■ 3-PHASE POWER QUALITY ANALYZER

3945

TEquipment
.NET
USA
An Interworld Highway, LLC Company

MODEL 3945

AEMC
INSTRUMENTS

07/25/02 10:26 ▮100%

---- Hz
① 0.0 v ② 0.0 v ③ 0.0 v

3U
3V
3A
L1
L2
L3

10V

0

-10
<t= --.- ms   V1= -0   V2= -0   V3= -0   >

RMS | THD | CF | max min

PowerPad™
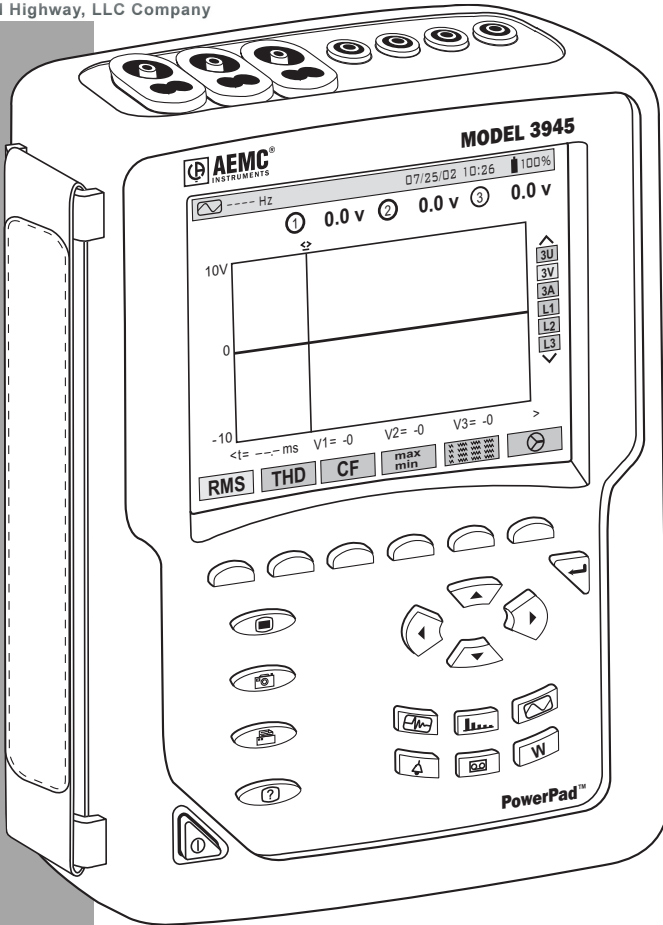
ENGLISH   **User Manual**

AEMC
INSTRUMENTS
®

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CHAPTER 1

INTRODUCTION

 Warning

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

International Electrical Symbols

This symbol signifies that the instrument is protected by double or reinforced insulation.

This symbol on the instrument indicates a WARNING and that the operator must refer to the user manual for instructions before operating the instrument. In this manual, the symbol preceding instructions indicates that if the instructions are not followed, bodily injury, installation/sample and product damage may result.

Risk of electric shock. The voltage at the parts marked with this symbol may be dangerous.

1.1   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.

1.2 Ordering Information

PowerPad™ Model 3945 ....**Cat. #2130.74**
Includes: Meter, (4) 10 ft color-coded voltage leads, (4) color-coded alligator clips, RS-232 DB9F optical cable, NiMh battery, US power cord, DataView® Pro Software, carrying bag, user manual and warranty card.

PowerPad™ Model 3945 with MN93 ....**Cat. #2130.75**
Includes: Meter, set of (3) 200A MN93 probes, (4) 10 ft color-coded voltage leads, (4) color-coded alligator clips, RS-232 DB9F optical cable, NiMh battery, US power cord, DataView® Pro Software, carrying bag, user manual and warranty card.

PowerPad™ Model 3945 with SR193 ....**Cat. #2130.76**
Includes: Meter, set of (3) 1000A SR193 probes, (4) 10 ft color-coded voltage leads, (4) color-coded alligator clips, RS-232 DB9F optical cable, NiMh battery, US power cord, DataView® Pro Software, carrying bag, user manual and warranty card.

PowerPad™ Model 3945 with AmpFlex™ 193-24 ....**Cat. #2130.77**
Includes: Meter, set of (3) 3000A 24" AmpFlex™ 193-24 probes, (4) 10 ft color-coded voltage leads, (4) color-coded alligator clips, RS-232 DB9F optical cable, NiMh battery, US power cord, DataView® Pro Software, carrying bag, user manual and warranty card.

PowerPad™ Model 3945 with AmpFlex™ 193-36 ....**Cat. #2130.78**
Includes: Meter, set of (3) 3000A 36" AmpFlex™ 193-36 probes, (4) 10 ft color-coded voltage leads, (4) color-coded alligator clips, RS-232 DB9F optical cable, NiMh battery, US power cord, DataView® Pro Software, carrying bag, user manual and warranty card.

1.2.1 Accessories and Replacement Parts

Set of 3, MN93 probes (200A)...**Cat. #2140.09**

Set of 3, SR193 probes (1000A) ....**Cat. #2140.10**

Set of 3, 24" AmpFlex™ 193-24 probes (3000A) ....**Cat. #2140.11**

Set of 3, 36" AmpFlex™ 193-36 probes (3000A) ....**Cat. #2140.12**

Set of 3, MR193 probes (1000A)..**Cat. #2140.13**

Set of 3, MN193 probes (5A and 100A) ....**Cat. #2140.14**

CHAPTER 2

PRODUCT FEATURES

2.1 Description

The PowerPad™ Model 3945 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 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 of the various magnitudes, detection, continuous recordings and their display without any constraints.

Features:

- Measurement of Vrms voltages up to 480V (phase-to-neutral) or 830V (phase-to-phase) for two, three or four-wire systems.
- Measurement of Arms current up to 6500Arms.
- Frequency measurement of 50/60Hz (40Hz to 70Hz).
- Calculation of neutral current by vector summing of phase current for WYE configurations.
- Calculation of Peak 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.
- 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 5 sec to 2 hrs.
- Measurement of active, reactive and apparent power per phase and their totals.
- Calculation of the power, phase shift 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
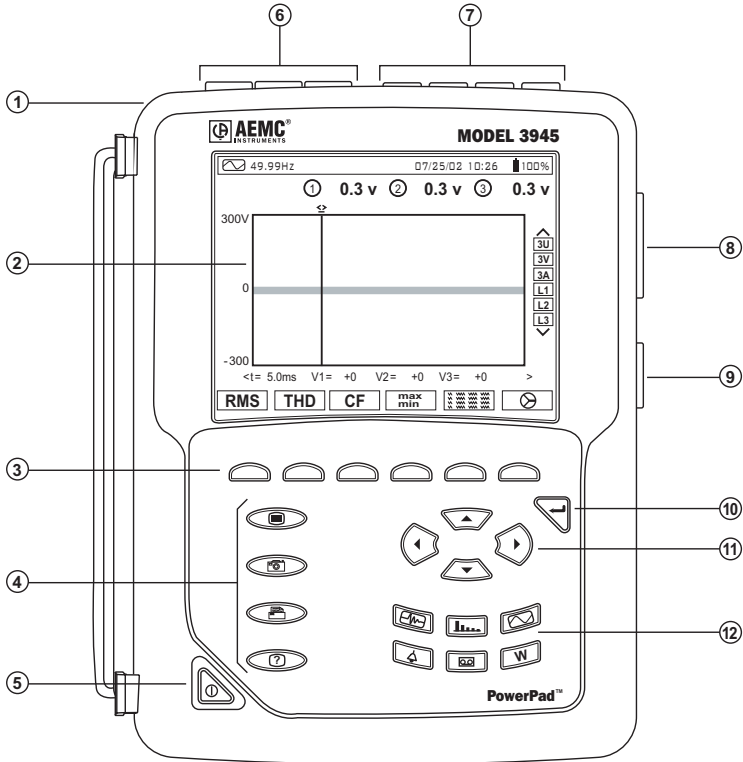
Figure 2-1

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 optical output for transferring data to a PC (bidirectional) 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 such as, motor startup current (INRUSH) and interruptions

Harmonics View:
- representation of the harmonic ratios 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 curves, of average power levels or of the average value of any parameter
- line voltage stability check
- management of power consumed and generated
- monitoring of harmonic variations

△ **Alarm:**

- 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

2.3   Display
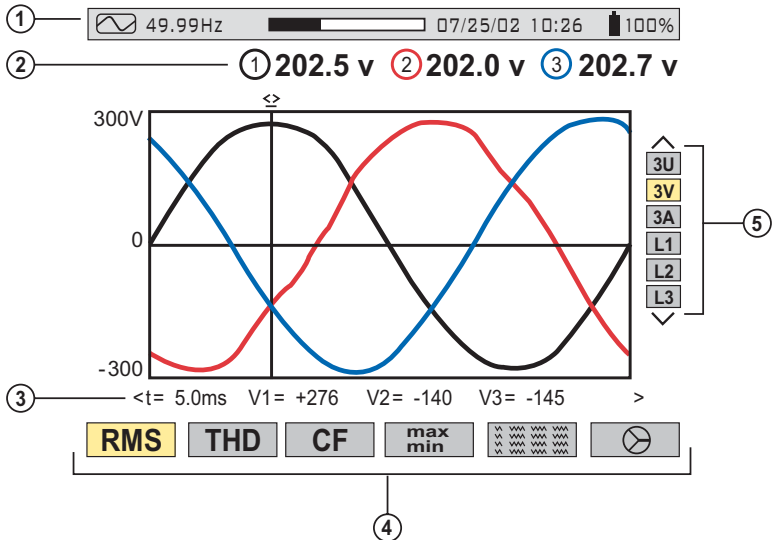
Figure 2-2

① Top display bar indicates:

- Symbol of the tested mode (e.g., �, Ⅱ▪▪▪, W, 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 is applied to the Ch1 voltage input.

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, do not turn the instrument OFF/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.

CHAPTER 3

SPECIFICATIONS

3.1 Reference Conditions

Parameter	Reference Conditions
Ambient temperature	73°F ± 5°F (23°C ± 3°C)
Humidity	45% to 75% RH
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	0.01V to 1Vrms without DC (<0.5%)
AmpFlex™ current circuit input voltage	3.9mV to 118mVrms without DC (<0.5%)
Current input voltage detection threshold	0.001 In
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.

3.2 Electrical Specifications

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

3.2.1 Voltage Inputs

Operating Range: Phase-Phase - 830Vrms AC/DC
Phase-Neutral - 480Vrms AC/DC

Input Impedance: 338kΩ 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: 1MΩ 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)	6V to 480V	0.1V	±0.5% ± 2cts
Phase-to-phase RMS voltages (Urms, Udem)	10V to 830V	0.1V	±0.5% ± 2cts
DC voltage component	6V to 100V	0.1V	±1% ± 2cts
Single phase peak voltages (Vpp, Vpm)	6V to 680V	0.1V	±1% ± 5cts
Phase-to-phase peak voltages (Upp, Upm)	10V 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™ (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 1200A	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™)	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™
	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™
	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™
	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 Cos Φ 0.2 to < 0.5	4 digits	±1.5% ± 1ct ±2.5% ± 1ct
Reactive Energy (VARh) AmpFlex™	0VARh to 9999MVARh Sin φ ≥ 0.5 Cos φ 0.2 to < 0.5	4 digits	±1.5% ± 1ct ±2.5% ± 1ct
Apparent Energy (Vah)	0VAh to 9999MVAh	4 digits	±1% ± 1ct

Function	Range	Display Resolution	Accuracy
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° ± 1ct
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

3.2.4   Nominal Range of Use

Harmonics: THD (I) : 40%; THD (U) : 20%

Magnetic field: <40.0A/m (Earth's magnetic field)

Electrical field: <3V/m

3.2.5   Power Supply

AC Power (internal power supply)

> **Operating Range:** 230VAC ± 20% and 110VAC ± 20%
>
> **Max Power:** 30VA

Battery Power Supply (allows use in the event of a power interruption)

> **Type:** NiMH 3800 mAh
>
> **Output:** 4-wire (2 for temperature probe)
>
> **Raged Voltage:** 9.6V
>
> **Charge Time:** 3 hrs 30 min approx
>
> **Battery Life:** >6 hrs with display on
> ≤96 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)

> **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.
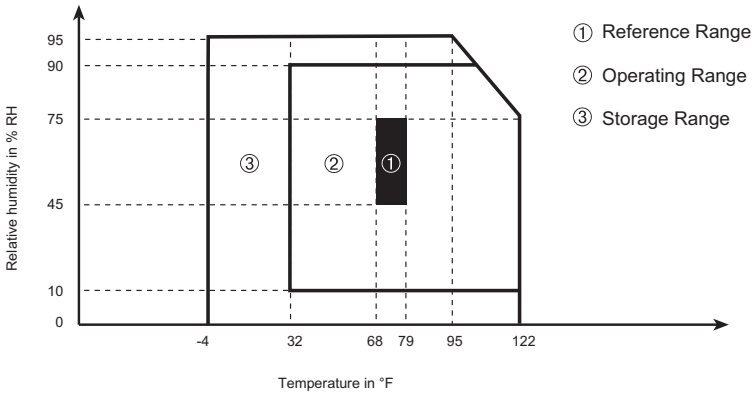
3.3   Mechanical Specifications

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

Weight: 4.6 lb (2.1kg)

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

Temperature and % RH:

Temperature in °F

① Reference Range

② Operating Range

③ Storage Range

3.4   Safety Specifications

3.4.1   Electrical Safety (per EN 61010-1)

- Double insulation: ▣
- 600Vrms, Cat. III, Pollution Degree 2

3.4.2   Electromagnetic Compatibility and Sensitivity

- Immunity and Emission: EN 61236 - 1 amendment 1
- Electrostatic discharges: IEC 1000-4-2
- Radiation field resistance: IEC 1000-4-3
- Fast transients resistance: IEC 1000-4-4
- Electric shock resistance: IEC 1000-4-5
- Conducted RF interference: IEC 1000-4-6

3.4.3   Mechanical Protection

- Shock and Vibration: per EN 61010-1
- Impermeability: IP 50 per EN 60529
  (electrical IP2X for the terminals)

3.5   AC Current Probe Model SR193 (with Model 3945)

Nominal Range: 1000AAC for f ≤1kHz

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

NOTE: Currents below X will be displayed as zero on the PowerPad™ with this probe

Probe Output Signal: 1mVAC/AAC

Maximum Clamping Diameter: 2" (52mm)

Safety: EN 61010-2-032, 600V, CAT III, POLL 2

Reference Conditions:

Ambient temperature	73°F (23°C) ± 5°F (3°C)
Humidity	45 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*

NOTE: Add PowerPad™ accuracy ±0.5% ± 1ct

Primary current (AAC)	3 to 10A	10 to 100A	100 to 1200A
Accuracy (% of the output signal)	≤0.8%	≤0.3%	≤0.2%
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%
Positions 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: $I \max \leq 1000A \times \dfrac{1}{f_{(in\ kHz)}}$

3.6 AC Current Probe MN93 Probe (with Model 3945)

Nominal Range: 200A$_{AC}$ for f ≤ 1kHz

Measurement Range: 2A to 240A$_{AC}$ (I > 200A not permanent)

NOTE: Currents below X will be displayed as zero on the PowerPad™ with this probe

Probe Output Signal: 5mVAC/AAC

Maximum Clamping Diameter: 0.8" (20mm)

Safety: EN 61010-2-032, 600V, CAT III, POLL 2

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

NOTE: Add PowerPad™ accuracy ±0.5% ± 1ct

Primary current (A$_{AC}$)	2 to 10A	10 to 100A	100 to 240A
Accuracy (% of the output signal)	≤5% ± 5mV	≤2.5% ± 5mV	≤1% ± 5mV
Phase shift (°)	≤15°	≤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%
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
DC current distortion	<20A$_{DC}$ on the nominal AC current	<5%
Crest factor distortion	≤3 and peak current = 200A	≤3%

Overload: Frequency derating beyond 1kHz: I max ≤ 1000A x $\dfrac{1}{f_{(in\ kHz)}}$

3.7 AC Current Probe MN193 Probe (with Model 3945)

The MN193 is designed to work with secondary current transformers.
Best accuracy is available when entering the transformer ratio (e.g. 1000/5A)

Nominal Range: 5A and 100AAC

Measurement Range: 5A: 0.005A to 5AAC; 100A: 0.1A to 100AAC

NOTE: Currents below X on the 5A range and Y on the 100A range will be displayed as zero on the PowerPad™ with this probe

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

Maximum Clamping Diameter: 0.8" (20mm)

Safety: NF EN 61010-2-032, 600V, CAT III, POLL 2

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

NOTE: Add PowerPad™ accuracy ±0.5% ± 1ct

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

Primary current (in AAC)	0.1A to 1A	1A to 120A
Accuracy (% of the output signal)	≤1% ±2mA	≤1%
Phase shift (°)	≤3.2°	≤2.2°

Overload: 120A continuous

Range: 200mV/A (1V @ 5Arms)

Primary current (in AAC)	5mA to 50mA	0.05A	0.5A	5A
Accuracy (% of the output signal)	≤1.5% ±0.1mA	≤1.5%	≤1%	≤1%
Phase shift (°)	≤6.5°	≤5°	≤4.5°	≤4°

Overload: 12A continuous

Factors affecting accuracy (% of the output signal)

Conditions	Range	Error
Ambient temperature	14° to 131°F (-10° to 55°C)	≤150 ppm/K or 0.15% 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
Crest factor distortion	≤3 and peak current = 200A	≤3%

3.8 AC Current Probe AmpFlex™ Probe (with Model 3945)

Nominal Range: 3000AAC

Measurement Range: 10A to 6500AAC
NOTE: Currents below 9A will be displayed as zero on the PowerPad™ with this probe

Probe Output Signal: 140mVAC/3000AAC at 50/60Hz
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, 1000V, CAT III, POLL 2

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

NOTE: Add PowerPad™ accuracy ±0.5% ± 1ct

	10 to 100A	100 to 6500A
Primary current (AAC)	10 to 100A	100 to 6500A
Accuracy (% of the output signal)	≤3%	≤2%
Phase shift (°)	≤1°	≤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 on internal perimeter of the undeformed sensor	2% (4% near latching system)
Adjacent conductor carrying an AC current	Conductor in contact with the sensor	1% (2% near latching system)

3.9 AC Current Probe MR Probe (with Model 3945)

Nominal Range: 1000A$_{AC}$, 1400A$_{DC}$

Measurement Range: 10A to 1000A$_{AC}$, 10A to 1300A$_{PEAK}$ AC+DC

NOTE: Currents below XA$_{DC}$ and YA$_{DC}$ will be displayed as zero on the Power-Pad™ 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, 600V, CAT III, POLL 2
EN 61010-2, 300V, CAT IV, POLL 2

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

NOTE: Add PowerPad™ accuracy ±0.5% ± 1ct

Primary current	10 to 100A	100 to 800A	800 to 1000A$_{AC}$ 800 to 1300A$_{PEAK}$
Accuracy	≤1.5% + 1mV	≤3%	≤4%

Primary current	10 to 200A	200 to 1000A	–
Phase angle	≤2°	≤2°	–

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 1 Hz 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/A$_{AC}$ (1" from clamp)
External field	400 A/m	<1.3A
Rejection in common mode (AC)	50 to 400Hz	>65dB
Remanence in DC	+1300A$_{DC}$ at -1300A$_{DC}$	<4mA/A
Frequency of the measurement signal	65Hz to 440Hz 440Hz to 1kHz 1kHz to 10kHz	-2% -5% -4dB

3.10 Three Phase 5A Adapter

The three phase transducer has three 5A$_{AC}$ input current circuits L1, L2, L3 and three output AC voltage circuits. All circuits are independent and isolated between input and output. The output connectors are designed for use with the Model 3945 PowerPad™ with automatic sensor recognition and measurement adjustment.

The input connections accept either Ø4mm male plugs or rigid leads between 1 and 2.5mm^2 copper section inserted in the bottom hole after pressing on the connector.

⚠ **Caution:** This adapter can be used on measurement Category III for voltages not exceeding 300V in relation to the ground according to IEC 61010.

3.10.1 Connecting to a secondary current transformer (CT)

1. Make a short circuit between 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 paying attention to the direction of the current flow (ground on P2) and the right phase order L1, L2, L3.

3.10.2 Specifications (add PowerPad™ accuracy ±0.5% ± 1ct)

Range:	5A
Output / Input Ratio:	0.2mV/mA AC
Dimensions:	6.00 x 3.75 x 3.40" (153 x 95 x 86mm)
Weight:	2 lbs (900g)
Impermeability:	IP50 per EN 60529 (electrical IP2X for the terminals)
Electrical safety:	Double Insulation, Category III 300V Pollution Degree 2 per IEC 61010-1
Operating Temperature:	5° to 131°F (-15° to 55°C), 10 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

The instrument is turned ON by pressing the green ⓞ button. The startup screen will appear and indicate the instrument's software version and serial number.

If there is no AC power supply, the instrument will operate 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.

NOTE: The current probes connected are identified at power ON only.

When changing type of probe, restart the PowerPad™.

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 ▣ key is pressed, the following setup choices appear:

```
┌──────────────────────────────────────────────┐
│ ⬛                        07/25/02 10:26  ▌100% │
└──────────────────────────────────────────────┘

              DATE / TIME
              CONTRAST / BRIGHTNESS
              COLORS
              CALCULATION METHOD
              ELECTRICAL HOOKUP
              CURRENT SENSORS
              BAUD RATE
              RECORDING
              ALARM
              CLEAR MEMORY
              LINE FREQUENCY

  [Français] [English] [Deutsch] [Italiano] [Español] [Portugues]
```
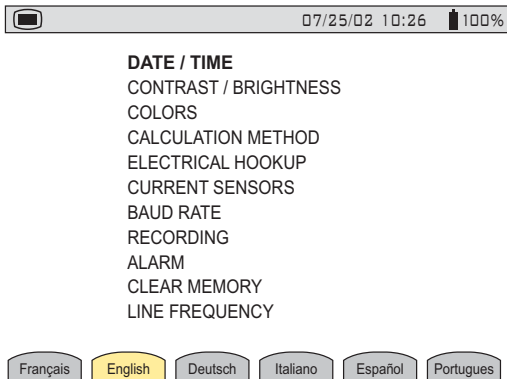
Figure 4-1

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

- Choose the language by pressing the function button below the chosen 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 Configuration menu will once again be displayed on the screen.

NOTE: The date and time format used 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. The Configuration menu will once again be displayed on the screen.

4.1.3 Colors

• Highlight COLORS with the ⇕ buttons, then press the ⬎ button.

The following screen will appear:

▭			07/25/02 10:26	▮ 100%

Phase voltage	**1**	<	███████	>
Phase current	1	<	███████	>
Phase voltage	2	<	███████	>
Phase current	2	<	███████	>
Phase voltage	3	<	███████	>
Phase current	3	<	███████	>
Neutral current		<	███████	>
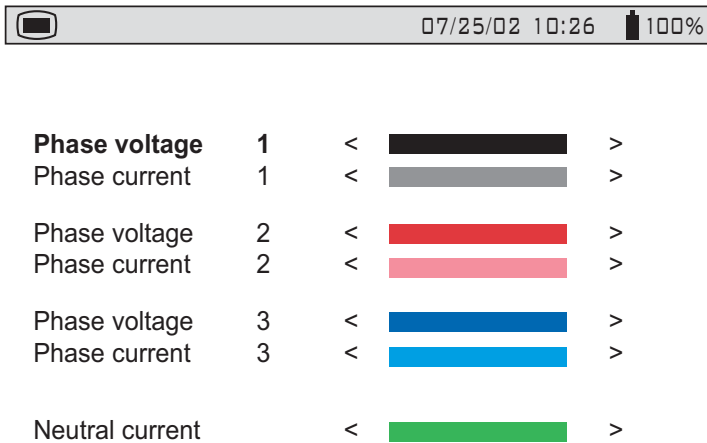
Figure 4-2

• Choose the phase with the ⇕ buttons and the color for that phase with the ◁▷ buttons.

• Press the ⬎ button to apply the new settings. The Configuration menu will once again be displayed on the screen.

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.

• Press the ⬎ button to apply the new settings. The Configuration menu will once again be displayed on the screen.

4.1.5   Electrical Hookup (electrical network)

• Highlight ELECTRICAL HOOKUP with the ⊗ buttons, then press the ⊟ button. The following screen will appear:
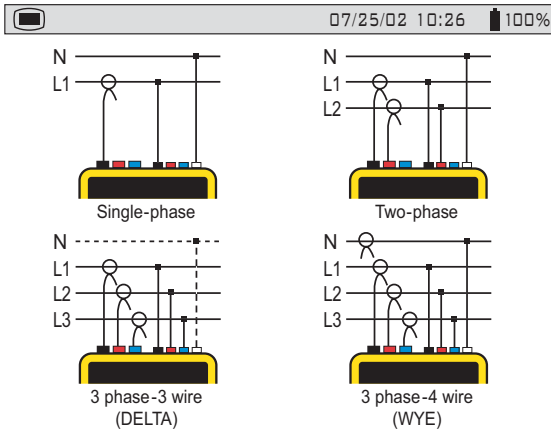
Figure 4-3

• Choose the hookup type with the ⊗ and ⊙⊙ buttons.

• Press the ⊟ button to apply the new hookup selection. The Configuration menu will once again be displayed on the screen.

Hookup Types:

> **Single or two-phase:** The neutral current is not measured or calculated.
>
> **3 phase-3 wire:**
> - DELTA network: Only power totals are representative of the actual situation.
> - WYE network: The neutral current is not calculated. It is necessary to connect neutral to obtain representative power levels per phase.
>
> **3 phase-4 wire:** The neutral current is available and its value and waveform are displayed.

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

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:

| | 07/25/02 10:26 | 100% |

200A MN clamp

C clamp

AmpFLEX

PAC clamp

Adapter   1000 / 5A

① ② ③
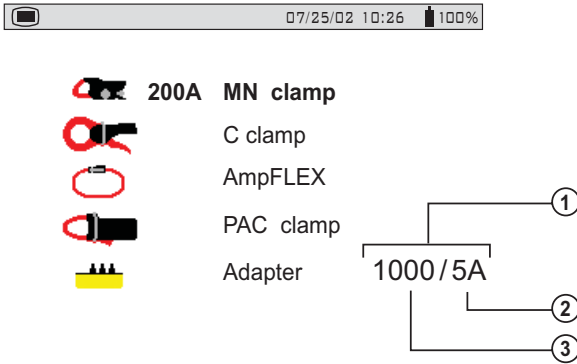
Figure 4-4

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 posistion 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.

NOTE: 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: 300, 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.

