G4K
Fixed PQ Analyzer
BLACKBOX

Datasheet

THE FUTURE OF POWER QUALITY

- Continuous Waveform Recordings

- Superior Accuracy

- Threshold Free Setup

IN THIS DOCUMENT

I. 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

II. BLACKBOX Web Interface Display

REAL-TIME DATA

Total Measurements

Available in Monitoring >> Summary

Summary		
Frequency	62.002 Hz	
I_{avg}	0.5000 A	
$V(LL)_{avg}$	207.80 V	
$V(LN)_{avg}$	119.98 V	
Power factor$_{total}$	1.0000	
Phase Order	123	

Synchronization Status		
Time Synchronization	Main	Good
DSP Synchronization	On	

Summary

- Frequency
- Current (Current Single Phase System/ Current Averaged Over All 3 Phases in 3 Phase System)
- Line to Line Voltage (Averaged Over All 3 Phases)
- Line to Neutral Voltage (Averaged Over All 3 Phases)
- Total System Power Factor (Over 3 Phases)
- Phase Order (Voltage Phase Order From V1 Moving Clockwise)

Synchronization Status

- Time Synchronization
- DSP Synchronization

10/12 Cycles

Available in Monitoring >> Voltage & Current

V/I	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	1.80515/
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

According to IEC 61000-4-30. Minimum, Maximum & Average Values of:

- RMS (Voltage & Current)
- THD (Voltage & Current)
- Crest Factor (Voltage & Current)
- K Factor (Current)
- TDD (Current)
- THD Even/Odd (Voltage & Current)
- Over/Under Deviation (Voltage)
- Unbalance (Voltage & Current)

150/180 Cycles, 10 Minutes, 2 Hours Aggregation

Available in 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

Under-deviation			
	150/180 Cycles	10 Min.	2 Hours
V_{12}	0.364090 %	0.214424 %	0.000000 %

| Over-deviation | | | |

According to IEC 61000-4-30:

- Frequency 10 Seconds
- RMS (Voltage)
- Over/Under Deviation (Voltage)
- Unbalance (Voltage & Current)

Power

Available in Monitoring >> Power

Power Summary					
	Active Power	Reactive Power	Apparent Power	True PF	Displacement PF
Phase 1	2.564086 kW	4.930077 kVAr	5.556996 kVA	0.461416 (Ind)	0.469361 (Ind)
Phase 2	5.637701 kW	-5.262132 kVAr	7.711919 kVA	0.731037 (Cap)	0.736560 (Cap)
Phase 3	12.74040 kW	2.974239 kVAr	13.08296 kVA	0.973816 (Ind)	0.982176 (Ind)
Total	20.94219 kW	2.642184 kVAr	26.35188 kVA	0.794713 (Ind)	0.469361 (Ind)

Per Phase & Total:

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

Temperature

Available in Monitoring >> Temperature

Displays Average, Minimum & Maximum Values of:

- Internal Temperature (DSP Module)
- External Temperature (Outside via PT100)
- PSU Temperature (Power Supply Module)

Phasor

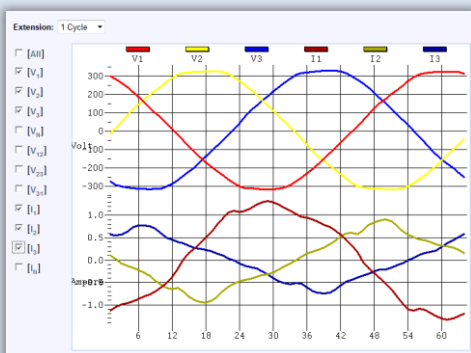*Available in Monitoring >> Phasors*
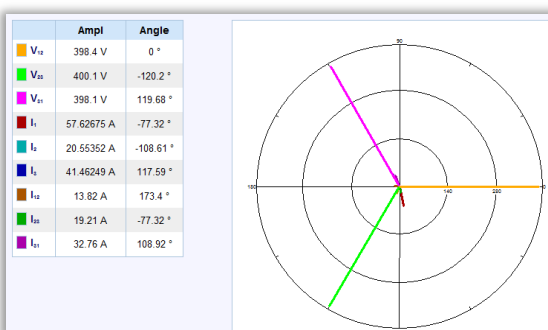
Shows Real Time Phasor Diagram:

