BLACKBOX Full User Guide

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Full User Guide

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Symbols

	***Note**: This symbol directs the user's attention to important installation, operating, and maintenance instructions.*
	***Warning:** This symbol indicates instructions that must be followed to avoid device malfunction or damage*
	***Danger:** This symbol indicates the presence of dangerous voltage within and outside the product enclosure that may constitute a risk of electric shock, serious injury or death to persons if proper precautions are not followed.*

Warranty

Elspec's technical support department provides professional and reliable service. All Elspec products are warranted as specified in the terms and conditions warranty. Elspec is not liable for any damages or injuries resulting from equipment misuse and/or unsafe work practices.

Installation Considerations

Installation and maintenance of the BLACKBOX should only be performed by qualified, competent personnel that have appropriate training and experience with high voltage and current devices. The device must be installed in accordance with all Local and National Electrical Codes and regulations. This equipment has no user serviceable parts.

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15.of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be liable for all monetary damages.

Standards Compliance

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Chapter 1: Installation

This manual is the hardware user guide for the BLACKBOX. The scope of this document is intended to cover all aspects of hardware installation and setup of the BLACKBOX with or without the I/O module. Additionally the BLACKBOX configuration through the firmware is covered as well as the real time monitoring of the unit.

The **Installation** section covers all relevant procedures relating to the first time hardware setup from the unpacking of the BLACKBOX, through the mounting of the unit, and finishing with voltage, current, and Ethernet wiring instruction. At the conclusion of this section, the unit is power tested and ready for configuration with the firmware (**The Embedded website**).

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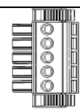
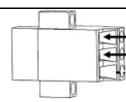
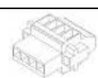
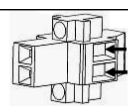
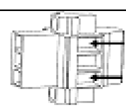
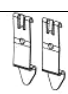
Step 1: Unpacking the BLACKBOX

The BLACKBOX comes from the factory in a sealed carton to protect from damage during transport. The small parts are shipped in sealed bag with the unit.

To unpack the BLACKBOX:

- Remove the unit and its all of the following components from the carton.

QTY	Illustration	PART DESCRIPTION
1		BLACKBOX Models • SPG -4410-0000 • SPG -4420-0000 • SPG-4430-0000
1		BLACKBOX w/ Multi I/O Module Models • SPG-4410-1000 • SPG-4420-1000 • SPG-4430-1000
1		Voltage terminal block connector - BUZ 10.16_05_180SF SW Clamping yoke,
1		AC/DC terminal block connector - BLT5.08/3F SN SW-3p Black, TOP Clamp connection socket
1		RS485/422 Communication terminal block connector BL3.5/4/90LF SW- 4p Black Clamping yoke,
1		48VDC terminal block connector - BL3.5/2/90LF SW – 2p Black Clamping yoke
1		Temperature Sensor terminal block connector PT100 type - BL3.5/3/90LF SW - 3p
2		Clamping yoke holder on rail 35mm FM 4

QTY	Illustration	PART DESCRIPTION
1		BLACKBOX Full User Guide

Table 1: Parts Listing

Step 2: Before Getting Started

Familiarize yourself with all components of the BLACKBOX device. In addition, follow all of the safety precautions below.

What You Will Need

- Wire Strippers
- Phillips Screwdriver
- Flat head screwdriver
- The complete BLACKBOX unit and components
- This User Guide

The BLACKBOX

The BLACKBOX is a state-of-the art power monitoring device. The following is a component identification and physical description:

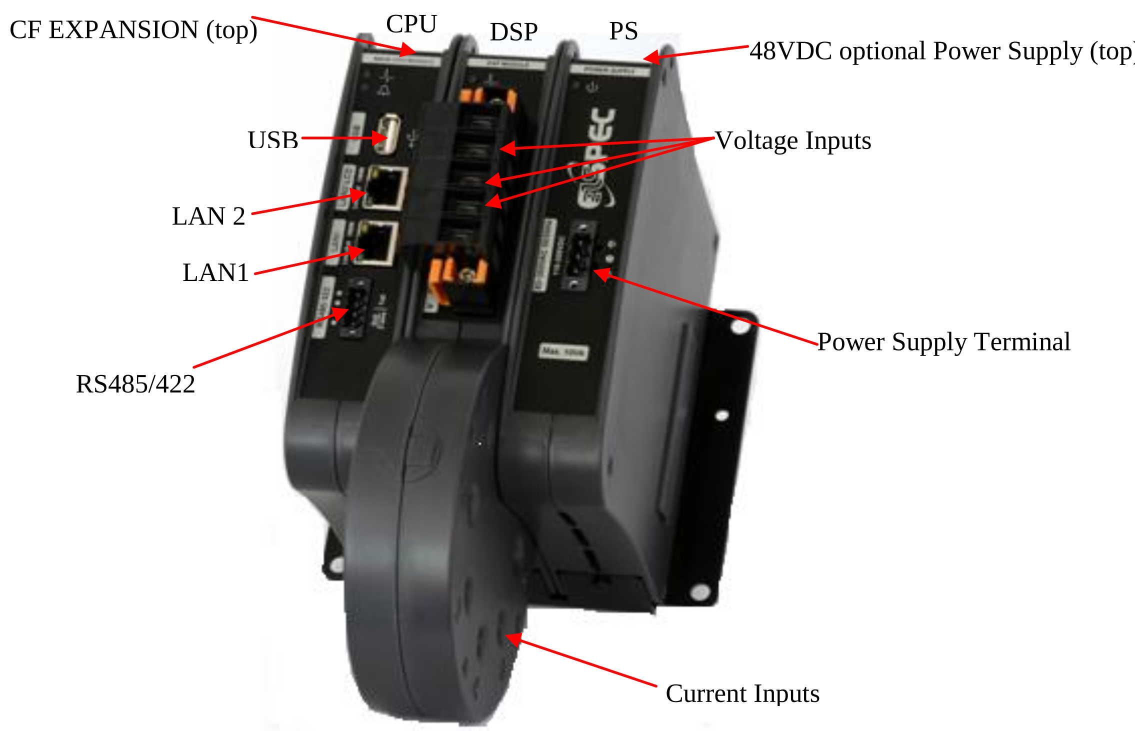


Figure 1: The BLACKBOX

The basic unit is made of three modules:

- **CPU**: Central Processing Unit
- **DSP**: Digital Signal Processing
- **PS**: Power Supply

Note: *For a detailed listing of technical specifications, refer to* ***Hardware Reference on page 157****.*

Safety Precautions

To use and operate the BLACKBOX, 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.

Warning: *Always observe the following safety precautions before performing any operation on this equipment.*

- The instructions contained in this manual are intended for qualified personnel only.
- Avoid making unauthorized modifications to the product.
- Always operate the product within the specified power tolerances refer to **Table 49: Specifications and Protocols on page 160.**

Danger: *Failure to observe the following instructions may lead to serious injury or death.*

- Before connecting cables to the unit, verify that the main power supply is disconnected.
- To prevent shock or fire hazard, do not expose the unit to rain or moisture.
- High voltage may be present on open secondary conductors of current transformers. Throughout installation, ensure that all transformer outputs are closed (connected to instrument or short circuited), and perform the procedure systematically as specified.

Step 3: Mounting the BLACKBOX

The BLACKBOX is intended to be mounted in an enclosure either fastened to a DIN Rail or a flat surface.

Note: *For a detailed listing of physical dimensions refer to* ***Unit Dimensions on page 159*****.**

Note*: Contact your local distributor for more information on mounting the unit outside of an enclosure***.**

Mounting to a DIN Rail

Din Rail mounting is the most common method of mounting the BLACKBOX. Utilizing this method requires the clamping yoke holders provided with each unit.

To mount the unit to a DIN Rail:

1. Connect the **clamping yoke holders** to the back plate of the BLACKBOX using the two screws provided.
2. Attach the entire unit with the holders to the **DIN rail.**

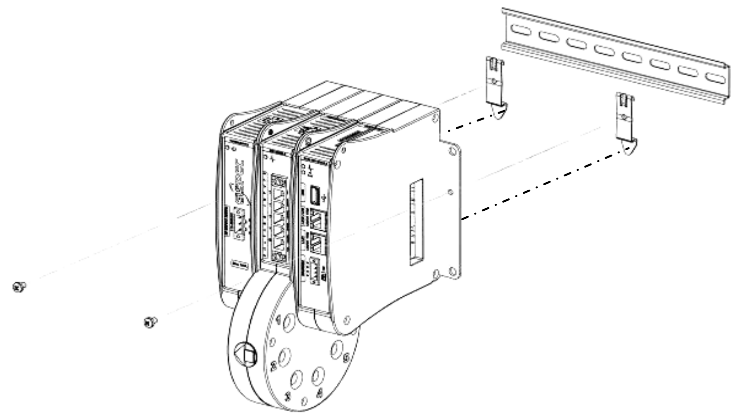


Figure 2: Din Rail Mounting

Mounting to a Plate

The BLACKBOX instrument can be directly mounted to a flat surface using four screws (not provided) through the back plate.

To mount the unit to a plate:

- Follow the diagram below.

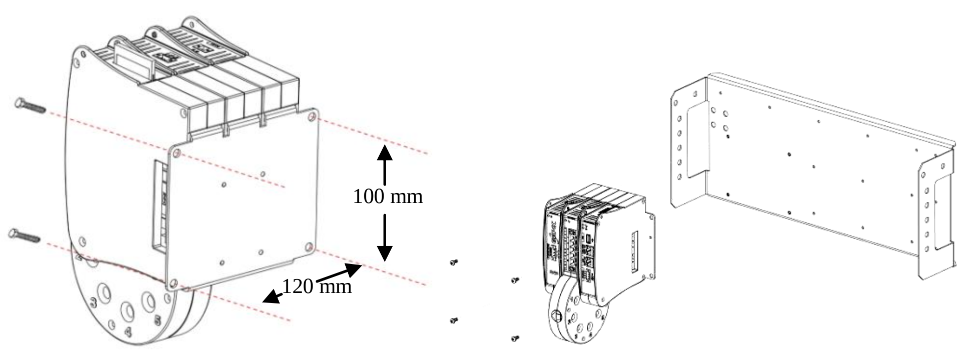


Figure 3: Plate Mounting

Step 4: Connecting Power Supply

The power supply module converts any of the following inputs to a stable operating voltage to be used for self consumption:

- AC 100-230V, 60/50 Hz (recommended)
- DC 100-300V
- DC 48V
- POE through the LAN 1 port on the CPU

Note: *For a detailed listing of technical specifications, refer to* ***Hardware Reference on on page 157 .***

Note: *Refer to* ***Power over Ethernet (PoE) on page 20*** *for instructions on PoE connections.*

Warning*: Make sure the panel is de-energized before commencing.*

Energizing the Power Supply Terminal

This AC terminal can be fed with either AC or DC voltage with the following parameters: The procedure to wire both is the same.

- 85~260VAC 50/60Hz
- 100-300VDC

To energize the Power Supply Terminal with AC/DC:

1. Install an Over current protection device on the AC phase line side before the unit.

Warning*: It is recommended to install a 2A fuse and/or circuit breaker in series to the instrument terminals according to local wiring codes.*

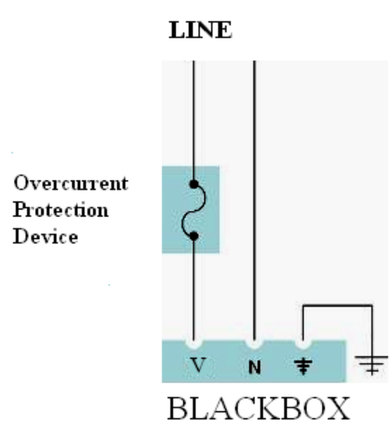


Figure 4: Over current Protection

2. Remove the **AC/DC terminal block connector** provided with the BLACKBOX package

3. Attach the bared ends of wires to the **AC/DC terminal block connector** using a properly sized screwdriver.

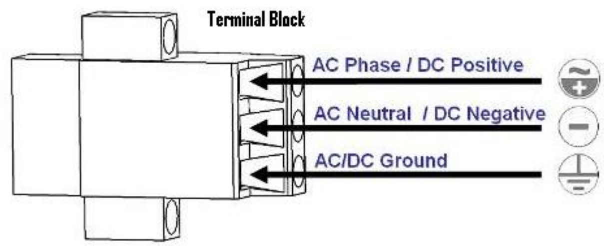


Figure 5: AC/DC Terminal Block Connector

4. Insert the terminal block into the **Power Supply Terminal**.

Power Supply Terminal

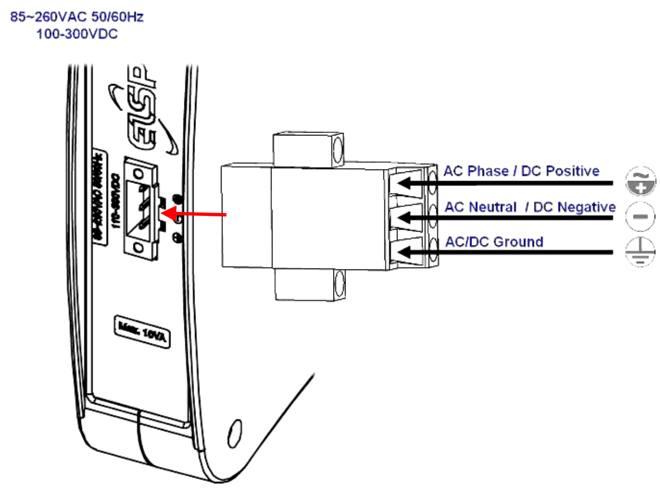


Figure 6: AC Terminal Connection

> ***Warning!*** *When powering down the instrument by closing the circuit breaker, voltage remains on the instrument terminals, and consequently on the downstream side of the circuit breaker for 25 seconds, due to the ride through back up feature.*

Energizing the 48V DC Optional Power Supply

The two wire 48V DC voltage input is positioned on the upper side of power supply module. This input can accept 24-56VDC.

> *Note: The instrument will operate most effectively at 48VDC An input range below 48v will allow POE usage.*

To energize the 48VDC terminal:

1. Remove the **48V DC terminal block connector** provided with the BLACKBOX package.
2. Attach lugged ends of wires to the terminal block using a properly sized screw driver.

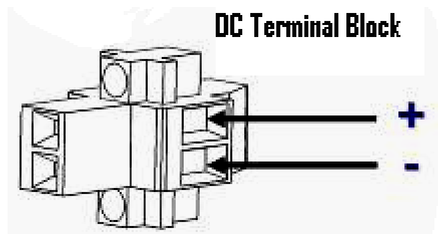


Figure 7: 48V DC Terminal Block Connector

3. Insert the **48V DC terminal block Connector** into the Power Supply module.

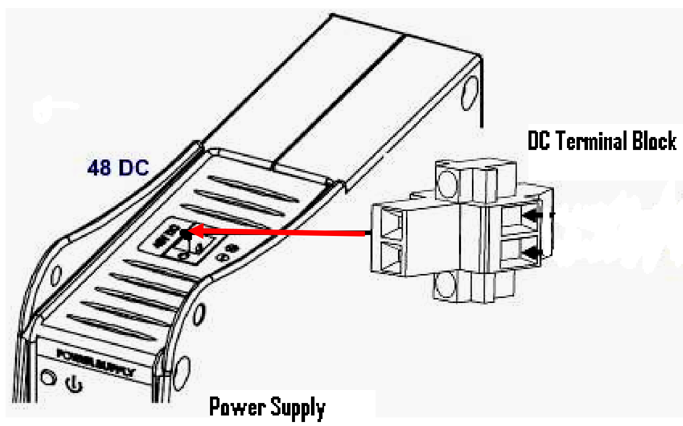


Figure 8: 48V DC Connection

Danger! *When powering down the instrument by closing the circuit breaker, voltage remains on the instrument terminals, and consequently on the downstream side of the circuit breaker for 25 seconds, due to the ride through back up feature designed into the instrument.*

Power Supply Features

The Power supply is equipped with the following features:

- The Power Supply module has an automatic power source selection circuit which will automatically switch to the strongest power source available.

> ***Note:*** *If the AC power connection is unplugged, but the 48VDC is still connected, the unit will automatically switch to 48VDC.*

- The power supply module is equipped with ride-through backup circuitry designed to keep the instrument energized for up to 25 seconds.

> ***Warning:*** *When powering down the unit for servicing, wait at least a few minutes before disconnecting the wires.*

Step 5: Wiring the Measured Voltage and Current Connections

The DSP (Digital Signal Processing) module receives analog signals and converts them to digital signals to be measured and stored for further process and analysis. This section will provide you with the following:

- Wiring voltage connections
- Wiring current connections
- Wiring both voltage and current in a variety of wiring configurations

> ***Note:*** *For a detailed listing of technical specifications, refer to* ***Hardware Reference on page 157****.*

> *Warning: Make sure the panel is de-energized before commencing.*

Wiring Voltage Connections

Five terminals are available for sampling. They are marked as ⏚, N, L1, L2, and L3. Each of the 4 inputs (V1, V2, V3, N) are capable of receiving electrical signals of up to 1KV continuous RMS (up to 8KV transient).

> ***Note:*** *Refer to* ***Wiring Configurations on page 15.***

To wire voltage connections

1. Install an over current device on the AC phase lines.

> **Warning:** *You must install a 2A fuse and/or circuit breaker in series to the instrument terminals according to local wiring codes.*

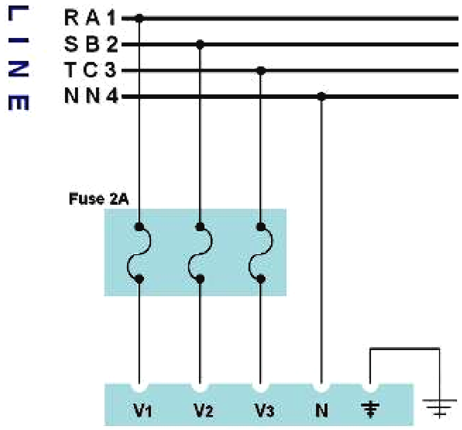


Figure 9: Over current Protection

2. Remove the **Voltage terminal block connector** provided with the BLACKBOX package.
3. Attach lugged ends of wires to the terminal block using a properly sized screw driver.

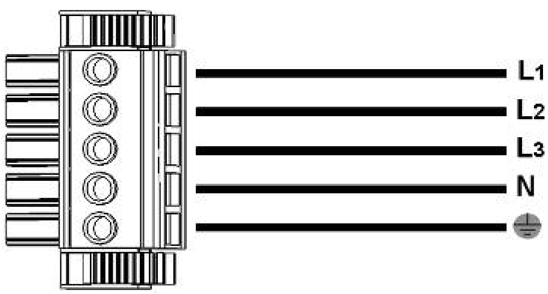


Figure 10: Voltage Terminal Block Connector

> **Note:** *Refer to the supported* ***Wiring Configurations on page 15.***

4. Insert the terminal block into the Voltage input.

Voltage Input

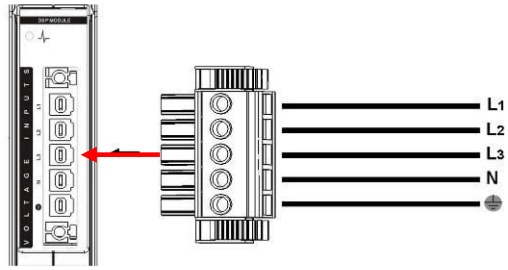


Figure 11: Voltage Terminal block Connection

Warning! *There is no connection between the self power lines feeding the Power Supply Module and the lines being monitored in the DSP module. Powering down the instrument does not remove voltage from these terminals.*

Detaching the Terminal Block

If you need to disconnect the unit from the measured voltages, you need to detach the terminal block.

To detach the terminal block:

1. Loosen the screws anchoring the block in place
2. Slide the orange thumb locks out.
3. Pull out the terminal block.

Wiring Current Connections

Electric current is sampled as it flows through holes in the circular section of the centrally mounted DSP module. There are up to six (6) inputs of current signals, CT's (holes).Typically only first four (4) are used as I1, I2, I3, and IN (Neutral current optional as the fourth input)

Note: *Refer to the supported* ***Wiring Configurations on page 15****.*

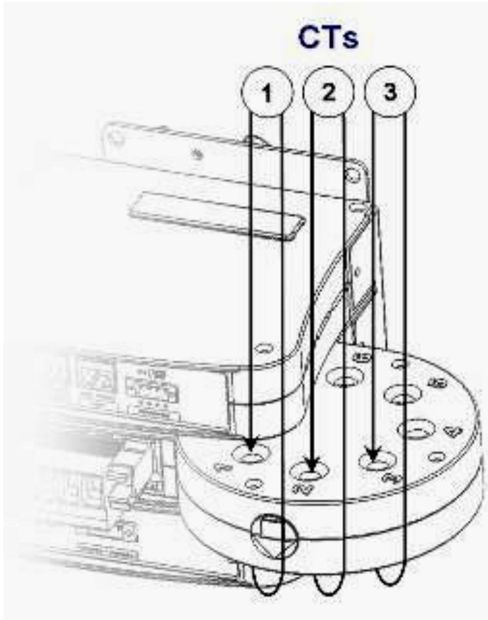


Figure 12: Measuring Current Lines

To wire current connections:

1. Install Current Transformers in series ahead of the unit.

> ***Warning!*** *Current Transformer outputs must be short circuited before handling; dangerous voltages exist between the two output conductors s.*

2. Feed the current lines through the holes in the circular section of the DSP module.

> ***Note:*** *The current lines are shorted secondary wires from current transformers (CT's). Take note of the CT ratio for set up later in the firmware.*

3. Verify polarity of current phase conductors with the arrows on the current measuring unit.

> ***Note:*** *If current polarity is reversed, it can be corrected later in the unit setup.*

Wiring Configurations

This section demonstrates the installation of the BLACKBOX in common wiring configurations

To wire the unit into the different wiring environments:

- Use the appropriate wiring schematic to follow:

Low Voltage 4-Wire Wye (<600V)

Connections to a low voltage network require 3 current transformers, with an option to connect a fourth CT on the Neutral line. Voltage connections are direct.

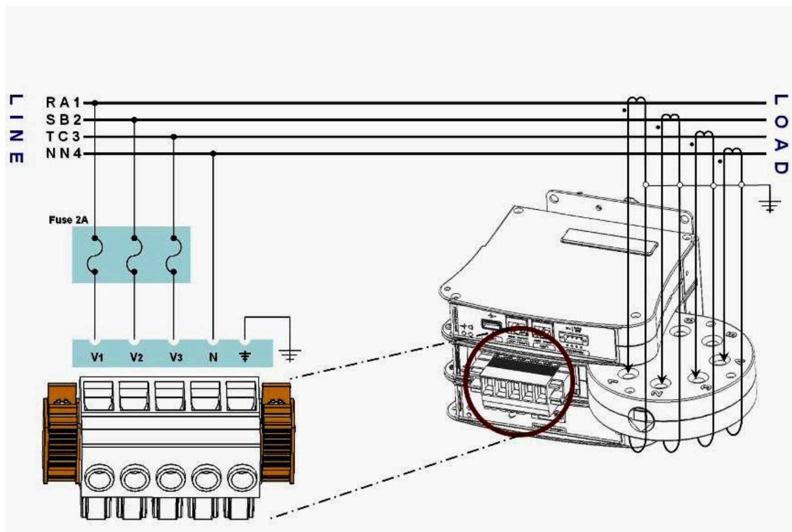


Figure 13: Low Voltage 4 Wire Wye

High Voltage 4-Wire Wye (600V)

Connecting to a Medium/High voltage network requires 3 PTs and 3 current transformers, with an option to connect a fourth CT on the Neutral line

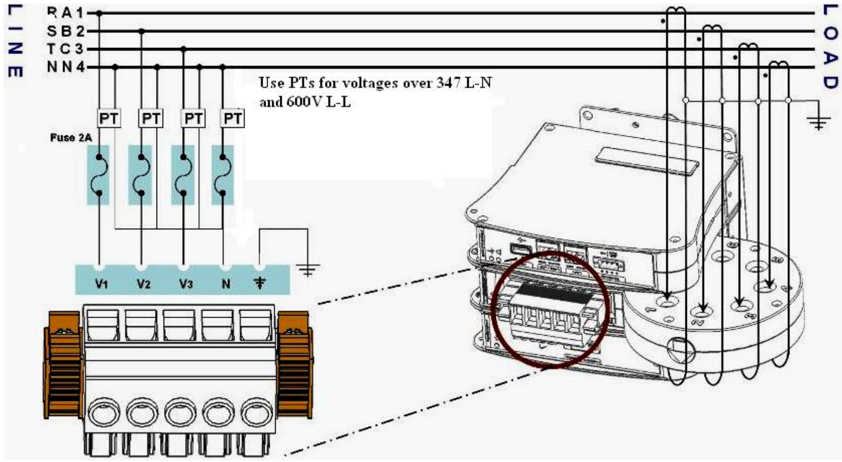


Figure 14: High Voltage 4 Wire Wye

Wye 3 Wire Solid Grounded

In a Wye system with a grounded common, the unit can be attached directly without PTs.

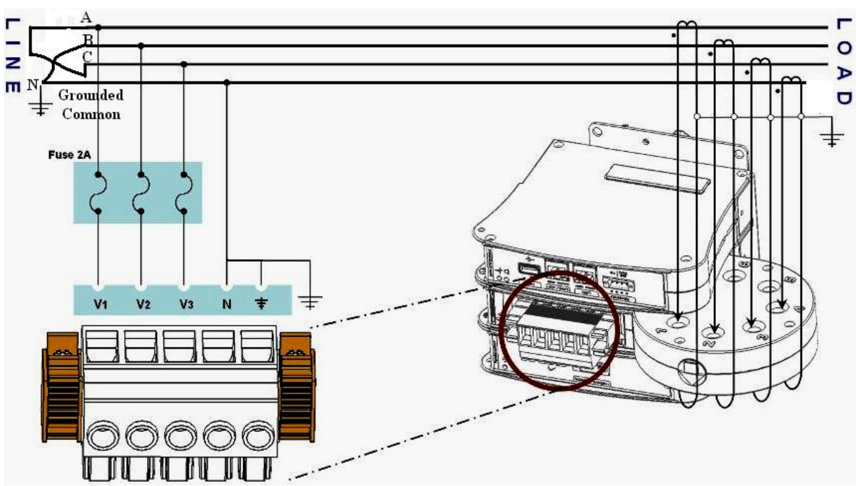


Figure 15: Wye 3 Wire Solid Grounded

Note: *You do not need to use PT's when the common point is grounded in this solid grounded system.*

Low Voltage Delta (<600 V)

Connections to a low voltage network require 3 current transformers Voltage connections are direct.

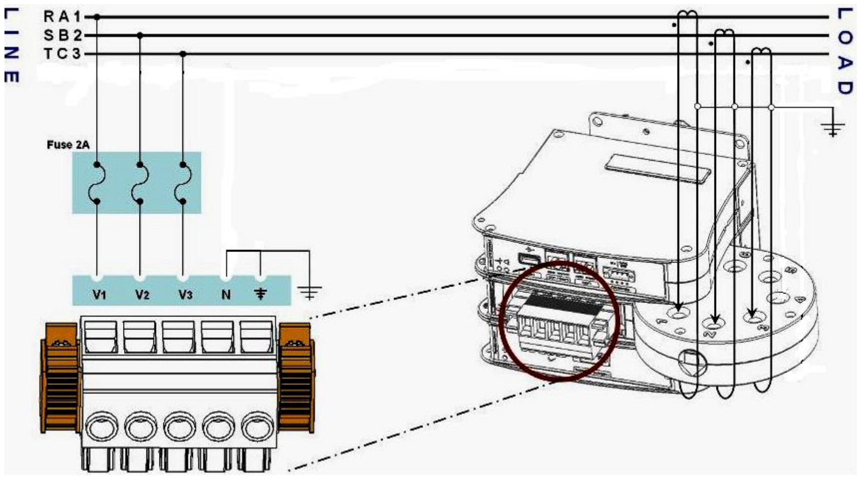


Figure 16: Low Voltage 3 Wire Delta

High Voltage Delta (>600V)

Connecting to a high voltage network requires 3 PTs and 3 current transformers.

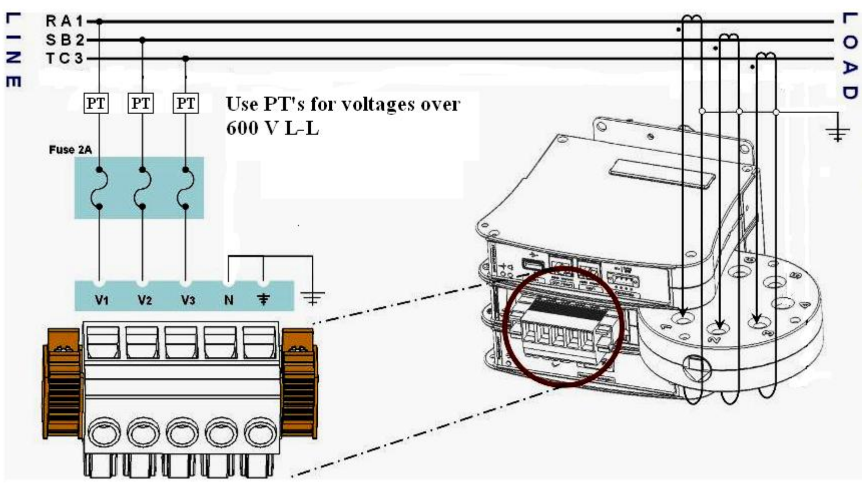


Figure 17: High Voltage 3 Wire Delta

Single Phase

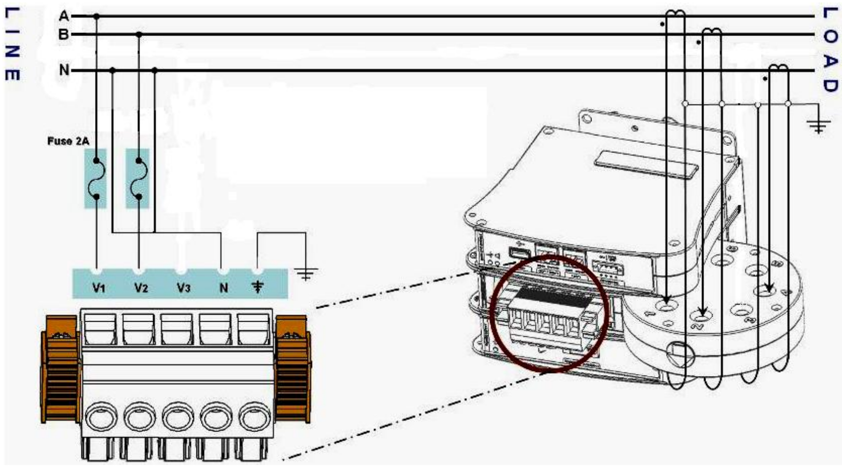


Figure 18: Single Phase

Step 6: Attaching the Temperature Connections (Optional)

The DSP module is equipped with an external connection terminal for a 2 wire PT-100 temperature sensor. The BLACKBOX is also equipped with two standard internal temperature sensors, one in the DSP module and the second in the Power supply module. The PT 100 temperature sensor is an optional device.

To attach the temperature connections:

1. Remove the Temperature Sensor Terminal block provided with the Elspec BLACKBOX package.
2. Attach lugged ends of wires to the terminal block using a properly sized screw driver.

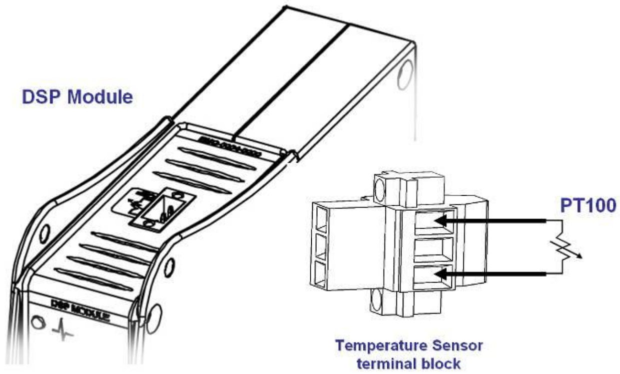


Figure 19: PT100 Temperature Sensor Connection

3. Insert the terminal block into the DSP module.

Step 7: Wiring the Communications

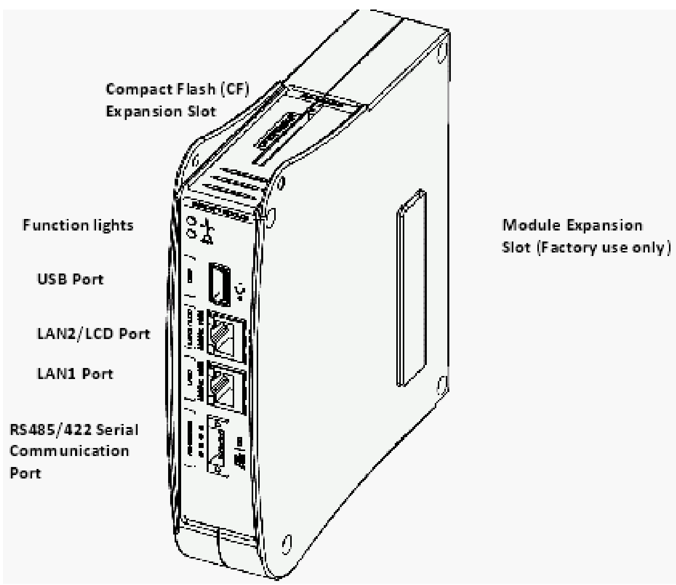


Figure 20: Connecting the Main CPU

Note: For a detailed listing of technical specifications, refer to Hardware Reference on page 157.

To wire the communications:

- Use the following data to wire the communications ports:

RS485/422

The RS485/422 serial communications hardware protocol is an industrial standard using 2 or 4 wires for communication. The wires are to be connected to the marked terminals on the CPU module. Described below are basic features of RS485/422:

- Voltage is typically 5V DC
- Cable is comprised of 2 shielded twisted pairs
- Typical length of cable is < 152 meters with no repeater
- Units are connected in multi-drop ("daisy chain") configuration. In 2 wire mode, the wires coming in and going out share the same terminal on the instrument
- Shield MUST be grounded, but **ONLY** at one point in the chain.

LAN1

The LAN1 Plug is a standard RJ45 receptacle connecting to any Ethernet LAN. This plug is also a PoE In plug, allowing supply voltage of 48VDC to be fed to the instrument on the same cable as the communications. The specifications for this connection are as follows:

- Connection via RJ45 plug
- Cable is to be of type CAT5 normal or crossed

LAN2/LCD

The LAN2/LCD Plug is a standard RJ45 receptacle connecting to any Ethernet LAN. This plug is also a PoE Out plug, allowing the supply of 48VDC to other instruments using the same cable as the communications. The specifications for this connection are as follows:

- Connection via RJ45 plug
- Cable is to be of type CAT5 normal or crossed

USB

Not currently supported

CF EXPANSION

Not currently supported

Power over Ethernet (PoE)

POE is a standard for feeding DC power to an RTU (Remote Terminal Unit) using the network RJ45 cable without the need for additional external power.

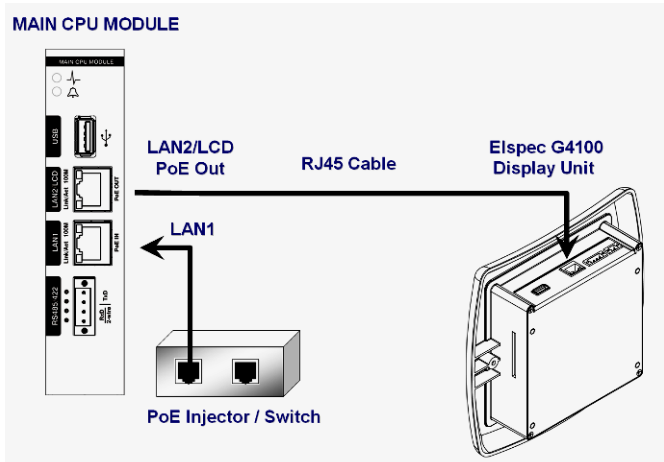


Figure 21: Power over Ethernet (POE)

The BLACKBOX contains two ports that support PoE:

- The LAN1 port can receive PoE injection from a remote source, enabling the Elspec BLACKBOX to operate. It is suggested that the LAN1 PoE be used as an alternative backup power source. To activate this PoE option, connect an RJ45 jack with PoE to the marked **LAN1 PoE In** on the CPU module.
- The LAN2/LCD port is a PoE injector capable of supplying power to other devices. The LAN2/LCD port can supply power for the Elspec G4100 Display unit. To activate this PoE option, connect an RJ45 jack to the port marked **LAN2/LCD PoE Out** on the CPU module, connecting the other end of the RJ45 jack to an Elspec G4100 Display unit.

Step 8: Powering Up the Unit

After the unit has been mechanically fastened and all voltage and current wiring is complete, you need to power up the BLACKBOX.

Preliminary Inspection before Power Up

Before applying supply power or activating measuring inputs the following precautionary measures must be taken:

- Verify that the unit is disconnected from the main power supply.
- Inspect all electrical and mechanical connections visually for mechanical damage and integrity of components and accessories.
- Inspect current transformer wiring for proper phase marking and for proper direction through the circular current block.
- Pull-test all control wiring to ensure secure seating in terminals.

To power up the unit:

1. Turn on the power supplying the unit

The LEDs on the power supply light up.

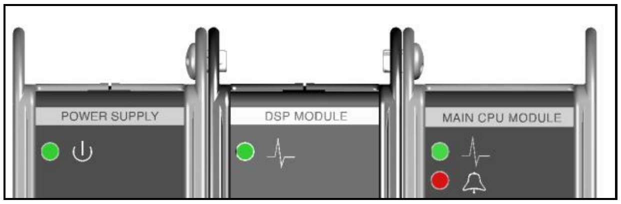


Figure 22: Status LEDs

***Note**: Wait approximately one minute until the startup process is complete.*

2. Verify the unit is operating correctly using the following table:

LED	Description
	Power Supply Module: Green signals external power exists. Red signals external power is out, unit will soon cease to function (25 seconds max.).
	DSP Module: Green signals normal operation. Blinks green during system boot.
	Main CPU: Module: Green signals normal operation.
	Red signals malfunction. See **Appendix L: Troubleshooting on page 225.** ***Note:** The red indicator light will be on until the unit is completely configured.*

Table 2: Powering Up

Chapter 2: Getting Started

Once the BLACKBOX has been correctly installed, wired into the electrical system, and powered up, the next step is to establish communication with the unit for the purpose of configuring, monitoring and storing PQZip files for analysis.

This section provides detailed instructions on connecting to the unit for the first time through the web interface using a desktop or laptop PC. You are directed through the network configuration, and finally the successful establishment of a communications link with the BLACKBOX.

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- **LAN and Internet** 26

CONNECTING TO THE UNIT FOR THE FIRST TIME 26

- **Required Equipment:** 26
- **Obtain the Search software** 26
- **Configuring the Network Connection** 28
- **Using the Automatic Search Utility – Elspec Search** 29

CONNECTION TROUBLESHOOTING 33

- **Disabling Proxy Server in Internet Explorer** 33
- **Entering IP Manually** 35
- **Changing the IP Configuration** 35
- **Connecting the Unit** 38

System Overview

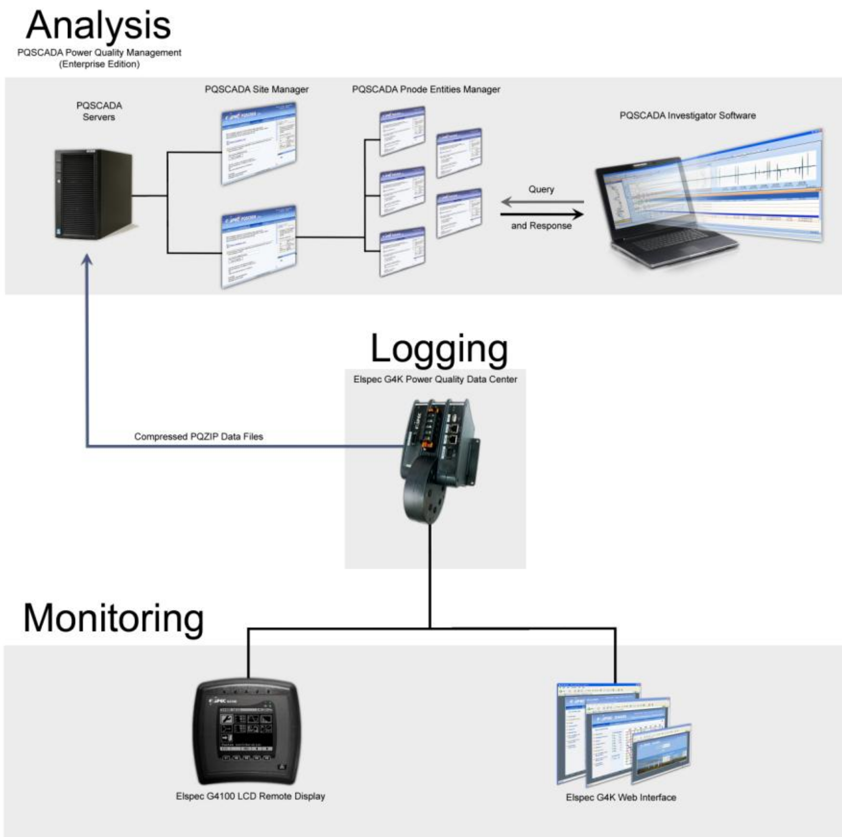

Figure 23: BLACKBOX System Overview

The BLACKBOX, with its integral web server, is an accurate electronic power meter capable of sampling both voltage and current waveforms at resolution of up to 1024 samples per cycle. The BLACKBOX has the capability of calculating relevant power quality parameters, and then compressing and storing the waveforms using the Elspec patented PQZip technology for collection by the PQSCADA Site Manager software.

PQSCADA Site Manager creates and manages nodes that collect, store, and analyze the compressed data from the BLACKBOX device(s).

Using the PQSCADA Investigator Software, it is possible to investigate and analyze power quality data from various locations around the electrical distribution system on the same time line. This allows you to accurately analyze any power quality event at any time.

The optional G4100 Display Unit enables configuring of the BLACKBOX and also displays all monitored real time values.

System Topology

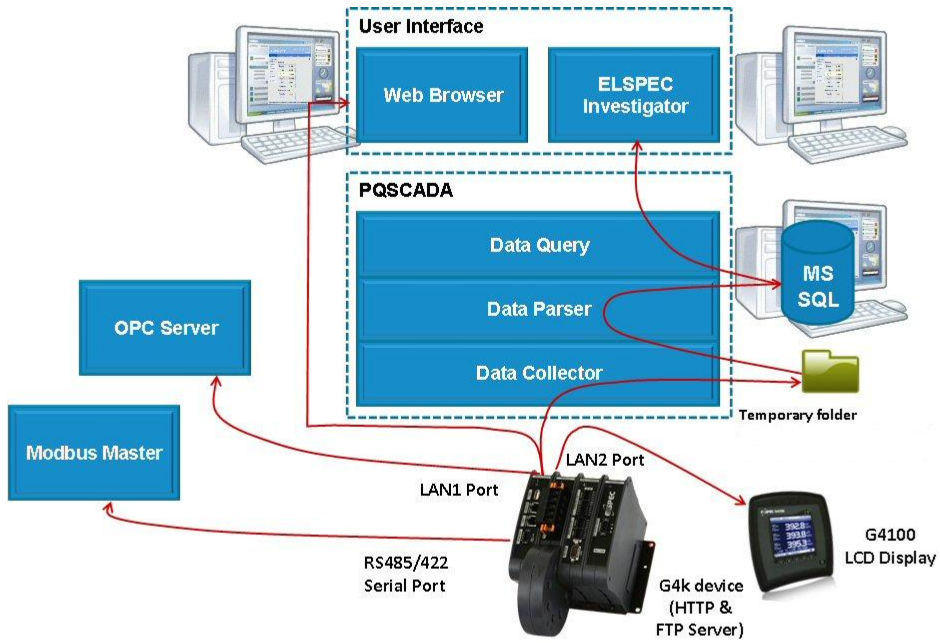

Figure 24: The System Topology

Communications

There are different ways to establish a first time connection with the BLACKBOX. The unit contains the following communications ports to facilitate each unique communications protocol.

- Two **Ethernet** LAN ports for communicating over TCP/IP.
- A single RS485/422 port for serial communications.

Note: *Refer to the **Communications** Specifications* ***on page 162*** *for protocols that can be used for these communications ports.*

LAN and Internet

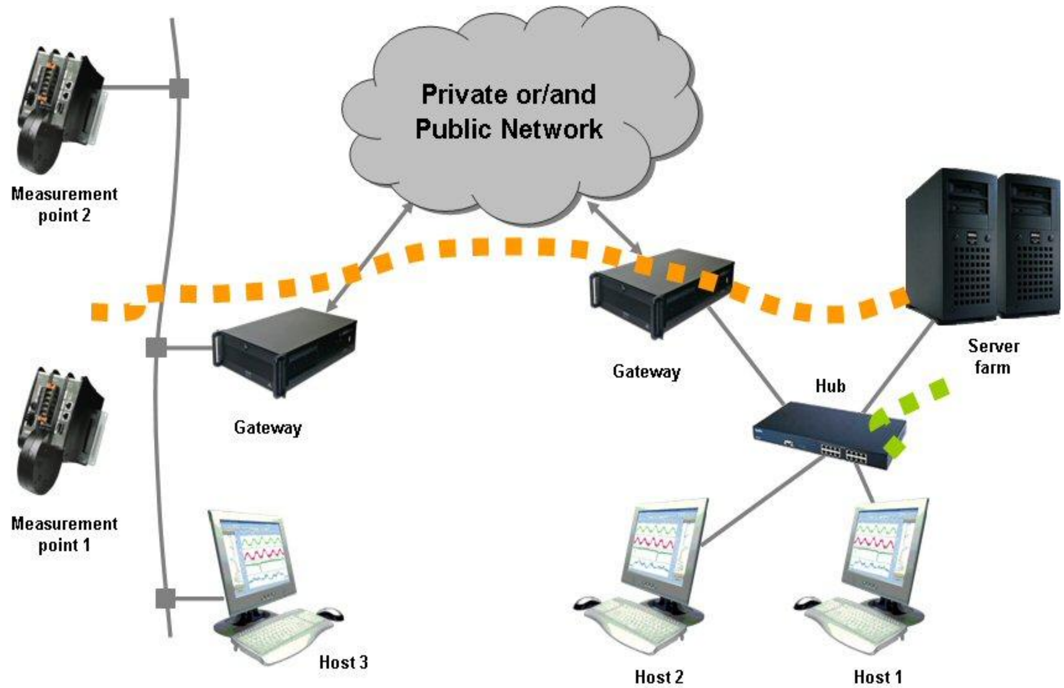

Figure 25: LAN/Internet Topography

Connecting to the Unit for the First Time

This following section describes how to achieve initial communication with the BLACKBOX for the purpose of configuring the instrument using the LAN port with IP connectivity.

Required Equipment:

- LAN cable with RJ45 plugs
- PC on same side of router with an Internet browser

Obtain the Search software

The Elspec search software is a utility that enables you to identify all BLACKBOX devices on the network.

You may obtain the Elspec search software either of the following ways:

- Download from the Elspec website
- Use the Elspec CD (if available)

To download the Elspec search:

1. Download the Elspec search utility program from this direct link: http://www.elspec.biz/ElspecG4k/ElspecSearch13.exe.

The download dialog box appears.

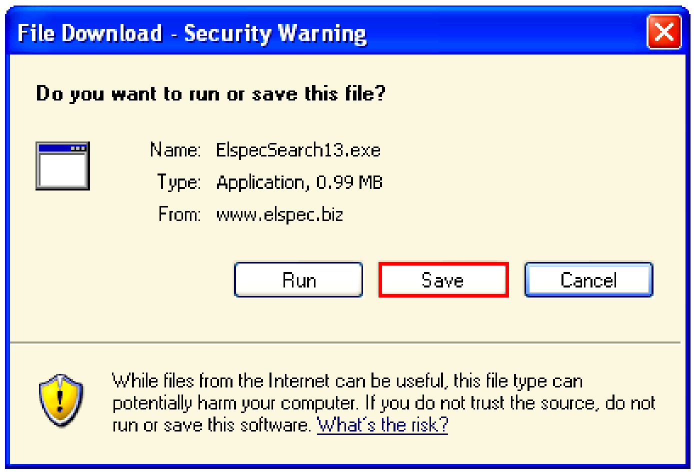

Figure 26: File Download Dialog Box

2. Click **Save.**

The Save As dialog box appears.

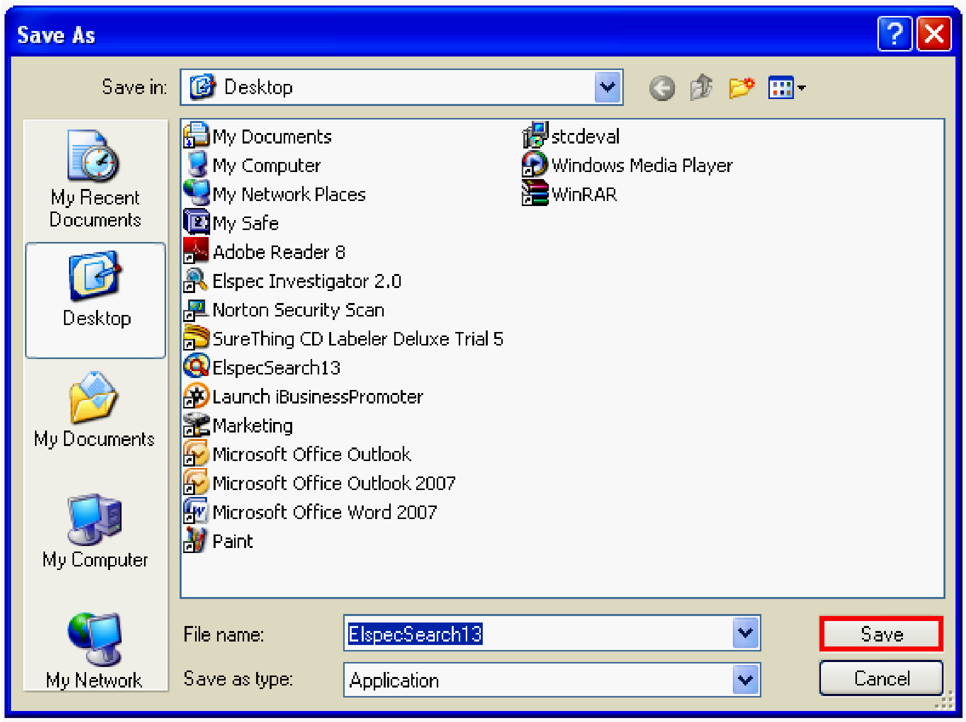

Figure 27: Save As Dialog Box

3. Save in desired location. (recommended on Desktop)

Configuring the Network Connection

The following steps describe how to connect to the unit for the first time:

Note: *There is no need to connect the PC directly to the BLACKBOX if they both are connected to the same LAN. See* ***Using the Automatic Search Utility on page 29****.*

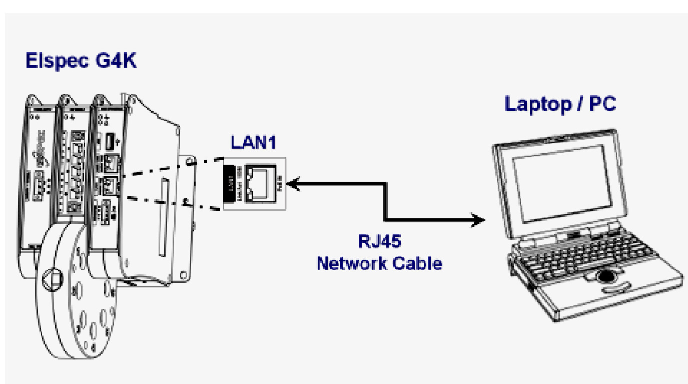

Figure 28: PC/Laptop to BLACKBOX Direct Connection

To connect to the network for the first time:

1. Disconnect the network cable linking your PC/Laptop to the server network.
2. Using the same cable (PC RJ45 interface), connect to the port marked **LAN1** on the BLACKBOX.
3. The green link-LED of the LAN1 connector begins to flash as Windows begins communicating with the unit.
4. Wait for about 2 minutes as the Windows operating system reverts to the default "**No Server" IP** configuration.

When this is completed, the **"Local Area Connection Status"** icon in the **"Quick Start**" tray will change to "Limited or no connectivity".

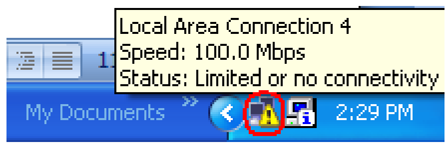

Figure 29: LAN Connection Status

5. Connect to the instrument using the **Automatic Search Utility**.

Using the Automatic Search Utility – Elspec Search

The most common method to connect the device to the PC is to use the automatic search utility – Elspec Search.

Note: *The Utility broadcasts "Discovery" transmissions over the LAN to which every unit responds with its configuration. The search cannot extend beyond the LAN area. The broadcast will extend across most hubs and switches, but will not pass gateways, routers or firewalls.*

To use Automatic Search

1. Click the **Elspec Search** icon. 

The Security Warning dialog box appears.

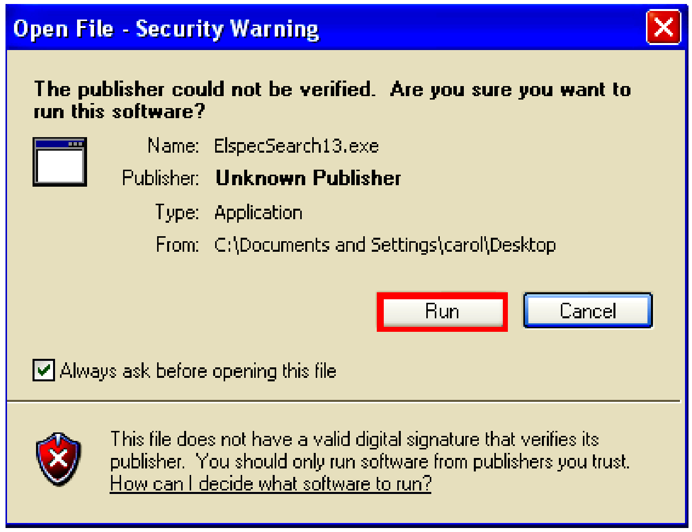

Figure 30: Security Warning

Note: *Only one occurrence of the Elspec search utility can be executed at one time.*

2. Click **Run**.

The Elspec Search window appears.

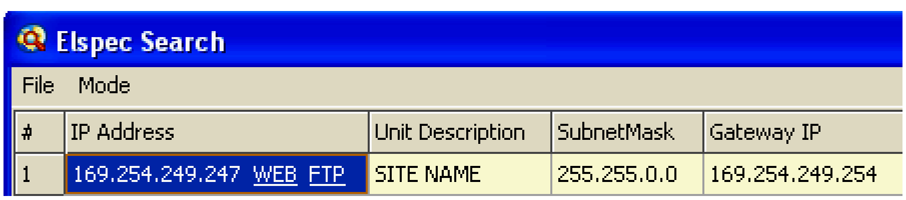

Figure 31: Elspec Search

3. Click **File→Refresh list**.

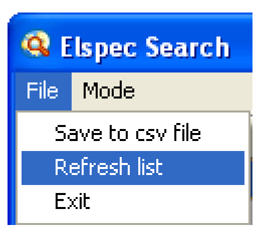

Figure 32: File Menu

> ***Note:*** *If Search does not find the unit, a blank screen will appear as below. You then need to verify perform the following procedure:*

a) Close all other running occurrences of the search or Investigator software

b) Click **File→Refresh List**.

c) If you still get a blank screen, then refer to **Entering IP Manually on page 35.**

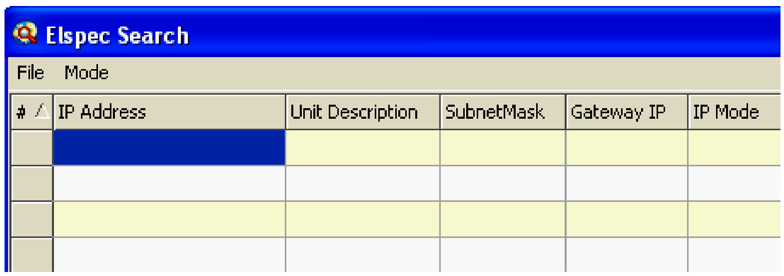

Figure 33: Elspec Blank Search

4. Select a specific device by clicking on the **WEB** link.

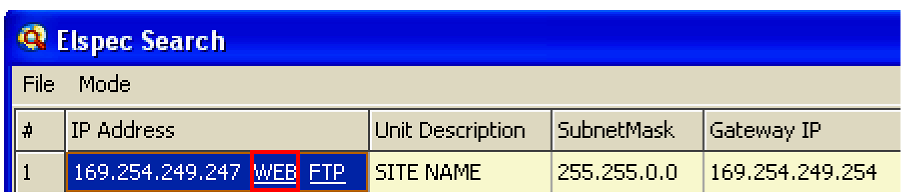

Figure 34: Web Link

The IE LOGIN page appears.

Figure 35: Login Page

5. If the Login page appears, proceed to Chapter 3 Setup.

> ***Note:*** *If the Login page does not appear and you see a screen as below, you need to refer to* ***Connection Troubleshooting on page 33.***

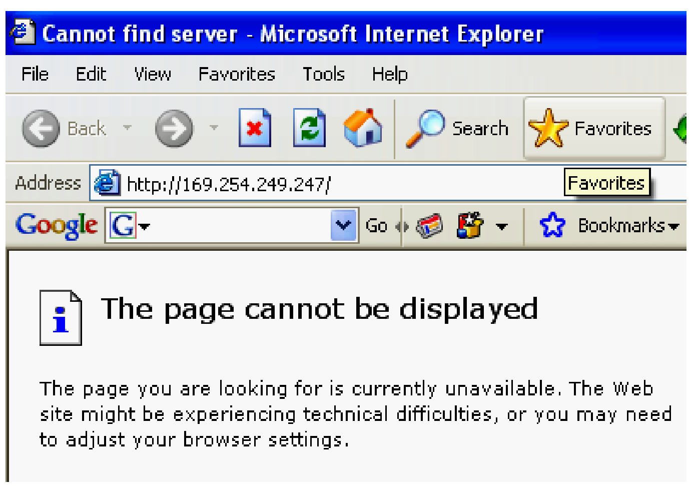

Figure 36: Error Login Page

Connection Troubleshooting

Disabling Proxy Server in Internet Explorer

The following procedure describes how to disable the proxy server setting in Windows XP.

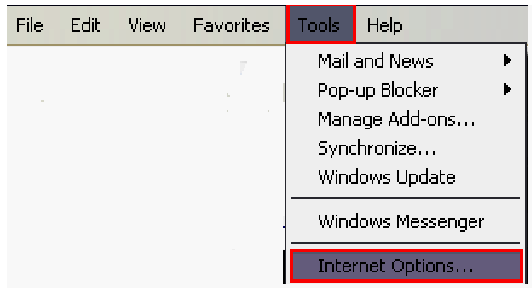

Figure 37: Main IE Window

To disable the proxy:

1. From the main IE main window, select **Tools→Internet Options.**

The Internet Options window appears.

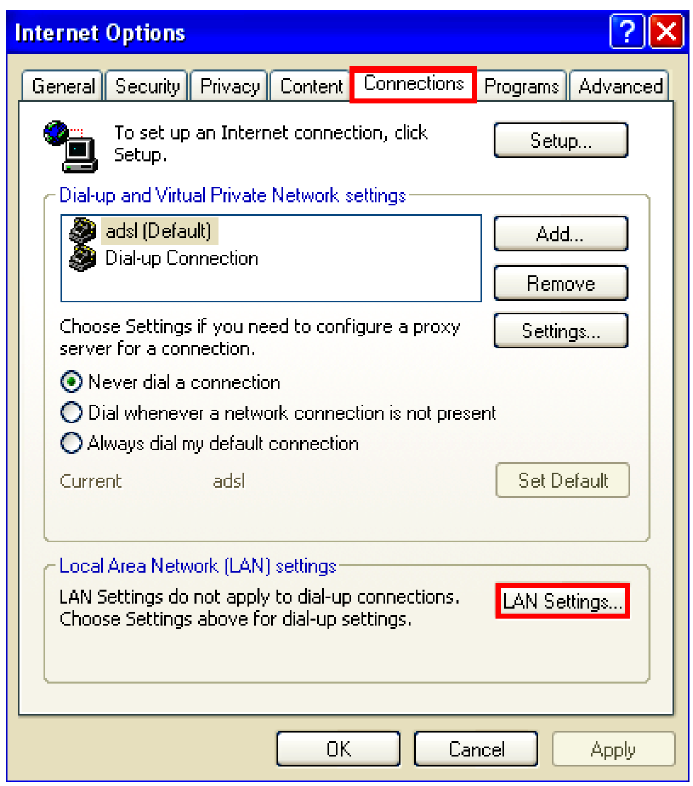

Figure 38: Internet Options

2. Select **Connection→LAN Settings**.

The LAN Settings dialog box appears.

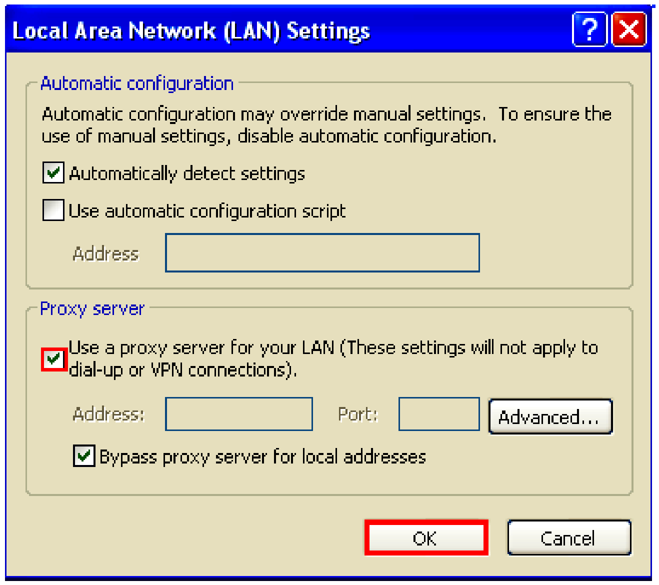

Figure 39: LAN Settings

3. Uncheck **Use a proxy server for your LAN**.
4. Click **OK**.
5. Press **F5** to refresh the Internet Explorer window.

The Login screen appears.

Figure 40: Login Screen 2

Entering IP Manually

If you are unable to automatically set your IP address, you need to manually enter an IP.

> ***Note**: Only perform this procedure if you are unable to automatically set your IP address.*

To enter an IP manually:

1. Open Internet Explorer or any Internet browser.
2. Type **169.254.249.247** into the address bar.
3. Click **Enter**.

> ***Note:** If the Elspec WEB page did not appear, then the IP configuration on the PC must be changed. Contact your system administrator for an available IP address in your network.*

Changing the IP Configuration

If you are unable to manually configure your IP consider the following:

- The BLACKBOX is programmed before leaving the factory with a default Internet protocol (IP) address of **169.254.249.247** and a default subnet mask of **255.255.0.0**.
- This default configuration typically fits the default network configuration used by the Windows operating system when no network server is detected.
- Windows operating systems use a default IP address in the range of **169.254.X.X** when no network server is found. This default configuration allows inter-connection with BLACKBOX WEB interface without any prior configuration on the PC side.
- If the default configuration of the PC has been changed, no connection will take place, since the BLACKBOX cannot find the PC.

> ***Note:** The purpose of the following configuration change is to allow for one-time communication with the BLACKBOX for the purpose of parameter setup. Carefully record all changed parameters in order to return your PC to its original network parameters.*

To change the IP configuration:

1. To open the Control Panel, click the network icon in the bottom tray.

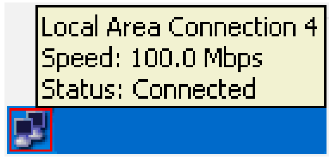

Figure 41: Network Icon

The LAN Status Window appears.

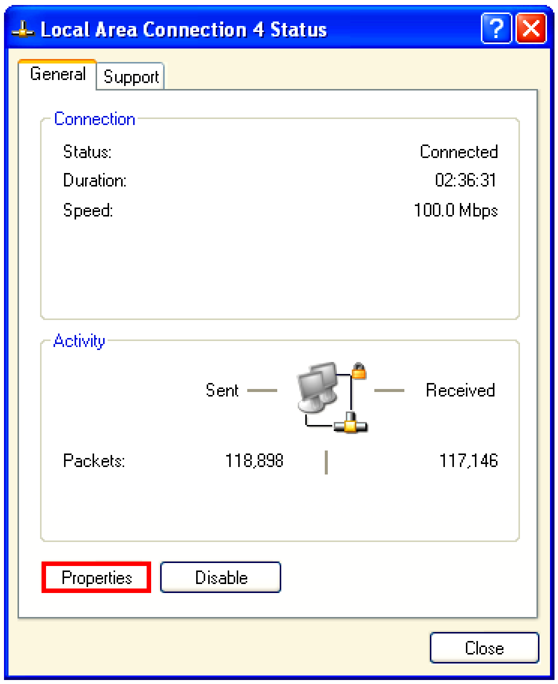

Figure 42: LAN Connection Window

2. Click **Properties**.

The LAN Properties window appears

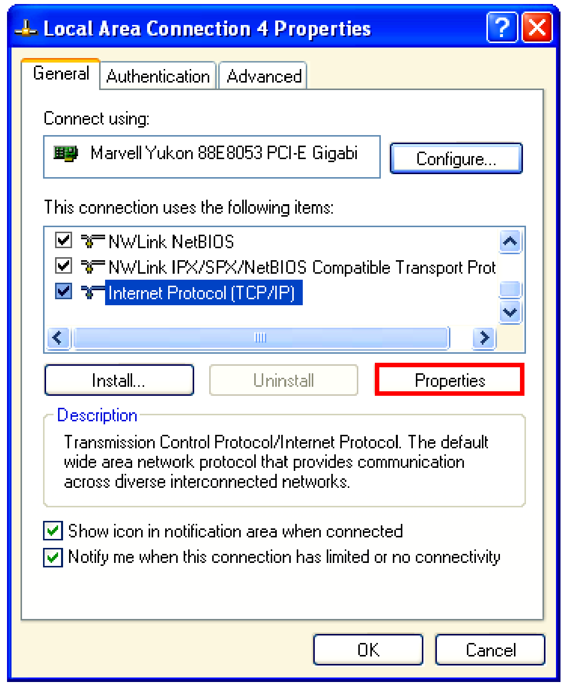

Figure 43: LAN Properties

3. Select **Internet Protocol (TCP/IP),** then Click Properties.

The TCP/IP Properties box will appear.

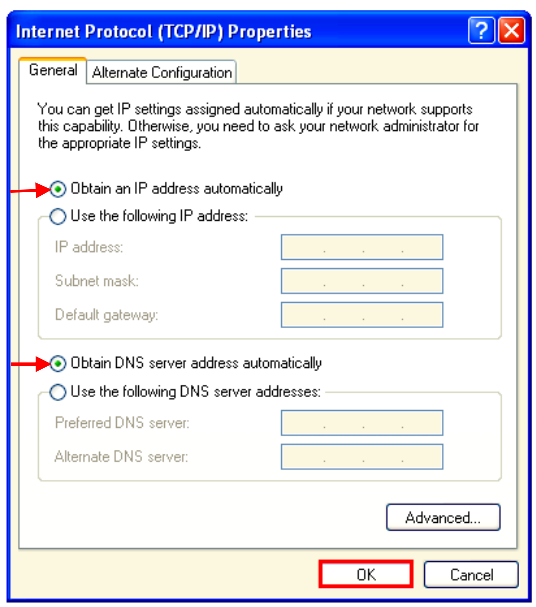

Figure 44: IP Properties Window

4. Select **Obtain an IP address automatically**.

5. Select **Obtain DNS server address automatically**.
6. Click **OK** to accept.

Connecting the Unit

Once the unit has been configured with a recognizable functioning IP address, then you need to configure the unit to the PC.

