DIGITAL TEMPERATURE ADJUSTMENT SYSTEMS TYPE 358

CONTROL BOARD FOR AUTOMATIC IGNITION CONDENSATION BOILERS WITH INBUILT E.M.C. FILTER AND REMOTE IGNITION DEVICE

DESCRIPTION

These electronic systems are suitable for operating cycle and temperature control in premix and condensation gas boilers.

GENERAL FEATURES

The board is provided with the following features:

- single electrode or double electrode ignition and flame monitoring (ionisation) system fitted with remote ignition device;
- boiler component control (installation circulator, modulating fan, deflection valve, gas valve, flow switch/ flowmeter, air pressure switch, thermostats, etc.);
- controls, adjusters and signals on a customized module connected to the mother board by means of a flat cable;
- use of NTC contact and/or immersion probes for temperature measurement (up to 4 probes);
- temperature adjustment function control by means of a microcontroller;
- 4kV and 8mm SELV (Safety Extra Low Voltage) insulation on the printed circuit board surface between components connected to the mains supply and low voltage controls;
- flame modulation by means of a proportional, integral and derivative electronic system (PID);
- differentiated water temperature adjustment for heating mode and domestic mode;
- adjustable boiler max. heat capacity in heating mode;
- domestic mode priority by means of a flowmeter/flow switch;
- pump overrun and lockout prevention and deflection valve lockout prevention;
- post-purge functions;
- cancellation of the heat demand in case of interruption of the signal emitted by temperature measuring probes;
- temperature safety limit in the boiler primary hydraulic circuit;
- prearranged for the connection of electromechanical limit and safety thermostats;
- prearranged for application in floor heating systems;
- diagnostic functions: signalling of heat demand, boiler lockout, probe cut-off, lack of water in the installation, lack of stack draft;
- EMC system;
- burner heat capacity modulation by means of a 230Vac brushless fan;
- pump speed modulation according to the installation features;
- varistor protecting the system from voltage transients which may be generated in the mains supply;
- outgoing water temperature adjustment programme by means of an external probe.

TECHNICAL DATA

Power supply:	230V-50/60Hz
Operating temperature range:	-20°C +60°C
Humidity:	95% max. at 40°C
Protection degree:	IP 00
Dimensions:	140x100x44mm

CONSTRUCTION

The system consists of three electronic boards:

a) **Mother Board (SM)**, which houses the boiler control and the connections to the remaining components;

b) **Ignition and Flame Control Module (ACF)**: this board, carrying out the burner safety functions, can control a single electrode or double electrode system, and is mounted directly on the mother board by soldering, reducing in this way the number of wires on the power switchboard;

c) **Control Board (SC)**, on which adjustment controls (push-buttons) and diagnostic signals (on a display) are mounted;

This system is fitted to a **Remote Ignition Device (AR)**, controlled by ACF, reducing electromagnetic interference and enabling the system to fully comply with electromagnetic compatibility standards without using any filters; (for technical characteristics, see our data sheets "REMOTE IGNITION TRANSFORMERS TYPE TR2").

ACCESSORIES

The system can be suppied with:

- connectors and terminals for wiring (The terminations used for board interfacing are type Lumberg series MSF and type Molex series 3003.);
- contact temperature probes (type ST03, ST04 and ST07);
- immersion temperature probes (type ST06 and ST09).

For the technical characteristics of the probes, see relevant data sheets.

As for the connectors, pay attention not to fit terminals and female connectors of different brands.

DIRECTIONS FOR INSTALLATION

- Respect the applicable national and European standards (e.g. EN60335-1/prEN50165) regarding electrical safety.
- Connect **live** and **neutral** correctly; the non-observance of live-neutral polarity may cause a dangerous situation.
- Before starting the system check the cables carefully; a wrong wiring can damage the devices and compromise the safety of the installation.
- Connect and disconnect the control system only after switching off the power supply.
- The system can be mounted in any position.
- Avoid exposing the system to dripping water.
- The appliance in which temperature adjusters are mounted must provide adequate protection against the risk of electrical shock (at least IP 20).
- Avoid placing control signal cables close to power cables.
- Ensure correct connection to the grounding system.

