

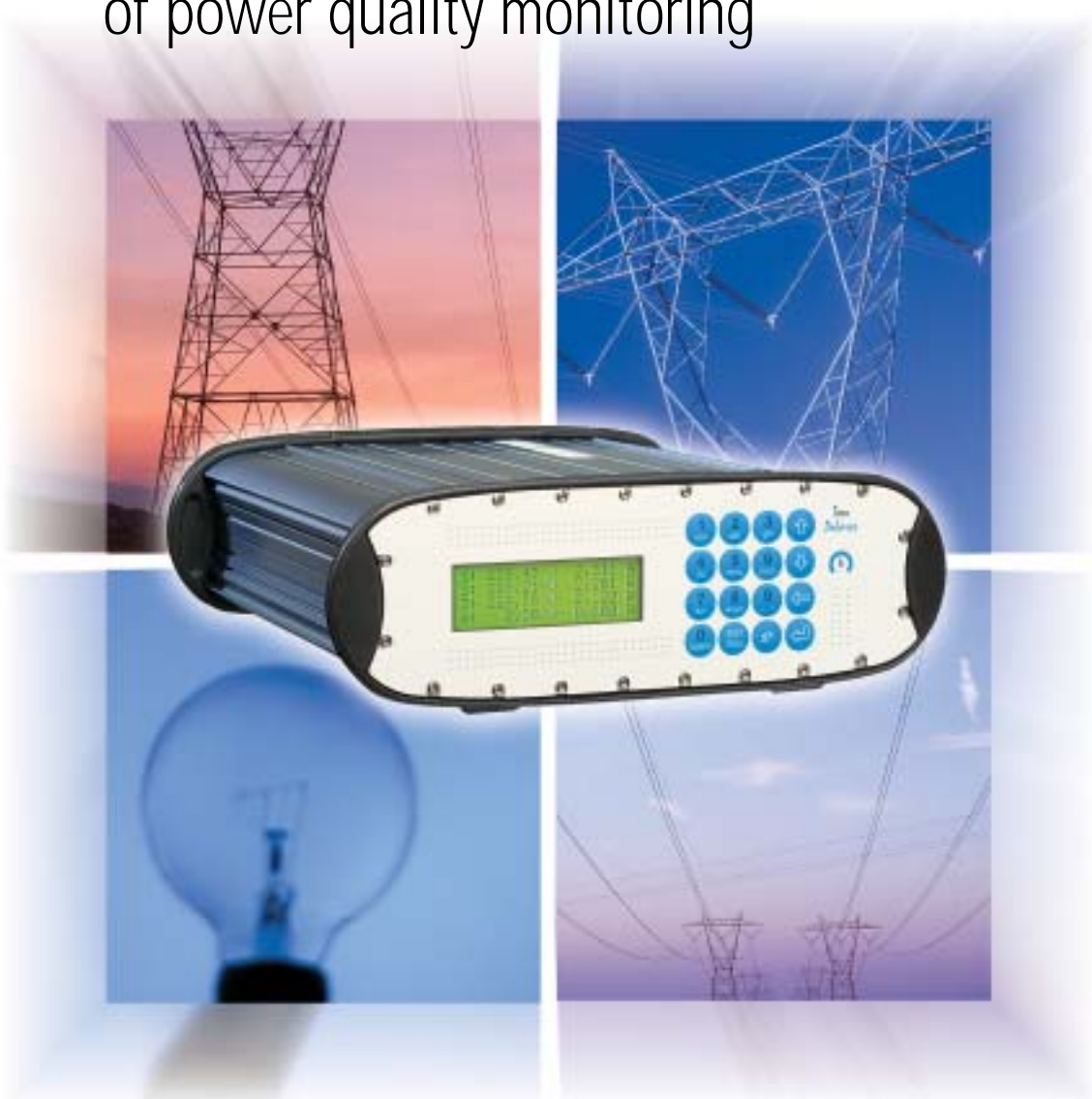
Errors and changes excepted

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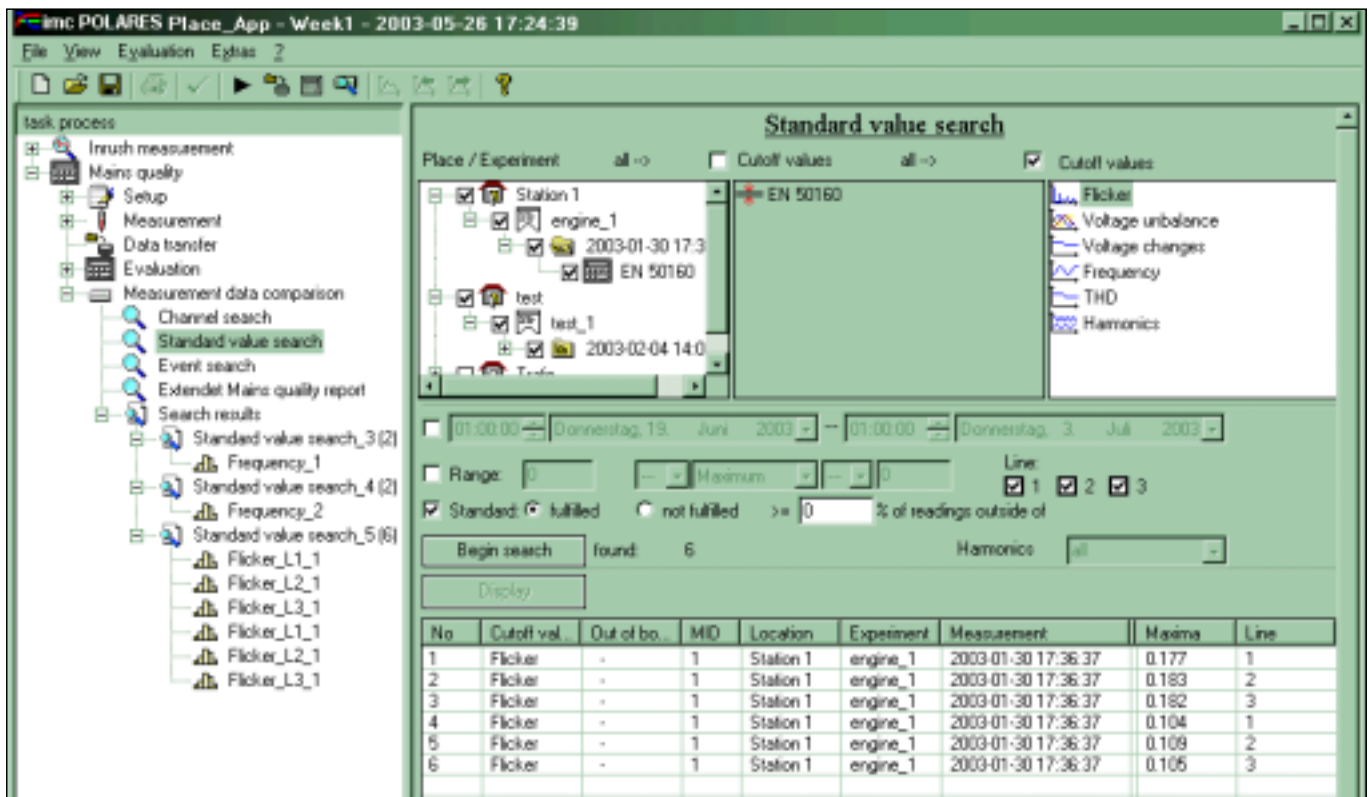
imc POLARES

