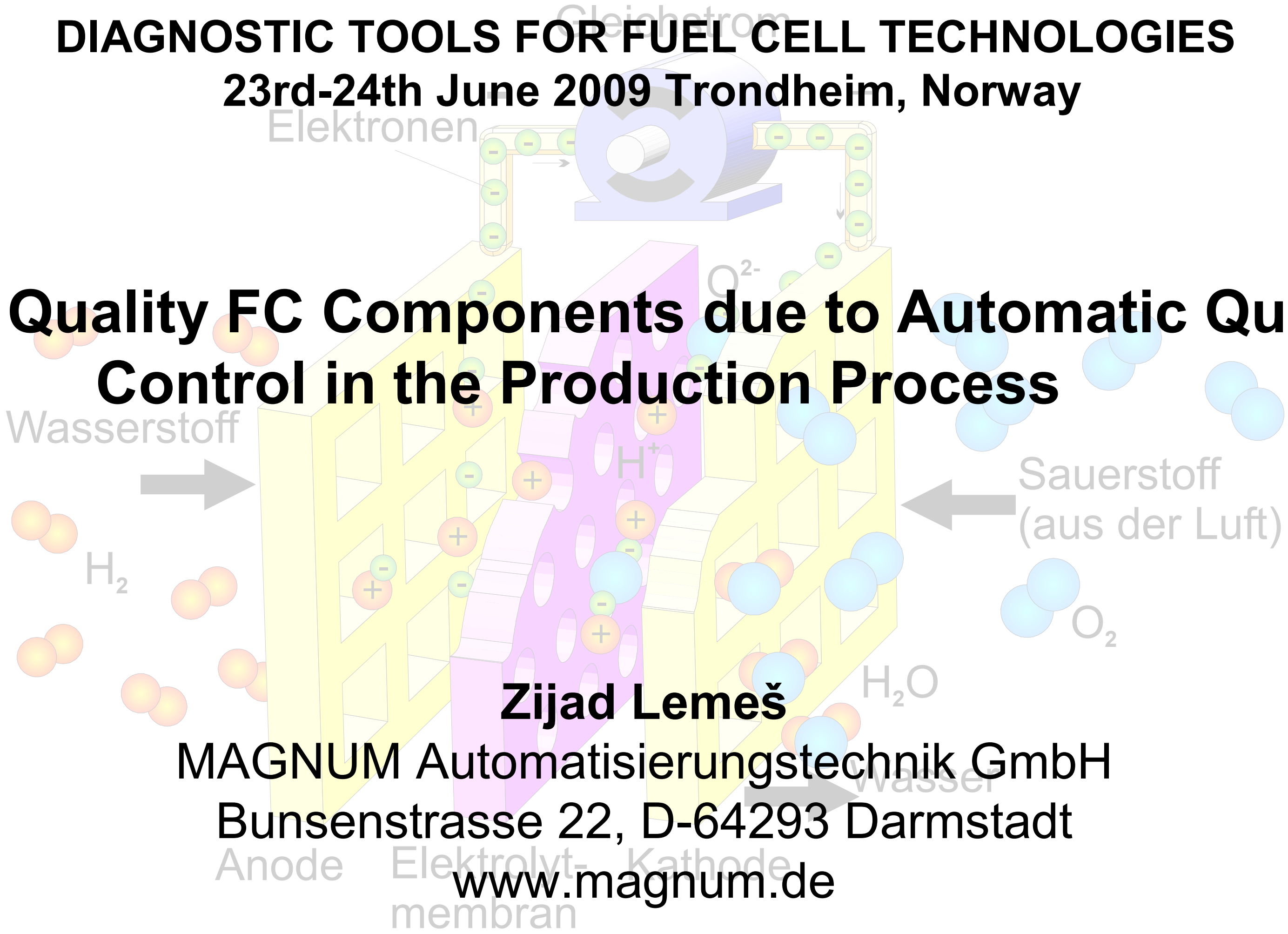
MAGNUM® Fuel Cell

DIAGNOSTIC TOOLS FOR FUEL CELL TECHNOLOGIES
23rd-24th June 2009 Trondheim, Norway



High Quality FC Components due to Automatic Quality Control in the Production Process

