## KEY FEATURES:

- **Scanning volume (X x Y x Z):**
  - **MMS-1A-RS: 125 x 125 x 125mm3**
  - **MMS-1X-RS: 570 x 570 x 290mm3**
  - **Other sizes on request**
- **Scanning speed: adjustable, up to 100 mm/s**
- **Linear encoders with the zero-point detection for motor control feedback for X-, Y-, and Z-linear modules**
- **Positioning repeatability: 10µm**
- **Point-to-point and continuous (on-the-fly) scanning**
- **Absolute magnet positioning utilizing Tactile (Touch) Sensor (Option: MMS-CMM)**
- **Rotary stage with the encoder (0.022° resolution;0.04° repeatability) and zero position detection (Option MMS-RS-SC3)**
- **Multi-jaw scroll chuck for precise magnet holding of diameters of 0-90mm (Option MMS-RS-SC3 with 3 jaws)**
- **Protection cabinet for a safe operation and CE compatibility (Option MMS-SafetyCabinet/Curtains)**
- **3-axis fully integrated CMOS Hall probe (Bx, By, Bz) with the spatial resolution (By: 0.02x0.005x0.02mm3; Bx & Bz: 0.14x0.01x0.14mm3); high angular accuracy: 0.1°**
- **Up to 3 selectable magnetic field meas. ranges: 0.1T, 0.5T, 2T or 50mT, 0.2T, 1T (MMS-MR2/3)**
- **Accuracy of magnetic field measurement: better than 0.1%**
- **DC and AC field measurements from DC to 2.5kHz (-3dB point); option: up to 25kHz**
- **Customizable, easy to use mapper software on MS Windows platform**
- **Color coded 2D and 3D isometric representation of the magnetic field**
- **Plug-in installation, configuration and calibration**
- **In-situ location of probe's sensitive area with an accuracy of 2µm**
- **In-situ calibration of the Hall probe (offset, sensitivity and orthogonality error)**
- **In-situ calibration of the mechanical system geometry (planarity & orthogonality)**