The new generation
of power quality monitoring



imc POLARES – MORE THAN JUST

➔ Power quality analyzer as per EN 50160



Analysis comprising multiple measurements, as per EN 50160

Professional power quality analysis as per EN 50160

- Power quality monitoring
- Detection and analysis of disturbance in the distribution network
- Quality assurance
- Recognition/location of network disturbance events
- Frequency monitoring
- Recognition of asymmetric network loading
- Recognition of harmonics and causes
- Long-term monitoring of power quality
- Flicker monitoring
- Power distribution optimization/network optimization
- Power measurement
- Monitoring of energy delivered/received
- Monitoring of energy flow direction
- Monitoring of switch-on/off

Class A power quality analyzer

The EN 50160 standard

All quantities required by the European standard EN 50160 for inspection of power quality are recorded and evaluated. The end result is fully automated, standard-compliant documentation of the entire measurement.

Calculation of RMS values after every half period (e.g. every 10 ms at 50 Hz fundamental frequency) is the touchstone of a Class A measurement device. In conjunction with a GPS/DCF 77 real-time radio clock receiver, data from different devices can be compared sample-by-sample. To define the range of normal voltage states, a hysteresis range is specified for the event recognition. imc POLARES meets the precision requirements for a Class A measurement device according to the standard EN 61000-4-30.

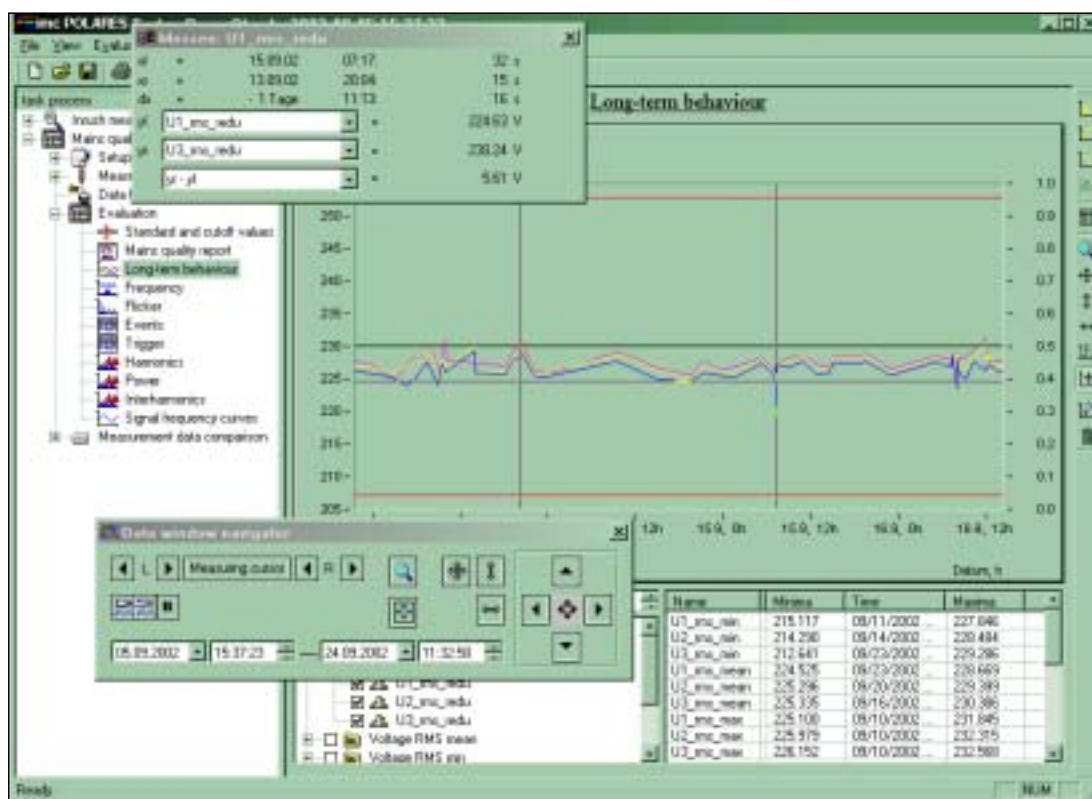
The Complete Recording principle – all data are recorded

imc POLARES implements the "Complete Recording" measurement philosophy. This means that all measured quantities are available for subsequent analysis even after the standards comparison, ensuring that even such events which don't reach the defined thresholds, but may still contain useful data, can be analyzed.

The "Complete Recording"-principle offers you the choice to perform data processing going beyond a completed EN-based measurement. Thus, the scope of imc POLARES' functionality extends far beyond the EN 50160 standards.

POWER QUALITY ANALYSIS

➔ Power measurement device ➔ Event analyzer



Over 500 waveforms are available for the analysis, which can be directly displayed as curves

Your all-purpose companion

Portable and intelligent
Lab or mobile applications
With or without a PC

With immediate, standard-compliant and automated analysis, imc POLARES is applicable to both mobile and stand alone long-term stationary monitoring of electrical networks. In this mode, imc POLARES starts recording on power-up, without any need for a PC connection.

