ARTEMES

measurement competence centre
www.artemes.org

AM-10-PA2

Table of Contents

1 Introduction

The **A**RTE**M**ES Power Analyser **AM-10-PA2** combines the tasks of energy consumption and power quality analysis with the state of the art possibilities of the modern telecommunication technology. Beside the operation via web interface with e.g. smartphone or PC also all post processing opportunities are available via the web - as a browser application directly on the instrument, on a dedicated server or by using the **A**RTE**M**ES CLOUD service.

KEY Features:

- 24 bit
- 2 MHz (H-Model) or 144 kHz sampling rate
- +-1600V
- GPS (option)
- GSM (option)
- WLAN

Beside classical energy and power analysis according to EN 50160 the instrument offers the new frequency bands up to 9 kHz or 150 kHz as well. Flicker emission and evaluations according to IEC 61400 also belong to the enhanced functionality of the analyser.

Also in terms of measurement connections the AM-10-PA2 offers various possibilities. Beside the single-phase connection and the two-phase connection three-phase star and delta connection are available. In addition, also the tranformer saving connections Aron and V are included.

By using the standard model AM-10-PA2 low voltage grids including neutral line and earth conductor, medium and high voltage grids can be measured.

The GPS input allows synchron measurements over long distances and using the instrument as an PMU, where not only the fundamental oscillation can be transmitted to an PDC Server, but also the harmonics and the flicker distribution.

2 Safety Information

2.1 General Safety

- Carefully read this manual before using the instrument.
- Use the instrument according to these instructions only.
- Use the instruments only under environmental conditions and signal strength described in the technical data. There is no guaranty if you exceed the values your safety.
- The input voltage shall not exceed the values rated in the technical data.
- The power supply must be within the limits given in the technical data.
- Always make a visual inspection of connection equipment such as leads and clamps before use.
- Use fuses (500mA) if you connect the instrument directly to voltage where no fuse is available or a high short circuit impedance is given.

- For working on equipment under voltage use the guidelines given in EN50110.
- Also follow the 5 golden safety rules:
  - Always switch off.
  - Secure against reconnection.
  - Test voltage for being switched off.
  - Connect to earth and short circuit the cables.
  - Protect voltage leading equipment in the neighborhood.

2.2 Warranty

The warranty for the instrument is 2 years - usual operating conditions preconditioned.

2.3 Recycling

This is an electronic instrument and must be recycled according to the WEEE directive.
Do not throw away!

More information see:
http://ec.europa.eu/environment/waste/weee/index_en.htm

2.4 CE Conformity

This instrument is compliant with the CE requirements.

CE

EMC Directive 2014/30/EU

Testprocedures:
- IEC 61326:2013
- IEC 61000-3-2:2014
- IEC 61000-3-3:2013

Safety:
- EN 61010-1:2010

2.5 ROHS

RoHS Compliant

This product is compliant with the RoHS Directive.

For further informations see:
http://ec.europa.eu/environment/waste/rohs_eee/index_en.htm

3 Initial Operation

To operate the instrument you have to follow two main steps:

1. Software Connection
2. Signal Connection

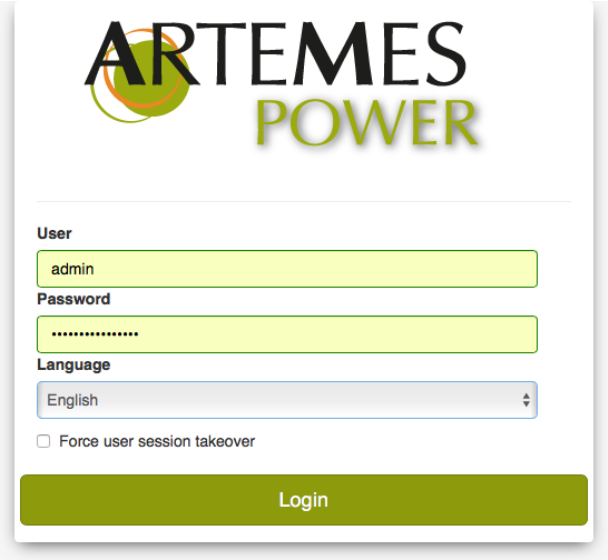
3.1 Software Connection

Start your web browser and connect to the instrument by entering the IP address (example WLAN: 192.168.1.1)

