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Sentron (Melexis) CSA-1V Linear Hall Effect Sensor

- Magnetic Measurement Requirements for Accelerator Magnets
- Magnetic Sensors for industrial, automotive, and consumer applications
- The Integrated Magnetic Concentrator for increased field sensitivity
- Possible Applications of the CSA-1V for “Fringe Field” measurement
    - Non-contact measurement of electric current
    - Three-Component Magnetic Field Sensor
    - Facility Field Monitor
    - Personal Magnetic Field Monitor
    - Sensor Arrays for Rapid Mapping Field
    - Electrical Equipment Condition Monitoring

Lou Law, Brian Richter, Ian Walker, GMW Associates

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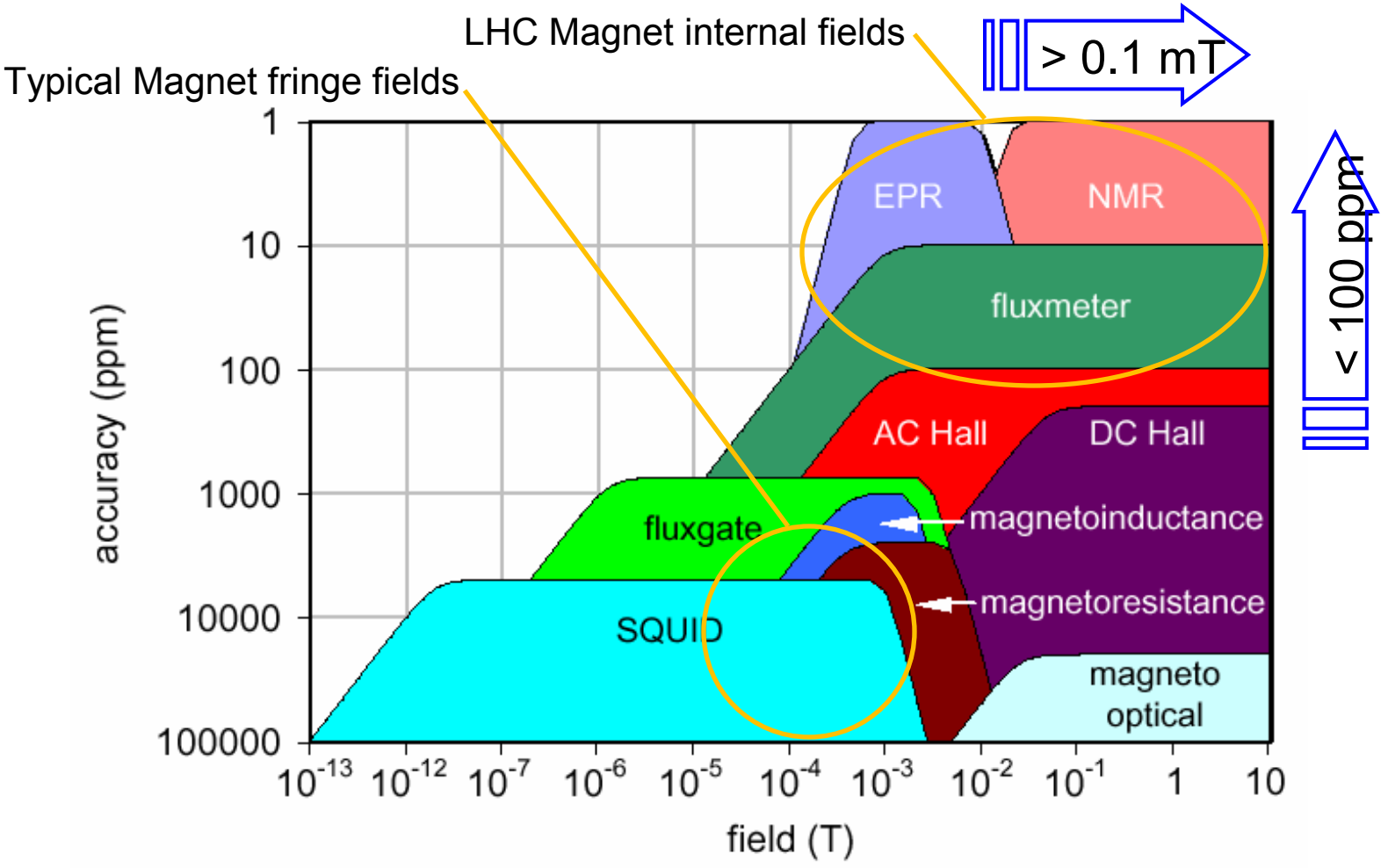

