

# Power Quality Analysers

Review of Power Quality Indicators and  
Introduction to Power Analysers

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# Power Quality Indicators

Review of main indicators of electrical energy performance commonly used in energy management systems and energy audits (i.e. AS 3598:2000)

- **Power Factor**
- **Voltage Unbalance**
- **Voltage Sag or Swell**
- **Transient Voltage**
- **Flicker**
- **Harmonic Distortion**

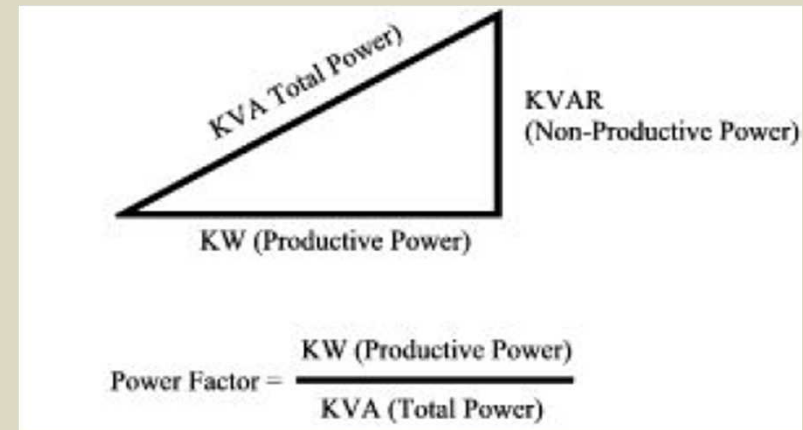
# Power Factor

## Description:

Power factor is an indication of how efficient the electrical power is used. A power factor of 1 means all the power is used and a power factor of less than one means a part of the consumed power is wasted.

## Causes of low power factor:

- Asynchronous machines
- Transformers
- Controlled current transformers
- Induction furnaces
- Self-ballasted lamps
- Fans
- Pumps
- Refrigerators



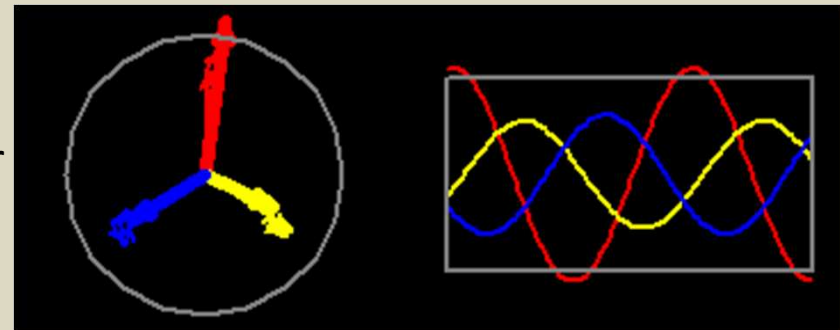
## Effects of Low Power Factor:

- Additional cost of reactive energy
- Drop of distribution capacity
- Transformer upgrades
- Larger conductor cross section

# Voltage Unbalance

## Description:

In an ideal three phase system all the voltages should be the same with 120 degrees of phase difference. The deviation of voltage amplitude or phase from the nominal values in any of the phases is referred to as voltage unbalance.



## Causes of Voltage Unbalance:

- Lighting facilities
- Welding machines
- Blown fuse in PF capacitors
- Uneven load distribution among phases
- Fault on one of the phases

## Effects of Voltage Unbalance:

- Irregular Motor operation
- Reduced motor load speed and torque
- Motor/Transformer Damage
- Current Unbalance (Insulation damage and heat)

