DIDACTIC MANUAL

FAMILY:	Wall-hung atmospheric boilers
GROUP:	Instantaneous type and forced draught
MODELS:	***Minorca-Nibir*** *Mono-thermal*
VERSIONS:	For indoor installation
PART NO.:	AST 14 C 292/00

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BRAND NAME

NOVA FLORIDA

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SECT. 1

TECHNICAL CHARACTERISTICS

1.1 MODELS

Mono-thermal MINORCA-NIBIR CTFS 9
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Mono-thermal MINORCA-NIBIR CTFS 13
Mono-thermal MINORCA-NIBIR CTFS 15
Mono-thermal MINORCA-NIBIR CTFS 18

ABBREVIATION KEY:

C: combined
TFS: forced draught, sealed chamber

MAIN CHARACTERISTICS:

Mono-thermal MINORCA-NIBIR **CTFS**: atmospheric boiler for indoor installation, combined instantaneous, with production of domestic hot water + heating, forced draught, sealed chamber, mono-thermal with plate exchanger;

1.2 OVERALL DIMENSIONS

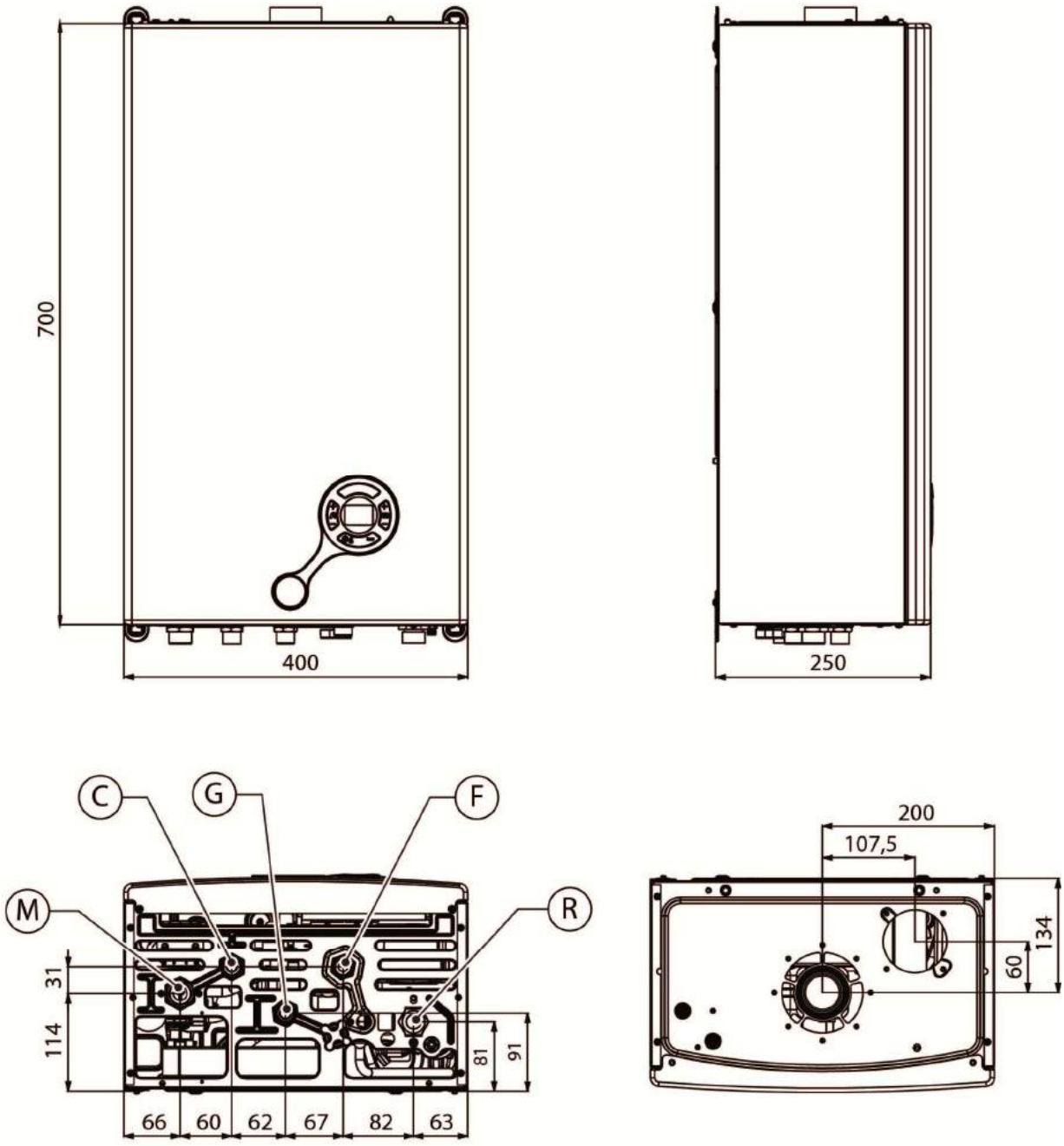
Height H = 700 mm

Width L = 400 mm

Depth D = 250 mm



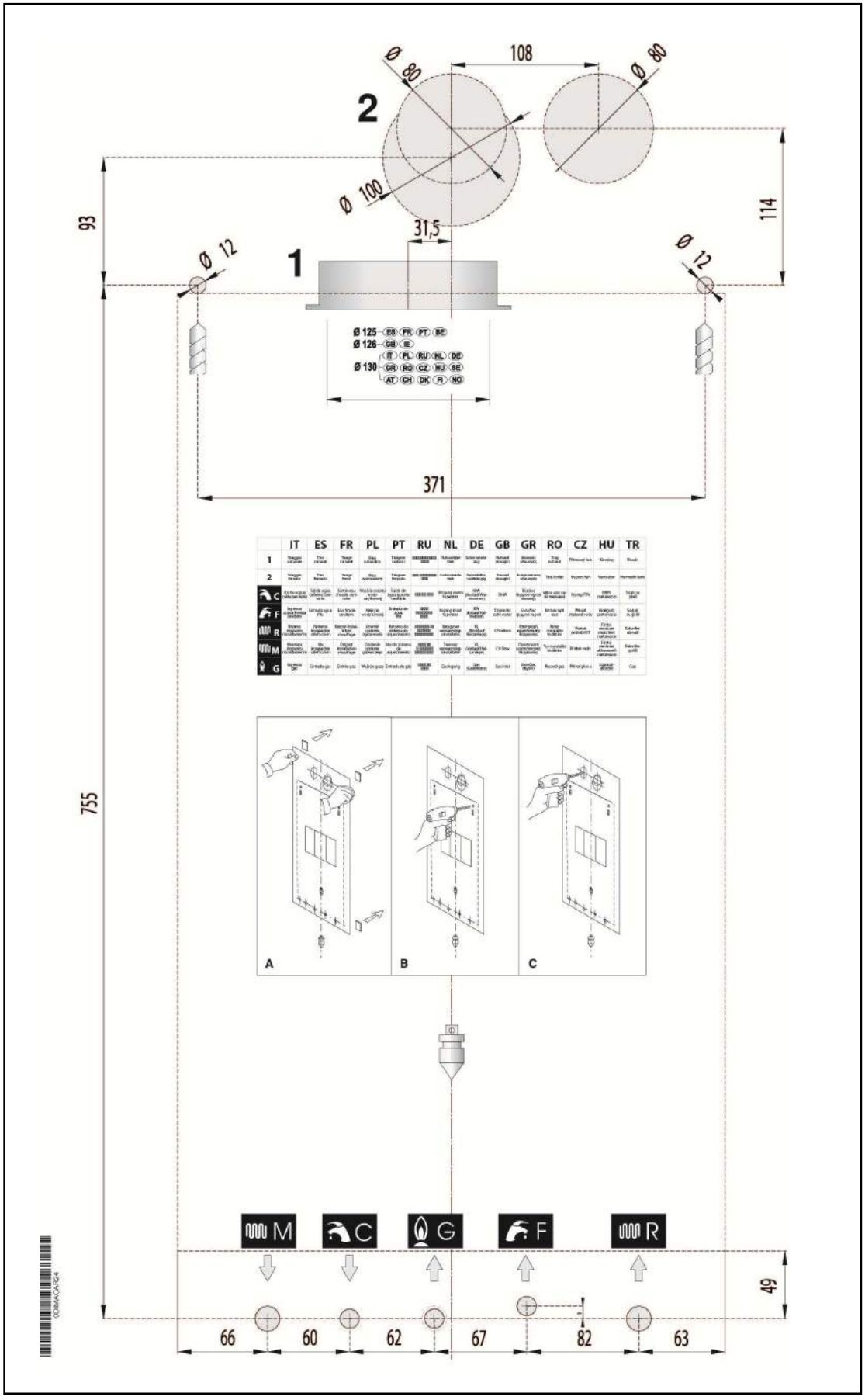
CTFS VERSION



Legenda

M Mandata impianto riscaldamento (3/4")
C Uscita acqua calda sanitaria (1/2")
G Ingresso gas (1/2")
F Ingresso acqua fredda (1/2")
R Ritorno impianto riscaldamento (3/4")

INSTALLATION TEMPLATE



1.3 TECHNICAL SPECIFICATIONS

General Characteristics

		CTFS 9	CTFS 11	CTFS 13	CTFS15	CTFS 18
Operating parameters						
Device category		II2HM3+ *(G20 - G230 - G30/G31)*				
Burner nozzles	no.	11				
CH circuit min. pressure	bar	0.5				
CH circuit max. pressure	bar	3				
DHW circuit min. pressure	bar	0.5				
DHW circuit max. pressure	bar	8				
DHW specific flow rate (Δt 30°C)	l/min	9.5				
Air pressure switch ON pressure	Pa	60				
Air pressure switch OFF pressure	Pa	50				
Central heating setting range	°C	35 ÷ 78				
Maximum CH working temperature	°C	78 + 5				
DHW setting range	°C	35 ÷ 57				
Maximum DHW working temperature	°C	57 + 5				
Total capacity of expansion vessel	l	6				
Maximum recommended system capacity (**)	l	90				
Nominal electrical data						
Power supply: Voltage/Frequency	V-Hz	230-50				
Power mains supply fuse	-	5x20mm 3.15 AF				
Electric cabinet protection degree	IP	X4D				
Power absorption	W	102				
Electric power in standby condition	W	2				
Overall dimensions and connections						
Height	mm	700				
Width	mm	400				
Depth	mm	250				
Net weight (without packaging)	Kg	23.6				
Gas connection	-	G ½				
Flow and return connection	-	G ¾				
Cold water and hot domestic water connection	-	G ½				
Consumption						
Natural gas consumption (*)	m^3/h	1.10	1.30	1.50	1.74	2.12
Butane gas consumption (*)	kg/h	0.82	0.97	1.12	1.29	1.58
Propane gas consumption (*)	kg/h	0.81	0.96	1.10	1.27	1.55
Operating characteristics						
Type of ignition	-	Electronics				
Flame detection method	-	Ionisation				
Flame detection system	-	Phase-neutral polarisation				
Hot DHW production	-	Instant				

(*) Value related to 15°C - 1013 mbar condition
(**) Maximum water temperature at 83°C, tank preloaded at 1 bar

Design data and flue sizing

CTFS 9

		Pmax.	*Pmin.*	*Load at 30 %*
Casing heat loss	%	1.59	2.55	-
Flue system heat loss with burner on	%	9.05	11.85	-
Flue (natural gas) mass flow	g/s	11.5	12.1	-
Flue gas temp. – air temp.	°C	101.3	63.9	-
CO_2 value (natural gas - butane gas - propane)	%	7.0/8.1 – 7.6	2.1/2.5 – 2.5	-
Boiler efficiency rating	%	89.2	85.6	86.2
Residual head available	Pa	61.5	61.5	-
Nox emission class	-	3		

CTFS 11

		Pmax.	*Pmin.*	*Load at 30 %*
Casing heat loss	%	1.46	2.55	-
Flue system heat loss with burner on	%	7.90	11.85	-
Flue (natural gas) mass flow	g/s	11.5	12.1	-
Flue gas temp. – air temp.	°C	101.3	63.9	-
CO_2 value (natural gas - butane gas - propane)	%	7.0/8.1 – 7.6	2.1/2.5 – 2.5	-
Boiler efficiency rating	%	90.2	85.6	86.9
Residual head available	Pa	61.5	61.5	-
Nox emission class	-	3		

CTFS 13

		Pmax.	*Pmin.*	*Load at 30 %*
Casing heat loss	%	1.46	2.55	-
Flue system heat loss with burner on	%	7.32	11.85	-
Flue (natural gas) mass flow	g/s	11.5	12.1	-
Flue gas temp. – air temp.	°C	101.3	63.9	-
CO_2 value (natural gas - butane gas - propane)	%	7.0/8.1 – 7.6	2.1/2.5 – 2.5	-
Boiler efficiency rating	%	91.2	85.6	87.6
Residual head available	Pa	61.5	61.5	-
Nox emission class	-	3		

CTFS 15

		Pmax.	*Pmin.*	*Load at 30 %*
Casing heat loss	%	1.37	2.55	-
Flue system heat loss with burner on	%	6.83	11.85	-
Flue (natural gas) mass flow	g/s	11.5	12.1	-
Flue gas temp. – air temp.	°C	101.3	63.9	-
CO_2 value (natural gas - butane gas - propane)	%	7.0/8.1 – 7.6	2.1/2.5 – 2.5	-
Boiler efficiency rating	%	91.8	85.6	87.7
Residual head available	Pa	61.5	61.5	-
Nox emission class	-	3		

CTFS 18

		Pmax.	*Pmin.*	*Load at 30 %*
Casing heat loss	%	1.55	2.55	-
Flue system heat loss with burner on	%	5.25	11.85	-
Flue (natural gas) mass flow	g/s	11.5	12.1	-
Flue gas temp. – air temp.	°C	101.3	63.9	-
CO_2 value (natural gas - butane gas - propane)	%	7.0/8.1 – 7.6	2.1/2.5 – 2.5	-
Boiler efficiency rating	%	93.2	85.6	88.2
Residual head available	Pa	61.5	61.5	-
Nox emission class	-	3		

Settings

CTFS 9

	Heat capacity	*Heat output MIN-MAX*	*Supply pressure*	*Diameter Nozzles*	*Burner pressure MIN-MAX*	*Burner pressure MAX (DHW)*
	(kW)	(kW)	(mbar)	(mm)	(mbar)	(mbar)
Natural gas G20	10.4 (CH) 20.0 (DHW)	7.0 – 9.3 (CH) 7.0 – 18.6 (DHW)	20	1.20	1.5 – 3.2	11.1
Butane gas G30			29	0.70	3.9 – 8.1	28.3
Propane Gas G31			37	0.70	5.1 – 10.7	35.9

CTFS 11

	Heat capacity	*Heat output MIN-MAX*	*Supply pressure*	*Diameter Nozzles*	*Burner pressure MIN-MAX*	*Burner pressure MAX (DHW)*
	(kW)	(kW)	(mbar)	(mm)	(mbar)	(mbar)
Natural gas G20	12.3 (CH) 20.0 (DHW)	7.0 – 11.1 (CH) 7.0 – 18.6 (DHW)	20	1.20	1.5 – 4.4	11.1
Butane gas G30			29	0.70	3.9 – 11.3	28.3
Propane Gas G31			37	0.70	5.1 – 14.5	35.9

CTFS 13

	Heat capacity	*Heat output MIN-MAX*	*Supply pressure*	*Diameter Nozzles*	*Burner pressure MIN-MAX*	*Burner pressure MAX (DHW)*
	(kW)	(kW)	(mbar)	(mm)	(mbar)	(mbar)
Natural gas G20	14.2 (CH) 20.0 (DHW)	7.0 – 13.0 (CH) 7.0 – 18.6 (DHW)	20	1.20	1.5 – 5.8	11.1
Butane gas G30			29	0.70	3.9 – 14.2	28.3
Propane Gas G31			37	0.70	5.1 – 19.3	35.9

CTFS 15

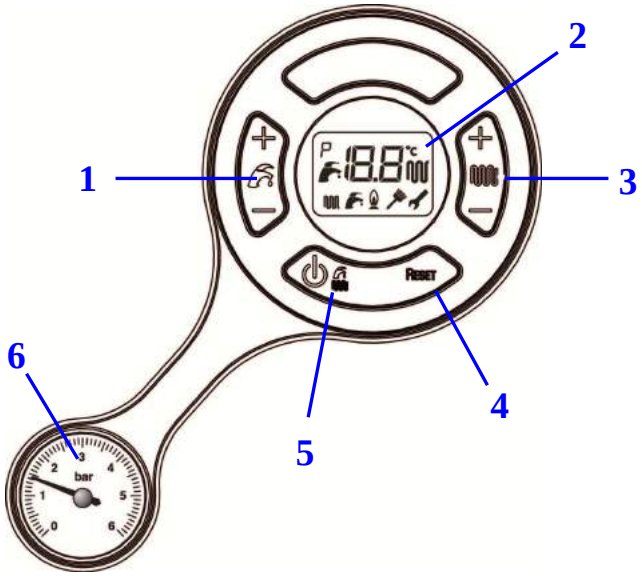
	Heat capacity	Heat output MIN-MAX	Supply pressure	Diameter Nozzles	Burner pressure MIN-MAX	Burner pressure MAX (DHW)
	(kW)	(kW)	(mbar)	(mm)	(mbar)	(mbar)
Natural gas G20	16.4 (CH) 20.0 (DHW)	7.0 – 15.1 (CH) 7.0 – 18.6 (DHW)	20	1.20	1.5 – 7.6	11.1
Butane gas G30			29	0.70	3.9 – 19.6	28.3
Propane Gas G31			37	0.70	5.1 – 25.4	35.9

CTFS 18

	Heat capacity	Heat output MIN-MAX	Supply pressure	Diameter Nozzles	Burner pressure MIN-MAX	Burner pressure MAX (DHW)
	(kW)	(kW)	(mbar)	(mm)	(mbar)	(mbar)
Natural gas G20	20.0 (CH) 20.0 (DHW)	7.0 – 18.6 (CH) 7.0 – 18.6 (DHW)	20	1.20	1.5 – 10.9	11.1
Butane gas G30			29	0.70	3.9 – 27.6	28.3
Propane Gas G31			37	0.70	5.1 – 35.9	35.9

SECT. 2
CONTROL PANEL AND DIAGNOSTICS

2.1 USER'S INTERFACE



1. Set domestic hot water temperature

These keys are used to set the domestic hot water temperature within a range from 35°C to 57°C.