- Voltage & Current (Depending on the Power Configuration. Select Combinations - Phase to Phase, Phase to Line Voltage & Current)
- Normalize (Vector Part of the Largest Vector)
- Amplitude (Per Phasor)
- Angle (Relative to V1/V12 - Depending on the Network Topology)

Exportable to: MetaFile, BMP, JPG, PNG, Text/Data

Waveform Display

Graph / Table / Both

Available in Monitoring >> Waveform

Captures Waveforms Up To 11 Channels – By:

- Cycle Selection (1 to 4 Cycles)
- Voltage & Current (Depending on Power Configuration: Select Combinations - Phase to Phase, Phase to Line Voltage & Current)

Exportable to: MetaFile, BMP, JPG, PNG, Text/Data

Voltage Flickering

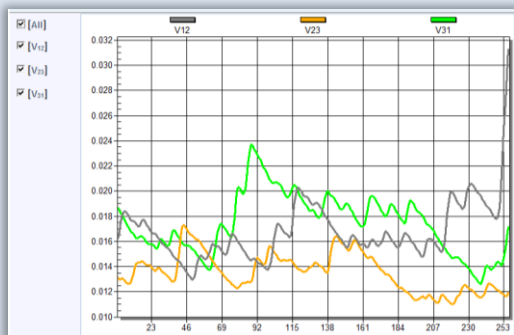*Available in Monitoring >> Voltage Flickering*

Aggregation:

- PSTINST to PST 2 Seconds (Instantaneous Flicker Evaluation)
- PSST 10 Seconds (As per PSST Averaged over 10 Seconds)
- PST 10 Minutes (According to IEC61000-4-15, Short Term Flicker Evaluation)
- SPLT – PLT 1 Hour
- PLT 2 Hours (According to IEC61000-4-15, Long Term Flicker Evaluation)
- LPLT 10 Hours (P_{LT} Averaged over 10 Hours)
- LPLT 1 Day (P_{LT} Averaged over 1 Day)
- LPLT 7 Days (P_{LT} Averaged over 7 Days)

Pinst Waveform

Graph / Table / Both

Available in Monitoring >> Pinst Waveforms

Displays Voltage Instantaneous Flicker Waveforms

Exportable to: MetaFile, BMP, JPG, PNG, Text/Data

Minimum / Maximum Flickering

*Available in Monitoring >> Min/Max Flickering*

Displays Minimum / Maximum Short & Long Term Voltage Flickering Values:

- PST INST – PST 2 Seconds (Instantaneous Flicker Evaluation)
- PSST 10 Seconds (As per PSST Averaged over 10 Seconds)
- PST 10 Minutes (According to IEC61000-4-15, Short Term Flicker Evaluation)
- SPLT – PLT 1 Hour
- PLT 2 Hours (According to IEC61000-4-15, Long Term Flicker Evaluation)
- LPLT 10 Hours (P_{LT} Averaged over 10 Hours)
- LPLT 1 Day (P_{LT} Averaged over 1 Day)
- LPLT 7 Days (P_{LT} Averaged over 7 Days)

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
V12	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
V23	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
V31	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

Voltage & Current Harmonics

Bar Graph / Table / Both

Available in Monitoring >> V&I Harmonics
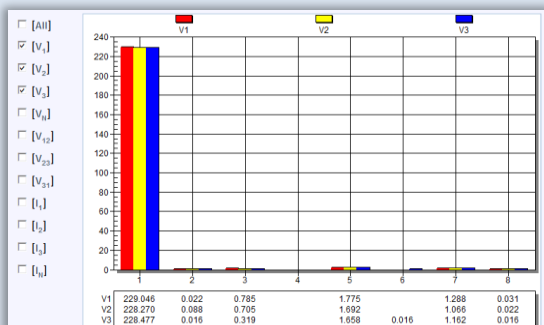
According to IEC61000-4-7:

- 10/12 Cycles Harmonics & Inter-Harmonics (Voltage & Current)
- 150/180 Cycles Harmonic & Inter-Harmonics (Voltage Only)
- 10 Minutes Harmonics & Inter-Harmonics (Voltage Only)
- 2 Hours Harmonics & Inter-Harmonics (Voltage Only)
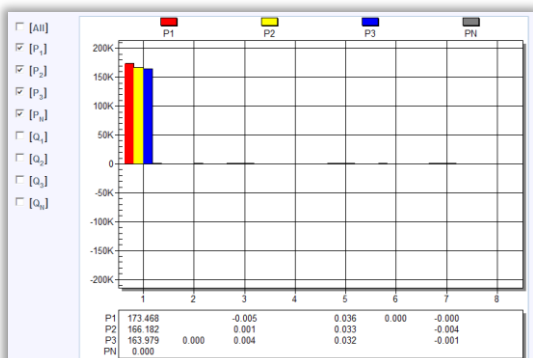- Harmonic Angles (Voltage & Current)

Harmonics Display:

- Real Values
- Values Relative to the Fundamental Harmonic

Exportable to: MetaFile, BMP, JPG, PNG, Text/Data

V1	229.046	0.022	0.785	1.775	1.288	0.031
V2	228.270	0.088	0.705	1.692	1.066	0.022
V3	228.477	0.016	0.319	1.658	0.016	1.162	0.016

Power Harmonics

Bar Graph / Table / Both

Available in Monitoring >> P&Q Harmonics

According to IEC61000-4-7:

- Active Power Harmonics
- Reactive Power Harmonics

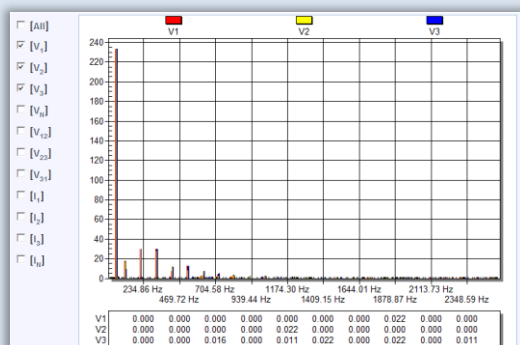Exportable to: MetaFile, BMP, JPG, PNG, Text/Data

P1	173.468	-0.005	0.036	0.000	-0.000
P2	166.182	0.001	0.033	0.001	-0.004
P3	163.979	0.000	0.004	0.032	-0.001
PN	0.000				

Spectrum
Bar Graph / Table / Both
Available in Monitoring >> Spectrum

Voltage & Current Spectrum Display:
- Harmonics Relative to the First Harmonic up to 11 Channels

Exportable to: MetaFile, BMP, JPG, PNG, Text/Data

Harmonics Table
Available in Monitoring >> Harmonics Table

According to IEC61000-4-7:
- 10/12 Cycles Harmonics & Inter-Harmonics (Voltage & Current)
- 150/180 Cycles Harmonic & Inter-Harmonics (Voltage Only)
- 10 Minutes Harmonics & Inter-Harmonics (Voltage Only)
- 2 Hours Harmonics & Inter-Harmonics (Voltage Only)
- Harmonic Angles (Voltage & Current)

Harmonics Display:
- Real Values
- Values Relative to the Fundamental Harmonic

V/I, Minimum & Maximum Harmonics Table
Available in Monitoring >> V/I Min/Max Harmonics

Summarizes V/I Minimum / Maximum Harmonic Values:
- Harmonic Angles (Voltage & Current)
- Harmonic Amplitude Values (Voltage & Current)

PQ Minimum & Maximum Harmonics Table
Available in Monitoring >> V/I Min/Max Harmonics

According to IEC61000-4-7:
- Active Power Harmonics
- Reactive Power Harmonics

ENERGY DATA

Consumption & Demand Table

Available in Energy >> Consumption & Demand

Consumption & Demand			
	Net Consumption	Demand	Peak Demand
Active Energy	42.822 kWh	0.0000 kW	4.5549 kW
Reactive Energy	-1.4878 kVArh	0.0000 kVAr	-1.8135 kVAr
Apparent Energy	43.248 kVAh	0.0000 kVA	4.5590 kVA

Summary Amount & Makeup of the Net Energy (Received & Delivered):

