# G4K Fixed Power Quality Analyzer

# BLACKBOX

## User & Installation Guide

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# G4K Power Quality Analyzer - System Overview

The innovative design of the G4400 BLACKBOX device series is a technological breakthrough providing the **Perfect Permanent PQ Analysis** solution. Its enhanced capabilities are uniquely adaptable to address the individual needs & requirements for almost any business and/or application. Empowered by the patented PQZIP compression technology, the G4K can store up to a thousand times more than other typical file formats. The PQZIP allows the G4K to continuously record & store all electrical waveforms for extended periods with no gaps in the data. Its superior accuracy yields a 2 x 16 Bit to yield, far surpassing IEC61000-4-30 Class A requirements. The G4K features a threshold-free setup, & is equipped with standard industrial protocols for seamless integration into any SCADA system. It provides PQ parameters according to EN50160, IEC61000-4-30, & other national standards, and the data may be analyzed over any network at any remote location.

The advanced **PQSCADA & Investigator Enterprise Analysis** software enables the operator to detect, view, control, analyze & isolate the minutest PQ anomaly for the diagnosis & effective maintenance of equipment. It simplifies troubleshooting & time-synchronized data recorded by any number of BLACKBOX devices, can be compared within a particular site and/or across many sites.

The embedded **Website** serves as the main user-interface with the unit, providing enhanced management, unit configuration & real-time monitoring of all parameters.

The optional **G4100 Remote Display LCD Unit** (RDU) is an integral part of the Elspec Power Quality Data Center system, allowing inter-connectivity with the G4400 series instruments for configuring and monitoring the electrical distribution system. The G4100 connects and communicates with the G4400 BLACKBOX devices directly via RJ45 network cable or through IP communication from anywhere in the world. One RDU can be used to monitor and configure many G4400 series instruments.

The figure below provides a graphical outline of the G4K System:


## SEE ALSO

- Acronyms
- G4K Warranty
- Product Selection Guide

# Warranty

Each Elspec product is under warranty to be free from defects in material and workmanship under normal use and service. The warranty period is for one year and commences on the date of shipment. Parts, product repairs, and services are under warranty for 90 days. This warranty extends only to the original buyer or end-user customer and it 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 in the operation or handling of the product. 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 re-sellers 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 the Buyer for any importation costs for the repair/replacement of parts when the product purchased in one country is 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. For warranty service, contact Elspec directly to obtain a return-authorization. On receipt of the authorization, return the product to Elspec with a description of the problem, including prepaid postage and insurance (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 do 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

decision-maker of competent jurisdiction, such holding will not affect the validity or enforceability of any other provision.

## NOTICE REGARDING PROPRIETARY RIGHTS

This publication contains information proprietary to Elspec. By accepting & using this manual, you agree that the information contained herein will be used solely for the purpose of operating equipment developed & manufactured by Elspec.

## SEE ALSO

- System Overview
- Acronyms
- Product Selection Guide

# Acronyms

The following acronyms are being used within this document:

| ACRONYM | DEFINITION |
|---|---|
| PQ | Power Quality |
| V | Voltage |
| F | Frequency |
| $V_N$ | Voltage Neutral |
| A | Ampere |
| CT | Current Transformer |
| PF | Power Factor |
| PT100 | Platinum Resistance Thermometers |
| PU | Per Unit |
| PT | Potential Transformer (transformation ratio in both magnitude and phase) |
| CT | Current Transformer |
| THD | Total Harmonic Distortion |
| HV | High Voltage |
| MV | Medium Voltage |
| LV | Low Voltage |
| ADC | Analog to Digital Converter |
| SSL | Secure Sockets Layer |
| GPS | Global Positioning System |
| UTC | Coordinated Universal Time |
| LAN | Local Area Network |
| CF | Compact Flash |

| ACRONYM | DEFINITION |
|---|---|
| OLP | OLE for P rocess C ontrol ( set o f connectivity s tandards f or industrial automation) |
| OPC | Open Connectivity (formerly OLE for Process Control) |
| TCP | Transport Control Protocol |
| FTP | File Transfer Protocol |
| DHCP | Dynamic Host Configuration Protocol |
| DNP3 | Distributed Network Protocol |
| PPP | Point to Point Protocol |
| PAP | Password Authentication Protocol |
| CHAP | Challenge Handshake Authentication Protocol |
| UART | Universal Asynchronous Receiver Transmitter |
| ISP | Internet Service Provider |
| INIT | Initialization (INIT String used in Modem) |
| AT | A command string should start with "AT" or "at", except for the commands "A/" and "+++". At or aT are invalid |
| PST | Value measured over x period that characterizes the likelihood that the voltage fluctuations would result in perceptible light flicker |
| THD | Total Harmonic Distortion |
| TDD | Total Demand Distortion |
| Ampl | Amplitude |
| FIFO | First In First Out |
| FFT | Fast Fourier Transform |
| csv | Comma Separated Values |

| ACRONYM | DEFINITION |
|---|---|
| **ELSPEC G4400 BLACKBOX DEVICE & ACCESSORIES** | |
| G4K | G4400 BLACKBOX Series of Power Quality Analyzers |
| PQZIP | Power Quality Data Compression & Archive File Format |
| PQSCADA | Power Quality Supervisory Control and Data Acquisition |
| RDU | G4100 Remote Display LCD Unit |
| CPU | G4K - Central Processing Unit Module |
| DSP | G4K - Digital Signal Processing Module |
| PS | G4K - Power Supply Module |
| FW | Firmware - G4K Software |

## SEE ALSO

- System Overview
- G4K Warranty
- Product Selection Guide

# Product Selection Guide

The product selection guide will assist you in choosing the optimal G4K Power Quality Analyzer that will suit your needs & requirements. The BLACKBOX device series includes 3 products, namely the G4410, G4420 & G4430. They are mainly differentiated by their measurement capabilities, storage capacity, PQ analysis & communication ports.

| CAPABILITIES | PRODUCT SERIES | | |
|---|---|---|---|
| | G4410 | G4420 | G4430 |
| **REAL-TIME MEASUREMENTS** | | | |
| Voltage Sampling Rate, Maximum Samples/Cycle | 256 | 512 | 1024 |
| Voltage/Current - Per Phase, Average, Unbalanced | √ | √ | √ |
| Power: Real, Reactive, Apparent, Power Factor, Frequency | √ | √ | √ |
| Energy: Bidirectional, Total, Import, Export, Net | √ | √ | √ |
| Demand: Block | √ | √ | √ |
| Voltage Harmonics (Individual, Even, Odd, Total) Up to- | 127TH | 255TH | 511TH |
| Type of Analog to Digital Converter | 16/20[1] Bit | 16/20[1] Bit | 16/20[1] Bit |
| Measurement During Overloading (From Nominal) | x2 | x10 | x10 |

| Capabilities | Product Series | | |
|---|---|---|---|
| | G4410 | G4420 | G4430 |
| **Data & Waveforms Logs** | | | |
| Cycle-By-Cycle PQZIP Recording | √ | √ | √ |
| Event Logs | √ | √ | √ |
| Continuous Waveform Recording | √ | √ | √ |
| Min/Max Logs For Any Parameter | √ | √ | √ |
| **Time Stamps, Resolution (Microseconds)** | | | |
| With Ethernet Synchronization | 50 | 50 | 50 |
| With GPS Synchronization | 1 | 1 | 1 |
| **Storage Capacity** | | | |
| Internal Memory | 128 MB | 4 GB | 16 GB |
| **Power Quality Analysis** | | | |
| Transient Detection, Microseconds (50Hz/60Hz) | 78.1/65.1µs | 39/32.5µs | 19.5/16.3µs |
| Sag/Swell Monitoring | √ | √ | √ |
| Unbalance Components: Zero, Negative, Positive | √ | √ | √ |
| Flicker (IEC 61000-4-15) | √ | √ | √ |
| Fast Flickering | √ | √ | √ |
| Compliance Testing To EN50160 | √ | √ | √ |
| EN50160 Timestamps | √ | √ | √ |
| Configurable for IEEE519-1992, IEEE159 (SEMI) | √ | √ | √ |
| Time Stamps Of Above | — | √ | √ |
| Inter-Harmonics | √ | √ | √ |

| Capabilities | Product Series | | |
|---|---|---|---|
| | G4410 | G4420 | G4430 |
| **Communication Ports** | | | |
| OPC | √ | √ | √ |
| Power Over Ethernet (PoE) - In | √ | √ | √ |
| Power Over Ethernet (PoE) - Out | — | √ | √ |
| Ethernet Ports | 1 | 2 | 2 |
| **Communication Ports - Continue** | | | |
| RS-485/422 Port | √ | √ | √ |
| Voltage Ride Through on Power Loss (Up to) | 10 sec. | 25 sec. | 25 sec. |
| USB Port (Power Only) | — | √ | √ |
| Onboard Comprehensive Web Server | √ | √ | √ |
| DNP3 | √ | √ | √ |
| Modbus TCP | √ | √ | √ |
| **E-Mail Notifications** | | | |
| SMTP Client | √ | √ | √ |
| [1] Effective Bits | Disclaimer: Outlined capabilities subject to change without prior notice | | |

## SEE ALSO

- System Overview
- Acronyms
- G4K Warranty

# Preparation - Safety Precautions

## Warnings

| |
|---|
| Review the entire manual before using the instrument and its accessories |
| Observe all warnings and cautions |
| Do not operate the instrument around explosive gas or vapor |
| Avoid working alone |
| Before use, inspect the instrument, leads and accessories for mechanical damage, and replace when damaged |
| Pay special attention to the insulation surrounding the connectors and plugs |
| Remove all accessories that are not in use |
| Make sure the instrument is properly grounded to a 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 the 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 |

**To avoid shock or fire**

| |
|---|
| Verify that the unit is disconnected from the main power supply |
| Inspect all electrical and mechanical connections visually for mechanical damage and integrity of components and accessories |
| Inspect current transformer wiring for proper direction through the cylindrical aperture of the current sampling module |
| Pull-test all control wiring to ensure secure seating in terminals |
| Before use, inspect the instrument, leads and accessories for mechanical damage, and replace when damaged |
| Do not operate the instrument or its accessories if it became wet for any reason |

## SEE ALSO

- System Overview
- What You'll Need
- Unpacking Components & Accessories
- G4K BLACKBOX Unit
- G4K BLACKBOX Unit Mounting

# What You'll Need

Familiarize yourself with the G4K BLACKBOX Unit, Components & Accessories. In addition, ensure that you follow the outlined Safety Precautions. You will need the following tools & additional items for the initial installation:

- Wire Strippers
- Phillips Screwdriver
- Flat Head Screwdriver
- G4K BLACKBOX Unit, Components & Accessories
- This User Guide

## SEE ALSO

- System Overview
- Preparation – Safety Precautions
- Unpacking Components & Accessories
- G4K BLACKBOX Unit

# Unpacking Components & Accessories

The G4K BLACKBOX is shipped from Elspec's factory in a sealed case to protect it from damage during transportation. The small parts are shipped in a sealed bag with the unit.

## TO UNPACK THE UNIT & ITS ACCESSORIES

Remove the unit & all of the following components from the casing:

| QUANTITY | ILLUSTRATION | DESCRIPTION & PART NUMBER |
|---|---|---|
| **DEVICE, COMPONENTS & ACCESSORIES** | | |
| 1 |  | **G4K BLACKBOX Device**<br>▪ G4410 BLACKBOX: SPG-4410-0000<br>▪ G4420 BLACKBOX: SPG-4420-0000<br>▪ G4430 BLACKBOX: SPG-4430-0000<br>**SEE ALSO**<br>▪ Product Selection Guide |
| 1 |  | **Voltage Terminal Block Connector** (For Sampling)<br>▪ ENT-1005-0090 |
| 1 |  | **AC/DC Terminal Block Connector** (For Powering the Unit)<br>▪ ENT-1003-0192 |
| 1 |  | **RS485/422 Communication Terminal Block** (For Communication)<br>▪ ENT-1004-0190 |

| QUANTITY | ILLUSTRATION | DESCRIPTION & PART NUMBER |
|---|---|---|
| 1 |  | **48VDC Terminal Block Connector** (For P owering the Unit)<br>▪ ENT-1002-0190 |
| 1 |  | **Temperature Sensor Terminal Block Connector** (For PT100 Type)<br>▪ ENT-1003-0190 |
| 1 |  | **Clamping Yoke Holder on Rail 35mm FM 4**<br>▪ MAL-2000-5002 |
| 1 |  | **Installation & Demonstration Disc**<br>▪ SMX-0408-0100 |

Orders for optional accessories will be delivered as well in a sealed casing. Unpack these parts from their sealed bags:

| QUANTITY | ILLUSTRATION | DESCRIPTION & PART NUMBER |
|---|---|---|
| **OPTIONAL ACCESSORIES** | | |
| As Ordered |  | **BLACKBOX Full User Guide**<br>SMX-0602-0100 |
| As Ordered |  | **G4100 Remote Display LCD Unit** (Provide G 4K I nter-Connectivity f or C onfiguring & M onitoring the El ectrical Distribution System)<br>▪ SPG-4100-0090 |
| As Ordered |  | **GPS (Global Position System)** (For M obile T ime Synchronization)<br>▪ SOA-0232-0400 |
| As Ordered |  | **Multi-Frequency 3.5G Wireless Modem** (For Fa st M obile Communication Access)<br>▪ SCM-0001-0000 |
| As Ordered |  | **G4400 Multi IO Expansion** (For M onitoring C apabilities Extension - Additional Digital & Analog IO Ports)<br>▪ **G4430 + 1 Multi IO Module:** SPG-4431-0090<br>▪ **G4430 + 2 Multi IO Modules:** SPG-4432-0090<br>▪ **G4420 + 1 Multi IO Module:** SPG-4421-0090<br>▪ **G4420 + 2 Multi IO Modules:** SPG-4422-0090<br>▪ **G4410 + 1 Multi IO Module:** SPG-4411-0090<br>▪ **G4410 + 2 Multi IO Modules** SPG-4412-0090 |

| Quantity | Illustration | Description & Part Number |
|---|---|---|
| **Optional Accessories** | | |
| As Ordered |  | **Protective Metal Cabinet (IP54)** with wiring (H x W x D) - 50 x 50 x 30cm (19.7 x 19.7 x 11.8") :<br>▪ SOA-0002-0000 |
| As Ordered |  | **Polycarbonate Enclosure (IP54)** with wiring (H x W x D) - 50 x 50 x 30cm (19.7 x 19.7 x 11.8") :<br>▪ SOA-0003-0000 |
| As Ordered |  | **200W Heater** with Thermostat:<br>▪ SOA-0101-0000 |
| As Ordered |  | **RJ45/Fiber Optic Converter**:<br>▪ SOC-0401-0000 |

## SEE ALSO

- System Overview
- Preparation – Safety Precautions
- What You'll Need
- G4K BLACKBOX Unit

# The G4K BLACKBOX Unit

The innovative design of the G4K BLACKBOX has been uniquely adapted to address the individual needs & requirements for almost any business and/or application. The modular & expandable design provides maximum flexibility for customized requirements.

The main base (front end) of the unit is comprised of three modules namely the **Central Processing Unit** (CPU), the **Digital Signal Processing** (DSP), & the **Power Supply** (PS).

The functions for the **CPU** are mainly data compression, file handling & facilitation of communication interfaces. The CPU features an AC/DC power supply, DC/DC converter, an automatic selection of highest voltage & an ultra capacitors' ride-through for up to 25 seconds.

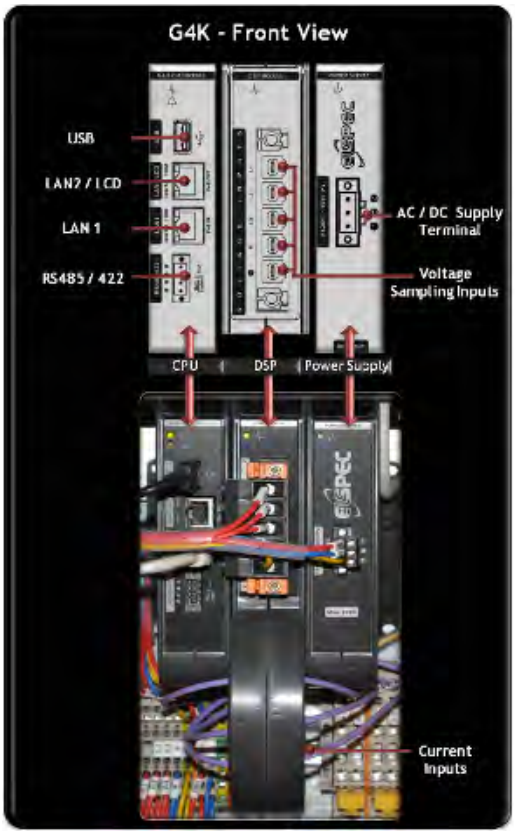
The **DSP** is responsible for capturing the electric signal & converting the waveforms to digital data. The DSP's capabilities include simultaneous 12 channel sampling at 250 kHz (4 µsec), full scale measurements 10 x from nominal voltages & currents at an extremely high accuracy. The CT's dual range with auto selection ranges from 0 - 5A, 0 - 50A RMS & has a reading accuracy of 0.1%. There are a total of six (6) apertures. Typically only the first four (4) are used as current inputs for I1, I2, I3, and IN (Neutral current optional as the fourth input).

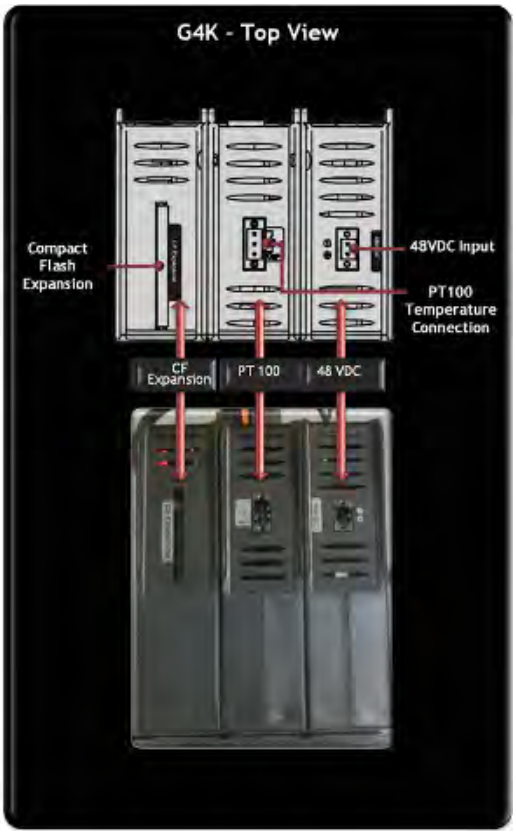
The **PS** facilitates a wide range of inputs that comply with the highest standards set by the industry. The power supply module contains internal backup circuitry to hold internal voltage during momentary transients and disturbances. Thus, when powering off the unit, it continues operating for up to 1 minute. The power supply supports the following power sources:

- DC 100-300V
- AC 100-260V, 60/50 Hz (recommended)
- PoE 48V

The top of this front end base facilitates the connection for the PT100 thermostat & the DC Converter input. In addition to the PT100 connection, the G4K is equipped with 2 additional internal temperature sensors (PS and DSP modules). The operating temperature ranges from -20 to +70°C & the storage temperature ranges from -30 to +80°C. The DC Converter ranges from an input DC of 48 VDC & a minimum voltage for PoE of 48 VDC.

**Physical layout of the 3 modules including the location of the system connectors for both the Front & Top View:**




## SEE ALSO

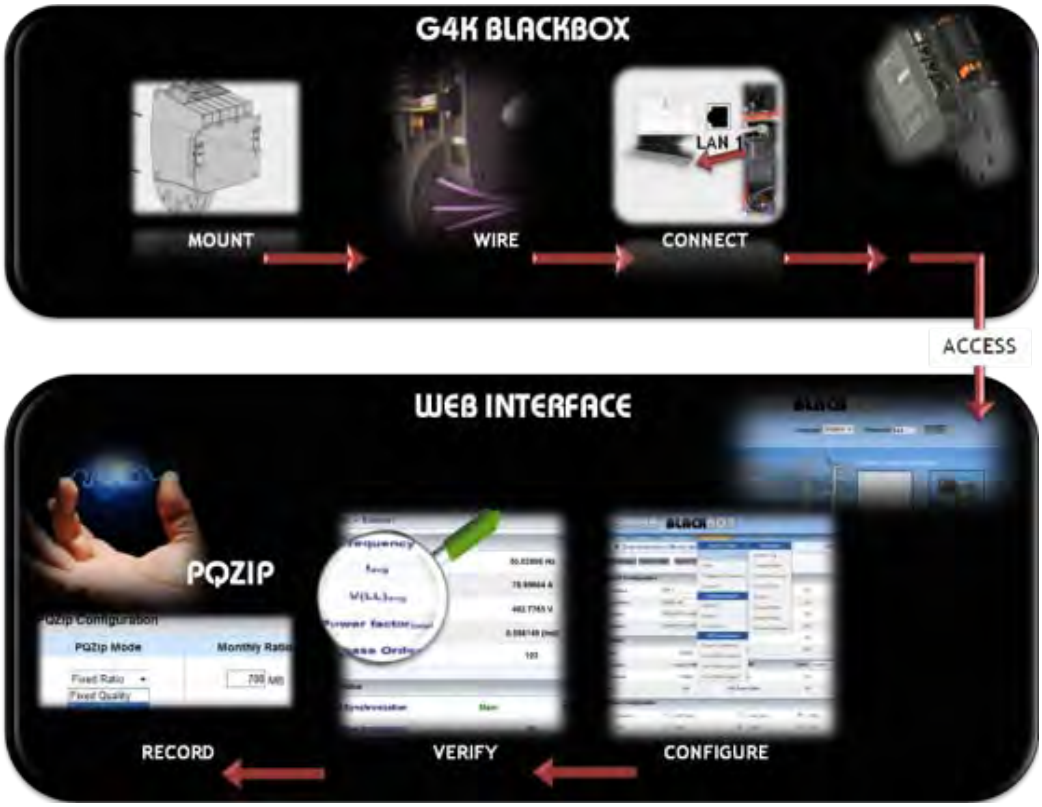
- System Overview
- Preparation – Safety Precautions
- What You'll Need
- Unpacking Components & Accessories

# G4K Quick & Simple Installation

This section contains the installation & setup procedure for the G4K BLACKBOX that is quick & simple to follow. After you have installed your G4K device, you can:

- Monitor the Quality of your Electrical Power,
- Monitor PQ Parameters according to EN50160, IEC61000-4-30 & Customized Standards
- Store a thousand times more than other typical file formats with PQZIP

## G4K - QUICK & SIMPLE INSTALLATION




The procedure includes:

- Mounting the G4K BLACKBOX
- Wiring the G4K BLACKBOX
- Connecting the G4K BLACKBOX
- Confirming the G4K's Operation
- G4K Unit Access via Elspec's Web Interface
- Configuring the G4K Device
- Verifying Measurement Readings
- Enabling PQZIP Recording

## WARNING

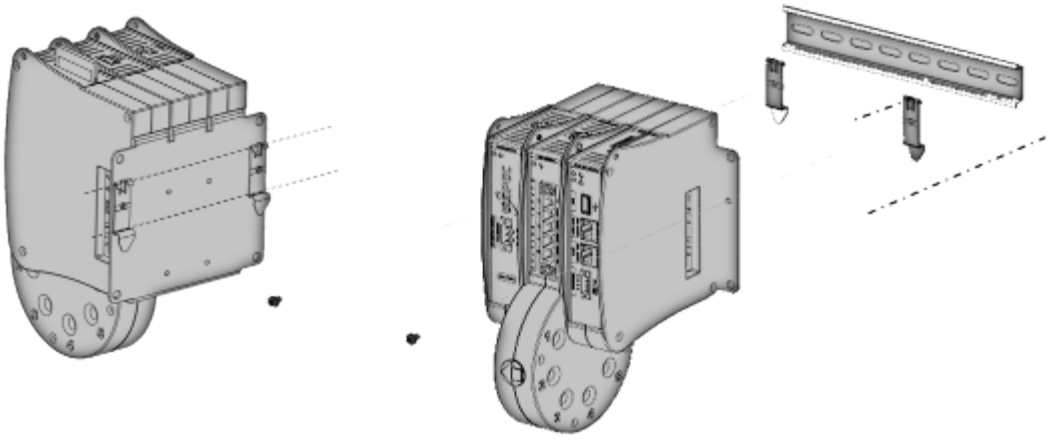
***Before you start, ensure that the panel is de-energized & that you take the necessary Safety Precautions!***

The G4K BLACKBOX is intended to be **mounted within an enclosure,** or can be fastened either to a DIN Rail or to a Flat Surface. The physical dimensions of the G4K are: 17.5 x 23.2 x 13.8cm (6.9 x 9.1 x 5.4") & it weighs 1.7Kg (3.7lbs).

## FASTENING THE G4K BLACKBOX TO A DIN RAIL

This is the most common mounting method & you will need the **Clamping Yoke Holders** provided with G4K & the unit itself - see Components & Accessories.

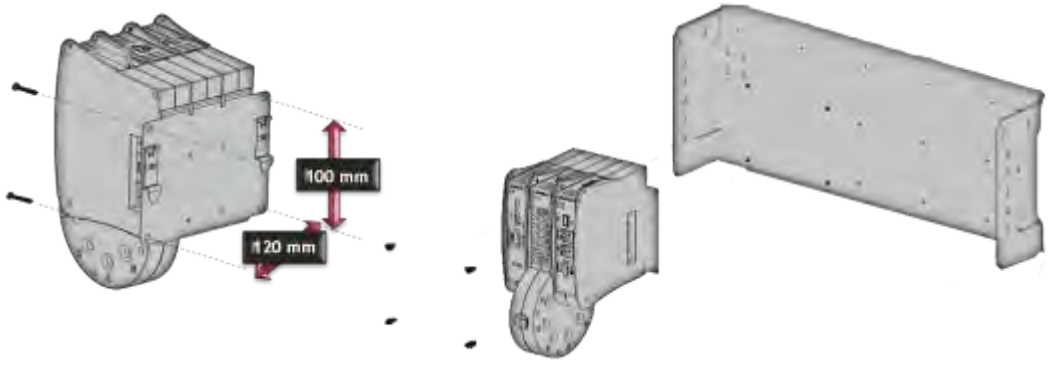
- Connect the **Clamping Yoke Holders** to the sides of the back plate of the G4K using the 2 screws provided,
- Attach the entire unit with the holders to the **DIN Rail**:



## FASTENING THE G4K BLACKBOX TO A PLATE

The G4K BLACKBOX can be directly mounted to a plate using 4 x standard 7mm (0.27") screws.

- The distance of the screws on the G4K plate is (H x W) 10 x 12cm (3.9 x 4.7"). Ensure the plate has corresponding holes,
- Simply screw the G4K unit onto the plate at the corresponding holes:




**Successfully Mounted G4K Unit**

## SEE ALSO

- Installation
- G4K Wiring BLACKBOX
- Establish 1st Time Connection
- Confirm Operation
- G4K Unit Access
- G4K Configuration
- Verifying Measurement Readings
- Enable PQZIP Recording

# G4K Wiring

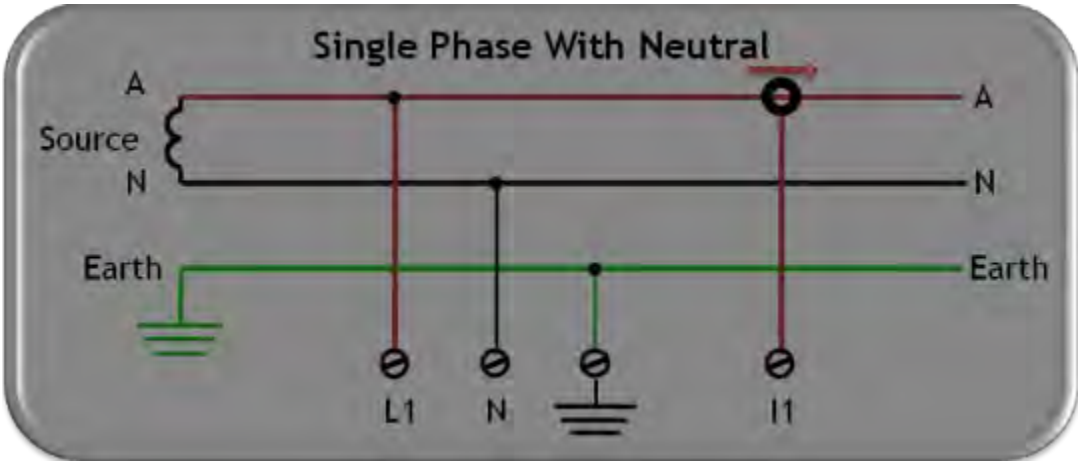
The DSP Module of the G4K receives analog signals and converts them to digital signals to be measured and stored for further process and analysis. An essential part of the G4K Wiring Procedure is the Power Configuration, which is configured in the Web Interface. Included in this section are the types of Power Topology the G4K supports that will be important to understand prior to proceeding with:

- Connecting the Voltage Connections
- Connecting the Current Connections
- Connecting the AC/DC Supply Terminal
- Connecting the 48 VDC Input

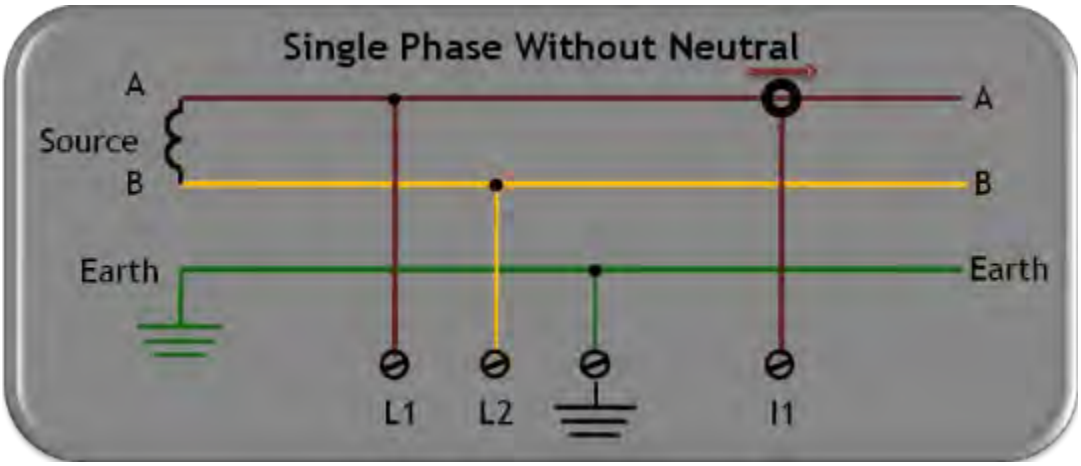
## G4K BLACKBOX POWER TOPOLOGY SUPPORTS

The G4K BLACKBOX is designed to serve in virtually any power topology configuration. The diagrams below outline the types of topologies with their applicable Configuration in Elspec's Web Interface:

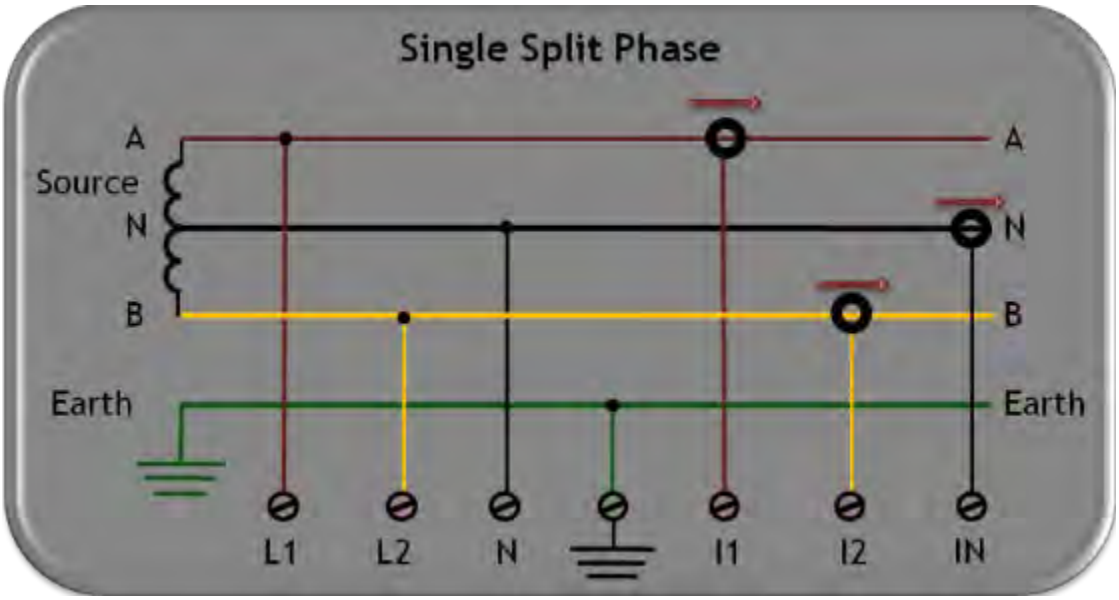
- **Single LN Configuration**:



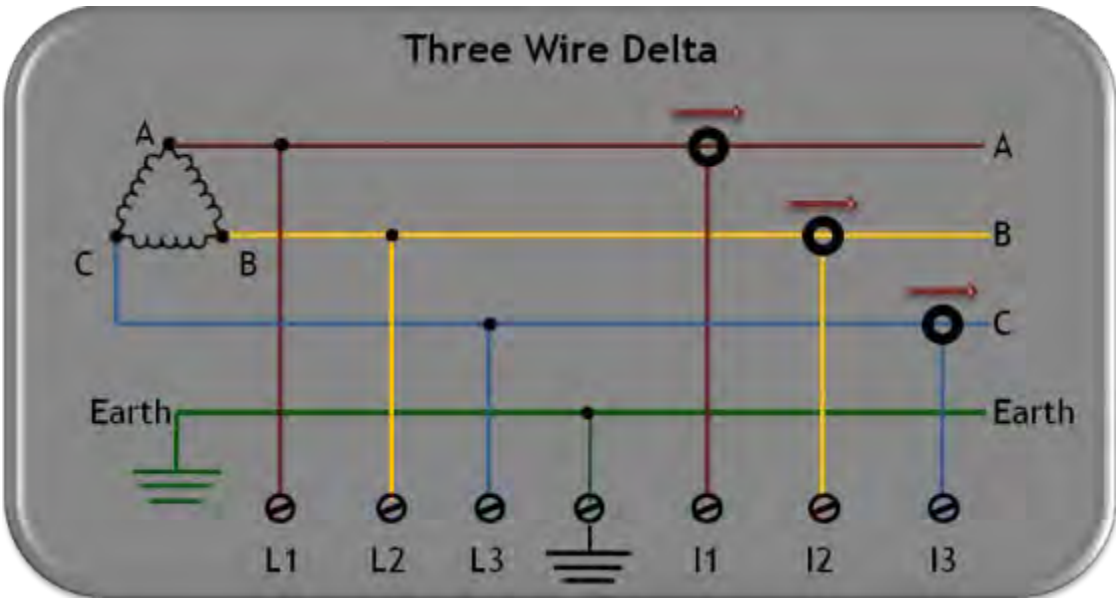

- **Single LL Configuration**:



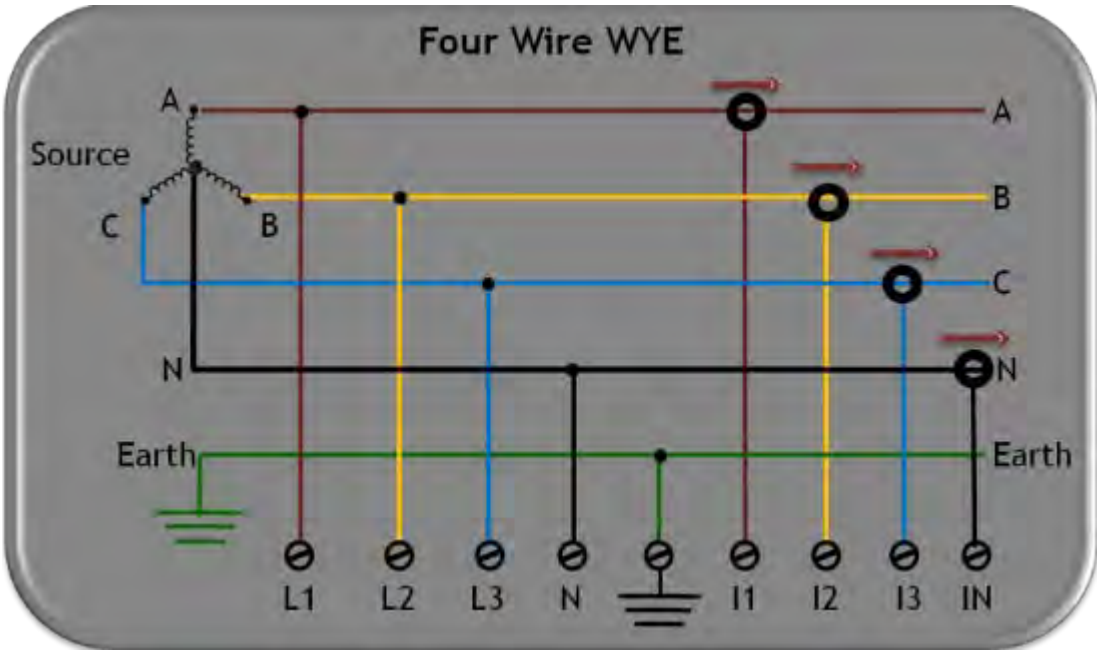
- **2Phase TR**:



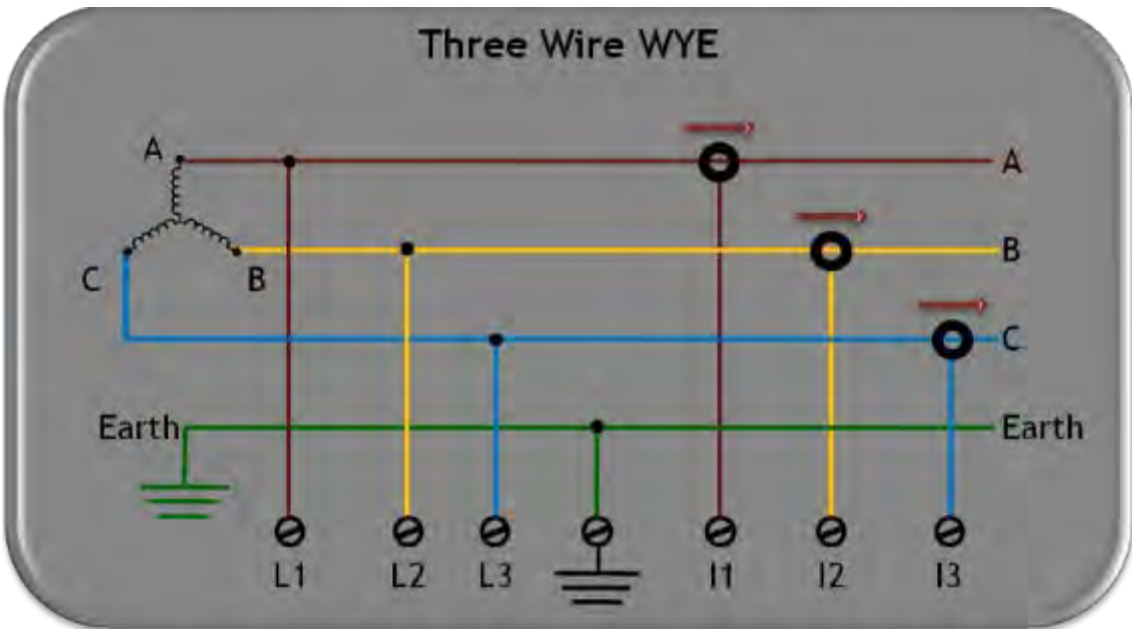

- **Delta 3 Wires:**



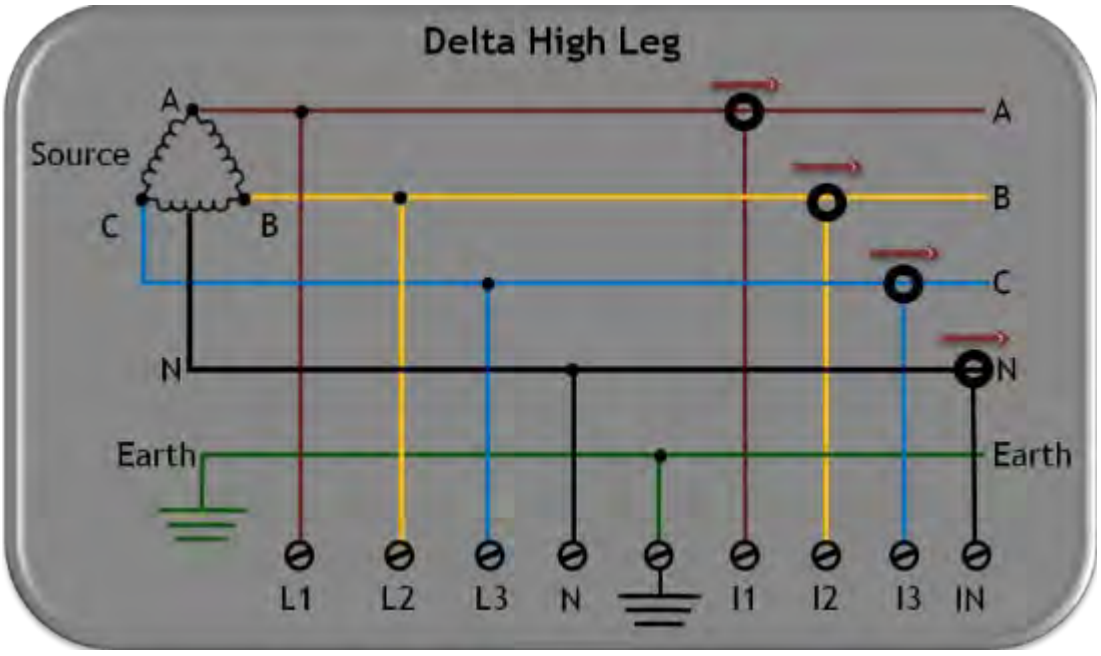
- **WYE 4 Wires:**



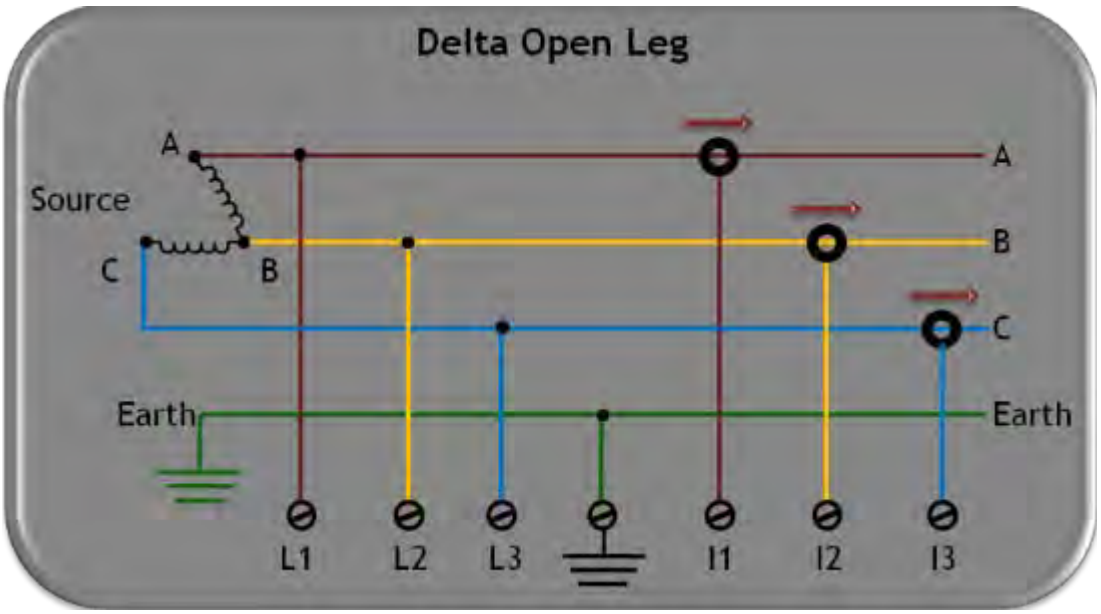

- **WYE 4 Wires:**



- **Delta 3 Wires:**



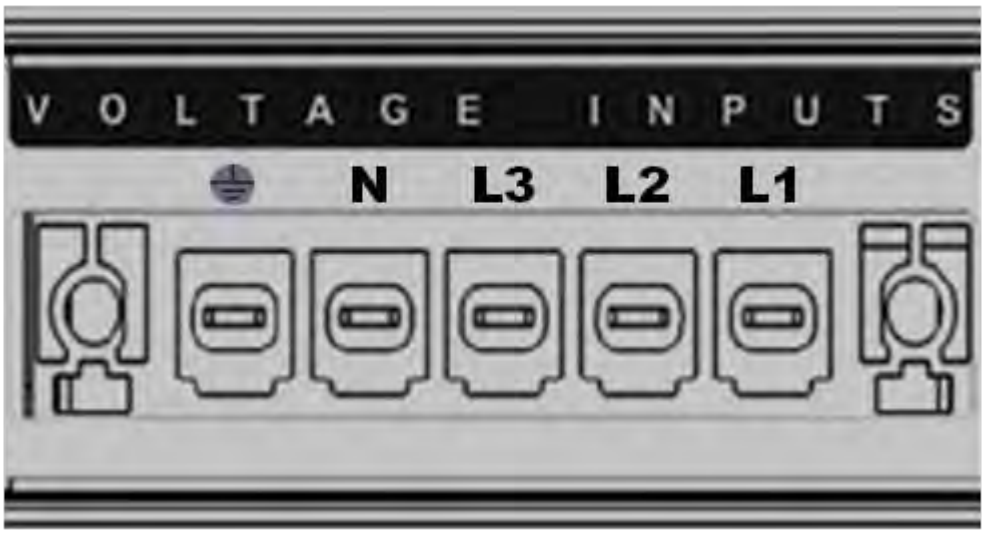

- **Delta 3 Wires:**




## SEE ALSO

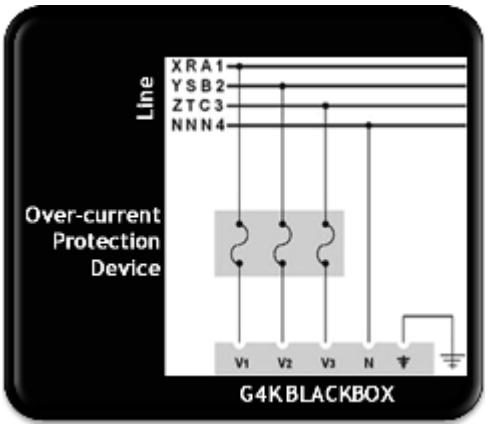
- Installation
- G4K Unit Mounting BLACKBOX
- Establish 1st Time Connection
- Confirm Operation
- G4K Unit Access
- G4K Configuration
- Verifying Measurement Readings
- Enable PQZIP Recording

# Voltage Connections

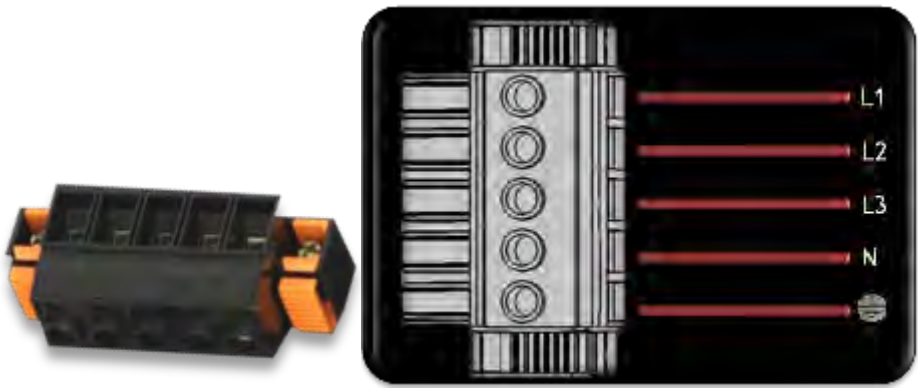



Five terminals are available for the voltage sampling inputs on the DSP Module of the G4K. They are marked as L1, L2, L3, N, & . Each of the 4 inputs (V1, V2, V3, N) are capable of receiving electrical signals of up to 1KV continuous RMS (up to 8KV transient). In order to wire voltage connections, follow the following procedure:

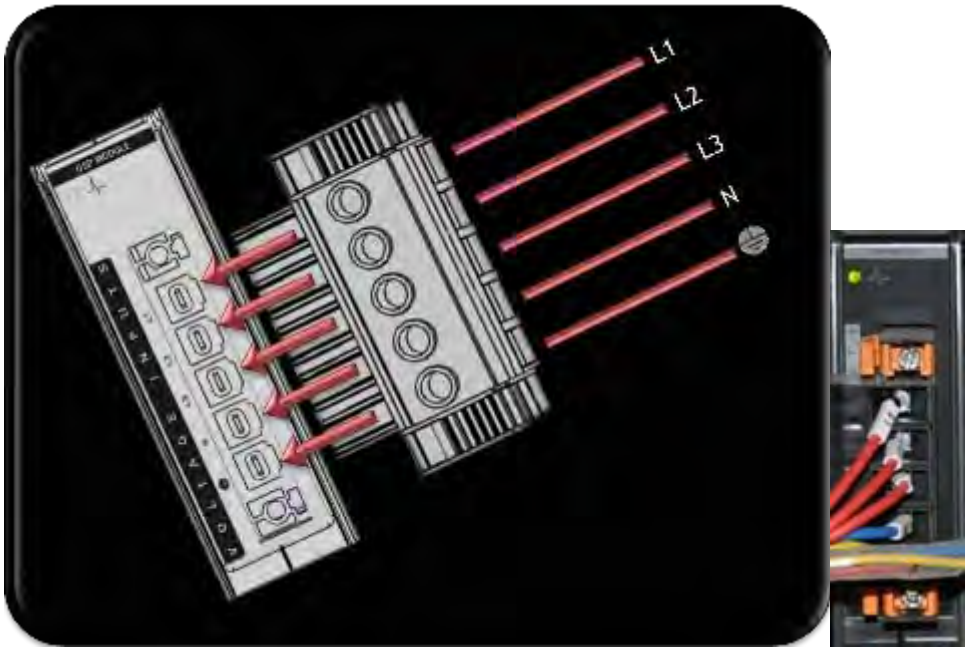
- Install an over current device on the AC phase lines:




- Remove the Voltage Terminal Block Connector provided with the G4K Unit:



- Insert the terminal block into the Voltage Sampling inputs:




- Attach lugged ends of wires to the terminal block securing it with an applicable sized screw driver,
- Verify the correct voltage polarity of the terminal.

## WARNING

- ***You need to install a 2A Fuse and/or Circuit Breaker in series to the instrument's Voltage Sampling Input Terminals according to local wiring codes.***
- ***Powering down the instrument does not remove voltage from the voltage sampling terminals.***

### *NOTE NOTE NOTE ...*

- **The Ground input is the reference for all channels therefore it is essential to connect it properly.**

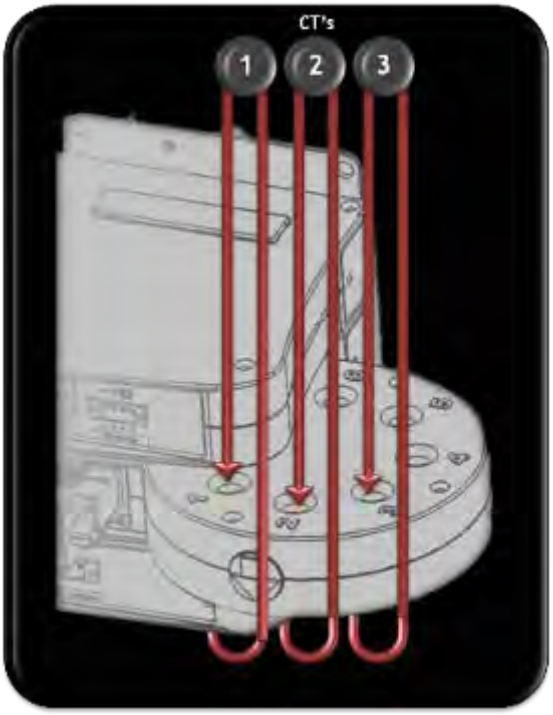
## SEE ALSO

- G4K Wiring
- Wiring the Current Connections
- Connect the AC/DC Supply Terminal
- Connect the 48VDC Input
- Establish 1st Time Connection

# Wiring the Current Connections

Electric current is sampled as it flows through cylindrical apertures in the circular section of the centrally mounted Digital Signal Processing (DSP) Module. There are a total of six (6) apertures. Typically only the first four (4) are used as current inputs for I 1, I 2, I 3, and I N ( Neutral current optional as the fourth input). Optionally, a fifth aperture may be ordered for an additional current input, and the sixth aperture is disabled at this stage. To wire current connections:

- Install Current Transformers in series ahead of the unit
- Feed the current lines through the cylindrical apertures in the circular section of the G4K's DSP Module:




- Verify the polarity of current conductors with the arrows on the circular section of the DSP

**G4K Successful Current Wiring**

## WARNING

***Current Transformer outputs must be short circuited to prevent them from getting damaged. Dangerous voltages exist between the two output leads.***

## SEE ALSO

- G4K Wiring
- Voltage Connections
- Connect the AC/DC Supply Terminal
- Connect the 48VDC Input
- Establish 1st Time Connection

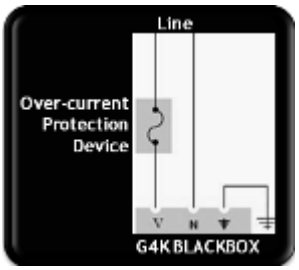
# Connect the AC/DC Supply Terminal

The AC terminal may be fed with either AC or DC voltage. The procedure to wire both is the same and has the following limits:

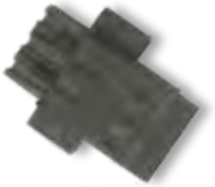
- AC: 80 to 260V @ 50/60Hz
- DC: 110 to 300V / 35Watt

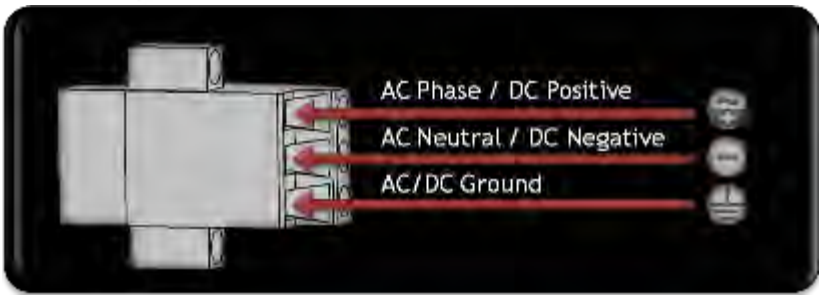
## CONNECTING THE AC/DC SUPPLY TERMINAL:

- Install an Over-current Protection device on the AC phase line side before the unit:




- Remove the AC/DC Terminal Block Connector provided with the G4K BLACKBOX unit:






- Insert the terminal block into the Power Supply Terminal:

- Attach the bared ends of wires to the AC/DC terminal block connector using the correct sized flat-head screwdriver
- Verify the correct polarity of the terminal

## WARNINGS

- ***It is recommended to install a 2A fuse & or circuit breaker in series to the instrument terminals according to local wiring codes.***
- ***When powering down the instrument by closing the circuit breaker, internal low voltage remains on the instrument terminals, and consequently on the downstream side of the circuit breaker for 25 seconds, due to the ride through back up feature.***

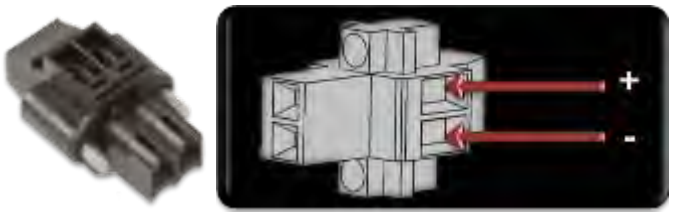
## SEE ALSO

- G4K Wiring
- Voltage Connections
- Wiring the Current Connections
- Connect the 48VDC Input
- Establish 1st Time Connection

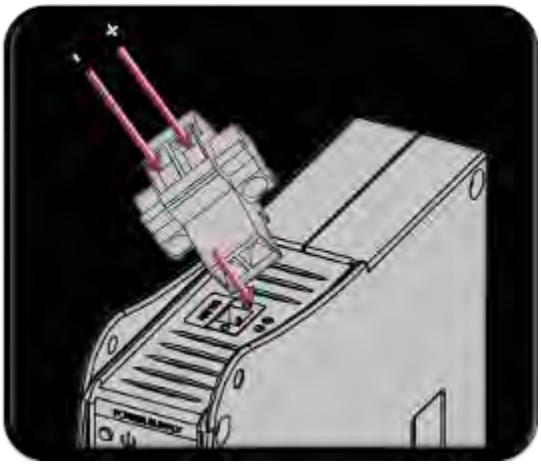
# Connect the 48VDC Input

The two wire 48V DC voltage input is positioned on the upper side of power supply module. In order to energize the 48VDC terminal follow the procedure outlined below:

- Remove the 48VDC Terminal Block Connector provided with the G4K BLACKBOX unit:




- Insert the 48V DC Terminal Block Connector into the Power Supply Module:



- Attach the lugged ends of wires to the Terminal Block using an applicable flat head screw driver
- Verify as to what the correct polarity is of the terminal

**WARNING**

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

**SEE ALSO**

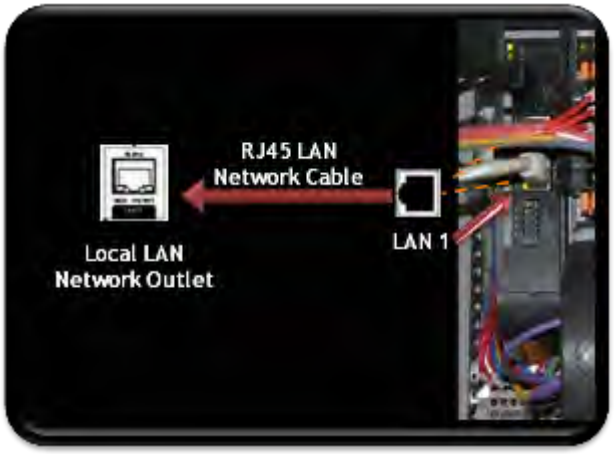
- G4K Wiring
- Voltage Connections
- Wiring the Current Connections
- Connect the AC/DC Supply Terminal
- Establish 1st Time Connection

# Establish 1st Time Connection

In order to establish communication between your G4K & the Network Server, the device may be connected using the LAN1 Port directly to an existing local LAN (if one exists). Alternatively, you may connect the device directly to the PC to establish initial communication.

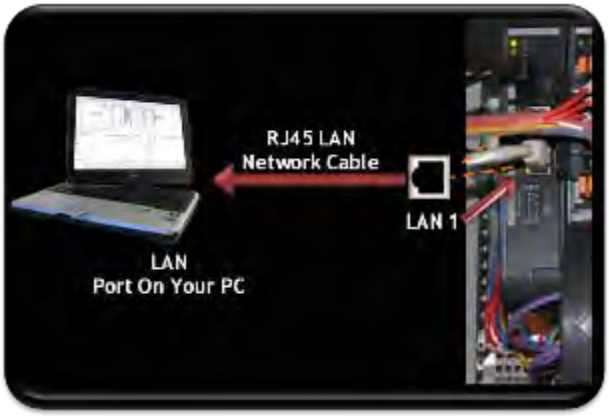
## CONNECT THE DEVICE TO THE LOCAL NETWORK

- Simply connect a RJ145 LAN Network Cable to the LAN1 Port on the G4K's CPU Module to your LAN Local Network Outlet:



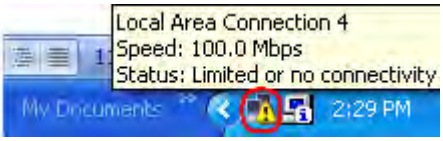

## CONNECT THE G4K DIRECTLY TO THE PC

- Disconnect the network cable linking your PC/Laptop to the server network
- Using the same cable (RJ45 LAN Network Cable), connect to the port marked LAN1 G4K's CPU Module:




- The green link-LED of the LAN1 connector begins to flash as Windows begins communicating with the unit
- Wait for about 2 minutes as the Windows operating system reverts to the default "No Server" IP configuration

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




## SEE ALSO

- Installation
- G4K Unit Mounting BLACKBOX
- G4K Wiring BLACKBOX
- Confirm Operation
- G4K Unit Access
- G4K Configuration
- Verifying Measurement Readings
- Enable PQZIP Recording

# Confirm Operation

Confirm that your G4K Device is operating & that all the connections are working with the following indicators:

- Turn on the power supplying the unit
- The LEDs on the power supply light up:


- Verify the unit is operating correctly with reference to the following table:

| LED | DESCRIPTION |
|---|---|
| | **G4K PS Module:** Green signals that external power exists. Red signals external power is out; unit will soon cease to function (25 seconds max.) |
| | **G4K DSP Module:** Blinking green signals normal operation and system boot |
| | **G4K Main CPU Module:** Green signals normal operation |
| | **Blinking Red:** During Shutdown process |
| | **Constant Red:** While Alarm is active (based on Alarm Configuration) may signal malfunction. |

## *NOTE NOTE NOTE ...*

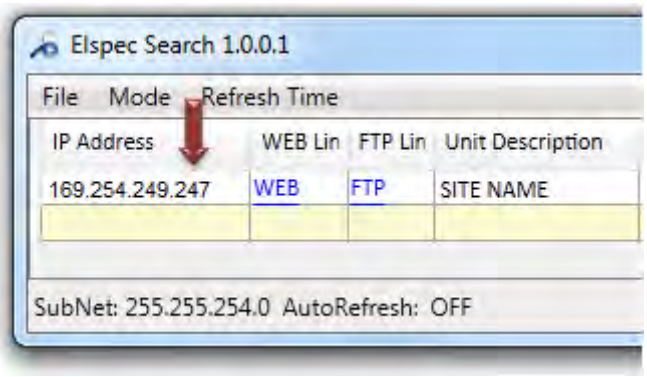
- After powering up, wait at least one minute until the startup process is complete
- The red indicator light will remain on until the PQZIP is enabled by the user. See Also: Enable PQZIP Recording

## SEE ALSO

- Installation
- G4K Unit Mounting BLACKBOX
- G4K Wiring BLACKBOX
- Establish 1st Time Connection
- G4K Unit Access
- G4K Configuration
- Verifying Measurement Readings
- Enable PQZIP Recording

# G4K Unit Access

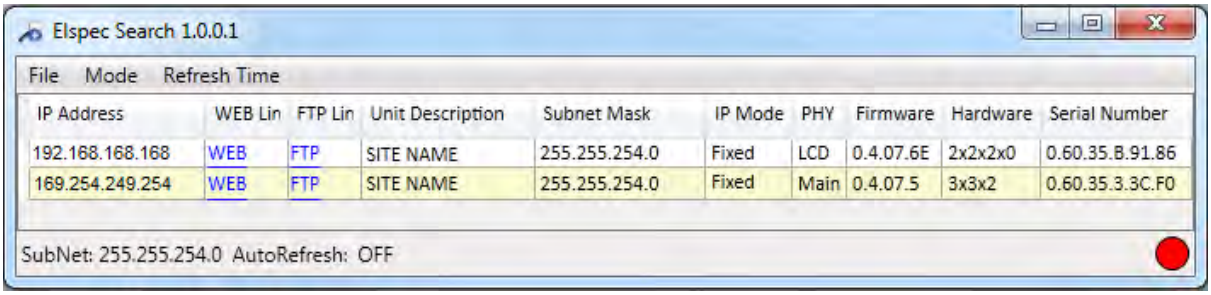
Once you have Connected the Device for the 1st Time, you may access your G4K Unit by simply clicking the WEB Hyperlink button in your Elspec's Search Utility. Alternatively you can simply access the device directly via Internet Explorer by inserting the Device's IP address directly (address is also indicated in Elspec's Search Utility). The Default IP Address for a newly supplied G4K unit is: **169.254.249.247**.




## ACCESS ELSPEC'S SEARCH UTILITY:

- After you have Copied the Utility on your Desktop, access it by clicking on the Elspec's Search Icon:


- Initially, the program may trigger a verification warning similar to the one below. You may proceed by clicking **Run**
- As can procedure is initiated; the Elspec Search utility appears as a grid displaying all BLACKBOX devices found on the intranet network:



## ACCESS INSTRUMENT VIA THE WEB HYPERLINK (RECOMMENDED):

- Select the **Web** link for your device, Elspec's Web Interface will now open:


- In order to view the different languages in the Web Interface, you will need to upload the language feature from Elspec's Website when installing your new Firmware. Once uploaded, simply select the applicable interface language from the drop-down list:


- The supported languages are:
  - English (Default)
  - Russian
  - German
  - Spanish
  - French
  - Chinese

  (For other languages – please contact your local Elspec distributor)
  - The Password field defines user level/privileges. The user levels are **Viewer / Administrator (**See Security Settings**).** The default password including privileges for each level are:
    - Viewer is **123** (Read only, can choose interface language only, no operations related changes are allowed)
    - Administrator is **12345** (Administration, setup & full control)

## NOTE NOTE NOTE

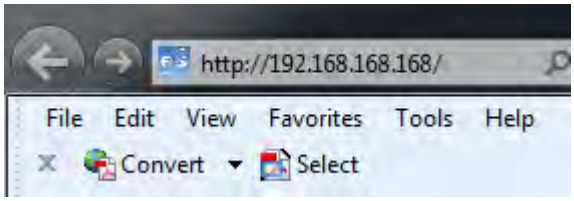
- The Website is optimized to work with Internet Explorer 7, 8 or 9 in "Compatibility View". Ensure that the Internet Explorer is running in **Compatibility View**:


  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 Disable Proxy Server in Internet Explorer.
- Should you be running Skype simultaneously with Elspec's Search, you will not be able to access the device via the Web Link. Close Skype & access Elspec's Search again to follow the Web Link.
- The passwords above are factory default values. You are advised to modify Admin password if extended security measures are required **(**See Security Settings).

## DIRECT INSTRUMENT ACCESS VIA INTERNET EXPLORER

Access the device by typing the G4K's IP address in the address field in Internet Explorer:




- Choose the language & enter the password as outlined above

## SEE ALSO

- Installation
- G4K Unit Mounting BLACKBOX
- G4K Wiring BLACKBOX
- Establish 1st Time Connection
- Confirm Operation
- G4K Configuration
- Verifying Measurement Readings

# G4K Quick Configuration

This section focuses only on the major configurations needed for initial installation of your G4K device. For a more detailed & comprehensive procedure see Instrument Settings. This procedure includes a quick & simple configuration procedure for your:

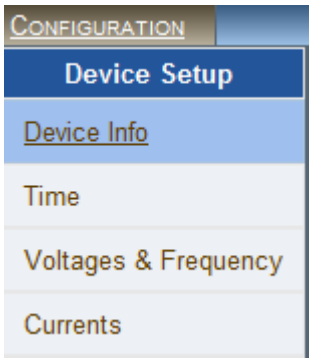
- G4K Unit
- Voltage & Frequency
- Currents

## SEE ALSO

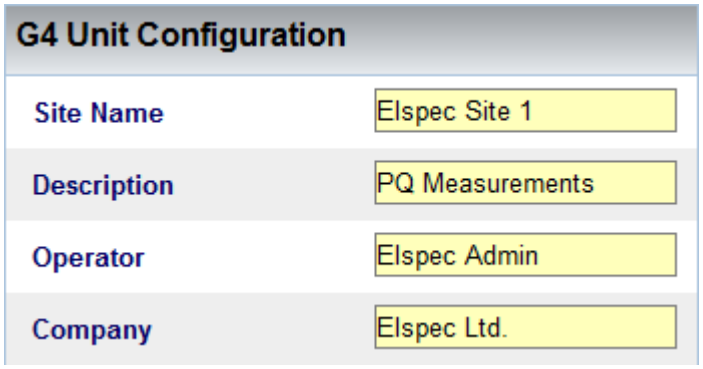
- Installation
- G4K BLACKBOX Unit Mounting
- G4K Wiring BLACKBOX
- Establish 1st Time Connection
- Confirm Operation
- G4K Unit Access
- Verifying Measurement Readings
- Enable PQZIP Recording

# G4K Unit Setup

Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** **(**Manufacturer's Default Passwords are: **12345 (Admin), & 123 (Viewer))** ➡ under **Configuration** ➡ **Device Setup** select the **Device Info Tab:**



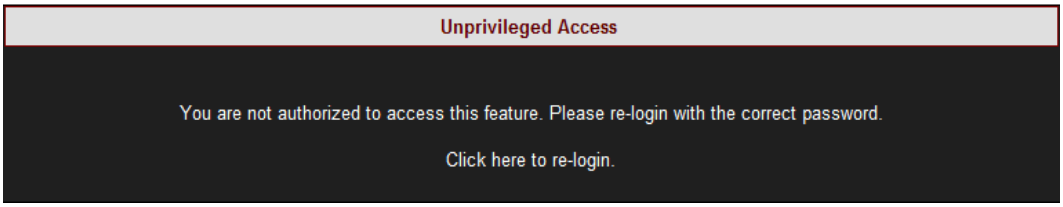

- In the **G4 Unit Configuration** Section complete:
  - **Site Name:** Enables the user to include a description of the site where the device is installed. This site description also appears in the Elspec's Search utility under Unit Description when searching for devices
  - **Description:** An additional text field for you to use optionally as you see fit
  - **Operator:** A text field for inputting an operator/technician's name
  - **Company**: A text field for inputting company's name




- To apply your changes select 

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to affect your changes.

