Investigation of permanent magnet properties
m-axis is a measurement system to investigate the magnetic specifications of permanent magnets (magnetization angle and magnetic moment). Due to the modular setup it is possible to customize the measurement range of the m-axis system in addition to the three standard ranges and for 100% quality control.
Measurement process:

The calculation routine of the m-axis-system is based on the determination of the dipole parameters of permanently magnetic materials using an integrated AMR sensor set-up. That way the three-dimensional position \((x, y, z)\) of the magnet as well as its magnetic moment \((m)\) and the angular direction \((\varphi, \theta)\) of the magnetization are determined simultaneously.

Because of the universally applicable approach the evaluation of axially as well as diametrically magnetized dipole permanent magnets regarding their quality and strength. By implementation of various user defined magnet types and measurement processes in the comprehensive user software the system delivers a real time classification of numerous dipole possibilities. All relevant settings and measurement results can be saved to a single report file.
Standard measurement systems:

The concept of the m-axis-system allows by the help of different set-ups three standard models available:

- **m-axis S** measurement range: 0.01 - 1.00 Am²
- **m-axis M** measurement range: 0.10 - 3.00 Am²
- **m-axis L** measurement range: 1.00 - 10.00 Am²

Models with specifically customized measurement ranges can be offered as well.

Items delivered:

- **PC (optional) & software**
- **Test magnet for system check**
- **Angled plate (optional)**
- **Foot switch**

Advantages of the m-axis measurement system:

- No temperature-related signal drift due to calibrated AMR sensors with temperature correction
- System-check by the user with the attached test magnet possible at any time
- Calibrated as a system
- Extensive user software for definition of various measurement processes and magnet types
- Automatically generated protocols with all relevant settings and measurement data
- Measurement independent of direction of magnetization (axially or diametrically)
- Display of measurement quality during the process
- User independent measurement of magnetic properties
- Option for integration in measurement environments
- Foot switch with USB interface
- Measurement processes are transferable to other matesy systems
- Modulated set-up for application specific measurements
- SAP-interface
m-axis modules:

Rotation axis module:

Systems containing a rotatable axis provide the possibility for 360°-rotation during the measurement process.

Hereby more than 160 distinct measurements are done and ultimately averaged. The angular accuracy is therefore improved to ± 0.1%.

North/South module:

The North/South module measures the surface magnetic field of axially magnetized permanent magnets using hall-sensors. Through a 180°-flip of the magnet and a second measurement the ratio regarding north pole and south pole can determined and issued in %. This measurement can be done both in addition to the dipole property determination and as a stand-alone test.

Temperature module:

The magnetic moment is corrected to the reference value at 20°C by simultaneously measuring the room temperature and entering the temperature coefficient for the evaluated magnets. Additionally studies of the magnetic moment at varying temperatures may be performed. The accuracy of the temperature correction is ± 0.1% for every 10°C temperature difference.

Table module:

To reduce the noise originating from laboratory tables the system electronics can be integrated within a non-magnetic table.
Automatic measurement:

For 100% automated measurement and classification an I/O-module for connection with a PLC as well as an embedded version are available.

I/O modul:

The I/O module possesses 16 predefined PINs for inclusion of the m-axis into a measurement environment:

- Input: 110-230V/AC, 50-60Hz
- Output: 24V/DC
- Data-Interface: USB
- adjusted m-axis-software for inclusion of the I/O module
- # of I/O PINs: 16

Embedded version:

With the integration of an embedded PC into the m-axis power supply unit the measurement system can be accessed externally using USB, serial BUS or via an Ethernet interface. Additionally a screen and a keyboard may be connected to the power supply unit.
Outlook:

Fully automated magnet measuring system

Technical features:

<table>
<thead>
<tr>
<th>Measuring range:</th>
<th>0.1 - 5 Am²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy:</td>
<td>± 0.5° (magnetization angle)</td>
</tr>
<tr>
<td></td>
<td>± 1% (magnetic moment)</td>
</tr>
<tr>
<td>Testing speed:</td>
<td>fewer than 2 s</td>
</tr>
<tr>
<td>Magnet reservoir:</td>
<td>up to 1800 magnets</td>
</tr>
<tr>
<td>Magnet size:</td>
<td>appr. 5cm³ (for NdFeB)</td>
</tr>
<tr>
<td>Sample geometry:</td>
<td>various shapes possible</td>
</tr>
</tbody>
</table>

Options:
- Magnetization unit
- Marking unit
- Geometry measurement
- Weight measurement
- Sorting unit
Technical features:

<table>
<thead>
<tr>
<th>Sensors:</th>
<th>Calibrated AMR sensors with temperature correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determination of the magnetic moment:</td>
<td>± 1% (within calibration range)</td>
</tr>
<tr>
<td>Repeatability of the magnetic moment (determined through MSA):</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>Accuracy of magnetization angle:</td>
<td></td>
</tr>
<tr>
<td>• Static measurement:</td>
<td>± 0.3°</td>
</tr>
<tr>
<td>• Rotation axis module measurement:</td>
<td>± 0.1°</td>
</tr>
<tr>
<td>Measurement time:</td>
<td></td>
</tr>
<tr>
<td>• Static measurement:</td>
<td>1s</td>
</tr>
<tr>
<td>• Rotation axis module measurement:</td>
<td>appr. 12s</td>
</tr>
<tr>
<td>Interface:</td>
<td>USB</td>
</tr>
<tr>
<td>User software:</td>
<td>Software adjustable for data acquisition and storage (Q-DAS interface)</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>450 x 450 x 60 - 230 mm³ (depending on module choice)</td>
</tr>
<tr>
<td>Power supply:</td>
<td>100 - 230V/AC, 50 - 60Hz</td>
</tr>
<tr>
<td>System check:</td>
<td>Testing with adapted fixtures possible through 4 included holes</td>
</tr>
<tr>
<td>Items delivered:</td>
<td><strong>m-axis</strong> measurement system, software, test magnet, foot switch</td>
</tr>
<tr>
<td>Options:</td>
<td>PC, rotation axis module, temperature module, table module, North/South module, angled plate, USB-cable</td>
</tr>
</tbody>
</table>