The PORTABLE POWER QUALITY ANALYZER

Connection, Operation and Troubleshooting

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Revision 01

PPQ-USERMAN-112003-1

500 West South Street Freeport, IL 61032 815.266.4210 (T) 815.266.8910 (F) www.elspecna.com

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1. OVERVIEW

1.1 Introduction

The Portable Power Quality Analyzer (PPQ-306) is a state-of-the-art device used for handy electrical network analysis.

The PPQ features:

- Ultra-rapid (cycle by cycle) advanced electrical network analysis
- Complete network harmonics analysis, up to the 63rd harmonic
- High visibility, 5" graphic backlit LCD screen
- Supports virtually all type of clamps
- Display of neutral voltage and current
- Comprehensive data logging
- Feeder transformer analysis
- Compliance monitoring of international power quality standards
- 1024 KB of flash memory
- User-friendly PC software (PowerIQ)
- Menu driven operation
- Lightweight and rugged weather-proof case
- Easy connection, configuration and use

This manual describes connection and operation procedures of the PPQ.

1.2 Product Versions

This manual includes all existing system functionality. Additional functions may be included in future versions, and earlier versions may not have all functionality. Table 1 summarizes the existing versions.

Item	Latest Version
PPQ-306 Firmware	3.2.0
PPQ-306 Boot Loader	1.5
PowerIQ Software	2.6.0

Table 1: Product Versions

1.3 Safety Precautions

Before working with the PPQ-306, please read this User Manual carefully. The manufacturer will not be responsible for any misuse.

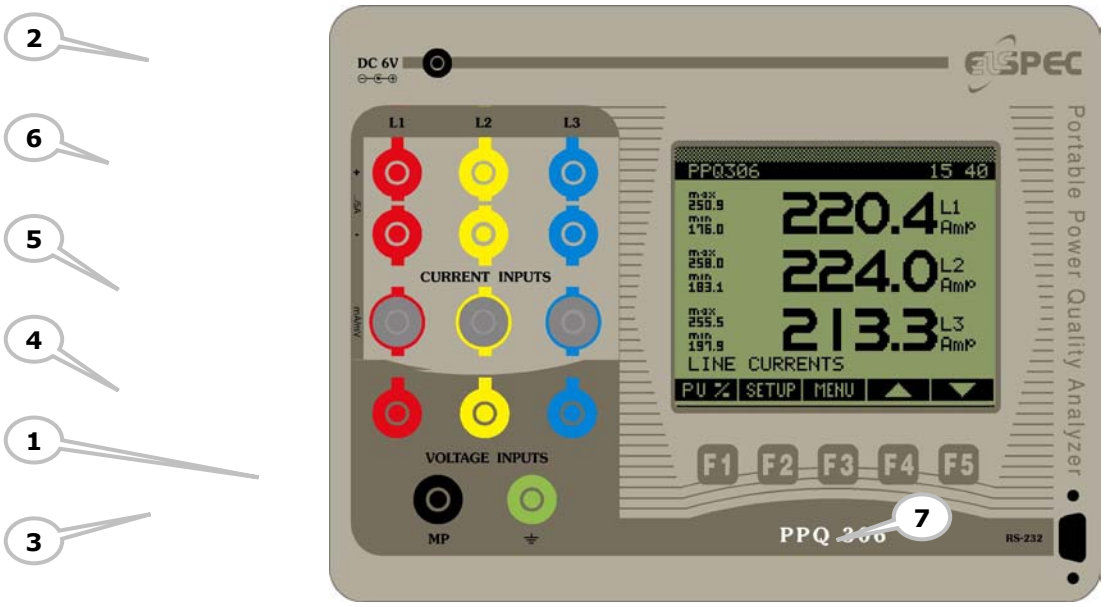
The following general safety guidelines apply to PPQ-306 connection and operation. When performing any operation with the PPQ-306, always observe these safety precautions.

- The instructions contained in this manual are intended for qualified personnel only. To avoid personal injury, do not perform any activity other than as contained herein unless you are qualified to do so.
- Before connecting cables to the PPQ, verify that the mains supply is disconnected.
- To prevent shock or fire hazard, do not expose the PPQ to rain or moisture.
- Avoid making unauthorized modifications to the PPQ.
- Always operate the PPQ within the specified power tolerances.
- The output of current transformers may be affected by high voltage due to cutout on the secondary coil. Throughout connection and operation, check all transformer outputs for connection to loads and perform the procedure systematically as specified. ***Failure to comply with this instruction may result in life-threatening situations***.
- To use and operate the PPQ, follow the specifications of this manual strictly. ***The manufacturer will not be responsible for any damage or injury resulting from equipment misuse and/or unsafe work practices***.

2. CONNECTION

Figure 1 shows general overview of the PPQ-306. It includes connectors, the main display and softkeys. This chapter describes the connection procedure of all connectors.

Figure 1: PPQ-306 Overview



The connection shall be done in the following order (in brackets the connectors' number in Figure 1):

GND (⏚) (1)
Connection to protective earth.

