**Read the operating and mounting instructions before commissioning.**

**Only specialised personnel may perform work on the automatic burner control system.**

**Never perform any work when the control system is live. This also applies if low-voltage components such as servomotors, display or communication components are replaced or installed.**

**In case of fuse failure, check the safety function of the automatic burner control system. Otherwise contact weld caused by short-circuit may occur.**

**Only specialised personnel may set operating parameters.**

**Only use the communication connection together with components expressly approved for this purpose.**

**Perform the connection related to the correct phase and the protective conductor connection according to the terminal diagram and check it before commissioning.**

**Warranty for the control system expires on improper handling of the electronic system or due to incorrect storage.**

**The data contained in these instructions specify the automatic burner control system. They do not imply any characteristics.**

**If you do not follow these instructions, danger to life to the equipment may occur.**

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# Operating and mounting instructions

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## Automatic burner control system MPA22

**Technical description**
The MPA22 is a microprocessor-controlled, automatic burner control system with intermittent duty for controlling and monitoring two- and three stage modulating blower burners with a single servomotor, electronic modulating blower burners with 2 servomotors in combination with an electronic control unit, and pneumatic modulating blower burners with 1 servomotor. With integrated valve proving system for operation as automatic gas burner control system.

**Accessories**
Flame monitoring device
Servomotors
Display unit
Minimum display
eBUS interface
Mounting bracket
Coding plug

**Order data**
see Annex

**Classification according to EN 298**
FMCLJN, depending on programming
FMLLJN, depending on programming

**Approvals for gas types**
EU type test approval as per EU Gas Appliance Directive.

| | |
|---|---|
| MPA22 | CE-0085AU316 |

**Approvals for oil types**
Register/type test number

| | |
|---|---|
| MPA22 | F185/99 |

# Contents

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## Specifications

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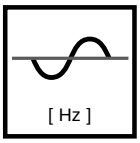
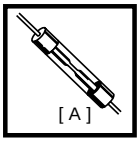
**Nominal voltage** 230 VAC - 15% to +10%



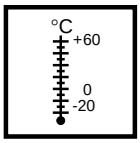

**Frequency** 50/60 Hz


**Performance rating** max. 17VA at 230VAC




**Fuse**
Back-up fuse: max. 10 A slow-blow
Internal fuse: none
Keep to the permissible breaking capacities

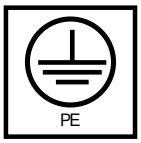

**Degree of protection**
IP 20 installation must comply with IP 40
IEC 529 (DIN 40 050)




**Ambient temperature** -20 °C to +60 °C


**Air humidity** Climate F DIN 40 040

**Electrical connection**
Boiler: with 7- and 4-pole plugs as per DIN
Burner: encoded plug system
pcb direct plug for servomotors, display unit and eBUS.
Perform wiring in compliance with the locally prevailing regulations and the terminal diagram of the burner manufacturer. Extra-low voltage is not protection-isolated. Make sure that you use the correct polarity.




**Protective conductor Connection**
Integrated in system.
The protective conductor connection for the burner is performed using the protective conductor cable with connector for the automatic burner control system. Permanently tighten the connection screw which connects the MPA22 and the protective conductor connection with the burner housing.


**Weight approx.** 0.9 kg

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**Breaking capacities**
**Total max. 10 A**

| Designation | Breaking capacity |
|---|---|
| Burner motor | 230 VAC/4 A/cos φ = 1 |
| Burner motor (endurance run) | 230 VAC/4 A/cos φ = 1 |
| Ignition transformer | 230 VAC/3 A/cos φ = 1 |
| Valve Y1 + status display | 230 VAC/2 A/cos φ = 1 |
| Valve Y2 | 230 VAC/2 A/cos φ = 1 |
| Valve Y3 | 230 VAC/2 A/cos φ = 1 |
| Fault output | 230 VAC/1 A/cos φ = 1 |
| Safety sequence (pressure switch max. gas) | 230 VAC/10 A |
| Pulse generator | 24 VDC/2 mA |
| Pressure switch air stage | 24 VDC/20 mA |
| Pressure switch min. gas | 24 VDC/20 mA |
| Pressure switch VPS | 24 VDC/20 mA |
| Flame detector | |
| Ionisation electrode | 230 VAC |
| UV diode | 230 VAC |
| Photoresistor | 5 VDC |
| Servomotor gas | 24 VDC/max.150 mA |
| Servomotor air | 24 VDC/max.150 mA |
| Display board | 24 VDC/max.10 mA |
| Bus interface | 5 VDC/10 mA |
| Temperature or pressure regulator | 230 VAC/10 mA |
| Negative capacity or stage 2 | 230 VAC/10 mA |
| Positive capacity or stage 3 | 230 VAC/10 mA |

**Flame supervision**

Ionisation, UV diode, with additional photoresistor for oil burner

**Servomotors**

Stepped-motor servomotor with integrated stepped motor driver and digital acknowledgement via encoder disk
SAD 0.6 with 0.6 Nm torque
SAD 1.2 with 1.2 Nm torque

**Display module**

Display module AM01 with 71/2-digit LCD display and 5 operating keys incl. unlocking key. Connected via a 6-pole cable, cable length: max. 1 m

**Minimum display**

Unlocking key with fault indicator lamp instead of display unit

**Coding plug / oil**

Coding plug CS01 for operation as oil burner instead of the servomotor gas

**Coding plug / gas**

Coding plug CS02 for operation as gas burner in combination with pneumatic system instead of the servomotor gas

**Fault unlock**

By means of unlocking key

**Pulse counter input**

Connection possibility for a floating pulse counter contact for fuel volume acquisition, adjustable divisor in EEPROM.

**Communication**

Connection to the eBUS via an approved MPA/eBUS interface or to a PC via an approved MPA/PC interface.
The interfaces must be electrically isolated (4 KV/8 mm) as per VDE 0551.

**As-delivered state**

The automatic burner control system has a default state so that a basic setting is available for the burner manufacturer or in case of replacement.

**Installation position**

Arbitrary

**Dimensions**

200 mm x 105 mm x 60 mm

**Mounting bracket**

For upright assembly of the automatic burner control system

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| **Switching times** | Setting range | Unit | Access level |
|---|---|---|---|
| Preventilation period | 10…60 | s | OEM |
| Pre-ignition period | 0…2 | s | OEM |
| Safety period, gas operation | 20…50 | 0.1 s | OEM |
| Safety period, oil operation | 20…50 | 0.1 s | OEM |
| Stabilising time | 1…60 | s | OEM |
| Postventilation period | 0…240 | s | Service |
| Test time, valve Y2 | 1…240 | s | Service |
| Test time, valve Y3 | 1…240 | s | Service |
| Wait time | 0…100 | min | Service |
| **Switching functions** | | | |
| Valve proving system | ON ≥ 1 OFF = 0 | | Service |
| Restarts | 0…1 | | OEM |
| Oil operation with/without supervision | with ≥ 1 , without = 0 | | Service |
| **Other settings** | | | |
| eBUS address | 03H, 13H, 33H, 73H, F3H | | Service |
| Divisor for pulse counters | 1…255 | pulses/l or $m^3$ | OEM |
| Air damper actuator standby mode | 0.0…25.5 | ° | Service |
| Regulator address | 10H, 17H, 30H, 37H, 70H, 77H, F0H, F7H | | Service |
| Direction of rotation servomotor air | 0, 8, 16, 24 | | OEM |
| Direction of rotation servomotor gas | 0, 8, 16, 24 | | OEM |
| **Customer parameters to save information for Service Department and the burner manufacturer** | | | |
| **Customer parameters on Level 2** | | | |
| Customer 20…Customer 29 | 0…255 | | OEM |
| **Customer parameters on Level 3** | | | |
| Customer 30…Customer 39 | 0…255 | | Service |

The switching times and the above-mentioned functions, settings and customer parameters can be changed within the limits indicated. Distinctions are made between several setting levels:

**Operator** System operator, access without password
**Service** Trained service personnel of burner manufacturer
**OEM** Burner manufacturer
**Manufacturer** Automatic burner control system manufacturer
**None** No access, read only

On the MPA22, the operator has read access only. If a password is not entered, only operating data request and fault unlock in case of fault are possible.
When a password is entered, the Service personnel can activate the setting and the parameterisation mode in order to change the settings marked as SERVICE (see above) within the limits indicated.
Access to the OEM level is possible when the burner hood is removed and using special external equipment and software as well as specific interactive operations.
The operating and mounting instructions do not contain these access possibilities and the subjacent access levels.

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**Setpoints for the servomotor characteristics**

The following setpoints for the air motor and gas motor in each operating mode may only be changed in setup mode; they are not enabled until the settings for automatic burner operation have been completed.
The setting values are to be recorded in the setup log after the burner has been set and should be kept in a safe place on the machine and in a suitable form.
Setting range on standby

---

**Setpoints for gas firing, pneumatic modulation**

| | |
|---|---|
| Setting range on standby | |
| Air motor P9 | 0.0°…90.0° |
| Air motor P1 | 0.0°…P9 |
| Air motor P0 | 0.0°…90.0° |
| Setting range in operation | |
| Air motor P9 | P1…90.0° |
| Air motor P1 | 0.0°…P9 |
| Air motor P0 | 0.0°…90.0° |

---

**Setpoints for gas firing, electronic modulation**

| | |
|---|---|
| Setting range on standby | |
| Air and gas motor P9 | 0.0°…90.0° |
| Air and gas motor P1 | 0.0°…P9 |
| Air and gas motor P0 | P1 - 25.5°…P1 + 25.5° and P0 ≥ 0.0° |
| Setting range in operation | |
| Air and gas motor P0 | P1 - 25.5°…P1 + 25.5° and P0 ≥ 0.0° |
| Air and gas motor P1 | 0.0°…P2 |
| Air and gas motor P2 | P1…P3 |
| Air and gas motor P3 | P2…P4 |
| Air and gas motor P4 | P3…P5 |
| Air and gas motor P5 | P4…P6 |
| Air and gas motor P6 | P5…P7 |
| Air and gas motor P7 | P6…P8 |
| Air and gas motor P8 | P7…P9 |
| Air and gas motor P9 | P8…90.0° |
| Lower limit bu | 0…bo (0 = P1; 200 = P9) |
| Upper limit bo | bu…200 (0 = P1; 200 = P9) |

---

**Setpoints for oil firing, three stage**

| | | |
|---|---|---|
| Setting range on standby | | |
| Air motor | P9 | 0.0°…90.0° |
| Air motor | P3 | 0.0°…P9-0.1° |
| Air motor | P1 | 0.0°…P3-0.1° |
| Air motor | P0 | 0.0°…P1 |
| Air motor | P2 | P1 + 0.1°…P3 |
| Air motor | P4 | P3 + 0.1°…P9 |
| Setting range in operation | | |
| Air motor | P0 | 0.0°…P1 |
| Air motor | P1 | 0.0°…P2 -0.1° |
| Air motor | P2 | P1 + 0.1°…P3 |
| Air motor | P3 | P2…P4 -0.1° |
| Air motor | P4 | P3 +0.1°…P9 |
| Air motor | P9 | P4…90.0° |

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**Device specific counters, storage devices and data**

Contain general information which is retrievable via the display unit by the operator.

**Counters and storage devices**

| Description | As-delivered state |
|---|---|
| Start-up counter | deleted |
| Operating hours counter stage 1 | deleted |
| Operating hours counter stage 2 | deleted |
| Operating hours counter stage 2 | deleted |
| Pulse counter | deleted |
| History buffer (6-layer fault memory) | deleted |

**Device specific data**

| | |
|---|---|
| Device no. | Serial no. |
| Production date | Date |

**This information may only be deleted by the manufacturer of the automatic burner control. The exception to the rule is the history buffer, which may be deleted in parameterisation mode by Service personnel.**

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**Direction of rotation of the servomotors**

MPA22 can be parameterised so that the servomotors can rotate both anti-clockwise and clockwise in all operating modes. Two reference marks (A and B) can be used for the servomotor. Also, the reference point can be defined as 0° damper position or 90° damper position. Depending upon the combination selected, anticlockwise rotation or clockwise rotation is possible. Four different combinations are possible for every servomotor.

Starting point 0
The reference mark A is used. The direction of rotation is anticlockwise. The zeropoint of the air- and gasdamper is on reference mark.
The rotation range of the air damper must be -5° to the desired angle (max. 95°).
The rotation range of gas damper (if exist) must be -5° to 109°.
Stops are to be provided at the rotation range limits.

Starting point 1
The reference mark A is used. The direction of rotation is clockwise. The zeropoint of the airdamper is 90°, the zeropoint of the gasdamper is 109° in rotation anticlockwise of the reference mark away.
The rotation range of the air damper must be 0° to 95°.
The rotation range of the gas damper (if exist) must be 0° to 109°.
Stops are to be provided at the rotation range limits.

Starting point 2
The reference mark B is used. The direction of rotation is clockwise. The zeropoint of the airdamper is 90°, the zeropoint of the gasdamper is 109° in rotation anticlockwise of the reference mark away.
The rotation range of the air damper must be 0° to 95°.
The rotation range of the gas damper (if exist) must be 0° to 109°.
Stops are to be provided at the rotation range limits.

Starting point 3
The reference mark A is used. The direction of rotation is anticlockwise. The zeropoint of the air- and gasdamper is on reference mark.
The rotation range of the air damper must be -5° to the desired angle (max. 95°).
The rotation range of gas damper (if exist) must be -5° to 109°.
Stops are to be provided at the rotation range limits.

In the operating modes „oil firing, three stage“ and „gas firing, pneumatic modulation“, the damper stops are required for reasons of safety. In the operating mode „Gas firing, electronic modulation“, an automatic device for recognition of interchanged servomotors is integrated. The stops are required to ensure that this device works properly.

**Setting the parameters**

| Starting point | Reference | Direction of rotation | Damper position at reference | | Parameter in EEPROM |
|---|---|---|---|---|---|
| | | | airdamper | gasdamper | |
| 0 | A | anticlockwise | 0° | 0° | 0 |
| 1 | A | clockwise | 90° | 109° | 8 |
| 2 | B | anticlockwise | 90° | 109° | 16 |
| 3 | B | clockwise | 0° | 0° | 24 |

This setting applies to servomotor air and servomotor gas. If only one servomotor and one coding plug are connected, the setting of the servomotor gas is irrelevant.

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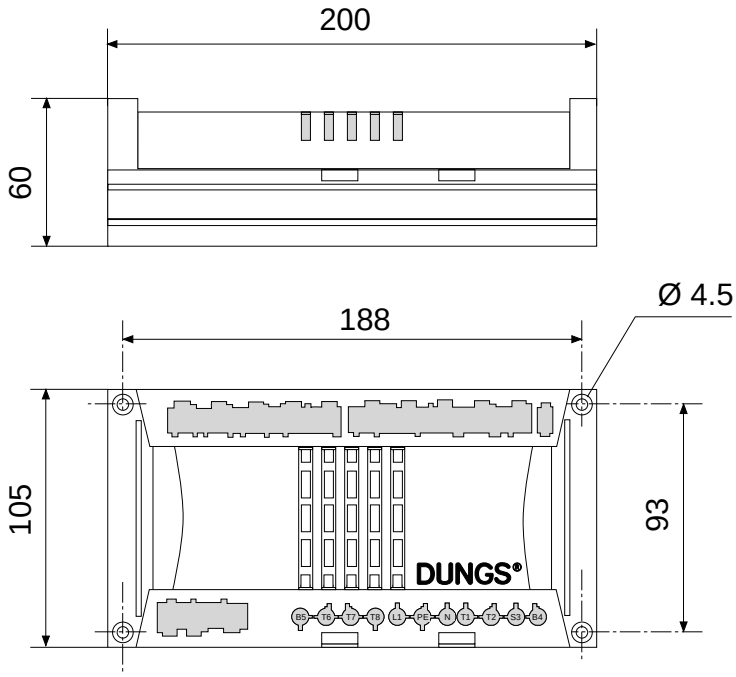
**Dimensions**




**Installation position** arbitrary

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■ **Operating modes of MPA22**

**Gas modulating mode (electronic)** with stepped motor to control the air and gas volume.

**Gas modulating mode (pneumatic)** with servomotor air damper control

**Oil firing, three stage** with oil preheater and servomotor air damper control

■ **Setting the operating mode**

The operating mode is set at the servomotor gas connection by means of the coding plug and is checked and identified when the automatic burner control is put into operation.

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# Operating mode
# Gas firing, electronic modulation

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■ **Configuration**
**Gas firing, electronic modulation**

Servomotor air plugged in
Servomotor gas plugged in

■ **Functional sequence**
**Gas firing, electronic modulation**

The internal self-tests are performed when the regulator issues a heating request. First, the servomotor air locates its reference point, then the servomotor gas.
The servomotor air then moves to pre-ventilation position P9.
The idle position of the air pressure switch is checked and the flame monitoring device is checked for flame simulation. If these checks are successful, the blower is energised.
When the air pressure switch is closed, the preset pre-purge period elapses and the remaining pre-purge period is displayed. Pre-purging is monitored by the air pressure switch.
During the pre-purge period, the servomotor gas runs to position 109° to check whether the servomotors for gas and air have been interchanged.
After the servomotor has reached the 109° position it returns to ignition point P0 during the pre-purge period.
If a valve test has still not been performed after a power failure or fault shut-down and the valve proving function has been selected, a valve test and restart are performed once the pre-purge period has expired.

Otherwise, external valve Y1 (liquid gas) of the servomotor air opens and the servomotor air moves to ignition point P0 after the pre-purge period has expired. After the servomotor air has reached ignition point P0, the ignition is turned on for the preset pre-purge period (with pre-ignition period = 2 s).
Valve Y2 is opened one second before the startup safety period commences (the ignition is also turned on if pre-ignition period = 1s). The gas pressure switch GW_min must indicate the presence of gas pressure within this period of time. Otherwise, a safety shut-down will be triggered and the gas fail-safe program executed.
If gas pressure is present after 1 second, the ignition is turned on (if pre-ignition period = 0) and valve Y3 is opened.
The ignition cuts out at the end of the safety period and, provided that a flame is present, the two servomotors remain in the ignition position for the preset stabilising time. After the stabilising time has expired, the servomotors alternately move to position P1 in stepping mode. When the servomotors reach position P1, the automatic burner control is in the service position.

If the “Lower limit” **bu** > 0, the automatic burner control operates according to the characteristic curve defined by points P1 to P9, consecutively activating the servomotors until it reaches the predefined minimum capacity point in the closed-loop control mode.
The MPA22 is now in closed-loop control mode, i.e. it accepts the control signals applied to the inputs capacity + and capacity - and thus regulates the capacity over the predefined characteristic curve in the range between bu and bo.
If the MPA22 has already been in service for 24 hours, a controlled shut-down is executed automatically.
If the heating request is cancelled, a controlled shut-down takes place. If the valve proving system is not activated, valves Y2 and Y3 and the external valve Y1 close and the blower runs on for the preset postventilation period.
If the valve proving system is activated, a leakage check is performed on gas valves Y2 and Y3. The post-ventilation period elapses in parallel with the leakage check.

When the blower is switched off, the servomotor air runs to the set standby position and then the servomotor gas runs to position 0°.
A restart lock-out period (if set) now elapses (the time is indicated on the display), or the automatic burner control enters standby mode (readout on display = OFF).

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■ **Response to faults Gas firing, electronic modulation**

If no flame is present after the startup safety period has elapsed, a safety shut-down takes place and the system executes a restart (if permitted). A fault lockout is triggered otherwise.
If the presence of a flame is not indicated after a restart attempt, a fault shut-down takes place and the burner enters the non-variable fault state.
If flame failure occurs when the burner is in operation, the burner is restarted (if permitted). Otherwise, a fault shut-down takes place and the burner enters the non-variable fault state.
In the event of a fault shut-down, all valves are closed and the blower and ignition are turned off.
If the presence of a flame is signalled before the gas is enabled, the automatic burner control enters the non-variable fault state.
If a malfunction occurs during the start-up phase or operating phase, a safety shut-down is activated. Depending upon the nature of the fault, the burner either enters the non-variable fault state or the start-up attempt is repeated.
After 5 failed attempts, the automatic burner control enters the non-variable fault state.
The type of fault or disturbance is displayed.

■ **Gas pressure switching Gas fail-safe program for gas burners with electronic modulation**

The gas pressure switch GW_min is fitted in between gas valves Y2 and Y3.
At burner start-up, valve Y2 is activated 1 second before the startup safety period commences and also 1 s before valve Y3 is opened.
If a pressure sufficient to actuate gas pressure switch GW_min does not build up inside the space between valve Y2 and valve Y3, burner start-up is interrupted. The valves are closed and the blower is switched off. The automatic burner control waits for 2 minutes before repeating the start-up attempt.
If there is a still a shortage of gas after this 2-minute wait, the start-up attempt is repeated a third time after waiting another 2 minutes.
After the third failed start-up attempt, the burner waits for an hour before attempting another restart.
This function makes possible leakage checks and gas pressure monitoring with only one pressure switch. It does not give rise to a fault lockout in the event of a gas shortage and reduces the frequency of start-up attempts if a gas shortage exists over a lengthy period of time.
The gas pressure switch must be set to at least the flow pressure necessary in between the two valves at full load.
Examples of a display during the wait period: 18 1-23 (= 1 minute 23 s remaining waiting time)
The waiting time can only be reset by disconnecting the voltage supply to the device (turn main switch OFF or disconnect the 7-pole connector).

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# Terminal diagram
# Gas firing, electronic modulation

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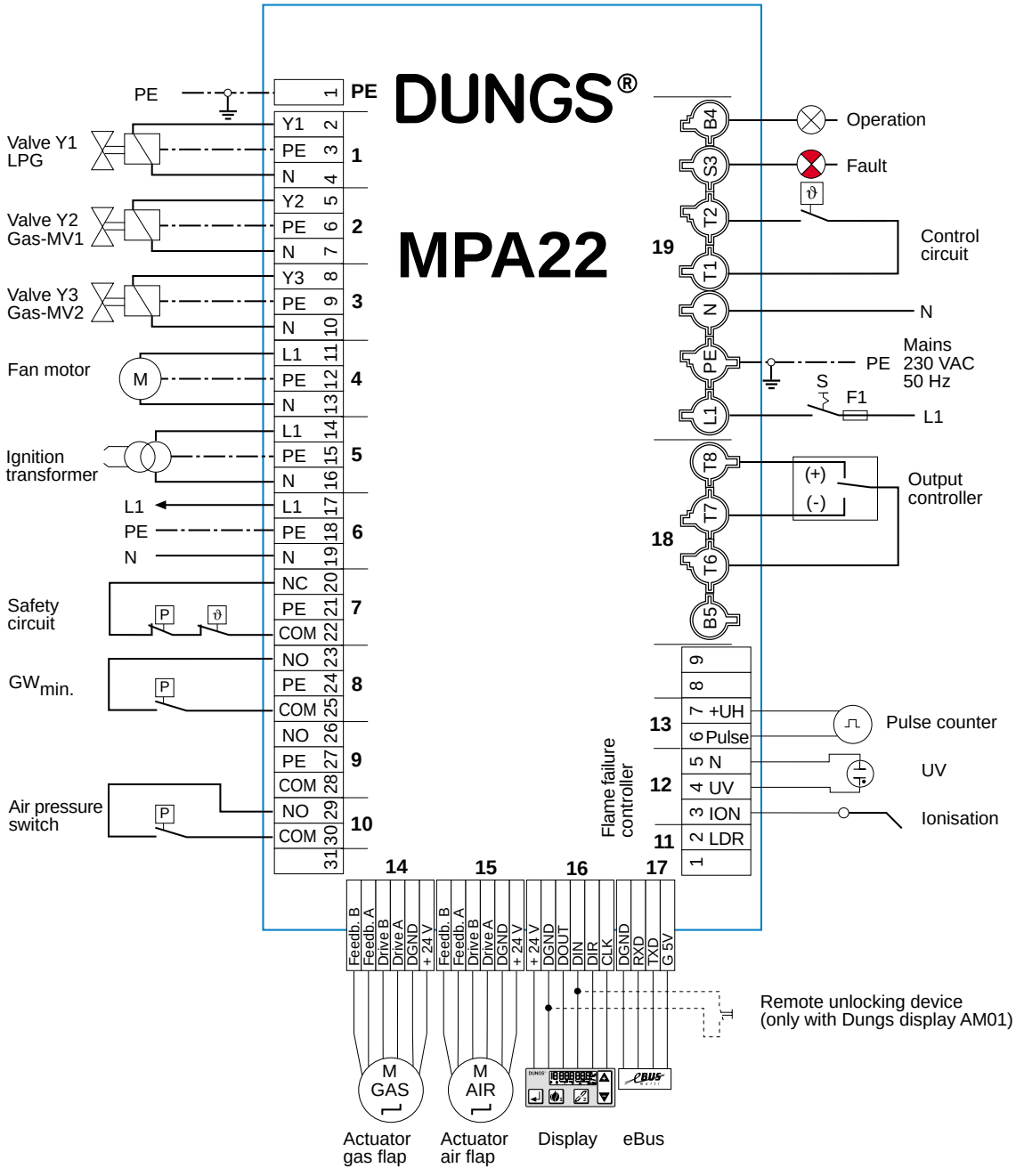
■ **Two servomotors**

Both servomotors connected.
Make sure you comply with the burner manufacturer's specifications.

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# Operating mode
# Gas firing, pneumatic modulation

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## ■ Configuration
**Gas firing, pneumatic modulation**

Servomotor air plugged in.
**Coding plug gas** plugged in instead of servomotor.

## ■ Functional sequence
**Gas firing, pneumatic modulation**

The internal self-tests are performed when the regulator issues a heating request.
The servomotor air locates its reference point and then the servomotor air moves to pre-purge position P9.
The idle position of the air pressure switch is checked and the flame monitoring device is checked for flame simulation. If these checks are passed, the blower is energised.
When the air pressure switch is closed, the preset pre-purge period elapses and the remaining pre-purge period is displayed. Pre-purging is monitored by LGW.
If a valve test has still not been performed after a power failure or fault shut-down and the valve proving function is selected, a valve test and restart are performed after the pre-purge period has expired.

Otherwise, the external valve Y1 (liquid gas) opens and the servomotor air moves to ignition point P0 after the pre-purge period has expired. After the servomotor air has reached the ignition point P0, the ignition is turned on for the preset pre-purge period (with pre-ignition period = 2 s).
Valve Y2 is opened one second before the startup safety period commences (the ignition is also turned on if pre-ignition period = 1s). The gas pressure switch GW_min must indicate the presence of gas pressure within this period of time. Otherwise, a safety shut-down will be triggered and the gas fail-safe program executed.
If gas pressure is present after 1 second, the ignition is turned on (if pre-ignition period = 0) and valve Y3 is opened. The ignition is turned off at the end of the safety period and, provided that a flame is present, the servomotor remains in the ignition position for the preset stabilising time. After the stabilising time has expired, the servomotor runs to position P1 and dwells there for 8 s.
The automatic burner control is now in the service position.
If the MPA22 has already been in service for 24 hours, a controlled shut-down is executed automatically.
If the heating request is cancelled, a controlled shut-down takes place. If the leakage check is not activated, valves Y2, Y3 and the external valve close and the blower runs on for the preset postventilation period. If the leakage check function is activated, a leakage check is performed on gas valves Y2 and Y3 by means of GW_VPS which is fitted in between valves Y2 and Y3. The postventilation period elapses in parallel with the leakage check. After the blower has been switched off, the servomotor air moves to the preset standby position. A restart lockout time (the time is displayed) now elapses (if set) or the automatic burner control enters standby mode (readout on display = OFF).

## ■ Response to faults
**Gas firing, pneumatic modulation**

If no flame is present after the startup safety period has elapsed, a safety shut-down takes place and executes a RESTART (if permitted). A fault lockout is triggered otherwise.
If the presence of a flame is not indicated after a restart attempt, a fault shut-down takes place and the burner enters the non-variable fault state.
If flame failure occurs while the burner is operating, the burner is restarted (if set in the EEPROM). Otherwise, a fault shut-down takes place and the burner enters the non-variable fault state.
In the event of a fault shut-down, all valves are closed and the blower and ignition are turned off.
If the presence of a flame is signalled before the gas is enabled, the automatic burner control enters the non-variable fault state.
If a malfunction occurs during the start-up phase or operating phase, a safety shut-down will be triggered. Depending upon the nature of the fault, the burner either enters the non-variable fault state or the start-up attempt is repeated. After 5 failed attempts, the automatic burner control enters the non-variable

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■ **Gas pressure switching**
**Gas fail-safe program for gas burners with pneumatic modulation**

Gas pressure switch GW_min is fitted upstream of the two gas valves of the Ratio control.
If a pressure sufficient to actuate gas pressure switch GW_min does not build up one second before the startup safety period commences, burner start-up is interrupted. The valves are closed and the blower is switched off. The automatic burner control waits for 2 minutes before repeating the start-up attempt.
If there is a still a shortage of gas after this 2-minute wait, the start-up attempt is repeated a third time after waiting another 2 minutes.
After the third failed start-up attempt, the burner waits for an hour before attempting another restart.
This function does not give rise to a fault lockout in the event of a gas shortage and reduces the frequency of start-up attempts if a gas shortage exists over a lengthy period of time.

Examples of a display during the wait period: 18 1-23 (= 1 minute 23 s remaining waiting time)

The waiting time can only be reset by disconnecting the voltage supply to the device (turn main switch OFF or disconnect the 7-pole connector).

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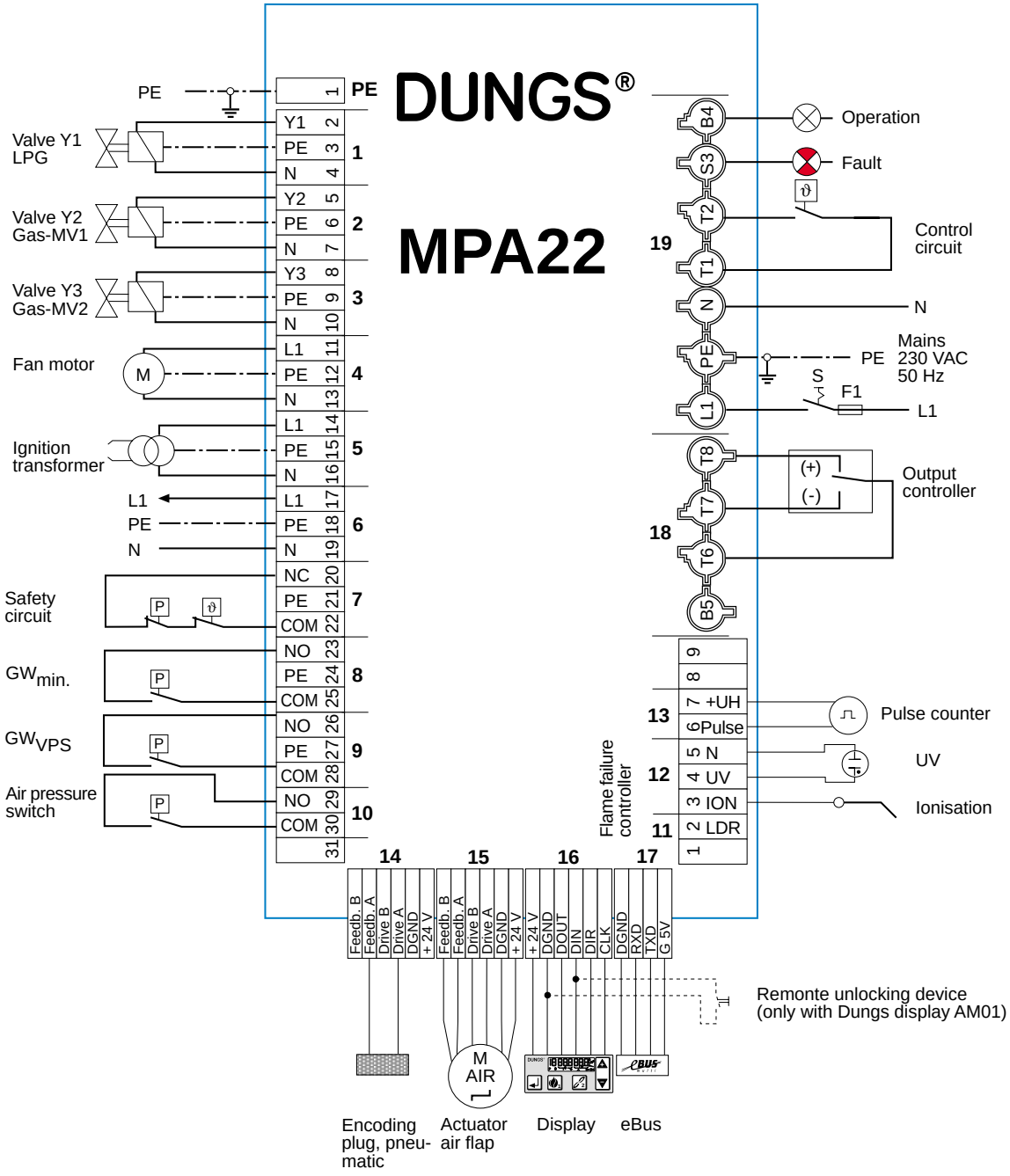
# Terminal diagram
# Gas firing, pneumatic modulation

DUNGS®

■ **Coding plug**
**Gas firing, pneumatic modulation**

Coding plug “gas single-stage” plugged in instead of “servomotor gas”. Make sure you comply with the burner manufacturer’s specifications.

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## ■ Configuration Oil firing, three stage

Servomotor air plugged in
**Coding plug oil** plugged in instead of servomotor gas.

## ■ Functional sequence Oil firing, three stage

The internal self-tests are performed when the regulator issues a heating request.
The servomotor air locates its reference point and then the servomotor air moves to preventilation position P9. Once the servomotor reaches this position, a 5-second delay commences.
The air pressure switch is checked for idle state and the flame monitoring device is checked for flame simulation. If these checks are passed, the blower and the ignition are turned on.
The preset pre-purge period elapses and the remaining pre-purge period is displayed. If the switch function has been activated, the preventilation cycle is monitored 3 s after switching on the blower. To ensure that the preventilation cycle is executed at the max. possible flow rate, the desired time should be increased by 3 s in the EEPROM. Once the pre-purge period elapses, the servomotor air moves to ignition point P0 and dwells there for 2 seconds, opens valve Y1 and (if exist) an additional pre-valve connected in parallel with Y1.
The ignition cuts out at the end of the preset safety period and, provided that a flame is present, the servomotor air dwells in the ignition position for the preset stabilizing time. When the watchdog function is activated, oil pressure switch input (GW_min) is monitored after the valve opens. If you want to monitor the air pressure but not the gas pressure, a bridge can be attached to inlet GW_min as a substitute.

After the stabilising time elapses, the servomotor air moves to position P1 (stage 1) and remains in this position for approx. 8 seconds. The automatic burner control is now in the service position and accepts the signals applied to the capacity control inputs for the second and third stages (Stage 2 and Stage 3).
Changeover to the high load setting takes place within 6 seconds after the signal is applied.
Changeover from the first stage to the second stage takes place within 6 s after the contact of the second stage closes. The servomotor air moves to the second stage P3 via changeover point P2 within $t < 3$ s, and valve Y2 (second stage) is connected when the servomotor passes the changeover point.

