AD-CPUW2

ADiS
Modular system central unit

Operation manual

Version 1.03

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History of revisions

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Revision	Date	Changes
100	1. 7. 2011	New document
101	13. 1. 2013	Default settings information added, corrections.
102	29. 7. 2014	Chapters 2, 3, 4, 6.3, 10 correction, figures correction.
103	14. 12. 2015	Correction of related documentation and chapters 2, 6.3, 7, 8, 9.1 and 10., change of chapter structure.

Related documentation

1. Help for PseDet part of DetStudio development environment
   file: Psedet_en.chm

2. **ADiS** – Modular control system – Technical manual
   file: adis_mh_en_xxx.pdf

3. Application Note AP0006 – Ethernet Network Communication
   file: ap0006_en_xx.pdf

4. Application Note AP0009 – DBNET Network Communication
   file: ap0009_en_xx.pdf

5. Application Note AP0016 – Principles of RS485 usage
   file: ap0016_en_xx.pdf

6. Application Note AP0037 – Principles of Ethernet network usage
   file: ap0037_en_xx.pdf

1 Introduction

ADiS is modular control system. A basis is formed of central processor unit **AD-CPUW2** that includes control core, operating memory, power supply, serial line circuits, and Ethernet interface. Specific configuration of control system **ADiS** is given by specialized I/O modules that are connected to a side of central processor unit. Up to 16 I/O modules can be connected to this unit. Up to 128 I/O signals within one system are available with eight-bit signals modules, up to 256 I/O signals for sixteen-bit signals modules.

It is possible to achieve further expansion by DIOCAN system expansion modules that can enlarge I/O area up to 1024 signals.

Control system can be connected to RS485 communication network (maximum 32 stations, operating system property) or to Ethernet network (number of station is practically unlimited). **ADiS** is suitable for both small and relatively demanding applications with an emphasis on communication skills because of its modularity and flexibility. The most common usage is controlling of large technological complexes, heating systems controlling, machines controlling and in special applications (monitoring, optimalization).

Processor core **AD-CPUW2** is designed as DualCPU architecture. This DualCPU architecture represents a separation on communication and processing part, each handled by a separate processor. Communication between processors is through SPI bus.

Basic features
- RS232 serial interface
- RS485 serial interface with galvanic isolation
- Ethernet interface 10/100 Mbps
- DIN 35 mm rail mounting
- Integrated Web server

1.1 Programming

Software engineer can program only the application program in processing processor. Communication processor program is fixed and its function cannot be changed by customer.

DetStudio development environment is used for application design.

2 Technical parameters

CPU		
	Procedural CPU	ST10F269
	FLASH	256 KB + 2048 KB in Single FLASH mode 256 KB + 1024 KB in Dual FLASH mode
	RAM	1024 KB
	EEPROM	2 KB
	RAM backup	Panasonic BR2477 Lithium battery
	Battery lifetime	5 years

	Communication CPU	STM32F207
	FLASH	512 KB
	RAM	128 KB
	Serial FLASH	8 MB

RTC		
	Type	RTC8564JE
	Precision at 25 °C	±20 ppm
	Precision (-10 to 70) °C	-120 ppm to +10 ppm

SD card		
	Type	Micro SD (HC)
	Capacity	128 MB to 32 GB *)

Note   *)   **AD-CPUW2** contains card slot, micro SD card is not included.

RS232		
	Quantity	1
	Galvanic isolation	No
	Logical level 0 (input)	Min. +3 V, max. +30 V
	Logical level 1 (input)	Min. -30 V, max. -3 V
	Logical level 0 (output)	Min. +5 V, max. +10 V
	Logical level 1 (output)	Min. -10 V, max. -5 V
	Maximum cable length	10 m
	Operation indication	LED on panel
	Connection point	D-sub DE-9 socket connector

RS485		
	Quantity	1
	Overvoltage protection	Transil 600 W
	Terminating resistor **)	120 Ω on the central unit

	Idle state definition **)
	    up to +5 V
	    up to 0 V
		
		1 kΩ on the central unit
		1 kΩ on the central unit

	Maximum wire length	1200 m / 19200 bps
	Maximum stations count	32
	Operation indication	LED on panel
	Galvanic isolation	Yes
	Isolation strength	500 V AC / 1 minute *)
	Connection point	WAGO 231-303/102-000
	Wire cross section	0.08 mm^2 to 2.5 mm^2

Note   *)   Isolation must not be used for dangerous voltage separation.
         **)   Terminating resistor and idle state definition are connected concurrently.