DC 6V (2)
Power supply input, 6V 1A DC Voltage. Connect the power supply to electricity outlet and then connect it to the PPQ.

VOLTAGE INPUTS (3, 4)
Connection of the measured voltages. In delta networks, there is no need to connect the neutral (MP, 3). In single-phase networks, connect either L1 and N (MP), or L1 and L2. The phases are identified using different colors: Red – L1, Yellow – L2, Blue – L3.

CURRENT INPUTS (5, 6)
The PPQ-306 support both voltage-output (e.g., 100mV/mA) and current-output (e.g., 2000A/5A) clamps. Voltage-output clamps are connected using the BNC connectors (5) and the current-output clamps are connected using the Banana Sockets (6). The upper Banana Socket is the positive input and the lower is the negative input. The phases are identified using different colors: Red – L1, Yellow – L2, Blue – L3.

RS-232 (7)
Connect the RS-232 port to a serial port of a computer. For PowerIQ installation and operation, see Chapter 6.

3. OPERATION

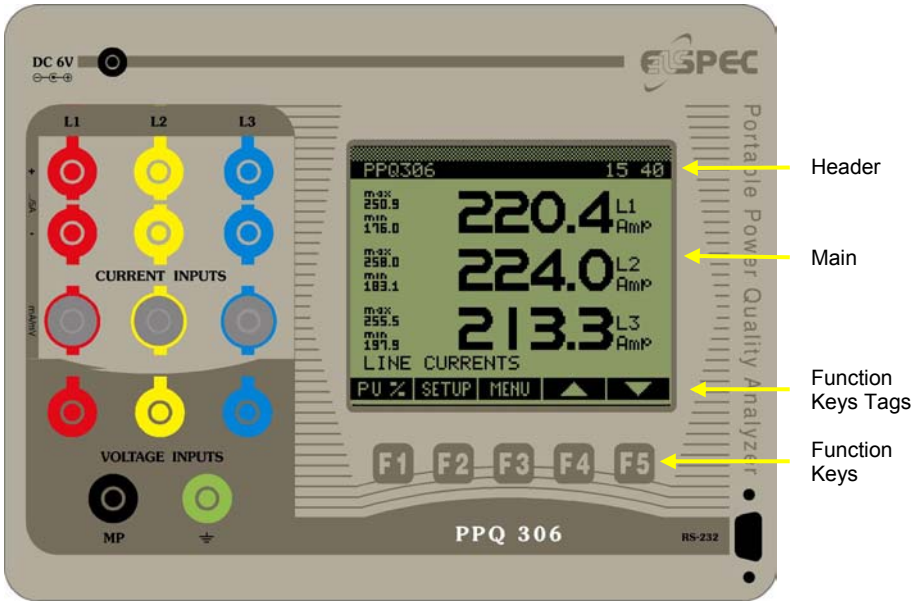
3.1 Front Panel

The front panel of the PPQ is divided into the following functional areas (see Figure 2):

- Header – showing product type and current time.
- Main Display.
- Function Keys & Tags.

The functions of the controls and indicators in each of these display areas are as described in the subsections below.

Figure 2: Functional Display Areas



3.2 Function Keys & Tags

General

All PPQ functions are accessible from five function keys at the bottom of the front panel. The function of each key changes according to the display mode and the information on the function key tag.

Three different display modes are available (see Chapter 5):

- Numeric display, comprising three large-set numbers with minimum and maximum values of the selected measurement
- Graphic display, comprising waveforms and harmonics.
- Text display, comprising menus, system information, energy and events

Table 2 on the next page summarizes the various functions of the keys in each display mode and submode.

Note that in Energy Display mode, key functions are identical to those in Numeric Display mode.

The Favorites List

The PPQ contains a pre-defined list of favorite display windows. In Numeric Display mode, **F4** and **F5** function as ▲ (up) and ▼ (down) keys, respectively, and serve to scroll up or down on the various favorites screen display options. Screen position on the list remains unchanged, therefore these keys will always move to the next or previous screen on the Favorites list whether the currently displayed screen was selected from the list or from another menu.

Key	Display	Tag	Function
F1	Numeric	PU%	Displays the value as a fraction of its nominal value
	Graphic	INFO	Opens the System Information screen
	Text	HELP	Displays a short help text for the specific screen, where available
		INFO	Opens the System Information screen
F2	Numeric	SETUP	Activates the Installation Procedure
	Graphic	SETUP	Activates the Installation Procedure
	Text	CANCEL	Cancels the last operation and returns to the previous state
		CLOSE	Closes the current window and returns to the previous one
		BACK	Moves back one step in a setup procedure
F3	Numeric	MENU	Opens system's Main Menu
	Graphic	MENU	Opens system's Main Menu
	Text	ENTER	Opens the selected item
		CLOSE	Closes the current window and returns to the previous one
		NEXT	Accepts the value entered and moves to the next step in a setup procedure
F4	Numeric	▲	Moves to the previous window on the Favorites list
	Graphic	◄	Moves the cursor one step to the left
	Text	▲	Moves the selection one line up
F5	Numeric	▼	Moves to the next window on the Favorites list
	Graphic	►	Moves the cursor one step to the right
	Text	▼	Moves the selection one line down

Table 2: Key Functions in Different Display Modes

Menu Key

System's Main Menu serves both to select display screens and to program the system. To open, use **F3** in one of the reading display modes.

