ECKEL

DFM 1
DFM 2
Digital Fluxmeters

Operating manual

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1. General description of the unit

The DFM 1 is a digital integrating fluxmeter for industrial use. It has been designed especially for the testing of larger magnets in industrial production. The DFM 1 includes all necessary features for fully automatic quality control and sorting. Due to its high accuracy it is suitable for manual laboratory measurements too, if the magnets have a minimum flux of 100 µVs.

The DFM 1 fluxmeter takes a high accuracy integrating DC flux measurement, independent of the resistance of the measurement coil.

Reset and hold are remote controllable. The result is compared with adjustable upper and lower limits and sets one of three relays.

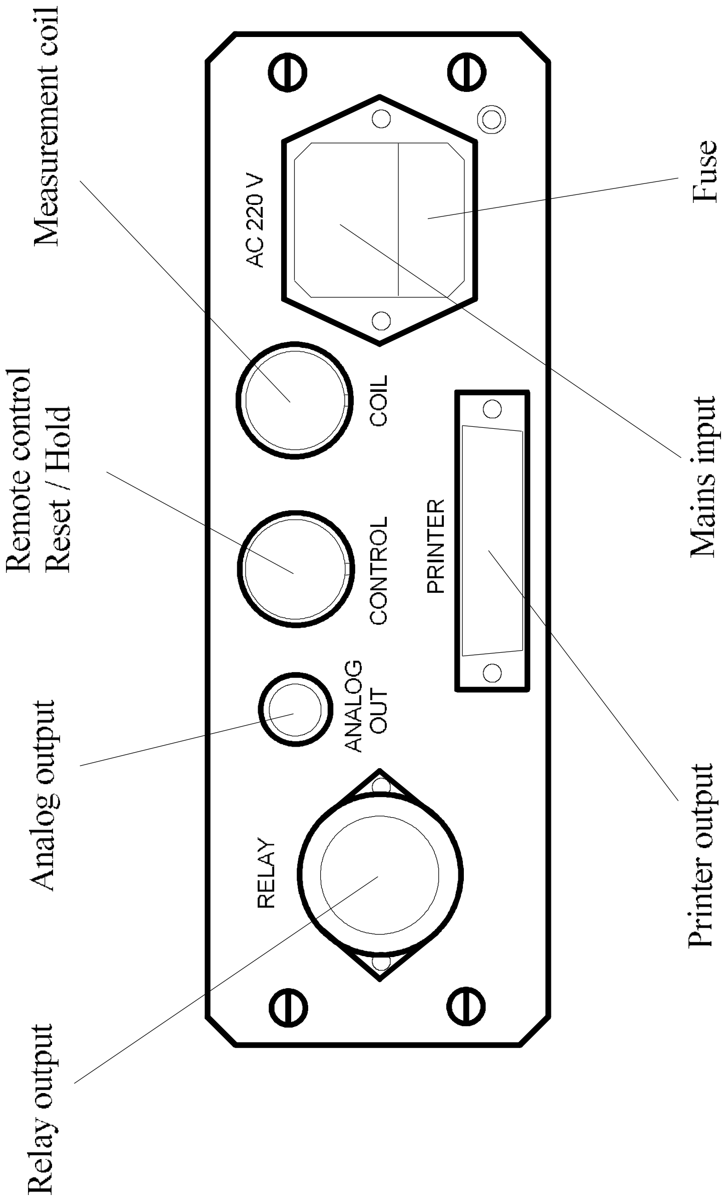
Through the combination of microcontroller and internal voltage reference the DFM 1 operates without requiring additional maintenance. Real digital software controlled integration allows fully automatic internal calibration and drift compensation.

The DFM 1 has an analog output for a standard plotter or an oscilloscope and a printer parallel interface for a standard line printer.

The DFM 2 for laboratory applications has been developed for measuring also considerably smaller magnets, but the basic equipment is identical to that of the DFM 1.
At a maximum resolution of 1 nVs even the smallest magnets can be measured without drift.

For measurements of very small magnets, an electromagnetic low-interference measuring location is absolutely vital.

Rear view of DFM 1



2. Connections on the rear of the unit

Mains connection:

The mains connection is an integral plug for a non-heating appliance up to 65 °C in accordance with IEC 320. At the end of the mains cable is the suitable non-heating connector.

The mains voltage is 220 - 240 V. The mains frequency is 50 or 60 Hz. If desired the DFM will be produced for 110 - 120 V.
The fuse holder is integrated into the mains plug. If the mains cable is not inserted, the fuse holder can be pulled out. It contains two 5 x 20 mm fuses in accordance with IEC 127. The interior fuse is the active fuse and the exterior fuse is the spare one. The correct fuse value is 0.63 amperes slow.

