

REMACOMP[®] C

for computer controlled measurement
of the dynamic characteristics
of soft magnetic materials



● Introduction

The REMACOMP[®] C is a fully automatic, computer controlled measuring system to determine the dynamic magnetic properties (AC) of soft magnetic material. The characteristic properties are core losses, remanence, coercivity and permeability.

Most components of the REMACOMP[®] C except the power amplifier are integrated in the system computer. This minimizes the external cable connections. The output values of the external power amplifier can be adapted to the specific requirements within a wide range. The instrument covers a frequency range from 10 Hz up to 10 kHz or 300 kHz, dependent on the components of the specific model.

Typical specimen shapes are for example tape-wound cores and C-cores. These shapes are characterized by a closed magnetic path which means that a closure yoke is not necessary. The samples must be provided with a primary and secondary winding for testing.

The magnetic field strength H is calculated from the current in the primary winding. This is realized by measuring the voltage drop across a measuring resistor of low inductance in series with this winding.

The flux density B is determined by numerical integration of the voltage induced in the secondary winding.

The course in time of these voltages is recorded oscillographically and is scanned by two fast analog-digital converters (ADC). From the data of one period the hysteresis loop and the characteristic values like core losses, remanence, coercivity and permeability are calculated.

The result (measuring curve) automatically appears in scaled form on the monitor. Besides the hysteresis loop, the course in time of field strength and flux density can also be displayed.

Digital display of the results on the visual display unit excludes reading errors. The graphic display obviates the need for time-consuming evaluation and conversion of data.

The application of digital signal processing techniques throughout is reflected in the high degree of accuracy, ease of operation, short measuring time and good documentation. The equipment is therefore suitable for use in the laboratory, quality control for both incoming and outgoing goods.

The measuring system corresponds to the International Standard IEC 60404-6 (Digital Method).



• Measuring Method

Depending on the specific type of equipment of the REMACOMP[®] C the following measuring methods are possible :

Measurement of specimen with closed magnetic path like ring samples by windings applied to the specimen.

Measurement of specimen in open circuits by using an open field coil with measuring coil (surrounding coil).

• Specimen, general information

The REMACOMP[®] C allows to measure a variety of different materials with different magnetic properties, for example:

- Soft magnetic steel
- Magnetic sheets
- Ferrous alloys
- Soft magnetic ferrites
- Crystalline NiFe compounds
- Amorphous material and nanocrystalline alloys

No general data of an ideal geometric shape can be given because these data depend on the specific test and hardware conditions as frequency, the type of power amplifier, the number of turns of the windings and the magnetic properties of the specimen itself.

The maximum field strength depends on the specific output values of the power amplifier and the number of turns of the primary winding. For ring shaped samples, the amplitude of the magnetic field strength normally should not exceed 10 kA/m in order to avoid heating of the specimen during testing.

Nevertheless, some data for a typical geometry of ring specimen can be given:

Cross-sectional area	100 mm ² – 500 mm ²
Relation between outer (\varnothing_a) and inner diameter (\varnothing_i)	$\varnothing_a / \varnothing_i \leq 1,1$ for steel and $\varnothing_a / \varnothing_i \leq 1,4$ for sintered specimen

For comparative measurements, test specimen with the following dimensions of outer diameter \varnothing_a , inner diameter \varnothing_i and height H are preferred:

- $\varnothing_a = 55$ mm,
- $\varnothing_i = 45$ mm,
- H = 5 mm.

