ELSPEC G4500

BLACKBOX

Portable

Operational Manual

Issue 1.1
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CE

ELSPEC

Warranty Notice

Each Elspec product is warranted to be free from defects in material and workmanship under normal use and service. The warranty period is one year and begins on the date of shipment. Parts, product repairs, and services are warranted for 90 days. This warranty extends only to the original buyer or end-user customer and does not apply to fuses, disposable batteries, or to any product which, in Elspec's opinion, has been misused, altered, neglected, contaminated, or damaged by accident or abnormal conditions of operation or handling. Elspec warrants that the software will operate substantially in accordance with its functional specifications for 90 days and that it has been properly recorded on non-defective media. Elspec does not warrant that the software will be error free and operate without interruption.

Elspec authorized resellers shall extend this warranty on new and unused products to end-user customers only but do not have authority to extend a greater or different warranty on behalf of Elspec. Warranty support is available only if the product is purchased through an Elspec authorized sales outlet or Buyer has paid the applicable international price. Elspec reserves the right to invoice Buyer for importation costs of repair/replacement parts when the product is purchased in one country are submitted for repair in another country.

Elspec’s warranty obligation is limited, at Elspec's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to Elspec within the warranty period.

To obtain warranty service, contact Elspec directly to obtain return authorization information, and then send the product to Elspec, with a description of the problem, postage and insurance prepaid (FOB destination). Elspec assumes no risk for damage in transit. Following warranty repair, the product will be returned to the Buyer, transportation prepaid (FOB destination). If Elspec determines that the failure was caused by neglect, misuse, contamination, alteration, accident, or abnormal condition of operation of handling, including overvoltage failures caused by use outside the product's specified rating, or normal wear and tear of mechanical components, Elspec will provide an estimate of repair costs and obtain authorization before commencing work. Following repair, the product will be returned to the Buyer, transportation prepaid, and the Buyer will be billed for the repair and return postage transportation charges (FOB Shipping Point).

This warranty is the Buyer's sole and exclusive remedy and is in lieu of all other warranties, express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose. Elspec shall not be liable for any special, indirect, incidental, or consequential damages or losses, including loss of data arising from any cause or theory.

Since some countries or states do not allow limitation of the term of an implied warranty, or exclusion or limitation of incidental or consequential damages, the limitations and exclusions of this warranty may not apply to every buyer. If any provision of this Warranty is held invalid or unenforceable by a court or other decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

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Introduction

The ELSPEC G4500 BLACKBOX *Portable* is the next generation in electrical Power Quality recorders and analyzers. Powered by revolutionary PQZip[1] compression technology, the G4500 BLACKBOX is capable of recording up to 1000 times more information than competitive instruments with equivalent memory sizes. Practically, the G4500 BLACKBOX is designed to store continuously, cycle by cycle, all parameters of data, including waveforms at maximum resolution for more than a year, internally, without the need of an external storage device or computer. The integrated PQSCADA software package provides an innovative and convenient way of performing even the most complicated power quality investigations. A State of the Art PQSCADA Investigator application helps to explore power quality events, zooming in and out on any parameter at High Definition resolution, from months to microseconds in mouse-click speed and simplicity.

The following are key features of the G4500 BLACKBOX *Portable*:

- **No field setup required:** Powered by a unique, continuous all-parameters recording with self-identifying current probes, the BLACKBOX Portable does not require any field setup or configuration for most of the usage scenarios (except PT/CT ratios)
- **8 GB of internal memory:** Capable of storing more than a year of continuous, all-inclusive data with 1024 samples per cycle resolution for AC voltages and 256 samples per cycle resolution for currents
- **Integrated WEB server:** and wireless Wi-Fi router and access point for the most convenient control and operation

[1] Refer to "PQZip" chapter on page 105 for more information

- **Mobile Analysis Lab** A Touch screen, LCD display for setup, control, and comprehensive power quality analysis which offers a full Tablet PC functionality
- **Up to 9 AC measurement channels** 4 AC/DC Voltages, 5[2] AC currents
- **Additional 2 DC measurement channels** Additional DC Voltage and DC current channels for simultaneous primary/secondary assessment of DC voltage converters
- **Internal and external (PT100) temperature recording** Internal and (optional) external temperature is recorded during the entire measurement session
- **Superior time synchronization** Ultimate time synchronization abilities for the most accurate multi-point assessment
- **Integrated rechargeable battery** For up to 2 hours of self-powered operation

[2] A 5th, DC current channel could be operated for "Earth" AC/DC current recording in 256 samples per cycle resolution.

Safety Information

To avoid electrical shock or fire:

- **Review the entire manual before using the Instrument and its accessories and observe all warnings and cautions.**
- **Avoid working alone.**
- **Do not operate the Instrument around explosive gas or vapor.**
- **Use only insulated current and voltage probes.**
- **Before use, inspect the Instrument, voltage and current probes, leads and accessories for mechanical damage, and replace when damaged. Pay special attention to the insulation surrounding the connectors and plugs.**
- **Remove all probes, test leads, and accessories that are not in use.**
- **Make sure the Instrument is properly grounded through the power cord to protective earth ground.**
- **Do not apply input voltages above the rating of the Instrument as shown on the name plate.**
- **Do not insert metal objects into connectors and openings.**
- **Never open Instrument's enclosure during operation; dangerous voltages are present.**
- **Use the Instrument only as specified in this manual, or the protection provided by the Instrument may be impaired.**
- **Do not expose the Instrument to extreme moisture and or rain.**
- **Do not operate the Instrument or its accessories when found wet for any reason.**

The Hardware

Specifications

General	
Power Requirements	100-240V RMS ±10% 47-63Hz, 35W 120-270VDC 48VDC (35- 55V)
Operation Time during Interruptions (internal UPS operation)	>2 hours on fully charged battery 25 seconds minimum on empty battery
Internal memory capacity for data	8 GB
Maximum recording period	Unlimited
Maximum Number of Events	Unlimited
Typical recording period	12[3] months of continuous, every cycle data
Real-time clock accuracy	Non synchronized: Not more than ±1s/day Synchronized[4]: up to ±50uS all times
Clock/Calendar	Leap years, 24-hour clock
Dimensions	250 x 60 x 300 mm
Mass (Weight)	3.7 kg
Power Quality Standard conformance	EN61000-4-30 Class A EN61000-4-15 EN50160 IEEE519
Voltage and Current Inputs	
Input channels	Voltage: 4AC/DC + 1DC Current: 4AC + 1AC/DC
Voltage channels	Input resistance: 3 MΩ Input capacitance: < 20pF
Current channels	Self-identifying probes Types available: current probes, flexible Rogowski coil types
Measuring method	Simultaneous digital sampling of voltages and currents. Digital PLL synchronized sampling, internal frequency reference used during voltage drops.
Synchronization and sampling	
PLL-Synchronized source	The PLL synchronized automatically to the best out of L12 (between L1-L2 lines) and L3-G (between L3 to earth) measurement channels
PLL Lock Range	42.5 to 69Hz

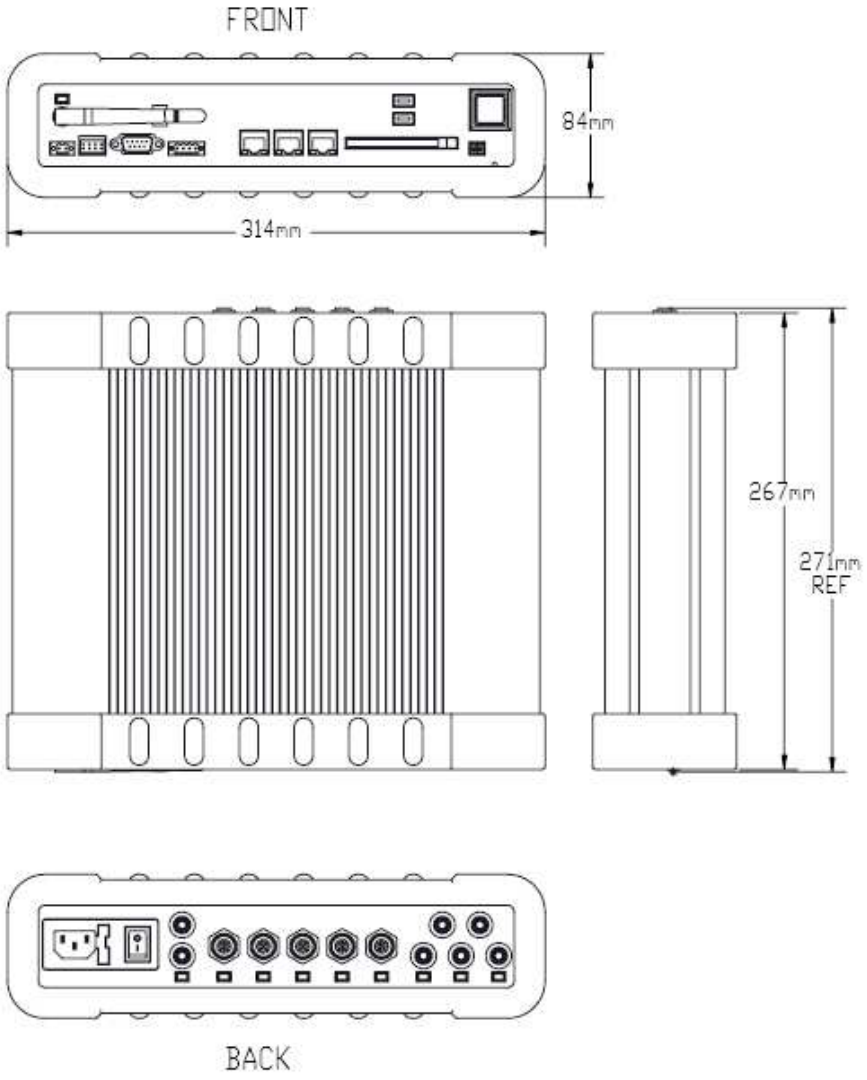
[3] Based on 700MB per month PQZip settings

[4] Required high accuracy GPS time source

Sampling Frequency	Voltage: 1024 samples/cycle Current: 256 samples/cycle Auxiliary DC Voltage: 200mS
Measurement Ranges	
Voltage Measurement Range	AC Voltage: 1kV RMS, ±8kV Transients DC Voltage: ±1kV DC
Current Measured Range	Depends on current probe used
Internal temperature	-40C° : +125C°
External temperature (PT100)	-100C° : +99C°
Measurement Accuracy	
RMS Voltages	TBD
RMS Currents	TBD
Powers	TBD
Energy	TBD
Voltage Harmonics	TBD
Current Harmonics	TBD
Flickering	≤5% (by EN6100-4-15)
Internal temperature	≤1%
External temperature (PT100)	≤1%
Transient Voltage detection	
Measurement type	1024 samples/cycle wave shape sampling, no peak detect
Full scale	8000 V pk
Sample resolution	19.5uSec (50Hz) 16uSec (60Hz).
Interfaces	
Color display	Touch screen “Mobile Analysis Lab” with complete tablet PC functionality
Optional B/W display	PoE self powered G4100 display
Integrated WEB server	Full control and real time monitoring
Integrated FTP server	A standard interface for a main storage memory
Integrated Telnet server	Command line control and troubleshooting
Communication	
Ethernet Ports	3 x 10/100Mb Fast Ethernet Ports, Integrated router, NAT and Firewall
Power Over Ethernet (PoE)	Available as output,13Watt
Wi-Fi interface	802.11 b/g with integrated antenna
Serial Interface	1 x RS-232, 1 x RS-485
Digital I/O	6 x 5-24VDC digital inputs
Extension slot	1xPCMCIA
Supported Protocols	HTTP, FTP, TELNET, OPC DA, Modbus RTU,
Wireless Security	WEP, WPA(TKIP), WPA2(AES), WPA2(Mixed)
Environmental and safety Specifications	
Operating Environment	Indoors or in covered area outdoors, up to 2000 m latitude
Storage Temperature and Humidity	-20 °C to 60 °C, 80% rh max, non-condensing
Operating Temperature and Humidity	0 °C to 50 °C, 80% rh max, non-condensing

Enclosure Protection	IP30 (per EN 60529)
Standard Conformance	
EMC	EN61326 FCC part 15, subpart B
Safety	EN61010-1 (Ed.2, 2001)

Physical Dimensions



Default Accessories

The following are the standard accessories that come shipped with the device:

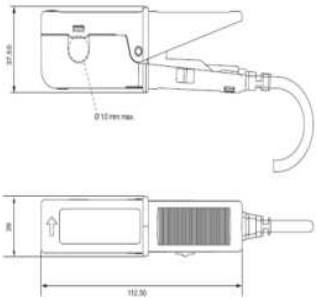
Qty	Part Number	Description	Illustration
1	**SNT-1010-0000**	Mobile Analysis Lab with complete tablet PC functionality	
1	**MEB-2999-0000**	Trolley Carrying Case	
1	**SOF-4000-xxxx**	PQSCADA– Power Quality Management Software Enterprise Edition installation CD	
4	**SOA-9045-3001**	Flexible AC current clamps 3000A (Diameter: 80 CM cable length: 2M)	
1	**EAH-4123-5100**	AC Voltage Cord with Crocodile Clip + Fuse (1.2M)	
1	**EAH-4123-5200**	Red AC Voltage Cord with Crocodile Clip + Fuse (1.2M)	
1	**EAH-4123-5300**	Blue AC Voltage Cord with Crocodile Clip + Fuse(1.2M)	
1	**EAH-4123-5400**	Yellow AC Voltage Cord with Crocodile Clip + Fuse(1.2M)	
1	**EAH-4123-9500**	Green AC Voltage Cord with Crocodile Clip(1.2M)	

1	**EAH-4123-5100**	Black DC Voltage Cord with Crocodile Clip + Fuse (1.2M)	
1	**EAH-4123-5200**	Red DC Voltage Cord with Crocodile Clip + Fuse (1.2M)	
1	**ENT-1002-0190**	48VDC terminal block connector (RoHS Compliant)	
1	**ENT-1002-0191**	Temperature Sensor terminal block connector PT100 type (RoHS Compliant)	
1	**ENT-1004-0190**	RS485/422 Communication terminal block connector (RoHS Compliant)	
1	**ENT-2008-0190**	Multi IO terminal block connector (RoHS Compliant)	
1	**TOE-0010-0013**	LAN communication cord length: 2M	
1	**EPC-2012-2190**	Power Cable for Cont. Europe 10A/125V, straight, 1.8M, Black	
	EPC-7012-2190	Power Cable for North America 10A/125V, straight, 1.8M, Black	

Optional Accessories

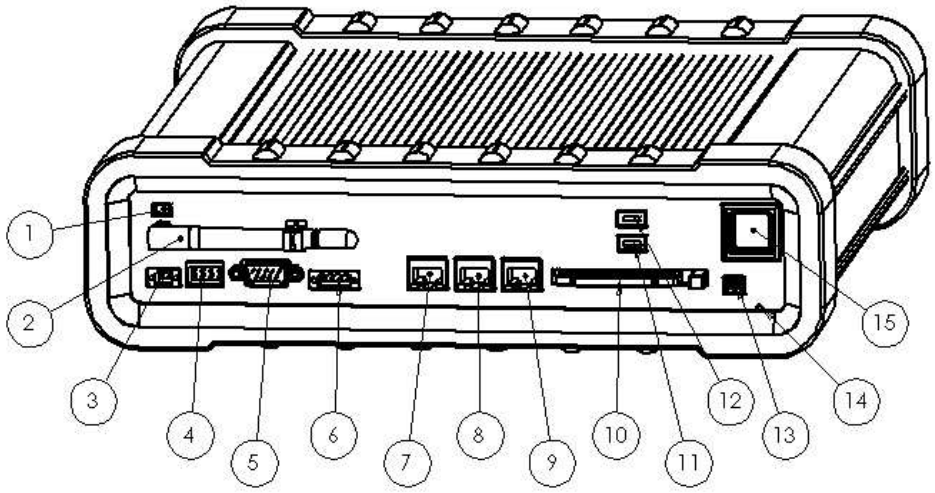
3000 Amp Flexible Current Clamp		
Ordering information (part name)	SOA-9045-3001	
Loop length	80cm	
Measurement range	Up to 14000A AC	
Linearity	< 0.3%	
Operating temperature	-20°C to + 60°C	
Cable length	2M	

300 Amp Flexible Current Clamp		
Ordering information (part name)	SOA-9045-3000	
Loop length	45cm	
Measurement range	Up to 1400A AC	
Linearity	< 0.3%	
Operating temperature	- 20°C to + 60°C	
Cable length	2M	

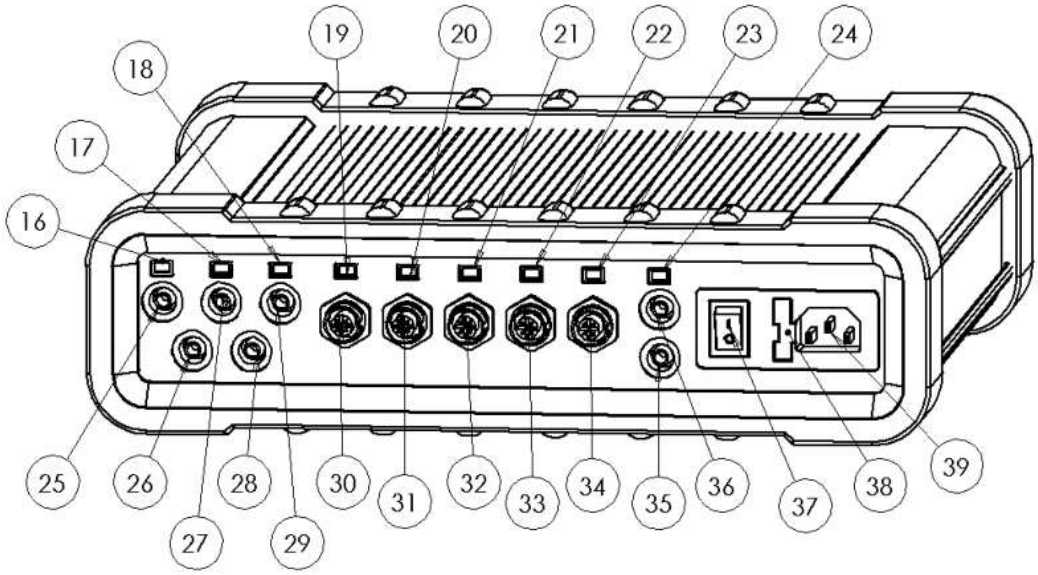
Mini Clamp			
Ordering information (part name)	SOA-0130-0100		
A "hole" dimensions	10mm Max		
Measurement range	Up to 6A AC (10A range) Up to 60A AC (100A range)		
Basic accuracy	≤3%		
Operating temperature	- 20°C to + 60°C		
Cable length	1.2M		

Controls and Indicators

Front Panel



Rear Panel



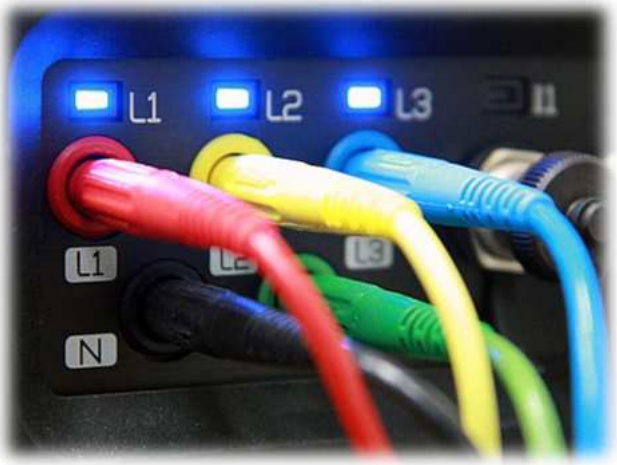
Reference

#	Description	For details refer to:
1	Wi-Fi activity indicator	The Wi-Fi Access Point on page 26
2	Wi-Fi antenna	The Wi-Fi Access Point on page 26
3	Auxiliary power supply socket	Auxiliary Power Supply on page 22
4	Digital Inputs socket	Digital Inputs on page 31
5	RS232 communication socket	RS232 Interface on page 29
6	RS485/422 communication socket	RS485/422 Interface" on page 29
7	WAN – 10/100Mb RJ45 Ethernet socket	Ethernet Ports View on page 25
8	LAN1 – 10/100Mb RJ45 Ethernet socket	Ethernet Ports View on page 25
9	LAN2/LCD – 10/100Mb RJ45 Ethernet socket	Ethernet Ports View on page 25
10	PCMCIA Extension slot	TBD
11	Battery status indicator	Battery Status Indicator" on page 22
12	Operational status indicator	Operational Status Indicator on page 23
13	External temperature sensor socket	Temperature Sensor on page 31
14	Reset to "factory defaults" button	Reset Button on page 32
15	Operation ON/OFF switch with indicator	Operation ON/OFF Switch's Indicator on page 23
16	L1 voltage "presence" indicator	Indication on page 14
17	L2 voltage "presence" indicator	Indication on page 14
18	L3 voltage "presence" indicator	Indication on page 14
19	I1/L1 current probe detection indicator	AC Current Channels on page 15

#	Description	For details refer to:
20	I2/L2 current probe detection indicator	AC Current Channels on page 15
21	I3/L3 current probe detection indicator	AC Current Channels on page 15
22	I4/Neutral current probe detection indicator	AC Current Channels on page 15
23	Idc/Earth probe detection indicator	Auxiliary AC/DC Current Channel on page 16
24	Vdc “presence” indicator	Auxiliary DC Voltage Channel on page 14
25	L1 voltage sensor socket	Voltage Inputs on page 13
26	Neutral voltage sensor socket	Fast AC/DC Channels on page 13
27	L2 voltage sensor socket	Voltage Inputs on page 13
28	Earth/Ground reference socket	Voltage Inputs on page 13
29	L3 voltage sensor socket	Voltage Inputs on page 13
30	I1/L1 current probe socket	AC Current Channels on page 15
31	I2/L2 current probe socket	AC Current Channels on page 15
32	I3/L3 current probe socket	AC Current Channels on page 15
33	I4/Neutral current probe socket	AC Current Channels on page 15
34	Idc/Earth current probe socket	Auxiliary AC/DC Current Channel on page 16
35	Vdc (minus) probe socket	Auxiliary DC Voltage Channel on page 14
36	Vdc (plus) probe socket	Auxiliary DC Voltage Channel on page 14
37	Main Power supply ON/OFF Switch	Power Supply on page 21
38	Fuse holder	Power Supply on page 21
39	Main Power Supply inlet socket	Power Supply on page 21

Voltage Inputs

The BLACKBOX Portable provides 4 fast sampling AC/DC voltage inputs and an auxiliary DC voltage input.



Fast AC/DC Channels

The fast sampling AC/DC channels are designed for AC network monitoring but are suitable for DC voltage readings as well. The inputs are marked as L1, L2, L3, and N with corresponded colors Red for L1, Yellow – L2, Blue – L3 and Black for an N (Neutral).

All inputs are sensed/sampled simultaneously and continuously at 1024 samples per cycle resolution using the Earth terminal (Green colored) as a reference. The Phase (line to neutral) and Line (line to line) voltages are further calculated by a digital signal processor unit at the same 1024 samples per cycle resolution.

Specifications Maximum voltage	±8kV peak (to Earth terminal)
Maximum continuous voltage	1kV (to Earth terminal)
Maximum voltage between channels	10kV
Input impedance (to Earth terminal)	>3 MΩ
Input capacitance	< 20pF
Reference	Earth terminal
Recording resolution	1024 samples per cycle[5], continues

[5] Defined by PLL frequency

A/D resolution	16Bit normal range + 16Bit extended range
PLL-Synchronized source	The PLL synchronizes automatically to the best out of L12 (between L1-L2 lines) and L3-G (between L3 to earth) measurement channels
PLL Lock Range	42.5 to 69Hz
PLL frequency when out of range	55Hz
PLL sensitivity	5% of nominal
Indication LEDs	10V AC

Indication

The L1, L2 and L3 voltage input channels are equipped with presence- indication LEDs. On voltage levels of above 10% of the nominal value the LED light illuminates in blue.

Auxiliary DC Voltage Channel

The auxiliary DC voltage channel provides an additional and independent input to the main AC/DC channel DC voltage readings. This is mainly suitable for a voltage converter DC link side reading while the main voltage channels are on the grid side.

DC Voltage Specifications

Maximum voltage	±1kV
Maximum continues voltage	±1kV
Galvanic insulation from the main AC/DC voltage channels	3kV
Recording resolution	200mS
Indications (Vdc LED)	> ±20V (blue)

Current Inputs

The BLACKBOX Portable provides 4 AC and 1 AC/DC current measurement channels/inputs.

AC Current Channels

The AC current Channels are marked as **1-4** (*see picture above*).

The inputs are designed to operate only with Elspec G4500 BLACKBOX compatible current probes. When the probe is connected and indentified, the corresponding LED illuminates in blue.

Maximum input voltage	5VDC	
Recording resolution	256 samples per cycle, continuous	
Suitable probe types	AC voltage output probes Rogowski flexible probes	

Auxiliary AC/DC Current Channel

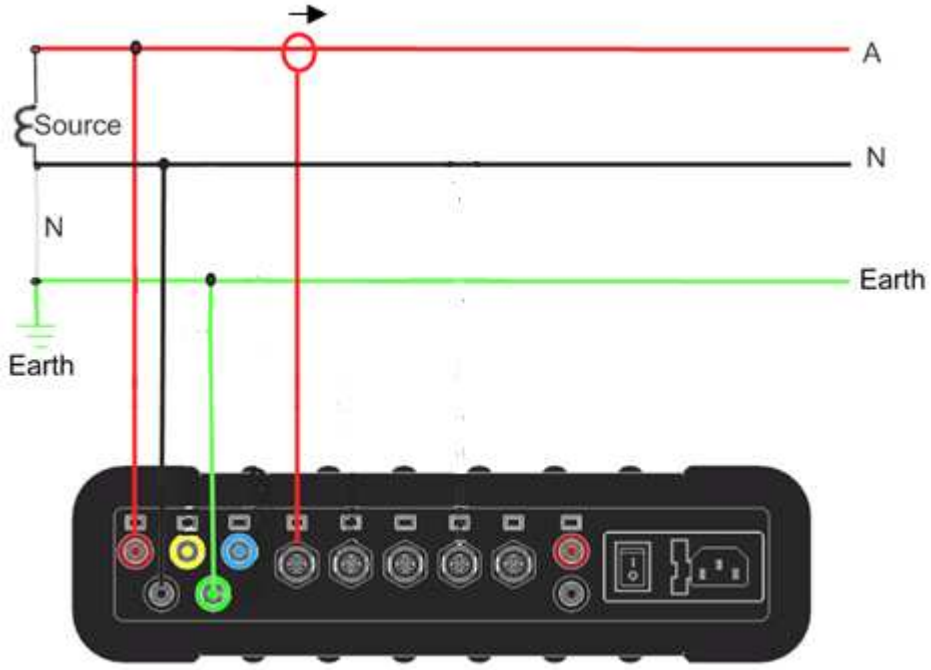
The Auxiliary AC/DC Current Channel is marked as **Idc.**

Maximum voltage	5VDC
Recording resolution	256 samples per cycle, continuous
Suitable probe types	AC/DC voltage output probes Rogowski flexible probes

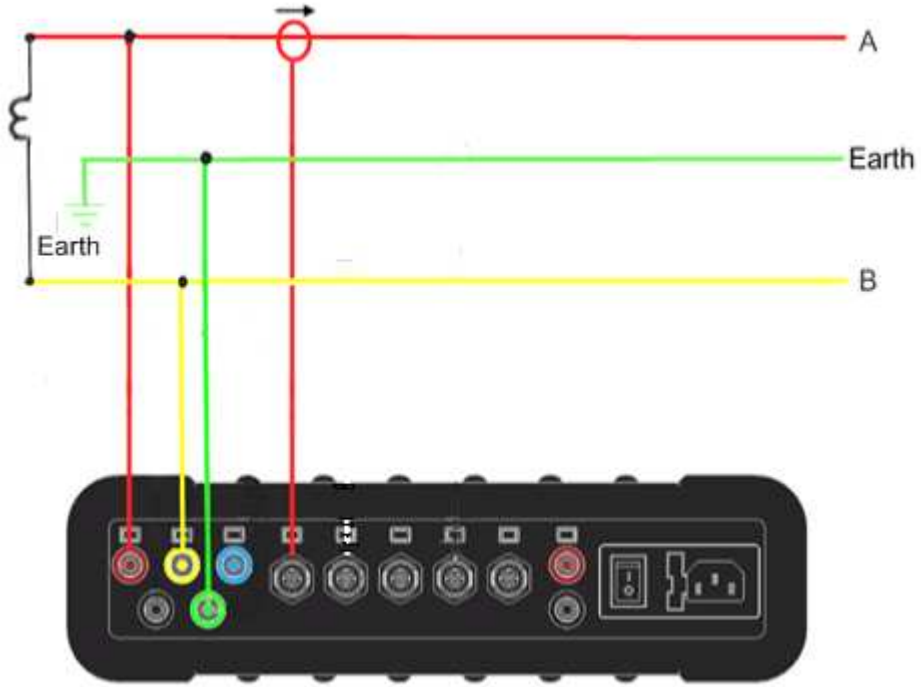
Power Type Diagrams

The G4500 BLACKBOX Portable is designed to serve in virtually any power topology configuration. Below are some of the most popular power types with suggested connection diagrams.