For short-term measurements, a PC connected via Ethernet TCP/IP offers a great variety of online display capabilities. Here, like in lab settings, imc POLARES can be used as an all-purpose power-meter, in addition to its full featured set of analysis tools.

Radically simplified operation
User-friendly while supporting advanced settings

The process of setting up measurements, data analysis and documentation is streamlined.

In imc POLARES, the EN 50160 measurements are pre-defined and only require a very few additional settings, so that imc POLARES is easy to use even for the inexperienced operator.

An expert, however, can freely define and save special measurements, value limits, analyses and documentation, to be re-used later at need.

A variety of special analyses

- Harmonics
- Inter-harmonics
- Events
- Flicker
- Trigger
- Frequency
- Power
- Ripple control signals

imc POLARES —



imc POLARES as a network analyzer as per EN 50160

- Standard-compliant default setting
- Measurement and monitoring of power quality
- Composition of standardized measurement report at the push of button

imc POLARES as a power meter

- 1-, 2-, 3-phase power measurement
- Bandwidth 25 kHz
- Up to the 50th harmonic
- Monitoring of up to 11 inter-harmonics

imc POLARES as an event analyzer

- Flexible value limit and event definition
- Flexible trigger options
- Capture of harmonics and inter-harmonics
- Flicker
- Ripple control signals

Extended properties

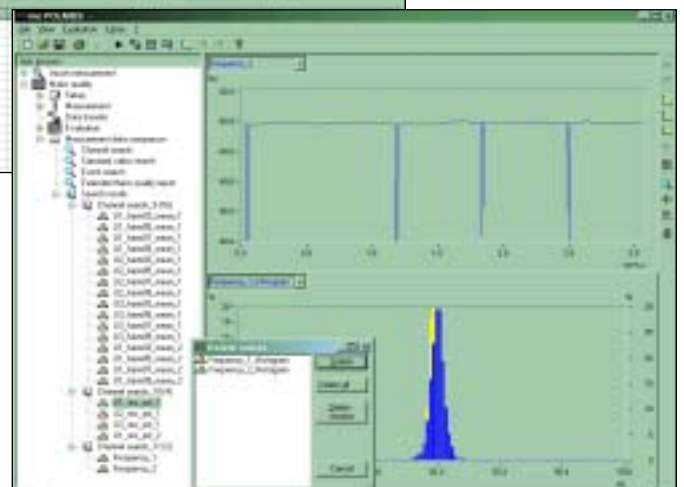
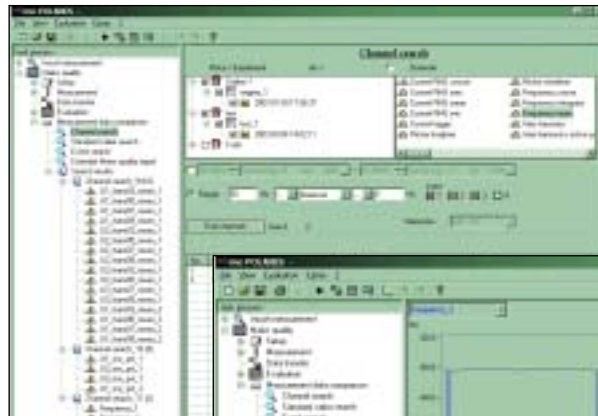
- PC-less operation with pre-settings
- Uninterrupted power supply (UPS)
- Automatic auto-start after power outage
- Removable storage medium
- Start/Stop and display on front panel
- Database linking
- Modem for remote monitoring and polling
- GPS/DCF 77 real-time clock for synchronization to absolute time

Long-term measurements without PC, accurate down to the last sample

In long-term monitoring and measurements, imc POLARES runs on its own, without a PC. As a stand-alone black box, it comes with an alphanumeric status and measurement display on the front panel.

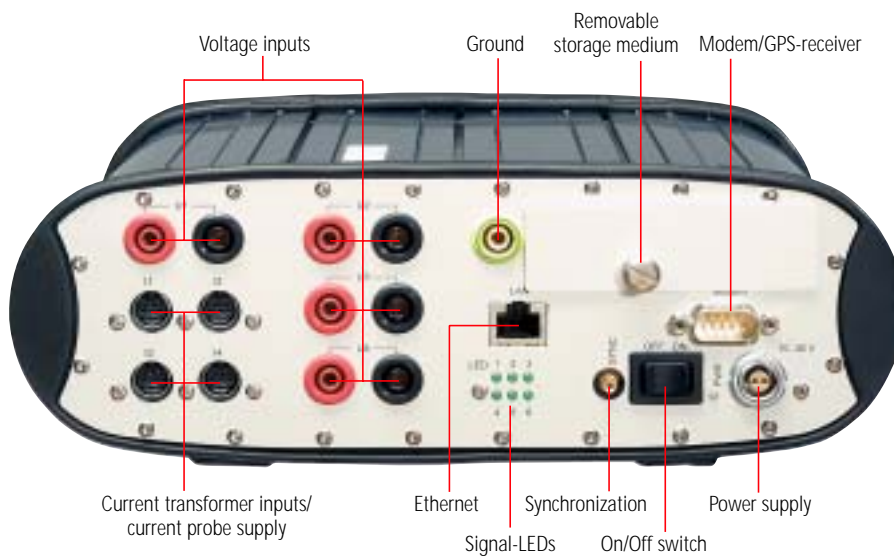
Automatic restart after power outage

Sporadic supply outages are bridged by the built-in UPS (uninterruptible power supply). For longer outages, the device deactivates itself. The data captured by then are saved in a defined way. The automatic restart of the measurement upon restoration of power is adjustable.



Measurement comparison enables a comprehensive analysis of different measurements belonging to one site or of different sites. The absolute time synchronization is provided by a radio-controlled GPS/DCF 77 real-time clock.

FULLY EQUIPPED



Current measurement

Current measurement with imc POLARES is conducted contact-free with clamp current probes. The (maximum of 4) probes are connected at the four mini-DIN sockets on the housing's rear panel. Current probes equipped by imc with Mini DIN plugs can be connected to these. Or other current transformers can be connected by means of adapters.



