

ALA • TALKKARI

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User's Manual for the LAMBDA 5 S Control Unit



USER'S MANUAL

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User's Manual

Instructions and technical data

The instructions and technical data in this User's Manual are based on the latest knowledge of the Lambda 5 S Control Unit. However, the development of our product is ongoing, and therefore this User's Manual is best suitable for the Control Unit with which it has been delivered.

Terms of warranty

This manufacturer warranty for this product is one (1) year and it covers the electric components and manufacturing defects. The warranty begins on the date of installation.

The warranty does not cover defects arising from misuse or failure to comply with the instructions, natural wear and tear without the approval of the manufacturer, installation fees, transportation fees, defects arising from changes or repairs, resulting effects or idle days and the subsequent economic losses.

Possible warranty claims must always be presented to the sales representative of the Control Unit. Approval of the warranty claim requires that the reason for the defect is investigated together with the sales representative before repairs on the product are made and that the damaged electric components are returned to the sales representative.

General safety instructions

- The transportation and storage temperature for the Control Unit should be between -20°C and $+60^{\circ}\text{C}$. The relative humidity should be between 10 % and 90 %, i.e. water should not condensate on the surface of the panel.
- The operating temperature for the Control Unit should be 0°C – 40°C . The relative humidity should be between 10 %–90 %, i.e. water should not condensate on the surface of the panel.
- The Control Unit's enclosure class is IP54, i.e. it is protected against objects, dust and splashing water.

- Electric installations require an electrician, and they should be done according to the circuit diagrams inside the panel.
- The electricity should be switched off by the main switch before opening the cover of the Control Unit. There is a dangerous main voltage of 400VAC inside the panel above the main switch! The cover should only be opened by a professional in the field of electricity if electrical work needs to be done.
- The Control Unit should be installed in a boiler room according to electrical safety regulations. The panel should not be mounted to the side of a fuel tank. The recommended place for the panel is vertical to the boiler's fire hatch because it makes the ignition easier.
- The Control Unit must be installed in a place where it will not create a fire hazard to the base on which it is mounted or to the structures on which it is fastened, even in the event a malfunction occurs.
- An electrician should connect the motors according to the given voltage information on the type plate for the motor in question.
- An electrician should install the protective switches on the short-circuit motor according to the type plate, and check that they function properly. The release current for the short-circuit motors should be adjusted from the configuration limit of the motor's protective switch such that the motor withstands start-up, but has a nominal current of 1,05* at most.
- When inspecting or servicing the blower, make sure it is not rotating. Cut off the voltage to the Control Unit with the main switch or with the circuit breaker switch for the blowers by turning it in a downward position.
- Before the electric motors are switched on for the first time, an electrician should make sure they rotate in the correct direction.
- To function properly, the firing device needs the temperature of the water in the boiler and the residual oxygen of the exit gas or the temperature of the exit gas from the boiler. Measure the temperature of the water in the boiler and the exit gas with a temperature sensor, and use an oxygen sensor for measuring the residual oxygen of the exit gas.
- The protective guard for preventing the boiler from boiling dry prevents the boiler from overheating without using water from the boiler. The protective guard should be tested in connection with start-up with the guard's trial switch. Indication of the boiler boiling dry will appear on the Control Unit's display.

- Before using the firing device for the first time, an electrician should check all of the Control Unit's alarms and sensors according to the circuit diagrams inside the unit and the instructions pertaining to alarms in this User's Manual.
- In the event the shut-off feed or feed screw for the firing device becomes clogged, the firing device will shut off at the sound of the flame monitoring alarm (the alarm will appear on the logic display), and the yellow light for the capacitative congestion sensor will turn on. At this point the voltage to the Control Unit must be shut off with the main switch or with the circuit breaker switch for the blowers by turning it in a downward position to allow the safe removal of the clog. Remove the clog through the inspection hatch of the shut-off feed or through the removal and inspection hatch for feed screw malfunctions.
- Do not touch the fire jet's fire grate mechanism because your limb(s) could be crushed. When inspecting or servicing the fire grate mechanism, make sure it is not functioning. Cut off the voltage to the Control Unit with the main switch or with the circuit breaker switch for the blowers by turning it in a downward position.
- Make sure the ash removal screw is not functioning before you inspect or maintenance it. Cut off the voltage to the Control Unit with the main switch or with the circuit breaker switch for the blowers by turning it in a downward position.
- The metal part of the oxygen sensor is **extremely hot**—hundreds of degrees. Use appropriate protective gloves when detaching the sensor.
- Please note that the metal part of the combustion temperature sensor may be **extremely hot**—hundreds of degrees
- If you use an aggregate, make sure it is compatible with the Control Unit. If the aggregate's power output is lower or higher than that of the unit, the electric components and motors could be damaged!

Instructions for Using the Control Unit

When the operation switch is in the *AUTO* position, the unit operates automatically according to the set full operation mode. Choose the full operation mode from the *Manual operation* menu.

1) Modulating operation mode

Operation mode 1 (continuous operation with oxygen test): Automatically adjusting the amount of the blower output by changing the blower's operation period keeps the water at the correct temperature. When the water temperature has nearly reached the parameter for temperature, the blower will adjust by changing the operation period. Before reaching the set temperature, the blower runs constantly at the adjusted temperature. The amount of fuel is adjusted according to the residual oxygen of the exit gas.

2) 100 % operation mode

Operation mode 2 (power/pause mode with oxygen test): Alternating between the power mode, where the blower rotates constantly and the pause mode where the blower does not rotate keeps the water at the correct temperature. The amount of fuel is adjusted according to the residual oxygen of the exit gas. An adjustable temperature difference in the boiler water can have an impact of temperature fluctuation and the length of the operation periods.

