

Power analyzers and Energy Meters

Power Analyzer

Type WM14-DIN

CARLO GAVAZZI



- Optional RS422/485 serial port
- Alarms (visual only) V_{LN} , A_n

- Class 2 (active energy)
- Class 3 (reactive energy)
- Accuracy ± 0.5 F.S. (current/voltage)
- Power analyzer
- Display of instantaneous variables: 3x3 digit
- Display of energies: 8+1 digit
- System variables and phase measurements: W , W_{dmd} , var , VA , VA_{dmd} , PF , V , A , A_n , A_{dmd} , Hz
- A_{max} , $A_{dmd max}$, $W_{dmd max}$ indication
- Energy measurements: kWh and kvarh
- Hour counter (5+2 DGT)
- TRMS meas. of distorted sine waves (voltages/currents)
- Power supply: 24V, 48V, 115V, 230V 50-60Hz; 18 to 60VDC
- Protection degree (front): IP40
- Front dimensions: 107.8x90mm

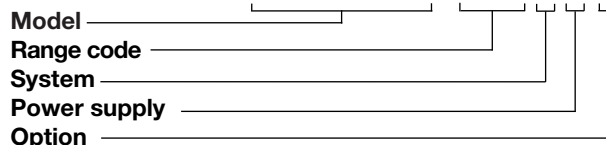
Product Description

3-phase power analyzer with built-in programming keypad. Particularly recommended for displaying the main electrical variables.

Housing for DIN-rail mounting, (front) protection degree IP40, and optional RS485 serial port.

How to order

WM14-DIN AV5 3 D X



Type Selection

Range codes	System	Power supply	Options
AV5: 400/660V _{L-L} /5(6)AAC VL-N: 185 V to 460 V VL-L: 320 V to 800 V AV6: 100/208V _{L-L} /5(6)AAC VL-N: 45 V to 145 V VL-L: 78 V to 250 V Phase current: 0.03A to 6A Neutral current: 0.09 to 6A	3 : 1-2-3-phase, balanced/unbalanced load, with or without neutral	A: 24VAC -15+10%, 50-60Hz B: 48VAC -15+10%, 50-60Hz C: 115VAC -15+10%, 50-60Hz D: 230VAC -15+10%, 50-60Hz 3: 18 to 60VDC	X: None S: RS485 port

Input specifications

Rated inputs	3 (shunt) 4	1700 samples/s @ 60Hz
Current		
Voltage		
Accuracy (display, RS485) (@25°C $\pm 5^\circ\text{C}$, R.H. $\leq 60\%$)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL	Display refresh time 700ms
Current	0.25 to 6A: $\pm(0.5\% \text{ FS} + 1\text{DGT})$ 0.03A to 0.25A: $\pm 7\text{DGT}$	Display
Neutral current	0.25 to 6A: $\pm(1.5\% \text{ FS} + 1\text{DGT})$ 0.09A to 0.25A: $\pm 7\text{DGT}$	Type Read-out for instant. var. Read-out for energies
Phase-phase voltage	$\pm(1.5\% \text{ FS} + 1 \text{ DGT})$	Read-out for hour counter
Phase-neutral voltage	$\pm(0.5\% \text{ FS} + 1 \text{ DGT})$	Measurements
Active and Apparent power,	0.25 to 6A: $\pm(1\% \text{ FS} + 1\text{DGT})$; 0.03A to 0.25A: $\pm(1\% \text{ FS} + 5\text{DGT})$	Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves.
Reactive power	0.25 to 6A: $\pm(2\% \text{ FS} + 1\text{DGT})$; 0.03A to 0.25A: $\pm(2\% \text{ FS} + 5 \text{ DGT})$	Coupling type Crest factor
Active energy	Class 2 (I start up: 30mA)	Input impedance
Reactive energy	Class 3 (I start up: 30mA)	400/660V _{L-L} (AV5) 100/208V _{L-L} (AV6)
Frequency	$\pm 0.1\% \text{ Hz}$ (48 to 62Hz)	Current
Additional errors		Frequency
Humidity	$\leq 0.3\% \text{ FS}$, 60% to 90% RH	Overload protection
Temperature drift	$\leq 200 \text{ ppm}/^\circ\text{C}$	Continuous voltage/current For 500ms: voltage/current
Sampling rate	1400 samples/s @ 50Hz	1.2 F.S. 2 Un/36A