To connect the unit:

1. Disconnect the network cable linking your PC/Laptop to the server network.
2. Using the same cable (PC RJ45 interface), connect to the port marked **LAN1** on the BLACKBOX.
3. The green link-LED of the LAN1 connector begins to flash as Windows begins communicating with the unit.
4. Wait for about 2 minutes as the Windows XP operating system reverts to the default "**No Server" IP configuration**. When this is completed, the "**Local Area Connection Status**" icon in the "Quick Start" tray will change to "**Limited or no connectivity**".
5. Run the Internet Explorer (or any other internet browser).
6. Type the following IP address into the address bar: **169.254.249.247/**
7. Click **Enter**.

Note: *If you do not see the Login page, see* ***Connection Troubleshooting***

The Login WEB page of the BLACKBOX unit appears.

Figure 45: Login Web Page 2

Chapter 3: Setup

Once a successful communications link has been established with The BLACKBOX, you need to perform the first time setup and configuration. This is accomplished by configuring the unit setup using a standard web browser. The following section provides detailed instructions on how to configure the unit for the first time.

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Configuring the BLACKBOX

This section begins with the Login WEB page of the BLACKBOX, and guides you through a specific order of operations as follows:

- Web Page Login
- Unit Setup
- Network Setup
- Power Setup
- Event Setup
- Display Setup
- RS 485/422 Setup
- Firmware Setup
- PPP Setup
- PQzip Enable

Note: *For additional communication method, see* ***Appendix J: Communication Methods on page 223.***

Logging into the Website

Once a successful communications link has been established with the BLACKBOX, the main login screen will appear.

Figure 46: Login Web Page 3

To login to the Website:

1. From the Main menu, choose the preferred language.
2. Enter **12345** as the initial password**,** then click **Login.**

Note: *You may change your password in the Unit setup section after your initial LOGIN**.***

The Main menu Summary screen appears

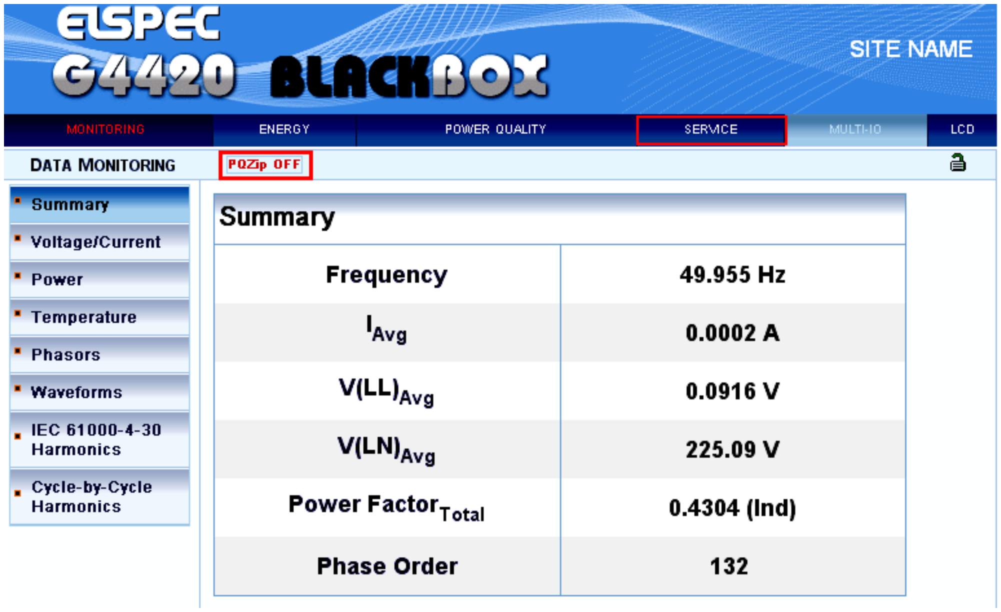

Figure 47: Summary Screen

3. Select **Service** under the main header display

The Service Header page opens to the Unit Setup Page.

Figure 48: Service Heading

Note: *You must perform Network Setup and Power Setup before any procedures that follow. Failure to do so may result in inaccurate measurement and lost communication. The order of all other set up operations is not critical.*

4. Perform all setup functions in order as presented.

Configuring the Unit Settings

This purpose of this setup is to assign specific attributes to the BLACKBOX.

To configure unit settings:

1. From the Service menu, Click **Unit Setup**.

The Unit Setup window appears under the Service header.

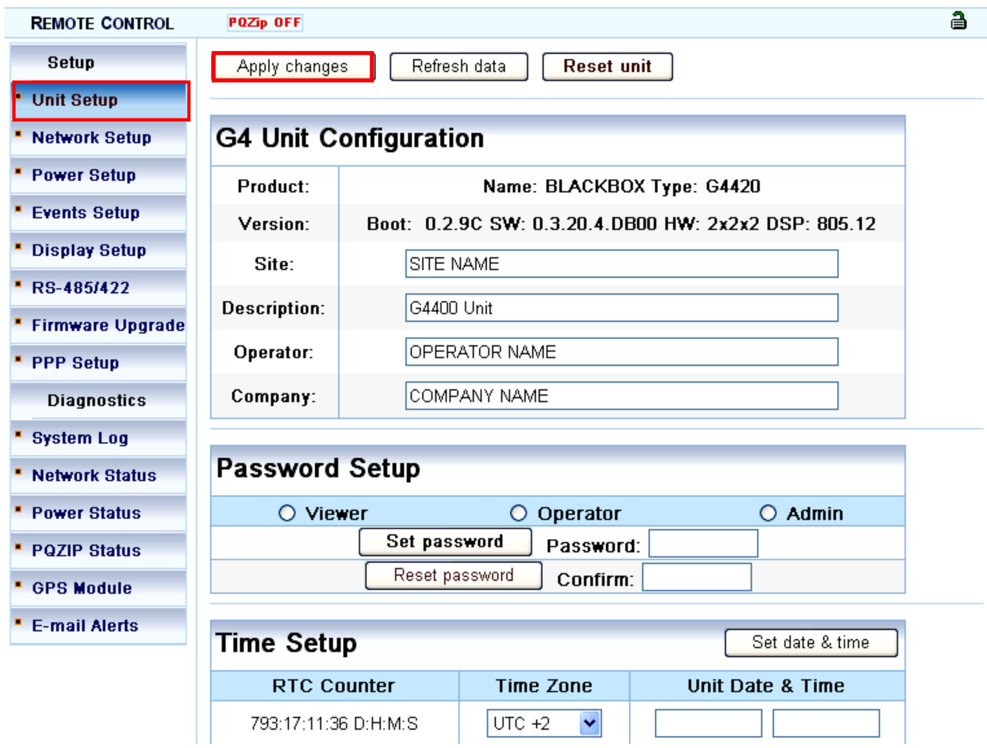

Figure 49: Unit Setup

2. Fill in the unit attributes.

Attribute	Description
Site	identifies the instrument by location name
Description	Identifies the type of instrument
Operator	indicates the main operator's name
Company	indicates the company/owner’s name
Password Setup	Select the desired level of Password access. (Viewer, Operator, Administrator) The Elspec BLACKBOX supports three access levels: Each level has a pre-set access password which can be changed by the administrator only.
Viewer	View system trends and data without modifying system data.

Attribute	Description
Operator	Performs ongoing system operational activities including changing basic parameter settings.
Administrator	Ability to change and reset every available network parameter (highest access level).
Set Password	Type in a password ○ **User**: 3 characters ○ **Technician**: 4 characters ○ **Administrator**: 5 characters. 1. Type in the same password for confirmation 2. Click set Password.
To reset the Password to the default 12345:	• Click Reset Password button. • Type the Admin password into the pop up authorization box.
Time Setup	• Select Local Time zone from drop down menu. (Expressed in relation to UTC). • Enter Unit date and time. • Click Set date & time. Note The Time Zone is used for time and date display only and not for storage of data or events. All data being logged by the unit will use UTC time stamping.

Table 3: Unit Setup

3. Click **Apply Changes** when complete.

Configuring the Network Setup

The Network setup is a crucial part of the BLACKBOX configuration. This setup procedure establishes the IP address of the unit in the network.

> ***Note:*** *If any one of the following: IP address, subnet mask or gateway, have been changed, the unit will reboot and restart with the new Network settings.*

To configure the network setup:

1. From the Service menu, select **Network Setup**.

The Network Setup menu appears.

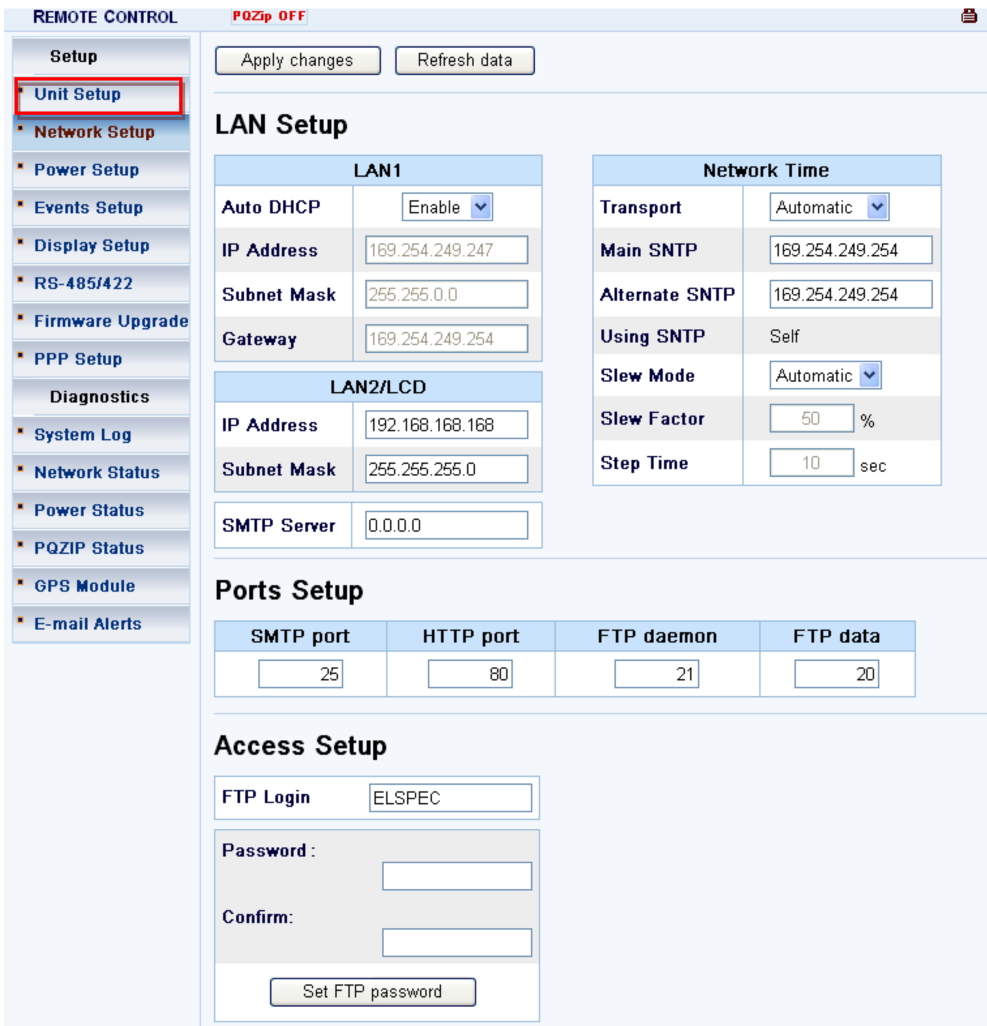

Figure 50: Network Setup

Each BLACKBOX unit must be configured to work in the host communication network.

2. Complete the Network Setup as follows
    - LAN 1
    - LAN 2
    - Network Time
    - Ports Setup
    - Access Setup

Configuring LAN 1

In most cases, the unit needs to have a fixed IP address. The reason for this is that we want to the unit to have a unique fixed IP address. In each network the available IP's are different; therefore before assigning the IP address to the unit, you must consult the IT manager.

To configure LAN 1:

a) Choose **Auto DHCP Disable**.

b) Enter the IP address obtained from the IT manager.

c) Enter the Subnet Mask.

d) Enter the Gateway (optional in many cases).

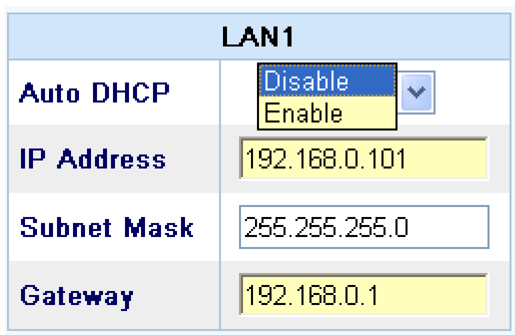

Figure 51: LAN1 Setup

Attribute	Description
Auto DHCP	• **Enable**: If enabled the following LAN1 parameters are configured by the LAN DHCP server (if available). • **Disable**: If disabled the following parameters are available for configuring the LAN.
IP Address	This is the assigned IP address for LAN 1 port on the instrument Obtain an available IP address from the system administrator.
Subnet	For this port on this instrument Obtain an available Subnet Mask address from the system

Mask	administrator.
Gateway	The IP address of the gateway for this LAN Obtain an available Gateway address from the system administrator.

Table 4: LAN 1

Configuring LAN 2

LAN 2 is primarily used for G4100 LCD Display connection. If no display is used, there is no need to configure LAN 2. If using an LCD, most cases do not require changing the default configuration.

To configure LAN 2:

- Change the relevant parameters using the table below.

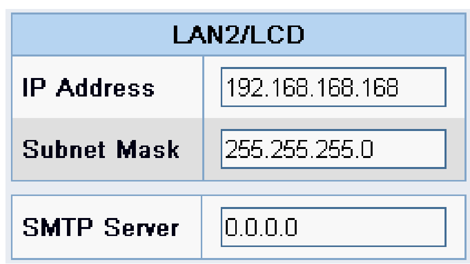

Figure 52: LAN 2

LAN 2	Function
IP Address	IP address for this port on the instrument. It is recommended that the default address of **192.168.168.168** be retained in order to enable plug and play compatibility with the Elspec G4100 LCD remote screen viewer.
Sub-Net Mask	Subnet mask for this port on the instrument. It is recommended that the default address of **255.255.255.0** be retained in order to enable plug and play compatibility with the Elspec G4100 LCD remote screen viewer.
SMTP Server	Address of the email server which supports **SMTP**.

Table 5: LAN2

Note: *The IP/Subnet of LAN1 and LAN2 need to be configured for different networks.*

Configuring Network Time

Each measured signal is time-stamped. The source of the timing signals is defined in the following section. This is especially important when you have multiple units in several locations All Elspec BLACKBOX instruments are carefully and precisely synchronized in order to ensure that the PQZip data from each unit in the electrical network represents the same time frame. See **Appendix G: Time Synchronization Technology on page 207.**

This is accomplished by using a reliable external time source such as a GPS module or SNTP/NTP server.

In a typical installation, the first installed instrument is configured with the address of either an industrial type NTP server equipped with a GPS receiver or an internet based NTP server such as the open access NTP server found at **209.51.161.238**.

Additional Elspec BLACKBOX units installed on the same LAN can use the first unit as their time source by typing in the IP address of the first unit into this box.

It is also possible to use an internal clock, but it is not as accurate as NTP or GPS time sources.

To configure network time:

- Configure network time parameters using the table below.

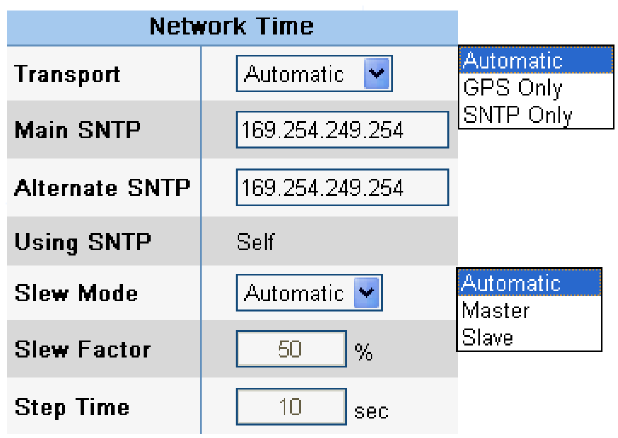

Figure 53: Network Time

Network Time	Function
Transport	**Automatic**: the unit chooses the best time source available automatically.
	GPS: the time source is a GPS/GPS+PPS or IRIGB input
	SNTP: the time source is SNTP (Simple Network Time Protocol).
Main SNTP	The primary SNTP source.

Network Time	Function
Alternate SNTP	Alternate SNTP source.
Using SNTP	Current Time Source.
Slew Mode	**Slew mode**: In case of a difference between the unit time and the external time source, this mode defines the method in which the unit will close the gap.
	Automatic: The unit decides the method of tracking the time source
	Master: The unit increments in small steps to synchronize with the time source
	Slave: The unit increments in large steps to synchronize with the time source.
Slew Factor	The interval of each step as it approaches the time source. Expressed as a percentage (%)
Step Time	A fixed time limit assigned to establish the minimum gap allowed to synchronize the unit time in one step.

Table 6: Network Time

Note: *If the unit time is unsynchronized, contact Elspec technical support before changing the Slew mode.*

Configuring the Ports

In most cases, the default values of the Ports setup should not be changed.

The Ports Setup provides the option to use different ports other than default for each protocol. This setup option is especially useful with unique network configurations.

To configure the ports:

- Use the table below to configure the ports.

Ports Setup

SMTP port	HTTP port	FTP daemon	FTP data
25	80	21	20

Figure 54: Ports

Port	Function
SMTP port	An assigned value that establishes the target port number for sending emails.
HTTP port	An assigned value that establishes the port number of the HTTP server.
FTP daemon	An assigned value that establishes the port number of the FTP server.
FTP data	An assigned value that establish to data port number f/ FTP protocol.

Table 7: Ports

Note: *Consult your IT Manager before changing any port configuration.*

Configuring Access Setup

The Access Setup is used to configure the user name and password of the FTP server on the unit.

To configure access setup:

- Use the table to fill in the access information.

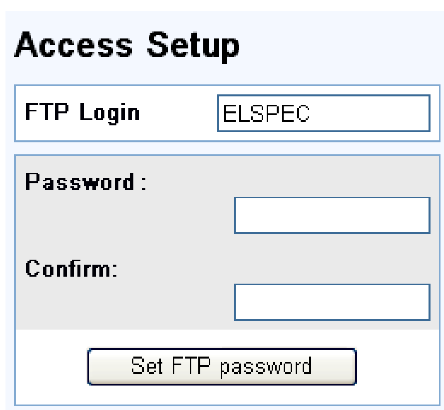

Figure 55: Access Setup

Access parameter	Function
FTP Login	Enter FTP user name
Password	Unique Password (minimum 8 characters)
Confirm	Re-type Password
Set FTP Password	Click **Set FTP Password** to apply changes.

Table 8: Access Setup

Note: *Refer to the PQSCADA Manual in order to change FTP access.*

3. Click **Apply Changes** when complete

Note: *After applying changes, the unit's IP is configured to the LAN, but not longer fits the windows default network therefore we are no longer able to connect*

Note: *Any change in LAN 1 settings require* ***Reconnecting to the BLACKBOX below****.*

Reconnecting to the BLACKBOX

1. Close the Explorer screen
2. Disconnect the network cable from the LAN 1 port on the BLACKBOX.
3. Using the same cable (PC RJ45 interface), connect to the LAN jack on your network.
4. Connect another RJ45 cable from the BLACKBOX to the network jack.
5. On the Elspec search screen, Click **File→Refresh list.**

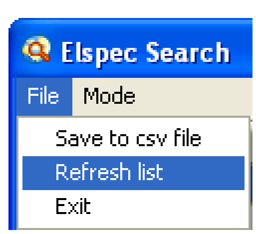

Figure 56: File Menu 2

6. Select a specific device by clicking on the **WEB** link.

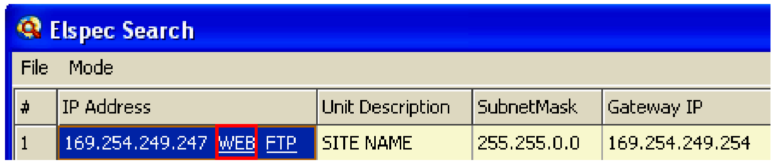

Figure 57: Web Link 2

The LOGIN page appears.

Figure 58: Login Page 2

7. Continue Network Configuration through the LAN

Configuring Power Setup

The BLACKBOX must be configured with the proper electrical input parameters for the system. The most important parameters are the nominal values of the measured network and the PT/CTs ratios.

To configure power setup:

1. From the main service menu, click **Power Setup**.

The Power Setup window appears.

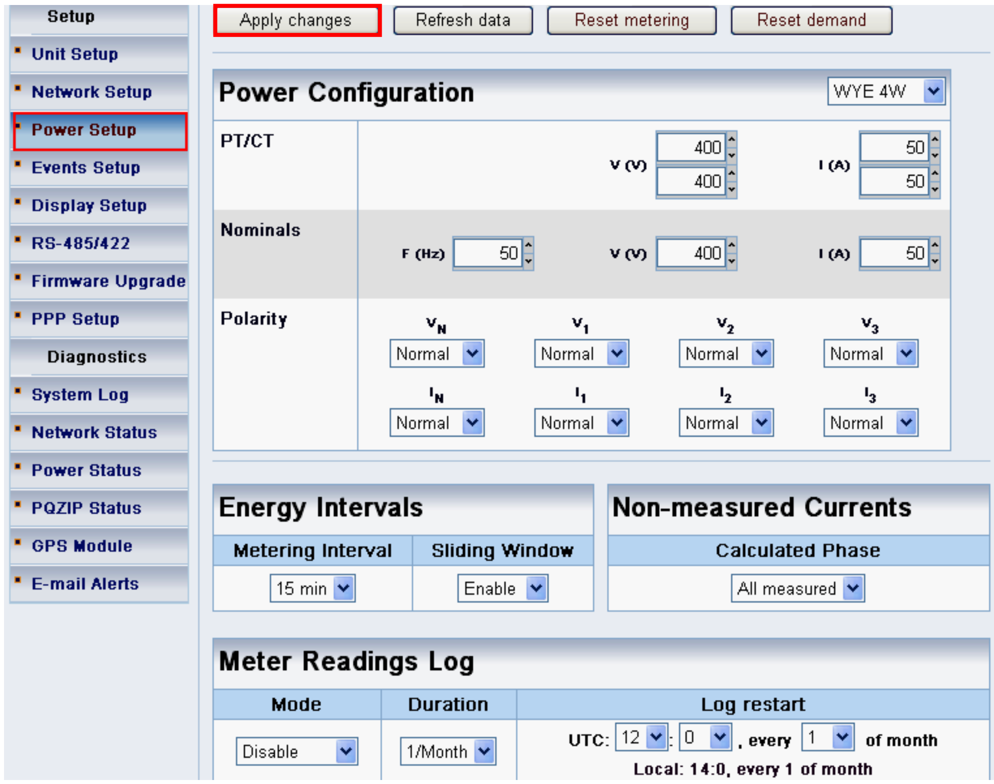

Figure 59: Power Setup

2. Complete the Power Setup configuration as follows:

- Power Configuration
- Energy Intervals
- Non-Measured Currents
- Meter Readings Log

Power Configuration

All power parameters must be completed to configure power.

To configure power:

- Use the table below to configure the power.

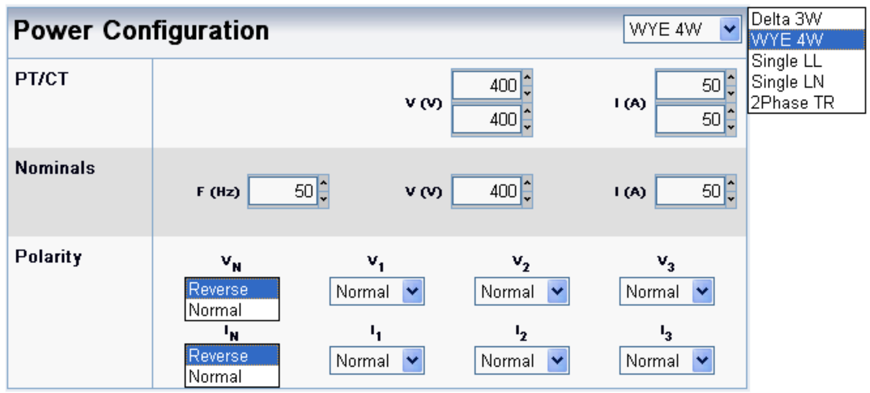

Figure 60: Power Configuration

Power Configuration	Definition
Configuration Type	• **Delta 3W** Delta 3 Phase • **WYE 4W** Wye 3 Phase with Neutral • **Single LL** Single Phase Line to Line • **Single LN** Single Phase Line to Neutral • **2 Phase TR** Australian split phase transformer
PT/CT	**PT V (V):** Input the primary voltage value in the top box and the secondary voltage in the lower box.
	CT I(A): Input the primary current value in the top box and the secondary current in the lower box
Nominals	• **F(Hz)** input for nominal system frequency • **V(V)** input for nominal system voltage • **I (A)** input for nominal system current.
Polarity	You can reverse polarity on any of the phases here in the event that current carrying wires are connected in the correct direction. (Vn. V1, V2, V3, In, I1, I2, I3).

Table 9: Power Configuration

Note: *It is possible to correct for polarity and mismatched current and voltage connections in the software, although it is recommended to wire in appropriate polarity in the initial setup.*

Note: *The nominals are set automatically to the primary CT/PT. Incorrect setting of the nominal values can cause incorrect measurements.*

Configuring Energy Intervals

The BLACKBOX utilizes three energy meters:

- Current Period
- Total Consumption
- Demand

The energy calculations are configurable with regards to the time and the method of averaging.

To configure energy:

- Enter the energy information using the table below.

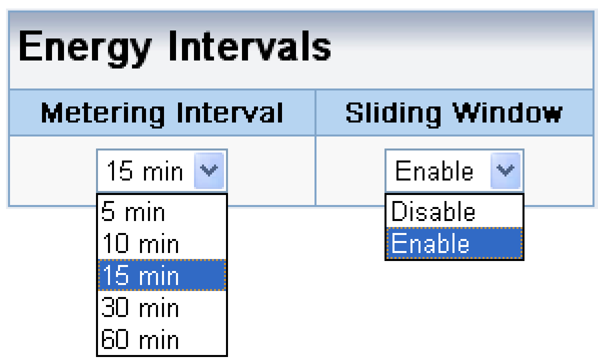

Figure 61: Energy Intervals

Energy Interval	Function
Metering Interval	Establish a configurable period of time (5, 10, 15, 30, 60 minutes) to measure demand metering and reporting interval
Sliding Window	• **Fixed Time Interval**: the energy is calculated using a fixed time average • **Sliding Window**: **refers only to the demand meter**. The energy is calculated using moving average time intervals (1 second).
	Disable: the energy is calculated using a fixed time interval. (see figure 62 below)
	Enable: the energy is calculated using a sliding window**.** (see figure 63 below.

Table 10: Energy Intervals

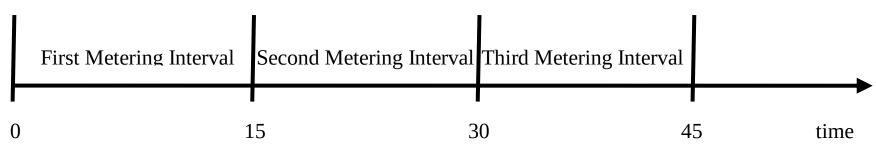

Figure 62: Fixed Time Interval

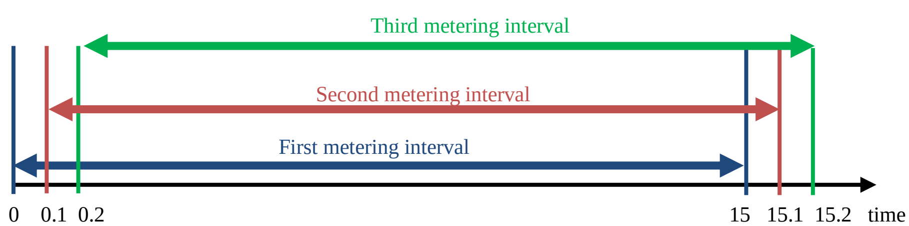

Figure 63: Sliding Window

Note: *In the figure above, the sliding window time difference is 0.1 minute. In reality, the time increment is one second.*

Configuring Non Measured Currents

The parameter options change according to the power configuration (WYE or Delta)

To configure non measured currents:

- Configure using appropriate tables below for WYE or Delta.

WYE

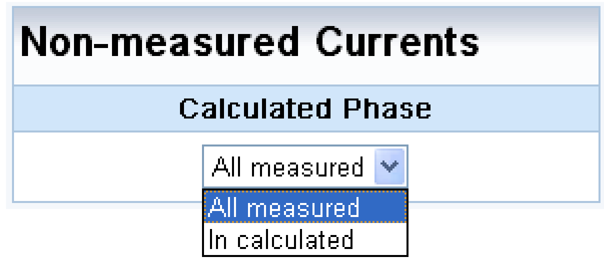

Figure 64: Calculated Phase

Power Type	Function
3 Phase 4 wire WYE	• **All measured**: All signals are measured. • **In Calculated**: $I_{N:}$ Neutral current channel is calculated.

Table 11: Non Measured Currents

Delta

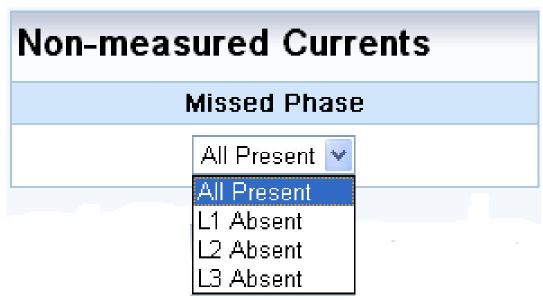

Figure 65: Missed Phase

Power Type	Function
3 Phase Delta	• **All Present**: All signals are measured. • **L1: Absent**: Phase 1 is calculated. • **L2: Absent**: Phase 2 is calculated. • **L3: Absent:** Phase 3 is calculated.

Table 12: Missed Phase

Configuring the Meter Readings Log

The BLACKBOX is capable of logging and saving on the compact flash two types of logs; energy log and parameter log:

Energy Log: The information from the total energy meter and the information. The information is saved on the compact flash in /CF_UPMB/Reports in a .csv file format. (comma separated values) and can be viewed in Excel. This report can also be configured to be sent as an email attachment. The values that are saved in this report:

- Kwh In
- Kwh Out
- KVArh In
- KVArh Out
- KVAh

> ***Note:*** *The values of the total energy meter are saved in the PQZip files even if the Meter Readings Log is disabled.*

Parameter Log: Parameter log saved by default the following values:

- **Kw -** average standard deviation maximum and minimum
- **Frequency -** average standard deviation maximum and minimum
- **KVAr -** average standard deviation maximum and minimum

> ***Note:*** *The parameter log can be customized to any other three parameters. The configuration needs to be done only through Elspec.*

To configure the meter readings log:

- Use the table below to configure.

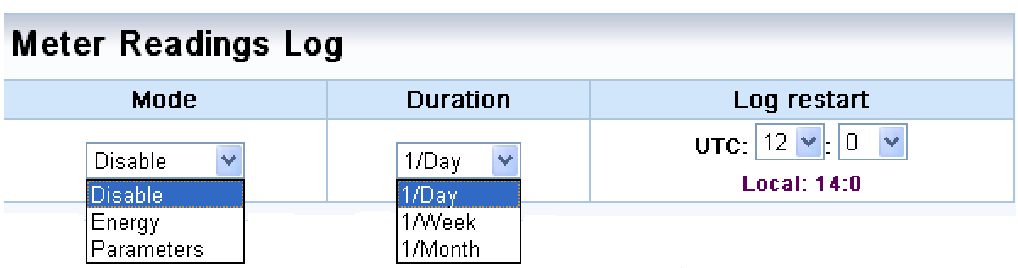

Figure 66: Meter Readings Log

Meter Readings Log	Function
Mode	• **Disable**: report log is disabled. • **Energy**: energy report is enabled. • **Parameters**: data meter report is enabled.
Duration	• **Day**: the duration of the report is one day (24 hrs). • **Week**: the duration of the report is one week. • **Month:** the duration of the report is one month.
Log restart	The starting time point of the duration expressed in **UTC**.

Table 13: Meter Readings Log

3. Click **Apply Changes** when complete.

Configuring Events

This is a custom setup procedure that defines unique events which are set by user request. The configuration can be based on any of the following:

- Preset 1
- Preset 2
- User Defined

To configure Events:

1. From the Service menu, click **Events Setup**.

The Events Setup window appears.

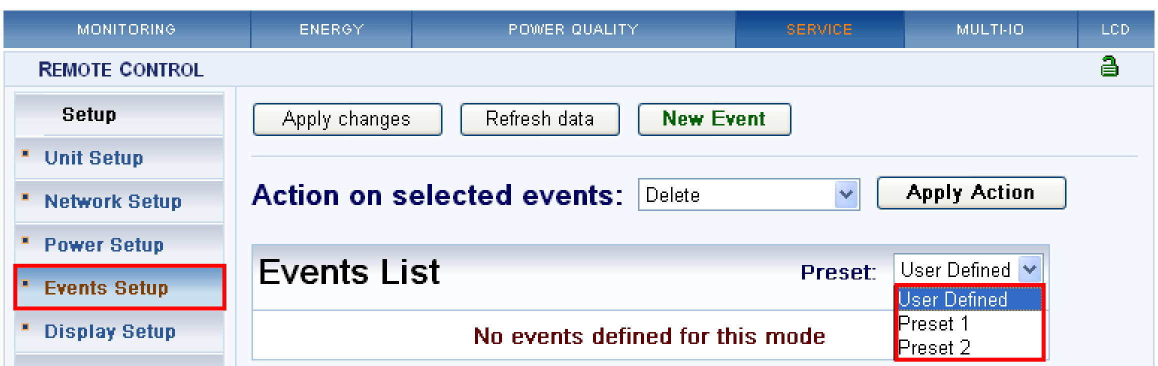

Figure 67: Events Setup

2. Select the desired Preset.
3. Configure using the appropriate table below.

Preset Events

A set of predefined events to be used with the unit in different types of installations.

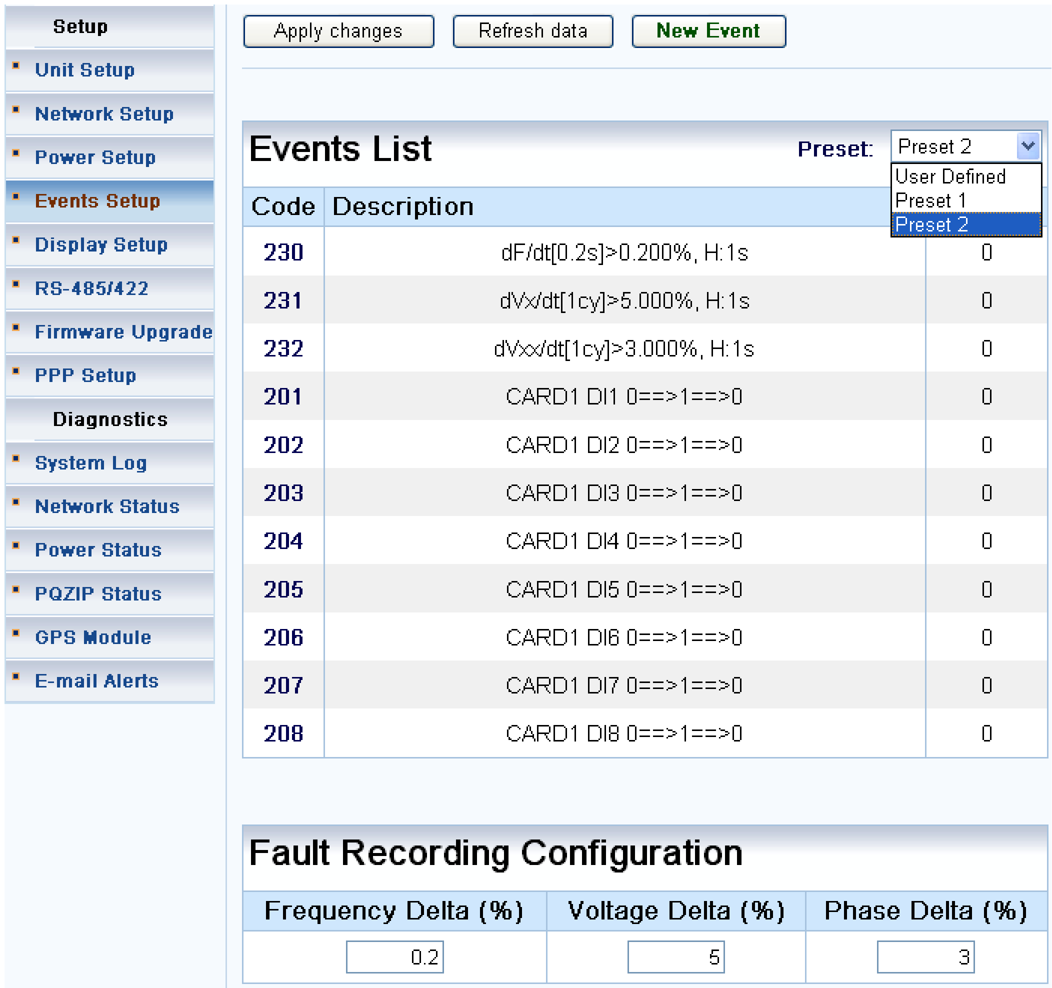

Figure 68: Events Setup

Events List	Definition
User Defined	Refer to the **User Defined** **on page 63.**
Preset 1	**3PH Iunbal>10% + Iavg>2%:** 3 phases current unbalance greater that 10% and average current greater than 2%.

Events List	Definition
	DI1 Low-DIG & 3PH I_H5>10% Fund: digital input 1 is low and harmonic #5 of the current of the 3 phases is greater than 10% of the fundamental.
	DI1 Low-DIG & Q total<-500kVAr digital input 1 is low and total reactive power less than 500 kilovolts ampere reactive
Preset 2	**dF/dt[0.2s]>0.200%,** H: 1s: rate of change of the frequency over 200 ms. is greater than the configured value.
	dVx/dt [1cy]>10.000%, H: 1s: the rate of change of the voltage in one cycle is greater than the configured value. Note The event does not start if voltage is less than 10% of the nominal.
	dVxx/dt [1cy]>3.000%, H: 1s (the rate of change of the phase to phase voltage in one cycle is greater than the configured value. Note The event does not start if voltage is less than 10% of the nominal.
	Multi I/O card: For each card there will be 8 additional events. One for each digital input.

Table 14: Events List

Note: *The Fault Recording Configuration window will only appear if the selected preset is Fault Record.*

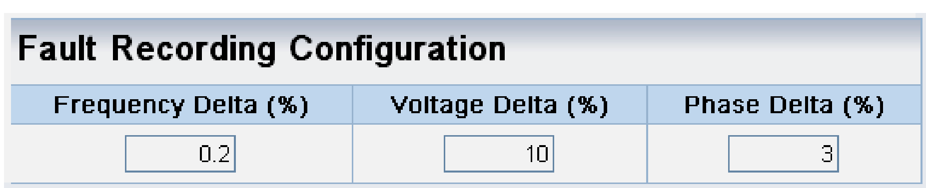

Figure 69: Fault Record Configuration

Value	Description
Frequency Delta %	The lower limit for a frequency rate change event (230).

Value	Description
Voltage Delta %	The lower limit for voltage rate change event (231)
Phase Delta	The lower limit for phase to phase voltage rate change event.(232)

Table 15: Fault Recording

User Defined

A custom event is a fully defined user event that enables the user to get a notification of an event occurrence in the BLACKBOX device. An event is typically a changed state of some real-time measured parameter/s. An event is identified by a descriptive string and a unique code (number). The code is auto selected by the system from a pre-defined range, and it is further used to represent the event when being recorded in the system log, PQZIP, or Email notification

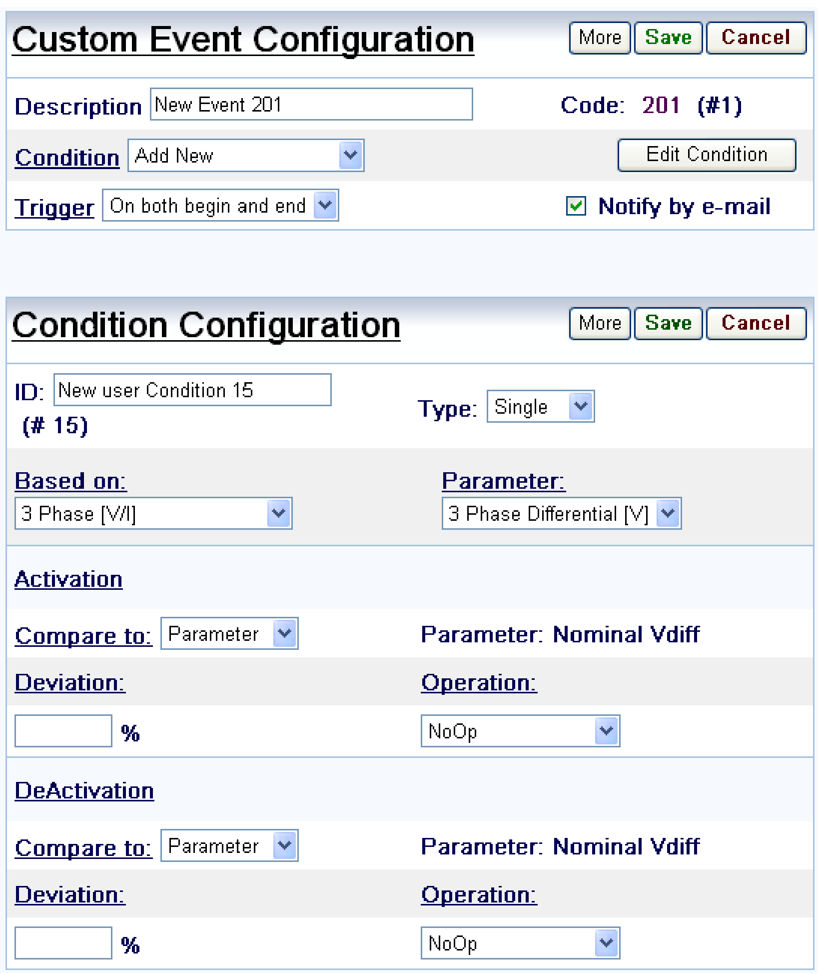

Figure 70: Custom Events

Parameter	Definition
Condition	Event is based on one or more conditions. There are two types of conditions "Single" and "Multiple", refer the condition configuration area for further information. No matter what type of condition is linked to the event, the linkage between an event and its dependent condition is by its ID string which appear in the selection list below
Trigger	Event is basically a logic signal. Anytime condition is not active the event remains in 0 state. When condition is met, the event becomes 1 state (beginning of event). The event remains on (1 state) until condition is de-activated (end of event). The trigger configuration field defines on what situations to generate event record. Notification is either on the beginning state, end state or at both cases. Notice that Duration indication of the event will be recorded as zero for beginning state events
Notify By Email	Select to notify by email occurrence of this event.
Based On	*The Based on list is used to select a group of parameters for further user selection*
Parameter	*The Parameter list is used to select the specific parameter (from previously selected group). The selected parameter will be used as the "X" variable in the condition rules definition*
Activation	*The Activation area is used to configure the rules that will be applied to cause real-time activation of the condition (change from 0 ➔ 1). For example if user sets the following: Parameter is Voltage RMS 1 ("X" = V1),' Compare to' reference is set to Nominal voltage ("V"= 230V), Deviation is set 10 ("D"=10%) and Operation is set 100*(|X-V|/V) >= D, so in this case condition will be activated when the RMS voltage of channel 1 goes 10% above or 10% below nominal*
De-Activation	*The De-Activation area is used to configure the rules that will be applied to cause real-time de-activation of the condition (change from 1 ➔ 0). For example if user sets the following : parameter is Voltage RMS 1 ("X" = V1),' Compare to' reference is set to Nominal voltage ("V"= 230V), Deviation is set 10 ("D"=10%) and Operation is set 100*(|X-V|/V) < D, so in this case condition will be de-activated when the RMS voltage of channel 1 goes below 10% deviation from nominal*

Parameter	Definition
Compare To:	*"The Compare to list is used to select the type of reference value ("V") to compare to previous selected "X" parameter value. The 'Parameter' option is typically some other system parameter like nominal voltage value. The 2nd option of 'User Value' enables the user to set his own reference value. The 3rd option of 'Interval average' enables user to compare "X" to its averaged value over defined time interval. The 4th option "Value ∆" enables dX/dt (time deviation) operation, which means the "X" is compared to its previous sample value. For instance if the selected "X" parameter is V1 RMS (from group "10[ms] Fast RMS") and the reference is set to "Value ∆"* than "V" = X[-1] (previous 10ms RMS value)
Deviation	This field defines the Deviation ("D"%) value used in the operation formula. Notice that some operations does not contains deviation, in this case the deviation configuration is not in use
Operation	This operation list defines the mathematical operation to apply for Activation/Deactivation of condition"

Table 16: User Defined

4. Click **Apply Changes** when complete.

Configuring the Display

The display setup enables you to monitor the electrical system parameters with user friendly units.

To configure the display setup:

1. From the Service menu, click **Display Setup**.

The Display Setup screen appears.

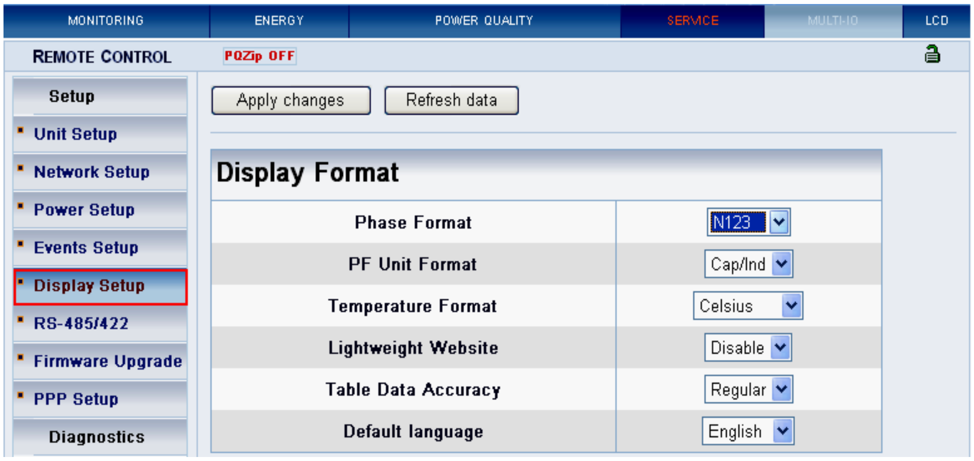

Figure 71: Display Setup

2. Fill in all relevant attributes.

Menu	Function
Phase Format	Enables the labeling of the 4 conductors according to the conventions of your specific country: • **N123** • **NABC** • **NRST** • **NXYZ** • **NRYB** • **NRWB**
PF Unit Format	Enables the labeling of the opposite phases of Power Factor.
	Cap/Ind: Capacitive and Inductive
	LD/LG: Lag and Lead
Temperature Format	Fahrenheit or Celsius
Lightweight Website	This option is intended for use when there is a slow internet connection. The interface is with simpler graphics that consumes less bandwidth.
	Enable: Set the lightweight website as default.
	Disable: Set the regular website as default.
Table Data Accuracy	**Regular**: Display up three decimals
	Extra: Display up to five decimals
Default Language	**English Russian German**: Defined per session

Table 17: Display Setup

3. Click **Apply Changes** when complete.

Configuring RS-485/422

The setup configures the parameters of RS485 interface.

To setup RS485/422:

1. From the Service menu, click **RS-485/422**.

The RS485/422 window appears.

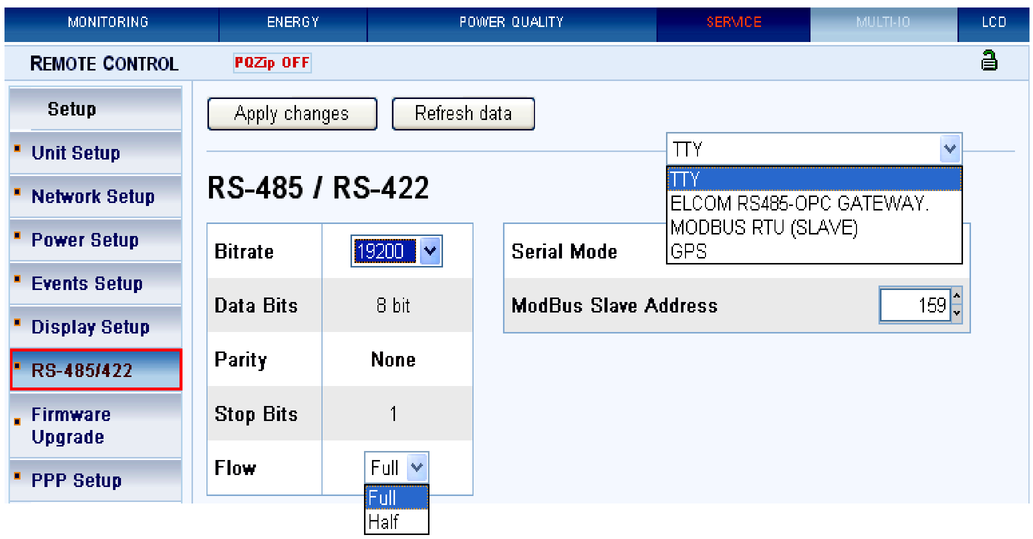

Figure 72: RS-485/422

2. Configure RS-485/422 using the table below.

Menu	Function
Bit rate	The transfer rate of data
Data Bits	Number of bits in a byte
Parity	**None**: no parity check is in use.
Stop Bits	Constant
Flow	**Full**: using full duplex for communication (4 wire)
	Half: using half duplex for communication (2 wire)
Serial Mode	**TTY:** Debug shell mode
	Elcom: Elspec communication for connecting to the equalizer
	ModBus RTU: ModBus protocol
	GPS: attach to the this serial port

Menu	Function
ModBus Slave Address	Unique ID of the BLACKBOX

Table 18: RS485/422

3. Click **Apply Changes** when complete.

Upgrading the Firmware

The firmware can be upgraded by two methods:

- FTP Firmware Upgrade
- HTTP Firmware Upgrade

To upgrade the firmware:

1. Click **Firmware Upgrade**.

The Firmware Upgrade screen appears.

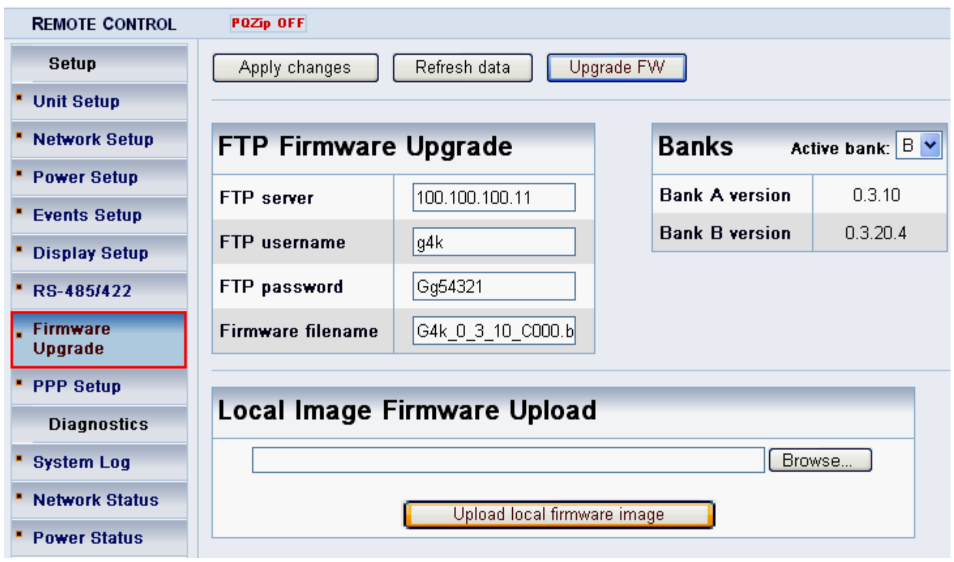

Figure 73: Firmware Upgrade

Configuring FTP Firmware Upgrade

Note *FTP Firmware upgrade procedure requires an FTP server that contains the FTP firmware. For direct uploading of firmware using HTTP, proceed to the Upload local firmware image section.*

To configure FTP Firmware Upgrade:

- Use the table below.

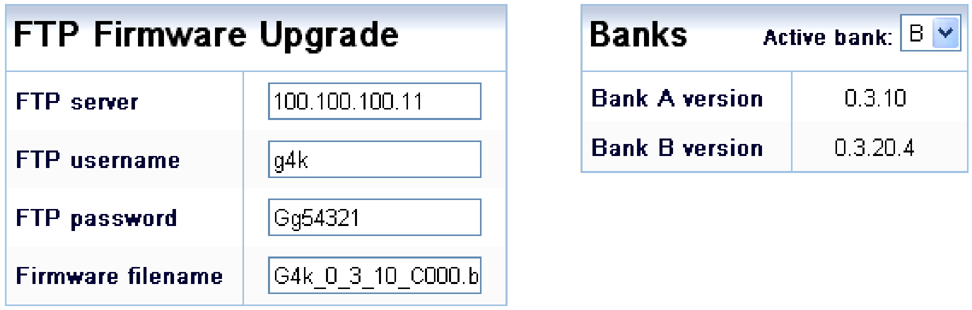

Figure 74: FTP Firmware Upgrade

Value	Description
FTP Server	indicates the FTP server IP address
FTP username	username for accessing the FTP server
FTP password	password for accessing the FTP server
Firmware filename	The complete directory and file name of the new firmware as located at the FTP server machine.
Banks	The unit has two memory locations from which it can run the firmware. When upgrading the firmware, the older version is also saved on one of the banks. It is possible to choose from which bank to run the firmware.
Active Bank	A: Activate bank A.
	B: Activate bank B.
Bank A version	Version of firmware on bank A
Bank B version	Version of firmware on bank B

Table 19: Firmware Upgrade

Configuring Local Image Firmware Upload (HTTP)

Note: *You must first download the firmware from the download section of the Elspec website at elspec-ltd.com.*

Figure 75: Local Image Firmware Upload

To configure HTTP upload:

a) Click **Browse**.

The Choose File dialog box appears.

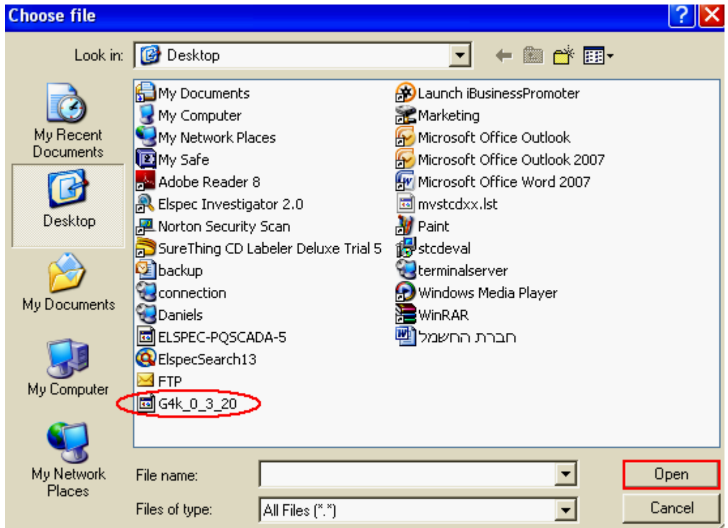

Figure 76: Choose File

b) Select the current downloaded file.

The file appears in the Browse window.

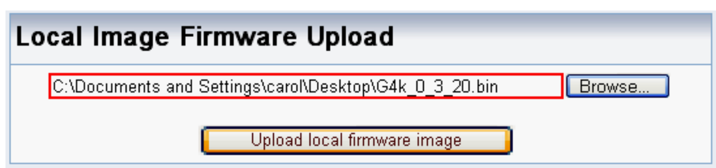

Figure 77: The File Selection Window

c) Click Upload local firmware image.

2. After using either FTP or HTTP to upgrade firmware, click **Apply Changes.**

3. Click **Upgrade FW** 

Configuring PPP

The purpose of PPP Setup is to configure the Point to Point protocol parameters.

To configure PPP:

1. From the Service menu, click **PPP Setup**.

The PPP Setup Screen appears.

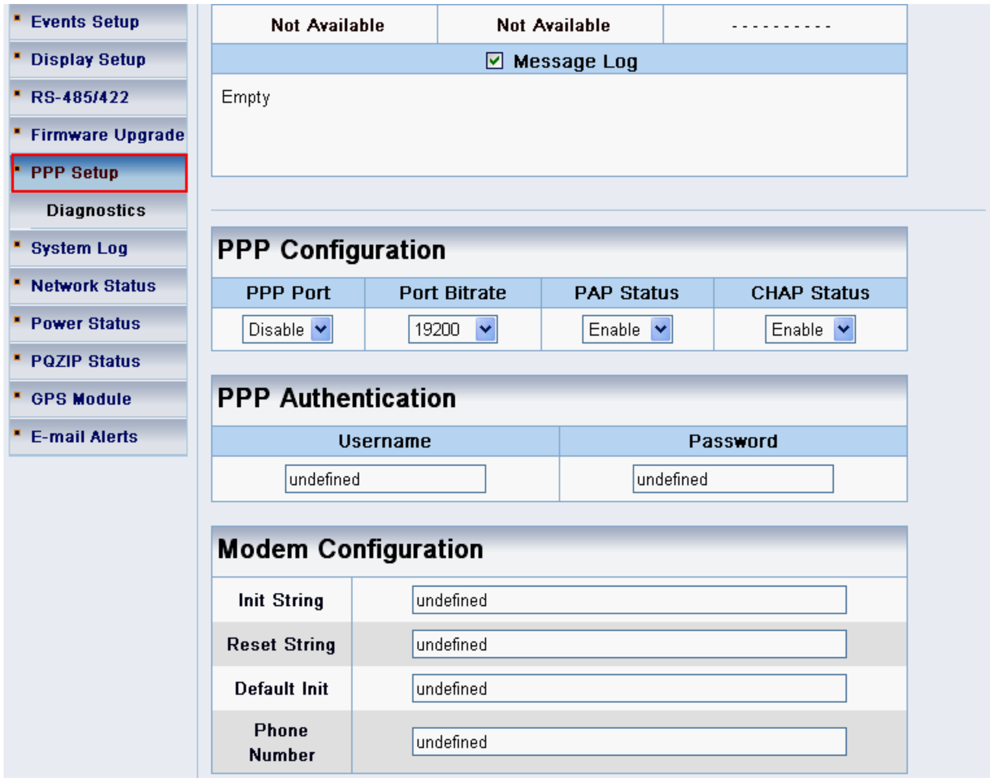

Figure 78: PPP Setup

2. Complete the PPP setup using the tables below.

PPP Status

The status of the PPP is shown here. You can select or deselect the message log

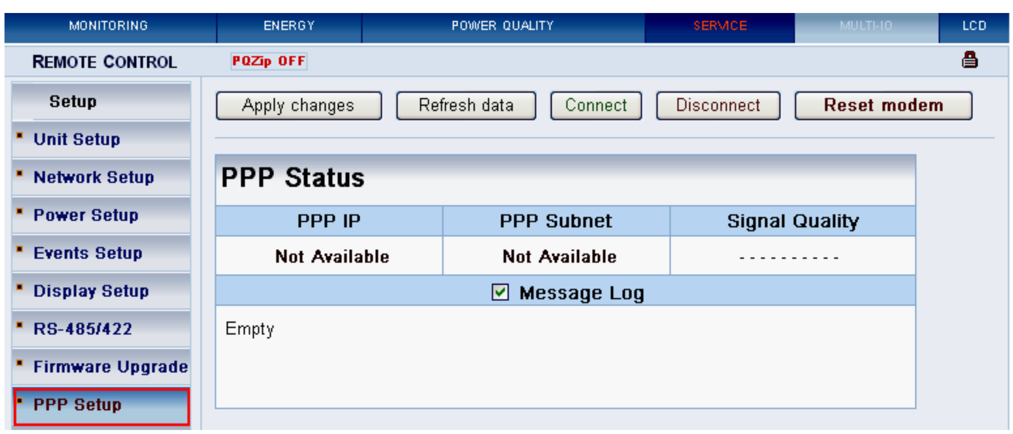

Figure 79: PPP Status

PPP Configuration

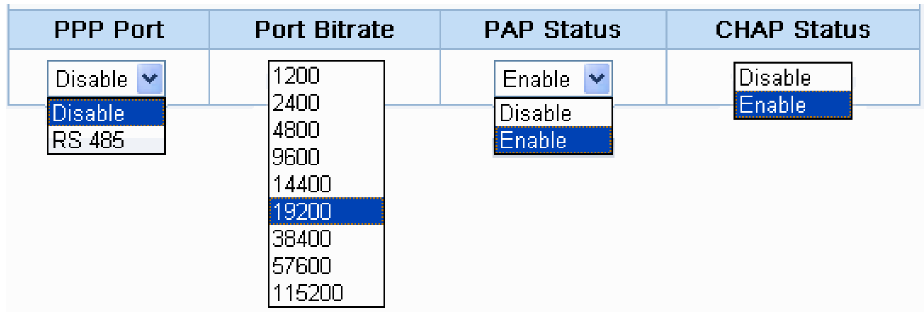

Figure 80: PPP Configuration

Parameter	Description
PPP Port	The port where the modem connects to the unit.
	Disable: the PPP is disabled.
	RS485: connected to the modem through the RS485 port
Port Bit rate	Data transfer rate with the modem
PAP Status	Enable/Disable PAP feature
CHAP Status	Enable/Disable CHAP feature

Table 20: PPP Configuration

PPP Authentication

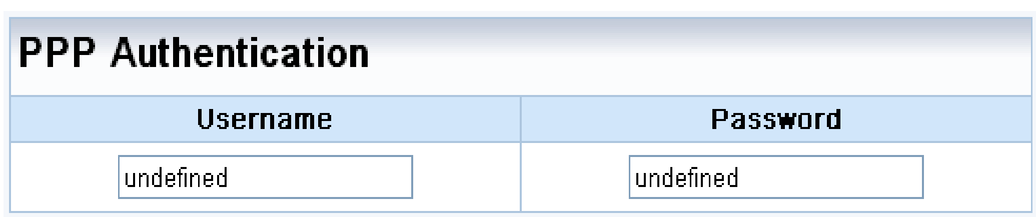

Figure 81: PPP Authentication

Username	This is the username that you receive from your ISP.
Password	This is the password that you receive from your ISP.

Table 21: PPP Authentication

Modem Configuration

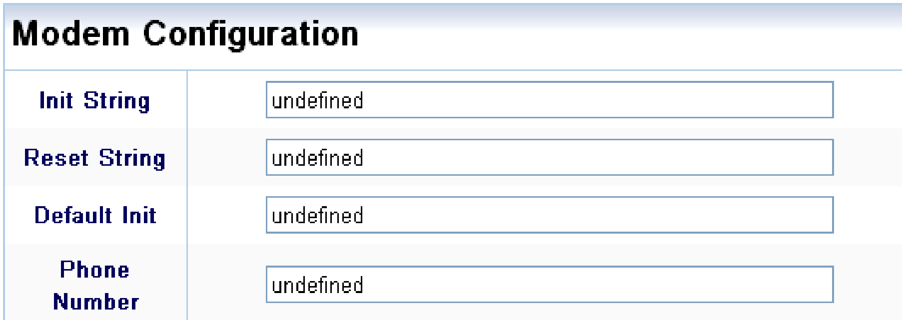

Figure 82: Modem Configuration

Attribute	Definition
Initial String	AT command string to initialize the modem
Reset String	AT command string to reset the modem
Default Init	AT command string to set modem to default configuration
Phone Number	Dial up number

Table 22: Modem Configuration

3. Click **Apply Changes** when complete.

Enabling PQZip

Now that all electrical system and communication network parameters are configured, the BLACKBOX is ready to continuously record the voltage and current waveforms. The last step necessary to begin recording is to enable the PQZip recording. This patented algorithm compresses the data as it is recorded, enabling continuous recording of all waveforms to the desired resolution.

To enable PQZip:

1. From the Service menu, click on **PQZip Status**.

The PQZIP Status main window appears.

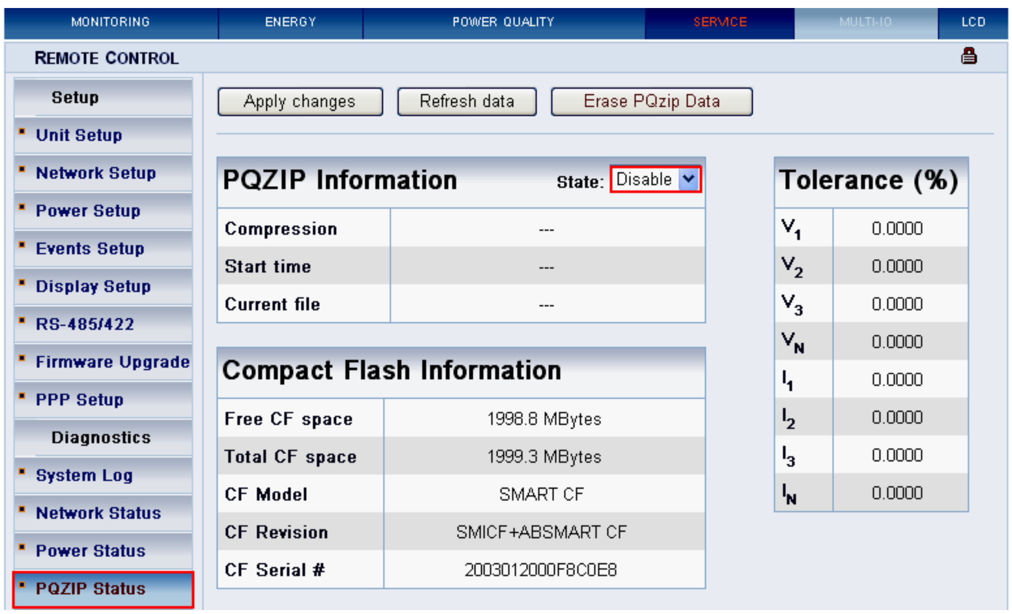

Figure 83: PQZip Status

2. Complete the PQZip Configuration using the table below.

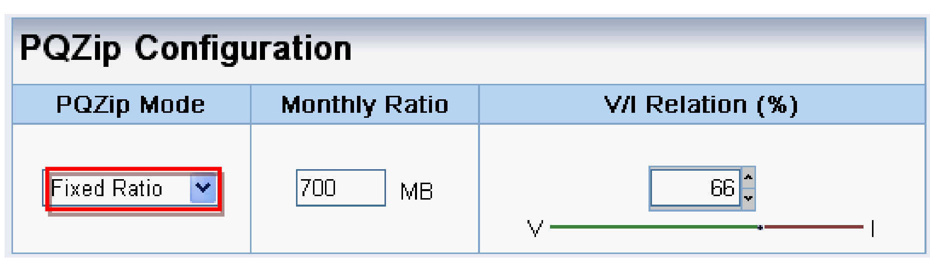

Figure 84: Fixed Ratio PQZip

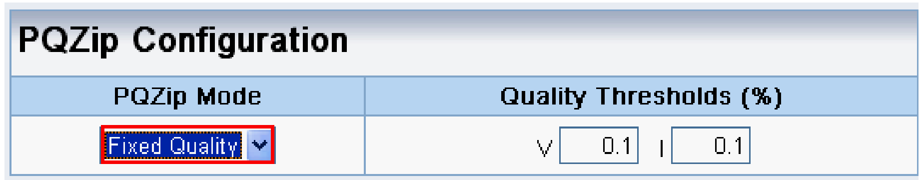

Figure 85: Fixed Quality PQZip

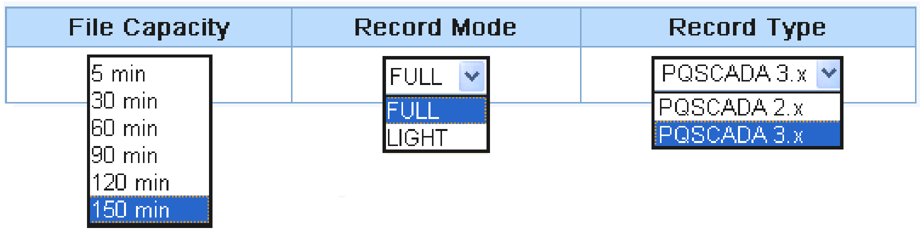

Figure 86: PQZip Configuration

Value	Description
PQZip Mode Fixed Ratio	Uses a fixed amount of storage space to save the data. **Monthly Ratio**: amount of storage space allowable per month
	V/I Relation the manner in which the storage space is proportioned between the voltage and current signals
	Note: *Fixing the ratio can adversely affect the level of accuracy.*
PQZip Mode Fixed Quality	Uses fixed quality for both voltage and current signals without regard for storage space.
	Quality Threshold setting a fixed tolerance for voltage and current.
File Capacity	The amount of recorded time contained in each file.
Record Mode	**Full**: save all the information of each time interval in one file.
	Light: save the signal and event information in separate files
Record Type	**PQSCADA 3.X:** should be used as default.
	PQSCADA 2.X: used only for backwards compatibility.