Ethernet	Quantity	1
	Data transmission rate	10 / 100 Mbps
	Recommended cabling	UTP CAT5
	Maximum segment length	120 m
	Interface controller used	STM32F207 + LAN8700
	Operation indication	LED (LNK and ACT)
	Isolation strength	200 V AC / 1 minute *)
	Connection point	RJ45 connector, according to IEEE802.3

Note *) Isolation must not be used for dangerous voltage separation.

Analogue inputs	Number of inputs	2 internal
	Measuring	Battery System power supply voltage

Power supply	Nominal power supply voltage	24 V DC
	Power supply voltage range	19.2 V DC To 28.8 V DC
	Power consumption	Max. 250 mA at 24 V DC
	Connection point	WAGO 231-302/102-00
	Wire cross section	0.08 mm^2 to 2.5 mm^2

Mechanics	Mechanical design	Plastic box
	Mounting	DIN 35 mm rail mounting
	Ingress protection rate	IP20
	Weight *) – netto	0.28 kg ±5 %
	– brutto	0.42 kg ±5 %
	Dimensions (w × h × d)	(58 + (n**) × 25)) mm × 104 mm × 96 mm

Note *)   Processor module weight only.
)   Where **n is the number of I / O modules in set.

Temperatures	Operating temperature range	**AD-CPUW2** 0 °C to 70 °C **AD-CPUW2/I** -40 °C to 70 °C
	Storage temperature range	**AD-CPUW2** **-**20 °C to 70 °C **AD-CPUW2/I** -40 °C to 70 °C

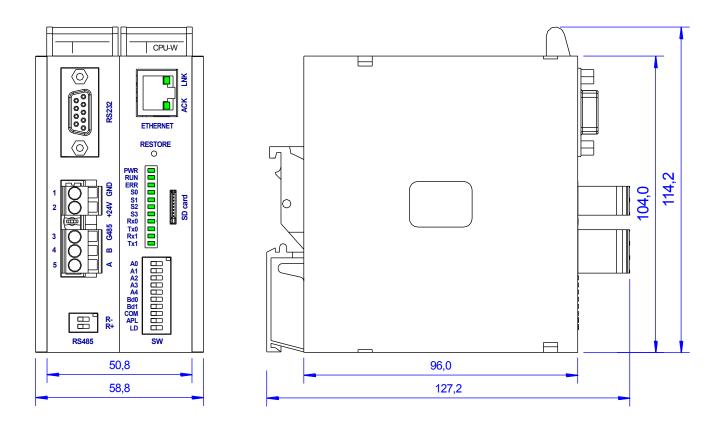| Others	Maximum ambient humidity	< 95 % non-condensing
	Programming	DetStudio (NOS)

2.1   Dimensions

Fig. 1 – **AD-CPUW2** dimensions

2.2 Recommended drawing symbol

Following drawing symbol is recommended for the central unit **AD-CPUW2**. Only part of it will be visible in following examples.
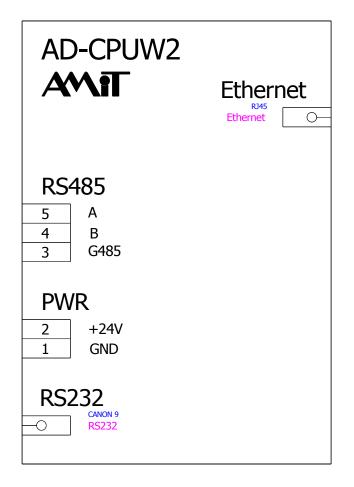

Fig. 2 – Recommended drawing symbol for **AD-CPUW2**

3 Conformity assessment

The equipment meets the requirements of NV616/2006 Czech governmental decree. The compliance assessment has been performed in accordance with harmonized standard EN 61326.1.