Changeover from the second stage to the third stage takes place within 6 s after the contact of the third stage closes. The servomotor air moves to the third stage P9 via changeover point P4 within $t < 3$ s, and valve Y3 (third stage) is connected when the servomotor passes the changeover point.

Changeover to the next lower stage is implemented in the reverse order.
Once a changeover has been initiated it is completed.
If the MPA22 has already been in service for 24 hours, a controlled shut-down is executed automatically.
If the heating request is cancelled, a controlled shut-down takes place. Valves Y1, Y2 and Y3 close and the blower runs on for the preset postventilation period. After the blower has been switched off, the servomotor air moves to the preset standby position. A restart lockout time (the time is displayed) now elapses (if set) or the automatic burner control enters standby mode (display = OFF).

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## ■ Response to faults Oil firing, three stage

If no flame is present after the startup safety period has elapsed, the burner enters the non-variable fault state.
If flame failure occurs while the burner is operating, a fault shut-down takes place and the system executes a restart. If the presence of a flame is not signalled, the system enters the non-variable fault state.
In the event of a fault shut-down, all valves are closed and the blower and ignition are turned off.
If the presence of a flame is signalled before the gas is enabled, the automatic burner control enters the non-variable fault state.
The type of fault or disturbance is displayed.
If air pressure switch failure is detected during the startup period, provided the watchdog function is activated, a safety shut-down takes place and 5 restart attempts are performed; if this occurs when the burner is operating, the automatic burner control enters the non-variable fault state.
If the oil pressure drops, the automatic burner control enters the non-variable fault state.

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# Terminal diagram
# Oil firing, three stage

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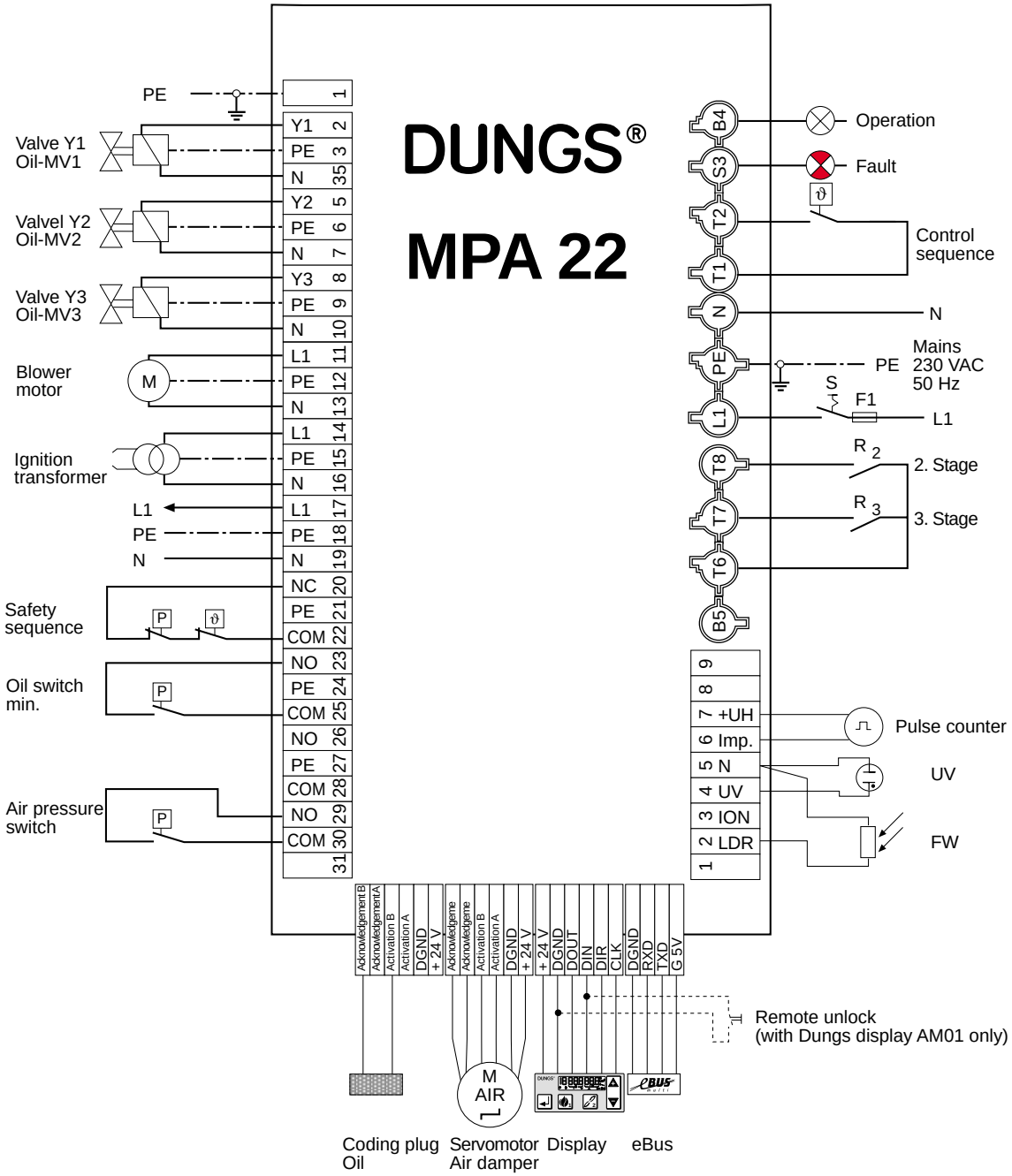
■ **Coding plug**
**Oil firing, three stage**

Coding plug „oil firing, three stage“ plugged in instead of “servomotor gas”.
Make sure you comply with the burner manufacturer’s specifications.

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■ **Valve test, gas burner**

The valve proving function can be enabled or disabled in parameterisation mode.
After a power failure or a fault unlock, the gas valves are always subjected to a leakage check before the burner is started. Otherwise, a leakage check is always performed after a controlled shut-down of the burner.

■ **Gas burner, electronic modulation**

Only a gas pressure switch is used to check the gas valves for leaks and monitor the minimum gas pressure. The gas pressure switch must be connected in the circuit between valve Y2 and valve Y3. A leakage check can thus be performed without the need for additional devices.

■ **Gas burner, pneumatic modulation**

A separate gas pressure switch (GW_VPS) is required to test the gas valves for leaks. The gas pressure switch must be connected in the circuit between valve Y2 and valve Y3.

■ **Functional sequence**

After a controlled shut-down, valve Y3 is closed after a 2-second delay. The external valve remains open. The test section is thus rendered pressureless. The gas pressure switch must have switched off (open). Test period V1 for the first valve (Y2) on the gas side now commences.
During the test period, a pressure sufficient to activate the gas pressure switch must not build up inside the test section, otherwise a fault shut-down will take place and the fault code for “valve 1 leaky” displayed.
At the end of test period V1, valve Y2 is opened for 1 s. The gas pressure switch must switch over within this period of time and indicate the presence of gas pressure, otherwise all valves are closed and the gas fail-safe program is executed.
Once the period of time has elapsed, valve Y2 and the external pilot valve are closed.
During the test period for valve Y3, a pressure drop below the operating point of the preset minimum gas pressure must not occur, otherwise a fault shut-down will take place and the fault code for “valve 2 leaky” displayed.

■ **Test times for valve Y2 and valve Y3 are derived from:**

- The volume of gas trapped in between valve Y2 and valve Y3
- The preset pressure switching points
- The gas mains pressure applied
- The permissible leakage rate

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# Time diagram
# Gas firing, electronic modulation

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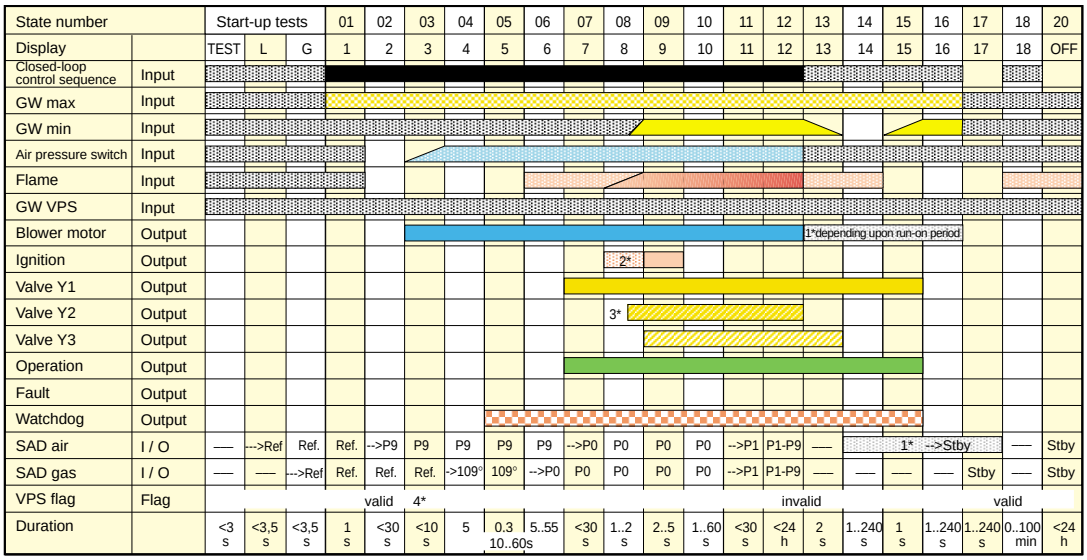
**Start and controlled shut-down with flame and active valve proving system**
**Test already performed at last controlled shut-down**




**Time diagrams for MPA22 gas burner, electronic modulation**

Definitions of individual states

| | |
|---|---|
| Start-up tests | Processor and program memory test/move servomotor to reference point |
| State 01 | Start-up decision (heating request issued) |
| State 02 | Idle state check, blower |
| State 03 | Blower start-up |
| State 04 | Pre-ventilation / move servomotor gas over full rotational range |
| State 05 | Pre-ventilation / energize and test watchdog |
| State 06 | Pre-ventilation / move servomotor gas to ignition position |
| State 07 | Move servomotor air to ignition position |
| State 08 | Pre-ignition (depending upon parameters) |
| State 09 | Start-up safety period |
| State 10 | Stabilising time |
| State 11 | Move servomotor from ignition point to operating characteristic |
| State 12 | Operation |
| State 13 | Evacuate VPS valve space / (postventilation) |
| State 14 | Test time Y2 / (remaining postventilation time) |
| State 15 | Fill VPS valve space / (remaining postventilation time) |
| State 16 | Test time Y3 / (remaining postventilation time) |
| State 17 | Remaining postventilation time |
| State 18 | Restart lockout time / wait time loop for gas fail-safe function |
| State 20 | Start-up wait state (standby) |
| State 21 | Postventilation before error |

Footnotes:

1* The blower runs during the leakage test until the postventilation period elapses. The servomotor air then enters standby state.

2* The pre-ignition cycle is started 0, 1 or 2 s before the start-up safety period commences, depending on the setting in the EEPROM.

3* Valve Y2 (SV) always opens 1s before the start-up safety period commences so the GWmin can detect the presence of gas pressure.

4* After a controlled shut-down a leakage test is performed on the valves, provided the VPS is active. The VPS flag is then set to „valid“. If the VPS flag is invalid, e.g. after a power outage or safety shut-down in state 08 to 16, the leakage test is performed before the main valves are opened.

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# Time diagram
# Gas firing, electronic modulation

DUNGS®

## Start without flame after start-up safety period
## 1 restart permitted, valve proving system inactive

| State number | | Start-up tests | | | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | Start-up tests | | | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 99 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Display | | TEST | L | G | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | TEST | L | G | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | F xxh |
| Closed-loop control sequence | Input | | | | | | | | | | | | | | | | | | | | | | | | | |
| GW max | Input | | | | | | | | | | | | | | | | | | | | | | | | | |
| GW min | Input | | | | | | | | | | | | | | | | | | | | | | | | | |
| Air pressure switch | Input | | | | | | | | | | | | | | | | | | | | | | | | | |
| Flame | Input | | | | | | | | | | | | | | | | | | | | | | | | | |
| GW VPS | Input | | | | | | | | | | | | | | | | | | | | | | | | | |
| Blower motor | Output | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ignition | Output | | | | | | | | | | | 2* | | | | | | | | | | | | 2* | | |
| Valve Y1 | Output | | | | | | | | | | | | | | | | | | | | | | | | | |
| Valve Y2 | Output | | | | | | | | | | | 3* | | | | | | | | | | | | 3* | | |
| Valve Y3 | Output | | | | | | | | | | | | | | | | | | | | | | | | | |
| Operation | Output | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fault | Output | | | | | | | | | | | | | | | | | | | | | | | | | |
| Watchdog | Output | | | | | | | | | | | | | | | | | | | | | | | | | |
| SAD air | I / O | — | -->Ref | Ref. | Ref. | -->P9 | P9 | P9 | P9 | P9 | -->P0 | P0 | P0 | — | -->Ref | Ref. | Ref. | -->P9 | P9 | P9 | P9 | P9 | -->P0 | P0 | P0 | — |
| SAD gas | I / O | — | — | -->Ref | Ref. | Ref. | Ref. | ->109° | 109° | -->P0 | P0 | P0 | P0 | — | — | -->Ref | Ref. | Ref. | Ref. | ->109° | 109° | -->P0 | P0 | P0 | P0 | — |
| VPS flag | Flag | disregarded 4* | | | | | | | | | | | | | | | | | | | | | | | | |
| Duration | | <3 s | <3,5 s | <3,5 s | 1 s | <30 s | <10 s | 5 | 0.3 10..60s | 5..55 | <30 s | 1..2 s | 2..5 s | <3 s | <3,5 s | <3,5 s | 1 s | <30 s | <10 s | 5 | 0.3 10..60s | 5..55 | <30 s | 1..2 s | 2..5 s | |

## Flame failure during operation
## 1 restart permitted, valve proving system inactive

| State number | | >---> | 12 | 12 | 21 | Start-up tests | | | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 21 | 99 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Display | | | 12 | 12 | | TEST | L | G | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | | F xxh |
| Closed-loop control sequence | Input | >---> | | | | | | | | | | | | | | | | | |
| GW max | Input | >---> | | | | | | | | | | | | | | | | | |
| GW min | Input | >---> | | | | | | | | | | | | | | | | | |
| Air pressure switch | Input | >---> | | | | | | | | | | | | | | | | | |
| Flame | Input | >---> | | | | | | | | | | | | | | | | | |
| GW VPS | Input | >---> | | | | | | | | | | | | | | | | | |
| Blower motor | Output | >---> | | | | | | | | | | | | | | | | | |
| Ignition | Output | >---> | | | | | | | | | | | | | | 2* | | | |
| Valve Y1 | Output | >---> | | | | | | | | | | | | | | | | | |
| Valve Y2 | Output | >---> | | | | | | | | | | | | | | 3* | | | |
| Valve Y3 | Output | >---> | | | | | | | | | | | | | | | | | |
| Operation | Output | >---> | | | | | | | | | | | | | | | | | |
| Fault | Output | >---> | | | | | | | | | | | | | | | | | |
| Watchdog | Output | >---> | | | | | | | | | | | | | | | | | |
| SAD air | I / O | >---> | P1-P9 | P1-P9 | — | — | --->Ref | Ref. | Ref. | -->P9 | P9 | P9 | P9 | P9 | -->P0 | P0 | P0 | — | — |
| SAD gas | I / O | >---> | P1-P9 | P1-P9 | — | — | — | --->Ref | Ref. | Ref. | Ref. | ->109° | 109° | -->P0 | P0 | P0 | P0 | — | — |
| VPS flag | Flag | disregarded | | | | | | | | | | | | | | | | | |
| Duration | | | <24 h | <1 s | 2 s | <3 s | <3,5 s | <3,5 s | 1 s | <30 s | <10 s | 5 | 0.3 10..60s | 5..55 | <30 s | 1..2 s | 2..5 s | 2 s | |

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# Time diagram
# Gas firing, pneumatic modulation

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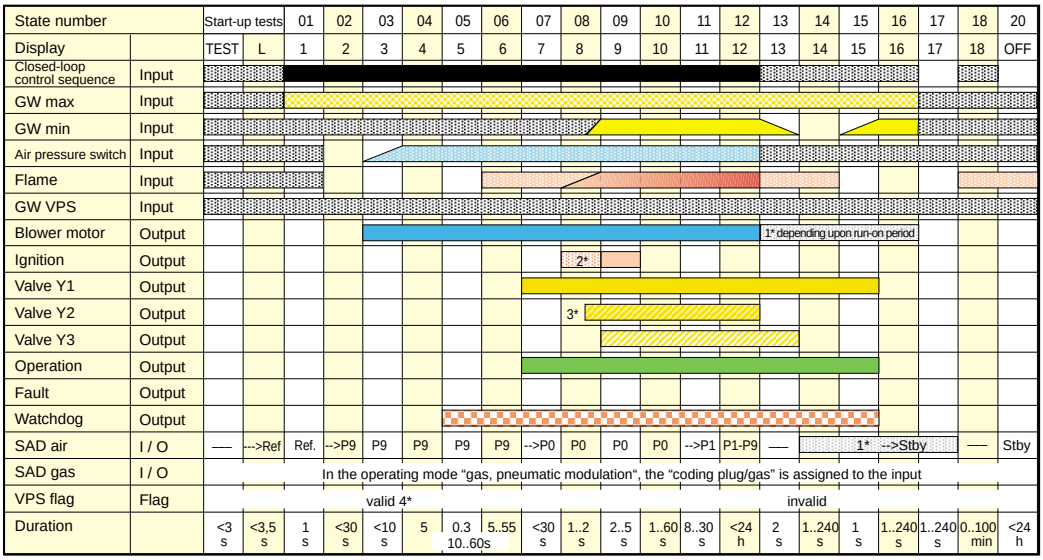
**Start and controlled shut-down with flame and valve proving system active**
**Test performed during previous controlled shut-down**




**Time diagram for MPA22 gas burner, pneumatic modulation**

Definitions of individual states

| | |
|---|---|
| Start-up tests | Processor and program memory test/move servomotor to reference point |
| State 01 | Start-up decision (heating request issued) |
| State 02 | Idle state check, blower |
| State 03 | Blower start-up |
| State 04 | Pre-ventilation |
| State 05 | Pre-ventilation / energize and test watchdog |
| State 06 | Pre-ventilation |
| State 07 | Move servomotor air to ignition position |
| State 08 | Pre-ignition (depending upon parameters) |
| State 09 | Start-up safety period |
| State 10 | Stabilising time |
| State 11 | Move servomotor from ignition point to operating characteristic |
| State 12 | Operation |
| State 13 | Evacuate VPS valve space / (postventilation) |
| State 14 | Test time Y2 / (remaining postventilation time) |
| State 15 | Fill VPS valve space / (remaining postventilation time) |
| State 16 | Test time Y3 / (remaining postventilation time) |
| State 17 | Remaining postventilation time |
| State 18 | Restart lockout time / wait time loop for gas fail-safe function |
| State 20 | Start-up wait state (standby) |
| State 21 | Postventilation before error |

Footnotes:

1* The blower runs during the leakage test until the postventilation period elapses. The servomotor air then enters standby state.

2* The pre-ignition cycle is started 0, 1 or 2 s before the start-up safety period commences, depending on the setting in the EEPROM.

3* Valve Y2 (SV) always opens 1s before the start-up safety period commences so the GWmin can detect the presence of gas pressure.

4* After a controlled shut-down a leakage test is performed on the valves, provided the VPS is active. The VPS flag is then set to „valid". If the VPS flag is invalid, e.g. after a power outage or safety shut-down in state 08 to 16, the leakage test is performed before the main valves are opened.

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# Time diagram
# Gas firing, pneumatic modulation

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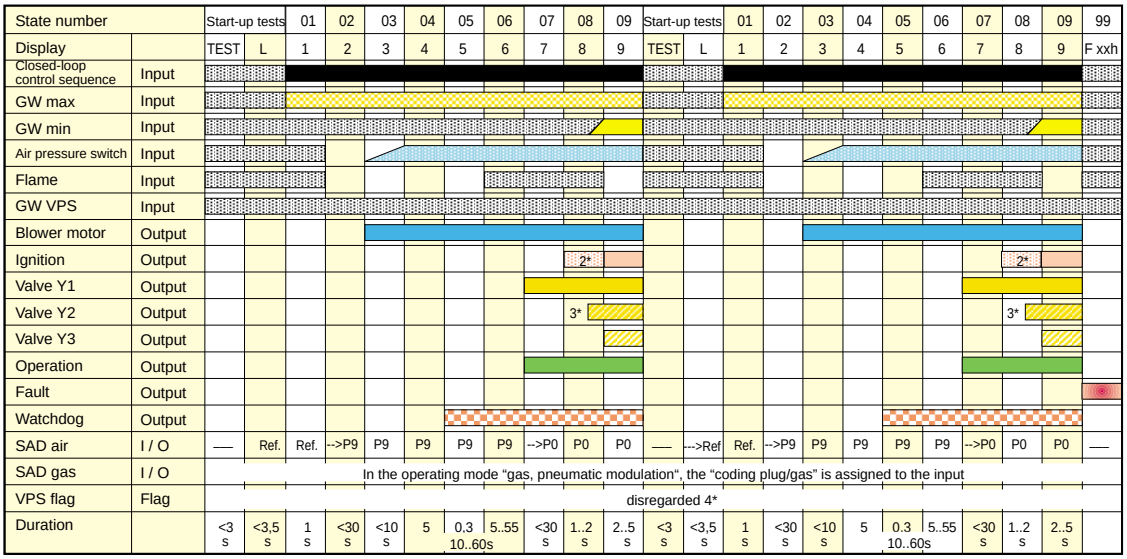
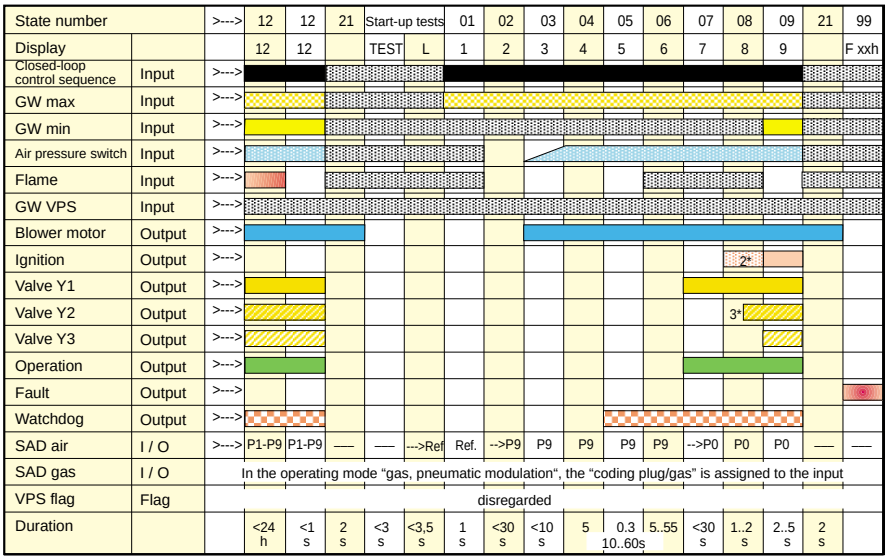
## Start without flame after start-up safety period
## 1 restart permitted, valve proving system inactive




## Flame failure during operation
## 1 restart permitted, valve proving system inactive

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# Time diagram
# Oil firing, three stage

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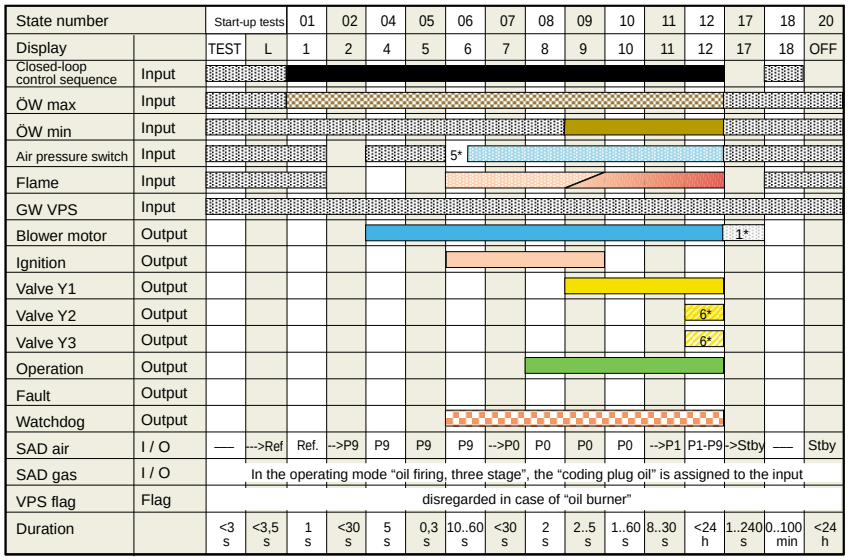
**Start and controlled shut-down with flame**
**Watchdog function active**




**Time diagram for MPA22 oil firing, three stage**

Definitions of individual states

| | |
|---|---|
| Start-up tests | Processor and program memory test/move servomotor to reference point |
| State 01 | Start-up decision (heating request issued) |
| State 02 | Idle state check, blower |
| State 03 | not used |
| State 04 | Pre-ventilation |
| State 05 | Pre-ventilation / energize and test watchdog |
| State 06 | Pre-ventilation |
| State 07 | Move servomotor air to ignition position |
| State 08 | Waiting time in ignition position |
| State 09 | Start-up safety period |
| State 10 | Stabilising time |
| State 11 | Move servomotor from ignition point to first stage |
| State 12 | Operation |
| State 17 | Remaining postventilation time |
| State 18 | Restart lockout time |
| State 20 | Start-up wait state (standby) |
| State 21 | Postventilation before error |

Footnotes:

1* The blower runs during the leakage test until the postventilation period elapses. The servomotor air then enters standby state.

2* The blower starts with State 06 and has 3s for start-up. The air pressure is now monitored, provided that the watchdog function is active.
=> To ensure that the pre-purge is performed at the max. possible flowrate, the pre-purge period should be increased by 3s in the EEPROM.

3* Valve Y2 is activated in stage 2 and valves Y2 + Y3 are activated in stage 3 depending on power input demand or eBUS default and air damper position.

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# Time diagram
# Oil firing, three stage

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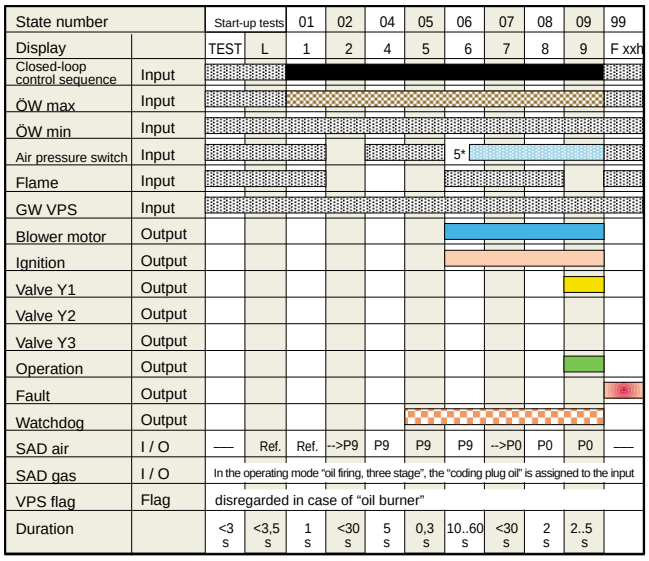
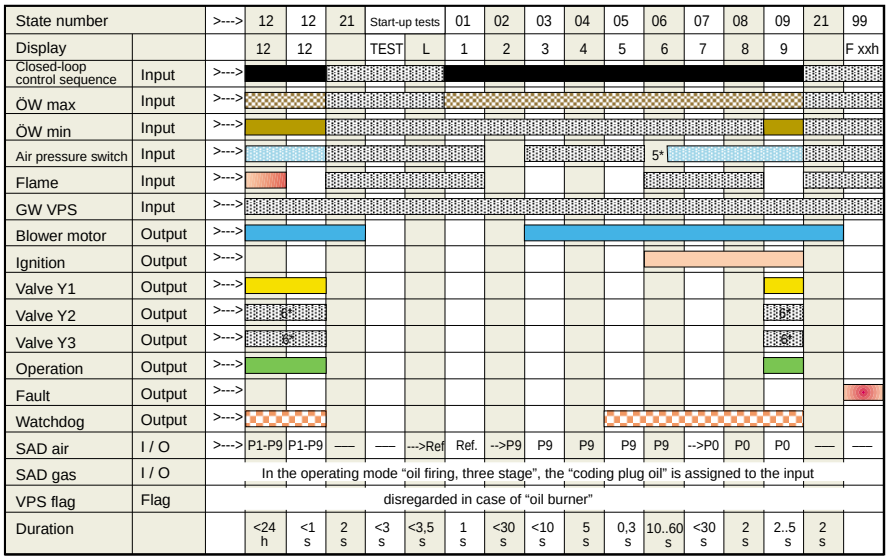
## Start without flame after start-up safety period




## Flame failure during operation

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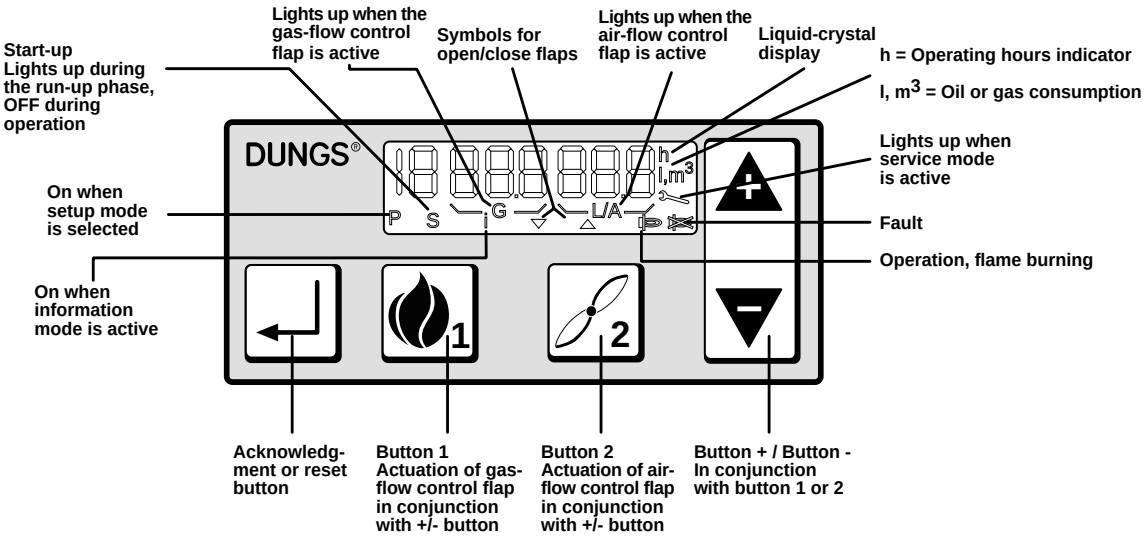
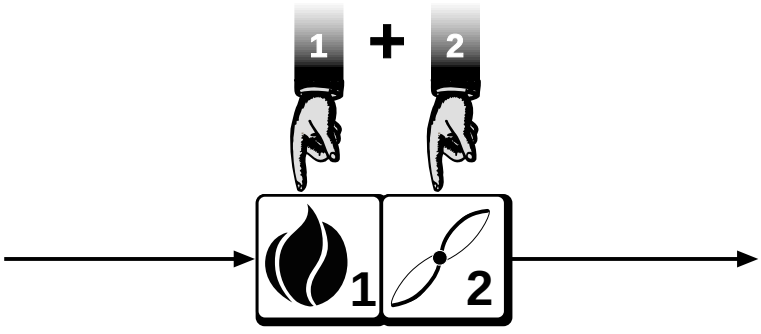
## ■ Display elements

The MPA22 is controlled by means of 5 buttons on the touch-sensitive display. The individual parameters are displayed on the liquid-crystal display.




