G4500 & G3500
Portable PQ Analyzer
BLACKBOX

Datasheet

Power Quality in High Definition

- No Missed Events
- Quick & Simple Setup
- Remote Connectivity

Date: October 2013

SMX- 1118-0100

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IN THIS DOCUMENT

I. Input Characteristics

VOLTAGE INPUTS	G4500	G3500
Number of Inputs	AC: 4 (3 Phases & Neutral) DC: 1	AC: 4 (3 Phases & Neutral)
Maximum Input Voltage (V_{RMS})	1KV	1KV
Nominal Voltage Range (V_{RMS})	110 to 690V	110 to 690V
Maximum Peak Measurement Voltage (V_{Pk})	8KV	8KV
Input Impedance	3MΩ	3MΩ
Bandwidth	25kHz	12.5kHz
Nominal Frequency	42.5 to 69Hz	42.5 to 69Hz
CURRENT INPUTS	**G4500**	**G3500**
Number of Inputs	AC: 4 (3 Phases & Neutral) DC: 1	AC: 4 (3 Phases & Neutral)
Maximum Peak Measurement (V_{Pk})	I1 to I4: 10; I5: 3 From Clamp	I1 to I4: 10; I5: 3 From Clamp
Type	Clamp On Current Transformer With mV Output	Clamp On Current Transformer With mV Output
Range (V_{Pk})	I1 to I4: 0 to 10; I5: 0 to 3 From Clamp	I1 to I4: 0 to 10; I5: 0 to 3 From Clamp
Bandwidth	6.25/12.5kHz	12.5kHz
SAMPLING SYSTEM	**G4500**	**G3500**
Maximum Sampling Rate for Each Channel Simultaneously:		
Voltage	1024 Samples/Cycle	512 Samples/Cycle
Current	256 Samples/Cycle	512 Samples/Cycle
VDC	1 Sample/Second	N/A
Type of Analog to Digital Converter	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
- 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

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

According to IEC 61000-4-30:
- Frequency 10 Seconds
- RMS (Voltage)
- Over/Under Deviation (Voltage)
- Unbalance (Voltage & Current)

Power

Available in Monitoring >> Power

Per Phase & Total:
- Active Power
- Reactive power
- Apparent Power
- True Power Factor
- Displacement Power Factor

REAL-TIME DATA

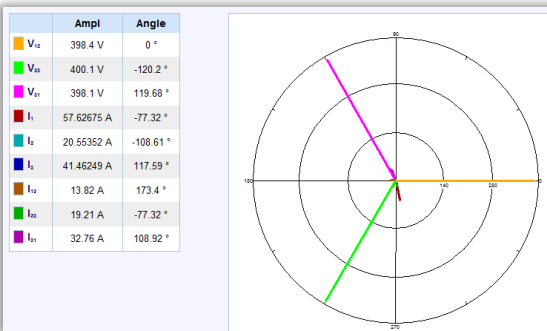### Temperature
Available in Monitoring >> Temperature

Internal Temperature		
Internal$_{avg}$	Internal$_{min}$	Internal$_{max}$
45.95 °C	43.99 °C	47.98 °C

External Temperature		
External$_{avg}$	External$_{min}$	External$_{max}$
No PT100	No PT100	No PT100

PSU Temperature		
PSU$_{avg}$	PSU$_{min}$	PSU$_{max}$
52.19 °C	48.50 °C	57.16 °C

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

|	Ampl	Angle
V$_{12}$	398.4 V	0 °
V$_{23}$	400.1 V	-120.2 °
V$_{31}$	398.1 V	119.68 °
I$_1$	57.62675 A	-77.32 °
I$_2$	20.55352 A	-108.61 °
I$_3$	41.46249 A	117.59 °
I$_{12}$	13.82 A	173.4 °
I$_{23}$	19.21 A	-77.32 °
I$_{31}$	32.76 A	108.92 °