The network connection can be:
- LAN
- WLAN
- Internet / GSM

The login screen appears and you have to log on:

factory default
user: admin
pw:admin



How to operate the instrument is described in the ARTEMES Software manual.

3.1.1 Connecting to the LAN

Connect you computer to the LAN port.
The IP address of the instrument is by default set to DHCP and alternatively to 192.168.1.50.

For further details see the instrument information sheet which was shipped with the instrument.

3.1.2 Connecting to the WLAN

The WLAN access is available in combination with the AM10/2-route option.

To connect to the WLAN use the settings from the instrument information sheet - page "router".

The IP address is by default set to 192.168.1.1.

3.1.3 Connecting throug the Internet

To connect to the instrument to the internet you should have a unique IP address or access to an ARTEMES cloud server with the instrument.

For further details about IP address contact your system administrator.

For details on the ARTEMES cloud access contact ARTEMES directly.

3.2 Connecting Signals

There are many possibilities to connect signals to the instrument.

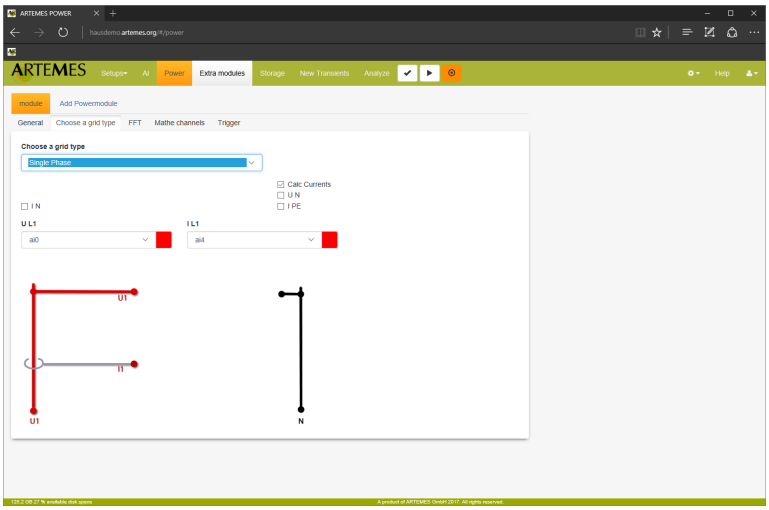
This guide shows two possibilities as example:

- Single phase connection with direct current input
- Full three phase low voltage connection

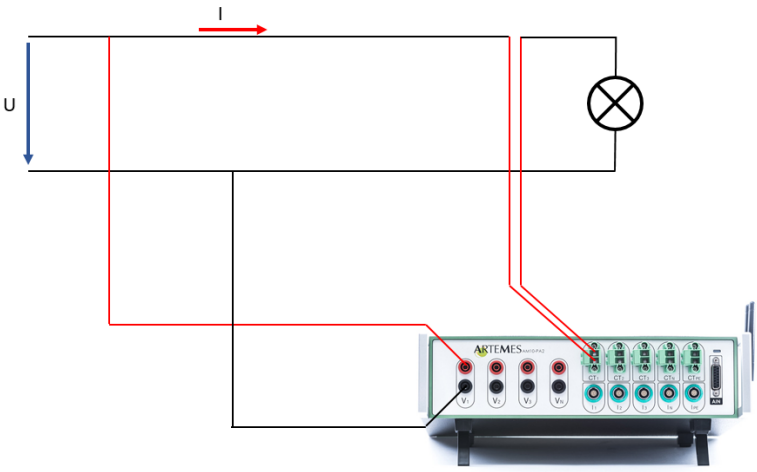
For the pin assignment of the connectors please see chapter Hardware/Connectors.