## ■ Using the buttons

⚠ **Combinations of two or three buttons: always press the buttons simultaneously. Note the direction of progress (arrows).**

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| | |
|---|---|
| ■ **Setup mode** | Gas, electronic modulation<br>Gas, pneumatic modulation<br>Oil, three stage |
| ■ **Display functions** | Operating mode<br>Information mode<br>Service mode |
| ■ **Parameterisation mode** | Parameterisation mode is password-protected. |
| ■ **Error indication** | System error messages<br>Error messages |

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# Relationships between the individual display modes

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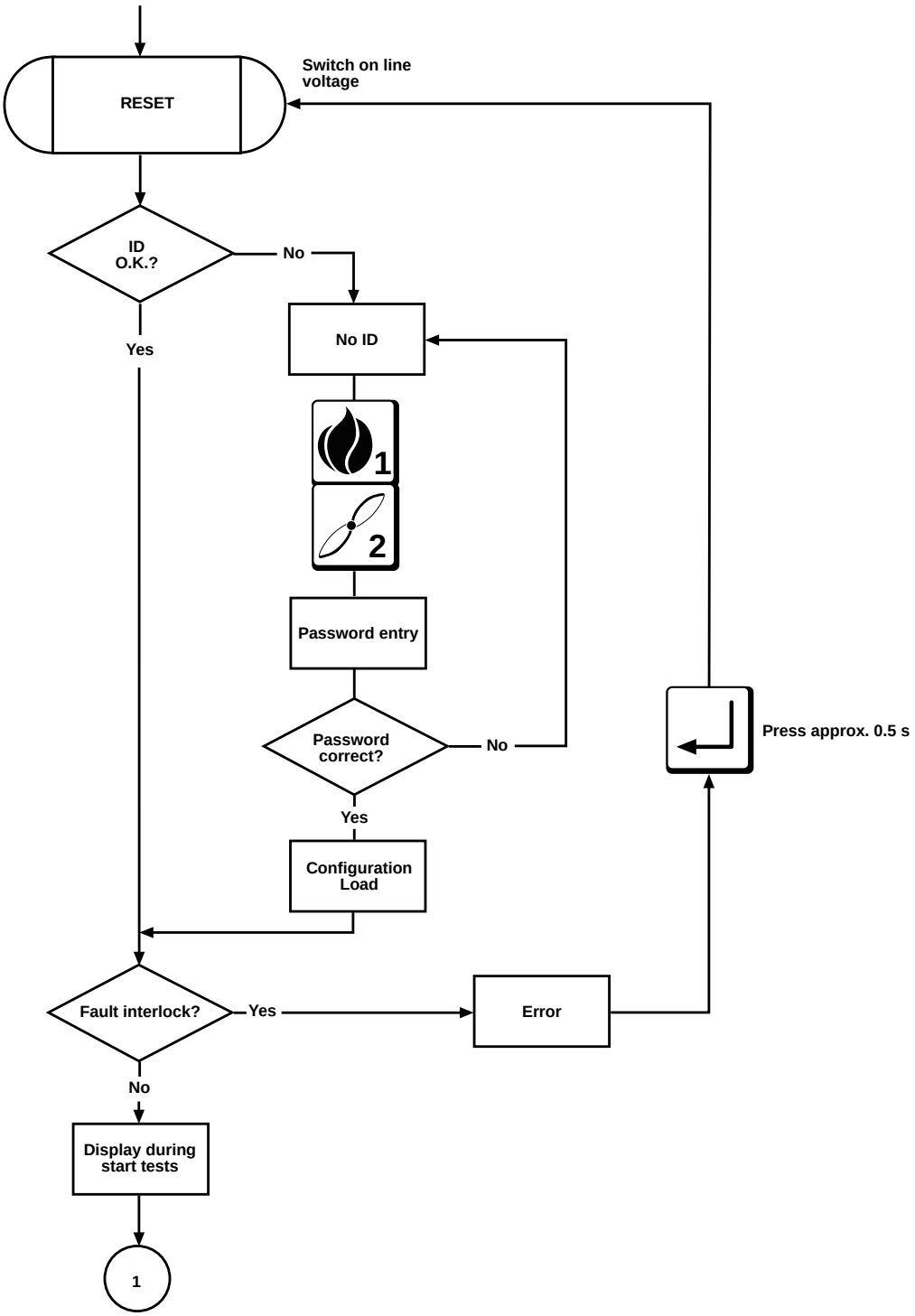


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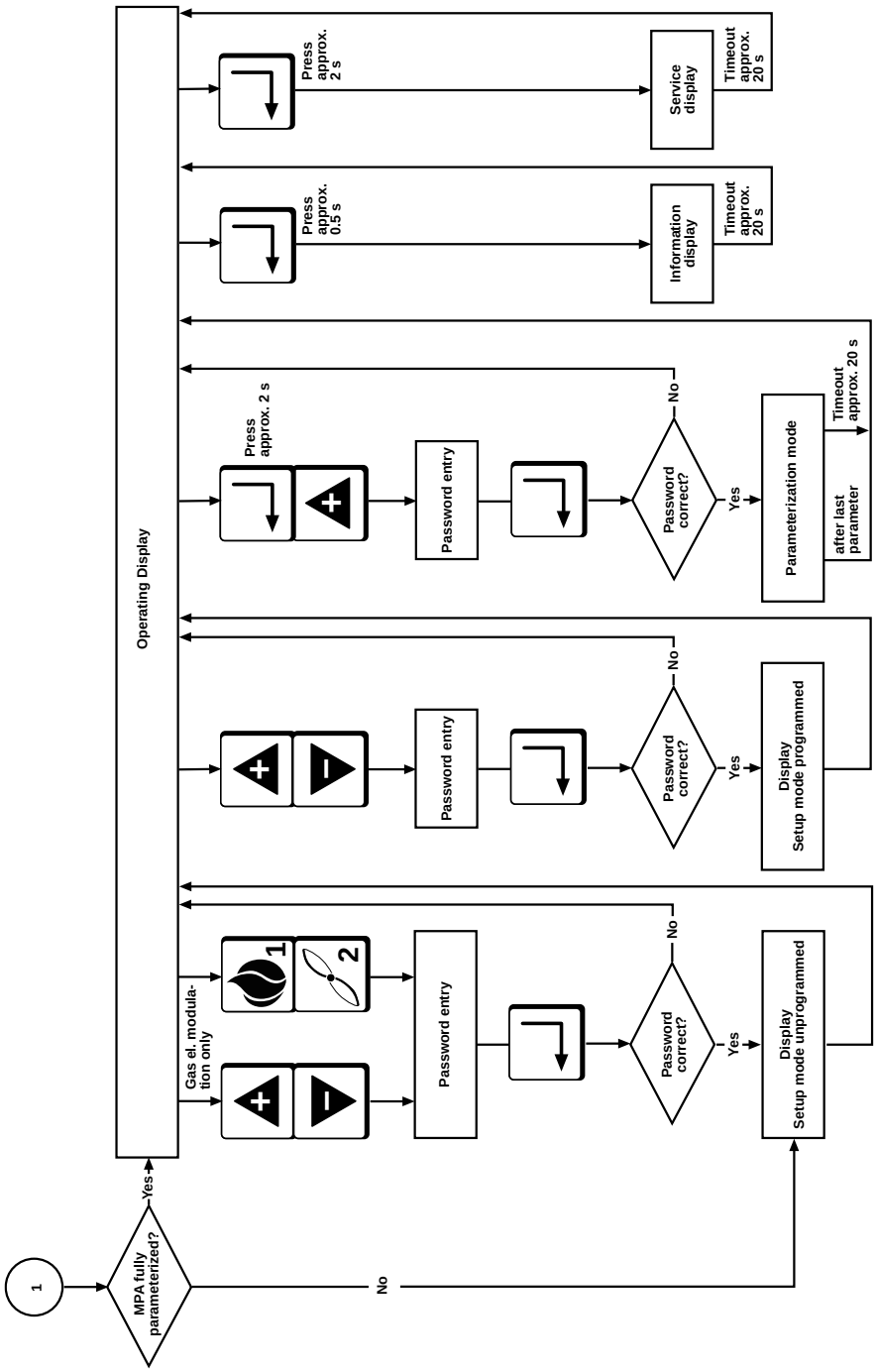
## Relationships between the individual display modes

DUNGS®

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## Display during standby

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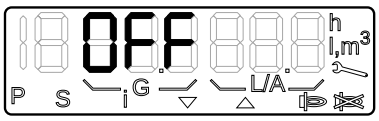
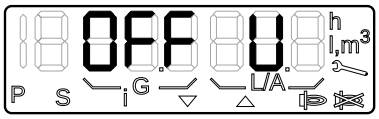
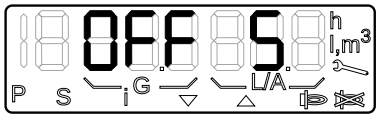


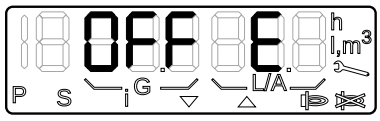

The automatic burner-control system is on standby following a controlled shut-down. No pending request for heat.




The automatic burner-control system is on standby because line voltage is too low.




The automatic burner-control system is on standby because the safety chain is interrupted at input GWmax.




The automatic burner-control system is on standby because the signal for start prevention is applied via the eBUS.

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# Display when a password is entered in parameterization or setup mode

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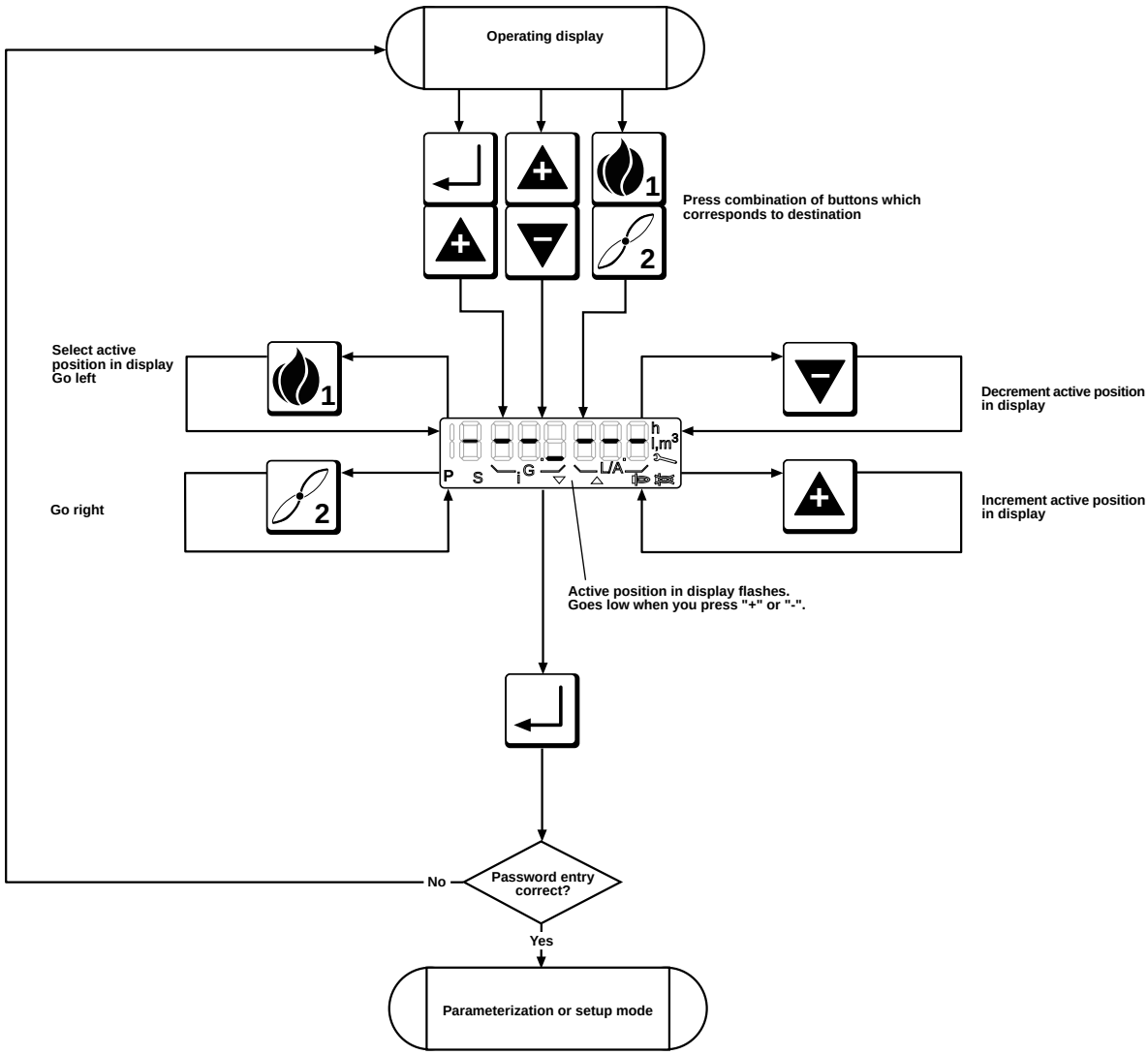


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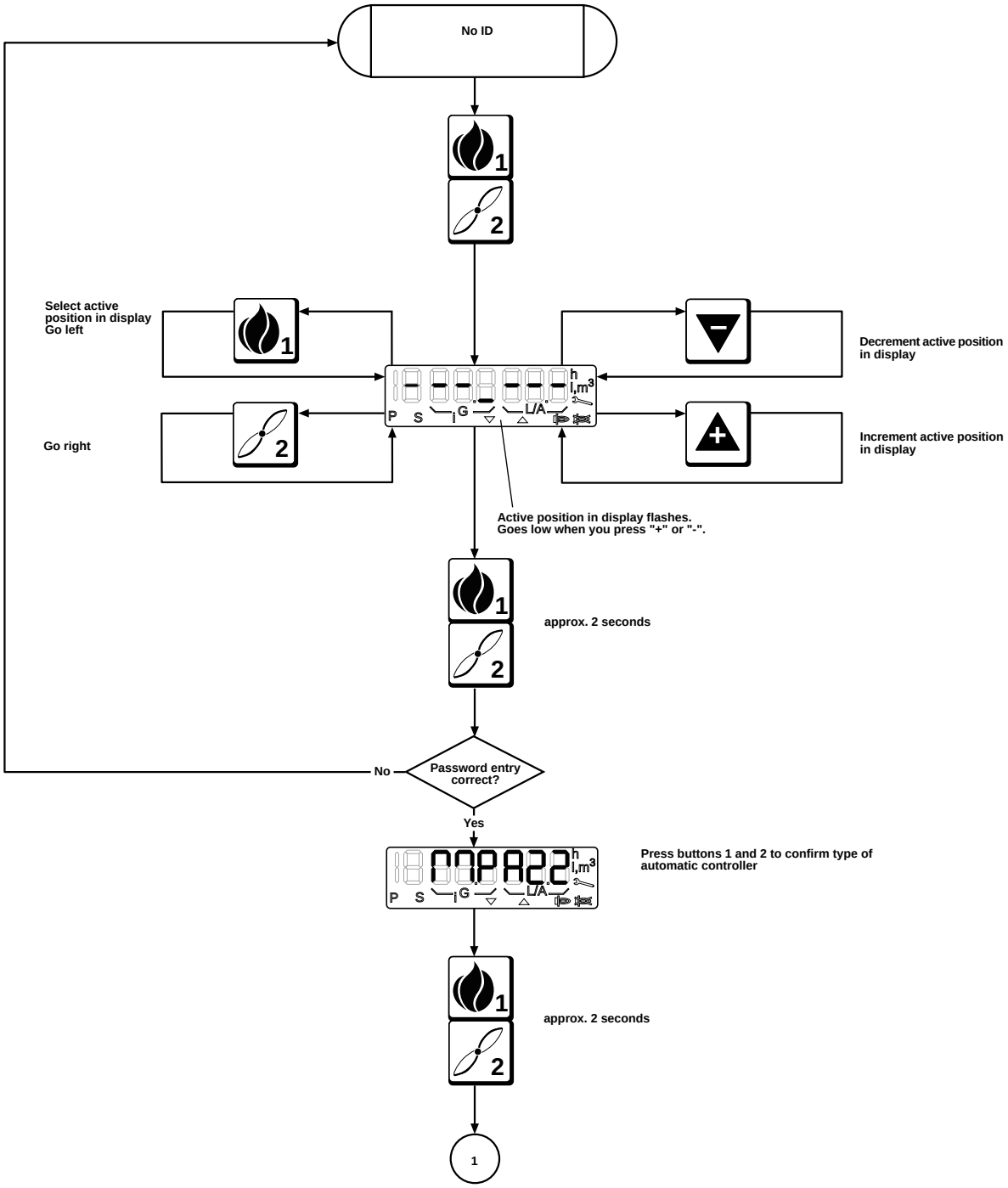
## Display when the basic configuration is entered

DUNGS®

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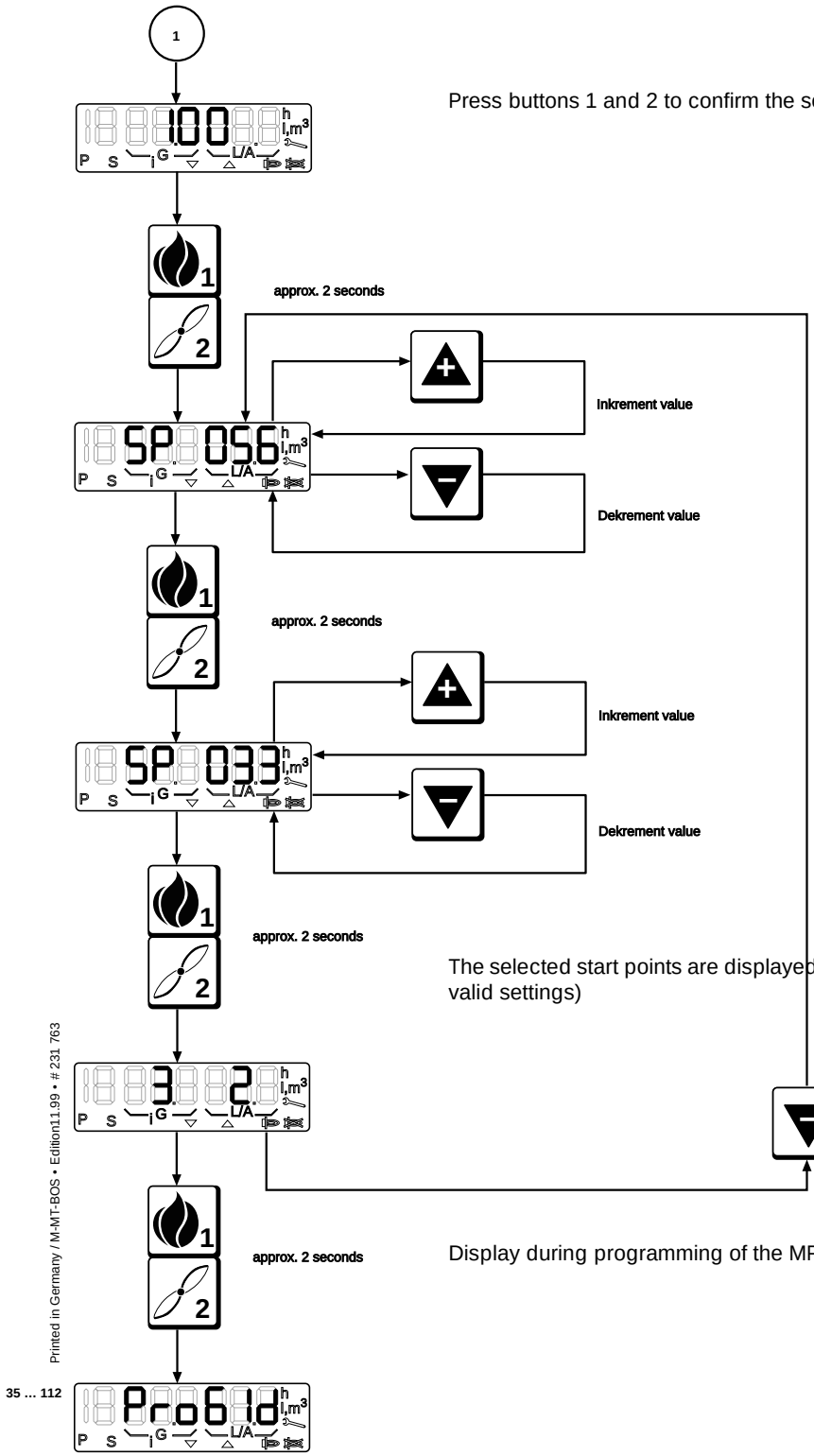
## Display when the basic configuration is entered

DUNGS®




Press buttons 1 and 2 to confirm the software version.

Setting for the air motor's start point.
Valid settings are:

| | | | |
|---|---|---|---|
| 073 | Ref. A | 0° | (0) |
| 005 | Ref. A | 90° | (1) |
| 209 | Ref. B | 90° | (2) |
| 157 | Ref. B | 0° | (3) |

Setting for the gas motor's start point.
Valid settings are:

| | | | |
|---|---|---|---|
| 067 | Ref. A | 0° | (0) |
| 015 | Ref. A | 109° | (1) |
| 219 | Ref. B | 109° | (2) |
| 151 | Ref. B | 0° | (3) |

If you set an invalid start point, the cursor returns to the start of the NOID display.

The selected start points are displayed (see numbers in parentheses in list of valid settings)

Display during programming of the MPA with default values.

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■ **Prior to commissioning, make sure that all connections are correct.**

■ **Check the following safety functions for commissioning:**

■ **Shutdown of the controllers, monitors and limiters (as installed)**
■ **switching points of gas-pressure switch**
■ **Flame monitor**
■ **Set times and operating modes**

⚠ **It is important to step the automatic burner-control system at least once through the entire setup procedure for the appropriate operating mode. Only then is the automatic burner-control system programmed for automatic operation in this mode.**

■ **Setup instructions, setup procedures**

■ **In setup mode**

When operating voltage is applied, the MPA22 automatic burner-control system performs a startup test and then displays "OFFUPr".
This means that no setup procedure has been completed as yet.

The MPA22 automatic burner-control system has separate setup procedures for each operating mode and characteristic-map memories which are backed up separately for each operating mode.

A "P" is displayed while setup is in progress. This mode has a 30-minute timeout; the timer is reset each time you press a button on the touch-sensitive display. If the timeout expires a safety shutdown is triggered and the "OFFUPr" message reappears in the automatic burner-control system's display.
The purpose of this timeout is to prevent incomplete setup causing the burner to remain on for a prolonged period of time.

All safety functions are activated during the setup procedure, just as in normal operation. The only difference is that the servomotors can be brought to the limits specified in the setup mode. As in normal operation, flame failure, air-pressure monitor failure or a fault in servomotor drive and feedback, or other, similar faults result in a fault-triggered or safety shutdown.

Setup has to be repeated if a fault-triggered, safety or controlled shutdown occurs during the setup procedure. The values entered beforehand are retained, on condition that they pass the plausibility check which takes place on startup.

You must enter a password before you can set the parameters of the MPA22 automatic burner-control system.

⚠ **Consult the operating instructions for the burner connected to the MPA22 for detailed settings.**

The first step is always to set the automatic burner-control system to setup mode: Simultaneously press buttons "1" and "2".

A prompt asking you to enter the password appears on the display:

EOI 1 **Setup mode: oil, three-stage**

EGAS Pn **Setup mode: gas, pneumatic modulation**

EGAS EL **Setup mode: gas, electronic modulation**

⚠ **If the mode displayed does not match the burner, check the wiring, the terminals of the servo drives and the coding plugs.**

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■ **Begin by setting the main parameters for the individual operating modes**

The sequence for the main parameters is invariable, because they are interrelated by certain dependencies and limit values and these limits are constantly checked and rechecked during the setup procedure.

■ **Main parameters for oil, three-stage Sequence**

⚠ **Only the servomotor for air can be parameterized.**

| Main parameter | Minimum | Maximum |
|---|---|---|
| P9 = Stage 3 | 00.0° | 90.0° |
| P3 = Stage 2 | 00.0° | P9-0.1° |
| P1 = Stage 1 | 00.0° | P3-0.1° |
| P0 = Ignition point | 00.0° | P1 |
| P2 = Changeover point | P1+0.1° | P3 |
| P4 = Changeover point | P3+0.1° | P9 |

■ **Main parameters for gas, pneumatic modulation: sequence**

⚠ **Only the servomotor for air can be parameterized.**

| Main parameter | Minimum | Maximum |
|---|---|---|
| P9 = Maximum power point | 00.0° | 90.0° |
| P1 = Minimum power point | 00.0° | P9 |
| P0 = Ignition point | 00.0° | 90.0° |

■ **Main parameters for gas, electronic modulation: sequence**

⚠ **Servomotors for air and gas can be parameterized.**

| Main parameter | Minimum | Maximum |
|---|---|---|
| P9 = Maximum power point | 00.0° | 90.0° |
| P1 = Minimum power point | 00.0° | P9 |
| P0 = Ignition point | P1-25.5° | P1+25.5° |

Points P2…P8 are interpolated automatically between P1 and P9.

■ **The first setting**

Press the "+" button

■ **Change the setting Air servomotor**

Press button "2" (air servomotor) and either "+" or "-".
Parameterizable within the defined limits.

■ **Change the setting Gas servomotor**

Press button "1" (gas servomotor) and either "+" or "-".
Parameterizable within the defined limits.

■ **Call up the next main parameter**

Press "+"

■ **Call up the preceding main parameter**

Press "-"

■ **Ready to start**

Press the "+" button after you have set all the main parameters. The automatic burner-control system is now ready to start and indicates readiness by displaying the following message:

**Setup mode: oil, three-stage** **Ready to start**

**Setup mode: gas, pneumatic modulation** **Ready to start**

**Setup mode: gas, electronic modulation** **Ready to start**

The burner starts when the control chain is closed; a "P" appears in the display indicating that the automatic burner-control system is in setup mode and that the timeout function is therefore active.
Following a successful start with flame stabilization, the burner settles to ignition setting P0, irrespective of the operating mode. You can now set the ignition point.

⚠ **If the start is not followed by flame stabilization, try another start with different values for the ignition point.**

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# Setup mode
# Gas firing, electronic modulation

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■ **The burner must be in standby status, otherwise you cannot access the setup mode**

The controller automatically goes to standby status if the automatic burner-control system has not been programmed. In the unprogrammed state, the automatic burner-control system remains on standby. Unprogrammed means that the characteristic has not been fully programmed.
Once a valid characteristic has been programmed and the automatic burner-control system detects the presence of the corresponding components when it starts up, the burner starts as soon as the control chain and GWmax are closed.

■ **Changing a characteristic defined beforehand**

If you want to correct a characteristic or ignition point P0 without recalculating all other points as well, you can access setup mode by simultaneously pressing the "+" and "-" buttons.

■ **Accessing setup mode**

Simultaneously press the "1" and "2" buttons if you want to enter the full setup mode. The "P" symbol always appears in the display to indicate that setup mode is activated. If you do not press a button in setup mode before the timeout expires, setup mode is exited automatically and a RESTART is performed.

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# Setup mode
# Gas firing, electronic modulation

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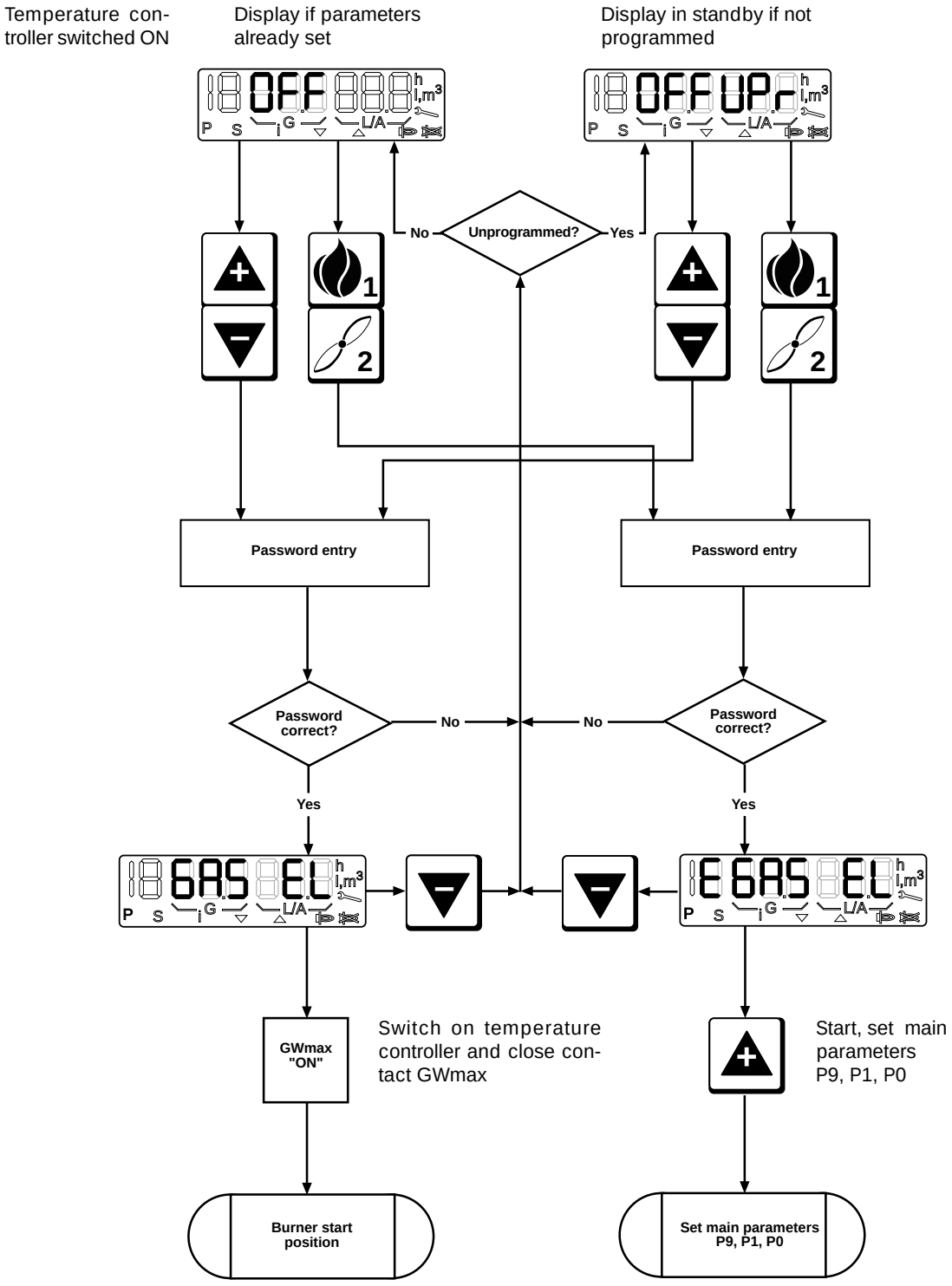


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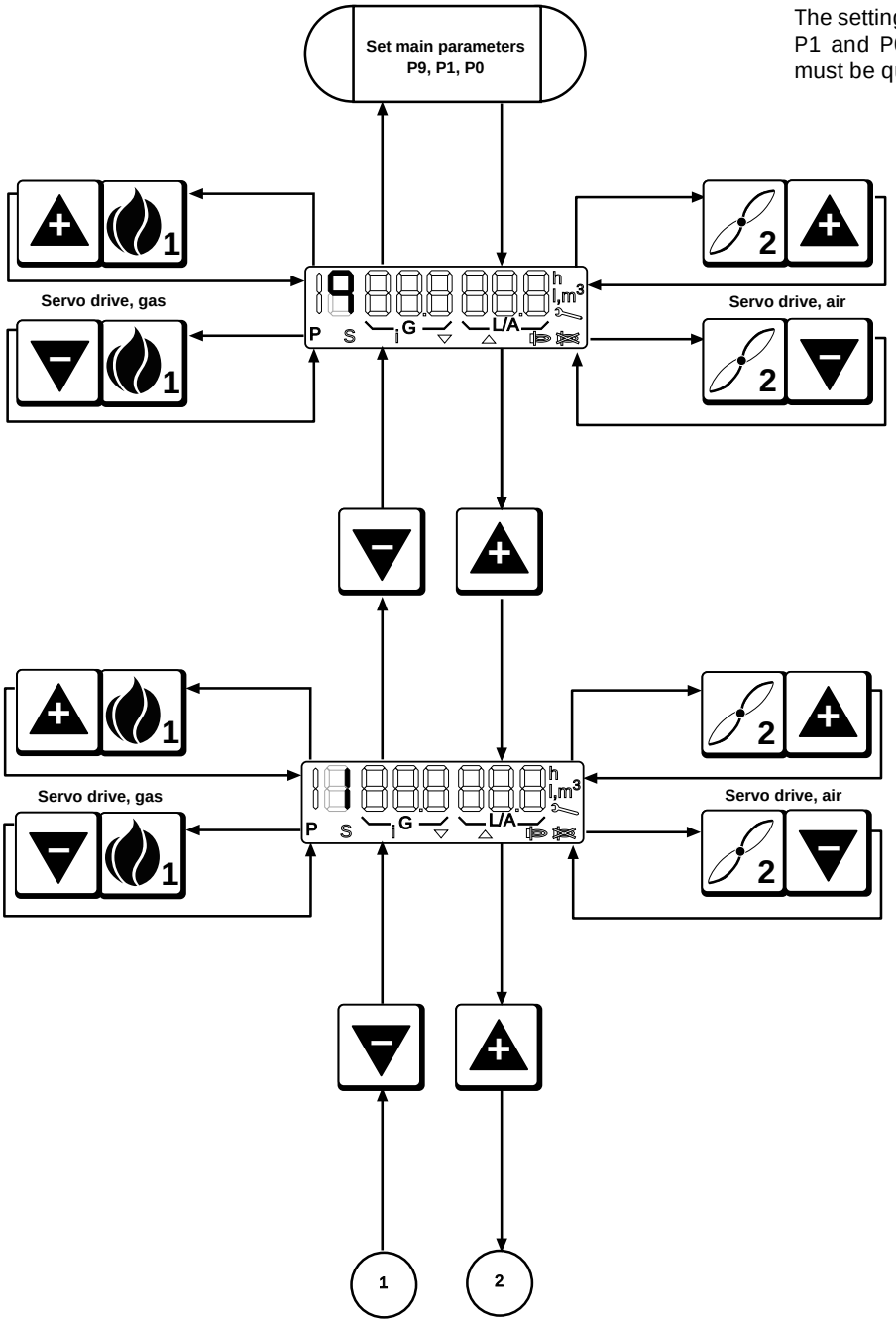
# Setup mode
# Gas firing, electronic modulation

DUNGS®




The settings for main parameters P9, P1 and P0 are burner-specific and must be quoted by the manufacturer.

Set characteristic point P9 max. 90.0°

min. 00.0°

Set characteristic point P1 max. P9

min. 00.0°

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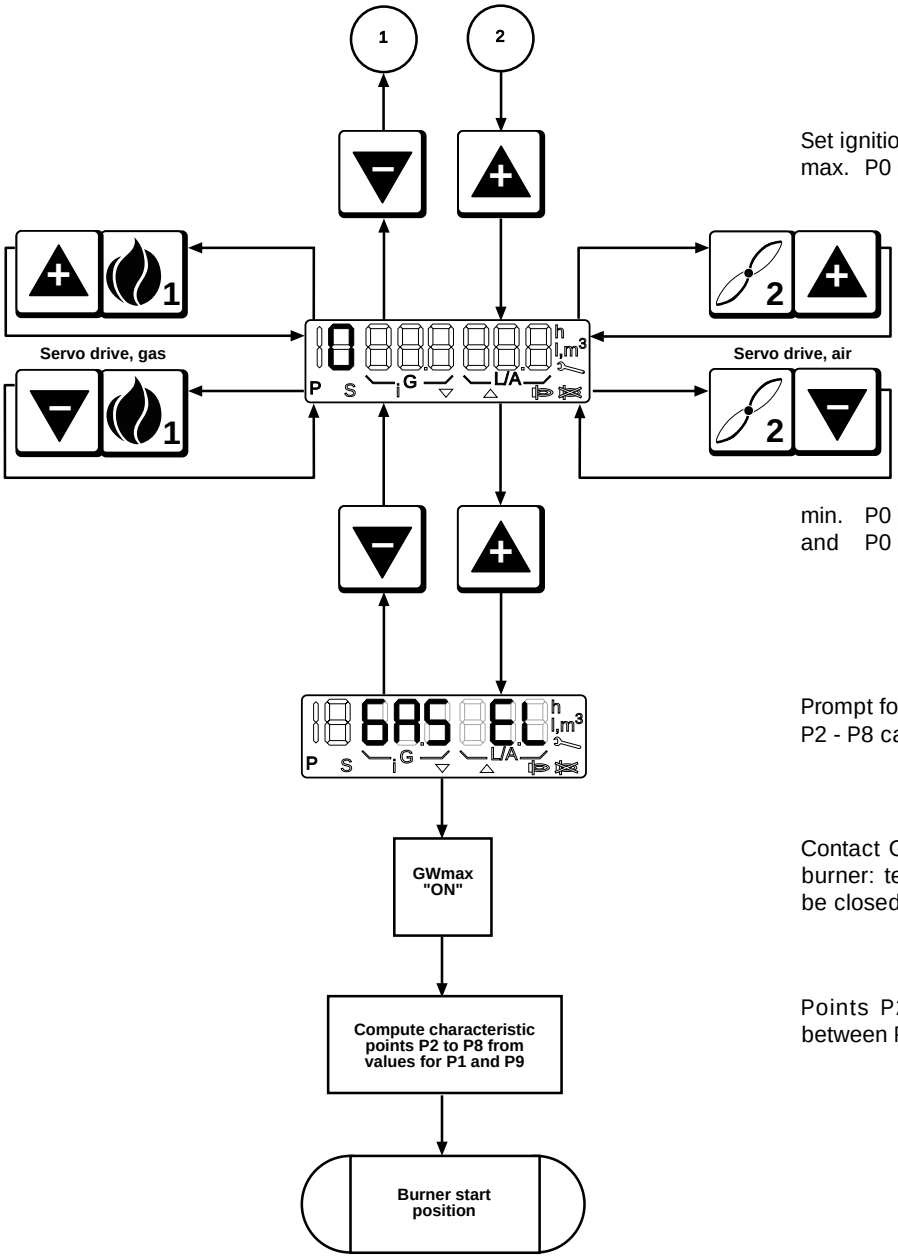
# Setup mode
# Gas firing, electronic modulation

DUNGS®




Set ignition point P0
max. P0 ≤ P1 + 25.5°

min. P0 ≥ P1 - 25.5°
and P0 ≥ 00.0°

Prompt for burner start so that points P2 - P8 can be set.

