Electrical point heating systems for extreme environmental conditions

ESA Grimma - System WHV®

ESA ELEKTROSCHALTANLAGEN GRIMMA GmbH

The company

ESA Elektroschaltanlagen Grimma GmbH has developed into a modern, medium-sized, internationally successful company.

The company has:

- Approx. 250 employees
- 7,100 m² of production space
- Modern production facilities
- Quality management according to DIN ISO 9001:2008

We develop • plan • produce • deliver

Control and power supply systems for:

- Railway point heaters
- Industry and buildings
- Hospitals

System description

The system WHV® with its modules is a complete solution for electrical point heating systems for isolated and earthed railway tracks.

Our electrical point heaters ensure safety and continuous availability of the track in winter in case of ice and snow. The systems ensure the highest level of operational safety and reliability, even under extreme operating and environmental conditions. They can be used for tracks in all speed classes and can be used for the realisation of projects of any dimension. Modern controllers realise safe heating operation while at the same time saving energy. For optimisation of the maintenance, monitoring of pending failure of individual heating rods can be performed at the points.

All systems can be remotely monitored and remotely controlled. The options range all the way to visualisation systems for entire regional sectors.

Controllers of lighting systems can be integrated into the WHV® system.

Our control and visualisation system ensures the display of all systems at central operating and monitoring locations. Long distances are covered through the use of modern data transmission technology. In addition to the modules from the WHV® system, other systems can be integrated into the remote monitoring.

Quality and the highest level of protection for personnel and system

- High quality through the use of tested, certified products
- Highest level of security of signal equipment due to secure switching off in case of insulation faults with redundant insulation monitoring
- Certified development, planning, production, assembly and commissioning

Why the system WHV®

- High-quality comprehensive solution
- Maximum operating safety, availability and reliability under extreme operating and environmental conditions
- Optimal maintenance
- Low energy consumption
- Safe control, monitoring, archiving, messaging and diagnostics for the system
- Automatic emergency mode for systems in isolated operation should a malfunction occur
- The option of integrating other electrical systems into the data transmission system and the remote monitoring system

System overview

The point heating system WHV® is suitable for isolated (IT systems) and earthed (TT systems) railway tracks.

The point heating system WHV® is fully modular in design and thus adaptable to any project specific and climatic requirements.The system WHV® can be used for point heating systems with a mains frequency of 50 Hz as well as for an incoming feeder from the overhead line (e.g. 16.7 Hz of the Deutsche Bahn).

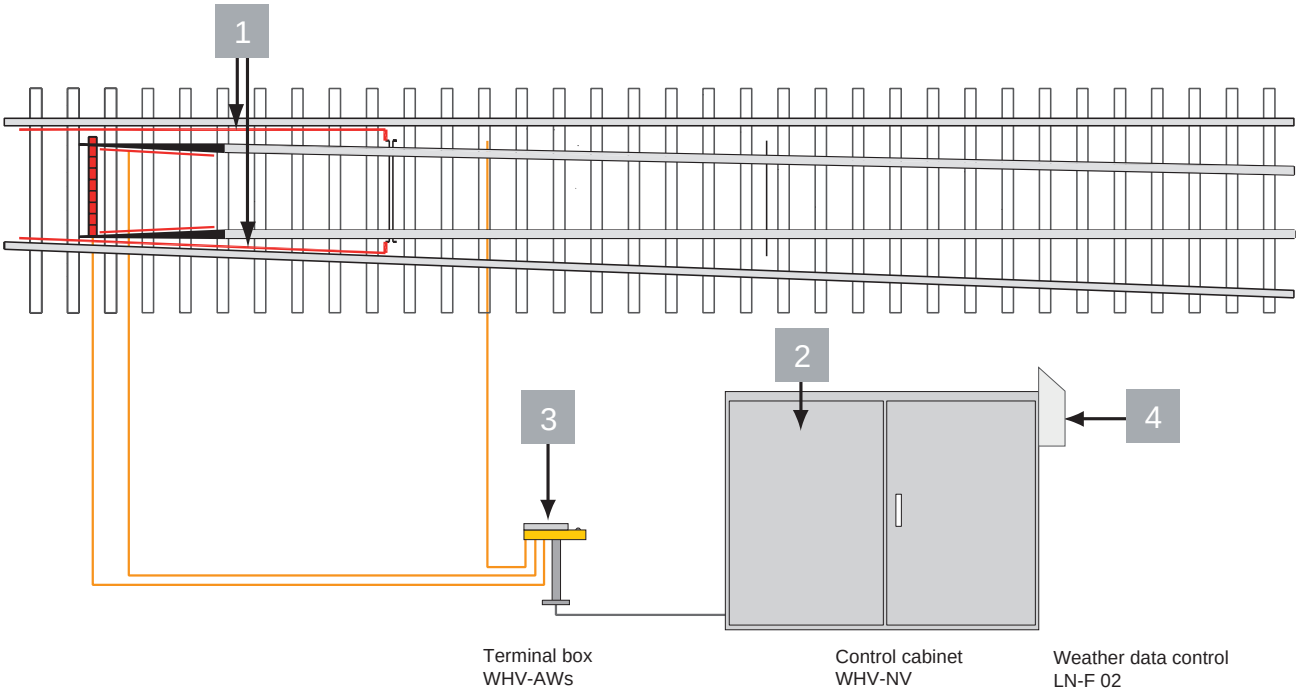
The point heating system WHV® ensures a high level of availability of the points during snow fall, snow storms, ice and frost with optimised energy consumption. With electrical heating rods at the points, ice and snow are melted.

