

System “MI860”

MICROCONTROLLER-BASED ELECTRONIC BOARD FOR BURNER IGNITION, CONTROL AND THERMOREGULATION IN CONDENSING PREMIX BOILERS



DESCRIPTION

This unit has been specifically designed for safety cycle and temperature control in condensing premix gas boilers.

GENERAL FEATURES

This control board is provided with the following features:

- Compliance (certificate 51CL4006) with EN 298:2003 (European standard for automatic gas burner control and flame monitoring systems). *The certificate 51CL4006 covers the integrated thermal cut-out function (TCF) for water temperature limit function according to the standard EN 14459:2007 as far as applicable, when combined to NTC probe complying with EN 60730-2-9 and annex J, classified as suitable for use in type 2 controls.*
- Compliance EN 12067-2. Gas/air ratio controls for gas burners and gas burning appliances. Part 2: Electronic types.
- EMC – compatible system.
- 4kV and 5mm PELV (Protective Extra Low Voltage) insulation on the printed circuit board surface between components connected to the mains supply and low voltage controls.
- Varistor protecting the system from voltage transients which may be generated in the mains supply.
- Single electrode or double electrode ignition and flame monitoring (ionization) system fitted with external high-efficiency ignition device (main power supply).
- Possibility of multiple ignition attempts.
- Electrical reset or manual reset.
- Control of the boiler thermo-regulation and safety parts (modulating circulator, gas valve, modulating fan, deflecting DHW valve, igniter, pneumatic gas valve, DHW flow-switch / flow-meter, air pressure switch, water pressure devices, thermostats, temperature probes).
- Settings and visualizations on a LCD control board connected to the board by means of a multi-polar flat cable.
- Use of (up to) 6 NTC contact and / or immersion probes for temperature measurement.
- Outgoing water temperature adjustment program by means of an outside probe.
- Water pressure detection by means of a water pressure switch or water pressure transducer.
- Possibility of reading an external “0÷10 Volt”–type signal supplied by an external electronic device for the management of any thermoregulation operation.
- Sanitary (DHW) system with instantaneous exchanger (managed by flow switch / flow-meter and NTC temperature probe) or external storage tank (managed by tank thermostat or NTC temperature probe).
- Heating (CH) request managed by room thermostat contact or remote OpenTherm-compatible chrono-thermostat (Brahma “Encrono”).
- Burner heat capacity modulation by means of a PWM-controlled brushless fan (with or without regulation electronics on board).
- Circulator speed modulation according to the system characteristics (main power supply).
- Possibility of driving an high-efficiency circulator with PWM regulation.
- Use of a pneumatic gas valve 230 V_{AC} or 24 V_{DC} supplied. Alternatively a VCM01 Brahma gas valve in an application with separated gas-air mixing (compliance EN12067-2 GARC), in which air and gas are electronically controlled for optimizing the combustion quality and automatically adapt to any gas or air changes (B-Premix system).
- Possibility of driving both 230 V_{AC} motorized DHW deflecting valve and 24 V_{DC} deflecting valve (by means of a stepper motor). Alternatively, the board can drive a sanitary (tank) circulator
- Microcontroller-based control of temperature adjustment functions.
- Microcontroller-based control of safety burner functions.
- Flame modulation by means of a proportional, integral and derivative (PID) electronic system.
- Differentiated setting of the required water temperature for heating and domestic hot water operation mode.

- CH and DHW auto-tuning functions, to set PID parameters accordingly with system characteristics.
- Prearranged for use in floor heating systems.
- Prearranged for use in systems with two separate zones, at the same temperature or with different temperatures; possibility to connect and manage two areas pump (valves) or a mixing valve.
- Prearranged for the management of cascade system application (via RS485 communication) both in autonomous configuration (only MI860 boards) or managed by an external Brahma CBS06 device.
- Connection with a remote PC by means of a RS232 cable or via GSM (wireless modem) for remote boiler analysis, diagnostics and settings.
- Prearranged for the management of a solar thermal system, reading up to 4 solar probes and driving up to 2 phase-cut solar circulators.

For the detailed description of all the features described in this document please refer to the technical datasheet of the specific customer's MI860 product.

ACCESSORIES

System can be provided with:

- Board plastic box.
- Connectors and terminals for wirings.
- Contact or immersion NTC temperature probes type ST03, ST04, ST07, ST11, ST06, ST6B, ST09 and ST10 for the detection of the temperature of water and combustion products.
- PT1000 temperature probes for the detection of the temperature of solar collectors.
- SSE temperature probe for the detection of the external environment temperature.
- External high-efficiency igniter type TSM.
- Room chrono-thermostat type BAT1.
- OpenTherm-compatible room chrono-thermostat type Encrono OT1 or Encrono OT2.
- CBS06 device for the management of cascade systems.
- Wiring for RS232 serial communication.
- Ignition and detection electrodes type SA, RS and RB.

For the detailed description of these devices please refer to the specific technical documentation that can be found on Brahma web site: www.brahma.it

CLASSIFICATION CODES:

Character	Description	Code
1°	Fanned	F
2°	Direct main burner ignition	M
3°	Non volatile lock-out	L
	Volatile-lock-out	V
	Recycling	C

4°	Non volatile lock-out	L
	Volatile-lock-out	V
5°	Fixed times	X
6°	Non-seff-check	N

CONSTRUCTION

The system consists of five electronic boards:

Mother Board MI860, which houses the electronics controlling the boiler parts (temperature adjustment) and carrying of the safety functions.

Control Board LCD, on which adjustment controls (push-buttons) and diagnostic signals (on a display) are mounted. On customer's request, this system can be fitted with different control board: for information see control board description and the relevant datasheet.

Option Board 861, including the electronics managing a solar thermal system and a two separate zones system.

Options Board 862, including the electronics managing a two separate zones system.

Fan Board 863, including the electronics managing a brushless fan. Supply and regulation circuits are integrated on the board. Fan in this case, is only equipped with an Hall speed sensor.

The integrated safety and thermoregulation system, though it is composed (in the full version) by the 5 boards described above, is identified by the name of the mother board, i.e. "MI860". So in this document we will refer to "MI860" as the whole system, comprehensive (eventually) of all options and fan boards.

TECHNICAL DATA

Supply voltage:	230 V _{AC} 50/60 Hz
Voltage range:	[-15% ÷ +10%]
Operating temperature range:	-20°C / +60°C
Consumption:	30 mA (*) → 6.9 VA
Humidity:	95% max at 40°C
Protection degree:	IP 00
Dimensions:	140 x 110 x 50 mm

(*) Only MI860 system (MI860 + 861 / 862 + 863 + LCD1) supplied without loads / devices connected.

Contacts:

High voltage contacts on mother board MI860 (230 V_{AC})

- Board power supply;
- Ignition device;
- Fan (power supply);
- Boiler circulator;
- Gas valve (with 230 V_{AC} gas valve configuration);
- Motorized deflecting valve (with 230 V_{AC} valve) / Tank circulator;
- Flame detection electrode.

Low voltage contacts on mother board MI860

- Safety thermostat (5 V_{DC});
- Air pressure switch (5 V_{DC});
- Combustion products thermostat (5 V_{DC});

- Water pressure switch / Water pressure transducer (5 V_{DC});
- Primary flow switch (5 V_{DC});
- Room thermostat (24 V_{DC});
- 0-10 Volt signal (10 V_{DC});
- OpenTherm remote chrono-thermostat (24 V_{DC});
- DHW flow-switch / flow-meter (5 V_{DC});
- Temperature probes (primary outgoing probe, return probe, DHW probe, external probe, combustion products probe) (5 V_{DC});
- Fan (driver) (24 / 5 V_{DC});
- Circulator (PWM driver) (24 V_{DC});
- Motorized deflecting valve (with 24 V_{DC} stepper motor) (24 V_{DC});
- Control board LCD (5 V_{DC});
- Connection strip for option boards 861 / 862 (24 / 5 V_{DC});
- Serial RS232 communication (5 V_{DC});
- Serial RS485 communication (5 V_{DC});

High voltage contacts on option board 861(230 V_{AC})

- Board power supply;
- Solar pump n. 1;
- Solar pump n. 2;
- Zone pump n. 1;
- Zone pump n. 2;
- Mixing valve;

Isolated contacts on option board 861

4 auxiliary isolated contacts

Low voltage contacts on option board 861

- Solar temperature probes (solar probe n. 1, 2, 3, 4) (5 V_{DC});
- Secondary (low-temperature) outgoing probe (5 V_{DC});
- Secondary room thermostat (24 V_{DC}).

High voltage contacts on option board 862 (230 V_{AC})

- Board power supply;
- Zone pump n. 1;
- Zone pump n. 2;
- Mixing valve;

Isolated contacts on option board 862

4 auxiliary isolated contacts

Low voltage contacts on option board 862

- Secondary (low-temperature) outgoing probe (5 V_{DC});
- Secondary room thermostat (24 V_{DC}).

High voltage contacts on Fan Board 863 (230 V_{AC})

Supply voltage.

Low voltage contacts on Fan Board 863

Hall sensor output (15 V_{DC}).

Contacts rating

Once the voltage supply is verified, in order to determine the maximum current rating for the devices connected to the system, the following thresholds must be respected (they are based on boards electrical characteristics and components):

Contacts on mother board MI860

- Fan + boiler circulator + deflecting valve (230 V_{AC}) + igniter + gas valve (230 V_{AC}) < 1.8 A
- Boiler circulator < 0,5 A
- Gas valve (24 V_{DC}) + deflecting valve (24 V_{DC}) + Water pressure transducer + DHW flow-switch / flow-meter + OpenTherm chrono-thermostat < 0.75 A

Contacts on option board 861

- Solar pump n.1 + solar pump n.2 + zone pump n.1 + zone pump n.2 + mixing valve < 5.5 A
- Solar pump n.1 < 0,5 A
- Solar pump n.2 < 0,5 A

Contacts on option board 862

- Solar pump n.1 + solar pump n.2 + zone pump n.1 + zone pump n.2 + mixing valve < 5.5 A
- Solar pump n.1 < 0,5 A
- Solar pump n.2 < 0,5 A

Maximum cable length

Room thermostat	50 m
OpenTherm chrono-thermostat	50 m
External probe	10 m
Tank (DHW) probe	10 m
Secondary (low temp.) outgoing probe	10 m
Solar probe (panels)	50 m
Other cables	1 m

INTEGRATED SAFETY AND THERMOREGULATION SYSTEM

Timings:

Pre-purge time (TW):	1,5 ... 60 s
Safety time (TS):	3 ... 120 s
Spark ignition time (TSP):	(TS - 1) s
Drop-out time on flame failure:	< 1 s
Post-purge time:	0 ... 60 s
Inter-purge time (TIP):	1...240 s

The above times correspond to guaranteed values. Actual values may differ from declared ones, as waiting (TW) or post-purge may be longer and safety time (TS) shorter.

Ignition attempts: 1...10

Flame control:

The flame detection device makes use of the rectification property of the flame.

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

DEVICES ON MOTHER BOARD MI860

The mother board MI860 is able to manage the following devices:

Temperature measuring probes

The system can control up to 5 temperature detection probes, one of which (the primary system outgoing water) must necessarily be always available: the remaining ones (domestic hot water probe, external probe, return probe, combustion products detection probe) can be available or not, depending on the settings (software) selected by the user and the comfort desired.

Please note that the each probe can also operate as limit thermostats, enabling any heat demand to be inhibited if the temperature exceeds the preset limit. In this sense, if this probe is cut-off or in short circuit, the temperature adjustment system will cancel any heat demand, preventing the boiler from operating. On customer's software setting, any probe can operate this way.

Safety thermostat

The system is perfectly safe against possible overheating in the primary system by means of a safety thermostat, either bi-metallic type (switch on/off operation, with manual or automatic reset) or realized with a double NTC thermistor probe. The thermostat switching can immediately lead the system to non-volatile lockout (signalled by a suitable error code).

Air pressure switch

MI860 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.

Combustion products thermostat

The system is perfectly safe against possible overheating of the combustion products by means of a combustion thermostat realized by a traditional bi-metal on/off thermostat

Water pressure transducer

It ensures that the primary circuit water pressure is within the required operation range.