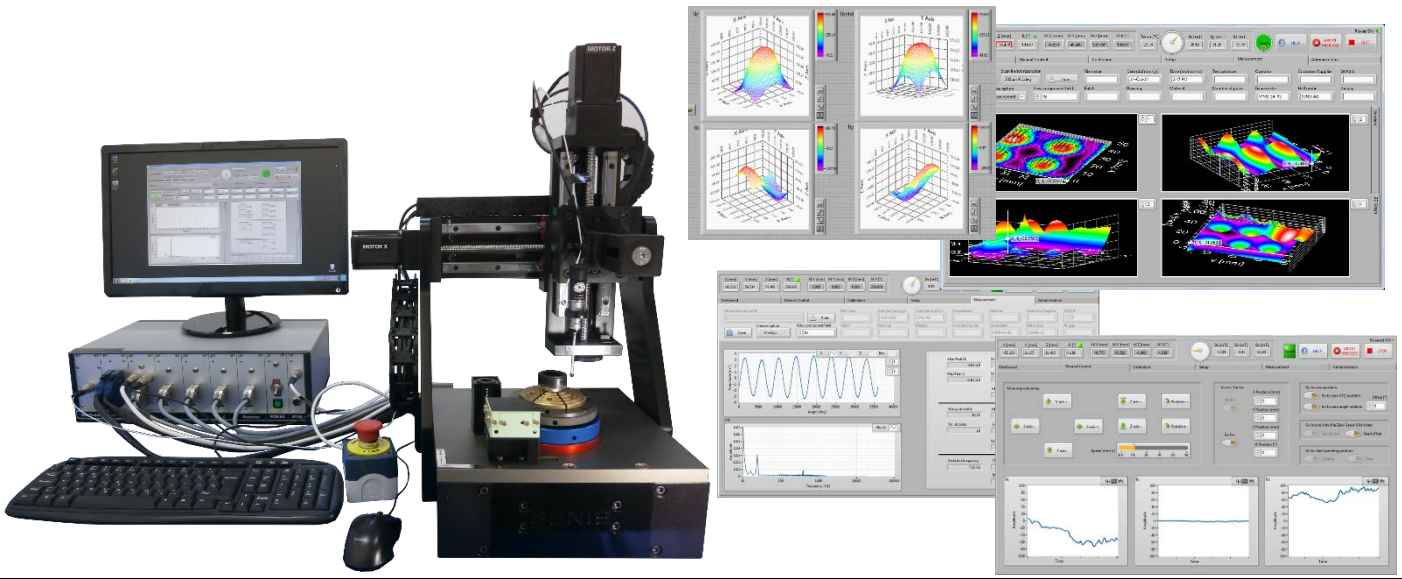


*Figure 1:* **Scanning system MMS-1A-RS**

## DESCRIPTION:

MMS-1A-RS, the high-end version of the SENIS Magnetic Field Mapping System allows users to perform a fast, high resolution mapping of magnetic field around an permanent magnets, electromagnets and electronic circuit PCBs. The map of the magnetic field can be presented as color coded 2D or 3D isometric visual display on a PC screen and as a table of numerical values of the magnetic field (each component Bx, By, Bz, Bxy, Btot, etc.). Due to unique features of the applied fully integrated Hall probe (Si-chip), all three components of the magnetic field are measured simultaneously at virtually same point (field sensitive area is within a 150µm square). Optionally, a Hall probe can provide up to three selectable magnetic field measuring ranges. The mapping system is controlled by an extremely easy-to-use-software built on MS Windows platform and LabVIEW. Scanning profiles and measured data visualization are fully customizable.

At a measurement start, the Hall probe moves automatically to its "Home position". The coordinates of the "Home position" are stored relative to the mapper coordinate system that is defined by linear encoders on all three movement axes. An autonomous motion control unit allows for the simultaneous control of four axes (X, Y, Z-linear modules and rotation stage). It allows a fast probe positioning with the highest accuracy and repeatability. Touch Sensor (Tactile Sensor prevents probe damage. It serves as an emergency stop provision, which is triggered whenever an object is touched by the probe during the measurement process. Optionally, the touch sensor can be used as an easy-to-use CMM (coordinate measurement machine) for dimensional measurements of objects and for absolute magnet positioning.

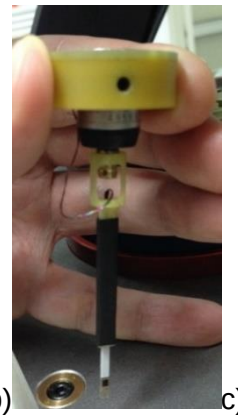
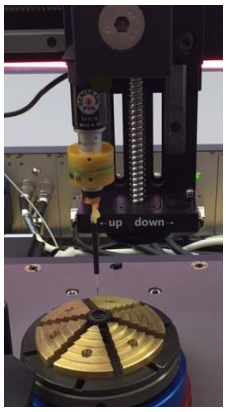
a)  b)  c) 


*Figure 2*: **a) Stylus attached to tactile sensor for dimensional measurement (MMS-CMM Option); b) Hall probe for magnetic field measurements; c) The smart connection solution allows an easy interchangeability of Hall probes, touch stylus and other specialized probes, such as the eddy-current probe for crack detection, sliding probe for in-contact measurement, etc.**