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
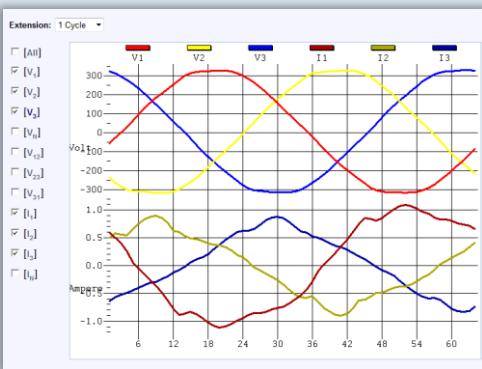
Captures Waveforms Up To 11 Channels – By:

- 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

Voltage Flickering	PST INST	PSST 10 Sec.	PST 10 Min.	SPLT 1 Hour	PLT 2 Hour	LPLT 10 Hour	LPLT 1 Day	LPLT 7 Day
V$_1$	0.2298	0.2907	0.3001	0.4546	1.1458	0.5399	0.4929	1.2156
V$_2$	0.1951	0.2615	0.2711	0.4374	1.1430	0.5259	0.4790	1.2125
V$_3$	0.2564	0.3164	0.3248	0.4710	1.1497	0.5451	0.5042	1.2186
V$_{12}$	65.539	65.913	65.519	65.504	65.442	63.866	63.768	63.615
V$_{23}$	129.67	133.08	134.01	133.73	133.76	130.73	130.38	127.01
V$_{31}$	241.87	247.63	182.70	182.70	182.70	182.70	182.70	182.69

|	10 Min.	2 Hours
Timestamp	12/08/1973 01:10:00	12/08/1973 00:00:00
Flag	Not flagged	Not flagged

Aggregation:

- PST INST 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
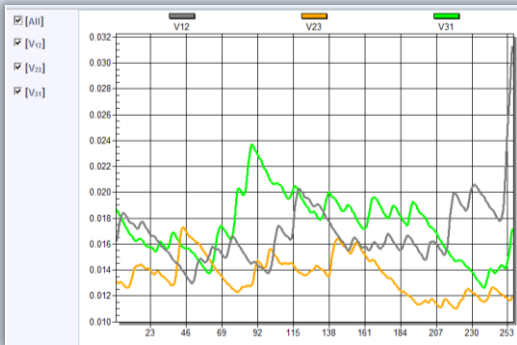
Displays Voltage Instantaneous Flicker Waveforms

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)

Voltage & Current Harmonics
Bar Graph / Table / Both
Available in Monitoring >> V&I Harmonics
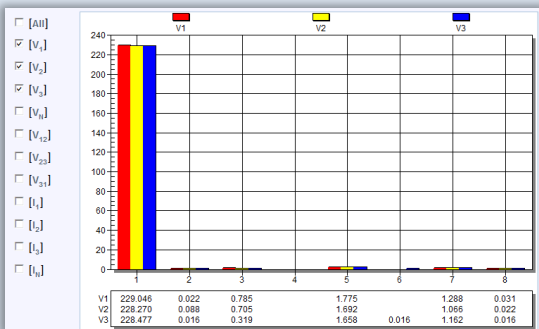
According to IEC61000-4-7:

- 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)
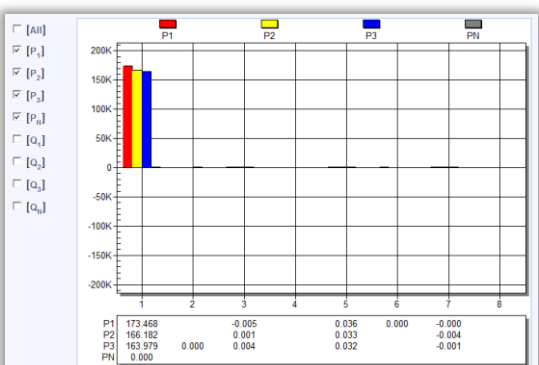- Harmonic Angles (Voltage & Current)

Harmonics Display:

- Real Values
- Values Relative to the Fundamental Harmonic

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

Power Harmonics
Bar Graph / Table / Both
Available in Monitoring >> P&Q Harmonics

