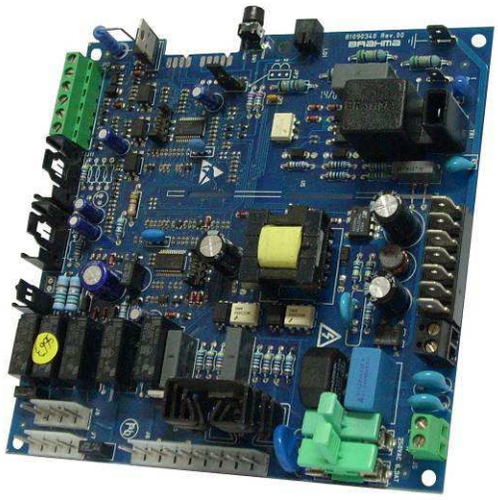
DIGITAL TEMPERATURE ADJUSTMENT SYSTEMS Type TC340

DIGITAL IGNITION AND FLAME CONTROL SYSTEMS FOR HOT AIR GENERATORS (TYPE TC340A – TC340P) AND FOR MODULATING PREMIX BURNERS (TYPE TC340P1)



DESCRIPTION

These systems are specifically designed for safety cycle control and temperature adjustment in hot air generators equipped with automatic-ignition fan-assisted gas burners and in modulating premix burners.

GENERAL FEATURES

The systems are provided with the following important features:

- In accordance with EN298:2012 (European Standard for automatic gas and oil burner control systems and flame detection) and with EN60730-2-5 (European Standard for automatic controls with C class software);
- **EC** type certification (CE PIN **0051BU3887**) in accordance with the new European **G**as **A**ppliances **R**egulation (EU) 2016/426 (GAR);
- conformity to EC directives, Electromagnetic compatibility* EMC (immunity) 2014/30/EU and Low-voltage directive 2014/35/EU;
- suitable for both phase-phase and phase-neutral power supply systems;
- non-polarized flame signal amplifier (the power supply polarity may not be respected even in case of a phase-phase power supply network);
- control of the hot air convector blower (FAN) by means of a phase-cut driver;
- control of the burner motor by means of a phase-cut driver (for fan-assisted gas burner appliances) or through a PWM signal (for premix gas burner appliances equipped with brushless fan with integrated management electronics);
- two independent safety contacts for driving the EV1 main solenoid gas valve;
- inbuilt capacitive-discharge ignition transformer (version for fan-assisted appliances);
- output for the control of an auxiliary electronic ignition transformer;
- prearranged for the control of the EV2 second valve stage by means of two independent contacts taking the power supply from the EV1 first valve stage (version for fan-assisted appliances);
- burner power modulation by means of a current modulator (version for fan-assisted appliances) or through a PWM signal (version for premix appliances);
- possible interfacing with a BRAHMA digital chronothermostat type ENCRONO GAxx through OpenTherm™ communication protocol, or with a power-free contact room thermostat;
- possible interfacing with additional TC340 devices for “cascade" applications (OpenTherm™ communication protocol);
- summer ventilation function (only in connection with BRAHMA chronothermostat type ENCRONO GAxx);
- control of a double BRAHMA NTC temperature probe type ST16 with outlet air temperature adjustment and safety functions;
- control of a single BRAHMA NTC temperature probe type ST08 with outlet air temperature adjustment functions;
- possible control of a safety thermostat;
- prearranged to control a BRAHMA NTC temperature probe type ST07 with room or outside temperature adjustment functions;
- possible connection to a fire damper contact (optional);
- possible application in modulating premix burners equipped with three-point adjuster or adjustment thermostat;

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- possible application in appliances provided with 0÷10V analogue signal adjustment (e.g. PLC);
- on-board manual reset push-button;
- operation status and failure signalling by a two-colour LED;
- possible connection to BRAHMA type LCD5 control panel;
- communication interface type RS-232 for diagnostic and set-up functions (through BRAHMA serial interface and management software);
- inbuilt EMC filter;
- two fuses provided with removing tool to protect the power supply network on both potentials;
- connections for on-board safety earthing.

TECHNICAL DATA

Nominal supply voltage:	220÷240V_{AC} @ 50/60 Hz
Power consumption:	20 VA
Operating temperature range:	-20 °C ÷ +60 °C
Humidity:	95% max. @ +40 °C
Protection rating:	IP00
	IP40 with box (upon request)
Internal fuse rating:	6.3 A slow-blow
for TC340P1:	3.15 A slow-blow
External fuse rating (recommended):	6.3 A fast-blow [1]
for TC340P1:	3.15 A slow-blow [1]
Max. total weight:	250 gr. approx.
EC type certificate:	CE0051-PIN0051BU3887

NOTES
1) The external protection fuse rating should be selected considering the max. load consumption in the most unfavourable operation stage and conditions.

Times:

Pre-purge time (TP):	0 … 60 s
Safety time (TS):	3 … 120 s
Response time in case of flame failure:	< 1 s
Post-purge times	
- on burner motor (EF) (**t_{POST}**):	0 … 1200 s
- on hot air blower (FAN) (**t_{FS}**): [2]	0 … 1200 s
Delay time on FAN activation (t_{FA}): [2]	0 … 1200 s
Inter-waiting or inter-purge time:	1 … 240 s
Waiting time for modulation start (t_{RP1}):	1 … 240 s
Lockout delay for extraneous light (opt. Knn):	0 … 60 s
Lockout for insufficient air flow (opt. Qnn)[3]:	3 … 1200 s
Pre-ignition time (opt. Jnn):	1 … 60 s
Recycling attempts (opt. Ynn):	1 … 10
Varnishing / Box:	upon request

NOTES
2) This parameter will be described in detail in the "*Heating mode (FAN function)*" section. It can be modified through BRAHMA serial interface and management software.
3) If the air pressure switch remains in "no-air-flow" position (fan-assisted versions) or if the burner motor revolutions per minute are insufficient in case a brushless fan is used (premix versions).
4) This parameter can be modified through BRAHMA serial interface and management software.

Max. contact rating (@ 240V - 50Hz):

Hot air blower (FAN):	3.5 A cos φ ≥ 0.4
Burner motor (EF):	0.5 A cos φ ≥ 0.4
Remote ignition device (ACC1):	0.8 A cos φ ≥ 0.4
First valve stage (EV1):	0.4 A cos φ ≥ 0.4 [6]
Second valve stage (EV2):	0.4 A cos φ ≥ 0.4 [6]
Current modulator:	≤ 170 mA_{DC} @ 24 V_{DC} [5]

NOTES
5) The limit can be increased up to 350mA upon request.
6) The valve load power supply is available on two independent connectors (J7 and J8). In case both connectors are used, the max. rating for each output should be considered equal to 0.2 A cos φ ≥ 0.4 approx.

Max. cable length for external components:

OpenTherm™ interfaces:	50 m
Ignition device (high voltage cables)**:**	2 m
Any other cable (load power supply cables, user interface connection cable, …):	1 m

Inbuilt ignition transformer (ACC2): [7]

Peak voltage: [8]		15 kV
	upon request:	18 kV
Peak current:		800 mA
Spark repetition rate: [9]		25 Hz
	upon request:	1 … 50 Hz
Recommended spark gap:		2 ÷ 4 mm
Power consumption:		2.5 VA
Spark energy:		20 mJ

NOTES
7) For appliances equipped with fan-assisted burner only.
8) Value measured with 30 pF load.
9) ATTENTION: the ignition device output is not safe to touch if the spark repetition rate is higher than 25Hz; in this case the appliance will have to be provided with further protection.

Flame monitoring

The flame detection device exploits the rectification property of the flame.

An important safety aspect to note is that the control unit is more flame-sensitive at start-up or during the waiting/pre-purge time (negative differential switching).

Min. ionization current:		0.5 µA
	upon request:	1.2 µA
Recommended ionization current:		3 ÷ 5 times the min. one
Min. insulation resistance of detection cable and electrode to earth:		≥ 50 MΩ
Max. electrode stray capacitance:		≤ 1nF
Max. short-circuit current:		< 200µA_{AC}

System adjustment temperatures:

Manual reset limit temperature (T_L): [10]	100 °C
Switch-off temperature (T_{OFF}): [11]	70 °C
Re-ignition temperature (T_{ON}): [11]	50 °C
Ventilation temperature (T_V): [11]	30 °C
Ventilation-stop temperature (T_{SV}): [11]	10 °C

NOTES
10) Available in versions using BRAHMA safety probe type ST16.
11) This parameter can be set up on customer's request and modified through BRAHMA serial interface and management software.

System temperature probes

The BRAHMA system type TC340 is provided with several inputs to control different temperature probes used for both temperature adjustment and safety related functions. The characteristics and functions of each probe are described in detail below.

- **Heating circuit probe (SR)**

The heating circuit probe has the purpose to measure the heat exchanger temperature and is mainly used in the FAN heating function (see description in "*OPERATION*" section).

This probe can be of three types:

1) *with double NTC sensor (standard version)*: in this case the probe has a double function, as it enables to avoid mounting a safety limit thermostat. This probe will therefore be used for both temperature adjustment and safety functions (e.g. safety shutdown due to system overtemperature).
   To this purpose, a BRAHMA temperature probe type ST16 is required.

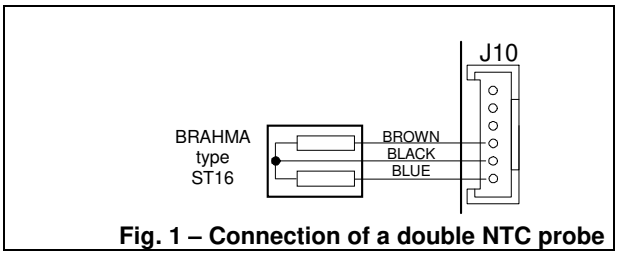


Fig. 1 – Connection of a double NTC probe

2) *with single NTC sensor with contact safety thermostat (opt. T)*: in this case the probe is provided with temperature adjustment functions only, and any system overtemperature will have to be controlled by a contact safety limit thermostat.
   To this purpose, a BRAHMA temperature probe type ST08 is required.