Contact GWmax. closed to start the burner: temperature controller must be closed.

Points P2 to P8 are interpolated between P1 and P9.

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# Setup mode
# Gas firing, electronic modulation

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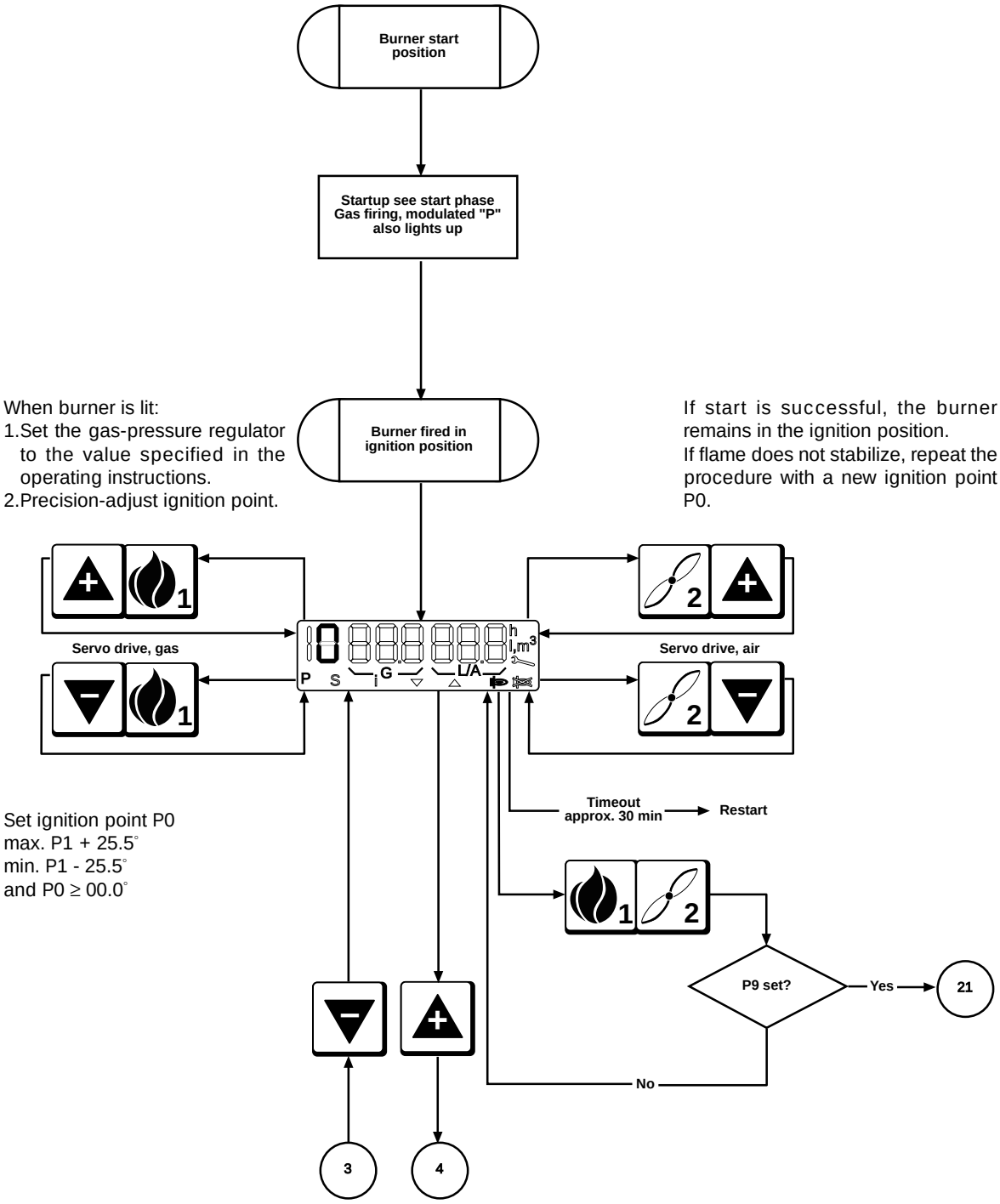


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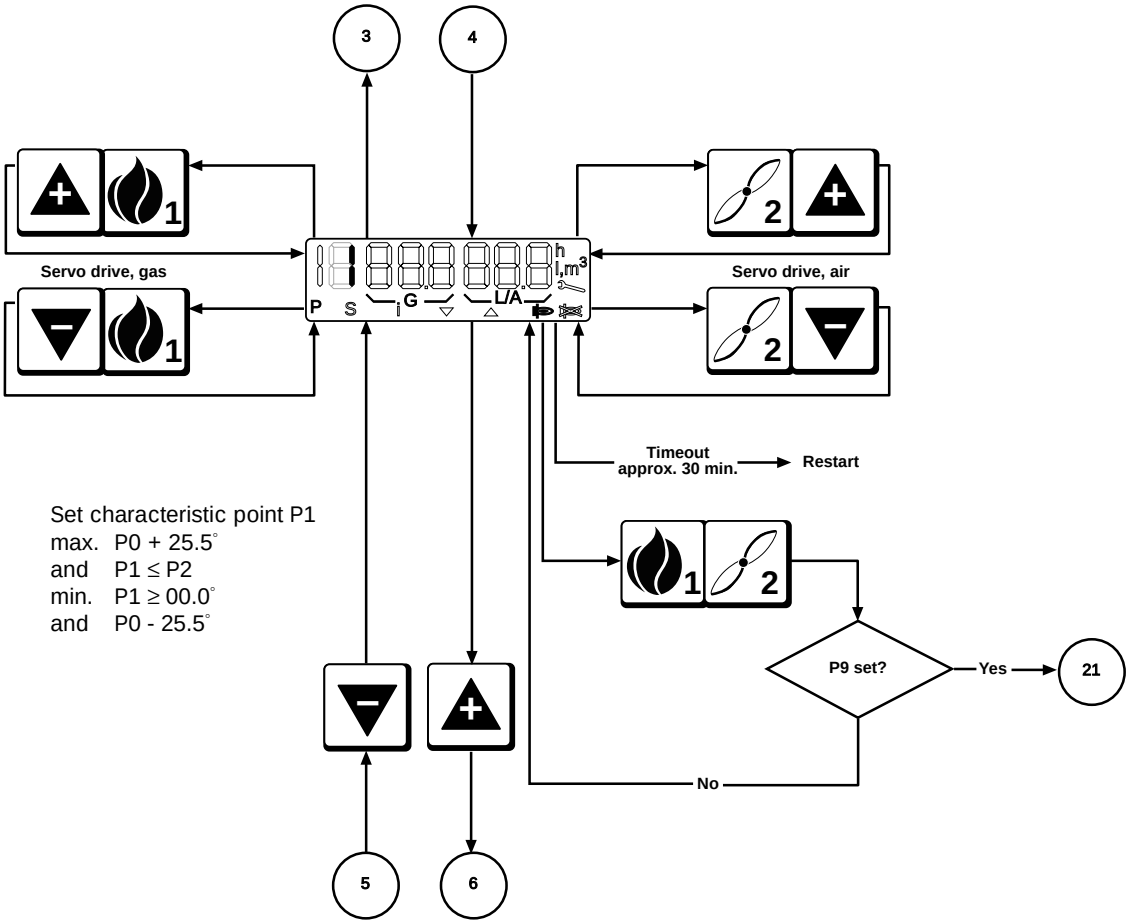
# Setup mode
# Gas firing, electronic modulation

DUNGS®

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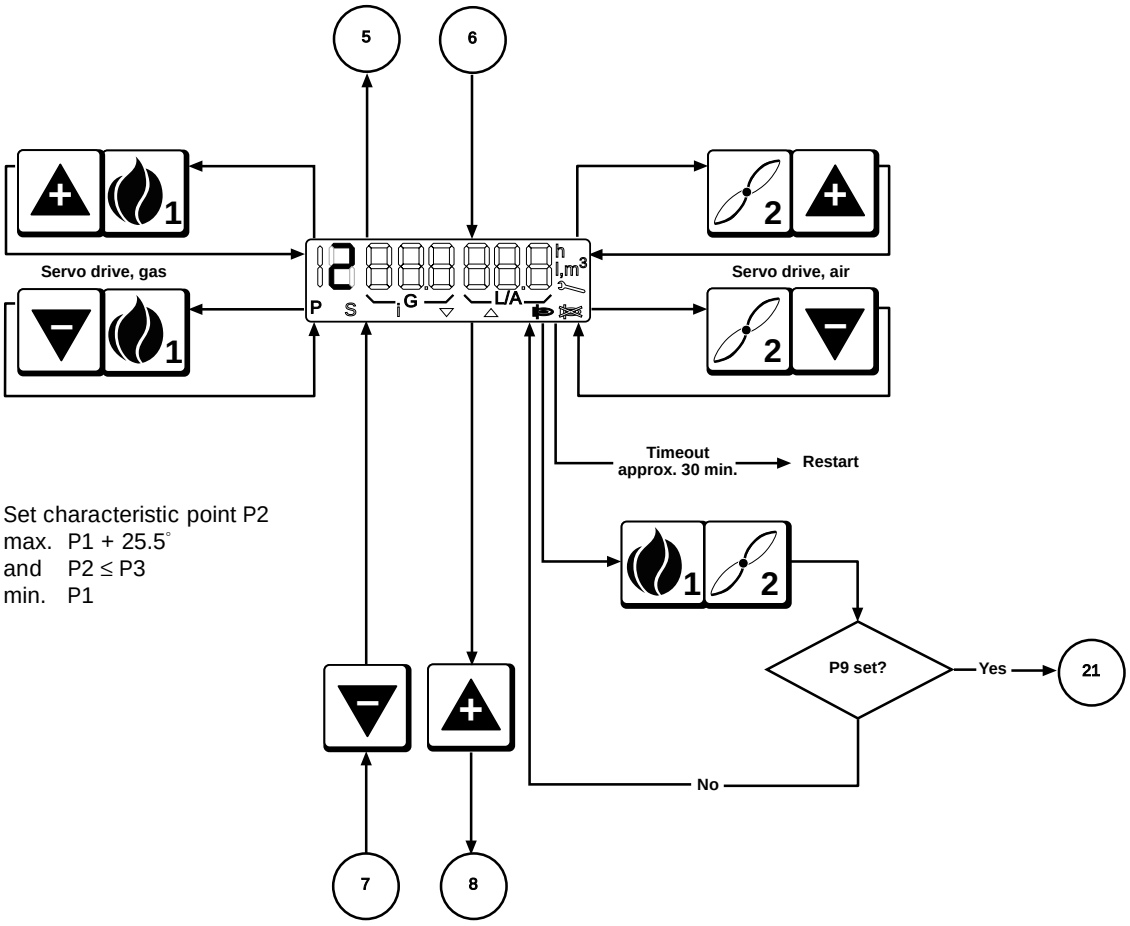
# Setup mode
# Gas firing, electronic modulation

DUNGS®




Set characteristic point P2
max. P1 + 25.5°
and P2 ≤ P3
min. P1

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# Setup mode
# Gas firing, electronic modulation

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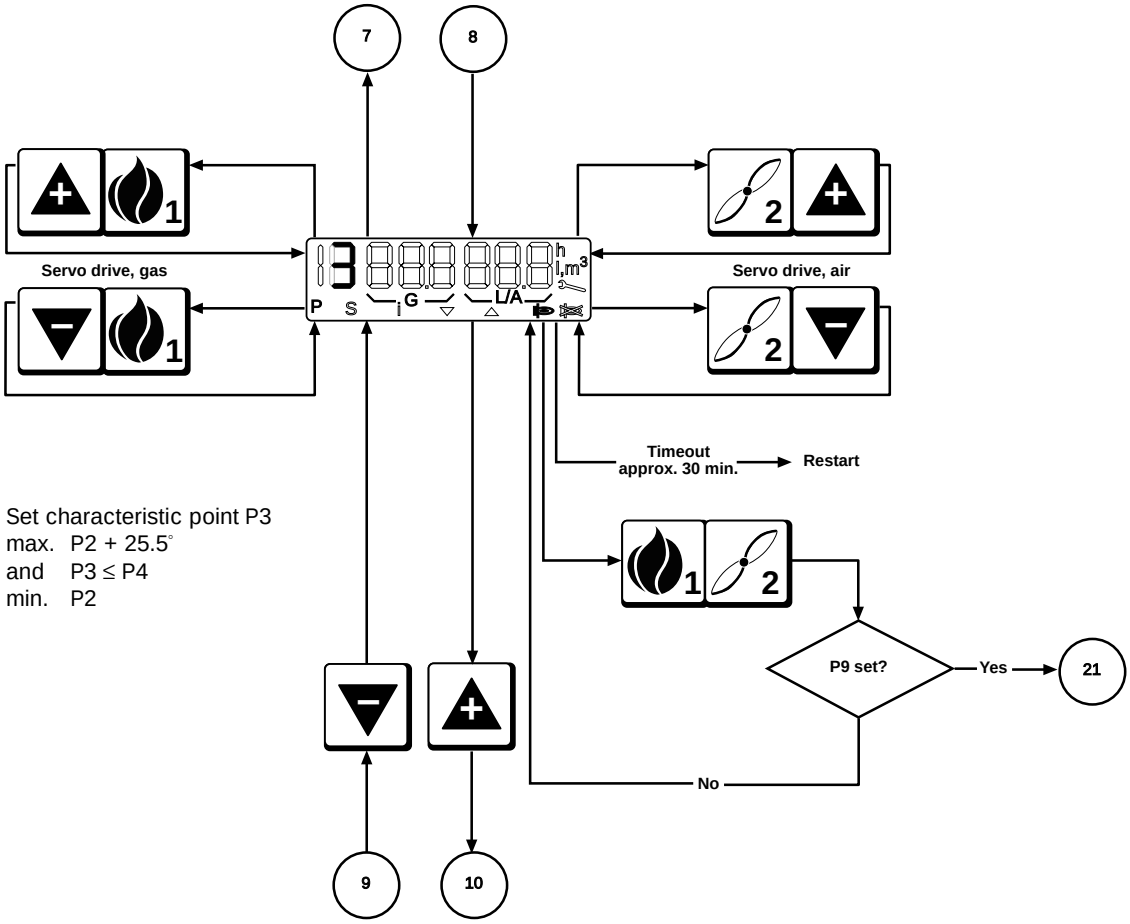


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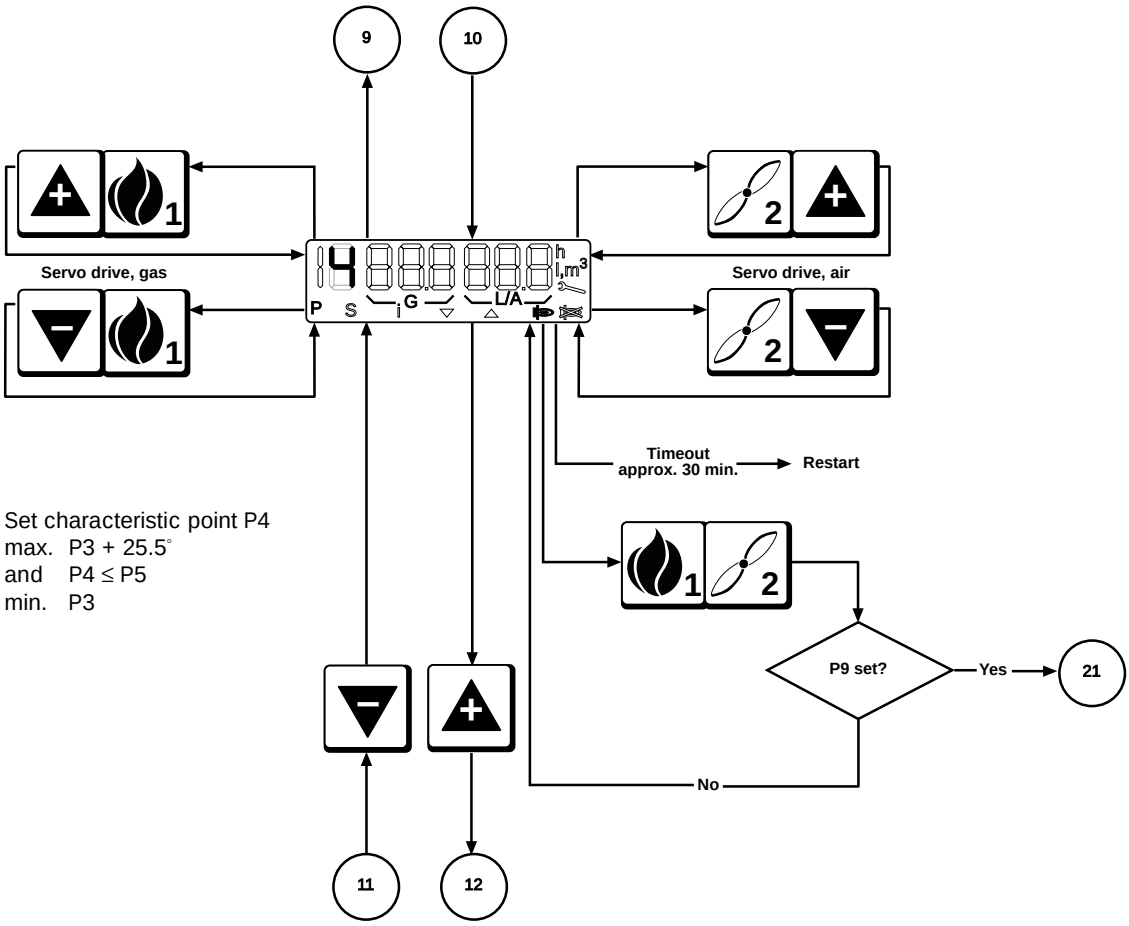
# Setup mode
# Gas firing, electronic modulation

DUNGS®




Set characteristic point P4
max. P3 + 25.5°
and P4 ≤ P5
min. P3

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# Setup mode
# Gas firing, electronic modulation

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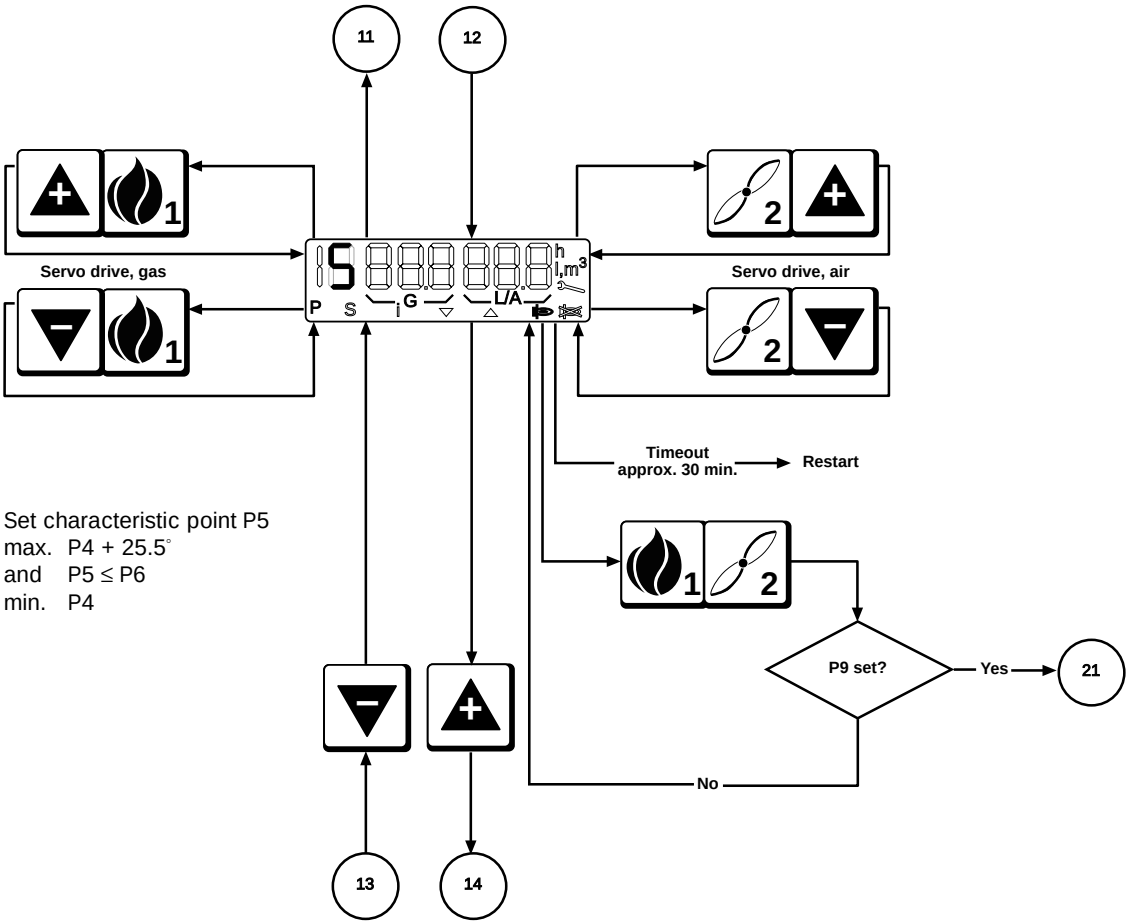


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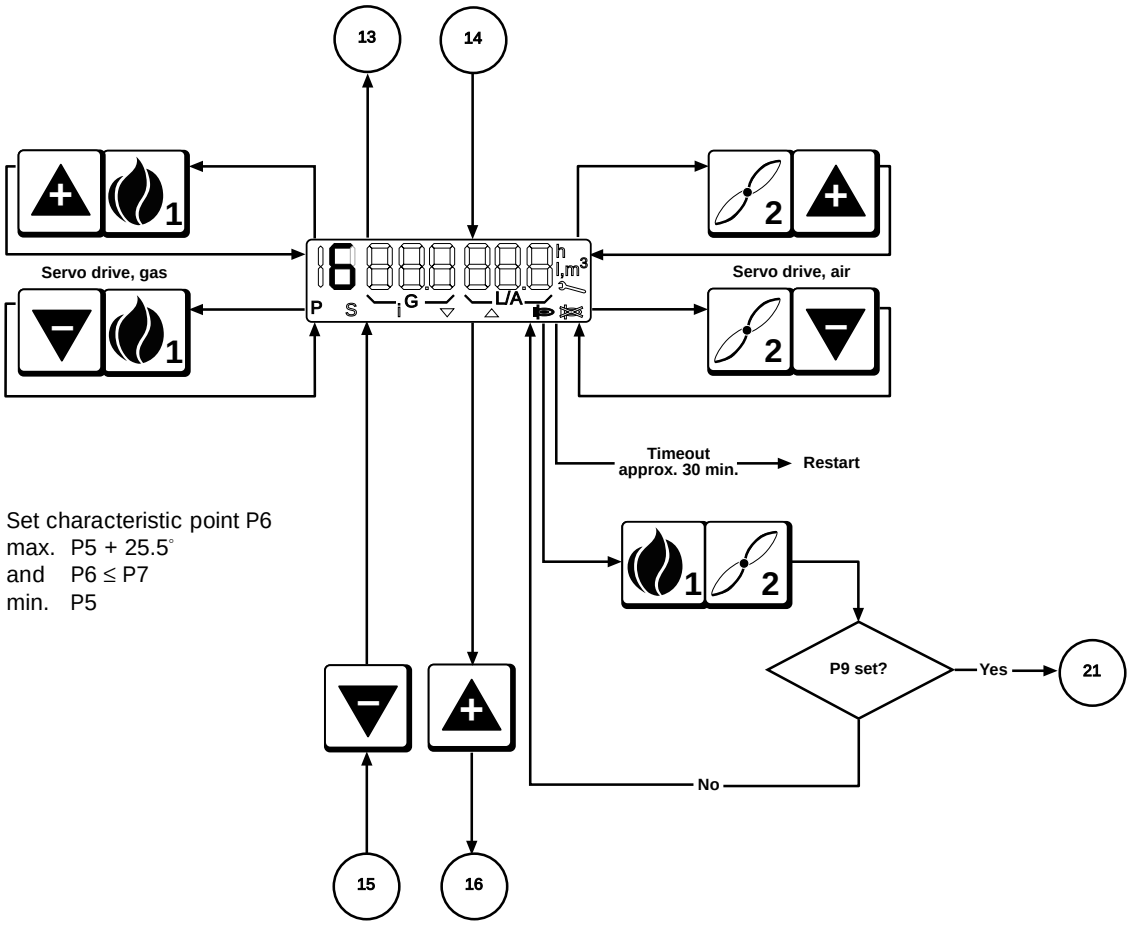
# Setup mode
# Gas firing, electronic modulation

DUNGS®

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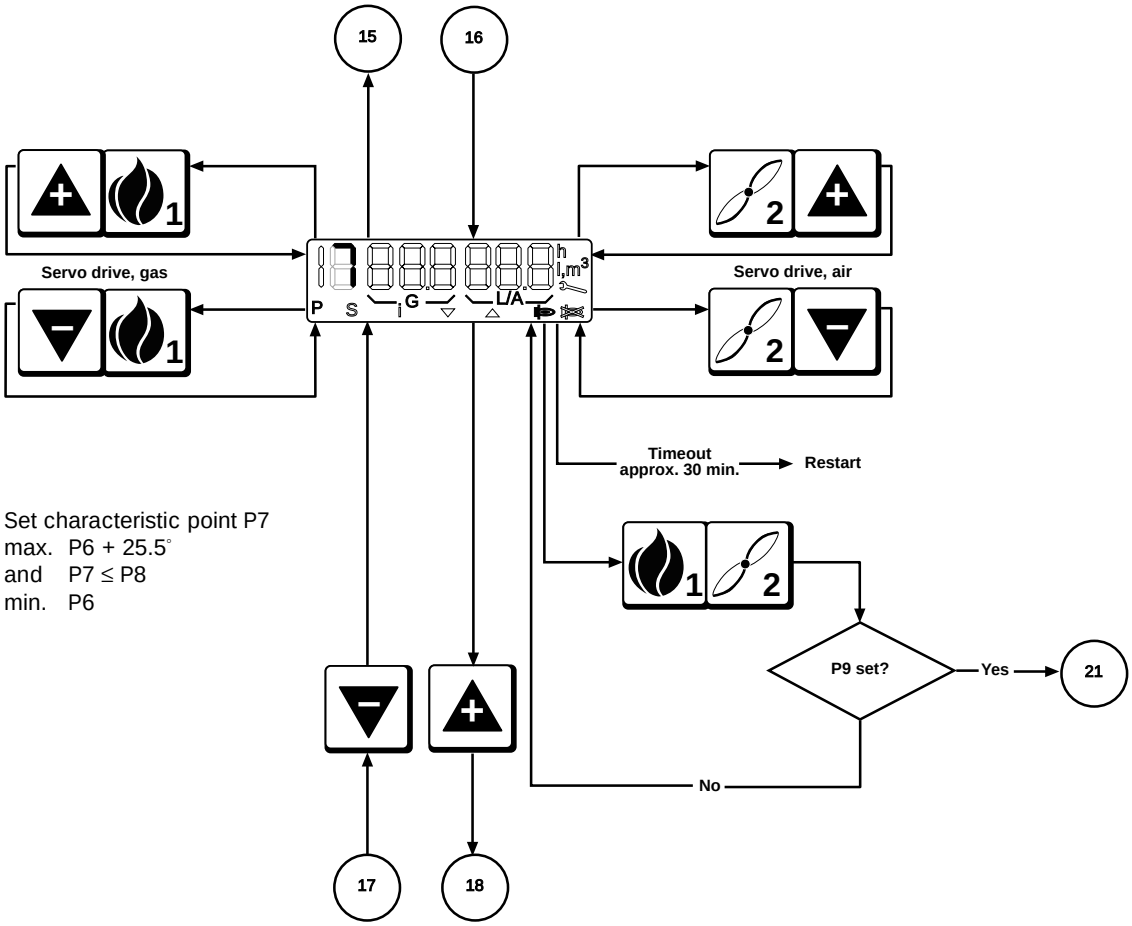
# Setup mode
# Gas firing, electronic modulation

DUNGS®

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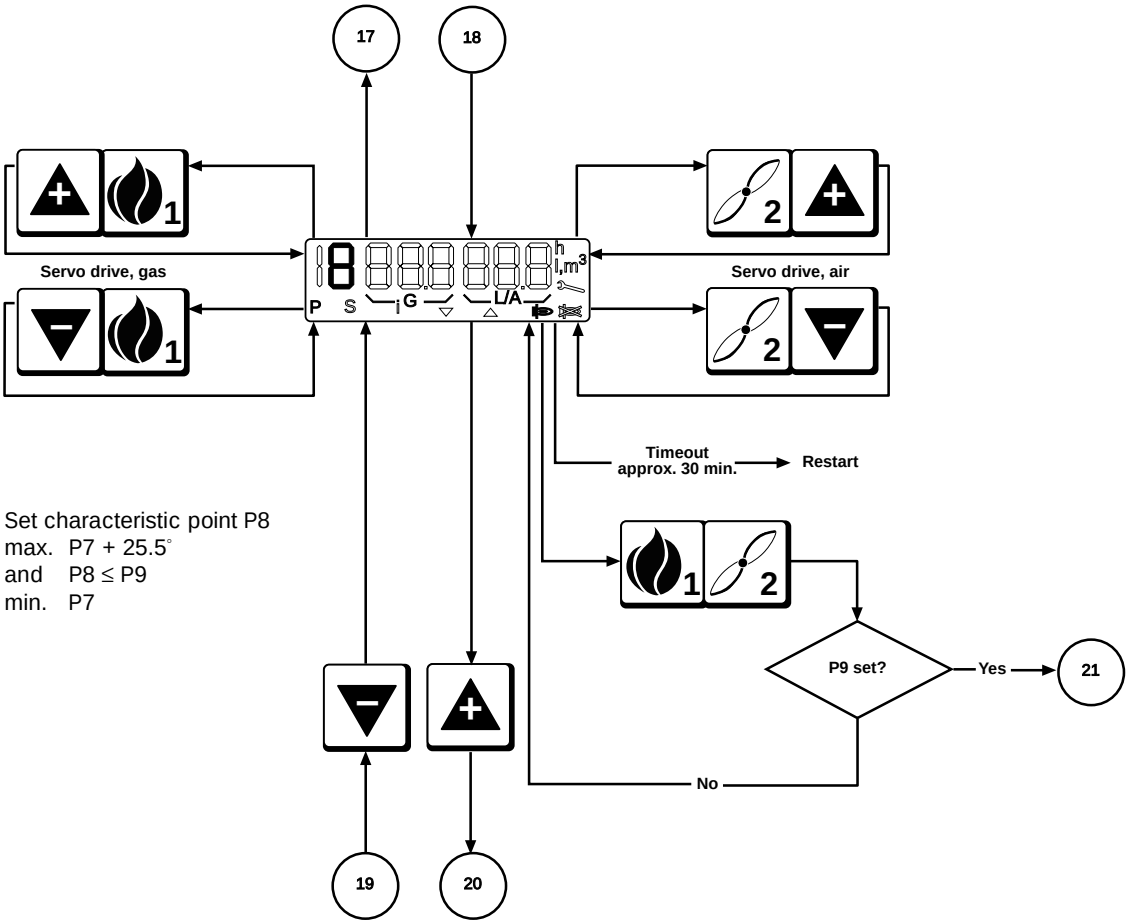
# Setup mode
# Gas firing, electronic modulation

DUNGS®

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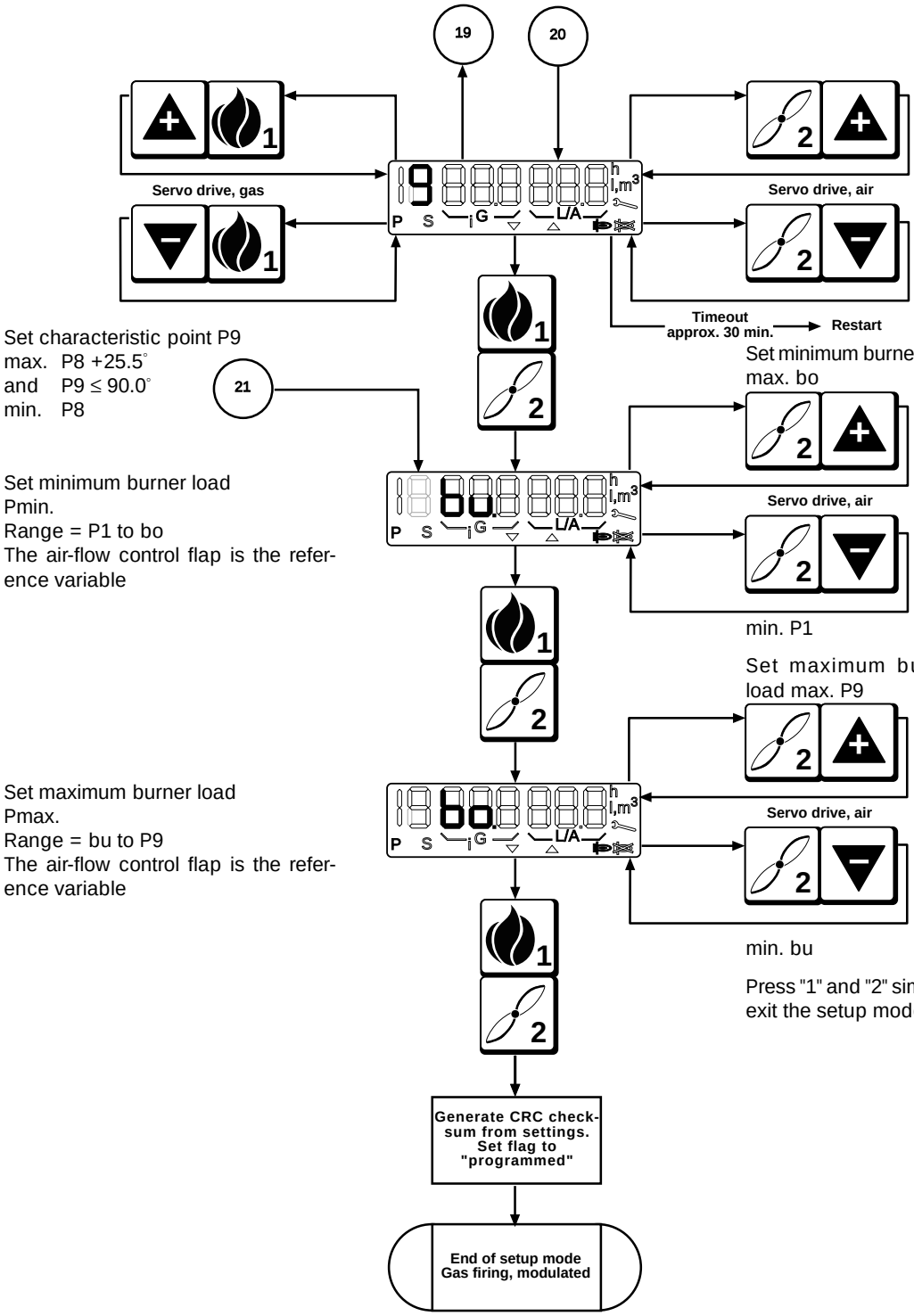
# Setup mode
# Gas firing, electronic modulation

DUNGS®

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# Setup mode
# Gas firing, pneumatic modulation

DUNGS®

■ **The burner must be in standby status, otherwise you cannot access the setup mode**

The controller automatically goes to standby status if the automatic burner-control system has not been programmed. In the unprogrammed state, the automatic burner-control system remains on standby. Unprogrammed means that the working point has not been fully programmed.
Once valid working points have been programmed and the automatic burner-control system detects the presence of the corresponding components when it starts up, the burner starts as soon as the control chain and GWmax are closed.