See full menu description in Appendix B.

Menu operations are effected through key functions as listed below:

HELP Function

Use **F1** to activate the HELP function, where a help screen is available for the menu displayed. Where no help screen is available, this key is disabled.

CANCEL & BACK Functions

Use **F2** to activate the CANCEL or the BACK functions. CANCEL will close the menu and return to the previous display mode, while BACK will close the current submenu and return to the previous one.

Note that, in either case, all changes made will be ignored.

SETUP Function

In all measurement display modes, use **F2** to activate the Installation Procedure (Paragraph 4.3).

ENTER, NEXT, SELECT & CLOSE Functions

Use **F3** to ENTER, NEXT, SELECT or CLOSE. All these functions are basically similar, serving to accept the information entered.

ENTER will open a submenu and select a menu item. In the Installation procedure, NEXT will accept the data entered and move to the next screen. SELECT will toggle between selected inputs (see CT Polarity screen), and CLOSE will accept data and close the screen.

UP & DOWN Functions

Use **F4** and **F5** to activate the ▲ (up) and ▼ (down) functions (for ▲ and ▼ functions in the reading modes, see "Favorites List").

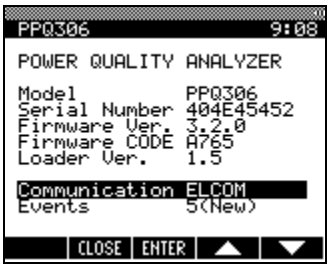
In data entry windows, ▲ (up) will increase the value by one while ▼ (down) will decrease it by one. Hold down to change the value in steps of 10.

In all other windows, ▲ (up) will move the selection bar one line up and ▼ (down) will move it one line down.

System Information

Use **F1** (info) to open the System Information screen as shown in Figure 3, with information as listed below:

Figure 3: System Information Screen



Model	PPQ model type.
Serial Number	PPQ serial number.
Firmware Ver.	Firmware (internal software) version.
Firmware Code	Firmware built code.
Loader Ver.	The version of the firmware loader used for initial firmware booting and for firmware upgrading.
Communication	Communication protocols (Elcom). Select this option to open a Communication Information screen displaying current baud rate, protocol and communication statistics.
Events	Total number of logged events. Select this option to display more details of the events.

4. PROGRAMMING

4.1 General

Figure 4: System Setup Menu

The PPQ-306 programming includes discrete parameters and Installation procedure. The Installation procedure is a complete procedure designed to set up the PPQ-306 and, together with the discrete parameters, manage its setup.

To initiate the Setup (programming) Menu, first open the Main Menu, then select "More..." and "Setup Parameters >>". System's Setup Menu will be displayed, as shown in Figure 4. The Installation Procedure can be run either from this menu or using the F2 key.

4.2 Setup Parameters

Display Contrast

Set this parameter to adjust the display contrast. Contrast is affected by the ambient temperature, lighting condition, viewing angle and user preferences.

Display Refresh Rate

The PPQ measures all the data once per cycle and displays an average over several cycles, for easier reading. Set this parameter to adjust the number of cycles to be used in averaging.
Note that the minimum and maximum values are checked for every cycle, regardless of the refresh value.

Clear Event history

Select this option to entirely delete the "Event" log.

Clear Energy history

Select this option to delete the data accumulated by the "Energy Meters". The meters will show zero readings and start accumulating data from the time they were cleared.

Installation

Use this option to invoke the Installation Procedure.

4.3 Installation Procedure

The PPQ-306 installation is done using the Installation procedure, which leads you through all parameter setups required and helps you install the unit quickly and easily.

To install, follow these steps:

1. **Welcome Screen:** The Welcome Screen will open to remind you to read this manual before installation.
2. **Date & Time Setting:** In this field, select "Modify the above". The system will prompt you to set the year, month, day, hour and minute.
3. **Network Type:** Select low voltage network (LV) or medium/high voltage (MV/HV).
4. **Nominal Voltage:** Set system's nominal voltage.
   In a three-phase system, the voltage is line-to-line.
   For network type LV and nominal voltage less than 500V, skip to step 6.
5. **PT Secondary:** Set the secondary rating of the step-down transformer. Where the primary of the PT transformer is other than the nominal voltage, set the PT secondary to a value where the ratio between the PT primary to the actual PT secondary will equal the ratio of nominal to programmed PT secondary.
6. **Nominal Current:** Set the measured network nominal current.
7. **Network Configuration:** Select 3-phase Wye, 3-phase Delta or single phase (L-N or L-L).
   For network configurations other than Delta, skip to step 9.
8. **CT Connection:** Set up the existing CTs in a Delta configuration. Where a CT is not connected, its current will be calculated from the other two, assuming L1+L2+L3 equals 0.