2. LCD Display

The LCD shows the boiler status and operation information *(see the following paragraph).*

3. Set central heating water temperature

This key is used to set the water temperature value of the heating system between a minimum value of 35°C and a maximum value of 45°C (*reduced range*) or 78°C (*standard range*). With external probe or ambient probe connected, instead, it is used to set the desired ambient temperature *(see paragraph about thermoregulation).*

4. Resume boiler function

This key is used to resume boiler operation after a shut-down *(only in case of shut-down with "RESET" message)*.

5. Select boiler state

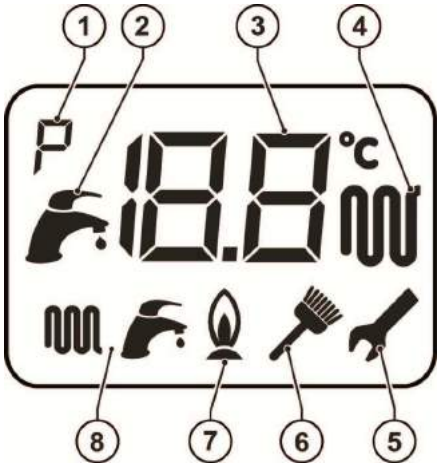
Press this key during standard operation to set the following functions:
SUMMER : Boiler produces domestic hot water only.
WINTER : Boiler provides both central heating and domestic hot water.
CENTRAL HEATING ONLY : Boiler provides central heating only
OFF: boiler in stand-by mode: central heating and DHW functions are disabled. Only anti-freeze function is enabled.

In *"programming"* mode, it is used to access and confirm the edited parameters setting.

6. Water pressure gauge

This shows the pressure of the water in the heating system.

2.2 LCD



1. Parameter indicator
It turns on when entering the TECHNICAL parameter programming mode.

2. DHW indicator
It turns steady on when *"DHW"* function is enabled.
It flashes when adjusting the domestic hot water temperature with **1** key (see previous paragraph) or when a *"DHW"* request is in progress.

3. Alphanumeric indicator
Alphanumeric values indicating:
- flow water temperature during "*heating*" function and in the absence of request;
- central heating water temperature setting;
- domestic hot water temperature during the "*DHW*" function;
- domestic hot water temperature setting;
- boiler status;
- parameters and relevant values;
- boiler diagnosis.

4. Central heating indicator
It turns steady on when *"heating"* function is enabled.
It flashes when adjusting CH water temperature with regulator **3** (see previous paragraph) or when a *"heating"* request is in progress.

5. Parameter editing indicator
It flashes to indicate that TECHNICAL and SUPER-TECHNICAL parameters can be edited (in this case the symbols **1** and **6** turn steady on at the same time).

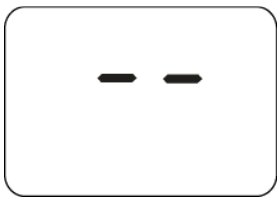
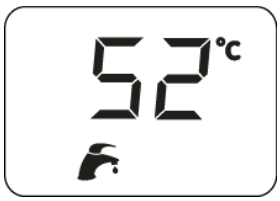
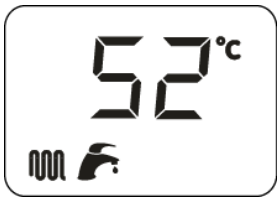
6. Chimney sweep function indicator
Steady on, it indicates that chimney sweep function is enabled through the simultaneous pressure of the *"Reset"* and *"- DHW"* keys. When this function is ON, the current supplied to the gas valve modulation coil is displayed (in mA).
In "programming" mode, it indicates the access to SUPER-TECHNICAL parameters list.

7. Flame lighting indicator
It indicates the flame detection on the burner.

8. Boiler operating mode indicator
It indicates the boiler active functions. In winter mode, both icons are on. In summer mode, only cock icon is on. In CH mode, only radiator icon is on.

2.3 BOILER STATUS AND FAULT CODES

Normal operation

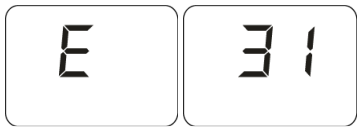
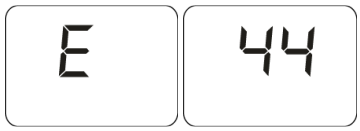
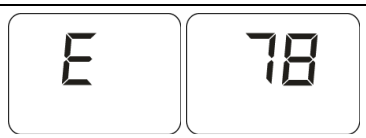
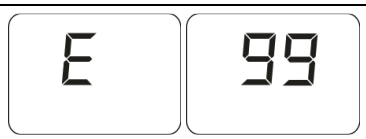
Boiler in STANDBY mode. *Only anti-freeze function is enabled*.	
Boiler in SUMMER mode. *No active function*. The flow water temperature is displayed	
Boiler in SUMMER or WINTER mode. *No active function*. The flow water temperature is displayed	
Boiler in CENTRAL HEATING ONLY mode. *No active function*. The flow water temperature is displayed	
Boiler in SUMMER mode. *DHW function active with flame lit*. DHW temperature displayed.	
Boiler in SUMMER or WINTER mode. *DHW function active* with flame lit. DHW temperature displayed.	
Boiler in SUMMER or WINTER mode. *CH function active* with flame lit. The flow water temperature is displayed.	
Boiler in CENTRAL HEATING ONLY mode. *CH function active* with flame lit. The flow water temperature is displayed.	

Malfunction, errors to be reset by user and self-resettable faults

The display shows the failure based on the corresponding error code, with possible reset indication on the display (see following table). For error codes after E09, the display shows alternatively the symbol E and the error code. In case of faults identified with (r), the user can reset the operation by pressing the proper reset key, otherwise the fault is self-resettable (a):



Boiler shut-down due to missing flame (r)	E1
Boiler shut-down due to safety thermostat triggering (r)	E2
Boiler shut-down due to air pressure switch triggering (a)	E3
Boiler shut-down due to water pressure switch triggering (a)	E4
Flow probe fault (a)	E5
DHW probe fault (a)	E6
Return probe fault (a)	E 15
Eprom fault due to altered data (a)	E 22
External probe fault (a)	E 23

Opentherm communication error (a)	
Ambient probe fault (a)	
CTFS/CTN identification error (a)	
Gas/fan operator relay feedback error (a)	
Gas valve modulation coil error (a)	
System error: mains voltage too low, or microprocessor fault	
High flow derivative error	
Max. number of reset attempts from remote control reached (r)	

NOTE: *The board is able to count and store the boiler's latest five faults (both resettable and self-resettable). View them by scrolling the parameters from P31 to P35.*

The display back-lighting works as follows:

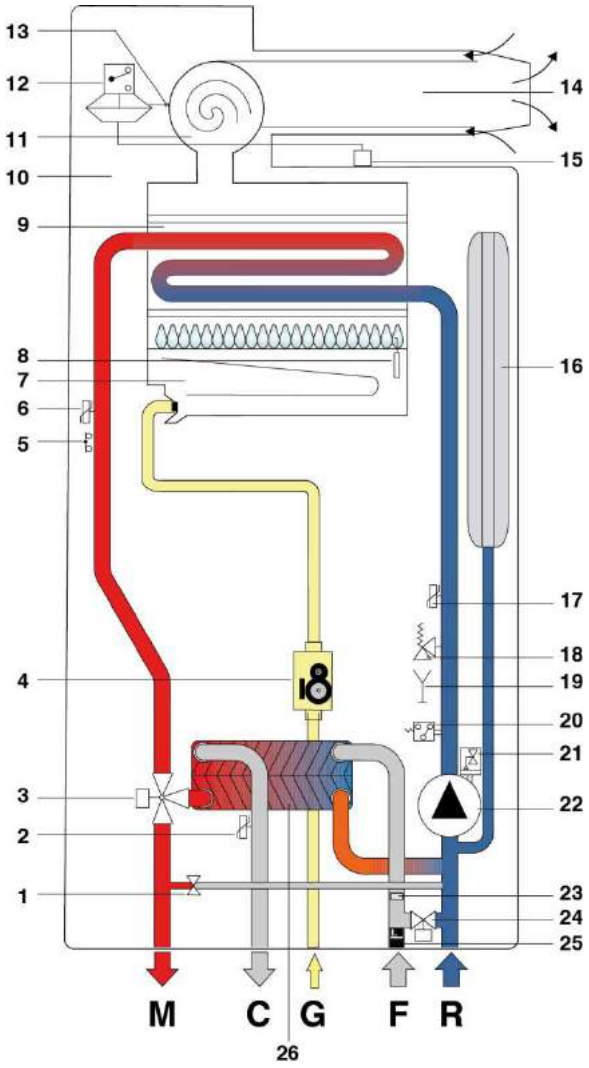
- Illuminates steadily when the boiler keys are enabled;
- It illuminates flashing (3 seconds ON and 2 OFF) when a shut-down or a fault occurs.

SECT. 3

HYDRAULIC DIAGRAMS AND COMPONENTS

3.1 HYDRAULIC DIAGRAM

CTFS



1. Automatic by-pass
2. DHW temperature probe
3. Motorised 3-way valve
4. Modulation gas valve
5. CH safety thermostat
6. CH temperature probe
7. Burner
8. Ignition/detection electrode
9. Mono-thermal exchanger
10. Sealed combustion chamber
11. Flue gas extractor fan
12. Flue gas duct safety pressure switch
13. Flue gas circuit pressure measurement point
14. Air intake/flue gas venting pipe
15. Flue gas circuit pressure measurement point
16. Expansion tank
17. CH return temperature probe
18. 3-bar safety valve
19. Discharge cock
20. Minimum pressure switch
21. Deaerator
22. Circulation pump
23. 8 l/min flow-limiting device
24. Filler cock
25. Cold water flow switch with filter
26. Secondary plate exchanger

M CH system flow
C Domestic hot water outlet
G Gas inlet
C Cold water inlet
R CH system return

3.2 HYDRAULIC UNIT

DHW FLOW SWITCH

The domestic hot water flow switch features a magnet switch whose position determines the minimum quantity of domestic hot water necessary to start the boiler (3 l/min ON and 1 l/min OFF). If the request of DHW does not exceed such value the micro-switch does not close the contact and inhibits the boiler starting to avoid the boiling risk.
A flow rate limiting device (flow regulator) is placed at the flow switch outlet. The former determines the litres/minute that can be drawn at Δt 30K:



Flow regulator:

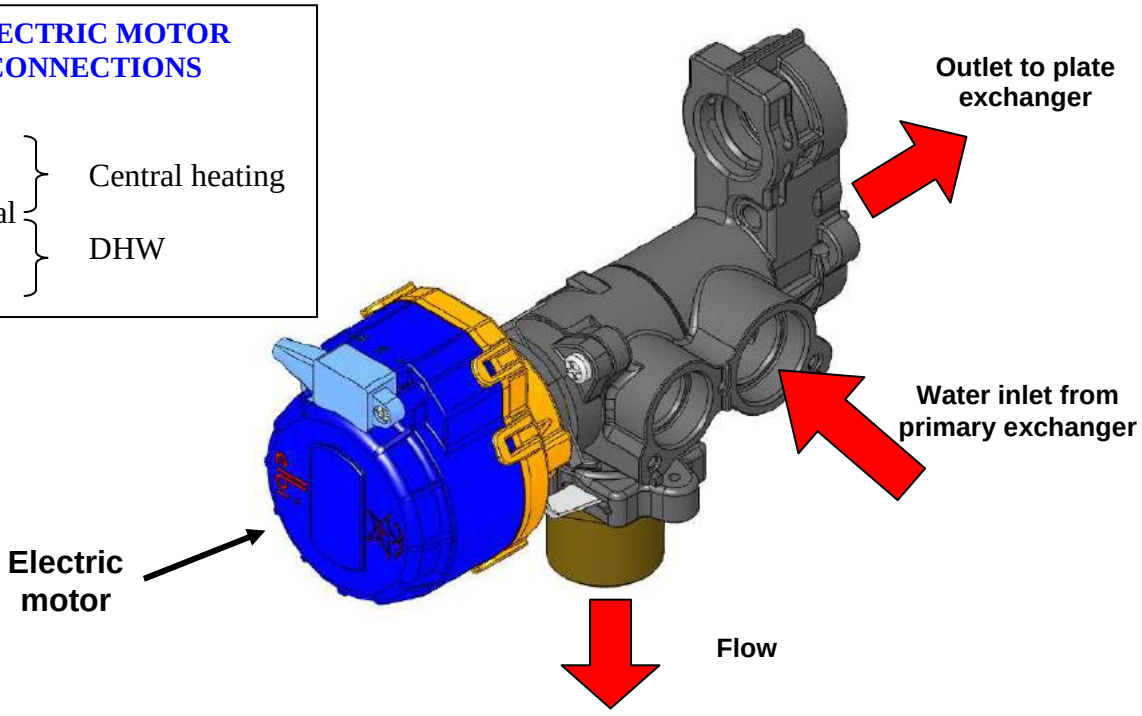
- 24 kW, 10 l/min regulator

MOTORISED THREE-WAY VALVE

The boiler uses a three-way valve to divert the water flow coming from the primary exchanger into another pipe, in particular it diverts the water into the secondary (plate) exchanger, where heat will be transferred to the DHW.
This valve consists of one main three-way body in thermosetting polymers, one removable cartridge, and one electric motor (actuator) to move the internal shutter of the valve.

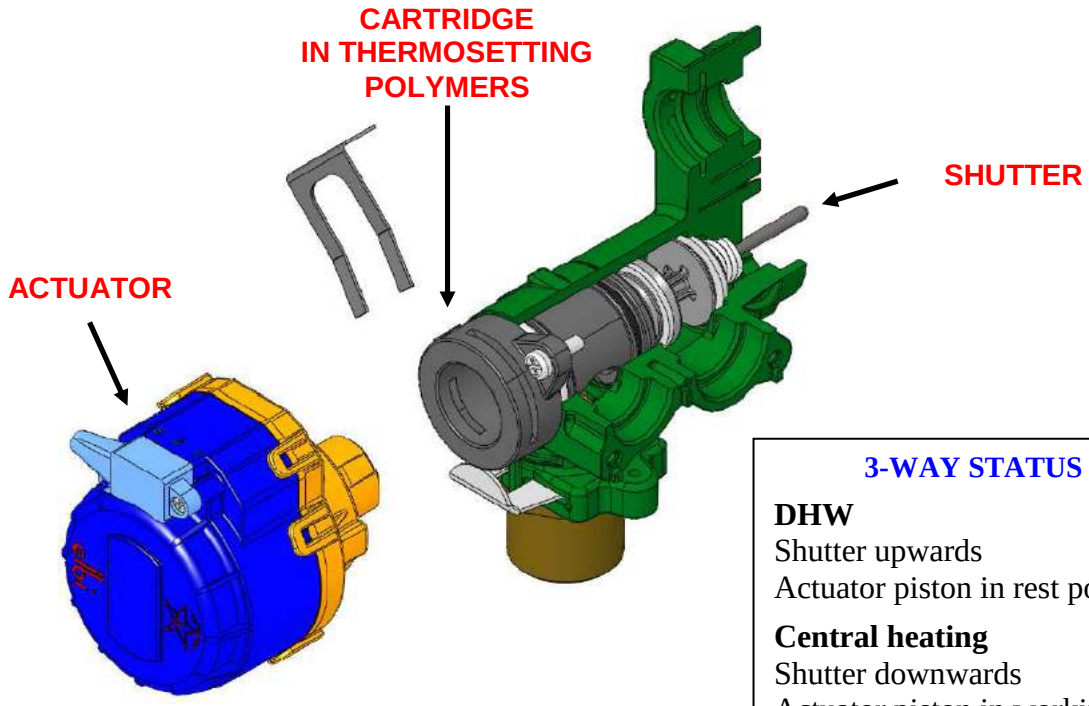
ELECTRIC MOTOR CONNECTIONS

1	Line1	Central heating
2	Neutral	DHW
3	Line2	



The secondary exchanger is fixed by the three-way valve and another unit made of thermosetting polymers connecting the cold water inlet pipe to the rest of the hydraulic system.
The plate exchanger consists of 12 plates made of stainless steel and the high production of domestic hot water is guaranteed by the horizontal expansion of the exchanger itself.
When hot domestic water is required, the cold water coming from the hot domestic water system passes through the flow switch setting the boiler to "DHW" mode. Then the three-way valve diverts the hot water coming from the primary exchanger into the secondary one so that it can transfer its heat to the plates for the instantaneous production of domestic hot water.