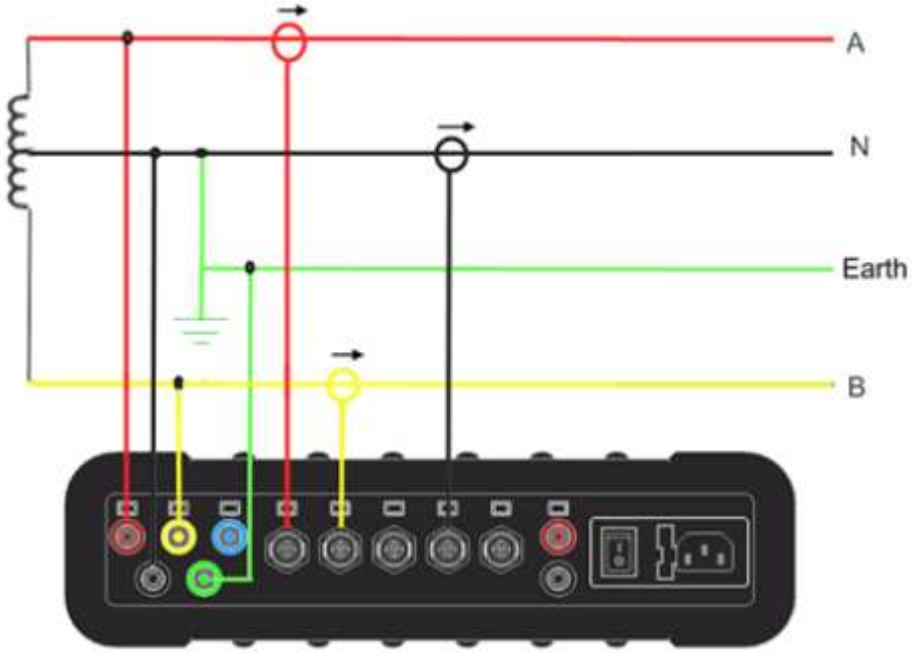
Single Phase with Neutral



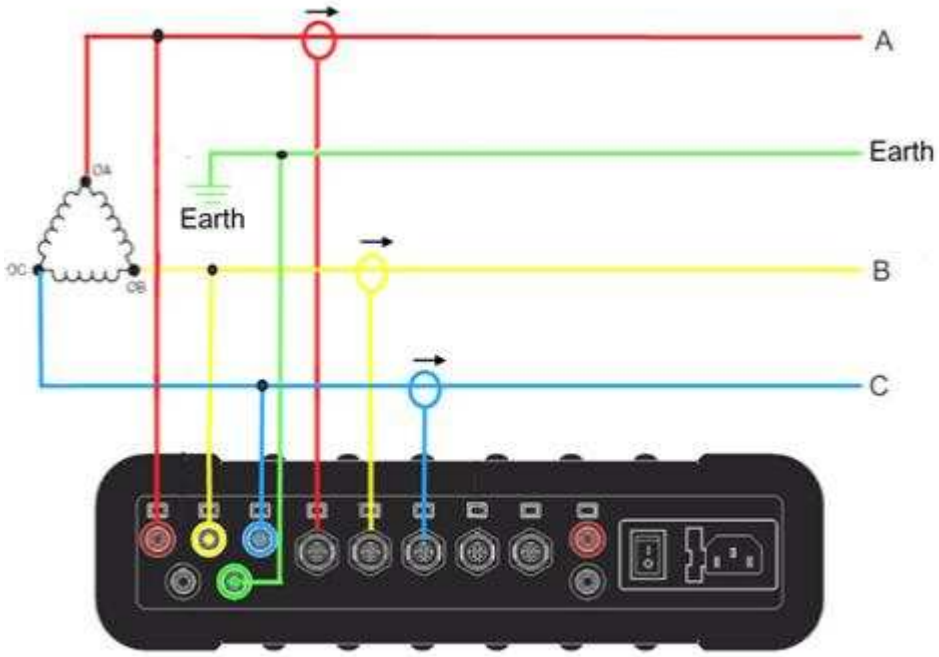
Single Phase without Neutral



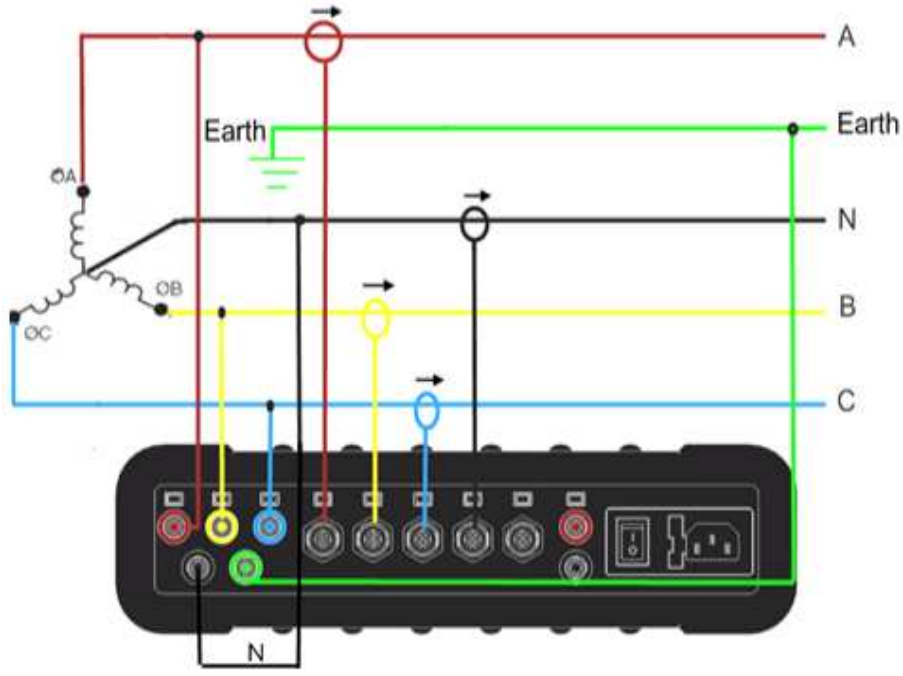
Single Split Phase



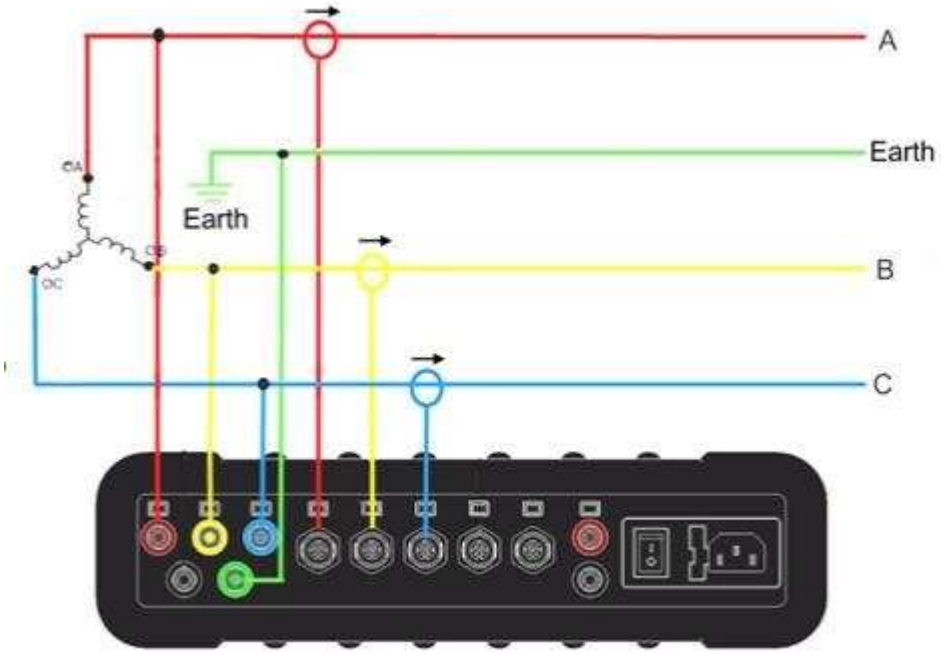
Three Wire Delta



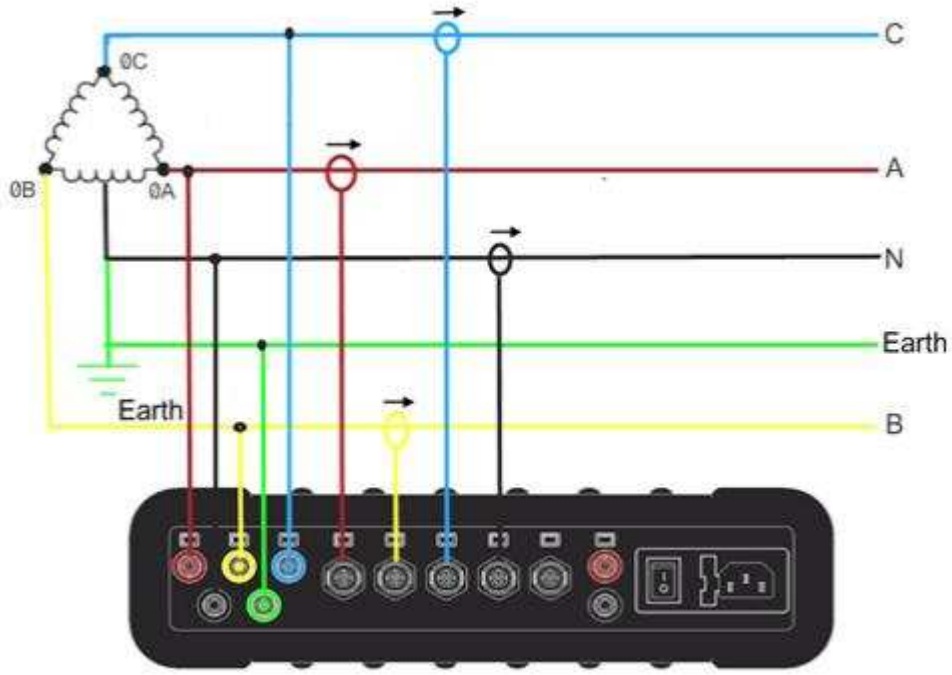
Four Wire WYE



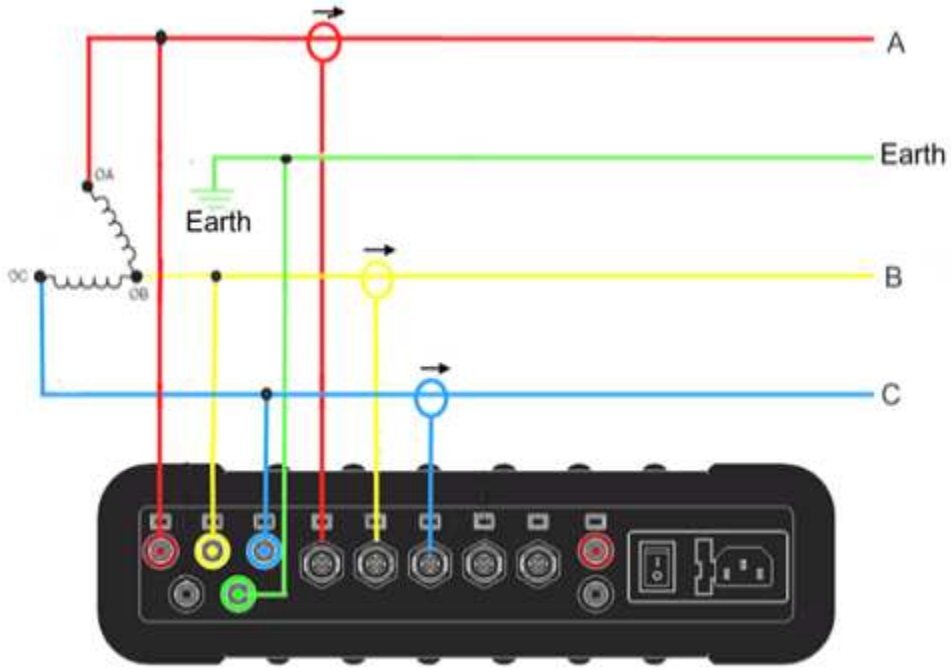
Three Wire WYE



Delta High Leg



Delta Open Leg



Power Supply

The BLACKBOX Portable can be powered by a main AC/DC or auxiliary DC power supply. The auxiliary power supply can be used with the main power supply at the same time, providing better redundancy.

Main Power

When the Main Power Supply ON/OFF switch (refer to **Rear Panel on page 10**) is switched ON, the internal battery starts charging regardless of an Operation ON/OFF switch position.

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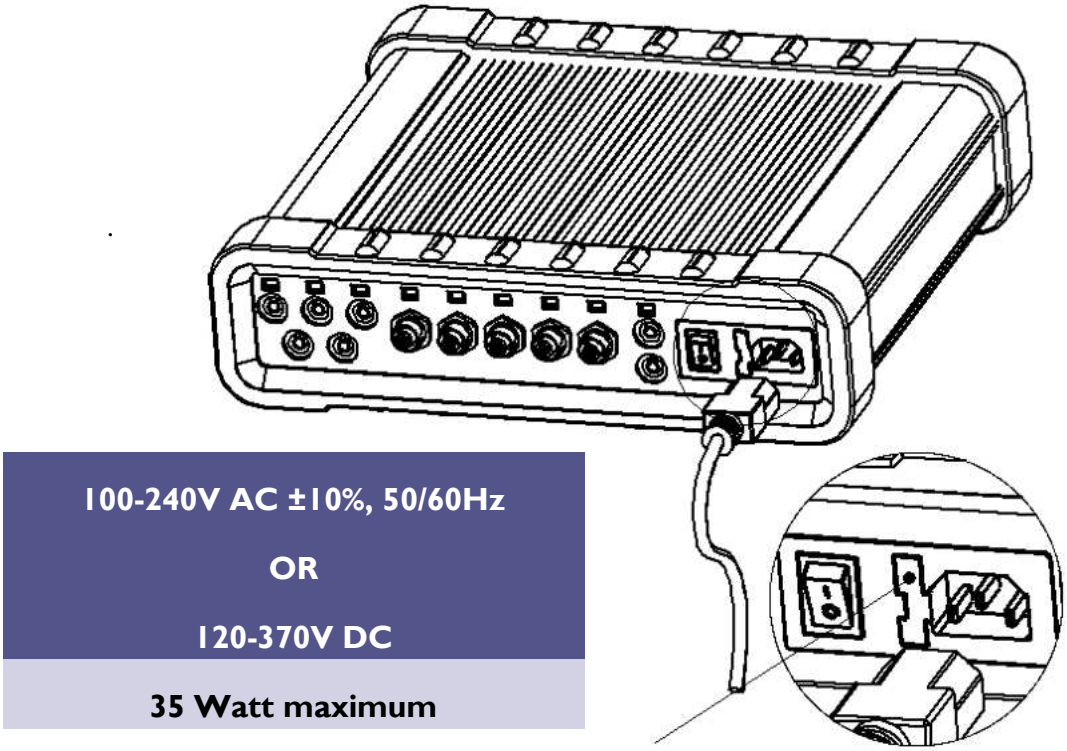


100-240V AC ±10%, 50/60Hz

OR

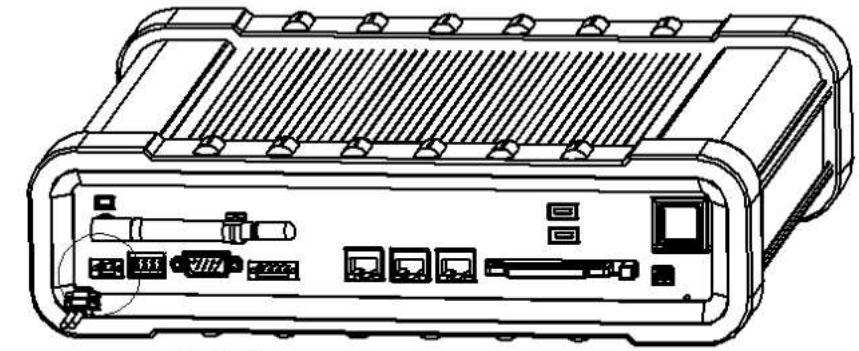
120-370V DC

35 Watt maximum

2A/250V fuse holder

Allow only suitable fuse replacement!

Auxiliary Power Supply



48V DC

(35- 55V)

35 Watt maximum

No replaceable fuse protection!

Do not allow significant overvoltage!

Status Indications

Battery Status Indicator

(Refer to: Front Panel on page 10**)**

Status	State
Flashing blue	Main or auxiliary power applied, Battery charging
Solid blue	Main or auxiliary power applied, Battery fully charged
Red	No main or auxiliary power available, Powered by internal battery

Operation ON/OFF Switch's Indicator

(Refer to: Front Panel on page 10**)**

Status	State
Flashing blue	Booting or shutting down
Solid blue	Normal operation

Operational Status Indicator

(Refer to: Front Panel on page 10**)**

Status	State
Solid blue	Normal operation, PQZip recording active
Solid Red	PQZip OFF / Flash Error / DSP Error / Error in initialization
Blinking Blue	Initialization state
Blinking Red	Communication Problem / Logger Problem / Shutdown in process

Internal UPS

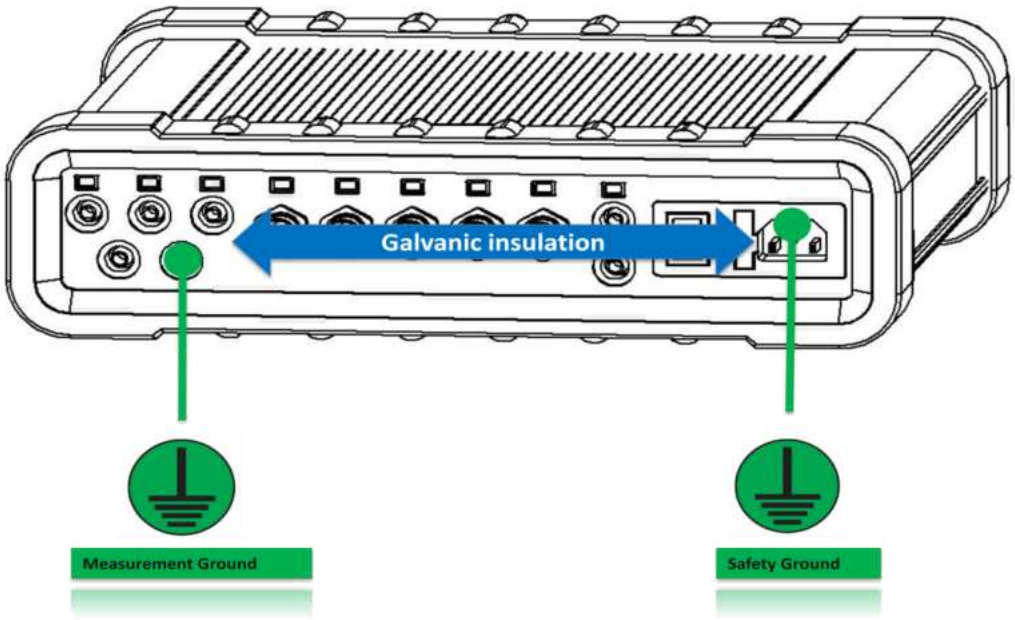
The BLACKBOX Portable contains an internal, uninterruptable power supply module providing a short period of self-powered measurements sessions and/or power supply interruptions ride-through.

The Internal UPS system contains a lithium battery for a up to 2 hours of fully-functioning operation and a super capacitors module allowing an additional 25 seconds of short interruptions ride-through even in the case of the main battery being fully discharged.

The battery and super capacitors modules require no maintenance and are de-signed for a long service life. However, if the battery shows a significant de-crease in performance, it should be replaced with a factory original. Consult with your local Elspec agency for replacement battery ordering information. Please refer to **Replacing the Battery on page 135.**

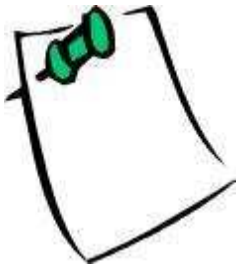
Grounding

The BLACKBOX Portable contains two independent ground systems:



- **Measurement ground:** The reference ground for a measured electrical system
- **Safety ground:** The line cord ground, same potential to all enclosure and connectors-related metal parts

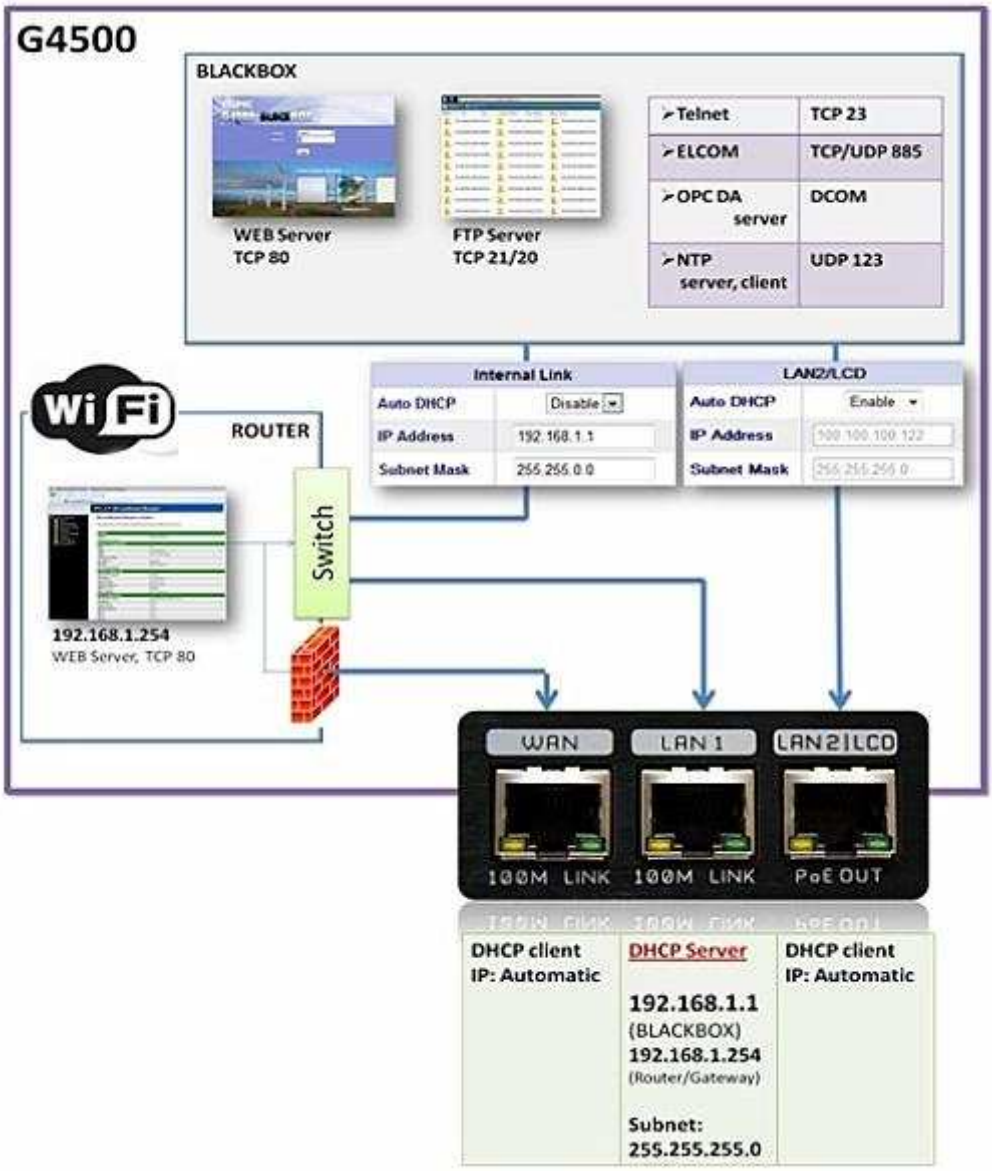
The ground systems are internally isolated to avoid ground loops when externally they could be safely connected to the same or different ground systems.



Maximum permitted voltage between Safety and Measurement grounds is 2kV DC or 1.5kV AC.

Networking

Ethernet Ports View

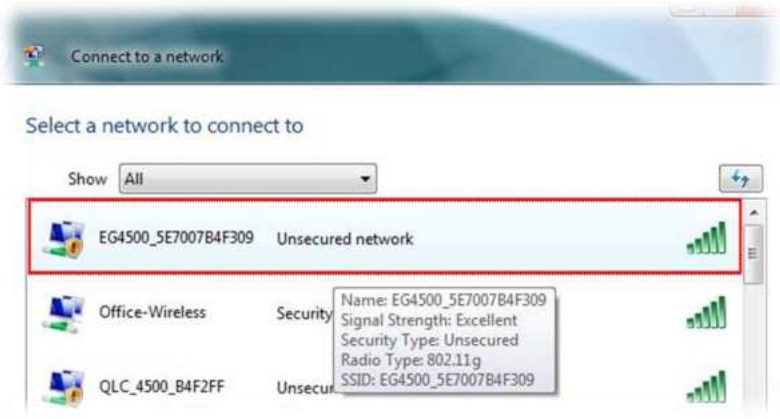


The above figure shows the factory default setting for the internal LAN and its default IP addresses for external use.

The BLACKBOX Portable has 3 fast Ethernet link 10/100Mb ports in addition to the wireless access point:

- **Wide Area Network (WAN):** Designed to connect the device's internal LAN with other types of networks. The most useful usage scenario would be connecting to the external Broadband router such as ADSL, Cable or Cellular for global, over Internet accessibility.
- **LAN1:** The main Ethernet port with DHCP server configured as active. This port is the main choice for a standalone PC or Laptop connection with the unit.
- **LAN2/LCD*:*** Direct connection port to the BLACKBOX device, bypassing the internal router. This port is mainly suitable for connecting the unit with a local LAN of computers.

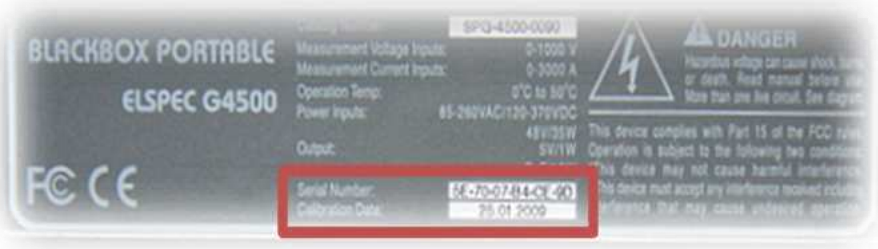
The Wi-Fi Access Point



The BLACKBOX Portable contains an integrated IEEE 802.11g/b router pre-configured as an industry standard access point. This is to provide the most convenient and simplest connectivity with the Mobile Analysis Lab or any other laptop or desktop Wi-Fi-enabled PC.

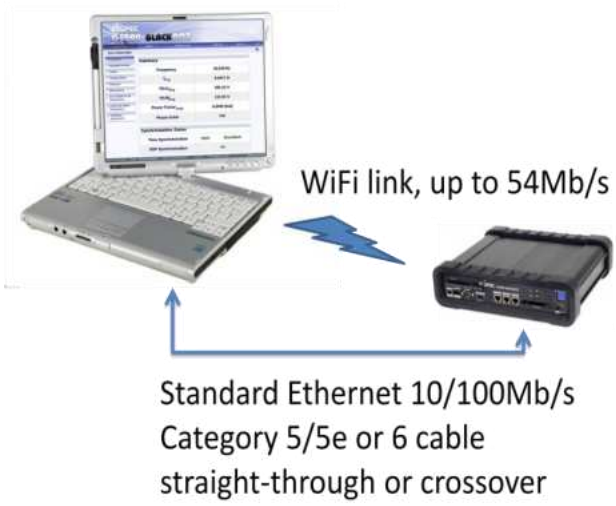
The internal Wi-Fi Access Point is configured by the factory default as an unsecure network. The SSID name is configured as EG4500_[*device serial number*].

The [*device serial number*] is a unique string which allows for distinguishing among several available devices. The device serial number is located on the name plate as shown below.



The Wi-Fi link is active when a Wi-Fi activity indicator light is flashing or solid blue.

A Mobile Analysis Lab or a Single PC Connection



The most convenient way to connect a Mobile Analysis Lab or any other PC is by using a Wi-Fi or wired Ethernet link. It is best to make only one connection type at time, and when a wired connection is used, disconnect or disable the wireless link.

Technically, any of the available Ethernet ports can be used for a single PC connection. However, the most recommended is a LAN1 option (as shown above) because of the integrated DHCP server available thru that port. When connected, a PC will automatically obtain an IP address configuration which allows a seamless connection to the BLACKBOX Portable's internal WEB/FTP servers as well as to a router management WEB server.

Office LAN Connection

When connected to an Office network, it most likely already employs a DHCP server. Do not connect a BLACKBOX Portable to the office network by LAN1 port, since an Office DHCP server operation could be interrupted which could lead to severe network malfunctions.

Use only WAN or LAN2 ports connecting to DHCP active LANs

Serial Communication

The BLACKBOX Portable is equipped with 2 isolated Serial Communication interfaces.

RS232 Interface

A standard DTE (Data Terminal Equipment) interface suitable for direct communication with COM compatible interface, such as a standard PC serial COM port

Description	Symbol	Pin no.
Data Carrier Detect	DCD	1
Receive Data (Serial data input)	RDx	2
Transmit Data (Serial data output)	TDx	3
Data Terminal Ready.	DTR	4
Signal ground	SG	5
Data ready state	DSR	6
Request to send	RTS	7
Clear to send	CTS	8
Ring Indicator	RI	9

Specifications

Maximum cable length	Up to 50 feet (15.2m)
Supported protocols	TTY mode (HyperTerminal, Telnet emulation) MODBUS RTU GPS
Duplex	Full
Insulation	2kV
Suitable plug connector type	Industry standard D-Type 9 pins, Female
Default configuration	Baud rate: 19200, Data bits:8 , Parity: None, Stop Bits:1

RS485/422 Interface

A standard RS485 (full duplex) or RS422 (half duplex) interface

The connector pin description is shown below.

1	2	3	4
TxD +	TxD -	RxD +	RxD -

Specifications

Maximum cable length	Up to 500 feet (152m)
Supported protocols	TTY mode (HyperTerminal,Telnet emulation) MODBUS RTU GPS
Duplex	Half/Full
Insulation	2kV
Suitable plug connector type	ENT-1004-0190 (supplied as default accessory, *refer to page 7*)
Default configuration	Baud rate: 19200 Data bits: 8 Parity: none Stop bits: 1
Supported data rates	19200 1200 2400 4800 9600 14400 19200 38400 57600 115200
Wiring requirements	24AWG twisted pair
Termination	Shunt capacitance of 16pF per foot

Temperature Sensor

The BLACKBOX Portable is equipped with an external connection terminal for a 2-wire PT-100 temperature sensor. The PT100 is an industry standard thermo-couple. Pt100 is also called an RTD element (Resistance Temperature Detector).

Suitable plug connector type	ENT-1002-0191 (supplied as default accessory, *refer to page 7*)	
Insulation	No insulation	

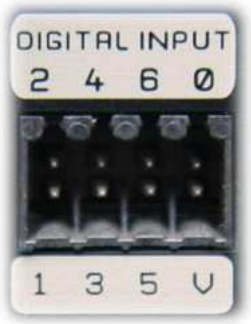
Digital Inputs

The BLACKBOX Portable has 6 Digital Inputs for continuous recording.

Specifications Maximum voltage	50VDC
Insulation	1kV
Sampling rate	16 times per cycle (~1.25mSec at 50Hz, ~1mSec at 60Hz)
Contact type	Dry contact

Pin Description

Pin no.	Description
1	Digital Input #1
2	Digital Input #2
3	Digital Input #3
4	Digital Input #4
5	Digital Input #5
6	Digital Input #6
V	+5V
0	Common



Reset Button

The Reset Button serves two main purposes:

- Check LED operation.
- Restore factory default settings.

To perform an action, the instrument should be powered ON and the Operational Status Indicator should be solid blue or red.

The button can be accessed by a sharp instrument such as a small screwdriver (*as shown*).

Press and hold the reset button:

After **5** seconds – All LEDs turn on. At that stage you can check if all the LEDs are okay.

After an additional **8** seconds-- The BLACKBOX Portable reboots and restarts with the factory default settings.

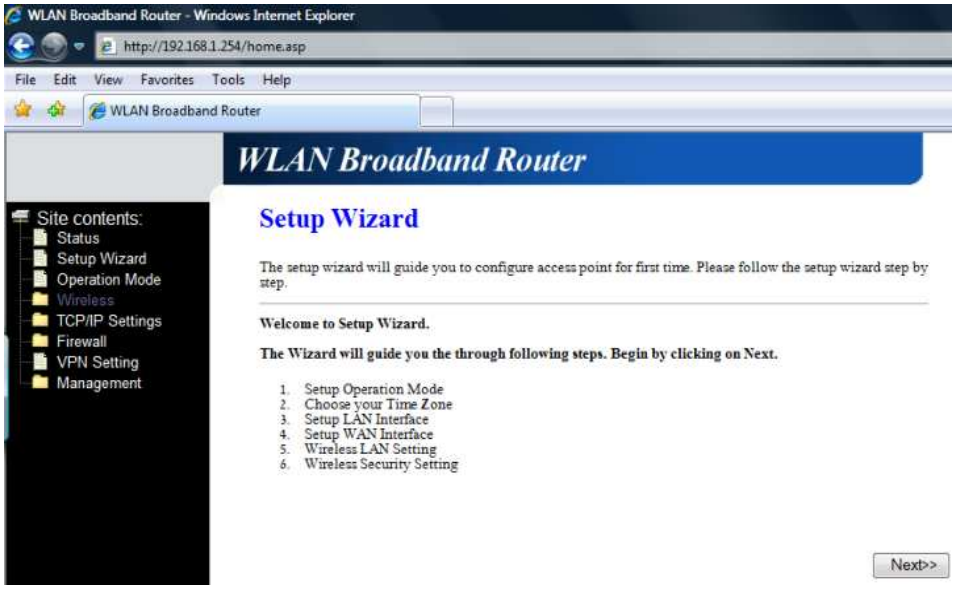
Wireless Router

1. To access the internal Wi-Fi router type **http://192.168.1.254** on a Microsoft Explorer address field.

A status WEB page appears:

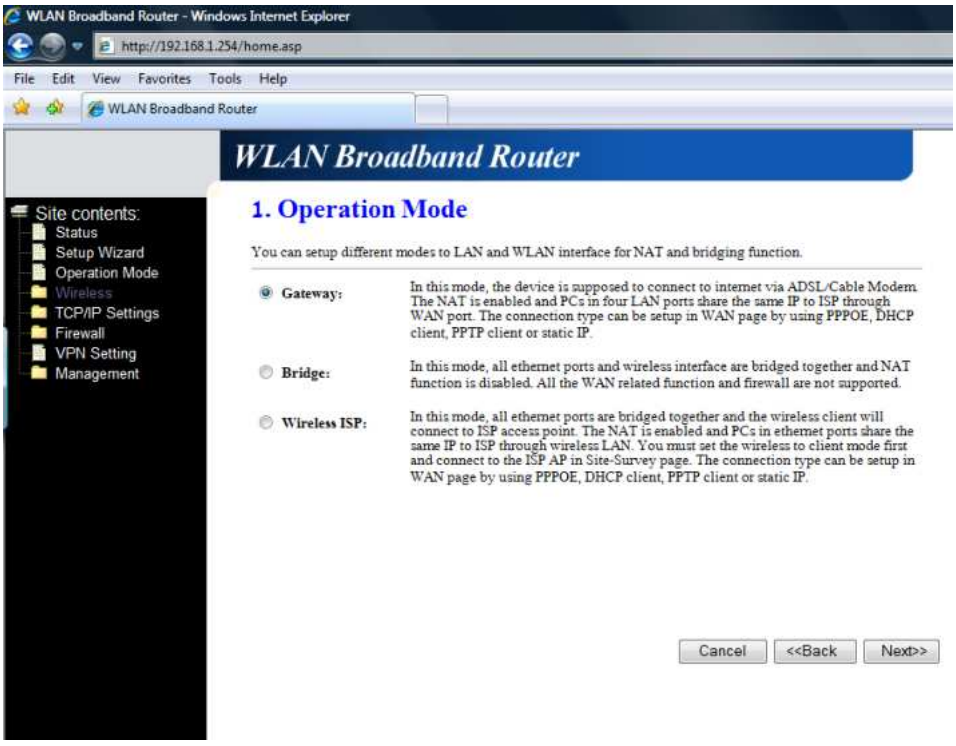
The most simplified way to verify settings or configure the router is using the **Setup Wizard (*marked in red above*).**

Factory Default Setup

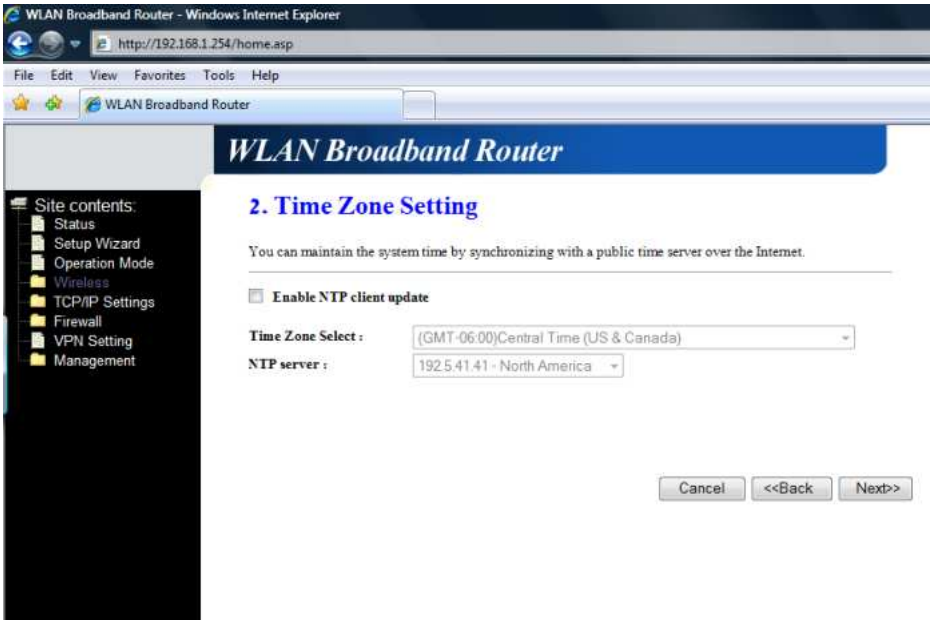


When initiated, the Setup Wizard begins with the above page.

2. To proceed with the setup procedure, press the ***next*** button.

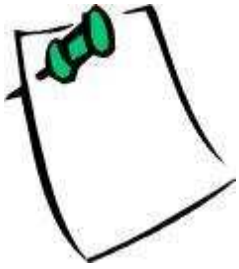


3. Define the mode of operation. (The default operation mode is Gateway).



4. The second step is for the configuration of the automatic time synchronization option.

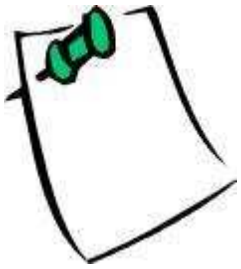
The default configuration for the router's time synchronization is **Disabled**.



The time synchronization refers to the router's internal time only. This setting has no influence on the G4500 time synchronization. Refer to G4500 website configuration for G4500 time synchronization options.