Water pressure switch

Used instead of the pressure transducer, it ensures that the primary circuit water pressure is higher than a minimum safety threshold.

Primary water flow switch

It checks water flow on primary system and it guarantees safety against possible circulator failures.

DHW flow-meter / DHW flow-switch / DHW tank-switch

The MI860 board is prearranged for an input connection signalling domestic water drawing: this signal is generated by a flow-meter which detects the exact water flow rate or by a (on-off) flow switch. Alternatively,

the MI860 board can read the signal generated by a thermostat on an external tank for DHW operations.

Room thermostat / OpenTherm chrono-thermostat

The room thermostat (or chrono-thermostat) is connected to the MI860 by two wires (24V); it is designed to operate with a contact isolated from the power supply line. The room thermostat can be a traditional on/off thermostat or a OpenTherm compatible thermostat such as, for example, the Brahma Encrono OT1 or Encrono OT2.

0-10 Volt signal

The board can read a variable signal, "0-10 Volt" type, supplied by an external electronic device to realize, on customer demand, any desired thermo-regulation operation.

Boiler circulator

The MI860 board can be fitted to any type of circulator with 230 V_{AC} power supply, which can be controlled in a classical way (constant speed) or through "phase-shift control" (variable speed): in case the latter characteristic is selected, the system will be able to optimize the circulator control so as to make the difference (ΔT) between outgoing water temperature and return water temperature as great as possible, to the advantage of the boiler performance (higher condensing capability).

The board can also drive an high-efficiency circulator with a PWM regulation electronics on board, in order to optimize performance and reduce power consumption.

Deflecting DHW valve / Tank circulator

The system can control a DHW deflecting valve driven by means of a 230 V_{AC} motor or provided with a 24 V_{DC} stepper motor. Also, instead of the deflecting valve, the board can manage a DHW circulator connected to an external tank for DHW operations.

Fan

The system is prearranged for the use of a modulating fan with 230 V_{AC} power supply and controlled by means of a 24V PWM signal.

Two types of fan can be utilized: fan with driver (control electronic) on board and fan without driver on board: in this case the fan is only equipped with an Hall effect sensor, while the control electronic is fitted on 863 board.

Gas valve (EGV)

The system is prearranged for driving a pneumatic gas valve with air-gas ratio control at 230 V_{AC} or 24 V_{DC}. The system is also prearranged for driving a electronic VCM01 Brahma gas valve modulated by the PWM signal 24VDC.

External ignition device

The board can drive any kind on external ignition device 230 V_{AC} supplied. A Brahma "TSM" high-efficiency igniter can be connected.

Serial communication RS232

The board MI860 is fitted with a connector for RS232 serial communication: this characteristic is useful for boiler analysis, diagnostics and settings on a remote computer connected via GSM modem or through a RS232 cable.

Serial communication RS485

The Options Board is provided with a connector for RS485 serial communication: this characteristic is useful to connect the board in a boiler-cascade (battery) system, both in autonomous configuration (application with only MI860 boards) or managed by an external Brahma CBS06 device.

Control board LCD

Back-lighted LCD control board fitted with 8 push-buttons to carry out any adjustment and setting, displaying information about temperatures and other digital inputs and signaling any situation of anomaly.

DEVICES ON OPTION BOARDS 861 AND 862

Options boards 861 and 862 are able to manage the following devices:

Secondary room thermostat (861 and 862)

The room thermostat (or chrono-thermostat) for the secondary system (used in systems with 2 separate zones) is connected to the option board, at low voltage, by means of two wires; it is prearranged for operation with a contact isolated from the mains supply.

Secondary (low temperature) outgoing probe (861 and 862)

Measures the temperature of the secondary system outgoing water.

Mixing valve (861 and 862)

The system can control an electric 230 V_{AC} mixing valve which can be utilized in case of a system with two areas with different temperatures, a low-temperature zone (e.g. floor radiant heaters) and a high-temperature area (e.g. classical radiators).

Zone pumps / valves (861 and 862)

In case of a system with two zones (at the same temperature or with different temperatures) the board can drive two independent 230 V_{AC} circulators or valves.

Solar probes (861)

Option board 861 is able to manage up to 4 probes (2 type PT1000 and 2 type NTC) in order to manage the

temperature on solar panels and / or solar storage boilers.

Solar pumps (861)

Option board 861 is able to manage up to 2 circulators with 230 V_{AC} power supply for solar operations, which can be driven through "phase-shift" control (variable speed).

Auxiliary isolated contact (861 and 862)

Instead of connecting the mixing valve and the zone circulators (valves), the same (4) connections can be utilized as isolated contacts (on / off) for general purposes, for example as signals for external devices.

FAN BOARD 863

The fan board is dedicated to supply and control a brushless fan 230 V_{AC} without regulation electronic. In this case both power supply and driver circuit are integrated on the 863 fan board; the fan is only equipped with an Hall speed sensor.

SYSTEM OPERATION

Burner operating cycle

The operating cycle starts if at least one of the following conditions is fitted and all the conditions for burner ignition are verified:

- CH demand (by room thermostat or OpenTherm chrono-thermostat request, or cascade operation request or solar storage heating demand);
- DHW demand (by flow-meter signal or water flow switch or external tank probe switch);
- Antilegionella operation;
- Chimney-sweep function at the minimum or maximum power;
- Antifreeze operation;
- PID (CH or DHW) auto-tuning operation.

Ignition cycle is performed as follows:

- Fan is energized;
- When fan speed reaches the ignition speed \pm 500 rpm the pre-purge time TW starts to be counted;
- At the end of the pre-purge time TW, the gas valve is supplied, the ignition device is started and the safety time TS begins, during which the fan speed (and the burner capacity) is kept at the ignition value;
- If no flame signal is detected within the safety time TS, the gas valve is closed and the ignition device inhibited. If the total number of available ignition attempts has not run out yet, the system performs an inter-purge time TIW at the inter-purge fan speed, then a new TW/TS cycle starts again, turning back fan speed at ignition value;
- Otherwise, if the total number of available ignition attempts has run out, a safety shutdown occurs and the board lock-out

condition is generated; to restore normal system operation, the corresponding push-button (RESET) must be pressed: if heating demand still occurs, the boiler starts a new ignition cycle (with one or more ignition attempts); if the conditions leading to lock-out still occur, after using all available ignition attempts the boiler will go back to lockout;

- If a flame signal is detected during TS, the system inhibits the ignition device at the end of TS and the burner flame modulates in order to reach the same water temperature as the preset value (running stage);
- The running stage continues until either heat demand stops, or one of the safety devices switches on, or the flame extinguishes;
- On accidental flame extinguishing during operation, the device carries out one or more re-ignition attempts (depending on the options selected); if these attempts do not succeed, lock-out occurs;
- After performing a safety shutdown or after heat demand stops, the device continues supplying the fan at the post-purge speed for a post-purge time: this behavior is useful to help the evacuation of humid vapors and prevent moisture from invading or damaging the fan driving circuit.

WORKING STATES

System, depending on the actual operating mode (OFF, WINTER, SUMMER), can perform the following working states (ordered by increasing priority):

- **Stand-by** (in WINTER or SUMMER operating modes).
The system is steady, not performing any other working state.
- **Off** (only in OFF operating mode).
In this mode, system can not perform any operation. All loads are de-activated, even if they are still electrically supplied.
- **Anti-freeze** (in OFF or WINTER or SUMMER operating modes).
This working state activate when the temperature of the primary outgoing water decreases under a pre-defined value, to prevent water to freeze in the heating circuit.
Two configurations are available for this state :
1) Anti-freeze first stage (only pump).
2) Anti-freeze second stage (burner).
- **CH** (only in WINTER operating mode).
This working state performs heating on the CH circuit(s), allowing hot water to circulate and exchange heat with the different elements of the system.
The following configurations are available for this state:
1) Primary system CH high temperature.
2) Primary system CH low temperature.
3) Primary and secondary systems CH high temperature.
4) Primary and secondary systems CH low temperature.

- 5) Primary system CH high temperature and secondary system CH low temperature.
- 6) Primary system CH low temperature and secondary system CH high temperature.

Within these configurations, depending on the heating request type and devices connected to the system, the following operations are available in CH working state:

- 1) Heating request by room thermostat.
- 2) Heating request by remote OpenTherm chrono-thermostat.
- 3) Heating request by serial bus RS485 (cascade system) – Cascade system with CBS device.
- 4) Heating request by serial bus RS485 (cascade system) – Master-Slave cascade system.
- 5) Heating request by solar storage demand.

An external probe can be fitted on the system in order to automatically calculate CH working temperature, according with the outside temperature and the building characteristics and following the “climatic curve” depicted below.

- **Chimney-sweep** (in WINTER or SUMMER operating modes).

This working state forces the system to work at a constant power, minimum or maximum, allowing the installer to perform tests, configure and regulate the combustion parameters.

The following configurations are available for this state:

- 1) Chimney-sweep at minimum (CH and DHW) power.
- 2) Chimney-sweep at maximum (DHW) power.

- **DHW** (in WINTER or SUMMER operating modes).

This working states performs water heating for the domestic use.

Within these configurations, depending on the heating request type and devices connected to the system, the following operations are available in CH working state:

- 1) DHW with heat exchanger, flow switch and DHW probe.
- 2) DHW with heat exchanger, flow-meter and DHW probe.
- 3) DHW with external tank and tank probe.
- 4) DHW with external tank and tank thermostat.

- **Antilegionella** (in WINTER or SUMMER operating modes).

This working states allows to periodically heat the water on an external tank in order to eliminate Legionella virus.

The following configurations are available for this state:

- 1) Antilegionella 3 hours.
- 2) Antilegionella weekly.

- **PID self-tuning** (in WINTER or SUMMER operating modes).

This working state allows the system to self-tune parameters of the PID regulating algorithm, both in CH and DHW modes.

The following configurations are available for this state:

- 1) CH PID self-tuning.
- 2) DHW PID self-tuning.

OTHER CHARACTERISTICS

Other functions are related to the system safeguard:

- Every time burner is switched off, after performing a working state that implies water heating, system runs CH (or DHW, if any) circulator for an interval that can be set by the user, in order to dissipate exceeding heat.
- Pump lockout prevention: if the boiler has not carried out any ignition cycle within a given period of time (usually 24 hours), the circulator will switch on for 5 seconds to avoid lockout due to protracted non-operation.

COMBUSTION CHECK

If a MI860 system is required provided with the "B-Premix" configuration, the check of combustion is managed as described here below.

System works following two separate set-points, i.e. a gas pressure set-point and a fan speed set-point. On the memory of the board, a fan speed Vs gas pressure characteristic is pre-loaded: this function is built on factory in a "ad hoc" way for the specific boiler type, fixing for each gas pressure value an optimum speed value that the fan must follow. "Optimum" means that these values optimize the efficiency of the combustion process and minimize the release of damaging CO products on the environment. The combustion characteristics could actually change during burner ignition, due to variations on the chimney loss or variations on the properties of the gas: in this case, the check of the ionization current on the detection electrode plays a fundamental role: analyzing this value in fact it is possible to detect the quality of the combustion and to act on the fan speed to bring the combustion back to its ideal value.

PARAMETERS SETTING MODE

Setting parameters on MI860 board, installers or manufacturers can configure the system.

Different parameters menus are available.

01 - Boiler menu

This menu allows to set all the boiler parameters (pump configuration, fan speed configuration, burner operating cycle timings, temperatures ranges and offsets). This menu also allows setting the system typology, i.e. CH configuration (CH mode available / not available, low or high temperature operation), DHW configuration (DHW mode available / not available, instantaneous DHW or external tank DHW, request by flow switch with on-off information or by Hall impulses flow-meter), climatic compensation with external probe, cascade system configuration and solar system configuration

02 - OEM menu

This menu (available only for manufacturer) allows to set some advanced parameters in the boiler, like the PID algorithm constants for the fan or the CH / DHW operations.

03 - Secondary system menu

This menu allows setting the parameters related to the secondary system configuration.

04 - Cascade menu

This menu allows setting parameters related to the cascade system configuration.

