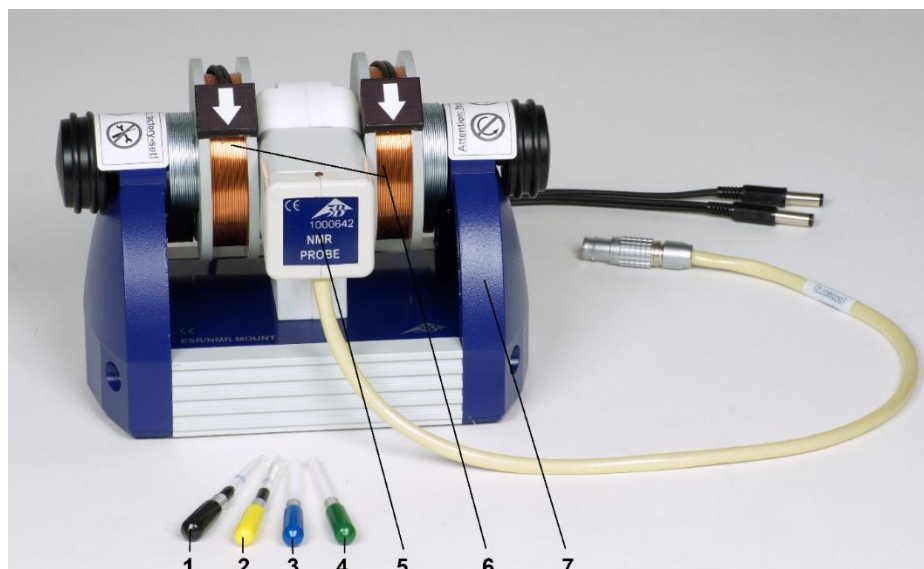


NMR Module 1022706

Product Manual

08/26 SD/HJB



- 1 Reference sample
- 2 Glycerin sample
- 3 Teflon® sample
- 4 Polystyrene sample

- 5 NMR measuring head
- 6 Pair of coils
- 7 Base unit

1. Safety Instructions

The NMR module is intended only to be connected to the control unit available as an accessory (item no.: 1022700/1022702). No external voltage may be applied!

Since the NMR module is factory-calibrated, no adjustments to the hardware are required. A broken warranty seal will result in voiding of the warranty.

The permanent magnet installed in this product generates considerable attractive and repulsive forces, creating a pinch hazard and a risk of injury due to shattering. Therefore, do not remove the magnet!

Warning!

Magnetic fields can erase storage devices and affect or destroy electronic and mechanical components, e.g., pacemakers.

- Persons with pacemakers must not conduct the experiment.

2. Description

The NMR module is used in conjunction with the ESR-NMR control unit (item no.: 1022700 or 1022702) for the investigation of nuclear magnetic resonance in glycerin, polystyrene, and Teflon®.

The NMR module consists of the factory-calibrated base unit with the pair of coils, the NMR measuring head, a glycerin sample, a polystyrene sample, a Teflon® sample, and an unfilled reference sample. A test report is supplied with each NMR module. It specifies the resonance frequency for glycerin and the magnetic field strength of the permanent magnet for the respective module. If several modules have been purchased, each one can be uniquely identified by its serial number (S/N, located on the bottom of the device, e.g. 203067-1).

3. Scope of Delivery

- 1 NMR module with mounted pair of coils
- 1 NMR measuring head
- 1 Reference sample
- 1 Glycerin sample
- 1 Teflon® sample
- 1 Polystyrene sample
- 1 Test report

4. Specifications

Magnetic flux density of the permanent magnet:	300 mT approx. (see test report)
Frequency range:	11.5 – 15 MHz approx.
Measuring head connection:	four-pole LEMO plug
Sample diameter:	4,5 mm
Distance from sample inlet to center of measuring chamber:	26 mm approx.
Dimensions:	175x125x125 mm ³ approx.
Weight:	3.20 kg approx.

Field coils:

Turns:	500 each
Magnetic flux density:	0 – 3.67 mT
Connection:	DC power plug 5.5 mm x 2.5 mm

5. Additionally required

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	RF cables	1002746

6. Operation

6.1 Connection to the control unit

- Insert the measuring head into the measuring head mount of the module until the housing is fully seated (see Fig. 1).
- Plug the connecting cable of the measuring head into the “Probe In” socket of the control

unit. Make sure to align the notch on the connection socket.

