POWER QUALITY
ANALYZERS

PQA series and VEGA78 can record all parameters of voltage, current and power simultaneously in order to achieve an advanced mains monitoring as well as a full analysis of spikes and flickers in a simple and intuitive way.

HT ®

Any company can be subject to a reduction in power quality or to an increase in management costs due to inner or external causes so bringing about damages to electrical equipment.

PQA series *represents a prompt solution to meet engineers' requirements in every electrical field, as regards monitoring single- and three-phase networks with the aim of detecting and solving any problem in power supply systems.*

Disturbances are featured by one origin (or more than one) and by a series of events transferred to the users. The noise origin is not always or exclusively due to the mains supplier, more often than not it can be traced back to some consumers who, because of particularly adverse conditions on their installations, affect power supply quality of other users connected to the same network.

To avoid this, the power company puts contractual obligations about possible disturbances caused by individual users. When checking power quality control of users is to be taken into account checking their compliance with contractual and standard limits.

The following are the various types of disturbances which may occur.
Non-linear loads with current harmonics causing the following problems:
- High current on neutral
- Overheating of transformers, motors and cables
- Generation of voltage harmonics due to interaction with power system impedance
- Risk of paying extra costs due to low power factor
- Faults and possible resonances with power factor correction capacitors
- Flickering
- Failures on PC networks, 200KHZ spikes
- Engine start and inrush currents
- Voltage anomalies (breaks, peaks)
- RCDs trip out or fuse damage
- Voltage imbalance

These problems cause an excess of energy consumption and maintenance costs. To face these kind of problems HT power analyzers permit the user to analyse numberless data simply and quickly like no other system does. PQA testers, designed according to innovative design, are provided with touch-screen display enabling intuitive and fast work. The user interface is based on identification icons. On-line help is available on each screen and represents a valuable assistance for the user when operating the instrument. Each parameter can be traced through the typical tree structure.

It is possible to display **directly**:
- General information on recording (configuration, comments, etc.)
- To draw the graphic of all the recorded quantities. The graphic function "vector diagram" permits the user to assess the mutual phase shift between voltage

signals and input currents, so defining load nature.

- To display table of events related to voltage (voltage anomalies, fast transients) indicating number, date and time of occurrence as well as voltage limits
- To display table of events related to current (inrush currents) indicating number, date and time of occurrence as well as current limits
- To display analysis of power quality in the form of graphics and tables according to standards EN50160.

Functions:
- TRMS voltage measurement/ recording (5 inputs)
- TRMS current measurement/ recording (3 inputs + 1 neutral)
- Measurement/recording of active, reactive, apparent powers and energy
- Measurement/recording of power factor and frequency
- Analysis of voltage and current harmonics up to 49th
- Flicker analysis (Pst, Plt)
- Dissymmetry of input voltage signals
- Voltage anomalies (dips, swells) on 10ms
- Starting current of electrical machines (Inrush)
- Analysis of voltage quick transients (spikes) with resolution 5µs (PQA824)
- Simultaneous measurements (max 251 quantities)
- Integration period ranging from 1s to 60min
- Numerical/graphical display of parameters
- Histograms of the harmonic analysis
- Vector diagram of voltages and currents
- Automatic selection of parameters for default recordings
- Wide colour TFT display with "touch-screen"
- Contextual help on the active display of each screen
- Backlighting and contrast adjustment
- Internal memory
- Memory expansion through external compact flash
- USB pen drive for record transfer
- USB serial interface for PC connection
- Display virtual keyboard for quick data entry
- Windows software to analyse recorded data on PC
- Rechargeable LI-ION battery with power pack.

General Menu

General Setting permits to set the instrument system parameters such as auto power off, memory type where to save recorded data, date/time, language, display contrast, protection password.

Display of Measurements permits the user to display measurement results in real time.

Analyser Setting permits the user to define simple and advanced configurations related to the connection of the instrument to the installation.

