LEDelektronika

MANUAL FOR HANDLING AND MAINTENANCE OF THE METEOROLOGICAL STATION CMP 6.0

Content

1. GENERAL PART

1.1. INTRODUCTORY PART

The owner is responsible for maintenance and is obliged to ensure the maintenance of the equipment so that the basic requirements for the equipment are preserved during its life. Likewise, the Road Manager is obliged to ensure that the highway is maintained in such a way as to enable safe traffic on them during maintenance, to preserve the basic properties and improve their traffic, technical and safety features, protection from the harmful impact of road traffic and to preserve their environment and neat appearance.

The Road Manager must take particular care to ensure that road maintenance works and installed equipment do not deviate from the assumptions and requirements specified in this Maintenance Manual.

The purpose of this Manual is to present the usual practice and procedures by which the Highway Manager ensures a uniform approach to the maintenance of all parts of the installed equipment as close as possible to their original state.

1.2. DEFINITIONS

Maintenance- protection, supervision, maintenance and restoration of the subject object and installed equipment in order to maintain them as close as possible to the designed and executed condition and enable their safe use in the designed period.

Road Manager- the legal entity that manages the subject section of the public road.

Construction contractor- the legal entity with which the Road Manager contracted the construction of the subject road section

1.3. RESPONSIBILITIES

The Road Manager is obliged to ensure the beginning of the maintenance of the road, associated buildings and installed equipment immediately after putting the entire road or each part of it into traffic. Equipment maintenance is carried out on the basis of applicable legal and technical regulations and in accordance with the requirements of this Manual. All costs of regular and extraordinary maintenance works that are carried out on the basis of applicable legal and technical regulations and in accordance with the requirements of this Manual for use and maintenance are borne by the Road Manager.

When maintaining the installed equipment, it is allowed to use only original parts recommended by the equipment manufacturer. The Road Manager is obliged to entrust regular maintenance works to an authorized and certified maintenance contractor, or to contract extraordinary maintenance works with authorized organizations for this type of work.

All maintenance activities should be carried out taking into account:

- Weather conditions
- Safety and ease of traffic
- All applicable laws, rules and standards

1.4. PROGRAM OF MAINTENANCE WORKS

1.4.1. Regular maintenance

Regular maintenance consists of a set of measures and actions that are performed during most or all of the year on the equipment, including facilities and installations, with the purpose of maintaining the passability and technical correctness of the road and the safety of traffic on it. The Road Manager is obliged to entrust the regular maintenance work to an authorized company for the maintenance and servicing of installed equipment, which starts the contracted maintenance work immediately after the commissioning of each of its elements, and to bear all the costs arising from such a contractual relationship.

Regular maintenance of equipment includes the following tasks in particular:

- Regular visual inspection of installed equipment
- Regular check of the correctness of the installed sensor equipment
- Regular maintenance and cleaning of the control cabinet
- Operational check of the battery condition
- Regular inspection of the condition of overvoltage protections of sensor equipment (DC side) and surge arresters (AC side)
- Regular inspection of the correctness of the differential protection system (FID switches)
- Regular inspection of the grounding system and other installations

1.4.1.1. The Road Manager is obliged to ensure that the maintenance contractor performs the regular maintenance of the equipment in such a way that it cleans and supplements, replaces or repairs worn out, damaged, defective or missing equipment or parts, i.e. constructions, that the traffic equipment installed on the road is maintained in such a way that ensure its complete functionality and visibility, as well as comply with all requirements arising from positive regulations regulating road traffic safety, as well as traffic signaling and road equipment.

1.4.1.2. The Road Manager is obliged to ensure that the contractor for the maintenance of installed equipment and devices maintains them in a way that ensures their functionality and to immediately, without delay, remove the causes that prevent this. If the functionality of the installed equipment/device cannot be established in a short time, it is necessary to ensure that appropriate temporary measures and safety measures are taken

immediately. The Road Manager is obliged to ensure that the maintenance contractor of the built-in equipment (built into the roadway or outside it), which is intended for the safe management and control of traffic, monitoring of the road condition, measurement, notification, as well as telecommunication devices, power cables, telecommunications cables (TK), fiber optic cables (SVK), uninterruptible power supply (UPS), protective and safety devices and maintains the devices in accordance with the manufacturer's technical instructions and technical regulations for the operation of these devices.

1.4.1.3. The Road Manager is obliged to ensure that the road maintenance contractor cleans all the components of the public road in such a way as to remove everything that can affect the safety of traffic, the functionality of the equipment.