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Outline

MAGNUM

- The Company
- Motivation
- QC Methods
- Application Examples
- Summary

MAGNUM® Fuel Cell
The Company

- MAGNUM Automatisierungstechnik GmbH
  www.magnum.de

- Located in Darmstadt, Germany

- Founded in 1987

- Fuel Cell Test Stands since 1998

- Supplier of Test Systems for Fuel Cells
- Specialist for Pipeline Monitoring
- Consultant in Research and Development

MAGNUM® Fuel Cell
The Company

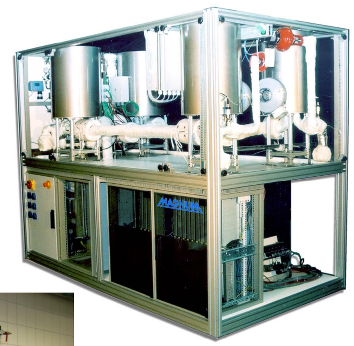
Engineering Service

MAGNUM®
Fuel Cell

LEO-Pipe®
Pipeline Monitoring

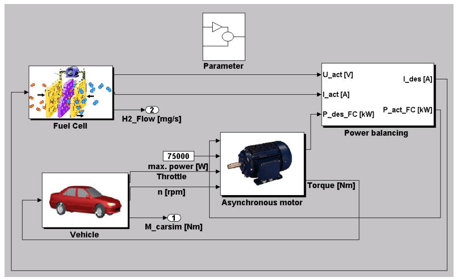
MAGNUM® Fuel Cell

The Company

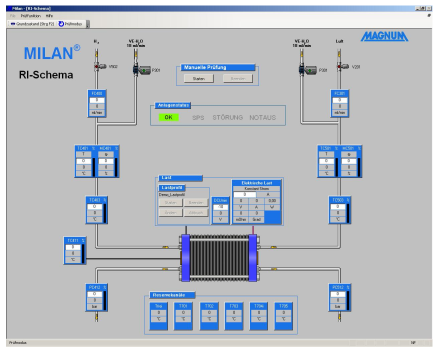


- Test stands for research, development and production

- Measurement service in own laboratory



- Modeling and HIL Simulation



- Controls and automation (MILAN®)

Motivation

- Online failure recognition
  - ⇒ efficient optimisation of production process
  - ⇒ high product standards
  - ⇒ cost reduction

- Integrated data management
  - ⇒ complete documentation
  - ⇒ batch tracking
  - ⇒ supervision of the different production steps

- Membrane Test
- Leakage Test of MEA
- Thickness Measurement of BPP
- Integrated Data Management for QC

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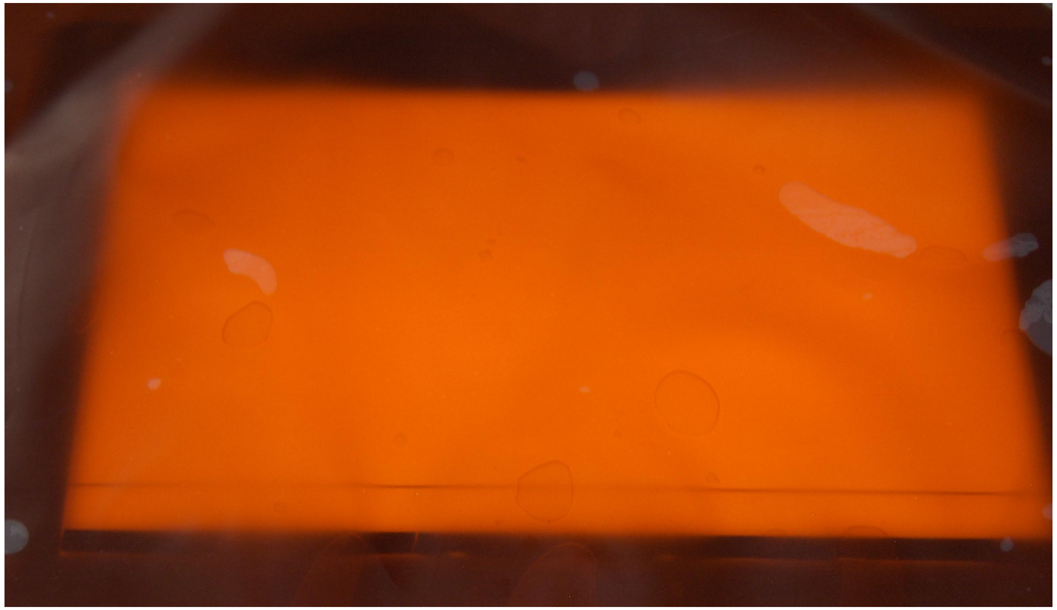
Membrane Test