Three-way valve section:



3-WAY STATUS

DHW
Shutter upwards
Actuator piston in rest position

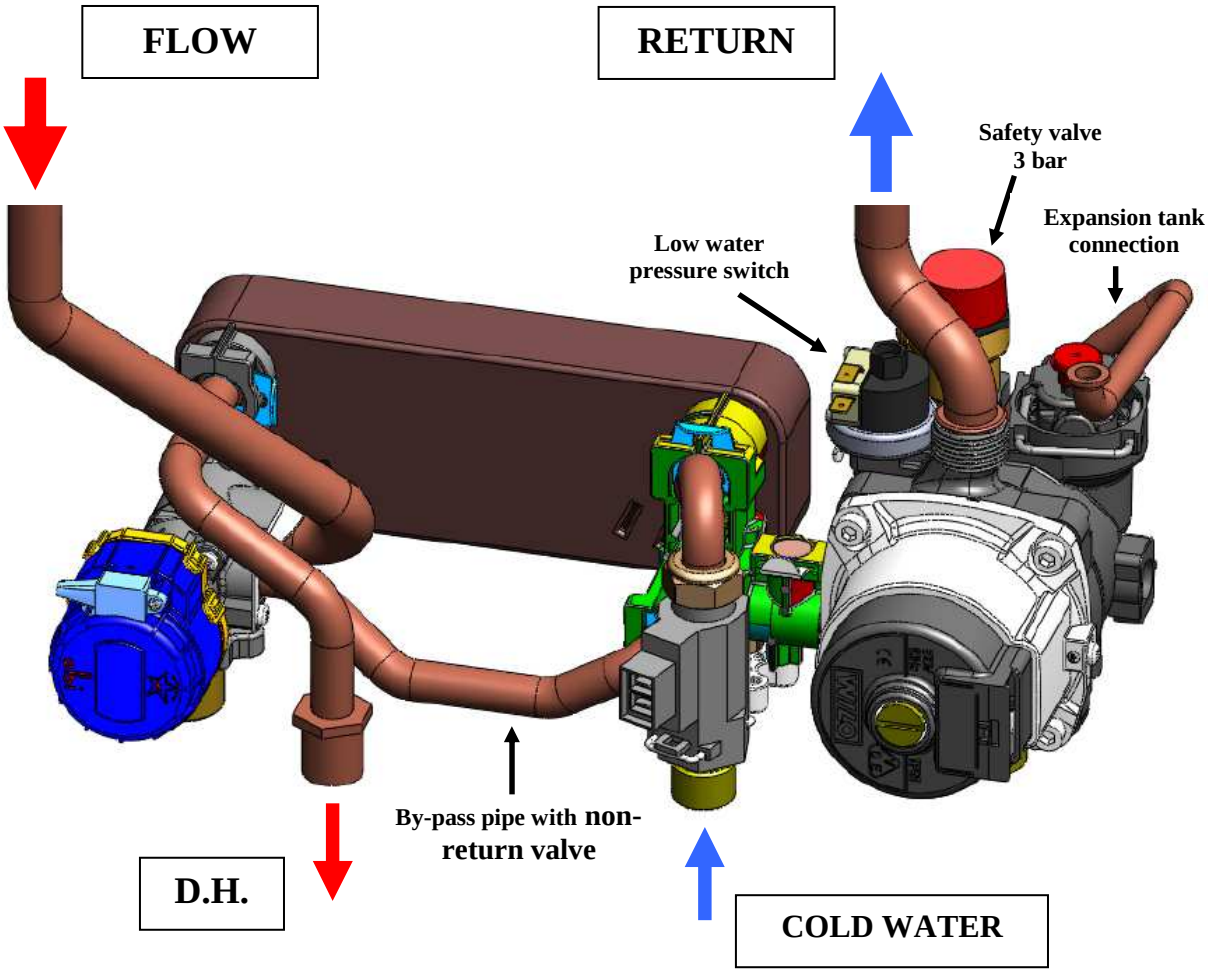
Central heating
Shutter downwards
Actuator piston in working position

The boiler is fitted with an internal automatic by-pass with non-return valve, whose opening threshold is 400 mmBar.
In case of load losses in the system due to thermostatic valve triggering, the by-pass ensures a minimum flow rate inside the primary exchanger. The function of the by-pass is to protect the primary exchanger from overtemperatures due to poor water flow.

One of the main factors which has helped to minimise the dimensions of the boiler consists in the collocation of the hydraulic unit. All components in "contact" with the water have been put together inside the circulation pump volute, including the 3-bar safety valve and the low water pressure switch.

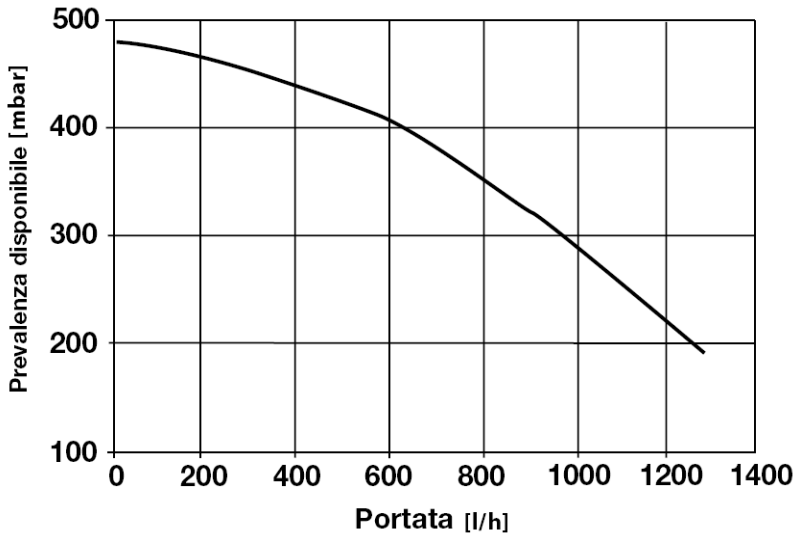
N.B. In rest condition, the three-way valve is in DHW mode position

Hydraulic Unit:



In this boiler model, pump speed is at fixed point and not changeable. Please find below the graph containing the available head to the system:

Circulation pump characteristic:

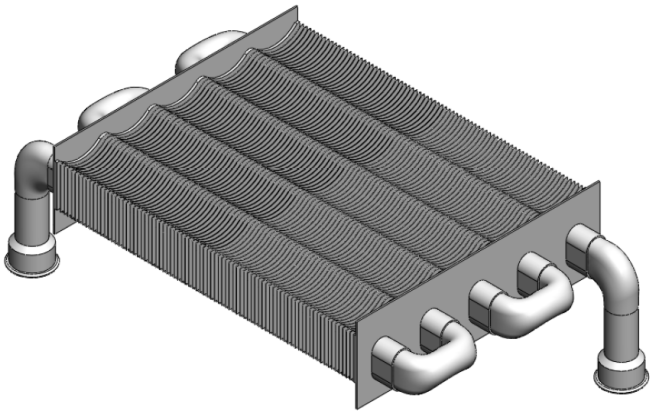


Maximum head:	5 m
Max.operating pressure:	6 bar
Max. circ. temperature:	95 °C

3.3 HEAT EXCHANGERS

PRIMARY EXCHANGER

It is made up of a set of aluminium pipes, connected to each other in a way to create a "coil".
The finning improves the efficiency of the heat exchange between the water flowing inside, the heat developed by the burner flame and the hot combustion flue gases.
The heat exchanger and the pipes are connected by means of special clips. Hydraulic sealing by pressure is ensured by O-rings applied to the specific pipes.
To improve resistance to corrosion, also the two flow and return pipes to primary exchanger are made of aluminium, with Aleternum 2 treatment.

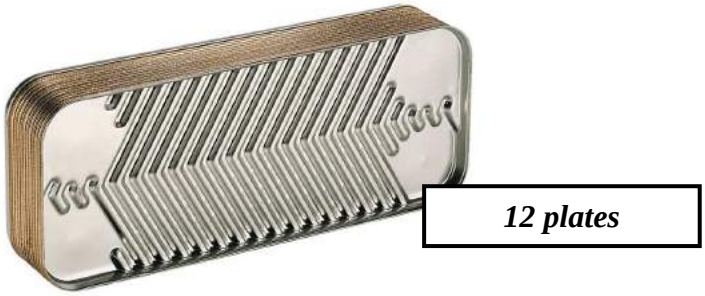


Warning: to replace the heat exchanger, proceed as follows:

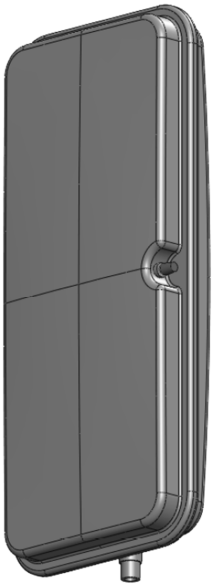
- remove combustion chamber front panel;
- remove the expansion tank;
- remove fan and flue gas hood;
- release the retaining clips;
- pull the exchanger upward to replace it;
- refit all components, lubricate O-ring with care.

SECONDARY EXCHANGER

It is made up of a number of overlaying metal plates. In the spaces between the plates, the hot water coming from the CH circuit and the DHW system cold water flow simultaneously in separate circuits.
The hot water will transfer its heat to the DHW system cold water. Therefore, at the outlet, the DHW will be warmer and the CH water (primary circuit) will be cooler.



3.4 EXPANSION TANK



An increase in heating water temperature inside a closed circuit corresponds to an increase in the water volume. As no further space is available, the increase will affect the pressure and not the volume. If pressure value exceeds safety valve triggering point, this latter will open and discharge water from the system. This problem is prevented thanks to an expansion vessel positioned inside circuit; vessel houses an air diaphragm to be used to balance this overpressure.

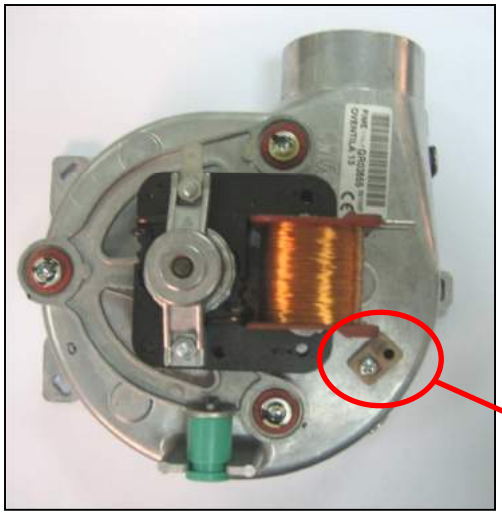
The expansion tank is placed vertically on the right side of the boiler.

Tank capacity: 7 litres

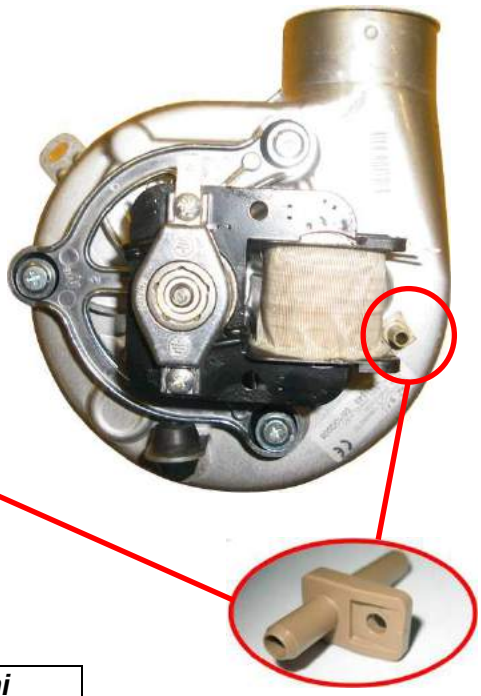
3.5 FLUE GAS FAN

The flue gas fan is of the asynchronous type and is fitted with a Pitot plastic pipe, which limits the condensate build up on the fan pressure measurement point and is approved for operating with the following models:

FIME



NATALINI



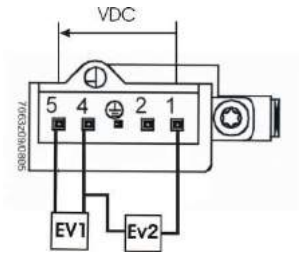
Technical characteristics:

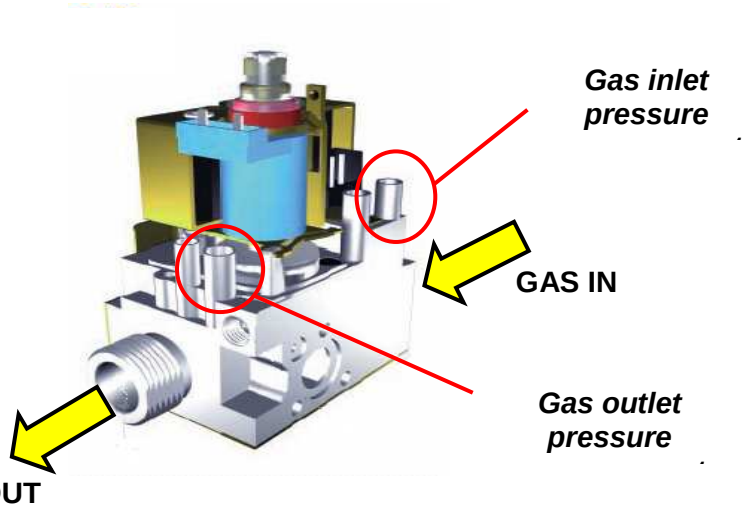
	Fime	***Natalini***
Power supply	230 Vac	
Power	38 W	35 W
Worm screw	Die-cast	Sheet metal

3.6 GAS VALVE

The boiler is approved for operating with gas valve, model SIT 845:

ELECTRICAL CONNECTIONS
*SOLENOID VALVES **EV1** and **EV2***





Gas valve characteristics	
EV1 and EV2 safety coil operating power supply	230 VAC 50 Hz
EV1 operating current	40 mA
EV2 operating current	12 mA
EV1 supply pin	4 - 5
EV2 supply pin	4 - 1
Modulation coil operating power supply	17 VDC
Max. operating pressure	60 mbar
Working temperature	-15 / 60°C
Modulation parameters	
Current of gas modulation coil at maximum output	**120** (natural gas) / **170** (LPG) mADC
Current of gas modulation coil at minimum output	**20** (natural gas) / **30** (LPG) mADC
Current of gas modulation coil at the end of the ignition ramp	85% of maximum current
Current of gas modulation coil at the end of the heating rising ramp	At maximum CH output (P1)
Coils	
Safety coil interchangeability	Yes
EV1 resistance value	~ 1600 Ohm
EV2 resistance value	~ 6.77 KOhm
Modulation coil resistance value	~ 78 Ohm

The valve features a compensation pressure point connected to the combustion chamber through a silicone pipe.
Valve thus knows the pressure on nozzles and can supply the correct quantity of gas even in case of overpressure or vacuum inside the chamber.
For example, upon ignition when fan is activated, a vacuum develops inside the combustion chamber. Thanks to this pressure point, valve decreases nozzle pressure so as to balance any exceeding gas supply due to vacuum.

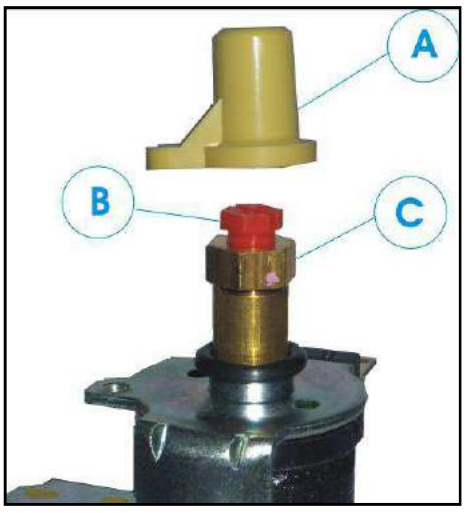
SECT. 4

GAS SETTING AND PARAMETERS

4.1 GAS VALVE SETTING

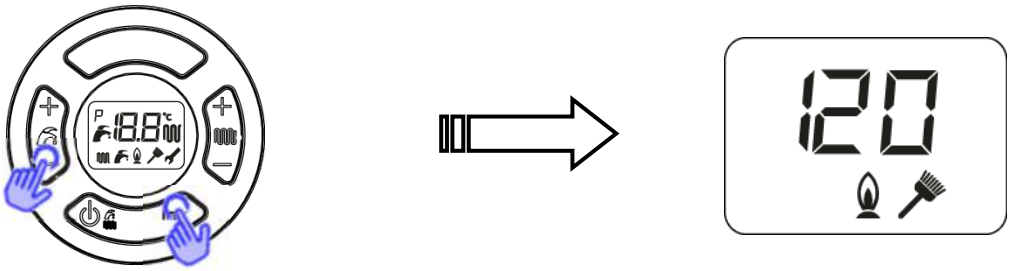
To set the gas valve, proceed as follows:

- **check supply *static* pressure** by means of the inlet pressure measurement point **E** referring to the "setting" table on pages 9-10, according to the type of fuel used (pressure values lower than requested do not guarantee proper boiler operation);
- check that parameter **P1** (**heating maximum output**) is correctly set (to view or edit this parameter, refer to the sequence described in the "parameter editing" paragraph, on page 26);
- switch heating system on with the ambient thermostat;
- ignite boiler in the "***chimney sweep***" mode (see following paragraph);
- with the pressure gauge in the inlet pressure measurement point **E,** check **supply *dynamic* system pressure** while the boiler is working (in case the pressure is too low, boiler proper operation is not guaranteed);
- remove the plastic cover protecting the adjustment screws at the top of the modulation coil;
- then connect the pressure gauge to the gas outlet pressure measurement point **D** after closing the inlet pressure measurement point;
- turn the maximum output screw **C** to increase or decrease the **maximum pressure**, making reference to the "setting" table on pages 9-10;
- electrically disconnect one of modulation coil connectors to operate the boiler at the minimum output;
- adjust the **minimum pressure** by turning the screw **B** of the gas valve (while holding the external screw **C**). Make reference to the "setting" table;
- re-connect connector to modulation coil and check maximum pressure again;
- disconnect the pressure gauge and check for any gas leakage both on the pressure measuring points and on the gas valve connection fly nuts;
- refit protection cover;
- quit the "chimney sweep" function by pressing the "**reset**" key;
- in case parameter **P1** has been edited, set the correct value again;
- switch the heating system off with the ambient thermostat.

