

MIKOTERM

electronic



Guidebook for installation, handling and maintenance – ENG
Electric hot water boiler for heating systems with microcontroller thermoregulator

TK-Profesional 40÷100kW

MADE IN SERBIA

MIKOTERM Industrijska zona Aleksandrovo, Niška 211, 18252 Merošina, Srbija

FU-TK-Profesional 40÷100kW_05/2025

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1. Explanation of symbols and instructions for safe work

1.1 Explanation of symbols

Warnings

	Warnings in text are marked by gray triangle, background warnings are framed
	Electric shock danger is marked by lightning symbol in warning triangle

The signal words at the beginning of the warning mean the way and level of consequences if protective measures are not applied

- **NOTE** means that smaller material damages may occur
- **CAUTION** means that smaller to middle injuries may occur
- **WARNING** means that heavy injuries may occur
- **DANGER** means that heavy injuries may occur

Important information



Important information, meaning no danger for people and things, are marked by the symbol displayed in the following text. These are limited by lines, above and below the text

Further symbols

Symbol	Meaning
▶	Action step
→	Directives to other places in document or to other documents
•	Enumeration/Entry from the list
–	Enumeration/Entry from the list (2.)

1.2 Instructions for safe work

General safety instructions

Non-compliance with safety instructions may cause heavy injuries – or lethal outcomes and material damages and environment pollution.

- ▶ Electrical installation should be examined by an expert prior to the device assembly.
- ▶ All electric works should be performed by authorised person in accordance with corresponding regulations.
- ▶ Commissioning and maintenance and repairs should be done by authorised service only.
- ▶ Technical acceptance of installations should be performed in accordance with corresponding regulations.

Danger because of disrespecting security rules in alert situations, for example fire.

- ▶ Never expose your-self to life danger. Own security always has priority

Damage occurred because of wrong handling

Wrong handling may lead to injuries of persons and/or installation damage.

- ▶ Make sure that device is available only to Basics.
- ▶ Installation and commissioning, and maintenance and repair, must be done only by service authorised for electrical works.

Installation and commissioning

- ▶ Placement of device can be done only by authorised service.
- ▶ Boiler can be turned on only if installation is with corresponding pressure level and working pressure regular. Do not close security valves in order to avoid damage caused by too high pressure. During warming water can leak on security valve of the hot water circuit and hot water pipes.
- ▶ Install this device only in the room where freezing is not possible to occur.
- ▶ Do not store or dispose inflammable materials or liquids in the vicinity of this device. Keep safe distance in accordance with valid regulations

Life threat of electric power shock

- ▶ Secure electric power connecting is done by authorised service! Comply with connecting scheme
- ▶ Prior to any work: turn off electric power supply. Secure against accidental turn on
- ▶ Do not mount this device in moist rooms

Control examination / Maintenance

- ▶ Recommendation for user: conclude agreement on maintenance with authorised service to perform annual maintenance and controlling examinations
- ▶ User is responsible for safety and environmental acceptance of the installation
- ▶ Comply with safety work instruction as given in the chapter *Cleaning and Maintenance*

Original spare parts

There shall not be undertaken any responsibility for damage occurred due to spare parts not delivered by the manufacturer

- ▶ Use only original spare parts

Material damages due to freezing

- ▶ When there is damage due to freezing drain water from the boiler, tank and pipelines for heating. Danger of freezing does not exist only when entire installation is dry

Instructions for service

- ▶ Inform users about mode of work of device and instruct them in maintenance
- ▶ Inform users not to perform any modifications or repair on their own
- ▶ Warn users that children cannot stay near heating installations
- ▶ Fill in and submit Commissioning log and Handover log attached in this document
- ▶ Deliver technical documentation to the user

Waste disposal

- ▶ Dispose packaging materials in ecologically Acceptable manner
- ▶ Secure device in ecologically acceptable manner and in authorised place

Cleaning

Clean outside of device with wet cloth

2. Device information

These instructions contain important information about safe and Basic assembly, commissioning and maintenance of the boiler.

These instructions are for installers who have knowledge for work with heating installations due to their Basicism and experience.

2.1 Overview of types

This manual applies to the following types:

El boiler TK-Profesional	40, 50, 60, 70, 80, 90, 100 kW
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2.1.1 Declaration of conformity

We declare that the devices are tested in accordance with the directives 2014/35/EU (Low Voltage Directive, LVD) and 2014/30/EU (Electromagnetic Compatibility Directive, EMC).

2.1.2 Proper use

The boiler can only be used for heating hot water and indirectly for preparation of hot water. To ensure proper use, one must follow the operating instructions, the data on the factory tile and the technical data.

2.2 Instructions for installation



Use only original spare parts of the manufacturer or spare parts approved by the manufacturer. There shall not be any responsibility for damages caused by spare parts which have not been delivered by the manufacturer

When installing the heat system please abide to the following:

- Valid regulations in construction industry
- Regulations and norms on safety-technical equipment of heating installations
- Changes on the place of mounting according to valid regulations

2.3 Operating instructions

When working with heating installation follow next instructions:

- Boiler should work in working range up to max temperature of 90°C and min pressure of 0.4 bars to max pressure of 4 bars, which should be controlled on regular basis
- Boiler should be operated only by adults with technical knowledge and qualifications to work with heating systems and which are acquainted with the instructions and operation of the boiler
- Do not close safety valve
- Inflammatory objects must not be put on the boiler surface or close to it (within safety distance)
- Boiler surface clean only with non-inflammatory products
- Inflammatory substances do not keep in the room for boiler installation (e.g. petroleum, oil, etc.)
- No lids should be opened during the operation
- Keep a safe distance according to the applicable local regulations

2.4 Freezing protection agents and inhibitors

It is not allowed to use protective products against frost neither inhibitors. If it is not possible to avoid anti-frost protection then should use anti-frost products allowed for heating installations.



Anti-frost products:

- Reduce lifetime of the boiler and its parts
- Reduce heat transmission

2.5 Norms, regulations and standards

This product is in compliance with the following regulations:

- EN 50110-1:2013 – Operation of electrical installations - Part 1: General requirements
- EN 55014-1:2017; EN 55014-2:2015 – Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission - Part 2: Immunity - Product family standard
- EN 60335-1:2016 Household and similar electrical appliances - Safety - Part 1: General requirements
- EN 61000-3-2:2019 Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions
- EN 61000-3-3:2014/A1:2020 Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems

2.6 Tools, materials and auxiliary components

Boiler installation and maintenance requires standard tools used in the area of installation of heating systems, plumbing and electrical installations.

2.7 Minimum spacing and flammability of construction materials

Depending on valid regulations, other minimum distances could be applied, different than mentioned below.

- Comply with regulations of electrical installations and minimum distances which are in force in the subject country
- Minimum distance for heavy inflammable and self-extinguishing materials is 200 mm

Inflammability of components		
A	Non-inflammable	
A1:	Non-inflammable	Asbestos, stone, wall tiles, baked clay, plaster (with no organic additives)
A2:	With smaller quantity of added elements (organic components)	Plaster cardboards plates, base felt, glass fibres, plates of ACUMIN, ISOMIN, RAIOT, LOGNOS, VELOX, AND HERACLITUS
B	Inflammable	
B1:	Hardly inflammable	Beech, oak, veneered wood, felt, HOBREX, VERSALIT and UMAKART plates
B2:	Normally inflammable	Pine, larch and spruce, veneered wood
B3:	Inflammable	Asphalt, cardboard, cellulose materials, tar-paper, plywood plates, cork plates, polyurethane, polystyrene, polyethylene, floor fibre materials

Table 1: Ignitable materials and composition of elements according to DIN 4102

2.8 Product description

Basic components of boiler:

- Boiler bowl with electric heaters
- Boiler control panel with automatic control
- Boiler sheath with doors
- Dashboard

Boiler can be installed as integral part of the central heating system, floor heating, hybrid, or accumulation systems.

The boiler bowl is made of steel sheet, tested at a pressure of 6bar and the maximum working pressure is 4bar. The boiler is mounted on the floor and can be fixed if necessary.

Electric heaters are mounted in the boiler bowl and fastened to the upper plate by a tourniquet. The built-in thermal insulation between the boiler and boiler shell reduces the loss of heat energy. At the same time, insulation also protects against noise.

Hydraulic connections are located at the back of the boiler. The automatic air valve (vent valve) and the safety valve (3/4 " 4bar) are mounted on the thrust connection. The fill / drain tap and flow switch are mounted on the return port. The pressure and temperature sensors as well as the limit thermostatic probe are located on the upper boiler plate.

The boiler sheath is made of decapitated sheet metal and protected by the electrostatic plastification process. On both sides there are vent openings for ventilation of the ambient of the dashboard. Cable glands are located on the bottom side of the boiler front zone. There is a lid on the upper side of the casing whose removing grants access to electric heaters mounted on the boiler top plate. Front side of the device has two doors.

The upper door has a window on it to allow easy value tracking of all relevant boiler parameters, both default and current. By opening the upper door, access is made to the control panel with the main boiler switch, microprocessing thermoregulator (CPU) with LCD display, showing all the data important for boiler operation, safety thermostat and signal lamp for indicating eventual problems with the boiler operation.

Lower doors cover the dashboard with boiler automatics and compact switches for power cable connecting as well as auxiliary connecting cables:

- Commands for circulation pump
- Signal for remote switching on / off (on/off signal), (room thermostat, external working condition, BMS signal, etc.)

The lower doors must be closed while the boiler is operating, and only qualified personnel are allowed to access them and automated switches.

2.9 Waste disposal

- Dispose packaging materials in ecologically sound manner
- Components that should be changed dispose in ecologically sound manner

2.10 Range of delivery

During the boiler delivery check the following::

- Check if packaging is damaged during delivery
- Check if delivery is complete

Part	Pieces
El Boiler TK-Profesional 40 ÷ 100kW	1
Instructions manual	1

2.11 Factory tile

The factory tile is located on the back side of the boiler and contains the following technical data:

- Boiler type
- Serial number
- Power
- Input power
- Maximal temperature
- Working pressure
- Water volume
- Mass
- Electric power supply
- Protection grade
- Manufacturer

2.12 Transport



NOTE: Damages during transport

- ▶ Pay attention to transport instructions located on the back side of the packaging.
- ▶ Use suitable means of transport, eg. bag carts with clasps. During transport, product should be in standing position.
- ▶ Avoid impacts or collisions

- Packed boiler put on carts, if needed secure it with strip and drive it to its mounting place
- Remove packaging
- Remove packaging materials and dispose it in ecologically acceptable manner

3. Dimensions and technical data

3.1 Dimensions of the device and components

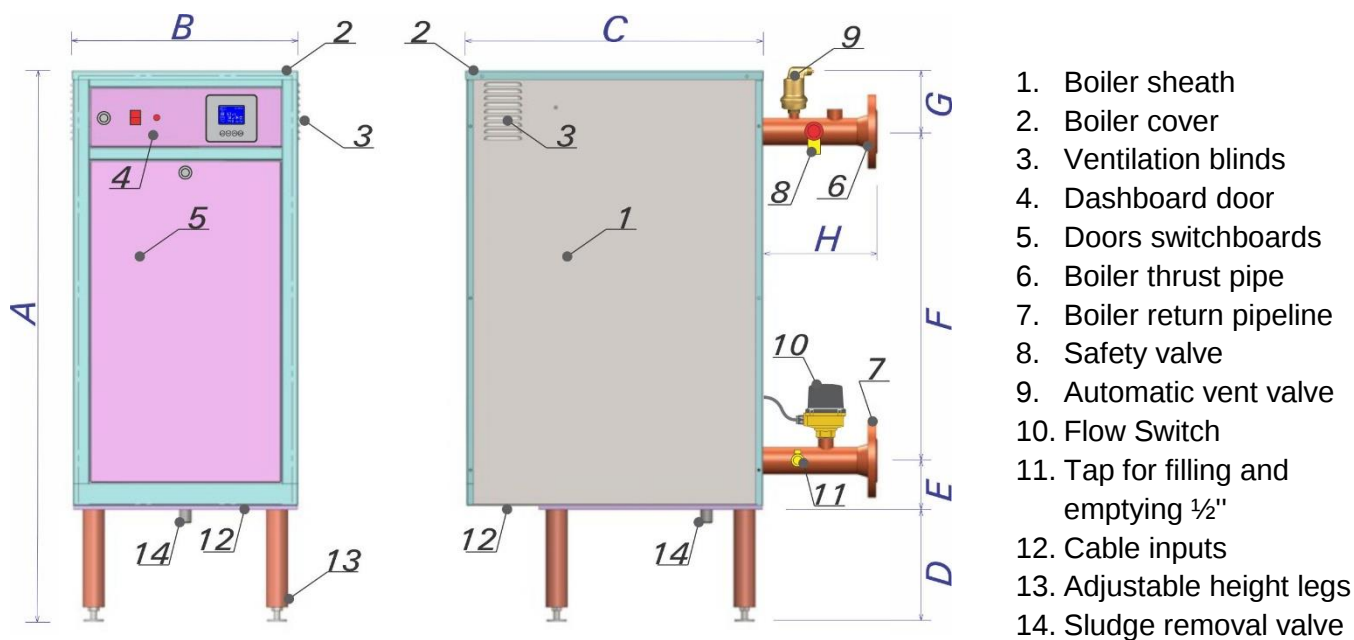


Image 1: Dimensions and connections of TK-Profesional 40 ÷ 100kW

3.2 Min and Max Flow rate (at nominal power)

P [kW]	40	50	60	70	80	90	100
DN	40	40	40	50	50	50	50
Qmin [m³/h]	2.6	2.6	3	3.5	4	4.5	5
Qmax [m³/h]	6	8	10	11	12	15	16
Δ T [°C]	Optimal flow [m³/h] depending on ΔT: Q= f {ΔT [°C]}						
5	5.4	6.8	8.1	9.45	10.8	13.5	15
10	2.7	3.4	4.1	4.7	5.4	6.8	7.5
15	2.2	2.7	3.1	3.6	4.1	5.2	5.7
20	1.6	2	2.1	2.5	2.8	3.6	3.9

3.3 Pressure drop

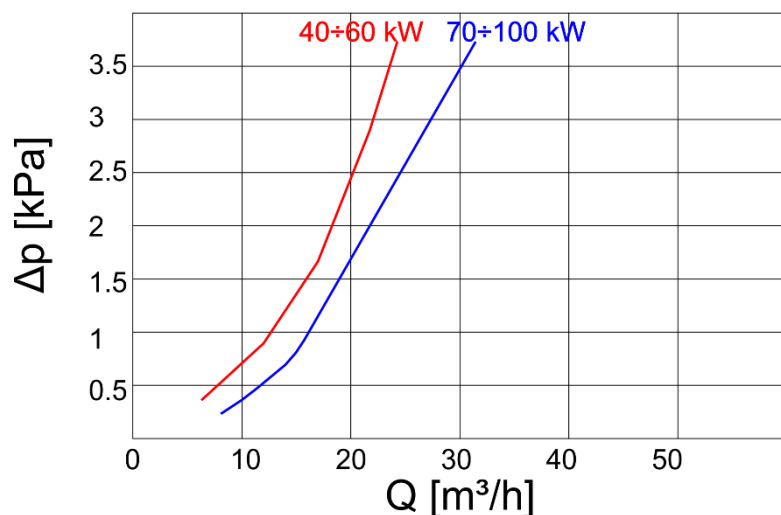


Image 2: Pressure drop of TK-Profesional 40 ÷ 100kW

3.3 Technical data for TK-Profesional 50 ÷ 100kW

	Unit	TK- Profesional 40kW	TK- Profesional 50kW	TK- Profesional 60kW	TK- Profesional 70kW	TK- Profesional 80kW	TK- Profesional 90kW	TK- Profesional 100kW
Rated Power	kW	40	50	60	70	80	90	100
Dimension	A	m	1165	1165	1165	1220	1220	1220
	B	m	400	400	400	500	500	500
	C	m	530	530	530	665	665	665
	D	m	215	215	215	235	235	235
	E	m	80	80	80	110	110	110
	F	m	740	740	740	735	735	735
	G	m	130	130	130	140	140	140
	H	m	215	215	215	255	255	255
Mass without water	kg	90	94	96	130	132	135	136
Water volume	ℓ	60	60	60	90	90	90	90
Connections to the hydraulic system		DN40 (6/4") PN16	DN40 (6/4") PN16	DN40 (6/4") PN16	DN50 (2") PN16	DN50 (2") PN16	DN50 (2") PN16	DN50 (2") PN16
Max. concentration of the glycol in the medium	%	30						
Maximum working pressure	bar	4,0 (on request 6,0)						
Minimum working pressure	bar	0,4						
Safety Valve	bar	½" 4,5bar	½" 4,5bar	½" 4,5bar	¾" 6bar	¾" 6bar	¾" 6bar	¾" 6bar
Degree of protection		IP20						
Supply voltage	V	3N ~ 400/230V 50Hz						
Usability level	%	99	99	99	99	99	99	99
Heaters	kW	4×10	5×10	6×10	7×10	8×10	9×10	10×10
Heating groups	kW	4×10	5×10	6×10	7×10	8×10	9×10	10×10
Heater fuses	A	4x 3-p C25A	5 x 3-p C25A	6 x 3-p C25A	7x3-p C25A	8x 3-p C25A	9x 3-p C25A	5x 3-p C40A
Molded case circuit breaker (MCCB) with build-in shunt trip release (trip unit)		Noark Ex9M1S 160A (36kA)	Noark Ex9M1S 160A (36kA)	Noark Ex9M1S 160A (36kA)	Noark Ex9M1S 160A (36kA)	Noark Ex9M1S 160A (36kA)	Noark Ex9M1S 160A (36kA)	Noark Ex9M1S 160A (36kA)
Rated current	A	3×58	3×72,5	3×87	3×101,5	3×116	3×130	3×145
Recommended main fuses	A	3×63	3×80	3×100	3×125	3×125	3×160	3×160
Minimum cross-section of the power cable	mm²	Cu Cable 3×16	Cu Cable 3×25	Cu Cable 3×35	Cu Cable 3×35	Cu Cable 3×50	Cu Cable 3×50	Cu Cable 3×70
Minimum cross-section of the protective earth	mm²	Cu 1×16	Cu 1×16	Cu 1×16	Cu 1×25	Cu 1×25	Cu 1×25	Cu 1×35
Range of temperature regulation	°C	10 ÷ 90						
Safety Thermostat	°C	95						
Microprocessor thermoregulator (CPU)		EK_CPU_1_5 fw: vs15.03.005						
Communication with cascade reg. / protocol		RS485_RTU / ModBus						
Communication with BMS / protocol		RS485_RTU / ModBus						

Table 2: Technical data of Device

4. Installation of device



CAUTION: Human or material damages occurred because of irregular installation!

- ▶ Never install boiler without expansion dish (AG) and safety valve
- ▶ The boiler must not be installed in protected areas where there is moisture, as well as in places with high concentrations of soot and dust



NOTE: Material damage due to freezing!

- ▶ Boiler must be installed only in room safe of freezing
- ▶ The use of anti-freeze agents is not recommended, due to the reduction of the heat capacity of water and causing more corrosion of metals than pure water. If their use is necessary, the use of ethylene-glycol mixture for heating and water systems is allowed, provided that it may contain a maximum of 30% ethylene-glycol.

4.1 Warnings before mounting



NOTE: Damage caused by failure to follow further instructions!

- ▶ Follow the instructions for the boiler and all installed components

Prior to installing take care of the following:

- All electrical connectors, protective measures and fuses should be done by Basic person respecting all valid norms, regulations and local laws
- Electric connector should be done according to the connecting plans
- After corresponding installation of device execute grounding of the plant
- Before opening device and all works turn off electric supply
- Non-Basic and non-authorized attempts to connect device under voltage can produce material damage of device and hazardous electrical shocks

4.2 Distances



DANGER: Fire threat due to burnable materials and liquids!

- ▶ Do not dispose burnable materials and liquids close to the boiler
- ▶ Let know the user the valid regulations for minimum distances from burnable materials (section 2.7)

- Comply with the regulations for electrical installations and minimum distances in force in certain countries.
- Position the boiler in such a way that there is free space near and above - as shown in Image 3

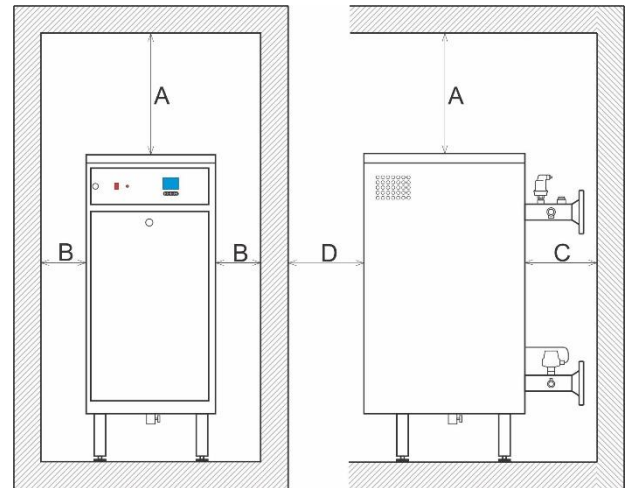


Image 3 : Minimum required free space for installation

	A [mm]	B [mm]	C [mm]	D [mm]
40÷60kW	600	500	600	1000
70÷100kW	500	500	600	1000

4.3 De-mounting of front casing

The switchboard door must be removed for easy connection to the mains and for installation.

- 1) Unlock the door lock
- 2) Gently pulling forward, open the door covering the switchboard of the boiler
- 3) Pulling upwards remove the door from the boiler
- 4) Slide the door to the side to access the switchboard

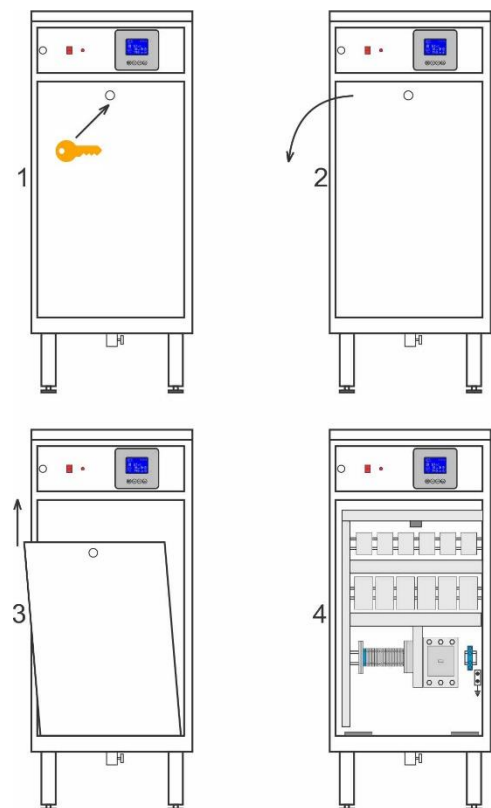


Image 4: De-mounting switchboard door

4.4 Boiler mounting

This chapter describes the installation of the boiler.

- The boiler is designed for floor mounting with minimum distances (Image 3)
- Ensure that the boiler is standing vertically - adjust the boiler legs in height so that the boiler is stable and level.
- If necessary, attach the boiler to the floor using anchor screws (adequate for floor type)

4.5 Hydraulic connections



NOTE: Material damage caused by the installation of connecting lines!

- ▶ Install the connecting lines without connecting them to the boiler connections

Connect the lines of the heating installation as follows:
Connect the return line to the return line of the boiler.
Connect the supply line to the boiler thrust line

4.6 Filling the installations and watertight testing

4.6.1 Filling the boiler with heating water and sealing test

It is necessary to check the tightness of the boiler before commissioning.



DANGER: Injuries and/or material damages can occur with overpressure when testing watertight!

High pressure can damage regulatory and safety devices and reservoir.

- ▶ After filling with water set the boiler on pressure that is equal to the opening pressure of safety valve
- ▶ Comply with maximum pressure of installed components
- ▶ After testing sealing, open again closing valves
- ▶ Make sure that all pressures, regulatory and safety parts work correctly



DANGER: Health threat due to mix of drinking water!

- ▶ Be sure to comply with national regulations and standards to avoid mixing with drinking water (eg with water from a heating installation)
- ▶ Comply with EN 1717



NOTE: Material damage caused by temperature changes.

- ▶ If you fill the boiler in a warm state, temperature changes can cause cracks due to stress and the boiler will start to leak water
- ▶ Only fill the boiler in cold condition with a maximum supply temperature of 40 °C)
- ▶ Only fill the boiler through the valve on the pipeline (return line) of the boiler



NOTE: Damage to the installation due to poor water quality!

Depending on the characteristics of the water, the installation of the heating system can be damaged by corrosion or by the formation of scale.

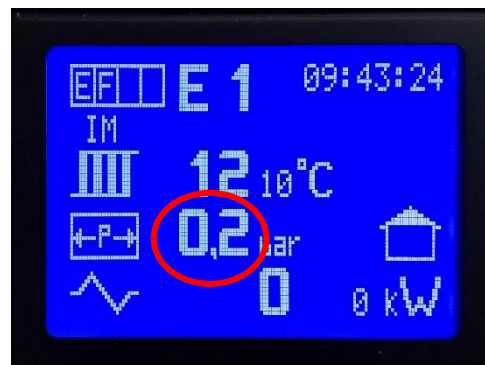


Image 5: Pressure value displayed

- Follow the requirements for water for filling according to VDI 2035, i.e. project documentation and the catalog
- It is allowed to use a glycol mixture as a medium, up to a maximum concentration of 30% glycol.
- Check the expansion vessel pre-pressure in the system
- Slowly fill the boiler via the fill and drain tap. Keep an eye on the pressure rise on the display (Image 5). When operating pressure is reached, close the tap
- The boiler is vented via a valve on the thrust pipe
- Venting the boiler results in a decrease in operating pressure, so water must be added
- Perform tightness testing according to local regulations
- After you have tested for leaks, open any elements that you have closed for filling
- Make sure all safety components are working properly
- If the boiler has been tested for leakage and no leakage has been observed, set the pressure to the required value
- Remove the hose from the fill and drain tap
- Enter the operating pressure and water quality values in the operating instructions

On first or repeated filling or when replacing water

- Comply with the water charge requirements

4.6.2 Circulation pump, air emission and unblocking

This device does not have a circulation pump in it.

When the external circulation pump is blocked, overheating and switching off of the safety circuits in the boiler can occur.

NOTE: There is a flow switch installed on the boiler return line and connected electrically to block the operation of the heater if there is no water flow.

For normal boiler operation, the pump must be unblocked.

4.6.3 Boiler and installation venting

This device has an automatic air vent.

An additional air vent for the pipe network must be installed on the installation.

5. Electrical connection



DANGER: Risk of life from electric shock!

- ▶ Electric works must be done only by qualified person
- ▶ Turn off voltage supply before opening device and secure it against accidental turn on
- ▶ Comply with assembly regulations



When connecting boiler on electric installation take care on connections scheme and connecting plans. Respect mandatory diameters of cables and fuses power outside the boiler



This device is manufactured for connection to three-phase power supply (3N ~ 400/230V 50Hz)

5.1 Connecting the boiler to the electrical network

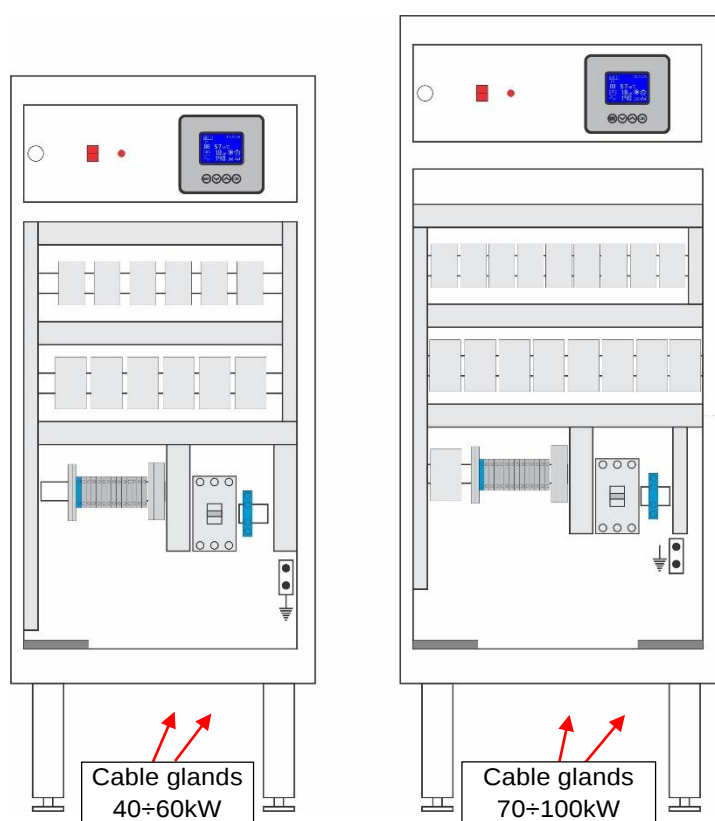


Image 6: Cable glands positions

The boiler is intended for connection to the mains voltage 3N ~ 400V 50Hz in accordance with current regulations. Protection against dangerous voltage is provided by a special protective line of suitable dimensions of the cross-section of the cable. Boiler power supply it must be via a separate power supply cabinet.