# Voltage Sag/Swell

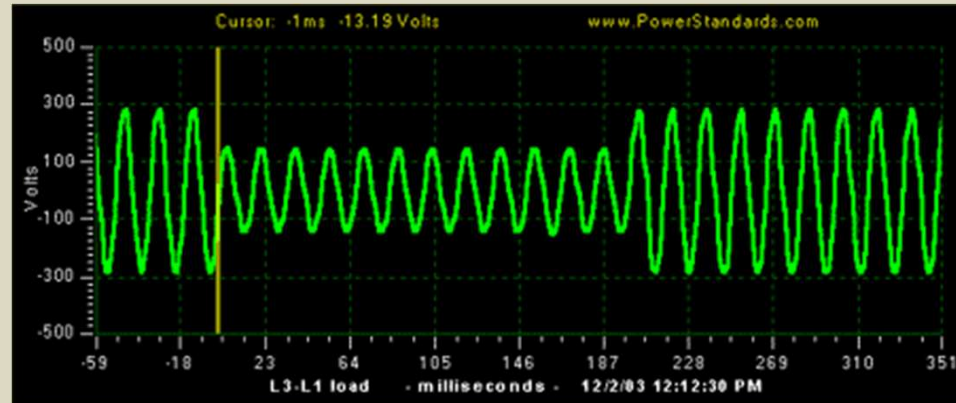
## Description:

Sag /dip is a decrease to between 0.1 and 0.9 pu in rms voltage or current at the power frequency for durations of 0.5 cycles to 1 minute.

Swell is an increase to between 1.1 pu and 1.8 pu in rms voltage or current at the power frequency durations from 0.5 to 1 minute.

## Causes of Voltage Sag/Swell:

- Dirty Insulations
- Lighting Strikes
- Tall Trees or plants
- Pollution



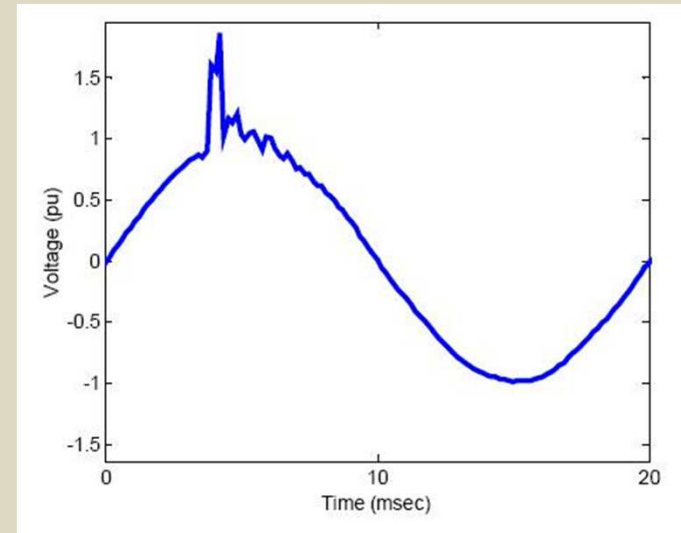
## Effects of Voltage Sag/Swell:

- PLC system malfunction
- Drop in light illumination
- Computer freeze
- Component breakdown
- Fuse blown out

# Transient Voltage

## Description:

Transient is an undesired increase in voltage lasting for a very short time, usually for a fraction of cycle. This increase can spike up to hundreds of volts over the nominal voltage.



## Causes of Transient Voltage:

- Switching major loads
- Lighting Strikes
- Electromagnetic interference
- Faults

## Effects of Transient Voltage:

- Malfunction of PLC's
- Computer crashes
- Insulation Loss
- Disturbance on data lines
- Damage of motor windings