9. **Current Inputs Type:** Select between current-output or voltage-output clamps (Chapter 2 - Connection). For current-output clamps, skip to step 14.
10. **Current Probe Output:** For voltage-output clamps, select the full scale of the probe output.
11. **Probe's Output Signal:** For voltage-output clamps, set the ratio of the clamp.
12. **Current Probe Location:** Defines whether the measurement is done directly or using existing CTs. If direct measurement is selected, the installation procedure is finished.
13. **Auxiliary CT Ratio:** Defines the CT ratio of installed CTs, whose secondary is being measured. This is the last step of the installation procedure for voltage-output clamps.
14. **Current Probe Multiplier:** Set the current probe ratio. If you use a …/1A CTs, set the ratio of the CTs rather than the primary value, however this will have an adverse effect on accuracy.

5. MONITORING

5.1 Introduction

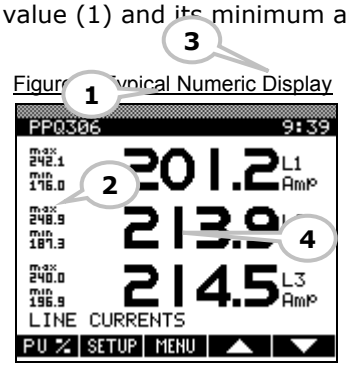
To monitor, use system displays as applicable:

- Numeric display, comprising three large-set numbers with their minimum and maximum values (Figure 5).
- Graphic display, covering harmonics (Figure 6) and waveforms (Figure 7).
- Text display, covering menus, system information (Figure 3), energy (Figure 8) and events (Figure 9).

5.2 Numeric Display

System's Numeric Display consists of three values. For each value, a large-set number is displayed with the current value (1) and its minimum and maximum (2). The minimum and maximum values are reset whenever the display is changed. This parameter includes phase and units indication (3) as well as screen description (4).

Figure 5: Typical Numeric Display



Use **F4** (▲) and **F5** (▼) to select the next or previous display screen from the Favorites list.

Click **F1 (PU%)** to display the value in a "Per Unit" format whereby the full scale of the parameter is displayed as 100% and the value itself is displayed as a fraction. For example, 392V in a 400V network will be displayed as 98% (392/400=0.98), and 408V will be displayed as 102% (408/400=1.02).

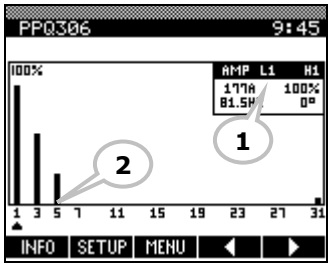
Per unit is useful for quick estimating of the parameter, comparing to its nominal value.

5.3 Graphic Display

Harmonics Spectrum

In a typical Harmonic Spectrum Display, the specific harmonic information (1) shows the type, phase and number of the harmonic, as well as its level (in amperes/volts or in percent), angle and frequency.

Figure 6: Typical Harmonic Spectrum Display

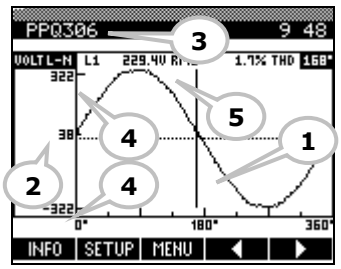


Use **F4** (◀) and **F5** (▶) to decrease or increase the number of the displayed harmonic (2). The harmonics are divided into two separated displays: 1st through 31st harmonic and 32nd through 62nd. The displays are switched automatically according to the number of the selected harmonic. For example, when the cursor is on the 31st harmonic, click **F5** (▶) to move the cursor to the 32nd harmonic and display the 32nd through 62nd harmonics.

Waveform Display

The Waveform Display includes a cursor (1) and the waveform value at this position (2), waveform type (3), and lower and upper peak values (4). In addition, specific waveform information (5) shows the type, phase and number of the waveform, as well as its RMS value, THD and angle of cursor position.

Figure 7: Typical Waveform Display



Use **F4** (◀) and **F5** (▶) to change cursor position.

5.4 Text display

General

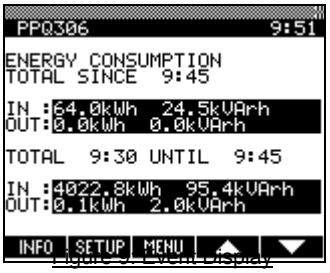
System's Text Display comprises menus, system information, energy and events.

See detailed menu descriptions in Appendix B and System Information on page 11.

Energy Display

The Energy Display comprises 15-minute meters and monthly totals, each showing the previous period total (15-minutes or month) and the value accumulated since the start of last period. The values include active energy (kWh) and reactive energy (kVAr) for both incoming and outgoing energy. The information is stored in the flash memory every 15 minutes, and the PowerIQ software can retrieve the information for easy display and calculation of Time-Of-Use.