Recording Setting permits the user to select settings for each recording and get information on the instrument's operating autonomy.
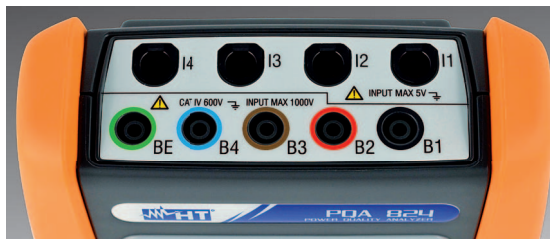
Management of stored data permits the user to display the list of all recordings as well as stored data.
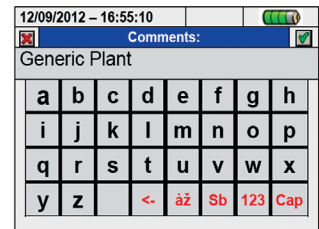
Instrument details where general information concerning the instrument are reported.
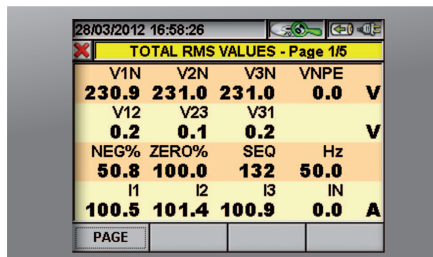
Input terminals

Configuration

## Display of measurements

The instrument permits the user to carry out analysis of harmonics, cosphi, powers on all phases, display of waveforms and vector quantities providing the user with a section called oscilloscope.


Measurement of voltages, AC TRMS currents as well as active, reactive and apparent powers, power factor for each single and total phase besides flicker values and voltage dissymetry.
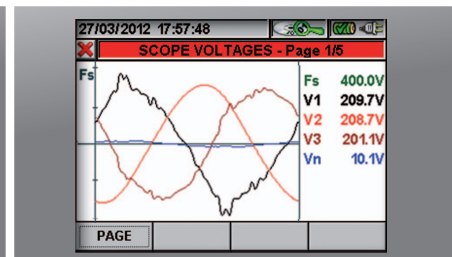
*Display of voltage and current waveforms for both single and total phase.*
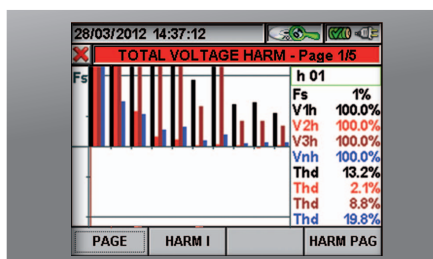
Display of voltage and current harmonics up to 49th component for both single and total phase both as table and as histogram plot. The THD% value is always present for each phase.
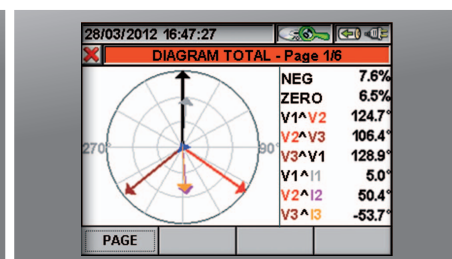
Display of vector diagram where voltages and currents with phase shift angles are drawn in order to define load nature.

Analyzer setting

Before starting a recording the instrument shows a series of system configurations: 4-wire, 3-wire, single, ARON so giving the user the opportunity to define clamp meter type STD or FLEX, clamp's full scale, system frequency as well as interface with voltage transformers (TV) of the installation under test displaying the value of voltages on the primary side of the transformers themselves.
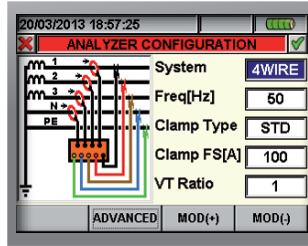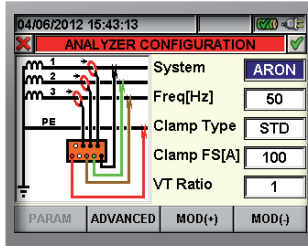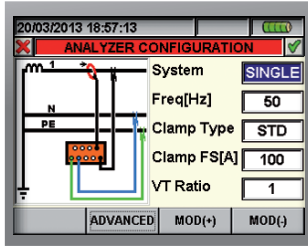

Recorder setting

Under this section the instrument permits the user to define any detail for activation of recordings, selection of parameters, type of analysis to be effected easily thanks to "touch-screen" display and special smart icons.

