Honeywell

krom schroder

Burner control units BCU 560, BCU 565

TECHNICAL INFORMATION

- For monitoring and controlling modulating or staged burners for multiple burner applications with a central air supply
- For directly ignited burners of unlimited capacity in intermittent or continuous operation
- With optional valve proving system
- Optionally with menox® operating mode to reduce the formation of thermal NO_X
- Optional bus module for fieldbus connection

EN
Edition 05.25
03251419

Contents

1 Application

Burner control unit with plug-in spring force connection terminals

Burner control units BCU 560 or BCU 565 control, ignite and monitor gas burners in intermittent or continuous operation. They can be used for directly ignited industrial burners of unlimited capacity. The burners may be modulating-controlled or stage-controlled. Their fast reaction to various process requirements makes the BCUs suitable for frequent cycling operation.

On industrial furnaces, they reduce the load on the central furnace control by taking over tasks that relate to the burner, for example they ensure that the burner ignites in a safe condition when it is restarted.

The air control on the BCU..F1, F2 or F3 assists the furnace control for cooling, purging and capacity control tasks.

The burner control units have an interface via which an air valve or actuator (IC 20, IC 40 or FS-BLAC) can be controlled for staged or modulating burner capacity control.

The BCU 565..F3 is equipped with air flow monitoring and pre- and post-ventilation for use on self-recuperative burners.

The program status, the device parameters and the level of the flame signal can be read directly from the unit. The burner or a connected control element can be activated manually using the integrated Manual mode for setting and diagnostic purposes.

Thanks to the optionally integrated valve proving system, the valves can be checked for leaks by querying an external gas pressure switch or it can be checked whether the gas valve on the inlet side is closed.

Using the BCSoft program, the parameters, analysis and diagnostic information can be read from a BCU via the optionally available opto-adapter. All valid parameters are saved on an integrated parameter chip card. The parameter chip card can be removed from the old unit and inserted into a new BCU to transfer the parameters, for example when replacing the unit.

The monitored actuator and valve outputs are housed in a plug-in power module. This can easily be replaced if necessary.

Once the plug-in power module has been removed, the parameter chip card and fuses are accessible.

The BCU can be installed on a DIN rail in the control cabinet. The plug-in connection terminal strips make it easier to install and remove.

The external operator-control unit OCU is available as an option for the burner control units. The OCU can be installed in the control cabinet door instead of standard control units. The program status, flame signal or fault messages can be read on the OCU. For burner adjustment, the operating points can be approached conveniently in Manual mode using the operator-control unit.

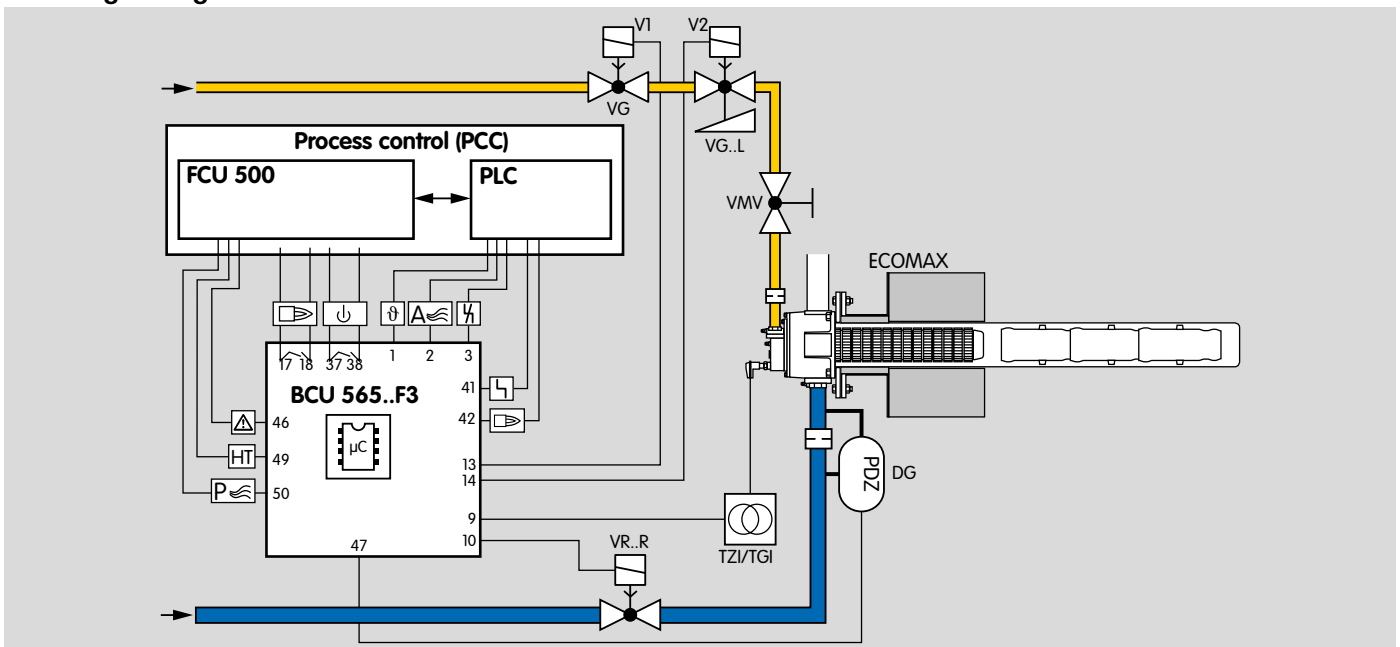
Thanks to the operator-control unit OCU, display functions and operation of the BCU can be relocated to the control cabinet door.

Using the bus module BCM 500, the BCU can be networked with a fieldbus system. Networking in a fieldbus system enables the burner control unit BCU to be controlled and monitored by an automation system (e.g. PLC). This also opens up a wide range of process visualization possibilities.

Bus module BCM 500 for DIN rail installation for lateral connection to the BCU

1.1 Application examples

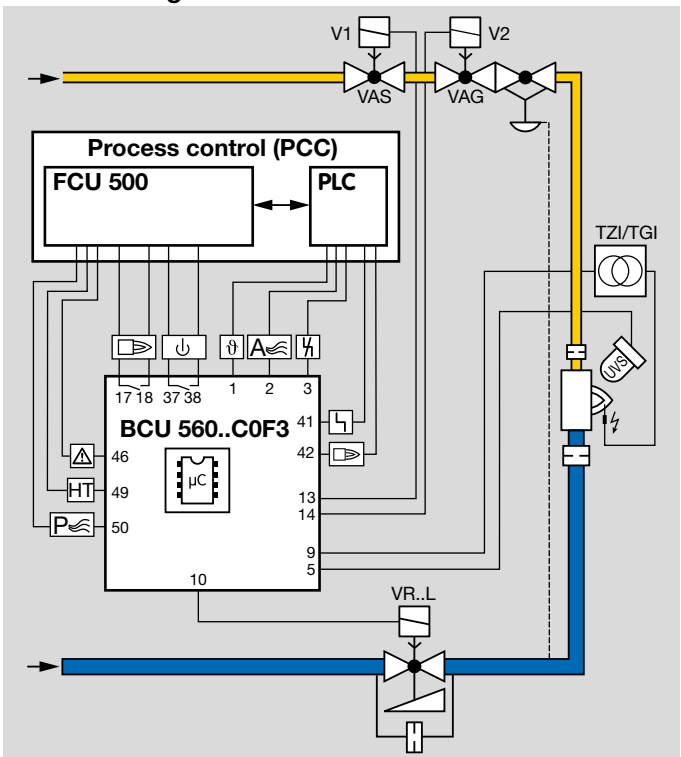
1.1.1 Single-stage-controlled burner



Control: ON/OFF.

The gas/air mixture is adjusted to the requirements of the applications using the parameters of pre-ventilation and post-ventilation. The pressure switch monitors the air flow in the air supply line or in the flue gas exhaust.

1.1.2 Two-stage-controlled burner

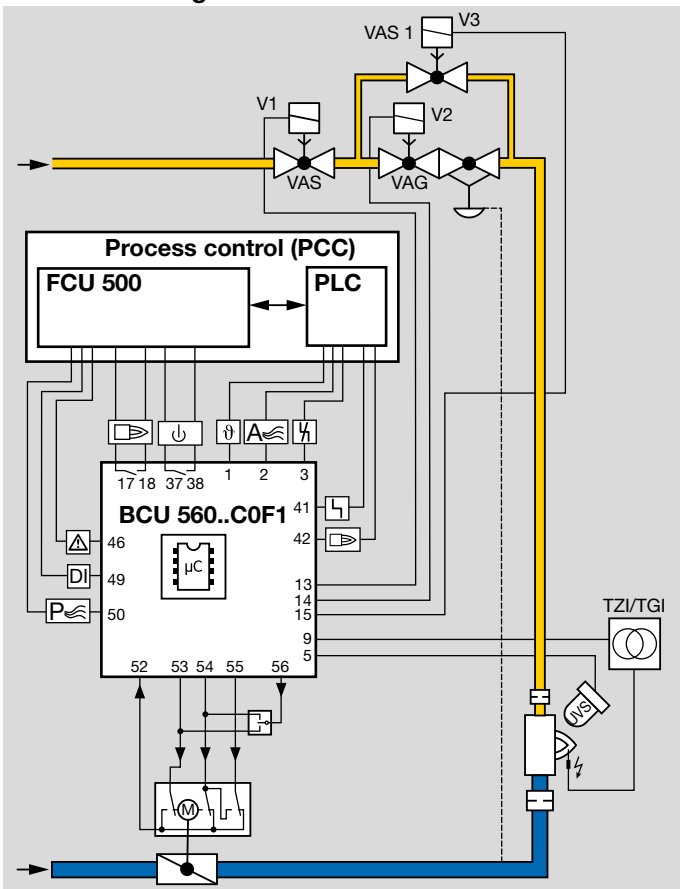


Control:

ON/OFF or High/Low

The BCU provides the cooling and purging processes. The burner starts at low-fire rate. When the operating state is reached, the BCU issues the controller enable signal. Depending on the parameter setting, the air valve is actuated to open and close by the program or externally via the input at terminal 2.

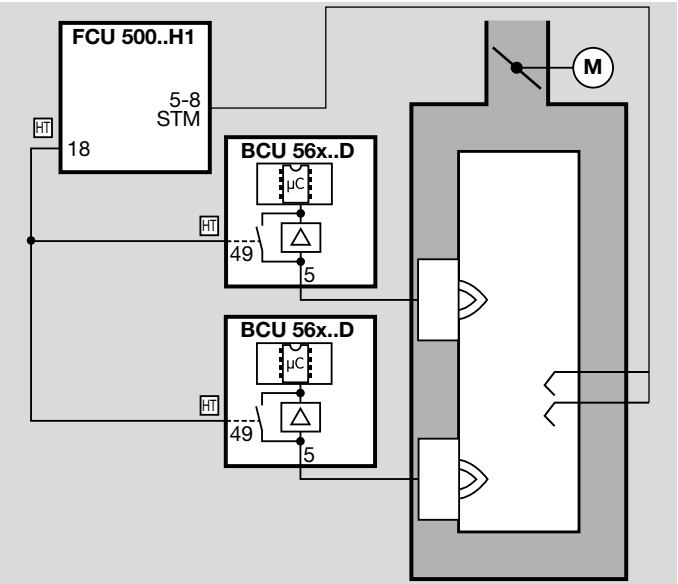
1.1.3 Modulating-controlled burner



Control: continuous

The BCU provides the cooling and purging processes. The BCU moves the butterfly valve for air to ignition position. The burner starts at low-fire rate, a three-point step controller controls the burner capacity via the butterfly valve for air after the operating state has been signalled.

1.1.4 Flame control using the temperature



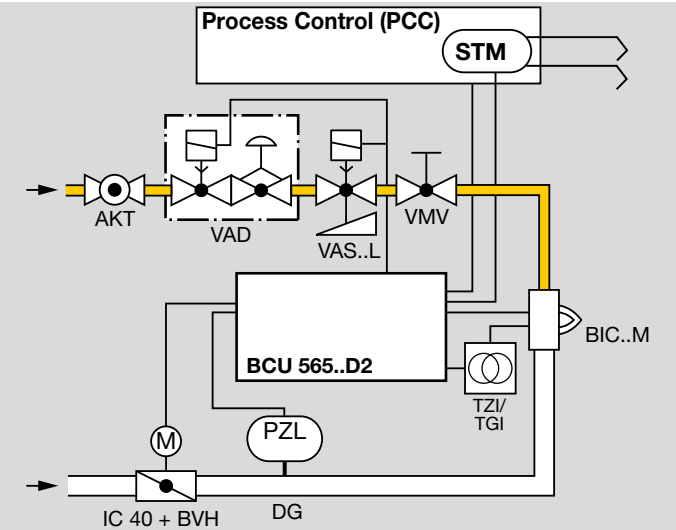
In high temperature systems (temperature > 750°C), the flame may be controlled indirectly via the temperature. As long as the temperature in the furnace chamber is below 750°C, the flame must be controlled by conventional methods.

If the temperature in the furnace chamber rises above the spontaneous ignition temperature of the gas/air mixture (> 750°C), the FCU signals to the burner control units via the fail-safe HT output that the furnace system is in High temperature mode (HT). When the HT input is activated, the burner control units switch to High temperature mode. They operate without evaluating the flame signal and their internal flame control system is non-functional.

If the furnace temperature falls below the spontaneous ignition temperature (< 750°C), the FCU disconnects the HT output from the electrical power supply. There is no longer an active signal at the HT inputs of the burner control units. The flame signals are monitored once again by the UV sensor or flame rod.

In the event of a fault in a temperature monitoring component (e.g. sensor discontinuity, sensor short circuit) or in the event of a mains failure, the flame control task is transferred to the burner control units.

1.1.5 menox® mode to reduce NO_x formation

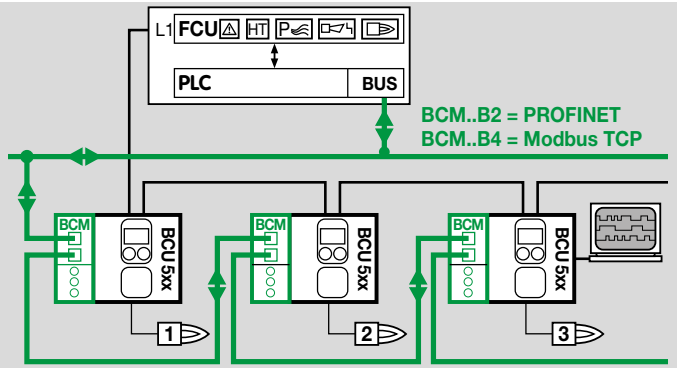


The burner control unit BCU 565 switches the burner BIC..M ON/OFF in cycles. Burner BIC..M is controlled without pneumatic air/gas ratio control system. The gas supply pressure is controlled by the gas pressure regulator VAD; the required burner capacity is set using the fine-adjusting valve VMV. The capacity is controlled by actuator IC 40 and butterfly valve BVH. An air pressure switch upstream of the burner monitors the functioning of the butterfly valve. In addition, air/gas ratio monitoring for the zone or the furnace is required.

As soon as the safety temperature monitor STM signals a furnace temperature of ≥ 850°C (1562°F), the burner can be switched to flameless combustion (menox® low NO_x mode) to significantly reduce NO_x emissions.

Switching to menox® low NO_x mode eliminates the flame counterpressure in the ceramic tube TSC. At a constant gas supply pressure, the gas volume increases by approximately 15%. In menox® low NO_x mode, the butterfly valve moves to a smaller open position tailored to the pressure conditions.

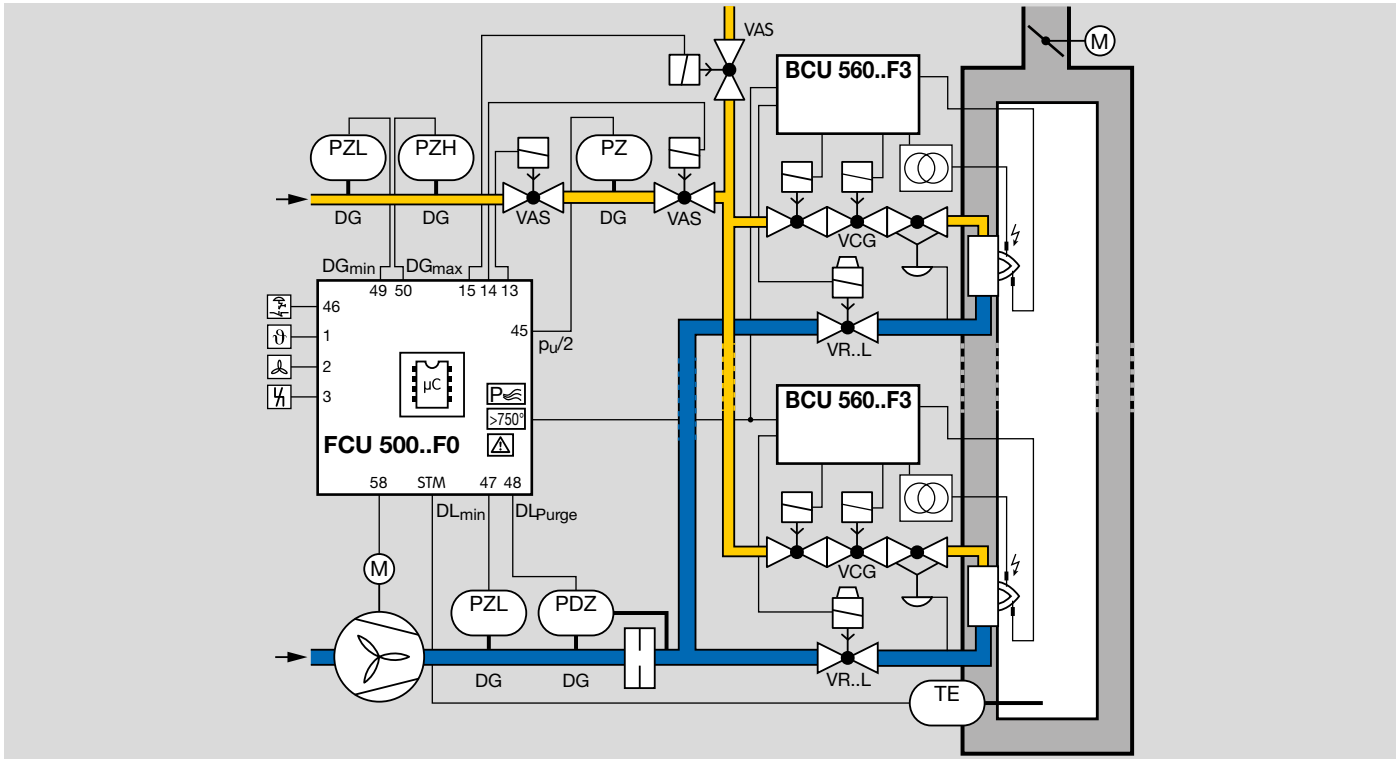
1.1.6 PROFINET/Modbus TCP connection using bus module BCM



The control signals for starting, resetting, controlling the air valve, purging the furnace or for cooling and heating during operation are transferred from the automation system (PLC) to the BCU/BCM. In the opposite direction, the automation system sends operating status, the level of the flame signal and the current program status.