- Net Consumption
- Demand
- Peak Demand

Energy Flow:

- Active Energy (Real Energy in kWh)
- Reactive Energy (Volt Amperes Reactive Energy in kVArh)
- Apparent Energy (Volt Amperes Reactive Energy in kVArh & Energy kVAh)

Detailed Information Table

Available in Energy >> Detailed Information

Received Energy

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0000 kWh	0.0205 kWh	0.0000 kW	0.0168 kW
Reactive Energy	0.0000 kVArh	27.657 kVArh	0.0000 kVAr	0.0001 kVAr

Delivered Energy

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0000 kWh	5.0917 kWh	0.0016 kW	0.0040 kW
Reactive Energy	0.0000 kVArh	0.1067 kVArh	0.0000 kVAr	0.0793 kVAr

Net Energy (Received-Delivered)

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0000 kWh	-5.0712 kWh	-0.0016 kW	0.0128 kW
Reactive Energy	0.0000 kVArh	27.550 kVArh	0.0000 kVAr	-0.0792 kVAr

Net Generated Energy (Delivered-Received)

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0000 kWh	5.0712 kWh	0.0016 kW	-0.0128 kW
Reactive Energy	0.0000 kVArh	-27.550 kVArh	0.0000 kVAr	0.0792 kVAr

Total Energy (Received+Delivered)

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0000 kWh	5.1122 kWh	0.0016 kW	0.0207 kW
Reactive Energy	0.0000 kVArh	27.764 kVArh	0.0000 kVA	0.0793 kVAr
Apparent Energy	0.0000 kVAh	31.405 kVAh	0.0010 kVA	0.5056 kVA

Detailed Amount & Makeup of the Energy Flow:

- Current Period
- Total Consumption
- Demand
- Peak Demand

Energy:

- Received Energy (Active & Reactive)
- Delivered Energy (Active & Reactive)
- Generated Energy (Active & Reactive)
- Net Energy, Received & Delivered (Active & Reactive)
- Total Energy, Received & Delivered (Active, Reactive & Apparent)

Measurement Status Summary Table

Available in Energy >> Measurement Status

Status Summary	
Started	23/05/2012 12:31:36 UTC
Last Start	23/09/2012 05:37:46 UTC
Up Time	155:4:25:30 D:H:M:S
Down Time	2:14:45:32 D:H:M:S
Availability	98.342857 %
Energy Interval	1 min
External Sync	Disable
Sliding Window	Enable

Summary with Additional Statistics & Context on Energy:

- Started (Date & time stamp when the Energy Meter was originally activated for the very first time)
- Last Start (Date & Time Stamp from the Last Energy Meter Reset)
- Up Time (Total Cumulative Operational Time of Energy Meter Since Last Start)
- Down Time (Total Cumulative Time Energy Meter was Inoperative)
- Availability (Actual Operational Time of Energy Meter)
- Energy (Metering) Interval
- Sliding Window (Averaging System In Use):
- Enable (Energy is Calculated Using Sliding Interval for Each Energy Meter)
- Disable (Energy is Calculated Using Fixed Interval for Each Energy Meter)

POWER QUALITY DATA

Compliance Summary Table

Available in Power Quality >> Summary

Compliance Standard Status & Summary:

- Event Status (Pass / Fail)
- Compliance Summary

Built in Multi-standard compliance, with support for EN50160 & other National Standards:

Available in Configuration >> PQ Compliance

Compliance Info Table

Available in Power Quality >> Information

Supplies Detailed Compliance Info:

- Compliance Criteria
- PQ Compliance

Built in Multi Standard Compliance, with support for EN50160 & other National Standards:

Available in Configuration >> PQ Compliance

Compliance Chart

Available in Power Quality >> Chart
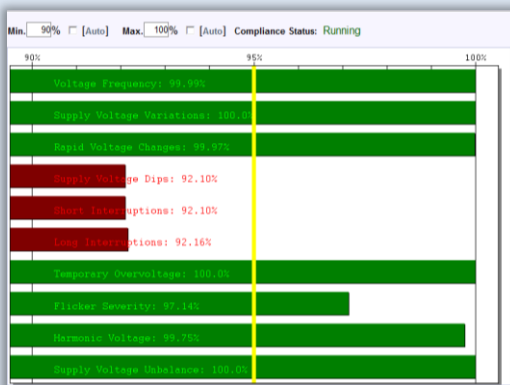
Displays Compliance Levels (Equals to % of Time OK):