RS485 Serial Port Specifications

RS422/RS485 (on request)		Data (bidirectional)	
Type	Multidrop bidirectional (static and dynamic variables)	Dynamic (reading only)	System, phase variables and energies
Connections	2 or 4 wires, max. distance 1200m, termination directly on the instrument	Static (writing only)	All configuration parameters
Addresses	1 to 255, key-pad selectable	Data format	1 start bit, 8 data bit, no parity, 1 stop bit
Protocol	MODBUS/JBUS	Baud-rate	9600 bit/s

Software functions

Password	Numeric code of max. 3 digits; 2 protection levels of the programming data		Page 4: A L1 dmd, A L2 dmd, A L3 dmd
1st level	Password "0", no protection		Page 5: An + An alarm
2nd level	Password from 1 to 999, all data are protected		Page 6: W L1, W L2, W L3
System selection	3-phase with or without n, unbal. 3-phase balanced 3-phase ARON 2-phase Single phase		Page 7: PF L1, PF L2, PF L3
Transformer ratio			Page 8: var L1, var L2, var L3
CT	1 to 999		Page 9: VA L1, VA L2, VA L3
VT	1.0 to 99.9		Page 10: VA Σ , W Σ , var Σ
Filter			Page 11: VA dmd, W dmd, Hz
Operating range	0 to 99.9% of the input electrical scale		Page 12: W dmd max
Filtering coefficient	1 to 16		Page 13: Wh
Filter action	Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones).	Alarms	Page 14: varh
Displaying			Page 15: VL-L Σ , PF Σ VLN Alarm
3-phase system with neutral	Up to 3 variables per page Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31 Page 3: A L1, A L2, A L3	Reset	Page 16: A max
			Page 17: A dmd max
			Page 18: working hours
			Programmable, for the VLN Σ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
			Independent alarm (VL Σ , An) max: A dmd, W dmd all energies (Wh, varh)

Power Supply Specifications

Auxiliary power supply	230VAC -15 +10%, 50-60Hz 115VAC -15 +10%, 50-60Hz 48VAC -15 +10%, 50-60Hz		24VAC -15 +10%, 50-60Hz 18 to 60VDC
		Power consumption	AC: 4.5 VA DC: 4W

General Specifications

Operating temperature	0° to +50°C (32° to 122°F) (RH < 90% non condensing)		measuring inputs and RS485.
Storage temperature	-10° to +60°C (14° to 140°F) (RH < 90% non condensing)		4kVAC, 500VDC between power supply and RS485
Installation category	Cat. III (IEC 60664, EN60664)	Dielectric strength	4kVAC (for 1 min)
Insulation (for 1 minute)	4kVAC, 500VDC between measuring inputs and power supply. 500VAC/DC between	EMC	
		Emissions	EN50084-1 (class A) residential environment, commerce and light industry

General Specifications (cont.)

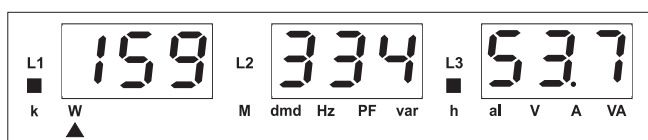
Immunity	EN61000-6-2 (class A) industrial environment.	Material	ABS self-extinguishing: UL 94 V-0
Pulse voltage (1.2/50µs)	EN61000-4-5	Mounting	DIN-RAIL
Safety standards	IEC60664, EN60664	Protection degree	Front: IP40 (standard) Connections: IP20
Approvals	CE, UL and CSA	Weight	Approx. 400 g (pack. incl.)
Connections 5(6) A Max cable cross sect. area	Screw-type 2.5 mm ²		
Housing Dimensions (WxHxD)	107.8 x 90 x 64.5 mm		

Display pages

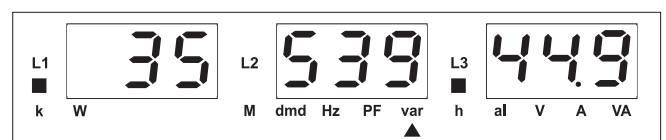
Display variables in a 3-phase system with neutral