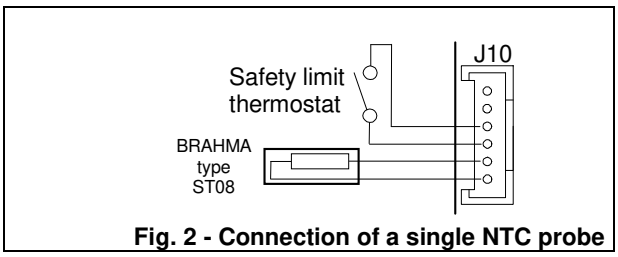


Fig. 2 - Connection of a single NTC probe

3) *with single NTC sensor without contact safety thermostat (opt. NT)*: in this case the probe is provided with temperature adjustment functions only, and any system overtemperature will have to be controlled by an external safety device.
   To this purpose, a BRAHMA temperature probe type ST08 is required.

- **Room temperature probe (SA)**

This (optional) probe can be used when the remote temperature adjuster (BRAHMA chronothermostat type ENCRONO GAxx) is not directly mounted in the room requiring temperature adjustment, or when this temperature adjustment should be related to the external environment temperature. For further details about the functions of this probe, please see the *"OPERATION"* section.

To this purpose, a BRAHMA temperature probe type ST07 (for local room temperature detection) or type SSE (for outside temperature detection) is required.

Fire damper (STF)

This input (option S) enables to check the status of the fire damper contact: in case this contact is open (anomaly condition), the ignition cycle is interrupted and the device goes to stand-by position signalling the failure through a LED. The behaviour of the device in case the fire damper contact is open can be customized upon request.

Overall dimensions

Fig. 3 shows the overall dimensions of this type of control units. All dimensions are expressed in millimetres.

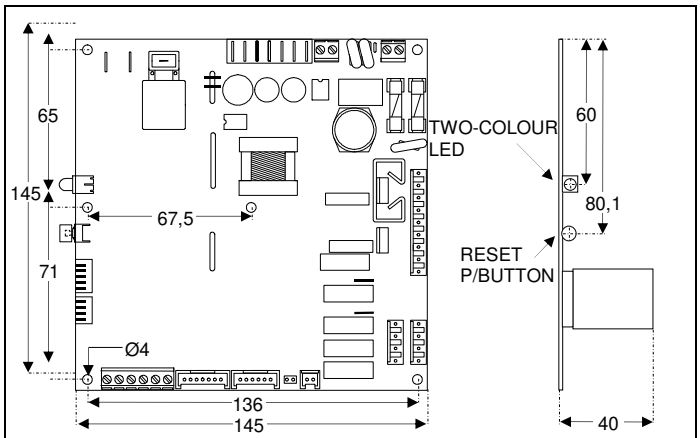


Fig. 3 – Overall dimensions

INSTALLATION DIRECTIONS

- Respect the applicable national and European standards regarding electrical safety (e.g. EN 60335-1, EN 60335-2-102, EN 50165), bearing in mind that ignition and flame control systems are safety devices: the manufacturer's responsibility and guarantee are invalidated in case of Customer's tampering with the product;
- before the first start-up, make sure that the loads are well connected to avoid any dangerous situation or failure in the appliance. Particular attention should be paid to earth connections: make sure that all loads (fans, gas solenoid valves, ignition transformer, …) are connected to the appliance safety earth, using for example the connector on board;
- the system is designed to stay in running status for less than 24h (system for non-permanent operation). Reaching this limit causes a regulation shutdown to enable the unit to check its own efficiency;
- connect and disconnect the control unit only after switching off the power supply;
- the unit can be mounted in any position;
- all operations (installation, maintenance, etc.) must be carried out by a qualified technician;
- before any connection operation, completely isolate the system from power supply (multi-pole disconnection). Place the system safely to avoid accidental switch-on and make sure there is no voltage. If the system is not switched off, there is a risk of electric shock;
- during and after any operation (installation, maintenance, etc.), make sure that the type, timing and code are the ones provided, the good conditions of the wiring and perform the checks described on section "Checking at start up";
- in the event of a fall or impact, the devices must not be started, as safety functions may be compromised even if no damage is visible to the outside;
- faulty or damaged devices must be unplugged from power supply and cannot be used.
- condensation, icing and liquids intake are not admitted;
- make sure that the device is protected against hot or live items/surfaces, eventually using a proper protective box;

- a ventilated installation environment and a suitably low temperature ensure the longest life of the control system;
- before installing or replacing the unit, make sure that the type, code and times are correct;
- the appliance in which the control systems are installed should provide adequate protection against the risk of electric shock (at least IP20);
- keep signal cables and power cables as far from each other as possible;
- use heat resistant detection cables and electrodes, and make sure that they are well insulated to the ground and protected from possible moisture or water in general;
- keep the ignition cable as short and straight as possible and place it far from other conductors to reduce the emission of electromagnetic interference (max. length <2m and insulation voltage >25kV);
- EMC emission requirements, according to the directive EN55014-1, shall be tested after the incorporation of the burner control system into the equipment;

IMPORTANT NOTE
In order to further reduce irradiated interference and increase the immunity of the control unit, it is strongly recommended to mount a wire-wound power resistor with a value from 1kΩ to 4.7kΩ between the high voltage cables and the related discharge electrodes.

- burner controls has a designed lifetime* of 250,000 burner startup cycles which, under normal operating conditions in heating mode, correspond to approx. 10 years of usage (starting from the production date given on the type field). This lifetime is based on the endurance tests in the standard EN 298. A summary of the conditions has been published by the European Control Manufacturers Association (Afecor) (www.afecor.org). The designed lifetime is based on use of the burner control according to the manufacturer's technical notes. After reaching the designed lifetime in terms of the number of burner startup cycles, or the respective time of usage, the burner control has to be replaced by authorized personnel.

  * The designed lifetime is not the warranty time specified in the Terms of Delivery

CHECKING AT START-UP

Check the control system before the first start-up, after any overhaul and after a long period of non-operation. Before any ignition attempt make sure that the combustion chamber is free from gas, then check the following:

- if the start-up attempt occurs without gas supply, the control system should go to lockout at the end of the safety time (of the last ignition trial, in case of option "Ynn" or "YnnRmm");
- when stopping the gas flow while the control system is running, the power supply to the gas valves should be interrupted within 1s, and the control system should proceed to lockout after a recycling attempt (or more than one, in case of option "Ynn" or "YnnRmm");
- when disconnecting the air pressure switch, the device will remain in continuous prepurge (or proceed with lockout after a delay time, in case of option "Qnn");
- the level of the flame signal should be high enough (see Fig. 4);
- the ignition probes should be adjusted in the most stable way for a spark gap between 2-4 mm;
- the intervention of limiters or safety devices should cause the lockout or safety shutdown of the control unit according to the type of application and the procedure provided for.

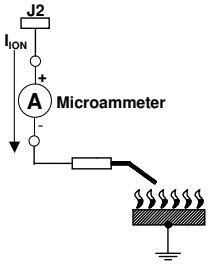


Fig. 4 – Flame signal measuring method

TC340(A-P) - OPERATION

The following description refers to the standard operating cycle of BRAHMA control units type TC340A and TC340P. The operating cycle can be modified both using the available options and according to particular customer's requirements.

- **First start-up**

At the first start-up, the device carries out a "*self-test*" to verify that all the conditions required at the beginning of the ignition cycle are respected.
At the end of this stage, the system goes on checking the type of heat demand used in the appliance (power-free contact or OpenTherm™ connection to BRAHMA chronothermostat type ENCRONO GAxx or to an additional TC340 unit): in this stage, lasting about 30 seconds, the SL LED signal flashes with green light indicating the stand-by status.
At the end of this diagnostic phase, the unit is ready to receive the heat demand and start the ignition cycle.

- **Ignition cycle**

The ignition and flame control cycle starts on receipt of the heat demand, which can occur in three ways:

- through a BRAHMA chronothermostat type ENCRONO GAxx;
- through a power-free contact with room thermostat function;
- through an additional BRAHMA device type TC340 in case of cascade systems.

The control unit starts the ignition cycle by checking the air pressure switch status (fan-assisted version) or the number of revolutions per minute of the EF burner motor (premix version). In case no signal is detected, the system starts the EF fume extractor at its max. speed; as soon as the air pressure switch goes to "air-flow" position (fan-assisted version) or the necessary number of revolutions per minute is reached (premix version), the pre-purge time (TP) begins.
In premix applications, a few seconds before the beginning of the safety time (about 3 seconds, customizable upon request), the system reaches a stage of the pre-purge time in which the EF combustion motor speed can be decreased (TP2): this function enables to carry out the burner soft-start, if necessary, starting the burner at an (adjustable) lower power than the first running stage (RP1).
At the end of the pre-purge time the device is ready to perform the safety time (TS) and activate the following:

- the inbuilt ignition transformer;
- the auxiliary electronic ignition transformer;
- the EV1 first valve stage;
- the modulator (if available) at the power level requested for ignition.

If a flame signal is detected, the unit will go to running position; if no flame signal is detected, the system will proceed to lockout due to ignition failure at the end of the safety time.

- **First running stage (RP1)**

At the end of the safety time and in case of flame signal detection, the control unit goes to running position. According to a delay customizable upon request (waiting time for modulation start t_{RP1}), the system ignores all modulating parameters giving max. power to the appliance in order to ensure a suitable heating of the heat exchanger; in this stage, in fan-assisted versions, the EV2 second valve stage is kept operating and the current modulator is kept supplied at max. power.

At the end of this time the device enters the second running stage, where the burner combustion power depends on the modulating parameters provided by the temperature adjustment system.

- **Second running stage (RP2)**

In the second running stage the control unit can perform temperature adjustment functions depending on the type of heat demand used in the appliance, which can be:

- an OpenTherm™ connection (to a BRAHMA chronothermostat type ENCRONO GAxx or to an additional TC340 unit);
- a contact room thermostat.

The behaviour of the control unit in the two above-mentioned cases will be shortly described hereunder.