05 - Solar operations menu

This menu allows setting the parameters related to the solar system configuration.

06 - Connections menu

This menu (available only for manufacturer) allows to select / deselect all the boiler devices.

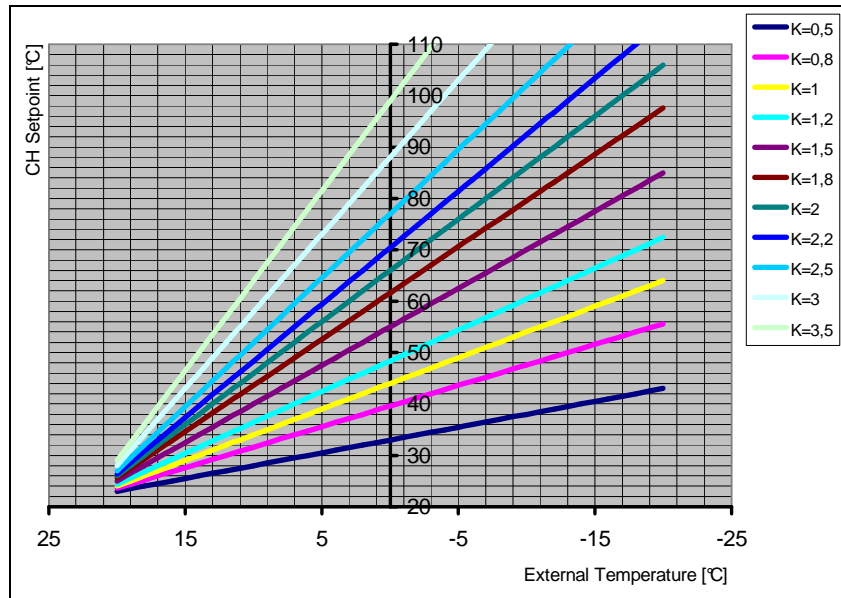
The parameters setting modes can be customized on customer's request. For more information on parameters setting mode you can see, the relevant MI860 technical datasheet.

ANOMALIES

The board can detect and display all the anomalies affecting the system.

Anomalies are displayed with the notation "Err. xx.yy", where "xx" is the general error code (a family of anomalies inherent to a specific device or part of the system) and "yy" is the detailed error code.

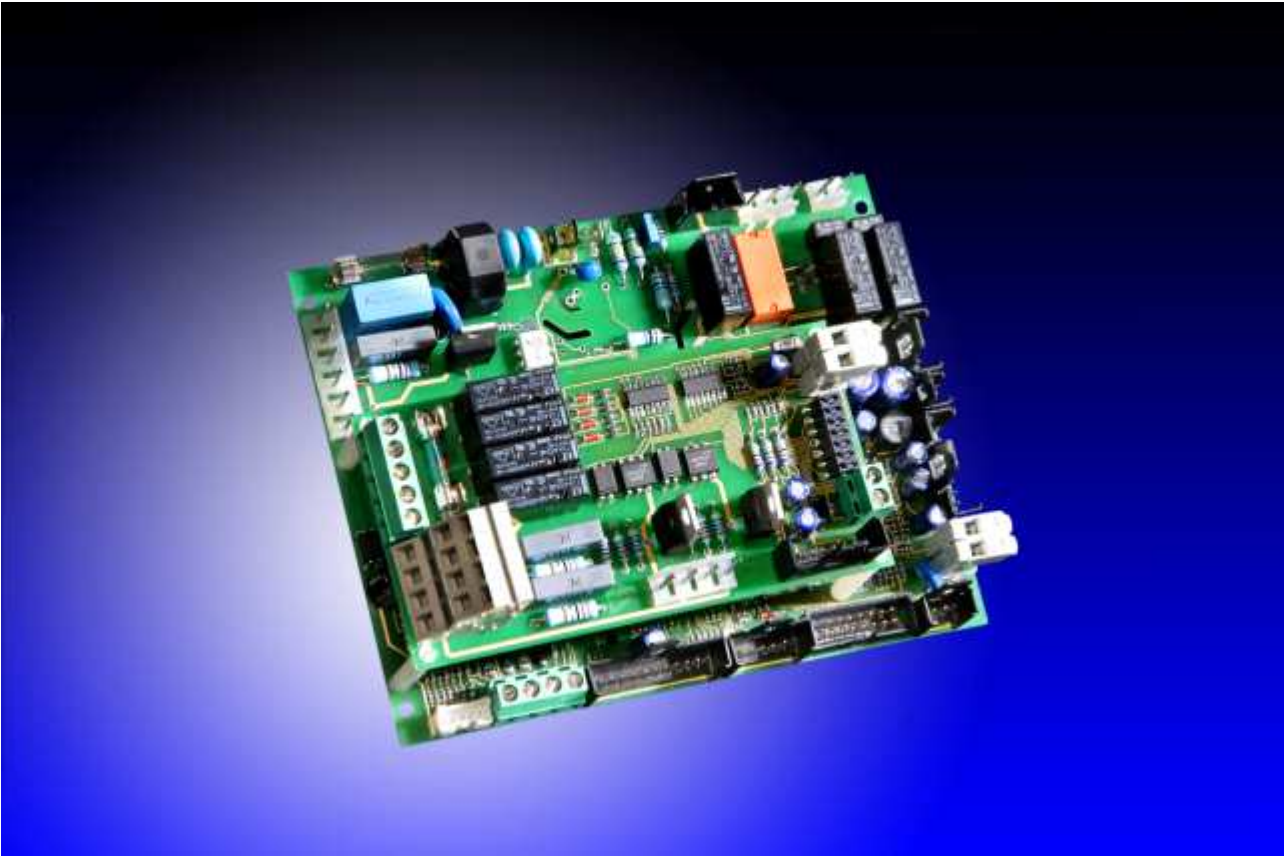
CLIMATIC CURVE (T_{ROOM} = 22°C)



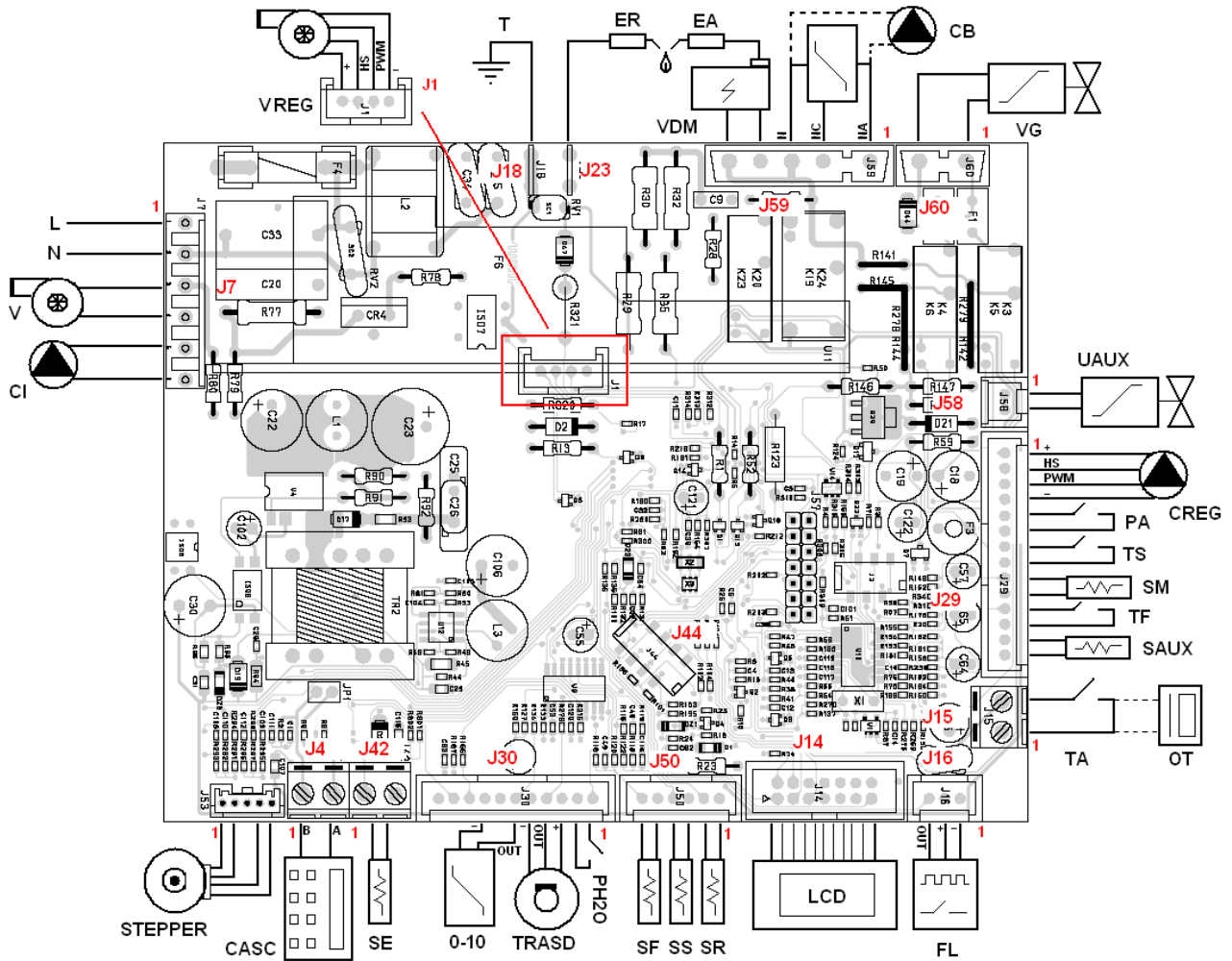
$$\text{CH setpoint} = (T_{\text{ROOM}} - \text{External probe temperature}) * K + T_{\text{ROOM}}$$

PRODUCT PICTURE

The following picture depicts the board "MI860" assembled with the optional board "861"



WIRING & CONTACTS Mother board MI860



Main power supply

Contacts: Connector: **J7**
 Type: Molex 6 poles
 Pin: 1. L: Live (230 V_{AC}, 50 Hz)
 2. N: Neutral

Voltage: High (230 V_{AC})

Fan power supply

Contacts: Connector: **J7**
 Type: Molex 6 poles
 Pin: 5. L: Live
 6. N: Neutral

Voltage: High (230 V_{AC})

Boiler pump

Contacts: Connector: **J7**
 Type: Molex 6 poles
 Pin: 5. N: Neutral
 6. L: Live

Voltage: High (230 V_{AC})

Motorized deflating valve with stepper motor (STEPPER)

Contacts: Connector: **J53**
 Type: JST B05B – PASK 5 poles

Pin: 1. P1B: Coil 1, terminal B
 2. P2B: Coil 2, terminal B
 3. Not connected
 4. P2A: Coil 2, terminal A
 5. P1A: Coil 1, terminal A

Voltage: Low (24 V_{DC})

Cascade connection (RS485)

Contacts: Connector: **J4**
 Type: Screw 2 poles
 Pin: 1. Connection B
 2. Connection A

Tensione: Low (5 V_{DC})

External probe

Contacts: Connector: **J42**
 Type: Lumberg 2,5 MSF 2 poles
 Pin: 1. Input signal
 2. GND

Voltage: Low (5 V_{DC})

Water pressure switch (PH2O) / Primary flow switch (FLOW)

Contacts: Connector: **J30**
 Type: Lumberg 2,5 MSF 11 poles
 Pin: 1. 5 V_{DC}
 2. Input signal

Voltage: Low (5 V_{DC})

Water pressure transducer (WPT)

Contacts: Connector: **J30**
 Type: Lumberg 2,5 MSF 11 poles
 Pin: 3. 5 V_{DC}
 4. Input signal
 5. GND

Voltage: Low (5 V_{DC})

0-10 Volt signal

Contacts: Connector: **J30**
 Type: Lumberg 2,5 MSF 11 poli
 Pin: 6. Input signal
 8. GND

Tensione: Low (10 V_{DC})

Return probe

Contacts: Connector: **J50**
 Type: Lumberg 2,5 MSF 6 poles
 Pin: 1. GND
 2. Input signal

Voltage: Low (5 V_{DC})