- PQ Compliance

Exportable to: MetaFile, BMP, JPG, PNG, Text/Data

Events

Available in Power Quality >> Events

Displays Log of Configured PQ Events

Configurable EN50160/Compliance Events (DIP/SWELL/V-Interruptions)

(Available in Configuration >> PQ Compliance)

III. 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 Event Detection Based Upon ½ Cycle RMS Voltages 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) 39 µs (G4420) 19.5 µs (G4430)

IV.   Measurement Method

V$_{RMS}$	$$V_{RMS_x} = \sqrt{\sum_{n=1} ((V \cos \varphi)^2 + (V \sin \varphi)^2)}$$ n = Number of Samples x = Specific Channel 10/12 Continuous Non-Overlapping Cycles In Accordance with IEC61000-4-30
V$_{RMS}$½ , A$_{RMS}$½	Value Is Measured Over 1 Cycle, Commencing At a Fundamental Zero Crossing, & Refreshed Each Half-Cycle. This Technique Is Independent For Each Channel In Accordance With IEC61000-4-30
A$_{RMS}$	$$I_{RMS_x} = \sqrt{\sum_{n=1} ((I \cos \varphi)^2 + (I \sin \varphi)^2)}$$ n = Number of Samples x = Specific Channel 10/12 Continuous Non-Overlapping Cycles In Accordance with IEC61000-4-30
H$_{RMS}$	$$H_{RMS_x} = \sqrt{\sum_{n=2} ((A \cos \varphi)^2 + (A \sin \varphi)^2)}$$ n = Number of Samples x = Specific Channel 10/12 Continuous Non-Overlapping Cycles In Accordance with IEC61000-4-30
V$_{Pk}$, I$_{Pk}$	Absolute Highest Sample Value Within 10/12 Cycle Interval
V Crest Factor	$$\frac{V_{Pk}}{V_{RMS}}$$ Measures Ratio Between the V$_{PK}$ and V$_{RMS}$
A Crest Factor	$$\frac{I_{Pk}}{I_{RMS}}$$ Measures ratio between the I$_{Pk}$ & A$_{RMS}$
Hz	$$\frac{Complete\ cycles\ in\ 10\ seconds}{10\ seconds}$$ Measured Every 10 Seconds in Accordance with IEC61000-4-30
THD	$$\sqrt{\frac{\sum_{n=2}^{50} C_n^2}{C_1^2}}$$ *C* = Harmonic RMS Value *n* = Harmonic Order
THD Even	$$\sqrt{\frac{\sum_1^{25} C_{2n}^2}{C_1^2}}$$ *C* = Harmonic RMS Value *n* = Harmonic Order
THD Odd	$$\sqrt{\frac{\sum_1^{25} C_{2n+1}^2}{C_1^2}}$$ *C* = Harmonic RMS Value *n* = Harmonic Order

Harmonics	$$G_{sg,n}^2 = \sum_{i=1}^{1} C_{k+i}^2$$ In Accordance With IEC61000-4-7
Inter-Harmonics	In Accordance With IEC61000-4-7
Watt	$$P = V_{h_1} * I_{h_1} * \cos(\varphi_1) + \sum_n V_{h_n} * I_{h_n} * \cos(n * \varphi_1 + \varphi_n)$$ *n* = 2 to 50
VA	$S = V_{RMS} * I_{RMS}$
VAR	$Q = \sqrt{S^2 - P^2}$
True Power Factor (PF)	$PF_{sign} = P_{sign} * Q_{sign}$ $if\ PF_{sign} > 0\ than\ IND;\ PF_{sign} < 0\ than\ CAP$

