PROLAN

SWITCH-POINT HEATING SYSTEM from PROLAN

INTRODUCTION

GENERAL

The development of this system aimed to ensure the operability of railway turnouts in winter weather conditions. This is solved using usually 3300mm long 330W/m heaters attached on the stock rails of the turnout, and controlled by the Prolan Profield industrial computer system. The system is prepared for turnouts equipped with both the new Spherolock type and the legacy lock systems, while the exact heated length is determined by the type of the turnout.

SYSTEM ARCHITECTURE

The basic components of the system are the **control cabinets** or with the given terminology **distribution frames (SHDF).** One frame is capable to control up to 8 turnouts. The communication between the frames is established by daisy-chaining them, practically optical fiber connection is suggested to ensure the reliable data transfer. An industrial computer is responsible for the upper level communication to remote monitoring and control workplaces (despatcher).

Environment sensors such as moisture, air- and cold rail temperature sensors are usually accompanied by the power supply areas. Each cabinet is equipped with hot rail temperature sensors ensuring the precise, location specific heating energy usage.

POWER SUPPLY

The power supply capacity for the distribution frames (SHDF) is depending on the size of their serviced zone, and usually provided by pole–top transformers from the overhead line electric system. Connecting such transformers assumes a standalone outdoor cabinet for each transformer, containing accessories like circuit breakers, fuses, overvoltage protectors etc. The consumed energy is measured here, using calibrated energy meters.

SWITCH-POINT HEATING DISTRIBUTION FRAMES (SHDF)

Distribution frames (SHDF-s) are designed to locally control the heating of the connected turnouts. Their size is1541x1250x420mm, and are outdoor IP54 quality UV protected, safety lockable ones. The internal outfit is modular, contains the circuitry as below:

- Power supply circuits up to 250A load, earth-short-circuit detector
- Operation mode and reserve controller circuits
- Central controlling and communication units (24V battery backup for remote monitoring)
- Heating circuitry with power switches
- Auxiliary 230V outlet, illumination and anti-damp cabinet heating

The unit receives the signals from the following sources:

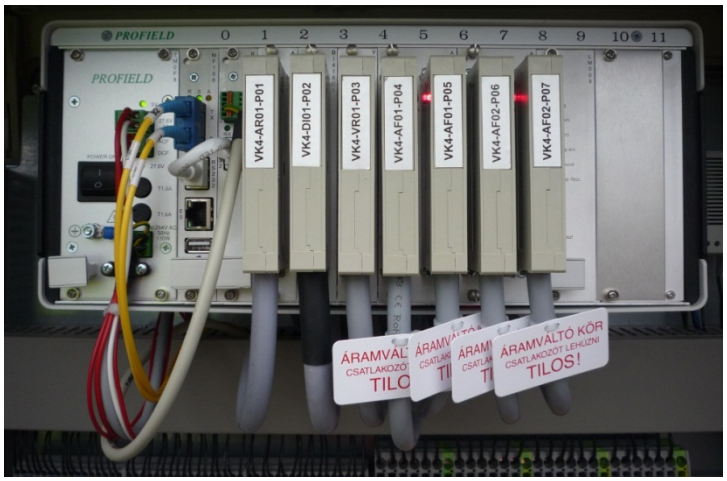
- Overvoltage and overcurrent sensors
- Operational mode selector, “Service” mode selector
- Door open
- Environmental sensors
- Heating current
- Power supply cabinet signals, such as: door open, overvoltage, overcurrent, energy meter

MODE SELECTOR SWITCH

A 3 state main selector switch puts the system into one of the „Heating Off", „Continuous heating" and „Automatic" basic operational modes. The system can be switched also into "Service" mode, where the on-site galvanic checking of the heater resistors can be verified.

The status of this switch is monitored by the heating controller.