INTEGRATED TEMPERATURE ADJUSTMENT SYSTEM

Integrated temperature adjustment systems are usually manufactured on customer's request regarding operation and control of the boiler parts. For a better description, we will refer to a particular type, the main features of which are shown in page 8. The integrated temperature adjustment system we are going to consider consists of the following components:

Timings:

- waiting or prepurge time **(TW):** 1,5 … 40 s
- safety time **(TS):** 3 … 60 s
- droup-out time on running flame failure: < 1 s

The above times correspond to guaranteed values. Actual values may differ from declared ones, as waiting or prepurge time may be longer and safety time shorter.

Power consumption: 15VA

Max. contact rating: (contacts mounted on SM)

- VG1 gas valve:	0.5A	cos φ ≥ 0.4
- Fan:	1	cos φ ≥ 0.4

Max. cable length of external components: 1 m

Internal fuse: 3.15A quick acting

Flame control:

The flame detection device makes use of the rectification property of the flame; this device is not provided with any protection impedance, therefore the detection electrode is not safe against electrical shock.

- Min. ionisation current: 0.5µA
- Recommended ionisation current: 3÷5 times the min. ionisation current
- Max. cable length: 1 m
- Min. insulation resistance of detection electrode and cable to earth: ≥ 50 MΩ
- Electrode max. stray capacitance: ≤ 1 nF
- Max. short circuit current: < 200µA AC

Mother Board (Sm)

Cut-off probe recognition threshold	> 100KΩ
Short-circuit probe recognition threshold	< 200Ω

Temperatures:

- Domestic mode set point: 30 ÷ 60 °C (default 50 °C)
- Domestic mode switching off: set point + 5°C
- Domestic mode switching on again: set point - 5°C
- Hot water tank set point: 40 ÷ 70 °C (default 60 °C)
- Hot water tank switching off: set point + 5°C
- Hot water tank switching on again: set point - 5°C
- Primary circuit OFF limit temperature: 85°C
- Primary circuit ON limit temperature: 75°C
- Heating mode set point: 30 ÷ 80 °C (default 60 °C)
- Heating mode switching off: set point + 5°C
- Heating mode switching on again: set point - 5°C
- Floor heating set point 28 ÷ 40 °C (default 35 °C)
- Floor heating switching off: set point + 5°C
- Floor heating switching on again: set point - 5°C
- Night/day temperature delta: 0 ÷ 20 °C (default 5 °C)
- Antifreeze ON temperature: 5°C
- Antifreeze OFF temperature: 25°C

Capacity settings:
- Heating mode capacity:
  18 ÷ 60 rev/min (default 48 rev/min)
- Domestic mode capacity:
  18 ÷ 60 rev/min (default 48 rev/min)

Timings:
- Ignition delay with recycling prevention function on: 180 sec
- Pump lockout prevention interval timing: 24 h
- Lockout prevention pump running time: 30 sec
- Post-purge time: 3 each minute for 10 min
- Post-circulation time: 90 sec
- Fan operation interval: 5 ÷ 30 sec (default 20 sec)

Outputs:
High voltage outputs
- Fan
- Circulator
- Gas valve
- Deflection valve
- Air pressure switch/Fume thermostat
- Safety thermostat
- Limit thermostat

Low voltage outputs
- Room thermostat
- Flow switch/Flowmeter
- Water pressure switch
- Fan driver
- 4 Temperature probes
- Control board
- Serial communication

Temperature measuring probes
The system operates with three temperature measuring probes; the first one is placed on the outgoing water pipe of the boiler heat exchanger (SM), the second one on the return water pipe of the boiler heat exchanger (SR) and the third one on the output pipe of the domestic circuit (SS). In case of short circuit or cut-off of one of the probes, depending on the type of boiler the temperature adjustment system can either operate with the remaining probes, signalling a failure, or cancel any heat demand, preventing the boiler from operating.
The probe fitted to the primary circuit also operates as limit thermostat, allowing any heat demand to be cancelled if the water temperature exceeds the preset limit temperature. The board can also be fitted to an external probe for room temperature adjustment in the systems in which this function may be useful.