Default setting

opens section of default configuration where the user can select the type of analysis to be carried out so letting the instrument automatically select the parameters suitable for that purpose. It is also possible to create and save up to 16 custom configurations.
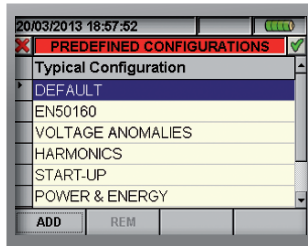
1. **DEFAULT**: setting of parameters when the instrument leaves factory.
2. **EN50160**: setting of parameters for power quality according to standards EN50160 relative to voltage anomalies, harmonic analysis, flicker, dissymetry and detection of voltage spikes.
3. **VOLTAGE ANOMALIES**: setting of parameters for power quality relative to voltage anomalies (breaks, peaks).
4. **HARMONICS**: setting of parameters for voltage and current harmonic analysis.
5. **MACHINE START**: setting of parameters relative to starting of motors and electrical machines.
6. **POWER & ENERGY**: setting of parameters relative to power and energy measurements.

Manual setting

permits selection of the required quantities for recording and analysis provided by the instrument (harmonics, voltage anomalies, dissymmetry, inrush currents, flicker with tree structure) and indication of recording autonomy changing dynamically depending on selection.
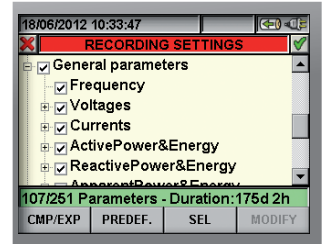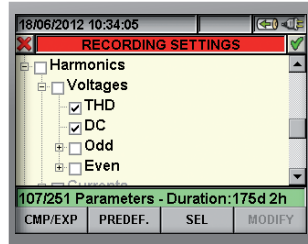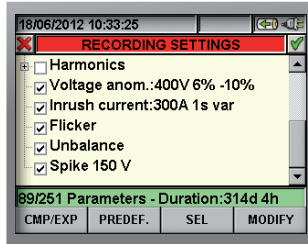
Recording outcome

Display of recording outcome is very easy thanks to table "RECORDING ANALYSIS" listing the measurements to analyse through EVENT tables such as inrush currents, anomalies, spike flicker as well as temporary harmonic/THD trends so getting an immediate analysis report according to EN50160. It is also possible to display waveforms, harmonics, power values, cosphi and vector diagrams relative to instantaneous measurements.
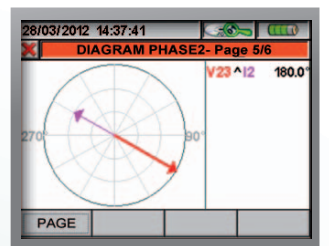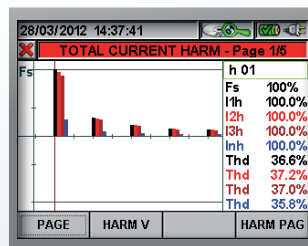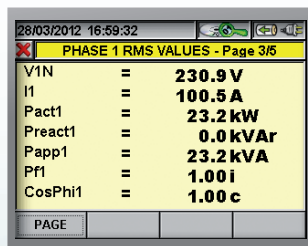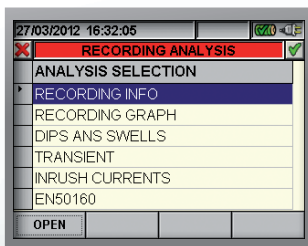
ANALYSIS OF CONSUMED ENERGY
This page shows the Energy and Peak power values consumed while recording