1.4.2. Extraordinary maintenance

Extraordinary equipment maintenance implies occasional work on installed equipment in order to ensure full functionality according to technical requirements, safety and conditions of the Road Manager.

Extraordinary road maintenance works can only be carried out on the basis of a project that must be drawn up for the implementation of such maintenance. The Road Manager is obliged to contract the preparation of project documentation, supervision and performance of extraordinary maintenance works with authorized organizations for this type of work.

A detailed list of the maintenance works of the equipment, the method and deadlines for checking the condition of all its installed parts, and the types and deadlines for carrying out works that maintain or restore the functionality of all its parts to the prescribed level, as well as the level of service for all regular maintenance of public roads are prescribed in detail in this The manual for use and maintenance for the part of the equipment in question (meteo stations on the M6/M60 highway).

1.5. OVERVIEW PLAN

1.5.1. Supervision and equipment overview

The condition of the installed equipment is monitored by the Road Manager, through regular and extraordinary inspections, and by the road maintenance contractor through the patrol service.

The Road Manager is obliged to keep records of the performed equipment inspections and all data collected during the inspection must be stored in a manner determined by positive regulations.

On the completed inspection of the equipment, an official of the Road Manager or maintenance contractor draws up a report that is an integral part of the records of the completed inspections.

With the report on the completed inspection of the equipment, the official person also attaches the collected evidence (pictures, sketches, statements, records, etc.) that are an integral part of it.

The collected data on the state of the installed equipment form the basis for creating plans for determining the necessary interventions during regular maintenance, extraordinary maintenance, repair or replacement of the installed equipment, with precisely defined objectives of the inspection, the method of its implementation, i.e. the necessary tests, personnel and equipment necessary for its implementation and the defined outcomes of the inspection.

The Road Manager is responsible for the organization, implementation and financing of periodic inspections.

The periodicity of inspections is defined through regular inspections, seasonal, annual, main and extraordinary inspections.

1.5.2. Regular inspections

Regular inspections are carried out as part of a regular inspection (patrol) of a certain road section.

The patrol is carried out primarily to achieve security goals. Road patrols are also responsible for monitoring the functionality of all parts of the building and reporting any damage, even if it does not pose an immediate risk.

The patrol is carried out by professional and qualified staff of road maintenance personel with appropriate equipment. Road patrols assess the danger to road users in the form of damage and events and react appropriately by taking direct measures to protect road users, either by removing the damage themselves or alerting the maintenance staff of subsequent actions. Road patrols are obliged to respond to emergency situations and take measures to protect road users.

Road patrol must remove all obstacles or dangerous places from the road immediately after learning about them, but if the same cannot be removed immediately, he must secure the aforementioned with prescribed traffic signals until they are removed.

Road patrol should also patrol during adverse weather conditions, unless conditions are so bad that they could endanger their own safety. Road patrol must pay special attention to sections that are subject to flooding, exposed to strong wind gusts, ice formation or snow drifts. If necessary, the road patrol must place signs that will warn road users of the danger.

1.5.3. Seasonal inspections

Seasonal inspections are carried out twice a year (spring - autumn) on days when the traffic flow is less intense. The report on the conducted seasonal inspections must be submitted to the construction contractor within 7 days after the inspection.

1.5.4. Annual inspections

Annual inspections are carried out periodically. The report on the annual inspection must be submitted to the construction contractor within 7 days after the inspection of each part of the building.

1.5.5. Main inspections

The main inspections are carried out periodically and according to the requirements of the equipment supplier (described under "3. Maintenance of the weather station"). The report on the main inspection must be submitted to the construction contractor within 14 days after the inspection of each part of the building.

1.5.6. Extraordinary inspections

- after extraordinary events such as earthquakes, explosions, floods or overloading
- when significant degradation of the pavement structure is observed

The report on the extraordinary inspection must be submitted to the construction contractor within 7 days after the inspection of each part of the installed equipment.

1.5.7. Warranty conditions

The warranty is valid only if the supplied and installed equipment is used in the manner of its intended purpose, following the manufacturer's or seller's instructions.

The warranty ceases to be valid if the maintenance of the equipment is not contracted with authorized services.

2. METEOROGICAL STATIONS

This manual provides all the necessary information for efficient use of the product and procedures for diagnosing and eliminating simple faults.