Safety thermostat
In general, the boiler is perfectly safe against possible overheating in the primary circuit by means of a safety thermostat connected on the SM and in series to the gas valve control. The thermostat stops the gas flow and consequently extinguishes the flame; then a starting attempt occurs followed by non-volatile lockout.
Before trying to start a new ignition cycle, wait at least 10 seconds before trying to reset the system manually.

Air pressure switch
It checks smoke circulation in the combustion chamber and allows boiler ignition only if the fan is operating and draft is regular; it also ensures the boiler safety shutdown if one of these conditions fails during operation.

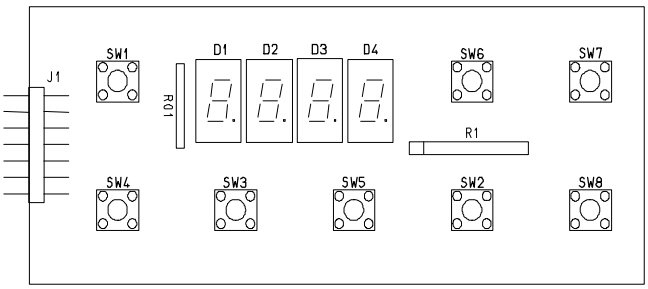
Water pressure switch
It ensures that the primary circuit pressure is within the required operation range. In case the pressure is too low, the temperature adjustment system cancels any heat demand and the type of failure appears on the control board.

Water flow switch
The SM is prearranged for an input connection signalling domestic water drawing. This signal can be generated by a flow sensor (flow switch or flowmeter). In this way it is possible to control an electrical three-way valve.

Room thermostat
The room thermostat (or chronothermostat) is connected to the SM at low voltage by two wires; it is designed to operate with a contact isolated from the mains supply.

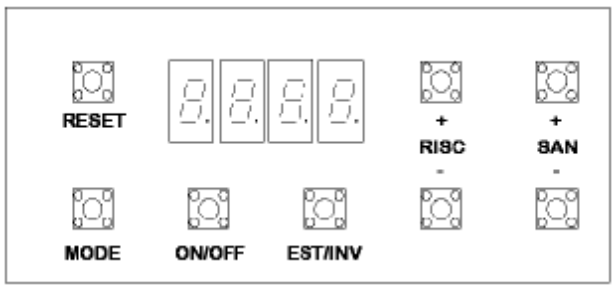
Timer
The SM is provided with a connection for a clock or timer (5V) mounted on the boiler to adjust heating times.
The same connection can also be used to fit the board to an information unit like a PC to carry out the board monitoring and diagnostic functions.

Control Board



The control board is fitted with the following elements: 8 push-buttons (SW), enabling the user to carry out any adjustment and setting during installation; 4 displays (D1 ... D4) showing temperature, settings and failure codes.
Two use modes are available: user's mode and installer's mode (by inserting a password).
Depending on the selected mode (user/installer/ password checking), the push-buttons and the symbols appearing on the display have the following meaning:

User's mode



Description of push-buttons:

Push-button	Function	Description
SW1	Reset	Boiler reset after ignition failure
SW2	- Risc	Normal or floor heating system set point decrease
SW3	On/Off	Board power
SW4	Mode	Temperature selection
SW5	Est/Inv	Summer/winter mode selection
SW6	+ Risc	Normal or floor heating system set point increase
SW7	+ San	Domestic mode or hot water tank system set point increase
SW8	- San	Domestic mode or hot water tank system set point decrease

Through the push-button "Mode", the user can display the probe temperature values, the installation pressure and the number of fan revolutions.