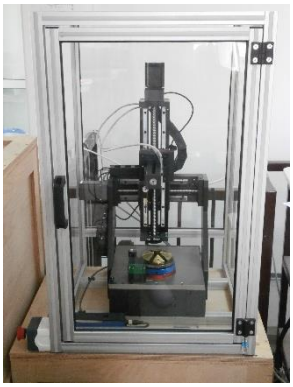
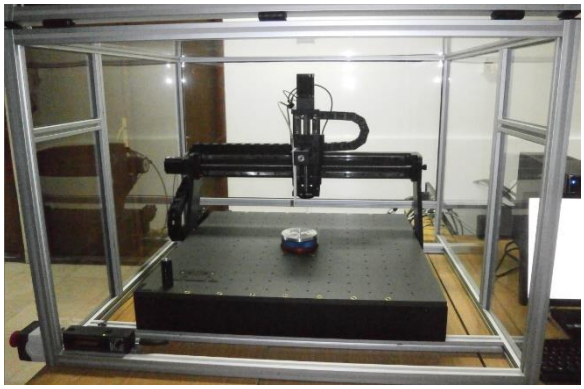
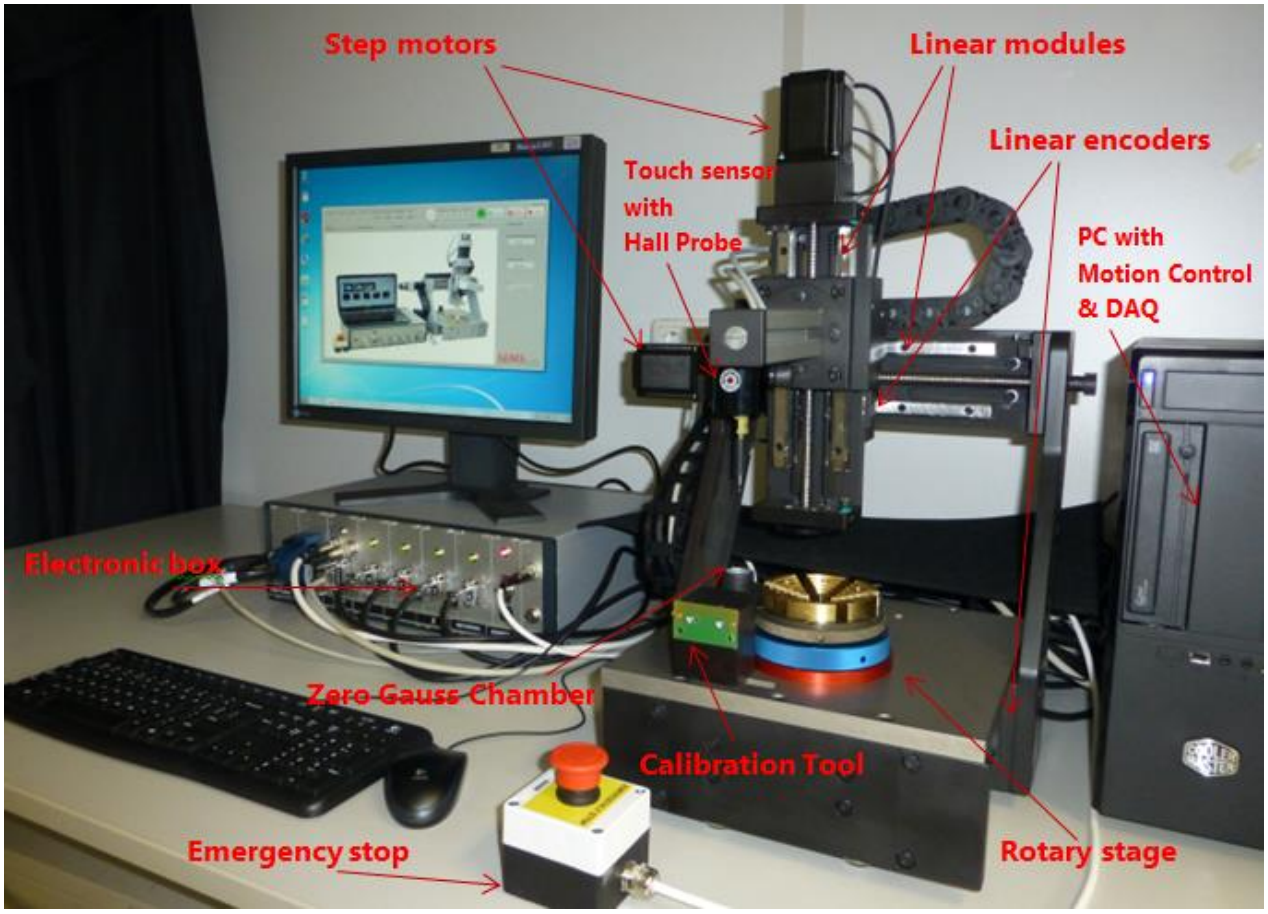
a)  b) 

*Figure 3:* **Scanning system MMS-1A-RS equipped with the safety cabinet (MMS-SafetyCabinet Option) to satisfy the CE directives (mandatory the production environments) – a) standard mapper size; b) extended mapping volume.**

The main parts of SENIS Magnetic Field Mapper are shown in the figures below:



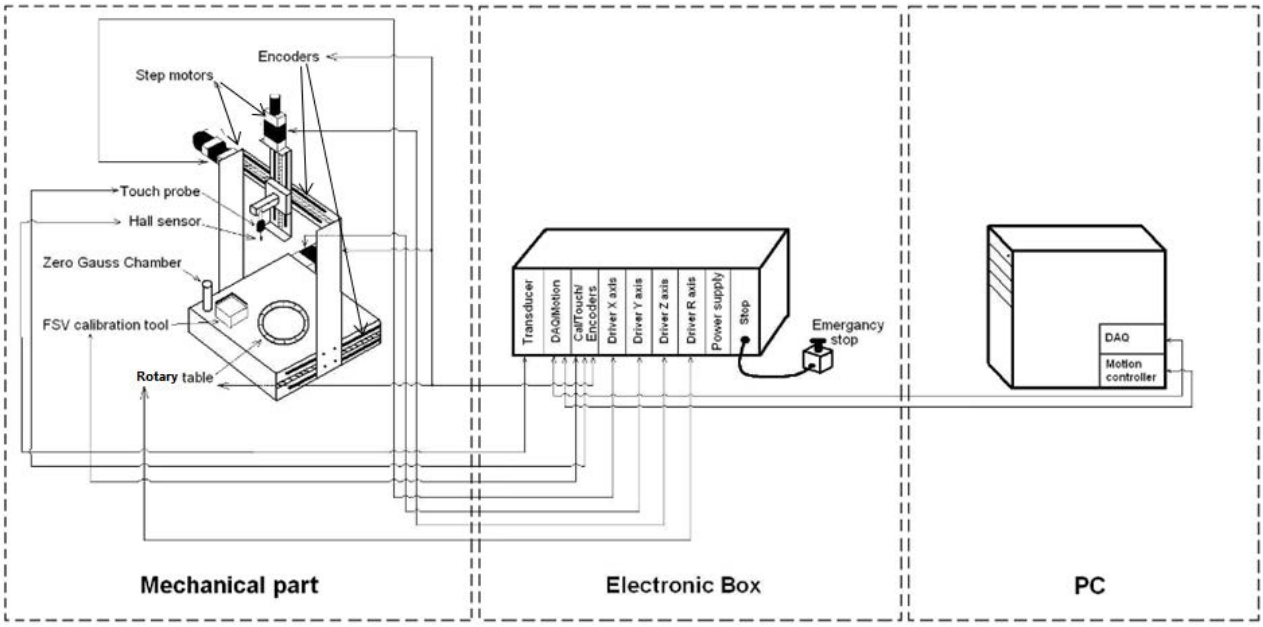




*Figure 4:* **Photograph and block-diagram of the magnetic field mapping system MMS-1A-RS**

The MMS-1A-RS mapper software allows an automated scanning procedure for QA inspection tests. The user with the **Administrator** permissions can set-up an automatic measurement profile (scanning path, visualisation and reports), so that the test **Operator** only needs to start the pre-defined measurement.
The software can be started with a permission setup (the login can be password protected). Permission roles of the administrator and operators can be individually set:

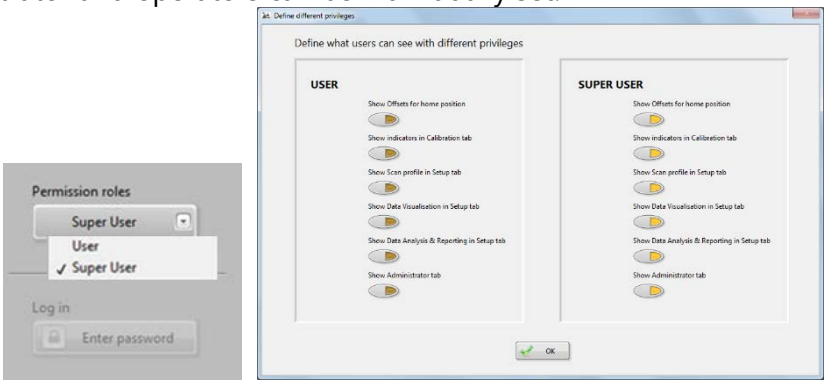



*Figure 5:* **Selection of user permission roles**

The Administrator sets the measurement profile in a setup software module:

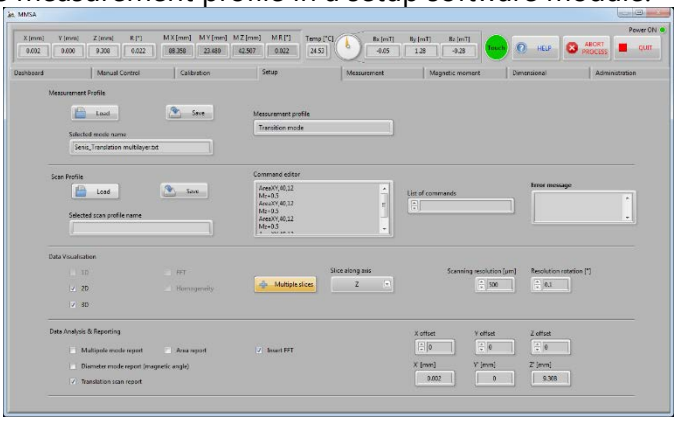


*Figure 6:* **Setup tab for measurement profile definition (Administrator role)**

The operator starts the scanning and monitors the measurement sequence:

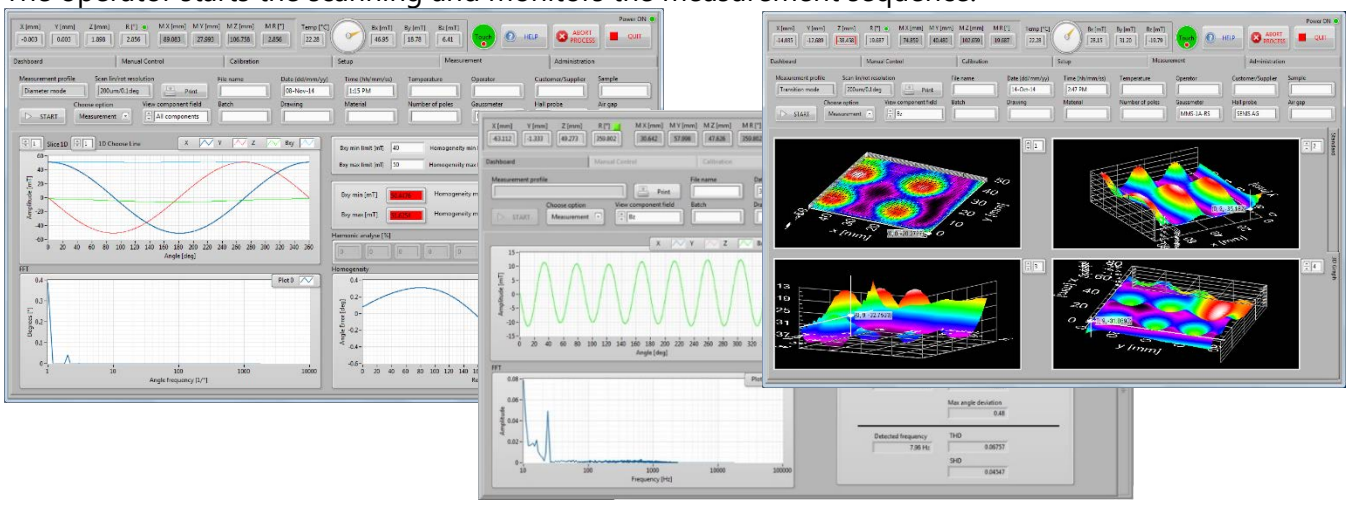
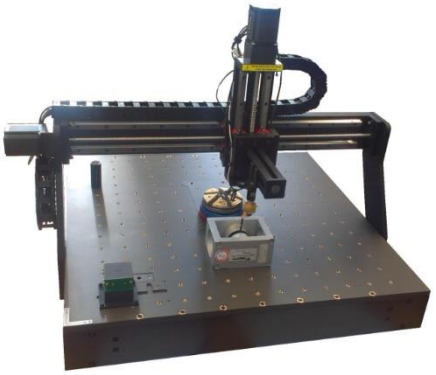


*Figure 7:* **Measurement tab for starting and monitoring of the magnet field mapping (Operator role)**

MM1-1A-RS Magnetic Field Mapper contains of:

High accuracy 3-axis Senis Magnetic Field Transducer (F3A), including the Hall probe (robust probe of type C, or thin probe of type K for a smaller distance to the magnet surface); and the signal processing electronic module

1. Personal Computer (PC) including the Motion Control (NI 73xx), which controls the motor drivers for all three mechanical axes and for the rotary stage; and DAQ (NI 6212) that receives data from transducer and sends them to the computer.
2. Electronic box that houses the power supply, electronic module of the magnetic transducer, step motor drivers, encoder electronics, touch sensor control and current supply for calibration tool
3. Step motor drivers SSMD, which control the movements of the platform
4. Cartesian moving platform CMP with linear modules for thee axes (X, Y and Z)
5. Linear encoders for X-, Y- and Z-axis
6. Rotary stage with encoder for rotating the object under test
7. Multi-jaw scroll chuck as very precise magnet holder
8. Reference cube for precise positioning of the rectangular magnets
9. Touch sensor for probe protection and for absolute magnet positioning
10. Emergency Stop safety equipment
11. Boundary switches for linear modules protection
12. Tool for in-filed calibration of the Hall probe's magnetic field sensitive area position.
    Calibration tool consists of two mutually orthogonal PCBs with a current conducting Cu-layer. The calibration is achieved by measuring the magnetic field above the current conducting Cu-layer. The obtained positions of zero-crossing of magnetic field are associated to the mechanical coordinates measured by touch stylus.
13. Zero Gauss Chamber for Offset Cancelling



**Options:**

1. MMS-SafetyCabinet/Curtains: Safety Cabinet to satisfy the CE directives (mandatory for the production environments).
2. MMS-CAL/REF: Calibration tool for In-Situ calibration of the Hall probe (sensitivity matrix of the Hall probe)
3. MMS-CMM: Dimensional measurement of objects under test and absolute magnet positioning utilizing 3D touch sensor.
4. MMS-MR2 and MMS-MR3: Up to three selectable magnetic field ranges.
5. MMS-DEF: Eddy-current probes for crack detection in magnetized and non-magnetized parts.
6. MMS-SLID: Sliding probe for in-contact magnetic field measurement; Field sensitive volume is less than 100µm from the magnet surface.
7. MMS-CMP500x500x300: Extended scanning volume (500 x 500 x 135mm$^3$)

The SENIS **In-Situ Calibration automatic procedures** for the magnetic field mapping system are derived from approved technical standards and are made with instrumentation calibrated under these standards. The full re-calibration process can be completed on-site by customer.