Relay output:

The output of the relays is a 4-pole mounted socket of the Hirschmann CA 3 type with a screw lock.
Automatic sorting is to be connected here.

The four poles are labelled with the numbers 1 to 3 and the sign for protective earth (PE). This pole is not, however, connected to the protective earth of the unit. The socket is only connected to non-potential relay contacts.

After the evaluation of the measurement by "HOLD" one of three relays is set, according to the result.

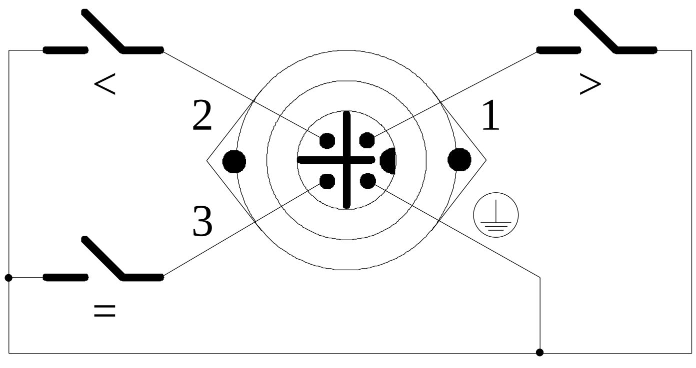
If the result of the flux measurement is above the selected upper limit a connection between the poles 1 and PE is set.

If the result is between the selected upper and lower limits a connection between the poles 3 and PE is set.

If the result is below the selected lower limit a connection between the poles 2 and PE is set.

This connection lasts until "HOLD" is released again.

The load capacity of the relay contacts is 8 amperes at 250 V AC.



Remote control connection:

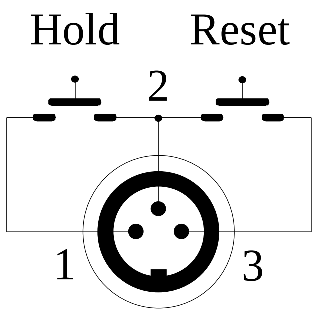
The remote control connection is a type KFV30 3-pole socket with a screw lock in accordance with DIN 41524.

The remote control of the "RESET" and "HOLD"-functions is achieved over this connection. Two non-potential switches are required for this.

A connection of the poles 2 and 3 causes a "RESET" and thus a clearing of the integration memory.

A connection of the poles 1 and 2 causes a "HOLD", which brings about the completion of the measurement, the holding of the result and starting of the evaluation. If none of these connections have been set and no functions have been set on the front panel, the fluxmeter is in a state of active flux measurement, which means the integration of the input voltage.

The switch voltage is 5 V at a current of 0.05 mA.



Measurement coil connection:

The measurement coil connection is a type SFV30 3-pole socket with a screw lock in accordance with DIN 41524.

The measurement coil, whose output voltage is integrated during measurement, is connected here. The measurement coil must be connected at the poles 1 and 2 and must be non-potential.
The polarity of the measurement coil is irrelevant because the measurement result is always shown as a positive value.
Pole 3 is not connected.

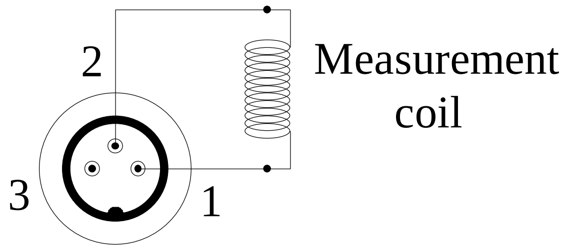
Attention: At open input the DFM shows an overload.

Connect the measuring coil and press "RESET".

The maximum input voltage for measurement is 6 V.

When no measurement is performed higher voltages are allowed. Voltages above 10 V are cut internally to protect the input amplifier. The input impedance is 10 GOhm if the unit is switched on.

Attention: The DFM must not be connected to a capacitor discharge pulse magnetizer if the magnetizing time is in a range of milliseconds. The voltage peaks are not sufficiently limited and will damage the input amplifier. Connection is allowed, if the DFM is separated from the coil during magnetization by a relay that short-circuits the coil at same time.



Analog output:

The analog output is a BNC jack.

The outer conductor is connected to ground. An output voltage, which is proportional to the measurement value shown, is present at the central conductor, at all times.