Magnetic Measurement Techniques for the LHC, Luca Battura, MT-19, 2005

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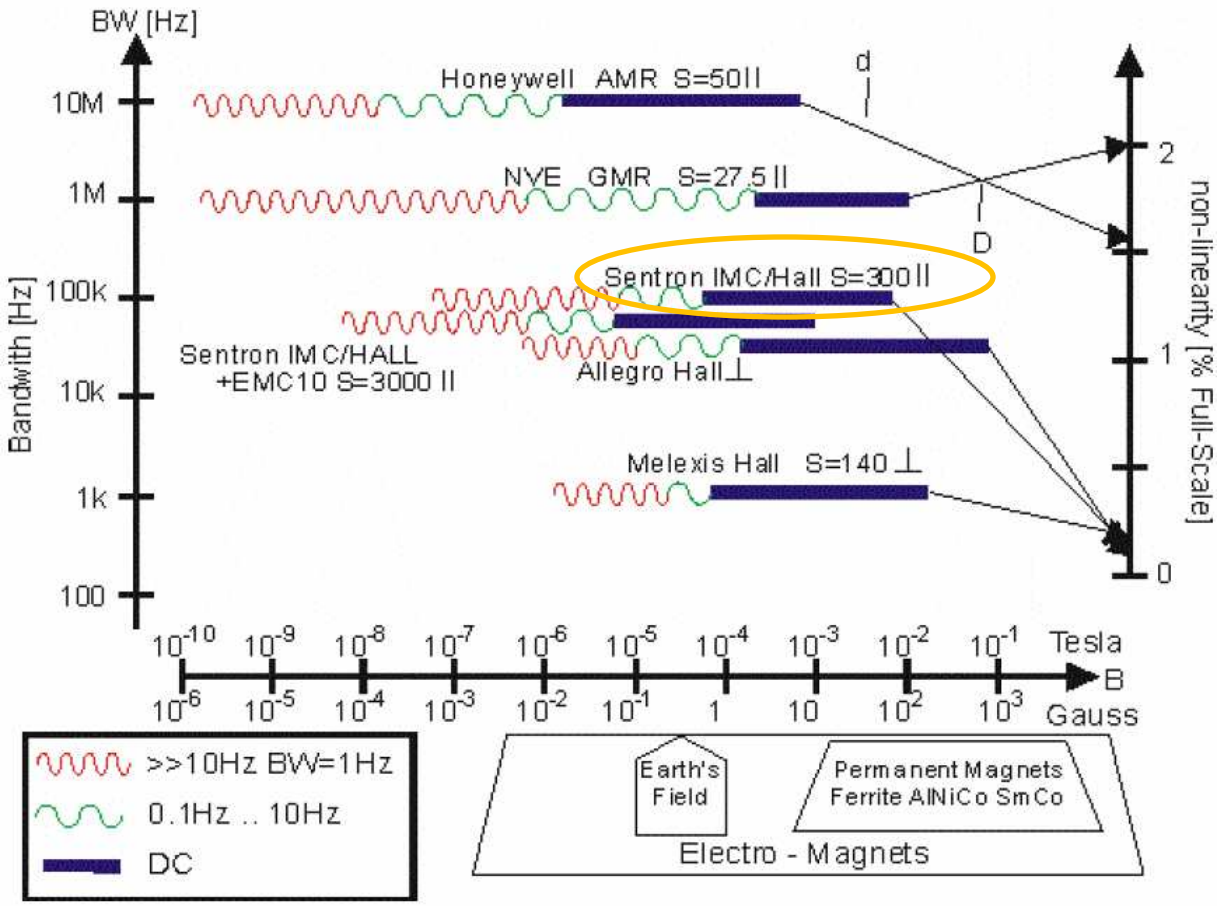
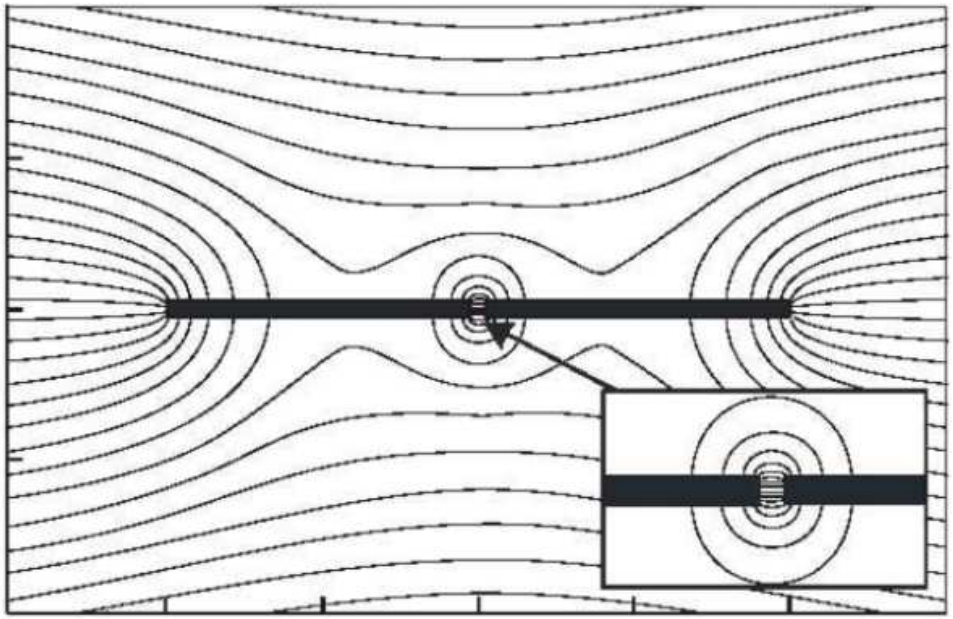


