matching (triple resonance probes only)
3	Magic Angle Adjustment	7	X Matching
4	Rotor Catcher	8	X Tuning

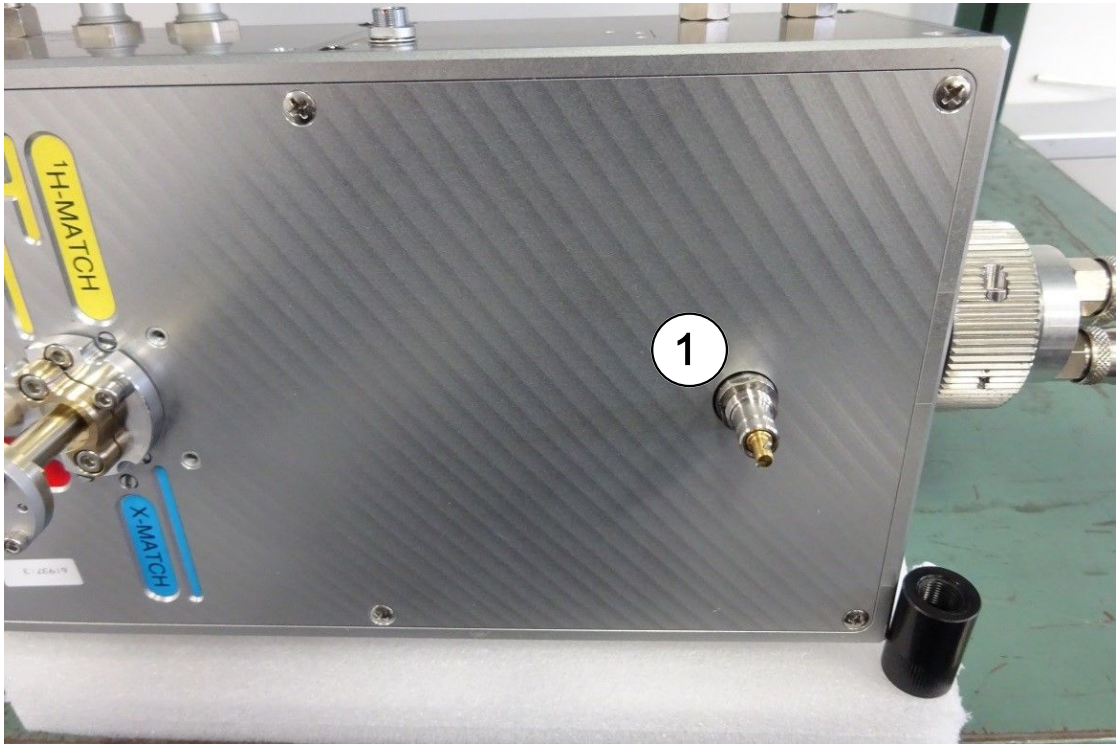


Figure 3.6: Vacuum Port

1	Vacuum Port		
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4 Opening the Probe

In order to change the probe's tuning range the shielding/dewar has to be removed. This can be done by unscrewing the holding ring and pulling the dewar off the probe. Turning the dewar clockwise while pulling makes it easier to remove it and reduces scuffing of the tube's inner plating. When getting everything assembled again, keep in mind that the orientation of the hooks for latching the probe to the shim system should be the same as before and the O-ring has to be in position like illustrated below.