Control signals that are relevant for safety, such as the safety interlocks, purge and HT input, are transferred independently of the bus communication by separate cables.

1.1.7 ON/OFF rotary impulse control



For processes which require a turndown of more than 10:1 and/or those which require heavy circulation of the furnace atmosphere to ensure a uniform temperature, e.g. heat treatment furnaces operating at low and medium temperatures in the metallurgical industry.

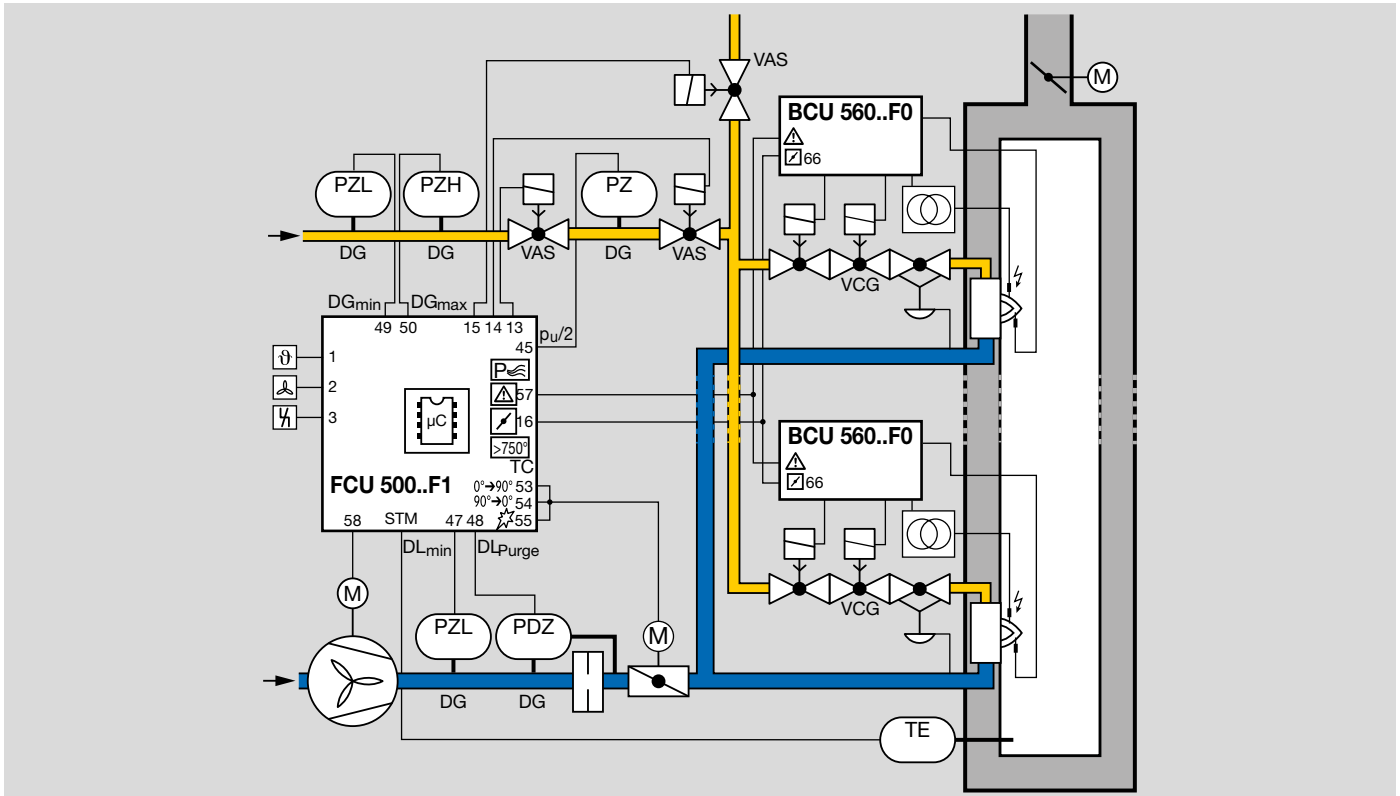
With cyclic control, the capacity supplied to the process is controlled by means of a variable ratio of the operating time to the pause time. In this type of control, the burner output pulse frequency always maintains full momentum and results in maximum convection in the furnace chamber, even with regulated heating.

The pneumatic ratio control system controls the gas pressure on the burner proportionally to the air pressure and thus maintains a constant air/gas ratio. At the same time, it acts as a low air pressure protection device.

The ignition and monitoring of the individual burners is ensured by burner control unit BCU 560.

The centrally checked safety functions such as pre-purge, tightness test, flow detector and pressure switch check ($gas_{min.}$, $gas_{max.}$, $air_{min.}$) are provided by the FCU 500.

1.1.8 Modulating burner control



For processes that do not require heavy circulation in the furnace, e.g. aluminium smelting furnaces.

This system is suitable for processes in which infiltrated air may flow into the furnace through switched off burners. The capacity can be adjusted continuously by activating the control element (analogue or 3-point step signal). The pneumatic ratio control system controls the gas pressure proportionally to the air pressure and thus maintains a constant air/gas ratio. At the same time, it acts as a low air pressure protection device.

One burner control unit per burner is required for ignition and monitoring.

The centrally checked safety functions such as pre-purge, setting the valve to ignition position via a butterfly valve

control system, tightness test, flow detector and pressure switch check ($gas_{min.}$, $gas_{max.}$, $air_{min.}$) are provided by the FCU 500.

2 Certification

2.1 Certificate download

Certificates – see www.docuthek.com

2.2 Certified pursuant to SIL

For systems up to SIL 3 pursuant to EN 61508. Pursuant to EN ISO 13849-1, Table 4, the BCU can be used up to PL e.

2.3 Declaration of conformity

We, the manufacturer, hereby declare that the products BCU 560, BCU 565 comply with the requirements of the listed Directives and Standards.

Directives:

- 2014/35/EU – LVD
- 2014/30/EU – EMC

Regulation:

- (EU) 2016/426 – GAR

Standards:

- EN 298:2012
- EN 1643:2014
- EN 61508:2010, suitable for SIL 3

The relevant product corresponds to the tested type sample.

The production is subject to the surveillance procedure pursuant to Regulation (EU) 2016/426 Annex III paragraph 3.

Elster GmbH

2.4 FM approved

Factory Mutual Research Class: 7610 Combustion Safeguards and Flame Sensing Systems. Designed for applications pursuant to NFPA 85 and NFPA 86.

2.5 ANSI/CSA approved

American National Standards Institute/Canadian Standards Association –ANSI Z21.20/CSA C22.2, No. 199/UL 372, Class number: 3335-01 (natural gas, LPG), 3335-81 (natural gas, propane).

2.6 AGA approved

Australian Gas Association, Approval No.: 8321
www.aga.asn.au

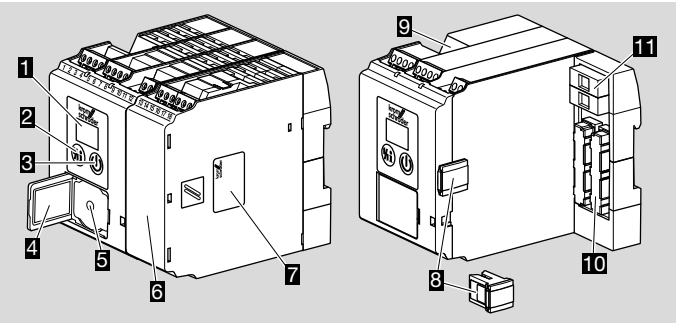
2.7 Eurasian Customs Union

EAC

The products BCU 560, BCU 565 meet the technical specifications of the Eurasian Customs Union.

3 Function

3.1 Part designations



1	LED display for program status and fault messages. To display the program status or fault message and, in conjunction with the Reset/Information button, to display the flame signal and the fault history or to view and set device parameters.
2	Reset/Information button. To reset the control unit to its starting position in the event of a fault. System faults (internal errors) can only be acknowledged using this button.
3	On/Off button. To switch the control unit on or off.
4	BCU type label Visible when the hinged cover is open
5	Connection for opto-adapter
6	Power module, replaceable
7	Power module type label
8	Parameter chip card (PCC), replaceable
9	OCU connection terminals
10	Contact strip for power module
11	Device fuses, replaceable

There are two control keys for the control unit:

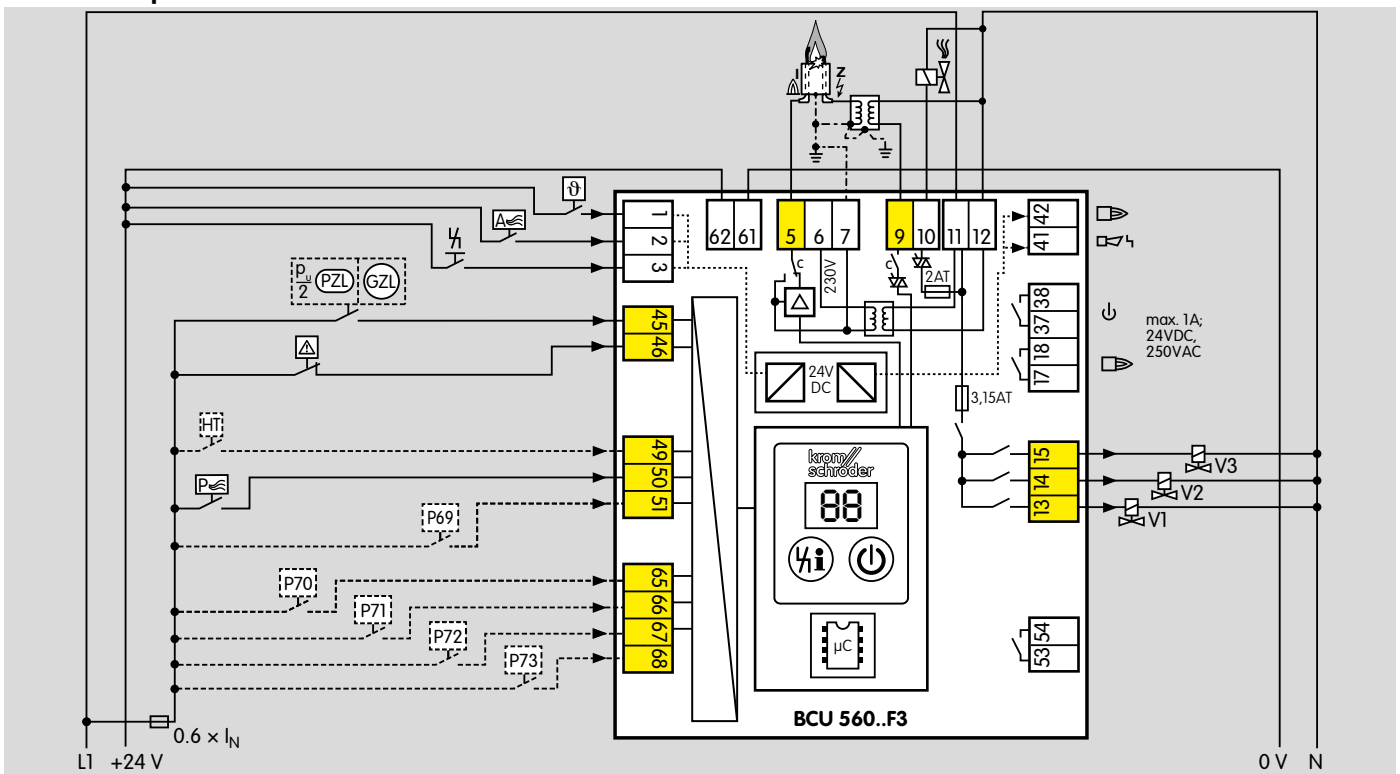
	ON/OFF Use the ON/OFF key to switch the control unit on or off.
	Reset/Information The control unit is reset to its starting position in the event of a fault using the Reset/Information button.

During operation, the LED display shows the program status. The flame signal intensity, the fault history and the parameters can be called up on the display by repeatedly pressing the Reset/Information button (for 1 s). The parameter display is ended 60 seconds after the last time the button is pressed or by switching off the BCU. When the BCU is switched off, -- is displayed. The parameters cannot be scanned when the BCU is switched off or when a fault/warning is displayed.

Display	Information
F1	Burner 1 flame signal intensity
E0 to E9	Last fault message to tenth to last fault message
01 to 99	Parameter 01 to Parameter 99

3.2 Connection diagram

3.2.1 BCU 560..F3 with ionization control in double-electrode operation

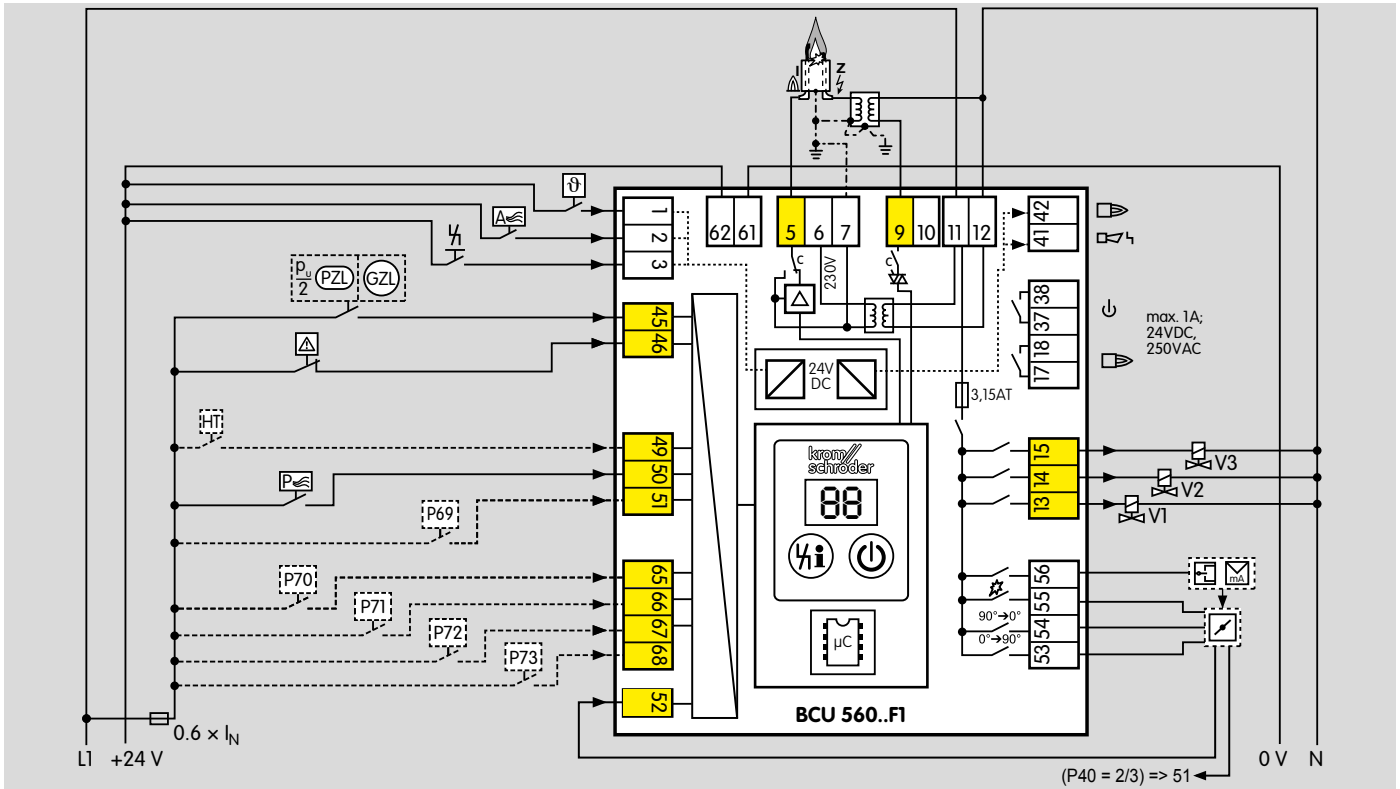


Alternative flame control, see page 27 (3.2.7 Flame control)

Electrical connection, see page 117 (13 Project planning information)

Explanation of symbols, see page 135 (20 Legend)