Figure 8: Typical Energy Display

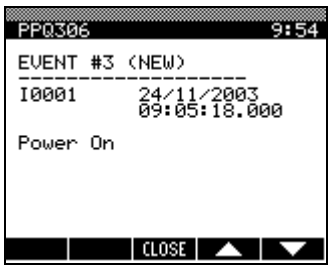


Events

The number of New Events (which were not displayed on the screen) is displayed on the System Information screen. When selected, "Summary of Events" window (Figure 9) opens, displaying the number of "New" and "Old" events. "New" events are events that were not displayed yet on the PPQ.

Selecting "New Events" will open the most recent event that is new, while selecting "Old Events" will open the most recent event that is old. The most recent new event is not necessarily the most recent event, as explained in Table 3. Each event's information includes event number, code, date, time, short description of the event and whether it is new or old. Use **F4** (▲) and **F5** (▼) to scroll to the previous or next recorded event by numerical order, regardless of its old/new status. After an event is displayed its status is changed to "old" and the next time it is displayed it will be indicated as such.

Figure 10: Typical Event Display



The entire Event log is downloadable through PowerIQ software ("Events" icon) to a PC, for easy reading, sorting and filtering.

Step	Operation	Events
1	3 events are logged	Events 1 to 3 are new
2	Selecting "New Events"	Event 3 is displayed and changed its status to "old"
3	Pressing "Close"	Events 1 & 2 are new (total 2 new) and 3 is old (total 1)
4	Selecting "New Events"	Event 2 is displayed, although it is older than #3.

Table 3: New and Old Events

5.5 Feeder Transformer Analysis (L-to-L Currents)

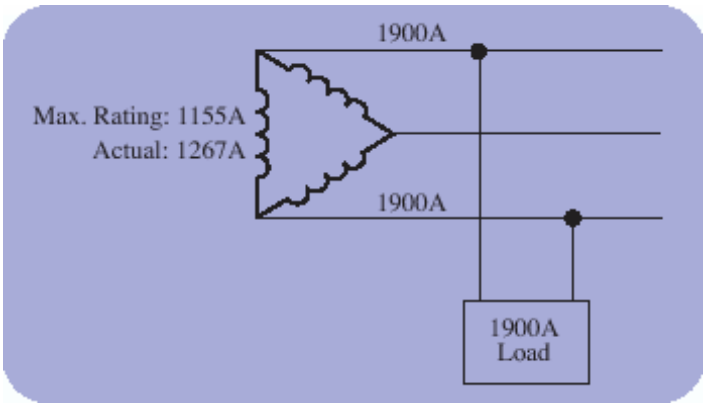
When the system is configured as a Delta network, it displays the L-to-L current and power, in addition to the line currents and total power. The system measures the line current from the CTs and calculates the current and power inside the feeder transformer (or generator). In completely balanced networks, the internal currents are $1/\sqrt{3}$ of the line currents. In many cases, the network is not balanced and the internal currents are different from these expected.

This can be explained with the following hypothetical example (Figure 11):

A transformer designed for a maximum current per phase of 2000A, therefore each internal line is designed for a maximum of 1155A ($2000/\sqrt{3}$). The network includes only one phase to phase load of 1900A between phases L1 and L2 and nothing on L3. The transformer appears incorrectly to have a 95% load (1900/2000).

The currents are divided into 67% on L1- L2 line and 33% on L1- L3 and L3- L2 lines, resulting in 1267A on the L1-L2 line, and the transformer is overloaded by 10%. Elspec's unique L-to-L current and power algorithm displays this information, enabling maximum network monitoring.

Figure 11: Feeder Transformer Analysis Example



6. POWERIQ SOFTWARE

6.1 General

The PowerIQ software is an application running under Microsoft Windows, providing a graphical user interface for ELSPEC products.

Minimum requirements are Pentium 166 MHz or higher, with minimum of 32 MB of memory, 50 MB of free space on the hard disk and Microsoft Windows 98 or higher, with TCP/IP installed. Larger disk space is required for data logging.

For best performance, use Pentium III 800 MHz or higher, with 128 MB of memory and Microsoft Windows XP Professional.

6.2 Installation

To install PowerIQ, follow the procedure below:

(1) PowerIQ uses Windows' TCP/IP. If your system does not have the TCP/IP installed, see Windows Help under "TCP/IP protocol, installing", to install.

(2) If you have another version of PowerIQ installed on your computer, reboot the computer before starting the installation procedure.

(3) Insert the installation CD-ROM into the CD-ROM drive.

(4) Click "Start" and select submenu "Run..."

(5) Type "D:SETUP", then click OK. Replace D: with your CD-ROM drive letter.

(6) Follow installation program instructions as they appear on the screen.

6.3 Operation

The software includes an application toolbar and client applications. The application toolbar also serves as a communication server for the clients and for other computers (in the network version). The server collects all the data requests from all clients and delivers the required information to all the clients. As many clients may be opened simultaneously as required, whether of different or of the same type.

All clients are accessible through the PowerIQ Main Taskbar.
To activate, select "Start" » "Programs" » "PowerIQ" » "PowerIQ".

6.4 Help System

For additional information on PowerIQ, seek PowerIQ on-line help.