• Product Family

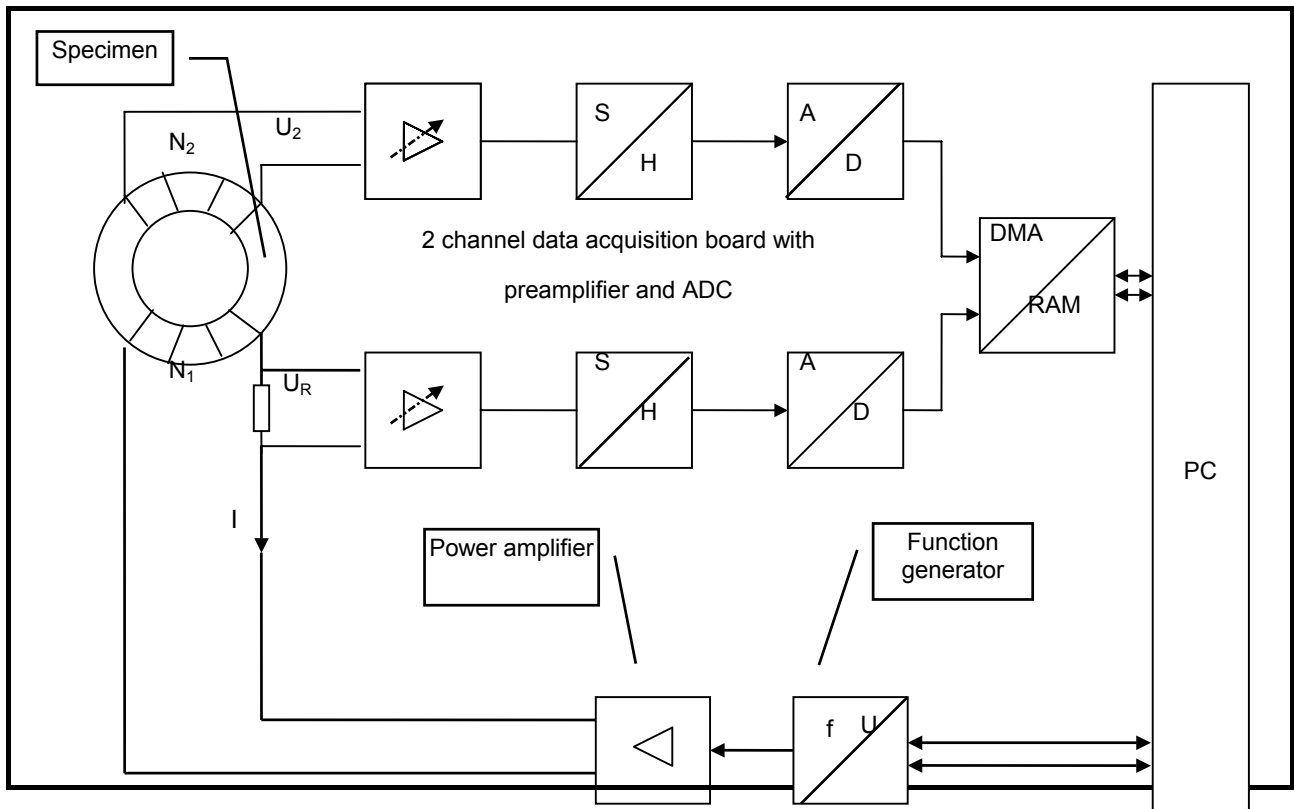
Two main models of the REMACOMP[®] C are available. They differ mainly in the frequency range.

Technical data of the components and extensions will follow on the next pages.

REMACOMP [®] C 200 10 kHz		REMACOMP [®] C 100	
Frequency range	: 10 Hz ... 10 kHz	Frequency range	: 10 Hz ... 300 kHz
ADC resolution	: 12 Bit	ADC resolution	: 12 Bit
Power amplifier	: 200 VA	Power amplifier	: 100 VA

Power amplifiers with different output values are available as option.
These values depend on the samples to be measured.

The block diagram shows the main components of the REMACOMP[®] C with a ring shaped test specimen supplied with a primary and a secondary winding. The frequency, amplitude and waveform of the excitation will be adjusted at the function generator. The output of the function generator is fed to the power amplifier. The primary winding consisting of N_1 turns is connected at the output of the power amplifier, in series with the measuring resistor R . The magnetizing current flows through this winding and the resistor. The voltage drop $U_R = R \cdot I$ across the measuring resistor is directly proportional to the magnetic field strength H . The voltage U_2 induced in the secondary winding is a measure of the flux variation $d\Phi / dt$. The flux density is obtained from the secondary voltage by numerical integration. Both voltages U_R and U_2 are sampled synchronous by two fast ADC. The resulting data are stored in the PC for further processing.