Table 23: PQZip Setup

3. Click **Enable** in the State pull down box.

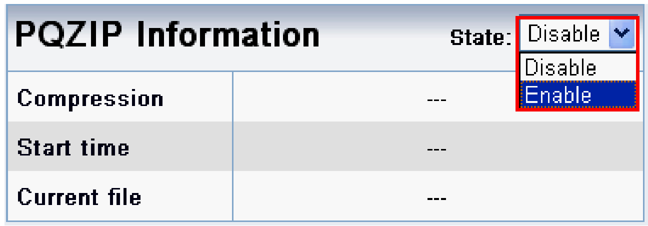

Figure 87: PQZip Information

The instrument will now run a self-test. The test will determine whether all parameters were correctly configured. Should the configuration appear faulty, an alert massage will appear on the upper screen. The alert message will indicate the cause of the failure and will offer methods for solution.

4. If the apparent faulty configuration is acceptable, Click **Resume**.
5. If the fault is not acceptable, correct the fault using the following table.

.Self Test Fault	Solution
No voltage is sensed on inputs	Check the voltage terminal block on the DSP module
Measured frequency differs significantly from the configured nominal frequency	Check nominal frequency in the power setup screen
Measured voltage signals differ significantly from configured nominal voltage	Check nominal voltage in the power setup screen
Configuration of current transformer left unchanged	Verify CT ratio in power setup screen
Configuration of Fixed IP address left unchanged	Verify network configuration in Network setup screen
No time synchronization source detected (See Note below)	Verify SNTP configuration in Network setup screen

Table 24: PQZip Alert Messages

Note: *The time synchronization configuration requires about 3 minutes to be fully activated. After changing this configuration, wait before attempting to enable PQZip.*

6. Repeat the step above until **PQZip** is successfully enabled.
7. Click **Apply Changes** when complete.

The verification of PQZIP enabling is very important. If PQZIP is off and not enabled, there are two warning indicators.

- A red indicator light on the CPU module
- A red PQZIP warning in the Embedded website.

After enabling the PQZIP, verify that both warning indicators are off.

The red indicator light on the CPU module turns off.

Figure 88: Indicator Light

The PQZIP off indicator is not active:

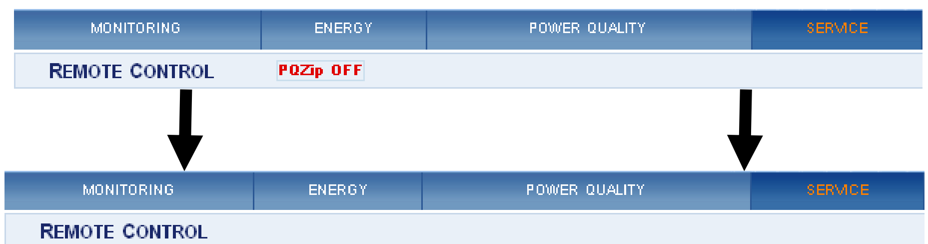

Figure 89: PQZIP Off Indication

Chapter 4: The Embedded Web Site

The Embedded Website is the user interface to the unit. Real time parameters can be viewed and the unit configuration can be performed using the website.

The simplest way to access all the BLACKBOX units on your LAN is through the use of the Elspec search utility.

This section will describe all of the pages displayed on the Embedded Web Site heading by heading. For each heading, all associated topics under the heading are explained in detail.

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Through the LAN

You can access all of the BLACKBOX real time data through your **LAN** after all first time configurations have been completed. Each heading in this section is presented chronologically top down left to right following the GUI of the firmware. A screen capture of the GUI is presented followed by an explanation of each topic.

Note: *For additional communication methods, refer to* ***Network Configurations on page 211.***

Monitoring

The first page to open upon logging in to the Elspec Black Box website is the **Summary** page under the **Monitoring** heading. On this page, you are able to see all real time data as it is collected by the BLACKBOX.

The BLACKBOX instruments calculate power quality parameters from the raw measured data using two different calculation methods.

- **Cycle by cycle**: the maximum sampling per cycle is used for calculating parameters. The FFT spectrum is calculated in multiples of 50/60 Hz
- **IEC 61000-4-30**: the maximum sampling is spread over 10/12 cycles in a 50/60 Hz distribution system. The FFT spectrum is calculated in multiples of 5 Hz.

Summary

The Elspec Black Box measures both voltage and current waveforms at a high sampling level at maximum 1024 samples per cycle, with an accuracy of better than 0.1%.

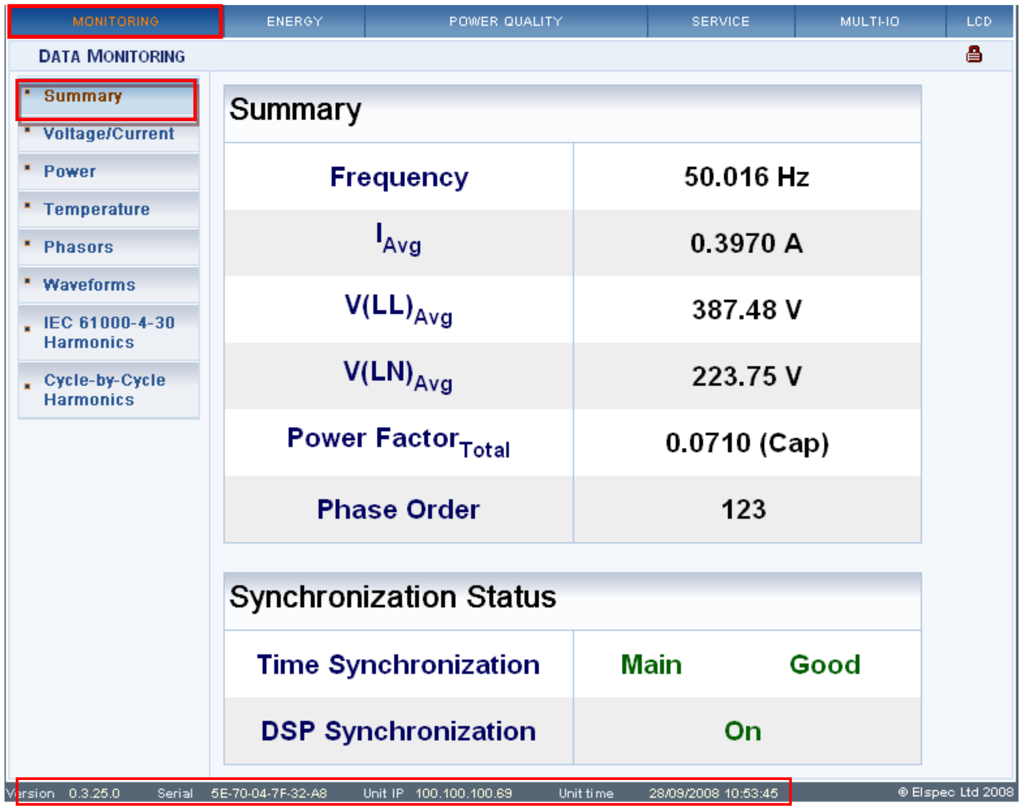


Figure 90: Summary

Figure 91: Summary Footer

Note: *At the bottom of the screen, there is pertinent information about the hardware and firmware*

Function	Description
Frequency	The number of cycles per second
I or I Avg	The current in a single phase system or the current averaged over all three phases in a three phase system.
V_{LL} Avg (shown only in 3 phase system)	Line to line voltage averaged over all three phases in a three phase system.
V_{LN} Avg	Line to neutral voltage averaged over the three phases
PF_{Total}	Total system power factor over three phases
Phase order (shown only in 3 phase system)	The order of the voltage phases starting from V_1 moving in a clockwise direction.

Function	Description
Time Synchronization	Indicates the connection quality to the time source and the time source. This connection supplies the instrument with world time (UTC) from a time source. The Time Sync quality is essential to PQZip coherent file generation. **In case of No Sync indication, see Appendix L: Troubleshooting on page 225.**
DSP Synchronization	The unit is synchronized with the signals of the device.

Table 25: Summary

Voltage/Current

This page displays specific values for voltage and current. The viewed parameters depend on the power configuration. These values can be viewed as calculated according to **IEC 61000-4-30 or Cycle-by-Cycle** (red arrows**)** as shown in **Figure 92: Voltage/Current on page 86.** You can change these parameters by clicking on the appropriate radio button at the top of the page.

Note: *There is a section at the bottom of the page for unbalanced voltages and currents which is only relevant if you choose the If IEC61000-4-30 viewing option.*

Note: *The values are displayed according to IEC calculation. Cycle by cycle values are displayed in one second averages.*

	RMS	Min Value	Max Value	THD	Crest Factor	K Factor
V_1	220.10 V	217.47 V	224.61 V	2.0990 %	1.3960	---
V_2	226.27 V	222.14 V	229.08 V	2.0635 %	1.3985	---
V_3	224.12 V	221.63 V	227.50 V	1.6809 %	1.4009	---
V_N	2.4528 V	1.6967 V	3.4863 V	56.005 %	2.9190	---
V_{12}	385.61 V	381.16 V	392.13 V	1.5450 %	1.4482	---
V_{23}	388.52 V	383.59 V	393.97 V	1.5573 %	1.4497	---
V_{31}	387.08 V	383.06 V	393.31 V	1.5718 %	1.4562	---
I_1	0.5297 A	0.5115 A	0.5598 A	120.56 %	2.9405	17.085
I_2	0.3965 A	0.3828 A	0.4189 A	120.47 %	3.0786	17.116
I_3	0.2651 A	0.2558 A	0.2800 A	120.47 %	3.2412	17.103
I_N	0.1324 A	0.1278 A	0.1399 A	120.55 %	3.8016	17.087

Figure 92: Voltage/Current

IEC 61000-4-30 Averages

	3 sec	10 min	2 hours
Flag	Not Flagged	Not Flagged	Not Flagged
V_1	220.50 V	220.01 V	221.52 V
V_2	226.49 V	226.69 V	226.37 V
V_3	224.38 V	224.20 V	224.91 V
V_N	2.3842 V	2.5166 V	2.1544 V
V_{12}	386.22 V	385.68 V	387.20 V
V_{23}	389.00 V	388.90 V	389.49 V
V_{31}	387.53 V	387.31 V	388.51 V
V_{Unbal}	0.4145 %	0.4815 %	0.3482 %

IEC 61000-4-30 Unbalanced

V_{Avg}	V_{Min}	V_{Max}	I_{Avg}	I_{Min}	I_{Max}
0.4056 %	0.1983 %	0.7275 %	33.420 %	33.404 %	33.455 %

Figure 93: Voltage Current II

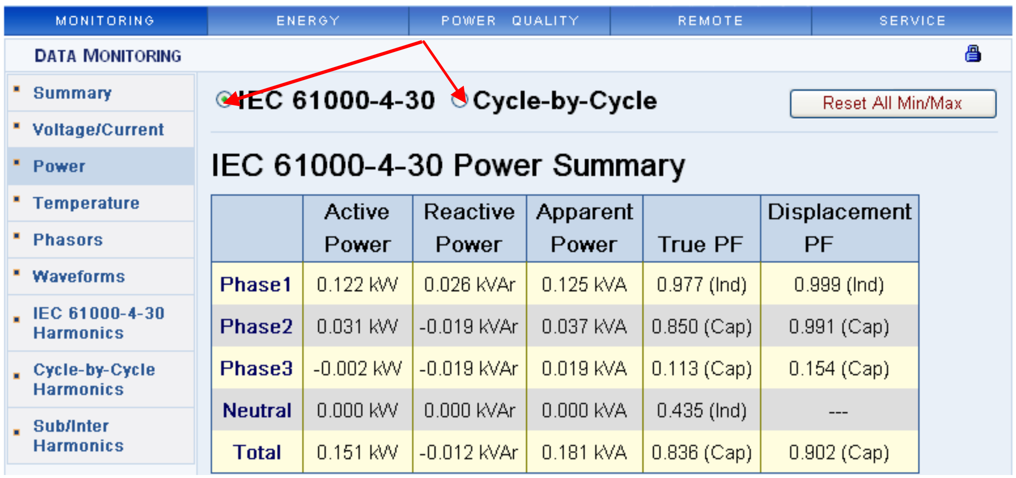
Function	Description
RMS,	Root-Mean-Square. Computed as the sum of the first 40 harmonics: $x_{RMS} = \sqrt{\sum_{n=1}^{N} h_n^2}$; where N is a constant N= 40
Min value	Minimum RMS value since the initial power up or the most recent Reset All Min/Max
Max value	Maximum RMS value since the initial power up or the most recent Reset All Min/Max
THD	$THD = \sqrt{\frac{\sum_{n=2}^{N} h_n^2}{h_1^2}}$; Where N is a constant N=40.
Crest Factor	$CrestFactor = \frac{x_{peak}}{x_{RMS}}$
K-factor	$K = \frac{\sum_1^{25} (i_h \times h)^2}{\sum_1^{25} i_h^2}$
Flag	Flag indicates whether the current displayed interval is either "Not flagged" (means ok) or" Flagged" (means disturbances and hence no value displayed). Flagged interval means that during the interval either a voltage interruption, dip or swell occurred. Notice that large time intervals (above 3 seconds) will have quite a delay in flagging presentation since the displayed value is always for the previous calculated interval
Averages	There are 3 second, 10 minute, and 2 hour averages based on the 61000-4-30 standard.
IEC 61000-4-30 Unbalanced	Measure the asymmetry between the phases in 3 phase system.
Reset Min/max	Reset all Min/max measurements of the unit.

Table 26: Voltage/Current

Note: *To reset the Min/Max values, log in as an administrator (factory default: 12345) and click on the button marked Reset All Min/Max.*

Power

The Power page presents the different electrical power parameters relevant to the specific power configuration. These values can be viewed as calculated according to **IEC 61000-4-30 or Cycle-by-Cycle** (red arrows**)** parameters by clicking on the appropriate radio button at the top of the page.



	Active Power	Reactive Power	Apparent Power	True PF	Displacement PF
Phase1	0.122 kW	0.026 kVAr	0.125 kVA	0.977 (Ind)	0.999 (Ind)
Phase2	0.031 kW	-0.019 kVAr	0.037 kVA	0.850 (Cap)	0.991 (Cap)
Phase3	-0.002 kW	-0.019 kVAr	0.019 kVA	0.113 (Cap)	0.154 (Cap)
Neutral	0.000 kW	0.000 kVAr	0.000 kVA	0.435 (Ind)	---
Total	0.151 kW	-0.012 kVAr	0.181 kVA	0.836 (Cap)	0.902 (Cap)

Figure 94: Power

Function	Description
Active power	The amount of active power consumed as usable energy. Sometimes referred to as Real power. Elspec calculates the Active power accurately by taking all harmonics up to the 40th into account using the following formula: **P =** $\frac{1}{2}\sum_{i} Vi,j \cdot Ii,j \cdot Cos\theta i,j$ [Watt] Where **i** is the harmonic and **j** is the phase.
Reactive power	The amount of reactive power consumed as unusable energy. Elspec calculates reactive power using the following formula: Q = -Pq = - $\lvert V\rvert\lvert I\rvert Sin\theta = -\vec{V}\times\vec{I}$ = $\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ Vx & Vy & 0 \\ Ix & Iy & 0 \end{vmatrix} = \hat{k}(-VxIy + IxVy)$ [VAr] Elspec calculates the sign of Q using the following formula: Sign of Q = sign of ($\sum_{i}(-Vxi \cdot Iyi + Vyi \cdot Ixi)$)

Function	Description
Apparent power	The amount of apparent power; a vector addition of the Active and Reactive power. Elspec uses formula: $S = V_{RMS} * I_{RMS}$ [VA]
True Power Factor	The most accurate measure of efficiency is the True Power Factor. It is defined as the sum of the P/S ratio over all the harmonics: $PF_{True} = P_{Total} / S_{Total} = \cos(\theta)$. $PF_{True} = \frac{\sum P}{\sqrt{\sum P^2 + \sum Q^2}}$ Where N=40.
Displacement Power Factor,	$PF_{Displacement} = P_{H1} / S_{H1}$.
Reset Min/max	Reset all Min/max measurements of the unit.

Table 27: Power

Temperature

Ambient temperature is an important parameter both within an electrical cabinet and within the BLACKBOX.

Temperature extremes do affect measuring accuracy. Therefore, monitoring the internal temperature of the instrument is important when monitoring all measured electrical parameters to ensure that the values can be assumed to be of maximum accuracy. A rise in power supply temperature could be a sign of loose connections or some other malfunction.

About the PT-100

Resistance thermometers are constructed in a number of forms and offer greater stability, accuracy and repeatability in some cases than thermocouples. Resistance thermometers use electrical resistance and require a small power source to operate. The resistance ideally varies linearly with temperature.

Resistance thermometers are usually made using platinum, because of its linear resistance-temperature relationship and its chemical inertness.

Commercial platinum (PT-100) grades are produced which exhibit a change of resistance of 0.385 ohms/°C (European Fundamental Interval) The sensor is usually made to have a resistance of 100Ω at 0 °C. This is defined in BS EN 60751:1996. The American Fundamental Interval is 0.392 Ω/°C.

Figure 95: PT 100

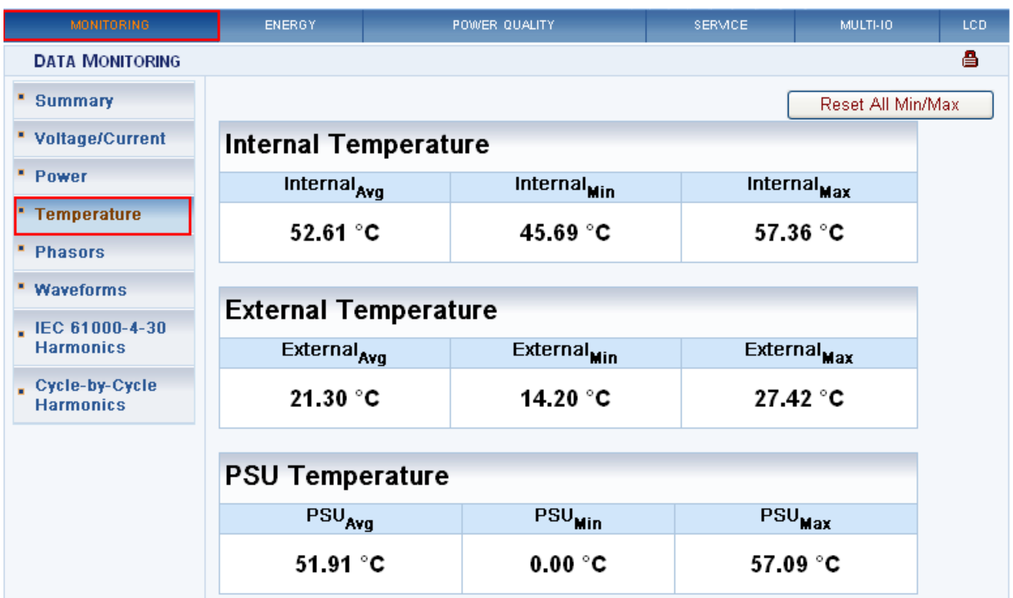


Figure 96: Temperature

Function	Description
Internal Temperature	The average, minimum, and maximum internal temperature of the DSP module.
External	Utilizing a remote Pt100 thermometer, average, minimum, and maximum outside temperatures are monitored.

Temperature	
PSU Temperature	The average minimum and maximum temperature of the Power Supply Module.
Reset Min/max	Reset all Min/max measurements of the unit.

Table 28: Temperature

Phasors

A phasor is a vector representation of the voltages and currents in the system. The Phasor page of the BLACKBOX website supports phasor representation of both Wye and Delta voltage configurations: The Phasors are a vector representation of the first harmonic.

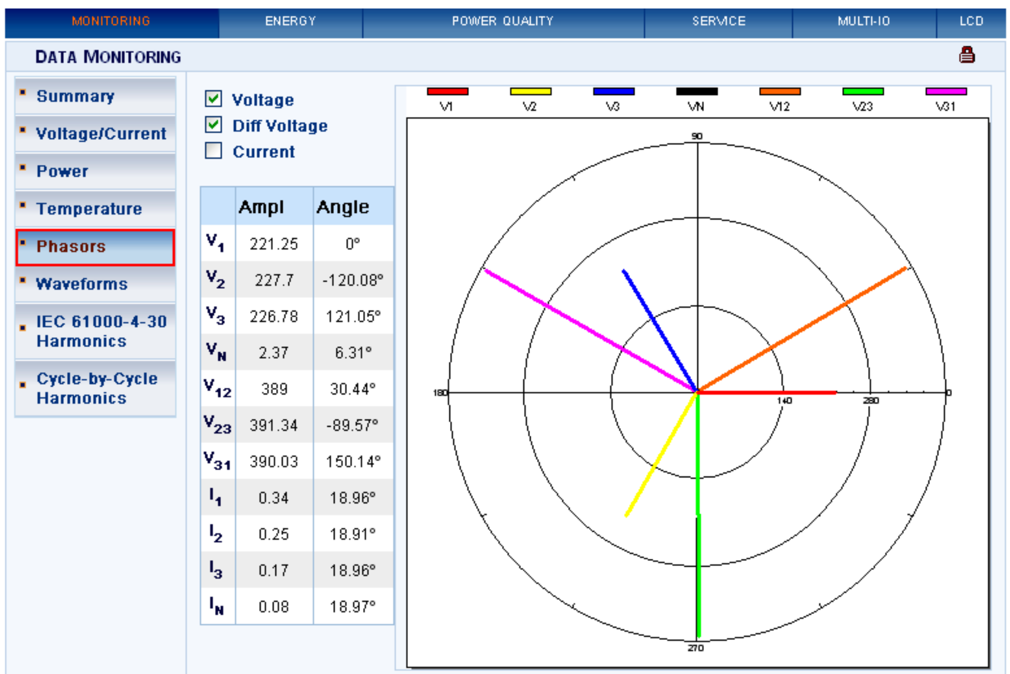


Figure 97: Phasors

Function	Description
Voltage	Shows voltage phase to neutral phasor (only present with WYE 4 wire).
Diff Voltage	Shows phase to phase voltages.
Current	Shows the phase to neutral current phasor.
Diff	Shows the phase to phase current (only present with Delta 3 wire).

Current	
Ampl	The amplitude of each phasor
Angle	V_1 /v_{12} is at 0°, all other vectors are in relation to V_1 /v_{12}.

Table 29: Phasors

Waveforms

The Waveform page displays the actual voltage and current waveforms monitored by the BLACKBOX.

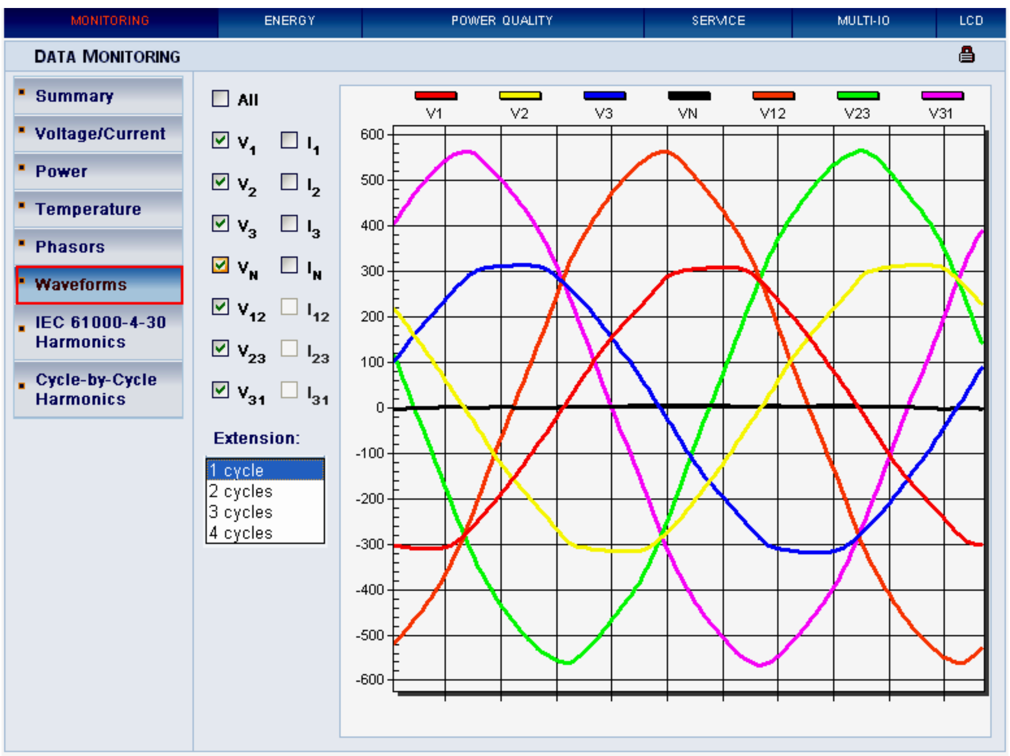


Figure 98: Waveforms

Function	Description
All	Checking the "All graphs" box will automatically select all the boxes below.
Voltage and Current check boxes	Depending on your power configuration, you can view all combinations of phase to phase and phase to line voltage and current combinations by making selections in the appropriate check boxes.
Extension	This pull down box allows view selection from 1 to 4 cycles.

Table 30: Waveforms

Waveform ZOOM IN

a) From the main Waveform window, select an area to zoom in.

b) Left click and drag the mouse to define the area.

The enlarged area appears in the window.

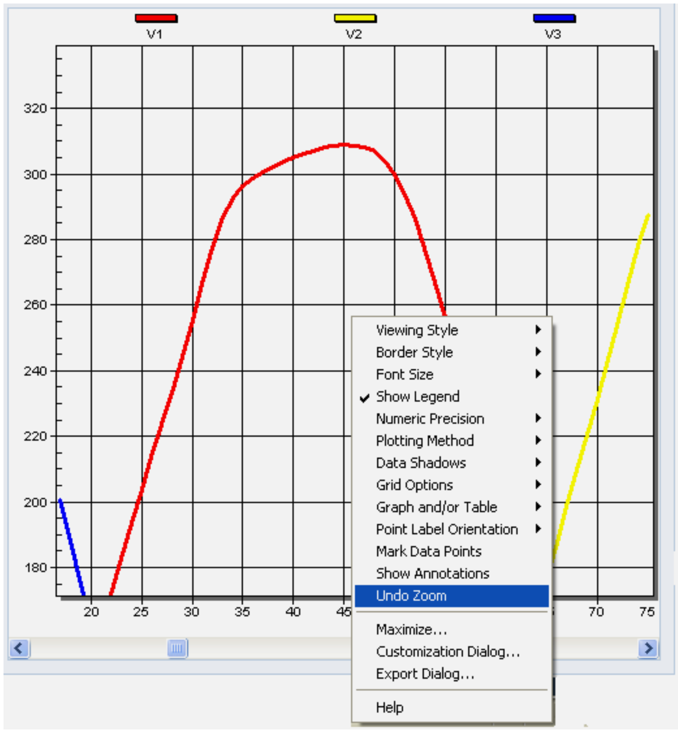


Figure 99: Waveform Zoom In

c) Release the mouse.

d) To zoom out, right click on the graph, then select **Undo Zoom**.

Harmonics According to IEC61000-4-30

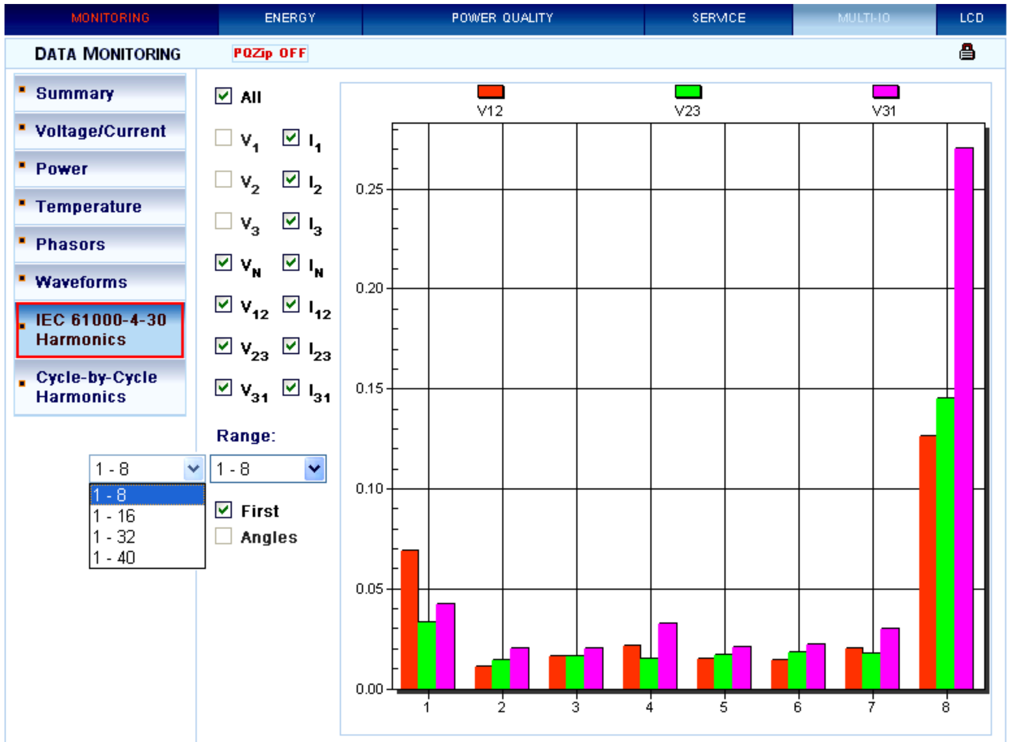


Figure 100: IEC 61000-4-30 Harmonics

Function	Description
All	Automatically select all the boxes below it.
Voltage/Current check boxes	Depending on your power configuration, you can view all combinations of phase to phase and phase to neutral voltage and current combinations by making selections in the appropriate check boxes.
Range	Select the number of harmonics viewed in the viewing window.
First	The first harmonic alongside all the other harmonics. Uncheck the box for better visual resolution of the harmonics.
Angles	Not currently active

Table 31: IEC 61000-4-30 Harmonics

Cycle-by-Cycle Harmonics

This page displays the Harmonics spectrum as it is calculated using the full sampling power of the BLACKBOX on a single cycle.

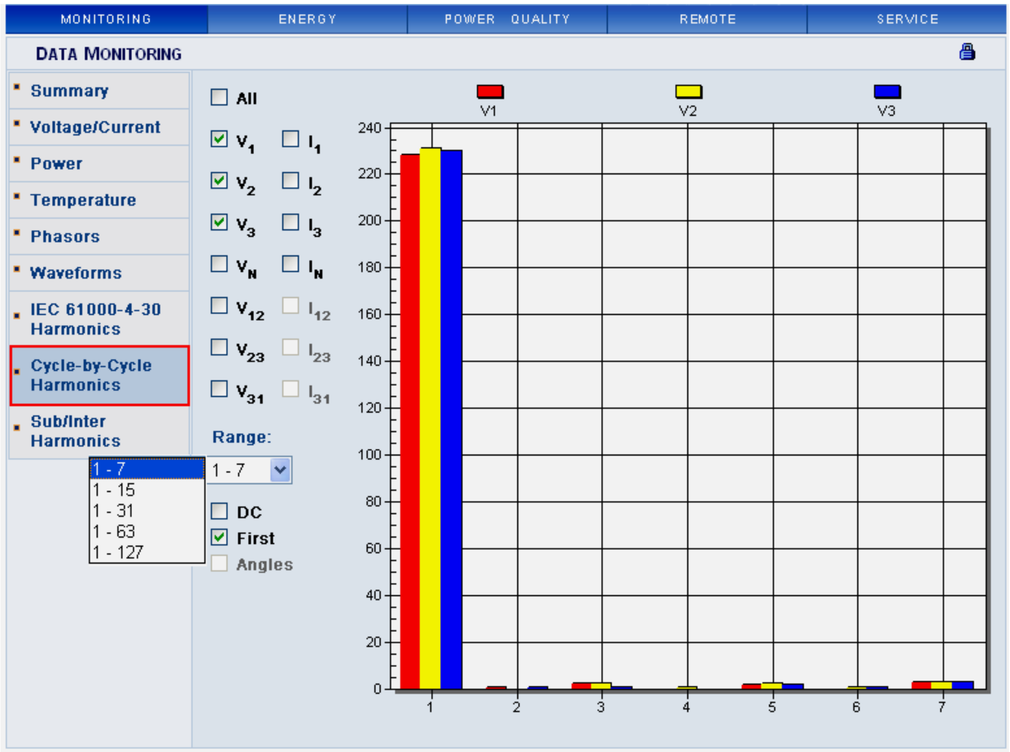


Figure 101: Cycle-by-Cycle Harmonics

Function	Description
All	Checking this box automatically selects all the boxes below it.
Voltage/Current check boxes	Depending on your power configuration, you can view all combinations of phase to phase and phase to neutral voltage and current combinations by making selections.
Range	Select the number of harmonics viewed in the viewing window.
DC	This displays the DC harmonic. First harmonic always displayed with DC.
First	The first harmonic alongside all the other harmonics. Uncheck the box for better visual resolution of the n*50/60 harmonics.
Angles	Not currently active

Table 32: Cycle by Cycle Harmonics

Sub/Inter Harmonics

This feature is only available in the BLACKBOX model #4430.

This page displays the Sub/Inter Harmonics as they are being calculated over 200 ms FF, with a resolution of 5 Hz. The Inter Harmonics being displayed up to 1.2 kHz.

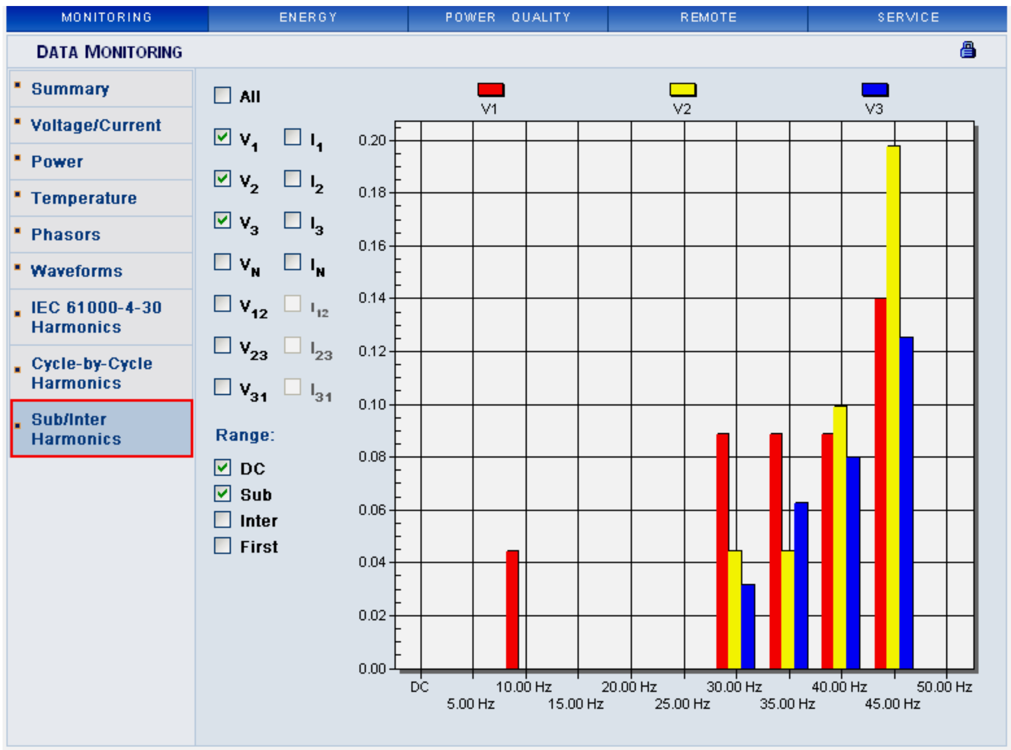


Figure 102: Sub/Inter Harmonics

Function	Description
All	Checking this box automatically selects all the boxes below it
Voltage/Current check boxes	Depending on your power configuration, you can view all combinations of phase to phase and phase to line voltage and current combinations by making selections in the appropriate check boxes.
DC	This displays the DC harmonic. First harmonic always displayed with DC
Sub	The harmonics below the 50/60Hz harmonic.
Inter	The harmonics above 50/60Hz harmonic. Which are not a multiple of the 50/60 Hz. Harmonic.
First	The first harmonic alongside all the other harmonics. Uncheck the box for better visual resolution of the harmonics.

Table 33: Sub/Inter Harmonics

Energy

Consumption and Demand

This page displays the summary of the energy measurement.

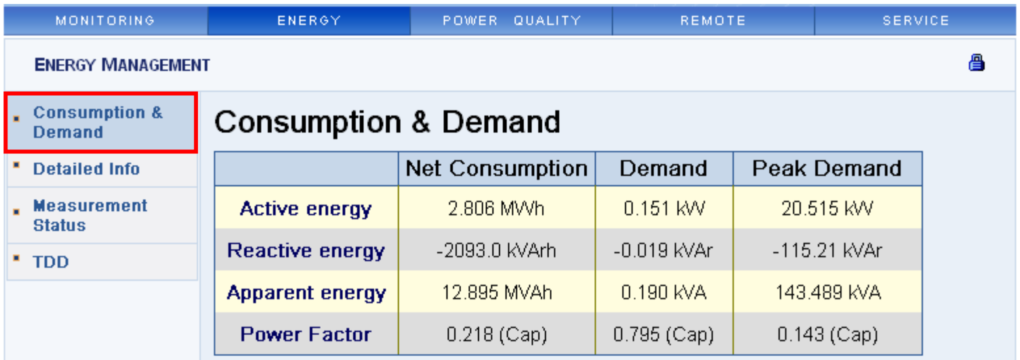


Figure 103: Consumption and Demand

Function	Description
Active Energy	The portion of power flow that, averaged over a complete cycle of the AC waveform, results in net transfer of energy in one direction expressed as kWh.
Reactive Energy	the portion of power flow due to stored energy, which returns to the source in each cycle counted
Apparent Energy	The combination of active and reactive energy
Power Factor	The ratio between real power and apparent power
Net Consumption	The difference between Delivered and Received energy.
Demand	A Demand is an arbitrary measure of power per configurable unit of time using different averaging methods. A demand is measured in units of power, even though a time element does exist.
Peak Demand	The highest demand calculated since the last reset

Table 34: Consumption & Demand

Detailed Information

This page provides detailed views of energy measurements.

Received Energy

The energy flows from the grid into the installation.

- Consumption & Demand
- Detailed Info
- Measurement Status
- TDD

Received Energy

	Current Period	Total Consumption	Demand	Peak Demand
Active energy	0.0046 kWh	110.74 kWh	0.0192 kW	0.0202 kW
Reactive energy	0.0000 kVArh	0.0828 kVArh	0.0000 kVAr	0.0000 kVAr
Power Factor	1.0000	1.0000	1.0000	1.0000

Figure 104: Recieved Energy

Delivered Energy

The energy flows from the installation to the grid.

Delivered Energy

	Current Period	Total Consumption	Demand	Peak Demand
Active energy	0.0000 kWh	0.2163 kWh	0.0000 kW	0.0000 kW
Reactive energy	0.0278 kVArh	723.30 kVArh	0.1150 kVAr	0.1172 kVAr
Power Factor	0.0000 (Ind)	0.0003 (Ind)	0.0000 (Ind)	0.0000 (Ind)

Figure 105: Delivered Energy

Net Energy

Net Energy is the difference between received and delivered energy.

Net Energy (Received-Delivered)				
	Current Period	Total Consumption	Demand	Peak Demand
Active energy	0.0046 kWh	110.52 kWh	0.0192 kW	0.0202 kW
Reactive energy	-0.0278 kVArh	-723.22 kVArh	-0.1150 kVAr	-0.1172 kVAr
Power Factor	0.1648 (Cap)	0.1511 (Cap)	0.1648 (Cap)	0.1698 (Cap)

Figure 106: Net Energy

Total Energy

Total Energy is the sum of received and delivered energy.

Total Energy (Received+Delivered)				
	Current Period	Total Consumption	Demand	Peak Demand
Active energy	0.0007 kWh	110.95 kWh	0.0191 kW	0.0202 kW
Reactive energy	0.0042 kVArh	723.39 kVArh	0.1146 kVA	0.1172 kVAr
Power Factor	0.1638 (Ind)	0.1516 (Ind)	0.1645 (Ind)	0.1698 (Ind)
Apparent energy	0.0098 kVAh	1.6220 MVAh	0.2681 kVA	0.2715 kVA

Figure 107: Total Energy

Measurement Status

The Measurement Status page under the Energy header provides additional statistical information and necessary context information

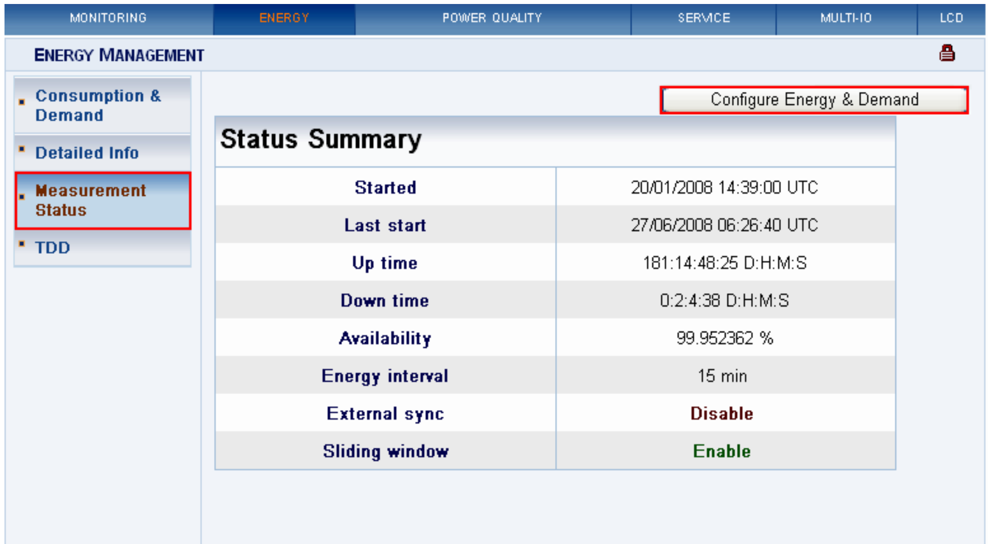


Figure 108: Measurement Status

Status	Description
Started	This is the date and time stamp from the last energy reset
Last start	This is the date and time stamp from the last system up time
Up time	The total cumulative time the mechanism was operational.
Down time	The total cumulative time the mechanism was not operational.
Availability	The percentage of time the system has been operational.
Energy interval	The energy interval is the size of the window used in computing demand.
External Sync	This function is currently fixed in disable mode.
Sliding window	Information regarding the demand averaging system in use: Enabled- The demand is calculated using the sliding window averaging system. Disabled- The demand is calculated according to stationary time points.
Configure Energy & Demand	Links you to the Power Setup Page

Table 35: Measurement Status

TDD

Total Demand Distortion – TDD – is the current distortion (harmonics above the 1st) as a percent of maximum demand load. TDD is defined using the following relationship:

$$I_{TDD}= \sqrt{\sum_{h=2}^{\infty}\left[\frac{I_h^2}{I_L^2}\right]}*100\%$$

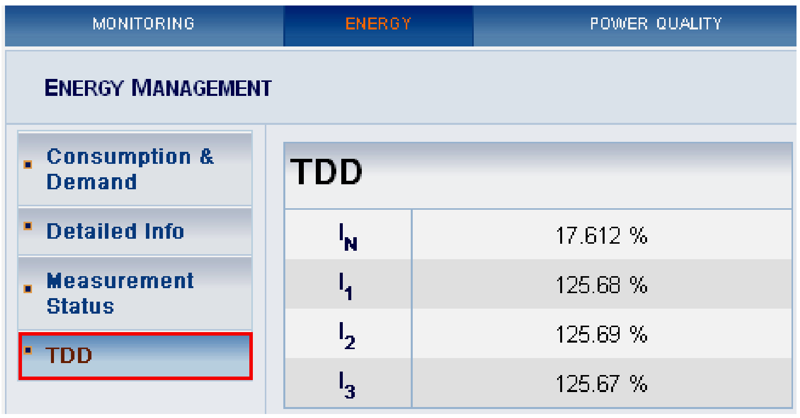


Figure 109: Total Demand Distortion

Power Quality

Elspec supports a number of standards, and also offers a custom user defined thresholds as well. The user defined option allows you to input your own parameters for online power quality tracking

Compliance Summary

The Compliance Summary is a power quality summation screen that gives you updated information regarding the compliance to the selected or defined power quality standard.

Summary

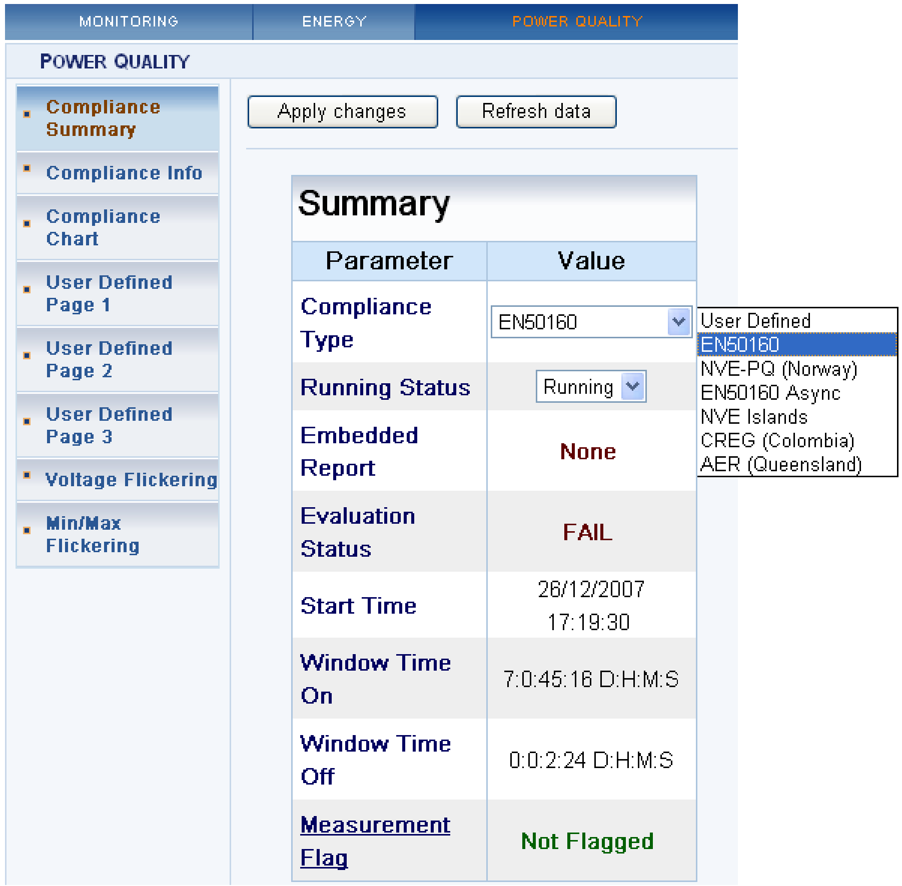


Figure 110: Summary

Parameter	Description
Compliance Type	You can choose which standard will be used for compliance comparison: **EN50160: E**uropean standard for Power Quality Compliance Evaluation **NVE-PQ** : Norwegian Regulator Specific Power Quality Compliance Evaluation **EN50160 A sync**: European standard Power Quality Evaluation for Asynchronous systems **NVE Islands:** Norwegian Regulator Specific PQ Compliance for non-grid connected (Islands) **CREG (Columbia)**: CEL (Colombia PQ Resolution) **User Defined**: Choosing User Defined from the Compliance Type pull down box will enable changing the Compliance Definitions in the User Defined Pages. **AER Queensland:** Australia Queensland Compliance Evaluation Per National Electricity Rules
Running Status	Choose to stop or run the compliance comparison mechanism.
Report Type	The type of embedded report generated by the BLACKBOX

Parameter	Description
Evaluation Status	The overall compliance combines all PASS/FAIL/NA results from all parameters.
Start Time	The date and time stamp when the system commenced compiling of data
Window Time On	The total cumulative time the mechanism was operational.
Window Time Off	The total cumulative time the mechanism was not operational.
Measurement Flag	Flagged state is on either during a voltage interruption, dip or swell occurrence. The flag influences the power quality compliance of most of the parameters. Each PQ parameter can be configured to mask periods (means no events counting) on flagged situations (for EN50160 this is the default behavior).Such configuration avoids counting a single event more than once in a different parameter. No matter if flagged or not, the PQ parameters are always being continuously recorded by the PQZIP engine

Table 36: Summary

Status

The Status table provides you with an update summary status report of the different power quality parameters. Clicking on individual checklist parameters opens an explanation window that defines the criteria for that particular parameter (Voltage Frequency in our example). The explanation is based on the compliance type chosen in the Summary section.

Some of these parameters require a period of monitoring as long as a week or more. Each parameter may display one the following values:

- OK: The parameter has fulfilled all requirements
- N/A: The period for monitoring has not passed since a unit reset,
- Fail: This value indicates the parameter did not fulfill the requirements for acceptable power quality as per the chosen compliance type during the last period of testing.

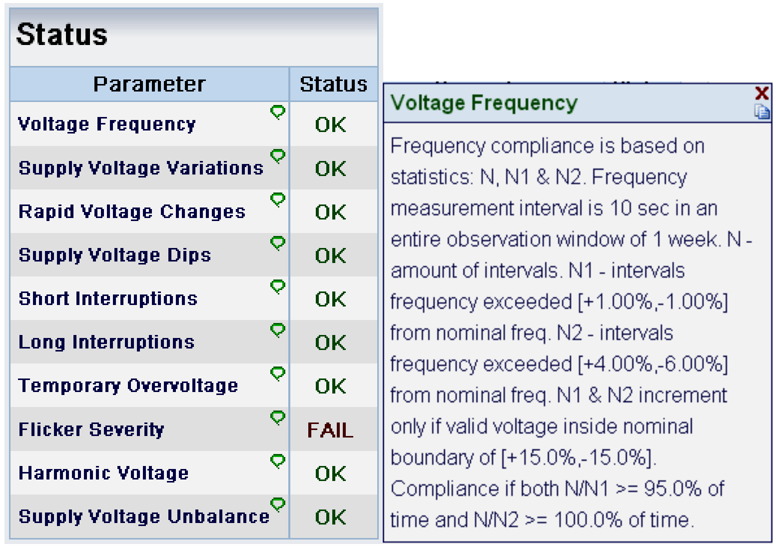


Figure 111: Compliance Status w/ Popup

Note: *The threshold values in the following table are based on 50160 standard. In the case of any other standard thresholds may be different.*

Parameter	Description
Voltage Frequency	The frequency is measured as a mean value over fixed 10 second intervals. The observation period is one week. The method for arriving at compliance is as follows: • N- the amount of 10 second intervals • N_1- the amount of intervals that the frequency varied ±1.00% from the nominal frequency • N_2- the amount of intervals that the frequency varied +4.00% or -6.00% from the nominal frequency • N_1 and N_2 increment only if the voltage at time of fluctuation is within ±15% of the nominal voltage • Compliance during an observation period is considered to be OK when $N/N_1 \geq 95\%$ and $N/N_2 = 100\%$
Supply Voltage Variations	The supply (slow) voltage variation is measured as a mean RMS value over fixed 10 minute intervals. The observation period is one week. The method for arriving at compliance is as follows: • N- the amount of 10 minute intervals • N_1- the amount of intervals that the voltage varied ±10.0% from the nominal voltage • N_2- the amount of intervals that the voltage varied ±15.0% from the nominal voltage • Compliance during an observation period is considered to be OK when $N/N_1 \geq 95\%$ and $N/N_2 = 100\%$

Parameter	Description
Rapid Voltage Changes	Rapid voltage change is calculated as follows: • For every 3 second window a minimum and maximum RMS voltage within ±10.0% of nominal is recorded. • The average RMS voltage over 3 consecutive 3 second windows is calculated (9 seconds). • The Rapid Voltage Change is the percent of the delta between min and max divided by the average 9 second RMS voltage. • The Rapid Voltage Change is limited to a number of events greater than 5% per viewing period of one week
Supply Voltage Dips	A voltage dip is defined as a drop in voltage greater than 10% but less than 97% for a period of time between 10 ms and 1 minute. Voltage dip events are counted within a 1 week period. • Compliance is defined as no more than 20 dips per one week period
Short Interruptions	An Interruption is defined as voltage dropping to a value less than 97.0% of nominal voltage. The viewing period is 1 week. • A short interruption is defined as between 10ms and 3 minutes. Compliance is defined as no more than 2 events per week.
Long Interruptions	An Interruption is defined as voltage dropping to a value less than 97.0% of nominal voltage. The viewing period is 1 week. • A long interruption is defined as lasting longer than 3 minutes. Compliance is defined as no more than 1 event per week
Temporary Over-voltage	Temporary over voltages are defined as any event where the voltage rises above 110% of nominal voltage for a period of at least 10 ms.
Flicker Severity	Flicker severity is evaluated within an observation window of 1 week. P_{lt} (2 hours) must be equal or under 1.0 during 95.0% of the observation time.
Harmonic Voltage	Under Normal operating conditions, during each period of one week, 95% of the 10 minute mean RMS values of each individual harmonic voltage shall be less than or equal to the value given for low voltage for medium voltage. The THD of the voltage (including all harmonics up to the order 40) shall be less than or equal to 8%.
Supply Voltage Unbalance	For compliance, in each period of one week, 95% of the RMS voltages mean values (calculated in 10 minute windows) of the negative phase sequence component must be less than 2% of the positive phase sequence component.

Table 37: Compliance Status

Compliance Info

The Compliance Info Page provides detailed information about the power parameters.

For each of the power parameters, the Compliance Info chart supplies a row with more in depth information regarding the compliance status.

	Status / Partial	Observation	Window / Interval	Time OK / Time Fail	Time N/A	Total Events
Voltage Frequency	OK / OK	Complete	1 week / 10 sec	100.000 % / 0.0000 %	0.0000 %	0
Supply Voltage Variations	OK / OK	Complete	1 week / 10 min	100.000 % / 0.0000 %	0.0000 %	0
Rapid Voltage Changes	OK / OK	Complete	1 week / 3 sec	99.998 % / 0.0015 %	0.0000 %	1
Supply Voltage Dips	OK / OK	Complete	1 week / 10 ms	100.000 % / 0.0000 %	0.0000 %	0
Short Interruptions	OK / OK	Complete	1 week / 10 ms	100.000 % / 0.0000 %	0.0000 %	0
Long Interruptions	OK / OK	Complete	1 week / 10 ms	100.000 % / 0.0000 %	0.0000 %	0
Temporary Overvoltage	OK / OK	Complete	1 week / 10 ms	100.000 % / 0.0000 %	0.0000 %	0
Flicker Severity	FAIL / OK	Complete	1 week / 10 min	84.706 % / 15.294 %	0.0000 %	13
Harmonic Voltage	OK / OK	Complete	1 week / 10 min	100.000 % / 0.0000 %	0.0000 %	0
Supply Voltage Unbalance	OK / OK	Complete	1 week / 10 min	100.000 % / 0.0000 %	0.0000 %	0

Figure 112: Detailed Compliance Info

Parameter	Description
Status/Partial	The upper **status** is the compliance result based on a full observation window. The **partial** is a status expressing the recent time slot. • **OK**: The parameter has been monitored for the requisite time and found to be compliant. • **N/A** (not available) – not enough time has elapsed to judge if he parameter is compliant • **Failed** – The parameter has been monitored for the requisite time and found to be non compliant.
Observation	Registers **Complete** if one full cycle has been monitored, otherwise, **Incomplete**
Window/Interval	Displays the time frames chosen for the monitoring short time (bottom) interval and the long time window(top)

Parameter	Description
Time OK/Time Fail	**Top**: The percentage of time during which the quality of this parameter met this standard.
	Bottom: The percentage of time during which the quality of this parameter did not meet the standard.
Time N/A	The percentage of time the system did not monitor.
Total Events	Total number of individual power quality events
Status	Choose to stop or run the compliance comparison mechanism.

Table 38: Detailed Compliance Info

Compliance Chart

The Compliance chart offers a visual representation of the electrical system compliance. The information is presented as a set of horizontal bar graphs representing the percentage of compliance of all chosen power parameters

Current system running status along with the minimum and maximum percentage of compliant parameters is situated above the compliance chart.

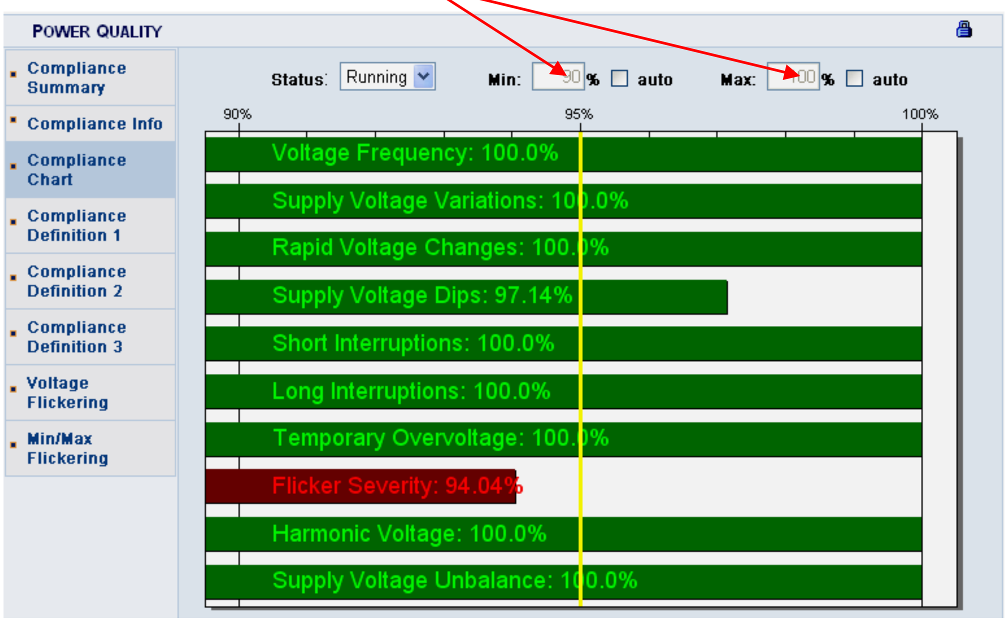


Figure 113: Compliance Chart

Note: *Flicker Severity is highlighted in red to demonstrate that its test readings fall below acceptable standards and therefore is given a fail status.*

User Defined

The three User Defined pages allow you to define custom power quality parameters for the different power quality elements.

Note: *The User Defined Pages 1-3 will reflect the values of the Compliance type chosen in the Summary chart.*

Note: *Refer to* ***Table 37: Compliance Status on page 104*** *for a definition and explanation of each parameter.*

The following terms are used throughout most of the User Defined Pages:

Term	Description
Threshold	Defines the upper and lower limits for parameter compliance
Compliance Condition	Describes the percentage of time out of the total that a parameter must be within the threshold limits. Also may be expressed in number of units.
Detection Interval	The minimum interval for event detection.
Observation Window	The minimum observational time for gathering enough statistics to determine whether a specific parameter is **Pass** or **Fail**.
Report Type	The only embedded report supported at this time is **Columbia.** It is possible to generate custom reports in the Investigator software.
Voltage Type	$\mathbf{U}_{din:}$ value obtained from the declared supply voltage by a transducer ratio
	$\mathbf{U}_{sr:}$ voltage magnitude averaged over a specified time interval, representing the voltage preceding a voltage dip or swell.

Table 39: User Defined

Note: *The user defined values should be changed after selecting User Defined as compliance type.*

Note: *The default settings are those of the EN50160. Changes to this definition require Administrator Login.*

User Defined 1

The first User defined page contains the following:

- Voltage Frequency
- Supply Voltage Dips
- Short Interruptions
- Long Interruptions
- Temporary Overvoltage

Voltage Frequency

Each parameter below refers to the values contained within the Voltage Frequency figure below.

- Voltage range: the RMS voltage must be within the specified range of nominal in order to allow voltage frequency event detection.
- Threshold1/Compliance condition: the frequency must be within the specified Threshold 1 values for at least the minimum specified percentage of time (95%) to be compliant.
- Threshold2 (critical)/Compliance condition: the frequency must be within the specified Threshold 2 values for at least the minimum specified percentage of time (100%) to be compliant
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**
- Mask Voltage Frequency: You can choose if you want to mask the voltage frequency event when either dips or swells occur and/or to mask the frequency during voltage interruptions.

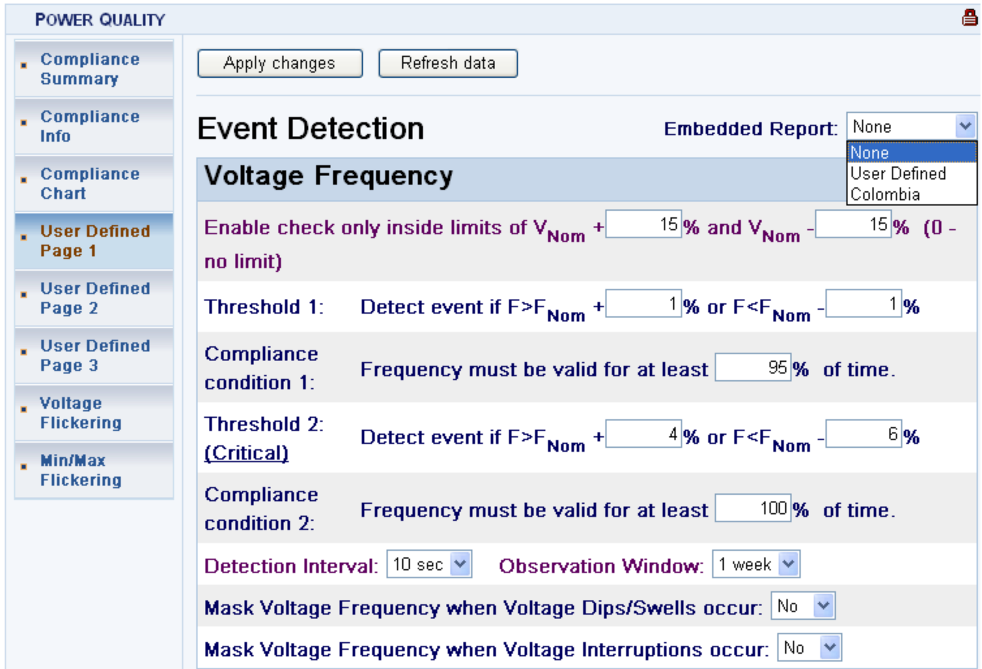


Figure 114: Voltage Frequency

A graphical representation of the Voltage Frequency threshold conditions and parameters appears below. The areas of Compliance, Events and Critical Events are represented as color coded zones.

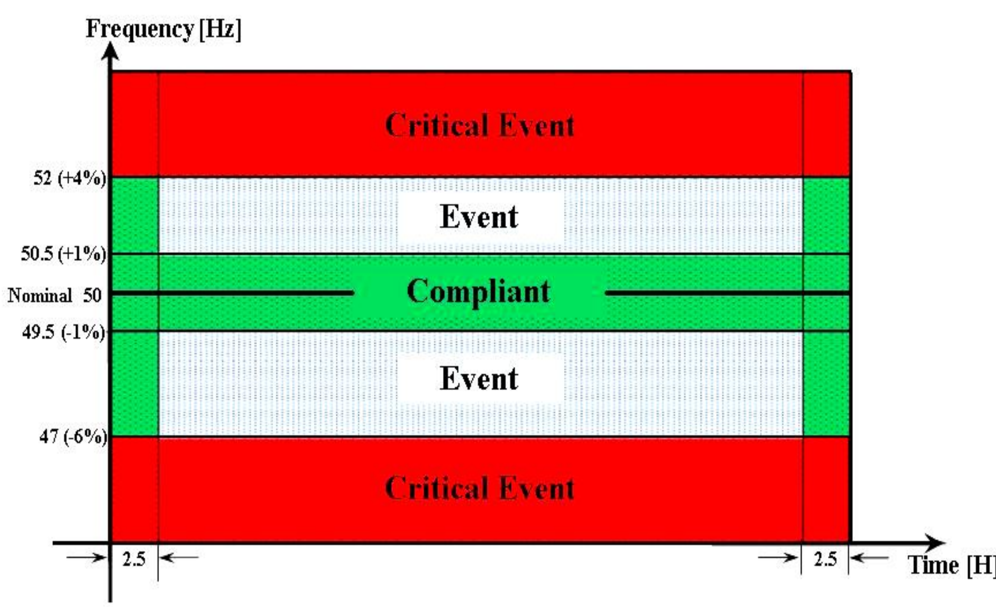


Figure 115: Frequency Events

Supply Voltage Dips

Each parameter below refers to the values contained within the Voltage Frequency figure below.