To access on-line help, do one of the following:

(1) Use **F1** to open the Help system for the specific function.

(2) Select "Help" from the PowerIQ Main Taskbar.

(3) Select "Start" » "Programs" » "PowerIQ" » "Help".

7. NETWORK ANALYSIS

7.1 General

This chapter includes network power quality analysis procedure guidelines. It is not intended to cover all power quality issues and it is given as general idea only. It includes the measurement procedure. For more involved engineering analysis, please contact Elspec.

7.2 Power Quality

What is Power Quality

Power Quality incorporates all issues concerning distorted power, including the voltage and the current waves.

The most common Power Quality issues are:

- Power Factor
- Harmonics (Voltage, Current)
- Voltage Sags & Swells
- Spikes (Transients)
- Flickering

Low Power Quality Implications

- Downtime
- Product Quality
- Energy Losses
- Service Utilization
- Maintenance Costs

Major Sources for PQ Problems

- Voltage Converters (e.g. DC Drives, Frequency Converters, UPS, Power Supplies)
- LV and MV Capacitors (Switching; Harmonics)
- Variable Loads (e.g. Welders, Motor Startup, Cranes)
- Service Utilization (most PQ events occur and peak demand)
- Backup Generators
- Long Lines
- Utility Company and Neighbors

7.3 Measurement Procedure

The measurement procedure includes the following steps:

- Studying the Site
- Identifying the Connection Points
- Connection of the PPQ-306
- Taking Measurements
- Repeating for Multiple Conditions
- Continuing to Next Connection Point

Study the Site

The first of step of successful analysis is getting to know the site using, but not only, the following:

- 1-line diagram
- Potential Problematic Loads
- Existing PFC Solution
- Power Quality History (PFC and Others)
- Local Utility Regulations
- Electricity Bill (value and components)
- Other Raised Issues and Objectives

Identify Connection Points

Normally, analysis is done in more than one connection point. Typical connection points are:

- Main Switchboard
- Major MCCs
- Existing PFC Solution
- Large Loads
- Backup Generators

Connection of the PPQ-306

Connect the PPQ-306 at the first connection point (Chapter 2 - Connection). Verify correct connection using chapter 8 - Troubleshooting.

Take Measurements

Use the PowerIQ software (Chapter 6) to view and collect the data. From one side it is always better to collect more data. On the other side, during fast analysis it is important to log only the necessary information for best performance. The two contraries can be combined by performing them one after the other rather than simultaneously.

Suggested Procedure:

- Use Table to brief all parameters in order to verify correct connection and setup
- Close Table before Data Logging for best performance
- Perform All Parameters Data Logging with few seconds resolution
- Perform Volt/Amp/kVAr Data Logging with Amp and Volt trigger
  (verify best resolution – high baud rate, no other PowerIQ windows and minimum number of parameters)
- Save Harmonic Screen for all parameters, including Minimum and Maximums
- Save Waveform Screen for all parameters

Repeat for Multiple Conditions

Some of the power quality issues happen during normal operation, some may occur on particular time of the day or week, and some may take place during certain network condition. It is good practice to repeat the analysis during multiple conditions, such as:

- Normal Condition
- Full Loading (the best is to schedule the audit to the busiest period)
- Large Motor Startups (for example, large motors which starts once a week)
- With and Without Existing Capacitors (including step by step for resonance detection)

Continue to Next Connection Point

Disconnect the PPQ-306 and continue to the next connection point. The next connection can be either planned or new point, due to the measured data. For example, one of the loads causes power quality issue and need to be monitored separately.

8. TROUBLESHOOTING

The secret to troubleshooting is to examine the evidence you have, gain as much information as you can, and eliminate the possibilities one by one. In most cases, the source of the problem will soon become clear.

See common problems and solutions below:

The PPQ doesn't power up

Make sure that the PPQ is connected to the power supply and that the external power supply is functional.

The PPQ displays a zero current reading

1. Check the CTs connections.
2. Confirm the CTs type (page 7). clamps type.
3. Verify the PPQ setup for the bus bar being measured carries current.
4. Make sure that the cable or the Tip: The PPQ may be measuring current is flowing (see Figure 12). the edge of the bus bar where no

Figure 12: CT Connection Example

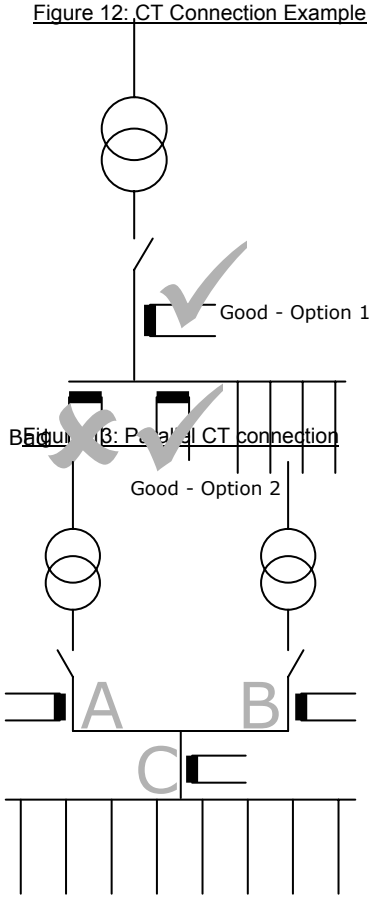


Figure 13: Parallel CT connection

The current RMS readings of all phases are similar, but they are different from those expected

Check for improper setting of the CT ratio, or verify that ALL the power input is surrounded by the CTs. A typical bad connection is one with two parallel transformers or multiple feeders. For example, in Figure 13, if the CT is set to position "A", the current will read 50% of the actual value.