Tested in accordance with standard	Type of test	Class
EN 55011:2009	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement	A *)
EN 61000-4-2:2009	Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test	Complies
EN 61000-4-4:2012	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test, power supply	±4 kV
EN 61000-4-4:2012	Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test, Ethernet	±2 kV
EN 61000-4-5:2006	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test, RS485	±3 kV [#])
EN 61000-4-5:2006	Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test, power supply	±3 kV [#])
EN 61000-4-6:2006	Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields	Complies

*) This is device of Class A. In the internal environment this product can cause some radio disturbances. In such case the user can be requested to take the appropriate measures.

[#]) Other than power supply circuitry cabling, which are longer than 30 m must be carried out by using the shielded cables.

3.1 Other tests

Tested in accordance with standard	Type of test	Class
EN 60068-2-1:2007	Environmental testing – Part 2-1: Tests – Test A: Cold	Complies
EN 60068-2-2:2007	Environmental testing – Part 2-2: Tests – Test B: Dry heat	Complies
EN 61000-4-29:2000	Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations on DC input power port – Immunity test	Complies

4   Power supply

The central unit **AD-CPUW2** can be power supplied only by DC power supply. Power source must meet requirements listed in chapter 2. Technical parameters. Power supply voltage connection is indicated by the status LED.
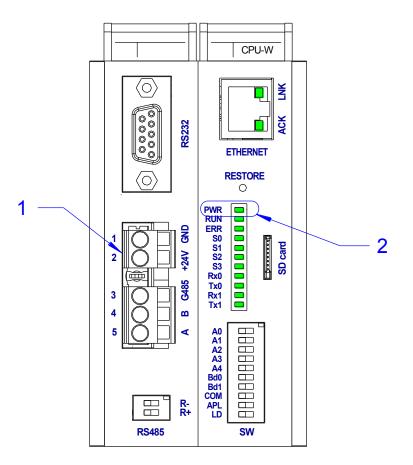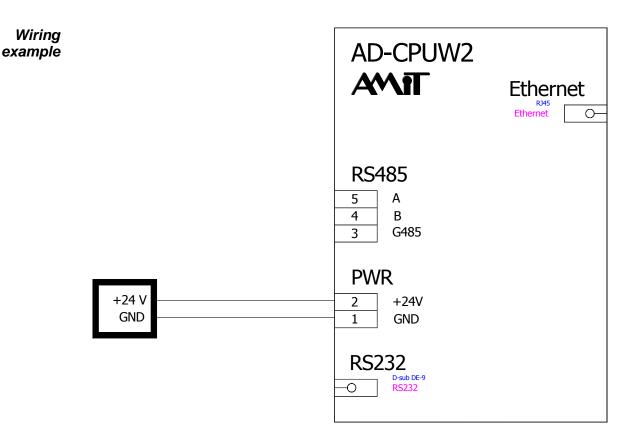

Fig. 3 – Power supply connector location

	Number	Signification
Legend	1	Power supply connector
	2	PWR status LED

	Terminal	Label	Signification
Connector terminal numbering	1	GND	Power supply GND
	2	+24V	Power supply +24 V DC

PWR status LED

Status	Signification
OFF	Power supply is not connected.
ON	Power supply is connected.

Wiring example

Fig. 4 – Example of stand-alone central unit's power supplying

Note It is recommended to connect GND, IGND (inputs ground) and EGND (outputs ground) terminals together with the switchboard PE terminal during installation.

Attention GND (1) terminal is hardwired to AGND terminals of **AD-AI5**, **AD-AI8** and **AD-NI8** analogue input modules.
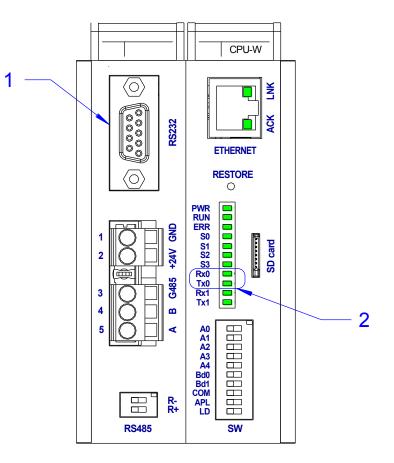
5   Communication interfaces

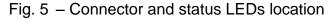The central unit **AD-CPUW2** has three communication interfaces:
- The RS232 interface is led to D-sub DE-9 socket connector.
- The RS485 interface is galvanically isolated and is led to WAGO 231 connector.
- The Ethernet interface is led to RJ45 connector.