- Go to the next step Configuring Voltage & Frequency

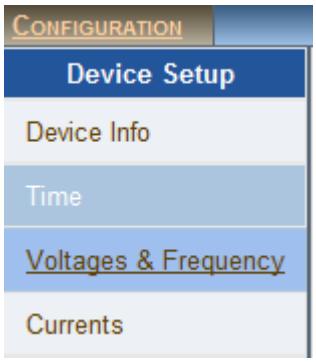
## SEE ALSO

- Instrument Settings
- G4K Unit Setup
- Voltage & Frequency Configurations
- Currents

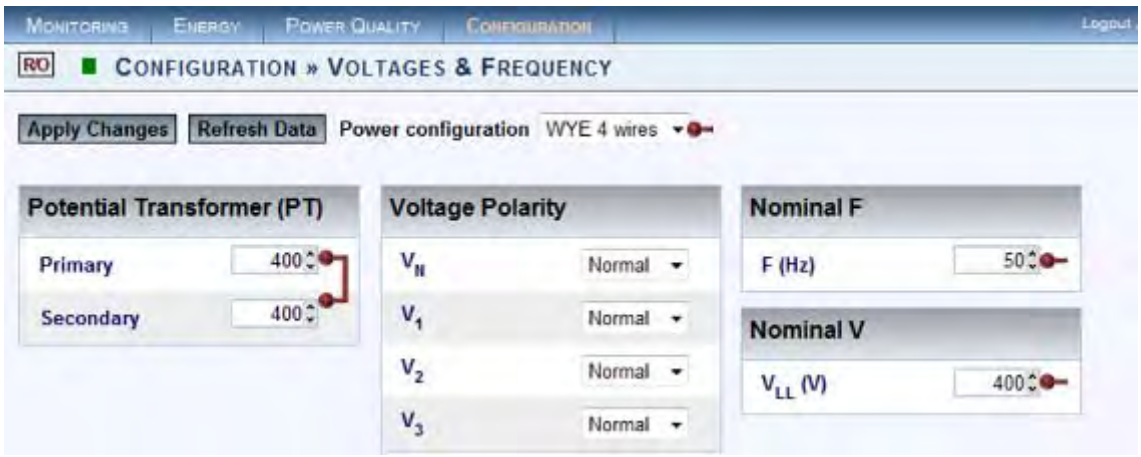
# Voltage & Frequency Configurations

The Voltage & Frequency Window defines all the major configurations regarding the Voltage & Frequency values, for a more comprehensive procedure see Voltage & Frequency.

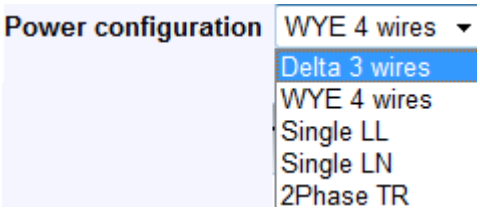
- Access your G4K Device via **Elspec's Web Interface** log on as the **Administrator** under **Configuration** **Device Setup** select the **Voltage & Frequency Tab:**



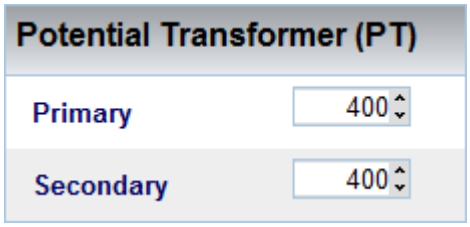

- In the **Voltage & Frequency Window:**




  - Select the applicable Network Type Settings according to your network type from the drop-down selection:

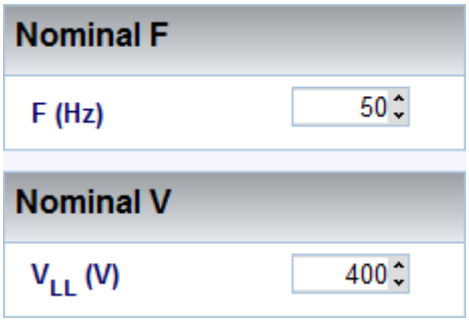



  - For MV/HV Networks (Voltage Measurements by PT's) set the correct **Primary & Secondary Ratio** (with ▲/▼) - according to **the PT Manufacturer's Specifications** & not just the **Ratio:**



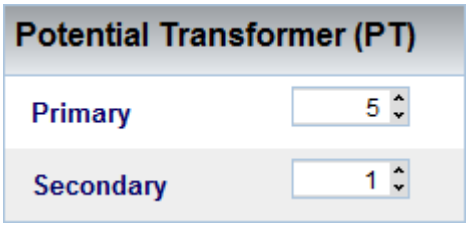

If the PT Ratio is inapplicable, then set your values to read:

- Define the **Nominal Values** for Frequency (F) and Voltages (V) (with ▲/▼):

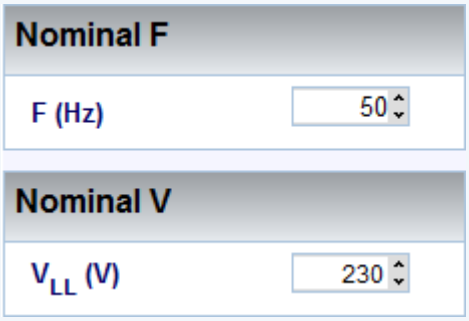



- The ratio for LV Networks is based on the same concept & specifications -

Set the **Primary & Secondary Ratio** (with ▲/▼) (according to **the PT Manufacturer's Specifications** & not just the **Ratio)**:



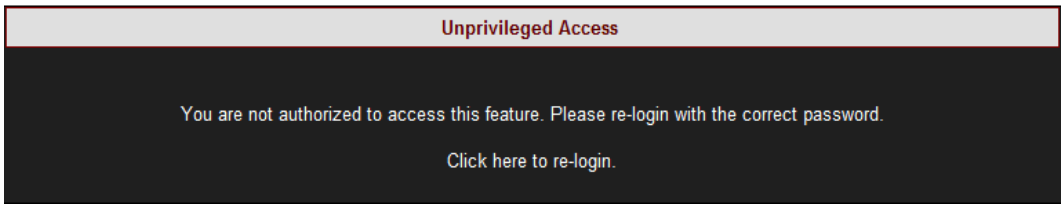

Define the **Nominal Values** for Frequency (F) and Voltages (V) (with ▲/▼):




- To apply your changes select Apply Changes

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

- Go to the next step Current Configuration

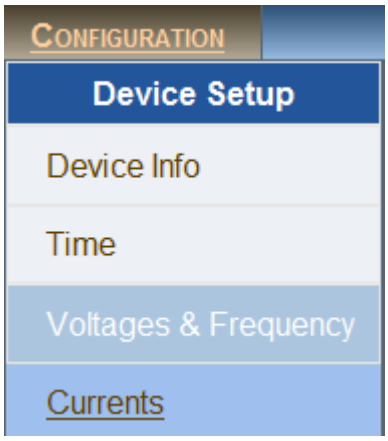
## SEE ALSO

- Instrument Settings
- G4K Unit Setup
- Voltage & Frequency Configurations

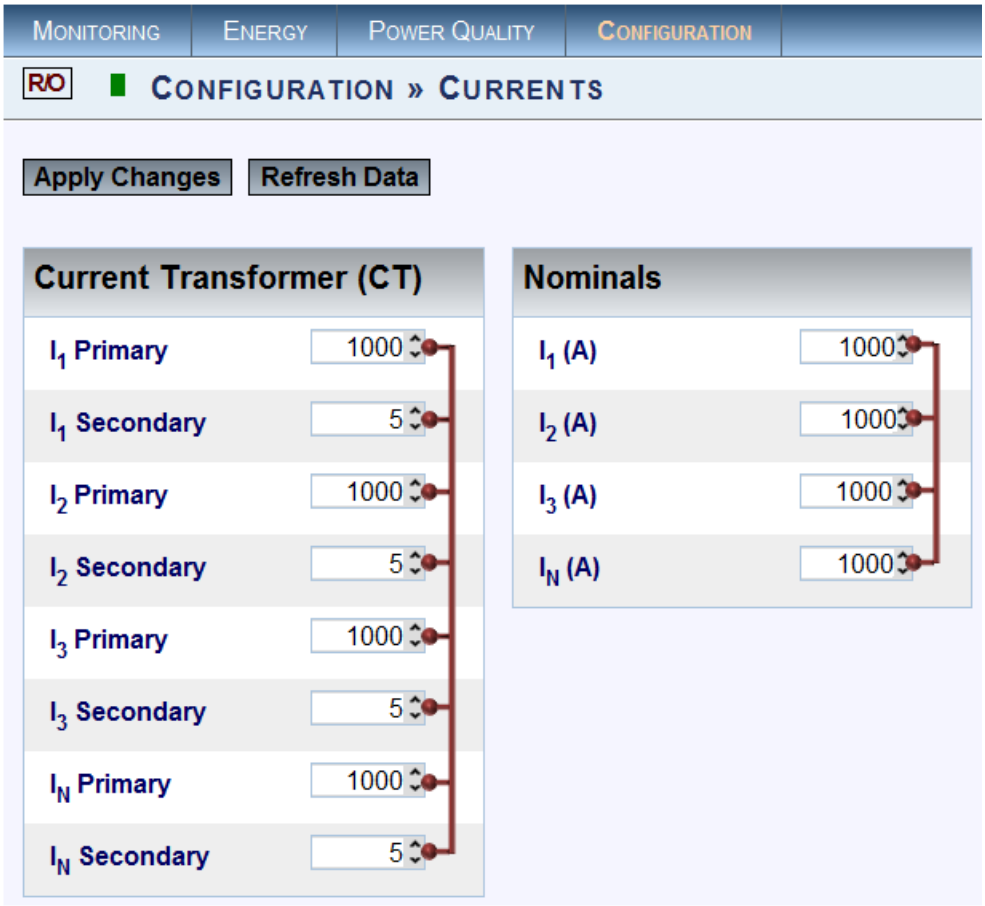
# Currents

In the Current Window you will be able to define all the major configurations for the Current Values, for a more comprehensive procedure see Currents.

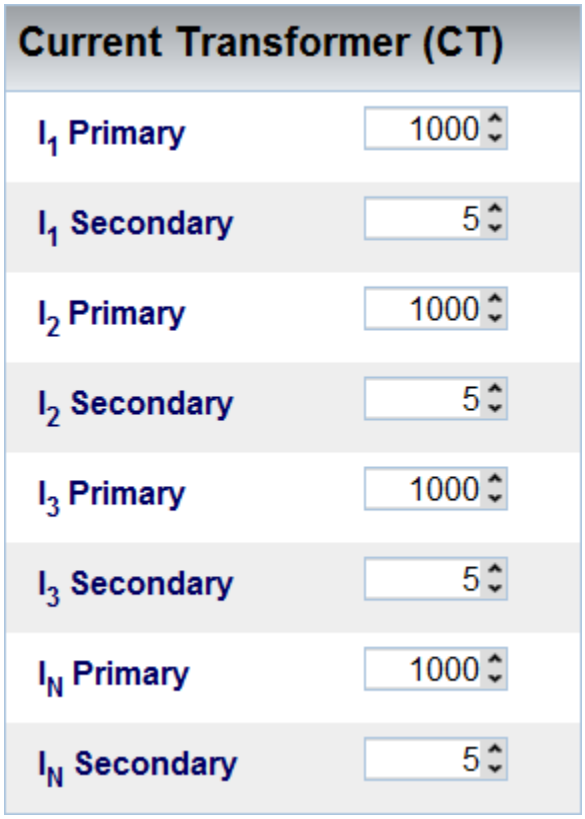
- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ under **Configuration** ➡ **Device Setup** select the **Currents Tab:**



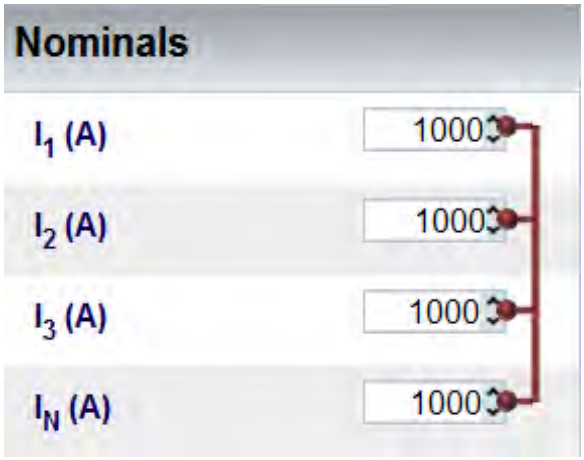

- In the **Currents Window:**




  - Set the correct **Primary & Secondary Transformation Ratios** for all the Current channels from $I_1$ to $I_N$ (with ▲/▼) - according to the **CT Manufacturer's Specifications** & not just the Ratio:




- Define the **Nominal Values** for all the Current Channels from $I_1$ to $I_N$ (with ▲/▼):



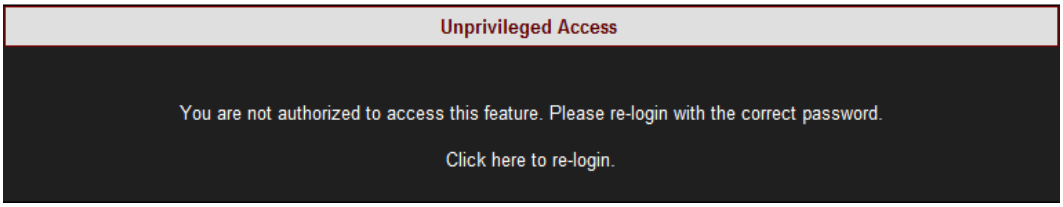

If the CT Ratio is inapplicable, then set your values to read:

**Primary = Secondary = Nominal**

- To apply your changes select Apply Changes

## *NOTE NOTE NOTE*

- The **Nominal Values** define both the Event Level as well as the measurement range. The maximum measured value is 16 times the nominal.
- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

- Instrument Settings
- G4K Unit Setup
- Voltage & Frequency Configurations

# Verify Measurement Readings

The final step after you have Configured your Device, is to verify the voltage & current measurements of your G4K Unit. This verification step covers only a partial section of the G4K's Full PQ Monitoring Capabilities. It includes:

- Accessing & Reviewing the Measurement Summary
- Monitoring Voltage & Current Measurements
- Monitoring the Power

## SEE ALSO

- Installation
- G4K Unit Mounting BLACKBOX
- G4K Wiring BLACKBOX
- Establish 1st Time Connection
- Confirm Operation
- G4K Unit Access
- G4K Configuration
- Enable PQZIP Recording

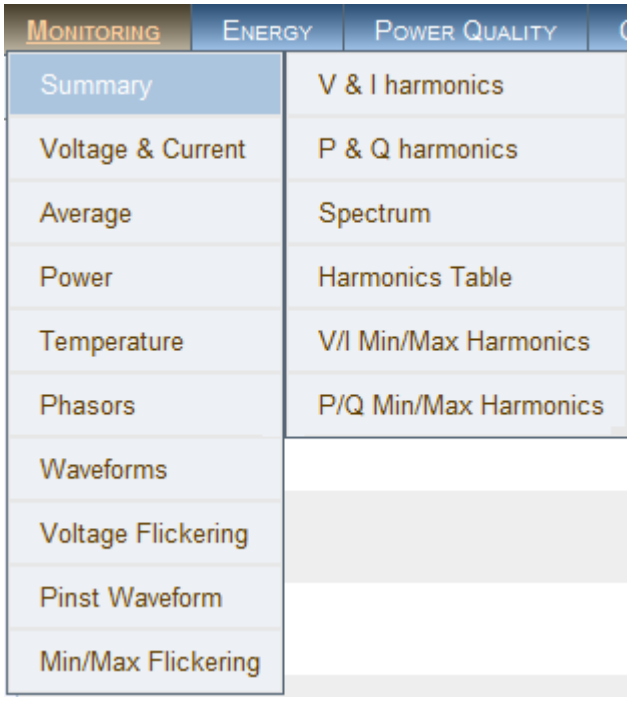
# Access the Measurement Summary

The **Measurement Summary** summarizes all your measurement readings. The most important parameters you will need to focus on in this window are **Phase Order (for 3 phase systems)** & **DSP Synchronization:**

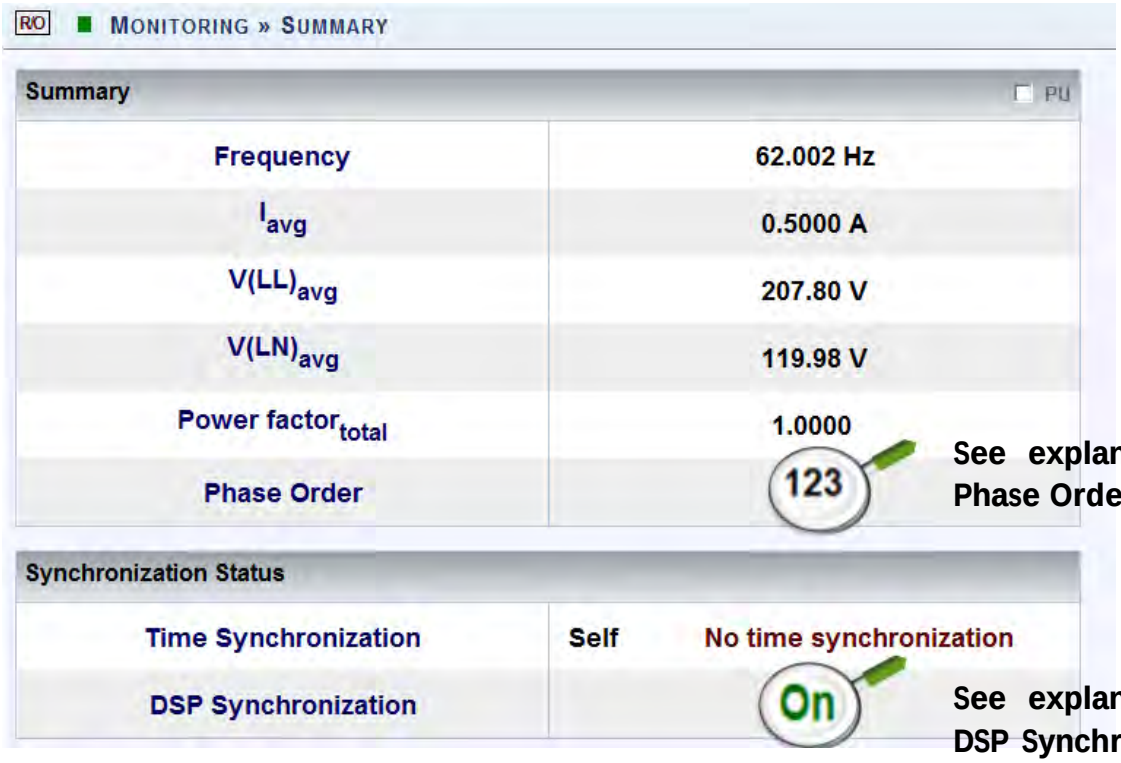
- **Phase Order:** Confirms the order of the voltage phases starts from $V_1$ & are moving in a clockwise direction. If the Phase Order is incorrect (not 123) recheck your Voltage Connections & that they are connected in the correct order.
- **DSP Synchronization:** Confirms that the unit is synchronized with the signals of the device. If this is **ON** it means that the device is reading all the signals in a synchronized manner, & if it is **OFF** it means that the device is not reading the signals. In this instance recheck all your Connections.
- See PQM onitoring for all the definitions & subsequent parameter calculations that appear on this window.

## ACCESS THE SUMMARY WINDOW

- Access your G4K Unit via the Web Interface ➡ Open **Monitoring** ➡ **Summary:**



- The **Summary Window** will now open:




**See explanation on Phase Order above.**

**See explanation on DSP Synchronization above.**

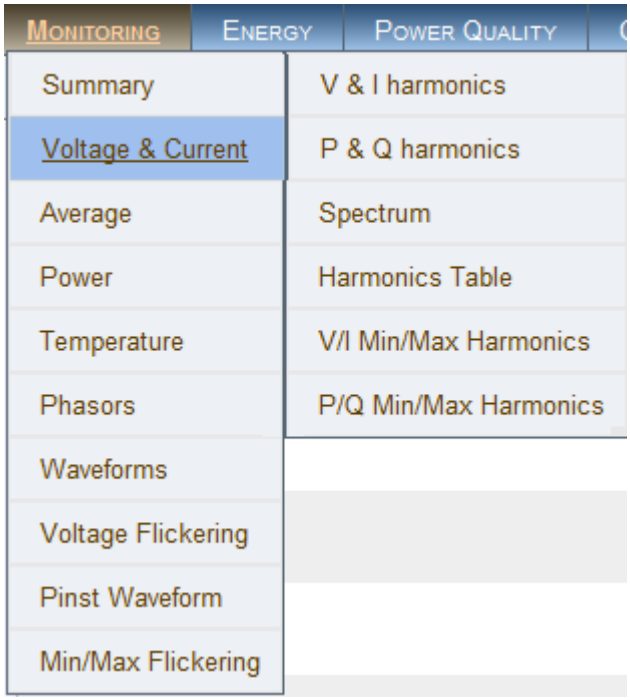
## SEE ALSO

- Verify Measurement Readings
- Verify Voltage & Current Readings
- Verify Power Readings
- About PQ Monitoring

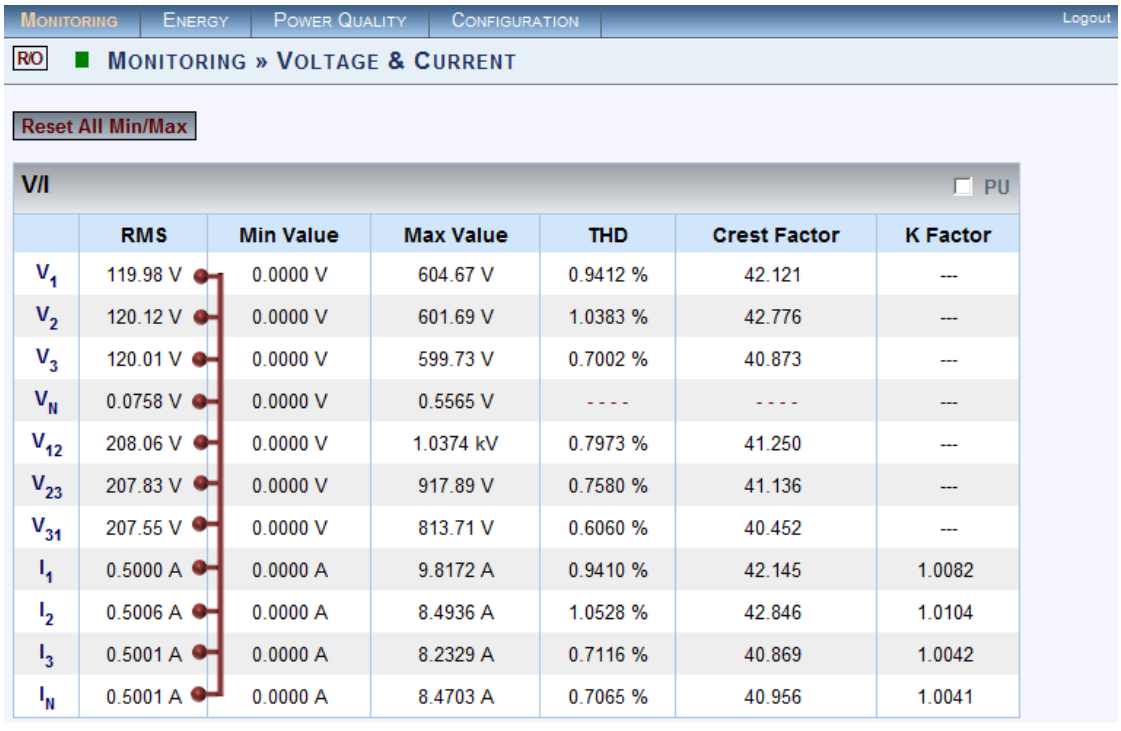
# Verify Voltage & Current Readings

This page displays specific values for voltage and current as per the parameters set when you Configured your G4K Unit. For a full description on all the definitions & subsequent parameter calculations see Voltage & Current.

- Access your G4K Unit via the Web Interface ➡ Open **Monitoring** ➡ **Voltage & Current:**




- Verify that the **RMS** values for both Voltage & Current are as per your Configurations:




| | RMS | Min Value | Max Value | THD | Crest Factor | K Factor |
|---|---|---|---|---|---|---|
| $V_1$ | 119.98 V | 0.0000 V | 604.67 V | 0.9412 % | 42.121 | --- |
| $V_2$ | 120.12 V | 0.0000 V | 601.69 V | 1.0383 % | 42.776 | --- |
| $V_3$ | 120.01 V | 0.0000 V | 599.73 V | 0.7002 % | 40.873 | --- |
| $V_N$ | 0.0758 V | 0.0000 V | 0.5565 V | - - - - | - - - - | --- |
| $V_{12}$ | 208.06 V | 0.0000 V | 1.0374 kV | 0.7973 % | 41.250 | --- |
| $V_{23}$ | 207.83 V | 0.0000 V | 917.89 V | 0.7580 % | 41.136 | --- |
| $V_{31}$ | 207.55 V | 0.0000 V | 813.71 V | 0.6060 % | 40.452 | --- |
| $I_1$ | 0.5000 A | 0.0000 A | 9.8172 A | 0.9410 % | 42.145 | 1.0082 |
| $I_2$ | 0.5006 A | 0.0000 A | 8.4936 A | 1.0528 % | 42.846 | 1.0104 |
| $I_3$ | 0.5001 A | 0.0000 A | 8.2329 A | 0.7116 % | 40.869 | 1.0042 |
| $I_N$ | 0.5001 A | 0.0000 A | 8.4703 A | 0.7065 % | 40.956 | 1.0041 |

- Go to the next step - Verifying your Power as per your Configurations

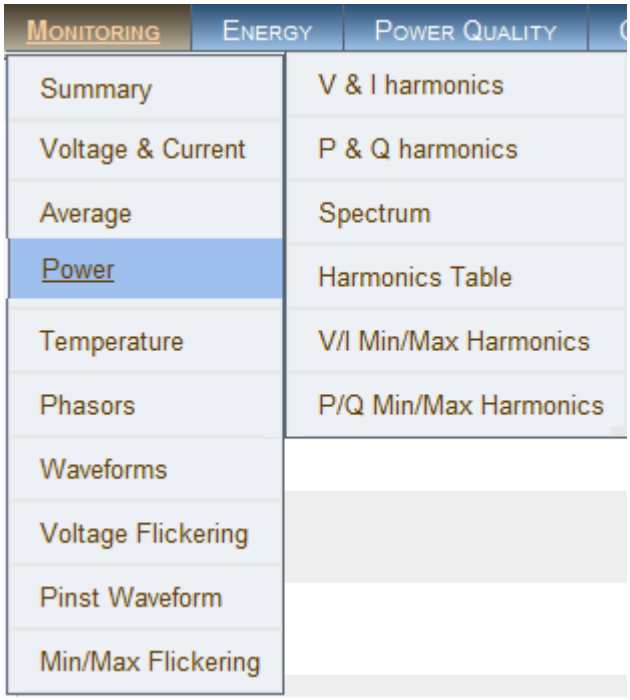
## SEE ALSO

- Verify Measurement Readings
- Access the Measurement Summary
- Verify Power Readings
- About PQ Monitoring

# Verify Power Readings

This page displays specific values for the different Electrical Power Parameters relevant to the Specific Power Configuration. For a full description on all the definitions & subsequent parameter calculations see Power.

- Access your G4K Unit via the Web Interface ➡Open **Monitoring** ➡**Power:**




**Power Summary**

| | Active Power | Reactive Power | Apparent Power | True PF | Displacement PF |
|---|---|---|---|---|---|
| Phase 1 | 22.511 kW | 3.5602 kVAr | 22.791 kVA | 0.9877 (Ind) | 0.9938 (Ind) |
| Phase 2 | 14.906 kW | -2.7707 kVAr | 15.161 kVA | 0.9832 (Cap) | 0.9961 (Cap) |
| Phase 3 | 13.527 kW | -1.9910 kVAr | 13.673 kVA | 0.9893 (Cap) | 0.9975 (Cap) |
| Neutral | 0.0000 kW | -0.0001 kVAr | 0.0001 kVA | 0.0027 (Cap) | --- |
| **Total** | **50.944 kW** | **-1.2015 kVAr** | **51.625 kVA** | **0.9868 (Cap)** | **0.9938 (Ind)** |

- Verify your Configurations in this window that displays:
  - Active Power
  - Reactive Power
  - Apparent Power
  - True & Displacement Power Factor

  In most network configurations the **Active Power** will reflect a **Positive Value**. Should it have a **Negative Value**, recheck your **Voltage** & **Current Polarity Configuration**. In the presence of a generator, the **Active Power** will reflect a **Negative Value**.

## SEE ALSO

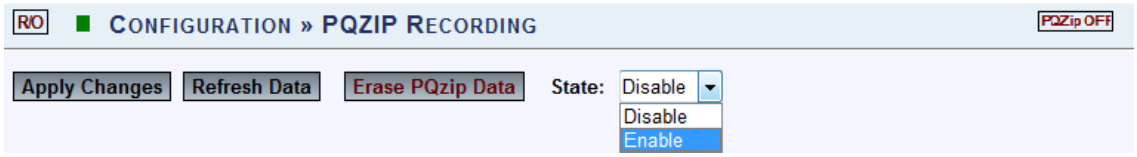
- Verify Measurement Readings
- Access the Measurement Summary
- Verify Voltage & Current Readings
- About PQ Monitoring

# Enable PQZIP Recording

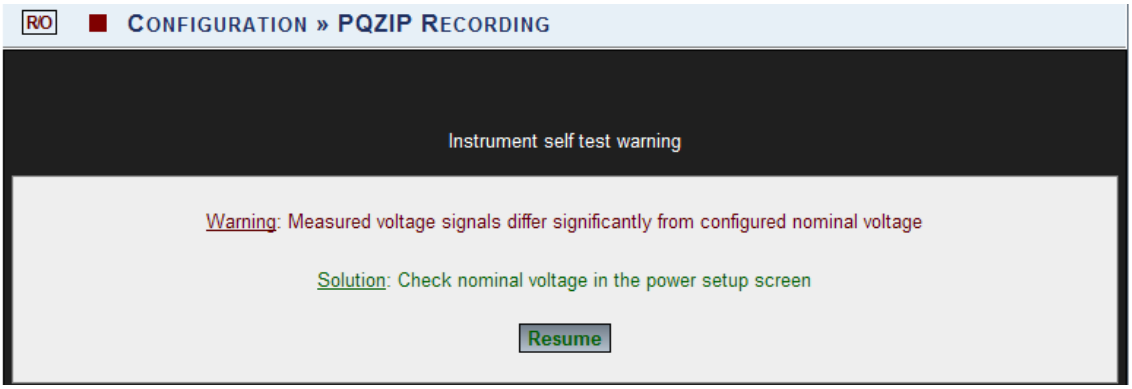
In order to record actual data for further analysis by PQSCADA & Investigator, you must first enable the PQZIP Recording.

## HOW TO ENABLE PQZIP RECORDING

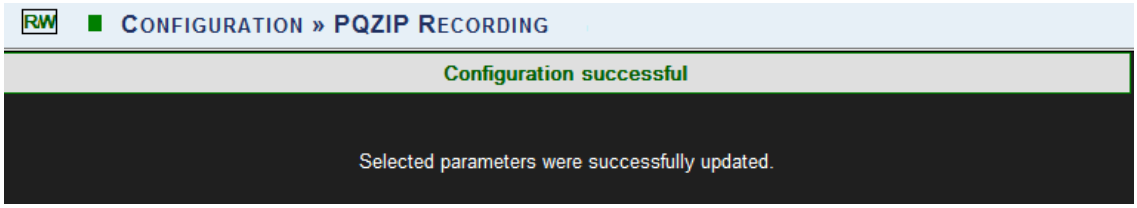
- Access your G4K Unit via the Web Interface ➡ Open **Configuration** ➡ **PQZIP Recording**
- In the **State** drop-down selection select **Enable:**




- To apply your changes select Apply Changes
- The following warning may appear if some parameter readings are inconsistent with the configuration. In this case make sure all parameters are correct before enabling the PQZIP:

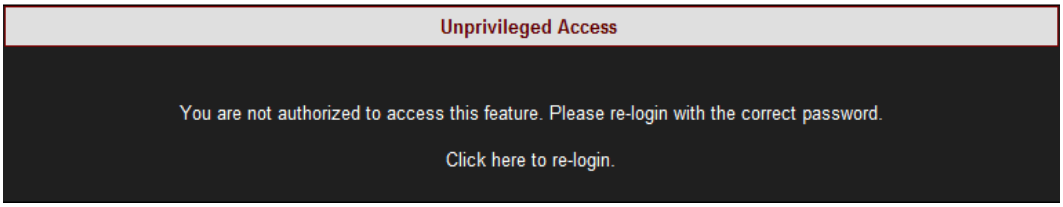



- Confirm by selecting Resume & the following success message will appear:



## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

- Installation
- G4K Unit Mounting BLACKBOX
- G4K Wiring BLACKBOX
- Establish 1st Time Connection
- Confirm Operation
- G4K Unit Access
- G4K Configuration
- Verifying Measurement Readings
- About PQ Monitoring

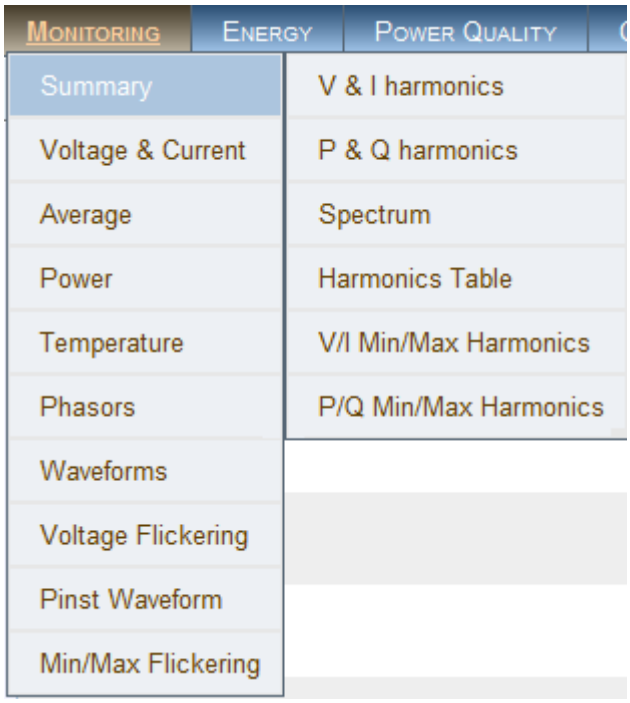
# Monitoring Real-Time Data

The Monitoring section displays real time readings and graphs of the grid's parameters. The graph display requires an ActiveX plug-in from Gigasoft that is downloadable either from Elspec's Website's Support Section or alternatively can be installed directly from your BLACKBOX CD. The ActiveX plug-in allows different view options needed for your PQ Monitoring. In the PQ Monitoring Section you will be able to monitor the following PQ measurements of your G4K Unit:

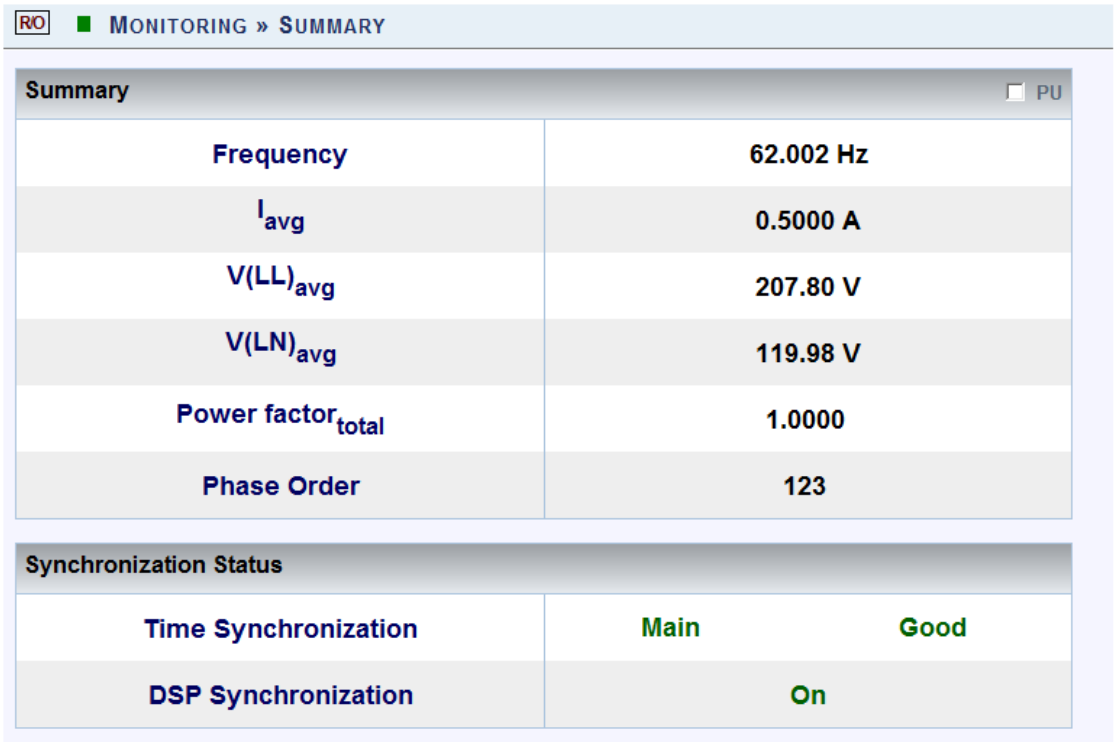
- Total measurements in the Summary Window
- Voltage & Current Measurements
- Average Measurements
- Power Measurements
- Internal & External Temperature Readings
- Voltage & Current Phase Diagrams
- Voltage & Current Waveforms
- Short & Long Term Voltage Flickering
- Flickering Waveforms
- Minimum & Maximum Flickering Values
- Voltage & Current Harmonics Spectrum
- Active & Reactive Harmonic Powers
- Voltage & Current Sub & Inter-Harmonics
- Voltage & Current Harmonics in Values & Angles
- Minimum, Maximum Values & Angles of Voltage & Current Harmonics
- Minimum & Maximum Values of Active & Reactive Power Harmonics

## ACCESS THE PQ MONITORING SUMMARY

- Access your G4K Unit via the Web Interface ➡ Open **Monitoring** ➡ **Summary:**




- The **Summary & Synchronization Status Window** will now open:



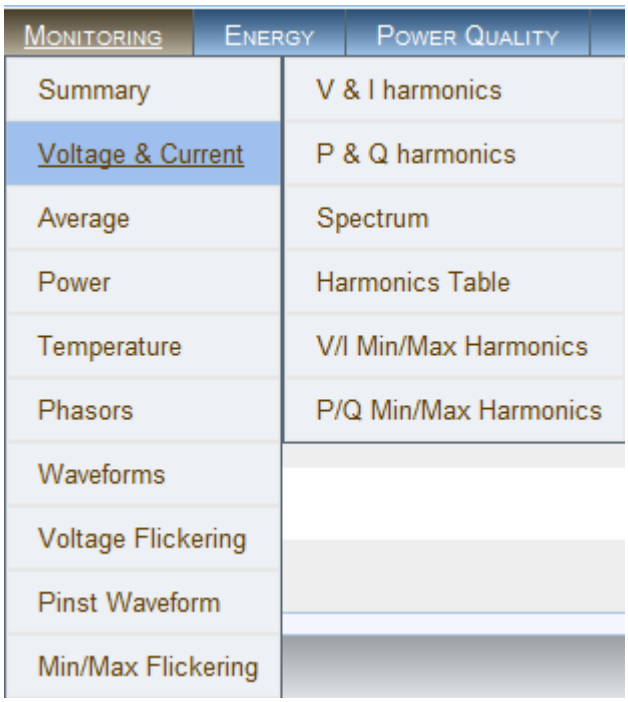
The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| **SUMMARY WINDOW** | |
| Frequency | The number of cycles per second |
| $I_{AVG}$ | The current in a single phase system or the current averaged over all three phases in a three phase system |
| $V(LL)_{AVG}$ | Line to line voltage averaged over all three phases in a three phase system |
| $V(LN)_{AVG}$ | Line to neutral voltage averaged over the three phases |
| Power $Factor_{TOTAL}$ | Total True Power Factor over three phases, averaged by default over 1 minute |
| Phase Order | Confirms the order of the voltage phases starts from $V_1$ & are moving in a clockwise direction. If the Phase Order is incorrect ( not 123) recheck your Voltage Connections & that they are connected in the correct order |
| **SYNCHRONIZATION STATUS** | |
| Time Synchronization | Indicates the connection quality to the time source. This connection supplies the instrument with world time ( UTC) from a time source. The Time Sync quality is essential to PQZIP coherent file generation |
| DSP Synchronization | Confirms that the unit is synchronized with the signals of the device. If this is **ON** it means that the device is reading all the signals in a synchronized manner, & if it is **OFF** it means that the device is not reading the signals. In this instance recheck all your Connections, Network Communication, & Device Configurations. |

# Voltage & Current Measurements

This page displays specific values for Voltage & Current Measurements at a 10/12 cycle resolution. The viewed parameters depend on how your G4K Unit has been Configured.

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Voltage & Current:**




- The Voltage & Current PQ Monitoring Window will now open

## VOLTAGE & CURRENT SECTION (RMS, MIN/MAX VALUE, THD, CREST FACTOR, K FACTOR)

V/I — PU

| | RMS | Min Value | Max Value | THD | Crest Factor | K Factor |
|---|---|---|---|---|---|---|
| $V_{12}$ | 403.1893 V | 381.5403 V | 420.2249 V | 1.713893 % | 1.448701 | --- |
| $V_{23}$ | 404.3133 V | 383.9400 V | 421.8228 V | 1.821636 % | 1.450176 | --- |
| $V_{31}$ | 403.2043 V | 383.6008 V | 420.2467 V | 1.614527 % | 1.447160 | --- |
| $I_1$ | 97.64386 A | 43.89695 A | 728.5047 A | 7.002274 % | 1.432072 | 1.295215 |
| $I_2$ | 53.23956 A | 17.21198 A | 719.1996 A | 14.46074 % | 1.779383 | 1.805157 |
| $I_3$ | 62.10047 A | 32.43429 A | 342.1426 A | 12.28039 % | 1.704414 | 1.499499 |
| $I_{12}$ | 20.71540 A | 10.81033 A | 114.0386 A | 12.27157 % | 1.703125 | 1.493802 |
| $I_{23}$ | 32.34406 A | 14.63008 A | 242.8318 A | 7.073332 % | 1.430983 | 1.288402 |
| $I_{31}$ | 51.18102 A | 24.85549 A | 290.8023 A | 7.955546 % | 1.502144 | 1.298753 |

The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| PU | By selecting PU (Per Unit) will present the values as part of nominal (for example: 230V ➡ 100.0%) |
| VRMS | $V_{RMS_x} = \sqrt{\sum_{n=1} ((V\cos\varphi)^2 + (V\sin\varphi)^2)}$<br>$n$ = Number of Samples<br>$x$ = Specific Channel<br>10/12 Continuous Non-Overlapping Cycles<br>In Accordance with IEC61000-4-30 |
| ARMS | $I_{RMS_x} = \sqrt{\sum_{n=1} ((I\cos\varphi)^2 + (I\sin\varphi)^2)}$<br>$n$ = Number of Samples<br>$x$ = Specific Channel<br>10/12 Continuous Non-Overlapping Cycles<br>In Accordance with IEC61000-4-30 |
| Min Value | Minimum RMS value since the initial power up or the most recent selection of: Reset All Min/Max |
| Max Value | Maximum RMS value since the initial power up or the most recent selection of: Reset All Min/Max |
| THD | $\sqrt{\frac{\sum_{n=2}^{50} C_n^2}{C_1^2}}$<br>$C$ = Harmonic RMS Value<br>$n$ = Harmonic Order |

| PARAMETER | DEFINITION |
|---|---|
| V Crest Factor | $\frac{V_{PEAK}}{V_{RMS}}$<br>Measures Ratio Between the VPEAK and VRMS |
| A Crest Factor | $\frac{I_{peak}}{I_{RMS}}$<br>Measures ratio between the IPEAK & ARMS |
| K-Factor | $\frac{\sum_{n=1}^{25}(i_n * n)^2}{\sum_{n=1}^{25} i_n^{\,2}}$<br>*Where $n$ is the Harmonic #, and $i_n$ is the RMS value of the $n^{TH}$ Harmonic* |

## VOLTAGE & CURRENT SECTION (TDD, THD EVEN, THD ODD, OVER-DEVIATION, UNDER DEVIATION)

V/I

| | TDD | THD Even | THD Odd | Over-deviation | Under-deviation |
|---|---|---|---|---|---|
| $V_{12}$ | --- | 0.047130 % | 1.725974 % | 403.3856 V | 400.0000 V |
| $V_{23}$ | --- | 0.000000 % | 1.826259 % | 404.4132 V | 400.0000 V |
| $V_{31}$ | --- | 0.018985 % | 1.638437 % | 403.2502 V | 400.0000 V |
| $I_1$ | 1.502666 % | 0.955213 % | 6.996640 % | --- | --- |
| $I_2$ | 3.085502 % | 0.872712 % | 15.01078 % | --- | --- |
| $I_3$ | 2.909767 % | 0.854348 % | 12.13882 % | --- | --- |
| $I_{12}$ | 1.886250 % | 0.896957 % | 12.28748 % | --- | --- |
| $I_{23}$ | 1.524358 % | 0.918502 % | 7.010171 % | --- | --- |
| $I_{31}$ | 1.774584 % | 0.918934 % | 7.902488 % | --- | --- |

The table outlines the sections' Parameters including Calculation:

| PARAMETER | DEFINITION |
|---|---|
| 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: $I_{TDD} = \sqrt{\sum_{h=2}^{\infty}\left[\frac{I_h^2}{I_L^2}\right]} * 100\%$ |
| THD Even | $\sqrt{\frac{\sum_1^{25} C_{2n}^2}{C_1^2}}$ <br> *C* = Harmonic RMS Value <br> *n* = Harmonic Order |
| THD Odd | $\sqrt{\frac{\sum_1^{25} C_{2n+1}^2}{C_1^2}}$ <br> *C* = Harmonic RMS Value <br> *n* = Harmonic Order |
| Over-Deviation | The Over-Deviation indicates how much higher the RMS Voltage is than the Reference Voltage |
| Under-Deviation | The Under-Deviation indicates how much lower the RMS Voltage is than the Reference Voltage |

## UNBALANCE SECTION (AVG, MIN, MAX)

**Unbalance**

| | Avg. | Min. | Max. |
|---|---|---|---|
| $u_{-}$ Unbalance | 0.178926 % | 0.009094 % | 1.555625 % |
| $U_{+}$ Positive Sequence | 570.5154 V | 541.6784 V | 594.8457 V |
| $U_{-}$ Negative Sequence | 1.020798 V | 0.051402 V | 8.629082 V |
| $U_0$ Sequence | 0.000000 V | 0.000000 V | 0.000000 V |
| $u_0$ Zero sequence ratio | 0.000000 % | 0.000000 % | 0.000000 % |
| $i_{-}$ Unbalance | 75.21848 % | 54.05648 % | 312.7102 % |
| $I_{+}$ Positive Sequence | 71.27623 A | 26.82935 A | 307.0463 A |
| $I_{-}$ Negative Sequence | 53.61290 A | 25.86587 A | 238.4883 A |
| $I_0$ Zero sequence | 48.62730 A | 14.82024 A | 235.9982 A |
| $i_0$ Zero sequence ratio | 68.22372 % | 23.88593 % | 449.3273 % |

The table outlines the sections' Parameters including Calculation:

| PARAMETER | DEFINITION |
|---|---|
| Unbalance | $Unbalance = \left[\frac{I_n}{I_p}\right] * 100$ The Supply Voltage Unbalance is Evaluated Using the Method of Symmetrical Components in Accordance with IEC61000-4-30 |
| Unbalance Avg. | The Average Supply Voltage Unbalance is Evaluated Using the Method of Symmetrical Components in Accordance with IEC61000-4-30 |
| Unbalance Min. | The Minimum Supply Voltage Unbalance is Evaluated Using the Method of Symmetrical Components in Accordance with IEC61000-4-30 |
| Unbalance Max. | The Maximum Supply Voltage Unbalance is Evaluated Using the Method of Symmetrical Components in Accordance with IEC61000-4-30 |
| Zero Sequence Unbalance | $U_0 = \left\| \frac{u_0}{u_1} \right\| * 100$ |
| Negative Sequence Unbalance | $U_2 = \left\| \frac{u_2}{u_1} \right\| * 100$ |
| Positive Sequence | Defined as the symmetrical vector system derived by application of the Fortescue's transformation matrix, and that rotates in the same direction as the power frequency voltage (or current): $\underline{U}_1 = \frac{1}{3}(\underline{U}_a + a \cdot \underline{U}_b + a^2 \cdot \underline{U}_c)$ where $a = 1\angle 120° = -\frac{1}{2} + j\frac{\sqrt{3}}{2}$ and $\underline{U}_a$, $\underline{U}_b$, $\underline{U}_c$ and are line to neutral voltages (fundamental component) In Accordance With IEC61000-3-13, ed. 1.0 (2008-02) Ref: 3.26.3 |
| Negative Sequence | Defined as the symmetrical vector system derived by application of the Fortescue's transformation matrix, and that rotates in the opposite direction to the power frequency voltage (or current): $\underline{U}_1 = \frac{1}{3}(\underline{U}_a + a^2 \cdot \underline{U}_b + a \cdot \underline{U}_c)$ where $a = 1\angle 120° = -\frac{1}{2} + j\frac{\sqrt{3}}{2}$ and $\underline{U}_a$, $\underline{U}_b$, $\underline{U}_c$ and are line to neutral voltages (fundamental component) In Accordance With IEC61000-3-13, ed. 1.0 (2008-02) Ref: 3.26.4 |
| Zero Sequence | Defined as the in-phase symmetrical vector system derived by application of the Fortescue's transformation matrix: $\underline{U}_0 = \frac{1}{3}(\underline{U}_a + \underline{U}_b + \underline{U}_c)$ where $\underline{U}_a$, $\underline{U}_b$, $\underline{U}_c$ and are line to neutral voltages (fundamental component) In Accordance With IEC61000-3-13, ed. 1.0 (2008-02) Ref: 3.26.5 |

## SEE ALSO

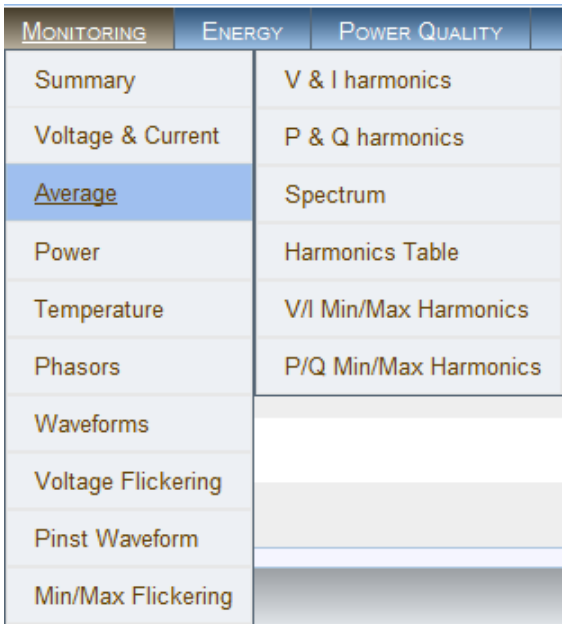
- Monitoring Real-Time Data
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Averaging

In accordance to the IEC-61000-4-30 measurement standards, the G4K BLACKBOX displays the following Average Measurements: Aggregation of 150/180 cycles (3seconds); 10 minutes & 2 hours based at a Frequency of 10 minutes. This window also displays the **Flagging** based on PQ configurations.

## OPEN THE AVERAGE WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Average:**



- The **Average Window** will now open:

RIO ■ MONITORING » AVERAGE

**Frequency**

| | |
|---|---|
| Frequency Over 10 sec | 50.03945 Hz |

**Averages**

| | 150/180 Cycles | 10 Min. | 2 Hours |
|---|---|---|---|
| Timestamp | 09/09/2010 19:17:25 | 09/09/2010 19:10:00 | 09/09/2010 18:00:00 |
| Flag | Not flagged | Not flagged | Not flagged |
| $V_{12}$ | 398.5608 V | 399.0757 V | 403.1885 V |
| $V_{23}$ | 399.9994 V | 400.5039 V | 404.6771 V |
| $V_{31}$ | 398.2115 V | 398.7762 V | 402.8430 V |

**Under-deviation**

| | 150/180 Cycles | 10 Min. | 2 Hours |
|---|---|---|---|
| $V_{12}$ | 0.364090 % | 0.214424 % | 0.000000 % |
| $V_{23}$ | 0.009476 % | 0.000015 % | 0.000000 % |
| $V_{31}$ | 0.448929 % | 0.289368 % | 0.000000 % |

**Over-deviation**

| | 150/180 Cycles | 10 Min. | 2 Hours |
|---|---|---|---|
| $V_{12}$ | 0.000000 % | 0.000000 % | 0.860155 % |
| $V_{23}$ | 0.008804 % | 0.142685 % | 1.210514 % |
| $V_{31}$ | 0.000000 % | 0.000000 % | 0.780482 % |

**Unbalance**

| | 150/180 Cycles | 10 Min. | 2 Hours |
|---|---|---|---|
| $u_-$ Unbalance | 0.271891 % | 0.265798 % | 0.280349 % |
| $U_+$ Positive Sequence | 564.0493 V | 564.9013 V | 570.7029 V |
| $U_-$ Negative Sequence | 1.533599 V | 1.501438 V | 1.599186 V |
| $U_0$ Sequence | 0.000000 V | 0.000000 V | 0.000000 V |
| $u_0$ Zero sequence ratio | 0.000000 % | 0.000000 % | 0.000000 % |
| $i_-$ Unbalance | 79.18645 % | 78.54414 % | 80.40035 % |
| $I_+$ Positive Sequence | 36.44508 A | 36.51681 A | 36.32321 A |
| $I_-$ Negative Sequence | 28.85961 A | 28.54987 A | 29.20407 A |
| $I_0$ Zero sequence | 20.54771 A | 20.55655 A | 19.71203 A |
| $i_0$ Zero sequence ratio | 56.38018 % | 56.56672 % | 54.26545 % |

The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| Frequency | Frequency – 10 seconds averaging |
| Average 150/180 Cycles | Average Measurements at an aggregation of 150/180 cycles (~3seconds) |
| Average 10 Min. | Average Measurements at an aggregation of 10 minutes |
| Average 2 Hours | Average Measurements at an aggregation of 2 hours |
| Under Deviation 150/180 Cycles | Displays how much lower the Average RMS Voltage is than the Reference Voltage at an aggregation of 150/180 cycles (~3seconds) |
| Under Deviation 10 Min. | Displays how much lower the Average RMS Voltage is than the Reference Voltage at an aggregation of 10 minutes |
| Under Deviation 2 Hours | Displays how much lower the Average RMS Voltage is than the Reference Voltage at an aggregation of 2 hours |
| Over Deviation 150/180 Cycles | Displays how much higher the Average RMS Voltage is than the Reference Voltage at an aggregation of 150/180 cycles (~3seconds) |
| Over Deviation 10 Min. | Displays how much higher the Average RMS Voltage is than the Reference Voltage at an aggregation of 10 minutes |
| Over Deviation 2 Hours | Displays how much higher the Average RMS Voltage is than the Reference Voltage at an aggregation of 2 hours |
| Unbalance 150/180 Cycles | The Supply Voltage Unbalance is Evaluated Using the Method of Symmetrical Components in Accordance with IEC61000-4-30<br>$Unbalance = \left[\frac{In}{Ip}\right] * 100$<br>This entry displays the Average Maximum/Minimum Unbalanced Values at an aggregation of 150/180 cycles (~3seconds) |
| Unbalance 10 Min. | This entry displays the Average Maximum/Minimum Unbalanced Values at an aggregation of 10 minutes |
| Unbalance 2 Hours | This entry displays the Average Maximum/Minimum Unbalanced Values at an aggregation of 2 hours |

## SEE ALSO

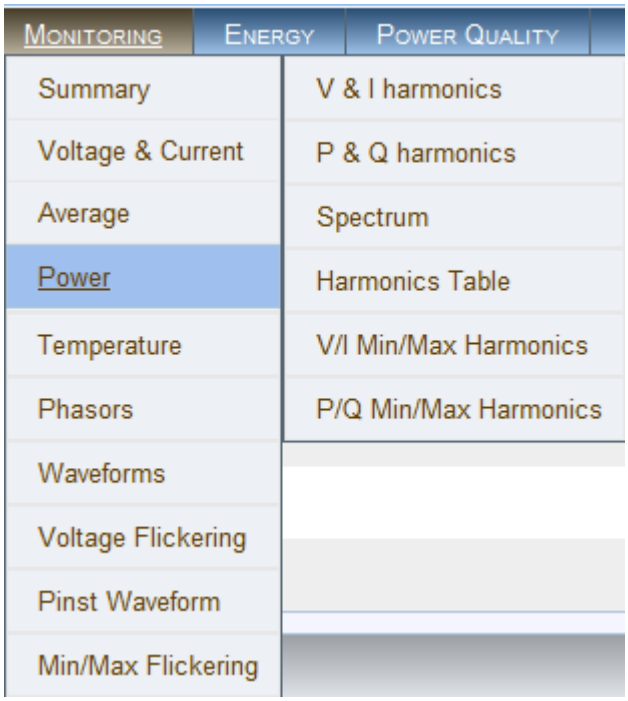
- Monitoring Real-Time Data
- Voltage & Current Measurements
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Power

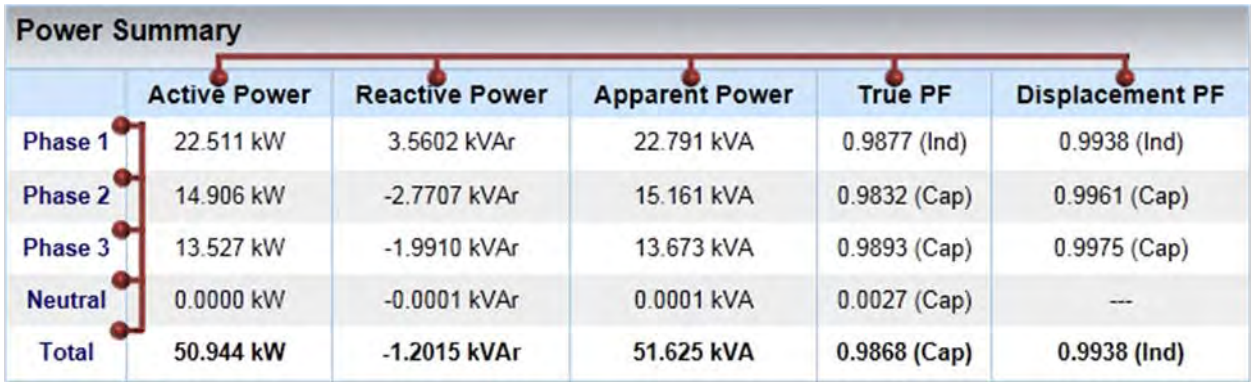
This page displays different electrical power parameters relevant to the Specific G4K Unit Configuration.

## OPEN THE POWER SUMMARY WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Power:**




- The **Power Summary Window** will now open:




| | Active Power | Reactive Power | Apparent Power | True PF | Displacement PF |
|---|---|---|---|---|---|
| Phase 1 | 22.511 kW | 3.5602 kVAr | 22.791 kVA | 0.9877 (Ind) | 0.9938 (Ind) |
| Phase 2 | 14.906 kW | -2.7707 kVAr | 15.161 kVA | 0.9832 (Cap) | 0.9961 (Cap) |
| Phase 3 | 13.527 kW | -1.9910 kVAr | 13.673 kVA | 0.9893 (Cap) | 0.9975 (Cap) |
| Neutral | 0.0000 kW | -0.0001 kVAr | 0.0001 kVA | 0.0027 (Cap) | --- |
| **Total** | **50.944 kW** | **-1.2015 kVAr** | **51.625 kVA** | **0.9868 (Cap)** | **0.9938 (Ind)** |

Verify your Configurations in this window that displays:

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

In most network configurations the **Active Power** will reflect a **Positive Value**. Should it have a **Negative Value**, recheck your **Voltage & Current Polarity Configuration**. In the presence of a generator, the **Active Power** will reflect a **Negative Value**.

The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| Active Power | The amount of Active Power consumed as usable energy. Sometimes referred to as Real Power. 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.<br><br>In most network configurations the **Active Power** will reflect a **Positive Value**. Should it have a **Negative Value**, recheck your **Voltage & Current Polarity Configuration**. In the presence of a generator, the **Active Power** will reflect a **Negative Value**.<br><br>Elspec calculates the Active Power accurately by taking all Harmonics up to the 40th into account using the following formula:<br><br>$\mathbf{P} = \frac{1}{2} \sum_i Vi,j \cdot Ii,j \cdot Cos\theta i,j$ [Watt]<br><br>**i = Harmonic**<br><br>**j = Phase** |
| Reactive Power | The amount of Reactive Power consumed as unusable energy. 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. Elspec calculates reactive power using the following formula:<br><br>$Q = -Pq = -\lvert V\rvert\lvert I\rvert Sin\theta = -\vec{V} \times \vec{I} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ Vx & Vy & 0 \\ Ix & Iy & 0 \end{vmatrix} = \hat{k}(-VxIy + IxVy)$ [VAr]<br><br>Elspec calculates the sign of Q using the following formula:<br><br>**Sign of Q = sign of:** $\left(\sum_i (-Vxi \cdot Iyi + Vyi \cdot Ixi)\right.$ |
| Apparent Power | The amount of Apparent Power; a vector addition of the Active and Reactive Power. The combination of active and reactive energy (kVAh)<br><br>Elspec uses formula:<br><br>$S = V_{RMS} * I_{RMS}$ [VA] |

<table>
<tr><th>PARAMETER</th><th>DEFINITION</th></tr>
<tr><td>True Power Factor (PF)</td><td>The ratio between Real Power & Apparent Power (a value between 0 and 1). The most accurate measure of efficiency is the True Power Factor. It is defined as the sum of the P/S ratio over all the Harmonics:<br><br>$PF_{sign} = P_{sign} * Q_{sign}$<br><br>$if\ PF_{sign} > 0\ than\ IND;\ PF_{sign} < 0\ than\ CAP$<br><br>
<table>
<tr><th>QUADRAT</th><th></th><th></th><th></th><th>PF UNIT</th></tr>
<tr><td>I</td><td>+</td><td>+</td><td>+</td><td>IND</td></tr>
<tr><td>II</td><td>-</td><td>+</td><td>-</td><td>CAP</td></tr>
<tr><td>III</td><td>-</td><td>-</td><td>+</td><td>IND</td></tr>
<tr><td>IV</td><td>+</td><td>-</td><td>-</td><td>CAP</td></tr>
</table>
</td></tr>
<tr><td>Displacement Power Factor (PF)</td><td>Same as True PF, But Only With Fundamental Components:<br><br>$true\ PF = \left| \frac{P_{h1}}{S_{h1}} \right|, if\ Q > 0\ than\ CAP;\ if\ Q < 0\ than\ IND$</td></tr>
</table>

## SEE ALSO

- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum

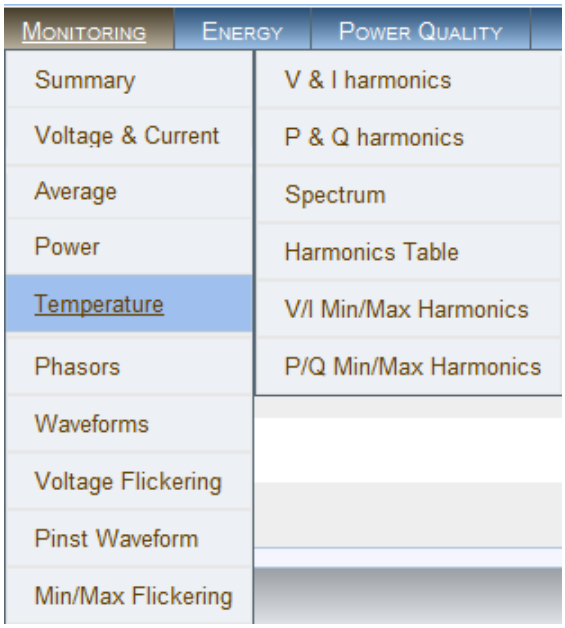
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Temperature

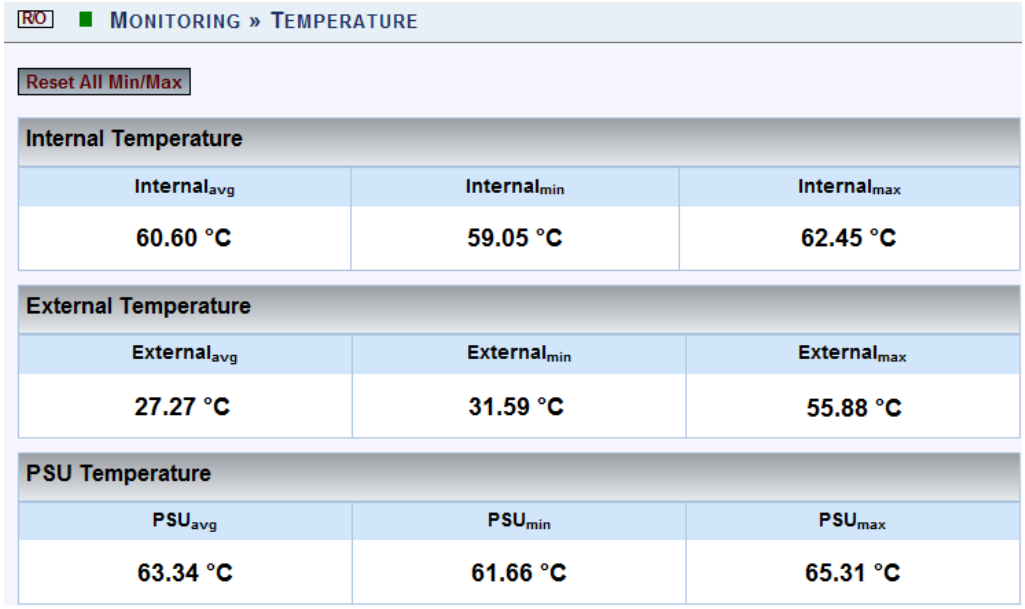
Ambient temperature is an important parameter both within an electrical cabinet and within your G4K BLACKBOX Unit. Temperature extremes do affect measuring accuracy. Therefore, monitoring the internal temperature of the instrument is important when monitoring all measured electrical parameters to ensure that the values can be assumed to be of maximum accuracy. A rise in power supply temperature could be a sign of loose connections or some other malfunction.

## OPEN THE TEMPERATURE WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Temperature:**




- The **Temperature Window** will now open:



The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| Internal Temperature | The average, minimum, and maximum internal temperature of the DSP Module |
| External Temperature | Utilizing a PT100 Thermometer, average, minimum, and maximum outside temperatures are monitored. The temperatures measured every network cycle and averaged over 10 cycles. The data is stored in the PQZIP files every 10 minutes. |
| PSU Temperature | The average minimum and maximum temperature of the Power Supply Module |
| Reset All Min/Max | Reset all Min/Max measurements of your G4K Unit |

## SEE ALSO

- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
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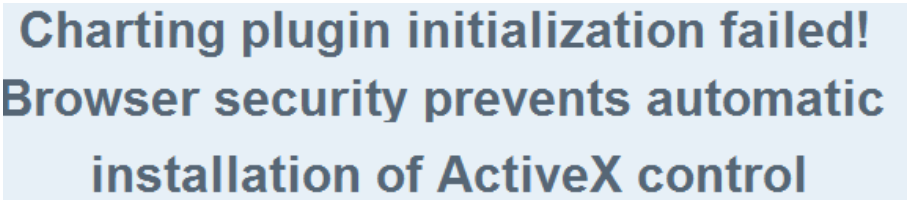
# Phasors

A Phasor is a vector representation of the Voltages & Currents in the system. The Phasor Window of the BLACKBOX Web Interface represents both Wye and Delta Voltage Configurations in a Phasor format. Therefore, the Phasors are a vector representation of the First Harmonic.