5. Specify the IP address and subnet mask for the router management interface, then click **Next.**

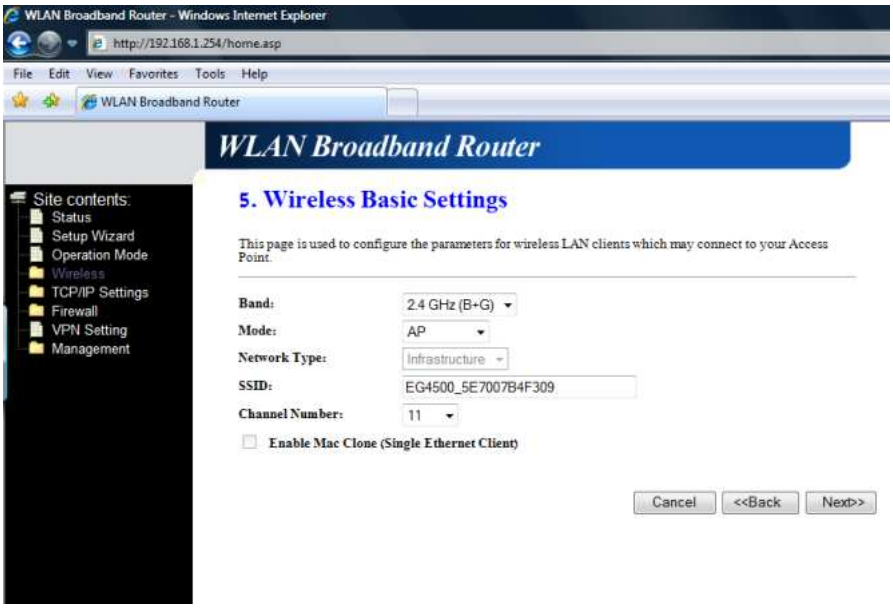
The default configuration is **192.168.1.254** with **255.255.255.0** subnet mask.



Change the G4500 LAN1 configuration accordingly when you modify the default IP address for the router.

Refer to G4500 website configuration for details.

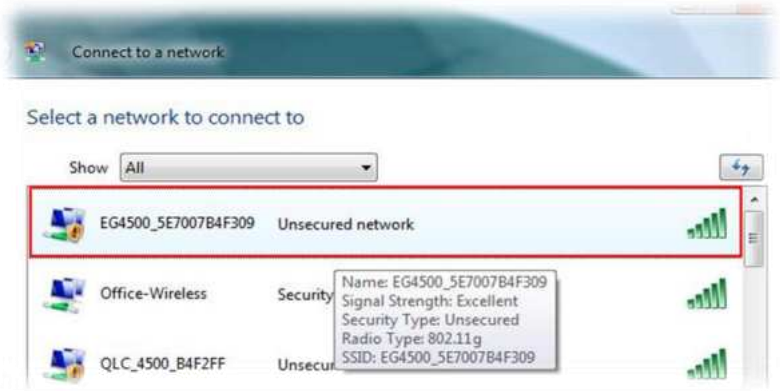
6. Set the WAN port operation type. The default setting is **DHCP Client**.



7. Configure the basic configuration of the Wireless interface.

The default settings are:

- Band: 2.4Ghz (B+G), enabling both 802.11b and 802.11g interfaces
- Mode: AP, (Access point)
- SSID: EG4500_[serial number]. Define what name string (SSID string) will appear on a list of wireless networks available.



- Channel number: 11. The 2.4 GHz Wi-Fi signal range is divided into a number of smaller bands or "channels," similar to television channels. But unlike television channels, some Wi-Fi channel numbers overlap each other. Channel 1 uses the lowest frequency band and each subsequent channel increases the frequency slightly. Therefore, the further apart two channel numbers are, the less the degree of overlap and likelihood of interference. If encountering interference with a neighbor's WLAN, change to a distant channel.
- Enable Mac clone: **Disabled**

8. Select your security method for the wireless interface. The default setting is: None– unsecured.

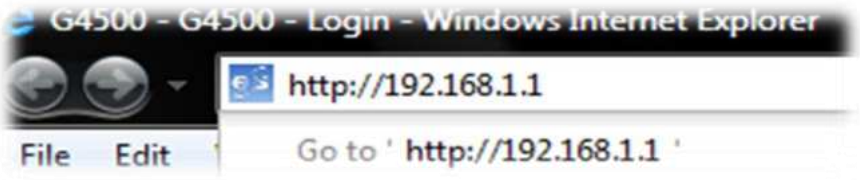
When complete the final screen appears.

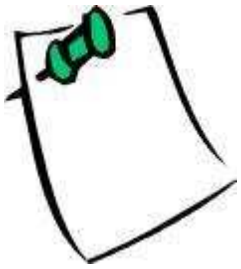
Website

The BLACKBOX Portable's internal Website is designed to serve as a main user interface with the instrument, providing enhanced management, configuration and real-time monitoring functionality.

Access

When a wired or wireless Ethernet connection is established, the internal Website can be accessed by simply typing the device IP address in the address field on a WEB browser application.





The Website is optimized to work with Microsoft© Explorer 7. Other web browser applications can limit some functionality and/or show an incorrect layout.

For local networking the browser should be configured as working without a proxy server. Refer to

Disabling Proxy Server in Internet Explorer chapter for instructions.

When the device IP address is unknown, use the Elspec Search utility to discover it. (Refer to page 102)

Login Page

The first page to appear is a Login Page.

Choose the interface language. The supported languages are:

- English (Default)
- Russian
- German
- Spanish

(For other languages – please contact your local Elspec distributor.)

The Password field defines user level/privileges. Two user levels are supported:

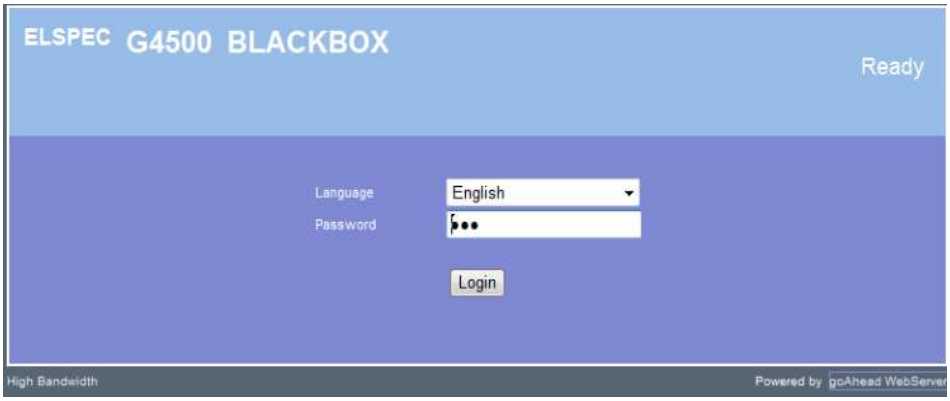
User level	Password	Role
Viewer	**123**	Read only, can choose interface language only, no operations related changes are allowed
Admin	**12345**	Administration, setup and full control

The passwords above are factory default values. You are advised to modify Admin password if extended security measures are required.

Low Bandwidth

If you have low bandwidth access, it is possible to reduce the site's complexity by using fewer graphics, images and other data.

To activate a graphics-free interface, press the *Low Bandwidth* button as shown above.



A graphics-free interface appears. To deactivate the feature, press *High Bandwidth*.

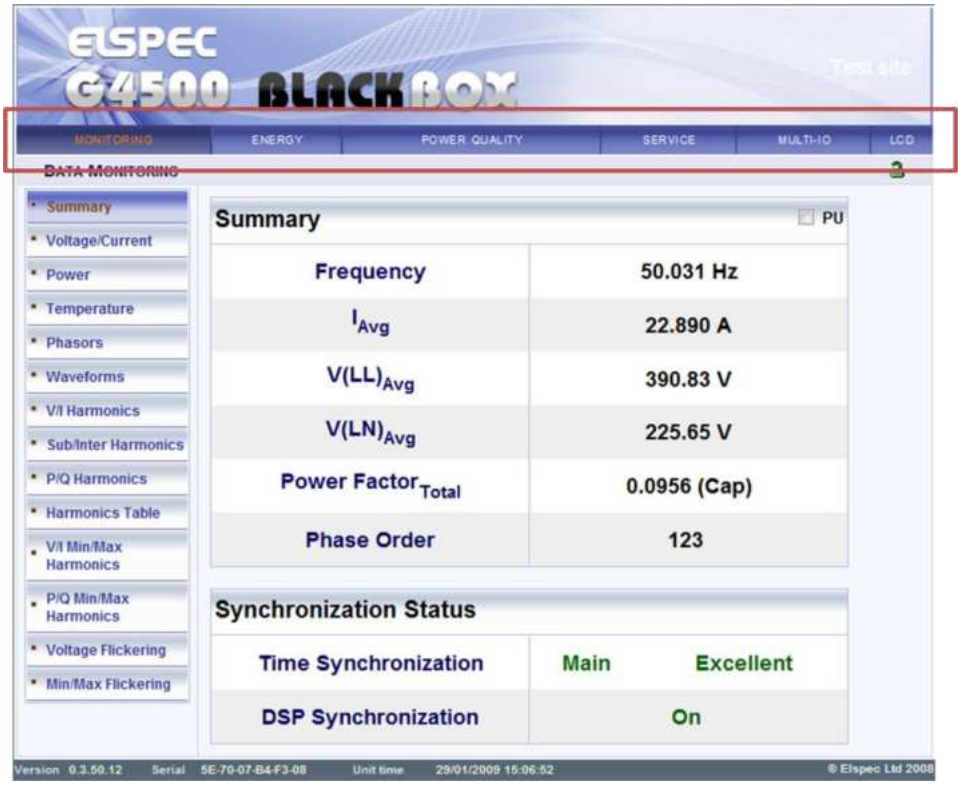
System Limitations

The BLACKBOX Portable's integrated Web Server is designed to support a maximum of 3 concurrent user interface connections. However, the Admin level can be logged in only one at a time. In the event that a new Admin connection is established (a user has successfully logged in with Admin password), the previous Admin connection will be automatically logged off. Also, any Admin connection which is idle for more than 5 minutes will be automatically logged off.

The Site Structure

The BLACKBOX Portable embedded website is organized into 6 subsections:

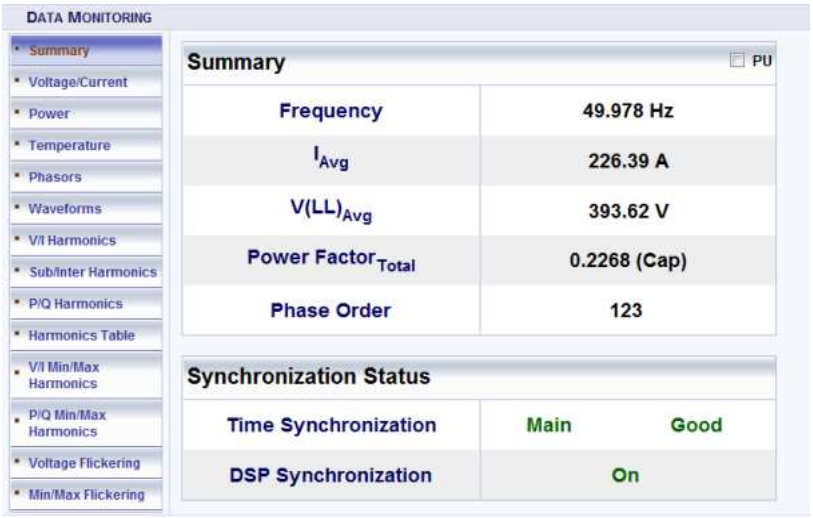
- **Monitoring:** Real time monitoring of a variety of electrical parameters
- **Energy:** Integrated energy meter readings
- **Power Quality:** Power Quality standard compliance monitoring and setup
- **Service:** Main entry for setup and device status monitoring
- **Multi-IO:** Integrated digital inputs setup and monitoring
- **LCD:** A virtual, black and white LCD emulation



Monitoring Section

The Monitoring section contains the following pages:

Summary



- Frequency
- Average Voltage and Currents
- Total Power Factor
- Phase Order
- Synchronization status

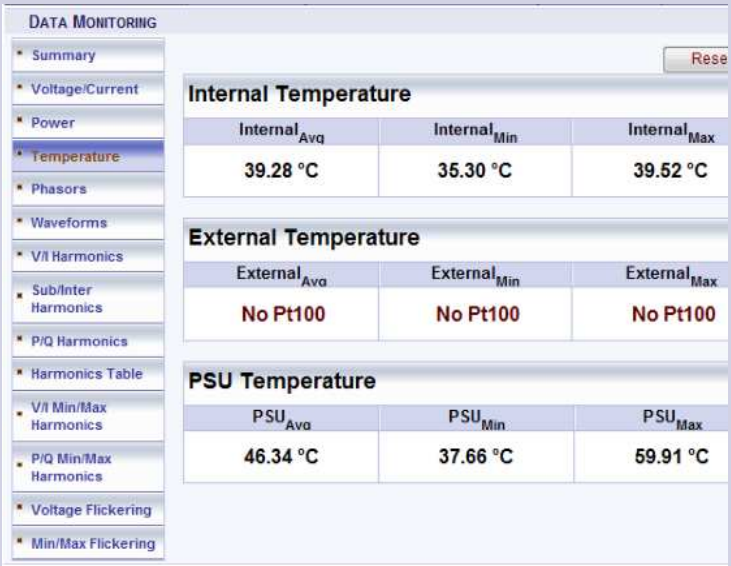
Voltage/ Current

- RMS Voltages and Currents per phase
- Unbalance, Positive and Negative Sequences
- DC Voltage and Current channels readings

Power

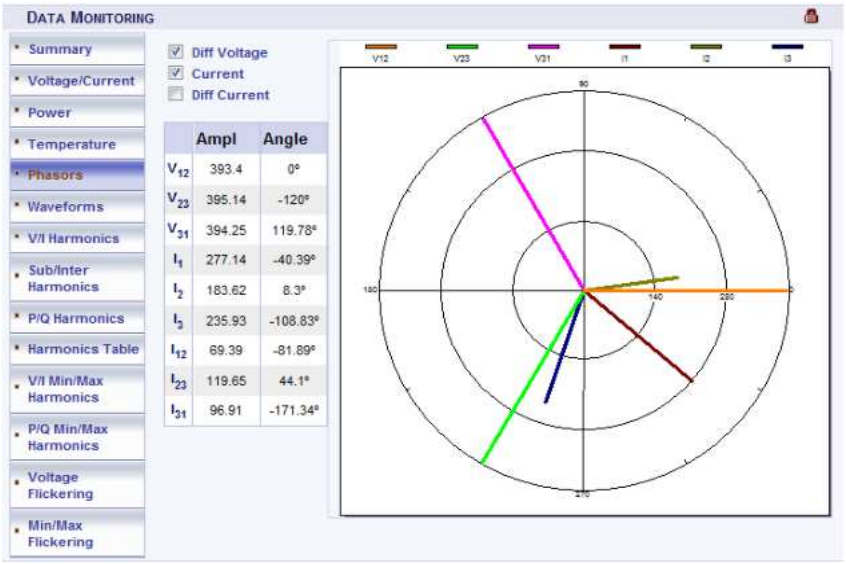
- Active Power
- Reactive Power
- Apparent Power
- True and Displacement Power Factor

Temperature



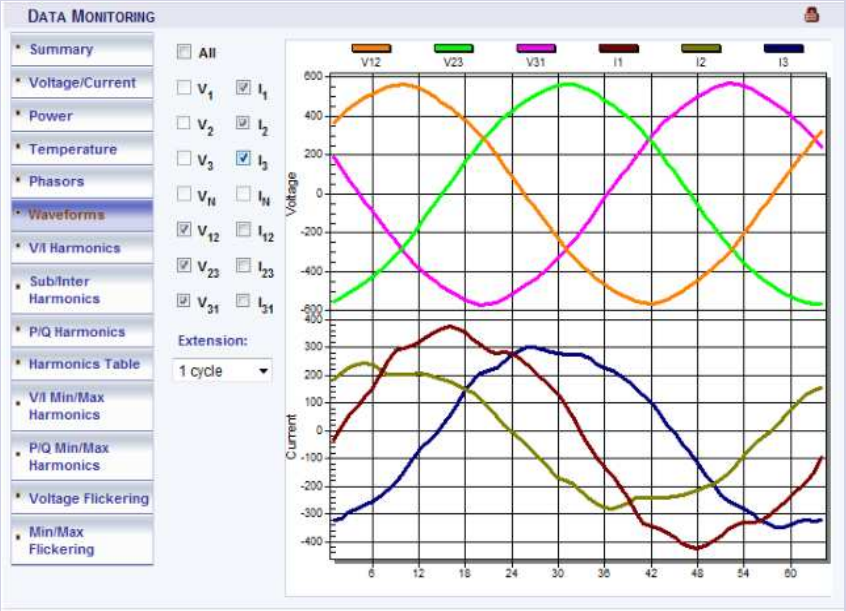
- Internal and External Temperature readings

Phasors



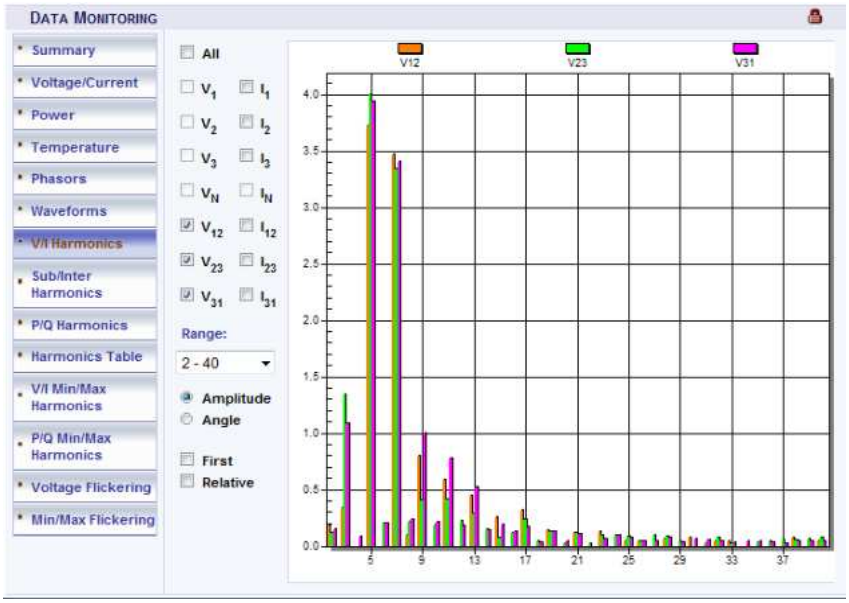
- Voltage and Current Phase diagram
- **Refer to Graphic Data Representation paragraph below**

Waveforms



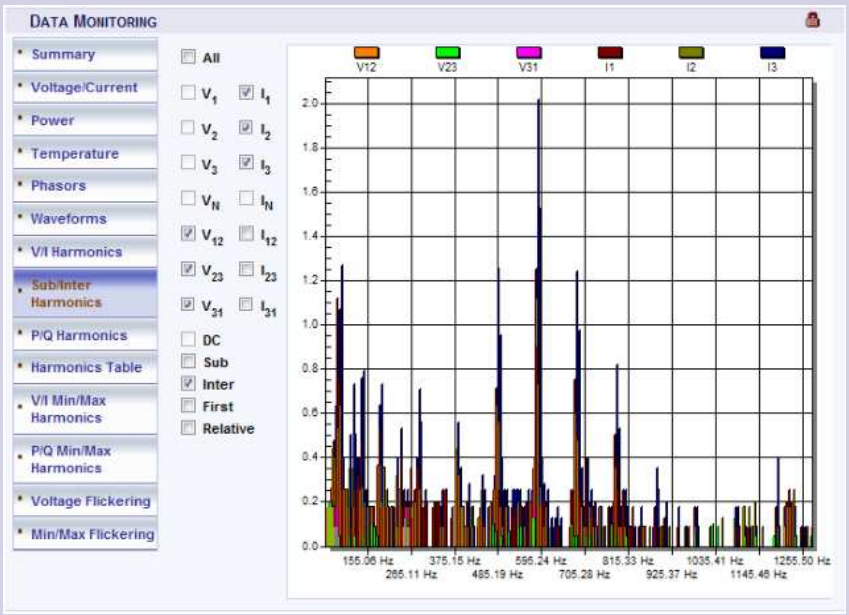
- **Voltage and Current waveforms**
- **Refer to Graphic Data Representation paragraph below**

V/I Harmonics



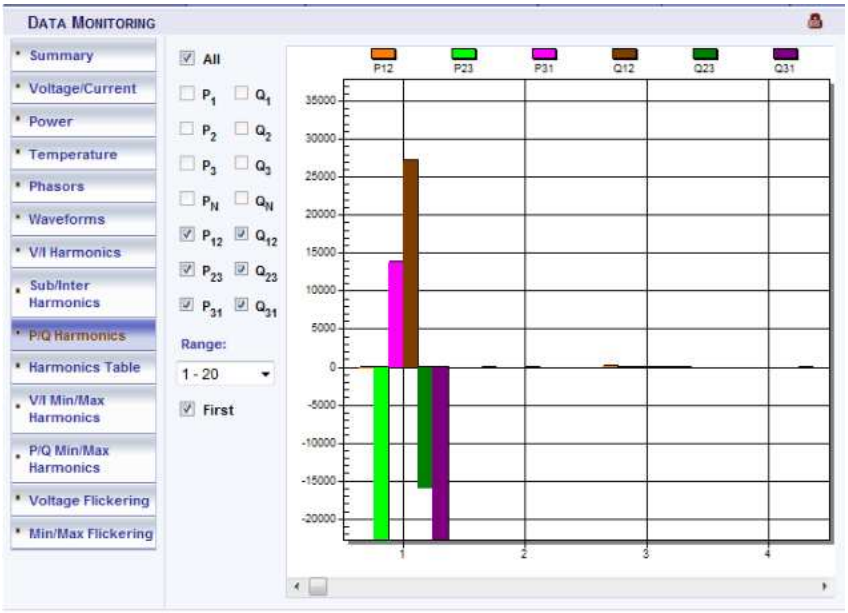
- Voltage and Current harmonics spectrum (up to 40)
- **Refer to Graphic Data Representation paragraph below**

Sub/Inter harmonics



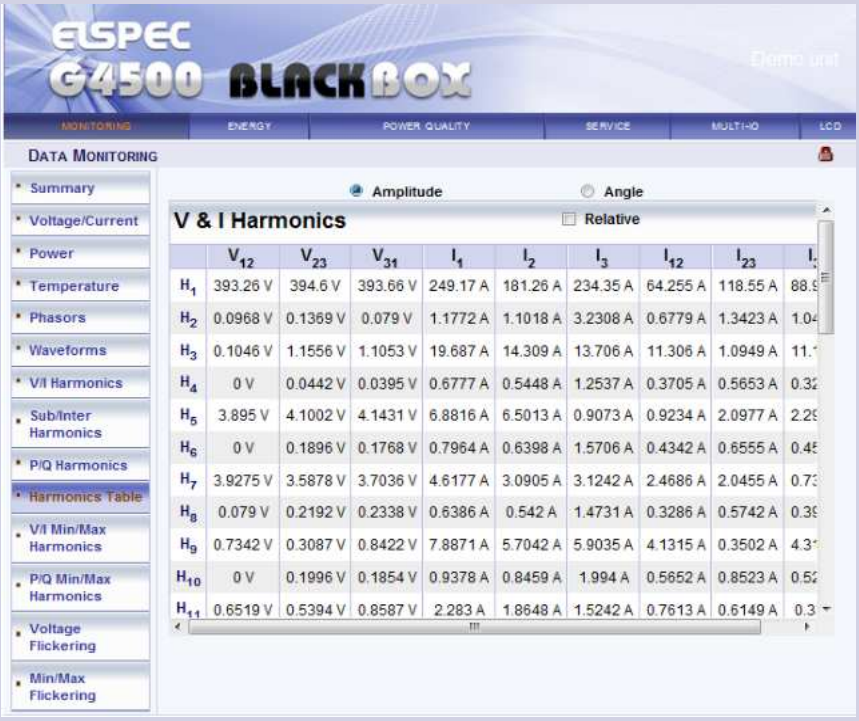
- **Voltage and Current sub and inter harmonics (in 5Hz bins)**
- **Refer to Graphic Data Representation paragraph below**

P/Q Harmonics



- **Active and Reactive Harmonic powers**
- **Refer to Graphic Data Representation paragraph below**

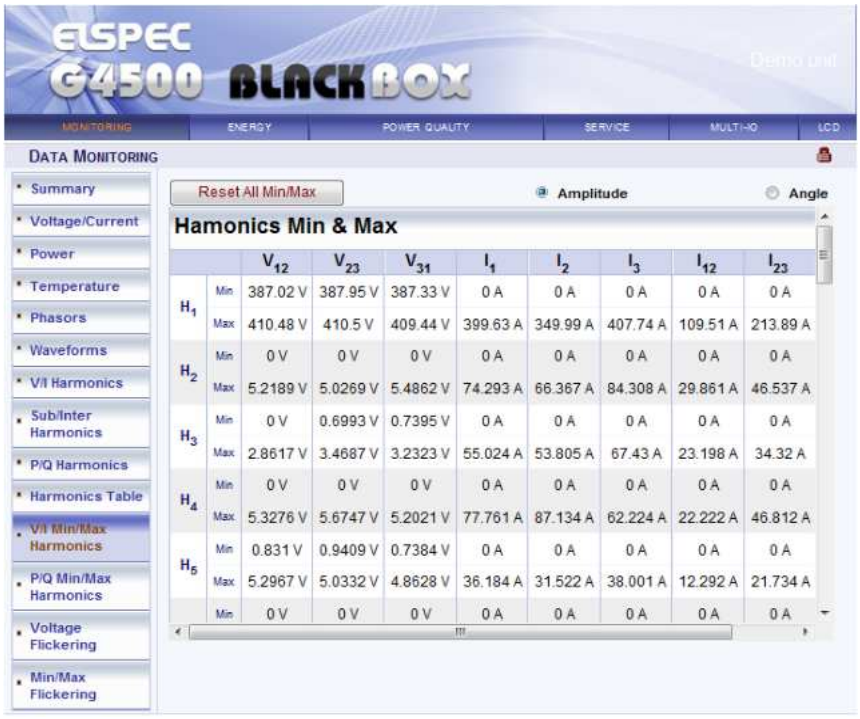
Harmonics Table



	V_{12}	V_{23}	V_{31}	I_1	I_2	I_3	I_{12}	I_{23}
H_1	393.26 V	394.6 V	393.66 V	249.17 A	181.26 A	234.35 A	64.255 A	118.55 A
H_2	0.0968 V	0.1369 V	0.079 V	1.1772 A	1.1018 A	3.2308 A	0.6779 A	1.3423 A
H_3	0.1046 V	1.1556 V	1.1053 V	19.687 A	14.309 A	13.706 A	11.306 A	1.0949 A
H_4	0 V	0.0442 V	0.0395 V	0.6777 A	0.5448 A	1.2537 A	0.3705 A	0.5653 A
H_5	3.895 V	4.1002 V	4.1431 V	6.8816 A	6.5013 A	0.9073 A	0.9234 A	2.0977 A
H_6	0 V	0.1896 V	0.1768 V	0.7964 A	0.6398 A	1.5706 A	0.4342 A	0.6555 A
H_7	3.9275 V	3.5878 V	3.7036 V	4.6177 A	3.0905 A	3.1242 A	2.4686 A	2.0455 A
H_8	0.079 V	0.2192 V	0.2338 V	0.6386 A	0.542 A	1.4731 A	0.3286 A	0.5742 A
H_9	0.7342 V	0.3087 V	0.8422 V	7.8871 A	5.7042 A	5.9035 A	4.1315 A	0.3502 A
H_{10}	0 V	0.1996 V	0.1854 V	0.9378 A	0.8459 A	1.994 A	0.5652 A	0.8523 A
H_{11}	0.6519 V	0.5394 V	0.8587 V	2.283 A	1.8648 A	1.5242 A	0.7613 A	0.6149 A

- Voltage and Current harmonics in values, % and angles

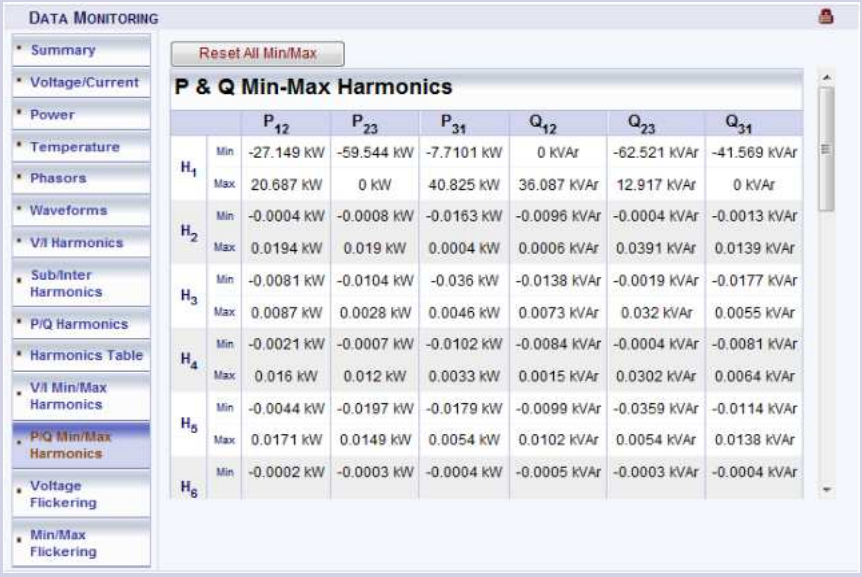
V/I Min/Max Harmonics



		V_{12}	V_{23}	V_{31}	I_1	I_2	I_3	I_{12}	I_{23}
H_1	Min	387.02 V	387.95 V	387.33 V	0 A	0 A	0 A	0 A	0 A
	Max	410.48 V	410.5 V	409.44 V	399.63 A	349.99 A	407.74 A	109.51 A	213.89 A
H_2	Min	0 V	0 V	0 V	0 A	0 A	0 A	0 A	0 A
	Max	5.2189 V	5.0269 V	5.4862 V	74.293 A	66.367 A	84.308 A	29.861 A	46.537 A
H_3	Min	0 V	0.6993 V	0.7395 V	0 A	0 A	0 A	0 A	0 A
	Max	2.8617 V	3.4687 V	3.2323 V	55.024 A	53.805 A	67.43 A	23.198 A	34.32 A
H_4	Min	0 V	0 V	0 V	0 A	0 A	0 A	0 A	0 A
	Max	5.3276 V	5.6747 V	5.2021 V	77.761 A	87.134 A	62.224 A	22.222 A	46.812 A
H_5	Min	0.831 V	0.9409 V	0.7384 V	0 A	0 A	0 A	0 A	0 A
	Max	5.2967 V	5.0332 V	4.8628 V	36.184 A	31.522 A	38.001 A	12.292 A	21.734 A
	Min	0 V	0 V	0 V	0 A	0 A	0 A	0 A	0 A

- Minimum and maximum values and angels of Voltage and Current harmonics

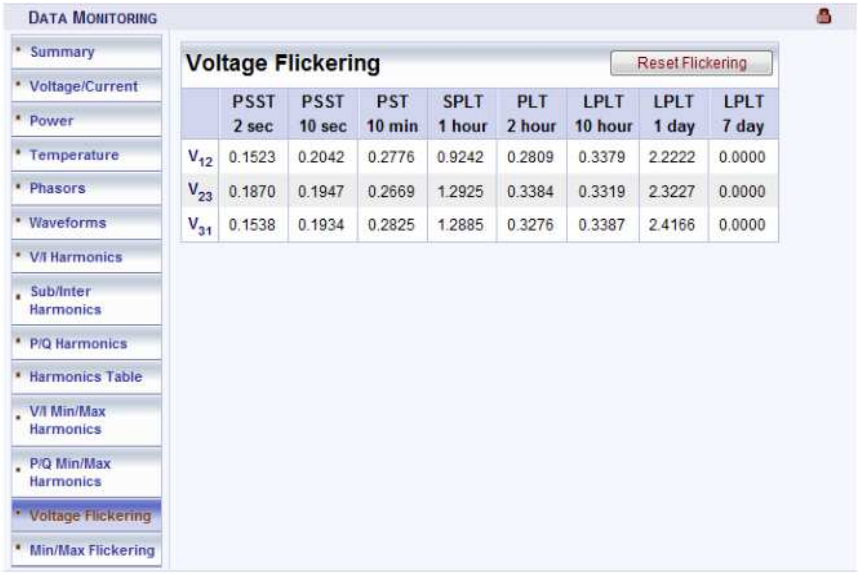
P/Q Min/Max Harmonics



		P_{12}	P_{23}	P_{31}	Q_{12}	Q_{23}	Q_{31}
H_1	Min	-27.149 kW	-59.544 kW	-7.7101 kW	0 kVAr	-62.521 kVAr	-41.569 kVAr
	Max	20.687 kW	0 kW	40.825 kW	36.087 kVAr	12.917 kVAr	0 kVAr
H_2	Min	-0.0004 kW	-0.0008 kW	-0.0163 kW	-0.0096 kVAr	-0.0004 kVAr	-0.0013 kVAr
	Max	0.0194 kW	0.019 kW	0.0004 kW	0.0006 kVAr	0.0391 kVAr	0.0139 kVAr
H_3	Min	-0.0081 kW	-0.0104 kW	-0.036 kW	-0.0138 kVAr	-0.0019 kVAr	-0.0177 kVAr
	Max	0.0087 kW	0.0028 kW	0.0046 kW	0.0073 kVAr	0.032 kVAr	0.0055 kVAr
H_4	Min	-0.0021 kW	-0.0007 kW	-0.0102 kW	-0.0084 kVAr	-0.0004 kVAr	-0.0081 kVAr
	Max	0.016 kW	0.012 kW	0.0033 kW	0.0015 kVAr	0.0302 kVAr	0.0064 kVAr
H_5	Min	-0.0044 kW	-0.0197 kW	-0.0179 kW	-0.0099 kVAr	-0.0359 kVAr	-0.0114 kVAr
	Max	0.0171 kW	0.0149 kW	0.0054 kW	0.0102 kVAr	0.0054 kVAr	0.0138 kVAr
H_6	Min	-0.0002 kW	-0.0003 kW	-0.0004 kW	-0.0005 kVAr	-0.0003 kVAr	-0.0004 kVAr

- Minimum and maximum values of Active and Reactive power harmonics

Voltage Flickering



	PSST 2 sec	PSST 10 sec	PST 10 min	SPLT 1 hour	PLT 2 hour	LPLT 10 hour	LPLT 1 day	LPLT 7 day
V_{12}	0.1523	0.2042	0.2776	0.9242	0.2809	0.3379	2.2222	0.0000
V_{23}	0.1870	0.1947	0.2669	1.2925	0.3384	0.3319	2.3227	0.0000
V_{31}	0.1538	0.1934	0.2825	1.2885	0.3276	0.3387	2.4166	0.0000

- Short and long term voltage flickering

Min/Max Flickering

		PSST 2 sec	PSST 10 sec	PST 10 min	SPLT 1 hour	PLT 2 hour	LPLT 10 hour	LPLT 1 day	LPLT 7 day
V_{12}	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	12.304	12.304	8.7238	8.7238	8.7238	2.3898	2.2222	0.0000
V_{23}	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	12.564	12.564	9.0972	9.0972	9.0972	2.4980	2.3227	0.0000
V_{31}	Min	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	Max	12.412	12.412	9.4539	9.4538	9.4538	2.5991	2.4166	0.0000

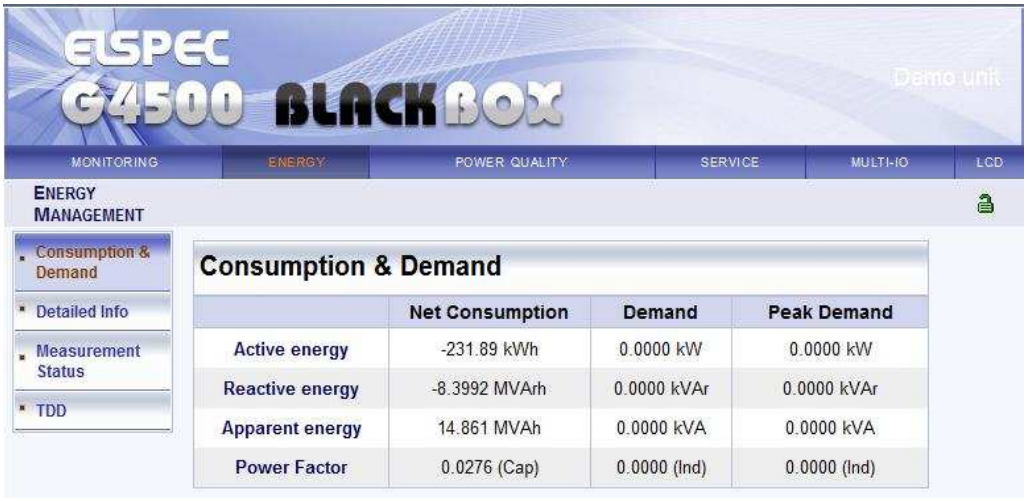
- Minimum and maximum flickering values

Graphic Data Representation

The BLACKBOX Portable website requires a third party ActiveX control (PE-Graph designed by Gigasoft) to present graphical data such as waveforms and harmonic spectral charts. The control can be downloaded from support section on http://www.elspec-ltd.com or directly from:

http://www.elspec.biz/g4kplugins/GigaPE.exe.

