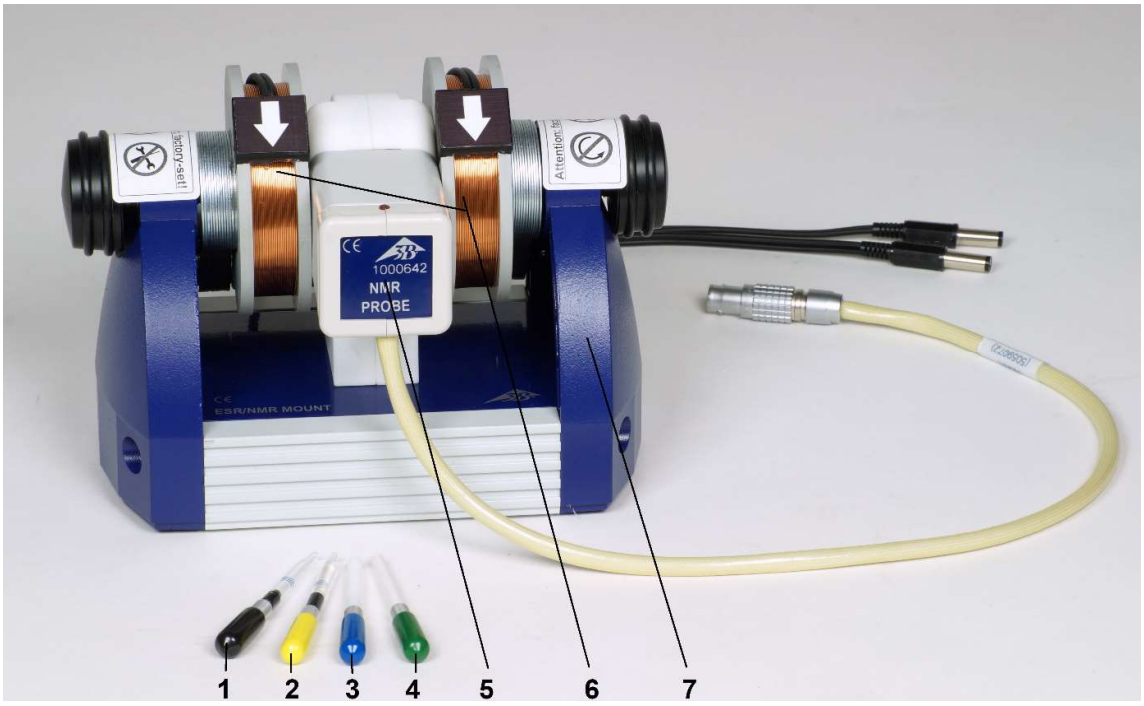
3B SCIENTIFIC® PHYSICS

NMR Module 1022706

Instruction manual

08/20 SD



1 Comparison sample
2 Glycerine sample
3 Teflon sample
4 Polystyrene sample
5 NMR probe
6 Pair of magnetic coils
7 Base unit

1. Safety instructions

The NMR module is only intended for connection to the ESR/ NMR control unit (1022700/ 1022702) available as an accessory. No external voltages may be applied!

Since the module is factory calibrated, no settings need to be made on the hardware. Destruction of the warranty seals will result in loss of warranty.

The permanent magnets can generate considerable forces of attraction and repulsion with the result that there is a risk of squashing or splintering.

Therefore do not remove the magnet!

Magnetic fields can erase data from magnetic media and affect or destroy electronic or mechanical components like heart pacemakers.

- **People with pacemakers should not conduct this experiment.**

2. Description

The NMR module is to be used with the ESR/NMR control unit (1022700 resp. 1022702) for investigating nuclear spin resonance in glycerine, polystyrene and Teflon.

The set consists of the factory-set base unit with the two magnetic coils, the NMR probe, glycerine sample, polystyrene sample, Teflon sample and an empty comparison sample. A measurement report is supplied with each NMR module. The resonance frequency for glycerine and the strength of the permanent magnetic net field for the respective module are specified in this report. An unambiguous assignment is guaranteed via the S/N on bottom of the device e.g. 203067-1, if several modules have been purchased.