The voltage is 1 mV / µVs with the DFM 1 or 1 mV / digit with the DFM 2. According to this, the maximum output voltage is 8.191 V at the DFM 1 and 9.999 V at the DFM 2. This is always positive, according to the measurement value.

The minimum load impedance is 1 kOhm.

Printer output:

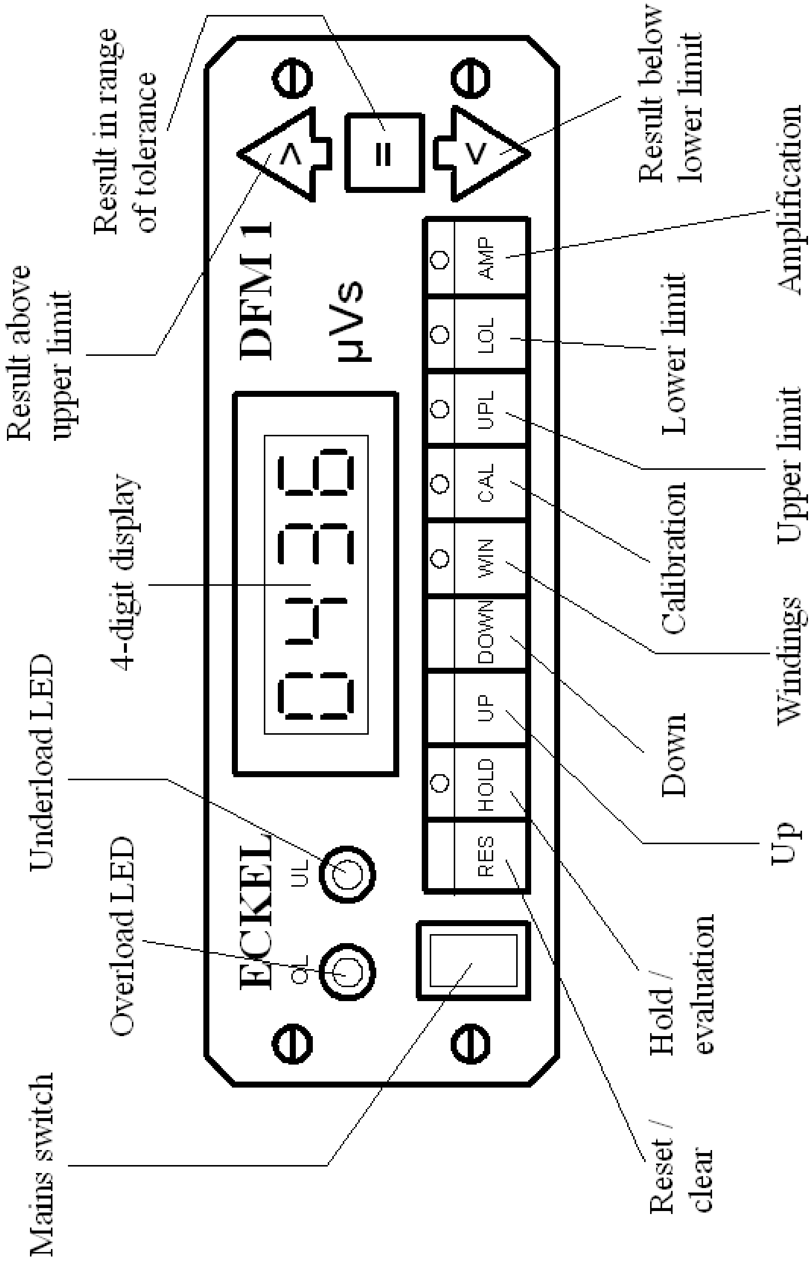
The printer output is a 25-pole Sub D socket.

It is a standard PC parallel interface. Strobe (pin 1), D0 to D7 (pins 2 to 9) and ground (pins 14, 15, 17 to 25) are connected.

The printing out of the result is initiated automatically at the end of the measurement by setting the "HOLD" function. The result is emitted in ASCII format as "XXXX µVs" with different decimal points and line feed with the DFM 1 and the DFM 2.
If the result exceeds 8191 µVs with the DFM 1 or 9.999 digits with the DFM 2 "OL" is emitted analogous to the display.

Attention: Modern printers drive the data lines with their own status information. This may cause problems at the drift correction with very high amplifications.

Front view of DFM 1



3. Explanation of the front of the unit

Mains switch:

The DFM is switched on by pressing the upper part of the mains switch and switched off by pressing the lower part of the mains switch.
If the unit is switched on the mains switch glows red.