3.2.1 Single phase connection with direct current input

For the single phase connnection choose the grid type "Single Phase" in the "Power" Section of the setup.



Connect the instrument as shown in the following picture:

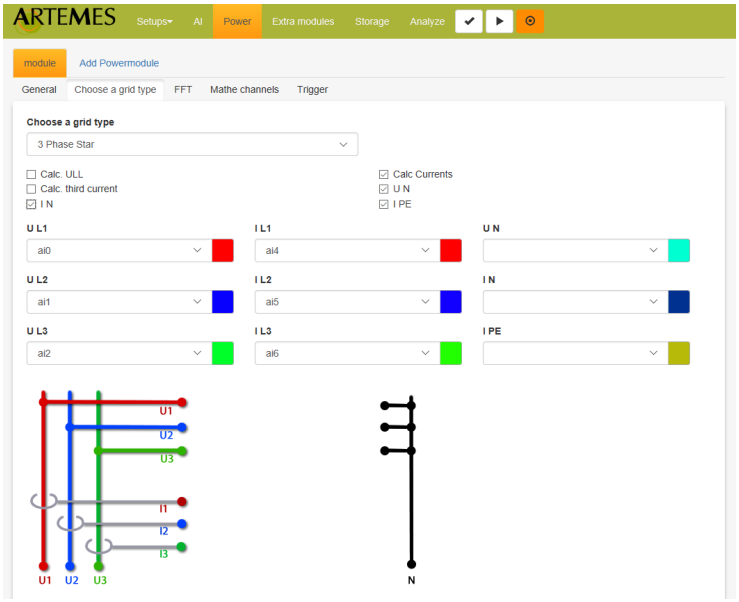


It is recommended, but not necessary to use fuses of type 500mA for the voltage connections.

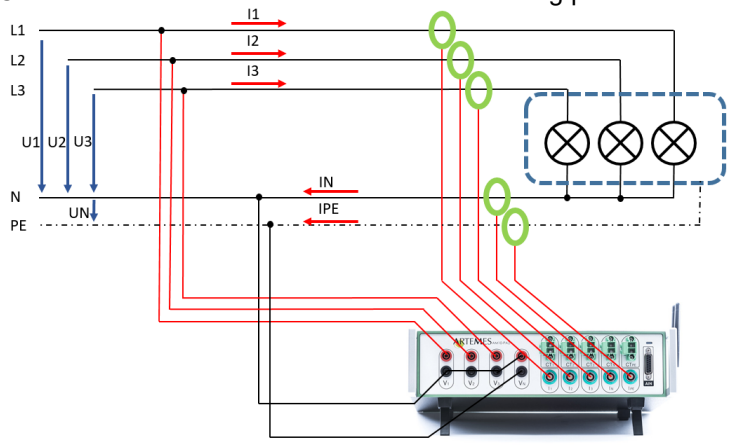
During connecting the leads take care of the voltage.

3.2.2 Full three phase low voltage connection

For a complete low voltage three phase connnection choose the grid type "3 Phase Star" in the "Power" section of the setup and select also "U N", "I N" and "I PE".



Connect the instrument as shown in the following picture:



It is recommended, but not necessary to use fuses of type 500mA for the voltage connections.

During connecting the leads take care of the voltage.

4 Hardware

4.1 The Instrument

The instrument is equipped with 5 current inputs and 4 voltage inputs.