This manual shows:

- How to access the weather station
- How to communicate with the weather station
- How to manage the weather station
- How to view current device data views
- How to diagnose and eliminate simple equipment malfunctions

In order to understand the working principle of the weather station, You need to be familiar with the following:

- Equipment technology
- Meteo system and sensor components
- Data transmission by RS 232/485 serial protocols

2.1. CONNECTING THE METEO STATION TO THE NETWORK

Communication with the weather station can take place in several ways:

- via the serial RS485 communication input for service communication at the station itself (labels: "OUT(RS485)"),
- via Ethernet and IP technology: local and remote (labels: "ETH")
- by connecting to the local device of the route (road traffic station),
- remotely from the competent traffic management and control center via the basic communication network (Ethernet / optics SM, MM)

2.1.1. Local connection

Local connection can be performed using a terminal program (eg. Termite, Modscan, Hercules, etc.).

Terminal "Termite" was used as an example for connection.

When starting the terminal, delete the record history by clicking on the "Clear" command.

For serial communication, it is necessary to adjust the settings as follows (click on the command

"Settings" opens an additional window "Serial port settings"):

- PORT – set the COM port through which communication takes place
- BAUD RATE: 19200
- DATA BITS: 8
- STOP BITS: 1
- PARITY: none
- FLOW CONTROL: none
- FORWARD: none
- TRANSMITTED TEXT: select "Append CR" and mark "Local echo"
- RECEIVED TEXT:

on Polling-100ms

on Max.lines - leave empty

on Font-default

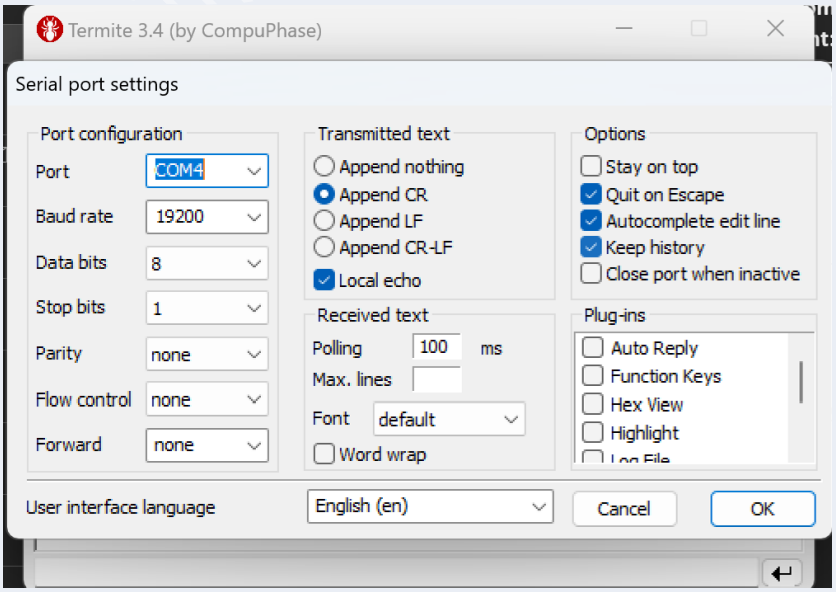
on Uncheck "Word wrap"

- OPTIONS: check "Quit on Escape", "Autocomplete edit line", "Keep history", uncheck other parameters

- PLUG-INS:uncheck all parameters

After all the necessary settings have been set, click on the confirmation of the selected one ("OK") and if the connection has not been established, automatically click on the "click to connect" command.