Energy Section

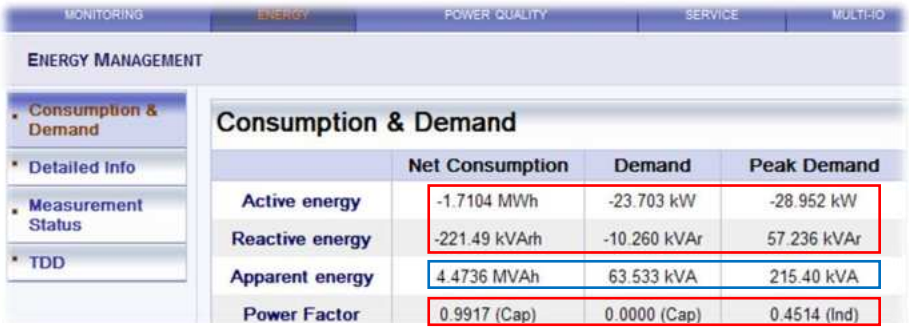


Energy is defined as power consumed over time. In electrical distribution systems, the unit of time is one hour for all energy measurements and the kWh is the basis for payment for buying and selling energy. This chapter focuses on the flow of energy or power both within a system (active, reactive) as well as the flow of power to and from the system to the grid (delivered or received). The following are commonly used terms in describing energy flow within a system:

- **Active or Real:** The portion of power flow that, averaged over a complete cycle of the AC waveform, results in the net transfer of energy in one direction expressed as kWh**.**
- **Reactive /Volt Amperes Reactive (kVArh):** Energy that flows back and forth with no actual power flow. Reactive power flow transfers no net energy to the load and is sometimes referred to as *wattless* power**.**
- **Apparent:** The combination of active and reactive energy (kVAh).
- **Power Factor:** The ratio between real power and apparent power (a value between 0 and 1).

Consumption & Demand

Energy is produced and consumed within an electrical distribution system. Some sites produce energy for the grid (Received Energy), others consume energy from the grid (Delivered Energy), and still others both consume and produce energy for/from the grid. The Net Consumption is the difference between energy that is used and produced. Therefore, a negative value for Net Consumption indicates that the site is producing more than it is consuming, or a *received net consumption*.



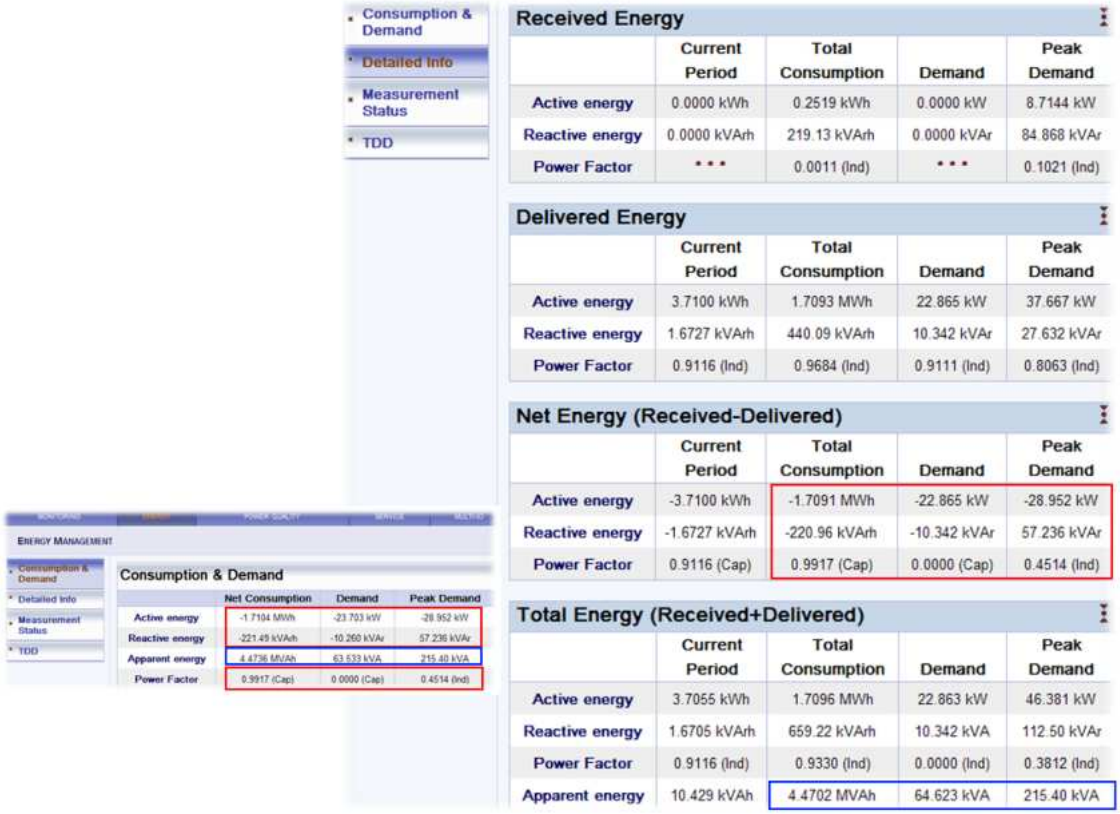
The Consumption & Demand page is a quick look at some of the key components of the Detailed Info page. Here you find a cross-sectional summary view of the amount and makeup (active or reactive) of the Net Energy (Received – Delivered) produced/consumed by a site.

A Demand is an arbitrary measurement of power per configurable unit time using different averaging methods. A demand is measured in units of power even though a time element does exist, while Peak Demand is the highest demand calculated since the last demand reset. Please refer to the Service→Power Setup

Detailed Info

For a detailed breakdown of energy flow components, the **Detailed Information** page presents all **Active, Reactive**, and **Power Factor** energy values individually for both produced and consumed (**Received or Delivered**) energy. Also shown below are the Net difference (**Net Energy)** as well as the sum total (**Total Energy)** computations. The **Total Energy** computation contains the combined figure for Active and Reacive Energy (**Apparent Energy).**

As previously stated, the summary page(**Consumption & Demand)** is extracted from the details page. (see below) Note that the red and blue boxed areas areas are consistent between the different page views. Please note that all values may(not) be absolutely identical due to the delay in page views.



Measurement Status

The Measurement Status page provides additional statistical information and necessary energy context information. The parameters and counters on this page are actually set up in the **Service→Power Setup** section using the **Configure Energy & Demand** button below.

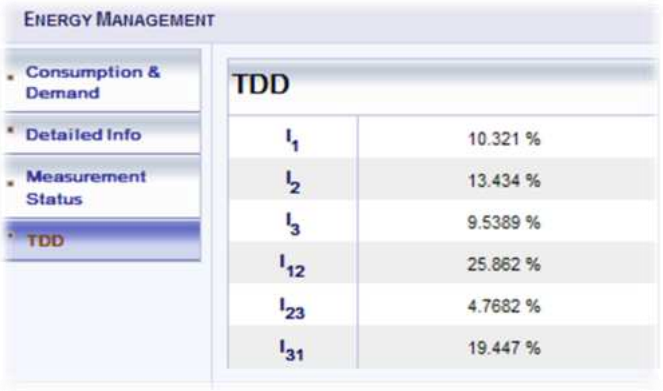
An explanation of all Status Summary terms follows:

- **Started**: This is the date and time stamp from the last energy reset
- **Last start**: This is the date and time stamp for the last metering reset. Total consumption is reset.
- **Up time**: The total cumulative time the mechanism has been operational during the current period (since last start).
- **Down time**: The total cumulative time the mechanism has not been operational during the current period.
- **Availability**: The percentage of time the system has been operational. This is important because if this time exceeds a certain threshold, the data may not be considered reliable
- **Energy (Metering) interval**: The energy interval is the size of the window used in computing demand (e.g. 10 minutes).
- **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 a sliding window averaging system.
    - **Disabled**: The demand is calculated according to stationary time points.

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:

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



Power Quality Section

The BLACKBOX Portable contains a power quality compliance engine that enables real-time evaluation of power quality according to standards such as EN50160.

Power quality compliance or in short PQ Compliance is a set of electrically measured parameters which are typically calculated based on some pre-defined intervals or event triggers and are evaluated over a large observation window. For most of the PQ parameters, the observation window is one week, which means the displayed online information refers to the previous week. However, using ELSPEC's PQSCADA and Investigator applications, all time intervals are able to be observed.

A PQ parameter is typically based on a power quality event. For example the DIP PQ parameter is based on counting DIP events over some observation period.

Different national standards vary in the way a specific PQ parameter is being measured or observed. The PQ Engine also supports a user-customizable mode in which all compliance parameters can be self-edited and modified by a user in order to meet new conditions, rules, measuring intervals and even different observation periods.

The Power Quality section in the WEB interface is used to control and view power quality measurement and compliance information computed by the PQ Engine.

The Compliance Summary Page This page enables you to select the specific compliance standard to be evaluated by the unit's internal compliance engine. This page further contains on-line information and compliance status.

The Compliance Type sets the compliance standard.

In order to change or to activate a new compliance type:

1. If the PQ Engine is already running, set the Running Status to *Stop*, then Click *Apply changes.*

Wait for the WEB page to refresh.

2. Select the desired compliance type, then change Running Status to *Running*.
3. Click *Apply changes*, then wait for the WEB page to refresh.

The new compliance type is now activated and running.

4. Verify that the Start Time field has changed.

Continuous compliance statistical information and events are stored in PQZIP files. In addition, the Embedded Report field further indicates a type of report that is auto-generated internally in the device's file system. Most compliance types are not generating any specific report, and therefore, the report type will be **None.** However, CREG type of compliance (used in Colombia) also auto-generates a specific format of report files as defined by the local regulator. The report files can be found in the **Integrated FTP Server on page 96**.

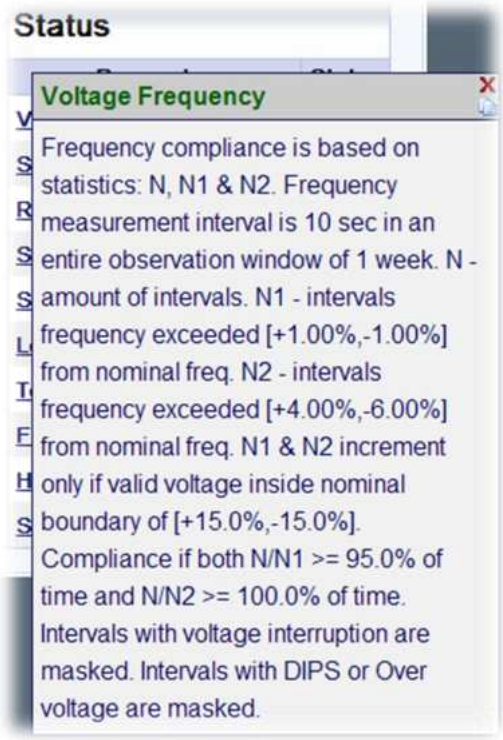
The Evaluation Status field provides an overall status of PASS or FAIL of the entire compliance. Anytime the evaluation period is not complete (typically it is required 1 week observation), the status will be N/A (Not Available).

The Start Time field shows the last time the compliance engine was restarted. The entire state and observation window history is stored on the internal non-volatile memory, so even after powering down, the Engine will continue its evaluation and maintain all indications. (Start time remains unchanged after device powered up.)

The Window Time On/Off fields specify how much aggregated time is already in the observation window. ON refers to the aggregated window time the device was powered on and OFF refers to the amount of window time the device power was off. The format presented is [Days: Hours: Minutes: Seconds]. Ideally the OFF time is all zeroes and the ON time is 7 days (which is the typical full observation period in most of the compliance types). Once the observation window reaches 7 days, it will start to slide in steps of 2 hours. Sliding means the information from the oldest 2 hours is being dropped, where a new up-to-date 2-hour interval is being stored.

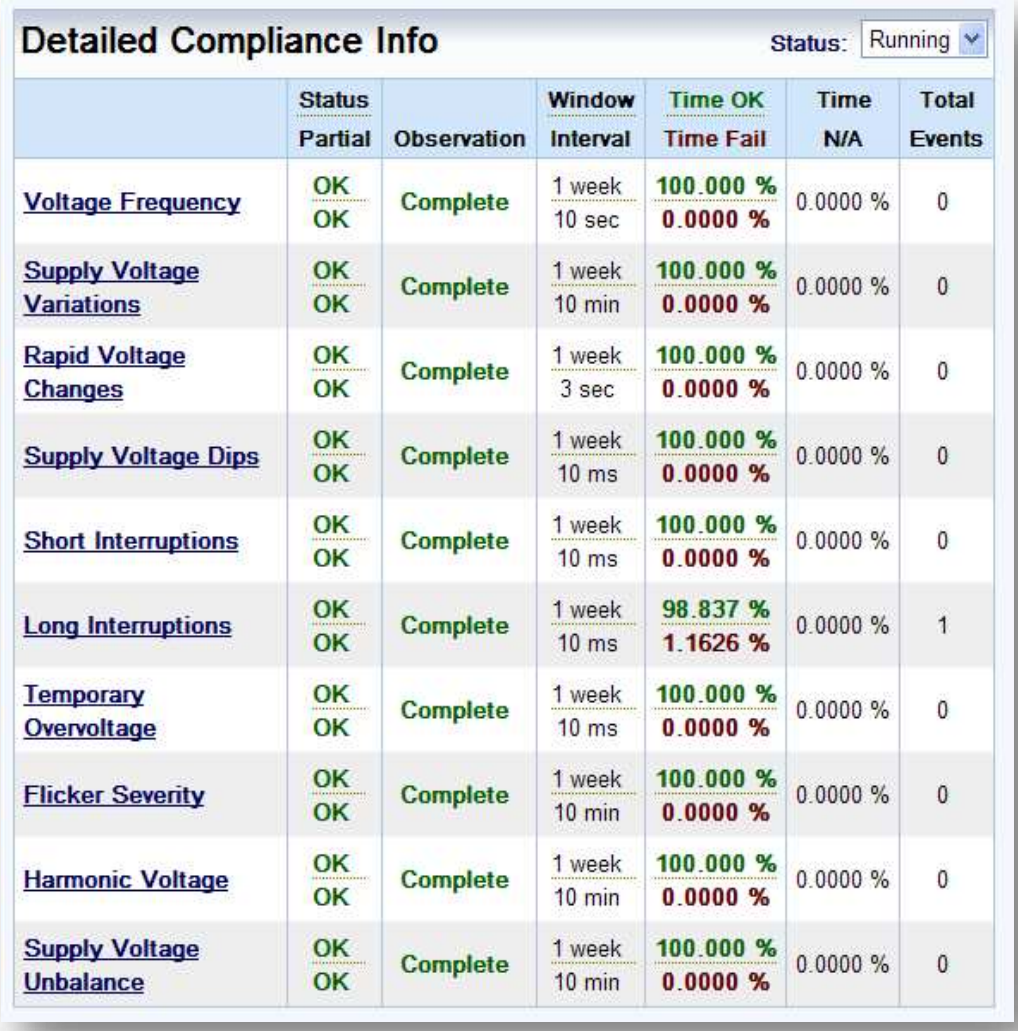
The Measurement Flag field indicates whether the compliance evaluation is currently Masked (equals Flagged) or not. Flagged time means a power quality event such as DIP/SWELL or INTERRUPTION.

The Status Table shows a high level PASS or FAIL indication of each PQ parameter. Any PQ parameter that has an incomplete observation period will be presented as N/A (Not Available). Additional information of how a PQ parameter is being evaluated can be seen by simply clicking on the parameter's text. For example, clicking on the Voltage Frequency parameter within the EN50160 compliance mode will show an info page as shown on the figure below.



The Compliance Info Page

This page contains detailed compliance information.



Detailed Compliance Info — Status: Running

	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	100.000 % 0.0000 %	0.0000 %	0
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	98.837 % 1.1626 %	0.0000 %	1
Temporary Overvoltage	OK OK	Complete	1 week 10 ms	100.000 % 0.0000 %	0.0000 %	0
Flicker Severity	OK OK	Complete	1 week 10 min	100.000 % 0.0000 %	0.0000 %	0
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

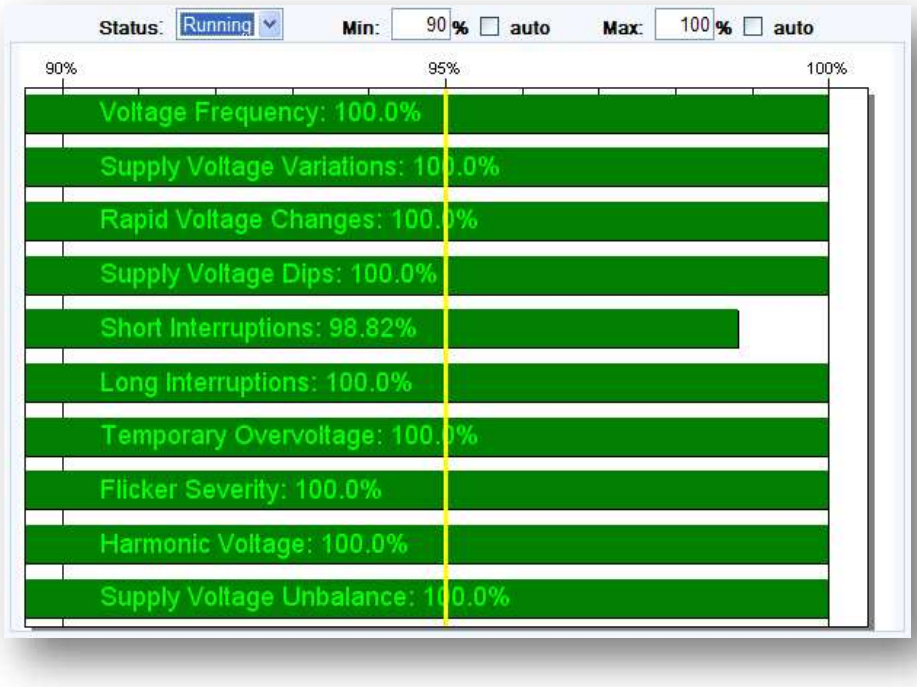
By clicking on the parameter's text, you get the following detailed information:

- **Status/Partial** contains two status indicators. The upper indicator refers to the entire observation window's PASS/FAIL result (same status as presented in the Summary page), while the lower indicator is a PASS/FAIL indicator of the most recent period. This recent indicator is served as real-time indicator and typically reflects only minutes to a few hours of history (this is dependent on the specific PQ parameter measurement' intervals and method).
- **Observation** indicates whether the observation window of the PQ parameter is complete.

- **Window/Interval** provides the observation window time in the upper area and measurement interval time in the lower area. *Time OK/Time FAIL* provides the percentage of time the PQ parameter was OK (as green text on the upper area) and percentage of time the PQ parameter was outside the defined limits or failed (as red text in the lower area).
- **Time N/A** provides the percentage of time the unit was not measuring due to lack of power.
- **Total Events** provides the overall number of PQ events influenced by the PQ parameter in the observation window.

The Compliance Chart Page

This page displays graphical bars of compliance levels (equals to percentage of time OK). The minimum and maximum values in the chart are configurable.



The User Defined Pages

These pages allow you to fully customize the compliance parameters. In order to be able to configure, you first need to change the compliance type to User Defined (under Compliance Summary page).

Service Section

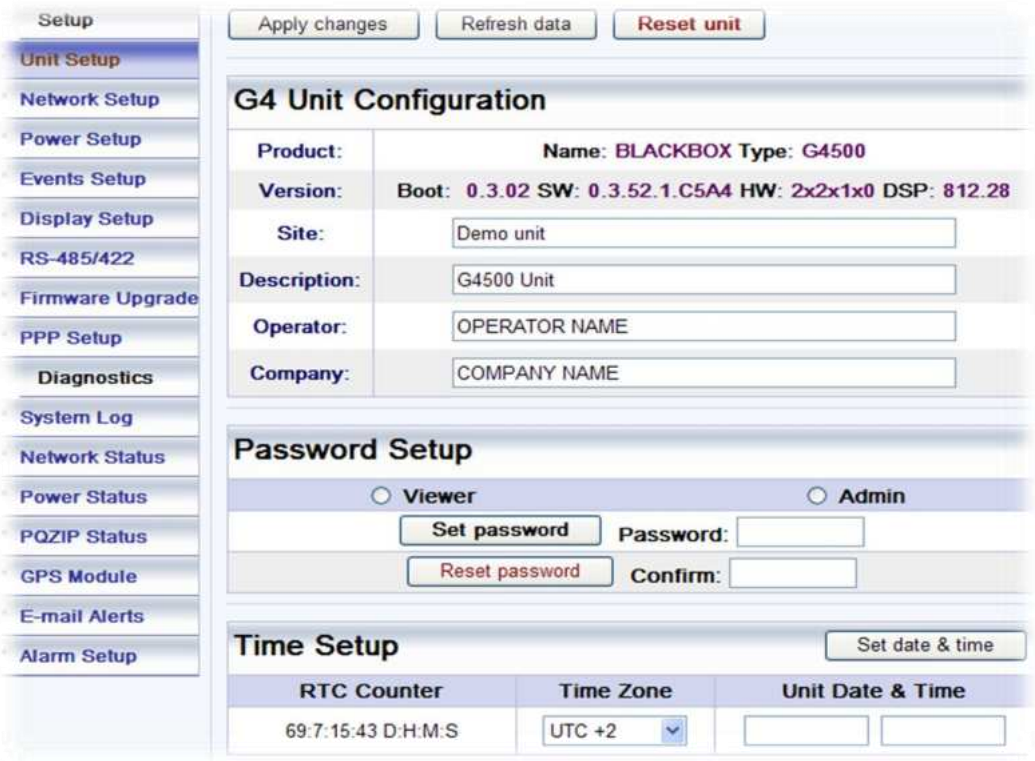
The Setup pages are used to configure the BLACKBOX Portable. Notice that in order to setup any of the pages and parameters in the BLACKBOX Portable interface, there is a need to login as Administrator.

To verify Administrator login, you should notice the unlocked sign at the right side of the page. A locked sign means Viewer level only and does not allow configuration.

(Refer to Login Page chapter on page 41)

Unit Setup

The Unit Setup page is used to configure the main properties of BLACKBOX Portable unit identification.



G4 Unit Configuration Section

The Product field specifies the type of BLACKBOX model in use. This field is for future use.)

The Version field specifies internal HW and SW versions in which:

- **Boot:** Specified Boot application version. The boot application is a small separated part of the firmware. The Boot is stored on a secured sector in the internal flash memory chip and is used for the very beginning of HW initialization and further execution of the BLACKBOX firmware. The Boot executes either Bank A or Bank B firmware.
  (Refer to Firmware Upgrade on page 83)
- **SW:** BLACKBOX firmware version. Notice that BLACKBOX device contains two banks of firmware, while the version in this field refers to the currently executed firmware.
  (Refer to Firmware Upgrade on page 83)
- **HW:** BLACKBOX hardware version.

- **DSP:** BLACKBOX DSP version. The BLACKBOX contains a dedicated DSP (Digital Signal Processing) module for high speed calculations. This field defines the firmware version of the code being executed on this DSP.
- **The Site field** enables the user to define a description of the site where the device is installed. This site's description also appears in the EL-SPEC Search utility under Unit Description when searching for devices.

For example:

- **The Description field** is an additional text field for optional use.
- **The Operator field** is an additional text field typically for inputting operator/technician name.
- **The Company field** is additional text field typically for inputting company name.

Password Setup section

This section enables the Administrator to change or reset the passwords of Viewer and Administrator levels. Notice that the default (Reset) passwords are:

- **123:** Viewer (can view but cannot configure)
- **12345:** Administrator (can view as well as configure the device)

Time Setup

The Time Setup section is used to set and control the displayed time.

- **The RTC Counter** refers to the counting of the internal battery backup real time clock. The RTC starts its counting from the manufacture date. RTC Counter format is: Days, Hours, Minutes, and Seconds.
- **Time Zone** specifies the date and time to be presented on the WEB (time and date are presented at the bottom of the page). The presented time is the local time derived from the GMT time and the configured Time Zone which shifts the GMT time backward or forward in accordance. (Greenwich Mean Time (GMT) means time at Greenwich, London . It is also referred to as UTC.)
- **Unit Date & Time** allows you to set the current time and date manually. Once you click on the configuration box, the date or time will instantly appear and you can set it. Click on the *Set Date & Time* button and the time is changed. However, if the unit's Time Synchronization module is synchronizing with an external source (like NTP or GPS), the time will

be overridden as soon as the time is updated. To prevent automatic updates, set the Time Sync module on Self synchronization refer to Time Synchronization on page 91.

Network Setup

The BLACKBOX Portable provides 3 Fast Ethernet Links and a Wireless connection (Wi-Fi Access point and router).

The Network Setup page is used to configure all units' Network connection settings, except for the wireless access point which is an additional web interface. Refer to Ethernet Ports View on page 25.

LAN2/LCD Port Setup

This port is for direct connection to the BLACKBOX Portable device, by-passing its internal router (suitable for connecting the unit with local LAN of computers/servers).

- **The Auto DHCP field** is used to control the IP automatic setup method; if set to *enable*, the unit gets its IP configuration from a DHCP server on the LAN2 port side. If set to *disable*, the unit uses a fixed IP configuration on its LAN2 side as further defined.
- **The IP Address** is used for setting the BLACKBOX Portable's internet address on LAN2 side.
- **The Subnet Mask** is used for setting the BLACKBOX Portable's subnet mask on LAN2 side.

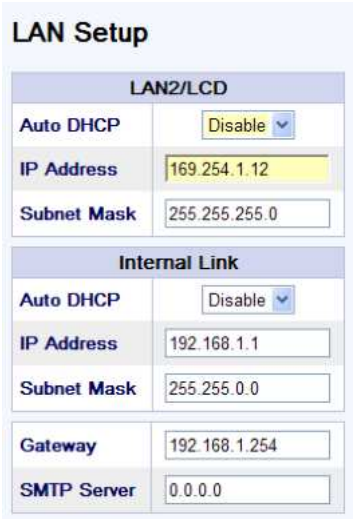
Internal Link Port Setup

This port is an internal link between the BLACKBOX Portable's internal main CPU and the internal router. **Ethernet Ports View on page 25.**

- **The Auto DHCP** field is used to control the IP automatic setup method; if set to *enable*, the unit gets its IP configuration from the internal BLACKBOX Wi-Fi router. If set to *disable*, the unit uses a fixed IP configuration on its Internal Link side as further defined.
- **The IP Address** is used for setting the BLACKBOX Portable's internet address on Internal Link side.
- **The Subnet Mask** is used for setting the BLACKBOX Portable's subnet mask on Internal Link side.

Address Range Validation

Valid addresses range resulting from LAN2 pair of IP address and subnet mask must be different than the address range resulting from the same pair of settings on the Internal Link; otherwise, a connection failure is expected.



Correct

***LAN2** = 169.254… is different than*

***Internal Link** = 192.168….*

Ok, Different ranges.

Incorrect

LAN2 = 192.168… equals to

Internal Link = 192.168….

IP range conflict!!!

Gateway and SMTP

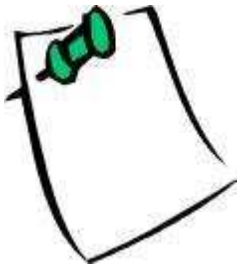
The Gateway is used for setting the BLACKBOX Portable's default Gateway IP address. This address is used when the BLACKBOX Portable needs to send data to IP addresses outside its LAN2 and Internal Link network range. Typically this is set to the internal router.

The SMTP Server is used for setting an IP Address for Email Server to be used for sending notification emails.

Ports Setup*:* This is a legacy option for remote access. Port Setup enables changing the standard configuration of internet port numbers for standard communication protocols (Emails, File Transfer, & Web browsing). This might be used in networks where standard port numbers are forbidden or reserved by firewalls or in case one wishes to reserve the standard port number for a legacy modem/router that does not support port forwarding. (Notice that most external modems/routers on the market today do support port forwarding). It is suggested to leave the port numbers in their default setup so that it will be straight forward for web browsers or FTP clients to access the device via LAN/Internet.

- **The SMTP Port** is used for setting port number of mail transfer.
- **The HTTP Port** is used for setting port number of Web browsing.

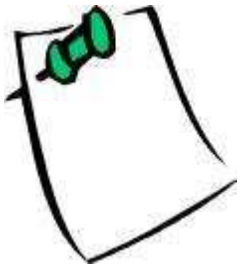
- **The FTP Daemon** is used for setting port number of File transfer (control channel).
- **The FTP Data** is used for setting port number of File transfer (data channel).



Notice that change of FTP ports also requires a change in PQSCADA configuration.

Access Setup

This controls the FTP login and FTP password (FTP is File Transfer) for security measures. If no security measures are required, it is suggested to leave the default settings for straightforward PQSCADA connection.



Notice that change of access setup also requires a change in PQSCADA configuration.

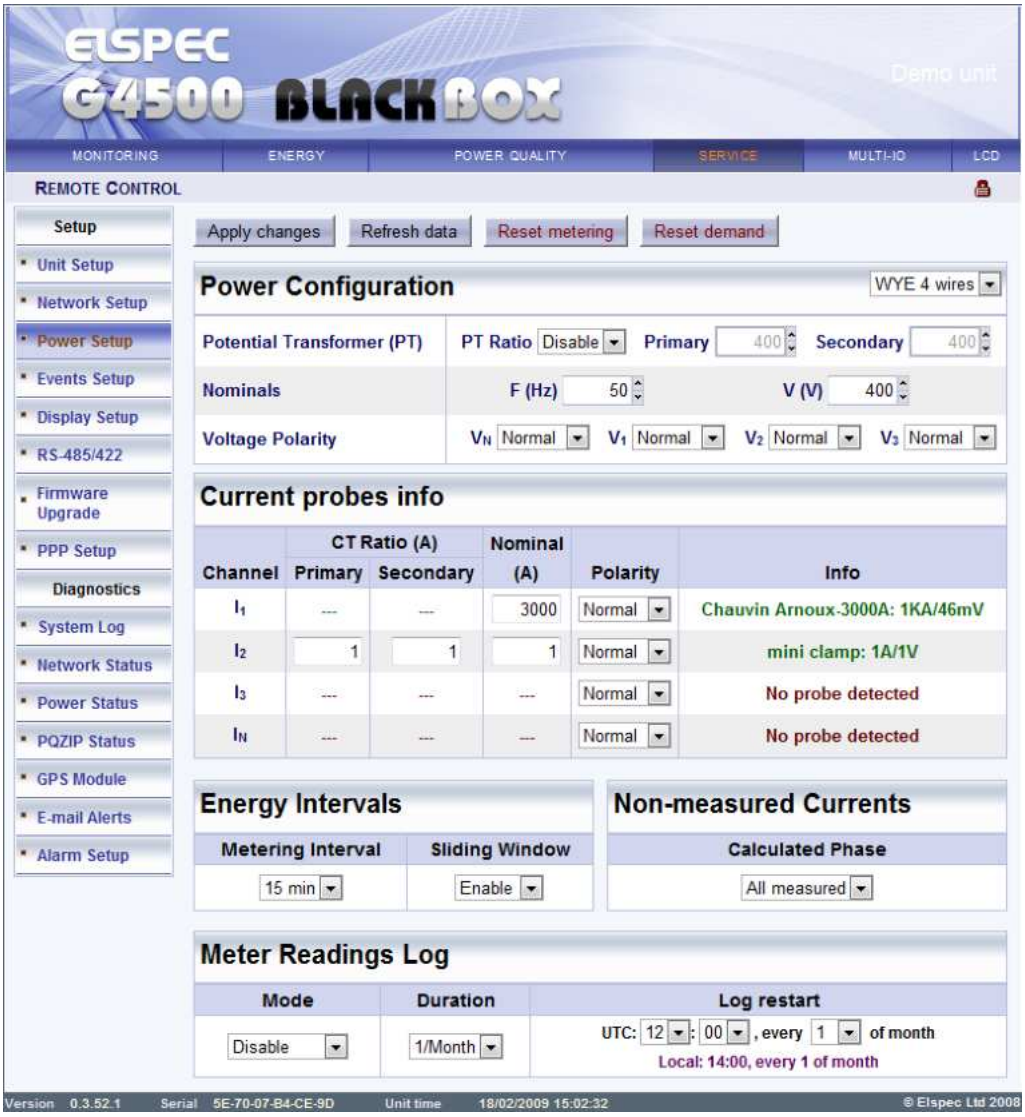
Network Time

This section controls Time Synchronization.