- Dip Depth/Max Depth Threshold: A voltage dip event is detected when the voltage is within the specified threshold range.
- Max allowed dip Duration: A voltage dip event must be less than the maximum allowed dip duration to be in compliance.
- Compliance Condition: the number of voltage dips per observation window must be less than the specified allowed number to be in compliant.
- Voltage Events: Refer to **Table 39: User Defined**
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**

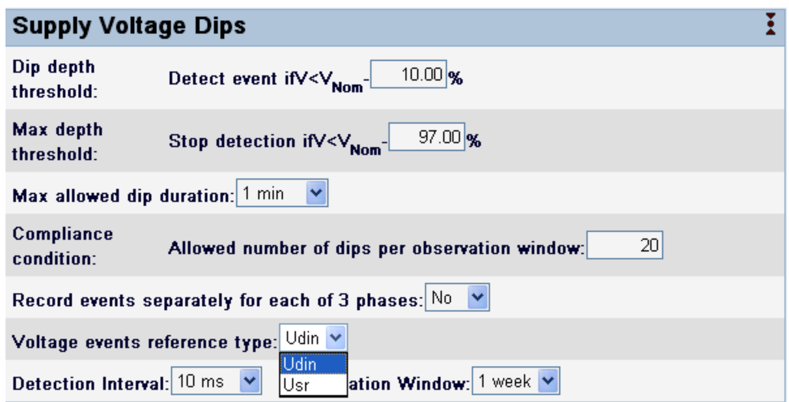


Figure 116: Supply Voltage Dips

A graphical representation of Supply Voltage Dip threshold conditions and parameters appears below. The areas of Compliance, Overvoltage, Dip, as well as Short and Long Interruptions are represented as color coded zones.

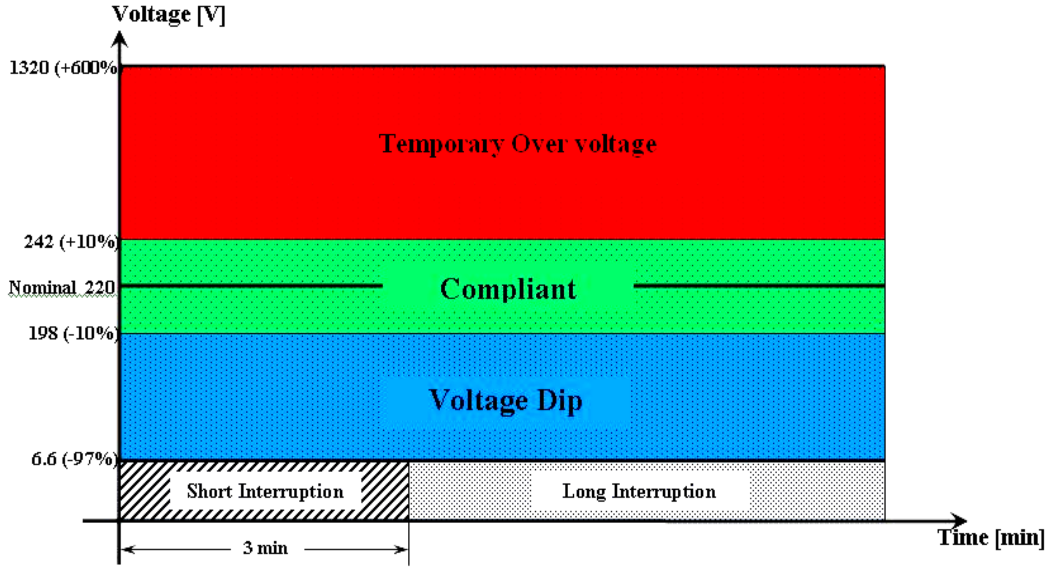


Figure 117: Voltage Events

Short Interruptions

Each parameter below refers to the values contained within the Short Interruptions figure below.

- Detection Threshold: A short interruption event is detected when the voltage is less than a specified value (%).
- Max allowed short interruption duration: The voltage dip must be less than the specified duration value (otherwise a long interruption event is detected).
- Compliance condition: the number of short interruptions events within the observation window must be less than the specified value to be compliant.
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**

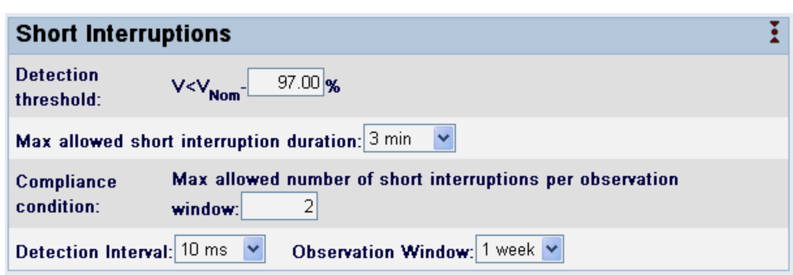


Figure 118: Short Interruptions

Long Interruptions

Each parameter below refers to the values contained within the Long Interruptions figure below

- Detection Threshold/Compliance: the same as the Short Interruption.
- Compliance condition: the number of long interruption events within the observation window must be less than the specified value to be compliant.
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**

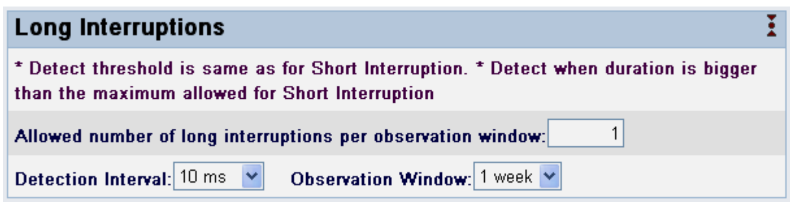


Figure 119: Long Interruptions

Temporary Overvoltage

Each parameter below refers to the values contained within the Temporary Overvoltage figure below

- Detection Threshold: A temporary overvoltage event is detected when the voltage is greater than a specified value (%).
- Detect up to level: The temporary overvoltage must be less than the specified value (percent).
- Compliance condition: the number of temporary overvoltage events within the observation window must be less than the specified value to be compliant.
- Voltage Events: Refer to **Table 39: User Defined**
- **on page 107.**
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**

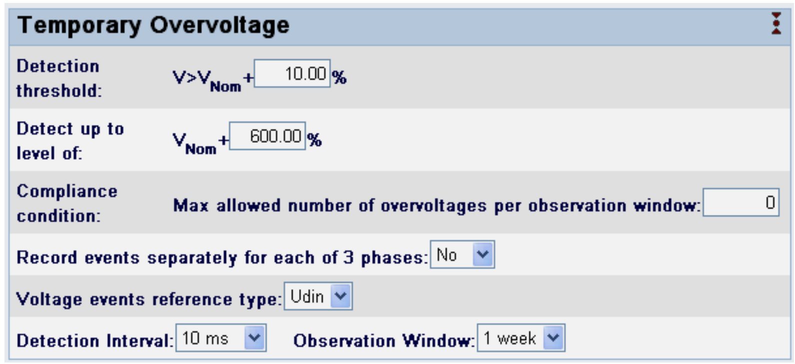


Figure 120: Temporary Overvoltage

User Defined 2

The second user defined page contains the following:

- Voltage Variations
- Rapid Voltage Changes
- Voltage Unbalance
- Voltage Flicker

Voltage Variations

Each parameter below refers to the values contained within the Voltage Variations figure below

- Threshold1/Compliance condition: the variation must be within the specified Threshold 1 values for at least the minimum specified percentage of time (95%) to be compliant**.**
- Threshold2 (critical)/Compliance condition: the frequency must be within the specified Threshold 2 values for at least the minimum specified percentage of time (100%) to be compliant.
- Enable Entire Observation Window: When enabled (yes), the compliance condition to follow to follow is active.
- Compliance condition: The RMS voltage mean must be within a specified range.
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**
- Voltage Interruptions: When there is a voltage interruption, ignore (yes) voltage variation even.
- Voltage Dips/Swells: When there is a voltage dip or swell, Ignore (yes) voltage variation event.

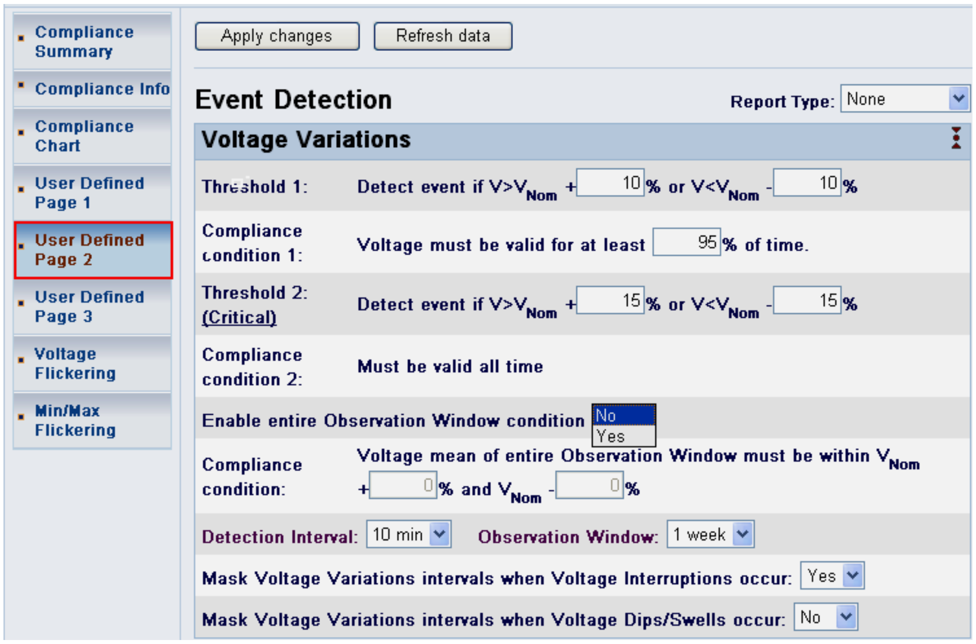


Figure 121: User Defined 2 Voltage Variations

Rapid Voltage Changes

Each parameter below refers to the values contained within the Rapid Voltage Changes figure below:

- Voltage range: the RMS voltage must be within the specified range of nominal in order to allow rapid voltage change event detection.
- Compliance conditions (1-4): The derivative of the voltage needs to be within a specified range for a set number of occurrences to be compliant.
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**

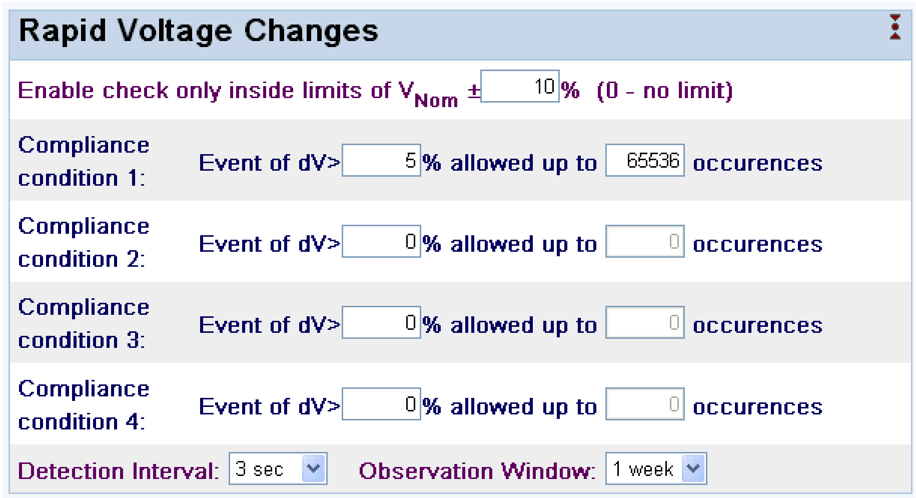


Figure 122: User Defined 2 Rapid Voltage Changes

Voltage Unbalance

Each parameter below refers to the values contained within the Voltage Unbalance figure below

- Voltage range: the RMS voltage must be within the specified range of nominal in order to allow voltage unbalance event detection.
- Threshold/Compliance condition: the voltage unbalance must be less than the specified threshold value for at least the minimum specified percentage of time (95%) to be compliant.
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**
- Additional Interval: Additional optional thresholds.
- Voltage Interruptions: When there is a voltage interruption, ignore (yes) the voltage variation event.
- Voltage Dips/Swells: When there is a voltage dip or swell, Ignore (yes) the voltage variation event.

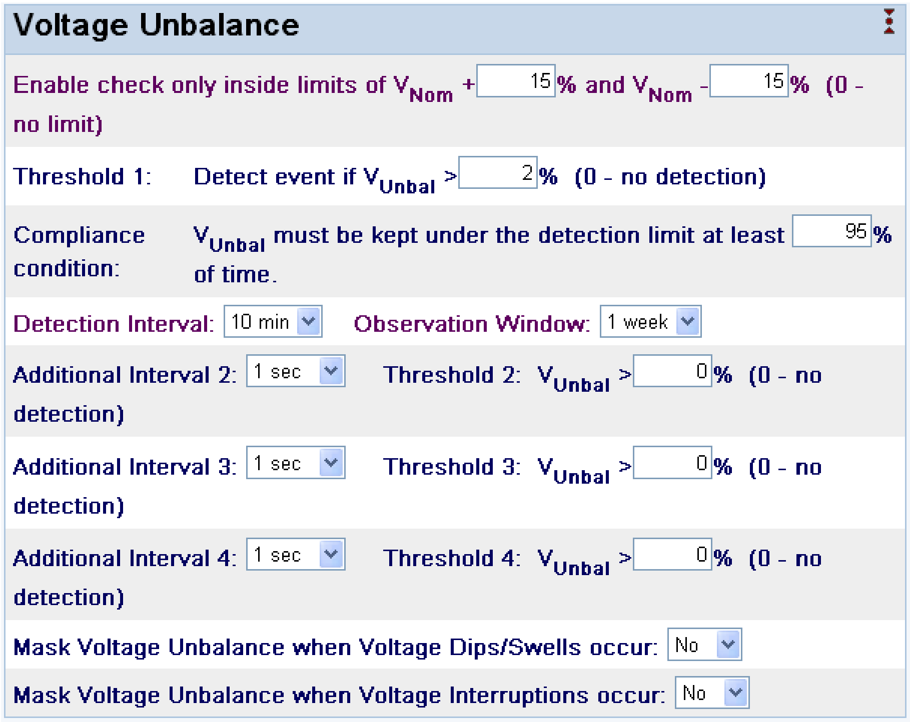


Figure 123: User Defined 2 Voltage Unbalance

Voltage Flicker

Each parameter below refers to the values contained within the Voltage Flicker figure below. Refer to: **Table 40: Voltage Flickering on page 120** for definitions:

- PST (10 minutes) threshold/condition: If the PST is larger than the specified value for more than allowed time, then the unit is not in compliance.
- PLT (2 hours) threshold/condition: If the PLT is larger than the specified value for more than allowed time, then the unit is not in compliance.
- Mask Flicker during voltage interruptions: When there is a voltage interruption, ignore (yes) voltage flickering event.
- Mask Flicker during voltage dips/swells: When there is a voltage dips or swells, ignore (yes) voltage flickering event.
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**

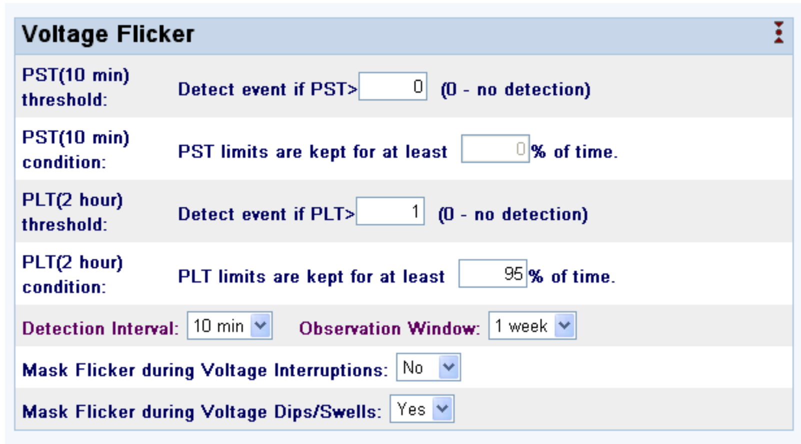


Figure 124: User Defined 2 Voltage Flicker

User Defined 3

The third user defined page allows you to define event detection parameters for voltage harmonics.

Voltage Harmonics

Each parameter below refers to the values contained within the Voltage Harmonics figure below:

- Voltage range: the RMS voltage must be within the specified range of nominal in order to allow voltage unbalance event detection.
- Threshold/Compliance condition 1: The total harmonic distortion and the individual harmonic need to be in a specific range for at least the specified percentage of time.
- Compliance condition 2: The THD of the entire observation window needs to be less than the specified value.
- Detection Interval/Observation Window: refer to **Table 39: User Defined**
- **on page 107.**
- Individual Limits: The lower half of the page contains individual lower thresholds for individual harmonics as part of nominal.
- Voltage Interruptions: When there is a voltage interruption, ignore (yes) voltage variation even.
- Voltage Dips/Swells: When there is a voltage dip or swell, Ignore (yes) voltage variation event.

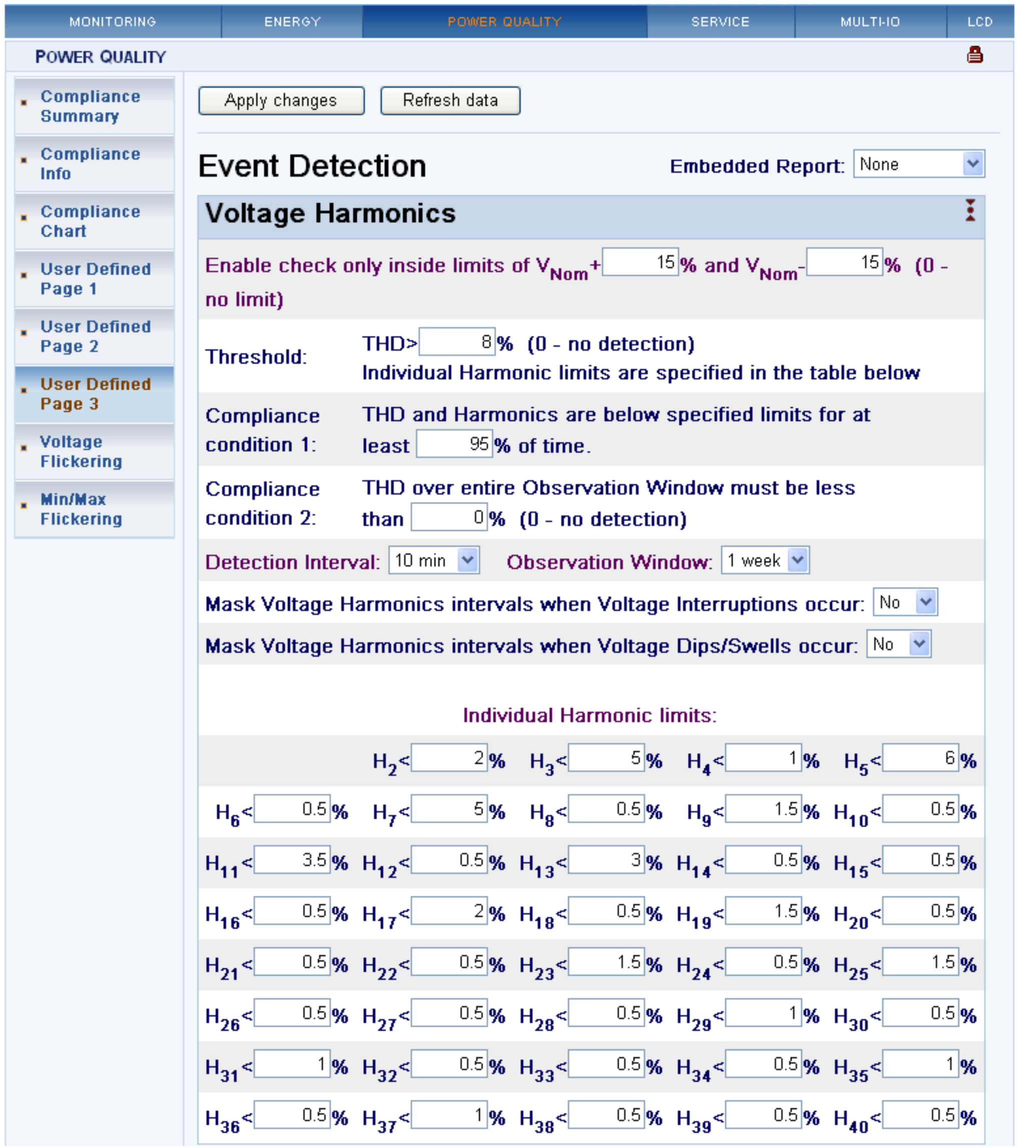
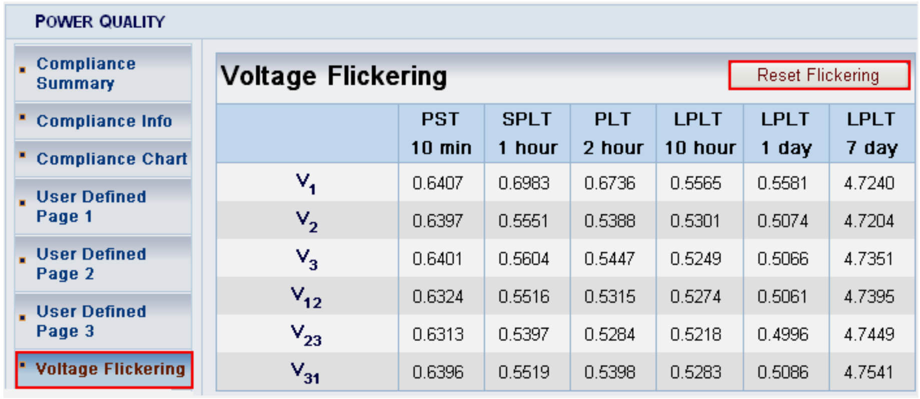


Figure 125: Voltage Harmonics

Voltage Flickering

The intensity of flicker annoyance is defined in the IEC 61000-4-15 (class 1) flicker measuring method standard and evaluated by the EN60150 standard:



	PST 10 min	SPLT 1 hour	PLT 2 hour	LPLT 10 hour	LPLT 1 day	LPLT 7 day
V_1	0.6407	0.6983	0.6736	0.5565	0.5581	4.7240
V_2	0.6397	0.5551	0.5388	0.5301	0.5074	4.7204
V_3	0.6401	0.5604	0.5447	0.5249	0.5066	4.7351
V_{12}	0.6324	0.5516	0.5315	0.5274	0.5061	4.7395
V_{23}	0.6313	0.5397	0.5284	0.5218	0.4996	4.7449
V_{31}	0.6396	0.5519	0.5398	0.5283	0.5086	4.7541

Figure 126: Voltage Flickering

Note: *The flicker types* $\boldsymbol{P_{SPLT}}$ *,* $\boldsymbol{P_{SST}}$ *and* $\boldsymbol{P_{LPLT}}$ ***are*** *only found in model # 4430.*

Flicker Type	Description
P_{st} 10 Minutes	Short term flicker evaluation P_{st} is a value measured over 10 minutes that characterizes the likelihood that the voltage fluctuations would result in perceptible light flicker. A value of 1.0 is designed to represent that 50% of people would perceive flicker in a 60 watt incandescent bulb.
P_{lt} 2 Hour	Long term flicker evaluation P_{lt} is derived from 2 hours of P_{st} values (12 values combined in cubic relationship)
P_{SST} 2 Seconds	An Elspec measurement designed to get quicker results regarding Flicker evaluation. This measurement reaches a very close approximation of the EN50160 values, but in a fraction of the time. The PSST is calculated the same as PST but averaged over 2 seconds. This Elspec defined value is valuable in that it enables faster assessment of the flicker. Elspec PSST converges to a real value within 3 min from a drastic flicker change, or immediately for periodic steady state flicker.
P_{SST} 10 Seconds	An Elspec measurement designed to get quicker results regarding Flicker evaluation. This measurement reaches a very close approximation of the EN50160 values, but in a fraction of the time. The PSST is calculated the same as PST but averaged over 10 seconds. This Elspec defined value is valuable in that it enables faster assessment of the flicker. Elspec PSST converges to a real value within 3 min from a drastic flicker change, or immediately for periodic steady state flicker.

P_{SST} 1 Minutes	An Elspec measurement designed to get quicker results regarding Flicker evaluation. This measurement reaches a very close approximation of the EN50160 values, but in a fraction of the time. The PSST is calculated the same as PST but averaged over 1 minute. This Elspec defined value is valuable in that it enables faster assessment of the flicker. Elspec PSST converges to a real value within 3 min from a drastic flicker change, or immediately for periodic steady state flicker.
P_{SPLT} 1 Hour	An Elspec measurement designed to get quicker results regarding Flicker evaluation. This measurement reaches a very close approximation of the EN50160 values, but in a fraction of the time. The SPLT is calculated the same as PLT but averaged over 1 hour. This Elspec defined value is valuable in that it enables faster assessment of the flicker.
P_{LPLT} 10 Hours	An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time. The LP_{LT} is calculated the same as P_{LT} but averaged over 10 hours to allow a quicker "long term" average.
P_{LPLT} 1 Day	An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time. The LP_{LT} is calculated the same as P_{LT} but averaged over 1 day.
P_{LPLT} 7 Days	An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time. The LP_{LT} is calculated the same as P_{LT} but averaged over 7 days, as per EN50160 parts 4-15.

Table 40: Voltage Flickering

Min/Max Flickering

- Reset All Min/Max: To reset all Min/max flickering values manually.
- Min/Max Flickering Values: These are the minimum/maximum flickering values.

		PST 10 min	SPLT 1 hour	PLT 2 hour	LPLT 10 hour	LPLT 1 day	LPLT 7 day
V_1	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	83.973	56.072	48.711	41.652	40.069	32.659
V_2	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	81.391	59.508	56.976	51.232	49.267	37.612
V_3	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	146.26	136.13	126.48	109.26	106.70	81.308
V_{12}	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	85.658	82.879	79.290	73.815	72.601	54.501
V_{23}	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	131.85	119.05	117.53	110.55	107.23	102.55
V_{31}	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	114.64	101.53	99.114	93.107	78.075	69.570

Figure 127: Min/Max Flickering

Service

This section addresses only Service Diagnostics. All Setup pages are discussed in the **Configuring the BLACKBOX on page 41**.

System Log

The system log is a list of all events recorded by the BLACKBOX instrument.

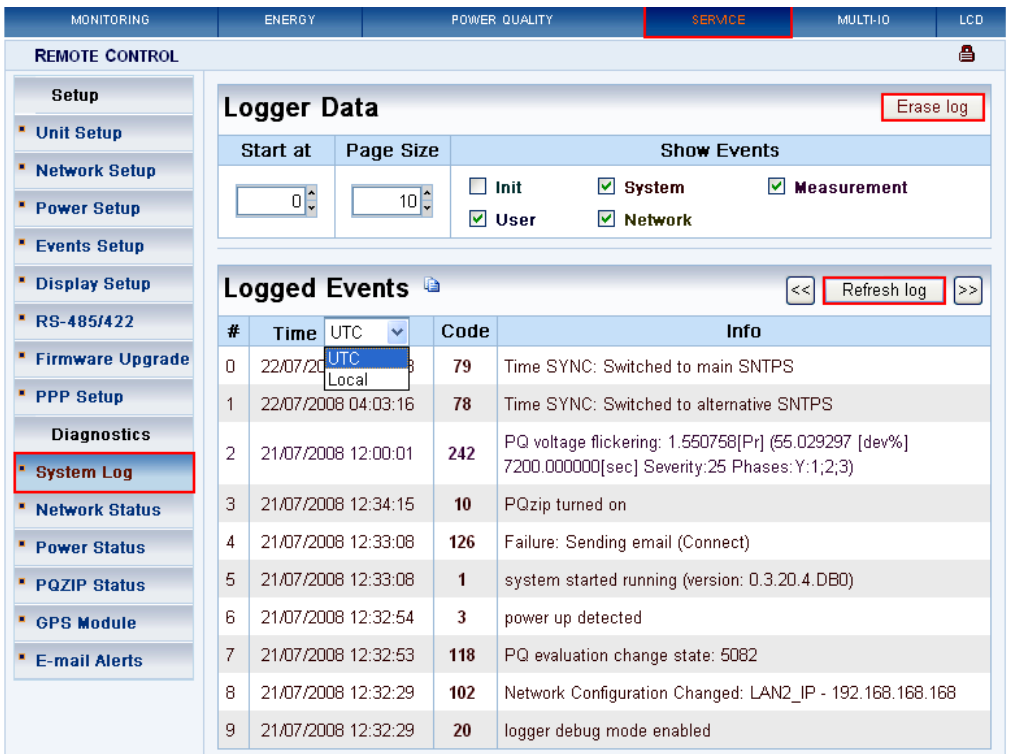


Figure 128: The System Log

Attribute	Description
Logger Data	**Start at**: Input the log entry to begin from the top of the list. The list starts from the top numbered at 0 with the most recent event. The numbering increased with the age of the entry, going down the list
	Page Size: Input the number of lines to show in the log page on the screen (max 100 events per page).

Attribute	Description
	Show Events: In this area, check boxes allow the user to choose any combination of events to be displayed: • Initialization events • User events • System events • Network events • Measurement events
Erase Log	Erase all the events in the log.
Logged Events	**Refresh Log**: The two arrow buttons enable the user to scroll up and down the logged events.
	Local Time: the time in relation to the time zone in which the instrument is installed. **UTC**: Universal Time Clock
	Number: This is the sorting number, as explained above under the description of the Start at field.
	Time: The time of the event
	Code: The numeric ID of the event
	Info: The description of the event

Table 41: System Log

Network Status

The page offers a summary of information concerning all communication systems resident on the BLACKBOX. The Network Status page is an information only page, with no options for making changes.

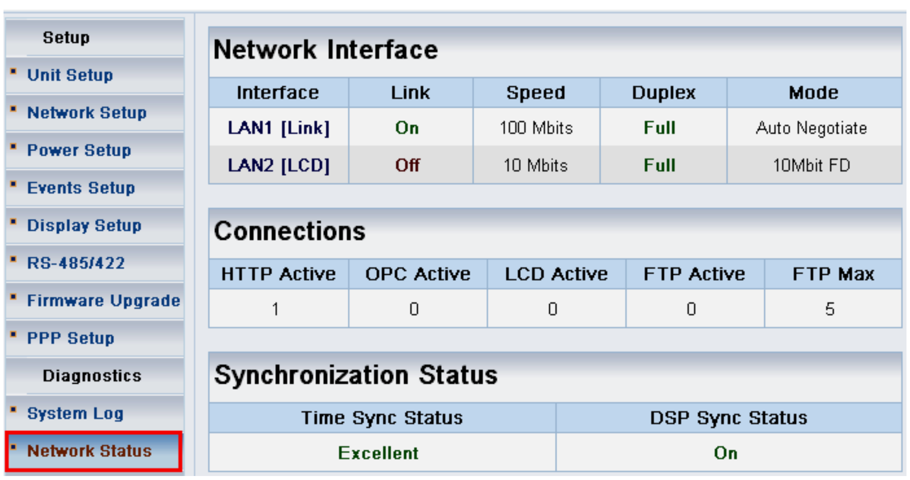


Figure 129: Network Status

Attribute	Description
Network Interface	**LAN 1 Link**: the link to which the Black Box connects to the LAN by default **LAN 2 Link**: the link by which the G4100 LCD connects to the Black Box by default
	Link: Status of the link- on or off
	Speed: The speed at which each port is configured
	Duplex Full- the communication is two way simultaneously **Duplex Half**: the communication is one way
	Mode: Mode of initial connection
Connections	**HTTP Active:** The number of computers currently connected to the Black Box through network browsers
	OPC Active: The amount of OPC clients currently connected to the Black Box
	LCD Active: The amount of G4100 LCD displays currently communicating with the Black Box through the network
	FTP Active: The number of agents currently downloading from the Black Box ftp site
	FTP Max: The maximum number of agents allowed to download from the Black Box FTP site
Synchronization Status	**Time Sync Status:** Quality of the time synchronization with the time source
	DSP Sync Status: The DSP module is establishing synchronization with the data (yes/no).

Table 42: Network Status

Power Status

The Power Status page displays the status of the various power supplies resident on the BLACKBOX.

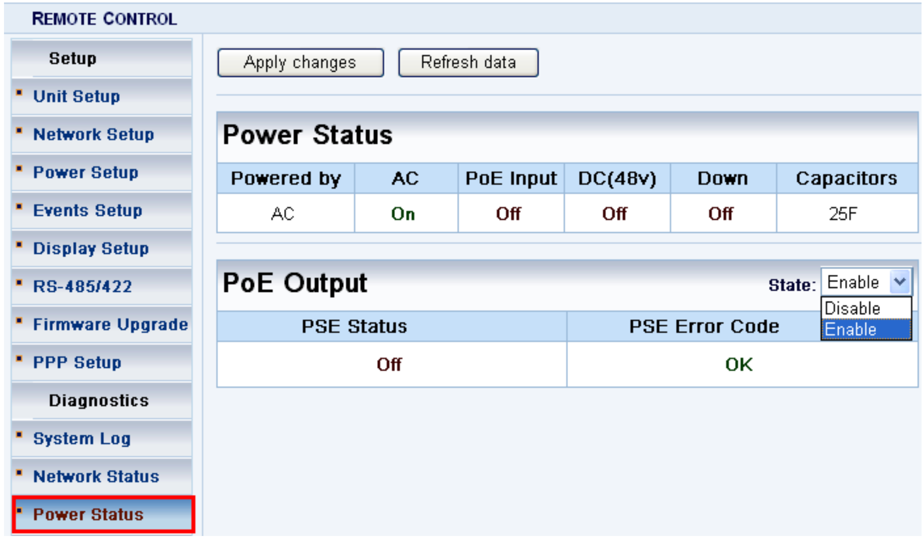


Figure 130: Power Status

Attribute	Description
Apply Changes	after in-putting information in the tables, clicking on this button sends the new information to the instrument
Refresh Data	Polls the instrument for current data
Power Status	**Powered by:** Informs the user as to the type of power currently supplying the instrument
	AC: AC status
	PoE Input: Status of the PoE on the LAN1 port; an alternate power input for the instrument
	DC (48v): Status of the DC power supply input
	Down: This flag will go to ON when the instrument has no power supply and is on ride through power supplied by the capacitors
	Capacitors: The size of the super capacitor supplying the ride through power
PoE Output	**PSE Status:** The status of the LAN2/LCD port. "On" signifies that an LCD screen is currently attached to this port
	PSE Error Code: Fail signifies that this port is malfunctioning
State	Enable/Disable: the POE of LAN2

Table 43: Power Status

PQZip Status

Elspec's Registered Patented PQZip compression algorithm compresses and stores the waveform data on the unit's compact flash. These files can be sent to a PQSCADA server.

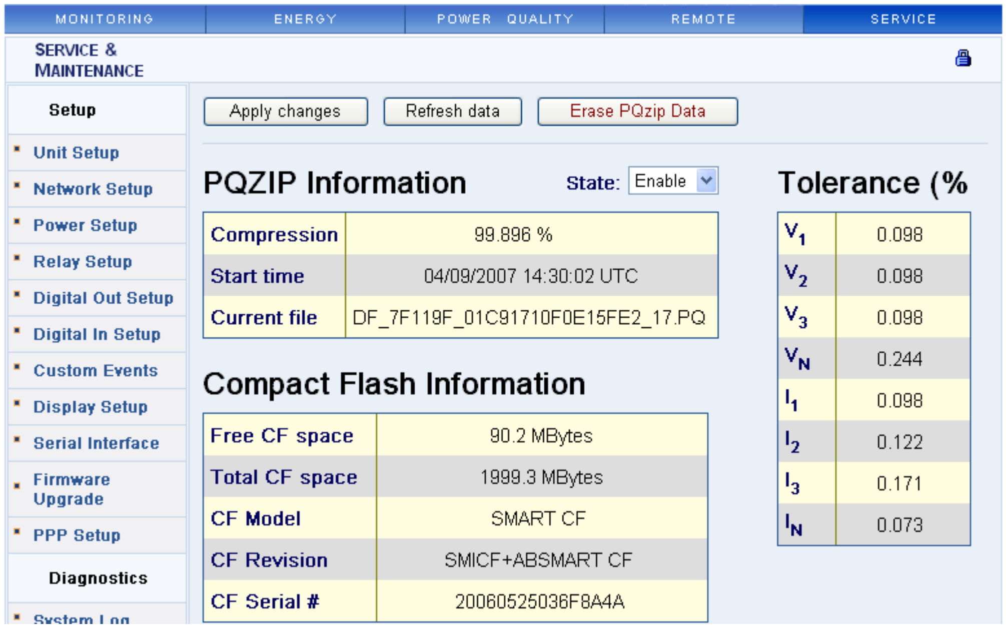


Figure 131: PQ Zip Status

Attribute	Description
Apply Changes	after in-putting information in the tables, clicking on this button sends the new information to the instrument
Refresh Data-	pulls the currently active information from the instrument
Erase PQZip Data	will erase the PQZip file on the instrument
State	**Enable/Disable**: used to enable or disable the PQZip compression mechanism. Enabling the mechanism is undertaken after all the setup parameters have been input, and the instrument is monitoring the electrical system.
PQZip Information	Compression: The percentage of compression
	Start Time: The date and time the PQZip mechanism was initiated
	Current File: The current file name.
Tolerance V_1 – I_n	The maximum error due to compression activity
Compact Flash Information	Free CF Space: The unused space on the memory
	Total CF Space: Total memory size
	CF Model: Model name/number of the memory medium
	CF Revision: Revision number of the memory medium
	CF Serial #: Serial number of the memory medium

Table 44: PQZip Status

GPS Module

When a GPS module is installed and enabled, you need to define a fixed time interval delay. The time delay is provided by Elspec.

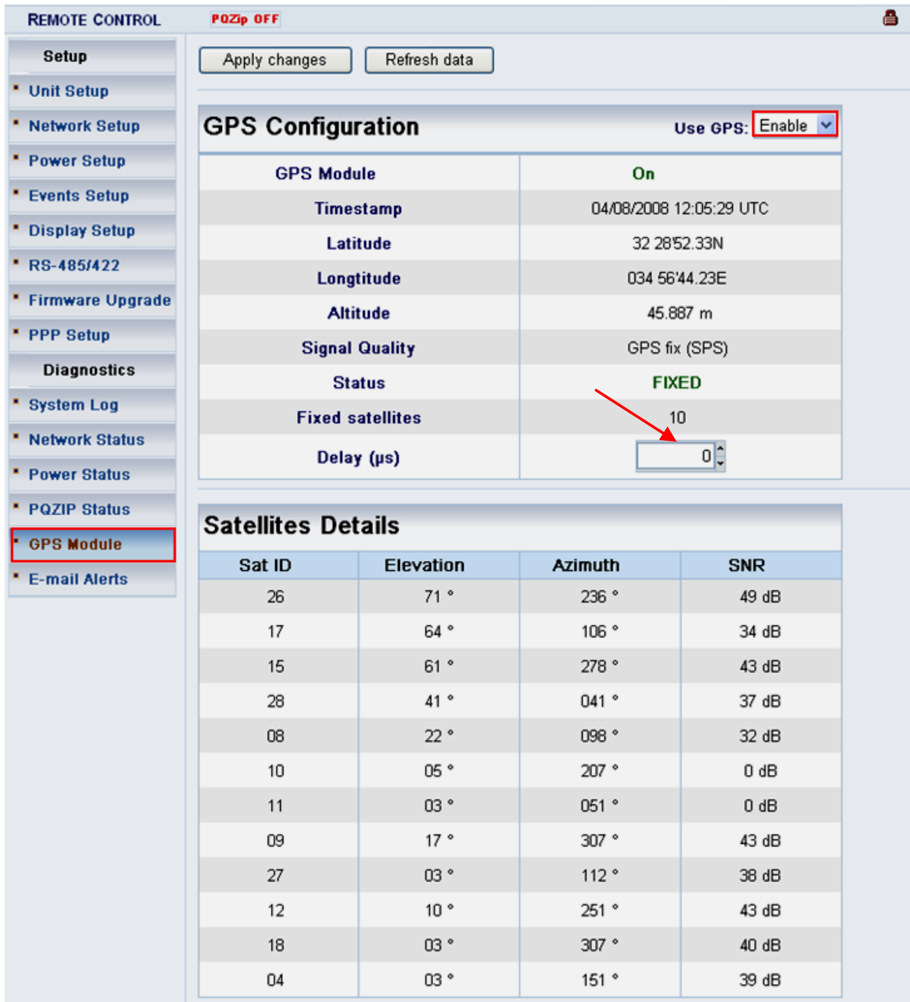


Figure 132: GPS Module

Email Alerts

The BLACKBOX can be configured to send email alerts to a selected recipient. The configuration of the email address to the recipient and the desired events are selected in this section.

The following figures display the Email Configuration pages individually. Clicking on the arrows to the right of each selection group (red arrow below) will open a menu of events that can be used to select those events for which an email notification is sent.

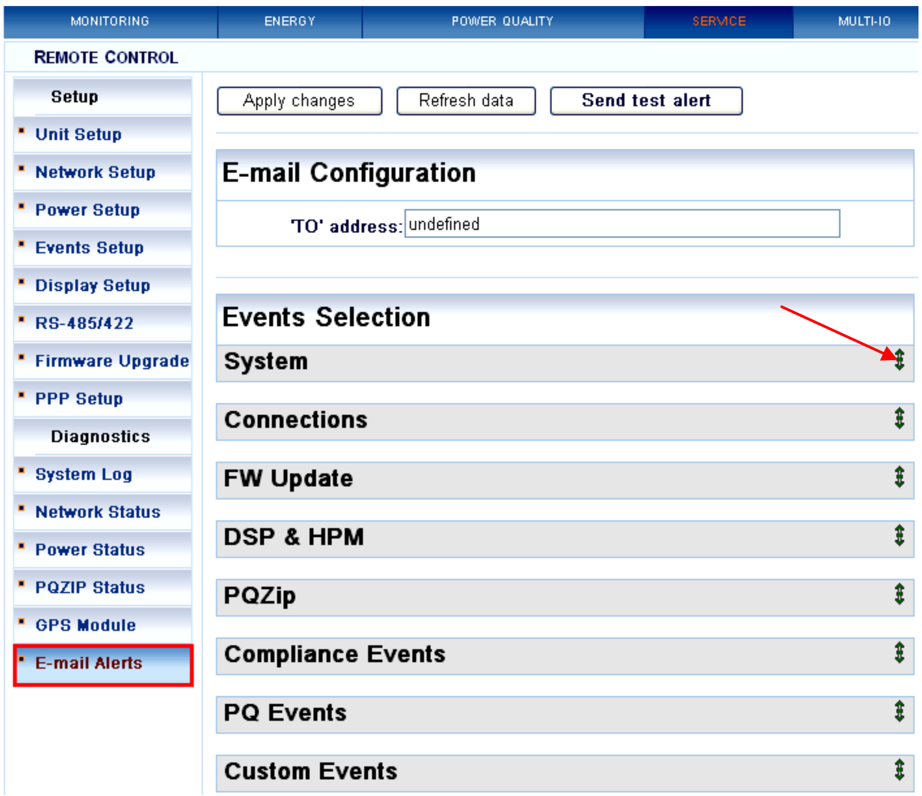


Figure 133: Email Alerts

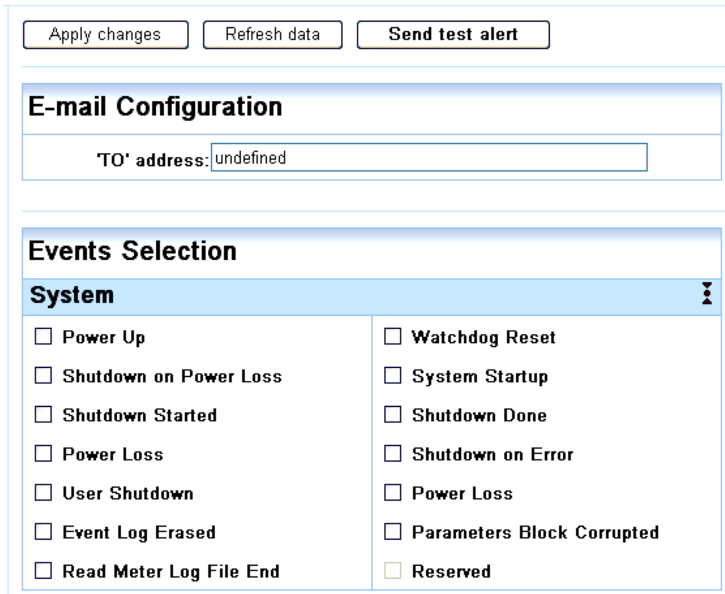


Figure 134: Events Selection

Connections:

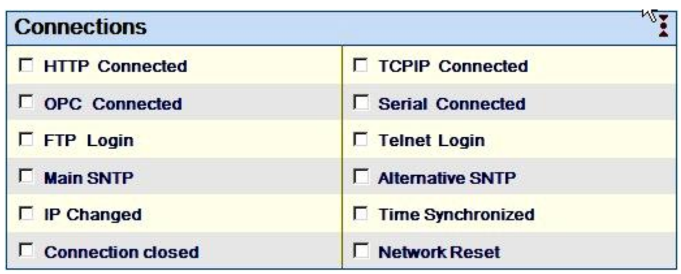


Figure 135: Connections

FW Update:

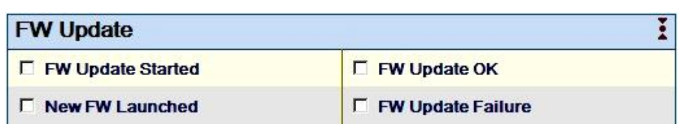


Figure 136: FW: Update

DSP & HPM:

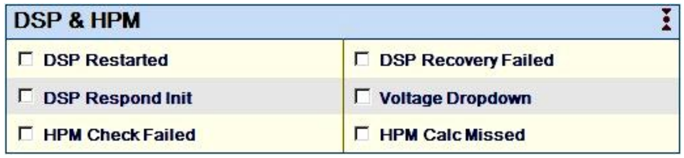


Figure 137: DSP & HPM

PQZip:

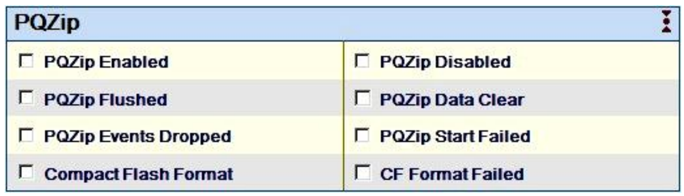


Figure 138: PQZip

Compliance Events:

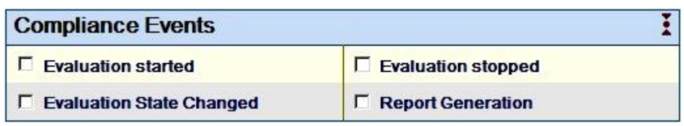


Figure 139: Compliance Events

PQ Events:

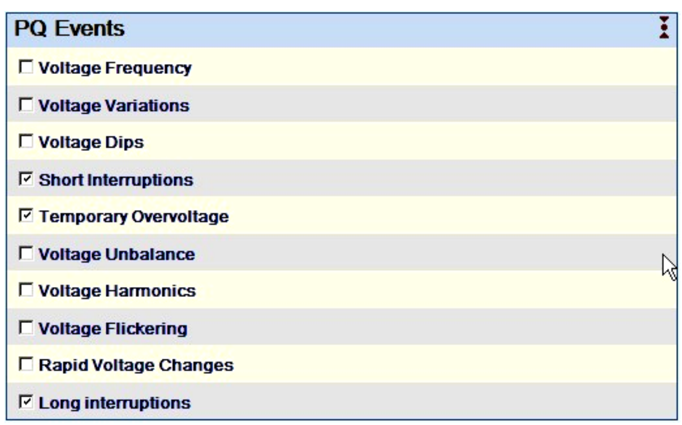


Figure 140: PQ Events

Custom Events:

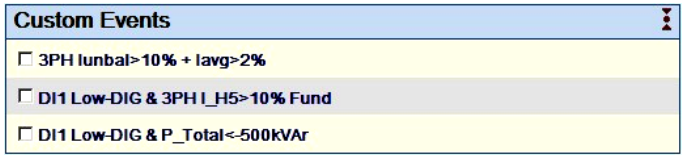


Figure 141: Custom Events

Multi-I/O

The Multi I/O is an optional multiple function I/O module available for all BLACKBOX units. Because this module is not shipped with all units, it is discussed separately in detail in the following chapter.

G4100 Display Unit

The G4100 Display Unit is used to both configure and monitor the BLACKBOX, achieving much the same effect as when using a web browser. This device is an optional component of the BLACKBOX and is shipped separately. A separate user manual is shipped with the device for more detailed operating instructions.

Figure 142: G4100 Display Unit

Note: *For more detailed information on the G4100 refer to the separate user guide packaged with the display.*

Chapter 5: Multi I/O

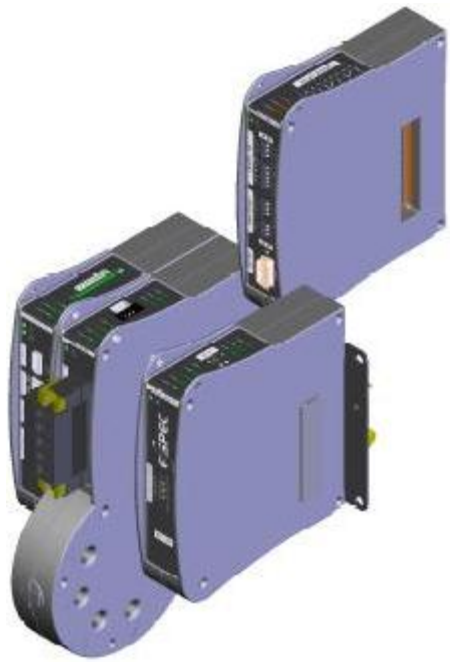


Figure 143: Multi I/O Expansion Module

The Multi I/O is an optional module available for the BLACKBOX. The Multi I/O Expansion module extends the monitoring capabilities of the BLACKBOX with additional digital and analog I/O ports.

In this section a full description of the I/O hardware is covered as well as information on navigating the I/O heading in the Embedded website.

Note: *If your BLACKBOX does not contain an I/O module, this section is not relevant at this time.*

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MULTI I/O FEATURES **136**

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Configuring the Relays **138**

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MONITORING THE MULTI I/O **151**

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Digital in Status 153

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Multi I/O Configuration

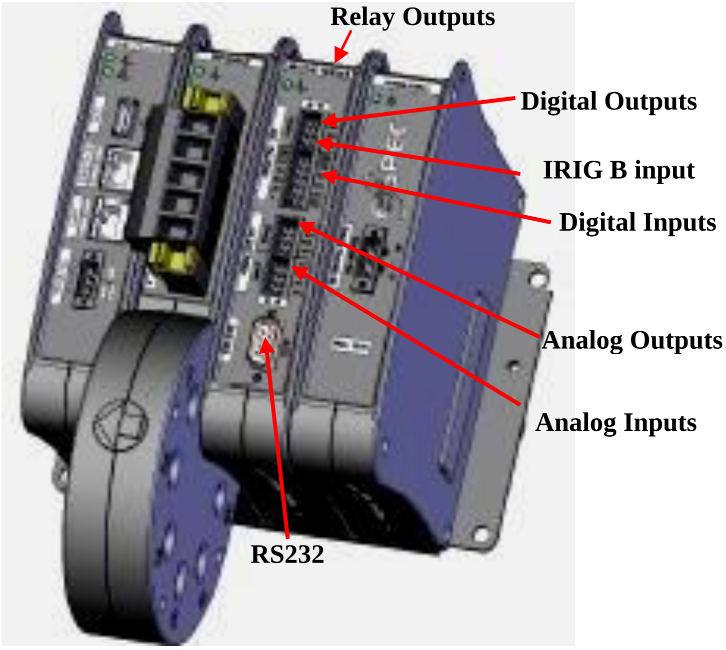

Figure 144: Multi I/O Configuration

The BLACKBOX w Multi I/O is configured with the following:

- 8×Digital Inputs (3.3VDC < Vin < 48VDC)
- 4×Digital Outputs (Max. 100 VDC, 70 VAC, 600mA)
- 3×Form C Relays (Max. 250 VAC, 6A)
- 4×Analog (4-20mA) Outputs (Max. 600 Ω, ±12 VDC)
- 4×Analog (4-20mA) Inputs
- 1×IRIG-B input
- 1×RS 232 (9 pin)

Multi I/O Features

- Enables the gathering of operational data.
- Enables overseeing temperatures, levels and statuses.
- Synchronous signals input readings from pulsed outputs (including TOU).
- Status determination of switches, protection relays, breakers, etc.
- Conditional operation and control of devices and equipment interfacing with digital signals.
- High rate I/O ports signals sampling and compression in method similar to that used in continuous logging.
- Expandable up to six I/O modules on the unit.
- The full high resolution logged waveform data is synchronized with logged I/O signals without gaps.

Note: *For a detailed listing of technical specifications, refer to* ***Table 54: Ethernet Port***

System Overview

There are type types of inputs for the I/O module:

- Energy
- Events

The I/O Engine periodically checks the inputs and set the outputs accordingly.

Energy pulses and events can be of different type as shown. They can also be collected and sent by electronic mail, opened as an Excel file, and displayed by the Investigator or by third party software through the OPC protocol.

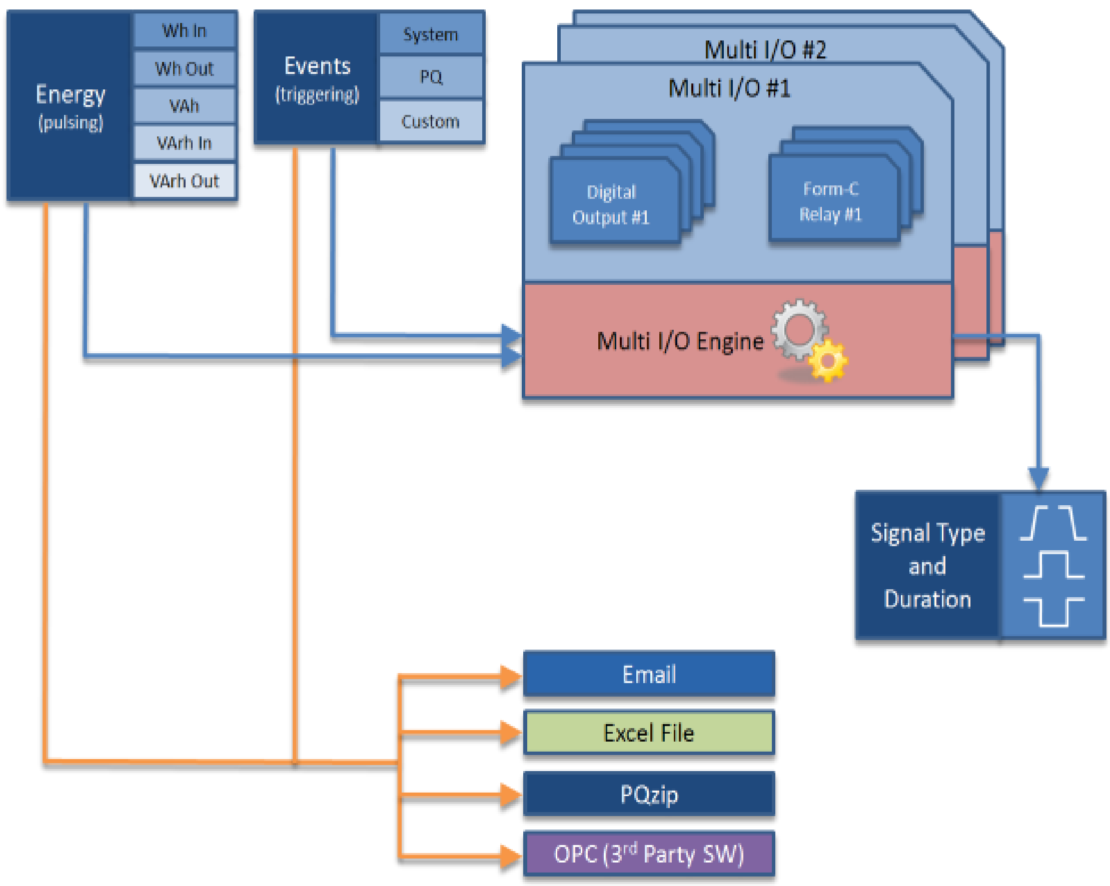

Figure 145: I/O System Overview

Configuring the Multi I/O

The Multi I/O can be configured through the firmware similar to the BLACKBOX setup. All setup procedures must be performed before any Status information is available. Multi I/O configuration consists of the following

Note: *Configuring the device requires administrative access. You must Login as administrator with an initial password of 12345.*

Configuring the Relays

The relays must be configured on the Multi I/O. There are three C-Form type relays per I/O module.

To Configure the Relays:

1. From the Multi I/O heading select **Relay Setup**.

The Relay Setup menu appears.

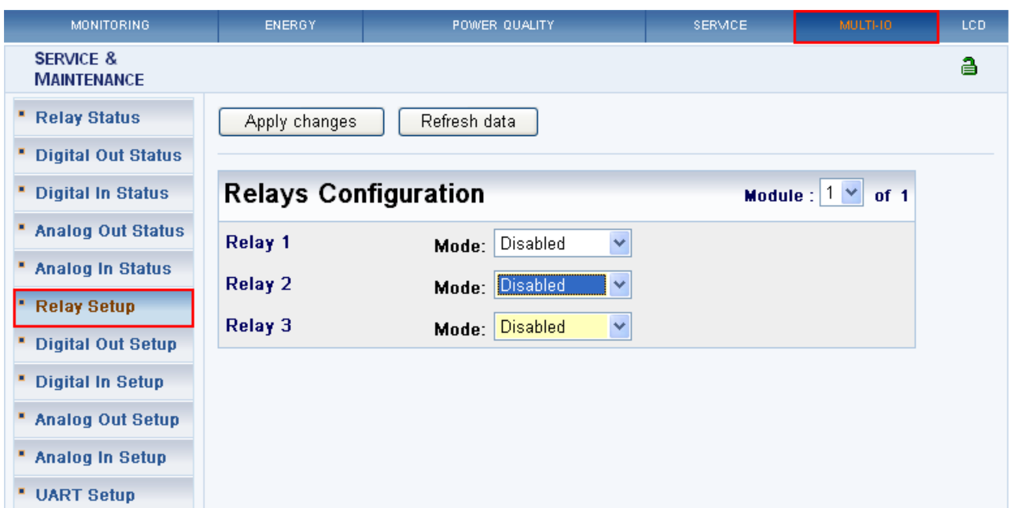

Figure 146: Relay Setup

2. Choose the module to configure if multiple modules exist.

Figure 147: Module Selection

3. From the three available relays, choose the one you want to configure.

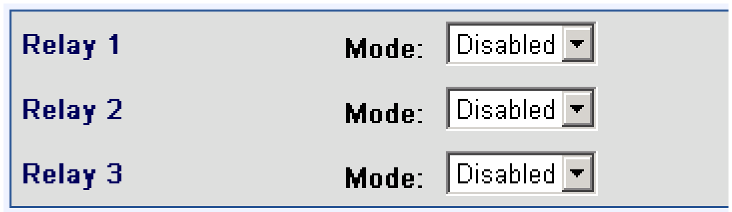

Figure 148: Relay Selection

4. From the drop down menu, select from the three options:

Figure 149: Mode Selection

- **Disable**: Default state. The relay is disabled.
- **Manual**: Static output, either ‘0’ (NC) or ‘1’ (NO)
- **Auto**: Functional output.

5. Configure each relay accordingly.

Manual

By selecting **Manual** the relay's output can be set either as **Normally Closed (NC)** or **Normally Open (NO).**

Note: *In some versions of the firmware, the notation of NC/NO is displayed only as 0/1.*

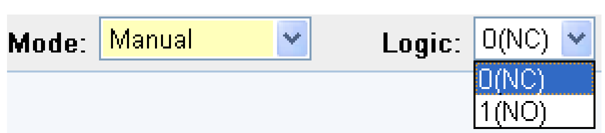

Figure 150: Relay's Manual Selection

Auto

By selecting Auto, the relay's output signal is a function of the following

- Energy

- Events
- Alarm

Energy Signal

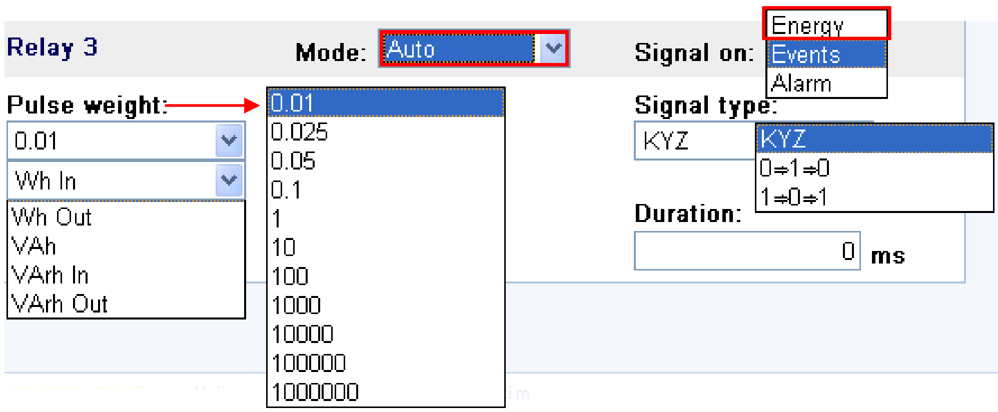

Figure 151: Signal on Energy

Energy Signal	Parameters
Pulse Weight	**Quantity:** the amount of energy needed to generate a pulse. Can contain values from 0.01 to 100000
	Energy parameter: the measurement unit. • Wh In • Wh out • Vah • Varh In • Varh Out
Signal Type:	The output signal type selection. **KYZ**: The Form C Relay output toggles
	0→1→0: The Form C Relay changes its output status from 'NC' to 'NO' and back to 'NC'
	1→0→1: The Form C Relay changes its output status from 'NO' to 'NC' and back to 'NO'
Duration	The output signal duration selection. ***Note: The duration is not relevant for KYZ output signal.***

Table 45: Energy Signal

Events Signal

There are three classes of Events Signals. Screen captures are below and an explanation of each to follow in **Table 46: Events Signal on page 140.**

Code Based

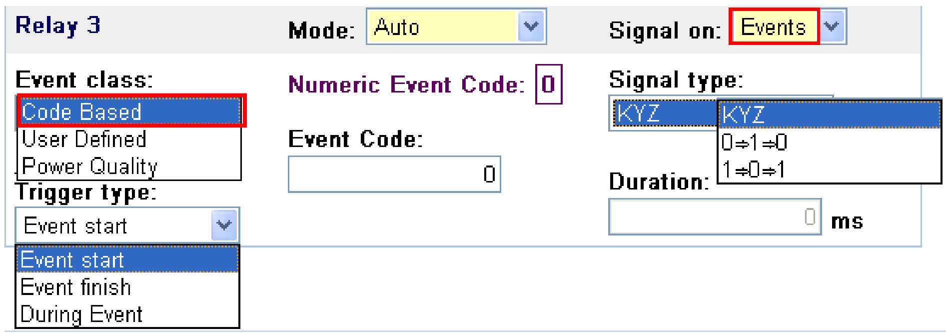

Figure 152: Signal on Events

User Defined

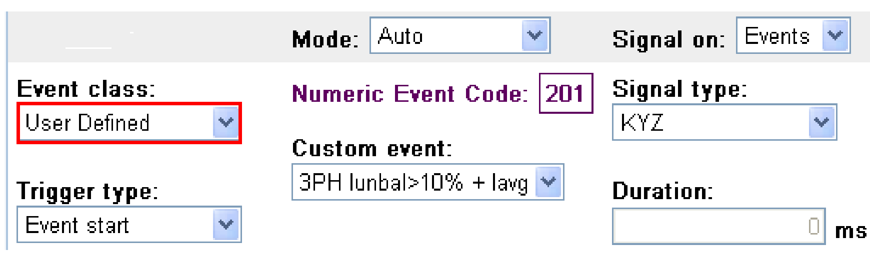

Figure 153: Relay Custom Event

Power Quality

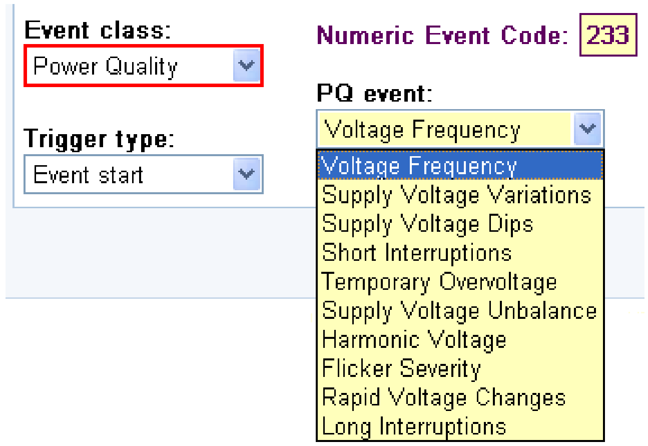

Figure 154: Power Quality Event

Events Signal	Parameters
Event Class	The type of event that is going to trigger the relay's output: • **Code Based:** Choose an event by its event ID number See 227Appendix M: Event Description on page 227
	• **User Defined:** Custom events defined by the user**.** See Figure 153: Relay Custom Event on page 14160. ***Note:*** *If you do not see a custom event, go to Configuring Events on page 60.*
	• **Power Quality:** The I/O output Relay will be triggered in accordance to the Compliance type selected. ***Note:*** *If you do not see the desired event, go to Compliance Summary on page 100.*
Trigger Type:	When the trigger is going to be activated: • **Event Start** • **Event Finish** • **During Event**:
Signal	The output signal type selection. **KYZ**: The Form C Relay output toggles

Type:	**0→1→0**: The Form C Relay changes its output status from 'NC' to 'NO' and back to 'NC'
	1→0→1: The Form C Relay changes its output status from 'NO' to 'NC' and back to 'NO'
Duration	The output signal duration selection. ***Note:*** *The duration is not relevant for KYZ output signal.*

Table 46: Events Signal

Alarm Signal

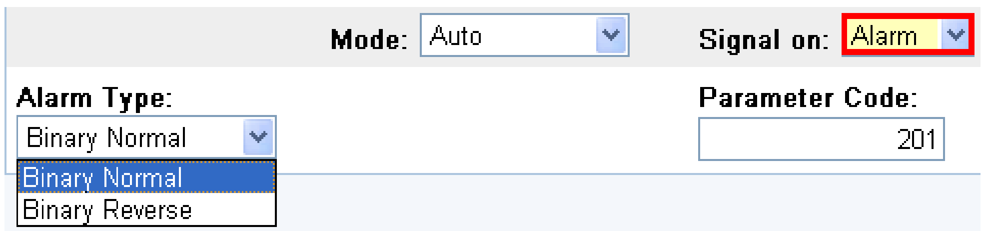

Figure 155: Alarm Signals

The following parameters relate to the Alarm Signal.

- **Binary Normal**: means that if the value of the parameter is 0 then the output is 0
- **Binary Reverse**: means that if the value of the parameter is 0, the output is 1.
- **Parameter Code**: Currently there is only one alarm parameter: General status Parameter Code: 4616

6. Click **Apply Changes** when complete.

Configuring Digital Output

The digital outputs must be configured. There are four digital outputs per I/O module.

To configure the digital output:

1. From the Multi I/O Menu, select **Digital Output Setup**.

The Digital Output screen appears.