Current probes for the input range 0.01 - 12 A (3 current probes included in standard product package)

Flexible current transformers for the input range 0.5 - 2000 A (additional CTs for other input ranges available upon request)

Voltage measurement

The device backplane has two banana-type safety jacks for each of the voltage phases (L1... and N), which L1, L2, L3, and N which are to be measured. The voltage channels come with amplifiers isolated channel-to-channel. They enable direct measurement of voltages ranging up to ± 600 V. The device's own safety banana jacks are used to connect the measurement signal directly. The analog bandwidth is 25 kHz.

imc POLARES Hardware

- Compact, rugged housing
- 500 V CAT III, Pollution Degree 2
- Only 2.8 kg weight
- 80 W (typ.) power consumption
- 4 voltage inputs ± 0.5 V to ± 600 V
- 4 terminals for external current probes
- 3 current probes included in standard product package

imc POLARES Software

- MS-Windows Software for standard-compliant operation, configuration, measurement data display and report composition

PQA-Software module (standard equipment)

- Measurement and analysis as per EN 50160 (approximates IEC 61000-4 15, IEC 61000-4 7, IEC 61000-4-30)

Database module (optional)

- Analysis and detection of events such as standards violations
- Tabular classification of results according to duration, amplitude etc.
- Time-correct analysis of multiple, networked devices/stations

In-Rush module (optional)

- Software for freely configurable short-term measurements
- Freely configurable measurement data capture
- Up to 50 kHz sampling rate per channel
- Definable threshold value or range trigger
- Trigger link, pre-trigger etc.

imc Devices standard software (optional)

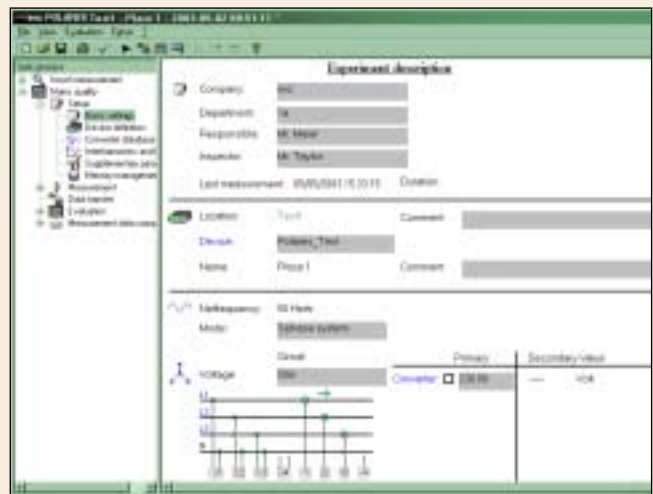
- For full access to all hardware and software functions
- Measurement with freely configurable, per-channel setups
- Freely configurable online curve display
- Report Generator for flexible, personally designed measurement documentation
- Unlimited access to the Personal Analyzer (Online FAMOS)
- Ethernet networking with additional imc measurement devices and operation under identical user interface

imc POLARES AS A POWER QUALITY

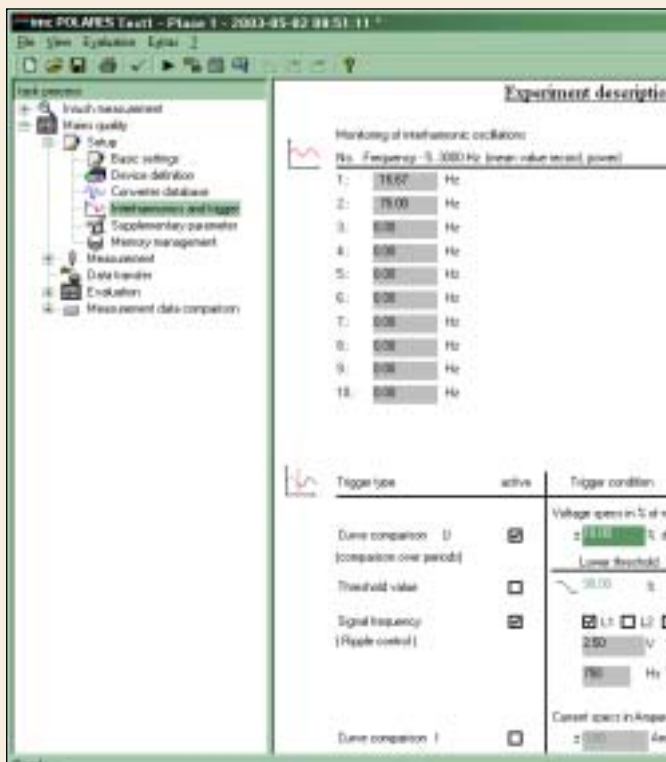
Intuitive, professional software for power quality monitoring applications

The PQA-Software module with its optional expansion modules is designed with the user in mind. Conducting a measurement according to industry standards requires no special instrumentation or computer skills. In terms of function and appearance, it corresponds to the familiar Windows®-Explorer.

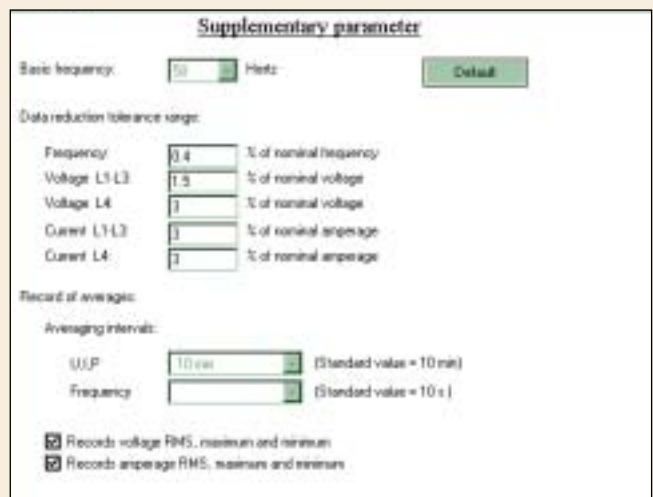
The standard software module includes all functions necessary for operation, display, analysis and documentation.