For the WHV® systems, a special micro-controller and system-specific serial software with RS485 interfaces was developed by us.

All system components are designed in terms of hardware and software so that in case of a malfunction and communication problems, each point is securely heated.
Operation, control and monitoring of the WWHV® systems is performed using the BEA operating unit and PC with web-based control system software WHV® -VIS.

The key component of the electrical point heating system is the WHV® control cabinet. It provides the energy for the heating elements and contains all system devices for automatic and manual control, notification, diagnosis and monitoring of the system.

The following illustration depicts the system components of the WHV® point heating systems.



1 Heating rods

For stock and tongue rails, hollow sleeper heating, frog heating

2 Control cabinet

For outdoor and indoor installation

3 Terminal box

Distribution for connecting the heating rods

4 Weather data control

With all weather sensors and rail temperature sensors

Heating rods

For heating the points, flat tubular heaters with a heating voltage of 230 V AC are used in various lengths with a specific heating power of 330 W/m, 500 W/m or 700 W/m. Primarily, standard heating rods with a length of 4750 mm (1200 watt) and 6000 mm (1500 watt) are used. All heating rods have a cross section of 13 x 5.5 mm and are made of high-quality, corrosion-resistant chrome-nickel steel in protection class IP65 (tested waterproof). The service life is approximately 20 years, depending on the conditions on site.

For stock and tongue rails

Depending on the point design and climatic conditions at the location, different heat outputs are required. The necessary number of heating rods is mounted on the rails. The mounting of the heating rods is performed at the connection with a screw-connection head mount and in each sleeper bay with a clamping bracket to the rail. The heating rods are supplied ready to be connected with a cable 3 x 1.5 mm² and including all necessary terminals. The PE conductor is isolated up to the insulation monitoring device.

For frog

For high-speed points and double-cross points, at the start of the tongue rail, there are both articulated and spring-actuated frogs, which can also be heated.

For hollow sleeper or tongue tip

In addition, a hollow sleeper heater is used, 230 V, 2 x 250 watt or 2 x 450 watt, consisting of sturdy galvanized steel with heating rods mounted on it. The hollow sleeper heater is located with a space to the sleeper rod, insulated from the rails recessed in the sleeper bay.

Features

- Flat tubular heater with a cross section of 13 x 5.5 mm for all point types
- Standard lengths of 4750 and 6000 mm
- Specific heating power of 330 W/m, 500 W/m and 700 W/m
- Made of high-quality, corrosion-resistant chrome-nickel steel
- The connection cable, with a length of 8 m, is included in the scope of delivery and is pre-assembled to the heating rods
- Terminals and fastening material are part of the scope of delivery

The selection of the heating rods is made depending on the point type. The area of the stock and tongue rails should be heated along the movable part of the tongue, from the end of the tongue to approx 4/5 of the entire length of the movable part of the tongue. For the hollow sleeper heater, special heating rods with heat radiation plates are available.

