Operating Instruction

DiaSusz

Version 2.1

Magnetic Susceptibility System for synthetic diamonds

This product is not qualified for use in explosive atmospheres or life support systems.

Please start the system only after reading the manual.

Contents:

1. General information - magnetic susceptibility

<u>Calculating Magnetic Susceptibility:</u>

The magnetic state of a specimen is generally described by the following equation:

$B=\mu_0 (H+M)$ … (1)

where:

B is the flux density of the specimen in T (Tesla).

μ_0 is the permeability of free space in N A-2. This is a constant ($4\pi \times 10^{-7}$)

H is the applied field strength in Am^{-1}.

M is the magnetisation of the specimen in Am^{-1}.

Dividing through by H we get:

$\mu = \mu_0 + \mu_0 K$ … (2)

where:

μ is the permeability of the specimen (in N A^{-2})

k is the volume magnetic susceptibility of the specimen (dimensionless)

Rewriting, we get:

$\mu_0 K = \mu - \mu_0$… (3)

The magnetic susceptibility system relies on the principle that any changes in the permeability of a core will cause a change to the inductance of a wound inductor.
The sensor operate on the principle of AC induction. Power is supplied to the oscillator circuit
within the sensor, generating a low intensity alternating magnetic field.
The frequency of oscillation is determined by the inductance of the system. When the inductor contains only air, the permeability μ_0 determines the inductance. When a sample is introduced inside the inductor, the change in permeability also leads to a change in inductance.
The meter reads the frequency values for μ_0 and μ, and uses them to calculate the change in inductance, and thus the magnetic permeability. The value of μ_0 is constant but the variable of interest is relatively small. Therefore any thermally induced sensor drift needs to be eliminated by occasionally obtaining a new 'air' value, to re-establish the μ_0

<u>Compactly explained:</u>

Magnetic susceptibility corresponds to the ability of a material to be magnetised in an external field. Bulk (volume) susceptibility χ_{vol} can be directly related to the relative permeability (μ_r) of a material: $\chi_{vol} = \mu_r - 1$ and where μ_r is the ratio of permeability of material/permeability of vacuum. The measuring principle rely on the change of inductance in an inductor when the permeability of its core is changed.
The reference state is measured when the sensor contains only air (the permeability of air is approximated as the permeability of a vacuum). Taking a reading with a sample will then give the permeability of the material.

2. DiaSusz - system for synthetic diamond

The system consists of a susceptibility meter DiaSusz Version 2.1 with a small volume sensor. It allows the precise control of the magnetic separators in a diamond plant. A small amount of every fraction is sufficient to measure directly the result of magnetic separation. The measuring process is quick enough to serve as an in-line process control. To control the output of a separator stage it takes 8 carats of diamond and approx. 15 seconds of handling and measuring. The diamond is not affected by the measurement.

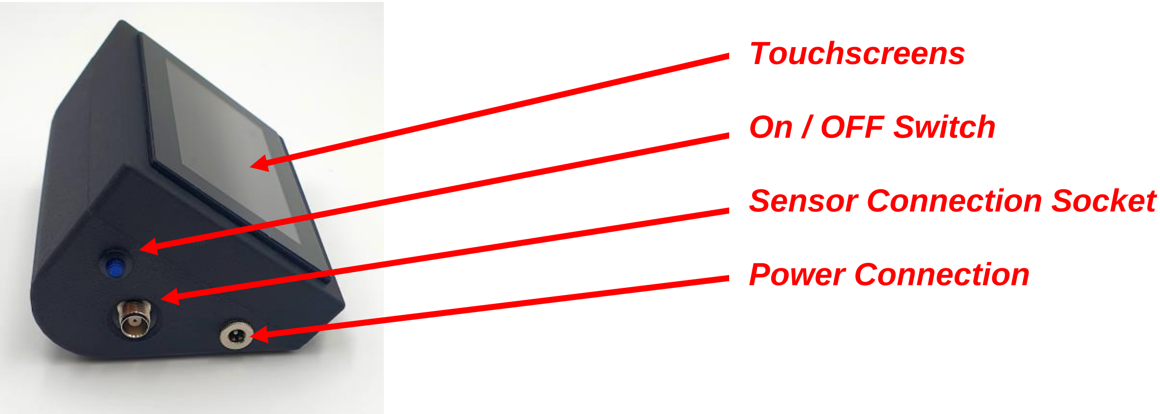
3. Hardware

The magnetic susceptibility measure system consists of:

