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5/89 -Kr-Brs-

Instruction Sheet **514 55/56/57**

ESR Basic Unit
ESR Adapter
ESR Control Unit

The *ESR basic unit* is used in experiments on electron spin resonance, the *ESR control unit* provides all the required voltages and also digitally indicates the frequency of the oscillatory circuit

The *ESR adapter* is used in those cases where other power supply units and frequency indicators are used instead of the ESR control unit.

Measuring Principle:

A paramagnetic electron spin system — probe consisting of DIPHENYL-PICRYL-HYDRAZYL (DPPH) — placed between the coils of an r-f oscillatory circuit and applying a constant field, will absorb r-f energy thus measurably changing the impedance of the oscillatory circuit. The impedance change of the constant magnetic field as produced by the modulation can be displayed on an oscilloscope.

Examples of experiments:

- Verification of electron spin resonance
- Magnetic field as a function of resonant frequency (linearity of Zeeman interaction)
- Measurement of the gyromagnetic ratio and factor of g
- ESR line width
- Signal amplitude as a function of resonant frequency

A monograph describing experiments on electron spin resonance is in preparation.

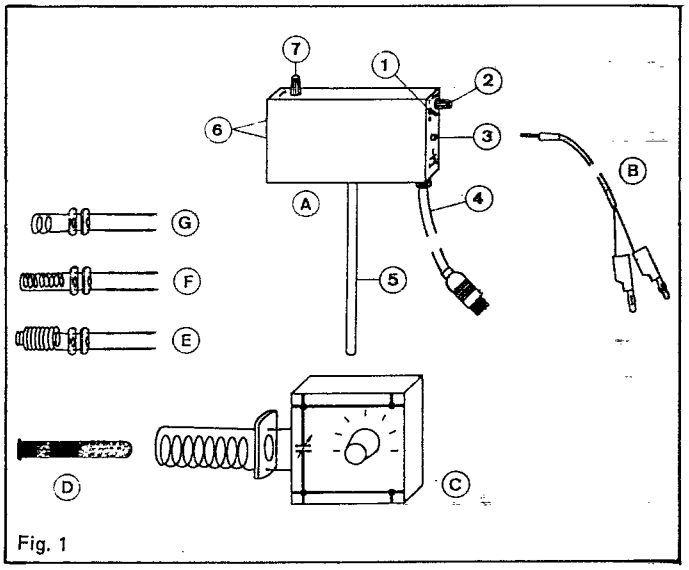


Fig. 1

Control elements:

① On/off switch
② Potentiometer for r-f amplitude adjustment
③ Socket for measuring cable Ⓑ
④ Multi-core lead for supply and signal voltages
⑤ Stand rod
⑥ Sockets for connecting the r-f plug-in coils
⑦ Variable capacitor for frequency adjustment

Technical Data:

Supply voltage and current:	±12 V/175 mA
Frequency ranges:	with plug-in coil Ⓔ: 13 to 30 MHz approx. with plug-in coil Ⓕ: 30 to 75 MHz approx. with plug-in coil Ⓖ: 75 to 130 MHz approx.
Voltage across the r-f coil: (with ref. to ground)	6 V_{pp} approx. at 13 MHz amplitude adjusted to maximum
ESR signal:	1 to 6 V approx. (depending on frequency)
Frequency divider:	1000 : 1
Frequency output for digital counter:	TTL
D. C. current (at output ③):	100 μA approx.
Test substance:	Diphenyl-Picryl-Hydrazyl (DPPH)
Frequency range of the passive resonant circuit Ⓒ:	10 to 50 MHz
Dimensions of the probe holder:	130 mm x 70 mm x 40 mm
Length of stand rod:	185 mm
Weight:	0.7 kg approx.

1 Safety

The ESR control unit can be converted for mains voltages other than 220 V a. c. (see Section 4.2).

Output Ⓑ of the ESR control unit (magnet supply) is not overload-protected! Max. current 3 A!