3) Full operation mode without oxygen test

Operation mode 3 (if necessary, the Control Unit may be used without oxygen testing): In this mode, the pause mode will start when the water temperature exceeds the set parameter. Once the water has cooled, the full operation mode will start up again.

Manual use

When the operating switch is in the *Manual* position, the blower will operate constantly, and the feed screw(s) can be rotated back and forth with a separate switch. The exit gas vacuum (sold separately) will also start up at the same time as the blower. In addition, all of the screws and the fire grate can be used with the *ON/OFF* keys in the *Manual mode* menu. The automatic sooting cleaning device (sold separately) functions in the Manual mode when the operating switch is in the *MANUAL* position and the *OPERATE* position in the *ON/OFF* menu. In this case, the automatic soot cleaning device functions in the Manual mode all the time. The automatic ignition (sold separately) functions in the Manual mode when the operating switch is in the *MANUAL* position and the *OPERATE* position in the *ON/OFF* menu. In this case, the ignitor functions in the Manual mode all the time.

Manual Operations Menu

Display	Description
BLOWER, START/STOP FEED SCREW, START/STOP	Manual operation of the blower (Manual operation of the exit gas vacuum) Manual operation of the feed screw(s)
SILO SCREW, FRONT SILO SCREW, BACK	Silo screw forward, Manual mode Silo screw backward, Manual mode
FIRE GRATE, START/STOP ASH REMOVAL SCREW FIRE CHAMBER START/STOP	Manual operation of the fire grate mechanism Manual operation of the ash removal screw(s)
IGNITION, START/STOP FEED SCREW, CANCELLATION START/STOP	Manual ignition Manual feed screw cancellation
AUTOMATIC SOOT CLEANING, START/STOP ASH REMOVAL SCREW ROTATION, START/STOP	Manual operation of the automatic soot cleaning feature Manual rotation of the ash removal screw
FULL OPERATION MODE: F1/F2/F3 F1: MODULATING OPERATION MODE F2: 100 % OPERATION MODE F3: WITHOUT OXYGEN TEST	1. Operation with oxygen test: adjust the temperature of the water by changing the power of the blower to the uncontinuous mode as needed. 2. Operation with oxygen test: adjust the temperature of the water by alternating between the operating mode in which the blower runs constantly and the pause mode in which the blower does not run. 3. Operation without oxygen test: enter the fixed feed parameters of the full operation mode and the pause mode from the control terminal.
OPERATING 100 % WITHOUT TEMPERATURE DIFFERENCE IN OXYGEN TEST _____ ° C	Difference in temperature used with operation modes 2 and 3. <i>Example: The temperature setting for water is 80° C, temperature difference is 4° C. When the temperature rises to 80° C, the device should be switched to the pause mode. When the temperature decreases to 76° C, the device should be switched back to the power output mode.</i>

POWER OUTPUT WITHOUT OXYGEN TEST: PULSE/PAUSE	Running the unit without oxygen test in operating mode Pulse and pause time of the feed screw
PAUSE MODE WITHOUT OXYGEN TEST PULSE/PAUSE	Running the unit without oxygen test in the pause mode: Pulse and pause time of the feed screw

Screw retention key

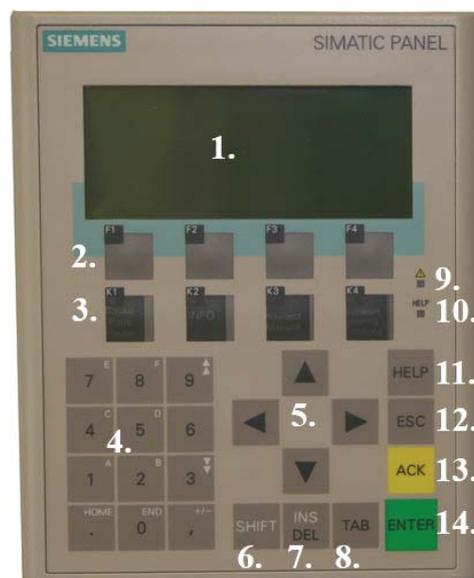
The rotation of the feed screw can be momentarily prevented by pressing the K1 key on the control terminal. This function can be used when you wish to open the hatch of the fire chamber, e.g. to check the fire. **Regulated with a timer, the screw's retention function turns off one minute after it has been turned on.**



Warning! When servicing or repairing the Control Unit, make sure its feed voltage is completely cut off with the main switch.

SIMATIC PANEL control terminal (OP77A or OP77B)

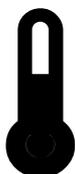
- Text Display:** The text display is used for displaying data and alarm messages, as well as for changing set parameters.
- Page-specific function keys:** The functions of these keys vary from page to page.
- General function keys.** These keys have only one fixed function each. The function is written on the keys.
- Digital keys:** used for editing numerical and written parameters.
- Arrow keys:** used for navigating from one page to another.
- Shift key:** The SHIFT key should be held



down when typing in letters. Change letters by pressing the arrow keys up or down.

7. **Delete/Insert key:** used for inserting/deleting numbers or letters.
8. **TAB parameter setting key:** allows navigation from one parameter setting to the next.
9. **Small, red blinking light:** lights up and starts blinking when the sensor for the combustion devices or other sensors trigger the alarm.
10. **Yellow HELP info page light:** always lights up when the HELP info page appears on the settings display page in question.
11. **Help key:** displays the help info for the menu page, if available.
12. **Esc key:** used to exit the menus.
13. **Alarm acknowledgement key:** removes the alarm page from the display.
14. **Enter key:** used for confirming set parameters.

Parameter setting menus



Operation Adjustment Menu

Press the *K4* key to access the Adjustment Menu. Use the up and down arrow keys to move from page to page.