Wind protection

Wind protection is used in general to reduce the cooling of the points due to wind, thus improving energy efficiency.
Improved heating of the relevant parts of the point is achieved even at very low ambient temperatures with a minimum of energy use. The functional security and availability of the points is thus increased in the winter.

Wind protection consists of

thermal insulation and brushes

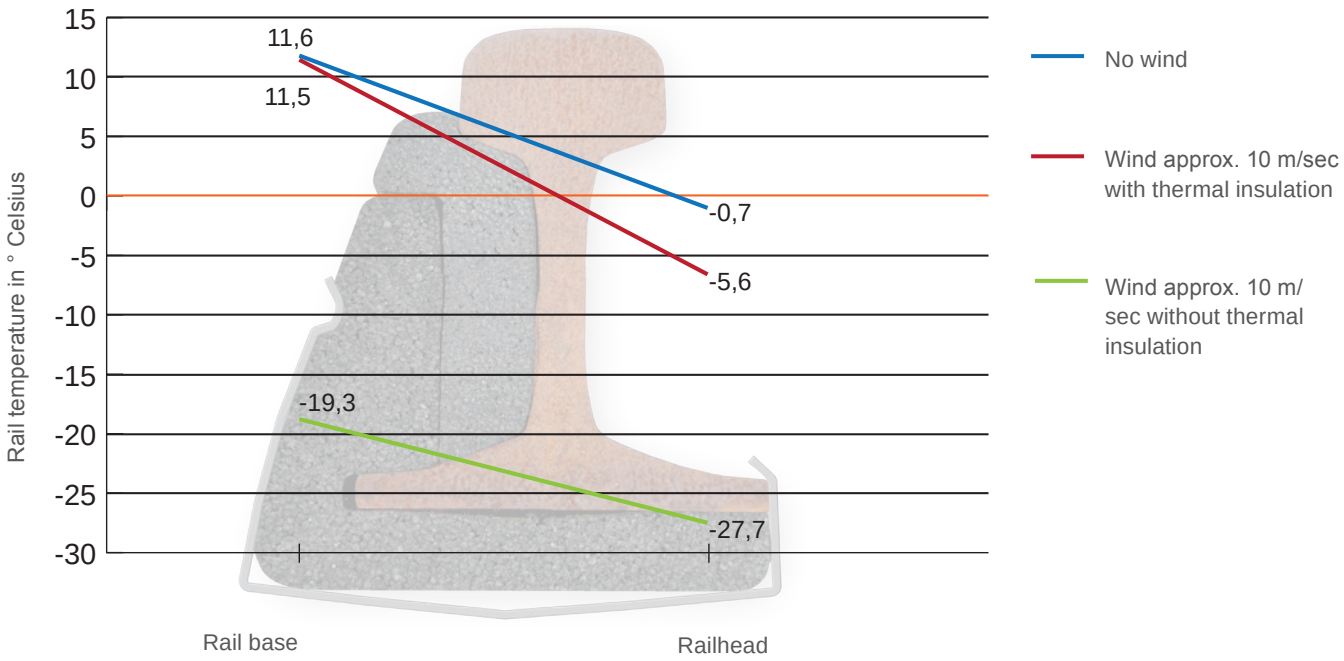
The stock rail of a point is equipped on the outside and at the rail base with thermal insulation segments and bushes all along the heated length of rail.

Benefits

- Due to the thermal insulation, the cooling of the rail from wind is compensated to a great degree and the rail temperature is reduced only slightly.

The following illustration shows the rail temperature with and without wind protection.