INTELLIGENT HEATING CONTROLLER (PROLAN PROFIELD RTU)



The intelligent controller of the system is the Prolan Profield RTU. It's configuration is more or less the same in every installation, only the current sensing circuitry may vary depending on the number of the connected turnouts.

HEATING CIRCUITRY

The design principle of the heating circuits is modularity and safety. Each module manages the left and right side heaters of one turnout, while the operational current is measured by current transducers. Each heater circuit is protected against overload by a 2 pole circuit breaker. A residual current breaker is applied due to life safety considerations.

HEATERS CABLING

The connection cables are deployed in protective pipes. Cables running across tracks are fixed to the sleepers. The heater resistors are attached to the rails with clamps, no rail drilling is necessary.

ENVIRONMENTAL SENSORS

The hot and cold rail temperature sensors are clamped onto the bottom side of the rails using a special clamp.

The moisture sensor detects rain or snowfall, and using the air temperature sensor data the processing unit decides switching the heating on or not.

OPERATIONAL MODES

The system operational mode can be one of the following:

- Off, no heating
- Continuous
- Automatic
- Service
- Remotely controlled

Preference can be set using the Mode selector switch as written above, however “Remotely controlled” mode can be initiated only from the computer workplace.

OFF MODE

s mode there is no heating energy directed to the heaters, but is important that the system remains under voltage, and the heating circuitry also remains connected to the supply terminals. The Profield RTU controller stays in standby mode and monitors the environment and transmits telemetry data to the remote despatcher workplace.

CONTINUOUS MODE

In this mode the system heats the rails without regulation, continuously. The only limitation is when the outside temperature exceeds +10 °C, in this case the internal thermostat terminates the heating.

AUTOMATIC

In this mode the turnout heating is started when the rail temperature sinks below +3 °C. The warm rail temperature will be kept in the +3 °C …. +8 °C range, however if any moisture occurs, the upper limit of this range will be set to +15 °C. These parameters are user programmable.

In case of Profield controller unit failure the system falls back to “Continuous” mode and the heating continues.

SERVICE MODE

In this mode the heaters can be switched on with bypassing the controller and the environmental sensors, enabling the direct testing of the heater resistors. For security reasons an independent timing circuit terminates this mode after a pre-defined period.

REMOTELY CONTROLLED MODE

Entering this mode can be initiated only from a computer workplace (locally or remotely). In this mode the automatic control algorithm can be overridden with the following modes:

- Switch to “Off” status
- Switch to “Continuous” mode
- Switch to “Automatic” mode
- Switch to “Service” mode (similar to the manual service mod, but here the controller makes the timing of 15 minutes

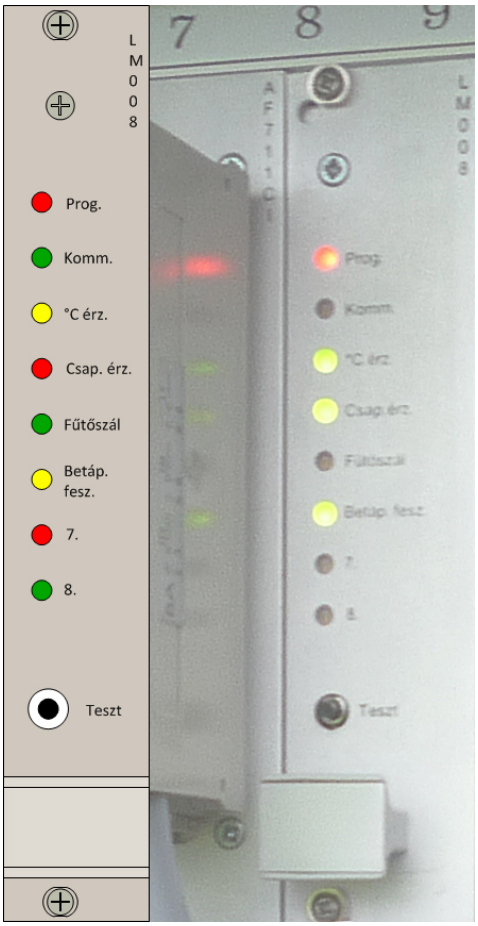
All these operational modes are displayed on the workstation.