- **Transport** is used to set whether the Time Sync module selects the source automatically or is manually forced to NTP or GPS source.
- **Main SNTP** is used to configure the IP address of the Primary NTP server to be used.
- **Alternate SNTP** is used to configure the IP address of the secondary NTP server to be used, in case the primary is not available.

(Refer to on page 91 for more information.)

Power Setup

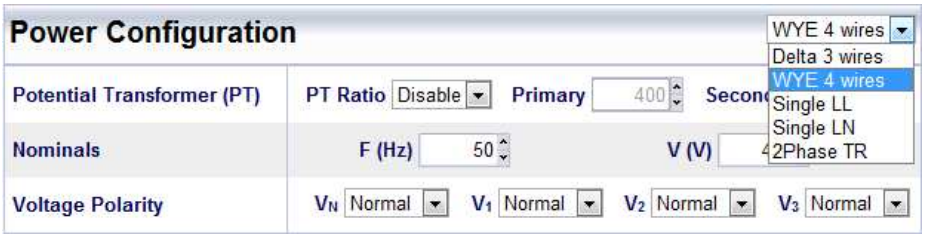

ELSPEC
G4500 BLACKBOX
Demo unit
MONITORING
ENERGY
POWER QUALITY
SERVICE
MULTI-IO
LCD
REMOTE CONTROL
Setup
Unit Setup
Network Setup
Power Setup
Events Setup
Display Setup
RS-485/422
Firmware Upgrade
PPP Setup
Diagnostics
System Log
Network Status
Power Status
PQZIP Status
GPS Module
E-mail Alerts
Alarm Setup
Apply changes
Refresh data
Reset metering
Reset demand
Power Configuration
WYE 4 wires
Potential Transformer (PT)
PT Ratio Disable
Primary 400
Secondary 400
Nominals
F (Hz) 50
V (V) 400
Voltage Polarity
VN Normal
V1 Normal
V2 Normal
V3 Normal
Current probes info
Channel
CT Ratio (A)
Primary
Secondary
Nominal (A)
Polarity
Info
I1 --- --- 3000 Normal Chauvin Arnoux-3000A: 1KA/46mV
I2 1 1 1 Normal mini clamp: 1A/1V
I3 --- --- --- Normal No probe detected
IN --- --- --- Normal No probe detected
Energy Intervals
Metering Interval
Sliding Window
15 min
Enable
Non-measured Currents
Calculated Phase
All measured
Meter Readings Log
Mode
Duration
Log restart
Disable
1/Month
UTC: 12 : 00 , every 1 of month
Local: 14:00, every 1 of month
Version 0.3.52.1
Serial 5E-70-07-B4-CE-9D
Unit time 18/02/2009 15:02:32
© Elspec Ltd 2008

The Power Setup page contains the following subsections:

- Power Configuration
- Current probes info
- Energy Intervals
- Non-measured Current
- Meter Readings Log

Power Configuration

This page defines the network type and nominal voltage and frequency values.



The network type settings are represented by five different configurations, although the actual number of supported networks could be extended to virtually any existing configuration.

The following table proposes the recommended configurations for several supported power types.

Power Type	Power Configuration to use
Single Phase with Neutral	Single LN
Single Phase without Neutral	Single LL
Single split phase	2Phase TR
Three Wire Delta	Delta 3 wires
Four Wire WYE	WYE 4 wires
Three Wire WYE	WYE 4 wires
Delta High Leg	Delta 3 wires
Delta Open Leg	Delta 3 wires

(Refer to Power Type Diagrams on page 16 for connection diagrams.)

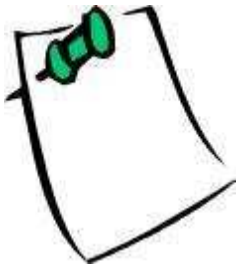
Potential Transformer (PT)

Potential Transformer configuration is required only for a MV/HV networks where the voltage is measured using PTs. When enabled, the Primary and Secondary transformer values should be configured.

Nominals

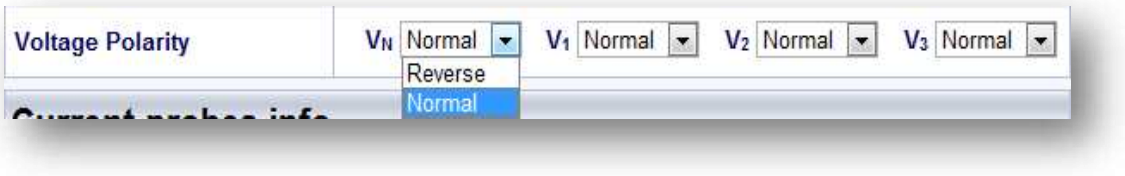
The Nominals section defines the nominal values for frequency (F) and Voltages (V). The Frequency nominal affects compliance (refer to Power Quality Section on page 58) and the EN61000-4-30 measurement window. When 50Hz nominal is set, the window is 10 cycles, and for 60Hz, it is 12 cycles.

The Voltage Nominal also affects the compliance engine (refer to Power Quality Section on page 58) and PQZip recording (refer to PQZip on page 105).



For maximum logging resolution and efficiency it is recommended keeping NOMINAL values as close to the expected normal condition values and NOT to maximum values!

Voltage Polarity



The Voltage Polarity settings allow for toggling the polarity without it being necessary to change the wiring when voltage probes are connected in wrong polarity due to a wiring mistake.

Current Probes Info

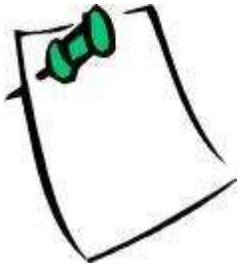
Current probes info

Channel	CT Ratio (A) Primary	CT Ratio (A) Secondary	Nominal (A)	Polarity	Info
I_1	---	---	3000	Normal	Chauvin Arnoux-3000A: 1KA/46mV
I_2	1	1	1	Normal	mini clamp: 1A/1V
I_3	---	---	---	Normal	No probe detected
I_N	---	---	---	Normal	No probe detected

The Current Probes Info section provides the status and configuration for the current probe detection mechanism. When it is successfully detected, the probe type is displayed on the Info section. If no probe is connected/detected, the Info shows a *No probe detected* string.

Configuration options are directly dependent on the probe type, for example, the mini clamp 1A/1V **(refer to page 9 for specifications)** is normally used to measure a secondary current of a current transformer (CT). In that case, the CT should be defined as Primary/Secondary values. On flexible probe types, these settings are not available.

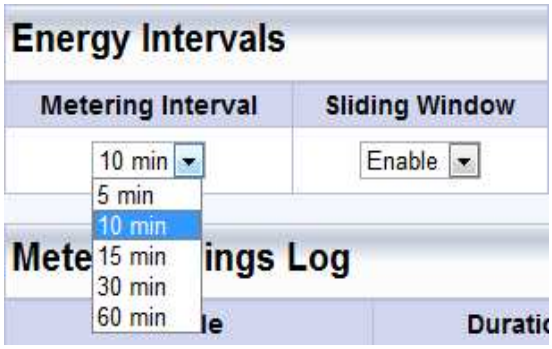
Nominal (A) value plays an important role for the PQZip recording functionality **(refer to PQZip on page 105).** In the event that the probe is identified, the value is automatically set to probe default.



For maximum logging resolution and efficiency it is recommended keeping NOMINAL values as close to the expected normal condition values and

NOT to maximum values!

Energy Intervals



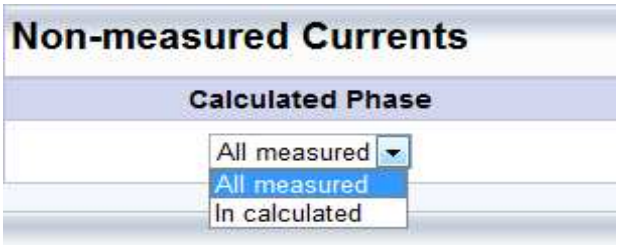
The Energy Intervals section defines the interval of energy consumption information to be aggregated and stored. The same interval is applicable for the Meter Reading Log **(see below).**

The aggregation for demand calculations can be further defined as a sliding window by enabling a Sliding Window parameter. The sliding window's step is defined as 1 second.

Non-measured Current

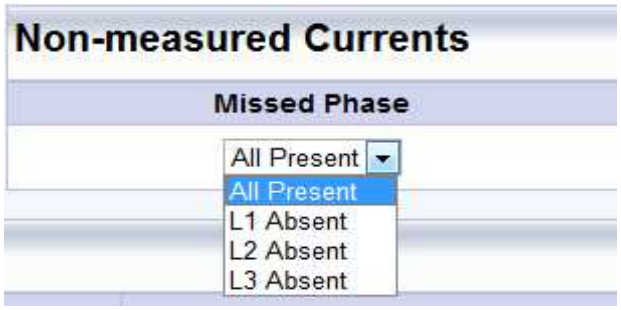
The Non-measured Current section helps to configure calculated current channels. The options are different for WYE and DELTA setups.

On WYE network type configurations:



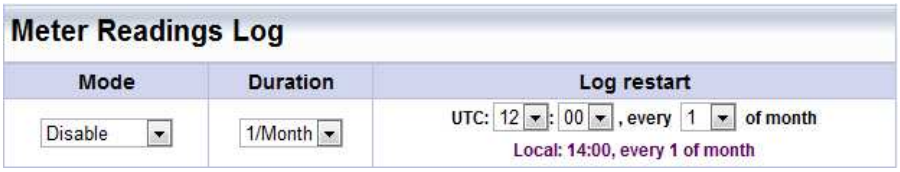
The neutral current (In) could be optionally calculated from the sum of three-phase currents, or alternatively, measured by the I4-current channel.

On DELTA network configurations:



One of the three-phase current channels could optionally be calculated from the **I1+I2+I3=0.**

Meter Readings Log



The Meter Reading Log section provides some extended meter reporting capabilities:

- Energy report **(refer to page 150 for details)**
- Power Curve Verification (PVC) report **(refer to page 146 for details)**

Events Setup

The Events Setup page is used for configuring custom events. While in the compliance configuration pages you are limited to configure only power quality events, in this page you are free to define any type of events notifications. Events can be triggered based on any measured parameters and conditioned by complex logical or mathematical functions.

Events setup is not related to power quality events. The Events setup is based on a custom events engine that works in parallel to the power quality events engine.

The BLACKBOX Portable contains following event types:

Type	Event Code range
System Events	1-200
User Custom Events Setup	201-232
Power Quality and Compliance Events	233-300

Reserved for other/future usage	301...

All events triggered in the BLACKBOX Portable are stored in the logger (flash memory) which is viewable through the System Log page.

In addition, all events are also stored in the PQZIP files and can be further analyzed in the ELSPEC PQSCADA/Investigator software.

Events can generate an email-notification (refer to E-mails Alerts page for more information).

Codes 201 – 232 are used for configuring up to 32 different, fully customized events.

A custom event is typically built from one or more logical/mathematical conditions. When the conditions are met, the event is triggered and the following information is generated and stored:

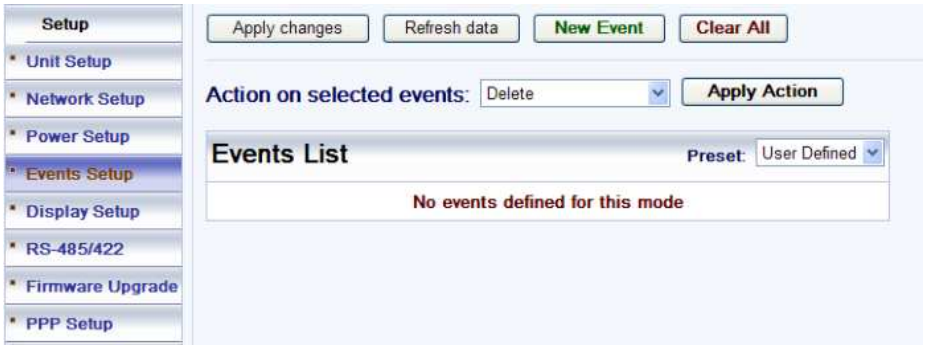
- Time Stamp of beginning
- Event Code number
- Duration of event
- Magnitude (A parameter value recorded during the event)
- Magnitude deviation (from the normal/configured value/treshold)
- Phases that were influenced
- Severity of the Event (value indicating how severe ithe event is)

Although the information implies a power related event, you are free to configure other type of events that are not related to specific power network parameters, such as digital input-based events or even temperature-based events and so on. (In such cases the Phases involved information should be left blank/ignored.)

Events can also be based on multiple conditions, for example an event which is triggered if both voltage is above some treshold and outside (PT-100) temprature exceeds a certain limit.

The Events Setup Page

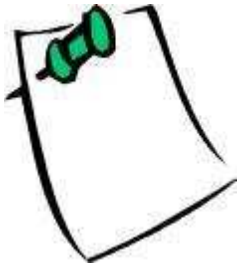
This page contains buttons for applying changes/creating/deleting and performing various actions on selected events.



Events List

The Events List section shows the existing user events. There are few modes to use. A user may create events manually or select an already prepared set of events from the Preset list.

- **Preset 1, Preset 2…:** An already prepared events configurations (hard coded in the firmware). Preset 2 is very useful for DFR (Digital Fault Recording) applications.
- **User Defined:** Manual creation of events



Notice that changing between presets will erase the content of what is already defined.

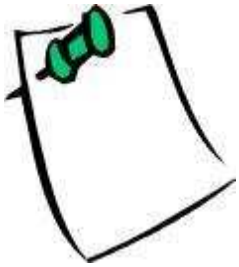
When selecting User Defined, you can create multiple events. Once an event is created, it is added to the list.

Example:

The check boxes at the left are used to select either all (if press on top) or a selective event entry. On the selected events, you may select a specific

action from the Action on Selected Events list and then press the *Apply action* button to perform the action.

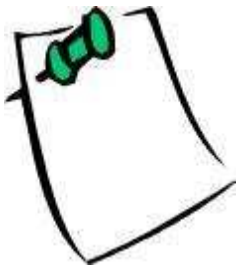
The Counter shows the current count of events. The counter can be zeroed by using the Reset Counter action.



Review the System Log to view the events online.

Creating a new User Defined Event

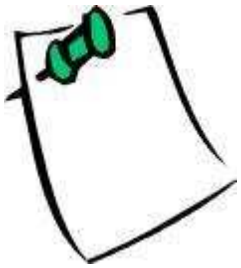
In order to create a new event, click on the button. The following section appears:



Notice the underlined fields which can be clicked for hints that provide online information about the field and its usage.

- **The Description** is used to set a meaningful name for the event.
- **The Code** is the event code #. The code number is selected automatically from the available user events codes.
- **An event** is based on one or more conditions. There are two types of conditions Single and Multiple. No matter what type of condition is linked to the event, the link between an event and its dependent condition/s is by a condition ID string as selected in the Condition selection box. Use the *Edit Condition* button to create new or edit an existing condition.

- **An event** is basically a logic signal. Anytime a condition is not active, the event remains in a "0" state. When a condition is met, the event becomes "1" state (beginning of event). The event remains on "1" state until the condition is de-activated (end of event). The trigger configuration field defines what situations will generate an event record. Notification is either on the beginning state, end state or at both states.



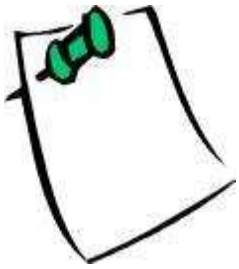
Notice that if selecting the beginning of an event, the duration indication of the event will be recorded as zero.

User events are stored automatically in the system log and PQZIP. In addition, you may set the Notify by Email to create an email notification as soon as the event is triggered.

- The *Save* button is used to save the configuration.
- The *More* button displays more advanced settings that you can control.

Creating Event's Conditions

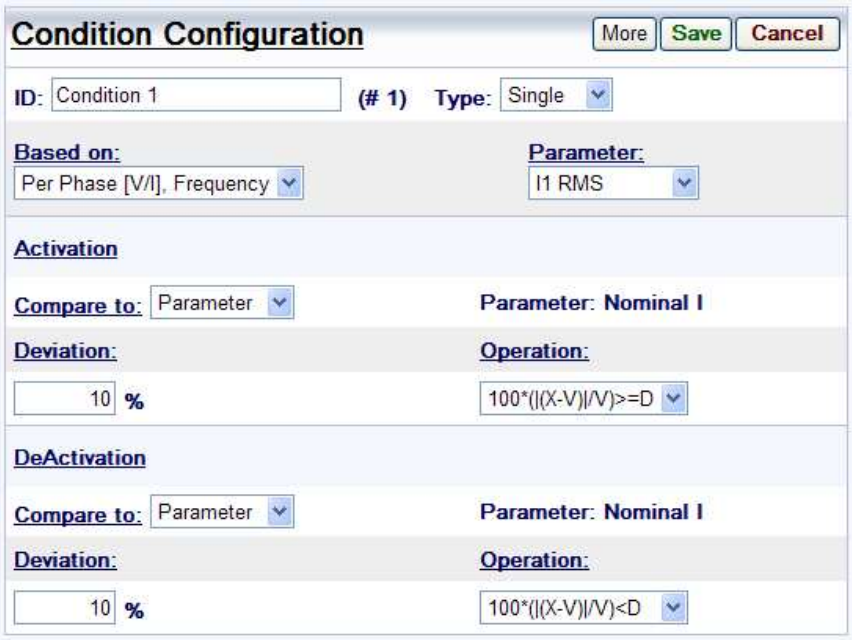
- **The Single type** of condition is defined as the result of some rule (mathematical operation on some system parameters), For instance, a percentage voltage drops below the threshold or a change of digital input and so on. The condition has 2 logic states, Activated(1) and De-activated(0). Transition to each state is fully user configurable.
- **A Multiple-type** of condition is a combination of 2 other subconditions. A Multiple-type condition must be linked to 2 subconditions, each of these 2 subconditions can be either Multiple or Single type. Therefore, the Multiple- type condition can be used to create a complex hierarchy of conditions.



Notice that until there are at least 2 conditions defined, it is impossible to create a Multiple condition.

- **The ID Condition** is identified by a text ID. Two conditions cannot be set to the same ID string.
- **The Type** selects the type of condition (either Single or Multiple).

Single Type Condition

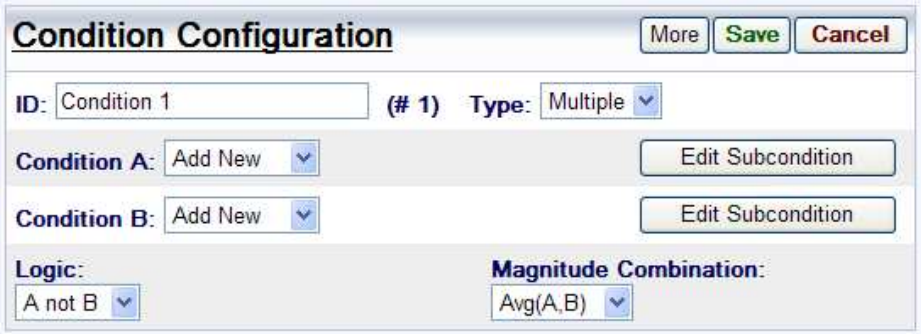


- **The Based on list box** is used to select a group of parameters for further user selection.
- **The Parameter list box** is used to select the specific parameter from a previously selected group. The selected parameter will be used as the "X" variable in the condition rules (operation).
- **The Activation 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 you set the following: Voltage RMS 1 (X = V1), Compare to is set to the configured Nominal voltage (say, V = 230V), Deviation is set 10 (D = 10%) and Operation is set 100*(|X-V|/V) >= D, the condition

will be activated when the RMS voltage of channel 1 goes 10% above or 10% below nominal voltage.

- **The Deactivation** 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 you set the following: Voltage RMS 1 (X = V1), Compare to is set to the configured Nominal voltage (say, V = 230V), Deviation is set 10 (D = 10%) and Operation is set 100*(|X-V|/V) < D, the condition will be de-activated when the RMS voltage of channel 1 goes below 10% deviation from nominal.
- **The Compare** to list is used to select the type of reference value ("V") to compare to the X parameter value.
- **The Parameter** is for setting reference to system parameter such as nominal voltage value.
- **User Value** enables the user to edit his own reference value.
- **Interval average** enables user to compare X to its averaged value over a defined time interval.
- **Value** Δ enables dX/dt (time deviation) operation, which means X is compared to its previous sample value. For instance, if the selected X parameter is V1 RMS (from group 10[ms] Fast RMS than V = X[-1] (meaning, previous 10ms RMS value).
- **Deviation** defines the Deviation ("D") value used in the operation formula. Notice that some operations do not contain deviation; in such cases the deviation configuration is not in use.
- **Operation** defines the rule or mathematical operation to apply for Activation or Deactivation of condition.

Multiple Type Condition



- **Condition A** is used to select ID of first sub-condition.
- **Condition B** is used to select ID of second sub-condition.

- **Logic** is used to define the combined logic state between the two sub-conditions A and B.
- **Magnitude Combination** instructs the events engine how to compute the Magnitude resulting from a combined condition. For instance, say condition A and condition B are both voltage parameters. In this case, selecting Avg. (Average) or Max (Maximum) is practical. However if condition A is voltage and condition B is current, then AVG or MAX is irrelevant, while A-only option is more practical (meaning only magnitude of voltage from condition A will be taken).

Display Setup

The Display Setup page enables customization for regional and generic display-related settings.

Firmware Upgrade

The BLACKBOX's internal software (firmware) can be upgraded on demand using a Firmware Upgrade page located on Service section.

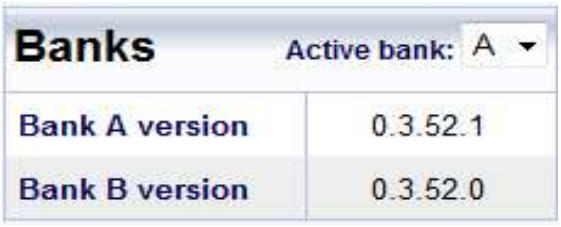
The firmware upgrade procedure requires Admin level privileges.
(Refer to Access on page 41.)

Firmware Banks

The BLACKBOX Portable implements a comprehensive firmware management mechanism designed to insure a failure-free field upgrading functionality. The mechanism insures that at any time there are two firmware images available, where only one is active, which means running, another is available to be upgraded.

The firmware images are stored in a dedicated non-volatile flash memory block referred to as Bank.

The Bank's status is displayed on the Banks section on Firmware Upgrade page.



- **Active Bank** shows which firmware Bank is actually in use.
- **Bank A/B version** displays a Bank's firmware and condition. A numerical- only firmware name means valid firmware, which is ready to use. In some situations the firmware could be further marked with a prefix character to identify a firmware status. The table below describes status prefixes available:

Prefix	Status
"*" (Asterisk)	The firmware was upgraded and reboot is pending to activate the image for the first time. The user is free to initiate reboot manually to complete the upgrading procedure.
"F"	The firmware image failed to complete the initialization process successfully. The firmware was declared as "Faulty", another bank is being used.
"+"	The firmware bank is being upgraded at the moment, wait for a completion.
"E"	The bank is empty.

For example, if firmware 0.3.52.0 would be found faulty/damaged/corrupted it will appear as F0.3.52.0 on the Bank A/B version field. In such a case it is recommended to check if the firmware file is authentic and attempt to upgrade it again.

Firmware File

New, complimentary firmware upgrades that can offer new and improved functionalities are released often. Usually, new firmware can be expected to be released every couple of months. The new firmware files are available in the Service/Download section on the Elspec web site: http://elspec-ltd.com/.

a) Select Power Quality Analyzers Section.

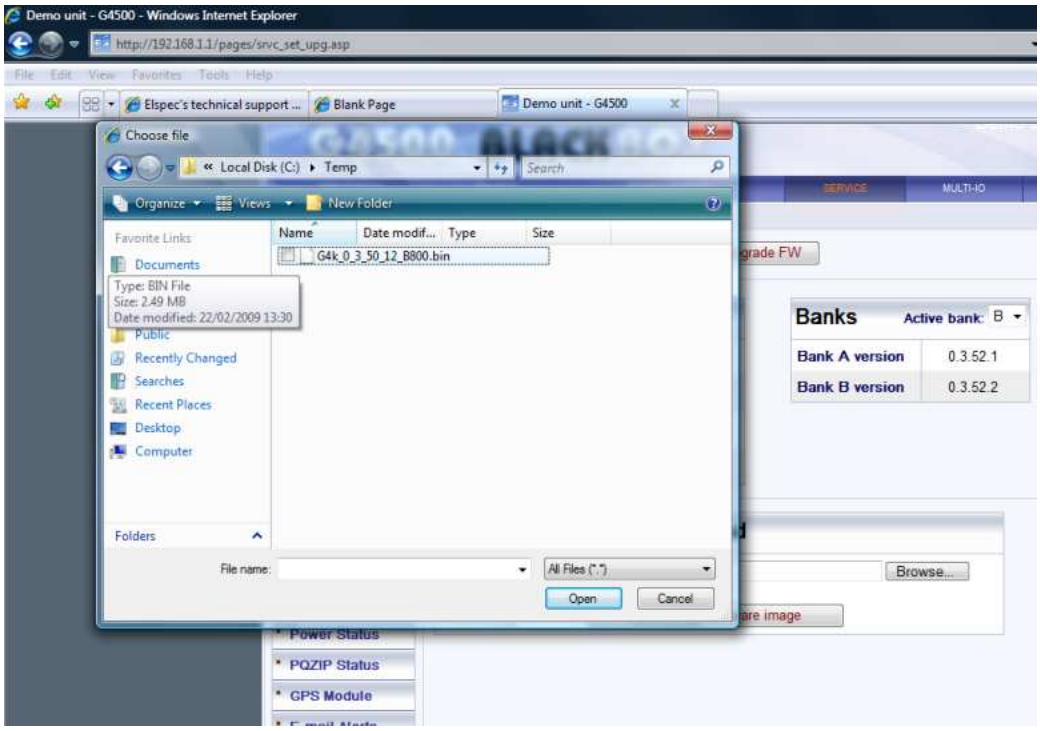
b) Download the latest firmware version from the Software section.

HTTP Upgrade

Probably, the simplest way of upgrading your instrument is by using the HTTP Upgrade functionality.

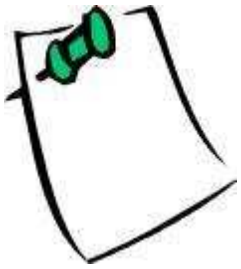
This can be initiated by using the Local Image Firmware Upload section.

a) Press the *Browse* button and select the image file you've downloaded on your local computer.



b) Press *Open.*

c) Press the *Upload local firmware image* button to initiate an actual upgrade process.



It is recommended using "simple" folders such as c:\Temp for local firmware upgrades.

Folders which require a special security, such as "My Documents" or "Desktop" may not operate correctly with HTTP upload.

FTP Upgrade

An alternative option of upgrading your instrument is by using an FTP (File Transfer Protocol) interface. The BLACKBOX Portable employs an FTP client module which is capable of downloading a firmware image file from an external FTP server automatically.

The FTP firmware upgrade functionality is configured in the FTP Firmware Upgrade section. The factory default configuration settings define an ELS-PEC corporate FTP server which is loaded with a latest released firmware. Alternatively, any other FTP server could be used. We recommend Filezilla, a free FTP server (**http://filezilla-project.org/)** or similar.

FTP server	The IP address of the external FTP server where the firmware file is located. The default settings is: **212.143.246.204** which is the ELSPEC's FTP server which is loaded with a latest released firmware
FTP username	The username to login to the FTP server. The default is **ELSPEC**, as for Elspec's FTP server
FTP password	The password to login to the FTP server. The default is **elspecelspec**, as for Elspec's FTP server
Firmware filename	The firmware filename. As default, the latest firmware located under Elspec's FTP server is **G4k.bin**

- When ready, press *Upgrade FW* to initiate the upgrade process.

When, completed it appears as:

Multi-IO Section

The Multi-IO Section provides the status and configuration for the digital Inputs and RS232 serial interface.

LCD Section

The LCD Section main page emulates an optional B/W display interface.

Time Synchronization

The BLACKBOX Portable contains a Time Synchronization module. This module maintains and tracks time that is being used by the entire BLACKBOX system and specifically by the PQZIP engine for storing compressed waveforms in accurate time stamp.

The Time Sync module is a multi-time-source receiver and manager that utilizes a unique algorithm to select the optimal time source, to adjust time and to compensate on various delays, jitters and other communication-related distortions.

The main purpose of synchronizing a BLACKBOX device is to be able to analyze and compare among multiple devices via the ELSPEC PQSACADA/Investigator system, such as analyzing an event's source or propagation over multiple points across the power network.

The following time sources are supported:

- Primary NTP Network Server
- Alternative NTP Network Server
- GPS Receiver
- RTC (internal real-time clock)

Typically, the Time Sync module selects the time source automatically per availability and quality of the existing time sources. However, the Time Sync module can be configured to work manually and force a specific time source (*explained later in this section*).

- **The NTP Network Server** is an external server machine that provides NTP Clients (such as a BLACKBOX or a PC) a time over IP network using NTP standard protocol. Time Sync supports two NTP Servers. The first is acting as primary, and the second is an alternative in case the primary is not available. NTP server is identified by an Internet (IP) address. The BLACKBOX is basically acting as an NTP Client that initiates time requests towards NTP servers. However the BLACKBOX also acts as an NTP time server, and therefore, it can respond and provide time for other BLACKBOX units that are configured to its NTP server.
- Synchronizing more than 5 BLACKBOX units to the same BLACKBOX is not recommended, as it may overload its server. Instead, use a maximum of 5 BLACKBOX client units to request time from one BLACKBOX server, and then direct up to 5 others to one of the previous 5, etc. NTP Time synchronization method is recommended anywhere there is a relatively good internet or intranet communication.
- **A GPS Receiver** is a GPS unit that receives a satellite signal and therefore requires special installation with a sky view or transponder from a GPS receiver with a sky view. A GPS unit provides location and time in-

formation via a serial port (typically RS232/RS485 communication port to the BLACKBOX). The GPS option is for remote sites where internet/intranet communication is not an option or, alternatively, network communication is poor.

- The **RTC i**s an internal peripheral in the BLACKBOX unit that serves as a default time source when no other external source available. The RTC is powered by a battery to maintain clock progress even when the BLACKBOX device power is off.
- **The Time Sync module** provides the BLACKBOX system with a global time format called GMT or UTC. Using a global time approach enables the BLACKBOX to synchronize measurements with other BLACKBOXs located somewhere else around the globe. While the time being recorded with PQZIP files is always GMT, the time shown on the WEB interface is the local time (refer to Unit Time at the bottom of the WEB page). The Local time is internally computed by the BLACKBOX from the UTC obtained from the Time SYNC module plus the Time Zone (which is the number of hours offset per specific country/area). The Time Zone is configurable (under *Service* tab, *Unit setup* page, *Time Setup* section).

The Time SYNC module also provides the source and the expected quality of time in Synchronization Status. (Refer to Monitoring Section on page 45)

Synchronization Status		
Time Synchronization	Main	Good
DSP Synchronization	On	

In this example the Main refers to primary NTP Server, while the Good refers to a good quality of time synchronization (meaning that the learned/estimated time is very close to the true GMT obtained from the external time source).

Displayed Time Sources:

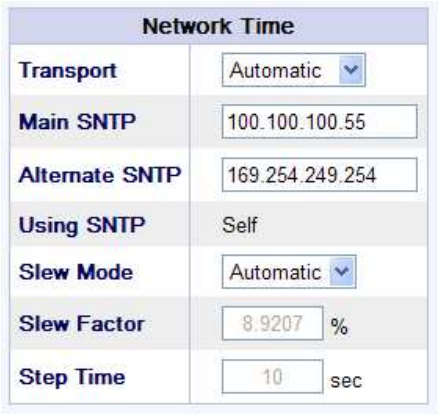
- **Main:** Primary NTP Server source is currently the active time source.
- **Alternate:** Alternative NTP Server is currently the active time source.
- **GPS:** GPS is currently the active time source.
- **Self:** RTC is currently the active time source.

Displayed Time Synchronization Quality/Accuracy:

- **Perfect:** Perfect time quality, expected less than 10 [microseconds] deviation from GMT
- **Good:** Good time quality, expected less than 100 [microseconds] deviation from GMT
- **Moderate:** Moderate time quality, expected less than 10[millisecond] deviation from GMT
- **Poor:** Poor time quality, expected less than 1[Second] deviation from GMT
- **No Time Synchronization:** No external time source available/expected more than 1 second deviation from GMT

Configuring the Time Sync Module

In order to configure the Time Synchronization module go to *Service* tab, *Network Setup* page, The *Network Time* section.



- **Transport** is used to set whether the Time Sync module selects the source automatically or is manually forced to NTP or GPS source.
- **The Main SNTP** is used to configure the IP address of Primary NTP server to be used.
- **The Alternate SNTP** is used to configure the IP address of secondary NTP server to be used, in case primary is not available.

Using SNTP shows the current NTP server in use (Main, Alternate or Self if no external NTP is used)

- Slew Mode configures the type of time slewing (adjustment) approach to be used by the Time Sync module to compensate for time deviations and network communication jitters. The default and preferred mode is Automatic. When set to automatic, the slewing factor is according to time source communication quality and you may only view the auto selected slew factor and step time in the below fields.

You may further configure the slewing mode to manual and set the Slew Factor and Step Time fields.

- Slew Factor is a percentage value between 0 to 100%, defining how much to correct time in percentage towards the new GMT learned from time source. 100% means full correction, or a step towards the received time as is, and 0% means no change at all.
- Step Time is time in seconds and defines the threshold value. Above this value, the Time Sync module will simply step towards the new learned GMT time.
- Manual slew modes contain Master and Slave,-which are manual modes with the same user control. The only difference is that the defaults are

automatically written in the WEB interface (SLEW Factor and Step Time fields). While the Master values fit more to a situation of a BLACKBOX receiving unstable time and acting as an NTP server that further feeds other BLACKBOX with its learned time, Slave values fit a situation of a BLACKBOX only acting as an NTP client without further spreading time to other units.

Time Sync and PQZIP Time Stamping

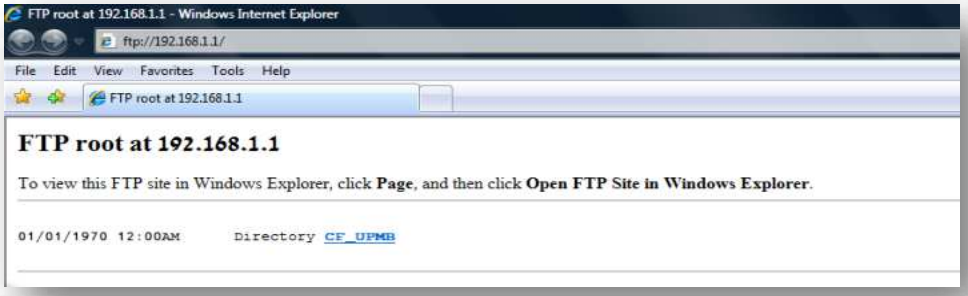
Since the main purpose of the BLACKBOX Portable is to continuously record and measure channels for analysis, it is essential to maintain a very accurate UTC time stamp. A PQZIP file is built from time records; typically a record represents several minutes. Each record contains a beginning and an end UTC time stamp. Once the Time Sync module detects that time is continuously drifting beyond a few tenths of milliseconds, the slewing is not enough to compensate for the drift. Instead, a time step/jump is made and the corresponding PQZIP record is closed with the old time stamp while a new record is opened with the new stepped time. Such cases may happen if the time source (NTP Server/GPS) is unstable or when the communication link with the NTP server is inconsistent.

