■ 3-PHASE POWER QUALITY ANALYZER

3945-B

PowerPad®

IMPORTANT WARRANTY NOTE:

By registering online within 30 days from the date of purchase, your warranty will be extended to 3 years

ENGLISH

User Manual

AEMC® INSTRUMENTS

Statement of Compliance

Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments certifies that this instrument has been calibrated using standards and instruments traceable to international standards.

We guarantee that at the time of shipping your instrument has met its published specifications.

An NIST traceable certificate may be requested at the time of purchase, or obtained by returning the instrument to our repair and calibration facility, for a nominal charge.

The recommended calibration interval for this instrument is 12 months and begins on the date of receipt by the customer. For recalibration, please use our calibration services. Refer to our repair and calibration section at **www.aemc.com**.

Serial #: ______________________________

Cat. #: ________________________________

Model #: 3945-B

Please fill in the appropriate date as indicated:

Date Received: ____________________________

Date Calibration Due: _______________________

AEMC® INSTRUMENTS

Chauvin Arnoux®, Inc.
d.b.a AEMC® Instruments
www.aemc.com

READ CAREFULLY BEFORE USING FOR THE FIRST TIME

Your instrument is equipped with a NiMH battery. This technology offers several advantages:

- **Long battery charge life for a limited volume and weight.**
- **Possibility of quickly recharging your battery.**
- **Significantly reduced memory effect: you can recharge your battery even if it is not fully discharged.**
- **Respect for the environment: no pollutant materials such as lead or cadmium, in compliance with the applicable regulations.**

After prolonged storage, the battery may be completely discharged. If so, it must be completely recharged.

Your instrument may not function during part of this recharging operation.

Full recharging of a completely discharged battery may take several hours.

In this case, at least 5 charge/discharge cycles will be necessary for your battery to recover 95% of its capacity.

To make the best possible use of your battery and extend its effective service life:

- **Only use the charger supplied with your instrument. Use of another charger may be dangerous.**
- **Only charge your instrument at temperatures between 0° and 40°C.**
- **Comply with the conditions of use defined in the operating manual.**
- **Comply with the storage conditions specified in the operating manual.**

NiMH technology allows a limited number of charge/discharge cycles depending significantly on:

- **The conditions of use.**
- **The charging conditions.**

Please refer to § 7 for correct replacement of the battery.

Do not dispose of the battery pack with other solid waste. Used batteries must be entrusted to a qualified recycling company or to a company specialized in processing hazardous materials.

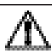
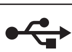
Table of Contents

INTRODUCTION

 **Warning**

- Never use on circuits with a voltage higher than 600V and an overvoltage category higher than CAT III or IV (probe dependant)
- Use in indoor environments only.
- Only use accessories that are compliant with the safety standards (IEC 664-1 Ed. 92) 600V min and overvoltage CAT III or IV.
- Only use factory specified replacement parts.
- Always disconnect the power cord, measurement leads and sensors before replacing the battery.

1.1 International Electrical Symbols

	Signifies that the instrument is protected by double or reinforced insulation.
	**CAUTION - DANGER!** Read the User Manual.
	Risk of electric shock. The voltage at the parts marked with this symbol may be dangerous.
	Refers to a type A current sensor. This symbol signifies that application around and removal from HAZARDOUS LIVE conductors is permitted.
	Refers to a type B current sensor. Do not apply around or remove from HAZARDOUS LIVE conductors without additional protective means (de-energizing the circuit or wearing protective clothing suitable for high voltage work).
	Important instructions to read and understand completely.
	Important information to acknowledge.
	USB socket
	The CE marking guarantees conformity with European directives and with regulations covering EMC.
	The trash can with a line through it means that in the European Union, the product must undergo selective disposal for the recycling of electric and electronic material, in compliance with Directive WEEE 2002/96/EC.

1.2 Definition of Measurement Categories

CAT IV: For measurements performed at the primary electrical supply (<1000V) such as on primary overcurrent protection devices, ripple control units, or meters.

CAT III: For measurements performed in the building installation at the distribution level such as on hardwired equipment in fixed installation and circuit breakers.

CAT II: For measurements performed on circuits directly connected to the electrical distribution system. Examples are measurements on household appliances or portable tools.

1.3 Receiving Your Shipment

Make sure that the contents shipped are consistent with the packing list. Notify your distributor of any missing items. If the equipment appears to be damaged, file a claim immediately with the carrier and notify your distributor at once, giving a detailed description of any damage. Save the damaged packing container to substantiate your claim. Do not use equipment which is damaged or appears to be damaged.

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i After receiving your PowerPad®, charge and discharge the instrument one or two cycles to ensure the proper level display of the battery indicator.

1.4 Ordering Information

PowerPad® Model 3945-B .... Cat. #2130.74
Includes extra large tool bag, soft carrying pouch, four 10 ft color-coded voltage leads and alligator clips, RS-232 DB9F optically coupled serial cable, RS-232 to USB adapter, US 115V power cord, rechargeable NiMH battery pack, and a USB stick with DataView® software and user manual.

PowerPad® Model 3945-B w/MN93 .... Cat. #2130.75
Includes meter, set of three MN93 (240A) probes, extra large tool bag, soft carrying pouch, four 10 ft color-coded voltage leads and alligator clips, RS-232 DB9F optically coupled serial cable, RS-232 to USB adapter, US 115V power cord, rechargeable NiMH battery pack, and a USB stick with DataView® software and user manual.

PowerPad® Model 3945-B w/SR193 .... Cat. #2130.76
Includes meter, set of three SR193 (1200A) probes, extra large tool bag, soft carrying pouch, four 10 ft color-coded voltage leads and alligator clips, RS-232 DB9F optically coupled serial cable, RS-232 to USB adapter, US 115V power cord, rechargeable NiMH battery pack, and a USB stick with DataView® software and user manual.

PowerPad® Model 3945-B w/24" AmpFlex® 193-24 .... Cat. #2130.77
Includes meter, set of three 24" AmpFlex® 193-24 (6500A) sensors, extra large tool bag, soft carrying pouch, four 10 ft color-coded voltage leads and alligator clips, RS-232 DB9F optically coupled

serial cable, RS-232 to USB adapter, US 115V power cord, rechargeable NiMH battery pack, and a USB stick with DataView® software and user manual.

PowerPad® Model 3945-B w/36" AmpFlex® 193-36 .... Cat. #2130.78
Includes meter, set of three 36" AmpFlex® 193-36 (6500A) sensors, extra large tool bag, soft carrying pouch, four 10 ft color-coded voltage leads and alligator clips, RS-232 DB9F optically coupled serial cable, RS-232 to USB adapter, US 115V power cord, rechargeable NiMH battery pack, and a USB stick with DataView® software and user manual.

PowerPad® Model 3945-B w/MR193 .... Cat. #2130.79
Includes meter, set of three color-coded MR193 (1000AAC/1400ADC) probes, extra large tool bag, soft carrying pouch, four 10 ft color-coded voltage leads and alligator clips, RS-232 DB9F optically coupled serial cable, RS-232 to USB adapter, US 115V power cord, rechargeable NiMH battery pack, and a USB stick with DataView® software and user manual.

PowerPad® Model 3945-B w/MN193 .... Cat. #2130.80
Includes meter, set of three color-coded MN193 (6A/120A) probes, extra large tool bag, soft carrying pouch, four 10 ft color-coded voltage leads and alligator clips, RS-232 DB9F optically coupled serial cable, RS-232 to USB adapter, US 115V power cord, rechargeable NiMH battery pack, and a USB stick with DataView® software and user manual.

Only the SR, Ampflex® and MiniFlex® sensors are rated 600V CAT IV
The MN, MR and SL probes are 300V CAT IV, 600V CAT III

1.4.1 Accessories and Replacement Parts

Extra Large Tool Bag .... **Cat. #2133.73**

Set of 3 Color-coded, MN93 Probes (240A).................................. **Cat. #2140.09**

Set of 3 Color-coded, SR193 Probes (1200A) .... **Cat. #2140.10**

Set of 3 Color-coded, 24" AmpFlex® 193-24 Probes (6500A) .... **Cat. #2140.11**

Set of 3 Color-coded, 36" AmpFlex® 193-36 Probes (6500A) .... **Cat. #2140.12**

Set of 3 Color-coded, MR193 Probes (1000AAC / 1400ADC) .... **Cat. #2140.13**

Set of 3 Color-coded, MN193 Probes (6A / 120A)........................... **Cat. #2140.14**

Replacement, Soft Carrying Pouch .... **Cat. #2140.15**

5A Adapter Box (for 1 or 5A probes)... **Cat. #2140.17**

10 ft Cable, PC RS-232, DB9 F/F.. **Cat. #2140.18**

Replacement Battery 9.6V NiMH.. **Cat. #2140.19**

Set of (3) Color-coded MN93 Probes, 30 ft Leads (200A)............... **Cat. #2140.24**

Set of (3) Color-coded SR193 Probes, 30 ft Leads (1200A) .... **Cat. #2140.25**

Set of (3) Color-coded 24", 30 ft Leads (6500A)
AmpFlex® Sensors Model 193-24-30 .... **Cat. #2140.26**

Set of (3) Color-coded 36", 30 ft Leads (6500A)
AmpFlex® Sensors Model 193-36-30 .... **Cat. #2140.27**

MR193 Probe (black connector) (1000AAC / 1400ADC).................... **Cat. #2140.28**

Set of (3) Color-coded MN193, 30 ft Leads (5A/100A)..................... **Cat. #2140.29**

Set of (3) Color-coded MR193, 30 ft Leads (1000AAC/1400ADC)..... **Cat. #2140.30**

AC Current Probe Model MN93-BK (200A)..................................... **Cat. #2140.32**

AC Current Probe Model SR193-BK (1200A) .... **Cat. #2140.33**

AmpFlex® Sensor 24" Model 193-24-BK (6500A) .... **Cat. #2140.34**

AmpFlex® Sensor 36" Model 193-36-BK (6500A) .... **Cat. #2140.35**

AC Current Probe Model MN193-BK (5A/100A) .... **Cat. #2140.36**

MiniFlex® Sensor 10" Model MA193-10-BK (1000A)........................ **Cat. #2140.48**

Set of 4, Color-coded 30 ft (9m) Voltage Leads (600V CAT IV 10A).. **Cat. #2140.61**

Replacement Lead - Set of 4, Color-coded 10 ft (3m)
with Color-coded alligator clips (red, black, blue & white) .... **Cat. #2140.64**

115V Power Cord US .... **Cat. #5000.14**

1.4.2 Third Party Accessories

Converter - USB to RS-232, DB9 M/M .... available online at **www.startech.com**

Converter - Ethernet to RS-232, Model ESP901...available online at **www.bb-elec.com**

Order Accessories and Replacement Parts Online: www.aemc.com/store
DataView® Software Updates Available Online: www.aemc.com

PRODUCT FEATURES

2.1 Description

The PowerPad® Model 3945-B is a three-phase power quality analyzer that is easy-to-use, compact and shock-resistant. It is intended for technicians and engineers to measure and carry out diagnostic work and power quality work on one, two or three phase low voltage networks.

Users are able to obtain instant waveforms of an electrical network's principal characteristics, and also monitor their variation over a period of time. The multi-tasking measurement system simultaneously handles all the measurement functions and waveform display of the various magnitudes, detection, continuous recordings and their display without any constraints.

Features:

- Measurement of TRMS voltages up to 480V (phase-to-neutral) or 830V (phase-to-phase) for two, three or four-wire systems
- Measurement of TRMS currents up to 6500Arms
- Measurement of DC voltage up to 850V
- Measurement of DC current up to 1400ADC (with MR193 probe)
- Frequency measurement (41 to 70Hz systems)
- Calculation of neutral current for WYE configurations
- Calculation of Crest Factors for current and voltage
- Calculation of the K Factor for transformers
- Calculation of short-term flicker for voltage
- Calculation of the phase unbalance for voltage and current (3 phase only)
- Measurement of harmonic angles and rates (referenced to the fundamental or RMS value) for voltage, current or power, up to 50th harmonic
- Calculation of overall harmonic distortion factors
- Monitoring of the average value of any parameter, calculated over a period running from 1 sec to 2 hrs
- Measurement of active, reactive and apparent power per phase and their respective sum total
- Calculation of power factor, displacement power factor and tangent factor
- Total power from a point in time, chosen by the operator
- Recording, time stamping and characterization of disturbance (swells, sags and interruptions, exceedence of power and harmonic thresholds)
- Detection of transients and recording of associated waveforms

2.2 Control Functions

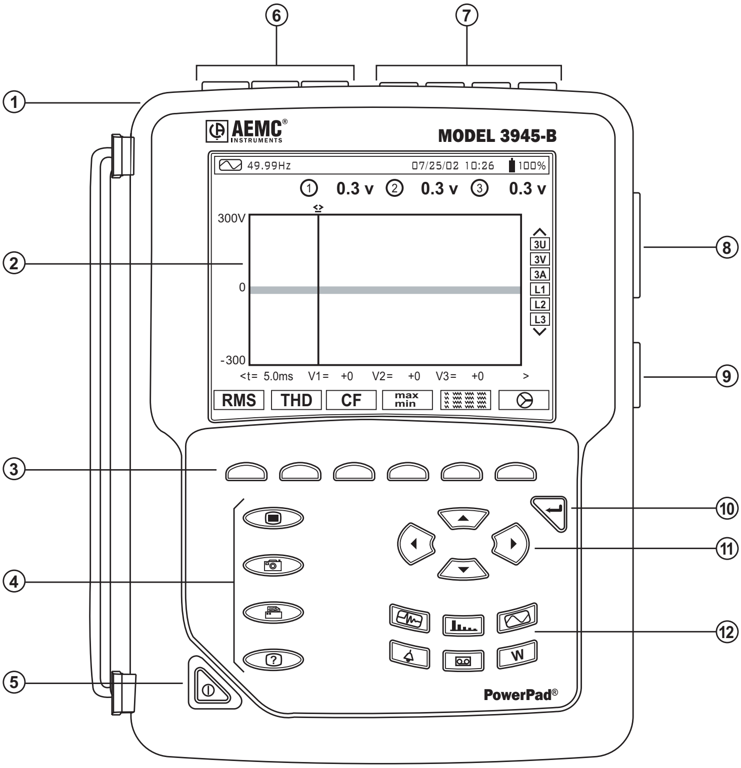


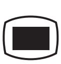
Figure 2-1

① Over molded protective case.

② Color LCD display with graphic representation of system parameters and measurements

③ Six (6) function buttons used to modify the display mode.

④ Four (4) function buttons which allow the user to:


Access the instrument setup parameters (*see § 4.1).*


Take a snapshot of the current screen or access screens already stored in the memory. Record associated waveform and power measurement data.


Print the measurement results on an external printer.


Get help on the current display functions, in the language chosen by the user.

⑤ ON / OFF button.

⑥ Three (3) current inputs on the top of the instrument to enable the use of current sensors (MN, SR, AmpFlex®, and MR probes).

⑦ Four (4) voltage inputs.

⑧ RS-232 bidirectional optically isolated output for transferring data to a PC (bi-directional) or printing to a dedicated printer (DPU 414 - SEIKO).

⑨ AC Line power input.

⑩ Enter button.

⑪ Four (4) buttons that enable movement of the cursor, browsing or the selection of data.

⑫ Buttons for directly accessing the 6 display modes at any time:

Transients (set recording or view recorded transient):
- displays waveforms associated with rapid changes in input

Harmonics View:
- display of the harmonics in percent and value ratios for of voltage, current and power, for each harmonic through the 50th
- determination of harmonic current produced by non-linear loads
- analysis of the problems caused by harmonics according to their order (heating of neutrals, conductors, motors, etc.)

Waveforms View:
- displays voltage and current waveforms or vector representation (Phasor diagram)
- identification of signal distortion signatures
- display of amplitude and phase unbalance for voltage and current
- checking connections for correct phase order

Power / Energy (view or start energy monitoring):
- display of power levels and the associated parameters (power factor, displacement and tangent)
- energy monitoring
- four quadrant measurement to discern produced/consumed active energies and inductive/capacitive reactive energies

Recording (set recording or view recorded data):
- time-related representation as bar charts or line graphs, of average power levels or of the average value of any parameter
- Line graphs of each selected parameter (up to 22) vs time
- line voltage stability check
- management of power consumed and generated
- monitoring of harmonic variations

Alarm Events:

- provides a list of the alarms recorded according to the thresholds programmed during configuration
- logging of interruption with half-cycle resolution
- determination of energy consumption exceedences
- stores value, duration, date, time and set point for up to 4096 events

2.3 Display

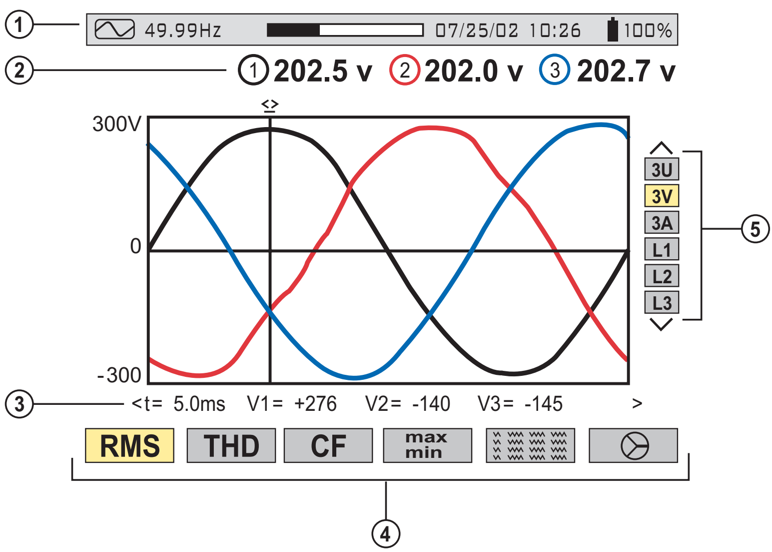


Figure 2-2

① Top display bar indicates:

- Symbol of the tested mode (e.g. , , , etc)
- Frequency of measured signal
- Memory capacity status bar (only available in certain modes)
- Current date and time
- Battery charge status

② Measured RMS values associated with waveforms.

③ Values of signals at an instant "t", at the intersection of cursor and the waveforms. The cursor can be moved along the time scale by pressing the buttons.

④ Measurement selection:

RMS	True RMS Measurement
THD	Total Harmonic Distortion
CF	Crest Factor
max/min	Maximum and Minimum values
	Simultaneous display of the various measurements in alphanumeric form
	Phasor diagram

The calculation of the DPF, Tan, KF, **Φ**, UNB, Min, Max, VAR, Harmonics, PST, and DF parameters and the frequency measurement can only be performed if voltage with a frequency of 41 to 70 Hz is applied to the Ch1 voltage input.

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⑤ Selection of waveforms to be displayed (use the buttons to select):

- **3U** displays the 3 phase-to-phase voltages U_{1-2}, U_{2-3}, U_{3-1}
- **3V** displays the 3 phase-to-neutral voltages V_{1N}, V_{2N}, V_{3N}
- **3A** displays the 3 phase currents
- **4A** displays the 3 phase currents and the neutral current
- **L1, L2** or **L3** displays the voltage and current, on phase 1, 2 or 3, when selected

Protocol:

U: Signifies phase-to-phase voltage

V: Signifies phase-to-neutral voltage

L1, L2, L3: Refer to the phases (A,B,C or other)

2.4 Battery Charge Status

Battery Charging — 25% — **NOTE:** Line cord is plugged in

- Battery capacity level relative to full charge
- % of total capacity already charged (between 0 and 99%)
- Battery sign and % are blinking

Battery Full — 100% — **NOTE:** Line cord may or may not be plugged in

- Battery sign and % are fixed
- % of total capacity is at 100%

Battery Discharging — 25% — **NOTE:** Line cord is not plugged in

- Battery capacity level relative to full charge
- % of the remaining capacity
- Battery sign and % are fixed

Battery Empty Discharging — 0% — **NOTE:** Line cord is not plugged in

- % of total capacity reads 0%
- Battery sign and % are fixed

New Battery Charging — ? — **NOTE:** Line cord is plugged in

- Fixed battery capacity level
- Question mark showing unknown capacity level
- Battery sign and % are blinking

New Battery Discharging — ? — **NOTE:** Line cord is not plugged in

- Fixed battery capacity level
- Question mark showing unknown capacity level
- Battery sign and % are fixed

WARNING: The battery may fully discharge when recording for long periods of time while not connected to a power supply. The PowerPad® will continue to record for some time, even if below the minimum battery charge value. However, the display may not come back on, and will eventually stop saving data when the battery is too low. All data recorded will be saved.

If in the Record Mode, and the display does not come ON, supply power to the PowerPad® with the line cord and the display will come back ON when any button (other than ON/OFF) is pressed.

NOTE: When the 3945-B is stopped using the button, a confirmation is requested if the equipment is in the process of recording.

SPECIFICATIONS

3.1 Reference Conditions

Parameter	Reference Conditions
Ambient temperature	73°F ± 5°F (23°C ± 3°C)
Humidity	45%
Atmospheric pressure	25.4" Hg to 31.3" Hg (860 to 1060 hPa)
Phase voltage	230Vrms and 110Vrms ±2% without DC
Clamp current circuit input voltage	0.03V to 1Vrms without DC (<0.5%)
AmpFlex® current circuit input voltage	11.8mV to 118mVrms without DC (<0.5%)
Frequency of electricity network	50 and 60Hz ± 0.1Hz
V/I phase shift	0° active power / 90° reactive power
Harmonics	<0.1%

The uncertainties given for power and energy measurements are maximum for Cos φ = 1 or Sin φ = 1 and are typical for the other phase shifts.

NOTE: The symbol "U" will be used throughout this manual and in the instrument to refer to phase-to-phase voltage measurement.
The symbol "V" will be used for phase-to-neutral voltage measurement.