3.2.2 BCU 560..F1



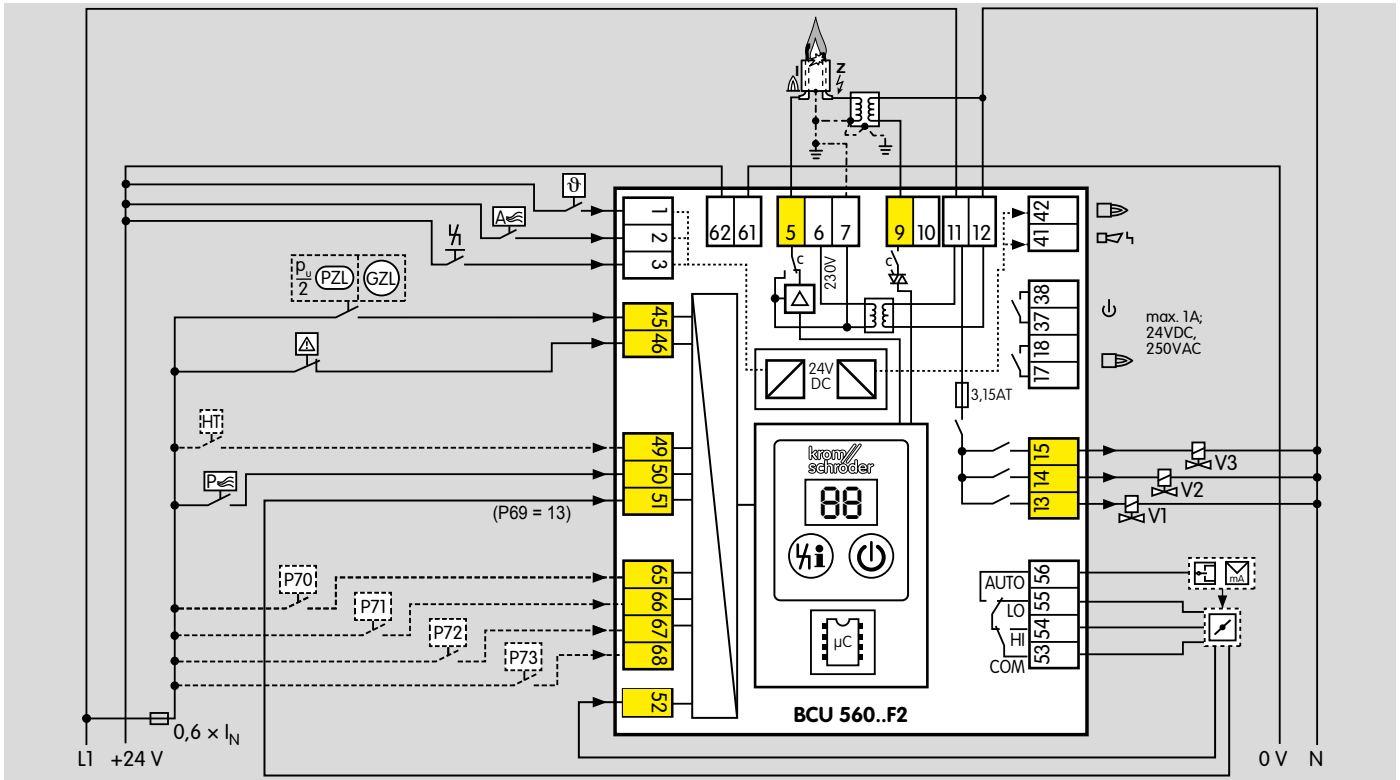
Alternative flame control, see page 27 (3.2.7 Flame control)

Detailed connection diagrams for actuators, see page 88 (11.6.5 Capacity control)

Electrical connection, see page 117 (13 Project planning information)

Explanation of symbols, see page 135 (20 Legend)

3.2.3 BCU 560..F2



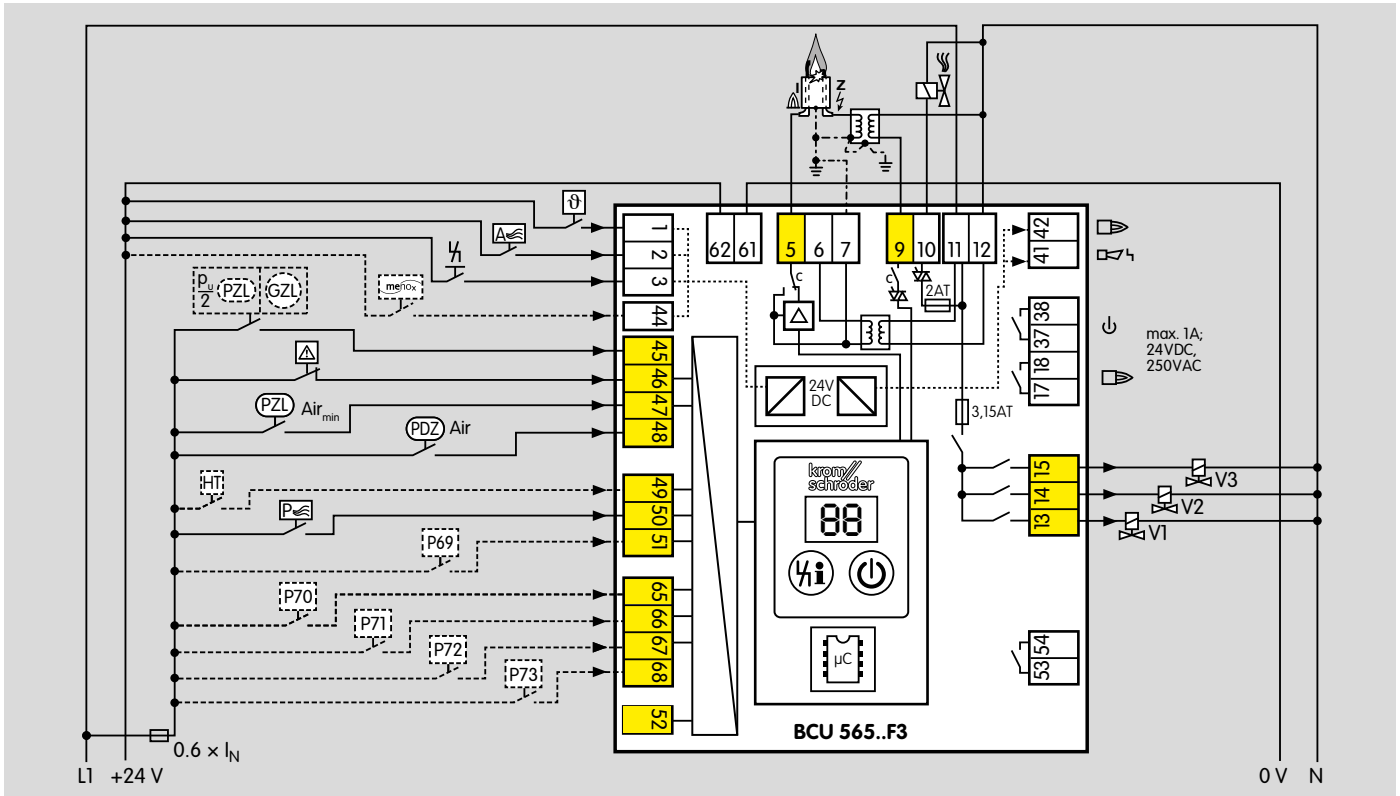
Alternative flame control, see page 27 (3.2.7 Flame control)

Detailed connection diagrams for actuators, see page 88 (11.6.5 Capacity control)

Electrical connection, see page 117 (13 Project planning information)

Explanation of symbols, see page 135 (20 Legend)

3.2.4 BCU 565..F3 with ionization control in double-electrode operation

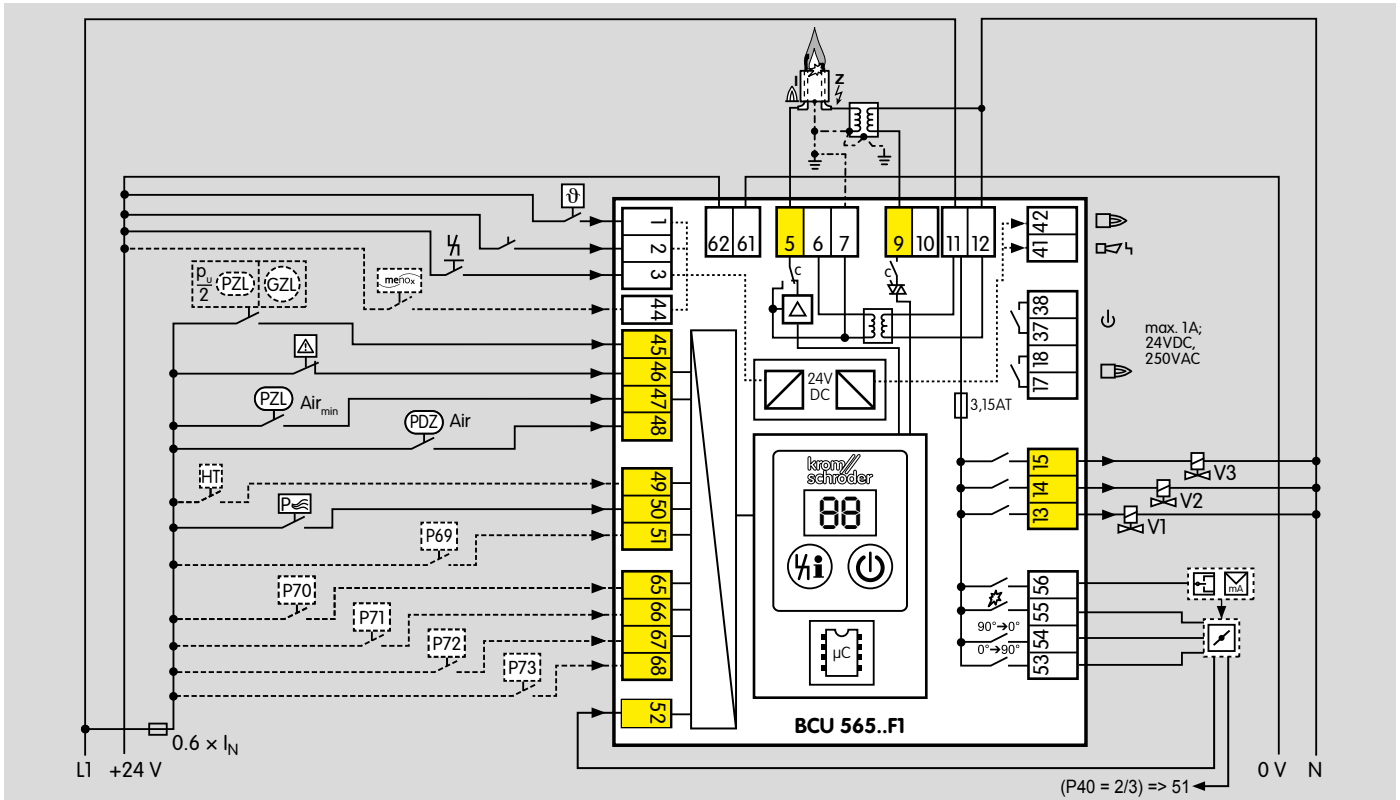


Alternative flame control, see page 27 (3.2.7 Flame control)

Electrical connection, see page 117 (13 Project planning information)

Explanation of symbols, see page 135 (20 Legend)

3.2.5 BCU 565..F1



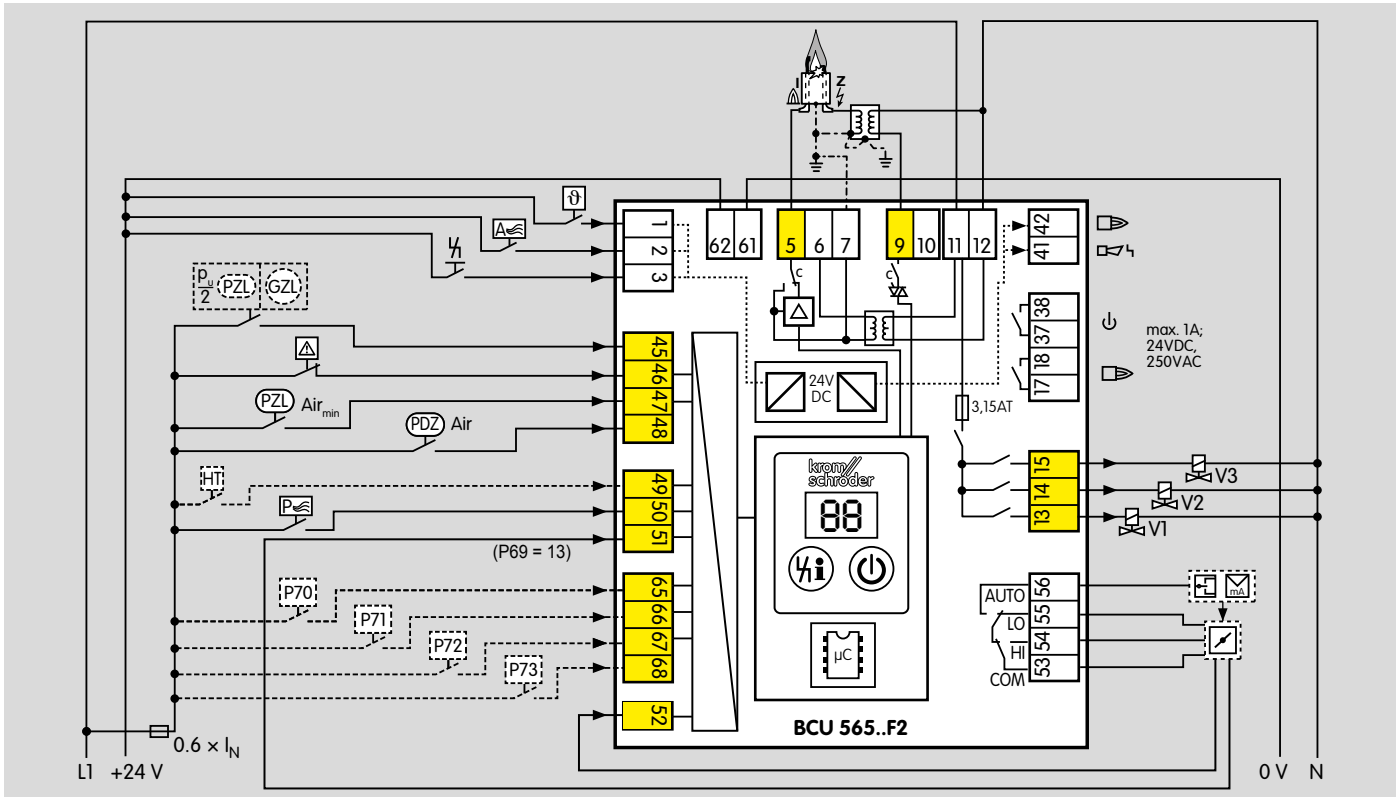
Alternative flame control, see page 27 (3.2.7 Flame control)

Detailed connection diagrams for actuators, see page 88 (11.6.5 Capacity control)

Electrical connection, see page 117 (13 Project planning information)

Explanation of symbols, see page 135 (20 Legend)

3.2.6 BCU 565..F2



Alternative flame control, see page 27 (3.2.7 Flame control)

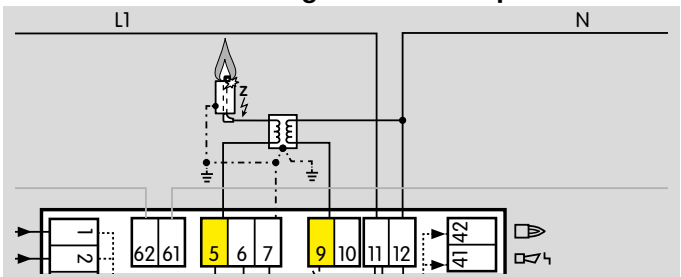
Detailed connection diagrams for actuators, see page 88 (11.6.5 Capacity control)

Electrical connection, see page 117 (13 Project planning information)

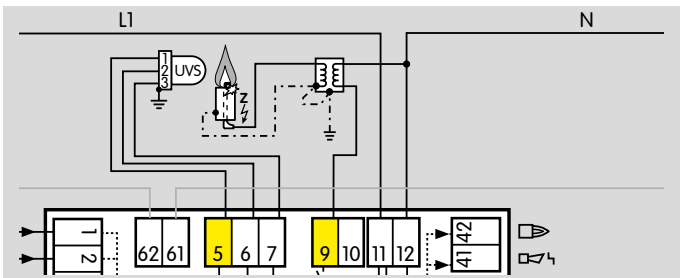
Explanation of symbols, see page 135 (20 Legend)

3.2.7 Flame control

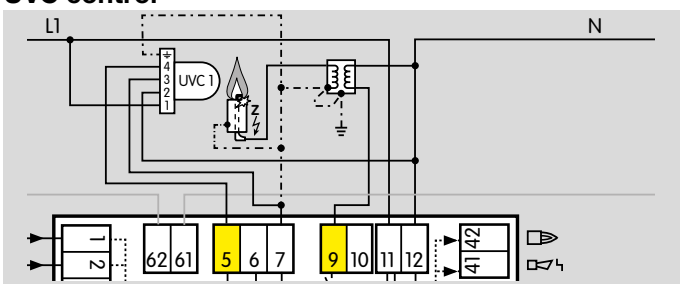
Ionization control in single-electrode operation



UVS control



UVC control



3.2.8 Assignment of connection terminals

Control input (AC mains voltage)

Terminal	Designation	Function
1	Start-up signal	Signal applied: heating start; no signal: heating stop
2	Controlled air flow	Signal applied: fan is started to supply air to the combustion chamber for cooling, for example. Controlled air flow is only possible in standby with deactivated start-up signal. As soon as heating operation is started (start-up signal at terminal 1), the function is interrupted.
3	Remote reset	Input for external signal (button) to reset the unit after a fault lock-out. System faults (internal errors) can only be acknowledged using this button.

Input (µA)

Terminal	Designation	Function
5	Flame signal	Connection for flame rod/UV sensor/ignition transformer

Output

Terminal	Designation	Function
6	UV sensor	Voltage supply for UV sensor UVS

Ground

Terminal	Designation	Function
7	Burner ground	Connection to be connected to the electrically conductive structure of a burner/furnace

Output (AC mains voltage)

Terminal	Designation	Function
9	Ignition	Connection for an ignition transformer or ignition unit

Supply (AC mains voltage)

Terminal	Designation	Function
11, 12	Supply voltage	Voltage to operate the BCU, 11 = phase (L1), 12 = neutral conductor (N)

Valve outputs (AC mains voltage)

Terminal	Designation	Function
13	Gas valve V1	Connection of phase for gas valve V1
14	Gas valve V2	Connection of phase for gas valve V2
15	Gas valve V3	Connection of phase for gas valve V3

Floating contact

Terminal	Designation	Function
17, 18	Operating signal	Contact between terminals 17 and 18 closes once the operating signal has been received from the burner
37, 38	Fault message	Contact between terminals 37 and 38 closes in the event of a BCU fault lock-out

Safety circuit input (AC mains voltage)

Terminal	Designation	Function
45	Valve proving system	Connection for the sensor of the valve proving system (pressure switch for tightness test or POC switch for checking the closed position)
46	Controller enable/Emergency stop	Connection for higher-level safety devices and interlocks (e.g. emergency stop)
47	Minimum air pressure	Connection for pressure switch to monitor the minimum air pressure, see page 84 (11.5.1 Low air pressure protection)
48	Minimum air flow	Connection for a sensor to monitor the minimum air flow during pre-purge or post-purge, see page 86 (11.6.2 Air flow monitoring during pre-purge)
49	High temperature operation feedback	High temperature operation feedback input. When the input is activated, the BCU operates without evaluating the flame signal. The safety function of the device's internal flame control system is deactivated.
50	External purge air	If there is an active signal, the BCU opens the air actuator regardless of the status of the other inputs.
51, 65, 66, 67, 68	Programmable fail-safe inputs	The terminals can be assigned a function using parameters. To do so, logical AND gatings with terminals 46, 47 and 48 are possible, for example.
52	Feedback from actuator	Feedback input for minimum and maximum capacity

Outputs (AC mains voltage)

Terminal	Designation	Function
53, 54, 55, 56	Capacity control	Connection for capacity control using an actuator, see page 88 (11.6.5 Capacity control), page 96 (11.6.6 Running time selection), page 96 (11.6.7 Running time), page 97 (11.6.8 Low fire over-run) and page 98 (11.6.9 Controller enable signal delay time tRF)
58	Fan	Connection for fan control. If the fan is not controlled by the BCU, this output can be used as an alternative to control a valve for the air pressure switch function check.