■ **Changing points defined beforehand**

If progamming has been completed and you want to correct points such as the ignition load P0, low load P1 or high load P9 in operation, press the "+" and "-" buttons simultaneously to access setup mode.

■ **Accessing setup mode**

Simultaneously press the "1" and "2" buttons if you want to enter the full setup mode. The "P" symbol always appears in the display to indicate that setup mode is activated. If you do not press a button in setup mode before the timeout expires, setup mode is exited automatically and a RESTART is performed.

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# Setup mode
# Gas firing, pneumatic modulation

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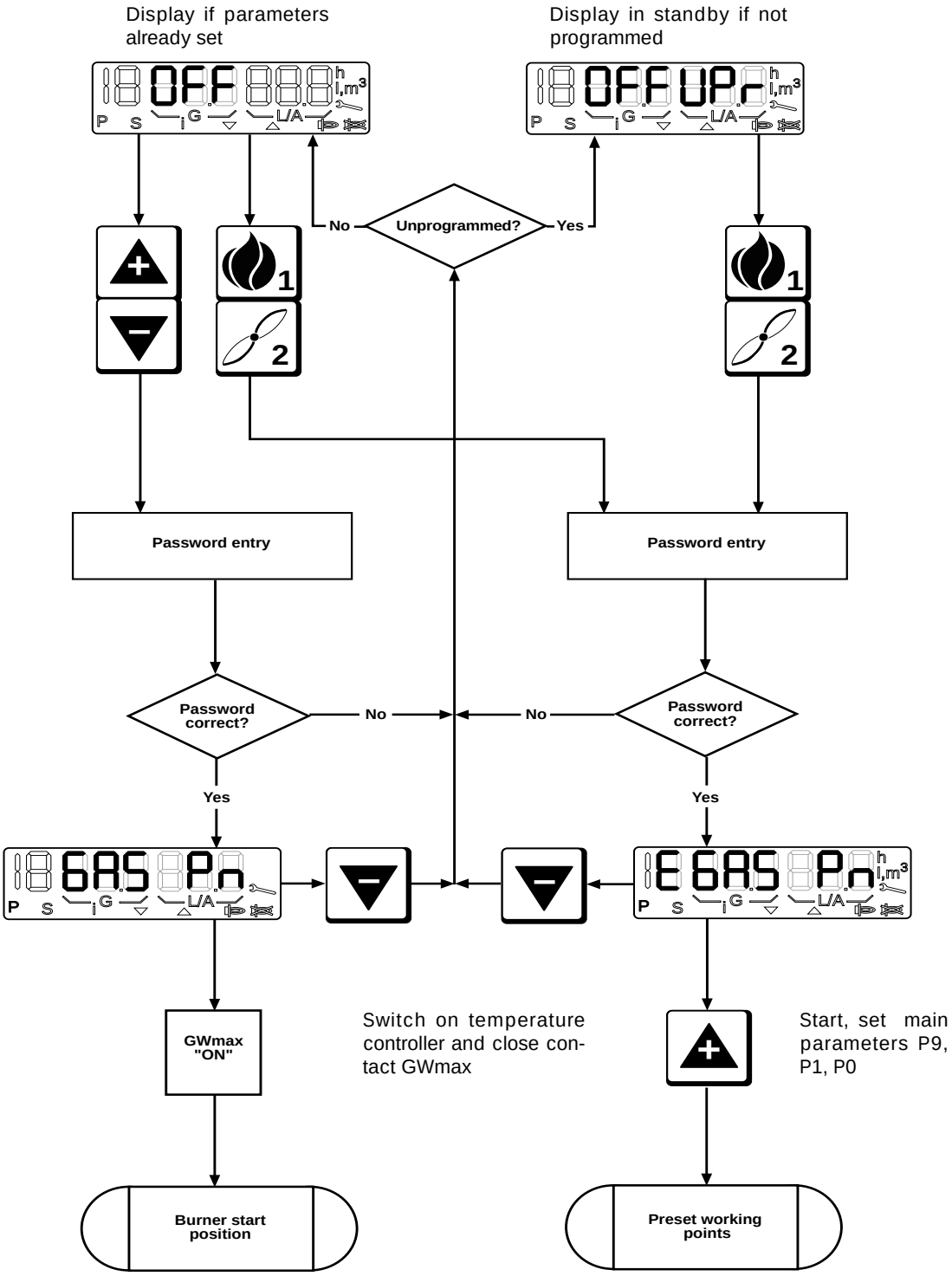


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# Setup mode
# Gas firing, pneumatic modulation

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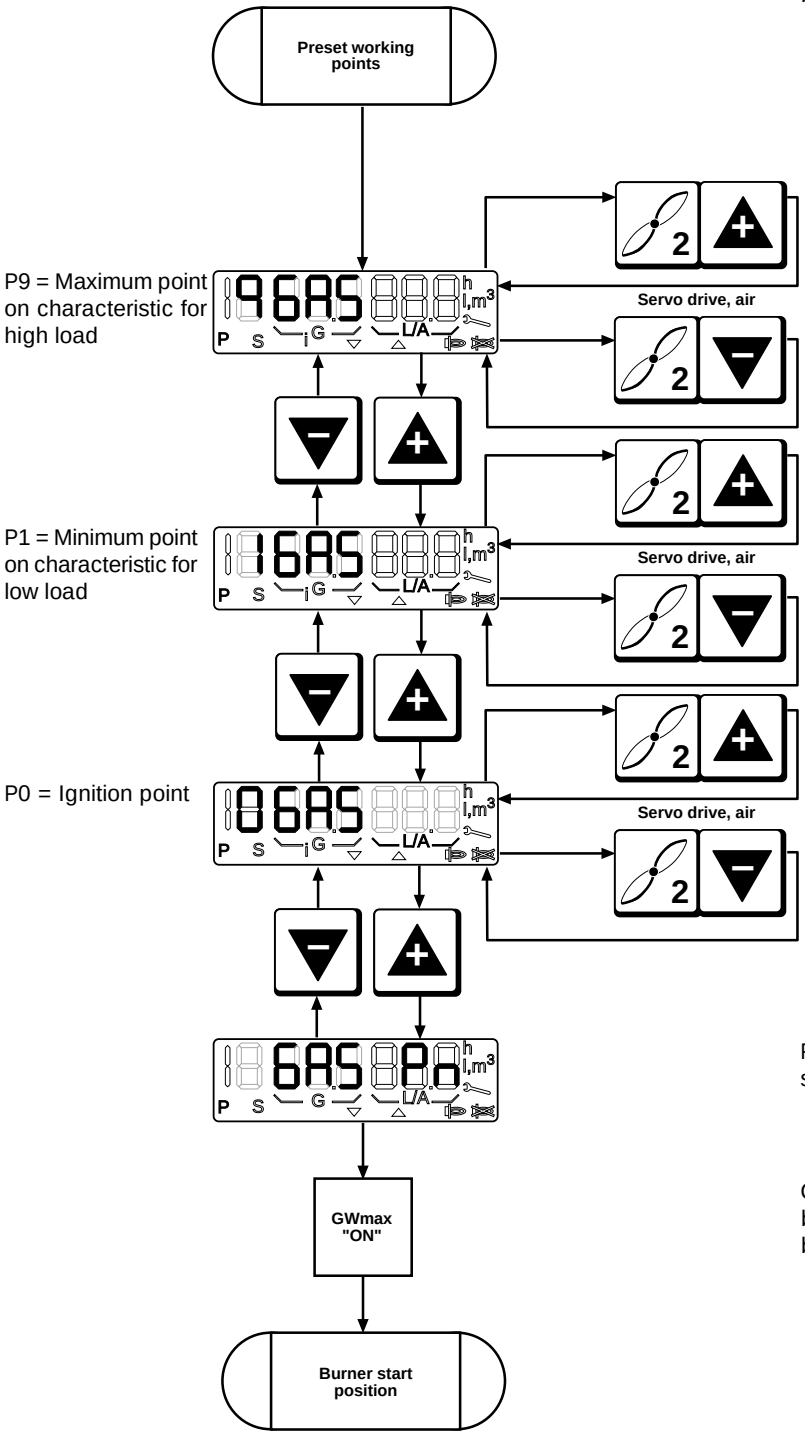
The settings for the working points are burner-specific and must be quoted by the manufacturer.




max. 90.0°

min. 00.0°

max. P9

min. 00.0°

max. 90.0°

min. 00.0°

Prompt for burner start

Contact GWmax. closed to start the burner: temperature controller must be closed.

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# Setup mode
# Gas firing, pneumatic modulation

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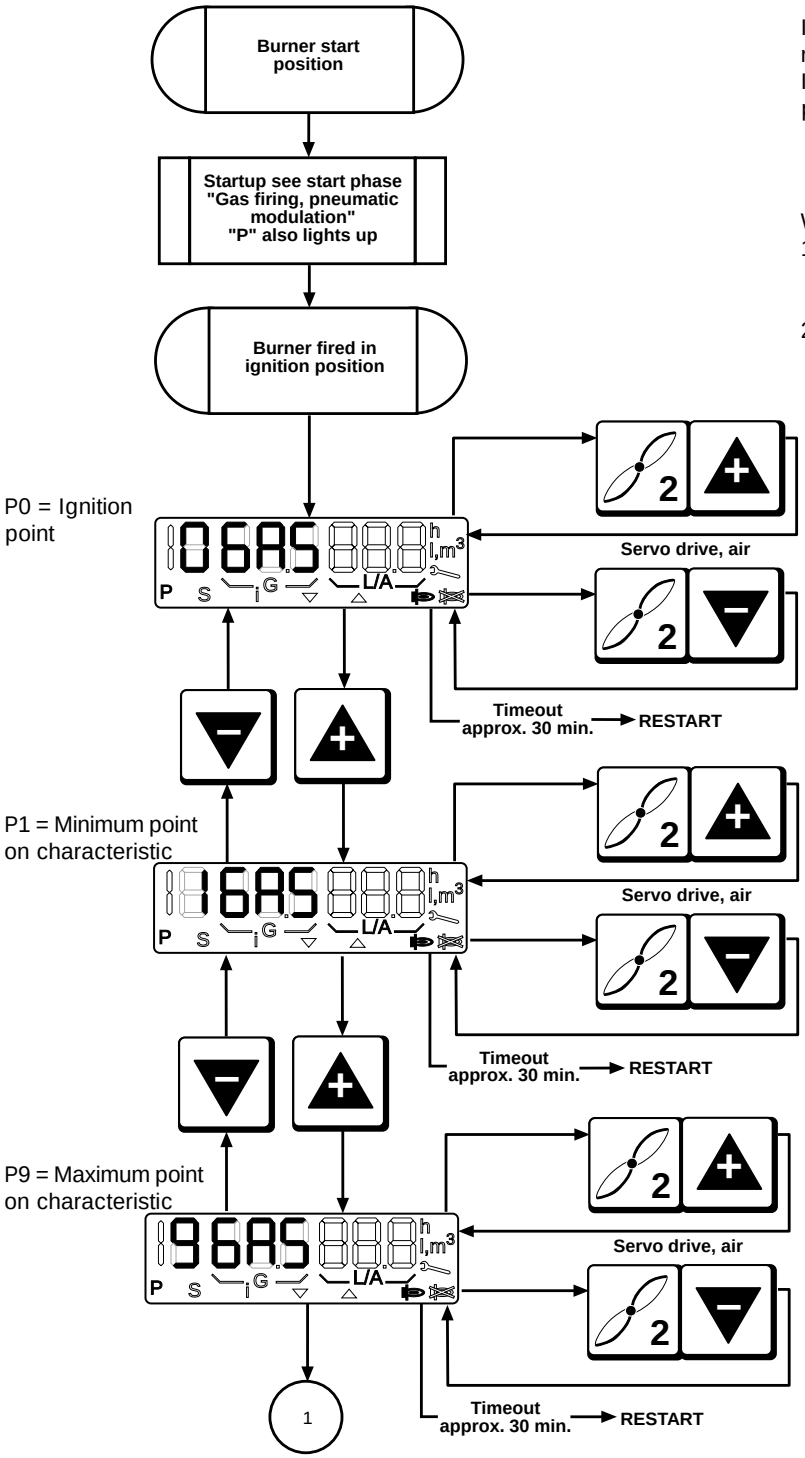


If start is successful, the burner remains in the ignition position.
If flame does not stabilize, repeat the procedure with new ignition point P0.

When burner is lit:
1. Set the gas-pressure regulator to the value specified in the operating instructions.
2. Precision-adjust ignition point.

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# Setup mode
# Gas firing, pneumatic modulation

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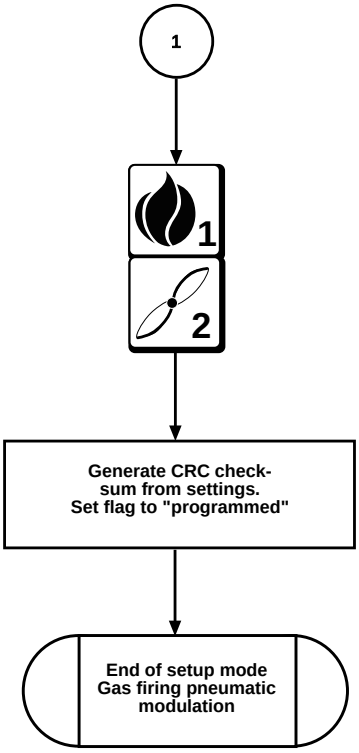


Press "1" and "2" simultaneously to exit the setup mode.

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■ **The burner must be in standby status, otherwise you cannot access the setup mode**

The controller automatically goes to standby status if the automatic burner-control system has not been programmed. In the unprogrammed state, the automatic burner-control system remains on standby. Unprogrammed means that the working point has not been fully programmed.
Once valid working points have been programmed and the automatic burner-control system detects the presence of the corresponding components when it starts up, the burner starts as soon as the control chain and GWmax are closed.

■ **Changing points defined beforehand**

If progamming has been completed and you want to correct points such as the the first stage P1, the second stage P3, the third stage P9 or the changeover points P2 and P4 in operation, press the "+" and "-" buttons simultaneously to access setup mode.

■ **Accessing setup mode**

Simultaneously press the "1" and "2" buttons if you want to enter the full setup mode. The "P" symbol always appears in the display to indicate that setup mode is activated. If you do not press a button in setup mode before the timeout expires, setup mode is exited automatically and a RESTART is performed.

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## Setup mode
## Oil firing, three stage

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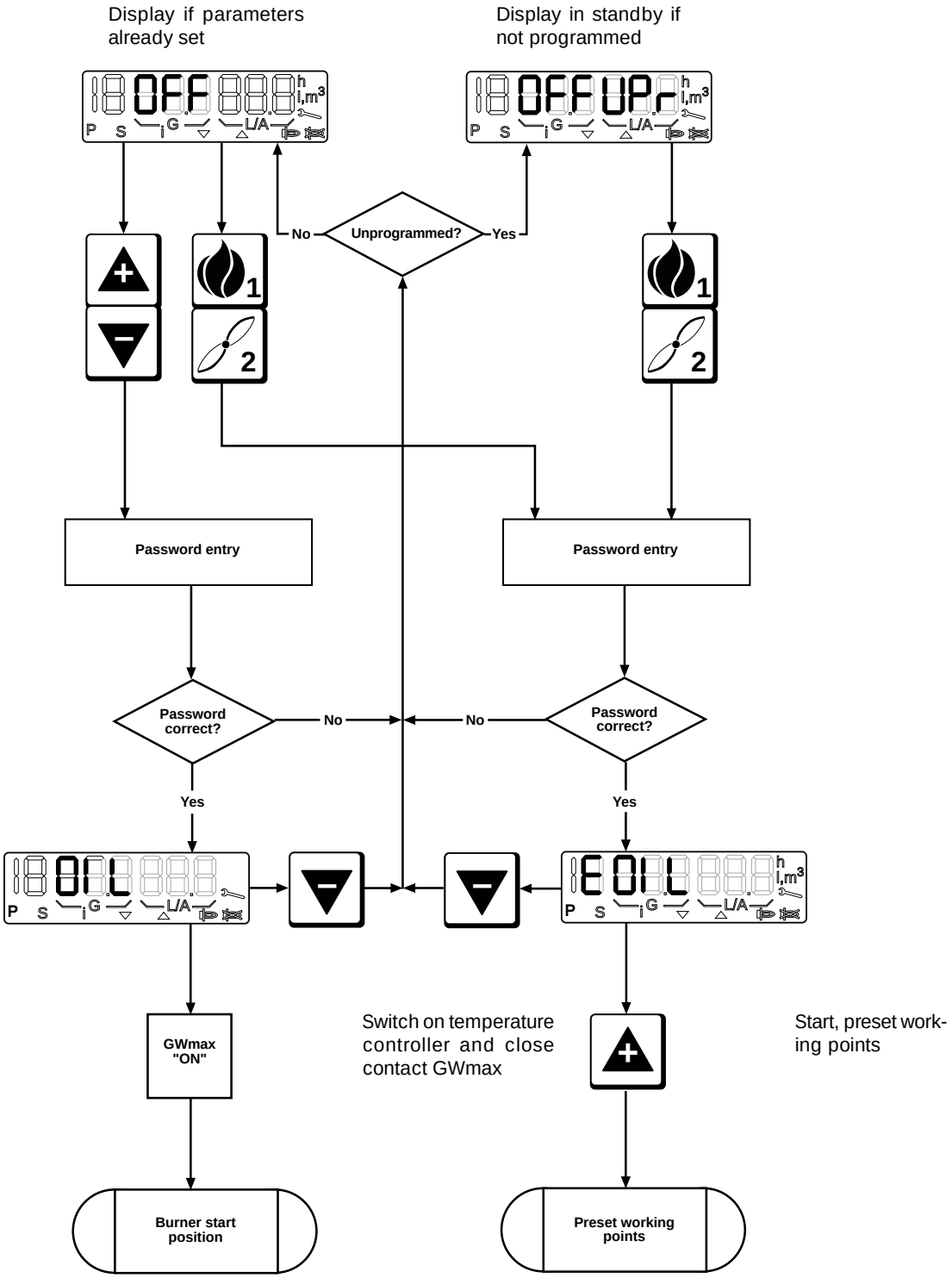


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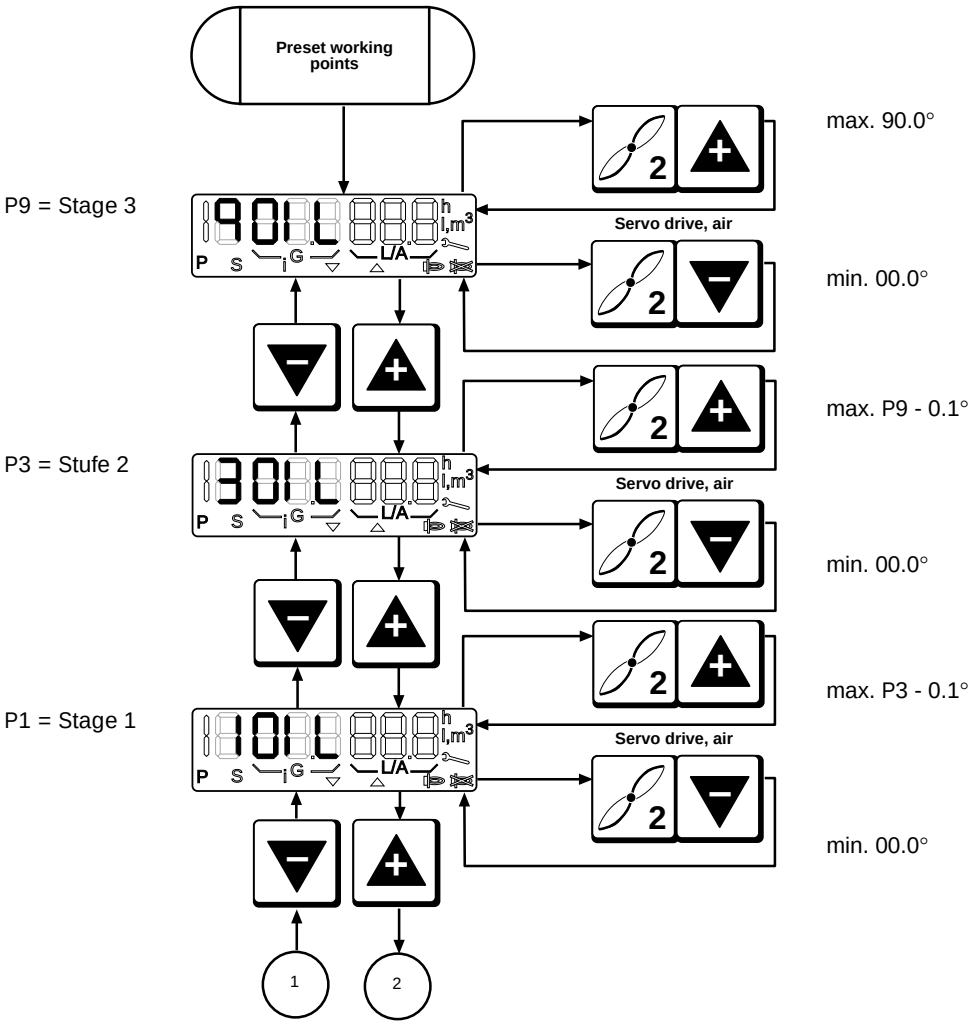
## Setup mode
## Oil firing, three stage

DUNGS®

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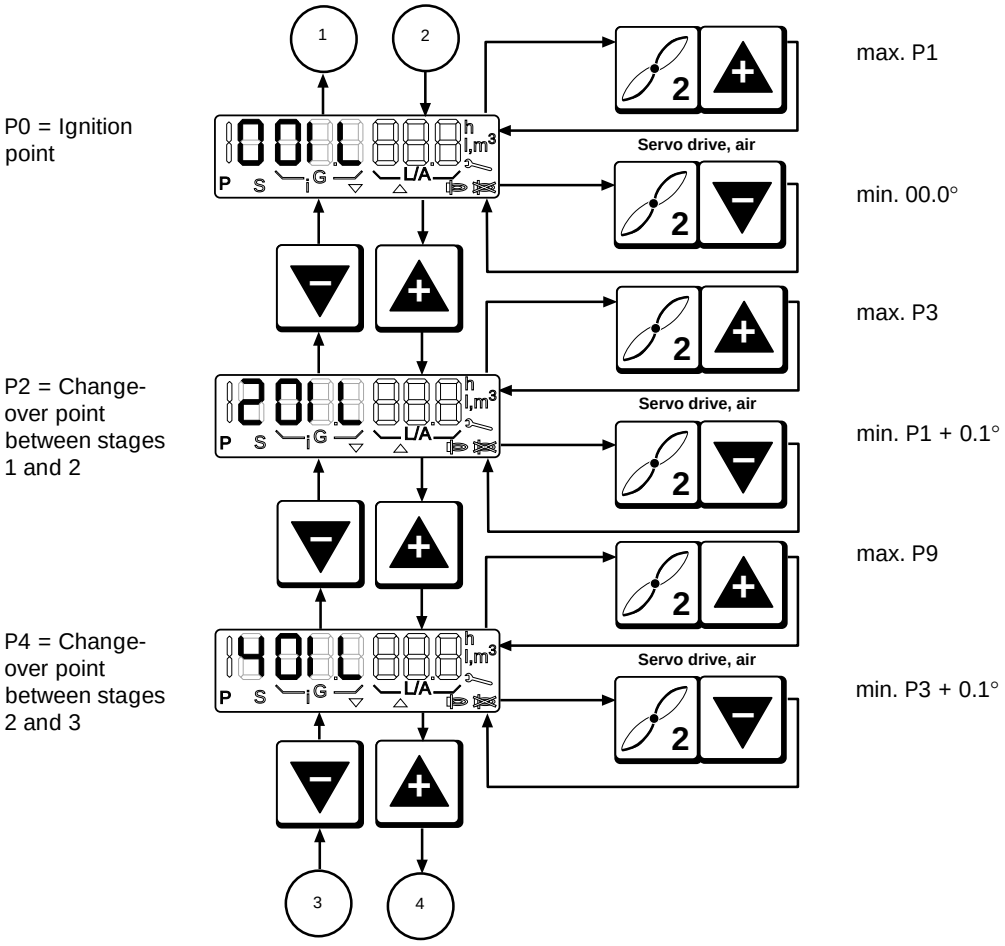
## Setup mode
## Oil firing, three stage

DUNGS®

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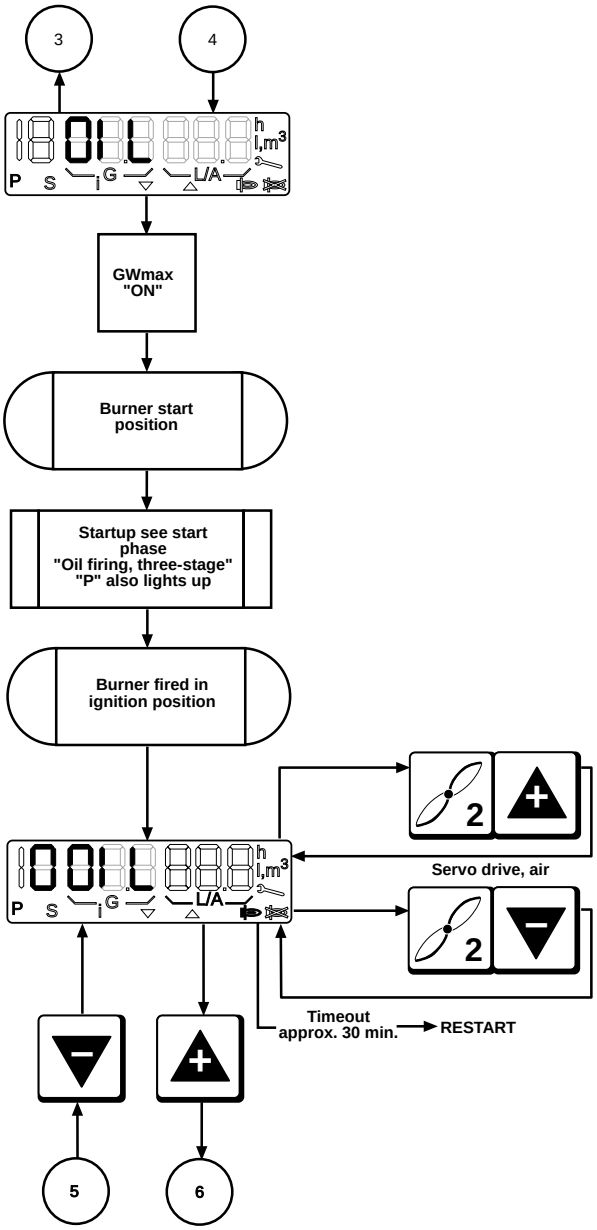
# Setup mode
# Oil firing, three stage

DUNGS®




Prompt for burner start

Contact GWmax. closed to start the burner: temperature controller must be closed.

If start is successful, the burner remains in the ignition position.
If flame does not stabilize, repeat the procedure with new ignition point P0.
When burner is lit:
1.Set oil-pressure regulator to desired value.
2.Precision-adjust ignition point.

max. P1

min. 00.0°

Press "+" to leave ignition setting

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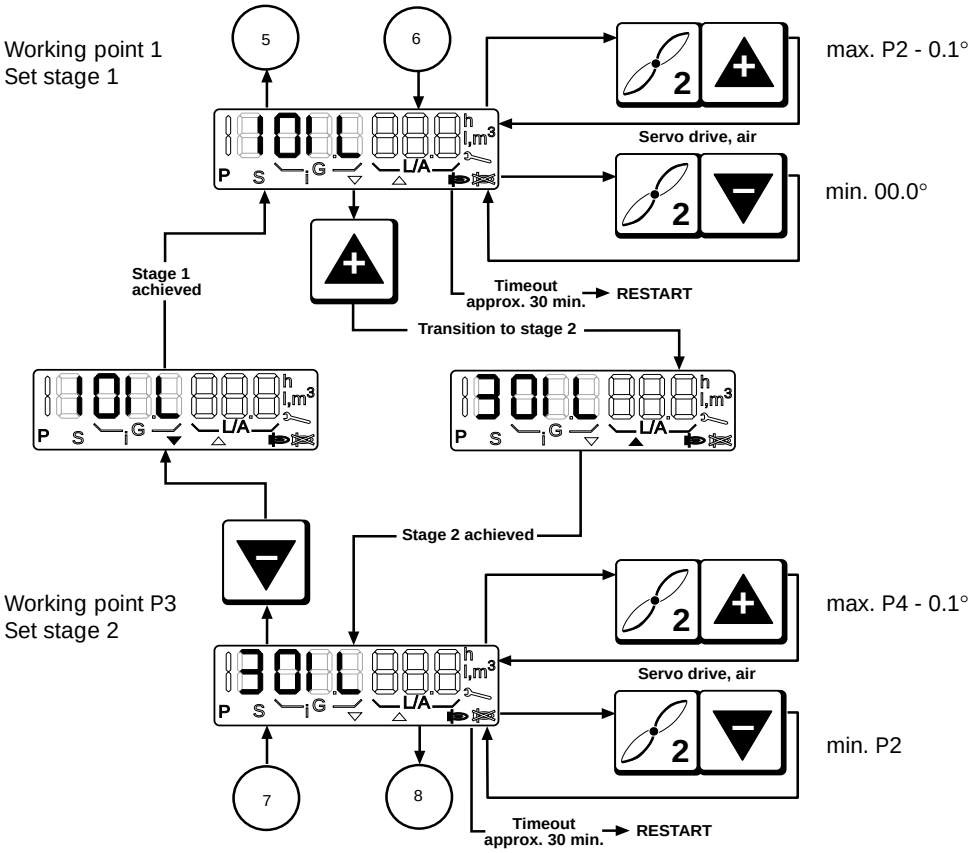
# Setup mode
# Oil firing, three stage

DUNGS®

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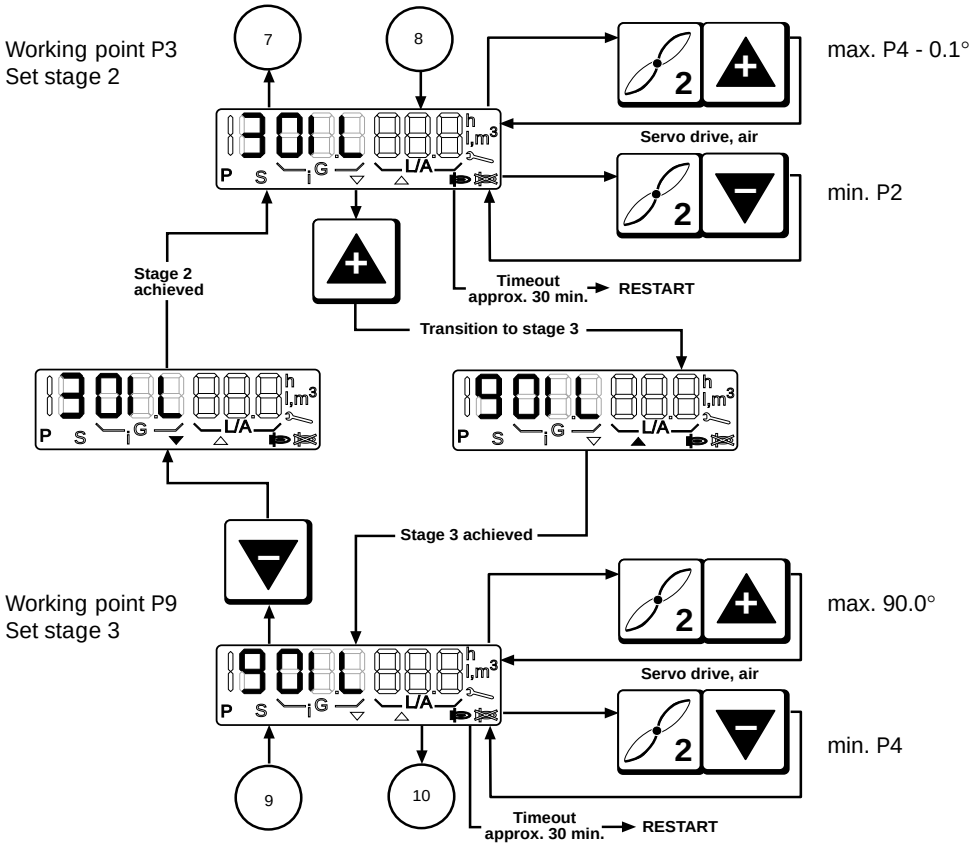
DUNGS®

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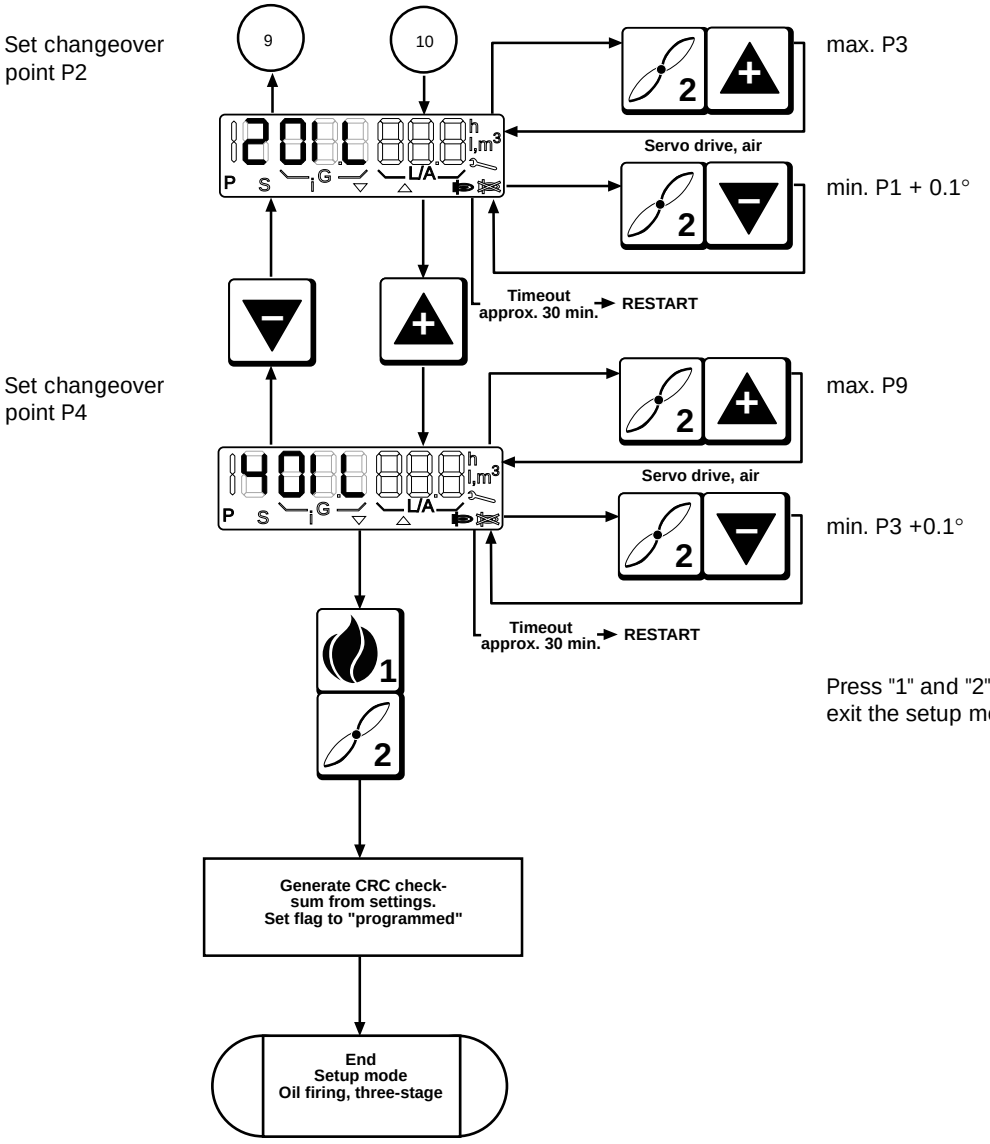
# Setup mode
# Oil firing, three stage

DUNGS®

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# Display in operating mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation

DUNGS®

Display in operating mode, gas firing with electronic modulation and gas firing with pneumatic modulation.
If setup mode is activated, the "P" symbol also appears in the start phase.