Description of display readings:

Display	Description
0 n	System ON
X X X X.	System and flame ON
0 X X	Outgoing water probe (SM) temperature / Comfort temperature*
1 X X	Domestic circuit probe (SS) temperature
2 X X	Return water probe (SR) temperature
3 X X	External probe (SE) temperature
4 X X	Pressure in bar
5 X X	Fan speed in number of revolutions
I n v	Winter mode
E s t	Summer mode
	System OFF
.	System OFF and power supply ON

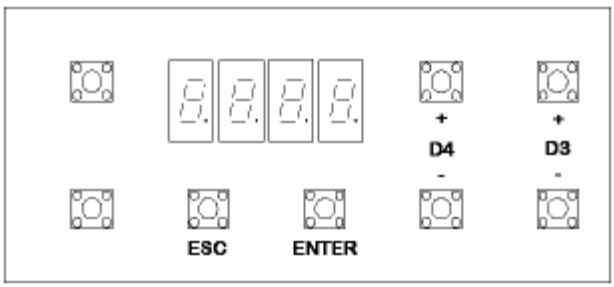
* If the external probe is connected, the required room temperature can be set.

Anomalies
The board monitors the system and signals any anomalies.

Description of anomalies:

Display	Description
E 0 0	Internal system error (EEPROM)
E 0 1	Installation pressure < 0.5 bar
E 0 2	Lockout due to ignition failure
E 0 3	Faulty outgoing water probe (SM)
E 0 4	Faulty domestic water probe (SS)
E 0 5	Faulty return water probe (SR)
E 0 6	Smoke exhaust failure

Password checking mode
By pressing on the push-buttons ON/OFF and MODE simultaneously for three seconds, it is possible to enter the password insertion and checking mode.
The symbols P X X will flash on the display. A password is a two-digit number which can be inserted through the corresponding push-buttons (see table below). After inserting the password and pressing on the push-button “enter”, the password is checked by the system; if the checking gives a positive result, it is possible to enter the installer's mode.

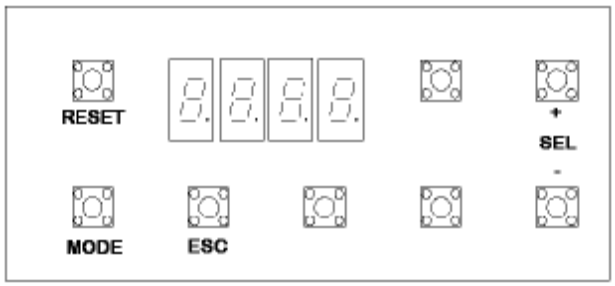


Description of push-buttons:

Push-button	Function	Description
SW2	- D4	digit decrease
SW3	Esc	Installer's mode exit
SW5	Enter	Password insertion
SW6	+ D4	digit increase
SW7	+ D3	digit increase
SW8	- D3	digit decrease

If the correct code is not inserted within 1 minute from access to the password insertion mode, the system goes back to the initial stage (user's mode). In case of wrong password insertion, the system exits from the installer's mode.

Installer's mode



Description of push-buttons:

Push-button	Function	Description
SW1	Reset	Boiler reset after ignition failure
SW3	Esc	Installer's mode exit
SW4	Mode	Parameter selection
SW7	+ Sel	Selected parameter increase
SW8	- Sel	Selected parameter decrease

By using the push-button "Mode", the installer can select the different parameters to set.

Description of display readings:

Display	Description
A X X	Ignition power (fan rev/min x 100)
H X X	Max. heating mode capacity (fan rev/min x 100)
T X X	Max. domestic mode capacity (fan rev/min x 100)
F X X	External probe (KE) creepage coefficient
O X X	Night/days time delta (°C)
N X X	Fan operation interval (seconds)
C X	Frequent recycling prevention (1=function on, 0=function off)
S X	Domestic mode (1=available, 0=not available)
E X	Modulating pump (1=available, 0=not available)
D X	Installation (1=high temperature, 0=low temperature)
L X	Pressure transducer (1=available, 0=not available)
B X	Hot water tank (1=available, 0=not available)
U X	condensation (1=available, 0=not available)

If the data modifications carried out are not confirmed by the push-button ESC, the system exits automatically (two minutes after the last push-button pressure) without saving the modifications set.

N.B.: The user/installer/password checking modes described above can be customized upon request.