DHW / Tank probe

Contacts: Connector: **J50**
 Type: Lumberg 2,5 MSF 6 poles
 Pin: 3. GND
 4. Input signal

Voltage: Low (5 V_{DC})

Combustion products (chimney) probe

Contacts: Connector: **J50**

Type: Lumberg 2,5 MSF 6 poles
 Pin: 5. GND
 6. Input signal
 Voltage: Low (5 V_{DC})

DHW flow-meter

Contacts: Connector: **J16**
 Type: Lumberg 2,5 MSF 3 poles
 Pin: 1. GND
 2. V+ (5 V_{DC})
 3. Input signal
 Voltage: Low (5 V_{DC})

DHW flow-switch / Tank thermostat

Contacts: Connector: **J16**
 Type: Lumberg 2,5 MSF 3 poles
 Pin: 1. GND
 3. Input signal
 Voltage: Low (5 V_{DC})

Room thermostat / OpenTherm chrono-thermostat

Contacts: Connector: **J15**
 Type: Stelvio CUM 2 poles
 Pin: 1. Input signal
 2. GND
 Voltage: Low (24 V_{DC})

Safety thermostat

Contacts: Connector: **J29**
 Type: Lumberg 2,5 MSF 14 poles
 Pin: 7. Input signal
 8. 5 V_{DC}
 Voltage: Low (5 V_{DC})

Central heating probe (CH probe)

Contacts: Connector: **J29**
 Type: Lumberg 2,5 MSF 14 poles
 Pin: 9. Input signal
 10. 5 V_{DC}
 Voltage: Low (5 V_{DC})

Combustion products (chimney) thermostat

Contacts: Connector: **J29**
 Type: Lumberg 2,5 MSF 14 poles
 Pin: 13. Input signal
 14. 5 V_{DC}
 Voltage: Low (5 V_{DC})

Air pressure switch

Contacts: Connector: **J29**
 Type: Lumberg 2,5 MSF 14 poles
 Pin: 5. 5 V_{DC}
 6. Input signal
 Voltage: Low (5 V_{DC})

Pump PWM driver

Contacts: Connector: **J29**
 Type: Lumberg 2,5 MSF 14 poles
 Pin: 1. 24 V_{DC}

- 2. Input Hall signal
- 3. Output PWM signal
- 4. GND

Voltage: Low (V_{DC})

Fan PWM driver

Contacts: Connector: **J1**
 Type: Lumberg 2,5 MSF 4 poles
 Pin: 1. $24 V_{DC}$
 2. Input Hall signal
 3. Output PWM signal
 4. GND

Voltage: Low (V_{DC})

Gas valve

Contacts: Connector: **J60**
 Type: Stocko 2 poles
 Pin: 1. L: Live / $24 V_{DC}$
 2. N: Neutral / GND

Voltage: High ($230 V_{AC}$)
 Low ($24 V_{DC}$)

Motorized deflecting valve with 230 V_{AC} motor

Contacts: Connector: **J59**
 Type: Stocko 5 poles
 Pin: 1. NO: Normally open (CH) way
 2. NC: Normally closed (DHW) way
 3. N: Neutral

Voltage: High ($230 V_{AC}$)

Tank (DHW) pump

Contact: Connector: **J59**
 Type: Stocko 5 poles
 Pin: 1. L: Live
 3. N: Neutral

Voltage: High ($230 V_{AC}$)

Igniter

Contacts: Connector: **J59**
 Type: Stocko 5 poles
 Pin: 4. N: Neutral
 5. L: Live

Voltage: High ($230 V_{AC}$)

Flame detection electrode for flame detection (DE)

Contact: Connector: **J23**
 Type: Faston 4,8x0,8

Voltage: High ($230 V_{AC}$)

Board earth connection

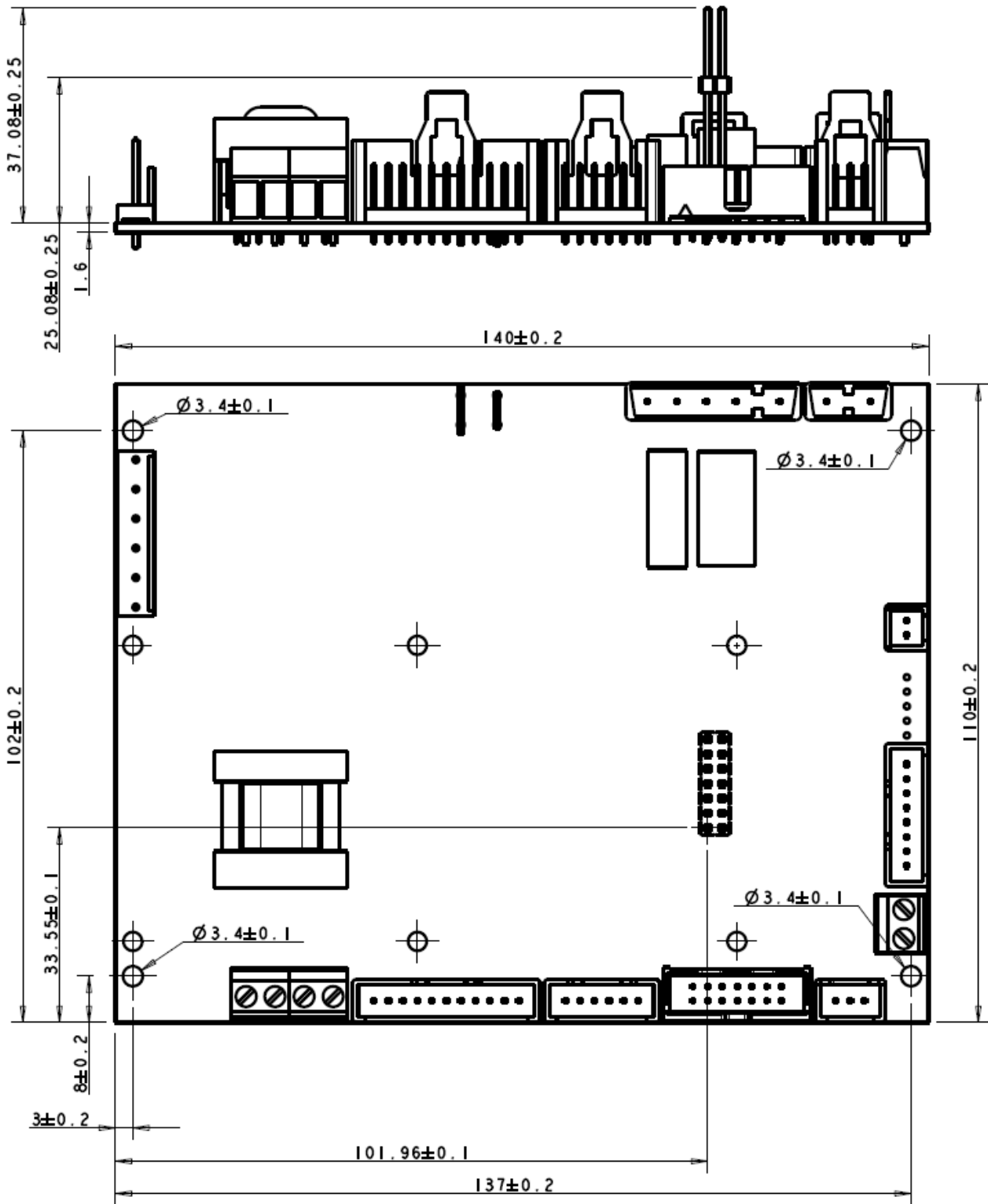
Contacts: Connector: **J18**
 Type: Faston 6,3x0,8

Serial communication RS232

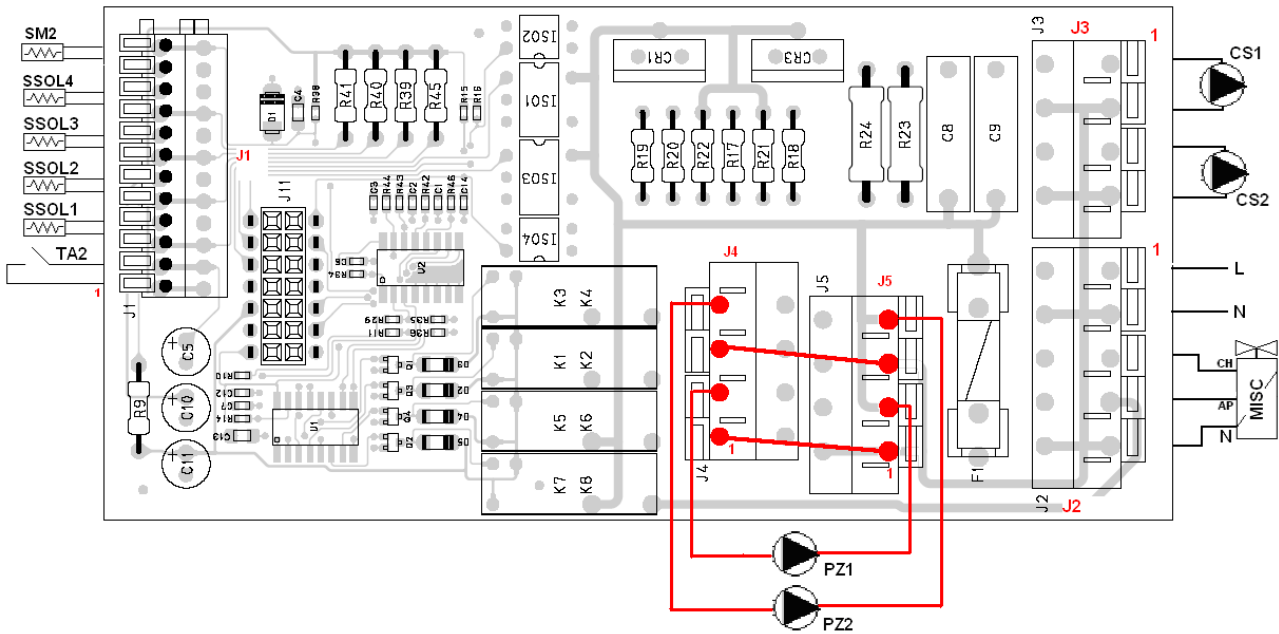
Contacts: Connector: **J44**
 Type: Mix 8 poles

Voltage: Low ($5 V_{DC}$)

Mother board MI860 – Dimensions



Option board 861



Board power supply

Contacts: Connector: **J2**
 Type: Spring 5 poles
 Pin: 1. L: Live (230 V_{AC}, 50 Hz)
 2. N: Neutral

Voltage: High (230 V_{AC})

Mixing valve

Contacts: Connector: **J2**
 Type: Spring 5 poles
 Pin: 3. CH: Closed way
 4. AP: Open way
 5. N: Neutral

Voltage: High (230 V_{AC})

Zone pump (valve) n. 1 / Zone pump (valve) n. 2

Contacts: Connector: **J4-J5**
 Type: Spring 4 poles
 Pin: J4.1. Bridge with J5.1
 J4.2. Live pump 1
 J4.3. Bridge with J5.3
 J4.4. Neutral pump 1
 J5.1. Bridge with J4.1
 J5.2. Live pump 2
 J5.3. Bridge with J4.3
 J5.4. Neutral pump 2

Voltage: High (230 V_{AC})

Solar pump n. 1

Contacts: Connector: **J3**
 Type: Spring 4 poles
 Pin: 1. Live
 2. Neutral

Voltage: High (230 V_{AC})

Solar pump n. 2

Contacts: Connector: **J3**
Type: Spring 4 poles
Pin: 3. Live
4. Neutral

Voltage: High (230 V_{AC})

Solar probe n. 1

Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 3. Input signal
4. GND

Voltage: Low (5 V_{DC})

Solar probe n. 2

Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 5. Input signal
6. GND

Voltage: Low (5 V_{DC})

Solar probe n. 3

Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 7. Input signal
8. GND

Voltage: Low (5 V_{DC})

Solar probe n. 4

Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 9. Input signal
10. GND

Voltage: Low (5 V_{DC})

Secondary (low temperature) outgoing water probe (CH2 probe)

Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 11. GND
12. Input signal

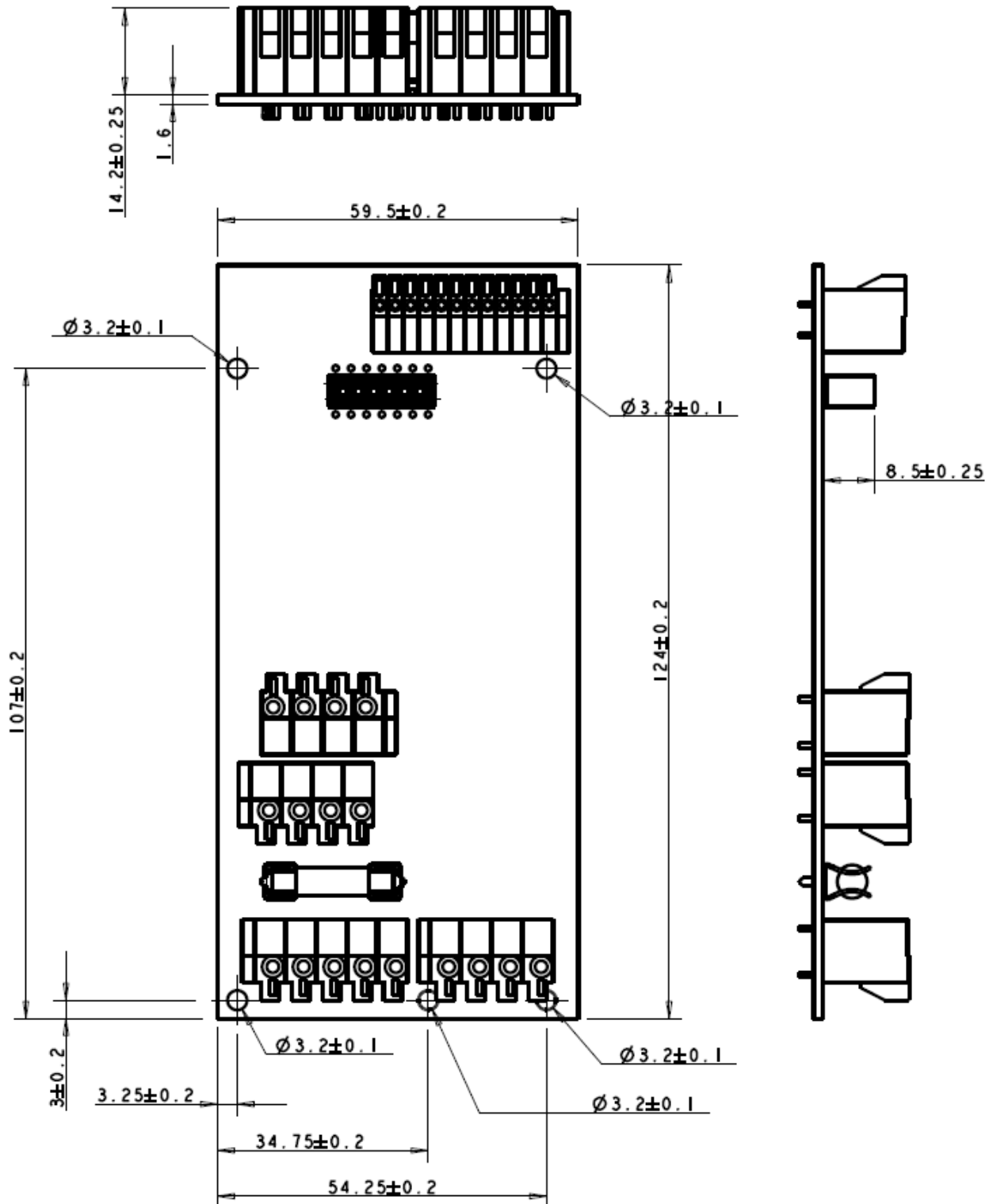
Voltage: Low (5 V_{DC})

Secondary room thermostat

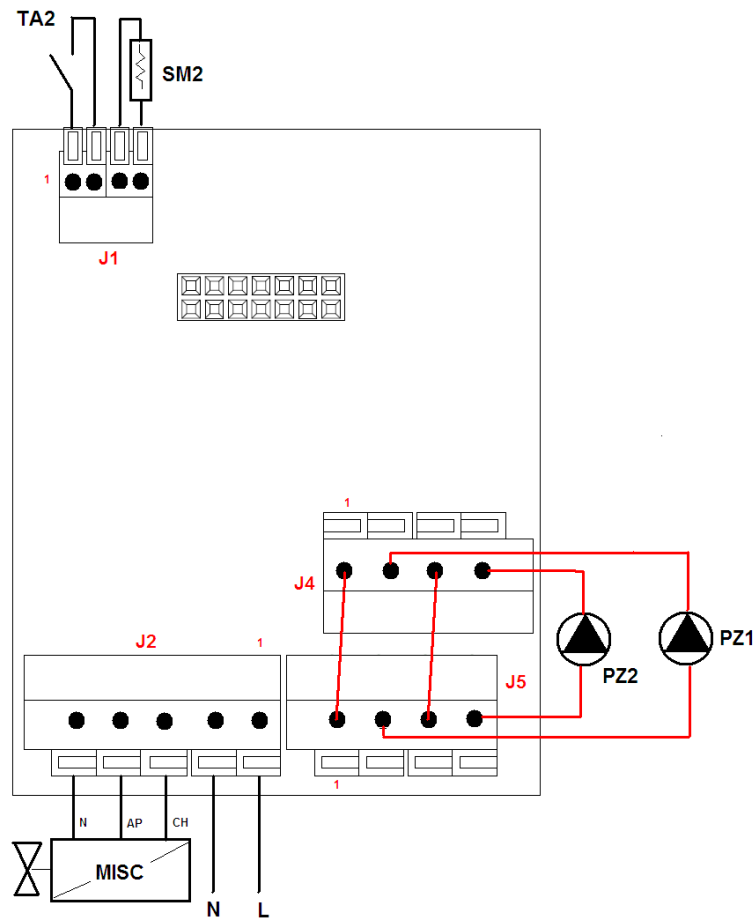
Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 1. 24 V_{DC}
2. Input signal

Voltage: Low (24 V_{DC})

Option board 861 – Dimensions



Option board 862



Board power supply

Contacts: Connector: **J2**
 Type: Spring 5 poles
 Pin: 1. L: Live (230 V_{AC}, 50 Hz)
 2. N: Neutral

Voltage: High (230 V_{AC})

Mixing valve

Contacts: Connector: **J2**
 Type: Spring 5 poles
 Pin: 3. CH: Closed way
 4. AP: Open way
 5. N: Neutral

Voltage: High (230 V_{AC})

Zone pump (valve) n. 1 / Zone pump (valve) n. 2

Contacts: Connector: **J4-J5**
 Type: Spring 4 poles
 Pin: J4.1. Bridge with J5.1
 J4.2. Live pump 1
 J4.3. Bridge with J5.3
 J4.4. Neutral pump 1
 J5.1. Bridge with J4.1
 J5.2. Live pump 2
 J5.3. Bridge with J4.3
 J5.4. Neutral pump 2

Voltage: High (230 V_{AC})

Secondary (low temperature) outgoing water probe (CH2 probe)

Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 3. GND
4. Input signal

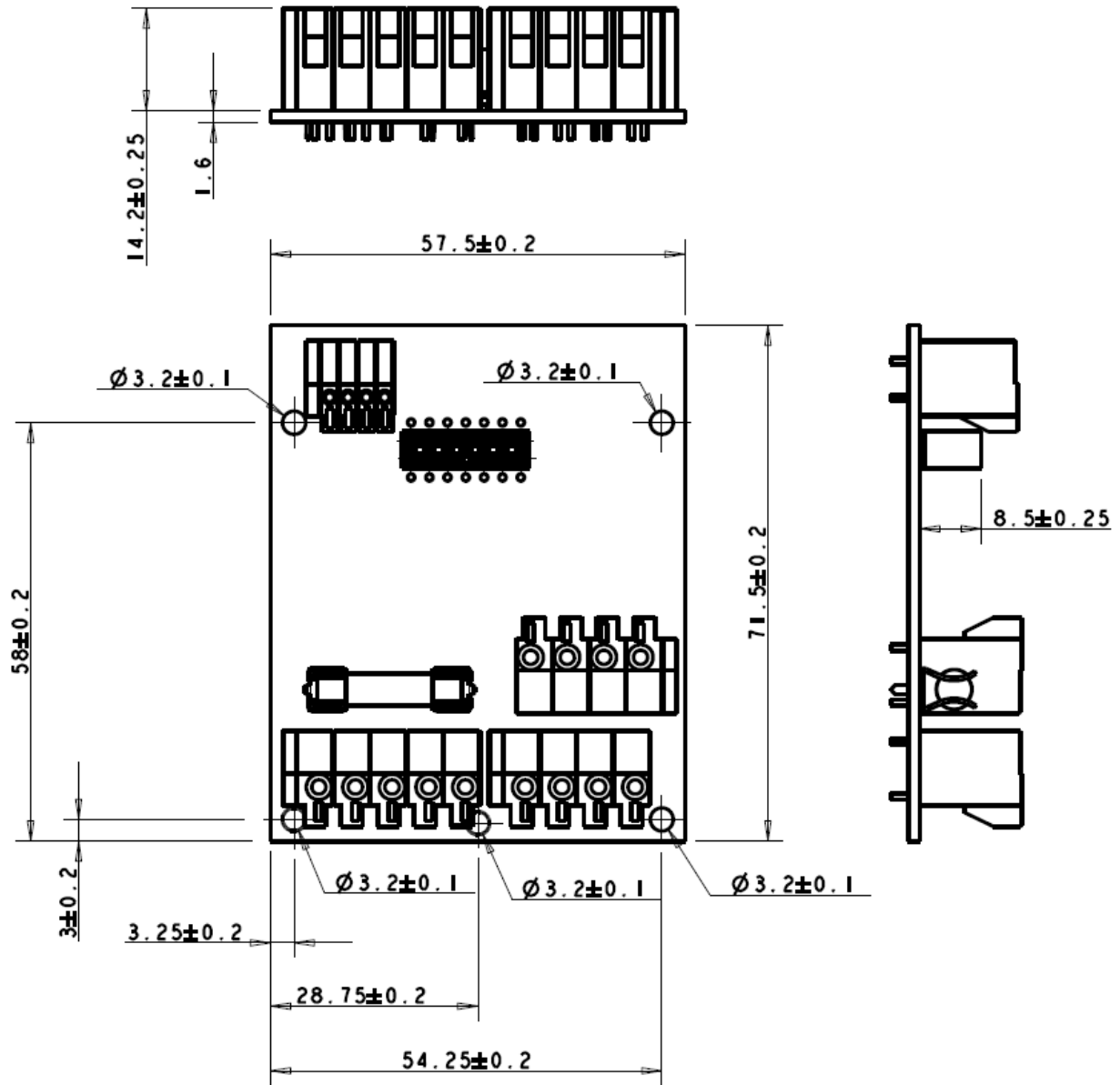
Voltage: Low (5 V_{DC})

Secondary room thermostat

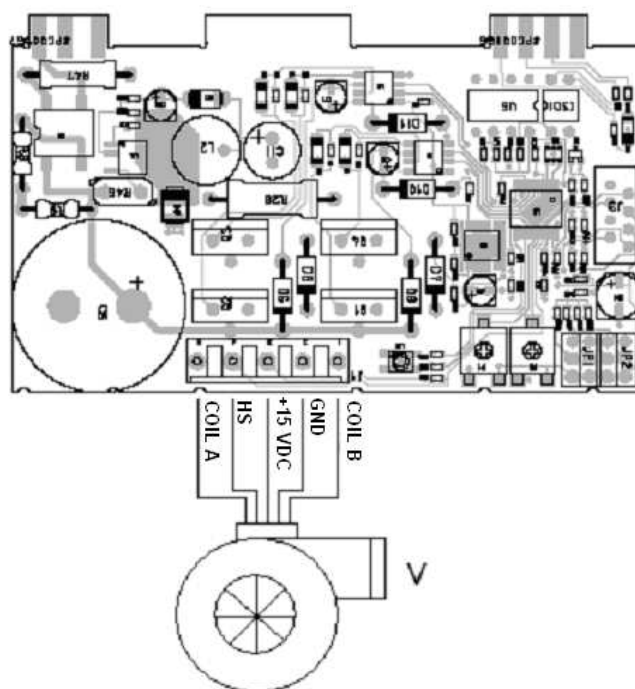
Contacts: Connector: **J1**
Type: Spring 12 poles
Pin: 1. 24 V_{DC}
2. Input signal