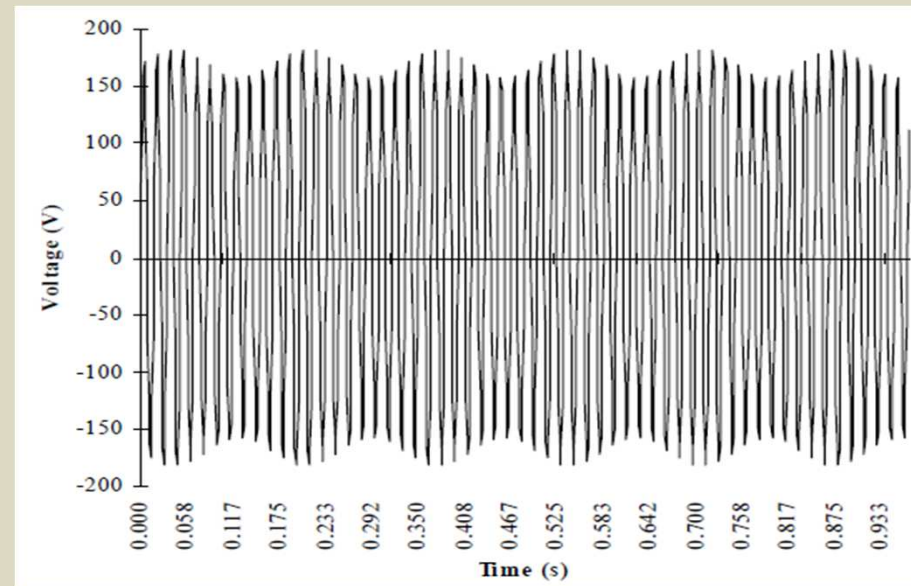
# Flicker

## Description:

Flicker is a small, regular fluctuations in voltage that creates an annoying change in light. Human perception is sensitive to light that changes

## Causes of Voltage Flicker:

- Welding machines
- Arc furnaces
- Starting engines with impulsive load
- Shredders, stone crushers
- Cranes
- Elevators
- Wind power plants



## Effects of Voltage Flicker:

- Irritating light flicker
- Eye Fatigue
- Insulation Loss
- Stroboscopic effect

# Harmonic Distortion

## Description:

Harmonic Distortion is the deviation from the nominal sine waveform of the AC voltage or current caused by non-linear loads.

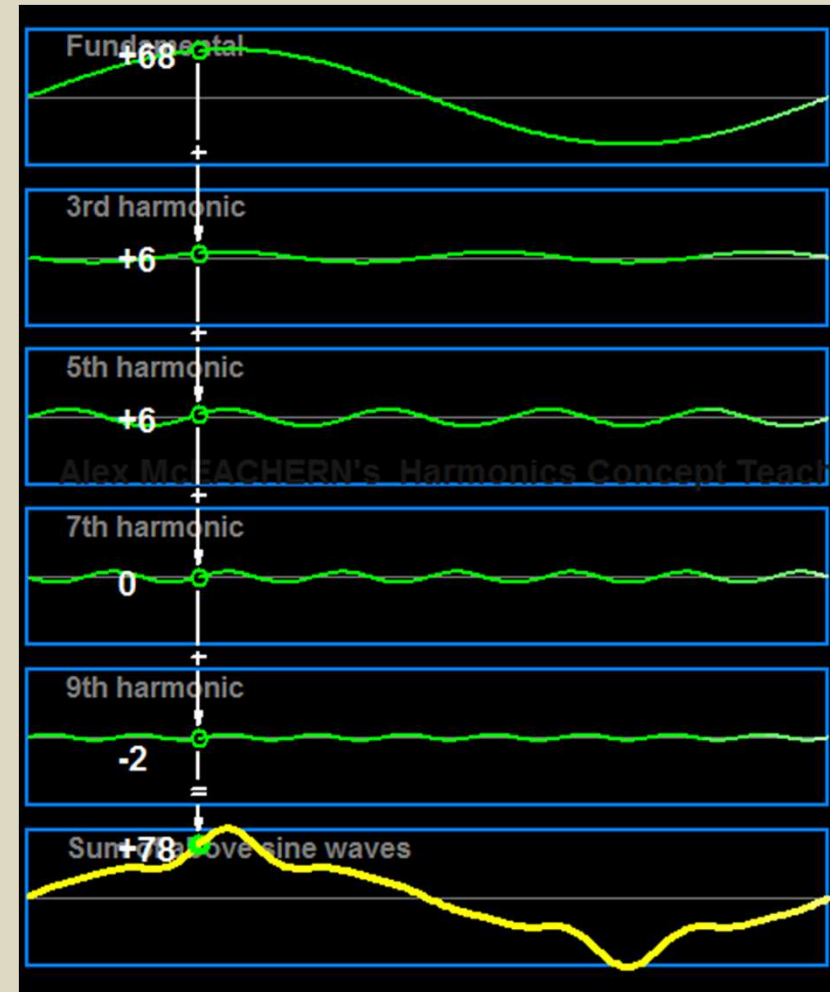
Deformed waveform can be interpreted to sum of multiple sine waveforms with higher frequencies. (Fourier Series)