Settings page	Instructions
Valitse kieli, välja språk Choose language, Sprache wählen F1-F2	Use the F1 and F2 keys to choose the language of the Control Unit. SVENSKA/SUOMI/DEUTCH/ENGLISH
CHOSEN FEED LEVEL: 1) PEAT 2) PELLETS 3) CHIPS	Change the feed level with the <i>F1</i> and <i>F2</i> keys.
SELECTED OXYGEN LEVEL %	Use the <i>F1</i> and <i>F2</i> keys to adjust the oxygen level.
SELECTED WATER TEMPERATURE °C	Use the <i>F1</i> and <i>F2</i> keys to change the temperature.
MOVING THE FIRE GRATE: OPERATING TIME s PAUSE TIME min	Enter the parameters with the digit keys. Change the digit field with the arrow keys. Confirm the numerical parameter with the ENTER key.
ASH REMOVAL SCREW FIRE CHAMBER: OPERATING TIME s PAUSE TIME min	Enter the parameters with the digit keys. Change the digit field with the arrow keys. Confirm the numerical parameter with the ENTER key.
ROTATION OF ASH REMOVAL SCREW: OPERATING TIME s PAUSE TIME min (ACCESSORY)	Enter the parameters with the digit keys. Change the digit field with the arrow keys. Confirm the numerical parameter with the ENTER key.
PAUSE MODE COOLING ON/OFF ON OFF	Turn on the cooling for the pause mode with the F1 key and turn it off with the F2 key.
PAUSE MODE	Enter the parameters with the digit keys. Confirm

COOLING MODE WHEN GOING FROM THE FULL OPERATION MODE TO THE PAUSE MODE: s	the numerical parameter with the ENTER key.
COOLING IN PAUSE MODE s	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
BLOWERS START PERCENT: 0 %–100 % ALL OPERATION MODES: %	Enter the percent parameter with the digit keys. Confirm the percent parameter with the ENTER key.
BLOWERS START DATE-TIME ALL OPERATION MODES: s	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
FIRE GRATE/ASH REMOVAL SCREW MECHANISM PROTECTION DELAY: h	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
AUTOMATIC IGNITION ON AND OFF ON/OFF ON OFF (ACCESSORY)	Press the <i>F1</i> key to turn on the automatic ignition and press <i>F2</i> to turn it off.
ALL OPERATION MODES FLAME CONTROL DELAY: min	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
IGNITION: OXYGEN LIMIT: % TEMPERATURE LIMIT FOR COMBUSTION GAS: °C	Enter the parameters with the digit keys. Change the digit field with the arrow keys. Confirm the numerical parameter with the ENTER key.
IGNITOR: PULSE: min PAUSE: min	Enter the parameters with the digit keys. Change the digit field with the arrow keys. Confirm the numerical parameter with the ENTER key.
IGNITION PAUSE MODE START FEED SCREW PULSE: s	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
IGNITION PAUSE MODE PAUSE MODE START FEED SCREW CANCELLATION: s	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
IGNITION IGNITION PHASE START FEED SCREW PULSE: s	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
EXIT GAS VACUUM	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.

COOLING MODE DELAY s	
AUTOMATIC SOOT CLEANING MOVEMENTS NO. PAUSE TIME: min	Enter the parameters with the digit keys. Change the digit field with the arrow keys. Confirm the numerical parameter with the ENTER key.
CANCELLATION TIME: s	Enter the parameters with the digit keys. Confirm the numerical parameter with the ENTER key.
SAVE THE SETTINGS TO PERMANENT MEMORY ON/OFF ON	Save the settings in the permanent memory by pressing F1 key. The saved settings will stay in the memory even during long power failures.
FEED LEVEL EDITING: PRESS "F1"	Press F1 to enter the feed level editing menu.
SPECIAL SETTINGS: (PASSWORD PROTECTED) PRESS "F1"	Press F1 to enter the special settings menu. This menu is protected with a password and contains settings that can be changed only by an authorized person who is familiar with this application.

Implications of operation settings

The functioning of the Control Unit can be precisely adjusted to the desired performance with the operation settings.

1. **Selected language:** Select your preferred language using the F1 and F2 keys. Use the F1 key to scroll up the language menu and F2 to scroll down it. The language options are Swedish, Finnish, German and English.
2. **Selected feed level:** The feed level affects the amount of fuel fed into the fire jet. The correct feed level depends on the size of the fire jet and the feed screw and on the fuel properties. The feed level editing menu allows you to edit each feed level individually.
3. **Selected oxygen level:** The oxygen level determines the proportion of residual oxygen in the exit gas. This setting raises/lowers the target level, which the control system strives to maintain. If the selected oxygen level is e.g. -2.0 % and the target level without adjustments is 10 %, the system strives to keep the residual oxygen at 8 %.
4. **Selected water temperature:** The system strives to reach this level by adjusting the amount of blower air and fuel.
5. **Fire grate mechanism:** These settings affect how long the fire grate is in the full operation mode and the pause mode. The times are selected according to the fire jet and fire grate types.

The pause time for the fire grate decreases by the same amount of time it takes for the feed screw to rotate.