3.3 BCU 560 program sequence

	Switch on BCU 560
	▼
	In the event of fault signal: reset
	▼
00	Safety interlocks Start-up position/Standby
	▼
00	Flame simulation check
	▼
P0	External actuation of the air valve for purging
	▼
A0	External actuation of the air valve for cooling
	▼
Ao	Actuator moves to the position for maximum capacity
	▼
H1	Start-up with ϑsignal
	▼
H1	Wait until the running time has elapsed (P42)
	▼
02	Safety time 1 t_{SA1} (P94) running, ignition in process, valves for 1st gas stage open
	▼
02	If no flame detected: max. 3 start-up attempts (P07) or fault lock-out
	▼
03	Flame proving period 1 t_{FS1} running (P95)
	▼
03	In the event of flame failure: fault lock-out
	▼
04	Operation signalling contact closes, valve for 2nd gas stage opens and min. operating time t_B starts to elapse (P61)
	▼
04	In the event of flame failure: restart or fault lock-out
	▼
04	In the event of flame failure: restart or fault lock-out
	▼
A4	External actuation of the air valve for capacity control
	▼
04	Controlled shut-down via ϑsignal
	▼
00	If min. operating time t_B has elapsed: operation signalling contact opens, gas valves close and running time (P42) starts to elapse

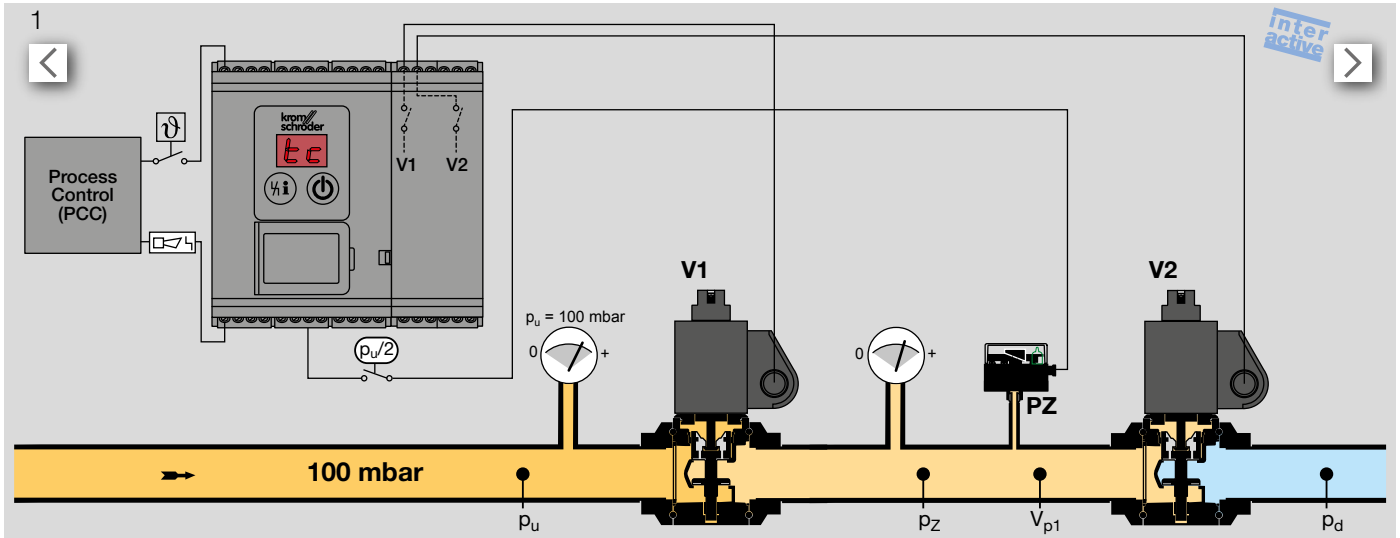
3.4 BCU 565 program sequence

	Switch on BCU 565
	▼
	In the event of fault signal: reset
	▼
00	Safety interlocks Start-up position/Standby
	▼
A0	The air actuator can be opened for cooling
	▼
00	Flame simulation check
	▼
H1	Start-up with ϑsignal
	▼
H1	Wait until the running time has elapsed (air actuator in ignition position) (P42) If P15 and P35 = 1 or 2: verification of air “no flow” state check
	▼
P1	Pre-purge after safety shut-down running (P34) If P15 and P35 = 1 or 2: air flow monitoring
	▼
A1	Pre-ventilation time t_{VL} running (P36), air actuator opens
	▼
A2	Safety time 1 t_{SA1} running (P94), ignition in process, valves for 1st gas stage open
	▼
A2	If no flame detected: max. 3 start-up attempts (P07) or fault lock-out
	▼
A3	Flame proving period 1 t_{FS1} running (P95)
	▼
A3	In the event of flame failure: fault lock-out
	▼
A4	Operation signalling contact closes, valve for 2nd gas stage opens and min. operating time t_B starts to elapse (P61)
	▼
A4	In the event of flame failure: restart or fault lock-out

A4	Controlled shut-down via ϑsignal
	▼
A0	If min. operating time t_B has elapsed: operation signalling contact opens, gas valves close and running time (P42) starts to elapse
	▼
A0	Post-ventilation time t_{NL} running (P39)

00	Air actuator is closed, running time starts to elapse (P42)

3.5 Slide show – BCU 5 tightness control



1 The aim of the tightness control is to identify an inadmissible leak on one of the gas solenoid valves and to prevent burner start.
Gas solenoid valves **V1** and **V2** are tested as is the pipework between the valves.

2 The tightness test can only be performed if pressure p_d downstream of **V2** is around atmospheric pressure and the volume downstream of **V2** is at least 5 × higher than the test volume V_{p1} between the valves.

3 Depending on the parameter setting, the tightness control checks the tightness of the pipework and the gas solenoid valves before each start-up and/or after each shut-down of the burner.
The gas line is always safeguarded by a gas solenoid valve (**V1** or **V2**) during this check.

4 Program sequence:
The tightness test starts by checking the external pressure switch **PZ**, the switching point of which is set to half the inlet pressure ($p_u/2$):
If pressure $p_Z > p_u/2$, program A starts.
If pressure $p_Z < p_u/2$, program B starts.
Program A
Valve **V1** opens for the set opening time t_L.

5 **V1** closes again. During the measurement time t_M, the tightness control checks the pressure p_Z between the valves.

6 If pressure p_Z is less than half the inlet pressure $p_u/2$, valve **V2** is leaking.

7 If pressure p_Z is greater than half the inlet pressure $p_u/2$, valve **V2** is tight.

8 Valve **V2** is opened for the set opening time t_L.

9 **V2** closes again. During the measurement time t_M, the tightness control checks the pressure p_Z between the valves.

10 If pressure p_Z is greater than half the inlet pressure $p_u/2$, valve V1 is leaking.

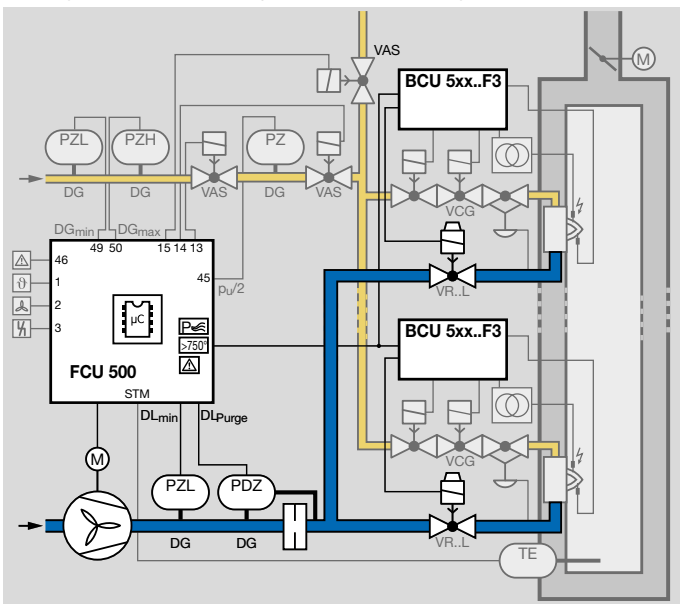
11 If pressure p_Z is less than half the inlet pressure $p_u/2$, valve V1 is tight.

12 For further information on the valve proving system, see page 41 (6 Valve proving system)

4 Air control

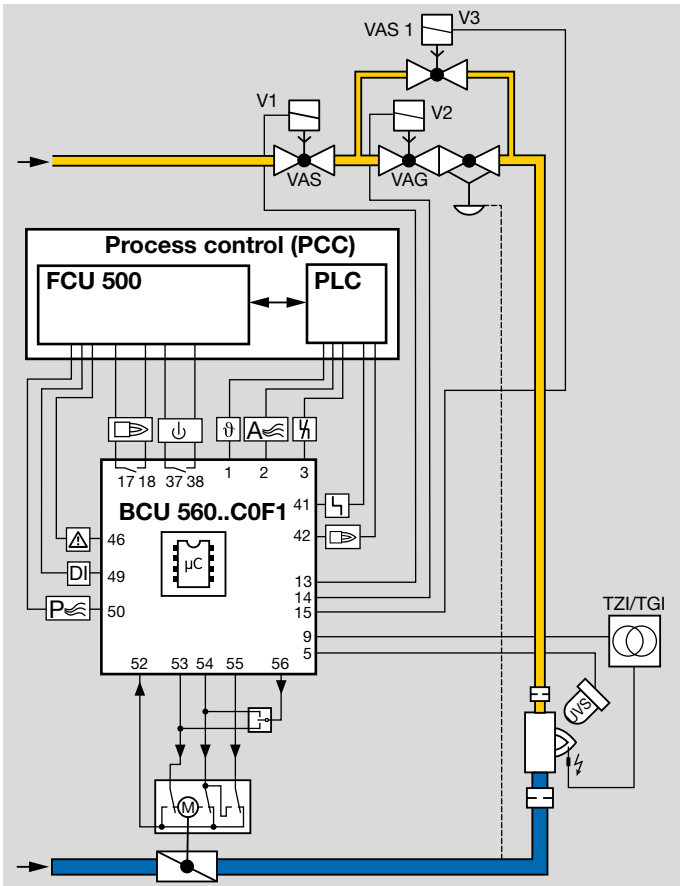
A central protective system such as the FCU 500 takes over air control. It monitors the static air pressure as well as the air volume required for pre-purge, start-up and after the furnace has been shut down. The air actuators (BCU..F1 = actuators IC 20/40,
BCU..F2 = FS-BLAC actuators,
BCU..F3 = valve) are actuated for this purpose by the capacity control system of the BCU.

After being enabled by the protective system, the BCU can start the burners. The capacity is controlled during operation by an external temperature control system.



4.1 Capacity control

4.1.1 BCU..F1/F2



The BCU..F1/F2 activates a control element via the outputs for capacity control (terminals 53 to 56) for purging, cooling or starting the burner. This control element moves to the required position for the relevant operating situation.

As soon as there is a purge signal at terminal 50 of BCU..F1/F2, the control element is activated by the outputs for capacity control to approach the position for pre-purge. The protective system (FCU 500) starts the pre-purge time if there is adequate air flow. After the elapse of the pre-purge time, the control element moves to the ignition position. Once the protective system (terminal 46, safety interlocks) has issued the enable signal, the burner can be started by the start-up signal at terminal 1. The control element can be activated to control the burner's capacity dependent on parameters 48 and 49.

Modulating control

Parameter 48 = 3

After the operating signal has been received from the burner and after expiry of the delay time for the controller enable signal (parameter 44), the BCU issues the controller enable signal via the output at terminal 56. Access to the control element is thus transferred to an external temperature controller (3-point step). The temperature controller controls the burner capacity (air volume) on the basis of the required temperature. Depending on the wiring of the temperature controller, the actuator may be adjusted between maximum capacity and ignition capacity or minimum capacity.

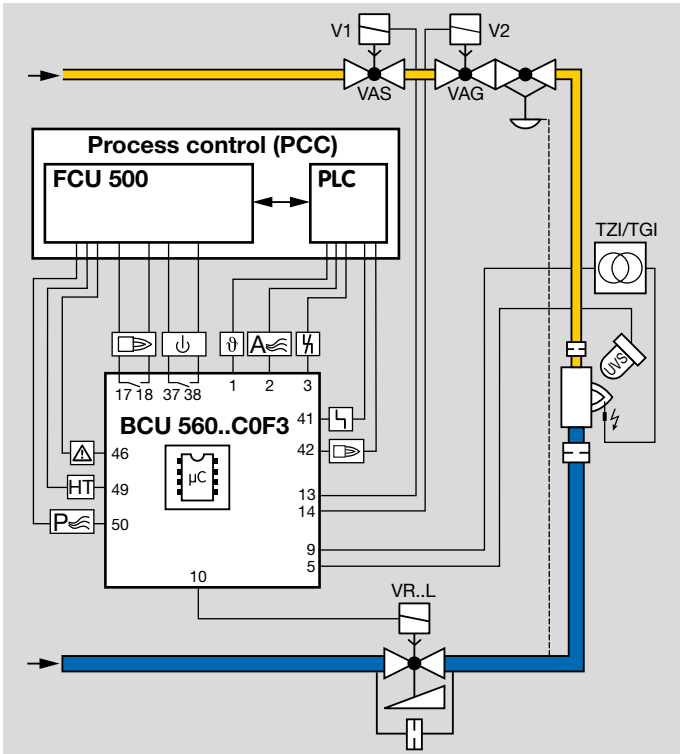
Depending on parameter 40, an actuator IC 20, IC 40, IC 50 or an actuator with FS-BLAC interface can be actuated via the outputs for capacity control. For detailed information about parameter 40, see page 88 (11.6.5 Capacity control).

Staged control

P48 = 0, 1 or 2

Depending on parameters 48 and 49, the control element may be activated either by the program or externally via the input at terminal 2, see also page 98 (11.6.10 Air actuator control) and page 100 (11.6.11 Air actuator on start-up can be activated externally).

4.1.2 BCU..F3



The BCU..F3 activates an air valve for purging, cooling or starting the burner. The required air capacity is released by the air valve.

As soon as there is a purge signal at terminal 50 of BCU..F3, the air valve is activated by the output at terminal 10. The protective system (FCU 500) starts the pre-purge time if there is adequate air flow. After the elapse of the pre-purge time, the air valve closes for ignition. Once the protective system (terminal 46, safety interlocks) has issued the enable signal, the burner can be started by the start-up signal at terminal 1. The gas valves for the 1st stage are opened and the burner is ignited (on the BCU..C1 after a successful valve check). After the operating signal has been received from the burner, the gas valve for the 2nd stage opens.

Staged control

P48 = 0, 1 or 2

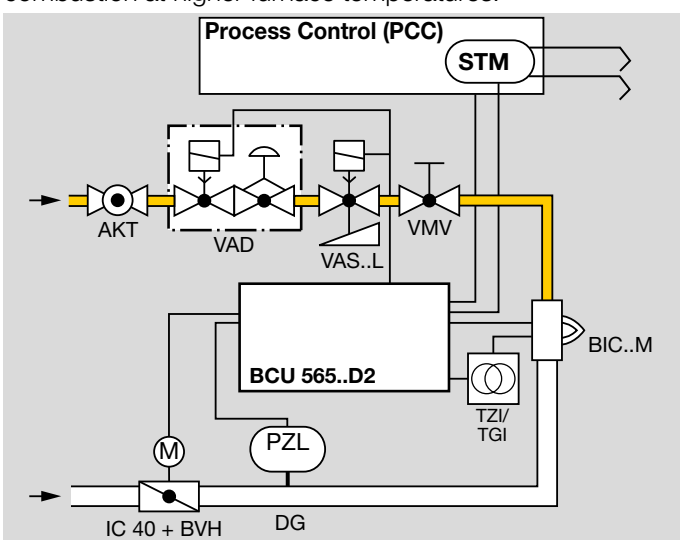
Depending on parameters 48 and 49, the control element may be activated either by the program or externally via the input at terminal 2, see also page 98 (11.6.10 Air actuator control) and page 100 (11.6.11 Air actuator on start-up can be activated externally).

5 menox® low NO_x mode (flameless operation)

menox® low NO_x mode leads to a drastic reduction in thermal NO_x formation in ON/OFF-controlled high-velocity burners.

5.1 System structure and function

The system consists of a burner BIC..M with system components tailored to the application. The system components make it possible to operate the burner in two operating modes: conventional Flame mode at low furnace temperatures and menox® low NO_x mode with flameless combustion at higher furnace temperatures.



A burner BIC..M in conjunction with a burner control unit BCU..D2 is required for safe burner operation in menox® low NO_x mode.