- **Possible failures:**
  - Pinholes
  - Bubbles
  - Impurities
  - Thin areas
  - Particle inclusions



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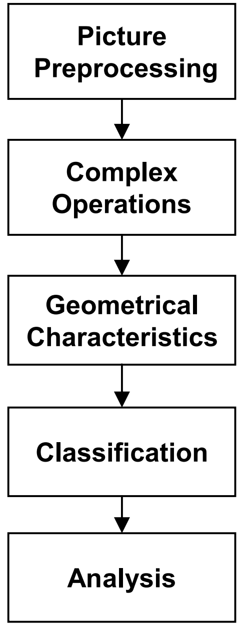
Membrane Test

- **Picture recording:**
  - § Picture recording with intelligent USB-Camera, optimized parameters for continuous band feed
- **Picture preprocessing:**
  - § SW based removal of disturbances, e.g. uneven illumination. Binary code of the picture
- **Extraction of attributes:**
  - § Detection of certain attributes, e.g. area, brightness,...
- **Classification:**
  - § Consumption in to different defined classes, e.g. certain form, size
- **Analysis:**
  - § Analysis of the test result



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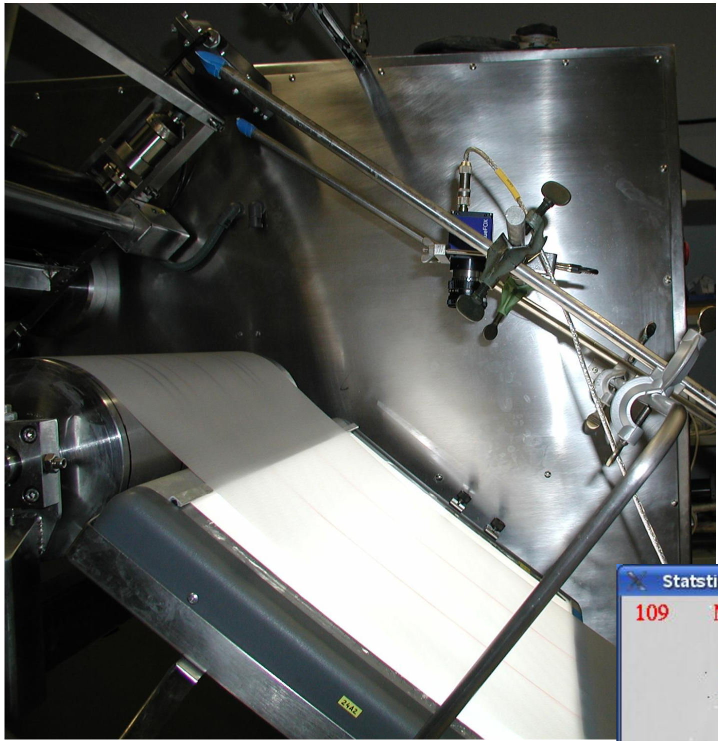
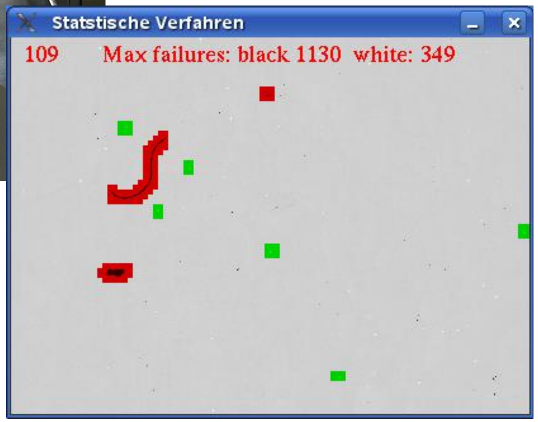
Membrane Test