How to measure two parallel transformers?

There are three ways to measure two parallel transformers (Figure 13):

Option 1

Install one set of CTs on "A" and one set on "B" and connect them to the PPQ-306 using a summation CT.

Option 2

Install set of CTs on "C".

Option 3

Verify that the currents on "A" and on "B" are identical, then install CTs on either "A" or "B". Now set the CT ratio to twice the actual ratio. However, this option is not recommended since, if the current is not identical or if one of the transformers is disconnected, the readings will be incorrect.

The voltage and current readings are OK, but the power and the power factor are not

Check for a mismatch between the phases of the voltage connections and the CT.

To fix, switch between phases L1 and L3 on either the voltage or the CT (but not on both).

The PPQ displays negative active power

Negative active energy indicates that the load supplies energy back to the network.

If the energy flows to the load, the connection of one or more of the CTs is reversed. To fix, change the CT polarity.

APPENDIX A: SPECIFICATIONS

LCD Display Size	94x76 mm
LCD Display Resolution	Graphic 160x128 pixels
LCD Display Type	Black/White, FSTN, LED backlight
Ambient Temperature	-20°C - +55°C
Storage Temperature	-25°C - +65°C
Computer Software	PowerIQ Professional included.
Input Channels	10 4×Voltage Channels 3×Current Inputs (../5A) 3×Current Inputs (mA/mV)
Dimensions (closed)	270 × 246 × 123 mm [W×D×H]
Weight (w/o accessories)	1.9 kg
Power Supply	100-240V ~ 0.2A 50-60Hz
Direct Voltage Measurement	347/600 VAC Max.
EMC Compatibility	EN61000-4-2/3/4/5, ENV50204, ENV50141
Safety Standards	EN61010-1, EN50439-1
Communication	Elcom (Elspec's Protocol)
Power Consumption	3 VA
Harmonic Analysis	1 through 63rd

Measured Parameters

Option	Displayed Phases	Accur.
Frequency		0.1
Current, per Phase	L1, L2, L3, Avg	0.2
Current, Neutral	N	0.2
Current, L-to-L (Transformer)	L12, L23, L31, Avg	0.2
Volts, L-to-L	L12, L23, L31, Avg	0.2
Volts, L-to-N	L1, L2, L3, Avg	0.2
Volts, Neutral	N	0.2
Real Power (kW)	L1, L2, L3, Sum	0.3
Reactive Power (kVAr)	L1, L2, L3, Sum	0.3
Apparent Power (kVA)	L1, L2, L3, Sum	0.3
Power Factor	L1, L2, L3, Sum	0.3
Time-of-Use (TOU):		
- Real Energy (kWh)	Sum	0.5
- Reactive Energy (kVARh)	Sum	0.5
- Energy Modes: in, out, net, total		
Currents THD, L-to-N	L1, L2, L3, Avg, N	0.2
Currents THD, L-to-L	L12, L23, L31, Avg	0.2
Voltage THD, L-to-N	L1, L2, L3, Avg, N	0.2
Voltage THD, L-to-L	L12, L23, L31, Avg	0.2
Currents HARMONICS, L-to-N	L1, L2, L3, Avg, N	0.2
Currents HARMONICS, L-to-L	L12, L23, L31, Avg	0.2
Voltage HARMONICS, L-to-N	L1, L2, L3, Avg, N	0.2
Voltage HARMONICS, L-to-L	L12, L23, L31, Avg	0.2
Currents WAVEFORM, L-to-N	L1, L2, L3, Avg, N	0.2
Currents WAVEFORM, L-to-L	L12, L23, L31, Avg	0.2
Voltage WAVEFORM, L-to-N	L1, L2, L3, Avg, N	0.2
Voltage WAVEFORM, L-to-L	L12, L23, L31, Avg	0.2