Integrated FTP Server

FTP is a file transfer protocol for exchanging and manipulating files over a TCP computer network. The BLACKBOX Portable uses an integrated FTP server providing the most convenient computer network standard interface to the generated PQZip files and auto generated reports. The PQSCADA software system makes use of the FTP server interface by automatically downloading PQZip files.

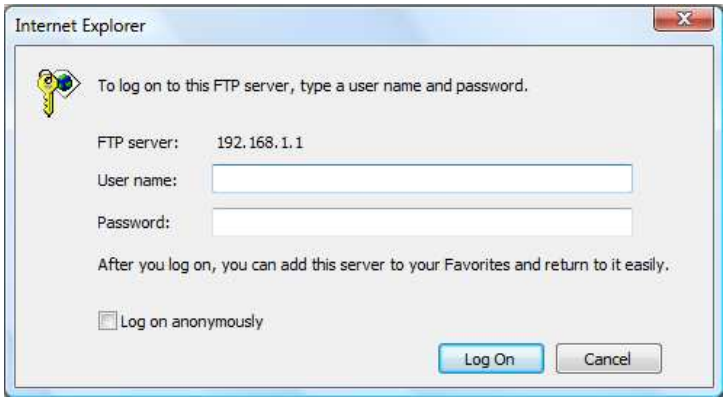
One of the easiest ways to launch an FTP session, which allows the user to access the BLACKBOX Portable's internal memory, is by using the Elspec Search utility (**refer to Launching WEB or FTP Session on page 133).**

Another way is by typing ftp://[device ip address]/ in the Windows Internet Explorer or Windows Explorer address field.



Login

When initiated from Elspec Search utility, this page will probably appear as shown above. On manual operation it will most likely require a user name and password like:



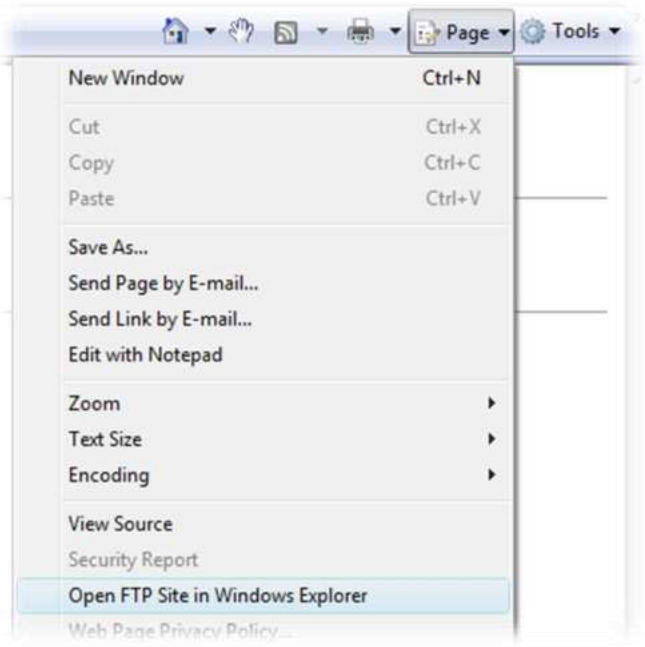
If so, type:

User name: **ELSPEC**

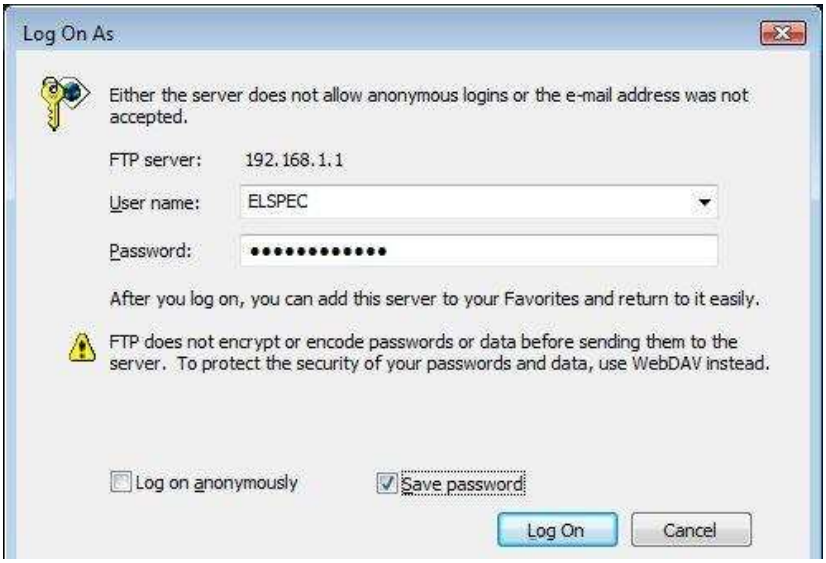
Password: **elspecelspec**

It is recommended to open the folder in Microsoft Explorer rather than Internet Explorer, since the latter may have some issues related to file operations.

To switch from Internet Explorer to the Windows Explorer, press the *Page* button and select *Open FTP Site in Windows Explorer*.



This will probably require typing a password again:

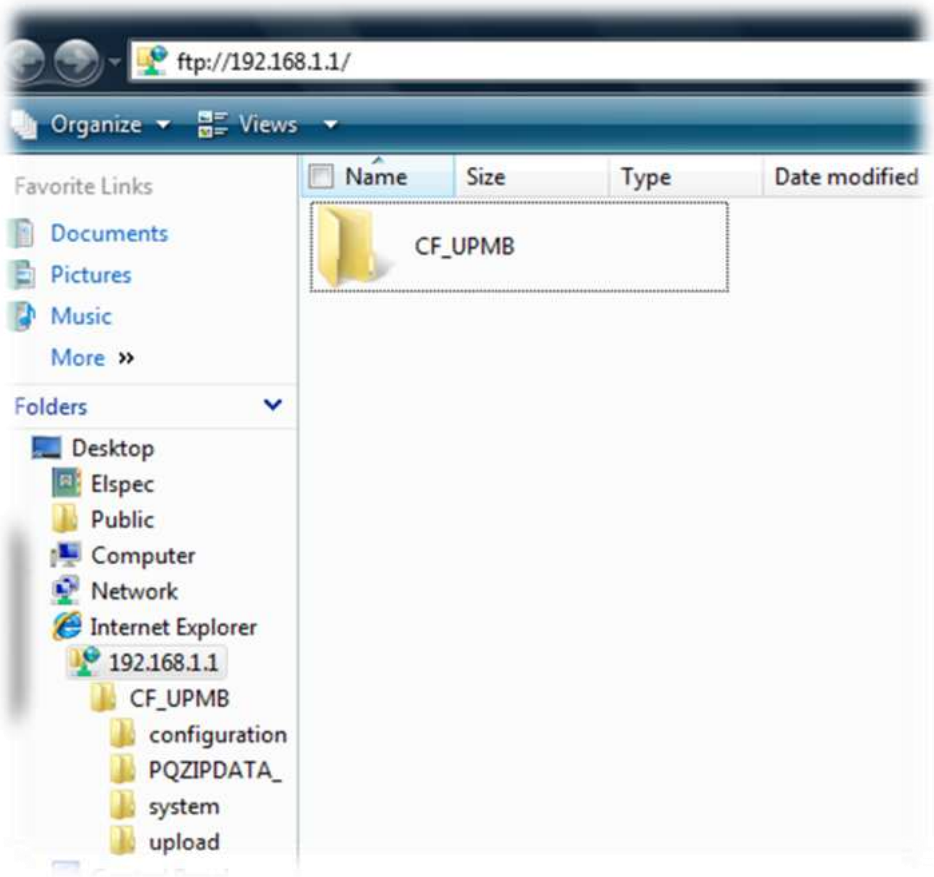


It is recommended marking the Save password checkbox if you prefer skipping that procedure the next time.

System limitations

The BLACKBOX Portable's integrated FTP server is limited by design to handle up to 4 concurrent FTP connections. Any connection while another 4 are still active will be denied. Connection which is idle for more than 2 minutes will be closed automatically.

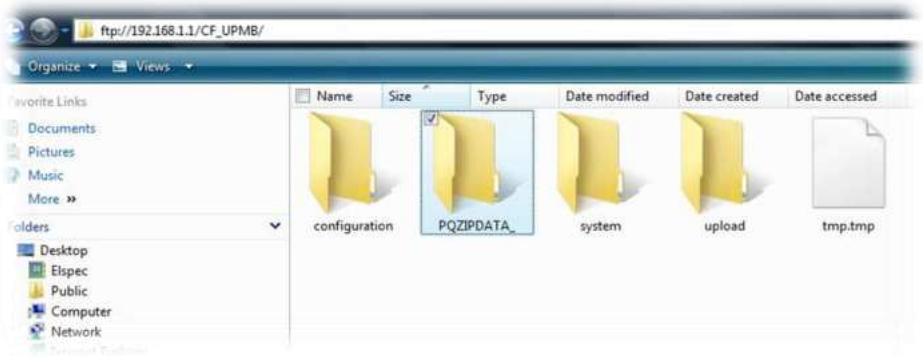
The File Structure



The root directory of the BLACKBOX Portable's FTP server appears as CF_UPMB which points to the main storage memory drive.

PQZip Files

The PQZip Files are located under PQZIPDATA_ folder

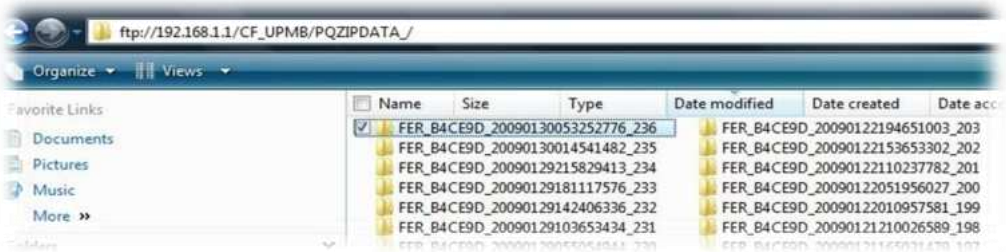


The PQZip files are organized under PQZip folders. The folder names are constructed as:

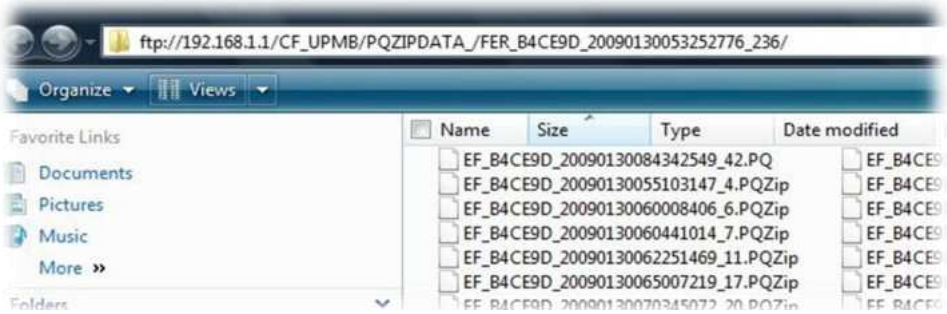
FER_A_B_C

Where:

- **A:** Device serial number
- **B:** The date and time the folder was created. The format is: **YYYYMMDDHHmmSSmmm**
  where **YYYY** = Year, **MM** = Month, **DD** = Day, **HH** = hour, **mm** – Minutes, **SS** = seconds, **mmm** = milliseconds
- **C:** Sequential index of the folder. The index value is started with "1" on the very first PQZip session initialization and incrementing on every new folder creation. When the value reaches 999 it resets to a "1" on with the next folder.



The PQZip folders normally contain no more than 50 PQZip files.

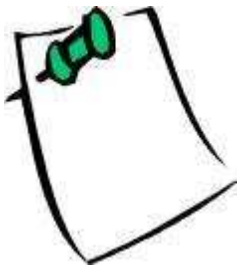


The PQZip files can be further recognized by a "PQZip" or "PQ" file extensions. The "PQZip" extension files are "closed" and ready for download while the "PQ" means that the file is still in a process. The PQZip file names are organized as:

EF_A_B_C

Where:

- **A:** Device serial number
- **B:** The date and time the folder was created. The format is: **YYY-YMMDDHHmmSSmmm**
  where **YYYY** = Year, **MM** = Month, **DD** = Day, **HH** = hour, **mm** – Minutes, **SS** = seconds, **mmm** = milliseconds
- **C**: Sequential index inside the folder. The index value is started with "1" on the first file created in the folder and increments sequentially with the next files in the same folder.



The Date and Time used to construct PQZip folder and file names are in UTC time format!

Integrated TelNet server

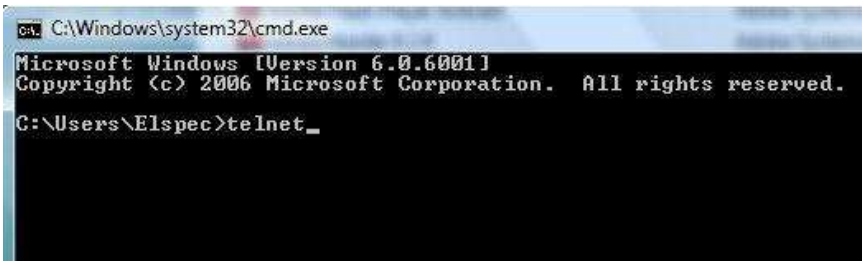
Telecommunications Network (Telnet) is a text-only (non-GUI) user command protocol terminal emulation program for TCP/IP networks such as the internet or a LAN. A Telnet client is often used to connect to a Telnet server in order to diagnose problems without specialized client software. The BLACKBOX Portable device comes enabled from the factory capable of being used as a Telnet server. In much the same way that we can enter the device through the Web as a GUI interface or FTP to transfer files, Elspec supports the use of a Telnet connection in order to perform specific high level administrative functions that are not accessible through other interfaces. In addition, the BLACKBOX Portable uses a Telnet emulation interface over a RS232 port.

Telnet Client Application

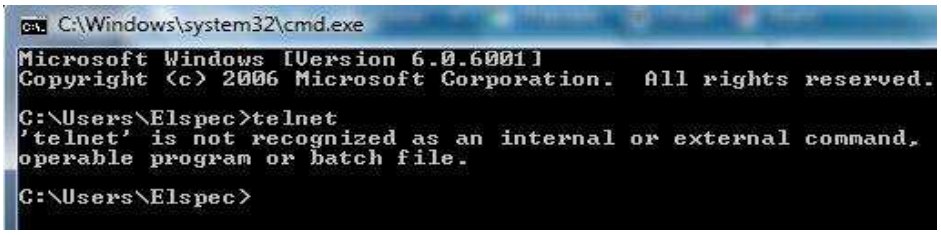
The standard Telnet Client Application is available as part of a Windows operation system. The client can be accessed using a command line interface.

1. Type *cmd* on a *run/search* field on windows Vista or *Start>Run* on Windows XP and press *Enter*.

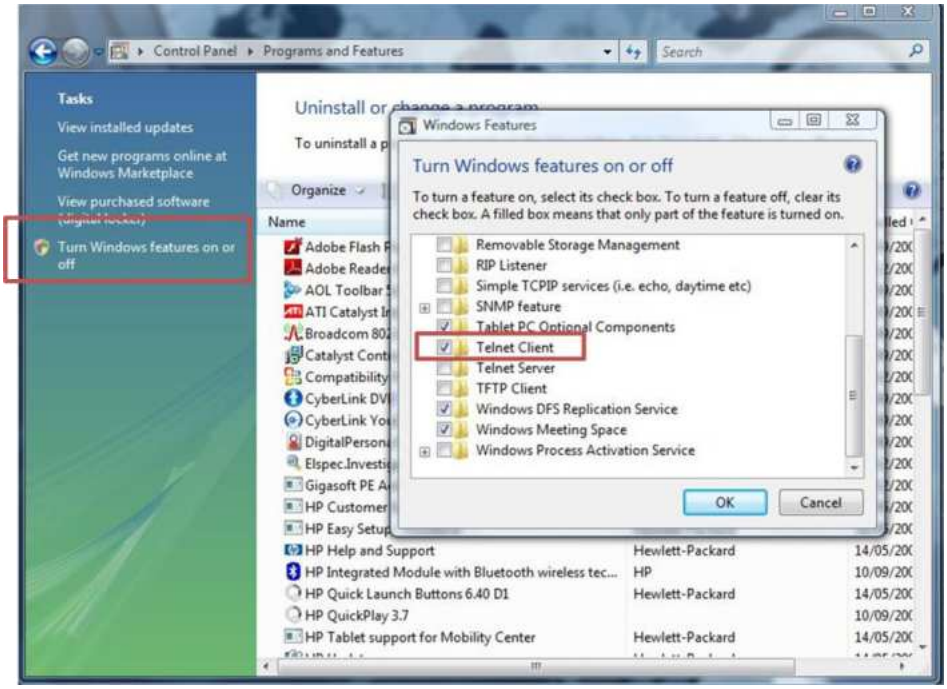
2. On the command prompt type *telnet* and press *Enter*.



In case of error like below:

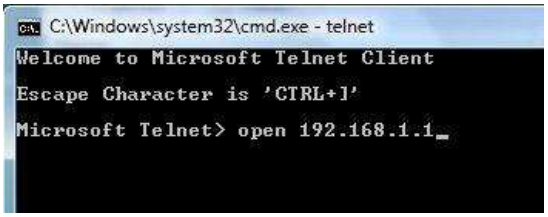


The Telnet client is probably not installed on the computer. To enable/install it, launch *Programs and Features* on the control Panel. Then, turn *Windows features on or off* and select *Telnet client* on the list.



Establishing a Telnet Session

1. Type *open [device IP]* on the telnet command line.



The login line appears:

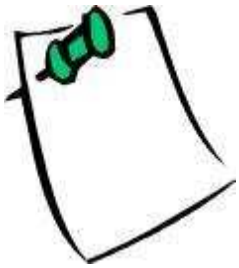
2. Use login name: **ELSPEC** (all cap letters)

3. And password: **elspecelspec**

When **->** line appears, the telnet session is ready for use.

Telnet Commands

The Telnet interface could be useful mainly for an advanced operational procedures such as restoring wireless router factory defaults **(refer to page 145).**



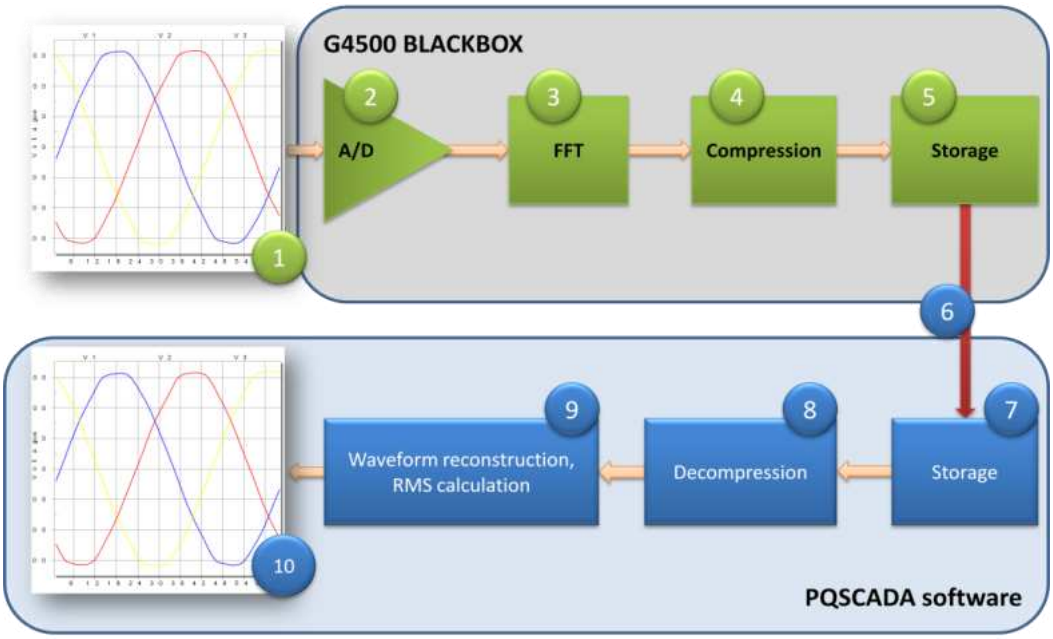
All Telnet commands and operations are case sensitive!

PQZip Recording

The BLACKBOX Portable utilizes a unique compression technology (referred as PQZip) which enables continuous gap-less recording of all electrical parameters-related data for a significant time duration without the need of event thresholds of any kind. The BLACKBOX Portable device with standard 8GB of internal memory can record continuously for a duration of several months or even a year depending on the network pollution level.

Principle of Operation

PQZip compression technology is based on *Lossy Compression Method* which is protected under US Federal Patent Law as well as by patent laws in several other countries.



This figure shows a simplified diagram of the compression/decompression process performed with accordance with Elspec PQZip technology.

1. Voltages and currents are being sensed and scaled to achieve a maximum resolution using the following A/D process.

2. The waveforms are being sampled at 1024 samples per cycle resolution for voltages and 256 samples per cycle resolution for currents.

3. The resulting digital waveform representation is being passed thru FFT computation, resulting 512 spectral components (harmonics) per cycle or voltages and 128 for currents.

4. Every harmonic component is being analyzed and compressed individually. Zero value components are being skipped. No zero harmonic components are being evaluated over time and only changes in a value or angle are being recorded. The resulting data is being compressed using industry known lossless compression algorithms.

5. The compressed harmonic data is being organized in blocks of up to 5 minutes of concurrent cycles and being stored along with the measured frequency of every cycle and reference time stamps into a PQZip file residing on the onboard flash memory. The typical compression ratio expected as a ratio between incoming data volume on block 3 and the data being stored is 1000:1.

6. The PQZip files can be downloaded automatically or manually using the integrated embedded FTP server to the Mobile Analysis Lab or any other computer system for further storage and analysis.

7. The compressed data is then reorganized and optimized for fast access while in a compressed state. The resulting data is stored in the SQL database for long term storage.

8. When required, the data is decompressed, recovering a full harmonic spectrum for each cycle along with the associated time stamps.

9. The spectral data can further be used to reconstruct any individual cycle's waveform in the same resolution as at the input module (1) with accurate time and cycle duration. Any possible electrical parameters can be calculated based on the data by retrieving precise accuracy and wave shape.

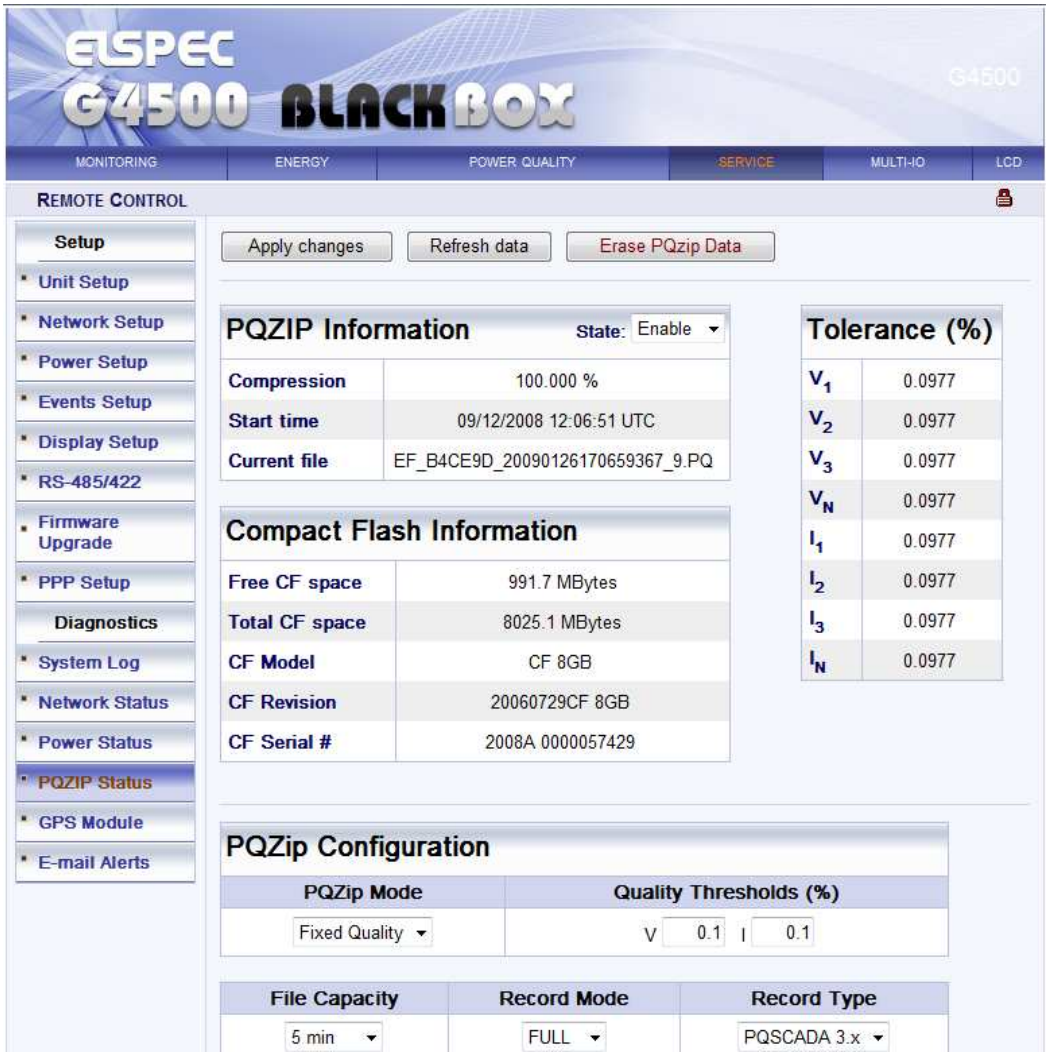
10. The waveform displayed by the Investigator application is reconstructed based on compressed spectral data of every concurrent network cycle. In addition, virtually any electrical parameter can be calculated based on that data and displayed at any resolution or time span.

Operation

The PQZip recording does not require any site-specific configurations. As default, all units leave the factory with PQZip recording being switched ON, and the instrument will start recording all channels automatically even on the first power on. The PQZip active state is further defined as a normal operation condition **(refer to Operational Status Indicator on page 23)**.

Configuration

The PQZip status and Configuration page is located under a service section on integrated WEB server interface (refer to page 28)



Administrator-user privileges are required to perform any change in configuration (refer to Login Page on page 41).

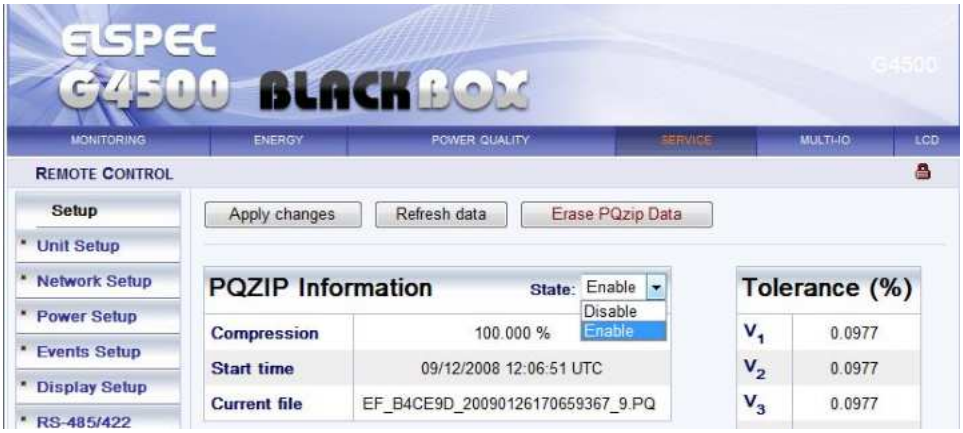
When modification is requested and the logged-in user privileges (the login password) are less than administrator, you will be prompted to perform a login with the Administrator password to allow modification.

1. Type the *Administrator* password and press *Login*.

2. Press *Apply changes* again to complete the change action.

Enabling/disabling

To disable the recording operation, change state to *Disabled* and press the *Apply changes* button.



FIFO Concept

PQZip files are maintained on a local flash memory in a FIFO (First In First Out) concept. This means that the file storage operation never stops, and when memory becomes full, the oldest files are deleted automatically to free required space for the newest data.

Fixed Quality versus Fixed Ratio

The most important parameter defining the actual compression ratio, (which determines the amount of storage required and maximum time continuous data can be stored) is a PQZip threshold value or Tolerance as it referred on the WEB page.

The Tolerance defines what change in an individual harmonic would be defined as significant enough to store and being reproduced afterwards. The tolerance value is defined in percentage to the full scale or nominal reading for the specific channel.

It is assumed that changes within 0.1% of nominal would have no importance in further power quality investigation, and the values within that range are averaged to store the representative value only. The basic and factory default tolerance value is normally defined as 0.1%. However, on some sites/networks that value can still be considered too tight, for example, a highly fluctuating load or voltage lines.

It is most likely that a user would prefer increasing a tolerance value for currents or voltages or even both in order to achieve better compression ratios on highly polluted network locations. The BLACKBOX Portable provides the possibility of automatic adjustment of the actual tolerance value presuming a compression ratio defined as amount of data being stored per month.

That option is called Fixed Ratio. When selected, the user is requested to define the amount of data to be stored per month (Monthly Ratio) in MB.

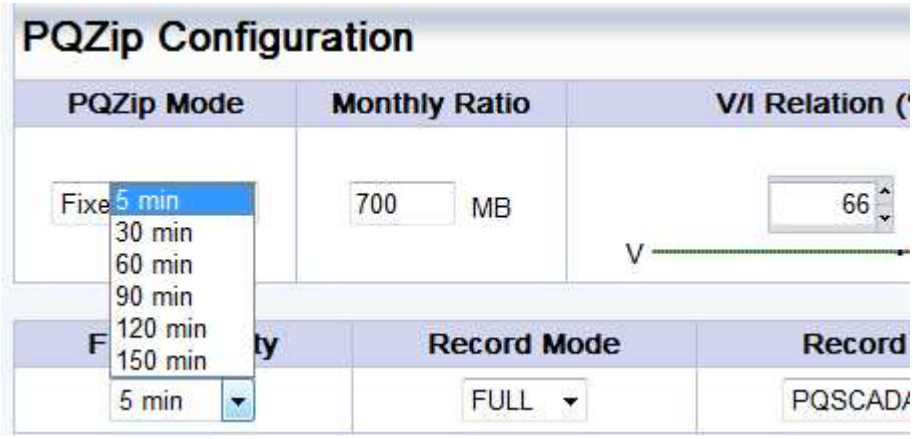
Usually, slight voltage spectral changes have higher importance than current changes. Therefore, the amount of data which could be stored for voltages may be determined as greater than for currents. The V/I Relation parameter defines the relationship between the data (a part of the Monthly Ratio) reserved for voltage. If the voltage portion is larger than currents, the system will define a tighter tolerance for voltages than for currents.

The alternative way is to define and fix the tolerance values for both voltages and currents to some user preferred value. This option is called Fixed Quality since in that case the data will be stored at the same tolerance/quality at all times.

When Fixed Quality mode is selected, you are requested to define the tolerance value for voltages and currents separately were the factory default value is 0.1%.

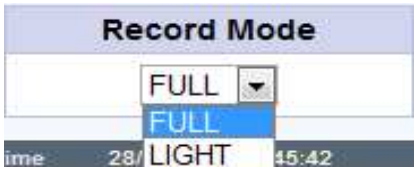
File Capacity

The File Capacity parameter is used to define the maximum time each PQZip file will comprise. The file can be downloaded and data can be analyzed only when the file is closed, so if you expect to monitor the data on the Investigator application shortly after the data is being collected, you should choose low time durations. For all other cases, longer durations are recommended so compression ratios can be slightly improved.



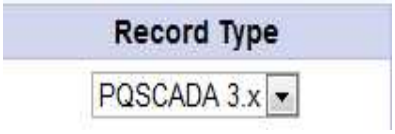
Record Mode

The Record Mode parameter defines whether PQZip files will comprise FULL data or event time stamps only (LIGHT mode). The default setting is FULL.



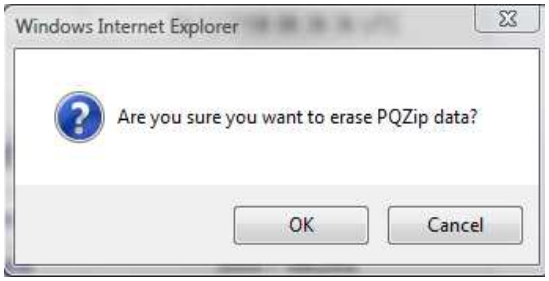
Record Type

Starting from PQSCADA version 3.0, the PQZip file structure and algorithm has been improved to gain better compression and data accuracy. When PQSCADA 3.0 or higher version is used, it is recommended keeping a *PQSCADA 3.x* setting.