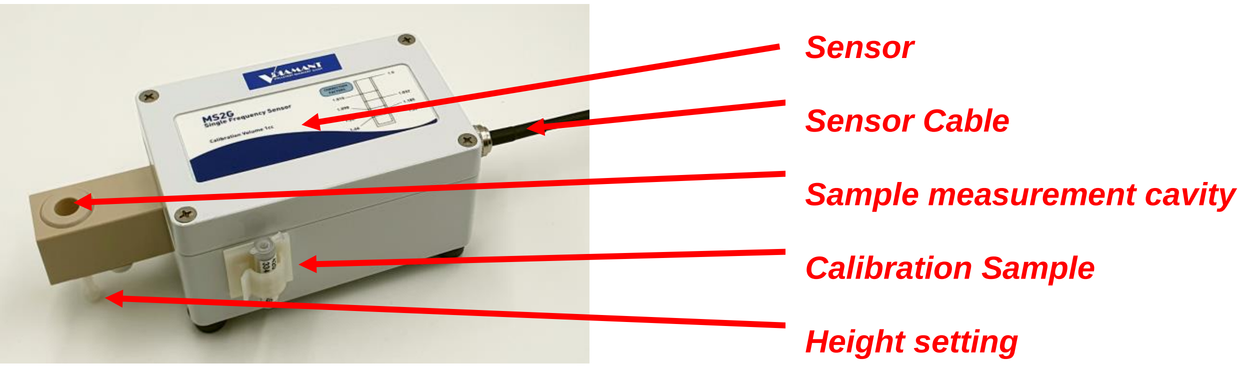
- Susceptibility Meter DiaSusz Version 2.1
- Sensor MS2G with connection cable
- 5VDV Power supply
- Calibration Sample
- Sample container
- Funnel and spatula

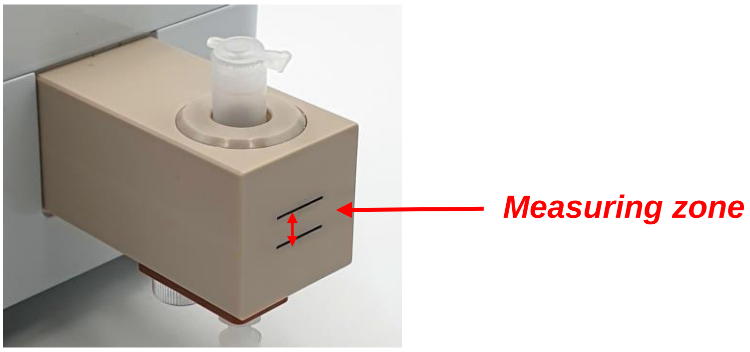
You can get the system info by pressing the display at any position for a long time. After some time the meter automatically returns to the measuring mode.

In general, the instrument is suitable for measuring the magnetic susceptibility of 1 ml liquid or powder samples.
The Magnetic Susceptibility System consists of a portable meter with touchscreens and the sensor. The meter displays the magnetic susceptibility value of materials when they are brought into the sensor's area of influence. The sensor is connected to the meter via a simple coaxial cable. The meter is powered by an external power supply.



The sensor operates on the principle of a.c. induction. Power is supplied to the oscillator circuit within the sensor. This generates a low intensity (80 amperes per metre approx.) alternating magnetic field. Any material brought within the influence of this field will bring about a change in oscillator frequency. The frequency information is returned in pulse form to the susceptibility meter DiaSusz, where it is converted into a value of magnetic susceptibility. The sensor operates at a low frequency, and has excellent temperature stability





The measuring zone is 5mm in height and senses only over a small portion of the sample. For this reason the sample appears infinite and volume susceptibility units apply. The density of the sample material should be controlled, wherever possible, by compressing the sample material in the bottom of the vial. The sample may be weighed to establish the density. The tare weight of the vial is 0.69 g.

The vial has a constant internal area of 0.33 cm2, so the fill height and volume are linearly related. The vial has a diamagnetic value of -0.55 x 10-6 CGS which is constant at all practical measurement positions.

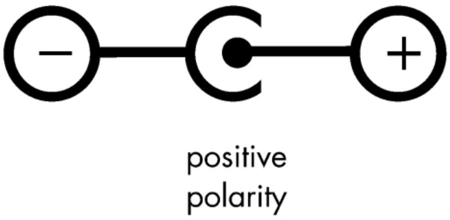
Remarks:

To exclude this error use an empty sample (air filled) container and placed in the measuring range during zero point calibration.

4. Electrical Connections

Use only the power supply that delivered with the device.

AC/DC Power Supply, ITE, 1 Output, 6 W, 5 V, 1.2 A



Damage caused by the use of other power supplies is not covered by the warranty!

5. Location

Generally choose an operating site well away from sources of electrical and radio interference. The site should also be free from magnetic materials and large non-magnetic sheets of electrically conductive material, e.g. aluminium bench tops.