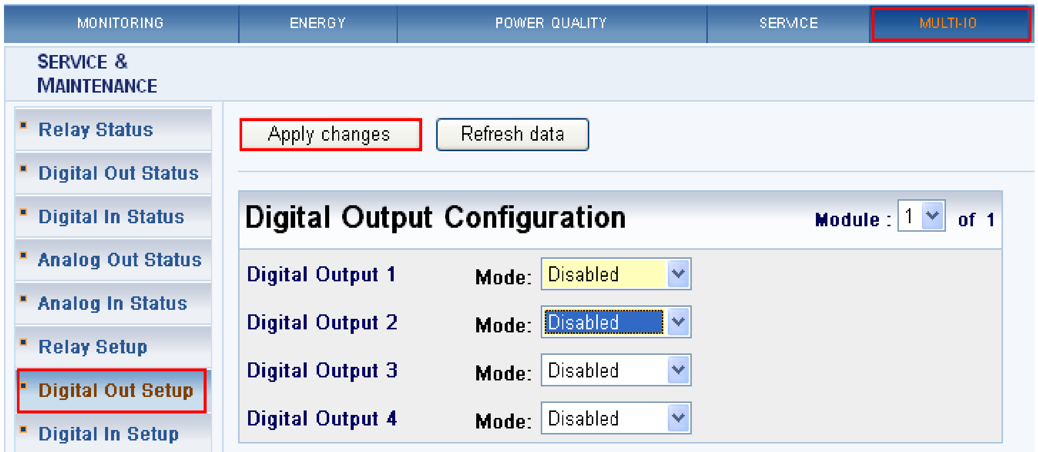

Figure 156: Digital Output

2. Choose the module to configure if multiple modules exist.

Figure 157: Module Selection

3. From the four available relays, choose the one to configure.

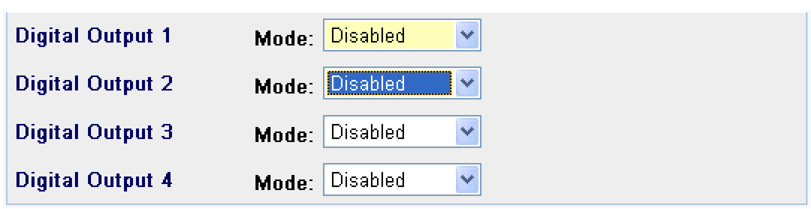

Figure 158: Digital Output Selection

4. Configure the digital outputs using the same parameters used in **Configuring the Relays on page 138.**

5. Click **Apply Changes** when complete.

Configuring Digital In

There are eight digital inputs per I/O module.

To configure digital in:

1. From the Multi I/O Menu, select **Digital In Setup**.

The Digital In Screen appears.

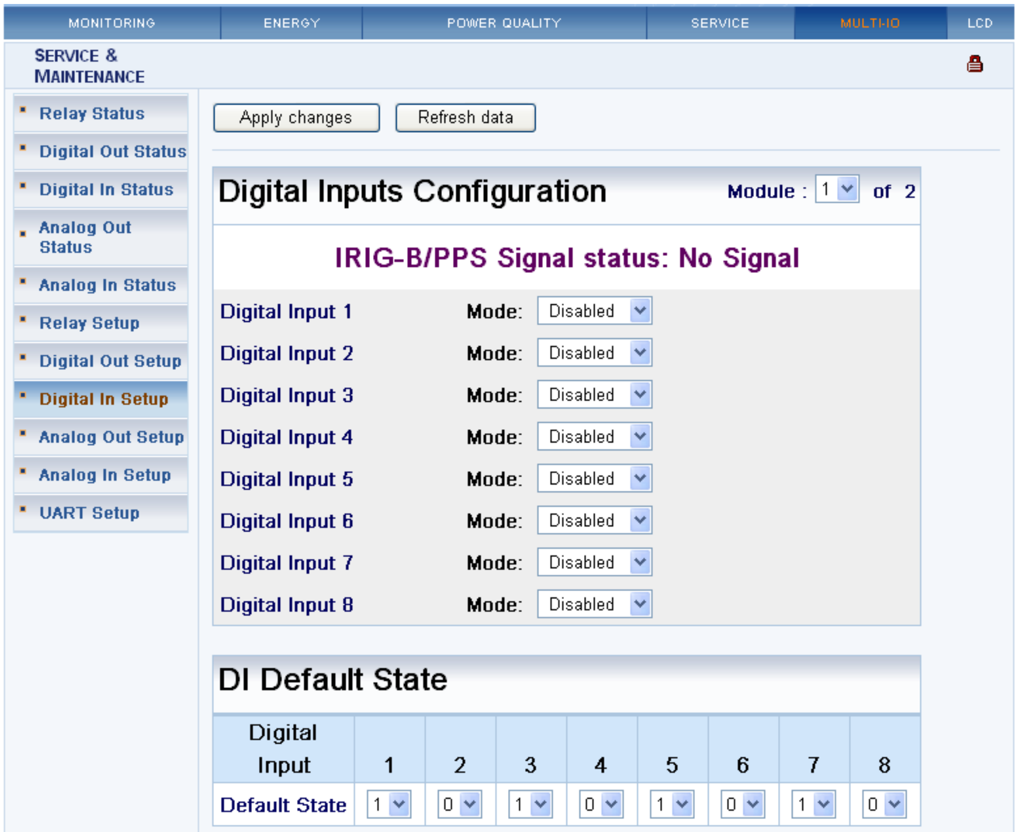

Figure 159: Digital Input

2. Choose the module to configure if multiple modules exist.

Figure 160: Module Selection

3. From the eight available inputs, choose the one you want to configure.

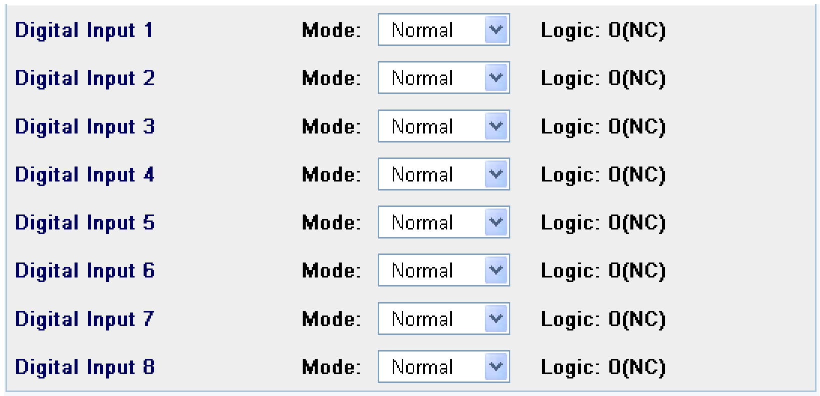

Figure 161: Digital Input Selection

4. Select the **Mode and Default State** for each input**.**

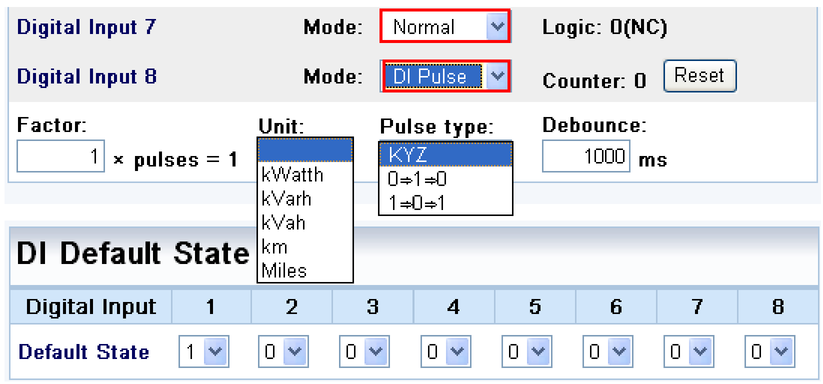

Figure 162: Digital Input Normal

Parameter	Description
Disabled Mode	not active
Normal Mode	Input data is sampled and stored in PQZip**.**
Di Pulse Mode	Input data is sampled and stored in PQZip as in Normal mode In addition, the number of input pulses is counted.
	Factor: the number of pulses that equal one unit.
	Unit: The measuring unit (time, energy, etc.)
	Pulse Type: • **KYZ** –the input toggles from 0 to 1 or from 1 to 0. • **0→1→0**; **1→0→1** –the status changes from one status to another, then returns to the original status.

	Debounce: the minimum amount of time the input must be constant after a change (for example: a debounce of 1000 ms means that a change in duration of less than 1000ms will not be counted)
Default State	the default state of a wired line to the input (0 or 1)

Table 47: Digital Input Configuration

5. Click **Apply Changes** when complete.

Configuring Analog Out

There are four Analog Outputs per I/O module.

To configure Analog out:

1. From the Multi I/O Menu, select Analog Out Setup.

The Analog Out menu appears.

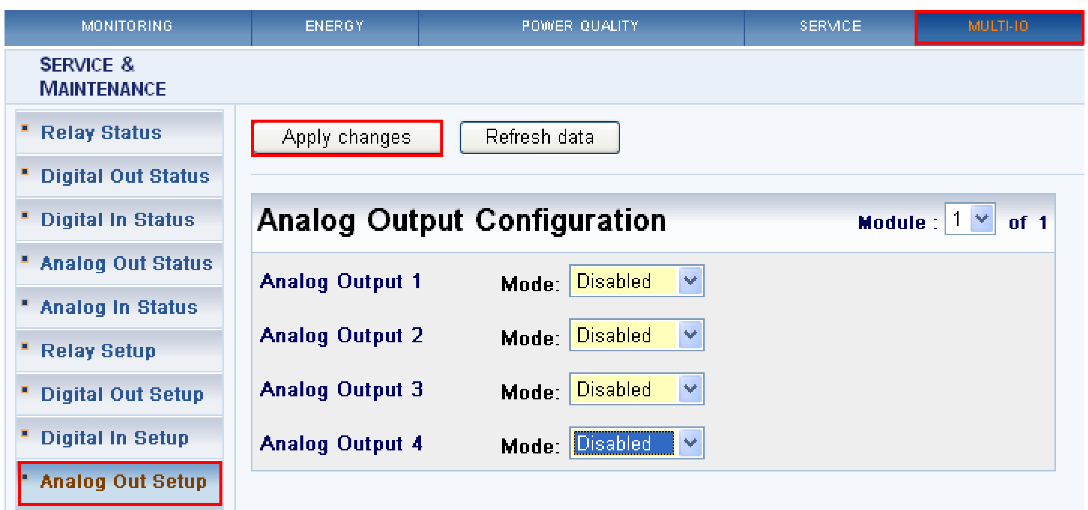

Figure 163: Analog Out

2. Choose the module to configure if multiple modules exist.

Figure 164: Module Selection

3. From the four available outputs, choose the one you want to configure.

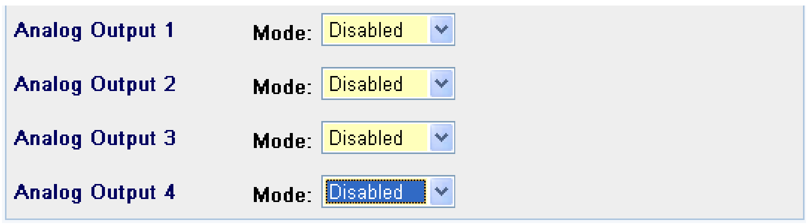

Figure 165: Analog Output Selection

4. Select the **Mode**.
5. If Mode is Manual, configure manually.

Configure Manually

All values need to be assigned when mode is manual.

To configure manually:

- Use the table below to configure.

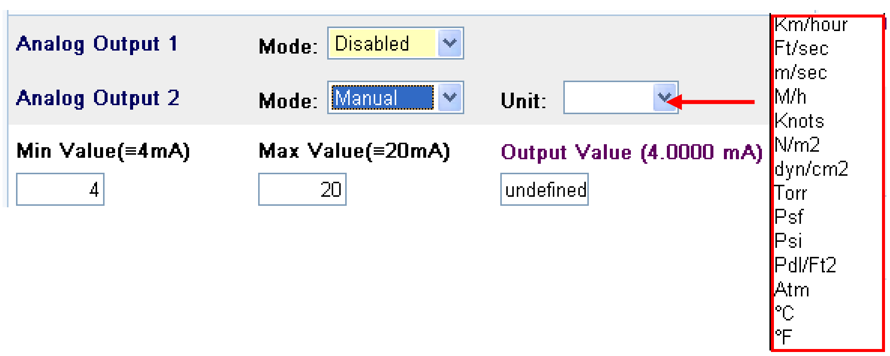

Figure 166: Manual Configuration

Manual Mode	Description
Unit	The unit of measurement
Minimum Value	The minimum value assigned to a logical scale.**1**
Maximum Value	The maximum value assigned to a logical scale**.**
Output Value	The actual output according to the logical scale.

Table 48: Manual Configuration

6. Click **Apply Changes** when complete.

Configuring Analog In

You must configure the Analog In. There are four Analog Inputs per I/O module.

To configure Analog In:

1. From the Multi I/O Menu, select Analog In Setup.

The Analog In menu appears.

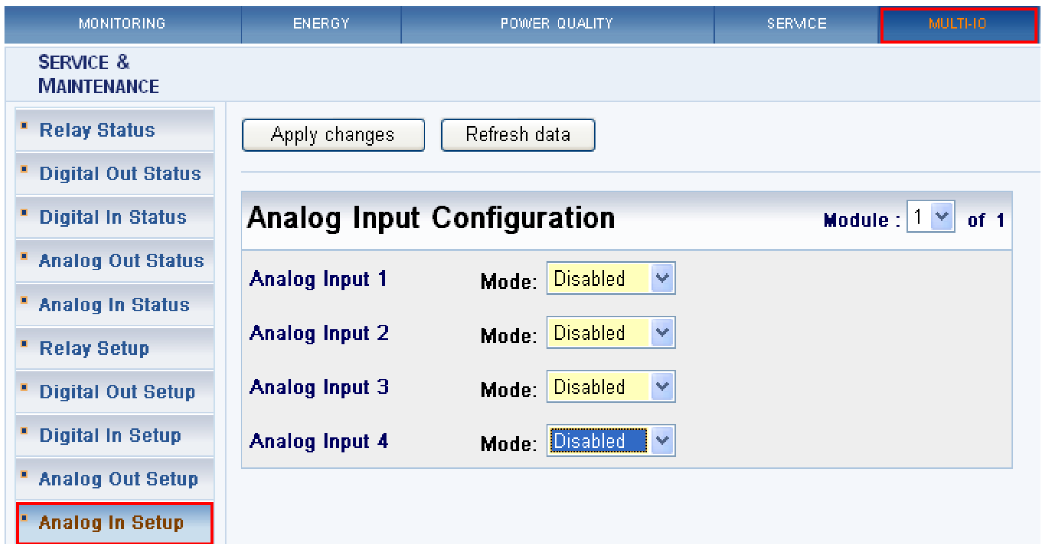

Figure 167: Analog In

2. Choose the module to configure if multiple modules exist.

Figure 168: Module Selection

3. From the four available inputs, choose the one you want to configure.

Figure 169: Analog Input Selection

4. Select the **Mode**.

5. If Mode is Normal, perform Normal Configuration

Normal Configuration

You must set the minimum and maximum values.

To configure normally:

- Follow the instructions below.

Note: *Normal Analog Parameters are the same as Analog Inputs.* Refer to ***Configure Manually on page 148.***

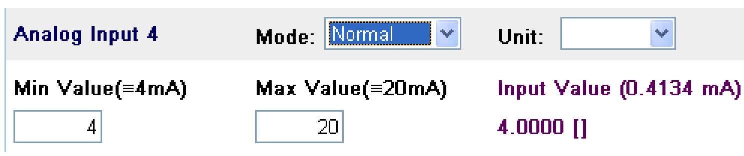

Figure 170: Normal Analog In Configuration

6. Click **Apply Changes** when complete.

Configure UART

You need to configure the UART.

To configure UART:

- From the Multi I/O Menu, select UART Setup.

The UART Setup menu appears

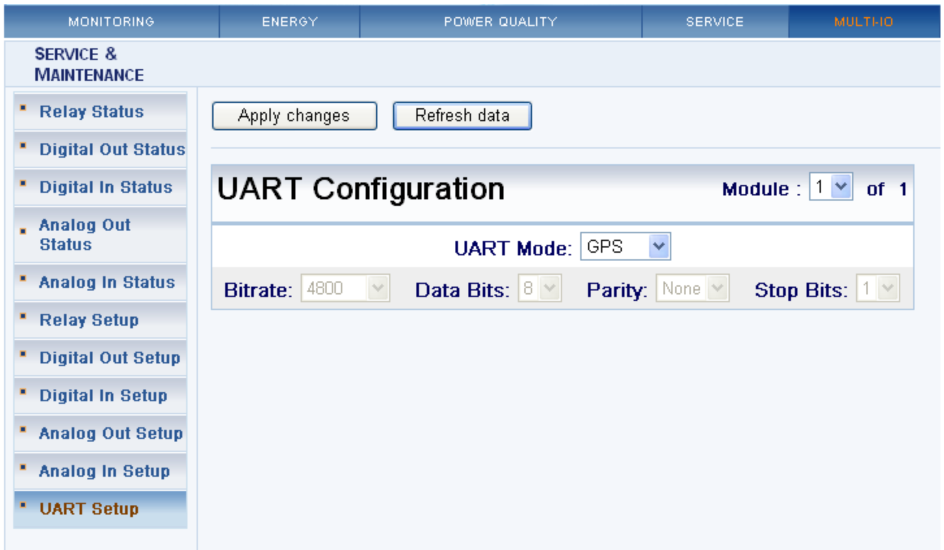

Figure 171: UART Setup

Note *In GPS mode, the unit will synchronize automatically to the GPS and the communication parameter will be detected automatically, therefore there is no configuration necessary.*

Monitoring the Multi I/O

The Multi I/O Module is monitored in real time with the Embedded firmware in the same manner that all other BLACKBOX functions are monitored.

All Status and Summary Screens are explained by providing an example of each type of configuration and parameter followed by a short explanation or definition.

Relay Status

The Relay Summary screen shows the status of all relays that are currently configured.

Note: *In some versions of the firmware, the notation of NC/NO is displayed only as 0/1.*

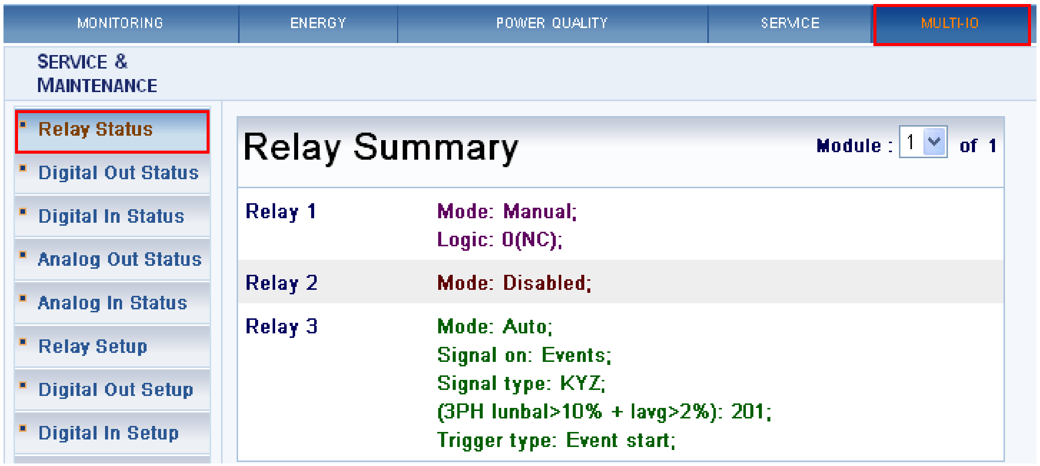

Figure 172: Relay Summary

The Relays are described below:

- **Relay 1**: configured to **Manual** mode and the state is **Normally Closed (NC).**
- **Relay 2**: disabled
- **Relay 3**: configured to **Auto mode**, signalled on **Events**, using **KYZ** as the signal type and the trigger type is **Event start**.

Note *Refer to* ***Configuring the Relays on page 138*** *for a detailed explanation of the Relay parameters.*

Digital Out Status

The Digital Out Summary screen displays the current status of all digital output signals.

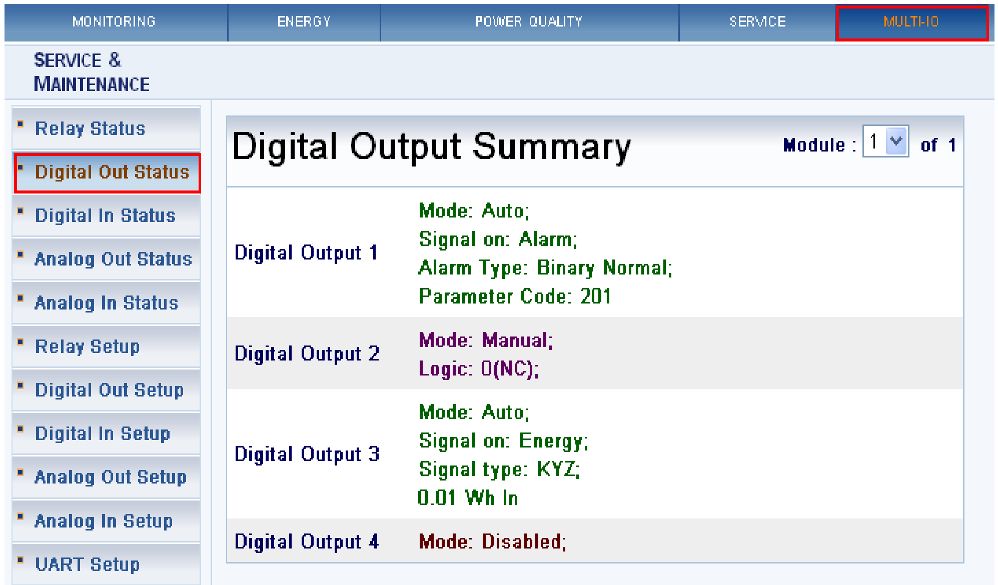

Figure 173: Digital Output Summary

The Digital Outputs are described below:

- **Digital Output 1**: configured to **Auto** mode, signalled by an **Alarm** using **Binary Normal** as a signal type and a **Parameter code** #201.
- **Digital Output 2**: configured to Manual mode
- **Digital Output 3**: configured to **Auto** mode, signalled by **Energy** using **KYZ** as a signal type and pulse weight of **.01 Wh In**.
- **Digital Output 4**: disabled

Note: *Refer to* ***Configuring Digital Output on page 143*** *for a detailed explanation of digital output parameters.*

Digital in Status

The Digital In Summary screen shows the current status of all digital input signals.

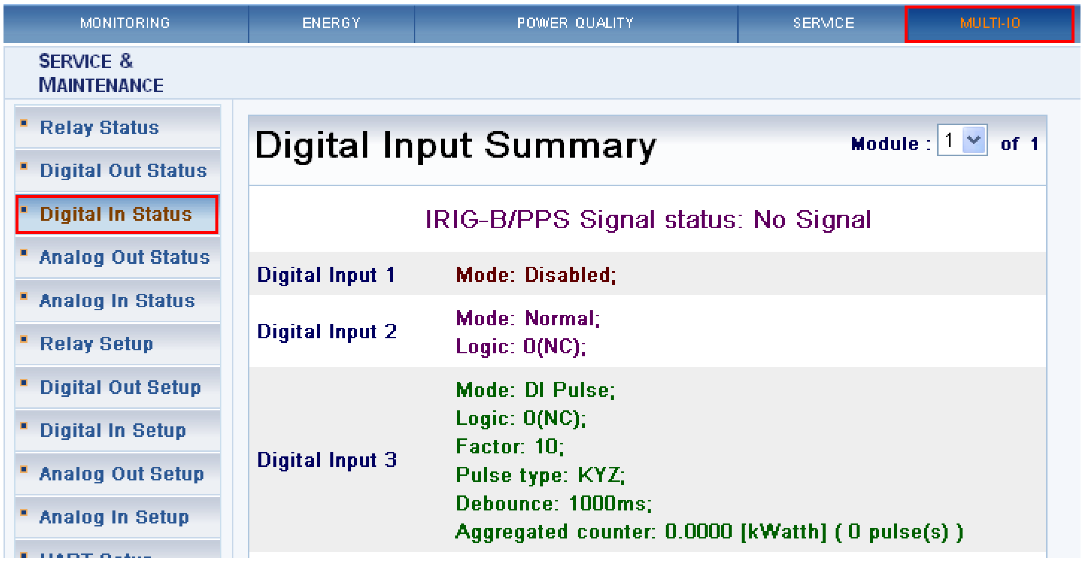

Figure 174: Digital Input Summary

This status of all Digital Inputs is explained below.

- **The IRIG-B/PPS:** input not currently active**.**
- **Digital Input 1: disabled**
- **Digital Input 2**: configured to **Normal mode**
- **Digital Input 3:** configured to **Pulse mode,** every **10** pulses is equal to **1** kWh, using **KYZ** as a pulse type, and Debounce is equal to **1000 ms**.

Note: *Refer to* ***Configuring Digital In on page 144*** *for a detailed explanation of all parameters.*

Analog Out Status

The Analog Out Summary screen shows the current status of all of the analog output signals.

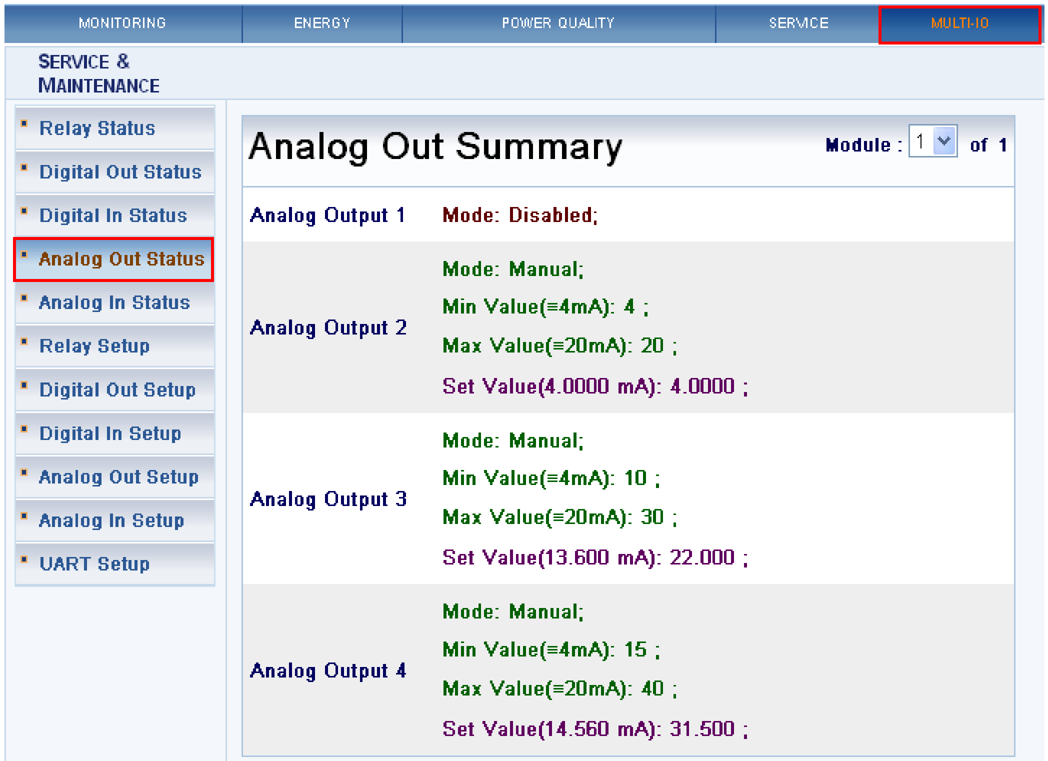

Figure 175: Analog Output Summary

The status of all Analog Outputs is described below:

- **Analog Output 1: disabled**
- **Analog Output 2** configured to **Manual** mode with a logic range of **4 to 20** and an output value of **4.0.**
- **Analog Output 3** configured to **Manual** mode with a logic range of **10 to 30** and an output value of **22.0** and physical output value of **13.6 mA**.
- **Analog Output 4** configured to **Manual** mode with a logic range of **15 to 40** and an output value of **31.5** and a physical output value of **14.560 mA**.

Note: *Refer to* ***Configuring Analog Out on page 147*** *for a detailed explanation of all parameters.*

Analog In Status

The Analog In Summary screen shows the current status of all of the analog input signals.

Figure 176: Analog In Summary

The status of all Analog Inputs is described below:

- **Analog Input 1: disabled**.
- **Analog Input 2** configured to **Normal mode** with a logic range of **0 to 200** and a physical measured value of **0.4134mA** and a logic value of **0 Ft/sec**.
- **Analog Input 3** configured to **Normal mode** with a logic range of **4 to 100** and a physical measured value of **0.4134mA** and a logic value of **4.0 m/sec**.
- **Analog Input 4** configured to **Normal mode** with a logic range of **20 to 150** and a physical measured value of **0.4134mA** and a logic value of **20° C**.

Note: *Refer to* ***Configuring Analog In on page 149*** *for a detailed explanation of all parameters.*

Chapter 6: Hardware Reference

This chapter is intended to provide a quick reference to technical specifications for the hardware features of the BLACKBOX and I/O module.

All specifications are subject to change without notice. It is recommended to consult the manufacturer and/or the hardware label for the most current information.

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General Specifications

Unit Dimensions

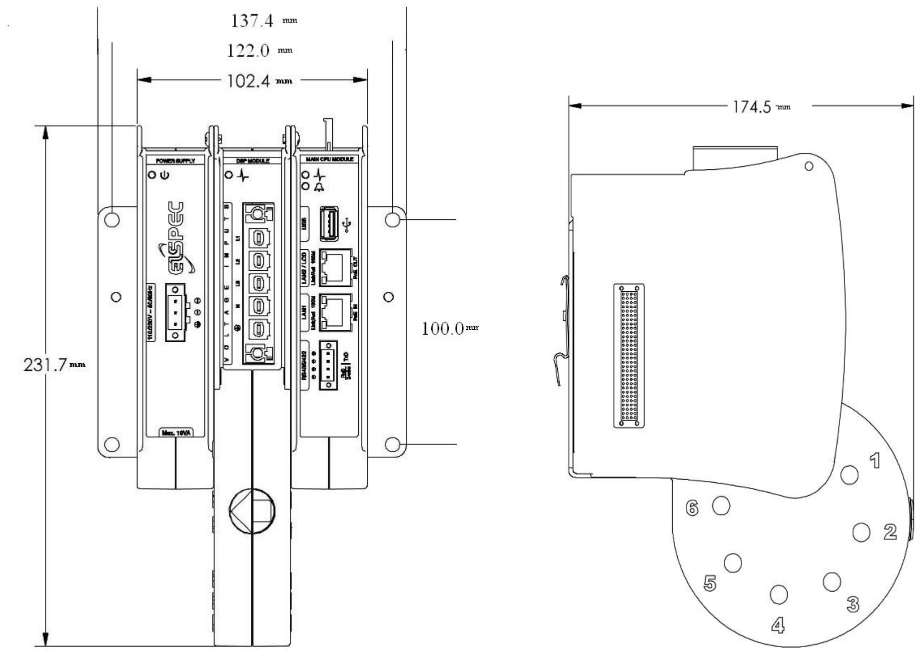

Figure 177: BLACKBOX Dimensions

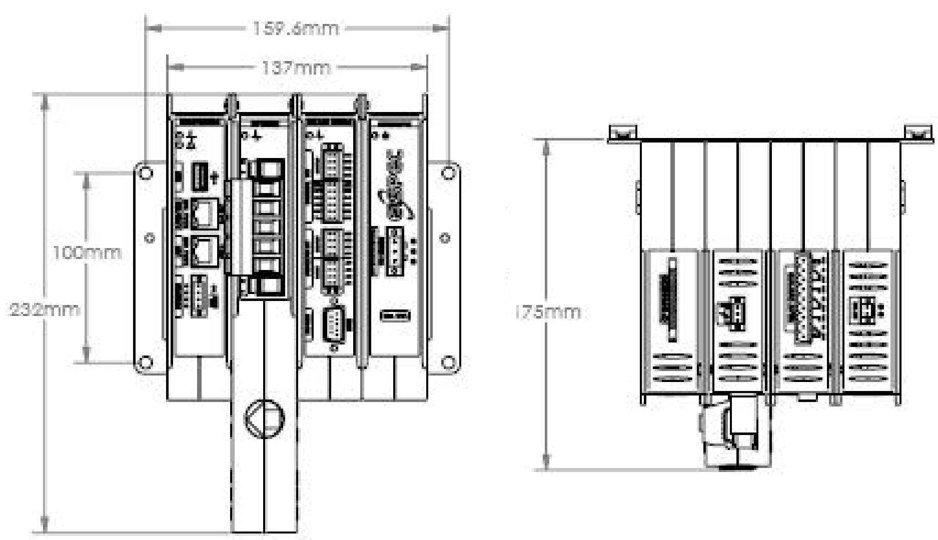

Figure 178: BLACKBOX w/Multi I/O Dimensions

General Specifications

Dimensions [HxWxD]	230x137x172 mm
Input channels	Up to 10
Rated voltage	1KV (8 KV transient)
Power Supply	Max 10 VA
Voltage inputs impedance	> 3 MOhm
Current input burden	0.08 VA
Power Supply	80-230 VAC~ 50-60 Hz 100-150 VDC 48 VDC (24-56VDC) PoE in, PoE out Up to 25 seconds ride-though on Power Loss
Ride-through	Up to 25 second
Cycle resolution	1,024 samples per cycle
PQZIP typical compress rate	1000:1
Fuse rating	2A fuse mounted in line with the AC power supply phase wire

Table 49: Specifications and Protocols

Technical and Environmental Specifications

Intended use	Indoor- mounted in a low voltage electrical distribution panel
Altitude	Up to 2000 meters
Operating temperature range	-20º to +60º C
Maximum relative humidity	95%
Power requirements	10 VA
Fuse rating	2 A fuse mounted in line with the AC power supply phase wire
Installation Category	Class III
Pollution Degree	Degree 2

Table 50: Technical and Environmental Specifications

Communications Specifications

LEDs

LED	Color	Function
Ethernet	Green	On – There is a connection to a network Blinks – data is being transfer between this point and other point over the network.
Ethernet	Orange	On – high speed (100Mbit)
Main CPU module	Green	Signals Normal operation
Main CPU module	Red	Signals Malfunction
DSP Module	Green	On – Module active
PSU module	Green/Red	Green – Works from external power source Red – Works from the super capacitors
Multi I/O Module	Green	On – Module active

Table 51: LEDs

RS232 Connections

Specification	Value
Baud Rate	1200/2400/4800/9600/14400/19200/38400/57600/115200
Duplex	Full
Supported Protocols	GPS
Cable Ends	DB9 female end for mating with DB9 male connector on the UUT
Max. Cable Length	50 feet (15.2m)

Table 52: RS232

RS-485/422 Connections

Specification	Value
Baud Rate	1200/2400/4800/9600/14400/19200/38400/57600/115200
Duplex	Full/Half
Cable Ends	SL-SMT3.5/4/90LF
Max. Cable Length	500 feet (152m)

Table 53: RS485/422

Ethernet Port

Specification	Value
Baud Rate	10/100Mbit
Supported Protocols	TCP/IP (FTP; HTTP; Telnet; DCOM; DHCP;SNTP;ELCOM)
Connector Type	XRJK-S-01-881-903-LF Male RJ45 Modular

Table 54: Ethernet Port

Multi I/O Specifications

Digital Inputs

Specification	Value
Max Voltage	61.3 VAC

Table 55: Digital Inputs

Digital Outputs

Specification	Value
Isolation to Ground	1500v
Max Voltage	100v
Connection Type	S2L-SMT3.5_8_90G

Table 56: Digital Outputs

Relay Outputs

Specification	Value
Rated Voltage	250VAC
Rated Load	6A
Max Voltage	400VAC
Max. Switching Load	500mW
Isolation	5KV (1.2/50uS)
Connector Type	SL-SMT5.00_9_90G

Table 57: Relay Outputs

Analog Outputs

Specification	Value
Scalable	4-20mA
Signal Type	Continuous DC
Accuracy	1%
Connection Type	S2L-SMT3.5_8_90G

Table 58: Analog Outputs

Analog Inputs

Specification	Value
Scalable	4-20mA
Signal Type	Continuous DC
Input Impedance	25 Ohm
Common-mode voltage	270V
Accuracy	1%
Connection Type	S2L-SMT3.5_8_90G

Table 59: Analog Inputs

Electrical Specifications

Measured Parameters by Product Series

Option	Product Series 1	Product Series 2	Product Series 3	Displayed Phases	Accur.
Current, per Phase	√	√	√	L1, L2, L3, Avg	0.1
Current, Neutral	√	√	√	N	0.1
Current, L-to-L (Transformer)	√	√	√	L12, L23, L31, Avg	0.1
Volts, L-to-L	√	√	√	L12, L23, L31, Avg	0.1
Volts, L-to-N	√	√	√	L1, L2, L3, Avg	0.1
Volts, Neutral	√	√	√	N	0.1
Real Power (kW)	√	√	√	L1, L2, L3, Sum	0.2
Reactive Power (kVAr)	√	√	√	L1, L2, L3, Sum	0.2
Apparent Power (kVA)	√	√	√	L1, L2, L3, Sum	0.2
Power Factor	√	√	√	L1, L2, L3, Sum	0.2
Time-of-Use (TOU):					
- Real Energy (kWh)		√	√	Sum	0.25
- Reactive Energy (kVARh)		√	√	Sum	0.25
- Energy Modes: in, out, net, total		√	√		
THD (SEE CHANNELS)		√	√	L1, L2, L3, Avg, N	0.2
Harmonics (SEE CHANNELS)		√	√	L1, L2, L3, N	0.2
Waveforms (SEE CHANNELS)			√	L1, L2, L3, N	0.1
Min/Max Readings	√	√	√		
Date/Time Stamping	√	√	√		
Flash Memory (Kilo Bytes)	256	512	512		
Maximum Flash Memory (Kilo Bytes)	256	1024	1024		

Table 60: Measured Parameters

Notes:
√ - Included.
○ - Optional.
Accuracy is in ± digit.
THD = Total Harmonic Distortion.
Channels: Current, Volts, L-to-L and L-to-N

Product Selection Chart

Product Series	ELSPEC G4410	ELSPEC G4420	ELSPEC G4430
Real-time Measurements			
Voltage/current: per phase, average, unbalance	✓	✓	✓
Power: real, reactive, apparent, power factor, frequency	✓	✓	✓
Energy: bi-directional, total, import, export, net	✓	✓	✓
Demand: block, rolling block, thermal, predicted	✓	✓	✓
Sampling rate, maximum samples/cycle	256	512	1024
Harmonics (individual, even, odd, total) up to	127th	255th	511th
Measurement according to IEC 61000-4-30	✓	✓	✓
Cycle-by-cycle RMS, Frequency and Harmonics	-	✓	✓
Measurement during overloading (from nominal)	x2	x10	x10
Type of Analog to Digital converter	12 bit	16/20* bit	16/20* bit
Data and Waveforms Logs			
Cycle-by-cycle PQZIP logging	✓	✓	✓
Event logs	✓	✓	✓
Waveform logs	✓	✓	✓
Min/max logs for any parameter	✓	✓	✓
Timestamps, resolution in micro seconds			
- with Ethernet synchronization	50	50	50
- with GPS synchronization	1	1	1
Internal Memory	64 MB	2048 MB	8192 MB

Product Series	ELSPEC G4410	ELSPEC G4420	ELSPEC G4430
Firmware limit for contiguous data and waveform capture	1 day	1 Month	Unlimited
Power Quality Analysis			
Sag/swell monitoring	✓	✓	✓
Symmetrical components: zero, negative, positive	✓	✓	✓
Transient detection, microseconds	78/65μSec	39/32.5μSec	19.5/16μSec
Flicker (IEC 61000-4-15)	-	✓	✓
Fast Flickering	-	-	✓
Compliance testing to EN50160	✓	✓	✓
EN50160 Timestamps	-	✓	✓
Configurable for IEEE 519-1992, IEEE 1159, SEMI	✓	✓	✓
Timestamps of above	-	✓	✓
Interharmonics	-	-	✓
Communication Ports and I/O			
Ethernet Port/s	1	2	2
Power Over Ethernet (PoE) - in, out	-	✓	✓
RS-485/422 port	✓	✓	✓
USB port	-	✓	✓
Compact Flash (CF) Expansion	-	✓	✓
Voltage Ride-through on Power Loss	10 sec	25 sec	25 sec
Onboard comprehensive WEB server	✓	✓	✓
Onboard OPC (Open Connectivity) Server	-	✓	✓

Product Series	ELSPEC G4410	ELSPEC G4420	ELSPEC G4430
OPC Gateway: other RS-485/422 accessible via OPC	-	✓	✓

Table 61: Selection Chart

Standards and Compliances

Standards Compliance
Configurable compliance support
Cycle by cycle
EN50160
EN50160 Time stamping
IEC 61000-4-30
IEC6100-4-15
IEC61000-4-7
IEC 687/62053-22 0.2S compliant
IEC 687/62053-22 0.5S compliant
ANSI C12.20 0.2 compliant, Class 10 & 20
NVE-PQ
CREG

Table 62: Standards Compliance

Appendices

The appendix for this user guide provides BLACKBOX feature details including custom configurations for your instrument.

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Appendix A: Automatic Web Login

Parameters

- "pass" – login password i.e. 123/1234/12345
- "lang" – login language index, which is language index in "Language" list, starting zero.
- "page" – page to go directly to, just as filename in the page url, i.e. mon_sum.asp is the default starting page.

Example

- http://100.100.100.58/login.asp?pass=12345&page=srvc_set_evt.asp
logs you into a unit as an administrator directly into "Events Setup" page.
- http://100.100.100.58/loginlite.asp?lang=1
logs you into light Russian interface.
- If the parameter has no/wrong/illegal value – default is used (except for wrong password).

Defaults

- Language is English.
- Page is MONITORING/Summary.
- Password is the one written in password field.
- To use the desired language, count it's index in the "Language" drop-down menu at Login page, starting zero and add it as a parameter.
- To use the "page" feature, copy the filename of desired page and add it as a parameter.

Appendix B: G4K & PQSCADA Compliance and Power Quality Events Description

Background

G4K (G4420, G4430 & Portable 4500) contains a software module called PQ Compliance. This module performs the detection of power quality events and compliance evaluation. The module is user customizable where the default setting is EN50160 standard types.

The G4K PQ Compliance module stored into PQZIP:

- PQ (Power Quality) events.
- Periodical records containing statistics information, a record every 2 hours.

Therefore, once a PQZIP file is fetched by the PQSCADA:

Both PQ events and compliance information is handled and stored on the DB for later on report/query. The Investigator application enables visualization of PQ events and compliance historical trends and reports.

In addition, on the device WEB interface:

- Compliance status can be viewed under "Power Quality" pages.
- PQ Events can be viewed under "Service>System Log" page.

Note: *Notice that device itself can show only latest information (1 week window for EN50160).*

The G4K compliance module

The G4K PQ Compliance module is a customizable software engine that detects power-quality events, and further computes the statistics to provide compliance results.

List of PQ compliance parameters

The compliance is generally separated into 10 compliance parameters (EN50160):

Compliance parameter	Related event (code #)
Frequency	233
Voltage Variations	234
Rapid Voltage Changes	244
Voltage Dips	235
Over Voltage/Swells	237
Short Voltage Interruptions	236
Long Voltage Interruptions	245
Voltage Harmonics	240
Voltage Unbalance	239
Voltage Flickering	242

Table 63: PQ Compliance Parameter

Once compliance module is enabled (via WEB), each parameter has its own events detection and statistical model (result computation). Regardless of statistics gathering, each event detected is automatically inserted into the system LOG and PQZIP file (and also can be sent as Email if configured to in WEB - "Email Alerts").

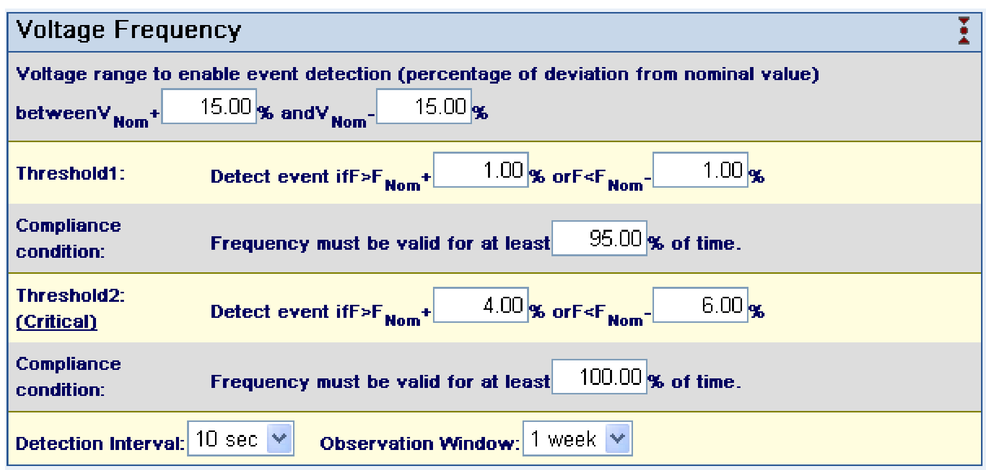
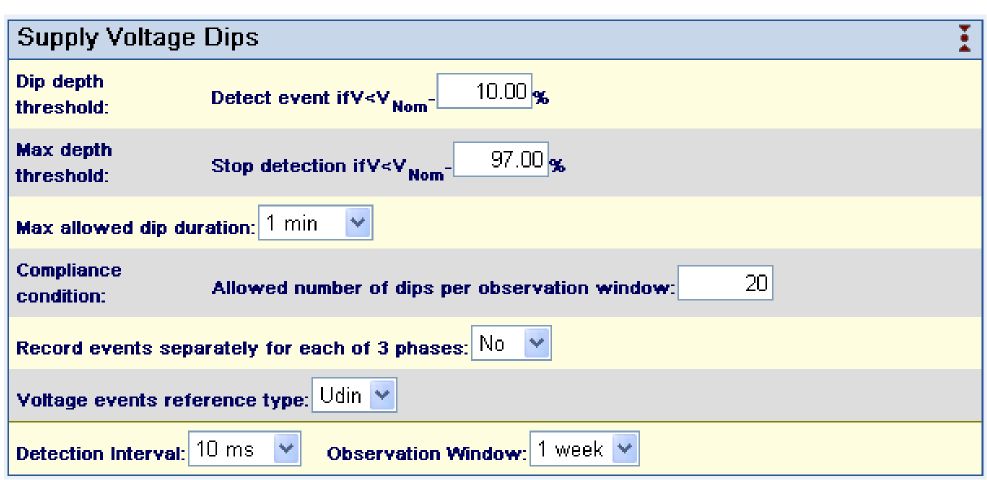
Some parameters may have interrelations in the events detection. Example, Voltage Variation may not be evaluated in periods where voltage interruptions occur. Another Example: DIPS are not detected if voltage goes below certain level which already counted as Voltage Interruption.

Anyhow, the exact behaviour of each compliance parameter is fully WEB customizable by user where the G4K provides a set of pre-defined configurations: EN50160 (European), NVE (Norwegian specific) and CEL (Colombia specific). Presets are added to the firmware from time to time.

PQ Events Detection mechanism & event related information

Note: See G4KEvents Excel information table which provides more information on each PQ events..

PQ compliance events and related configuration

<table>
<tr><th>Compliance events</th><th>Related configuration (values are set to EN50160 defaults)</th></tr>
<tr><td>Frequency</td><td>
</td></tr>
<tr><td>Voltage Variations</td><td>
</td></tr>
<tr><td>Rapid Voltage Changes</td><td>Refer web…</td></tr>
</table>

Voltage Dips	Refer web…
Over Voltage/Swells	Refer web…
Short Voltage Interruptions	Refer web…
Long Voltage Interruptions	Refer web…
Voltage Harmonics	Refer web…
Voltage Unbalance	Refer web…
Voltage Flickering	Refer web…

Table 64: PQ Compliance Events

Measurement Interval, Window, and Period

Each compliance parameter can be set to behave with different properties. The most basic properties needed for every parameter are:

MI (Measurement Interval or Detection Interval) – This is the minimum or constant period interval for event detection. For example: for DIPS, Over Voltage and Interruption events, MI is typically set to 10 milliseconds, meaning that the RMS detection is half a cycle period while for Frequency the value is typically set to 10 seconds which means a constant period of 10 seconds is used for averaging the power frequency.

OW (Observation Window) – This is the minimal observation time for gathering enough statistics to answer the question of whether the specific parameter is PASS or FAIL. The typical time is 1 week.

Note: *The compliance module also provides information for periods much shorter than the OW. These are called "Periodical" or "Real time" or "Partial" results (will be further explained.*

G4K Sliding window statistics approach

The PQ compliance module basically gathers statics per every compliance parameter on a sliding window approach. Each slot contains aggregated events counters (the amount of counters are compliance parameter dependent).

Based on the configured **OW** (Observation Window), the module divides the entire window time to 84 slots (Example: if OW = 1 Week ➔ slot = 2 hours), while maintaining total of recent 85 slots as effective observation window. Each slot maintains the events statistics relevant to its correspondence time (these slots are maintained on local unit flash in case of power down).

Once elapsed a slot time the oldest slot is discarded and a new fresh one is added at the front:

Once elapsed a slot time the oldest slot is discarded and a new fresh one is added at the front:

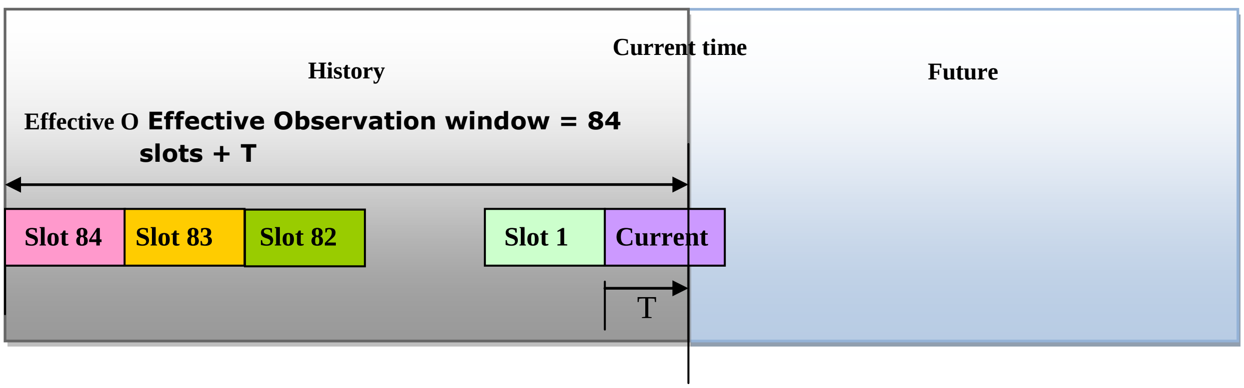


Figure 179: Observation Window

So for OW = 1 week, the effective observation window is actually varying between 1Week to 1Week + 2hours.

Statistics maintained per each PQ parameter

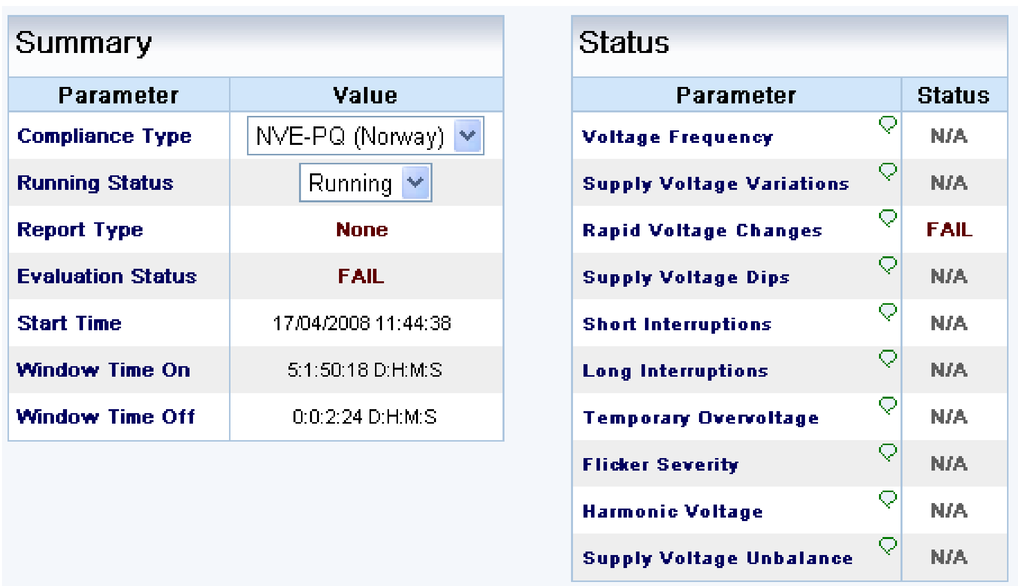
Compliance parameter	Statistics gathered per slot	Specific for EN50160
Frequency	N – Number of **MI** (measurement intervals) N1 – Number of events threshold 1 N2 – Number of events threshold 2	MI = 10 Seconds. Counters not incremented in invalid voltage range (+-15% of nominal)
Voltage Variations	N – Number of **MI** (measurement intervals) N1 – Number of events threshold 1 N2 – Number of events threshold 2	MI = 10 Minutes, counters not incremented on intervals with voltage interruptions.
Rapid Voltage Changes	N1 – Number of events threshold 1 N2 – Number of events threshold 2 N3 – Number of events threshold 3 N4 – Number of events threshold 4	
Voltage Dips	N – Number of events threshold 1	
Over Voltage/Swells	N1 – Number of events threshold 1 N2 – Number of events threshold 2	N1 is overvoltage counter. (typically threshold is set to +10% of nominal) Where N2 is unlikely extreme overvoltage events counter (default set is to above 2500% of nominal)
Short Voltage Interruptions	N – Number of events.	
Long Voltage Interruptions	N – Number of events.	The difference between short and long interruption is the time duration.
Voltage Harmonics	N – Number of **MI** (measurement intervals) N1- Number of intervals at least one of the individual harmonics is invalid. N2 - Number invalid THD intervals.	For EN50160 MI = 10 Seconds (Notice that under event, either N1 or N2 are incremented at the same interval but not both…so N1+N2 <= N always)
Voltage Unbalance	N – Number of **MI** (measurement intervals) N1 – Number of events threshold 1	For EN50160 MI = 10 Minutes
Voltage Flickering	Ni1 – Number of Pst intervals (10mins)	For EN50160, Ni1 will result in 12 and Ni2 in1 per slot.

	Ni2 - Number of Plt intervals (2hours) N1 - Number of Pst events (above T1-PST) N2 – Number of Plt events (Above T2-PLT)	

Table 65: Statistics

Computation of compliance statuses and other indicators

Every few seconds the compliance statuses are updated by scanning on all the events statistics and using compliance formulas. At the end of computation each parameter contains a simple PASS/FAIL indication or non-available ("N/A") if the observation window time is not complete.



Summary

Parameter	Value
Compliance Type	NVE-PQ (Norway)
Running Status	Running
Report Type	None
Evaluation Status	FAIL
Start Time	17/04/2008 11:44:38
Window Time On	5:1:50:18 D:H:M:S
Window Time Off	0:0:2:24 D:H:M:S

Status

Parameter	Status
Voltage Frequency	N/A
Supply Voltage Variations	N/A
Rapid Voltage Changes	FAIL
Supply Voltage Dips	N/A
Short Interruptions	N/A
Long Interruptions	N/A
Temporary Overvoltage	N/A
Flicker Severity	N/A
Harmonic Voltage	N/A
Supply Voltage Unbalance	N/A

Figure 180: Indicators

Since each compliance parameter can be set to different observation window, status of one parameter can be available before the other (in this example Rapid Voltage Changes is using 1 day observation window while the rest are 1 week).

The overall compliance referred as "Evaluation Status" is simply combining of all PASS/FAILS results from all parameters using "AND" logic: Meaning, if one parameter fails ➔ the overall compliance fails.

	Status / Partial	Observation	Window / Interval	Time OK / Time Fail	Time N/A	Total Events
Voltage Frequency	N/A / OK	Incomplete	1 week / 10 sec	100.000 % / 0.000 %	100.000 %	0
Supply Voltage Variations	N/A / OK	Incomplete	1 week / 10 min	100.000 % / 0.000 %	100.000 %	0
Rapid Voltage Changes	N/A / OK	Incomplete	1 week / 3 sec	100.000 % / 0.000 %	100.000 %	0
Supply Voltage Dips	N/A / OK	Incomplete	1 week / 10 ms	100.000 % / 0.000 %	100.000 %	0
Short Interruptions	N/A / OK	Incomplete	1 week / 10 ms	100.000 % / 0.000 %	100.000 %	0
Long Interruptions	N/A / OK	Incomplete	1 week / 10 ms	100.000 % / 0.000 %	100.000 %	0
Temporary Overvoltage	N/A / OK	Incomplete	1 week / 10 ms	100.000 % / 0.000 %	100.000 %	0
Flicker Severity	N/A / OK	Incomplete	1 week / 10 min	100.000 % / 0.000 %	100.000 %	0
Harmonic Voltage	N/A / OK	Incomplete	1 week / 10 min	100.000 % / 0.000 %	100.000 %	0
Supply Voltage Unbalance	N/A / OK	Incomplete	1 week / 10 min	100.000 % / 0.000 %	100.000 %	0

Figure 181: Compliance Parameters

The status indications:

- As can be seen on first column, the G4K provides two status indications "Status" and "Partial" (located below the "Status").
- The upper status indication is the compliance result based on a full observation window. Anytime the aggregated evaluation time is less than a full observation window this status is simply not available ("N/A"). For EN50160 this is a minimum of 1 week time.
- The lower indication referred as "Partial" is a status expressing the recent time slot/s. The exact amount of time taken is defined as following: less than 1 slot if the overall aggregated time is less than one time slots. The maximum time is up to 2 full time slots (means, current + previous time slot).

Observation field

Observation per each parameter is complete once compliance engine is running for at least the specified observation window interval. Otherwise it will be marked as incomplete.

Window, Interval fields

Per every compliance parameter this is the configured value of OW and MI (below).

Time Ok, Time Fail and Time N/A fields

Per every compliance parameter the Time OK/FAIL is estimation of a 2 values:

- Time in which the parameter was according to compliance (OK %)
- Time in which the parameter was violating compliance (FAIL %)

Where FAIL% is simply obtained by the equation of ***FAIL% = 100-OK%***

Unlike the status, these two percentage values are updated anytime (even when the compliance observation window is not complete yet)

The Time N/A % is used to provide additional information of the availability in time (any time in which unit was off working this value will be incremented). The OK/FAIL % is therefore, computed only for the available times.

Total events

Information about total number of events (from any type) occurred per each parameter. (Of course, those "too old" events outside the observation window history are not counted)

Compliance formulas

Compliance parameter	Rule is based on:	Compliance OK if	% Time OK Calculation
Frequency	Valid/invalid periods	100 - 100*N1/N >= X% and 100 - 100*N2/N >= Y% For EN50160 X=95%, Y=100%	100 - 100*(N1+N2)/N
Voltage Variations	Valid/invalid periods	100 - 100*N1/N >= X% and N2<1 For EN50160 X=95%	100 - 100*(N1+N2)/N
Rapid Voltage Changes	Number of events	N1<= T1 and N2 <= T2 and N3 <= T3 and N4 <= T4 (Where Ti are defined counter thresholds, Ti=0 means bypass check) For EN50160 no limits (all Ti	Refer below If one of the inner slot threshold (there are 4) fails than the slot will be 100% fail. (0% Time Ok)

		= 0).	
Voltage Dips	Number of events	N<= T (max num of DIPS allowed)	Refer below
Over Voltage/Swells	Number of events	N1<= T and N2 = 0 (Where T is maximum over voltage events allowed, T = 0 means no limit)	Refer below
Short Voltage Interruptions	Number of events	N<= T (max num of Short Int. events allowed)	Refer below
Long Voltage Interruptions	Number of events	N<= T (max num of Long Int. events allowed)	Refer below
Voltage Harmonics	Valid/invalid periods	100 - 100*(N1+N2)/N > X% (For EN50160 X = 95%)	100 - 100*(N1+N2)/N
Voltage Unbalance	Valid/invalid periods	100 - 100*N1/N >= X% and (For EN50160 X = 95%)	100 - 100*N1/N
Voltage Flickering	Valid/invalid periods	Ok PST%=100 - 100*N1/Ni1 Ok PLT%=100 - 100*N2/Ni2 If Ok PST% >=TIME PST% and If Ok PLT% >=TIME PLT% (if T1 of PST is zero, PST part ignored…if T2 of PLT is zero than PLT part ignored) (For EN50160 TIME PLT% = 95%, no condition on PST)	MIN of (ok PST%, ok PLT%) (if T1 of PST is zero, PST part ignored…if T2 of PLT is zero than PLT part ignored)

Table 66: Compliance Formulas

Calculation of % Time OK for parameters based on "Number of events":

Each time slot is specifically being checked for its "inner slot Time Ok %" by setting thresholds levels relative to the slot time:

For example, if allowed 1000 Dips per observation window of 1 week, than for one time slots the allowed # will be 1000/84 = 12 (always rounded up). If for example 2 dips occurred inside the time slot, than the "inner slot Time Ok %" will be 100 – 100*(2/12) = 84%.

The overall Time OK % value is combining of all values from all time slots:

Time OK % = ∑[inner SLOT i Time OK %]/Number of slots

G4K internal unit - Embedded reporting option

The G4K Compliance module also contains an embedded reporting option. This option enables exporting PQ events and periodical information into Excel (CSV) files (stored on the internal Compact flash card and also possible to be sent as email attachments). However, at this stage this option is not user customizable, the only possible configuration (via WEB interface) is for setting one report type which is hard coded to suit Colombia standard format:

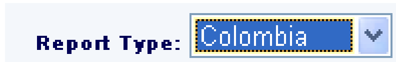


Figure 182: Emedded Reporting Option

Periodic and Window compliance information used by the PQSCADA

Using PQZIP means that PQSCADA contains all waveform signals, so theoretically all events and compliance statistics can be computed by the PQSCADA without the need for device to generate statistics. However, at this stage, the PQSCADA does not contain its own compliance computation engine; therefore, PQSCADA is using the already generated G4K statistics and stores it in the DB.

Every two hours The G4K device generates a periodical record of compliance and stores it in the PQZIP file. The record contains:

- The compliance type running on the device (typically EN50160).
- The period time (2 hours)
- The number of compliance parameters (typically depend on type…10 for EN50160)
- Per parameter periodical statistical information (for EN50160 1 period = 1 time slot)
- Status OK/FAIL
- Time OK %
- Per each parameter a full observation window information:
- Status OK, FAIL but if observation window not complete yet so it is set "N/A"
- Time OK %

This information can be viewed in the Investigator (using Trends or PQ Report).

How to customize the compliance module

In order to define own compliance events thresholds and compliance rules, user shall first stop the compliance (by selecting "Running status" to be stop and applying changes…) and then set the compliance type to "User defined" and apply changes.

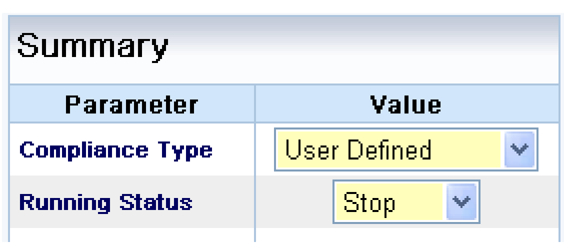


Figure 183: Summary Compliance Module

Now the compliance definition WEB pages can be edited. Once changed all parameters needed, user should start the compliance again (by selecting "Running status" to be running and applying changes…)

Appendix C: Embedded Reports

Report Types

- **Meter Read** – An energy
- **Data Logging** – Customized Parametric data report; the default parameters being used are shown below. This log can be customized via Telnet commands (contact Elspec for further information on special customization.

Report Parameters

- interval of report is set by the energy interval.
- By default the report mode is disable.
- The report mode can be changed from the web interface as follows:
  - Service→ Power Setup→ Meter Reading Logs: Mode
- The report is saved in format of comma separated (CSV file) and can be open by Excel.

Filename structure:

- Report Type MR/DL: **M**eter **R**ead / **D**ata **L**ogger.
- Start time stamp in format: YYYY_MM_DD_HH_MM_SS.
- End time stamp in format: YYYY_MM_DD_HH_MM_SS.
- For example: MR log 2008_06_03 08_30_00 to 2008_06_03 12_00_00.csv

Meter Read Report:

The report contains the following fields:

- UTC timestamp of the end of the record.
- Local timestamp of the end of the record.
- kW In.
- kW Out.
- kVA In.
- kVAr In.
- kVAr Out.

Data Log Report:

The Data Logging report contains the following fields:

- UTC timestamp of the end of the record.
- Local timestamp of the end of the record.
- Three parameters:
    - W Total
    - Frequency
    - VAR Total

For each parameter there are the following fields:

- Average of the current record interval.
- standard deviation of the current record interval.
- Maximum of the current record interval.
- Minimum deviation of the current record interval.

This report is saved on the CF and can be sent via email.

- example

Appendix D: Calibrating the Unit via TELNET

General Overview

The calibration process comprises the following parts:

- Get connected to the BLACKBOX TELNET
- Preparation of the Signal Generator (setting the input signals)
- Injection of the signals in the BLACKBOX
- Running the calibration process
- Upon receiving the message ‘Calibration success’ rebooting the BLACKBOX unit

Calibration Parameters

Voltages

Line

- DC-Offset
- Low voltage (300.0V)
- High Voltage (900.0V)

Neutral

- Low voltage (300.0V)
- High voltage (900.0V)

Currents

Line

- DC-Offset
- Low current (3.0A)
- High current (9.0A)

Warning: *For calibrating purposes, you MUST inject Voltage and Current simultaneously Refer to **Figure 12: Measuring Current Lines on page 14** no matter what type of calibration you are going to perform.*

> **Warning:** *When setting up the BLACKBOX, ALWAYS set the power parameters of CT and CP in a ratio similar to 1:1 (i.e. 50:50; 400:400).*

> ***Warning****: Always perform the Low Voltage or Low Current calibration prior to High Voltage or High Current calibration.*

Calibration Process

1. Get Connected to the BLACKBOX unit via TELNET:
   a) **Start→Run: telnet <UnitIP**>
   b) Access username and password the same as FTP access

2. Calibrate the Voltage
   a) Connect the Signal Generator to the BLACKBOX *Line Voltage Inputs*

Voltage DC-Offset Calibration:

1. Set the Signal Generator Voltage to 300.0V (and Current to 3.0A)
2. Type the next line on the shell:
   - Calibrate DC Of Voltages

Line Low Voltage Calibration:

1. Set the Signal Generator Voltage to 300.0V
2. Confirm the measured voltage input is close to 300.0V
3. Type in the next lines on the shell:
   - **TargetV = (float)**300.0
   - **Calibrate Voltages Low (TargetV)**

Line High Voltage Calibration:

1. Set voltage Signal Generator Voltage to 900.0**V**
2. Confirm the measured voltage input is close to 900.0V
3. Type in the next lines on the shell:
   - **TargetV = (float)**900.0
   - **CalibrateVoltagesHigh (TargetV)**

b) Connect the Signal Generator to the BLACKBOX *Neutral Voltage Input*

Neutral Low Voltage Calibration:

1. Set the Signal Generator Voltage to 300.0**V**
2. Confirm the measured neutral voltage is close to 300.0V
3. Type in the next lines on the shell:
   - **TargetV = (float)**300.0
   - **CalibrateVoltageNeutralLow (TargetV)**

Neutral High Voltage Calibration:

1. Set the Signal Generator Voltage to 900.0**V**
2. Confirm the measured neutral voltage is close to 900.0V
3. type in the next lines on the shell:
   - **TargetV = (float)**900.0
   - **CalibrateVoltageNeutralHigh (TargetV)**

3. Calibrate the Current

a) Connect the Signal Generator to the BLACKBOX *Line Current Inputs*

Current DC-Offset Calibration:

1. Set the Signal Generator Current to 3.0A (and Voltage to 300.0V)
2. Type the next line on the shell:
   - Calibrate DC Of Currents

Line Low Current Calibration

1. Set Signal Generator Current to 3.0**A**
2. Confirm the measured current is close to 3.0A
3. Type in the next lines on the shell:
   - **TargetI = (float)**3.0
   - **CalibrateCurrentsLow (TargetI)**

Line High Current Calibration

1. Set Signal Generator Current to 9.0**A**
2. Confirm the measured current is close to 9.0A
3. type the next lines in the shell:
   - **TargetI = (float)**9.0
   - **CalibrateCurrentsHigh (TargetI)**

4. After finishing the calibration process type → **reboot,** the unit should pass a reboot process and save the new calibration parameters.