- **Note!**

Always exercise caution when plugging in and unplugging the measuring head cable. The red dot on the plug must point toward the “Sensitivity” LED display. When disconnecting the plug, pull only on the housing; the plug unlocks automatically. Never pull on the cable!

- Connect the coils to the “Coil” sockets on the rear of the control unit.
- Connect the control unit to the plug-in power supply via the “12 VAC / 1A” socket.



Fig. 1: Base unit with measuring head

6.2 Adjustment and settings

- Connect the “SIGNAL OUT” output of the control unit to channel 1 of the oscilloscope and the “FIELD OUT” output 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 Experimental Procedure

Note!

Mobile devices interfere with the measurement; therefore, no mobile devices should be in the vicinity of the apparatus during the measurement. Use only high-quality RF cables for the measurement.

- Insert the glycerin sample (yellow cap) into the sample receiver (see Fig. 2).

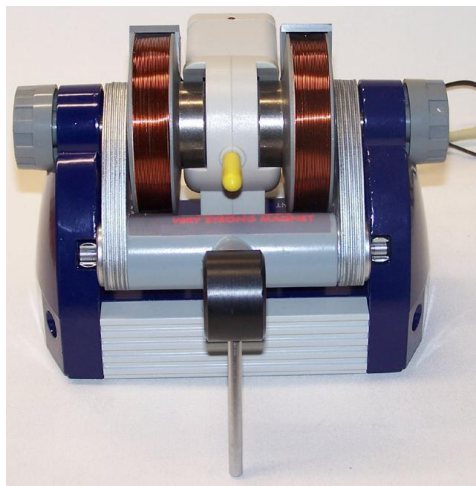


Fig. 2: Base unit with glycerin sample inserted

- On the control unit, adjust the frequency to the value specified in the supplied test report. (Several turns of the frequency control may be necessary to set the frequency).
- Adjust the sensitivity to the center position and readjust if necessary.

At the optimal setting, a faint flicker of the LED can be observed. If the LED lights up brightly, the signal is overdriven. Likewise, when overdriven, the display no longer indicates a frequency.

- Carefully make the fine adjustment using the frequency control and look for a “peak” in the signal with a width of approximately 1 ms to 1.5 ms.

Note!

- No further adjustment of the signal quality is required because the NMR module is supplied factory calibrated.

For the polystyrene sample (green cap), the frequency is in the same range as for the glycerin sample. For the Teflon® sample (blue cap), the frequency is lower (see Fig. 4 to 6).

In a further experiment, a plant stem can be inserted into the sample receiver, and the resonance frequency can be determined.

6.4 Evaluation

Resonance frequency of the material samples:

Glycerin (¹ H)	42,58 MHz/T
Polystyrene (¹ H)	42,58 MHz/T
Teflon® (¹⁹ F)	40,06 MHz/T
Plant stem (¹ H)	42,58 MHz/T

Thus, at a constant magnetic field:

$$\nu_{\text{Glycerin}} = \nu_{\text{Polystyrol}} \cdot \frac{\nu_{\text{Teflon}}}{\nu_{\text{Glycerin}}} = 0,941$$

Compare Fig. 4, 5, and 6 with:

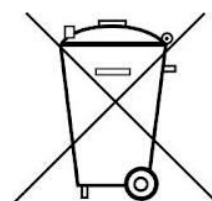
$$\nu(\text{Glycerin}) = 12,854 \text{ MHz}$$

$$\nu(\text{Polystyrol}) = 12,854 \text{ MHz}$$

$$\nu(\text{Teflon®}) = 12,100 \text{ MHz}$$

7. Disposal of Waste (WEEE)

The symbol of the crossed-out wheeled bin means that this device must be collected separately from unsorted municipal waste at the end of its service life. Do not dispose of the device in normal household waste. For return, please use the local free collection and return systems provided by municipalities (e.g., recycling centers) or the take-back options provided by retailers.



- **Batteries and Lamps:** Remove waste batteries and accumulators that are not enclosed by the waste equipment, as well as lamps that can be removed without being destroyed, from the waste equipment prior to delivery to a collection point.
- **Data Protection:** As an end-user, you are legally responsible for deleting personal data from the waste equipment to be disposed of.
- **Packaging:** Dispose of the packaging materials separately at local recycling points (e.g., paper/cardboard in paper waste, plastics in designated recycling bins).