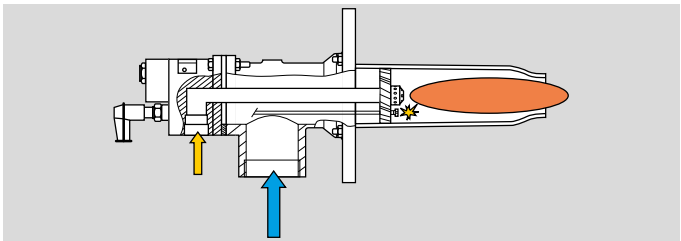
The gas and air for Flame mode and Low NO_x mode are supplied via the same connections. The gas pressure upstream of the burner is adjusted using a pressure regulator (e.g. VAD). The gas volume is set using a fine-adjusting valve (e.g. VMV). The air volume for the operating modes is set by adjusting the butterfly valve (e.g. BVH). The air pressure is monitored on each burner by a pressure switch to check the functioning of the butterfly valve. **In addition, air/gas ratio monitoring for the zone or the furnace is required since the air pressure switch is not sufficient for use as a low air pressure protection device.**

The menox® burner BIC..M has a special mixing unit whose geometric design ensures reliable ignition and a stable flame while also making sure that the flameless combustion process is transferred to the furnace chamber.

In menox® mode, the inflammable gas/air mixture must be prevented from igniting prematurely in the ceramic combustion chamber each time the burner is switched on. The flow velocity at the burner nozzle must be adequately high to prevent the danger of flashback into the combustion chamber. Burners BIC..M are tailored to the appropriate capacity and combined with tapered ceramic tubes (TSC..M).

Flame mode

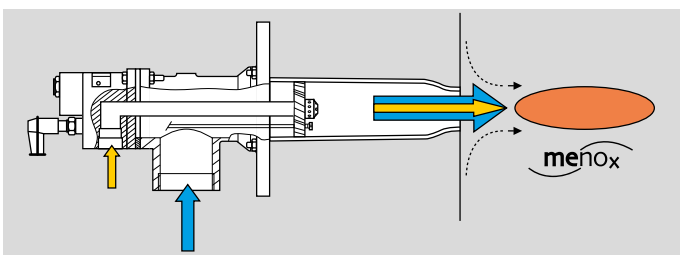
In order to heat up the furnace, the burner operates in Flame mode.



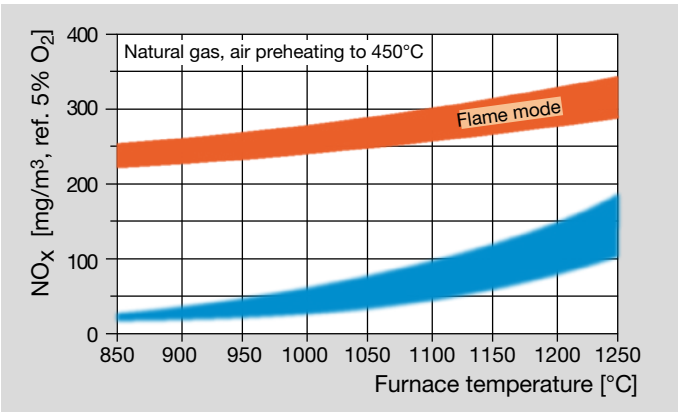
The ignitable gas/air mixture is ignited using an electrical ignition spark and combusts inside and outside of the ceramic burner tube. The presence of the flame is monitored in compliance with EN 746-2.

menox® mode

As soon as the combustion chamber temperature is ≥ 850°C, the burner control unit BCU..D2 can switch to menox® mode.



Gas and air are supplied via the same connections as in Flame mode. No ignition takes place in the burner tube. The combustion process is relocated to the combustion chamber. The oxidation reactions take place without a visible flame. Compared to traditional Flame mode, the reaction zone is considerably larger and the reaction density considerably lower. This prevents the occurrence of peak temperatures which are responsible for high NO_x values. Emissions of NO_x are drastically reduced.

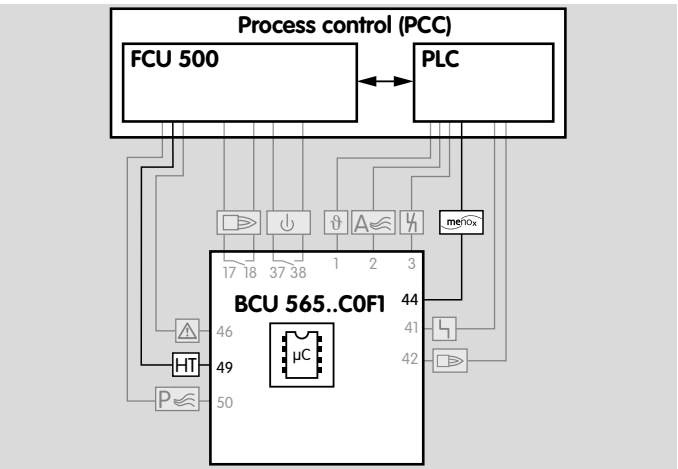


In menox® mode, NO_x values can be reduced to below 150 mg/m³ (reference value of 5% O_2) even at a furnace temperature of 1200°C and hot air at 450°C – without expensive additional piping. The high output pulse frequency and rotary impulse control ensure temperature uniformity which is of great advantage.

For further information on burner BIC..M, see www.docuthek.com.

5.2 BCU..D2

The BCU coordinates the signals for starting the burner and the fail-safe monitoring of the burner in Flame mode. In menox® mode, the BCU switches off the ignition device and flame control. The furnace chamber temperature must be monitored by a safety temperature monitor (STM) for operation in menox® mode. This function must satisfy the requirements of a protective system pursuant to EN 746-2.



Parameter 06 = 5 must be set to switch to menox® low NO_x mode. The BCU..D2 must signal via terminal 49 that the required temperature for high temperature operation has been reached. A higher switching point of 850°C is required for menox® mode. menox® mode is enabled via the input at terminal 44: depending on parameter 64, the system is either switched over immediately or the next time the burner starts with the parameters of menox® pre-ventilation time, burner application and settings for the control element coordinated for menox® mode.

Parameter settings for switching between Flame mode and menox® mode, see page 73 (11.3.2 Burner application), page 106 (11.7.1 menox pre-ventilation time tVLM) and page 106 (11.7.2 Switchover to menox® operating mode).

If there is no signal at terminal 44, the system switches from menox® mode to Flame mode.

If the enable signal for High temperature mode (HT mode) drops out as the furnace temperature falls, the BCU automatically switches from menox® mode to Flame mode. To avoid a pressure surge in the gas supply due to several burners being switched off at the same time, it is recommended that the furnace control unit switches the burners to Flame mode again zone by zone, for example.

Hot air compensation and ratio control are not the responsibility of the BCU. These functions must satisfy the requirements of a protective system pursuant to EN 746-2 and be implemented externally.

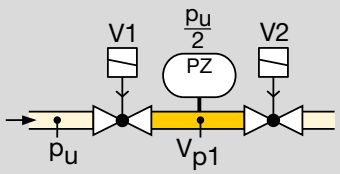
6 Valve proving system

The BCU 500..C1 is fitted with an integrated valve proving system. This allows either the tightness of the gas solenoid valves and the pipework between them to be checked or the closed position of a solenoid valve to be checked.

Once the test has been carried out successfully, the burner enable signal is issued.

6.1 Tightness control

The aim of the tightness control is to identify an inadmissible leak on one of the gas solenoid valves and to prevent burner start. Gas solenoid valves V1 and V2 are tested as is the pipework between the valves.



European standards EN 746-2 and EN 676 stipulate tightness controls for capacities over 1200 kW (NFPA 86: from 117 kW or 400,000 Btu/h).

The tightness control function satisfies the requirements of EN 1643 (Valve proving systems for automatic shut-off valves for gas burners and gas appliances).

6.1.1 Test instant

Depending on the parameter setting, the tightness control checks the tightness of the pipework and the gas solenoid valves before each start-up and/or after each shut-down of the burner, see page 107 (11.8.1 Valve proving system).

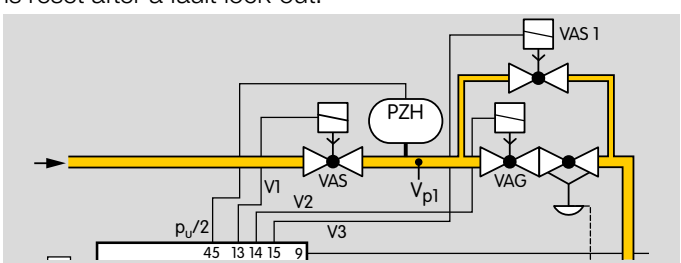
The gas line is always safeguarded by a gas solenoid valve during this check.

Before burner start-up

The valve check is started when the start-up signal ϑ is present at terminal 1. The BCU checks the tightness of the gas solenoid valves and the pipework between the valves. The gas line is always safeguarded by a gas solenoid valve during this check. The burner is ignited when pre-purge is ended and the tightness has been checked successfully.

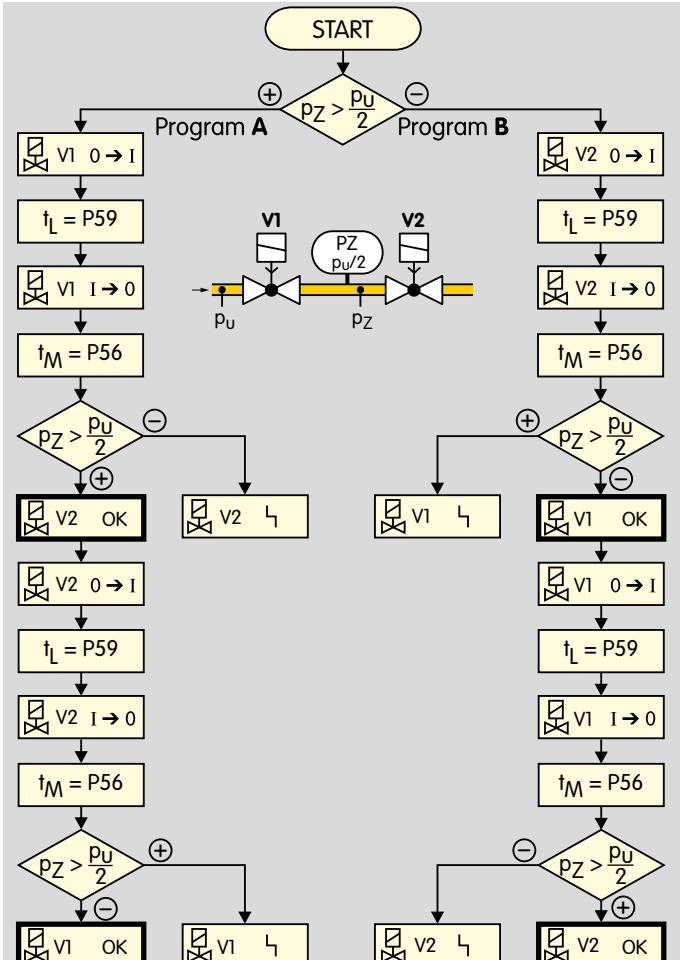
After burner shut-down

After the burner has been shut down, the BCU checks the tightness of the gas solenoid valves and the pipework between them. Once the test has been carried out successfully, the next burner start is enabled. The BCU immediately conducts a tightness test if mains voltage is available or if it is reset after a fault lock-out.



An additional bypass/relief valve must be installed in gas sections with an air/gas ratio control. This ensures that the test volume V_{p1} can be vented during the tightness test with the air/gas ratio control closed.

6.1.2 Program sequence



The tightness test starts by checking the external pressure switch:

If pressure $p_Z > p_u/2$, program A starts.
If pressure $p_Z < p_u/2$, program B starts.

Program A

Valve V1 opens for the opening time t_L set in parameter 59. V1 closes again. During the measurement time t_M, the tightness control checks the pressure p_Z between the valves.

If pressure p_Z is less than half the inlet pressure $p_u/2$, valve V2 is leaking.

If pressure p_Z is greater than half the inlet pressure $p_u/2$, valve V2 is tight. Valve V2 is opened for the set opening time t_L. V2 closes again.

During the measurement time t_M, the tightness control checks the pressure p_Z between the valves.

If pressure p_Z is greater than half the inlet pressure $p_u/2$, valve V1 is leaking.

If pressure p_Z is less than half the inlet pressure $p_u/2$, valve V1 is tight.

The tightness test can only be performed if pressure p_d downstream of V2 is around atmospheric pressure and the volume downstream of V2 is at least 5 × higher than the volume between the valves.

Program B

Valve V2 opens for the set opening time t_L. V2 closes again. During the measurement time t_M, the tightness control checks the pressure p_Z between the valves.

If pressure $p_Z > p_u/2$, valve V1 is leaking. If pressure $p_Z < p_u/2$, valve V1 is tight. Valve V1 is opened for the set opening time t_L. V1 closes again.

During the measurement time t_M, the tightness control checks the pressure p_Z between the valves.

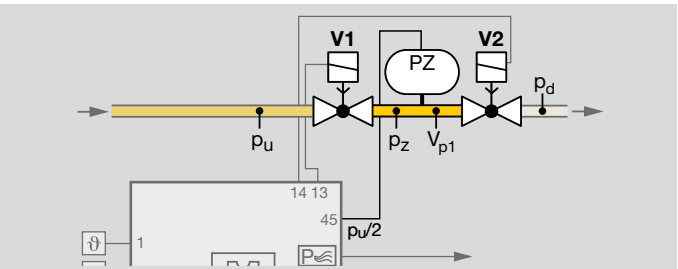
If pressure $p_Z < p_u/2$, valve V2 is leaking.

If pressure $p_Z > p_u/2$, valve V2 is tight.

The tightness test can only be performed if pressure p_d downstream of V2 is around atmospheric pressure and the volume downstream of V2 is at least 5 × higher than the volume between the valves.

6.1.3 Test period t_P

Depending on the burner capacity, the tightness of the gas solenoid valves must be checked in accordance with the relevant application standard, e.g. EN 676, EN 746, NF-PA 85 and NFPA 86.



The test period t_P is calculated from:

- Opening times t_L for V1 and V2,
- Measurement times t_M for V1 and V2.

$$t_P\ [s] = 2 \times t_L + 2 \times t_M$$

6.1.4 Opening time t_L

Standard EN 1643:2000 allows a maximum opening time of 3 s for the tightness test if the main gas valves are actuated directly. If gas can flow into the combustion chamber when a valve is opened, the gas volume must not exceed 0.083% of the maximum flow rate.

6.1.5 Measurement time t_M

The sensitivity of the tightness control in the BCU can be adjusted for each individual system by adapting the measurement time t_M. The longer the measurement time t_M, the greater the sensitivity of the tightness control. The measurement time is set using parameter 56 to a value between 3 and 3600 s, see page 108 (11.8.3 Measurement time for Vp1).

The required measurement time t_M is calculated from:
Inlet pressure p_u [mbar]
Leakage rate Q_L [l/h]
Test volume V_{p1} [l]

For one test volume V_{p1} between 2 gas solenoid valves

Adjustable using parameter 56

$$t_M\,[s] = \left(\frac{2 \times p_u \times V_{p1}}{Q_L}\right)$$

For a large test volume V_{p1} with reduced testing time

Adjustable using parameter 56

$$t_M\,[s] = \left(\frac{0.9 \times p_u \times V_{p1}}{Q_L}\right)$$

Conversion into US units, see www.adlatus.org

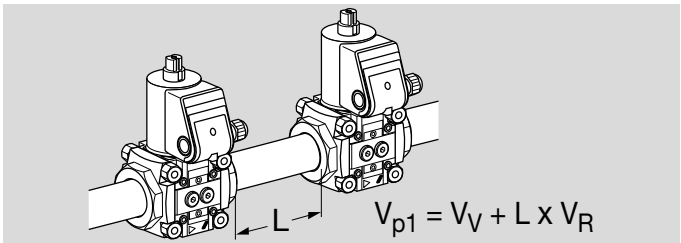
Leakage rate

The BCU tightness control makes it possible to check a specific leakage rate Q_L. Within the European Union, the maximum leakage rate Q_L is 0.1% of the maximum flow rate $Q_{(N)max.}$ [m^3/h].

ıkage rate Q_L [l/h] = $Q_{(N)max.}$ [m^3/h] x 0.1 %

Test volume V_{p1}

Test volume V_{p1} is calculated from the valve volume V_V, added to the volume of the pipe V_R for each additional metre in length L.

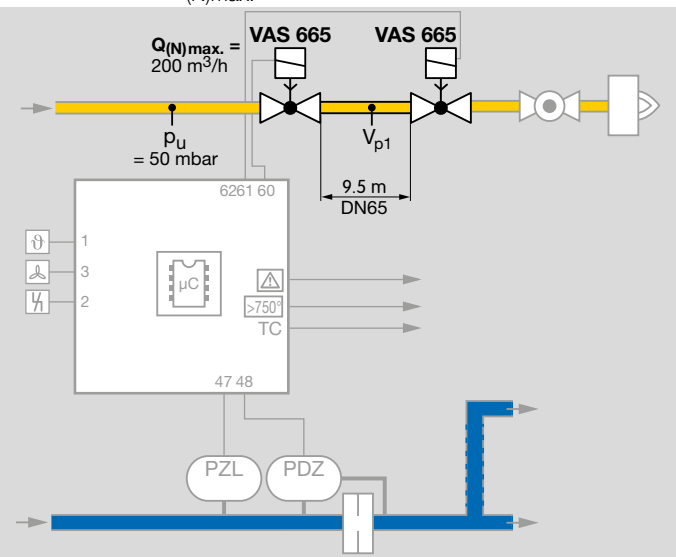


Valves			Pipe	
Type	Volume V_V [l]		DN	Volume per metre V_R [l/m]
VG 10	0.01		10	0.1
VG 15	0.05		15	0.2
VG 20	0.10		20	0.3
VG 25	0.11		25	0.5
VG 40/VK 40	0.64		40	1.3
VG 50/VK 50	1.61		50	2
VG 65/VK 65	2.86		65	3.3
VG 80/VK 80	4		80	5
VG 100/ VK 100	8.3		100	7.9
VK 125	13.6		125	12.3
VK 150	20		150	17.7
VK 200	42		200	31.4
VK 250	66		250	49
VAS 1	0.08			
VAS 2	0.28			
VAS 3	0.68			
VAS 6	1.37			
VAS 7	2.04			
VAS 8	3.34			
VAS 9	5.41			
VCS 1	0.06			
VCS 2	0.18			
VCS 3	0.39			
VCS 6	1.11			
VCS 7	1.40			
VCS 8	2.82			
VCS 9	4.34			

The measurement time required for the test volume V_{p1} must be set on the basis of the calculation using parameter 56.