## *NOTE NOTE NOTE*

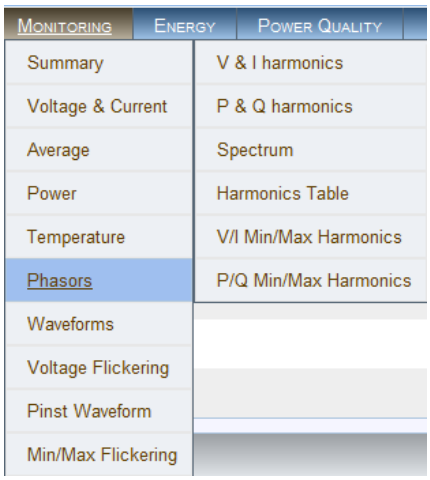
- In order to display the Phasor graph, ensure that you install the ActiveX plug-in from Gigasoft (downloadable either from Elspec's Website's Support Section or alternatively can be installed directly from your BLACKBOX CD). You will receive the following error message if the program is not installed:



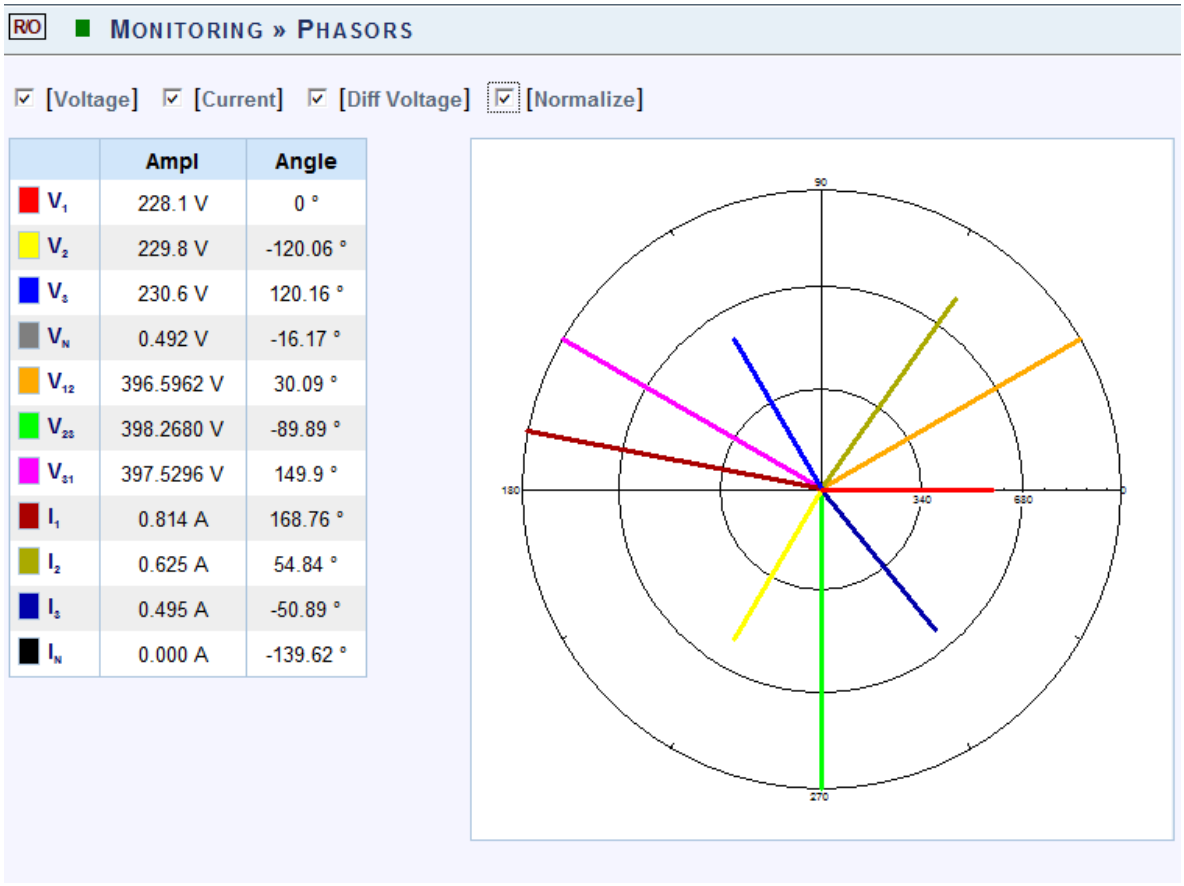

- **For Internet Explorer 8/9 Users**: Once you have installed Gigasoft, ensure that the Internet Explorer is running in **Compatibility View**:


## OPEN THE PHASORS WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Phasors:**



- The **Phasor Window** will now open:

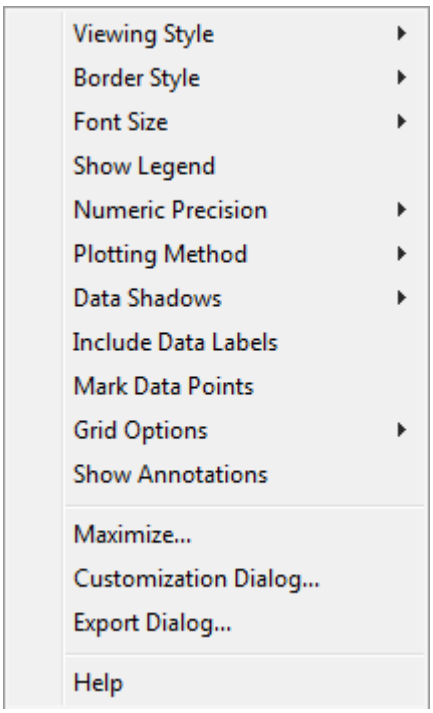



The table outlines the sections' Parameter options (for your selection) including their Definition:

| PARAMETER | DEFINITION |
|---|---|
| Voltage | Displays Voltage Phase to Neutral Phasor (only present with WYE 4 Wire configuration) |
| Current | Displays Phase Current |
| Diff Voltage | Displays the Phase to Neutral Voltages Phasor |
| Diff Current | Displays the Phase to Phase Current (only present with Delta 3 Wire configuration) |
| Normalize | Displays the all vector as part of the largest vector |
| Ampl | The Amplitude of each Phasor |
| Angle | V1 /V12 is at 0º, all other vectors are in relation to V1 /V12 |

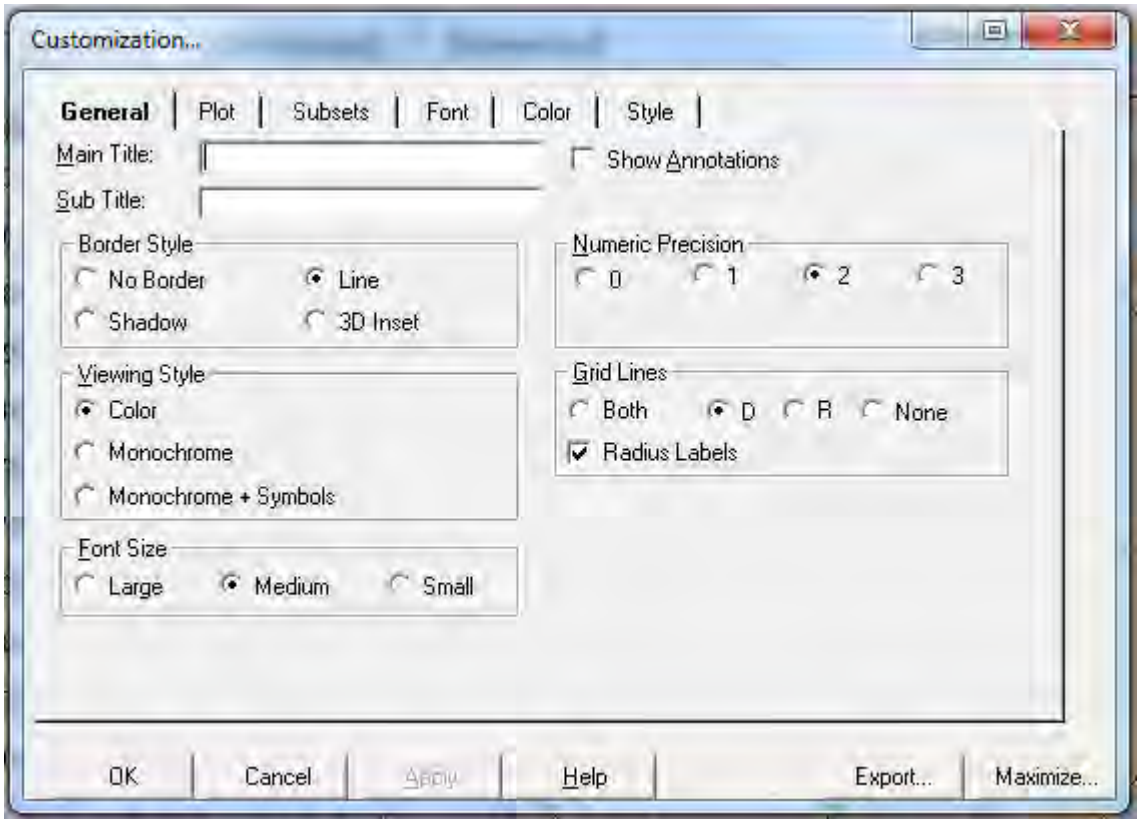
## CHART OPTIONS

- Right-click on the chart to access various options & capabilities for the chart:

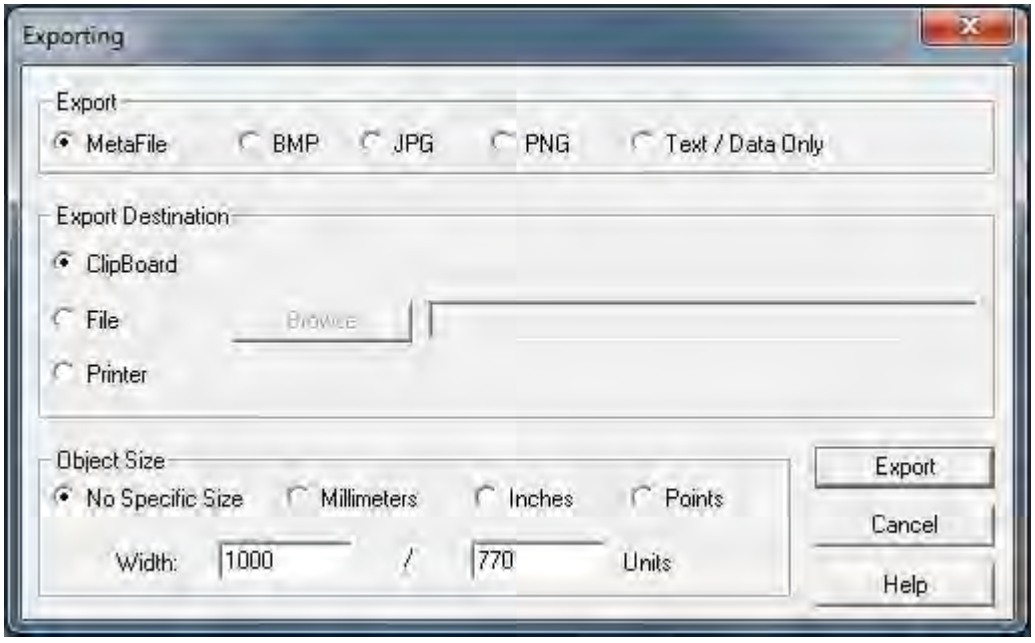



- You may use the following chart options & capabilities:
  - **Viewing Style:** Different styling options Color / Monochrome (B&W) with/without Symbols / Bitmap etc. By selecting the option you can view on screen the different styles available to you
  - **Border Style:** No Border, Thin Line, Shadow / Inset
  - **Font Size:** Large / Medium / Small
  - **Show Legend:** Display / Not display Legend
  - **Plotting Method:** From Line / Point / Point & Line
  - **Data Shadows:** Off / Shadow / 3D
  - **Include Data Labels**: Include / Exclude Numeric Data Labels
  - **Mark Data Points:** Mark/Unmark Data Points
  - **Grid Options:** Extend Radius Tick Marks, Both Degrees & Radius, Degrees, Radius, Hid Grid Lines, Thin Grid Lines, Thick Grid Lines, Dotted Grid Lines, Dashed Grid Lines & One Pixel Grid Lines
  - **Maximize:** Min / Max the Phasor Graph Only

- **Customization Dialog - Various General Graph Customization Options** (all options)**:**




- **Export Dialog - Various Export Options:**



## SEE ALSO

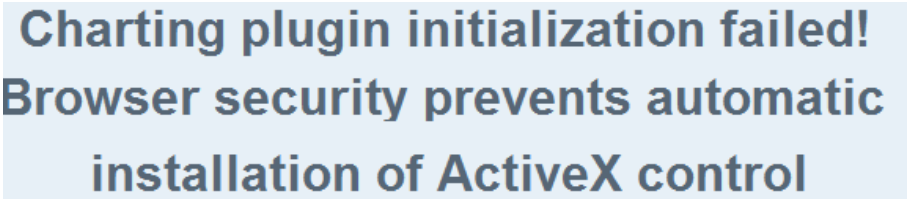
- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Waveforms

The Waveform page displays the actual Voltage & Current waveforms monitored by your G4K BLACKBOX Unit.

## *NOTE NOTE NOTE*

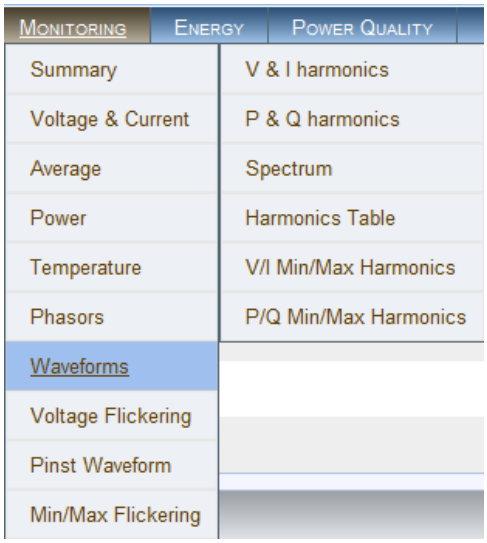
- In order to display the Phasor graph, ensure that you install the ActiveX plug-in from Gigasoft (downloadable either from Elspec's Website's Support Section or alternatively can be installed directly from your BLACKBOX CD). You will receive the following error message if the program is not installed:




- **For Internet Explorer 8/9 Users**: Once you have installed Gigasoft, ensure that the Internet Explorer is running in **Compatibility View**:


## OPEN THE WAVEFORMS WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Waveforms:**



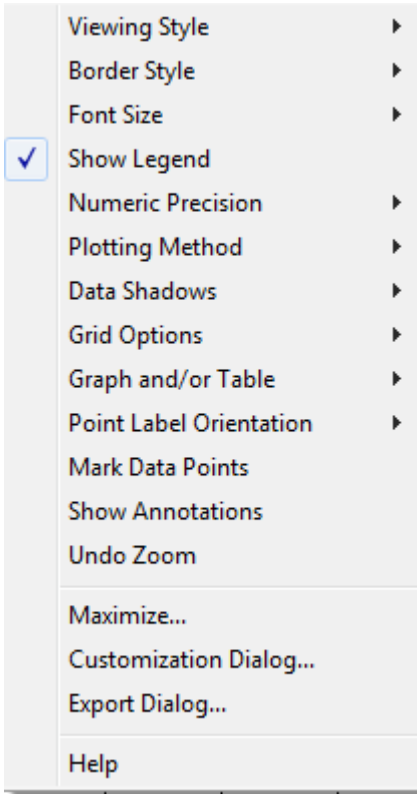
- The **Waveforms Window** will now open:


The table outlines the sections' Parameter options (for your selection) including their Definition:

| PARAMETER | DEFINITION |
|---|---|
| Cycle | Cycle Selection (1-4 Cycles) |
| All | Checking the "All graphs" box will automatically select all the boxes below |
| Voltage & Current | Depending on your power configuration, you can view all combinations of phase to phase and phase to line voltage and current combinations by making selections in the appropriate check boxes |

## CHART OPTIONS

- By right-clicking on the chart you have various chart options & capabilities available to you:

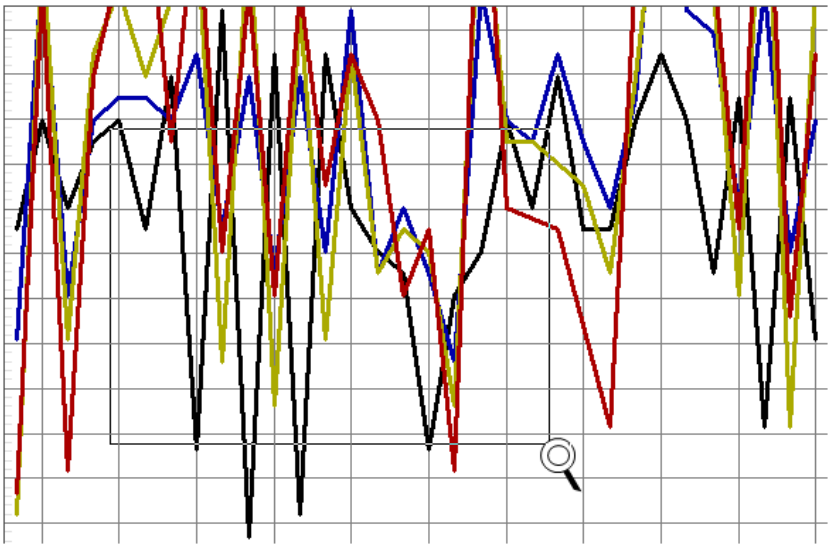



  - **Viewing Style:** Different styling options Color / Monochrome (B&W) with/without Symbols / Bitmap etc. By selecting the option you can view on screen the different styles available to you
  - **Border Style:** No Border, Thin Line, Shadow / Inset
  - **Font Size:** Large / Medium / Small
  - **Display / Not display** Legend
  - **Numeric Precision:** No up to 3 Decimals
  - **Plotting Method:** From Line / Bar / Point / Area / Spline / Combinations
  - **Data Shadows:** Off / Shadow / 3D
  - **Grid Options:** Various grid options ranging from dots / lines / different axis etc.

- **Graph & Table:** Display either the graph / table / both:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| V1 | -0.610 | 0.316 | 0.487 | -0.659 | -0.220 | 0.512 | -0.413 | -1.240 | -0.145 | 0.245 |
| V2 | -0.514 | 0.270 | 0.245 | -0.586 | -0.219 | 0.391 | -0.075 | -0.516 | 0.097 | 0.195 |
| V3 | -0.927 | 0.439 | 0.463 | -0.903 | -0.367 | 0.756 | -0.243 | -0.876 | 0.465 | 0.318 |
| VN | 0.122 | -0.049 | -0.391 | -0.293 | -0.513 | -0.318 | -0.293 | -0.220 | 0.024 | 0.073 |
| V12 | 0.244 | 0.049 | 0.098 | -0.047 | -0.338 | 0.001 | -0.000 | -0.266 | -0.243 | 0.340 |
| V23 | 0.317 | 0.365 | -0.293 | -0.050 | 0.509 | -0.123 | -0.146 | 0.388 | 0.219 | -0.365 |
| V31 | -0.561 | -0.415 | 0.195 | 0.097 | -0.172 | 0.122 | 0.146 | -0.123 | 0.024 | 0.025 |
| I1 | 3.906 | 0.244 | -1.465 | 0.488 | -0.244 | 0.488 | 1.221 | 0.977 | -0.977 | 0.488 |
| I2 | 3.418 | | -1.709 | 0.244 | -0.488 | 0.977 | 0.732 | 0.732 | -1.465 | 0.244 |
| I3 | 3.174 | 0.488 | -1.221 | 0.488 | | 0.488 | 0.244 | 0.488 | -1.221 | -1.221 |
| IN | 0.732 | -0.244 | -1.953 | -1.465 | -2.197 | -0.488 | | -0.977 | -1.465 | -0.488 |

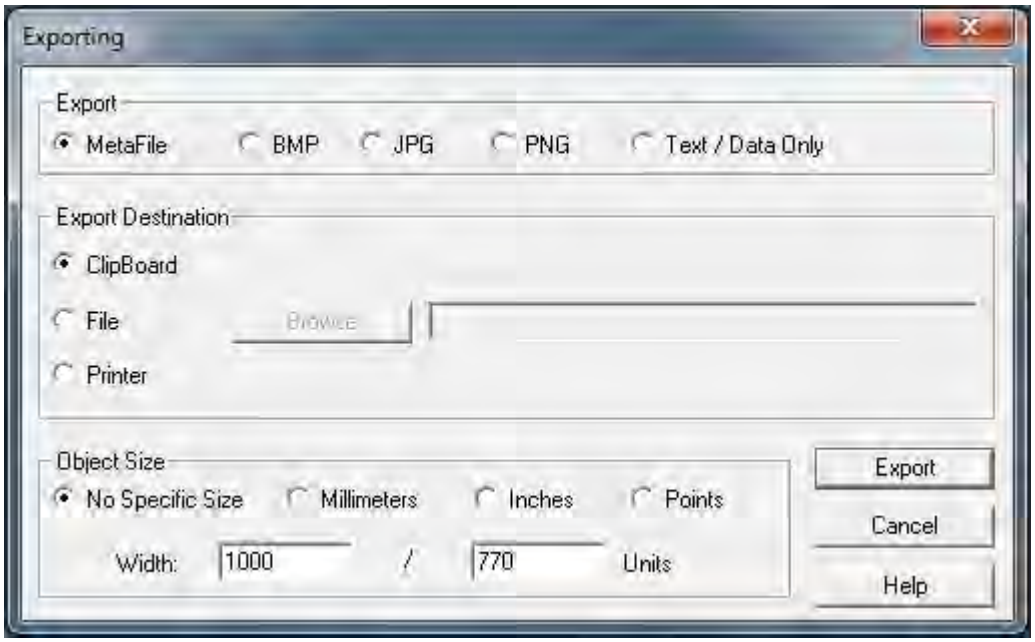
- **Point Label Orientation:** Auto / Vertical / Horizontal / Slanted
- **Mark Data Points:** Displays data points on graph
- **Show Annotations:** Displays annotations data descriptions
- **Zoom / Undo Zoom - Zoom in /out on your graph:**
  - From the main Waveform window, select an area to zoom in. Left-click and drag the mouse to define the area:



  - The enlarged area will now appear in the window
  - Zoom out by right/click ➡ & select **Zoom out**
- **Maximize**: Maximize / Minimize graph

- **Customization Dialog - Various General Graph Customization Options** (all options apart from zooming above)**:**


- **Export Dialog - Various Export Options:**



## SEE ALSO

- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
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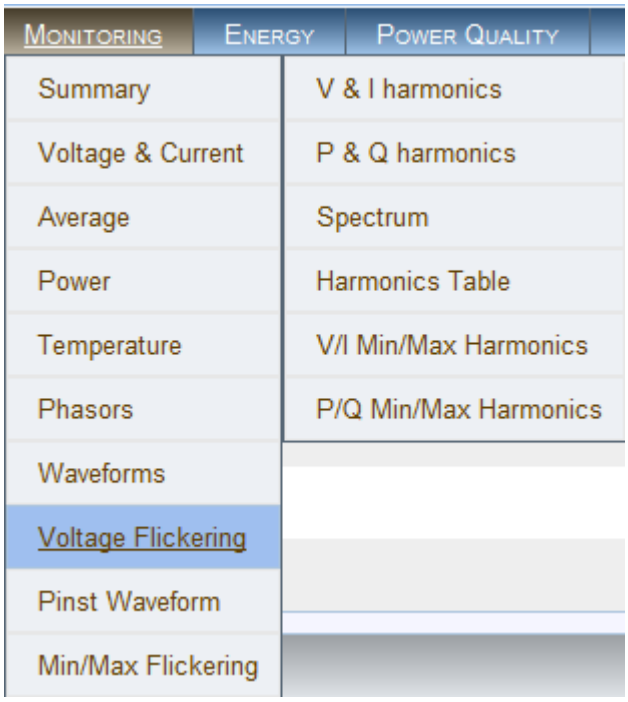
# Voltage Flickering

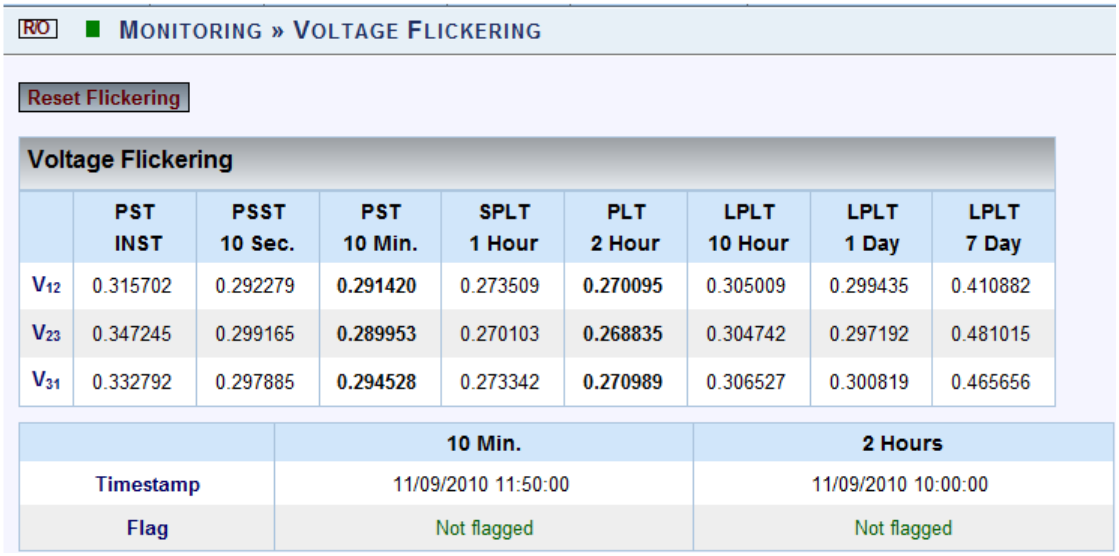
Displays the short & long term Voltage Flickering to a very close approximation of the EN50160 values.

## OPEN THE VOLTAGE FLICKERING WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Voltage Flickering:**




- The **Voltage Flickering Window** will now open:




| | PST INST | PSST 10 Sec. | PST 10 Min. | SPLT 1 Hour | PLT 2 Hour | LPLT 10 Hour | LPLT 1 Day | LPLT 7 Day |
|---|---|---|---|---|---|---|---|---|
| $V_{12}$ | 0.315702 | 0.292279 | **0.291420** | 0.273509 | **0.270095** | 0.305009 | 0.299435 | 0.410882 |
| $V_{23}$ | 0.347245 | 0.299165 | **0.289953** | 0.270103 | **0.268835** | 0.304742 | 0.297192 | 0.481015 |
| $V_{31}$ | 0.332792 | 0.297885 | **0.294528** | 0.273342 | **0.270989** | 0.306527 | 0.300819 | 0.465656 |

| | 10 Min. | 2 Hours |
|---|---|---|
| Timestamp | 11/09/2010 11:50:00 | 11/09/2010 10:00:00 |
| Flag | Not flagged | Not flagged |

The table outlines the sections' Parameter options (for your selection) including their Definition:

| PARAMETER | DEFINITION |
|---|---|
| PST INST | Instantaneous f licker ev aluation. Output o f Bl ock 5 o f the Flickermeter in Accordance with IEC61000-4-15 Edition 2 |
| PSST 10 Sec. | An E lspec m easurement d esigned to g et q uicker r esults r egarding Flicker evaluation. T his measurement r eaches a very cl ose approximation of the EN50160 values, but in a fraction of the time.<br>The P SST is cal culated t he s ame as P ST b ut averaged o ver 10 seconds. T his E lspec d efined v alue is valuable in t hat it en ables faster as sessment o f the f licker. E lspec P SST co nverges t o a r eal value within 3 min from a drastic flicker change, or immediately for periodic steady state flicker |
| PST | $P_{ST} = \sqrt{0.0314P_{0.1} + 0.0525P_{1S} + 0.0657P_{3S} + 0.28P_{10S} + 0.08P_{50S}}$<br>Where t he P ercentiles $P_{0.1}$, $P_1$, $P_3$, $P_{10}$, $P_{50}$ are t he F licker L evels Exceeded for 0.1, 1, 3, 10 & 50% of the Time During The Observation Period. T he S uffix "s" in t he F ormula I ndicates t hat t he S moothed Value Should be Used. The Smoothed Values are Obtained Using the Following Formulas:<br>P(1s) = (P(.7) + P(1) + P(1.5))/3<br>P(3s) = (P(2.2) + P(3) + P(4))/3<br>P(10s) = (P(6) + P(8) + P(10) + P(13) + P(17))/5<br>P(50s) = (P(30) + P(50) + P(80))/3 |
| PST 10 Min | Short term flicker evaluation.<br>$P_{ST}$ is a v alue m easured o ver 1 0 m inutes t hat c haracterizes t he likelihood that th e v oltage f luctuations w ould r esult i n p erceptible light f licker. A v alue o f 1 .0 is d esigned t o r epresent t hat 5 0% o f people would perceive flicker in a 60 watt incandescent bulb. |
| PLT | $P_{LT} = \sqrt[3]{\frac{\sum_{i=1}^{N} P_{ST_i}^3}{N}}$<br>Where $P_{ST_i}$ (i = 1, 2, 3, ...) are the Consecutive Readings of the $P_{ST}$ |

| PARAMETER | DEFINITION |
|---|---|
| SPLT 1 Hour | An Elspec measurement designed to get quicker results regarding Flicker evaluation. This measurement reaches a very close approximation of the EN 50160 values, but in a fraction of the time.<br>The SPLT is calculated the same as PLT but averaged over 1 hour. This Elspec defined value is valuable in that it enables faster assessment of the flicker |
| PLT 2 Hour | The Long-Term PLT is Derived From the Short-Term Values Over 12 Short-Term Values of 10 Minutes Each Over a Period of 2 hours |
| LPLT 10 Hour | An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time. The $LP_{LT}$ is calculated the same as $P_{LT}$ but averaged over 10 hours to allow a quicker "long term" average |
| LPLT 7 Day | An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time.<br>The $LP_{LT}$ is calculated the same as $P_{LT}$ but averaged over 7 days, as per EN50160 parts 4-15 |
| Reset Flickering | Reset all Flickering measurements of your G4K Unit |

## SEE ALSO

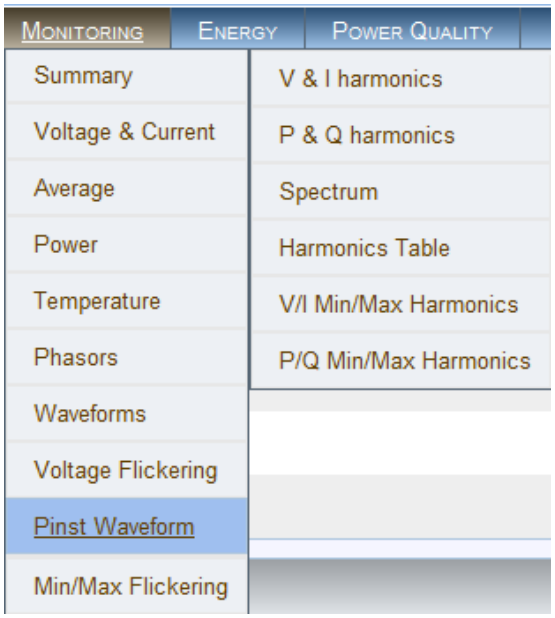
- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Pinst Waveform

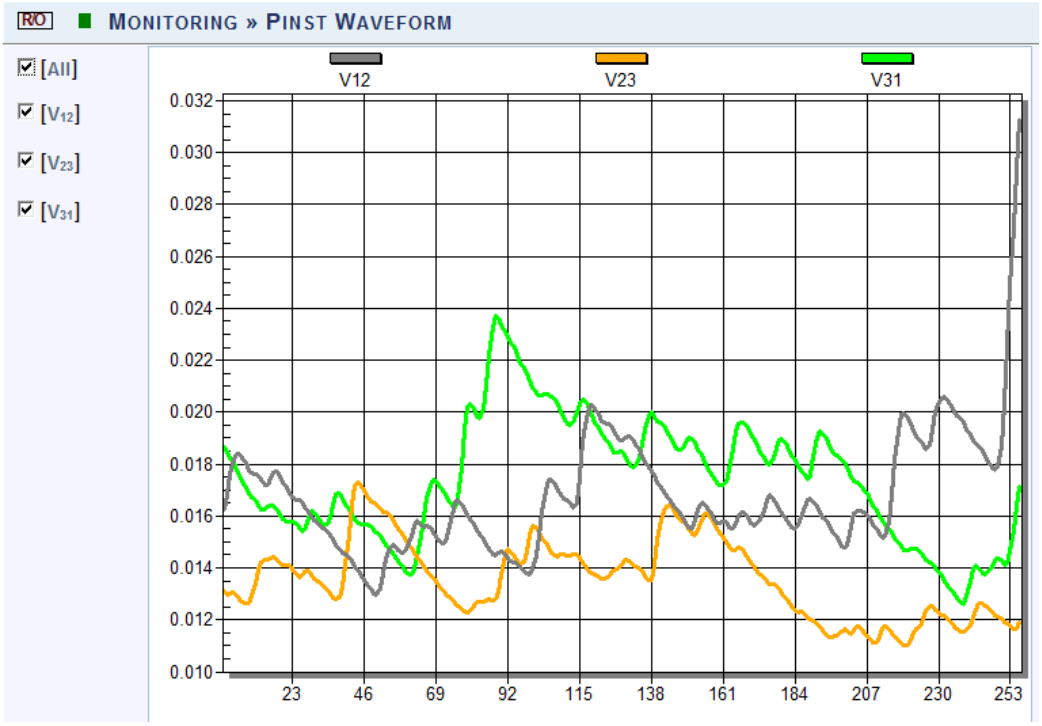
Pinst is instantaneous flicker sensation that the G4K calculates for every selected channel.

## OPEN THE PINST WAVEFORM WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Pinst Waveforms:**




- The **Pinst Waveforms Window** will now open:



The table outlines the sections' Parameter options (for your selection) including their Definition:

| PARAMETER | DEFINITION |
|---|---|
| All | Checking the "All graphs" box will automatically select all the boxes below |
| Voltage Channels | Select t he applicable ch annel f or F lickering W aveform display. |

## SEE ALSO

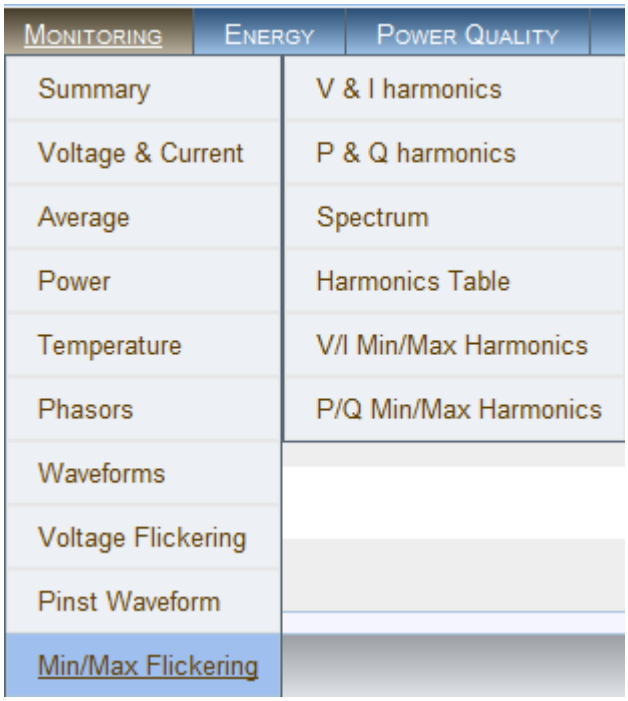
- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Minimum / Maximum Flickering

Displays the minimum & maximum short & long term Voltage Flickering vales to a very close approximation of the EN50160 values.

## OPEN THE MIN/MAX FLICKERING WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Min/Max Flickering:**




- The **Min/Max Flickering Window** will now open:

RO ■ MONITORING » MIN/MAX FLICKERING

Reset All Min/Max

**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. | N/A | N/A | **N/A** | N/A | **N/A** | N/A | N/A | N/A |
| | Max. | 71637.10 | 23127.63 | **124.9797** | 1.194570 | **0.950628** | 0.580950 | 0.478969 | 0.410882 |
| $V_{23}$ | Min. | N/A | N/A | **N/A** | N/A | **N/A** | N/A | N/A | N/A |
| | Max. | 70519.79 | 22767.93 | **124.8582** | 1.407181 | **1.182908** | 0.780778 | 0.654229 | 0.481015 |
| $V_{31}$ | Min. | N/A | N/A | **N/A** | N/A | **N/A** | N/A | N/A | N/A |
| | Max. | 71572.71 | 23106.75 | **125.2780** | 1.350298 | **1.109859** | 0.752893 | 0.624114 | 0.465656 |

The table outlines the sections' Parameter options (for your selection) including their Definition:

| PARAMETER | DEFINITION |
|---|---|
| PST INST | Instantaneous f licker ev aluation. Output o f Bl ock 5 o f the Flickermeter in Accordance with IEC61000-4-15 Edition 2 |
| PSST 10 Sec. | An E lspec m easurement d esigned t o g et quicker r esults r egarding Flicker ev aluation. T his m easurement reaches a v ery cl ose approximation of the EN50160 values, but in a fraction of the time.<br>The P SST i s calculated the sa me as P ST b ut av eraged over 1 0 seconds. T his E lspec d efined v alue is v aluable i n t hat i t en ables faster as sessment o f the f licker. E lspec P SST co nverges t o a r eal value within 3 min from a d rastic flicker change, or immediately for periodic steady state flicker |
| PST | $P_{ST} = \sqrt{0.0314P_{0.1} + 0.0525P_{1S} + 0.0657P_{3S} + 0.28P_{10S} + 0.08P_{50S}}$<br>Where t he Percentiles $P_{0.1}$, $P_1$, $P_3$, $P_{10}$, $P_{50}$ are t he F licker L evels Exceeded for 0.1, 1, 3, 10 & 50% of the Time During The Observation Period. T he S uffix "s" i n the F ormula I ndicates tha t th e Smoothed Value Should b e Used. The Smoothed Values a re Obtained Using the Following Formulas:<br>P(1s) = (P(.7) + P(1) + P(1.5))/3<br>P(3s) = (P(2.2) + P(3) + P(4))/3<br>P(10s) = (P(6) + P(8) + P(10) + P(13) + P(17))/5<br>P(50s) = (P(30) + P(50) + P(80))/3 |
| PST 10 Min | Short term flicker evaluation.<br>$P_{ST}$ is a v alue m easured over 1 0 m inutes t hat ch aracterizes the likelihood t hat t he v oltage f luctuations w ould r esult in p erceptible light f licker. A v alue o f 1 .0 is d esigned t o r epresent that 5 0% o f people would perceive flicker in a 60 watt incandescent bulb. |
| PLT | $P_{LT} = \sqrt[3]{\frac{\sum_{i=1}^{N} P_{sti}^3}{N}}$<br>Where $P_{sti}$ (i = 1, 2, 3, ...) a re C onsecutive Readings of t he S hort-Term Severity $P_{ST}$ |

| PARAMETER | DEFINITION |
|---|---|
| SPLT 1 Hour | An Elspec measurement designed to get quicker results regarding Flicker evaluation. This measurement reaches a very close approximation of the EN50160 values, but in a fraction of the time.<br>The SPLT is calculated the same as PLT but averaged over 1 hour. This Elspec defined value is valuable in that it enables faster assessment of the flicker |
| PLT 2 Hour | The Long-Term PLT is Derived From the Short-Term Values Over 12 Short-Term Values of 10 Minutes Each Over a Period of 2 hours |
| LPLT 10 Hour | An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time. The $LP_{LT}$ is calculated the same as $P_{LT}$ but averaged over 10 hours to allow a quicker "long term" average |
| LPLT 1 Day | An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time.<br>The $LP_{LT}$ is calculated the same as $P_{LT}$ but averaged over 1 day |
| LPLT 7 Day | An Elspec measurement designed to give better results regarding Flicker evaluation by using a longer averaging time.<br>The $LP_{LT}$ is calculated the same as $P_{LT}$ but averaged over 7 days, as per EN50160 parts 4-15 |
| Reset All Min/Max | Reset all Flickering measurements of your G4K Unit |

## SEE ALSO

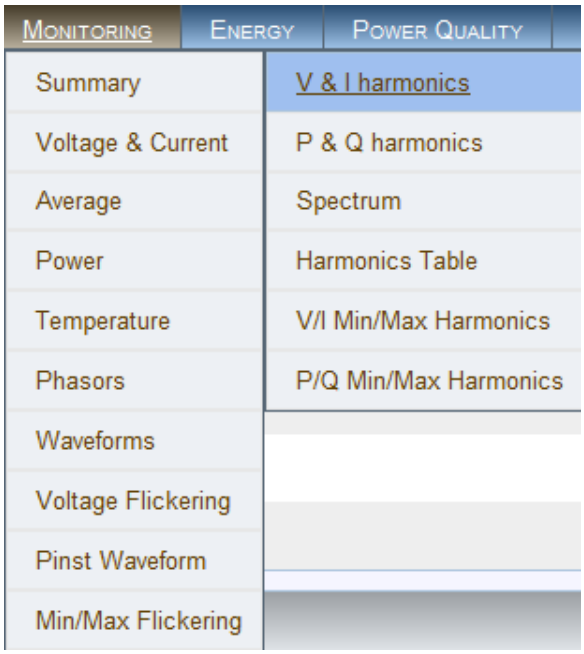
- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Voltage & Current Harmonics

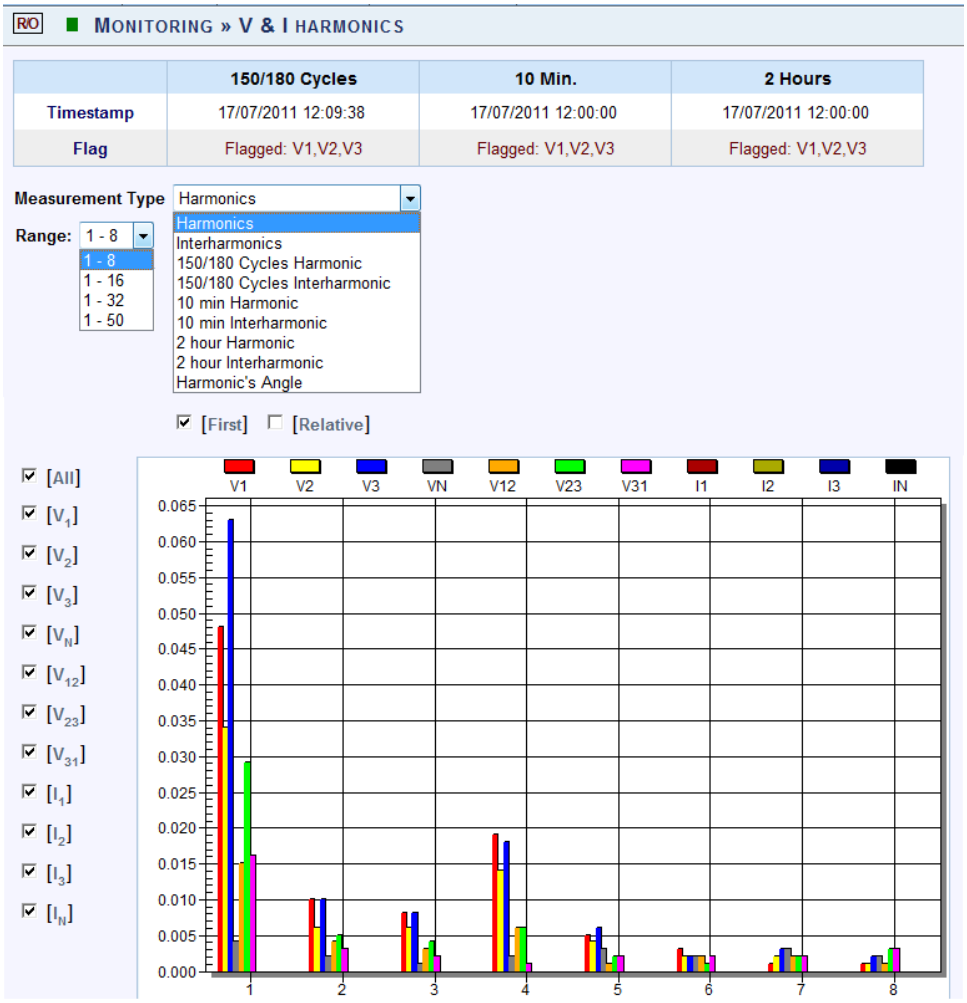
This window opens the Spectrum of Voltage & Current Harmonics measured by your G4K Unit. The graph is able to display of up to 40 Harmonics.

## OPEN THE V&I HARMONICS WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **V&I Harmonics:**



- The **V&I Harmonics Window** will now open:



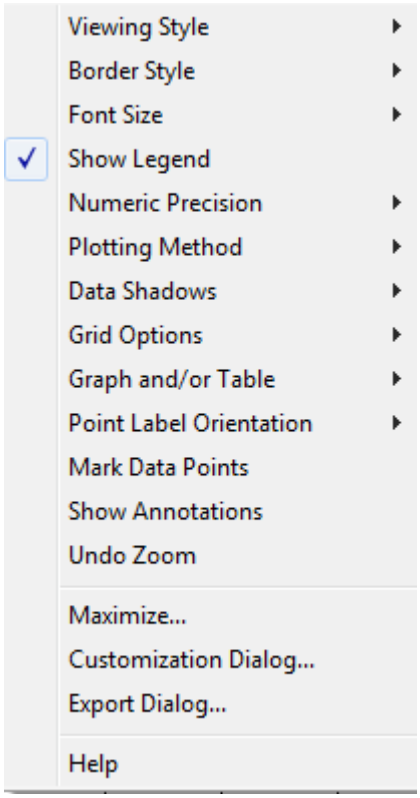

The table outlines the sections' Parameter options (for your selection) including their Definition:

| PARAMETER | DEFINITION |
|---|---|
| Timestamp | Indicates the timestamps of the last averaging intervals |
| Flag | Indicates whether or not the last interval is valid according to the set standard |
| **MEASUREMENT TYPE** | |
| Harmonics | Real time (10/12 cycles) calculation of sub group harmonics, in accordance with IEC61000-4-7. $G_{sg,n}^2 = \sum_{i=1}^{1} C_{k+i}^2$ |
| Interharmonics | Real time (10/12 cycles) calculation of inter sub group harmonics, in accordance with IEC61000-4-7. |
| 150/180 Cycles Harmonic | 150/180 Cycle averaging of the sub group harmonics |

| PARAMETER | DEFINITION |
|---|---|
| 150/180 Cycles Interharmonic | 150/180 Cycle averaging of the inter sub group harmonics |
| 10 Min Harmonic | 10 Minutes averaging of the sub group harmonics |
| 10 Min Interharmonic | 10 Minutes averaging of the inter sub group harmonics |
| 2 Hour Harmonic | 2 Hours averaging of the 10 minutes averaging of the sub group harmonics |
| 2 Hour Interharmonic | 2 Hours averaging of the 10 minutes averaging of the inter sub group harmonics |
| Harmonic's Angle | The angle of each harmonic based on the real time value |
| **RANGE** | |
| 1-8 | Select the number of harmonics to be displayed 1-8 |
| 1-16 | Select the number of harmonics to be displayed 1-16 |
| 1-32 | Select the number of harmonics to be displayed 1-32 |
| 1-50 | Select the number of harmonics to be displayed 1-50 |
| **OPTIONS** | |
| First | Check/Uncheck the checkbox in order to display/not display the first harmonic |
| Relative | Check/Uncheck the checkbox in order to display/not display the harmonics relative to the first harmonic (Whereas the first harmonic is 100, and the other harmonic values as part of the harmonic 100) |
| All | Checking the "All" will display all the channels |
| Voltage & Current | Select the applicable Voltage / Current channel to be displayed |

## CHART OPTIONS

- By right-clicking on the chart you have various chart options & capabilities available to you:

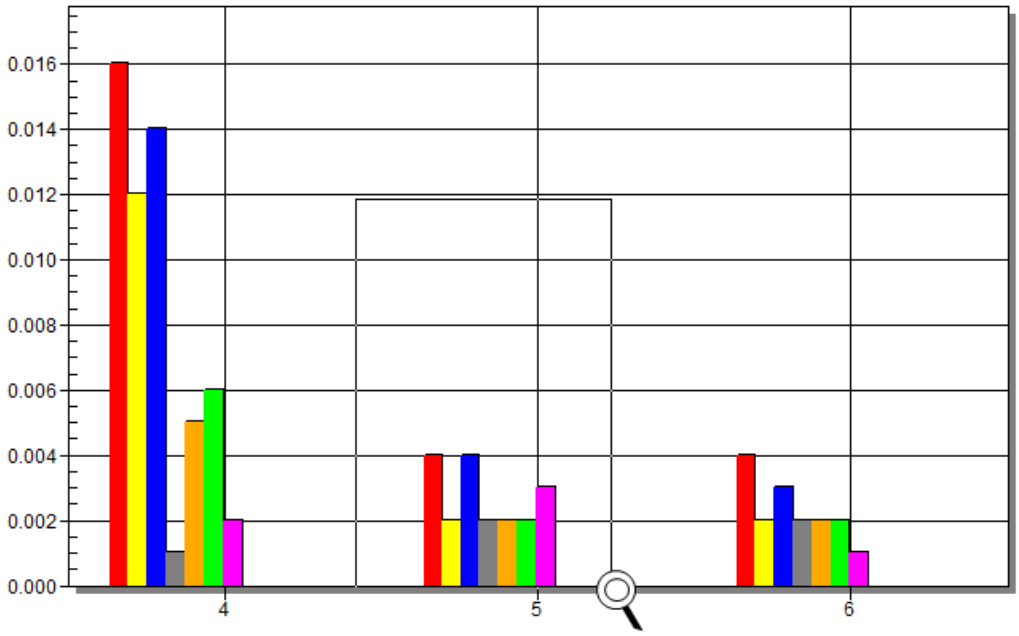



  - **Viewing Style:** Different styling options Color / Monochrome (B&W) with/without Symbols / Bitmap etc. By selecting the option you can view on screen the different styles available to you
  - **Border Style:** No Border, Thin Line, Shadow / Inset
  - **Font Size:** Large / Medium / Small
  - **Display / Not display** Legend
  - **Numeric Precision:** No up to 3 Decimals
  - **Plotting Method:** From Line / Bar / Point / Area / Spline / Combinations
  - **Data Shadows:** Off / Shadow / 3D
  - **Grid Options:** Various grid options ranging from dots / lines / different axis etc.
  - **Graph & Table:** Display either the graph / table / both:

| | 4 | 5 | 6 |
|---|---|---|---|
| V1 | 0.016 | 0.003 | 0.005 |
| V2 | 0.013 | 0.003 | 0.003 |
| V3 | 0.017 | 0.003 | 0.005 |
| VN | 0.002 | 0.003 | 0.003 |
| V12 | 0.005 | 0.003 | 0.003 |
| V23 | 0.006 | 0.002 | 0.003 |
| V31 | 0.003 | 0.003 | 0.002 |

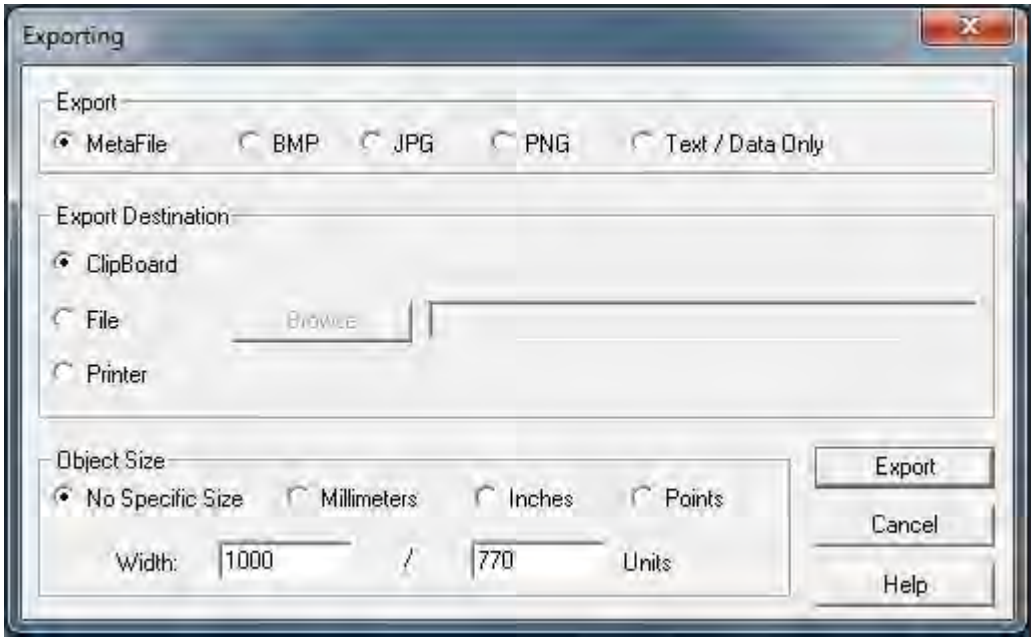
  - **Point Label Orientation:** Auto / Vertical / Horizontal / Slanted
  - **Mark Data Points:** Displays data points on graph

- **Zoom / Undo Zoom - Zoom in /out on your graph:**
  - From the main Waveform window, select an area to zoom in. Left-click and drag the mouse to define the area:




  - The enlarged area will now appear in the window
  - Zoom out by right/click ➡ & select **Zoom out**
- **Maximize**: Maximize / Minimize graph
- **Customization Dialog - Various General Graph Customization Options** (all options apart from zooming above)**:**

- **Export Dialog - Various Export Options:**




## SEE ALSO

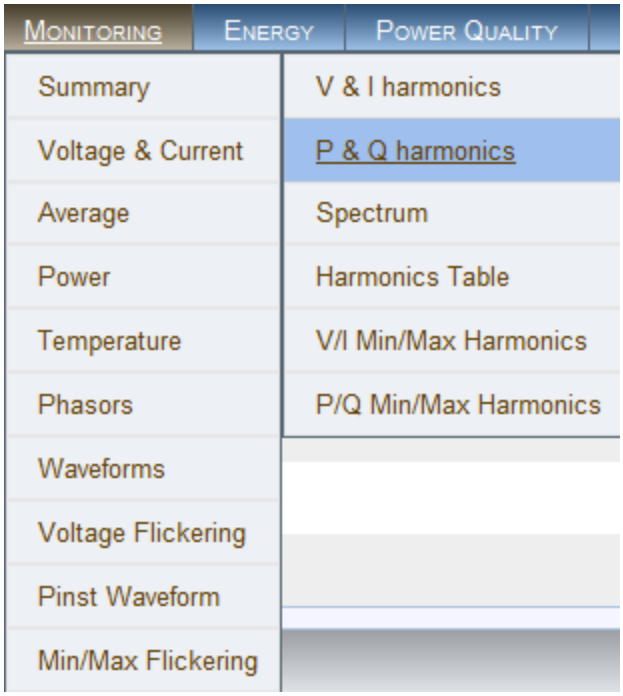
- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# P & Q Harmonics

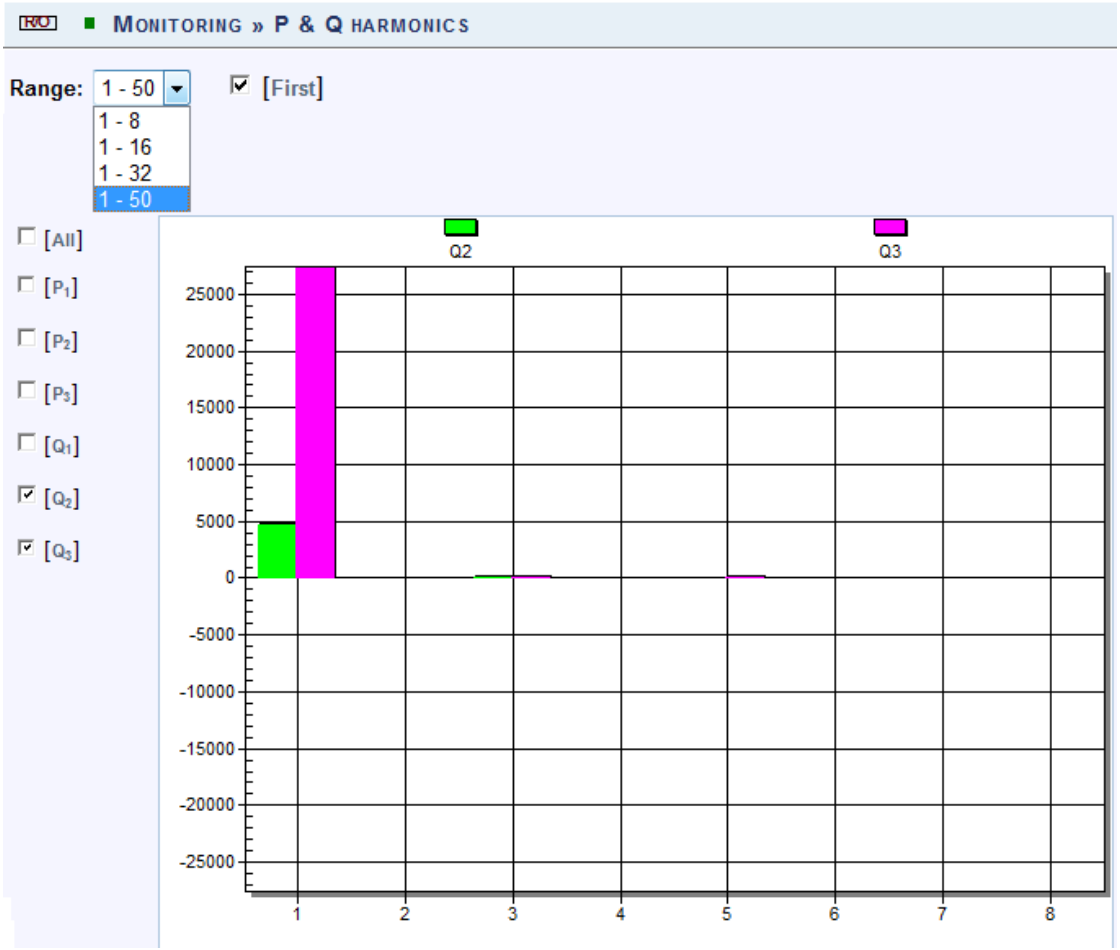
This window opens the Active & Reactive Harmonic Powers measured by your G4K Unit.

## OPEN THE P&Q HARMONICS WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **P&Q Harmonics:**




- The **P&Q Harmonics Window** will now open:



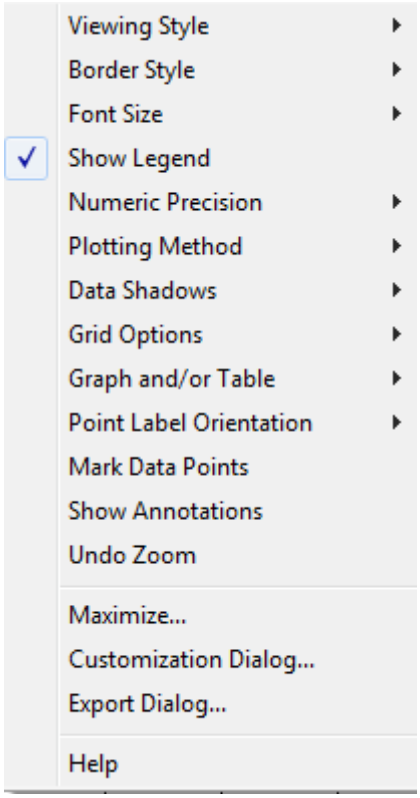

The table outlines the sections' Parameter options (for your selection) including their Definition:

| PARAMETER | DEFINITION |
|---|---|
| **RANGE** | |
| 1-8 | Select the number of harmonics to be displayed 1-8 |
| 1-16 | Select the number of harmonics to be displayed 1-16 |
| 1-32 | Select the number of harmonics to be displayed 1-32 |
| 1-50 | Select the number of harmonics to be displayed 1-50 |
| **OPTIONS** | |
| First | Select either Yes/No in order to display or not display the first harmonic |
| All | Checking the "All" will display all the channels |
| P1 | Checking the "P1" box will display the Active Power (P) of the first line |

| PARAMETER | DEFINITION |
|---|---|
| **OPTIONS** | |
| P2 | Checking the "P2" box will display the Active Power (P) of the second line |
| P3 | Checking the "P3" box will display the Active Power (P) of the third line |
| Q1 | Checking the "Q1" box will display the Reactive Power (Q) of the first line |
| Q2 | Checking the "Q2" box will display the Reactive Power (Q) of the second line |
| Q3 | Checking the "Q3" box will display the Reactive Power (Q) of the third line |

## CHART OPTIONS

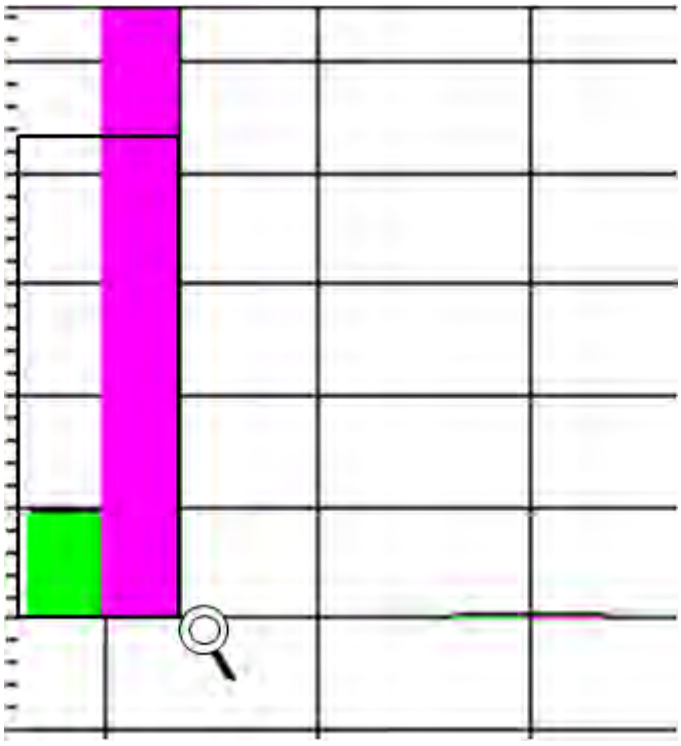
- By right-clicking on the chart you have various chart options & capabilities available to you:



- **Viewing Style:** Different styling options Color / Monochrome (B&W) with/without Symbols / Bitmap etc. By selecting the option you can view on screen the different styles available to you
- **Border Style:** No Border, Thin Line, Shadow / Inset
- **Font Size:** Large / Medium / Small
- **Display / Not display** Legend
- **Numeric Precision:** No up to 3 Decimals
- **Plotting Method:** From Line / Bar / Point / Area / Spline / Combinations
- **Data Shadows:** Off / Shadow / 3D
- **Grid Options:** Various grid options ranging from dots / lines / different axis etc.
- **Graph & Table:** Display either the graph / table / both:

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Q1 | -0.610 | 0.316 | 0.487 | -0.659 | -0.220 | 0.512 | -0.413 | -1.240 | -0.145 | 0.245 |
| Q2 | -0.514 | 0.270 | 0.245 | -0.586 | -0.219 | 0.391 | -0.075 | -0.516 | 0.097 | 0.195 |
| Q3 | -0.927 | 0.439 | 0.463 | -0.903 | -0.367 | 0.756 | -0.243 | -0.876 | 0.465 | 0.318 |
| QN. | | | | | | | | | | |

- **Point Label Orientation:** Auto / Vertical / Horizontal / Slanted
- **Mark Data Points:** Displays data points on graph
- **Show Annotations:** Displays annotations data descriptions
- **Zoom / Undo Zoom - Zoom in /out on your graph:**
  - From the main Waveform window, select an area to zoom in. Left-click and drag the mouse to define the area:

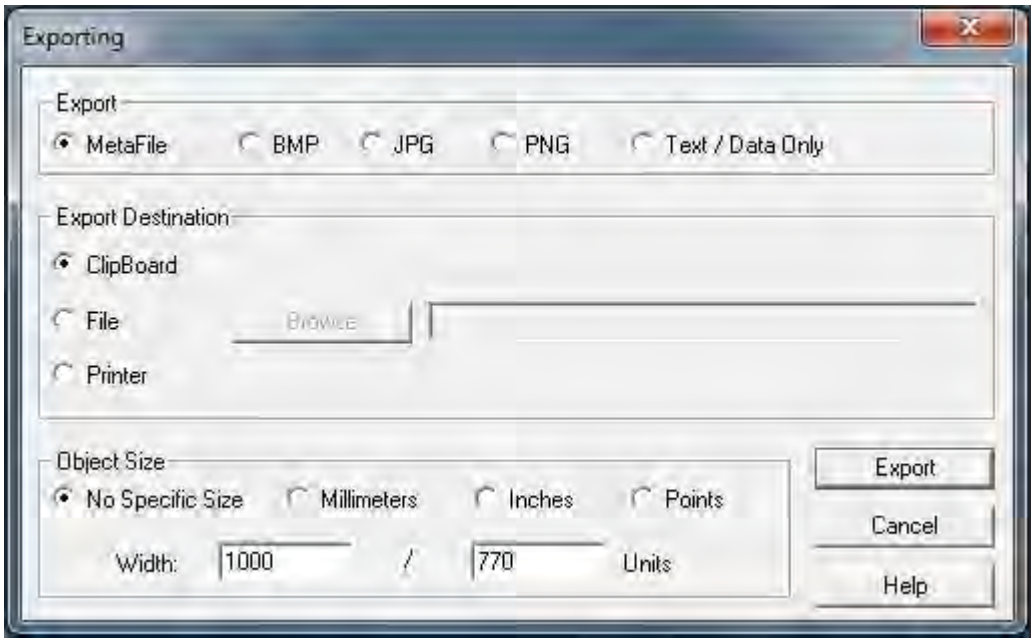


  - The enlarged area will now appear in the window

- Zoom out by right/click ➡ & select **Zoom out**

- **Maximize**: Maximize / Minimize graph
- **Customization Dialog - Various General Graph Customization Options** (all options apart from zooming above)**:**


- **Export Dialog - Various Export Options:**



## SEE ALSO

- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
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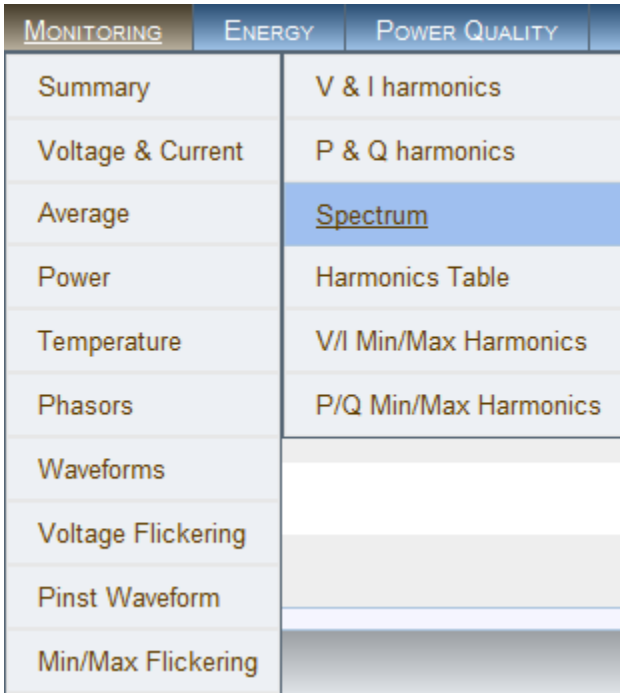
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Spectrum

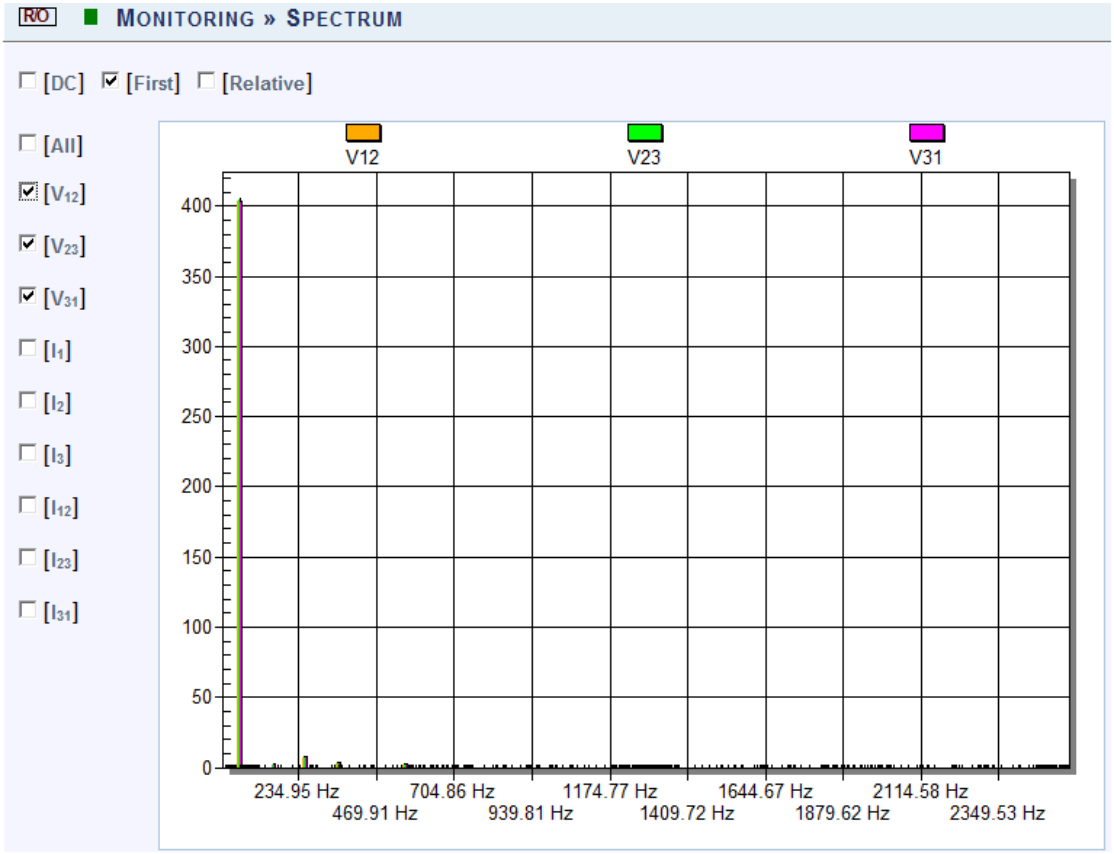
This window opens the Voltage & Current Sub & Inter-Harmonics measured by your G4K Unit.