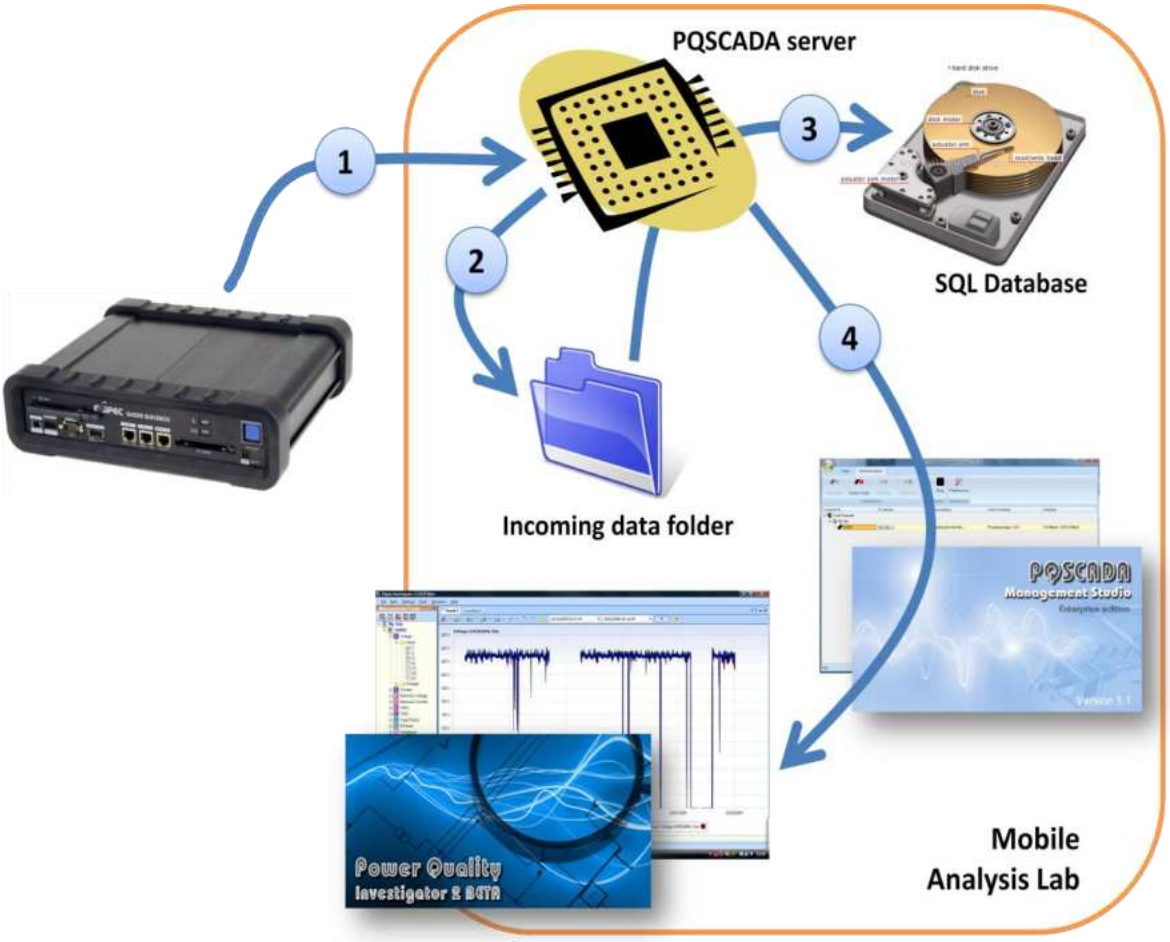
Erasing All PQZip Data

By pressing the *Erase PQZip Data* button it is possible to clean the memory from the all files being recorded. This operation requires Administrator-level privileges and prompts for confirmation to avoid unauthorized data deletion.



The Software

PQSCADA Suite



The PQSCADA Software Suite is installed on a Mobile Analysis Lab computer (or other laptop/computer) providing unparalleled data monitoring and analysis functionality for the BLACKBOX Portable devices. For software installation instructions, please refer to the PQSCADA installation manual or contact your local Elspec distributor.

The PQSCADA software suite:

- PQSCADA server
- PQSCADA Management studio
- Elspec Power Quality Investigator
- MS SQL 2005/2008 database engine

PQSCADA Server

The PQSCADA server is the heart of the BLACKBOX data management and analysis system. The main functionalities of the PQSCADA server are shown in the figure above and further described below with corresponded numbering marks:

1. **Data collection (Downloading):** The PQSCADA server system is responsible for collecting all continuous data (PQZip files) from a connected device automatically. When the device is connected (wired or wirelessly) the PQSCADA server automatically checks for any new data availability using an FTP[6] communication protocol.

2. **Placing new files into the Incoming data folder*:*** All new PQZip files found on a connected device are copied (the original files remain on device) to a temporary location on a local hard drive "Incoming data folder".

3. **Data processing and storage*:*** The next stage is data processing, in which the data is being organized for storage and quick access (Stage 1) and then a variety of electrical parameters are being calculated (Stage 2) based on the raw PQZip data. The reorganized PQZip data, as well as the calculated parameter statistics are being stored in a local SQL database. The files which have been processed and successfully inserted to the database are then removed from the Incoming folder

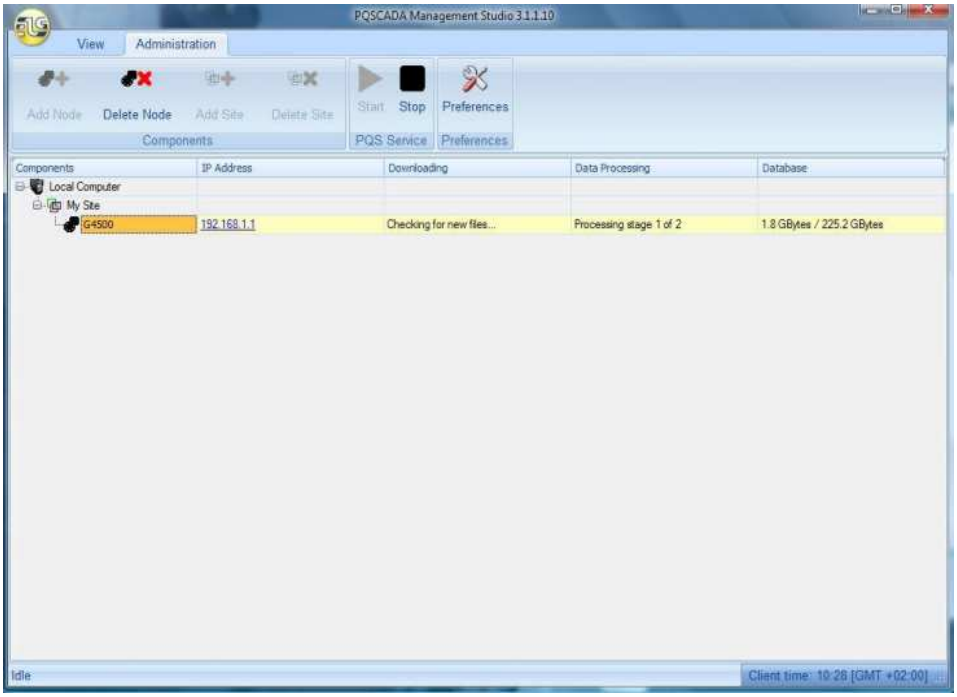
4. **Networking*:*** The PQSCADA server integrates a dedicated HTTP (default port 80) interface that communicates with the PQSCADA Management Studio (interactive management application) and the Elspec Power Quality Investigator (data analysis application) running on either the same or different machine.

PQSCADA Management Studio

The PQSCADA Management Studio is an interactive tool which provides full control and monitoring of all of PQSCADA's activities.

[6] Refer to page 96 for more details

Administration Console



The main PQSCADA Management Studio's window is a hierarchical table/grid with following columns:

- Components
- IP Address
- Downloading
- Data Processing
- Database

Components

The PQSCADA suite is designed to operate and manage a virtually unlimited number of BLACKBOX devices, both Portable and fixed. The physical device is represented under the system by the term Node.

The NODE is the software component which represents data taken by a physical device such as BLACKBOX Portable or a fixed G4k model.

The SITE is a software component which represents a group of Nodes. The SERVER is the representation of the physical machine (Analysis lab) on which the PQSCADA server application is installed.

The Node Status Fields

Component

Status	Description	Right Click Menu
The name	The given name to the node	• Refresh • Rename • Configure • Delete
"Needs Upgrade"	The node requires upgrade. Use *Upgrade* on right mouse click menu.	• Refresh • Upgrade • Delete

IP Address

Status	Description	Right Click Menu
IP Address or host name in hyperlink format	The IP Address is defined.	• Open in Explorer • Open in FTP • IP Setup
"No IP defined"	No IP Address is defined, Link is disabled.	• IP Setup

Downloading

The Downloading field displays the status of the data downloading process. Below is the list of status variations could be expected on that field.

Status	Description	Right Click Menu
"Disabled" in light gray	The FTP downloading service is disabled.	• Schedule operation • IP Setup • Folders setup • Open incoming folder • Enable
"No IP defined" in light gray	IP address not defined. FTP downloading service is disabled.	• Schedule operation • IP Setup • Folders setup • Open incoming folder • Enable
Error: link failure	No communication IP was set. However, device is not reachable. Check physical connection.	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable

Status	Description	Right Click Menu
Error: login failure	No communication IP was set. Login failure Use *IP Setup* to verify/modify FTP user name and/or password.	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable
"Next attempt in XX seconds"	Waiting for the next communication attempt	• Refresh • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable
"Checking for new files…"	Communication established, Checking for new files	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable
"XXX kB/sec" in normal color	Downloading new files	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable
Error: Incoming folder full	PQZip folder is full due to folder limitations. Use Folders Setup to modify the Incoming folder quota or free some disk space.	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable

Status	Description	Right Click Menu
Error: Disk full	PQZip folder is full due to disk space limitations.	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable
Error: incoming folder not found	**The incoming directory is missing.**	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable
Error: cannot write file	**Cannot write the downloaded file to disk**	• Refresh • Force connection attempt • Schedule operation • IP Setup • Folders setup • Open in Explorer • Open in FTP • Open incoming folder • Disable

Data Processing

The Data Processing field displays the status of the PQZip data processing engine. Below is the list of status variations could be expected on that field.

Status	Description	Right Click Menu
"Disabled" in light gray color	The service is disabled.	• Folders setup • Define 'time of interest' interval • Configure service • Open incoming folder • Open 'bad files' folder • Open data backup folder • Enable
"Processing stage 1 of 2"	Stage 1 (PQZip parsing)	• Refresh • Force file parse attempt • Folders setup • Define 'time of interest' interval • Show/ modify data channels configurations • Configure service • Open incoming folder • Open 'bad files' folder • Open data backup folder • Disable • Recalculate data
"Processing stage 2 of 2" in normal colors	Stage 2 (Recalculate summaries)	• Refresh • Force file parse attempt • Folders setup • Define 'time of interest' interval • Show/ modify data channels configurations • Configure service • Open incoming folder • Open 'bad files' folder • Open data backup folder • Disable • Recalculate data
Database error	Database is full or unavailable	• Refresh • Force file parse attempt • Folders setup • Define 'time of interest' interval • Configure service • Open incoming folder • Open 'bad files' folder • Open data backup folder • Disable • Recalculate data

Status	Description	Right Click Menu
"Waiting for new data"	Idle, no new data found in Incoming folder	• Refresh • Force file parse attempt • Folders setup • Define 'time of interest' interval • Show/ modify data channels configurations • Configure service • Open incoming folder • Open 'bad files' folder • Open data backup folder • Disable • Show last day log • Recalculate data
Bad files folder is full	"Bad files" folder is full.	• Refresh • Folders setup • Define 'time of interest' interval • Configure service • Open incoming folder • Open 'bad files' folder • Open data backup folder • Disable • Show last day log • Recalculate data

Database

The Database field displays the status of the Node's database. Below is the list of status variations could be expected on that field.

Status	Description	Right Click Menu
Login Error	Login Error. The administrative access to the database was denied. Please select Login setup option on right mouse click menu.	• Login setup
Database is full	Database is full. The database size has reached its maximum state. Please resolve that issue on Size limitation setup, free more disk space or truncate unnecessary data.	• Refresh • Login setup • Size limitation setup
XXX MB / **YYY MB**	Online	• Refresh • Login setup • Size limitation setup • Backup • Restore • Delete data • Re-index • Import data • Export data

Elspec Investigator

The Elspec Power Quality Investigator is an innovative tool which helps explore electrical network anomalies and investigating power quality issues with mouse-click simplicity.

Elspec Investigator is a client application that communicates, receives, and displays data from the PQSCADA server system (refer to page 113). The communication performed uses a standard HTTP protocol (port 80), so it is firewall friendly and can be easily used over local LAN and/or over the Internet.

Getting Started

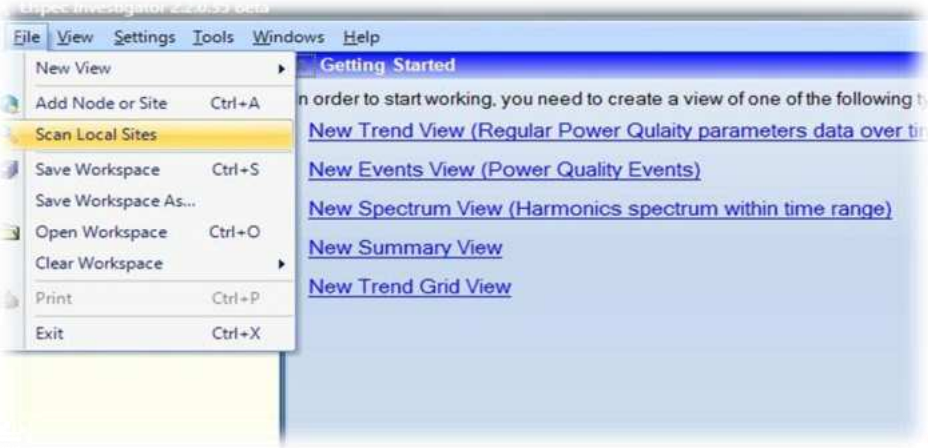
Initially, the Investigator application appears with a window as shown below.

The panel on the left titled Measurement Points appears blank. In order to start working with the tool, you need to add a PQSCADA SITE to work with.

Adding a Measurement SITE

Automatic Scan

When the PQSCADA server application is running on the same machine, such as in the Mobile Analysis Lab, the most convenient way of adding a site is by automatically scanning for local sites functionality. This Scan Local sites procedure is available in the File menu. This tool makes use of UDP broadcasting on port 885 in a similar manner as the Elspec Search utility searches for G4k devices.



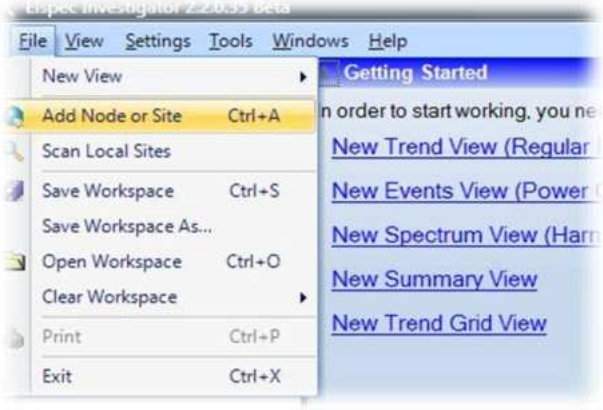
However, in some situations, the tool may fail to discover local sites, due to some of the following reasons:

- The local firewall prohibited UDP broadcasting.
- The Elspec Search tool is running and making use already on UDP 885 port.
- The local site is down or unreachable.

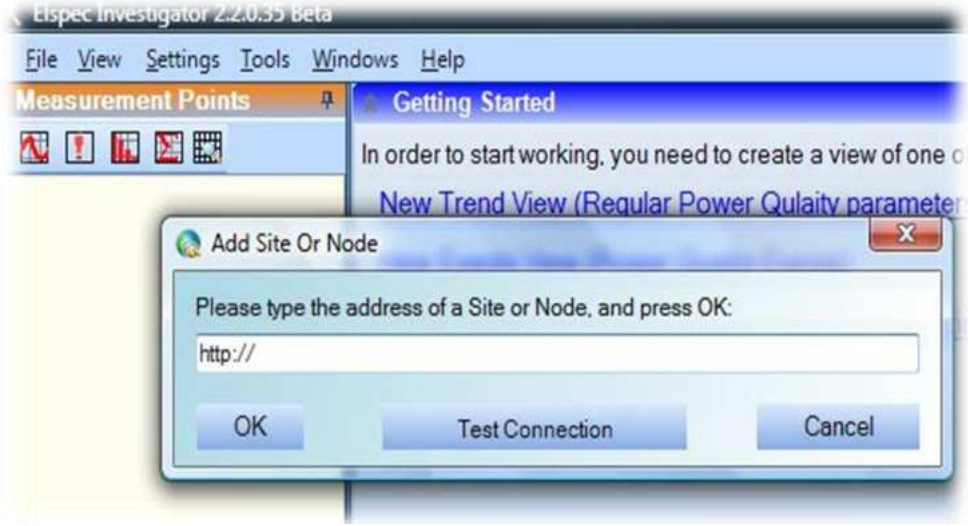
If the automatic scan procedure does not provide sufficient results, it is recommended adding the SITE manually as described below.

Adding a SITE Manually

a) To Add a SITE manually, choose *Add Node or Site* option from File menu.



b) Type a full URL for the SITE.



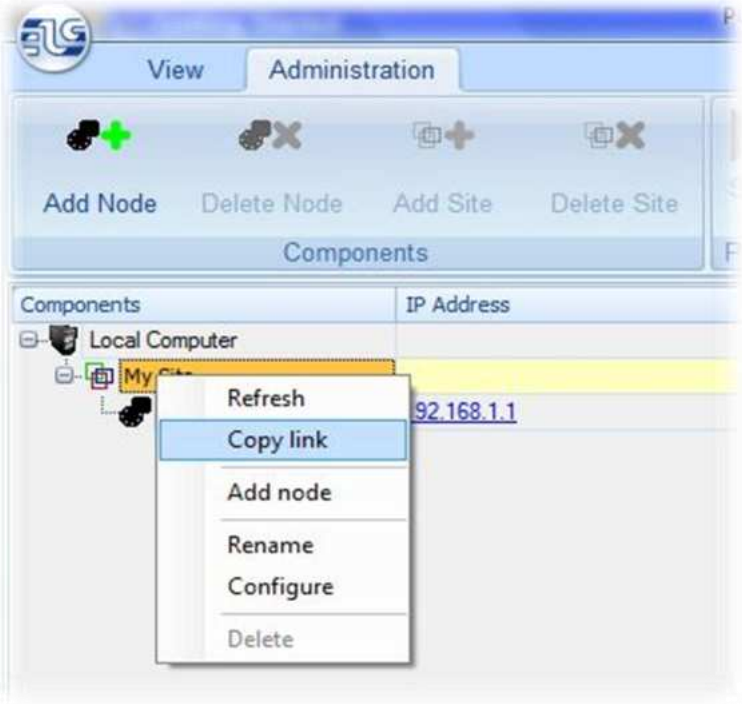
For example: if the computer is connected to Internet, the following site could be added: http://pqscada.com/demosite

This site is managed by the Elspec computer system and provides continuous measurements from an actual facility with multiple G4k devices.

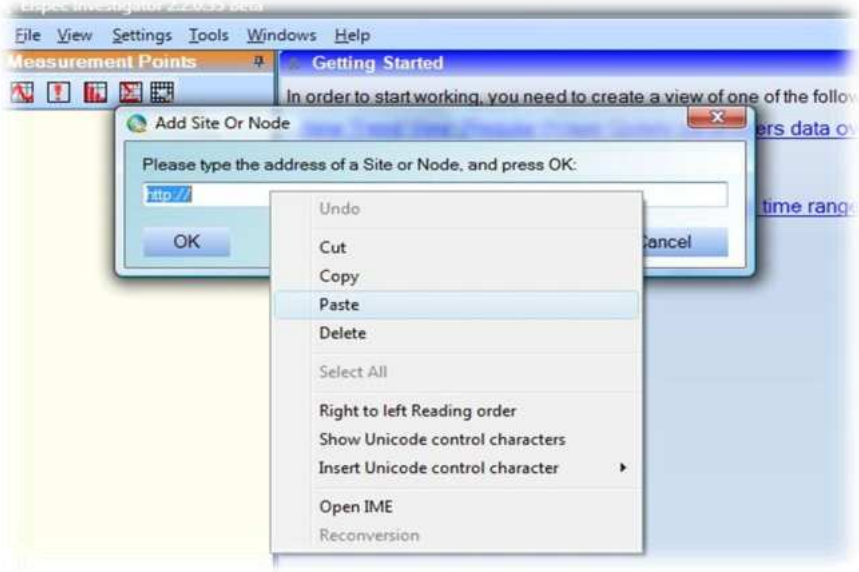
When PQSCADA server software is running on the same computer, the site URL can be easily obtained from the PQSCADA management studio application by:

a) Right mouse clicking on *SITE* under PQSCADA management studio

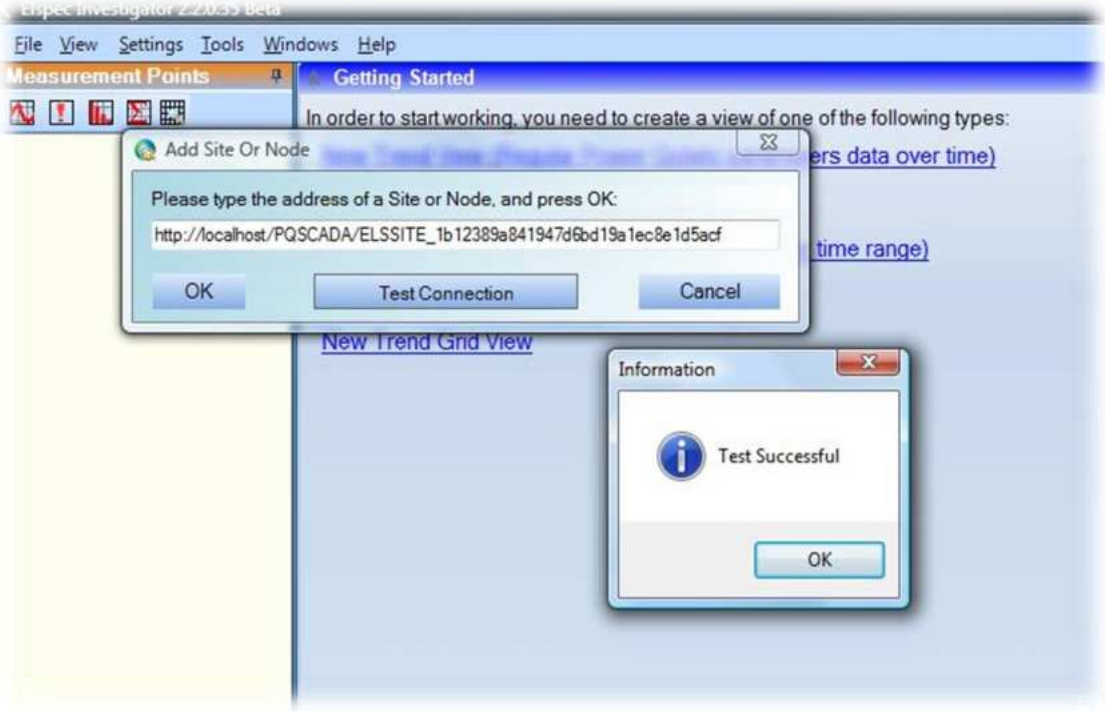
b) Choose *Copy Link* as shown below.



c) Then paste the link under *Add Site or Node* window, as shown below:



The full URL link to the site managed by a local PQSCADA server will appear.

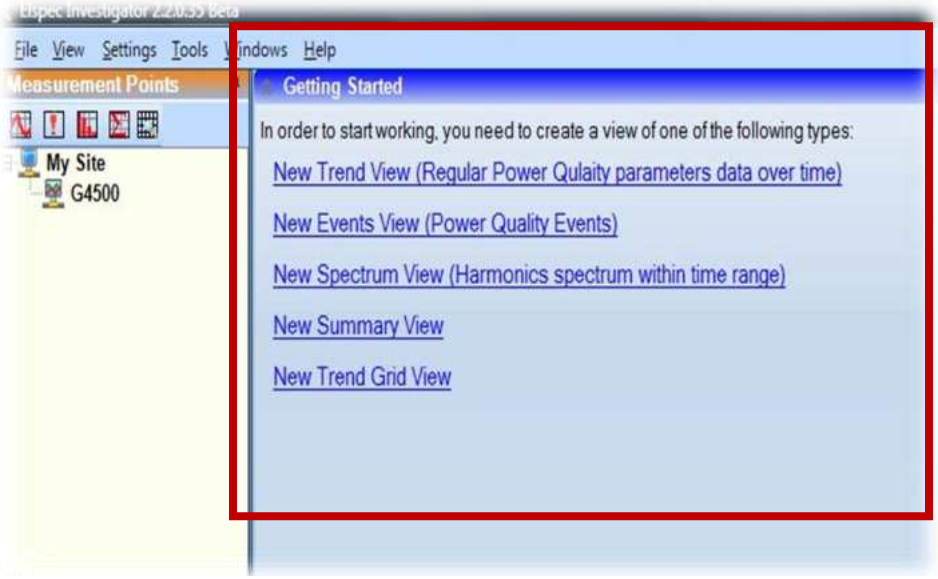


It is recommended that you press the *Test Connection* button before *OK* to ensure that the URL is valid.

When successful, the site will appear on the Measurement Points panel.

Operation

The Investigator application can present the recorded data in 5 different ways. The data representation is called a View. To start work with the data analysis, it is necessary to choose the view type first.

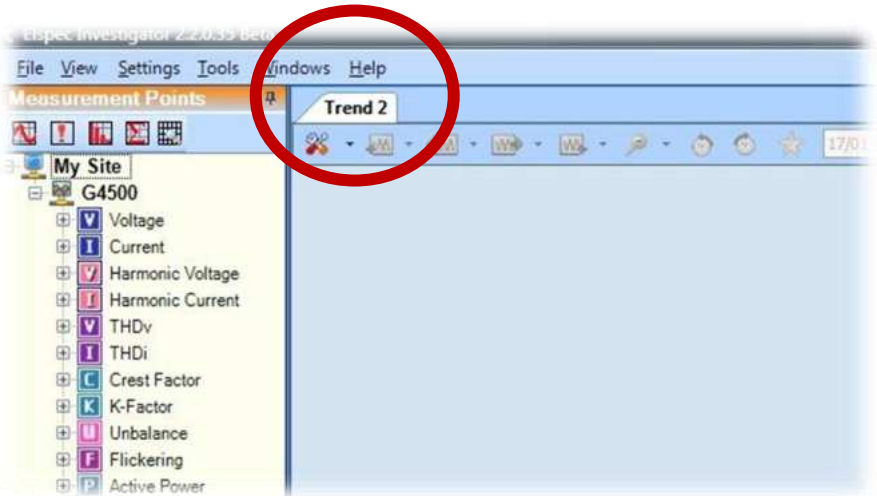


The view types available are:

- **Trend View:** An historic data representation where user-selected electrical parameters are presented as a trend graph in a continuous time frame
- **Events View:** A table of events captured/detected by the device according to the "Power Quality compliance program"
  (refer to Power Quality Section on page 58)
- **Spectrum View:** Useful for harmonic spectrum representation including voltages, current and power harmonics
- **Summary View:** Displays summary information over a defined period of time, including maximum, minimum and true mathematical averages of any parameter over a time span defined by the user
- **Trend Grid View:** Similar to the trend view, but with a grid/table style display

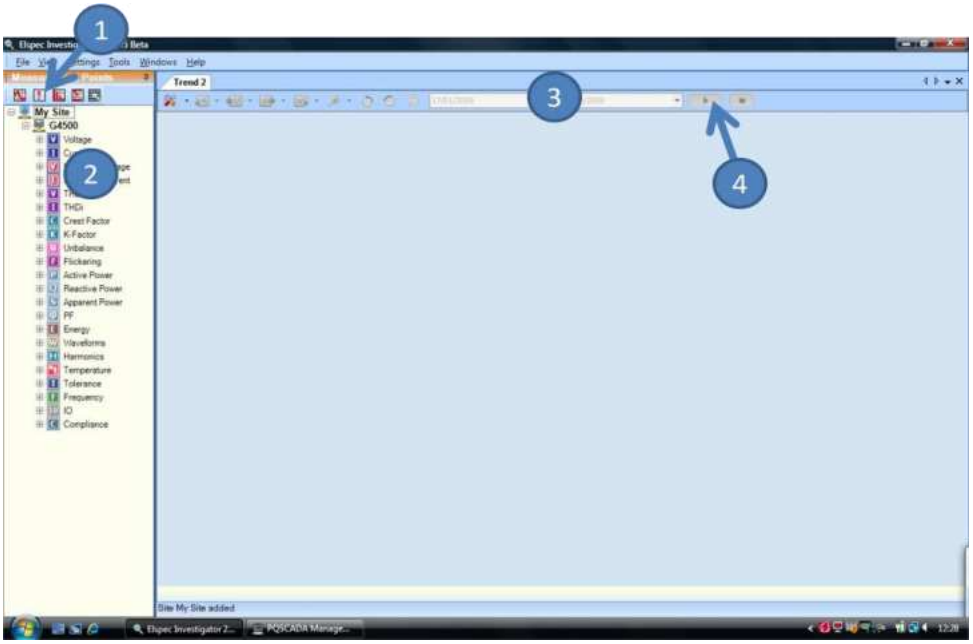
The Multi-View Concept

The Elspec Investigator supports a multi-view operation, which means that you can open and operate a number of views of any type simultaneously. When a new view is created, it appears as a blank screen and is docked as a tab in the working area.

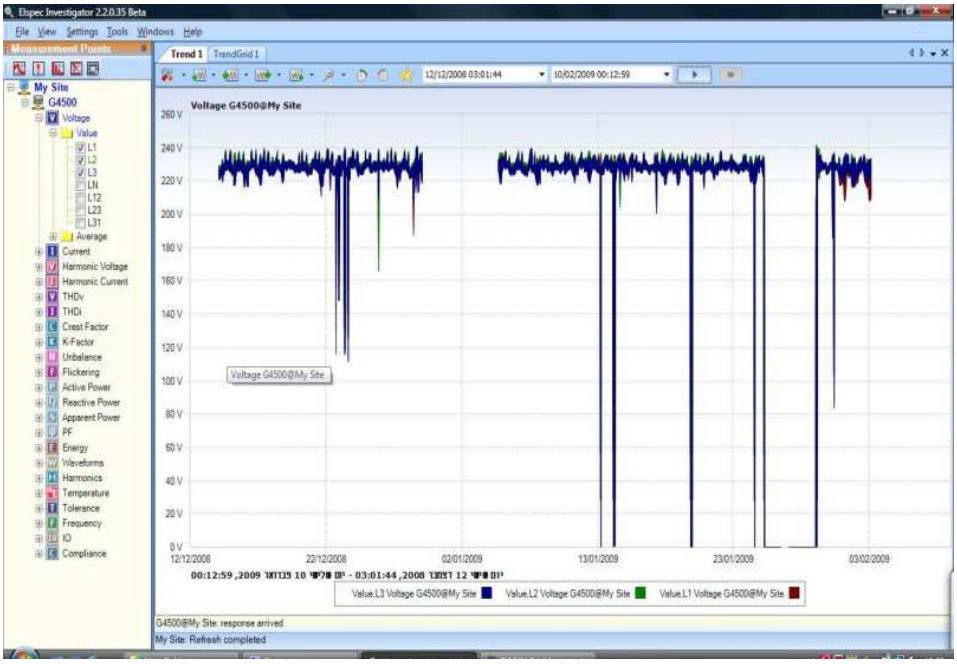


Any open view has its own number of parameters and time span, so it is possible to display different data or different time spans simultaneously using a number of views.

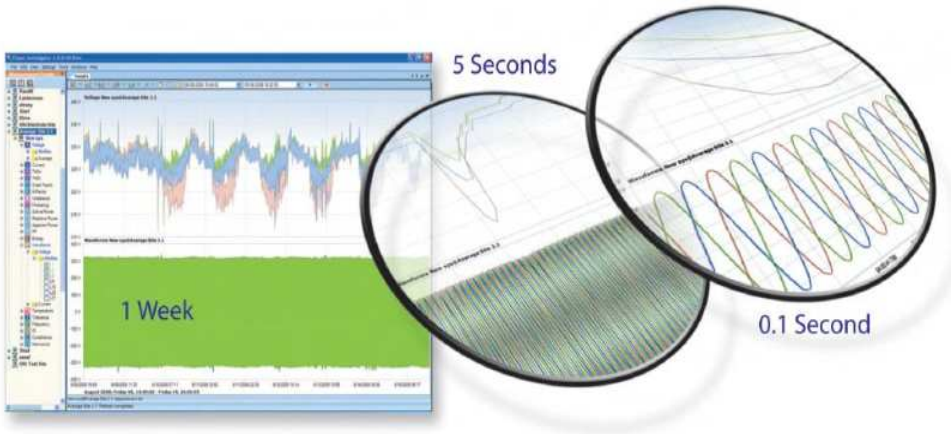
Generally, the operation can be simplified as a 4 stage process:



1. Select the view
2. Select the parameters
3. Select the time span
4. Press a *query* button and receive the data



You can add/remove parameters any time and choose any time intervals.



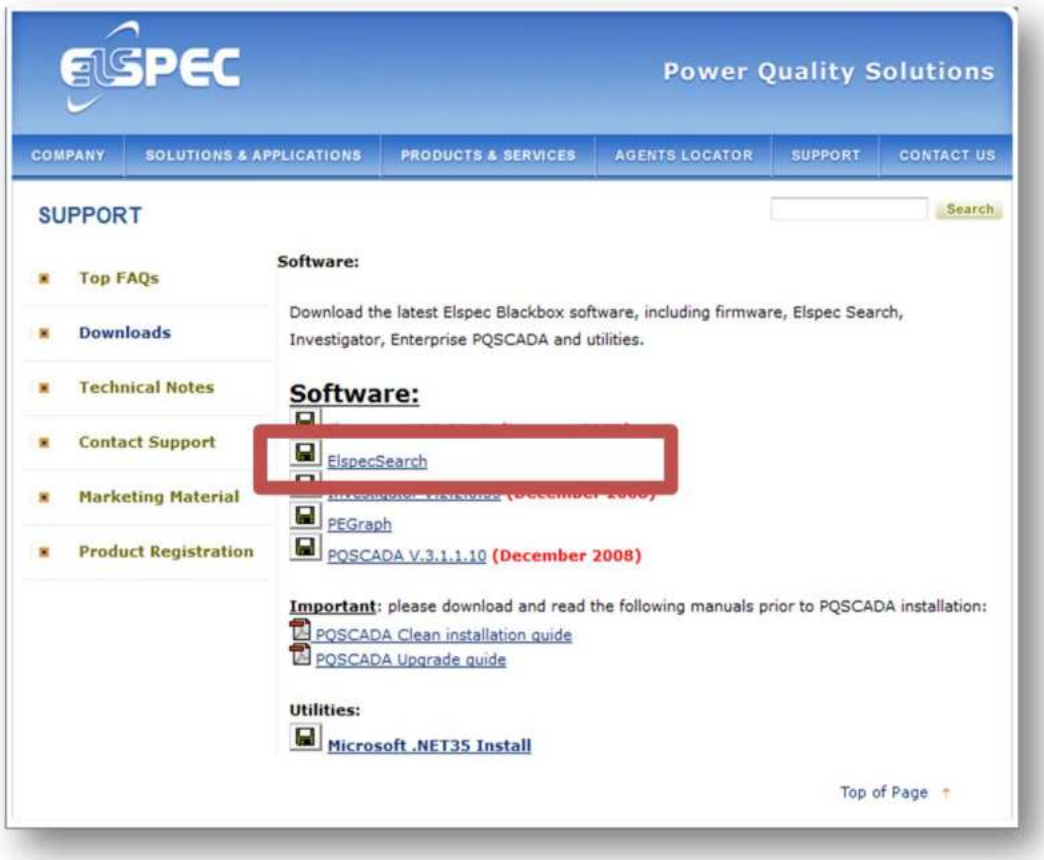
The data can be further zoomed in and out using a mouse from/to any time resolution.