4.1.8   Recording

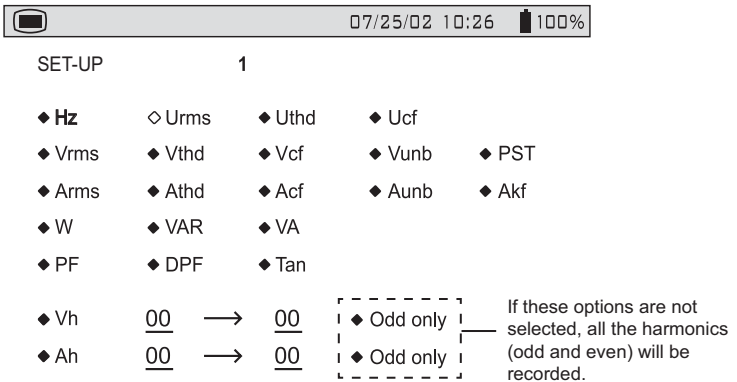- Highlight RECORDING with the ⊠ buttons, then press the ⊟ button.

  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.

⚠ **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, do not turn the instrument OFF/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.

4.1.9 Alarm

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

The following screen will appear:

| 07/25/02 10:26 | 100% |

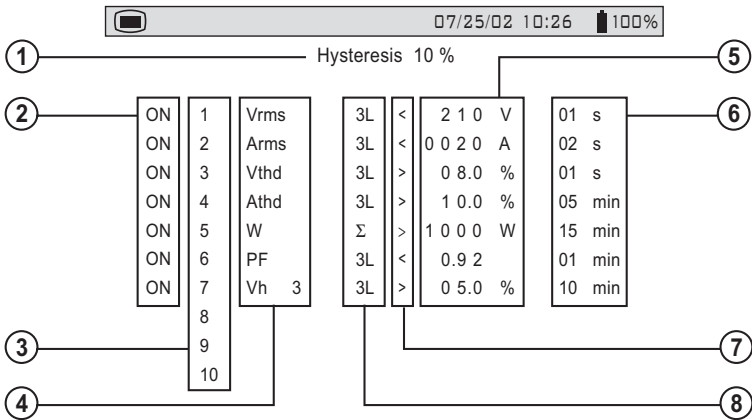|							
ON	1	Vrms	3L	<	2 1 0	V	01 s
ON	2	Arms	3L	<	0 0 2 0	A	02 s
ON	3	Vthd	3L	>	0 8.0	%	01 s
ON	4	Athd	3L	>	1 0.0	%	05 min
ON	5	W	Σ	>	1 0 0 0	W	15 min
ON	6	PF	3L	<	0.9 2		01 min
ON	7	Vh 3	3L	>	0 5.0	%	10 min
	8						
	9						
	10						

Figure 4-6

⚠ **A programmed alarm must be set to "ON" to function properly** (general activation or deactivation of alarms is generated in the ⌂ 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%)

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/3 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).

NOTE: 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.

NOTE: 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.

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

4.1.11 Line Frequency

Rated frequency of network: 50 or 60Hz

> ⚠ **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
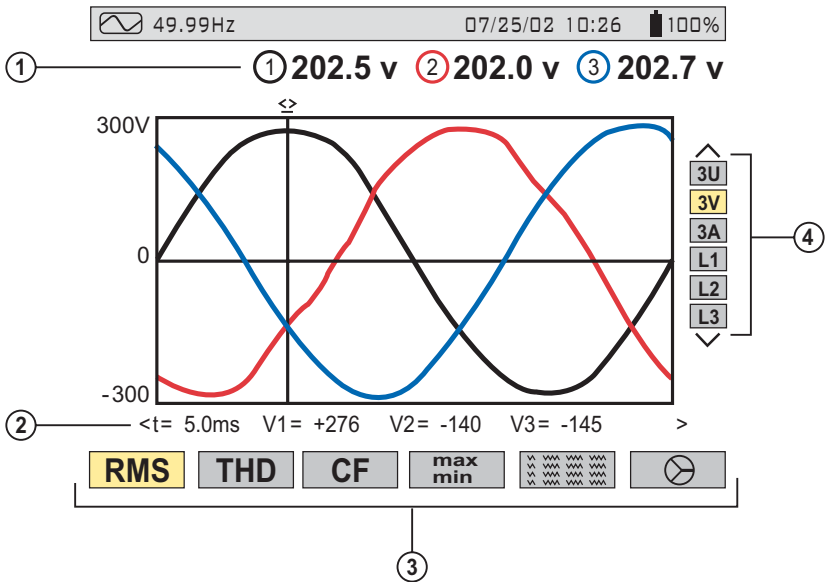
Figure 5-1

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, 3A, 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
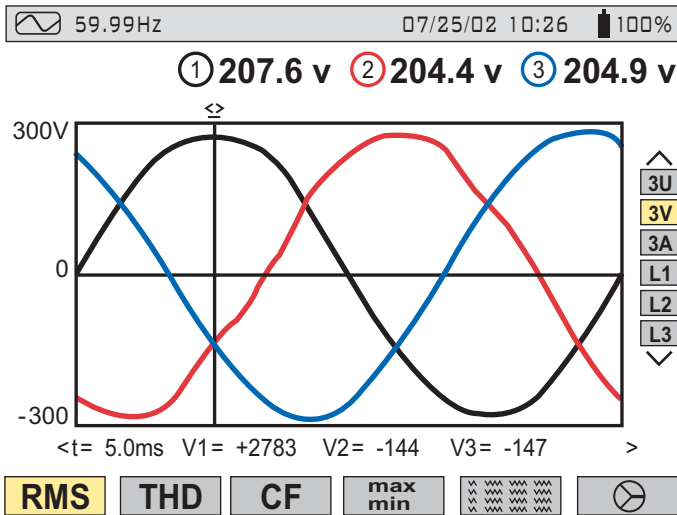
Figure 5-2

5.1.3 RMS Current Measurement on the 3 Phases and Neutral Current of a Three Phase-4 Wire System
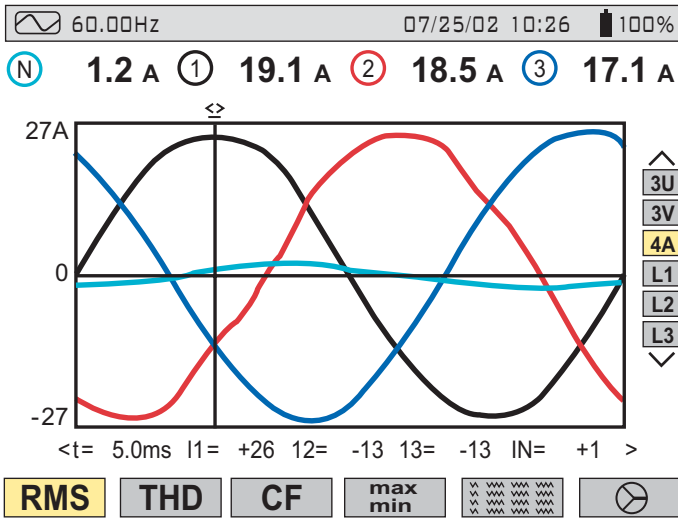
Figure 5-3

5.1.4 Total Harmonic Distortion Measurement on One Phase
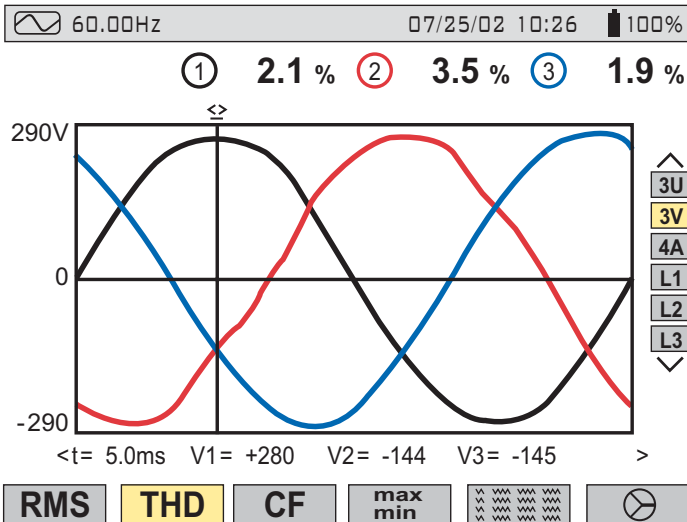
Figure 5-4

5.1.5　Minimum and Maximum Current Value Measurements

	①	②	③	Ⓝ	
MAX	**21.7**	**18.8**	**17.6**		A≃
AVG	**6.3**	**18.5**	**17.1**	**15.0**	A≃
MIN	**0.0**	**0.0**	**0.0**		A≃
PEAK+	**+11.4**	**+25.8**	**+24.0**		A
PEAK-	**−11.0**	**−25.8**	**−24.8**		A

| RMS | THD | CF | max min | | ⊘ |
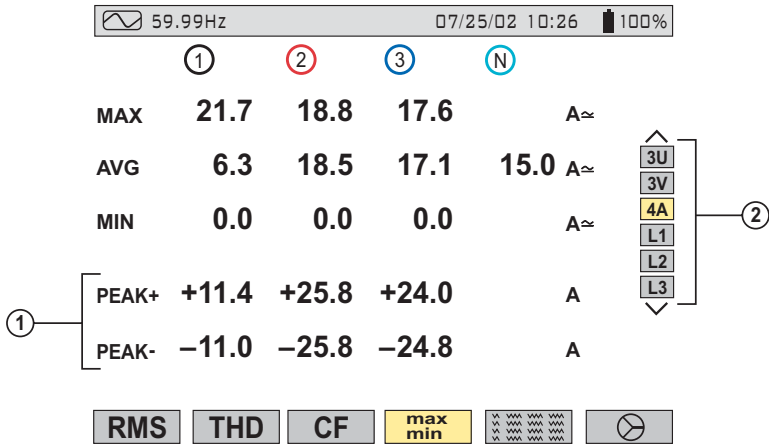
Figure 5-5

① Crest Factor - refreshed every 250ms

② Select 3V or 4A with ⟱ 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.

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

5.1.6　Simultaneous Display of the Different Current Measurements

	①	②	③	Ⓝ	
RMS	**10.4**	**18.4**	**16.9**	**11.6**	A≃
DC	**+0.0**	**+0.0**	**−0.3**	**−0.3**	A≃
THD	**27.7**	**3.0**	**1.6**		%
CF	**1.61**	**1.40**	**1.45**		
KF	**1.92**	**1.03**	**1.00**		
DF	**25.9**	**2.9**	**1.5**		%

| RMS | THD | CF | max min | | ⊘ |
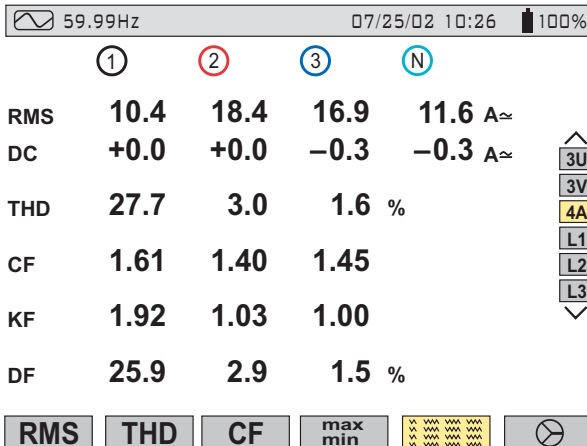
Figure 5-6

NOTE: K factor is only available when current (4A, 3A or 2A depending on hook up) is selected from the choices on the right side of the screen. Flicker is only available when voltage (3V or 2V depending on hook up) is selected from the choices on the right side of the screen.

Flicker and K factor are available when L1, L2 or L3 are 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 (Fresnal Diagram)
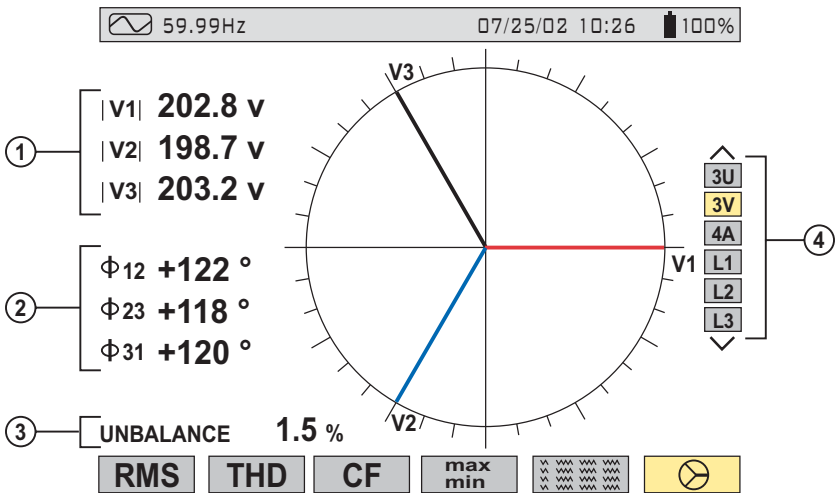
Figure 5-7

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 current (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.