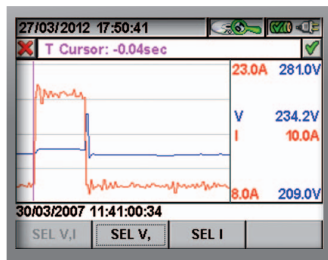|	
Eact	Total active power consumed while Recording.
Ppeak	Max. active power peak (measured on 16 periods of mains frequency) consumed while recording
Date Ppeak	Date and time in which the power peak occurred
Start rec.	Starting date of the recording
Stop rec.	Stopping date of the recording
Rec. Time	Recording time expressed in days (d), hours (h) and minutes (m)
Int. Per.	Set integration period value

Inrush currents

During a dynamic phase such as the start of motors as well as of uninterruptible power supplies or other applications, measurement of inrush currents aims at properly sizing the installation in order to estimate how other elements such as RCDs and fuses could be affected.

PQA models are capable of carrying out recordings of inrush currents with minimum resolution of 10ms whose data can be reported both numerically and graphically.

The results are as follows:
- *The number of detected events (max 1000 recordable events)*
- *Phase L1, L2, L3 corresponding to event occurrence*
- *Date/Time when event took place*
- *Maximum value of inrush current.*

N.	L	Time	Max/Mi
1	3	30/03/07 11:30:24:44	180.2
2	3	30/03/07 11:32:10:18	175.3
3	3	30/03/07 11:32:38:23	178.5
4	3	30/03/07 11:32:43:30	183.8
5	1	30/03/07 11:41:01:25	262.7
6	3	30/03/07 11:41:01:27	185.4

TABLE STRUCTURE
- *anomaly serial number;*
- *phase number on which anomaly occurred;*
- *date and time when anomaly occurred;*
- *anomaly max/min volt value;*
- *anomaly duration in seconds;*
- *anomaly type (up or down).*

N.	L	Time	Max[A]
1	1	30/03/07 11:41:00:34	20.7
2	2	30/03/07 11:41:00:34	21.0
3	3	30/03/07 11:41:00:34	20.7
4	1	30/03/07 11:42:00:80	22.3
5	2	30/03/07 11:42:00:80	22.8
6	3	30/03/07 11:42:00:80	22.6

By means of cursor this graph shows maximum/minimum current and voltage values, value of current and voltage of the selected inrush current.

Voltage anomalies

Voltage anomalies (breaks, peaks) are due to connection/disconnection of high power loads as well as to network undersizing compared to the extent of loads.

For example a voltage break occurs when inrush current interacts with impedance of electrical circuit so causing current increase and voltage decrease along with tripping out of RCDs, malfunction/power off of equipment and sodium vapour lamps.

During recording phase PQA stores all EVENTS such as breaks/peaks. Thanks to an easy and intuitive report the user can immediately estimate the extent of the event.

Spikes

Pulses generated in one plant are often caused by switching power supplies, diagnostics electro medical equipment and switching on/off of loads as well as by lightning bringing about a fast increase of voltage. They can affect equipment logical circuits through capacitive couplings and burn out PCBs or damage electrical insulation.

Model PQA824 permits to detect rapid voltage transients (spikes) through high frequency sampling with minimum resolution 5μs (200kHz) storing them in a full report:
- *spike serial number;*
- *phase number on which spike occurred;*
- *date and time when spike occurred;*
- *Volt spike positive peak;*
- *Volt spike negative peak;*
- *Volt spike positive delta;*
- *Volt spike negative delta;*
- *type Up or Down (higher or lower than set threshold);*
- *phenomenon speed (Fast or Slow).*

N.	L	Time	Peak+
1	1	30/03/07 11:43:00:62	485.3
2	1	30/03/07 11:43:00:74	501.9
3	1	30/03/07 11:43:00:86	505.2
4	1	30/03/07 11:43:01:10	41.6
5	3	30/03/07 11:43:01:76	0.0
6	3	30/03/07 11:43:01:76	40.9