3. Scope of delivery

1 Base unit with preinstalled magnetic coils and magnet
1 NMR probe
1 Comparison sample
1 Glycerine sample
1 Teflon sample
1 Polystyrene sample
1 Measurement report

4. Technical data

Magnetic flux density of the permanent magnet, see report:	approx. 300 mT
Frequency range:	approx.11.5 MHz−15 MHz
Probe connector:	4-pole Lemo plug
Sample diameter:	4.5 mm
Distance sample inlet to center of measuring chamber	approx. 26 mm

Magnetic coils

Coils:	500 each
Magnetic flux density:	0 – 3.67 mT
Connector:	coaxial connector 5.5 x 2.5 mm
Dimension:	approx. 175x125x125mm^3
Weight:	approx. 3.20 kg

5. Additionally required equipment

1 ESR/NMR control unit (230 V, 50/60 Hz)	1022700
or	
1 ESR/NMR control unit (115 V, 50/60 Hz)	1022702
1 Digital oscilloscope, 2x 30 MHz	1020910
or	
1 PC oscilloscope 2x 25 MHz	1020857
2 HF-cable	1002746

6. Operation

6.1 Connection to the control unit

- Insert the probe into the chamber in the basic unit so that it touches the housing (Fig. 1).
- Plug the lead from the probe into the socket “Probe In” on the control unit. Take note of the slot in the connector socket.
- **Note!**

  Always be careful when connecting and disconnecting the measuring head cable. The red dot on the connector must point in the direction of the "Sensitivity" LED. When disconnecting the plug, only pull on its housing, the plug unlocks automatically. Never pull on the cable!
- Connect the coils to the “Coil” output on the back of the console.
- Connect the control console with plug-in power supply via socket “12 VAC/1A”.

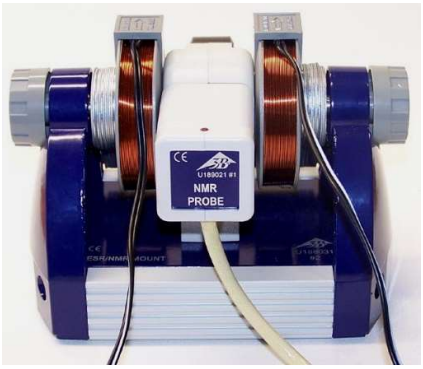


Fig. 1 Base unit with probe

6.2 Calibration and settings

- Connect the output “SIGNAL OUT” on the control console to channel 1 of the oscilloscope and the output “FIELD OUT” to channel 2 (see Fig. 3).
- Set the oscilloscope as follows:

  Channel 1: 1 V DC (0.5 V DC)

  Channel 2: 1 V DC (0.5 V DC)

  Time base: 5 ms

  Trigger settings:
  - Channel 2
  - Filter: low frequency
  - Trigger mode: falling edge

6.3 Experiment procedure

Note!

Mobile phones interfere with the measurement, therefore no mobile phones should be near the device during the measurement.

Use only high-quality HF cables for the measurement.

- Insert the glycerine sample (yellow top) into the sample chamber (see Fig. 2).

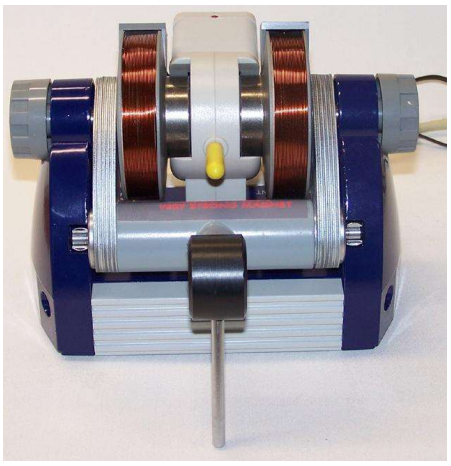


Fig. 2 Base unit with glycerine sample inserted

- Set the specified frequency on the control panel from the measurement report supplied (since the frequency controller is a 10-turn potentiometer, several turns may be necessary to do this).
- Set the sensitivity to medium and adjust if necessary.

At the optimum setting, the LED can be seen to flicker slightly. If the LED lights up fully, the signal is overloaded.

- Carefully adjust the fine setting using the frequency selector knob seeking out a peak in the signal between about 1 ms to 1.5 ms in width.

Note!

- A further adjustment of the signal quality is not necessary, since the NMR module is delivered factory calibrated.

For the polystyrene sample (green top) the frequency will be in the same range as for the glycerine sample. For the Teflon sample (blue top) the frequency will be lower (see Figs. 4 to 6).