The power cabinet is not an integral part of the boiler. Designer el. boiler power installations will design an adequate power supply cabinet. The supply cabinet must be installed near the boiler with a clearly visible signal that the boiler is switched on.

Table 3 shows the minimum cross-sections of power cables as well as protective conductors (PE). Copper (Cu) cables are provided.

The phase conductors should be connected to the Molded Case Circuit Breaker (MCCB). A remote voltage trigger (Shunt trip release) is built into the MCCB, and it reacts to the signal of the safety thermostat, so that they form a safety circuit (→ 12.3), i.e. MCCB turn off the heaters supply if the water temperature exceeds 95 ° C. The safety thermostat is with a manual reset and is located in the upper left corner of the switchboard. Next to it is an overheating relay (with a signal lamp) which is also switched on by the signal of the safety thermostat.

Only a qualified specialist can open the boiler door and access the switchboard with the electrical components of the boiler. Before opening this door, be sure to turn off the main switch on the terminal box and remove the main fuses mounted in the terminal box.



All listed cable cross sections are minimum cross sections. The sections that need to be installed depend on the length of the lines and the method of installation and will be defined by the electrical installation designer according to the specific situation at the installation site.

3N ~ 400/230V 50Hz	TK- Profesional 40kW	TK- Profesional 50kW	TK- Profesional 60kW	TK- Profesional 70kW	TK- Profesional 80kW	TK- Profesional 90kW	TK- Profesional 100kW
Rated current In[A]	3 × 58	3 × 72,5	3 × 87	3 × 101,5	3 × 116	3 × 130	3 × 145
Main fuses[A]	3 × 63	3 × 80	3 × 100	3 × 125	3 × 125	3 × 160	3 × 160
Min diameter of power cable	Cu 3×16mm ²	Cu 3×25mm ²	Cu 3×35mm ²	Cu 3×35mm ²	Cu 3×50mm ²	Cu 3×50mm	Cu 3×70mm
Min diameter of protective line	Cu 1×16mm ²	Cu 1×16mm ²	Cu 1×16mm ²	Cu 1×25mm ²	Cu 1×25mm ²	Cu 1×25mm ²	Cu 1×35mm ²

Table 3: Rated current, required main fuses and Min. cross section* of the power cables for a 40 ÷ 100kW boiler

* Dimension the cable cross-section according to local regulations.

5.2 Connecting power (voltage) cable

Make the connection according to the diagram on Image 7. Power cables are connected directly to the compact switches (phase conductors), and zero and PE lines to the clamps. Auxiliary terminal clamps are provided for connecting the remote control and monitoring signals.



ATTENTION! When connecting the phase conductors, be sure to tighten the screws in the regular terminals in order to achieve the best possible connection between the conductors and the terminals.



DANGER! If the connection between the conductor and the terminal is not good, the terminal may overheat and break



NOTE! Connecting this device must be performed by a person qualified to do this type of work

Connect the phase conductors to the terminals of MCCB, respecting the same order of connection, from left to right: L1, L2 and L3.

Connect Neutral (zero) line to the appropriate line clamp (RSN). Line clamp of the zero conductor is blue.

Connect the protective earth (grounding) to the screw marked by a sign for grounding.

- The auxiliary clamps RSP10 and RSP11 are designed to connect a circulation pump or contactor that supply a circulation pump, with a voltage of 230V AC ($I_{max} = 2A$) present on them when CPU allows the operation of the pump.
- The auxiliary clamps RSP 12, RSP 13 are designed to connect the external control (remote start/stop of the boiler). Voltage 230V 50Hz goes from the boiler to the relay with voltage-free contacts (e.g. on the BMS), and back to the boiler (if the remote control is "on").



NOTE: Clamps (RSP 12 and RSP 13) are Factory-made short-circuited. Before connecting external control, terminate this short connection.

- The auxiliary clamps RSP 14, RSP 15 are designed to connect the Outdoor temperature sensor (Optional).
 - Auxiliary terminals RSP 16 and RSP 17 are provided for connecting an additional safety thermostat (OHS), installed, for example: in a buffer. This thermostat is connected in parallel with the safety thermostat installed in the boiler.
 - Auxiliary terminals RSP18, RSP19, RSP20 are intended for connecting RS485 communication between the boiler and the Cascade Controller CKP09-M (or a system for monitoring and control, e.g.: SCADA, BMS...) if the boiler is the first in the cascade connection. If the boiler is not the first in the cascade connection, these terminals are used to connect to the previous boiler in the cascade connection.
 - Auxiliary terminals RSP21, RSP22, RSP23 are provided for connecting RS485 communication with the next boiler from the cascade connection.
- On the last boiler in a cascade connection, the terminating resistor (120 Ohm) should be connected to the terminals RSP21, RSP22 (A and B).
- RE4 : Fault Relay (error in boiler operation). Contact system is voltage-free, can be used to activate an alarm signal, etc.
 - RE5 : Boiler in Operation Relay (voltage-free contacts).

5.3 Connection scheme of power cables and remote control

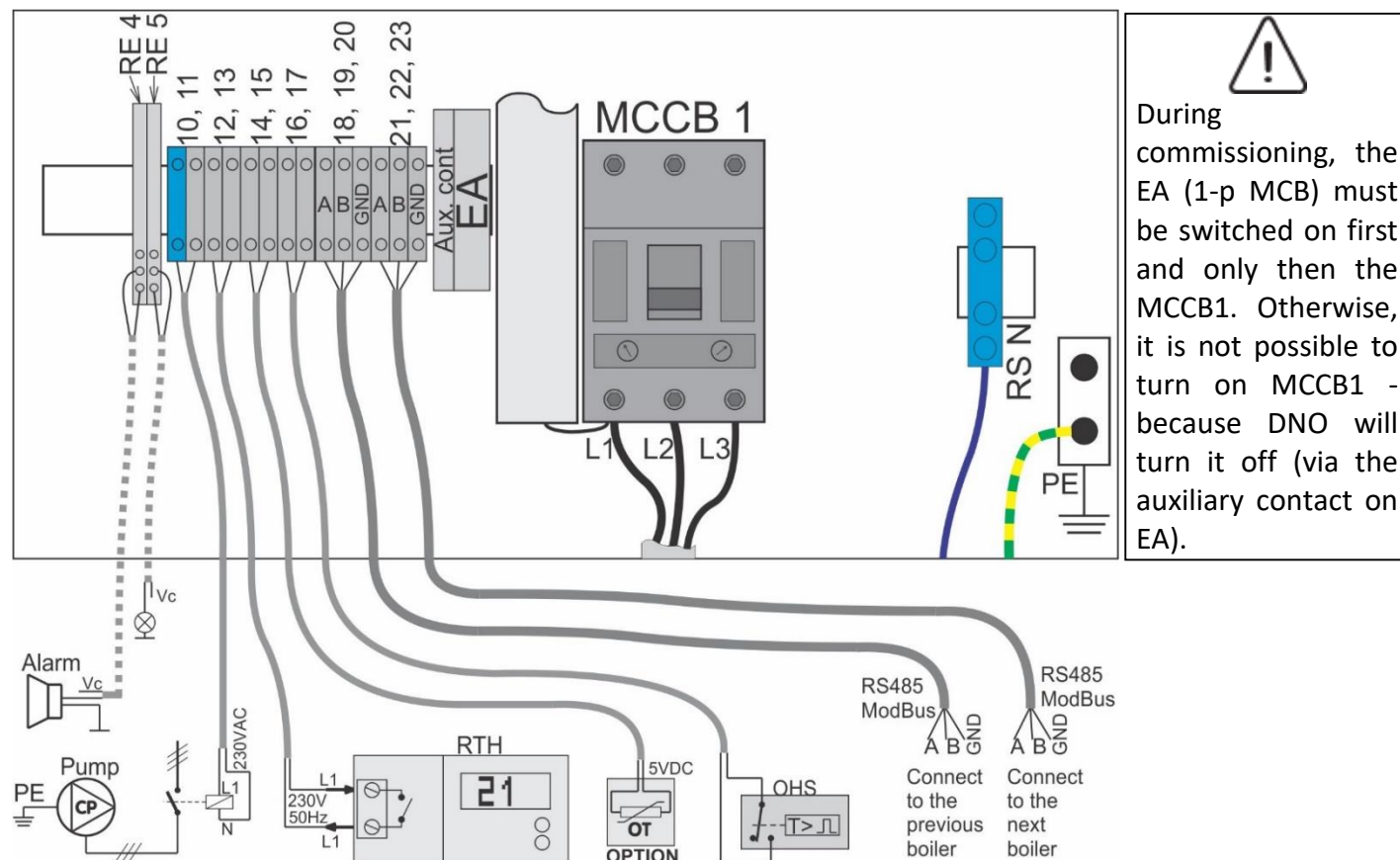
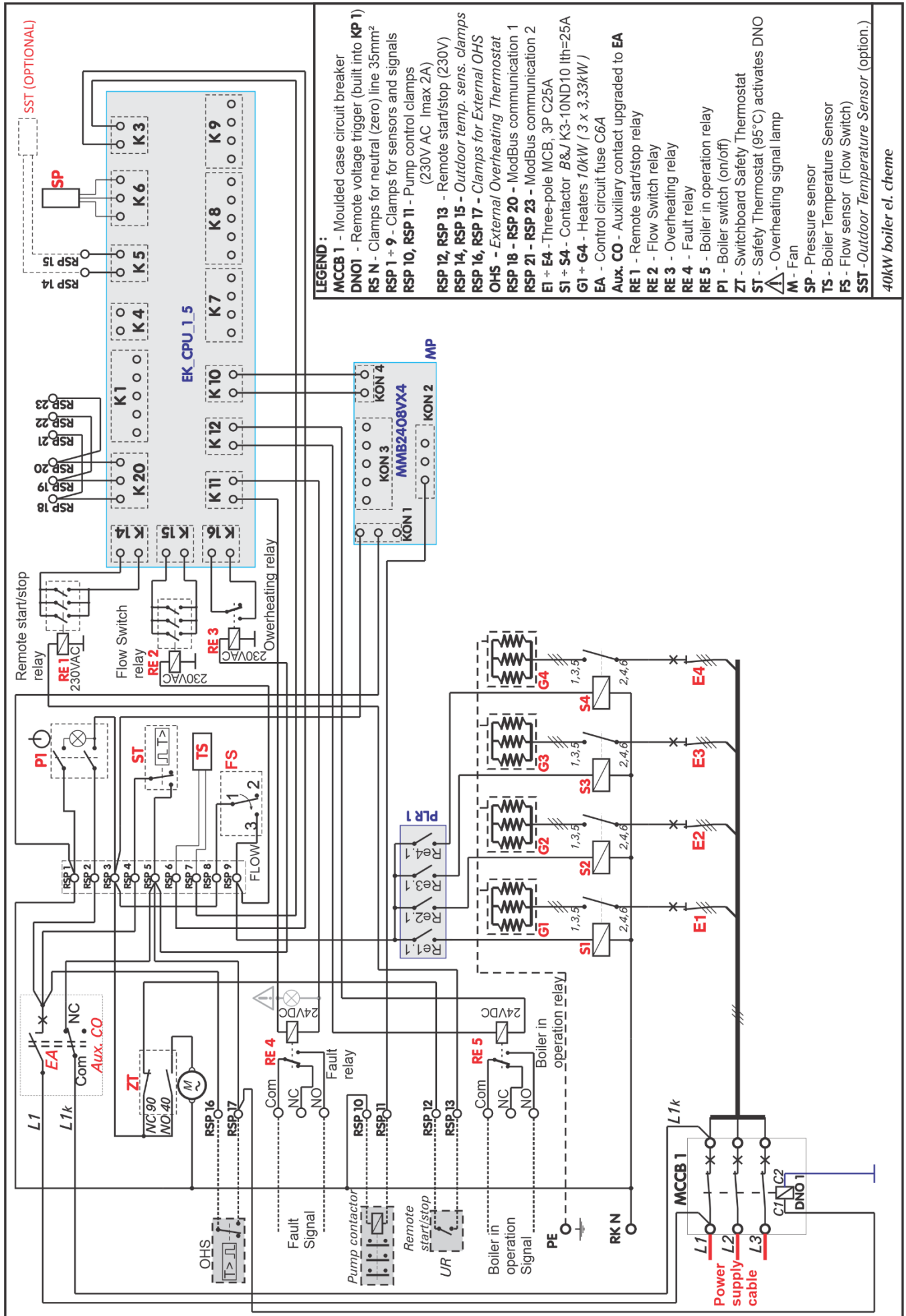


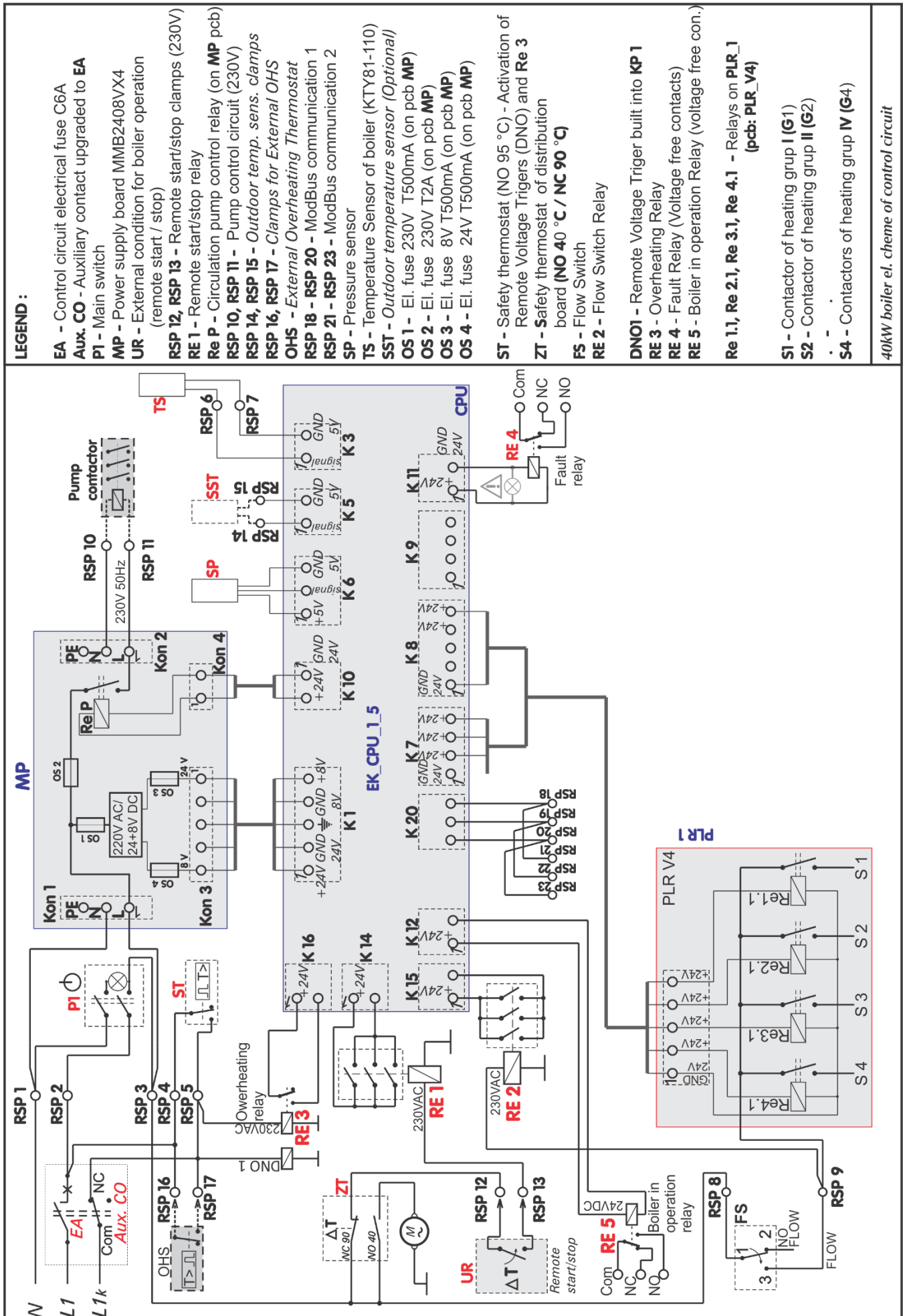
Image 7: Connection diagram of power cables, circulation pump, remote on / off signals, and RS485 ModBus communication

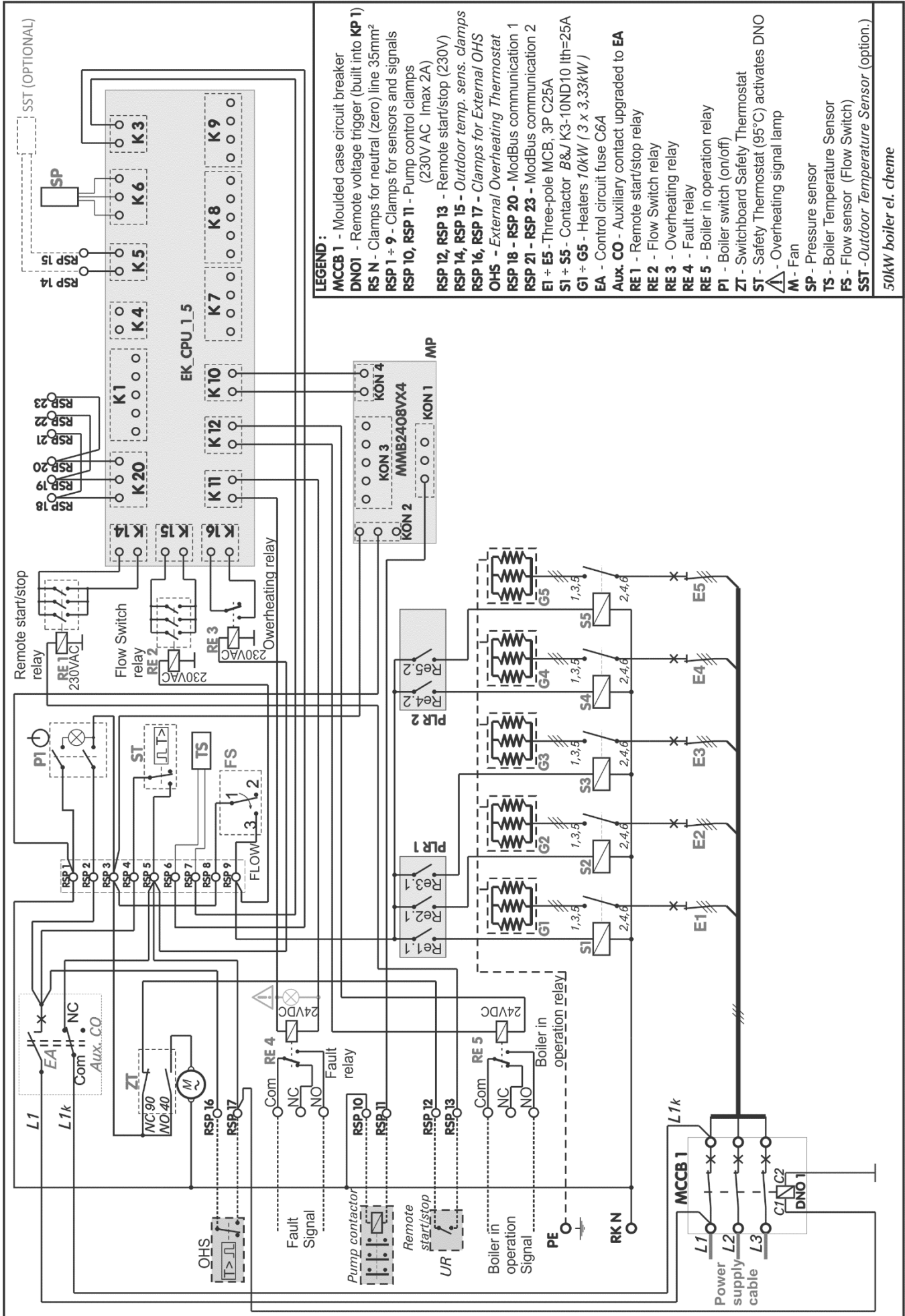
5.4 Electrical schemes

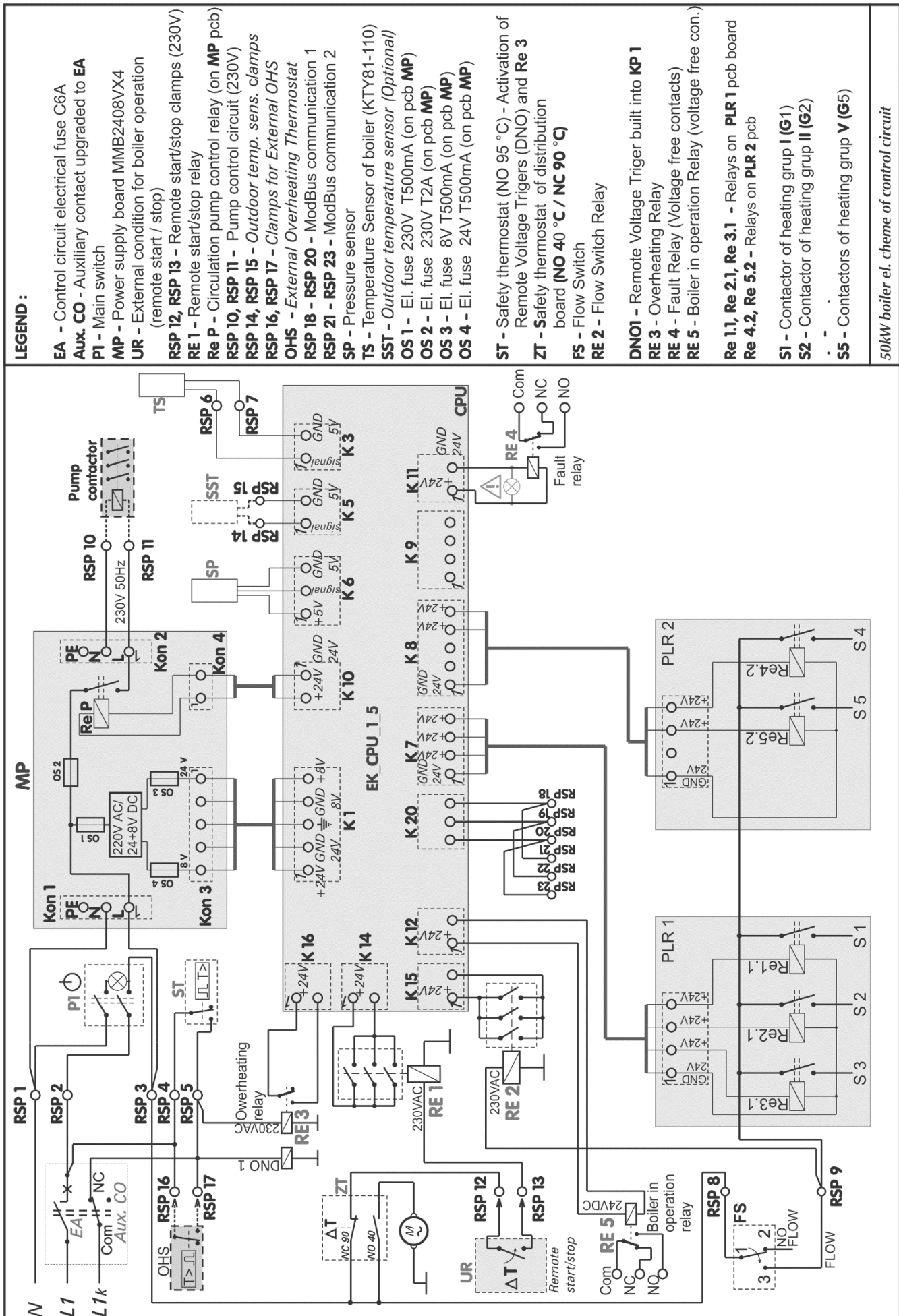
Legend	
MCCB1	Molded Case Circuit Breaker (MCCB) Noark Ex9M1S TM 160A 3P with upgraded shunt trip release (DNO) SHT21
RS N	Neutral (zero) cable connection clamp (35mm ²)
E1 ÷ EX	Three-pole MCB 3-p C25A (except 100kW : 3-p C40A)
DNO1	Shunt trip release (trip unit) SHT21 built into MCCB1
S1 ÷ SX	Contactor BENEDICT K3-10ND10 (Ith=25A)
RS G1 ÷ RS GX	Heater connection clamps (10mm ²)
G1 ÷ GX	Immersion heater 10kW (3×3333W;) Three-phase;
EA	1-p MCB for control circuit (C6A)
ST	Safety thermostat (95 °C) – Activates Shunt trip release (DNO) built into MCCB1 in case of thermic boiler overload – heaters power is turned off, and activate RE3
P1	Boiler switch (ON/OFF) on the dashboard
RSP1 ÷ RSP9	Auxiliary line clamps for CPU power, conn. sensors and safety thermostat (4mm ²)
TS	Temperature Sensor KTY81-110 (connected to RSP6 i RSP7)
SP	Pressure sensor (connected directly to CPU)
RSP10 ÷ RSP11	Clamps of the circulation pump control circuit (230V AC; 2A)
RSP12, RSP13	Clamps for external operation of the boiler - Remote start/stop of the boiler (230VAC)
RE1	Remote start/stop relay: to adapt the signal from 230VAC to 24VDC
RSP14, RSP15	Clamps for Outdoor temperature sensor (Optional).
SST (OT)	Outdoor Temperature sensor - Option: this sensor is not part of the standard equipment
RSP16, RSP17	Clamps for connecting an additional safety thermostat (OHS), installed e.g: into the buffer
FS	Flow Switch (mounted on the return line)
RE2	Flow Switch relay (To adapt the signal from 230VAC to 24VDC - for CPU input)
RSP18 ÷ RSP20	Conection clamps of RS485 RTU ModBus comunication
RSP21 ÷ RSP23	Conection clamps of RS485 RTU ModBus comunication
RE3	Overheating relay (To adapt the overheating signal from 230VAC to 24VDC - for CPU input)
RE4	Fault Relay (errors in boiler operation) with voltage-free contacts
RE5	Boiler in operation Relay (voltage-free contacts)
ZT	Distribution board Safety thermostat 40°C-NO / 90 °C-NC Fan starting at Ta=40°C and turns boilef off at Ta=90°C
MP	Power supply board – Generates 8V DC for CPU, and 24V DC for PLR panel relays
OS1	Electric soluble fuse of the transformer primary circuit (T500mA)
OS2	Electric soluble fuse of command voltage of the circulation pump (T2A)
OS3	Electric soluble fuse of secondary transformer circuit 24V (T500mA)
OS4	Electric soluble fuse of secondary transformer circuit 8V (T500mA)
Re P	Circulation Pump Voltage Command Relay
EK_CPU_1_5	Microprocessor thermoregulator pcb board
Re1.1, Re2.1, Re3.1	Board contactor relays PLR1 (PLR_V3B)
Re4.2 ÷ Re6.2 (Re7.2)	Board contactor relays PLR2 (PLR_V3B)
Re8.3, Re9.3, Re10.3	Board contactor relays PLR3 (PLR_V3B)