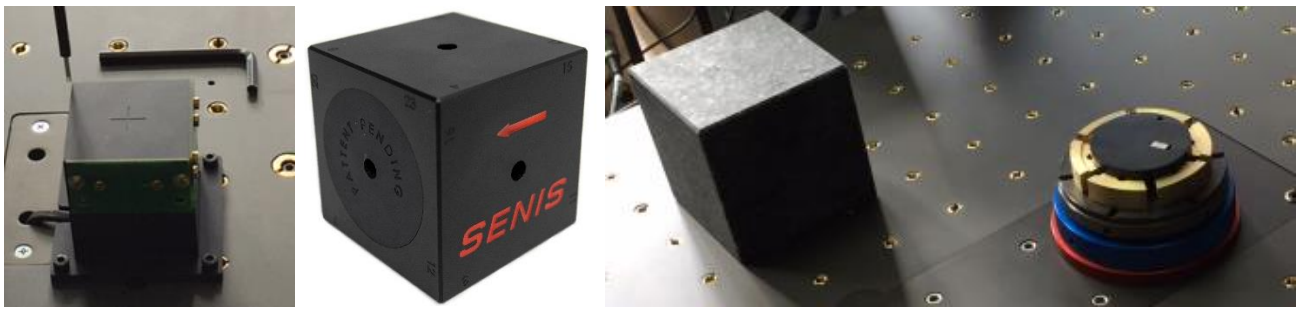



*Figure 8:* **In-Situ Calibration tools – a) Magnetic field sensitive spot location; b) Hall probe sensitivity matrix; c) Mechanical system calibration for extended scanning volume (alignment of the Cartesian Moving Platform)**

## SYSTEM SPECIFICATIONS:

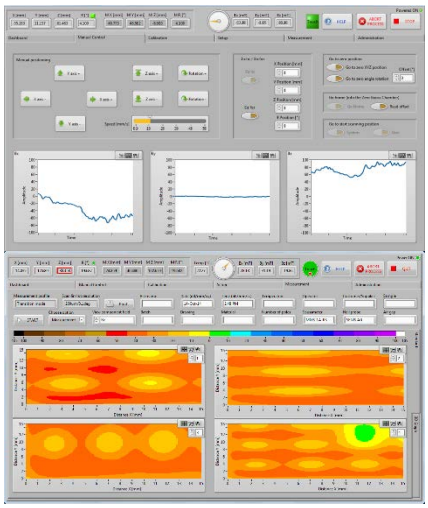
| **Mechanical Specifications:** | | | | |
|---|---|---|---|---|
| **Parameter** | **Values** | | | |
| **The dimensions of the mechanical part of the scanner** | **400 mm x 350 mm x 650 mm** | | | |
| **Total system weight** | • **Mechanical part: 26 kg**<br>• **Electronic module: 7 kg**<br>• **Personal Computer: 2 kg** | | | |
| **Maximal scanning volume (other on request)** | | **X [mm²]** | **Y [mm²]** | **Z [mm²]** |
| | **MMS-1A-RS** | **125** | **125** | **125** |
| | **- extended Z-axis** | **125** | **125** | **290** |
| | **MMS-1X-RS** | **570** | **570** | **290** |
| | **- extended Z-axis** | **570** | **570** | **380** |
| **Minimal distance of MFSV (Magnetic Field Sensitive Volume) from the magnet** | **0.3 mm** | | | |
| **Maximal scanning speed** | **100 mm/s** | | | |
| **Encoder resolution** | **1 µm (linear); 0.022° (rotational)** | | | |
| **Positioning repeatability** | **10 µm (linear), 0.05° (rotational)** | | | |
| **Start-up time from cold start till availability for measurement** | **< 3 min** | | | |
| **Shut down time** | **< 1 min** | | | |
| **Recovery time from an emergency stop** | **< 1 min** | | | |
| **Magnetic Field Measurement Specifications:** | | | | |
| **Parameter** | | **Set 1** | **Set 2** | |
| **Magnetic field measuring range** | **Included** | **± 100 mT** | **± 50 mT** | |
| | **Optional** | **± 500 mT** | **± 200 mT** | |
| | **Optional** | **± 2'000 mT** | **± 1'000 mT** | |
| **Magnetic measurement resolution** | **better than 0.02% for measurement range ≥200mT**<br>**better than 0.05% for measurement range ≤100mT** | | | |
| **Accuracy of the magnetic field measurement** | **better than 0.1%** | | | |
| **Measurement sampling rate** | **> 60 kSamples/s, *for 3-channels acquisition***<br>**> 200 kSamples/s, *for 1-channel acquisition*** | | | |
| **Magnetic field Frequency Bandwidth** | **DC to 2.5 kHz (-3dB point)**<br>**Optional: DC to 25kHz for 3-axis** | | | |