## OPEN THE SPECTRUM WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Spectrum:**



- The **Spectrum Window** will now open:

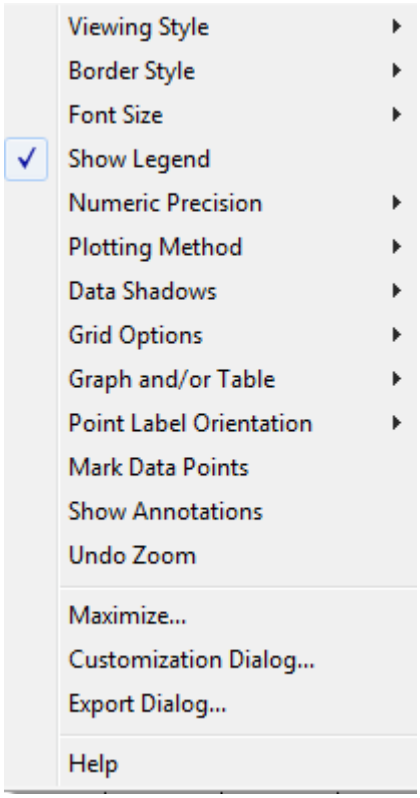



The table outlines the sections' Parameter options (for your selection) including their Definition:

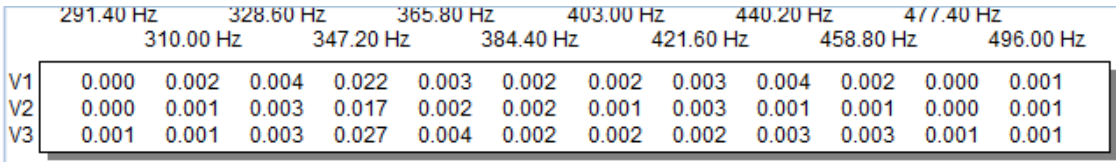
| PARAMETER | DEFINITION |
|---|---|
| DC | Check/Uncheck the checkbox in order to display/not display the DC Harmonics |
| First | Check/Uncheck the checkbox in order to display/not display the First Harmonic |
| Relative | Check/Uncheck the checkbox in order to display/not display the harmonics relative to the first harmonic (Whereas the first harmonic is 100, and the other harmonic values as part of the harmonic 100) |
| All | Checking the "All" will display all the channels |
| Voltage & Current | Select the applicable Voltage / Current channel to be displayed |

## CHART OPTIONS

- By right-clicking on the chart you have various chart options & capabilities available to you:



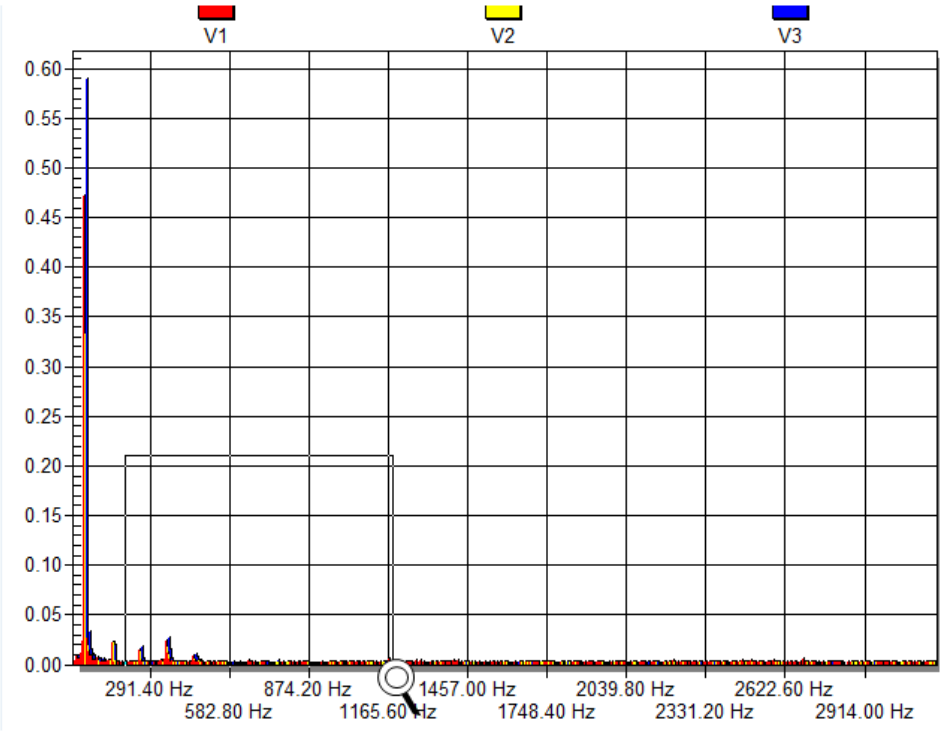

  - **Viewing Style:** Different styling options Color / Monochrome (B&W) with/without Symbols / Bitmap etc. By selecting the option you can view on screen the different styles available to you
  - **Border Style:** No Border, Thin Line, Shadow / Inset
  - **Font Size:** Large / Medium / Small
  - **Display / Not display** Legend
  - **Numeric Precision:** No up to 3 Decimals
  - **Plotting Method:** From Line / Bar / Point / Area / Spline / Combinations
  - **Data Shadows:** Off / Shadow / 3D
  - **Grid Options:** Various grid options ranging from dots / lines / different axis etc.
  - **Graph & Table:** Display either the graph / table / both:



| | 291.40 Hz | 310.00 Hz | 328.60 Hz | 347.20 Hz | 365.80 Hz | 384.40 Hz | 403.00 Hz | 421.60 Hz | 440.20 Hz | 458.80 Hz | 477.40 Hz | 496.00 Hz |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V1 | 0.000 | 0.002 | 0.004 | 0.022 | 0.003 | 0.002 | 0.002 | 0.003 | 0.004 | 0.002 | 0.000 | 0.001 |
| V2 | 0.000 | 0.001 | 0.003 | 0.017 | 0.002 | 0.002 | 0.001 | 0.003 | 0.001 | 0.001 | 0.000 | 0.001 |
| V3 | 0.001 | 0.001 | 0.003 | 0.027 | 0.004 | 0.002 | 0.002 | 0.002 | 0.003 | 0.003 | 0.001 | 0.001 |

  - **Point Label Orientation:** Auto / Vertical / Horizontal / Slanted
  - **Mark Data Points:** Displays data points on graph
  - **Show Annotations:** Displays annotations data descriptions

- From the main Waveform window, select an area to zoom in. Left-click and drag the mouse to define the area:



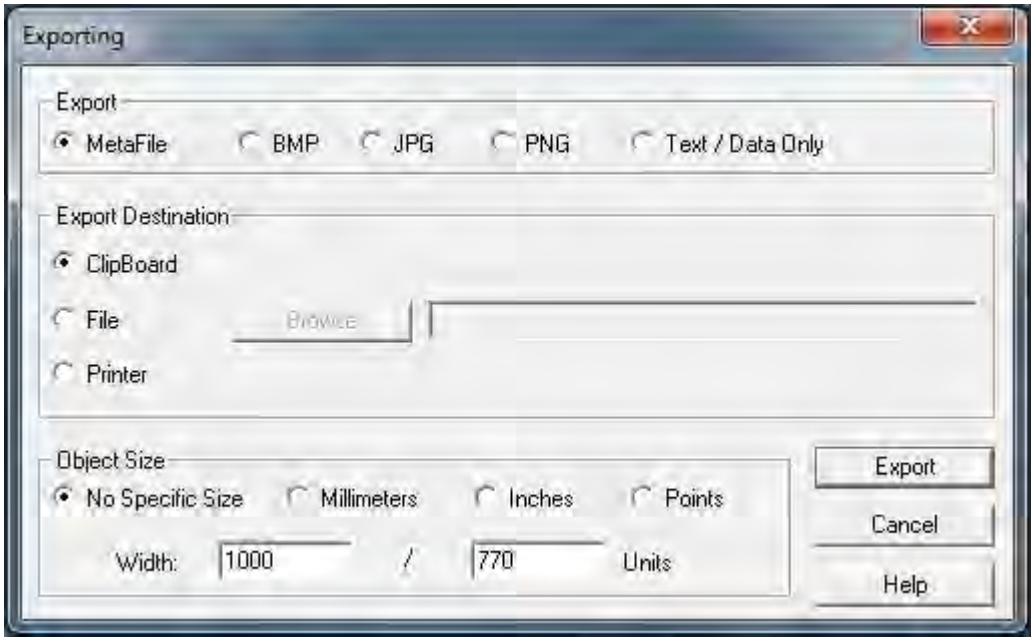

- The enlarged area will now appear in the window

- Zoom out by right/click & select **Zoom out**

- **Maximize**: Maximize / Minimize graph

- **Customization Dialog - Various General Graph Customization Options** (all options apart from zooming above)**:**

- **Export Dialog - Various Export Options:**




## SEE ALSO

- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
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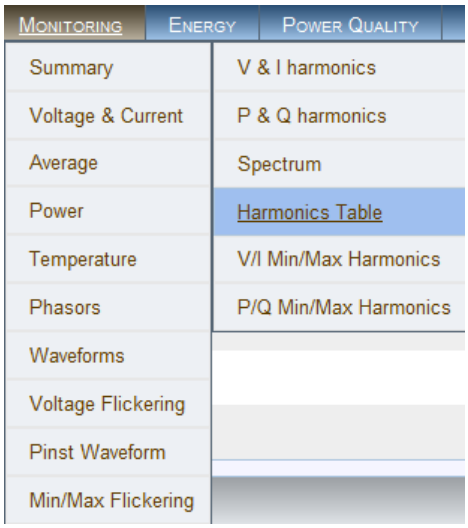
# Harmonics Table

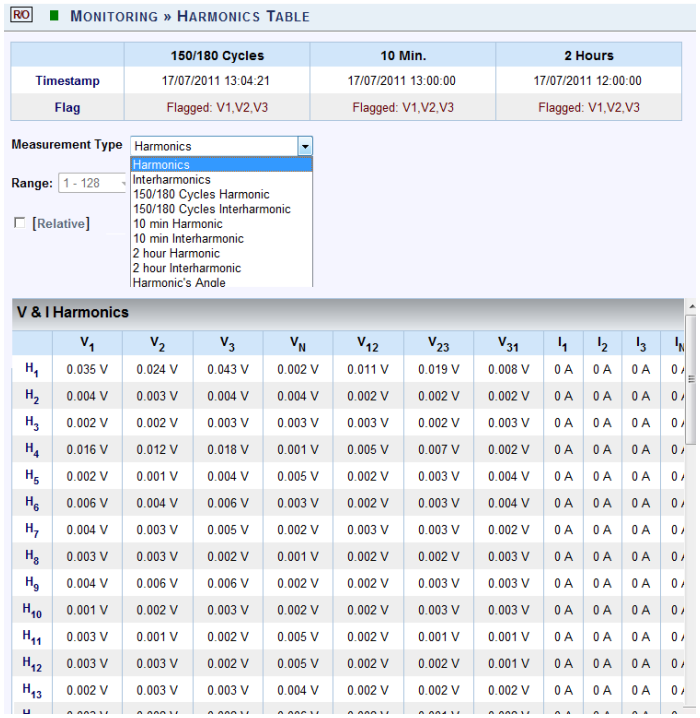
This page summarizes all the Voltage & Current Harmonics in either Value - Percentages or Angles - up to the 50th Harmonic.

## OPEN THE HARMONICS TABLE WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **Harmonics Table:**




- The **Harmonics Table Window** will now open:




| | $V_1$ | $V_2$ | $V_3$ | $V_N$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | $I_N$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $H_1$ | 0.035 V | 0.024 V | 0.043 V | 0.002 V | 0.011 V | 0.019 V | 0.008 V | 0 A | 0 A | 0 A | 0 A |
| $H_2$ | 0.004 V | 0.003 V | 0.004 V | 0.004 V | 0.002 V | 0.002 V | 0.002 V | 0 A | 0 A | 0 A | 0 A |
| $H_3$ | 0.002 V | 0.002 V | 0.003 V | 0.003 V | 0.003 V | 0.002 V | 0.003 V | 0 A | 0 A | 0 A | 0 A |
| $H_4$ | 0.016 V | 0.012 V | 0.018 V | 0.001 V | 0.005 V | 0.007 V | 0.002 V | 0 A | 0 A | 0 A | 0 A |
| $H_5$ | 0.002 V | 0.001 V | 0.004 V | 0.005 V | 0.002 V | 0.003 V | 0.004 V | 0 A | 0 A | 0 A | 0 A |
| $H_6$ | 0.006 V | 0.004 V | 0.006 V | 0.003 V | 0.002 V | 0.003 V | 0.004 V | 0 A | 0 A | 0 A | 0 A |
| $H_7$ | 0.004 V | 0.003 V | 0.005 V | 0.002 V | 0.003 V | 0.003 V | 0.002 V | 0 A | 0 A | 0 A | 0 A |
| $H_8$ | 0.003 V | 0.003 V | 0.002 V | 0.001 V | 0.002 V | 0.002 V | 0.003 V | 0 A | 0 A | 0 A | 0 A |
| $H_9$ | 0.004 V | 0.006 V | 0.006 V | 0.002 V | 0.002 V | 0.003 V | 0.003 V | 0 A | 0 A | 0 A | 0 A |
| $H_{10}$ | 0.001 V | 0.002 V | 0.003 V | 0.002 V | 0.002 V | 0.003 V | 0.003 V | 0 A | 0 A | 0 A | 0 A |
| $H_{11}$ | 0.003 V | 0.001 V | 0.002 V | 0.005 V | 0.002 V | 0.001 V | 0.001 V | 0 A | 0 A | 0 A | 0 A |
| $H_{12}$ | 0.003 V | 0.003 V | 0.002 V | 0.005 V | 0.002 V | 0.002 V | 0.001 V | 0 A | 0 A | 0 A | 0 A |
| $H_{13}$ | 0.002 V | 0.003 V | 0.003 V | 0.004 V | 0.002 V | 0.002 V | 0.002 V | 0 A | 0 A | 0 A | 0 A |

The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| Timestamp | Indicates the timestamps of the last averaging intervals |
| Flag | Indicates whether or not the last interval is valid according to the set standard |
| **MEASUREMENT TYPE** | |
| Harmonics | Real time (10/12 cycles) calculation of sub group harmonics, in accordance with IEC61000-4-7: $G_{sg,n}^2 = \sum_{i=1}^{1} C_{k+i}^2$ |
| Interharmonics | Real time (10/12 cycles) calculation of inter sub group harmonics, in accordance with IEC61000-4-7 |
| 150/180 Cycles Harmonic | 150/180 Cycle averaging of the sub group harmonics |
| **MEASUREMENT TYPE** | |
| 150/180 Cycles Interharmonic | 150/180 Cycle averaging of the inter sub group harmonics |
| 10 Min Harmonic | 10 Minutes averaging of the sub group harmonics |
| 10 Min Interharmonic | 10 Minutes averaging of the inter sub group harmonics |
| 2 Hour Harmonic | 2 Hours averaging of the 10 minutes averaging of the sub group harmonics |
| 2 Hour Interharmonic | 2 Hours averaging of the 10 minutes averaging of the inter sub group harmonics |
| Harmonic's Angle | The angle of each harmonic based on the real time value |

| PARAMETER | DEFINITION |
|---|---|
| **RANGE** | |
| 1-128 | Select the number of harmonics to be displayed 1-128 |
| 129-256 | Select the number of harmonics to be displayed 129-256 |
| 257-384 | Select the number of harmonics to be displayed 257-384 |
| 1-50 | Select the number of harmonics to be displayed 285-511 |
| **OPTIONS** | |
| First | Check/Uncheck the checkbox in order to display/not display the First Harmonic |
| Relative | Check/Uncheck the checkbox in order to display/not display the harmonics relative to the first harmonic (Whereas the first harmonic is 100, and the other harmonic values as part of the harmonic 100) |
| All | Checking the "All" will display all the channels |
| Voltage & Current | Select the applicable Voltage / Current channel to be displayed |

## SEE ALSO

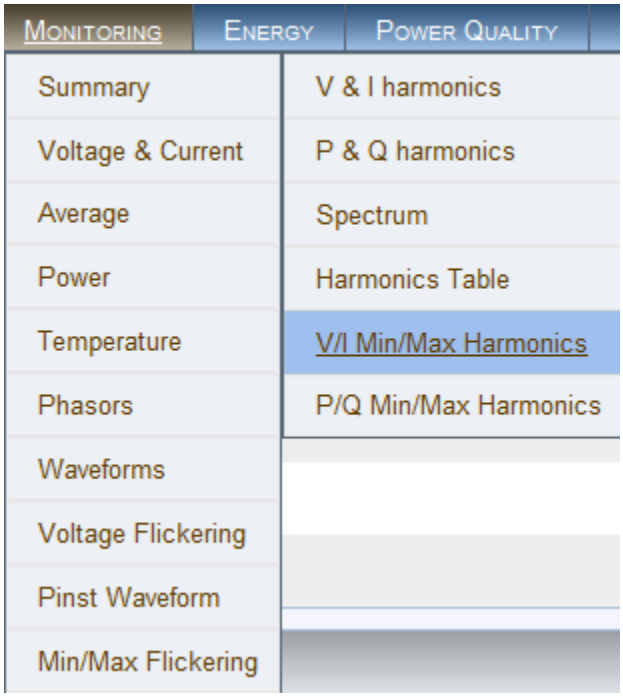
- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Voltage & Current, Min & Max Harmonics Table
- PQ Min & Maximum Harmonics

# Voltage & Current, Min & Max Harmonics Table

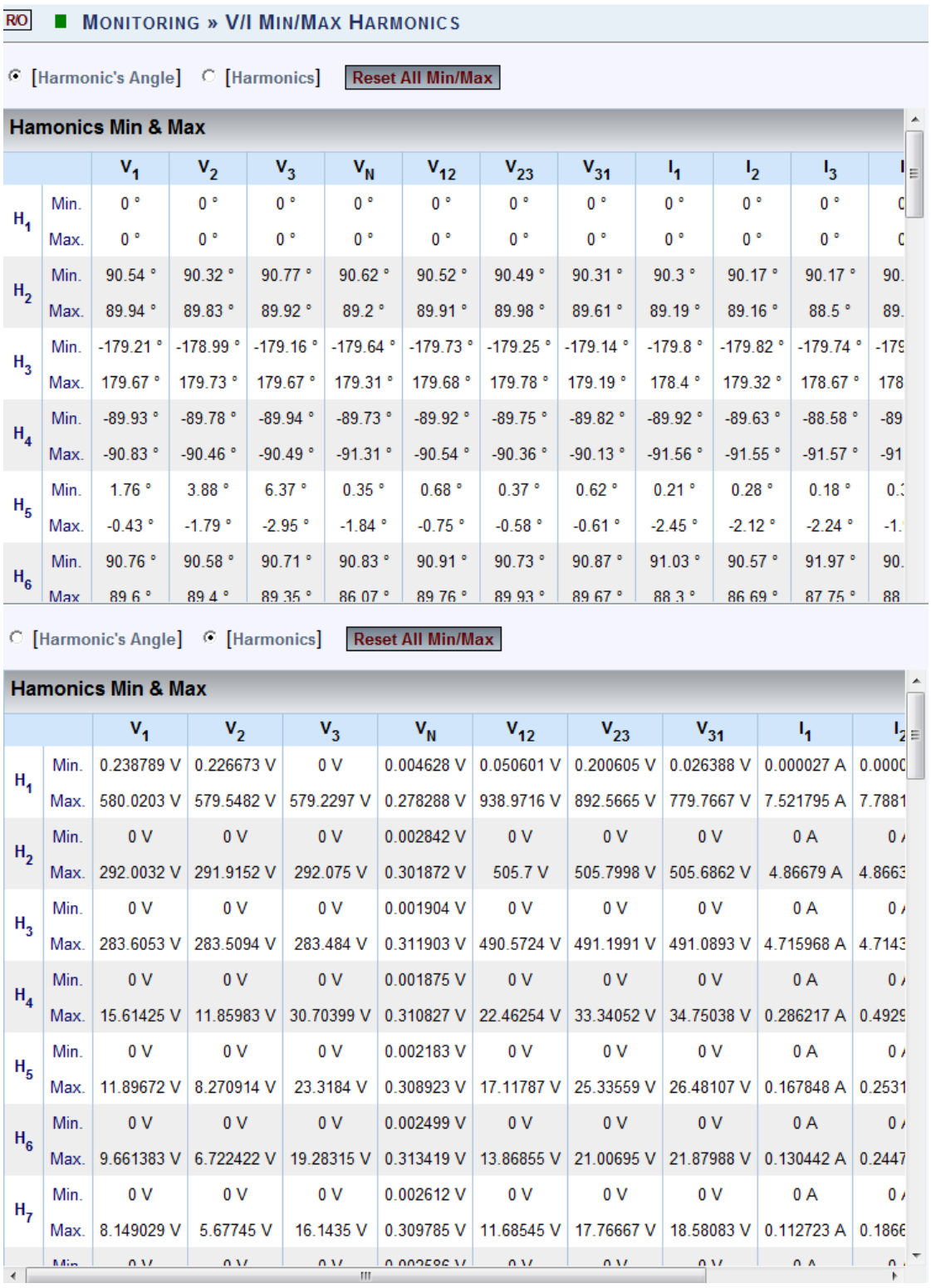
For each Harmonic, there is a Minimum & Maximum value for Voltage & Current. Voltage values are seen as phase to phase, while currents are displayed in both phase to neutral and phase to phase combinations. This page summarizes all the minimum Voltage & Current Harmonics Values.

## OPEN THE V/I MIN/MAX HARMONICS WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **V/I Min/Max Harmonics:**



- The window containing the table for **V/I Min/Max Harmonics** values will now open:



R/O ■ MONITORING » V/I MIN/MAX HARMONICS

[Harmonic's Angle] [Harmonics] Reset All Min/Max

**Hamonics Min & Max**

| | | $V_1$ | $V_2$ | $V_3$ | $V_N$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ | $I_3$ | I |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $H_1$ | Min. | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 |
| | Max. | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 ° | 0 |
| $H_2$ | Min. | 90.54 ° | 90.32 ° | 90.77 ° | 90.62 ° | 90.52 ° | 90.49 ° | 90.31 ° | 90.3 ° | 90.17 ° | 90.17 ° | 90. |
| | Max. | 89.94 ° | 89.83 ° | 89.92 ° | 89.2 ° | 89.91 ° | 89.98 ° | 89.61 ° | 89.19 ° | 89.16 ° | 88.5 ° | 89. |
| $H_3$ | Min. | -179.21 ° | -178.99 ° | -179.16 ° | -179.64 ° | -179.73 ° | -179.25 ° | -179.14 ° | -179.8 ° | -179.82 ° | -179.74 ° | -179 |
| | Max. | 179.67 ° | 179.73 ° | 179.67 ° | 179.31 ° | 179.68 ° | 179.78 ° | 179.19 ° | 178.4 ° | 179.32 ° | 178.67 ° | 178 |
| $H_4$ | Min. | -89.93 ° | -89.78 ° | -89.94 ° | -89.73 ° | -89.92 ° | -89.75 ° | -89.82 ° | -89.92 ° | -89.63 ° | -88.58 ° | -89 |
| | Max. | -90.83 ° | -90.46 ° | -90.49 ° | -91.31 ° | -90.54 ° | -90.36 ° | -90.13 ° | -91.56 ° | -91.55 ° | -91.57 ° | -91 |
| $H_5$ | Min. | 1.76 ° | 3.88 ° | 6.37 ° | 0.35 ° | 0.68 ° | 0.37 ° | 0.62 ° | 0.21 ° | 0.28 ° | 0.18 ° | 0. |
| | Max. | -0.43 ° | -1.79 ° | -2.95 ° | -1.84 ° | -0.75 ° | -0.58 ° | -0.61 ° | -2.45 ° | -2.12 ° | -2.24 ° | -1. |
| $H_6$ | Min. | 90.76 ° | 90.58 ° | 90.71 ° | 90.83 ° | 90.91 ° | 90.73 ° | 90.87 ° | 91.03 ° | 90.57 ° | 91.97 ° | 90. |
| | Max. | 89.6 ° | 89.4 ° | 89.35 ° | 86.07 ° | 89.76 ° | 89.93 ° | 89.67 ° | 88.3 ° | 86.69 ° | 87.75 ° | 88 |

[Harmonic's Angle] [Harmonics] Reset All Min/Max

**Hamonics Min & Max**

| | | $V_1$ | $V_2$ | $V_3$ | $V_N$ | $V_{12}$ | $V_{23}$ | $V_{31}$ | $I_1$ | $I_2$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $H_1$ | Min. | 0.238789 V | 0.226673 V | 0 V | 0.004628 V | 0.050601 V | 0.200605 V | 0.026388 V | 0.000027 A | 0.0000 |
| | Max. | 580.0203 V | 579.5482 V | 579.2297 V | 0.278288 V | 938.9716 V | 892.5665 V | 779.7667 V | 7.521795 A | 7.7881 |
| $H_2$ | Min. | 0 V | 0 V | 0 V | 0.002842 V | 0 V | 0 V | 0 V | 0 A | 0 A |
| | Max. | 292.0032 V | 291.9152 V | 292.075 V | 0.301872 V | 505.7 V | 505.7998 V | 505.6862 V | 4.86679 A | 4.8663 |
| $H_3$ | Min. | 0 V | 0 V | 0 V | 0.001904 V | 0 V | 0 V | 0 V | 0 A | 0 A |
| | Max. | 283.6053 V | 283.5094 V | 283.484 V | 0.311903 V | 490.5724 V | 491.1991 V | 491.0893 V | 4.715968 A | 4.7143 |
| $H_4$ | Min. | 0 V | 0 V | 0 V | 0.001875 V | 0 V | 0 V | 0 V | 0 A | 0 A |
| | Max. | 15.61425 V | 11.85983 V | 30.70399 V | 0.310827 V | 22.46254 V | 33.34052 V | 34.75038 V | 0.286217 A | 0.4929 |
| $H_5$ | Min. | 0 V | 0 V | 0 V | 0.002183 V | 0 V | 0 V | 0 V | 0 A | 0 A |
| | Max. | 11.89672 V | 8.270914 V | 23.3184 V | 0.308923 V | 17.11787 V | 25.33559 V | 26.48107 V | 0.167848 A | 0.2531 |
| $H_6$ | Min. | 0 V | 0 V | 0 V | 0.002499 V | 0 V | 0 V | 0 V | 0 A | 0 A |
| | Max. | 9.661383 V | 6.722422 V | 19.28315 V | 0.313419 V | 13.86855 V | 21.00695 V | 21.87988 V | 0.130442 A | 0.2447 |
| $H_7$ | Min. | 0 V | 0 V | 0 V | 0.002612 V | 0 V | 0 V | 0 V | 0 A | 0 A |
| | Max. | 8.149029 V | 5.67745 V | 16.1435 V | 0.309785 V | 11.68545 V | 17.76667 V | 18.58083 V | 0.112723 A | 0.1866 |

The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| Harmonics Angle | Check in order to display the Min/Max value of the Harmonics Angle |
| Harmonics Value | Check in order to display the Min/Max value of the Harmonics Value (amplitude) |
| Reset All Min/Max | Reset all Min/Max measurements of your G4K Unit |

## SEE ALSO

- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- PQ Min & Maximum Harmonics

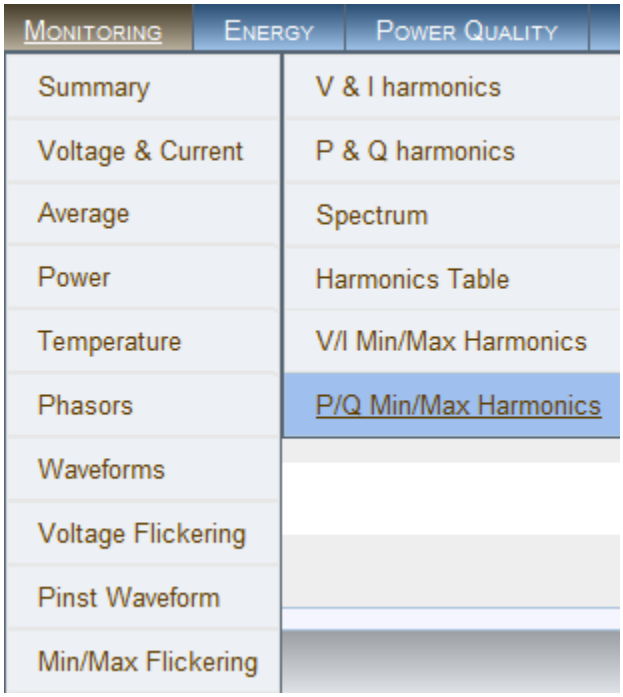
# PQ Min & Maximum Harmonics

This page summarizes all the minimum & maximum Active & Reactive Power Harmonic Values per phase, up to the 50th Harmonic.

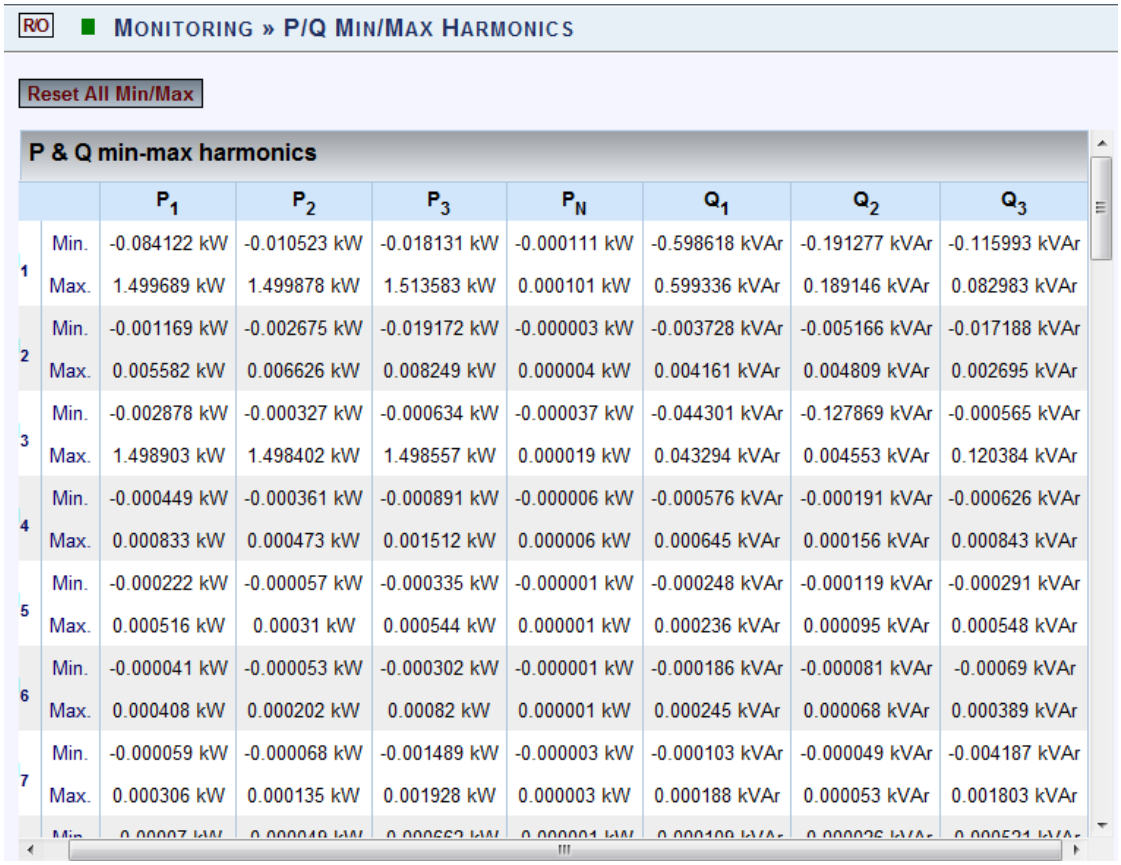
- (P) = Active Power Harmonic Values
- (Q) = Reactive Power Harmonic Values

## OPEN THE P/Q MIN/MAX HARMONICS WINDOW

- Access your G4K Unit via the Web Interface ➡ select **Monitoring** ➡ **P/Q Min/Max Harmonics:**



- The window containing the table for **P/Q Min/Max Harmonics** values will now open:




| | | $P_1$ | $P_2$ | $P_3$ | $P_N$ | $Q_1$ | $Q_2$ | $Q_3$ |
|---|---|---|---|---|---|---|---|---|
| 1 | Min. | -0.084122 kW | -0.010523 kW | -0.018131 kW | -0.000111 kW | -0.598618 kVAr | -0.191277 kVAr | -0.115993 kVAr |
| | Max. | 1.499689 kW | 1.499878 kW | 1.513583 kW | 0.000101 kW | 0.599336 kVAr | 0.189146 kVAr | 0.082983 kVAr |
| 2 | Min. | -0.001169 kW | -0.002675 kW | -0.019172 kW | -0.000003 kW | -0.003728 kVAr | -0.005166 kVAr | -0.017188 kVAr |
| | Max. | 0.005582 kW | 0.006626 kW | 0.008249 kW | 0.000004 kW | 0.004161 kVAr | 0.004809 kVAr | 0.002695 kVAr |
| 3 | Min. | -0.002878 kW | -0.000327 kW | -0.000634 kW | -0.000037 kW | -0.044301 kVAr | -0.127869 kVAr | -0.000565 kVAr |
| | Max. | 1.498903 kW | 1.498402 kW | 1.498557 kW | 0.000019 kW | 0.043294 kVAr | 0.004553 kVAr | 0.120384 kVAr |
| 4 | Min. | -0.000449 kW | -0.000361 kW | -0.000891 kW | -0.000006 kW | -0.000576 kVAr | -0.000191 kVAr | -0.000626 kVAr |
| | Max. | 0.000833 kW | 0.000473 kW | 0.001512 kW | 0.000006 kW | 0.000645 kVAr | 0.000156 kVAr | 0.000843 kVAr |
| 5 | Min. | -0.000222 kW | -0.000057 kW | -0.000335 kW | -0.000001 kW | -0.000248 kVAr | -0.000119 kVAr | -0.000291 kVAr |
| | Max. | 0.000516 kW | 0.00031 kW | 0.000544 kW | 0.000001 kW | 0.000236 kVAr | 0.000095 kVAr | 0.000548 kVAr |
| 6 | Min. | -0.000041 kW | -0.000053 kW | -0.000302 kW | -0.000001 kW | -0.000186 kVAr | -0.000081 kVAr | -0.00069 kVAr |
| | Max. | 0.000408 kW | 0.000202 kW | 0.00082 kW | 0.000001 kW | 0.000245 kVAr | 0.000068 kVAr | 0.000389 kVAr |
| 7 | Min. | -0.000059 kW | -0.000068 kW | -0.001489 kW | -0.000003 kW | -0.000103 kVAr | -0.000049 kVAr | -0.004187 kVAr |
| | Max. | 0.000306 kW | 0.000135 kW | 0.001928 kW | 0.000003 kW | 0.000188 kVAr | 0.000053 kVAr | 0.001803 kVAr |

The table outlines the sections' Parameters including Definition:

| PARAMETER | DEFINITION |
|---|---|
| P1 | Displays the Active Power (P) of the first line |
| P2 | Displays the Active Power (P) of the second line |
| P3 | Displays the Active Power (P) of the third line |
| Q1 | Displays the Reactive Power (Q) of the first line |
| Q2 | Displays the Reactive Power (Q) of the second line |
| Q3 | Displays the Reactive Power (Q) of the third line |
| Reset All Min/Max | Reset all Min/Max measurements of your G4K Unit |

## SEE ALSO

- Monitoring Real-Time Data
- Voltage & Current Measurements
- Average
- Power
- Temperature
- Phasors
- Waveforms
- Voltage Flickering
- Pinst Waveform
- Minimum / Maximum Flickering
- Voltage & Current Harmonics
- P & Q Harmonics
- Spectrum
- Harmonics Table
- Voltage & Current, Min & Max Harmonics Table

# About Power Quality Monitoring

The BLACKBOX contains a power quality compliance engine that enables real-time evaluation of power quality according to standards such as EN50160. Power Quality (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 the way a specific PQ parameter is being measured or observed. The PQ Engine also supports a mode that can be customized by the user, in which all compliance parameters can be self-edited and modified in order to meet new conditions, rules, measuring intervals, and even different observation periods.

The Power Quality section in Elspec's Web Interface is used to control and view power quality measurement and compliance information computed by the PQ Engine that includes:

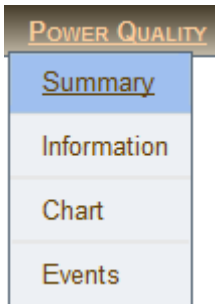
- View & Evaluate Summary of the Compliance Engine
- View Detailed Compliance Information
- View Graphical Bars of Compliance Levels
- Set & View Log of Events

# PQ Compliance Summary

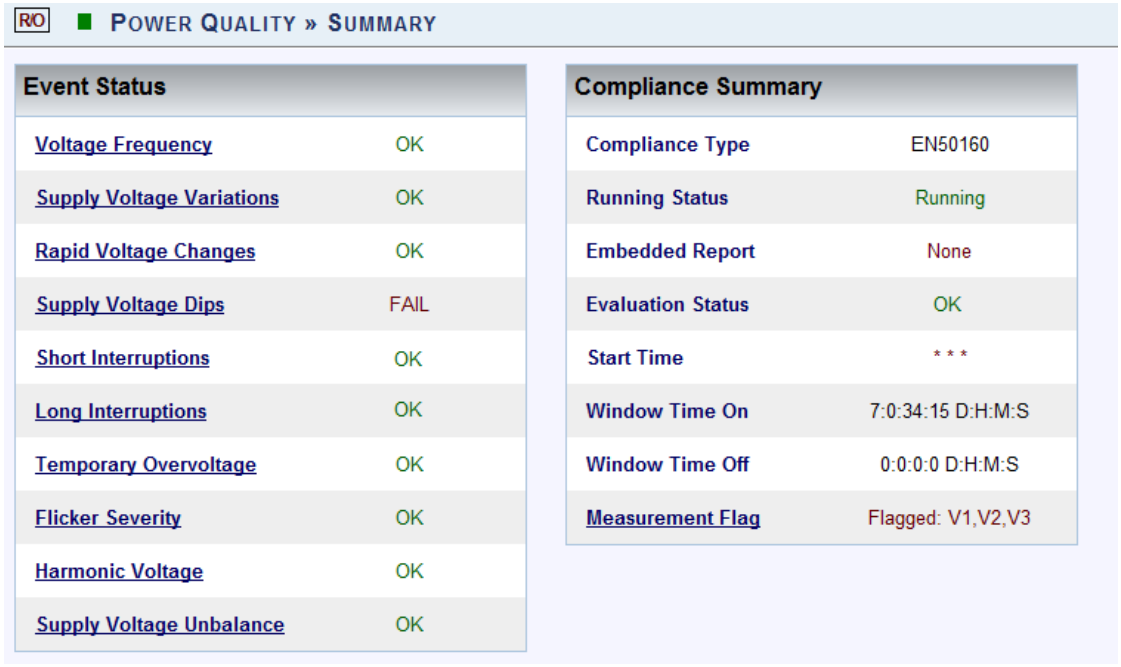
In this window you are able to review the specific **Compliance Standard & Status** that is being evaluated by your G4K Unit's Internal Compliance Engine.

## OPEN THE COMPLIANCE SUMMARY WINDOW

- Access your G4K Unit ➡ log on as the **Viewer/Administrator** ➡ under **Power Quality** ➡ open the **Summary Tab**:




- The **Summary** window will now open:



## EVENT STATUS SECTION

The Events 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). The definitions defined below are PQ Parameters Configured as per EN50160 compliance. You may choose any other PQ Compliance or set your own Unique PQ Compliance:

- **Voltage Frequency OK/FAIL:** Frequency compliance is based on statistics: N, N1 & N2. Frequency measurement interval is 10 sec. in an entire observation window of 1 week. N - amount of intervals. N1 - intervals frequency exceeded [+1.00%,-1.00%] from Nominal Frequency. N2 - intervals frequency exceeded [+4.00%,-6.00%] from Nominal Frequency. N1 & N2 increment only if valid voltage inside nominal boundary of [+15.0%,-15.0%]. Compliance if both N1/N <= 5% of time & N2=0 of time. Intervals with voltage interruption are discarded. Intervals with DIPS or Over voltage are discarded.
- **Supply Voltage Variations OK/FAIL:** Variations are evaluated by collecting statistics: N, N1 & N2. Statistics are collected as average voltage within intervals of 10 min. in observation window of 1 week. N - amount of intervals. N1 - intervals voltage exceeded [+10.0%,-10.0%] boundary of nominal. N2 - intervals voltage exceeded [+15.0%,-15.0%] boundary of nominal. Compliance if N1/N <=5% & N2=0 during the entire observation window. Intervals with voltage interruption are discarded. Intervals with DIPS or OVER Voltage are discarded.
- **Rapid Voltage Changes OK/FAIL:** Rapid voltage change is based on a 3 sec. window in which RMS voltage minimum & maximum values are obtained (minimum/maximum values should be within +-10.0% from nominal). The rapid change is the percent of delta between minimum & maximum divided by average RMS of 9 sec. The Rapid percent results are evaluated during observation window of 1 week. Rapid changes are limited to specific count (N): Rapids of more 5.00% allowed: N <= 65536 occurrences.
- **Supply Voltage Dips OK/FAIL:** DIP is a voltage drop of more than 10.0% from Nominal (but no more than 100.0%, & deactivate on 8.0%) DIP minimum time is 10 ms. & maximum time of 1 min. DIP events are counted per all phases combined within observation window of 1 week. Total events (N) allowed is: 20.
- **Short Interruptions OK/FAIL:** Short interruption is a voltage drop of less than 97.0% from nominal (event deactivate on 77.6%). Min duration 10 ms., Max duration 3 min. events are counted in the entire observation window of 1 week. Total events (N) allowed is: 2.
- **Long Interruptions OK/FAIL:** Long interruptions are the same as short ones but with a longer duration (longer than short interruption maximum time).

Long interruptions events are counted within observation window of 1 week. Total events (N) allowed is: 1.

- **Temporary Overvoltage OK/FAIL:** Over-voltage events are characterized with RMS voltage higher than 110.0% above Nominal (event deactivate on 108.0%). Minimum over-voltage event duration is 10 ms., events are counted per all phases combined within observation window of 1 week. No specific events count limitation is defined.
- **Flicker Severity OK/FAIL:** Flicker severity is evaluated within observation window of 1 week. During interruption Flicker interval is discarded. During DIPS or Over voltage Flicker Interval is discarded. Plt (2 hours) must be equal or under 1.0 during 95.0% of observation time.
- **Harmonic Voltage OK/FAIL:** Harmonics evaluated at intervals of 10 min. within observation window of 1 week. Evaluation at intervals in which voltage is inside nominal boundary of [+15.0%,-15.0%]. Discarding Intervals with VOLT-INT. Discarding Intervals with DIPS or OVER-VOLT. Individual Harmonics are limited according to the following table: H2<=2.0%, H3<=5.0%, H4<=1.0%, H5<=6.0%, H6<=0.5%, H7<=5.0%, H8<=0.5%, H9<=1.5%, H10<=0.5%, H11<=3.5%, H12 <=0.5%, H13<=3.0%, ... THD limit is set 8.0% (N2). THD and Harmonics limits shall be kept at least 95.0% of time.
- **Supply Voltage Unbalance OK/FAIL:** Voltage unbalance is evaluated at intervals of 10 min. within observation window of 1 week. Evaluation is only at intervals in which voltage is inside nominal boundary of [+15.0%,-15.0%]. Unbalance limit N1 is set to 2.00% and must be kept 95.0% of observation time. Intervals with voltage interruption are discarded. Intervals with DIPS or Over voltage are discarded.

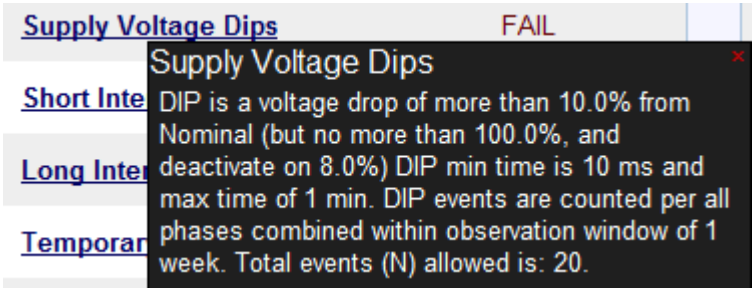
## COMPLIANCE SUMMARY SECTION

- **The Compliance Type** is configured when setting your Instrument in PQ Compliance Configuration.
- **Running Status** means whether or not the G4K's Power Quality engine is evaluating the power quality according to the Configured PQ Compliance.
- **The Embedded Report** field further indicates a type of report that is auto-generated internally in the device's file system. Most compliance types do not generate any specific report, & 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 Evaluation Status** field provides an overall status of PASS or FAIL of the entire compliance. Anytime the evaluation period is not complete (typically required is a 1 week observation), the status will be **N/A** (Not Available), otherwise PASS will be indicated as **OK.**

- **The Start Time** field shows the last time the compliance engine was restarted. The entire state & observation window history is stored on the internal non-volatile memory, so even after powering down; the Engine will continue its evaluation & 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 & **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 & 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 used for calculations.
- **The Measurement Flag** field indicates whether there is a power quality event such as a **DIP/SWELL** or **INTERRUPTION** at the moment.

## *NOTE NOTE NOTE*

All underlined parameters are accompanied by a Tool Tip, Right-click on the command to open the Tool Tip & x to close the Pop-up:




## SEE ALSO:

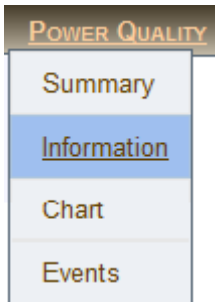
- About Power Quality Monitoring
- Compliance Information
- Compliance Chart
- Events
- PQ Compliance Configuration

# Compliance Information

This window contains detailed compliance information.

## ACCESS THE COMPLIANCE INFORMATION WINDOW

- Access your G4K Unit ➡ log on as the **Viewer/Administrator** ➡ under **Summary** ➡ open the **Information Tab**:




- The **Information** window will now open:

RO ■ POWER QUALITY » INFORMATION

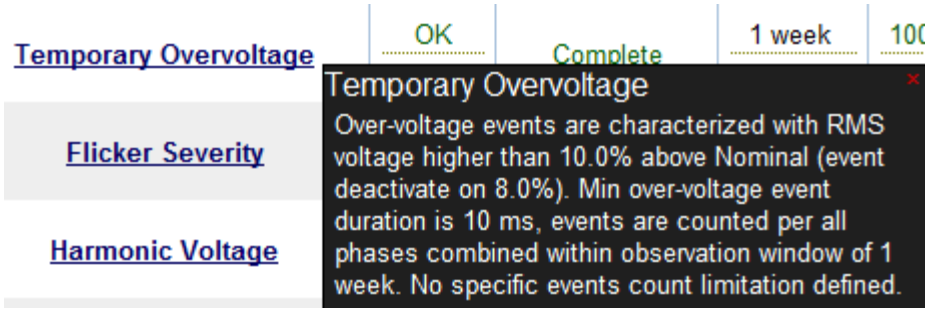
**Detailed Compliance Info** — Compliance Status: Running

| | Status<br>Partial | Observation | Window<br>Interval | Time OK<br>Time Fail | Time N/A | Total Events |
|---|---|---|---|---|---|---|
| Voltage Frequency | OK<br>OK | Complete | 1 week<br>10 sec | 100.000 %<br>0.0000 % | 0.0000 % | 0 |
| Supply Voltage Variations | OK<br>OK | Complete | 1 week<br>10 min | 100.000 %<br>0.0000 % | 0.0000 % | 0 |
| Rapid Voltage Changes | OK<br>OK | Complete | 1 week<br>3 sec | 100.000 %<br>0.0000 % | 0.0000 % | 0 |
| Supply Voltage Dips | FAIL<br>OK | Complete | 1 week<br>10 ms | 97.647 %<br>2.3529 % | 0.0000 % | 4583 |
| Short Interruptions | FAIL<br>OK | Complete | 1 week<br>10 ms | 96.498 %<br>3.5021 % | 0.0000 % | 5 |
| Long Interruptions | FAIL<br>OK | Complete | 1 week<br>10 ms | 97.675 %<br>2.3253 % | 0.0000 % | 2 |
| Temporary Overvoltage | OK<br>OK | Complete | 1 week<br>10 ms | 100.000 %<br>0.0000 % | 0.0000 % | 10623 |
| Flicker Severity | OK<br>OK | Complete | 1 week<br>10 min | 100.000 %<br>0.0000 % | 0.0000 % | 0 |
| Harmonic Voltage | OK<br>OK | Complete | 1 week<br>10 min | 100.000 %<br>0.0000 % | 0.0000 % | 0 |
| Supply Voltage Unbalance | OK<br>OK | Complete | 1 week<br>10 min | 100.000 %<br>0.0000 % | 0.0000 % | 0 |

- **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 serves as real-time indicator & typically reflects to only minutes to a few hours of history (this is dependent on the specific PQ parameter measurement' intervals & method).
- **Observation:** Indicates whether the observation of a specific PQ parameter is complete.
- **Window/Interval:** *Upper Area* - Provides the observation window time (contains historical data used for the calculations). You may uniquely set the observation period in User Defined Pages (Options - 1 or 2 Hours, or 1 Day, or 1 Week, or 1 Year). *Lower Area* – Provides the measurement interval time or parameter resolution that falls within the observation window (the measured time length for the PQ parameter). The interval may also be set in User Defined Pages (Options - 1, 3, 10 or 20 seconds, or 1, 3, 10 or 30 minutes, or 1, or 2 Hours, or 1 Day). If you configure your PQ Compliance to a set standard (i.e. EN50160), the Observation Window & Interval Time will be calculated according to the standard.
- **Time OK/Time FAIL:** provides the percentage of time the PQ parameter was OK (as green text on the upper area) & percentage of time the PQ parameter was outside the defined limits or FAILED (as red text in the lower area) for the entire observation period (Observation Window). Example as per the Information Window: if Voltage Dips was observed for a period of 1 week at a resolution of 10 ms (interval), the PQ parameter was OK for 97.647% & FAILED for 2.352% of the time (observation week). It should not be confused to the lower area on the previous column.
- **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.

## *NOTE NOTE NOTE*

All u nderlined  parameters ar e ac companied b y a T  ool T ip, R ight-click o n t he command to open the Tool Tip & x to close the Pop-up:




## SEE ALSO:

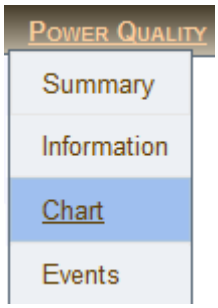
- About Power Quality Monitoring
- PQ Compliance Summary
- Compliance Chart
- Events
- PQ Compliance Configuration

# Compliance Chart

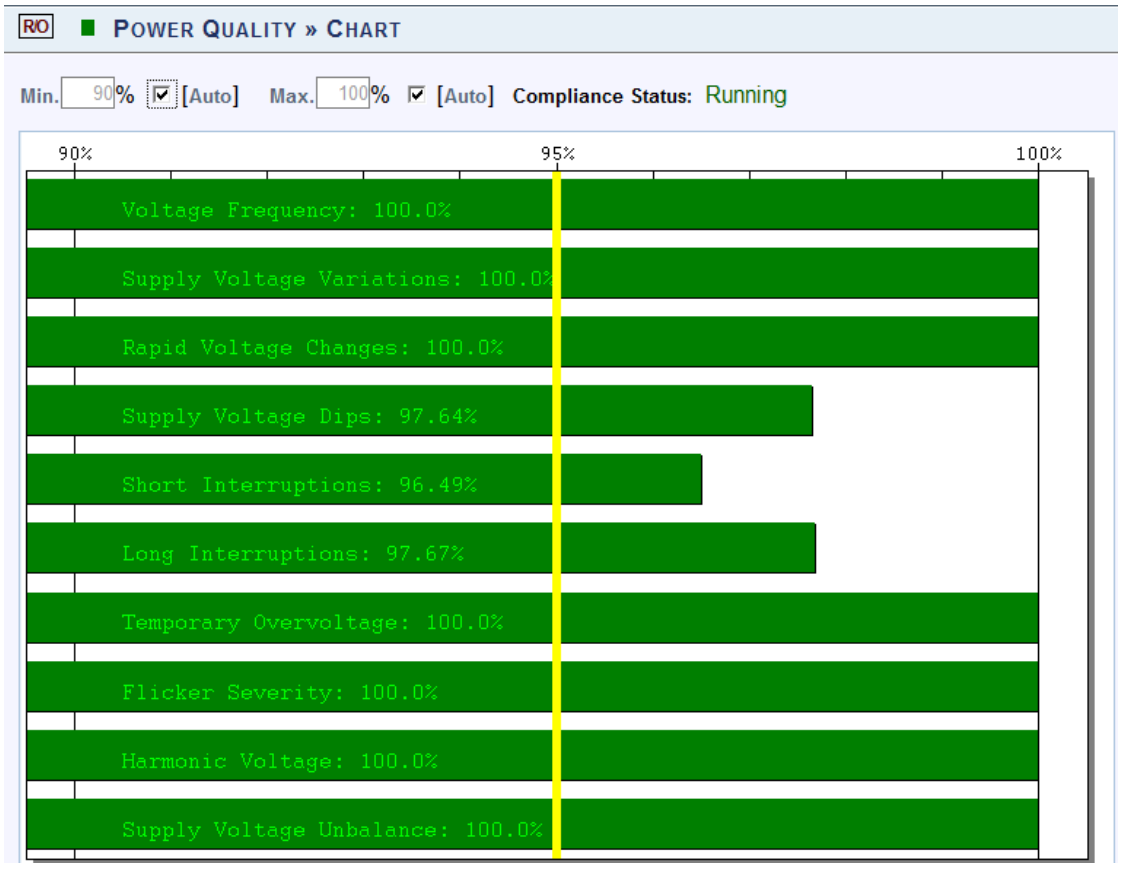
This page displays graphical bars of compliance levels (equals to percentage of time OK).

## ACCESS THE COMPLIANCE CHART WINDOW

- Access your G4K Unit ➡ log on as the **Viewer/Administrator** ➡ under **Power Quality** ➡ open the **Chart Tab**:




- The **Compliance Chart** window will now open:

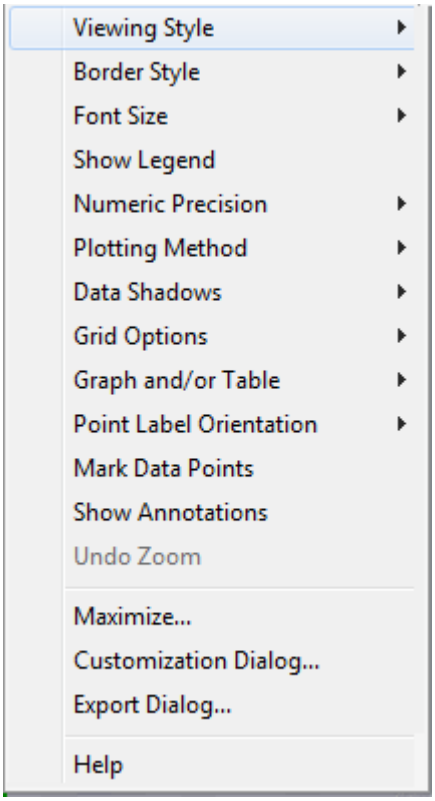



- The minimum and maximum values in the chart may be configured by deselecting **Auto** for each value (Default = 90% Min / 100% Max)

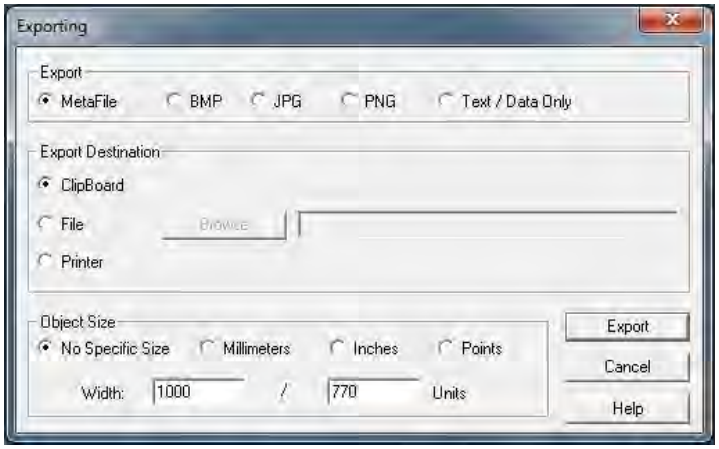
## CHART OPTIONS

As the Compliance Chart is intended to be used only as a chart & regardless that all the options are displayed, only certain options & capabilities are available for the Compliance Chart.

- Right-click on the chart to access the options:




- You may use the following chart options & capabilities:
  - **Viewing Style:** Different styling options Color / Monochrome (B&W) with/without Symbols / Bitmap etc. By selecting the option you can view on screen the different styles available to you
  - **Border Style:** No Border, Thin Line, Shadow / Inset
  - **Font Size:** Large / Medium / Small
  - **Data Shadows:** Off / Shadow / 3D
  - **Dialog - Various Export Options:**




## SEE ALSO:

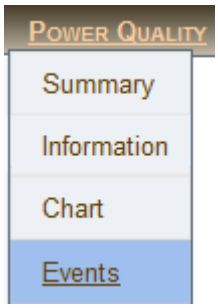
- About Power Quality Monitoring
- PQ Compliance Summary
- Compliance Information
- Events
- PQ Compliance Configuration

# Events

The Events window supplies a **Log** that displays Configured PQ Events. Within in the Log you can decide what data you would like to display & produce a report.

## OPEN THE EVENTS WINDOW TO PRODUCE A PQ EVENT LOG

- Access your G4K Unit ➡ log on as the **Viewer/Administrator** ➡ under **Power Quality** ➡ open the **Event Tab**:




- The **Event Log** window will now open:


| # | Event Timestamp | Code | Detailed Event Data |
|---|---|---|---|
| 0 | 29/09/2010 08:00:01 | 242 | PQ Voltage Flickering: 1.241312 (24.121094[dev%] 7200.000000[sec] Severity:22 Phases:Delta 3 wires:;23;31) |
| 1 | 27/09/2010 10:00:00 | 242 | PQ Voltage Flickering: 1.054226 (5.419922[dev%] 7200.000000[sec] Severity:20 Phases:Delta 3 wires:;23;31) |
| 2 | 26/09/2010 22:44:53 | 244 | PQ Rapid Voltage Changes: 5.990278[%] (5.957031[dev%] 2.997351 [sec] Severity:37 Phases:Delta 3 wires:12;23;31) |
| 3 | 26/09/2010 22:44:53 | 235 | PQ Voltage Dips: 355.140625[V] (11.181641[dev%] 0.059910[sec] Severity:52 Phases:Delta 3 wires:;23;31) |
| 4 | 26/09/2010 06:00:00 | 242 | PQ Voltage Flickering: 1.074149 (7.373047[dev%] 7200.000000[sec] Severity:20 Phases:Delta 3 wires:;23;31) |
| 5 | 24/09/2010 18:10:56 | 233 | PQ Frequency Out of Range: 49.494373[Hz] (0.976563[dev%] 10.000000[sec] Severity:130 Phases:Delta 3 wires:) |

**Options & Functions:**

- **Start at:** Specify the event range
- **Page Size:** Number of entries per page
- **Time:** Log entries will be displayed at specific time zone ( UTC or Local time)

- Copy log to clipboard: Will copy the Event Log over to common Windows applications (Notepad, MS Outlook, Excel & Word). Simply select the command & **Paste** it in one of these applications.
- Erase Log: Will clear all the log entries & restart the System log from the time you select this option
- <<: Go to previous page
- Refresh Log: Refresh your view
- >>: Go to the next page

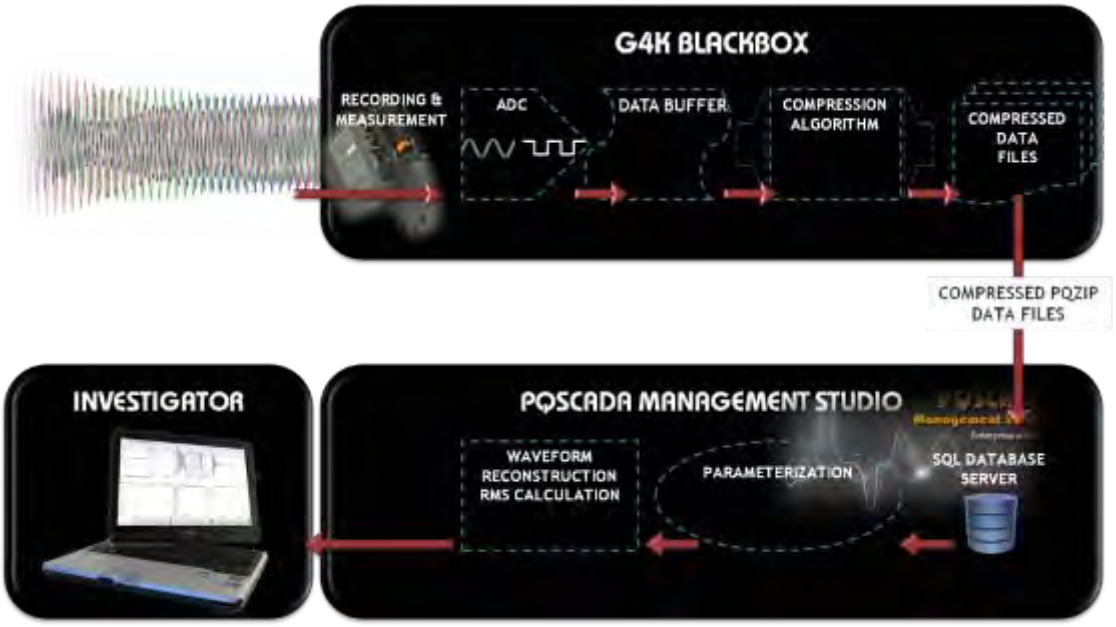
## SEE ALSO:

- About Power Quality Monitoring
- PQ Compliance Summary
- Compliance Information
- Compliance Chart
- PQ Compliance Configuration
- System Log

# PQZIP Recording - Principle

The G4 K BLA CKBOX is a ble to c ontinuously r ecord & s tore a ll t he el ectrical waveforms, all the time, in the case of G44430 for more than a year, with no gaps in the data. The flow diagram & subsequent definitions outline the PQZIP process: The i nnovation behind t his c apability is t he P QZIP compression t echnology. The patented PQZIP enables you to store up to a thousand times more information than typical f ormats, allowing f or s torage o f complete & precise d ata o ver extended periods of t ime. The f low d iagram & s ubsequent d efinitions o utline t he P QZIP process:

## FLOW DIAGRAM




## DEFINITIONS

- **Recording & Measurement:** The w aveforms ar e b eing s ampled at 1 024 samples p er cy cle r esolution f or v oltages an d 2 56 s amples p er cycle resolution for currents.
- **ADC:** Voltages an d c urrents ar e b eing c onverted & s caled t o a chieve a maximum r esolution u sing t he f ollowing A nalog t o D igital C onversion process.
- **Data Buffer:** The digital waveform data is buffered resulting in 512 spectral components (harmonics) per cycle for voltages and 128 for currents.
- **Compression Algorithm:** Every harmonic component is being analyzed and compressed in dividually. Z ero v alue co mponents ar e s kipped. N o-zero harmonic components are evaluated over time & only changes in a value or angle ar e processed. Resulting in storage of complete & precise data over extended periods of time.

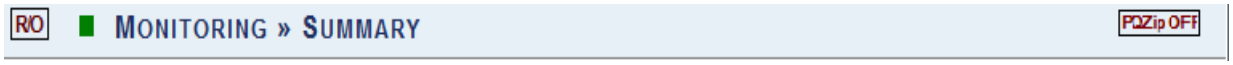
- **Compressed Data Files:** The compressed harmonic data is being organized in blocks of up to 5 minutes of concurrent cycles and being stored along with the measured frequency of every cycle and reference time stamps into a PQZIP file residing on the onboard flash memory. The typical compression ratio expected as a ratio between incoming data volume on block 3 and the data being stored is 1000:1.
- **Compressed PQZIP Data File Transferral:** The PQZIP files can be downloaded automatically or manually over a number of communication gateways for further storage and analysis.
- **SQL Database Server:** The resulting data is stored in the SQL database for long term storage. The compressed data is then reorganized and optimized for fast access while in a compressed state.
- **Parameterization:** When required, the data is decompressed, recovering a full spectrum of all the electrical parameters for each cycle, at the associated time stamps.
- **Waveform Reconstruction RMS Calculation:** The spectral data can further be used to reconstruct waveforms for any individual cycle at an extremely high resolution with accurate time and cycle duration. Any possible electrical parameters can be calculated based on the data by retrieving precise accuracy and wave shape.
- **Investigator:** 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.

## SEE ALSO

- Default Settings
- PQZIP Recording - Configuration
- Enabling / Disabling PQZIP
- FIFO
- Fixed Quality vs. Fixed Ratio
- File Capacity
- FFT Mode
- Erase All PQZIP Data

# Default Settings

All G4K BLACKBOX Units leave the factory with PQZIP recording being **Disabled (Off)**. The instrument does not start recording until PQZIP is Enabled. When you access your unit for the first time, the Summary in Elspec's Web Interface will display the default settings:




## SEE ALSO

- PQZIP Recording - Principle
- PQZIP Recording - Configuration
- Enabling / Disabling PQZIP
- FIFO
- Fixed Quality vs. Fixed Ratio
- File Capacity
- FFT Mode
- Erase All PQZIP Data

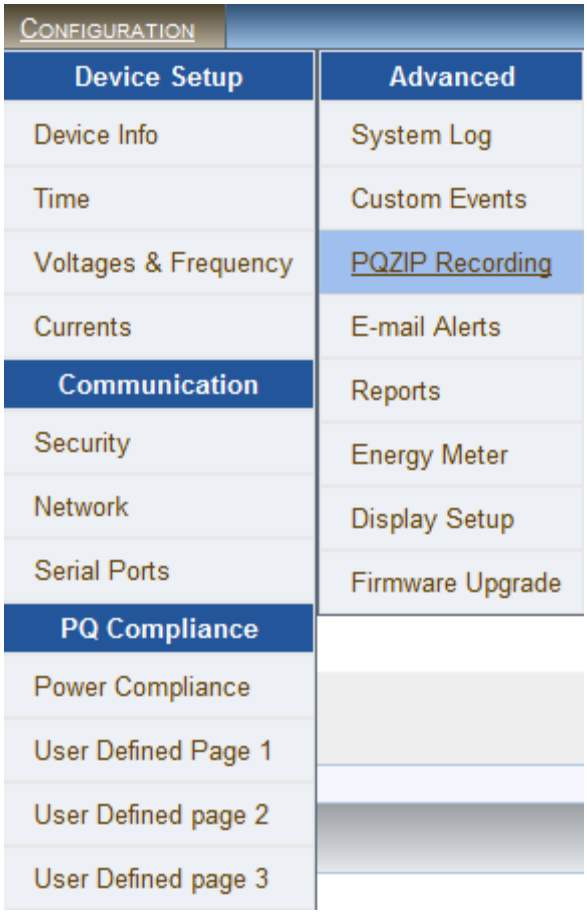
# PQZIP Recording - Configuration

The window for PQZIP Configuration & Status is located on the **PQZIP Recording** Window. In this window you will be able to:

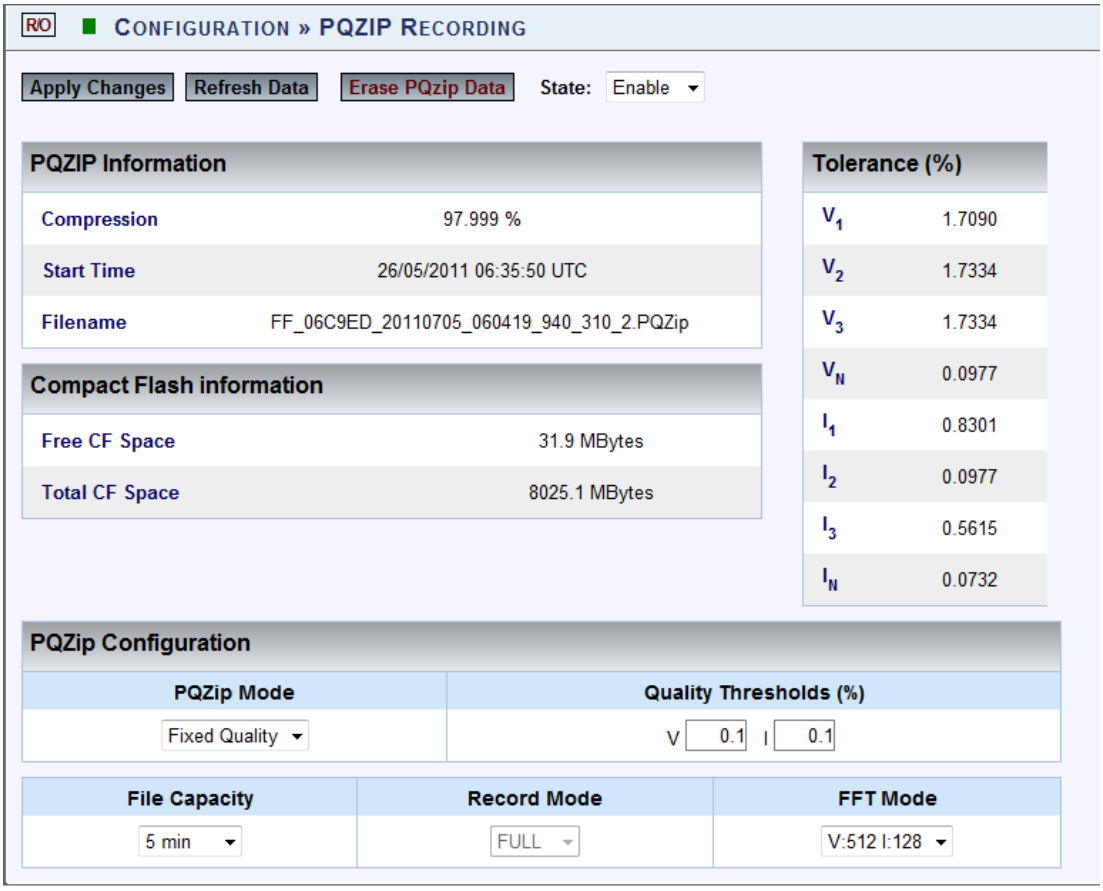
- Enable / Disable the PQZIP
- Understand how the disc space is managed with the FIFO concept
- Configure either Fixed Quality / Fixed Ratio
- Configure the Time for Compression with File Capacity
- Set FFT Mode Calculation
- How to Erase All PQZIP Data

## OPEN THE PQZIP RECORDING WINDOW

- Access G4K's PQZIP Configuration via **Elspec's Web Interface** ➡ log on as the **Viewer/Administrator** ➡ select the **Configuration Tab**
- Under **Advanced** select the **PQZIP Recording Tab:**



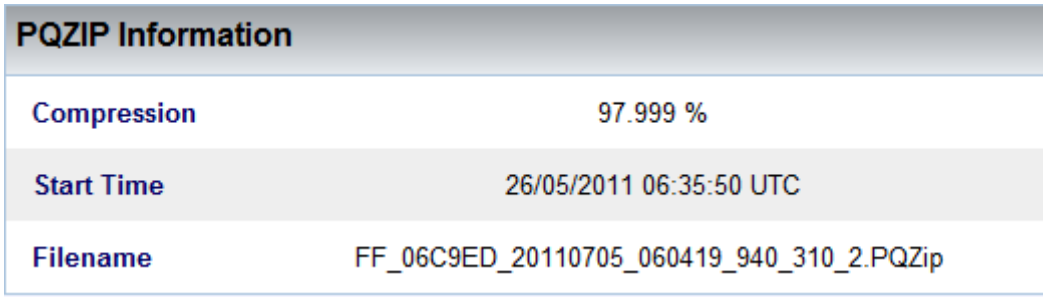
- The **PQZIP Status & Configuration Window** will now open:




## STATUS SECTION

The Status Section of the PQZIP Recording Window is divided into three sections:

- **PQZIP Information:**




  - **Compression %:** % Of data compressed for configured period on successful completion of previous compression
  - **Start Time:** Time when data compression started (according to configuration)
  - **File Name:** Name under which the file for this session will be saved - this is important for future reference
- **Compact Flash Information:**

| Compact Flash information | |
|---|---|
| Free CF Space | 31.9 MBytes |
| Total CF Space | 8025.1 MBytes |

- **Free CF Space:** Free internal memory space of your G4K unit
- **Total CF Space:** Total memory capacity of your G4K unit

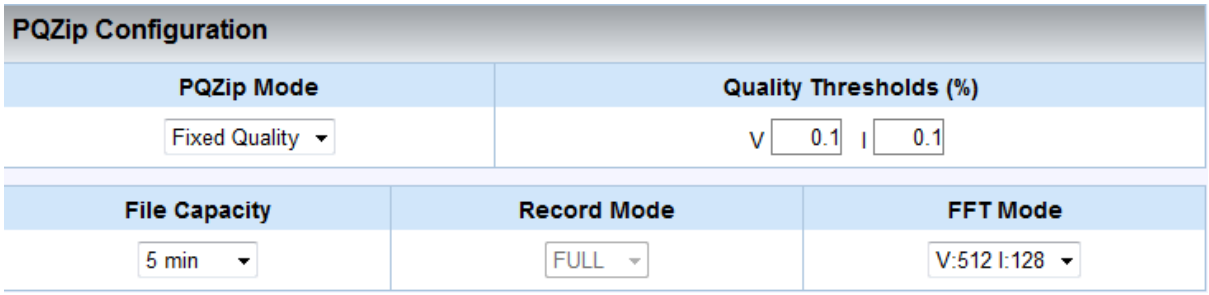
- **Tolerance %;**

| Tolerance (%) | |
|---|---|
| $V_1$ | 1.7090 |
| $V_2$ | 1.7334 |
| $V_3$ | 1.7334 |
| $V_N$ | 0.0977 |
| $I_1$ | 0.8301 |
| $I_2$ | 0.0977 |
| $I_3$ | 0.5615 |
| $I_N$ | 0.0732 |

The tolerance value is calculated in % to the Nominal Configuration for the specific channel.