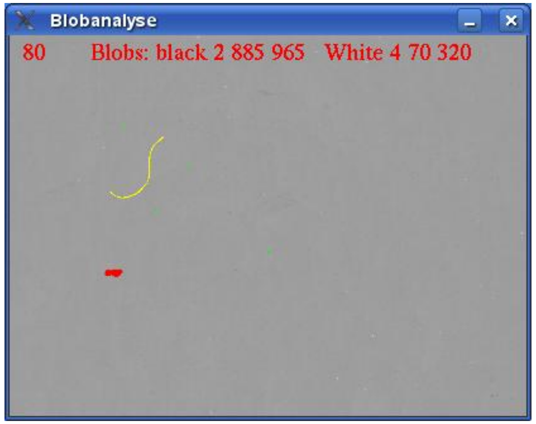


Membrane plant

Original picture



Statistical methods



Blob analysis

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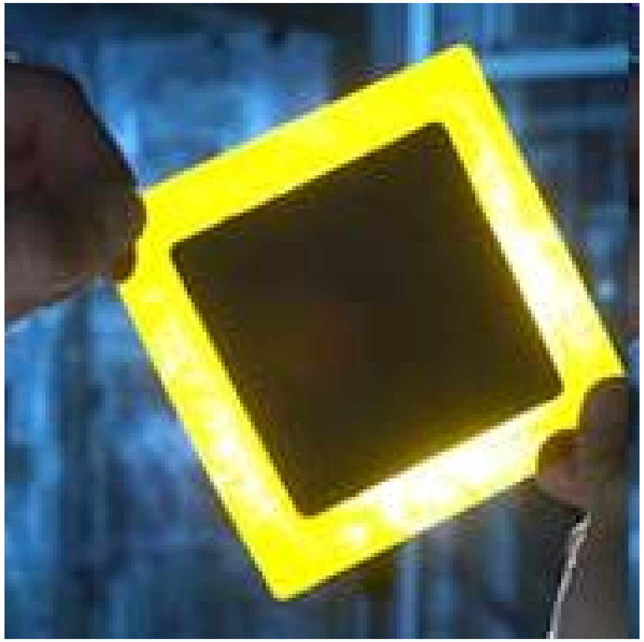
Leakage Test of MEA

- **Detection of leakages:**
  - End of line control
  - Fast control cycles (100 % -control)
  - Optimisation of production process
  - Minimisation of failures
  - Cost saving



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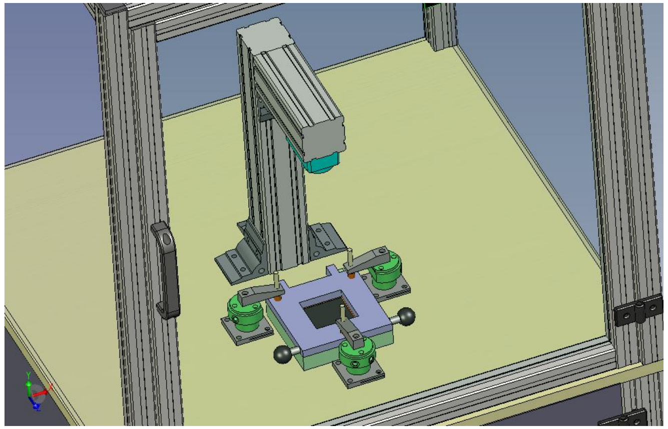
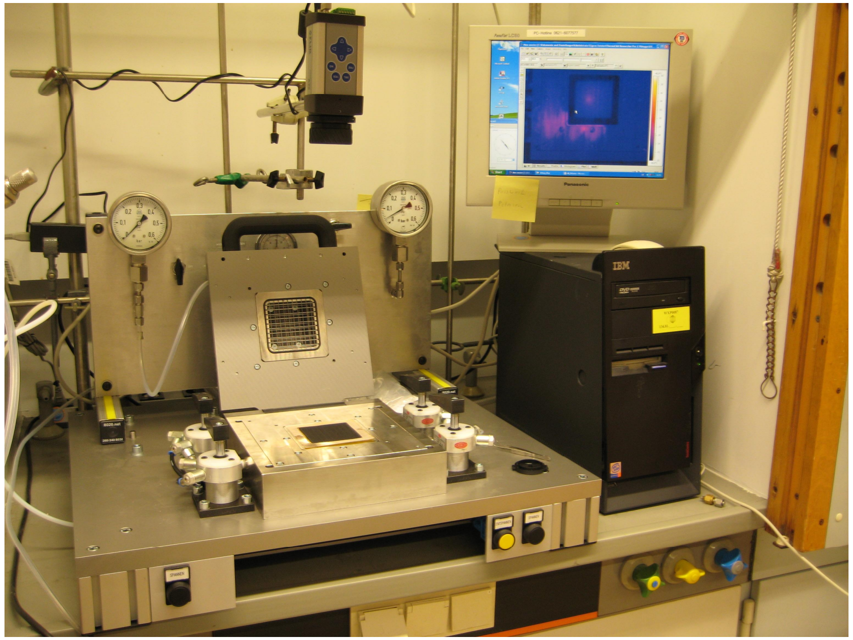
Leakage Test of MEA