5.1   RS232

This interface is intended for connection of two devices according to RS232 standard. Three wires are normally sufficient for bidirectional communication, a fully equipped D-sub DE-9 connector is necessary for modem control.

RS232 has a number 0 within SW in case of using NOS.

Fig. 5 – Connector and status LEDs location

Legend	Number	Signification
	1	RS232 interface connector
	2	Status LEDs

Connector wiring D-sub DE-9 socket on the central unit **AD-CPUW2**.

Pin	Signification	Type
1	Not used	–
2	TxD	Output
3	RxD	Input
4	DSR	Input
5	GND	Ground
6	DTR	Output
7	CTS	Input
8	RTS	Output
9	RI	Input

Note The **Signification** item corresponds to the central unit **AD-CPUW2** signals. Cross-cable must be used for PC connection. The **Type** item corresponds to the signal type on the central unit **AD-CPUW2**. **232P CABLE** is used for connection between central unit and PC.

RS232 interface activity is indicated by system LEDs located on front panel.

RS232 status LEDs

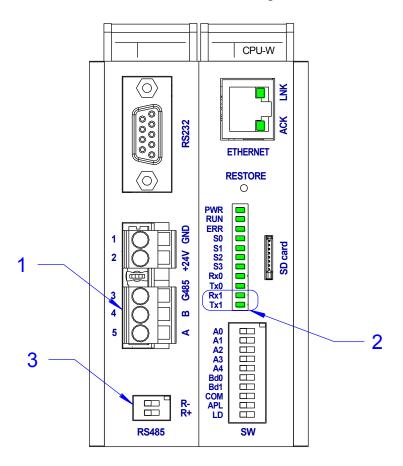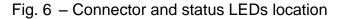| LED	Signification
Rx0	Unit is receiving data.
Tx0	Unit is transmitting data.

5.2 RS485

RS485 is a half-duplex serial interface. It can be used for interconnection of more units (up to 32 within single segment). All units communicate through single signal pair.

RS485 interface circuitry is galvanically isolated from other electronics of the central unit **AD-CPUW2**.

RS485 has a number 1 within SW in case of using NOS.

Fig. 6 – Connector and status LEDs location

	Number	Signification
Legend	1	RS485 interface connector
	2	Status LEDs
	3	Idle state definition and wires termination switches

	Terminal	Label	Signification
Connector terminal numbering	3	G485	RS485 interface ground
	4	B	RS485 interface, signal B
	5	A	RS485 interface, signal A

RS485 interface activity is indicated by system LEDs located on front panel.

	LED	Signification
RS485 status LEDs	Rx1	Unit is receiving data.
	Tx1	Unit is transmitting data.

Each unit on RS485 communication network must have properly set the wires termination resistors. The switches located under RS485 connector serve to termination setting.

	Switch	Position	Signification
Switch significations	R- and R+	ON	Terminal station.
		OFF	Intermediate station.

More information about the RS485 interface usage can be found in Application Note AP0016.

5.3 Ethernet interface

The control system can be directly connected into LAN network through Ethernet interface. Components of standard structured cabling can be used for connection.

The Ethernet interface can be used both for visualization and remote uploading of application software into control system through Internet. This interface is supported by DetStudio environment. TCP / IP protocols are used for communication; therefore the communication network can be shared both by control systems and personal computers.

The central unit **AD-CPUW2** can route to DB-Net network at RS485 interface as well.

Note Isolation must not be used for dangerous voltage separation.
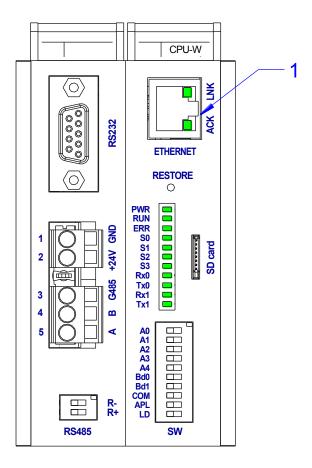
Fig. 7 – Connector location

Legend	**Number**	**Signification**
	1	Ethernet interface connector with status LEDs

Interface state indication Ethernet activity is indicated by LEDs (LNK and ACT) in connector's front panel.