Another experiment can be carried out in which the stalk of a plant can be inserted into the sample chamber for its resonant frequency to be determined.

6.4 Evaluation

Resonant frequencies of material samples

Glycerine (^{1}H)	42.58 MHz/T
Polystyrene (^{1}H)	42.58 MHz/T
Teflon (^{19}F)	40.06 MHz/T
Plant stalk (^{1}H)	42.58 MHz/T

Therefore, in a constant magnetic field:

$$\nu_{Glycerin} = \nu_{Polystrol}\ ,\ \frac{\nu_{Teflon}}{\nu_{Glycerin}} = 0{,}941$$

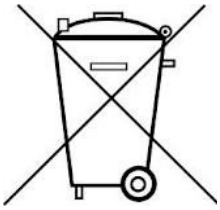
cf. Figs. 4, 5, und 6 where

ν (Glycerine) = 12.854 MHz

ν (Polystyrene) = 12.854 MHz

ν (Teflon) = 12.100 MHz

7. Disposal



- The packaging should be disposed of at local recycling points.
- Should you need to dispose of the equipment itself, never throw it away in normal domestic waste. Local regulations for the disposal of electrical equipment will apply.

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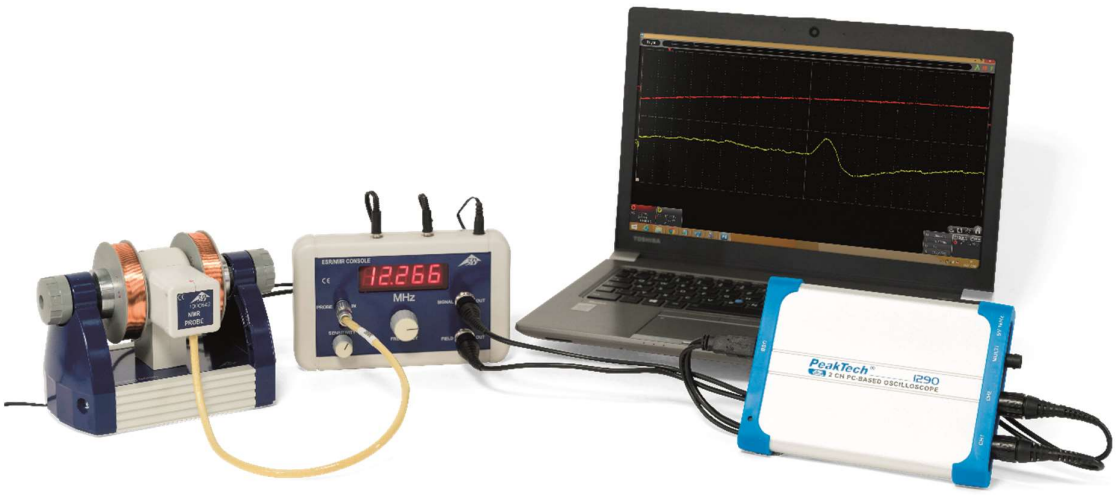

Fig. 3 NMR-experiment set-up with a PC oscilloscope

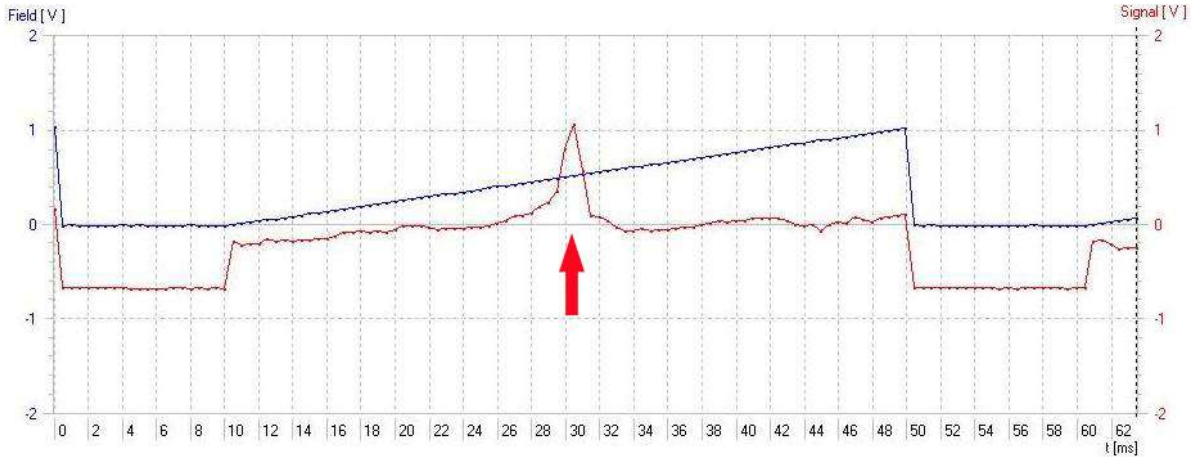

Fig. 4 Display of the signal (glycerine ν = 12.854 MHz)