## Causes of Harmonic Distortion:

- Rectifiers
- Frequency Converters
- VVVF drives
- Pulse width controlled devices

## Effects of Harmonic Distortion:

- Excess heat in motors and transformers
- Noise at electromagnetic devices like motors, transformers and coils
- Interference with telecommunication lines
- PLC malfunctions



# Gossen PQ Analysers

- MAVOWATT-20
- MAVOWATT-30 (Power Vista)
- MAVOWATT-40 (Power Guide)
- MAVOWATT-70 (Power Xplorer)
- MAVOWATT-50



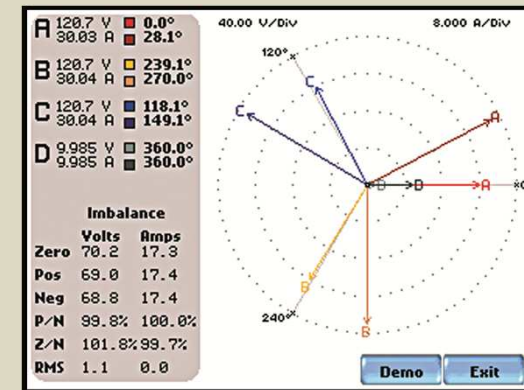
# MAVOWATT-20

- Touch Screen LCD
- External interface:
  - RS232 - Fiber Optic adapter
  - USB - Fiber Optic adapter
  - LAN - Fiber Optic adapter
  - Modem
- 3 single ended voltage inputs and 1 differential voltage input
- Voltage input Range of 10 to 600 Vrms
- Voltage RMS Accuracy of  $\pm 0.1\%$  of Reading,  $\pm 0.05\%$  Full Scale, over 7 KHz bandwidth (1 second rms readings)
- 4 full differential current inputs with range: 10 - 200% of Rated Probe Input
- Current RMS Accuracy of  $\pm 0.1\%$  of Reading  $\pm 0.05\%$  Full Scale plus Probe Accuracy, 3KHz bandwidth (1 second rms readings)
- Two frequency ranges of 30 - 70 Hz and 15 - 30 Hz with accuracy of  $\pm 0.2\%$  of reading



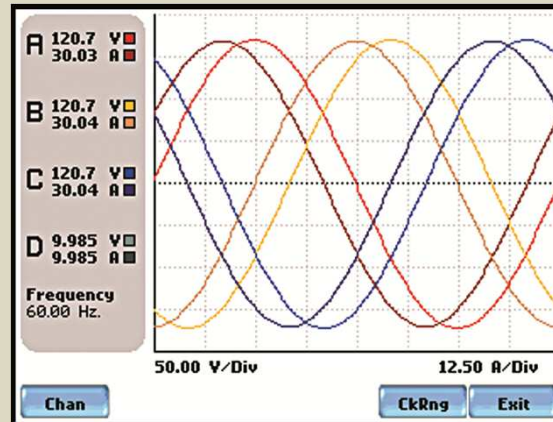
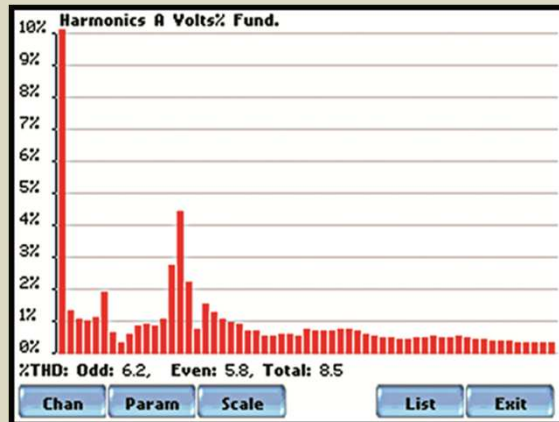
# MAVOWATT-30 (Power Vista)