Calculation examples

2 valves VAS 665,
distance L = 9.5 m,
inlet pressure p_u = 50 mbar,
max. flow rate $Q_{(N)max.}$ = 200 m^3/h.



Leakage rate Q_L = 200 m_3/h x 0.1 % = 20

Test volume V_{p1} = 1.1 l + 9.5 m x 3.3 l/m = 32.45 l

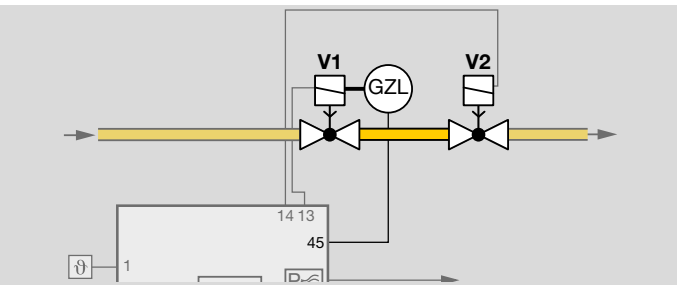
Measurement time for test volume V_{p1}:

$$t_M\,[s] = \left(\frac{2 \times 50\ \text{mbar} \times 32{,}45\ \text{l}}{200\ \text{l/h}}\right) = 16{,}23\ \text{s}$$

Set the next highest value (20 s) using parameter 56, see page 108 (11.8.3 Measurement time for Vp1).

6.2 Proof of closure function

The proof of closure function monitors the function of the gas solenoid valve V1. The proof of closure function can be activated by setting parameter 51 = 4, see page 107 (11.8.1 Valve proving system). A limit switch on gas solenoid valve V1 signals the closed position of the valve to the BCU (terminal 45) for this purpose.



By checking the closed position using the proof of closure function, the BCU complies with the requirements of NFPA 85 (Boiler and Combustion Systems Hazards Code) and NFPA 86 (Standard for Ovens and Furnaces).

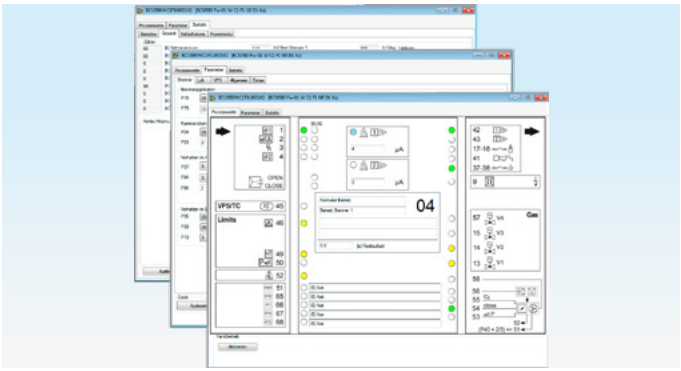
6.2.1 Program sequence

When the start-up signal is received at terminal 1, the BCU checks that valve V1 is in its closed position using the POC switch. If a signal is not received at terminal 45 from the POC switch after a timeout time of 10 s (valve V1 is closed), the BCU performs a fault lock-out with fault message c1.

As soon as the BCU has opened valve V1, it queries the open position of the valve via the POC switch. If a signal is still being received at terminal 45 from the POC switch after a timeout time of 10 s, the BCU performs a fault lock-out with fault message c8.

7 BCSoft

BCSoft is an engineering tool for PCs with a Windows operating system. BCSoft (from version 4.x.x) makes it possible to set device parameters in order to adjust them to the specific application. BCSoft logs and archives the device parameters. In addition, BCSoft offers further functions. In conjunction with Manual mode, the process values overview provides commissioning support in order to facilitate the commissioning process. In the event of faults or service interventions, details on troubleshooting can be derived from the device statistics and the fault history.



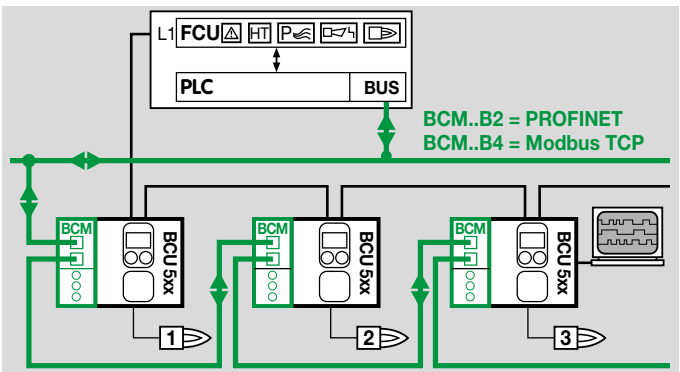
The current version of the engineering tool BCSoft4 is available at
www.docuthek.com.

In addition to the engineering tool BCSoft, an opto-adapter with USB connection is required for data transfer between the PC and BCU. If the burner control unit BCU is operated in conjunction with the bus module BCM 500, communication via Ethernet is possible.

BCSoft4 and opto-adapter PCO 200, see page 122 (14.1 BCSoft).

8 Fieldbus communication

PROFINET and Modbus TCP are manufacturer-independent, open standards for industrial network communication. They cover the requirements for automation technology (manufacturing automation, process automation, drive applications without functional safety). They are bus variants for fieldbus communication optimized for speed and low connection costs.



The basic function of fieldbus communication is the exchange of process and required data between a controller (e.g. a PLC) and several distributed devices (e.g. BCM with BCU/FCU).

The signals from the devices are read into the controller cyclically. There, they are processed and are then output to the devices again.

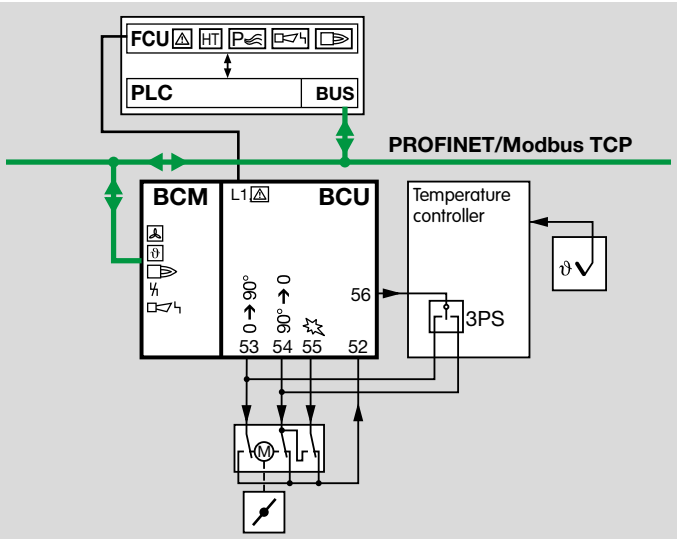
8.1 BCU and bus module BCM

The optional bus module BCM 500 is required to integrate the BCU in a fieldbus system (PROFINET IO or Modbus TCP).

Control signals (for start, reset and air actuator control, for example), signal states from the device inputs and outputs and information about the device status (operating states, flame signal and current program step), warnings and faults can be transferred simultaneously via the bus module between the BCU and PLC.

Bus module BCM 500 has two RJ45 connection sockets for connection to the fieldbus on its front. The RJ45 connection sockets are combined with an internal 2-port switch. This allows the BCM 500 together with the BCU to be integrated in various network topologies (star, tree or line topology). Requirements such as Auto Negotiation and Auto Crossover are satisfied.

Safety-related signals and interlocks (e.g. safety interlock) must be wired independently of the fieldbus communication direct between the BCU and the protective system (e.g. FCU).



All network components which connect the automation system and the field devices must be certified for the relevant fieldbus use.

For information on planning and the structure of a network and the components to be used (e.g. cables, lines and switches)
for PROFINET, see www.profibus.com,
for Modbus TCP, see www.modbus.org.

8.2 Configuration, planning

Before commissioning, the bus module must be configured for data exchange with the fieldbus system using an engineering tool or BCSoft.

To do so, fieldbus communication must be enabled on the control unit with connected bus module BCM and the code switches on the BCM set, see also page 115 (11.13 Fieldbus communication).

8.2.1 Device master data file (GSD)

The technical properties of a device are described by the manufacturer in a device master data file (GSD file). The GSD file is required for integration of the device (BCU/FCU) in the configuration of the PLC. The GSD file contains the device image, the communications properties and all fault messages from the device in text form which are important for the configuration of the PROFINET network and the data exchange. Modules defined in the GSD file may be selected for configuration to integrate the device. The GSD file for the bus module can be ordered at www.docuthek.com. The steps required to integrate the file are described in the instructions for the engineering tool for your automation system.

8.2.2 PROFINET

In addition to cyclic data exchange, PROFINET also provides acyclic data exchange for events which are not constantly repeated such as sending device statistics. In the event that the bus communication is faulty or interrupted and during initialization of the bus communication after switching on, the digital signals are interpreted as “0”.

8.2.3 Modbus TCP

The Modbus protocol is a communications protocol based on a Client/Server architecture. Once the TCP/IP connection between client (PLC) and server (BCU/FCU) has been established, useful data can be transferred via this connection as often and in as great an amount as required. The PLC and BCU/FCU can establish up to 3 parallel TCP/IP connections at the same time. Using the function codes 3, 6 and 16, data can be transferred to and from the BCU/FCU. The PLC must send output data to the BCU/FCU at least every 125 ms in order to ensure data transfer and functioning of the BCU/FCU. If the output data is missing or sent too late, the bus module will interpret them as “0”.

8.2.4 Modules/Registers for process data

All modules (PROFINET) and registers (Modbus TCP) required for data exchange between the PLC and the burner control units BCU 560/BCU 565 are shown in the following table.

Module (PROFINET) Register (Modbus TCP)	PROFINET slot	Modbus address	Address	Operation
Outputs	1	0	n	w
Inputs	1	6[1)]	n...n+1	r
Inputs	1	7	n+2	r
Burner 1 flame signal	2	9	n	r
Free	3	12	n	r
Status signal	4	15	n	r
Fault and warning signals	5	18	n...n+1	r
Remaining times	6	21	n	r
TC remaining times[2)]	7	24	n...n+1	r
PLC output terminal information	8	27	n	r
BCU input terminal information	9	30	n...n+1	r
BCU input terminal information	9	31	n+2	r
BCU output terminal information	10	32	n...n+1	r

1) Modbus TCP: see table "Modbus TCP – register structure".

2) Only for BCU..C1. Slot 7/Address 24 is not transferred with other device versions.

Modbus TCP – register structure

Example of "Inputs" register:

Modbus address	6		7	
Format	Word		Word	
PLC address byte	Byte n .7 .0	Byte n+1 .7 .0	Byte n+2 .7 .0	Byte n+3 .7 .0

Inputs/Outputs

The digital input and output signals of the burner control units BCU 560 and BCU 565 are included in this module/ register.

Input bytes (BCU ➔ PLC)

The input bytes describe the digital signals which are transferred from the BCU to the digital inputs of the PLC. The digital signals take up 3 bytes (24 bits).

Bit	Byte n	Byte n+1	Byte n+2	Format
0	Operating signal	Max. capacity reached[1)]	menox ON	BOOL
1	Free	Min. capacity reached[1)]	Free	BOOL
2	BCU system fault	Air ON	Free	BOOL
3	Fault lock-out	Pre-purge ON	Free	BOOL
4	Safety shut-down	DI ON	Free	BOOL
5	Warning	Ready for operation	Free	BOOL
6	ON	Free	Free	BOOL
7	Manual mode	Burner 1 flame signal	Free	BOOL

1) Only with three-point step control via bus.

Output byte (PLC ➔ BCU)

The output byte describes the digital signals which are output by the PLC to the BCU. The digital signals to control the burner control unit BCU occupy 1 byte (8 bits).

Parallel to the bus communication, terminals 1 to 3 of the BCU can be wired. This allows the BCU to be controlled using the digital signals of the bus communication or the inputs at the terminals.

Bit	Byte n	Format
0	Reset[1)]	BOOL
1	Burner 1 start[1)]	BOOL
2	External air ON[1)]	BOOL
3	Pre-purge ON	BOOL
4	Free	BOOL
5	menox ON	BOOL
6	Open control element, three-point step Open[2)]	BOOL
7	Close control element, three-point step Close[2)]	BOOL

1) Parallel to the bus communication, terminals 1 to 3 can be wired.
2) Only with three-point step control via bus.

Burner 1 flame signal (BCU → PLC)

The flame signal for burner 1 is transferred from the BCU to the PLC as an analogue value using this module/register. The flame signal occupies one byte with values from 0 to 255 (= flame signal from 0 to 25.5 µA).

Bit	Byte n	Data type	Format	Value
1 2 3 4 5 6 7	Burner 1 flame signal	Byte	DEC	0–255[1)] (0–25.5 µA)

[1)] See code tables "GSD Codes BCU 56x" or "Modbus Profile BCU 56x" at www.docuthek.com.

Status signal (BCU → PLC)

This module/register transfers the status signals from the BCU to the PLC. The status signals occupy one byte (0 to 255). Every status signal is allocated a code.

Bit	Byte n	Data type	Format	Value
0 1 2 3 4 5 6 7	Status signals	Byte	DEC	0–255[1)]

[1)] See code tables "GSD Codes BCU 56x" or "Modbus Profile BCU 56x" at www.docuthek.com.

Fault and warning signals (BCU → PLC)

The fault and warning signals are transferred from the BCU to the PLC using this module/register. The fault and warning signals occupy one byte each (0 to 255).

The same allocation table applies to the fault signals and the warning signals.

Bit	Byte n	Data type	Format	Value
0 1 2 3 4 5 6 7	Fault signals	Byte	DEC	0–255[1)]

Bit	Byte n+1	Data type	Format	Value
0 1 2 3 4 5 6 7	Warning signals	Byte	DEC	0–255[1)]

[1)] See code tables "GSD Codes BCU 56x" or "Modbus Profile BCU 56x" at www.docuthek.com.

TC remaining times (BCU ➔ PLC)

This module/register transfers the remaining times of various processes from the BCU to the PLC. The remaining time occupies 2 bytes.

Bit	Byte n	Byte n+1	Data type	Format	Value
0 1 2 3 4 5 6 7	Remaining times		Word	DEC	0–6554 (0 to 6554 s)

Remaining times of the valve proving system (BCU ➔ PLC)

Only with BCU..C1.

The module/register in BCU..C0 contains no information.

This module/register transfers the remaining time of the valve proving system from the BCU..C1 to the PLC. The remaining time occupies 2 bytes.

The valve check runs parallel to other time-related processes, e.g. pre-purge. To display the remaining time of the valve proving system separately, it is transferred separately.

Bit	Byte n	Byte n+1	Data type	Format	Value
0 1 2 3 4 5 6 7	Remaining times of the valve proving system		Word	DEC	0–6554 (0 to 6554 s)

PLC output terminal information (BCU ➔ PLC)

This module/register transfers information on signals which the PLC uses to control the BCU back to the PLC. This allows the signal transfer from the PLC to the BCU to be checked.

Bit	Byte n	Format
0	Reset	BOOL
1	Burner 1 start	BOOL
2	External air ON	BOOL
3	Pre-purge ON	BOOL
4	Free	BOOL
5	menox ON	BOOL
6	Open control element, three-point step Open[1)]	BOOL
7	Close control element, three-point step Close[1)]	BOOL

1) Only with three-point step control via bus.

BCU input terminal information (BCU ➔ PLC)

This module/register transfers the signal states of the digital inputs on the BCU (input terminals) to the PLC.

Bit	Byte n	Byte n+1	Byte n+2	Format
0	Terminal 1	Terminal 48	Terminal 68	BOOL
1	Terminal 2	Terminal 49	Free	BOOL
2	Terminal 3	Terminal 50	Free	BOOL
3	Free	Terminal 51	Free	BOOL
4	Terminal 44	Terminal 52	Free	BOOL
5	Terminal 45	Terminal 65	Free	BOOL
6	Terminal 46	Terminal 66	Free	BOOL
7	Terminal 47	Terminal 67	Free	BOOL

BCU output terminal information (BCU ➔ PLC)

This module/register transfers the signal states of the digital outputs on the BCU (output terminals) to the PLC.

Bit	Byte n	Byte n+1	Format
0	Terminal 9	Terminal 42	BOOL
1	Terminal 10	Free terminal	BOOL
2	Terminal 13	Terminal 53	BOOL
3	Terminal 14	Terminal 54	BOOL
4	Terminal 15	Terminal 55	BOOL
5	Terminal 17/18	Terminal 56	BOOL
6	Terminal 37/38	Terminal 57	BOOL
7	Terminal 41	Free	BOOL

1) Only for BCU..F2: terminal 53 is used as an input. Bit 2 has no function.

8.2.5 Device parameters and statistics

PROFINET

With the help of acyclic communication between the PLC and BCU, it is possible to read information on parameters, statistics and fault history on an event basis (e.g. using system function block Siemens FSB 52 RDREC).

Index	Description
1001	Parameters
1002	Device statistics, counter
1003	Device statistics, faults/warnings
1004	Operator statistics, counter
1005	Operator statistics, faults/warnings
1006	Fault history
1007	Power module statistics

The available data records differ in terms of their indexes. The contents and description of the indexes are described in the code table “GSD Codes BCU 56x” (download from www.docuthek.com).

Modbus TCP

Address	Description
256–511	Parameters
512–767	Device statistics, counter
768–1023	Device statistics, faults/warnings
1024–1279	Operator statistics, counter
1280–1535	Operator statistics, faults/warnings
1536–1791	Fault history
1792–2047	Power module statistics

The available data records differ in terms of their addresses. The contents and description of the addresses are described in the code table “Modbus Profile BCU 56x” (download from www.docuthek.com).

9 Program step/status

DISPLAY[1]	Program step/status
00	Start-up position/Standby
A0	Cooling
P0	Pre-purge
H0	Delay
01	Burner pause time t_{MP}
d A1	Pre-ventilation[2]
d 0	"No flow" state check of low air pressure protection device
d 1	Low air pressure protection check
Ac	Approaching minimum capacity/closed position[2]
Ao	Approaching maximum capacity[2]
P0	Pre-purge
P1	Pre-purge
Ai	Approaching ignition capacity[2]
H2	Delay
tc	Valve check
02	Safety time 1
03	Flame proving period 1 t_{FS1}
04	Burner 1 operation/controller enable
09	Over-run up to minimum capacity
P9	Post-purge
UI	Remote control with OCU
	Data transfer (programming mode)
X.X.	High temperature operation
--	Device Off

[1] In Manual mode, two dots flash on the display.