4.2 ON OFF Switch

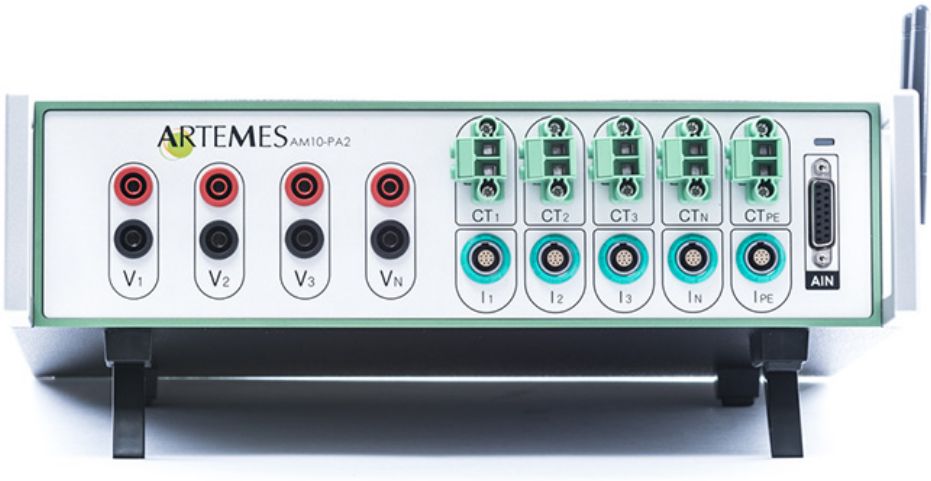
The ON/OFF switch is located on the right side of the instrument.

S/W…on/off switch

Position	Function
Top	START (push)
Center	ON
Bottom	OFF

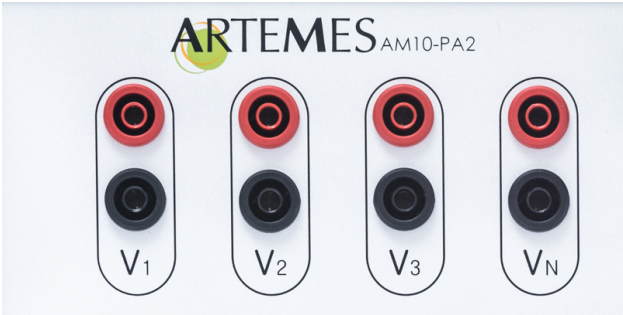
4.3 Connectors

All signal connectors are located on the front of the instrument.



4.3.1 Voltage

The voltage connectors:



Pin	Signal
red	U+ (L)
black	U- (N)

All channels are differential and isolated one to each other. You can either connect three voltages of a three phase system or even connect totally different voltages.

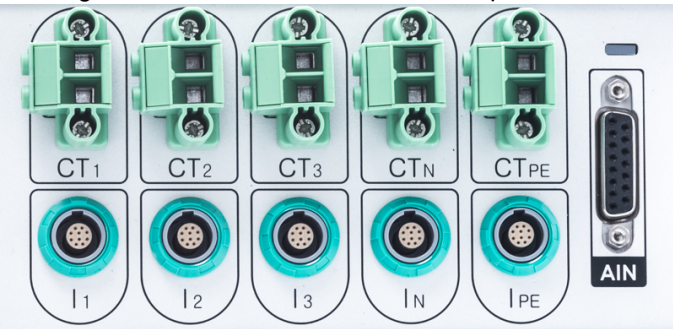
The inputs are for DC and AC.

Depending on the hardware the channels are assigned to different AI channels.

AI0...V1
AI1...V2
AI2...V3
AI3...VN

4.3.2 Current

The target of the current connectors is the possible connection the different sensors:



The current can be connected either directly (screw terminals) or with a sensor (Lemo connector).

Screw Terminals 4mm^2:

- Direct current input 5A

Pin	Signal
bottom	I CT+ (k)
top	I CT- (I)

Connector 10pin Lemo Redel P1:

- Clamp
- Rogowsky coil
- other clamps

Pin	Signal
1	Signal +
2	Signal -
3	FGND
4	NC
5	TEDS
6	GND
7	+3.3V
8	+12V
9	+15V
10	-15V

Depending on the hardware the channels are assigned to different AI channels.