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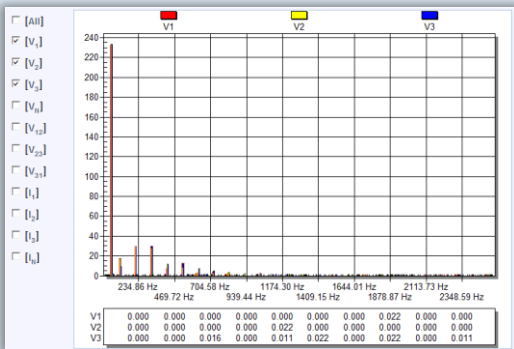
- Active Power Harmonics
- Reactive Power Harmonics

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

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	1.2901 kWh	-1.0898 kW	57.616 kW
Reactive Energy	0.0370 kVArh	0.2892 kVAr	-0.1698 kVAr
Apparent Energy	1.0092 kVAh	1.1738 kVA	6.7446 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	1.7110 kWh	0.0000 kW	61.356 kW
Reactive Energy	0.0010 kVArh	0.0862 kVArh	0.2892 kVAr	0.2956 kVAr

Delivered Energy

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0037 kWh	0.4208 kWh	1.0898 kW	3.7393 kW
Reactive Energy	0.0000 kVArh	0.0492 kVArh	0.0000 kVAr	0.4654 kVAr

Net Energy (Received-Delivered)

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	-0.0037 kWh	1.2901 kWh	-1.0898 kW	57.616 kW
Reactive Energy	0.0010 kVArh	0.0370 kVArh	0.2892 kVAr	-0.1698 kVAr

Net Generated Energy (Delivered-Received)

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0037 kWh	-1.2901 kWh	1.0898 kW	-57.616 kW
Reactive Energy	-0.0010 kVArh	-0.0370 kVArh	-0.2892 kVAr	0.1698 kVAr

Total Energy (Received+Delivered)

	Current Period	Total Consumption	Demand	Peak Demand
Active Energy	0.0037 kWh	2.1318 kWh	1.0898 kW	65.095 kW
Reactive Energy	0.0010 kVArh	0.1353 kVArh	0.2892 kVA	0.7609 kVAr
Apparent Energy	0.0040 kVAh	1.0092 kVAh	1.1738 kVA	6.7446 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	09/05/1972 21:23:24 UTC
Last Start	26/12/2011 16:05:50 UTC
Up Time	2:16:17:49 D:H:M:S
Down Time	0:0:0:55 D:H:M:S
Availability	99.976242 %
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
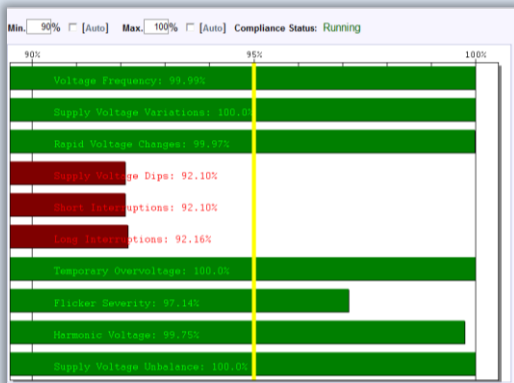
Displays Compliance Levels (Equals to % of Time OK):

- 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} With SOA-9045-3001	90A to 15kA	0.1mA	±0.5% ±0.5A of Nominal Current[2]
With SOA-9091-3000	9 to 1.5kA	0.1mA	±0.8% ±0.1A of Nominal Current[2]
With SOA-0010-0500	0.02 to 6A	0.1mA	±0.15% ±0.5mA of Nominal Current[2]
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 @ 50Hz Nominal	42.5 to 62Hz	10mHz	±0.005Hz
Hz @ 60Hz Nominal	51 to 69Hz	0.01Hz	±0.005Hz
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

[2] Depending on the Clamp Accuracy

POWER & ENERGY	MEASUREMENT RANGE	RESOLUTION	ACCURACY
Active Power	Depends on Clamp & PT Configuration	10mW	±0.2%[1]
Reactive Power	Depends on Clamp & PT Configuration	10mVAR	±2%[1]
Apparent Power	Depends on Clamp & PT Configuration	10mVA	±0.2%[1]
Active Energy	Depends on Clamp & PT Configuration	10mWh	±0.2%[1]
Reactive Energy	Depends on Clamp & PT Configuration	10mVArh	±2%[1]
Apparent Energy	Depends on Clamp & PT Configuration	10mVAh	±0.2%[1]
True Power Factor	±1 (CAP\IND)	10μ	±0.2%[1]
Displacement Power Factor	±1 (CAP\IND)	10μ	±0.2%[1]
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%[1]
TRANSIENT CAPTURE			**ACCURACY**
Minimum Detection Duration			39 μs (G3500) 19.5 μs (G4500)