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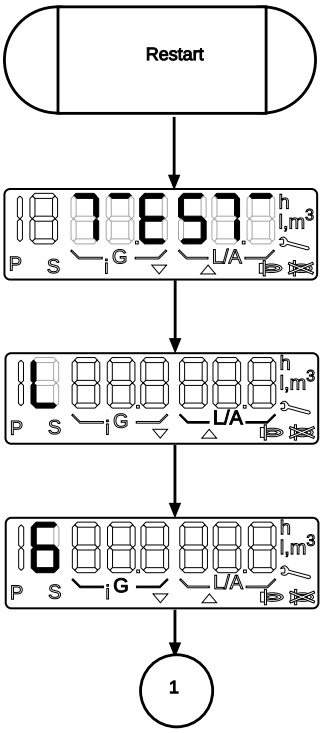
# Display in operating mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation

DUNGS®




After line-voltage interruption or if a request for heat was pending in standby mode.

Internal tests such as ROM test, CPU test, RAM test, etc.

Check servo drive for air and go to reference point.

Check servo drive for gas and go to reference point.
(not applicable for gas firing, pneumatic modulation)

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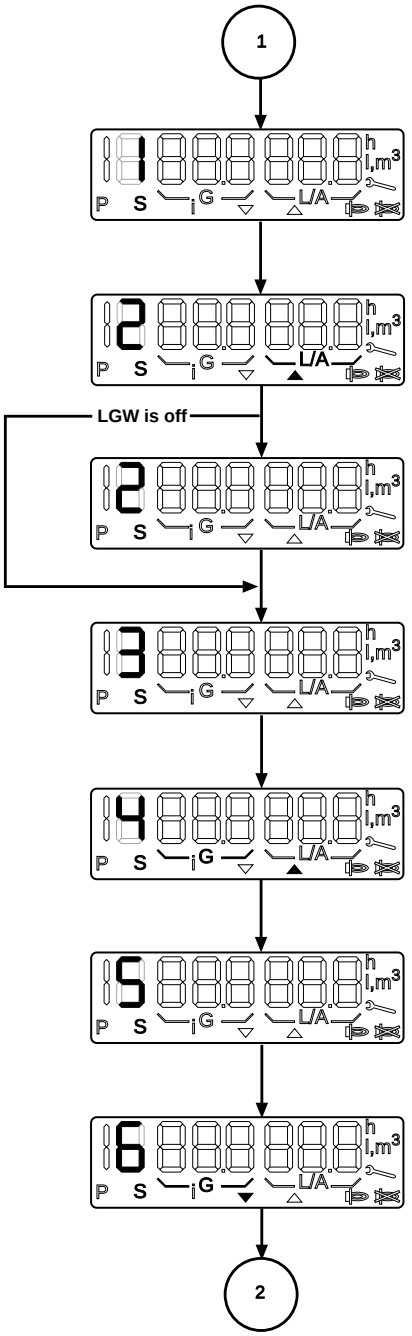
# Display in operating mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation

DUNGS®




Safety chain and temperature controller are both polled. Process continues if both are closed. Otherwise, go to standby ="OFF".

Move servo drive for air to characteristic point P9. Idle-position check of air-pressure monitor.

If servo drive for air is at characteristic point P9 and the air-pressure monitor is not in idle position.

Blower running up. Air-pressure monitor not yet closed.

Purging time countdown in seconds. Watchdog loads.

Purging time countdown in seconds. Watchdog pulls up and latches.

While pre-venting is in progress, servo drive for gas goes to ignition point P0 (not applicable for gas firing, pneumatic modulation)
Purging time countdown in seconds.

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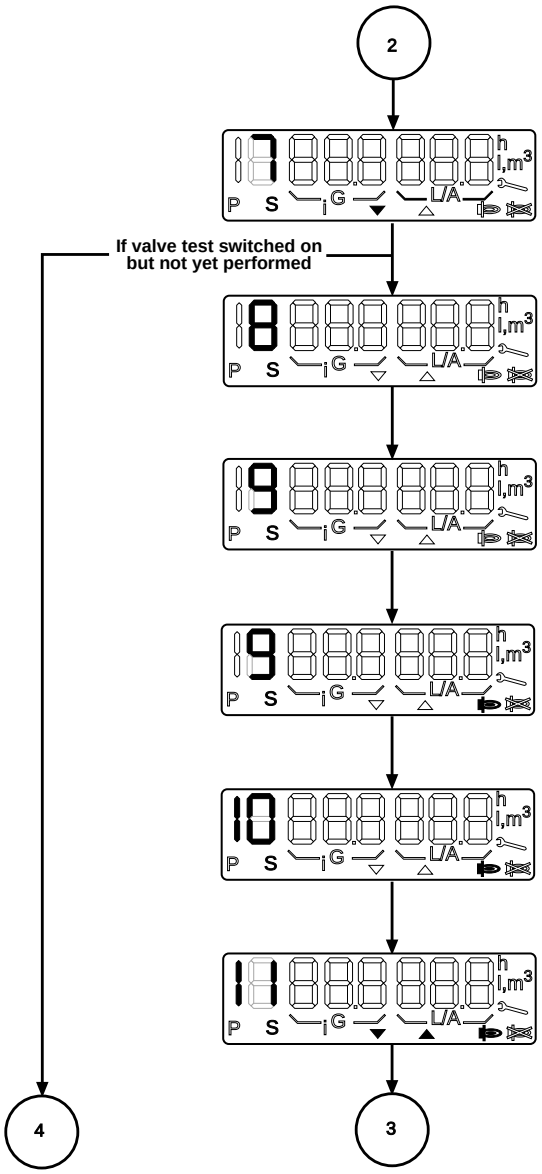
# Display in operating mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation

DUNGS®




Move servo drive for air to ignition point P0.

Pre-ignition

Safety period without flame message

Safety period with flame message

Stabilization time
At ignition point P0

Go to characteristic point P1 from ignition point P0: Up arrow or Down arrow lights up accordingly.

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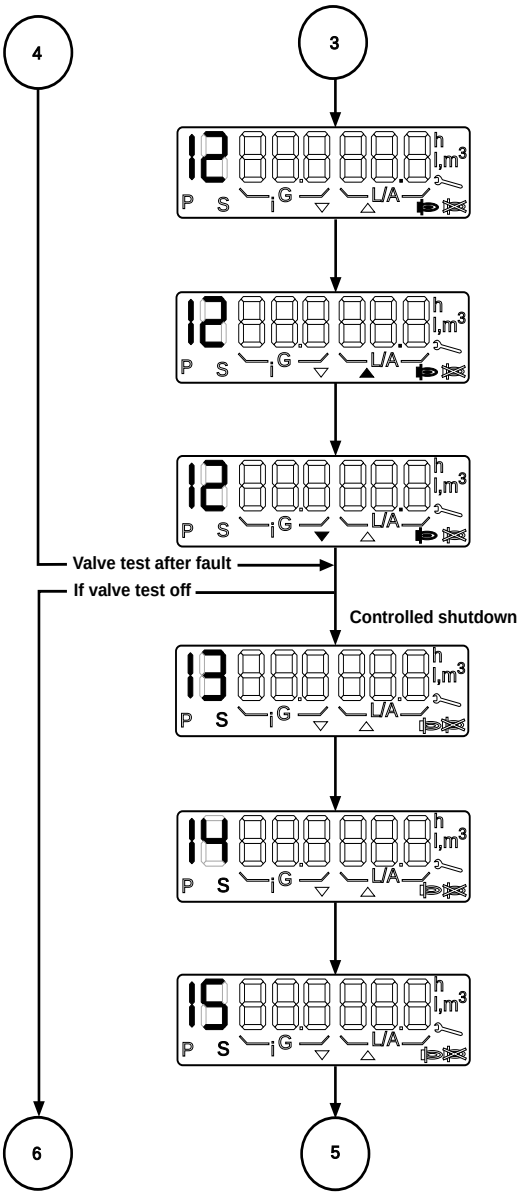
# Display in operating mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation

DUNGS®




Operating position.
Shows position of the servo drive for air in XX.X°

Operating position.
Increase output or go to minimum output point.

Operating position.
Reduce output.

Valve test, phase 1 (emptying).
The "Flame" symbol might also light up. If no post-purging time has been set, the brackets G or brackets L/A symbols and the Down arrow might also light.

Valve test, phase 2 (test time V1).
When the post-purging time expires, the brackets G or brackets L/A symbols and the Down arrow might also light up while the servo drive for air is moving to the standby position.

Valve test, phase 3.
When the post-purging time expires, the brackets G or brackets L/A symbols and the Down arrow might also light up while the servo drive for air is moving to the standby position.

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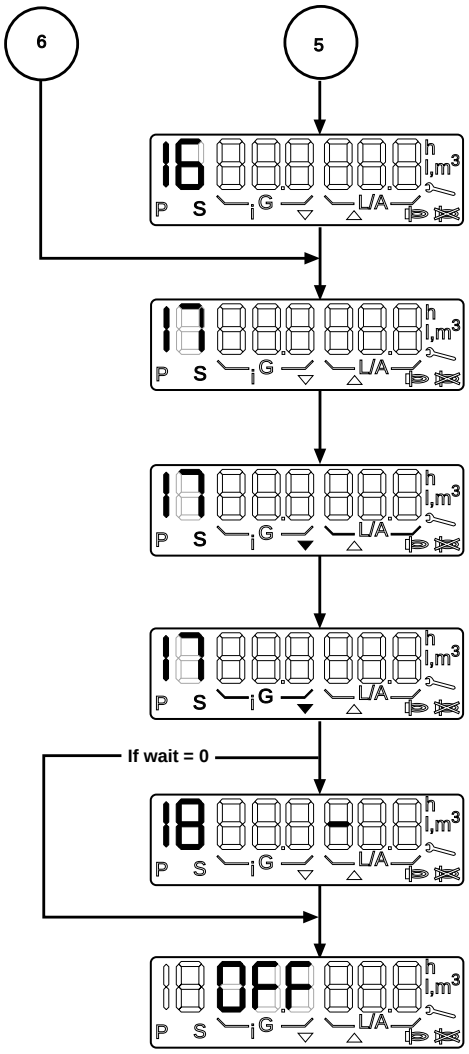
# Display in operating mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation

DUNGS®




Valve test, phase 4 (test time V2). When the post-purging time expires, the brackets G or brackets L/A symbols and the Down arrow might also light up while the servo drive for air is moving to the standby position.

Post-venting with blower in operation.

Post-venting ended. The blower is off. The servo drive for air goes to the standby position.

With electronic modulation in gas firing mode only. Post-ventilation terminated. The blower is OFF. Gas servomotor is moved into idling position.

If a wait is programmed or if low gas supply is detected during the start phase, the wait is counted down. Minutes on the left, seconds on the right.

Standby, wait for request for heat. Setup mode and parameterisation mode can be activated. See setup mode, "Gas firing, electronic modulation", "Gas firing, pneumatic modulation", and "Display in parameterisation mode".

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# Display in operating mode
# Oil firing, three stage

DUNGS®

Display in operating mode, oil firing, three stage.
If setup mode is activated, the "P" symbol also appears in the start phase.

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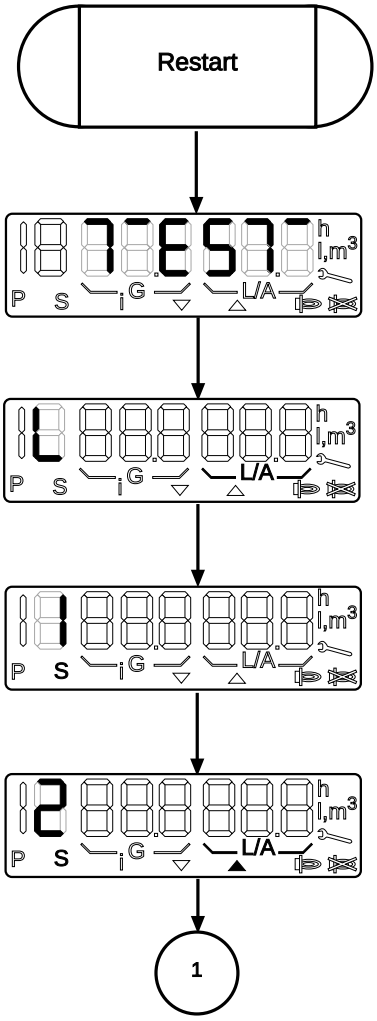
## Display in operating mode
## Oil firing, three stage

DUNGS®




After line-voltage interruption or if a request for heat was pending in standby mode.

Internal tests such as ROM test, CPU test, RAM test, etc.

Check servo drive for air and go to reference point.

Safety circuit and temperature controller are both activated. Process continues if both are closed; otherwise, go to standby =“OFF“.

Move servo drive for air to characteristic point P9. Idle-state check of air-pressure monitor.

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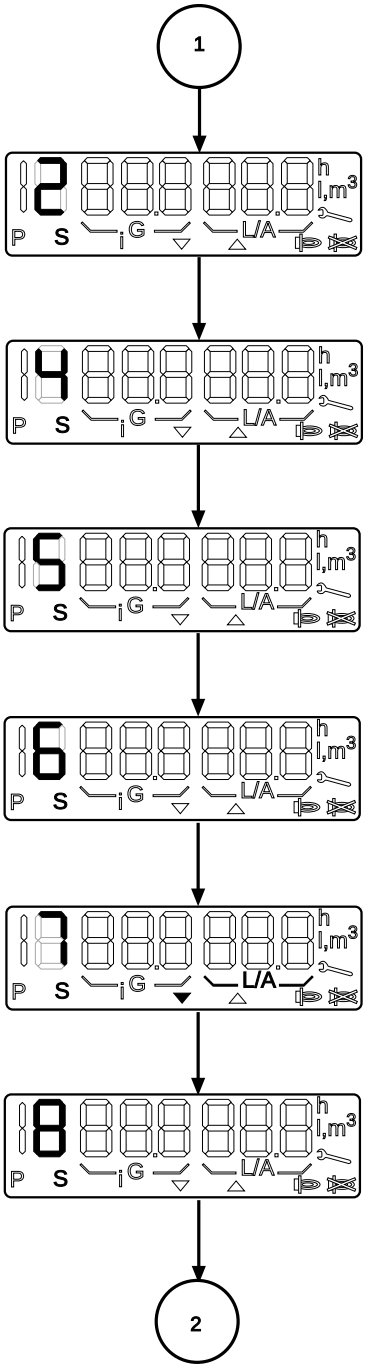
## Display in operating mode
## Oil firing, three stage

DUNGS®




If servo drive for air is at characteristic point P9 and the air-pressure monitor is not in idle position.

Watchdog loads.

Pre-vent
Purging time countdown in seconds.
Watchdog pulls up and latches.

Pre-vent
Purging time countdown in seconds.

Move servo drive for air to ignition point P0.

Wait 2 seconds at ignition point

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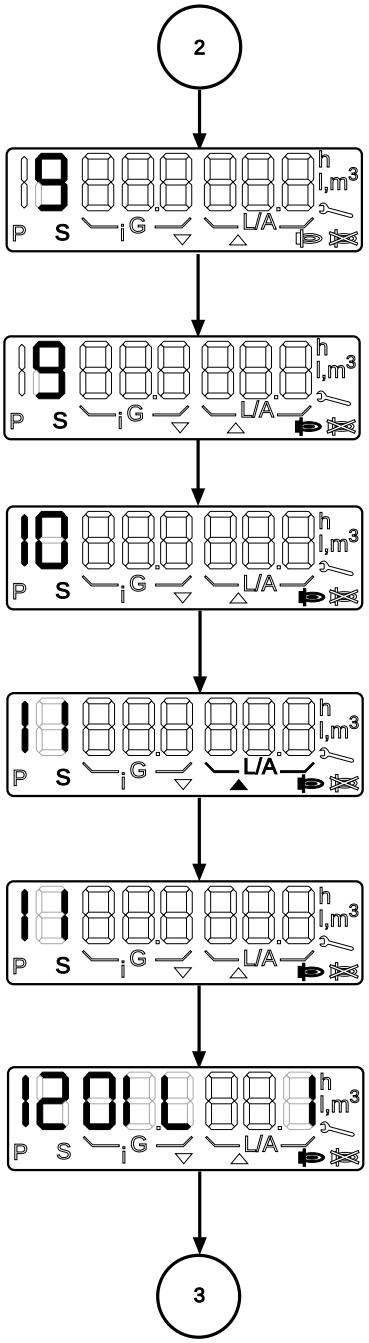
## Display in operating mode
## Oil firing, three stage

DUNGS®




Safety period without flame message

Safety period with flame message

Stabilization time

Go to characteristic point P1 from ignition point P0

Wait before operating position at Stage 1

Operation
Stage 1

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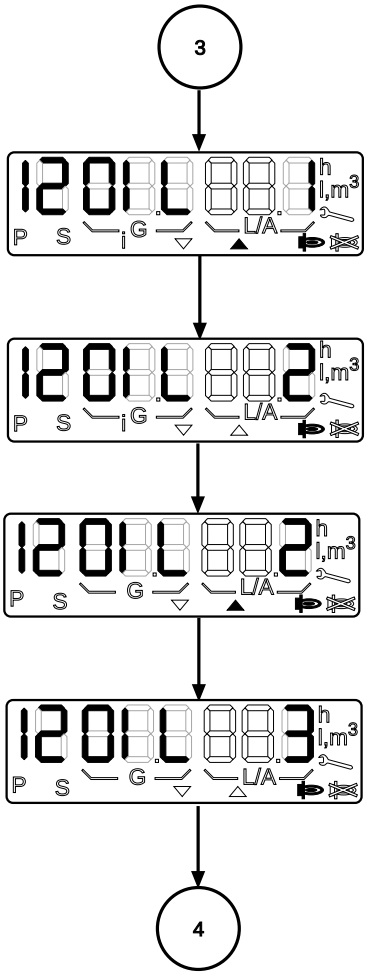
## Display in operating mode
## Oil firing, three stage

DUNGS®




Operation
Changeover point between stages 1 and 2

Operation
Stage 2

Operation
Changeover point between stages 2 and 3

Operation
Stage 3

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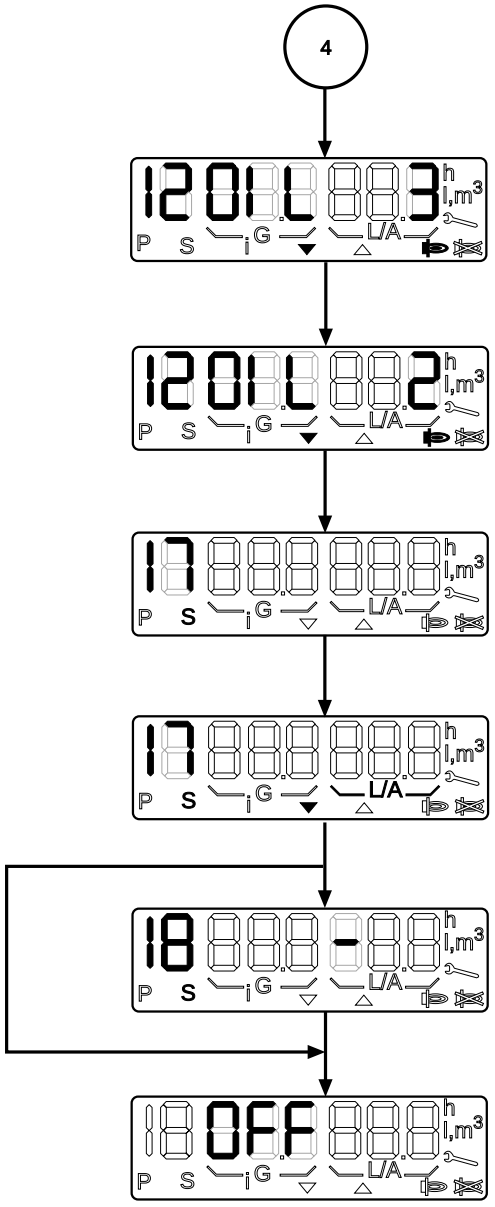
# Display in operating mode
# Oil firing, three stage

DUNGS®




Operating position.
Changeover point between stages 3 and 2

Operating position.
Changeover point between stages 2 and 1

Post-venting with blower in operation.

Post-venting ended. The blower is off. The servo drive for air goes to the standby position.

If a wait is programmed, the wait is counted down. Minutes on the left, seconds on the right.

Standby, wait for request for heat. Setup mode and parameterisation mode can be activated. See setup mode, "Oil firing, two stage" and "Display in parameterisation mode".

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# Display in information mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

DUNGS®

The information-mode display can be accessed only from the operating-mode display. It can be called up irrespective of burner status and provides information on:

Current counts for

- Fuel quantities
- Operating hours
- Starts

Information about:

- Software status
- Date of production
- Machine serial number

This display mode is exited after a 20-second timeout or if the readout is scrolled past the last item.

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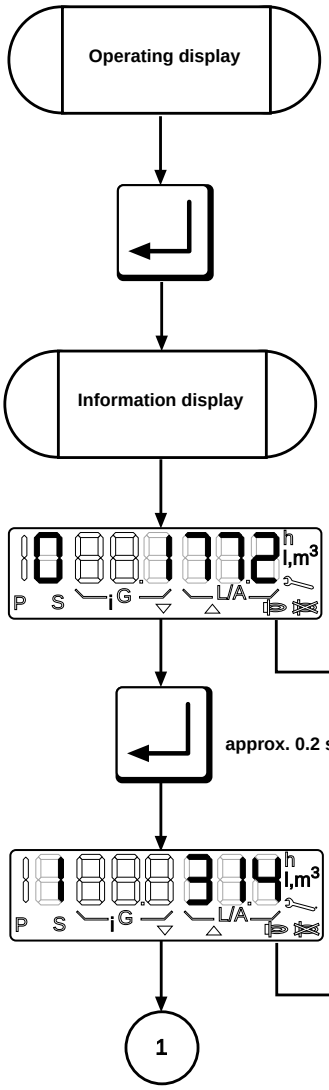
# Display in information mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

DUNGS®




Press for approx. 0.5 s until the "i" symbol is displayed.
Release button.

Total fuel consumption in liters of oil or cubic meters of gas.

Total operating hours for gas-fired burners or operating hours in stage 1 for oil-fired burners.

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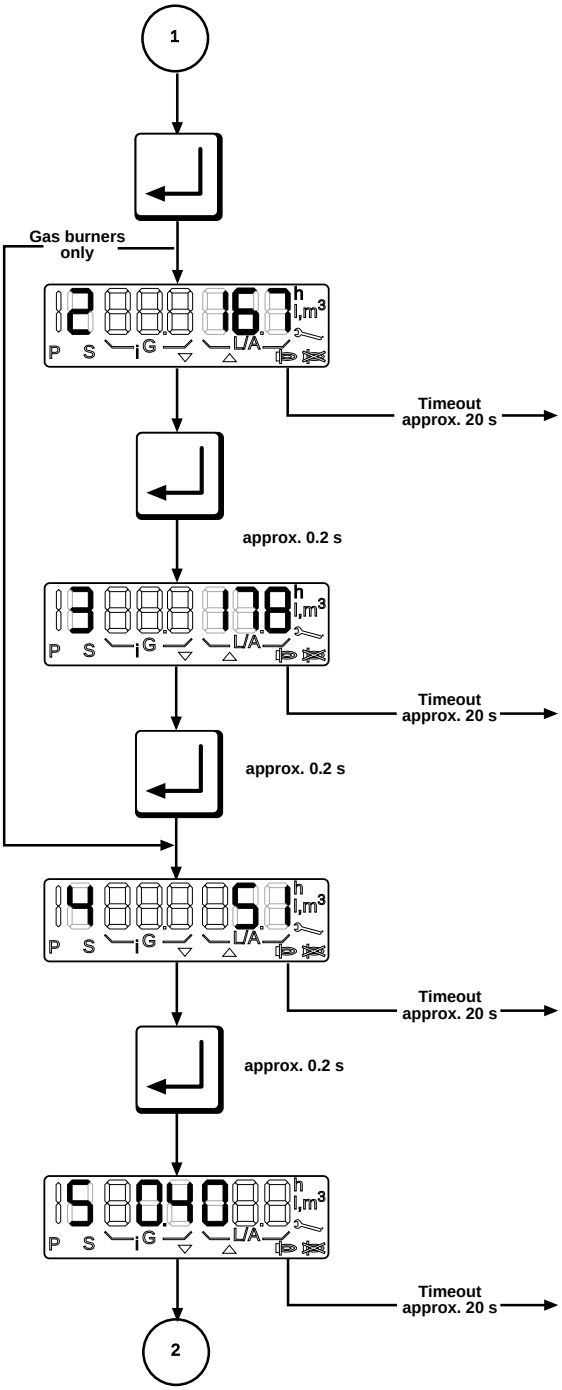
# Display in information mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

DUNGS®




Total operating hours in stage 2 for oil-fired burners.

Total operating hours in stage 3 for oil-fired burners.

Number of successful starts, in other words flame detected after safety period expires.

The version number of the software running in the automatic controller.

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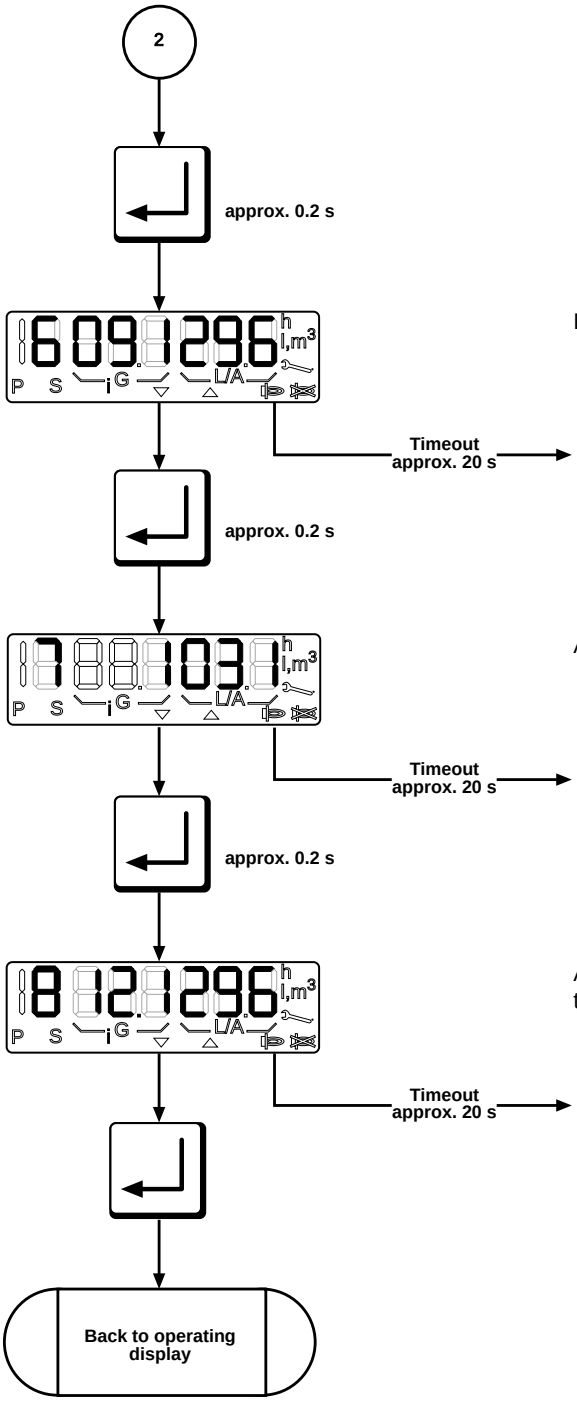
# Display in information mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

DUNGS®




Date of compilation of the software.

Automatic controller's serial number.

Automatic controller's date of production (date of works testing).

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# Display in service mode Gas firing, electronic modulation

DUNGS®

■ **The service-mode display can be accessed only from the operating-mode display.**

The service display can be called irrespective of the burner status and provides information on the characteristic stored in the EEPROM. The following data are displayed:

- The characteristic points P0 - P9
- The last 6 error messages
- The test times of the valve testing system
- Flame quality
- The e-BUS address
- The switch position of the valve testing system
- The limits of the modulation range
- Controller address

This display mode is exited after a 20-second timeout or if the readout is scrolled past the last item.

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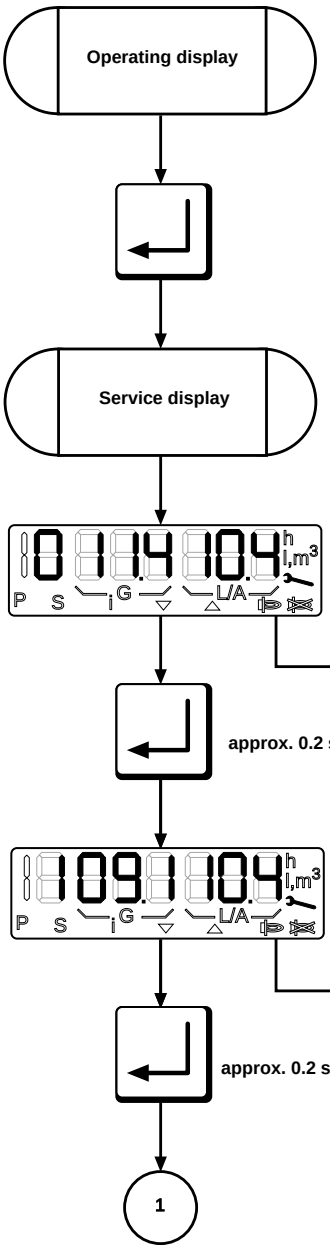
# Display in service mode
# Gas firing, electronic modulation

DUNGS®




Press for approx. 0.5 s until the "Wrench" symbol is displayed. Release button. The "i" symbol is displayed for approx. 1.5 s beforehand.