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
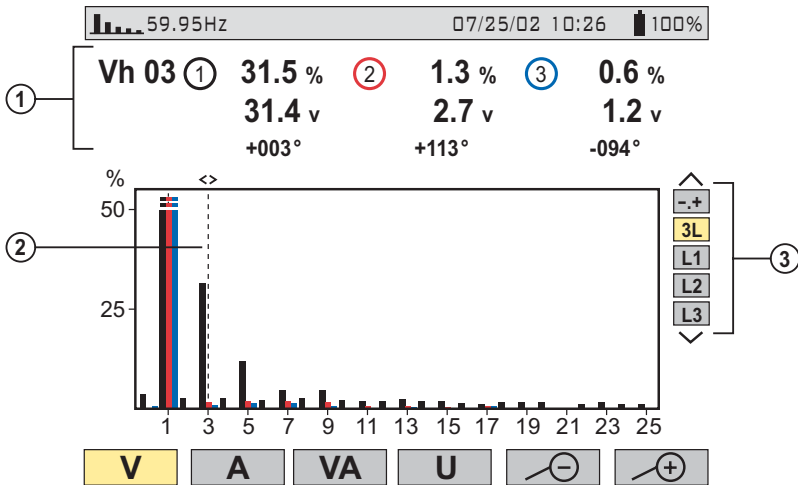
Figure 5-8

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
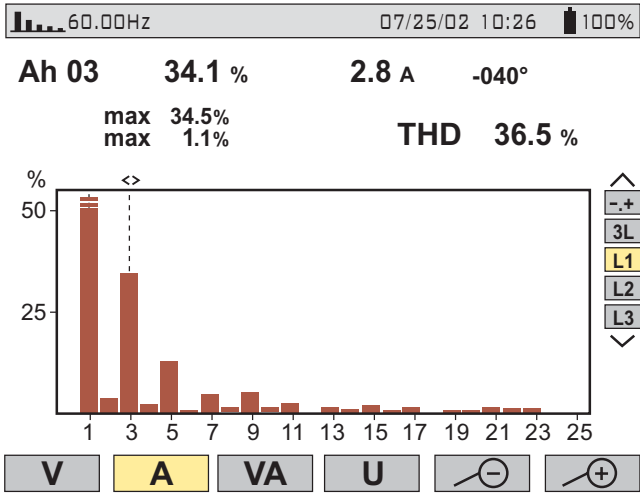
Figure 5-9

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
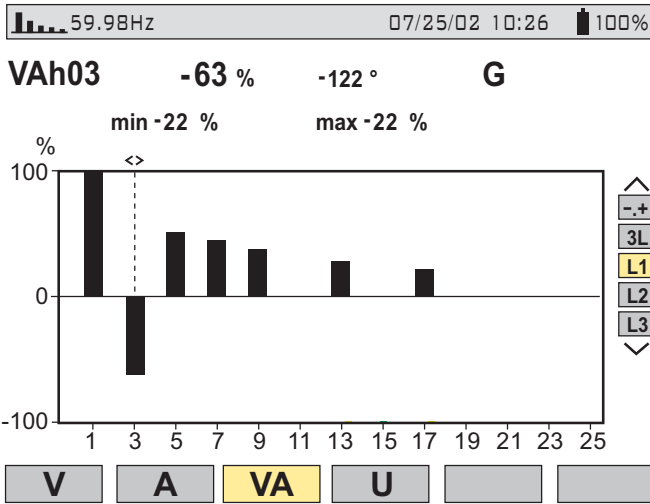
Figure 5-10

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.

NOTE: 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.

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:
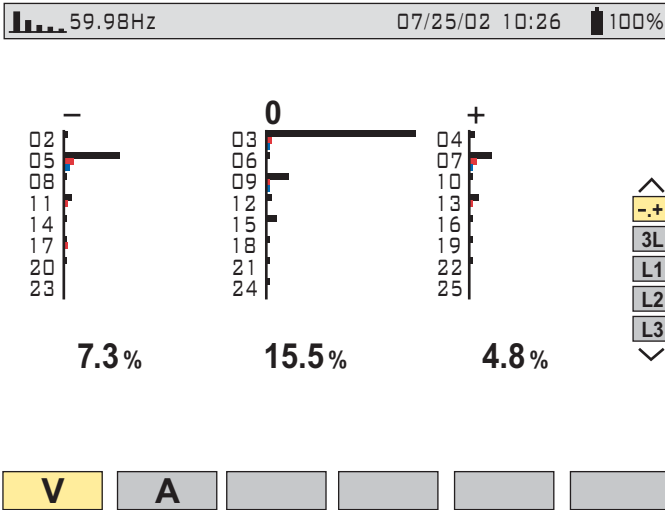
Figure 5-11

- **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 contest is useful to evaluate the influence of harmonics causing heating of the neutral or on rotating machines can be analyzed.

5.3   Power / Energy Mode W

Press the power display mode button - W

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	$\frac{W}{VA}$
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
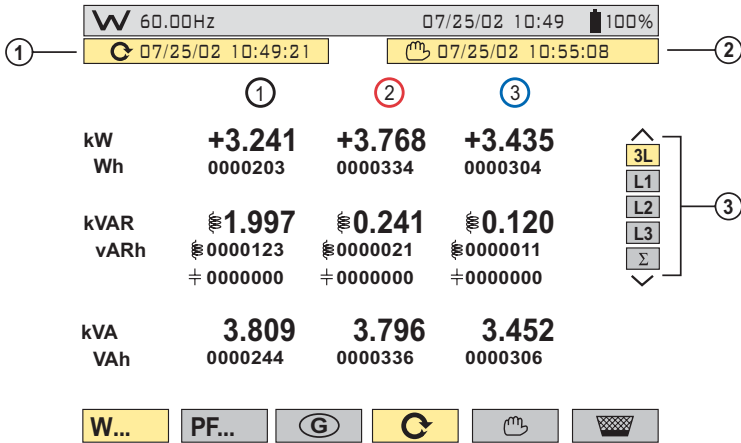
Figure 5-12

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.

NOTE: 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 aggregation.

5.3.2 Ⓖ 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 Ⓖ 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.

	①	②	③
Power Factor —— **PF**	**0.634**	**0.998**	**0.995**
DPF or Cosine φ —— **DPF**	**0.742**	**0.999**	**0.999**
Tangent φ —— **Tan**	**-0.439**	**+0.050**	**+0.035**
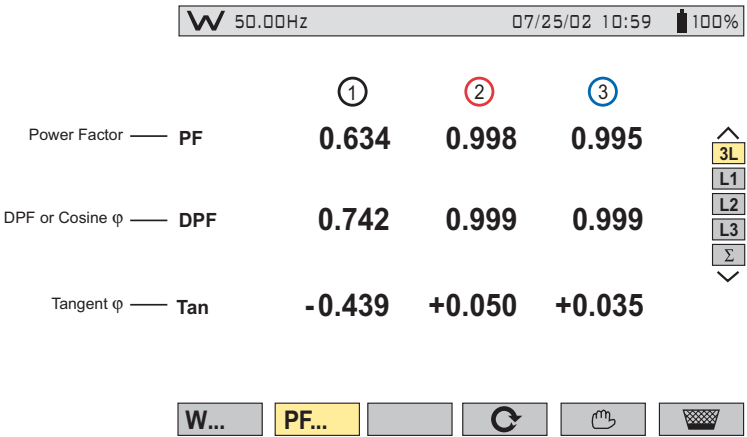
Figure 5-13

Four Quadrant Power Diagram:
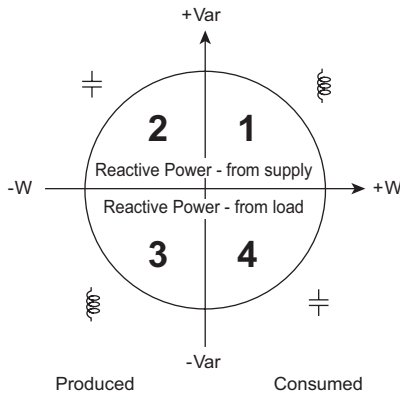
Figure 5-14

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.

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

| ⌐Ⓜ | | 07/25/02 10:54 | ▌100% |

SEARCH FOR NEW TRANSIENTS

SLOTS AVAILABLE   **50**

①

| START | : 07/25/02 10:55 |
| END | : 07/25/02 10:55 |

②

| V threshold | : 1 % |
| A threshold | : 1 % |

③

| Number | : 1 |
| NAME | : T E S T_ |
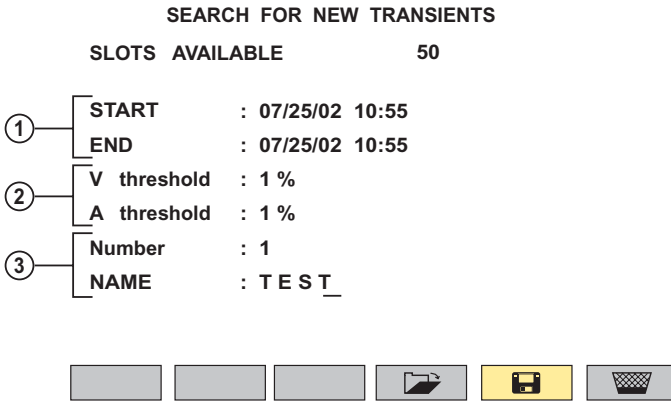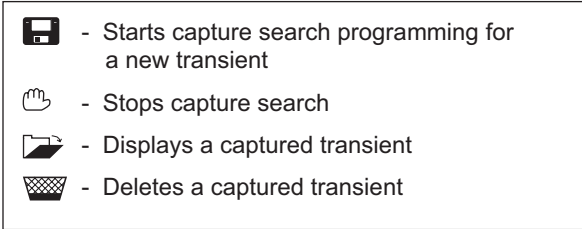
Figure 5-15

① Transient recording start and end time.

② Trigger threshold: selection of 1%, 2%, 5%, 10%, 20%, 50%, 100% 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%
MN clamp	200A	100A	40A	20A	10A	4A	2A
SR clamp	1000A	500A	200A	100A	50A	20A	10A
AmpFlex™	2900A	1400A	580A	290A	140A	58A	29A
MR clamp	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.

```
┌──────────────────────────────────────────────────────┐
│ ⊟∿      ▐████████▌              07/25/02  10:56  ▮100% │
└──────────────────────────────────────────────────────┘
```
①

SELECTION OF TRANSIENT

TEST 05	**05/07/02**	**14:31:41**
TEST 04	05/07/02	14:31:41
TEST 03	05/07/02	14:31:21
TEST 02	05/07/02	14:31:04
TEST 01	05/07/02	14:31:04

②   ③

```
┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐ ┌──────┐
│      │ │      │ │      │ │  ➦  │ │  💾  │ │  🗑  │
└──────┘ └──────┘ └──────┘ └──────┘ └──────┘ └──────┘
```
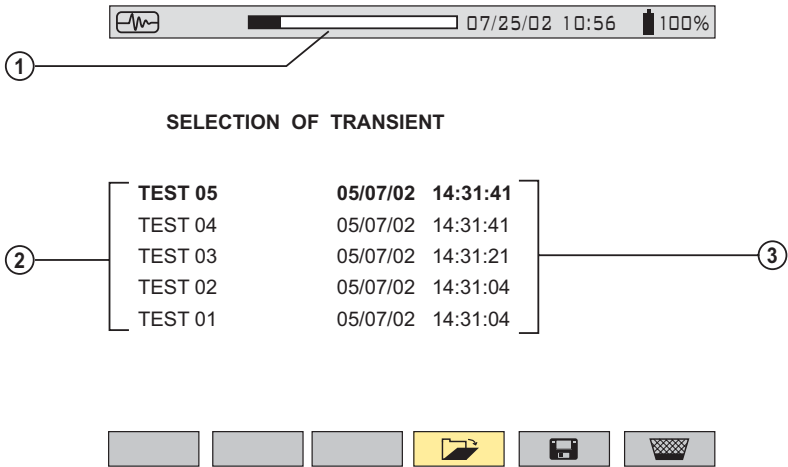
Figure 5-16

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.
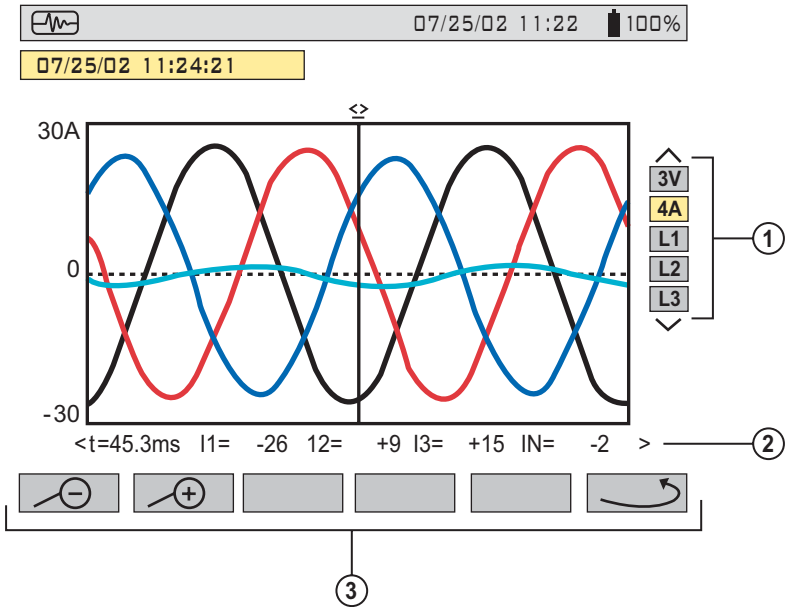
Figure 5-17

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.

NOTE: 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.