6. **Ash removal screw in fire chamber:** These settings affect how long the ash removal screw is in the full operation mode and the pause mode. The times are selected according to the size of the ash removal screw and amount of ash formation. The pause time of the ash removal screw in the fire chamber is calculated by the rotation of the feed screw. The pause time for the ash removal screw in the fire chamber decreases by the same amount of time it takes for the feed screw to rotate.
7. **Ash removal screw rotation (accessory):** These settings affect how long the ash removal screw is in the full operation mode and the pause mode. The times are selected according to the size of the ash removal screw and amount of ash formation. The pause time in the rotation of the ash removal screw is calculated by the rotation of the ash removal screw in the fire chamber. The pause time in the rotation of the ash removal screw decreases by the same amount of time it takes for the ash removal screw in the fire chamber to rotate.
8. **Cooling in the pause mode (on/off):** When the cooling is on during the pause mode, the blower is on when switching over to the pause mode and remains on during the pause mode. When the cooling is in the off position, the blower are off during the pause mode.
9. **Cooling when switching from the full operation mode to the pause mode:** When switching to the pause mode, the duration of the cooling is according to the set parameter(s).
10. **Cooling in the pause mode:** The duration of the cooling in the pause mode is according to the set parameters until after the rotation of the feed screw. During the cooling, the fuel used in the pause mode is burned to an appropriate amount.
11. **Blowers, start-up percentage (0 %–100 %) in all modes:** When the blowers turn on after the ignition phase, the blowers are turned on according to the start-up percentage, over the span of the updating time. Therefore, the blowers will not blow full blast right away. This prevents the blowers from possible smoking.
12. **Blowers, start-up, updating time, all modes:** When the blowers turn on after the ignition phase, the blowers are turned on according to the start-up percentage, over the span of the updating time.
13. **Motor guard delay for fire grate/ash removal screw:** The motor guard delay for the fire grate and ash removal screw prevents the automation from turning off the firing device when the motor guard(s) for the fire grate or ash removal screw triggers.
14. **Automatic ignition, on and off (accessory):** The automatic ignition is turned on using the ON function and turned off using the OFF function. There is no pulse when the automatic ignition is on during the pause mode; the fire is extinguished. There are separate display pages for extinguishing the fire. At the beginning of the ignition phase, the ignitors ignite the fire in the firing device again. Item 18: Ignition at beginning of pause mode and feed screw pulse, item 19: Ignition at beginning of pause mode and cancellation of feed screw, and item 20: Ignition at the beginning of the ignition phase and feed screw pulse.
15. **Flame monitoring delay for all modes:** The flame monitoring delay is a delay time to be set for all of the operation modes to keep the fire chamber from overflowing with fuel. The time for

the flame monitoring delay must be set for the modulating operation mode and the 100 % operation mode. The oxygen limit for the ignition is the limit under which the residual oxygen in the exit gas must be. When the residual oxygen goes below the oxygen limit, the firing device with switch to the full operation mode. The full operation mode for all of the operation modes has a temperature limit alarm for the exit gas, which sounds after the flame monitoring delay when the temperature of the exit gas goes below the set limit.

16. **Oxygen limit for ignition and temperature limit for exit gas:** The oxygen limit for the ignition is used when monitoring the flame and as an ignition limit in the fire jet's ignitors. The temperature limit for the exit gas is also used when monitoring the flame and as an ignition limit in the fire jet's ignitors. Flame monitoring was discussed in item 15. There is an oxygen limit for the ignition and a temperature limit for the exit gas in the ignition phase. In the modulating operation mode and the 100 % operation mode, the ignition will turn off when the oxygen limit goes below the set limit or when the temperature of the exit gas exceeds the set temperature. The ignition will turn off in the "no oxygen test" operation mode when the temperature of the exit gas exceeds the set temperature.
17. **Ignition, pulse and pause:** The pulse and pause times for the ignitor are set here. If the pause time is set at 0 minutes in the automatic operation mode, the ignitor will stay on until the fuel reaches the oxygen or exit gas limit. The ignitor can be tested when it is in the ON position, set in the Manual operation menu under Manual operating switch. The ignitor will then be on constantly.
18. **Ignition at beginning of pause mode, pulse of feed screw:** The pulse of the feed screw will begin when the ignitor for the firing device is on and switching to the pause mode. The pulse of the feed screw thrusts the fuel toward the fire jet on the account of the pause in the ignition.
19. **Ignition at beginning of pause mode, cancellation of feed screw:** The pulse of the feed screw will cease when the ignitor for the firing device is on and switching to the pause mode. The cessation creates a small space for the fuel at the fire jet on the account of the pause in fuel supply.
20. **Ignition at beginning of ignition phase, pulse of feed screw:** When the ignition for the firing device is on at the beginning of the ignition phase, an amount of fuel equal to that which has been set for the ignition phase pulse is released into the fire jet, which is then ignited with ignitors.
21. **Discharge delay of exit gas vacuum (accessory):** The exit gas vacuum turns on simultaneously with the blowers. It turns off after the discharge delay, when the blowers have turned off.
22. **Movements of the automatic soot cleaner, number and pause times (accessory):** The pause time for the automatic soot cleaner is calculated from the rotation time of the feed screw, when the operating switch is in the *AUTO* position. The number of movements determines the movements of the automatic soot cleaner. Movement from center position to center position creates one back-and-forth movement. Putting the operating switch in the *AUTO* position makes the automatic soot cleaner go to the center automatically and wait for the duration of the pause. The automatic soot cleaner can be tested when it is in the ON position, set in the Manual operation menu under Manual operating switch. The automatic soot cleaner will then be on constantly.

23. **Cancellation time:** The silo screw cancellation cancels the silo screw after the pulse if the pulse time so permits. The cancellation mode is off when set on 0.0 s. The cancellation time increases by the same amount of time as the time set for the silo screw pulse.
24. **Saving settings in the permanent memory:** The settings are saved in the permanent memory with the F1 key. When settings have been changed, they should always be saved in the permanent memory. The application also includes automatic saving, i.e. the settings are saved twice a day, every 12 hours.
25. **Editing the feed levels:** The F1 key takes you to the feed levels – EDITING FEED LEVELS: PRESS “F1” on the settings page.