	LED	Signification
Ethernet ***status LEDs***	ACT	Lights when Ethernet is connected.
	LNK	Lights when receiving / transmitting data.

More information can be found in Application notes: AP0006 – Ethernet network communication and AP0037 – Principles of Ethernet network usage.

6   Internal measuring, SD card

6.1   Backup battery measurement

A backup battery voltage can be measured in applications written in DetStudio development environment through predefined analogue channel.

Operation example
```
AnIn #Vbatt, fBat, 5.000, 0.000, 10.000, 0.000, 10.000
```
Measured value is battery voltage [V].

Warning can be displayed in application when it is necessary to replace the battery.

6.2   Measuring of power supply voltage

A power supply voltage can be measured in applications written in DetStudio development environment through predefined analogue channel.

Operation example
```
AnIn #Vint, fPwr, 56.0000, 0.000, 56.000, 0.700, 55.000
```
Measured value is power supply voltage [V].

6.3   SD card

AD-CPUW2 front panel includes micro SD (HC) card slot. The card usage depends on operating system and communication processor program. The possible SD card usage is described in development software documentation.

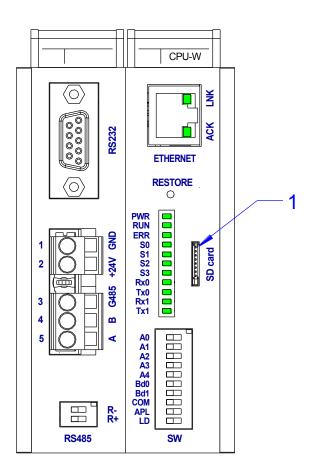The card is inserted with contacts facing the status LEDs.

Fig. 8 – Micro SD slot location

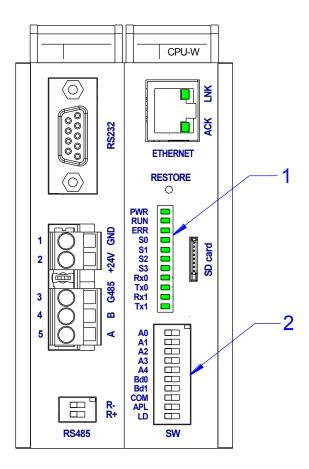| Legend	Number	Signification
	1	Micro SD slot

Tested micro SD cards:
- Sandisk 2 GB
- SONY 2 GB
- Transcend 2 GB
- Transcend 16 GB (Class 10)
- A-Data 32 GB (Class 10)
- Kingston 32 GB (Class 10)

Other SD cards functionality cannot be guaranteed.

Note If the micro SD card capacity is up to 2 GB, FAT16 must be used. Otherwise FAT32 must to be used for more than 2 GB capacity.

7 System LEDs and SW switches

Fig. 9 – Location of switches and indications

Legend

Number	Signification
1	System LEDs
2	SW switches

System LEDs

LED	Colour	Signification
RUN	Green	Application running (see DetStudio environment help).
ERR	Green	Application error (see DetStudio environment help).
S0	Green	Procedural processor activity (see DetStudio environment help).
S1	Green	Procedural processor activity (see DetStudio environment help).
S2	Green	Procedural processor activity (see DetStudio environment help).
S3	Green	Communication processor activity (see DetStudio environment help).

SW switches

Switch	Position	Signification
1 to 8	ON	Configuration of system communication parameters (see DetStudio environment help).
	OFF	
9	ON	User application running.
	OFF	User application blocking.
10	ON	IP configuration / activating NOS loading mode (see DetStudio environment help).
	OFF	Standard run.

8 Factory settings

RS485 configuration The wires termination and idle state definition switches are in ON position.

Ethernet

Parameter	Default value
Station IP address	**192.168.1.1**
Network mask	**255.255.255.0**
Default gateway	**0.0.0.0**

Web server

Parameter	Default value
Administrator login / password	**root / amit**
Service login / password	**service / amit**
User login / password	**user / amit**

Parameter	TCP port default value
FTP server – data	**20**
FTP server – control	**21**
WEB server	**80**

DB-Net / IP server

Parameter	UDP port default value
UDP port	**59**
Password	**0**

8.1 Restoring of factory setting

User can select this option in case of communication problems with station, e.g. an unknown station's IP address, communication problems through Ethernet, etc.