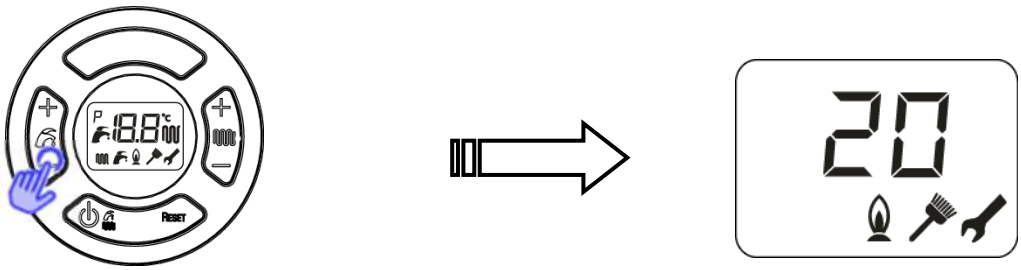


4.2 CHIMNEY SWEEP FUNCTION

The boiler features a chimney sweep function which must be used to measure combustion efficiency during operation and to adjust the burner.
This function can be enabled only in the HEATING + DOMESTIC HOT WATER operating mode. To enable it **press keys "- *DHW*" and "*reset*" at the same time and keep them pressed for five seconds**. Now the boiler performs the ignition sequence and then operates at the burner **maximum output** set by parameter **P1**.
The display will show simultaneously the current (mA) supplied to the modulation coil, the lit flame symbol with burner on, the "broom" symbol to indicate that the chimney sweep function is active:



Use the "**+**" or **"- *DHW*"** keys to change the value of the **current supplied to the modulation coil**, from the minimum to the maximum value according to parameter P1. In this case, the display will show the wrench symbol (parameter editing indicator) and the value of the current supplied to the modulation coil being edited:



This operation is useful when setting the boiler combustion with closed casing. The desired output is set by pressing the DHW keys.
The current supplied to the modulation coil at the minimum and at the maximum output values according to the gas used are given below:

	Max [mA]	**Min** [mA]
Natural gas	120	20
LPG	170	30

Release the "+" or "- *DHW*" keys to return to the previous page showing the current at the modulation coil.
The burner is switched off when the temperature detected by the flow probe exceeds 90°C and switched on again when reaching 70°C.
During this function, pump is powered, and the three-way valve switches to heating position.
The function automatically stops after 15 minutes, or by pressing the "*reset*" key, or setting a mode other than "*CH+DHW*".

4.3 GAS CONVERSION

Boilers are manufactured to run on the type of gas (natural gas or LPG) specifically required upon purchase order placing, and any conversion shall be made by qualified personnel.

During gas conversion, proceed as follows:

- make sure to work with the boiler disconnected from the electric power supply;
- remove combustion chamber front panel;
- remove burner upper part concerning gas ramps;
- remove burner nozzles and replace them with new ones having a diameter suitable for the new gas type (see "setting" paragraph on pages 9-10).
  WARNING: it is mandatory to fit the copper gaskets supplied along with the conversion kit;
- refit burner and combustion chamber;
- supply the boiler with power;
- access parameter setting page, and set the P0 parameter to the value corresponding to the type of gas used (refer to the illustrated sequence on "Parameter editing" on page 26):

  P0 → 0 = natural gas **P0 → 1 = LPG**

- gas valve can now be set (paragraph 4.1).

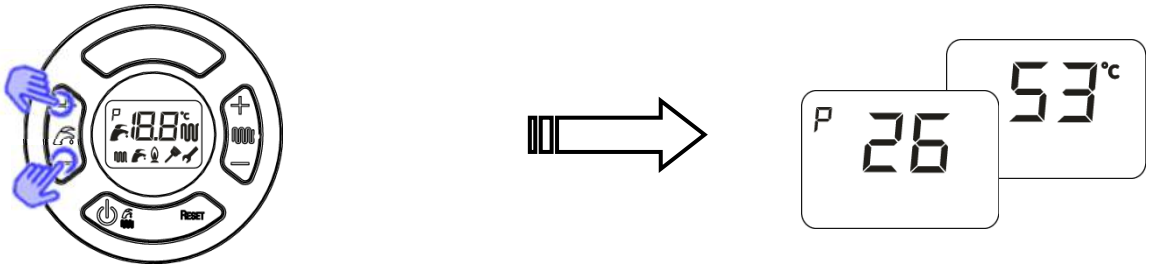
N.B. "**Polidoro**" burners feature as a standard nozzles without copper washers. It is mandatory to fit them during conversion. Failure to do so may affect the proper sealing.

4.4 PARAMETERS

The boards house a memory with a series of parameters to be accessed for displaying purposes only, or to be edited for boiler perfect setting based on the system used. These parameters can be directly accessed from user's interface, or through the remote control. In the latter case, it is possible to access only up to the 29th parameter.

Displaying parameter

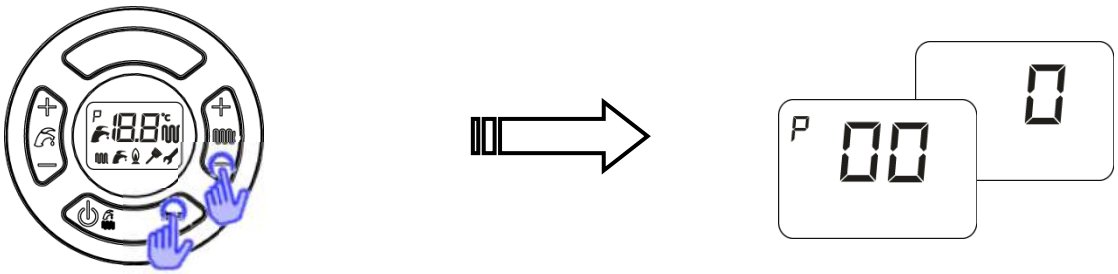
By pressing keys + and – for domestic hot water, you gain access to the displaying of read-only parameters (from P26 to P39, P36 excluded), such as the temperature values read by the different connected probes, the fault log, etc. Then, if the same keys are pressed one at a time, you can scroll the list of parameters.



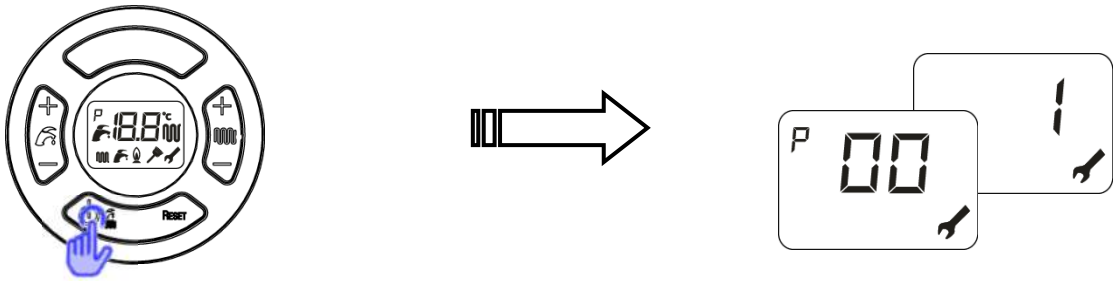
To quit the displaying function, simply press "*reset*". Display will anyway go back to the starting screen 30 seconds after keys have been pressed.

TECHNICAL parameter editing

If keys "*reset*" and "- *heating*" are pressed together for three seconds, you will access the parameter setting mode.
Use "*heating* +/-" keys, to select the desired parameter:



Press the operating mode key to confirm that parameter value must be edited; the adjustable wrench symbol indicates that parameter value can be edited using keys "+/- *heating*":



To confirm parameter value editing, press the operating mode key. Scroll the parameter list to edit other values, or press "*reset*" to quit the setting function.

TECHNICAL parameters list *(in red the parameters for basic settings during board replacement)*

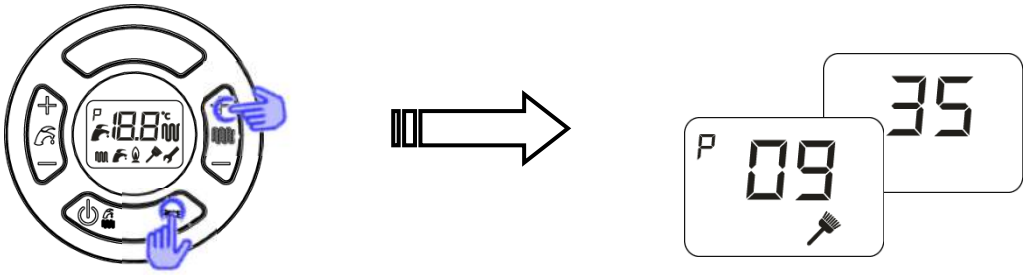
Parameter	*Range*	*Default values*	*Notes*
P0 Supply gas selection	0 ÷ 1	0	**0** = Natural gas **1** = LPG
P1 Gas valve modulation coil maximum current, based on heating	0 ÷ 180	120	**58** = 9 kW Natural gas **97** = 9 kW LPG **66** = 11 kW Natural gas **109** = 11 kW LPG **74** = 13 kW Natural gas **120** = 13 kW LPG **84** = 15 kW Natural gas **132** = 15 kW LPG **120** = 18 kW Natural gas **170** = 18 kW LPG
P2 Ignition power setting	0 ÷ 100%	0	**0** = operation with ignition ramp; **≠ 0**, ignition power identical to set power
P3 Heating thermostat timing	0 ÷ 10 min.	4	
P4 CH power rising ramp timer	0 - 10 min	4	

P5 Timer for CH post-circulation, anti-freeze and chimney sweep function	1 to 199 s	30	
P6 Setting of "solar" DHW thermostats	0 ÷ 1	0	**0** = Standard **1** = Solar
P7 Water hammer protection delay, configurable	0 to 10 s	0	
P8 Ambient thermostat reading delay / OT	0 to 199 s	0	
P9 Multifunction relay setting	0 ÷ 2	2	Do not edit this value!
P10 Heating output curves	0 ÷ 3	1.5	With external probe: *Low temp. from 0 to 0.8* *High temp. from 1 to 3* Without external probe: Value < 1, reduced range (low temperature)
P11 Boiler type selection	1 ÷ 3	1	**1** = combined instantaneous **2** = CH only **3** = CH only + water heater
P12 Heating timer reset temperature	25 ÷ 78 °C	40	
P13 Max. ΔT between flow and return (heat.)	1 ÷ 78 °C	30	
P14 Default parameter setting (except for P0 and P9)	0 ÷ 1	0	**0** = OFF **1** = default parameters
P15 Heating temperature differential OFF with installed ambient probe	0 ÷ 1 °C	0	
P16 Heating temperature differential ON with installed ambient probe	-1 ÷ -0.1 °C	-0.5	
P17 Ambient temperature correction with installed ambient probe	-5 ÷ +5 °C	0	
P18 Ambient modulation type with installed ambient probe	0 ÷ 1	1	**0** = on/off **1** = ambient probe modulation
P19 Flow temperature at fixed point with P18 = 0 and P21 = 1	30 ÷ 78 °C	60	
P20 Selection of the displayed temperature	0 ÷ 2	0	**0** = flow **1** = ambient / external **2** = return
P21 Association of supplementary input	0 ÷ 2	0	**0** = no probe **1** = ambient probe **2** = external probe
P22 Pump anti-seize timer	1 to 180 s	10	
P23 Anti-legionella function interval timer	0 ÷ 199 days	15	

P24 Anti-legionella function request temperature		35 ÷ 70 °C	65	
P25 Anti-legionella function operation timer		1 ÷ 199 min.	30	
Displaying only	**P26** Flow temperature			
	P27 Return temperature			
	P28 DHW temperature			
	P29 Ambient / external temperature			
	P30 Boiler type			**B** = natural draught **C** = forced draught
	P31 Most recent boiler shut-down	Fault code		
	P32 Second last boiler shut-down	Fault code		
	P33 Third last boiler shut-down	Fault code		
	P34 Fourth last boiler shut-down	Fault code		
	P35 Fifth last boiler shut-down	Fault code		
P36 Boiler shut-down display reset		0 ÷ 1	0	**0** = OFF **1** = shut-down reset
Displaying only	**P37** Number of faults since last reset			
	P38 Modulation power percentage			
	P39 Board use months			

SUPER-TECHNICAL parameter editing

Press "*reset*" and "*heating* + at the same time for three seconds to access:



Once entered the programming mode, proceed as described in the paragraph about technical parameters.

List of SUPER-TECHNICAL parameters

Parameter	*Range*	*Default values*	*Notes*
P0st Post-ventilation timer	0 ÷ 60 sec.	10	
P6st Flow set-point minimum limit with ambient probe and P10 > 1	0 ÷ 78 °C	45	
P7st Flow set-point minimum limit with ambient probe and P10 < 1	0 ÷ 78 °C	30	
P8st Multiplication parameter for flow set-point with ambient probe	0 ÷ 78	20	
P9st Heating range minimum limit with P10 > 1	10 ÷ 59 °C	35	
P10st Heating range maximum limit with P10 > 1	60 ÷ 78 °C	78	
P11st Heating range minimum limit with P10 < 1	10 ÷ 40 °C	35	
P12st Heating range maximum limit with P10 < 1	41 ÷ 50 °C	45	
P13st Plate DHW range minimum limit	10 ÷ 49 °C	35	
P14st Plate DHW range maximum limit	50 ÷ 70 °C	57	

SECT. 5

OPERATING LOGIC

5.1 MAIN GENERAL CHARACTERISTICS

- Function priority;
- Boiler type selection;
- Automatic flame control;
- Ignition with ramp at pre-set power;
- DHW priority;
- DHW modulation;
- Ambient thermostat;
- Adjustable CH maximum output;
- Temperature range pre-selection;
- Heating modulation;
- Ambient thermostat timer (antifast);
- Modulation with external probe or ambient probe;
- Presetting for OpenTherm Remote Control;
- Temperature probe integrity check;
- Gas proportional modulation coil integrity check;
- Anti-seize function;
- Post-ventilation function;
- Pump post-circulation function;
- Anti-freeze function;
- Safety devices and functions;

FUNCTION PRIORITY

The following table shows main function enabling priorities in case of simultaneous request of two or more functions:

Priority	Status
1	Shut-down status (pump only freeze protection mode and pump anti-seize functions can anyway be performed)
2	Chimney sweep
3	DHW request
4	DHW anti-freeze
5	Heating request in "DHW + CH" mode
6	Heating anti-freeze both in "DHW" and "DHW + CH" modes
7	Post-circulation
8	Pump anti-seize function
9	Waiting for a request

BOILER TYPE SELECTION

Natural gas or LPG configuration

This selection is obtained by setting technical parameter **P0** (see previous section) to select the *"current-output"* curve to be applied to the gas proportional modulation coil in order to achieve the correct modulation.

CTFS *(forced draught)* or CTN *(natural draught)* auto-configuration

The type of boiler is automatically recognised each time the board is supplied with power. The board attempts to read the inputs dedicated to the air pressure switch and to the flue gas thermostat. Upon the recognition (which must take place within the first two minutes) the following message will be displayed for 5 seconds:

C = sealed chamber
B = open chamber *(not available)*

Warning: during the combustion chamber type recognition step, no request is performed. In case of wrong self-recognition, see the specific paragraph on page 49.

Boiler type configuration

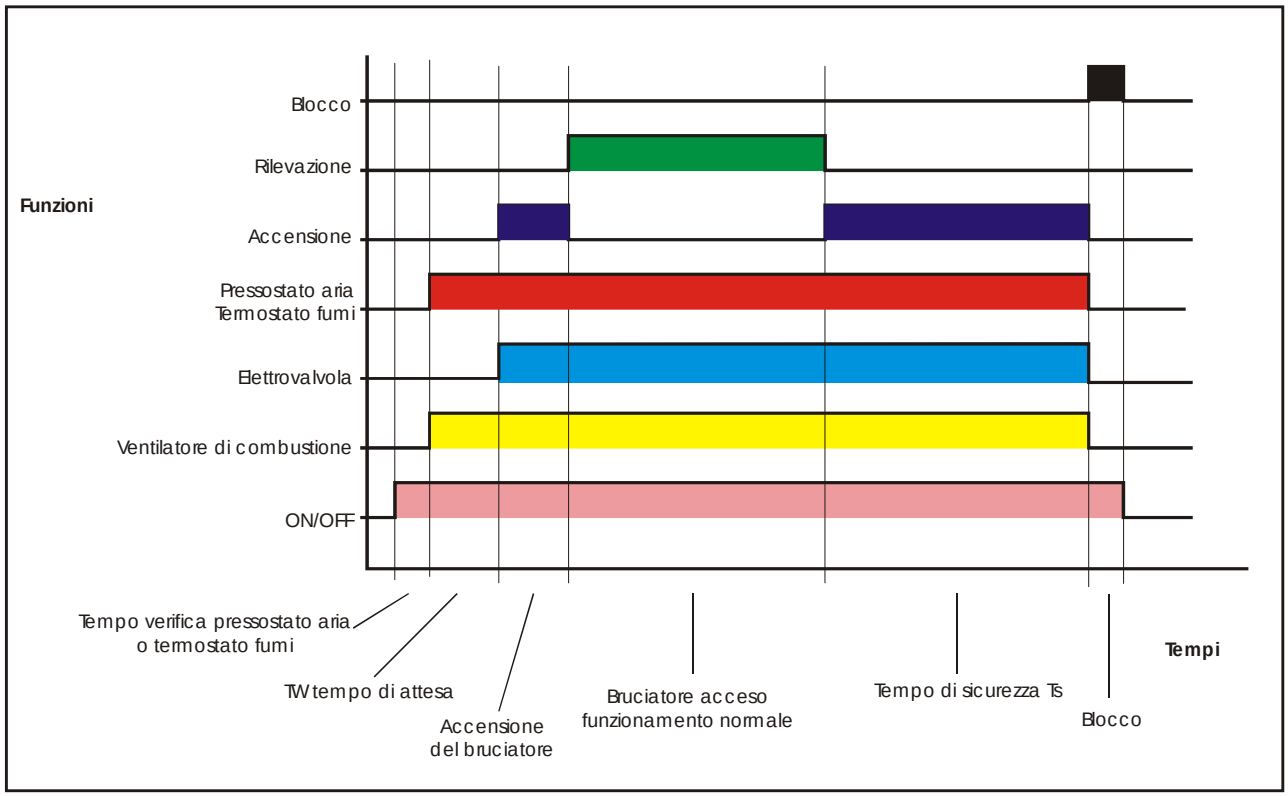
This board is pre-set to manage 3 different types of boiler configurations, depending on the setting of parameter **P11**:

P11 = 1 → *combined instantaneous, plates* (model C)
P11 = 2 → *CH only* (not available)
P11 = 3 → *with boiler* (not available)

AUTOMATIC FLAME CONTROL

The *"flame control"* device is always enabled and constantly performs self-check functions. Upon an operation request, the fan is supplied with power after checking that the air pressure switch (C type boiler) is in rest condition. As soon as the air pressure switch or the flue gas thermostat (type B boiler) enabling is given, the flame control device starts measuring the waiting time TW (1.5 seconds); after such time, gas valve and igniter will be energised for a maximum safety time TS (10 seconds). If a flame is detected within such time, the gas valve is kept open (energised) and the igniter is cut-out.