Harmonics

Harmonic distortion is caused by non linear loads where current does not change according to voltage. Some effects due to harmonics are:
- *Overheating of transformers and motors*
- *Damage or false alarms on switches, fuses and relays*
- *Increase of parallel resonance in phase shift capacitors due to inductive loads*
- *Vibration on motors with possible deterioration.*
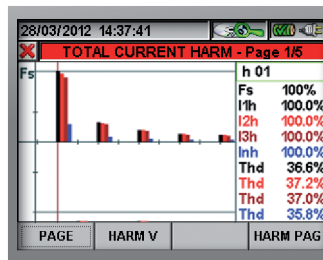
The graph shows the third current harmonic over time. A special effect is represented by neutral overload due to odd current harmonics multiple of THREE. These harmonics are added in the neutral conductor which shall be therefore suitably sized in order to get a current higher than the phase one circulating on it. In the stator the windings of an asynchronous motor are fed with AC current and generate a rotating magnetic field moving the rotor. Some harmonics particularly the 5th, the 11th and the 17th create a negative sequence opposing the motion and generating an anti-torque so reducing the motor performance.

THD%

To assess the overall harmonic content of a waveform reference is made to the total harmonic distortion (THD%) which represents a kind of quadratic mean of the harmonics set. As for voltages this parameter shall comply with standards EN50160 with a value lower than 8%.
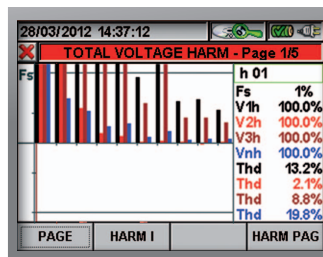

Flicker

In the electro technical field **Flicker** is a visible change in brightness of an incandescent lamp due to rapid fluctuations in the voltage of the power supply. The source of this is the voltage drop generated over the source impedance of the grid by the changing load current of an equipment or facility. These fluctuations in time generate flicker.

The effects can range from disturbance to epileptic attacks of photosensitive persons. Flicker may also affect sensitive electronic equipment such as television receivers or industrial processes relying on constant electrical power. The requirements of flicker measurement equipment are defined in the standards IEC/EN61000-4-15. Flicker may be produced, for example, if a steel mill uses large electric motors or arc furnaces on a distribution network, or frequent starting of an elevator motor in an office building, or if a rural residence has a large water pump starting regularly on a long feeder system. The likelihood of flicker increases as the size of the changing load becomes larger with respect to the prospective short circuit current available at the point of common connection. Electric utility companies shall keep to limitations as far as such a disturbance is concerned. Some testers called flicker meters can detect the distorted signal so starting a statistical analysis with the following quantities, whose value **shall always be <1**:
- **PPst** = Short-term flicker severity is calculated over an interval of 10 minutes.
- **Plt** = Long-term flicker severity is calculated as from a sequence of 12 Pst values over an interval of 2 hours
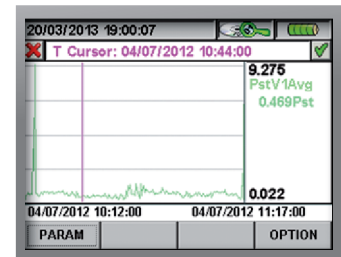
Vrms and Power

Graphs show TRMS values of quantities and powers displaying MAX, MIN and AVERAGE values during the whole recording.
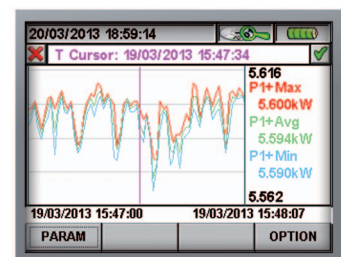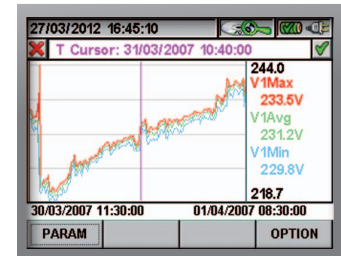
TopView software