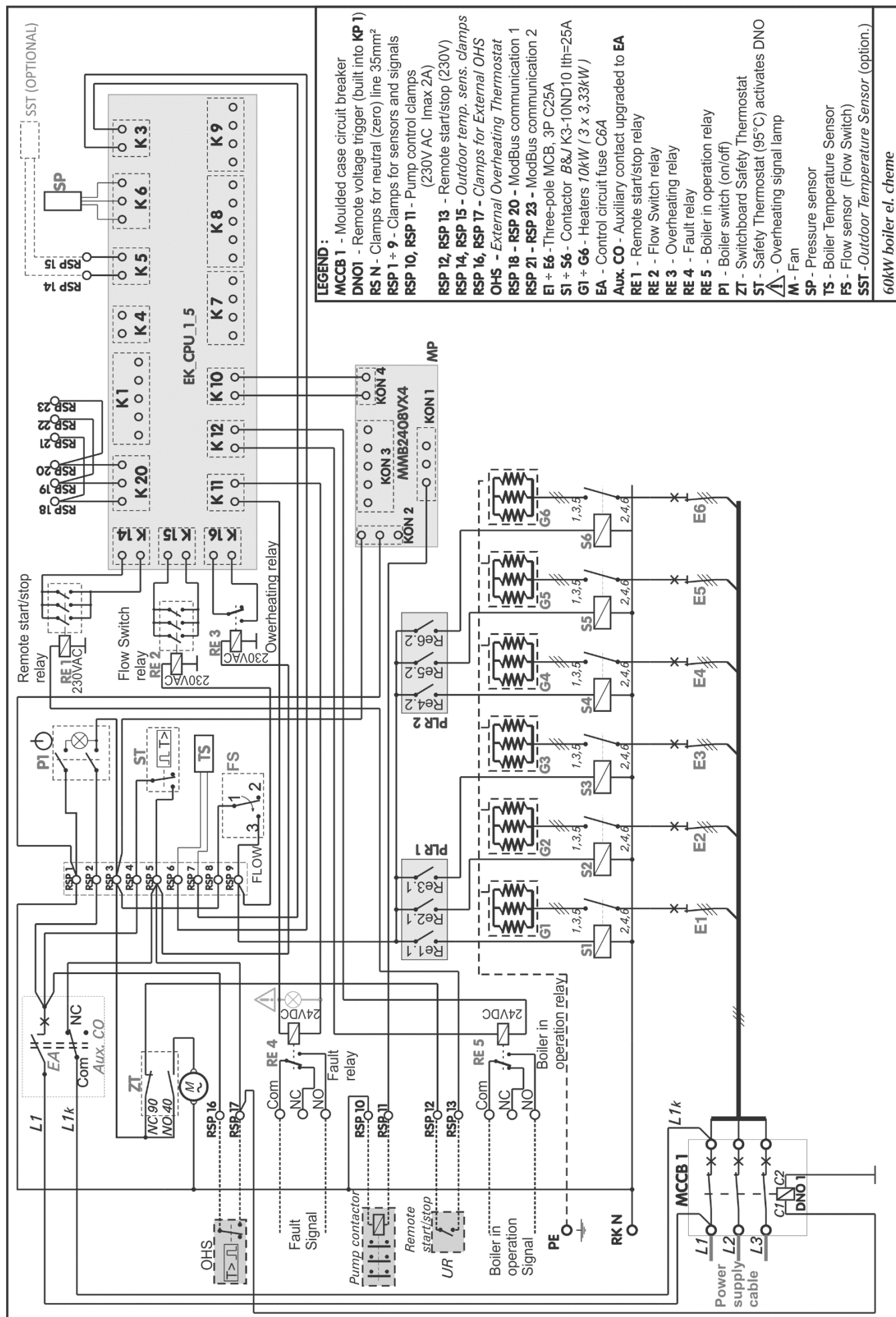
Table 4: Legend of EI-Cm Basic connection scheme for power 40 ÷ 100kW