OpenTherm™ connection available

In this case, temperature adjustment will be carried out according to four variables:

1) *room temperature (T_A)*: which can be measured both through a chronothermostat or through an SA room temperature probe (if available);
2) *set-point temperature (T_I)*: this is the temperature set up on the chronothermostat by the user, i.e. the required room temperature;
3) *thermal differential (d)*: the modulating power, on a percentage basis, is calculated according to the T_A room temperature and the T_I set-point temperature. In case the room temperature is lower than or equal to (T_I - d), the percentage of modulating power is at its highest level (100%); in case the room temperature is higher than or equal to T_I, the percentage of modulating power is zero (0%: heat demand OFF), as the required temperature has already been reached/exceeded; in case the room temperature is comprised between (T_I - d) and T_I, the percentage of modulating power is calculated by means of a specific formula which will be described later on;
4) *thermal hysteresis (i)*: any T_A room temperature values next to the T_I set-point may generate a repeated sudden switch-on / switch-off of the heat demand. The thermal hysteresis parameter helps avoiding such unwanted occurrences: during the T_A increasing stage the burner switches off as soon as the T_I threshold is reached, while during the T_A decreasing phase the heat demand is activated again if the room temperature drops below (T_I - i);
5) *outside temperature (t_e)*: if the system is equipped with an outside temperature probe, this temperature value will influence the final power percentage as shown in Fig. 5;
6) *design min. outside temperature (t_{ep}):* if the system is equipped with an outside temperature probe, the design min. temperature, i.e. the min. outside temperature that can be reached by the system, will influence the final power percentage as shown in Fig. 5.

The type of temperature adjustment performed by the control unit can be LOCAL, REMOTE or assisted by an outside temperature probe: in the first case, an SA room temperature probe is used and the temperature adjustment is totally managed by the control unit, while the remote adjuster is only used to establish the set-point temperature; in the second case, no SA room temperature probe is connected and the temperature adjustment is totally controlled by the chronothermostat type ENCRONO GAxx; in the third case, an outside temperature probe is used and the final power percentage is influenced by this parameter.

The calculated/acquired modulation percentage affects the power supplied to the EF fume extractor, to the FAN hot air blower and to the current modulator(s) according to the min. and max. pre-set values.

Fig. 5 shows the three types of temperature adjustment available in the system.

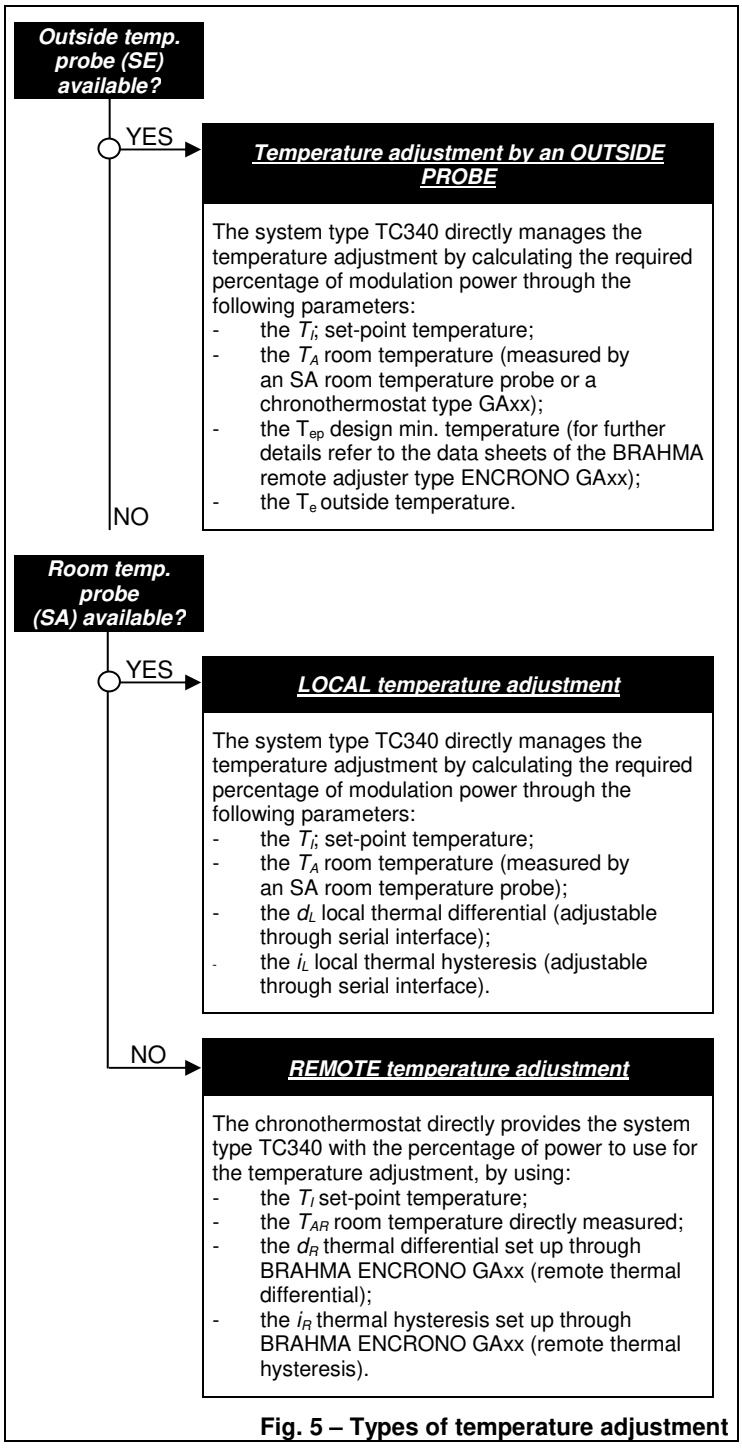


Fig. 5 – Types of temperature adjustment

In case an outside temperature probe is used, the TC340 device calculates the percentage of modulation power through the following formula:

$$P_{\%} = 100 * \frac{(T_I - T_e) + F_C(T_I - T_A)}{T_I - T_{ep}}$$

NOTE: the F_C coefficient (corrective factor) is a parameter which varies according to the T_e outside temperature and is directly calculated by the TC340 device.

To better understand the behaviour of the system type TC340 in running status in case no outside temperature probe is connected, please refer to the diagram of figure 6, assuming a set-point temperature of 22°C, a thermal hysteresis of 0.4°C (in this way, in case of room temperature decrease, the system re-ignition threshold will be 21.6°C) and a thermal differential of 2.0°C (in this way, the modulation area starting threshold will be 20°C). The thermal hysteresis and differential can be of local or remote type depending on the availability of the SA room temperature probe, as shown in the diagram of figure 6.

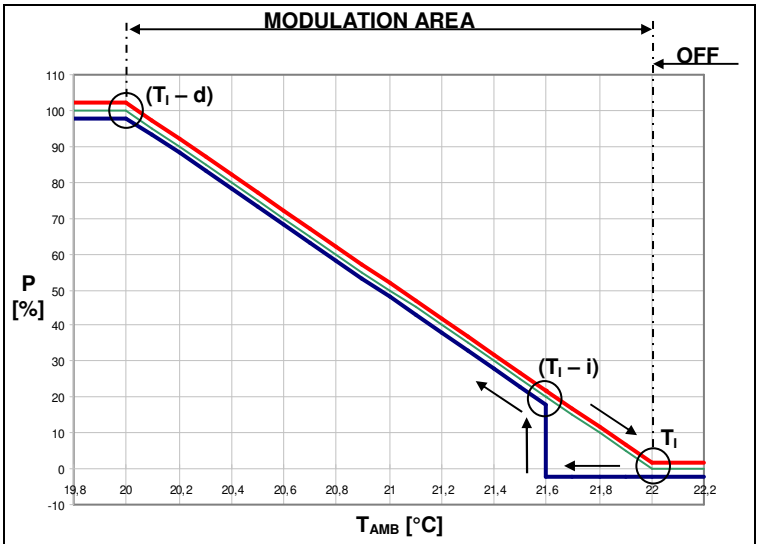


Fig. 6 – Parameter-based modulation diagram

Based on the room temperature value, three conditions can occur:

1) *T_{AMB} room temperature lower than (T_I – d)*: in this case the percentage of modulation power will always be equal to 100% (max. heat demand) and the second EV2 valve stage will be activated;
2) *T_{AMB} room temperature between (T_I – d) and T_I*: in this case the percentage of modulation power will be calculated according to the following formula:

$$P_{\%} = \frac{T_I - T_{AMB}}{d} * 100$$

3) *T_{AMB} room temperature higher than T_I*: in this case the modulation power will always be equal to zero (a condition corresponding to the absence of heat demand).

The *thermal hysteresis* parameter takes effect on the modulation only in case the room temperature exceeds the T_I set-point value and then decreases. In these conditions the percentage of modulation power will remain equal to zero (no heat demand) until the T_{AMB} room temperature will reach the threshold (T_I - i), below which the formula on point 2 will be respected again.

Contact room thermostat

In this case, the modulation power depends on the status of the adjustment thermostat only, i.e.:

- *TA thermostat closed (ON):* in this case the modulation power will always be equal to 100% (max. heat demand) and the EV2 second valve stage will be activated;
- *TA thermostat open (OFF):* in this case the modulation power will always be equal to zero (a condition corresponding to the absence of heat demand).

- **Heating mode (FAN function)**

The introduction of hot air into the environment is carried out by means of a hot air blower (FAN). The operation of this type of load is dependent upon different factors:

- the operation status of the system (pre-purge time, first running stage, …);
- the heat exchanger (outlet) air temperature measured by means of the SR heating circuit probe;
- switch-on and switch-off delay times.

The FAN function begins when the system enters the first running stage (RP1). As already described above, this phase of the cycle enables a suitable heating of the exchanger: in fact, hot air can be introduced into the environment only if its temperature is high enough.

From the RP1 first running stage entering, the system guarantees a waiting time (delay time on FAN activation) which is considered to be necessary to enable an appropriate heating of the exchanger: at the end of this time, hot air can be introduced into the environment and the FAN hot air blower can therefore be activated. If the heat exchanger temperature exceeds the T_V (ventilation temperature) threshold during the switch-on delay time, the activation of the FAN hot air blower will be anticipated, as the system will have already reached suitable conditions for the environment heating.

A similar operation is carried out during the heat exchanger cooling phase: in case the control unit leaves the running status (due, for example, to heat demand failure), the FAN hot air blower remains activated at its max. speed for a time which can be set up on request (post-purge time on FAN hot air blower); if before the end of the cooling phase the temperature measured by the SR heating circuit probe is lower than the T_{SV} (ventilation-stop temperature) threshold, the FAN hot air blower will be switched off and the post-purge stage interrupted.

The device is prearranged for the (electrically parallel) connection of two blowers.

- **Summer ventilation**

This function enables to use the FAN hot air blower for summer ventilation. The FAN blower can be activated even in case the control unit is in lockout status.

- **Manual reset limit temperature, switch-off temperature and re-ignition temperature**

The operation of the system also depends on three additional temperature thresholds of the heat exchanger: the manual reset limit temperature (T_L), the burner switch-off temperature (T_{OFF}) and the re-ignition temperature (T_{ON}).