AI4...I1, CT1
AI5...I2, CT2
AI6...I3, CT3
AI7...IN, CTN
AI8...IPE, CTPE

4.3.3 Additional AI

In addition 4 low voltage signals can be used on the AI connector (SUBD-15)

Pin	Signal
1	AGND
2	AI 0-
3	AI 1-
4	AI 2-
5	AI 3-
6	AGND
7	+5V
8	+15V
9	AI 0+
10	AI 1+
11	AI 2+
12	AI 3+
13	AGND
14	AGND

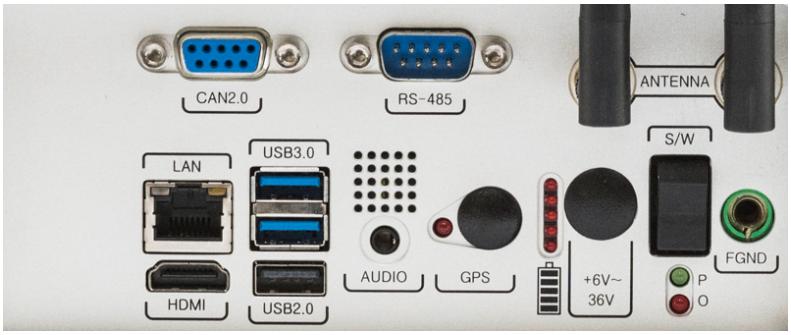
15	-15V

The channels are named in the software by default as following:

AI9...AI 0
AI10...AI 1
AI11...AI 2
AI12...AI 3

4.3.4 Digital Connectors

The digital connectors are on the right side:



HDMI output

Pin	Signal
1	TMDS Data 2+
2	TMDS Data 2 shield
3	TMDS data 2-
4	TMDS Data 1+
5	TMDS Data 1 shield
6	TMDS data 1-
7	TMDS Data 0+
8	TMDS Data 0 shield
9	TMDS data 0-
10	TMDS clock+
11	TMDS clock shield
12	TMDS clock-
13	CEC
14	NC
15	DDC clock
16	DDC data
17	GND
18	+5V
19	Plug detect

LAN

Pin	Signal
1	BI_DA+
2	BI_DA-
3	BI_DB+
4	BI_DC+
5	BI_DC-
6	BI_DB-
7	BI_DD+
8	BI_DD-

2 * USB 3.0
1 * USB 2.0

Pin	Signal
1	Vcc
2	Data-
3	Data+
4	GND

CAN 2.0 (Option)

Pin	Signal
1	
2	CAN_L
3	CAN_GND
4	
5	Shield
6	Power GND
7	CAN_H
8	
9	Power +

RS 485

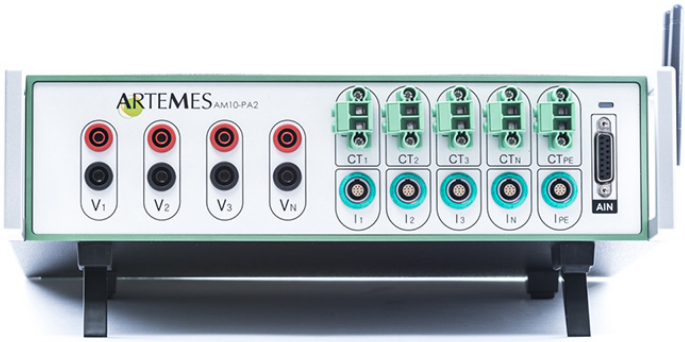
Pin	Signal
1	DCD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	NC

Audio
Antenne WLAN
Antenna GSM (Option)
Antenna GPS (Option)

FGND...Additional GND for chassis in highly emc disturbed environment

4.4 Status LEDs

Front panel:



green LED right top: Measurement status
blinking ... measurement is running (measurement or storing mode)

Connector panel right side:

P ... green ... power on
O ... red ... power connected, but power is off

5 red leds ... battery status

GPS ... GPS signal detected

5 Software

The used software is the ARTEMES software.