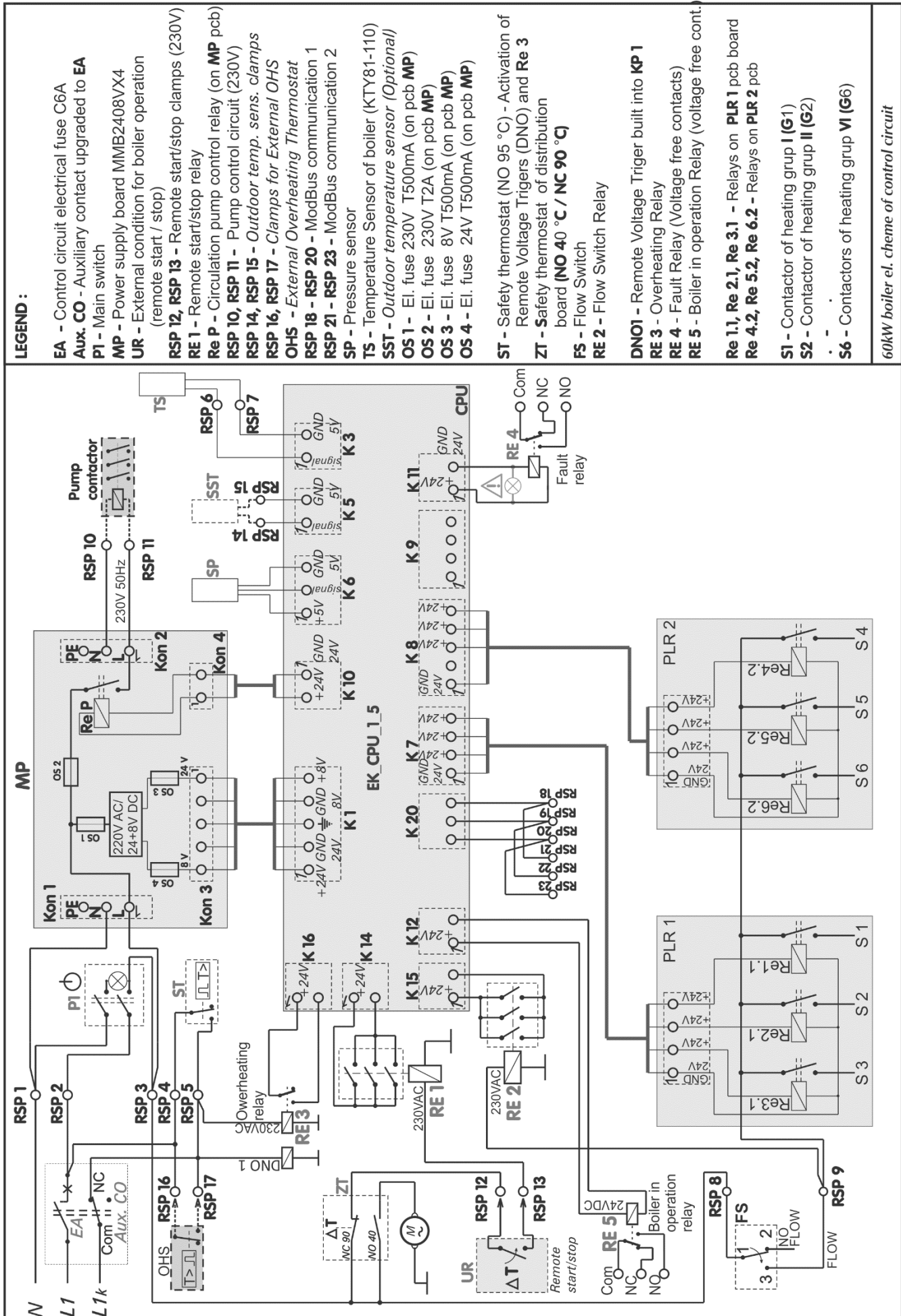


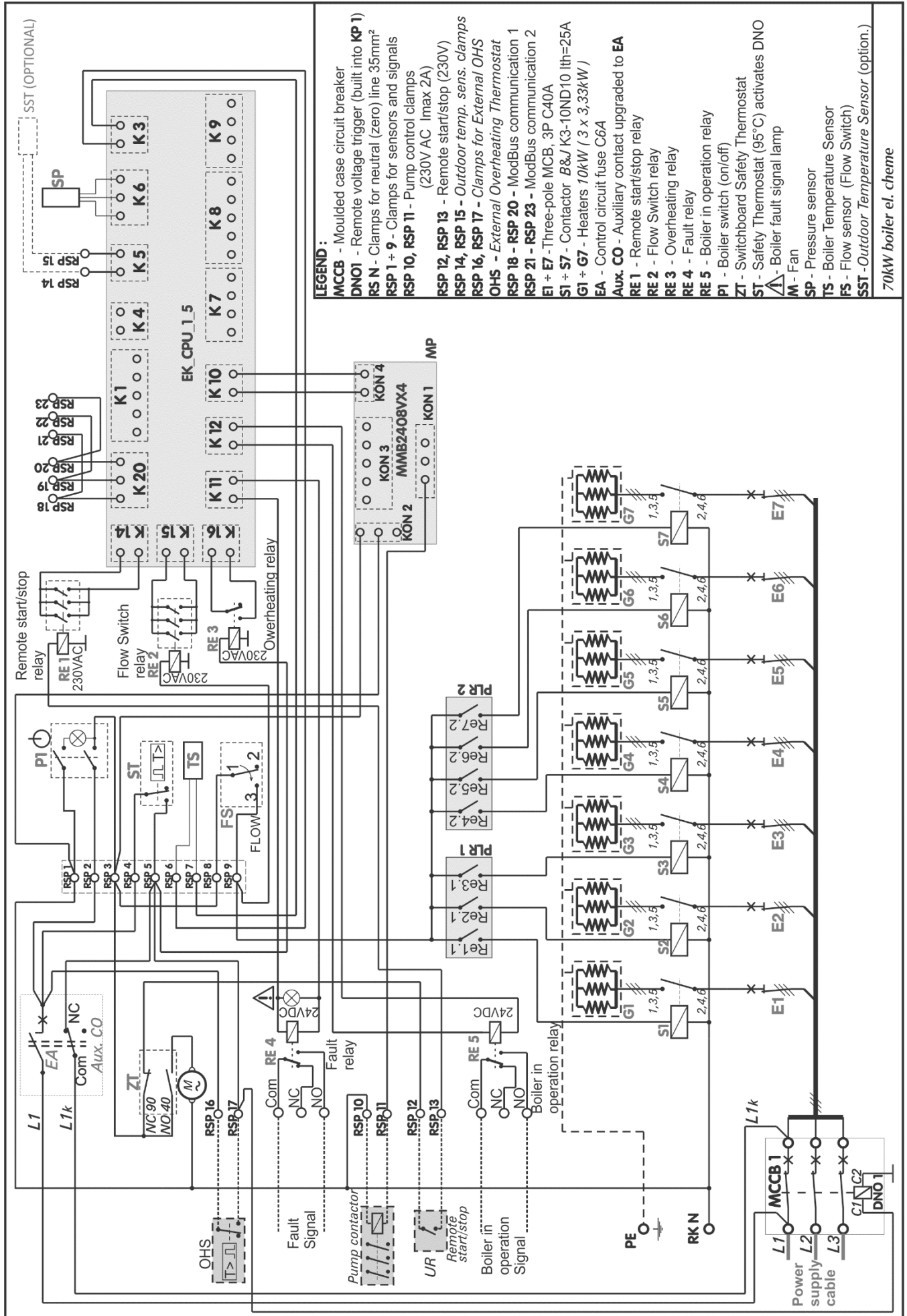


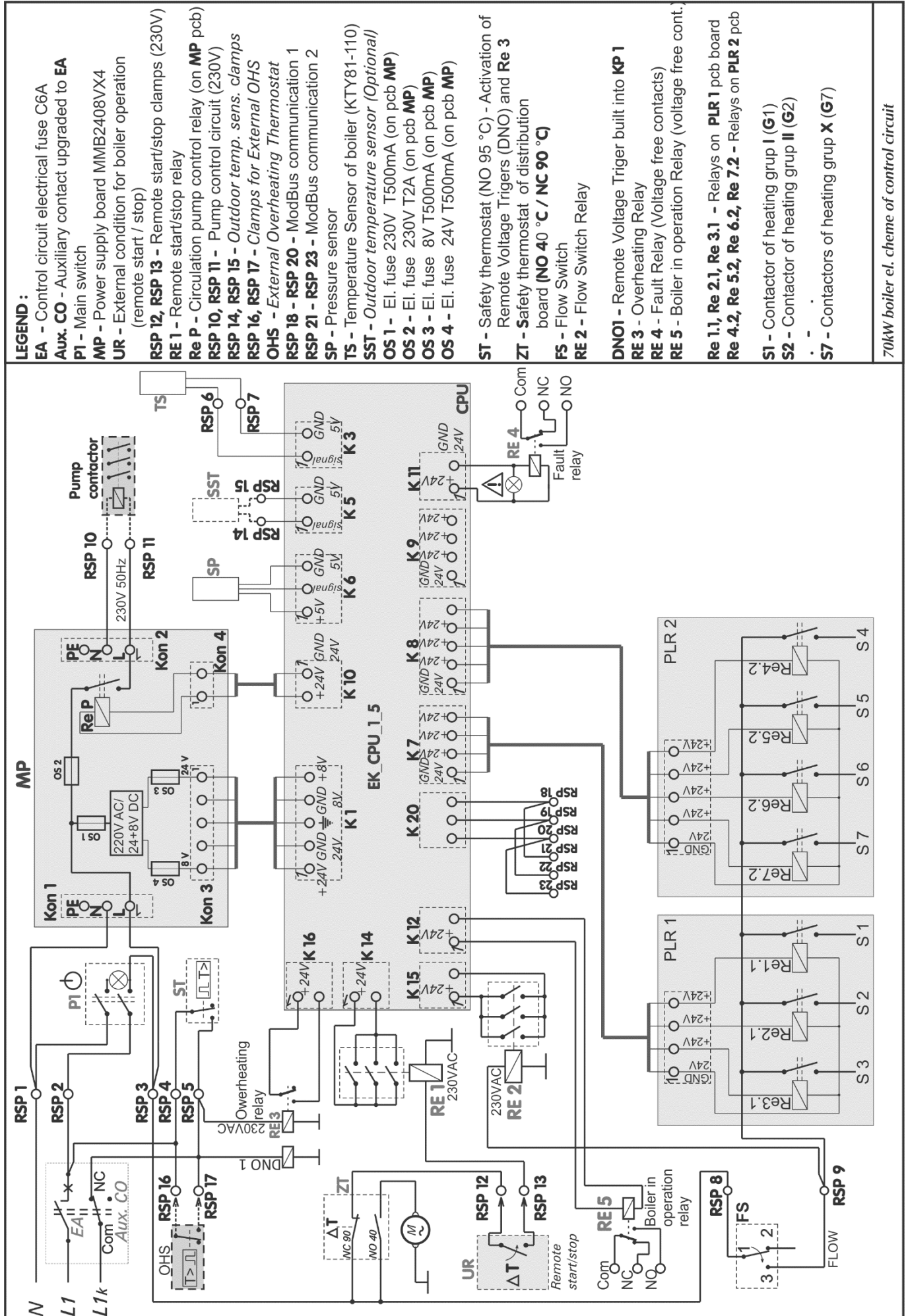


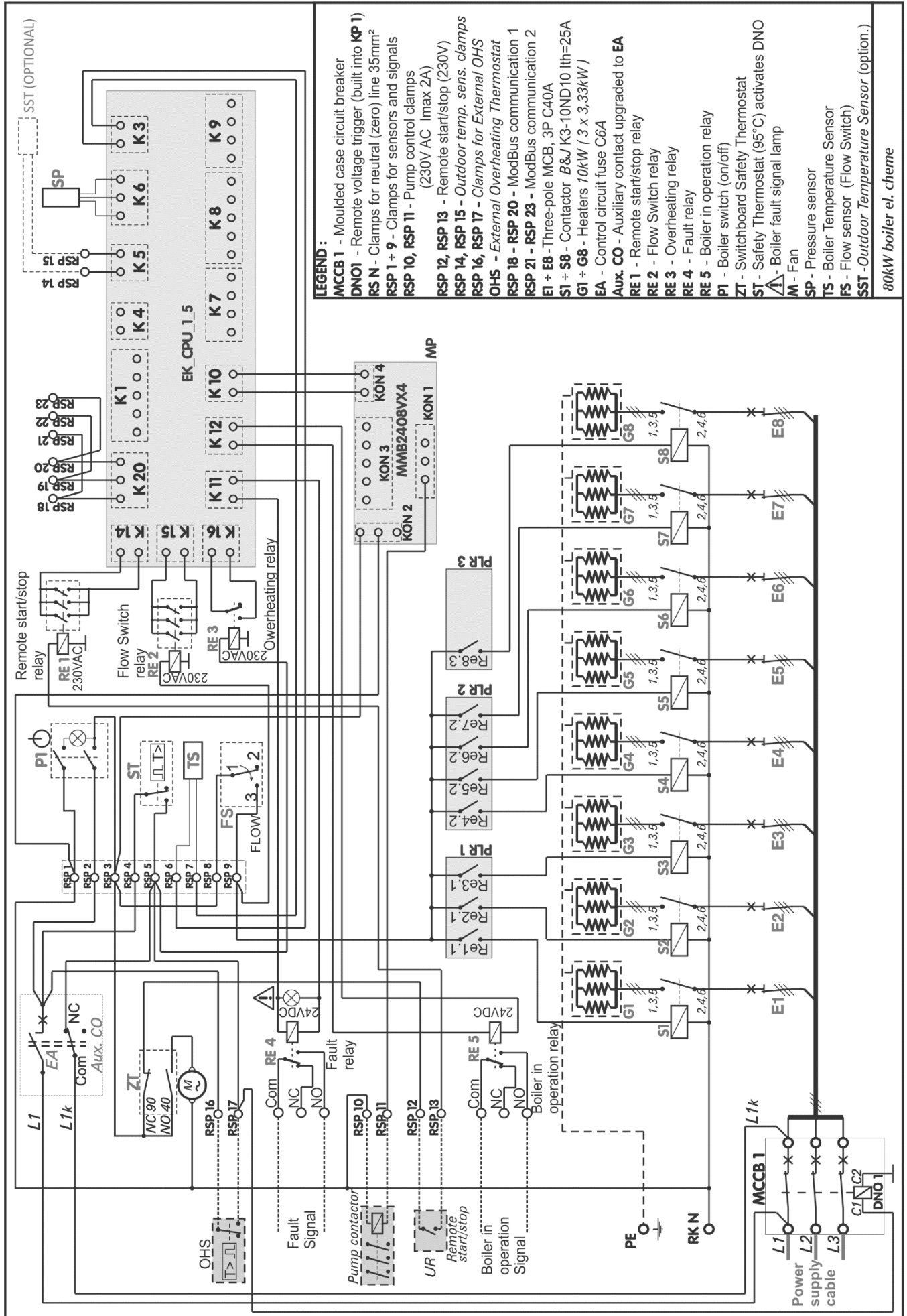


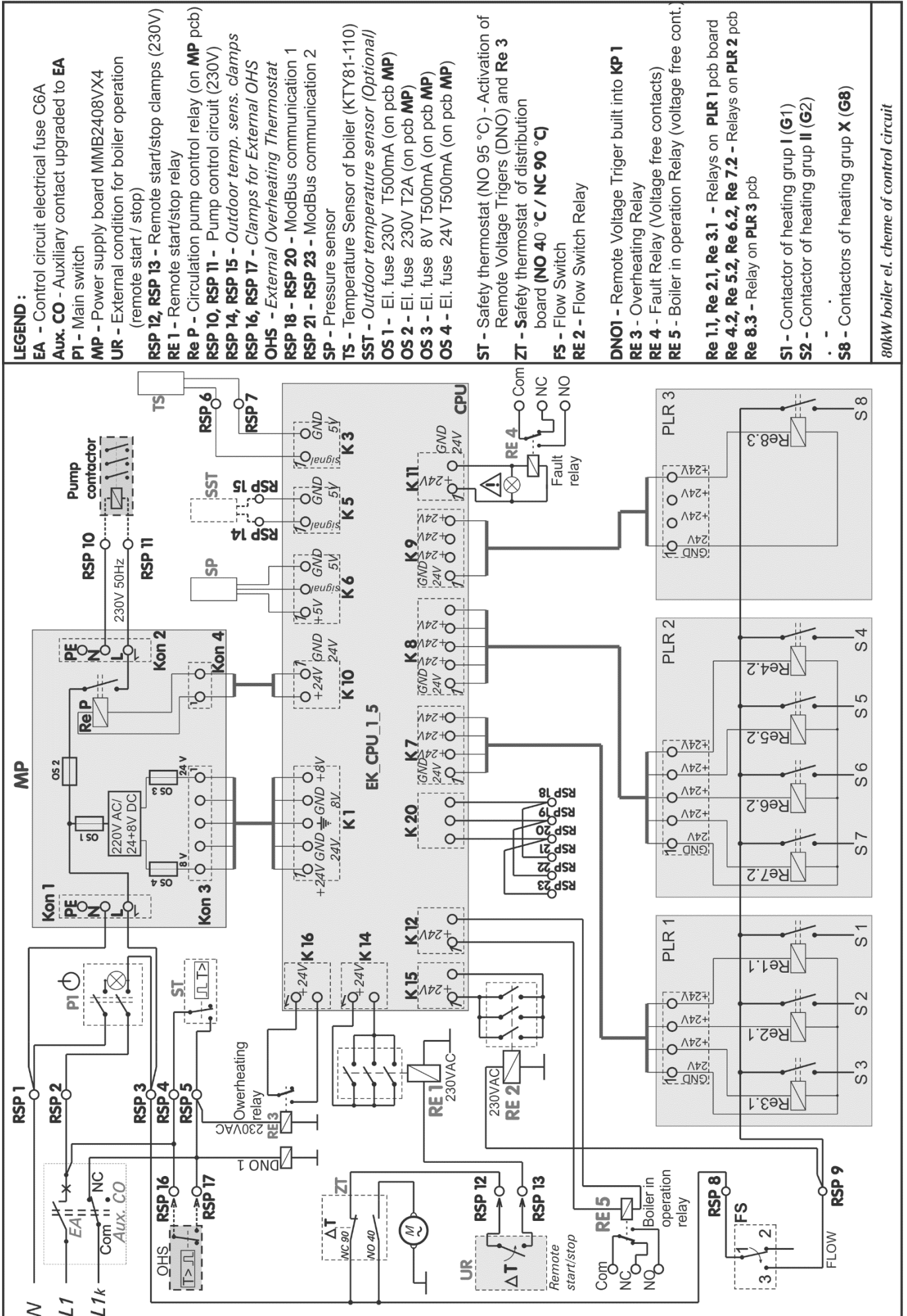


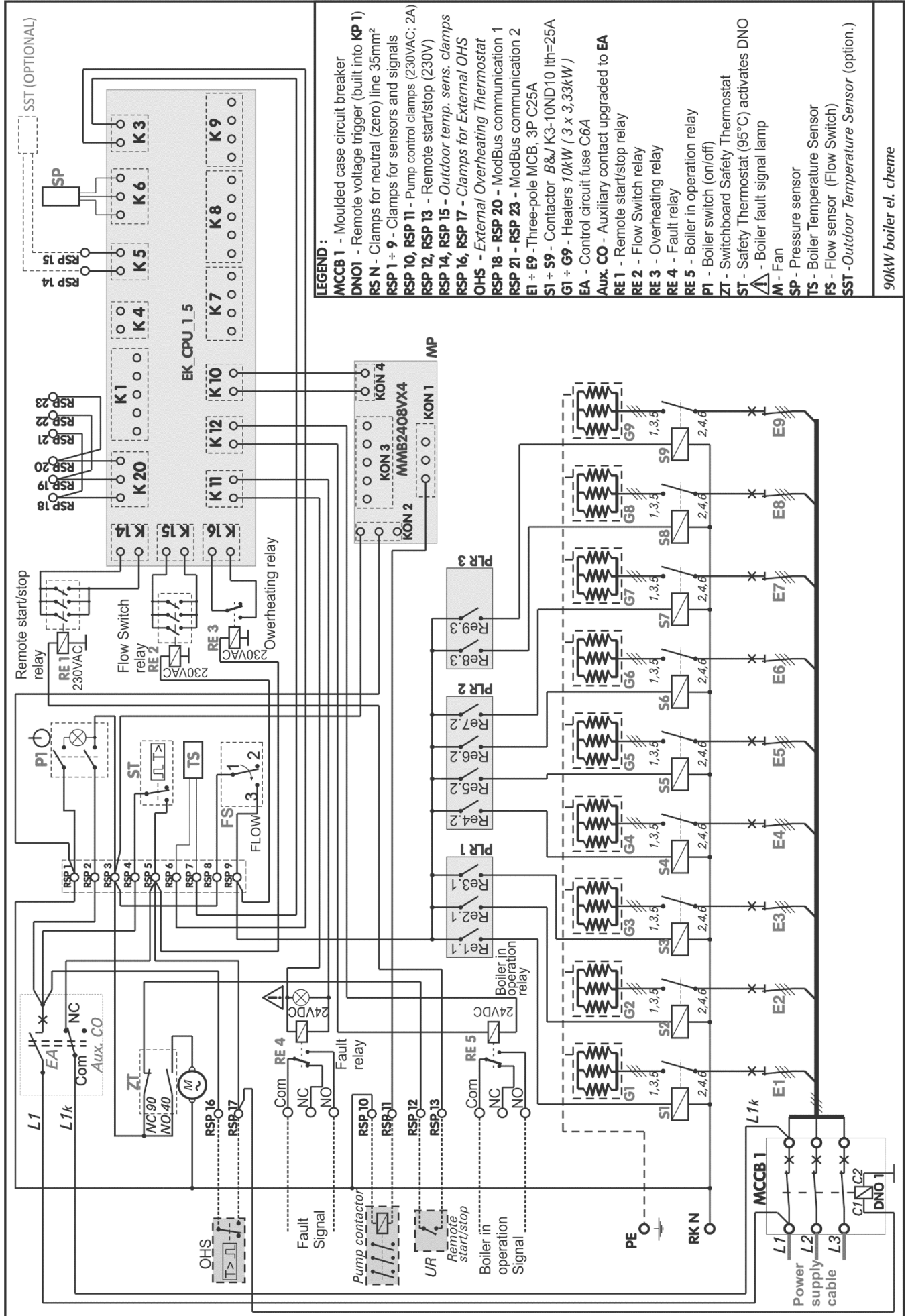


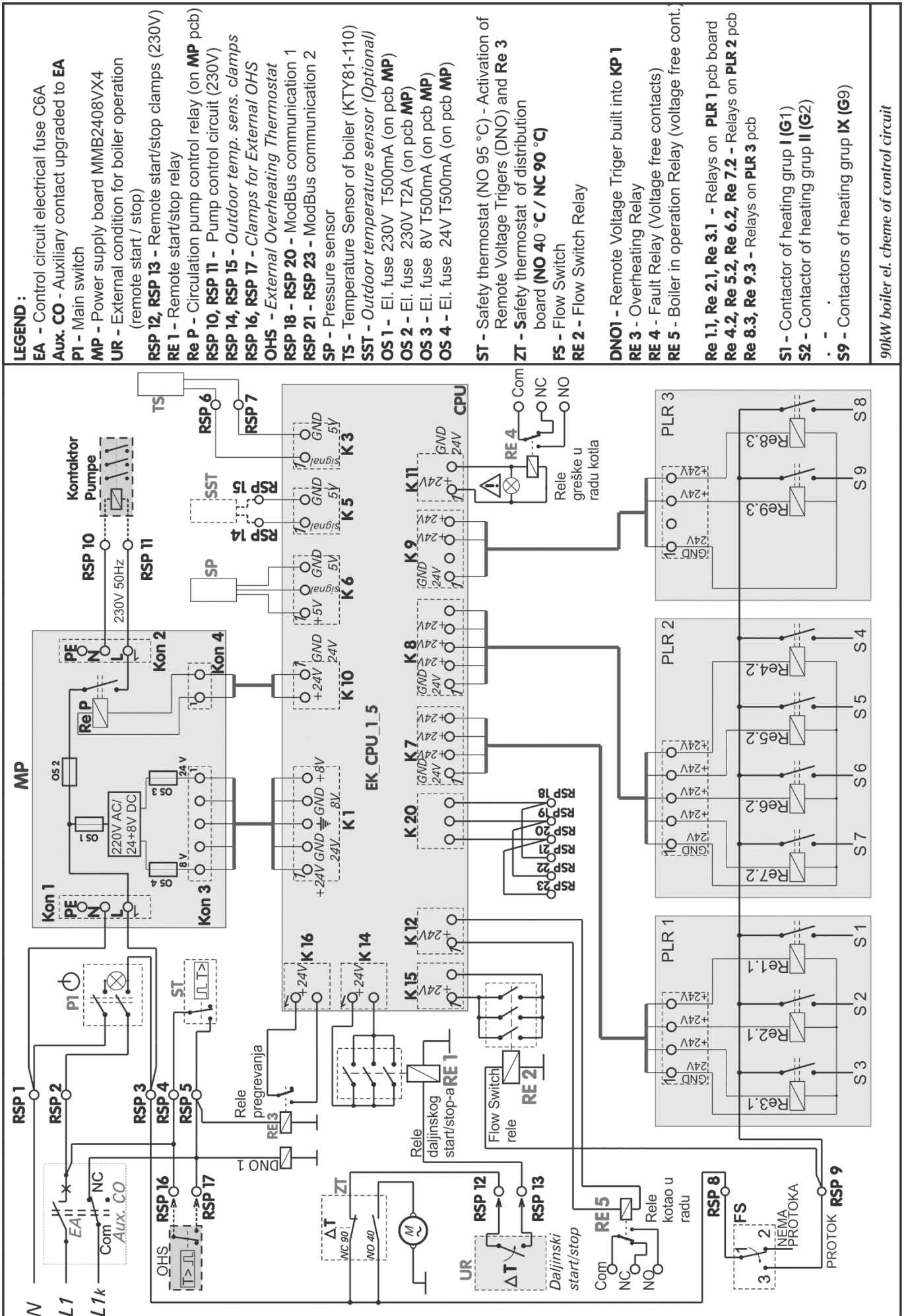


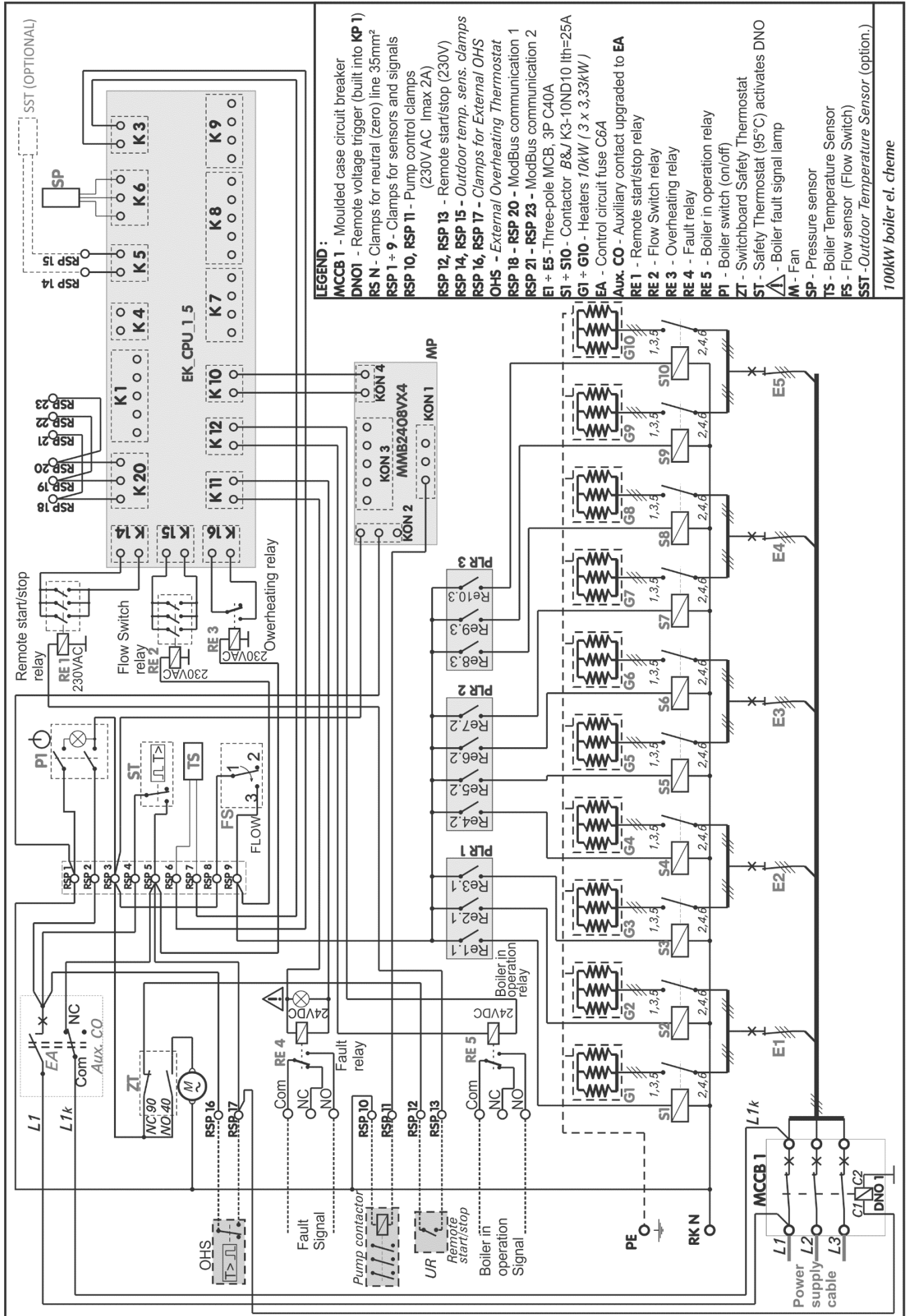








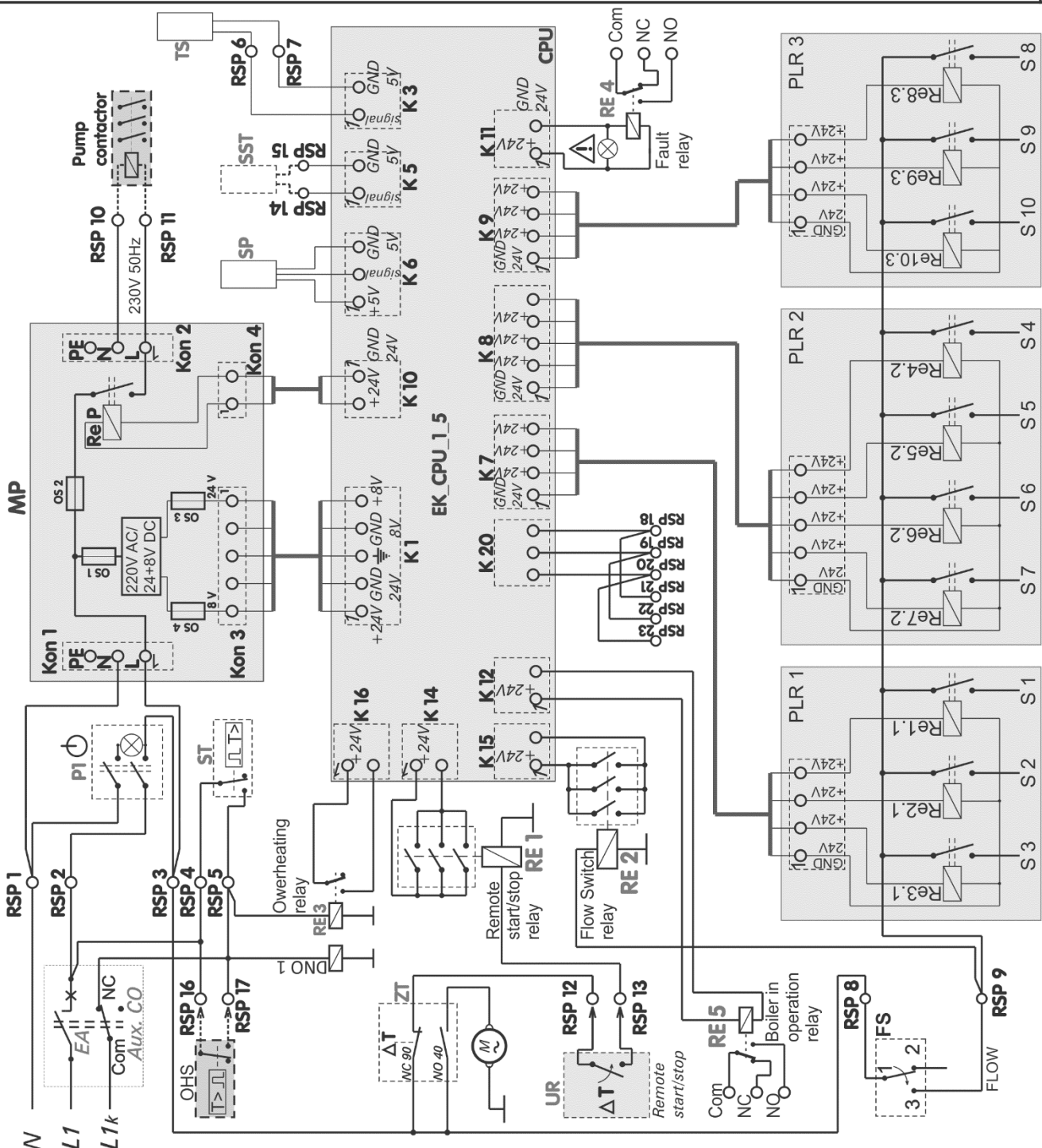




LEGEND :

- EA - Control circuit electrical fuse C6A
 Aux. CO - Auxiliary contact upgraded to EA
 P1 - Main switch
 MP - Power supply board MMB2408VX4
 UR - External condition for boiler operation (remote start / stop)
 RSP 12, RSP 13 - Remote start/stop clamps (230V)
 RE 1 - Remote start/stop relay
 Re P - Circulation pump control relay (on MP pcb)
 RSP 10, RSP 11 - Pump control circuit (230V)
 RSP 14, RSP 15 - Outdoor temp. sens. clamps
 RSP 16, RSP 17 - Clamps for External OHS
 OHS - External Overheating Thermostat
 RSP 18 - RSP 20 - ModBus communication 1
 RSP 21 - RSP 23 - ModBus communication 2
 SP - Pressure sensor
 TS - Temperature Sensor of boiler (KTY81-110)
 SST - Outdoor temperature sensor (Optional)
 OS 1 - EI. fuse 230V T500mA (on pcb MP)
 OS 2 - EI. fuse 230V T2A (on pcb MP)
 OS 3 - EI. fuse 8V T500mA (on pcb MP)
 OS 4 - EI. fuse 24V T500mA (on pcb MP)
 ST - Safety thermostat (NO 95 °C) - Activation of Remote Voltage Triggers (DNO) and Re 3
 ZT - Safety thermostat of distribution board (NO 40 °C / NC 90 °C)
 FS - Flow Switch
 RE 2 - Flow Switch Relay
 DNO1 - Remote Voltage Trigger built into KP 1
 RE 3 - Overheating Relay
 RE 4 - Fault Relay (Voltage free contacts)
 RE 5 - Boiler in operation Relay (voltage free cont.)
 Re 1.1, Re 2.1, Re 3.1 - Relays on PLR 1 pcb board
 Re 4.2, Re 5.2, Re 6.2, Re 7.2 - Relays on PLR 2 pcb
 Re 8.3, Re 9.3, Re 10.3 - Relays on PLR 3 pcb
 S1 - Contactor of heating grup I (G1)
 S2 - Contactor of heating grup II (G2)
 S10 - Contactors of heating grup X (G10)

100kW boiler el. scheme of control circuit



6. Commissioning

When complete below described works fill in the Start-up log (chapter 6.4).

6.1 Before commissioning



NOTE: Material damage occurred due to unBasic operating!
Start-up without sufficient quantity of water destroys device

- Turn on the boiler and use it only if there is sufficient quantity of water



The boiler must operate with a pressure of **0,9** (0,4)bar up to **3,5** (4,0)bar (see 12.1) (0,3÷6bar for boiler on request)

Before commissioning, make sure that the following elements and connections are properly connected and working properly:

- All pipes and valves and other system elements
- All electrical connections
- Leakage of heating installation

6.2 First start



NOTE: Material damage due to incorrect handling!

- Instruct client/user how to handle device

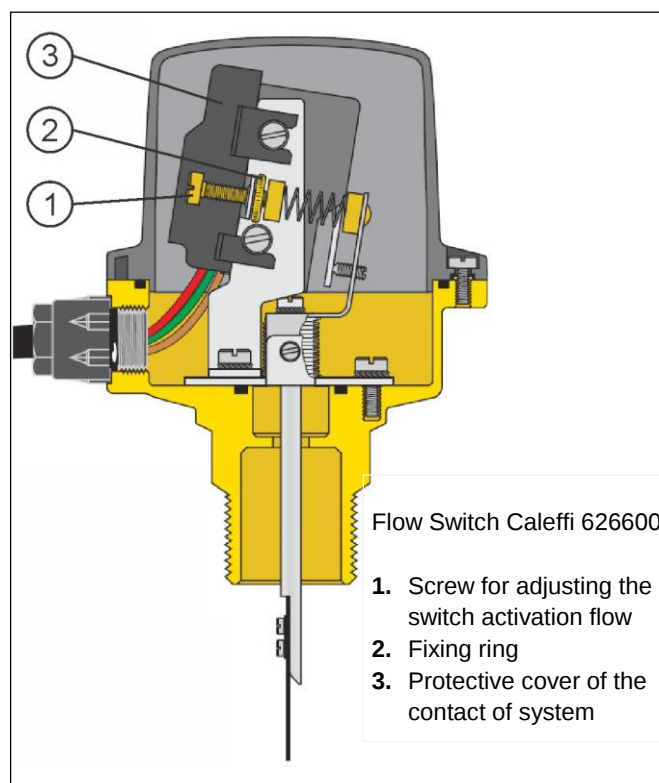
Before commissioning for the first time, make sure that the heating installation is filled with water and vented

- Turn on the main switch (on the dashboard)
- Switch on the circulation pump of the heating system
- Adjust the set power of the heater
- Adjust the operating temperature with the thermostat

6.4 Start-up log

1.	Boiler type	
2.	Serial number	
3.	Set thermostat regulation	☐
4.	Fill and air-vent heating installation and check sealing of all connectors	☐
5.	Establish working pressure Check expansion dish pressure	_____ bar _____ bar
6.	Test safety devices	☐
7.	Set electric connection according to local regulations	☐
8.	Test function	☐
9.	Users informed, technical documentation submitted	☐
10.	Notes	
11.	Certificate of Basic turn on device	Service seal / Signature / Date

6.3 Setting the Flow Switch



In order for the heaters to be switched on, the circulation pump must be switched on, i.e., the Flow Switch must detect the flow through the boiler and only then allow the boiler to operate.

Flow at which the Flow Switch is activated (switches on by microswitch) can be adjusted using a screw - position 1 in the figure above. The minimum and maximum flow rates required to activate the microswitch are given in the table below.

Range of Flow Switch activation					
Caleffi 626600		Min.		Max.	
		Flow reduction	Increase in flow	Flow reduction	Increase in flow
DN40 (6/4") 40÷60kW	[l/min]	31,7	43,3	96,7	98,3
	[m³/h]	1,9	2,6	5,8	5,9
DN50 (2") 70÷100kW	[l/min]	36,7	50	110	111,7
	[m³/h]	2,2	3	6,6	6,7

7. Operation of the device

7.1 Safety instructions

- The boiler can only be operated by adults who are familiar with the boiler's instructions and operation.
- Do not leave or store easily flammable objects within a safety distance of 400mm around the boiler.
- Flammable objects must not be placed on the boiler.
- The user must adhere to the operating instructions.

7.2 Overview of controls and protection elements

7.2.1 Boiler control panel



1. ON / OFF switch
2. Boiler fault signal lamp
3. Microprocessor Controller (CPU) - Device operation management. Constantly displayed setpoints and current values of temperature, pressure and power.
4. Buttons - Communication with the device

Symbols that may appear on the display



1. Time
2. Status indicator of the operating mode to which the boiler is set
3. The radiator symbol, to the right of it are the current and set temperature of the boiler
4. Current temperature (possible display - 99 ÷ 120 ° C)
5. The temperature (can be displayed from 10 to 90 ° C)
6. Temperature unit symbol (° C)
7. Pressure vessel symbol (current system pressure is displayed on the right side of the symbol)
8. Pressure in the system (Can display from 0 to 4,3bar)
9. Pressure unit symbol (bar)
10. Electric power symbol (current and set boiler power are displayed on the right side of the symbol)
11. Current boiler output in kW
12. Set boiler output in kW
13. Symbol measurement unit of electrical power (kW)
14. Circulation pump symbol (appears when the CPU sends a command voltage to turn on the pump relay). The triangle in the pump symbol is static if the Flow Switch is not detecting flow. If there is sufficient fluid flow through the boiler, the triangle is animated - symbolizing fluid flow.
15. The symbol of the space that is heated (house)
16. Remote start signal symbol (boiler operation allowed)
17. Warning symbol (A1 - A4) or errors (E0 - E9)
18. Labels of selected optional conditions for boiler operation:
 - First field: "E" - Checking the external condition for operation (remote start/stop).
 - Second field: "F" - Checking the state of the Flow Switch.
 - Third field: "O" - Checking the safety therm. (**Overheating**)
 - Fourth field: "L" - The water level in the boiler is checking. In this version, the option from the 4th fields are not supported.
19. Outside temp
20. O.T.C mode or daily profile symbol
21. The snowflake symbol (❄) indicates that the "Antifreeze Liquid" mode is activated - the boiler is protected by antifreeze from freezing.

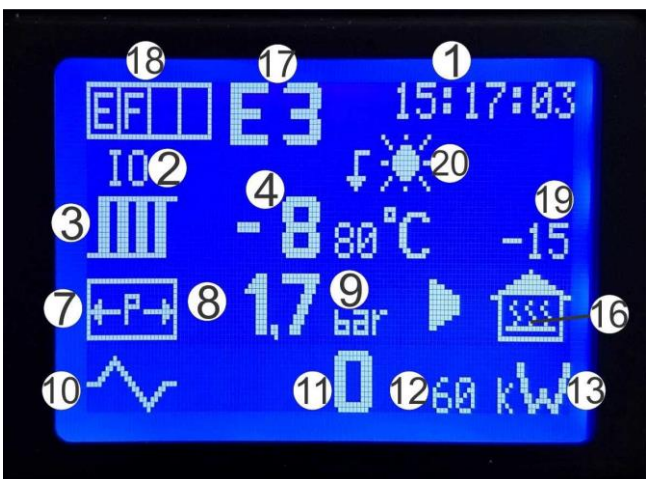


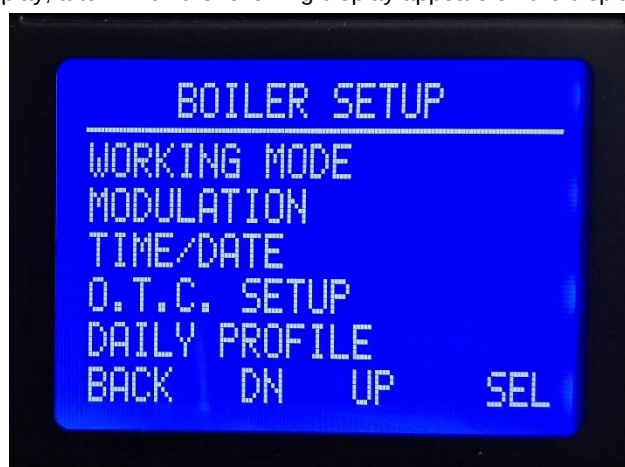
Image 8: All Symbols on the boiler display

8 Boiler settings

To enter the menu for selecting the operating mode, press and hold the "OK" button for ≈10 seconds, after which the "MAIN MENU" will appear on the display:



In the "MAIN MENU" one of the sub-menus can be selected: Boiler operation mode setting, ModBus communication setting, Technical settings and Parameter overview. Changing the flashing option is done with the " ^ " and " v " keys, and returning back with the SET key. To enter the Boiler Settings, press the "OK" button briefly, while the following message flashes on the display, after which the following display appears on the display:

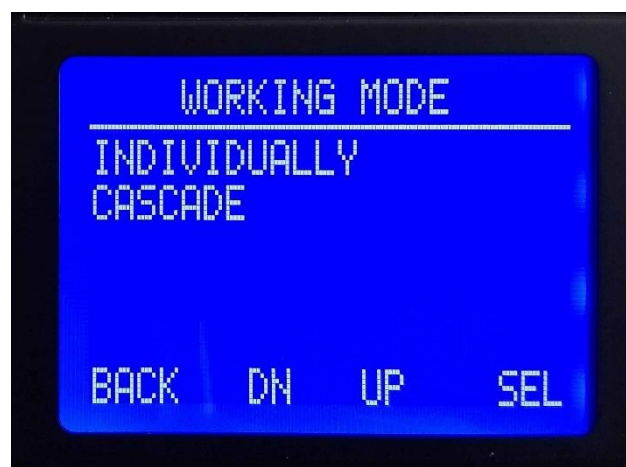


In "Boiler settings" there are more sub-menus than it is possible to display on one screen, that's why the last 2 items are on the "second" screen, i.e., they can be reached when using the " v " key when passed all items from the "first" screen:



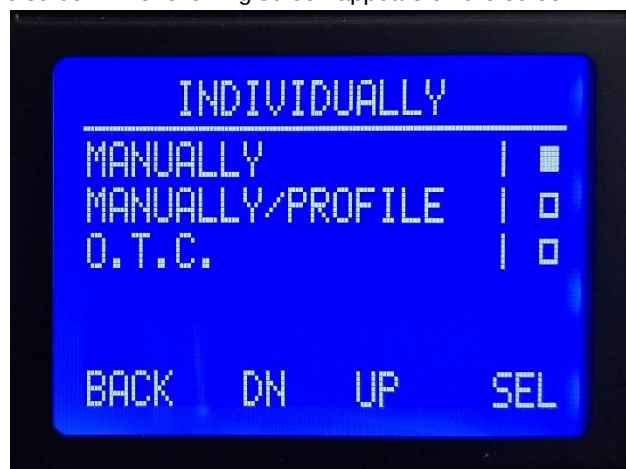
8.1 Mode of operation

Entering the sub-menu for selecting the boiler's operating mode is done by pressing the "OK" button, while the "Operating mode" is flashing on the display. A menu for selecting the mode of boiler operation opens on the display:



8.1.1 Individual mode

In the case where only one boiler is used as a heat energy generator, or if the boiler operates independently of other boilers, select "Individual" with the "OK" button while this option flashes on the screen. The following screen appears on the screen:



The current operating mode is marked with a full "cube", the change is made by pressing the " ^ " and " v " keys, selecting the desired operating mode, confirming the selection by pressing the "OK" key (the cube next to it will be fulfilled). The return is done with the "SET" key.

8.1.1.1 MANUAL (Individual Manual Mode)

In this operating mode, the set temperature and set power are set manually (description in the rest of this chapter). The boiler works independently of other boilers, which is the basic, i.e. operating mode that is set at the factory and with which the boiler is delivered to the customer. On the basic display, in the upper left corner of the display (above the radiator symbol), the status symbol "IM" will be written, indicating that the boiler is in the "Individual Manual" operating mode.

In this mode, the boiler can be monitored and controlled by a remote system (eg SCADA), via RS485 communication and the open ModBus protocol. So, although the name of the operating mode is "Manual", if the boiler is connected to remote monitoring via RS485 communication (→ 9), it will answer questions and send all current parameter values, and will also accept remotely set power values and temperature.

In the Individual Manual mode of operation of the device, the display shows the following:



1. Time
2. Status label of the operating mode it is set to: IM
4. Current thrust line temperature
5. The set temperature on boiler thrust line
8. Current pressure in the boiler
11. Current engaged power
12. The set power
14. Pump operation information - if the pump symbol is on the display, (CPU gave a signal to activate the pump), means that the auxiliary terminals of RSP 10 and RSP 11 have a voltage of 230V 50Hz, which can be used to start the circulation pump, or the contactor that powers the circulation pump.
16. Information on the status of external working conditions, i.e. remote control (start / stop signal) - If the symbol is on the display, boiler operation is allowed.
20. Labels of selected optional conditions for boiler operation:
 - First field: "E" - Checking the external condition for operation (remote start/stop). It can be a room thermostat or similar.
 - Second field: "F" - Checking the state of the Flow Switch'. A flow of heating fluid must exist for the boiler to operate.
 - Third field: "O" - Checking the safety thermostat. CPU will get signal from Safety Therm. in case of overheating.
 - Fourth field: "L" - The water level in the boiler is checking.

This option is not supported in this version.

User communication with the device is facilitated and improved by displaying all system parameters on a graphical LCD and by simple command with four keys.

The operating temperature is set in steps of 1°C, and it is possible to set the value from 10 to 90 °C.

The power of the boiler is adjusted in steps of 10kW.

There are 4 ÷ 10 heaters available, power of 10kW each.

After 3 minutes of the last key press the display illumination is reduced to 10% of normal. By pressing any key returns to normal illumination.

The principle of operation in manual mode

Temperature and hydraulic pressure sensors monitor changes in the system and send information to the microcontroller (CPU) who processes them and based on them, controls the operation of the boiler. Also, the microcontroller constantly receives information on the status of the start / stop signal, i.e. external condition to operate the boiler.

To make the device work normally, pressure and temperature must be within permitted limits.

The Flow Switch is electrically connected to interrupt the contactor control circuit if no flow through the boiler is detected.

The CPU can receive a remote start signal, it turns on the pump relay as well as the contactor relay. But if, for example: the impeller of the pump is mechanically blocked - the flow through the boiler will not exist. In that case, the Flow switch represents an interruption of the heater contactor control circuit and does not allow the contactor to be switched on, that is, turning on the heater. Also, the information from the flow sensor is sent to the CPU, (via RE2) and the error information (E5) appears on the CPU display, which is automatically canceled when the water flow through the boiler is established and the flow indicator detects it, which takes ≈5s according to the factory setting (can be set from 2sec ÷ 10sec). This error (E5) can also occur if the flow through the boiler exists, but is not enough to activate the flow switch. In this case, the flow switch (Flow Switch setting range → 6.3) or the pump power must be set.

The pump can be controlled by a signal from the boiler which switches it on when it receives a signal from an external operating condition (remote activation by a room thermostat or any other device). After the boiler is switched off remotely, the pump continues to run for 2 min (due to heat dissipation from still hot heaters immediately after switching off), after which it shuts down. The CPU turns on the pump even in case of overheating, when the boiler temperature exceeds 90 °C regardless of the status of the external working condition.

The pump can be controlled externally, and in this case the pump control circuit should be designed so that it turns on the pump before or at the same time as the remote switch-on of the boiler, and turns it off delayed, after the remote switch-off of the boiler with a delay of at least 1 minute (due to the removal of heat energy dissipated because are hot heaters immediately after switching off).

The CPU divides the given power into 3 parts (3 "Power Packages"). When Power Modulation is enabled, upon reaching the set temperature, the "power packages" are switched off one by one, with a temperature gap of 2 °C. (When switching on, the "power packages" are switched on one by one, with a temperature gap of 2 °C). "Power packages" are formed by the microcontroller based on the operating time of each heating group and depending on the selected level of power modulation - the heating groups that form the "power package" are not fixed, nor is the number of heating groups in the "power package" fixed. The microprocessor (CPU) decides which heating groups will form a certain "power packages" at each new power-up, by first selecting the heaters with the shortest operating time. In this way, an even distribution of the working time of each heating group is achieved, which results in a longer working life of the device as a whole.

Switching on and off the heating groups that make up the "power package" is successive, with a 3-second interval between each heating group.

Turning the heater on and off is successive, with a gap of 3sec between each heater, with the division of the engaged power into 3 parts (3 "power packages"), with temperature gap of 2 °C

Heating groups form a microcontroller based on the time of each heater are not strictly specified heaters forming a heating group. The microprocessor (CPU) decides which heaters will form the heating group each time they are switched on, depending on the set power and the selected modulation level.

In case of pressure or temperature approaching impermissible values, warning codes appear in the display (→ 12.1).

The occurrence of any fault in the boiler, the microcontroller takes measures to protect the device from damage (blocking the operation of the heater, if necessary, starts the pump relay), and the error codes that have occurred (→ 12.1) appear on the display.



In order for the heaters to be switched on, it is necessary that the circulation pump is switched on, e.g. The Flow Switch must detect the flow through the boiler and only then allow the boiler to operate

Setting temperature

By briefly pressing the "SET" button, the mode for setting the set temperature and set power is entered. The set value of the boiler temperature starts flashing, which can now be increased or decreased using the "▲" and "▼" keys.



Each press of the button increases or decreases the set temperature of the boiler by 1 °C. The temperature range that can be set is: 10 ÷ 90 °C. In order for the change to be remembered, it must be confirmed by pressing the "SET" key, which exits the settings. To switch to the power setting, press "OK" after selecting the temperature. If the change is not confirmed, after 15 seconds of pressing any key (except SET), the thermoregulator continues working at the previous value of the set temperature and exits the setting mode.

The set power is always divided into 3 heating groups, except when the power modulation is switched off. Power distribution by heating groups depends on the selected level of power modulation (→ 8.2) and nominal power of the boiler.

1) Power modulation OFF: The boiler works at the set power until the set temperature is reached, then all heaters are turned off with a 3-second interval. When the temperature drops 2 °C from the set point, all heaters are switched on with a delay of 3 seconds.