[2] Air actuator (control element/valve) is open.

10 Fault messages

Fault message (flashing)	DISPLAY	Description
Burner 1 flame simulation	01	Flame simulation/Flame signal before ignition
No flame after safety time 1	02	No flame formation to end of 1st safety time
Flame failure during flame proving period 1 t_{FS1}	03	
Flame failure during burner 1 operation	04	Flame failure during operation
Too many remote resets	10	Remote reset activated > 5 × in 15 min.
Too many restarts	11	> 5 restarts in 15 min.
Controller enable output (trm. 56)	20	Controller enable output incorrectly connected/supplied with power from an external source
Simultaneous activation (terminals 51 and 52)	21	"Maximum capacity" and "Ignition capacity" position feedback from butterfly valve set simultaneously
Actuator wiring (trm. 52-55)	22	Faulty wiring of terminals 52 to 55
Actuator feedback (terminal 52)	23	Maximum or ignition capacity is not constantly signalled back to terminal 52
Simultaneous Min./Max. bus command	24	"Open actuator" and "Close actuator" bus signals set simultaneously
Non-fail-safe parameters (NFS) inconsistent	30	NFS parameter range is inconsistent
Fail-safe parameters (FS) inconsistent	31	FS parameter range is inconsistent
Mains voltage	32	Supply voltage too high/low
Faulty parameterization	33	Parameter set contains illegal settings
Air valve control defective	34	
Incompatible bus module	35	
Power module defective	36	Relay contact fault caused by defective relay contacts, EMC influence, by applying voltage to outputs or by an incorrect load module
Fuse defective	39	Device fuse F1 is defective
Inlet valve(s) leaking	40	Leak found on inlet valve(s)
Outlet valve(s) leaking	41	Leak found on outlet valve(s)
Pressure switch/gas valve wiring	44	
Gas valve wiring	45	Reversed valve connection
Safety interlock failure	51	
Permanent remote reset	52	Remote reset input activated > 10 s
Timing cycle too short	53	Minimum timing cycle not observed
Waiting for ignition position (LDS)	54	Faulty feedback signal of the control element position for ignition capacity

Fault message (flashing)	DISPLAY	Description
Wiring for multi-flame control	56	Faulty wiring for multi-flame control
Incorrect voltage supply to terminal 44	57	menox® mode without HT signal
Internal error	80	Flame amplifier error/Device error
Internal error	89	Error in processing internal data
Internal error	94	Error at digital inputs
Internal error	95	Error at digital outputs
Internal error	96	Error when checking the SFR
Internal error	97	Error when reading the EEProm
Internal error	98	Error when writing to the EEProm
emBoss	99	Shut-down without application error
Minimum capacity not reached	Ac	Closed position not reached after 255 s
Maximum capacity not reached	Ao	Purge position not reached after 255 s
Ignition capacity not reached	Ai	Ignition position not reached after 255 s
Communication with bus module	b E	Internal communication with bus module has suffered a fault
Parameter chip card (PCC)	bc	Incorrect or defective PCC
POC valve open	c 1	No input signal from the valve proof of closure switch (POC) during standby
POC valve closed	c 8	Input signal from the valve proof of closure switch (POC) does not drop out after burner start-up
Air monitor “no flow” state	d 0	Fault Air monitor “no flow” state check. The signal from the pressure switches is received at terminal 47 or 48 before the air actuator is opened.
Low air pressure	d 1	Fault Air monitor make contact check; no signal from pressure switch at terminal 48
Low air pressure	d 2, d 3, d 4, d 5, d 6, d 7, d 8, d 9	No input signal from pressure switch or failure in air supply during program step 2, 3, 4, 5, 6, 7, 8 or 9
Air flow during pre-purge	d P	No input signal from pressure switch or failure in air supply during pre-purge
Waiting for connection	n 0	BCU waiting for connection to controller
Invalid address	n 1	Invalid or incorrect address set on bus module
Invalid configuration	n 2	The bus module has received an incorrect configuration from the controller
Invalid network name	n 3	Invalid network name or no address allocated in the network name
Controller in STOP position	n 4	Controller in STOP position
Burner 1 flame simulation	A 1	Burner 1 flame simulation while air valve open

Fault message (flashing)	DISPLAY	Description
No flame after safety time 1	A 2	No flame during safety time 1 while air valve open
Flame failure during flame proving period 1	A 3	Flame failure during flame proving period 1 while air valve open
Flame failure during burner 1 operation	A 4	Flame failure during burner 1 operation while air valve open
Burner 1 flame simulation	F1	Burner 1 flame simulation during multi-flame control
No flame after safety time 1	F2	No flame during safety time 1 during multi-flame control
Flame failure during flame proving period 1	F3	Flame failure during flame proving period 1 during multi-flame control
Flame failure during burner 1 operation	F4	Flame failure during burner 1 operation in multi-flame control

11 Parameter

Any changes to parameters will be saved to the parameter chip card.

Name	Parameter	Value range	Factory default settings
page 68 (11.2.1 Burner 1 flame signal FS1 switch-off threshold)	01	0–20	2–20 µA where P04 = 0, 5–20 µA where P04 = 1, 5 µA where P04 = 2
page 68 (11.2.2 Flame control)	04	0 = Flame rod 1 = UVS sensor 2 = UVC sensor	0
page 69 (11.2.3 High temperature operation)	06	0 = Off 2 = Intermittent operation with UVS 3 = Continuous operation with ionization/UVC 5 = menox intermittent	0
page 72 (11.3.1 Burner 1 start-up attempts)	07	1 = 1 start-up attempt 2 = 2 start-up attempts 3 = 3 start-up attempts	2
page 82 (11.4.1 Restart)	09	0 = Off 1 = Burner 1 4 = Max. 5 x in 15 min. for burner 1	2
page 84 (11.5.1 Low air pressure protection)	15	0 = Off 1 = With safety shut-down 2 = With fault lock-out	2
page 84 (11.5.2 Delayed low air pressure protection)	16	0 = Off 1 = On	
page 85 (11.5.3 Safety time during operation)	19	0; 1; 2 = Time in seconds	1
page 106 (11.7.1 menox pre-ventilation time tVLM)	28	0–250 = Time in seconds	0
page 86 (11.6.1 Pre-purge time tPV)	34	0–6000 = Time in seconds	6000
page 86 (11.6.2 Air flow monitoring during pre-purge)	35	0 = Off 1 = With safety shut-down 2 = With fault lock-out	2
page 87 (11.6.3 Pre-ventilation time tVL)	36	0–250 = Time in seconds	0
page 87 (11.6.4 Post-ventilation time tNL)	39	0; 1; 2; 3 = Time in seconds	0

Name	Parameter	Value range	Factory default settings
page 88 (11.6.5 Capacity control)	40	0 = Off 1 = With IC 20 2 = With IC 40 3 = With FS-BLAC 5 = With air valve	BCU..F0 = 0 BCU..F1 = 1 BCU..F2 = 2 BCU..F3 = 5
page 96 (11.6.6 Running time selection)	41	0 = Off; checking the positions for minimum/maximum capacity 1 = On; for approaching the positions for minimum/maximum capacity 2 = On; for approaching the position for maximum capacity 3 = On; for approaching the position for minimum capacity	0
page 96 (11.6.7 Running time) -->	42	0–250 = Running time in seconds, if parameter 41 = 1, 2 or 3	30
page 97 (11.6.8 Low fire over-run) -->	43	0 = Off 1 = Up to minimum capacity 2 = 1 s 3 = 2 s 4 = 3 s 5 = 4 s 6 = 5 s 7 = 10 s 8 = 20 s 9 = 30 s 10 = 40 s	30
page 98 (11.6.9 Controller enable signal delay time tRF)	44	0–250 = Time in seconds	0
page 98 (11.6.10 Air actuator control)	48	0 = Opens on external activation 1 = Opens with gas stage 1 2 = Opens with operating signal 3 = Controller enable after operating signal or in standby 4 = Opens with V4 burner 1	0
page 100 (11.6.11 Air actuator on start-up can be activated externally)	49	0 = Cannot be activated 1 = Can be activated externally	0
page 100 (11.6.12 Air actuator in the event of fault)	50	0 = Cannot be activated 1 = Can be activated externally	1
page 107 (11.8.1 Valve proving system)	51	0 = Off 1 = Tightness test before start-up 2 = Tightness test after shut-down 3 = Tightness test before start-up and after shut-down 4 = Proof of closure function	0
page 107 (11.8.2 Relief valve (VPS))	52	2 = V2 3 = V3	2

Name	Parameter	Value range	Factory default settings
page 108 (11.8.3 Measurement time for Vp1)	56	3 = Time in seconds 5–25 = in 5 s steps 30–3600 = in 10 s steps	10
page 108 (11.8.4 Valve opening time tL1)	59	2–25 = Time in seconds	2
page 83 (11.4.2 Minimum operating time tB)	61	0–250 = Time in seconds	0
page 109 (11.9.1 Minimum pause time tMP)	62	0–3600 = Time in seconds	0
page 106 (11.7.2 Switchover to menox® operating mode)	64	0 = On next burner start 1 = Immediately	1
page 110 (11.10.1 Operating time in Manual mode)	67	0 = Unlimited 1 = 5 minutes	1
page 111 (11.11.1 Function of terminal 50)	68	23 = Purge with Low signal 24 = Purge with High signal	1
page 111 (11.11.2 Function of terminal 51)	69	0 = Off 8 = AND with emergency stop (trm. 46) 9 = AND with $air_{min.}$ (trm. 47) 10 = AND with air flow monitoring (trm. 48) 13 = Max. capacity position feedback (IC 40/FS-BLAC)	0
page 111 (11.11.3 Function of terminal 65)	70	0 = Off 8 = AND with emergency stop (trm. 46) 9 = AND with $air_{min.}$ (trm. 47) 10 = AND with air flow monitoring (trm. 48)	0
page 112 (11.11.4 Function of terminal 66)	71	0 = Off 8 = AND with emergency stop (trm. 46) 9 = AND with $air_{min.}$ (trm. 47) 10 = AND with air flow monitoring (trm. 48) 20 = LDS ignition position check	0
page 113 (11.11.5 Function of terminal 67)	72	0 = Off 8 = AND with emergency stop (trm. 46) 9 = AND with $air_{min.}$ (trm. 47) 10 = AND with air flow monitoring (trm. 48) 21 = Multi-flame control start-up conditions	0
page 114 (11.11.6 Function of terminal 68)	73	0 = Off 8 = AND with emergency stop (trm. 46) 9 = AND with $air_{min.}$ (trm. 47) 10 = AND with air flow monitoring (trm. 48) 21 = Multi-flame control operating conditions	0

Name	Parameter	Value range	Factory default settings
page 100 (11.6.13 Capacity control (bus))	75	0 = Off 1 = MIN. to MAX. capacity; standby in position for MIN. capacity 2 = MIN. to MAX. capacity; standby in CLOSED position 3 = IGNITION to MAX. capacity; standby in CLOSED position 4 = MIN. to MAX. capacity; standby in position for MIN. capacity; burner quick start 5 = IGNITION to MAX. capacity; standby in CLOSED position; burner quick start	0
page 115 (11.12 Password)	77	0000–9999 = Four-digit number code	1234
page 73 (11.3.2 Burner application)	78	0 = Burner 1 1 = Burner 1 with pilot gas 4 = Two-stage burner 1 11 = menox 1/0 and burner 1/0 12 = menox 1/0 and burner L/H/O 13 = menox 1/0 with 2 gas paths	1
page 115 (11.13 Fieldbus communication)	80	0 = Off 1 = With address check 2 = No address check	1
page 81 (11.3.3 Safety time 1 tSA1)	94	2, 3, 5, 10 = Time in seconds	5
page 81 (11.3.4 Flame proving period 1 tFS1)	95	0–20 = Time in seconds	2

11.1 Scanning the parameters

During operation, the 7-segment display shows the program step/status.

All the parameters of the BCU 560, BCU 565 can be scanned in numerical order by repeatedly pressing the Reset/Information button (for 1 s).

The parameter display is ended 60 seconds after the last time the button is pressed or by switching off the BCU 560, BCU 565.

The BCU 560, BCU 565 displays -- when the mains switch is off. The parameters cannot be scanned when the BCU 560, BCU 565 is switched off or when a fault message is displayed.

11.2 Flame control

The BCU is fitted with a flame amplifier which evaluates whether an adequate flame signal is supplied by the burner using a flame rod or UV sensor.

11.2.1 Burner 1 flame signal FS1 switch-off threshold

Parameter 01

The sensitivity at which the burner control unit detects a flame can be set using parameter 01.

As soon as the measured flame signal falls below the set value (2 to 20 µA), the BCU performs a fault lock-out during start-up after the elapse of the safety time or during operation after the elapse of the safety time during operation (parameter 19).

In the case of UV control, this value can be increased, should the burner to be monitored be influenced by other burners, for example.

11.2.2 Flame control

Parameter 04

Parameter 04 = 0: flame control is performed with a flame rod.

Parameter 04 = 1: flame control is performed with a UV sensor for intermittent operation (UVS). For intermittent operation, the operating state of the complete system is limited to 24 h pursuant to EN 298. To meet the requirement for intermittent operation, the burner is shut down and restarted automatically after a continuous operating time of 24 hours if it is not operated in compliance with the standard. The restart does not meet the requirements of EN 298 for UV sensor continuous operation because the required self-test (at least once per hour) is not performed while the burner is operating. This shut-down and subsequent restart are performed in the same way as a normal controlled shutdown. Depending on the parameterization, the burner is started with or without pre-purge. This process is controlled independently by the BCU. Therefore it must be checked whether the industrial process permits the pause in heat supply it creates.

Parameter 04 = 2: flame control is performed with a UV sensor for continuous operation (UVC).

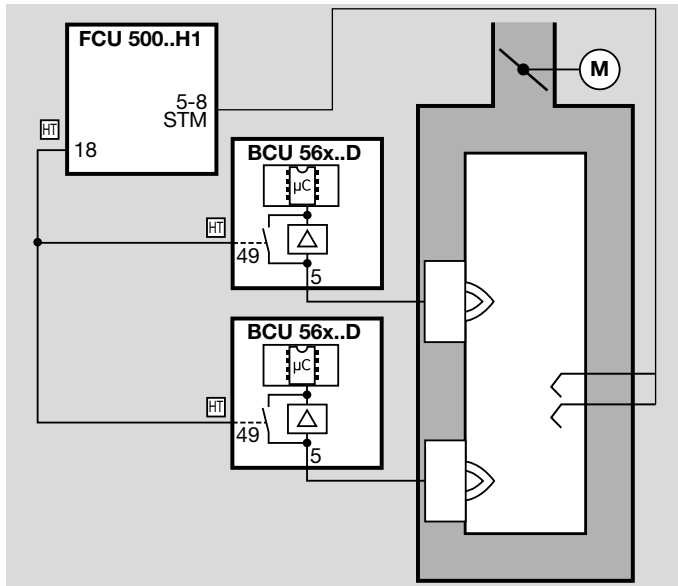
The response times of the BCU and UV sensor for continuous operation are coordinated so that the set safety time during operation (parameter 19) is not extended.

11.2.3 High temperature operation

Parameter 06

Operation of firing systems above 750°C. The BCU..D1 and BCU..D2 have a fail-safe input with the function “High temperature operation”. If firing systems are operated above 750°C, the system is considered to be an item of high temperature equipment (see EN 746-2). Here, flame control must be in operation until the furnace wall temperature has exceeded 750°C.

Below 750°C, the flame is monitored by conventional means (UV sensor or flame rod). In High temperature mode (> 750°C), the flame may be controlled via the temperature using a safety temperature monitor (STM) in order to increase the system’s availability. This means that no incorrect flame signals, e.g. signals from a UV sensor which interprets reflected UV radiation as extraneous signals, may lead to faults.



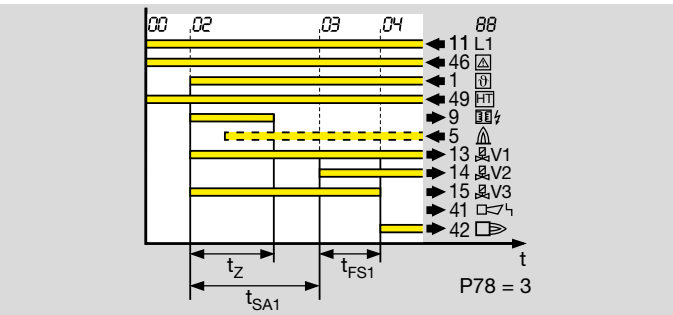
When the HT input is activated (terminal 49), the burner control unit reverts to High temperature mode, i.e.: **the BCU operates without evaluation of the flame signal. The safety function of the device’s internal flame control system is deactivated.**

In High temperature mode, the gas valves are opened and the burners are started as usual without monitoring the presence of a flame.

The precondition for this operating mode is that an external flame supervision device ensures the presence of the flame in a fail-safe manner indirectly via the temperature. For this purpose, we recommend a safety temperature monitor with double thermocouple (DIN 3440). The flame must be monitored again by conventional means (UV sensor or flame rod)

in the event of sensor discontinuity or short circuit, failure of the safety temperature monitor or power failure.

The voltage may be applied to the HT input (terminal 49) so as to activate High temperature operation only when the temperature at the furnace wall has exceeded 750°C.



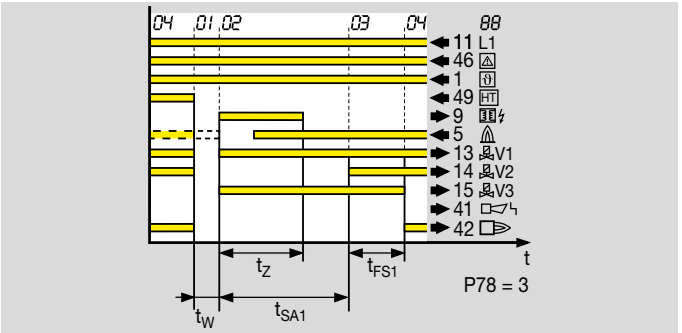
If the temperature in the furnace chamber drops below 750°C, the HT input must be disconnected from the electrical power supply and the furnace must then be operated with flame control.