[1] Depending on the Clamp Accuracy

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$_{RM}$S½	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: $$\underline{U}_0 = \frac{1}{3}\left(\underline{U}_a + \underline{U}_b + \underline{U}_c\right)$$ 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: $$P_{LT} = \sqrt[3]{\frac{\sum_{i=1}^{N} P_{ST_i}^3}{N}}$$ Where P_{ST_i} (i = 1, 2, 3, ...) are the Consecutive Readings of the P_{ST}
K-Factor	$$\frac{\sum_{n=1}^{25}(i_n * n)^2}{\sum_{n=1}^{25} i_n^{\,2}}$$ *Where n is the Harmonic #, and i_n is the RMS value of the n^{TH} Harmonic*

V. General Specifications

STORAGE CAPACITY	G4500	G3500
Internal Memory	32GB	256MB

STORAGE CAPACITY	
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	100 to 200μs
DCF-77	±15ms
SNTP Server	50-100μs

COMMUNICATION	
CONTROL	
Web Server	Comprehensive web server for local & remote real-time monitoring & control
FTP Server	Standard protocol for main storage memory

PORTS	G4500	G3500
Ethernet Ports	2 LAN & 1 USB (Integrated Router, NAT & Firewall)	1 LAN
RS-232	1	1
RS-485/422	1	1
Wi-Fi Communications (802.11g)	1 (With Integrated Antenna)	—

LAN 1	
Baud Rate	10/100 Mbit
Communication Protocols	TELNET, OPC & 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	10/100 Mbit
Communication Protocols	TELNET, OPC, & 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	PPP & TTY
Duplex	Full
Maximum Cable Length	15.2m (50')

RS232 CONNECTION (COM Compatible Interface)	
Default Configuration	Baud rate: 19200, Data Bits: 8 , Parity: None, Stop Bits: 1
Communication Protocols	GPS
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
EMC Standards	EN61326, CFR47FCC, CISPR11 Group 1, FCC PART 15 Subpart B, EN61010-2, IEC61000-3-3, IEC61000-4-2, IEC61000-4-3, IEC61000-4-4, IEC61000-4-5, IEC61000-4-6, IEC61000-4-11
Environmental Standards	IEC60068-2-1, 2, 6, 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: 80 to 260V @ 50/60Hz DC: 110 to 300V
Auxiliary AC Supply	DC: 48V
Battery Backup	2 Hours

[1] G4500 Unit 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	G4500	G3500
Voltage Sampling per Cycle	1024/512	512
Current Sampling per Cycle	256/512	512
Recording Time	1 + Year Continuous Recording at a Fixed Ratio Mode of 2.5GB/Month	1 Week Continuous Recording at a Fixed Ratio Mode of 1GB/Month

EVENTS		
Memory	Up to 12K Event Logs	

FLICKER PST		
Recording Interval	10 Minutes	10 Minutes
Recording Time	1 + Year Continuous Recording at a Fixed Ratio Mode of 2.5GB/Month	1 Week Continuous Recording at a Fixed Ratio Mode of 1GB/Month

ENERGY		
Energy Interval	1, 2, 5, 10, 15, 30 & 60 Minutes	
Recording Time	1 + Year Continuous Recording at a Fixed Ratio Mode of 2.5GB/Month	1 Week Continuous Recording at a Fixed Ratio Mode of 1GB/Month

[1] 99.9% of the Time

VII.   I/O Ports

DIGITAL INPUTS	
Channels	4
Sampling	800 Hz @ 50Hz (16 Samples per Cycle) 960 Hz @ 60Hz (16 Samples per Cycle)
Range	DC: 0 – 220V
Pulse Type	0->1->0, 1->0->1, KYZ
Isolation Connector	125V
RELAY OUTPUT	
Channels	1 x Change Over
Contact Configuration	1 CO (SPDT – Single Pole Double Throw)
Maximum Switching Voltage	AC: 277V
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