> ***Note***: *On every calibration command there should be a statement: Calibration success / Calibration fail.*

> ***Note***: *In any error or failure massage, please send us the snapshot (or the telnet log*

> ***Note:*** *For debugging purposes add the following line in the shell as the first step*

> ***Note***: *You can calibrate the BLACKBOX unit for just only one range. If for example you want to calibrate Line Voltage Low only, then follow the instructions of Step 2 (Voltage Calibration) a.1 (Voltage DC-Offset) and a.2 (Line Low Voltage).*

Appendix E: Upgrading the Boot Loader

***Note**: This document is intended for skilled BLACKBOX technicians who have a vast experience with handling and configuring the unit.*

Who needs to upgrade the boot loader?

If you need to establish a Half Duplex communication link through MODBUS.

What do you need to upgrade the boot loader?

In order to upgrade the boot loader of the BLACKBOX unit you need:

- Communication link to the BLACKBOX unit to be upgraded
- The most updated boot loader file
- An FTP Server application in the computer side (OS Windows XP Professional SP2)

***Note**: Every time you want to configure the device you have to enter the web interface as an administrator.*

***Note**: As an FTP Server application we are using FileZilla (http://filezilla-project.org/). See Appendix F: Configuring the FileZilla on page 203*

Upgrading the Boot Loader

***Note:** Upgrading the BLACKBOX unit's boot loader involves a risky process. If the process fails you will not be able to access the unit until you will get Elspec's assistance*

***Note:** Prior to upgrading your boot loader, verify the version you have in your device.*

To upgrade the boot loader:

1. From the main menu, click **SERVICE→Unit Setup**.

The Unit Setup screen appears.

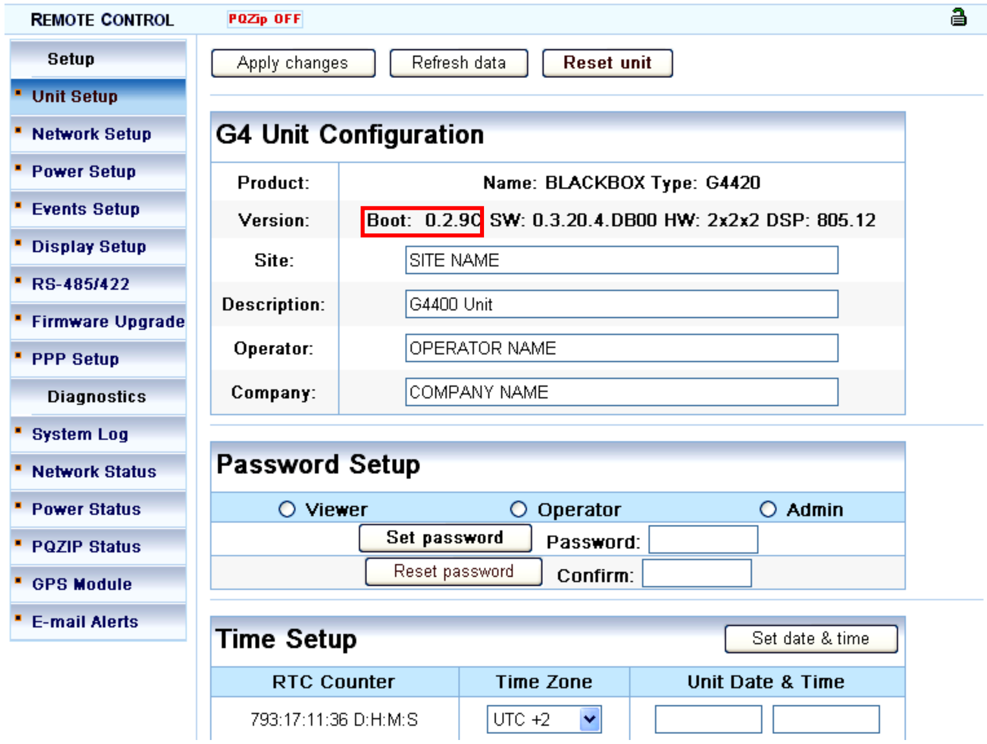


Figure 184: Unit Setup

The boot loader version appears inside the red box in the configuration area.

2. After downloading the latest boot loader version software and saved on your disk go to **Service→Firmware Upgrade**

The Firmware Upgrade screen appears.

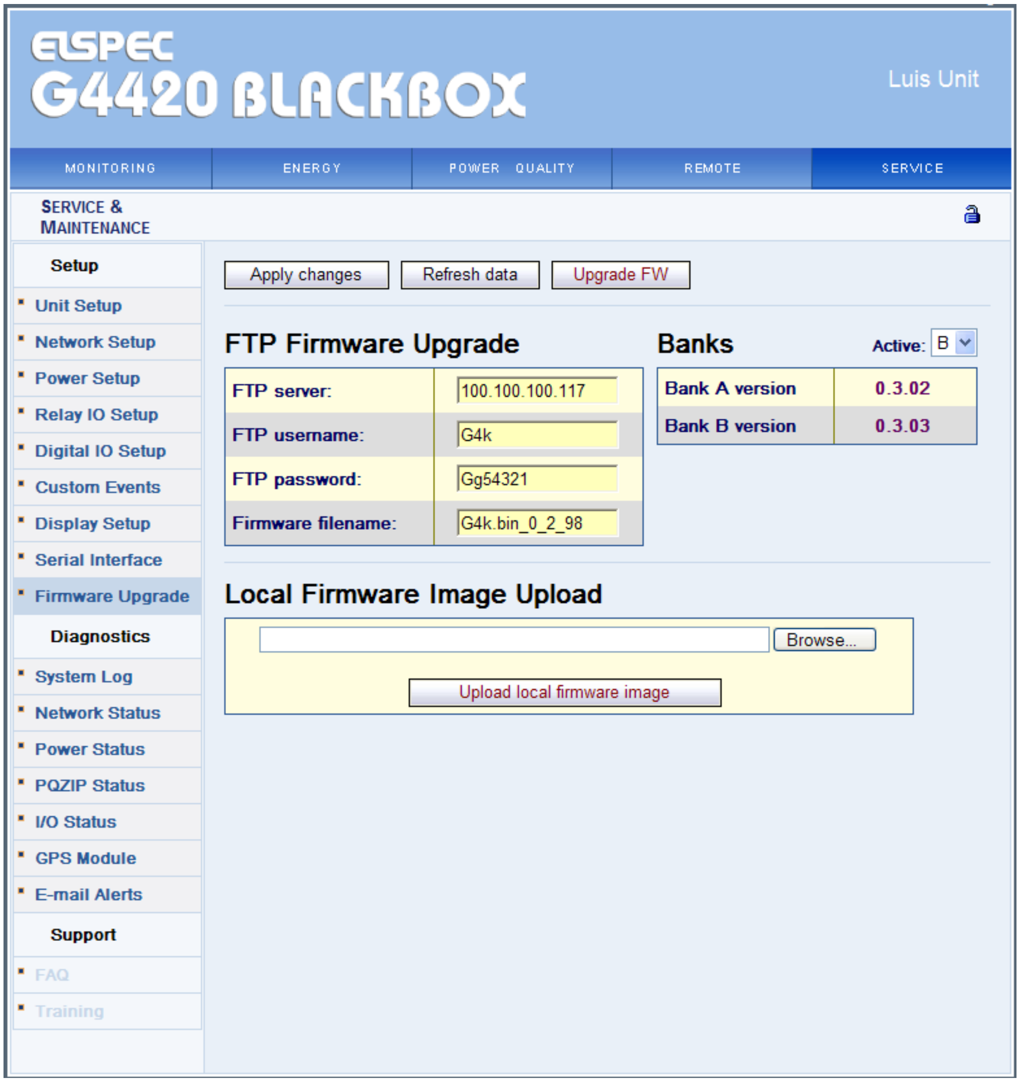


Figure 185: Firmware Upgrade for Boot Loader

3. Configure the Firmware using the table below.

Firmware Upgrade

Parameter	Description
FTP server IP address	This is the IP of the computer that is running the FTP Server application and where you saved the latest Boot Loader program
FTP user name	This is the user name of the profile you built for proceeding in the upgrading boot loader process
FTP password	The corresponding password of the profile you built
Firmware filename	The name of the Boot Loader file without the extension (.ldr)

Table 67: Firmware for Boot Loader

a) Once you completed all the four fields click on [Apply changes] button to confirm.

b) Click on [Refresh data] to confirm that the changes were applied

The Windows confirmation dialog box appears.

Figure 186: Confirmation dialog box

c) Click **OK** to confirm.

***Note:** Do not click on the [Upgrade FW] button at this time.*

By confirming the changes the following message will appear in the upper part of the screen:

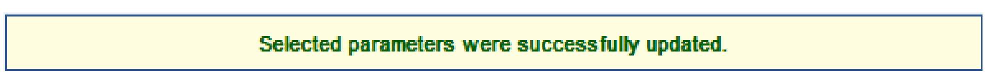


Figure 187: Close up to the Firmware Upgrade Screen after successfully changing parameters

The yellow shaded field change to white.

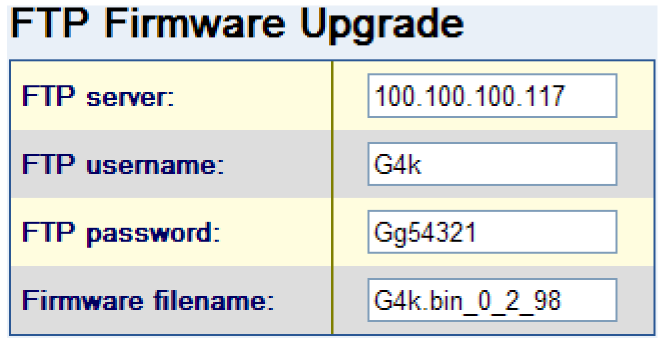


Figure 188: Close-up of TFP settings

4. Configure Telnet.

Configuring Telnet

In order to complete the Boot Loader process, you need to configure Telnet.

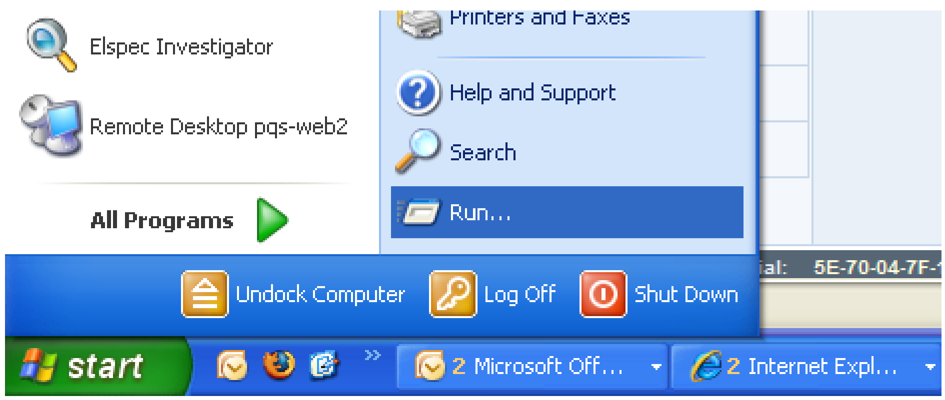


Figure 189: Running a command

To configure Telnet:

a) On the Windows Desktop, select **Start→Run.**

The Run command box appears.

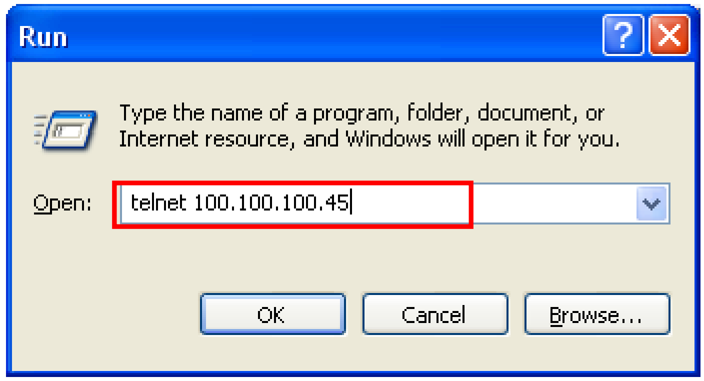


Figure 190: Run Command Box

b) Enter the IP address of the destination BLACKBOX unit in the Open box.

c) Click **OK**

The Telnet session is opened.

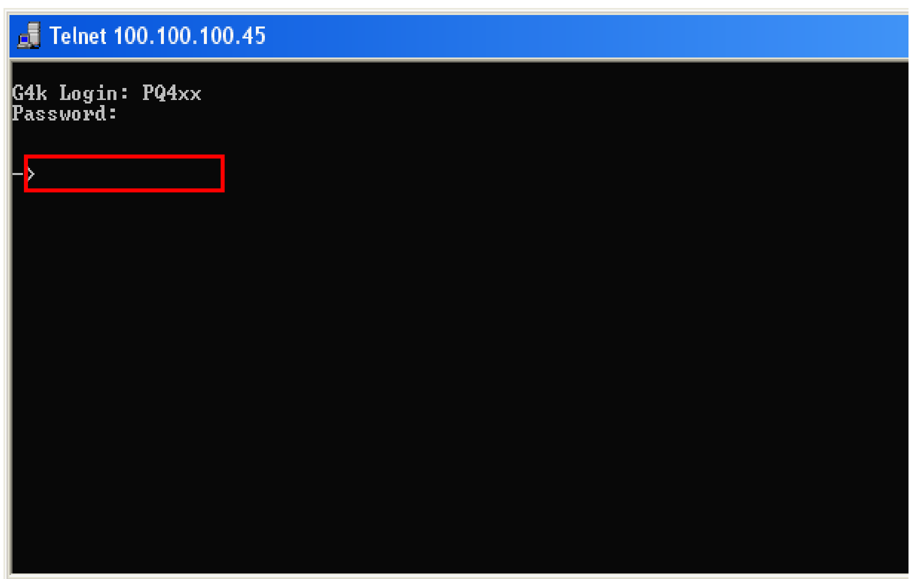


Figure 191: Telnet session to BLACKBOX is opened

d) Enter the BLACKBOX Login name and Password.

The user and password by default are PQ4xx and PQ4xxPQ4xx.

e) At the command prompt, enter **Firmware_BootLoader_Update 3**.

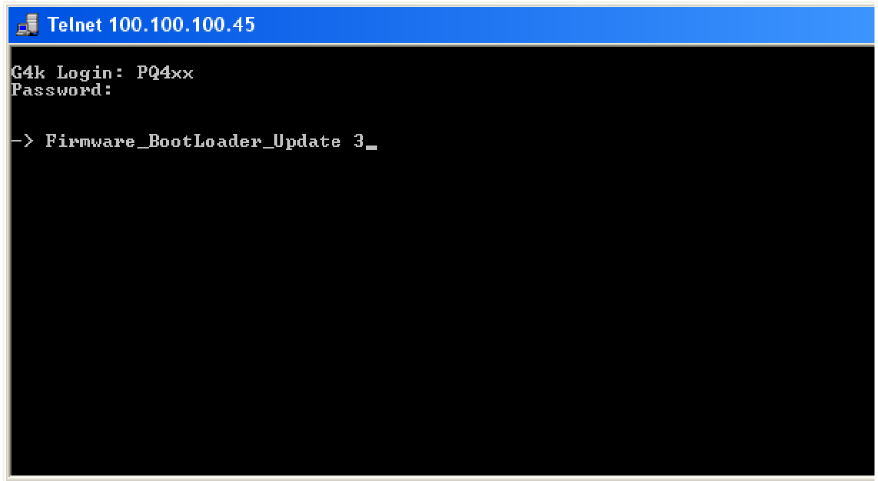


Figure 192: Firmware Boot Loader Update

Note: *The update will take a few seconds.*

A successful update screen appears.

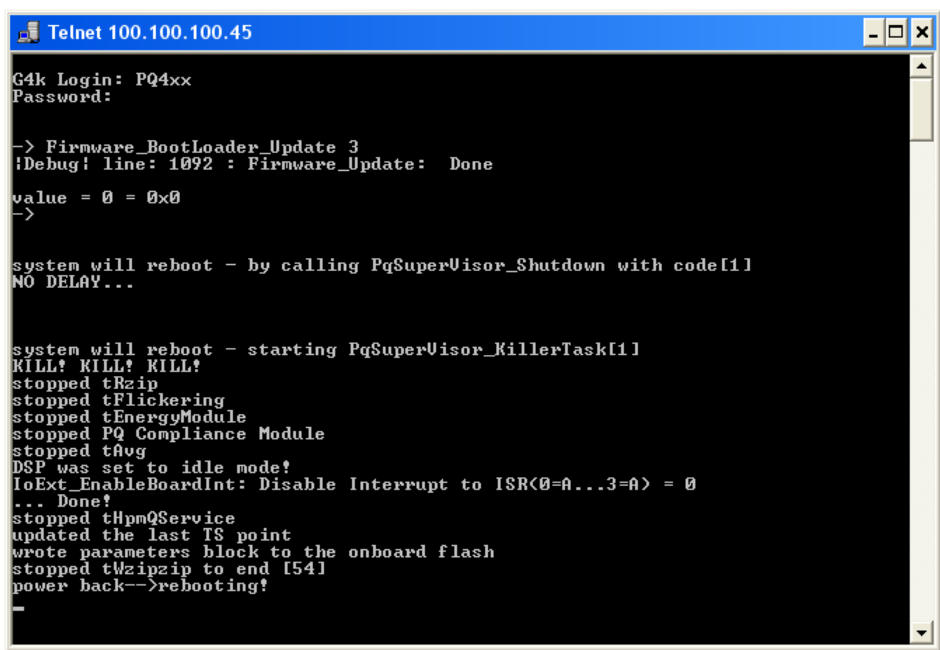


Figure 193: BLACKBOX Telnet session finished successfully

5. Verify Upgrade

Upgrade Verification

You need to verify the upgrade.

To verify upgrade:

a) In the main Login screen, select **Service→Unit Setup**.

The Unit Setup screen appears.

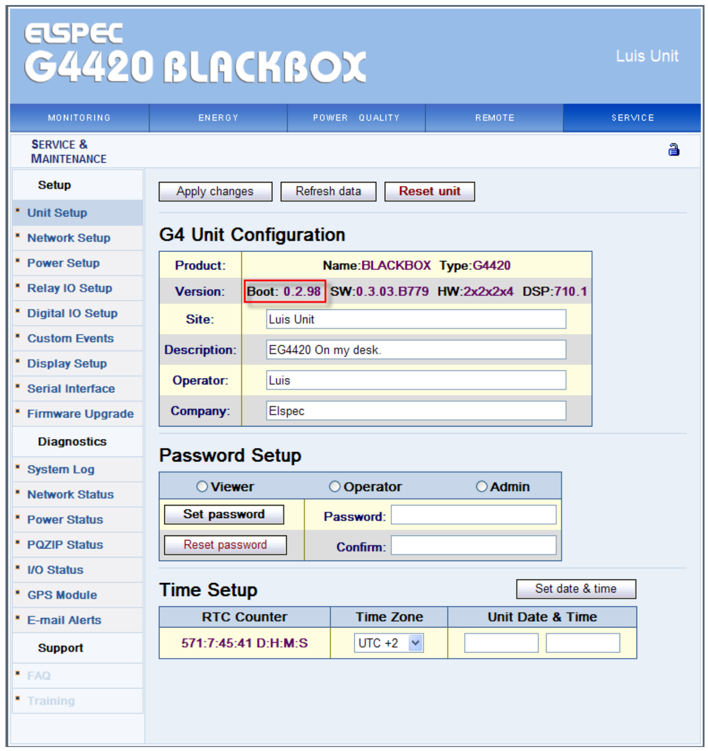


Figure 194: The new Boot Loader was installed

b) Verify the Version: Boot has changed.

6. Click Reset Unit on the main Unit Setup screen.

The Windows verification box appears.

Figure 195: Explorer Verification

7. Click **OK**.

A restart message appears.

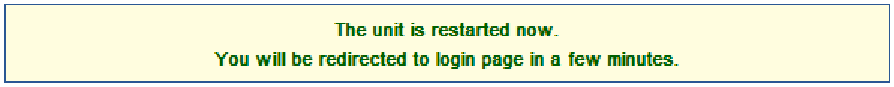


Figure 196: Restart Message

The upgrading process was completed successfully!

Appendix F: Configuring the FileZilla

This procedure describes in detail the process of opening the FileZilla interface.

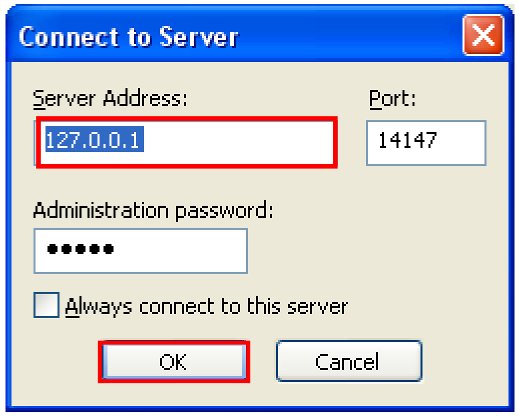


Figure 197: FileZilla FTP Server connection

1. To Open the FileZilla Server Interface, click **OK** on the dialog box.

The FileZila server screen appears.

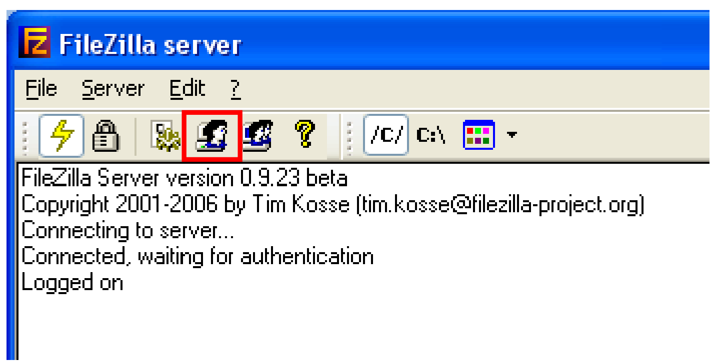


Figure 198: FileZilla Server application

2. Click on the  icon to create the account

The User page appears.

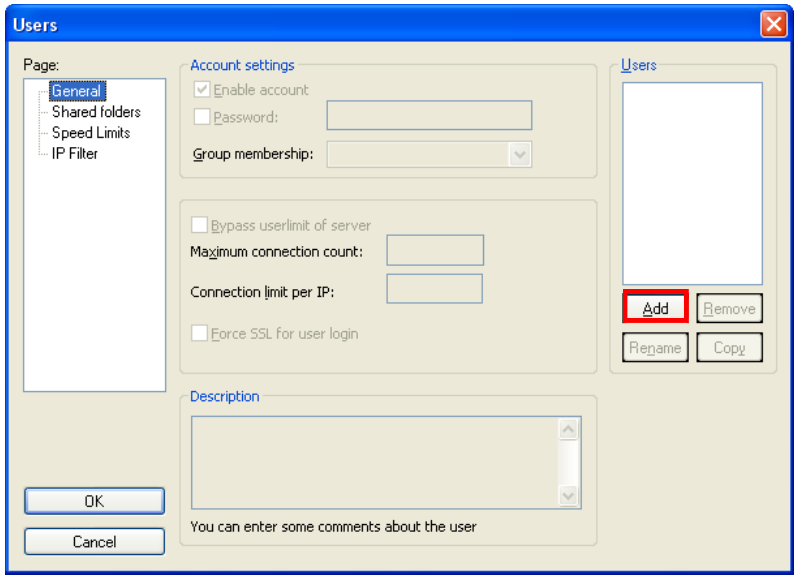


Figure 199: User Page

Note: *The IP address to create an account comes from the specific computer being used.*

3. Click **Add**.

The Add user account screen appears.

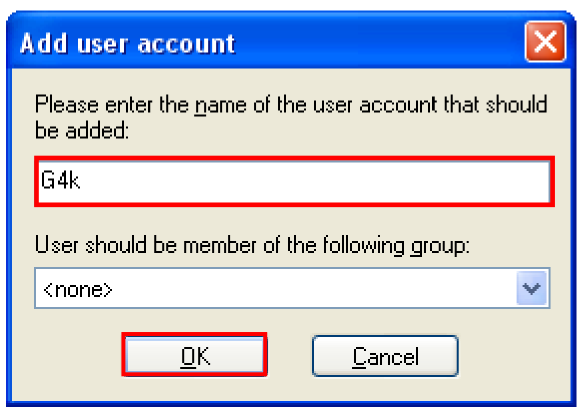


Figure 200: Add User Account

4. Enter the user name account, then click **OK**.

The User Page appears again.

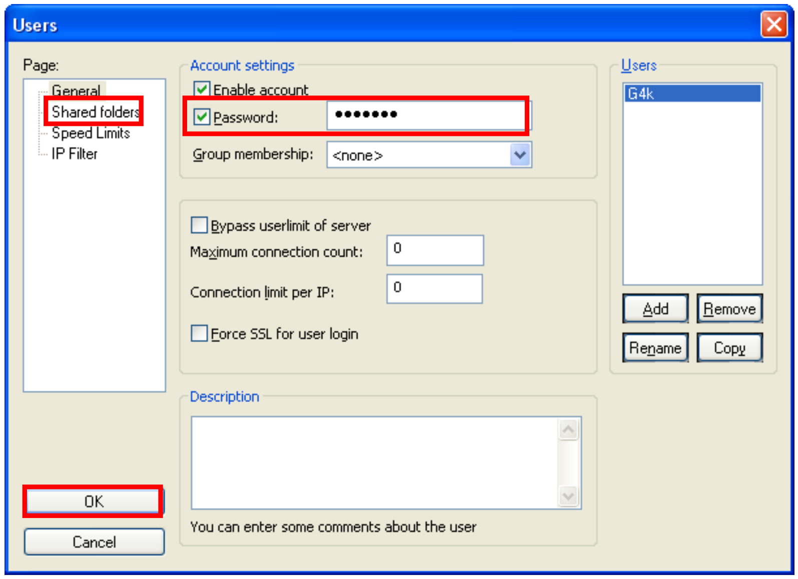


Figure 201: Password configuration

5. Check the **Password** check box, then enter your password.
6. Click **Add** button from the **Shared folders** canvas.

The Browse for Folders dialog box appears.

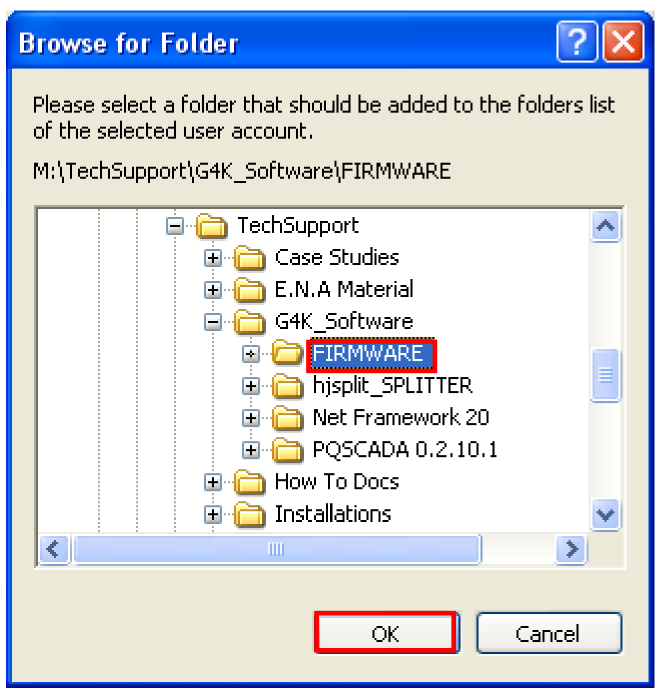


Figure 202: Browse for Folder

7. Select the specific subdirectory where the files you want to share, then click **OK**.

The User page appears again.

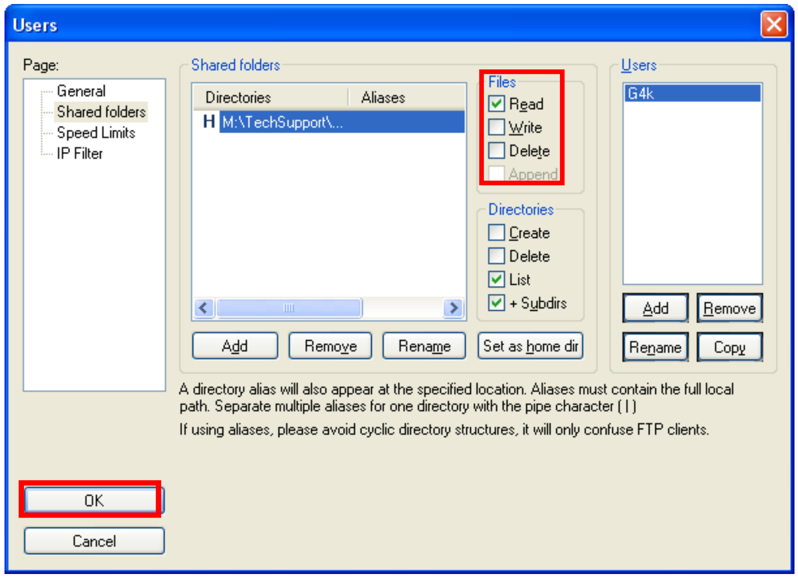


Figure 203: User Page

8. Select the specific permissions you want to give to the FTP Client user.
9. Click **OK** on the 'Users' dialog box

You are ready to share folders through FTP protocol.

***Note:** If you are unable to install or use the FileZilla, you may try the WFTPD32.exe application.*

Appendix G: Time Synchronization Technology

Elspec BLACKBOX system supports a unique time synchronization approach which provides the highest level of accuracy in today's market. The algorithm also presents the highest level of availability of time, exploiting all available optional time sources. Elspec's time synchronization algorithm supports three main time-synchronization sources:

- NTP (Network Time source obtained by network communication)
- GPS (GPS time source obtained from satellites).
- IRIG-B (Coded time pulsing obtained from IRIG-B source)

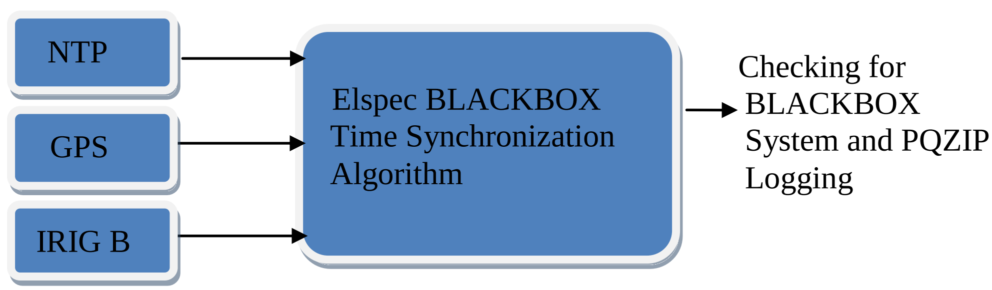


Figure 204: Time Synchronization

The Elspec BLACKBOX Time Synchronization Algorithm smoothly switch in between different time sources keeping system clock synchronized even at periods when all sources are lost by using an internal accurate RTC (Real Time Clock).

Network Time Protocol

NTP is Elspec's advanced extension of the Network Time Protocol (NTP) standard. NTP is used to synchronize clocks and computers to a given time reference. The protocol is implemented to ensure that system units constantly time synchronize with a given reference and among each other. The protocol is based on IP (Internet) Network.

This application note examines the time-synchronization configuration scenarios for BLACKBOX systems and details the innovative time synchronization algorithm in relation to the basic deviation set in the industry today.

GPS-based Time Synchronization

Many power quality measurement systems use GPS as time reference. GPS as a time reference is provided to ELSPEC Black-Box device via a combination of serial interface (R232 or RS485) and a PPS signal (Pulse per second) the interface is applicable using an IO Extension module and a suitable GPS module (recommended ELSPEC-CW46…

Using GPS with "BLACKBOX Verified GPS Module" – <take formal marketing name>…and …explanation of CW46 module, linked to where installation is shown. (By Using BLACKBOX IO module extension)

However, GPS receivers and supporting antennas for each measurement device are difficult to install in certain power networks. Time accuracy requires good reception for receiving satellite signals to achieve time synchronization. Valid GPS signals usually require an external-to-building installation which makes the installation expensive and difficult to maintain. Therefore, the BLACKBOX technology provides several flexible and cost-effective configuration schemes that achieve GPS level synchronization without the need for GPS.

The accuracy of the entire measurement solution and not only the accuracy of a specific GPS receiver device is of utmost importance. Comprehensive system accuracy (over multiple measurement units) is dependent on many aspects and not only on the accuracy of a specific GPS receiver. Some GPS receivers may claim less than 1 micro-second time accuracy; yet, it is not uncommon to obtain the same accuracy level within the measurement device itself. It is highly dependent on the hardware, software and internal algorithm used to synchronize time with the GPS receiver itself, therefore, many power quality solutions available today claim 10 milliseconds or generally "milliseconds" **time stamp** resolution. However, the providers do not specify the exact deviation among different measurement units installed in the field.

IRIG-B Time Synchronization

IRIGB Time input is provided to ELSPEC Black-Box device using IO Extension module (IRIG-B pins) The ELSPEC BLACKBOX hardware decodes the time and provide it synchronized to the time synchronization algorithm.

Other Time Synchronization Schemes

There are other types of time synchronization in the power quality measurement world. For instance, time synchronization based on correlation of power signals (without external time source). It is important to mention that this type of synchronization is sometimes highly inaccurate due to impedance changes that may cause delays between signals at different points, and the correlation algorithms cannot predict these delays. And, signal correlation cannot be performed on more than two measurement points if the third measurement device is connected on a totally different branch of the power network. Therefore, time synchronization based on a central/global reference clock is the only method that provides real-time accuracy, especially when working with a large number of measurement units and when line impedances and delays are an important factor.

Elspec's unique synchronization technology and configuration schemes ensure not only cost-effective installation and operation but very accurate time synchronization among all measurement units in the field. The algorithm handles all aspects of time accuracy losses resulting in **micro second resolution of time deviation**. Elspec's unique synchronization algorithm allows accurate synchronization over Local as well as wide Area Network without the cost and complexity of GPS. This algorithm also ensures time synchronization over three different available time sources: IRIGB, GPS, Network and of course anytime no external source is provided there is always available the self RTC (Real Time Clock).

Real Time Clock

RTC is considered 2nd level backup in case no other time source available. The RTC power is backed up using an internal battery, allowing continuous incrementation, even when no power is supplied to the BLACKBOX unit. The entire process of selecting the time source is automatic both on failure and recovery points.

The new algorithm represents a dramatic improvement of the industry standard (NTP). The algorithm makes use of NTP protocol as a fundamental building block which enables it to communicate with any standard NTP server equipment for obtaining and generating a highly accurate and stable time reference.

The time synchronization algorithm is configurable through two main parameters: Main Time Source and Alternate Time Source. The Main Time Source serves as the primary/external time synchronization source while the Alternate Time Source is used as the secondary time source in case the primary fails. Both sources can be configured as GPS time source or NTP time source.

How Time synchronization source is selected

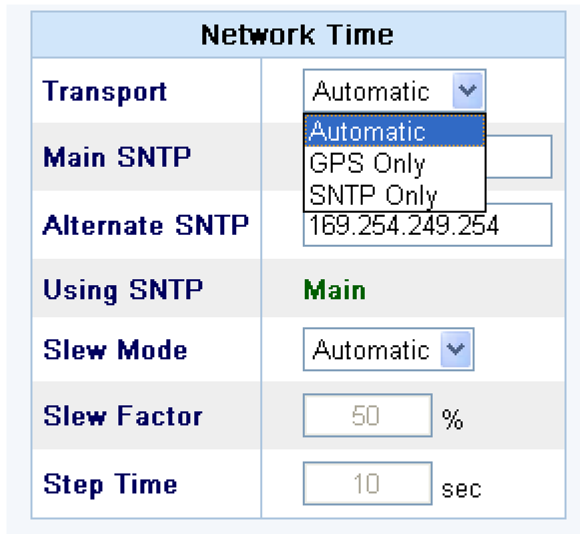


Figure 205: Network Time

Automatic (default) means the time-synchronization algorithm self selecting the optimal time source. Typically a GPS (or IRIGB) time source input will be preferred over NTP time (that is, if both are available). However if only NTP is presented than switching between Main and Alternate NTP servers is automatically based on availability with prioritization to main one.

Setting GPS only will enable inputting GPS or IRIGB inputs only.

- Setting SNTP only will enable inputting network time only.

Network Configurations

Generally, The BLACKBOX with Elspec's Registered Patented PQZip data compression technology supports three time-synchronization configuration schemes.

Each scheme is described in relation to functionality and network benefits.

Network-based Time Source

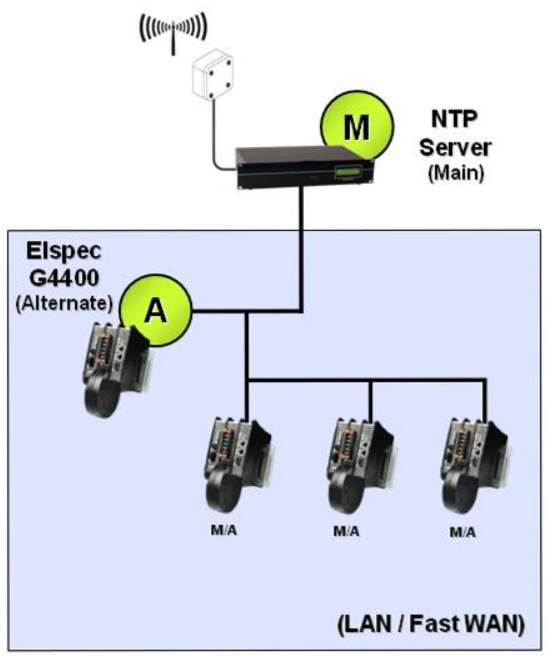


Figure 206: Network Time Source

This configuration is a total network-based time synchronization scheme without the need for GPS receiver

The Main Time Source is set to an external time server. Such a time server is either GPS-based /radio reception based NTP server equipment (standard market equipment) or an NTP server computer located at network management headquarters (i.e., SCADA location) or even a remote internet time server used for the wider Internet users. The Alternate Time Source is a designated to an Elspec G4000 unit. Each G4000 unit also acts as an NTP server and therefore can be used as time reference to other units. Such designated G4000 time servers act as the central site time synchronization element for the entire Elspec G4000 system.

Therefore configuration across all G4000 units (except for the one designated as central site time synchronization server):

- Main Time Source = IP address of external time server

- Alternate Time Source = IP address of Elspec G4000 unit (the designated central site synchronization server)

Configuration in the G4000 unit designated as central time synchronization server:

- Main Time Source = IP address of external time server
- Alternate Time Source = self (0.0.0.0)

Such configuration enables very accurate time synchronization among all Elspec G4000 units in the network. If the external time server malfunctions, the central unit which acts as site synchronization server takes control of the time source, keeping time according to the internal RTC reference. The internal RTC is a battery backed-up real-time clock with a typical deviation of less than 10 ppm.

Therefore, the following time accuracies are achieved (Considering good network connectivity):

- In site Time deviation expected: ±100 [μsec]
- GMT deviation expected: ±200 [μsec]

The In Site Time deviation parameter expresses the maximum deviation value among all Elspec G4000 units on-site, while the GMT deviation expresses the deviation of all units from GMT - Greenwich Mean Time (commonly used universal time). In Site Time deviation is the most sensitive parameter regarding power quality analysis because the higher the value, the harder it is to correlate or analyze the effect of power events on different locations.

GPS/Network Hybrid Time Synchronization

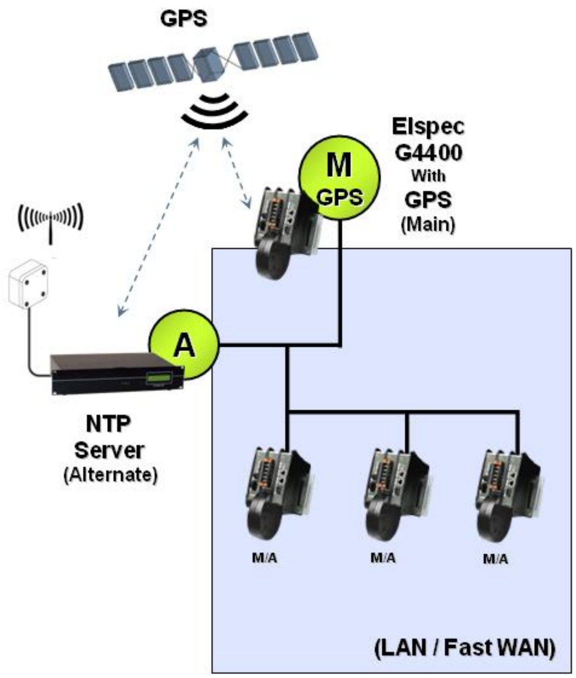


Figure 207: GPS/Network Hybrid Synchronization

It is possible to configure a hybrid time synchronization scheme using one Elspec G4000 with GPS receiver extension module. The remaining Elspec G4000 units are configured without any GPS extension and obtain time from the unit with the GPS receiver. Using such a configuration ensures a very small time deviation from GMT.

Therefore, configuration across all Elspec G4000 units (excepting the unit configured with GPS) yields:

- Main Time Source = IP address of Elspec G4000 unit with GPS
- Alternate Time Source = IP address of some external NTP server (as backup in case the unit with GPS is unavailable)

Configuration in the G400 unit with the GPS:

- Main Time Source = Internal GPS
- Alternate Time Source = IP address of some external NTP server (in case GPS signal is unavailable)
- In Site Time deviation expected:±100 µsec
- Considering good GPS signal:
- GMT deviation expected in all site units: ±100 µsec

- GMT deviation expected at main unit (with GPS): ±50 µsec

Clearly, the time deviation for comprehensive system synchronization becomes more accurate using one Main unit with GPS receiver as time source.

Full GPS Time Synchronization

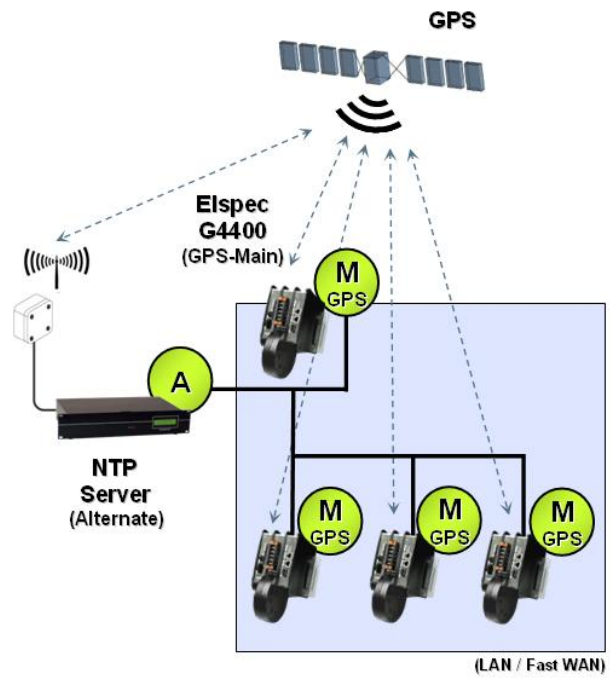


Figure 208: ***GPS External Synchronization***

With this scheme all Elspec G4000 units are equipped with extension GPS modules. Using GPS within all units ensures the highest accuracy possible.

Therefore configuration within all units yields:

- Main Time Source = GPS
- Alternate Time Source = IP address of some external NTP server (backup for GPS)
- Considering good GPS signal:
- In Site Time deviation expected: ±50 µsec
- GMT deviation expected in all site units: ±50 µsec

While accuracy of such configuration is the highest possible, the implementation cost as well as the operation cost is the most expensive of the available configuration options.

Appendix H: OPC and the BLACKBOX Data Quality Center

General

OPC (Open Connectivity, formerly OLE for Process Control) is an industry standard based on Microsoft's OLE/COM technology for communicating to numerous data sources, either devices on the factory floor, or a database in a control room.

In other words, OPC is a common way for applications to access data from any data source.

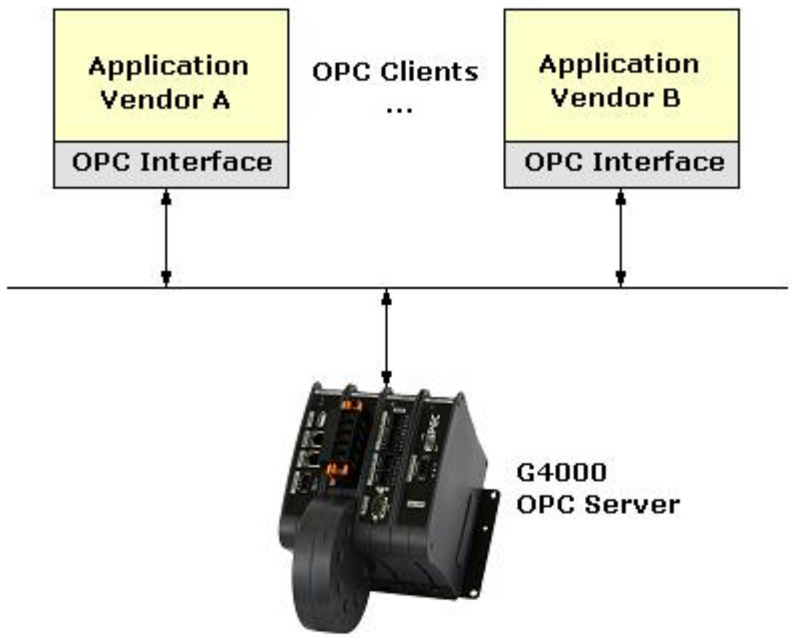


Figure 209: OPC Client Server Mode

OPC brings the value that comes with the use of standards, including reduced training costs, reduced custom development costs, and lower long-term maintenance costs. By design, OPC-compliant products work seamlessly with one another. With this plug-and-play approach, off-the-shelf components can be brought together efficiently to solve immediate requirements. With OPC, system integration in a heterogeneous computing environment becomes simple.

The Current Client Application Architecture

All of the OPC Specifications are based on the OPC Client/Server model. Client/Server describes the relationship between two computer applications in which one application, the OPC client, makes a service request from another application, the OPC Server, which fulfills the request.

- An OPC Server is a software application that has been written to one of the OPC specifications. An OPC Server will respond to requests, and provide data to one or more OPC Clients in a standard, consistent manner. Any compliant OPC Client can interface with, and request data from any complaint OPC Server, regardless of the vendor, or the underlying system providing the data.

- An OPC Server provides a set of standard interfaces, properties and methods, such than any OPC Client can connect/disconnect, obtain information on what data is available, and read/write data in a standard manner.

Further information on OPC can be found at *OPC Foundation*.

Types of Services

The primary OPC Specifications, OPC Data Access (OPC DA), OPC Historical Data Access (OPC HDA) and OPC Alarms & Events (OPC A&E) are based on Microsoft COM (and DCOM), which is also based on the Client/Server model.

***Note**: Online Data Access: The efficient reading and writing of data between an application and a device flexibly and efficiently*

***Note:** Alarm and Event Handling: The mechanisms for OPC Clients to be notified of the occurrence of specified events and alarm conditions*

***Note**: Historical Data Access: The reading, processing and editing of data of a historian engine.*

The Elspec BLACKBOX and Its Embedded OPC Server

The Elspec BLACKBOX uses built-in TPC/IP based fast Ethernet ports (2 ports for EG4420 and EG4430 and 1 port for EG4410) for communications purposes.

The three most useful protocols that are used are the http (Hyper Text Transfer Protocol), ftp (File Transfer Protocol) and OPC (Open Connectivity). Http is the standard website protocol. Ftp is the Internet's standard file transfer protocol and it is used to fetch PQZIP files from the BLACKBOX to the server.

The embedded OPC Server provided by the Elspec BLACKBOX unit supports *OPC Data Access Custom Interface Standard Specification version 2.05a*. In future versions the BLACKBOX shall support Alarm and Events and Historical Data Access.

The BLACKBOX embedded OPC Server includes all available data and there is no need to setup anything rather than the device IP address.

BLACKBOX OPC Server Parameters

The Elspec BLACKBOX OPC Server provides a standard way to access real-time data from the device. The following is the list of parameters, calculated based on the standards IEC 61000-4-30 – Testing and measurement techniques – Power quality measurement methods:

- **RMS Group values** comprising line voltages and phase voltages, line current and phase currents plus neutral voltage and current.
- **Total Harmonic Distortion Group values** comprising line voltages, phase voltages, phase currents, and neutral voltage and current.
- **K-Factor values** comprising line and phase currents
- **Crest Factor values** comprising line voltages, phase voltages, phase currents, and neutral voltage and current
- **RMS values**, comprising line voltages, phase voltages, phase currents, neutral voltage and current, and average line and phase voltages and phase currents
- **Power Factor values**, comprising power factor per phase, neutral and total power factor.
- **Apparent Power values** comprising apparent power per phase, neutral and total.
- **Reactive Power values** comprising reactive power per phase, neutral and total.
- **Active Power values** comprising active power per phase, neutral and total.
- **Total Harmonic Distortion values** comprising line voltages, phase voltages, phase currents, and neutral voltage and current.

OPC parameters are BLACKBOX memory resource consumers. Addition of parameters in the embedded OPC interface will be evaluated upon specific customer request.

Note: *RMS Group values and THD Group values are calculated according to the definitions of IEC 61000-4-7, Testing and measurement techniques.*

Using BLACKBOX OPC Server with Third Party OPC Client Applications

There are several third party OPC Client applications in the marker. One of them is *dOPC Explorer* from **Kassl GmbH** which is a free (for non commercial use) program to read/write OPC Items from/to OPC DA servers.

DOPC Explorer is an easy to use OPC diagnostic and communication tool that enables you to connect to the Elspec BLACKBOX OPC DA server.

With dOPC Explorer you can browse for different BLACKBOX OPC DA servers connected to the same network, browse for OPC items, read item properties and create different OPC groups.

With the embedded Trend Graph you can view the change of data compared to the time in the following figure.

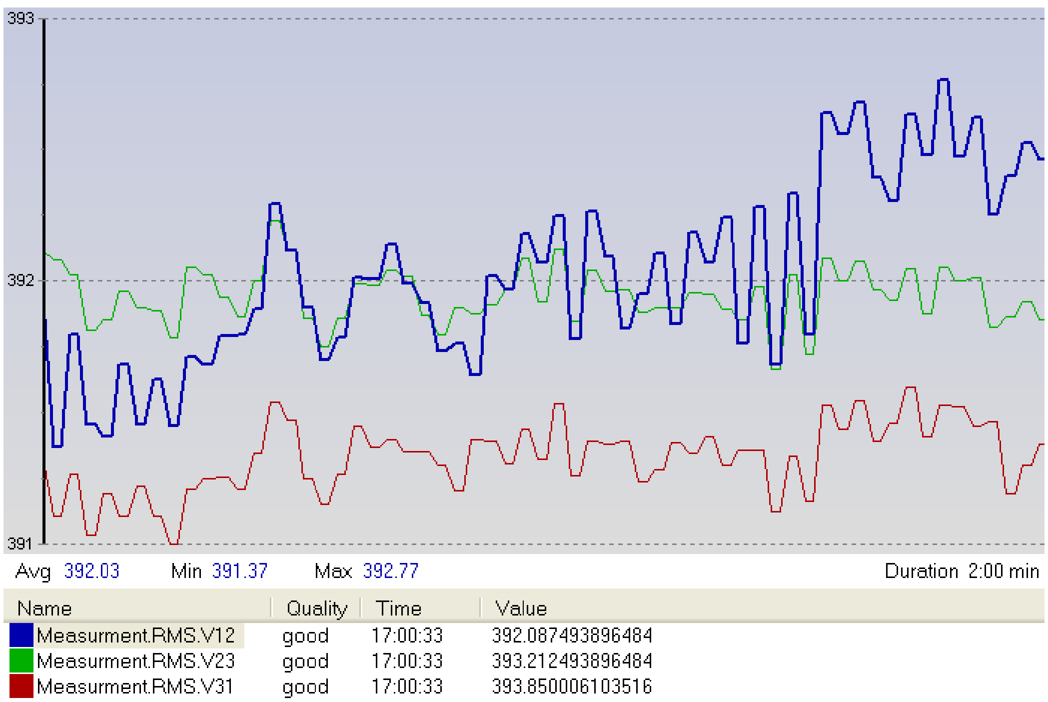


Figure 210: Trend Graph

By using the 'Trend Graph' option the interface can also show you the *Average*, *Minimum* and *Maximum value* per parameter per screen.

***Note**: The implemented OPC Server does not support Microsoft's changes made in Windows XP Service Pack 2 DCOM interface. In case you are using Windows XP with Service Pack 2 you should configure the client computer as describe in the Using*

OPC via DCOM with Microsoft Windows XP Service Pack 2.

Appendix of URL links

The following are URL link references from the text.

OPC Foundation

http://www.opcfoundation.org/

OPC Data Access Custom Interface Standard Specification version 2.05a

http://www.opcfoundation.org/DownloadFile.aspx?CM=3&RI=66&CN=KEY&CI=274&CU=17

DOPC Explorer

http://www.kassl.de/opc/explorer.shtml

Using OPC via DCOM with Microsoft Windows XP Service Pack 2

http://opcfoundation.org/Archive/72e9fbfa-6a89-4ef2-9b6d-3f746fd7eb05/Using%20OPC%20via%20DCOM%20with%20XP%20SP2%20v1.10.pdf

Appendix I: List of OPC Tags

The following is the list of the BLACKBOX OPC tags. A '.' character refers to subgroup.

OPC Tag List
Measurement.THD.Vn
Measurement.THD.V1
Measurement.THD.V2
Measurement.THD.V3
Measurement.THD.V12
Measurement.THD.V23
Measurement.THD.V31
Measurement.THD.In
Measurement.THD.I1
Measurement.THD.I2
Measurement.THD.I3
Measurement.ActivePower.Neutral
Measurement.ActivePower.Phase1
Measurement.ActivePower.Phase2
Measurement.ActivePower.Phase3
Measurement.ActivePower.Phase12
Measurement.ActivePower.Phase23
Measurement.ActivePower.Phase31
Measurement.ActivePower.3Phase_Total
Measurement.ReActivePower.Neutral
Measurement.ReActivePower.Phase1
Measurement.ReActivePower.Phase2
Measurement.ReActivePower.Phase3
Measurement.ReActivePower.Phase12
Measurement.ReActivePower.Phase23
Measurement.ReActivePower.Phase31
Measurement.ReActivePower.3Phase_Total
Measurement.ApparentPower.Neutral
Measurement.ApparentPower.Phase1
Measurement.ApparentPower.Phase2
Measurement.ApparentPower.Phase3
Measurement.ApparentPower.Phase12
Measurement.ApparentPower.Phase23
Measurement.ApparentPower.Phase31

OPC Tag List
Measurement.ApparentPower.3Phase_Total
Measurement.PowerFactor.True.Neutral
Measurement.PowerFactor.True.Phase1
Measurement.PowerFactor.True.Phase2
Measurement.PowerFactor.True.Phase3
Measurement.PowerFactor.True.3Phase_Total
Measurement.PowerFactor.Displacement.Phase1
Measurement.PowerFactor.Displacement.Phase2
Measurement.PowerFactor.Displacement.Phase3
Measurement.PowerFactor.Displacement.3Phase_Total
Measurement.PowerFactor.True.Phase12
Measurement.PowerFactor.True.Phase23
Measurement.PowerFactor.True.Phase31
Measurement.PowerFactor.Displacement.Phase12
Measurement.PowerFactor.Displacement.Phase23
Measurement.PowerFactor.Displacement.Phase31
Measurement.RMS.Vn
Measurement.RMS.V1
Measurement.RMS.V2
Measurement.RMS.V3
Measurement.RMS.V12
Measurement.RMS.V23
Measurement.RMS.V31
Measurement.RMS.In
Measurement.RMS.I1
Measurement.RMS.I2
Measurement.RMS.I3
Measurement.RMS.V1_2_3_Average
Measurement.RMS.V12_23_31_Average
Measurement.RMS.I1_2_3_Average
Measurement.CrestFactor.Vn
Measurement.CrestFactor.V1
Measurement.CrestFactor.V2
Measurement.CrestFactor.V3
Measurement.CrestFactor.V12
Measurement.CrestFactor.V23
Measurement.CrestFactor.V31
Measurement.CrestFactor.In
Measurement.CrestFactor.I1

OPC Tag List
Measurement.CrestFactor.I2
Measurement.CrestFactor.I3
Measurement.K_factor.In
Measurement.K_factor.I1
Measurement.K_factor.I2
Measurement.K_factor.I3
Measurement.THDG.Vn
Measurement.THDG.V1
Measurement.THDG.V2
Measurement.THDG.V3
Measurement.THDG.V12
Measurement.THDG.V23
Measurement.THDG.V31
Measurement.THDG.In
Measurement.THDG.I1
Measurement.THDG.I2
Measurement.THDG.I3
Measurement.RMSG.Vn
Measurement.RMSG.V1
Measurement.RMSG.V2
Measurement.RMSG.V3
Measurement.RMSG.V12
Measurement.RMSG.V23
Measurement.RMSG.V31
Measurement.RMSG.In
Measurement.RMSG.I1
Measurement.RMSG.I2
Measurement.RMSG.I3

Table 68: OPC

Appendix J: Communication Methods

LAN

HTTP server	Web interface: used for monitoring and configuring of the unit
FTP server	Access the file system within the unit For additional information about the file system structure see File System directory.
Telnet	Debug shell interface
OPC	Open Connectivity, formerly OLE for Process Control)
SNTP Server	Time server provides accurate time stamp
TCP Port #885	Uses internal Elspec protocol for communicating and debugging.

Table 69: LAN

RS485/422

ModBus RTU	Responds to ModBus server requests.
TTY	Serial debug interface
ELCOM	Elspec proprietary communication method.

Table 70: LAN

Appendix K: File System Directories

Configuration	This folder contains the active firmware
PQZIP Data	This folder contains the PQZip files
System	Internal Use only
Upload	This folder contains uploaded files like firmware.
Reports	This folder contains the completed reports.

Table 71: File System Directories

Appendix L: Troubleshooting

Problem	Description	Solution
Red led constant on	PQZip is inactive.	Active the PQZip
	Flash parameter corrupted	Restart the unit.
	DSP module communication failure	• Unplug the unit and wait for power down • Power up the unit again.
	Initialization error – DSP communication, PQZip or the event module failed on initialization	• Unplug the unit and wait for power down • Power up the unit again.
	EG4100 LCD failed to initialize	• Unplug the unit and wait for power down • Power up the unit again.
Red led blinks	Warning: Connection problem with the EG4100	Restart the unit
	Warning: Logger corrupted	• Erase Log • Restart the unit
Green led blinks and does not stop after a minute	Application stuck in initialization phase.	Contact support
Unable to access web interface	Browser may be incorrectly configured for direct or remote access to the network.	If the problem continues, see solutions for **Unable to communicate.**
Unable to communicate with the unit	The unit is not responding to network communication.	• Run ElspecSearch for trying to locate the unit. See if the network configuration is correct • Open shell window (**Start→Run→ cmd)** and **Run→ping <Unit IP>.** • Restart the unit. • Unplug the network cable and attach to the back of the unit
OPC: Group items return error while reading from the unit	Possible incorrect parameters	Check if all the parameters in the group are valid in the current power configuration.