Below is boiler operation logical diagram:



In case no flame is detected during an **ignition** attempt, the automatic flame control will repeat the ignition sequence, performing up to **5 ignition attempts in the case of forced draught boilers, or 2 ignition attempts in the case of a natural draught boilers**, with ventilation cycles of 10 seconds and 35 seconds respectively to flush the chamber after each attempt.
In case of flame detection, even if just for a moment, only one ignition attempt will be performed.
The "*flame control shut-down"* will be activated if no flame is detected within the TS safety time since the last ignition attempt, or if a parasitic flame (while the gas valve is not energised) is detected for over one minute. After 5 seconds, reset the shut-down status by pressing the "reset" key on the boiler board or on the remote control.

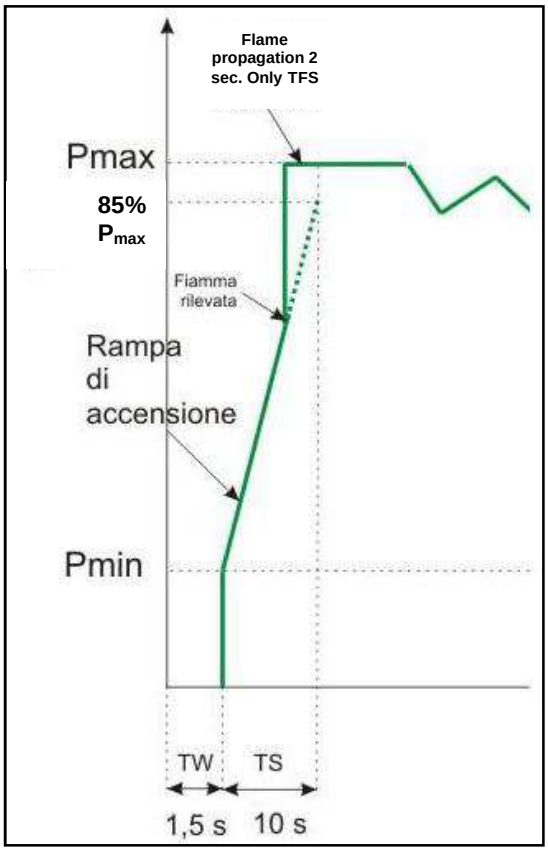
WARNING: maximum 5 reset attempts from remote are allowed. Then it will be necessary to directly make the reset from boiler. Alarm counting is reset each time the board detects a flame or its power supply is interrupted.

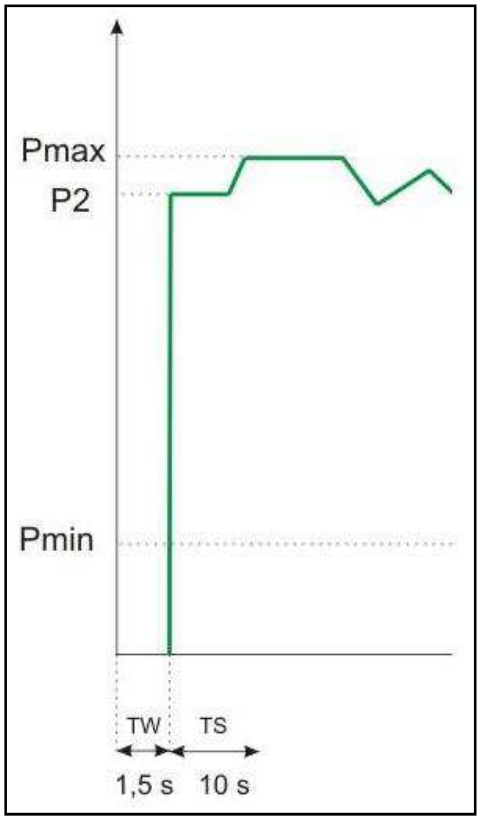
IGNITION WITH RAMP AT PRE-SET POWER

Boiler ignition mode can be selected with technical parameter **P2** (default setting is 0):

P2=0 → Ignition with ramp

Upon every operation request entailing burner ignition, burner will be ignited with a current ramp to modulation coil changing from the initial to the final value within a safety time TS (10 seconds). The initial value corresponds to the minimum current supplied to the modulation coil (30 mA for LPG and 20 mA for natural gas), whereas the final value is 85% of the maximum current (170 mA for LPG and 120 mA for natural gas). The ignition ramp ends one second after the *flame control* has detected the flame.
"Flame propagation" will now take place only in forced draught boilers, i.e. the modulation coil will be supplied with current for maximum two seconds. At the end of the flame propagation phase, boiler will start operating normally and igniter will be cut out two seconds after flame detection or one second before TS time runs out.





P2≠0 → Ignition at pre-set and adjustable power

Upon every operation request entailing burner ignition, burner will be ignited by supplying the modulation coil with a pre-set current, equal to parameter P2 value. Once flame is detected, the following *"flame propagation"* phase, in which the current supplied to modulation coil is brought to the maximum value for 2 seconds, will be started, proceeding then with the modulation output.
Igniter will be cut out five seconds after flame detection or one second before TS safety time runs out.

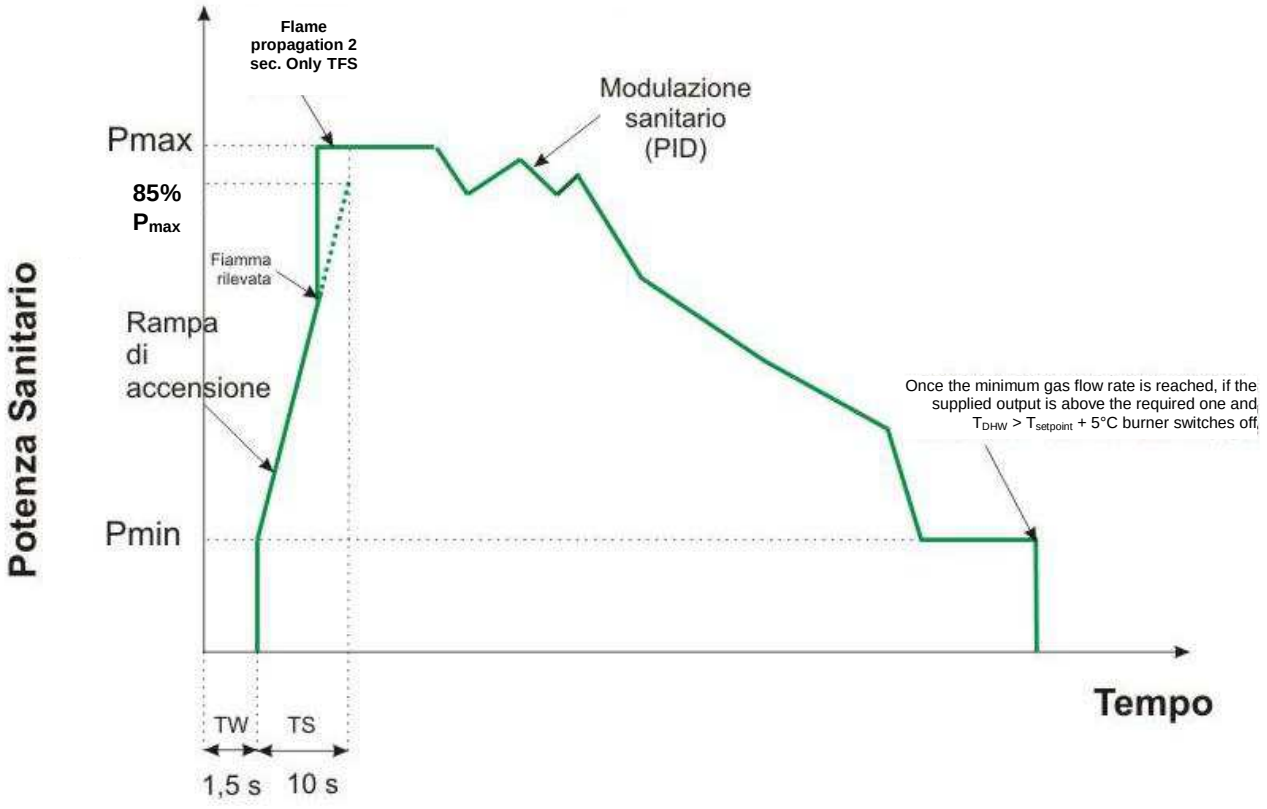
DHW PRIORITY

With boiler running in “DHW” or “DHW + CH” mode, DHW flow switch electric contact closing will originate a DHW operation request, thus starting modulation.
Such request can be delayed in order to avoid events deriving from the water hammer through parameter P7 (max. 10 seconds).
The sequence finishes when the electric contact is open again, enabling the subsequent pump post-circulation.

DHW MODULATION

Upon closing up of pressure switch electric contact, if the water temperature read by the domestic hot water NTC probe is lower than the set-point value + 3°C *(plate DHW thermostat triggering temperature ON*), the burner ignition sequence is started with the automatic flame control enabling.
Immediately after burner ignition, gas flow rate corresponds to flame modulation value which, thanks to a PID-type action, allows to reach and maintain the set DHW temperature.
In case of poor heat output by the plate exchanger due to possible clogging and consequent overtemperature of the primary body, another PID type adjustment of the flow is added to the DHW modulation. Such operation occurs at a flow temperature higher than 81°C and disables when the flow temperature falls below 75°C. In presence of double modulation, the gas flow rate supplied to the burner corresponds to the lowest of the two calculated modulation values.

Modulation with P2=0



During DHW modulation, once the min. gas flow rate is reached and with the supplied output above the required one, the burner is switched off when DHW temperature reaches the + 5°C set-point value. After burner switching off, whilst the operation request is still present, burner will be ignited again when the temperature falls below the usual + 3°C set-point.
During the first 20 seconds when the DHW is being drawn, to avoid boiler continuous “switch on/off", the maximum temperature allowed by the DHW probe to switch off the burner is set to 15°C higher than the set-point, whereas to switch it on again the temperature must fall below the + 8°C set-point.

Warning: the burner is switched off also in case the flow probe detects a value of 85°C and then ignited again (with the request still present) only upon reaching 80°C.

Plate DHW modulation temperatures:

- DHW temperature setting range: ***35 °C ÷ 57 °C***
- DHW thermostat triggering temperature OFF = *set point + 5°C*
- DHW thermostat triggering temperature ON = *set point + 3°C*
- DHW thermostat triggering temp. initial draw (first 20 sec) OFF = *set point + 15° C*
- DHW thermostat triggering temp. initial draw (first 20 sec) ON = *set point + 8° C*
- Flow water thermostat triggering temperature with plate DHW mode: *OFF 85° C*
- Flow water thermostat triggering temperature with plate DHW mode: *ON 80° C*
- Flow water PID triggering temperature with DHW mode: *81° C*
- Flow water PID deactivating temperature with DHW mode: *75° C*

N.B. *In case the boiler is combined with a solar system with instantaneous-type integration, it is recommended to set technical parameter P6 to 1. This increases the modulation range avoiding boiler hunting (start and stop) with inlet temperature very close to the set-point. In such case the limit temperatures are as follows*:

- DHW thermostat triggering temp. OFF with instantaneous solar integr.: *set-point + 10° C*
- DHW thermostat triggering temp. ON with instantaneous solar integr.: *set-point + 9° C*

CH CONTROL

The electronic board features two inputs used for heat request with boiler set to *DHW + CH"* or *"CH only"* modes. An input *(terminals 3 and 4)* is for the ambient thermostat (TA) or remote control (OT), whereas the other input *(terminals 1 and 2)* is of "additional" type and used only to connect a climate sensor (external or ambient probe) according to the programming of technical parameter P21:

- ***P21 = 0****: no probe connected.*
  The heat request depends only by the presence of TA ambient thermostat or OT remote control;
- ***P21 = 1****: ambient probe.*
  The heat request depends on both the ambient probe presence and the TA ambient thermostat, whose inputs are logically connected in series. Therefore, the CH function with ambient probe is enabled only if TA contact is closed;

- ***P21 = 2**: external probe.*
  The heat request depends on both the external probe presence and on the TA ambient thermostat or OT remote control, whose inputs are logically connected in series. Therefore, the CH function with external probe is enabled only if there is a request from TA or OT;

According to the value set with parameter P21 (therefore whether or not there is a climate sensor), the boiler modulation may occur in *"on/off"* mode or through a specific thermoregulation (for more information refer to paragraph *"Thermoregulation with ambient probe"* on page 39).

WARNING: with parameter P8 it is possible to delay (from 0 to 199 seconds) the CH request starting from TA contact closing to allow the zone valves to open before the boiler pump starts.

ADJUSTABLE HEATING MAXIMUM OUTPUT

During operation in CH mode, the maximum power supplied to the burner is equal to the one set by parameter **P1**.
This parameter represents the maximum admissible current to the modulation coil in mA. *The admissible values for this parameter depend on the output and on boiler type of gas, and are specified on the table on page 26*.

TEMPERATURE RANGE PRE-SELECTION

With parameter **P10**, without any external probe, it is possible to set two ranges (standard or reduced) in order to adjust the flow water temperature by means of the boiler keys or the remote control:

P10 < 1 → heating temperature reduced range: 35 ÷ 45°C
P10 ≥ 1 → heating temperature standard range: 35 ÷ 78°C

Such ranges are parametrizable, i.e. it is possible to set the minimum and maximum reference value through the following super-technical parameters:

$P9_{st}$ and $P10_{st}$: *minimum and maximum limit for standard range (default 20 and 78°C);*
$P11_{st}$ and $P12_{st}$: *minimum and maximum limit for reduced range (default 20 and 45°C).*

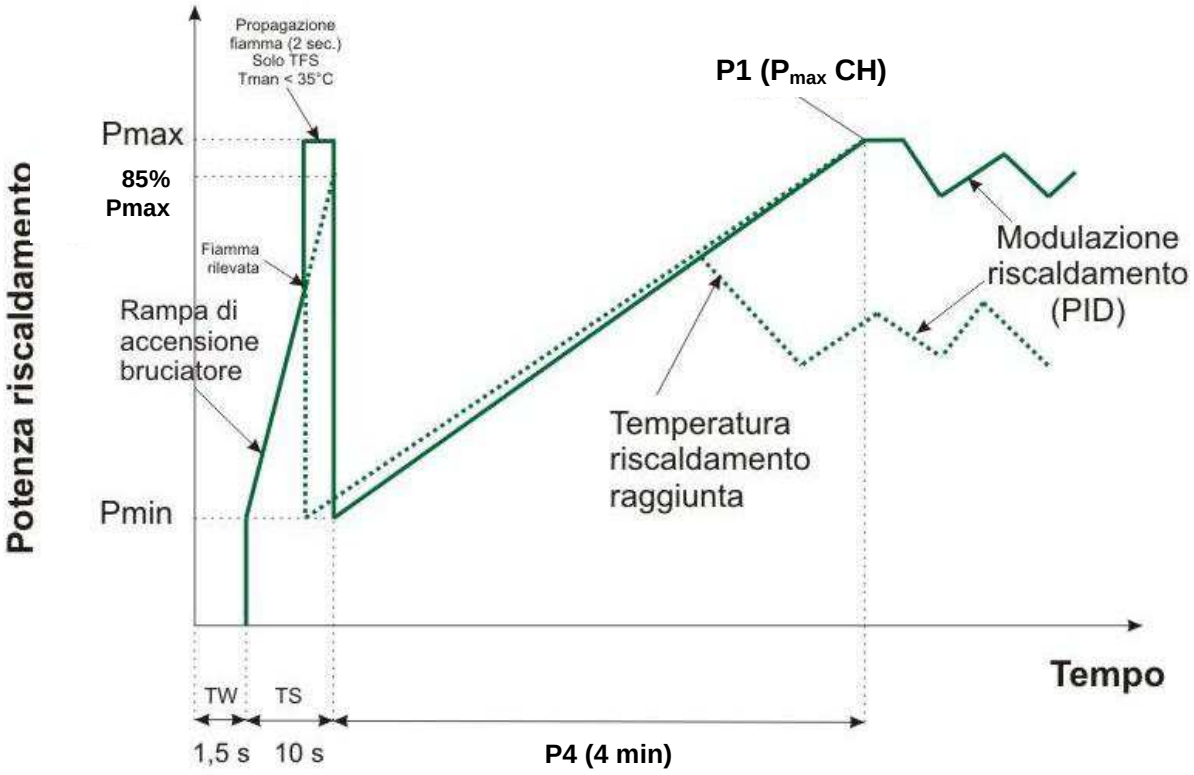
Warning: these parameters can be changed only with boiler in *"on/off"* modulation, or with thermoregulation on external probe. In presence of ambient probe, in fact, the limit values remain the default ones according to parameter P10.