In addition, the measurement data stored in the computer can also be used for other purposes, e.g. statistical analysis of quality control of incoming or outgoing goods.

The REMACOMP[®] is easy to use, in interactive mode between visual display unit and computer. Once the required parameters have been set, the push of a button is all that is needed to set the fully automatic measurement process in motion.

The application of an external power amplifier offers the possibility to adapt the system excellent to different measurement purposes.

The following values will be measured :

- REMANENCE
- COERCIVITY
- CORE LOSSES
- PERMEABILITY
- MAXIMUM FIELD STRENGTH
- MAXIMUM FLUX DENSITY



Reg. No. 004201 QM



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www.magnet-physik.de

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• Technical Data

		REMACOMP® C 200 10 kHz	REMACOMP® C 100
Function generator PC board	Resolution Output voltage Waveform, max. frequency/Rate	16 bit ± 10 V arbitrary up to 4 MS/s	12 bit ± 5 V sine, up to 16 MHz rectangle, triangle, ramp each up to 1 MHz
Analog-Digital-Converter (ADC) PC board	Number of inputs Resolution Input voltage (full scale) Maximum input voltage Uncertainty Maximum sampling rate	2 12 bit ± 0,2 to ± 42 V ± 50 V up to 10 V: 0,2 % of range > 10 V: 0,7 % of range 5 MS/s	2 12 bit ± 0,2 to ± 5 V, with extension up to ± 50 V ± 50 V typical: 0,2 % of range maximal: 0,4 % of range 30 MS/s
Power amplifier 4-quadrant operation Current / voltage source	Current Voltage Power Bandwidth Operating modes Voltage amplifier Current amplifier	± 2 to ± 20 A ± 20 to ± 100 V 200 VA DC to 10 ... 20 kHz (model dependent) Yes Yes	± 1,5 to ± 15 A ± 40 to ± 120 V min. 120 VA DC to 750 kHz Yes No
Measuring resistance	Value (depends on specific power amplifier) Tolerance Maximum burden	0,1 - 1 Ω 0,1 % 10 W	0,1 - 1 Ω 0,1 % 10 W
Others / special features	Offset adjustment direct / inductive coupling Regulation B(t) sinusoidal H(t) sinusoidal	Switchable Yes Yes	Switchable No No



• Description of Hard- and Software

COMP 6.0 Software for the REMACOMP[®] C

The magnetic field strength is controlled by the PC via the function generator board. A regulation of the waveform is possible for some models. Other parameters of a measurement are controlled by software. The values of the voltages required for the calculation of the field strength and flux density are sampled by two fast synchronous ADC. When the desired excitation level is reached, the hysteresis loop will be displayed on the computer screen.

A feature, which facilitates work considerably, is the possibility to store the set sample and measuring parameters. Thus in the case of new measurements only a few new inputs must be made.

This is especially useful for measurement sequences on similar probes. The necessary adjustments must be set only once. For successive measurements, the final settings of the last measurement are taken as the new start settings.

The measured results and curves are outputted on the monitor, printer or in a results file, which can then be further processed by programs such as Excel etc. This enables a statistical treatment, e.g. of series measurements, over a longer period of time to be carried out.

