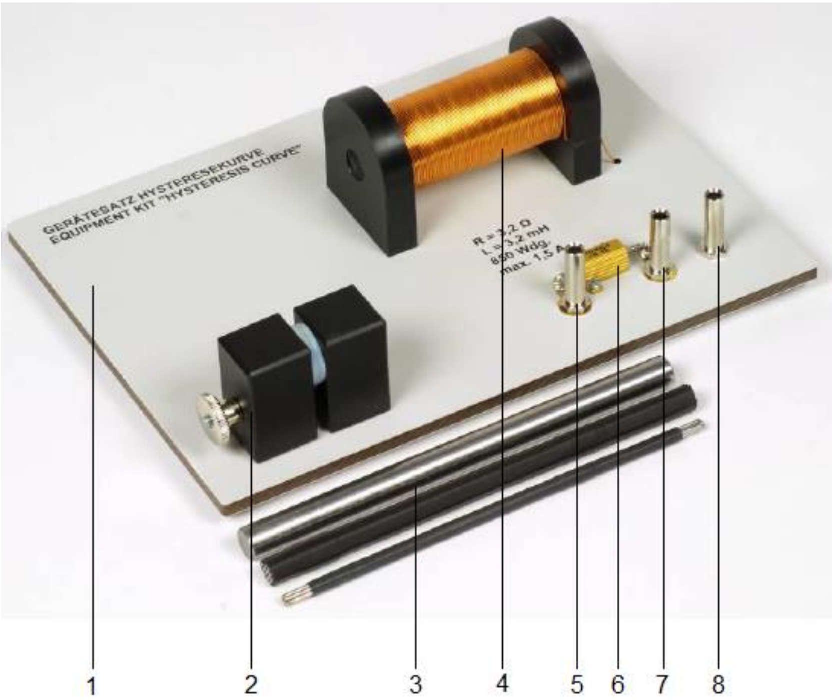
# Hysteresis curve equipment set 1018889

## Instruction manual

07/15 MH/ALF




1 Base plate
2 Holder for Hall sensor
3 Samples of iron
4 Coil
5/8 4-mm sockets for connecting function generator
6 Measurement resistor
7 4-mm ground socket for connecting oscilloscope

## 1. Safety instructions

Safe operation of this equipment is guaranteed as long as it is used as stipulated. Safety cannot be guaranteed, however, if the equipment is used incorrectly or carelessly.

If there is a suspicion that it is no longer possible to operate the equipment safely (e.g. visible damage, live components exposed to contact), the equipment is to be taken out of action immediately.

- Caution: In order to prevent the coil from getting damaged due to overheating, do not exceed the maximum current consumption of 1.5 A DC.
- The equipment may only be used in dry rooms.

## 2. Description

This equipment set is designed for recording hysteresis curves (magnetic flux density B as a function of magnetic field strength H) in cores made of various ferro-magnetic materials.

The equipment set consists of a cylindrical coil with 850 windings mounted on a base plate. Three different samples of iron can be used as a core for the coil. A holder on the base plate is designed to accommodate a field sensor. 4-mm sockets are provided for connection of a function generator and an oscilloscope. A resistor for taking measurements is connected in series with the coil.

**Equipment:**

1 Base plate with coil and holder for Hall sensors

3 Material samples

## 3. Technical data

| | |
|---|---|
| Number of windings: | 850 |
| Diameter of wire | 0.65 mm |
| Internal resistance: | 3.2 Ω |
| Inductance without core: | 3.2 mH |
| Current consumption: | max. 1.5 A DC |
| Dimensions: | 200 x 145 x 60 mm |
| Total weight: | 470 g approx. |
| Iron samples: | 140 mm x 10 mm diam. approx. |
| Material: | Silver steel, spring steel, Vacon 11 |

## 4. Operation

In order to record hysteresis curves, the following equipment is additionally required:

| | |
|---|---|
| 1 Magnetic Field Sensor, Axial/Tangential | 1001040 |
| 1 Teslameter E | 1008537 |
| alternativly | |
| 1 Magnetic Field Sensor100 mT | 1000558 |
| 1 3B Net*log*™ @230 V | 1000540 |
| or | |
| 1 3B Net*log*™ @115 V | 1000539 |
| 2 HF Patch Cord, BNC/4 mm Plug | 1002748 |
| Safety Experiment Leads | |

A. Dynamic measurement:

| | |
|---|---|
| 1 Analogue Oscilloscope2x30 MHz | 1002727 |
| 1 Function Generator FG 100 @230 V | 1009957 |
| or | |
| 1 Function Generator FG100 @115 V | 1001036 |
| 1 Digital Multimeter E | 1006809 |

B. Static measurement

| | |
|---|---|
| 1 DC Power Supply 20 V, 5 A @230 V | 1003312 |
| or | |
| 1 DC Power Supply 20 V, 5 A @115 V | 1003311 |

### 4.1 Recording of hysteresis curve with an oscilloscope (dynamic measurement)

- Connect up the function generator, coil, ammeter, teslameter or 3B Net*log* and oscilloscope as shown in Fig. 1 and Fig. 2.
- Insert the core into the coil.
- Attach the field sensor into the holder in such a way that the tangential sensor is next to the middle of the iron sample. The iron probe must always be adjacent to the tangential sensor, otherwise the results of the measurement will be skewed.
- Turn on the function generator and set the frequency to anything between 30 and 50 Hz. Slowly increase the coil current using the 100x amplitude knob on the function generator until the magnetic field density $B$ reaches saturation. The coil current must not exceed its maximum of 1.5 A.
- Observe the results on the oscilloscope screen.
- Repeat the experiment with different samples of iron.