Settings page	Instructions
1: PEAT PULSE 0 % POWER/100 % POWER	<p>1–3 feed levels: Enter the parameters with the digit keys. Change the digit field with the arrow keys.</p> <p>Confirm the numerical parameter with the <i>ENTER</i> key.</p> <p>Editing the name: Activate the letter keys with the <i>SHIFT</i> key. Select the desired letter with the up/down and left/right arrow keys. Confirm the name with the <i>ENTER</i> key.</p>
2: PELLETS PULSE 0 % POWER/100 % POWER	
3: CHIPS PULSE 0 % POWER/100 % POWER	

The effect of the feed levels

Pulse: The time the feed screw operates when feeding fuel to the fire jet. The longer the pulse, the larger the amount of fuel is fed.

0 % power pause: The time the feed screw is paused between the pulses in the pause mode. This time is set to keep the fire from going out during the pause mode.

100 % power pause: The time the feed screw is paused between the pulses in the full operation mode. This time is set to keep the amount of fuel adequate when operating in full power.

INFO Pages display



The Info Pages provide you with information about how the equipment functions. To get to the Info Pages, press the K2 key. If there is an alarm on the page being displayed, you can confirm it when the operating switch is in the MANUAL position.

Menu page	Function
IGNITION STAGE	The automatic operation mode has been turned on and the equipment gradually raises the power to improve the quality of the fire and lower the amount of residual oxygen. If the ignition phase lasts longer than 15 minutes, the equipment will stop operating. This is also an adjustable delay, i.e. a flame monitoring delay for all operation modes. The flame monitoring delay is also the alarm time for the exit gas temperature limit.
NORMAL MODE	The device is operating in the normal operation mode and adjusts the blower and feed power as needed. The device starts at the 100 % operation and the modulating modes when the amount of residual oxygen goes below the set oxygen limit.
PAUSE MODE	The temperature of the water does not need to be increased, and the device operates in the pause mode. In this mode, the blower is not on and a minimum amount of fuel is fed to maintain the fire. The cooling system burns the fuel from the pause mode until there is an appropriate amount. When the ignitor is on during the pause mode, no fuel is fed into the system and the fire is extinguished.

Pages with additional information



Pressing the arrow key downward will take you from the Info Pages to the additional information pages. These pages will help you to follow the functions of your device more closely. Browse the pages using the up/down arrow keys.

Menu page	Function
WATER TEMPERATURE: °C OXYGEN LEVEL: % EXIT GASES: °C	The current boiler water temperature and the current amount of residual oxygen in the exit gases. Current exit gas temperature.
OXYGEN LEVEL: % OXYGEN GOAL: % BLOWER POWER: % FEEDING POWER: %	The current amount of residual oxygen in the exit gases and the oxygen goal. Blower power level and feeding power level in percents.
BLOW. PULSE s BLOW. PAUSE s FEED. PULSE s FEED. PAUSE s	Blower operation cycle in seconds. Blower pause cycle in seconds. Feed screw operation cycle in seconds. Feed screw pause cycle in seconds.
LOGIC PROGRAM VERSION	Write the name of the program version on page 21 of the User's Guide.
PROGRAM VERSION OF CONTROL TERMINAL	Write the name of the program version on page 21 of the User's Guide.

Alarm pages



When a malfunction occurs, the alarm page is displayed and the system stopped. After correcting the malfunction, the alarm must be acknowledged by turning the operation switch to *Manual* position for a few seconds. The *ACK* key on the control terminal resets the alarm only on the display but will not restart the system.

1.	Malfunction! No flame.
2.	Malfunction! Boiler overheated.
3.	Malfunction! Circuit breaker tripped.
4.	Malfunction! Overboiling protection activated.
5.	Malfunction! Excess pressure.
6.	Malfunction! Lid is open.
7.	Malfunction! Oxygen level too low.
8.	Malfunction! Ignition failed.
9.	Malfunction! Flue gas exhauster frequency converter fault.
10.	Malfunction! Boilers firing chamber pressure alarm.
11.	Malfunction! Feed tube overheated.
12.	Malfunction! Flue gas temperature too high.
13.	Malfunction! Automatic cleaning jam alarm.
14.	Malfunction! Identified by the capacitive sensor on the congestion guard.
15.	Malfunction! Max. time of feed and silo screw has been exceeded. Safety circuit tripped.

Reasons for alarms

1. Flame has gone out. When the blower power is more than 60 % and the level of oxygen exceeds 20 % for a span of five (5) minutes in the *modulating* and *100 % operation modes*, the equipment should be turned off because the rise in the level of oxygen indicates that the flame has gone out. However, if the flame has not gone out, the malfunction could be in the oxygen sensor. If the temperature of the exit gas in the *modulating*, *100 %* and *no oxygen testing operation modes* is less than 80° C for a span of ten (10) minutes or greater than 400° C, the equipment will sound an alarm. If the exit gas sensor displays 500° C or 0° C constantly, there is most likely a malfunction in the exit gas sensor or the wiring.

2. Boiler overheated. The boiler water temperature has exceeded the safety limit causing the thermostatic switch to open. The logic sounds an alarm if the overheating parameter exceeds 105° C. If however the thermostate has not tripped, there may be a fault in the wiring of the thermostate, or in the thermostate itself.

3. Motor protection tripped. Due to a motor overload the motor protection has broken the motor circuit. Check if one of the screws is stalled. Motor protections are reset with the black START-keys.

If the motor protection keeps on tripping, the motor protection switch may be wrongly adjusted or not the right size for the motor in question. Also the motor or the motor cabling may be faulty.

4. Overboiling protection has tripped. The boiler water has boiled out causing the overboiling protection to stop the system. If the overboiling protection has not tripped there is probably a fault in the wiring of the protection.

5. Excess pressure. There is excess pressure in the boiler water network.

6. The lid is open. The wood chip container lid has been opened and the system has been stopped. If the container lid is closed and the limit switch in the correct position, there is probably a fault in wiring of the limit switch or in the limit switch itself. If the limit switch of the wood chip container is not in use, a jumper wire must be connected to replace the opening switch.