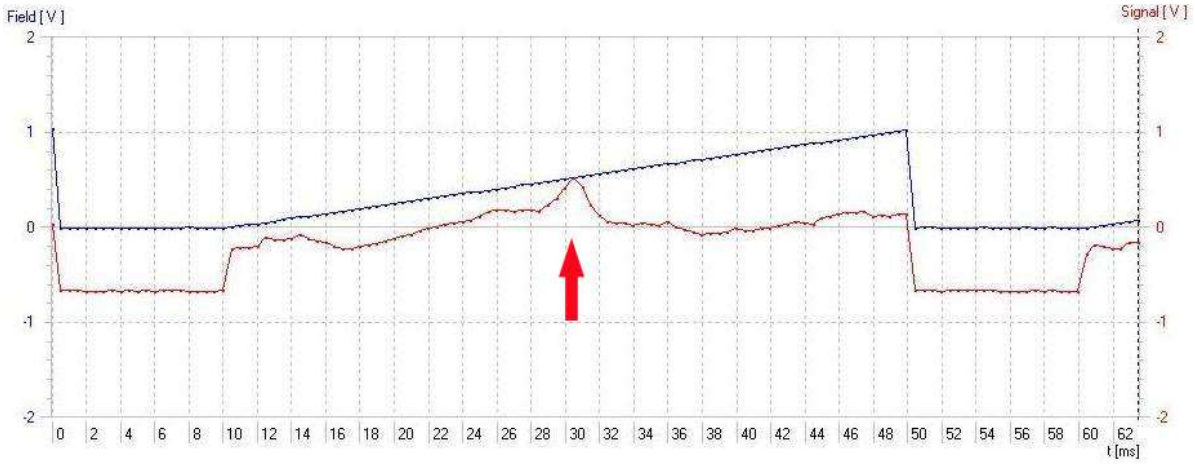

Fig. 5 Display of the signal (polystyrene ν = 12.854 MHz)

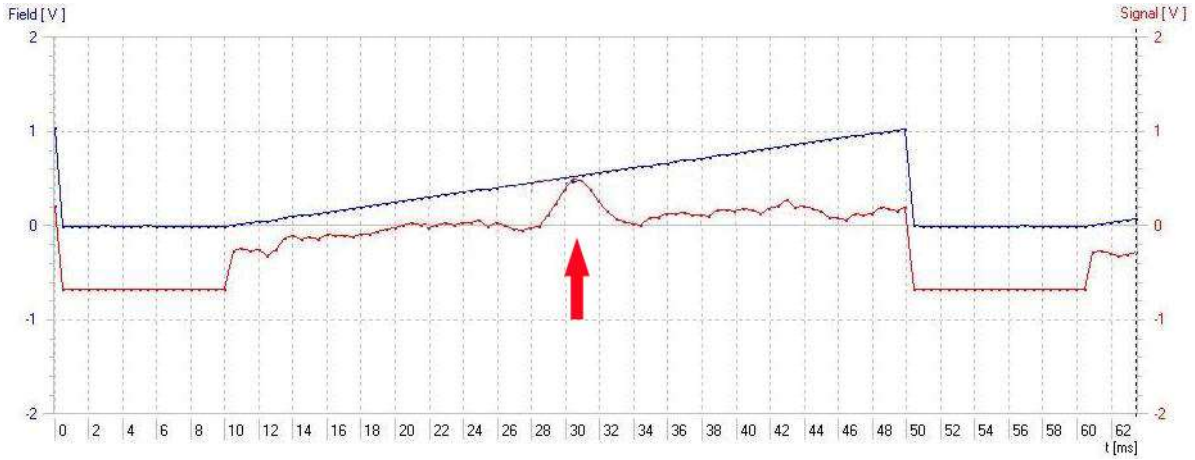

Fig. 6 Display of the signal (Teflon ν = 12.100 MHz)