Construction of MEA Tester



MEA Tester

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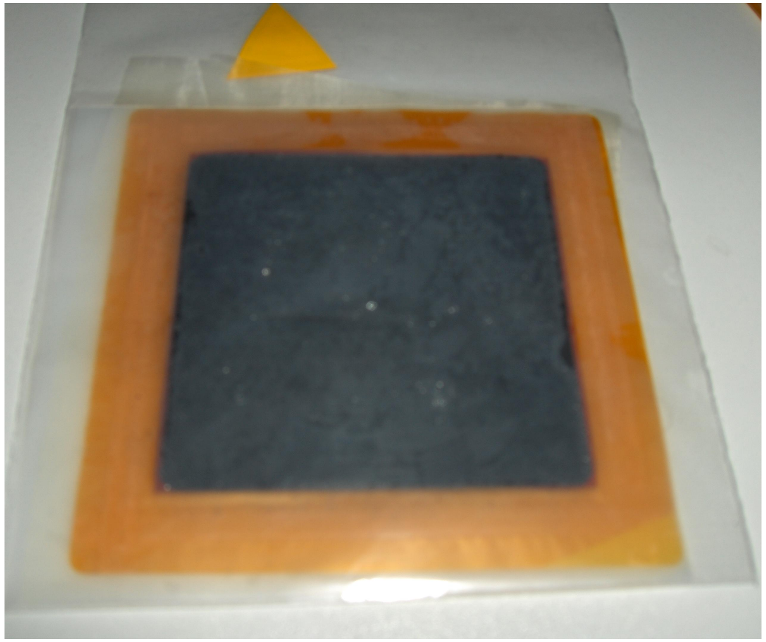
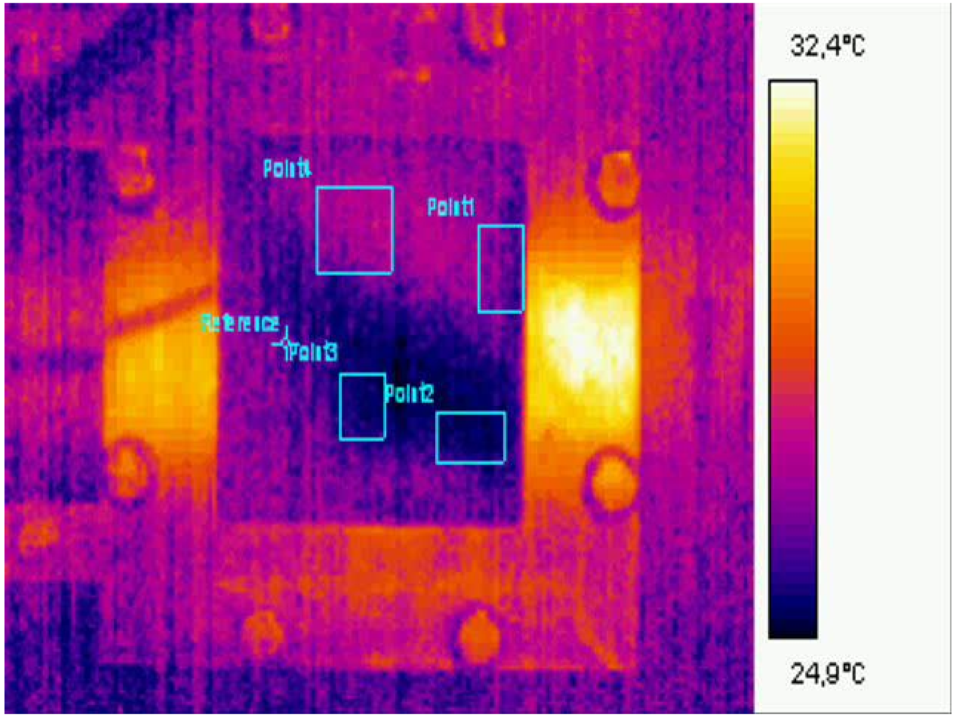
Leakage Test of MEA