Voltage: Low (24 V_{DC})

Option board 862 – Dimensions



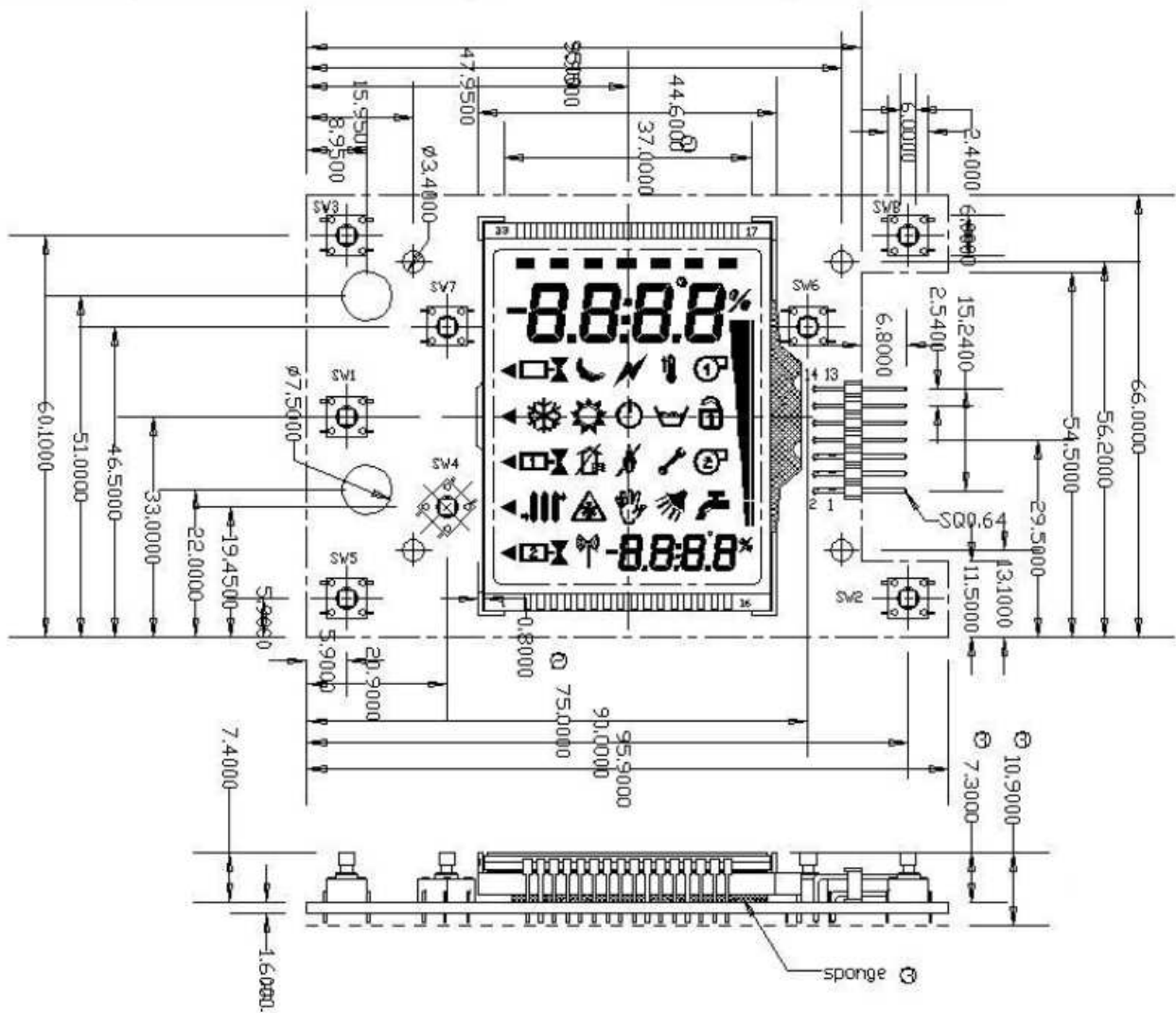
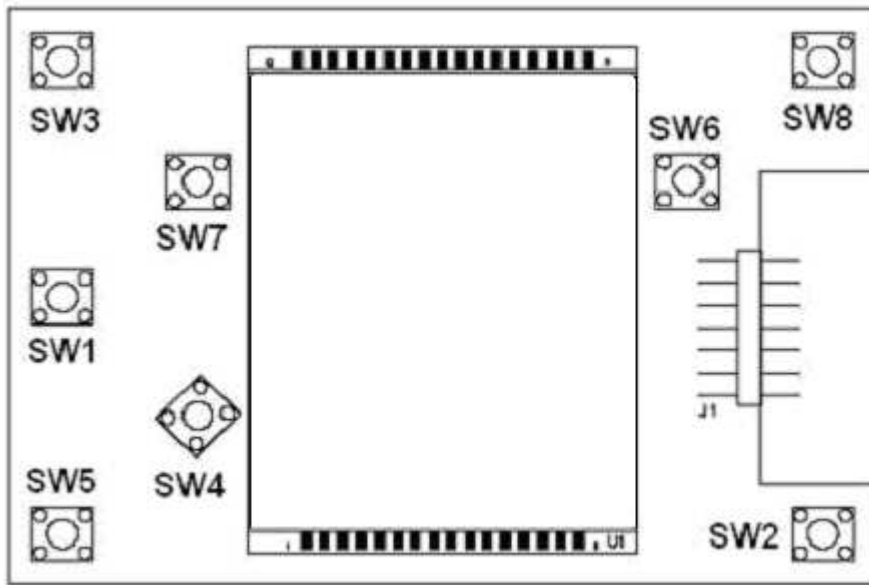
Fan board 863



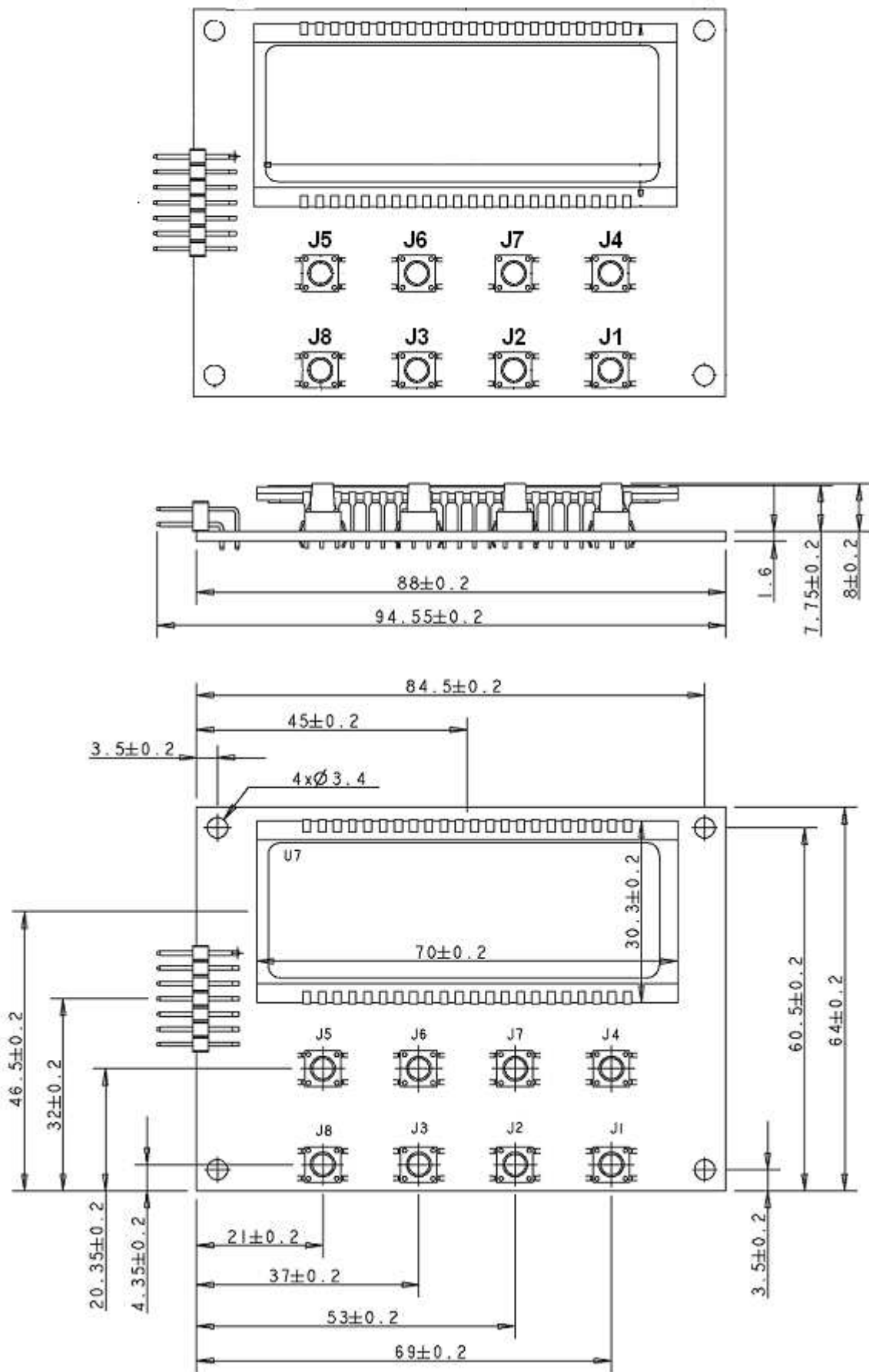
Contacts:	Connector:	J1
	Tipo:	Molex 5 poles
	Pin:	1. Coil terminal B
		2. GND
		3. 15 V _{DC}
		4. Hall sensor input signal (HS)
		5. Coil terminal A
Voltage:	High (230 V _{DC}) – Coil	
	Low (15 V _{DC}) – Hall sensor	