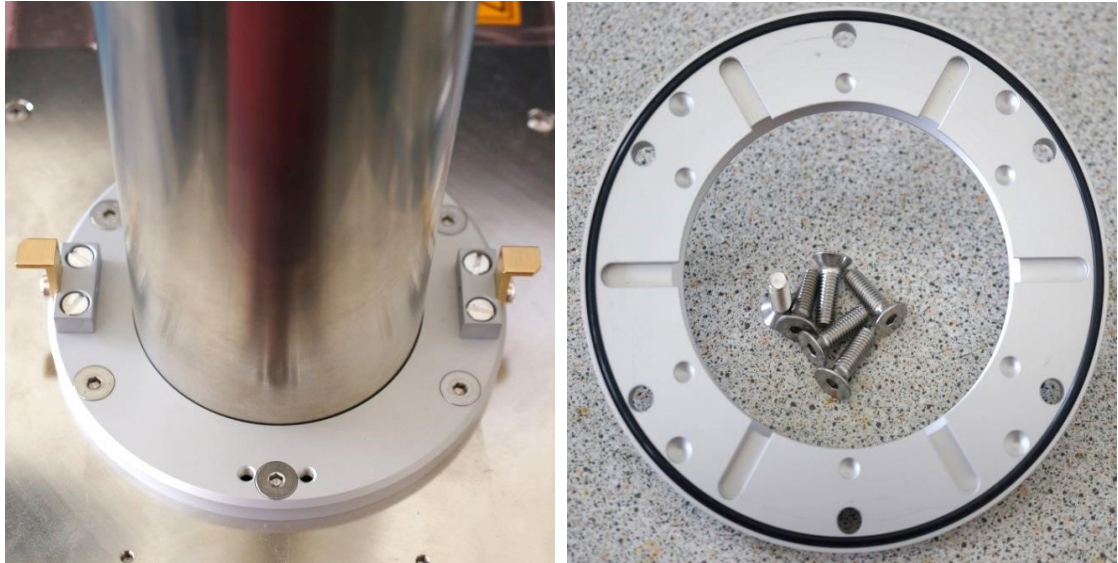


Figure 4.1: Dewar Holding Ring with Latching Hooks Mounted and Unmounted

5 Options for Modifying the Tuning Range

This chapter discusses the options available for modifying the tuning range.

5.1 Serial Capacitor C_s

Handling

The ceramic capacitor at the upper end of the ^1H transmission line can be shortened by setting a jumper onto the dedicated pins with the corresponding tool. An attached jumper is indicated by **Yes** in the [tuning table \[22\]](#), while **No** means the jumper must be removed.