2) Power modulation STANDARD (Factory setting). Example: a boiler with a nominal power of 100kW with a set power of **100kW**:

Heating group 1: 70kW (7 × 10kW)

Heating group 2: 20kW (2 × 10kW)

Heating group 3: 10kW (1 × 10kW)

3) Power modulation MAXIMUM. Example: boiler with a nominal power of 100kW with a set power of **100kW**:

Heating group 1: 40kW (4 × 10kW)

Heating group 2: 30kW (3 × 10kW)

Heating group 3: 30kW (3 × 10kW)

With STANDARD and MAXIMUM modulation, the principle of modulation is the same, and only the powers of the heating groups differ:

The boiler works with the engaged power equal to the set point until the current temperature approaches 4 °C to the set point temperature - when the third heating group switched off. The boiler continues to operate at a power lower than the set (third heating group switched off) until the current temperature approaches 2 °C to the set temperature, when the second heating group also switched off.

In the last area (temperature 1 or 2 °C lower than the set point) the boiler works only with heating group no. 1, until the set temperature is reached. If the power is not enough - the temperature will decrease, which leads to reactivation of heating group 2.

The heating groups are formed by the microcontroller, according to the measured operating times of each heater, so that the group does not always consist of the same heaters, and all heaters are equally burdened.

Setting power

If the "OK" button is pressed after setting the temperature, the thermoregulator switches to setting the power - the set power blinks. If you don't want to change the temperature, but only the power, press the "SET" button when the display is normal, when the temperature starts to flash, press "OK" and go to the boiler power setting.

The set boiler power value starts flashing, which can now be increased or decreased using the "▲" and "▼" keys..



Each press of the "▲" key increases the set power by one power step (20kW except for the 240kW boiler, where one step is 40kW), and each press of the "▼" key decreases the boiler power by one power step.

The possible values of the set power according to the models are:

40kW→ 0kW, 10, 20, 30, 40kW

50kW→ 0kW, 10, 20, 30, 40, 50kW

60kW→ 0kW, 10, 20, 30, 40, 50, 60kW

70kW→ 0kW, 10, 20, 30, 40, 50, 60, 70kW

80kW→ 0kW, 10, 20, 30, 40, 50, 60, 70, 80kW

90kW→ 0kW, 10, 20, 30, 40, 50, 60, 70, 80, 90kW

100kW→ 0kW, 10, 20, 30, 40, 50, 60, 70, 80, 90, 100kW

In order for the change of the set power to be accepted, it must be confirmed by pressing the "SET" key, which is also the exit from the setting. If the change is not confirmed, after 15 seconds of pressing any button, the thermoregulator continues to work at the old value of the set power and exits the adjustment mode. During operation, the engaged power will be equal to the set one until the current temperature approaches the set temperature, and then the engaged power is reduced, i.e. the heaters are gradually turned off, which achieves energy saving and precisely reaching the set temperature.

In this mode, the set temperature and power, in addition to manual adjustment on the boiler itself, can also be set via a central monitoring and control system (SCADA, BMS...)

8.1.1.2 MANUALLY by PROFILE (PROGRAM)

In this mode, the boiler works according to a preset daily program, in which the set temperature is set for every hour, from 0h to 24h (→ 8.5 Daily profile).

The set power is the same for the whole day, and only the power of the boiler can be adjusted, either manually on the boiler itself, or remotely via ModBus communication. Manual adjustment of the boiler power is performed by pressing the "SET" key, the set power starts flashing and it is possible to increase or decrease it using the "▲" and "▼" keys. In order for the change to be remembered, it must be confirmed by pressing the "SET" key, which exits the settings. When setting the power via ModBus communication, if the temperature is also set - it will not be accepted by the boiler, because it takes the temperature from its daily program, while the power of boiler will of course will be accepted.

In this mode, as with other modes from the "INDIVIDUAL" group, the boiler works independently of other boilers. On the basic view, in the upper left corner of the display (above the radiator symbol), the status symbol "IP" will be written, which indicates that the boiler is in the "Individually by Program" operating mode. The basic view on the display is given in the following picture:



Another difference compared to the view in Manual mode is the appearance of "bars" that symbolize the program-defined temperature. Next to the "bars" there is an arrow indicating that the graph formed by the bars refers to the set temperature.

8.1.1.3 O.T.C (Outdoor Temp. Compensation)

This mode is optional, that is, in order to be available, it must be requested when ordering the boiler, and an external temperature sensor must be connected, which is part of the additional equipment.

In O.T.C. mode, the temperature of the boiler is controlled according to the outdoor temperature (Individual Outdoor Temperature Compensation), that is, the microcontroller determines the set temperature of the system according to one of the two operating curves that are set in O.T.C. settings (→8.4) or maintains a constant temperature (which set in the same settings).

Before choosing O.T.C. mode, a 24-hour program should be set (→8.4.1), whereby for each 1-hour period it is possible to choose one of 2 operating curves or Const. temperature. Also, work curves should be defined (→8.4.2 and 8.4.3), as well as set Const. temperature (→8.4.4).

The power of the boiler is set manually (or via ModBus communication). Manual adjustment of the boiler power is performed by pressing the "SET" key, the set power starts flashing and it is possible to increase or decrease it using the "▲" and "▼" keys. In order for the change to be remembered, it must be confirmed by pressing the "SET" key, which exits the settings. When setting the power via ModBus communication, if the temperature is also set - it will not be accepted by the boiler, because it takes the temperature from the O.T.C. program, while strength will of course be accepted.

The basic view on the display is given in the following picture:



In this mode, as with other modes from the "INDIVIDUAL" group, the boiler works independently of other boilers. On the basic display, in the upper left corner of the display (above the radiator symbol), the status symbol "IO" will be written, indicating that the boiler is in the "Individually O.T.C." operating mode..

The difference compared to the display in Manual mode is the appearance of the sun, moon or Const. symbols, which indicate which curve the temperature is currently being guided by. Next to this symbol, there is an arrow indicating that the symbol refers to the set temperature.

Another difference compared to the display in Manual mode is the display of the outside temperature, in the right part of the display above the house symbol.

8.1.2 WORKING IN CASCADE

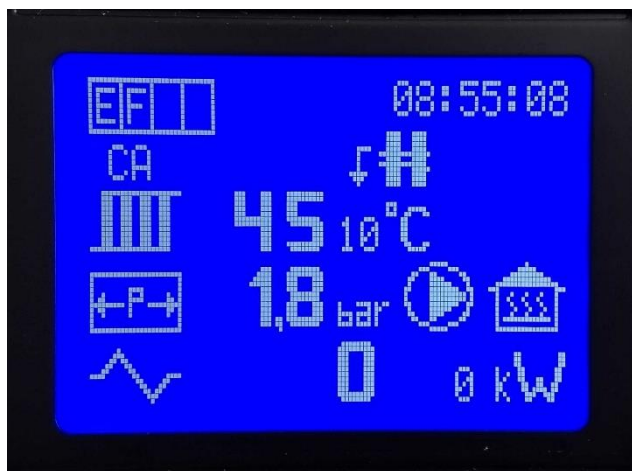
If the boiler should work in a cascade connection with one or more boilers of the same power, in the "OPERATION MODE" submenu, you should select "CASCADE OPERATION" and confirm by pressing "OK", after that the display will show the following view:



8.1.2.1 AUTOMATIC OPERATION IN CASCADE

By selecting the "AUTOMATIC" option, the boiler is set to work in a cascade mode with several boilers of the same power.

The boiler operating mode status symbol located in the upper left corner of the display (above the radiator symbol) will now be: "CA" - Cascade Automatic. The display is as follows:



In this operating mode, neither the temperature nor the power can be set manually (via the buttons on the boiler's control panel). Setting the set temperature and power is done through the Cascade regulator "CPK09-M", which communicates with all boilers in the cascade via RS485 RTU ModBus communication and forwards the set temperature values, and distributes the set power to all boilers in the cascade with which there is correct communication..

In order for the boiler to be able to communicate with the Cascade regulator, it is necessary to make settings in the "COMMUNICATION" submenu (→ 9).

If there is no communication between a boiler and the cascade regulator for 2 minutes, that boiler will continue to work according to the last instructions received, or automatically switch to the operating mode selected in "Loss of communication" (→ 9.5).

8.1.2.2 EMERGENCY WORK IN CASCADE

"EMERGENCY" (Emergency) mode of operation of the boiler is provided in case of interruption of communication between the boiler and the Cascade Regulator, or malfunction of the Cascade Regulator.

The status code of this boiler operation mode is "CE" - Cascade Emergency. The display is as follows:



This option allows the boiler, which is hydraulically and electrically connected in a cascade with several other boilers, to still be manually controlled and set the temperature and power.

As mentioned in the description of Cascade Automatic mode of operation, if 2 min. there is no communication between a boiler and the cascade regulator - that boiler automatically switches to the operating mode selected in case of communication loss (→ 9.5), and when communication is established it will automatically continue to work according to the instructions received from the cascade regulator. If manual control is desired without automatically switching to instructions from the cascade controller (when communication is established), then "Emergency" mode should be selected.

It goes without saying that the boiler is correct, but due to the lack of communication, it does not participate in the operation of the cascade.

This mode should be used only in an emergency situation, as a temporary solution until the problem due to which the boiler cannot be controlled via the cascade regulator is fixed..

The set temperature and boiler power are set manually in this mode, the same as in the manual mode: by pressing the "SET" button, the set temperature starts flashing and it is possible to increase or decrease it using the " ^ " and " v " keys. '. Switching to setting the set power is done by pressing the "OK" key, the set power starts flashing and it is possible to increase or decrease it using the " ^ " and " v " keys. In order for the changes to be remembered, they must be confirmed by pressing the "SET" key, which exits the settings.

The set temperature and power of the boiler are therefore set manually in this mode - as in the Individual Manual mode, but unlike it, in the Cascade Emergency mode any instruction from the cascade regulator or centralized remote monitoring and control system (SCADA, BMS) is ignored ..., i.e., an instruction that comes via ModBus communication - because it is assumed that the boiler is in this mode due to the Cascade regulator malfunctioning.

8.2 MODULATION OF POWER

The boiler does not have to work at the set power until the set temperature is reached. In most cases, it is a more optimal solution to reduce the engaged power when the current temperature approaches the set temperature of the boiler. This reduces the "shift" of the current temperature compared to the set one, and saves energy. Also, when maintaining the set temperature, a smaller power than the set is often sufficient. The boiler automatically modulates the engaged power and adapts it to the consumer according to the selected modulation level.

In the "Boiler Settings" menu, pressing the "OK" button while "MODULATION" is flashing opens a submenu in which it is possible to set the boiler power modulation level. The submenu display on the display is as follows:



8.2.1 MODULATION OFF

Modulation of engaged power is turned off. It is recommended in the case when the power of the heating installation and the power of the boiler are equal and / or in case of low outside temperature.

Reaching the set temperature: the engaged power of the boiler is equal to the set power of the boiler, until the set temperature is reached, when all the heaters are turned off and the power drops to 0kW.

Maintaining the set temperature: when the current temperature drops 2°C below the set value, all heaters are switched on again. This is an on/off regulation, with the fact that the switching on and off of individual heaters is time-shifted by 3 seconds.

8.2.2 MODULATION NORMAL (DEFAULT)

This is the factory setting, the boiler slowly reduces the engaged power when the current temperature approaches the set temperature. It is recommended when the power of the installation is slightly less than the power of the boiler and / or moderate outside temperature.

Reaching the set temperature: the boiler works at the set power until the current temperature reaches a value of 4°C below the set temperature, when the boiler will reduce the power by ≈ 10% compared to the set. When the current temperature approaches 2°C below the set value, the power is reduced by another ≈ 20%. The remaining part of the heater is turned off when the current temperature reaches the set value.

Setpoint maintenance: when the current temperature drops 2°C below the setpoint, only part of the power is turned on again (≈70%), and if the temperature continues to fall, the engaged power will increase, in the reverse order of the power reduction when reaching the setpoint temperature.

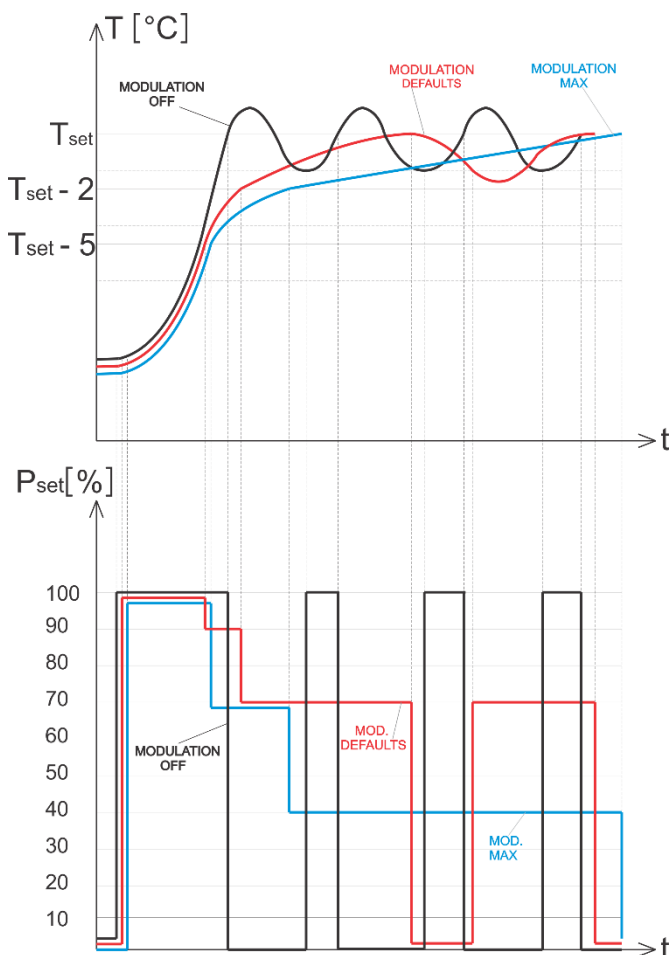
8.2.3 MAXIMUM MODULATION

At the maximum level of modulation, the boiler quickly reduces the engaged power when the current temperature approaches the set temperature. It is recommended in the case when the power of the heating installation is significantly lower than the power of the boiler and / or relatively high outside temperature.

Reaching the set temperature: the boiler works with the set power until the current temperature reaches a value of 5°C below the set temperature, when it will reduce the engaged power by ≈ 30% compared to the target. When the current temperature approaches 2°C below the set value, the power is reduced by another ≈ 30%. When the current temperature reaches the set value, the remaining part of the power (≈ 40%) is switched off.

Maintaining the set temperature: When the current temperature drops by 2°C below the set point, part of the power is switched on again (≈ 40%), and if the temperature continues to drop, the engaged power will increase, in the reverse order of the power reduction when reaching the set temperature.

Graphic view of the movement of Temperature and Engaged Power:



The graph shows that the set temperature is reached the fastest when the modulation is turned off, but in that case there are also the largest current temperature oscillations around the set point and frequent switching on and off of the heater - which affects the shorter life of the contactor.

On the other hand, at the maximum level of modulation, it takes a long time to reach the set temperature, so the factory setting "NORMAL MODULATION" is optimal for most situations.

However, the correct choice of power modulation level depends on each individual heating system and the specific facility conditions.

8.3 TIME / DATE

In the "BOILER SETTINGS" menu, select "TIME/DATE" using the "Λ" and "v" keys and enter the time and date settings with the "OK" key. The display is as follows:



Use the "Λ" and "v" keys to set the correct time and date, then confirm the change with the "SET" key, which returns you to the previous "BOILER SETUP" menu.

8.4 O.T.C. SETUP

In order to be able to use this mode of operation (Outdoor Temperature Compensation), it is necessary to mount an outdoor temperature sensor, which is part of the optional equipment and is not supplied with the boiler. The outdoor temperature sensor is mounted on the north side of the building, protected from atmospheric influences (direct radiation of the sun, as well as rain, snow...). In this mode, the microcontroller determines the required temperature of the system according to the external temperature, using one of the two operating curves that are set in the settings, or maintains a constant temperature that is also set in the settings for O.T.C. mode.

In the "BOILER SETUP" menu, select "O.T.C." SETUP" using the "Λ" and "v" keys and the "OK" key to enter this submenu. The display is as follows:



8.4.1 24h PROFILE

To set the 24-hour programming, press "OK" while "24h PROFILE" is flashing. There is now a graphic display on the display where you should choose the desired operating curve for each hour of the day, from 0 ÷ 24h, by which the boiler temperature will be determined, or const. the temperature that the boiler should maintain:

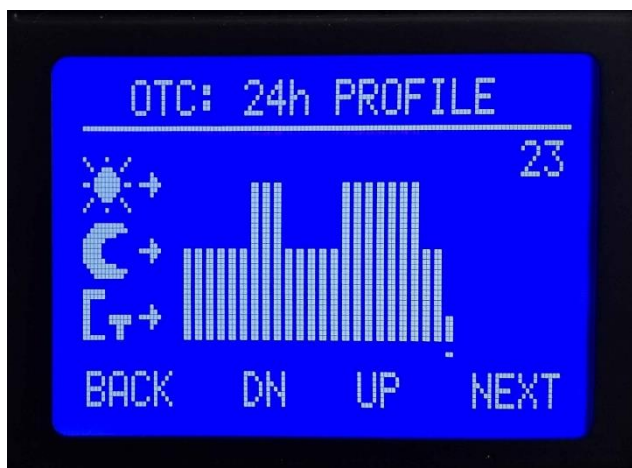


At the beginning of the setting, the column flashes for 0÷1h. Use „Λ“ и „v“ keys to select::

- ☀ DAILY (Comfortable) operating curve – symbol of the sun;
- ☾ NIGHT (economic) work curve - symbol of the moon;
- CT Constant temperature - Const. for that period.

Press the "OK" button to switch to the setting for the next hour: from 1÷2h. (In the upper right corner is a number that indicates the beginning of the period that is currently being set. At the beginning of the setting, it was "0", each time you press "OK" and move to the next setting period, it will increase by 1h). The procedure is repeated for each subsequent period of one hour and is confirmed by pressing the "OK" button, which moves to the setting for the next hour. After setting the last period, it is also necessary to confirm the setting by pressing the "OK" button and then exit the setting by pressing the "SET" button'.

The following picture shows an example of a set 24-hour program:



In the example shown, the following setting is selected:

- 0 ÷ 6h The boiler is controlled according to the external temperature according to the economic operating curve (Moon ☾)
- 6 ÷ 9h The boiler is guided by the outside temperature according to a comfortable working curve (Sun ☀)
- 9 ÷ 14h The boiler is controlled according to the external temperature according to the economic operating curve (Moon ☾)
- 14 ÷ 21h The boiler is guided by the outside temperature according to a comfortable working curve (Sun ☀)
- 21 ÷ 23h The boiler is controlled according to the external temperature according to the economic operating curve (Moon ☾)
- 23 ÷ 24h The boiler maintains a constant temperature defined when setting "Const".

8.4.2 DAILY (COMFORTABLE) CURVE

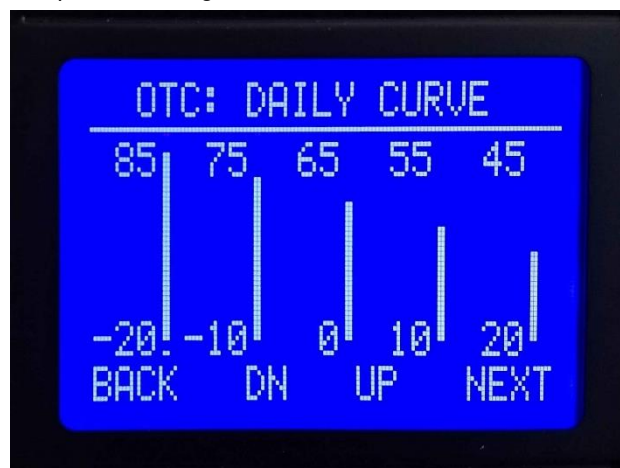
To set the DAILY curve, press "OK" while this display is flashing in O.T.C. the menu. There is now a graphic display on the display where for each of the 5 external temperature reference points (T_o): -20, -10, 0, +10, +20 you need to set the boiler temperature at that external temperature: Tset(-20), Tset (-10), Tset (0), Tset (+10) and Tset (+20).

At the beginning of the setting, a dot next to the outside temperature value flashes -20 °C, which indicates that the boiler temperature should be set for this reference point. Each press of the "▲" key increases the set boiler temperature by 1 °C, which is shown by changing the numbers in the upper part display, above this ref. points and by changing the number of cubes in the vertical column. Pressing the "▼" key reduces the set temperature by 1 °C. Pressing the 'OK' button - moving to the next reference point, and pressing the 'SET' button confirmation and return to the OTC mode menu.

Boiler temperature setting range for ref. point -20 °C starts from 10 °C, up to max. allowed boiler temperatures in "Technical settings". The factory default value is 90 °C, this is the range (if the boiler's max. temp. is not reduced in the technical settings): Tset (-20) = 10 °C ÷ 90 °C.

The boiler temperature adjustment range for the point -10 °C is: Tset (-10) = Tset (-20) - 10 °C ÷ Tset (-20) °C, that is, the minimum temperature that can be set for the reference point Tset (-10) is 10 °C lower than that set for the previous point, and the maximum which can be set is identical to the temperature set for the previous point, in this case it is Tset (-20).

The same restrictions apply to the adjustment in the remaining points. In this way, it is ensured that the working line has a proper appearance and that the slope of the working line is not too great. An example of a setting "DAILY CURVE":



- At an outside temperature of -20 °C, the boiler will maintain 85 °C
- At an outside temperature of -10 °C, the boiler will maintain 75 °C
- At an outside temperature of 0 °C, the boiler will maintain 65 °C
- At an outside temperature of +10 °C, the boiler will maintain 55 °C
- At an outside temperature of +20 °C, the boiler will maintain 45 °C

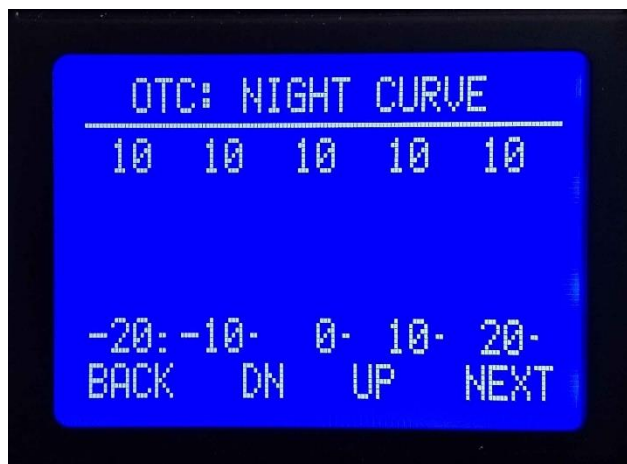
After setting the operating curve, confirm and remember the set parameters by pressing the "SET" button, which returns the display to the OTC menu.

The factory (default) settings are as follows:

Tset (-20) = 70 °C; Tset (-10) = 60 °C; Tset (0) = 50 °C;
Tset (+10) = 40 °C; Tset (+20) = 30 °C;

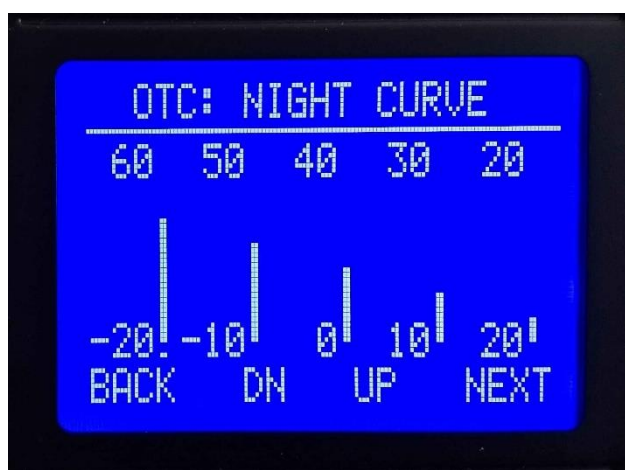
8.4.3 NIGHT (Economic) CURVE

Setting the NIGHT curve is identical to setting the DAY curve: Press "OK" while "NIGHT CURVE" is flashing in O.T.C. the menu. The display now has a graphic display that shows for each of the 5 reference points the external temperature (T_o): -20, -10, 0, +10, +20 set the boiler temperature at that outside temperature: Tset(-20), Tset (-10), Tset (0), Tset (+10) and Tset (+20). Appearance of an unadjusted Night Curve:



At the beginning of the setting, a dot next to the outside temperature value flashes -20 °C, which indicates that the boiler temperature should be set for this reference point. Each press of the "▲" key increases the set boiler temperature by 1 °C, which is shown by changing the numbers in the upper part display, above this ref. points and by changing the number of cubes in the vertical column. Pressing the "▼" key reduces the set temperature by 1 °C. Pressing the 'OK' button - moving to the next reference point, and pressing the 'SET' button confirmation and return to the OTC mode menu.

Boiler temperature setting range for all ref. points is the same as with the "Daily Curve". Example of a set "NIGHT CURVE": (this is also the factory setting) is in the following picture:



- At an outside temperature of -20 °C, the boiler will maintain 60 °C
 - At an outside temperature of -10 °C, the boiler will maintain 50 °C
 - At an outside temperature of 0 °C, the boiler will maintain 40 °C
 - At an outside temperature of +10 °C, the boiler will maintain 30 °C
 - At an outside temperature of +20 °C, the boiler will maintain 20 °C
- After setting the operating curve, confirm and remember the set parameters by pressing the "SET" button, which returns the display to the OTC menu.

8.4.3 CONSTANT VALUE

To set this value, press "OK" while the display "CONSTANT VALUE" flashes in the O.T.C. the menu. The display now shows:



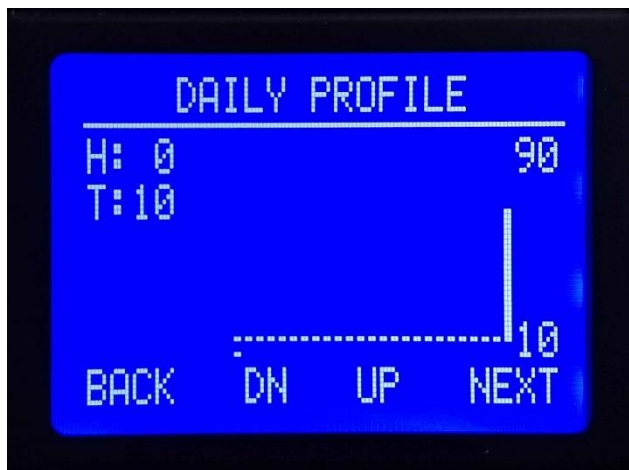
Using the "▲" and "▼" keys, set the temperature value that the boiler will maintain in the periods defined in the 24h Profile O.T.C. mode.

The factory (default) settings are: 50 °C

8.5 DAILY PROFILE

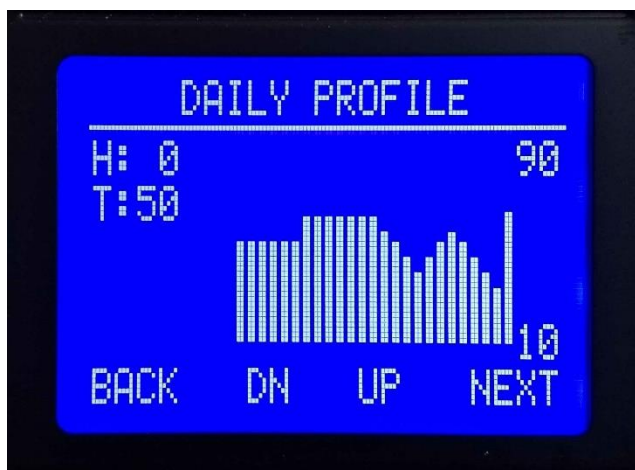
In the "BOILER SETTINGS" menu, use the "^" and "v" keys to select "DAILY PROFILE", select with the "OK" key and enter this submenu. In it, a 24-hour profile (Program) is set, according to which the boiler maintains the temperature for 24 hours, every day - as long as it is in the "MANUAL PROFILE" operating mode. (→ 8.1.1.2).

There is now a graphic display on the display where you need to choose the desired temperature that the boiler will maintain for every hour of the day, from 0 ÷ 24h :



At the beginning of the setting, a dot flashes below the temperature value for the period of 0h÷1h, which indicates that the boiler temperature should be set for this period. In the upper left corner of the display there is another indicator that defines the beginning of the period to be adjusted: "H: 0". In this case, it is a period that starts at 0h and ends at 1h. Each press of the "^" button increases the set temperature of the boiler by 1 °C, which is shown by changing the height of the vertical column above the flashing dot, and by changing the temperature value shown in the upper part of the display, in this case "T: 10". Pressing the "v" key reduces the set temperature by 1 °C. Pressing the 'OK' button - switching to the next period, and pressing the 'SET' button confirmation and return to the previous menu.