**All specifications are subject to change without notice.*

3.2 Electrical Specifications

Sampling Frequency (256 samples per cycle):
12.8kHz samples/sec per channel @ 50Hz
15.36kHz samples/sec per channel @ 60Hz

Memory Size: 4MB

Memory Partition: Data Logging - 2MB; Waveform capture - XXMB; Transient capture -XXB; Alarms - XXB

3.2.1 Voltage Inputs

Operating Range: Phase-Phase - 960Vrms AC/DC
Phase-Neutral - 480Vrms AC/DC

Input Impedance: 340kΩ between phase and neutral

Overload: 1.2Vn permanently; 2Vn for 1 sec (Vn = nominal voltage)

3.2.2 Current Inputs

Operating Range: 0 to 1V

Input Impedance: 100kΩ for current probe circuit and 12.4kΩ for AmpFlex® circuit

Overload: 1.7V

3.2.3 Accuracy Specifications (excluding current probes)

Function	Range	Display Resolution	Accuracy
Frequency	40 to 69Hz	0.01Hz	±0.01Hz
Single phase RMS voltages (Vrms, Vdem)	15V to 480V	0.1V	±0.5% ± 2cts
Phase-to-phase RMS voltages (Urms, Udem)	15V to 960V	0.1V	±0.5% ± 2cts
DC voltage component	15V to 680V	0.1V	±1% ± 5cts
Single phase peak voltages (Vpp, Vpm)	15V to 680V	0.1V	±1% ± 5cts
Phase-to-phase peak voltages (Upp, Upm)	15V to 1360V	0.1 V if I < 1000 V 1 V if I ≥ 1000 V	±1% ± 5cts
Current probe (Arms, Adem)	Inom/1000 to 1.2 Inom	0.1 A if I < 1000 A 1 A if I ≥ 1000 A	±0.5% ± 2cts
AmpFlex® & MiniFlex®* (Arms, Adem)	10A to 6500A	0.1 A if I < 1000 A 1 A if I ≥ 1000 A	±0.5% ± 1A
DC current (MR193)	1A to 1400A	0.1 A if I < 1000 A 1 A if I ≥ 1000 A	±(1% + 1A)
Peak Current (App, Apm)	0 to 1.7 x Inom	0.1 A if I < 1000 A 1 A if I ≥ 1000 A	±(1% + 1A)
Peak Current (AmpFlex® & MiniFlex®*)	10 to 9190A	0.1 A if I < 1000 A 1 A if I ≥ 1000 A	±(1% + 1A)
Crest Factor (Vcf, Ucf, Acf)	1.00 to 9.99	0.01	±1% ± 2cts
Real Power (W) Clamp-on and AmpFlex® Clamp-on AmpFlex® & MiniFlex®*	0W to 9999kW Cos φ ≥ 0.8 Cos φ 0.2 to < 0.8 Cos φ 0.5 to < 0.8	4 digits (10000cts)	 ±1% ± 1ct ±1.5% ± 10cts ±1.5% ± 10cts
Reactive Power (VAR) Clamp-on and AmpFlex® Clamp-on AmpFlex® & MiniFlex®*	0W to 9999kW Sin φ ≥ 0.5 Cos φ 0.2 to < 0.8 Cos φ 0.5 to < 0.8	4 digits (10000cts)	 ±1% ± 1ct ±1.5% ± 10cts ±1.5% ± 10cts
Apparent Power (VA)	0VA to 9999kVA	4 digits	±1% ± 1ct
Power Factor (PF, DPF)	-1.000 to 1.000 Cos φ ≥ 0.5 Cos φ 0.2 to < 0.5	0.001	 ±1.5% ± 1ct ±1.5% ± 1ct
Tangent (Tan) for VA ≥ 50VA	-32.76 to 32.76	0.001 Tan φ < 10 0.01 Tan φ < 10	±1° on φ ±1° on φ
Active Energy (Wh) Clamp-on and AmpFlex® Clamp-on AmpFlex® & MiniFlex®*	0Wh to 9999MWh Cos φ ≥ 0.8 Cos φ 0.2 to < 0.8 Cos φ 0.5 to < 0.8	4 digits (10000cts)	 ±1% ± 1ct ±1.5% ± 1ct ±1.5% ± 1ct
Reactive Energy (VARh) Clamp-on	0VARh to 9999MVARh Sin Φ ≥ 0.5 Sin Φ 0.2 to < 0.5	4 digits	 ±1.5% ± 1ct ±2.5% ± 1ct
Reactive Energy (VARh) AmpFlex® & MiniFlex®*	0VARh to 9999MVARh Sin φ ≥ 0.5 Sin φ 0.2 to < 0.5	4 digits	 ±1.5% ± 1ct ±2.5% ± 1ct

Function	Range	Display Resolution	Accuracy
Apparent Energy (Vah)	0VAh to 9999MVAh	4 digits	±1% ± 1ct
Unbalance (Vunb, Aunb) three phase supply	0% to 100%	0.1%	±1% ± 1ct
Phase angle (V/I; I/I; V/V)	-179° to +180°	1°	±2°
Harmonics ratios F = 40 to 69Hz (Vrms > 50V) (rms > Inom/100)	0% to 999% 1 to 50th harmonic	0.1%	±1% + 5cts
Harmonics angles F = 40 to 69Hz (Vrms > 50V) (rms > Imax/100)	-179° to +180° 1 to 25 26 to 50	1°	±3° ±10°
Total harmonics distortion (Vthd, Athd, Uthd)	0% to 999% 50th harmonic	0.1%	±1% + 5cts
Current K factor (Akf)	1 to 99.99	0.01	±5% ± 1ct
Voltage flicker (Vflk)	0.00 to 9.99	0.01	not specified

***Note:** MiniFlex® specified up to 1000A only*

***Vdem, Adem and Udem** = Values measured on half cycle (allow to get a measurement with positive and negative values)*

***Vpm, Upm and Apm** = Peak values min.*

3.2.4 Nominal Range of Use

Frequency: 40 to 69Hz
Harmonics: THD (I) : 0 to 40%; THD (U) : 0 to 20%
Magnetic field: <40.0A/m (Earth's magnetic field)
Electrical field: <3V/m
Relative Humidity: 10 to 90% without condensation

3.2.5 Power Supply

AC Power (internal power supply)
Operating Range: 230VAC ± 20% and 110VAC ± 20% (88 to 276VAC)
Max Power: 30VA

Battery Power (allows use in the event of an interruption)
Type: NiMH 3800 mAh
Output: 4-wire (2 for temperature probe)
Rated Voltage: 9.6V
Charge Time: 6 hrs approx.
Battery Life: >8 hrs with display on
≥35 hrs with display off (recording mode)
Operating Temperature: 32° to 122°F (0° to 50°C)
Recharging Temperature: 50° to 104°F (10° to 40°C)
Storage Temperature: -4 to +122°F (-20 to +50°C) for ≤ 30 days

NOTE: The battery starts to charge when the power cord is connected. When the battery is charged, the instrument uses the current supplied by the power supply, without drawing from the battery.

3.3 Mechanical Specifications

Dimensions: 9.5 x 7.0 x 2.0" (240 x 180 x 55mm)

Weight: 4.6 lb (2.1kg)

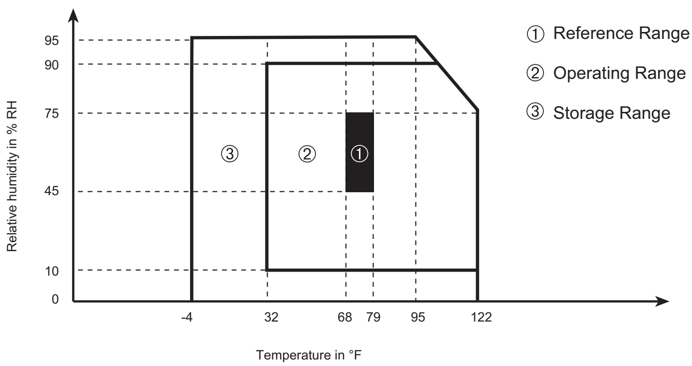
Shock and Vibration: per EN 61010-1

Tightness: IP 50 per EN 60529 *(electrical IP2X for the terminals)*

3.4 Environmental Specifications

Altitude: Operating: 0 to 2000 meters (6560 ft)
Non-Operating: 0 to 10,000 meters (32800 ft)

Temperature and % RH:



3.5 Safety Specifications

Electrical Safety

600V CAT IV (probe dependent)

Pollution Degree 2

EN 61010-31: 2002
EN 61010-1: 2001
EN 61010-2-032: 1995

Electromagnetic Compatibility

Immunity: EN 61326-1+A1: 1998; IEC 61000-4-30: 2003

Emission: EN 61326-1+A1: 1998

3.6 AC Current Probe Model SR193 (3945-B accuracy included)

When installing probes, face the arrow on the probe in the direction of the load.

Nominal Range: 1000AAC for f ≤ 1kHz

Measurement Range: 3A to 1200AAC max (I > 1000A not continuously)

Currents <0.5A will be displayed as zero with this probe.

Probe Output Signal: 1mVAC/AAC

Maximum Clamping Diameter: 2" (52mm)

Safety: EN 61010-2-032, Pollution Degree 2, 300V CAT IV, 600V CAT III

Reference Conditions:

Ambient temperature	73°F (23°C) ± 5°F (3°C)
Humidity	20 to 75% of RH
Frequency	48 to 65Hz
Distortion factor	< 1% no DC current
Magnetic field of external origin	< 40 A/m (earth's magnetic field)

Accuracy*

Primary current (AAC)	3 to 10A	10 to 100A	100 to 1200A
Accuracy (% of the output signal)	≤0.8% ± 1ct	≤0.3% ± 1ct	≤0.2% ± 1ct
Phase shift (°)	≤1°	≤0.5°	≤0.3°

** Logarithmic interpolation between each specified value*

Factors affecting accuracy (% of the output signal)

Conditions	Range	Error
Temperature	14° to 122°F (-10° to 50°C)	≤200 ppm/°C or 0.2% per 10°C
Relative humidity	10 to 90%	< 0.1%
Frequency	30 to 48Hz 65 to 1000Hz 1 to 5kHz	< 0.5% < 1% < 2%
Position of the cable in the jaws	–	< 0.1% @ ≤ 400Hz
Adjacent conductor carrying a 60Hz AC current	Conductor in contact with the sensor	≤0.5mA/A
Crest factor distortion	≤6 and current ≤3000A peak	< 1%
DC current distortion	≤15ADC on the nominal AC current	< 1%

Overload: Frequency derating beyond 1kHz: $1000A \times \frac{1}{F \text{ (in kHz)}}$

3.7 AC Current Probe MN93 Probe (3945-B accuracy included)

When installing probes, face the arrow on the probe in the direction of the load.

Nominal Range: 200AAC for f ≤ 1kHz

Measurement Range: 2A to 240AAC max (I > 200A not permanent)

Currents <0.5A will be displayed as zero with this probe.

Probe Output Signal: 5mVAC/AAC

Maximum Clamping Diameter: 0.8" (20mm)

Safety: EN 61010-2-032, Pollution Degree 2, 300V CAT IV, 600V CAT III,

Reference Conditions:

Ambient temperature	73°F (23°C) ± 5°F (3°C)
Humidity	20 to 75% of RH
Frequency	48 to 65Hz
Distortion factor	<1% no DC current
Magnetic field of external origin	<40 A/m (earth's magnetic field)

Accuracy

Primary current (AAC)	2 to 10A	10 to 100A	100 to 240A
Accuracy (% of the output signal)	≤3% ± 1ct	≤2.5% ± 1ct	≤1% ± 1ct
Phase shift (°)	≤6°	≤3°	≤2°

Factors affecting accuracy (% of the output signal)

Conditions	Range	Error
Temperature	14° to 122°F (-10° to 50°C)	≤150 ppm/K or 0.15% per 10K
Relative humidity	10 to 90%	< 0.2%
Frequency response	40Hz to 10kHz	40Hz to 1kHz: <3% 1 to 10kHz: <12%
Position of the cable in the jaws	–	<0.5% to 50/60Hz
Adjacent conductor carrying a 60Hz AC current	Conductor in contact with the sensor	≤15mA/A
DC current distortion	<20ADC on the nominal AC current	<5%
Crest factor distortion	≤3 and peak current = 200A	≤3%

Overload: Frequency derating beyond 1kHz: $1000A \times \frac{1}{F_{\text{(in kHz)}}}$

3.8 AC Current Probe MN193 Probe (3945-B accuracy included)

When installing probes, face the arrow on the probe in the direction of the load.

The 5A range of the MN193 is designed to work with secondary current transformers. Best accuracy is available when entering the transformer ratio (e.g. 1000/5A). When used to measure 5A direct, the resolution will be limited to 0.1A max.

Nominal Range: 5A and 100AAC

Measurement Range:
5A: 0.005A to 6AAC max (1A to 1200A with ratio 1000/5 selected)
100A: 0.1A to 120AAC max

Currents < (Primary x 5) ÷ (Secondary x 1000) or <250mA on the 5A range and <0.2A on the 100A range will be displayed as zero with this probe. Power calculations will also be zeroed when the current is zeroed.

Probe Output Signal: 5A: 200mV/AAC; 100A: 10mV/AAC

Maximum Clamping Diameter: 0.8" (20mm)

Safety: NF EN 61010-2-032, Pollution Degree 2, 300V CAT IV, 600V CAT III

Reference Conditions:

Ambient temperature	73°F (23°C) ± 5°F (3°C)
Humidity	20 to 75% of RH
Frequency	48 to 65Hz
Distortion factor	<1% without superimposed DC current
Magnetic field of external origin	<40 A/m (earth's magnetic field)

Accuracy Specifications:

Range: 10mV/A (1V @ 100Arms)

Primary current (in AAC)	0.1A to 1A	1A to 120A
Accuracy (% of the output signal)	≤1% ± 2cts	≤1% ± 1ct
Phase shift (°)	≤1.5°	≤1°

Overload: 120A continuous

Range: 200mV/A (1V @ 5Arms) with ratio 1000/5 selected

Primary current (in AAC) Probe output	1 to 10A 5 to 50mA	10 to 100A 0.05 to 0.5A	100 to 1200A 0.5 to 6A
Accuracy (% of the output signal)	≤1.5% ± 1ct	≤1.5% ± 1ct	≤1% ± 1ct
Phase shift (°)	≤1.7°	≤1°	≤1°

Overload: 12A continuous

Factors affecting accuracy (% of the output signal)

Conditions	Range	Error
Ambient temperature	14° to 131°F (-10° to 55°C)	≤200 ppm/K or 0.2% per 10K
Relative humidity	10° to 35°C 85%	< 0.2%
Frequency response	40Hz to 3kHz	40Hz to 1kHz: <0.7% 1 to 3kHz: <2%
Positions of the cable in the jaws	–	<0.5% to 50/60Hz
Adjacent conductor carrying a 60Hz AC current	Conductor in contact with the sensor	≤15mA/A

3.9 AC Current Probe AmpFlex® Probe (3945-B accuracy included)

When installing probes, face the arrow on the probe in the direction of the load.

Nominal Range: 3000AAC

Measurement Range: 10A to 6500AAC max

Currents below 9A will be displayed as zero with this probe.

Probe Output Signal: 140mVAC/3000AAC at 50Hz
NOTE: Output is proportional to the amplitude and frequency of the measured current.

Sensor: Length = 24" (610mm); Ø = 7.64" (190mm)
Length = 36" (910mm); Ø = 11.46" (290mm)

Safety: EN 61010-1 and 2, Pollution Degree 2, 600V CAT IV, 1000V CAT III

Reference Conditions:

Ambient temperature	64 to 82°F (18 to 28°C)
Humidity	20 to 75% of RH
Position of conductor in the sensor	Centered
Continuous magnetic field	<40A/m (earth's magnetic field)
External alternative magnetic field	None present
External electric field	None present
Frequency	10 to 100Hz
Type of signal measured	Sinusoidal

Accuracy

Primary current (AAC)	10 to 100A	100 to 6500A
Accuracy (% of the output signal)	≤3% ± 1ct	≤2%
Phase shift (°)	≤0.5°	≤0.5°

Factors affecting accuracy (% of the output signal)

Conditions	Range	Error
Temperature	-4 to 140°F (-20 to 60°C)	0.2% per 10°C
Relative humidity	10 to 90% RH	0.5%
Frequency response	10Hz to 20kHz	0.5%
Position of conductor in clamp	Any position	2% (4% near latching system)
Adjacent conductor carrying an AC current	Conductor in contact with the sensor	1% (2% near latching system)

3.10 AC Current Probe MiniFlex® Sensor (3945-B accuracy included)

When installing probes, face the arrow on the probe in the direction of the load.

Nominal Range: 1000AAC

Measurement Range: 10A to 1000AAC max

Currents below 10A will be displayed as zero with this probe.

Probe Output Signal: 47µVAC/1000AAC at 60Hz
NOTE: Output is proportional to the amplitude and frequency of the measured current.

Sensor: Length = 10" (250mm); Ø = 2.75" (70mm)

Safety: EN 61010-1 and 2, Pollution Degree 2, 600V CAT IV, 1000V CAT III

Reference Conditions:

Ambient temperature	64 to 82°F (18 to 28°C)
Humidity	20 to 75% of RH
Position of conductor in the sensor	Centered
Continuous magnetic field	<40A/m (earth's magnetic field)
External alternative magnetic field	None present
External electric field	None present
Frequency	10 to 100Hz
Type of signal measured	Sinusoidal

Accuracy

Primary current (AAC)	20 to 100A	100 to 1000A
Accuracy (% of the output signal)	≤3%	≤2%
Phase shift (°)	-90° ±0.5°	

Factors affecting accuracy (% of the output signal)

Conditions	Range	Error
Temperature	-4 to 140°F (-20 to 60°C)	0.2% per 10°C
Relative humidity	10 to 90% RH	0.5%
Frequency response	10Hz to 20kHz	0.5%
Position of conductor in clamp	Any position	< 2% (6% near latching system)
Adjacent conductor carrying an AC current	Conductor in contact with the sensor	<0.7% (6% near latching system)

3.11 AC Current Probe MR193 Probe (3945-B accuracy included)

When installing probes, face the arrow on the probe in the direction of the load.

Nominal Range: 1000AAC, 1400ADC max

Measurement Range: 10A to 1000AAC, 10A to 1300APEAK AC+DC

Currents <1AAC/DC will be displayed as zero with this probe.

Probe Output Signal: 1mV/A

Maximum Cable Diameter: One 1.6" (42mm) or two 0.98" (25.4mm) or two bus bars 1.96 x 0.19" (50 x 5mm)

Safety: EN 61010-2-032, Pollution Degree 2, 300V CAT IV, 600V CAT III

Reference Conditions:

Ambient temperature	64 to 82°F (18 to 28°C)
Humidity	20 to 75% of RH
Battery voltage	9V ±0.1V
Position of conductor in the sensor	Centered
Magnetic field	DC magnetic field
AC External magnetic field	None
External electric field	None
Frequency	≤65Hz
Type of signal measured	Sinusoidal

Accuracy

Primary current	10 to 100A	100 to 800A	800 to 1000AAC 800 to 1300APEAK
Accuracy	≤1.5% + 1ct	≤3% + 1ct	≤5% + 1ct

Primary current	10 to 100A	100 to 1000A	–
Phase angle	≤2.0°	≤15°	–

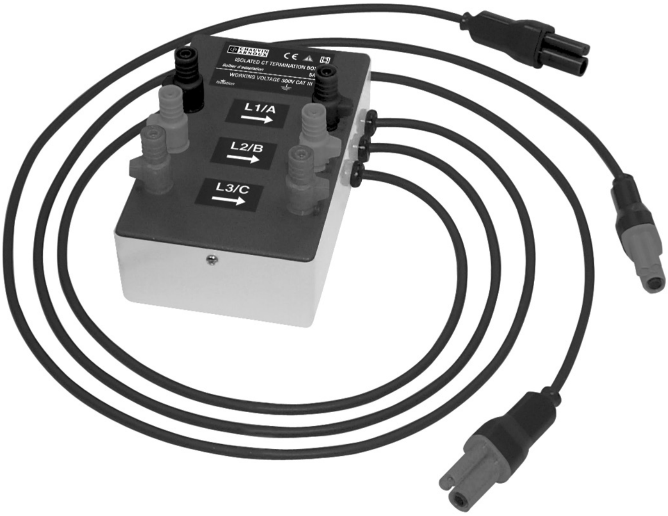
Factors affecting accuracy (% of the output signal)

Conditions	Range	Error
Temperature	64 to 82°F (18 to 28°C)	Zero: ≤2 A/°C Scale: ≤300ppm/°C or 0.3%/10°C
Relative humidity	10 to 90% RH	0.5% of Reading
Battery voltage	6.5 to 10V	≤1 A/V
Position of a 20mm Ø 20 conductor	DC at 440Hz DC at 1Hz DC at 2Hz DC at 5Hz	<0.5% of Reading <1% of Reading <3% of Reading <10% of Reading
Live adjacent conductor	50 and 60Hz	<10mA/AAC (1" from clamp)
External field	400 A/m	<1.3A
Rejection in common mode (AC)	50 to 400Hz	>65dB
Residual DC	+1300ADC at -1300ADC	<4mA/A
Frequency of the measurement signal	65Hz to 440Hz 440Hz to 1kHz 1kHz to 10kHz	-2% -5% -4dB

Power Source: 9V alkaline (NCDA 1604A, 6LR61)

Battery Life: Approx 120 hrs with alkaline

3.12 Three-phase 5A Adapter Box



This adapter is a three-phase adapter with three 5AAC inputs L1, L2, L3 and three AC voltage outputs. All circuits are independent and isolated between input and output. The outputs are equipped with connectors to mate with the PowerPad® Model 3945-B current channel inputs.

It facilitates automatic sensor recognition and probe ratio programming for both 1A and 5A output probes. Additionally, the adapter box can be used directly in series in a 5 Amp circuit.

The input connections accept either Ø 4mm male plugs or rigid leads between 1mm and $2.5mm^2$ inserted in the side hole after pressing the spring loaded connector down to expose the hole.

WARNING: This adapter is rated EN 61010, **300V, CAT III** and permits the use of standard current probes with either a 1A or 5A output.

3.12.1 Connecting to Secondary Current Transformer (CT)

WARNING: Use caution when connecting to a secondary current transformer.

1. Short the two leads of each secondary current measurement transformer.
2. Never open a secondary circuit of a CT if its primary circuit is connected to a supply voltage. In any case, disconnect the primary measurement transformer circuit from the supply network.
3. Connect each CT secondary to the input of the 5A adapter in the correct order (ground on P2) and the right phase order L1, L2, L3.

3.12.2 Specifications (add PowerPad® accuracy ±0.5% ± 1ct)

Currents < (Primary x 5) ÷ (Secondary x 1000) will be displayed as zero on the PowerPad® with this probe.

Range: 5A
Output / Input Ratio: 0.2mV/mAAC
Dimensions: 6.00 x 3.74 x 3.38" (153 x 95 x 86mm)
Weight: 1.98 lbs (900g)
Impermeability: IP50 per EN 60529 (electrical IP2X for the terminals)
Electrical safety: Double Insulation, 300V CAT III
Pollution Degree 2 per IEC 61010-1
Operating Temperature: 5° to 131°F (-15° to 55°C), 0 to 90% RH
Storage Temperature: -40° to 185°F (-40° to 85°C), 0 to 90% RH
Reference Conditions: 73°F (23°C) ±3K, 50 to 85% RH, 50/60Hz ±2Hz

Current measurement according to IEC 44-1 Class 0.5

Range	5mA to 50mA	50mA to 1A	1A to 6A
Error %	0.35% + 1.5mA	0.25% + 1mA	0.25% + 0.5mA
Phase Error	0.5°	0.4°	0.33°

Primary Voltage Loss: < 0.3V
Permanent Overload: 10A
Temperature Influence: < 0.1% par 25K

Frequency Influence	65Hz to 500Hz	500Hz to 1kHz	1kHz to 5kHz
Error	0.1%	0.3%	0.5%
Phase error	0.1°	0.2°	1°

CHAPTER 4

OPERATION

NOTE: Charge the instrument fully before use.