Display

The four-digit display usually shows the temperature measured by the outgoing water probe (SM) if the boiler is in heating mode, or the temperature measured by the domestic water probe (SS) if the boiler is in domestic mode.
By pressing one of the push-buttons (SW) for heating or domestic temperature set point adjustment, the display shows the last temperature value set and then again the current temperature value.

Settings during installation

During the boiler installation, some system functions are usually set, which depend on the features of the installation, such as max. capacity in heating mode, ignition power, floor heating system and hot water tank system. These settings can be carried out directly on the control board.

OPERATING CYCLE

Starting cycle

The starting cycle begins on heat demand by the room thermostat (heating mode) or the water flow switch (domestic mode if operating). The water pump is energised, and if the water temperature is lower than the preset value, a burner starting demand occurs.
The control unit starts the fan only if the air pressure switch is in "no-air-flow" state; when it switches into "air-flow" position, the prepurge time TW begins, at the end of which the gas valve is supplied, the ignition device is started and the safety time TS begins. In this stage the burner heat capacity is kept at a lowe value (ignition power or soft start). If a flame signal is detected at the end of TS, the fan power remains at soft-start level for a while, then the temperature adjustment process begins and the burner flame is modulated in order to reach the same water temperature as the preset value. If no flame signal is detected within TS, the gas valve is closed and lockout occurs. The boiler lockout is signalled on the control board; to reset the system press the corresponding push-button. If hot water demand still occurs, the boiler starts a new ignition cycle; if the conditions leading to lockout still occur, the boiler goes back to lockout. The boiler keeps on running until either heat demand stops, or one of the safety devices starts operating, or the flame extinguishes.
On accidental flame extinguishing in running state, the device carries out a re-ignition attempt; if this attempt does not succeed, lockout occurs.

Domestic mode

Ignition demand in domestic mode has priority over heating mode. Access to domestic mode occurs when hot water is drawn; the boiler will try to supply the user with domestic water at preset temperature. If the required capacity is lower than the min. modulation capacity, the boiler will perform short ignition and turnoff cycles. If the required capacity is higher than the boiler max. capacity set by the installer (through the push-buttons on the control board), the water temperature will be proportional to the temperature of the drawn water, but lower than preset temperature. The system monitors the primary circuit temperature constantly and turns the burner off if the temperature detected by the outgoing water probe (SM) is higher than the *primary circuit OFF limit temperature*. The burner is turned on again in case the outgoing water temperature drops below the *primary circuit ON limit temperature*.

Heating mode

If the boiler is in winter position, and on room thermostat switching off the outgoing water temperature is lower than preset temperature, a boiler ignition occurs and after running at low power for a while, flame modulation begins until the boiler reaches the running state. If the temperature exceeds the *heating switching off* temperature, the burner is turned off. The burner re-ignition occurs at *heating switching on* temperature after the frequent recycling prevention interval timing.
The frequent recycling prevention interval timing (TACF) stops in case of room thermostat opening and subsequent closing, domestic hot water drawing or boiler switching off. In case of opening or short circuit of the outgoing water probe (SM) or the return water probe (SR), the heating mode cannot be performed any more.
During installation, through the control board the installer can switch off the TACF function and set the boiler max. capacity in heating mode.

Circulator overrun

Every time the boiler switches off, the circulator keeps on running for a short time, in order to lower the water temperature in the plate heat exchanger.

Post-purge

Every time the boiler switches off, the fan keeps on running for a short while at min. speed (40 to 50 rev/min), to enable humid smoke exhaust and prevent condensed water from damaging the fan driving circuit.

Failures:

- **Lockout**
  In case of lockout, a failure code is displayed (see the paragraph: "Anomalies") alternating with the outgoing water temperature measured when lockout occurred.

- **Probes**
  In case of failure of the outgoing water probe (cut-off or short circuit), the burner is immediately turned off and the failure is signalled on the display.
  In case of cut-off or short circuit of the domestic circuit probe, the failure is signalled on the display and the outgoing water probe is used instead of the faulty probe; in this way, operation in domestic mode is still possible.
  In case of cut-off or short circuit of the return water probe, the domestic and heating modes are still operating, but the combustion smoke condensation process cannot be guaranteed.