TopView software is a multifunctional application program capable of managing results measured by safety testers, power quality analyzers and combined instruments.
As for power quality analyzers (PQA82x / VEGA78) software

permits the following operations:
- Instrument setting (system type, recording parameters, etc.)
- On line display of quantities measured by the instrument (numerical values, waveforms, histograms, saving of instantaneous samplings)

- Start/Stop of a recording
- Data transfer from instrument to PC through USB and accurate data analysis with graphs and tables
- Creation of professional reports on power quality according to EN50160
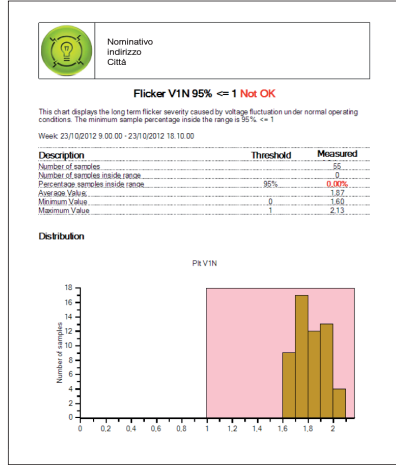
- Differential analysis of energy consumption per time
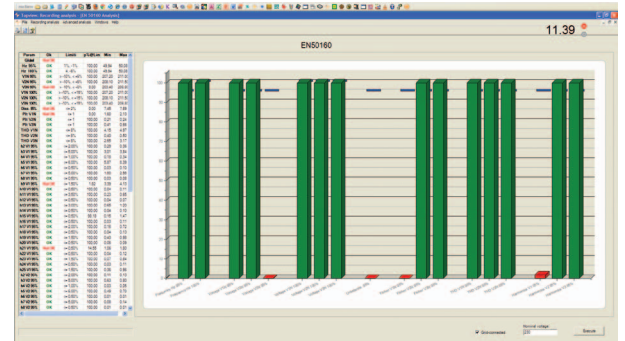- Creation of custom printing reports which can be exported as XLS and PDF format
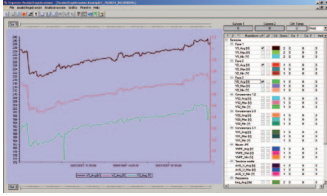
Selection and analysis of recording data
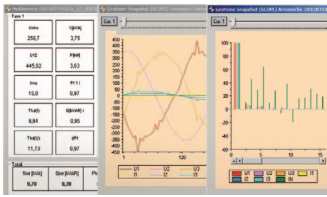
On line display of measured quantities
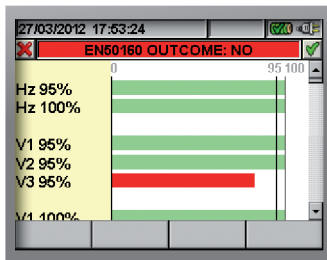

Detailed display of report EN50160

Overall display of report EN50160

Report EN50160

Numerical display of analysis data according to EN50160

Graphical histogram display of analysis data according to EN50160

Summary display of analysis data according to EN50160

Data loggers for single-phase and three-phase TRMS current and voltage

XL421, XL422, XL423, XL424 are innovative portable Data Loggers, capable of measuring AC current and voltage in real efficient (TRMS) value up to 2500A and 600V respectively, in single-phase or three-phase electric systems. These instruments are very useful especially in the industrial sector (evaluations of electric load consumption, verification of nominal power of transformers, measurement of mains voltage, unbalanced loads, etc.) and are extremely versatile due to their small size, thanks to which they are easily installed also as panel units. These models are enclosed in a practical and safe plastic case, with a high mechanical protection index IP65 (protected both against dust and water sprays); they are, therefore, suitable for use in common industrial environments. These models are provided with appropriate in-built

flexible clamps or cables with alligator clips respectively, which allow safely carrying out current and voltage measurements (also on cables and/or big bars). Thanks to a sophisticated internal memory algorithm, continuous recordings are possible also for prolonged time intervals and, therefore, it is possible to accurately monitor electric mains.