The instrument is turned ON by pressing the green button. The startup screen appears and indicates the instrument's software version and serial number.

If there is no AC power supply, the instrument operates on batteries. The instrument's batteries are charged when it is connected to a 120/240; 60/50Hz line.

The instrument is turned OFF by pressing the green button. Confirmation will be asked, if the instrument is recording or detecting transients.

The current probes connected are identified at power ON only. Use the same probe type for each phase. When changing type of probe, restart the 3945-B or select the correct probe type using the set up mode. When installing probes, face the arrow on the probe in the direction of the load.

4.1 Instrument Configuration (Set-up mode)

NOTE: All configurations are available through the DataView® software.

The instrument must be configured the first time it is used and then whenever necessary, should your needs change. The configuration is saved in the non-volatile memory when the instrument is turned OFF.

When the button is pressed, the following setup choices appear:

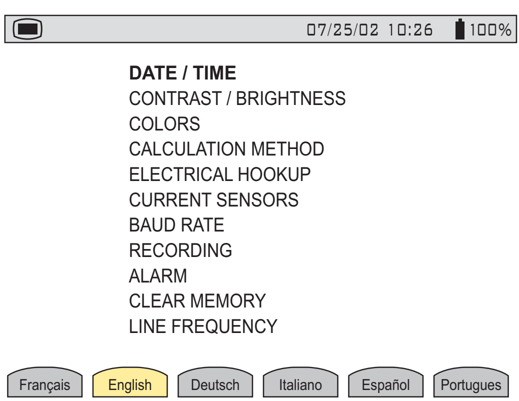


Figure 4-1

WARNING: When "CLEAR MEMORY" is selected, all configurations are deleted.

- Choose the language by pressing the function button below the desired language. Your choice will remain highlighted in yellow.
- Select the configuration settings you wish to modify, with the buttons. As you scroll through the choices, they will be highlighted.
- Press the enter button to modify the highlighted selection.

4.1.1 Date / Time

- Highlight DATE/TIME using the buttons, then press the button.
- Select the number to be modified with the buttons (it will appear in bold type).
- Modify the value of the number selected with the buttons.
- Press the button to apply the new settings.

The date and time format is indicated at the bottom of the screen.

This format can also be modified:

- The Date format can be set to MM/DD/YYYY or DD/MM/YYYY.
- The Time format can be set to a 12 hour clock (AM/PM) or a 24 hour clock (military - 12/24)

4.1.2 Contrast / Brightness

- Highlight CONTRAST/BRIGHTNESS with the buttons, then press the button.
- The setting is adjusted with the buttons and the contrast level will be indicated on the bargraph.
- Press the button to apply the new settings.

4.1.3 Colors

- Highlight COLORS with the buttons, then press the button.

  The following screen will appear:

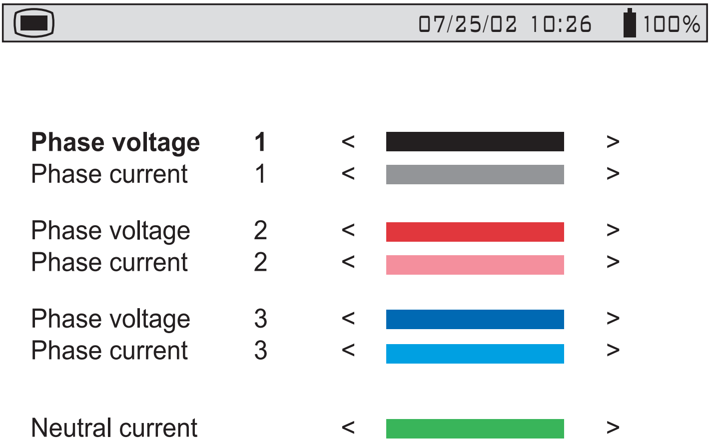


Figure 4-2

- Choose the phase with the buttons and the color for that phase with the buttons.
- Press the button to apply the new settings.

4.1.4 Calculation Parameters

- Highlight CALCULATION METHOD with the buttons, then press the button.
- Select either With Harmonics or Without Harmonics with the buttons. This affects the VAR calculation.
- Press the button to apply the new settings.

4.1.5 Electrical Hookup (electrical network)

- Highlight ELECTRICAL HOOKUP with the buttons, then press the button.

The following screen will appear:

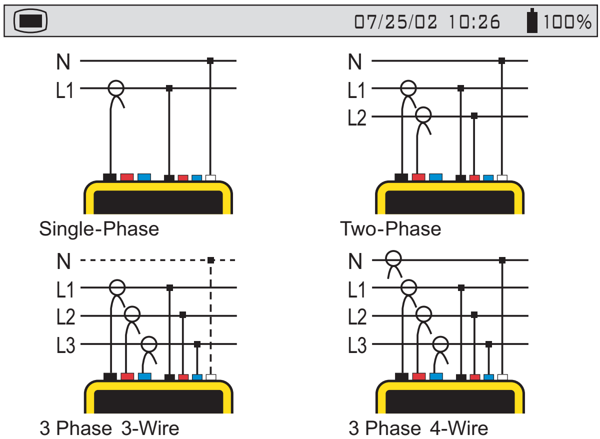


Figure 4-3

- Choose the hookup type with the and buttons.
- Press the button to apply the new hookup selection.

Hookup Types:

Single or two-phase: The neutral current is not measured or calculated.

3 phase-3 wire connection (3V, 3A):

On DELTA network: ***Only power totals are measured.***
Powers per phase are displayed, but not valid.

On WYE network: The neutral current is not calculated. It is necessary to connect neutral (V) to obtain the power per phase.

3 phase-4 wire connection (4V, 3A): The neutral current is available and its value and waveform are displayed.

On WYE network: Powers per phase are available.

NOTE: *Neutral current is calculated, not measured, in the 4 wire hookup.*

V1 must be connected in all hookups, since the display is synchronized from V1 and the network frequency measured by V1.

Neutral current is calculated by adding, for each datapoint, each of the 3 measured phases of current. This assumes that all current flows through neutral. This results in a 256 datapoint waveform. If the 3 phases of current were balanced, the calculated neutral current would be 0 for every datapoint.

Synchronization of the Display in “Waveform” mode:

Display selection (vertical right menu)	Reference channel for synchronization
3U	U1
3V	V1
4A / 3A	A1
L1	V1
L2	V2
L3	V3

4.1.6 Current Sensors

- Highlight CURRENT SENSORS with the buttons, then press the button.

  The following screen will appear:

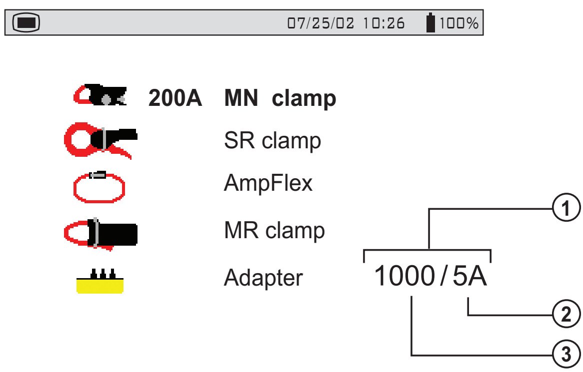


Figure 4-4

① Current transducer ratio.

- moves the cursor left or right to select which digit will be edited.
- increases or decreases the value at the highlighted position.

② Secondary current value.

③ Nominal value of primary current from 5 to 2999A.

- Choose the sensor type with the buttons.
  - The MN Clamp also requires a range selection to match your probe. The range choices are 200, 100 and 5 Amps. The 200 Amp Range is used for the MN93 Probe and the 100 or 5 Amp Range is used for the MN193 Probe.
  - To select the proper range first ensure that the MN Probe choice is highlighted using the buttons.
  - Next press the button to highlight the range, then press either of the

buttons to select the desired measurement range of 200, 100 or 5 Amps. If the 5 Amp range is selected, a choice for programming the ratio is offered.

- To change the ratio, press the button to highlight the secondary value. Pressing either of the buttons will toggle this value to either 1 or 5.
- After making this selection, press the button to adjust the primary value. Each press of the buttons will move the highlight one digit to the left or right, accordingly. Use the buttons to change each digit position as desired. The primary range can be set between 1 and 2999.

• Press the button to apply the current sensor selection. The Configuration menu will once again be displayed on the screen.

In addition to the 4 current probe choices, there is an adapter selection. This selection allows the operator to use current probes that have a current output with PowerPad®. The ratio for these probes can be programmed with this selection. The primary current can be programmed from 5 to 2999 Amps. The secondary current can be set to 1 or 5 Amps. Adjustment for the ratio is performed in the same way as described on the previous page for the MN probe.

4.1.7 Baud Rate

• Highlight BAUD RATE with the buttons, then press the button.

• Choose from the baud rate values: 2400, 4800, 7200, 9600, 19200, 38400, 57600 or 115200 with the buttons.

• Press the button to apply the current sensor selection. The Configuration menu will once again be displayed on the screen.

For transfer of data between the PowerPad® and PC, the communication speeds must be identical on both sides.

4.1.8 Recording

- Highlight RECORDING with the buttons, then press the button.

  The following screen will appear:

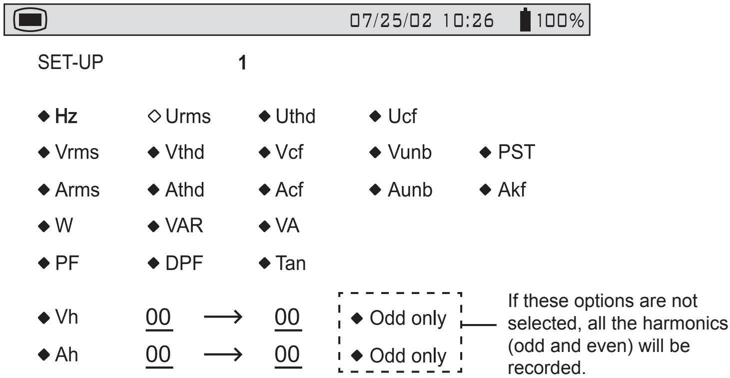


Figure 4-5

- Four recording set-ups are available.
- Choose recording configuration 1, 2, 3, or 4 with the buttons.
- Next, move through the choices with the buttons and select the desired parameters with the buttons.

  As you move through the parameters, each choice, in turn, will be highlighted.
- To activate the selected parameter for recording, use the buttons.

  The selected parameters will have a filled in ◆ and those not selected will have an unfilled ◇.

- There are two user-defined parameters at the bottom of the window. At first, they will be listed as a question mark "**?**". These parameters allow you to monitor specific, or a range, of voltage, current or power harmonics.

  To activate these parameters:

  - Use the buttons to select the parameter.
  - Next use the buttons to scroll through the available choices. These are: Uh, Vh, Ah, and VAh.
  - Once the desired parameter is selected, use the to move to the first modifiable field for this parameter. A value from 00 to 50 may be selected for this field using the buttons.
  - After selecting the desired harmonic order for the beginning value, press the button to move to the upper value. Use the same process to select the upper limit.

- Press the button again to move to the right to modify the last value needed to complete the definition. Here you will choose whether to include all harmonics or only the odd harmonics.

- Use the buttons to make this selection. The diamond preceding the **Odd Only** choice will appear filled in ◆ for selected and unfilled ◇ for not selected.

Example of a user defined choice: Vh 02 → 15 ◆ Odd Only.

In this user defined condition, all odd voltage harmonics between the 2nd and the 15th will be recorded.

• Press the button when you have finished selecting all the parameters to be recorded to apply the new setup.

The battery may fully discharge when recording for long periods of time while not connected to a power supply. The PowerPad® will continue to record for some time, even if below the minimum battery charge value. However, the display may not come back on, and will eventually stop saving data when the battery is too low. All data recorded will be saved.

If in the Record Mode, and the display does not come ON, do not turn the instrument OFF. Supply power to the PowerPad® with the line cord and the display will come back ON when any button (other than ON/OFF) is pressed.

4.1.9 Alarm

• Highlight ALARM with the buttons, then press the button.

The following screen will appear:

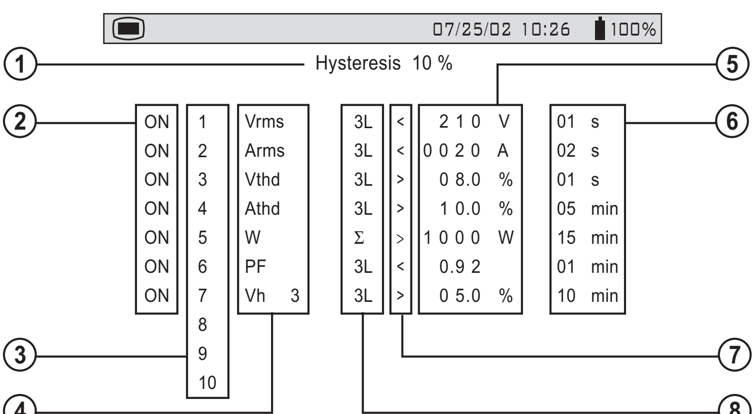


Figure 4-6

A programmed alarm must be set to "ON" to function properly (general activation or deactivation of alarms is generated in the alarm mode).

Modifying one or several characteristics of an alarm set to "ON", automatically switches it to "OFF".

① Hysteresis Percentage (1, 2, 5 or 10%). A hysteresis value is set to prevent multiple recordings of an event that goes above the threshold and a certain percentage below it at times. **Example:** Alarm threshold is 100 Volts or higher, hysteresis is 1%. When voltage goes up to 100V, the alarm condition starts, when it next goes back down to 99V, the alarm condition stops.

② Alarm activation (ON or OFF)

③ Alarm number (1 to 10)

④ There are 24 parameters to choose from for alarm triggering. They are: Vrms, Urms, Arms, Vpst, Vcf, Ucf, Acf, Vumb, Aumb, Hz, Akf, Vthd, Uthd, Athd, W, VAR, VA, DPF, PF, Tan, Vh, Uh, Ah and VAh.

⑤ Threshold value for triggering an alarm

⑥ Minimum duration from beginning threshold detection to store the alarm (from 0.01 seconds to 99 minutes)

⑦ Less than "<" or greater than ">"

⑧ Capture
- 3L: capture all phases (1, 2, or 3 depending on hookup selection)
- N: neutral capture
- Σ: total power capture
- Σ/3: average value of 3-phase capture (Σ/2 for 2-phase)
- 0-50 harmonic order available for harmonic event capture

Alarm Programming

Choose the parameters associated with an alarm from the available parameters (phases survey, threshold value and minimum duration filtering can be programmed).

The programmed hysteresis is common to all alarms.

- Highlight Alarm with the ▲▼ buttons, then press the ↵ button.
- Select the modifiable field using the ◄► buttons.
- Activate or adjust the threshold values using the ▲▼ buttons. (The field to be modified is shown in bold.)
- Press the ↵ button when you have finished setting all the alarm parameters.

When the alarm is "OFF", the parameters previously used are stored in memory and reappear if the alarm is selected again.

4.1.10 Clear Memory

When CLEAR MEMORY is selected, the following question is displayed:

Are you sure you want to delete all the data?	
Yes	**No**

- Choose the answer with the ◁▷ buttons.
- Press the ↵ button to apply your choice. The Configuration menu will once again be displayed on the screen.

> **i** When data is deleted, all detected alarms, screen snapshots, captured transient states and all recordings are deleted.
> The configuration will return to the default setting and the instrument will automatically turn OFF once the data has been deleted.

4.1.11 Line Frequency

Rated frequency of network: 50 or 60Hz

> **i** This parameter determines the correction coefficients used for calculating power and energy.

- Highlight Line Frequency with the △▽ buttons, then press the ↵ button.
- Choose the line frequency using the ◁▷ buttons.
- Press the ↵ button to apply your selection. The Configuration menu will once again be displayed on the screen.

DISPLAY MODES

The screen presentations in this section depict three-phase setups for the purpose of explaining the various choices. Your actual screens will appear differently based upon your particular set up.

5.1 Waveform Mode

Press the waveform display mode button -

5.1.1 RMS Voltage Measurement on a Three-phase System

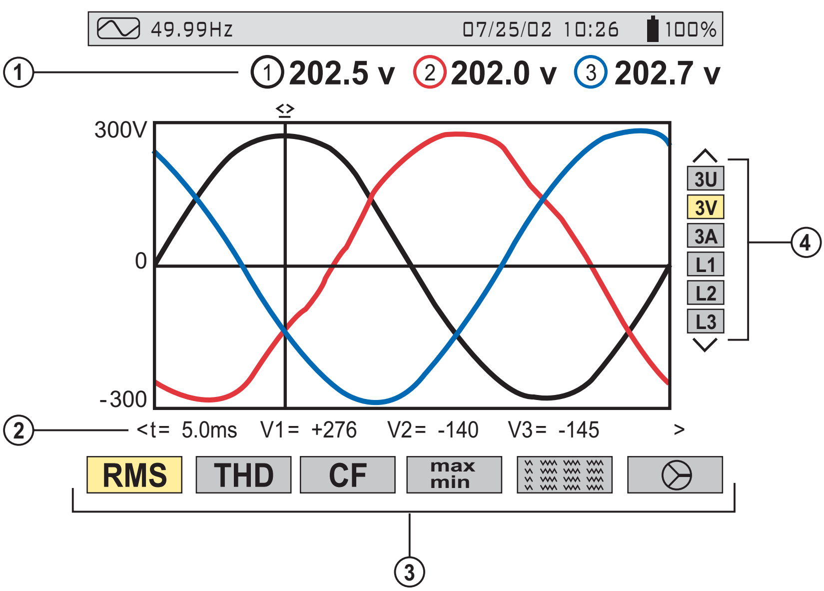


Figure 5-1

① Values measured for each waveform, updated every second, according to the measurement type chosen with the variable function buttons. Value will be color matched to its waveform.

② Instantaneous values of signals at time "t", at the intersection of the cursor and the waveforms. The cursor is moved along the time axis with the buttons.

③ The measurement type is selected using one of the six variable function buttons. All of these measurements are valid in 3U, 3V, 3A, L1, L2 and L3.

④ The waveforms are selected by pressing the ⇳ buttons:

- **3U** displays the three phase-phase voltages of a three-phase system
- **3V** displays the three voltages of a three-phase system
- **3A** displays the three phase currents of a three phase-3 wire system

> The neutral current is not a direct measurement, but the resulting total of the 3 currents measured.

- **L1, L2** or **L3** displays the current and voltage, on phase one, two or three, respectively.

IMPORTANT NOTE: The choice of waveforms to be displayed, in any display mode, depends on the type of connection (see § 4.1.5).

- Single-phase: No choice (L1)
- Two-phase: 2V, 2A, L1, L2
- Three phase-3 wire: 3U, 3V, 3A, L1, L2, L3
- Three phase-4 wire: 3U, 3V, 4A, L1, L2, L3

5.1.2 RMS Voltage Measurement on 3 Phases

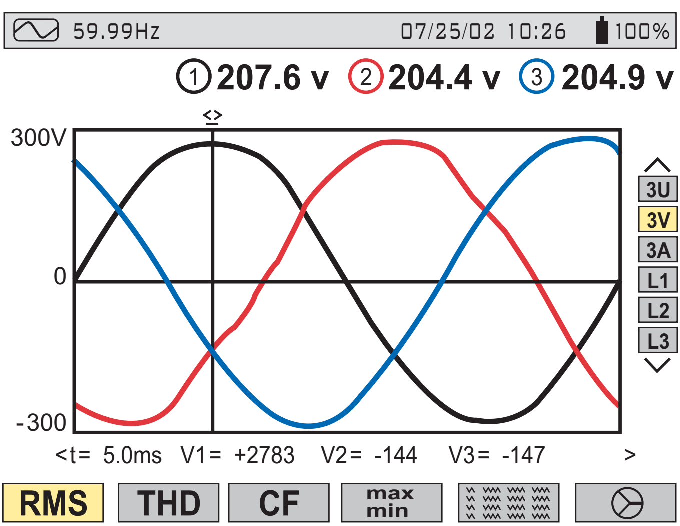


Figure 5-2

5.1.3 RMS Current Measurement on the 3 Phases and Neutral Current on a Three Phase-4 Wire System

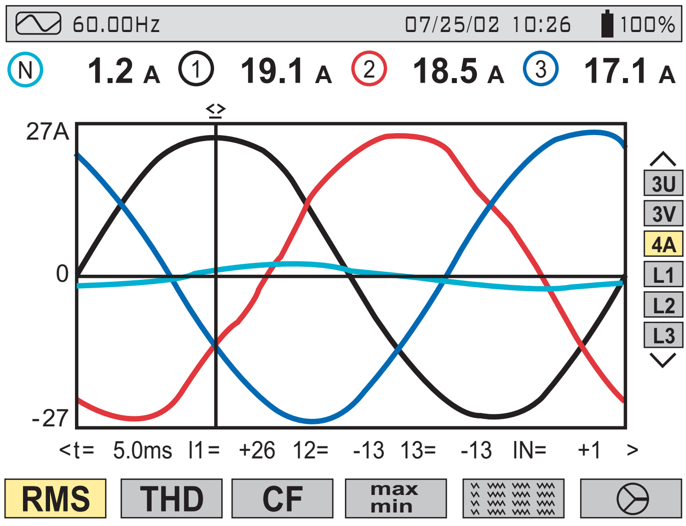


Figure 5-3

5.1.4 Total Harmonic Distortion Measurement on One Phase

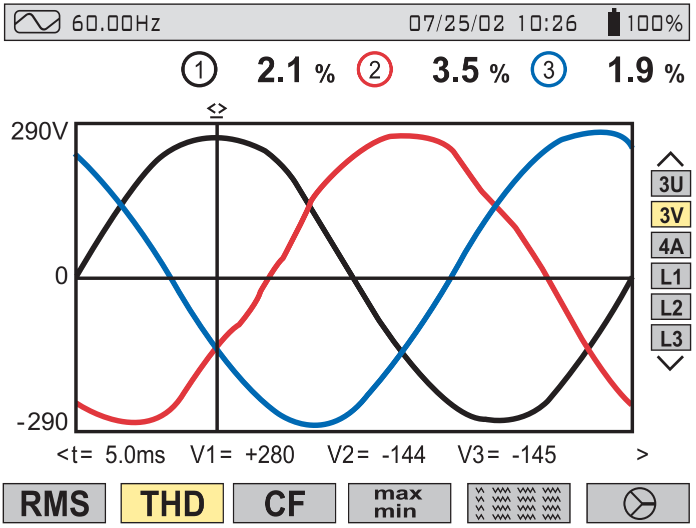


Figure 5-4

5.1.5 Minimum and Maximum Current Value Measurements

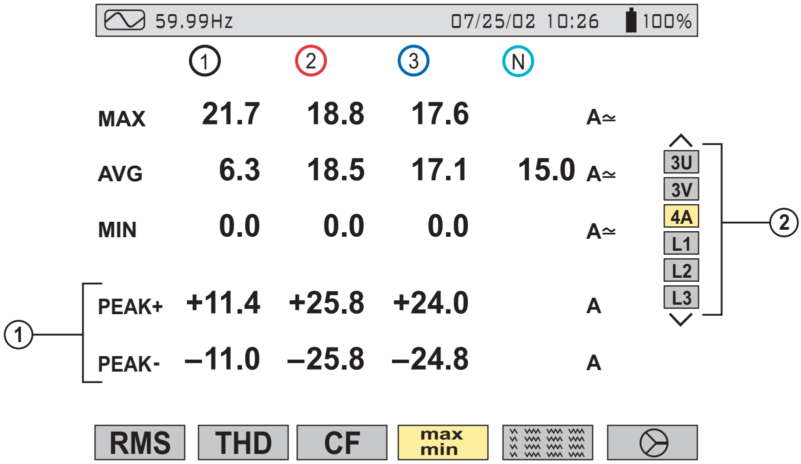


Figure 5-5

① Crest Factor - refreshed every 250ms (but calculated every second).