2 Parts, Description, Technical Data

2.1 514 55 ESR basic unit

The basic unit consists of the following parts:

Ⓐ ESR probe holder with frequency divider 1000 : 1 and signal amplifier

Ⓑ Measuring lead to use the apparatus as a resonance meter

Ⓒ Electric resonant circuit, passive (for investigating the relationship between resonant frequency and magnetic field)

Ⓓ DPPH probe

Ⓔ, Ⓕ, Ⓖ Plug-in coils for different frequency ranges

2.2 514 56 ESR adapter

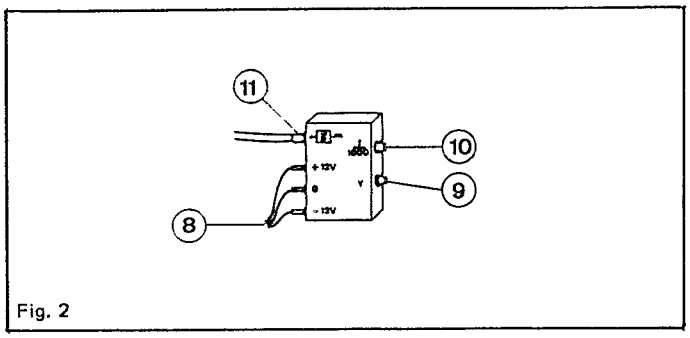


Fig. 2

Control elements:

⑧ Supply voltage connection
⑨ Signal output Y
⑩ Frequency output
⑪ Connection for the ESR basic unit (probe holder)

Technical Data:

Signal output Y:	BNC socket
Frequency output $\frac{f}{1000}$:	BNC socket
Supply voltage input +12 V, 0, −12 V:	4-mm sockets
Socket for ESR basic unit:	for 5-pin connector
Dimensions:	95 mm x 75 mm x 25 mm
Weight:	0.2 kg

2.3 514 57 ESR control unit

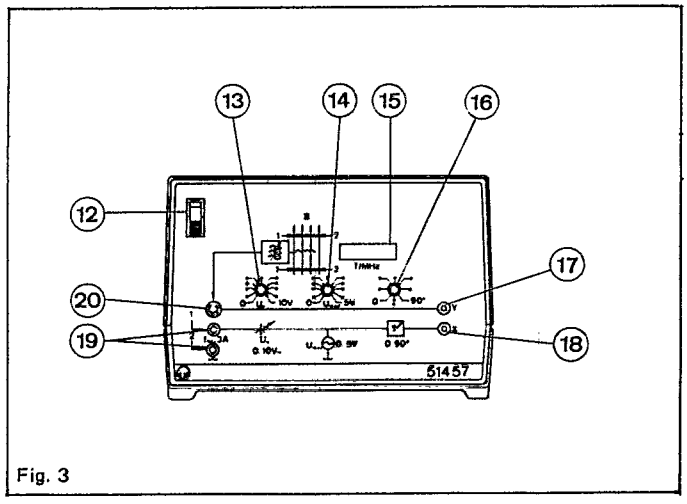


Fig. 3

Control elements:

⑫ On/off switch
⑬ D. C. voltage adjusting potentiometer
⑭ Modulation voltage adjusting potentiometer
⑮ Digital frequency indication
⑯ Phase shifter
⑰ Signal output
⑱ Modulation output
⑲ Output magnet supply
⑳ Socket for connection to the ESR basic unit (probe holder)

Technical Data:

Mains connection:	110/130/220/240 V a. c., 50/60 Hz
Primary fuse:	0.8 A (slow blow) for 220 V and 240 V (Spare Part No. 69 814) 1.6 A (slow blow) for 110 V and 130 V (Spare Part No. 69 817)
Magnetic field supply:	0 to 10 V d. c. 0 to 5 V a. c. max. current 3 A (no overload protection!)
Phase shifter:	0 to 90°
Digital frequency indication:	4 digits
Signal output:	BNC socket
Modulation output:	BNC socket
Magnet supply output:	pair of 4-mm sockets
Dimensions:	30 cm x 21 cm x 23 cm
Weight:	6.2 kg approx.

