

## ***DIGITAL TEMPERATURE ADJUSTMENT SYSTEMS***

### **DESCRIPTION**

These electronic systems are suitable for temperature control in closed-chamber or open-chamber wall hung boilers fitted with atmospheric gas burners.

### **GENERAL FEATURES**

Temperature adjustment systems are usually manufactured on customer's request according to the type of boiler, the components used and the operation specification. In general, these systems are provided with the following features:

- single electrode or double electrode ignition and flame monitoring (ionization) system fitted with remote ignition device;
- control of the boiler parts (pump, fan, deflection valve, flow switch, air pressure switch, thermostats, etc.);
- controls, adjusters and signals on a module connected to the mother board by means of a flat cable;
- use of contact or immersion probes for temperature measurement, exploiting the resistivity characteristic of NTC components;
- 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);
- different water temperature adjustment for heating mode and domestic mode;
- adjustable boiler max. heat capacity in heating mode;
- domestic mode priority by means of a (power-driven or hydraulic) three-way valve or a flowmeter;
- low power ignition for softstart;
- pump overrun and lockout prevention and deflection valve lockout prevention;
- antifreeze function;
- cancellation of the heat demand in case of interruption of the signal emitted by temperature measuring probes;
- fixed temperature safety limit of the boiler primary hydraulic circuit;
- connection to a safety limit thermostat;
- possible application in floor heating systems;
- prearranged for LPG or natural gas;
- diagnostic functions: heat demand signal, boiler lockout, probe switching off, lack of water in the installation, lack of stack draft;
- EMC system.

**TECHNICAL DATA**

**Supply voltage:** 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 units (electronic boards):

- a) **Mother Board (SM)**, enabling the boiler control and the connections to the remaining components;
- b) **Ignition and Control Module (MAC)**: 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, thus reducing the number of wires on the power switchboard; the surface of this board is protected with epoxy resin to prevent possible damages resulting from incautious handling or external agents such as dust or humidity;
- c) **Control Board (SC)**, on which adjustment controls (push-buttons) and diagnostic signals (LEDs and display) are mounted.

The above units are fitted to a **Remote Ignition Device (AR)** controlled by MAC, 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").

The use of non-reversible connectors with a different number of poles makes connection easy and reliable. A varistor protects the components from possible voltage transients in the power supply.

An inbuilt fuse protects the internal relays in case of short circuit on the control outputs.

**ACCESSORIES**

The system can be supplied with:

- connectors and terminals for wiring (see Fig.1);
- 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.

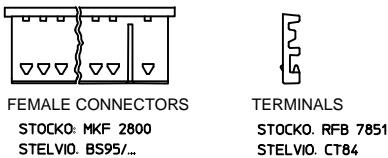


Fig.1

**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 electric shock (at least IP 20).
- Avoid placing control signal cables close to power cables.

**INTEGRATED TEMPERATURE ADJUSTMENT SYSTEM**

Integrated temperature adjusters are usually manufactured on customer's request according to the 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 Fig.3. The type we are going to consider consists of the following components:

- **Ignition and Control Module**  
**Times:**
  - waiting or prepurge time (**TW**): 1,5 s
  - safety time (**TS**): 10 s
  - drop-out time on running flame failure: < 1 s

The above times correspond to guaranteed values. Actual values can differ slightly from the above values, as waiting or prepurge time can be longer and safety time shorter than their nominal values.

**Starting power consumption:**
  - open chamber 18VA
  - closed chamber 20VA**Operating power consumption:**
  - open chamber 15VA
  - closed chamber 17VA**Max. contact rating:** (contacts mounted on SM)
  - VG1: 0.5A cos φ ≥ 0.4
  - Fan: 1A cos φ ≥ 0.4**Max. cable length of external components:** 1 m  
**Internal fuse:** 3,15 A 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 electric shock.
  - Min. ionization current: 0.5µA
  - Recommended ionization current: 3÷5 times the min. ionization current
  - Max. cable length: 1 m
  - Min. insulation resistance of detection cable and electrode to earth: ≥ 50 MΩ
  - Max. stray capacitance of the electrode: ≤ 1 nF
  - Max. short-circuit current: < 200µA AC

- **Temperature measuring probes**

The system operates with one or two temperature measuring probes; the first one is placed on the output pipe of the boiler heat exchanger (SR), whereas the second one is placed on the output pipe of the domestic circuit (SS). The BRAHMA contact probes type ST04 we usually employ enable great manufacture and service advantages and guarantee the same performance as immersion sensors. In case of short-circuit or interruption of the operation of one of the probes, depending on the type of boiler the temperature adjustment system can either operate with the remaining probe, signalling a failure, or cancel any heat demand, preventing the boiler from operating.