② Select 3V or 4A with the arrow buttons to obtain the MIN, AVG, MAX, or PEAK values for current or voltage. Select L1, L2 or L3 to obtain these values for an individual phase.

---

i MIN, AVG and MAX values are measured as soon as the power is turned ON. Pressing the enter button will reset these values and begin a new update.

---

i The MAX and MIN measurements are calculated every half period (e.g. every 10ms for a 50Hz signal). The AVG measurements are calculated every second. However, the MAX, AVG and MIN measurements are refreshed every 250ms.

5.1.6 Simultaneous Display of the Different Current Measurements

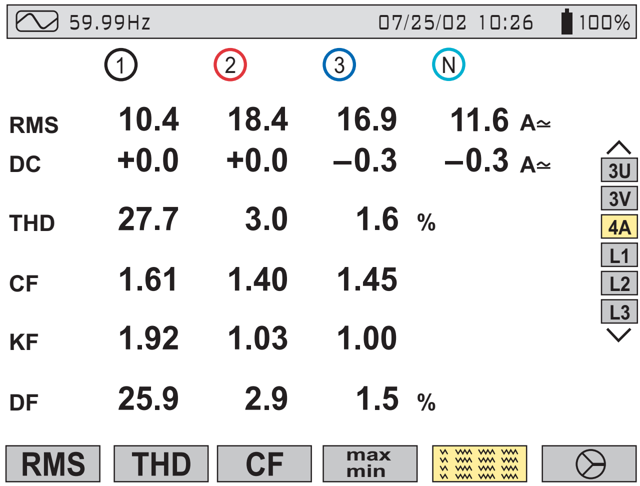


Figure 5-6

As seen on the bar on the right, K factor is only available for currents 4A, 3A or 2A, depending on hook up of leads.

As seen on the bar on the right, flicker is only available for voltages 3V or 2V, depending on hook up of leads.

Flicker and K factor are available when either L1, L2 or L3 is selected from the choices on the right side of the screen.

DC current will be displayed, however the values are only valid when a current probe capable of measuring DC is used. The MR193 probe is available for this purpose.

5.1.7 Phasor Diagram Display (Fresnel Diagram)

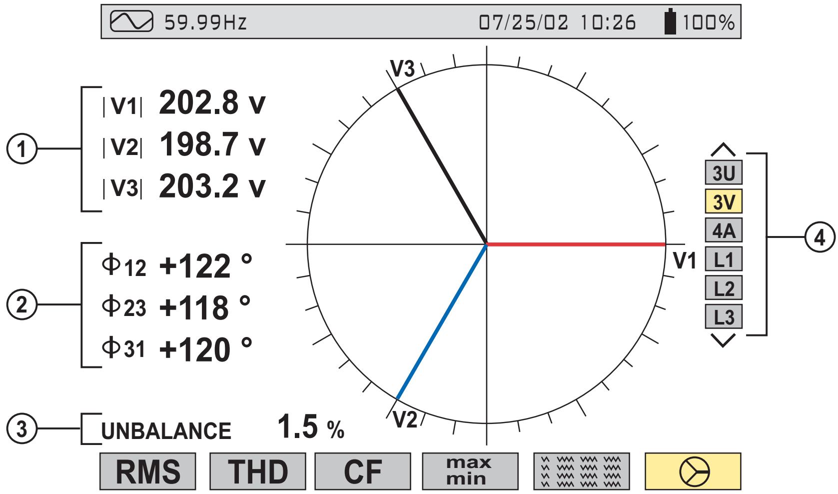


Figure 5-7

① Absolute value of voltage or current, depending on display selection.

② Φ 12 corresponds to phase angle between channel 1 and channel 2
Φ 23 corresponds to phase angle between channel 2 and channel 3
Φ 31 corresponds to phase angle between channel 3 and channel 1

NOTE: This is valid for currents (4A and 3A) and for single voltage (3V). When the user chooses to look at a specific phase (L1, L2 or L3) ΦVA is the phase angle of V in relation to A.

③ Current or voltage unbalanced ratio.

④ Phasor diagram displays selection by voltage, current or phase.

It is advised to look at the phasor diagram prior to recording to check if the probes are installed correctly. I1, I2 and I3 should be shown, when installed on a live circuit, in a clockwise fashion.
The leading (inductive) or lagging (capacitive) effects of the load can be seen at this time and a snapshot of this screen may be appropriate.

5.2 Harmonics Mode

Press the harmonic display mode button -

Use the function buttons to select the type of harmonic analysis:

> **V** - Single phase voltage analysis
> **A** - Current analysis
> **VA** - Power and direction flow analysis
> **U** - Phase-to-phase voltage analysis
>
> The ⊕ and ⊖ buttons allow the user to zoom in or out, in increments of 2%, 5%, 10%, 20%, 50% and 100%.

5.2.1 Single Phase and Phase-to-Phase Voltage Analysis

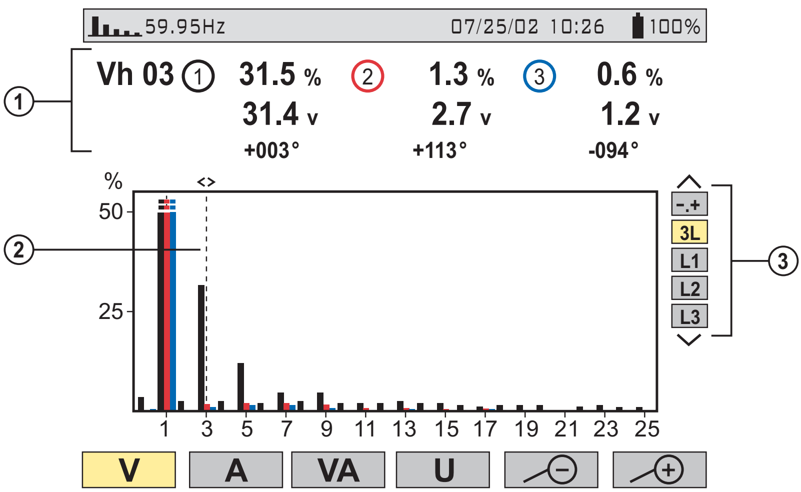


Figure 5-8

① Values measured for each phase, at cursor position (in the example shown above, the 3rd harmonic is selected and displayed).

The information displayed is:

- Harmonic order.
- Percentage relative to the fundamental.
- RMS value.
- Phase angle in relation to the fundamental, according to the measurement type chosen (in this example V) with the variable function buttons just below the screen.

② Cursor enables selection up to 50th harmonic, with the buttons. As soon as the 25th harmonic is reached, the 25th to 50th range appears (0 represents the DC component).

③ Selection of expert mode **-.+** is available for 3-phase hookups by pressing the buttons (see §5.2.4 for description).

5.2.2 Single Phase and Phase-to-Phase Current Analysis

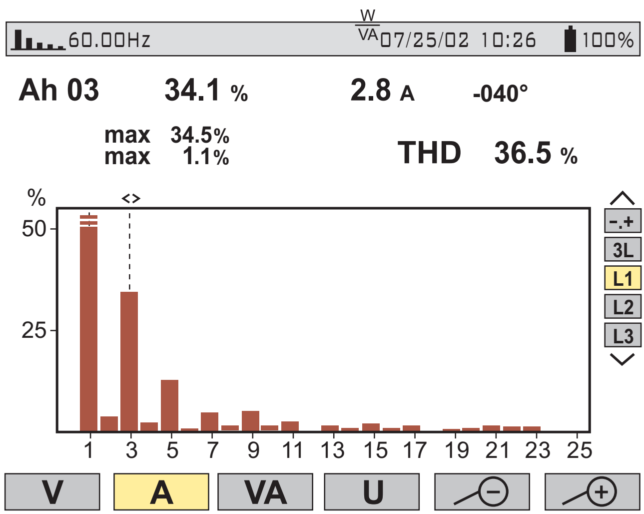


Figure 5-9

Selection of 3-phase or individual phases L1, L2 and L3, displays:

- The total THD
- The MIN and MAX instantaneous values
- The parameters for the harmonic order selected by the cursor:
  - Percentage in relation to the fundamental
  - RMS value and phase angle in relation to the fundamental component
- MIN, MAX instantaneous values for the selected current harmonic

MIN, MAX values are reset each time the cursor position is changed.

5.2.3 Power and Direction Flow Analysis

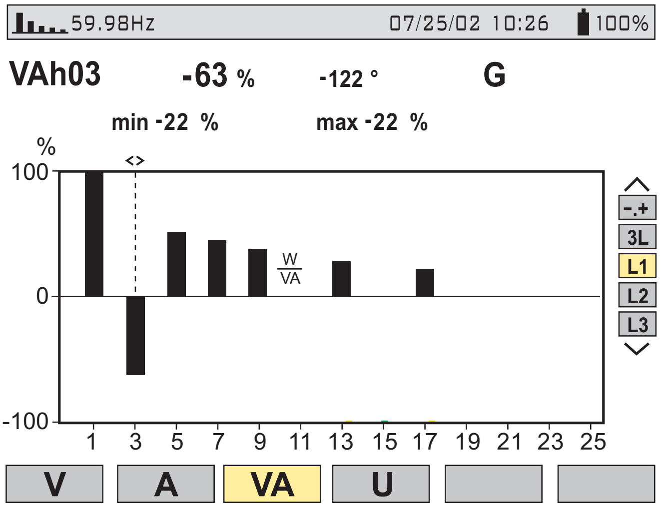


Figure 5-10

Harmonics on this screen are shown with either a positive or negative orientation.

Since the bar selected in this example is negative, it indicates that it is a harmonic from load to source.

By convention, positive harmonics are from supply to load, and negative harmonics are from load to supply.

The signs are only available in harmonic power measurement.

The example above shows a power harmonic display with the 3rd harmonic highlighted by the cursor. This harmonic is generated by the load.

Harmonic direction is influenced by probe installation on the proper phase and arrow on probe facing the load.

5.2.4 Harmonic Analysis in Expert Mode

Press on the ⏶ button to select **"-.+"** and then either the **"V"** or **"A"** variable function button **"V"** or **"A"**.

Example of a typical display:

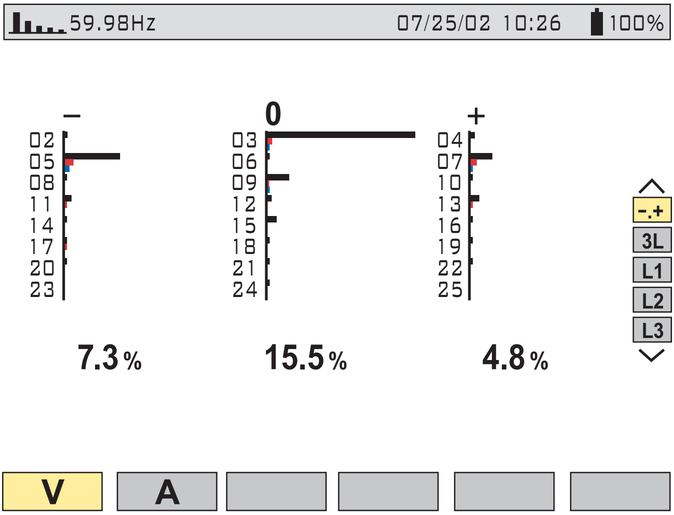


Figure 5-11

- **First column:** The harmonics inducing a negative sequence are displayed.
- **Second column:** Those inducing a zero sequence (triplens added into the neutral) are displayed.
- **Third column:** Those inducing a positive sequence are displayed.

Harmonic content is useful to evaluate the influence of harmonics that cause heating of the neutral or on rotating machines.

5.3 Power / Energy Mode

Press the power display mode button - . This will enable:

- Measurement of the real power (generated and consumed)
- Measurement of reactive power (capacitive or inductive)
- Measurement of apparent power

W...	-	Choice of power parameters
PF...	-	Power factor
G	-	Displays the generated or consumed energy
	-	Starts energy totalization
	-	Stops energy totalization
	-	Resets the counters to zero

5.3.1 Starting and Stopping Energy Totalization

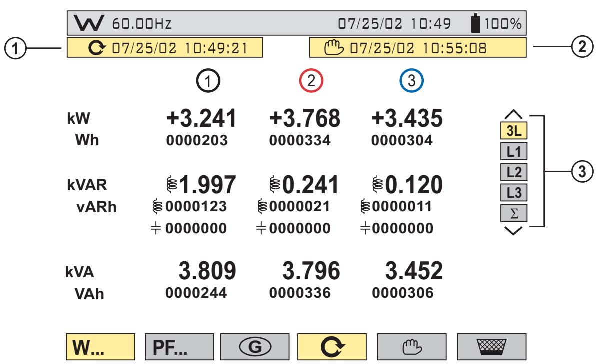


Figure 5-12

① Start date and time of energy totalization.

② Stop date and time of energy totalization.

③ Selection of the three phases (3L) or one in particular (L1, L2, L3) by pressing the buttons. Select Σ to display total for all phases.

The display is automatically adjusted for a display in W, VA, VAR or kW, kVA, kVAR. It is possible to switch to other display modes without stopping the totalization.

Incorrect probe installation on phases (black on B phase or C phase) or arrow on probe facing in the wrong direction (towards line instead of load) will result in inaccurate data. Negative data on one or more phases may be an indication of this.

5.3.2 (G) Button

This function key is used to display generated or consumed power, or real, reactive and apparent energy.

This button toggles the display between generated energy (from load to supply) and consumed energy (from supply to load) each time it is pressed. When the (G) is highlighted (yellow background) the display shows generated energy.

5.3.3 PF... Button

In **"3L"** display mode, the PF (Power Factor), DPF (Displacement Power Factor [fundamental V, I, phase shift]) or Cosine φ values and the Tangent φ can be displayed by pressing the **"PF..."** button.

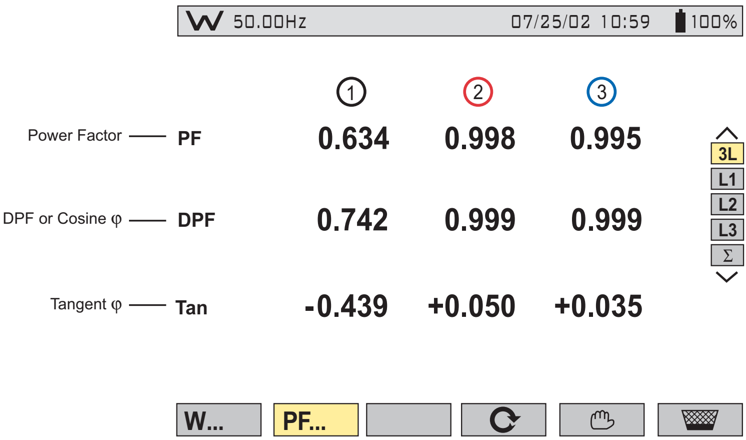


Figure 5-13

Four Quadrant Power Diagram:

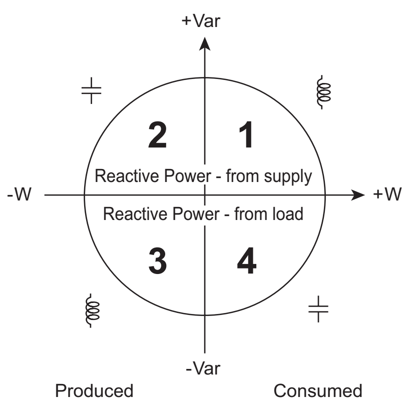


Figure 5-14

5.4 Transient Mode

Press the transient display mode button -

Transients are displayed in the form of waveforms. All channels (up to 6, based upon configuration) are stored in memory for each transient. Up to 50 transients can be captured, which include the pre-tripped waveform, the tripped waveform and two post trip waveforms for each active input.

The function buttons have the following functions in this mode:

- Starts capture search programming for a new transient
- Stops capture search
- Displays a captured transient
- Deletes a captured transient

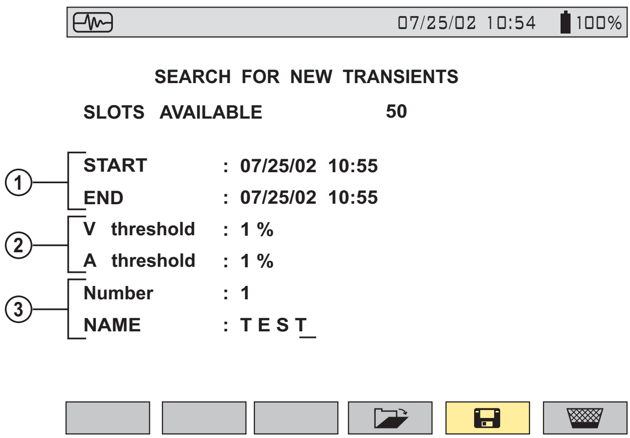


Figure 5-15

① Transient recording start and end time.

② Trigger threshold: selection of 1%, 2%, 5%, 10%, 20%, 50%, 100% of full scale for voltage and current are available.

- Press the buttons to select either "**V**" or "**A**", then use the buttons to modify the trigger threshold.

③ Choose a name for the session and the number of transients to be captured with the arrow buttons:

- : Selection of the character place (7 characters max)
- : Selection of the alphanumeric value
- : Press the Enter button to apply the conditions and to activate transient capture

The table below lists the capture threshold levels, based on the probe in use (for the current channels) and voltage at the different percent selections.

	Thresholds						
	100%	**50%**	**20%**	**10%**	**5%**	**2%**	**1%**
MN93	200A	100A	40A	20A	10A	4A	2A
MN193 (100A)	100A	50A	20A	10A	5A	2A	1A
MN193 (5A)	[(primary x 5) ÷ (secondary)] x (percent x 100)						
SR193	1000A	500A	200A	100A	50A	20A	10A
AmpFlex® 193	2900A	1400A	580A	290A	140A	58A	29A
MiniFlex™	2900A	1400A	580A	290A	140A	58A	29A
MR193	1000A	500A	200A	100A	50A	20A	10A
2999A ratio adapter	3000A	1500A	600A	300A	150A	60A	30A
1A ratio adapter	1A	0.5A	0.2A	0.1A	0.05A	0.02A	0.01A
Voltage	480V	240V	96V	48V	24V	9.6V	4.8V

Transients are detected by comparing all 256 samples on the current cycle with their counterparts from the previous cycle for each active input channel. Should any one sample deviate from its counterpart by the selected percentage value in the set up, this will be considered a transient and the data will be captured.

When capture occurs, four cycles are recorded for each input. These include the trigger cycle, the previous cycle to the trigger and the two cycles that follow the triggered cycle. All active inputs will be captured.

5.4.1 Opening Previously Stored Transients

The screen below can be accessed with the retrieve button. It displays a list transients previously stored in the memory.

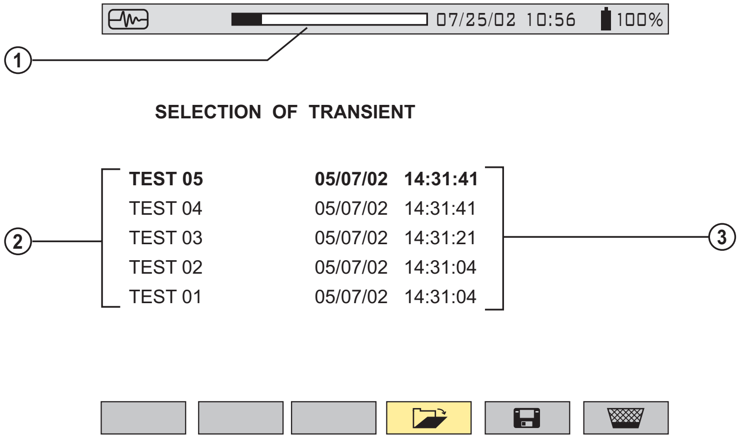


Figure 5-16

If the "@" symbol appears as the first letter of the recording name (e.g. @EST 05), the data may be corrupted and should be checked carefully.

---

① The status bar at the top displays the memory filled by stored transients.

② Name and transient number (from 01 to 50) for each stored transient.

③ Transient recording time and date are displayed for each transient.

- To select a transient, press the buttons, then select it with the button
- To delete a selected transient, press the button, then confirm it with the button

5.4.2 Storing the Trigger

The threshold T in percent, defined as an envelope width (over and under) the last cycle of signal V or A input signal. Its width W is calculated with the nominal measurement range R for a channel (depending on the selected current sensor).

$$W = T \times R$$

Example: Using the SR193 probe and a 2% trigger level, the width would be 1000A x 2% = 20A. Therefore, a deviation of ±20A will cause a transient event to be captured.

The display below shows the transient selected in Fig. 5-16 on the previous page.