Example: Retrieving data via serial communication



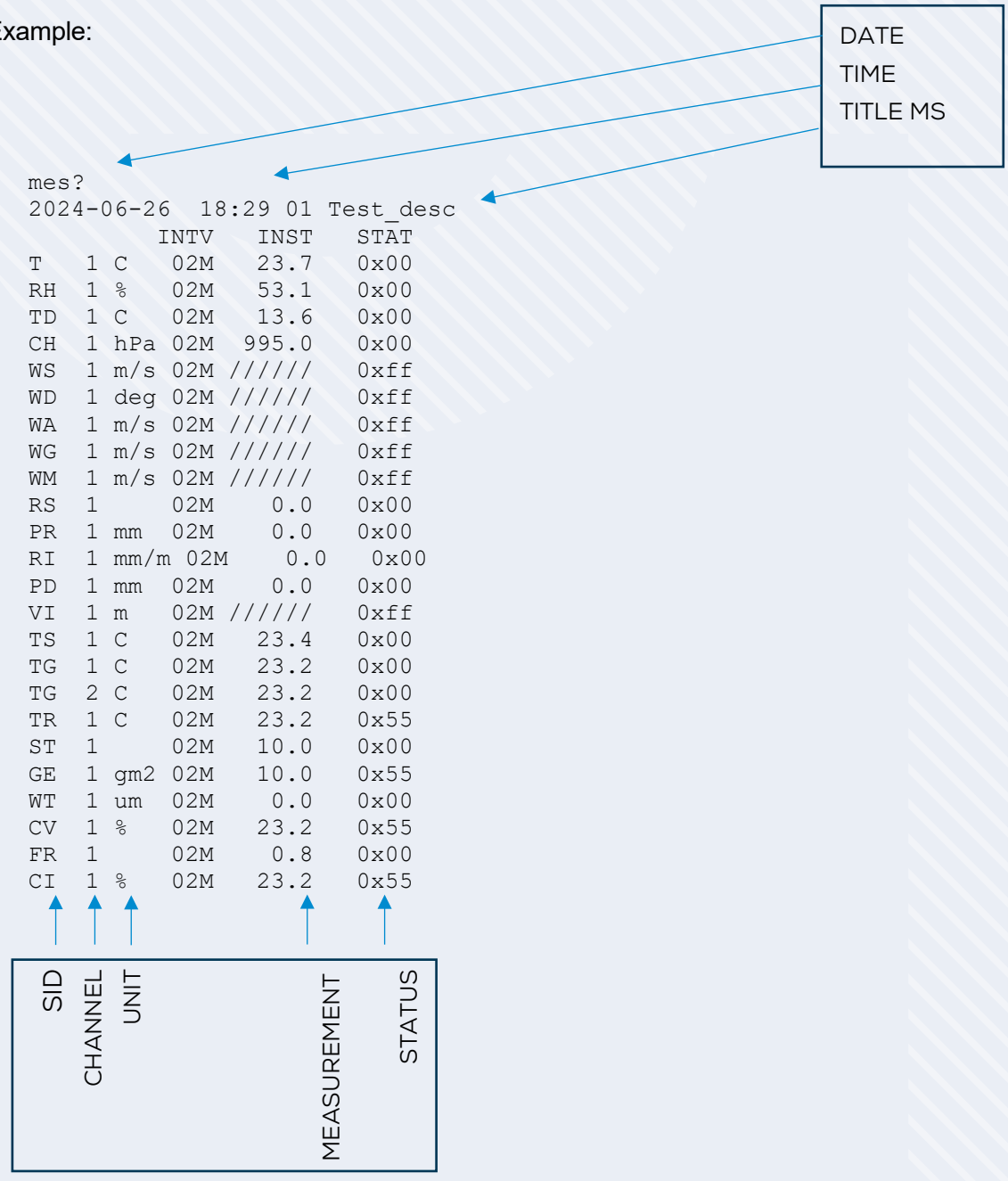
2.1.2. Remote connection

Remote connection to the weather station is possible via TCP/IP connection. The protocol to the station is in ASCII format. Each command sent to the station must have a UNIX line termination method, i.e. it must end with CR (carriage return).

Commands for local/remote data reading:

Retrieving measurement data in a structured printout and reading sensor status.

Example:



Note: the protocol and connection method are described in more detail in the attachment "Remote communication protocol CMP 6.0_LEDelektronika_V2.01.

2.2. Tables of meteorological measured values

Table 1. – Measurement quantity, unit and range:

The name of the measuring quantity	SID	Unit
Air Temperature	T	°C
Relative Humidity	RH	%
Dew Point	TD	°C
Relative Air Pressure	CH	hPa
Wind Speed	WS	m/s
Wind Direction	WD	deg
Average Wind Speed	WA	m/s
Wind Gust Speed	WG	m/s
Max Wind Speed	WM	m/s
Precipitation Type (Table 2.)	RS	status
Precipitation Quantity	PR	mm
Precipitation Intensity	RI	mm/h
Precipitation Difference Quantity	PD	mm
Visibility	VI	m
Surface Temperature	TS	°C
Ground Temperature on 10cm	TG	°C
Ground Temperature on 30cm	TG	°C
Freezing temperature	TR	°C
Road condition (Table 3)	ST	status
Salt Quantity	GE	g/m2
Water film height	WT	µm
Salt Concentration	CV	%
Friction	FR	
Ice Coverage	CI	%