The T_L manual reset limit temperature is used in the versions equipped with double NTC heating circuit probe (standard version) and represents the threshold above which the control unit goes to lockout. In the versions equipped with single NTC heating circuit probe, this threshold corresponds to the contact safety thermostat switch-on temperature: when the heat exchanger temperature drops to acceptable values for a correct operation, the burner does not restart automatically, but needs the manual reset of the control unit by the user.

The T_{OFF} burner switch-off temperature represents the threshold above which the normal burner operation is stopped without system lockout: in fact, the control unit will go to stand-by position, while the FAN hot air blower will remain activated at its max. speed to enable an appropriate cooling of the heat exchanger.

Once the heat exchanger has been suitably cooled (temperature measured by the SR heating circuit probe lower than the T_{ON} re-ignition temperature), the system can start operating normally again.

- **Destratification gradient**

Spacious rooms can be subject to air stratification phenomena: hot air tends to rise above creating a considerable temperature difference between the comfort zone and the room ceiling.

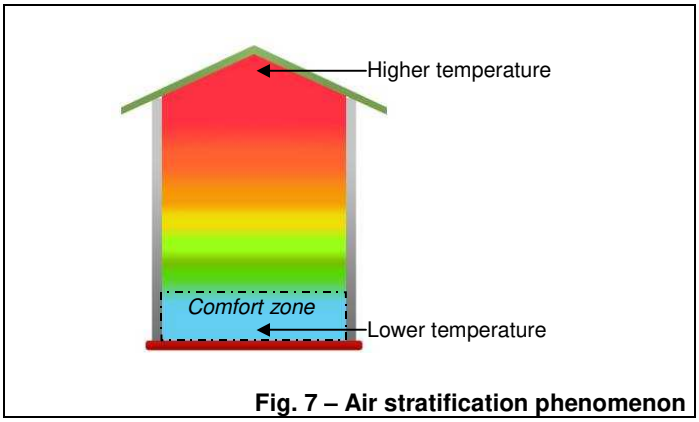


Fig. 7 – Air stratification phenomenon

If the hot air generator is installed in a high position and an SA local room temperature probe is used, the following directions will have to be observed for a correct room temperature adjustment:

1) place the SA probe next to the comfort zone for a correct room temperature detection (fig. 8a), or
2) use the *destratification gradient* (0 ÷ 10°C), which will be deducted from the temperature measured where the hot air generator is installed in order to calculate the temperature of the comfort zone (fig. 8b).

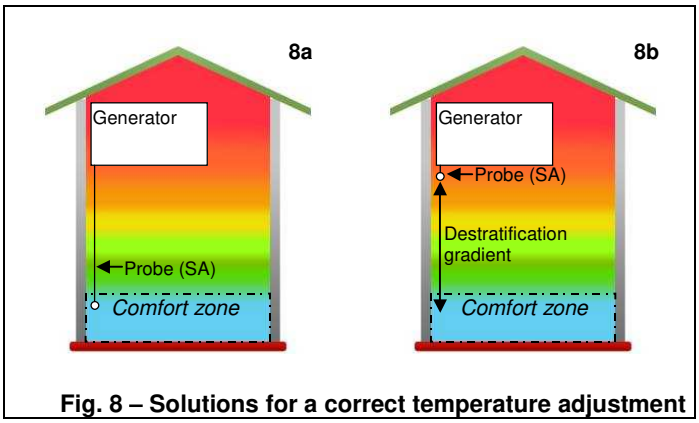


Fig. 8 – Solutions for a correct temperature adjustment

The destratification gradient factory setting is zero (0°C): different parameter values can be set up on request.

IMPORTANT NOTE
This parameter can be modified through BRAHMA serial interface and management software.

- **Outside temperature probe function**

As already mentioned before, the outside ambient temperature can contribute to the system temperature adjustment process: in fact, through a remote controller it is possible to reserve the SA input of the control unit no. "n" (in case of a cascade system) to this function, enabling all units to adjust the modulation power according to the outside temperature measured.

TC340(P1) - OPERATION

In this case, the device is used for the ignition, the flame control and (if available) the modulation of premix burners equipped with fan with PWM control.
To better understand the operation of the system, please refer to the operating cycle diagrams in the next pages.
At the first start-up, the device is in stand-by status and the fan control is disabled (point 1).
In case of heat demand (TC boiler thermostat closing, point 2), the device performs the start-up cycle, carrying out the TP pre-purge time at TP1_speed and then the TP2 second pre-purge time and the TS safety time at start-up speed (TP2_TS_speed, point 3).
In case of flame signal failure at the end of the safety time, the system goes to lockout; else, the system goes on (point 4) carrying out the modulation delay time lasting for DELAY_RP_STAB at RP_STAB_speed in order to settle the burner flame.
At the end of this phase (which can be set up to "0" if it is not necessary), the device enters the real operation stage (point 5, running position), setting up the fan speed to the RP_speed value, which can be increased (point 7) or decreased (point 9) dynamically through the IN(+) and IN(-) adjustment inputs within a range limited by the RP_MAX_speed and RP_MIN_speed values (as soon as these two values are reached, as shown on points 8 and 10, the adjustment inputs do not affect the PWM output signal value).
In running status, the output modulation power can be increased to a predetermined RP_T2_speed value by means of the T2 adjustment input (point 6): this function can be used if the burner is provided with two flame stages or if you wish to obtain a temporary modulation “boost”.
As soon as the heat demand stops (point 11), during operation the system can:

– go to stand-by position;
– proceed to post-purge at POST_speed (in case of option P or PT).

The following table shows the modulation parameters of the device, which can be pre-set and modified through serial interface or BRAHMA type LCD5 control panel (option “L”).

No.	Parameter	Range	Description
1	TP1_speed	1÷100 %	PWM percentage during the first pre-purge time (TP1)
2	TP2_TS_speed	1÷100 %	PWM percentage during the second pre-purge time (TP2) and the safety time (TS)
3	RP_STAB_speed	1÷100 %	PWM percentage during the flame settlement time
4	RP_STAB_delay	0÷255 s	Flame settlement time duration
5	RP_speed	1÷100 %	PWM percentage during operation (RP), further to a flame settlement delay
6	RP_MIN_speed	1÷100 %	Min. suppliable PWM percentage in case of decrease through the IN(-) input in running status
7	RP_MAX_speed	1÷100 %	Max. suppliable PWM percentage in case of increase through the IN(+) input in running status
8	VARIATION_delay	0÷255 s	Modulation ramp time to vary the PWM from 0% to 100% during operation
9	RP_T2_speed	1÷100 %	PWM percentage during operation (RP) in case of T2 closing (boost function)
10	POST_speed	1÷100 %	PWM percentage during the post-purge time (if available)
11	POST_delay	0÷255 s	Post-purge time duration

RESETTING THE CONTROL UNIT

Non-volatile lockout (manual reset)

If the control unit goes to non-volatile lockout, to reset the system press the reset push-button (mounted on board or on the BRAHMA chronothermostat type ENCRONO GAxx) till the lockout signal switches off.

Volatile lockout (electrical reset)

In case of volatile lockout, the control unit can be reset by cutting off and then restoring the power supply. It is not possible to reset the system by switching off the heat demand device.

OPERATING CYCLE VARIATIONS

Followings are the available operating cycle variations of the control units:

– *Option 9 ("K", "Knn"): lockout due to extraneous light*

If extraneous light is detected at start-up or during the waiting/pre-purge time, the control unit will proceed to lockout immediately (option "K") or with a delay (expressed in seconds) settable upon request (option "Knn").

– *Option 10 ("Qnn"): insufficient or no air flow at start-up*

If insufficient or no air flow is detected or the pre-heater thermostat does not switch at start-up or during the waiting/pre-purge time, the control unit will go to lockout within 3÷120 seconds (the time is settable upon request).

– *Option 11 ("R"): insufficient or no air flow in running status*

In case of air failure in running status, the ignition and flame control unit proceeds to immediate lockout.

– *Option 12 ("V"): flame failure in running status*

In case of flame failure in running status, the control unit proceeds to immediate lockout.

– *Option 13 ("Pnn", "PTnn"): post-purge time on EF burner motor*

The control unit carries out a post-purge action on the EF combustion motor fan (the time is settable upon request).

With option "Pnn", post-purge is carried out regardless of the heat demand status; with option "PTnn", post-purge can be interrupted by restoring the heat demand and having a new ignition cycle start.

– *Option 14 ("Ynn"): recycling attempts*

The control unit performs multiple recycling attempts in case of burner ignition failure (the number of attempts is settable upon request). On request, with "YnnRmm" option, the "nn" attempts number is restored with "mm" upon flame failure during the running condition (i.e. Y3R0 recycle attempts according to EN646 and EN746-2).

IMPORTANT NOTE

The indication "nn" corresponds to the max. allowed number of recycling attempts and is not therefore the total number of ignition cycles carried out in case of heat demand switching on.

For example, a system with option Y2 can carry out a max. of 2 recycling attempts, but the total number of ignition cycles starting from the heat demand switching on is 3 (1 ignition cycle + 2 recycling attempts).

– *Option 15 ("Inn"): inter-waiting or inter-purge time*

A waiting or pre-purge time (expressed in seconds) is performed after a failed ignition attempt and before the next recycling attempt.

– *Option 16 ("G", "GP"): air pressure switch checking*

Option "G", available in the devices type TC340A, enables the control unit to start the ignition cycle without checking the air pressure switch; option "GP", available in the devices type TC340P and TC340P1, allows the air pressure switch checking during the pre-purge stage and at start-up only.

– *Option 17 ("Jnn"): pre-ignition time*

The transformer is switched on at the end of the waiting/pre-purge time and before the beginning of the safety time, for a time settable upon request.

– *Option 29 ("QS"): QuickStart function*

This function enables to carry out a short pre-purge in case the heat demand is restored before the end of a post-purge phase (for this reason, this function can only be requested in case the PT function is available), in order to perform the ignition as soon as possible by exploiting the portion of post-purge already accomplished.

To better understand this function, please refer to figure 9, representing an example with a control unit having a pre-purge time and a post-purge time of 10 seconds: if the heat demand (HR) is restored, for example, 6 seconds after the beginning of the post-purge, the device will carry out a pre-purge equal to 10 - 6 = 4 seconds, i.e. the difference between the nominal pre-purge time and the performed post-purge time.