Basic settings – Input of measurement descriptions and rated voltage/start for EN 50160/current transformer parameter entry for power measurement



Extended settings options – Inter-harmonics, curve-form trigger, ripple control monitoring

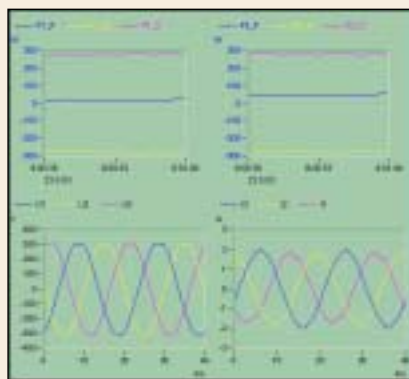


Extended settings options – Data reduction factor, selection of max/min value recording

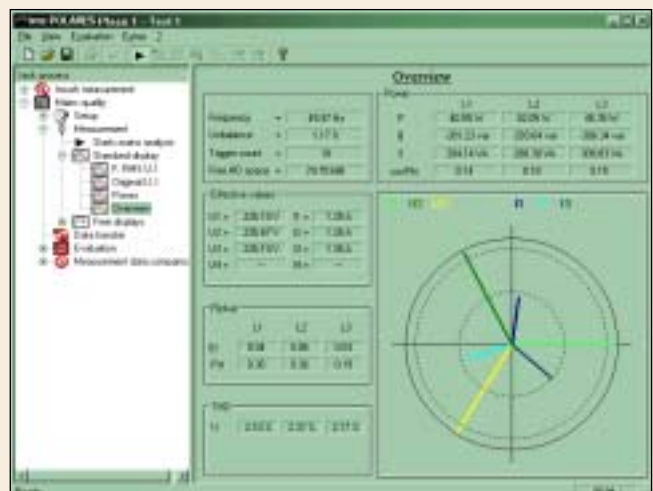
Measurement

There are two basic curve window types available for display of measurements. The standard display with its overview window offers a comprehensive view of all measured data. It shows the overall plots of all curves including the vector graphics for the current and voltage, frequency, and power.

The freely configurable display offers 1 to 4 curve windows side-by-side, to each of which any measurement channel can be assigned.



Customized display of original signal and power



Online overview as the pre-defined standard display

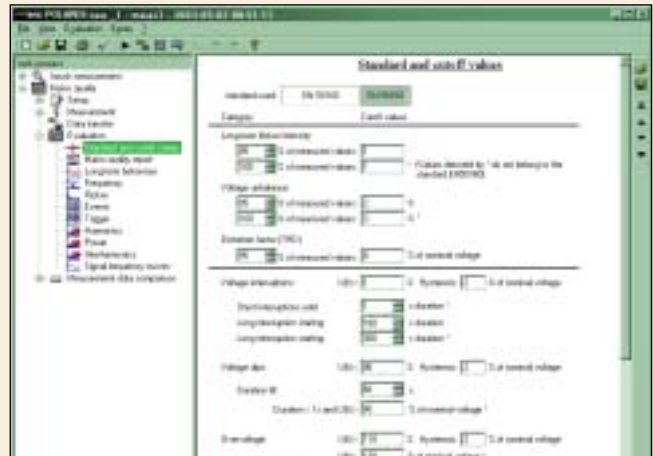
ANALYZER AS PER EN 50160

Analysis

Limit values

The value limits stipulated in the standard EN 50160 serve as the basis for the power quality report. A single form displays all values in relation to the user-selected value limits. Depending on the particular quality demands, they can be changed and saved under the user's choice of names.

As the basis for the analysis, either personally defined data or default value limits can be selected.



The limit values stipulated by European standard EN 50160 are included in imc POLARES as default values

Documentation

After analysis comes fully automated composition of documentation for the overall measurement, in accordance with industry standards.

Report Generator

The Report Generator serves to create graphical reports to document the measurement and analysis results. In contrast to the curve window's print function, which only prints out the current curve plot, the report can comprise layouts of curve plots, text, tables and other graphical objects.

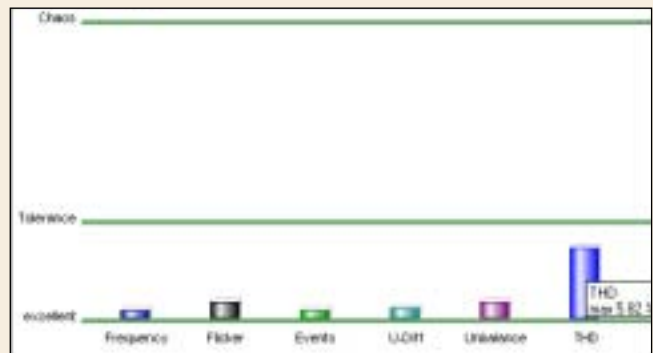
The Report Generator possesses a multi-document user interface which can edit multiple reports all at once. The usual editing operations, such as multi-selection, copy, paste, move, orientation etc. are all provided.

The properties of the objects, such as colors, fonts etc. can be changed in various ways, even by group. An Undo-function, seamless zooming, a freely definable grip with snap-function and context sensitive online help round out the support tools available to the user for rapid composition of complex reports.

The Report Generator can be used to give every report and protocol its very own layout.

For analysis purposes, over 500 waveforms per measurement are available. To make the data volume manageable, the data are organized in a tree diagram according to the results. The data belonging to the result group activated can be displayed directly.

All other available waveforms can, naturally, be added for comparison purposes.



