Power analyzers and Energy Meters
Power Analyzer
Type WM14-DIN

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

- 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, An, 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 key-pad. 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

- Model
- Range code
- System
- Power supply
- Option

Type Selection

Range codes

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

System

3 : 1-2-3-phase, balanced/unbalanced load, with or without neutral

Power supply

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

Options

X:	None
S:	RS485 port

Input specifications

Rated inputs	
Current	3 (shunt)
Voltage	4
Accuracy (display, RS485) (@25°C ±5°C, R.H. ≤60%)	with CT=1 and VT=1 AV5: 1150W-VA-var, FS:230VLN, 400VLL; AV6: 285W-VA-var, FS:57VLN, 100VLL
Current	0.25 to 6A:±(0.5% FS +1DGT) 0.03A to 0.25A: ±7DGT
Neutral current	0.25 to 6A: ±(1.5% FS +1DGT) 0.09A to 0.25A: ±7DGT
Phase-phase voltage	±(1.5% FS + 1 DGT)
Phase-neutral voltage	±(0.5% FS + 1 DGT)
Active and Apparent power,	0.25 to 6A: ±(1% FS +1DGT); 0.03A to 0.25A: ±(1% FS +5DGT)
Reactive power	0.25 to 6A: ±(2% FS +1DGT); 0.03A to 0.25A: ±(2% FS +5 DGT)
Active energy	Class 2 (I start up: 30mA)
Reactive energy	Class 3 (I start up: 30mA)
Frequency	±0.1%Hz (48 to 62Hz)
Additional errors	
Humidity	≤0.3% FS, 60% to 90% RH
Temperature drift	≤ 200ppm/°C
Sampling rate	1400 samples/s @ 50Hz 1700 samples/s @ 60Hz
Display refresh time	700ms
Display	
Type	LED, 9mm
Read-out for instant. var.	3x3 DGT
Read-out for energies	3+3+3 DGT (Max indication: 999 999 99.9)
Read-out for hour counter	1+3+3 DGT (Max. indication: 9 999 9.99)
Measurements	Current, voltage, power, power factor, frequency, energy, TRMS measurement of distorted waves.
Coupling type	Direct
Crest factor	< 3, max 10A peak
Input impedance	
400/660V_{L-L} (AV5)	1 MΩ ±5%
100/208V_{L-L} (AV6)	453 KΩ ±5%
Current	≤ 0.02Ω
Frequency	48 to 62 Hz
Overload protection	
Continuos voltage/current	1.2 F.S.
For 500ms: voltage/current	2 Un/36A

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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
1st level	Password "0", no protection
2nd level	Password from 1 to 999, all data are protected
System selection	3-phase with or without n, unbal. 3-phase balanced 3-phase ARON 2-phase Single phase
Transformer ratio	
CT	1 to 999
VT	1.0 to 99.9
Filter	
Operating range	0 to 99.9% of the input electrical scale
Filtering coefficient	1 to 16
Filter action	Measurements, alarms, serial out. (fundamental var: V, A, W and their derived ones).
Displaying	Up to 3 variables per page
3-phase system with neutral	Page 1: V L1, V L2, V L3 Page 2: V L12, V L23, V L31 Page 3: A L1, A L2, A L3 Page 4: A L1 dmd, A L2 dmd, A L3 dmd Page 5: An + An alarm Page 6: W L1, W L2, W L3 Page 7: PF L1, PF L2, PF L3 Page 8: var L1, var L2, var L3 Page 9: VA L1, VA L2, VA L3 Page 10: VA ∑, W ∑, var ∑ Page 11: VA dmd, W dmd, Hz Page 12: W dmd max Page 13: Wh Page 14: varh Page 15: VL-L ∑, PF ∑ VLN Alarm Page 16: A max Page 17: A dmd max Page 18: working hours
Alarms	Programmable, for the VLN∑ and An (neutral current). Note: the alarm is only visual, by means of LED on the front of the instrument.
Reset	Independent alarm (VL∑, 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)
Storage temperature	-10° to +60°C (14° to 140°F) (RH < 90% non condensing)
Installation category	Cat. III (IEC 60664, EN60664)
Insulation (for 1 minute)	4kVAC, 500VDC between measuring inputs and power supply. 500VAC/DC between measuring inputs and RS485. 4kVAC, 500VDC between power supply and RS485
Dielectric strength	4kVAC (for 1 min)
EMC	
Emissions	EN50084-1 (class A) residential environment, commerce and light industry

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General Specifications (cont.)