The probe fitted to the primary circuit also acts as limit thermostat, thus allowing any heat demand to be cancelled if the water temperature exceeds the preset limit temperature.

- **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, ask for service intervention in order to manually reset the thermostat.

- **Air pressure switch** (for closed-chamber boilers only)

It checks the circulation of combustion products in the combustion chamber and allows boiler ignition only if the fan is operating and the draft is regular; it also ensures the boiler safety shutdown if one of these conditions fails during operation. Upon request, in open-chamber boilers the air pressure switch can be replaced by a combustion products discharge safety device using the same connector.

- **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 power switchboard.

- **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 case the three-way valve (if available) is electrically controlled by the system; otherwise the signal can be generated automatically by an hydraulic three-way valve.

- **Room thermostat**

The room thermostat (or chronothermostat) is connected to the SM by two wires; it is designed to operate with a contact isolated from the power supply line.

- **Timer**

The SM is provided with a connection for a timer (12-24V or 220V) mounted on the board to adjust the heating time, as required by the new standards regarding energy saving. Thanks to this timer, the use of a chronothermostat is not required.

- **External probe**

The system is prearranged for the connection to an NTC sensor (similar to the one used in temperature probes), which measures the external temperature outside the building in which the installation is

placed. The available adjustments in heating mode are the required ambient temperature and the heat dispersion coefficient of the room walls. The temperature appearing on the display is the primary circuit temperature, resulting from the two preset parameters and the external temperature. Upon variation in the latter one, the primary circuit temperature changes automatically to adjust the ambient temperature according to the preset value.

- **Control board (Fig.2)**

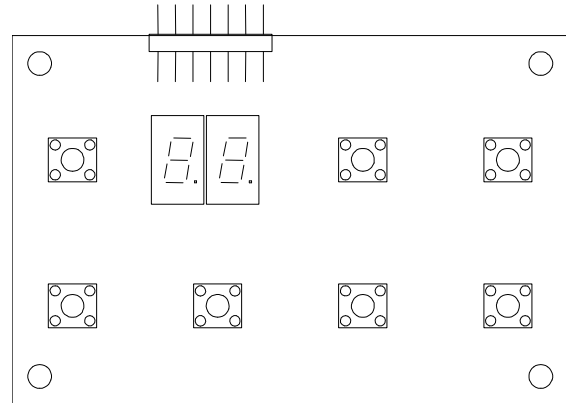


Fig.2

The control board is fitted with the following: 7 push-buttons (enabling the user to carry out any adjustment and setting during installation), two displays (showing temperature, settings and failure signals), and up to two LEDs for any required customization.

- **Display**

The two-digit display usually shows the current water temperature in heating or domestic mode; however, when pressing one of the push-buttons for water temperature adjustment, the display shows first the last preset temperature value and then the current adjusted value. If the adjustment functions required during installation are set, the display shows a percentage value of the adjustment level (0-99%).

- **Setting functions during installation**

During the boiler installation, some system functions are usually set, which depend on the features of the installation, such as the max. power in heating mode, the ignition power, the allowed water temperature range in domestic mode. These settings can be carried out directly on the control board, acting on the jumpers J16-19, therefore these setting functions cannot be reached by the user when the boiler is closed.

- **Function of jumpers**

The mother board is provided with a number of jumpers to fit the system to the final plant and to carry out settings during installation (Fig.3):

**J7** this jumper must be fitted to LPG systems;

**J21** selects the supply voltage (12-24V) of the clock in continuous current;

**I - J16** if J16 is placed on position **0**, the usual user's functions are available on the keyboard (domestic mode, heating mode, summer/winter selection); whereas if J16 is placed on position **1**, the parameters required during setting can be adjusted;

**T - J16** placed on position **0** requires a delay of at least 2,5 min. between the boiler shutdown and re-ignition in heating mode; if J17 is placed on position **1**, re-ignition occurs as soon as the temperature drops 5°C below the preset value;

**P - J18** placed on position **0** enables heat adjustment in traditional systems; placed on position **1**, it enables heat adjustment in floor heating systems;

**B - J18** on position **0** adjusts the temperature in domestic hot water mode from 30 to 60°C; placed on position **1**, it selects hot water tank boilers or boilers for heating use only.