QUADRAT	*P*	*Q*	*PF*	PF UNIT
I	+	+	+	IND
II	-	+	-	CAP
III	-	-	+	IND
IV	+	-	-	CAP

Displacement Power Factor (PF)	Same as True PF, But Only With Fundamental Components: $$true\ PF = \left| \frac{P_{h1}}{S_{h1}} \right|, if\ Q > 0\ than\ CAP;\ if\ Q < 0\ than\ IND$$
Unbalance	The 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): $$\underline{U}_1 = \frac{1}{3} \left(\underline{U}_a + a^1\ \underline{U}_b + a^2\ \underline{U}_c \right) \text{ where } a = 1\angle 120° = -\frac{1}{2} + j\frac{\sqrt{3}}{2}$$ 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): $$\underline{U}_2 = \frac{1}{3} \left(\underline{U}_a + a^2\ \underline{U}_b + a^1\ \underline{U}_c \right) \text{ where } a = 1\angle 120° = -\frac{1}{2} + j\frac{\sqrt{3}}{2}$$ 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: $\underline{U}_0 = \dfrac{1}{3}(\underline{U}_a + \underline{U}_b + \underline{U}_c)$ 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
Flicker	Five Block Digital Flickermeter as Described in IEC 61000-4-15 Edition 2. Functional & Design Specification Includes 230V/50Hz, 230V/60Hz, 120V/50Hz, 120V/60Hz Lamp Models
Flicker P$_{INST}$ (Instantaneous Term Flicker Evaluation)	Output of Block 5 of the Flickermeter in Accordance with IEC61000-4-15 Edition 2
Flicker P$_{ST}$ (Short Term Flicker Evaluation)	The Standard Measurement Time For P_{ST} is 10 Minutes: $P_{ST} = \sqrt{0.0314P_{0.1} + 0.0525P_{1S} + 0.0657P_{3S} + 0.28P_{10S} + 0.08P_{50S}}$ Where the Percentiles $P_{0.1}$, P_1, P_3, P_{10}, P_{50} are the Flicker Levels Exceeded for 0.1, 1, 3, 10 & 50% of the Time During The Observation Period. The Suffix "s" in the Formula Indicates that the Smoothed Value Should be Used. The Smoothed Values are Obtained Using the Following Formulas: P(1s) = (P(.7) + P(1) + P(1.5))/3 P(3s) = (P(2.2) + P(3) + P(4))/3 P(10s) = (P(6) + P(8) + P(10) + P(13) + P(17))/5 P(50s) = (P(30) + P(50) + P(80))/3
Flicker P$_{LT}$ (Long Term Flicker Evaluation)	The Long-Term P$_{LT}$ is Derived From the Short-Term Values Over 12 Short-Term Values of 10 Minutes Each Over a Period of 2 hours: $P_{LT} = \sqrt[3]{\dfrac{\sum_{i=1}^{N} P_{ST_i}^3}{N}}$ Where P_{ST_i} (i = 1, 2, 3, …) are the Consecutive Readings of the P_{ST}
K-Factor	$\dfrac{\sum_{n=1}^{25}(i_n * n)^2}{\sum_{n=1}^{25} i_n^{\ 2}}$ *Where n is the Harmonic #, and i_n is the RMS value of the n^{TH} Harmonic*

V. 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')

[1] Only if Multi I/O Module is present

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 2ND Edition
POWER SUPPLY	
Power Over Ethernet (PoE- In)[1]	According to 802.3af
Operating Range	AC: 100 to 260V @ 50/60Hz DC: 100 to 300V
Auxiliary AC Supply	DC: 48V
Low Voltage Ride Through	Up to 25 Seconds