Rail temperature for profile R65, heating power 500 W/m at -35 °Celsius



Control cabinet NV

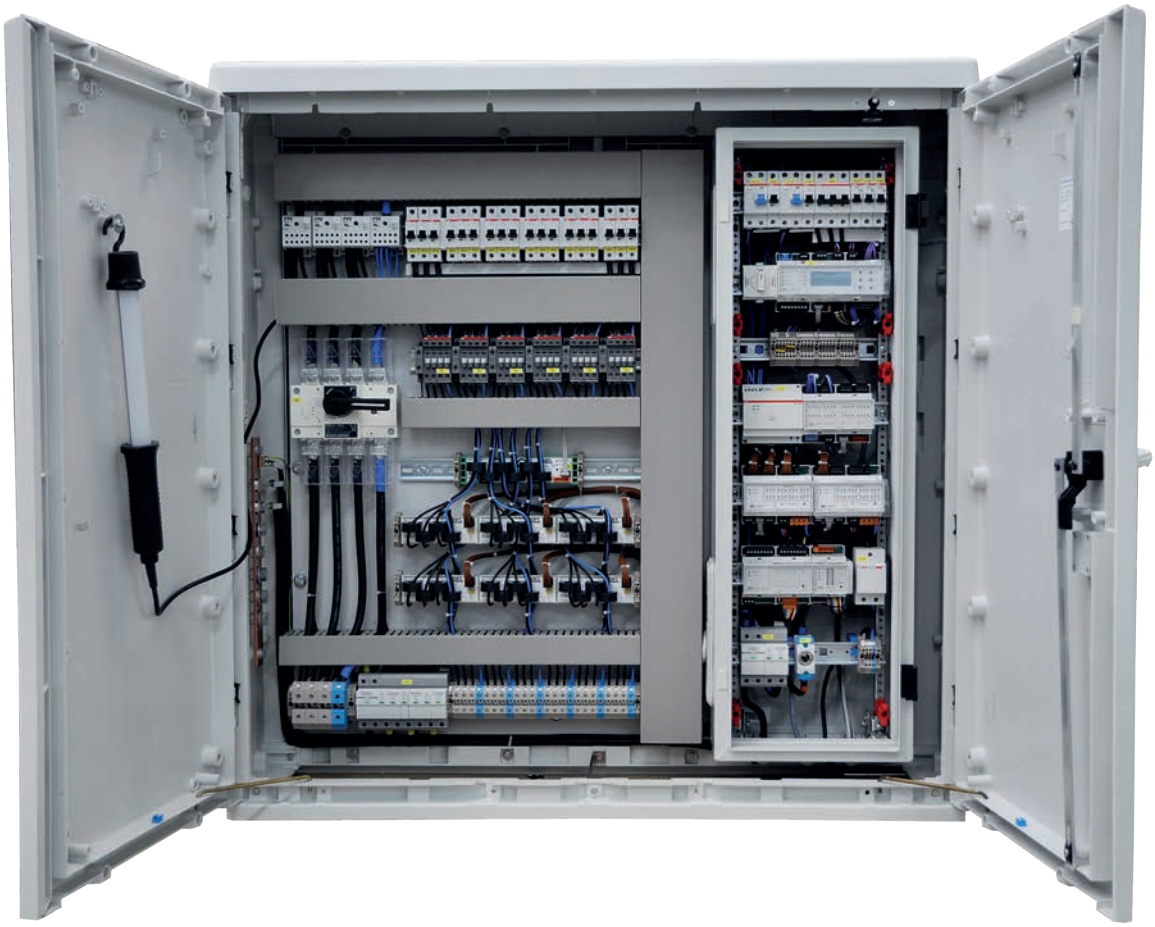
The main component of a point heating system is a WHV® control cabinet. It supplies the heating elements of all connected points with energy and takes on the control and monitoring functions. The control cabinet is installed at the track in a plastic or metal cabinet on a base. The cabinets and base comply with the DIN/EN standards.

The WHV control cabinet consists primarily of:

- Incoming feeder
- Overvoltage protection device
- Controller (e.g. TRS-03)
- Power switching element (e.g. ISR25-N)
- Outgoing feeders including fuse, RCD and current monitor

Expansion, for example with:

- Energy meter
- Mast separation switch controller (e.g. ANP05)
- Insulation monitoring



Control components in LV control cabinet

The main component of a control cabinet is the configurable TRS-03 compact controller including operating and display options.