> ↻ - Starts alarm capture
> ✋ - Stops alarm capture
> 🗑 - Deletes all stored alarms

① Alarm memory status bar

⌂	▬▬▭▭▭▭▭▭▭	07/25/02 11:27	100%		

②   ④

< 17/04/01

11:27	L1	Vthd	23.1%	2s
11:28	L1	Vrms	0V	$1s24\frac{1}{100}s$
	L1	Vthd	34.3%	1s
	L1	Vthd	35.0%	1s
	L1	Arms	1A	$1s5\frac{1}{100}s$
	L2	Arms	1A	$1s3\frac{1}{100}s$
11:29	L1	Arms	0A	$1s9\frac{1}{100}s$
	L2	Arms	0A	$1s9\frac{1}{100}s$
	L3	Arms	0A	$1s8\frac{1}{100}s$
	L1	Vrms	109V	$3s37\frac{1}{100}s$
	L1	Vthd	35.1%	3s

3L
L1
L2
L3
Σ

③   2/2   ⑤

[ ] [ ] [ ] [↻] [✋] [🗑]
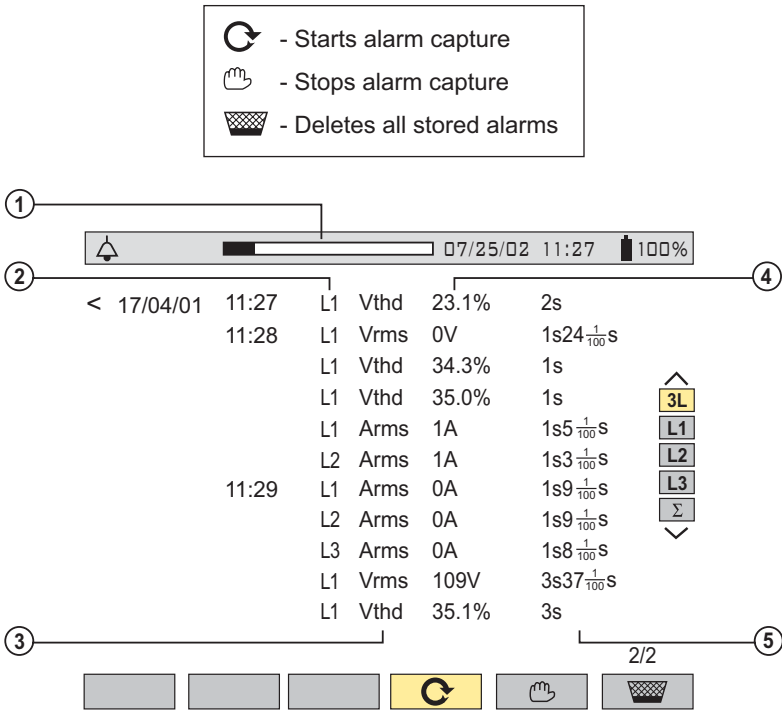
Figure 5-18

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.**

5.6 Recording Mode 〔oo〕

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 - 〔oo〕

The variable function buttons have the following functions in this mode:

> 🖫 - Creates a new recording
>
> 📂 - Opens a previous recording
>
> 🗑 - Deletes recording
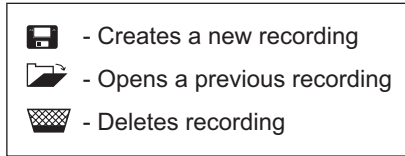
5.6.1 Saving the Selected Parameters
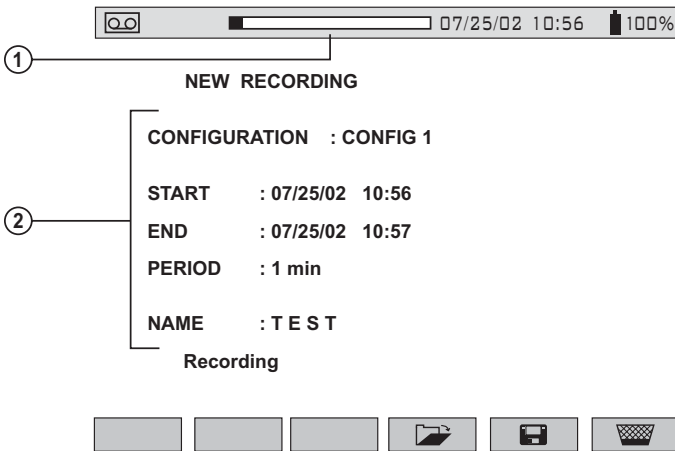
Figure 5-19

① Recording status bar (displays remaining memory capacity).

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

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

  - Select the dates with the ⟨ꞎ⟩ buttons.

  - Select a recording storage rate using the ⟨ꞎ⟩ buttons.

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

  - Save the changes with the ⟨◁⟩ button.

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

5.6.2 Selecting or Deleting a Record

| ᗧᗧ | ▬▬▬▬▬▭ 07/25/02 10:56 | ▌100% |

SELECTION OF RECORDING

TEST	**07/25/02**	**17:58**	**> In progress**
PUMP	07/18/02	17:58	> 07/18/02 11:45
MOTORA	07/12/02	14:41	> 07/12/02 16:40

| | | | ➦ | 💾 | 🗑 |

Figure 5-20

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 any of the following:
- the current date
- the current time
- the set storage rate

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

NOTE: 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.
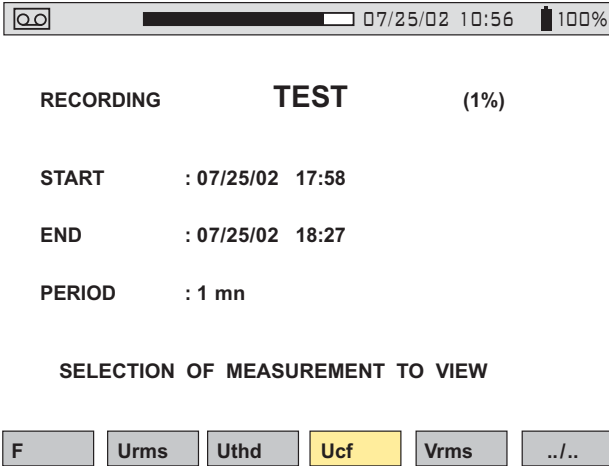
Figure 5-21

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
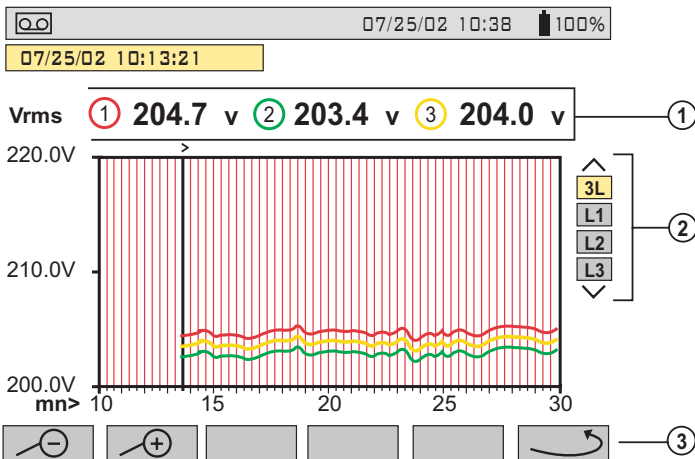
Figure 5-22

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
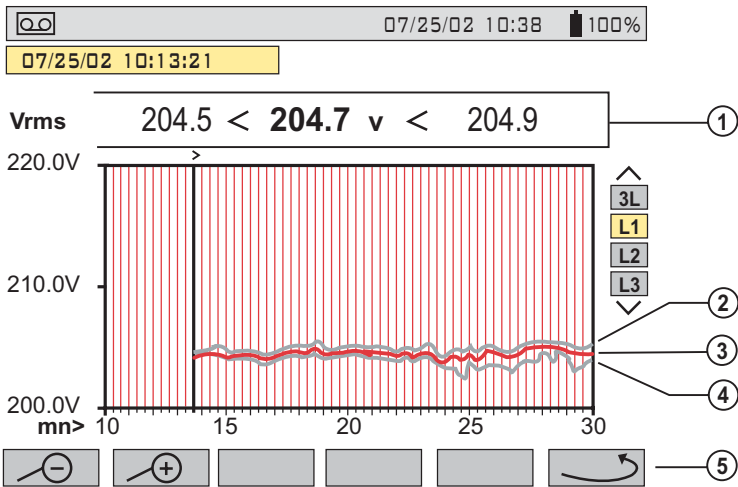
Figure 5-23

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.
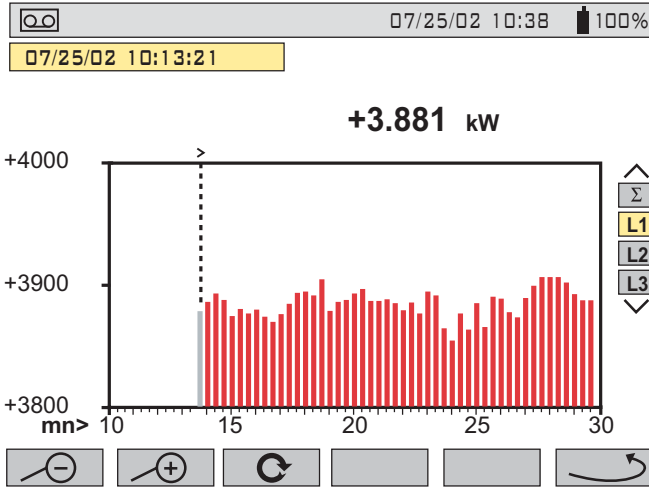
Figure 5-24

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.

NOTE: Hold the cursor button down to switch to fast forward.

Energy Measurement for a Determined Period
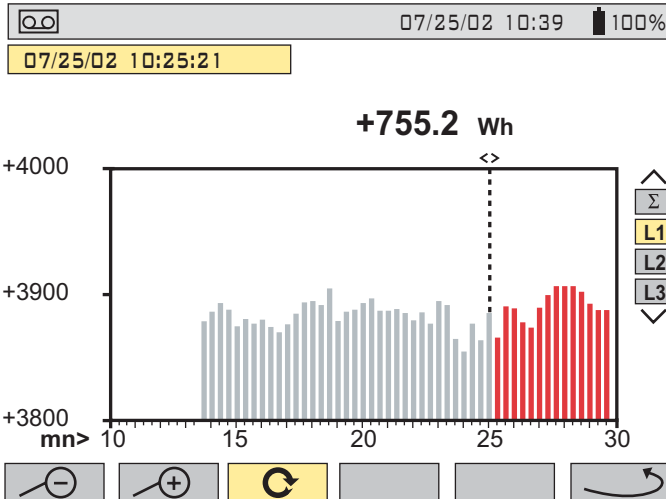
Figure 5-25

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

- Move the cursor to the start time.

- Press the $\mathcal{C}$ function button.

- Move the cursor with $\langle\rangle\langle\rangle$ 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.

NOTE: All data in a recording session can be downloaded to a PC using the DataView® software.

The $\bigoplus$ and $\bigominus$ 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.

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.

NOTE: These screens can be downloaded to a PC via 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.
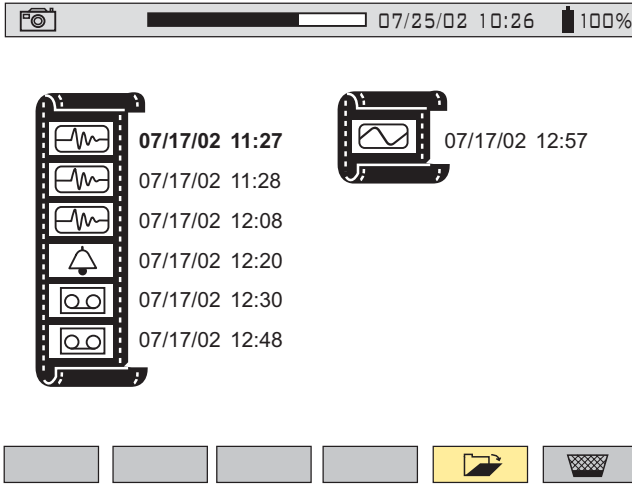
Figure 5-26

- 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.

5.9   Printing 🖶

The print button allows a screen to be printed directly to a dedicated printer connected to the serial port.
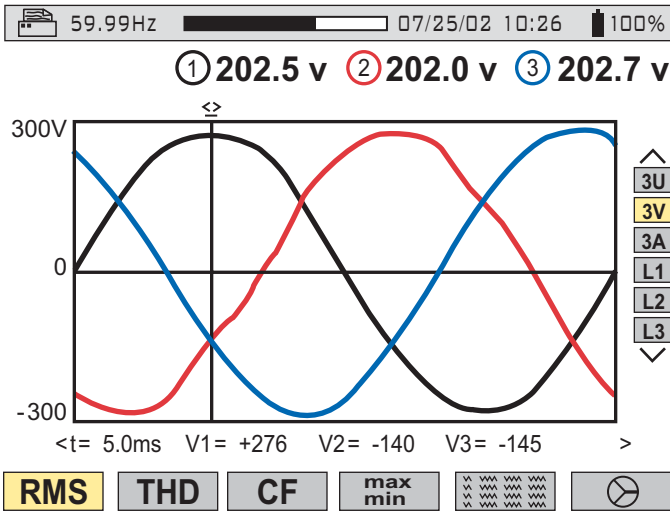
Figure 5-27

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.

⚠️ **To stop the printing in progress** (e.g. in the event of an error), press the 🖶 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.

CHAPTER 6

USING DATAVIEW® PRO

6.1 Introduction

The DataView® graphing and analysis program is a full function Windows® based application software package.

It provides you the ability to configure and run any test or recording from the computer as you can from the instrument itself.

Additionally, it enhances the information captured for snapshots as it captures all the information to display and report waveforms, and harmonic spectrums of the data captured.

DataView® includes several pre-defined templates for reporting and printing reports, as well as the ability for you to totally customize the reports to meet your exact needs.

This chapter will give you the information you need to know to use this program. More extensive information on specific functions available in DataView® is available in the online help system included with the software.

The DataView® Program supplied with the Model 3945 PowerPad™, provides four main functions:

1. The ability to configure the PowerPad™ from the computer.

2. The ability to initiate a recording test from the computer.

3. The ability to store test results and print out reports of any test.

4. The ability to view and store real-time data.

DataView® software is a copyright of Chauvin Arnoux®, Inc. d.b.a. AEMC® Instruments

6.2   Features

The DataView® Program has a simple, easy-to-use interface for configuring and running tests with the Model 3945 Power Quality Analyzer, as well as printing reports of the test results. There are many features that are available through this program. A few of the most popular are listed below.