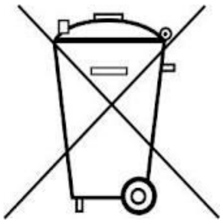
### 4.2 Manual recording of hysteresis curve (static measurement)

- Connect up the power supply, coil, teslameter or 3B Net*log* as shown in Fig. 3 and Fig. 4.
- Insert the core into the coil.
- Attach the field sensor into the holder in such a way that the tangential sensor is next to the middle of the iron sample. The iron probe must always be adjacent to the tangential sensor, otherwise the results of the measurement will be skewed.
- Turn on the power supply and set it to 0 V. Calibrate the teslameter to 0 (by reversing the polarity of the supply voltage as necessary and not by using the offset knob).
- Increase the coil current in suitable steps up to a maximum of 1.5 A and afterwards turn it back down to 0 amps. Write down the current and the corresponding magnetic flux density at each step. Change the polarity of the power supply and do the experiment again. *Note: the magnetic flux density remains non-zero after the coil current has been turned back down.*
- Work out the magnetic field strength $H$ from the current in the coil $I$, the number of windings $n$ and the length of the coil $s$.
  $H = n*I/s$
- Plot how the magnetic flux density depends on the magnetic field strength on a graph.
- Repeat the experiment with different samples of iron.

## 5. Storage, cleaning and disposal

- Keep the equipment in a clean, dry and dust-free place.
- Before cleaning the equipment, disconnect it from its power supply.
- Do not clean the unit with volatile solvents or abrasive cleaners.
- Use a soft, damp cloth to clean it.

- 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.