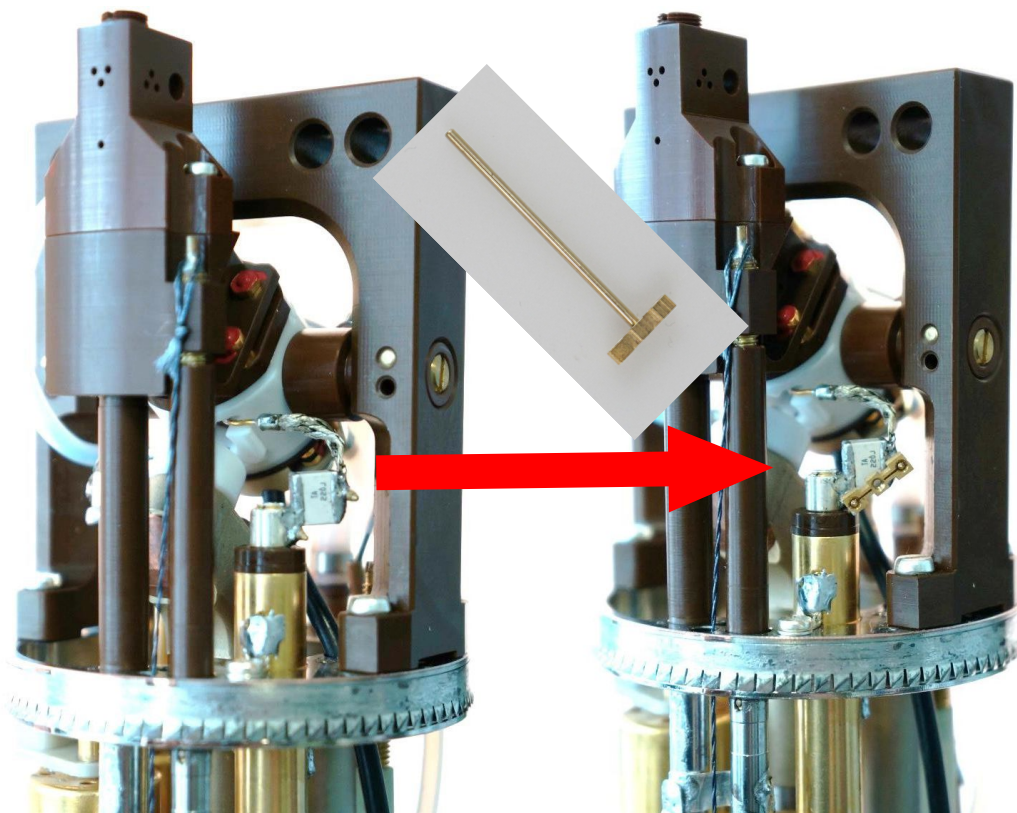


Figure 5.1: Serial Capacitor Active (left) and Shortened by the Jumper (right)

Additional Information

C_s is the small ceramic capacitor between the $\lambda/4$ -transmission line and the NMR-coil. It has two functions. First, it raises the frequency of both, the X and the Y channel and secondly it helps to balance the X-channel thus increasing its sensitivity. In order to tune frequencies below ^{13}C it usually is necessary to short the capacitor. No matter if C_s is active or not the ^1H frequency won't be affected as the capacitance value is large compared to other parts of the ^1H circuit.

5.2 Changing the XY Insert, the Short Circuit Insert and Double Mode Adapter

Handling

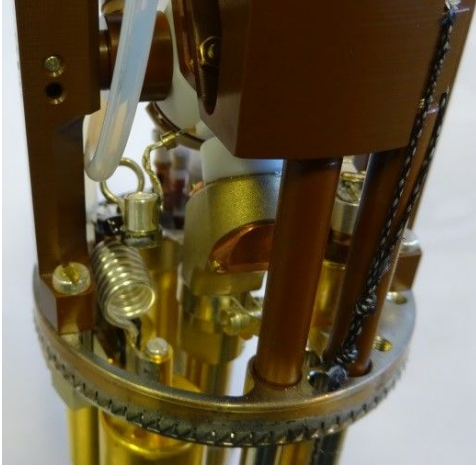
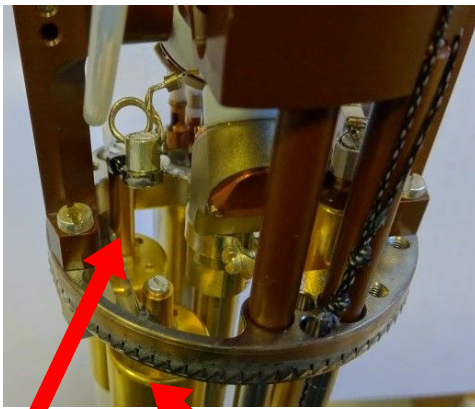
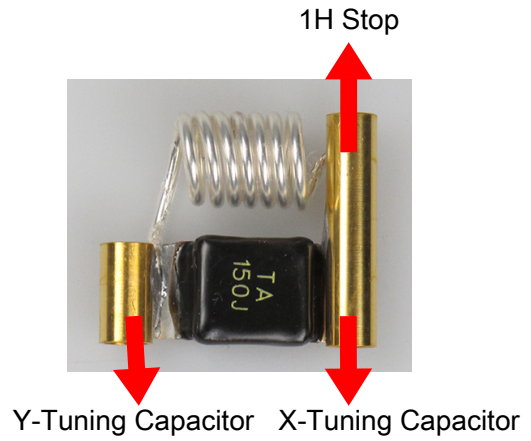