To ensure proper operation of the system choose the location so that the following environmental conditions are fulfilled:

- Temperature: +18 ... +25 °C
- Permissible relative humidity: 45 to 80 %,
- well away from sources of electrical and radio interference

Remarks: A reasonably stable room temperature is desirable

6. Handling

The main switch is located on the left side. Press the switch *(Blue LED lights up)* to "ON". The system starts automatically and changes to the measuring mode.

Start- screen

7. Measurement

Allow app. 5 minutes settling time before taking measurements to allow the sensor to warm up.
Materials with sensitivity values of less than 5-10 SI, it is useful to zero the instrument between each measurement.
For best accuracy each sample container should be uniformly filled.

Any thermally induced sensor drift needs to be eliminated by occasionally obtaining a new 'air' value, to re-establish the zero reference. This is done by pressing the 'Z' button on the device

Remarks:
The samples should warm up to room temperature before you start the measurements.

Check that the sensor is functioning correctly by performing a calibration check using the 1cc check sample located on the side of the sensor. The value obtained should be within 1% of the stated value.

All control operations are realized via buttons on the touch panel. Operation is especially simple and intuitive.

In the first step of a measurement, the zero value must always be set.

The ZERO botton is pressed without a probe (empty - air filled sample container).

(If you now press the measuring key, you will perform a zero measurement).

The probe is then inserted and the measuring button is pressed. The displayed value is cleared during the next measurement . As soon as the measurement is completed, the current measured value is shown on the display.

Remarks:

To measure weak magnetic material, compensate for any thermally induced drift by taking a series of three measurements. The mean value of an air measurement before and after the sample is subtracted from the sample measurement.

8. Key description - Measurement

ZERO button

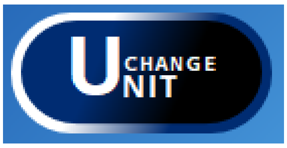
This button is used to set the meter to zero.

Measurements are performed without a sample. By carrying out a measurement on "air", the instrument is reset (zero) and the subsequent measurements can be made.

MEASURE button

With this button you can perform a measurement.

REMARKS:
(By pressing the display at any position a measurement is triggered!)



UNIT CHANGE button

This button changed the measuring unit.

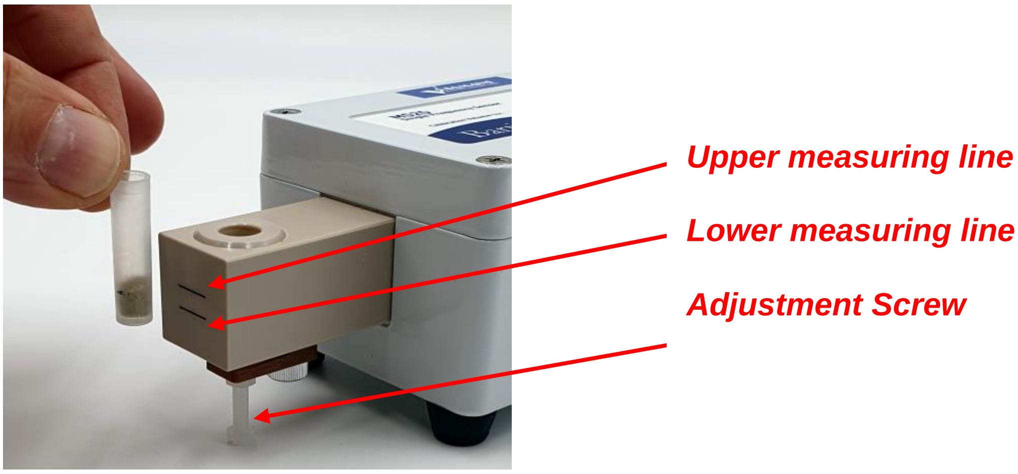
CORRECTION button

With this button you can enter a special measuring mode which you can use if your sample material is not sufficient for a normal measurement.

9. Fill height correction

For best results, a fully filled sample container should always be used!

However, satisfactory measurements are also possible with a sample volume of less than 1 cm³, provided the sample material is positioned at the correct height and the appropriate correction factor is applied.