VIII. Physical

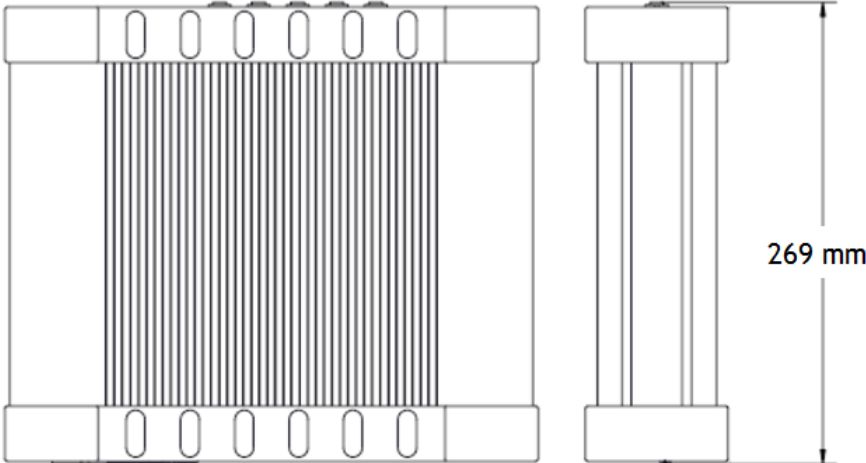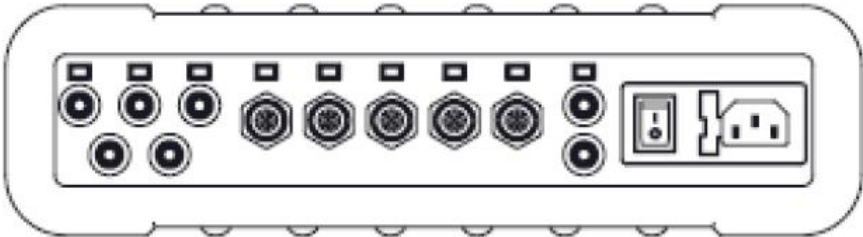| PHYSICAL	
Dimensions	314mm x 84mm x 269mm (12.36" x 3.3" x 10.59")
Weight	3.7Kg (8.15Lb)
ENVIRONMENTAL	
Design	Rugged, Shock Proof with Integrated Protective Holster
Drip & Dust Proof	IP20 according to IEC60529 when used in tilt standard position
Shock & Vibration	Shock 30g, Vibration: 3g Sinusoid, Random 0.03 g2/Hz According to MIL-PRF-28800F Class 2
Operating Temperature	-0 to 40°C (32 to 104°F)
Storage Temperature	-20 to 60°C (-4 to 140°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

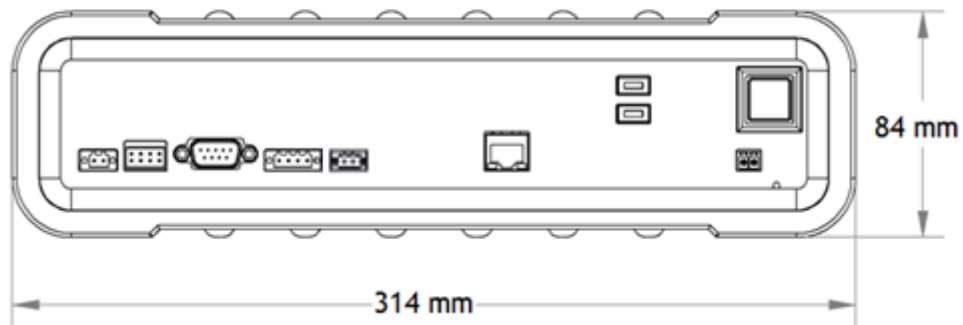# IX. Dimensional View

IX.1 G4500

Front View

84 mm

314 mm

Side View

269 mm

Back View

IX.2 G3500

Front View

84 mm

314 mm

Side View

269 mm

Back View