FUNCTIONS	XL421	XL422	XL423	XL424
TRMS current measurement	Single phase	Three phase	Single phase	Three phase
Measurement range	1 ÷ 2500A AC		0 ÷ 600V AC	
Accuracy	±(1.0%rdg+1dgt)		±(1.0%rdg+1dgt)	
Resolution	1A		1A	
Frequency range	50±6Hz, 60±6Hz		50±6Hz, 60±6Hz	
Bandwidth	3200Hz		3200Hz	
Sample rate	64 points in 20ms		64 points in 20ms	
Integration period	1s, 6s, 30s, 60s, 5min		1s, 6s, 30s, 60s, 5min	
Memory size	1Mbyte		1Mbyte	
PC serial interface	RS-232		RS-232	
Integration period	Recording duration (days)		Recording duration (days)	
1s	5	1,5	5	1,5
6s	34	8	34	8
30s	170	42	170	42
60s	364(*)	91	364(*)	91
5min	1820(*)	455(*)	1820(*)	455(*)

*(*) Depending on battery life*

HT9022

HT9022 is a combination of a power quality analyzer, a phase sequence/conformity detector, a clamp meter and a voltage detector in one single handy device. The advanced design of HT9022 ensures reliable and accurate measurements under a wide range of operating conditions. HT9022 is the ideal instrument for troubleshooting power quality problems, calculating power factor correctors, recording energy consumption, recording DC power, etc. Unlike the data loggers that take snapshots of the electrical parameters in regular intervals, losing what happens between an interval and the next, HT9022 continuously records all electrical parameters as a true power quality analyzer. The internal memory enables long-term recording for further download to (and analysis on) a PC, a PDA or a smartphone. HT9022 is flexible and portable to grant the user the most reliable measurements with an easy-to-use interface.

FUNCTIONS

Measuring/recording of DC and AC+DC TRMS voltage
Measuring/recording of DC and AC+DC TRMS current
Phase sequence and conformity
Measuring/recording of active, reactive and apparent power, power factor in single-phase and balanced three-phase systems
Measuring/recording of active, reactive and apparent energy in single-phase and balanced three-phase systems
Measuring/recording V / I harmonics up to the 25th order and THD%
Measuring/recording of DC power
Measuring/recording of current and voltage frequency
Resistance measurement and continuity test with buzzer
Inrush current
Non-contact AC voltage detection with built-in sensor
MAX/MIN/CREST
Bluetooth connection
Backlight
Auto Power OFF
Data HOLD
MAX/MIN/CREST
PC connection with Bluetooth
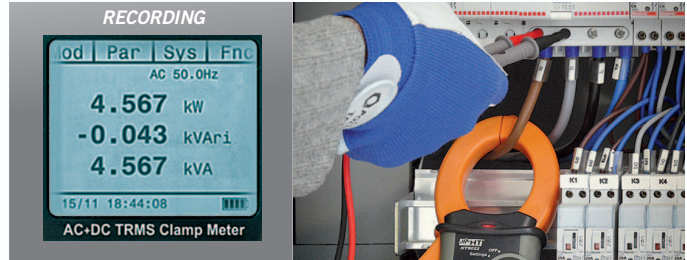
Display and recording power
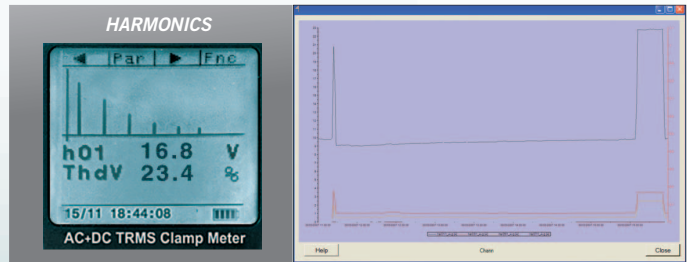
Display harmonics and analysis software
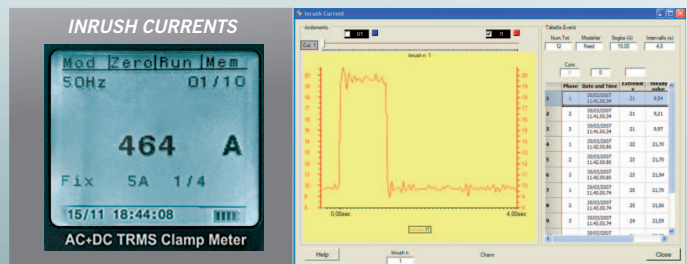
Inrush currents and analysis software