- 4 voltage inputs, 1-600 V rms differential, AC/DC, +0.1% rdg +0.05% fs
- 4 current inputs 0.1-6000 A rms CT-dependent, AC/DC, +0.1% rdg + CTs
- Cycle-by-cycle analysis; 256 samples/cycle
- THD, TID and Spectrum for all the parameters
- Energy Survey
- Flicker measurement for all three phases
- RMS Recordings V & I, 30 pre-fault, 100 post-fault cycles
- Frequency range 45-60HZ, 15-20 HZ
- Low and Medium Frequent Transients



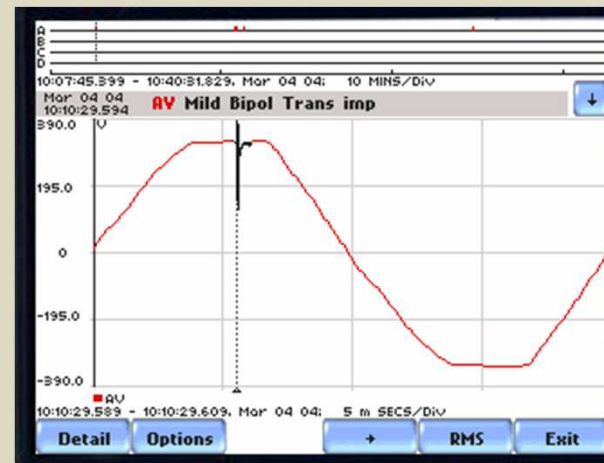
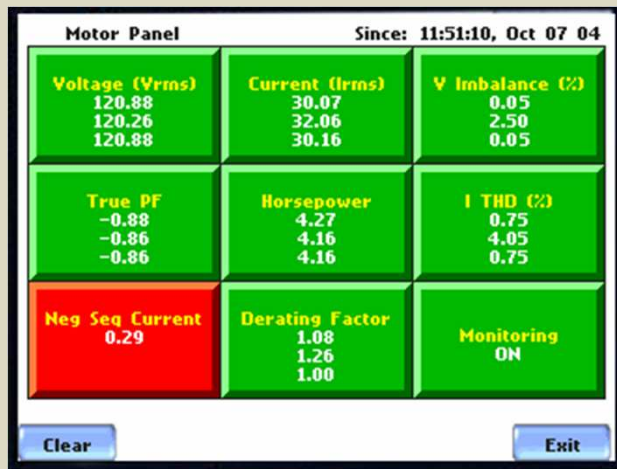
# MAVOWATT-40 (Power Guide)

- All the MAVOWATT-30 features
- Current Inrush / Energization detection
- RMS Recordings V & I, 30 pre-fault, 10000 post-fault cycles
- Sag Directivity
- Power Factor Capacitor Switching
- Motor Diagnostics