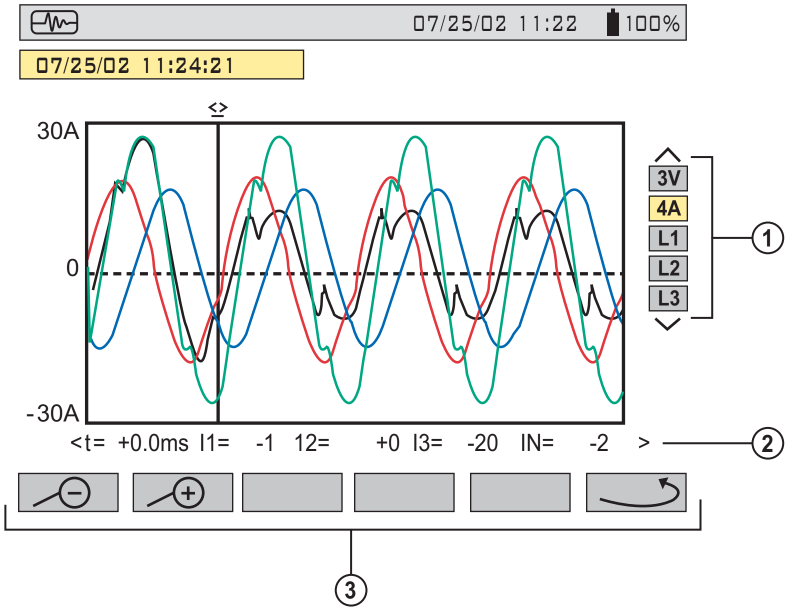


Figure 5-17

The screen displays 4 cycles of 256 points/cycle, with 1 cycle before the trigger and 3 cycles after.

① The waveforms to be displayed are selected by pressing on the buttons.

- **3V** displays the three phase voltages during the transient
- **4A** displays the three phase currents and the neutral current during the transient
- **L1, L2** or **L3** displays the current and voltage on phase 1, 2 or 3

② Instant values at an instant "t", in relation to the cursor, can be displayed on the time scale with the buttons.

③ : Returns to the transient selection screen

and : Changes the time scale (screen display of 4, 2 or 1 periods) centered on the cursor, which can be moved with the buttons.

All transients captured and stored can be downloaded to a PC with the DataView® software (see Chapter 6).

5.5 Alarm Mode

Press the alarm display mode button -

Figure 5-18 presents the various alarms stored.

NOTE: The threshold values must first have been programmed in the mode. Also, the alarm event, or alarm capture, must end before an alarm will be displayed.

- Starts alarm capture
- Stops alarm capture
- Deletes all stored alarms

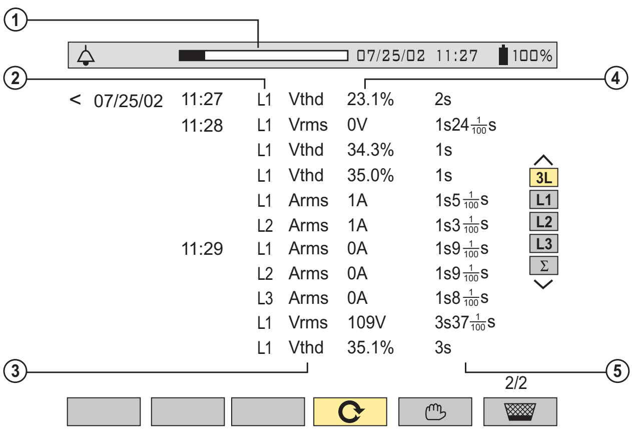


Figure 5-18

① Alarm memory status bar (indicates available alarm storage memory)

② Alarm target

③ Measurement parameter monitored

④ Maximum or minimum amplitude detected

⑤ Alarm duration

Use the buttons to select an alarm.

Use the buttons to display alarms within a period of time.

NOTE: All the alarms recorded can be downloaded to a PC with the DataView® software (see Chapter 6). Up to 4096 alarms can be captured.

The Alarm values for PF, DPF, Tan, φ, W and VAR are absolute values.

NOTE: The type of connection selected in the mode has no influence on the possibilities of choices, target and monitored parameter. The user is responsible for making pertinent choices.

5.6 Recording Mode

After a recording is set, the instrument will go into sleep mode (no display) to save the batteries. The recording will start as programmed. Press any button other than the ON/OFF button to turn ON the display again. Turning off the PowerPad® clears the schedule, even if turned on again, the recording will not start.

This mode enables all the parameters previously configured in the setup mode to be recorded (see § 4.1.8). Press the record display mode button -
The variable function buttons have the following functions in this mode:

- Creates a new recording
- Opens a previous recording
- Deletes recording

5.6.1 Saving the Selected Parameters

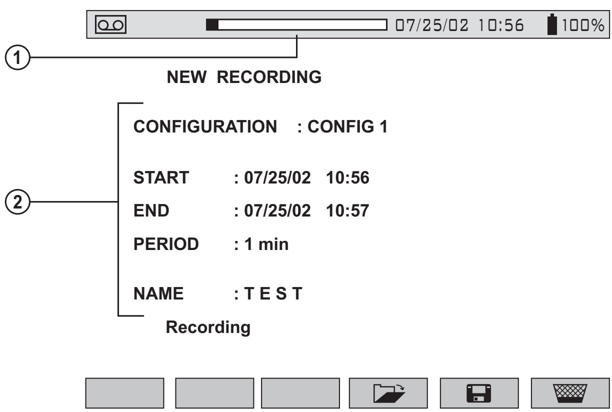


Figure 5-19

① Recording status bar (displays remaining memory capacity).

② Parameters - press the buttons to select the parameters and the buttons to modify them. An underline will appear under the selected parameter.

- Select the configuration number to be modified with the buttons. (CONFIG 1, 2, 3 or 4)
- Select the dates with the buttons.

  NOTE: The dates are adjusted according to the chosen recording integration period. "PERIOD" does not refer to a sampling period, but rather, to an integration period (average).

- Select a recording storage rate using the buttons.

  NOTE: The possible storage rates are 1, 5 or 20 sec; 1, 2, 5, 10 or 15 min.

- Enter the record name with the buttons, which scroll through the alphabet and numbers. Up to 7 characters may be entered.

- Save the changes with the button.

  NOTE: The 3945-B will calculate the storage needs of the recording, and if necessary, will display the message “Not enough memory”.

If the recording is scheduled, the PowerPad® will display “Recording on Standby”.

If it doesn’t accept any of the parameters, it will instead move the cursor to the field it doesn’t accept. After changing the parameter, press enter again.

Parameters not accepted could include the start time being before the present time. If the period (storage rate) is more than 1 minute, the start time must be a multiple of the storage rate (e.g. if there is a 10 minute storage rate, the recording start time could not be 4:09, but should instead be 4:00 or 4:10). The duration must also be a multiple of the storage rate.

The setup config number must have at least 1 parameter selected to record. The recording name cannot be blank. There must be enough memory.

☞ **TIP:** *It may be wise to do a very short sample program to be sure everything is set correctly. For example, choose a 10 minute recording session called “test 1” and evaluate results.*

☞ **TIP:** *Make sure to leave the PowerPad® on until the recording is completed and check that there is AC power or enough time left on the battery.*

5.6.2 Selecting or Deleting a Record

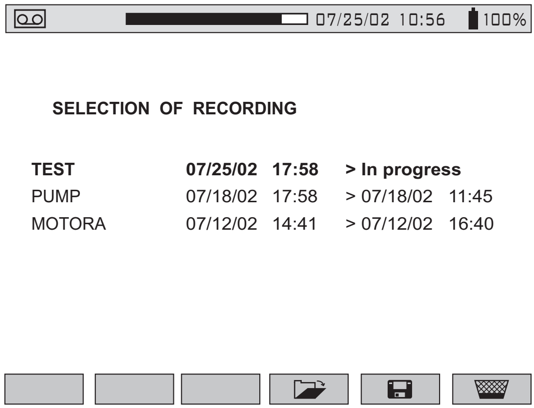


Figure 5-20

If the "@" symbol appears as the first letter of the recording name (e.g. @EST), the data may be corrupted and should be checked carefully.

The status bar at the top displays the memory occupied by previous records.

To Select a Recording:

- Press the buttons to select the recording. The current selection will appear in bold type. Press the button to accept the selection.

To Delete a Recording:

- Select the record to be deleted with the buttons, press on button and then press the button to delete the selection.

> **TIP:** *It is possible to display a measurement being recorded by selecting the name of the recording. To refresh the screen, press the mode buttons (caution: loss of cursor position and zoom capability will occur).*

The instrument automatically makes a correction if the programmed dates and times do not match the current date, the current time or the set storage rate.

It is recommended to set multiple times:
- of 2 for 2 min
- of 5 for 5 min

The instrument automatically corrects the start and end time in order to improve the readability of the time scales of the recording mode (graph representation).

5.6.3 Selecting a Graphic Display for Recorded Measurements

Recorded data can be displayed in graphic form.

- Select the recording to be displayed using the buttons. Then, open the recording by pressing the button. A screen similar to figure 5-21 will appear.

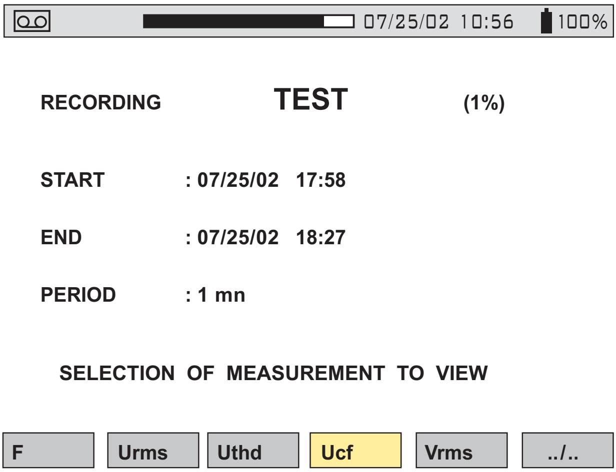


Figure 5-21

Use the function buttons to enable direct selection of the measurement to be displayed.

Pressing the "**../..**" key enables the user to scroll through all the measurements selected when the record was programmed.

Example when Vrms is Selected

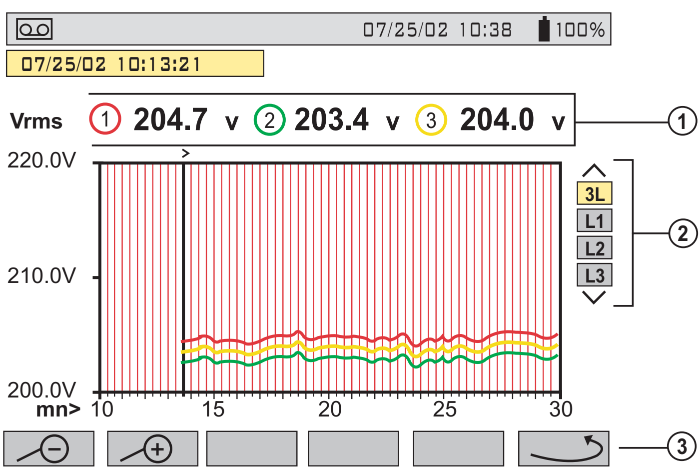


Figure 5-22

① Display of the average voltage for each of the 3 voltages. Moving the cursor with the ◁▷ buttons updates the values to reflect the new cursor position.

② Selection of the 3 phases or each phase separately with the ▲▼ buttons.

③ Returns to the screen where the measurement to be displayed is selected.

Example when L1 is Selected

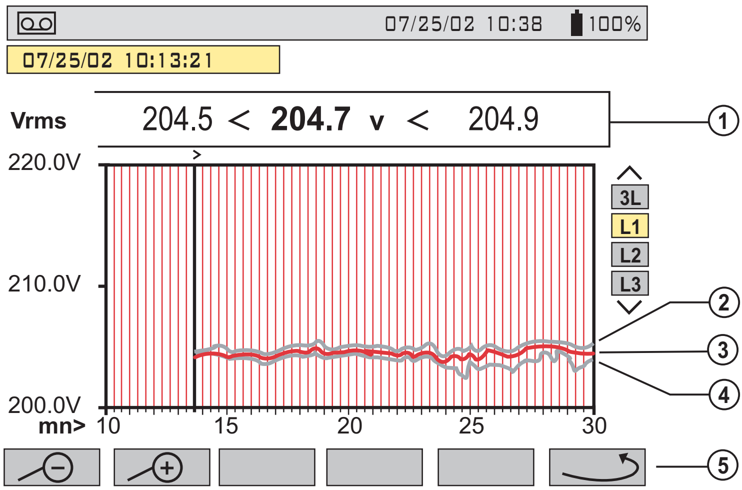


Figure 5-23

① MIN, AVG and MAX values over the display period

② MAX value

③ AVG value

④ MIN value

⑤ Returns to the Measurement Selection Screen (see Fig. 5-21)

When the display period is different from the averaging integration period:

- The average value is calculated with the sum of each integration period stored.
- The extreme values are the minimum and the maximum of an integration period during the display period selected with the cursor.

Graphic Display of Average Power

After returning to the Measurement Selection Screen (see Fig. 5-21) use the "../.." button to view more recorded parameters, if necessary. Pressing the "W" button, will bring up a screen similar to Fig. 5-24 below.

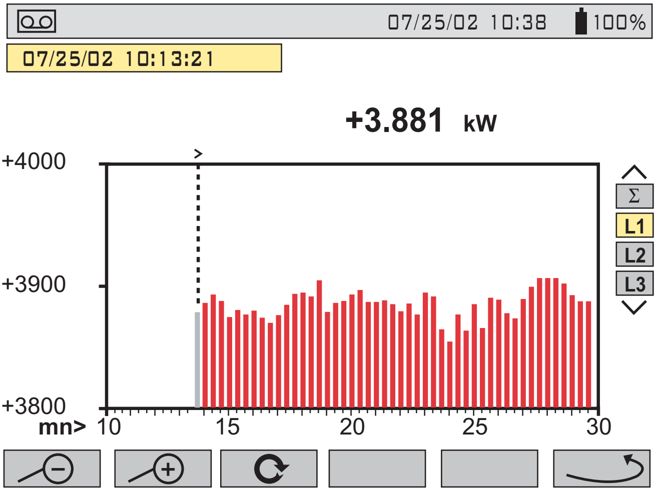


Figure 5-24

In the example above, the display shows the average value of the real power on the phase L1. The value is updated as the cursor is moved with ◁▷ buttons.

Hold the cursor button down to switch to fast forward.

Energy Measurement for a Determined Period

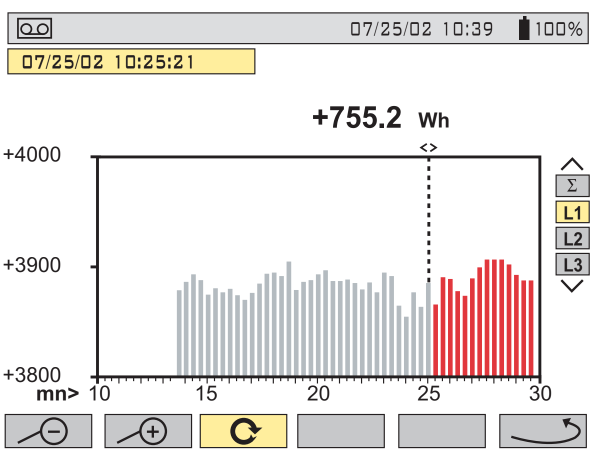


Figure 5-25

The energy over a selected period can be calculated from the average power records:

- Move the cursor to the start time.
- Press the ⟳ function button.
- Move the cursor with ◁▷ buttons to the desired end time.
- The energy value is displayed, with **end date and end time**.

It is possible to make an energy measurement over several recording ranges in the 4 quadrants.

All of the data in a recording session can be downloaded to a computer using the DataView® software.

The ⊕ and ⊖ buttons allow the integration period of the displayed measurement and the graph time-scale to be changed.

Display Averaging Period	Graph Scale
2 hours	over 5 days
1 hour	over 2 1/2 days
15 minutes	over 15 hours
10 minutes	over 10 hours
5 minutes	over 5 hours
1 minute	over 1 hour
20 seconds	over 20 minutes
5 seconds	over 5 minutes
1 second	over 1 minute

NOTE: The minimum integration period is limited by the recording period. The recording integration period of 2 minutes is a special case. In this case, only the following display integration periods are possible: 10 minutes, 1 hour and 2 hours.

5.7 Saving a Display

This button allows 12 snapshots to be saved for future recall and evaluation.

- Press the button (for about 3s) to capture the current display.
- The icon is displayed in the top left corner as soon as the operation is successful.
- This icon is replaced by if there is no space left in the memory to record the display.

These screens can be downloaded to a computer using the DataView® software.

5.8 Opening a Previously Saved Snapshot

A **short press** (about 1s) on the button gives access to the menu of snapshots that have been saved.

The small icon to the left of each snapshot (date and time) tells you what type of data was stored.

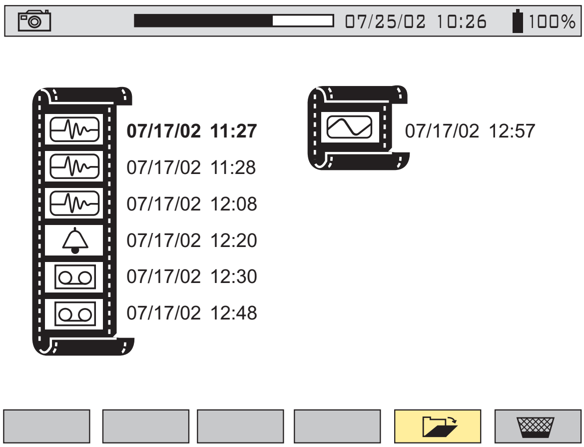


Figure 5-26

- Use the buttons to select the snapshot.
- To display the snapshot, press the button, then the enter button.
- After reviewing the snapshot, press the enter button again to return to the list of saved snapshots.
- To delete a selected snapshot, press the button, then press the enter button.

The various storage spaces of the Model 3945-B are of a fixed size and are completely independent. There are four memory spaces available (alarms, snapshot, transients and recordings).

5.9 Printing

The print button allows a screen to be printed directly to a dedicated printer connected to the serial port.

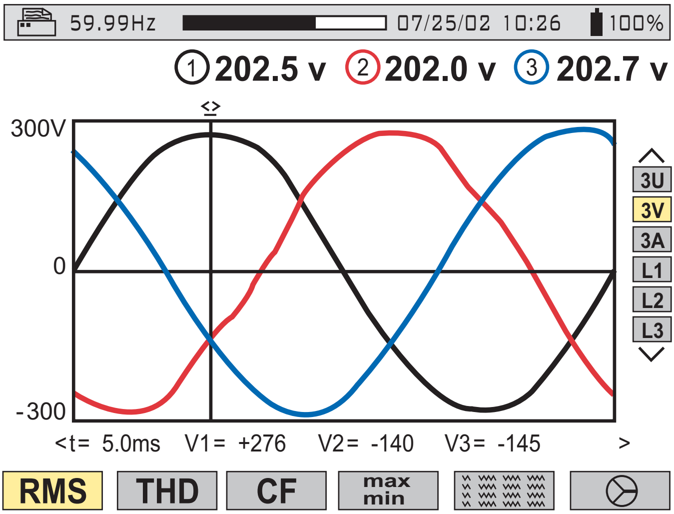


Figure 5-27

When the button is pressed, the screen freezes and the top left mode icon is replaced by the icon (as shown in Figure 5-27 above).

NOTE: It will take a few seconds for the icon to appear. Print transmission speed is 19.2kb.

> **i** To stop the printing in progress (e.g. in the event of an error), press the print button once again.

5.10 Help ?

Press this button to obtain help for the current display mode.

To exit the Help mode, press the ? button once again.

DATAVIEW® SOFTWARE

6.1 Installing DataView®

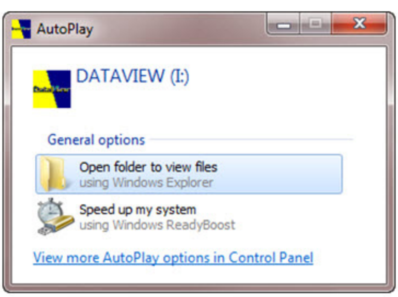
DO NOT CONNECT THE INSTRUMENT TO THE PC BEFORE INSTALLING THE SOFTWARE AND DRIVERS.

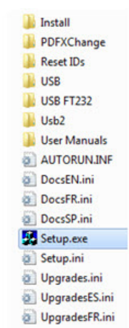
NOTE: When installing, the user must have Administrative access rights during the installation. The users access rights can be changed after the installation is complete.

DataView® must be reinstalled for each user in a multi-user system.

USB Flash Drive Install

1. Insert the USB stick into an available USB port (wait for driver to be installed).
2. If Autorun is enabled then an AutoPlay window should appear as shown.





NOTE: If Autorun is disabled, it will be necessary to open Windows Explorer, then locate and open the USB stick drive labeled "DataView" to view the files on the drive.

3. In the AutoPlay window, select **Open Folder to view Files**.

4. Double-click on **Setup.exe** from the opened folder view to launch the DataView setup program.

NOTE: If installing onto a Vista based computer the **User Account Control** dialog box will be displayed. Select the **Allow** option to proceed.

5. A **Set-up** window, similar to the one below, will appear.

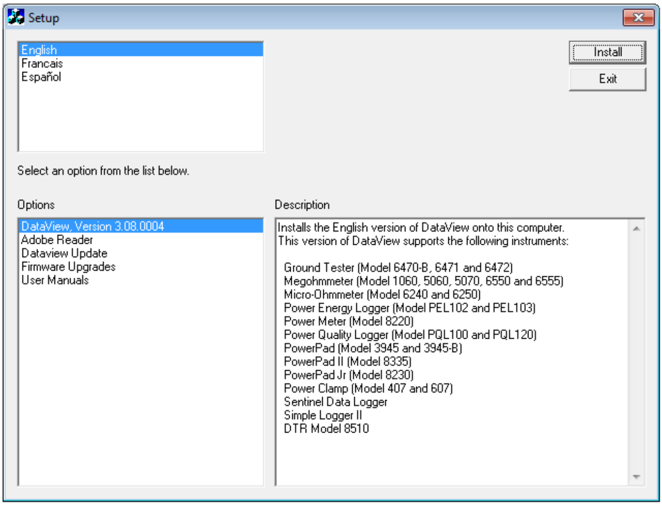


Figure 6-1

There are several different options to choose from. Some options(*) require an internet connection.

- **DataView, Version x.xx.xxxx** - Installs DataView® onto the PC.
- ***Adobe Reader** - Links to the Adobe® website to download the most recent version of Adobe® Reader to the computer. *Adobe® Reader is required for viewing PDF documents supplied with DataView®.*
- ***DataView Updates** - Links to the online DataView® software updates to check for new software version releases.
- ***Firmware Upgrades** - Links to the online firmware updates to check for new firmware version releases.
- **Documents** - Shows a list of instrument related documents that you can view. Adobe® Reader is required for viewing PDF documents supplied with DataView®.