TRS-03 compact controller

The TRS-03 compact controller is operated directly using menu windows and function keys. The menu provides information on switch-on and switch-off values for humid and dry weather conditions, all temperature values and texts for malfunctions. The compact controller has an interface for the internal control cabinet data bus and a switchable RS485/RS232 interface for communication.

System devices for expanding functionality can be connected to the TRS-03 compact controller.

- MWU voltage monitoring device: Monitors the operational voltage
- ISO insulation monitoring
- RCM current monitoring device: Monitors the operating-current of the heating outgoing feeders
- MPM controller: Digital controller for input expansion and programmable switching logic
- ANP-05 adaptation module: If necessary, takes on control of the mast separation switch and transformer monitoring

Terminal box

The individual heating rods of a point are connected in terminal boxes. They are in the direct vicinity of the points and are supplied via cables from the switched outgoing feeders in the point heating distributor.
The terminal boxes are designed for rough use and the effects of weather on the railway line.

Terminal box for connecting heating rods to earthed tracks (TT system)

AWs terminal box

For connecting up to 12 heating rods in point heating systems with 50 Hz.

Mounting: To ground socket

AWS

Terminal boxes for connection of heating rods to isolated tracks

Transformer cabinet AT

For connection of the IT system via isolating transformers. Versions with maximum of 8 isolating transformers 50 Hz, each 400/2 x 220 V, nominal power up to 8 kVA. The transformers are vacuum impregnated.

Assembly: Outdoor installation on concrete base or an entrenched polyester base

AT

ATWB transformer terminal box

For connecting the heating rods each via one isolating transformer 50 Hz, 400/2 x 230 V. Versions with maximum nominal power of 4 kVA.

Mounting: On mounting frame

ATWB

Weather data control

The weather data control includes all necessary sensors. The data are transmitted to the controller in the point heating distributor via an RS485 data bus.
The TRS-03 compact controller records and processes all data from the connected sensors. It performs calculations on precipitation intensity and rime detection. All current measurement, operational and fault values are available on the device display.

Precipitation

Detection with the LN-F 02 precipitation indicator, mounted directly on the housing (distribution board).

Air temperature

Detection with the LF air temperature sensor. The sensor is mounted directly on the weather station.

Rail temperature

The SF rail temperature sensor is used. The sensor is secured to the stock rail with special clamps 50 mm in front of the point tongue (in the heated area).

Blowing snow

Optionally, blowing snow and ice can also be detected. The FSF blowing snow sensor is used for this purpose. It is robust and wear-free and is mounted directly on the rail.

Rime

As an additional option, a calculation on the presence of rime can be made. Here, the combined LF-R air temperature and humidity sensor is used. It is mounted directly on the weather station.

Operating unit design

In the point heating distributor itself, the corresponding system with the controls and display on the TRS-03 compact controller can be monitored and controlled on site. If multiple point heating distributor systems are connected, they can be used with an external operating unit.

Serial operating unit

The operating unit is used for operation and monitoring of up to 8 point heating systems.

The user-friendly messaging and operation is achieved with clearly arranged LEDs, full graphic displays and short travel keys. Individual fault messages and notification that the required rail temperature has been reached are displayed as plain text.

Map panel

Map panel with clearly arranged system topography for operation and monitoring of the track field lighting. In addition, operation and monitoring of other systems can be integrated (e.g. point heating/pump systems, etc.). Resistive film surface with short-travel keys and LEDs, optionally available with plain text display.

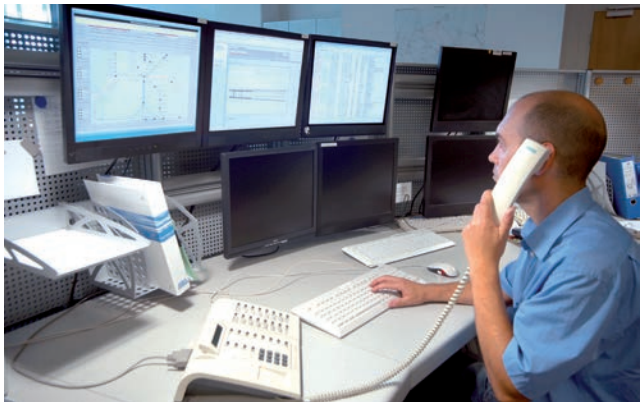
Touch screen

The Vis-Touch touch screen is used for operation and monitoring of up to 16 point heating or external systems.