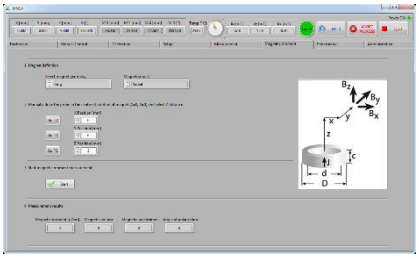
## SOFTWARE:

The user-friendly software, based on LabVIEW on MS Windows platform, offers the following features:

- User defined scanning paths, scanning resolution and movement speed
- Command editor for scanning path definition
- Automatic color coding of magnetic field maps
- Zoom and rotate of 2D and 3D images
- Magnetic field and magnetic angle measurement presentation
- Movable cursor displaying X and Y coordinate and magnetic flux density value
- Report generation (PDF and txt files)
- Measurement range selection
- Dimensional measurement (CMM)
- Crack detection (eddy-current measurement)
- On-site calibrations
- Probe positioning via mouse and via keyboard
- Operator and Administrator permissions
- Probe returns to the start measuring point after the full scan is performed

... and much more.





## TYPICAL APPLICATIONS:

- Measurement of all three components of magnetic field (Bx, By, Bz), magnetic angle measurement, angle error, inhomogeneity, peak and zero value detection of magnetic encoders, number of magnetic poles counting, pole width calculation, pole distribution of multipole magnets and rotors, etc.
- Quality assessment tool in production, for assemblies such as single and multi-pole permanent magnets, rotors, encoders, loudspeakers, photocopier rollers and magnetic ribbons, smartphones, tablets, PCBs, etc.
- Detection of cracks in permanent magnets
- AC magnetic field mapping
- Development of magnet systems
- Application in laboratories and in production lines, etc.

## Probe types:

| Denomination | Description | Chip | Minimal measuring distance | | Dimension (excl. holder) | | |
|---|---|---|---|---|---|---|---|
| | | | X [mm] | Z [mm] | L [mm] | W [mm] | T [mm] |
| HM | Ceramic packaged probe | covered chip | 0.25±0.05 | 0.3±0.05 | 47 | 2 | 0.78 |
| HMs | Ceramic packaged probe | covered chip | | | 47 | 2 | 0.5 |
| HL | Ceramic packaged probe | covered chip | | | 71 | 2 | 0.78 |
| HLs | Ceramic packaged probe | covered chip | | | 71 | 2 | 0.5 |
| KM | Ceramic packaged probe | open chip | 0.25±0.05 | | 47 | 2 | 0.78 |
| KMs | Ceramic packaged probe | open chip | | | 47 | 2 | 0.5 |
| KL | Ceramic packaged probe | open chip | Tip: <0.1 | | 71 | 2 | 0.78 |
| KLM | Ceramic packaged probe | open chip | | | 71 | 2 | 0.5 |
| KF | Flexprint and Ceramic | open chip | 0.1±0.05 | 0.35±0.1 | 47 | 2 | 0.78 |
| SHP | In-contact Sliding Probe | covered chip | 0.5 | - | 25 | 3 | 3 |