Immunity	EN61000-6-2 (class A) industrial environment.
Pulse voltage (1.2/50µs)	EN61000-4-5
Safety standards	IEC60664, EN60664
Approvals	CE, UL and CSA
Connections 5(6) A	Screw-type
Max cable cross sect. area	2.5 mm^2
Housing	
Dimensions (WxHxD)	107.8 x 90 x 64.5 mm

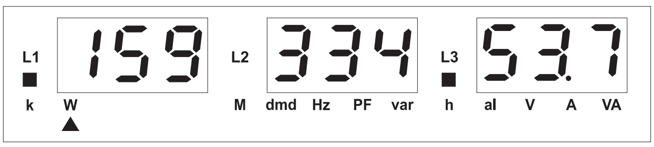
Material	ABS self-extinguishing: UL 94 V-0
Mounting	DIN-RAIL
Protection degree	Front: IP40 (standard) Connections: IP20
Weight	Approx. 400 g (pack. incl.)

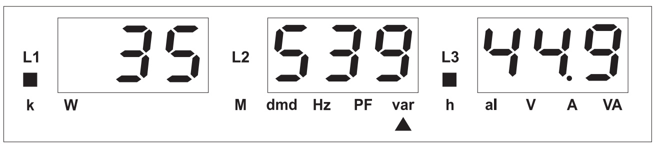
Display pages

Display variables in a 3-phase system with neutral

No	1st variable	2nd variable	3rd 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

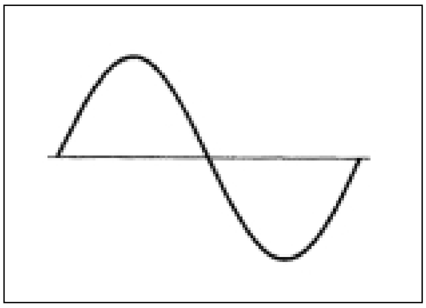


Figure A
Sine wave, undistorted
Fundamental content 100%
Harmonic content 0%
A_{rms} = 1.1107 | $\overline{A}$ |

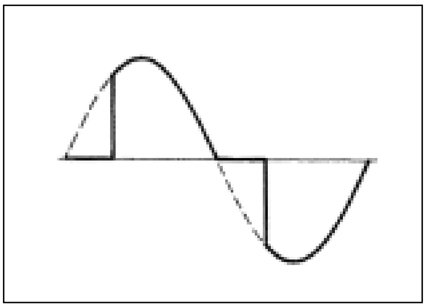


Figure B
Sine wave, indented
Fundamental content 10...100%
Harmonic content 0...90%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <1% FS

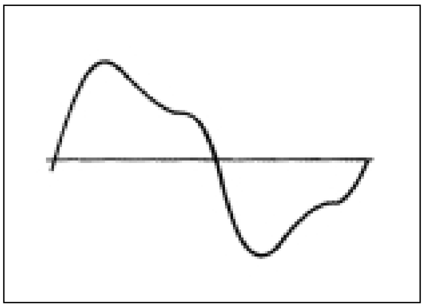
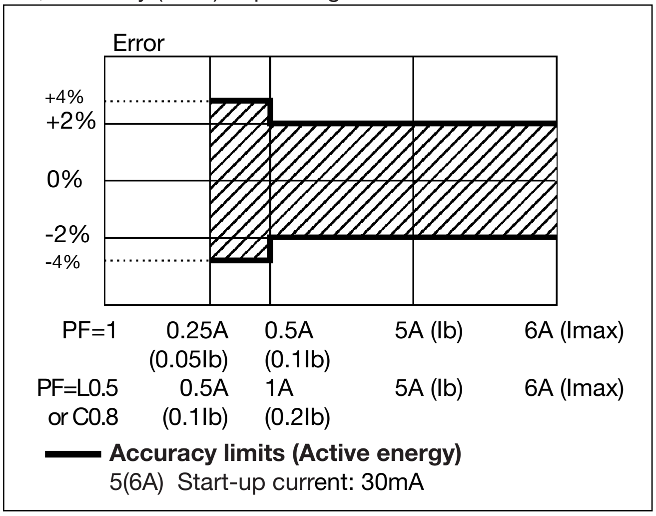