Overload LED:

This red LED lights up as soon as the A/D converter at the input is overloaded during measurement.

In this case the measurement is broken off because the result would be too small. "----" flashes on the display.

An evaluation with "HOLD" is not possible.

These conditions are cleared using "RESET".

Before repeating the measurement the input amplification (button AMP) must be reduced.

Underload LED:

With the DFM 1 this yellow LED lights up after the evaluation using "HOLD" if the A/D converter was not loaded more than 25% during measurement.
This LED is cleared by "RESET".

With the DFM 2 the Underload LED is set by "RESET" and turns off after sufficient load during measurement even without evaluation by "HOLD".

Although the result is correct, to achieve greater accuracy the input amplification (button AMP) should be increased until this LED no longer lights up after measurement.

4-digit display:

The current integrated measurement value from 0 to 8191 µVs respectively from 0 to 9999 µVs is normally shown on this display. **The result is always related to the magnet considering the number of turns.** The DFM 1 shows results below 1000 µVs as XXX.X µVs.

If the result exceeds the maximum value the display shows "OL" (overload).

While changing the parameters (number of windings, calibration, upper limit, lower limit or amplification) the display shows the values of these parameters.

Display for result:

After evaluation using "HOLD" one of three lamps analogous to the output relays is set depending on the result.

If the result is above the selected upper limit, the yellow lamp ">" lights up.
If the result is between the selected upper and lower limits, the green lamp "=" lights up.
If the result is below the selected lower limit, the red lamp "<" lights up.

The lamps are switched off by ending the "HOLD" state.

The **buttons** for operation on the front panel are explained in their own chapters.

4. Theory and practice of flux measurement

The DFM takes an integrating flux measurement, adding up the input voltage during the measurement time to get the total flux of the measured magnet at the end.

Before measurement "RESET" must be carried out, to set the content of the integrator to the starting value of 0.

As the starting position for the measurement the magnet is positioned in the air gap of an iron ring. This air gap must be the same shape as the magnet and be filled by the magnet as far as this is possible.

Directly above or below the magnet is the measurement coil with n windings which should correspond to the form of the magnet as exactly as possible. Then it can be assumed that nearly the whole magnetic flux Φ flows through the measurement coil.

After turning off "RESET" the measurement starts, during which the magnet is pushed out of the air gap of the iron ring.

During this process a continuously increasing part of the magnetic flux flows past the measurement coil, so that the total flux through the measurement coil continuously decreases.

During the movement of the magnet this results in the voltage

$$u = - n * d\Phi/dt$$

being induced in the measurement coil.

With digital sampling this equation changes to

$$u = - n * \Delta\Phi/\Delta t.$$

Δt stands for the sampling period.

This voltage is dependent on the total flux Φ, the number of windings n and the speed at which the magnet is pushed out of the air gap.

In the fluxmeter this voltage is integrated during measurement:

$$\Sigma u = - n * \Sigma\Delta\Phi/\Delta t,$$

respectively

$$\Sigma\Delta\Phi = - \Delta t/n * \Sigma u.$$

At the end of the measurement the magnet is pushed out of the air gap of the iron ring totally and the flux through the measurement coil is nearly 0. This results in:

$$\Sigma\Delta\Phi = \Phi,$$

respectively

$$\Phi = - \Delta t/n * \Sigma u.$$

Since the sample period Δt and the number of windings n are known, the flux Φ can be calculated from the value Σu in the integration memory at any time.

In addition the factor of the selected input amplification must be taken into consideration in the DFM.

At the end of the measurement the integration is ended and the result held using "HOLD". Then the evaluation is started, resulting in a relay and a lamp being set and the printout of the result being started.

With the DFM 1 the drift compensation is re-set at the same time during the "HOLD" phase.

Since some losses always occur during this measurement, due to the physics of the measurement coil and the iron ring, the result can be changed to a desired value through the selection of a calibration factor.

The measurement also can be carried out whilst pushing the magnet into the area of the measurement coil from the outside.

The measurement also can be carried out with coils independent of the magnets geometry, e.g. Helmholtz coils.

5. Important hints for the use of the DFM 2:

At measurements of **small magnets** for a good precision some hints about the physics and the needs of the DFM 2 must be observed. Therefore here some **important rules** are summarized again.

The DFM 2 measures the **external level of distortion**. This takes place **after switching on** and **after pressing the "AMP" button**, e.g. after changing the amplification.
During this measurement the **measurement coil must be connected**. During the offset and distortion measurement no voltage may be induced into the coil. **No magnet may be moved near the coil** and **the coil must not be moved** either. At the end of the measurement the level of distortion is shown.