7. Oxygen level is too low. The residual oxygen level of the exit gases has lowered to a level below 2% for a period that exceeds 10 minutes, and the system has ceased to function. Check whether the blower functions properly. Check also the pulse and pause values of the feeding level used.

If there is no excess fuel in the fire jet and if the blower functions properly, but the oxygen level still remains too low for an extended period of time, there may be a fault in the wiring of the oxygen sensor or in the oxygen sensor itself.

The function of the oxygen sensor can be checked by taking it out of the gas pipe. (Note that the equipment must be switched off when performing this procedure). When surrounded by clean air, the device must indicate an oxygen value of 20 – 21%.



Warning! The metallic surface of the oxygen sensor is **extremely hot**, even hundreds of degrees Celsius. Use protective gloves when removing the sensor from the pipe.

8. Unsuccessful ignition. An alarm sounds in the ignition phase of the *modulating* and *100 % operation modes*, when the level of oxygen has not decreased to 16 % within 15 minutes. The ignition phase can be lengthened and the oxygen level changed from the flame monitoring delay and the oxygen limit of the ignition. Check the functioning of the blower and the set pulse and pause parameters for the feed level. The malfunction may also be in the oxygen sensor.

9. Malfunction in the frequency transformer of the exit gas vacuum. An alarm sounds when a malfunction occurs in the frequency transformer of the exit gas vacuum. We recommend writing down the text on the frequency transformer to aid in determining the reason for the alarm. Acknowledge the alarm by cutting off the electricity to the frequency transformer.

10. Overpressure in the fire chamber. An alarm sounds when there is over pressure in the fire chamber. Check to see if the blowers and exit gas vacuum are functioning properly.

11. Overheated feed line. An alarm sounds when the temperature of the feed screw's feed line reaches 80° C due to back firing. The fuel is emptied from the feed screw for a span of 40 s, and the feed screw turns off the firing device.

12. Temperature of the exit gas too high. An alarm sounds when the temperature of the exit gas reaches the maximum temperature on the adjustable thermostat.

13. Automatic soot cleaner jammed. An alarm sounds when the automatic soot cleaner gets jammed twice for a duration of one (1) minute. After the first jam, the cleaner will change direction. The alarm sounds after the cleaner jams for the second time. The alarm time can be adjusted by a maintenance person using the special settings.

14. Capacitive sensor indicates clogging. An alarm sounds when the capacitive sensor detects clogging in the shut-off feed. While trying to remove the clog, the silo screw may rotate according to special settings for the amount of pulses or rotation of the silo screw. If the clog cannot be removed after the duration of the set pulses or rotation of the silo screw, the alarm will sound and the silo screw will no longer be able to provide fuel. Use caution when removing a clog from the shut-off feed.

15. Maximum pulse time of the silo and feed screw exceeded, the safety circuit is released. When the silo and feed screws rotate for 30 s, an alarm sounds and the firing device switches off. If the Control Unit has been used for a long time, an electrician should inspect and change the contactors to the feed and silo screws. Electrical installations require an electrician, and they should be done according to the circuit diagrams inside the Control Unit.

Type plate details for the control unit:

Product number of the control unit: 039 028 _____

Serial number of the control unit: _____

The type plate is situated inside the control unit

Program version of the unit's logic: _____

Program version of the unit's control panel: _____

The program versions of the Control Unit are on the last page of the INFO Pages.

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Part 2. Additional instructions for maintenance persons

Special settings

The *Special settings* menu is protected with a password to prevent unauthorised or unintentional changes. Press the F1 key to enter the password page. Enter a three-digit password in the *Password* field, and confirm the password with the *ENTER* key. After this, the menu can be accessed by pressing the *F1* key again.

Password for special settings: 1 0 0 (one-zero-zero)



Only an authorised person familiar with this application is allowed to change the special settings. The PID controller parameters, especially, are critical to ensure the system functions properly. Incorrect parameters may cause an emergency situation.

PROGRAM TRANSFER MODE FOR LOADING THE TERMINAL PROGRAM	Press the <i>F1</i> key to access the program transfer mode.
PID CONTROLLER FOR WATER TEMPERATURE P / I / D	The available control parameters. The parameters can be edited separately for each feed level.
PID CONTROLLER FOR OXYGEN LEVEL P / I / D	The available control parameters. The parameters can be edited separately for each feed level.
TIME RANGE FOR START-UP PHASE	Enter the time parameter with the digit keys. Confirm the parameter with the ENTER key.
FEEDING LEVEL RANGE IN START-UP PHASE	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
BLOWER LEVEL RANGE IN START-UP PHASE	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
MOVEMENT OF FIRE GRATE AT START OF FULL OPERATION MODE OFF/ON ON: F1 OFF: F2	Pressing <i>F1</i> switches the function on and <i>F2</i> switches it off.

MODULATING RUN TEMPERATURE DIFFERENCE OF BOILER WATER 100% BLOWER OUTPUT °C.	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
RUUHKAVAHTI SIILORUUVI ROTATION PERMITTED PULSE RATE: PULSE TIME MAX.:	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
ROTATION TIME FOR FEED SCREW FEED LINE OVERHEATED:	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
GSM ALARM ON/OFF ON: F1 OFF: F2	Pressing <i>F1</i> switches the function on and <i>F2</i> switches it off.
INITIAL IGNITION PHASE FEED OUTPUT % BLOWER OUTPUT %	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
MAX. ROTATION TIME FOR FEED AND SILO SCREWS:	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
AUTOMATIC SOOT CLEANING JAMMING ALARM TIME s	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
AUTOMATIC SOOT CLEANING ALIGNMENT OF MOVEMENT MINIMUM VDC MAXIMUM VDC	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
OVERPRESSURE ALARM FOR BOILER'S FIRE CHAMBER DELAY s	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
AUTOMATIC SOOT CLEANING ON/OFF ON OFF	Pressing <i>F1</i> switches the function on and <i>F2</i> switches it off.
LEVEL x TEMPERATURE ADJUSTMENT CONFIRMATION/PARAMETER I/RISING TIME	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.
LEVEL x OXYGEN ADJUSTMENT CONFIRMATION / PARAMETER I	Enter the parameter(s) with the digit keys. Confirm the parameter(s) with the ENTER key.