Problem	Description	Solution
ModBus Communication over serial RS485fails	Connection problem	Check serial connection • Wiring • Bit rate • ModBus address Check client configuration • Each parameter returns a 32bit floating value. • The parameter ids are incremented by one.
GPS Module is connected but NO Time SYNC status	Verification	Check time synchronization source: • Should be on GPS or Auto. GPS page: • Check the information there is valid. • If nothing displayed, check the power source of the gps and the wiring. Verify PPS/IRIG Signal state and check connection to IRIG pin

Appendix M: Event Description

Event Code	Event Description	Type
0	LOGGER_EVENT_ENERGY_MEASUREMENT	MEASUREMENT
1	LOGGER_EVENT_STARTUP	SYSTEM
2	LOGGER_EVENT_POWER_LOSS	SYSTEM
3	LOGGER_EVENT_POWER_UP	SYSTEM
4	LOGGER_EVENT_UNDER_3V	SYSTEM
5	LOGGER_EVENT_START_SHUTDOWN_POWER_LOSS	SYSTEM
6	LOGGER_EVENT_START_SHUTDOWN_SYSTEM_ERROR	SYSTEM
7	LOGGER_EVENT_START_SHUTDOWN_BY_USER	SYSTEM
8	LOGGER_EVENT_END_SHUTDOWN	SYSTEM
9	LOGGER_EVENT_WD_RESET	SYSTEM
10	LOGGER_EVENT_PQZIP_ENABLED	SYSTEM
11	LOGGER_EVENT_PQZIP_DISABLED	SYSTEM
12	LOGGER_EVENT_PQZIP_FLUSH	SYSTEM
13	LOGGER_EVENT_PQZIP_FAIL_TO_START	SYSTEM
14	LOGGER_EVENT_SYSTEM_PARAMETER_CHANGE	SYSTEM
15	LOGGER_EVENT_FIRMWARE_UPDATE_START	SYSTEM
16	LOGGER_EVENT_FIRMWARE_UPDATE_SUCCEEDED	SYSTEM
17	LOGGER_EVENT_FIRMWARE_UPDATE_FAILED	SYSTEM
18	LOGGER_EVENT_HPI_LOST_CYCLES	DEBUG
19	LOGGER_EVENT_PQZIP_LOST_CYCLES	DEBUG
20	LOGGER_EVENT_DEBUG_MODE_ENABLED	SYSTEM
21	LOGGER_EVENT_DEBUG_MODE_DISABLED	SYSTEM
22	LOGGER_EVENT_DSP_NOT_FOUND	SYSTEM
23	LOGGER_EVENT_EXTERNAL_CF_PLUGGED_IN	SYSTEM
24	LOGGER_EVENT_EXTERNAL_CF_UNPLUGGED	SYSTEM
25	LOGGER_EVENT_ETHERNET_LINK_CONNECTED	SYSTEM
26	LOGGER_EVENT_ETHERNET_LINK_DISCONNECTED	SYSTEM
27	LOGGER_EVENT_RS485_LINK_CONNECTED	SYSTEM
28	LOGGER_EVENT_RS485_LINK_DISCONNECTED	SYSTEM
29	LOGGER_EVENT_EVENTS_LOG_CLEARED	SYSTEM
30	LOGGER_EVENT_PRM_BLOCK_CORRUPTED	SYSTEM
31	LOGGER_EVENT_SYSTEM_OUT_OF_MEMORY	DEBUG
32	LOGGER_EVENT_TIME_SYNC	SYSTEM
33	LOGGER_EVENT_GENERIC	DEBUG
34	LOGGER_EVENT_DBG_HPM_TOO_MUCH_DATA_BLOCKS	DEBUG
35	LOGGER_EVENT_DBG_HPM_ERR_REQ_LEN	DEBUG
36	LOGGER_EVENT_DBG_HPM_ERR_UNDEFINED_COMMAND	DEBUG
37	LOGGER_EVENT_DBG_HPM_NEW_QUEUE_FULL	DEBUG
38	LOGGER_EVENT_DBG_HPM_DEBUG_QUEUE_FULL	DEBUG
39	LOGGER_EVENT_DBG_HPM_SINGLE_QUEUE_FULL	DEBUG
40	LOGGER_EVENT_DBG_HPM_REPEAT_QUEUE_FULL	DEBUG
41	LOGGER_EVENT_DBG_HPM_REPEAT_RETURN_QUEUE_FULL	DEBUG

Event Code	Event Description	Type
42	LOGGER_EVENT_DBG_HPM_ERR_REQ_DEFINITION	DEBUG
43	LOGGER_EVENT_DBG_HPM_SYNCH_TIMEOUT	DEBUG
44	LOGGER_EVENT_DBG_HPM_TASK_TIMEOUT	DEBUG
45	LOGGER_EVENT_DBG_HPM_REQ_UNKNOWN	DEBUG
46	LOGGER_EVENT_DBG_HPM_INT_TIMEOUT	DEBUG
47	LOGGER_EVENT_DBG_HPM_EVENT_FAILED	DEBUG
48	LOGGER_EVENT_DBG_HPM_RESUME_TASK	DEBUG
49	LOGGER_EVENT_DBG_HPM_TASK_NOT_SUSPENDED	DEBUG
50	LOGGER_EVENT_DBG_HPM_TASK_NOT_FOUND	DEBUG
51	LOGGER_EVENT_DBG_HPM_REQUEST_IS_NOT_SENT	DEBUG
52	LOGGER_EVENT_DBG_HPM_CANT_SUSPEND_REQ	DEBUG
53	LOGGER_EVENT_HTTP_CONNECTED	DEBUG
54	LOGGER_EVENT_TCPIP_CONNECTED	DEBUG
55	LOGGER_EVENT_OPC_CONNECTED	DEBUG
56	LOGGER_EVENT_SERIAL_CONNECTED	DEBUG
57	LOGGER_EVENT_RESET_GOLDUSER	DEBUG
58	LOGGER_EVENT_SET_GOLDUSER	DEBUG
59	LOGGER_EVENT_DBG_PQZIP_CLOSE_FILE	DEBUG
60	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR	DEBUG
61	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_WRITE	DEBUG
62	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_CLOSE	DEBUG
63	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_OPEN	DEBUG
64	LOGGER_EVENT_CONNECTION_CLOSED	DEBUG
65	LOGGER_EVENT_PQZIP_ERR_SWITCH_BUFFER	DEBUG
66	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_RENAME	DEBUG
67	LOGGER_EVENT_CPU_USE_OVER_LIMIT	DEBUG
68	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_MKDIR	DEBUG
69	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_RMDIR	DEBUG
70	LOGGER_EVENT_DBG_HPM_SUPERVISOR_CHECK_FAILED	DEBUG
71	LOGGER_EVENT_DBG_STOPING_WD	DEBUG
72	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_READ_FOLDER	DEBUG
73	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_OPEN_FOLDER	DEBUG
74	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_DEL_FOLDER	DEBUG
75	LOGGER_EVENT_DBG_PQZIP_FILE_SYSTEM_ERR_DEL_FOLDER	DEBUG
76	LOGGER_EVENT_DBG_FILE_SYSTEM_ERR_READ_INFO	DEBUG
77	LOGGER_EVENT_GENERIC_WEB	NETWORK
78	LOGGER_EVENT_SNTP_SERVER_SWITCH_TO_ALTERNATIVE	SYSTEM
79	LOGGER_EVENT_SNTP_SERVER_SWITCH_TO_MAIN	SYSTEM
80	LOGGER_EVENT_LOGIN_VIA_TELNET	SYSTEM
81	LOGGER_EVENT_LOGIN_VIA_FTP	SYSTEM
82	LOGGER_EVENT_DSP_RESTART	SYSTEM
83	LOGGER_EVENT_DSP_FAIL2RECOVER	SYSTEM
84	LOGGER_EVENT_INIT_FAIL_CF	INIT
85	LOGGER_EVENT_INIT_FAIL_DSP	INIT

Event Code	Event Description	Type
86	LOGGER_EVENT_INIT_FAIL_WEB	INIT
87	LOGGER_EVENT_INIT_FAIL_LCD	INIT
88	LOGGER_EVENT_INIT_FAIL_PQZIP	INIT
89	LOGGER_EVENT_INIT_FAIL_IOEXT	INIT
90	LOGGER_EVENT_INIT_FAIL_DSP_BOARD	INIT
91	LOGGER_EVENT_INIT_FAIL_PSU_BOARD	INIT
92	LOGGER_EVENT_INIT_FAIL_ETC	INIT
93	LOGGER_EVENT_INIT_FAIL_FIRST_TIME	INIT
94	LOGGER_EVENT_INIT_FAIL_AVG	INIT
95	LOGGER_EVENT_INIT_FAIL_FLICKERING	INIT
96	LOGGER_EVENT_INIT_FAIL_LONGHPM	INIT
97	LOGGER_EVENT_INIT_FAIL_SUPERVISOR	INIT
98	LOGGER_EVENT_INIT_FAIL_TIMESYNC	INIT
99	LOGGER_EVENT_INIT_FAIL_DSP_RESPOND	INIT
100	LOGGER_EVENT_INIT_DSP_RESPOND	INIT
101	LOGGER_EVENT_DBG_INIT_STATUS	INIT
102	LOGGER_EVENT_IP_CHANGED	SYSTEM
103	LOGGER_EVENT_DBG_PQZIP_BIAS_CHANGED	DEBUG
104	LOGGER_EVENT_DBG_WEB	DEBUG
105	LOGGER_EVENT_FIRST_TIME_INITIALIZATION	INIT
106	LOGGER_EVENT_DBG_SET2DEFAULT	SYSTEM
107	LOGGER_EVENT_FIRMWARE_RUNNING	SYSTEM
108	LOGGER_EVENT_PRMFLASH_WRITE_FAIL	SYSTEM
109	LOGGER_EVENT_EVENT_UNKNOWN	NONE
110	LOGGER_EVENT_CF_FORMAT	SYSTEM
111	LOGGER_EVENT_CF_FORMAT_FAIL	SYSTEM
112	LOGGER_EVENT_DBG_HPM_MISS_CALC	DEBUG

Table 72: General and System Events

Appendix N: Custom and Power Quality Events

ID	BLACKBOX Name	PQ Description/Custom Events Presets	Custom/PQ	Custom/PQ	Custom/PQ
			Value	Magnitude	Phases
201	**CUSTOM 1**	Fault Recording = DFR(2): Event if MIO Card 1, DI1 Change state from default state.(both START and STOP events) For all change state events, Severity: BASE = 100, TF=1, MF = 0, Sampling is ~1 millisecond resolution	peak 3 phase current unbalance	3 phase current unbalance	
		PQ DESCRIPTION / P&H(1): 200ms based sampling, A multi condition event that occurs when the 3 phase current unbalance value is bigger than 10% while the average current is bigger than 2% from nominal current (both START and END events generated) For severity calculation: BASE =0, TF=0.1, MF = 1. (Magnitude is average current deviation %)			
202	**CUSTOM 2**	Fault Recording = DFR(2): Event if MIO Card 1, DI2 Change state from default state.(both START and STOP events)			
		PQ DESCRIPTION / P&H(1): 200ms based sampling, A multi condition event that occurs if DI1 is lower (DIG cycle indication) & 3 phase harmonic 5th current is bigger than 10% from fundamental current (both START and END events generated) BASE =0, TF=0.1, MF = 1. (Magnitude is 5th harmonic current deviation %)			
203	**CUSTOM 3**	Fault Recording = DFR(2): Event if MIO Card 1, DI3 Change state from default state.(both START and STOP events)			

ID	BLACKBOX Name	PQ Description/Custom Events Presets	Custom/PQ	Custom/PQ	Custom/PQ
			Value	Magnitude	Phases
		PQ DESCRIPTION / P&H (1): 200ms based sampling, A multi condition event that occurs if DI1 is low (DIG cycle indication) & Reactive power value is less than -500kVAr (both START and END events generated) BASE =0, TF=0.1, MF = 0.			
204	**CUSTOM 4**	Event if MIO Card 1, DI4 Change state from default state.(both START and STOP events)			
205	**CUSTOM 5**	Event if MIO Card 1, DI5 Change state from default state.(both START and STOP events)			
206	**CUSTOM 6**	Event if MIO Card 1, DI6 Change state from default state.(both START and STOP events)			
207	**CUSTOM 7**	Event if MIO Card 1, DI7 Change state from default state.(both START and STOP events)			
208	**CUSTOM 8**	Event if MIO Card 1, DI8 Change state from default state.(both START and STOP events)			
209	**CUSTOM 9**				
210	**CUSTOM 10**				
211	**CUSTOM 11**	Event if MIO Card 2, DI1 Change state from default state.(both START and STOP events)			
212	**CUSTOM 12**	Event if MIO Card 2, DI2 Change state from default state.(both START and STOP events)			
213	**CUSTOM 13**	Event if MIO Card 2, DI3 Change state from default state.(both START and STOP events)			
214	**CUSTOM 14**	Event if MIO Card 2, DI4 Change state from default state.(both START and STOP events)			
215	**CUSTOM 15**	Event if MIO Card 2, DI5 Change state from default state.(both START and STOP events)			

ID	BLACKBOX Name	PQ Description/Custom Events Presets	Custom/PQ	Custom/PQ	Custom/PQ
			Value	Magnitude	Phases
216	**CUSTOM 16**	Event if MIO Card 2, DI6 Change state from default state.(both START and STOP events)			
217	**CUSTOM 17**	Event if MIO Card 2, DI7 Change state from default state.(both START and STOP events)			
218	**CUSTOM 18**	Event if MIO Card 2, DI8 Change state from default state.(both START and STOP events)			
219	**CUSTOM 19**				
220	**CUSTOM 20**				
221	**CUSTOM 21**	Event if MIO Card 3, DI1 Change state from default state.(both START and STOP events)			
222	**CUSTOM 22**	Event if MIO Card 3, DI2 Change state from default state.(both START and STOP events)			
223	**CUSTOM 23**	Event if MIO Card 3, DI3 Change state from default state.(both START and STOP events)			
224	**CUSTOM 24**	Event if MIO Card 3, DI4 Change state from default state.(both START and STOP events)			
225	**CUSTOM 25**	Event if MIO Card 3, DI5 Change state from default state.(both START and STOP events)			
226	**CUSTOM 26**	Event if MIO Card 3, DI6 Change state from default state.(both START and STOP events)			
227	**CUSTOM 27**	Event if MIO Card 3, DI7 Change state from default state.(both START and STOP events)			
228	**CUSTOM 28**	Event if MIO Card 3, DI8 Change state from default state.(both START and STOP events)			
229	**CUSTOM 29**				

ID	BLACKBOX Name	PQ Description/Custom Events Presets	Custom/PQ	Custom/PQ	Custom/PQ
			Value	Magnitude	Phases
230	**CUSTOM 30**	200ms based sampling, Event if Df/dt bigger than X% (configurable, default X=0.1%...~0.1Hz). Minimum 1 second of event holding time (deactivation event hysteresis) Severity: BASE = 100, TF=0, MF = 100	Frequency peak deviation %	Frequency peak deviation %	
231	**CUSTOM 31**	1 cycle based sampling, Event if DV_phase/dt bigger than X% and Voltage is bigger than 10% from nominal (configurable, default X=10%) Minimum 1 second of event holding time (deactivation event hysteresis)	Voltage to neutral peak deviation %	Voltage to neutral peak deviation %	relevant phases
232	**CUSTOM 32**	1 cycle based sampling, Event if DVph2ph/dt bigger than X% and Voltage is bigger than 10% from nominal (configurable, default X=3%) Minimum 1 second of event holding time (deactivation event histerezis)	Diff-Voltage peak deviation %	Diff-Voltage peak deviation %	relevant phases
233	**PQ FREQ**	Frequency event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 seconds, Severity BASE=100, MF=30, TF=0 (Duration is always fixed and equal to measurement interval)	Frequency[Hz]	Frequency deviation from nominal frequency %	Y/Delta & relevant phases
234	**PQ VOLT VARIATION**	Voltage variation event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 minutes, Severity BASE=30, MF=1, TF=0 (Duration is always fixed and equal to measurement interval)	Voltage level	Voltage deviation from Nominal or USR (stationary) voltage in %	Y/Delta & relevant phases
235	**PQ VOLT DIP**	Voltage DIP event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 milliseconds, Severity BASE=30, MF=2, TF=5	Min Voltage level	Voltage deviation from Nominal voltage in %	Y/Delta & relevant phases

ID	BLACKBOX Name	PQ Description/Custom Events Presets	Custom/PQ	Custom/PQ	Custom/PQ
			Value	**Magnitude**	**Phases**
236	**PQ VOLT SHORT INTERUPTION**	Voltage Short Interruption event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 milliseconds (limited duration up to 1 minute otherwise considered long interruption), Severity BASE=150, MF=0, TF=1	Min Voltage level	Voltage deviation from Nominal voltage in %	Y/Delta & relevant phases
237	**PQ OVER VOLT**	Over Voltage event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 milliseconds, Severity BASE=50, MF=3, TF=5	Max Voltage level	Voltage deviation from Nominal voltage in %	Y/Delta & relevant phases
239	**PQ VOLT UNBALANCE**	Voltage unbalance event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 minutes, Severity BASE=60, MF=5, TF=0 (Duration is always fixed and equal to measurement interval)	Unbalance %	Unbalance %	Y/Delta & relevant phases
240	**PQ VOLT HARMONICS**	Voltage harmonics event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 minutes, Severity BASE=20, MF=5, TF=0 (Duration is always fixed and equal to measurement interval)	THD or single harmonics %	THD or single harmonics %	Y/Delta & relevant phases
241	**PQ VOLT INTER HARMONICS**	N/A			
242	**PQ VOLT FLICKERING**	Voltage harmonics event is compliance type or user compliance configurable , measurement interval is 10 minutes for PST and 2 hours for PLT, Severity BASE=20, MF=0.1, TF=0 (Duration is always fixed and equal to measurement interval)	PST or PLT value	PST or PLT deviation from typical 1 value in %	Y/Delta & relevant phases
243	**PQ VOLT MAIN SIGNALLING**	N/A			

ID	BLACKBOX Name	PQ Description/Custom Events Presets	Custom/PQ	Custom/PQ	Custom/PQ
			Value	Magnitude	Phases
244	**PQ RAPID VOLT CHANGES**	Rapid Voltage Change event is compliance type or user compliance configurable , typical (EN50160) measurement interval 3 seconds, Severity BASE=20, MF=2, TF=2	RVC %	RVC %	Y/Delta & relevant phases
245	**PQ VOLT LONG INTERUPTION**	Voltage Long Interruption event is compliance type or user compliance configurable , typical (EN50160) measurement interval 10 milliseconds (where duration is bigger than maximum duration time for short one), Severity BASE=150, MF=0, TF=1	Min Voltage level	Voltage deviation from Nominal voltage in %	Y/Delta & relevant phases

Table 73: Custom and Power Quality Events

Appendix O: Parameter Table

General Notes:

- BLACKBOX firmware must be 0.3.0.0.0 or higher
- The functions supported are 03 (Read Registers) and 16 (Write Registers)
- Registers addressing is between 40001 and 50000 per the Address column
- Hardware connection is via the devices' RS485/422 port
- Default operation is full-duplex (configurable via Web interface)
- Default baud rate is 19200 (configurable via Web interface)
- Settings are 8 data bits, no parity, 1 stop bit

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
Cycle by Cycle Measurements							
DSP FREQUENCY	R	100	256	40256	IEEE Float	4	
VN THD	R	101	257	40257	IEEE Float	4	
V1 THD	R	102	258	40258	IEEE Float	4	
V2 THD	R	103	259	40259	IEEE Float	4	
V3 THD	R	104	260	40260	IEEE Float	4	
V12 THD	R	105	261	40261	IEEE Float	4	
V23 THD	R	106	262	40262	IEEE Float	4	
V31 THD	R	107	263	40263	IEEE Float	4	
IN THD	R	108	264	40264	IEEE Float	4	
I1 THD	R	109	265	40265	IEEE Float	4	
I2 THD	R	10A	266	40266	IEEE Float	4	
I3 THD	R	10B	267	40267	IEEE Float	4	
I12 THD	R	10C	268	40268	IEEE Float	4	
I23 THD	R	10D	269	40269	IEEE Float	4	
I31 THD	R	10E	270	40270	IEEE Float	4	
ACTIVE POWER N	R	10F	271	40271	IEEE Float	4	
ACTIVE POWER MAIN 1	R	110	272	40272	IEEE Float	4	
ACTIVE POWER MAIN 2	R	111	273	40273	IEEE Float	4	
ACTIVE POWER MAIN 3	R	112	274	40274	IEEE Float	4	
ACTIVE POWER MAIN 12	R	1A0	416	40416	IEEE Float	4	
ACTIVE POWER MAIN 23	R	1A1	417	40417	IEEE Float	4	
ACTIVE POWER MAIN 31	R	1A2	418	40418	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
ACTIVE POWER SUM	R	113	275	40275	IEEE Float	4	
REACTIVE POWER N	R	114	276	40276	IEEE Float	4	
REACTIVE POWER MAIN 1	R	115	277	40277	IEEE Float	4	
REACTIVE POWER MAIN 2	R	116	278	40278	IEEE Float	4	
REACTIVE POWER MAIN 3	R	117	279	40279	IEEE Float	4	
REACTIVE POWER MAIN 12	R	1A3	419	40419	IEEE Float	4	
REACTIVE POWER MAIN 23	R	1A4	420	40420	IEEE Float	4	
REACTIVE POWER MAIN 31	R	1A5	421	40421	IEEE Float	4	
REACTIVE POWER SUM	R	118	280	40280	IEEE Float	4	
APPARENT POWER N	R	119	281	40281	IEEE Float	4	
APPARENT POWER MAIN 1	R	11A	282	40282	IEEE Float	4	
APPARENT POWER MAIN 2	R	11B	283	40283	IEEE Float	4	
APPARENT POWER MAIN 3	R	11C	284	40284	IEEE Float	4	
APPARENT POWER MAIN 12	R	1A6	422	40422	IEEE Float	4	
APPARENT POWER MAIN 23	R	1A7	423	40423	IEEE Float	4	
APPARENT POWER MAIN 31	R	1A8	424	40424	IEEE Float	4	
APPARENT POWER SUM	R	11D	285	40285	IEEE Float	4	
POWER FACTOR N	R	11E	286	40286	IEEE Float	4	
POWER FACTOR 1	R	11F	287	40287	IEEE Float	4	
POWER FACTOR 2	R	120	288	40288	IEEE Float	4	
POWER FACTOR 3	R	121	289	40289	IEEE Float	4	
POWER FACTOR TOTAL	R	122	290	40290	IEEE Float	4	
PF FUNDAMENTAL 1	R	123	291	40291	IEEE Float	4	
PF FUNDAMENTAL 2	R	124	292	40292	IEEE Float	4	
PF FUNDAMENTAL 3	R	125	293	40293	IEEE Float	4	
PF FUNDAMENTAL TOTAL	R	126	294	40294	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
POWER FACTOR 12	R	154	340	40340	IEEE Float	4	
POWER FACTOR 23	R	155	341	40341	IEEE Float	4	
POWER FACTOR 31	R	156	342	40342	IEEE Float	4	
PF FUNDAMENTAL 12	R	157	343	40343	IEEE Float	4	
PF FUNDAMENTAL 23	R	158	344	40344	IEEE Float	4	
PF FUNDAMENTAL 31	R	159	345	40345	IEEE Float	4	
VN RMS	R	12B	299	40299	IEEE Float	4	
V1 RMS	R	12C	300	40300	IEEE Float	4	
V2 RMS	R	12D	301	40301	IEEE Float	4	
V3 RMS	R	12E	302	40302	IEEE Float	4	
V12 RMS	R	12F	303	40303	IEEE Float	4	
V23 RMS	R	130	304	40304	IEEE Float	4	
V31 RMS	R	131	305	40305	IEEE Float	4	
IN RMS	R	132	306	40306	IEEE Float	4	
I1 RMS	R	133	307	40307	IEEE Float	4	
I2 RMS	R	134	308	40308	IEEE Float	4	
I3 RMS	R	135	309	40309	IEEE Float	4	
I12 RMS	R	136	310	40310	IEEE Float	4	
I23 RMS	R	137	311	40311	IEEE Float	4	
I31 RMS	R	138	312	40312	IEEE Float	4	
V1 2 3 RMS AVERAGE	R	139	313	40313	IEEE Float	4	
V12 23 31 RMS AVERAGE	R	13A	314	40314	IEEE Float	4	
I1 2 3 RMS AVERAGE	R	13B	315	40315	IEEE Float	4	
I12 23 31 RMS AVERAGE	R	13C	316	40316	IEEE Float	4	
VN CREST FACTOR	R	13D	317	40317	IEEE Float	4	
V1 CREST FACTOR	R	13E	318	40318	IEEE Float	4	
V2 CREST FACTOR	R	13F	319	40319	IEEE Float	4	
V3 CREST FACTOR	R	140	320	40320	IEEE Float	4	
V12 CREST FACTOR	R	141	321	40321	IEEE Float	4	
V23 CREST FACTOR	R	142	322	40322	IEEE Float	4	
V31 CREST FACTOR	R	143	323	40323	IEEE Float	4	
IN CREST FACTOR	R	144	324	40324	IEEE Float	4	
I1 CREST FACTOR	R	145	325	40325	IEEE Float	4	
I2 CREST FACTOR	R	146	326	40326	IEEE Float	4	
I3 CREST FACTOR	R	147	327	40327	IEEE Float	4	
I12 CREST FACTOR	R	148	328	40328	IEEE Float	4	
I23 CREST FACTOR	R	149	329	40329	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
I31 CREST FACTOR	R	14A	330	40330	IEEE Float	4	
IN K FACTOR	R	14B	331	40331	IEEE Float	4	
I1 K FACTOR	R	14C	332	40332	IEEE Float	4	
I2 K FACTOR	R	14D	333	40333	IEEE Float	4	
I3 K FACTOR	R	14E	334	40334	IEEE Float	4	
I12 K FACTOR	R	14F	335	40335	IEEE Float	4	
I23 K FACTOR	R	150	336	40336	IEEE Float	4	
I31 K FACTOR	R	151	337	40337	IEEE Float	4	
TEMPERATURE DSP INTERNAL	R	152	338	40338	IEEE Float	4	
TEMPERATURE DSP EXTERNAL	R	153	339	40339	IEEE Float	4	
DSP FREQUENCY MIN	R	500	1280	41280	IEEE Float	4	
VN THD MIN	R	501	1281	41281	IEEE Float	4	
V1 THD MIN	R	502	1282	41282	IEEE Float	4	
V2 THD MIN	R	503	1283	41283	IEEE Float	4	
V3 THD MIN	R	504	1284	41284	IEEE Float	4	
V12 THD MIN	R	505	1285	41285	IEEE Float	4	
V23 THD MIN	R	506	1286	41286	IEEE Float	4	
V31 THD MIN	R	507	1287	41287	IEEE Float	4	
IN THD MIN	R	508	1288	41288	IEEE Float	4	
I1 THD MIN	R	509	1289	41289	IEEE Float	4	
I2 THD MIN	R	50A	1290	41290	IEEE Float	4	
I3 THD MIN	R	50B	1291	41291	IEEE Float	4	
I12 THD MIN	R	50C	1292	41292	IEEE Float	4	
I23 THD MIN	R	50D	1293	41293	IEEE Float	4	
I31 THD MIN	R	50E	1294	41294	IEEE Float	4	
ACTIVE POWER N MIN	R	50F	1295	41295	IEEE Float	4	
ACTIVE POWER MAIN 1 MIN	R	510	1296	41296	IEEE Float	4	
ACTIVE POWER MAIN 2 MIN	R	511	1297	41297	IEEE Float	4	
ACTIVE POWER MAIN 3 MIN	R	512	1298	41298	IEEE Float	4	
ACTIVE POWER MAIN 12 MIN	R	554	1364	41364	IEEE Float	4	
ACTIVE POWER MAIN 23 MIN	R	555	1365	41365	IEEE Float	4	
ACTIVE POWER MAIN 31 MIN	R	556	1366	41366	IEEE Float	4	
ACTIVE POWER SUM MIN	R	513	1299	41299	IEEE Float	4	
REACTIVE POWER N MIN	R	514	1300	41300	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
REACTIVE POWER MAIN 1 MIN	R	515	1301	41301	IEEE Float	4	
REACTIVE POWER MAIN 2 MIN	R	516	1302	41302	IEEE Float	4	
REACTIVE POWER MAIN 3 MIN	R	517	1303	41303	IEEE Float	4	
REACTIVE POWER MAIN 12 MIN	R	557	1367	41367	IEEE Float	4	
REACTIVE POWER MAIN 23 MIN	R	558	1368	41368	IEEE Float	4	
REACTIVE POWER MAIN 31 MIN	R	559	1369	41369	IEEE Float	4	
REACTIVE POWER SUM MIN	R	518	1304	41304	IEEE Float	4	
APPARENT POWER N MIN	R	519	1305	41305	IEEE Float	4	
APPARENT POWER MAIN 1 MIN	R	51A	1306	41306	IEEE Float	4	
APPARENT POWER MAIN 2 MIN	R	51B	1307	41307	IEEE Float	4	
APPARENT POWER MAIN 3 MIN	R	51C	1308	41308	IEEE Float	4	
APPARENT POWER MAIN 12 MIN	R	55A	1370	41370	IEEE Float	4	
APPARENT POWER MAIN 23 MIN	R	55B	1371	41371	IEEE Float	4	
APPARENT POWER MAIN 31 MIN	R	55C	1372	41372	IEEE Float	4	
APPARENT POWER SUM MIN	R	51D	1309	41309	IEEE Float	4	
POWER FACTOR N MIN	R	51E	1310	41310	IEEE Float	4	
POWER FACTOR 1 MIN	R	51F	1311	41311	IEEE Float	4	
POWER FACTOR 2 MIN	R	520	1312	41312	IEEE Float	4	
POWER FACTOR 3 MIN	R	521	1313	41313	IEEE Float	4	
POWER FACTOR TOTAL MIN	R	522	1314	41314	IEEE Float	4	
PF FUNDAMENTAL 1 MIN	R	523	1315	41315	IEEE Float	4	
PF FUNDAMENTAL 2 MIN	R	524	1316	41316	IEEE Float	4	
PF FUNDAMENTAL 3 MIN	R	525	1317	41317	IEEE Float	4	
PF FUNDAMENTAL TOTAL MIN	R	526	1318	41318	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
VN RMS MIN	R	52B	1323	41323	IEEE Float	4	
V1 RMS MIN	R	52C	1324	41324	IEEE Float	4	
V2 RMS MIN	R	52D	1325	41325	IEEE Float	4	
V3 RMS MIN	R	52E	1326	41326	IEEE Float	4	
V12 RMS MIN	R	52F	1327	41327	IEEE Float	4	
V23 RMS MIN	R	530	1328	41328	IEEE Float	4	
V31 RMS MIN	R	531	1329	41329	IEEE Float	4	
IN RMS MIN	R	532	1330	41330	IEEE Float	4	
I1 RMS MIN	R	533	1331	41331	IEEE Float	4	
I2 RMS MIN	R	534	1332	41332	IEEE Float	4	
I3 RMS MIN	R	535	1333	41333	IEEE Float	4	
I12 RMS MIN	R	536	1334	41334	IEEE Float	4	
I23 RMS MIN	R	537	1335	41335	IEEE Float	4	
I31 RMS MIN	R	538	1336	41336	IEEE Float	4	
V1 2 3 RMS AVERAGE MIN	R	539	1337	41337	IEEE Float	4	
V12 23 31 RMS AVERAGE MIN	R	53A	1338	41338	IEEE Float	4	
I1 2 3 RMS AVERAGE MIN	R	53B	1339	41339	IEEE Float	4	
I12 23 31 RMS AVERAGE MIN	R	53C	1340	41340	IEEE Float	4	
VN CREST FACTOR MIN	R	53D	1341	41341	IEEE Float	4	
V1 CREST FACTOR MIN	R	53E	1342	41342	IEEE Float	4	
V2 CREST FACTOR MIN	R	53F	1343	41343	IEEE Float	4	
V3 CREST FACTOR MIN	R	540	1344	41344	IEEE Float	4	
V12 CREST FACTOR MIN	R	541	1345	41345	IEEE Float	4	
V23 CREST FACTOR MIN	R	542	1346	41346	IEEE Float	4	
V31 CREST FACTOR MIN	R	543	1347	41347	IEEE Float	4	
IN CREST FACTOR MIN	R	544	1348	41348	IEEE Float	4	
I1 CREST FACTOR MIN	R	545	1349	41349	IEEE Float	4	
I2 CREST FACTOR MIN	R	546	1350	41350	IEEE Float	4	
I3 CREST FACTOR MIN	R	547	1351	41351	IEEE Float	4	
I12 CREST FACTOR MIN	R	548	1352	41352	IEEE Float	4	
I23 CREST FACTOR MIN	R	549	1353	41353	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
I31 CREST FACTOR MIN	R	54A	1354	41354	IEEE Float	4	
IN K FACTOR MIN	R	54B	1355	41355	IEEE Float	4	
I1 K FACTOR MIN	R	54C	1356	41356	IEEE Float	4	
I2 K FACTOR MIN	R	54D	1357	41357	IEEE Float	4	
I3 K FACTOR MIN	R	54E	1358	41358	IEEE Float	4	
I12 K FACTOR MIN	R	54F	1359	41359	IEEE Float	4	
I23 K FACTOR MIN	R	550	1360	41360	IEEE Float	4	
I31 K FACTOR MIN	R	551	1361	41361	IEEE Float	4	
TEMPERATURE DSP INTERNAL MIN	R	552	1362	41362	IEEE Float	4	
TEMPERATURE DSP EXTERNAL MIN	R	553	1363	41363	IEEE Float	4	
DSP FREQUENCY MAX	R	600	1536	41536	IEEE Float	4	
VN THD MAX	R	601	1537	41537	IEEE Float	4	
V1 THD MAX	R	602	1538	41538	IEEE Float	4	
V2 THD MAX	R	603	1539	41539	IEEE Float	4	
V3 THD MAX	R	604	1540	41540	IEEE Float	4	
V12 THD MAX	R	605	1541	41541	IEEE Float	4	
V23 THD MAX	R	606	1542	41542	IEEE Float	4	
V31 THD MAX	R	607	1543	41543	IEEE Float	4	
IN THD MAX	R	608	1544	41544	IEEE Float	4	
I1 THD MAX	R	609	1545	41545	IEEE Float	4	
I2 THD MAX	R	60A	1546	41546	IEEE Float	4	
I3 THD MAX	R	60B	1547	41547	IEEE Float	4	
I12 THD MAX	R	60C	1548	41548	IEEE Float	4	
I23 THD MAX	R	60D	1549	41549	IEEE Float	4	
I31 THD MAX	R	60E	1550	41550	IEEE Float	4	
ACTIVE POWER N MAX	R	60F	1551	41551	IEEE Float	4	
ACTIVE POWER MAIN 1 MAX	R	610	1552	41552	IEEE Float	4	
ACTIVE POWER MAIN 2 MAX	R	611	1553	41553	IEEE Float	4	
ACTIVE POWER MAIN 3 MAX	R	612	1554	41554	IEEE Float	4	
ACTIVE POWER MAIN 12 MAX	R	654	1620	41620	IEEE Float	4	
ACTIVE POWER MAIN 23 MAX	R	655	1621	41621	IEEE Float	4	
ACTIVE POWER MAIN 31 MAX	R	656	1622	41622	IEEE Float	4	
ACTIVE POWER SUM MAX	R	613	1555	41555	IEEE Float	4	
REACTIVE POWER N MAX	R	614	1556	41556	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
REACTIVE POWER MAIN 1 MAX	R	615	1557	41557	IEEE Float	4	
REACTIVE POWER MAIN 2 MAX	R	616	1558	41558	IEEE Float	4	
REACTIVE POWER MAIN 3 MAX	R	617	1559	41559	IEEE Float	4	
REACTIVE POWER MAIN 12 MAX	R	657	1623	41623	IEEE Float	4	
REACTIVE POWER MAIN 23 MAX	R	658	1624	41624	IEEE Float	4	
REACTIVE POWER MAIN 31 MAX	R	659	1625	41625	IEEE Float	4	
REACTIVE POWER SUM MAX	R	618	1560	41560	IEEE Float	4	
APPARENT POWER N MAX	R	619	1561	41561	IEEE Float	4	
APPARENT POWER MAIN 1 MAX	R	61A	1562	41562	IEEE Float	4	
APPARENT POWER MAIN 2 MAX	R	61B	1563	41563	IEEE Float	4	
APPARENT POWER MAIN 3 MAX	R	61C	1564	41564	IEEE Float	4	
APPARENT POWER MAIN 12 MAX	R	65A	1626	41626	IEEE Float	4	
APPARENT POWER MAIN 23 MAX	R	65B	1627	41627	IEEE Float	4	
APPARENT POWER MAIN 31 MAX	R	65C	1628	41628	IEEE Float	4	
APPARENT POWER SUM MAX	R	61D	1565	41565	IEEE Float	4	
POWER FACTOR N MAX	R	61E	1566	41566	IEEE Float	4	
POWER FACTOR 1 MAX	R	61F	1567	41567	IEEE Float	4	
POWER FACTOR 2 MAX	R	620	1568	41568	IEEE Float	4	
POWER FACTOR 3 MAX	R	621	1569	41569	IEEE Float	4	
POWER FACTOR TOTAL MAX	R	622	1570	41570	IEEE Float	4	
PF FUNDAMENTAL 1 MAX	R	623	1571	41571	IEEE Float	4	
PF FUNDAMENTAL 2 MAX	R	624	1572	41572	IEEE Float	4	
PF FUNDAMENTAL 3 MAX	R	625	1573	41573	IEEE Float	4	
PF FUNDAMENTAL TOTAL MAX	R	626	1574	41574	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
VN RMS MAX	R	62B	1579	41579	IEEE Float	4	
V1 RMS MAX	R	62C	1580	41580	IEEE Float	4	
V2 RMS MAX	R	62D	1581	41581	IEEE Float	4	
V3 RMS MAX	R	62E	1582	41582	IEEE Float	4	
V12 RMS MAX	R	62F	1583	41583	IEEE Float	4	
V23 RMS MAX	R	630	1584	41584	IEEE Float	4	
V31 RMS MAX	R	631	1585	41585	IEEE Float	4	
IN RMS MAX	R	632	1586	41586	IEEE Float	4	
I1 RMS MAX	R	633	1587	41587	IEEE Float	4	
I2 RMS MAX	R	634	1588	41588	IEEE Float	4	
I3 RMS MAX	R	635	1589	41589	IEEE Float	4	
I12 RMS MAX	R	636	1590	41590	IEEE Float	4	
I23 RMS MAX	R	637	1591	41591	IEEE Float	4	
I31 RMS MAX	R	638	1592	41592	IEEE Float	4	
V1 2 3 RMS AVERAGE MAX	R	639	1593	41593	IEEE Float	4	
V12 23 31 RMS AVERAGE MAX	R	63A	1594	41594	IEEE Float	4	
I1 2 3 RMS AVERAGE MAX	R	63B	1595	41595	IEEE Float	4	
I12 23 31 RMS AVERAGE MAX	R	63C	1596	41596	IEEE Float	4	
VN CREST FACTOR MAX	R	63D	1597	41597	IEEE Float	4	
V1 CREST FACTOR MAX	R	63E	1598	41598	IEEE Float	4	
V2 CREST FACTOR MAX	R	63F	1599	41599	IEEE Float	4	
V3 CREST FACTOR MAX	R	640	1600	41600	IEEE Float	4	
V12 CREST FACTOR MAX	R	641	1601	41601	IEEE Float	4	
V23 CREST FACTOR MAX	R	642	1602	41602	IEEE Float	4	
V31 CREST FACTOR MAX	R	643	1603	41603	IEEE Float	4	
IN CREST FACTOR MAX	R	644	1604	41604	IEEE Float	4	
I1 CREST FACTOR MAX	R	645	1605	41605	IEEE Float	4	
I2 CREST FACTOR MAX	R	646	1606	41606	IEEE Float	4	
I3 CREST FACTOR MAX	R	647	1607	41607	IEEE Float	4	
I12 CREST FACTOR MAX	R	648	1608	41608	IEEE Float	4	
I23 CREST FACTOR MAX	R	649	1609	41609	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
I31 CREST FACTOR MAX	R	64A	1610	41610	IEEE Float	4	
IN K FACTOR MAX	R	64B	1611	41611	IEEE Float	4	
I1 K FACTOR MAX	R	64C	1612	41612	IEEE Float	4	
I2 K FACTOR MAX	R	64D	1613	41613	IEEE Float	4	
I3 K FACTOR MAX	R	64E	1614	41614	IEEE Float	4	
I12 K FACTOR MAX	R	64F	1615	41615	IEEE Float	4	
I23 K FACTOR MAX	R	650	1616	41616	IEEE Float	4	
I31 K FACTOR MAX	R	651	1617	41617	IEEE Float	4	
TEMPERATURE DSP INTERNAL MAX	R	652	1618	41618	IEEE Float	4	
TEMPERATURE DSP EXTERNAL MAX	R	653	1619	41619	IEEE Float	4	
Minimum Values of Cycle by Cycle Measurements - Per Unit (PU) Presentation							
PU DSP FREQUENCY MIN	R	450	1104	41104	IEEE Float	4	
PU ACTIVE POWER N MIN	R	451	1105	41105	IEEE Float	4	
PU ACTIVE POWER MAIN 1 MIN	R	452	1106	41106	IEEE Float	4	
PU ACTIVE POWER MAIN 2 MIN	R	453	1107	41107	IEEE Float	4	
PU ACTIVE POWER MAIN 3 MIN	R	454	1108	41108	IEEE Float	4	
PU ACTIVE POWER MAIN 12 MIN	R	4CF	1231	41231	IEEE Float	4	
PU ACTIVE POWER MAIN 23 MIN	R	4D0	1232	41232	IEEE Float	4	
PU ACTIVE POWER MAIN 31 MIN	R	4D1	1233	41233	IEEE Float	4	
PU ACTIVE POWER SUM MIN	R	455	1109	41109	IEEE Float	4	
PU REACTIVE POWER N MIN	R	456	1110	41110	IEEE Float	4	
PU REACTIVE POWER MAIN 1 MIN	R	457	1111	41111	IEEE Float	4	
PU REACTIVE POWER MAIN 2 MIN	R	458	1112	41112	IEEE Float	4	
PU REACTIVE POWER MAIN 3 MIN	R	459	1113	41113	IEEE Float	4	
PU REACTIVE POWER MAIN 12 MIN	R	4D2	1234	41234	IEEE Float	4	
PU REACTIVE POWER MAIN 23 MIN	R	4D3	1235	41235	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
PU REACTIVE POWER MAIN 31 MIN	R	4D4	1236	41236	IEEE Float	4	
PU REACTIVE POWER SUM MIN	R	45A	1114	41114	IEEE Float	4	
PU APPARENT POWER N MIN	R	45B	1115	41115	IEEE Float	4	
PU APPARENT POWER MAIN 1 MIN	R	45C	1116	41116	IEEE Float	4	
PU APPARENT POWER MAIN 2 MIN	R	45D	1117	41117	IEEE Float	4	
PU APPARENT POWER MAIN 3 MIN	R	45E	1118	41118	IEEE Float	4	
PU APPARENT POWER MAIN 12 MIN	R	4D5	1237	41237	IEEE Float	4	
PU APPARENT POWER MAIN 23 MIN	R	4D6	1238	41238	IEEE Float	4	
PU APPARENT POWER MAIN 31 MIN	R	4D7	1239	41239	IEEE Float	4	
PU APPARENT POWER SUM MIN	R	45F	1119	41119	IEEE Float	4	
PU POWER FACTOR N MIN	R	460	1120	41120	IEEE Float	4	
PU POWER FACTOR 1 MIN	R	461	1121	41121	IEEE Float	4	
PU POWER FACTOR 2 MIN	R	462	1122	41122	IEEE Float	4	
PU POWER FACTOR 3 MIN	R	463	1123	41123	IEEE Float	4	
PU POWER FACTOR TOTAL MIN	R	464	1124	41124	IEEE Float	4	
PU PF FUNDAMENTAL 1 MIN	R	465	1125	41125	IEEE Float	4	
PU PF FUNDAMENTAL 2 MIN	R	466	1126	41126	IEEE Float	4	
PU PF FUNDAMENTAL 3 MIN	R	467	1127	41127	IEEE Float	4	
PU PF FUNDAMENTAL TOTAL MIN	R	468	1128	41128	IEEE Float	4	
PU VN RMS MIN	R	46D	1133	41133	IEEE Float	4	
PU V1 RMS MIN	R	46E	1134	41134	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
PU V2 RMS MIN	R	46F	1135	41135	IEEE Float	4	
PU V3 RMS MIN	R	470	1136	41136	IEEE Float	4	
PU V12 RMS MIN	R	471	1137	41137	IEEE Float	4	
PU V23 RMS MIN	R	472	1138	41138	IEEE Float	4	
PU V31 RMS MIN	R	473	1139	41139	IEEE Float	4	
PU IN RMS MIN	R	474	1140	41140	IEEE Float	4	
PU I1 RMS MIN	R	475	1141	41141	IEEE Float	4	
PU I2 RMS MIN	R	476	1142	41142	IEEE Float	4	
PU I3 RMS MIN	R	477	1143	41143	IEEE Float	4	
PU I12 RMS MIN	R	478	1144	41144	IEEE Float	4	
PU I23 RMS MIN	R	479	1145	41145	IEEE Float	4	
PU I31 RMS MIN	R	47A	1146	41146	IEEE Float	4	
PU V1 2 3 RMS AVERAGE MIN	R	47B	1147	41147	IEEE Float	4	
PU V12 23 31 RMS AVERAGE MIN	R	47C	1148	41148	IEEE Float	4	
PU I1 2 3 RMS AVERAGE MIN	R	47D	1149	41149	IEEE Float	4	
PU I12 23 31 RMS AVERAGE MIN	R	47E	1150	41150	IEEE Float	4	
Maximum Values of Cycle by Cycle Measurements - Per Unit (PU) Presentation							
PU DSP FREQUENCY MAX	R	4A0	1184	41184	IEEE Float	4	
PU ACTIVE POWER N MAX	R	4A1	1185	41185	IEEE Float	4	
PU ACTIVE POWER MAIN 1 MAX	R	4A2	1186	41186	IEEE Float	4	
PU ACTIVE POWER MAIN 2 MAX	R	4A3	1187	41187	IEEE Float	4	
PU ACTIVE POWER MAIN 3 MAX	R	4A4	1188	41188	IEEE Float	4	
PU ACTIVE POWER MAIN 12 MAX	R	4DB	1243	41243	IEEE Float	4	
PU ACTIVE POWER MAIN 23 MAX	R	4DC	1244	41244	IEEE Float	4	
PU ACTIVE POWER MAIN 31 MAX	R	4DE	1246	41246	IEEE Float	4	
PU ACTIVE POWER SUM MAX	R	4A5	1189	41189	IEEE Float	4	
PU REACTIVE POWER N MAX	R	4A6	1190	41190	IEEE Float	4	
PU REACTIVE POWER MAIN 1 MAX	R	4A7	1191	41191	IEEE Float	4	
PU REACTIVE POWER MAIN 2 MAX	R	4A8	1192	41192	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
PU REACTIVE POWER MAIN 3 MAX	R	4A9	1193	41193	IEEE Float	4	
PU REACTIVE POWER MAIN 12 MAX	R	4DF	1247	41247	IEEE Float	4	
PU REACTIVE POWER MAIN 23 MAX	R	4E0	1248	41248	IEEE Float	4	
PU REACTIVE POWER MAIN 31 MAX	R	4E1	1249	41249	IEEE Float	4	
PU REACTIVE POWER SUM MAX	R	4AA	1194	41194	IEEE Float	4	
PU APPARENT POWER N MAX	R	4AB	1195	41195	IEEE Float	4	
PU APPARENT POWER MAIN 1 MAX	R	4AC	1196	41196	IEEE Float	4	
PU APPARENT POWER MAIN 2 MAX	R	4AD	1197	41197	IEEE Float	4	
PU APPARENT POWER MAIN 3 MAX	R	4AE	1198	41198	IEEE Float	4	
PU APPARENT POWER MAIN 12 MAX	R	4E2	1250	41250	IEEE Float	4	
PU APPARENT POWER MAIN 23 MAX	R	4E3	1251	41251	IEEE Float	4	
PU APPARENT POWER MAIN 31 MAX	R	4E4	1252	41252	IEEE Float	4	
PU APPARENT POWER SUM MAX	R	4AF	1199	41199	IEEE Float	4	
PU POWER FACTOR N MAX	R	4B0	1200	41200	IEEE Float	4	
PU POWER FACTOR 1 MAX	R	4B1	1201	41201	IEEE Float	4	
PU POWER FACTOR 2 MAX	R	4B2	1202	41202	IEEE Float	4	
PU POWER FACTOR 3 MAX	R	4B3	1203	41203	IEEE Float	4	
PU POWER FACTOR TOTAL MAX	R	4B4	1204	41204	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
PU PF FUNDAMENTAL 1 MAX	R	4B5	1205	41205	IEEE Float	4	
PU PF FUNDAMENTAL 2 MAX	R	4B6	1206	41206	IEEE Float	4	
PU PF FUNDAMENTAL 3 MAX	R	4B7	1207	41207	IEEE Float	4	
PU PF FUNDAMENTAL TOTAL MAX	R	4B8	1208	41208	IEEE Float	4	
PU VN RMS MAX	R	4BD	1213	41213	IEEE Float	4	
PU V1 RMS MAX	R	4BE	1214	41214	IEEE Float	4	
PU V2 RMS MAX	R	4BF	1215	41215	IEEE Float	4	
PU V3 RMS MAX	R	4C0	1216	41216	IEEE Float	4	
PU V12 RMS MAX	R	4C1	1217	41217	IEEE Float	4	
PU V23 RMS MAX	R	4C2	1218	41218	IEEE Float	4	
PU V31 RMS MAX	R	4C3	1219	41219	IEEE Float	4	
PU IN RMS MAX	R	4C4	1220	41220	IEEE Float	4	
PU I1 RMS MAX	R	4C5	1221	41221	IEEE Float	4	
PU I2 RMS MAX	R	4C6	1222	41222	IEEE Float	4	
PU I3 RMS MAX	R	4C7	1223	41223	IEEE Float	4	
PU I12 RMS MAX	R	4C8	1224	41224	IEEE Float	4	
PU I23 RMS MAX	R	4C9	1225	41225	IEEE Float	4	
PU I31 RMS MAX	R	4CA	1226	41226	IEEE Float	4	
PU V1 2 3 RMS AVERAGE MAX	R	4CB	1227	41227	IEEE Float	4	
PU V12 23 31 RMS AVERAGE MAX	R	4CC	1228	41228	IEEE Float	4	
PU I1 2 3 RMS AVERAGE MAX	R	4CD	1229	41229	IEEE Float	4	
PU I12 23 31 RMS AVERAGE MAX	R	4CE	1230	41230	IEEE Float	4	
Flicker Parameters							
FLICKERING V1 PST 2SEC	R	16A	362	40362	IEEE Float	4	
FLICKERING V2 PST 2SEC	R	16B	363	40363	IEEE Float	4	
FLICKERING V3 PST 2SEC	R	16C	364	40364	IEEE Float	4	
FLICKERING V12 PST 2SEC	R	16D	365	40365	IEEE Float	4	
FLICKERING V23 PST 2SEC	R	16E	366	40366	IEEE Float	4	
FLICKERING V31 PST 2SEC	R	16F	367	40367	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
FLICKERING V1 PST 10SEC	R	170	368	40368	IEEE Float	4	
FLICKERING V2 PST 10SEC	R	171	369	40369	IEEE Float	4	
FLICKERING V3 PST 10SEC	R	172	370	40370	IEEE Float	4	
FLICKERING V12 PST 10SEC	R	173	371	40371	IEEE Float	4	
FLICKERING V23 PST 10SEC	R	174	372	40372	IEEE Float	4	
FLICKERING V31 PST 10SEC	R	175	373	40373	IEEE Float	4	
FLICKERING V1 PST 10MIN	R	17C	380	40380	IEEE Float	4	
FLICKERING V2 PST 10MIN	R	17D	381	40381	IEEE Float	4	
FLICKERING V3 PST 10MIN	R	17E	382	40382	IEEE Float	4	
FLICKERING V12 PST 10MIN	R	17F	383	40383	IEEE Float	4	
FLICKERING V23 PST 10MIN	R	180	384	40384	IEEE Float	4	
FLICKERING V31 PST 10MIN	R	181	385	40385	IEEE Float	4	
FLICKERING V1 PLT 1HOUR	R	182	386	40386	IEEE Float	4	
FLICKERING V2 PLT 1HOUR	R	183	387	40387	IEEE Float	4	
FLICKERING V3 PLT 1HOUR	R	184	388	40388	IEEE Float	4	
FLICKERING V12 PLT 1HOUR	R	185	389	40389	IEEE Float	4	
FLICKERING V23 PLT 1HOUR	R	186	390	40390	IEEE Float	4	
FLICKERING V31 PLT 1HOUR	R	187	391	40391	IEEE Float	4	
FLICKERING V1 PLT 2HOUR	R	188	392	40392	IEEE Float	4	
FLICKERING V2 PLT 2HOUR	R	189	393	40393	IEEE Float	4	
FLICKERING V3 PLT 2HOUR	R	18A	394	40394	IEEE Float	4	
FLICKERING V12 PLT 2HOUR	R	18B	395	40395	IEEE Float	4	
FLICKERING V23 PLT 2HOUR	R	18C	396	40396	IEEE Float	4	
FLICKERING V31 PLT 2HOUR	R	18D	397	40397	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
FLICKERING V1 PLT 10HOUR	R	18E	398	40398	IEEE Float	4	
FLICKERING V2 PLT 10HOUR	R	18F	399	40399	IEEE Float	4	
FLICKERING V3 PLT 10HOUR	R	190	400	40400	IEEE Float	4	
FLICKERING V12 PLT 10HOUR	R	191	401	40401	IEEE Float	4	
FLICKERING V23 PLT 10HOUR	R	192	402	40402	IEEE Float	4	
FLICKERING V31 PLT 10HOUR	R	193	403	40403	IEEE Float	4	
FLICKERING V1 PLT 1DAY	R	194	404	40404	IEEE Float	4	
FLICKERING V2 PLT 1DAY	R	195	405	40405	IEEE Float	4	
FLICKERING V3 PLT 1DAY	R	196	406	40406	IEEE Float	4	
FLICKERING V12 PLT 1DAY	R	197	407	40407	IEEE Float	4	
FLICKERING V23 PLT 1DAY	R	198	408	40408	IEEE Float	4	
FLICKERING V31 PLT 1DAY	R	199	409	40409	IEEE Float	4	
FLICKERING V1 PLT 7DAY	R	19A	410	40410	IEEE Float	4	
FLICKERING V2 PLT 7DAY	R	19B	411	40411	IEEE Float	4	
FLICKERING V3 PLT 7DAY	R	19C	412	40412	IEEE Float	4	
FLICKERING V12 PLT 7DAY	R	19D	413	40413	IEEE Float	4	
FLICKERING V23 PLT 7DAY	R	19E	414	40414	IEEE Float	4	
FLICKERING V31 PLT 7DAY	R	19F	415	40415	IEEE Float	4	
FLICKERING V1 PST 2SEC MIN	R	1512	5394	45394	IEEE Float	4	
FLICKERING V2 PST 2SEC MIN	R	1513	5395	45395	IEEE Float	4	
FLICKERING V3 PST 2SEC MIN	R	1514	5396	45396	IEEE Float	4	
FLICKERING V12 PST 2SEC MIN	R	1515	5397	45397	IEEE Float	4	
FLICKERING V23 PST 2SEC MIN	R	1516	5398	45398	IEEE Float	4	
FLICKERING V31 PST 2SEC MIN	R	1517	5399	45399	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
FLICKERING V1 PST 10SEC MIN	R	1518	5400	45400	IEEE Float	4	
FLICKERING V2 PST 10SEC MIN	R	1519	5401	45401	IEEE Float	4	
FLICKERING V3 PST 10SEC MIN	R	151A	5402	45402	IEEE Float	4	
FLICKERING V12 PST 10SEC MIN	R	151B	5403	45403	IEEE Float	4	
FLICKERING V23 PST 10SEC MIN	R	151C	5404	45404	IEEE Float	4	
FLICKERING V31 PST 10SEC MIN	R	151D	5405	45405	IEEE Float	4	
FLICKERING V1 PST 10MIN MIN	R	1524	5412	45412	IEEE Float	4	
FLICKERING V2 PST 10MIN MIN	R	1525	5413	45413	IEEE Float	4	
FLICKERING V3 PST 10MIN MIN	R	1526	5414	45414	IEEE Float	4	
FLICKERING V12 PST 10MIN MIN	R	1527	5415	45415	IEEE Float	4	
FLICKERING V23 PST 10MIN MIN	R	1528	5416	45416	IEEE Float	4	
FLICKERING V31 PST 10MIN MIN	R	1529	5417	45417	IEEE Float	4	
FLICKERING V1 PLT 1HOUR MIN	R	152A	5418	45418	IEEE Float	4	
FLICKERING V2 PLT 1HOUR MIN	R	152B	5419	45419	IEEE Float	4	
FLICKERING V3 PLT 1HOUR MIN	R	152C	5420	45420	IEEE Float	4	
FLICKERING V12 PLT 1HOUR MIN	R	152D	5421	45421	IEEE Float	4	
FLICKERING V23 PLT 1HOUR MIN	R	152E	5422	45422	IEEE Float	4	
FLICKERING V31 PLT 1HOUR MIN	R	152F	5423	45423	IEEE Float	4	
FLICKERING V1 PLT 2HOUR MIN	R	1530	5424	45424	IEEE Float	4	
FLICKERING V2 PLT 2HOUR MIN	R	1531	5425	45425	IEEE Float	4	
FLICKERING V3 PLT 2HOUR MIN	R	1532	5426	45426	IEEE Float	4	
FLICKERING V12 PLT 2HOUR MIN	R	1533	5427	45427	IEEE Float	4	
FLICKERING V23 PLT 2HOUR MIN	R	1534	5428	45428	IEEE Float	4	
FLICKERING V31 PLT 2HOUR MIN	R	1535	5429	45429	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
FLICKERING V1 PLT 10HOUR MIN	R	1536	5430	45430	IEEE Float	4	
FLICKERING V2 PLT 10HOUR MIN	R	1537	5431	45431	IEEE Float	4	
FLICKERING V3 PLT 10HOUR MIN	R	1538	5432	45432	IEEE Float	4	
FLICKERING V12 PLT 10HOUR MIN	R	1539	5433	45433	IEEE Float	4	
FLICKERING V23 PLT 10HOUR MIN	R	153A	5434	45434	IEEE Float	4	
FLICKERING V31 PLT 10HOUR MIN	R	153B	5435	45435	IEEE Float	4	
FLICKERING V1 PLT 1DAY MIN	R	153C	5436	45436	IEEE Float	4	
FLICKERING V2 PLT 1DAY MIN	R	153D	5437	45437	IEEE Float	4	
FLICKERING V3 PLT 1DAY MIN	R	153E	5438	45438	IEEE Float	4	
FLICKERING V12 PLT 1DAY MIN	R	153F	5439	45439	IEEE Float	4	
FLICKERING V23 PLT 1DAY MIN	R	1540	5440	45440	IEEE Float	4	
FLICKERING V31 PLT 1DAY MIN	R	1541	5441	45441	IEEE Float	4	
FLICKERING V1 PLT 7DAY MIN	R	1542	5442	45442	IEEE Float	4	
FLICKERING V2 PLT 7DAY MIN	R	1543	5443	45443	IEEE Float	4	
FLICKERING V3 PLT 7DAY MIN	R	1544	5444	45444	IEEE Float	4	
FLICKERING V12 PLT 7DAY MIN	R	1545	5445	45445	IEEE Float	4	
FLICKERING V23 PLT 7DAY MIN	R	1546	5446	45446	IEEE Float	4	
FLICKERING V31 PLT 7DAY MIN	R	1547	5447	45447	IEEE Float	4	
FLICKERING V1 PST 2SEC MAX	R	1612	5650	45650	IEEE Float	4	
FLICKERING V2 PST 2SEC MAX	R	1613	5651	45651	IEEE Float	4	
FLICKERING V3 PST 2SEC MAX	R	1614	5652	45652	IEEE Float	4	
FLICKERING V12 PST 2SEC MAX	R	1615	5653	45653	IEEE Float	4	
FLICKERING V23 PST 2SEC MAX	R	1616	5654	45654	IEEE Float	4	
FLICKERING V31 PST 2SEC MAX	R	1617	5655	45655	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
FLICKERING V1 PST 10SEC MAX	R	1618	5656	45656	IEEE Float	4	
FLICKERING V2 PST 10SEC MAX	R	1619	5657	45657	IEEE Float	4	
FLICKERING V3 PST 10SEC MAX	R	161A	5658	45658	IEEE Float	4	
FLICKERING V12 PST 10SEC MAX	R	161B	5659	45659	IEEE Float	4	
FLICKERING V23 PST 10SEC MAX	R	161C	5660	45660	IEEE Float	4	
FLICKERING V31 PST 10SEC MAX	R	161D	5661	45661	IEEE Float	4	
FLICKERING V1 PST 10MIN MAX	R	1624	5668	45668	IEEE Float	4	
FLICKERING V2 PST 10MIN MAX	R	1625	5669	45669	IEEE Float	4	
FLICKERING V3 PST 10MIN MAX	R	1626	5670	45670	IEEE Float	4	
FLICKERING V12 PST 10MIN MAX	R	1627	5671	45671	IEEE Float	4	
FLICKERING V23 PST 10MIN MAX	R	1628	5672	45672	IEEE Float	4	
FLICKERING V31 PST 10MIN MAX	R	1629	5673	45673	IEEE Float	4	
FLICKERING V1 PLT 1HOUR MAX	R	162A	5674	45674	IEEE Float	4	
FLICKERING V2 PLT 1HOUR MAX	R	162B	5675	45675	IEEE Float	4	
FLICKERING V3 PLT 1HOUR MAX	R	162C	5676	45676	IEEE Float	4	
FLICKERING V12 PLT 1HOUR MAX	R	162D	5677	45677	IEEE Float	4	
FLICKERING V23 PLT 1HOUR MAX	R	162E	5678	45678	IEEE Float	4	
FLICKERING V31 PLT 1HOUR MAX	R	162F	5679	45679	IEEE Float	4	
FLICKERING V1 PLT 2HOUR MAX	R	1630	5680	45680	IEEE Float	4	
FLICKERING V2 PLT 2HOUR MAX	R	1631	5681	45681	IEEE Float	4	
FLICKERING V3 PLT 2HOUR MAX	R	1632	5682	45682	IEEE Float	4	
FLICKERING V12 PLT 2HOUR MAX	R	1633	5683	45683	IEEE Float	4	
FLICKERING V23 PLT 2HOUR MAX	R	1634	5684	45684	IEEE Float	4	
FLICKERING V31 PLT 2HOUR MAX	R	1635	5685	45685	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
FLICKERING V1 PLT 10HOUR MAX	R	1636	5686	45686	IEEE Float	4	
FLICKERING V2 PLT 10HOUR MAX	R	1637	5687	45687	IEEE Float	4	
FLICKERING V3 PLT 10HOUR MAX	R	1638	5688	45688	IEEE Float	4	
FLICKERING V12 PLT 10HOUR MAX	R	1639	5689	45689	IEEE Float	4	
FLICKERING V23 PLT 10HOUR MAX	R	163A	5690	45690	IEEE Float	4	
FLICKERING V31 PLT 10HOUR MAX	R	163B	5691	45691	IEEE Float	4	
FLICKERING V1 PLT 1DAY MAX	R	163C	5692	45692	IEEE Float	4	
FLICKERING V2 PLT 1DAY MAX	R	163D	5693	45693	IEEE Float	4	
FLICKERING V3 PLT 1DAY MAX	R	163E	5694	45694	IEEE Float	4	
FLICKERING V12 PLT 1DAY MAX	R	163F	5695	45695	IEEE Float	4	
FLICKERING V23 PLT 1DAY MAX	R	1640	5696	45696	IEEE Float	4	
FLICKERING V31 PLT 1DAY MAX	R	1641	5697	45697	IEEE Float	4	
FLICKERING V1 PLT 7DAY MAX	R	1642	5698	45698	IEEE Float	4	
FLICKERING V2 PLT 7DAY MAX	R	1643	5699	45699	IEEE Float	4	
FLICKERING V3 PLT 7DAY MAX	R	1644	5700	45700	IEEE Float	4	
FLICKERING V12 PLT 7DAY MAX	R	1645	5701	45701	IEEE Float	4	
FLICKERING V23 PLT 7DAY MAX	R	1646	5702	45702	IEEE Float	4	
FLICKERING V31 PLT 7DAY MAX	R	1647	5703	45703	IEEE Float	4	
Energy Measurement	R						
TOTAL ENERGY W IN	R	200	512	40512	IEEE Double	8	
TOTAL ENERGY W OUT	R	201	513	40513	IEEE Double	8	
TOTAL ENERGY VA IN	R	202	514	40514	IEEE Double	8	
TOTAL ENERGY VA OUT	R	203	515	40515	IEEE Double	8	
TOTAL ENERGY VAr IN	R	204	516	40516	IEEE Double	8	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
TOTAL ENERGY VAr OUT	R	205	517	40517	IEEE Double	8	
DEMAND ENERGY W IN	R	206	518	40518	IEEE Double	8	
DEMAND ENERGY W OUT	R	207	519	40519	IEEE Double	8	
DEMAND ENERGY VA IN	R	208	520	40520	IEEE Double	8	
DEMAND ENERGY VA OUT	R	209	521	40521	IEEE Double	8	
DEMAND ENERGY VAr IN	R	20A	522	40522	IEEE Double	8	
DEMAND ENERGY VAr OUT	R	20B	523	40523	IEEE Double	8	
PEAK DEMAND W IN	R	20C	524	40524	IEEE Float	4	
PEAK DEMAND W OUT	R	20D	525	40525	IEEE Float	4	
PEAK DEMAND VA IN	R	20E	526	40526	IEEE Float	4	
PEAK DEMAND VA OUT	R	20F	527	40527	IEEE Float	4	
PEAK DEMAND VAr IN	R	210	528	40528	IEEE Float	4	
PEAK DEMAND VAr OUT	R	211	529	40529	IEEE Float	4	
INTERVAL ENERGY W IN	R	212	530	40530	IEEE Double	8	
INTERVAL ENERGY W OUT	R	213	531	40531	IEEE Double	8	
INTERVAL ENERGY VA IN	R	214	532	40532	IEEE Double	8	
INTERVAL ENERGY VA OUT	R	215	533	40533	IEEE Double	8	
INTERVAL ENERGY VAr IN	R	216	534	40534	IEEE Double	8	
INTERVAL ENERGY VAr OUT	R	217	535	40535	IEEE Double	8	
ENERGY MEASURE START	R	218	536	40536	IEEE Double	8	
ENERGY MEASURE LAST START	R	219	537	40537	IEEE Double	8	
ENERGY MEASURE UP TIME	R	21A	538	40538	IEEE Double	8	
ENERGY MEASURE DOWN TIME	R	21B	539	40539	IEEE Double	8	
ENERGY MEASURE AVAILABILITY	R	21C	540	40540	IEEE Double	8	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
TOTAL ENERGY W IPO	R	21D	541	40541	IEEE Double	8	Energy In+Out
TOTAL ENERGY VA IPO	R	21E	542	40542	IEEE Double	8	Energy In+Out
TOTAL ENERGY VAr IPO	R	21F	543	40543	IEEE Double	8	Energy In+Out
TOTAL ENERGY W IMO	R	223	547	40547	IEEE Double	8	Energy In-Out
TOTAL ENERGY VA IMO	R	224	548	40548	IEEE Double	8	Energy In-Out
TOTAL ENERGY VAr IMO	R	225	549	40549	IEEE Double	8	Energy In-Out
DEMAND ENERGY W IPO	R	226	550	40550	IEEE Double	8	Energy In+Out
DEMAND ENERGY VA IPO	R	227	551	40551	IEEE Double	8	Energy In+Out
DEMAND ENERGY VAr IPO	R	228	552	40552	IEEE Double	8	Energy In+Out
DEMAND ENERGY W IMO	R	229	553	40553	IEEE Double	8	Energy In-Out
DEMAND ENERGY VA IMO	R	327	807	40807	IEEE Double	8	Energy In-Out
DEMAND ENERGY VAr IMO	R	328	808	40808	IEEE Double	8	Energy In-Out
PEAK DEMAND W IPO	R	329	809	40809	IEEE Float	4	Energy In+Out
PEAK DEMAND VA IPO	R	32A	810	40810	IEEE Float	4	Energy In+Out
PEAK DEMAND VAr IPO	R	35D	861	40861	IEEE Float	4	Energy In+Out
PEAK DEMAND W IMO	R	35E	862	40862	IEEE Float	4	Energy In-Out
PEAK DEMAND VA IMO	R	35F	863	40863	IEEE Float	4	Energy In-Out
PEAK DEMAND VAr IMO	R	360	864	40864	IEEE Float	4	Energy In-Out
INTERVAL ENERGY W IPO	R	361	865	40865	IEEE Double	8	Energy In+Out
INTERVAL ENERGY VA IPO	R	362	866	40866	IEEE Double	8	Energy In+Out
INTERVAL ENERGY VAr IPO	R	363	867	40867	IEEE Double	8	Energy In+Out
INTERVAL ENERGY W IMO	R	364	868	40868	IEEE Double	8	Energy In-Out
INTERVAL ENERGY VA IMO	R	365	869	40869	IEEE Double	8	Energy In-Out