Remove the coil **as far as possible** from all running electrical units or switch off these units. Try different positions and compare the levels of distortion shown at the display. Use the position with the lowest level of distortion.

After **every change of the measurement coil** the measurement of distortion must be initiated again. Press the "AMP" button.

By all means use an amplification that loads the A/D converter sufficiently. The **LED "UL" must turn off during measurement**. If it doesn't turn off, increase the amplification and repeat the measurement. Only then you can reach a good accuracy.
The display will automatically show the right resolution.

If the DFM 2 starts to drift, the level of distortion has raised and must be measured again. Press the "AMP" button.

If possible, use measurement coils with an **area identical to the magnet**. This reduces the level of distortion significantly. An iron ring with an air gap with the shape of the magnet is perfect. A pole housing measurement with a coil wound on an iron with the same shape like the rotor has the same quality.

During pulling out the magnet from this air gap a very constant signal with clear start and end is given.

Helmholtz-coils:
With big magnets or coils fitting to the size of the magnet no problems occur. The worst are Helmholtz-coils. These coils are significant bigger than the magnets to be measured. Helmholtz-coils are big antennas with a very high level of distortion. For these coils a **reduction of the level of distortion is extremely important**. The advantage of a Helmholtz-coil is the absolute result for axial magnetized magnets.

Use the **smallest possible** Helmholtz-coil.

The coil **must not move**. If the coil moves during measurement the earth's magnet field is interfering with the measurement.

The DFM 2 has to recognize the beginning of the measurement. At inserting the magnet to the Helmholtz- coil a very slow raise of the voltage is given. This is a bad start indication. Taking out the magnet leads to a fast raise of the voltage. **Therefore use the taking out of the magnet for the measurement**. Then the result is more accurate.

Pulling out the magnet to the side through the coils of the Helmholtz-coil is very unfavourable. This results in a polarity change during the measurement. It's better to take out the magnet to the top.

Take care that the magnet is **removed from the coil far enough**. Otherwise a part of the field stays in the coil and falsifies the result.

Move the magnet **fast and constantly** but not jerkily.

Calibration of Helmholtz-coils:
For the Helmholtz-coil a factor K is given. This factor is entered in the DFM 2 as follows: The factor K is multiplied by 10, 20, 50 or 100 so that the result is a number between 0.5 and 2. The multiplier is the number of turns to be set.

The remaining factor between 0.5 and 2 is entered as calibration factor by the "CAL" button. Then the DFM 2 shows the magnetic moment M of the magnet. This is the product of the polarisation J and the volume V.
Example: K = 0.01543 cm. 100 turns are set. K * 100 = 1.543. Calibration factor "CAL" is 1.543.

To deal with high distortion levels of Helmholtz-coils a **very long time constant** had to be selected. This causes a **temporal difference** between the integration result, respectively the output voltage at the analog output, and the magnet movement. Thus the analog output of the DFM 2 can only be used to read the final result and not for recording the running measurement.

By new calculation of the input circuit of the DFM 2 the input impedance has changed. Anyway the result is still **independent** of the impedance of the measurement coil.

The remote control of **Hold and Reset** is only released **after recognizing the end** of the measurement. According to the time constant a slight delay may be possible.

5.1 Automatic drift compensation

The DFM has internal automatic drift compensation.

Since this flux measurement is an integrating measurement even slightest deviations of the input voltage from ideal zero are noticeable as drift of the measurement value.
This error results from offset voltages of the operational amplifiers used and the A/D converter.

Usually, this error is eliminated by manual adjustment or is measured by pressing a button and then compensated internally, which can result in high accuracy. So, this value is only correct for the connected measurement coil, in which no voltages may be induced by magnetic fields during adjustment.

Unfortunately, the drift value is extremely dependent on time and temperature. So, an adjustment which has been made soon becomes worthless.
In laboratories this is of little account. But in industrial production a permanent manual adjustment is not practicable.

For this reason the DFM contains a computer controlled, fully automatic drift compensation, which works in two ways and therefore meets all the requirements for both manual and automatic measurements.

On principle the drift compensation is brought up to date during integration at those times when measurements are not being made. Thus the drift is eliminated absolutely. Of course, voltages that are induced in the coil by magnetic interference are not suppressed.

In the case of automatic assembly line measurements, the time between measurements is too short because voltages are constantly being induced in the measurement coil by magnetisation processes and machines. But here the remote control of "RESET" and "HOLD" is used.