- **External probe**
  The system detects the connection with the external probe (SE) automatically. In this case, the user's interface changes, i.e. the outgoing water probe temperature cannot be set any more, but through the same push-buttons, it will be possible to set the required room temperature. According to the temperature set and the temperature measured by the SE probe, the system will calculate the required modulation.

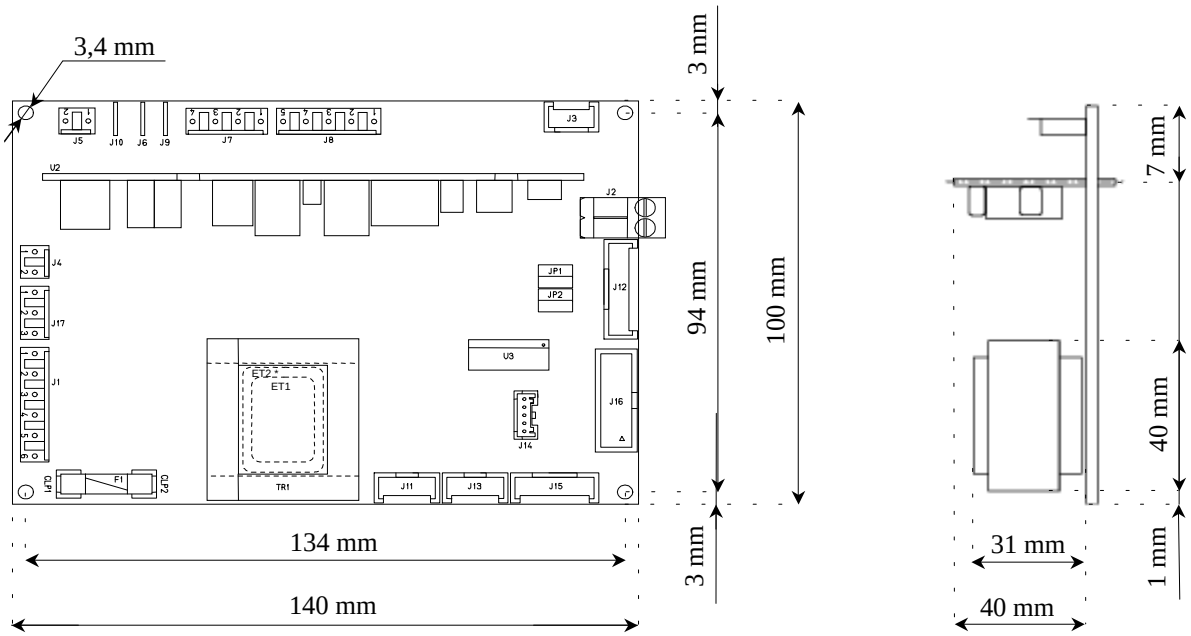
- **Installation pressure**
  The min. operating pressure is 0.5 bar. Otherwise, a failure is signalled.

- **Stack draft**
  In case of air pressure switch failure, the system closes the gas valve and signals a failure.
  As soon as the failure signal disappears, if a demand still occurs, the ignition cycle is carried out.