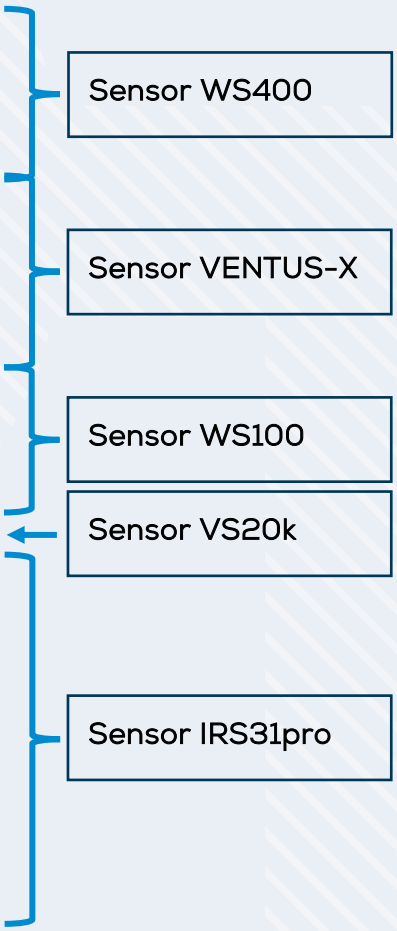


Table 2 – Precipitation type status:

Status	Rainfall type
0	No precipitation
60	Rain
70	Snow
40	Unknown
67	Ice rain
69	Blizzard
90	Hail

Table 3. – Roadway status:

Status	Road condition
10	Dry
15	Moist
20	Wet
25	Moist salted
30	Wet salted
35	Ice
40	Snow
45	Frost

**Note: the condition of the pavement surface depends on the thickness of the water layer (<30µm-dry, 30µm<wet<200µm and >200µm-wet)

Table 4. – Sensor status:

Status	Sensor status
0x00	OK
0x10	Unknown query
0x11	Invalid parameter
0x24	Invalid channel
0x28	The device is not ready
0x50	Measured variable outside set range
0x51	
0x52	Measured data outside set range
0x53	
0x54	Measurement error
0x55	Measurements are not ready
0xff	Failed to read data

3. MAINTENANCE OF METEOROLOGICAL STATIONS

The maintenance of weather stations and the accompanying sensor assembly is essential for the proper operation of the system and should be carried out as timely regular maintenance, and certainly at least one inspection before the winter season and one control inspection after the winter season.

DISTRIBUTION AND CONTROL CABINET

· The interior of the cabinet must be clean and dry.

· Check the value of the incoming supply voltage at -VR1 (230VAC)

· The following should be checked for system wiring and cables:

- Check the tightness of all cable connections
- Check all power and data cables coming to the equipment and communication equipment. Check that their insulation is intact and check that all connections are undamaged.
- Check whether the fiber optic cable transmits the appropriate signal.
- The signal must not be choked.

· Check the 24V DC voltage values on the -3G1 device:

- Check the battery voltage value at terminals 4.1(+) and 4.2 (-)
- Check the voltage value on outgoing terminals 2.1(+) and 2.3 (-)

· Checking the correctness of surge protectors/surge arresters (-VR1)

- If there is a RED mark on the overvoltage protection → the overvoltage protection is not working - it needs to be replaced

· Checking the correctness of the overvoltage protections of the sensor equipment (-3A1, -3A2 and -3A3)

- If the power indicator (DCout) or the communication indicator (RS485) does not light up, it is necessary to check and replace faulty parts

· Checking the correctness of the FID switch (-Q00 APU)

- It is necessary to check the correctness of the automatic lifter of the FID switch by clicking the test button, according to the manufacturer's instructions

METEO STATION - SENSORS

· REMOTELY/LOCALLY check the communication with the sensors (check if all the data is displayed on the workstation in the competent traffic control center or on the meteo controller inside the meteo station)

· Check the values obtained from the sensor with the external atmospheric condition at the location

· Once a year, clean the sensors of accumulated dust and dirt according to the manufacturer's instructions

· Once a year (after the winter season), it is mandatory to visually inspect the pavement probes (IRS31pro) due to possible damage from the plow, plow and spreading, and perform calibration/check of the measured data according to the manufacturer's instructions

· If necessary, fill the slits in the space between the asphalt and the probe with the sealing compound used during installation

· Perform calibration and adjustment of individual sensors of the weather station once a year (according to the manufacturer's instructions with a moderate device) - it is necessary to call an authorized service technician of the installed equipment for calibration and adjustment

4. DIAGNOSIS AND SYSTEM FAILURES

Fault diagnostics is an essential element in maintaining system functionality.

In order to properly check the condition and functionality of the installed equipment and the diagnostics of malfunctions, we can start testing them by following the following steps:

Grounding test:

· It is necessary to measure with a multimeter the resistance between the connection point on the equipment and the reference grounded point of the system (PE terminal cabinet, weather station pole, etc.) - if the resistance exceeds 5Ω, then it is necessary to tighten all the connections and/or replace the wires if, after tightening the connections and further measures still reads greater resistance

· It is necessary to use a multimeter to measure the resistance between the connection points of the weather station cabinet and the grounding device - if the resistance exceeds 5Ω, then it is necessary to tighten all the connections and/or replace the wires if, after tightening the connections, a higher resistance is still measured.