The boiler temperature adjustment range is from 10 °C, up to max. allowed temperature of the boiler which is defined in "Technical settings" (→ 10.4). The factory setting is 90 °C, so the range (if the boiler's max. temp. is not reduced in the Technical settings) is: Tset = 10 °C ÷ 90 °C. An example of a complete 24h Profile (program) is in the following picture:



8.6 LANGUAGE SELECTION

In the "BOILER SETTINGS" menu, use the "^" and "v" keys to select "LANGUAGE SELECTION" and use the "OK" key to enter this submenu. Using the keys "^" and "v" it is possible to select Serbian or English language:



Use the "SET" key to confirm the selection, which is also a return to the previous menu.

8.7 INFORMATION

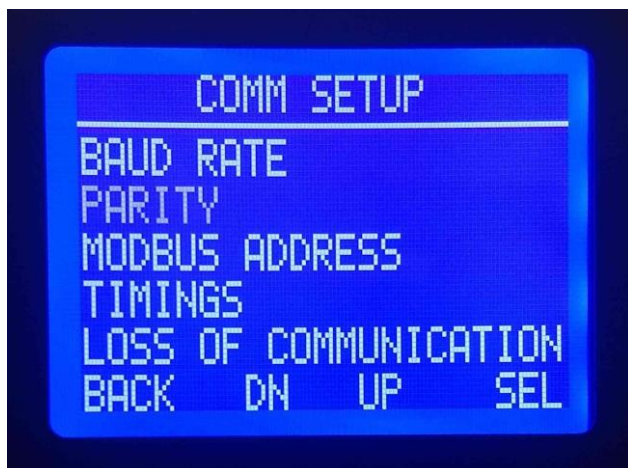
In this menu, information is available about the hardware version of the CPU board, the software version and the unique identification serial number of the microcontroller embedded on the CPU board.



In the example from the picture above, it is about hardware (that is pcb) "EK_CPU_1_5" and software version: "vs15.03.004" and the unique identification number of the microcontroller is "08683913"

9. COMMUNICATION

In order for the boiler to be able to communicate with the Cascade regulator, or the centralized monitoring and control system, the settings in this submenu should be made via the ModBus RTU (RS485) protocol. The procedure for entering this sub-menu is as follows: When the basic view is on the display, you should hold down the "SET" key for ≈ 5 seconds to enter the "MAIN MENU", and then use the " $\wedge$ " and " $\vee$ " keys to select "COMM SETUP" and confirm the selection by pressing the "OK" key. The display shows the following:



9.1 BAUD RATE

By briefly pressing the "OK" button while "BAUD RATE" is flashing, a submenu for selecting the communication speed opens. The factory setting is 9600bps, and using the keys " $\wedge$ " and " $\vee$ " it is possible to choose (from the list) the speed of: 2400bps, 4800bps, ..., 19200bps.



Confirmation of the selected speed is done with the "OK" key, which returns to the "COMM SETUP" submenu, where the next parameter ("PARITY") that can be selected for adjustment is flashing, or with the " $\wedge$ " key. and " $\vee$ " to go to the setting of another parameter from this menu.

9.2 PARITY

The factory setting is "NO PARITY" and if the boiler is connected to the Cascade control device (CPK09-M) it should not be changed. The display is shown in the following picture:



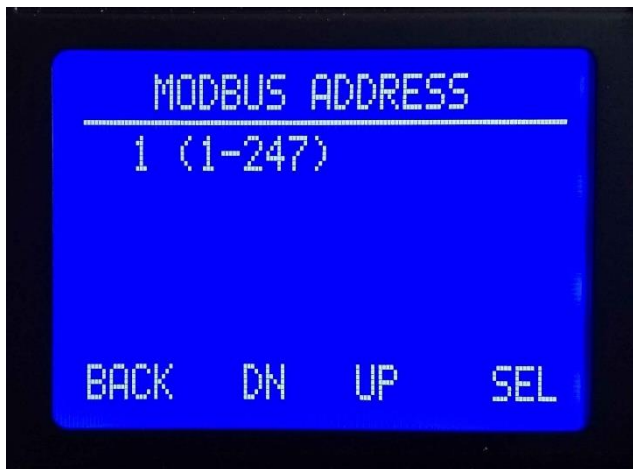
If the boiler is connected to a centralized monitoring and control system, the setting of this parameter should be coordinated with it, i.e. it is possible (with the " $\wedge$ " and " $\vee$ " keys) to select (from the list), the parity type:

- "EVEN PARITY" or
- "ODD PARITY".

Confirmation of the selected parity type is done with the "OK" button, which returns to the "COMM SETUP" submenu, where it is possible to choose another parameter setting, and by default, when returning from the "PARITY" setting, the parameter flashes: "MODBUS ADDRESS".

9.3 MODBUS ADDRESS

This parameter is factory-set to "1" and if the boiler works independently and is connected to a centralized monitoring and management system, it should not be changed, or in case of change, a unique address (from 1 ÷ 247) should be assigned, according to the specific configuration of the communication network.



If several boilers are controlled by the cascade regulator CPK09-M, each boiler should be assigned a unique address, from 1 to 10.

Confirmation of the selected address of the boiler is done with the "OK" button, which returns to the "COMM SETUP" submenu, where it is possible to select the setting of another parameter, and by default, when returning from the "MODBUS ADDRESS" setting, the parameter flashes : "MODBUS ADDRESS".

9.4 TIMINGS

In order for the boiler to communicate properly with the Cascade regulator, or the centralized monitoring and control system, the times in this submenu should be set correctly. The factory setting is as in the following picture:



T1 - The time from the reception of data (queries) sent from the cascade regulator or centralized monitoring and control system to the start of sending the response by the boiler.

T2 - The time from the permission to send data (response) from the boiler to the start of sending data by the boiler.

T3 - Time from the end of sending data (response) by the boiler until the permission to send data is turned off by the boiler.

The factory-set times are optimal for boiler communication with the CPK09-M Cascade Regulator.

If the boiler needs to communicate with a centralized monitoring and control system and these time settings do not match, they should be adjusted.

9.5 LOSS OF COMMUNICATION

If there is a communication break (→ 8.1.2.1) between the boiler and the Cascade regulator, or between the boiler and the BMS, the boiler will continue to work according to the mode selected here. The factory setting is "Continue with the current". This means continuing to operate according to the last parameters received from the cascade regulator (or BMS), as in the following figure:



Using the keys "▲" and "▼" it is possible to choose (from the list) one of 2 additional options.

The second option is: "Continue with 24h Profile".

The boiler will continue to working according to the set 24-hour profile, explained in chapter 8.5.

The third option is: "Reduce Power to Zero".

The boiler will set the target power to 0kW, which means the boiler will wait for communication to recover, with the heaters turned off.

You should choose the mode of operation that best corresponds to the specific conditions and requirements that the boiler should realize.

10. TECHNICAL SETTINGS

In this sub-menu, essential parameters essential for the proper operation of the device can be viewed and set, and access to it is possible only by entering a PIN code..



WARNING: This sub-menu is intended for professionals, i.e. authorized service personnel who have the appropriate knowledge needed to configure the CPU unit of the boiler.

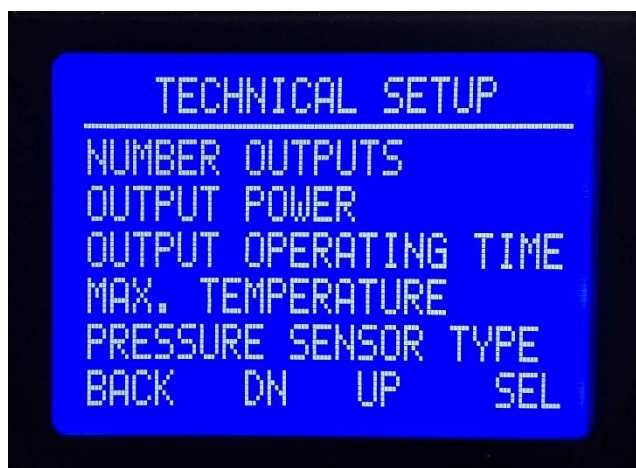
Any change of parameters in this section by non-professionals can cause significant damage to the boiler and serious injury to people.

The procedure for entering this sub-menu is: When the basic view is on the display, hold down the "SET" key for ≈5 seconds to enter the "MAIN MENU", and then use the "Λ" and "v" keys ' select "TECH SETUP" and confirm the selection by pressing the "OK" button. The display shows the following:



To enter "TECH SETUP" you need to enter the PIN code. First, use the keys "Λ" and "v" to define the first digit (which blinks when this display is opened). Confirm and switch to setting the next digit with the "OK" button. When the last digit is selected and confirmed with the "OK" button, enter "TECH SETUP":

Due to the volume, 3 screens are needed to display this submenu, the image below shows the first of them:



Selecting an item for viewing and setting, as well as switching from one screen to another, is done using the "Λ" and "v" keys. The display of the second screen of this menu is given in the following picture:

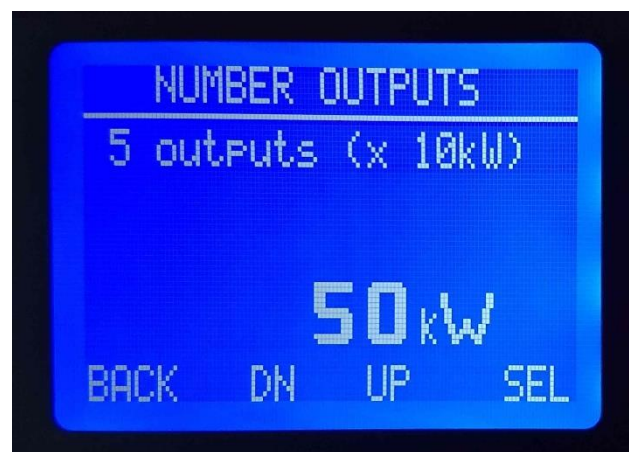


The display of the third screen of this menu is given in the following picture:



10.1 NUMBER OF OUTPUTS

The CPU has at its disposal a maximum of 10 "outputs" intended for the control of heating groups, that is, in this submenu it is possible to define the number of heating groups to which the nominal power of the boiler will be divided. The possible number of "outputs", ie heating groups, is from 1 to 10. Example: Number of heating groups = 5; Power of the heating group = 10kW; Based on these 2 parameters, the CPU itself calculates the nominal power of the boiler, in this case: 50kW; Example in the next picture:



10.2 OUTPUT POWER

In this submenu, the "output" power (heating group) is defined. Example of a 50kW boiler: Heating group power = 10kW;



The "output" power (heating group) can be adjusted in the range of 1÷100kW, in steps of 1kW. After changing this parameter, the CPU recalculates the nominal power of the boiler. In case the "OUTPUT POWER" is set to 10kW, the CPU will set the nominal power value to: 50kW (because the output number is set to 5).

10.3 OUTPUT OPERATING TIME

The time (in minutes) defined in this submenu is the maximum continuous operation time of the "output" when the boiler is in power modulation mode.

In power modulation mode, a certain number of heating groups will be inactive (switched off). If one of the active, i.e., switched on "outputs" (heating groups) reaches the continuous operation time in one cycle defined in this submenu, the CPU will turn it off and instead switch on the "output" (heating group) that was until then was inactive.

In this way, the CPU maintains the same engaged power that is needed at that moment, but it does so by changing the heating groups in order to evenly distribute the load on all heating groups, i.e. all boiler components (contactors, heaters...) - which contributes to a longer lifetime of all components and the device as a whole.

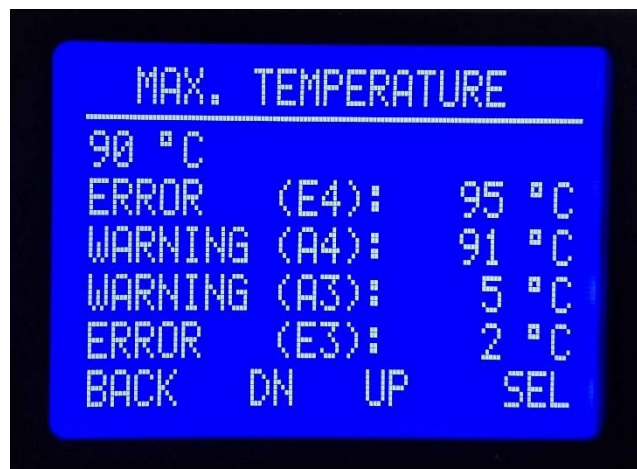
The setting range of this time is from 1 minute to 240 minutes. The factory setting is 90 minutes, as in the picture below:



10.4 MAX TEMPERATURE

In this submenu, the maximum allowed temperature of the boiler that can be set when setting the "Set temperature" is defined" (→ 8.1.1.1).

The factory setting of this parameter is 90 °C:

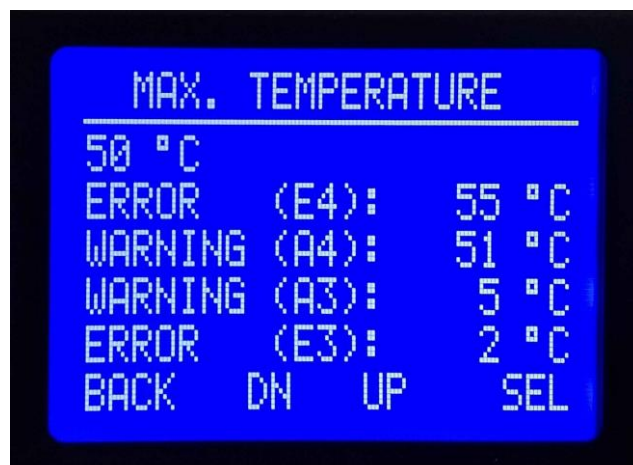


In addition to the maximum temperature value, the display also shows the temperature limit values at which warnings (A3, A4) and errors (E3, E4) will be activated.

The user can choose one of the following Max. temperature: 50 °C; 60 °C; 70 °C; 80 °C; 90 °C; Temperature limit values at which warnings (A3, A4) and errors (E3, E4) will be activated, will automatically change according to the choosed parameter of Max. temperature. Confirmation and move to the next parameter setting using the "OK" key.

NOTE: Always set this parameter according to the actual conditions of the specific heating system. For example: With underfloor heating, you should set "Max. temperature" at 50 °C because in the case of exceeding the warning and error information will appear at lower temperatures and thus prevent possible damage to the heating system due to overheating.

Example of setting the maximum allowed temperature to 50 °C. It can be seen that the temperature limit values at which warnings (A3, A4) and errors (E3, E4) will be activated have also been automatically changed.



10.5 PRESSURE SENSOR TYPE

Depending on the Maximum permissible working pressure and other conditions, one of the 3 types of pressure sensors (transmitters) listed in this submenu is installed in the boiler. During the installation and testing of the boiler in the factory, the appropriate pressure sensor was selected, so the sensor type in this submenu should be changed only in the case of replacing the factory installed sensor with a new one, or in the case of replacing the CPU unit, when it is possible that the default set sensor type differs from the actual one built-in type of sensor in the boiler.



10.6 MAXIMUM PRESSURE

In this submenu, the Maximum allowed working pressure in the boiler is defined, after exceeding which the CPU will block the operation of the heater. During assembly and testing of boilers from serial production in the factory, this parameter is set to 4 bar, because safety valves at 4 bar are also installed on the boiler as standard.

The exception is boilers manufactured for max. pressure 6bar, which are produced on request and have a built-in "Danfoss" pressure sensor, which must be selected in the previous submenu, where the Max. the pressure can be set to 6bar.

Display with the selected maximum pressure of 4bar:



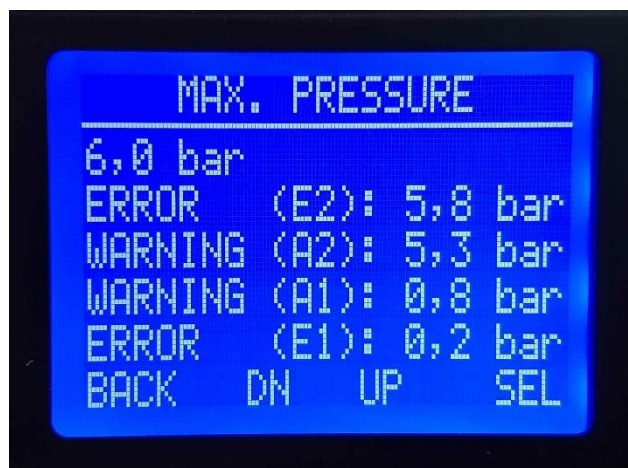
In addition to the maximum allowable pressure, where the possible values are: 3bar, 4bar (specially 6bar), the pressure limit values at which warnings (A1, A2) and errors (E1, E2) will be activated can be slightly corrected ($\pm 0.2\text{bar}$). Change the parameters using the " $\wedge$ " and " $\vee$ " keys, confirm and move to the next parameter setting with the "OK" key, and return to the previous menu with the "SET" key.

Display with the selected maximum pressure of 3bar:

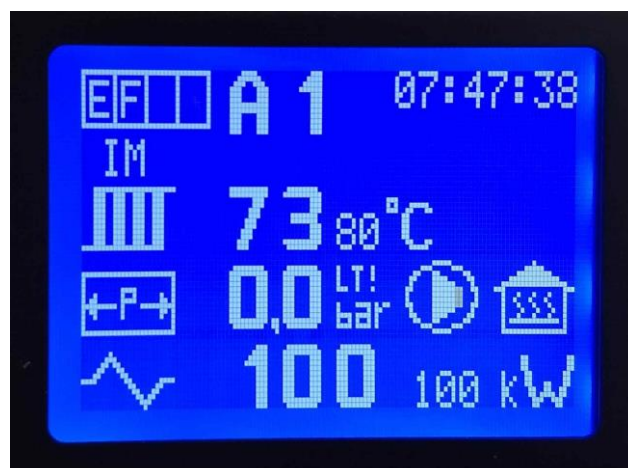


It can be seen that the pressure limit values at which warnings (A1, A2) and errors (E1, E2) will be activated have also been automatically changed.

Display on the display with the selected maximum pressure of 6bar:

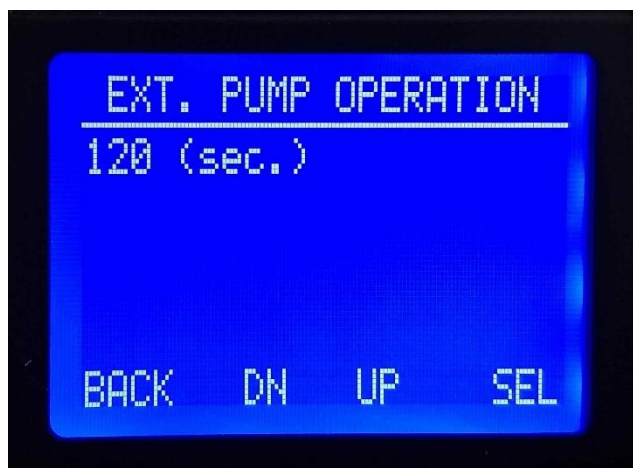


If (for any selected Max. pressure) the limit value of the low pressure error is set to **E1 : 0bar**, the boiler will work normally and without pressure in the system, that is, only the low pressure warning will flash on the display, but the boiler will not enter an error E1. Example in the next picture:



10.7 DELAYED PUMP OPERATION

After the remote shutdown of the boiler, the pump continues to work for some time due to the removal of heat energy dissipated from the still hot heaters immediately after the shutdown, after which it switches off. This applies if the pump is controlled by a signal from the boiler (→ 8.1.1.1) . Delayed shutdown can be set in this submenu in the range of 30sec ÷ 240sec and the factory setting is 120 seconds.



Using the "▲" and "▼" keys, it is possible to change the value of this parameter, confirm with the "OK" key, and return to the previous menu with the "SET" key.

10.8 FLOW DETECTION TIME

When the pump is turned on, the Flow Switch will not detect flow immediately. The time after which the normal flow will be established and the Flow Switch will be activated depends primarily on the type and power of the circulation pump. In order for the boiler not to go into lockout due to the time it takes to restore normal flow from the moment the pump is turned on, the processing of the flow information from the Flow Switch is delayed by the time defined here.

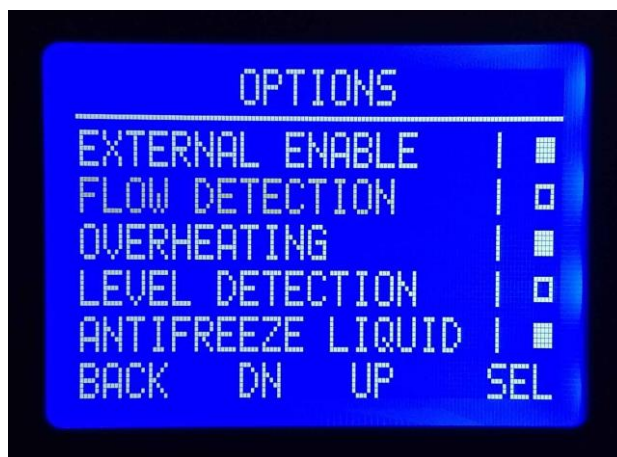


The factory setting is 5 seconds, the adjustment range is 2÷10sec. Setting is done with the "▲" and "▼" keys, confirmation with the "OK" key, return with the "SET" key.

10.9 OPTIONS

In this submenu, it is possible to allow or prohibit the processing of some input signals, certain operating modes and the operation of 4 signal relays.

Due to the volume, 3 screens are needed to display this submenu, the image below shows the first of them:



- **EXTERNAL ENABLE** : Permission / prohibition of signal processing from an external operating condition (room thermostat or other remote start/stop signal). If it is forbidden, the boiler works as if it has this condition all the time, and if it is allowed, the boiler works only when it receives permission from the external condition for operation. The factory setting is: Allowed.

- **FLOW DETECTION** : Permit / prohibition of signal processing from the Flow Switch. If it is forbidden, the boiler works as if there is constant flow, and if it is allowed, the boiler works only when it receives a signal from the Flow Switch about the existence of flow. The factory setting is: Allowed.

- **OVERHEATING**: Permission / prohibition of processing the signal about the status of the Safety Thermostat. If it is prohibited, the CPU of the boiler does not have the information whether the independent safety thermostat has detected overheating and turned off the contactors. (The Safety Thermostat break the control circuit and switches off the contactors, i.e. the heaters, if it detects overheating). If allowed, the CPU has this information and can send it to the Cascade controller or the BMS. The factory setting is: Allowed.

- **LEVEL DETECTION**: Permission / prohibition of signal processing from the water level indicator in the boiler. If it is forbidden, the boiler works as if the water level is always good, and if it is allowed, the boiler goes into blocking if it receives information that the water level in the boiler is low.

NOT AVAILABLE IN THIS DEVICE VERSION.

- **ANTIFREEZE LIQUID** : May be activated only when the system is filled with antifreeze. If this option is activated, the boiler works even at low temperatures of the media in the system, because it is protected against freezing. The factory setting is: Prohibited.

Selecting an item for viewing and setting, as well as switching from one screen to another, is done using the "▲" and "▼" keys.

The display of the 2nd screen of this menu is given in the following picture:



- ANTI-FREEZE PROGRAM : Program to protect the system from freezing - **NOT AVAILABLE IN THIS VERSION OF THE DEVICE.**

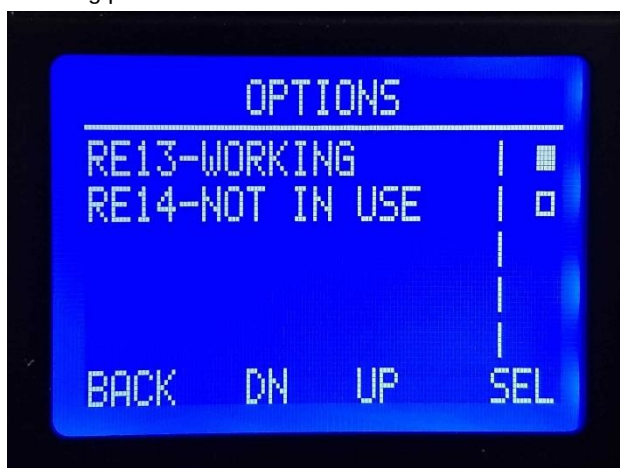
- RETURN PIPE TEMP. : Boiler return temperature measurement - **NOT AVAILABLE IN THIS DEVICE VERSION.**

- TEMP. RATE: Measurements of the temperature of the boiler's return and pressure lines are used for dynamic power modulation, i.e., the engaged power is affected by the dynamics of the return and pressure line temperatures in real time, as well as their difference - **NOT AVAILABLE IN THIS VERSION OF THE DEVICE.**

- RE11- PUMP : Permission/Prohibition of the operation of the relay (output) RE11, which is intended to control the operation of the pump. The factory setting is: Allowed.

- RE12- ERROR : Permission/Prohibition of operation of the relay (output) RE12, which is intended for the fault relay signal. The factory setting is: Allowed.

The display of the 3rd screen of this menu is given in the following picture:



- RE13 - WORKING: Permission/Prohibition of operation of relay (output) RE13, which is intended for the relay signal "Boiler in operation". The factory setting is: Allowed.

- RE14 : Enable/Disable operation of relay (output) RE14, which is not used in this version of the device.

10.10 PIN CHANGE

The factory-set PIN for entering technical settings is the same for all boilers: **PIN: 1111**. In this submenu, you can select and set a new PIN for viewing and setting items, as well as switching from one screen to another using the "∧" and "∨".



The first digit to be set using the "∧" and "∨" keys flashes. Confirmation and moving to the next digit is done with the "OK" button. In this way, all digits of the new PIN should be entered:



Confirming the last digit opens the display with the new PIN:



The new PIN should be saved by pressing the "OK" button or cancel the change by pressing the "SET" button:

10.11 SAVE CONFIGURATION

The CPU unit is identical for all boiler powers. When installing at the factory or replacing it at the service center, it is necessary to configure the CPU according to the boiler in which it is installed. The factory settings are given in the manual through the descriptions of the menu and functions of the boiler.

Also, if parameters were changed in any menu during the exploitation of the device (eg: power modulation level, activated option "ANTIFREEZE LIQUID"...), this function can save them as a configuration that will be loaded during CPU reset



NOTE: With the "Save Configuration" function, all parameter settings in all menus (Boiler settings, Communication, Technical settings) will be saved and ready for loading by activating the "Load Configuration" function. The only parameters that are not recorded as part of the configuration and remain the same are the Set Temperature (10 °C) and the Set Power (0kW).

Display on the display after activation of SAVE CONFIGURATION by pressing the "OK" button while this option is flashing:



After recording the parameters, the display shows :



10.12 LOAD CONFIGURATION

Activating this function loads the parameters recorded in the "Save Configuration" submenu into the CPU memory, whether they are the factory settings or later, during the exploitation of the recorded values. The display after activating this function is shown in the picture :



Loading the parameters usually takes ≈1 minute, after which the information appears that the parameters have been successfully written into the working memory, the CPU is quickly reset and is ready to work



10.13 LOAD FACTORY CONFIGURATION

Activating this function loads the factory-set parameters into the CPU memory, they are stored in a protected part of the memory and cannot be changed when setting up and recording the configuration on the boiler itself by the service technician.



NOTE: With the "LOAD FACTORY CONFIGURATION" function, all settings in all menus (Boiler settings, Communication, Technical settings) will be returned to the factory default values for a specific model and boiler power as they were set when the boiler was delivered to the customer.

Activating this function shows on the display:

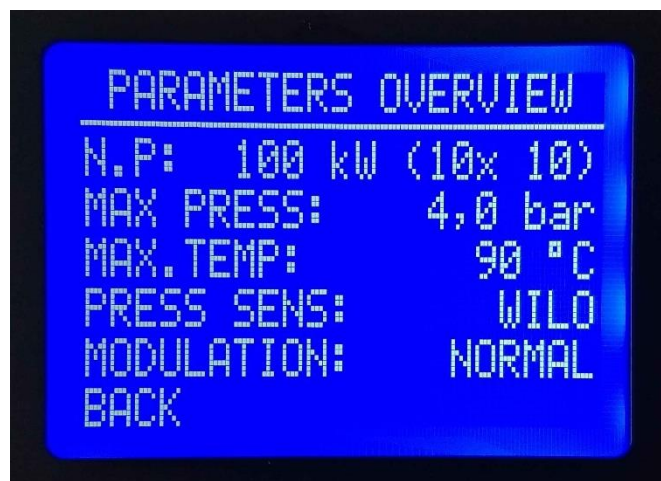


Loading the parameters usually takes ≈ 1 minute, after which the information appears that the parameters have been successfully written into the working memory, the CPU is quickly reset and is ready to work:



11. OVERVIEW OF THE PARAMETERS

In this submenu, the settings of vital parameters for the operation of the boiler can be seen on one display. Example in the picture:



It can be seen from the example that it is a boiler with nominal power (N.P) 100kW, Max. the allowed pressure is set to 4bar, Max. temperature at 90 °C, Pressure sensor type "Wilo" is installed, Power modulation is set to "Normal".