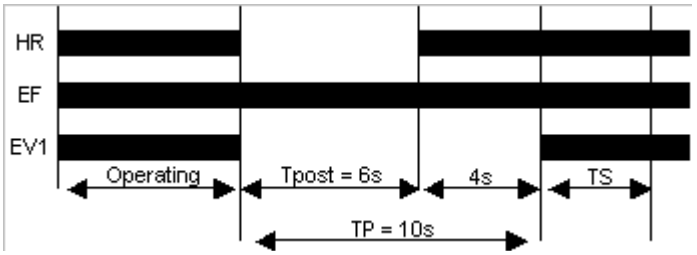


Fig. 9 – *QuickStart* function

SIGNALLING DURING OPERATION

The system can signal its operation status or the presence of any anomalies by a two-colour LED. The following figure represents the main standard displays of the unit, which can be modified upon request.

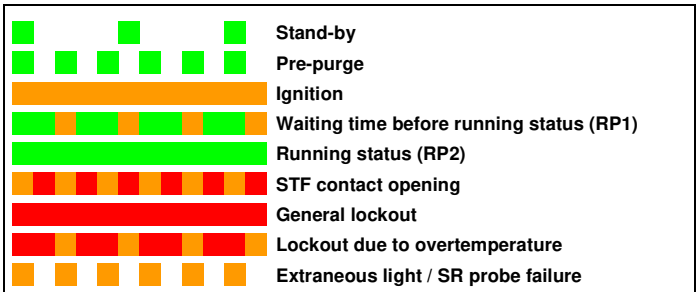


Fig. 10 – Main LED displays

In case the control unit is not installed in frontal position next to the hot air generator panel, both the light signals and the reset signals can be remoted by J4 connector.

COMMUNICATION INTERFACE

The BRAHMA system type TC340 can communicate with a personal computer through RS-232 communication protocol. The communication interface enables to:

- check the operation status of the unit and carry out some diagnostic functions to locate any anomalies or errors in the system;
- programme the "open" parameters of the unit (e.g. the motor speed in different modulation stages, the switch-on delay time and the post-purge time of the FAN blower, the T_{ON} and T_{OFF} intervention thresholds, …).

The serial interface of the system can be used by means of the BRAHMA interface device and dedicated management software.

PART REFERENCES

Type

TC340(1)**.**(2)(3)**.**(4)**.**(5) option (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26)

Type description

(1) **Type of application**
- A: device for fan-assisted hot air generators
- P: device for premix hot air generators
- P1: device for premix burners with or without modulation

(2) **Customer's identification letter(s)**

(3) **Progressive number identifying the type of board for a specific customer**

(4) **Revision number of the microcontroller software with safety functions**

(5) **Revision number of the microcontroller software with temperature adjustment functions**

Options description

(6) **Ignition mode**
- No letter: the ignition spark operates for the whole TSP (TS-1) time. Standard mode
- A: the ignition spark operates for the whole TS time
- B: the ignition spark switches off as soon as a flame signal is detected

(7) **Ignition voltage of the inbuilt ignition transformer**
- No letter: 15 kV for TC340A; not available for TC340 (P-P1). Standard mode
- H: 18 kV

(8) **Spark repetition rate of the inbuilt ignition transformer**
- No number: 25 Hz. Standard mode
- nn: see "Inbuilt ignition transformer" section in "*TECHNICAL DATA"* paragraph

(9) **Lockout due to extraneous light**
- No letter: not available (the unit remains in permanent waiting/pre-purge status). Standard mode
- K: immediate lockout
- Knn: lockout with delay settable upon request (see *"OPERATING CYCLE VARIATIONS"* paragraph)

(10) **Insufficient or no air flow at start-up**
- No letter: the unit remains in stand-by status. Standard mode
- Qnn: lockout with delay settable upon request (see *"OPERATING CYCLE VARIATIONS"* paragraph)

(11) **Insufficient or no air flow during ignition or in running status**
- No letter: recycling without lockout. Standard mode
- R: immediate lockout (see *"OPERATING CYCLE VARIATIONS"* paragraph)

(12) **Flame failure in running status**
- No letter: recycling. Standard mode
- V: immediate lockout

(13) **Post-purge of the burner motor (EF)**
- No letter: no post-purge. Standard mode
- Pnn: the post-purge is settable upon request and cannot be interrupted in case of heat demand restoration (see *"OPERATING CYCLE VARIATIONS"* paragraph)
- PTnn: the post-purge is settable upon request and can be interrupted in case of heat demand restoration (see *"OPERATING CYCLE VARIATIONS"* paragraph)

(14) **Recycling attempts after an ignition failure**
- No letter: single ignition cycle after a safety shutdown. Standard mode
- Ynn: multiple recycling attempts upon request (see *"OPERATING CYCLE VARIATIONS"* paragraph)
- YnnRmm*: nn multiple recycle attempts, with restoring of mm recycle attempts in operation (see *"TECHNICAL DATA"* paragraph)

* ***Remark***: *Y3R0 3 recycles according to EN676 and EN746-2, single attempt to recycle upon flame failure during the running condition.*

(15) **Inter-waiting or inter-purge time**
- No letter: no inter-waiting or inter-purge time. Standard mode
- Inn: inter-waiting or inter-purge time settable upon request (see *"OPERATING CYCLE VARIATIONS"* paragraph)

(16) **Air pressure switch checking**

- For TC340A versions:
  - No letter: air pressure switch checking available. Standard mode
  - G: no air pressure switch checking (see *"OPERATING CYCLE VARIATIONS"* paragraph)

  Note: *option "G" is available for the control units designed for special applications where checking the air flow is not required by the reference standard.*
- For TC340 (P – P1) versions:
  - No letter: no air pressure switch checking. Standard mode
  - GP: air pressure switch checking at start-up and during pre-purge

(17) **Pre-ignition**
- No letter: no pre-ignition. Standard mode
- Jnn: pre-ignition settable upon request (see *"OPERATING CYCLE VARIATIONS"* paragraph)

(18) **Safety thermostat**
- No letter: function carried out by BRAHMA double NTC safety probe type ST16. Standard mode
- T: device with contact safety thermostat control
- NT: device without safety thermostat control

Options description

(19) **Type of lockout**
- No letter: non-volatile lockout. Standard mode
- E: volatile lockout

(20) **Fire damper input (STF)**
- No letter: input not used. Standard mode
- S1: input used for air damper control
- S2: input used for the management of 0÷10 V analogue signals (PLC applications)
- Sxx: for future applications

(21) **Flame signal detection mode**
- No letter: double-electrode configuration (separate ignition electrode and flame detection electrode). Standard mode
- M: single-electrode configuration (one electrode with both ignition and flame signal detection functions)

(22) **EV1 gas valve**
- No letter: gas valve with 220-240V power supply. Standard mode
- C1: use of BRAHMA gas valve type VCM01* S [0/P] [0/P] 24VDC (valve with pressure sensor)
- C2: use of BRAHMA gas valve type VCM01* [0/P] [0/P] 24VDC (valve without pressure sensor)

(23) **EV2 gas valve (in case of standard EV1 only)**
- No letter: not available. Standard mode
- D: with flame signal on
- X: at the end of the safety time
- Wnn: during operation, after "nn" seconds from the end of the safety time

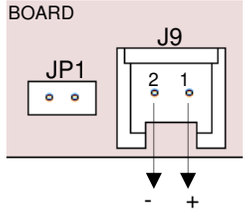
(24) **FAN hot air blower switch-on delay (**t_{FA}, for TC340A and TC340P versions only**)**
- RAnn: hot air blower switched on after "nn" seconds from the end of the safety time

(25) **FAN hot air blower switch-off delay (**t_{FS}, for TC340A and TC340P versions only**)**
- RSnn: hot air blower switched off after "nn" seconds from burner stop

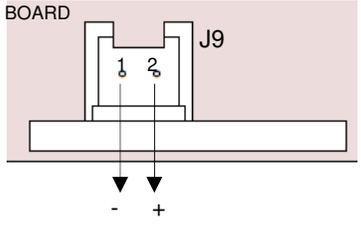
(26) **Waiting time for modulation start (**t_{RP1} for TC340A and TC340P; RP_STAB_delay for TC340P1**)**
- RPnn: delay of "nn" seconds from the end of the safety time before modulation start

(27) **SR heating circuit probe:**
- No letter: available (BRAHMA type ST08 or ST16 depending on option 18). Standard mode
- NS: system not provided with heating circuit probe

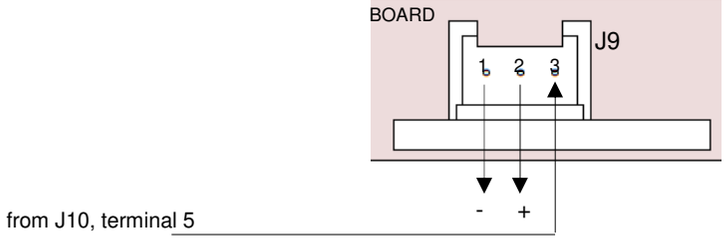
(28) **Low voltage auxiliary output:**
- No letter: not available. Standard mode
- MD: output for current modulator (I_{MAX} = 170mA)



- EC: PWM 0÷10V (frequency ≈ 1kHz) output, suitable for EC motor with electronic control



- EI: 0÷10V_{DC} (continuous) output, suitable for EC motor with electronic control or inverter
  NOTA: with this option, SA probe is not available