Using an external probe instead, parameter P10 corresponds to the thermoregulation curve selection (refer to paragraph *"Thermoregulation with external probe").*

CH MODULATION

Upon closing of ambient thermostat electric contact, if the water temperature read by the flow NTC probe is lower than the set temperature value, the burner ignition sequence is started with the automatic flame control enabling.
At the end of the ignition sequence, gas flow rate goes to its minimum value and then reaches the value set by technical parameter P1 (maximum heating output) with a ramp duration equal to the heating output rising ramp timer which can be set by technical parameter P4 (default - four minutes).
From now on, the flow water temperature will constantly be read and the rising ramp will be stopped with a PID-type action upon reaching the set temperature, in order to maintain the selected flow temperature.

Modulation with P2=0



Upon reaching the minimum gas flow rate (P_{min}), if the power supplied is still higher than requested, the burner will be switched off as soon as a flow temperature higher than the set temperature is reached (set-point +5°C in case of a standard range and set-point +2°C at a reduced range). The burner is switched off and measuring of burner deactivation time starts (see following section about "*Ambient thermostat timer*").

During the operation in heating mode, upon any DHW request, the latter has higher priority and forces the interruption of the function in progress.

Heating modulation temperature - standard range (P10≥1):

- CH temperature setting range: *35÷78°C*
- CH thermostat triggering temperature OFF = *set-point + 5° C*
- CH thermostat triggering temperature ON = *set-point + 0° C*
- Heating thermostat timer (antifast) - can be set through P3: *0÷10 min, default 4 min with* T_{flow} *> P12*
- CH thermostat timer reset temperature through parameter P12: *25÷78°C, default 40°C*
- Heating output rising ramp timing by means of parameter P4: *0÷10 min, default 4 min*

Heating modulation temperature reduced range (P10<1):

- Heating temperature setting reduced range: *35÷45°C*
- Reduced CH thermostat triggering temperature OFF = *set-point + 2° C*
- Reduced CH thermostat triggering temperature ON = *set-point - 2° C*
- Heating thermostat timer (antifast) - can be set through P3: *0÷10 min, default 4 min with* T_{flow} *> P12*
- CH thermostat timer reset temperature through parameter P12: *25÷78°C, default 40°C*
- Heating output rising ramp timing by means of parameter P4: *0÷10 min, default 4 min*

The **set-point** depends on the adjustment of the heating temperature through the boiler keys or the temperature set through remote control.

AMBIENT THERMOSTAT TIMER (ANTIFAST)

During modulation in heating mode, after burner switching off, wait 240 sec (technical parameter P3). After that, if the flow temperature is lower than the “set-point”, the burner is switched on again.

The heating thermostat timer is reset:

- upon a DHW request;
- at the end of a heating request;
- selecting the “stand-by” or “DHW” mode or resetting the boiler;
- if the flow water temperature value falls below the parameter P12 (40°C, with both standard and reduced range).

EXCHANGER BOILING CONTROL

In CH function only, the flow value can be automatically edited (decreased) based on the temperature values read by flow and return NTC probes. If the differential calculated by these two probes is higher than the reference Δt set through parameter P13 (default 30°C), it prevents that output is fully released with limited water quantity inside the exchanger, with consequent boiling of the exchanger.

The algorithm used for this calculation is:

If $T_{set\text{-}point} \geq T_{return}+\Delta T_{max}$, ***then*** $T_{flow\ set}=T_{return}+\Delta T_{max}$

If $T_{set\text{-}point} < T_{return}+\Delta T_{max}$ *-1°C*, ***then*** $T_{flow\ set}=T_{set\text{-}point}$

where,

$T_{set\text{-}point}$*:* flow temperature set from boiler or from remote;
T_{return}*:* temperature value read by the return probe
ΔT_{max}*:* differential to be set through parameter P13 (from 0 to 78°C)
$T_{flow\ set}$*:* edited flow temperature.

When "exchanger boiling control" function is active, the "C" symbol will be displayed flashing.

Calculation example with $\mathbf{T_{set\text{-}point}}$ temperature at **60°C**:

ΔTmax = 15		***ΔTmax = 20***		***ΔTmax = 30***	
Treturn	***Test-flow***	***Treturn***	***Test-flow***	***Treturn***	***Test-flow***
20	35	20	40	20	50
30	45	30	50	30	60
40	55	40	60	40	60
50	60	50	60	50	60
60	60	60	60	60	60

WARNING: if parameter P13=0, function is disabled and return probe can also be disconnected.

THERMOREGULATION WITH AMBIENT PROBE *(with P21=1)*

To allow the management of the heating using the ambient probe, the latter has to be enabled through technical parameter P21=1.
With ambient probe present, the TA input is logically in series with the probe, then the heating functions are enabled only if TA contact is closed as well.
The ambient temperature set-point selection is performed with *"heating +/-"* keys and the selection range is between 5°C and 35°C.

Warning: the CH function is enabled only if the boiler is in the "*DHW + CH*" or *"Heating only"* mode.

Operating logic

The ambient probe activates the heating function when the temperature detected by the probe is lower than or equal to the "*Ambient set-point*" set through *"heating +/-"* keys minus "*triggering temperature differential ON*" (parameter P16). Request stops when ambient temperature is higher than or equal to "*Ambient set-point*" plus "*triggering differential OFF"* value (parameter P15).

Example: $T_{set\text{-}point}$*: 20°C ;* *P15=0.2; P16=-0.3*

Heating is enabled when ambient temperature ≤ 19.7
Heating is disabled when ambient temperature ≥ 20.2

In case of probe not correctly set or installed in an improper position, the ambient probe reading can be corrected with parameter P17 *(from -5°C to +5°C)*. In this case the ambient probe value is the result of the temperature detected after having added or subtracted the correction parameter value previously indicated.

***WARNING**: in case the probe is damaged (short-circuit, open circuit or out of range value) error E44 is displayed. In this case, heating continues in "ambient thermostat" mode (P21=0) with on/off modulation.*
In case of probe not active (P21 different from 1), parameters P15, 16, 17, 18 and 19 are not displayed.

Modulation types with ambient probe

According to the setting of technical parameter P18, it is possible to set the type of modulation in CH mode with the most suitable ambient probe for the system:

P18=0 On-off modulation

In this case the **flow** set-point is set at **fixed point** through technical parameter **P19** *(default 60°C with standard range, 45°C with reduced range).*
The maximum temperature that can be set is connected to the operating range according to parameter P10 setting:

P10 < 1 → heating temperature reduced range: 35 ÷ 45°C
P10 ≥ 1 → heating temperature standard range: 35 ÷ 78°C

P18=1 Ambient probe modulation

With active modulation on the ambient probe, the flow set-point is calculated according to the ambient temperature (set and detected) and the range selected through parameter P10 based on the following relations:

$P10 < 1 \rightarrow T_{flow_set} = P6_{st} + P8_{st}*(T_{set\text{-}point_Ambient} - T_{Current_Ambient})$
$P10 \geq 1 \rightarrow T_{flow_set} = P7_{st} + P8_{st}*(T_{set\text{-}point_Ambient} - T_{Current_Ambient})$

where,

T_{flow_set}: calculated flow temperature;
$T_{set\text{-}point_Ambient}$ = ambient temperature set with “heating +/-” keys
$T_{Current_Ambient}$ = instantaneous ambient temperature detected by the probe
$P6_{st}$ = super-technical parameter for minimum temp. with curves ≥ 1 *(default 45°C)*
$P7_{st}$ = super-technical parameter for minimum temp. with curves < 1 *(default 30°C)*
$P8_{st}$ = super-technical parameter for multiplication factor *(default 20)*

Warning: whatever the calculated flow temperature, this is in any case limited within the **maximum limit** of 78 or 45°C according to the set range (values **not editable** through parameters $P10_{st}$ e $P12_{st}$). To modify the modulation algorithm, it is necessary to operate on the multiplication factor with super-technical parameter $P8_{st}$.

THERMOREGULATION WITH EXTERNAL PROBE *(with P21=2)*

The external temperature probe to be connected will automatically modify the heating flow water temperature according to:

- the *external temperature* detected;
- the selected *thermoregulation curve* through technical parameter P10;
- the *fictitious ambient temperature* set through*"heating +/- "* keys.

Warning: to activate such thermoregulation, it is necessary to set the technical parameter P21 to 2; moreover, the heating function is active only if the boiler is in "*DHW + CH*" or "*CH only*" mode.

With external probe present, the TA input is logically in series with the probe, therefore the heating functions are enabled only if there is a request from TA ambient thermostat or OT remote control.

If both the external probe and the remote control are present, assuming that the remote control is able to set and carry out its own thermoregulation, the modulation board transmits the external temperature value to the remote control, and if the heating request is determined by the same control, this will determine the flow temperature according to its thermoregulation curve and to the room temperature previously set.

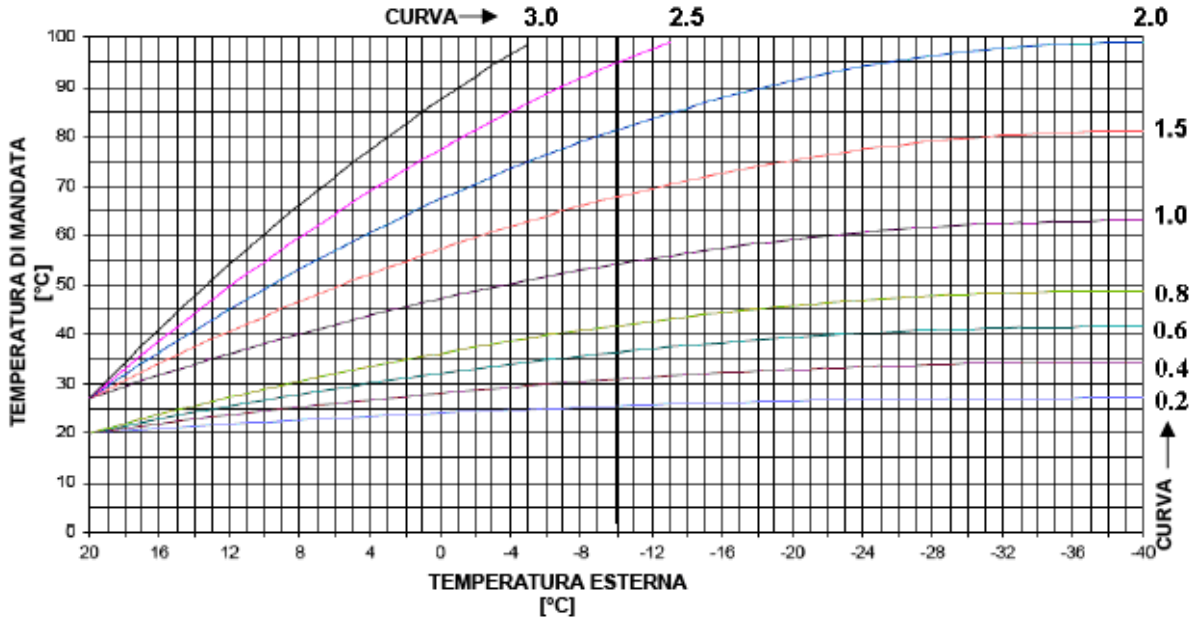
External probe installation

The external probe must be connected to boiler terminals 1 and 2 using a double insulated wire, minimum cross-section 0.35 mm^2.
It must be installed on a wall facing North - North East, in a position protected from weather (not in niches or near ventilation openings or sources of heat).

Thermoregulation curve setting

The thermoregulation curve is set through technical parameter P10 and it is important to select the one with the right slope according to the thermal system:

- **For high temperature systems** *(radiators)*, we recommend setting a value between 1 and 2.
- **For low temperature systems** *(floor)*, we recommend a value between 0.2 and 0.8.



Warning, the curves given in the diagram refer to a request of a "*fictitious ambient temperature*" of 20°C. In case of different fictitious temperature, all curves will be shifted in a parallel translation with subsequent increase or decrease of the calculated flow temperature.

Curves can be chosen proceeding either *roughly and approximately* or using a simple mathematical formula. In either case, it will be necessary to check the temperature changes so as to correct and choose the proper curve accurately.

In the former case you will simply need to take an actual value of external temperature and associate the desired flow value to it. Then choose the most suitable curve.

> *Example:*
> at an external temp. of -4°C, a flow of 62°C is preferable; **curve: 1.5**

In the second case use the following formula:

$$\textbf{CURVE} = \frac{\text{Tmax} - 20}{20 - \text{Testmin}}$$

where Tmax is the maximum flow temperature and Textmin is the minimum external temperature.

Example:

Low temperature:

Tmax = 44°C
Text = -10°C

$$\textbf{CURVE} = \frac{44 - 20}{20 - (-10)}$$

P10 curve = 0.8

High temperature:

Tmax = 70°C
Text = -10°C

$$\textbf{CURVE} = \frac{70 - 20}{20 - (-10)}$$

P10 curve = 1.7

Checking the thermoregulation curve setting

It takes time to choose the best curve. Consider the following suggestions:

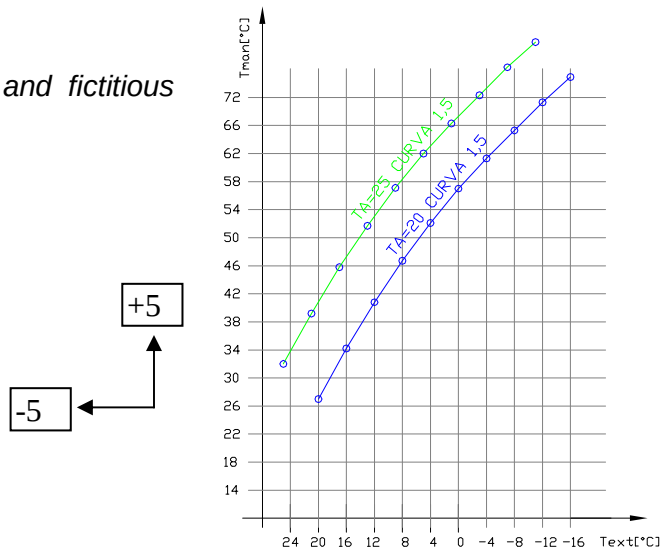
- If upon external temperature decrease the ambient temperature increases, it is necessary to set a curve with a lower slope, i.e. a lower curve;
- If upon external temperature decrease the ambient temperature decreases, it is necessary to set a curve with a higher slope, i.e. a higher curve;
- Lastly, if the ambient temperature remains constant upon changing of the external temperature, the curve is correct.

If the ambient temperature is constant but different from the desired value it is necessary to translate the curve. This occurs automatically by pressing the "*heating* +/-" keys on the boiler panel. In fact, with an external probe installed, such keys do not adjust the flow temperature but the fictitious desired one in a ambient ranging from 5°C to 35°C.

We recommend to set a value between 20°C and 25°C, or at least similar to the ideal one in the ambient.

The curves given in the diagram refer to a request of a "*fictitious ambient temperature*" of 20°C. In case of different fictitious temperature, all curves are shifted in a parallel translation

Example of curve translation with P10=1.5 and fictitious ambient temperature from 20° to 25°C:



OPENTHERM REMOTE CONTROL PRE-SETTING

The board is provided with an internal interface that allows the connection of an OpenTherm protocol-based remote control. This latter, besides serving as an ambient thermostat for its zone, allows to set some of the boiler main parameters.
The remote control must be connected to the board with two non-polarized connectors.
Instead of the remote control, an ambient thermostat connection (clean contact) is arranged: when closed for more than 10 seconds, it generates a heating request for the zone managed by the remote control. The request stops when

the contact remains open for more than one second. When the remote control is not connected and/or does not communicate, all settings are made from the boiler. Board and remote control communicate in each operating mode: DHW, DHW+CH, CH or STANDBY.

A communication loss will entail the continuous attempt to restore it but, after 1 minute, the board will resume operation in local mode until connection is restored. In this case the system temporarily ignores the heating request that could be generated by a possible contact connected on opentherm. When the connection is active, remote control has a priority over boiler switch, and it enables/disables DHW and CH functions.
The remote control can request the boiler and display the flow, DHW, external probe temperatures, the temperatures set for DHW and heating, the current modulation level, as well as the error code. It can also display the different operation states (DHW, heating, flame lighting, fault presence or shut-down) and it can reset the boiler after a shut-down for a limited number of times and period (no more than 3 times in 24 hours).

Warning: the remote control allows access only to the first 25 parameters.

TEMPERATURE PROBE INTEGRITY CHECK

The system checks for any faults in the probes connected to the modulation board, signalling any detected faults with the relevant error code. The failure condition occurs when probe is not supplied with power, or when it detects a temperature value outside probe correct operating range:

- ***External probe (E23)*** fault: each operation request in heating mode entailing the burner ignition is carried out ignoring the calculation algorithm. The request continues in *"ambient thermostat"* mode and the curve value (technical parameter P10) is used to determine the operation range (standard or reduced) with set-point corresponding to the set one.
  Warning: the error is indicated only with external probe active (P21=2).

  Correct operating range: *from -40 to +50°C, general tolerance: +/- 3°C.*

- ***Ambient probe (E44)*** fault: each operation request in heating mode entailing the burner ignition is carried out ignoring the calculation algorithm. The request continues in *"ambient thermostat"* mode and the set-point value corresponds to the set one.
  Warning: the error is indicated only with ambient probe active (P21=1).

  Correct operating range: *from -10 to +45°C, general tolerance: +/- 3°C.*

- ***Flow probe (E05)*** fault: the burner is switched off immediately and the fans performs a one-minute post-ventilation cycle.
  The pump performs a CH post-recirculation cycle (30 sec., adjustable through P5) with deviating valve in heating position if before the fault

  a heating, flow-return anti-freeze, chimney sweep request was present, or if the boiler does not feature any request.
  The pump performs a DHW post-circulation cycle (30 sec.) with deviating valve in DHW position only if before the fault there was a request in DHW or DHW anti-freeze mode.

- Return probe ***fault (E15)***: no function is interrupted. Heating requests are accepted without performing the "*exchanger boiling control*" function. If the "*exchanger boiler control*" function is disabled (P13=0), return probe fault will not be displayed.