For further information use the manual of the software, which can be downloaded from our website: https://www.artemes.org/index.php/de/blackboard-de/downloads/category/3-manuals

The online manual is available here: https://www.artemes.org/index.php/de/blackboard-de/online-manuals

6 Technical Data and Specifications

6.1 Instrument

		AM-10-PA2	AM-10-PA2-H
voltage inputs		4	4
	range	+/-1.600V	+/-1.600V
	accuracy (on value, 5-100% of range)	0,1%	0,1%
current inputs		5	5
	clamp 5A (order code: AM-CL-5)	AC	AC
	range	5A	5A
	accuracy	0,5%	0,5%
	Rogowski coil (order code: AM-CL-Rog10K)	AC	AC
	range	10 / 100 / 1k / 10 kA	10 / 100 / 1k / 10 kA
	accuracy	1%	1%
	DC Clamp (order code: AM-CL-300DC)	AC + DC	AC + DC
	range	150A / 300A peak	150A / 300A peak
	accuracy	0,5%	0,5%
	direct current input (included)	AC + DC	AC + DC
	range	5A	5A
	accuracy	0,5%	0,5%
	other clamps (https:// store.artemes.org/zubehoer/ stromsensoren/)	on request	on request
measurement parameters	resolution	24 bit	24 bit
	sampling rate	up to 144 kSamples/sec per channel	up to 2 MSamples/ sec per channel
	bandwidth	70kHz	500kHz
additional inputs	low voltage +/- 10V	4 channels / each 144 kSamples/sec	4channels / each 2 MSamples/sec
measurement values	phase voltages, neutral voltage	✓	✓
	line voltages	✓	✓
	phase currents, neutral current, earth current	✓	✓
evaluation online	web interface	✓	✓
	recorder - diagram and actual values	✓	✓

	scope	✓	✓
	FFT	✓	✓
data processing	flexible report generator on web	✓	✓
	EN 50160	✓	✓
	IEC 61000-2-4 class 1,2,3	✓	✓
	IEC 61400-12-1	option: AM-10-PA2-Opt Wind	option: AM-10-PA2-Opt Wind
	IEC 61400-21	option: AM-10-PA2-Opt Wind	option: AM-10-PA2-Opt Wind
	ISO 50001 energy report	✓	✓
data storage	internal SSD (not rotating)	256 GB	256 GB
	ARTE**M**ES server	licence included (max 3 measurement clients)	licence included (max 3 measurement clients)
	ARTE**M**ES CLOUD	option: AM-10-CLOUD	option: AM-10-CLOUD
communication ports	USB 2.0 / 3.0	2 / 1	2 / 1
	RS485	1	1
	LAN	1	1
	WLAN	✓	✓
	GSM	option: AM-10-PA2-Opt GSM	option: AM-10-PA2-Opt GSM
	CAN 2.0	option: AM-10-PA2-Opt Wind	option: AM-10-PA2-Opt Wind
	GPS	option: AM-10-PA2-Opt PMU	option: AM-10-PA2-Opt PMU
EMC	IEC 61326-1 industry	✓	✓
	IEC 61000-4-4 surge, IEC 61000-4-5 burst	4 kV	4 kV
	isolation (AC, 1 min)	6 kV	6 kV
safety	IEC 61010-1	✓	✓
power supply	AC - V/f	85-264 VAC / 47-63 Hz	85-264 VAC / 47-63 Hz
	DC option instead of AC (AM-10-PA2-Opt DC)	6-36 V DC	6-36 V DC
	internal battery	3 hours	3 hours
power consumption	VA	30 VA	30 VA
weight	kg	5,7 kg	5,7 kg
temperature range	operation	-20°C to +60°C	-20°C to +60°C
	storing	-20°C to +80°C	-20°C to +80°C
order options			
AM-10-PA2-Opt Wind	Wind report according to IEC 61400-12-1 and IEC 61400-21, for AM-10-PA2	software option	software option
AM-10-PA2-Opt PMU	PMU - phasor measurement add-on including software according IEEE C37.118 and GPS input, for AM-10-PA2	software option	software option
AM-10-PA2-Opt GSM	GSM modem, internal, for AM-10-PA2	hardware option	hardware option