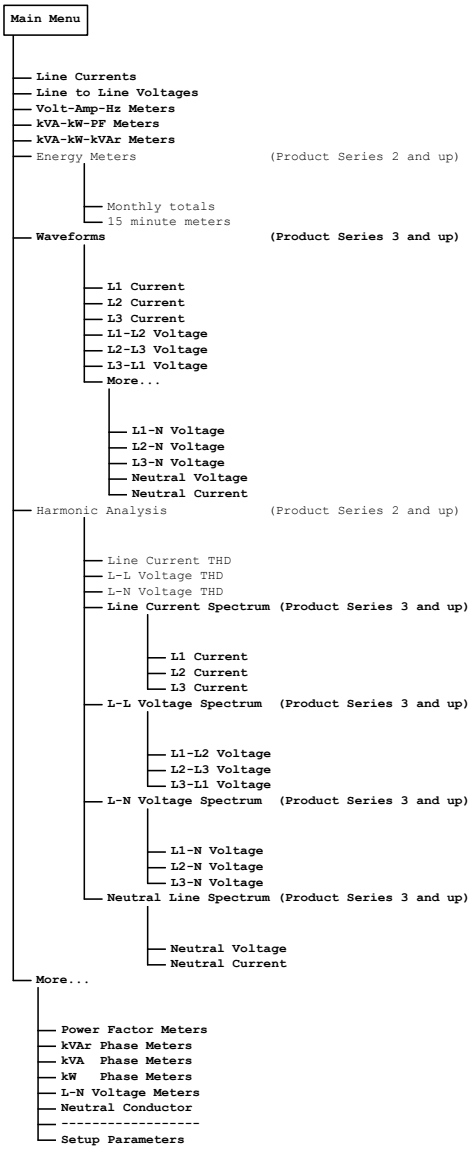
Notes:

Accuracy is in ± digit.

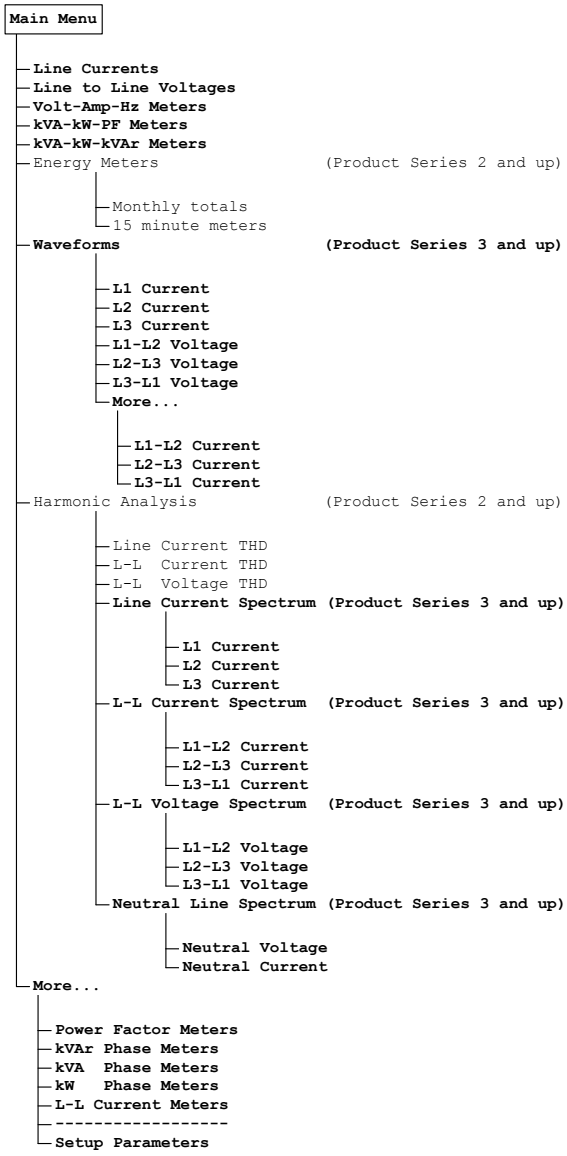
THD = Total Harmonic Distortion.

APPENDIX B: DETAILED MENU DESCRIPTION

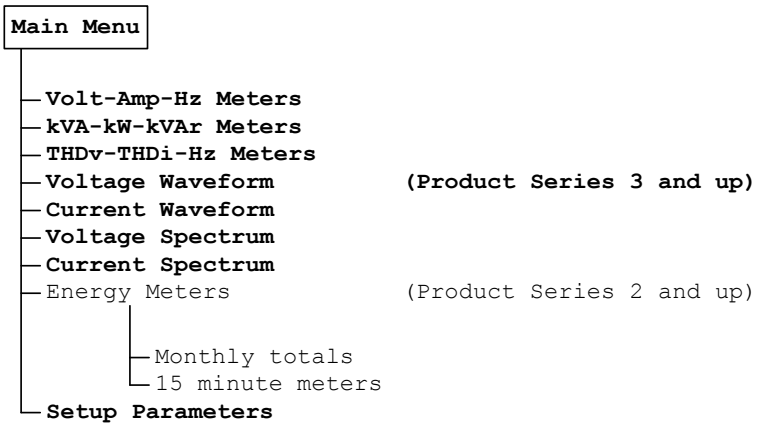
B.1 Three-phase WYE configuration



B.2 Three-phase DELTA configuration



B.3 Single-Phase configuration



Elspec North America Headquarters:
500 West South Street
Freeport, IL 61032
USA

+1.815.266.4210 (Tel)
+1.815.266.8910 (Fax)
www.elspecna.com