HUMAN-MACHINE INTERFACE

DISTRIBUTION FRAME INSIDE COMPONENTS

The cabinet can be switched on with the main switch, and the mode selector switch is used to select the operation mode. If the Profield RTU works, a LED display shows the current operational conditions. The indicated conditions are as follows:

- Operation mode status indicator
  - Red: „switched off" or program failure;
  - Green: "Automatic" operation mode;
  - Yellow: „Continuous" mode.
- Communication channel status indicator
  - Red: no connection;
  - Green: connection OK.
- Temp. sensors status indicator
  - Red: at least one sensor is out
  - Green: all sensors working properly.
- Moisture sensor status indicator
  - Red: moisture sensor is out
  - Green: moisture sensor is working properly
- Heater resistor status indicator
  - Red: at least heater is out
  - Green: all heaters are OK
- Heating power supply status indicator
  - Red: no heating power sup
  - Green: power supply OK

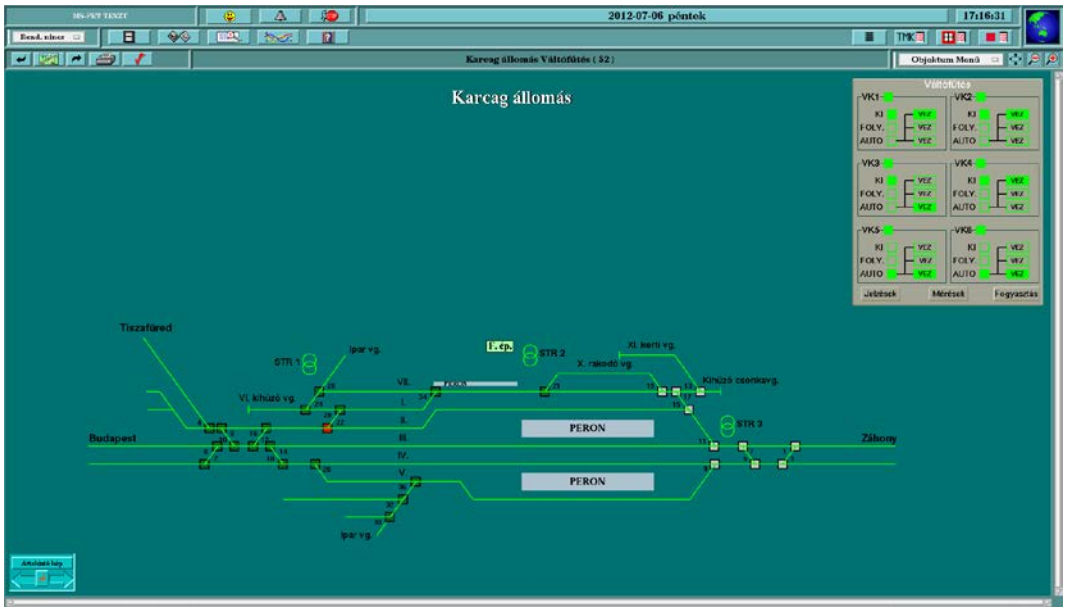


DESPATCHER WORKPLACE (HMI)

The supervisory computer for the turnout heating system is usually deployed in the traffic control room at the railway stations.