After processing, an overview of the power quality is available

Report Generator

- The quick way to get measurements results in hard copy
- Creation of document templates
- Insertion of measurement plots of any length
- Insertion of measurement value tables
- Insertion of elements via the MS-Windows Clipboard
- Text, pixel graphics, vector graphics, OLE-objects
- Texts in any font, color or format
- Structural elements lines, frames, fields, arrows
- Grid functions for millimeter-precise layouts (e.g. 1 V corresponds to 10 mm)
- Automation of documentation using FAMOS-sequences or imc COM

| 5. Network frequency | | | | | |
|----------------------|-----------|-------------------------------------|-----------|-----------|----------------------|
| Unit | Component | Limit value (Deviation of 50.00 Hz) | Value min | Value max | Values out of bounds |
| % | 50.50 | +1.00% | -1.12% | 1.13% | - |
| Hz | | 49.70 - 50.70 Hz | 49.92 Hz | 50.07 Hz | - |
| % | 100 | -1.00% | -1.15% | 1.17% | - |
| Hz | | 47.00 - 52.00 Hz | 49.92 Hz | 50.09 Hz | - |

| 6. Flicker | | | | | | |
|------------|-----------|---------------------------------|------|-----------|-----------|----------------------|
| Unit | Component | Limit value (Flicker intensity) | Line | Value min | Value max | Values out of bounds |
| dB | 95 | 0 - 1.000 | L1 | 0.000 | 0.194 | - |
| dB | | | L2 | 0.000 | 0.199 | - |
| dB | | | L3 | 0.000 | 0.195 | - |
| dB | 100 | 0 - 1.000 | L1 | 0.000 | 0.177 | - |
| dB | | | L2 | 0.000 | 0.192 | - |
| dB | | | L3 | 0.000 | 0.182 | - |

All values are displayed in detail in a table

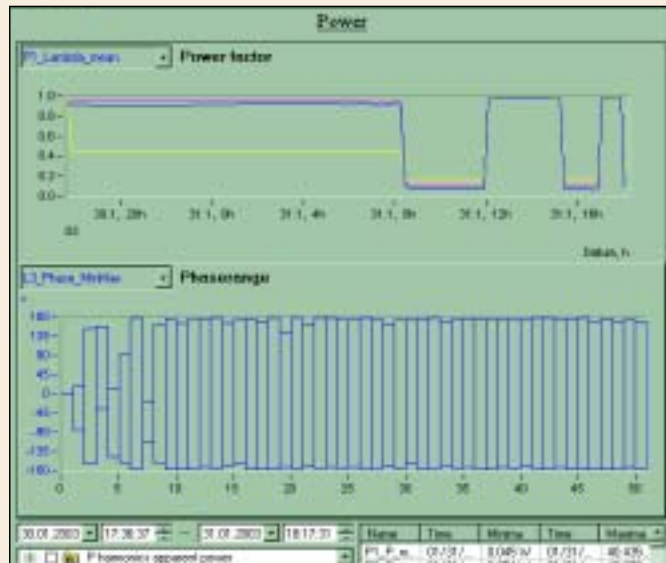
imc POLARES AS A POWER METER

Smart – Multi-functional

Power

Evaluation of

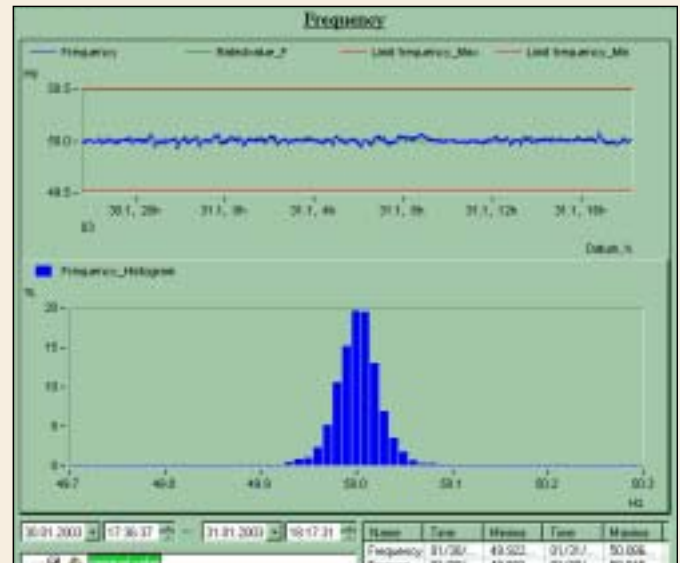
- Actual, reactive and apparent power
- Power factor
- Harmonics power
- Power of monitored signal frequency
- Single and multiple phase



Graphic display of power measurement

Frequency

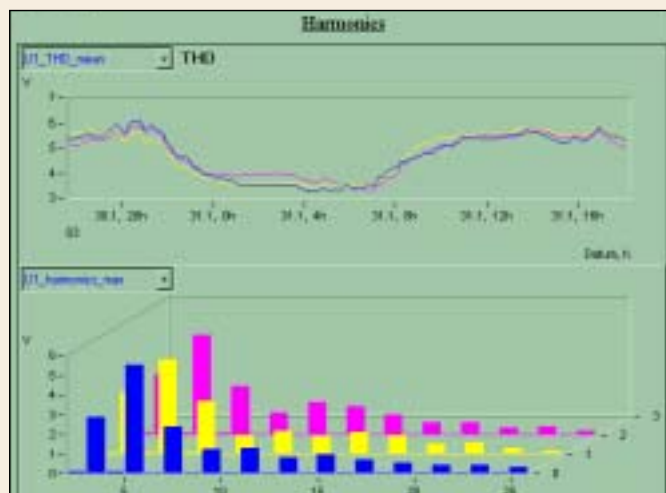
- Mean values: 10 s
- Signal with data reduction: resolution 10 s - 42 min, adjustable precision
- Input range: 30 - 90 Hz
- Resolution: 0.01 Hz
- Measurement uncertainty: ± 0.01 Hz



Graphic display of frequency measurement

Upper harmonics

The Online-Display can immediately show the spectra derived from the FFT, for which the mean values have not been computed. The data-reduced, recorded (ripple control signals) signal voltage is fed directly from the FFT. The FFT is calculated seamlessly with a square window over each group of 10 periods. This corresponds to the specifications for the measurement of harmonics and interharmonics in power supply networks according to EN 61000-4-7. The resulting resolution in the frequency range is approx. 5 Hz.



The harmonics analysis serves to capture display and analyze voltages up to the 50th harmonic. Calculation is performed by Fast Fourier Transformation (FFT).