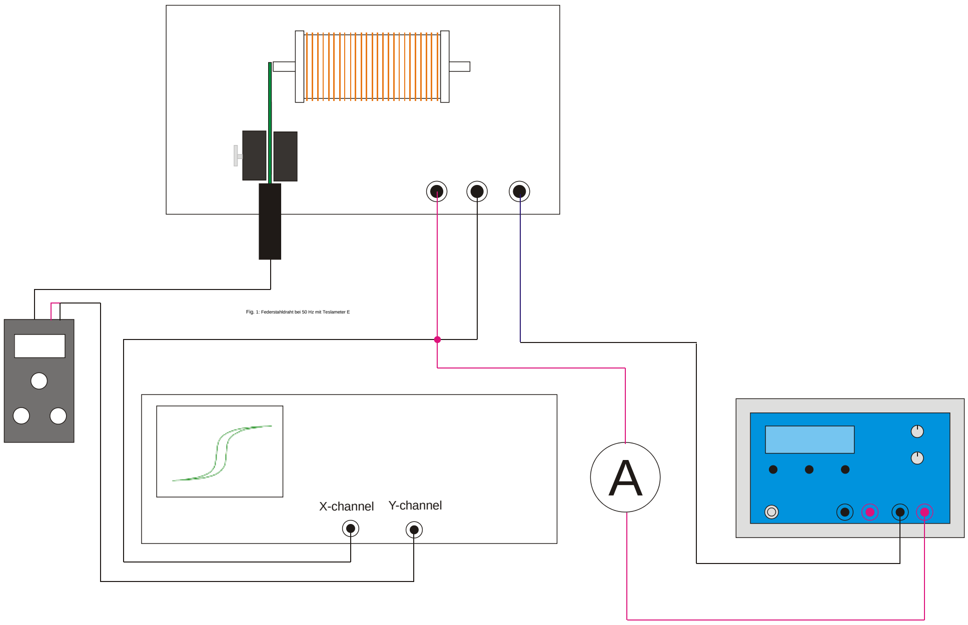



Fig. 1: Experiment set-up with teslameter E

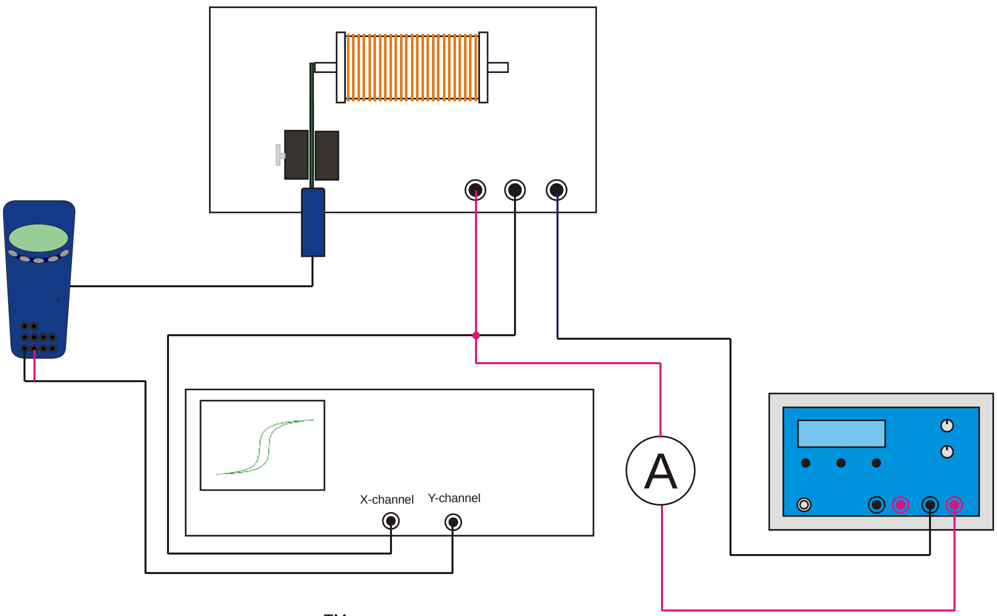



Fig. 2: Experiment set-up with 3B Net*log*™

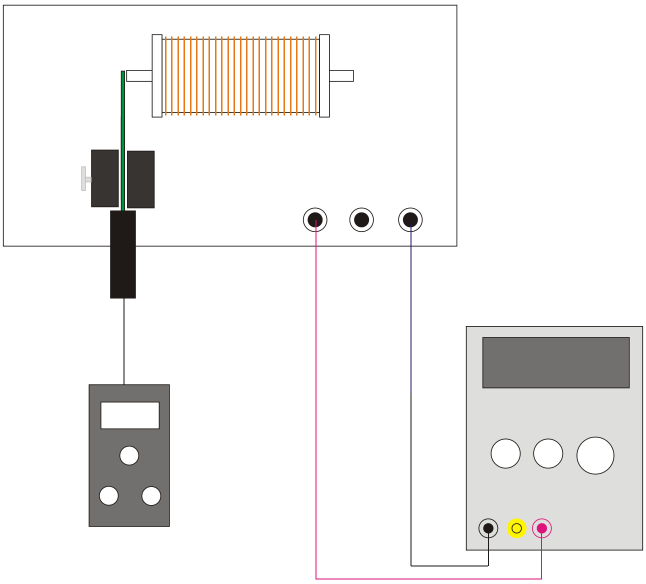


Fig. 3: Manual recording of hysteresis curve with teslameter E

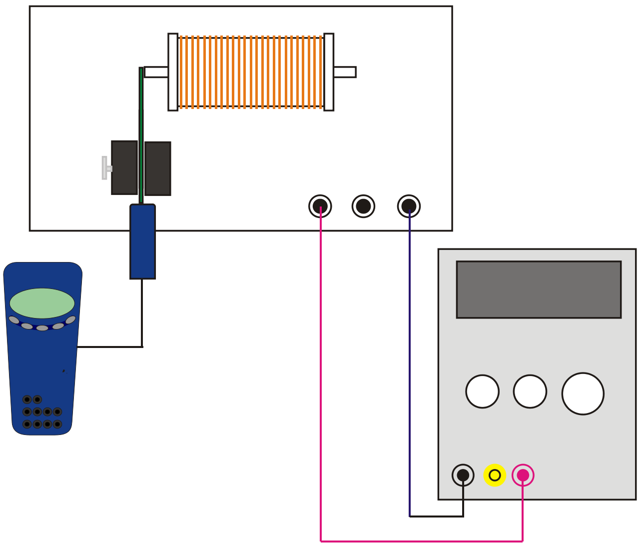


Fig. 4: Manual recording of hysteresis curve with 3B Net*log*™

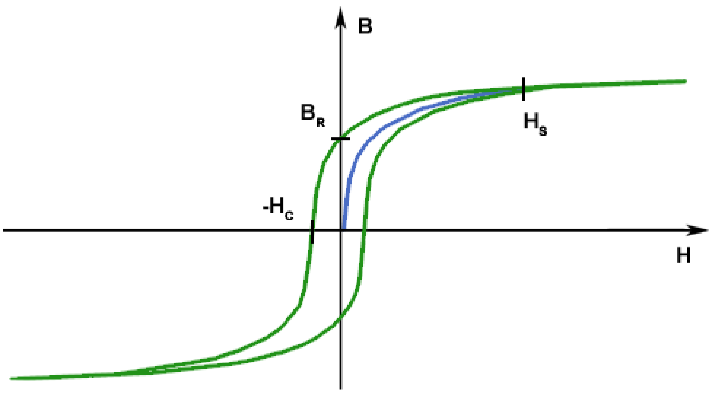



Fig. 5: Example of a hysteresis curve