CONTROL BOARDS

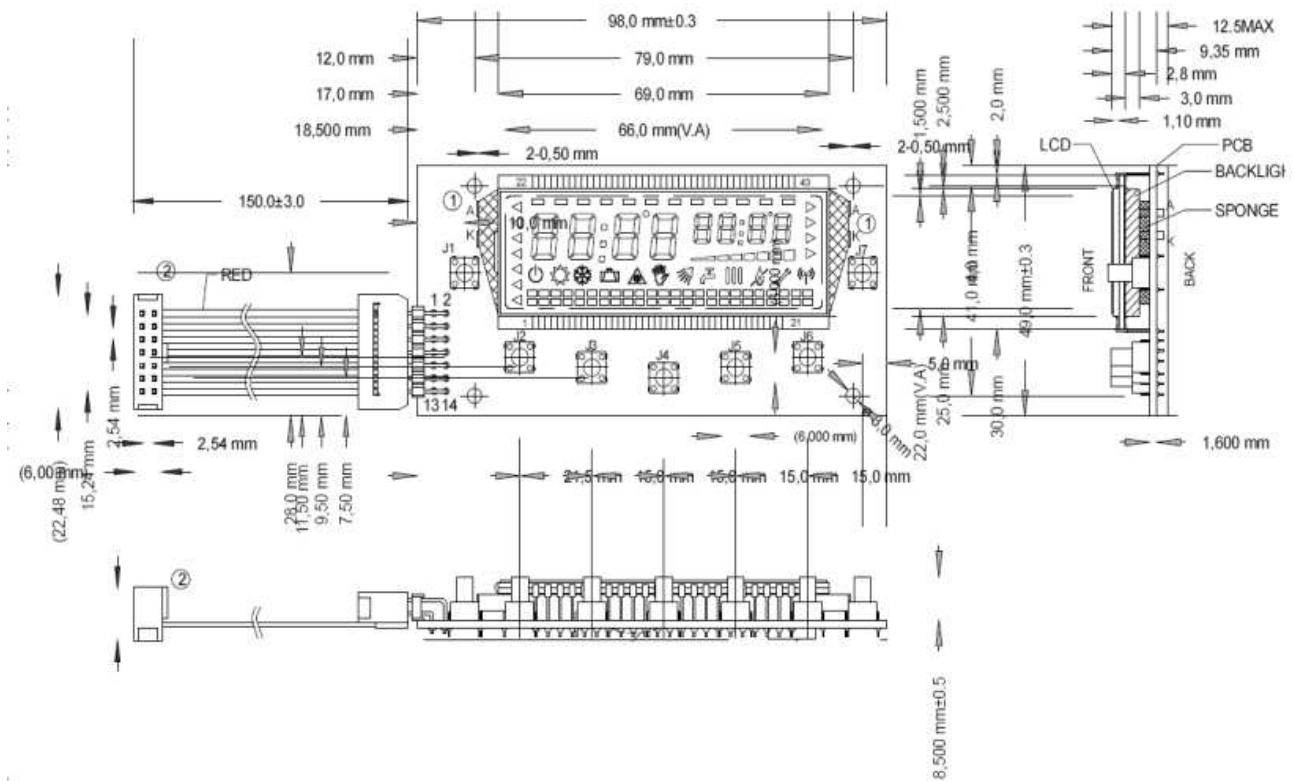
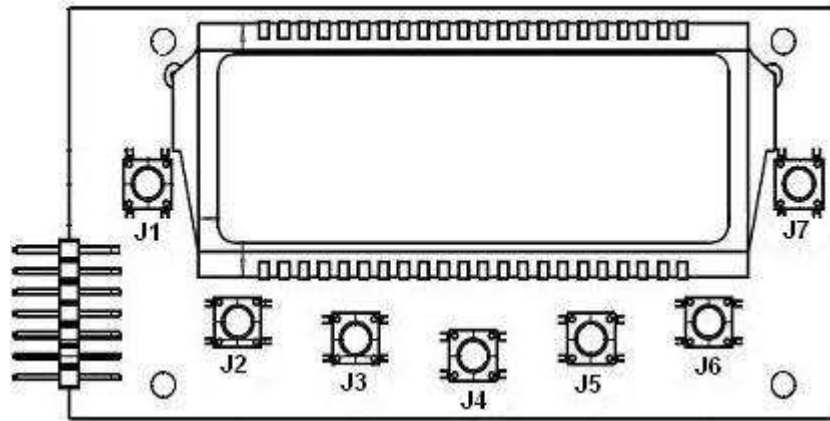
Control board LCD1



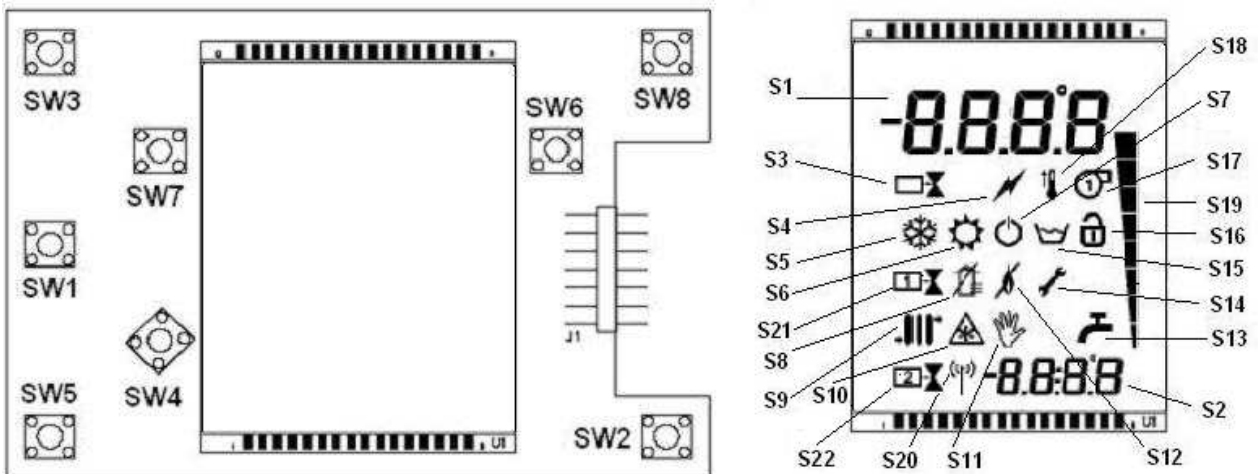
Control board LCD2



Control board LCD4



Settings and visualizations (ex. LCD1)



BUTTONS

- SW1: Show / Increase CH set-point / Increase parameter index
- SW2: Reset from non-volatile lockout
- SW3: Show / Increase DHW set-point / Increase parameter value
- SW4: Show / Decrease DHW set-point / Decrease parameter index
- SW5: LCD Backlight / Exit
- SW6: Menu access / Show device info
- SW7: Show / Decrease CH set-point / Decrease parameter index
- SW8: Menu access / Show device info

VISUALIZATIONS

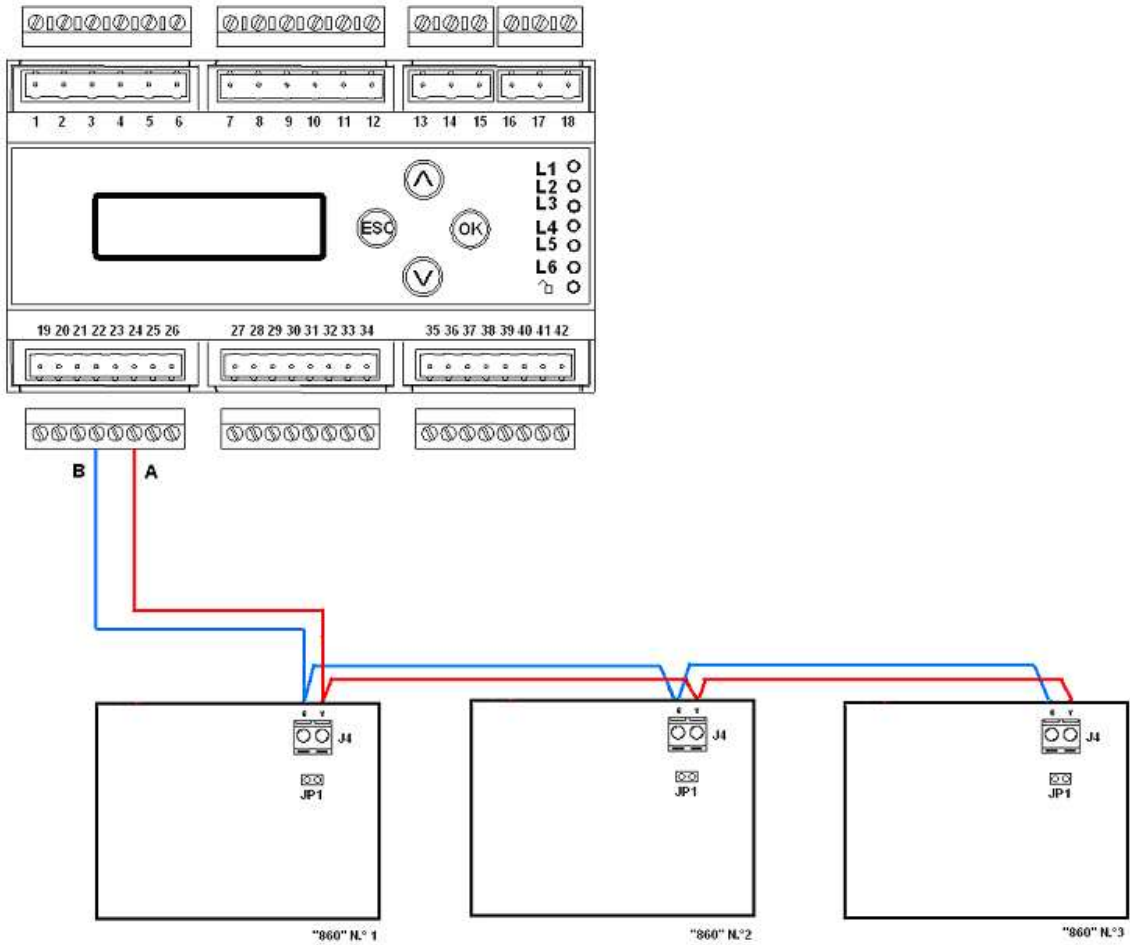
- | | |
|-----------------------------------|---|
| S1: Probes temperature value | S12: Flame detected or flame lack |
| S2: Water pressure value | S13: Domestic hot water state |
| S3: Gas valve | S14: Boiler anomaly |
| S4: Igniter | S15: Water pressure switch / transducer |
| S5: Winter operative mode | S16: Password for parameters menu |
| S6: Summer operative mode | S17: Fan |
| S7: OFF operative mode | S18: Probes temperature |
| S8: Chimney-sweep state | S19: Modulation bar |
| S9: Central Heating request state | S20: Opentherm communication |
| S10: Antifreeze state | S21: Stepper motor CH position / Zone pump / Mixing valve |
| S11: Parameters setting menu | S22: Stepper motor DHW position/Zone pump/Mixing valve |

N.B: On customer's request, the push-buttons operations and visualizations can be modified.

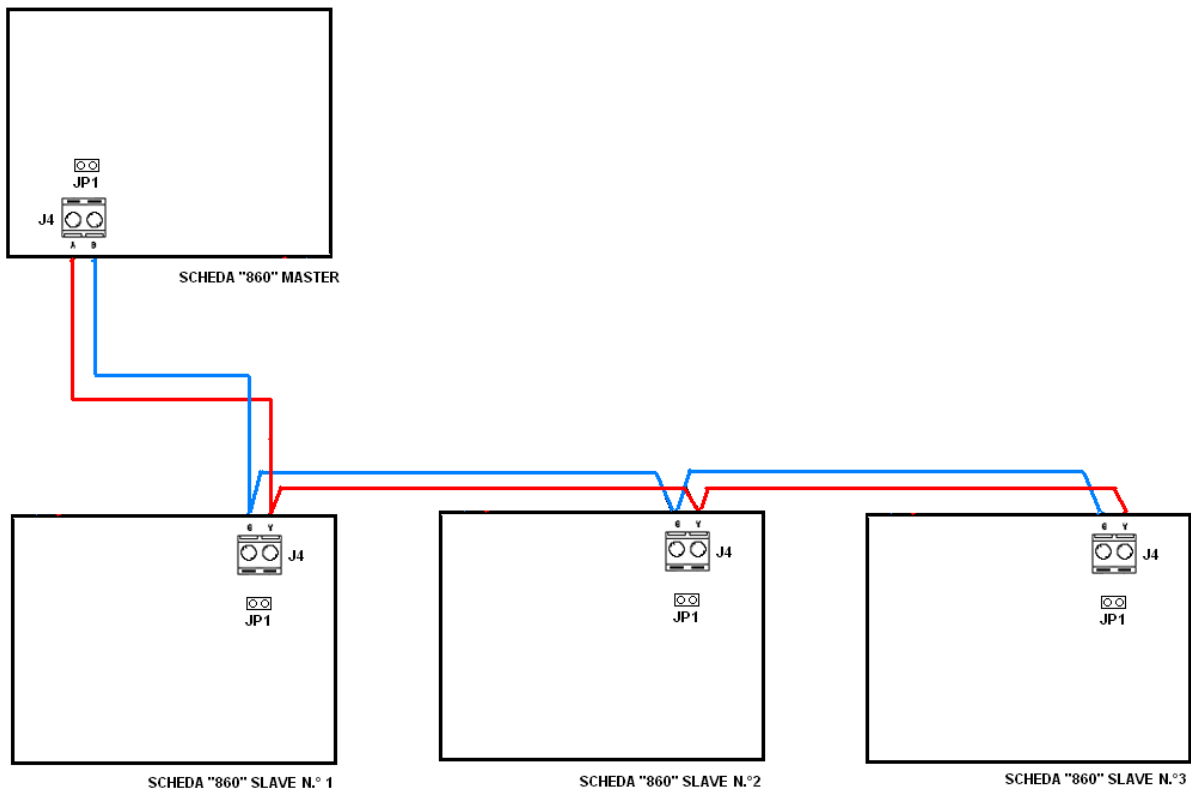
N.B: On customer's request, this system can be fitted with different control board; for further information see the relevant datasheets.