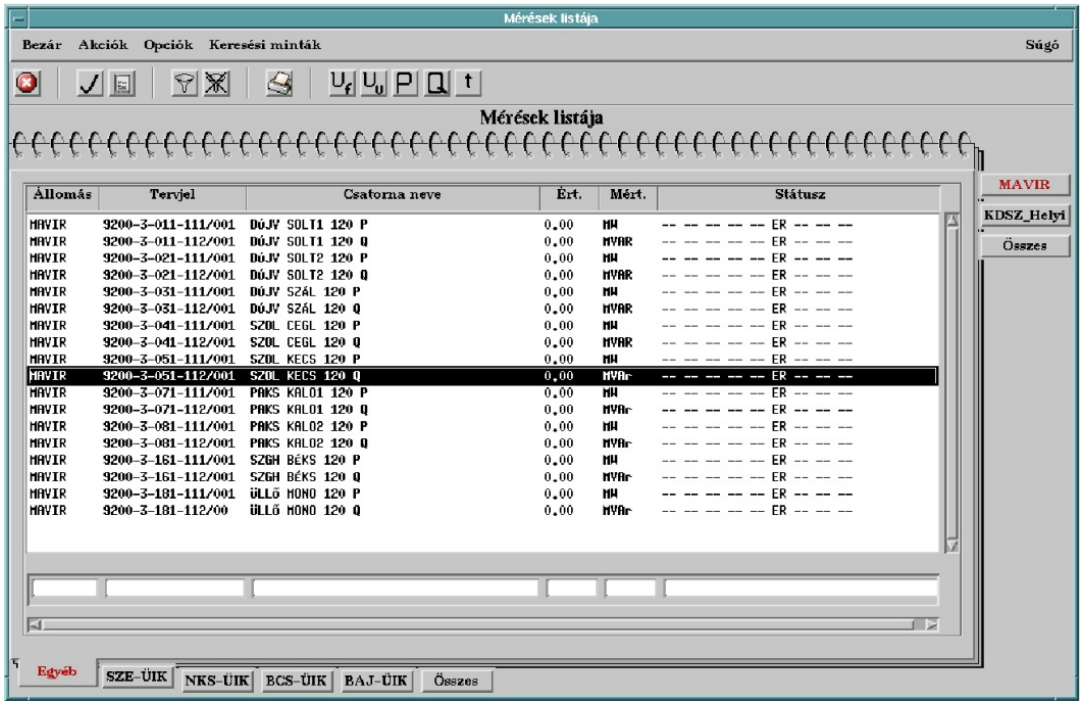
The display shows the schematic layout of the station and all the relevant data related to the heating status. The example below is the monitor screen of a Hungarian middle sized station:

At right upper corner the exact status of each SHDF on the station are displayed. From here one can modify the operational mode or request for more, detailed telemetry data.



VARIOUS REPORTS

Since the system logs every elementary sensor readings, status changes or events concerning the heating system, detailed.



Állomás	Tervjel	Csatorna neve	Ért.	Mért.	Státusz
MAVIR	9200-3-011-111/001	DÚJV SOLT1 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-011-112/001	DÚJV SOLT1 120 Q	0,00	MVAR	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-021-111/001	DÚJV SOLT2 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-021-112/001	DÚJV SOLT2 120 Q	0,00	MVAR	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-031-111/001	DÚJV SZÁL 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-031-112/001	DÚJV SZÁL 120 Q	0,00	MVAR	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-041-111/001	SZDL CEGL 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-041-112/001	SZDL CEGL 120 Q	0,00	MVAR	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-051-111/001	SZDL KECS 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-051-112/001	SZDL KECS 120 Q	0,00	MVAr	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-071-111/001	PAKS KAL01 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-071-112/001	PAKS KAL01 120 Q	0,00	MVAr	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-081-111/001	PAKS KAL02 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-081-112/001	PAKS KAL02 120 Q	0,00	MVAr	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-161-111/001	SZGH BÉKS 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-161-112/001	SZGH BÉKS 120 Q	0,00	MVAr	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-181-111/001	ÜLLŐ MONO 120 P	0,00	MW	-- -- -- -- -- ER -- -- --
MAVIR	9200-3-181-112/00	ÜLLŐ MONO 120 Q	0,00	MVAr	-- -- -- -- -- ER -- -- --