Figure 5.2: XY Insert



X-Tuning Capacitor
Y-Tuning Capacitor

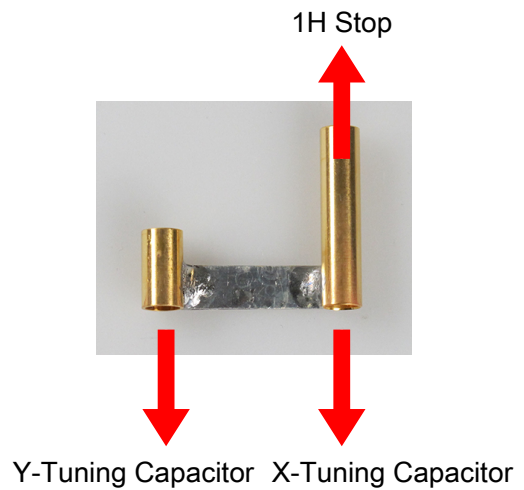


Figure 5.3: Short Circuit Insert

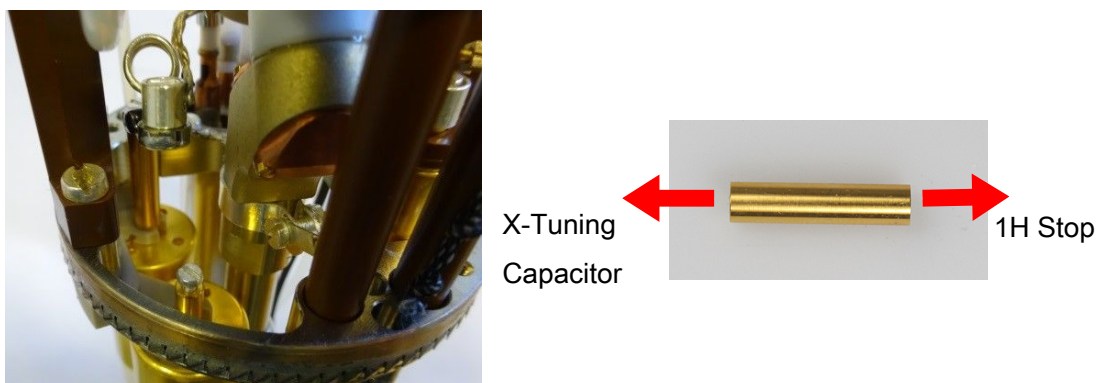


Figure 5.4: Double Mode Adapter

In order to replace the XY-/Short circuit-insert loosen two screws. The first screw connects the longer sleeve of the insert to the X-tuning capacitor and the ^1H stop circuit respectively while the second screw connects the shorter sleeve to the Y-tuning capacitor. After the screws are removed you can lift the insert from the X and Y tuning. It may be necessary to push the ^1H stop circuit towards the waveguide to provide sufficient space to remove the (specify) insert. Take extreme care when handling the ^1H stop circuit. When the new insert is in place, screw the ^1H stop to the long sleeve. Try to align the ^1H stop so that is parallel to the MAS turbine. This is necessary to maintain the isolation between the ^1H and the other two channels.

If you use the double mode adapter, attach the short screw to the Y-tuning capacitor.

Additional Information

- XY Insert

The XY-insert is a stop circuit tuned to the X-nuclei isolating the two channels. Changing the insert will always alter the tuning range of both the X and Y channels.

- Short circuit insert

When using the short circuit insert it is recommended to tune the X-channel to its highest frequency. This means the tuning screw must be screwed in until you reach the stop. This way the coupling of the X-channel to the Y-channel, which isn't in use in this configuration, is minimized. You should also terminate the X-channel with $50\ \Omega$. In some cases, it might be necessary to use the X-tuning to further lower the Y-frequency. This is possible because X-tuning capacitor is still connected to the circuitry inside the probe and hence, changing the X-tuning will alter the Y-frequency. As a strongly coupled X-channel will lower the sensitivity of the Y-channel you should always tune the Y to its minimum frequency before using the X-tuning to get further down.

- Double mode adapter

With this adapter it is possible to switch the probe to double mode. Doing so, you will get a broader tuning range and a higher sensitivity on the X-channel.