Elspec Search Utility

The Elspec Search Utility is a small yet useful tool that allows searching and the ability to determine BLACKBOX family device IP addresses sharing the same local LAN. The Elspec Search makes use of UDP broadcasting, sending a *please respond* message to all devices on the LAN and displaying the resultant list of all devices responding to it.

Obtaining the Search Utility

Elspec Search is a small program which does not require installation and is available free on the Support/Downloads section of Elspec WEB site http://elspec-ltd.com



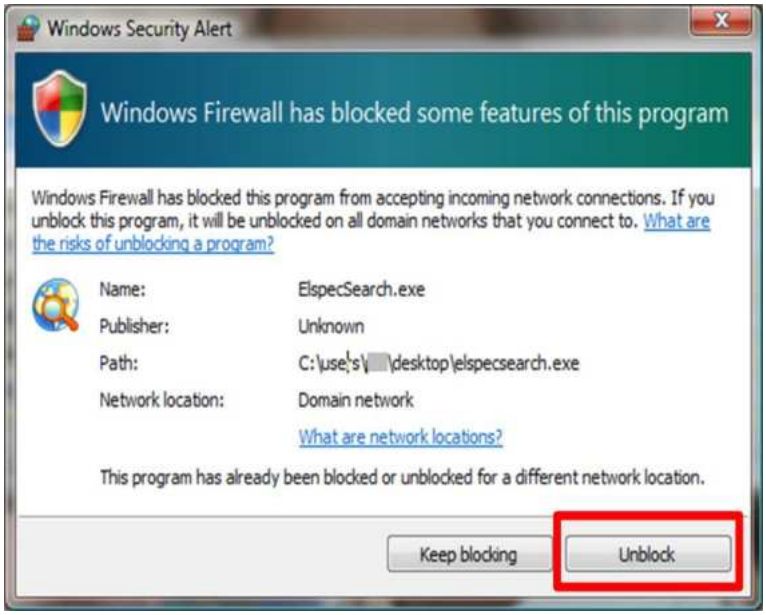
Alternatively, it can be downloaded directly from: http://www.elspec.biz/ElspecG4k/ElspecSearch13.exe.

Or, found on the Elspec PQSCADA disk.

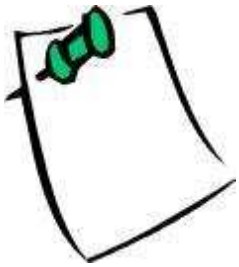
Since the program is small and does not require installation, it is recommended copying it and operating it directly from the computer Desktop.

Operation

Initially, the program will most likely be detected by a firewall system as trying to open UDP port 885.



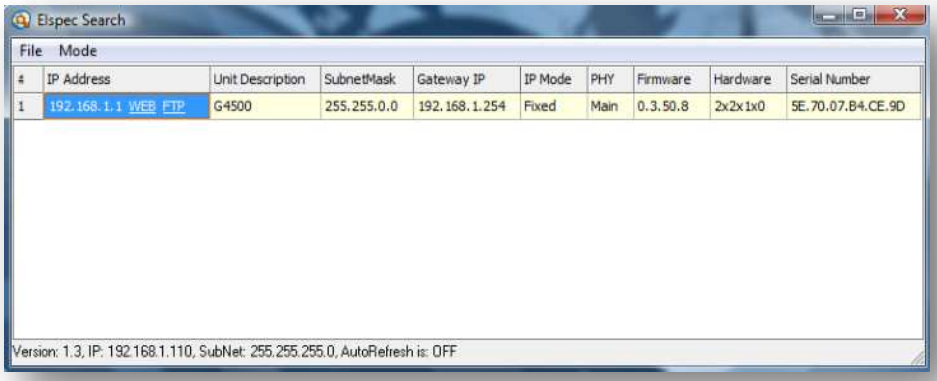
If so, the above or similar window will appear prompting an operation approval.



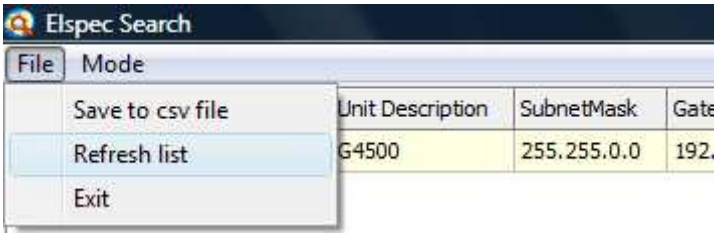
It is highly important to enable the operation on the first run by pressing the "Unblock" button. Failure to do so will permanently disable the operation without any further notification.

Some organizations do not allow manual firewall configuration as a part of a corporate policy. Contact your system administrator for assistance in opening UDP port 885 when necessary.

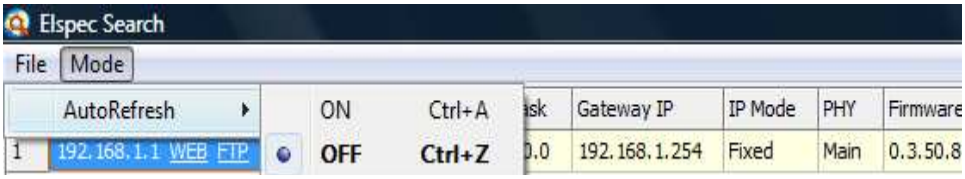
When initiating a scan procedure, the utility appears as a grid displaying all BLACKBOX devices found on the network.



Once open, the scan procedure can be manually prompted by using the *File>Refresh List* menu as shown below.



As an alternative, the scan procedure can be configured to automatically refresh each second. This can be done by setting the *Mode>AutoRefresh* to *ON*. The default state is OFF.



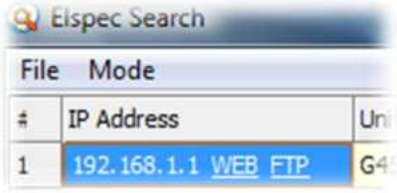
The Elspec Search list shows a variety of important information about every BLACKBOX device found on network; most of it is helpful to identify devices. However, probably the most important information is the IP Address of each device. This allows the initiation of WEB, FTP or Telnet session with the device.

Limitations

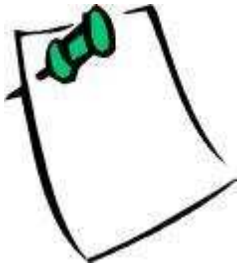
The Elspec Search utility can operate only as one single instance at a time, since it uses a single and fixed UDP port. When more than one instance is running at the same time – only the first one will operate correctly, the rest will show no devices.

Useful Features

Launching WEB or FTP Session

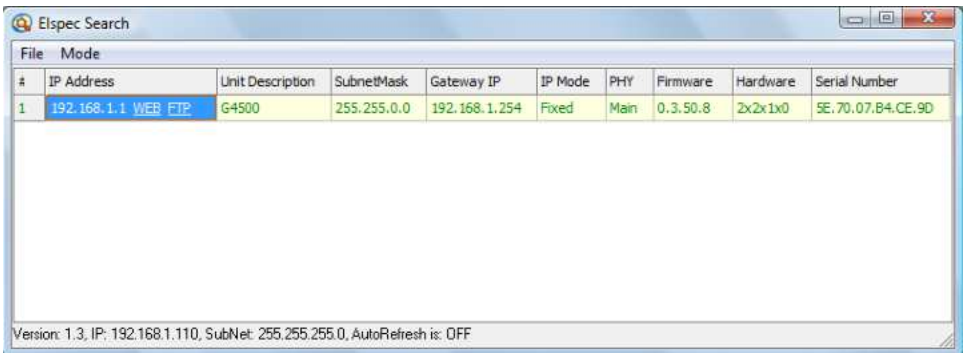


The WEB and FTP hyperlink buttons on the right of the IP Address string launch WEB or FTP sessions directly from the Elspec Search window.



It is recommended that you define MS Internet Explorer© 7 as the default internet browser application.

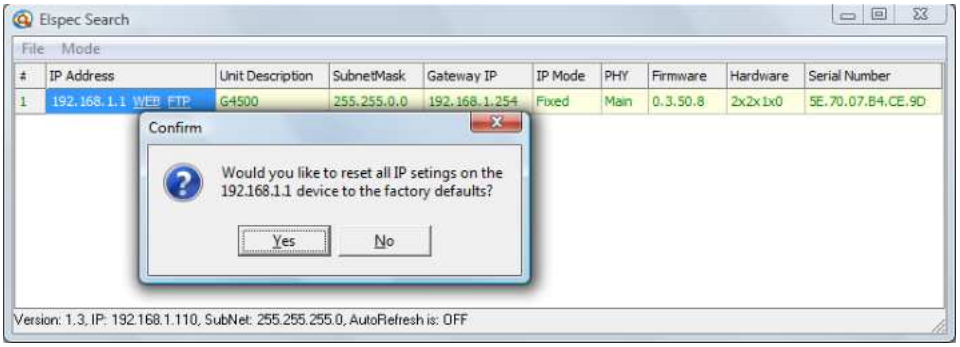
New Device Indication



Every new device – one that wasn't found on the previous refresh is marked in green.

Restoring Factory Defaults

The device can be forced to restore the factory default network configuration through a left mouse button double click.



Please allow a couple of minutes for a change to take effect as the device will automatically reboot, restoring factory default settings upon pressing the *Yes* button.

How to….?

Replacing the Battery

The BLACKBOX Portable contains a lithium battery that will provide up to 2 hours of fully functional operation without an external AC/DC power source. The battery requires no maintenance and is designed for long service life. However, if the battery shows a significant decrease in performance, it should be replaced with a factory original. Please consult with your local Elspec agency for information on how to order a replacement battery. The following procedure takes you step by step through the process of replacing the battery in the BLACKBOX Portable device.

Before You Begin

We recommend that you have all of the following ready and available to complete the battery replacement process:

- BLACKBOX Portable device
- Replacement Battery
- Phillips head screwdriver
- Flat head screwdriver

Removing the Battery

***Warning**: We strongly recommend that you power down this device and remove all connected power and communication cables before commencing service.*

1. Remove the Rubber Cover from the front side of the device.
2. Remove all screws from Front Bracket (6 flat, 2 Phillips).

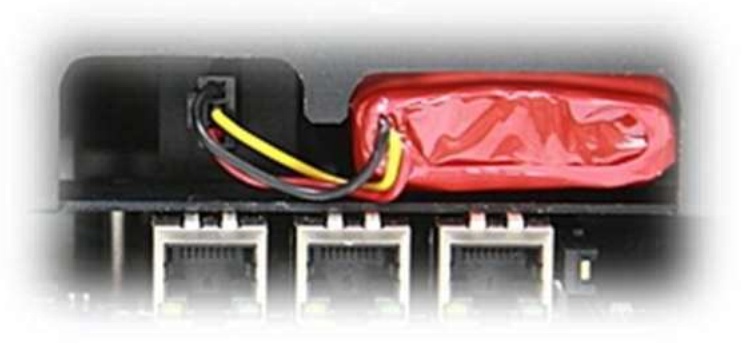
3. Remove the Front Bracket with Antenna extended straight**.**

4. Remove Battery Connector from the device terminal.

5. Remove Battery from the Carriage.

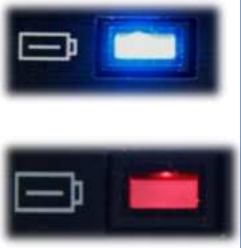
Installing the New Battery

1. Place new battery in carriage.
2. Re- connect plug connector from battery to device terminal inside the device (make sure wires are tucked into the device cavity).

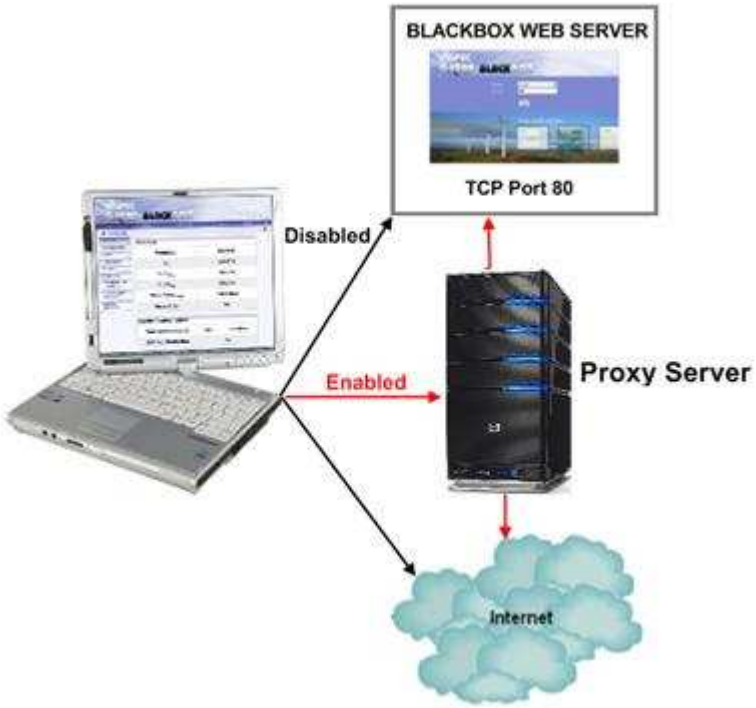


3. Replace Front Bracket and secure with screws.
4. Replace Rubber Cover.
5. Re-connect all Power and communication cables.
6. Power up to test connections.

Status	State
Flashing blue	Main or auxiliary power applied/Battery charging.
Solid blue	Main or auxiliary power applied/Battery is fully charged.
Red	No main or auxiliary power availa-ble/Powered by internal battery.



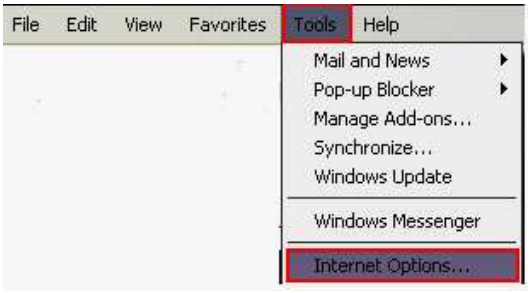
Disabling Proxy Server in Internet Explorer



A Proxy Server is a computer or application that functions as an intermediary between a web browser (such as Internet Explorer) and the Internet or Web Server. Originally proxy servers were designed to help improve web performance by storing a collection cache of frequently used web pages. With the advent of much faster connection speeds to the Internet, proxy servers are now primarily used in corporate networks to help improve security by filtering out some web content and malicious software.

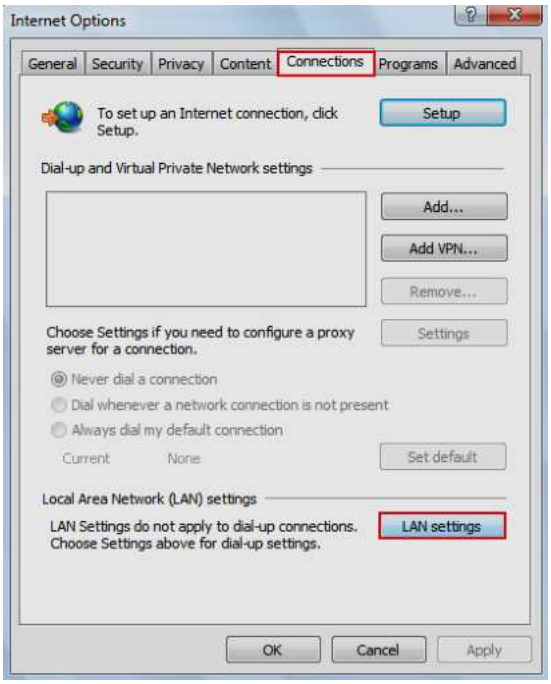
Using a web browser, you connect to the BLACKBOX Portable's web server through HTTP in much the same way you connect to the Internet. To view the web server of the device or embedded router, access to TCP Port 80 is required. Depending on the configuration of your LAN, (please consult your Network Administrator), you may (not) have permissions set to allow direct access to Port 80 on the BLACKBOX Portable device. In such cases, it may be necessary to disable the proxy server in Internet Explorer.

To disable the proxy server:



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

   The Internet Options window appears.



2. Select **Connection→LAN settings.**

The LAN Settings dialog box appears.

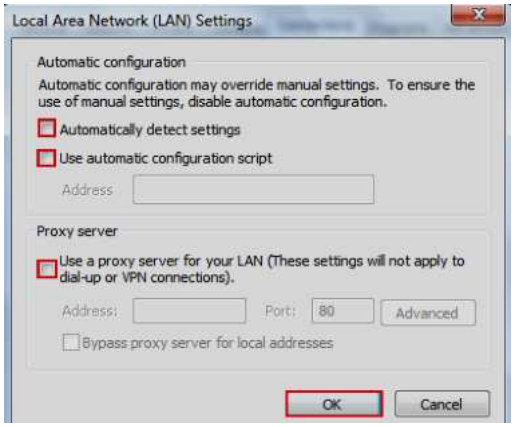


Figure 1: LAN Settings

3. Uncheck all pick boxes.
4. Click **OK.**
5. Press **F5** to refresh the browser window.

The Login screen appears.

Establishing a Security on Wireless Interface

As a factory default setting, a BLACKBOX Portable is supplied with an unsecured wireless (Wi-Fi) interface configuration. This is probably the most convenient way of getting starting and using the device for the first time. However, in practical usage scenarios, it is most likely that some level of security would be required to avoid unauthorized access to configuration screens and/or the data.

The BLACKBOX Portable utilizes an industry standard wireless router which is capable of providing a full list of security measures required for establishing a fully secure and reliable wireless communication even on the most security-sensitive applications.

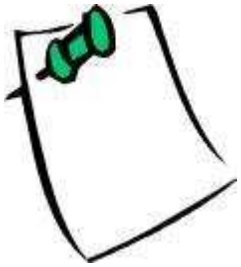
The most simplified way of enabling a wireless security is using the wireless router's Setup Wizard (refer to Wireless Router on page 34).

Step 6 of the wizard allows setup of wireless security, turning ON WEP or WPA encryption access and password control.

The main selection is between two most popular security key exchange and encryption methods:

- **WEP** is the one of the oldest and probably still most popular encryption scheme. Some security experts used to believe that this security mechanism it relatively easy to crack, or break into, so it is not the best form of security for the wireless network. The password is defined as a 10 characters HEX number, which is quite easy to remember/use, yet probably easier to break as well.
- **WPA** is a latest wireless security technology that provides significantly stronger wireless data encryption than WEP. WPA uses a 64 character passphrase as a Pre-Shared key and provides a much stronger security level.

WPA encryption scheme is recommended for all cases when the client device supports this scheme.



Making changes in security configuration while connected by a wireless interface is strongly discouraged.

Establish a LAN connection on port LAN1 to configure the wireless router.

WPA Configuration Example

1. To establish a WPA data encryption scheme using TKIP encryption technology, select *WPA(TKIP)* from the list
2. Type a desired security key, then press the *Finished* button.

The BLACKBOX Portable unit is now wirelessly secured.

3. To establish a connection from the Mobile Analysis Lab select Start>Connect to
4. Select the interface from the list and then right mouse click > Properties

5. On the Properties window, select *WPA-Personal* , then *TKIP*.

6. Type the same security key as was used in router configuration and press *OK*.

7. Press the *Connect* button to begin a secure communication session with the instrument.

Restore Wireless Router to Factory Defaults

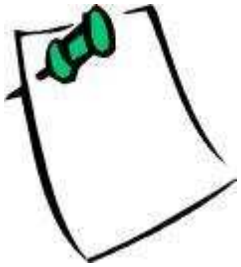
The wireless router can be reset to the factory setting as a part of a complete instrument reset to default settings using the Reset button (**refer to page 32**). However, in some situations, only the wireless router is intended to be reset leaving the instrument's settings without change.

The procedure described below is intended to restore to factory defaults only on the wireless router.

The procedure requires establishing a Telnet session with the instrument. (**Refer to Establishing a Telnet Session on page 104****).**

1. On the Telnet terminal type the following wireless router reset command:

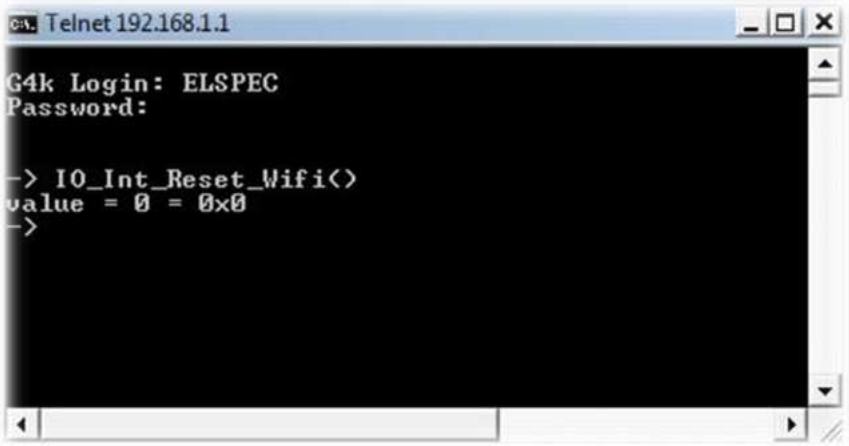
IO_Int_Reset_Wifi()



All Telnet commands and operations are case sensitive!

2. Press *Enter* and wait a few seconds for the operation to complete.

When finished the function returns with the following:



The wireless router is now reset to its factory default settings.

Simplified Power Curve Verification (PCV) Report

The Power Curve Verification (PCV) Report is typically required by the Wind Turbine Power Performance Measurement procedure, defined per IEC 61400-12-1 standard. The typical report requires a continuous statistical aggregation and periodical recording the following for several electrical and wind related parameters:

- mean value (Avg)
- standard deviation (StDev)
- maximum value (Max)
- minimum value (Min)

The BLACKBOX Portable implements a special reporting feature that performs required statistical analysis onboard, without a need of an external PC or post–processing of data. This feature can be extremely helpful in assisting a final PCV report preparation, as well as in some other non-wind related applications.

The parameters available by default are:

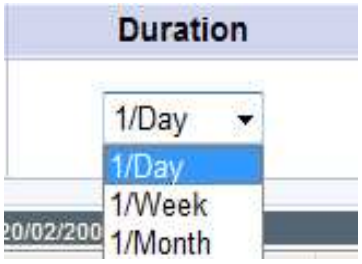
- Total Active power (Avg, StDev, Min, Max)
- Frequency (Avg, StDev, Min, Max)
- Total Reactive power (Avg, StDev, Min, Max)

Please contact your local Elspec distributor if some additional parameters are required.

Configuration

The PVC report Configuration is located in the Service/Power Setup section (refer to Meter Readings Log on page 75). To enable this automatic reporting feature select *Parameters* on the *Mode* field.

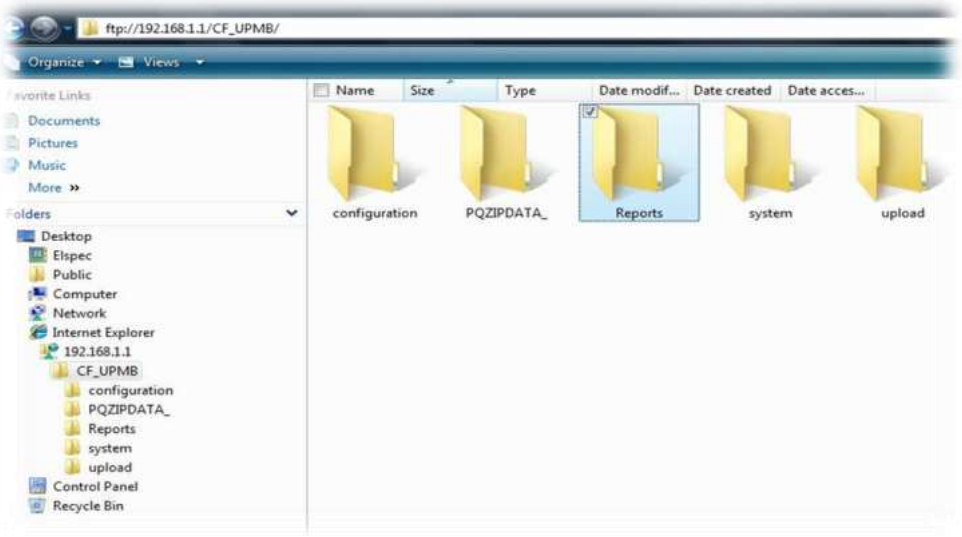
The Duration field defines the way the output files should be recreated. 1/Day selection on file duration will force the system to produce separate files each day, and the time a new file should be created is defined on the Log restart field. In the configuration example above, a new report file will be generated each day at 12:00 (UTC time).



The aggregation period for the statistical analysis is defined in the Energy Interval configuration (refer to Energy Intervals on page 74).

The Outcome

The report Outcome file/s is/are created in the Reports folder on the main flash drive. The files are available through an FTP interface on page 91).



File Format

The report files are created in MS Excel's Comma Separated Values (CSV) File Format.

The filename's Structure

DL log A to B.csv

Where:

- **A** : Start time stamp in format: YYYY_MM_DD_HH_MM_SS
- **B** : End time stamp in format: YYYY_MM_DD_HH_MM_SS

For example: file "**DL log 2009_02_18 13_10_00 to 2009_02_19 07_40_00.csv"** is a report file was created at 18/02/2009 at 13:10:00 and finalized on 19/02/2009 at 07:40:00

While the file is being processed, the filename consists of only the start time record.

The filename time stamps are in UTC time format (not local time).

The Internal Structure

Below is an example of a typical file generated.

	A	B	C	D	E	F
1	Device Name: Demo unit					
2	UTC Time	Local Time	kW_Total_Avg	kW_Total_StDev	kW_Total_Max	kW_Total_Mi
3	18/02/2009 13:10	18/02/2009 15:10:00	0.000007	0.002527	0.000029	-0.0000
4	18/02/2009 13:20	18/02/2009 15:20:00	0.000007	0.002673	0.000053	-0.0000
5	18/02/2009 13:30	18/02/2009 15:30:00	0.000007	0.002205	0.000053	-0.0000
6	18/02/2009 13:40	18/02/2009 15:40:00	0.000007	0.001662	0.000053	-0.0000
7	18/02/2009 13:50	18/02/2009 15:50:00	0.000003	0.006332	0.000053	-0.0000
8	18/02/2009 14:00	18/02/2009 16:00:00	-0.000007	0.001534	0.000053	-0.0000
9	18/02/2009 14:10	18/02/2009 16:10:00	-0.000007	0.001727	0.000053	-0.0000
10	18/02/2009 14:20	18/02/2009 16:20:00	-0.000007	0.001222	0.000053	-0.0000
11	18/02/2009 14:30	18/02/2009 16:30:00	-0.000007	0.00155	0.000053	-0.0000
12	18/02/2009 14:40	18/02/2009 16:40:00	-0.000007	0.001538	0.000053	-0.0000
13	18/02/2009 14:50	18/02/2009 16:50:00	0.000002	0.006652	0.000053	-0.0000
14	18/02/2009 15:00	18/02/2009 17:00:00	0.000006	0.005164	0.000053	-0.0000
15	18/02/2009 15:10	18/02/2009 17:10:00	-0.000007	0.001473	0.000053	-0.0000
16	18/02/2009 15:20	18/02/2009 17:20:00	0.000002	0.006656	0.000053	-0.0000
17	18/02/2009 15:30	18/02/2009 17:30:00	0.000006	0.00187	0.000053	-0.0000

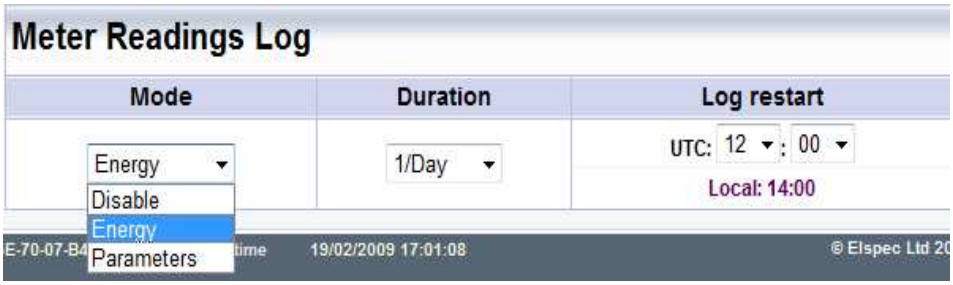
The first two columns specify a time stamp in UTC and local area time of the last data included in the statistical analysis presented by the row. The start time for a record is, in actuality, the stop time for the previous record in the file.

Producing a Simple Time of Use (TOU) Energy Report

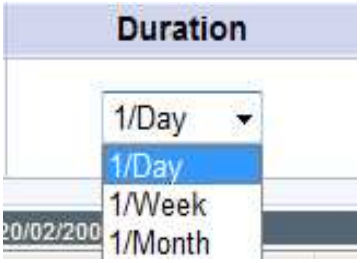
The BLACKBOX Portable is designed to produce a basic energy report file internally. The report is generated in a MS Excel Comma Separated Values (CSV) file format and intended to be used for further Time of Use (TOU) report generation.

Configuration

The Energy report Configuration is located at a Service/Power Setup section **(refer to Meter Readings Log on page 75)**. To enable this automatic reporting feature select *Energy* on the *Mode* field.



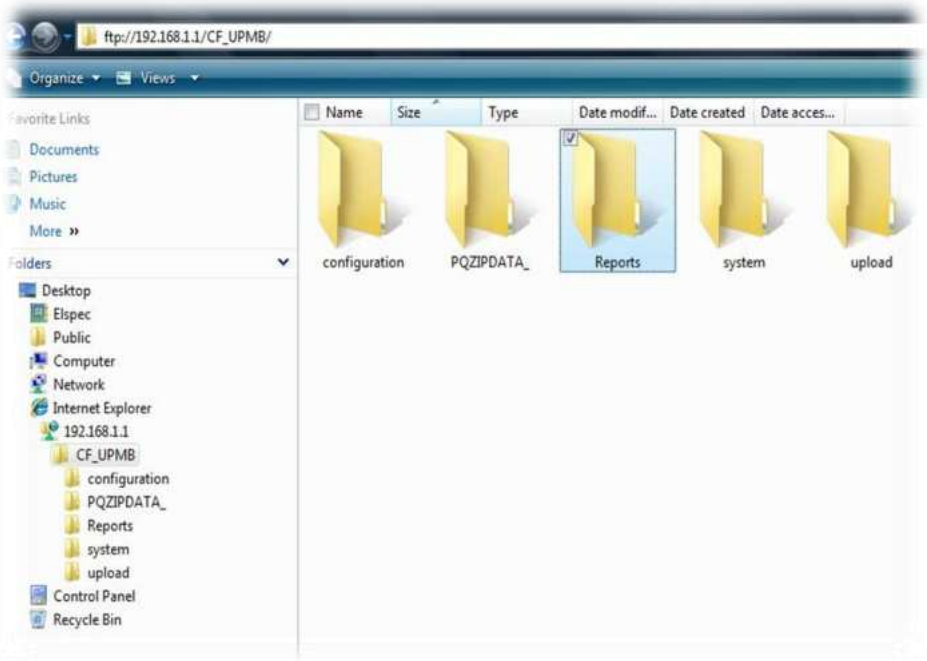
The Duration field defines the way the output files should be created. 1/Day selection on file duration will force the system to produce separate files each day, and the time a new file should be created is defined on the Log Restart field. In the configuration example above, a new report file will be generated each day at 12:00 (UTC time).



The aggregation period is as defined as the Energy Interval configuration **(refer to Energy Intervals on page 74)**.

The Outcome

The report Outcome file/s is/are created in the Reports folder on the main flash drive. The files are available through an FTP interface.



File Format

The report files are created in MS Excel's Comma Separated Values (CSV) File Format.

The Filename's Structure

MR log A to B.csv

Where:

- **A**: Start time stamp in format: YYYY_MM_DD_HH_MM_SS
- **B**: End time stamp in format: YYYY_MM_DD_HH_MM_SS

For example: file "**MR log 2009_02_18 13_10_00 to 2009_02_19 07_40_00.csv"** is a report file was created at 18/02/2009 at 13:10:00 and finalized on 19/02/2009 at 07:40:00

While the file is being processed, the filename consists of only the start time record.

The filename time stamps are in UTC time format.

The Internal Structure

Below is an example of the typical file generated.

	A	B	C	D	E	F	G
1	UTC Time	Local Time	kWh in	kWh out	kVAh	kVArh in	kVArh ou
2	19/02/2009 07:40	19/02/2009 09:40:00	0	0.000001	0.00001	0.000009	0.000001
3	19/02/2009 07:50	19/02/2009 09:50:00	0	0.000002	0.000023	0.00002	0.000003
4	19/02/2009 08:00	19/02/2009 10:00:00	0.000001	0.000005	0.000038	0.000031	0.000005
5	19/02/2009 08:10	19/02/2009 10:10:00	0.000001	0.000006	0.000051	0.000041	0.000008
6	19/02/2009 08:20	19/02/2009 10:20:00	0.000001	0.000007	0.000064	0.000052	0.00001
7	19/02/2009 08:30	19/02/2009 10:30:00	0.000002	0.000009	0.000077	0.000063	0.000012
8	19/02/2009 08:40	19/02/2009 10:40:00	0.000006	0.000012	0.000098	0.000079	0.000014
9	19/02/2009 08:50	19/02/2009 10:50:00	0.000008	0.000013	0.000112	0.00009	0.000015
10	19/02/2009 09:00	19/02/2009 11:00:00	0.000011	0.000014	0.000129	0.000103	0.000017
11	19/02/2009 09:10	19/02/2009 11:10:00	0.000012	0.000016	0.000145	0.000116	0.000019
12	19/02/2009 09:20	19/02/2009 11:20:00	0.000013	0.000019	0.00016	0.000128	0.000021
13	19/02/2009 09:30	19/02/2009 11:30:00	0.000017	0.000023	0.000182	0.000145	0.000022
14	19/02/2009 09:40	19/02/2009 11:40:00	0.000017	0.000024	0.000195	0.000156	0.000024

The first two columns specify a time stamp in UTC and local area time of the last data included in the energy aggregation presented by the row. The start time for a record is, in actuality, the stop time of the previous record in the file.

Available parameters are:

- kWh In
- kWh Out
- kVAh In
- kVArh In
- kVArh Out

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