- ***Plate DHW probe (E06)*** fault: with a request in DHW mode, the burner is not activated (if it was ON it is switched OFF) and the pump is activated with three-way valve in DHW position as long as the request persists. At the end of the request, if no other requests are present, the system performs a 30-second post-circulation cycle. This circulation occurs even without operating request. With operating request in heating, flow anti-freeze, or chimney sweep function, the standard management operations of the request are ensured.
  If the fault is reset, the system restores the standard operation.

Resistance values (Ω) of DHW, return, and flow NTC probes at different temperatures:
Probe calibration: ***10k Ohm at 25°C β3435***

T°C	0	2	4	6	8
0	27203	24979	22959	21122	19451
10	17928	16539	15271	14113	13054
20	12084	11196	10382	9634	8948
30	8317	7736	7202	6709	6254
40	5835	5448	5090	4758	4452
50	4168	3904	3660	3433	3222
60	3026	2844	2674	2516	2369
70	2232	2104	1984	1872	1767
80	1670	1578	1492	1412	1336
90	1266	1199	1137	1079	1023

Correct operating range: *from -20 to +120°C, general tolerance: +/- 3°C*

Warning: if the boiler or the remote control is in "OFF" mode, all these faults are just signalled, whereas all the other boiler control elements (gas valve, fan, pump, tree-way valve) remain in rest position.

GAS PROPORTIONAL MODULATION COIL INTEGRITY CHECK

The system checks the gas proportional modulation coil for faults (error E76) in case of modulation coil not being supplied with power.
In case of fault, all the standard boiler functions are anyway performed with the burner working at minimum output. The faulty modulation coil signal is interrupted when its electric parameters return within the preset limits.

PUMP AND DEVIATING VALVE ANTI-SHUT-DOWN FUNCTION

The electronic board calculates the time elapsed since pump disabling; if this time is equal to 24 hours, both the pump and the deviating valve will be enabled again for a time specified in parameter P22 (default = 10 sec.).
During the anti-seize function the burner remains off and upon each activation of the pump, for any request, the timer is reset.
Any operation request in CH, DHW or anti-freeze functions will have higher priority, and thus the function in progress will be forced to end in order to carry out such request.

POST-VENTILATION FUNCTION.

Upon burner switching off**,** the fan is still supplied with power for **10 seconds(**time can be adjusted through super-technical parameter $P0_{st}$), regardless of boiler operating mode. Moreover, a post-ventilation cycle is started when the temperature read by the flow probe reaches 95°C and is stopped when the temperature falls below 90°C.
Any operation request during CH, DHW, anti-freeze, chimney sweep functions will have higher priority and thus the ventilation function in progress will be forced to end in order to carry out such request.

PUMP POST-CIRCULATION FUNCTION

At the end of a heating, anti-freeze or chimney sweep request, the burner (if ON) is immediately switched off, whereas the pump continues to be supplied with power for 30 secseconds (time that can be set by means of technical parameter P5).
At the end of an operation request in plate DHW mode, the pump is still supplied with power for 30 seconds, with deviating valve switched to DHW mode.

With no operation request, if the water temperature detected by the flow NTC probe is higher than 78 °C, pump is operated and remains supplied for the time necessary to let flow temperature fall below 78°C, plus 30 additional seconds. Deviating valve is switched to DHW if boiler is in WINTER or CH ONLY mode. It is switched to DHW, if boiler is in SUMMER mode or OFF.

Any operation request during CH, DHW, anti-freeze, chimney sweep mode will have higher priority, and thus the post-circulation function in progress will be forced to end in order to carry out such request.

ANTI-FREEZE FUNCTION

Flow

A flow NTC probe measures the water temperature inside the boiler and if it falls below 5°C it generates an operation request in flow anti-freeze mode, with consequent burner ignition.
At the end of the ignition sequence the output rate supplied to burner will be forced to the minimum value.

The operation request in flow anti-freeze mode ends when the flow temperature exceeds 30°C or when reaching an operation time of 15 minminutes with flow temperature above 5°C.

Any operation request in heating mode or DHW has higher priority, and forces the interruption of the function in progress.

During a flow anti-freeze operation the boiler pump is activated, whereas the three-way valve switches to heating position.

In case of flame control shut-down and impossibility to ignite the burner, the anti-freeze function will anyway carry out a pump circulation cycle.

Warning, the freeze protection function does not protect the CH system but the boiler only.

Summary of operation thresholds:

DESCRIPTION	ON	OFF
Flow anti-freeze function	5°C	30°C (or after 15' of operation)
Temperature general tolerance	± 3°C	

Plate DHW

The DHW NTC probe measures the DHW temperature and if it falls below la temperatura di 5°C it generates an operation request in DHW freeze protection mode. The pump is activated and after a 30 sec. waiting time, the burner ignites with output forced to the minimum value.

During a DHW anti-freeze operation the temperature detected by the flow probe is constantly checked, and in case it reaches 60°C the burner is switched off. The burner ignites again if the operation request in anti-freeze mode is still present and the flow temperature is lower than 60°C.
The operation request in DHW anti-freeze mode ends when the DHW temperature exceeds 10°C or when reaching an operation time of 15 minminutes with DHW temperature above 5°C.

Any operation request in DHW mode has higher priority, and forces the interruption of the function in progress.
During a DHW anti-freeze operation, the pump is supplied with power, the electric deviating valve is in DHW position.

In case of flame control shut-down and impossibility to ignite the burner, the DHW anti-freeze function will anyway carry out a pump circulation cycle.

Summary of operation thresholds:

DESCRIPTION	ON	OFF
DHW freeze protection function	5°C	10°C (or after 15’ of operation, or if the flow temperature is > 60°C)
Temperature general tolerance	± 3°C	

Room

This function is active only in case of use of the ambient probe with relevant technical parameter P21 enabling. In this condition, if the ambient probe detects a temperature lower than 5°C, it generates an operation request in "heating" mode until the ambient temperature reaches 6°C.
During this function, the flow temperature is calculated according to the algorithm provided by technical parameter P18.

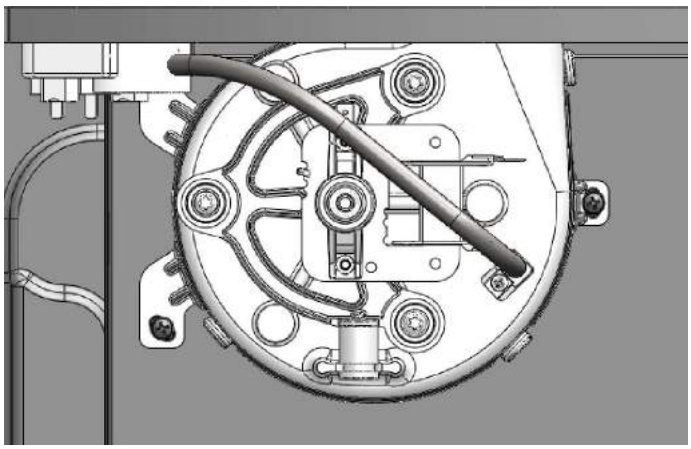
SAFETY DEVICES

Safety thermostat (E02 shut-down)

The safety thermostat positioned on main exchanger is a normally closed contact. When the water temperature detected by thermostat is above 95°C, contact opens by interrupting the power supply to the gas valve, with consequent burner switching off.
The safety thermostat triggering, with powered gas valve, originates boiler shut-down for "*safety thermostat triggering*" only if the contact remains open for a time longer than 4 seconds (non-volatile shut-down), otherwise burner switches off but shut-down is not signalled.
The safety thermostat is acknowledged and managed only during a burner ignition request. Hence, in case it was already open before the ignition request, this latter is delayed until thermostat contact closes.
In case of non-volatile shut-down due to safety thermostat triggering, fan performs a 35-second post-ventilation cycle, while pump performs a CH or DHW post-circulation, based on the request made during failure.

Air pressure switch (E03 shut-down)

The air pressure switch is an electric contact connected in series with the gas valve operator, and is directly managed by the automatic flame control. Its function is to detect a proper pressure difference in two different points of the boiler.
The pressure switch contact must be open before fan is supplied with power and closed when it starts working. At the end of the request, when the fan is no more supplied with power, the contact must re-open. Therefore, the board double-checks the contact opening, one check is performed at the initial and one at the final phase.
When the pressure switch is open, the gas valve cannot be supplied with power.
After 10 seconds since powering the combustion fan, if the pressure switch contact is still open, a volatile shut-down signal is generated. Said signal does not need to be reset. The same shut-down signal is generated if the pressure switch is in a wrong position or in a waiting status. The boiler will enter a non-volatile shut-down mode only if the pressure switch is in a wrong position for more than one minute and must be reset, otherwise just a volatile shut-down will occur an no error will be displayed.



Differential pressure switch: 6PRESSOS11 (**60/50 Pascal** Pmax=1500 Pa)

Low water pressure switch (E04 shut-down)
The water pressure switch is constantly checked. If it is open (with pressure lower than 0.5 bar), a signal of insufficient pressure (E04) is sent, the pump is immediately disabled and the operation requests are ignored.
If the pressure switch contact closes, the standard operation is restored.

Boiler combustion chamber automatic recognition (E72 shut-down)
The type of boiler *(C=forced draught or B=natural draught, not available)* is automatically recognised each time the board is supplied with power. The board attempts to read the inputs dedicated to the air pressure switch. Upon the following recognition (which must take place within the first two minutes) the following message will be displayed for 5 seconds:



If for any reason the board is not able to detect the presence of the air pressure switch, the E72 fault will be signalled. To reset this shut-down status, power off and back on to start a new self-recognition cycle.

Warning: during the combustion chamber type recognition step, no request is performed.

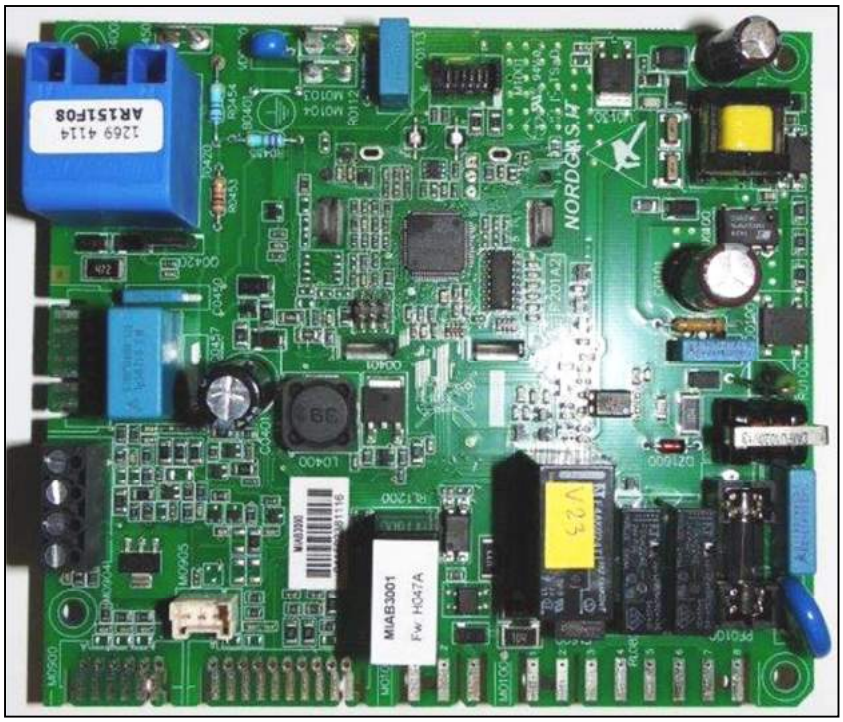
3-bar safety valve
This valve is installed on CH water pipe, and checks that pressure does not exceed 3 bar as this condition would entail boiler inner problems.
Should valve read a pressure higher than the allowed limit, it will open to discharge water outside.

SECT. 6

ELECTRICAL SYSTEM

6.1 ELECTRONIC BOARD

Spare part number: **6SCHEMOD34**



Board characteristics

Operating voltage: from 170Vac to 300 Vac

Power supply frequency: 45 - 66 Hz

Protection class: IP00

Protection fuse: 5x20mm 3.15AF

Ionisation current: 1.2 µA

Flame detection method: ionisation

Type of detection: phase-neutral polarisation

LCD characteristics (board back)

No. of digits: 2

Back-lighting: Yes

Background: green

6.2 OUTER TERMINAL BOX ELECTRICAL CONNECTIONS

All the electrical connections are carried out through a terminal box directly placed on the boiler electronic board, that can be accessed by removing the relevant protection cover.
Only one control device *(ambient thermostat or remote control)* and only one climate sensor *(external or ambient probe)* can be connected to the boiler, the latter according to parameter P21 programming.



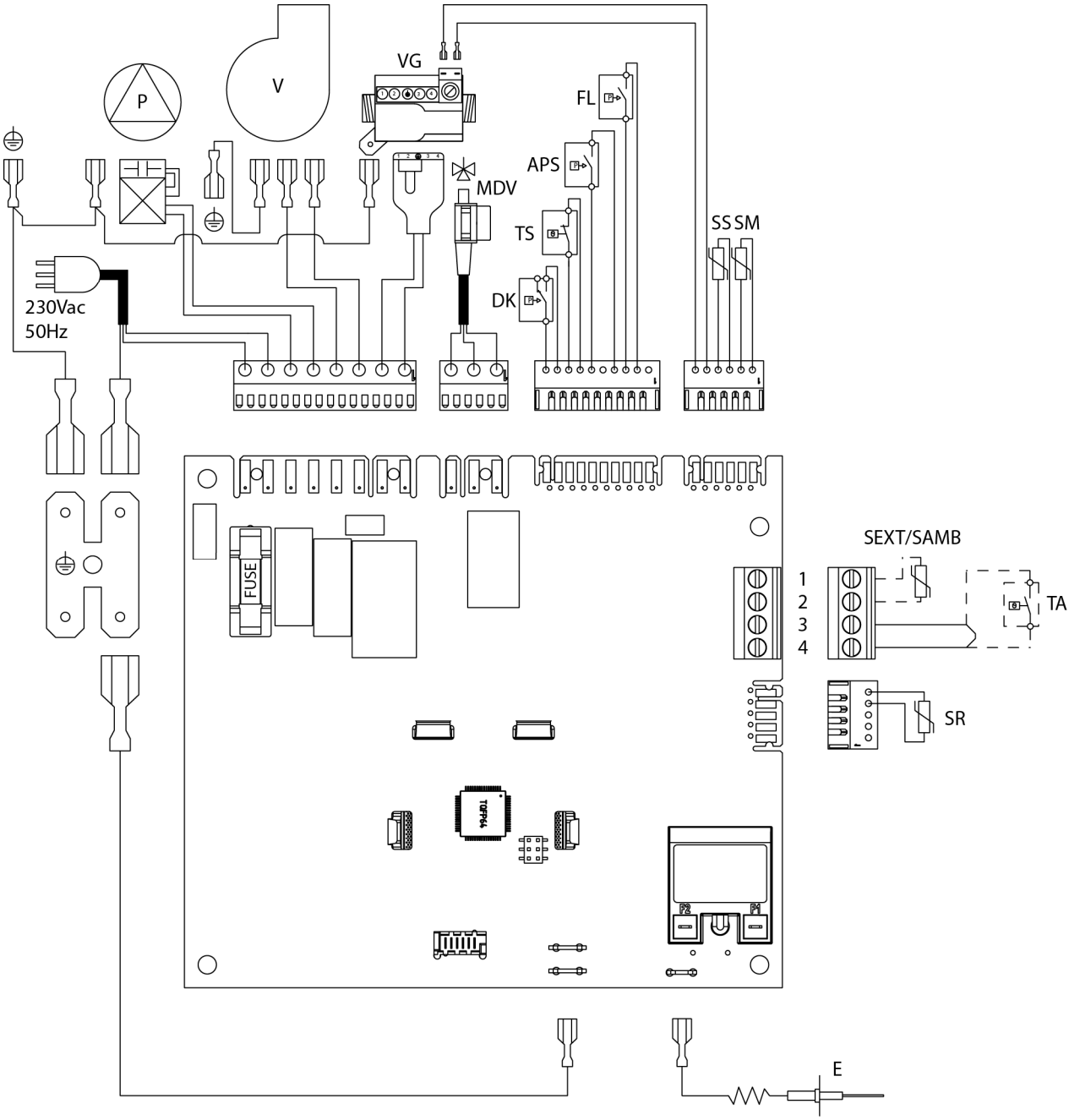
Output hole
for electrical connections

Key to connections
(to be made by the installer)

1-2 external probe with P21=2 or ambient probe with P21=1 *(10kOhm at 25°C β=3977)*

3-4 ambient thermostat or Remote Control *(L≤30m)*

6.3 WIRING DIAGRAM



Key:

APS:	air pressure switch
DK:	low water pressure switch
E:	ignition/flame detection electrode
FL:	DHW flow switch
MDV:	electric deviating valve
P:	boiler circulation pump
SM:	heating NTC probe 10kOhm at 25°C β=3435
SR:	return NTC probe 10kOhm at 25°C β=3435
SS:	DHW NTC probe 10kOhm at 25°C β=3435
V:	fan
VG:	gas valve
TS:	heating flow safety thermostat

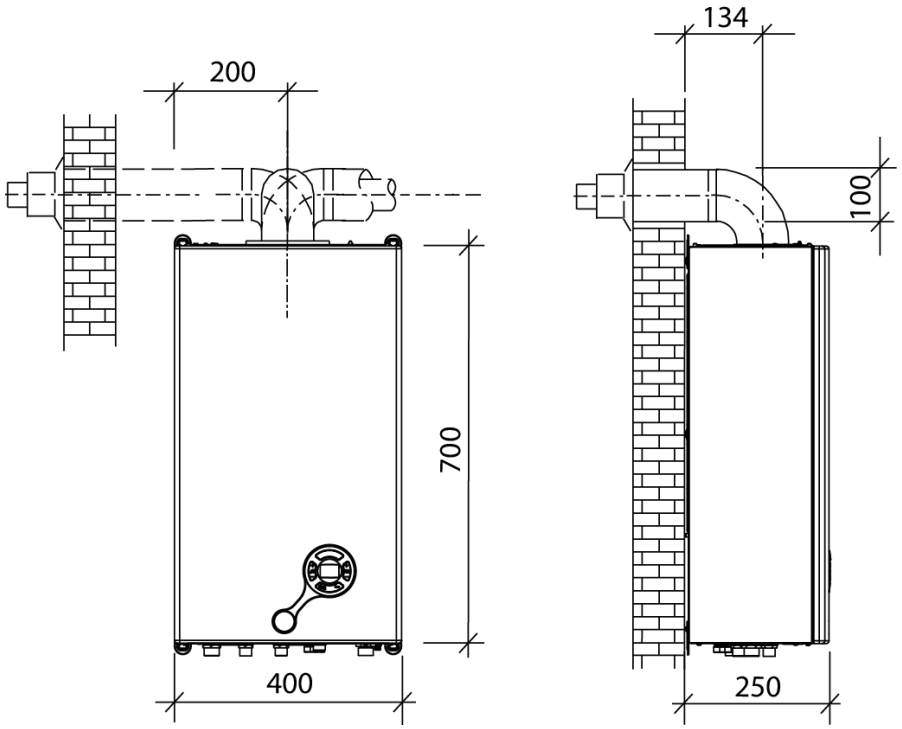
SECT. 7

VENT DUCTS AND PIPES

For intake/flue gas vent lines use only original ducts designed for the specific boiler (as per manufacturer's specifications).