5.3 Shunt Capacitor

Handling

Shunt capacitors are used to lower the frequency of the Y-channel in order to tune low gamma nuclei. The capacitors can be attached in parallel to the Y-tuning capacitor with two screws as illustrated below:

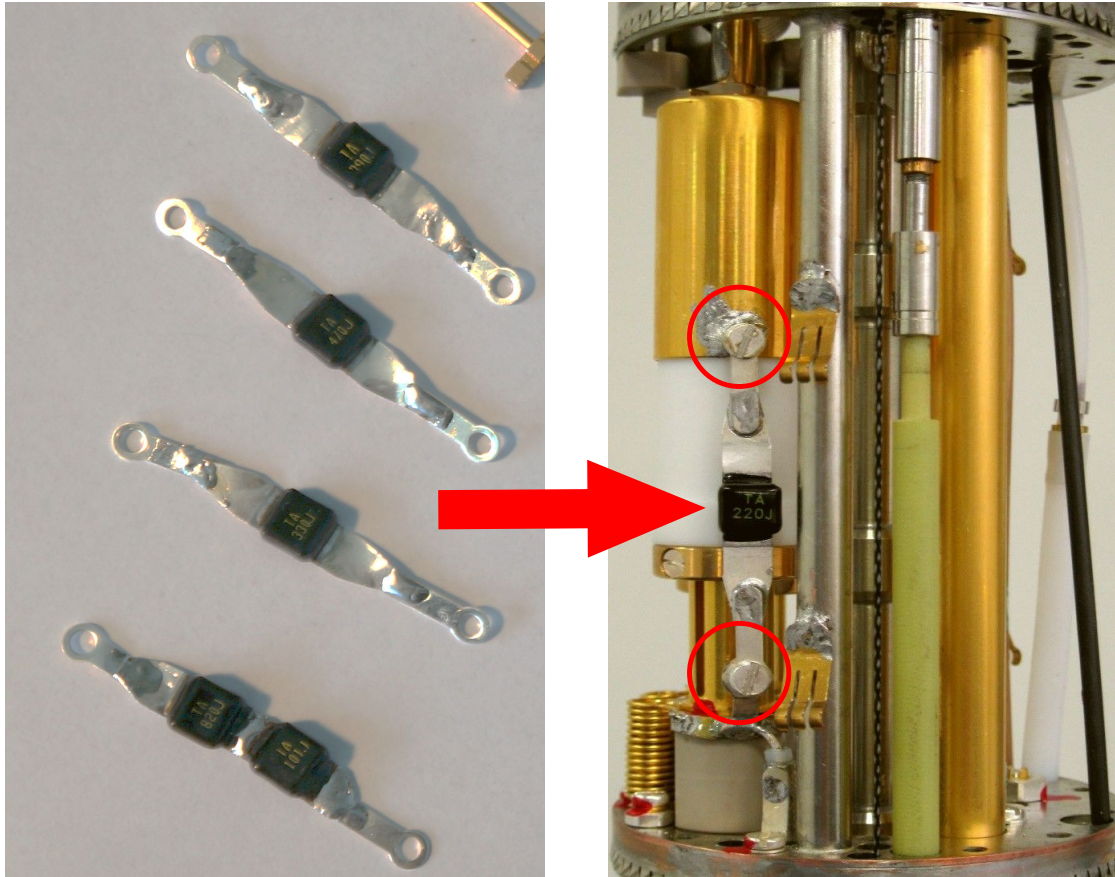


Figure 5.5: Shunt Capacitors (left) and How They are Connected to the Y-Tuning Trimmer (right)

Additional Information

The imprinted code on the shunts reads as follows. The first two digits give the number and the third indicates the power of ten. All values are in pF. For values below 10 pF there is an R between the first two digits. For better understanding some examples are listed below.

2R7 → 2.7 pF

270 → 27 pF

271 → 270 pF

5.4 Range Coil

Handling

To connect the range coil remove the screw that is used to attach the ^1H stop to the XY-insert and add one end of the coil to this joint. The second, larger solder flange must be connected to the probe frame.