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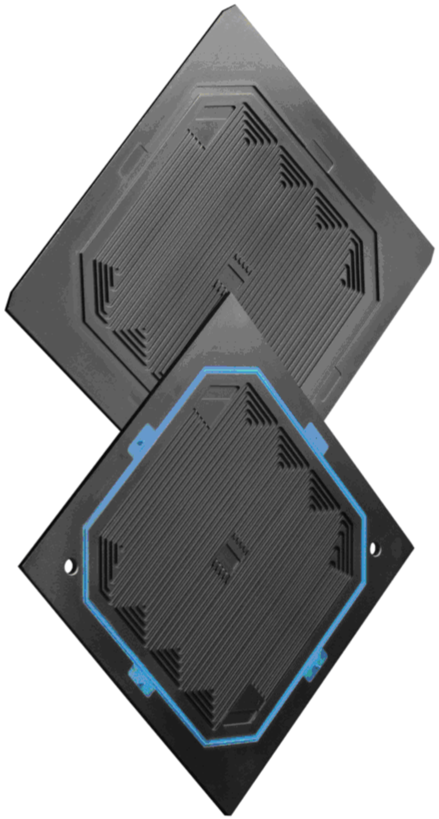
Thickness Measurement of BPP

- **Specification:**
  - BPP from 50 mm x 50 mm to 250 mm x 300 mm
  - Thickness from 1 mm to 5 mm
  - Accuracy: +/- 0.005 mm
  - Measurement of thickness profile
  - Data management with MILAN®
  - Data interface to existing QC system



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Thickness Measurement of BPP

Sensor-type	Accuracy	Price	Environmental Influences	Wear	Surface Property
Capacitive Sensor	0	+	-	0	+
Ultrasonic Sensor	0	++	-	++	+
Metering Roller	+	--	-	-	+
Laser Sensor	++	-	0	++	++

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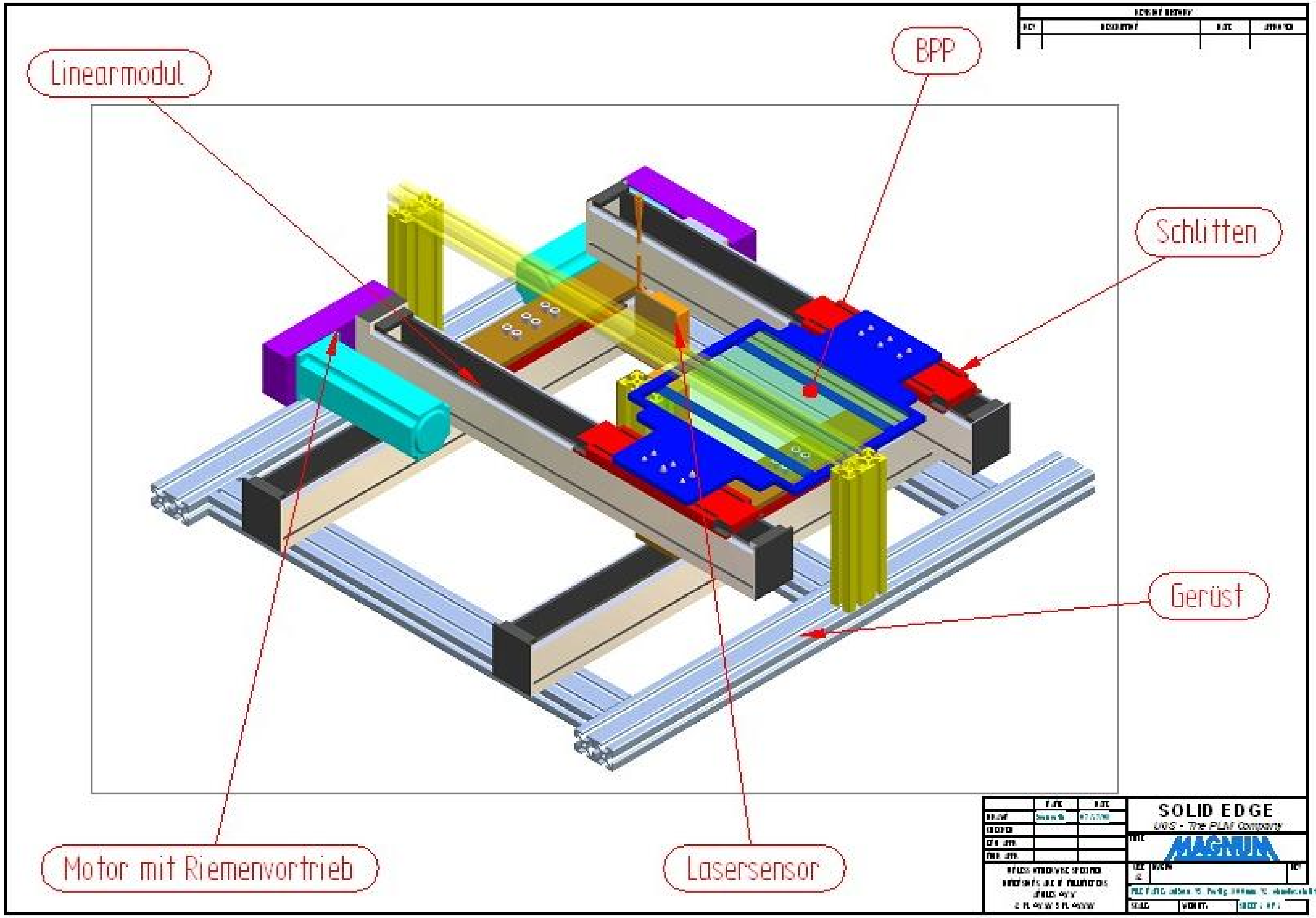
Thickness Measurement of BPP