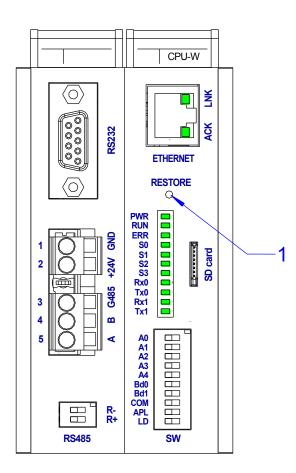RESTORE button is used for restoring of factory setting (press with a suitable blunt tool).

Fig. 10 – RESTORE button location

	Number	Signification
Legend	1	RESTORE button

Factory setting activation
- Disconnect the central unit from power supply.
- Switch DIP10 to OFF position.
- Press "RESTORE" button.
- Connect the unit power supply while holding the "RESTORE" button.
- Hold the "RESTORE" button for about 15 s (LED S3 is swiftly flashing during this period), until LED S3 is permanently lit.
- Release the "RESTORE" button.
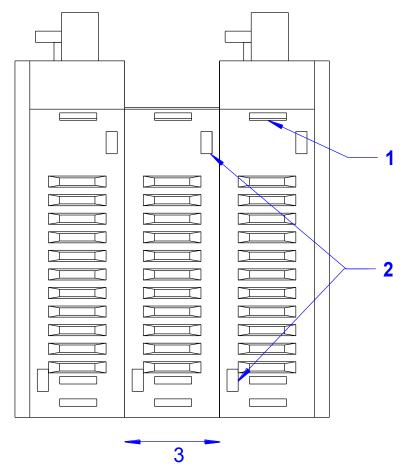- LED S3 starts flashing with 1 s period after another 15 seconds.
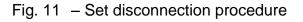
Factory setting is restored.

9 Mounting

The central unit **AD-CPUW2** must be built in metal sheet switchboard. It is intended for DIN 35 mm rail mounting.

Assembly System is delivered in completion according to an order. When inserting another module or replacing defective one proceeds as follows:
- Remove set from DIN rail
- Remove labels
- Disconnect DIN rail carrier – use screwdriver to pry carefully on top and bottom marked points
- Disconnect modules – use screwdriver to pry carefully on top and bottom marked points and disconnect modules
- **AD-CPUW2 double module is internally screwed by two screws** – it is necessary to unscrew them before dismantle!

Fig. 11 – Set disconnection procedure

Legend	**Number**	**Signification**
	1	Prying position for carrier dismounting
	2	Prying position for modules disconnection
	3	Disconnection direction

9.1   Installation rules

EMC filter Use an EMC filter on 230 V AC power supply voltage input. This requirement can be revised on the basis of environment character and wiring layout.

Connect the negative supplying terminal of control system (GND) to the switchboard PE terminal.

Digital I/O Wire the negative terminal of all inputs and outputs to the switchboard PE terminal.

Separate power supply section is recommended. It is sufficient to use the same power supply for both digital inputs and outputs.

Realize the PE connection on the switchboard input.

Use the shielded wires for longer distances and in higher level disturbance environment. Connect the cable shielding to the switchboard's PE terminal just on the input.

If the wires are led outside the building, the appropriate inputs and outputs need to be overvoltage protected.

Analogue inputs Use the shielded cables for wiring. Connect the cable shielding to the switchboard's PE terminal just on the input.

If the wires are led outside the building, the appropriate inputs and outputs need to be overvoltage protected.

RS485 channel It is necessary to perform RS485 interface connecting according to recommendations in Application Note *AP0016 – Principles of RS485 interface usage*.

RS232 channel It is enough to use an unshielded flat communication cable for service purposes and within the switchboard frame usage.

Use the shielded cables for permanent usage outside the switchboard frame. Connect the cable shielding to the switchboard's PE terminal just on the input.

Ethernet interface It is enough to use an unshielded cable (the patch cable) for service purposes and within the switchboard frame usage.