Operating unit

Map panel

Touch screen VIS-Touch



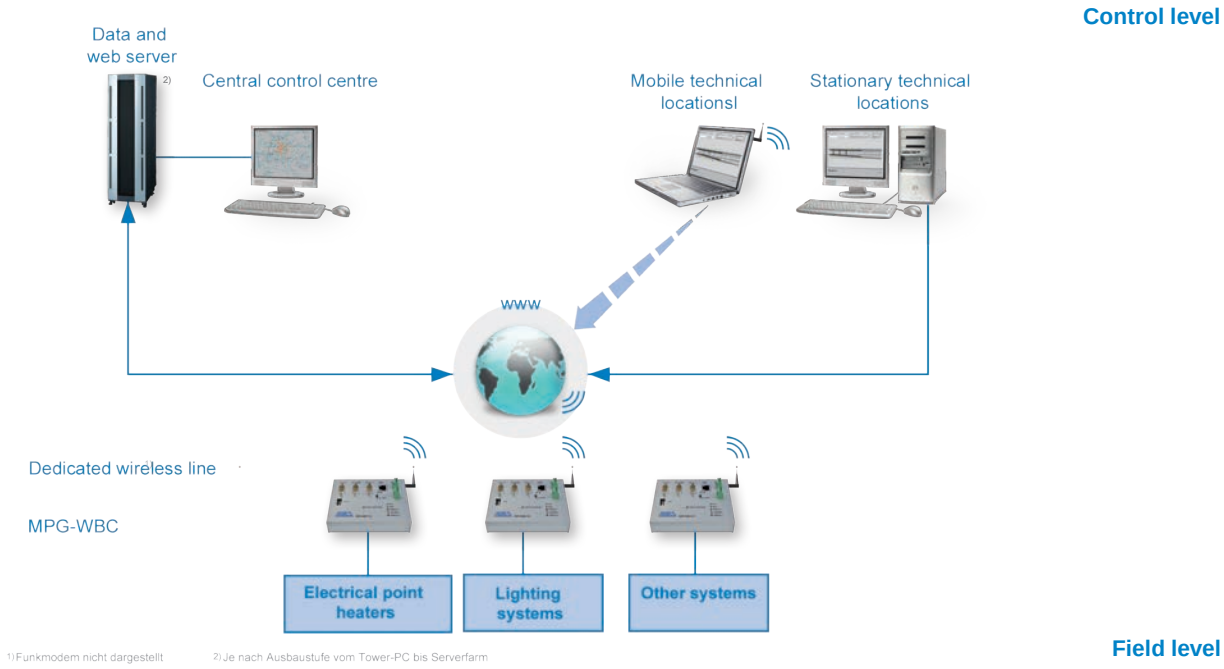
zentrales Leitsystem Arbeitsplatz bei DB AG in Berlin, VIS-Win

The visualisation software VIS-CM provides the core of the remote monitoring and control of electrical point heating systems in the central control centre.

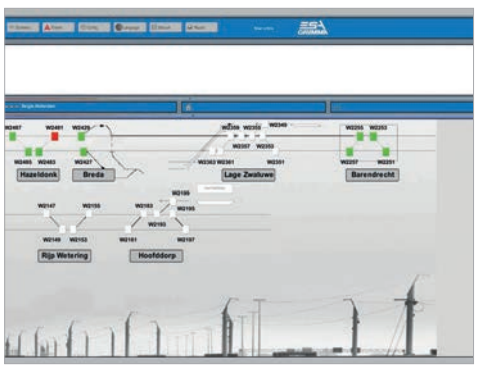
The visualization interface offers, in addition to the track view, detail images of the respective systems all the way to a point image with display of the defective heating rod. Messages can be comfortably displayed and filtered, for instance according to network area and system, date, time and priority.
Graphic trend observations (e.g. weather data in conjunction with system data) and events are available for CSV export and for further processing (e.g. with EXCEL).