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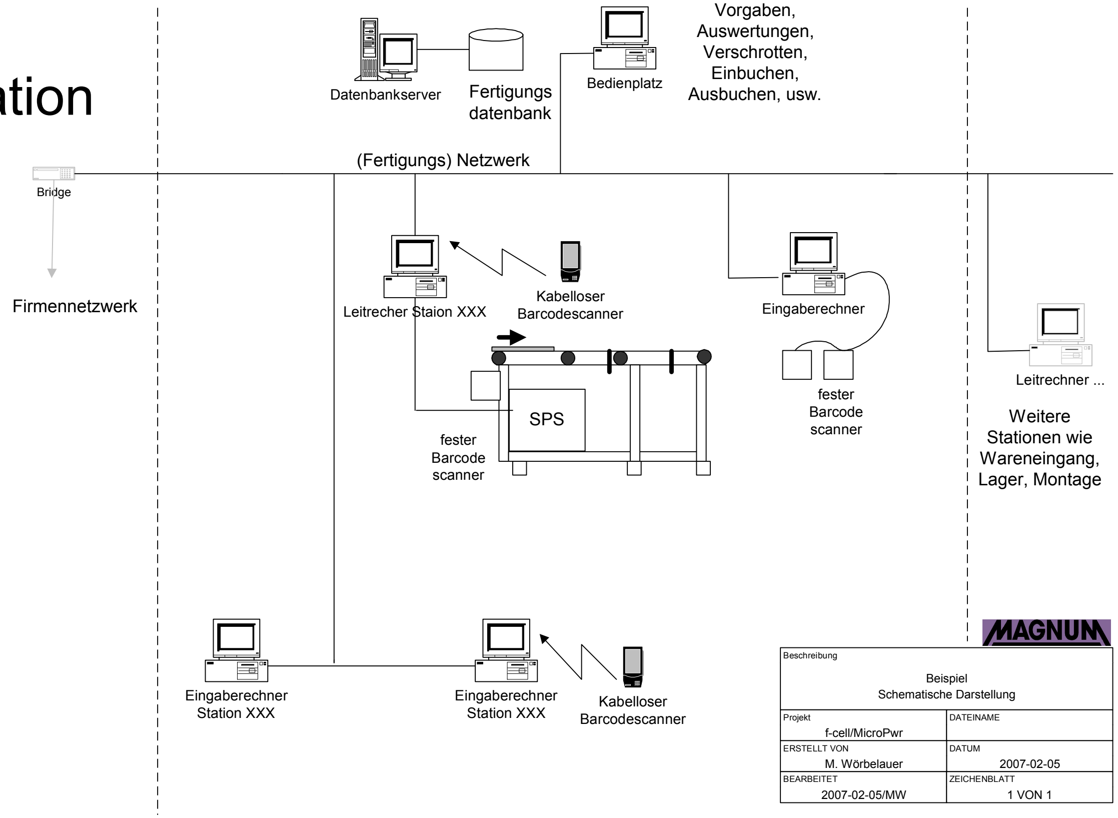
Integrated Data Management for QC