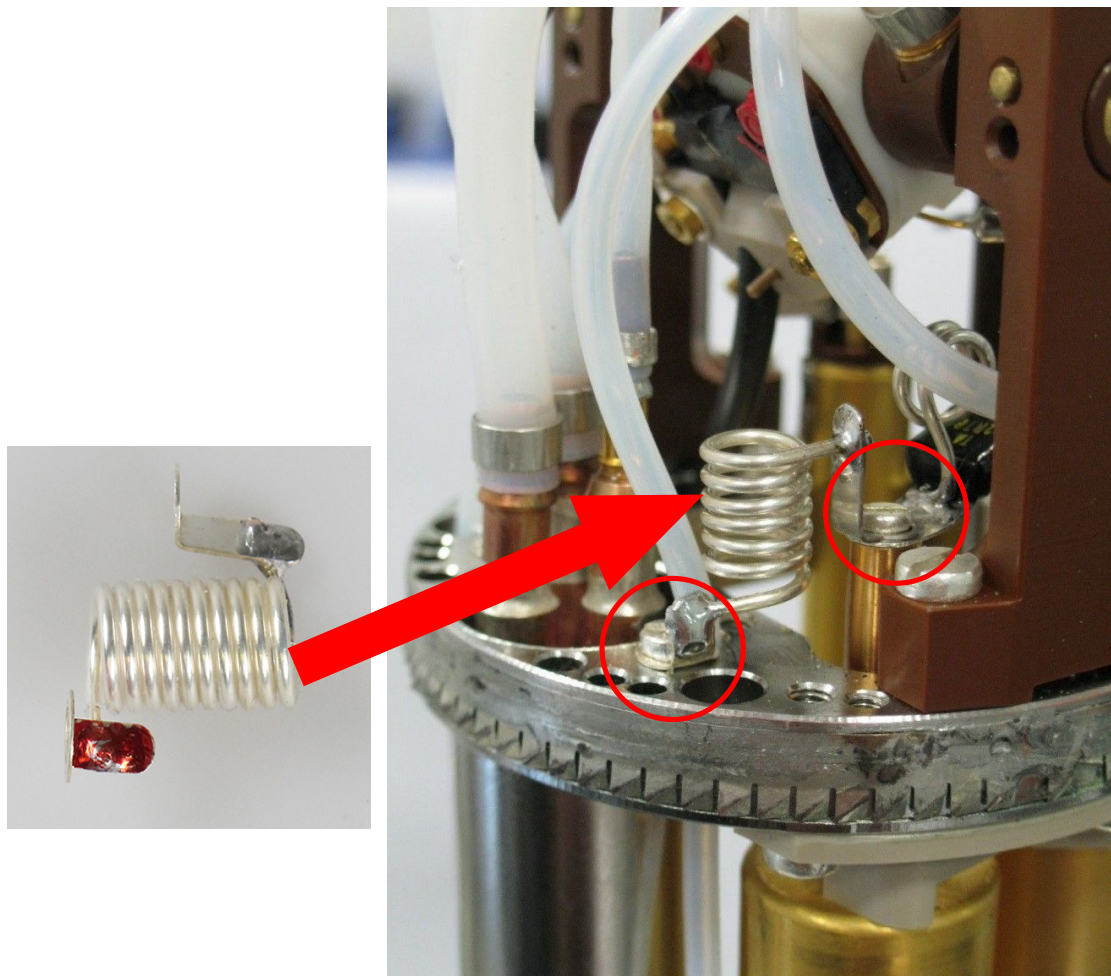


Figure 5.6: Range Coil (left) and How it's Built In (right)

Additional Information

The range coil is an inductor parallel to the NMR-coil that reduces the overall inductance of the X and Y circuit. With the reduced inductance it is possible to tune up to ^{31}P . The magnetic field generated in the circuit now is distributed to two coils, the NMR coil and the range coil. Only the B_1 of the NMR coil is relevant to NMR performance, therefore a range coil should always have as much windings as possible, in order to not lower the sensitivity too much.

6 Probe Tuning Table

This table gives an overview of what tuning ranges are feasible with the inserts, shunts and range coils shipped with this probe.

X-Nucleus	Y-Nucleus	Insert (C/L)	Tuning Range X (MHz)	Tuning Range Y (MHz)	Jumper for C _s	Shunt (imprint)	Range Coil
		Contact Bruker for probe tuning information.					

Table 6.1: Probe Tuning Table

7 Contact

Manufacturer

Bruker BioSpin GmbH
Silberstreifen 4
D-76287 Rheinstetten
Germany

E-Mail: nmr-support@bruker.com

<http://www.bruker.com>

WEEE DE43181702

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