## OPERATING CYCLE

The following operating cycle refers to the temperature adjustment system described above.

### Starting cycle

The starting cycle begins on heat demand by means of the room thermostat (heating mode) or the water flow switch (domestic hot water mode). The water pump is supplied, and if the water temperature is lower than previously adjusted, the burner starting demand occurs.

In case of a closed-chamber boiler, 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 low (slow ignition). If a flame signal is detected at the end of TS, the temperature adjustment process begins, and the burner flame is modulated in order to reach the same water temperature as previously adjusted. If no flame signal is detected within the safety time, on the elapsing of TS the gas valve is closed and lockout occurs. The boiler lockout is signalled on the power switchboard; 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 proceeds with lockout. The boiler keeps on running until either heat demand stops, or one of the safety devices starts operating, or the flame extinguishes.

### Domestic mode

Ignition demand in domestic mode has priority over heating mode. The boiler burner ignition occurs when hot water is drawn; the boiler will try and supply the user with domestic hot water at preset temperature. If the required capacity is lower than the min. modulation capacity, the boiler performs short ignition and turnoff cycles. If the required capacity is higher than the boiler max. capacity, the water temperature is proportional to the quantity of drawn water, but lower than preset temperature.

### Heating mode

If the boiler is in winter position, and on room thermostat switching off the outgoing water temperature is lower than previously adjusted, the boiler ignition occurs and flame modulation begins until the boiler reaches the running state.

If the outgoing water temperature is 5°C higher than previously adjusted by the user, the boiler switches off; re-ignition occurs as soon as the water temperature drops of 5°C below the preset value, provided that at least 150 sec

have elapsed from the boiler switching off. The boiler max. capacity in heating mode is set during installation by means of the push-buttons on the power switchboard.

### Circulator overrun

When the boiler switches off (in heating mode), the circulator keeps on running for a short time (preset during manufacture), in order to prevent water overheating in the primary heat exchanger. For example, suggested overrun periods are: 30s, 60s or 180s.

## SYSTEM SELF-CHECK AND SAFEGUARD FUNCTIONS

The system is provided with some diagnostic functions signalling the boiler operation conditions and the type of failures which may occur:

- current water temperature;
- lockout and relevant temperature;
- insufficient pressure in the primary hydraulic circuit;
- failure of one of the temperature probes;
- lack of draft at start;
- combustion products discharge safety device switching on;
- failures in the safety system;
- overtemperature.

Other functions regard the installation safeguard:

- lockout prevention of the circulator: if the boiler has not carried out any ignition cycle within a given period of time (generally 24 hours), the circulator switches on for some seconds to avoid lockout due to long non-operation; in case of boilers with double primary heat exchanger circuit (commonly called "bithermal"), ignition cycles in heating mode only are considered;
- lockout prevention of the deflection valve: each time the circulator switches off, the deflection valve switches for one second and then switches back to its previous position.
- Antifreeze function: when the system probe measures a temperature lower than 6°C, the burner starts at lowest power, and the pump switches on. This status persists until a temperature of 20°C is reached.

## ADDITIONAL FEATURES AND FUNCTIONS

In the particular case of bithermal boilers, a different set point can be selected for water temperature in domestic mode according to the installation features; this allows the use of water at a lower temperature in the heat exchanger, reducing limestone deposit inside it.

In case water drawing in domestic mode is signalled by means of a flowmeter, it is possible to obtain the flow capacity value and act before the signal of temperature sensors, increasing the system reaction quickness and consequently the user's comfort.

A different operating temperature range can be selected in heating mode when using the boiler in floor installations. In this case, the system must be fitted with a safety thermostat calibrated at 50°C, mounted in contact with the water-conveying collector and electrically connected in series to the room thermostat.

"Chimney-sweep" function: this function is meant to switch off the usual boiler adjustment control, making the boiler work at the max. available heat capacity. This function is useful during installation and when taking any combustion products check measures, as required by the standards in force. The function can be cancelled manually or on any domestic hot water demand.