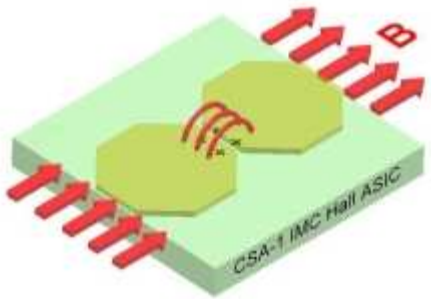
Performance Data for Magnetic Field Sensors, Radivoje Popovic, Sensors Expo, 2002

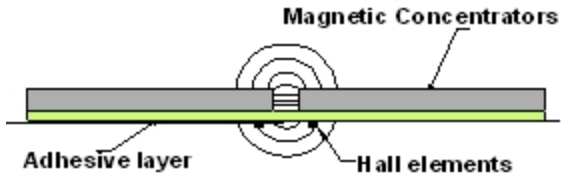
The Integrated Magnetic Concentrator (IMC)



Flux lines

Geometry





Magnetic field and current and/or energy sensor, Swiss patent CH 030062/95
Radivoje Popovic et al, application date October 1995.

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CSA-1V Specifications

Symbol	Parameter	Value
S	Magnetic Sensitivity	280 ±3% mV/mT
$\Delta s/s\Delta T$	Magnetic Sensitivity Temp Drift	±0.2% °C
V_{off}	Offset Voltage	±15mV (±0.05mT, ±0.5G)
$V_{off}/\Delta T$	Offset Voltage Temp Drift	±0.2mV/°C (0.7μT/°C, ±7mG/°C)
B_L	Linear Field Range	7.3mT (±73G) (2.5V ±2.0V)
B_{FS}	Full Scale Field Range	±9mT (±90G)
NL	Non-Linearity	±0.02% $B<B_L$
BW	Bandwidth	DC to 100kHz (-3dB)
t_r	Response Time	6μs
B_{noise}	Equivalent Field Noise	±10μT (±0.1G)
	Package Dimensions (overall)	6L x 5W x 1.5H mm
	Field Sensitivity	In-plane
	Unit Price (1 reel of 2600 pieces)	$2.03