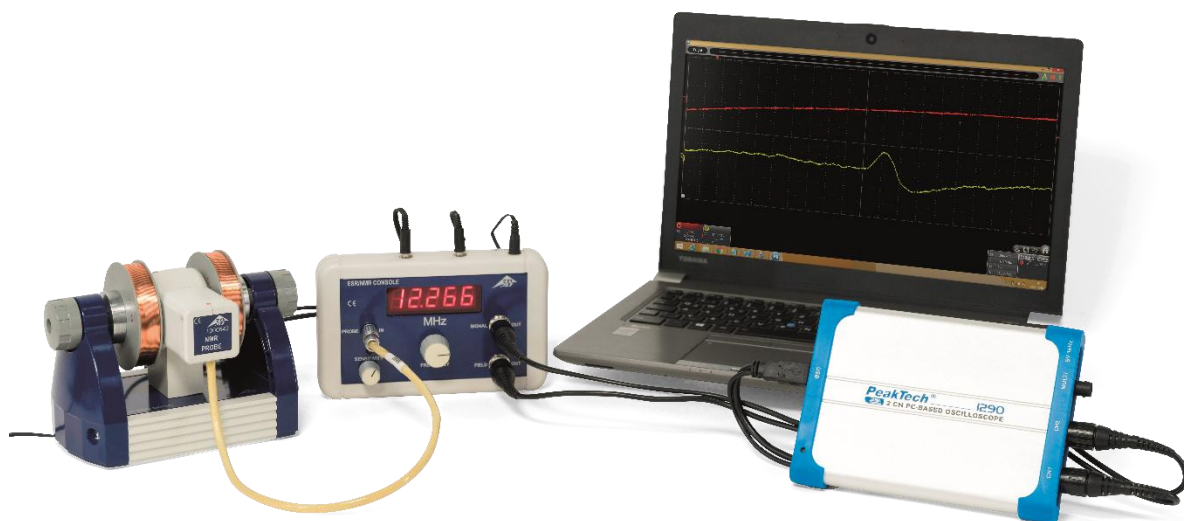


Fig. 3: Experimental setup for ESR with a PC oscilloscope

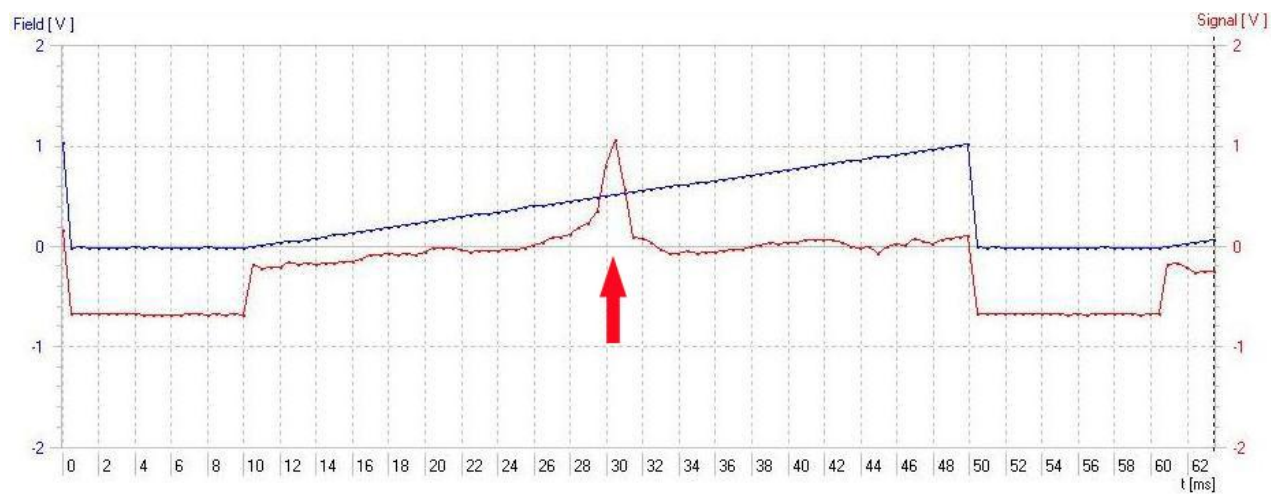


Fig. 4: Graphical display of the signal (glycerin $\nu = 12,854$ MHz)