Execution of the special settings

1. Program transfer mode is used when a new program is downloaded from a computer to the control terminal memory. If the program transfer mode is selected, *Transfer ... Connecting to host...* will appear on the display. Press the *ESC* key to exit this mode.

2. Water temperature PID controller controls the blower and feed levels according to the water temperature and keeps the water temperature as close to the set parameter as possible.

P: PID controller gain defines the gain of the controller, i.e. how much the controller changes the power at a time when trying to reach the set parameter. The higher the gain is, the stronger adjustments the controller makes. Recommended setting parameter scale: 1...6.

I: PID controller integration time defines the speed of the adjustment, i.e. the time period used when calculating the error parameter of the measurement and setting. Recommended setting value scale: 100–1000 s.

D: PID controller derivation time affects the functions of the controller during rapid changes. Using the derivation time in this application is not recommended. Thus the recommended setting is 0 seconds. **Warning!** Entering a derivation time may confuse the controller.

3. Oxygen level PID controller controls the feed level according to the residual oxygen of the exit gases and tries to maintain the residual oxygen as close to the appropriate parameter for each feed level as possible. This way the fuel burns effectively and purely.

P: PID controller gain defines the gain of the controller, i.e. how much the controller changes the power at a time when trying to reach the set parameter. The higher the gain is, the stronger adjustments the controller makes. The gain of the oxygen level controller is negative. Recommended setting value: -0.5...-2.

I: PID controller integration time defines the speed of the adjustment, i.e. the time period used when calculating the error value of the measurement and setting. Recommended setting value scale: 10–300 s.

D: PID controller derivation time affects the functions of the controller during rapid changes. Using the derivation time in this application is not recommended. Thus the recommended setting is 0 seconds. **Warning!** Entering a derivation time may confuse the controller.

4. Starting stage step time affects the speed at which the blower and feed power rises during the start-up phase when putting the operating switch in the AUTO position in the ignition phase for the first time during the *modulating* and *100 % operation modes*. The shorter the gradation, the faster the levels rise. Recommended setting value scale: 30–120 s.

5. Starting stage feeding level step affects the amount of increase in the feeding level during the start-up phase. The larger the gradation, the larger the increase in the feed level at a time. Recommended setting value scale: 2–10 %.

6. Start-up phase blower level gradation affects the amount of increase in the blower level during the start-up phase. The larger the gradation, the larger the increase in the blower level at a time.

Recommended setting value scale: 1–8 %. **Note!** The feed level gradation must be larger than the blower level gradation in order to decrease the oxygen level.

7. Movement of fire grate at beginning of full operation mode: When the function has been turned on, the fire grate moves at the beginning of the full operation mode. The fire grate always moves once when switching from the pause mode to the ignition phase.

8. Difference in temperature of boiler water in the modulating operation mode, 100 % blower power: The blower power can be set at 100 % in the full operation mode during the *modulating operation mode*, when the temperature of the boiler water is less than the set temperature by the amount of the temperature difference or more. At this time, the blower is in the full operation mode constantly, and the firing device is more efficient.

9. Congestion guard and rotation of silo screw, permitted amount and duration of pulses: In the event a clog occurs, the silo screw for the shut-off feed of the firing device may rotate by the amount of the set amount and duration of the pulses. This may remove the clog. Once the clog is removed the alarm will disappear from the display on the control panel.

10. Rotation time for feed screw, feed line overheated: In the event the feed line of the firing device, i.e. back-firing occurs, the feed screw will rotate for the duration of the set time and thrust the back-fire into the fire jet and turn off the firing device. The factory setting for the rotation of the feed screw is 40 s.

11. GSM alarm, on/off: This allows you to turn the flame monitoring alarms, urgent and non-urgent alarms on and off.

12. Feed power and blower power in the initial ignition phase: The initial ignition power and blowing power are set for the feed power and blower power at the beginning of the ignition phase. The factory setting for the feed power is 60 % and the blower power is 25 % at the beginning of the ignition phase. A gradation for the feed power and blower power are added to the initial ignition feed power and blowing power at the interval of the time change value for the start-up phase.

13. Maximum rotation time for the feed and silo screws: The maximum rotation time for the feed and silo screws is measured by the control contactors of the screws' motors. In the event the control contactors are worn out or jammed, an alarm will sound after a given time, and the firing device will be turned off. The factory setting for the maximum rotation time for the feed or silo screw is 30 s. If the alarm sounds, an electrician should inspect and change the contactors for the feed and silo screws.

14. Alarm duration for jammed automatic soot cleaner: The duration of the alarm for a jammed automatic soot cleaner is the time by which the cleaner must go from the top down and from the bottom up. The alarm will sound when the automatic soot cleaner gets jammed twice for a duration of one (1) minute. After the first jam, the cleaner will change direction. The alarm sounds after the cleaner jams for the second time. The alarm time can be adjusted.

15. Centering movement for the automatic soot cleaning: The center part of the automatic soot cleaner can be adjusted. The cleaner will stop at the set center part after it has moved. After setting the operating switch on automatic operation, the cleaner will move between the upper and lower limits of the center. The setting for the third movement, which affects the change in direction of a jammed cleaner, must be between the upper and lower limit. This setting is the first adjustment setting.