- **Integrated data management:**
  - § Traceability
  - § Complete documentation
  - § Supervision of production process
  - § Optimisitaion of production process



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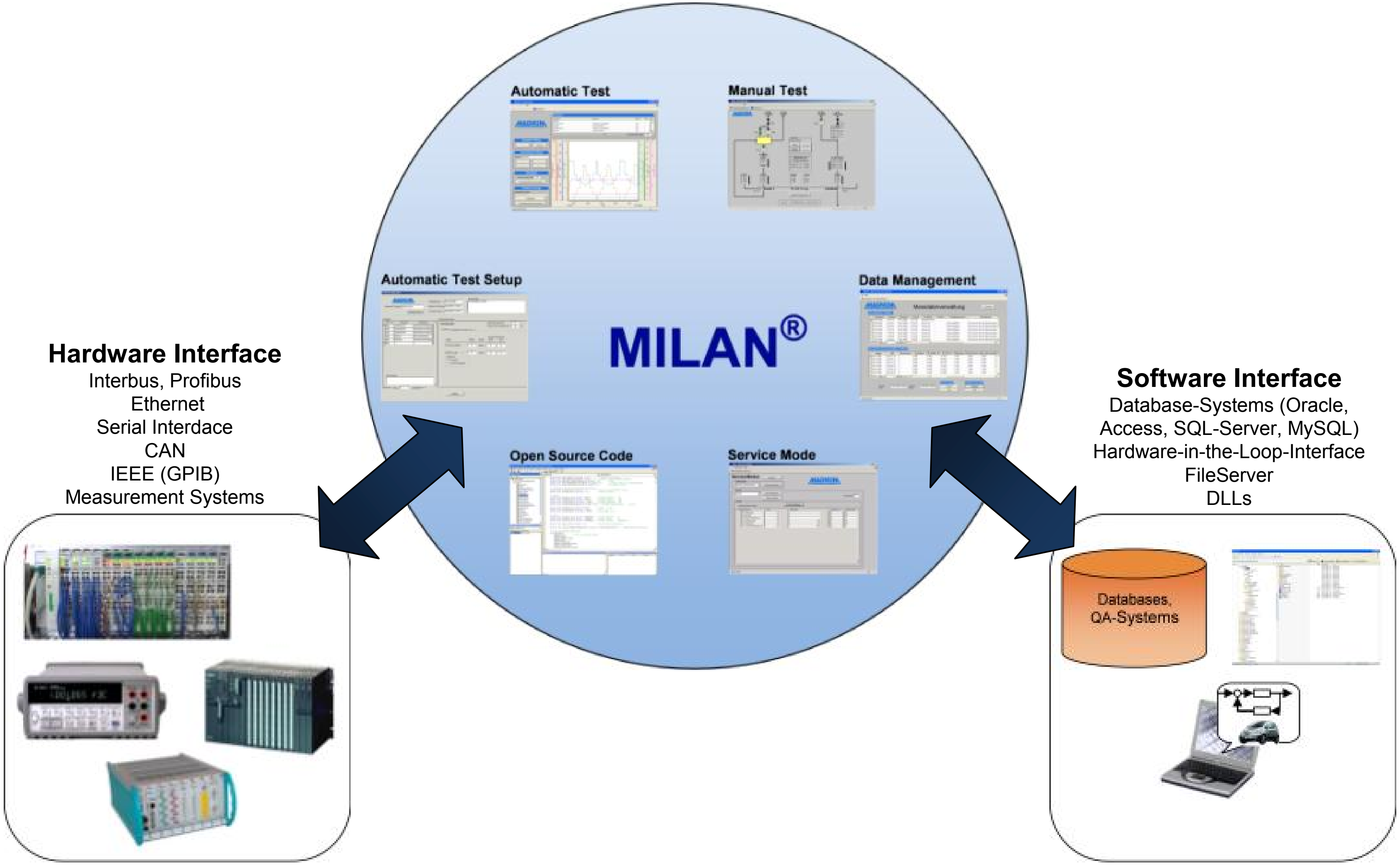
Integrated Data Management for QC



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Summary

- **Different methods and applications of QC in the production process of FC components**
  - Membrane Test
  - Leakage Test of MEA
  - Thickness Measurement of BPP
  - Integrated Data Management for QC

Acknowledgements

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