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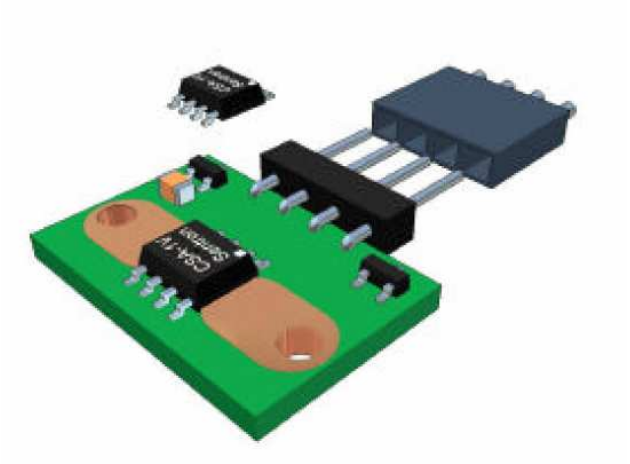
Non-Contact Measurement of Electric Current

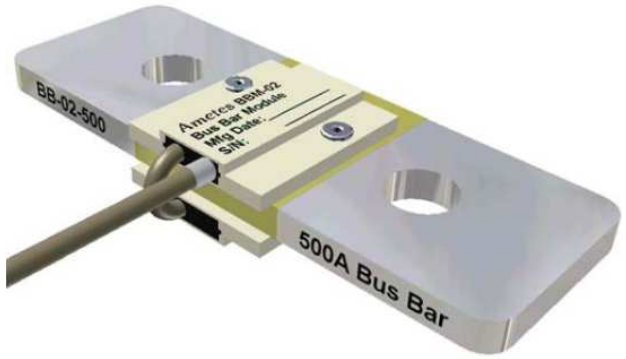


CSA-1V Application Engineering Kit
AN_120 KIT

Current Range: 0 to $8A_{rms}$

Peak current: 50A <0.5sec

Sensitivity: 38mv/A



BBM, Bus Bar Module for measuring current in electrical bus bar

Current Range: up to many kA

Electrical Isolation: <5kV

High Overload Tolerance: >100x nominal current

Sensitivity: Changed by geometry of bus bar

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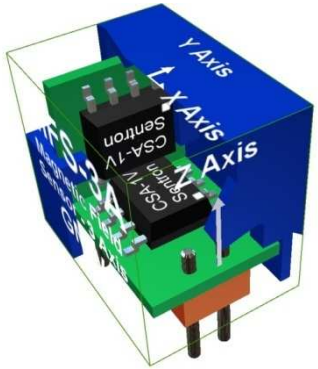
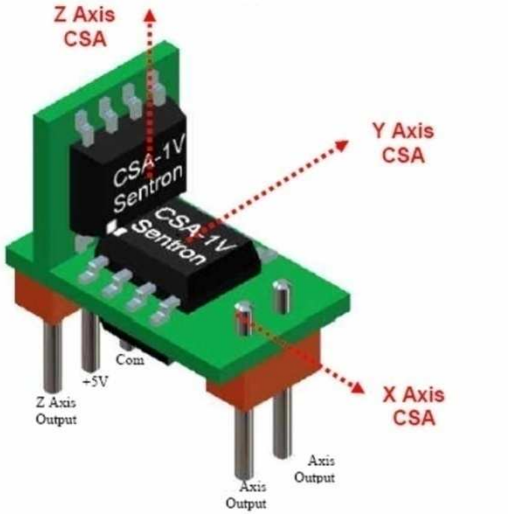
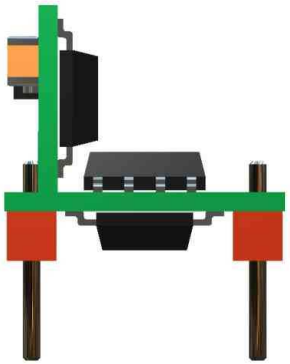
Three-Component Magnetic Field Sensor



Ametes Three Axis Magnetic Field Sensor, **MFS-3A**





- Measures Bx, By, Bz
- Suitable for environmental magnetic fields
- Field linear range: ±7.3mT (+/-73G)
- Resolution: ±10μT (+/-0.1G)
- Three linear analog outputs Vx, Vy, Vz of 2.5V ±2V
- Sensitivity: S = 280mV/mT