## Probe Holder types:

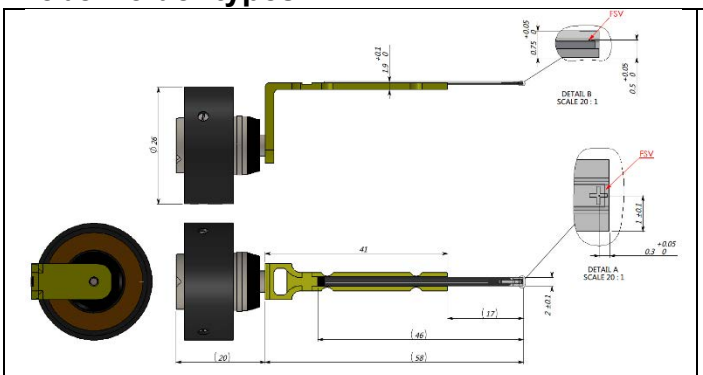


*Fig. 9: Bend holder with KM probe*

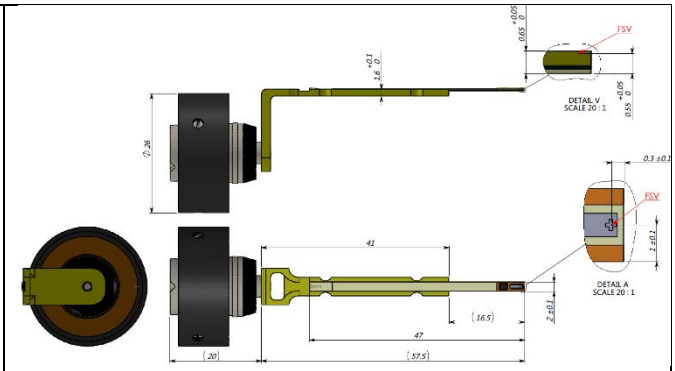


*Fig. 10: Bend holder with KF probe*

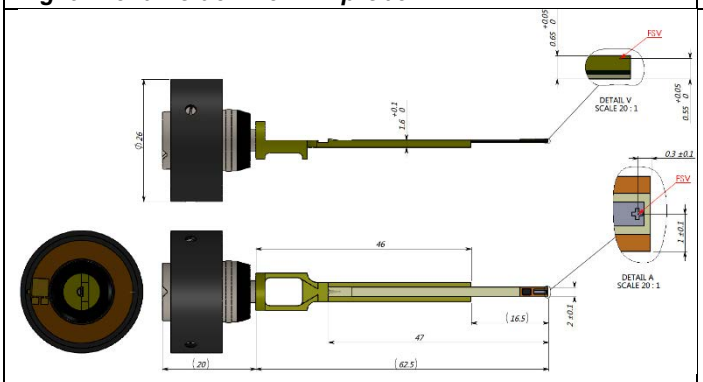


*Fig. 11: Straight holder with KF probe*

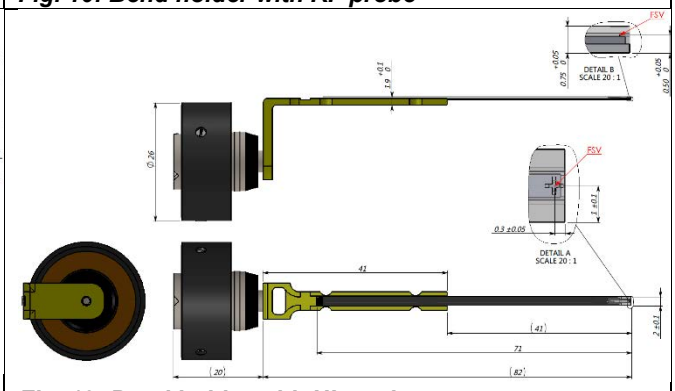


*Fig. 12: Bend holder with HL probe*

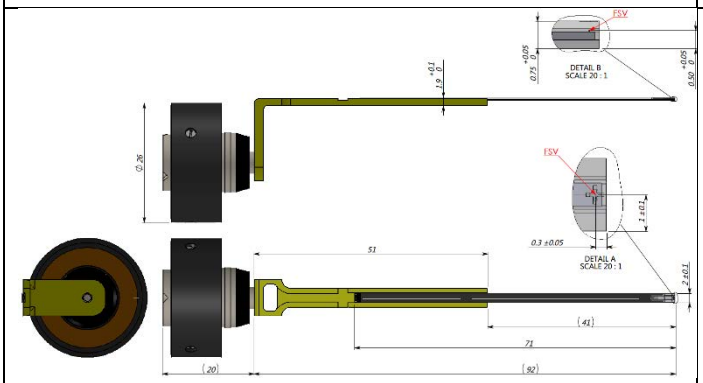


*Fig. 13: Extralong bend holder with HL probe*

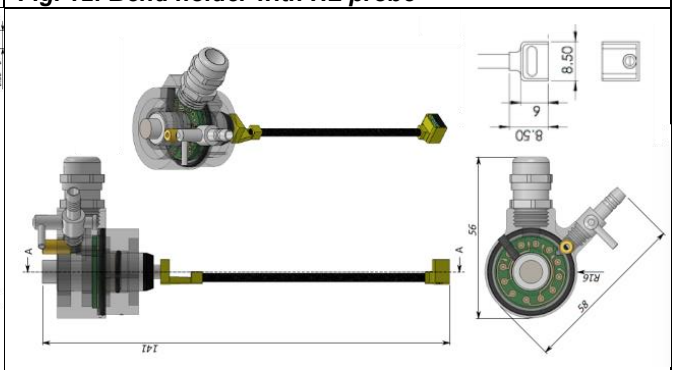


*Fig. 6: AMR probe (MMS-AMR)*