No	1 st variable	2 nd variable	3 rd variable	Note
1	V L1	V L2	V L3	
2	V L12	V L23	V L31	Decimal point blinking on the right of the display
3	A L1	A L2	A L3	
4	A L1 dmd	A L2 dmd	A L3 dmd	dmd = demand (integration time selectable from 1 to 30 minutes)
5	An	AL.n		AL.n if neutral current alarm is active
6	W L1	W L2	W L3	Decimal point blinking on the right of the display if generated power
7	PF L1	PF L2	PF L3	
8	var L1	var L2	var L3	Decimal point blinking on the right of the display if generated power
9	VA L1	VA L2	VA L3	
10	VA system	W system	var system	
11	VA dmd (system)	W dmd (system)	Hz (system)	dmd = demand (integration time selectable from 1 to 30 minutes)
12		W dmd MAX		Maximum sys power demand
13	Wh (MSD)	Wh	Wh (LSD)	The total indication is given in max 3 groups of 3 digits.
14	varh (MSD)	varh	varh (LSD)	The total indication is given in max 3 groups of 3 digits.
15	V LL system	AL.U	PF system	AL.U= is activated only if one of VLN is not within the set limits.
16	A MAX			max. current among the three phases
17	A dmd max			max. dmd current among the three phases
18	h			hour counter

MSD: most significant digit
LSD: least significant digit



1) Example of kWh visualization:
This example is showing 15 933 453.7 kWh



2) Example of kvarh visualization:
This example is showing 3 553 944.9 kvarh



Waveform of the signals that can be measured

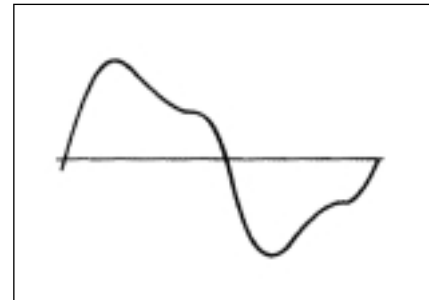
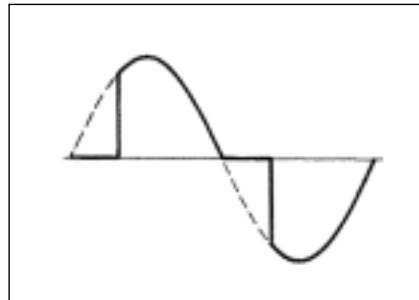
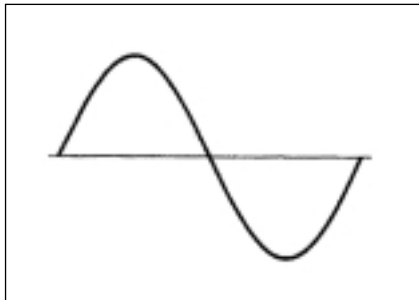


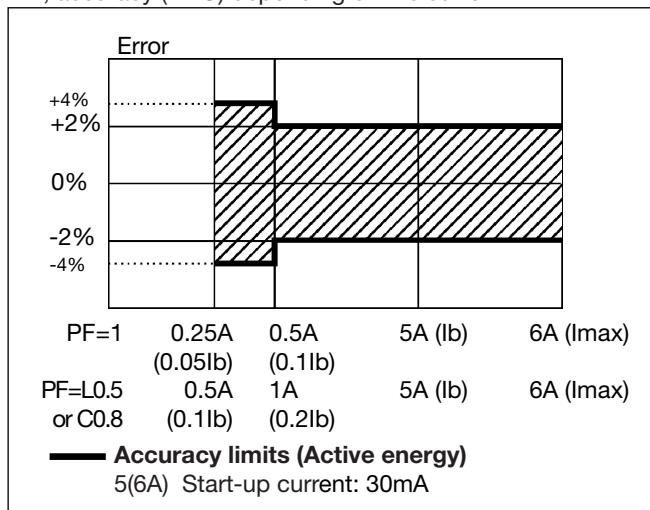
Figure A
Sine wave, undistorted
 Fundamental content 100%
 Harmonic content 0%
 $A_{rms} = 1.1107 |A|$

Figure B
Sine wave, indented
 Fundamental content 10...100%
 Harmonic content 0...90%
 Frequency spectrum: 3rd to 16th harmonic
 Additional error: <1% FS