CASCADE SYSTEMS – TYPES OF CONNECTION

Cascade with Brahma “CBS06”

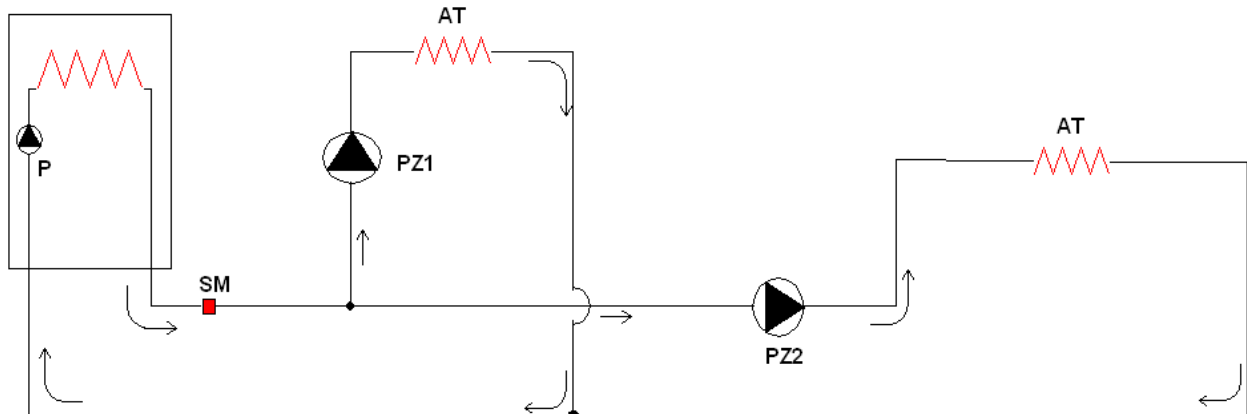


Cascade with “MI860” boards - “Master / Slave”

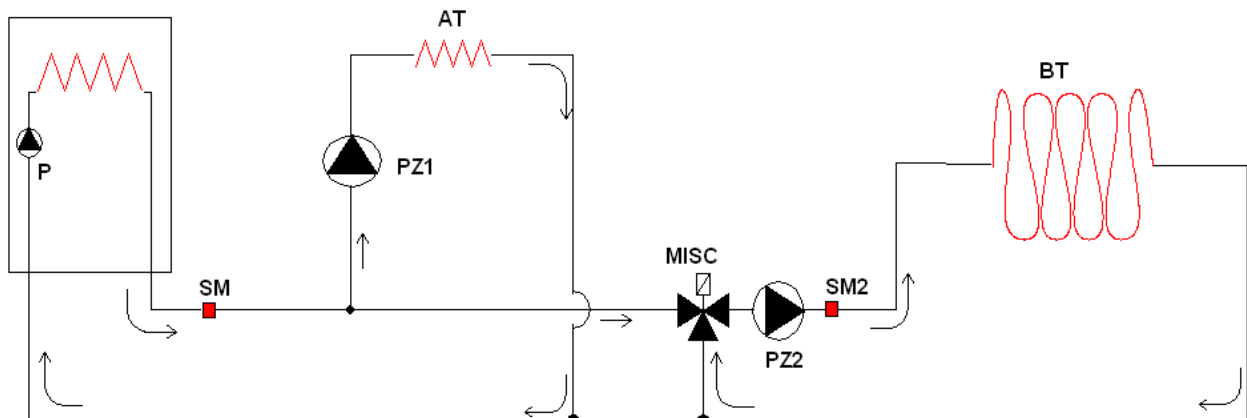


SYSTEMS WITH TWO ZONES – TYPES OF HYDRAULIC CIRCUITS

Two zones at the same temperature (both high or low temperature)



Two zones at different temperature (one high and one low temperature)

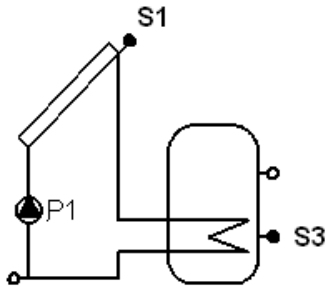


Where:

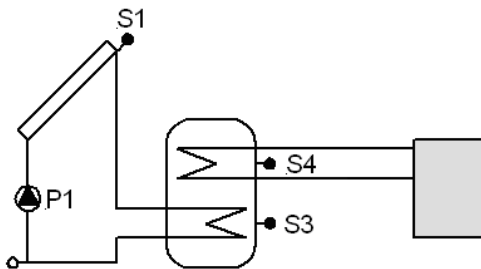
- P = Boiler pump
- SM = CH primary outgoing water probe
- SM2 = CH2 secondary (low temperature) outgoing water probe
- PZ1 = Zone pump n. 1
- PZ2 = Zone pump n. 1
- MISC = Mixing valve
- AT = High temperature zone
- BT = Low temperature zone

SOLAR SYSTEM – TYPES OF HYDRAULIC CIRCUITS

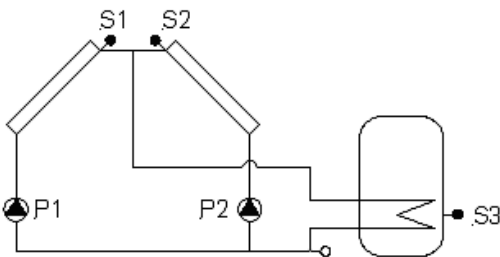
Solar system with storage



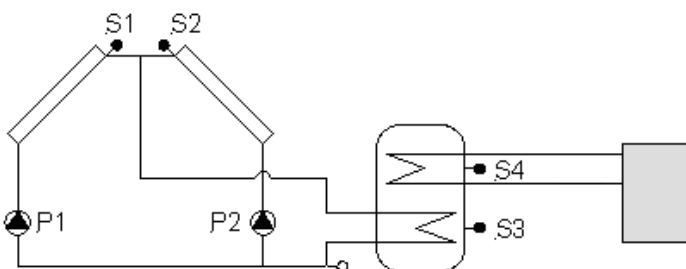
Solar system with storage and boiler integration



Solar "East – West" system



Solar "East – West" system with boiler integration



Where:

- S1: Solar probe S1 (PT1000)
- S2: Solar probe S2 (PT1000)
- S3: Solar probe S3 (NTC)
- S4: Solar probe S4 (NTC)
- P1: Solar pump n. 1
- P2: Solar pump n. 2

SYSTEM DENOMINATION AND CODE PLAIN

Mother board MI860

The complete board description is the following:

MI860. (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) .CN.XX.YY

Where:

C: Litter(s) referred to the customer following Brahma internal codify

N: Progressive number that identifies a particular hardware and software configuration, following the "code plain" below.

XX: Safety software release index (00, 01 ...)

YY: Thermoregulation software release index (00, 01 ...)

And here below the complete MI860 hardware code plain is described:

HARDWARE OPTIONS

- (1) Fan regulation electronics**
 - Regulation electronic board mounted on fan (NOT Brahma BFAN)
 - V** Regulation electronic board mounted on 863 option board
 - B** Regulation electronic board mounted on Brahma BFan
- (2) PWM 24 V_{DC} circulator**
 - Board without electronics for circulator (eventually with PWM regulation)
 - C** Board with electronics for circulator
- (3) Motorized 230 V_{AC} deflecting valve**
 - Board without electronics for driving a motorized 230 V_{AC} deflecting valve
 - D** Board with electronics for driving a motorized 230 V_{AC} deflecting valve
- (4) Stepper motor**
 - Board without electronics for driving a 24 V_{DC} stepper motor
 - M** Board with electronics for driving a 24 V_{DC} stepper motor
- (5) Auxiliary 24 V_{DC} output**
 - Board without electronics for driving an auxiliary 24 V_{DC} output
 - U** Board with electronics for driving an auxiliary 24 V_{DC} output
- (6) Polarization for flame detection**
 - Board not polarized for flame detection
 - P** Board polarized for flame detection
- (7) Flame amplifier for gas/air mixing**
 - Flame amplifier for a system with traditional (pneumatic) air/gas mixing
 - E** Flame amplifier for a system with electronic gas/air mixing ("B-Premix" with VCM0x gas valve)
- (8) RS485 communication**
 - Board without electronics for RS485 communication (cascade)
 - R** Board with electronics for RS485 communication (cascade)
- (9) Gas valve**
 - A** 230 V_{AC} proportional gas valve
 - B** 24 V_{DC} proportional gas valve
 - H** Brahma VCM0x gas valve
- (10) Safety operations**
 - Board without electronics for safety thermostat / double sensor probe
 - T** Safety operations realized by means of a normally closed contact thermostat
 - S** Safety operations realized by means of a double sensor temperature probe

Customer also must choose safety-software configuration basing on the listed option:

SAFETY SOFTWARE OPTIONS

- (1) **Air pressure switch**
 - 0 Not fitted
 - 1 Fitted
- (2) **Combustion products thermostat**
 - 0 Not fitted
 - 1 Fitted
- (3) **Safety thermostat monitoring**
 - 0 Safety thermostat contact is monitored only if burner ignition request is active
 - 1 Safety thermostat contact always monitored
- (4) **Lack of flame on running stage**
 - 0 Ignition attempts are repeated
 - 1 Immediate burner lock-out
- (5) **Ignition device operation**
 - 0 Spark is activated throughout the whole TSP time
 - 1 Spark is suspended when flame is detected
- (6) **Minimum current threshold for flame detection**
 - 0 0.5 μA_{DC}
 - 1 1.2 μA_{DC}
- (7) **Lock-out**
 - 0 Non-volatile lock-out (reset only on SW2 key pushing)
 - 1 Volatile lock-out (reset if main power supply is switched off)
- (8) **Ignition attempts**
 - 1 Only one ignition attempt
 - n Multiple ignition attempts ("n" ignition attempts)
- (9) **Air pressure switch or combustion thermostat contact opening on running stage**
 - 0 Burner is switched off but not locked-out
 - 1 Immediate burner lock-out
- (10) **Air pressure switch or combustion thermostat contact opening on ignition cycle**
 - 0 Device stops ignition cycle but is not locked-out
 - n,n Burner lock-out after "n,n" seconds
- (11) **Flame amplifier failure on ignition cycle (false flame detection)**
 - 0 Device stops ignition cycle but is not locked-out
 - n,n Burner lock-out after "n,n" seconds
- (12) **Pre-ignition time**
 - 0 No pre-ignition time (spark is activated on safety time TS)
 - n,n Spark is activated "n,n" seconds before safety time TS
- (13) **Inter-purge time (TIW)**
 - 0 No inter-purge time between two ignition attempts
 - n,n Inter-purge time of "n,n" seconds between two ignition attempts
- (14) **Pre-purge time (TW)**
 - n,n "n,n" seconds pre-purge time
- (15) **Safety time TS**
 - n,n "n,n" seconds safety time

Following denomination explains instead the label applied on the board:

MI860.CN.XX.YY

Where:

C: Litter(s) referred to the customer following Brahma internal codify

N: Progressive number that identifies a particular hardware and software configuration, following the "code plain" below.

XX: Safety software release index (00, 01 ...)

YY: Thermoregulation software release index (00, 01 ...)

Option board 861

Following denomination explains the label applied on the board:

861.OX0

Where:

010 Option "solar" + option "zone" fitted

020 Only option "solar" fitted

030 Only option "zone" fitted

Option board 862

Following denomination explains the label applied on the board:

862.OX0

Where:

010 Option "zone" fitted

ATTENTION: Company Brahma S.p.A. takes no responsibility for any damage resulting from Customer tampering with the device.

NOTES ABOUT PRODUCT DISPOSAL

The device contains electronic components and cannot therefore be disposed of as normal household waste. For the disposal procedure, please refer to the local rules in force for special waste.

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