## CONFIGURATION SECTION

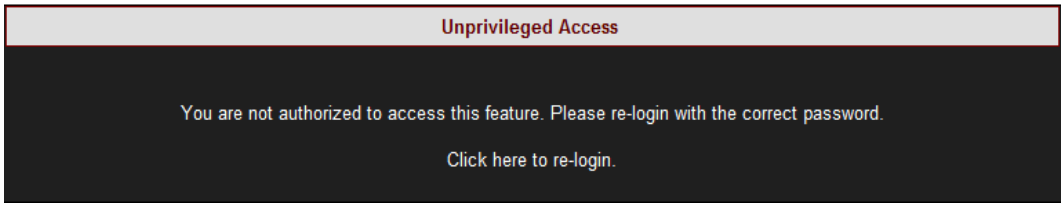
In this section you will be able to configure the PQZIP Recording:




- To apply your changes select Apply Changes

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the Administrator ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

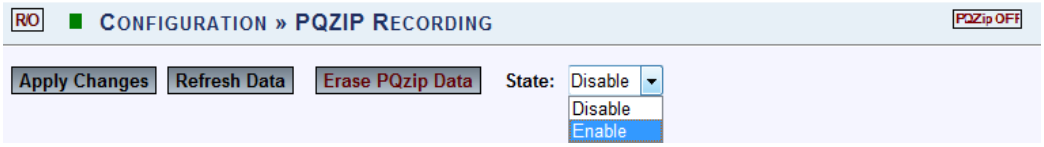
- PQZIP Recording - Principle
- Default Settings

# Enabling / Disabling PQZIP

As mentioned previously, your G4K Unit arrives from the factory with PQZIP recording **Disabled.** Initiating **Enable** will prompt your G4K BLACKBOX to commence recording and **Disable** will cause your device to cease recording.

## HOW TO ENABLE & DISABLE PQZIP RECORDING

- Access G4K PQZIP Configuration via the PQZIP Recording Tab
- In the **State** drop-down selection select **Enable:**

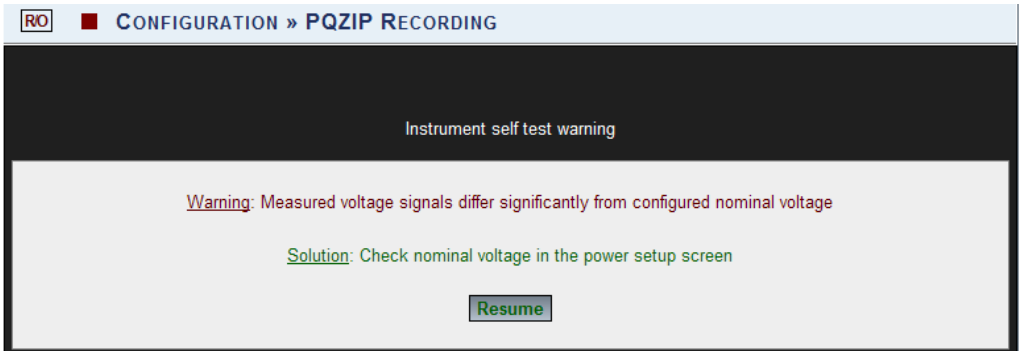



- To apply your changes select Apply Changes

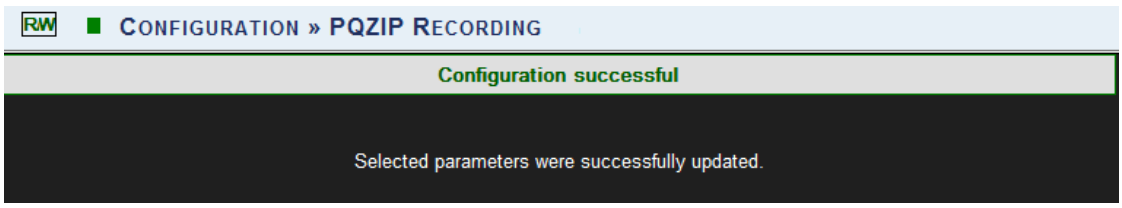
### NOTE NOTE NOTE

- Once you have enabled the PQZIP recording, the PQZip OFF Icon will no longer appear on the right-hand side on this & any other screen:


- The following warning may appear if some parameter readings are inconsistent with the configuration. In this case make sure all parameters are correct before enabling the PQZIP:



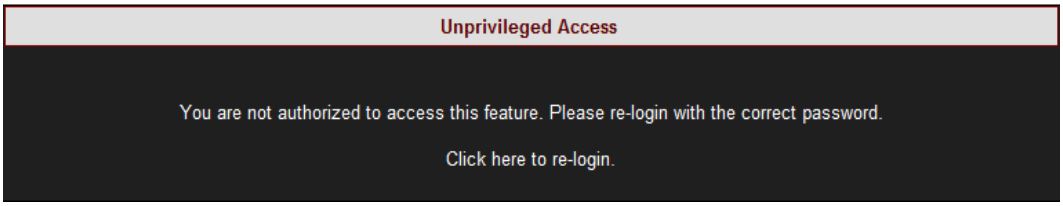

- Confirm by selecting Resume & the following success message will appear:




- To view your changes (refresh your current view) select Refresh Data

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the Administrator ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

- PQZIP Recording - Principle
- Default Settings
- PQZIP Recording - Configuration
- FIFO
- Fixed Quality vs. Fixed Ratio
- File Capacity
- FFT Mode
- Erase All PQZIP Data

# FIFO

PQZIP files are maintained on the G4K's Built-In Flash Memory based on the FIFO (First In First Out) concept. The G4K unit continuously records & measures all electrical information, and therefore file storage operations never stop. As such, when the on-board memory becomes full, the oldest files are deleted automatically to free required space for the newest data. However, the PQZIP compression itself allows for the storage of a 1000 times more information than typical formats & in addition the G4K BLACKBOX Device series is equipped with substantial memory capacity (G4410 - 128MB; G4420-4GB & G4430-16GB). This dramatically increases storage capacity and, thus, the G4430 is capable of recording and storing all electrical wave forms, all the time, for more than a year.

Additionally by simply downloading the files from the Incoming Folder using PQSCADA / FTP, data can be stored outside the G4K's on-board memory up to your Network Server's capacity.

## SEE ALSO

- PQZIP Recording - Principle
- Default Settings
- PQZIP Recording - Configuration
- Enabling / Disabling PQZIP
- Fixed Quality vs. Fixed Ratio
- File Capacity
- FFT Mode
- Erase All PQZIP Data

# Fixed Quality vs. Fixed Ratio

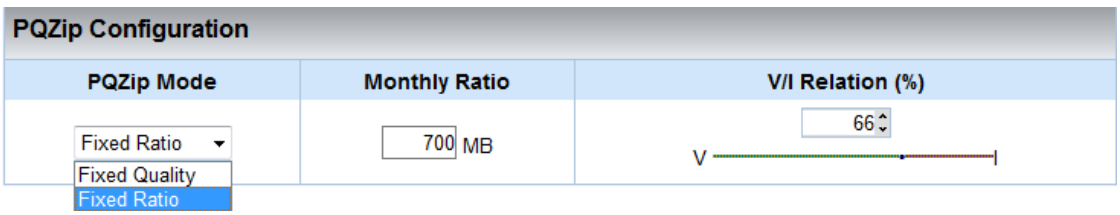
The most important parameter defining the actual compression ratio, (which determines the amount of storage required and maximum time continuous data can be stored) is a PQZIP Threshold value or **Tolerance** as it referred on the WEB page. The Tolerance defines what change in an individual harmonic would be defined as significant enough to be stored and reproduced afterwards.

The tolerance value is calculated in percentage to the Nominal Configuration 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 low, 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. To set the tolerance values see PQZIP Recording - Configuration.

## CONFIGURING FIXED RATIO

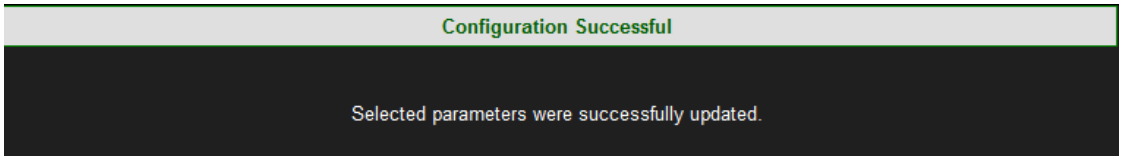
The G4K BLACKBOX provides the possibility of automatic adjustment of the actual tolerance value presuming a compression ratio defined as amount of data being stored per month. This option is called **Fixed Ratio**. When selected, the user is requested to define the amount of data to be stored per month (**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 that for currents, the system will define a tighter tolerance for voltages than for currents.

- Access G4K PQZIP Configuration via the PQZIP Recording Tab
- In the **PQZIP Configuration** section, go to the **PQZIP Mode** & from the drop-down selection select **Fixed Ratio:**




- Define the amount of data stored per month, by entering the **MB Value** in the **Monthly Ratio** text box
- Set the appropriate **V/I Relation** value with the

- To apply your changes select Apply Changes
- You will receive the following success message:

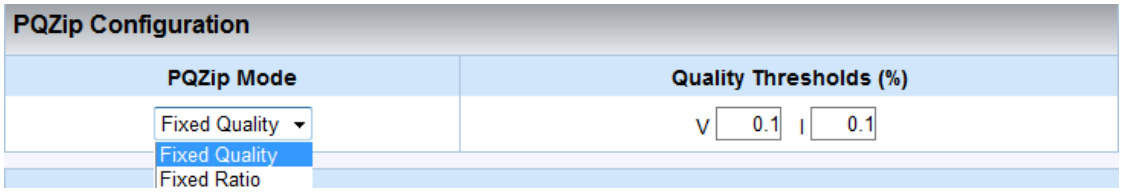



- To view your changes (refresh your current view) select Refresh Data

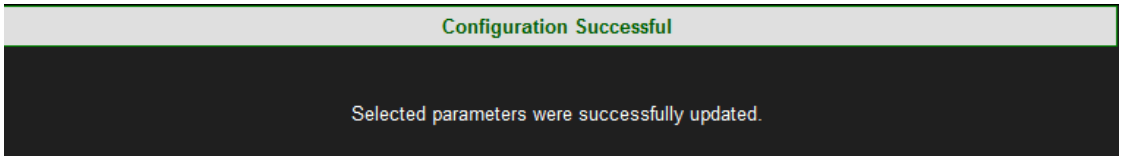
## CONFIGURING FIXED QUALITY

With the **Fixed Quality** option you are able to define & fix the tolerance values for both voltages and currents as per your preferred value. This means that data will be stored at the same tolerance/quality at all times.

- Access G4K PQZIP Configuration via the PQZIP Recording Tab
- In the **PQZIP Configuration** section, go to the **PQZIP Mode** & from the drop-down selection select **Fixed Quality:**



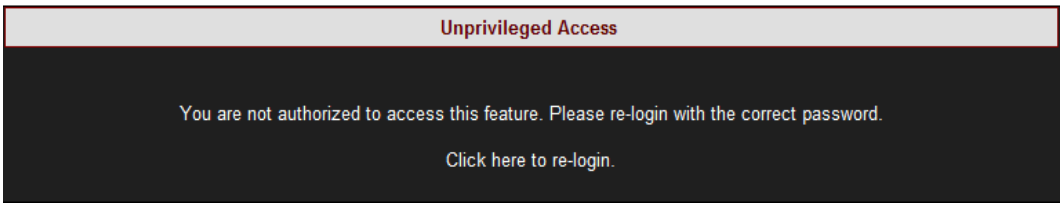

- Define the fixed tolerance values for both **Voltage** & **Current** by entering the **Threshold %** in the respective **Quality Threshold %** text box. **REMINDER:** The tolerance value is calculated in percentage to the Nominal Configuration for the specific channel.
- To apply your changes select Apply Changes
- You will receive the following success message:




- To view your changes (refresh your current view) select Refresh Data

### NOTE NOTE NOTE

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the Administrator ensure that you select Apply Changes to actually affect your changes.
- Setting thresholds to 0 creates large amounts of data that can fill up all available disk space. This should only be done when investigating localized faults for brief periods of time.

## SEE ALSO

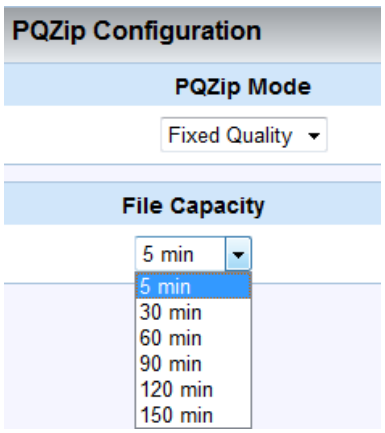
- PQZIP Recording - Principle
- Default Settings
- PQZIP Recording - Configuration
- Enabling / Disabling PQZIP
- FIFO
- File Capacity
- FFT Mode
- Erase All PQZIP Data

# File Capacity

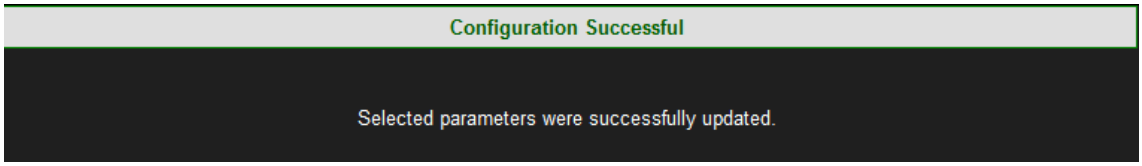
The File Capacity parameter is used to define the maximum time each PQZIP file will take to compress. The file can be downloaded and data can be analyzed only when the file is closed, so if you expect to monitor the data in the Investigator application shortly after the data is being collected, you should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

## CONFIGURING THE FILE CAPACITY PARAMETER

- Access G4K PQZIP Configuration via the PQZIP Recording Tab
- In the **PQZIP Configuration** section, go to the **File Capacity** & from the drop-down selection select the applicable **Time Period:**



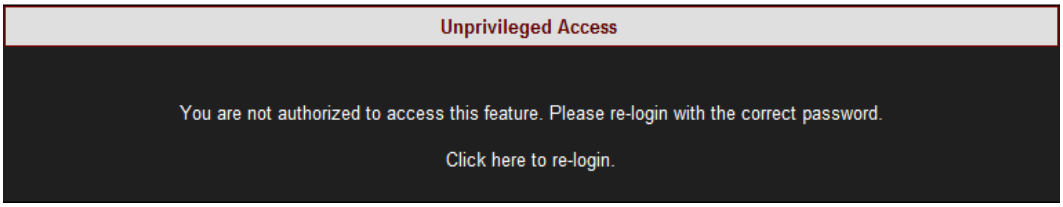

- To apply your changes select Apply Changes
- You will receive the following success message:




- To view your changes (refresh your current view) select Refresh Data

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the Administrator ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

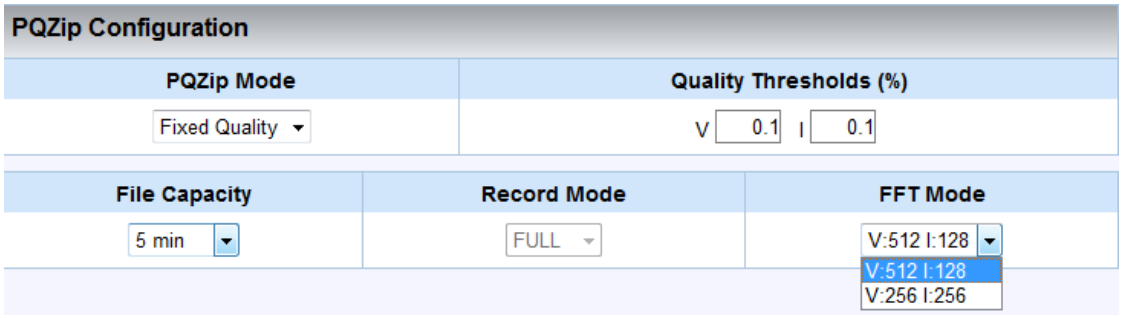
- PQZIP Recording - Principle
- Default Settings
- PQZIP Recording - Configuration
- Enabling / Disabling PQZIP
- FIFO
- Fixed Quality vs. Fixed Ratio
- FFT Mode
- Erase All PQZIP Data

# FFT Mode

The FFT Mode is a built-in capability applicable only to the G4430 BLACKBOX. The sampling rate for the G4430 is 1,024 samples per cycle for Voltage & 256 samples per cycle for Current. Or alternatively, the sampling rate may be switched to 512 samples per cycle for Voltage & 512 samples per cycle for Current.

## CONFIGURING THE FFT MODE

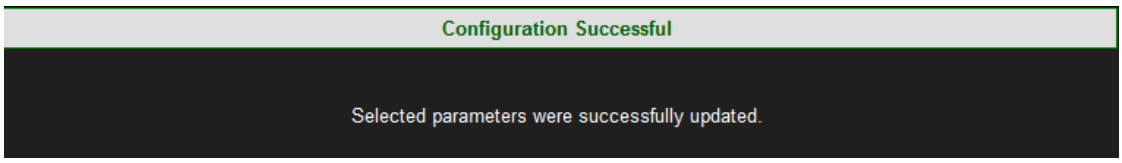
- Access G4K PQZIP Configuration via the PQZIP Recording Tab
- In the **PQZIP Configuration** section, go to the **FFT Mode** & from the drop-down selection select the applicable **Ratio:**




Select:

- **File Capacity:** Used for setting compression at every: 5 min; 30min; 60min; 90min; 120min & 150min (Increased frequency will produce more files - therefore set the frequency according to your network capacity)
- **FFT Mode:** The sampling rate setting reflected from the drop down selection is half of the actual sampling rate - V:512 I:128 & V:256 I:256. To set your sampling rate select:
  - **V:512 I:128** for actual 1,024 (Voltage) & 256 (Current) samples per cycle
  - **V:256 I:256** for actual 512 (Voltage) & 512 (Current) samples per cycle

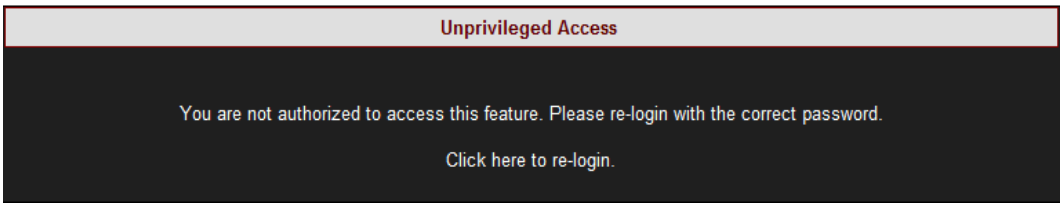
- To apply your changes select Apply Changes
- You will receive the following success message:




- To view your changes (refresh your current view) select Refresh Data

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

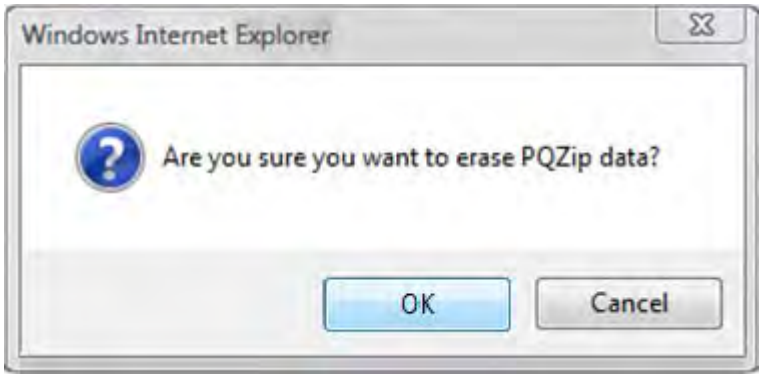
- PQZIP Recording - Principle
- Default Settings
- PQZIP Recording - Configuration
- Enabling / Disabling PQZIP
- FIFO
- Fixed Quality vs. Fixed Ratio
- File Capacity
- Erase All PQZIP Data

# Erase All PQZIP Data

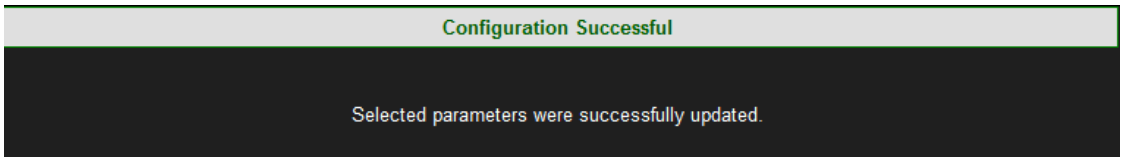
This function will allow you to delete all the PQZIP files from your G4K BLACKBOX's internal C ompact F lash M emory. Prior to p roceeding e nsure th at y ou've downloaded all the PQZIP files you needed from your G4K unit, as the procedure cannot be reversed.

## ERASE PQZIP DATA

- Access G4K PQZIP Configuration via the PQZIP Recording Tab
- Select Erase PQzip Data & you will receive the following message:



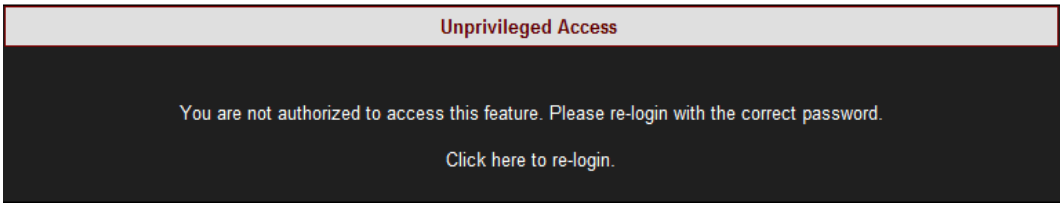

- To apply your changes select OK ➡ Apply Changes
- You will receive the following success message:




- To view your changes (refresh your current view) select Refresh Data

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

- PQZIP Recording - Principle
- Default Settings
- PQZIP Recording - Configuration
- Enabling / Disabling PQZIP
- FIFO
- Fixed Quality vs. Fixed Ratio
- File Capacity
- FFT Mode

# About Energy

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.

The Energy section 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). In this section you will be able to:

- Review the overall Consumption & Demand of your Electrical System
- View a Detailed Breakdown of Energy Flow Components
- Review Statistical Information Regarding Measurement Status

# Consumption & Demand

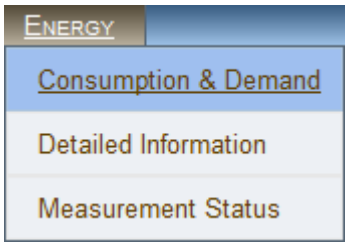
Energy is produced and consumed within an electrical distribution system. Some sites produce energy for the grid (Received Energy), others consume energy from the grid (Delivered Energy), and still others both consume and produce energy for/from the grid. The Net Consumption is the difference between 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 window is a quick look at some of the key components of the Detailed Information window. 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.

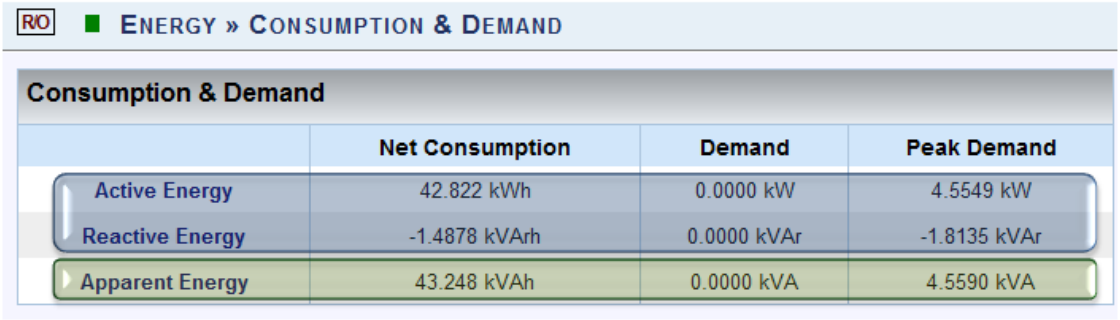
A Demand is an arbitrary measurement of average power usage per configurated unit time. A demand is measured in units of power even though a time element does exist, while Peak Demand is the highest demand calculated since the last demand reset. Refer to Energy Meter in the **Advanced Settings** section to reset the demand of your energy meter.

## ACCESS GENERAL INFORMATION REGARDING CONSUMPTION & DEMAND

- Access your G4K Unit ➡ log on as the **Viewer/Administrator** ➡ under **Energy** ➡ open the **Consumption & Demand Tab**:



- The **Consumption & Demand** window will now open:




Included in this window are commonly used terms in describing energy flow within a system:

  - **Active Energy (Real Energy)**: 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 Energy (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)
- The corresponding Blue & Green sections will be displayed in more detail in the Detailed Information window.

## SEE ALSO

- About Energy
- Detailed Information
- Measurement Status

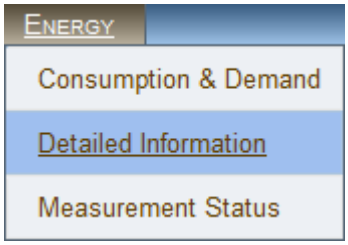
# Detailed Information

For a detailed breakdown of energy flow components, the Detailed Information window presents all the **Active & Reactive** values individually for both produced and consumed (**Received or Delivered)** energy. In addition the **Net Difference (Net Energy)** as well as the **Sum Total (Total Energy)** computations are included within this window. The **Total Energy Computation Section** contains the combined figure for **Received & Delivered Energy**.

As previously stated, the Consumption & Demand (Summary) window is extracted from the Details window. The corresponding values are indicated in Blue & Green in the Detailed Information Window below.

## ACCESS GENERAL INFORMATION REGARDING CONSUMPTION & DEMAND

- Access your G4K Unit ➡ log on as the **Viewer/Administrator** ➡ under **Energy** ➡ open the **Detailed Information Tab**:



- The **Detailed Information** window on energy flow components will now open:


## SEE ALSO

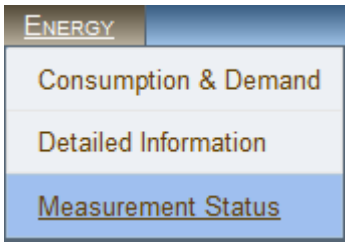
- About Energy
- Consumption & Demand
- Measurement Status

# Measurement Status

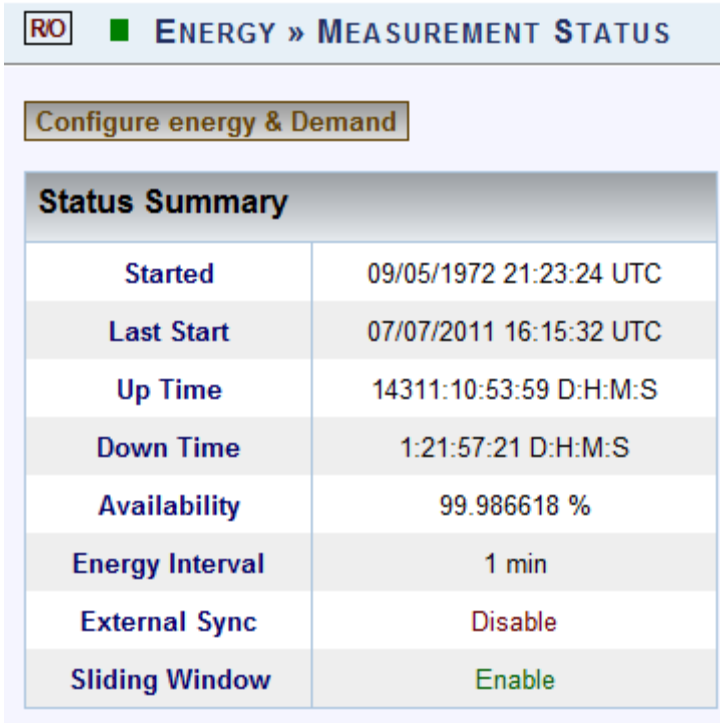
The Measurement Status window provides additional statistical information & necessary context on energy. The parameters & counters on this window are configured in **Energy Meter in the Advanced Settings Section,** which is directly accessible by selecting the Configure energy & Demand button.

## ACCESS THE MEASUREMENT STATUS WINDOW

- Access your G4K Unit ➡ log on as the **Viewer/Administrator** ➡ under **Energy** ➡ open the **Measurement Status Tab**:



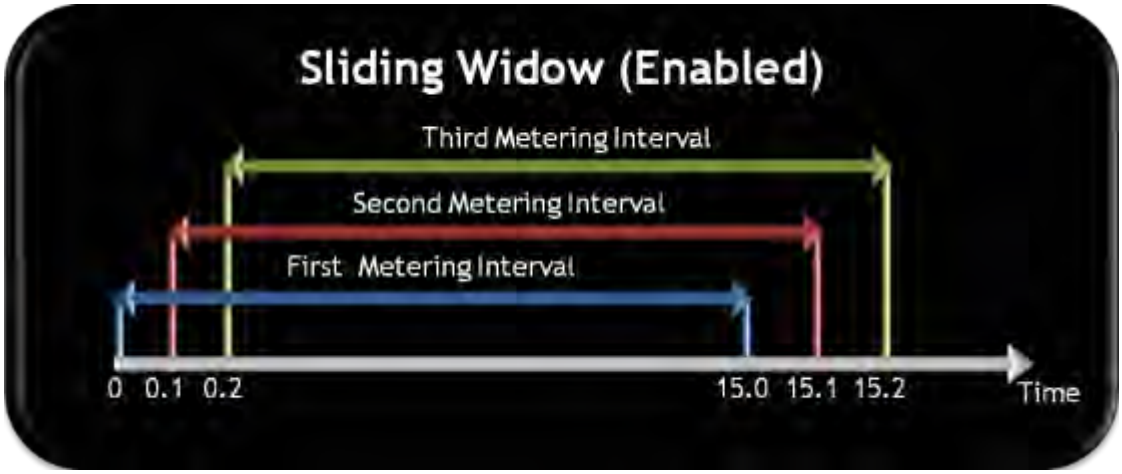

- The **Measurement Status** window will now open:



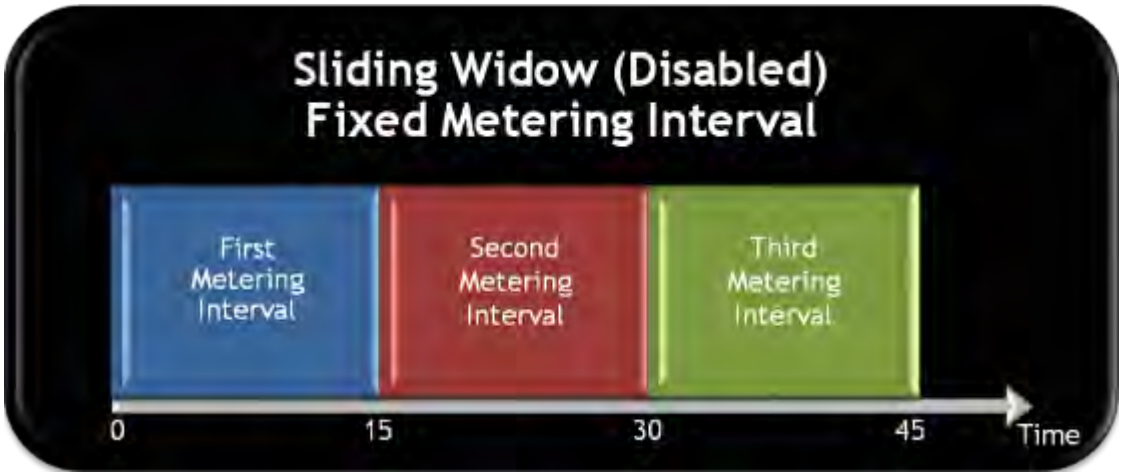

Included in this window are the following terms:

- **Started:** This is the date & time stamp when the Energy Meter was originally activated for the very first time
- **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. 1 minute)
- **External Sync:** This function is currently fixed in disable mode
- **Sliding Window (Accessed by selecting** Configure energy & Demand **in** Energy Meter**:** Information regarding the demand averaging system in use:
  - **Enable:** The energy is calculated using a sliding window. The figure below illustrates the time increment as 1 second:




  - **Disable:** The energy is calculated using fixed interval for each meter - illustration:



## SEE ALSO

- About Energy
- Consumption & Demand
- Detailed Information

# About Instrument Settings

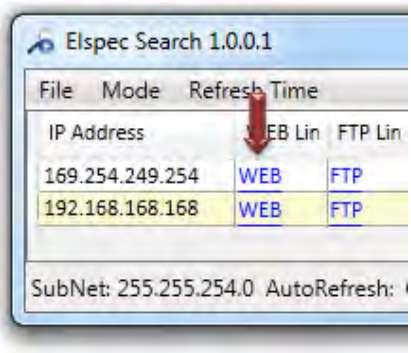
After initial Communication has been Established & you have been successful in Connecting to the Device for the 1st Time, you will need to configure your G4K device itself in Elspec's Web Interface. The procedure will demonstrate how to:

- Setup the Device
- Configure all Communication Settings
- Configure the PQ Settings
- Configure User Defined Pages

# Device Setup

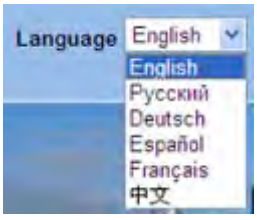
Configuration of your G4K device itself occurs in Elspec's Web Interface on successful Connection to the Device.

- Access your device via Elspec's Search Utility through the **Web** (Identifiable either by the Serial Number / indicated in green as a New Device):




- Select the **Web** link for your device, Elspec's Web Interface will now open:


- In order to view the different languages in the Web Interface, you will need to upload the language feature from Elspec's Website when installing your new Firmware. Once uploaded, simply select the applicable interface language from the drop-down list:




- The supported languages are:
  - English (Default)
  - Russian
  - German
  - Spanish
  - French
  - Chinese

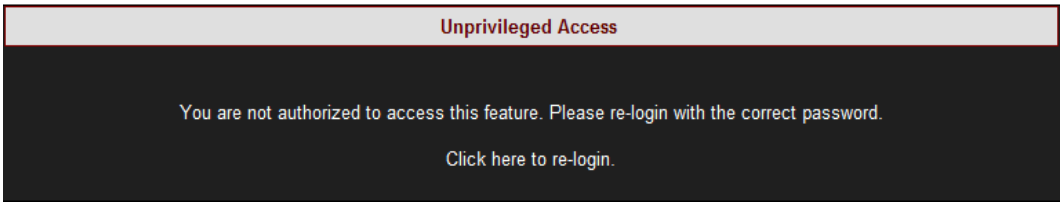
(For other languages – please contact your local Elspec distributor)

- The Password field defines user level/privileges. The user levels are **Viewer / Administrator** (See Security Settings). The default password including privileges for each level are:
  - Viewer is **123** (Read only, can choose interface language only, no operations related changes are allowed)
  - Administrator is **12345** (Administration, setup & full control)
- By selecting the **Configuration Tab** & within the **Device Setup** section you'll be able to:
  - Complete the Device Info
  - Configure the Voltage & Frequency
  - Set the Time Settings
  - Configure the Currents

## NOTE NOTE NOTE

- The Website is optimized to work with Internet Explorer 7, 8 or 9 in "Compatibility View". Ensure that the Internet Explorer is running in **Compatibility View**:


- 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 Disable Proxy Server in Internet Explorer.
- The passwords above are factory default values. You are advised to modify Admin password if extended security measures are required **(**See Security Settings).
- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:



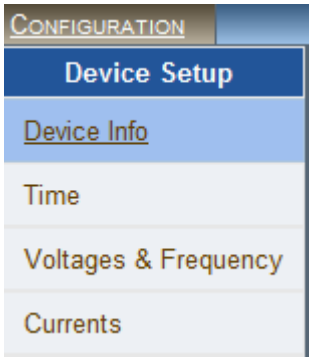
# Device - Info G4K Unit Configuration

Within this window you will be able to:

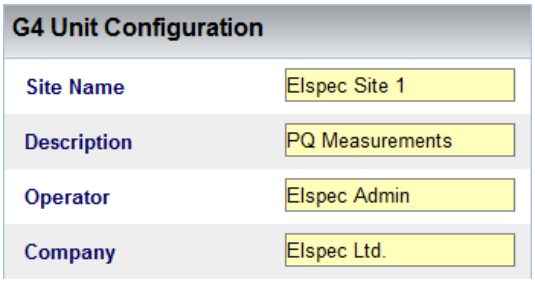
- Configure your G4K Unit
- View Hardware & Software Information for your G4K
- View all the Details Regarding Power System
- Enable/Disable the PoE Output
- Configure Alarm Settings

## CONFIGURE YOUR G4K UNIT

- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator (**Manufacturer's Default Password is : **12345)** ➡ select the **Configuration Tab**
- Under **Device Setup** select the **Device Info Tab:**



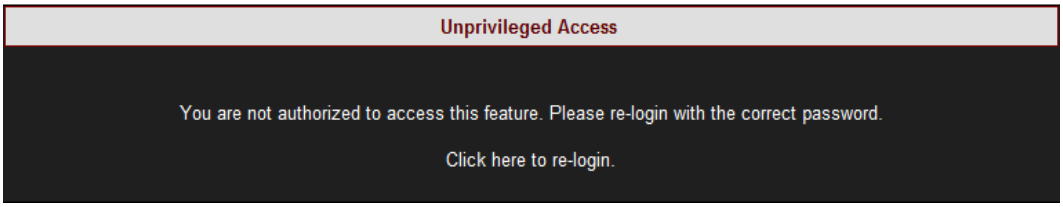

- In the **G4 Unit Configuration** Section complete:
  - **Site Name:** Enables the user to include a description of the site where the device is installed. This site description also appears in the Elspec's Search utility under Unit Description when searching for devices
  - **Description:** An additional text field for you to use optionally as you see fit
  - **Operator:** A text field for inputting the operator/technician's name
  - **Company**: A text field for inputting the company's name




- To apply your changes select Apply Changes
- Review your changes by selecting Refresh Data
- To enforce your changes to your G4K unit select Restart Unit
- Go on to the next step View Product Settings

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO

- About Device Setup
- Voltage & Frequency
- Time Settings
- Currents

# G4K Product Attributes

The Product section specifies information regarding the G4K System Attributes (Software, Hardware):

| Product | |
|---|---|
| Boot | 0.2.95 |
| Software | 0.4.03.1.5800 |
| Hardware | 2x2x2 |
| DSP | 4.6 |

The fields specify the following internal HW and SW Versions:

- **Boot:** Displays the Boot Loader application version. The Boot Loader application is a small separated part of the BLACKBOX Firmware. The Boot is stored on a secured sector in the internal flash memory chip & is used for the HW initialization for loading Firmware upgrades and for further execution of the G4K'S Firmware. The Boot executes either Bank A or Bank B Firmware. See Firmware Upgrade
- **Software:** Displays the BLACKBOX Firmware Version is in use. See Firmware Upgrade
- **Hardware:** Displays the BLACKBOX Hardware Version of the G4K's Modules
- **DSP:** Displays the BLACKBOX DSP Version in use. The G4K is equipped with 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.

## SEE ALSO

- G4K Unit Configuration
- Power Status
- PoE Output
- Alarms

# Power Status

| Power Status | |
|---|---|
| Powered by | AC |
| AC | On |
| PoE Input | Off |
| DC(48v) | Off |
| Down | Off |
| Capacitors | 25F |

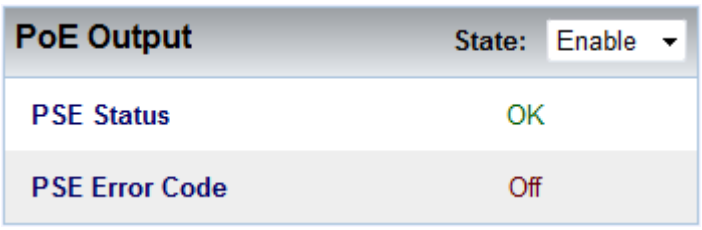
In this section you can view all the Power Status:

- **Powered by:** Informs the user as to the type of power currently supplying the instrument
- **AC**: AC status
- **PoE Input:** Status of the PoE on the LAN1 port; an alternate power input for the instrument
- **DC (48v):** Status of the DC Power Supply Input
- **Down:** Should this flag indicate "**ON**" it means that the G4K has no power supply & is on ride through power supplied by the capacitors
- **Capacitors:** Indicates the size of the Super Capacitor supplying the ride through power

## SEE ALSO

- G4K Unit Configuration
- G4K – Product Attributes
- PoE Output
- Alarms

# PoE Output

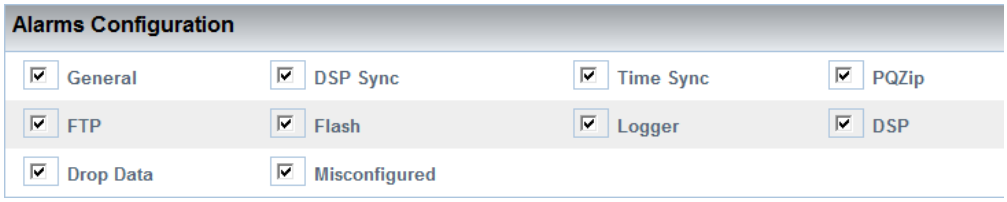



- **State:** Allows you to **Enable/Disable** the POE Output for LAN2 (See Also Establish Communication)
- **PSE Status:** Indicates the status of the LAN2/LCD port (Ok/ Fail)
- **PSE Error Code: Off** signifies that this port is not in use. **On** signifies that an LCD screen is currently attached to this port.
- To apply your changes select Apply Changes → Refresh Data to review them
- To enforce your changes to your G4K unit select Restart Unit

## SEE ALSO

- G4K Unit Configuration
- G4K – Product Attributes
- Power Status
- Alarms

# Alarms




A checked item that is malfunctioning causes the red alarm indicator light on the BLACKBOX unit to turn on: & to be displayed in the System Log. The table below includes the types of alarms that you may want to configure into your G4K Unit & what indication it will cover:

| ALARM TYPE | INDICATION |
|---|---|
| **General** | General G4K startup & system initiation |
| **SNTP** | Availability of the Network connection to the SNTP server |
| **Drop Data** | Temporary loss of PQZIP data |
| **DSP Sync** | Verification unit synchronization with the network power |
| **Flash** | Success of the data transfer to the G4K's internal Flash memory |
| **Misconfigured** | Verification of configured nominal value compared with the CT/PT value |
| **Time Sync** | Verification of the quality of the time synchronization (POOR or less) |
| **Logger** | Verification of a corrupted Logger |
| **PQZIP** | Verification whether or not the PQZIP is enabled |
| **DSP** | Communication verification between CPU with DSP module |

- To apply your changes select Apply Changes Refresh Data to review them
- To enforce your changes to your G4K unit select Restart Unit

## SEE ALSO

- G4K Unit Configuration
- G4K – Product Attributes
- Power Status
- PoE Output

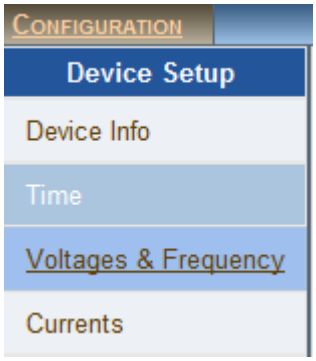
# Voltage & Frequency

The Voltage & Frequency Window defines all the major configurations regarding the Voltage & Frequency values. In this window you will be able to:

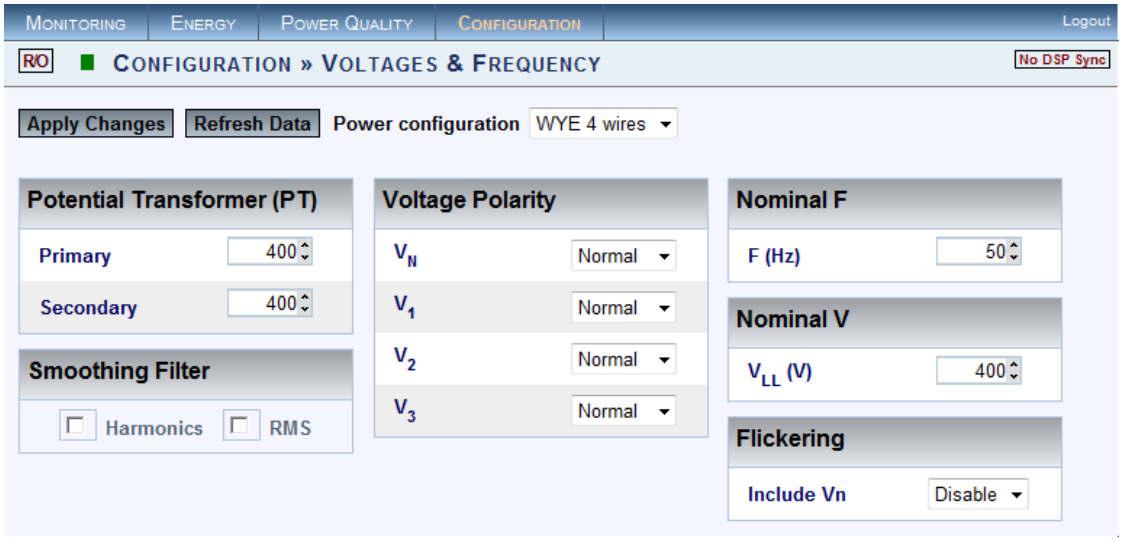
- Configure the Power
- Configure the Potential Transformation Ratio
- Smooth the curve in significant change of P Q P arameter (IEC61000-4-7 Compliance)
- Toggle the polarity without rewiring
- Define nominal values for Voltage & Frequency

## OPEN THE VOLTAGE & FREQUENCY WINDOW

- Access the G4K Device Configuration via **Elspec's Web Interface** ➡ log on as the **Administrator (**Manufacturer's Default Password is: **12345)** ➡ select the **Configuration Tab**
- Under **Device Setup** select the **Voltage & Frequency Tab:**

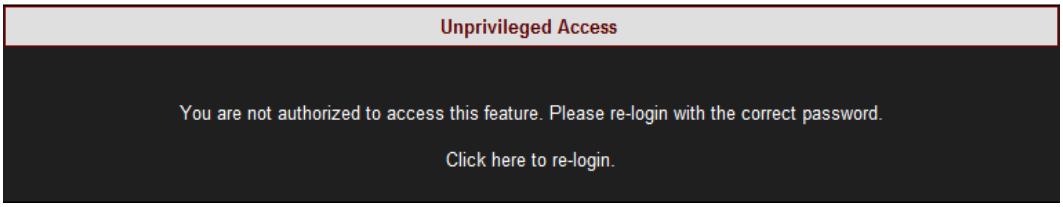



- The **Voltage & Frequency Window** will now open:



### *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




## SEE ALSO

- About Device Setup
- Device - Info G4K Unit Configuration
- Time Settings
- Currents

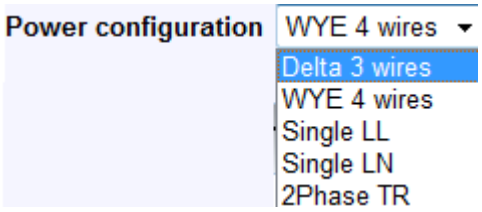
# Power Configuration

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. Refer to G4K Wiring in order to view the types of Power Topology the G4K supports.

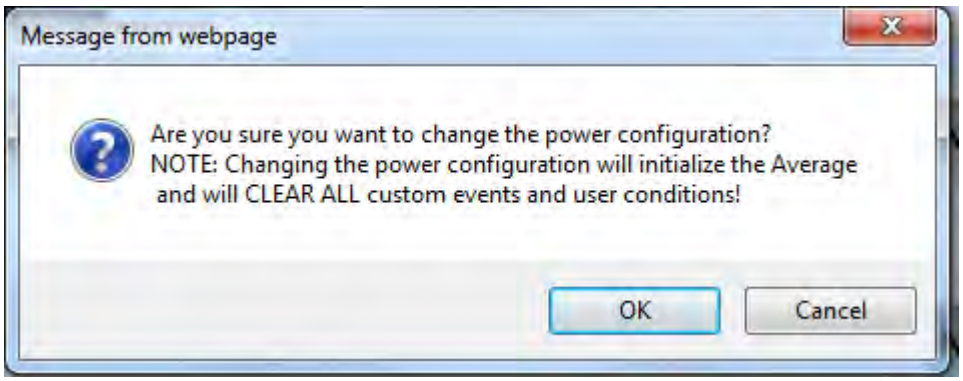
- The following table outlines the recommended configurations for several supported power types:

| Power Type | Recommended Power Configuration |
|---|---|
| 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 |

- Select the applicable **Network Type Settings** according to your network type from the drop-down selection:

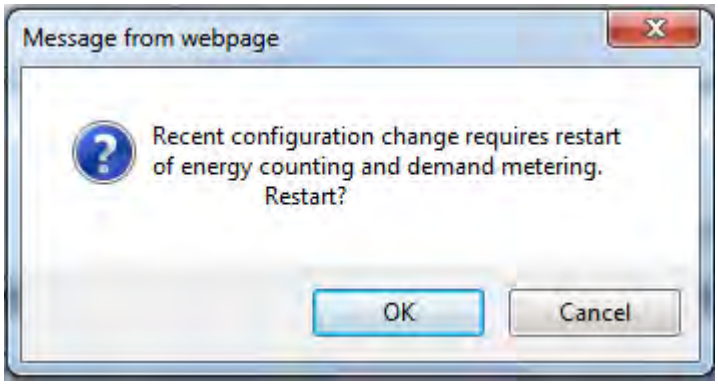



- To apply your changes select Apply Changes
- You will receive the following warning message as changing the network configuration will result in all the energy calculations to be averaged & will clear all your Custom Event configurations. Click OK in order to proceed:




- You will receive a "Configuration Successful" message & will be prompted to initiate a restart of the energy calculations.

  Click OK in order to proceed:




- Review your changes by selecting Refresh Data

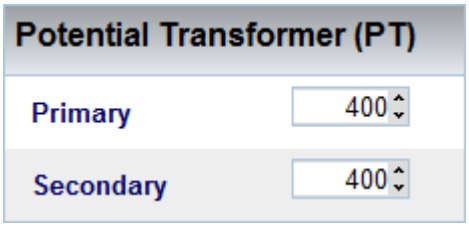
## SEE ALSO

- About Voltage & Frequency
- Potential Transformer
- Smooth Filtering
- Voltage Polarity
- Define Nominal Values

# Potential Transformer

Potential Transformer configuration is required only for MV/HV networks where the voltage is measured using PT's. This option allows you to accurately configure the known transformation ratio in both magnitude and phase, over a range of measuring circuit impedances. The voltage transformer is intended to present a negligible load to the supply being measured. The low secondary voltage allows protective relay equipment and measuring instruments to be operated at lower voltages.

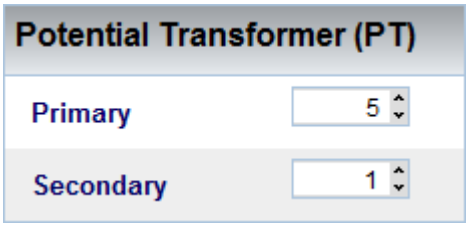
- For MV/HV Networks (Voltage Measurements by PT's) set the correct **Primary & Secondary Ratio** (with ▲/▼) - according to **the PT Manufacturer's Specifications** & not just the **Ratio:**




If the PT Ratio is inapplicable, then set your values to read:

**Primary = Secondary = Nominal**

- The ratio for LV Networks is based on the same concept & specifications - Set the **Primary & Secondary Ratio** (with ▲/▼) (according to **the PT Manufacturer's Specifications** & not just the **Ratio)**:




If the PT Ratio is inapplicable, then set your values to read:

**Primary = Secondary = Nominal**

- To apply your changes 

to review them

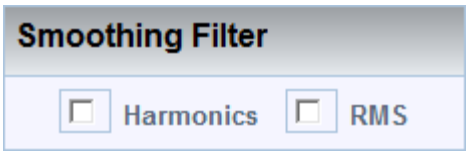
## SEE ALSO

- About Voltage & Frequency
- Power Configuration
- Smooth Filtering
- Voltage Polarity
- Define Nominal Values

# Smooth Filtering

This filter is introduced according to IEC standard 61000-4-7. It allows (enabled) smoothing of the curve when there are fluctuations in a power quality parameter such as in Harmonics / RMS.

- Mark the **Applicable Parameter** for filtering (Harmonics & / RMS):




- To apply your changes select Apply Changes → Refresh Data to review them

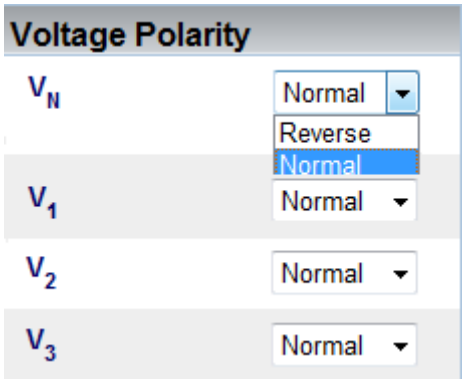
## SEE ALSO

- About Voltage & Frequency
- Power Configuration
- Potential Transformer
- Voltage Polarity
- Define Nominal Values

# Voltage Polarity

Wiring errors usually result in an incorrect polarity. The Voltage Polarity settings allow you to toggle the polarity without the necessity of rewiring.

- Either **Reverse** the polarity / maintain it at **Normal** from the drop-down selection:




- To apply your changes select Apply Changes  Refresh Data to review them

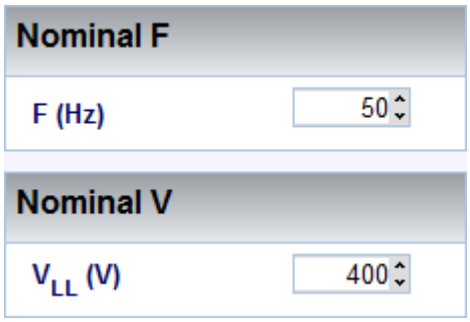
## SEE ALSO

- About Voltage & Frequency
- Power Configuration
- Potential Transformer
- Smooth Filtering
- Define Nominal Values

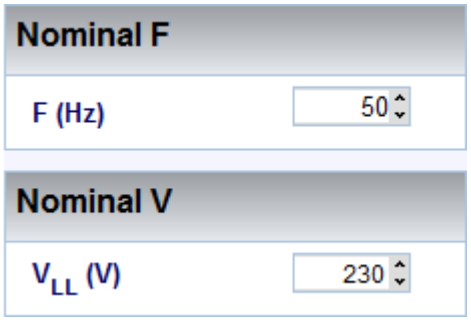
# Define Nominal Values

The Nominal section defines the nominal values for Frequency (F) and Voltages (V). The Frequency nominal affects compliance. For example, when 50Hz nominal is set, the window is 10 cycles, and for 60Hz the window is 12 cycles.

- For HV & MV Networks, define the **Nominal Values** for Frequency (F) and Voltages (V) (with ▲/▼):




- The ratio for LV Networks is based on the same concept & specifications - Define the **Nominal Values** for Frequency (F) and Voltages (V) (with ▲/▼):




If the PT Ratio is inapplicable, then set your values to read:

**Primary = Secondary = Nominal**

- To apply your changes select Apply Changes ➡ Refresh Data to review them

## *NOTE NOTE NOTE ...*

- Should you enter incorrect nominal values, the device may not record anything.
- 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!
- **FOR NOMINAL V VALUES:** If you are using a Potential Transformer (PT) Configuration for MV/HV networks, the Nominal V values needs to be set to the PT values.

## SEE ALSO

- About Voltage & Frequency
- Power Configuration
- Potential Transformer
- Smooth Filtering
- Voltage Polarity

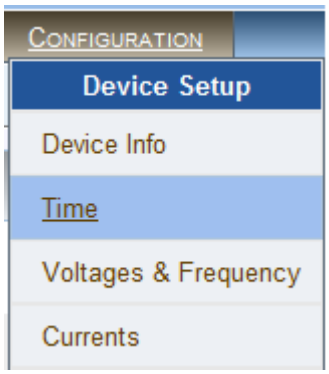
# Time Settings

The Time section is used to set and control the time. In additions it may also be used for displaying & logging of the data & events. Within this window you'll be able to:

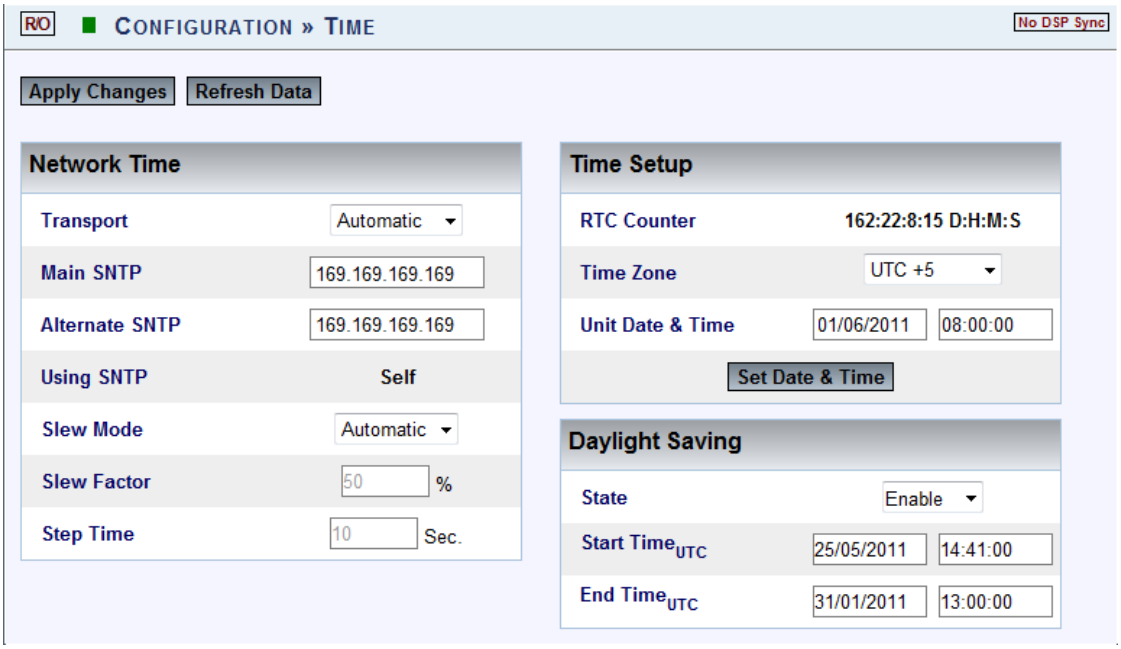
- Control the time synchronization of external time sources with Network Time
- Set & control the internal clock of the G4K unit with Setup the Time
- Automatically adjust the G4K Unit with Daylight Saving Time

## ACCESS TIME CONFIGURATION

- Access the G4K Device Configuration via **Elspec's Web Interface** ➡ log on as the **Administrator (**Manufacturer's Default Password is: **12345)** ➡ select the **Configuration Tab**
- Under **Device Setup** select the **Time Tab:**

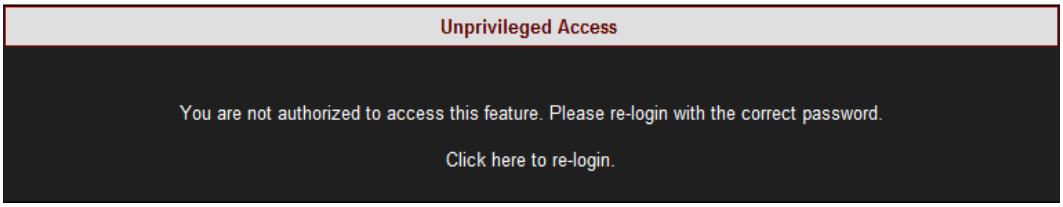


- The **Time Window** will now open:




## *NOTE NOTE NOTE*

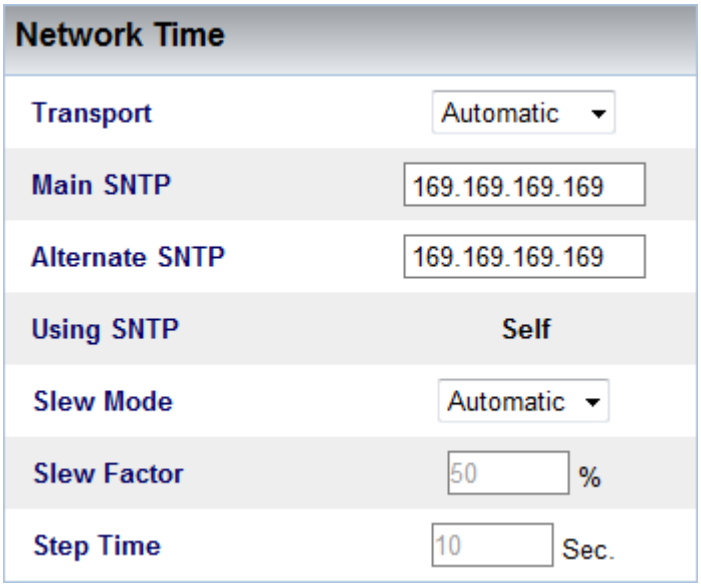
- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




## SEE ALSO

- About Device Setup
- Device - Info G4K Unit Configuration
- Voltage & Frequency
- Currents

# Network Time



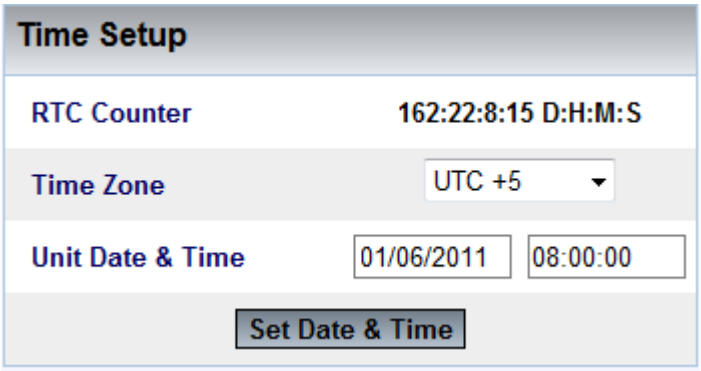

This section controls Time Synchronization with a variety of external time sources. Make your changes according to your selection:

- **Transport:** Utilize this option for the Time Sync Module to select the source Automatically, or to force the source Manually to NTP or GPS source
- **Main SNTP:** Use this option in order to configure the IP address of the Primary SNTP server to be used
- **Alternate SNTP:** Use this option to configure the IP address of the secondary SNTP server to be used (A contingency should the Primary Server become unavailable)
- **Slew Mode:** Set the type of Time Slewing/Adjustment to be used by the Time Sync module. This will compensate for time deviations and network communication jitters. The default & preferred mode is **Automatic,** as the Slewing Factor is according to time source communication quality.
- To apply your changes select Apply Changes → Refresh Data to review them

## SEE ALSO

- About Time Settings
- Time Setup
- Daylight Saving

# Time Setup




This section is used to set and control the internal clock of the G4K Unit. Set:

- **The RTC Counter:** Is used for setting the counting of the internal real time clock. The RTC starts its counting from the date of manufacture. RTC Counter format reads as: Days, Hours, Minutes, and Seconds
- **Time Zone:** Specifies the date and time to be presented on the WEB interface (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 (Also referred to as UTC)
- **Unit Date & Time:** Utilized for setting the current time & 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 updates are received. To prevent automatic updates, set the Time Sync module on Self synchronization.
- To apply your changes select Set Date & Time → Apply Changes
- Review your changes by selecting Refresh Data

## SEE ALSO

- About Time Settings
- Network Time
- Daylight Saving

# Daylight Saving


You can **Enable** the daylight saving time (Winter / Summer Clock) feature and set the period in this section. This will cause the time to automatically adjust to daylight savings time during the pre-defined period. This information is passed to the PQSCADA together with all other information via PQZip where it is displayed to the user. To set the daylight saving time:

- Select **Enable**
- Enter Start / End Date & Time (UTC)
- To apply your changes select Apply Changes → Refresh Data to review them

## SEE ALSO

- About Time Settings
- Network Time
- Time Setup

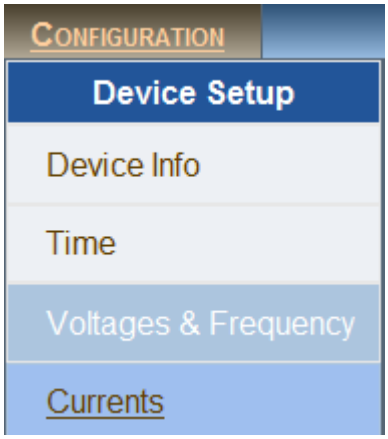
# Currents

The Current Window defines all the Current values. In this window you will be able to:

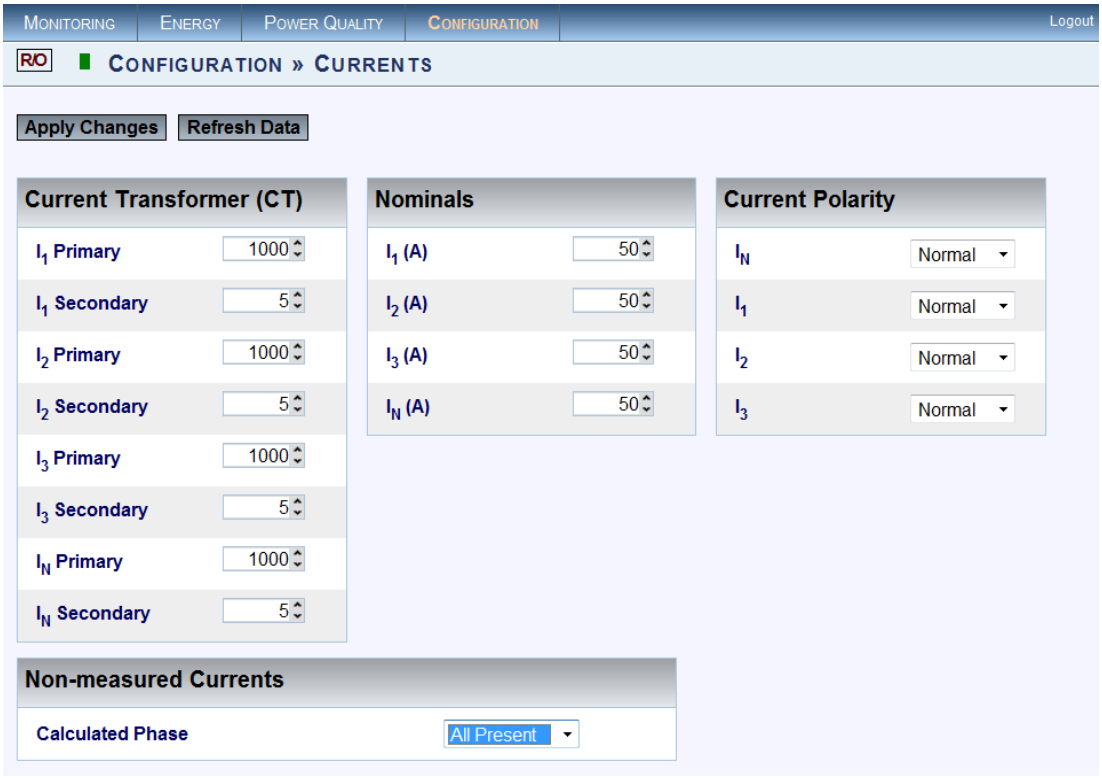
- Configure all the Primary & Secondary Current Transformer Values
- Define Nominal Current Values
- Toggle the Current Polarity without rewiring
- Configure Calculated Current Channels

## OPEN THE CURRENTS WINDOW

- Access the G4K Device Configuration via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under **Device Setup** select the **Currents Tab:**

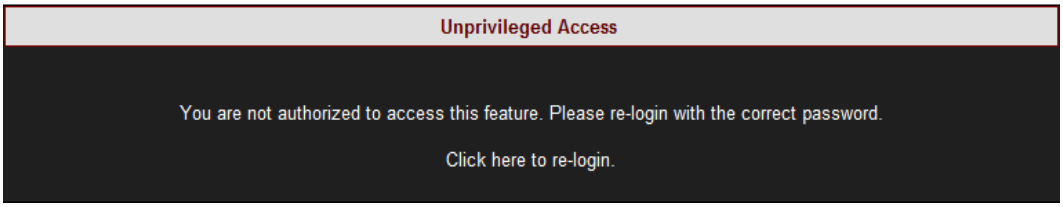



- The **Currents Window** will now open:




## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:



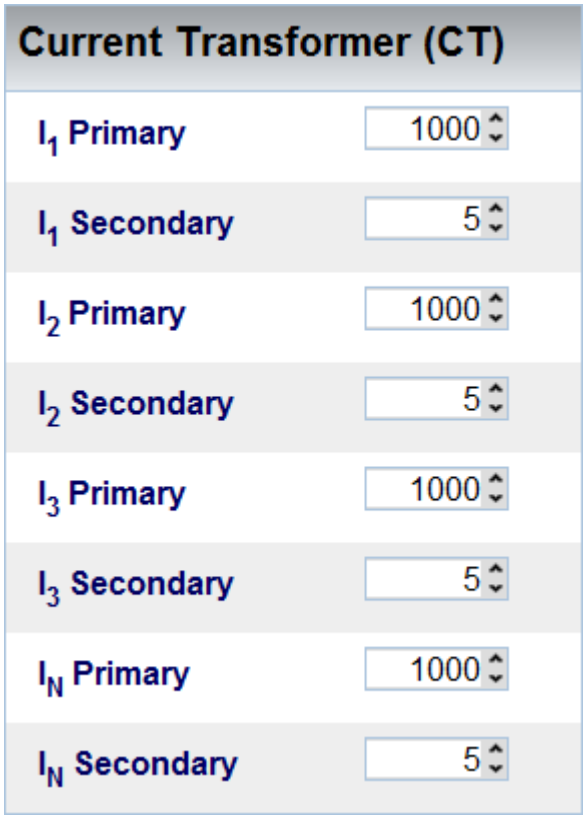

## SEE ALSO

- About Device Setup
- Device - Info G4K Unit Configuration
- Voltage & Frequency
- Time Settings

# Current Transformer

This option allows you to accurately configure the known Primary & Secondary Transformation Ratios for all the Current channels from $I_1$ to $I_N$:

- Set the correct **Primary & Secondary Ratios** (with ▲/▼):




If the CT Ratio is inapplicable, then set your values to read:

**Primary = Secondary = Nominal**

- To apply your changes select Apply Changes → Refresh Data to review them

## SEE ALSO

- About Current Window
- Nominal
- Current Polarity
- Non-Measured Currents

# Nominal

The Nominal section defines the nominal Ampere values for all the Current Channels from $I_1$ to $I_N$:

- Define the **Nominal Values** (with ▲/▼):


If the CT Ratio is inapplicable, then set your values to read:

**Primary = Secondary = Nominal**

- To apply your changes select Apply Changes → Refresh Data to review them

## *NOTE NOTE NOTE ...*

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!