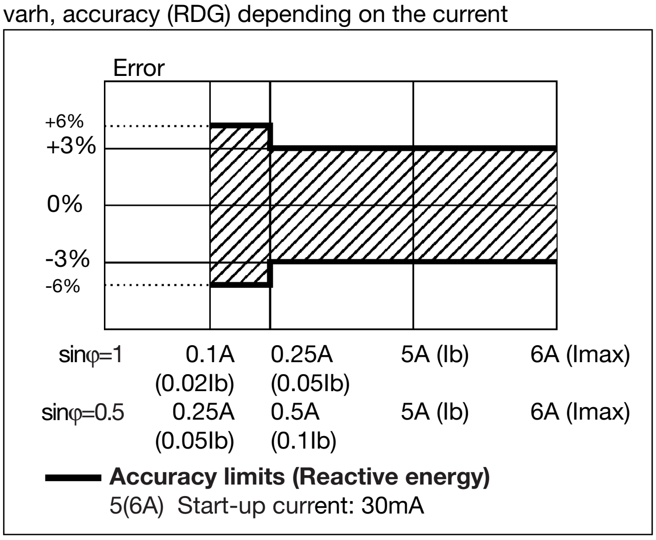
Figure C
Sine wave, distorted
Fundamental content 70...90%
Harmonic content 10...30%
Frequency spectrum: 3rd to 16th harmonic
Additional error: <0.5% FS

Accuracy

Wh, accuracy (RDG) depending on the current



varh, accuracy (RDG) depending on the current



Used calculation formulas

Phase variables

Instantaneous effective voltage

$$V_{1N} = \sqrt{\frac{1}{n} \cdot \sum_{1}^{n} (V_{1N})_i^2}$$

Instantaneous active power

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

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

$$VA_1 = V_{1N} \cdot A_1$$

Instantaneous reactive power

$$VAr_1 = \sqrt{(VA_1)^2 - (W_1)^2}$$

System variables

Equivalent 3-phase voltage

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

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

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

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Used calculation formulas (cont.)