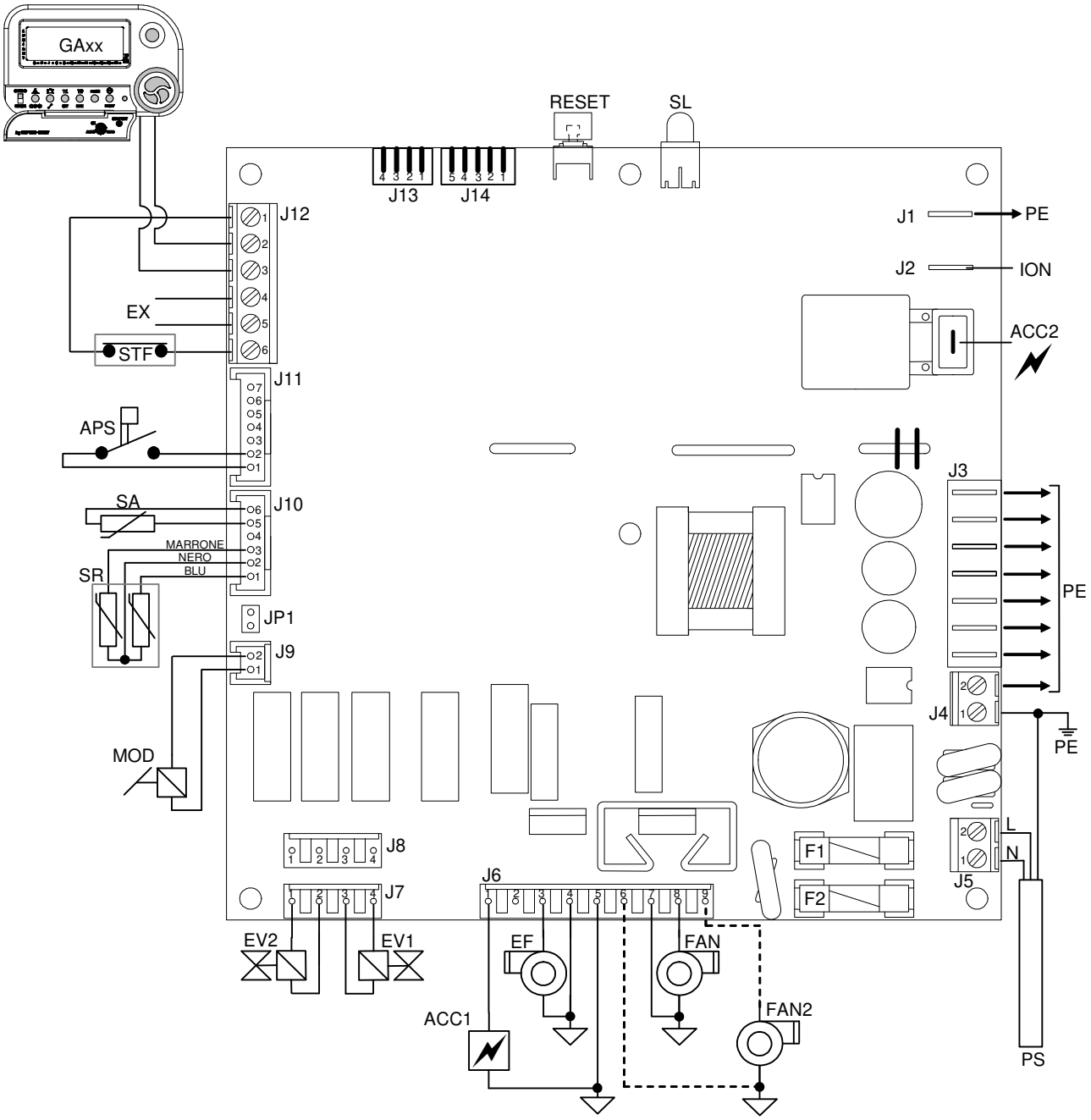
(29) ***QuickStart*** **function (in combination with "PT" function)**
- No letter: not available. Standard mode
- QS: *QuickStart* function available (see *"OPERATING CYCLE VARIATIONS"* paragraph)

(30) ***LCD5 control panel***
- No letter: not available. Standard mode
- L: equipped with interface for BRAHMA type LCD5 control panel (code 16021102)

ПРОМЭЛЕКТРОНИКА / sales@prom-elec.com

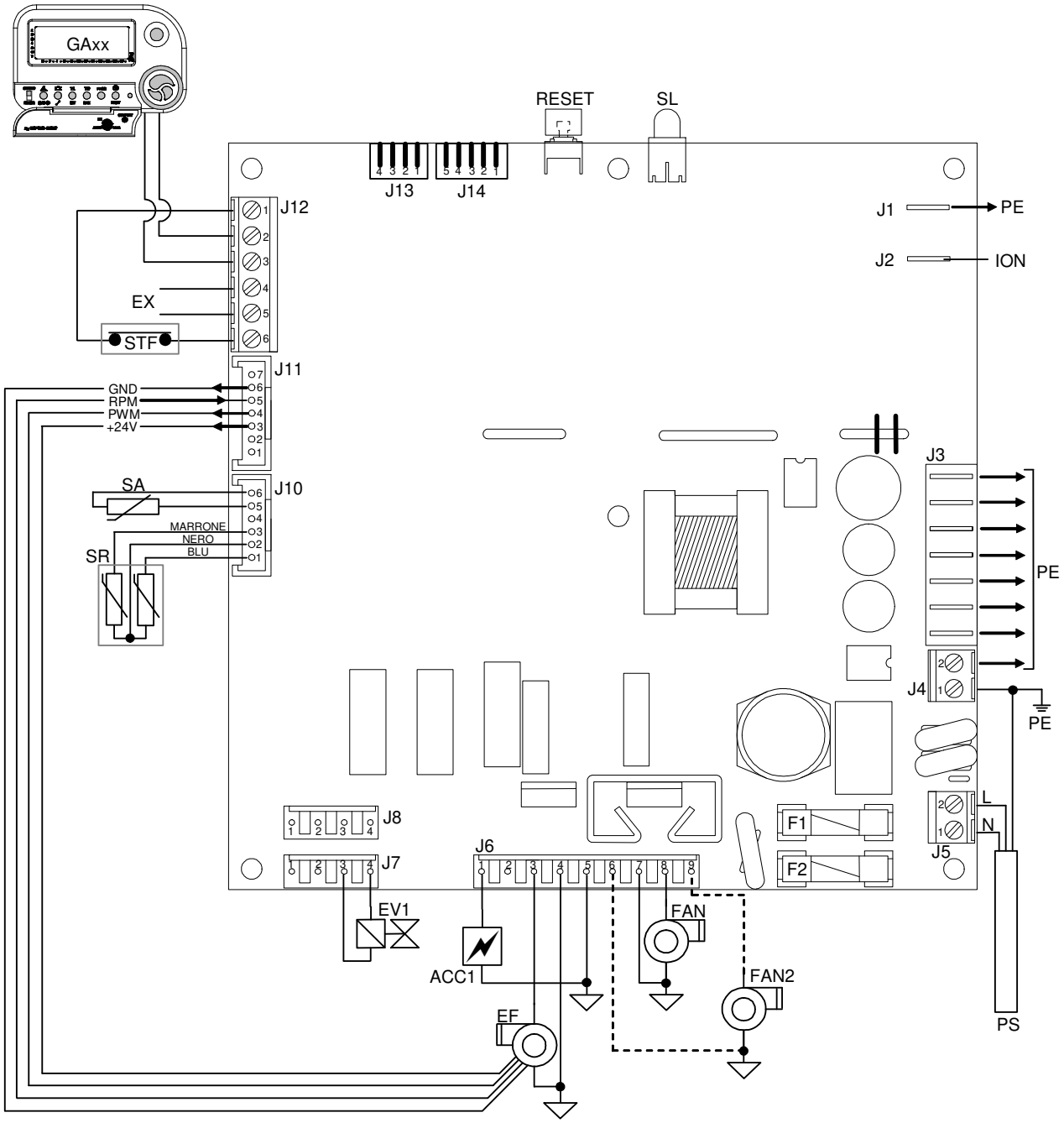
WIRING DIAGRAMS
The following wiring diagrams refer to the most complete device versions.

WIRING DIAGRAM FOR BRAHMA DEVICES type TC340**A**.**.**.**



Key to symbols			
GAxx	Chronothermostat type ENCRONO GAxx	SR	Heating circuit probe
EF	Burner motor	SA	Room temperature probe (optional)
FAN	Hot air blower	APS	Air pressure switch
FAN2	Second hot air blower	STF	Fire damper
ACC1	Remote auxiliary ignition transformer	SL	LED signalling
ACC2	Inbuilt ignition transformer	RESET	Reset push-button
EV1	First valve stage	JP1	LPG/GAS selection jumper
EV2	Second valve stage	EX	Connection for cascade appliances
MOD	Gas valve current modulator	ION	Ionization electrode

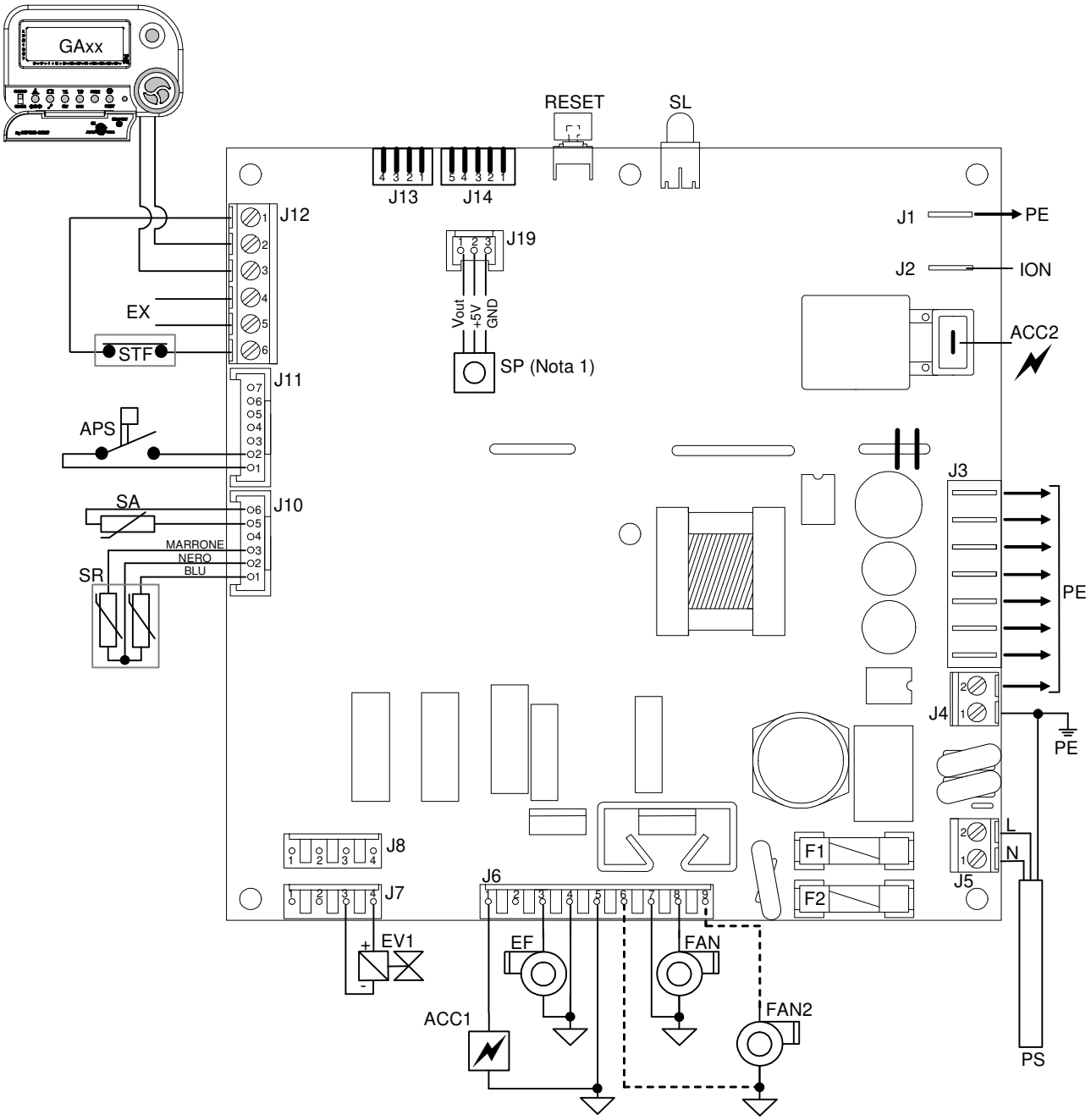
WIRING DIAGRAM FOR BRAHMA DEVICES type TC340**P**.**.**.**