BLUETOOTH
connection

POWER QUALITY ANALYZERS and DATA LOGGERS	POWER QUALITY ANALYZERS				DATA LOGGERS			
Model	PQA824	PQA823	VEGA78	HT9022	XL423	XL424	XL421	XL422
AC TRMS voltage in single phase plants	●	●	●	●	●	●		
AC TRMS voltage in three phase plants	●	●	●			●		
AC TRMS current in single phase plants	●	●	●	●			●	●
AC TRMS current in three phase plants	●	●	●					●
AC TRMS voltage, current, power, energy, PF in single phase plants	●	●	●	●				
AC TRMS voltage, current, power, energy, PF in three phase plants	●	●	●					
Neutral to ground voltage	●	●	●	●				
DC voltage, current, power	●	●	●	●				
Neutral current	●	●	●	●				
Phase sequence indication	●	●	●	●				
Voltage unbalance (NEG%, ZERO%)	●	●	●					
Voltage Flicker (Pst, Plt)	●	●						
Measurements by external CTs and VTs	●	●	●					
Voltage/current waveforms with selectable pages	●	●	●					
Voltage/current harmonic histograms and THD% calculation	●	●	●	●				
Voltage/current vectorial diagram	●	●	●					
Recording analysis with selectable integration period IP	●(1s-60m)	●(1s-60m)	●(1s-60m)	●(1s-15m)	●(1s-60m)	●(1s-60m)	●(1s-60m)	●(1s-60m)
Simultaneous recording of any available parameter	●	●	●	●				
Max number of selectable parameters for simultaneous recording	251	251	251	60 (fixed)	1	3	1	3
Voltage/current harmonic analysis up to 49th order	●	●	●	●(25th)				
Complete EN50160 analysis	●	●						
Voltage anomalies (sags, swells) from 10ms @50Hz with selectable thresholds	●	●	●					
Inrush currents of electric motors	●	●		●				
Voltage fast transients (spikes) (5µs resolution, 200kHz sampling rate)	●							
Recording duration indication	●	●	●	●				
Predefined and customized recording settings	●	●	●					
"Touch screen" LCD display	●	●	●					
Display resolution (pxl)	320x240	320x240	320x240	128x128				
Colour display	●	●	●					
Battery	Li-Ion	Li-Ion	Li-Ion	Alkaline	Alkaline	Alkaline	Alkaline	Alkaline
Power supply by rechargeable battery	●	●	●					
Power supply by external AC/DC adapter	●	●	●					
Auto Power OFF	●	●	●	●				
Internal memory size	15Mb	15Mb	15Mb	2Mb	1Mb	1Mb	1Mb	1Mb
External Compact Flash memory	●	●	●					
USB port for external memory stick	●	●	●					
Approx. memory duration (in days @ IP=15min @ max parameters)	110	110	110	2.1	365(60s)	365(60s)	365(60s)	365(60s)
PC interface	USB	USB	USB	Bluetooth	RS232	RS232	RS232	RS232
Contextual help at display on each screen	●	●	●					
Saving of recordings and snapshots	●	●	●	●				
Protection password on recordings	●	●	●					
Dimensions (LxWxH) (mm)	235x165x75	235x165x75	235x165x75	252x88x44	120x80x43	120x80x43	120x80x43	120x80x43
Weight (batteries included)	1 Kg	1 Kg	1 Kg	0,42 Kg	0,5 Kg	0,5 Kg	0,5 Kg	0,5 Kg
Safety in compliance with IEC/EN61010-1	●	●	●	●	●	●	●	●
Power quality analysis reference	EN50160	EN50160						

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