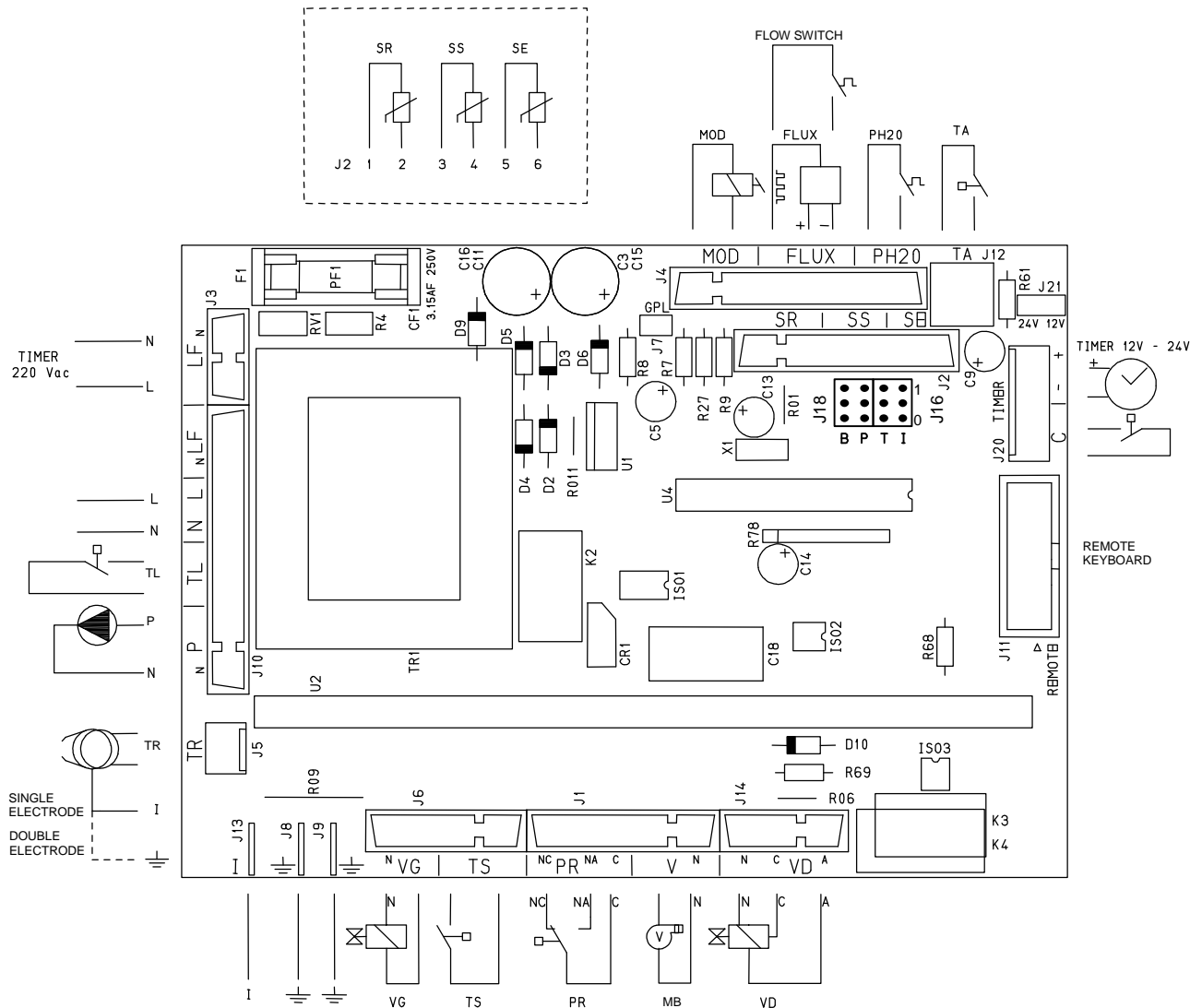


Fig. 3

**KEY**

**Board:**

L	power supply line	SR	heating circuit probe	TR	ignition transformer
N	neutral	SS	domestic circuit probe	VD	deflection valve
P	pump	SE	external probe	VG	gas valve
U2	safety module	I	ionization	TS	safety thermostat
TL	limit thermostat	TA	room thermostat	MB	fan
MOD	modulator (24V)	PR	air pressure switch	FLUX	flow switch / flowmeter
TIMER 220	timer power supply 220V			PH20	water pressure switch
TIMER 12-24	timer power supply 12-24V			J11	control board

**FUNCTION OF JUMPERS**

J7	natural gas / LPG	J21	12/24V for timer	I - J16	protection during installation
T - J16	time cancelling	P - J18	floor heating system	B - J18	domestic temperature range / boiler type selection

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