Key to symbols	
GAxx	Chronothermostat type ENCRONO GAxx
EF	Burner motor
FAN	Hot air blower
ACC1	Remote auxiliary ignition transformer
EV1	First valve stage
SR	Heating circuit probe

STF	Fire damper
SA	Room temperature probe (optional)
SL	LED signalling
RESET	Reset push-button
EX	Connection for cascade appliances
ION	Ionization electrode

WIRING DIAGRAM FOR BRAHMA DEVICES type TC340**A**.**.**.** opt. **C1** / **C2**



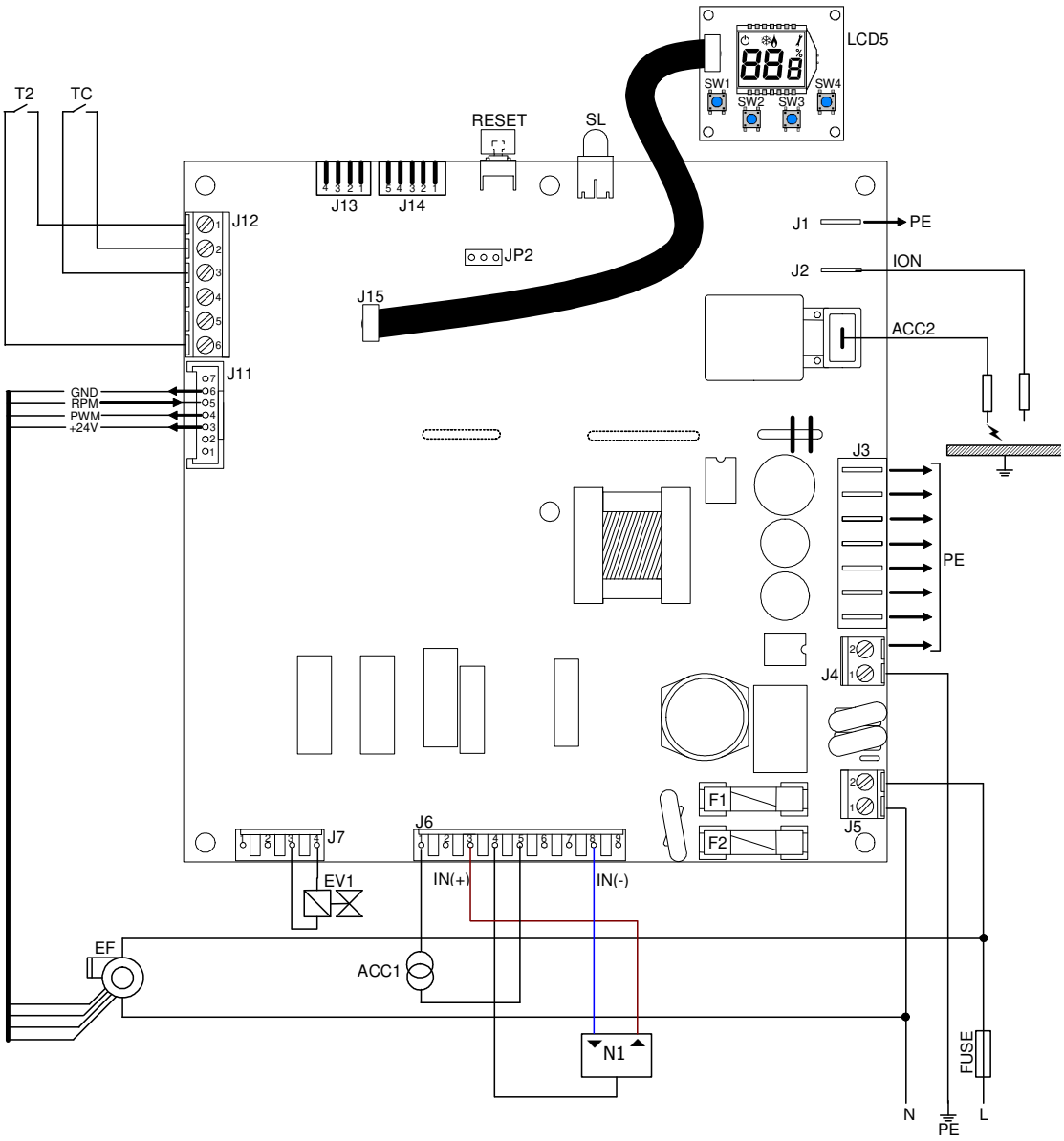
Key to symbols	
GAxx	Chronothermostat type ENCRONO GAxx
EF	Burner motor
FAN	Hot air blower
ACC1	Remote auxiliary ignition transformer
ACC2	Inbuilt ignition transformer
EV1	BRAHMA valve type VCM01* # (0/P) (0/P) 24VDC
SP	VCM01 valve pressure sensor
SR	Heating circuit probe

SA	Room temperature probe (optional)
APS	Air pressure switch
STF	Fire damper
SL	LED signalling
RESET	Reset push-button
EX	Connection for cascade appliances
ION	Ionization electrode

NOTES

1. Connector and wiring not available in C2 version.

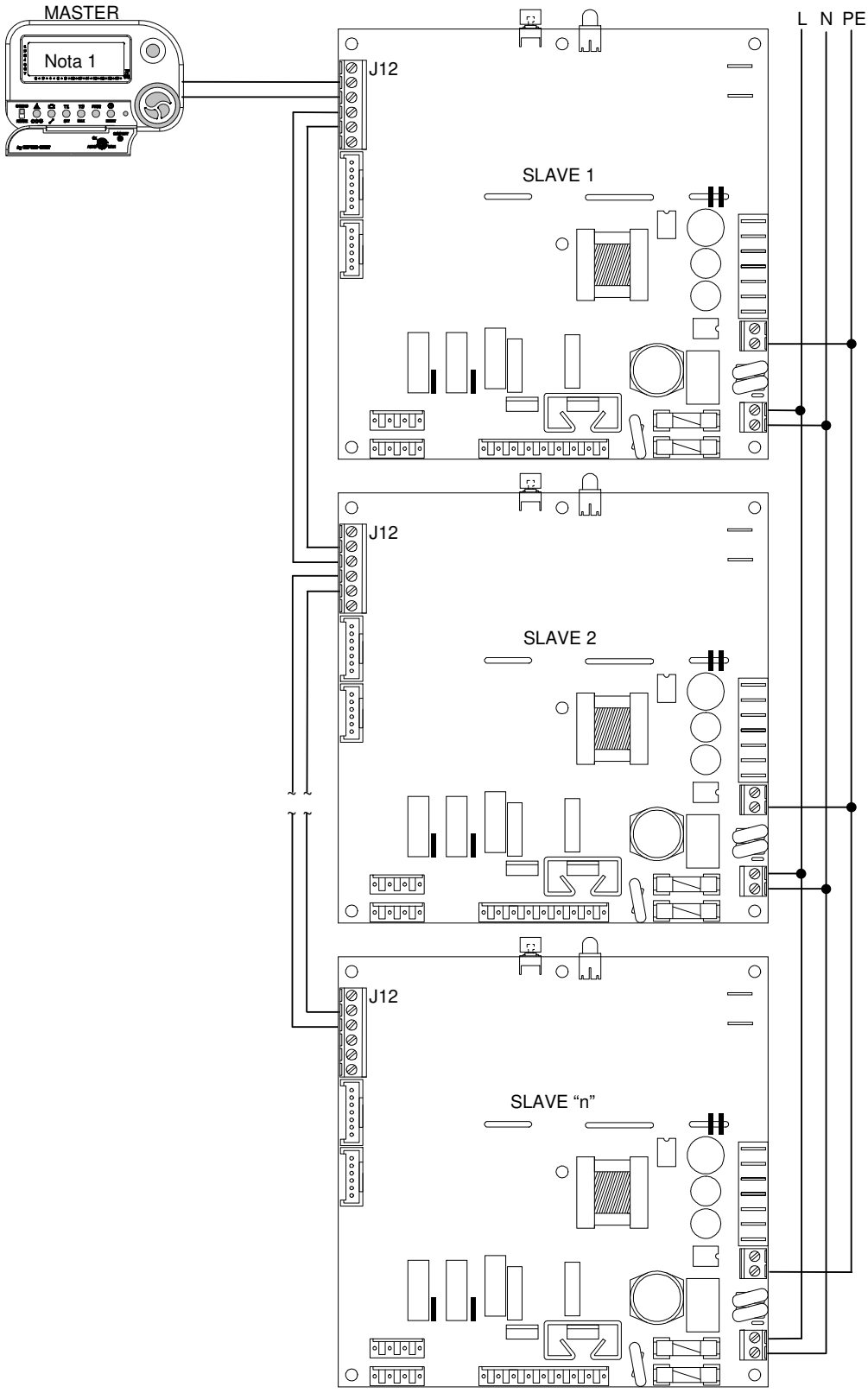
WIRING DIAGRAM FOR BRAHMA DEVICES type TC340**P1**.**.**.** opt. NT NS L



Key to symbols	
TC	Heat demand room thermostat
T2	Adjustment thermostat / BOOST function
EF	Burner motor
ACC1	Remote auxiliary ignition transformer
ACC2	Inbuilt ignition transformer
EV1	First valve stage

N1	Three-point adjuster
SL	LED signalling
RESET	Reset push-button
EX	Connection for cascade appliances
ION	Ionization electrode
LCD5	BRAHMA type LCD5 control panel

WIRING DIAGRAM FOR THE CASCADE CONNECTION OF SEVERAL DEVICES THROUGH OpenTherm™



NOTES

1. The cascade connection is possible also by a contact chronothermostat. This configuration is not used in TC340P1 versions.