16. Delay of the over pressure alarm for the fire chamber: The delay for overpressure alarm for the boiler's fire chamber is set here. The alarm to indicate overpressure in the fire chamber sounds when there is overpressure in the fire chamber equal to the delay.

17. Automatic soot cleaning, on and off: Here you can turn the automatic soot cleaner on and off.

18. RISING TIME, LEVELS 1, 2 AND 3: In the *modulating* and *100 % operation modes*, the rising time affects the speed at which the blowing and feed power rises when switching from the normal operation mode to the pause mode. The shorter the rising time, the quicker the power can be increased. The gradation time 4 in the start-up phase affects the operating switch in the ignition phase when putting it in the *AUTO* position for the first time.

Troubleshooting



This section lists possible problem situations and suggestions for corrective actions.

Some of these corrective actions may only be carried out by a professional familiar with the application.

Problem: An alarm appears on the control terminal display for no reason.

Cause: The current circuit of a device, e.g. the thermostat or the overboiling protection is broken, or the logic receives faulty information about the oxygen levels or water temperature.

Action: Check the LED lights on the bottom of the SIMATIC CPU224 logic to see if the device provides voltage to the logic input. E.g. if the thermostat is working properly, the I0.5 LED should be on. Also check the control terminal for the water temperature and oxygen level displays.

Problem: Faulty reading on the water temperature display.

Cause: The temperature sensor, O2TC measuring board, logic analog unit or wiring is faulty.

Action: Measure the voltage between the terminals C+ and C- at the top of the analog unit EM231. The voltage should be as follows:

Water temperature	DC voltage between C+/C-
0° C	~0V
75° C	~5V
150° C	~10V

If the voltage between the terminals C+ and C- is over 1V and the water temperature display shows 0°C, the logic analog unit EM231 is probably damaged.

If the temperature is high and there is no voltage, measure the same voltage between terminals 0 and T3 on the top of the O2TC board. (The terminals are marked on the surface of the circuit board.)

If there is no voltage here either, measure the board operating voltage on the 9VAC terminals of the board.

If there is no 9VAC voltage, check the fuse of the transformer T2 and the primary and secondary voltages.

If there is 9 VAC voltage on the board, but no voltage between the terminals 0 and T3 when the water temperature is over 10° C, either the board, temperature sensor or the sensor cable is faulty. Check the wiring of the sensor.

You can test a disconnected temperature sensor with a general resistor meter between the red and white wire. The resistance parameter should be 100–150 Ω, depending on the sensor temperature. In room temperature, a PT-100 sensor should have a resistance parameter of ca. 110 Ω, if it is working properly.

Problem: The oxygen level fluctuates up and down; sometimes too much fuel is fed, sometimes too little. A lot of smoke forms at times.

Cause: The oxygen level PID controller tries to fix the oxygen level too vigorously.

Action: Reduce the gain of the oxygen level PID controller, e.g. -0.75 -> -0.5 or lengthen the derivation time of the oxygen level PID controller, e.g. 100s -> 200s.

Problem: Fire goes out during pause mode.

Cause: Too much/too little fuel is fed during the pause mode.

Action: Go to the feed level editing menu and adjust the selected 0 % level pause time to the system and fuel in question. The shorter the pause time, the larger the amount of fuel is fed.

Problem: The feed screw is running but the silo screw is not running.

Cause: The capacitive sensor on the middle container is very dirty or the protective switch of the silo screw has tripped.

Action: Check the motor guard switch of the silo screw. If it is on, cut the power supply from the main switch and check the capacitive sensor on the middle container. The sensor light will be on if there is something in front of it.

Problem: The oxygen level parameter is faulty, i.e. it does not drop although the fire jet has a proper flame and the blower is working. Or the oxygen level does not increase although the fire has gone out completely.

Cause: There is a fault in the oxygen sensor, O2TC measuring board, logic analog unit or in the wiring.

Action: Measure the voltage between the terminals D+ and D- at the top of the analog unit EM231. The voltage should be as follows:

Oxygen level	DC voltage between D+/D-
0 %	~0V
10 %	~5V
21 % (clean air)	~10V

If the voltage between the terminals D+ and D- is more than 1V and the oxygen level display shows 0° C, the logic analog unit EM231 is probably damaged.

If the temperature is high and there is no voltage, measure the same voltage between terminals 0 and L1 on the top of the O2TC board. (The terminals are marked on the surface of the circuit board.)

If there is no voltage here either, measure the board operating voltage on the 9VAC terminals of the board.

If there is no 9VAC voltage, check the fuse of the transformer T2 and the primary and secondary voltages.

If there is 9 VAC voltage on the board, but no voltage between the terminals 0 and L1 when the oxygen level is high, either the board, Lambda sensor or the sensor cable is faulty. Check the wiring of the sensor. If the Lambda sensor breaks, something of the same the oxygen level percentage of 0 %–21 % will remain on the display.

Problem: The parameters appear in the form of ##### on the display of the control terminal.

Cause: There is no connection between the control terminal and the logic.

Action: If the green *RUN* light on the left end of the SIMATIC CPU224 logic is not on, measure the voltage between the terminals L+ and M on the top of the logic. If there is a 24VDC voltage and the *RUN* light is not on, the logic has probably been damaged by excess voltage, due to thunder for example.

If there is no voltage, check the secondary voltage and primary fuse –F2 of the transformer T2.

If the *RUN* light of the logic is on, check the fastening of the cable between the control terminal and the logic.

Problem: The control terminal display is off, although the main switch is in position 1.

Cause: The control terminal is damaged or there is no operating voltage.

Action: Measure the control terminal voltage on the +24DCV terminals behind the control terminal.

If there is no voltage, check the secondary voltage and primary fuse –F2 of the transformer T2.

If there is voltage and the display does not work, the control terminal has probably been damaged by excess voltage, due to thunder for example.