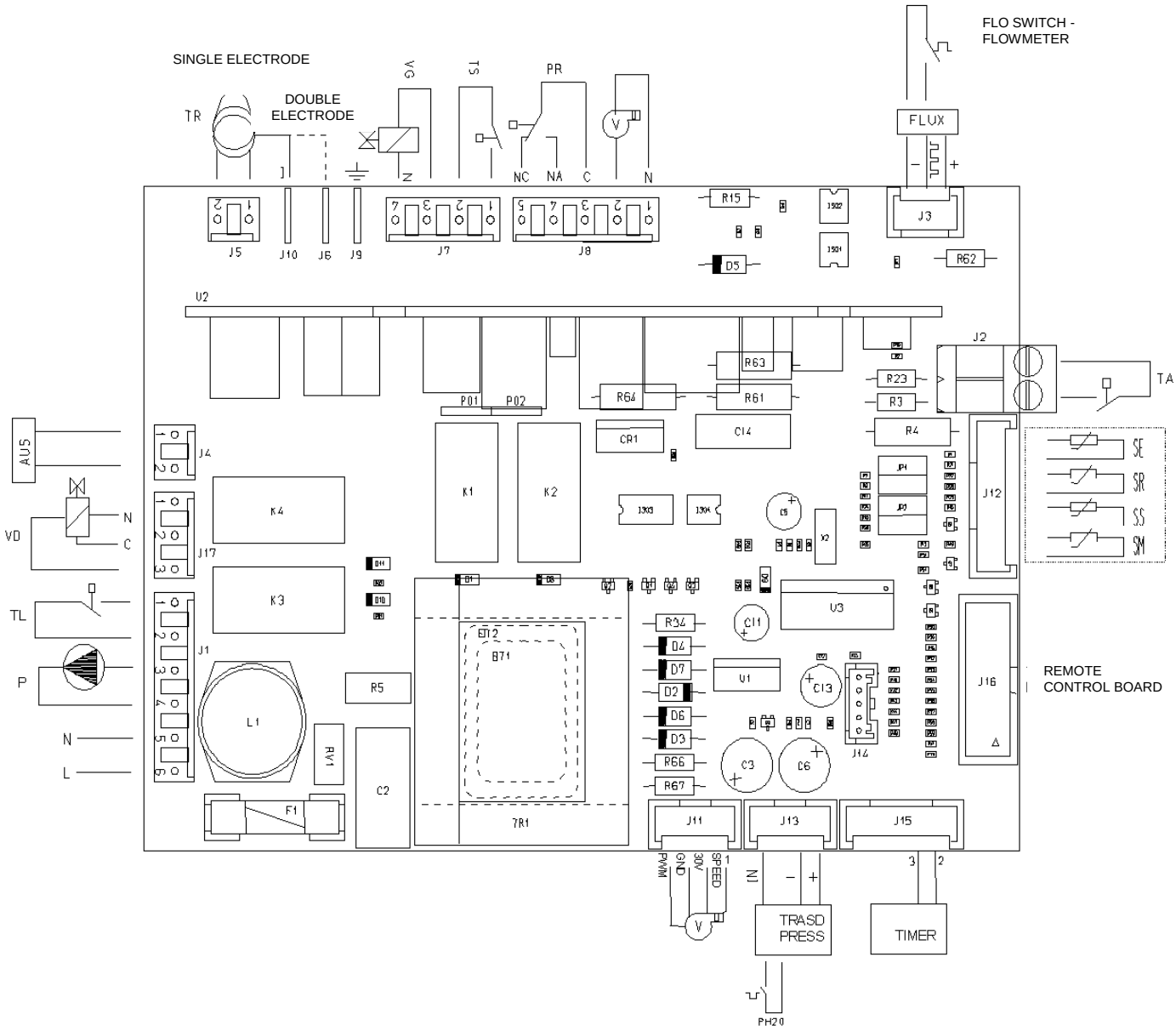
- **Lockout prevention function**
  A lockout prevention function is available, which switches on the circulator and the deflection valve for 30s every 24h of non-operation. Upon power supply cut-off, the lockout prevention function switches on for the first time after 1 hour of non-operation. The function is operating also in boiler lockout state.

- **Antifreeze function**
  In case the temperature measured by the outgoing water probe drops at antifreeze starting temperature, the pump and the burner are switched on, and the system runs at min. capacity until it reaches the antifreeze stopping temperature leading to antifreeze function switching off. The function remains operating also in summer mode or in OFF mode. If the boiler is in lockout state, the circulator is still operated.

DIMENSIONS



WIRING DIAGRAM



KEY:

SE: External probe	P: Installation circulator	VG: Gas valve	PR: smoke/air pressure switch
SR: Return water probe	AUS: Auxiliary contact	PH20: Water pressure switch	V: Fan
SS: Domestic circuit probe	TL: Limit thermostat	TA: Room thermostat	FLUX: Flowmeter/flow switch
SM: Outgoing water probe	TS: Safety thermostat	VD: Deflection valve	TR: Ignition transformer

TRASD PRESS: Pressure transducer

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