6. **DataView, Version x.xx.xxxx** option should be selected by default. Select the desired language and then click on **Install**.

7. The **Installation Wizard** window will appear. Click **Next**.

8. To proceed, accept the terms of the license agreement and click **Next**.

9. In the **Customer Information** window, enter a Name and Company, then click **Next**.

10. In the **Setup Type** window that appears, select the **"Complete"** radio button option, then click **Next**.

11. In the **Select Features** window that appears, select the instrument's control panel that you want to install, then click **Next**.

NOTE: The **PDF-XChange** option must be selected to be able to generate PDF reports from within DataView®.

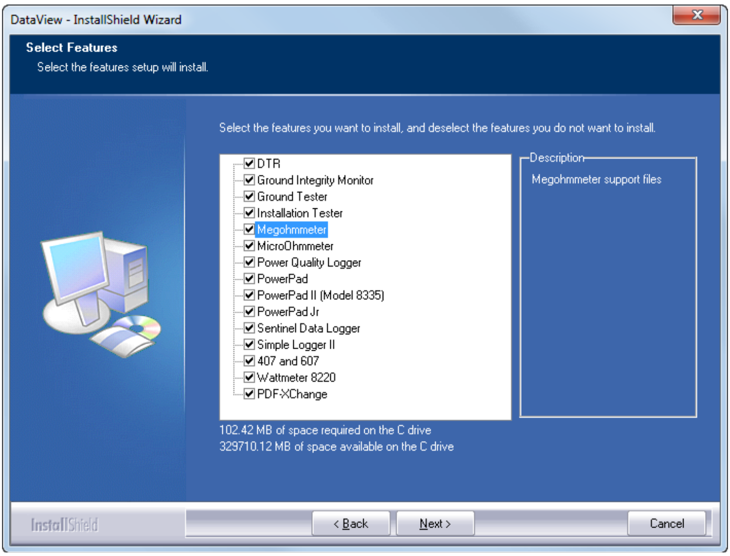


Figure 6-2

12. In the **Ready to Install the Program** window, click on **Install**.

13. If the instrument selected for installation requires the use of a USB port, a warning box will appear, similar to Figure 6-3. Click **OK**.

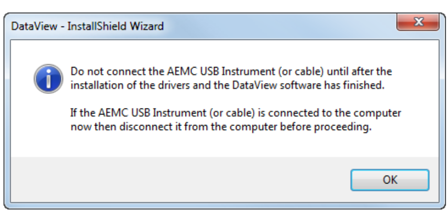


Figure 6-3

NOTE: The installation of the drivers may take a few moments. Windows may even indicate that it is not responding, however it is running. Please wait for it to finish.

14. When the drivers are finished installing, the **Installation Successful** dialog box will appear. Click on **OK**.

15. Next, the **Installation Wizard Complete** window will appear. Click on **Finish**.

16. A **Question** dialog box appears next. Click **Yes** to read the procedure for connecting the instrument to the USB port on the computer.

NOTE: The Set-up window remains open. You may now select another option to download (e.g. Adobe® Reader), or close the window.

17. **Restart** your computer, then connect the instrument to the USB port on the computer.

18. Once connected, the **Found New Hardware** dialog box will appear. Windows will complete the driver installation process automatically.

Shortcuts for DataView® and each instrument control panel selected during the installation process have been added to your desktop.

NOTE: If you connected your instrument to the computer before installing the software and drivers, you may need to use the **Add/Remove Hardware** utility to remove the instrument driver before repeating the process.

6.2 Connecting the Model 3945-B to your Computer

The Model 3945-B is supplied with an optically isolated serial interface cable required for connecting the instrument to the computer. This cable (Cat. #2140.18) is equipped with a 9-pin connector on one end, and an optical connector on the other end.

To connect the Model 3945-B to your computer:

1. Connect the optical connector end of the cable to the serial port on the side panel of the Model 3945-B PowerPad®.
2. Connect the 9-pin connector end of the cable, to an available serial port on your computer. If your computer does not have a serial port, you can obtain a serial port to USB converter from many computer stores.

You are now ready to use the DataView® software with the PowerPad®.

6.3 Opening the Control Panel

To open the Power Analyzer Control Panel:

- Double-click the **PowerPad** Icon in the DataView folder that was created during installation, located on the desktop.
- The **Connection** window will appear (see Figure 6-4).

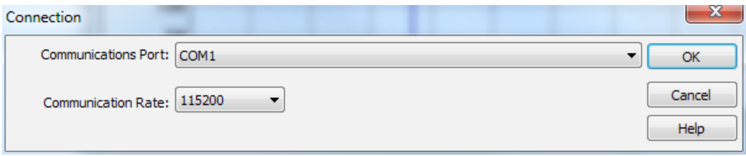


Figure 6-4

- Make sure that the serial port displayed in the dialog box matches the port you plugged the serial cable into. If the correct serial port is not selected, click on the drop-down menu to select it.
- The Baud Rate needs to be set at the same rate as the Model 3945-B. The Baud Rate can be selected from the Communication Rate drop-down menu.

To check the baud rate on the instrument:

- Turn ON the Model 3945-B by pressing the green button -
- Press the menu button -
- Scroll down with the button, until you reach **"BAUD RATE"**
- Press the enter button - and read the baud rate
- Set to read 115200

- When the proper communication parameters have been specified, click OK.

For detailed instructions and descriptions for any feature in a dialog box, click on the **Help Button**, or **right-click on the feature** you want information about.

Once the communication link is established, DataView® will automatically identify the instrument that it is connected to. The Control Panel will appear:

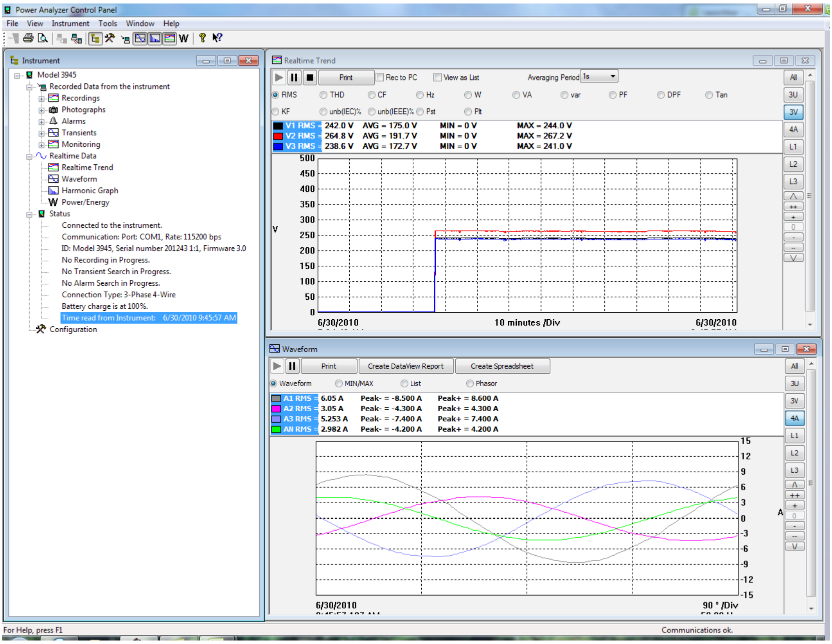


Figure 6-5

This Control Panel displays:

- Recorded Data from the instrument
- Real-time Data
- Connection status
- The communications port and speed of the connection
- The model number, serial number, and firmware revision
- The battery charge level, whether the battery is charging or discharging, and the time on the clock
- If a recording is in progress and when it is scheduled to end
- If a delayed recording is scheduled and when it is scheduled to begin
- Connection type (Electrical Hookup)

If the indicated items are not shown on the screen, select **Restore Default Layout** from the Window menu.

If the battery charge is shown to be unknown, plug the PowerPad® into AC Power, when it reaches 100% charge, the display should again be able to show the battery charge.

6.4 Common Functions

The buttons described below appear on several DataView® Setup Screens.

- **Re-Read from Instrument:** Reads the current configuration of the PowerPad® attached via the serial cable.
- **Save to File:** Saves the current configuration. This file will reside on the computer's disk drive. Saving different configuration setups can be useful for future functions and tests.
- **Load from File:** Retrieves a saved file from the computer's disk drive to be used in programming the PowerPad®.
- **OK:** Closes the dialog box and brings up the Control Panel.
- **Cancel:** Exit without saving configuration.
- **Apply:** Programs the PowerPad® using the current settings without closing the window.
- **Help:** Opens the online Help.

6.5 Configuring the Instrument

The Configure dialog box lets you configure every aspect of the Model 3945-B PowerPad®. Each field is identical to the programmable features available from the instrument's front panel itself.

Several of the functions are configured by typing the appropriate value in the field provided. Others are configured by clicking on the appropriate radio button or Icon, such as, selecting the current probe.

To configure the instrument, go to **Instrument > Configure** or select **Configuration** from the Instrument Tree.

6.5.1 Setup

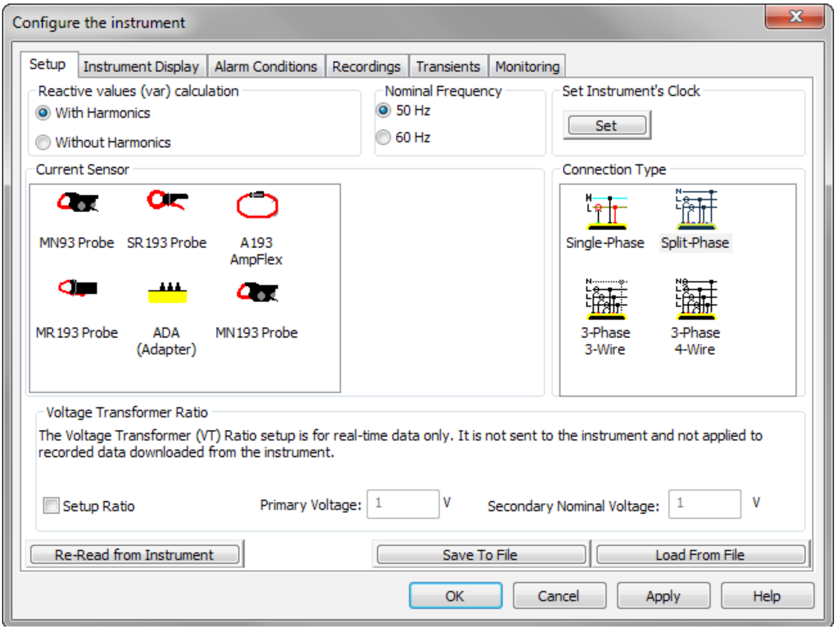


Figure 6-6

- **Reactive Values Calculation:** With or without harmonics. Applies to VAR calculation.
- **Nominal Frequency:** 50 or 60Hz. This parameter determines the correction coefficients used for calculating power and energy.
- **Current Sensor:** MN93, MN193, SR193, MR193, A193 AmpFlex®, MiniFlex® or ADA Adapter (used to accept probes with other ratios or a direct 1 Amp or 5 Amp input)
- **Connection Type:** Single Phase, Two phase, Three phase-3 wire or Three phase-4 wire.
- **Set Instrument's Clock:** Programs the computer's time and date into the configuration of the PowerPad®.
- **Voltage Transformer Ratio:** Sets the scale for voltage measurement in cases where measurements are on the secondary side of a transformer and the primary value needs to be displayed.

6.5.2 Instrument Display

The PowerPad® display window allows you to customize the display (colors, clocks, language and contrast).

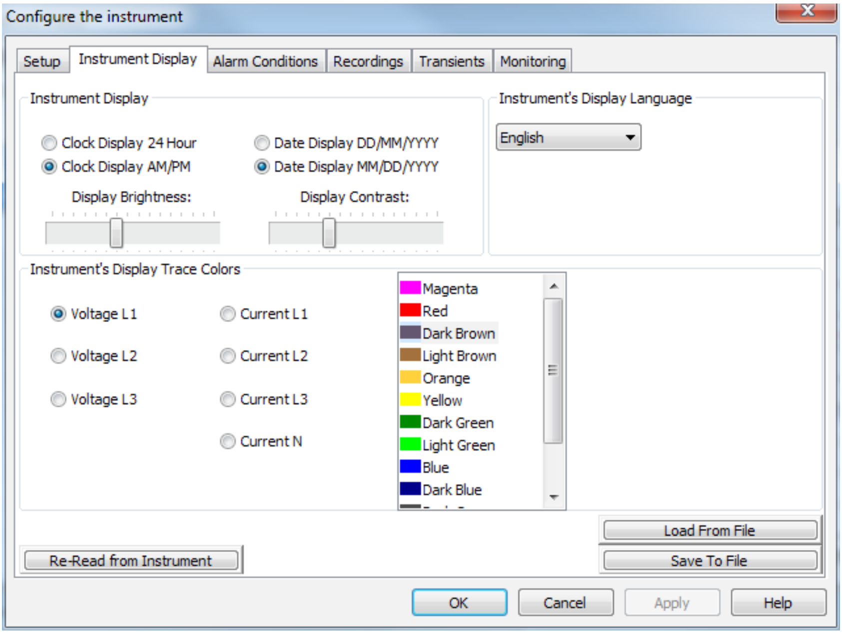


Figure 6-7

For detailed instructions and descriptions for any feature in a dialog box, click on the **Help Button** (lower right-side of the dialog box), or **right-click on the feature** you want information about.

6.5.3 Alarm Conditions Configuration

The Alarm Conditions window allows you to set up 10 alarm configurations.

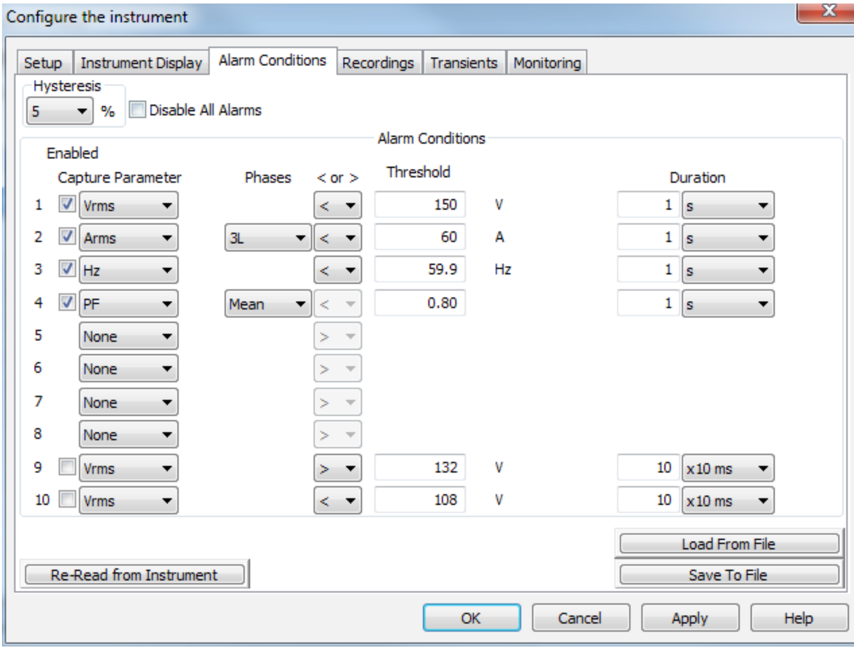


Figure 6-8

- **Hysteresis:** This value for alarms is set to prevent multiple recordings of an event that goes above the threshold and a certain percentage below it at times.

Example: If the alarm threshold is 100 Volts or higher, hysteresis is 1%. When the voltage goes up to 100V, the alarm condition starts. When it goes back down to 99V, the alarm condition stops.

- **Disable All Alarms:** When this box is checked, all alarms will be disabled even if the individual alarm enable box is checked. **Make sure this is not checked if you want to record alarms.**

Alarm Conditions

- **Enabled:** When check box is checked, alarm is enabled.
- **Harmonic Number:** For alarm parameters, Vh, Ah, Uh, and VAh, selects which harmonic number is being used as an alarm condition. For example, Vh with a harmonic number of 2, will only look at Voltage phase to neutral, harmonic 2.

- **Capture Parameter:** The Alarm will be triggered based on the value of the selected parameter.

Choices include:

None: no alarm

Vrms: voltage root mean squared

Urms: voltage phase minus phase root mean squared

Arms: current root mean squared

VPST: voltage short term flicker

Vcf: voltage crest factor

Ucf: voltage phase minus phase crest factor

Acf: current crest factor

Vunb: voltage unbalance

Aunb: current unbalance

Hz: frequency

Akf: current K factor

Vthd: voltage total harmonic distortion

Uthd: voltage phase minus phase total harmonic distortion

Athd: current total harmonic distortion

W: active power

- **Phases:** Some alarm conditions have a phase selection. W, VAR, and VA, have a choice of “3L” or each individual phase, or “Sum” which is the sum of phases. DPF, PF, and TAN have the choice of “3L” or each individual phase, or “Mean” which is the mean of phases.
- **Threshold:** The value that must be reached to start an alarm. For “>” alarms, the value or higher must be reached, for “<” alarms, the value or lower must be reached.
- **Duration:** The Alarm will only be recorded if the duration of the parameter meeting the threshold criteria exceeds the duration. The minimum alarm duration can be in minutes or seconds. In the case of Vrms, Urms or Arms not using neutral current, can also be in hundredths of a second. For Vrms, Urms, and Arms, it can be useful to set a duration of 0 seconds. In that case an event as short as a half cycle can be detected (8 milliseconds at 60Hz). For all other parameters, the minimum duration that can be detected is 1 second.

ℹ You can check for alarms, records and search for transients at the same time.

6.5.4 Recordings Configuration

The Recording window shows the dialog box used to configure the parameters for a recording session.

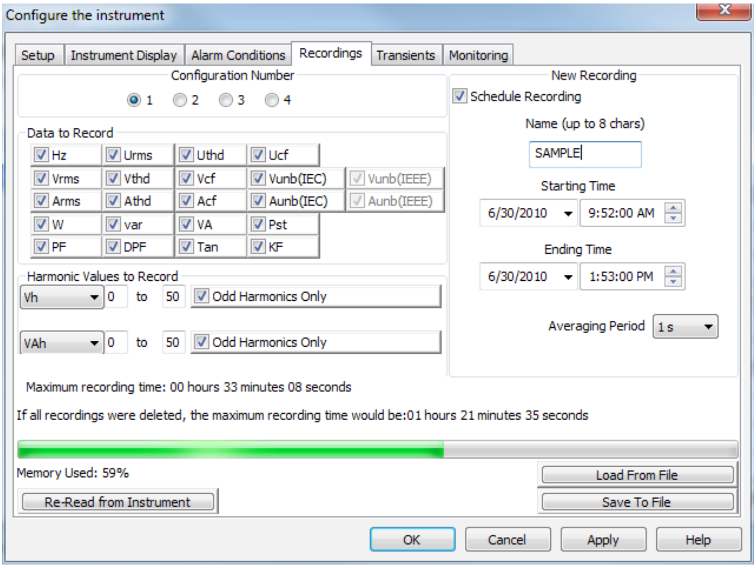


Figure 6-9

Four different configurations are available. More configurations can be saved by pressing **"Save to File"** and recalled later by pressing **"Load From File"**.

1. Check the configuration you wish to set up: 1, 2, 3 or 4.
2. Check all the "Data to Record" parameters you wish to record by clicking on each one.
3. Configure the harmonic values to be recorded, if desired.

   It is also possible to record up to 2 of 4 types of harmonic data, voltage (Vh), current (Ah), phase to phase voltage (Uh), and power (VAh).

   For each selected harmonic data type, you can choose a range of harmonics to record from the 1st to 50th. You can further limit that range to only include odd numbers by checking the box for "Odd Harmonics Only".

---

i The PowerPad® loses its scheduled recording if it is powered off before the recording begins. If it is powered off during the recording, a partial recording will usually still exist but with the first letter of its name changed to "@". The start and end times requested for the recording might be adjusted by the PowerPad® to be in even multiples of the averaging period. For instance, if an integration period of 10 minutes was requested, and the start time was 9:03, the recording might not actually begin until 9:10.

6.5.5 Transients

The Transients window allows you to set up the criteria for capturing transients.

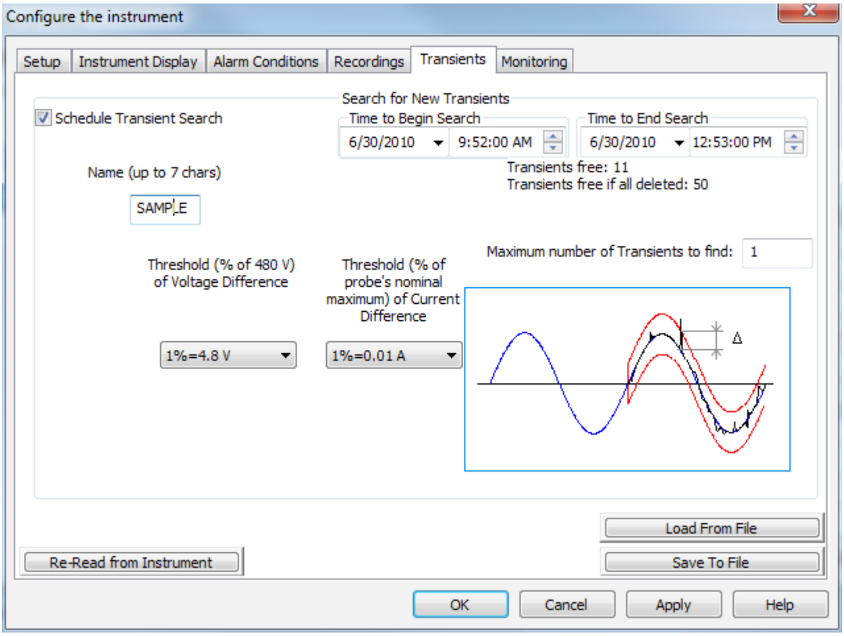


Figure 6-10

1. Type a name for the session, up to seven characters.
2. Select the date and time to begin and end the search for transients.
3. Select the percent deviation for voltage and current transients. The choices available from the drop-down menu are 1, 2, 5, 10, 20, 50 and 100% of the full scale range of measurement. See § 5.4 for detailed information on these values.
4. Select the maximum number of transients to capture (from 1 to 50).

6.5.6 Monitoring

The EN50160 standard defines limiting values and permissible variations of the voltage quality for the European Community. It defines which parameters are relevant, and how are they measured. Continuous or random sampling control of the voltage quality provides the supplier of electric energy with a reliable basis when dealing with network problems, and it contributes to quality assurance.