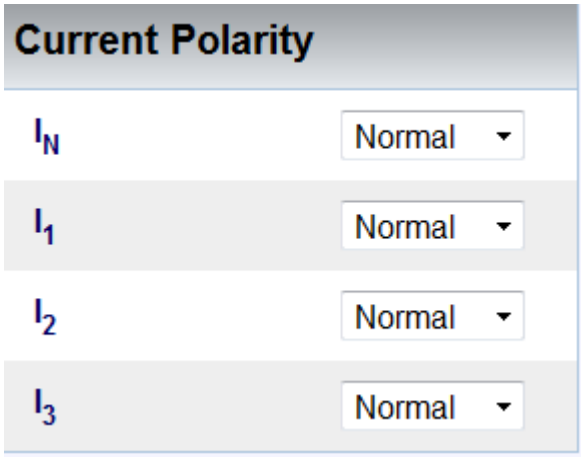
## SEE ALSO

- About Current Window
- Current Transformer
- Current Polarity
- Non-Measured Currents

# Current Polarity

The Current Polarity settings allows you to toggle the polarity values for all the Current Channels (from $I_1$ to $I_N$) without the necessity of rewiring (due to polarity errors caused by incorrect wiring).

- Either **Reverse** the polarity / maintain it at **Normal** from the drop-down selection:




- To apply your changes select Apply Changes → Refresh Data to review them

## SEE ALSO

- About Current Window
- Current Transformer
- Nominal
- Non-Measured Currents

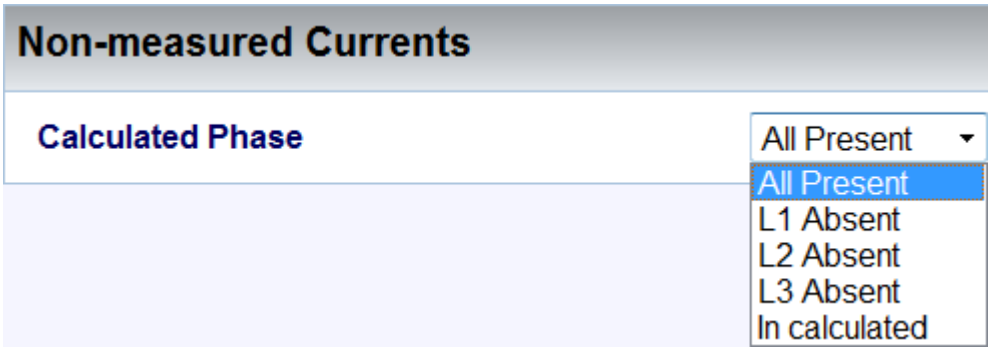
# Non-Measured Currents

The Non-measured Current section helps to configure calculated current channels. There are two calculation options & they differ for:

- WYE Network,
- DELTA & Single Split Phase Network

## CONFIGURING CALCULATED CURRENT CHANNELS FOR WYE NETWORK

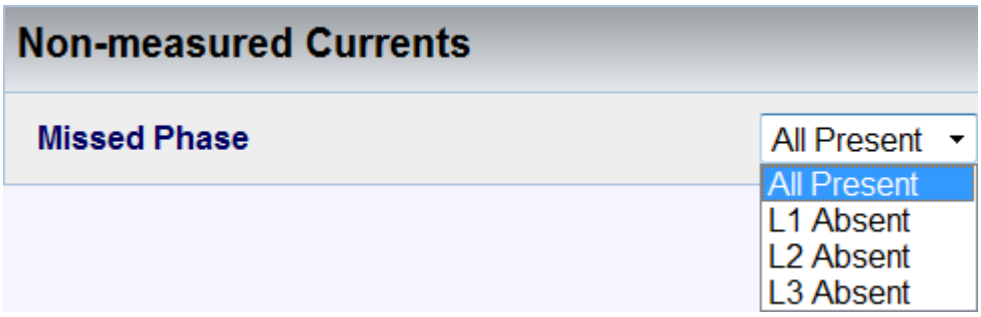
- Ensure the Power Configuration coincides with your Network
- In the **Non-Measured Currents** section, select the applicable phase to be calculated:




Calculation is based on Kirchhoff's laws - everything that comes in must go out, in order for the calculation of one of the current line to be based on the other measured lines instead of measuring it. For example when $L_x$ is Absent it is being calculated using the other lines instead of measuring it. Or the neutral current $I_N$ could be optionally calculated from the sum of three-phase currents, or alternatively, measured by the $I_4$ current channel.

## CONFIGURING CALCULATED CURRENT CHANNELS FOR DELTA & SINGLE SPLIT PHASE NETWORK

- Ensure the Power Configuration coincides with your Network
- In the Non-Measured Current section, select the applicable phase to be missed:



One of the three-phase current channels could optionally be calculated from the $\mathbf{I_1 + I_2 + I_3 = 0}$

## SEE ALSO

- About Current Window
- Current Transformer
- Nominal
- Current Polarity

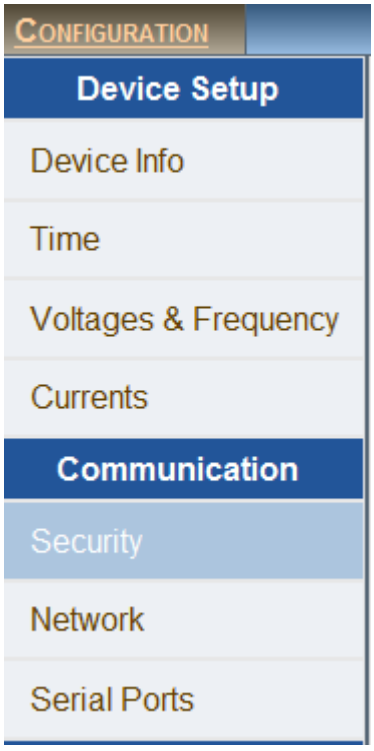
# Communication Configuration

After Communication has been Established & you have been successful in Connecting to the Device for the 1st Time, you will need to configure the communication settings G4K device itself in Elspec's Web Interface. The procedure includes:

- Setting Web Entry Passwords & Providing Access to the FTP Server
- Establish the G4K device's IP in your Network
- Configure RS485/RS422 interface parameters in Serial Ports

## ACCESS THE G4K'S COMMUNICATION CONFIGURATIONS

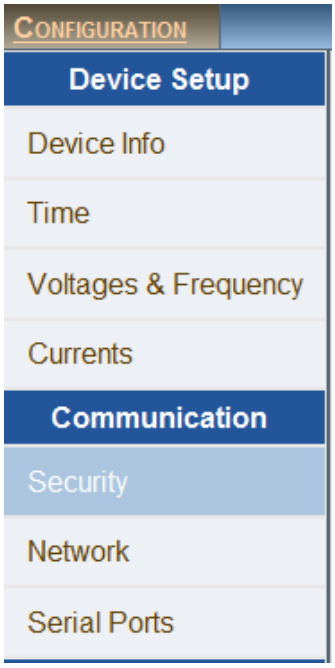
- Access the G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- All the Communication Configurations are located under the **Communication Tab:**



# Security

In this window you can set either Entry Passwords to the Web Interface and/or Provide Access to the FTP Server for your G4K unit.

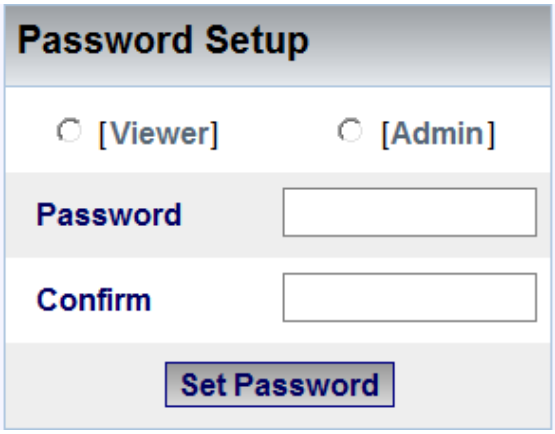
- Access the G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under **Communication** select the **Security Tab:**




## PASSWORD SETUP

This section enables the Administrator to change or reset the passwords of **Viewer** & **Administrator** levels at one option at a time:

- Select either the **Viewer** or **Admin** option:



**Levels:**

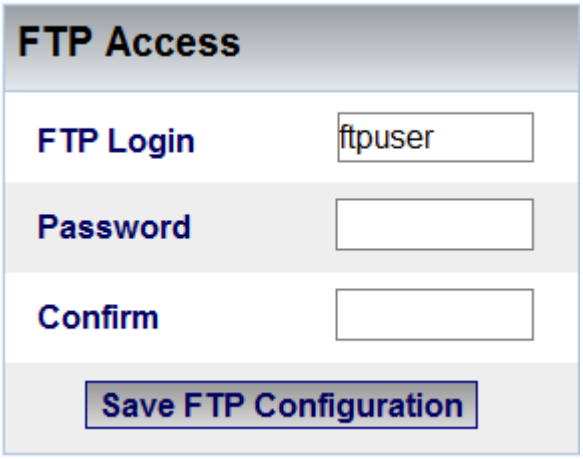
- **Viewer:** Users are able to view all the functions within Elspec's Web Interface, but are unable to configure the G4K Device (Manufacture's Default Password is **123)**
- **Admin:** Usually the Administrator of the G4K Device, is able to view & configure the unit (Manufacture's Default Password is **12345**)

- **Enter & Confirm the Password** ➡ select Set Password
- **To Reset** the passwords to the Manufacture's Default passwords select Reset Passwords.

## FTP ACCESS

The G4K BLACKBOX includes a FTP server which is accessed via the PQSCADA / Elspec's Search Utility in order to retrieve the PQZIP files recorded by the unit. The PQZIP files may be manually retrieved by initiating an FTP session with the BLACKBOX device. The **FTP Access** section below controls the **FTP Login** and **FTP Password** for security measures.

- Enter the **User Login**, **Password** & **Confirm the Password (**Manufacture's Default Login is **ftpuser** & Password is **ftppassword**)




- Select Save FTP Configuration
- **To Reset** the passwords to the Manufacture's Default passwords select Reset Passwords.

### *NOTE NOTE NOTE*

- **Changes made in the FTP Access section needs to be duplicated in the PQSCADA Configuration. (In the F1 Help Wizard of the PQSCADA, follow the Components ➡Nodes ➡Configuration ➡Device procedure)**

## SEE ALSO

- About G4K's Communication Configuration
- Network
- Serial Ports

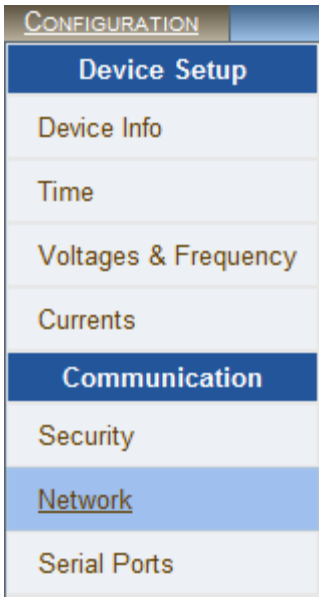
# About Network Setup

The Network setup is a crucial part of your G4K BLACKBOX's unit configuration. This setup procedure establishes the IP Address of your G4K Unit in the network. The procedure includes:

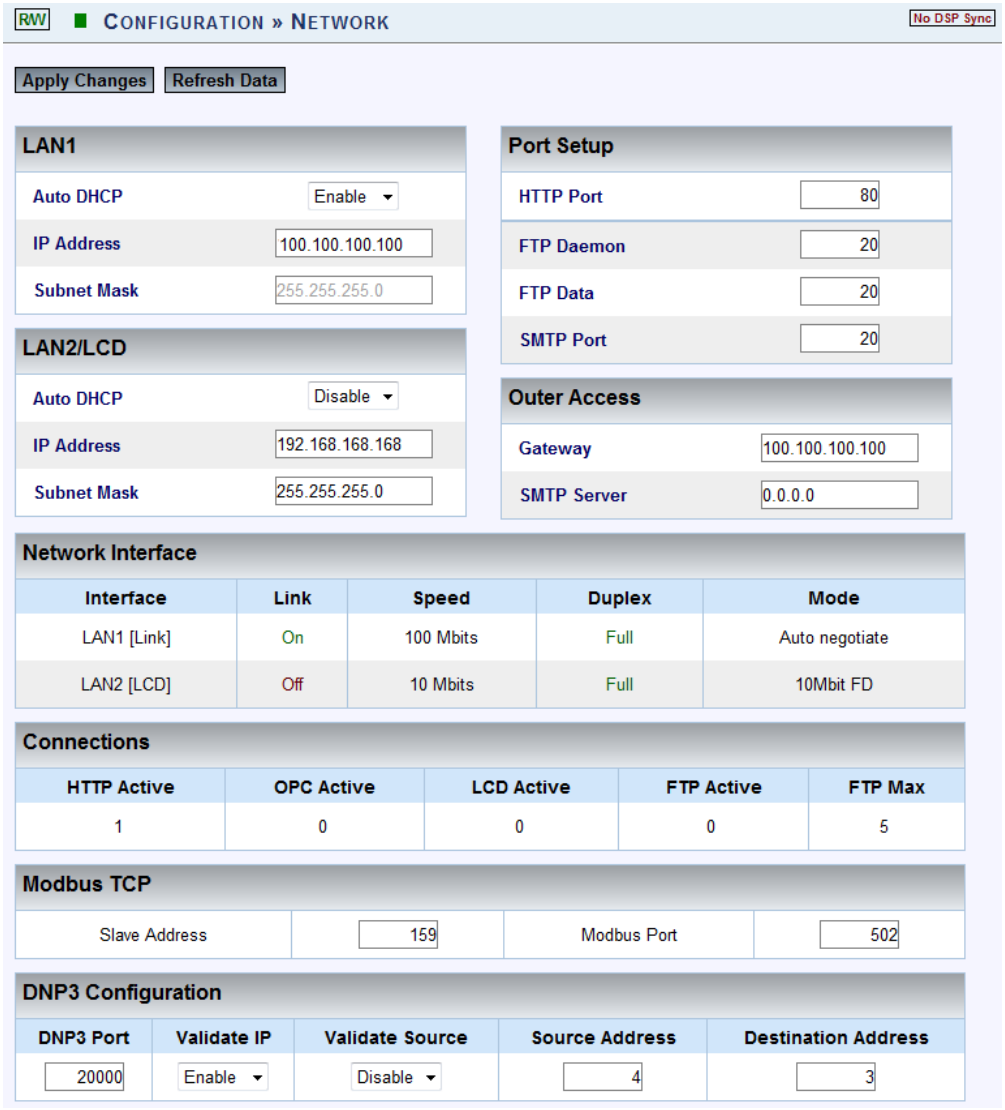
- Assign an IP Address for LAN 1 Port
- Connect G4100 RTU via LAN 2 Port (if applicable)
- Make allowances for Remote Access by configuring the Port Setup
- Send Data & Notifications from your G4K unit by providing Outer Access
- Set up ports for Data Retrieval from the G4K Device via Modbus Protocol
- Set up port for Data Retrieval from the G4K Device over the Ethernet
- View the Status Summaries of your G4K Device's Network Configurations

## OPEN THE NETWORK WINDOW

- Access G4K Device Configuration via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under **Communication** select the **Network Tab:**

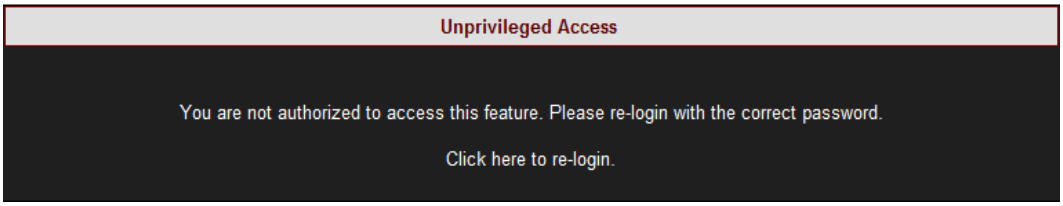


- The **Network Window** will now open:




## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




## SEE ALSO

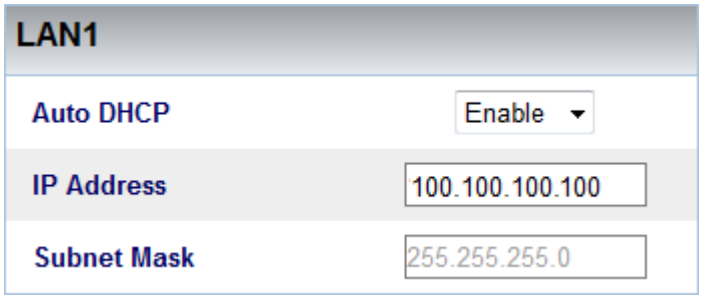
- About G4K's Communication Configuration
- Security
- Serial Ports

# LAN 1

Each G4K BLACKBOX unit needs to have a fixed IP Address. In each network the available IP numbers differs. The IP Address may be assigned either automatically via the LAN DHCP Server, or manually assigned by the user. Regardless as to what option you choose, prior to assigning the IP address to the unit you will need to consult your IT manager for the network as how to proceed.

## HOW TO CONFIGURE LAN 1

- As per the previous step Access the Network Window & in the **LAN 1 Section** you will have two options:




  - **Auto DHCP Disable** (User Assigned IP Address obtained from the IT Manager) all parameters will be fixed & User-Assigned:
    - Select **Auto DHCP Disable**
    - Enter the **IP Address**
    - An optional **Subnet Mask** (for this port & instrument) is entered as per your IT Manager's instructions
  - **Auto DHCP Enabled** allows the LAN DHCP server to assign an IP Address to the unit
    - Select **Auto DHCP Enable**
    - Your G4K's unit's **IP Address** & **Subnet Mask** will now be automatically assigned

- To apply your changes select Apply Changes → Refresh Data to review them

## *NOTE NOTE NOTE*

- LAN 1 & LAN 2 cannot co-exist in the same logical IP subnet, even if only one of them is actively connected to a network. For example: if LAN1 is configured as 172.17.4.68 with subnet mask of 255.255.0.0, then LAN2 cannot be configured as 172.17.X.X.
- The PQSCADA will not be able to identify any newly assigned IP Addresses for your G4K unit. As such, when the PQSCADA will download the PQZIP files from your G4K unit, it will not automatically associate the new IP with the same database. Therefore, you will need to configure the new IP Address for your G4K BLACKBOX Device in the PQSCADA (In the **F1 Help Wizard** of the **PQSCADA**, follow the **Components** ➡**Nodes** ➡**Configuration** ➡**Device** procedure)

## SEE ALSO

- About Network Setup
- LAN 2 / LCD Port Setup
- Port Setup
- Outer Access
- Modbus TCP
- DNP3 Configuration
- Status Summaries

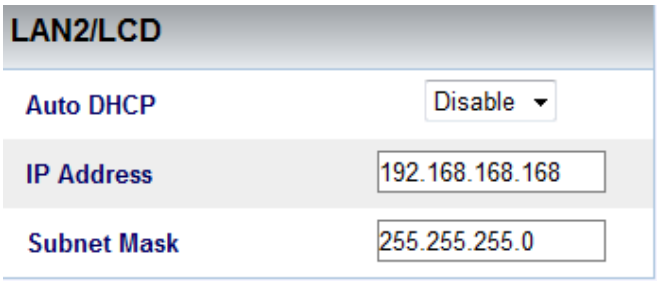
# LAN 2 / LCD Port Setup

The LAN 2 port is used for the G4100 LCD Display connection & the configuration procedure is very quick & easy to follow. There is no need to configure the LAN 2 port if the G4100 LCD Display is absent.

The port may also be used for to connect the device to an additional network other than the LAN 1 Port connection. As mentioned previously each Portable BLACKBOX unit needs to have a fixed IP Address & that in each network the available IP numbers differs. The IP Address may be assigned either automatically via the LAN DHCP Server, or manually assigned by the user. As per the LAN 1 Port, regardless as to what option you choose, prior to assigning the IP address to the unit you will need to consult your IT manager for the network as how to proceed.

## HOW TO CONFIGURE LAN 2

- Access the Network Window
- If you need to change the default settings, in the **LAN 2 Section** for Auto DHCP select **Disable**:




- **IP Address:** Is the IP address for this port on the instrument. It is recommended that you retain the default address of **169.254.249.247** in order to enable the G4100 LCD remote screen viewer's plug-&-play compatibility
- **Sub-Net Mask:** Is the Sub-net mask for this port on the instrument. It is recommended that you retain the default address of **255.255.255.0** in order to enable the G4100 LCD remote screen viewer's plug-&-play compatibility
- The Default settings will automatically appear in this section should no changes be required & the Auto DHCP will remain on **Enable**
- To apply your changes select 

to review them

### *NOTE NOTE NOTE*

**IMPORTANT: The IP Address & Sub-net for LAN 1 differs from LAN 2's IP Address & Sub-net as they are configured for two different networks. Therefore should you choose to Disable the default settings, ensure the IP Address for the G4100 LCD Display is configured on an additional Network.**

## SEE ALSO

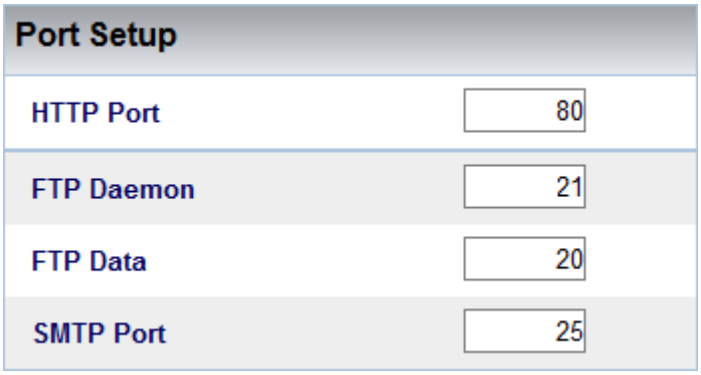
- About Network Setup
- LAN 1
- Port Setup
- Outer Access
- Modbus TCP
- DNP3 Configuration
- Status Summaries

# Port Setup

Within the Port Setup section, you will be able to configure your G4K Unit for remote access. In the Port Setup section you can configure the internet port numbers for standard communication protocols (E-Mails, File Transfer & Web Browsing). The primary reasons for utilizing this procedure is for networks where standard port numbers are forbidden or reserved by Firewalls; or it may be used in instances where you would like to reserve the standard port number for a legacy modem/router that does not support port forwarding. Most external modems/routers on the market today do support port forwarding. Elspec recommends retaining the default port addresses setup, in order to simplify & provide straightforward access for web browsers or FTP clients to your G4K unit via LAN/Internet.

## CONFIGURING PORT NUMBERS FOR STANDARD COMMUNICATION PROTOCOLS

- Access the Network Window
- In the **Port Setup Section** you have the following settings:




- **HTTP Port:** Utilized for setting the Web Browser's Port Address
- **FTP Daemon:** Utilized for setting the Port Address of File Transfer (Control Channel)
- **FTP Data:** Used for setting the Port Address of File Transfer (Data Channel)
- **SMTP Port:** Used for setting the Port Address of Mail Transfers. The SMTP server should allow anonymous clients. G4d oesn't support SMTP authentication.
- To apply your changes select Apply Changes → Refresh Data to review them

### *NOTE NOTE NOTE*

Changes to the FTP Ports also requires changes to Elspec's PQSCADA's configuration. (In the **F1 Help Wizard** of the **PQSCADA**, follow the **Components** ➡ **Nodes** ➡**Configuration** ➡ **Device** procedure. The FTP Port is added in the PQSCADA as an addition with your G4K's Device IP in the IP Address field as : 100.100.100.100:20)

## SEE ALSO

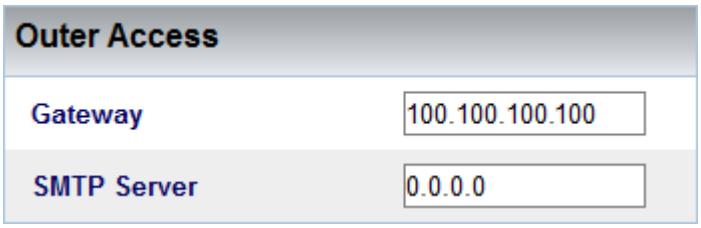
- About Network Setup
- LAN 1
- LAN 2 / LCD Port Setup
- Outer Access
- Modbus TCP
- DNP3 Configuration
- Status Summaries

# Outer Access

In this section you will be able to configure your G4K BLACKBOX for sending data to an IP Address outside its LAN 1 & setting an IP Address for sending Notification E-Mails.

## CONFIGURING THE G4K BLACKBOX FOR OUTER ACCESS

- Access the Network Window
- In the **Outer Access Section** you have the following settings:




- **Gateway:** Is utilized for setting the BLACKBOX'S default Gateway IP addresses in order to send data to an IP addresses outside its LAN 1
- **SMTP Server:** Is used for setting an IP Address for an E-Mail Server to be used for sending E-Mail Notifications
- To apply your changes select Apply Changes ➡ Refresh Data to review them

### *NOTE NOTE NOTE*

Configurations need to be duplicated & configured in Elspec's PQSCADA. (In the **F1 Help Wizard** of the **PQSCADA**, follow the **Components** ➡**Server** ➡**Configuration**➡**E-Mail** procedure).

## SEE ALSO

- About Network Setup
- LAN 1
- LAN 2 / LCD Port Setup
- Port Setup
- Modbus TCP
- DNP3 Configuration
- Status Summaries

# Modbus TCP

Modbus TCP allows your G4K unit to communicate in Modbus protocol, as well as, serve as a Modbus slave over the Ethernet. This protocol is used to retrieve data from the device. See How to Read and Write MODBUS Parameters for G4K BLACKBOX Device Series, for a detailed procedure on this integration.

## MODBUS CONFIGURATION

- Access the Network Window
- In the **Modbus TCP Section** you have the following settings:

| Modbus TCP | | | |
|---|---|---|---|
| Slave Address | 159 | Modbus Port | 502 |

- **Slave Address:** ID Address of a unit on a Modbus network
- **Modbus Port:** TCP Port on which the Modbus Protocol Operates
- To apply your changes select Apply Changes → Refresh Data to review them

## SEE ALSO

- About Network Setup
- LAN 1
- LAN 2 / LCD Port Setup
- Port Setup
- Outer Access
- DNP3 Configuration
- Status Summaries

# DNP3 Configuration

An Ethernet (OPC) protocol is an additional protocol that may be used for data retrieval from your G4K Unit via a DNP3 Server. It is within this section that you configure the settings for the DNP3 Server.

## CONFIGURING THE G4K'S PORT SETTINGS FOR A DNP3 SERVER

- Access the Network Window
- In the **DNP3 Configuration Section** you have the following settings:


- **DNP3 Port:** TCP port for the DNP3 protocol
- **Validate IP:** When this option is **Enabled** (default), it is possible to verify that the IP address of the UDP broadcast messages (if present) is equal to the current active TCP connection address in order to avoid unwanted inbound access
- **Validate Source:** When this option is **Enabled**, it is possible to check if the source address (the address of the client which sent the message to the G4k) of a message (any message) is equal to the destination address that the user inserts
- **Source Address:** The local DNP Address of your G4K Unit
- **Destination Address:** In order to "Validate Source"
- To apply your changes select 

to review them

## SEE ALSO

- About Network Setup
- LAN 1
- LAN 2 / LCD Port Setup
- Port Setup
- Outer Access
- Modbus TCP
- Status Summaries

# Status Summaries

Within the Network Window you are able to view two sections that summarize your G4K BLACKBOX's network configurations. The summaries include:

## NETWORK INTERFACE

| Network Interface | | | | |
|---|---|---|---|---|
| **Interface** | **Link** | **Speed** | **Duplex** | **Mode** |
| LAN1 [Link] | On | 100 Mbits | Full | Auto negotiate |
| LAN2 [LCD] | Off | 10 Mbits | Full | 10Mbit FD |

- **LAN 1 Status**:
  - **Link:** On ( indicates G4K U nit's I P A ddress i s e stablished in y our Network) / Off (G4K Unit's IP Address is not established)
  - **Speed:** Flow control of data transferrable speed
  - **Duplex:** Full (using Full Duplex for communication) / Half (using Half Duplex for communication)
  - **Mode:** Auto n egotiate m eans tha t y our G4K c onnected w ith th e Network s ever ch ooses co mmon t ransmission p arameters ( Speed, Duplex Mode & Flow Control)
- **LAN 2 G4100 LCD Status**:
  - **Link:** On (indicates your G4100 Unit's IP Address is established in the 2nd Network) / Off (Unit's IP Address is not established / not in use)
  - **Speed:** Flow control of data transferrable speed
  - **Duplex:** Full (using Full Duplex for communication) / Half (using Half Duplex for communication)
  - **Mode:** Transmission parameter is set at 10Mbit at Full Duplex (FD) to the 2nd Network's Server

## CONNECTIONS

| Connections | | | | |
|---|---|---|---|---|
| **HTTP Active** | **OPC Active** | **LCD Active** | **FTP Active** | **FTP Max** |
| 1 | 0 | 0 | 0 | 5 |

- **HTTP Active:** Connection status of your G4K BLACKBOX Unit & Web Browser as per Port Configuration
- **OPC Active:** Connection s tatus b etween y our G4 K BLA CKBOX & the DNP3 OPC Server
- **LCD Active:** Connection status of G4100 as per LAN 2 Configuration to the 2nd Network
- **FTP Active:** Connection status of the File Transfer Control Channel as per

- **FTP Max:** Number of users defined FTP Access
- Review your changes by selecting Refresh Data

## SEE ALSO

- About Network Setup
- LAN 1
- LAN 2 / LCD Port Setup
- Port Setup
- Outer Access
- Modbus TCP
- DNP3 Configuration

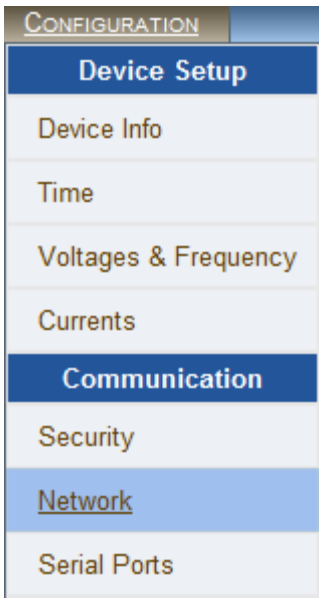
# Serial Ports

In this section you will be able to configure the serial lines of your G4K BLACKBOX for data link connectivity, including:

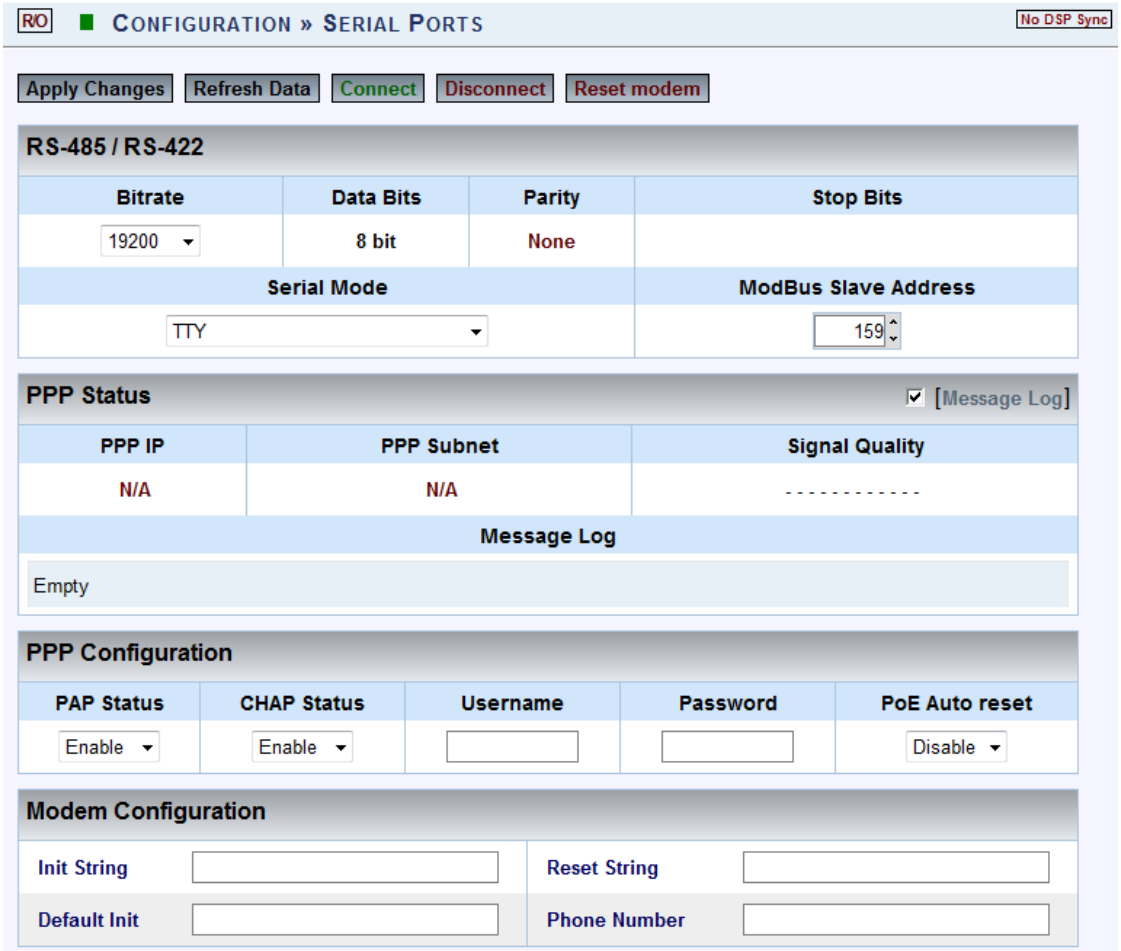
- Setting up the configurations of the RS485/RS422 interface parameters itself
- Configuring the PPP (Point-to-Point Protocol) parameters for serial communication
- Viewing the status of the PPP
- Setting up a standard AT commands modem (See also G4K GPRS Remote Modem Connectivity)

## OPEN THE SERIAL PORTS WINDOW

- Access G4K Device Configuration via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under **Communication** select the **Serial Ports Tab:**

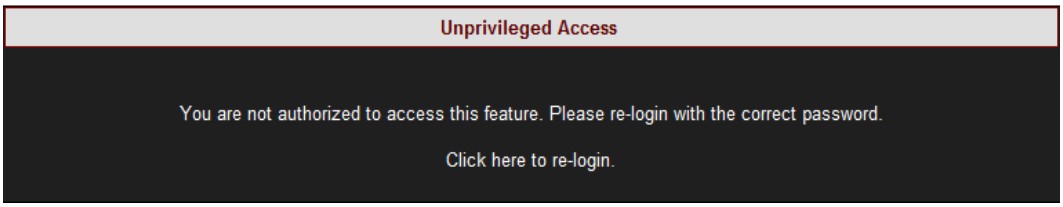


- The **Serial Ports Window** will now open:




## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




## SEE ALSO

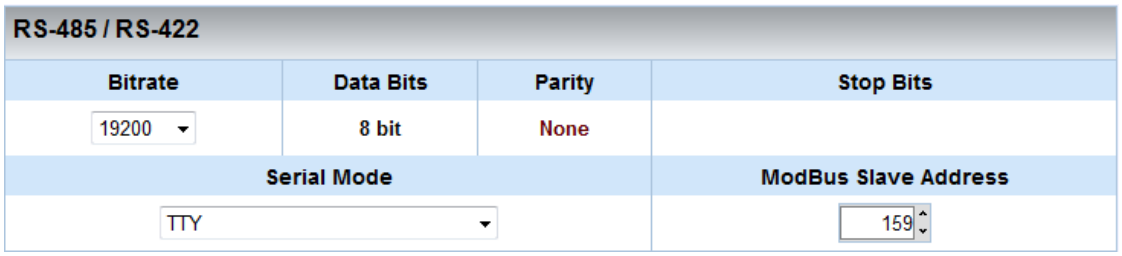
- About G4K's Communication Configuration
- Security
- Network

# RS-485 / RS-422

The setup configures the parameters of RS-485/RS-422 serial interface.

## HOW TO CONFIGURE RS-485 / RS-422 SERIAL INTERFACE

- As per the previous step Access the **Serial Ports Window** & in the **RS-485/RS-422 Section** complete the applicable **Parameters**:




  - **Bitrate:** With the ▼adjust the transfer rate for data
  - **Data Bits:** (For information only) Indicates the number of data bits in a byte
  - **Parity:** (For information only) Parity code indicating error detection (Movement of digital data from one location to another)
  - **Stop Bits:** (For information only) Number of stop bits used to mark the end of a byte transmission
  - **Serial Mode:** With the ▼select configuration from available **Options:**
    - **TTY:** Debug shell mode for PPP stream
    - **Elcom :** Elspec communication for connecting to the Equalizer
    - **ModBus RTU:** ModBus protocol (serving as a slave on a Modbus network)
    - **GPS:** For GPS attachment to this serial port
    - **PPP:** Connection for PPP communication through this serial port
  - **ModBus Slave Address:** Unique ID of the BLACKBOX on a Modbus network

- To apply your changes select Apply Changes ➡ Refresh Data to review them
- In order to establish connection as per the setup configurations select Connect
- In order to discontinue the connection select Disconnect

## SEE ALSO

- About Serial Ports
- PPP Configuration
- PPP Status
- Modem Configuration

# PPP Configuration

In this section you will be able to configure PPP (Point-to-Point Protocol) parameters for serial communication.

## HOW TO CONFIGURE PPP PARAMETERS

- Access the **Serial Ports Window** & in the **PPP Configuration Section** complete the applicable **Parameters**:


  - **PAP Status:** With the ▼Enable/Disable the PAP (Password Authentication Protocol) feature
  - **CHAP Status:** Enable/Disable CHAP (Challenge Handshake Authentication Protocol) feature
  - **Username:** This is the Username that you receive from your ISP (Internet Service Provider)
  - **Password:** This is the Password that you receive from your ISP

- To apply your changes select Apply Changes → Refresh Data to review them
- In order to establish connection as per the setup configurations select Connect
- In order to discontinue the connection select Disconnect

## SEE ALSO

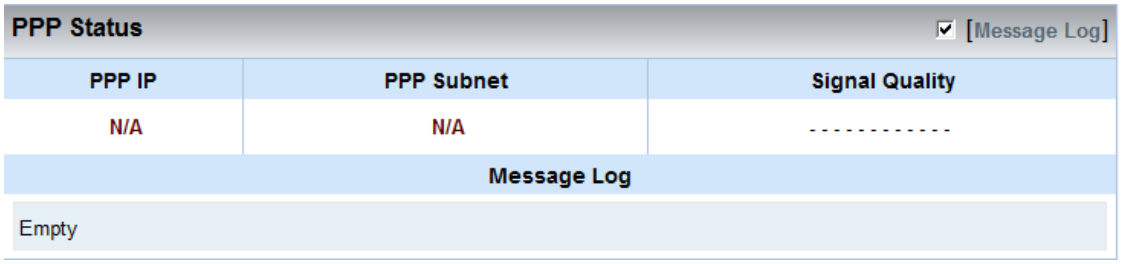
- About Serial Ports
- RS-485 / RS-422
- PPP Status
- Modem Configuration

# PPP Status

This indicates the status of the PPP with a Log.

## HOW TO VIEW PPP STATUS

- Access the **Serial Ports Window** & in the **PPP Status** section **Select/Deselect** the **Message Log** with ☑☐. This will Enable/Disable the logging of this protocol's activity in the log:




- To apply your changes select Apply Changes → Refresh Data to review them

## SEE ALSO

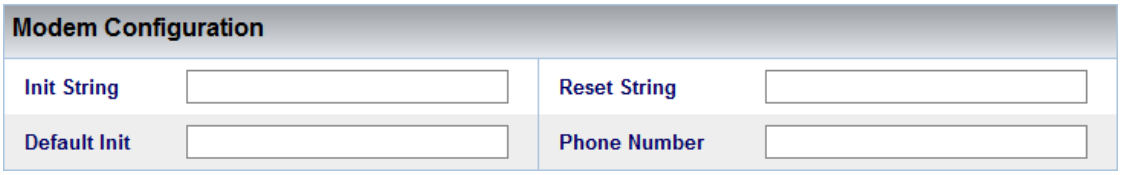
- About Serial Ports
- RS-485 / RS-422
- PPP Configuration
- Modem Configuration

# Modem Configuration

The following strings require setup when working with a standard AT commands modem.

## HOW TO CONFIGURE THE MODEM SETUP

- Access the **Serial Ports Window** & in the **Modem Configuration Section** complete the applicable **Parameters**:




  - **Init String:** AT command string to initialize the modem
  - **Reset String:** AT command string to reset the modem
  - **Default Init:** AT command string to set the modem to default configuration
  - **Phone Number:** Dial up number (without any gaps/hyphenation marks)

- To apply your changes select Apply Changes → Refresh Data to review them
- In order to connect the modem as per the setup configurations select Connect
- In order to disconnect the modem select Disconnect

## SEE ALSO

- About Serial Ports
- RS-485 / RS-422
- PPP Configuration
- PPP Status

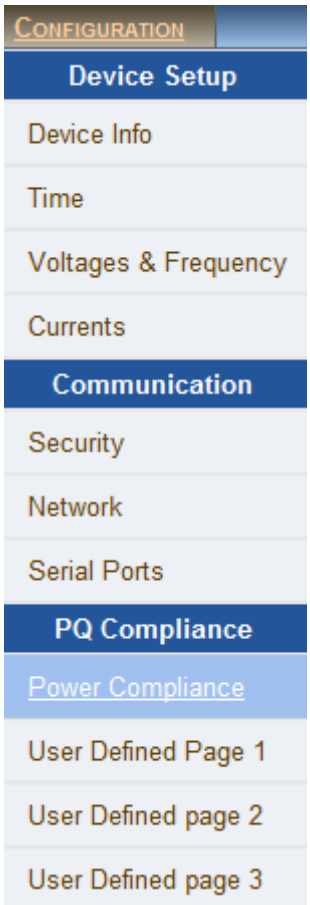
# About Power Quality Compliance

The G4K BLACKBOX device series provides PQ Parameters according to EN50160 & IEC61000-4-30, including other National Standards. In this window you will be able to:

- Select the specific compliance standard to be evaluated by the unit's internal compliance engine
- Customize parameters to comply with any other unique standards or requirements

## ACCESS THE G4K'S POWER QUALITY COMPLIANCE WINDOW

- Access the G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- All the PQ compliance configurations (including the user-defined pages) are located under the **PQ Compliance Tab:**



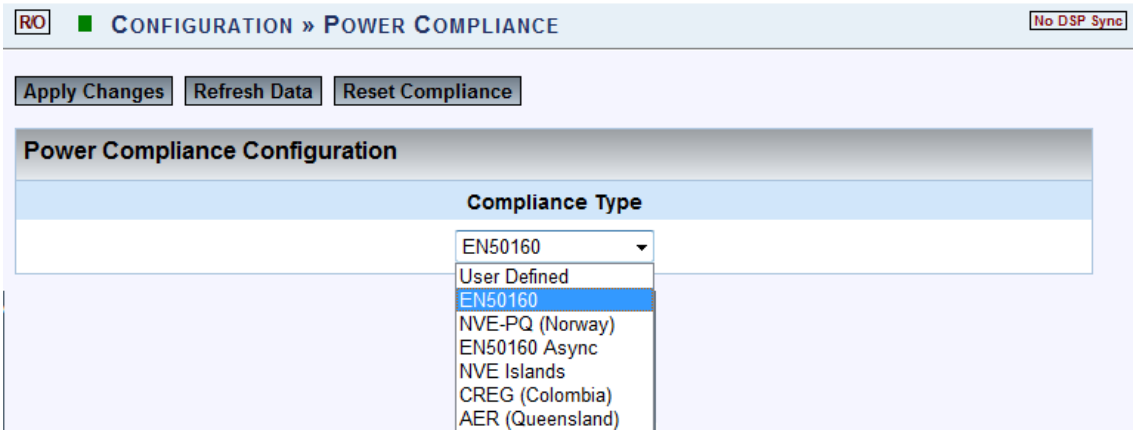
# Power Quality Compliance Configuration

The G4K BLACKBOX contains a power quality compliance engine that enables real-time evaluation of power quality according to a number of standards, such as:

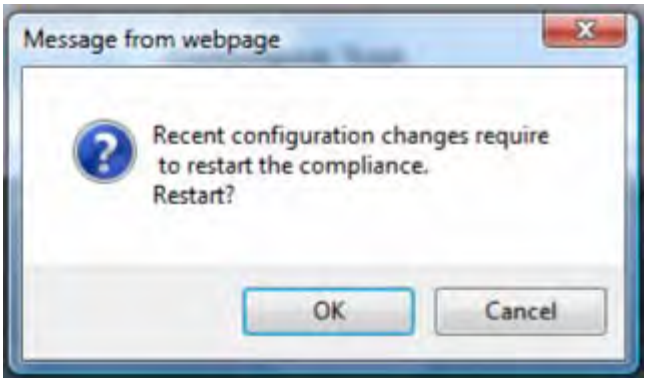
- EN50160
- EN50160 Asynchronous Torque
- NVE-PQ (Norway)
- NVE (Islands)
- CREG (Colombia)
- AER (Queensland - Australia)

On this page you will be able to select the specific compliance standard to be evaluated by your G4K unit's internal compliance engine.

- Access the G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select **Configuration** ➡ **PQ Compliance** ➡ **Power Compliance.** The **Power Compliance** window will now open:




- From the drop down selection ▼select the **Applicable Compliance Standard**
- Select Apply Changes & the following Message Box will appear in order to **Restart the Compliance Evaluations by the G4K**:

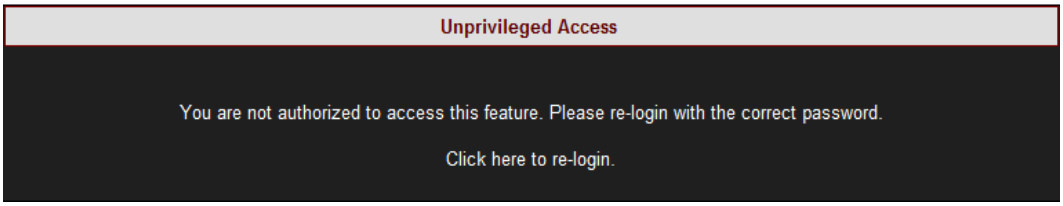


- Select OK & you will receive the following Success Message:


- Select Refresh Data to review your changes

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes ➡ OK to actually affect your changes.

## SEE ALSO

- About PQ Compliance
- User Defined Pages
- User Defined Page 1
- User Defined Page 2
- User Defined Page 3

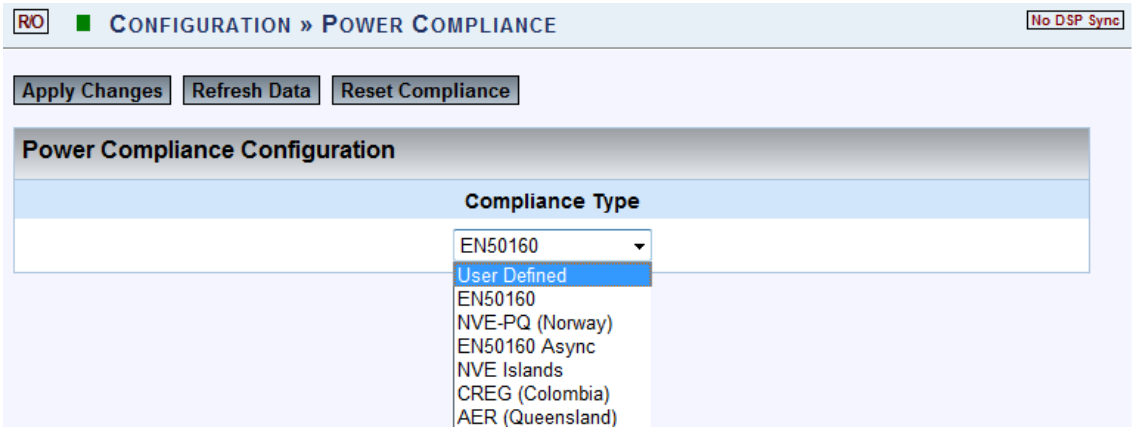
# User Defined Pages

In addition to real-time evaluations for an number of Power Quality Compliance standards, the G4K's built-in PQ engine supports a user-compliance mode in which all compliance parameters can be self-edited & modified. This self-editing & modification allows the user to set parameters that will meet unique conditions, rules, measurement intervals at different observation periods. The windows consist of:

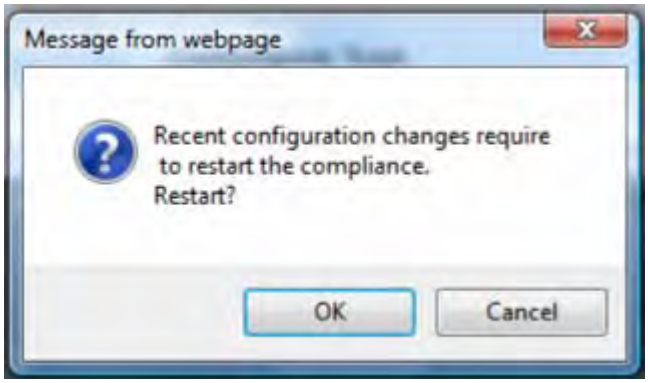
- User Defined Page 1 - Which encompasses: Voltage Frequencies, Voltage Dips Supply, Long Interruptions & Temporary Overvoltage (Swells)
- User Defined Page 2 - Which encompasses: Voltage Variations, Rapid Voltage Changes, Unbalanced Voltage & Voltage Flickering
- User Defined Page 3 - Which encompasses: Voltage Harmonics ( Including individual Harmonics)

## OPEN & ACTIVATE THE USER DEFINED PAGES

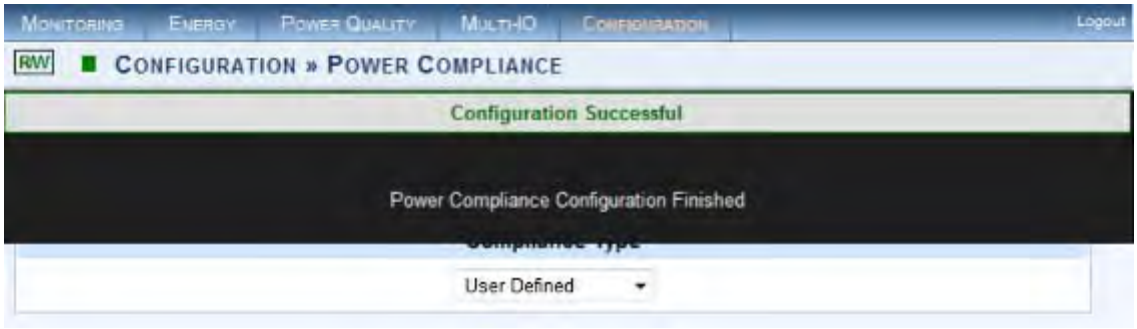
- Access the G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select **Configuration Tab** ➡ **PQ Compliance Tab**
- In the **Power Compliance** window select **User Defined:**




- Select Apply Changes & the following Message Box will appear in order to **Restart the Compliance Evaluations by the G4K**:



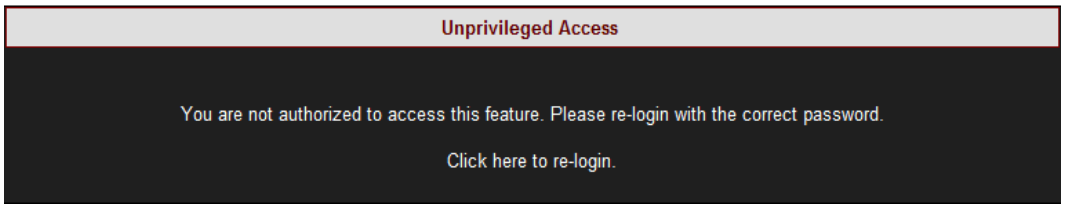

- Select OK & you will receive the following Success Message:




- Select Refresh Data to review your changes.

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes ➡ OK to actually affect your changes.

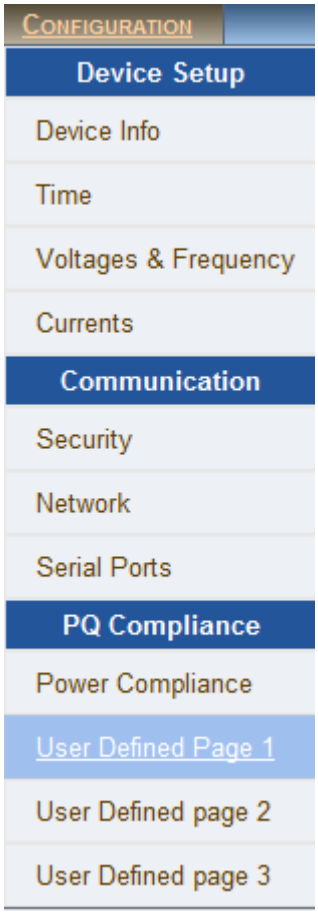
## SEE ALSO

- About PQ Compliance
- Power Quality Compliance Configuration
- User Defined Page 1
- User Defined Page 2
- User Defined Page 3

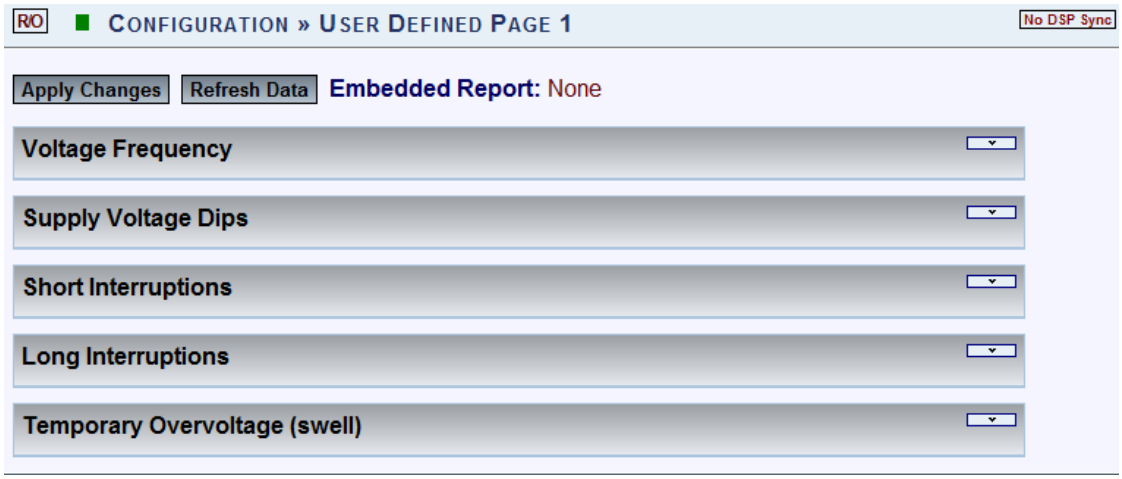
# User Defined Page 1

In this window you will be able to edit & modify an number of compliance parameters thereby enabling your G4K BLACKBOX's built-in engine to perform real-time evaluations that will meet unique Power Quality Compliance standards.

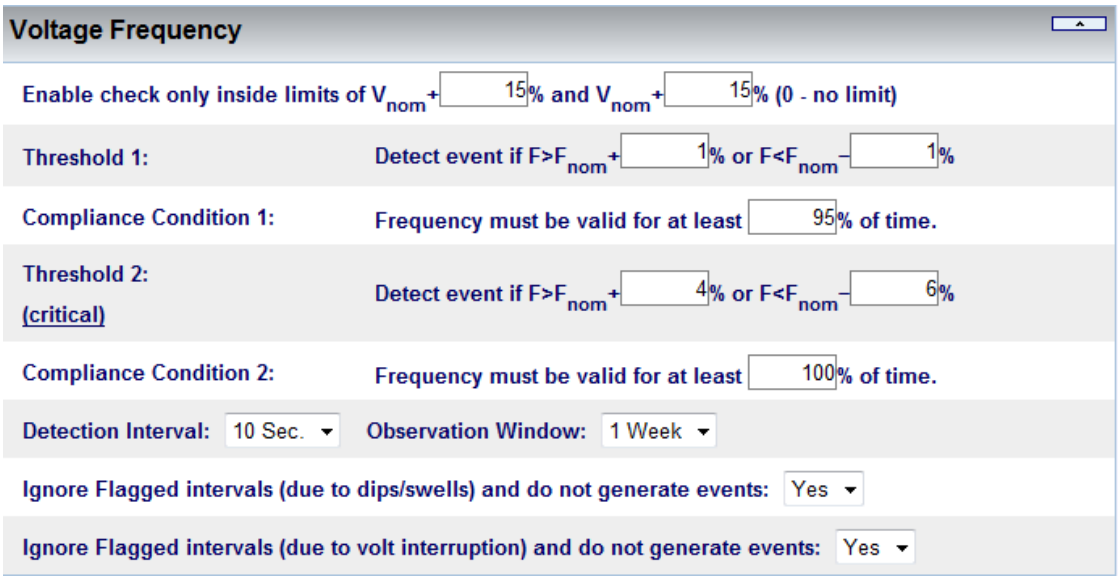
- After you have set the PQ Compliance to Evaluate User Defined Parameters, open **PQ Compliance → User Defined Page 1:**




- Collapse / Expand with ⌃ ⌄ in order to edit & modify compliance parameters for each of the following sections:

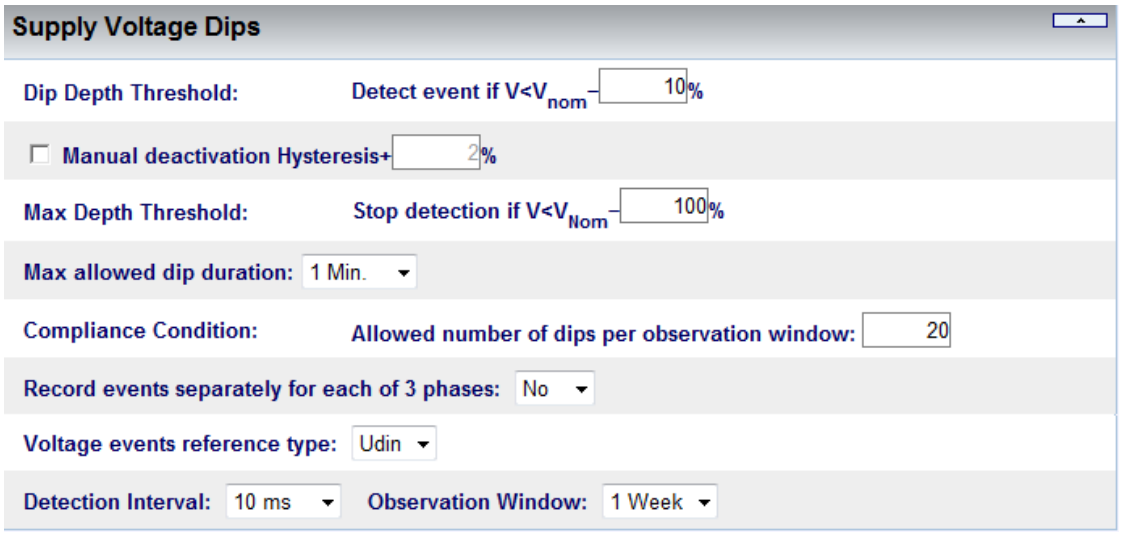


## VOLTAGE FREQUENCIES



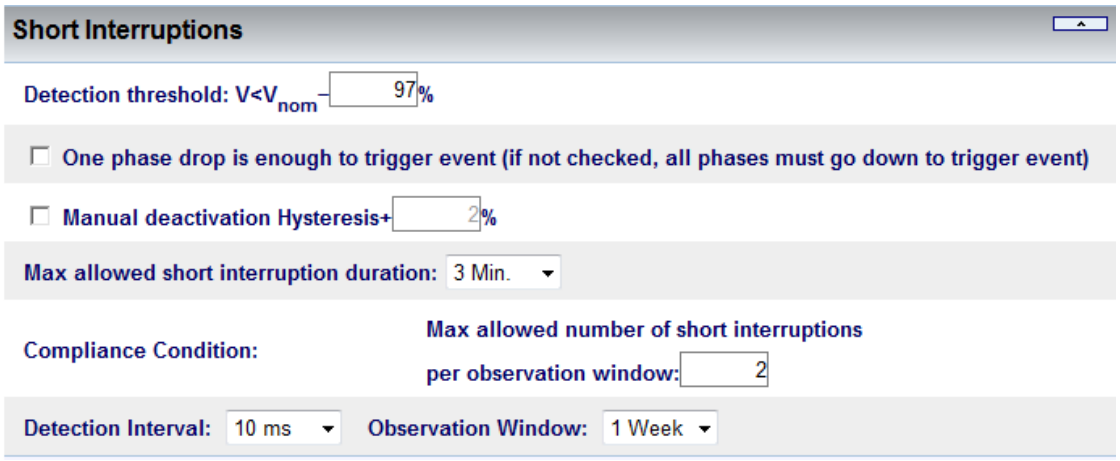

- Frequency compliance is based on statistics: N, N1 & N2. Frequency measurement interval is 10 sec in an entire observation window of 1 week. N - amount of intervals. N1 - intervals frequency exceeded [+1.00%,-1.00%] from nominal freq. N2 - intervals frequency exceeded [+4.00%,-6.00%] from nominal freq. N1 & N2 increment only if valid voltage inside nominal boundary of [+15.0%,-15.0%]. Compliance if both N/N1 >= 95.0% of time and N/N2 >= 100.0% of time. Intervals with voltage interruption are discarded. Intervals with DIPS or Over voltage are discarded.

## SUPPLY VOLTAGE DIPS



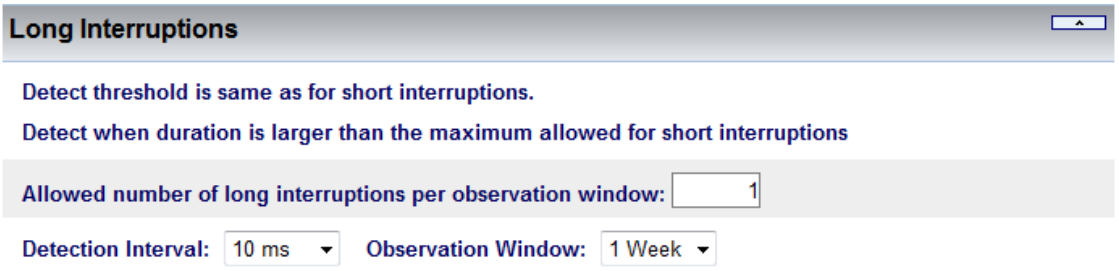

- DIP is a voltage drop of more than 10.0% from Nominal (but no more than 100.0%, and deactivate on 8.0%) DIP min time is 10 ms and max time of 1 min. DIP events are counted per all phases combined within observation window of 1 week. Total events (N) allowed is: 20.

## SHORT INTERRUPTIONS



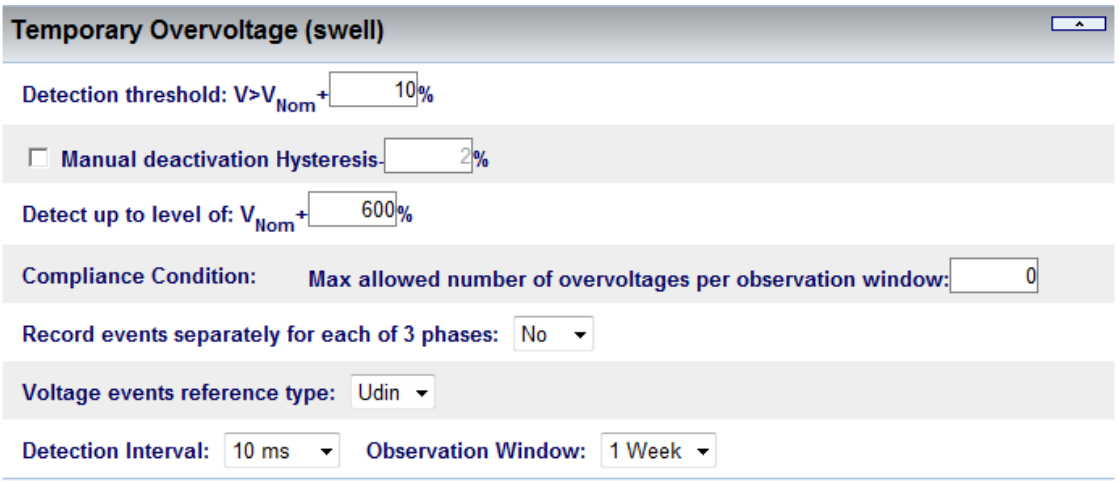

- Short interruption is a voltage drop of less than 97.0% from nominal (event deactivate on 77.6%). Min duration 10 ms, Max duration 3 min. events are counted in the entire observation window of 1 week. Total events (N) allowed is: 2.

## LONG INTERRUPTIONS

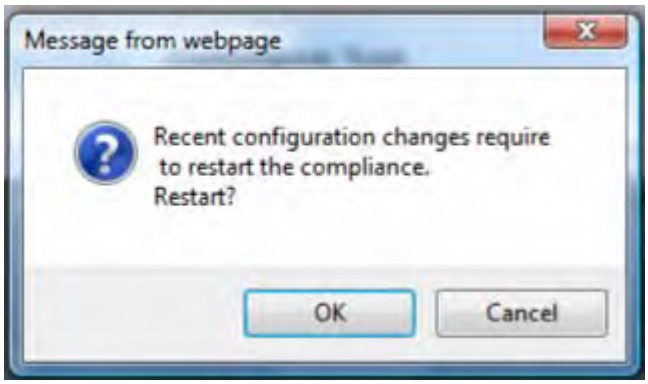



- Long interruptions are the same as short ones but with a longer duration (longer than short interruption maximum time). Long interruptions events are counted within observation window of 1 week. Total events (N) allowed is: 1.

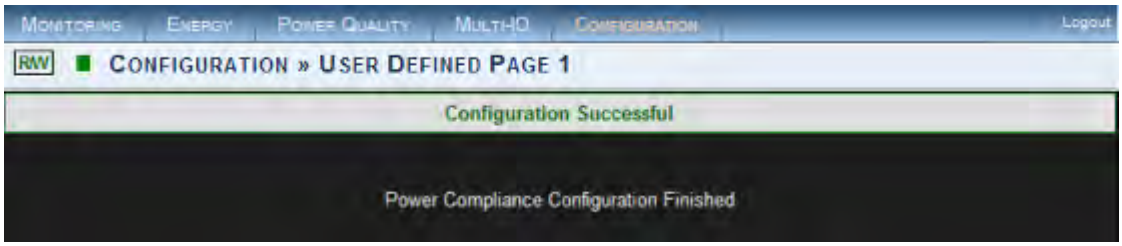
## TEMPORARY OVERVOLTAGE (SWELLS)



- Over-voltage events are characterized with RMS voltage higher than 10.0% above Nominal (event deactivate on 8.0%). Min over-voltage event duration is 10 ms, events are counted per all phases combined within observation window of 1 week. No specific events count limitation defined.
- After you have made your selection, select Apply Changes & the following Message Box will appear in order to **Restart the Compliance Evaluations by the G4K**:



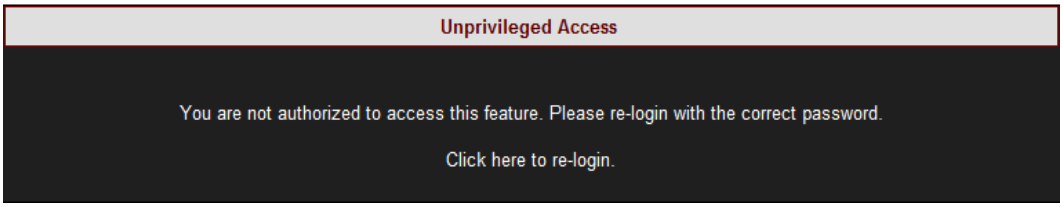

- Select OK & you will receive the following Success Message:




- Select Refresh Data to review your changes.

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes ➡ OK to actually affect your changes.

## SEE ALSO

- About PQ Compliance
- Power Quality Compliance Configuration
- User Defined Pages
- User Defined Page 2
- User Defined Page 3

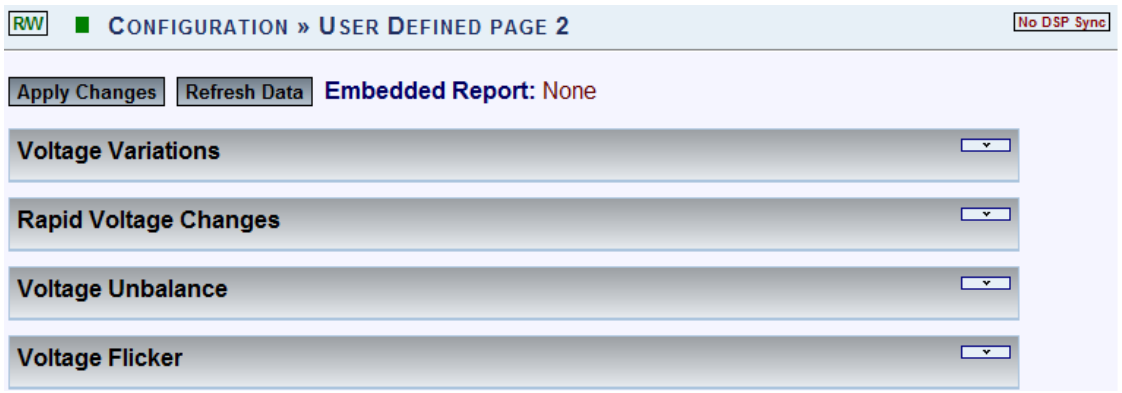
# User Defined Page 2

In t his w indow y ou will b e a ble to edit & m odify a n umber o f co mpliance parameters thereby enabling your G4K BLACKBOX's built-in engine to perform real-time evaluations that will meet unique Power Quality Compliance standards.