7.1 100/60 CO-AXIAL AIR/VENT DUCTS

Dimensions for connection of flue gas duct to co-axial pipes



Type C12 ***horizontal vent***

The minimum permissible length of horizontal coaxial pipes is 0.5 metres, including the first elbow connected to the boiler.
The maximum permissible length of horizontal coaxial pipes is 6 metres, including the first elbow connected to the boiler.
For each additional 90° elbow, maximum permissible length is to be reduced by 1 metre, whereas for the 45° one by 0.5 metres. With wall-mounted terminal, maximum permissible length is to be reduced by one metre. The duct is to be tilted down by 1% toward its outlet, to prevent rain water from entering it.

Flue gas vent diaphragms:

Pipe length [m]	Flue gas vent diaphragm diameter [mm]
0 ≤ L < 1*	Ø 38
1 ≤ L < 3*	Ø 40
3 ≤ L ≤ 6*	Ø 42

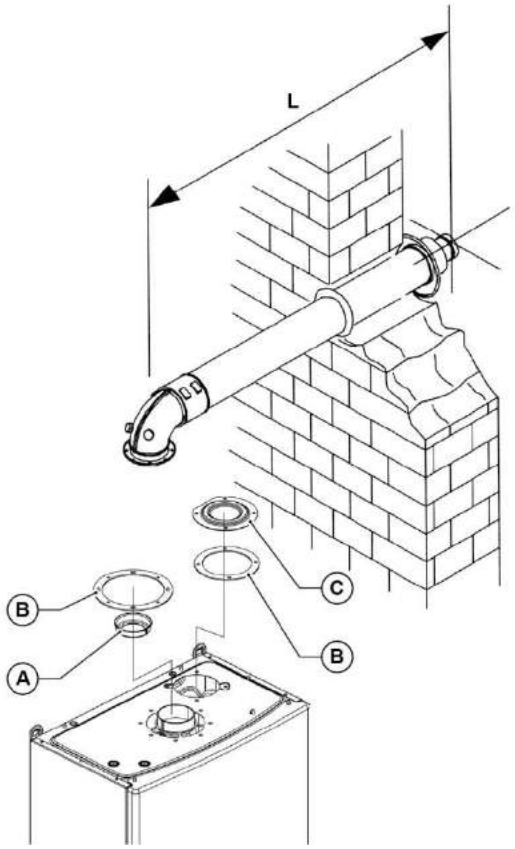
***** Including the first elbow

Type C32 ***vertical vent***

Minimum permissible length for vertical coaxial pipes is one metre, equal to the length of the flue.
Maximum permissible length for vertical coaxial pipes is 6 metres, including the chimney.
For each additional 90° elbow, maximum permissible length is to be reduced by 1 metre, whereas for the 45° one by 0.5 metres. Roof vent terminal is equivalent to 1.5 metres of pipe.

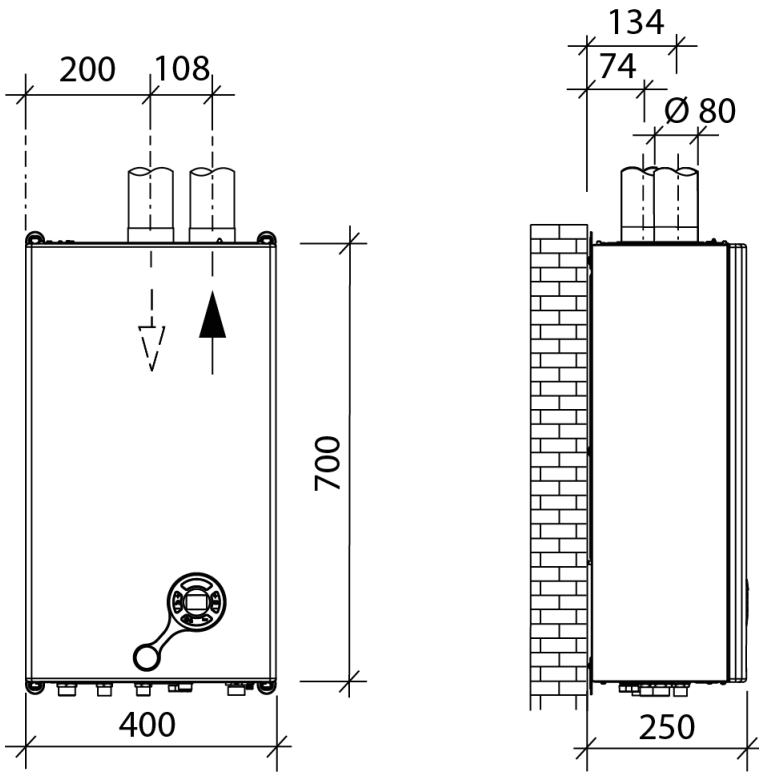
Flue gas vent diaphragms:

Pipe length [m]	Flue gas vent diaphragm diameter [mm]
0 ≤ L < 1	Ø 38
1 ≤ L < 3	Ø 40
3 ≤ L ≤ 6	Ø 42



L: from 0.5 to 6 metres
A: diaphragm
B: neoprene gasket
C: blanking cap

7.2 80/80 SPLIT AIR/VENT DUCTS



Type B22 – B52 - C42 – C52 – C82

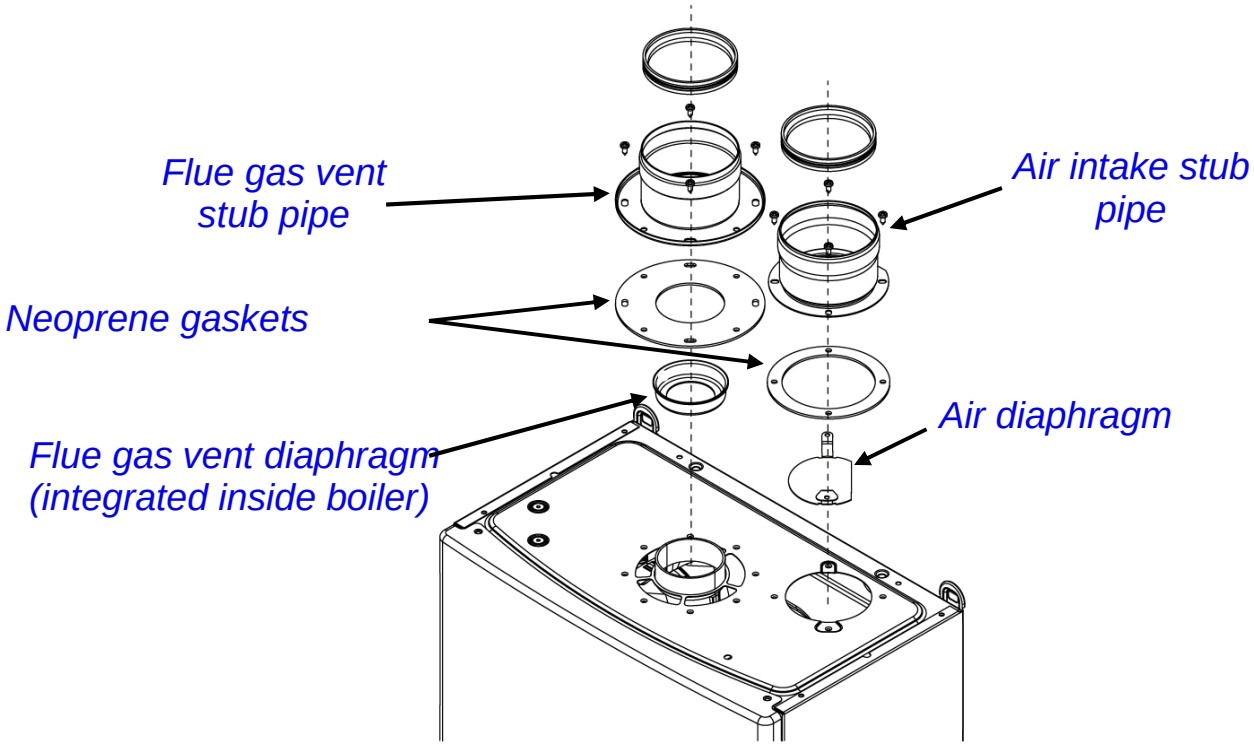
AIR INTAKE
Minimum permissible length of flue gas venting pipe is 0.5 metre.
Each wide radius 90° air-intake duct elbow (R=D) is equivalent to a 1.5 metres long straight pipe section.
Each wide radius 90° air-intake duct elbow (R=D) is equivalent to a 2.5 metres long straight pipe section.
Every split pipe flue at intake is equivalent to a 7 metre long straight pipe section.
WARNING: Install the intake Ø 47 mm diaphragm.

FLUE GAS VENT
Minimum permissible length of venting pipe is 0.5 metres.
Each wide radius 90° vent duct elbow (R=D) is equivalent to 1.5 metres.
Each wide radius 90° vent duct elbow (R=D) is equivalent to a 2.5 metres long straight pipe section.
Every split pipe flue at vent is equivalent to a 5.5 metre long straight pipe section.

Air diaphragms:

Split pipe kit kit	Pipes total length [m]	Vent pipe length [m]	Flue gas vent diaphragm diameter [mm]
0SDOPPIA11	1 ≤ L ≤ 10	-	Ø 41
	10 < L ≤ 20	-	Ø 47
	20 < L ≤ 30	0 < L ≤ 14	Ø 47
		14 < L ≤ 30	-

Base splitter kit **0SDOPPIA11**:

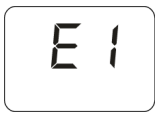


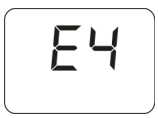
WARNING: the air diaphragm is supplied with the splitter kit.

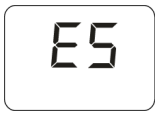
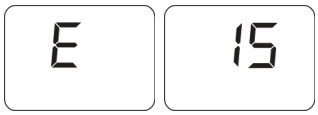
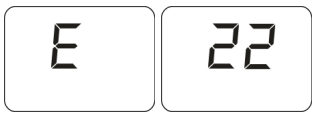
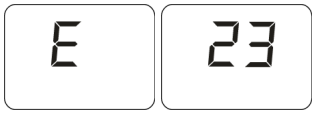
80/80 split duct load loss table

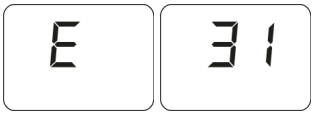
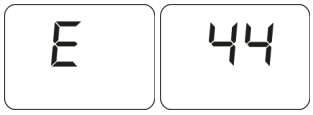
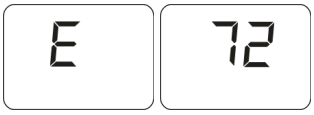
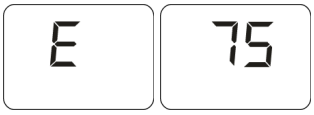
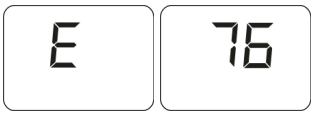
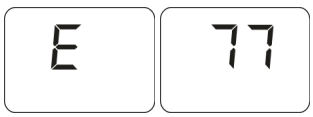
Part	Vent	Intake
1m extension	1.0	1.0
0.5m extension	0.5	0.5
90° elbow	1.5	1.5
90° Elbow - narrow radius	2.5	2.5
45° elbow	2.0	2.0
Elbow with flue gas measurement point	2.5	2.5
Wall vent terminal	4.0	-
Roof vent terminal	4.0	-
Vertical stub pipe	0.0	0.0
Vertical condensate drain	2.5	-
Horizontal condensate drain	0.5	-
Chinese-type vertical vent terminal	4.5	-
Suction opening	-	4.0
Split vent duct flue	5.5	7.0

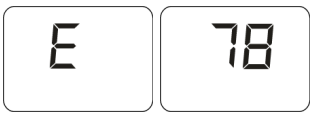
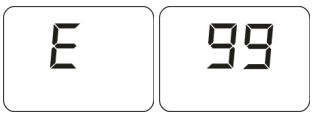
TABLE OF TECHNICAL FAULTS

Boiler Status	Malfunction	Probable cause	Solution
Boiler shut-down, picture flashes: 	Burner does not ignite	Gas supply fault	Check gas pressure. Check gas supply cock or gas network safety valve intervention.
		Gas valve is disconnected	Re-connect it
		Gas valve is faulty	Replace it
		The board is faulty	Replace it
	Burner does not ignite: no spark.	Ignition relay is faulty.	Replace the electrode.
		The electronic board (transformer) does not switch on	Replace electronic board.
	Burner ignites for a few seconds and goes off	Electronic board does not detect flame: inverted phase and neutral	Check for the correct phase and neutral connections
		Detection electrode cable interrupted	Replace the electrode
		Flame detection electrode is faulty	Replace the electrode
		Electronic board does not detect flame: it is faulty	Replace the board
		Ignition heat input setting is too low	Increase it
		Minimum heat input is not set correct	Check burner setting
Boiler shut-down, picture flashes: 	The safety thermostat has triggered	CH water does not flow in the system: pipes might be clogged, thermostatic valves might have shut, system stopcocks might be closed	Check system status
		Circulation pump is blocked or faulty	Check the circulation pump.
		Safety thermostat is faulty.	Check safety thermostat.
Boiler shut-down, picture flashes: 	Flue gas exhaust pressure switch does not give the consensus.	Air intake or flue gas vent flow is not correct.	Check the air intake/vent ducts
		The board is faulty.	Replace it.
		Fan is not working properly	Check the fan.
		Flue gas pressure switch is faulty.	Replace the faulty component
		Silicone pipe is clogged or not connected	Restore connection or clean it

Boiler shut-down, picture flashes: 	CH system water pressure is low	Low water inside heating system	Fill up system
		Leaks in the CH system	Check system
		Low water pressure switch is faulty	Replace the pressure switch

Boiler shut-down, picture flashes: 	Flow probe failure	Disconnected or short-circuited probe	Reconnect or replace it
Boiler shut-down, picture flashes: 	DHW probe failure	Disconnected or short-circuited probe	Reconnect or replace it
Boiler is not supplying DHW	DHW flow switch is not working	System insufficient pressure or flow rate	Check system Check DHW flow switch filter
		DHW flow switch probe is faulty or disconnected	Connect or replace it
	DHW probe does not give consensus	Probe not correctly set	Replace the probe
	DHW function is not enabled on the display	Check active functions on the display	Enable the function
Boiler shut-down, picture flashes: 	Return probe not working	Disconnected or faulty probe	Reconnect or replace it
Boiler shut-down, picture flashes: 	Eprom fault	Altered memory data	Replace electronic board
Boiler shut-down, picture flashes: 	External probe is not working	Disconnected or faulty probe	Reconnect or replace it

Boiler shut-down, picture flashes: 	The boiler does not communicate with the Remote Control	The connection with the Remote Control is interrupted.	Check the Remote Control connections *(wiring longer than 5 meters must be shielded)*
		Remote control is faulty	Replace the Remote Control
Boiler shut-down, picture flashes: 	Ambient probe is not working	Disconnected or faulty probe	Reconnect or replace it
Boiler shut-down, picture flashes: 	Boiler type recognition failure (CTFS or CTN)	Flue gas pressure switch is faulty	Check flue gas pressure switch: replace if faulty
		Wiring connecting the flue gas pressure switch to the boiler board is damaged or interrupted	Reconnect or replace wiring
		Combustion air intake or flue gas discharge flow is not sufficient	Check intake/vent ducts: clean or replace if necessary
Boiler shut-down, picture flashes: 	Gas valve/fan operator relay feedback error	The board is faulty	Replace the board
Boiler shut-down, picture flashes: 	Gas valve modulation coil is not working	Modulation coil wiring is disconnected or wrongly connected	Check wiring connection
		Gas valve modulation coil is faulty	Replace gas valve modulation coil
Boiler shut-down, picture flashes: 	Mains voltage too low	Electrical power supply below 190 V threshold	Have electrical system checked
	Hardware fault	Board microprocessor altered	Replace electronic board

Boiler shut-down, picture flashes: 	Flow temperature increases too quickly	Pump is seized	Unseize the pump
		Pump is faulty	Replace the pump
Boiler shut-down, picture flashes: 	Max. number of reset attempts from remote control reached	Boiler has been reset three times with the remote control	Reset boiler through panel

IF NONE OF THESE HYPOTHESES IS VALID, FAILURE IS ORIGINATED BY MAIN ELECTRONIC BOARD. YOU CAN JUST CHECK CONNECTIONS OR CHANGE THE BOARD.

NOTES



FONDITAL GROUP

Minorca Monothermal Technic Manual

Customer Care Department

1st edition, June 2016

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