[1] G4420 & G4430 Units Only

VI.   PQZIP Recording

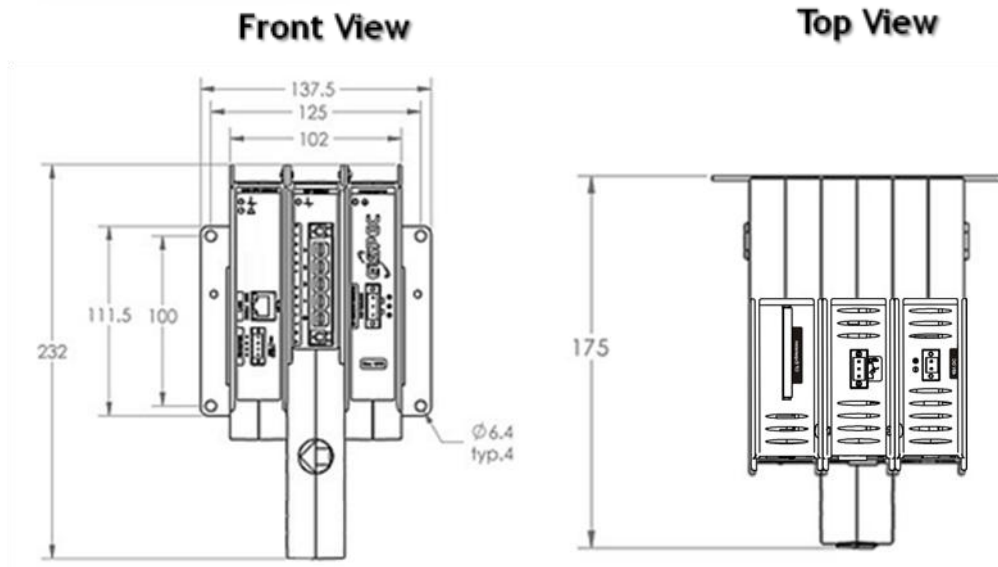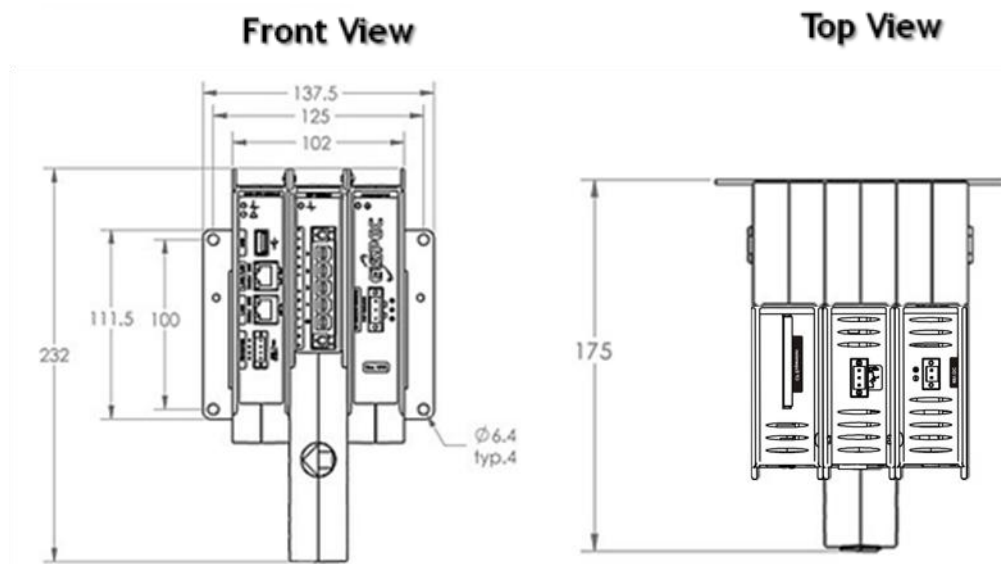| METHOD			
PQZIP compression technology which enables continuous gap-less[1] recording of all electrical parameters-related data for a significant time duration without the need of event thresholds of any kind. Events, Flicker and Energy are non-compressed parameters.			
WAVEFORM	**G4410**	**G4420**	**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

VII. Physical

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 I/O 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