12. Control of the boiler operation

12.1 Errors and warnings

- A1** Pressure below value defined in 10.6 (WARNING A1): The boiler operates normally, and the warning "A1" blinks.
Recommendation: Fill the system to a pressure above the value defined in 10.6 (WARNING A1).
- A2** Pressure above value defined in 10.6 (WARNING A2): If the pressure rise above defined value, the boiler operates normally, and the warning "A2" blinks.
- A3** Temperature below 5 °C: The boiler operates normally until the temperature drops to 2 °C and the warning "A3" blinks.
Recommendation: check the functionality of the device
- A4** Temperature above value for A4, according to MAX TEMPERATURE defined in 10.4: The boiler operates normally and the warning "A4" blinks. Recommendation: check the temperature sensor, contactors, valves and piping.
- E0** Problem with eeprom memory: CPU does not have valid initial data - device operation blocked.
Recommendation: Turn off the power to your device and call for service, CPU replacement is probably required.
- E1** Pressure below value defined in 10.6 (ERROR E1): Heaters and pump relay (after 2 minutes) switched off.
Recommendation: Refill the system to a pressure above the value defined in 10.6 (WARNING A1) and the boiler will automatically resume operation according to the predefined power and temp., without having to reset or re-adjust parameters.
- E2** Pressure above value defined in 10.6 (ERROR E2): If the pressure rise above defined value, CPU will turn off the heaters, and E2 will blinks on display. Pump relay switched off after 2 minutes.
Recommendation: Drain the water to a pressure below value defined in 10.6 (WARNING A2) and the boiler will automatically resume operation according to the predefined power and temperature, without having to reset or re-adjust the parameters.

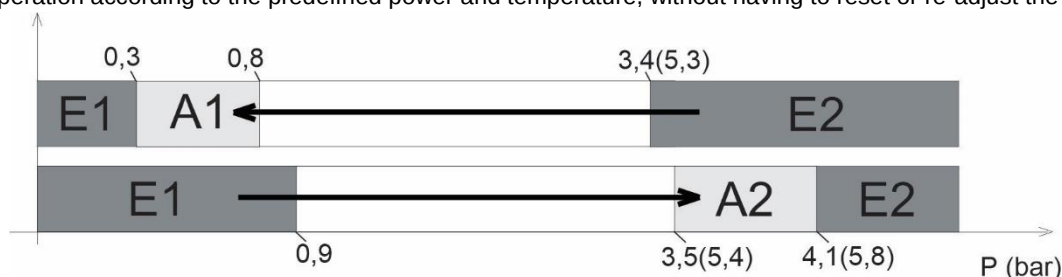


Image 9: Warnings and errors caused by pressure

- E3** Temperature equal to or below 2 °C: Pump and heater operation is not allowed due to the risk of some part of the system being frozen. The alarm signal lamp blinks.
Recommendation: Turn off the power to the device and check the installation status
- E4** Temperature equal to or above value for E4, according defined MAX TEMPERATURE in 10.4: Heater operation is not allowed due to the risk of overheating. The pump relay switches on (regardless of the status of the start signal) to turn on the pump and thereby reduce the boiler temperature (If the pump is operated externally, the signal from the CPU to turn on the pump has no effect.)
Recommendation: Turn off the power of the device to check the functionality of the temperature sensor, contactors, valves and piping

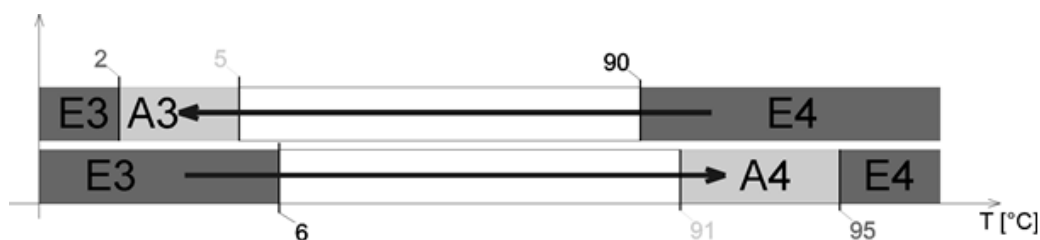


Image 10: Warnings and errors caused by temperature

- E5** There is no flow and the start signal is given: Operation of the heater is not permitted due to danger of overheating. Pump relay turns on (regardless of the start signal status) to turn the pump on and in that manner prevent eventual overheating due to heaters operating without existence of flow in the boiler (If the pump is operated externally, the signal from CPU for turning on the pump has no effect).
Recommendation: Turn off power to the device and check if pump sensor, flow sensor, valves and pipe grid are working correctly.
- E6** Boiler temperature sensor, or outdoor temperature sensor in interruption or short circuit: Heater operation is not allowed due to danger of overheating. The pump relay is also switched off.
Recommendation: Turn off the power to the device to check the functionality of the temperature sensor.
- E8** Pressure sensor in interruption or short circuit: The heater is not allowed to operate due to the risk of overheating. The pump relay is also switched off.
Recommendation: Turn off the power to the device, check the functionality of the pressure sensor.
- E9** An independent mechanical Safety thermostat has detected overheating of boiler. DNO turns off KP1, KP2 - the heater's power supply is cut off, until the service technician resets the Safety Thermostat and manually turns on MCCB1.

12.2 Error and warning priorities

Multiple warnings and errors may occur at the same time during operation. Only one can be displayed, so the one with the highest priority will be displayed. After fixing it, an error with the next priority (if any) will be displayed.

List of priorities:

E0	Problem with eeprom memory
E5	There is no flow and the start signal is given
E6	Boiler temperature sensor, or outdoor temperature sensor in interruption or short circuit
E3, E4	Temperature outside permitted limits
E8	Pressure sensor in interruption or short circuit
E1, E2	Pressure outside the permissible limits
E9	Overheating of boiler

12.3 Protective elements

In order for the heaters to be switched on, the circulation pump must be switched on.

A flow switch is installed on the boiler on the boiler return line, which is electrically connected as a condition in the control circuit which interrupts the control voltage of the contactor, i.e. does not allow the heater to switch on if it did not detect the existence of flow through the boiler. If the pump is on and there is water flow through the boiler, the contact system of the flow indicator is closed and the heaters can be switched on.

In addition to the electronic temperature sensor, which provides information to the thermostat, an independent safety capillary thermostat (ST) is mounted on the boiler. In the event of a temperature rise above 95 °C, it switches on, and activates the Shunt trip release built into MCCB (Molded Case Circuit Breaker), which leads to turning off the MCCB, i.e. the power supply interruption. To start the boiler again, the temperature in the boiler must be returned to normal, in order to be able to reset the safety thermostat (manual reset) and to enable the automatic fuses / compact switches to be switched on manually.

Reactivation of the boiler must be carried out by an authorized person (servicer) as it determines the cause of the boiler overheating and corrects the fault if it exists.

Another protective thermostat (ZT) is located on the boiler switchboard. When the temperature on the boiler switchboard reaches 40 °C it switches on the fans for forced cooling of the switchboard environment, and if the temperature in the area where the automation is located rises above 90 °C turns off the control circuit voltage, which prevents the contactor and heater from switching on.

Short-term protection is provided by 3p C40A automatic fuses for each heater. The fuses are three-pole, so in the event of failure of any segment of the heater, they switch off the power of the complete heater (20kW). When replacing the fuse, be sure to install a fuse of the same characteristics.

Protection against extreme pressure increase in the boiler and heating installation is provided by safety valves with a nominal opening pressure of 4,5bar, mounted on the boiler thrust connection.

12.4 Remote start/stop

This device has the ability to be turned on or off remotely via a room thermostat or another device for controlling the heating system. It must be installed in the reference room.

Radiators in the reference room should not be equipped with thermostatic valves, or they must always be open. All radiators in other rooms can be equipped with thermostatic valves. Connection of external conditions for boiler operation is shown in chapter 5.3.

12.5 Heating Interruption

In case of a short-term interruption of the heating operation, the temperature of the boiler must be lowered using the boiler's thermostatic regulator. In order to prevent the heating installation from freezing, the temperature of the boiler must not be set below 10°C. In the event of a longer heating interruption, the boiler must be put out of operation, and the hydraulic installation drained.

12.5.1 Putting the boiler out of operation

If the heating installation is not in operation, it could freeze at low temperatures.

- ▶ Protect the heating installation from freezing.
- ▶ If there is a risk of freezing and the boiler is not in operation, drain the installation.
- ▶ Set the main switch on the control panel to position "0" (off).



When the device is put out of operation for a long time, the heating pump can be blocked. (→ 4.6.2).

13 Components arrangement

Access to the switchboard is allowed only to qualified professionals. Before opening the cover, turn off the power supply.



13.1 Arrangement of components in a boiler of 40kW nominal power

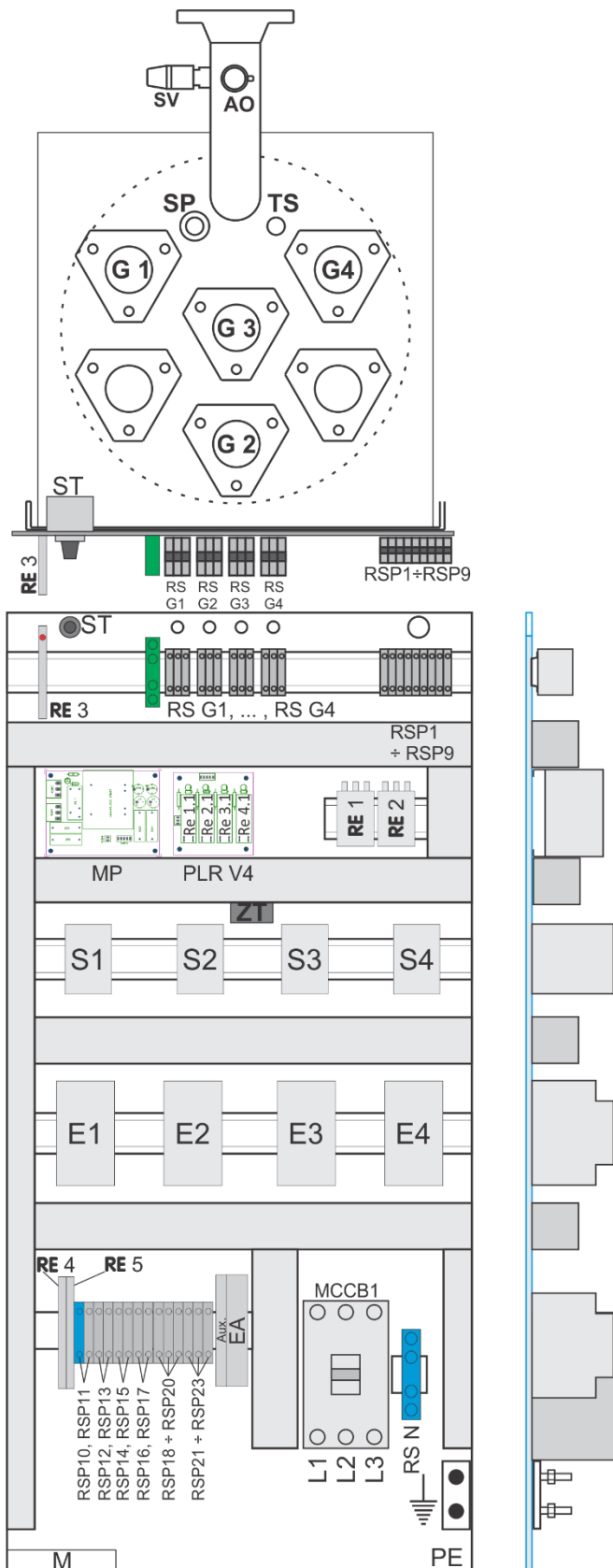


Image 11: Switchboard and top plate of vessel a boiler power 40kW

SV	Safety Valve 4,5bar
AO	Automatic Air valve
FS	Flow Switch
G1 ÷ G4	Heater 10kW; 3-phase
SP	Pressure Sensor (Transmitter)
TS	Boiler Temperature Sensor (KTY81-110)
ST	Safety Thermostat NO95 °C activation of Shunt Trip Release (built into MCCB1)
ZT	Switchboard Safety Thermostat; Fan activation (NO 40 °C); break contactors control circuit (NC 90 °C)
RS G1 ÷ RS G4	Heaters connection terminals
RSP 1 ÷ RSP 3	Control circuit supply terminals
RSP 4, RSP 9	Terminals for sensors and signals
RE 1	Remote start / stop Relay
RE 2	Flow Switch Relay
RE 3	Overheating Relay
RE 4	Fault Relay
RE 5	Boiler in operation Relay
PLR V4	Relay boards, contactors on/off control
MP	Power supply board MMB2408VX4 - power supply for EK_CPU_1_5) and PLR1, PLR2
S1, ..., S4	Contactor BENEDICT K3-10ND10 (Ith=25A)
E1, ..., E4	3P C25A Three pole MCB for each heater
MCCB1	Molded Case Circuit Breaker (160A; 36kA)
EA	1-p MCB for control circuit (C6A) with upgraded Auxiliary contact
RSP 10, RSP 11	Pump control clamps (230V AC I _{max} 2A)
RSP 12, RSP 13	Remote start/stop (230V)
RSP 14, RSP 15	Clamps for Outdoor Temperature Sensor
RSP 16, RSP 17	Clamps for External Safety Thermostat
RSP 18 ÷ RSP 20	Clamps for ModBus communication between the boiler and Cascade Controller, or previous boiler in the cascade connection (or centralized system for remote monitoring and control, eg: SCADA, BMS...).
RSP 21 ÷ RSP 23	Clamps for ModBus communication with the next boiler from the cascade connection. On the last boiler in the cascade connection, a terminating resistor (120 Ohm) should be connected to the auxiliary terminals RSP21, RSP22 (A and B).
RS N	Neutral line clamp
M	Fan

13.2 Arrangement of components in a boiler of 50kW nominal power

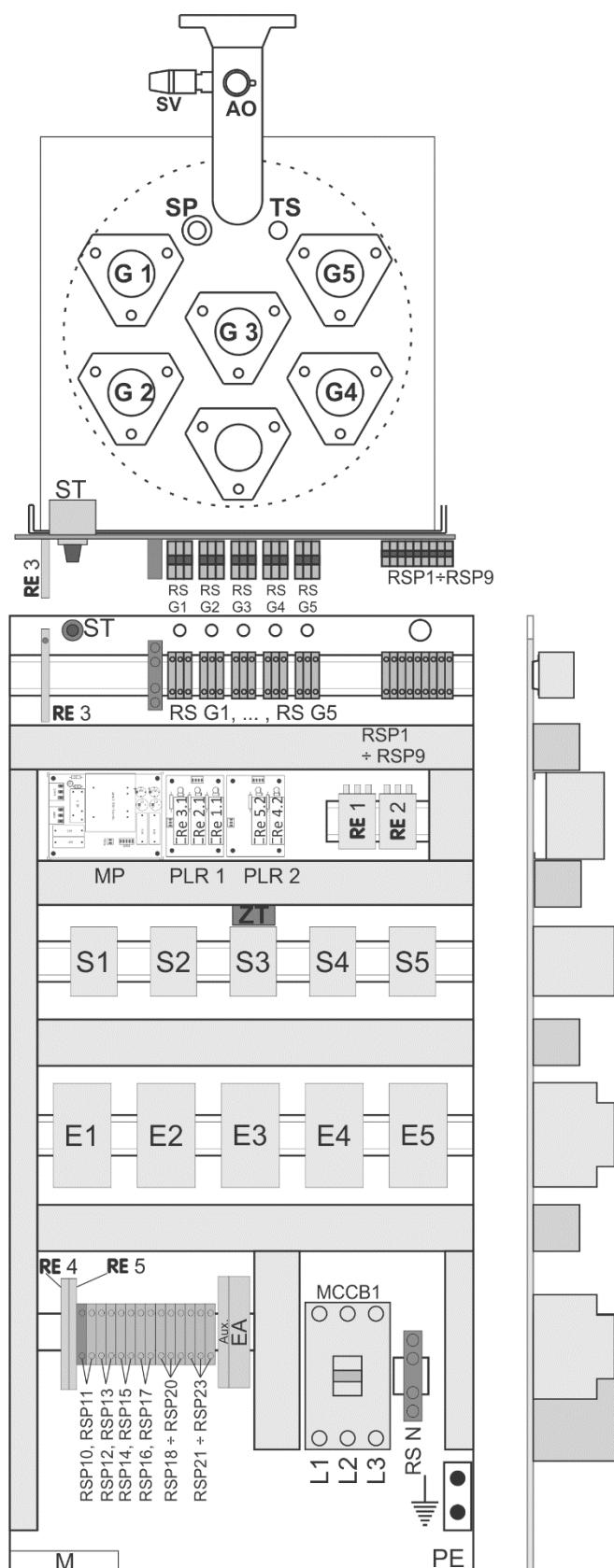


Image 12: Switchboard and top plate of vessel a boiler power 50kW

SV	Safety Valve 4,5bar
AO	Automatic Air valve
FS	Flow Switch
G1 ÷ G5	Heater 10kW; 3-phase
SP	Pressure Sensor (Transmitter)
TS	Boiler Temperature Sensor (KTY81-110)
ST	Safety Thermostat NO95 °C activation of Shunt Trip Release (built into MCCB1)
ZT	Switchboard Safety Thermostat; Fan activation (NO 40 °C); break contactors control circuit (NC 90 °C)
RS G1 ÷ RS G5	Heaters connection terminals
RSP 1 ÷ RSP 3	Control circuit supply terminals
RSP 4, RSP 9	Terminals for sensors and signals
RE 1	Remote start / stop Relay
RE 2	Flow Switch Relay
RE 3	Overheating Relay
RE 4	Fault Relay
RE 5	Boiler in operation Relay
PLR1 ÷ PLR2	Relay boards, contactors on/off control
MP	Power supply board MMB2408VX4 - power supply for EK_CPU_1_5) and PLR1, PLR2
S1, ..., S5	Contactor BENEDICT K3-10ND10 (Ith=25A)
E1, ..., E5	3P C25A Three pole MCB for each heater
MCCB1	Molded Case Circuit Breaker (160A; 36kA)
EA	1-p MCB for control circuit (C6A) with upgraded Auxiliary contact
RSP 10, RSP 11	Pump control clamps (230V AC I _{max} 2A)
RSP 12, RSP 13	Remote start/stop (230V)
RSP 14, RSP 15	Clamps for Outdoor Temperature Sensor
RSP 16, RSP 17	Clamps for External Safety Thermostat
RSP 18 ÷ RSP 20	Clamps for ModBus communication between the boiler and Cascade Controller, or previous boiler in the cascade connection (or centralized system for remote monitoring and control, eg: SCADA, BMS...).
RSP 21 ÷ RSP 23	Clamps for ModBus communication with the next boiler from the cascade connection. On the last boiler in the cascade connection, a terminating resistor (120 Ohm) should be connected to the auxiliary terminals RSP21, RSP22 (A and B).
RS N	Neutral line clamp
M	Fan

13.3 Arrangement of components in a boiler of 60kW nominal power

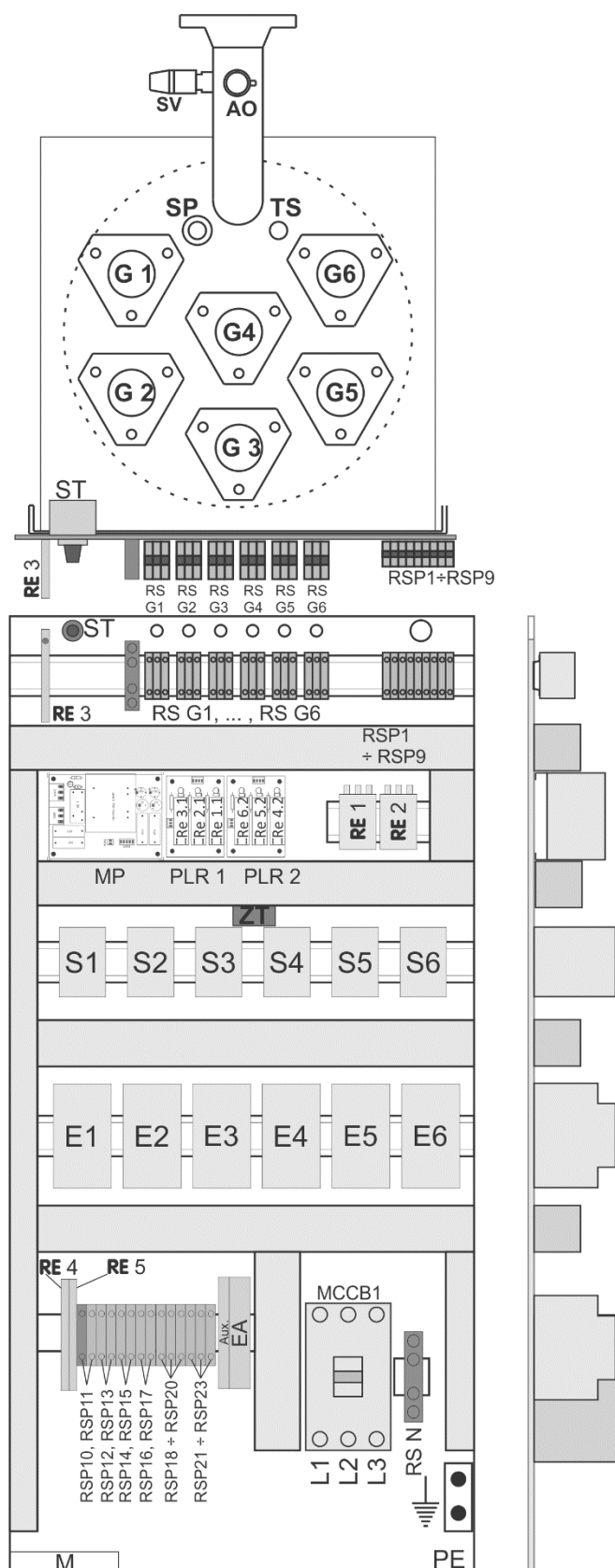


Image 13: Switchboard and top plate of vessel a boiler power 60kW

SV	Safety Valve 4,5bar
AO	Automatic Air valve
FS	Flow Switch
G1 ÷ G6	Heater 10kW; 3-phase
SP	Pressure Sensor (Transmitter)
TS	Boiler Temperature Sensor (KTY81-110)
ST	Safety Thermostat NO95 °C activation of Shunt Trip Release (built into MCCB1)
ZT	Switchboard Safety Thermostat; Fan activation (NO 40 °C); break contactors control circuit (NC 90 °C)
RS G1 ÷ RS G6	Heaters connection terminals
RSP 1 ÷ RSP 3	Control circuit supply terminals
RSP 4, RSP 9	Terminals for sensors and signals
RE 1	Remote start / stop Relay
RE 2	Flow Switch Relay
RE 3	Overheating Relay
RE 4	Fault Relay
RE 5	Boiler in operation Relay
PLR1 ÷ PLR2	Relay boards, contactors on/off control
MP	Power supply board MMB2408VX4 - power supply for EK_CPU_1_5) and PLR1, PLR2
S1, ..., S6	Contactor BENEDICT K3-10ND10 (Ith=25A)
E1, ..., E6	3P C25A Three pole MCB for each heater
MCCB1	Molded Case Circuit Breaker (160A; 36kA)
EA	1-p MCB for control circuit (C6A) with upgraded Auxiliary contact
RSP 10, RSP 11	Pump control clamps (230V AC I _{max} 2A)
RSP 12, RSP 13	Remote start/stop (230V)
RSP 14, RSP 15	Clamps for Outdoor Temperature Sensor
RSP 16, RSP 17	Clamps for External Safety Thermostat
RSP 18 ÷ RSP 20	Clamps for ModBus communication between the boiler and Cascade Controller, or previous boiler in the cascade connection (or centralized system for remote monitoring and control, eg: SCADA, BMS...).
RSP 21 ÷ RSP 23	Clamps for ModBus communication with the next boiler from the cascade connection. On the last boiler in the cascade connection, a terminating resistor (120 Ohm) should be connected to the auxiliary terminals RSP21, RSP22 (A and B).
RS N	Neutral line clamp
M	Fan

13.4 Arrangement of components in a boiler of 70kW nominal power

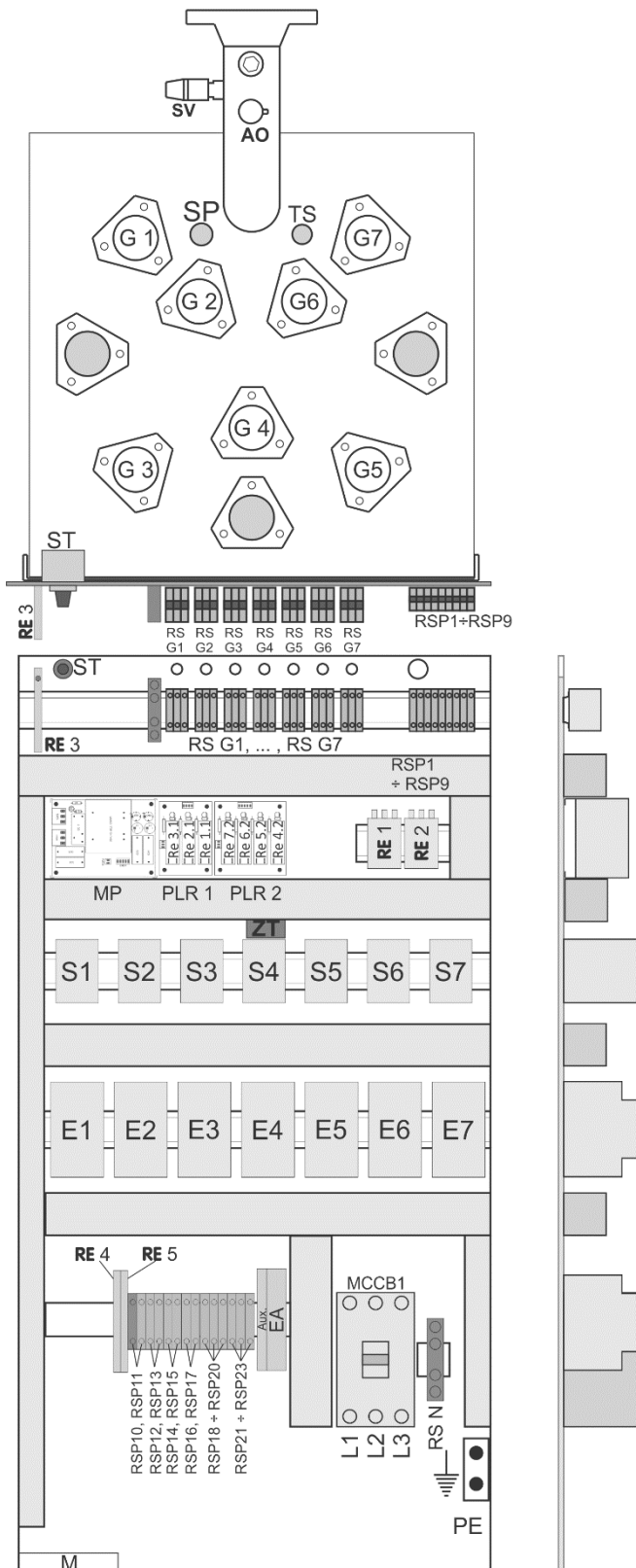


Image 14: Switchboard and top plate of vessel a boiler power 70kW

SV	Safety Valve 4,5bar
AO	Automatic Air valve
FS	Flow Switch
G1 ÷ G7	Heater 10kW; 3-phase
SP	Pressure Sensor (Transmitter)
TS	Boiler Temperature Sensor (KTY81-110)
ST	Safety Thermostat NO95 °C activation of Shunt Trip Release (built into MCCB1)
ZT	Switchboard Safety Thermostat; Fan activation (NO 40 °C); break contactors control circuit (NC 90 °C)
RS G1 ÷ RS G7	Heaters connection terminals
RSP 1 ÷ RSP 3	Control circuit supply terminals
RSP 4, RSP 9	Terminals for sensors and signals
RE 1	Remote start / stop Relay
RE 2	Flow Switch Relay
RE 3	Overheating Relay
RE 4	Fault Relay
RE 5	Boiler in operation Relay
PLR1 ÷ PLR2	Relay boards, contactors on/off control
MP	Power supply board MMB2408VX4 - power supply for EK_CPU_1_5) and PLR1, PLR2
S1, ..., S7	Contactor BENEDICT K3-10ND10 (Ith=25A)
E1, ..., E7	3P C25A Three pole MCB for each heater
MCCB1	Molded Case Circuit Breaker (160A; 36kA)
EA	1-p MCB for control circuit (C6A) with upgraded Auxiliary contact
RSP 10, RSP 11	Pump control clamps (230V AC I _{max} 2A)
RSP 12, RSP 13	Remote start/stop (230V)
RSP 14, RSP 15	Clamps for Outdoor Temperature Sensor
RSP 16, RSP 17	Clamps for External Safety Thermostat
RSP 18 ÷ RSP 20	Clamps for ModBus communication between the boiler and Cascade Controller, or previous boiler in the cascade connection (or centralized system for remote monitoring and control, eg: SCADA, BMS...).
RSP 21 ÷ RSP 23	Clamps for ModBus communication with the next boiler from the cascade connection. On the last boiler in the cascade connection, a terminating resistor (120 Ohm) should be connected to the auxiliary terminals RSP21, RSP22 (A and B).
RS N	Neutral line clamp
M	Fan