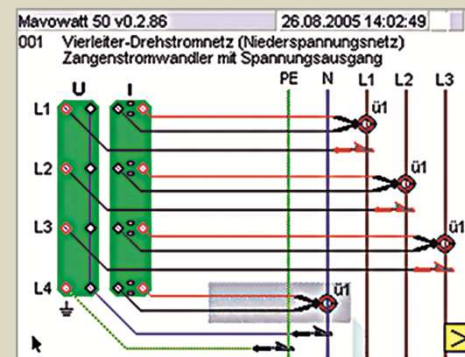
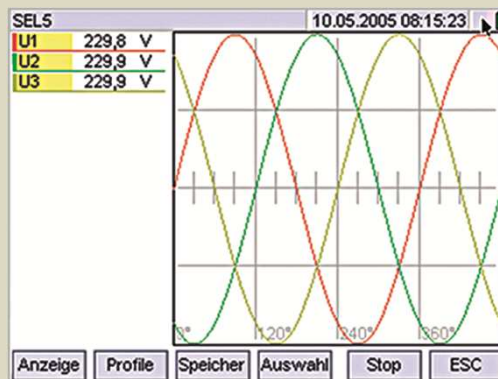
# MAVOWATT-70 (Power Xplorer)

- All the MAVOWATT-40 features
- 1 MHz High Speed Sampling.
- Frequency range 45-60HZ, 15-20 HZ and 380-420 Hz.
- Transient Event Characterization
- More Parameters for Distorted & unbalanced Systems



# MAVOWATT-50

- Power and energy analysis
- Spectral analysis
- Flicker analysis
- Power disturbance analysis
- Transient measurements (as of 10  $\mu$ s, max. 1300 Vpk)
- Analyser for power and mains quality, for DC as well as 1 $\sim$  and 3 $\sim$  systems with up to 1000 Hz
- High speed communication interfaces including USB interfaces for PC



# Fixed PQ Analysers

MAVOSYS is a modular power analyser that can be customised for different applications. They are designed to have the same advanced measurements and analysis as MAVOWATT.



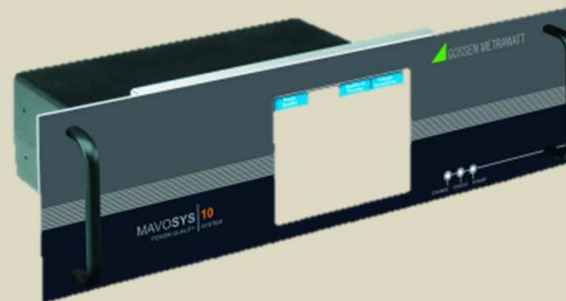
Standard Version



19" Rack Mount Version



Switch Gear Version  
with or without Display



19" Rack Mount Version with Display

# MAVOSYS Features

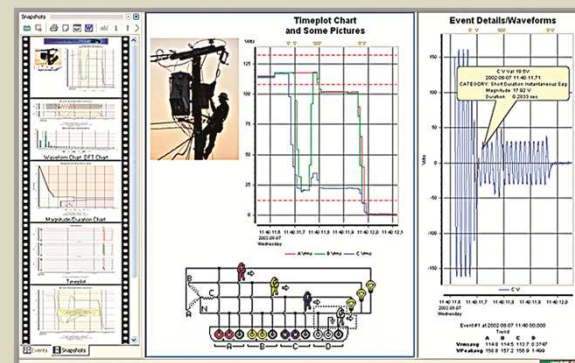
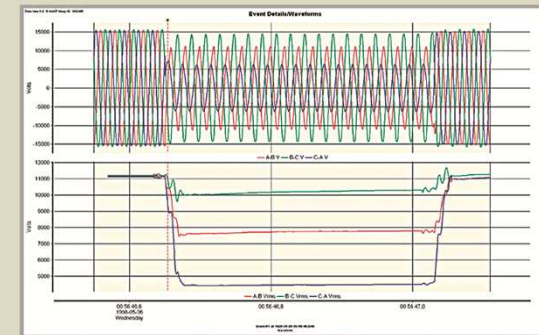
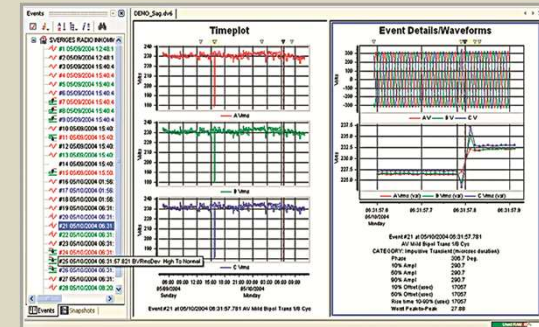
- **Modularity**
  - Ability to easily configure the instrument to cost-effectively meet customers applications
- **Compliance**
  - Meets all international power quality monitoring standards
- **Communications**
  - Strong and diverse suite of communications
- **Visualization**
  - Provide an easy to use local user interface. Web browser based system interface
- **Intelligence - Answer Modules®**
  - Clear and simple event explanations. Apply years of GMC-I Gossen-Metrawatt experience by automatically performing advanced analysis and characterization of data.