Software Features

- User friendly, menu driven operation
- Context sensitive help
- Saving of measuring data and parameters
- Automatic saving of results (e.g. under a test number)
- Calculation of results
- Print preview
- Output of measuring results and curves on a printer
- Output of measuring results and curves via the Windows clipboard
- Output of measuring results in files
- Various possibilities for customer specific output design
- Display of permeability curve and/or normal magnetization curve, for permeability measurements
- Display of hysteresis loop and/or the course in time of H and B, for hysteresis measurements
- Display of up to 5 curves in one diagram with results
- Language separately selectable for program menus and output (english, german)
- Microsoft Windows 9x/2000 compatible

• Parameters

- Default parameters minimize the number of necessary inputs
- Calculation of the cross-sectional area of rings
- Calculation of the magnetic path length of rings
- Extensive data sets including data of geometry for C-cores



● Measurement

- Complete hysteresis loop with setting of the desired excitation level for field strength or flux density
- Normal magnetization curve with setting of the desired excitation level for field strength or flux density
- Regulation towards a form factor corresponding to that of a sinusoidal waveform for field strength or flux density (only 10 kHz model)
- Automatic or manual control of hardware components
- Option for smoothing by averaging

● Evaluation

General

- Maximum field strength and flux density
- Amplitude permeability, either as relative Permeability or inductance factor (A_L value)
- Output of sample and measurement parameters and calculated results in ASCII files
- Possibility of considering the influence of an air gap (sheared hysteresis loop)
- Possibility of considering a temperature coefficient

Hysteresis measurements

- Remanence
- Coercivity
- Loss, specific total loss or total power loss in the corresponding units: W/m^3 , W , W/kg
- Form factor of field strength or flux density
- Table of $B(H)$, where H are user defined field strengths. The values of H can be stored.

Permeability measurements

- Maximum relative permeability and corresponding field strength
- Static relative Permeability
- Table of $\mu_r(H)$, where H are user defined field strengths. The values of H can be stored.

● Units

- Full support of SI and CGS units in software and output
- Change of unit system possible at any time
- Simultaneous display of SI and CGS units on diagram axis



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CONTROL UNIT

The computer hardware is included in the REMACOMP[®] C

For the set-up of an automatic measuring system and smooth installation of the before mentioned software a computer with the following minimum properties is required:

- | | | |
|--|---|---|
| <ul style="list-style-type: none">▪ Computer with one or three free PCI slots (dependent on the model)▪ Floppy disk drive 3½ ", 1,44 MB▪ Hard disk drive▪ RAM, min. 32 MB | <ul style="list-style-type: none">▪ Graphics monitor, VGA Resolution min. 800 x 600▪ Graphics card, VGA mode Resolution min. 800 x 600 | <ul style="list-style-type: none">▪ Keyboard AT, international▪ Mouse▪ WINDOWS (aktuelle Version)▪ Color Ink printer (current model) |
|--|---|---|

The computer cannot be provided by the customer and has to be configured by MPS.

ATTENTION ! We can guarantee a smooth operation only if no other software except the programs installed by us is installed on the computer.

● Additional Accessories

▪ Coil system MC-REMACOMP

For the measurement of the polarization of soft magnetic material of stripes or cylindrical shape. The coil system consists of an open field coil and a measuring coil (surrounding coil). The sheared hysteresis loop is measured.

The coil design is made according to the customers specification.

▪ Measuring yoke MJ-REMACOMP

Closure yoke with low core losses. The yoke is used in combination with the coil system MC-REMACOMP in order to close the magnetic path. Suitable for the measurement of magnetic stripes.

The yoke design is made according to the customers specification.

● Services

Taking into operation and training

- in our premises -

in the operation of the computer controlled REMACOMP[®] C and its software.

The training will take 1 day and is free of charge.

The customer has to bear all costs in connection with the journey, the stay in Germany, accommodation, food, etc.

Taking into operation and training

- at customer's works -

in the operation of the computer controlled REMACOMP[®] C and its software.

The training will take 1 day and is liable for the costs.

Additionally the customer has to bear all costs for our engineer in connection with the journey (including expenses for travelling hours), the stay, accommodation, food, etc.



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At least we take the liberty to draw your attention to our gratis booklet

MAGNETIC MEASURING TECHNIQUES

by Dr. E. Steingroever

and

Dr. Gunnar Ross

in which you can find more information in connection with the computer controlled REMACOMP® C.

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