AM-10-PA2-Opt DC	DC power supply instead of AC, without battery	option only available with new instrument	option only available with new instrument

6.2 Bandwidth Specifications

		Voltage Inputs	Current Inputs, AI (low voltage)
CH		HV	LV
Input Range		±1600V	±10V
DC Accuracy		±0.05%FS	±0.05%FS
Gain Linearity		-	10ppm (MAX)
Gain Drift Range		-	10ppm/K (MAX)
Offset Drift		6mV/K (MAX)	9uV/K (MAX)
Input Resistance		3.8MOhm	10MOhm
ADC	Type	SigmaDelta	SigmaDelta
	Oversampling Frequency	9MHz(Typ)	9MHz(Typ
	Datarate	144ksps(MAX)	144ksps(MAX)
-3dB BW	Analog	630kHz 4th Order Butterworth	
	Digital	68kHz@140ksps	68kHz@140ksps
		9.6kHz@20ksps,140ksps	
		3.1kHz@12ksps,6ksps	
		2.6kHz@10ksps,5ksps	
-0.1dB BW	Analog	320kHz 4th Order Butterworth	
	Digital	66kHz@140ksps	66kHz@140ksps
		9.2kHz@20ksps,140ksps	
		3kHz@12ksps,6ksps	3kHz@12ksps,6ksps
		2.5kHz@10ksps,5ksps	
Typical SNR		95dB	
Typical CMRR		90dB	
Isolation Voltage		6kV	Sensor Isolation
Surge		±4000V	-
Burst		±4000V	±4000V

6.3 Mechanical Dimensions

width x height x length	390 / 105 / 310 mm

7 Accessories

Order Code	Description
AM-CL-5	current clamp 5A, Lemo connector 10pin
AM-CL-Rog10k	Rogowski coil up to 10kA, Lemo connector 10pin
AM-CL-300DC	DC clamp up to 300A, Lemo connector 10pin
AM-10-TP	rugged carrying case for AM-10-PA
AM-10-Route	internal Router for GSM and WLAN
AM-10-antenna	external antenna for AM-10-Route
AM-screwadapter	5 red and 5 black screwable banana adapter for terminals
AM-magnetic adapter	5 black magnetic voltage adapters, 5mm
AM-alligator clamp	5 crocodile clamps, black
AM-10-leads	5 red and 5 black measurement leads, 2m
AM-leadfuse	3 fuse holders for measurement leads, 500mA
AS-Server-light	ARTEMES server light for up to 4 measurement units (included in AS-Basic)
AS-Server	ARTEMES Server for more than 4 measurement units, web-based analysis tool for ARTEMES measurement instruments, for Windows Server, Linux on request
AS-Topo	ARTEMES toplogical view for control centres (add-on to the ARTEMES server)
AS-Cloud-light	using the cloud for 6 months, for new instruments only (included in AS-Basic)
AS-Cloud	monthly rent for the cloud server; The cloud server is a virtual server in the internet on which you can store and analyse your data, secured by VPN. The software corresponds to the ARTEMES server technology.
AS-Modbus	ARTEMES driver for AS-Basic: Modbus (TCP and serial)
AS-104	ARTEMES driver for AS-Basic: IEC 60870-5-104 protocol
AS-61850	ARTEMES driver for AS-Basic: IEC 61850

8 Maintainance and care

8.1 Regular calibration

We recommend a calibration of the instrument every 2 years.
Calibration can be carried out directly by ARTEMES.

8.2 Service

In case of any questions, malfunction, damage or misuse, please contact ARTEMES.

Maintenance work should be done by ARTEMES only.

The service address is:

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