· Checking the condition of the housing of the units.

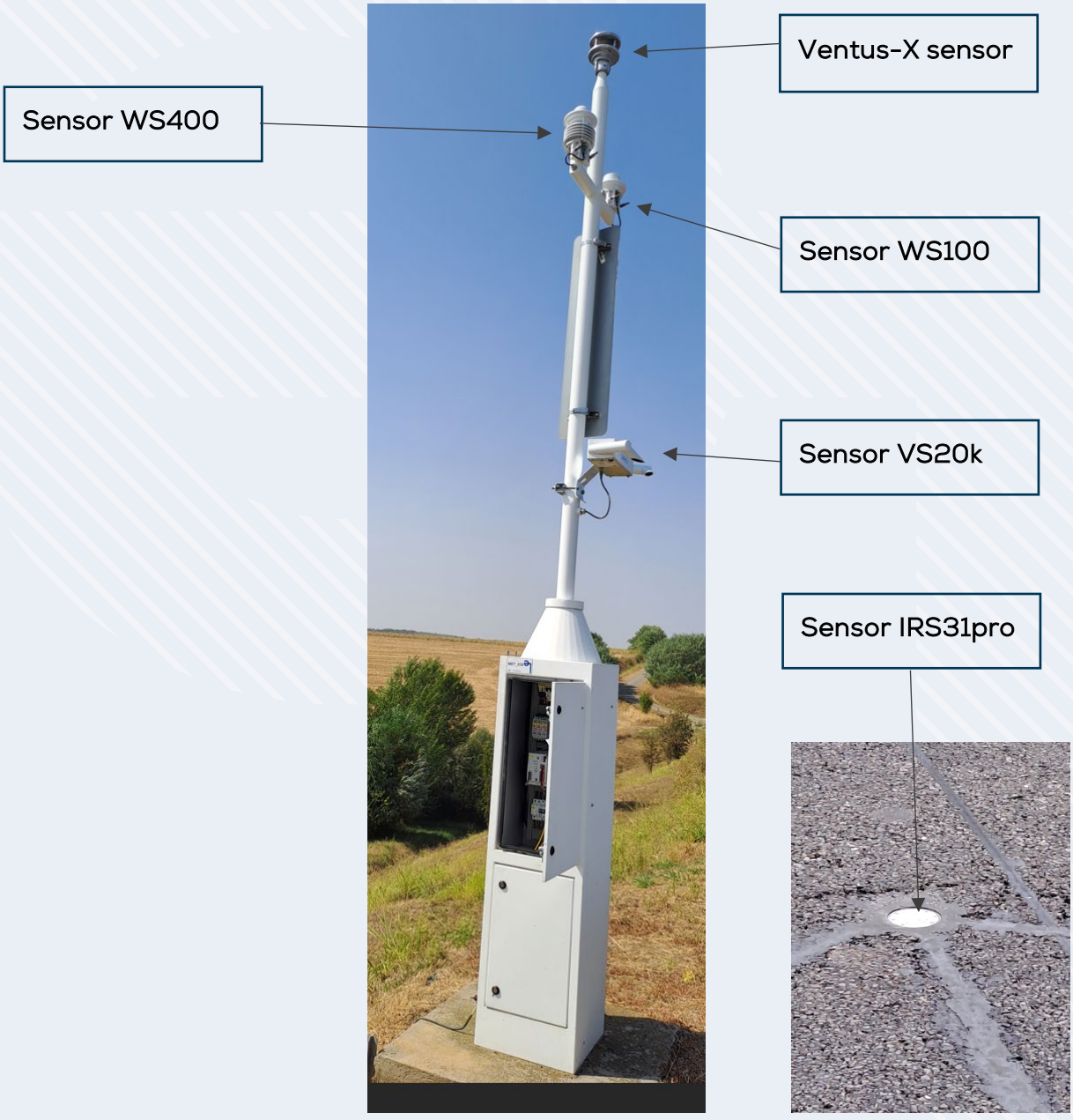
· Checking the condition of all data lines