Values of ignition point P0

Values of characteristic point P1

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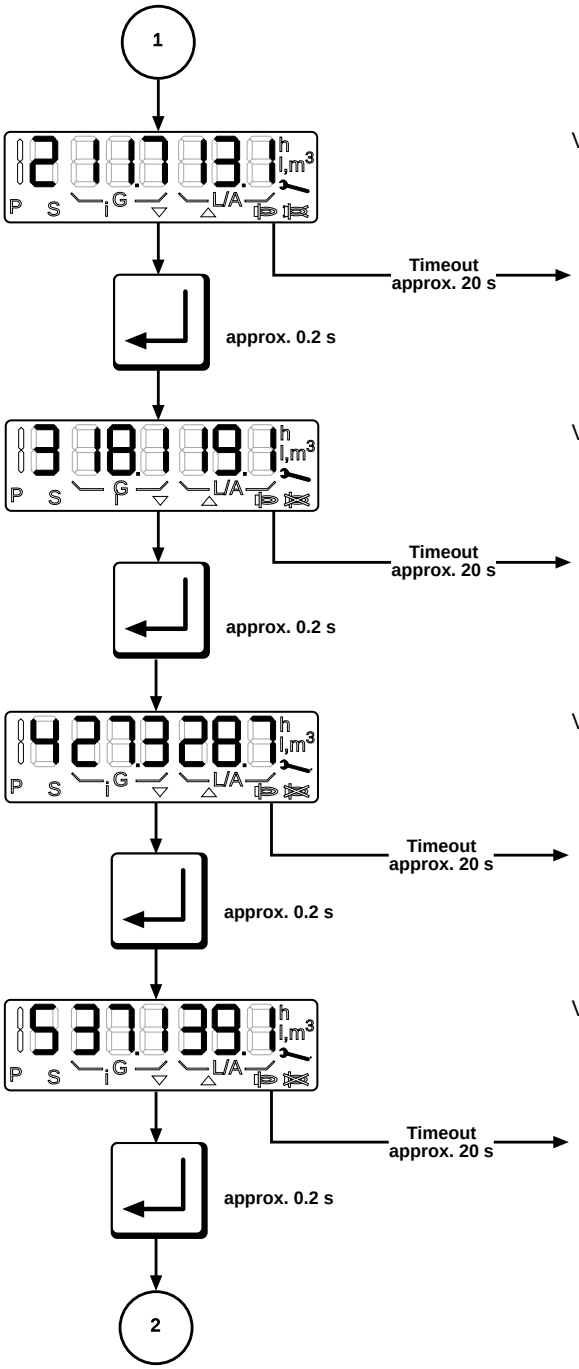
# Display in service mode
# Gas firing, electronic modulation

DUNGS®

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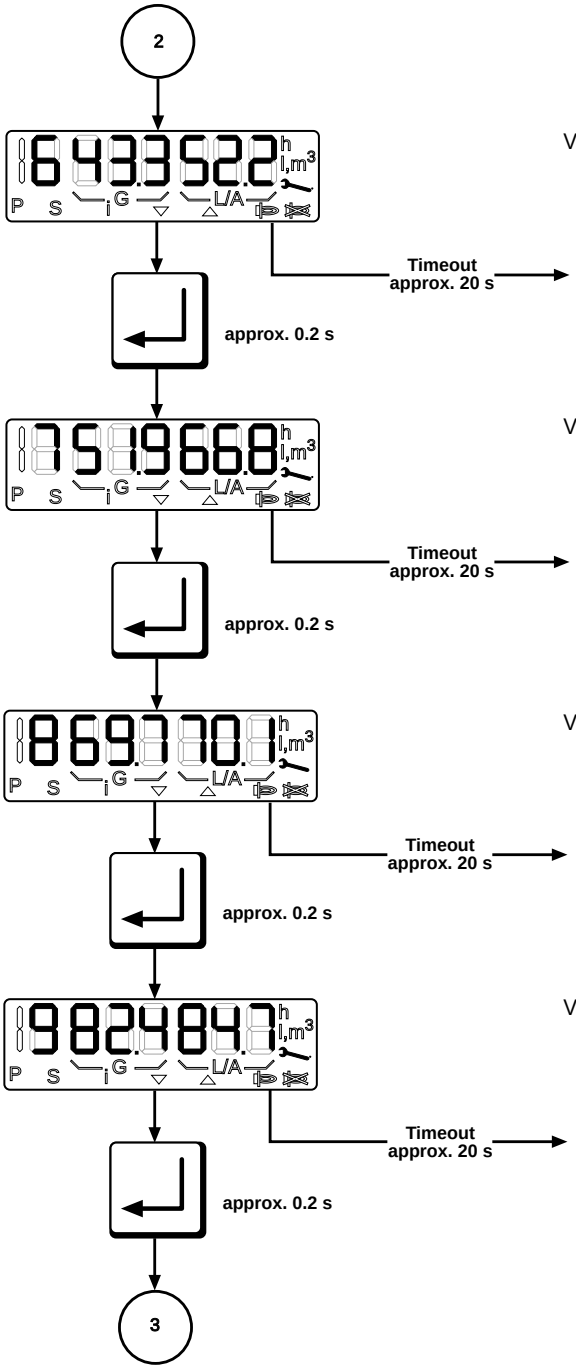
# Display in service mode
# Gas firing, electronic modulation

DUNGS®

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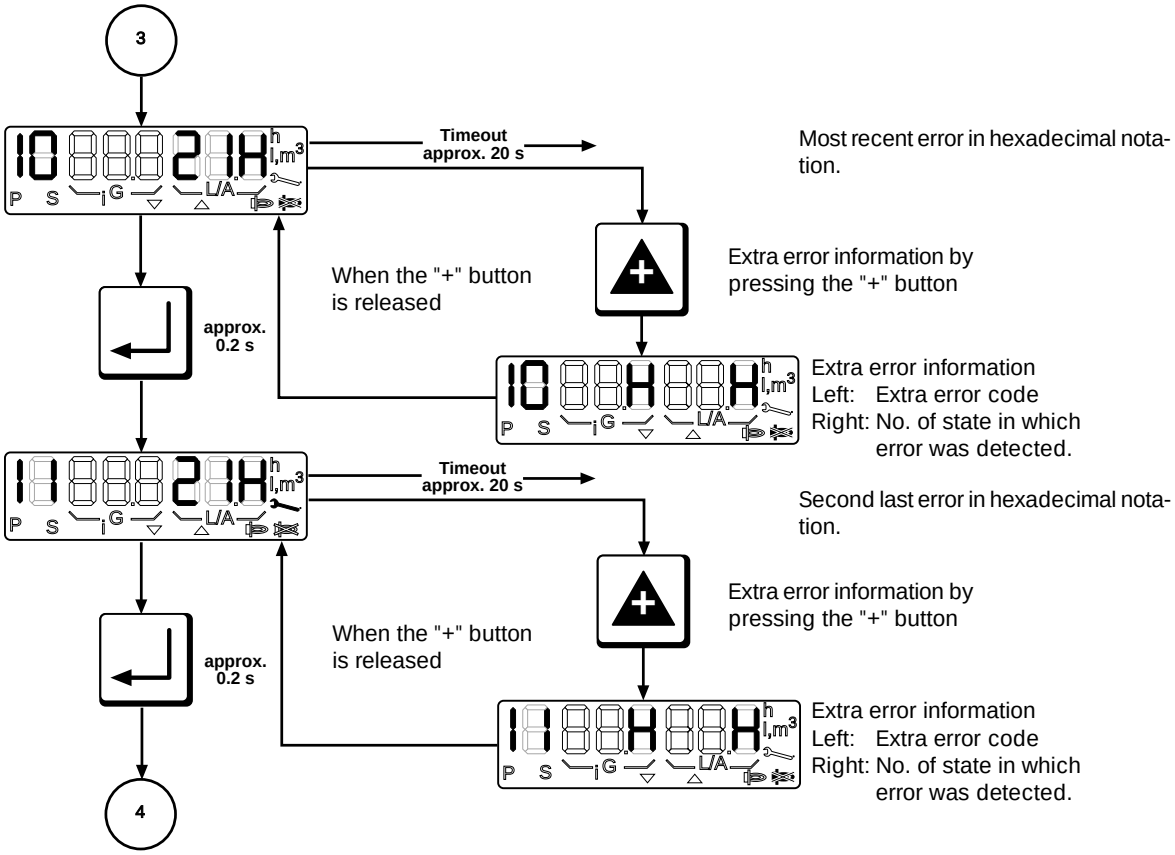
# Display in service mode
# Gas firing, electronic modulation

DUNGS®

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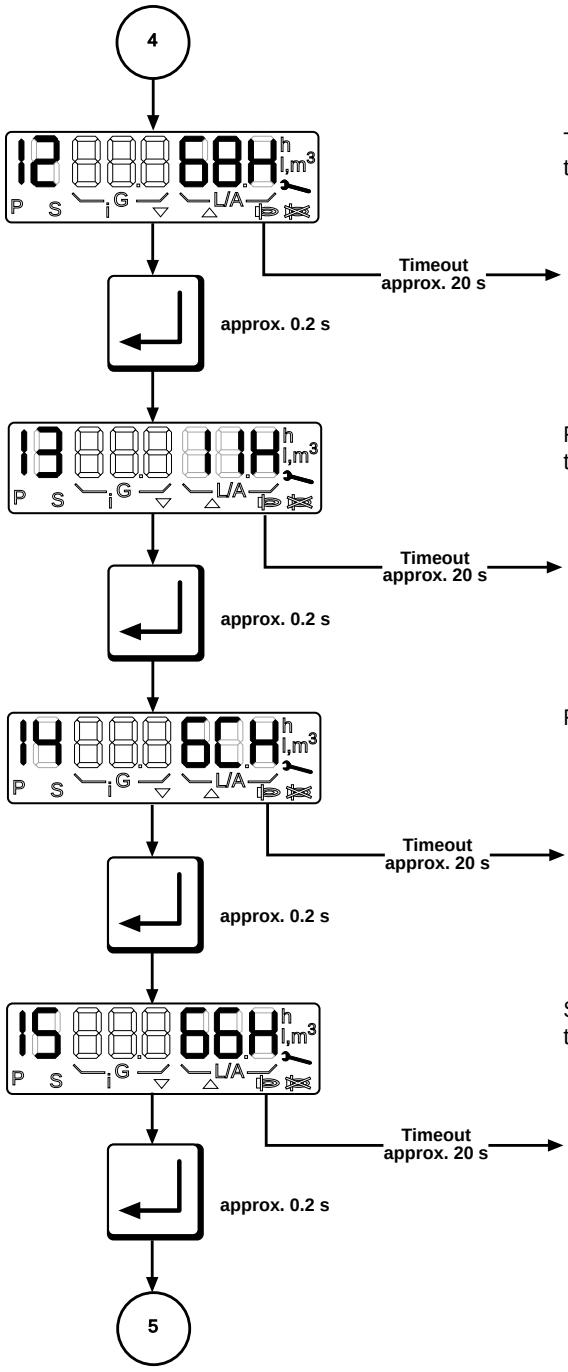
# Display in service mode Gas firing, electronic modulation

DUNGS®




Third last error in hexadecimal notation.

Fourth last error in hexadecimal notation.

Fifth last error in hexadecimal notation.

Sixth last error in hexadecimal notation.

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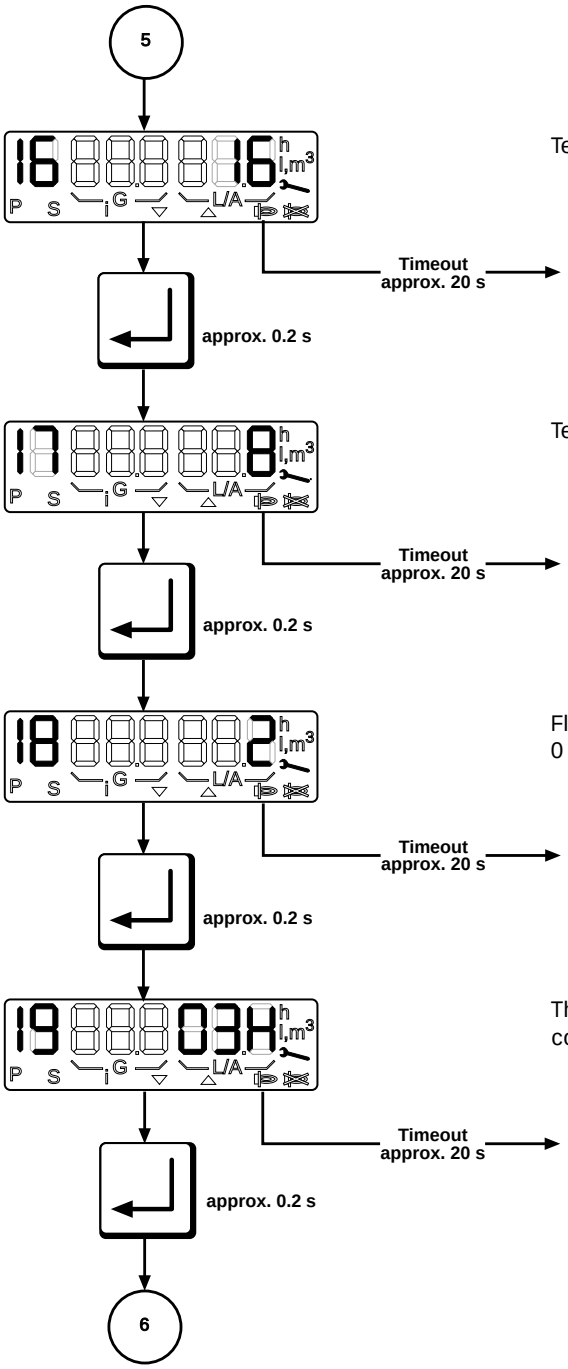
# Display in service mode
# Gas firing, electronic modulation

DUNGS®




Testing time, valve Y2

Testing time, valve Y3

Flame quality indication 0 - 4
0 = no flame

The eBUS address of this automatic controller

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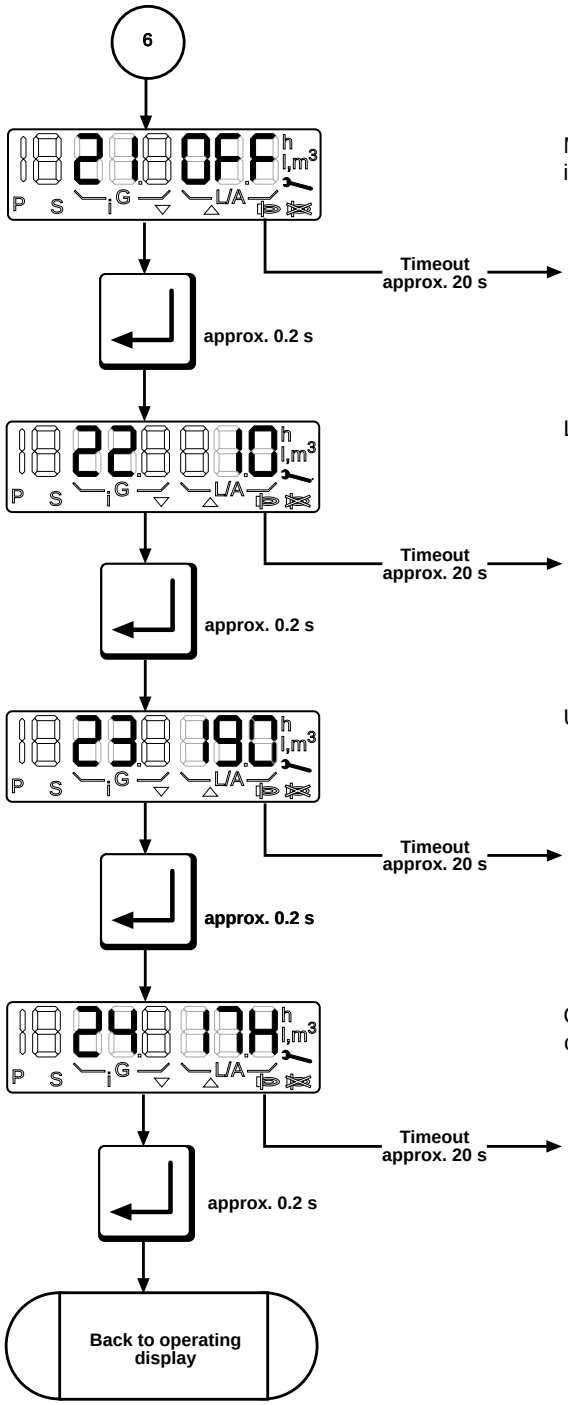
# Display in service mode
# Gas firing, electronic modulation

DUNGS®




Mode indicator: integrated valve testing system is ON or OFF.

Lower limit of modulation range

Upper limit of modulation range

Controller address of this automatic controller

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# Display in service mode Gas firing, pneumatic modulation

DUNGS®

■ **The service-mode display can be accessed only from the operating-mode display.**

The service display can be called irrespective of the burner status and provides information on the characteristic stored in the EEPROM.
The following data are displayed:

- The characteristic points P0, P1 and P9
- The last 6 error messages
- The test times of the valve testing system
- Flame quality
- The e-BUS address
- The switch position of the valve testing system
- Controller address

This display mode is exited after a 20-second timeout or if the readout is scrolled past the last item.

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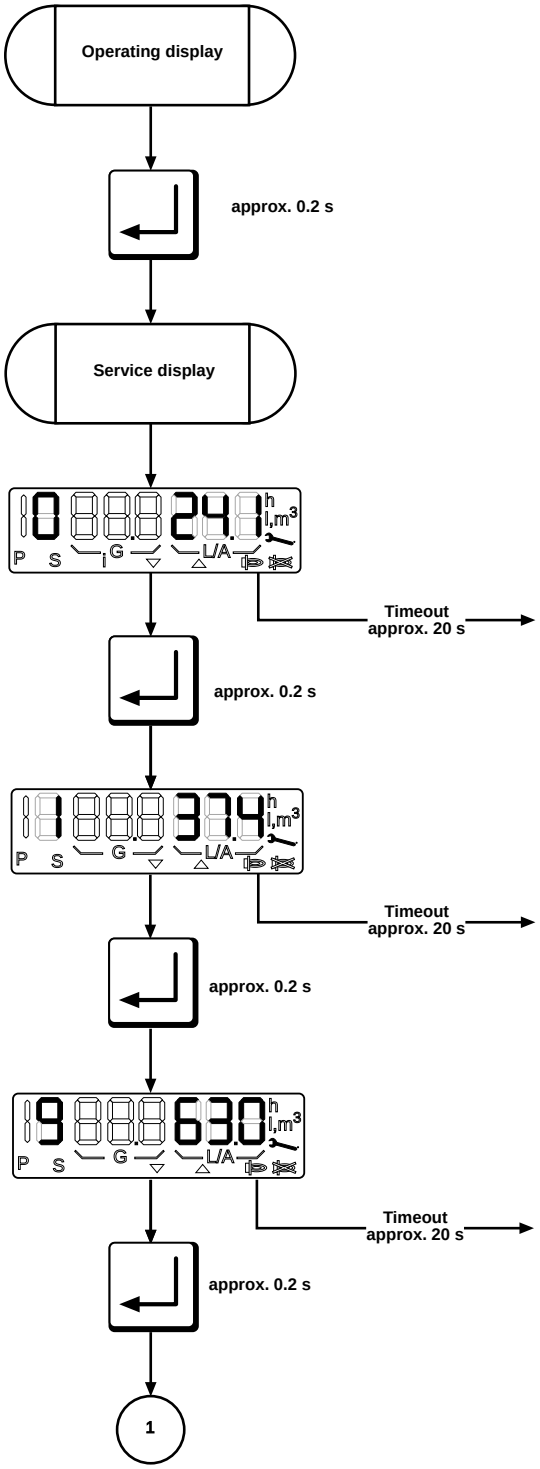
# Display in service mode Gas firing, pneumatic modulation

DUNGS®




Press for approx. 0.5 s until the "Wrench" symbol is displayed. Release button. The "i" symbol is displayed for approx. 1.5 s beforehand.

Value of ignition point P0 for gas burner with pneumatic modulation.

Minimum point (P1) of the characteristic for gas burner with pneumatic modulation.

Value of the maximum point (P9) of the characteristic for gas burner with pneumatic modulation.

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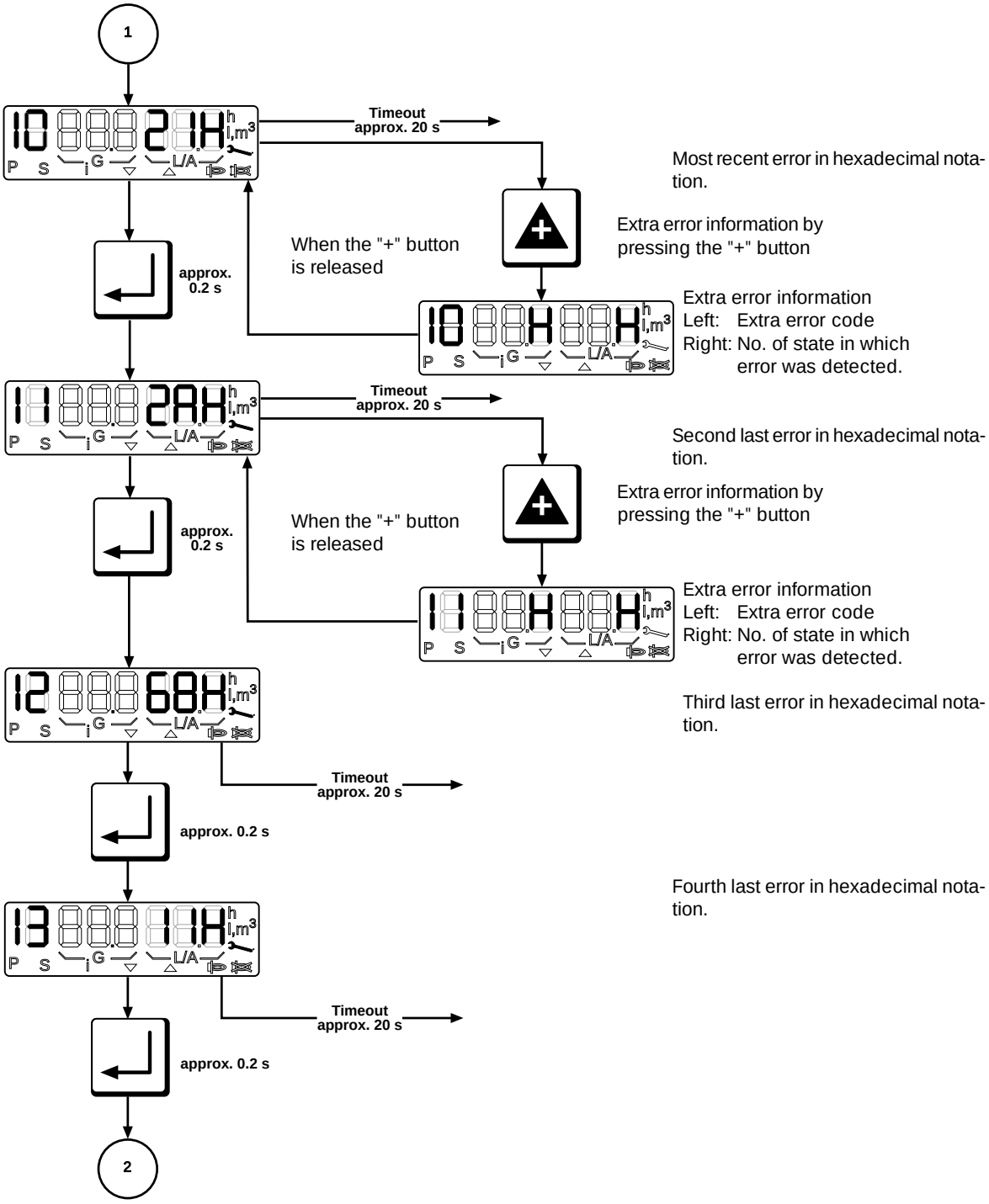
# Display in service mode
# Gas firing, pneumatic modulation

DUNGS®

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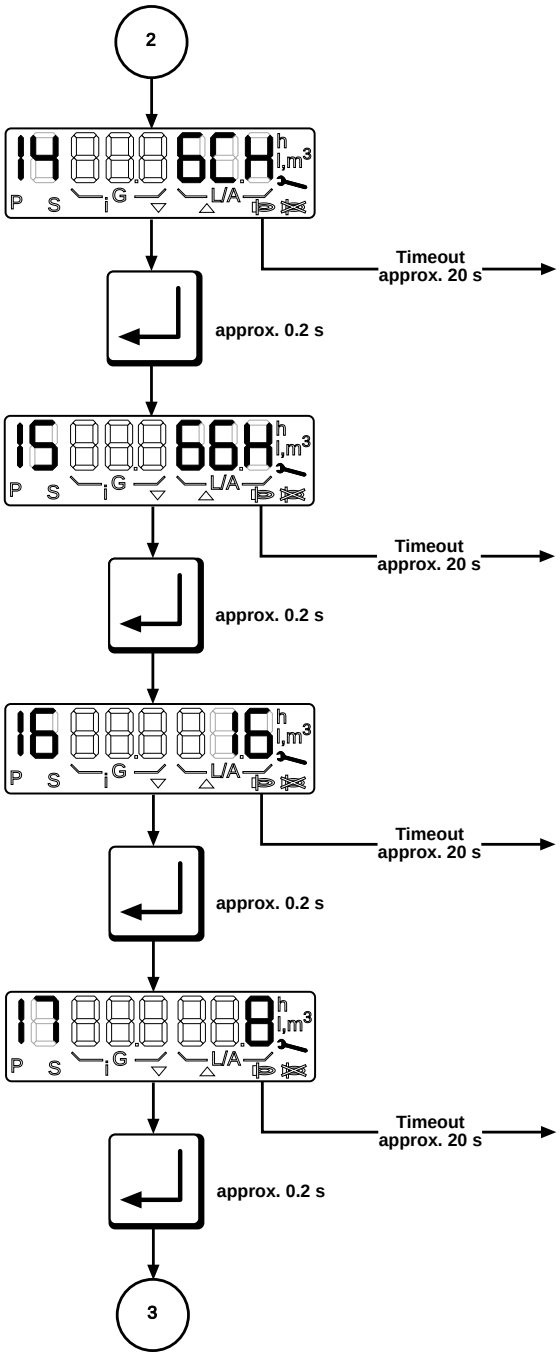
# Display in service mode
# Gas firing, pneumatic modulation

DUNGS®




Fifth last error in hexadecimal notation.

Sixth last error in hexadecimal notation.

Testing time, valve Y2

Testing time, valve Y3

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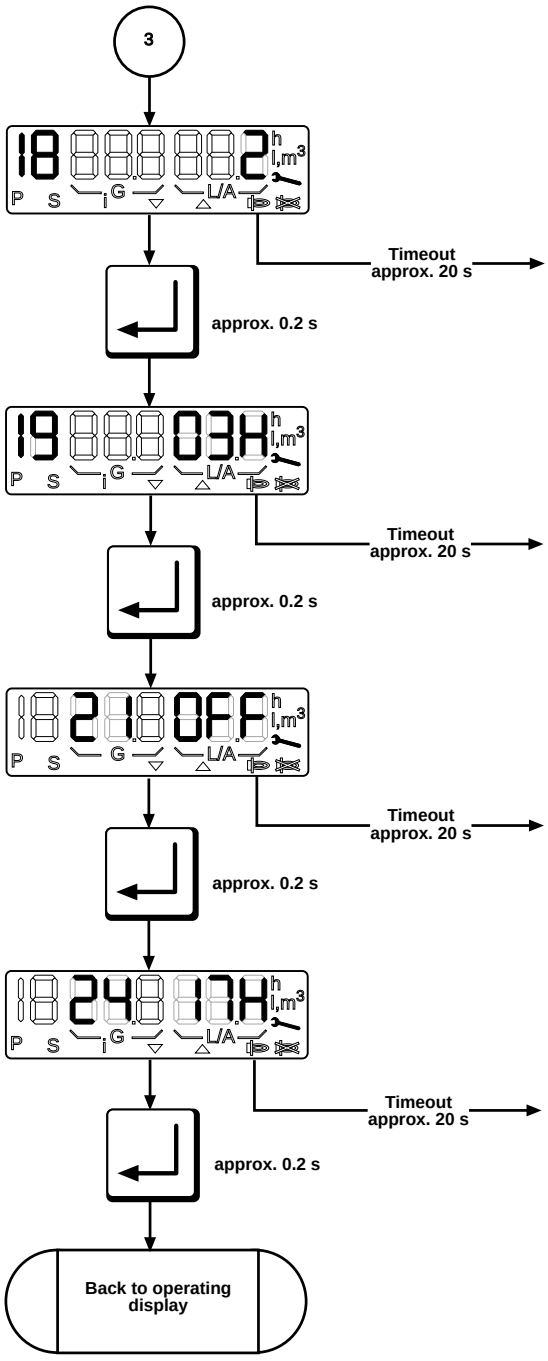
# Display in service mode
# Gas firing, pneumatic modulation

DUNGS®




Flame quality indication 0 - 4
0 = no flame

The eBUS address of this automatic controller

Mode indicator: integrated valve testing system is ON or OFF.

Controller address of this automatic controller

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# Display in service mode
# Oil firing, three stage

DUNGS®

■ **The service-mode display can be accessed only from the operating-mode display.**

The service display can be called irrespective of the burner status and provides information on the characteristic stored in the EEPROM.
The following data are displayed:

- The characteristic points P0, P1, P3 and P9
- The changeover points P2, P4
- The last 6 error messages
- Flame quality
- The e-BUS address
- The switch position of the monitor function
- Controller address

This display mode is exited after a 20-second timeout or if the readout is scrolled past the last item.

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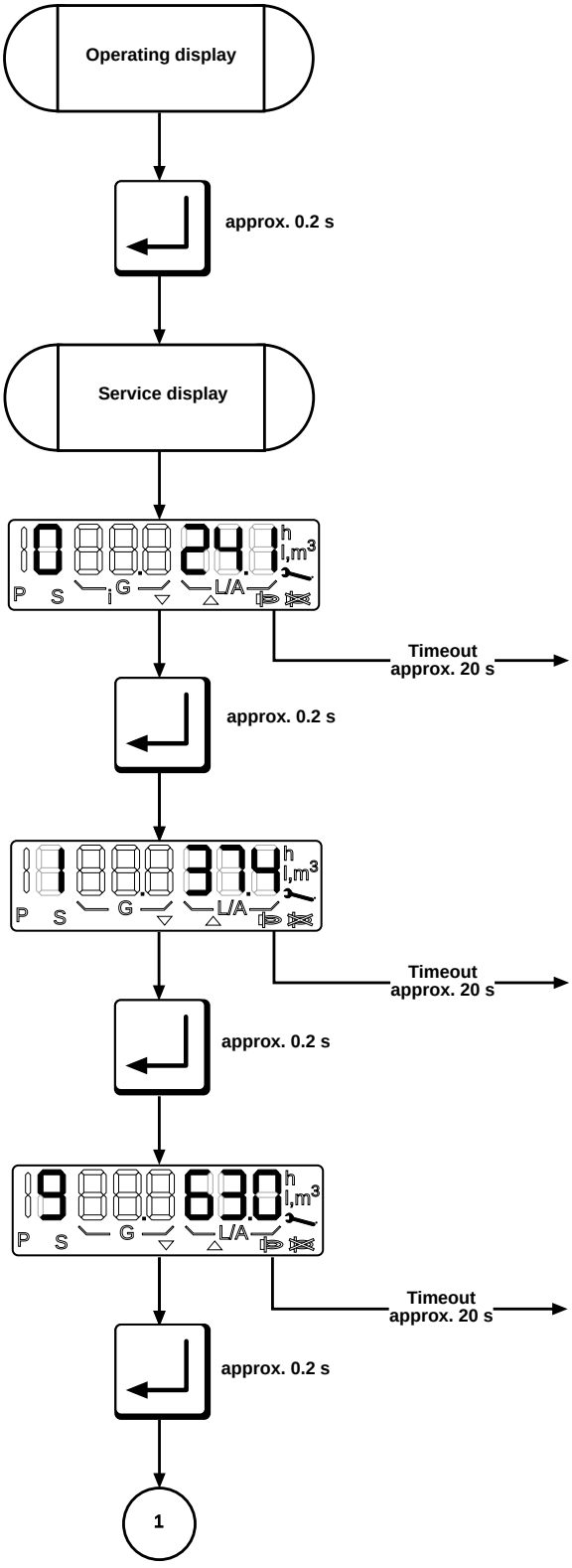
# Display in service mode
# Oil firing, three stage

DUNGS®




Press for approx. 0.5 s until the "Wrench" symbol is displayed. Release button. The "i" symbol is displayed for approx. 1.5 s beforehand.

Value of ignition point P0 for oil burner, three-stage.

Value of working point, stage 1 (P1) for oil burner, three-stage.

Value of changeover point P2 for changeover between stage 1 and stage 2 for oil burner, three-stage.

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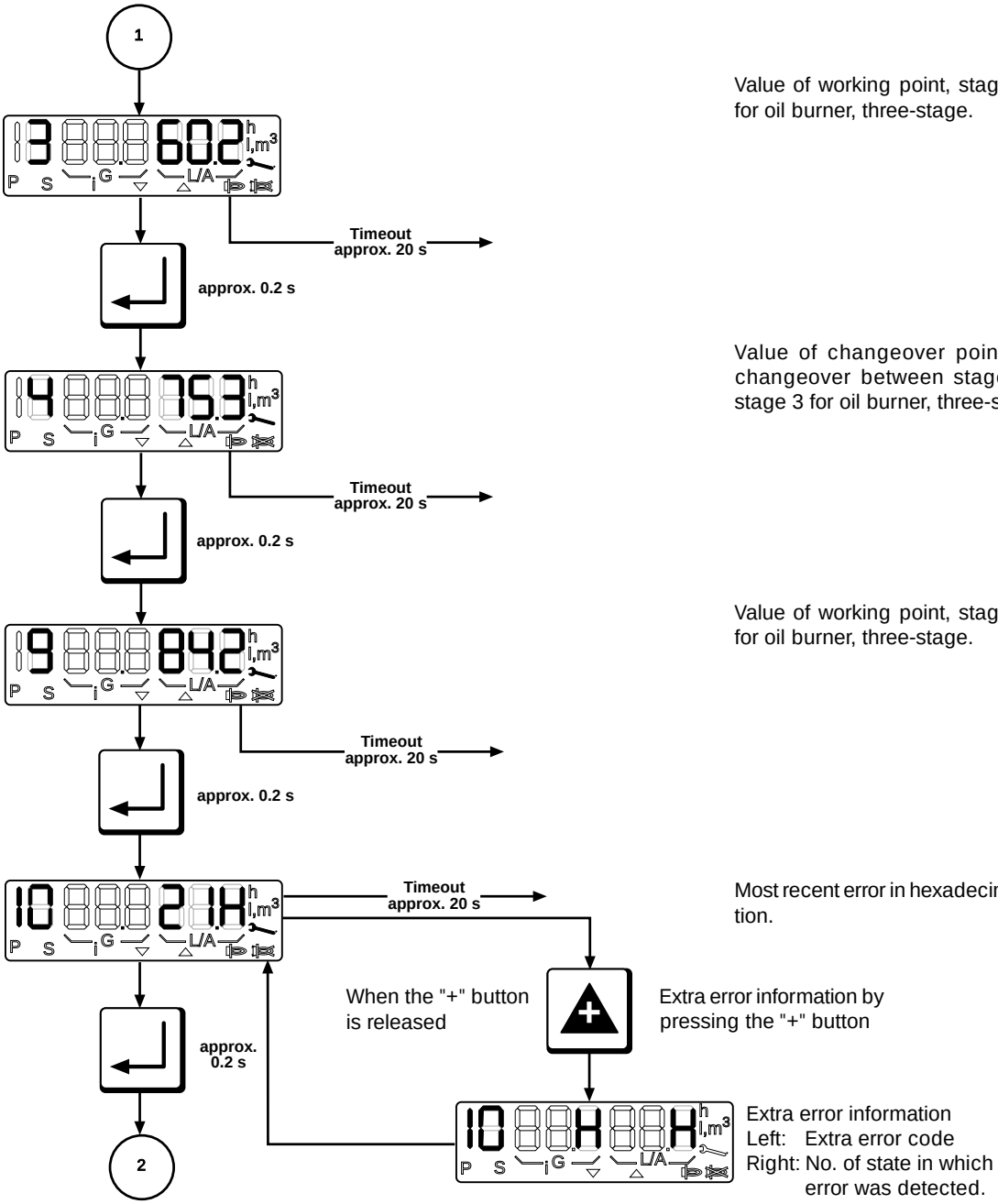
# Display in service mode
# Oil firing, three stage

DUNGS®




Value of working point, stage 2 (P3) for oil burner, three-stage.

Value of changeover point P4 for changeover between stage 2 and stage 3 for oil burner, three-stage.

Value of working point, stage 3 (P9) for oil burner, three-stage.

Most recent error in hexadecimal notation.

Extra error information by pressing the "+" button

Extra error information
Left: Extra error code
Right: No. of state in which error was detected.