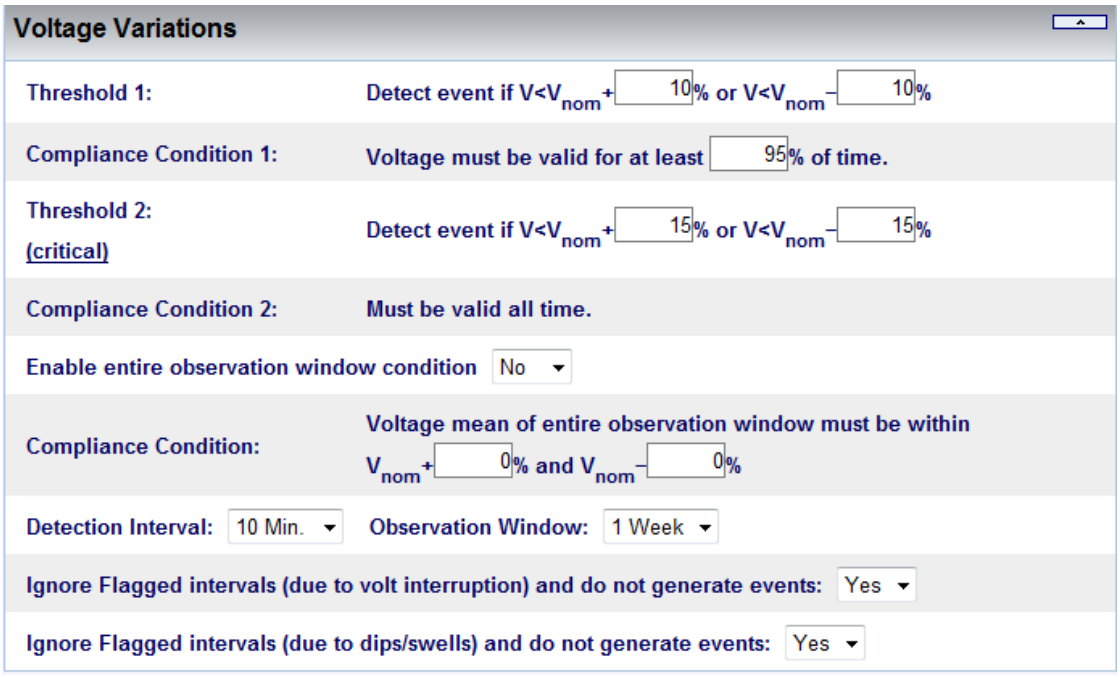
After you have set the PQ Compliance to Evaluate User Defined Parameters, open

**PQ Compliance ➡ User Defined Page 2:**


- Collapse / Expand with ⌃ ⌄ in order to edit & modify compliance parameters for each of the following sections:

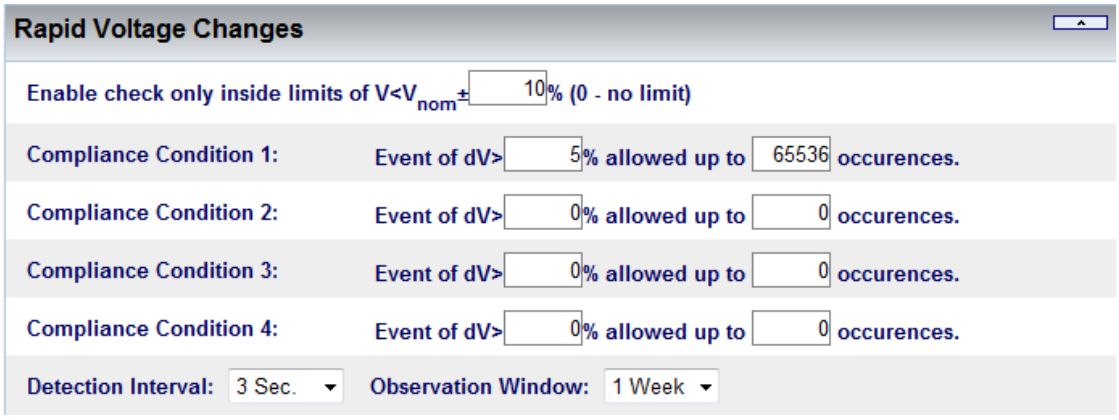


## VOLTAGE VARIATIONS



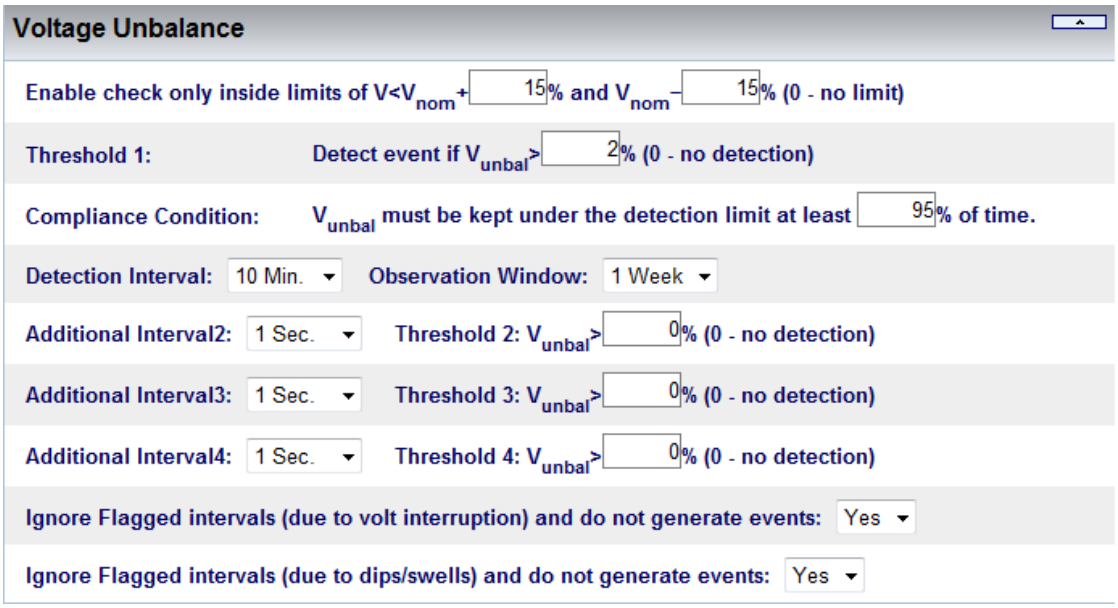

- Variations are evaluated by collecting statistics: N, N1 & N2. Statistics are collected as average voltage within intervals of 10 min in observation window of 1 week. N - amount of intervals. N1 - intervals voltage exceeded [+10.0%,-10.0%] boundary of nominal. N2 - intervals voltage exceeded [+15.0%,-15.0%] boundary of nominal. Compliance if N/N1 >= 95.0% during the entire observation window. Intervals with voltage interruption are discarded. Intervals with DIPS or OVER Voltage are discarded.

## RAPID VOLTAGE CHANGES



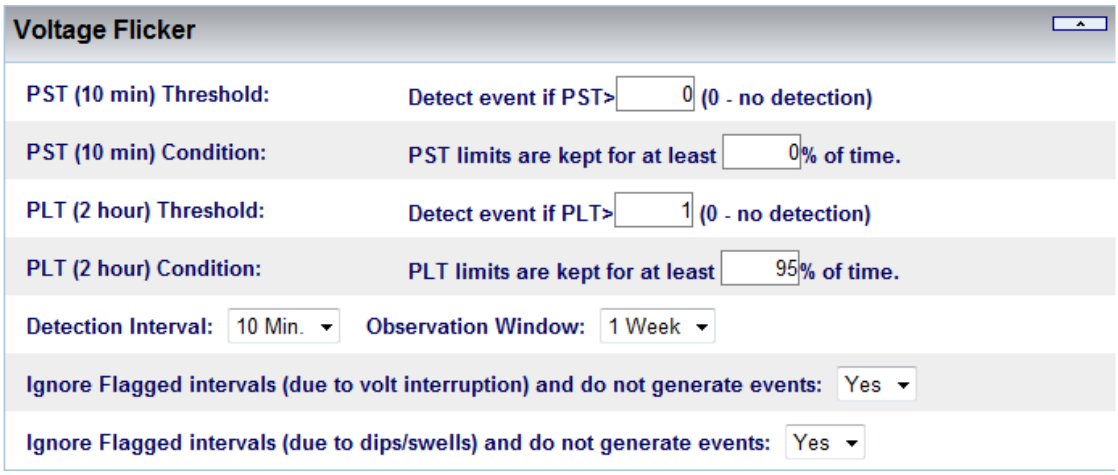

- Rapid voltage change is based on a 3 Sec window in which RMS voltage min and max values are obtained (min,max values should be within +-10.0% from nominal). The rapid change is the percent of delta between min and max divided by average RMS of 9 Sec. The Rapid percent results are evaluated during observation window of 1 week. Rapid changes are limited to specific count (N): Rapids of more 5.00% allowed: N <= 65536 occurrences.

## VOLTAGE UNBALANCE



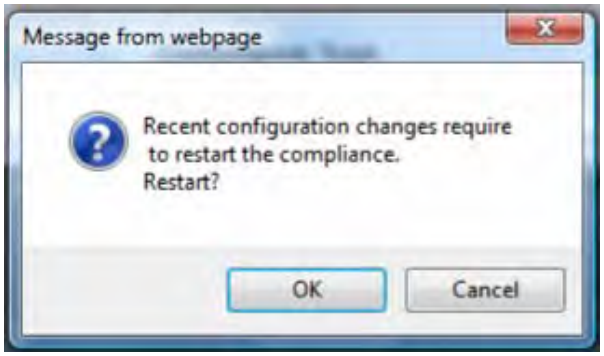

- Voltage unbalance is evaluated at intervals of 10 min within observation window of 1 week. Evaluation is only at intervals in which voltage is inside nominal boundary of [+15.0%,-15.0%]. Unbalance limit N1 is set to 2.00% and must be kept 95.0% of observation time. Intervals with voltage interruption are discarded. Intervals with DIPS or Over voltage are discarded.

## VOLTAGE FLICKER

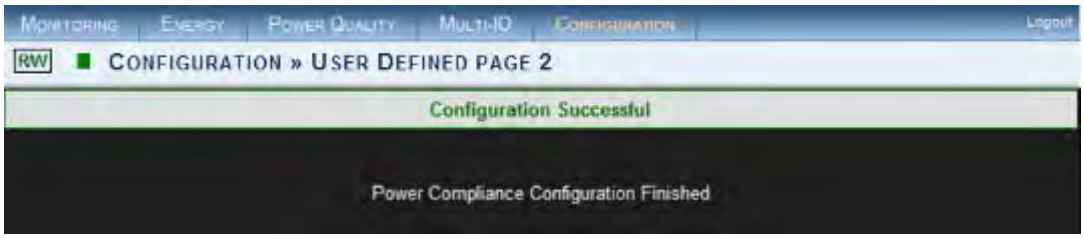



- Flicker severity is evaluated within observation window of 1 week. During interruption Flicker interval is discarded. During DIPS or Over voltage Flicker Interval is discarded. Plt (2 hours) must be equal or under 1.0 during 95.0% of observation time.

- After you have made your selection, select Apply Changes & the following Message Box will appear in order to **Restart the Compliance Evaluations by the G4K**:



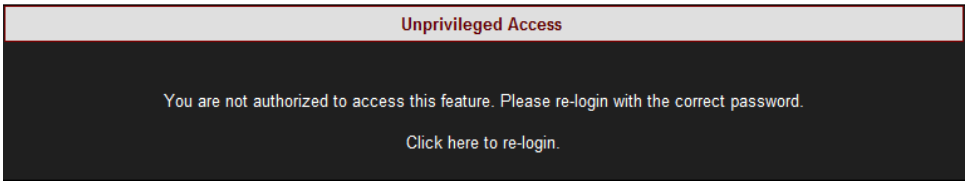

- Select OK & you will receive the following Success Message:




- Select Refresh Data to review your changes.

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes ➡ OK to actually affect your changes.

## SEE ALSO

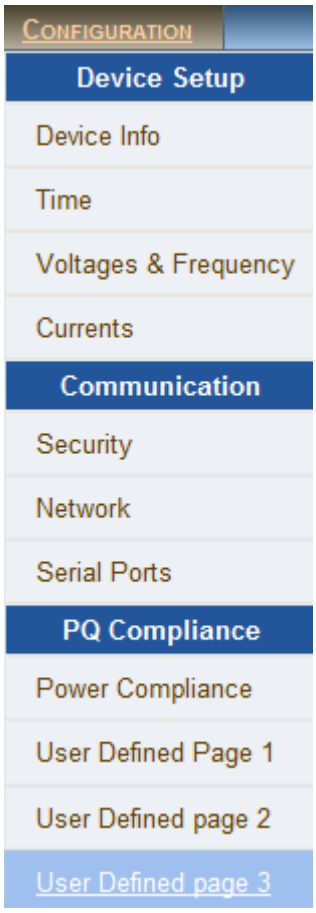
- About PQ Compliance
- Power Quality Compliance Configuration
- User Defined Pages
- User Defined Page 1
- User Defined Page 3

# User Defined Page 3

In this window you will be able to edit & modify a number of compliance parameters thereby enabling your G4K BLACKBOX's built-in engine to perform real-time evaluations that will meet unique Power Quality Compliance standards.

After you have set the PQ Compliance to Evaluate User Defined Parameters, open

**PQ Compliance ➡ User Defined Page 3:**




- Collapse / Expand with ▲ ▼ in order to edit & modify compliance parameters for each of the following sections:

## VOLTAGE HARMONICS

**Voltage Harmonics**

| | |
|---|---|
| Enable check only inside limits of $V<V_{nom}+$ 15% and $V_{nom}-$ 15% (0 - no limit) | |
| Threshold: | THD> 8% (0 - no detection)<br>Individual harmonic limits are specified in the table below |
| Compliance Condition 1: | THD and harmonics are below specified limits<br>for at least 95% of time. |
| Compliance Condition 2: | THD over entire observation<br>window must be less than 0% (0 - no detection) |
| Detection Interval: 10 Min. | Observation Window: 1 Week |
| Ignore Flagged intervals (due to volt interruption) and do not generate events: Yes | |
| Ignore Flagged intervals (due to dips/swells) and do not generate events: Yes | |

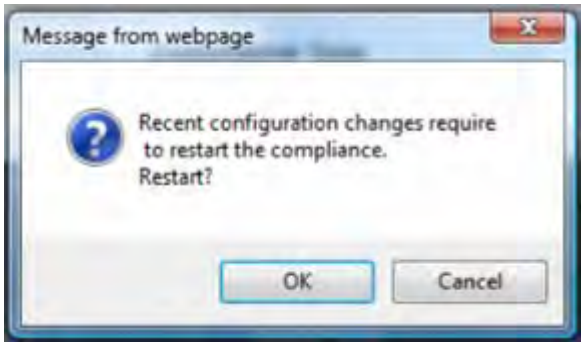
- Harmonics evaluated at intervals of 10 min within observation window of 1 week. Evaluation at intervals in which voltage is inside nominal boundary of [+15.0%,-15.0%]. Discarding Intervals with VOLT-INT. Discarding Intervals with DIPS or OVER-VOLT. Individual Harm is limited according to the following table: H2<=2. 0%, H3<=5.0%, H 4<=1.0%, H5< =6.0%, H6<=0.5%, H7< =5.0%, H8<=0.5%, H 9<=1.5%, H10 <=0.5%, H11 <=3.5%, H12< =0.5%, H1 3<=3.0%, . . . THD limit is set 8 .0% ( N2). THD and H arms limits shall be kept at least 9 5.0% of time.

## INDIVIDUAL HARMONIC LIMITS

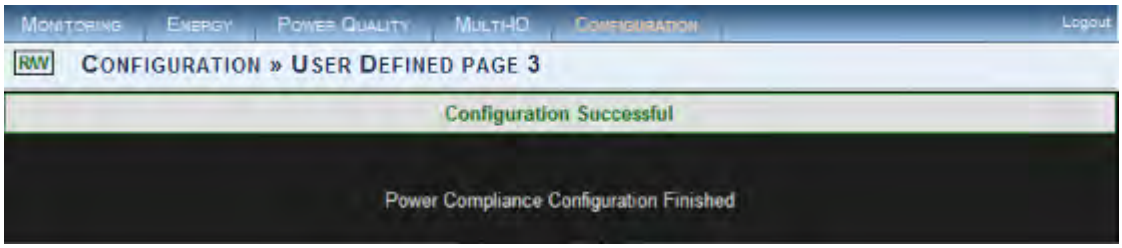
**Individual Harmonic Limits:**

| | | | | |
|---|---|---|---|---|
| | $H_2<$ 2% | $H_3<$ 5% | $H_4<$ 1% | $H_5<$ 6% |
| $H_6<$ 0.5% | $H_7<$ 5% | $H_8<$ 0.5% | $H_9<$ 1.5% | $H_{10}<$ 0.5% |
| $H_{11}<$ 3.5% | $H_{12}<$ 0.5% | $H_{13}<$ 3% | $H_{14}<$ 0.5% | $H_{15}<$ 0.5% |
| $H_{16}<$ 0.5% | $H_{17}<$ 2% | $H_{18}<$ 0.5% | $H_{19}<$ 1.5% | $H_{20}<$ 0.5% |
| $H_{21}<$ 0.5% | $H_{22}<$ 0.5% | $H_{23}<$ 1.5% | $H_{24}<$ 0.5% | $H_{25}<$ 1.5% |
| $H_{26}<$ 0.5% | $H_{27}<$ 0.5% | $H_{28}<$ 0.5% | $H_{29}<$ 1% | $H_{30}<$ 0.5% |
| $H_{31}<$ 1% | $H_{32}<$ 0.5% | $H_{33}<$ 0.5% | $H_{34}<$ 0.5% | $H_{35}<$ 1% |
| $H_{36}<$ 0.5% | $H_{37}<$ 1% | $H_{38}<$ 0.5% | $H_{39}<$ 0.5% | $H_{40}<$ 0.5% |

- After you have made your selection, select Apply Changes & the following Message Box will appear in order to **Restart the Compliance Evaluations by the G4K**:



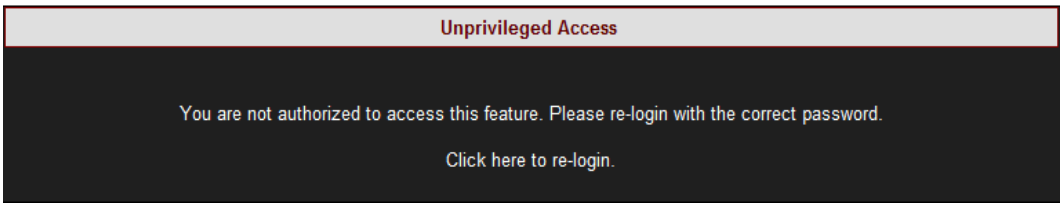

- Select OK & you will receive the following Success Message:




- Select Refresh Data to review your changes.

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes ➡ OK to actually affect your changes.

## SEE ALSO

- About PQ Compliance
- Power Quality Compliance Configuration
- User Defined Pages
- User Defined Page 1
- User Defined Page 2

# Advanced Settings

Within the **Advanced Tab** you may configure the G4K BLACKBOX device series' unique capabilities. These capabilities include:

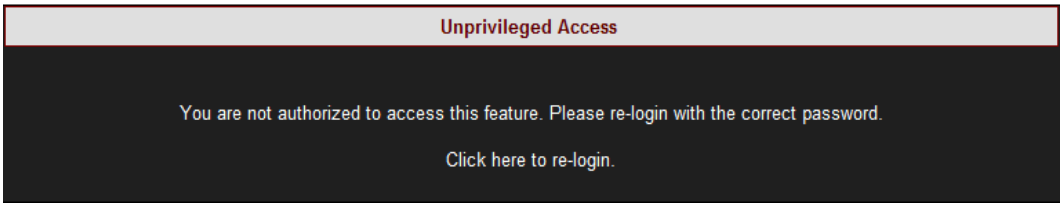
- View & Copy the System Log
- Create Custom Events
- Configure & Send E-Mail Alerts
- Produce Energy & Parameter Logs for Reporting
- Configure the Energy Meter
- Customize Display in Display Setup
- Upgrade your G4K's Software

## OPEN THE ADVANCED TAB

- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- All the advanced settings are located under the **Advanced Tab:**

## NOTE NOTE NOTE

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:

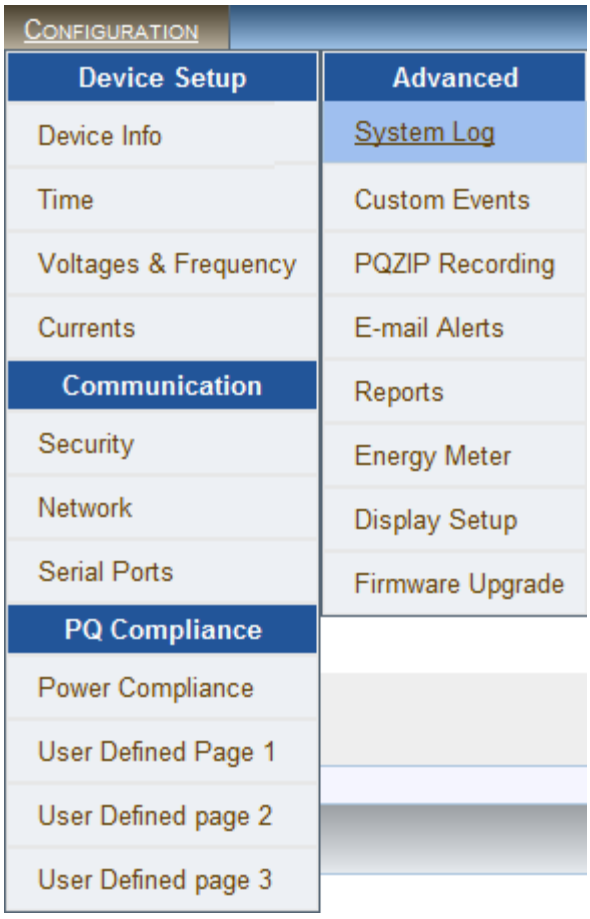


# System Log

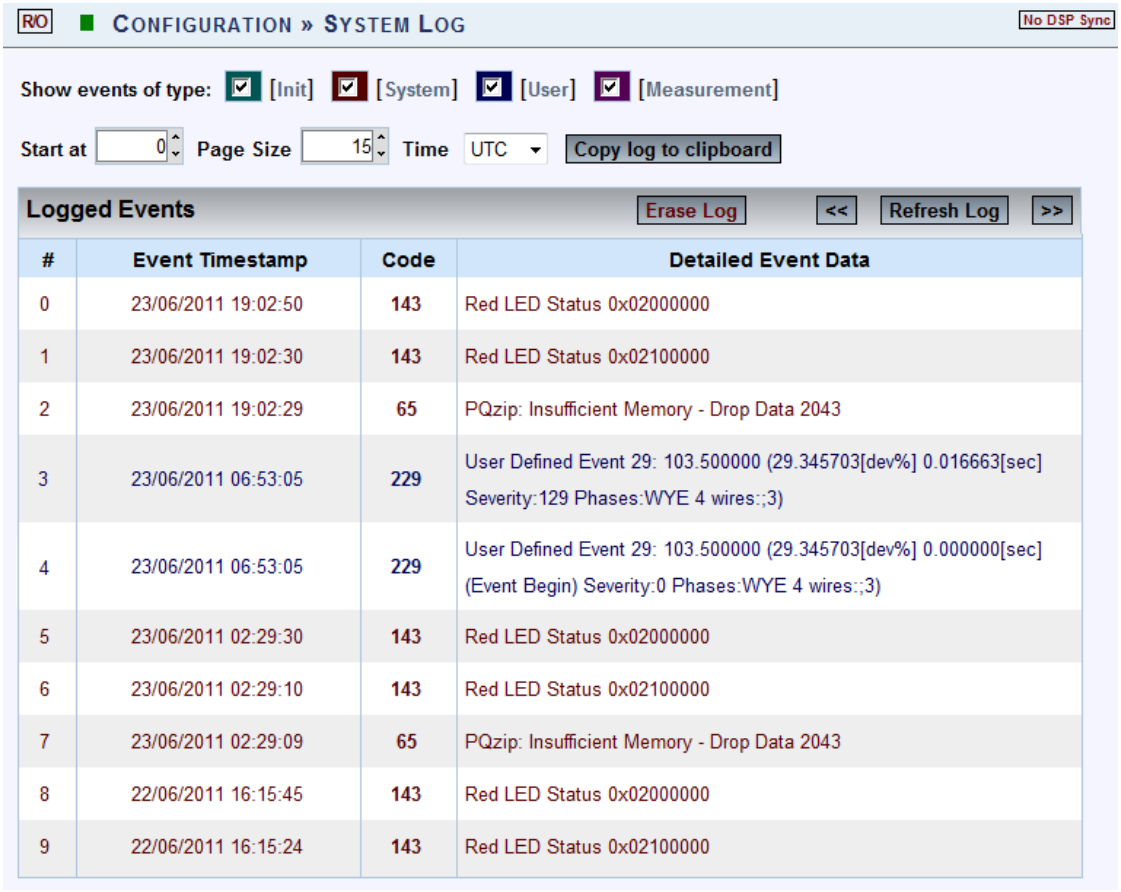
The **System Log** displays existing user events. All events are created in the Custom Events & the Energy & Parameter Logs are created in Reports. Within the Log you can decide what data you would like to display & produce a report.

## CONFIGURE THE SYSTEM LOG

- Access your G4K Device ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ under **Configuration** ➡ Advanced open the **System Log Tab**:



- The **System Log** window will now open:




| # | Event Timestamp | Code | Detailed Event Data |
|---|---|---|---|
| 0 | 23/06/2011 19:02:50 | 143 | Red LED Status 0x02000000 |
| 1 | 23/06/2011 19:02:30 | 143 | Red LED Status 0x02100000 |
| 2 | 23/06/2011 19:02:29 | 65 | PQzip: Insufficient Memory - Drop Data 2043 |
| 3 | 23/06/2011 06:53:05 | 229 | User Defined Event 29: 103.500000 (29.345703[dev%] 0.016663[sec] Severity:129 Phases:WYE 4 wires:;3) |
| 4 | 23/06/2011 06:53:05 | 229 | User Defined Event 29: 103.500000 (29.345703[dev%] 0.000000[sec] (Event Begin) Severity:0 Phases:WYE 4 wires:;3) |
| 5 | 23/06/2011 02:29:30 | 143 | Red LED Status 0x02000000 |
| 6 | 23/06/2011 02:29:10 | 143 | Red LED Status 0x02100000 |
| 7 | 23/06/2011 02:29:09 | 65 | PQzip: Insufficient Memory - Drop Data 2043 |
| 8 | 22/06/2011 16:15:45 | 143 | Red LED Status 0x02000000 |
| 9 | 22/06/2011 16:15:24 | 143 | Red LED Status 0x02100000 |

## OPTIONS & FUNCTIONS:

- **Show Events of type** (Color Coded) - You may choose the type of events to display in the list:
  - **Init:** Data related to Modem initialization
  - **System:** All Flagged function & configurations related to your G4K Device system
  - **User:** All User-Defined events
  - **Measurement:** All Flagged events related to recording & measurements of your G4K Device
- **Start at:** Specify the event range for # of entries per page
- **Time:** Log entries will be displayed at specific time zone (UTC or Local time)
- **Logged Events:** Displays the event information (for Code definition see Creating Custom Events & Alarms)
- Copy log to clipboard: Will copy the System Log over to common Windows applications (Notepad, MS Outlook, Excel & Word). Simply select the command & **Paste** it in one of these applications.
- Erase Log: Will clear all the log entries & restart the System log from the time you select this option
- <<: Go to previous page

- Refresh Log: Refresh your view
- >>: Go to the next page

## SEE ALSO:

- Advanced Settings
- Creating Custom Events
- E-Mail Alerts
- Reports
- Energy Meter
- Display Setup
- Upgrade G4K Software - Firmware Upgrade

# Creating Custom Events

The Custom Events window is used for configuring custom events. Unlike Compliance Configuration, where you are able to only configure power quality events, in this configuration you are free to define any type of event notification. Events can be triggered based on any measured parameters & conditioned by complex logical or mathematical functions.

The Custom Event Section is not related to Power Quality Event Section. The Events setup is based on a custom events engine that works parallel to the power quality events engine allowing the user to define tailored events according to his specific needs. All events triggered in the G4K BLACKBOX device series are stored in the logger (Flash Memory) which is displayed in the System Log. Each event is coded & the following event types with their respective codes can be viewed in the System Log accordingly:

| EVENT | EVENT CODE RANGE |
|---|---|
| System Events | 1-200 |
| User Custom Events | 201-232 |
| PQ & Compliance Events | 233-300 |

In addition, all events are also stored in the PQZIP files and can be further analyzed in Elspec's PQSCADA/Investigator Software programs. Furthermore, you may choose to send E-Mail Alerts on the event and/or receive SMS Text Messages (See PQSCADA's F1 Help Wizard; follow the Components ➡ Server ➡ Configuration ➡ SMS/Text procedure).

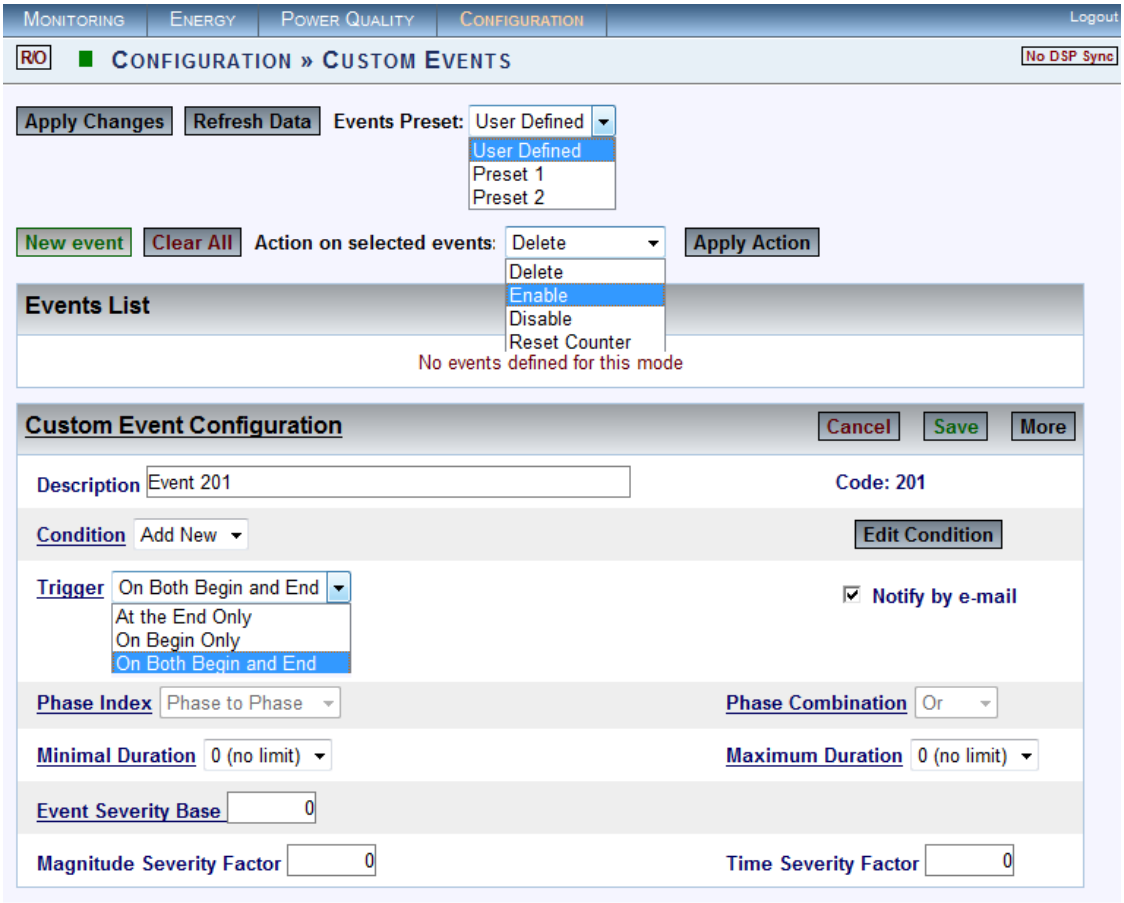
In the Custom Events window you will be able to:

- Perform Actions on the Events List
- Create General Event Conditions
- Define Single Type Conditions
- Multiple Type Conditions

## CREATING CUSTOM EVENTS

- Access your G4K Device ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ under **Configuration** ➡ Advanced open the **Custom Events Tab**:

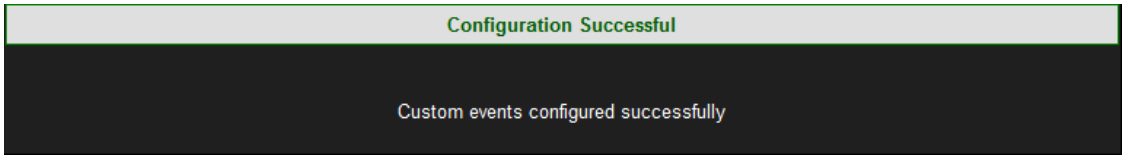
- In the **Custom Events** window select New event in order to create a **New Event**:




## CONFIGURATION & DEFINITIONS:

- **Event Preset:** Select User Defined (Preset 1 & 2 used in other applications)
- **Events List:** See Events List for possible configurations
- **Description:** Used to set a meaningful name for the event
- **Code:** Event code # allocated automatically by the system from the available user events codes & viewed in the System Log
- **Condition:** An event is based on one or more conditions. There are two types of conditions Single & Multiple. No matter what type of condition is linked to the event, its dependency is dictated by the condition ID string selected in the **Condition** selection box
- Edit Condition: Will open the Edit Condition window
- **Trigger:** 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 (**On Begin Only**). The event remains on "1" state until the condition is de-activated (**At the End Only**). 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 (**On Both Begin & End)**
- **Notify by E-Mail:** Will send E-Mail Alerts as soon as the event is triggered

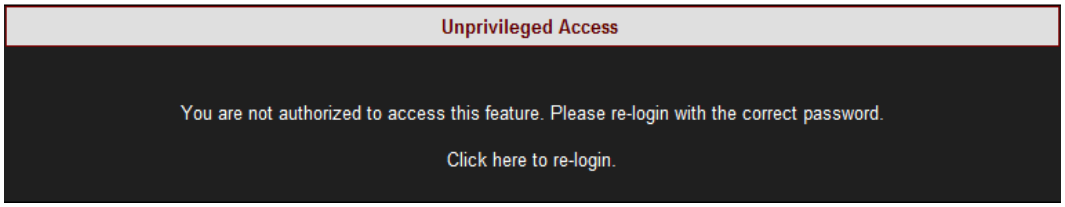
- **Phase Index:** This field should not be changed by user (reserved for future). In general this field defines how phase indication will be recorded with the event.
- **Phase Combination:** Event based on a condition of a 3 phase parameter can be further configured with an additional logic operator in between phases to further mask/enable the event generation. A 3 phase based condition (i.e 3 phase voltage lines compared to nominal voltage) will generate 3 parallel activation/deactivation statuses (0->1 changes). In such a 3 phase case the user has the control to determine whether an event is generated only when all 3 phases are activated (AND) or alternatively if at least one of the phases is activated (OR).
- **Minimal Duration:** The duration limit enables the user to limit notification of event based on its duration. In this case you will be able to set a minimum time & events with a duration of a lesser than specified time will not be triggered (this is true for the end of the event only; anyhow the beginning of the event will only be reported if it was configured).
- **Maximum Duration:** The duration limit enables the user to limit notification of an event based on its duration. In this case you will be able to set the maximum time, so that an event that elapses more time than defined won't be triggered.
- **Event Severity Base:** Each recorded event contains a severity factor. This severity factor is a number between 0 and 255, where 0 is no severity at all and 255 is top severity (For instance, PQ compliance events which are part of the Compliance module, uses this severity field to indicate how much voltage/frequency deviates from nominal and how significant the event was based on its duration). The Severity fields define how the events engine will compute a severity factor.
- Cancel: Will cancel your configuration
- Save: Will save your configuration
- More / Less: Will open / close the additional configuration settings
- To apply your changes select Apply Changes & you will receive the following message:



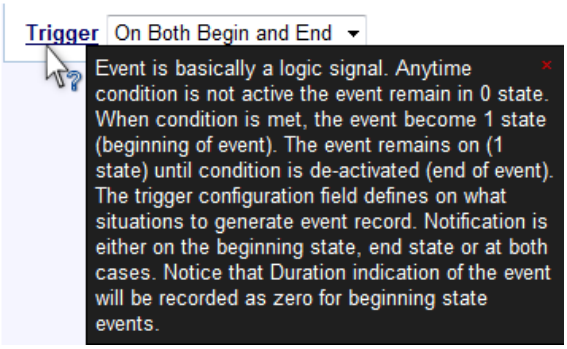

- To refresh your current view select Refresh Data

## NOTE NOTE NOTE

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.
- Every underlined Configuration is accompanied with a Tool Tip (function explanation). In order to activate it, Right-click on the configuration:




## SEE ALSO:

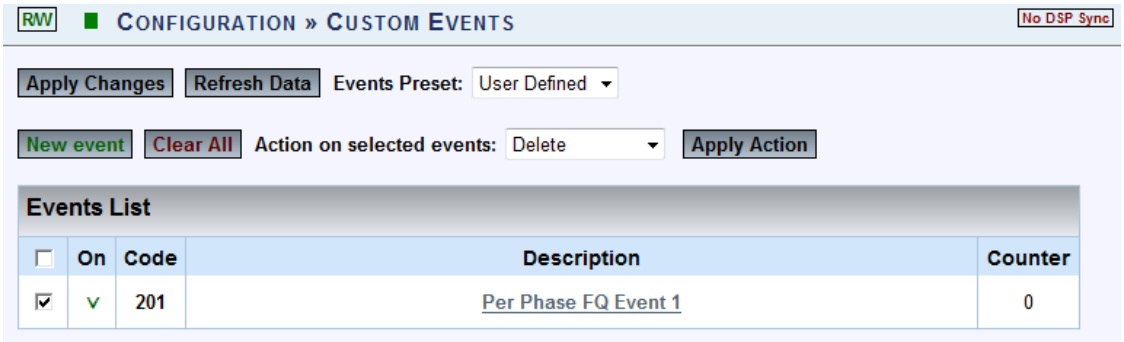
- Advanced Settings
- System Log
- E-Mail Alerts
- Reports
- Energy Meter
- Display Setup
- Upgrade G4K Software - Firmware Upgrade

# Events List

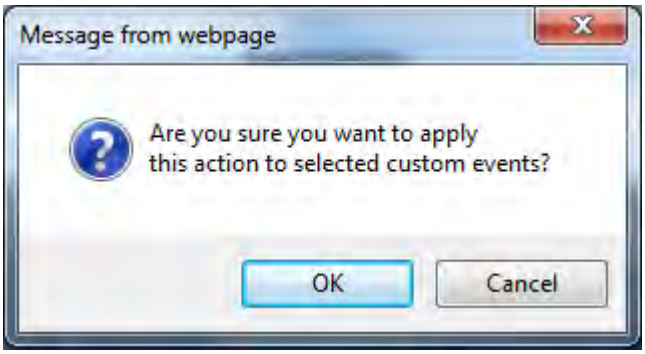
After you have Created a Custom Event the event will appear on the **Events List** & System Log. The event will be coded & will appear with their respective codes (as per Create Custom Events). You may create 31 Custom events.

## CONFIGURING EVENTS LIST ACTION

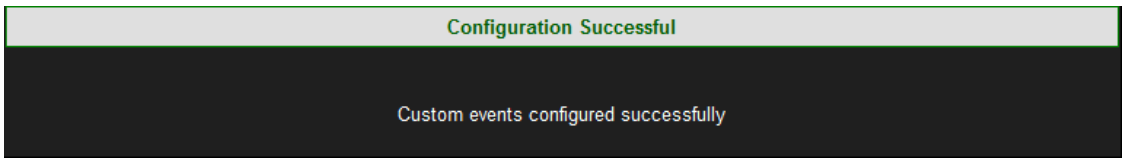
- Each event is preceded with a check-box, select the applicable events that you wish to perform actions for:




- Select Clear All to deselect the events that you marked on the **Events List**
- Choose **Action** on selected events:
  - **Delete:** Will enable you to delete the event in case you don't need it anymore
  - **Enable:** Will allow you to enable / activate the event (if disabled previously)
  - **Disable:** Will disable / deactivate the event until you wish to enable it at a later stage
  - **Reset Counter:** Will enable you to rerun the event at the configured trigger
- Select Apply Action to enforce selected actions for the applicable marked event(s) ➡ select OK:



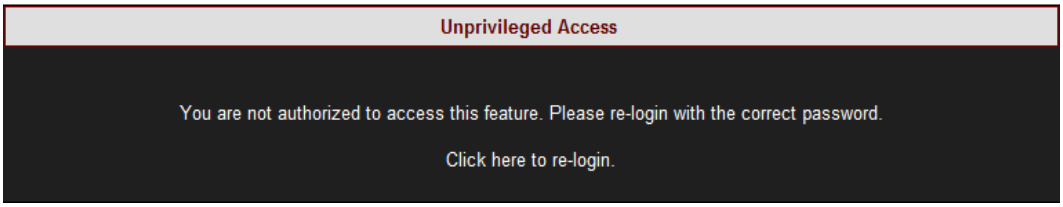

- The following success message will appear:




- Clicking on the event will open the event configuration itself & you may edit the configurations as you wish

### *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




## SEE ALSO:

- Creating Custom Events
- Create Event Conditions
- Single Type Conditions
- Multiple Type Conditions

# Create Event Conditions

Codes 201 – 232 are used for configuring up to 31 different events that are 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/threshold)
- Phases that were influenced
- Severity of the Event ( value indicating how severe the 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.)

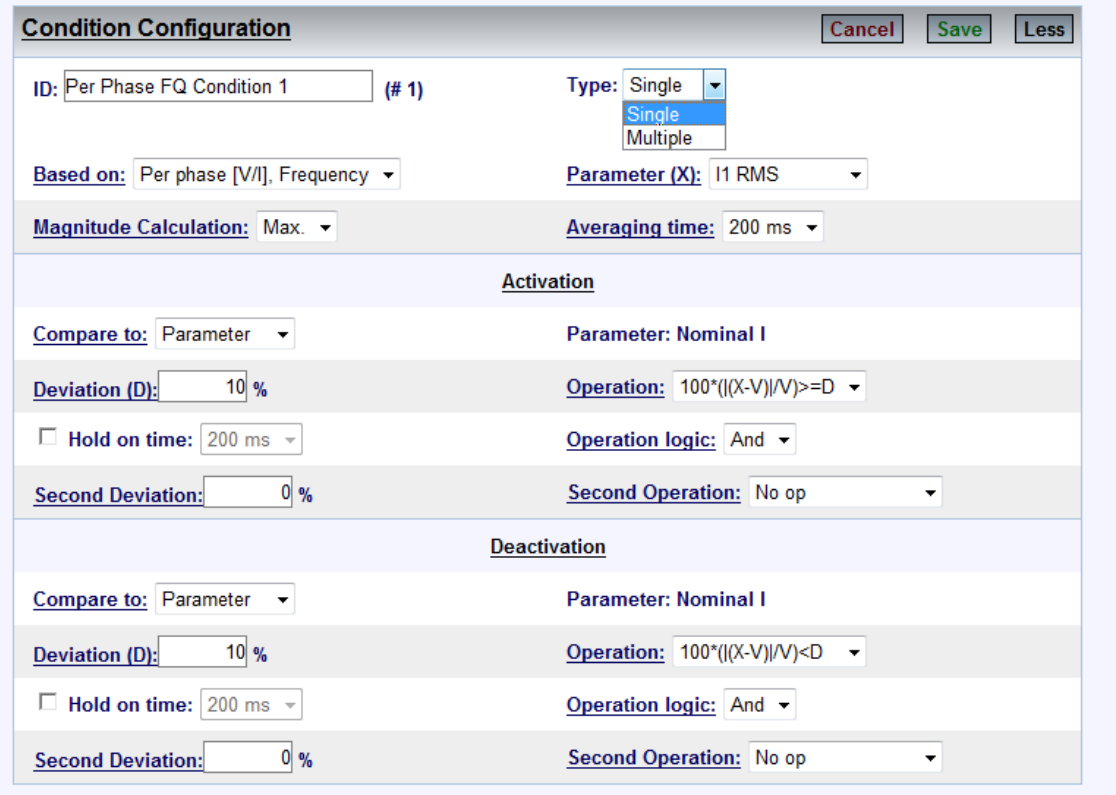
Events can also be based on multiple conditions. For example: an event will be triggered should the voltage exceed threshold ( x) and the outside ( PT-100) temperature exceeds (x) limit.

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

## CREATE EVENT CONDITIONS

- Access your G4K Device ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ under **Configuration** ➡ Advanced open the Custom Events Tab

- After selecting Create New Events ➡ naming the event in **Description** ➡ select **Edit Condition** to open the **Condition Window:**




- **Name the Condition** & you will need to create a Single Condition in order to create Multiple Conditions:
  - **ID:** The ID Condition is identified by a text ID. Two conditions cannot be set to the same ID string.
  - **The Single-Type Condition:** 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 & so on. The condition has 2 logic states, Activated (1) and De-activated (0). Transition to each state is fully configurated by the user.
  - **A Multiple-Type Condition:** Is the combination of 2 other sub conditions. A Multiple-type condition must be linked to 2 sub conditions, each of these 2 sub conditions can be either Multiple or Single type. Therefore, the Multiple-type condition can be used to create a complex hierarchy of conditions.
- Go to the next steps creating Single Conditions &/or Multiple Conditions

## SEE ALSO:

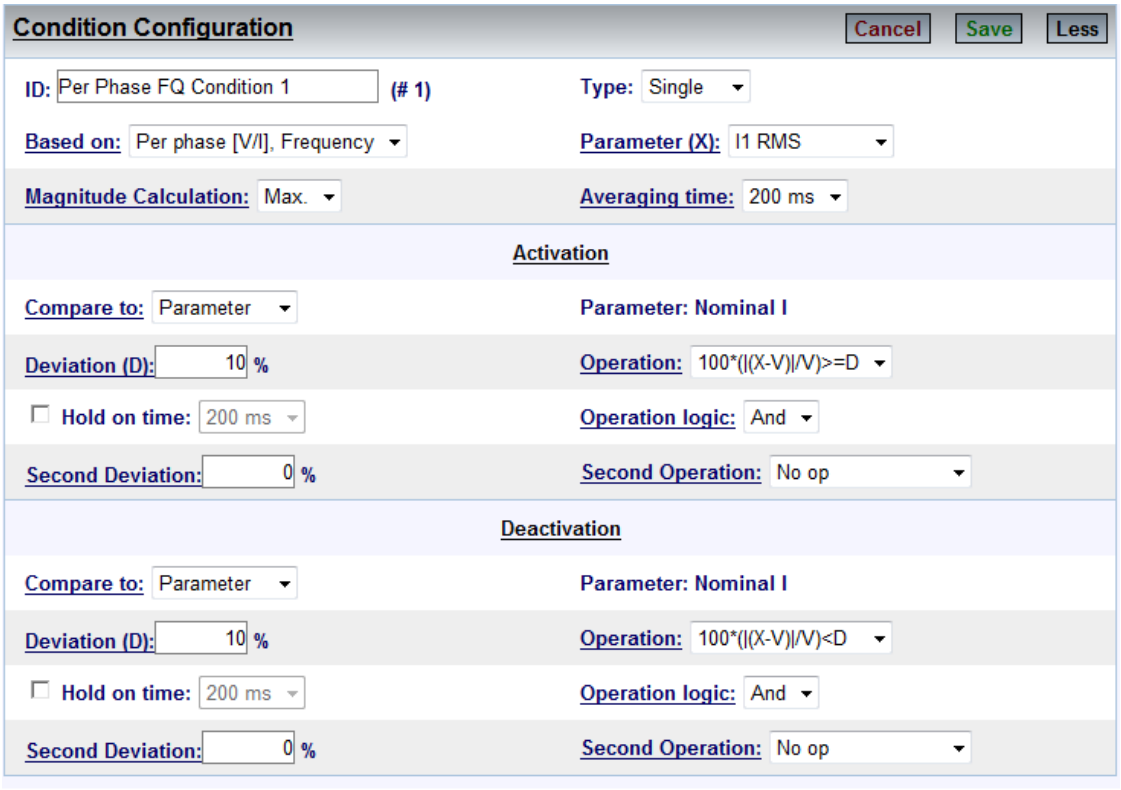
- Creating Custom Events
- Events List

# Single Type Conditions

As mentioned previously **Single Type Conditions** are used to define the result of an occurrence (example - voltage drops below the threshold) or a change of digital input & so on. You will need to configure the condition, including the transition of the condition from the **Activated** to the **Deactivated** State.

## CONFIGURE SINGLE TYPE CONDITIONS

- Access your G4K Device ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ under **Configuration** ➡ Advanced open the Custom Events Tab
- After selecting Create New Events ➡ naming the event in **Description** ➡ select **Edit Condition** to open the **Condition Window**
- Select **Single** for the **Type** ➡ open the **More** / **Less** in order to view the additional configuration options:

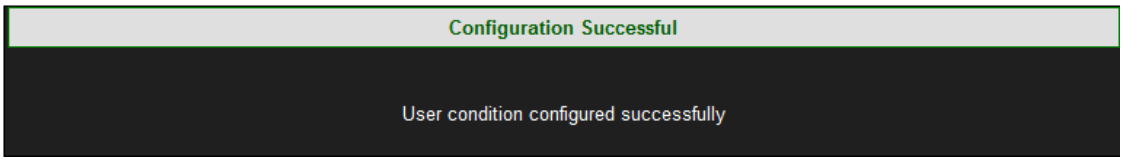


## CONFIGURATIONS:

- **Based on:** The parameter selection to base your condition on
- **Parameter (X):** 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)
- **Magnitude Calculation:** Determines the way the condition engine will compute the resulting magnitude of change in accordance to its set of rules. For example if defined a voltage change rule, where now voltage ("X") is 280V while its reference ("V") is 230V, the computed deviation now will be 21% - this is the instant deviation, but what happens if event continues and the next value sampled is 260V? Now the deviation is only 13% so what value should be reported? The "Magnitude calculation" field defines how the value is being computed. It is either by saving the maximum deviation measured or by average in between all values measured during the event
- **Averaging Time:** Setting averaging time enables the user to extend the sampling interval. For instance if user selected "3phase differential V" parameter, the typical time is 200[ms] (per IEC-61000-4-30). Yet, if the user change it to 3sec, it means the value will be averaged and a sample will be taken only every 3 seconds, meaning that quick rapid change of voltage will be smoothed by the averaging operation and would not be detected
    - **Activation Section:** 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
    - **Deactivation Section:** 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
- **Compare to:** Used to select the type of reference value ("V") to compare to the X parameter value
- **Parameter:** Reference to system parameter such as nominal voltage value
- **Deviation ("D"):** Defines the 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. User Value enables the user to edit his own reference value
- **Operation Logic (And / Or):** This operation logic field defines the logic to be applied between 2 operations for enabling activation or deactivation in accordance. By using two operations & a logical operation in between, the user can define a more complex condition rule
- **Second Deviation:** This field defines the additional Deviation ("D"%) value used in the operation formula. Note that some operations do not contain a deviation, & in these instances the configured deviation is not utilized
- **Second Operation:** This operation list defines the additional mathematical operation to apply for Activation/Deactivation of condition

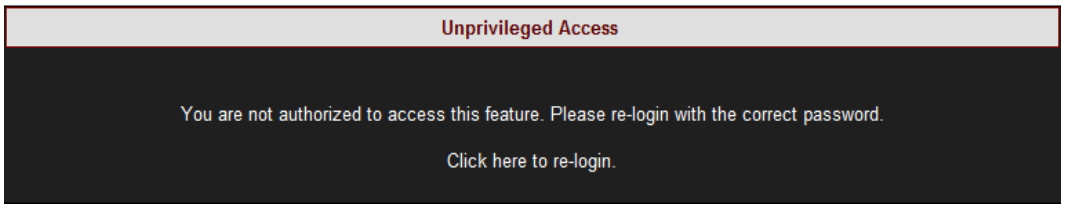
- Select Save / Cancel to Save / Cancel your configuration in **Condition Configuration**
- You will receive the following Success Message:




- Proceed either to creating Multiple Type Conditions or conclude your configuration as per Create Custom Events

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




## SEE ALSO:

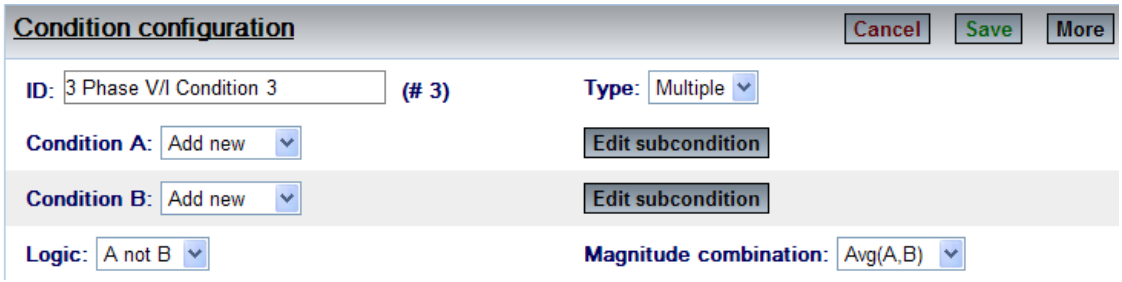
- Create Custom Events
- Events List

# Multiple Type Conditions

As mentioned previously, **Multiple Type Conditions** is the combination of 2 other sub conditions. It needs to be linked to 2 sub conditions, whereas each 2 sub conditions can be either **Multiple** or Single type. Therefore, you need to configure at least two Single types of conditions prior to proceeding in creating a hierarchy of **Multiple Conditions**.

## CONFIGURE MULTIPLE TYPE CONDITIONS

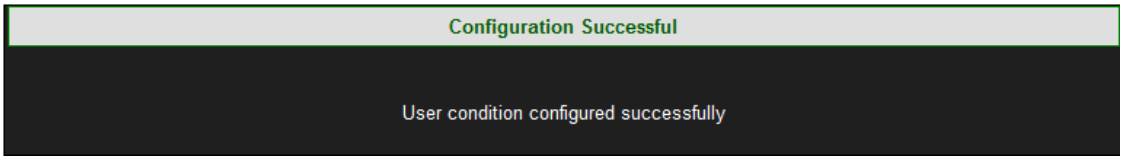
- Access your G4K Device ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ under **Configuration** ➡ Advanced open the Custom Events Tab
- From the listed events in the Events List select the applicable event with 2 or more Single Type Conditions ➡ & select Edit Condition to open the **Condition Window**
- Select **Multiple** for the **Type**:




Configuration Options:

  - **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 an A-only option is more practical (meaning only magnitude of voltage from condition A will be taken)
- Select Save / Cancel to Save / Cancel your configuration in **Condition Configuration**

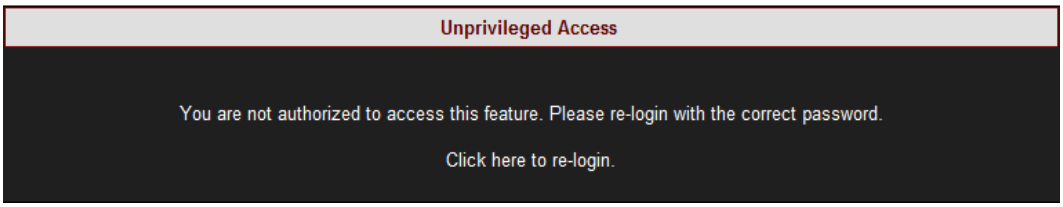
- You will receive the following Success Message:




- Conclude your configuration as per Create Custom Events

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




## SEE ALSO:

- Create Custom Events
- Events List

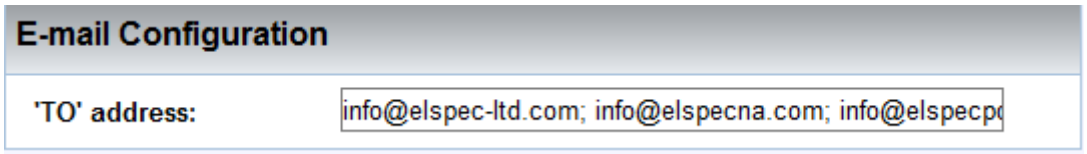
# E-Mail Alerts

Your G4K BLACKBOX can be configured to send E-Mail alerts to any recipient(s) entered in the "**To**" text box. This configuration also allows you to choose which alert(s) you would like to be notified on from a wide range of configurations, i.e.: System, Connections, Firm Ware Updates, PQZIP, Compliance Events, PQ Events & Custom Events.

## CONFIGURE THE G4K TO SEND E-MAIL ALERTS

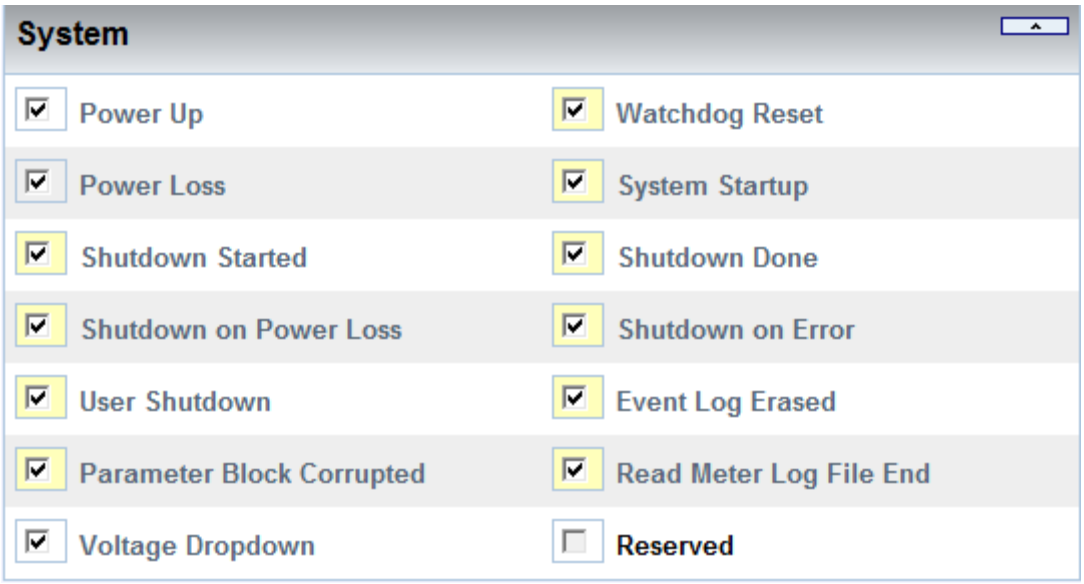
- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under the **Advanced** section select **E-Mail Alerts:**

- The E-Mail Alerts window will now open & you need to enter the exact **E-Mail Address(s)** (without spaces, for multiple E-Mails enter a **;** as a separator between the E-Mails). Make sure that you are connected to the pre-configured SMTP server that will have the e-mails already setup within the server:

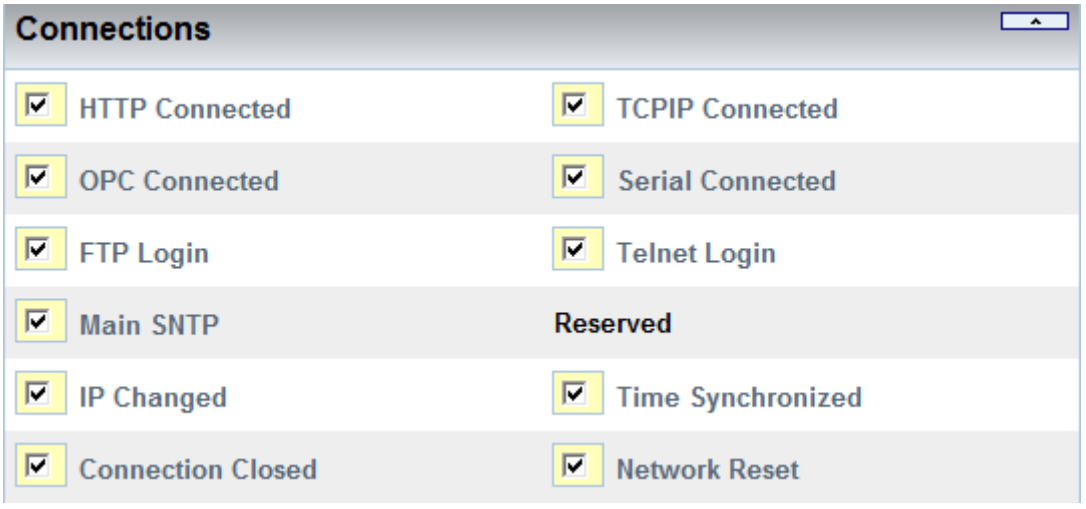



- Under each section (you may collapse / expand with ▲▼) select the **Configuration** on which you will need to send/receive E-Mail Alerts:

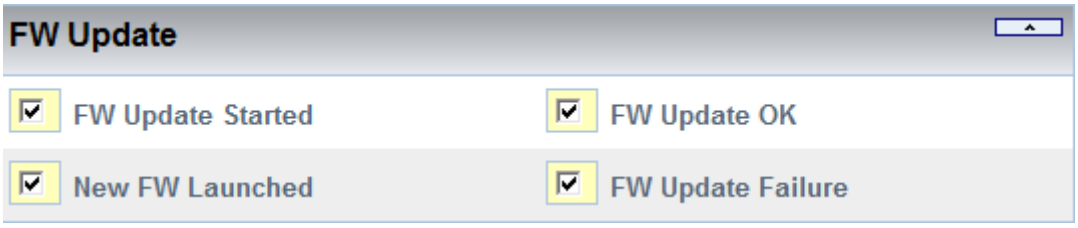
**System:**



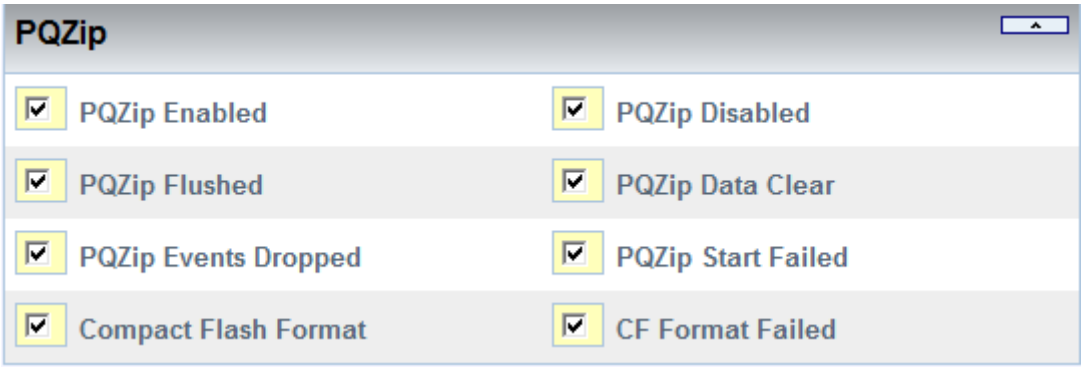

**Connections**:



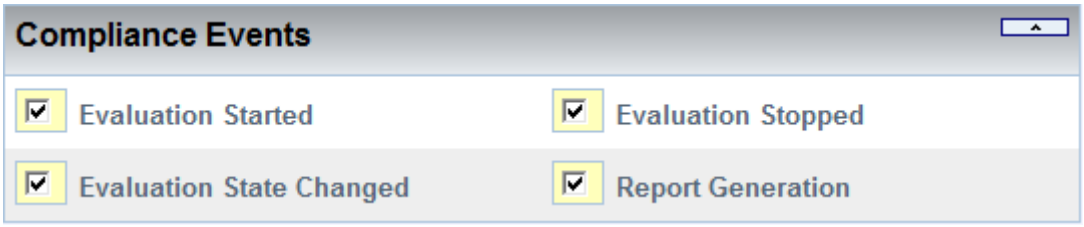

**FW Update:**



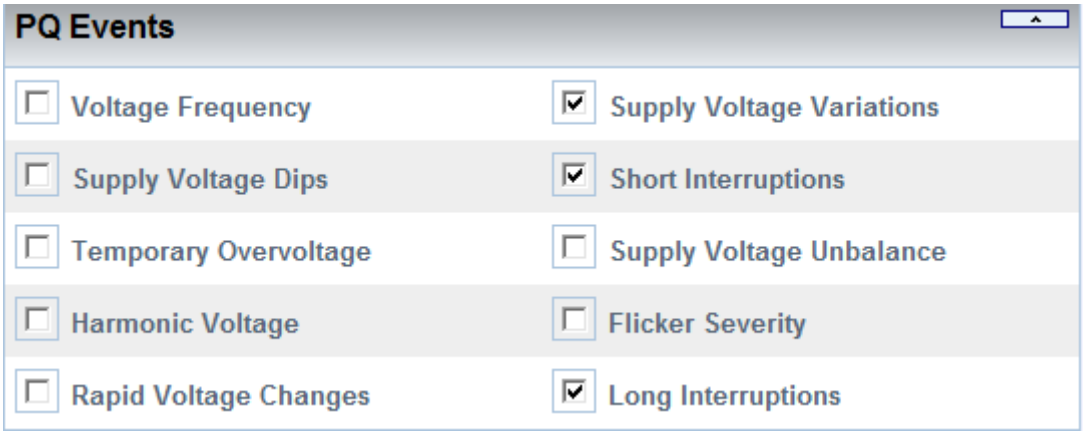
**PQZIP:**




**Compliance Events:**




**PQ Events:**

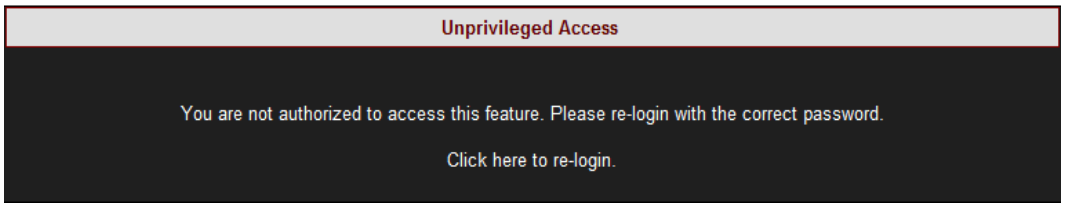



**Custom Events:**


- Select Send Test Alert to send a **Test E-Mail**
- To apply your changes select Apply Changes → Refresh Data to review them

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the Administrator ensure that you select Apply Changes to actually affect your changes.
- Ensure that you are connected to the pre-configured SMTP server that will have the e-mails already setup within the server.

## SEE ALSO:

- Advanced Settings
- System Log
- Creating Custom Events
- Reports
- Energy Meter
- Display Setup
- Upgrade G4K Software - Firmware Upgrade

# Reports

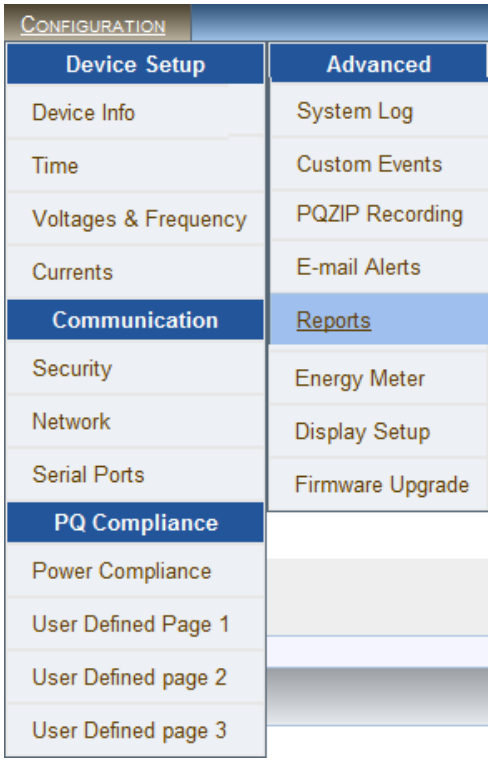
The G4K BLACKBOX saves & copies reports over to its internal Compact Flash memory. This report includes 2 log types namely: **Energy & Parameter Logs.** As in many cases this may include a vast amount of information. Therefore it is recommended that you:

1. Configure the unit to send you E-Mail Alerts (mark Report Generation under Compliance Events) once it has concluded the report.
2. You retrieve the reports from the G4K's CF Memory via **FTP Server**. Access the FTP server via Elspec's Search Utility & the file is located under **Reports**. (Any user may copy the log over to this location). Retain the reports on the CF memory only when necessary in order to not occupy unnecessary disc space.

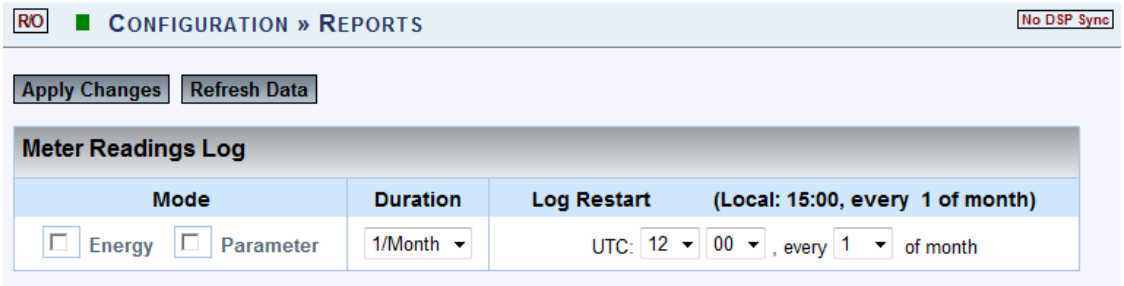
## USING THE METER READING LOG

In this window you will be able to configure the report to include modes for either Energy or Parameter logs

- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under the **Advanced** section select **Reports:**



- Select:

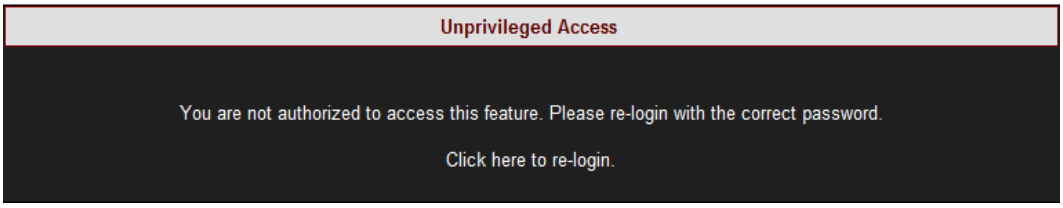



  - **Mode Energy or Parameter**
  - **Duration:** 1 Day, 1 Month, 1 Week
  - **Log Restart:** At - Time Local to UTC Time / Every - 1-25th of the Month

- To apply your changes select Apply Changes → Refresh Data to review them

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO:

- Advanced Settings
- System Log
- Creating Custom Events
- E-Mail Alerts
- Energy Meter
- Display Setup
- Upgrade G4K Software - Firmware Upgrade

# Energy Mode

The information included in the Report includes data from the total Energy Meter. The information is saved on the compact flash & retrievable from the FTP under: **/CF_UPMB/Reports** & is saved in a **.csv** file format. As such the report can be viewed in Excel & be sent as an E-Mail attachment. The values that are saved in this report include:

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

### *NOTE NOTE NOTE*

The values of the total energy meter are saved in the PQZIP files even if the Meter Readings Log is disabled.