- **Harmonics:** measurement of 0 - 50, THD for the 2nd – 40th, record of RMS-values
- **Inter-harmonics:** monitoring of up to 10 frequencies; RMS-value, power acquisition, frequencies of 5 - 3000 Hz can be set
- **Signal frequency monitoring:** (e.g. ripple control signals) Channel 1,2,3; Frequency 5 - 3000 Hz, long-term acquisition with data reduction (time resolution 0.4 s, 100 s), mean values (over mean value interval), additional high-resolution trigger signals 0.01 s, power
- **Trigger voltage:** 0.5 - 50 V

imc POLARES AS AN EVENT ANALYZER

Advanced measurement functions for the most demanding technical requirements

Events

The plots of the RMS-value curves are the source for the capture of events. While the deviation of the RMS in one direction results in a new data point in the acquisition of the reduced curves, an event by contrast is characterized by two transitions: one from the normal voltage level to the faulty level and one back to the normal level.

The duration of the event is measured between the two points of departure, in other words at the normal level. The depth of the result is determined from the minimum or maximum of the amplitude in the disturbed region.

This assumes that the amplitude remains almost constant during the disturbance. According to the currently valid standard, every deviation >10 % of the rated voltage counts as an event. Depending on the duration and amplitude, further distinctions are made in terms of the sags and short/long interruptions.



Typical plots of the voltage RMS values, which are characterized by the duration and depth of the amplitude, are recorded by imc POLARES as events (e.g. swells, sags, interruptions, rapid voltage fluctuations, classification as per UNIPEDE)

Triggers

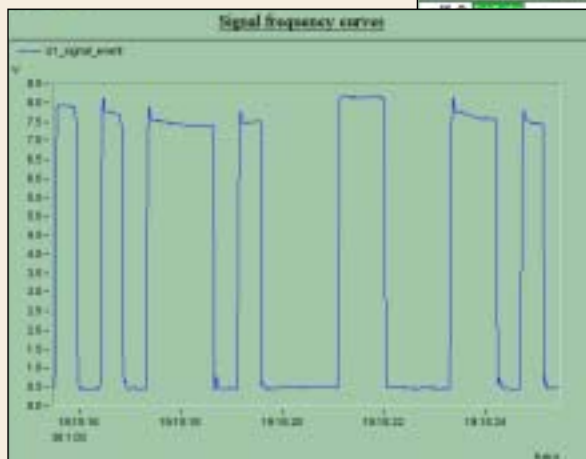
The recording duration after occurrence of a trigger event is 10 network periods. Of these, one period is recorded as a pre-trigger. In contrast to normal recording, triggered raw data recording comes with a time resolution of 100 μ s. In addition, there is a trigger for signal frequencies. Here, the input signal is first band-pass filtered and next triggered. In this way, the signal whose amplitude is modulated over a signal frequency can be made visible. The classic application for this is ripple control telegrams.



Triggers serve in imc POLARES exclusively for raw data recording at 100 μ s resolution. Changes of the RMS-value for the recognition of events are optimally captured in the curve plots.

Ripple control signals

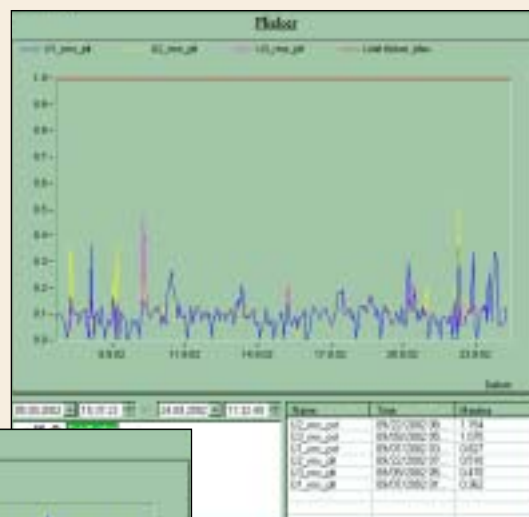
The scope of imc POLARES' functions makes it a user-friendly tool for investigating disturbances and ripple control signals. All quantities which can affect these signals are evaluated and displayed.



Graphic display of the ripple control signals

Flicker

Amplitude fluctuations in the network of low frequency cause fluctuation of luminous density in lamps which is perceptible as flickering. Above a certain intensity, this is considered a nuisance. By means of a Flicker-meter, such fluctuations can be measured technically and analyzed. Computation of the flicker is performed according to the description of a flicker-meter in the standard EN 61000-4-15 (EN DIN 60868) with a sampling rate of 100 Hz.



The flicker-meter analyzes the voltages of all three phases and offers different observation periods. Thus, short-term flicker and 120 min long-term flicker can be selected.

GENERAL TECHNICAL SPECS

| Parameter | Value/Value range | Comments |
|----------------------------|--|---|
| Power consumption | < 130 W (typ. 80 W) | |
| Operating power | 10 - 36 V DC | External 110 - 230 V AC adapter |
| Safety | 500 V CAT III, Pollution Degree 2 | Conformant to EN 61010-1, IEC-664-1 |
| UPS | Buffer duration: approx. 8 min. | 23° C, for fully-charged UPS battery, extension possible |
| Weight | 2.8 kg | Without power supply unit |
| Dimensions (W x H x D), mm | 250 x 85 x 250 | |
| Operating temp. range | 5 – 40° C or -20 – 65° C (optional) | Optional extended temp. range with condensation protection |
| Humidity | 5 - 95 % | |
| Shock resistance | 30 g pk over 3 ms impact | |
| Storage temp. | -20 - 70° C | |
| Resolution | 16 bit | |
| Accessories | Channel-specific terminal plug Power supply adapter incl. cabling | |
| Voltage inputs | 4 high-impedance inputs | |
| Input range | Nominal: 0 - 600 V | |
| Measurement circuits | Star/Y, delta, Aron/2-phase | |
| Bandwidth | 25 kHz | |
| Gain error | Typ. 0.05 %; max.: < 0.1 % | |
| Connectors | 8 x 4 mm safety jacks | |
| Current inputs | 4 current probe inputs | |
| Input range | ± 0.01 - ± 3000 A depending on current transformer used | Chauvin Arnoux MN71 0.01 - 12 A~ AmpFLEX A100 5 - 2000 A~ |
| Input voltage | ± 0 - 10 V | |
| Bandwidth | 25 kHz | |
| Uncertainty | Typ.: 0.05 %; max.: < 0.1 % | |
| Connectors | 4 x Mini-DIN 8 sockets | |
| Measurements | | |
| A/D converter | 16 bit | |
| Sampling rate | 10 kHz Max. sampling rate/channel: 50 kHz Aggregate sampling rate: 400 kHz | 50 kHz/channel with imc-Devices software or In-Rush module |
| Filter | 5 Hz - 10 kHz, bypass | |
| Calculations | | |
| Power | 1-, 2-, 3-phase, overall | Actual, apparent, reactive power |
| Flicker | 0 - 20 | |
| Symmetry | 0 - 20 % | |
| Frequency | 30 - 90 Hz | |
| Harmonics | 0 - 50 | |
| Analysis | Voltage quality | EN 50160 Plus: IEC 61000-4-15, IEC 61000-4-7, IEC 61000-4-30 |
| Interfaces | Ethernet, TCP/IP, Modem PPP | |
| Memory capacity | PCMCIA-hard drive | Up to 512 MB |