3 Experiment Assemblies, Operation

3.1 Assembly for demonstrating the operating principle of the ESR basic unit (514 55)

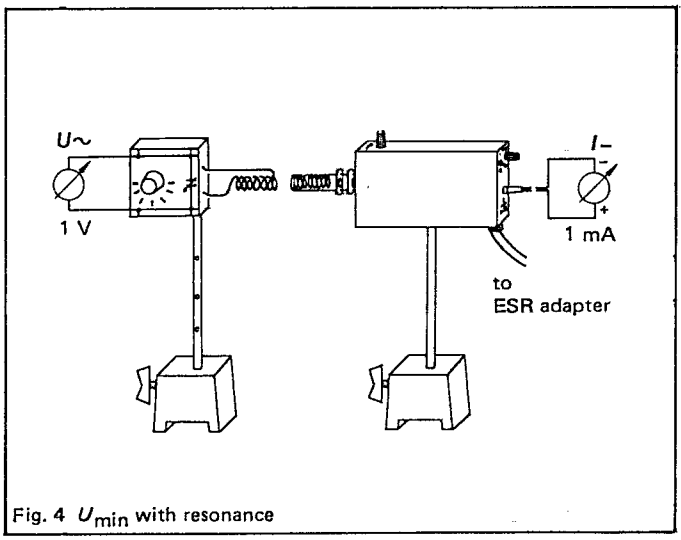
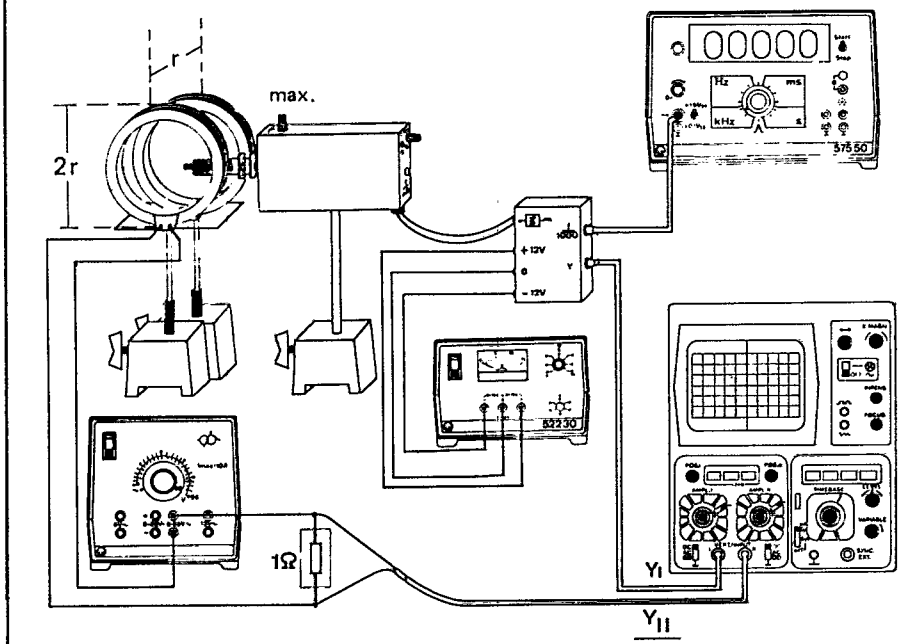
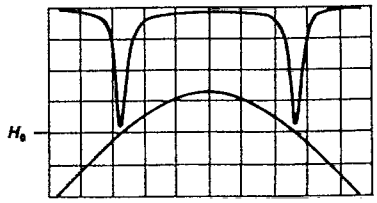


Fig. 4 U_{min} with resonance

Equipment: *Cat. No.*

1 ESR basic unit (probe holder)	514 55
1 Perforated stand rod	590 13
2 Saddle bases	300 11
1 D. C. power supply, stabilized	522 30
1 ESR adapter	514 56
or instead of (522 20) and (514 56):	
1 ESR control unit	514 57
1 Voltmeter, range 1 V a. c.	
1 Ammeter, range: 1 mA d. c.	
e. g. E measuring instruments D	531 88