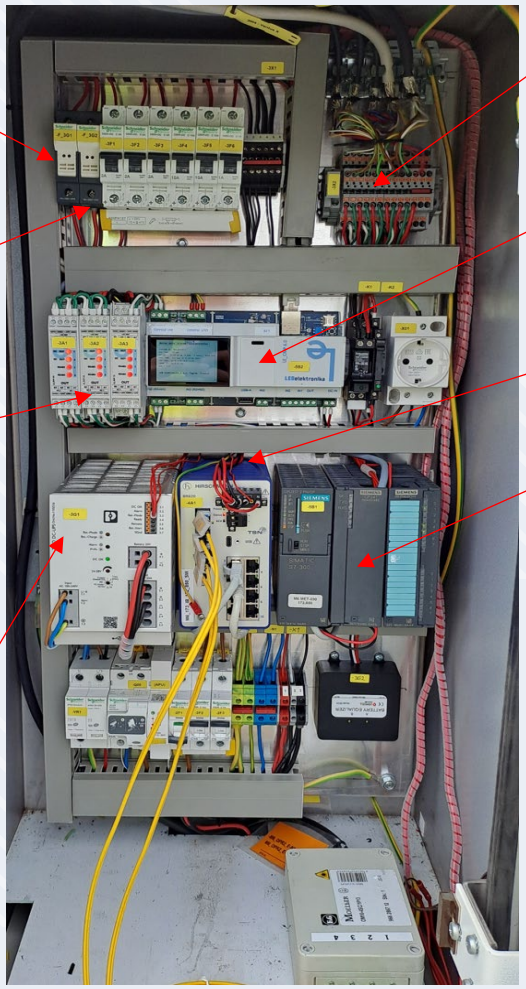
· Checking the condition of the cabinet's power cable

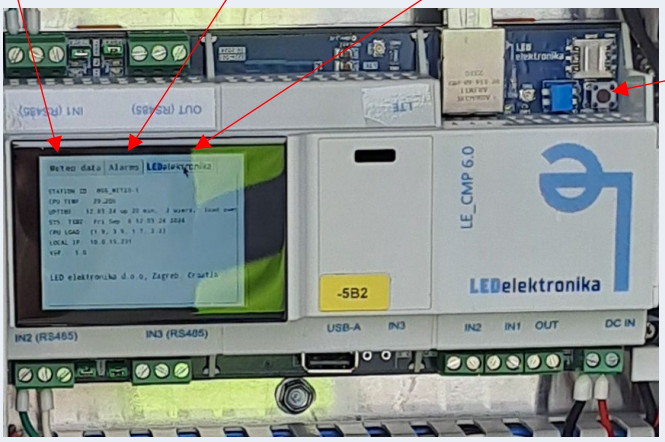
Communication check:

It is necessary to connect the test computer to the free LAN port of the network switch in the weather station cabinet, "ping" the IP telegram in the Windows interface to the competent traffic control center - if the base network does not respond - communication to the center is lost - an inspection of the optical infrastructure from the cabinet is required to the connecting network cabinet of the traffic control center.

4.1. Parts of the weather station




DC disconnect fuse (-F_3G1)
Battery fuse (-F_3G2)
Sensor power supply and communication modules (surge protection of sensor equipment (-3A1, -3A2, -3A3)
UPS with integrated power supply (-3G1)
Terminals for power supply and communication with sensors (-3X2)
Weather controller (-5B2)
Switch (-4A1)
Controller (– 5B1)


Weather data
Alarms
LEDelektronika
Reset button
LE_CMP 6.0
-5B2
LEDelektronika

SPECIFICATION OF INSTALLED EQUIPMENT

Label	Description
- VR1	surge arrester,350V, 20kA, 1P+N Type: iPRD20r, Schneider
- F00	Miniature circuit breaker, 1P, 25A, C Type: iC60N,Schneider
-Q00 (APU)	Residual current circuit breaker, 2P, 40/0.3A, Type: Acti9 REDs,Schneider
-2F1, -2F3, -2F4	Miniature circuit breaker,1P, 6A, C Type: iC60N, Schneider
-2F2	Miniature circuit breaker,1P, 1A, C Type: iC60N, Schneider
- X01	DIN socket, 2P + E, 250V, 16A Type: KEMA VDE,Schneider
-2S1, -2S2	Limit switch 1NC
-3G1	Uninterruptible power supply with integrated power supply, 24V DC, 20A, Type: TRIO-UPS-2G/1AC/24DC/20, Phoenix
-3G2	Battery equalizer 24VDC Type: BE24, Lioncell
-3X1	Terminal blocks, GND Phoenix
-3X2	Terminal blocks2P 0.2-2.5(4)mm2 Phoenix
-F_3G1, -F_3G2	Fuse carrier, +24V DC, Gg 20A, 10x38 Type:TeSys, Schneider
-3F6, -3F7	Miniature circuit breaker , 1P, 2A Type: iC60H-DC, Schneider
-3F1..-3F3	Miniature circuit breaker , 1P, 2A Type: iC60H-DC, Schneider
-3F4, -3F5	Miniature circuit breaker , 1P, 10A