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
INTERVAL ENERGY VAr IMO	R	366	870	40870	IEEE Double	8	Energy In-Out
INTERVAL ENERGY PF IN	R	367	871	40871	IEEE Float	4	
INTERVAL ENERGY PF OUT	R	368	872	40872	IEEE Float	4	
INTERVAL ENERGY IPO	R	369	873	40873	IEEE Float	4	Energy In+Out
INTERVAL ENERGY IMO	R	36A	874	40874	IEEE Float	4	Energy In-Out
TOTAL ENERGY PF IN	R	36B	875	40875	IEEE Float	4	
TOTAL ENERGY PF OUT	R	36C	876	40876	IEEE Float	4	
TOTAL ENERGY PF IPO	R	36D	877	40877	IEEE Float	4	Energy In+Out
TOTAL ENERGY PF IMO	R	36E	878	40878	IEEE Float	4	Energy In-Out
DEMAND PF IN	R	36F	879	40879	IEEE Float	4	
DEMAND PF OUT	R	370	880	40880	IEEE Float	4	
DEMAND PF IPO	R	371	881	40881	IEEE Float	4	Energy In+Out
DEMAND PF IMO	R	372	882	40882	IEEE Float	4	Energy In-Out
PEAK DEMAND PF IN	R	373	883	40883	IEEE Float	4	
PEAK DEMAND PF OUT	R	374	884	40884	IEEE Float	4	
PEAK DEMAND PF IPO	R	375	885	40885	IEEE Float	4	Energy In+Out
PEAK DEMAND PF IMO	R	376	886	40886	IEEE Float	4	Energy In-Out
PEAK DEMAND W IN MIN	R	150C	5388	45388	IEEE Float	4	
PEAK DEMAND W OUT MIN	R	150D	5389	45389	IEEE Float	4	
PEAK DEMAND VA IN MIN	R	150E	5390	45390	IEEE Float	4	
PEAK DEMAND VA OUT MIN	R	150F	5391	45391	IEEE Float	4	
PEAK DEMAND VAr IN MIN	R	1510	5392	45392	IEEE Float	4	
PEAK DEMAND VAr OUT MIN	R	1511	5393	45393	IEEE Float	4	
PEAK DEMAND W IN MAX	R	160C	5644	45644	IEEE Float	4	
PEAK DEMAND W OUT MAX	R	160D	5645	45645	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
PEAK DEMAND VA IN MAX	R	160E	5646	45646	IEEE Float	4	
PEAK DEMAND VA OUT MAX	R	160F	5647	45647	IEEE Float	4	
PEAK DEMAND VAr IN MAX	R	1610	5648	45648	IEEE Float	4	
PEAK DEMAND VAr OUT MAX	R	1611	5649	45649	IEEE Float	4	
Average of Measured Parameters over 1 sec (50/60 Cycles)				R			
AVG DSP FREQUENCY	R	300	768	40768	IEEE Float	4	
AVG VN THD	R	301	769	40769	IEEE Float	4	
AVG V1 THD	R	302	770	40770	IEEE Float	4	
AVG V2 THD	R	303	771	40771	IEEE Float	4	
AVG V3 THD	R	304	772	40772	IEEE Float	4	
AVG V12 THD	R	305	773	40773	IEEE Float	4	
AVG V23 THD	R	306	774	40774	IEEE Float	4	
AVG V31 THD	R	307	775	40775	IEEE Float	4	
AVG IN THD	R	308	776	40776	IEEE Float	4	
AVG I1 THD	R	309	777	40777	IEEE Float	4	
AVG I2 THD	R	30A	778	40778	IEEE Float	4	
AVG I3 THD	R	30B	779	40779	IEEE Float	4	
AVG I12 THD	R	30C	780	40780	IEEE Float	4	
AVG I23 THD	R	30D	781	40781	IEEE Float	4	
AVG I31 THD	R	30E	782	40782	IEEE Float	4	
AVG ACTIVE POWER N	R	30F	783	40783	IEEE Float	4	
AVG ACTIVE POWER MAIN 1	R	310	784	40784	IEEE Float	4	
AVG ACTIVE POWER MAIN 2	R	311	785	40785	IEEE Float	4	
AVG ACTIVE POWER MAIN 3	R	312	786	40786	IEEE Float	4	
AVG ACTIVE POWER MAIN 12	R	354	852	40852	IEEE Float	4	
AVG ACTIVE POWER MAIN 23	R	355	853	40853	IEEE Float	4	
AVG ACTIVE POWER MAIN 31	R	356	854	40854	IEEE Float	4	
AVG ACTIVE POWER SUM	R	313	787	40787	IEEE Float	4	
AVG REACTIVE POWER N	R	314	788	40788	IEEE Float	4	
AVG REACTIVE POWER MAIN 1	R	315	789	40789	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG REACTIVE POWER MAIN 2	R	316	790	40790	IEEE Float	4	
AVG REACTIVE POWER MAIN 3	R	317	791	40791	IEEE Float	4	
AVG REACTIVE POWER MAIN 12	R	357	855	40855	IEEE Float	4	
AVG REACTIVE POWER MAIN 23	R	358	856	40856	IEEE Float	4	
AVG REACTIVE POWER MAIN 31	R	359	857	40857	IEEE Float	4	
AVG REACTIVE POWER SUM	R	318	792	40792	IEEE Float	4	
AVG APPARENT POWER N	R	319	793	40793	IEEE Float	4	
AVG APPARENT POWER MAIN 1	R	31A	794	40794	IEEE Float	4	
AVG APPARENT POWER MAIN 2	R	31B	795	40795	IEEE Float	4	
AVG APPARENT POWER MAIN 3	R	31C	796	40796	IEEE Float	4	
AVG APPARENT POWER MAIN 12	R	35A	858	40858	IEEE Float	4	
AVG APPARENT POWER MAIN 23	R	35B	859	40859	IEEE Float	4	
AVG APPARENT POWER MAIN 31	R	35C	860	40860	IEEE Float	4	
AVG APPARENT POWER SUM	R	31D	797	40797	IEEE Float	4	
AVG POWER FACTOR N	R	31E	798	40798	IEEE Float	4	
AVG POWER FACTOR 1	R	31F	799	40799	IEEE Float	4	
AVG POWER FACTOR 2	R	320	800	40800	IEEE Float	4	
AVG POWER FACTOR 3	R	321	801	40801	IEEE Float	4	
AVG POWER FACTOR TOTAL	R	322	802	40802	IEEE Float	4	
AVG PF FUNDAMENTAL 1	R	323	803	40803	IEEE Float	4	
AVG PF FUNDAMENTAL 2	R	324	804	40804	IEEE Float	4	
AVG PF FUNDAMENTAL 3	R	325	805	40805	IEEE Float	4	
AVG PF FUNDAMENTAL TOTAL	R	326	806	40806	IEEE Float	4	
AVG VN RMS	R	32B	811	40811	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG V1 RMS	R	32C	812	40812	IEEE Float	4	
AVG V2 RMS	R	32D	813	40813	IEEE Float	4	
AVG V3 RMS	R	32E	814	40814	IEEE Float	4	
AVG V12 RMS	R	32F	815	40815	IEEE Float	4	
AVG V23 RMS	R	330	816	40816	IEEE Float	4	
AVG V31 RMS	R	331	817	40817	IEEE Float	4	
AVG IN RMS	R	332	818	40818	IEEE Float	4	
AVG I1 RMS	R	333	819	40819	IEEE Float	4	
AVG I2 RMS	R	334	820	40820	IEEE Float	4	
AVG I3 RMS	R	335	821	40821	IEEE Float	4	
AVG I12 RMS	R	336	822	40822	IEEE Float	4	
AVG I23 RMS	R	337	823	40823	IEEE Float	4	
AVG I31 RMS	R	338	824	40824	IEEE Float	4	
AVG V1 2 3 RMS AVERAGE	R	339	825	40825	IEEE Float	4	
AVG V12 23 31 RMS AVERAGE	R	33A	826	40826	IEEE Float	4	
AVG I1 2 3 RMS AVERAGE	R	33B	827	40827	IEEE Float	4	
AVG I12 23 31 RMS AVERAGE	R	33C	828	40828	IEEE Float	4	
AVG VN CREST FACTOR	R	33D	829	40829	IEEE Float	4	
AVG V1 CREST FACTOR	R	33E	830	40830	IEEE Float	4	
AVG V2 CREST FACTOR	R	33F	831	40831	IEEE Float	4	
AVG V3 CREST FACTOR	R	340	832	40832	IEEE Float	4	
AVG V12 CREST FACTOR	R	341	833	40833	IEEE Float	4	
AVG V23 CREST FACTOR	R	342	834	40834	IEEE Float	4	
AVG V31 CREST FACTOR	R	343	835	40835	IEEE Float	4	
AVG IN CREST FACTOR	R	344	836	40836	IEEE Float	4	
AVG I1 CREST FACTOR	R	345	837	40837	IEEE Float	4	
AVG I2 CREST FACTOR	R	346	838	40838	IEEE Float	4	
AVG I3 CREST FACTOR	R	347	839	40839	IEEE Float	4	
AVG I12 CREST FACTOR	R	348	840	40840	IEEE Float	4	
AVG I23 CREST FACTOR	R	349	841	40841	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG I31 CREST FACTOR	R	34A	842	40842	IEEE Float	4	
AVG IN K FACTOR	R	34B	843	40843	IEEE Float	4	
AVG I1 K FACTOR	R	34C	844	40844	IEEE Float	4	
AVG I2 K FACTOR	R	34D	845	40845	IEEE Float	4	
AVG I3 K FACTOR	R	34E	846	40846	IEEE Float	4	
AVG I12 K FACTOR	R	34F	847	40847	IEEE Float	4	
AVG I23 K FACTOR	R	350	848	40848	IEEE Float	4	
AVG I31 K FACTOR	R	351	849	40849	IEEE Float	4	
AVG TEMPERATURE DSP INTERNAL	R	352	850	40850	IEEE Float	4	
AVG TEMPERATURE DSP EXTERNAL	R	353	851	40851	IEEE Float	4	
Average of Measured Parameters over 1 sec (50/60 Cycles) - Per Unit (PU) Presentation							
AVG PU DSP FREQUENCY	R	400	1024	41024	IEEE Float	4	
AVG PU ACTIVE POWER N	R	401	1025	41025	IEEE Float	4	
AVG PU ACTIVE POWER MAIN 1	R	402	1026	41026	IEEE Float	4	
AVG PU ACTIVE POWER MAIN 2	R	403	1027	41027	IEEE Float	4	
AVG PU ACTIVE POWER MAIN 3	R	404	1028	41028	IEEE Float	4	
AVG PU ACTIVE POWER MAIN 12	R	42F	1071	41071	IEEE Float	4	
AVG PU ACTIVE POWER MAIN 23	R	430	1072	41072	IEEE Float	4	
AVG PU ACTIVE POWER MAIN 31	R	431	1073	41073	IEEE Float	4	
AVG PU ACTIVE POWER SUM	R	405	1029	41029	IEEE Float	4	
AVG PU REACTIVE POWER N	R	406	1030	41030	IEEE Float	4	
AVG PU REACTIVE POWER MAIN 1	R	407	1031	41031	IEEE Float	4	
AVG PU REACTIVE POWER MAIN 2	R	408	1032	41032	IEEE Float	4	
AVG PU REACTIVE POWER MAIN 3	R	409	1033	41033	IEEE Float	4	
AVG PU REACTIVE POWER MAIN 12	R	432	1074	41074	IEEE Float	4	
AVG PU REACTIVE POWER MAIN 23	R	433	1075	41075	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG PU REACTIVE POWER MAIN 31	R	434	1076	41076	IEEE Float	4	
AVG PU REACTIVE POWER SUM	R	40A	1034	41034	IEEE Float	4	
AVG PU APPARENT POWER N	R	40B	1035	41035	IEEE Float	4	
AVG PU APPARENT POWER MAIN 1	R	40C	1036	41036	IEEE Float	4	
AVG PU APPARENT POWER MAIN 2	R	40D	1037	41037	IEEE Float	4	
AVG PU APPARENT POWER MAIN 3	R	40E	1038	41038	IEEE Float	4	
AVG PU APPARENT POWER MAIN 12	R	435	1077	41077	IEEE Float	4	
AVG PU APPARENT POWER MAIN 23	R	436	1078	41078	IEEE Float	4	
AVG PU APPARENT POWER MAIN 31	R	437	1079	41079	IEEE Float	4	
AVG PU APPARENT POWER SUM	R	40F	1039	41039	IEEE Float	4	
AVG PU POWER FACTOR N	R	410	1040	41040	IEEE Float	4	
AVG PU POWER FACTOR 1	R	411	1041	41041	IEEE Float	4	
AVG PU POWER FACTOR 2	R	412	1042	41042	IEEE Float	4	
AVG PU POWER FACTOR 3	R	413	1043	41043	IEEE Float	4	
AVG PU POWER FACTOR TOTAL	R	414	1044	41044	IEEE Float	4	
AVG PU PF FUNDAMENTAL 1	R	415	1045	41045	IEEE Float	4	
AVG PU PF FUNDAMENTAL 2	R	416	1046	41046	IEEE Float	4	
AVG PU PF FUNDAMENTAL 3	R	417	1047	41047	IEEE Float	4	
AVG PU PF FUNDAMENTAL TOTAL	R	418	1048	41048	IEEE Float	4	
AVG PU VN RMS	R	41D	1053	41053	IEEE Float	4	
AVG PU V1 RMS	R	41E	1054	41054	IEEE Float	4	
AVG PU V2 RMS	R	41F	1055	41055	IEEE Float	4	
AVG PU V3 RMS	R	420	1056	41056	IEEE Float	4	
AVG PU V12 RMS	R	421	1057	41057	IEEE Float	4	
AVG PU V23 RMS	R	422	1058	41058	IEEE Float	4	
AVG PU V31 RMS	R	423	1059	41059	IEEE Float	4	
AVG PU IN RMS	R	424	1060	41060	IEEE Float	4	
AVG PU I1 RMS	R	425	1061	41061	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG PU I2 RMS	R	426	1062	41062	IEEE Float	4	
AVG PU I3 RMS	R	427	1063	41063	IEEE Float	4	
AVG PU I12 RMS	R	428	1064	41064	IEEE Float	4	
AVG PU I23 RMS	R	429	1065	41065	IEEE Float	4	
AVG PU I31 RMS	R	42A	1066	41066	IEEE Float	4	
AVG PU V1 2 3 RMS AVERAGE	R	42B	1067	41067	IEEE Float	4	
AVG PU V12 23 31 RMS AVERAGE	R	42C	1068	41068	IEEE Float	4	
AVG PU I1 2 3 RMS AVERAGE	R	42D	1069	41069	IEEE Float	4	
AVG PU I12 23 31 RMS AVERAGE	R	42E	1070	41070	IEEE Float	4	
Waveform and Harmonics - Cycle by Cycle							
V1 WAVE	R	1E4	484	40484	IEEE Float*[128]	512	128 samples/cycle
V2 WAVE	R	1E5	485	40485	IEEE Float*[128]	512	128 samples/cycle
V3 WAVE	R	1E6	486	40486	IEEE Float*[128]	512	128 samples/cycle
V12 WAVE	R	1E7	487	40487	IEEE Float*[128]	512	128 samples/cycle
V23 WAVE	R	1E8	488	40488	IEEE Float*[128]	512	128 samples/cycle
V31 WAVE	R	1E9	489	40489	IEEE Float*[128]	512	128 samples/cycle
I1 WAVE	R	1EA	490	40490	IEEE Float*[128]	512	128 samples/cycle
I2 WAVE	R	1EB	491	40491	IEEE Float*[128]	512	128 samples/cycle
I3 WAVE	R	1EC	492	40492	IEEE Float*[128]	512	128 samples/cycle
I12 WAVE	R	1ED	493	40493	IEEE Float*[128]	512	128 samples/cycle
I23 WAVE	R	1EE	494	40494	IEEE Float*[128]	512	128 samples/cycle
I31 WAVE	R	1EF	495	40495	IEEE Float*[128]	512	128 samples/cycle
VN WAVE	R	1F0	496	40496	IEEE Float*[128]	512	128 samples/cycle
IN WAVE	R	1F1	497	40497	IEEE Float*[128]	512	128 samples/cycle
V1 HARMONICS	R	1F2	498	40498	IEEE Float*[256]	1024	128 pairs mag/ph
V2 HARMONICS	R	1F3	499	40499	IEEE Float*[256]	1024	128 pairs mag/ph

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
V3 HARMONICS	R	1F4	500	40500	IEEE Float*[256]	1024	128 pairs mag/ph
V12 HARMONICS	R	1F5	501	40501	IEEE Float*[256]	1024	128 pairs mag/ph
V23 HARMONICS	R	1F6	502	40502	IEEE Float*[256]	1024	128 pairs mag/ph
V31 HARMONICS	R	1F7	503	40503	IEEE Float*[256]	1024	128 pairs mag/ph
I1 HARMONICS	R	1F8	504	40504	IEEE Float*[256]	1024	128 pairs mag/ph
I2 HARMONICS	R	1F9	505	40505	IEEE Float*[256]	1024	128 pairs mag/ph
I3 HARMONICS	R	1FA	506	40506	IEEE Float*[256]	1024	128 pairs mag/ph
I12 HARMONICS	R	1FB	507	40507	IEEE Float*[256]	1024	128 pairs mag/ph
I23 HARMONICS	R	1FC	508	40508	IEEE Float*[256]	1024	128 pairs mag/ph
I31 HARMONICS	R	1FD	509	40509	IEEE Float*[256]	1024	128 pairs mag/ph
VN HARMONICS	R	1FE	510	40510	IEEE Float*[256]	1024	128 pairs mag/ph
IN HARMONICS	R	1FF	511	40511	IEEE Float*[256]	1024	128 pairs mag/ph
V1 GROUP HARMONICS	R	250	592	40592	IEEE Float*[40]	160	
V2 GROUP HARMONICS	R	251	593	40593	IEEE Float*[40]	160	
V3 GROUP HARMONICS	R	252	594	40594	IEEE Float*[40]	160	
V12 GROUP HARMONICS	R	253	595	40595	IEEE Float*[40]	160	
V23 GROUP HARMONICS	R	254	596	40596	IEEE Float*[40]	160	
V31 GROUP HARMONICS	R	255	597	40597	IEEE Float*[40]	160	
I1 GROUP HARMONICS	R	256	598	40598	IEEE Float*[40]	160	
I2 GROUP HARMONICS	R	257	599	40599	IEEE Float*[40]	160	
I3 GROUP HARMONICS	R	258	600	40600	IEEE Float*[40]	160	
I12 GROUP HARMONICS	R	259	601	40601	IEEE Float*[40]	160	
I23 GROUP HARMONICS	R	25A	602	40602	IEEE Float*[40]	160	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
I31 GROUP HARMONICS	R	25B	603	40603	IEEE Float*[40]	160	
VN GROUP HARMONICS	R	25C	604	40604	IEEE Float*[40]	160	
IN GROUP HARMONICS	R	25D	605	40605	IEEE Float*[40]	160	
Phase Order	R						
PHASE ORDER	R	700	1792	41792	int	4	123 or 132
Measurements over 200 msec (10-12 Cycles) per IEC 61000-4-30				R			
LONG VN THD	R	2101	8449	48449	IEEE Float	4	
LONG V1 THD	R	2102	8450	48450	IEEE Float	4	
LONG V2 THD	R	2103	8451	48451	IEEE Float	4	
LONG V3 THD	R	2104	8452	48452	IEEE Float	4	
LONG V12 THD	R	2105	8453	48453	IEEE Float	4	
LONG V23 THD	R	2106	8454	48454	IEEE Float	4	
LONG V31 THD	R	2107	8455	48455	IEEE Float	4	
LONG IN THD	R	2108	8456	48456	IEEE Float	4	
LONG I1 THD	R	2109	8457	48457	IEEE Float	4	
LONG I2 THD	R	210A	8458	48458	IEEE Float	4	
LONG I3 THD	R	210B	8459	48459	IEEE Float	4	
LONG I12 THD	R	210C	8460	48460	IEEE Float	4	
LONG I23 THD	R	210D	8461	48461	IEEE Float	4	
LONG I31 THD	R	210E	8462	48462	IEEE Float	4	
LONG ACTIVE POWER N	R	210F	8463	48463	IEEE Float	4	
LONG ACTIVE POWER MAIN 1	R	2110	8464	48464	IEEE Float	4	
LONG ACTIVE POWER MAIN 2	R	2111	8465	48465	IEEE Float	4	
LONG ACTIVE POWER MAIN 3	R	2112	8466	48466	IEEE Float	4	
LONG ACTIVE POWER MAIN 12	R	2152	8530	48530	IEEE Float	4	
LONG ACTIVE POWER MAIN 23	R	2153	8531	48531	IEEE Float	4	
LONG ACTIVE POWER MAIN 31	R	2154	8532	48532	IEEE Float	4	
LONG ACTIVE POWER SUM	R	2113	8467	48467	IEEE Float	4	
LONG REACTIVE POWER N	R	2114	8468	48468	IEEE Float	4	
LONG REACTIVE POWER MAIN 1	R	2115	8469	48469	IEEE Float	4	
LONG REACTIVE POWER MAIN 2	R	2116	8470	48470	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG REACTIVE POWER MAIN 3	R	2117	8471	48471	IEEE Float	4	
LONG REACTIVE POWER MAIN 12	R	2155	8533	48533	IEEE Float	4	
LONG REACTIVE POWER MAIN 23	R	2156	8534	48534	IEEE Float	4	
LONG REACTIVE POWER MAIN 31	R	2157	8535	48535	IEEE Float	4	
LONG REACTIVE POWER SUM	R	2118	8472	48472	IEEE Float	4	
LONG APPARENT POWER N	R	2119	8473	48473	IEEE Float	4	
LONG APPARENT POWER MAIN 1	R	211A	8474	48474	IEEE Float	4	
LONG APPARENT POWER MAIN 2	R	211B	8475	48475	IEEE Float	4	
LONG APPARENT POWER MAIN 3	R	211C	8476	48476	IEEE Float	4	
LONG APPARENT POWER MAIN 12	R	2158	8536	48536	IEEE Float	4	
LONG APPARENT POWER MAIN 23	R	2159	8537	48537	IEEE Float	4	
LONG APPARENT POWER MAIN 31	R	215A	8538	48538	IEEE Float	4	
LONG APPARENT POWER SUM	R	211D	8477	48477	IEEE Float	4	
LONG POWER FACTOR N	R	211E	8478	48478	IEEE Float	4	
LONG POWER FACTOR 1	R	211F	8479	48479	IEEE Float	4	
LONG POWER FACTOR 2	R	2120	8480	48480	IEEE Float	4	
LONG POWER FACTOR 3	R	2121	8481	48481	IEEE Float	4	
LONG POWER FACTOR TOTAL	R	2122	8482	48482	IEEE Float	4	
LONG PF FUNDAMENTAL 1	R	2123	8483	48483	IEEE Float	4	
LONG PF FUNDAMENTAL 2	R	2124	8484	48484	IEEE Float	4	
LONG PF FUNDAMENTAL 3	R	2125	8485	48485	IEEE Float	4	
LONG PF FUNDAMENTAL TOTAL	R	2126	8486	48486	IEEE Float	4	
LONG POWER FACTOR 12	R	215B	8539	48539	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG POWER FACTOR 23	R	215C	8540	48540	IEEE Float	4	
LONG POWER FACTOR 31	R	215D	8541	48541	IEEE Float	4	
LONG PF FUNDAMENTAL 12	R	215E	8542	48542	IEEE Float	4	
LONG PF FUNDAMENTAL 23	R	215F	8543	48543	IEEE Float	4	
LONG PF FUNDAMENTAL 31	R	2160	8544	48544	IEEE Float	4	
LONG VN RMS	R	212B	8491	48491	IEEE Float	4	
LONG V1 RMS	R	212C	8492	48492	IEEE Float	4	
LONG V2 RMS	R	212D	8493	48493	IEEE Float	4	
LONG V3 RMS	R	212E	8494	48494	IEEE Float	4	
LONG V12 RMS	R	212F	8495	48495	IEEE Float	4	
LONG V23 RMS	R	2130	8496	48496	IEEE Float	4	
LONG V31 RMS	R	2131	8497	48497	IEEE Float	4	
LONG IN RMS	R	2132	8498	48498	IEEE Float	4	
LONG I1 RMS	R	2133	8499	48499	IEEE Float	4	
LONG I2 RMS	R	2134	8500	48500	IEEE Float	4	
LONG I3 RMS	R	2135	8501	48501	IEEE Float	4	
LONG I12 RMS	R	2136	8502	48502	IEEE Float	4	
LONG I23 RMS	R	2137	8503	48503	IEEE Float	4	
LONG I31 RMS	R	2138	8504	48504	IEEE Float	4	
LONG V1 2 3 RMS AVERAGE	R	2139	8505	48505	IEEE Float	4	
LONG V12 23 31 RMS AVERAGE	R	213A	8506	48506	IEEE Float	4	
LONG I1 2 3 RMS AVERAGE	R	213B	8507	48507	IEEE Float	4	
LONG I12 23 31 RMS AVERAGE	R	213C	8508	48508	IEEE Float	4	
LONG VN CREST FACTOR	R	213D	8509	48509	IEEE Float	4	
LONG V1 CREST FACTOR	R	213E	8510	48510	IEEE Float	4	
LONG V2 CREST FACTOR	R	213F	8511	48511	IEEE Float	4	
LONG V3 CREST FACTOR	R	2140	8512	48512	IEEE Float	4	
LONG V12 CREST FACTOR	R	2141	8513	48513	IEEE Float	4	
LONG V23 CREST FACTOR	R	2142	8514	48514	IEEE Float	4	
LONG V31 CREST FACTOR	R	2143	8515	48515	IEEE Float	4	
LONG IN CREST FACTOR	R	2144	8516	48516	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG I1 CREST FACTOR	R	2145	8517	48517	IEEE Float	4	
LONG I2 CREST FACTOR	R	2146	8518	48518	IEEE Float	4	
LONG I3 CREST FACTOR	R	2147	8519	48519	IEEE Float	4	
LONG I12 CREST FACTOR	R	2148	8520	48520	IEEE Float	4	
LONG I23 CREST FACTOR	R	2149	8521	48521	IEEE Float	4	
LONG I31 CREST FACTOR	R	214A	8522	48522	IEEE Float	4	
LONG IN K FACTOR	R	214B	8523	48523	IEEE Float	4	
LONG I1 K FACTOR	R	214C	8524	48524	IEEE Float	4	
LONG I2 K FACTOR	R	214D	8525	48525	IEEE Float	4	
LONG I3 K FACTOR	R	214E	8526	48526	IEEE Float	4	
LONG I12 K FACTOR	R	214F	8527	48527	IEEE Float	4	
LONG I23 K FACTOR	R	2150	8528	48528	IEEE Float	4	
LONG I31 K FACTOR	R	2151	8529	48529	IEEE Float	4	
LONG VN THDG	R	2161	8545	48545	IEEE Float	4	
LONG V1 THDG	R	2162	8546	48546	IEEE Float	4	
LONG V2 THDG	R	2163	8547	48547	IEEE Float	4	
LONG V3 THDG	R	2164	8548	48548	IEEE Float	4	
LONG V12 THDG	R	2165	8549	48549	IEEE Float	4	
LONG V23 THDG	R	2166	8550	48550	IEEE Float	4	
LONG V31 THDG	R	2167	8551	48551	IEEE Float	4	
LONG IN THDG	R	2168	8552	48552	IEEE Float	4	
LONG I1 THDG	R	2169	8553	48553	IEEE Float	4	
LONG I2 THDG	R	216A	8554	48554	IEEE Float	4	
LONG I3 THDG	R	216B	8555	48555	IEEE Float	4	
LONG I12 THDG	R	216C	8556	48556	IEEE Float	4	
LONG I23 THDG	R	216D	8557	48557	IEEE Float	4	
LONG I31 THDG	R	216E	8558	48558	IEEE Float	4	
LONG VN RMSG	R	216F	8559	48559	IEEE Float	4	
LONG V1 RMSG	R	2170	8560	48560	IEEE Float	4	
LONG V2 RMSG	R	2171	8561	48561	IEEE Float	4	
LONG V3 RMSG	R	2172	8562	48562	IEEE Float	4	
LONG V12 RMSG	R	2173	8563	48563	IEEE Float	4	
LONG V23 RMSG	R	2174	8564	48564	IEEE Float	4	
LONG V31 RMSG	R	2175	8565	48565	IEEE Float	4	
LONG IN RMSG	R	2176	8566	48566	IEEE Float	4	
LONG I1 RMSG	R	2177	8567	48567	IEEE Float	4	
LONG I2 RMSG	R	2178	8568	48568	IEEE Float	4	
LONG I3 RMSG	R	2179	8569	48569	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG I12 RMSG	R	217A	8570	48570	IEEE Float	4	
LONG I23 RMSG	R	217B	8571	48571	IEEE Float	4	
LONG I31 RMSG	R	217C	8572	48572	IEEE Float	4	
LONG VN THD MIN	R	1751	5969	45969	IEEE Float	4	
LONG V1 THD MIN	R	1752	5970	45970	IEEE Float	4	
LONG V2 THD MIN	R	1753	5971	45971	IEEE Float	4	
LONG V3 THD MIN	R	1754	5972	45972	IEEE Float	4	
LONG V12 THD MIN	R	1755	5973	45973	IEEE Float	4	
LONG V23 THD MIN	R	1756	5974	45974	IEEE Float	4	
LONG V31 THD MIN	R	1757	5975	45975	IEEE Float	4	
LONG IN THD MIN	R	1758	5976	45976	IEEE Float	4	
LONG I1 THD MIN	R	1759	5977	45977	IEEE Float	4	
LONG I2 THD MIN	R	175A	5978	45978	IEEE Float	4	
LONG I3 THD MIN	R	175B	5979	45979	IEEE Float	4	
LONG I12 THD MIN	R	175C	5980	45980	IEEE Float	4	
LONG I23 THD MIN	R	175D	5981	45981	IEEE Float	4	
LONG I31 THD MIN	R	175E	5982	45982	IEEE Float	4	
LONG ACTIVE POWER N MIN	R	175F	5983	45983	IEEE Float	4	
LONG ACTIVE POWER MAIN 1 MIN	R	1760	5984	45984	IEEE Float	4	
LONG ACTIVE POWER MAIN 2 MIN	R	1761	5985	45985	IEEE Float	4	
LONG ACTIVE POWER MAIN 3 MIN	R	1762	5986	45986	IEEE Float	4	
LONG ACTIVE POWER MAIN 12 MIN	R	1806	6150	46150	IEEE Float	4	
LONG ACTIVE POWER MAIN 23 MIN	R	1807	6151	46151	IEEE Float	4	
LONG ACTIVE POWER MAIN 31 MIN	R	1808	6152	46152	IEEE Float	4	
LONG ACTIVE POWER SUM MIN	R	1763	5987	45987	IEEE Float	4	
LONG REACTIVE POWER N MIN	R	1764	5988	45988	IEEE Float	4	
LONG REACTIVE POWER MAIN 1 MIN	R	1765	5989	45989	IEEE Float	4	
LONG REACTIVE POWER MAIN 2 MIN	R	1766	5990	45990	IEEE Float	4	
LONG REACTIVE POWER MAIN 3 MIN	R	1767	5991	45991	IEEE Float	4	
LONG REACTIVE POWER MAIN 12 MIN	R	1809	6153	46153	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG REACTIVE POWER MAIN 23 MIN	R	180A	6154	46154	IEEE Float	4	
LONG REACTIVE POWER MAIN 31 MIN	R	180B	6155	46155	IEEE Float	4	
LONG REACTIVE POWER SUM MIN	R	1768	5992	45992	IEEE Float	4	
LONG APPARENT POWER N MIN	R	1769	5993	45993	IEEE Float	4	
LONG APPARENT POWER MAIN 1 MIN	R	176A	5994	45994	IEEE Float	4	
LONG APPARENT POWER MAIN 2 MIN	R	176B	5995	45995	IEEE Float	4	
LONG APPARENT POWER MAIN 3 MIN	R	176C	5996	45996	IEEE Float	4	
LONG APPARENT POWER MAIN 12 MIN	R	180C	6156	46156	IEEE Float	4	
LONG APPARENT POWER MAIN 23 MIN	R	180D	6157	46157	IEEE Float	4	
LONG APPARENT POWER MAIN 31 MIN	R	180E	6158	46158	IEEE Float	4	
LONG APPARENT POWER SUM MIN	R	176D	5997	45997	IEEE Float	4	
LONG POWER FACTOR N MIN	R	176E	5998	45998	IEEE Float	4	
LONG POWER FACTOR 1 MIN	R	176F	5999	45999	IEEE Float	4	
LONG POWER FACTOR 2 MIN	R	1770	6000	46000	IEEE Float	4	
LONG POWER FACTOR 3 MIN	R	1771	6001	46001	IEEE Float	4	
LONG POWER FACTOR TOTAL MIN	R	1772	6002	46002	IEEE Float	4	
LONG PF FUNDAMENTAL 1 MIN	R	1773	6003	46003	IEEE Float	4	
LONG PF FUNDAMENTAL 2 MIN	R	1774	6004	46004	IEEE Float	4	
LONG PF FUNDAMENTAL 3 MIN	R	1775	6005	46005	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG PF FUNDAMENTAL TOTAL MIN	R	1776	6006	46006	IEEE Float	4	
LONG VN RMS MIN	R	177B	6011	46011	IEEE Float	4	
LONG V1 RMS MIN	R	177C	6012	46012	IEEE Float	4	
LONG V2 RMS MIN	R	177D	6013	46013	IEEE Float	4	
LONG V3 RMS MIN	R	177E	6014	46014	IEEE Float	4	
LONG V12 RMS MIN	R	177F	6015	46015	IEEE Float	4	
LONG V23 RMS MIN	R	1780	6016	46016	IEEE Float	4	
LONG V31 RMS MIN	R	1781	6017	46017	IEEE Float	4	
LONG IN RMS MIN	R	1782	6018	46018	IEEE Float	4	
LONG I1 RMS MIN	R	1783	6019	46019	IEEE Float	4	
LONG I2 RMS MIN	R	1784	6020	46020	IEEE Float	4	
LONG I3 RMS MIN	R	1785	6021	46021	IEEE Float	4	
LONG I12 RMS MIN	R	1786	6022	46022	IEEE Float	4	
LONG I23 RMS MIN	R	1787	6023	46023	IEEE Float	4	
LONG I31 RMS MIN	R	1788	6024	46024	IEEE Float	4	
LONG V1 2 3 RMS AVERAGE MIN	R	1789	6025	46025	IEEE Float	4	
LONG V12 23 31 RMS AVERAGE MIN	R	178A	6026	46026	IEEE Float	4	
LONG I1 2 3 RMS AVERAGE MIN	R	178B	6027	46027	IEEE Float	4	
LONG I12 23 31 RMS AVERAGE MIN	R	178C	6028	46028	IEEE Float	4	
LONG VN CREST FACTOR MIN	R	178D	6029	46029	IEEE Float	4	
LONG V1 CREST FACTOR MIN	R	178E	6030	46030	IEEE Float	4	
LONG V2 CREST FACTOR MIN	R	178F	6031	46031	IEEE Float	4	
LONG V3 CREST FACTOR MIN	R	1790	6032	46032	IEEE Float	4	
LONG V12 CREST FACTOR MIN	R	1791	6033	46033	IEEE Float	4	
LONG V23 CREST FACTOR MIN	R	1792	6034	46034	IEEE Float	4	
LONG V31 CREST FACTOR MIN	R	1793	6035	46035	IEEE Float	4	
LONG IN CREST FACTOR MIN	R	1794	6036	46036	IEEE Float	4	
LONG I1 CREST FACTOR MIN	R	1795	6037	46037	IEEE Float	4	
LONG I2 CREST FACTOR MIN	R	1796	6038	46038	IEEE Float	4	
LONG I3 CREST FACTOR MIN	R	1797	6039	46039	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG I12 CREST FACTOR MIN	R	1798	6040	46040	IEEE Float	4	
LONG I23 CREST FACTOR MIN	R	1799	6041	46041	IEEE Float	4	
LONG I31 CREST FACTOR MIN	R	179A	6042	46042	IEEE Float	4	
LONG IN K FACTOR MIN	R	179B	6043	46043	IEEE Float	4	
LONG I1 K FACTOR MIN	R	179C	6044	46044	IEEE Float	4	
LONG I2 K FACTOR MIN	R	179D	6045	46045	IEEE Float	4	
LONG I3 K FACTOR MIN	R	179E	6046	46046	IEEE Float	4	
LONG I12 K FACTOR MIN	R	179F	6047	46047	IEEE Float	4	
LONG I23 K FACTOR MIN	R	17A0	6048	46048	IEEE Float	4	
LONG I31 K FACTOR MIN	R	17A1	6049	46049	IEEE Float	4	
LONG V UNBALANCE MIN	R	1811	6161	46161	IEEE Float	4	
LONG I UNBALANCE MIN	R	1812	6162	46162	IEEE Float	4	
LONG VN THDG MIN	R	1831	6193	46193	IEEE Float	4	
LONG V1 THDG MIN	R	1832	6194	46194	IEEE Float	4	
LONG V2 THDG MIN	R	1833	6195	46195	IEEE Float	4	
LONG V3 THDG MIN	R	1834	6196	46196	IEEE Float	4	
LONG V12 THDG MIN	R	1835	6197	46197	IEEE Float	4	
LONG V23 THDG MIN	R	1836	6198	46198	IEEE Float	4	
LONG V31 THDG MIN	R	1837	6199	46199	IEEE Float	4	
LONG IN THDG MIN	R	1838	6200	46200	IEEE Float	4	
LONG I1 THDG MIN	R	1839	6201	46201	IEEE Float	4	
LONG I2 THDG MIN	R	183A	6202	46202	IEEE Float	4	
LONG I3 THDG MIN	R	183B	6203	46203	IEEE Float	4	
LONG I12 THDG MIN	R	183C	6204	46204	IEEE Float	4	
LONG I23 THDG MIN	R	183D	6205	46205	IEEE Float	4	
LONG I31 THDG MIN	R	183E	6206	46206	IEEE Float	4	
LONG VN RMSG MIN	R	183F	6207	46207	IEEE Float	4	
LONG V1 RMSG MIN	R	1840	6208	46208	IEEE Float	4	
LONG V2 RMSG MIN	R	1841	6209	46209	IEEE Float	4	
LONG V3 RMSG MIN	R	1842	6210	46210	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG V12 RMSG MIN	R	1843	6211	46211	IEEE Float	4	
LONG V23 RMSG MIN	R	1844	6212	46212	IEEE Float	4	
LONG V31 RMSG MIN	R	1845	6213	46213	IEEE Float	4	
LONG IN RMSG MIN	R	1846	6214	46214	IEEE Float	4	
LONG I1 RMSG MIN	R	1847	6215	46215	IEEE Float	4	
LONG I2 RMSG MIN	R	1848	6216	46216	IEEE Float	4	
LONG I3 RMSG MIN	R	1849	6217	46217	IEEE Float	4	
LONG I12 RMSG MIN	R	184A	6218	46218	IEEE Float	4	
LONG I23 RMSG MIN	R	184B	6219	46219	IEEE Float	4	
LONG I31 RMSG MIN	R	184C	6220	46220	IEEE Float	4	
LONG VN THD MAX	R	17A2	6050	46050	IEEE Float	4	
LONG V1 THD MAX	R	17A3	6051	46051	IEEE Float	4	
LONG V2 THD MAX	R	17A4	6052	46052	IEEE Float	4	
LONG V3 THD MAX	R	17A5	6053	46053	IEEE Float	4	
LONG V12 THD MAX	R	17A6	6054	46054	IEEE Float	4	
LONG V23 THD MAX	R	17A7	6055	46055	IEEE Float	4	
LONG V31 THD MAX	R	17A8	6056	46056	IEEE Float	4	
LONG IN THD MAX	R	17A9	6057	46057	IEEE Float	4	
LONG I1 THD MAX	R	17AA	6058	46058	IEEE Float	4	
LONG I2 THD MAX	R	17AB	6059	46059	IEEE Float	4	
LONG I3 THD MAX	R	17AC	6060	46060	IEEE Float	4	
LONG I12 THD MAX	R	17AD	6061	46061	IEEE Float	4	
LONG I23 THD MAX	R	17AE	6062	46062	IEEE Float	4	
LONG I31 THD MAX	R	17AF	6063	46063	IEEE Float	4	
LONG ACTIVE POWER N MAX	R	17B0	6064	46064	IEEE Float	4	
LONG ACTIVE POWER MAIN 1 MAX	R	17B1	6065	46065	IEEE Float	4	
LONG ACTIVE POWER MAIN 2 MAX	R	17B2	6066	46066	IEEE Float	4	
LONG ACTIVE POWER MAIN 3 MAX	R	17B3	6067	46067	IEEE Float	4	
LONG ACTIVE POWER MAIN 12 MAX	R	17FC	6140	46140	IEEE Float	4	
LONG ACTIVE POWER MAIN 23 MAX	R	17FD	6141	46141	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG ACTIVE POWER MAIN 31 MAX	R	17FE	6142	46142	IEEE Float	4	
LONG ACTIVE POWER SUM MAX	R	17B4	6068	46068	IEEE Float	4	
LONG REACTIVE POWER N MAX	R	17B5	6069	46069	IEEE Float	4	
LONG REACTIVE POWER MAIN 1 MAX	R	17B6	6070	46070	IEEE Float	4	
LONG REACTIVE POWER MAIN 2 MAX	R	17B7	6071	46071	IEEE Float	4	
LONG REACTIVE POWER MAIN 3 MAX	R	17B8	6072	46072	IEEE Float	4	
LONG REACTIVE POWER MAIN 12 MAX	R	17FF	6143	46143	IEEE Float	4	
LONG REACTIVE POWER MAIN 23 MAX	R	1800	6144	46144	IEEE Float	4	
LONG REACTIVE POWER MAIN 31 MAX	R	1801	6145	46145	IEEE Float	4	
LONG REACTIVE POWER SUM MAX	R	17B9	6073	46073	IEEE Float	4	
LONG APPARENT POWER N MAX	R	17BA	6074	46074	IEEE Float	4	
LONG APPARENT POWER MAIN 1 MAX	R	17BB	6075	46075	IEEE Float	4	
LONG APPARENT POWER MAIN 2 MAX	R	17BC	6076	46076	IEEE Float	4	
LONG APPARENT POWER MAIN 3 MAX	R	17BD	6077	46077	IEEE Float	4	
LONG APPARENT POWER MAIN 12 MAX	R	1802	6146	46146	IEEE Float	4	
LONG APPARENT POWER MAIN 23 MAX	R	1803	6147	46147	IEEE Float	4	
LONG APPARENT POWER MAIN 31 MAX	R	1804	6148	46148	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG APPARENT POWER SUM MAX	R	17BE	6078	46078	IEEE Float	4	
LONG POWER FACTOR N MAX	R	17BF	6079	46079	IEEE Float	4	
LONG POWER FACTOR 1 MAX	R	17C0	6080	46080	IEEE Float	4	
LONG POWER FACTOR 2 MAX	R	17C1	6081	46081	IEEE Float	4	
LONG POWER FACTOR 3 MAX	R	17C2	6082	46082	IEEE Float	4	
LONG POWER FACTOR TOTAL MAX	R	17C3	6083	46083	IEEE Float	4	
LONG PF FUNDAMENTAL 1 MAX	R	17C4	6084	46084	IEEE Float	4	
LONG PF FUNDAMENTAL 2 MAX	R	17C5	6085	46085	IEEE Float	4	
LONG PF FUNDAMENTAL 3 MAX	R	17C6	6086	46086	IEEE Float	4	
LONG PF FUNDAMENTAL TOTAL MAX	R	17C7	6087	46087	IEEE Float	4	
LONG VN RMS MAX	R	17CC	6092	46092	IEEE Float	4	
LONG V1 RMS MAX	R	17CD	6093	46093	IEEE Float	4	
LONG V2 RMS MAX	R	17CE	6094	46094	IEEE Float	4	
LONG V3 RMS MAX	R	17CF	6095	46095	IEEE Float	4	
LONG V12 RMS MAX	R	17D0	6096	46096	IEEE Float	4	
LONG V23 RMS MAX	R	17D1	6097	46097	IEEE Float	4	
LONG V31 RMS MAX	R	17D2	6098	46098	IEEE Float	4	
LONG IN RMS MAX	R	17D3	6099	46099	IEEE Float	4	
LONG I1 RMS MAX	R	17D4	6100	46100	IEEE Float	4	
LONG I2 RMS MAX	R	17D5	6101	46101	IEEE Float	4	
LONG I3 RMS MAX	R	17D6	6102	46102	IEEE Float	4	
LONG I12 RMS MAX	R	17D7	6103	46103	IEEE Float	4	
LONG I23 RMS MAX	R	17D8	6104	46104	IEEE Float	4	
LONG I31 RMS MAX	R	17D9	6105	46105	IEEE Float	4	
LONG V1 2 3 RMS AVERAGE MAX	R	17DA	6106	46106	IEEE Float	4	
LONG V12 23 31 RMS AVERAGE MAX	R	17DB	6107	46107	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG I1 2 3 RMS AVERAGE MAX	R	17DC	6108	46108	IEEE Float	4	
LONG I12 23 31 RMS AVERAGE MAX	R	17DD	6109	46109	IEEE Float	4	
LONG VN CREST FACTOR MAX	R	17DE	6110	46110	IEEE Float	4	
LONG V1 CREST FACTOR MAX	R	17DF	6111	46111	IEEE Float	4	
LONG V2 CREST FACTOR MAX	R	17E0	6112	46112	IEEE Float	4	
LONG V3 CREST FACTOR MAX	R	17E1	6113	46113	IEEE Float	4	
LONG V12 CREST FACTOR MAX	R	17E2	6114	46114	IEEE Float	4	
LONG V23 CREST FACTOR MAX	R	17E3	6115	46115	IEEE Float	4	
LONG V31 CREST FACTOR MAX	R	17E4	6116	46116	IEEE Float	4	
LONG IN CREST FACTOR MAX	R	17E5	6117	46117	IEEE Float	4	
LONG I1 CREST FACTOR MAX	R	17E6	6118	46118	IEEE Float	4	
LONG I2 CREST FACTOR MAX	R	17E7	6119	46119	IEEE Float	4	
LONG I3 CREST FACTOR MAX	R	17E8	6120	46120	IEEE Float	4	
LONG I12 CREST FACTOR MAX	R	17E9	6121	46121	IEEE Float	4	
LONG I23 CREST FACTOR MAX	R	17EA	6122	46122	IEEE Float	4	
LONG I31 CREST FACTOR MAX	R	17EB	6123	46123	IEEE Float	4	
LONG IN K FACTOR MAX	R	17EC	6124	46124	IEEE Float	4	
LONG I1 K FACTOR MAX	R	17ED	6125	46125	IEEE Float	4	
LONG I2 K FACTOR MAX	R	17EE	6126	46126	IEEE Float	4	
LONG I3 K FACTOR MAX	R	17EF	6127	46127	IEEE Float	4	
LONG I12 K FACTOR MAX	R	17F0	6128	46128	IEEE Float	4	
LONG I23 K FACTOR MAX	R	17F1	6129	46129	IEEE Float	4	
LONG I31 K FACTOR MAX	R	17F2	6130	46130	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG V UNBALANCE MAX	R	1813	6163	46163	IEEE Float	4	
LONG I UNBALANCE MAX	R	1814	6164	46164	IEEE Float	4	
LONG VN THDG MAX	R	184D	6221	46221	IEEE Float	4	
LONG V1 THDG MAX	R	184E	6222	46222	IEEE Float	4	
LONG V2 THDG MAX	R	184F	6223	46223	IEEE Float	4	
LONG V3 THDG MAX	R	1850	6224	46224	IEEE Float	4	
LONG V12 THDG MAX	R	1851	6225	46225	IEEE Float	4	
LONG V23 THDG MAX	R	1852	6226	46226	IEEE Float	4	
LONG V31 THDG MAX	R	1853	6227	46227	IEEE Float	4	
LONG IN THDG MAX	R	1854	6228	46228	IEEE Float	4	
LONG I1 THDG MAX	R	1855	6229	46229	IEEE Float	4	
LONG I2 THDG MAX	R	1856	6230	46230	IEEE Float	4	
LONG I3 THDG MAX	R	1857	6231	46231	IEEE Float	4	
LONG I12 THDG MAX	R	1858	6232	46232	IEEE Float	4	
LONG I23 THDG MAX	R	1859	6233	46233	IEEE Float	4	
LONG I31 THDG MAX	R	185A	6234	46234	IEEE Float	4	
LONG VN RMSG MAX	R	185B	6235	46235	IEEE Float	4	
LONG V1 RMSG MAX	R	185C	6236	46236	IEEE Float	4	
LONG V2 RMSG MAX	R	185D	6237	46237	IEEE Float	4	
LONG V3 RMSG MAX	R	185E	6238	46238	IEEE Float	4	
LONG V12 RMSG MAX	R	185F	6239	46239	IEEE Float	4	
LONG V23 RMSG MAX	R	1860	6240	46240	IEEE Float	4	
LONG V31 RMSG MAX	R	1861	6241	46241	IEEE Float	4	
LONG IN RMSG MAX	R	1862	6242	46242	IEEE Float	4	
LONG I1 RMSG MAX	R	1863	6243	46243	IEEE Float	4	
LONG I2 RMSG MAX	R	1864	6244	46244	IEEE Float	4	
LONG I3 RMSG MAX	R	1865	6245	46245	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
LONG I12 RMSG MAX	R	1866	6246	46246	IEEE Float	4	
LONG I23 RMSG MAX	R	1867	6247	46247	IEEE Float	4	
LONG I31 RMSG MAX	R	1868	6248	46248	IEEE Float	4	
Sliding Reference Voltage (Usr) per IEC 61000-4-30							
AVG LONG VN USR	R	16F0	5872	45872	IEEE Float	4	
AVG LONG V1 USR	R	16F1	5873	45873	IEEE Float	4	
AVG LONG V2 USR	R	16F2	5874	45874	IEEE Float	4	
AVG LONG V3 USR	R	16F3	5875	45875	IEEE Float	4	
AVG LONG V12 USR	R	16F4	5876	45876	IEEE Float	4	
AVG LONG V23 USR	R	16F5	5877	45877	IEEE Float	4	
AVG LONG V31 USR	R	16F6	5878	45878	IEEE Float	4	
AVG LONG IN USR	R	16F7	5879	45879	IEEE Float	4	
AVG LONG I1 USR	R	16F8	5880	45880	IEEE Float	4	
AVG LONG I2 USR	R	16F9	5881	45881	IEEE Float	4	
AVG LONG I3 USR	R	16FA	5882	45882	IEEE Float	4	
AVG LONG I12 USR	R	16FB	5883	45883	IEEE Float	4	
AVG LONG I23 USR	R	16FC	5884	45884	IEEE Float	4	
AVG LONG I31 USR	R	16FD	5885	45885	IEEE Float	4	
1 sec Average of IEC 61000-4-30 Measurements							
AVG LONG VN THD	R	1700	5888	45888	IEEE Float	4	
AVG LONG V1 THD	R	1701	5889	45889	IEEE Float	4	
AVG LONG V2 THD	R	1702	5890	45890	IEEE Float	4	
AVG LONG V3 THD	R	1703	5891	45891	IEEE Float	4	
AVG LONG V12 THD	R	1704	5892	45892	IEEE Float	4	
AVG LONG V23 THD	R	1705	5893	45893	IEEE Float	4	
AVG LONG V31 THD	R	1706	5894	45894	IEEE Float	4	
AVG LONG IN THD	R	1707	5895	45895	IEEE Float	4	
AVG LONG I1 THD	R	1708	5896	45896	IEEE Float	4	
AVG LONG I2 THD	R	1709	5897	45897	IEEE Float	4	
AVG LONG I3 THD	R	170A	5898	45898	IEEE Float	4	
AVG LONG I12 THD	R	170B	5899	45899	IEEE Float	4	
AVG LONG I23 THD	R	170C	5900	45900	IEEE Float	4	
AVG LONG I31 THD	R	170D	5901	45901	IEEE Float	4	
AVG LONG ACTIVE POWER N	R	170E	5902	45902	IEEE Float	4	
AVG LONG ACTIVE POWER MAIN 1	R	170F	5903	45903	IEEE Float	4	
AVG LONG ACTIVE POWER MAIN 2	R	1710	5904	45904	IEEE Float	4	
AVG LONG ACTIVE POWER MAIN 3	R	1711	5905	45905	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG LONG ACTIVE POWER MAIN 12	R	17F3	6131	46131	IEEE Float	4	
AVG LONG ACTIVE POWER MAIN 23	R	17F4	6132	46132	IEEE Float	4	
AVG LONG ACTIVE POWER MAIN 31	R	17F5	6133	46133	IEEE Float	4	
AVG LONG ACTIVE POWER SUM	R	1712	5906	45906	IEEE Float	4	
AVG LONG REACTIVE POWER N	R	1713	5907	45907	IEEE Float	4	
AVG LONG REACTIVE POWER MAIN 1	R	1714	5908	45908	IEEE Float	4	
AVG LONG REACTIVE POWER MAIN 2	R	1715	5909	45909	IEEE Float	4	
AVG LONG REACTIVE POWER MAIN 3	R	1716	5910	45910	IEEE Float	4	
AVG LONG REACTIVE POWER MAIN 12	R	1805	6149	46149	IEEE Float	4	
AVG LONG REACTIVE POWER MAIN 23	R	17F6	6134	46134	IEEE Float	4	
AVG LONG REACTIVE POWER MAIN 31	R	17F7	6135	46135	IEEE Float	4	
AVG LONG REACTIVE POWER SUM	R	1717	5911	45911	IEEE Float	4	
AVG LONG APPARENT POWER N	R	1718	5912	45912	IEEE Float	4	
AVG LONG APPARENT POWER MAIN 1	R	1719	5913	45913	IEEE Float	4	
AVG LONG APPARENT POWER MAIN 2	R	171A	5914	45914	IEEE Float	4	
AVG LONG APPARENT POWER MAIN 3	R	171B	5915	45915	IEEE Float	4	
AVG LONG APPARENT POWER MAIN 12	R	17F8	6136	46136	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG LONG APPARENT POWER MAIN 23	R	17F9	6137	46137	IEEE Float	4	
AVG LONG APPARENT POWER MAIN 31	R	17FA	6138	46138	IEEE Float	4	
AVG LONG APPARENT POWER SUM	R	171C	5916	45916	IEEE Float	4	
AVG LONG POWER FACTOR N	R	171D	5917	45917	IEEE Float	4	
AVG LONG POWER FACTOR 1	R	171E	5918	45918	IEEE Float	4	
AVG LONG POWER FACTOR 2	R	171F	5919	45919	IEEE Float	4	
AVG LONG POWER FACTOR 3	R	1720	5920	45920	IEEE Float	4	
AVG LONG POWER FACTOR TOTAL	R	1721	5921	45921	IEEE Float	4	
AVG LONG PF FUNDAMENTAL 1	R	1722	5922	45922	IEEE Float	4	
AVG LONG PF FUNDAMENTAL 2	R	1723	5923	45923	IEEE Float	4	
AVG LONG PF FUNDAMENTAL 3	R	1724	5924	45924	IEEE Float	4	
AVG LONG PF FUNDAMENTAL TOTAL	R	1725	5925	45925	IEEE Float	4	
AVG LONG VN RMS	R	172A	5930	45930	IEEE Float	4	
AVG LONG V1 RMS	R	172B	5931	45931	IEEE Float	4	
AVG LONG V2 RMS	R	172C	5932	45932	IEEE Float	4	
AVG LONG V3 RMS	R	172D	5933	45933	IEEE Float	4	
AVG LONG V12 RMS	R	172E	5934	45934	IEEE Float	4	
AVG LONG V23 RMS	R	172F	5935	45935	IEEE Float	4	
AVG LONG V31 RMS	R	1730	5936	45936	IEEE Float	4	
AVG LONG IN RMS	R	1731	5937	45937	IEEE Float	4	
AVG LONG I1 RMS	R	1732	5938	45938	IEEE Float	4	
AVG LONG I2 RMS	R	1733	5939	45939	IEEE Float	4	
AVG LONG I3 RMS	R	1734	5940	45940	IEEE Float	4	
AVG LONG I12 RMS	R	1735	5941	45941	IEEE Float	4	
AVG LONG I23 RMS	R	1736	5942	45942	IEEE Float	4	
AVG LONG I31 RMS	R	1737	5943	45943	IEEE Float	4	
AVG LONG V1 2 3 RMS AVERAGE	R	1738	5944	45944	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG LONG V12 23 31 RMS AVERAGE	R	1739	5945	45945	IEEE Float	4	
AVG LONG I1 2 3 RMS AVERAGE	R	173A	5946	45946	IEEE Float	4	
AVG LONG I12 23 31 RMS AVERAGE	R	173B	5947	45947	IEEE Float	4	
AVG LONG VN CREST FACTOR	R	173C	5948	45948	IEEE Float	4	
AVG LONG V1 CREST FACTOR	R	173D	5949	45949	IEEE Float	4	
AVG LONG V2 CREST FACTOR	R	173E	5950	45950	IEEE Float	4	
AVG LONG V3 CREST FACTOR	R	173F	5951	45951	IEEE Float	4	
AVG LONG V12 CREST FACTOR	R	1740	5952	45952	IEEE Float	4	
AVG LONG V23 CREST FACTOR	R	1741	5953	45953	IEEE Float	4	
AVG LONG V31 CREST FACTOR	R	1742	5954	45954	IEEE Float	4	
AVG LONG IN CREST FACTOR	R	1743	5955	45955	IEEE Float	4	
AVG LONG I1 CREST FACTOR	R	1744	5956	45956	IEEE Float	4	
AVG LONG I2 CREST FACTOR	R	1745	5957	45957	IEEE Float	4	
AVG LONG I3 CREST FACTOR	R	1746	5958	45958	IEEE Float	4	
AVG LONG I12 CREST FACTOR	R	1747	5959	45959	IEEE Float	4	
AVG LONG I23 CREST FACTOR	R	1748	5960	45960	IEEE Float	4	
AVG LONG I31 CREST FACTOR	R	1749	5961	45961	IEEE Float	4	
AVG LONG IN K FACTOR	R	174A	5962	45962	IEEE Float	4	
AVG LONG I1 K FACTOR	R	174B	5963	45963	IEEE Float	4	
AVG LONG I2 K FACTOR	R	174C	5964	45964	IEEE Float	4	
AVG LONG I3 K FACTOR	R	174D	5965	45965	IEEE Float	4	
AVG LONG I12 K FACTOR	R	174E	5966	45966	IEEE Float	4	
AVG LONG I23 K FACTOR	R	174F	5967	45967	IEEE Float	4	
AVG LONG I31 K FACTOR	R	1750	5968	45968	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG LONG V UNBALANCE	R	180F	6159	46159	IEEE Float	4	
AVG LONG I UNBALANCE	R	1810	6160	46160	IEEE Float	4	
AVG LONG VN THDG	R	1815	6165	46165	IEEE Float	4	
AVG LONG V1 THDG	R	1816	6166	46166	IEEE Float	4	
AVG LONG V2 THDG	R	1817	6167	46167	IEEE Float	4	
AVG LONG V3 THDG	R	1818	6168	46168	IEEE Float	4	
AVG LONG V12 THDG	R	1819	6169	46169	IEEE Float	4	
AVG LONG V23 THDG	R	181A	6170	46170	IEEE Float	4	
AVG LONG V31 THDG	R	181B	6171	46171	IEEE Float	4	
AVG LONG IN THDG	R	181C	6172	46172	IEEE Float	4	
AVG LONG I1 THDG	R	181D	6173	46173	IEEE Float	4	
AVG LONG I2 THDG	R	181E	6174	46174	IEEE Float	4	
AVG LONG I3 THDG	R	181F	6175	46175	IEEE Float	4	
AVG LONG I12 THDG	R	1820	6176	46176	IEEE Float	4	
AVG LONG I23 THDG	R	1821	6177	46177	IEEE Float	4	
AVG LONG I31 THDG	R	1822	6178	46178	IEEE Float	4	
AVG LONG VN RMSG	R	1823	6179	46179	IEEE Float	4	
AVG LONG V1 RMSG	R	1824	6180	46180	IEEE Float	4	
AVG LONG V2 RMSG	R	1825	6181	46181	IEEE Float	4	
AVG LONG V3 RMSG	R	1826	6182	46182	IEEE Float	4	
AVG LONG V12 RMSG	R	1827	6183	46183	IEEE Float	4	
AVG LONG V23 RMSG	R	1828	6184	46184	IEEE Float	4	
AVG LONG V31 RMSG	R	1829	6185	46185	IEEE Float	4	
AVG LONG IN RMSG	R	182A	6186	46186	IEEE Float	4	
AVG LONG I1 RMSG	R	182B	6187	46187	IEEE Float	4	
AVG LONG I2 RMSG	R	182C	6188	46188	IEEE Float	4	
AVG LONG I3 RMSG	R	182D	6189	46189	IEEE Float	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
AVG LONG I12 RMSG	R	182E	6190	46190	IEEE Float	4	
AVG LONG I23 RMSG	R	182F	6191	46191	IEEE Float	4	
AVG LONG I31 RMSG	R	1830	6192	46192	IEEE Float	4	
Measurement Configuration							
NOMINAL V	RW	80	128	40128	IEEE Float	4	
NOMINAL I	RW	81	129	40129	IEEE Float	4	
NOMINAL V DIFF	RW	C5	197	40197	IEEE Float	4	
NOMINAL I DIFF	RW	C6	198	40198	IEEE Float	4	
NOMINAL FREQUENCY	RW	82	130	40130	IEEE Float	4	
POWER CONFIGURATION	RW	83	131	40131	int	4	Delta 3W=0, WYE 4W=1, Single LL=2, Single LN=3, 2PhaseTR=4
CT PRIMARY	RW	5C	92	40092	int	4	
CT SECONDARY	RW	5D	93	40093	int	4	
PT PRIMARY	RW	5E	94	40094	int	4	
PT SECONDARY	RW	5F	95	40095	int	4	
VN POLARITY	RW	9F	159	40159	int	4	
V1 POLARITY	RW	A0	160	40160	int	4	
V2 POLARITY	RW	A1	161	40161	int	4	
V3 POLARITY	RW	A2	162	40162	int	4	
IN POLARITY	RW	A3	163	40163	int	4	
I1 POLARITY	RW	A4	164	40164	int	4	
I2 POLARITY	RW	A5	165	40165	int	4	
I3 POLARITY	RW	A6	166	40166	int	4	
System (Network, Connection, CF) Information							
TIME SYNC STATUS	R	101B	4123	44123	Get	4	
CF FREE SPACE	R	100B	4107	44107	Get	8	
CF TOTAL SPACE	R	100C	4108	44108	Get	8	
CF MODEL	R	101C	4124	44124	string[40]	40	
CF REV	R	101D	4125	44125	int [Boolean]	8	
CF SERIAL	R	101E	4126	44126	string[20]	20	
PHY1 LINK	R	1016	4118	44118	int [Boolean]	4	
PHY2 LINK	R	1017	4119	44119	int [Boolean]	4	
PHY1 SPEED	R	1030	4144	44144	int [Boolean]	4	
PHY2 SPEED	R	1031	4145	44145	int [Boolean]	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
PHY1 MODE	RW	1032	4146	44146	int [Boolean]	4	Ethernet Port: AUTO=0, 100_FD=1, 100_HD=2, 10_FD=3, 10_HD=4
PHY2 MODE	RW	1033	4147	44147	int [Boolean]	4	Ethernet Port: AUTO=0, 100_FD=1, 100_HD=2, 10_FD=3, 10_HD=4
PHY1 DUPLEX	R	1034	4148	44148	int [Boolean]	4	
PHY2 DUPLEX	R	1035	4149	44149	int [Boolean]	4	
ACTIVE CONNECTIONS WEB	R	1018	4120	44120	int	4	
ACTIVE CONNECTIONS OPC	R	1019	4121	44121	int	4	
ACTIVE CONNECTIONS LCD	R	101A	4122	44122	int	4	
FTP ACTIVE CONNECTION	R	1024	4132	44132	int	4	
FTP MAX CONNECTION	R	1025	4133	44133	int	4	
SNTP SOURCE	R	1036	4150	44150	int	4	
SMTP FROM ADRS	RW	104C	4172	44172	string[80]	80	MAX_LOGIN_ NAME_LEN
SMTP TO ADRS	RW	1049	4169	44169	string[80]	80	MAX_LOGIN_ NAME_LEN
SMTP EVENTS	RW	104A	4170	44170	word*[NumEvents]		-1= END; NumEventsMax=100
SMTP REOCCURRENCE TIME LIMT	R	104B	4171	44171	int	4	
Power Supply Information							
POWER POWERED 220	R	1020	4128	44128	int [Boolean]	4	
POWER POWERED LAN	R	1021	4129	44129	int [Boolean]	4	
POWER POWERED 48	R	1022	4130	44130	int [Boolean]	4	
POWER DOWN	R	1023	4131	44131	int [Boolean]	4	
POWER POWERED STATUS	R	1028	4136	44136	int [Boolean]	4	
POWER PSE STATUS	R	102D	4141	44141	int [Boolean]	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
POWER PSE ACTIVE	R	102E	4142	44142	int [Boolean]	4	
POWER PSE FAILURE	R	102F	4143	44143	int [Boolean]	4	
PSU TEMPERATURE	R	377	887	40887	IEEE Float	4	
PSU TEMPERATURE MIN	R	378	888	40888	IEEE Float	4	
PSU TEMPERATURE MAX	R	379	889	40889	IEEE Float	4	
Compliance Related							
PQ COMPLIANCE RUNNING STATUS	RW	261	609	40609	int	4	STOP=0, RUN=1
PQ COMPLIANCE TYPE	R	6BE	1726	41726	int	4	
PQ COMPLIANCE NAME	R	262	610	40610	String[40]	40	
PQ COMPLIANCE DESCRIPTION	R	263	611	40611	String[80]	80	
PQ COMPLIANCE STATUS	R	264	612	40612	int	4	
PQ COMPLIANCE START TIME	R	265	613	40613	FILE TIME	8	
PQ COMPLIANCE LAST TIME	R	6BD	1725	41725	FILE TIME	8	
PQ COMPLIANCE AGGREGATE ON TIME	R	266	614	40614	FILE TIME	8	
PQ COMPLIANCE AGGREGATE OFF TIME	R	267	615	40615	FILE TIME	8	
PQ COMPLIANCE PRCNTG TIME OK	R	268	616	40616	float	4	
PQ COMPLIANCE PRCNTG TIME FAIL	R	269	617	40617	float	4	
PQ COMPLIANCE PRCNTG TIME NA	R	26A	618	40618	float	4	
PQ COMPLIANCE NUM PARAMS	R	26B	619	40619	int	4	
GPS Data							
GPS BAUD RATE	R	70D	1805	41805	int	4	
GPS ATTACHED	R	70E	1806	41806	int	4	
GPS ENABLE	R	70F	1807	41807	int	4	
GPS TIMESTAMP	R	710	1808	41808	FILETIME	8	
GPS LATITUDE	R	711	1809	41809	String	12	
GPS LONGTITUDE	R	712	1810	41810	String	13	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
GPS ALTITUDE	R	713	1811	41811	String	6	
GPS STATUS	R	714	1812	41812	String	2	
GPS QUALITY	R	715	1813	41813	String	2	
GPS SATELLITE TRACKED	R	716	1814	41814	String	3	
GPS SATELLITE INVIEW	R	717	1815	41815	String	3	
GPS SATELLITE FIXED	R	718	1816	41816	String	36	
GPS DILLUTION	R	719	1817	41817	String	5	
GPS GEOSEPARATION	R	71A	1818	41818	String	6	
GPS PRECISION DILUTION POSITION	R	71B	1819	41819	String	4	
GPS PRECISION DILUTION HORIZONTAL	R	71C	1820	41820	String	4	
GPS PRECISION DILUTION VERTICAL	R	71D	1821	41821	String	4	
GPS SPEED	R	71E	1822	41822	String	6	
GPS ANGLE	R	71F	1823	41823	String	6	
GPS MagneticVar	R	720	1824	41824	String	9	
GPS MODE	R	721	1825	41825	String	2	
GPS MODE VERIFY	R	722	1826	41826	String	2	
GPS - Satellite Information							
GPS S1 PRN	R	723	1827	41827	String	3	
GPS S1 ELEVATION	R	724	1828	41828	String	3	
GPS S1 AZIMUTH	R	725	1829	41829	String	4	
GPS S1 SNR	R	726	1830	41830	String	3	
GPS S2 PRN	R	727	1831	41831	String	3	
GPS S2 ELEVATION	R	728	1832	41832	String	3	
GPS S2 AZIMUTH	R	729	1833	41833	String	4	
GPS S2 SNR	R	72A	1834	41834	String	3	
GPS S3 PRN	R	72B	1835	41835	String	3	
GPS S3 ELEVATION	R	72C	1836	41836	String	3	
GPS S3 AZIMUTH	R	72D	1837	41837	String	4	
GPS S3 SNR	R	72E	1838	41838	String	3	
GPS S4 PRN	R	72F	1839	41839	String	3	
GPS S4 ELEVATION	R	730	1840	41840	String	3	
GPS S4 AZIMUTH	R	731	1841	41841	String	4	
GPS S4 SNR	R	732	1842	41842	String	3	
GPS S5 PRN	R	733	1843	41843	String	3	
GPS S5 ELEVATION	R	734	1844	41844	String	3	
GPS S5 AZIMUTH	R	735	1845	41845	String	4	
GPS S5 SNR	R	736	1846	41846	String	3	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
GPS S6 PRN	R	737	1847	41847	String	3	
GPS S6 ELEVATION	R	738	1848	41848	String	3	
GPS S6 AZIMUTH	R	739	1849	41849	String	4	
GPS S6 SNR	R	73A	1850	41850	String	3	
GPS S7 PRN	R	73B	1851	41851	String	3	
GPS S7 ELEVATION	R	73C	1852	41852	String	3	
GPS S7 AZIMUTH	R	73D	1853	41853	String	4	
GPS S7 SNR	R	73E	1854	41854	String	3	
GPS S8 PRN	R	73F	1855	41855	String	3	
GPS S8 ELEVATION	R	740	1856	41856	String	3	
GPS S8 AZIMUTH	R	741	1857	41857	String	4	
GPS S8 SNR	R	742	1858	41858	String	3	
GPS S9 PRN	R	743	1859	41859	String	3	
GPS S9 ELEVATION	R	744	1860	41860	String	3	
GPS S9 AZIMUTH	R	745	1861	41861	String	4	
GPS S9 SNR	R	746	1862	41862	String	3	
GPS S10 PRN	R	747	1863	41863	String	3	
GPS S10 ELEVATION	R	748	1864	41864	String	3	
GPS S10 AZIMUTH	R	749	1865	41865	String	4	
GPS S10 SNR	R	74A	1866	41866	String	3	
GPS S11 PRN	R	74B	1867	41867	String	3	
GPS S11 ELEVATION	R	74C	1868	41868	String	3	
GPS S11 AZIMUTH	R	74D	1869	41869	String	4	
GPS S11 SNR	R	74E	1870	41870	String	3	
GPS S12 PRN	R	74F	1871	41871	String	3	
GPS S12 ELEVATION	R	750	1872	41872	String	3	
GPS S12 AZIMUTH	R	751	1873	41873	String	4	
GPS S12 SNR	R	752	1874	41874	String	3	
PRM_CODE_NOMINAL_I	RW	81	129	40129	IEEE Float	4	
PRM_CODE_NOMINAL_V_DIFF	RW	C5	197	40197	IEEE Float	4	
PRM_CODE_NOMINAL_I_DIFF	RW	C6	198	40198	IEEE Float	4	
PRM_CODE_NOMINAL_FREQUENCY	RW	82	130	40130	IEEE Float	4	
PRM_CODE_POWER_CONFIGURATION	RW	83	131	40131	int	4	Delta 3W=0, WYE 4W=1, Single LL=2, Single LN=3, 2PhaseTR=4
PRM_CODE_CT_PRIMARY	RW	5C	92	40092	int	4	
PRM_CODE_CT_SECONDARY	RW	5D	93	40093	int	4	

Parameter	R/W	Hex Code	Dec.	Address	Type ([Size])	Size	Remarks
PRM_CODE_PT_PRIMARY	RW	5E	94	40094	int	4	
PRM_CODE_PT_SECONDARY	RW	5F	95	40095	int	4	
PRM_CODE_VN_POLARITY	RW	9F	159	40159	int	4	
PRM_CODE_V1_POLARITY	RW	A0	160	40160	int	4	
PRM_CODE_V2_POLARITY	RW	A1	161	40161	int	4	
PRM_CODE_V3_POLARITY	RW	A2	162	40162	int	4	
PRM_CODE_IN_POLARITY	RW	A3	163	40163	int	4	
PRM_CODE_I1_POLARITY	RW	A4	164	40164	int	4	
PRM_CODE_I2_POLARITY	RW	A5	165	40165	int	4	
PRM_CODE_I3_POLARITY	RW	A6	166	40166	int	4	

Table 74: Parameter Table