Y_I: AC; 0,5 $\frac{V}{cm}$

Y_{II}: AC; 0,5 $\frac{V}{ms}$

TIMEBASE: 1 $\frac{ms}{cm}$

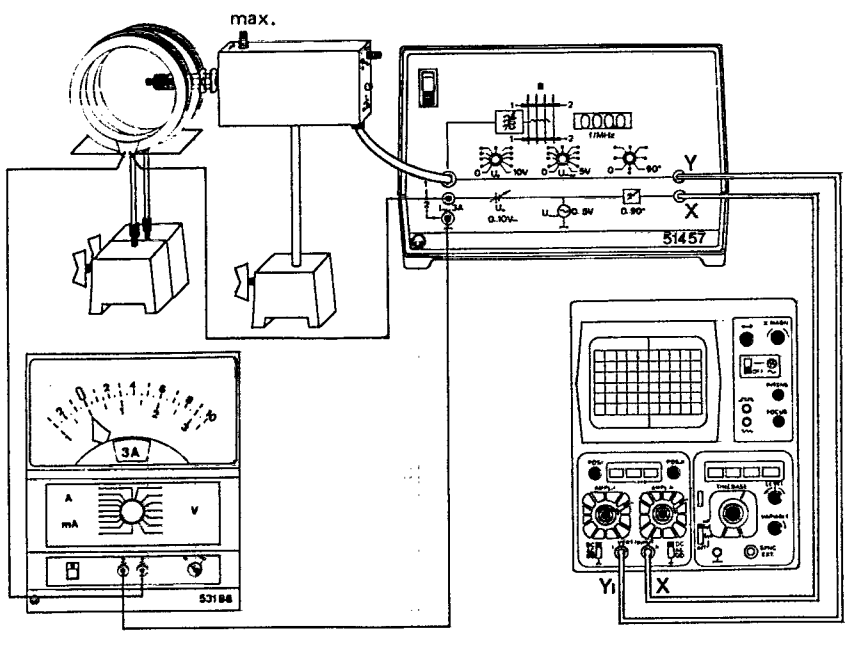
TRIGGER: II or LINE

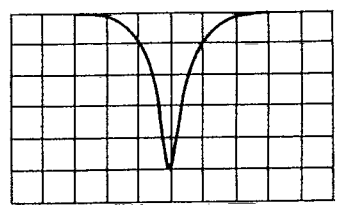
Fig. 5 Experiment assembly for electron spin resonance, with adapter

3.2 Assembly for demonstrating electron spin resonance

Equipment:	*Cat. No.*
1 ESR basic unit (probe holder)	514 55
1 Pair of Helmholtz coils	555 06
3 Saddle bases	300 11
1 Two-channel oscilloscope, e. g.	575 20
Power supply options:	
a) 1 ESR control unit	514 57
and	
1 Ammeter, range: 3 A, e. g.	
E measuring instrument D	531 88
or	
b) 1 ESR adapter	514 56
1 Measuring resistor, 1 Ω	536 10
1 D. C. power supply unit, regulated	522 30
1 Low-voltage transformer SE	522 20
or	
Low-voltage transformer S	591 09
1 Digital counter	575 50
or	
Counter P	575 45
and stop-clock, e. g.	313 05

Fig. 6 Assembly for electron spin resonance, with the ESR control unit





HOR. EXT.

Y_I: AC; 0,5 $\frac{V}{cm}$

X: AC; 2 $\frac{V}{cm}$

4 Exchanging the Primary Fuse, Mains Voltage Conversion

4.1 Changing the primary fuse on the ESR control unit (514 57)

- Take out insert ⓐ (with holder for primary fuse ⓑ and replacement fuse ⓒ) using a suitable screw-driver – refer to Fig. 7.1.
- Replace the blown fuse ⓑ by the new fuse ⓒ (check rating) –refer to Fig. 7.2.
- Insert replacement fuse ⓒ and then insert the fuse holder ⓐ back into the unit.

4.2 Converting equipment to mains frequencies other than 220 V a. c.

Note! First disconnect from the mains!

- Use a cross-head screw-driver (size 2) to loosen screws ⓓ on the bottom of the unit (Fig. 8.1).
- Place the unit in the normal position and remove upper part ⓔ (Fig. 8.2).
- Remove p. c. board ⓖ from the blue socket ⓕ at the transformer (Fig. 8.3).
- Position the p. c. board ⓖ so that the imprint of the intended mains voltage, e. g. 110 V a. c., appears above the '1' on the plug-in socket ⓕ (bottom left-hand corner) (Fig. 8.4).
- Insert p. c. board ⓖ and reassemble the casing.
- Change the primary fuse to adapt to the changed mains voltage (see Technical Data).

  Changing of the primary fuse is described in Section 4.1 (Figs. 7.1 and 7.2).