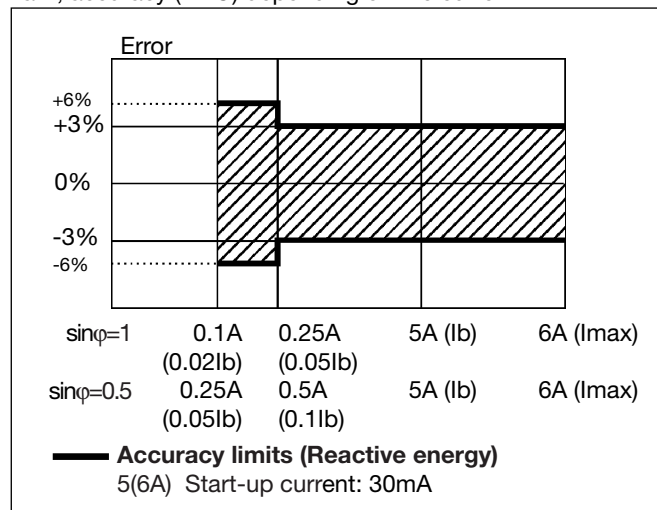
Figure C
Sine wave, distorted
 Fundamental content 70...90%
 Harmonic content 10...30%
 Frequency spectrum: 3rd to 16th harmonic
 Additional error: <0.5% FS

Accuracy

Wh, accuracy (RDG) depending on the current



varh, accuracy (RDG) depending on the current



Used calculation formulas

Phase variables

Instantaneous effective voltage

$$V_{IN} = \sqrt{\frac{1}{n} \cdot \sum_1^n (V_{INi})^2}$$

Instantaneous active power

$$W_1 = \frac{1}{n} \cdot \sum_1^n (V_{INi}) \cdot (A_1)_i$$

Instantaneous power factor

$$\cos\phi_1 = \frac{W_1}{VA_1}$$

Instantaneous effective current

$$A_1 = \sqrt{\frac{1}{n} \cdot \sum_1^n (A_1)_i^2}$$

Instantaneous apparent power

$$VA_1 = V_{IN} \cdot A_1$$

Instantaneous reactive power

$$VAR_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent 3-phase voltage

$$V_{\Sigma} = \frac{V_1 + V_2 + V_3}{3} \cdot \sqrt{3}$$

3-phase reactive power

$$VAR_{\Sigma} = (VAR_1 + VAR_2 + VAR_3)$$

3-phase active power

$$W_{\Sigma} = W_1 + W_2 + W_3$$

3-phase apparent power

$$VA_{\Sigma} = \sqrt{W_{\Sigma}^2 + VAR_{\Sigma}^2}$$

3-phase power factor

$$\cos\phi_{\Sigma} = \frac{W_{\Sigma}}{VA_{\Sigma}}$$

Neutral current

$$An = \bar{A}_{L1} + \bar{A}_{L2} + \bar{A}_{L3}$$

Used calculation formulas (cont.)

$$kWh_i = \int_{t_1}^{t_2} P_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} P_{a,j}$$

$$kVarh_i = \int_{t_1}^{t_2} Q_i(t) dt \approx \Delta t \sum_{n_1}^{n_2} Q_{a,j}$$

Energy metering

Where:

i = considered phase (L1, L2 or L3)

