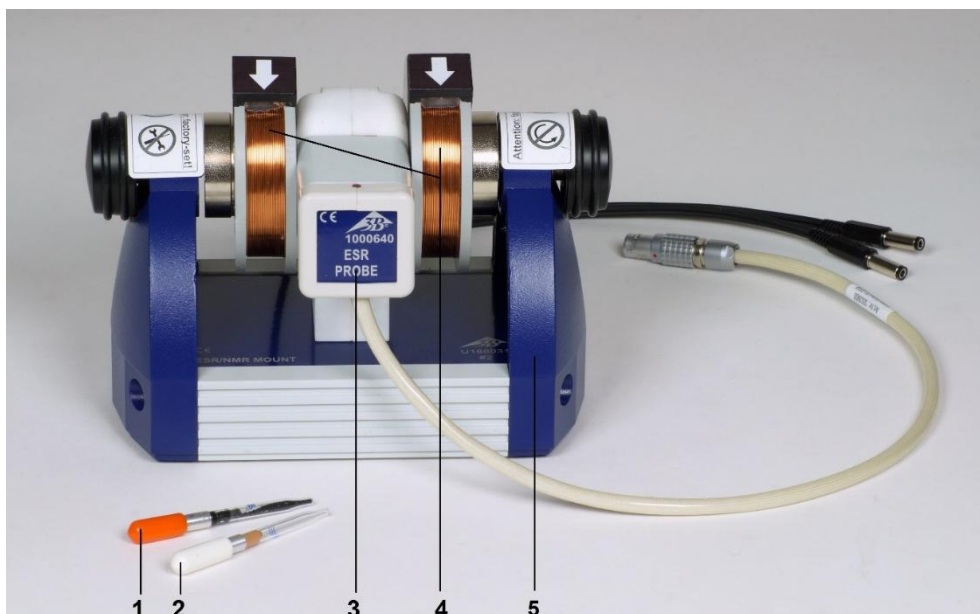


ESR Module 1022705

Product Manual

08/26 HJB



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|---|--------------------|---|---------------|
| 1 | DPPH sample | 4 | Pair of coils |
| 2 | Reference sample | 5 | Base unit |
| 3 | ESR measuring head | | |

1. Safety Instructions

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

Always handle the DPPH sample with care!

Warning:

DPPH (2,2-diphenyl-1-picrylhydrazyl) can cause an allergic skin reaction. If inhaled, it may cause allergies, asthma-like symptoms, or breathing difficulties!

2. Description

The ESR module, in conjunction with the ESR-NMR control unit (item no.: 1022700 or 1022702), is used for the investigation of electron spin resonance in DPPH.

The set consists of the factory-calibrated base unit with the pair of coils, the ESR measuring

head with RF coil, a DPPH sample, and an unfilled reference sample. A test report is supplied with each ESR module.

3. Scope of Delivery

- 1 ESR module with mounted field coils
- 1 ESR measuring head
- 1 Reference sample
- 1 DPPH sample
- 1 Test report

4. Specifications

Frequency range:	38 - 75 MHz approx.
Measuring head connection:	four-pole LEMO plugs
Sample diameter:	4.5 mm
Distance from sample inlet to center of measuring chamber:	26 mm approx.
Dimensions:	175x125x125 mm ³ approx.
Weight:	2.25 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.
- Insert the DPPH sample (orange cap) into the sample receiver (see fig. 2).

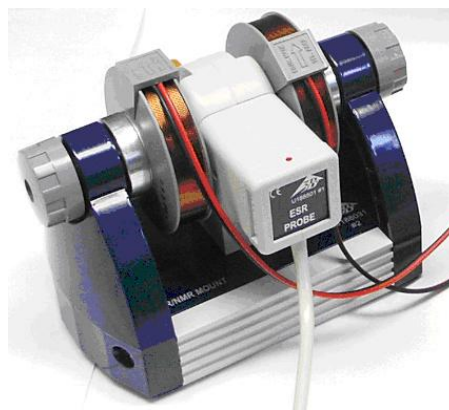


Fig. 1: Base unit with measuring head



Fig. 2: Base unit with DPPH sample inserted

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.