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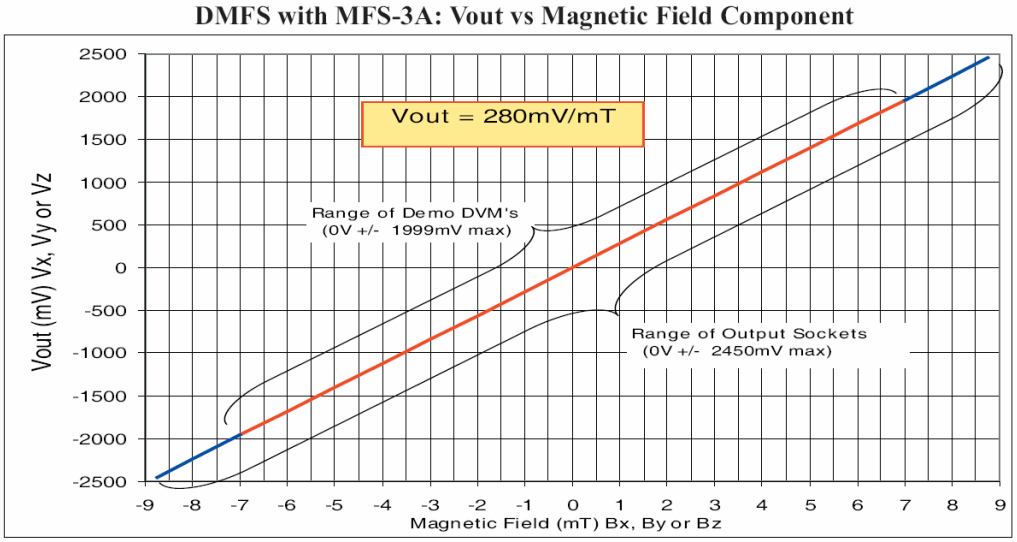
Demonstration of MFS-3A, DMFS-3A

- Self contained instrument used to demonstrate and monitor the output voltages from the Ametes MFS-3A 3-axis Magnetic Field Sensor.
- Powered by two 9V batteries and includes three DVM, one for each of the three axes, Bx, By, and Bz.



MFS-3A

Can be mounted directly on Demonstrator or end of 5m Adapter Cable.

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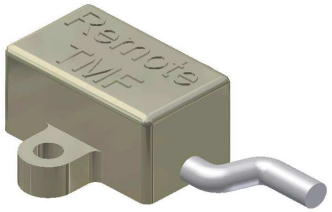
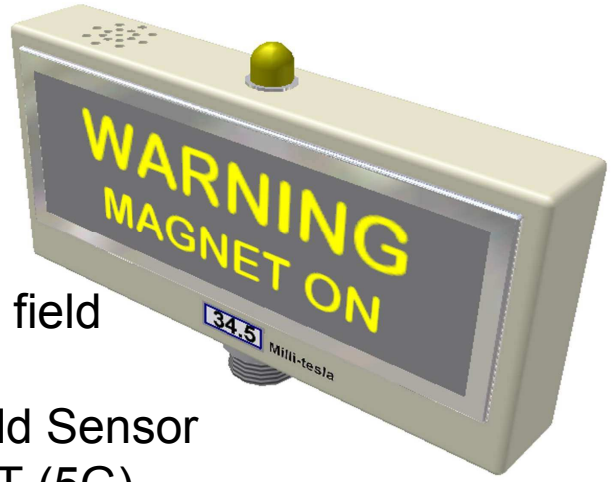
Facility Magnetic Field Detector





- Remote MFS-3A Field Sensor located in a magnetic field
- Wire or wireless communication
- Warning or Indicator location independent of the Field Sensor
- Selectable field threshold, typically total field ~ 0.5mT (5G)
- Text can be special ordered to Purchaser's artwork including different languages.
- Flashing top light (10 flashes/min) to give visibility over wide direction range. Flash rate can be increased with field level.
- Total Magnetic Magnet Field readout in Gauss or milliTesla.

Metrolab TMFD-02 Facility Magnetic Field Detector (concept)

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Personal Magnetic Field Detector

- Worn by service and user personnel
- Selectable field threshold, typically total field ~ 0.5mT (5G)
- Alarm frequency increases with increasing field
- Alarm resets after 5 minutes then operates for 5 seconds
- Alarm operates within 0.1 Sec of total field increasing over set threshold.
- Alarm produces short audio bursts every 2 min when battery is low.