It is necessary to perform Ethernet interface connection according to recommendations in Application Note *AP0037 – Principles of Ethernet network usage* in case of permanent usage outside the switchboard frame.

Note All PE interconnections must be realized with the lowest impedance as possible. Technical parameters of control system are guaranteed only when these wiring rules are applied.

10 Ordering information and completion

Central Unit	**AD-CPUW2**	Complete, see chapter 10.1 Completion
	AD-CPUW2/I	Complete, see chapter 10.1 Completion

10.1 Completion

AD-CPUW2

Part	Quantity
Modular system ADiS central unit	1
WAGO 231-302/102-000	1
WAGO 231-303/102-000	1
WAGO 231-131	1
DIN carrier	2

AD-CPUW2/I

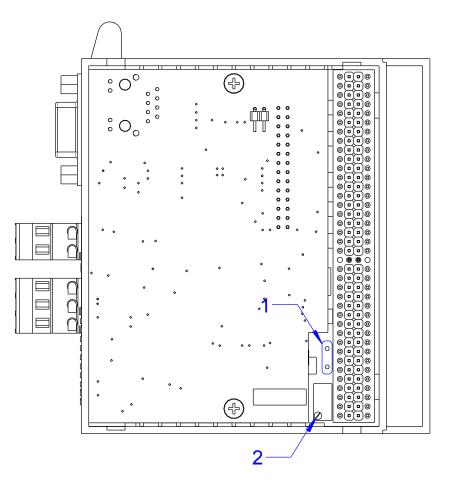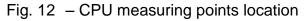| Part	Quantity
Modular system ADiS central unit with temperature range -40 °C to 70 °C	1
WAGO 231-302/102-000	1
WAGO 231-303/102-000	1
WAGO 231-131	1
DIN carrier	2

11 Maintenance

The device does not require any regular inspection or service, except checking of reference voltage setting as well as backup accumulator voltage.

Reference voltage source A/D converter reference voltage of 5.0 V is set with ±1 mV precision from manufacturer. Only sufficiently accurate measuring instrument can check this voltage value correctly!

Checking is necessary at least once every five years.

Fig. 12 – CPU measuring points location

Legend	**Number**	**Signification**
	1	Measuring points
	2	V_{ref} setting trimmer

Backup battery The backup battery is used for backing up program and RAM memory parameters. Its nominal voltage is 3.0 V DC; nominal capacity is 1 Ah. If battery voltage drops under 2.7 V, it is considered as discharged. When this happens, it is necessary to change it.

Checking is necessary at least once every five years. An assumed battery lifetime is 10 years according to manufacturer.
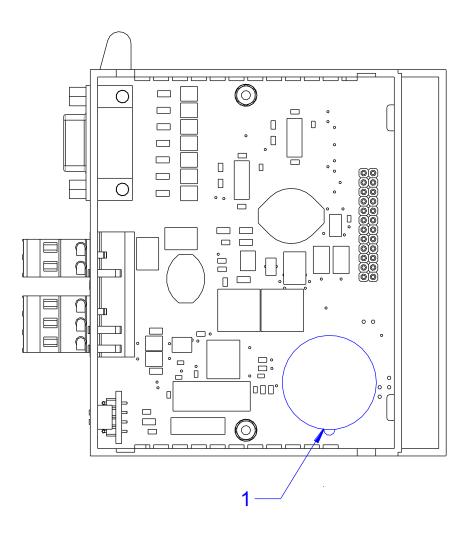
Fig. 13 – Battery location on power supply board

	Number	Signification
Legend	1	Battery

Cleaning Time after time with regard to way of device usage, it is necessary to remove dust from inside electronics. The device can be cleaned by dry soft brush or vacuum cleaner, only when turned-off and disassembled.

Note **The maintenance mentioned above can be performed by manufacturer or authorized service only!**

12 Waste disposal

Electronics disposal The disposal of electronic equipment is subject to the regulations on handling electrical waste. The equipment must not be disposed in common public waste. It must be delivered to places specified for that purpose and recycled.

Battery disposal The equipment contains a lithium battery. The battery is a hazardous waste. Therefore, it must be delivered to places specified for that purpose. Disposal of worn-out batteries and accumulators must not be in contrary to valid regulations.