Therefore, in every "HOLD" phase the DFM 1 carries out a new automatic drift adjustment which is independent of the measurement coil and the voltage induced in it during this time.

The minimum time needed for this is 0.2 seconds. The result is improved with a converging algorithm if more time is available.

Thermocouple voltages which may occur in the measurement coil cannot be registered here. But in practice they are of little importance.

In any case, even here, the drift compensation is so good that an influence on the result during the relatively short measurement time is impossible.

The maximum possible drift compensation here is 0.025% of LSB of the 14 bit A/D converter.

The great advantage is that the DFM 1 can be used for an unlimited time without being adjusted.

In addition, a drift adjustment is carried out after the switching on of the device and after every change in the input amplification.

If, during manual measurements, the automatic drift compensation should stop functioning correctly due to external influences a re-start of the algorithm is initiated by pressing the "HOLD" button on the front panel.

The DFM 2 uses a changed algorithm for drift compensation to work under very different circumstances at very high amplifications.

This algorithm is started automatically after switching on and after every change of amplification.

If the measuring coil was changed, the "AMP" button must be pressed to start the drift algorithm.

The DFM 2 will show "OFFS" and measure the external level of interference. Then this level is shown for a short time.

This level is depending on the amplification, the coil and external electromagnetic fields. It is a measure for the quality of the measurement.

The lower this value is, the better. The value is limited to 255. If the interference level is even higher, the drift correction will not work. With such enormous interference levels a measurement is not possible.

It is difficult to say, which value is a good one. Too many factors are interfering. For the upper limit a value of 100 with an amplification of 4000 may be right. With low amplifications the external interference level is unimportant.

If the value is too high, switch off or remove all other electric instruments or look for another location. Even turning the coil may change the value.

The level of interference has influence on the measurement result. If measurement is carried out with different and also higher levels of interference, a calibration sample is recommended to calibrate the DFM 2 before measurement.
Look at 6.5 calibration.

If the DFM 2 starts to drift, the external level of interference has increased significantly. Then the "AMP" button must be pressed to restart the algorithm. Then eventually the DFM 2 must be calibrated again with the calibration sample.

6. Functions

6.1 Reset

Before the beginning of every measurement the DFM must be "RESET" if the display is not at 0.

"RESET" can be initiated by remote control or with the button "RES" on the front panel. Both methods are identical.

"RESET" can be only be carried out if neither "HOLD" nor one of the parameter settings is active.

"RESET" causes a clearing of the measurement integration memory and resets the Overload- and Underload-LED with the DFM 1. In the opposite the Underload-LED is set with the DFM 2.

The display shows "0000" with different decimal points.

This state is terminated and the measurement is started by releasing the "RESET" button.

Since, unlike analogous fluxmeters, no capacitor must be discharged, this button can be pressed for as short a time as you like.

A change of parameters is impossible during the "RESET" phase.

6.2 Hold

At the end of the measurement the evaluation is initiated with "HOLD". "HOLD" can be omitted for manual measurements.

Whilst "HOLD" is carried out on the remote control until the switch is open again, the "HOLD" phase is started on the front panel by pressing the button once and ended by pressing the button again.
During the "HOLD" phase the red LED in the "HOLD" button lights up.

"HOLD" can only be carried out if neither "RESET" nor one of the parameter settings is active.

At the start of the "HOLD" phase the evaluation is carried out and one of the lamps for the result, one relay and possibly the underload LED are set and the printout of the result is initiated.
In addition, the automatic drift compensation is started.

At the end of the "HOLD" phase the lamp for the result and the relay are reset and the automatic drift compensation is ended. If "RESET" is not pressed the DFM is back in a measuring condition.

The parameters can be changed during a remote controlled "HOLD" phase, which is not possible during "HOLD" operated from the front panel.

6.3 Up and down

The values of the parameters are changed using "UP" and "DOWN".

One of the parameters must be selected beforehand. This is visible from the yellow LED in the corresponding button.

The selection of parameters is possible during measurement and in the "HOLD" phase, when this is operated by remote control. But this is not possible during "RESET" and the "HOLD" phase when operated from the front panel.

The measurement is interrupted during the changing of the parameters.
The display shows the current value of the parameter.
This value can be increased with "UP" and decreased with "DOWN", up to the minimum and maximum possible values.

All other functions are blocked.

The parameters calibration ("CAL"), upper limit ("UPL") and lower limit ("LOL") are changed in three different running speeds by pressing "UP" or "DOWN" continuously.