Key Features:

- Configures and displays all functions of the Model 3945

- Runs tests from your computer with a simple click and execute process

- Views and captures data in real time

- Retrieves data from the instrument's memory

- Plots graphs of recorded information that has been downloaded

- Presents reports, including your analysis in the comments section

- Stores a library of setups for different applications

- Provides consistency in testing, regardless of who performs the test

6.3   Getting Started

The DataView® Program is supplied on a CD-ROM format. The CD is simple to use and will self-install, prompting you along the way for any information that is needed. Simply insert the CD in your CD-ROM drive and follow the on-screen instructions.

6.4   Minimum Computer Requirements

- Windows 95/98/2000/ME/XP or Windows NT 4.0

- 32MB of RAM (128MB recommended)

- 35MB of hard disk space (200MB recommended)

- CD-ROM drive

6.5 Connecting the Model 3945 to your Computer

The Model 3945 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 to your computer:

1. Connect the optical connector end of the cable to the serial port on the side panel of the Model 3945 PowerPad™.

2. Connect the 9-pin connector end of the cable, to an available serial port on your computer.

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

6.6 Starting DataView®

Once the serial connection between the computer and the Model 3945 has been completed, start the DataView® program.

To start DataView®:

1. Double-click on the DataView® icon on your desktop, or select it using the Start menu and Programs selection from the pop-up menu that appears.

2. Select DataView® and click on DataView® Pro in the menu that opens.

After the program is loaded and the Title Screen appears, a Quick Start dialog box will open as shown in Figure 6-1 on the next page.

☞ **TIP:**

Right-Clicking on any field in a dialog box will open a Help file with detailed descriptions and instructions for that specific function.
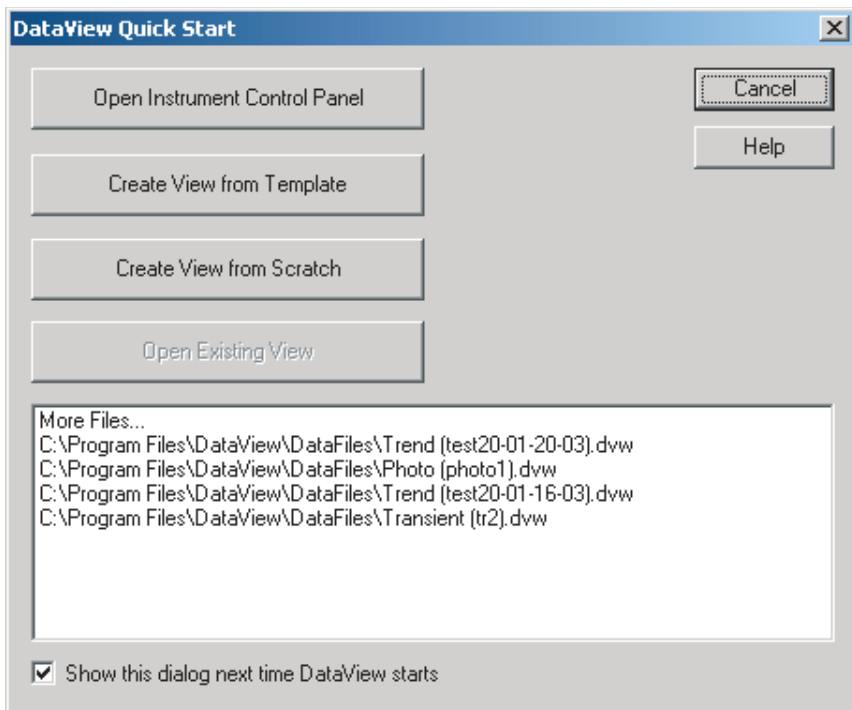
Figure 6-1

The Quick Start Dialog Box contains the following options:

- **Open Instrument Control Panel:** Facilitates creation of a configuration for the PowerPad™.

- **Create View from Template:** Facilitates creation of a printable report from existing data already stored on the computer or from previous downloads.

- **Create view from Scratch:** Loads a blank sheet onto the screen, which allows you to manually create a view from an existing database.

- **Open Existing View:** Opens a previously created view. A file previously stored must be selected before this button becomes active**.**

6.7   Configuring the Instrument

To configure the instrument, perform the following steps.

1. Click the **Configure Instrument** button. A dialog box will open, allowing you to select the Communication Rate (baud rate) and the Communications Port (serial port) for communicating with the PowerPad™.
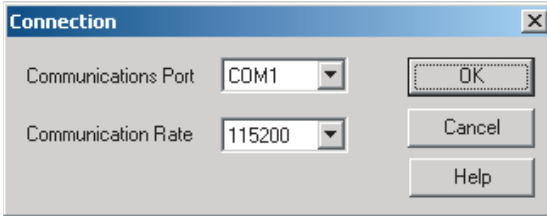
Figure 6-2

2. 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 arrow and select the proper port.

3. The Baud Rate needs to be set at the same rate as the Model 3945. You may select the baud rate, if necessary, by clicking on the drop down arrow in the Baud Rate window and selecting from the available values.

   To check the baud rate on the instrument:

   • Turn on the Model 3945 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

4. Once the proper communication parameters have been specified, click on OK.

NOTE: The instrument must be configured for the same communications rate specified in Figure 6-2. If it is not, then you must either select the corresponding rate or change the instrument's rate.

When a serial communication link is established, the DataView® program will automatically identify the instrument that it is connected to. A status screen will then appear as shown in Figure 6-3.
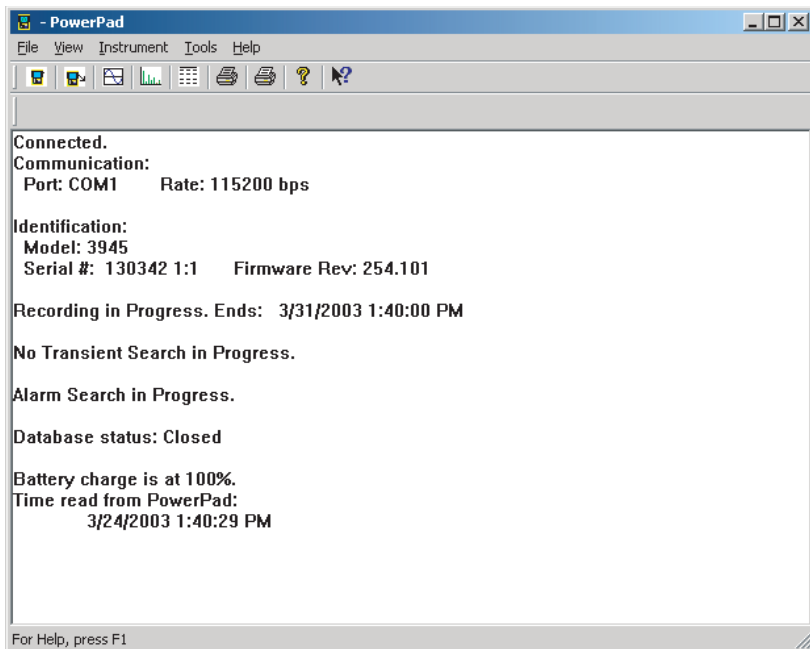
Figure 6-3

This screen shows:

- The status of PowerPad™.

- If DataView® is connected to the PowerPad™

- The communications port and speed of the connection.

- The model number, serial number, and firmware revision.

- If a database is open, and if so, its name, 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.

NOTE: 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 its battery charge.

6.7.1   General Functions

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

- **Re-Read from PowerPad:** Reads the current configuration of the Power-Pad™ 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.

6.7.2   Set-up Configuration

The Setup dialog box (Fig. 6-4) lets you configure every aspect of the Model 3945 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.
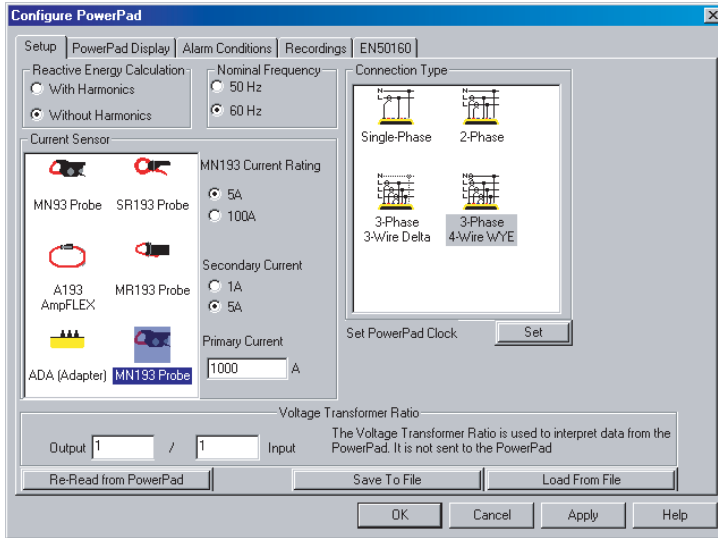
Figure 6-4

*   **Reactive Energy:** with or without harmonics

*   **Line Frequency:** 50 or 60Hz

*   **Current Sensors to be used:** MN93, MN193, SR193, MR193, AmpFlex A193 or Adaptor (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 Delta or Three phase-4 wire WYE

*   **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.

*   **Set PowerPad Clock:** Programs the computer's time and date into the configuration of the PowerPad™.

6.7.3 PowerPad™ Display Configuration

The PowerPad Display window (Fig. 6-5) allows you to customize the PowerPad™ display (colors, clocks, language and contrast).
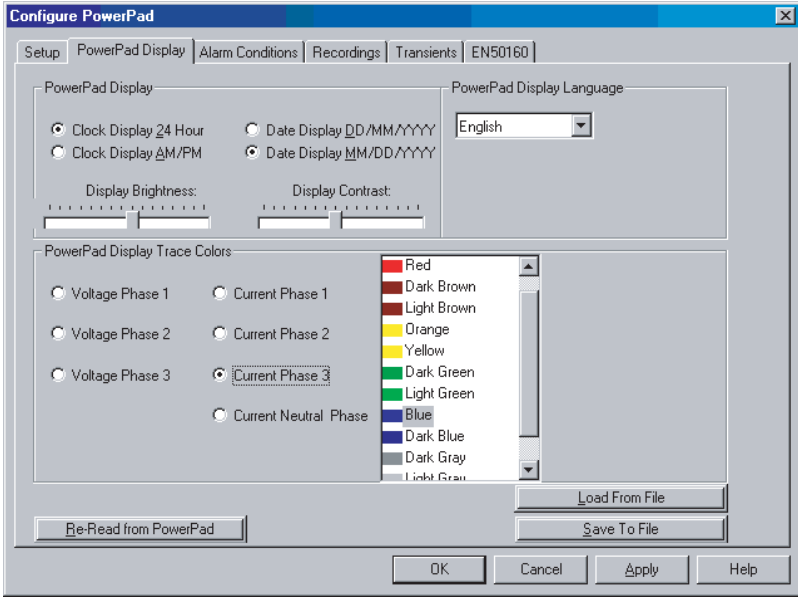
Figure 6-5

NOTE:

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

6.7.4   Alarm Conditions Configuration

The Alarm Conditions window allows you to set up 10 alarm configurations.
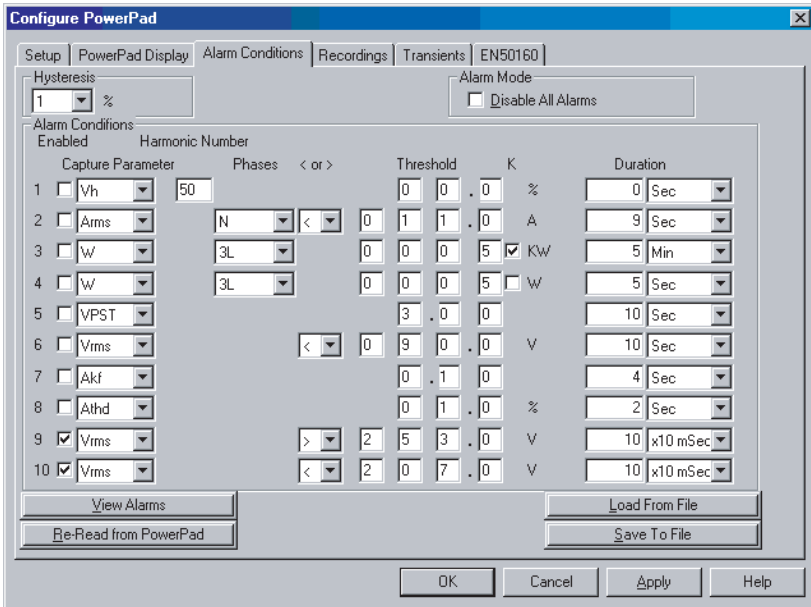
Figure 6-6

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.

Disable All Alarms: When this box is checked, all alarms will be disabled even if the individual alarm enable box is checked.

Enabled: When check box is checked, alarm is enabled.

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

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.

Disable All Alarms: This check box prevents any alarms from being captured. **Make sure this is not checked if you want to record alarms.**

View Alarms: This button allows you to view a list of all the alarms already recorded and downloaded to DataView®.

NOTE: You can check for alarms and record at the same time.