P = active power

Q = reactive power

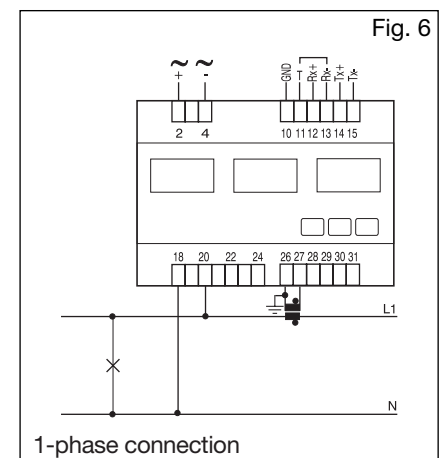
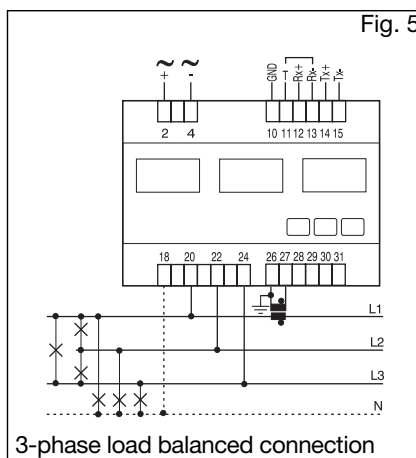
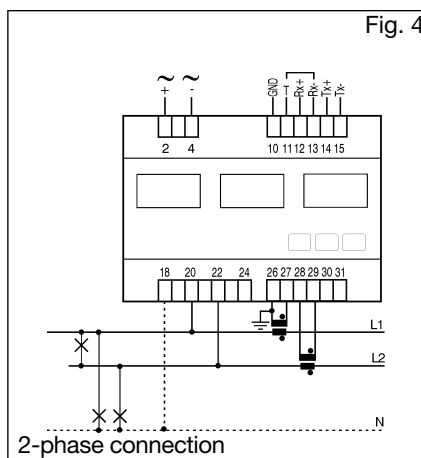
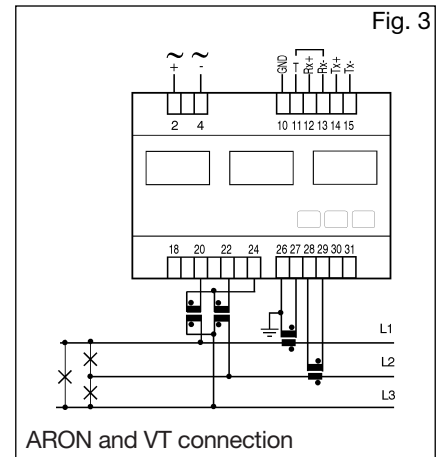
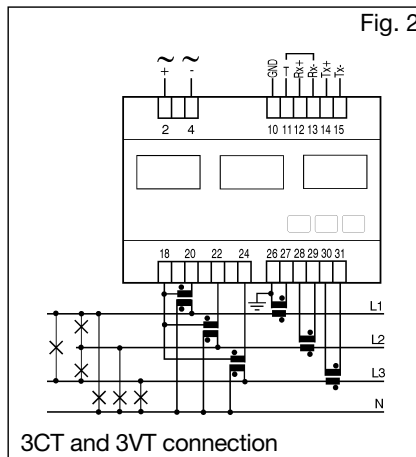
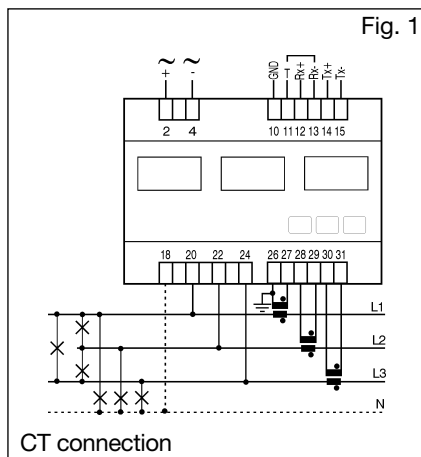
t_1, t_2 = starting and ending time points of consumption recording

n = time unit

Δt = time interval between two successive power consumptions

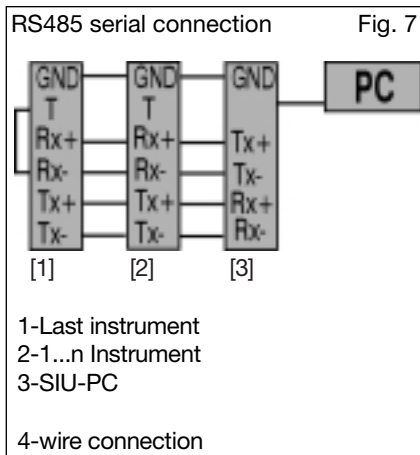
n_1, n_2 = starting and ending discrete time points of consumption recording