The purpose of the EN50160 standard “Voltage characteristics of electricity supplied by public distribution systems” is to specify the characteristics of the supply voltage with regard to the course of the curve, the voltage level, the frequency and symmetry of the three phase-network at the interconnecting point to the customer. The goal is to determine limiting values for regular operating conditions.

However, facility defects may lead to major disturbances in the electricity distribution supply network. Accordingly, the standard establishes these values as limiting values, which are not allowed to be exceeded on the high or low side during 95% of the controlled period typically one week.

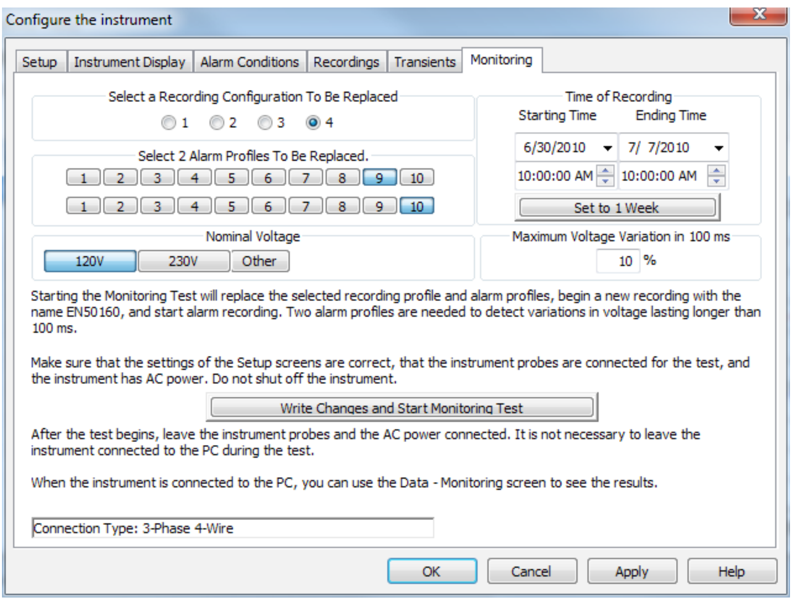


Figure 6-11

Configure and start an EN50160 test of line quality. It is recommended that a brief test of 10 minutes or shorter be done first, to verify the connections and parameters of the test are correct. Only then should the 1-week test be done.

If neither of the voltage profiles are chosen, a field appears to enter the nominal voltage. The frequency is not asked for, since it will be asked for when the test result is downloaded.

Follow the instructions in the dialog box to set up and run this special test. Press the Help button for further instructions.

6.5.7 Running the Test

After configuring the instrument, press **"OK"**. The status window will display if a recording is ready to start. Select Yes to schedule a recording, select No to bring you back to the Configure dialog box.

6.6 Real-time Windows

When your setup is completed, you can display different views on the screen of real-time data and waveforms.

6.6.1 Waveform, Harmonic Bar and Harmonic Text

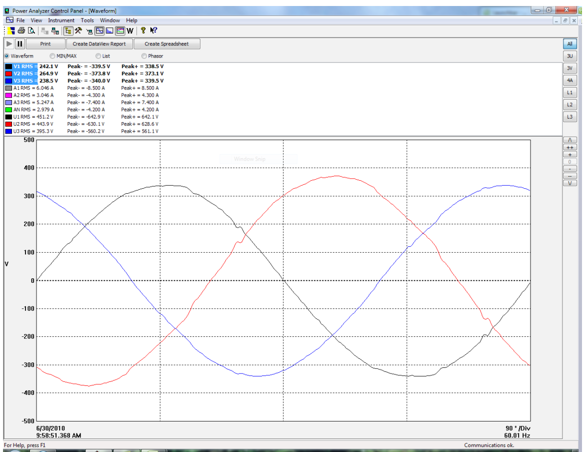


Figure 6-12a

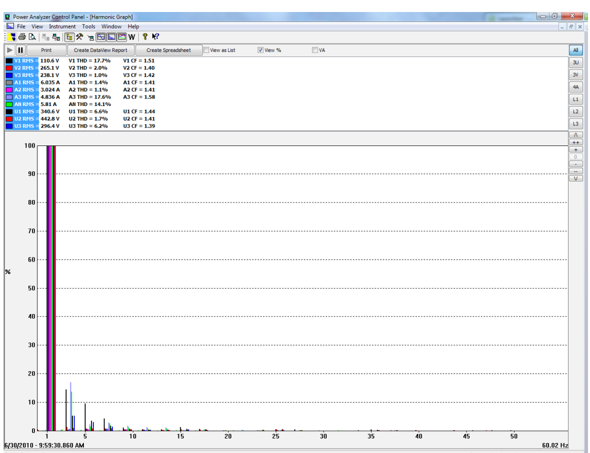


Figure 6-12b

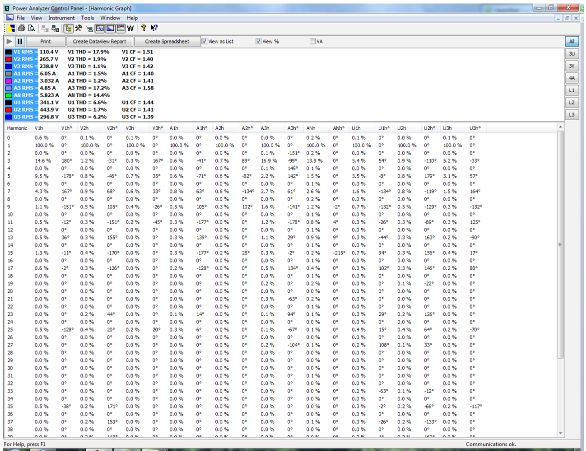


Figure 6-12c

On each screen, you can:

- Select the type of data to see.
- Stop the update with the Hold function.
- Print the screen selected.
- Save it to disk. There is a choice of a database to be viewed in DataView or a .csv file to view in a spreadsheet program.

6.6.2 Power/Energy

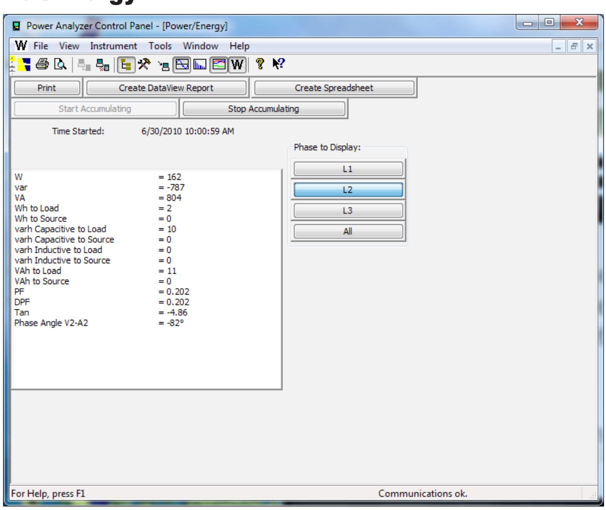


Figure 6-13

The Power/Energy window displays accumulated power and energy data.

Accumulated energy data can be started or stopped and the results can be downloaded to a database and viewed on the screen, selected by phase.

> ℹ The data for all available phases are downloaded to a database or spreadsheet, not just what is shown on the screen.

6.6.3 Trend

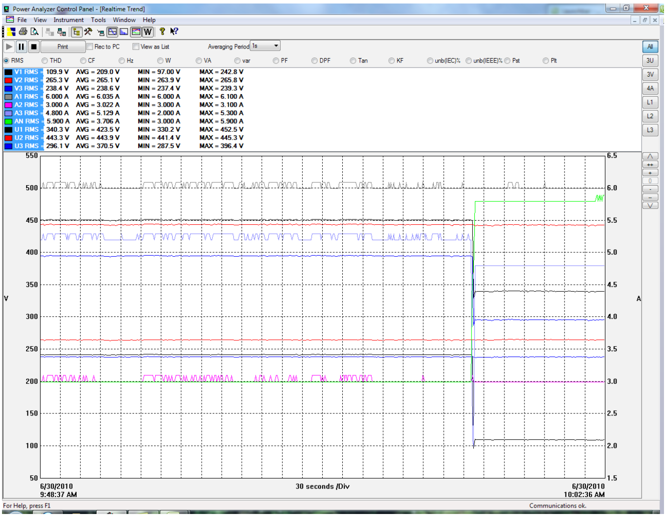


Figure 6-14

Shows a real-time trend of data from the PowerPad®. The data is an average of waveforms downloaded to the PC. There might be 1 waveform per 2.6 seconds. The data is summarized to 1 datapoint every 10 seconds.

6.7 Downloading Data to Database

To download recorded data, go to **Instrument > Recorded Data**.

1. Select the data you want to Download by clicking on the desired tab (Recordings, Photographs, etc.), then clicking on the file name.
2. Select **"Save"** (this may take few minutes).
3. Type a name for the downloaded file and click "**OK**". It can be saved as a database to be viewed in DataView® or as a comma delimited file to be viewed in a spreadsheet program (e.g. Microsoft® Excel).
4. Alternatively, select "**View**". After the download is complete, a window will appear with a graph of the data and some viewing or channel options. In that window you can select "**Save**" or "**Print**".
5. From the Instrument tree view, expand the sections under "**Recorded Data from the instrument**" then click on a line that describes the recorded data. It will bring up a window with a graph of the data.

Following are examples of each tab listed in the display window.

6.7.1 Recordings

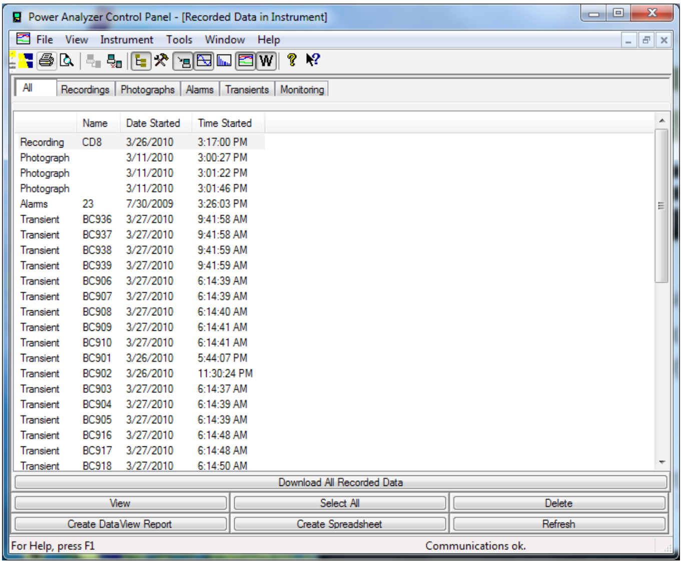


Figure 6-15a

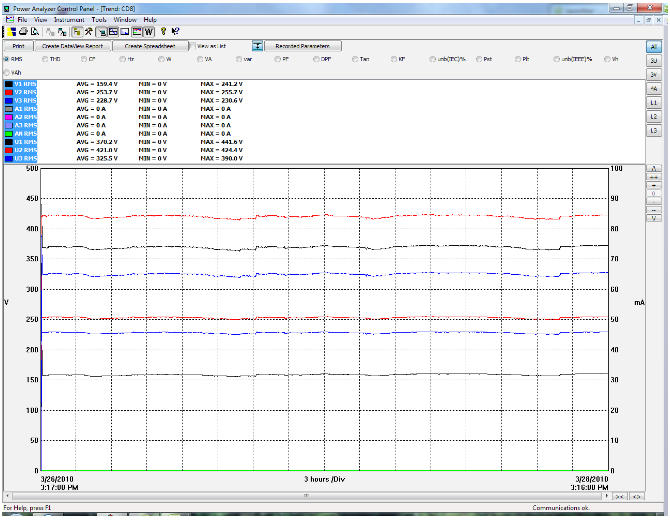


Figure 6-15b

The Recording window displays a list of recordings within the PowerPad®. These recordings can be selected and downloaded to a database.

6.7.2 Photographs

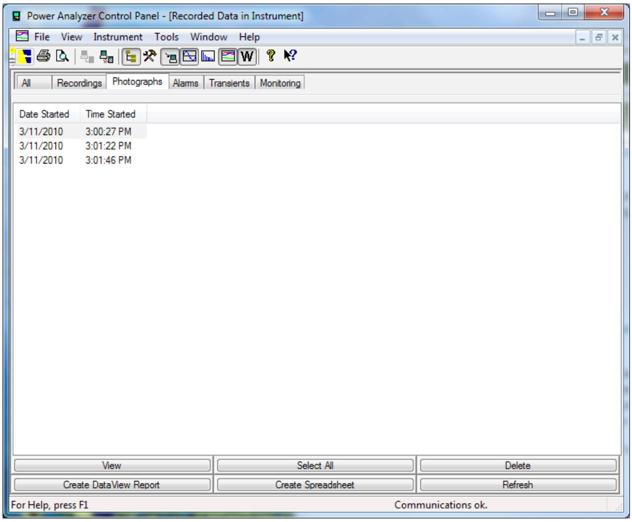


Figure 6-16a

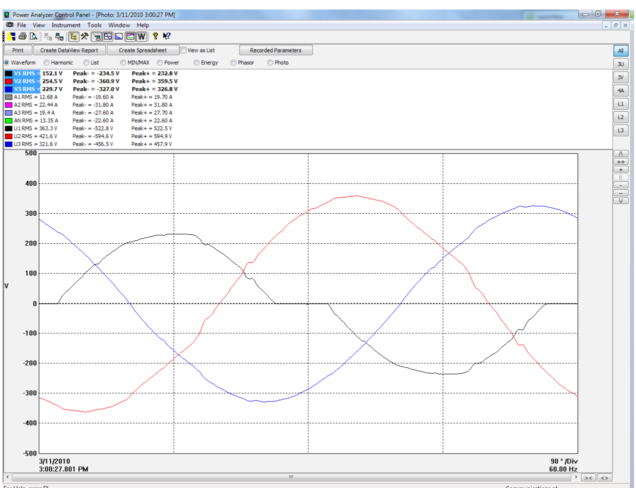


Figure 6-16b

The Photographs window displays a list of photographs (snapshots), with the date and time, taken when the camera button was pressed.

When “**View**” is selected, it shows the waveforms, power data and Bitmap image of the PowerPad® screen from the time the camera button was pressed.

Snapshots can only be initiated using the camera button on the PowerPad® itself, not by DataView®.

6.7.3 Alarms

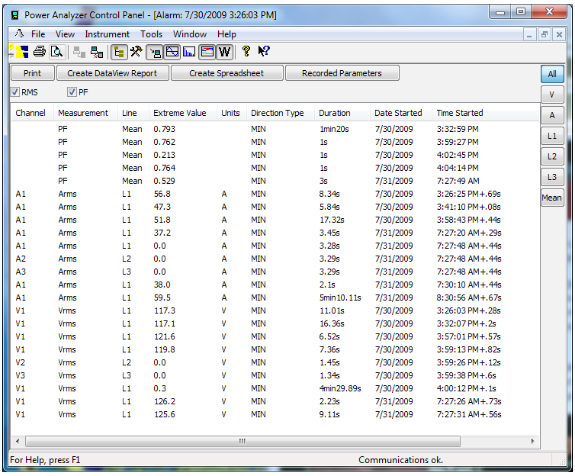


Figure 6-17

The Alarms window displays a list of alarms recorded on the PowerPad®. A subset of the list, can be viewed by the phase of the triggering event.

Alarms can be selected and downloaded to a database. The downloaded alarms contain no more information than is shown in the screen display.

Alarm Phase: Allows the user to select which type of alarms to display (either all, those that were triggered by an event in phase 1, 2 or 3, neutral phase, or an event that involved multiple phases or no phase, such as frequency).

6.7.4 Transients

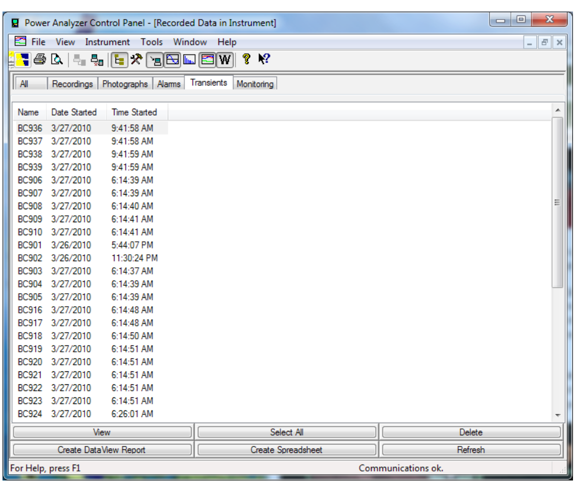


Figure 6-18a

The Transients window displays transients stored on the PowerPad® It shows the number and name of the recording, and the time it began and ended. The selected transient(s) can either be downloaded or deleted.

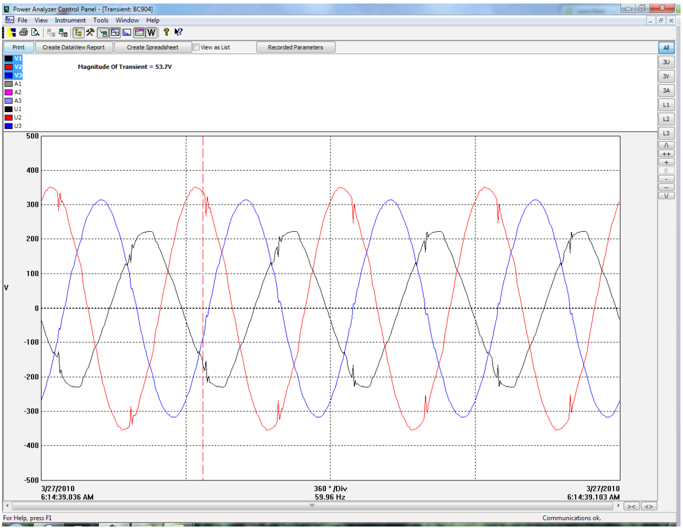


Figure 6-18b

The downloaded result contains many waveforms. Use the controls “><” and “<>”, located at the lower right corner of the window, to zoom in or out of the data.

These controls are available in every graph from recorded data.

There is also a checkbox, **“View As List”**, which can be used to show the value of every datapoint.

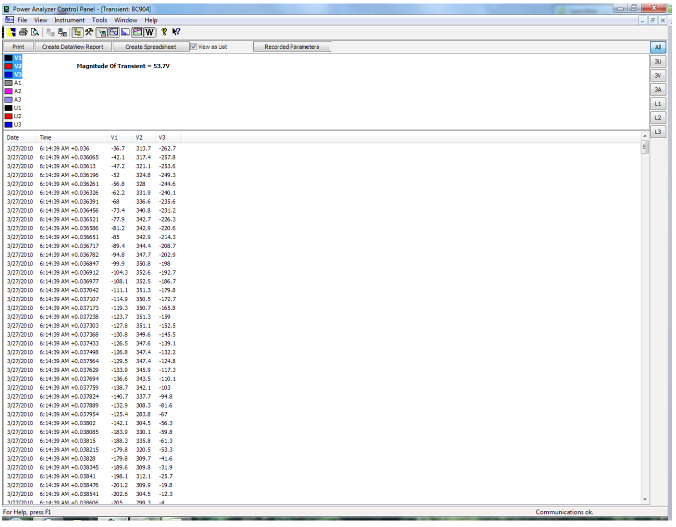


Figure 6-18c

6.7.5 Monitoring

The Monitoring window displays recorded tests that can be downloaded and analyzed.

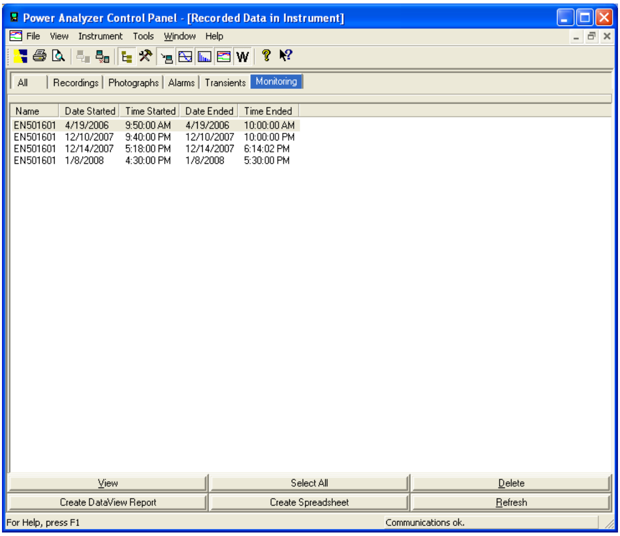


Figure 6-19a

After selecting a recording and clicking **"View"**, the summary window appears showing the results after all the data has been downloaded to a database. It displays the name, percent of the 10-minute periods that it has been out of range, followed by the range it needed to be within.

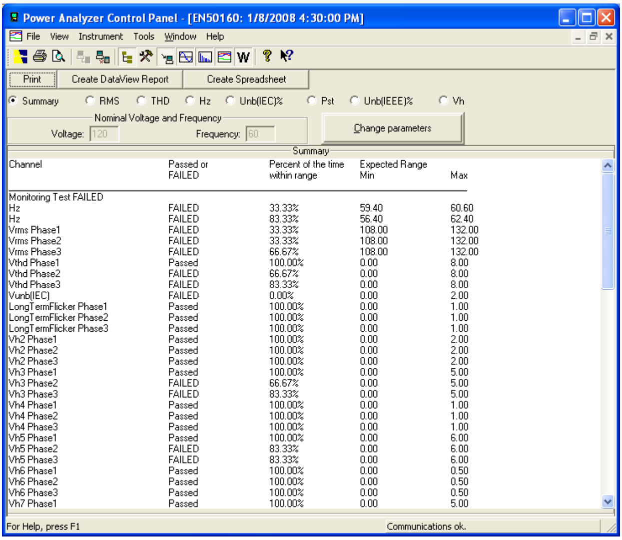


Figure 6-19b

6.7.6 Saving Real-time Measurements

Real-time data received from an instrument can be saved directly into a recording session database. This differs from the process of downloading and saving recorded data in that the measurements are stored on the computer as the instrument measures them. These measurements are not necessarily being stored within the instrument. However, the instrument may be configured to record at the same time real-time measurements are being received from the instrument. In which case, two copies of the measurements will be stored. One copy is stored on the local computer and the other in memory within the instrument.

To Save a Real-time Measurement:

1. From the Realtime Trend window, check the "Rec to PC" checkbox.
2. In the Save As dialog box that appears, specify the type of file to save in the "Save as Type" field. The choices are .dvb (DataView database), .xls (Excel spreadsheet), or .csv (Comma Separated File). Specify the name of the file by typing it into the File name field, select the desired location to save the file, then click Save to save the file.
3. When the "Rec to PC" option is unchecked the file can be opened by selecting **Yes** from the View Saved File dialog box.