The visualisation is also used for monitoring other equipment of the track, such as lighting, air conditioning, pumps and brake test systems.

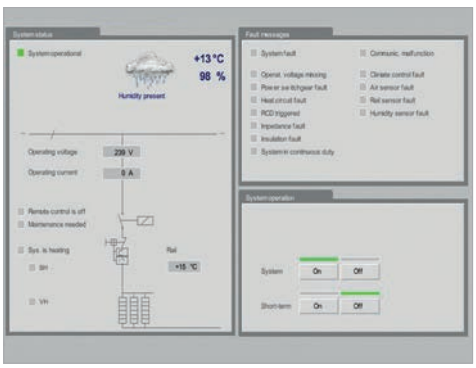
Highly advanced M2M technology (machine-to-machine) is used with the MPG-WBC multi-protocol device as a connection between field and control levels.



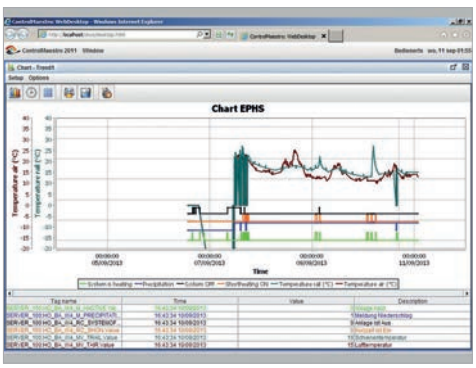
Schematic diagram: Data transmission with the help of the MPG WBC (WEB Connector) multi-protocol device via dedicated wireless line



Visualization of the network area



Visualization of the system status of the point heating



Visualisation of the Trendhistory

Transmission media

The multi-protocol device MPG-WBC acts as a communication link between the systems at the field level and the control centres (control level). For example, in conjunction with a GPRS wireless modem for a wireless connection via a dedicated radio line or, using its Ethernet connection, for wired connection to the Internet.

Multi-protocol device MPG-WBG(WEB-Connector)

Database and control connection

- Connection options from external databases using SQL interface (enterprise systems)
- Professional EXCEL-based reporting solution
- Integrated control logic using PLC functionality with Soft-PLC, e.g. for special control tasks

Compatibility

- Data c oupling of existing systems o r other e lectrical systems with WEB Connectors in conjunction with additional digital input and output components or serial field bus interface
- Integration of manufacturer-neutral building management-systems

Safety concepts

Secure data transmission and protection against unauthorised use have the highest priority.

Access security

- Access authorization takes places at various levels by means of user names and password.
- Authorization is necessary for access to the web server, the control system and also for logging into the browser.
- Management of various user rights with user groups.

Data security

- Basic principle: „The WEB Connector only permits authorized connections.“
- The WEB Connector sends its data only to t he configured central control station, all queries from third parties, whether targeted or through port scanning, are rejected.
- Data encryption: All data is transmitted encrypted.
- Setup of a firewall in the central control centre (typically already present)
- Additional options:
  - Setup of a VPN (Virtual Private Network)
  - Creation of non-public access points in the mobile network

Availability – „connection failure“ scenario

- In case of a connection failure, automatic data buffering occurs:
  - Data buffering with time stamp
  - Automatic transmission once connection is re-established
- The system is designed to be redundant in the following-points (optional):
  - Server in the central control centre
  - Internet access
  - Mobile network (2 different providers)

Assembly

- Complete installation of electrical point heating systems by system partners including associated overhead line-connection and underground cable installation
- Construction and assembly of track field lighting systems, backup power systems and transformer stations

Services – engineering

- Consultation before you make your investment decision
- Planning or input for your specific project

Service and training

- Complete system commissioning
- Instruction of the operating personnel
- Troubleshooting/remote maintenance
- Training for products and systems
- Service for all products by system partner and our hotline

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