When completing the setting of the parameter, by pressing again the corresponding parameter button, the value currently shown on the display is accepted and the result of the measurement changed as if it had been measured with the new parameters.

6.4 Number of windings

By pressing the "WIN" button during measurement or the remote controlled "HOLD" phase the current number of windings of the measurement coil is shown. This can then be changed with "UP" and "DOWN".

The number of windings 10, 20, 50 and 100 are available.
Attention: Special function: Look at chapter 7.

By pressing the "WIN" button again the shown value is accepted and the result is reset to zero.

6.5 Calibration

The DFM includes its own highly accurate reference voltage source. Therefore the measurement result exactly corresponds to the integrated input voltage.

But because deviations from the real value are unavoidable, due to physical imperfections in the measuring equipment, there is a possibility of multiplying the result with a factor from 0.500 to 2.000, additionally.
For this the button "CAL" (calibration) must be pressed, whereupon the current calibration value is shown.
Attention: Special function: Look at chapter 7.

Errors in measurement result from the fact that at the start of the measurement the total flux of the magnet is not detected by the measurement coil and inversely at the end of the measurement a part of magnetic flux is still flowing through the measurement coil since the magnet is still nearby.

Further error sources are the remanence of the iron ring, eddy current at high measurement speed and the temperature coefficient of the remanence induction of the magnet.

If a reference magnet is measured and the required value is, for instance, 124.3% of the shown result, at calibration factor 1.000, the calibration factor must be set to 1.243 in order to attain the required result from the measurement.

When the "CAL" function is switched off, the calibration factor shown is accepted and the internal reference voltage source is sampled and the reference value is brought up to date automatically and the result is reset to zero.

6.6 Upper limit

The upper limit setting is selected with the button "UPL" (upper limit).
This can be adjusted from the selected lower limit up to 8000 μVs respectively 9999 using "UP" and "DOWN".
The limit value itself still counts as part of the range "in tolerance".
By pressing the "UPL" button again the value shown is accepted.

6.7 Lower limit

The lower limit setting is selected with the button "LOL" (lower limit).
This can be adjusted from 0000 up to selected upper limit using "UP" and "DOWN".
The limit value itself still counts as part of the range "in tolerance".
By pressing the "LOL" button again the value shown is accepted.

With the DFM 2 the upper and lower limits are always related to the measuring range. A change of the range will also change the decimal point of the limits.

6.8 Amplification

To load the A/D converter in an advantageous range the input amplification must be selected properly.
This is done by pressing the button "AMP" (amplification).
The following amplifications are available:

DFM 1:

0.5, 1, 2, 4, 8, 16, 32

DFM 2:

With a range of 9.999 mVs and a resolution of 1 µVs:
0.5, 1, 2, 4
With a range of 999.9 µVs and a resolution of 100 nVs:
5, 10, 20, 40
With a range of 99.99 µVs and a resolution of 10 nVs:
50, 100, 200, 400
With a range of 9.999 µVs and a resolution of 1 nVs:
500, 1000, 2000, 4000

The amplifications are varied with "UP" and "DOWN".

After switching off the "AMP" function by pressing the button again, the drift value is brought up to date. With the DFM 1 only if the amplification has been changed.
The result is reset to zero.

6.9 Storing of parameters

When the DFM is switched on all parameters are read automatically from an EEPROM. Since an EEPROM is only guaranteed a serviceable life of about 1000000 writing cycles, not all parameter changes are stored automatically.

If desired the currently selected parameters can be stored with the following procedure:

The "HOLD" function is started by pressing the "HOLD" button on the front panel. Then the "RESET" button must be pressed and the "HOLD" function is switched off by keeping the "RESET" button pressed, and pressing the "HOLD" button once again. Then the "RESET" button can be released. With this procedure the current parameters are taken as standard parameters and are loaded automatically when the DFM is switched on.

Theoretically there is a possibility that more than 1000000 writing cycles are completed and the incorrect storing of parameters renders the contents useless, so that measurement is no longer possible.
Then the EEPROM 93C46 must be replaced.

To write in the empty EEPROM the DFM must be switched on with the "RESET" button on the front panel pressed.

Thus the EEPROM is not read-out, but fixed standard parameters are loaded.

The DFM is then ready to work.

Then new parameters can be selected and stored in the EEPROM.

7. Relative calibration according to Bosch specification

In addition to the described functions in the operating manual **the upper and lower limits** can be calculated **automatically**.

This function is selectable **alternatively** to the calibration function described at 6.5.

For adjusting the limits a calibration magnet or a calibration motor housing is used. Its flux value is specified in % (e.g. 103%). Then the lower limit is at **100%** and the upper limit is at **110%**.