Metrolab TMFD-01 Personal Magnetic Field Detector (concept)

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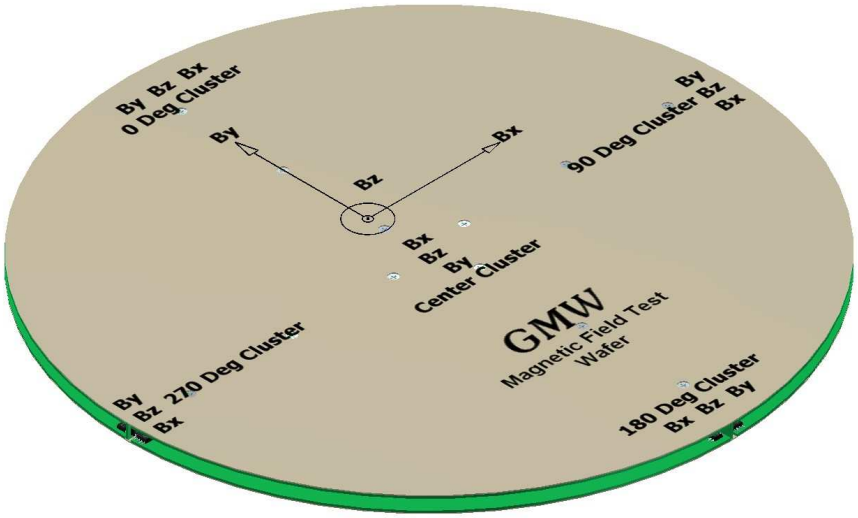
Sensor Arrays for Rapid Magnetic Field Mapping

- Three components of magnetic field measured at several different points (say 5)
- Temperature measured
- On board microprocessor accumulates readings, calculates total field, checks average, and standard deviation.
- Wireless link to USB port
- PC corrects all data for linearity and temperature.
- For 5 points data collection, transmission and correction is less than 60 seconds.



GMW Magnetic Field Test Wafer for Plasma Etch or Deposition Chamber (concept)

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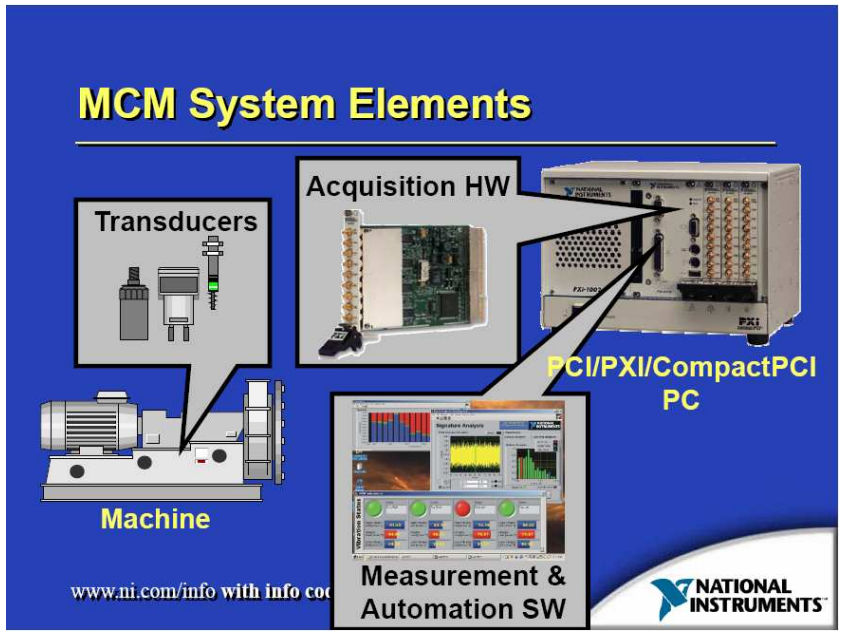
Electrical Equipment Condition Monitoring

- Machine Condition Monitoring well established.
- Add Magnetic Sensors to the Transducers list
- Non-contact and redundant monitoring of:
  - Power Transformers
  - Motors
  - Generators
  - Switching Electromagnets
- Magnetic Sensors are lower cost than accelerometers and other MCM Probes
- CSA-1V Frequency Response DC to 100kHz



Condition Monitoring Signature Analysis

Many Analysis Methods exist
The CSA-1V offers:

- Excellent amplitude and phase stability
- Stable frequency response from DC
- High magnetic sensitivity