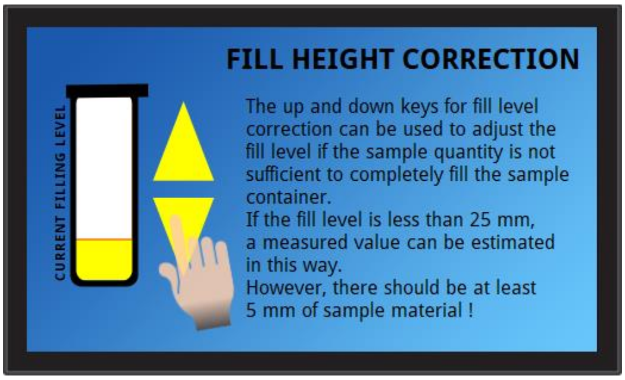


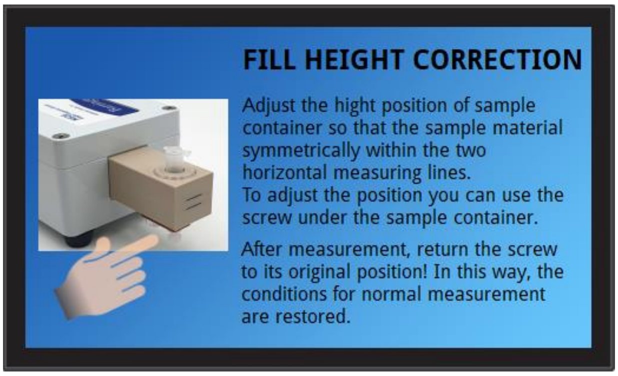
Sample position adjust between the 2 measuring line

Place the sample container on the display and set the sample height with the corresponding bearing keys.

Adjust the sample container position so that the sample material lies symmetrically within the two horizontal measuring lines.
To adjust the position you can use the screw under the sample container.

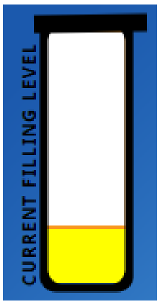
After measurement, return the screw to its original position. In this way, the conditions for normal measurement are restored.





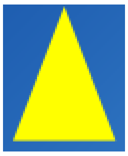
You can get help by pressing the display at any position for a long time.
After some time the meter automatically returns to the selected mode

10. Key description - Fill height correction



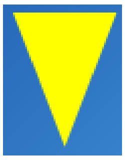
Fill level for the correction factor

Schematic illustration of the filling level of your material in the sample container.



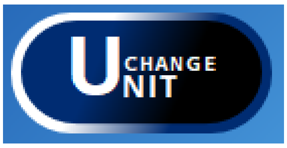
UP button

This button increase the fill level.



DOWN button

This button degrease the fill level.



UNIT CHANGE button

This button changed the measuring unit.

Return button

11. SI and CGS units

The instrument may be set to display the susceptibility value directly in one or other of the dimensional systems thus producing a basic mass or volume specific unit of:

	Mass (x)	Volume (k)
SI	10^{-8} (m^3/kg)	10^{-5}
CGS	10^{-6} (m^3/g)	10^{-6}

Numerical conversion from SI to CGS units is accomplished by dividing the SI value by 4pi-i.e. $X_{CGS} = X_{SI} /4pi$.
The meter performs this function internally.

12. Care and Maintenance

Surface dirt contamination on the device be removed only using a mild detergent solution.

The sensor is supplied in a cushioned case, which is ideal for storing and transporting the device.

13. Troubleshooting

In the event of any apparent malfunction, email **info@vdiamant.de**

Caution: Fault finding by customers may invalidate the warranty.

14. End of Life

This product (electrical and electronic equipment) should not be placed in municipal waste. Check local regulations for disposal of electronic products.

15. Technical data

Measuring Device DiaSusz Version 2.1

Display	:	4 digit LCD including sign
Units	:	SI or CGS
Measuring Time	:	0,1s
Linearity	:	1% 1 to 9998
Maximum Display Range	:	-9998 … 9998 SI (-7956 … 7959 CGS)
Measuring range	:	-9998 … 9998 SI
Over range	:	- 9999 and 9999 SI
Sensor connection	:	50 ohm TNC connector
Sensor cable type	:	RG58CU 50 ohms 100 pF/M
Enclosure material	:	PA
Operating temperature range	:	-10°C to 40°C
Storage temperature range	:	-20°C to 55 °C
Weight	:	470 g
Overall dimensions	:	140 x 110 x 80 mm

Sensor MS2G

Sample cavity diameter	:	8.5 mm
Sample cavity height	:	28 mm
		(approx. 8ct. Diamond powder 40/50 mesh)
Sensitive region	:	5 mm length at centre of cavity
Calibration accuracy	:	2% (a calibration check sample supplied)
Resolution	:	1×10^{-7} CGS
Measurement period	:	0,9 seconds
Operating frequency	:	l.3 kHz
Drift at room temperature	:	$< 2\times 10^{-7}$ CGS in 5 minutes
Enclosure	:	Aluminium and ceramic
Weight	:	670g
Dimensions	:	180 x 80 x 67 (mm)

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