The calculation of the limits is performed with the following procedure:

First the **function "Pro"** must be activated, if this function has not been saved before. For this the button "WIN" is used (look at 6.4). The number of windings is reduced by pressing "DOWN" until "10" windings are shown. Then once again the button "DOWN" must be pressed. As result **"Pro"** is shown for a short time. The DFM then is in this state. After this select the desired number of windings.

Then the **calibration magnet is measured**. **While the result is shown**, the button "CAL" must be pressed. The shown calibration value, if necessary, is then adjusted, e.g. at 103% to 1.030. By pressing the button "CAL" once again the calibration function is finished and the limits are calculated. They can be controlled by "LOL" and "UPL".

Do not forget to **save** the state and the parameters (look at 6.9)!

The DFM can be re-set to the standard state "nor" by pressing the button "UP" at "100" windings shown.

8. Absolute maximum value of a rotor

The DFM 1 can show the absolute maximum value of a rotor. For this all negative values are set to zero. As soon as the DFM gets a positive value, integration is started until maximum. This value is held until it is deleted by RESET.

This function is optional. Please read chapter 7. After “Pro” has been shown in the display, press DOWN again. Then “Abs” will be shown in the display and the DFM is in this mode.

Connect the coil input to the outer windings of the rotor. Then press RESET and push the rotor so that it rotates at least half a turn. The result is shown immediately. This value may not be understood as an absolute value if number of windings and inner construction of the rotor are unknown. If necessary the result can be changed by CAL (see chapter 6.5).

Please do not turn the rotor slowly by hand. This may irritate the zero crossing detection and falsify the result. The rotor must be pushed so that it turns itself and then stops again. If it is pushed too hard it may result in an input overload.

9. Average of multipolar motors

By pressing DOWN in WIN mode over “Pro” and “Abs” (see chapter 7), the “Pol” mode is accessible. There are the modes “Pol 2”, “Pol 4”, “Pol 6” and “Pol 8”. Go down until the desired mode, then set windings and leave WIN mode.
There is no way to go up. Go UP above 100 windings to “nor” (normal mode) and then go DOWN again until desired mode. See chapter 6.9 to store the settings.

The “Pol 2” mode is for 2 pole motors. The DFM 1 will find the 2 poles of the motor and calculate the average flux of these 2 poles. The other modes are the same for 4, 6 and 8 pole motors. These modes are only available with DFM 1.

During measurement the DFM 1 will show no result until end of measurement, but will count up the number of found poles. After all 2, 4, 6 or 8 poles have been found, the DFM 1 will show the average result and then not change result anymore. To start a new measurement press RESET.

For measurement press RESET and then turn the motor housing with constant speed until poles have been counted and result is shown. Do not stop or turn back during measurement. Take care to set the correct number of poles.

If a 4 pole motor is measured in 2 or 6 pole mode, the result may be different from measurement to measurement since some poles are measured twice or not at all.

10. Technical data

Measurement:	Digital integrating flux measurement
Range	
DFM 1:	0.1 µVs to 8191 µVs
DFM 2:	1 µVs to 9999 µVs
	100 nVs to 999.9 µVs
	10 nVs to 99.99 µVs
	1 nVs to 9.999 µVs
Sample period:	1600/s
Resolution:	14 Bit
Integration size:	32 Bit
Maximum error:	0.5%

With the DFM 2: Depending on the external interference level with high amplifications.

Reference-voltage source:	0.2%, 10 ppm/°C
Input ranges	
DFM 1:	93.75 mV, 187.5 mV, 0.375 V, 0.75 V, 1.5 V, 3 V, 6 V.
DFM 2:	0.75 mV, 1.5 mV, 3 mV, 6 mV, 7.5 mV, 15 mV, 30 mV, 60 mV, 75 mV, 150 mV, 300 mV, 600 mV, 0.75 V, 1.5 V, 3 V, 6 V.
Differential input resistance:	10 GOhm

Accuracy of drift compensation:	0.025% of LSB of A/D converter
Analog output:	14 Bit, 1mV / digit, minimum load impedance 1kOhm
Printer output:	Standard parallel interface
Windings:	10, 20, 50, 100
Upper and lower limit	
DFM 1:	0000 to 8000 µVs
DFM 2:	0.000 to 9.999
Relative calibration:	0.500 to 2.000
Size:	185 * 180 * 65 mm
Weight:	1.6 kg
Power:	220-240 V AC, 50/60 Hz, 6 W On demand 110-120 V.