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

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

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

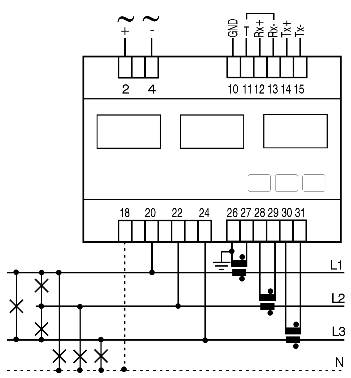
n = time unit

Δt = time interval between two successive power consumptions

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

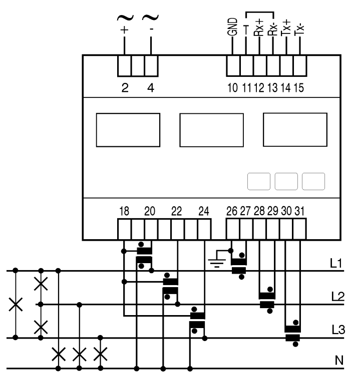
Wiring diagrams

Fig. 1



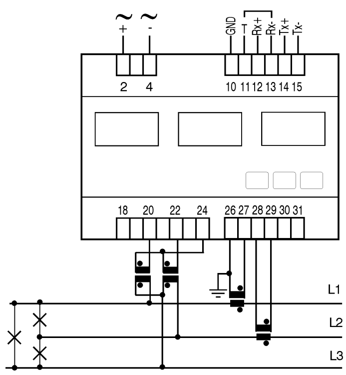
CT connection

Fig. 2



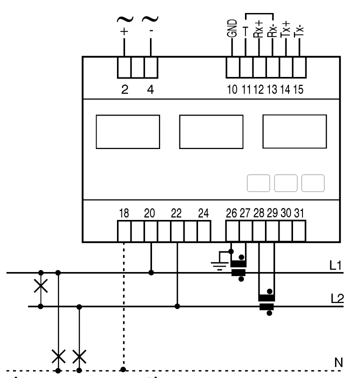
3CT and 3VT connection

Fig. 3



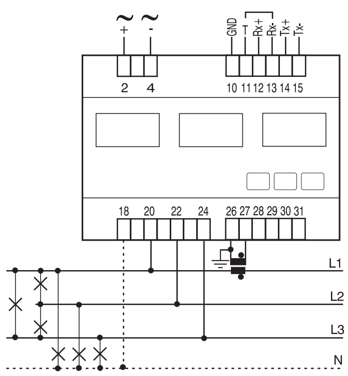
ARON and VT connection

Fig. 4



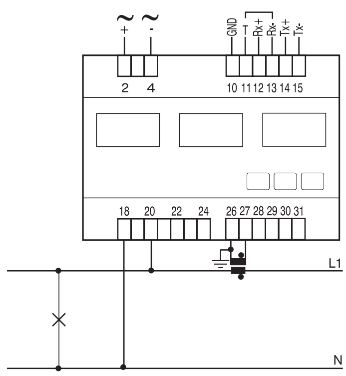
2-phase connection

Fig. 5



3-phase load balanced connection

Fig. 6

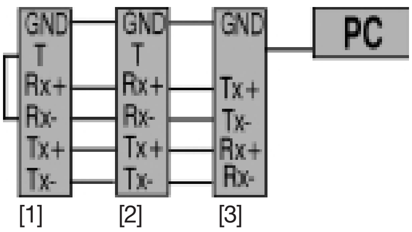


1-phase connection

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

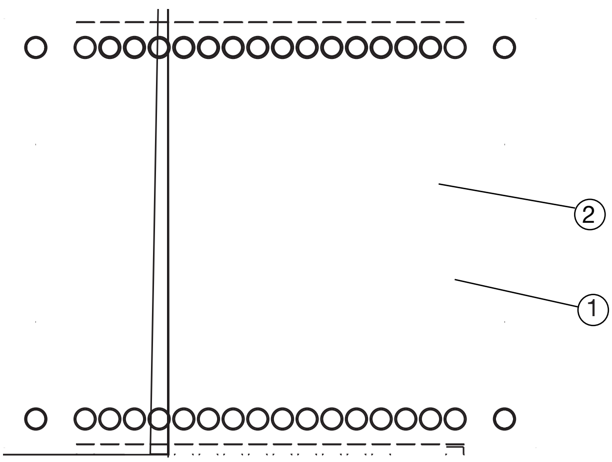
RS485 serial connection Fig. 7



1-Last instrument
2-1...n Instrument
3-SIU-PC

4-wire connection

Front Panel Description



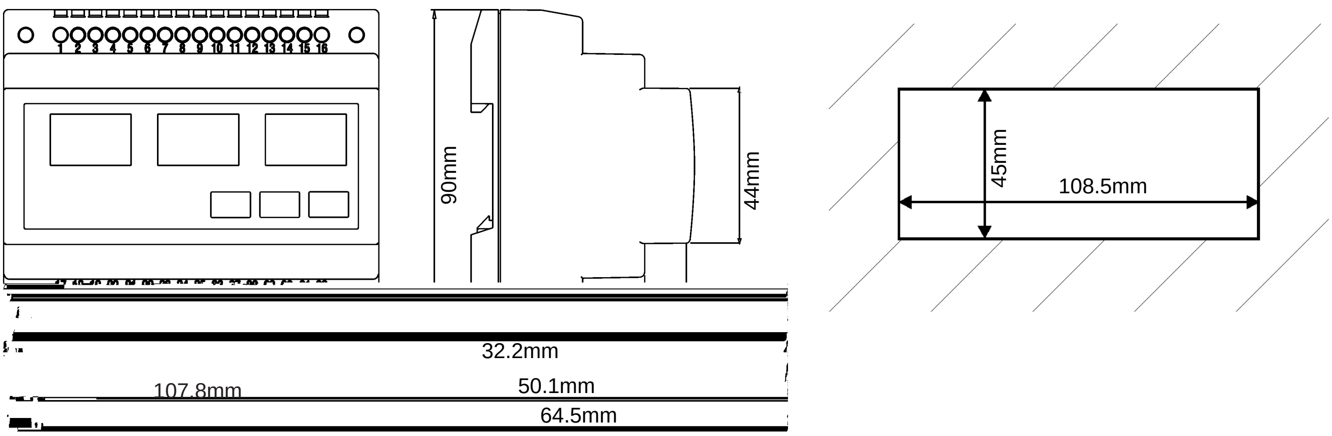
1. **Key-pad**
   To program the configuration parameters and the display of the variables.

   S
   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



Abbreviation		***Description***
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
Imax	=	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
Amax	=	Maximum current
Wdmd max	=	Maximum Demanded Power
PF avg	=	Average Power Factor