13.5 Arrangement of components in a boiler of 80kW nominal power

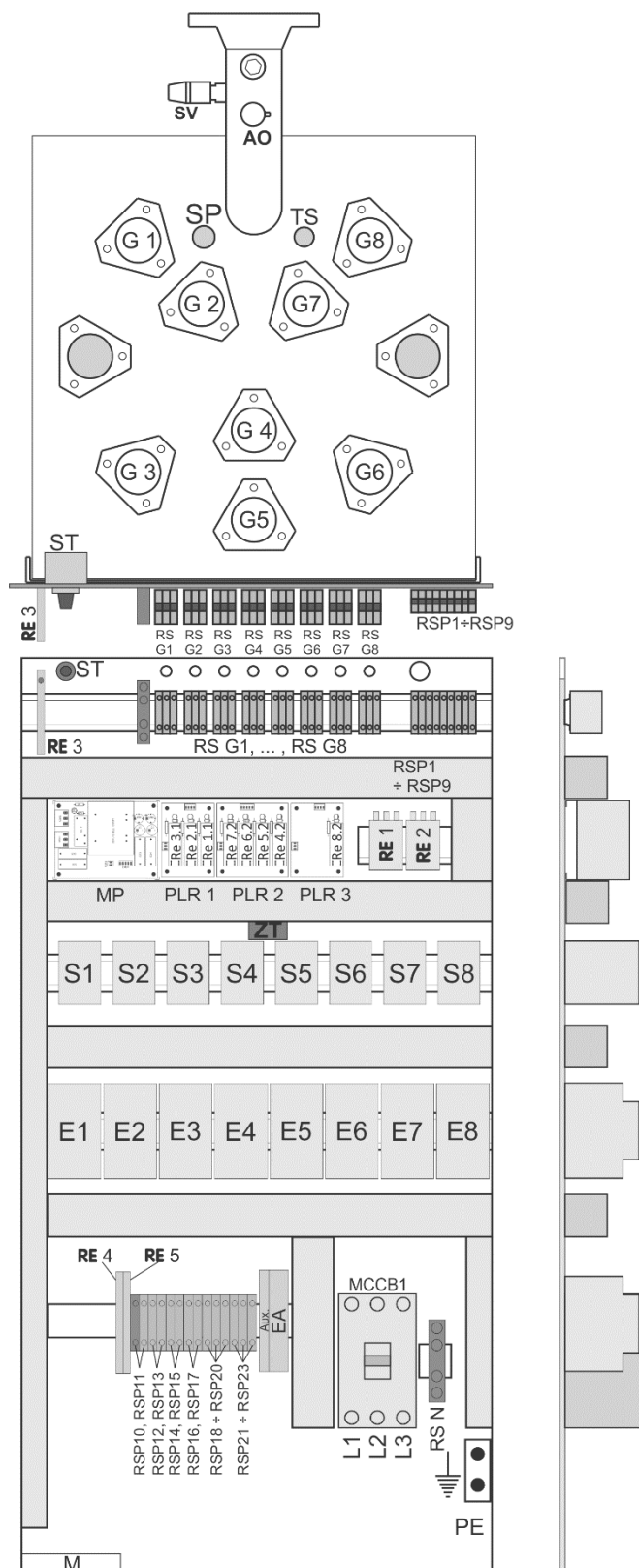


Image 15: Switchboard and top plate of vessel a boiler power 80kW

SV	Safety Valve 4,5bar
AO	Automatic Air valve
FS	Flow Switch
G1 ÷ G8	Heater 10kW; 3-phase
SP	Pressure Sensor (Transmitter)
TS	Boiler Temperature Sensor (KTY81-110)
ST	Safety Thermostat NO95 °C activation of Shunt Trip Release (built into MCCB1)
ZT	Switchboard Safety Thermostat; Fan activation (NO 40 °C); break contactors control circuit (NC 90 °C)
RS G1 ÷ RS G8	Heaters connection terminals
RSP 1 ÷ RSP 3	Control circuit supply terminals
RSP 4, RSP 9	Terminals for sensors and signals
RE 1	Remote start / stop Relay
RE 2	Flow Switch Relay
RE 3	Overheating Relay
RE 4	Fault Relay
RE 5	Boiler in operation Relay
PLR1 ÷ PLR3	Relay boards, contactors on/off control
MP	Power supply board MMB2408VX4 - power supply for EK_CPU_1_5) and PLR1÷ PLR3
S1, ..., S8	Contactors BENEDICT K3-10ND10 (Ith=25A)
E1, ..., E8	3P C25A Three pole MCB for each heater
MCCB1	Molded Case Circuit Breaker (160A; 36kA)
EA	1-p MCB for control circuit (C6A) with upgraded Auxiliary contact
RSP 10, RSP 11	Pump control clamps (230V AC I _{max} 2A)
RSP 12, RSP 13	Remote start/stop (230V)
RSP 14, RSP 15	Clamps for Outdoor Temperature Sensor
RSP 16, RSP 17	Clamps for External Safety Thermostat
RSP 18 ÷ RSP 20	Clamps for ModBus communication between the boiler and Cascade Controller, or previous boiler in the cascade connection (or centralized system for remote monitoring and control, eg: SCADA, BMS...).
RSP 21 ÷ RSP 23	Clamps for ModBus communication with the next boiler from the cascade connection. On the last boiler in the cascade connection, a terminating resistor (120 Ohm) should be connected to the auxiliary terminals RSP21, RSP22 (A and B).
RS N	Neutral line clamp
M	Fan

13.6 Arrangement of components in a boiler of 90kW nominal power

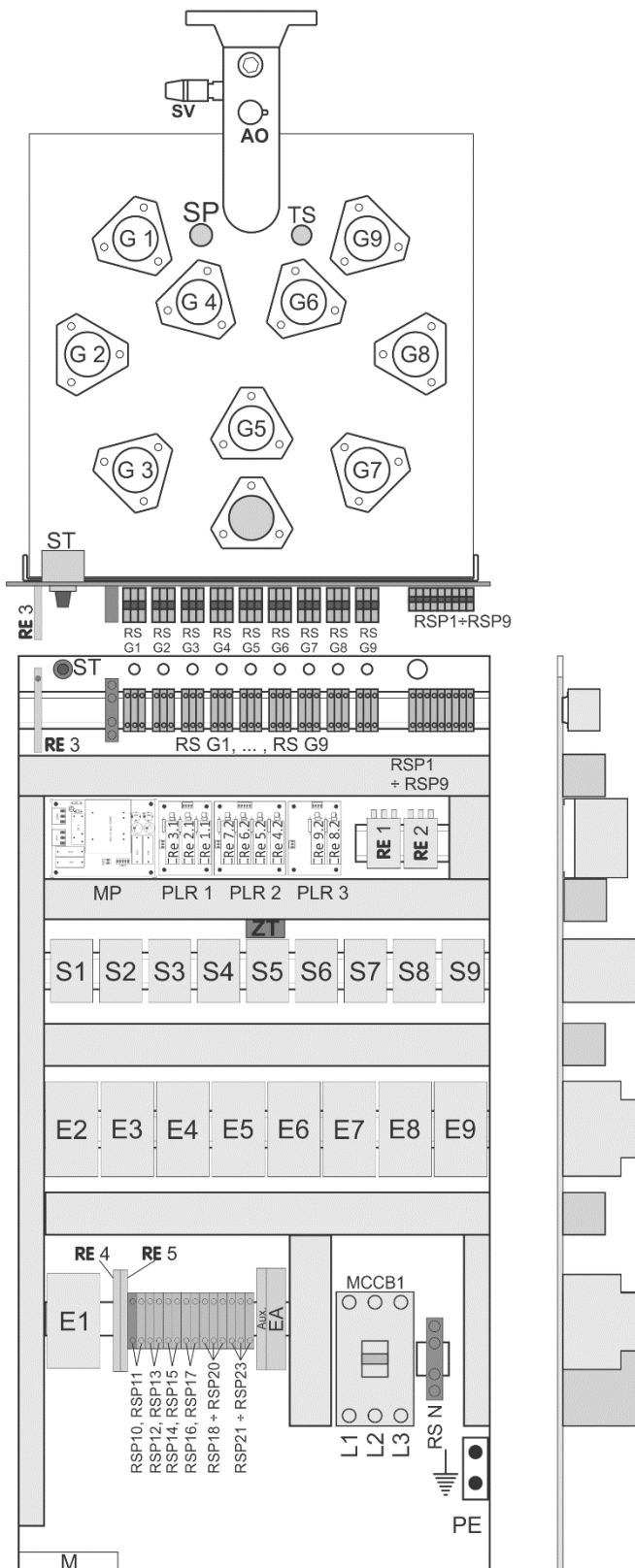


Image 16: Switchboard and top plate of vessel a boiler power 90kW

SV	Safety Valve 4,5bar
AO	Automatic Air valve
FS	Flow Switch
G1 ÷ G9	Heater 10kW; 3-phase
SP	Pressure Sensor (Transmitter)
TS	Boiler Temperature Sensor (KTY81-110)
ST	Safety Thermostat NO95 °C activation of Shunt Trip Release (built into MCCB1)
ZT	Switchboard Safety Thermostat; Fan activation (NO 40 °C); break contactors control circuit (NC 90 °C)
RS G1 ÷ RS G9	Heaters connection terminals
RSP 1 ÷ RSP 3	Control circuit supply terminals
RSP 4, RSP 9	Terminals for sensors and signals
RE 1	Remote start / stop Relay
RE 2	Flow Switch Relay
RE 3	Overheating Relay
RE 4	Fault Relay
RE 5	Boiler in operation Relay
PLR1 ÷ PLR3	Relay boards, contactors on/off control
MP	Power supply board MMB2408VX4 - power supply for EK_CPU_1_5) and PLR1÷PLR3
S1, ..., S9	Contactors BENEDICT K3-10ND10 (Ith=25A)
E1, ..., E9	3P C25A Three pole MCB for each heater
MCCB1	Molded Case Circuit Breaker (160A; 36kA)
EA	1-p MCB for control circuit (C6A) with upgraded Auxiliary contact
RSP 10, RSP 11	Pump control clamps (230V AC I _{max} 2A)
RSP 12, RSP 13	Remote start/stop (230V)
RSP 14, RSP 15	Clamps for Outdoor Temperature Sensor
RSP 16, RSP 17	Clamps for External Safety Thermostat
RSP 18 ÷ RSP 20	Clamps for ModBus communication between the boiler and Cascade Controller, or previous boiler in the cascade connection (or centralized system for remote monitoring and control, eg: SCADA, BMS...).
RSP 21 ÷ RSP 23	Clamps for ModBus communication with the next boiler from the cascade connection. On the last boiler in the cascade connection, a terminating resistor (120 Ohm) should be connected to the auxiliary terminals RSP21, RSP22 (A and B).
RS N	Neutral line clamp
M	Fan

13.7 Arrangement of components in a boiler of 100kW nominal power

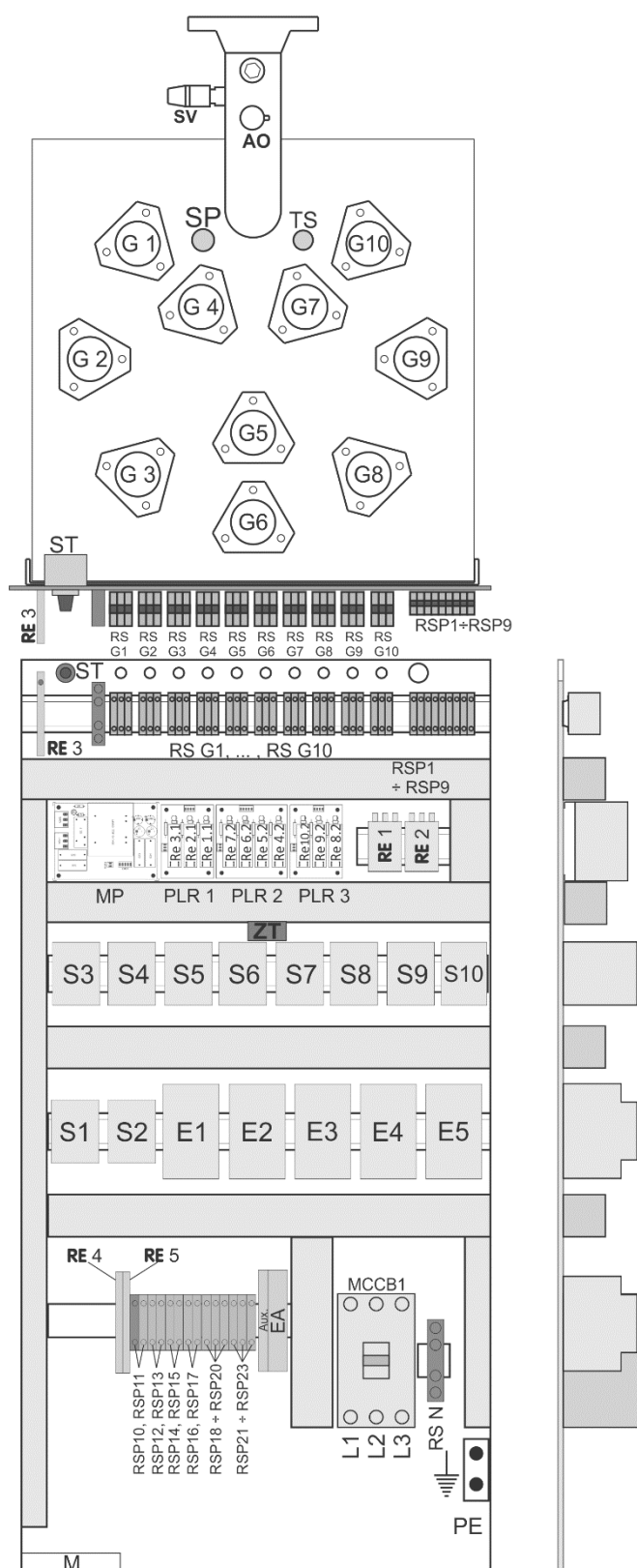


Image 17: Switchboard and top plate of vessel a boiler power 100kW

SV	Safety Valve 4,5bar
AO	Automatic Air valve
FS	Flow Switch
G1 ÷ G10	Heater 10kW; 3-phase
SP	Pressure Sensor (Transmitter)
TS	Boiler Temperature Sensor (KTY81-110)
ST	Safety Thermostat NO95 °C activation of Shunt Trip Release (built into MCCB1)
ZT	Switchboard Safety Thermostat; Fan activation (NO 40 °C); break contactors control circuit (NC 90 °C)
RS G1 ÷ RS G10	Heaters connection terminals
RSP 1 ÷ RSP 3	Control circuit supply terminals
RSP 4, RSP 9	Terminals for sensors and signals
RE 1	Remote start / stop Relay
RE 2	Flow Switch Relay
RE 3	Overheating Relay
RE 4	Fault Relay
RE 5	Boiler in operation Relay
PLR1 ÷ PLR3	Relay boards, contactors on/off control
MP	Power supply board MMB2408VX4 - power supply for EK_CPU_1_5) and PLR1, PLR2
S1, ..., S10	Contactor BENEDICT K3-10ND10 (Ith=25A)
E1, ..., E5	3P C40A Three pole MCB for two heaters
MCCB1	Molded Case Circuit Breaker (160A; 36kA)
EA	1-p MCB for control circuit (C6A) with upgraded Auxiliary contact
RSP 10, RSP 11	Pump control clamps (230V AC I _{max} 2A)
RSP 12, RSP 13	Remote start/stop (230V)
RSP 14, RSP 15	Clamps for Outdoor Temperature Sensor
RSP 16, RSP 17	Clamps for External Safety Thermostat
RSP 18 ÷ RSP 20	Clamps for ModBus communication between the boiler and Cascade Controller, or previous boiler in the cascade connection (or centralized system for remote monitoring and control, eg: SCADA, BMS...).
RSP 21 ÷ RSP 23	Clamps for ModBus communication with the next boiler from the cascade connection. On the last boiler in the cascade connection, a terminating resistor (120 Ohm) should be connected to the auxiliary terminals RSP21, RSP22 (A and B).
RS N	Neutral line clamp
M	Fan

14 Cleaning and maintenance



DANGER! Life threat of electric power shock!

- ▶ Electric power work must be done only by qualified person
- ▶ Before opening device: turn heating installation off electric power supply using safety switcher and disconnect it from power supply net through corresponding fuse
- ▶ Secure heating installation against accidental turn on
- ▶ Comply with instructions for installation



WARNING: Material damage due to unBasic maintenance!

Insufficient or unBasic maintenance of boiler can lead to damage or destruction and to loss of Warranty rights

- ▶ Secure regular, entire and Basic maintenance of heating installation
- ▶ Electric parts and work units protect against water and humidity



Use only spare parts delivered by the manufacturer or those approved by manufacturer. There will be no responsibility for damage occurred due to spare parts not delivered by the manufacturer



Control examination log is provided on chapter 8.4

- Perform works in accordance with log on control and maintenance
- All deficiencies remove immediately

14.1 Boiler cleaning

Clean this device externally with wet cloth

14.2 Check working pressure



DANGER: Health threat due to mix of drinking water!

- ▶ It is demanding to respect state regulations to avoid mix of drinking water (with water from heating installations)
- ▶ Comply with EN 1717



Establish a working pressure of at least 1 bar, depending on the height of the highest point of the installation. If, due to the height of the installation, the operating pressure is greater than 1 bar (eg 1.5 bar) before the system is filled with water, it is necessary to lift the air intake in the expansion vessel to the same value - 1.5 bar

The volume of newly filled water is reduced in the first days after charging due to heating. This creates airbags that create interference in the heating system.

Testing working pressure

- Working pressure of new heating installation should control on daily basis at the beginning of its work. If needed, re-fill water and air vent the system
- Later check working pressure once per month. If needed, re-fill water and air vent the system
- Check working pressure. If it decreases below 1 bar re-fill water
- Re-fill the water
- Air vent the heating installation
- Check working pressure again

14.3 Re-fill the water and air-vent the installation



WARNING: Material damage due to heat tension. Filling heating installations in warm condition can produce cracks due to tension

- ▶ Fill heating installation only in cold condition (temperature of starting duct lines of max 40 °C)



WARNING: Material damage due to frequent re-filling!

Due to frequent water re-filling installations can be damaged by corrosion and carbonate layers depending on water characteristics

- ▶ Test sealing and watertight of heating installations and expansion dish on functionality

- Connect hose on water faucet
 - Fill the hose with water and connect to connector for filling/draining
 - Tighten the hose and open the water faucet for filling/draining
 - Slowly fill the heating installation while following up with pressure (manometer)
 - During filling procedure air vents the system
 - When reach working pressure close the drainage faucet
 - When reach working pressure close the drainage faucet
- Remove the hose from filling/drainage faucet

14.4 Inspection and maintenance log



At least once a year perform maintenance or when a check shows the status of installations that require maintenance

The commissioning, inspection and maintenance record serves as an attachment for copying

- Executed works should be authorised by signature and date

Inspection and maintenance works when needed		Date:	Date:	Date:
		_____	_____	_____
1.	Check condition of installations	☐	☐	☐
2.	Visual and functional control	☐	☐	☐
3.	Making working pressure			
	• Check pre-pressure of expansion dish	☐	☐	☐
	• Working pressure set on ...	_____ bar	_____ bar	_____ bar
	• Heating installation air vent	☐	☐	☐
	• Check safety heating valve	☐	☐	☐
4.	Clean water filter	☐	☐	☐
5.	Check if there is any damage on electric duct lines	☐	☐	☐
6.	Check if electric control connections and used elements are fitted; tighten it if needed	☐	☐	☐
7.	Check the functions of the microprocessor thermostat (CPU) on the boiler	☐	☐	☐
8.	Check the function of the safety circuits (MCCB1 with built-in remote shunt trip release)	☐	☐	☐
9.	Check remote control function (start / stop)	☐	☐	☐
10.	Check the flow switch function	☐	☐	☐
11.	Check the conductors and insulation of electric heaters	☐	☐	☐
12.	Check function of grounding device	☐	☐	☐
13.	Check heating pump function	☐	☐	☐
14.	Make final control of inspection works and document results of measuring and inspecting	☐	☐	☐
		Seal/Signature	Seal/Signature	Seal/Signature
15.	Certification of Basically conducted inspection			

Table 5: Inspection and maintenance log

15. Environment protection / Waste disposal

One of the Basic concepts of business is environment protection. Quality of products, thriftiness and environment protection are equally valuable goals for us.

It is critical to strictly comply with law and regulations on environment protection. In order to protect environment and respecting economy concepts we use only the best technique and materials.

Packaging

Regarding packaging, we respect system of recycling which is specific in certain states and which secure optimal recycling. All materials applied for packaging do not harm environment and It is possible to recycle it.

Old devices

Old devices contain valuable materials that can recycle. Structures are easily demountable and plastic materials are labeled. In such manner structures can be sorted and deliver for recycling.

16. Troubles and troubleshooting



Troubleshooting on regulations and hydraulics must be done by an authorised firm



For repairs use only original spare parts

TROUBLE	DESCRIPTION	CAUSE	MEASURE
Boiler does not react after turn on of main switcher	Display does not react, other components do not work	- Boiler is out of power supply - Fuses on bottom plate are off - Vanishing of managing phase - Damage of main fuse ON/ OFF	- Provide power supply - Turn on fuses - Check if fuses have three phases on output - Change damaged part
Boiler does not heat or insufficiently heat / heating pump works	All on display are within recommended values but boiler does not make hot water	- Lack of 1 or 2 phases - Small power of boiler - Some relay damaged - Some heater damaged	- Check all three phases - Check set power of boiler - Change damaged part - Change damaged part
Boiler heats but it is very noisy	Higher level of noise during work	- Air in the system - Small water flow - Possible carbonate layer on heater - Worn contactor	- Check if the system is air vented and vent it - Check valves below boiler and open it - Clean filter below boiler - Take out heaters and clean it (this is not included in claims during warranty period) - Change damaged part
Boiler turns on quickly	Reaches temperature too quickly and turns on	- Valves below the boiler off - Pump fuse stop to work - Pump jammed - Pump inaccurate	- Open valves - Change inaccurate part - Start pump rotor - Change inaccurate part
Big oscillations of working pressure	Too fast and too big changes of working pressure	- One valve off - Expansion dish pressure inadequate - Inaccurate dish	- Open the valve - Check pressure in expansion dish and if needed set dish pressure adequately - Change inaccurate part
The boiler does not switch on the heaters by displaying a fault in the display	It is possible to set the operating temperature and power, but the heaters do not turn on but an error code appears	- Circulation pump off - Defective circulation pump - System pressure is not within the permissible range - The temperature is not within the permissible range - Some of the sensors are not connected or incorrect	- Switch on the pump and check for proper operation - Replace defective part - Adjust the pressure to the required value - Set the temperature to the required value - Replace faulty part according to fault code (section 7.3.5).

Table 6: Troubles and troubleshooting

17. Product data sheet (in accordance with EU regulation no. 811/2013)

1.	Manufacturer		MIKOTERM DOO
2.	Brand name		TK-Profesional
3.	Models	I	TK-Profesional 40kW
		II	TK-Profesional 50kW
		III	TK-Profesional 60kW
		IV	TK-Profesional 70kW
		V	TK-Profesional 80kW
		VI	TK-Profesional 90kW
		VII	TK-Profesional 100kW
		VIII	TK-Profesional 120kW
		IX	TK-Profesional 140kW
		X	TK-Profesional 160kW
		XI	TK-Profesional 180kW
		XII	TK-Profesional 200kW
		XIII	TK-Profesional 240kW

				I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
4.	Room heating: Seasonal energy- efficiency class			D	D	D	D	D	D	D	D	D	D	D	D	D
5.	Room heating: Nominal heat output(*8) (*11)	P_{rated}	kW	40	50	60	70	80	90	100	120	140	160	180	200	240
6.	Room heating: Seasonal energy efficiency(*8)	η_s	%	37,82	37,87	37,95	38	38,02	38,04	38,07	38,09	38,12	38,20	38,24	38,27	38,30
7.	Annual energy consumption(* 8)	Q_{HE}	kWh	47540	59425	71310	83195	95080	10696 5	11855 0	14262 0	16639 0	19016 0	21393 0	23770 0	28524 0
8.	Sound power level, indoor	L_{WA} indoor	dB(A)	49	50	52	54	55	56	58	60	62	64	66	68	70
9.		 All specific precautions for assembly, installation and maintenance are described in the operating and installation instructions. Read and follow the operating and installation instructions.														
10.		 All of the data that is included in the product information was determined by applying the specifications of the relevant European directives. Differences to product information listed elsewhere may result in different test conditions. Only the data that is contained in this product information is applicable and valid.														

(*8) For average climatic conditions

(*11) For boilers and combination boilers with a heat pump, the nominal heat output " P_{rated} " is the same as the design load in heating mode " $P_{designh}$ ", and the nominal heat output for an auxiliary boiler " P_{sup} " is the same as the additional heating output " $sup(T_j)$ "

18. Memory map

Use the following map for ModBus communication with the Centralized Monitoring and Control System:

MODBUS-RTU FUNCTIONS:

0x03: Read Holding Registers
 0x04: Read Input Registers
 0x06: Write Single Register
 0x10: Write Multiple registers

MEMORY MAP:

1. HOLDING REGISTERS

Holding Registers

Number	Address (HEX)		Type	Name
	High Byte	Low Byte		
40001	00	00	uint	BOILER SET TEMPERATURE
40002	00	01	uint	BOILER SET POWER
40003	00	02	uint	TIME/DATE: seconds
40004	00	03	uint	TIME/DATE: minutes
40005	00	04	uint	TIME/DATE: hours
40006	00	05	uint	TIME/DATE: weekdays
40007	00	06	uint	TIME/DATE: days
40008	00	07	uint	TIME/DATE: months
40009	00	08	uint	TIME/DATE: years

2. INPUT REGISTERS

Input Registers

Number	Reg. Address (HEX)		Type	Name
	High Byte	Low Byte		
30001	00	00	sint	CURRENT TEMPERATURE
30002	00	01	sint	OUTDOOR TEMPERATURE
30003	00	02	uint	INSTANT POWER
30004	00	03	uint	NOMINAL POWER
30005	00	04	uint	PRESSURE IN THE BOILER VESSEL x 10
30006	00	05	sint	WARNING/ERROR STATUS
30007	00	06	uint	REGULATION STEP (SINGLE OUTPUT POWER)
30008	00	07	uint	BOILER OPERATION MODE
30009	00	08	uint	O.T.C. BOILER OPERATION MODE
30010	00	09	uint	STATUS OF INPUT SIGNALS
30011	00	0A	uint	STATUS OF CONFIG SIGNALS
30012	00	0B	uint	STATUS OF OUTPUT SIGNALS
30013	00	0C	uint	BOILER SET TEMPERATURE
30014	00	0D	uint	BOILER SET POWER
30015	00	0E	uint	MODULATION
30016	00	0F	uint	OUTPUT WORK TIME
30017	00	10	uint	MAX. TEMPERATURE
30018	00	11	uint	MAX. PRESSURE x 10
30019	00	12	uint	PRESSURE SENSOR TYPE
30020	00	13	uint	PUMP DELAY TIME
30021	00	14	uint	FLOW DETECTION TIME

[illegible]

MIKOTERM DOO

Ind. zona Aleksandrovo, Niska 211,
18252 Merosina, Serbia

00 381 18 4542002 / 4156900 / 4156901

www.mikoterm.com

office@mikoterm.com

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