POWER QUALITY CRITERIA AS PER EN 50160

Electrical energy has a number of properties at the interchange point which affect the power quality. These properties' values change during normal operation of a network due to load fluctuations, interference from certain systems and errors caused by external occurrences. EN 50160 describes the properties of electric energy by means of specifications concerning the network AC voltage.

For the purpose of optimized use of electric energy, it is desirable for the supply voltage to have a constant frequency, a perfect sinusoidal curve and a constant magnitude. The goal of the EN 50160 standard is thus to define and describe power quality criteria in terms of magnitude, curve form, frequency and symmetry of the three line voltages.

| Power evaluation criteria | Values/Value ranges | Measurement and evaluation parameters | | | | | | | | | | | | | | | | | | | |
|--|--|---------------------------------------|----------------------|---------|---------|---------|---------|----------|---------|----------|---------|----------|--|----------|--|----------|-----------|----------|--------------|-----|--|
| | | Basis quantity | Integration interval | | | | | | | | | | | | | | | | | | |
| | Low voltage | | | | | | | | | | | | | | | | | | | | |
| Frequency (when connected to an intrasystem) | 49.5 Hz to 50.5 Hz (-1 % to 1 %) 47 Hz to 52 Hz (-6 % to +4 %) (59.4 Hz to 60.6 Hz) (56.4 Hz to 62.4 Hz) | Mean value | 10 s | | | | | | | | | | | | | | | | | | |
| Slow voltage fluctuations | 230 V ± 10 % -15 % - 230 V - +10 % | RMS | 10 min | | | | | | | | | | | | | | | | | | |
| Rapid voltage fluctuations | 5 % Max. 10 % | RMS | 10 ms | | | | | | | | | | | | | | | | | | |
| Flicker (definition only for long-term flicker) | PR = 1 | Flicker- algorithm | 2 h | | | | | | | | | | | | | | | | | | |
| Voltage sags (< 1 min) | From tens to 1000 per year (under 90 % of Un and > 1 % Un) | RMS | 10 ms | | | | | | | | | | | | | | | | | | |
| Voltage sags (< 1 s) | (the majority of sags are < 1 s and ≥ 40 % of Un) | | | | | | | | | | | | | | | | | | | | |
| Short power interruption (< 3 min) | From tens to 1000 per year (under 1 % Un) | RMS | 10 ms | | | | | | | | | | | | | | | | | | |
| Random prolonged power interruptions (> 3 min) | From tens to 50 per year (under 1 % Un) | RMS | 10 ms 10 ms | | | | | | | | | | | | | | | | | | |
| Sporadic network frequency overvoltage (phase to ground) | Mostly < 1.5 kV | RMS | None | | | | | | | | | | | | | | | | | | |
| Transient overvoltages (phase to ground) | Mostly < 6 kV | crest value | 10 min | | | | | | | | | | | | | | | | | | |
| Voltage symmetry (ratio of negative to positive phase sequence system) | Mostly 2 %; in special cases up to 3 % | RMS | 10 min | | | | | | | | | | | | | | | | | | |
| Harmonic voltage | Total harmonic distortion (THD) 8 % Individual harmonics: Order h, Uh in % <table border="0"> <thead> <tr> <th>Odd/not multiple of 3</th> <th>Even/multiple of 3</th> </tr> </thead> <tbody> <tr> <td>5 6.0 %</td> <td>2 2.0 %</td> </tr> <tr> <td>7 5.0 %</td> <td>3 5.0 %</td> </tr> <tr> <td>11 3.5 %</td> <td>4 1.0 %</td> </tr> <tr> <td>13 3.0 %</td> <td>9 1.5 %</td> </tr> <tr> <td>17 2.0 %</td> <td></td> </tr> <tr> <td>19 1.5 %</td> <td></td> </tr> <tr> <td>23 1.5 %</td> <td>Remaining</td> </tr> <tr> <td>25 1.5 %</td> <td>6 - 24 0.5 %</td> </tr> </tbody> </table> | Odd/not multiple of 3 | Even/multiple of 3 | 5 6.0 % | 2 2.0 % | 7 5.0 % | 3 5.0 % | 11 3.5 % | 4 1.0 % | 13 3.0 % | 9 1.5 % | 17 2.0 % | | 19 1.5 % | | 23 1.5 % | Remaining | 25 1.5 % | 6 - 24 0.5 % | RMS | |
| Odd/not multiple of 3 | Even/multiple of 3 | | | | | | | | | | | | | | | | | | | | |
| 5 6.0 % | 2 2.0 % | | | | | | | | | | | | | | | | | | | | |
| 7 5.0 % | 3 5.0 % | | | | | | | | | | | | | | | | | | | | |
| 11 3.5 % | 4 1.0 % | | | | | | | | | | | | | | | | | | | | |
| 13 3.0 % | 9 1.5 % | | | | | | | | | | | | | | | | | | | | |
| 17 2.0 % | | | | | | | | | | | | | | | | | | | | | |
| 19 1.5 % | | | | | | | | | | | | | | | | | | | | | |
| 23 1.5 % | Remaining | | | | | | | | | | | | | | | | | | | | |
| 25 1.5 % | 6 - 24 0.5 % | | | | | | | | | | | | | | | | | | | | |
| Interharmonic voltage | | RMS | 10 min | | | | | | | | | | | | | | | | | | |
| Signal voltage | | RMS | 10 min | | | | | | | | | | | | | | | | | | |