Wiring diagrams

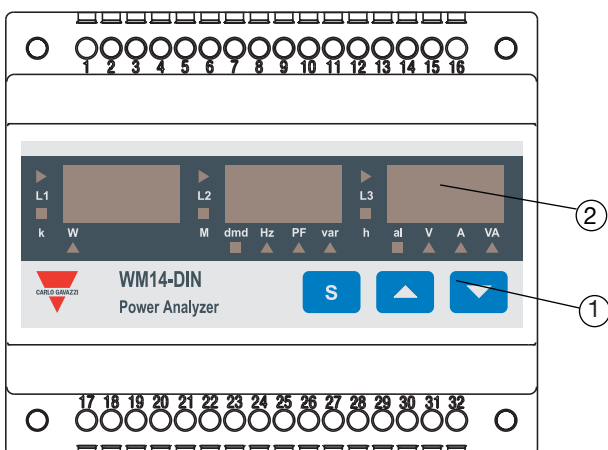


NOTE: the current inputs can be connected to the lines ONLY by means of current transformers. The direct connection is not allowed.

RS485 Serial connection



Front Panel Description



1. Key-pad
To program the configuration parameters and the display of the variables.



Key to enter programming and confirm selections;



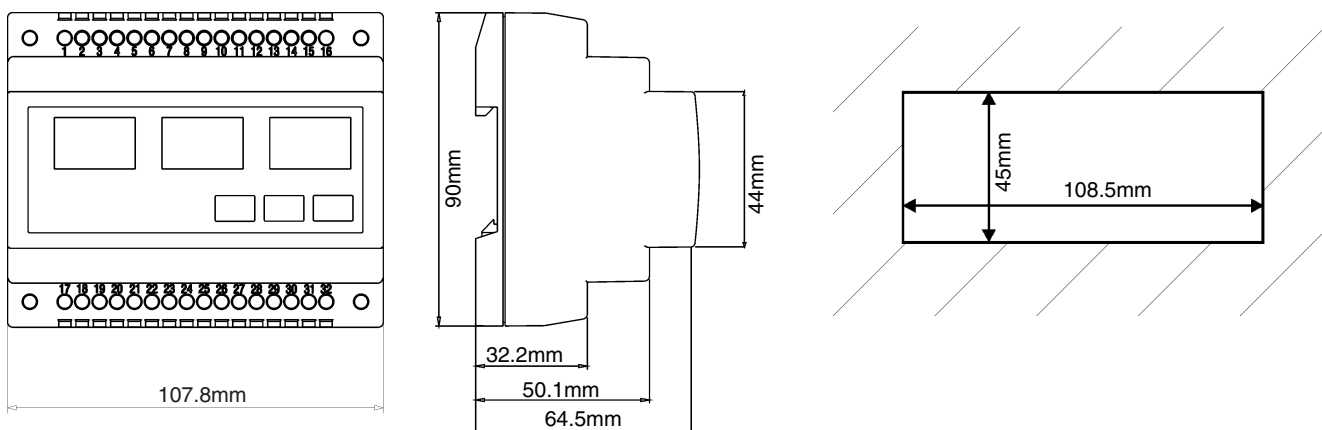
Keys to:

- programme values;
- select functions;
- display measuring pages.

2. Display
LED-type with alphanumeric indications to:

- display configuration parameters;
- display all the measured variables.

Dimensions and Panel Cut-out



<u>Abbreviation</u>		<u>Description</u>
LCD	=	Liquid Crystal Display
W	=	Active power
VA	=	Apparent power
var	=	Reactive power
VLL	=	Voltage phase to phase
VLN	=	Voltage phase to neutral
ppm	=	Part per milion
Ib	=	Basic current
I_{max}	=	Maximum current
dmd	=	Demanded
CT	=	Current Transformer
VT	=	Voltage Transformer
An	=	Neutral current
TRMS	=	True Root means square
PF	=	Power Factor
Hz	=	Frequency
THD	=	Total Harmonic Distortion
Wh	=	Active Energy
Wh total	=	Total Active Energy
Wh partial	=	Partial Energy
varh	=	Reactive Energy
varh total	=	Total Reactive Energy
varh partial	=	Partial Reactive Energy
R.H.	=	Relative Humidity
SW	=	Software
HW	=	Hardware
Wdmd	=	Demanded Power
VAdmd	=	Demanded Apparent Power
A_{max}	=	Maximum current
Wdmd max	=	Maximum Demanded Power
PF avg	=	Average Power Factor