TYPES OF CONNECTION

All connections available in the system are listed below.

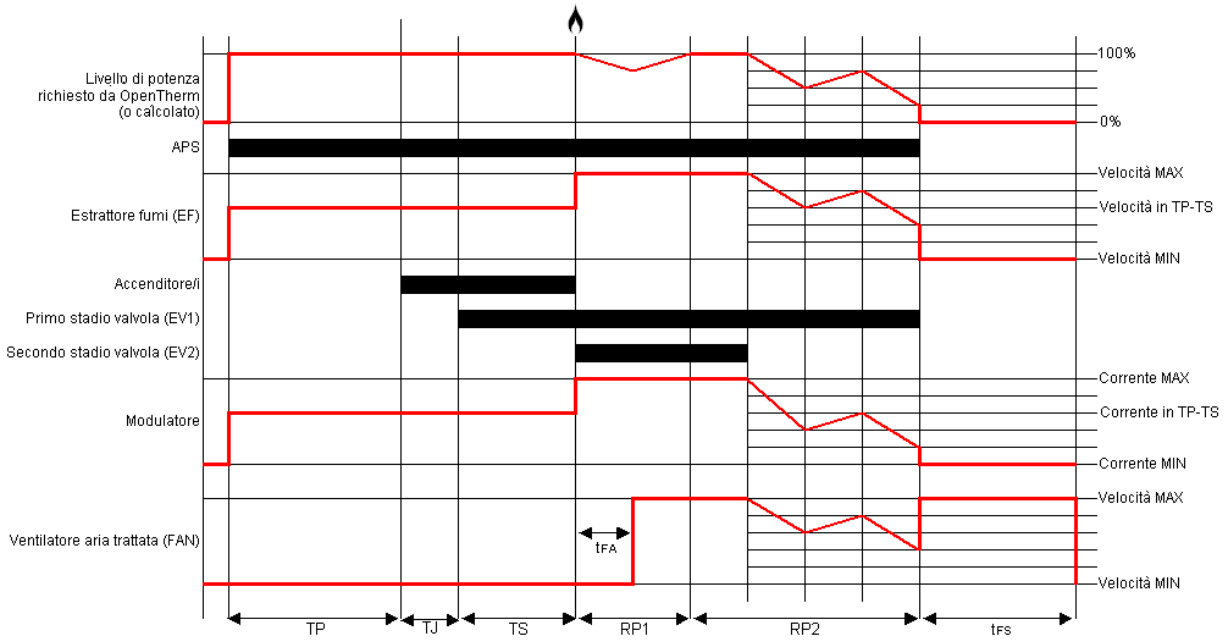
Reference	*Description*	*Type of connector*
J1	Functional earth (flame monitoring)	Female fast-on 6.3 mm
J2	Flame detection electrode	Female fast-on 4.8 mm
ACC2	Ignition electrode	Female fast-on 2.8 mm
J3	Load safety earth connection	Female fast-on 6.3 mm (7 pins)
J4	Earth connection input	2-pin screw terminal board for cables Ø 2.5 mm^2
J5	Power supply input	2-pin screw terminal board for cables Ø 2.5 mm^2
J6	Power supply for FAN hot air blower, EF burner motor, auxiliary electronic ignition transformer and modulation increase/decrease inputs	9-pin connector type MOLEX® 3001 series (terminals type MOLEX® 2478 series)
J7 – J8 (note 1)	Power supply for EV1 first valve stage and EV2 second valve stage	4-pin connector type MOLEX® 3001 series (terminals type MOLEX® 2478 series)
J9	Auxiliary output	2 (or 3) pin connector type LUMBERG® 3114 series (terminals type LUMBERG® 3111 01 L series)
J10	Heating circuit probe (SR) and room temperature probe (SA)	6-pin connector type LUMBERG® 3114 series (terminals type LUMBERG® 3111 01 L series)
J11	Air pressure switch (APS) or PWM control brushless fan low-voltage signals	7-pin connector type LUMBERG® 3114 series (terminals type LUMBERG® 3111 01 L series)
J12	Opentherm® communication and fire damper input	6-pin screw terminal board for cables Ø 2.5 mm^2
J13	Serial communication type RS-232 for diagnostic software interfacing	4-pin connector type LUMBERG® 3517 04 K series
J14	LED status signals and reset signal remoting connector	5-pin connector type LUMBERG® 3517 05 K series
J19	Pressure sensor	3-pin connector type LUMBERG® 3114 series (terminals type LUMBERG® 3111 01 L series)

NOTES

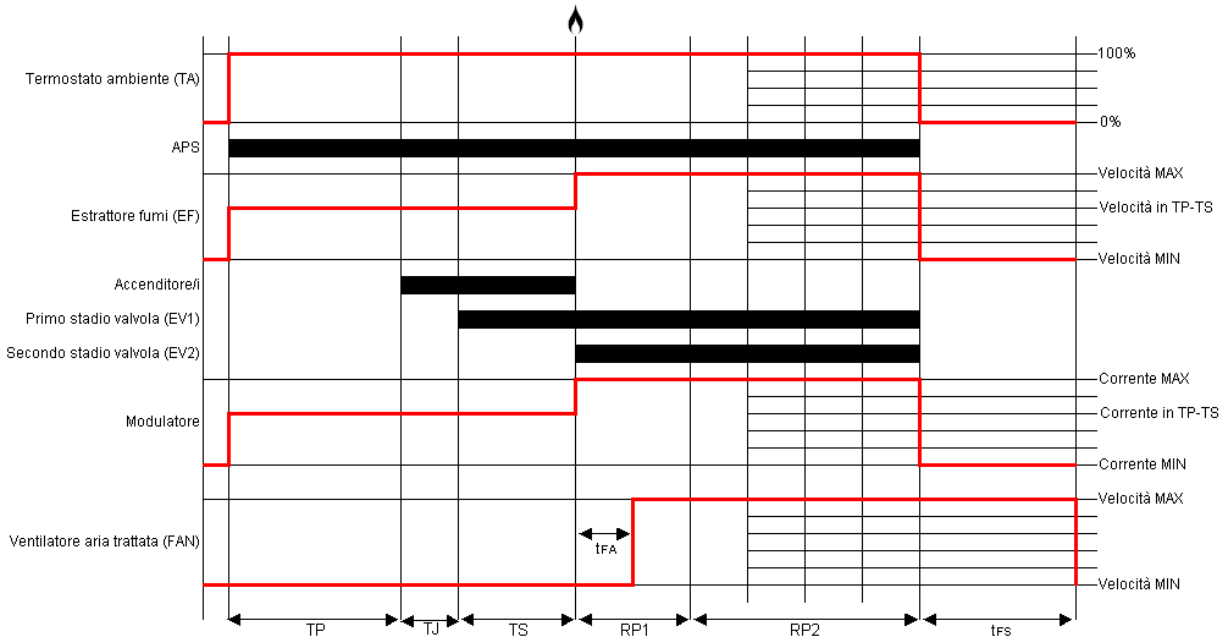
1. The J8 connector is mounted in parallel to the J7 connector, i.e. from the same position it is possible to take the same output signal. This connector is useful for appliances equipped with double-coil gas valves.

OPERATING CYCLE DIAGRAMS

TC340(A-P) – Standard operating cycle using BRAHMA chronothermostat type ENCRONO GAxx



TC340(A-P) – Standard operating cycle using a contact room thermostat

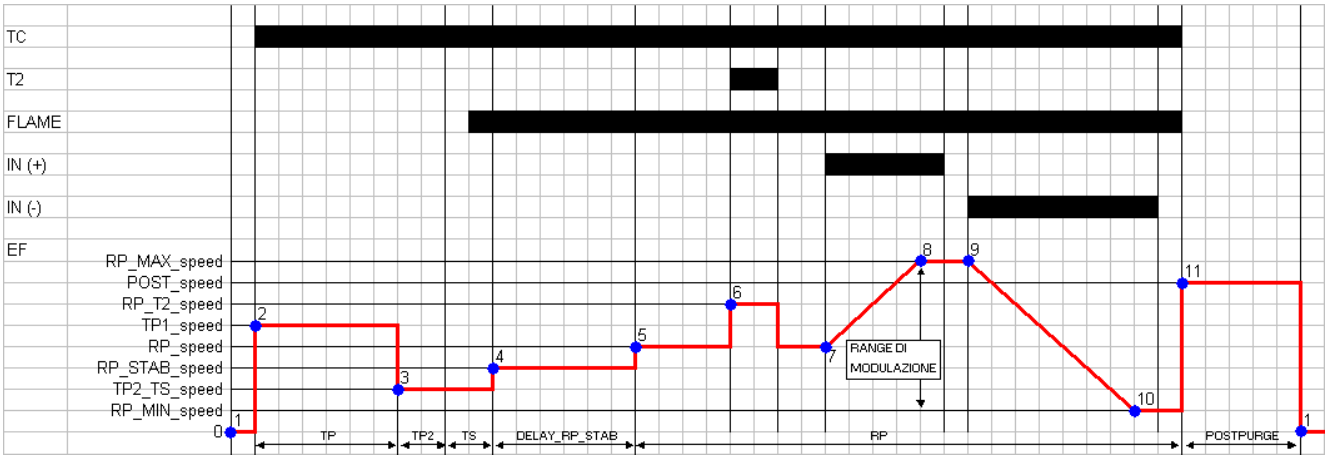


NOTES

- the EV2 second valve stage, if available, depending on option no. 23 may be activated in a different moment in comparison to what appears in the diagrams (in these specific cases, option X);
- the modulation circuit may not be available depending on the type of device and on option no. 28;
- at the end of the heat demand, a post-purge on the EF burner motor may be performed depending on option no. 13.

OPERATING CYCLE DIAGRAMS

TC340P1 – Standard operating cycle



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

NOTES ABOUT PRODUCT DISPOSAL

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

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