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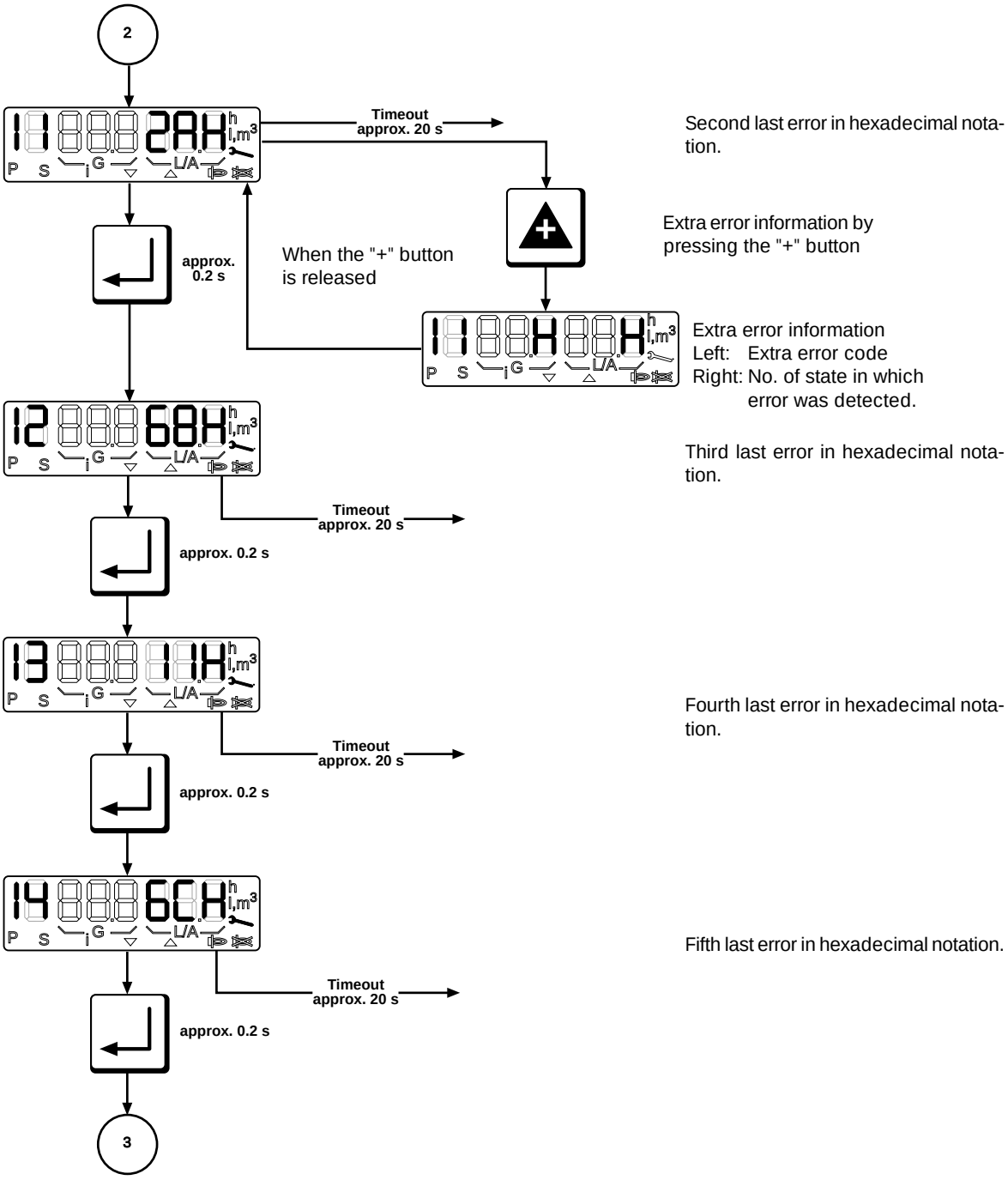
# Display in service mode
# Oil firing, three stage

DUNGS®

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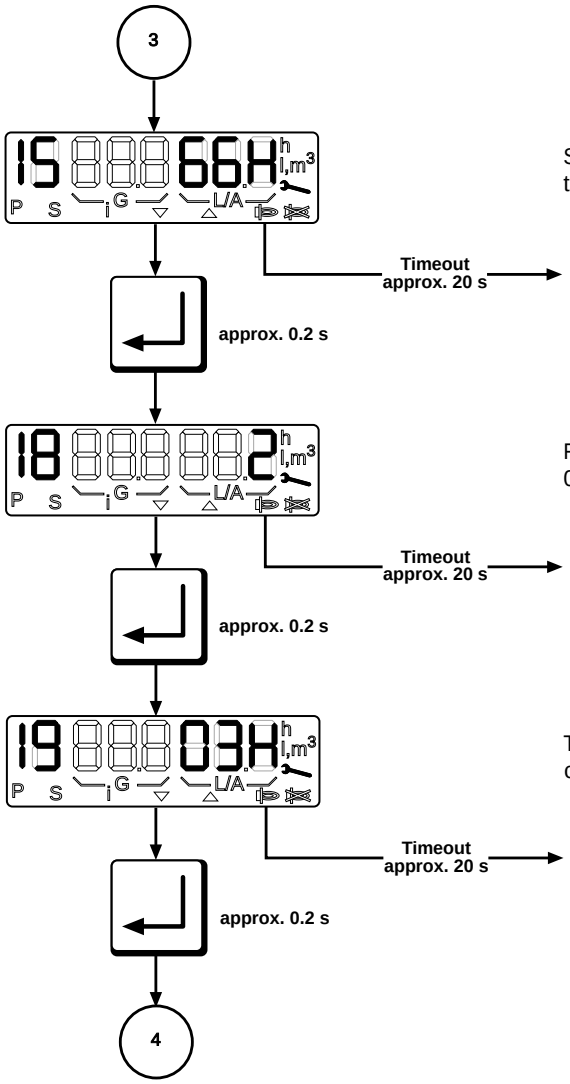
## Display in service mode
## Oil firing, three stage

DUNGS®




Sixth last error in hexadecimal notation.

Flame quality indication 0 - 4
0 = no flame

The eBUS address of this automatic controller

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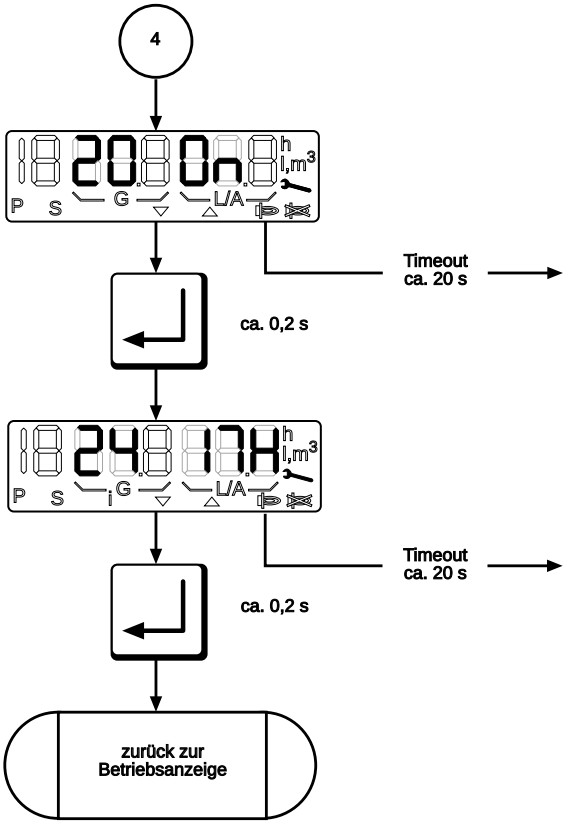
## Display in service mode
## Oil firing, three stage

DUNGS®




Status indicator: monitor function active or inactive
active = ON
inactive = OFF

Controller address of this automatic controller

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# Display in parameterization mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

DUNGS®

■ **The parameterisation-mode display can be accessed only from the operating-mode display in standby status.**

Parameterisation mode can be accessed only from the operating-mode display when the controller is on standby ("OFF"). Parameterisation mode is used to view important operating parameters and adjust the settings by means of the buttons on the touch-sensitive display.

Paramterization mode defines access priority in such a way that all service-level parameters can be configured with MPA Vision.

This display mode is exited after a 20-second timeout or if the readout is scrolled past the last display image.

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# Display in parameterization mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

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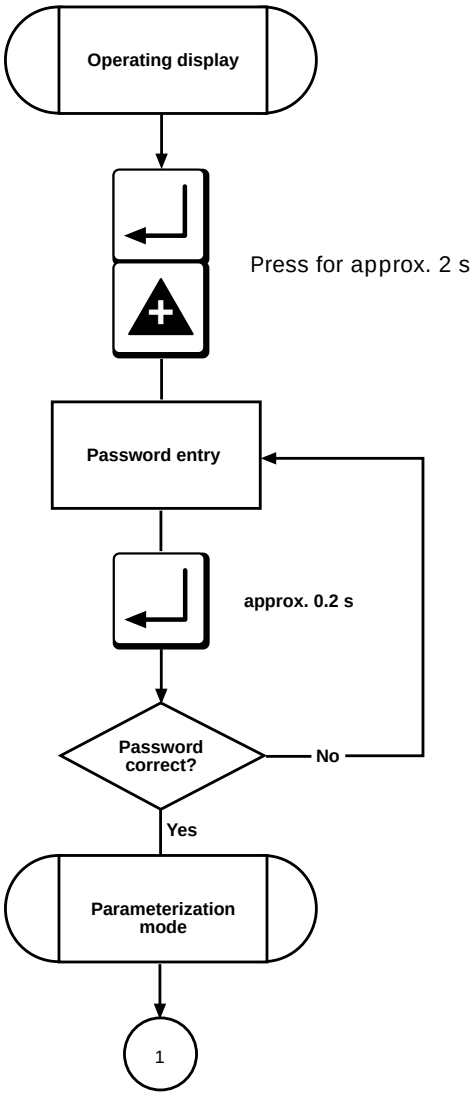


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**Display in parameterization mode**
**Gas firing, electronic modulation**
**Gas firing, pneumatic modulation**
**Oil firing, three stage**

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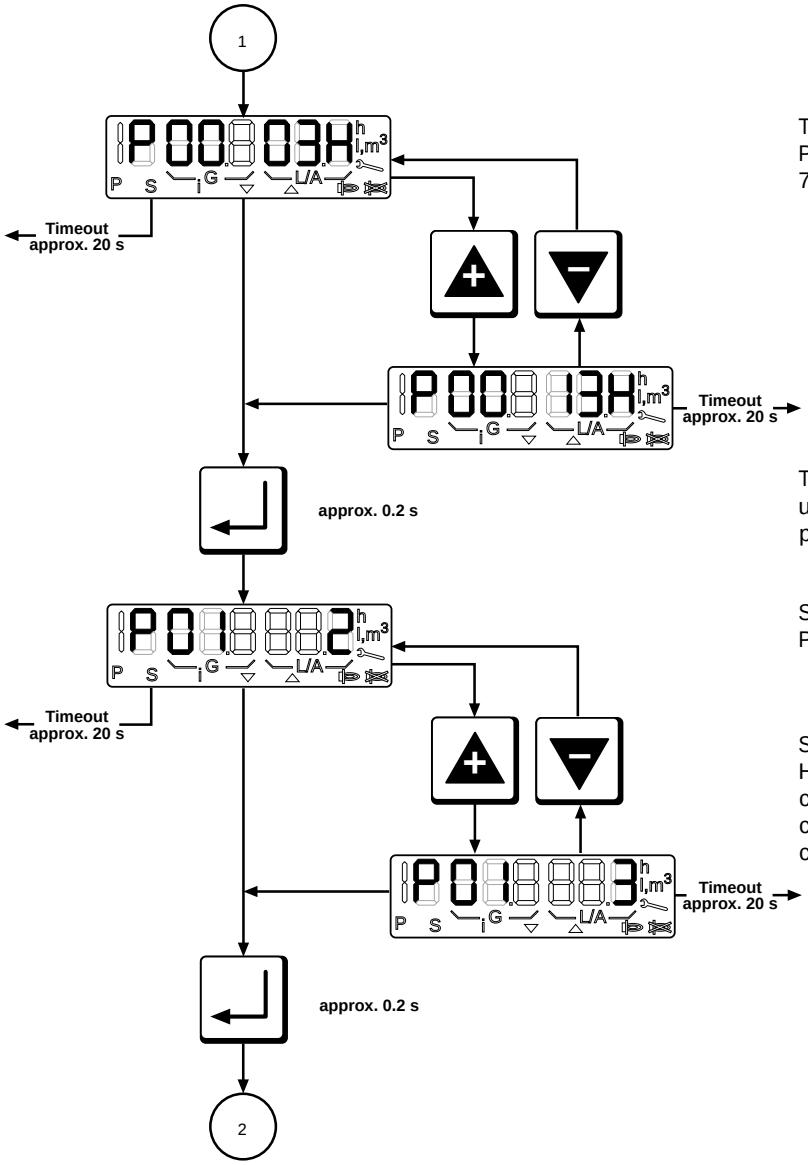


The eBUS communication address. Possible values are 03H, 13H, 33H, 73H, F3H

The changed address is not stored until you advance the program or exit parameterisation mode via timeout.

Specify run-on time in seconds
Permissible range: 0 - 240 s

Strike key = 1 step
Hold down key = 25 steps slow counting followed by high-speed counting. Each individual step is counted.

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# Display in parameterization mode
# Gas firing, electronic modulation
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# Oil firing, three stage

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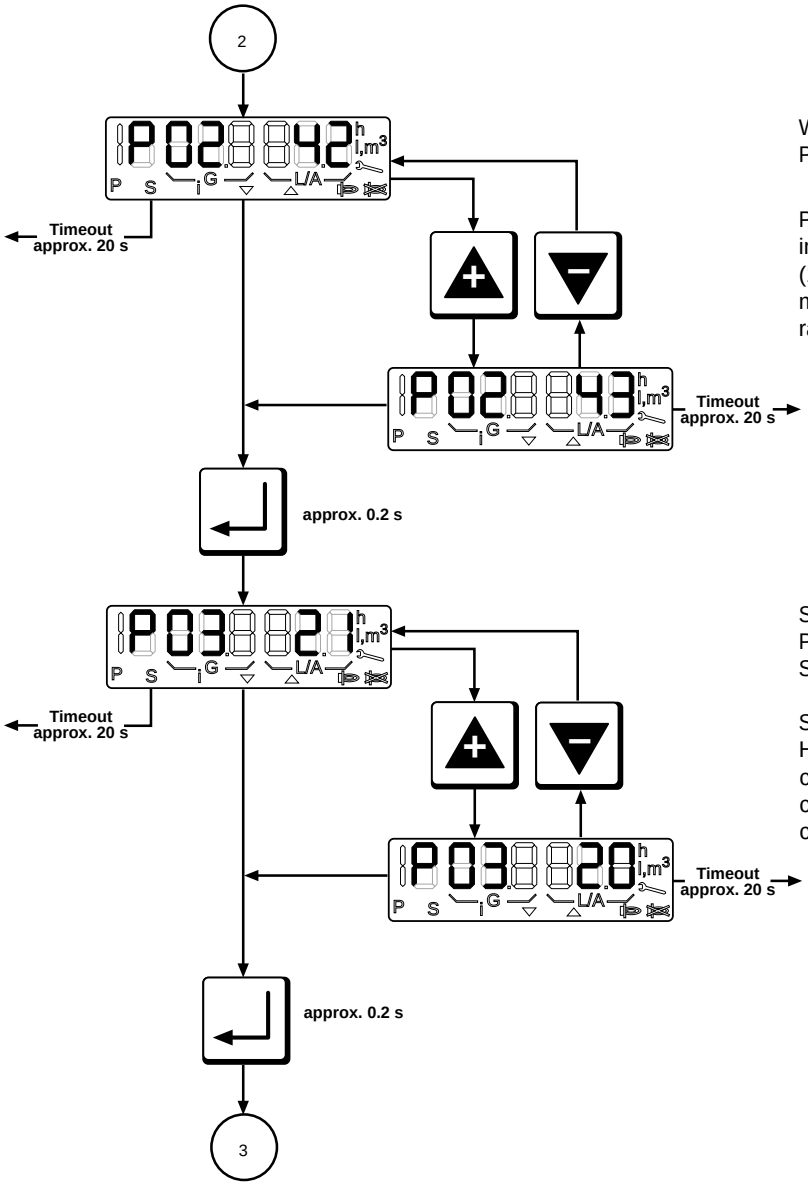


Wait in minutes
Permissible range 0 - 100 min.

Press button and release = one increment
(1 s). Press and hold down = increments slowly for 2.5 s, then more rapidly. Each increment is saved.

Specify pulse divider
Permissible range: 1 - 255
Specify in pulses/litres or pulse/m³

Strike key = 1 step
Hold down key = 25 steps slow counting followed by high-speed counting. Each individual step is counted.

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**Display in parameterization mode**
**Gas firing, electronic modulation**
**Gas firing, pneumatic modulation**
**Oil firing, three stage**

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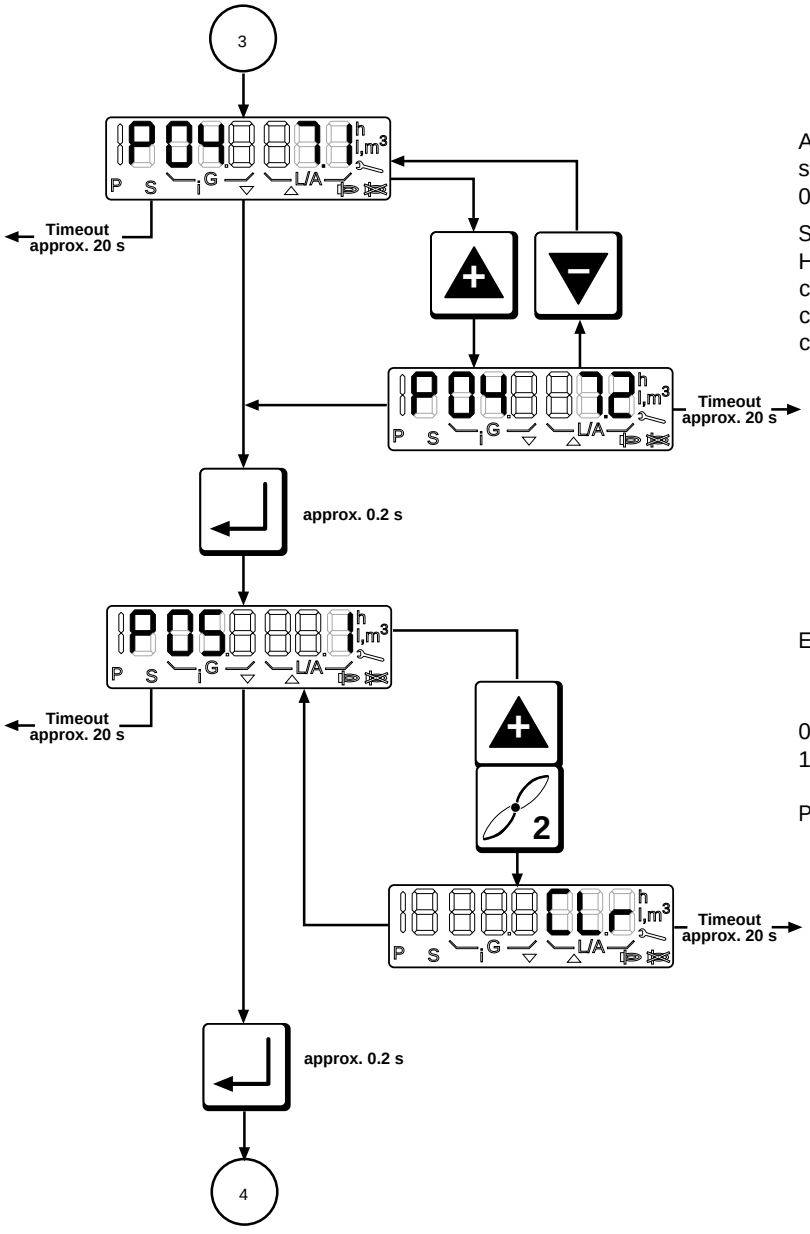


Air-flow control flap position in standby. Variable in the range 0 - 25.5°.

Strike key = 1 step
Hold down key = 25 steps slow counting followed by high-speed counting. Each individual step is counted.

Error memory can be cleared.

0 = Error memory is empty
1 = Error memory contains data

Press both buttons for approx. 2 s.

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# Display in parameterization mode
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

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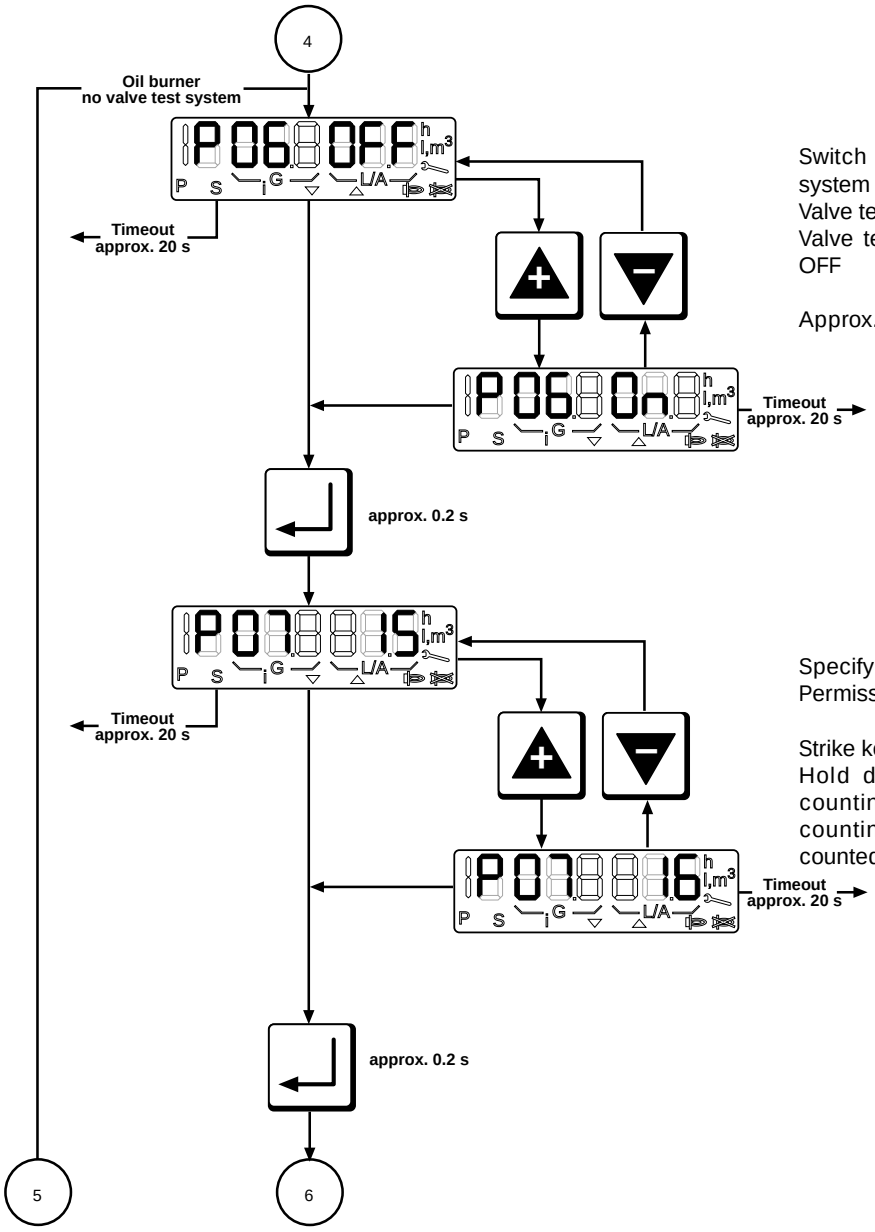


Switch position of the valve testing system
Valve testing system activated = ON
Valve testing system deactivated = OFF

Approx. 0.5 s: each change is saved.

Specify test time for valve Y2
Permissible range: 1 - 240

Strike key = 1 step
Hold down key = 25 steps slow counting followed by high-speed counting. Each individual step is counted.

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**Display in parameterization mode**
**Gas firing, electronic modulation**
**Gas firing, pneumatic modulation**
**Oil firing, three stage**

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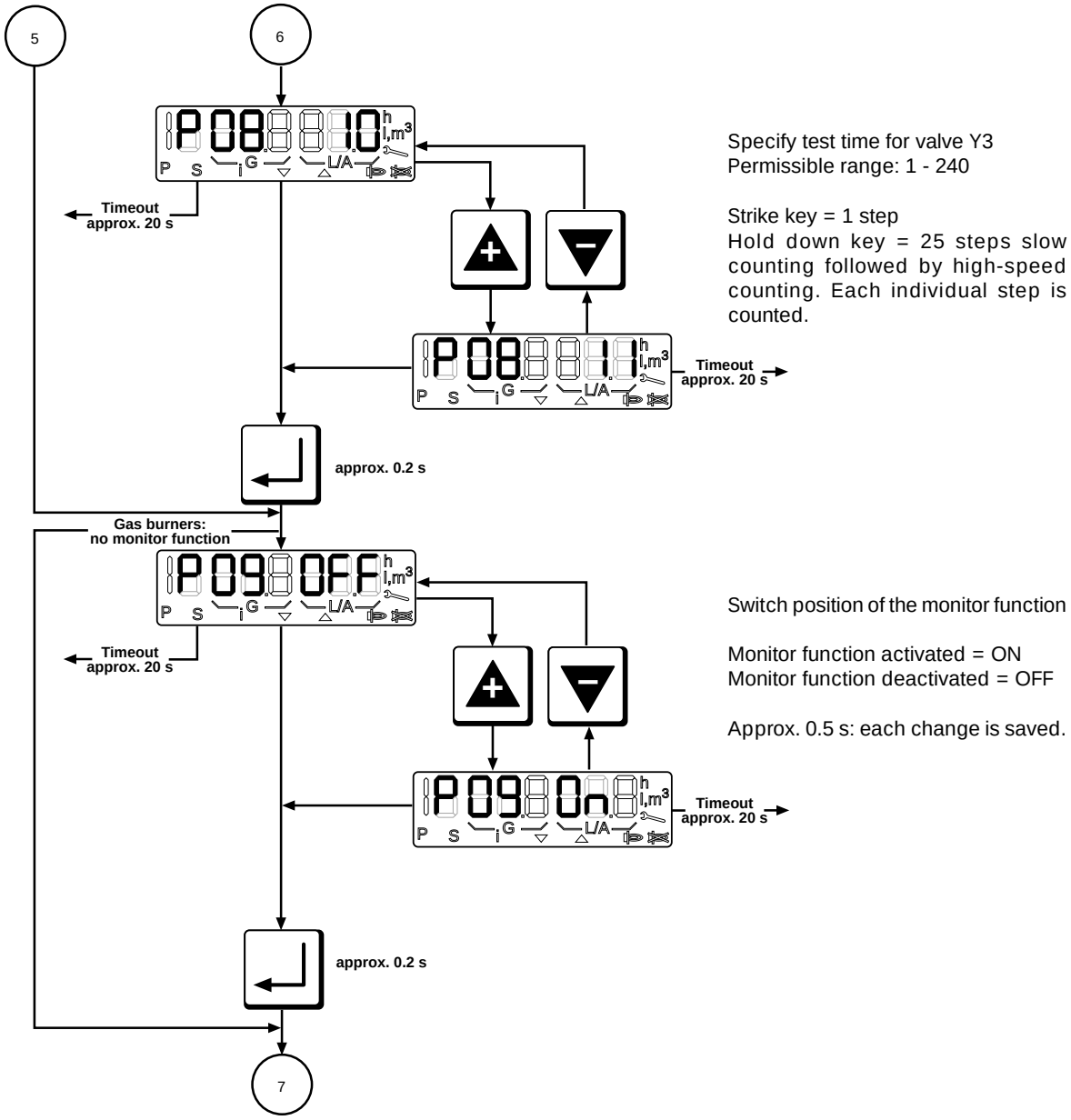


Specify test time for valve Y3
Permissible range: 1 - 240

Strike key = 1 step
Hold down key = 25 steps slow counting followed by high-speed counting. Each individual step is counted.

Switch position of the monitor function

Monitor function activated = ON
Monitor function deactivated = OFF

Approx. 0.5 s: each change is saved.

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**Display in parameterization mode**
**Gas firing, electronic modulation**
**Gas firing, pneumatic modulation**
**Oil firing, three stage**

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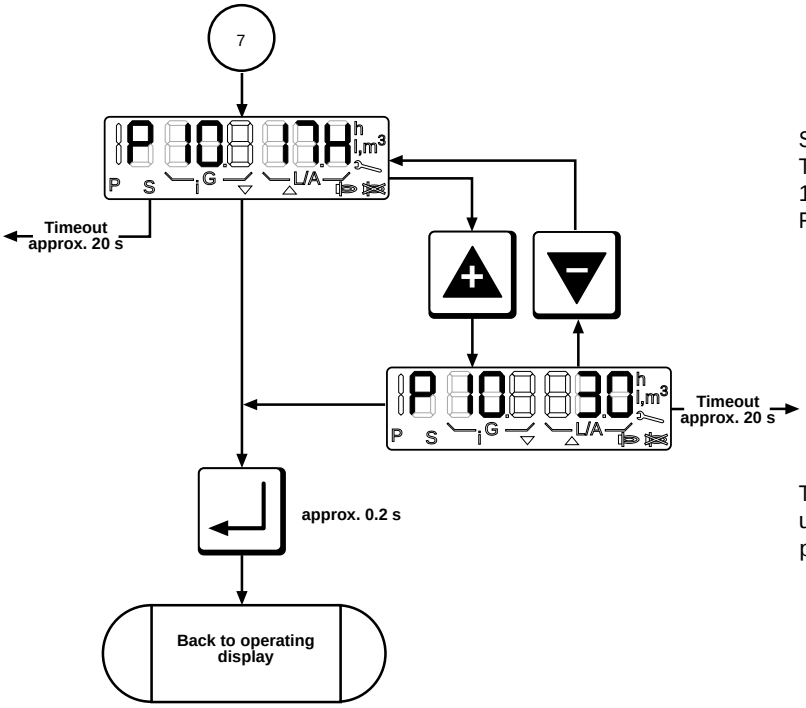


Specify control address of system. The following addresses are possible: 10H, 17H, 30H, 37H, 70H, 77H, F0H, F7H

The changed address is not stored until you advance the program or exit parameterisation mode via timeout.

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# Error indication
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

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■ **Error mode**

⚠ Error mode overwrites all other display modes.
Error mode is not active unless a error is detected.

■ **Error indication**

The following appears on the display:

- An "F" on the left
- The "Flame with strike-through" symbol
- The error code in hexadecimal notation; occupies the three places on the right.
- The error code flashes

■ **Error code**

The error codes are listed complete with their individual meanings in the Error Codes list below.

■ **Extra error code**

Press the "+" button to call up an extra error code which provides more detailed information on the error, along with details of the program state in which the error occurred. The extra error code does not flash on the display.

■ **Reset**

You must press the "Acknowledgment" or "Reset" button to reset.

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# Error indication
# Gas firing, electronic modulation
# Gas firing, pneumatic modulation
# Oil firing, three stage

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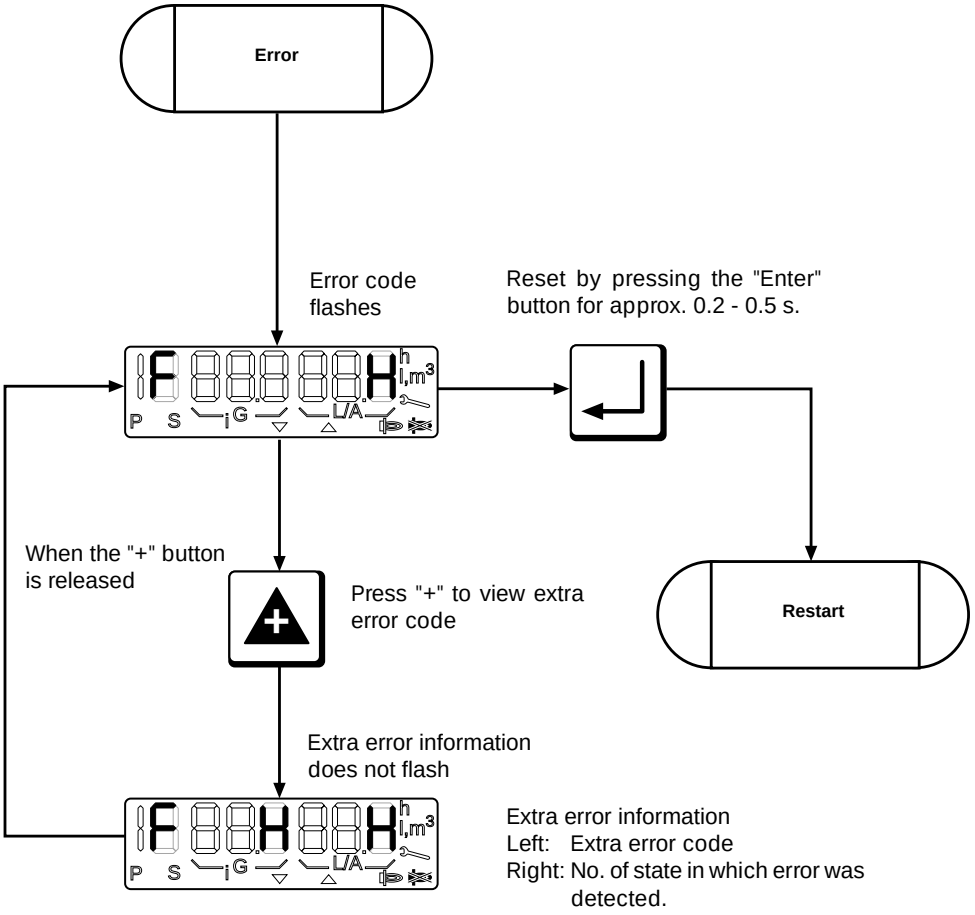


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| Code | Meaning |
|---|---|
| 04H | Internal device fault |
| 05H | Internal device fault |
| 06H | Internal device fault |
| 07H | Internal device fault |
| 09H | Internal device fault |
| 10H | Internal device fault |
| 11H | Internal device fault |
| 12H | Internal device fault |
| 13H | Internal device fault |
| 14H | Internal device fault |
| 15H | Internal device fault |
| 20H | Air pressure switch is not in "off" position |
| 21H | Air pressure switch failure |
| 22H | Gas pressure switch failure |
| 25H | No flame after safety period elapses |
| 26H | Extraneous light |
| 27H | Flame failure during operation |
| 29H | Internal device fault |
| 2AH | Internal device fault |
| 2BH | Short circuit in photoresistor or internal fault |
| 2CH | Internal device fault |
| 30H | Internal device fault |
| 31H | Internal device fault |
| 32H | Internal device fault |
| 33H | Internal device fault |
| 34H | Internal device fault |

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| Code | Meaning |
|---|---|
| 42H | Safety circuit interrupted |
| 43H | Y2 found to be leaky during leak test |
| 44H | Y3 found to be leaky during leak test |
| 45H | Internal device fault |
| 46H | Internal device fault |
| 47H | Internal device fault |
| 48H | Internal device fault |
| 4AH | Internal device fault |
| 4BH | Internal device fault |
| 4CH | Internal device fault |
| 4DH | Internal device fault |
| 4EH | Internal device fault |
| 50H | Internal device fault |
| 51H | Internal device fault |
| 52H | Internal device fault |
| 53H | Internal device fault |
| 54H | Internal device fault |
| 55H | Internal device fault |
| 56H | Internal device fault |
| 57H | Internal device fault |
| 58H | Internal device fault |
| 59H | Internal device fault |
| 5AH | Internal device fault |
| 5CH | Internal device fault |
| 5DH | Internal device fault |
| 5EH | Internal device fault |

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| Code | Meaning |
|---|---|
| 63H | Internal device fault |
| 64H | Internal device fault |
| 65H | Internal device fault |
| 67H | Internal device fault |
| 68H | Air servomotor, incorrect acknowledgement (check cable and plug, servomotor and air damper mechanism) |
| 69H | Gas servomotor, incorrect acknowledgement (check cable and plug, servomotor and gas damper mechanism) |
| 6AH | Air servomotor position out of tolerance (check cable and plug, servomotor and air damper mechanism) |
| 6BH | Gas servomotor position out of tolerance (check cable and plug, servomotor and gas damper mechanism) |
| 6CH | Internal device fault |
| 6DH | Internal device fault |
| 6EH | Servomotors have been interchanged or connected incorrectly |
| 6FH | Error in burner recognition / zero reference run (incorrect coding plug, check cable and plug) |
| 70H | Internal device fault |
| 71H | Internal device fault |
| 73H | Internal device fault |
| 74H | Internal device fault |
| 75H | Internal device fault |
| 76H | Internal device fault |
| 77H | Internal device fault |
| 78H | Internal device fault |
| 79H | Internal device fault |

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