## SEE ALSO

- How to create Reports
- Parameter Mode

# Parameter Mode

The information included in the Report includes data from PQ Compliance. The information is saved on the compact flash & retrievable from the FTP under: **/CF_UPMB/Reports** & is saved in PDF / Excel ( According to the Applicable Standard) file format. As such the report can be viewed in Excel & be sent as an E-Mail attachment. The values that are saved in this report include:

- **Kw (Power):** Average, standard deviation, maximum and minimum values
- **Frequency:** Average, standard deviation, maximum and minimum values
- **KVAr:** Average, standard deviation, maximum and minimum values

### *NOTE NOTE NOTE*

The parameter log can be customized to include any other three parameters. For this configuration please contact your local Elspec representative.

## SEE ALSO

- How to create Reports
- Energy Mode

# Energy Meter

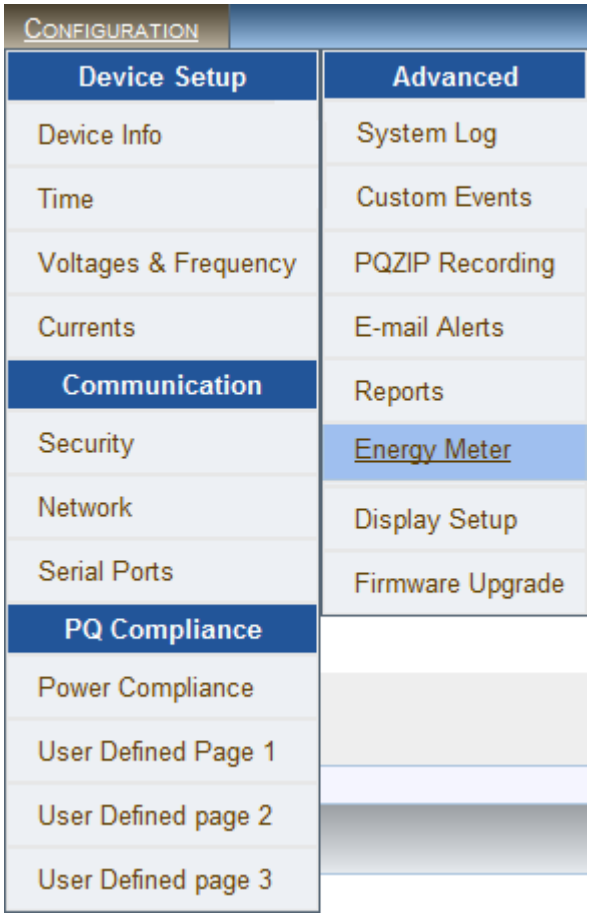
The G4K BLACKBOX Device Series is equipped with 3 Energy Meters for continuously recording & measuring all the electrical energy. The meters measure:

- Current Period,
- Total Consumption &
- Demand

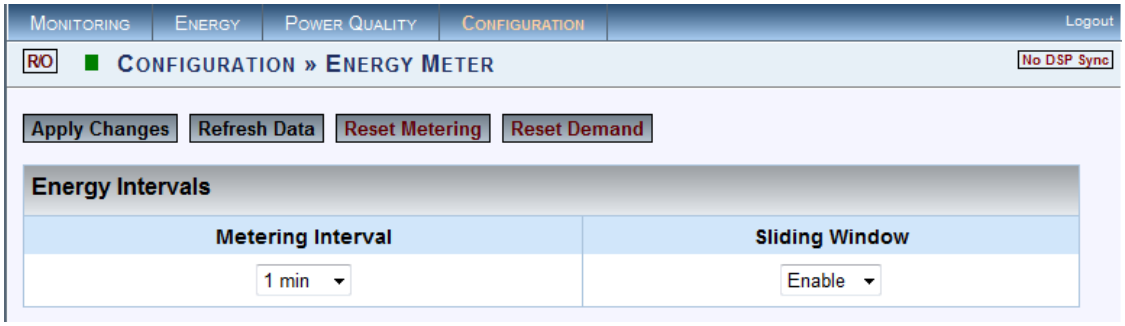
## CONFIGURING THE ENERGY CALCULATIONS FOR THE ENERGY METERS

In this window you will be able to configure the energy calculations of these meters by time & the method of averaging:

- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under the **Advanced** section select the **Energy Meter Tab:**

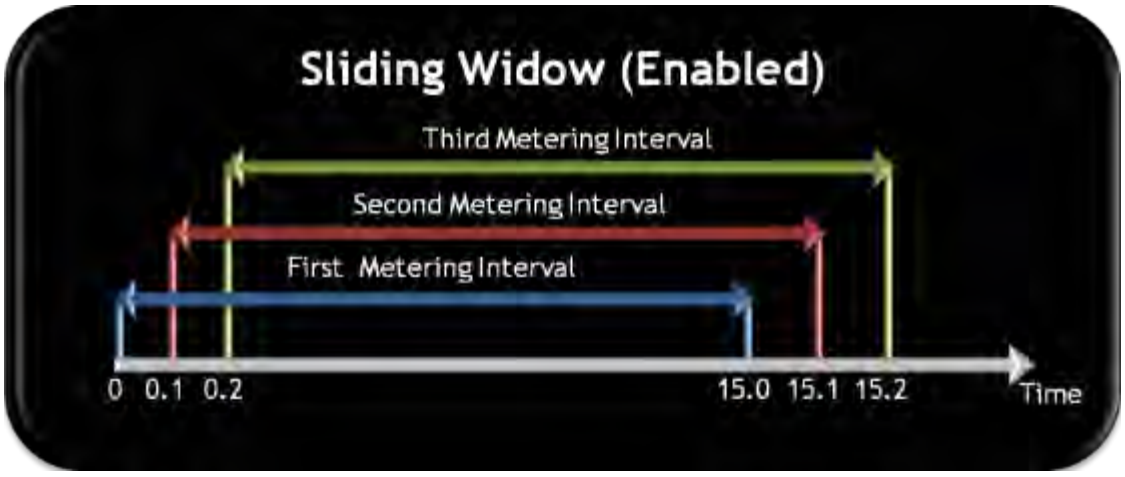


- The **Energy Intervals** window for the Energy Meters will now open:

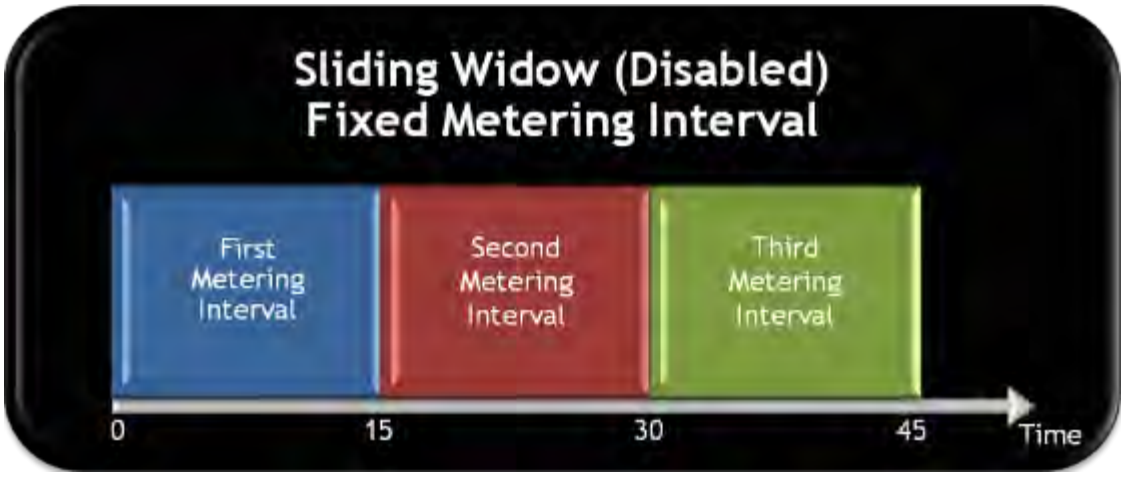



In the 2 Sections Select:

- **Metering Interval:** This sets the meters to measure energy according to a preset interval (1, 2, 5, 10, 15, 30 & 60 minutes)
- **Sliding Window (Applicable For The Demand Meter):** The energy is calculated using moving average time intervals (1 second). Options:
  - **Enable:** The energy is calculated using a sliding window. The figure below illustrates the time increment as 1 second:



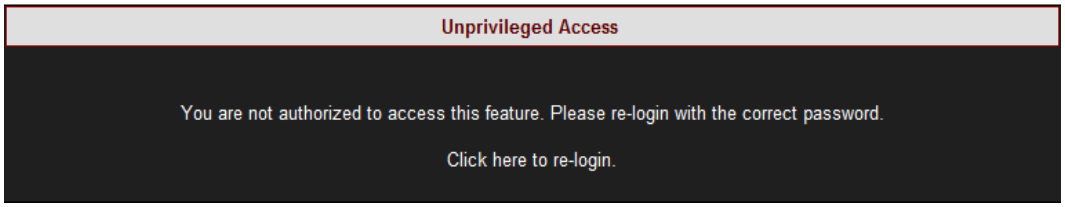

  - **Disable:** The energy is calculated using fixed interval for each meter - illustration:




- To ensure that you have reset the **All the Meters** select Reset Metering
- To reset only the **Demand Meter** select Reset Demand
- To apply your changes select Apply Changes → Refresh Data to review them

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

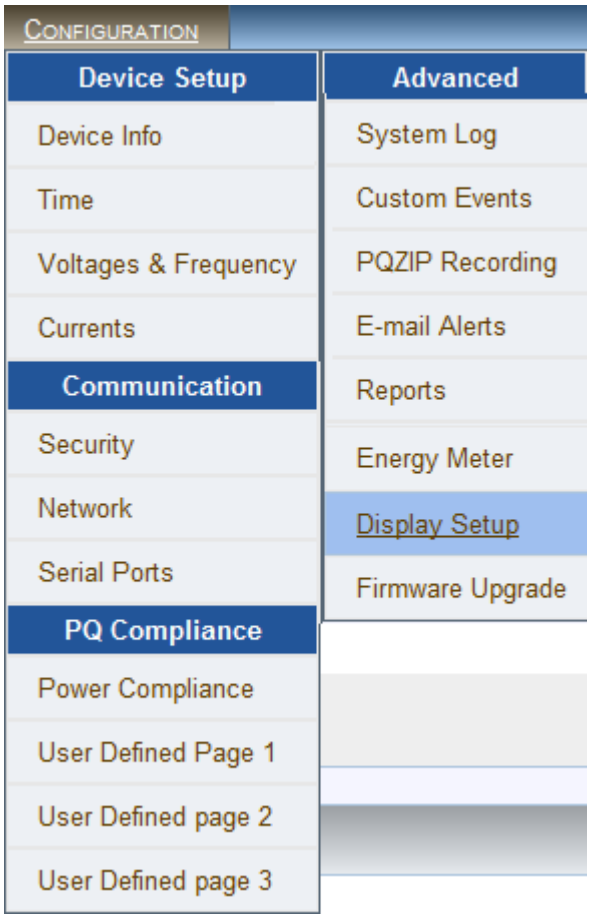
## SEE ALSO:

- Advanced Settings
- System Log
- Creating Custom Events
- E-Mail Alerts
- Reports
- Display Setup
- Upgrade G4K Software - Firmware Upgrade

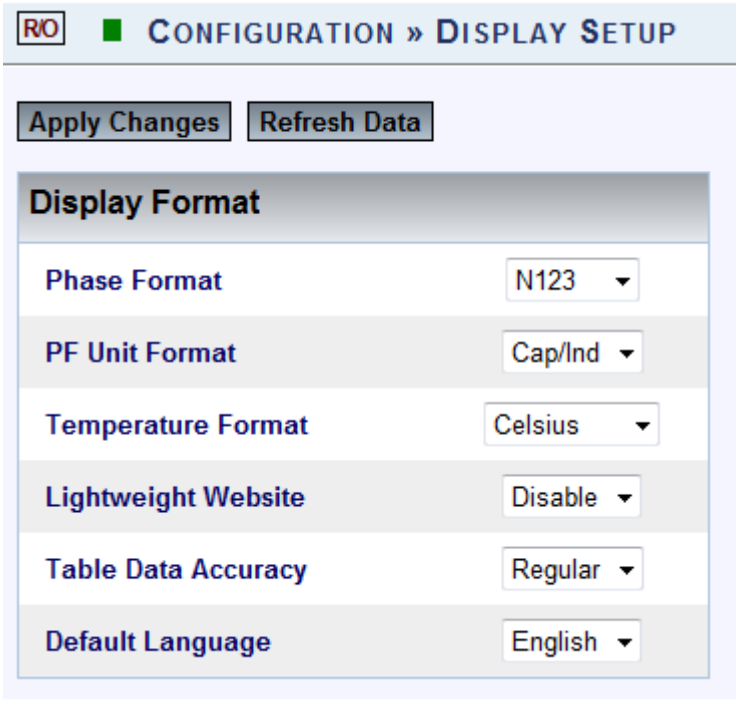
# Display Setup

The Display Setup page enables you to customize your G4K BLACKBOX to display regional & generic display preferences for both Elspec's Web Interface & for your G4100 RDU.

- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under the **Advanced** section select the **Display Setup Tab:**



- The **Display Setup** window will now open:



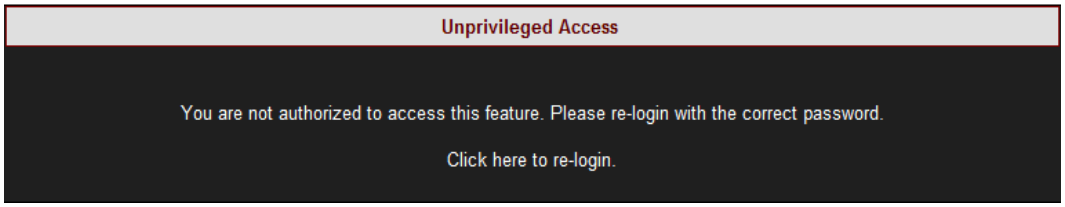

Configuration Options:

- **Phase Format:** Format that will be used to indicate phases. For example: V1,V2,V3 ; VA,VB,VC; Vx Vy, Vz; etc.
- **PF Unit Format:** Format that will be used to indicate the PF Unit. For example: For Capacitive/Inductive select **Cap/Ind**
- **Temperature Format:** Preferred temperature measurements in either **Celsius / Farenheit**
- **Lightweight Website:** When disabled, the web interface doesn't use any images (and also flash on the login page) in order to speed up your connection. It is recommended when the network connection to the unit is weak.
- **Table Data Accuracy: Extra** will extend the display to 7 digits (230.5612) & **Regular** will extend the display to 5 digits (230.56)
- **Default Language:** Select your default system language

- To apply your changes select Apply Changes → Refresh Data to review your changes

### *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO:

- Advanced Settings
- System Log
- Creating Custom Events
- E-Mail Alerts
- Reports
- Energy Meter
- Upgrade G4K Software - Firmware Upgrade

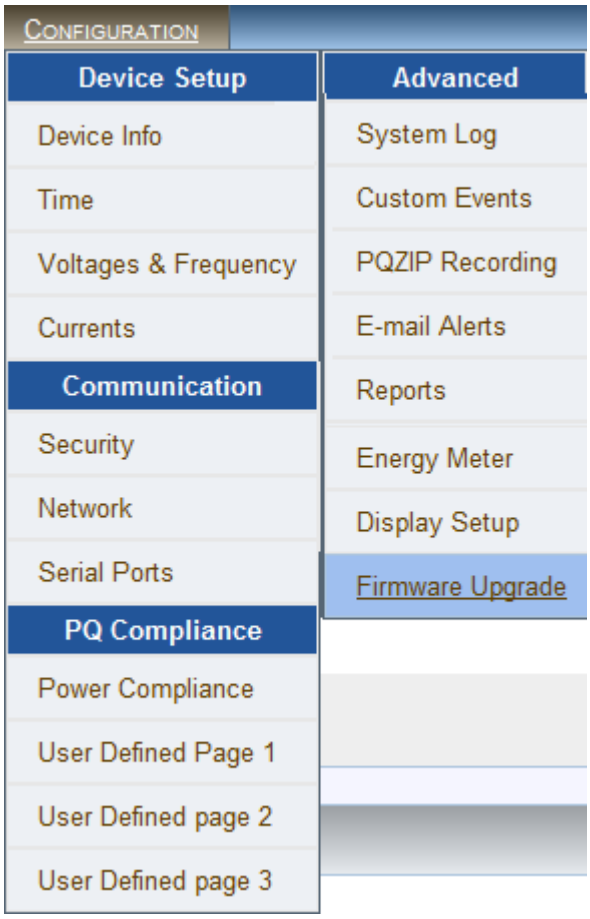
# Upgrade G4K Software - Firmware Upgrade

The internal software of the G4K BLACKBOX device series is named Firmware (FW). On every upgrade (every couple of months) Elspec will announce the new release accompanied by the features, benefits, access & upgrade instructions. The latest version is located on Elspec's Website. It is recommended that you take advantage of every new upgrade, but it is not compulsory. In the Firmware Upgrade window you will be able to:

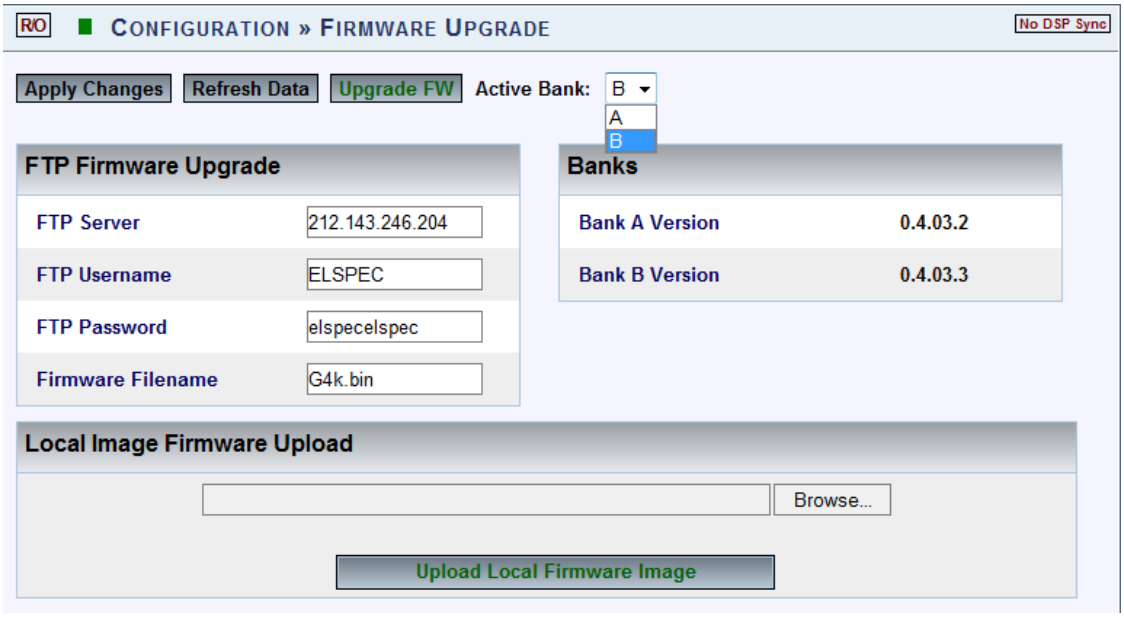
- Upgrade the FW directly using the FTP, or
- Upgrade the FW locally (Recommended)

## ACCESS THE FIRMWARE UPGRADE WINDOW

- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab**
- Under the **Advanced** section select the **Firmware Upgrade Tab:**



- The Firmware Upgrade window will now open:




## IN THE BANKS SECTION:

The BLACKBOX implements a comprehensive Firmware management mechanism designed to ensure a failure-free field upgrading functionality. The mechanism ensures that at any time there are two Firmware images available, where only one are active (running). The user may select which one of the two banks is the active bank. When the user initiates a Firmware upgrade, the newly added Firmware will load into the inactive bank. Once the process of uploading the new Firmware is completed, the unit will reboot from the inactive bank, turning it into the active bank.

## OPTIONS & DISPLAY

- **Active Bank:** Indicates which Firmware Bank is actually in use. Select the applicable version Bank **A/B**
- **Bank A/B Version:** Displays a Bank's Firmware and condition. A numeric only Firmware name means it's a 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 a 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. |
| W | The Firmware bank is being upgraded at the moment, wait for the completion. |
| E | The bank is empty. |

### *NOTE NOTE NOTE*

Should Firmware 0.4.07.0 be found faulty/damaged/corrupted it will appear as F0.4.07.0 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.

## SEE ALSO:

- Advanced Settings
- System Log
- Creating Custom Events
- E-Mail Alerts
- Reports
- Energy Meter
- Display Setup

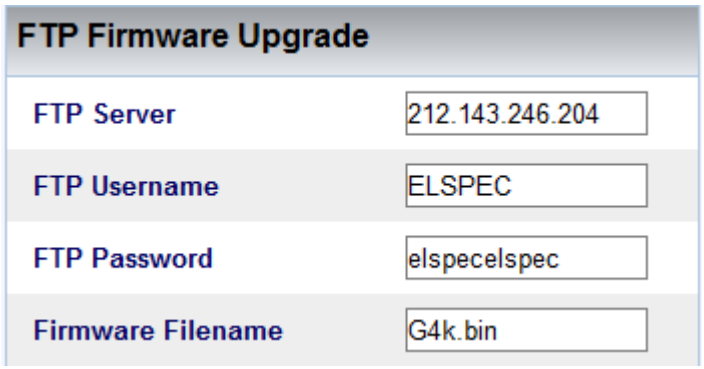
# Upgrade the FW Using FTP

An alternative option of upgrading your instrument is by using an FTP (File Transfer Protocol) interface. The BLACKBOX employs an FTP client module which is capable of downloading a Firmware image file from an external FTP server automatically. Prior to using this option, ensure that you have Established Communication & that your G4K Unit has been Configured for FTP access.

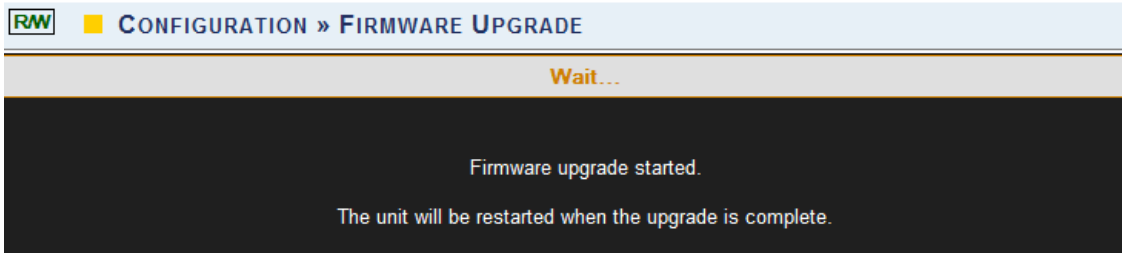
## FTP UPGRADE

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

- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab** ➡ **Advanced** ➡ **Firmware Upgrade Tab**
- In the **FTP Firmware Upgrade Section** insert:



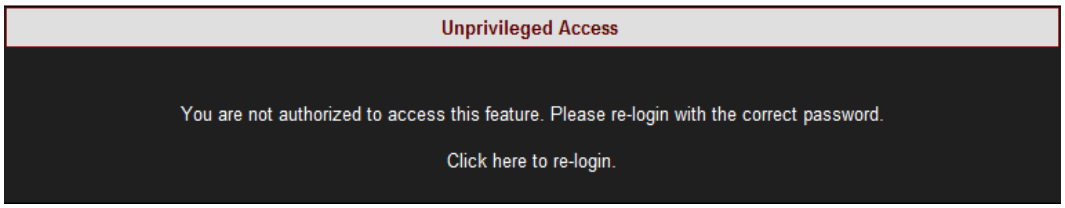

  - **FTP Server:** The IP address of the external FTP server where the firmware file is located. The default setting is: 212.143.246.204 which is the ELSPEC's FTP server which is loaded with a latest released Firmware
  - **Firmware User-Name:** The User-Name to login to the FTP server
  - **Firmware Password:** The Password to login to the FTP server
  - **Firmware Filename:** As default, the latest Firmware located under Elspec's FTP server is G4k.bin
- To apply your changes select Upgrade FW after which you'll receive a success message & the unit will automatically restart on completion of the upgrade:




- After the restart, select Apply Changes to apply your changes
- In order to refresh your screen & view the changes select Refresh Data

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO:

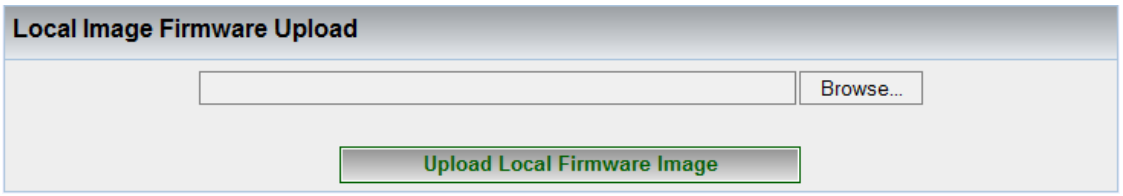
- About Firmware Upgrade
- Upgrade - HTTP

# Local FW Upgrade

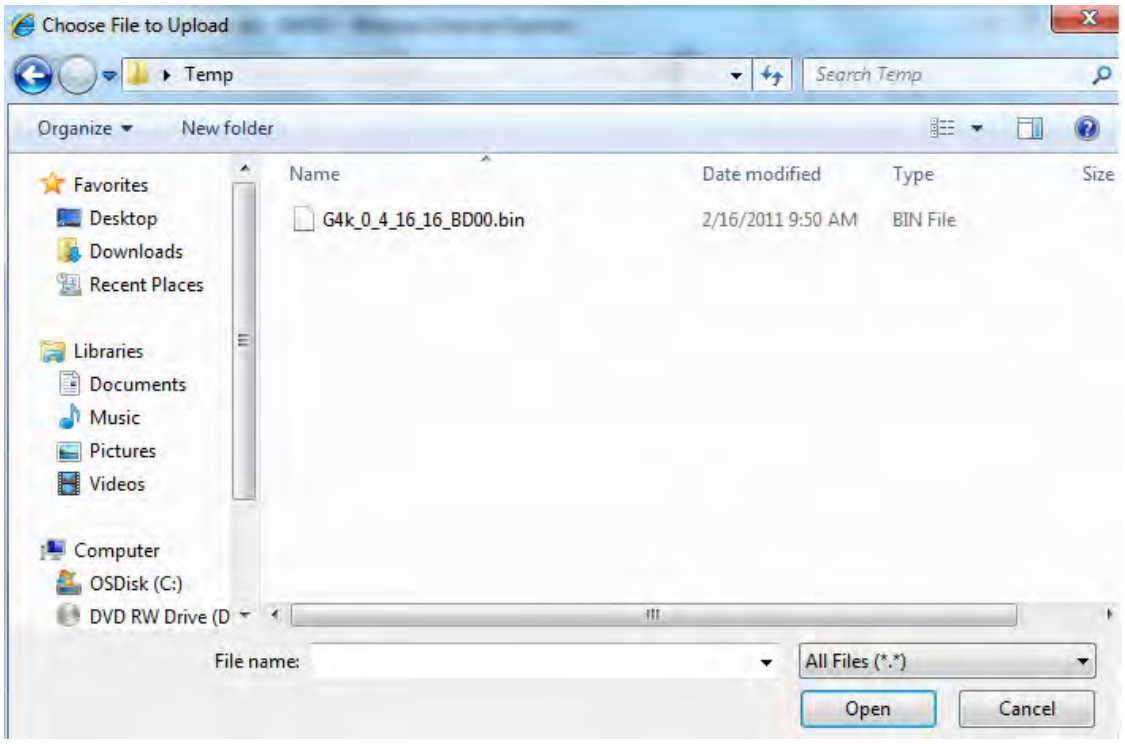
Probably, the simplest way of upgrading your instrument is by using the Local Upgrade functionality.

## OPEN THE LOCAL UPGRADE FUNCTIONALITY

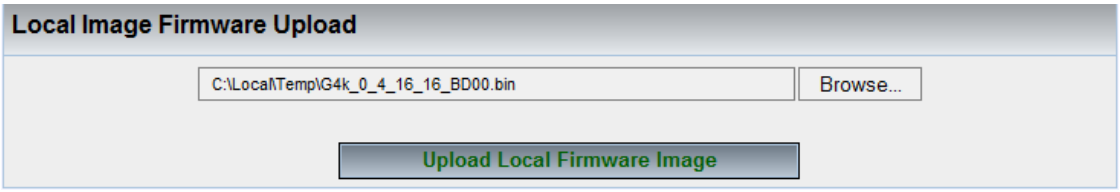
- Access your G4K Device via **Elspec's Web Interface** ➡ log on as the **Administrator** (Manufacturer's Default Password is: **12345**) ➡ select the **Configuration Tab** ➡ **Advanced** ➡ **Firmware Upgrade Tab**
- Go to the **Local Image Firmware Upload Section:**



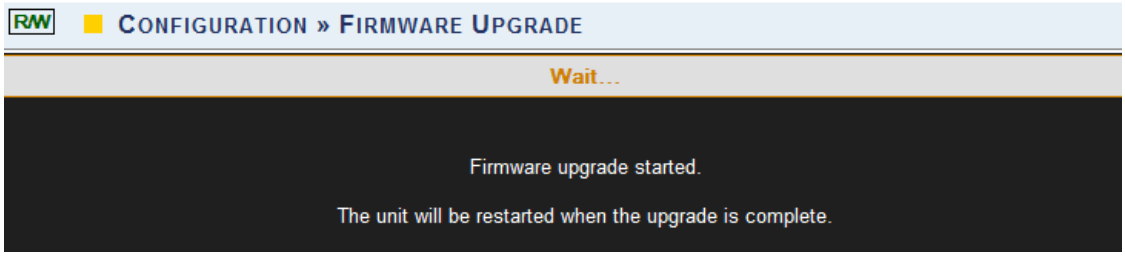

- Select the Browse... search for the file on your local computer & select Open:




- Select the Upload Local Firmware Image button to initiate the upgrade process:



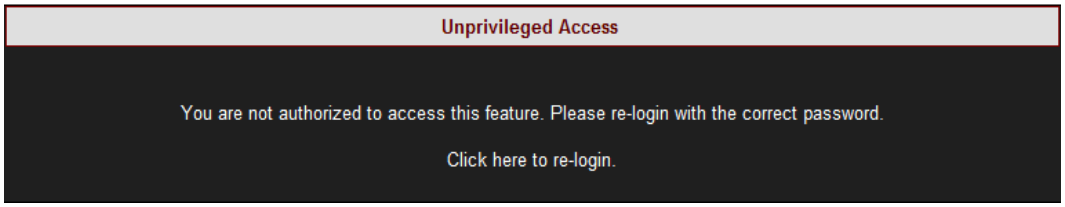

- For your changes to be taken into affect select Upgrade FW after which you'll receive a success message & the unit will automatically restart on completion of the upgrade:




- After the restart, select Apply Changes to apply your changes
- In order to refresh your screen & view the changes select Refresh Data

## *NOTE NOTE NOTE*

- If you are not logged on as the Administrator, you will not be able to change any of these settings & you will receive the following error message in your attempt to do so:




- Once you have signed on at the **Administrator** ensure that you select Apply Changes to actually affect your changes.

## SEE ALSO:

- About Firmware Upgrade
- Upgrade - FTP

# Optional Installations & Disconnections

# Attach The PT100 Temperature Connection

The DSP Module of the G4K is equipped with an external connection terminal for a PT100 T emperature S ensor. T he B LACKBOX is al so eq uipped w ith t wo internal temperature sensors, one in the DSP module and the second in the PS Module. The PT100 temperature sensor is an optional device. The temperature module from the DSP provides reference for compensation of temperature related reading offsets. Attachment procedure:

- Remove the PT100 Temperature Sensor provided with the G4K BLACKBOX unit:

- Connect the sensor to the DSP Module of the G4K:

## SEE ALSO

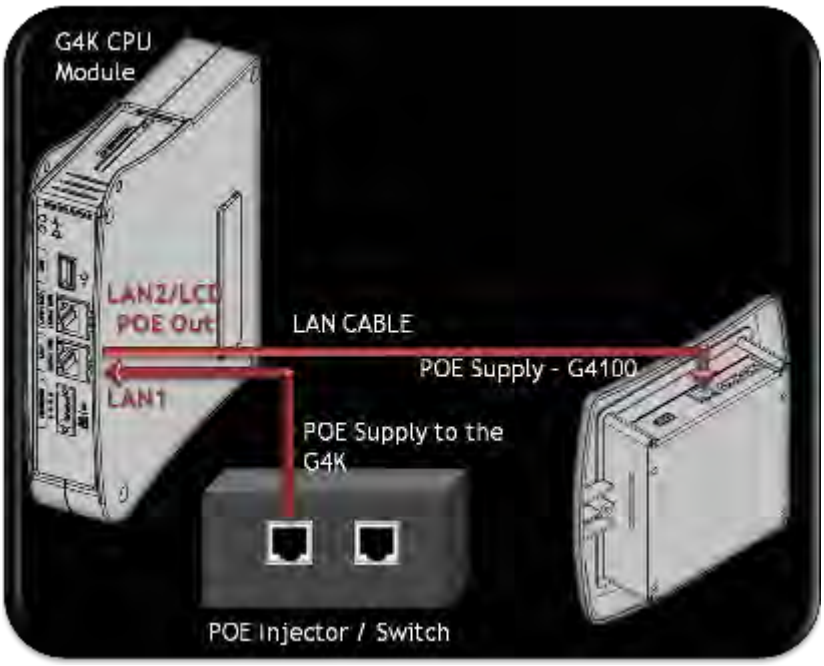
- Connect Power Over Ethernet
- Detach the Voltage Terminal Block Connector

# Connect Power Over Ethernet

PoE is a standard for feeding DC power to the RTU using the network LAN cable without the need for additional external power. The G4K contains 2 ports that support PoE:

- The **LAN1 Port** can receive PoE supply for the G4K unit from a remote source, thus enabling the BLACKBOX to operate. It is suggested that the LAN1 PoE be used as an alternative backup power source. To activate this PoE option, connect an RJ45 jack with PoE to the marked LAN1 PoE In on the CPU module.
- The **LAN2/LCD Port** has PoE out capability for supplying power to other devices. The LAN2/LCD port can supply power for the Elspec G4100 Display unit. To activate this PoE option, connect an RJ45 jack to the port marked LAN2/LCD POE Out on the CPU module, connecting the other end of the RJ45 jack to the G4100 RDU. Procedure:

- Connect a LAN to the indicated ports on the G4K / PoE Injector / G4100:



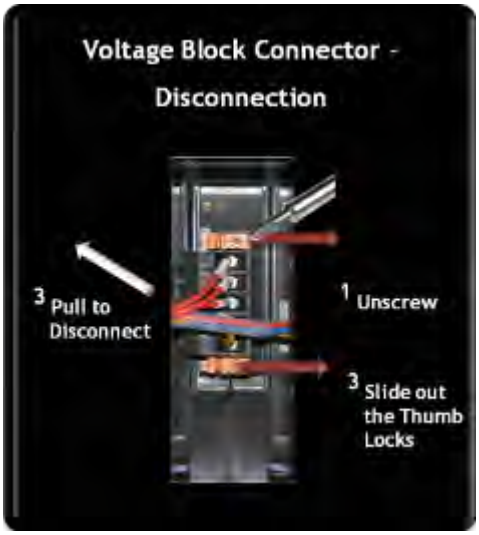

## SEE ALSO

- Attach The PT100 Temperature Connection
- Detach the Voltage Terminal Block Connector

# Detach the Voltage Terminal Block Connector

If you need to disconnect the unit from the measured voltages, you need to detach the Voltage T erminal B lock C onnector. T o d etach the v oltage t erminal b lock connector:

- Loosen the screws anchoring the block in place
- Slide the orange thumb locks out
- Pull out the terminal block




## SEE ALSO

- Attach The PT100 Temperature Connection
- Connect Power Over Ethernet

# About Elspec's Search Utility

Elspec's Search Utility is a small, yet powerful tool that allows searching for multiple G4K BLACKBOX device IP addresses sharing the same local LAN. The Elspec Search makes use of UDP broadcasting, sending a "please respond" broadcast request to all devices on the LAN and displaying the resultant list of all devices responding to it.

When a 1st Time Connection has been Established between a unit and the host computer, the internal Web Interface can be accessed most commonly using the **Search Utility**, or by typing the IP address (if known) directly into the address field of the **Internet Web Browser.** This Web interface is designed to serve as the main user interface with the instrument, providing enhancement, configuration, & real-time monitoring functionality. The Website is optimized to work with Microsoft© Explorer 7. Other web browser applications can limit some functionality and/or show an incorrect layout.

In order connect to your G4K Unit & FTP Server you will need to:

- Obtain Elspec's Search Utility
- Use the Utility
- Access either the Unit or FTP Server with the Utility
- How to look for a New Device
- Know its Limitations

# Obtain Elspec's Search Utility

Elspec S earch is a sm all p rogram w hich does n ot require in stallation an d is available free on the Elspec WEB site: www.elspec-ltd.com. You may also copy it by using the G4K BLACKBOX CD delivered with the G4K Unit. Since the program is small and does not require installation, it is recommended copying it and operating it directly from the computer Desktop.

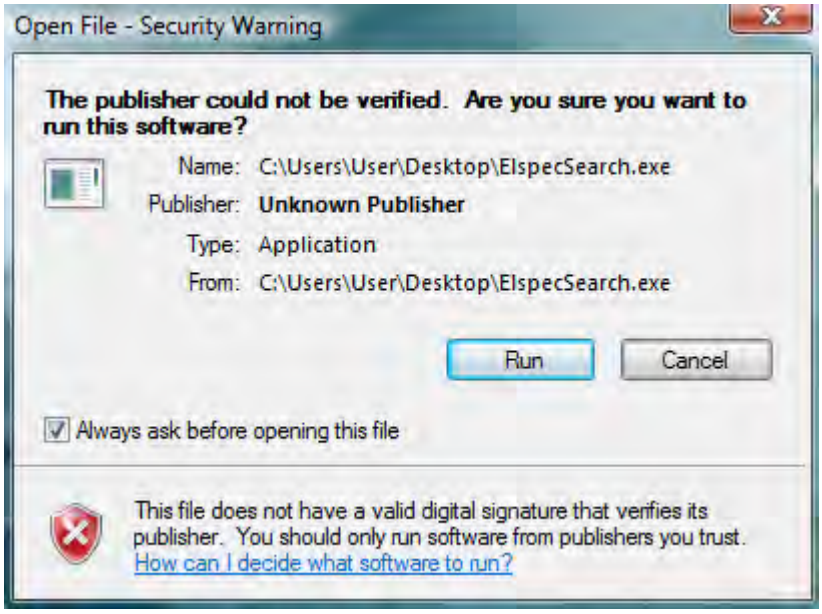
## SEE ALSO

- About Elspec's Search Utility
- Use the Elspec's Search Utility
- G4K Unit Access
- New Device Indication
- Limitations of Elspec's Search Utility

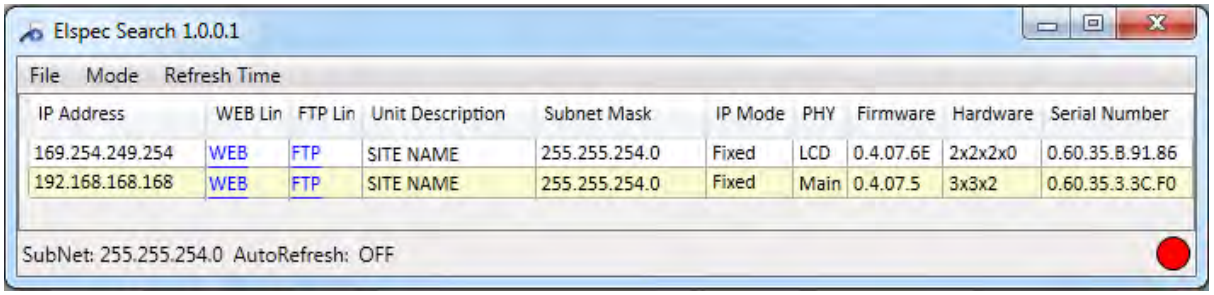
# Use the Elspec's Search Utility

- After you have Copied the Utility on your Desktop, access it by clicking on the Eslpec's Search Icon:

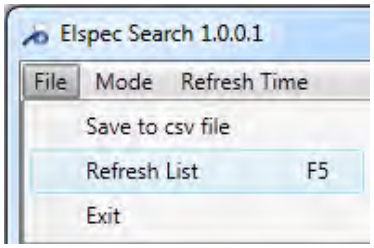

- Initially, the program may trigger a verification warning similar to the one below. You may proceed by clicking **Run**:




- A scan procedure is initiated; the Elspec Search utility appears as a grid displaying all BLACKBOX devices found on the intranet network:

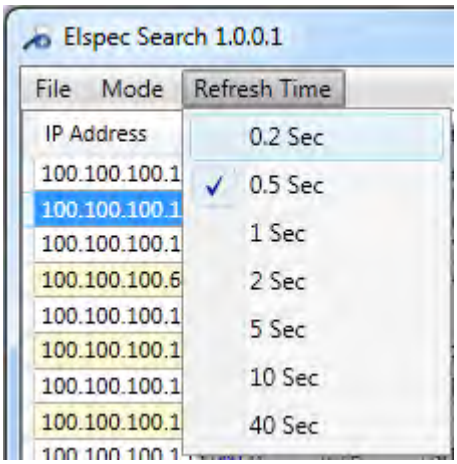



- Once open, the scan procedure can be manually prompted by using the **File Refresh List Menu**:



- As an alternative, the scan procedure can be configured to automatically refresh to the **Refresh Time**. This can be done by setting the **Mode** ➡ **AutoRefresh** to **ON:** (The default state is **OFF**)

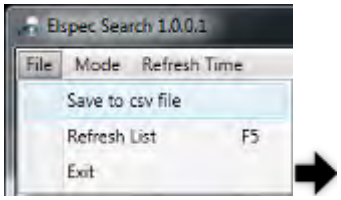

- Set the **Refresh Time** by selecting **Refresh Time** ➡ **Second:**




## *NOTE NOTE NOTE ....*

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. It includes the IP Address, Unit Description, SubnetMask, Gateway IP, IP Mode, Firmware Version & the G4K's Serial Number. The most important information being the **IP address** of each device. This access allows you to Establish a 1st Time Connection.

- By selecting **File** ➡ **Save to csv file** will allow you to export all the information appearing in the utility regarding G4K devices in your network for further reference:



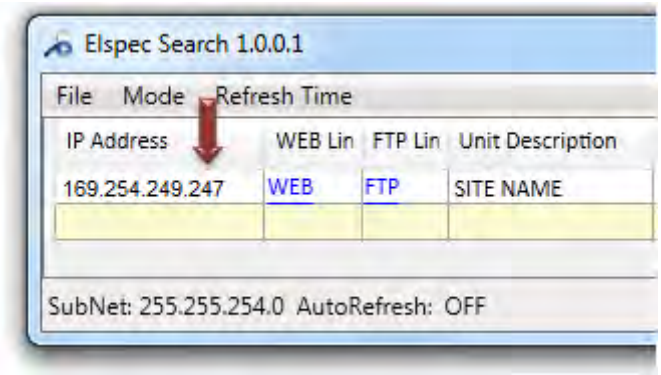

| IP Address | Unit Description | Subnet Mask | IP Mode | PHY | Firmware | Hardware | Serial Number |
|---|---|---|---|---|---|---|---|
| 169.254.249.254 | SITE NAME | 255.255.254.0 | Fixed | LCD | 0.4.07.6E | 2x2x2x0 | 0.60.35.8.91.86 |
| 192.168.168.168 | SITE NAME | 255.255.254.0 | DHCP | Main | 0.4.07.5C | 3x3x2 | 0.60.35.3.3C.F0 |

## SEE ALSO

- About Elspec's Search Utility
- Obtain Elspec's Search Utility
- G4K Unit Access
- New Device Indication
- Limitations of Elspec's Search Utility

# G4K Unit Access

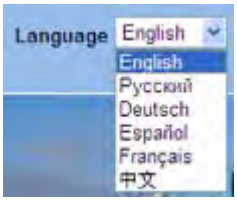
Once you have Connected the Device for the 1st Time, you may access your G4K Unit by simply clicking the WEB Hyperlink button in your Elspec's Search Utility. Alternatively you can simply access the device directly via Internet Explorer by inserting the Device's IP address directly (address is also indicated in Elspec's Search Utility). The Utility also provides you with access to your PQZIP Files via the FTP Server.: Once you have Connected the Device for the 1st Time, you may access your G4K Unit by simply clicking the WEB Hyperlink button in your Elspec's Search Utility. Alternatively you can simply access the device directly via Internet Explorer by inserting the Device's IP address directly (address is also indicated in Elspec's Search Utility. The Default IP Address for a newly supplied G4K unit is: **169.254.249.247**.




## ACCESS INSTRUMENT VIA THE WEB HYPERLINK [RECOMMENDED]

- Select the **Web** link for your device, Elspec's Web Interface will now open:


- In order to view the different languages in the Web Interface, you will need to upload the language feature from Elspec's Website when installing your new Firmware. Once uploaded, simply select the applicable interface language from the drop-down list:



- The supported languages are:
  - English (Default)
  - Russian
  - German
  - Spanish
  - French
  - Chinese

  (For other languages – please contact your local Elspec distributor)
- The Password field defines user level/privileges. The user levels are **Viewer / Administrator (**See Security Settings**).** The default password including privileges for each level are:
  - Viewer is **123** (Read only, can choose interface language only, no operations related changes are allowed)
  - Administrator is **12345** (Administration, setup & full control)

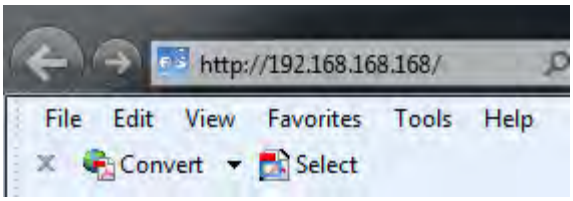
### *NOTE NOTE NOTE*

- The Website is optimized to work with Internet Explorer 7, 8 or 9 in "Compatibility View". Ensure that the Internet Explorer is running in **Compatibility View**:


  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 Disable Proxy Server in Internet Explorer.
- Should you be running Skype simultaneously with Elspec's Search, you will not be able to access the device via the Web Link. Close Skype & access Elspec's Search again to follow the Web Link.
- The passwords above are factory default values. You are advised to modify Admin password if extended security measures are required **(**See Security Settings).

## DIRECT INSTRUMENT ACCESS VIA INTERNET EXPLORER

Access the device by typing the G4K's IP address in the address field in Internet Explorer:



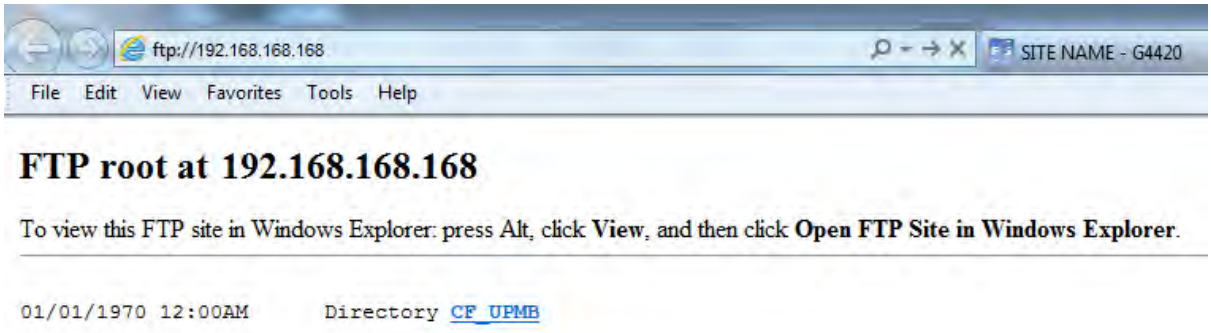

Choose the language & enter the password as outlined above

- Read how to Identify a New Device, about Elspec's Search Limitations

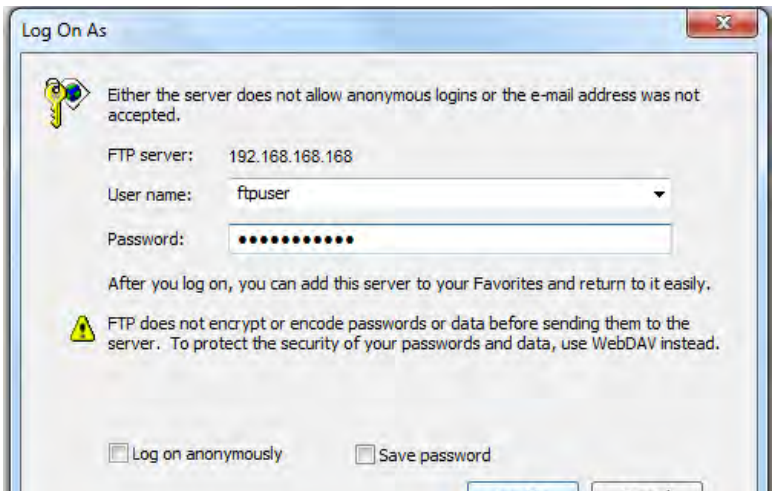
## ACCESS FTP VIA THE FTP HYPERLINK [RECOMMENDED]

The FTP (File Transfer Protocol) link is used for exchanging and manipulating files over a TCP computer network. The BLACKBOX 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. The same protocol may be used to manually download the PQZIP files.

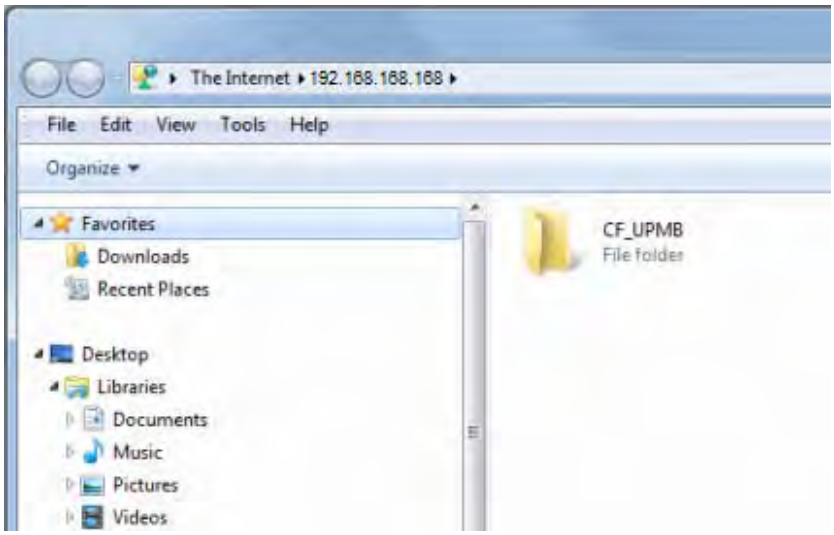
- Select the **FTP** link for your device, FTP Server will now open:




- Open **Page** ➡ **Open FTP Site in Windows Explorer.** Insert the Username & Password (Either default as above / as per your Security Settings) ➡ Log On:

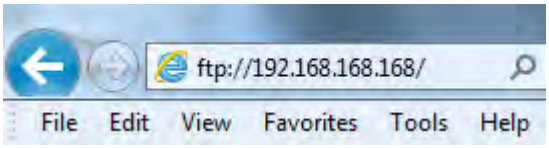


- The FTP server will now open in Windows Explored containing all the PQZIP files:




## DIRECT FTP ACCESS VIA INTERNET EXPLORER

Access the FTP by typing: **ftp://IP address** in the address field in the Internet Explorer:



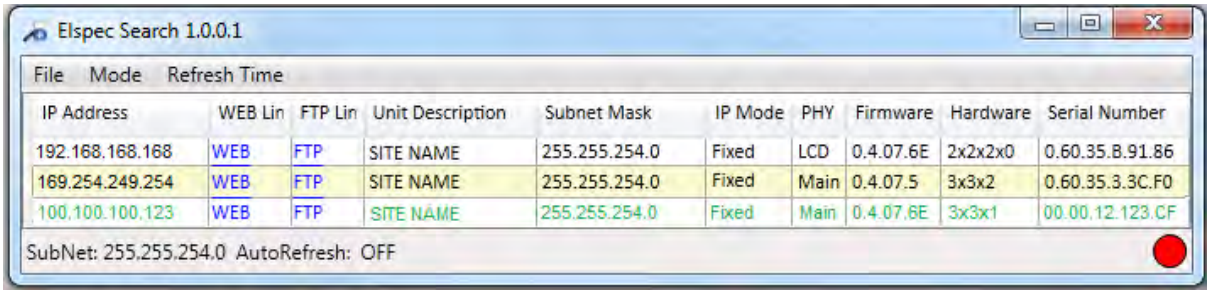

- Enter the password as outlined above.
- Read how to Identify a New Device, about Elspec's Search Limitations.

## SEE ALSO

- About Elspec's Search Utility
- Obtain Elspec's Search Utility
- Use the Elspec's Search Utility

# New Device Indication

Every new device that wasn't found after the last refresh is marked in green on Elspec's Search Utility:




## SEE ALSO

- About Elspec's Search Utility
- Obtain Elspec's Search Utility
- Use the Elspec's Search Utility
- G4K Unit Access
- Limitations of Elspec's Search Utility

# Limitations of Elspec's Search Utility

Elspec's Search utility can operate only as one single instance at a time, since it uses a single and fixed UDP port. Should you choose to open a new Search Utility window, only the initial Search Utility window will function properly.

When accessing the device via the Web Link ensure that the Internet Explorer is running in **Compatibility View,** as some web browser applications can limit the functionality and/or show an incorrect layout:


For local networking, the browser should be configured as working without a proxy server. Refer to Disable Proxy Server in Internet Explorer.

Should you be running Skype simultaneously with Elspec's Search, you will not be able to access the device via the Web Link. Close Skype & access Elspec's Search again to follow the Web Link.

## SEE ALSO

- About Elspec's Search Utility
- Obtain Elspec's Search Utility
- Use the Elspec's Search Utility
- G4K Unit Access
- New Device Indication

# G4K Specifications

This section includes common specifications for the G4K:

## INPUT CHARACTERISTICS:

| VOLTAGE INPUTS | G4410 | G4420 | G4430 |
|---|---|---|---|
| Number of Inputs | AC: 4 (3 Phase & Neutral) | AC: 4 (3 Phase & Neutral) | AC: 4 (3 Phase & Neutral) |
| Maximum Input Voltage ($V_{RMS}$) | 1KV | 1KV | 1KV |
| Nominal Voltage Range ($V_{RMS}$) | 110 to 690V | 110 to 690V | 110 to 690V |
| Maximum Peak Measurement Voltage ($V_{Pk}$) | 8kV | 8kV | 8kV |
| Input Impedance | 3MΩ | 3MΩ | 3MΩ |
| Bandwidth | 6.25kHz | 12.5kHz | 25kHz |
| Nominal Frequency | 42.5 to 69Hz | 42.5 to 69Hz | 42.5 to 69Hz |
| **CURRENT INPUTS** | **G4410** | **G4420** | **G4430** |
| Number of Inputs | AC: 4 (3 Phase & Neutral) | AC: 4 (3 Phase & Neutral) | AC: 4 (3 Phase & Neutral) |
| Nominal Full Scale ($I_{RMS}$) | 5A | 5A | 5A |
| Maximum Peak Measurement ($I_{Pk}$) | 50A | 50A | 50A |
| Range | 0 to 50A | 0 to 50A | 0 to 50A |
| Burden | 0.1mVA @ 5A | 0.1mVA @ 5A | 0.1mVA @ 5A |
| Bandwidth | 6.25kHz | 6.25kHz | 6.25kHz |
| **SAMPLING SYSTEM** | **G4410** | **G4420** | **G4430** |
| Maximum Sampling Rate for Each Channel Simultaneously: | | | |
| Voltage | 256 Samples/Cycle | 512 Samples/Cycle | 1024/512 Samples/Cycle |
| Current | 256 Samples/Cycle | 256 Samples/Cycle | 256/512 Samples/Cycle |
| Type of Analog to Digital Converter | 16/20[1] Bit | 16/20[1] Bit | 16/20[1] Bit |
| Resolution | Dual Range Gain of 2 x 16 Bit on 8 Channels | | |
| PLL Synchronization | 1024 Samples on 10/12 Cycles According IEC61000-4-7 | | |

[1] Effective Bit

## MEASUREMENT RANGE, RESOLUTION, ACCURACY:

| VOLT/AMPS/HERTZ | MEASUREMENT RANGE | RESOLUTION | ACCURACY |
|---|---|---|---|
| $V_{RMS}$ (AC & DC) | 0 to 900V | 0.01V | ±0.1% of Nominal Voltage[1] |
| $A_{RMS}$ | 1 to 5A | 0.1mA | ±0.1% of Nominal Current |
| $V_{Pk}$ | 8KV | 10mV | ±0.1% from Reading |
| Voltage Crest Factor | 1< | 0.01 | Better than 0.5% |
| Current Crest Factor | 1< | 0.01 | Better than 0.5% |
| Hz to 50Hz Nominal | 42.5 to 62Hz | 10mHz | ±5mHz |
| Hz to 60Hz Nominal | 51 to 69Hz | 10mHz | ±5mHz |
| K-Factor | 0< | 0.01 | ±0.25% |
| **DIPS, SWELLS & INTERRUPTIONS** | **MEASUREMENT RANGE** | **RESOLUTION** | **ACCURACY** |
| $V_{RMS}$½ (AC & DC) | 0 to 900V | 0.01V | ±0.2% of Nominal Voltage |
| Duration | HHH,MM,SS,MMM | Half Cycle | One Cycle |
| Threshold Levels | Programmable Thresholds & Hysteresis in Percentage of Nominal Voltage<br>Event Detection Based Upon ½ Cycle RMS Voltages<br>Captures Dips, Swells, Interruptions & Rapid Voltage Changes | | |
| **VOLTAGE HARMONICS** | **MEASUREMENT RANGE** | **RESOLUTION** | **ACCURACY** |
| Harmonic Order | 1 to 50 Grouping: Harmonic Subgroups According to IEC61000-4-7 | | |
| Inter-Harmonic Order | 1 to 50 Grouping: Inter-Harmonic Subgroups According to IEC61000-4-7 | | |
| THD $_{(n=50)}$ | 0 to 100% | 0.01% | ±0.25% |
| THD Even | 0 to 100% | 0. 01% | ±0.25% |
| THD Odd | 0 to 100% | 0.01% | ±0.25% |
| Hz (Spectrum) | 0 to 3174Hz | fSys 10/12 | ±5% |
| Phase Angle | -180 to +180° | 0.01° | ±0.01° |

[1] For Nominal Voltage 80 to 690V

| POWER & ENERGY | MEASUREMENT RANGE | RESOLUTION | ACCURACY |
|---|---|---|---|
| Active Power | ±5kW x CT Ratio x PT Ratio | 10mW | ±0.2% |
| Reactive Power | ±5kVAr x CT Ratio x PT Ratio | 10mVAR | ±2% |
| Apparent Power | ±5kVA x CT Ratio x PT Ratio | 10mVA | ±0.2% |
| Active Energy | ±5kWh x CT Ratio x PT Ratio | 10mWh | ±0.2% |
| Reactive Energy | ±5kVArh x CT Ratio x PT Ratio | 10mVArh | ±2% |
| Apparent Energy | ±5kVAh x CT Ratio x PT Ratio | 10mVAh | ±0.2% |
| True Power Factor | ±1 (CAP\IND) | 10µ | ±0.2% |
| Displacement Power Factor | ±1 (CAP\IND) | 10µ | ±0.2% |
| **FLICKERING** | **MEASUREMENT RANGE** | **RESOLUTION** | **ACCURACY** |
| $P_{SST}$, $P_{ST}$ 10 Minutes, $S_{PLT}$, $P_{LT}$ 2 Hours, $L_{PLT}$ | 0 to 20 | 0.01 | ±5% |
| $PST_{INST}$ | 0 to 20 | 0.01 | ±8% |
| **UNBALANCE** | **MEASUREMENT RANGE** | **RESOLUTION** | **ACCURACY** |
| Volts (Negative & Zero Seq.) Ratio | 0 to 100% | 0.1% | 0.15% |
| Current (Negative & Zero Seq.) Ratio | 0 to 100% | 0.1% | 0.5% |
| **TRANSIENT CAPTURE** | | | **ACCURACY** |
| Minimum Detection Duration | | | 78.1 µs (G4410)<br>39 µs (G4420)<br>19.5 µs (G4430) |

## GENERAL SPECIFICATIONS:

| STORAGE CAPACITY | G4410 | G4420 | G4430 |
|---|---|---|---|
| Internal Memory | 128MB | 4GB | 16GB |
| **REAL-TIME (SELF SYNCHRONIZATION)** | | | |
| Real Time Clock | ± 1 Second per 24 Hours | | |
| Time Synchronization | Optional GPS/SNTP/IRIGB/DCF-77 time sync module provides time uncertainty better than 100µs. When synchronization becomes unavailable, Time Tolerance is 1 second per day. | | |
| **DEVICE SYNCHRONIZATION ACCURACY** | | | |
| GPS & PPS | Better than 100µs | | |
| IRIG B[1] | 100 to 200µs | | |
| DCF-77 | ±15ms | | |
| SNTP Server | 50 to 100µs | | |
| **COMMUNICATION CONTROL** | | | |
| Web Server | Comprehensive web server for local & remote real-time monitoring & control | | |
| FTP Server | Standard protocol for main storage memory | | |
| **PORTS** | **G4410** | **G4420** | **G4430** |
| Ethernet Ports | 1 | 2 | 2 |
| RS485/422 | 1 | 1 | 1 |
| **LAN 1** | | | |
| Baud Rate | 10/100MBit | | |
| Communication Protocols | Modbus TCP, OPC, DNP3, TELNET & SMTP Client | | |
| Connector Type | RJ45 Female With Led Indicators | | |
| Power Over Ethernet (PoE- In) | 1 (Available as Input – 13 Watt, DC: 48V) | | |
| **LAN 2** | | | |
| Baud Rate | 10/100MBit | | |
| Communication Protocols | Modbus TCP, OPC, DNP3, TELNET & SMTP Client | | |
| Connector Type | RJ45 Female With Led Indicators | | |
| Power Over Ethernet (PoE- Out) | 1 (Available as Output - 13 Watt, DC: 48V) | | |
| **RS485/422 CONNECTION** | | | |
| Baud Rate | Configurable: 1200 / 2400 / 4800 / 9600 / 14400 / 19200 / 38400 57600 / 115200 | | |
| Communication Protocols | Modbus RTU, PPP & TTY | | |
| Duplex | Full | | |
| Maximum Cable Length | 15.2m (50') | | |

| APPLICABLE STANDARDS | |
|---|---|
| Measurement Standards | EN50160, IEEE1159, IEEE519, IEC61000-4-15, IEC61000-4-7, IEC61000-4-30 Class A, IEC62053-22/23 Class 0.2 |
| EMC Standards | EN55011 Group 1 Class A, EN60439-1 (Clauses 7.9.1, 7.9.3, 7.9.4, 7.10.3, 7.10.4), FCC Part 15 Subpart B Class A, IEC61000-3-3,EN61000-6-2, IEC60255 |
| Environmental Standards | IEC60068-2-1, 2, 6, 11, 27, 30, 75 |
| Safety Standards | EN61010-1:2001 2$^{ND}$ Edition |
| **POWER SUPPLY** | |
| Power Over Ethernet (PoE- In)[2] | According to 802.3af |
| Operating Range | AC: 100 to 260V @ 50/60Hz<br>DC: 100 to 300V |
| Auxiliary AC Supply | DC: 48V |
| Low Voltage Ride Through | Up to 25 Seconds |

[1] Only if Multi IO Module is present

[2] G4420 & G4430 Units Only

## PQZIP RECORDING:

| METHOD | | | |
|---|---|---|---|
| PQZIP compression technology which enables continuous gap-less[1] recording of all electrical parameters-related data for a significant time duration without the need of event thresholds of any kind. Events, Flicker and Energy are non-compressed parameters. | | | |
| **WAVEFORM** | **G4410** | **G4420** | **G4430** |
| Voltage Sampling per Cycle | 256 | 512 | 1024/512 |
| Current Sampling per Cycle | 256 | 256 | 256/512 |
| Recording Time | 1 Day Continuous Recording at a Fixed Ratio Mode of 3GB/Month | 3 Months Continuous Recording at a Fixed Ratio Mode of 1.2GB/Month | 1 & Year Continuous Recording at a Fixed Ratio Mode of 1.2GB/Month |
| **EVENTS** | | | |
| Memory | Up to 12K Event Logs | | |
| **FLICKER PST** | **G4410** | **G4420** | **G4430** |
| Recording Interval | 10 Minutes | 10 Minutes | 10 Minutes |
| Recording Time | 1 Day Continuous Recording at a Fixed Ratio Mode of 3GB/Month | 3 Months Continuous Recording at a Fixed Ratio Mode of 1.2GB/Month | 1 & Year Continuous Recording at a Fixed Ratio Mode of 1.2GB/Month |
| **ENERGY** | **G4410** | **G4420** | **G4430** |
| Energy Interval | 1, 2, 5, 10, 15, 30 & 60 Minutes | 1, 2, 5, 10, 15, 30 & 60 Minutes | 1, 2, 5, 10, 15, 30 & 60 Minutes |
| Recording Time | 1 Day Continuous Recording at a Fixed Ratio Mode of 3GB/Month | 3 Months Continuous Recording at a Fixed Ratio Mode of 1.2GB/Month | 1 & Year Continuous Recording at a Fixed Ratio Mode of 1.2GB/Month |

[1] 99.9% of the Time

## SEE ALSO:

- G4K Physical Specifications

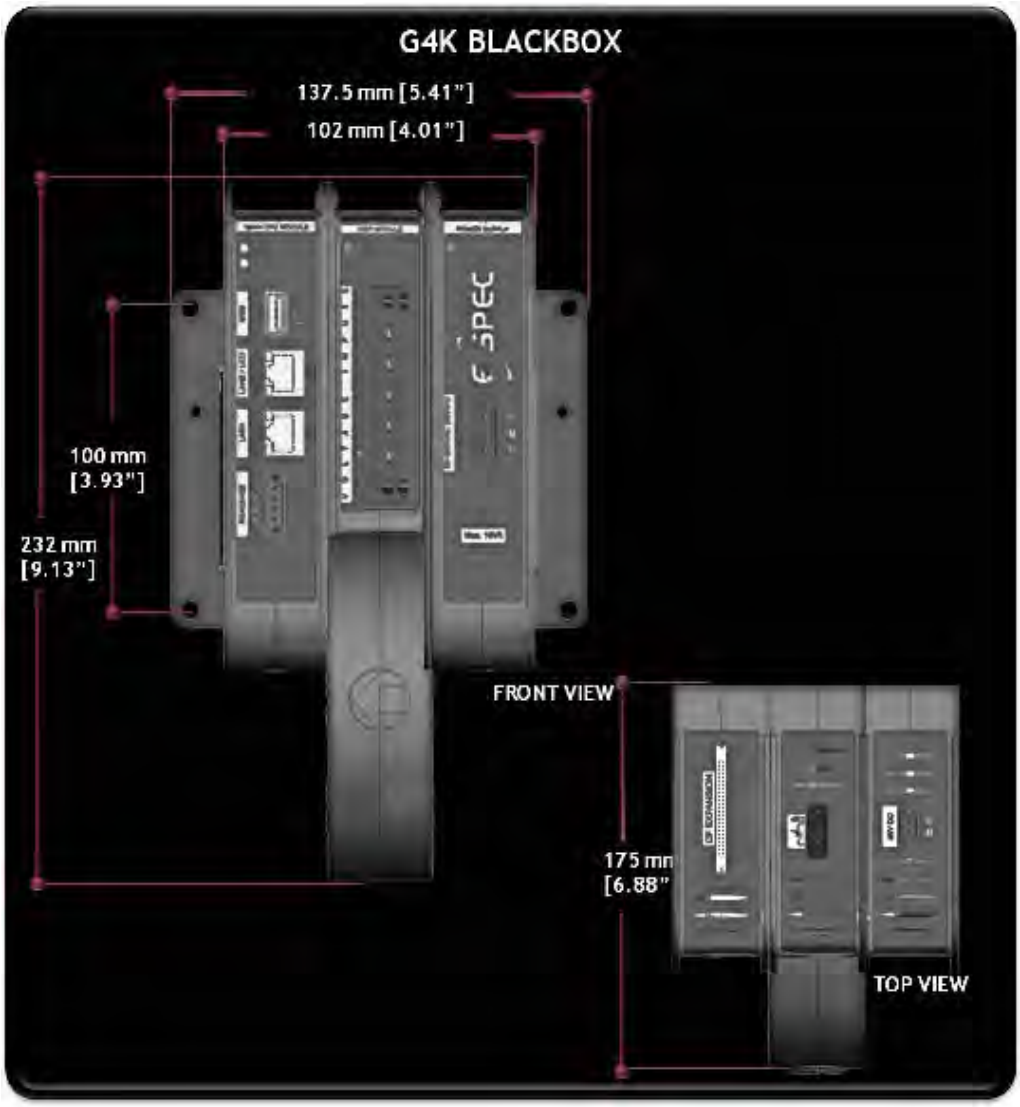
# G4K Physical Specifications

This section includes the Physical specifications for the G4K without the Multi IO, including:

## PHYSICAL SPECIFICATIONS:

| PHYSICAL | |
|---|---|
| Dimensions | 175mm x 232mm x137.5mm (6.88” x 9.13” x 5.41”) |
| Weight | 1.7Kg (3.74Lb) |
| **ENVIRONMENTAL** | |
| Design | Sleek black, shock proof, easy install, with Multi IO extension option |
| Drip and Dust Proof | IP20 according to IEC60529 when used in tilt stand position |
| Shock and Vibration | Shock 30g, Vibration: 3g Sinusoid, Random 0.03 g2/Hz according to MIL-PRF-28800F Class 2 |
| Operating Temperature | -20 to 70˚C (-4 to 158˚F) |
| Storage Temperature | -40 to 85˚C (-40 to 185˚F) |
| Humidity | 85% |
| Maximum Operating Altitude | 2Km (1.24Mi) |
| Warranty | One Year |
| **TEMPERATURE SENSORS** | |
| External Temperature Sensor (PT100) | -40 to 90˚C (-40 to 210˚F) |
| Internal PSU Temperature Sensor | Informative |
| Internal DSP Temperature Sensor | Informative |

## DIMENSIONS:




## SEE ALSO:

- G4K Specifications