6.7.5   Recordings Configuration

The Recording window shows the dialog box used to configure the parameters for a recording session.
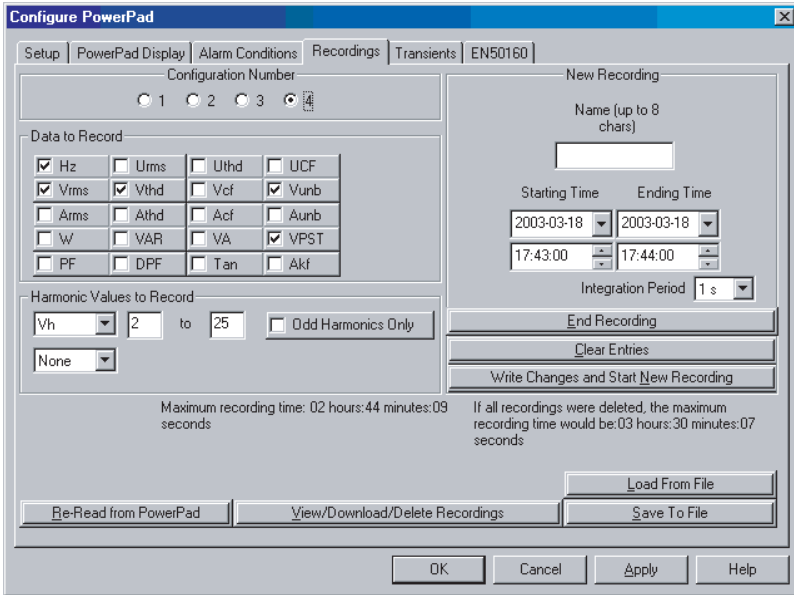
Figure 6-7

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 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".

End Recording: Ends any recording in progress or any future recording.

Clear Entries: Clears the data entered in the new recording window. It does not cause any changes to the PowerPad™.

Write Changes and Start New Recording: Causes the PowerPad™ to schedule a new recording. The PowerPad™ loses its scheduled memory 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 were requested, and the start time was 9:03, the recording might not actually begin until 9:10.

6.7.6 Transients Configuration

The Transients window allows you to set up the criteria for capturing transients.
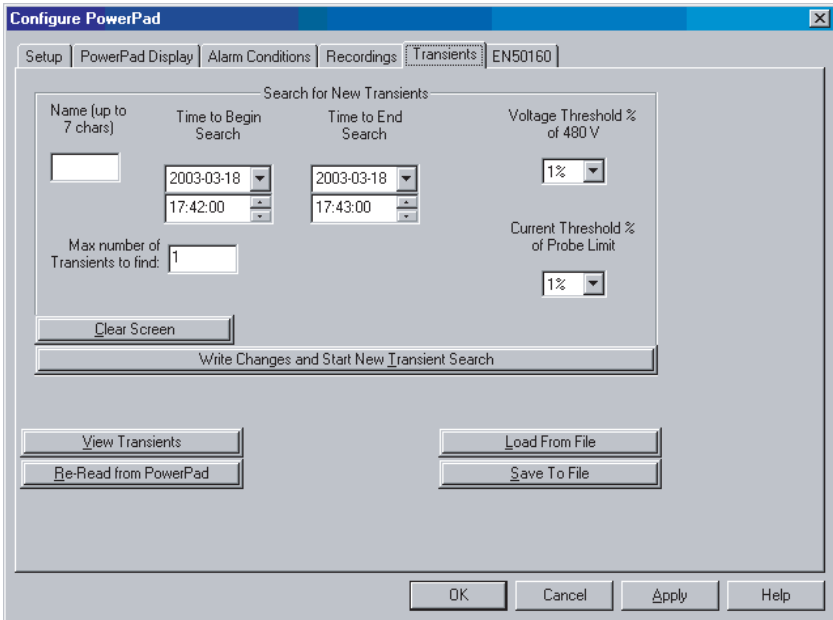
Figure 6-8

1. Type a name for the session, up to seven characters.

2. Select the date and time to end the search for transients.

3. Select the percent deviation for voltage and current transients. The choices available from the drop down window 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).

Clear Screen: Clears the fields that were already entered for a new transient search. This button doesn't cause any changes on the PowerPad™.

Write Changes and Start New Transient Search: Initiates searching from new transients when the **OK** or **Apply** button is pressed.

View Transients: View the PowerPad's stored transients. Download and delete transients options are also available.

6.7.7 EN50160 Configuration

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.
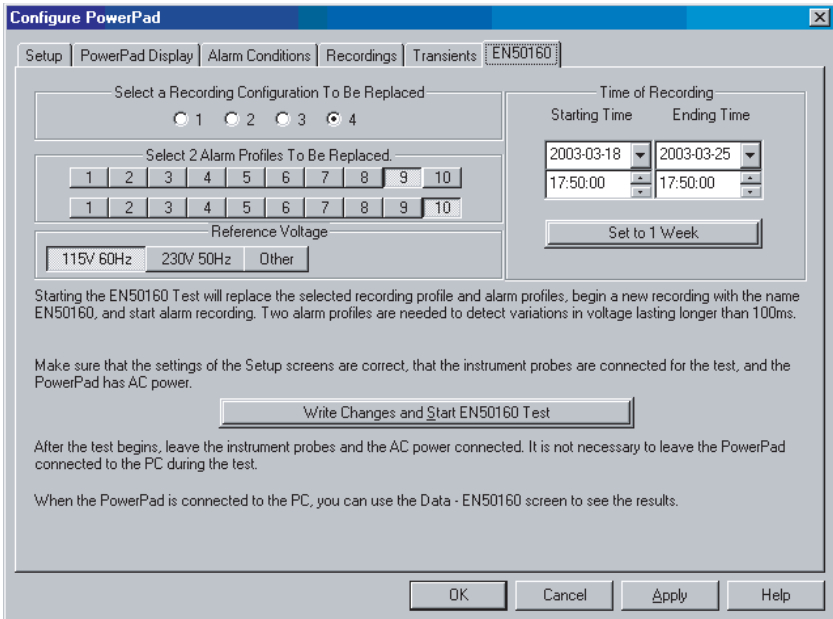
Figure 6-9

Configure and start an EN50160 test of line quality. It is recommended that a brief test of 10 minutes or longer 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 setup and run this special test. Press the Help button for further instructions.

6.8   Running the Test

After configuring the instrument, press **"OK"**. The status window will display if a recording is ready to start..

Download: Retrieves data from the memory of the PowerPad™ for storage in the computer.

6.9   Real Time Windows

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

6.9.1   Waveform, Harmonic Bar and Harmonic Text
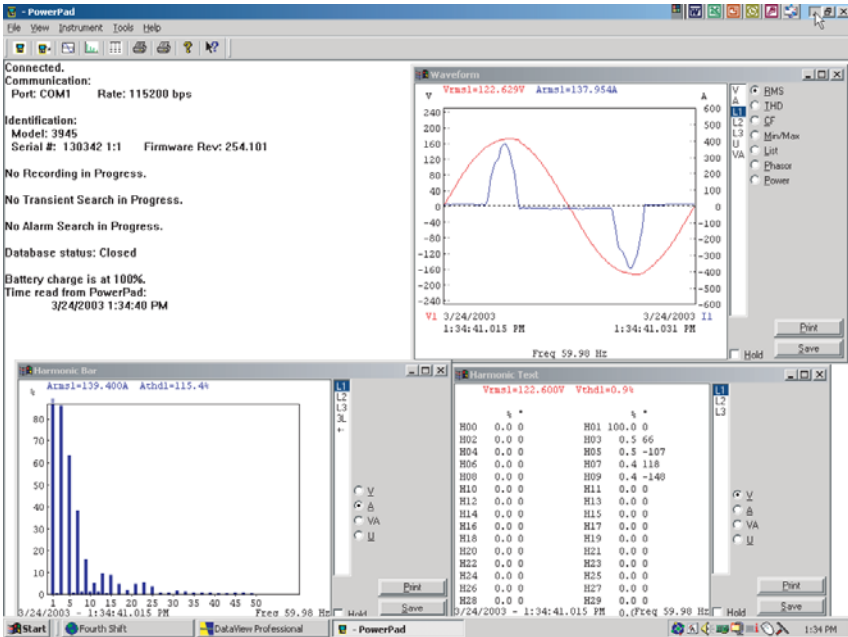
Figure 6-10

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.

6.10 Downloading Data to Database

From the **Instrument menu**, select **"data"** to download the data recorded to the PowerPad™.

1. Select the data you want to Download by clicking on the desired tab (Recordings, Photographs, Alarms, Transients, Power/Energy, EN50160), then clicking on the file name.

2. Select **"Download to Database"** (this may take few minutes).

3. Type a name for the file downloaded and click **"OK"**.

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

6.10.1 Photographs
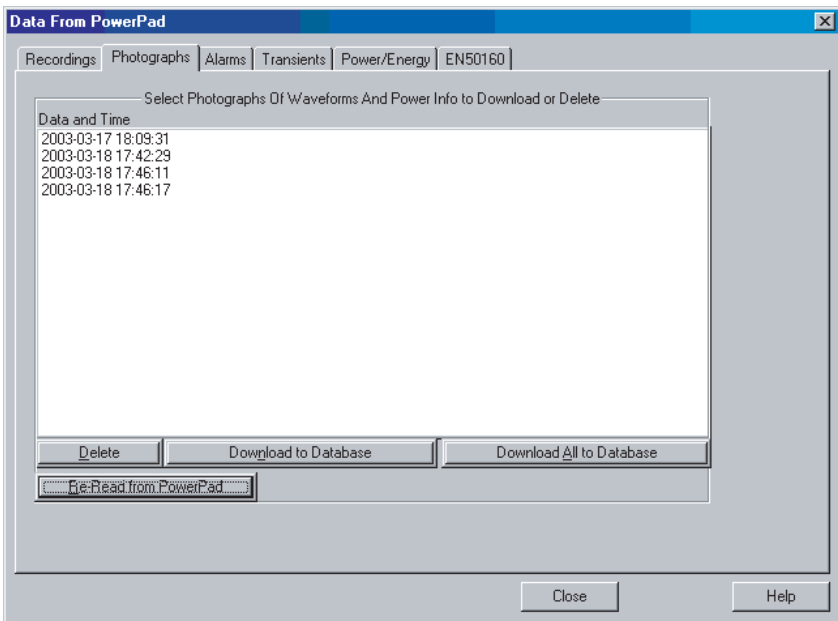
Figure 6-11

The Photographs window displays a list of photographs taken on the PowerPad™. It shows the date and time when the camera button was pressed.

When **"Download to Database"** is selected it shows the waveforms and power data from the time the camera button was pressed.

NOTE: Snapshots can only be initiated using the 📷 button on the PowerPad™ itself, not by DataView®.

6.10.2 Alarms
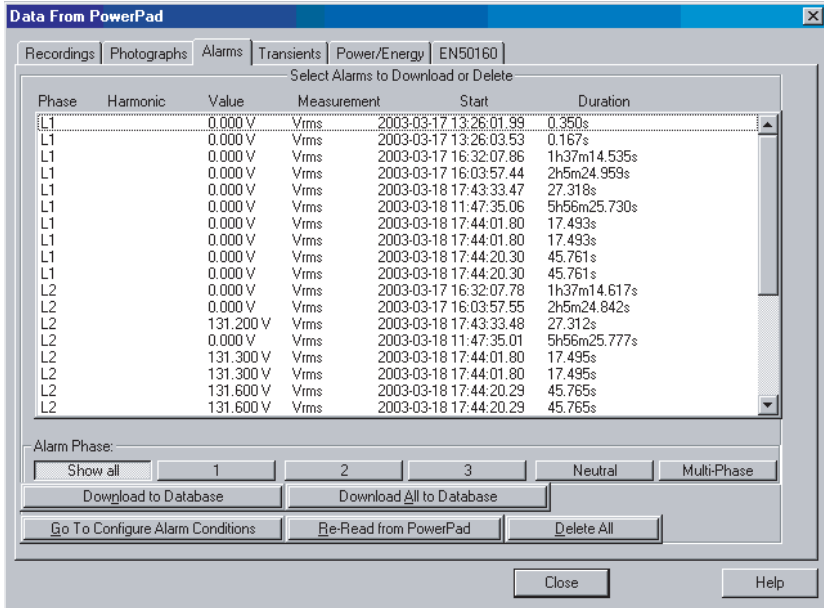
Figure 6-12

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).

6.10.3 Transients
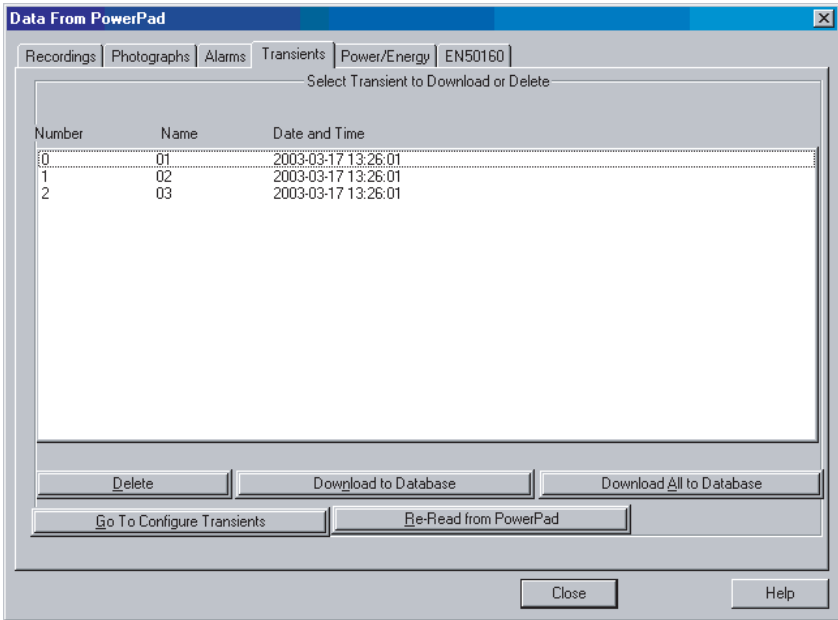
Figure 6-13

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.