# DranView-6

The data from GMC-I power quality analysers MAVOWATT 30,40,50, 70 and MAVOSYS-10 can be evaluated and documented with this extremely versatile and convenient PC software.

The parameters of the stored events can be represented as a line diagram, in 3D representation or as wave form. The documentation can be done automatically by the report generator or user-defined in Word.



# Metrel PQ Analysers

- MI 2392 PowerQ Plus
- MI 2492 PowerQ
- MI 2592 PowerQ4
- MI 2292
- MI 2092



# PowerQ & PowerQ Plus

- True RMS measurement and data logging of voltages, currents, power, power factor and energy
- Simultaneous analysis of basic power quality parameters (U,I,P,Q,S, PF)
- Harmonics analysis up to 50th component
- Phase diagram and unbalance calculation for 3-phase systems
- Voltage and current on-line scope function
- Inrush current measurement
- Voltage events (dip, swells and interrupts) registration (PowerQ Plus only)
- Recording and reporting according to EN 50160 (PowerQ Plus only)
- Voltage accuracy is 1% of reading
- Current accuracy is 2% of reading



# MI 2592 PowerQ4

- 4 voltage channels with wide measurement range: 0-1000 Vrms (CAT III / 1000 V)
- 4 current channels with support for automatic clamp recognition
- Basic accuracy is 0.2% of reading
- Simultaneous measurement and recording of basic power quality parameters (U, I, P, Q, S, PF,  $\cos \varphi$ , THD)
- 8 MB of internal memory space allows recording over 4 weeks
- PowerQ4 is compliant with power quality standard IEC 61000-4-30 Class S
- Power measurements comply with IEC 61557-12 and IEEE 1448
- Sampling rate is 1024 samples per 10 periods
- On-line Scope, Trend and Metering modes
- Phase diagram
- Simultaneous 8 channels - 16 bit AD conversion for accurate power measurements (minimal phase shift error) 15 hours of autonomous (battery) supply
- PC SW package PowerView is supplied in a standard set



# MI 2292

- Three current and three voltage inputs combined with an internal memory modules allow recording up to 4 weeks
- 64 parameters can be monitored or recorded simultaneously
- Instrument can be programmed either directly or via PC
- Current and voltage harmonics up to 63rd order
- Power quality assessment according to EN 50160 including Flicker measurement and standardised printout report in graph and table form
- Transients measurements down to 20  $\mu$ s with adjustable level triggers
- Waveform measurements with harmonics direction detection. Adjustable level and slope triggers on voltage and current
- Accuracy is 0.5% of reading
- 128 samples per period



# MI 2092

- Three current and three voltage inputs combined with an internal memory module allow recording up to 4 weeks
- 64 parameters can be monitored or recorded simultaneously
- Instrument can be programmed either directly or via PC
- Current and voltage harmonics up to 63rd order
- 128 samples per period
- Voltage & Current measurement accuracy is 0.5%