- Set a frequency of approx. 50 MHz on the control unit. Several turns of the frequency control may be necessary to set the frequency.
- Adjust the sensitivity so that a maximum signal appears.

At the optimal setting, a faint flicker of the LED can be observed. If the LED lights up brightly, the signal is overdriven.

- Record the coil voltage at resonance U_R and the corresponding resonance frequency ν_R .
- Read the coil voltage at resonance from the oscilloscope.
- Repeat the measurement at different frequencies (in 5 MHz steps).

6.4 Evaluation

- Calculate the magnetic field using the equation

$$B_R = 3,67 \frac{mT}{V} \cdot U_R$$

- Plot the magnetic field as a function of frequency. (see fig. 6).

The relationship between the resonance frequency ν_R and the magnetic field at resonance B_R is:

$$\nu_R = g \cdot \frac{\mu_B}{h} \cdot B_R$$

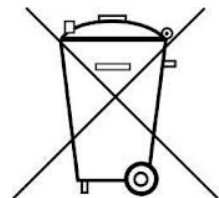
where:

$$\mu_B = 9,28 \cdot 10^{-24} \frac{J}{T}$$

$$h = 6,626 \cdot 10^{-34} Js$$

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).

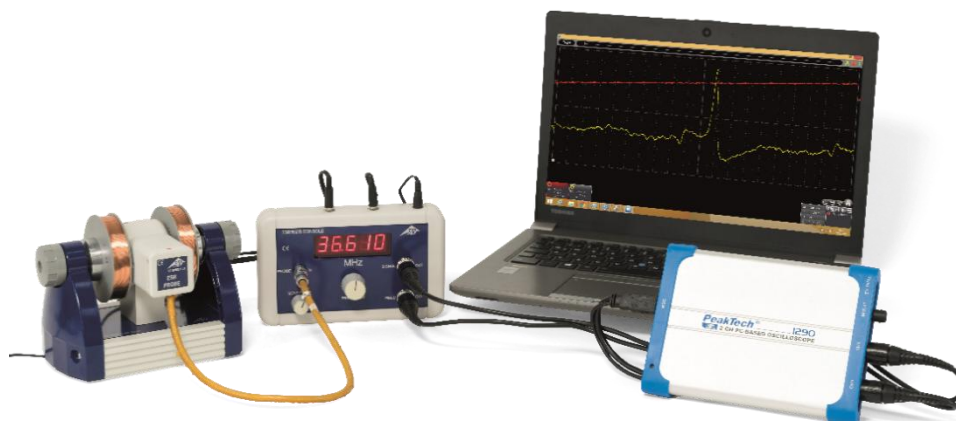


Fig. 3: Experimental setup for ESR with a PC oscilloscope

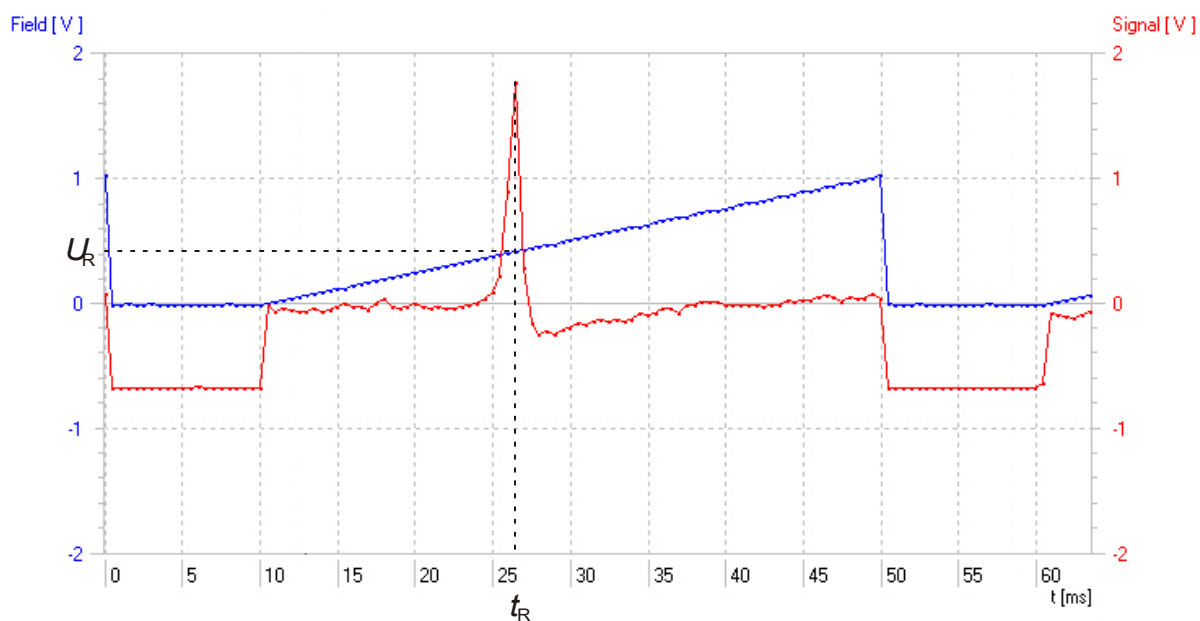


Fig. 4: Signal trace at 40 MHz (red: absorption signal as a function of time, blue: coil voltage as a function of time))

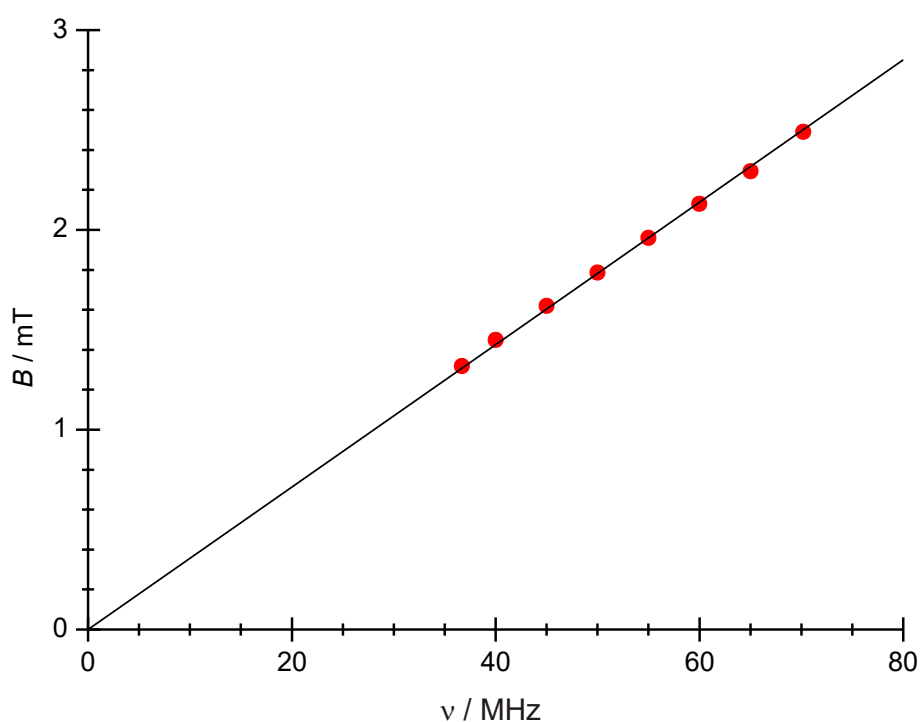


Fig. 5: Graphical display of the magnetic field as a function of frequency