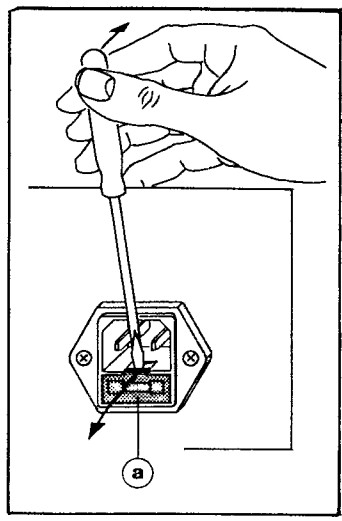


Fig. 7.1

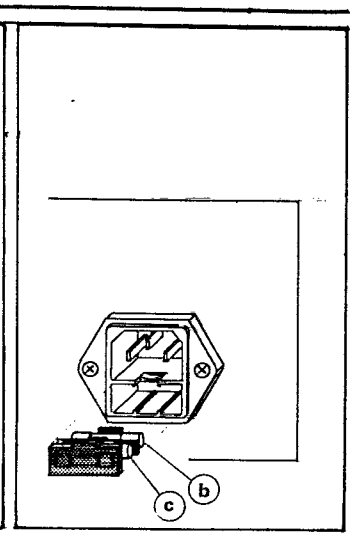


Fig. 7.2

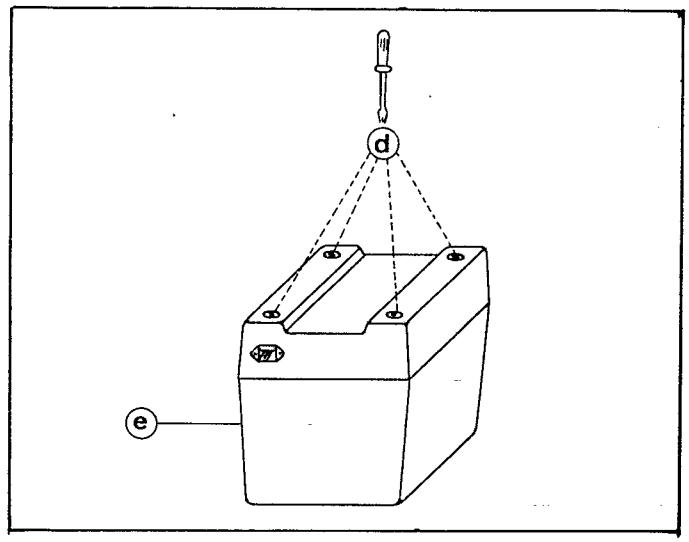


Fig. 8.1 ▲

Fig. 8.2 ▼

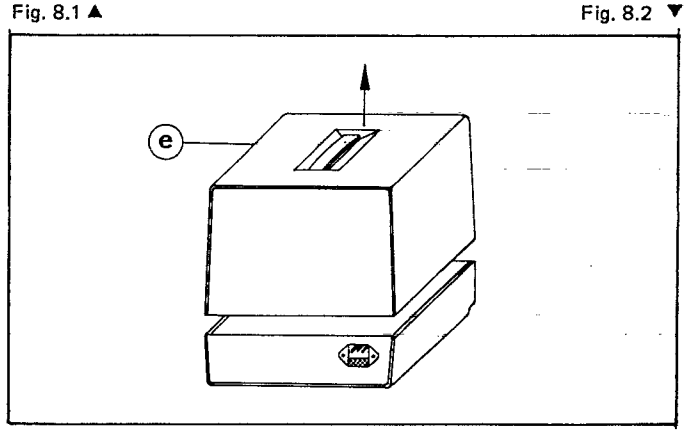
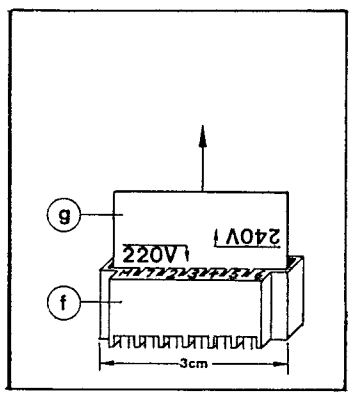
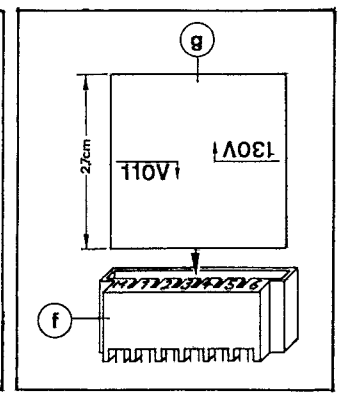


Fig. 8.3 ▼

Fig. 8.4 ▼





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Printed in the Federal Republik of Germany