	Type: iC60H-DC, Schneider
-3A1, -3A2	Overvoltage protector for sensors 24VDC Type: LE_OVP 24, LED electronics
-3A3	Overvoltage protector for sensors 12VDC Type: LE_OVP 12, LED electronics
-4A1	Industrial managed switch Type: BRS20, Hirschmann
-5B1	Modular controller, 12-24V DC Type: Simatic S7-300, Siemens
-5B2	Weather controller Type: LE_CMP 6.0, Led electronics
-K1	Harmony electromechanical relay,24VDC, 2CO, 8A Type: RSB, Schneider
-K2	Harmony electromechanical relay,24VDC, 1CO, 6A Type: RSL, Schneider
WS100	Radar Precipitation Sensor, 24VDC Luft
WS400	Smart weather sensor, 24VDC Luft
VS20k	Visibility sensor, 24VDC Luft
Ventus-X	Ultrasonic sensor with extended heating, 24VDC Luft
IRS31pro	Intelligent passive road sensor, 12VDC Luft

4.2. Equipment diagnostics

Data from the sensor can be read remotely in the competent traffic control center or locally in the weather station itself on the weather controller -5B2.
The following data can be read on the meteo controller (-5B2):

- Meteo data: display of the status and values of all measured values from the sensors
- Alarms: display of warning and alarm status
- LEDelektronika: display of basic data about the weather controller, such as the name of the weather station, CPU temperature, IP address, etc.

If remote reading of data from the sensor is disabled (and locally is possible), it is necessary to check the voltage on the switch -4A1 and -5B1 controller itself, check the communication status on switch -4A1, check the connection of controllers -5B1 and -5B2, and if necessary check the optical cable to the competent traffic control center.

If it is not possible to read the data from the sensor locally (and it is possible remotely), it is necessary to reset the meteo controller (-5B2) in such a way that the fuse -3F2 is turned off and on again or by clicking the reset button on the meteo controller itself.

If it is not possible to read data from the sensor either locally or remotely, the following must be checked:

- First, check the tightness of all connections in the cabinet

- Checking the voltage on the residual current circuit breaker (-Q00), that is, on the surge arrester (-VR1). If there is no 230VAC voltage - loss of power on the incoming power cable - it is necessary to check the state of the power supply in the competent main distribution cabinet.

- If there is voltage on the residual current circuit breaker (-Q00), and there is no 230VAC voltage on the UPS with integrated power supply (-3G1), it is necessary to check the correctness of its fuse -2F3.

- If 230VAC voltage is present on -3G1, the following must be checked:
  - Check the battery voltage value at terminals 4.1(+) and 4.2 (-).
    If the voltage on the batteries is less than 23 VDC, perform a reset, that is, disconnect and reconnect the F_3G2 fuse after a few minutes. After reconnecting, it is necessary to wait a few minutes to check whether the battery is charging. If the battery does not charge, it is necessary to replace either the battery or the UPS (-3G1).
  - Check the voltage value at outgoing terminals 2.1(+) and 2.3 (-). If there is no power supply at the outgoing terminals, it is necessary to measure the battery voltage according to the instructions in the previous point.
  - If we have 24VDC on the outgoing terminals -3G1, it is necessary to check the power supply on the controller itself -5B2 (DC-, DC+) and on the communication and power supply modules for the sensors -3A1, -3A2, -3A3

(IN: 24V, GND). If there is no voltage, it is necessary to check the associated fuses -F_3G1, -3F2, -3F4.

- In the event that everything previously works, it is necessary to check the voltage at the output terminals of the sensor module -3A1, -3A2 (OUT: 24V, GND), -3A3 (OUT: 12V, GND). If there is no voltage on any of the outgoing terminals, it is necessary to check and replace the glass fuses inside the devices -3A1, -3A2, -3A3.
- If there is voltage on the output terminals for sensors -3X2 and still no data is read from the sensors, it is necessary to tighten the connections on the sensors themselves.

In case that it is still not possible to read data from the sensors, it is necessary to connect directly to the sensors themselves using the instructions given in chapter 2.1.1. Local connection, to determine the correctness of the sensor.

In case that you have gone through all the above steps and still have not determined the location and nature of the fault, it is necessary to call an authorized repairer of the installed equipment.

In case of failure of any of the sensors or wrong measurements, the repair must be done by calling an authorized service technician of the installed equipment.

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