The downloaded result contains four waveforms. The triggering event is contained in the second waveform, and within the first 32 samples of the 256-sample waveform.

6.10.4 Power/Energy
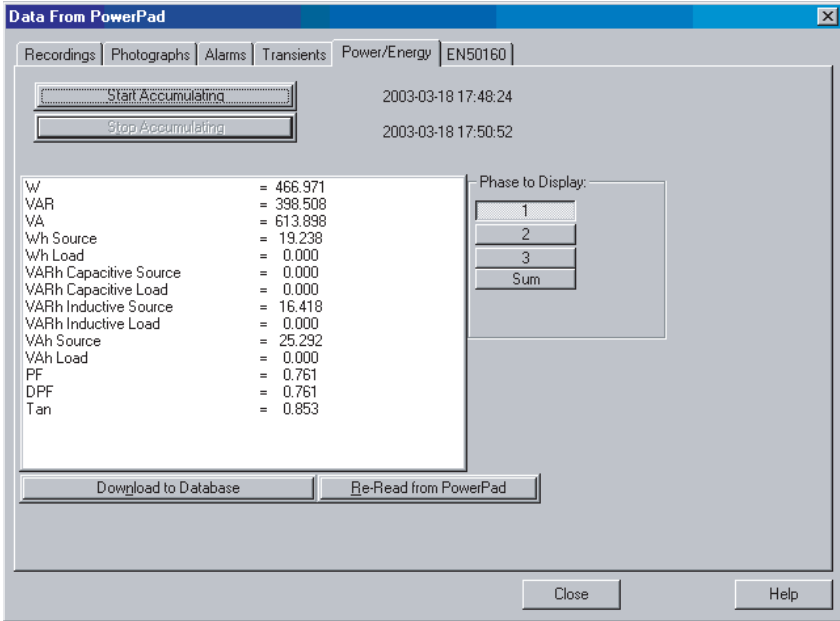
Figure 6-14

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

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

NOTE: The data for all available phases are downloaded to a database, not just that shown on the screen.

6.10.5 EN50160
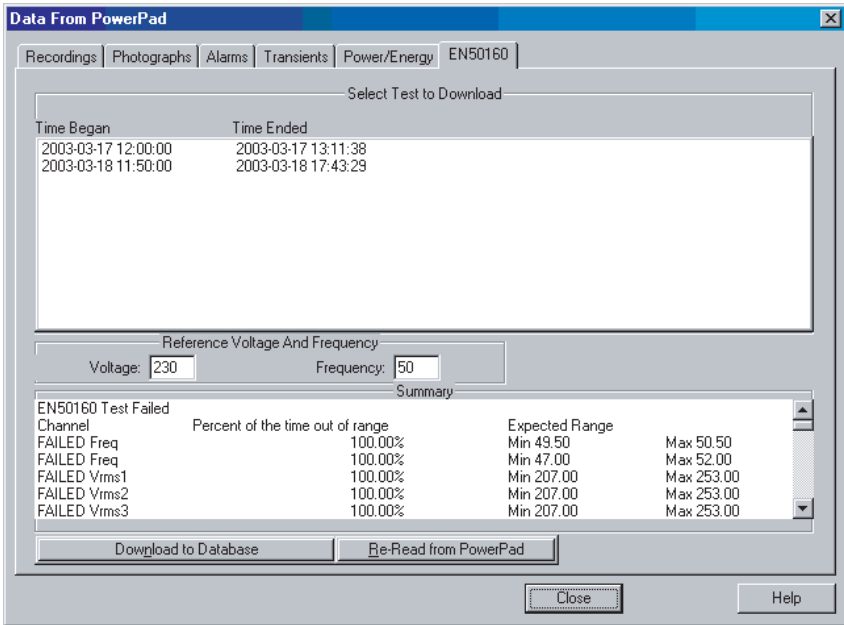
Figure 6-15

The EN50160 window displays recorded tests that can be downloaded and analyzed.

The summary window shows 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.

6.10.6 Session Properties

After downloading the data that is selected, the Session Properties window will open (see Figure 6-16), which consists of the following:

- **Operator Information:** Information associated with the person and company conducting the test.

- **Site Information:** Information about the site itself.

- **Comments:** A place where information can be typed, such as, further descriptive analysis of the test, the test results, reasons for running the test, etc.

- **Make Default:** Saves the operator information into memory so that it will automatically appear the next time. This will save time on future tests.

Power Quality Analyzer Model 3945

Figure 6-12

4. After filling in the appropriate information, close the Session Properties dialog box by clicking on the **"X"** at the top right hand corner.

5. You will then be asked if you want to open the database just downloaded. Click the "**Yes"** button, which will open a dialog box labeled **Create View from Template**.

6. In the Groups window of this dialog box, click on **"PowerPad™"** and in the Templates window click on **"PowerPad™ 3945 Summary Report"**.

7. In Step 2: Specify Database(s) window, the file you just saved and named should be visible. If this is the file you wish to generate a report from, click the **"OK"** button. The report will now be available on the screen including graph, individual data points and all statistical data.

8. To print this report, either click on the Print icon or click on the File from the top menu and then Print.

This completes the process of configuring, running, retrieving data, and printing a report using DataView® with your Model 3945 PowerPad™.

In addition to the pre-designed report templates, DataView® allows you to totally configure reports to your needs.

Refer to the DataView® Program Manual on the CD-ROM, containing the DataView® program, for complete details.

CHAPTER 7

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.

7.1 Recharging and Changing the Battery

The battery is automatically charged when the unit is connected to AC power.

⚠️ **WARNING:**

- **When changing the battery, it must be de-energized, the equipment turned off, and 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**

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

CHAPTER 8

APPENDIX

8.1 Mathematical Formulas for Various Parameters

8.1.1 Half-period Voltage and Current RMS Values

$$\text{Vdem}[i] = \sqrt{\frac{2}{NSC} \cdot \sum_{n:Zero}^{Next\,Zero} V[i][n]^2}$$ Single rms voltage half-period i + 1 phase

$$\text{Udem}[i] = \sqrt{\frac{2}{NSC} \cdot \sum_{n:Zero}^{Next\,Zero} U[i][n]^2}$$ Compound rms voltage half-period i + 1 phase

$$\text{Adem}[i] = \sqrt{\frac{2}{NSC} \cdot \sum_{n:Zero}^{Next\,Zero} A[i][n]^2}$$ Rms current half-period i + 1 phase

NSC: number of samples by cycle

n: sample (0; 255)

i: phase (0; 1; 2)

8.1.2 MIN / MAX Values for Voltage and Current

Vmax[i] = max (Vdem[i]), Vmin[i] = min (Vdem[i]), Vavg = 1/6000 Σ Vdem[i]

Umax[i] = max (Udem[i]), Umin[i] = min (Udem[i]), Aavg = 1/6000 Σ Adem[i]

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

8.1.3 Peak Values for Voltage and Current

Vpp[i] = max (V[i]][n]), Vpm[i] = min (V[i][n]), n $\in$ [0..NECHPER-1]

Upp[i] = max (U[i]][n]), Upm[i] = min (U[i][n]), n $\in$ [0..NECHPER-1]

App[i] = max (A[i][n]), Apm[i] = min (V[i][n]), n $\in$ [0..NECHPER-1]

8.1.4 Peak Factors for Current and Voltage

$$\mathrm{Vcf}[i] = \frac{\max(\mathrm{Vpp}[i], \mathrm{Vpm}[i])}{\sqrt{\dfrac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} V[i][n]^2}} \qquad \text{Peak factor single voltage } i + 1 \text{ phase}$$

$$\mathrm{Ucf}[i] = \frac{\max(\mathrm{Upp}[i], \mathrm{Upm}[i])}{\sqrt{\dfrac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} U[i][n]^2}} \qquad \text{Peak factor phase-phase voltage } i + 1 \text{ phase}$$

$$\mathrm{Acf}[i] = \frac{\max(\mathrm{App}[i], \mathrm{Apm}[i])}{\sqrt{\dfrac{1}{NSC} \cdot \sum_{n=0}^{NSC-1} A[i][n]^2}} \qquad \text{Peak factor current } i + 1 \text{ phase}$$

8.1.5 1 sec RMS values for voltage and current

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

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

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

NSS: number of samples in a second (multiple of NSAMPER)

8.1.6 Voltage and Current Unbalance

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

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

$$\mathrm{Vunb} = \frac{|\mathrm{Vrms}_-|}{|\mathrm{Vrms}_+|}, \quad \mathrm{Aunb} = \frac{|\mathrm{Arms}_-|}{|\mathrm{Arms}_+|}$$

8.1.7 THD Calculation

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

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

8.1.8 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 %: $\mod_k = \dfrac{c_k}{c_1} \times 100$ angle in degree: $\varphi_k = \arctan\left(\dfrac{a_k}{b_k}\right)$

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

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

F_s: sampled signal

c_0: DC component

k: ordinal number (spectral bin)

8.1.9 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.

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

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

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]

8.1.10 K Factor

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

8.1.11 Different Power Levels 1 sec

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

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

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

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

8.1.12 Ratios

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

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

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

$\cos(\phi[i]) = \dfrac{\displaystyle\sum_{n=0}^{NSS-1} VF[i][n] \cdot AF[i][n]}{\sqrt{\displaystyle\sum_{n=0}^{NSS-1} VF[i][n]^2}\sqrt{\displaystyle\sum_{n=0}^{NSS-1} AF[i][n]^2}}$ Cosine angle between voltage fundamental and i + 1 phase current

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

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

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

8.1.13 Various Types of Energy

$Wh[i] = \displaystyle\sum_{Tint} \dfrac{W[i]}{3600}$ Active energy i + 1 phase

$VAh[i] = \displaystyle\sum_{Tint} \dfrac{VA[i]}{3600}$ Active energy i + 1 phase

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

$VARhC[i] = \displaystyle\sum_{Tint} \dfrac{VAR[i]}{3600}$ for $VAR[i] \geq 0$ Reactive capacitive energy i + 1 phase

Wh[3] = Wh[0] + Wh[1] + Wh[2] total active energy

VAh[3] = VA[0] + VA[1] + VA[2] total apparent energy

VARhC[3] = VARhC[0] + VARhC[1] + VARhC[2] total reactive capacitive energy

VARhL[3] = VARhL[0] + VARhL[1] + VARhL[2] total reactive inductive energy

8.1.14 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 activate 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.

Swell Detection

Hysteresis = 2% Uref

Threshold of swell = 120% Uref

Level to go back = 120% -2% = 118% Uref

Swell duration
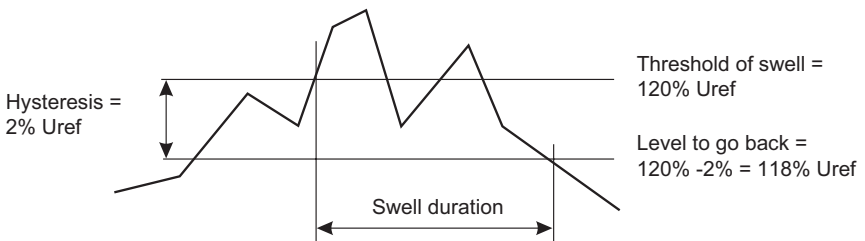
Sag or Interruption Detection

Duration

Hysteresis = 2% Uref

Level to go back = (x% -2%)Uref

Threshold = x% Uref
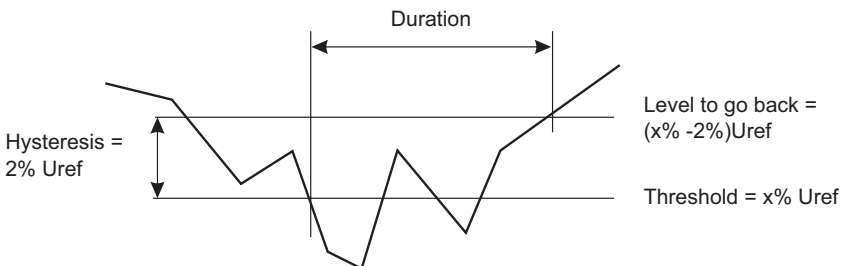
Repair and Calibration

To ensure that your instrument meets factory specifications, we recommend that it be submitted 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).

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

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

(Or contact your authorized distributor)

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

NOTE: All customers 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, mail, fax or e-mail our technical support hotline:

Chauvin Arnoux®, Inc.
d.b.a. AEMC® Instruments
200 Foxborough Boulevard
Foxborough, MA 02035, USA

Phone: (800) 343-1391
          (508) 698-2115
Fax: (508) 698-2118
techsupport@aemc.com
 www.aemc.com

NOTE: Do not ship Instruments to our Foxborough, MA address.

Limited Warranty

The PowerPad™ Model 3945 is warranted to the owner for a period of one year 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.

For full and detailed warranty coverage, please read the Warranty Coverage Card, which is attached to the Warranty Registration Card. Please keep the Warranty Coverage Card with your records.

What AEMC® Instruments will do:

If a malfunction occurs within the one-year period, you may return the instrument to us for repair or replacement free of charge, provided we have your REGISTRATION CARD on file. AEMC® Instruments will, at its option, repair or replace the faulty material.

If a registration card is not on file, we will require a dated proof of purchase, as well as your REGISTRATION CARD accompanied by the defective material.

REGISTER ONLINE AT:
www.aemc.com

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:

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

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

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

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