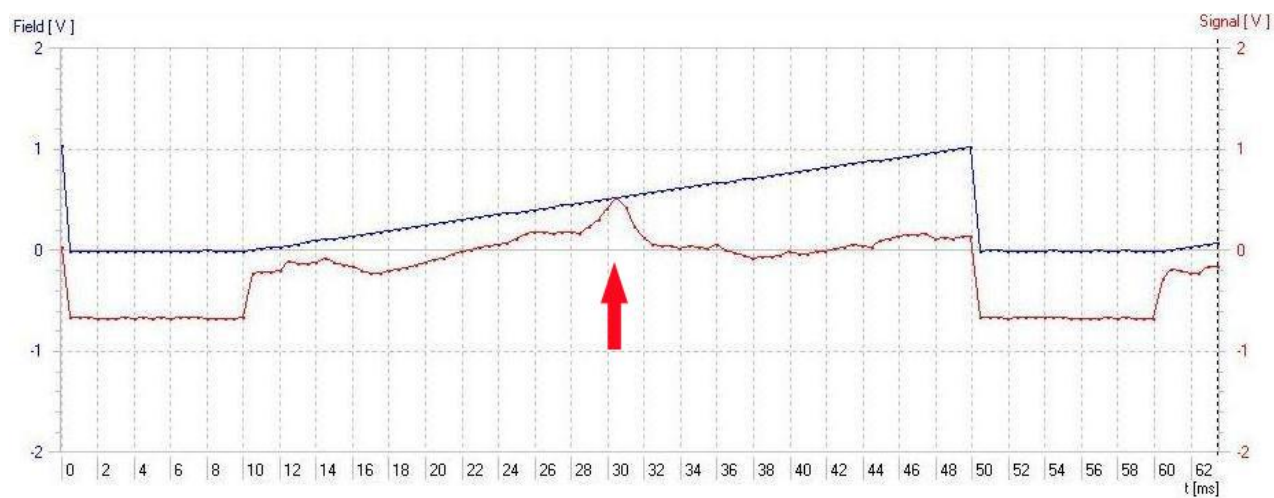


Fig. 5: Graphical display of the signal (polystyrene $\nu = 12,854$ MHz)

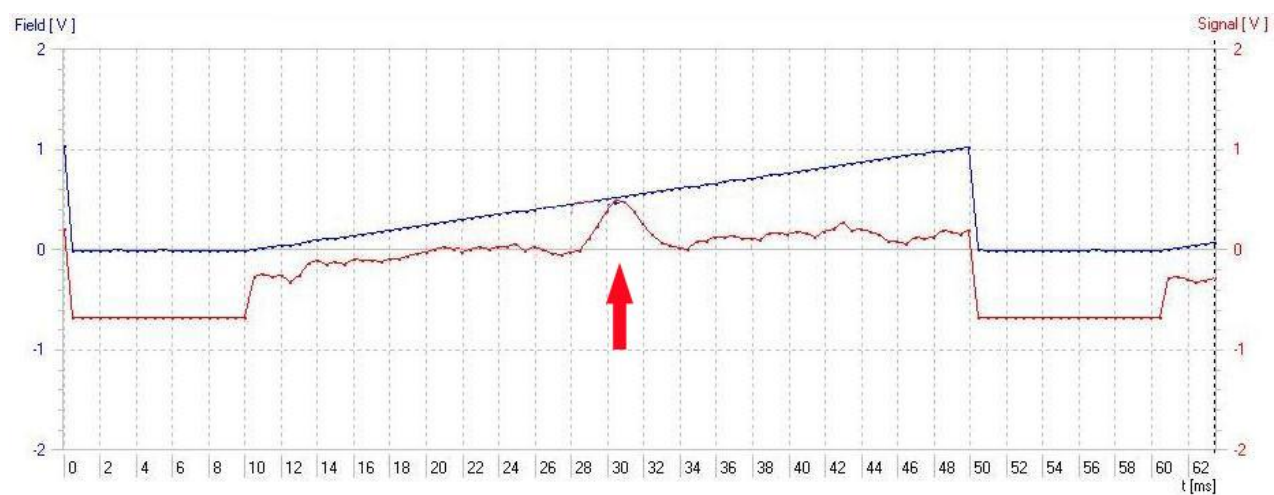


Fig. 6: Graphical display of the signal (Teflon® $\nu = 12,100$ MHz)