VIII. Dimensional View

VIII.1 G4410

VIII.2 G4420 & G4430

IX. Multi IO Module

DIGITAL INPUTS	
Channels	8
Sampling	800Hz @ 50Hz 960Hz @ 60Hz
Range	3 DC Options Ranging From 0 to 220V: ▪ 3.3V, Vin < 48V ▪ <48 to 110V ▪ <110 to 220V (Requires Additional Resistor)
Pulse Type	KYZ, 0->1->0, 1->0->1
Isolation Connector	125V
DIGITAL OUTPUTS	
Channels	4
Maximum Switching Voltage	AC: 35V; DC: 45V
Pulse Type	KYZ, 0->1->0, 1->0->1
ANALOG INPUTS	
Channels	4
Sampling Rate	2Hz
Signal	4-20mA (Continuous DC)
Impedance	25Ω
Maximum Voltage (Common Mode)	270V
ANALOG OUTPUTS	
Channels	4
Signal	4-20mA (Continuous DC)
Accuracy	0.1% (10 Bit D to A Resolution)
RELAY OUTPUT MODULE	
Channels	3 x Change Over
Contact Configuration	1 CO (SPDT – Single Pole Double Throw)
Rated Voltage	AC: 250V
Maximum Switching Voltage	AC: 400V
Maximum Current	AC: 5A/250V; 10A/110V DC: 5A/30V
Maximum Peak Current	15A
Rated Current	6A
Operating Time	4ms
Release Time	6ms
Maximum Reaction Time	10ms
Maximum Drop-out Time	4ms
Output Resistance	50MΩ

| RS232 CONNECTIONS	
Baud Rate	Configurable: 1200 / 2400 / 4800 / 9600 / 14400 / 19200 / 38400 57600 / 115200
Duplex	Full
Supported Protocols	GPS
Connector Type	DB9 Male
Maximum Cable Length	15.2m (500')

IX.1 Physical

PHYSICAL	
Dimensions	
Expansion Option A – One Module	175mm x 232mm x 137.5mm (6.88" x 9.13" x 5.41")
Expansion Option B – Two Modules	175mm x 232mm x 171mm (6.88" x 9.13" x 6.73")
Weight	
Expansion Option A – One Module	1.8Kg (3.96Lb)
Expansion Option B – Two Modules	1.9Kg (4.18Lb)

IX.2 Dimensional View

IX.2.1 Expansion Option A - G4K With One Multi I/O Module
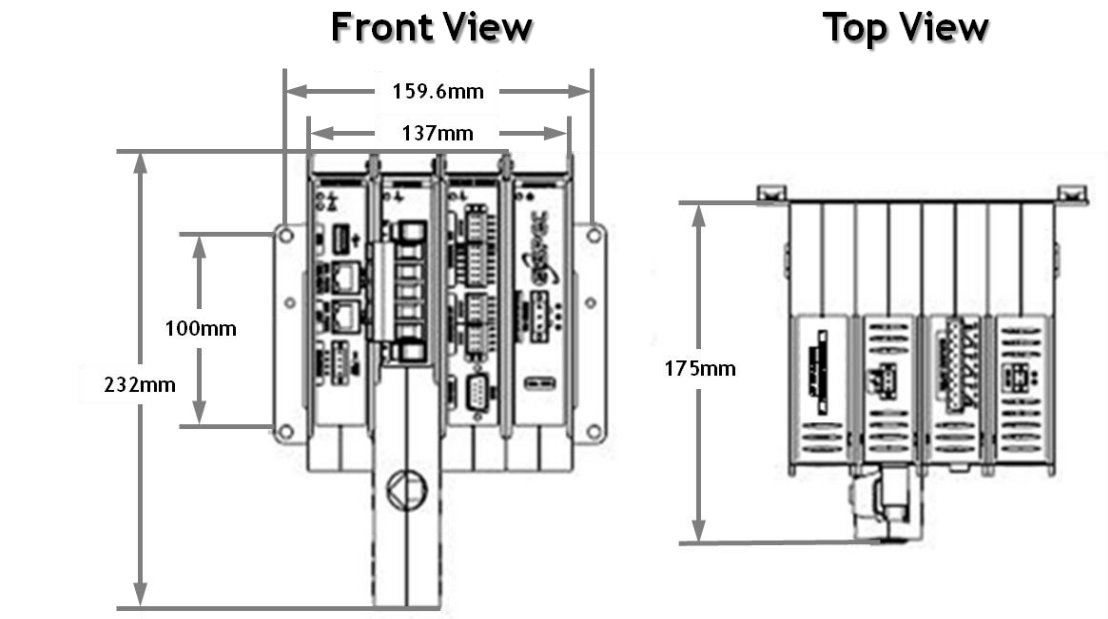
IX.2.2 Expansion Option B - G4K With Two Multi I/O Modules