To edit the Session Properties, return to the Power Analyzer Control Panel and select **File > Edit Session Properties**.

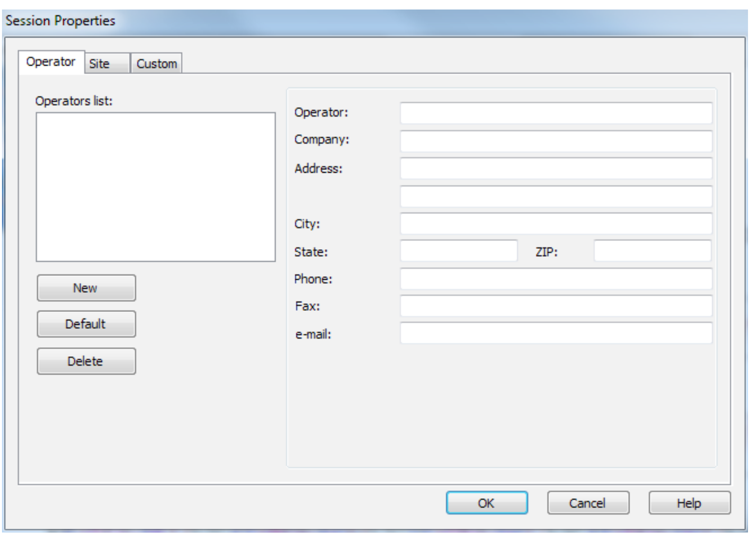


Figure 6-20

The Session Properties dialog box allows you to specify the Operator, Site and Custom parameters that are to be saved with recorded data. These parameters are used when generating reports.

The Operator and Site tabs allow you to maintain lists of operators and sites, saving you time when specifying parameters for reports.

On the left of the Operator and Site tabs is the list of previously defined Operators and Sites. On the right of the Operator and Site tabs is the individual parameters that will be saved in an associated database. Only a single set of operator and site fields are saved in the recording database.

The Custom tab contains a list of user defined parameters. Along side each user defined parameter is a check box. Items that are checked will be added to an associated database. Only a single set of Custom parameters can be maintained (unlike the Operator and Site lists). The Custom tab allows you to specify any user defined parameters (in addition to the comments field of the Site tab) that are to be used in displaying a report.

In addition to the pre-designed report templates, DataView® allows you to totally configure reports to your needs. **Refer to the DataView® HELP file on "Templates" to learn more about templates.**

MAINTENANCE

Use only factory specified replacement parts. AEMC® will not be held responsible for any accident, incident, or malfunction following a repair done other than by its service center or by an approved repair center.

After receiving your PowerPad® shipment, charge and discharge the instrument one or two cycles to ensure the proper level display of the battery indicator.

7.1 Recharging the Battery

The batteries automatically begin recharging when the PowerPad® is connected to the AC power supply. Only use the supplied AC power supply to recharge the batteries of the PowerPad®.

It will take approximately 6 hours to fully charge completely drained batteries. The batteries will not be depleted when the unit is connected to the power supply.

The instrument will not recharge if the message “Instrument will soon turn OFF” is displayed on the screen. The Enter button must be pressed or the instrument must be turned OFF before recharging will start.

7.2 Battery Replacement

WARNING:

- When changing the battery, disconnect all instrument inputs and turn the equipment off. There must be a delay of at least one minute without the battery being connected.
- Do not expose the battery to heat exceeding 212°F (100°C)
- Do not short-circuit the battery terminals

To change the battery, disconnect from any input and make sure the instrument is turned off.

With a coin, remove back panel and replace with a 9.6V NiMH factory supplied battery pack.

7.2 Cleaning

Disconnect the instrument from any source of electricity.

- Use a soft cloth, lightly dampened with soapy water
- Wipe with a damp cloth and then dry with a dry cloth
- Do not splash water directly on the clamp
- Do not use alcohol, solvents or hydrocarbons

APPENDIX A

MATHEMATICAL FORMULAS FOR VARIOUS PARAMETERS

NOTE the following abbreviations used in this section:

NSHC = number of samples per half cycle (between two consecutive zeros)

NSC = number of samples per cycle

NSS = number of samples in a second (multiple of NSC)

V = voltage phase to neutral

U = voltage phase to phase

Half-period Voltage and Current RMS Values

Half-cycle RMS phase-to-neutral voltage of phase (i+1) with i $\in$ [0; 2].

$$\text{Vhalf}[i] = \sqrt{\frac{1}{NSHC} \cdot \sum_{n=Zero}^{(Next\ Zero)-1} V[i][n]^2}$$

Half-cycle RMS phase-to-phase voltage of phase (i+1) with i $\in$ [0; 2].

$$\text{Uhalf}[i] = \sqrt{\frac{1}{NSHC} \cdot \sum_{n=Zero}^{(Next\ Zero)-1} U[i][n]^2}$$

Half-cycle RMS current of phase (i+1) with i $\in$ [0; 2].

$$\text{Ahalf}[i] = \sqrt{\frac{1}{NSHC} \cdot \sum_{n=Zero}^{(Next\ Zero)-1} A[i][n]^2}$$

To avoid missing any fault, these values are calculated for each half-cycle.

MIN / MAX Values for Voltage and Current

Vmax[i]=max (Vdem[i]), Vmin[i]=min (Vdem[i])

Umax[i]=max (Udem[i]), Umin[i]=min (Udem[i])

Amax[i]=max (Adem[i]), Amin[i]=min (Adem[i]) (Avg calculation on 1s)

Peak Values for Voltage and Current (Updated on each waveform refresh)

Vpp[i]=max (V[i][n]), Vpm[i]=min (V[i][n]), n ∈ [0..NSC-1]

Upp[i]=max (U[i][n]), Upm[i]=min (U[i][n]), n ∈ [0..NSC-1]

App[i]=max (A[i][n]), Apm[i]=min (V[i][n]), n ∈ [0..NSC-1]

Peak Factors for Current and Voltage

$$Vcf[i] = \frac{\max(Vpp[i], Vpm[i])}{\sqrt{\frac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} V[i][n]^2}}$$

Peak factor single voltage i + 1 phase

$$Ucf[i] = \frac{\max(Upp[i], Upm[i])}{\sqrt{\frac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} U[i][n]^2}}$$

Peak factor phase-phase voltage i + 1 phase

$$Acf[i] = \frac{\max(App[i], Apm[i])}{\sqrt{\frac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} A[i][n]^2}}$$

Peak factor current i + 1 phase

1 sec RMS Values for Voltage and Current

$$Vrms[i] = \sqrt{\frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} V[i][n]^2}$$ Single rms voltage i + 1 phase

$$Urms[i] = \sqrt{\frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} U[i][n]^2}$$ Compound rms voltage i + 1 phase

$$Arms[i] = \sqrt{\frac{1}{NSS} \cdot \sum_{n=0}^{NSS-1} A[i][n]^2}$$ Rms current i + 1 phase

Voltage and Current Unbalance

$V_{+} = \frac{1}{3}(VF[0] + a \cdot VF[1] + a^2 \cdot VF[2])$ Direct voltage (complex notation $a = e^{j\frac{2\pi}{3}}$)

$V_{-} = \frac{1}{3}(VF[0] + a^2 \cdot VF[1] + a \cdot VF[2])$ Reverse voltage

$$Vunb = \frac{|Vrms_{-}|}{|Vrms_{+}|}, \quad Aunb = \frac{|Arms_{-}|}{|Arms_{+}|}$$

THD Calculation

$$Vthd[i] = \frac{\sqrt{\sum_{n=2}^{50} Vharm[i][n]^2}}{Vharm[i][1]}, \quad Uthd[i] = \frac{\sqrt{\sum_{n=2}^{50} Uharm[i][n]^2}}{Uharm[i][1]}, \quad Athd[i] = \frac{\sqrt{\sum_{n=2}^{50} Aharm[i][n]^2}}{Aharm[i][1]}$$

i: phase (0; 1; 2) n: range (2 to 50)

Calculation of Harmonic Bins

Harmonic bins are calculated by FFT with 16 bit resolution (1024 samples on 4 cycles) without windowing (IEC 1000-4-7). From real and imaginary components, each bin ratio is calculated on each phase Vharm[3][51], Uharm[3][51] and Aharm[3][51] in proportion to the fundamental value and the phase angles Vph[3][51], Uph[3][51] and Aph[3][51] between each bin and the fundamental.

This calculation is accomplished using the following principle:

module in %: $\mathrm{mod}_k = \frac{c_k}{c_1} \times 100$ angle in degree: $\varphi_k = \arctan\left(\frac{a_k}{b_k}\right)$

$$\text{with} \begin{cases} c_k = \left|b_k + ja_k\right| = \sqrt{a_k^2 + b_k^2} \\ b_k = \frac{1}{512}\sum_{s=0}^{1024} F_s \times \sin\left(\frac{k\pi}{512}s + \varphi_k\right) \\ a_k = \frac{1}{512}\sum_{s=0}^{1024} F_s \times \cos\left(\frac{k\pi}{512}s + \varphi_k\right) \\ c_0 = \frac{1}{1024}\sum_{s=0}^{1024} F_s \end{cases}$$

ck: amplitude of the component with a frequency of $f_k = \frac{k}{4} f_1$

Fs: sampled signal

co: DC component

k: ordinal number (spectral bin)

Multiplying the voltage harmonic factor with the current harmonics factor gives the power harmonic factor. Differentiating voltage harmonic phase angle with current harmonic phase angle gives power harmonic phase angle.

VAharm[3][51] , VAph[3][51]

Distortion Factor Calculation (DF)

Two global values giving the relative quantity of harmonics are computed: the THD in proportion to the fundamental and the DF in proportion to the RMS value.

$$\mathrm{Vdf}[\mathrm{i}] = \frac{\sqrt{\frac{1}{2}\sum_{n=2}^{50} Vharm[i][n]^2}}{Vrms[i]}, \mathrm{Udf}[\mathrm{i}] = \frac{\sqrt{\frac{1}{2}\sum_{n=2}^{50} Uharm[i][n]^2}}{Urms[i]}, \mathrm{Adf}[\mathrm{i}] = \frac{\sqrt{\frac{1}{2}\sum_{n=2}^{50} Aharm[i][n]^2}}{Arms[i]}$$

K Factor

$$\text{Akf}\left[\text{i}\right] = \frac{\sum_{n=1}^{\text{n=50}} n^2 Aharm\left[i\right]\left[n\right]^2}{\sum_{n=1}^{\text{n=50}} Aharm\left[i\right]\left[n\right]^2} \quad \text{K factor for the i + 1 phase}$$

Different Power Levels 1 Sec

$$\text{W}\left[i\right] = \frac{1}{NSS} \sum_{n=0}^{\text{NSS-1}} V\left[i\right]\left[n\right] \cdot A\left[i\right]\left[n\right] \quad \text{Active power i + 1 phase}$$

$$\text{VA}[i] = \text{Vrms}[i] \cdot \text{Arms}[i] \quad \text{Apparent power i + 1 phase}$$

$$\text{VAR}[i] = \frac{1}{NSS} \cdot \sum_{n=0}^{\text{NSS-1}} VF\left[i\right]\left[n - NSC/4\right] \cdot AF\left[i\right]\left[n\right] \quad \text{Reactive power i + 1 phase}$$

$$\text{or VAR}[i] = \sqrt{\text{VA}[i]^2 - \text{W}[i]^2} \quad \text{if computation method is with harmonics}$$

W[3] = W[0] + W[1] + W[2]	Total active power
VA[3] = VA[0] + VA[1] + VA[2]	Total apparent power
VAR[3] = VAR[0] + VAR[1] + VAR[2]	Total reactive power

Ratios

$$PF[i] = \frac{W[i]}{VA[i]}$$ i + 1 phase power factor

$$DPF[i] = \cos(\phi[i])$$ i + 1 phase displacement factor

$$Tan[i] = \tan(\phi[i])$$ i + 1 phase tangent

$$\cos(\phi[i]) = \frac{\sum_{n=0}^{NSS-1} VF[i][n] \cdot AF[i][n]}{\sqrt{\sum_{n=0}^{NSS-1} VF[i][n]^2}\sqrt{\sum_{n=0}^{NSS-1} AF[i][n]^2}}$$

Cosine angle between voltage fundamental and i + 1 phase current

$$PF[3] = \frac{PF[0] + PF[1] + PF[2]}{3}$$ Total power factor

$$DPF[3] = \frac{DPF[0] + DPF[1] + DPF[2]}{3}$$ Total shift factor

$$Tan[3] = \frac{Tan[0] + Tan[1] + Tan[2]}{3}$$ Total tangent

Various Types of Energy

$$Wh[0][i] = \sum_{Tint} \frac{W[i]}{3600}$$ Active energy consumed phase i + 1

$$VAh[0][i] = \sum_{Tint} \frac{VA[i]}{3600}$$ Apparent energy consumed phase i + 1

$$VARhL[0][i] = \sum_{Tint} \frac{VAR[i]}{3600} \text{ for } VAR[i] \geq 0$$ Reactive inductive energy consumed phase i + 1

$$VARhC[0][i] = \sum_{Tint} \frac{-VAR[i]}{3600} \text{ for } VAR[i] \leq 0$$ Reactive capacitive energy consumed phase i + 1

Total active energy consumed:
Wh[0][3] = Wh[0][0] + Wh[0][1] + Wh[0][2]

Total apparent energy consumed:
VAh[0][3] = VAh[0][0] + VAh[0][1] + VAh[0][2]

Total reactive capacitive energy consumed:
VARhC[0][3] = VARhC[0][0] + VARhC[0][1] + VARhC[0][2]

Total reactive inductive energy consumed:
VARhL[0][3] = VARhL[0][0] + VARhL[0][1] + VARhL[0][2]

$$\mathrm{Wh}[1][i] = \sum_{\mathrm{Tint}} \frac{\mathrm{W}[i]}{3600}$$ Active energy generated phase i + 1

$$\mathrm{VAh}[1][i] = \sum_{\mathrm{Tint}} \frac{\mathrm{VA}[i]}{3600}$$ Active energy generated phase i + 1

$$\mathrm{VARhL}[1][i] = \sum_{\mathrm{Tint}} \frac{-\mathrm{VAR}[i]}{3600} \text{ for } \mathrm{VAR}[i] \leq 0$$ Reactive inductive energy generated phase i + 1

$$\mathrm{VARhC}[1][i] = \sum_{\mathrm{Tint}} \frac{\mathrm{VAR}[i]}{3600} \text{ for } \mathrm{VAR}[i] \geq 0$$ Reactive capacitive energy generated phase i + 1

Total active energy consumed:
Wh[1][3] = Wh[1][0] + Wh[1][1] + Wh[1][2]

Total apparent energy consumed:
VAh[1][3] = VAh[1][0] + VAh[1][1] + VAh[1][2]

Total reactive capacitive energy consumed:
VARhC[1][3] = VARhC[1][0] + VARhC[1][1] + VARhC[1][2]

Total reactive inductive energy consumed:
VARhL[1][3] = VARhL[1][0] + VARhL[1][1] + VARhL[1][2]

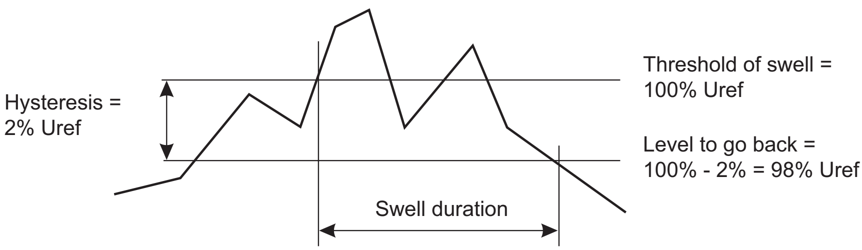
Hysteresis

Hysteresis is a filtering principle, often used after the threshold detection has occurred. A correct setting of hysteresis value will avoid repeated triggering when the measure is varying close to the threshold.

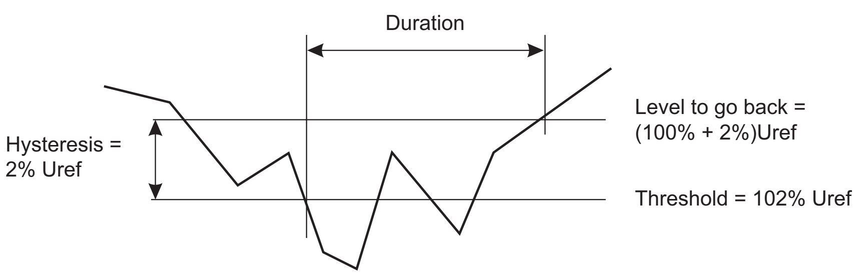
The event detection is activated when the measure is going over the threshold but it can only be deactivated if the measure goes under the threshold minus the value of the hysteresis.

The default hysteresis value is 2% of the reference voltage but it may be set in the range of [1%, 5%] depending of the voltage stability on the system.

Alarm for high voltage RMS (Swell Detection)



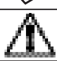
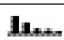
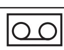
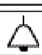
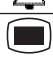
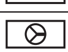
Alarm for low voltage RMS (Sag or Interruption Detection)



APPENDIX B

GLOSSARY OF TERMS

Symbol	Definition
F	Frequency
Vrms	Volts rms
Arms	Amps rms
W	Watts (Real Power)
PF	Power Factor
Urms	Volts (phase-to-phase rms)
Vthd	Volts total harmonic distortion
Athd	Amps total harmonic distortion
VARS	VARS (reactive power)
DPF	Displacement power factor
Uthd	Volts total harmonic distortion (phase-to-phase)
Vcf	Volts crest factor
Acf	Amps Crest Factor
VA	Volt-Amps (apparent power)
Tan	Tangent (Volt-Amp)
Ucf	Volts crest factor (phase-to-phase)
Vunb	Volts Unbalanced. On the instrument's screen, the calculation method is the IEC method that takes into account phase angle.
Aunb	Amps Unbalanced. On the instrument's screen, the calculation method is the IEC method that takes into account phase angle.
PST	Short term flicker
Akf	"K" factor
Vh	Harmonic volt
Ah	Harmonic amps
3L	Capture of each 3 phases
N	Neutral current (calculated)
Σ	Sum of three-phase power capture

Σ/3	Average value of three-phase capture
3U	Three phases of voltage (phase-to-phase)
3V	Three phases of voltage (phase-to-neutral)
3A	Three phases of current
4A	Three phases of current including derived neutral current
L1	Phase one of voltage (phase-to-neutral) plus current
L2	Phase two of voltage (phase-to-neutral) plus current
L3	Phase three of voltage (phase-to-neutral) plus current
	Up/Down buttons
	Enter button
♦	Parameter selected for recording
◊	Parameter not selected for recording
	Left/Right selection buttons
	Right selection button
	Left selection button
	Warning
	Double or reinforced insulation
	Danger – Risk of electric shock
	Transients mode
	Harmonics mode
	Harmonic analysis
	Waveforms mode
	Power/Energy mode
	Recording mode
	Alarm mode
	Set Up mode
	Snapshot capture
	Direct print
	Help
	Tabular display of measurements
	Phasor diagram display

 25%	Battery charging or discharging
 100%	Battery full
 0%	Battery empty discharging
 ?	New battery discharging
	Power On/Off
	Validate the setting
W...	Power parameters
PF...	Power factor
	Starts energy accumulation
	Stops current activity
	Resets counter to zero
	Displays each type of energy (real, reactive, apparent)
	Starts capture or recording search
	Displays a captured transient
	Deletes a captured transient
	Returns to the transient selection screen
	Zoom In
	Zoom out
	Saving
	Opening a saved display

Repair and Calibration

To ensure that your instrument meets factory specifications, we recommend that it be scheduled back to our factory Service Center at one-year intervals for recalibration, or as required by other standards or internal procedures.

For instrument repair and calibration:
You must contact our Service Center for a Customer Service Authorization Number (CSA#). This will ensure that when your instrument arrives, it will be tracked and processed promptly. Please write the CSA# on the outside of the shipping container. If the instrument is returned for calibration, we need to know if you want a standard calibration, or a calibration traceable to N.I.S.T. (Includes calibration certificate plus recorded calibration data).

Ship To: Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments
15 Faraday Drive
Dover, NH 03820 USA

Phone: (800) 945-2362 (Ext. 360)
(603) 749-6434 (Ext. 360)
Fax: (603) 742-2346 or (603) 749-6309
E-mail: repair@aemc.com

(Or contact your authorized distributor)

Costs for repair, standard calibration, and calibration traceable to N.I.S.T. are available.

NOTE: You must obtain a CSA# before returning any instrument.

Technical and Sales Assistance

If you are experiencing any technical problems, or require any assistance with the proper operation or application of your instrument, please call, fax or e-mail our technical support team:

Contact: Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments

Phone: (800) 945-2362 (Ext. 351)
(603) 749-6434 (Ext. 351)
Fax: (603) 742-2346
E-mail: techsupport@aemc.com

Limited Warranty

The PowerPad® Model 3945-B is warranted to the owner for a period of 2 years from the date of original purchase against defects in manufacture. This limited warranty is given by AEMC® Instruments, not by the distributor from whom it was purchased. This warranty is void if the unit has been tampered with, abused or if the defect is related to service not performed by AEMC® Instruments.

Full warranty coverage and product registration is available on our website at www.aemc.com/warranty.html.

IMPORTANT WARRANTY NOTE:

By registering online within 30 days from the date of purchase, your warranty will be extended to 3 years

Please print the online Warranty Coverage Information for your records.

What AEMC® Instruments will do:
If a malfunction occurs within the warranty period, you may return the instrument to us for repair, provided we have your warranty registration information on file or a proof of purchase. AEMC® Instruments will, at its option, repair or replace the faulty material.

Warranty Repairs

What you must do to return an Instrument for Warranty Repair:

First, request a Customer Service Authorization Number (CSA#) by phone or by fax from our Service Department (see address below), then return the instrument along with the signed CSA Form. Please write the CSA# on the outside of the shipping container. Return the instrument, postage or shipment pre-paid to:

Ship To: Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments
15 Faraday Drive • Dover, NH 03820 USA
Phone: (800) 945-2362 (Ext. 360)
(603) 749-6434 (Ext. 360)
Fax: (603) 742-2346 or (603) 749-6309
E-mail: repair@aemc.com

Caution: To protect yourself against in-transit loss, we recommend you insure your returned material.

NOTE: You must obtain a CSA# before returning any instrument.

02/18

99-MAN 100261 v38

Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments
15 Faraday Drive • Dover, NH 03820 USA • Phone: (603) 749-6434 • Fax: (603) 742-2346
www.aemc.com