The BCU then responds, depending on setting:

Parameter 06 = 0

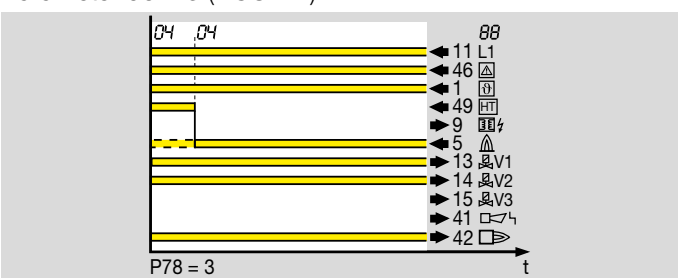
The High temperature mode function is switched off. Flame control takes place dependent on the setting in parameter 04 (using flame rod, UVS sensor or UVC sensor).

Parameter 06 = 2 (BCU..D1)



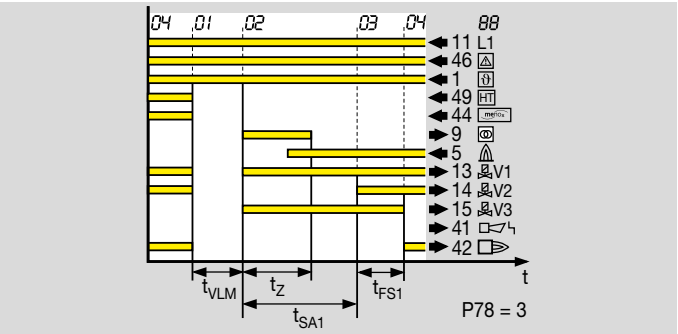
The BCU switches off the burner and restarts with flame simulation check (recommended in the case of UV control with UVS).

Parameter 06 = 3 (BCU..D1)



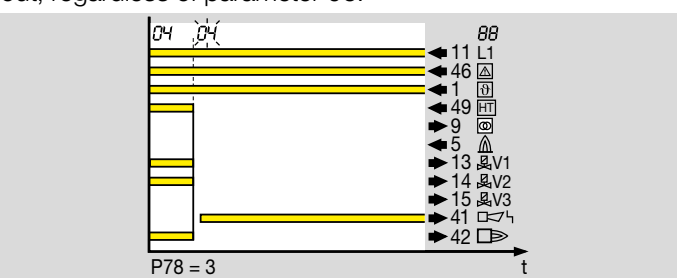
The burner remains in operation and the BCU performs flame control again (recommended in the case of ionization control or UV control with UVC).

Parameter 06 = 5 (BCU..D2)



The BCU switches off the burner and restarts with the menox pre-ventilation time t_{VLM} set in parameter 28 (see page 106 (11.7.1 menox pre-ventilation time tVLM)).

If no flame signal is present when High temperature mode is deactivated, the burner control unit performs a fault lock-out, regardless of parameter 06.



11.3 Behaviour during start-up

11.3.1 Burner 1 start-up attempts

Parameter 07

This parameter defines the maximum number of possible start-up attempts of the burner.

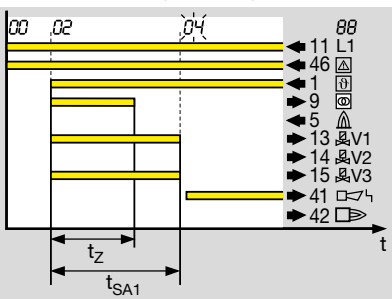
Taking into account national standards and requirements, it must be clarified whether multiple start-up attempts are permitted.

In accordance with EN 746-2, a start-up attempt may be conducted only if the safety of the installation is not impaired.

Multiple start-up attempts are not permitted under NFPA 86. If no flame forms during start-up, this must result in a fault lock-out..

If no flame is detected during start-up, an immediate fault lock-out (P07 = 1) or up to two additional start-up attempts (P07 = 2, 3) are performed depending on parameter 07.

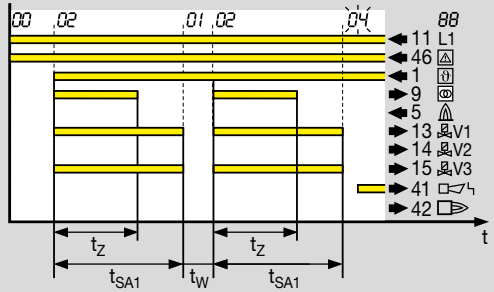
Parameter 07 = 1: 1 start-up attempt.



If no flame is formed during the start-up, so that at the end of the safety time t_{SA1} no flame signal is detected, this will result in a BCU safety shut-down with subsequent fault lock-out. The fault message 04 will flash in the BCU display depending on the burner operating mode.

Parameter 07 = 2, 3:

2 or 3 start-up attempts.



If no flame is formed during the start-up, so that at the end of the safety time t_{SA1} no flame signal is detected, the BCU closes the gas valves and repeats the start-up. Each start-up attempt begins with the parameterized start-up behaviour.

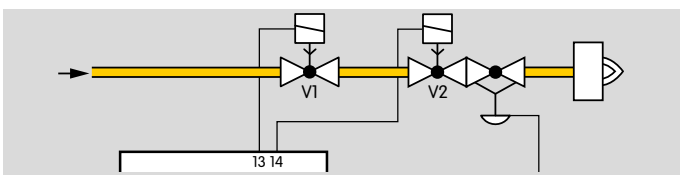
If the safety time t_{SA1} elapses without a flame signal having been detected, even after the last parameterized start-up attempt, this will result in a BCU safety shut-down with subsequent fault lock-out. The fault message 04 will flash in the BCU display depending on the burner operating mode.

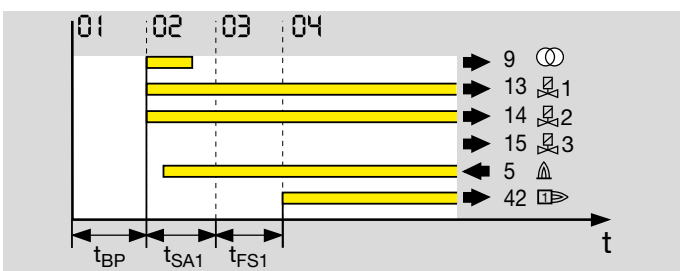
11.3.2 Burner application

Parameter 78

This parameter enables the BCU to be adjusted to various burner applications. In addition, an optional pilot gas valve (V3) can be parameterized via which the burner is started with a defined ignition capacity.

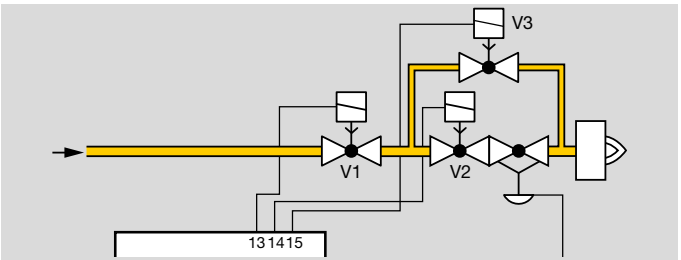
Parameter 78 = 0: burner 1. Two valves (V1, V2) are included for the burner. These are connected to the valve outputs (terminals 13 and 14). Valves V1 and V2 are opened in parallel to start the burner in order to release the gas supply to the burner.

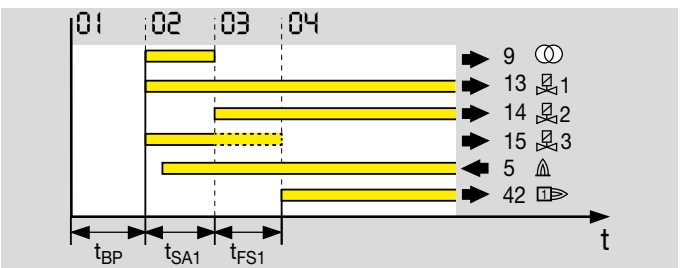




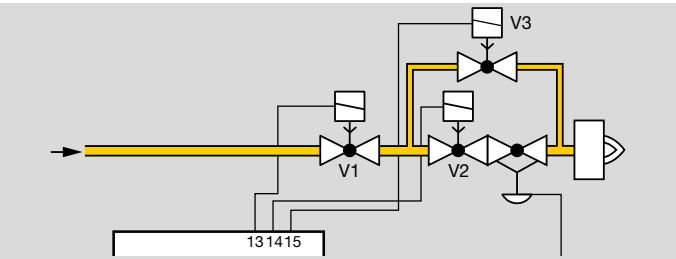
Parameter 78 = 1: burner 1 with pilot gas. Three valves (V1, V2 and V3) are included for a burner with a pilot gas valve. These are connected to the valve outputs (terminals 13, 14 and 15). Valves V1 and V3 open to start the burner. The burner is started with a limited ignition capacity using gas valve V3. After the elapse of the safety time t_{SA1} (program step 02), valve V2 opens. Valve V3 limits the ignition capacity. After the elapse of the flame proving period t_{FS1} (program step 04), it is closed again.

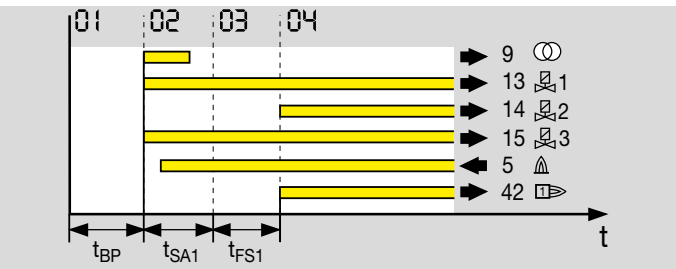
For this application, it must be ensured that the flame proving period (P95) is set to a value ≥ 2 s.





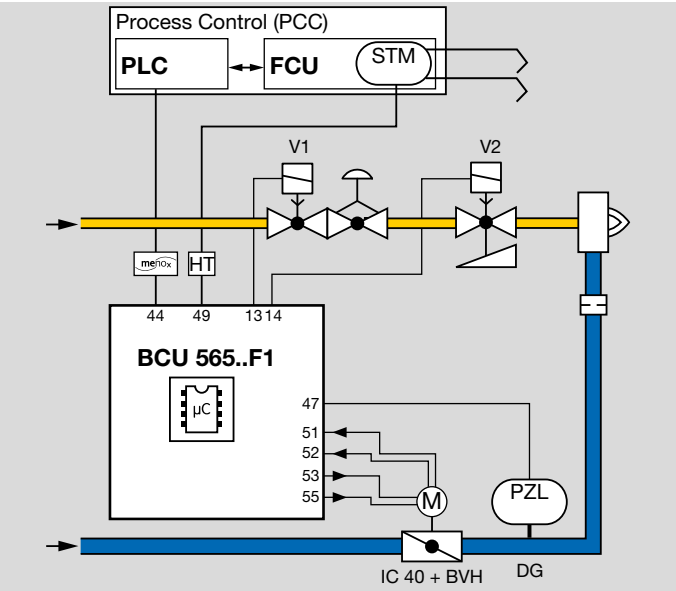
Parameter 78 = 4: two-stage burner 1. Three valves (V1, V2 and V3) are included for a two-stage burner. These are connected to the valve outputs (terminals 13, 14 and 15).



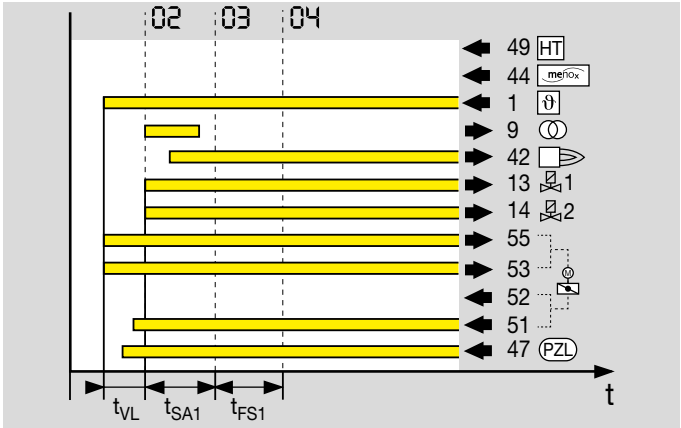


Valves V1 and V3 open to start the burner. The burner is started with a limited ignition capacity using gas valve V3. After the flame proving period t_{FS1} has elapsed, valve V2 opens to enable the 2nd gas stage.

Parameter 78 = 11: menox 1/0 and burner 1/0. Burner is operated On/Off in Flame mode and in menox®.

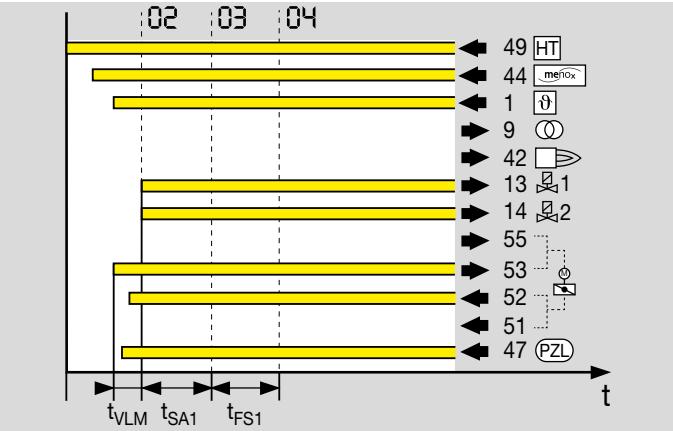


In Flame mode (< 850°C), the burner is started conventionally (as with P78 = 0) with the pre-ventilation time t_{VL} defined in parameter 36. The air control valve is in the “high” position for Flame mode.

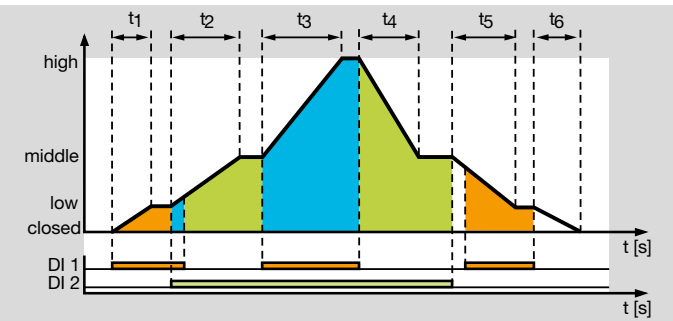


The switchover from flame to menox® mode is performed either immediately or the next time the burner is started depending on the setting made in parameter 64. To switch to menox® mode, the HT signal from the STM (terminal 49) and the menox® signal from a separate control unit (terminal 44) must be applied to the BCU.

In menox® mode, the burner is started with the pre-ventilation time t_{VLM} defined in parameter 28. The air control valve is in the “middle” position for menox® mode. No ignition using the transformer takes place during the safety time t_{SA}. The gas valves V1 and V2 are opened at the start of the safety time t_{SA}.



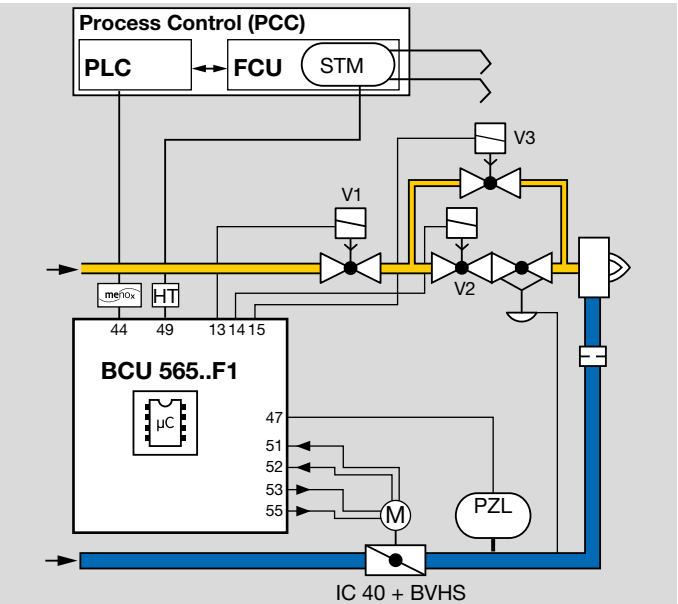
An IC 40 with operating mode 06 is used as the actuator. The relevant position is approached via terminals 53 and 55 of the BCU. The air pressure switch and the position of the IC are checked by terminals 48, 51 and 52 of the BCU. The BCU signals a fault if the desired state is not reached within the time set in parameter 42.



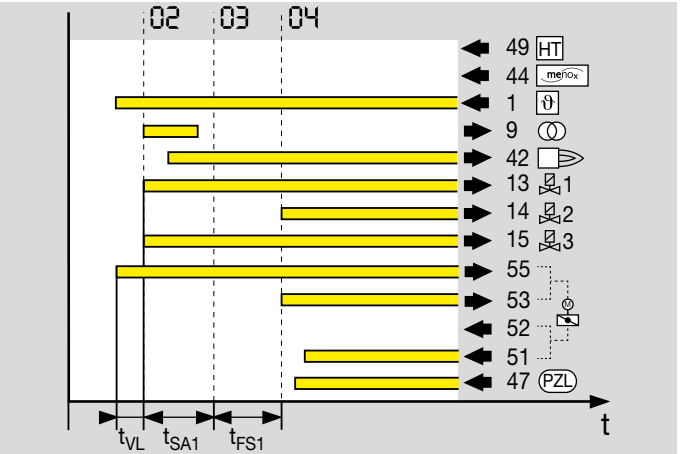
BCU		IC 40 (operating mode 6)	
Signal at terminal		Position	Butterfly valve position
55	53		
OFF	OFF	closed	Closed
ON	OFF	low	Closed
OFF	ON	middle	menox
ON	ON	high	Flame

Wiring of BCU/IC 40, see page 88 (11.6.5 Capacity control), IC 40.

Parameter 78 = 12: menox 1/0 and burner L/H/O. Low/High/Off burner operation in Flame mode and On/Off control in menox® mode.

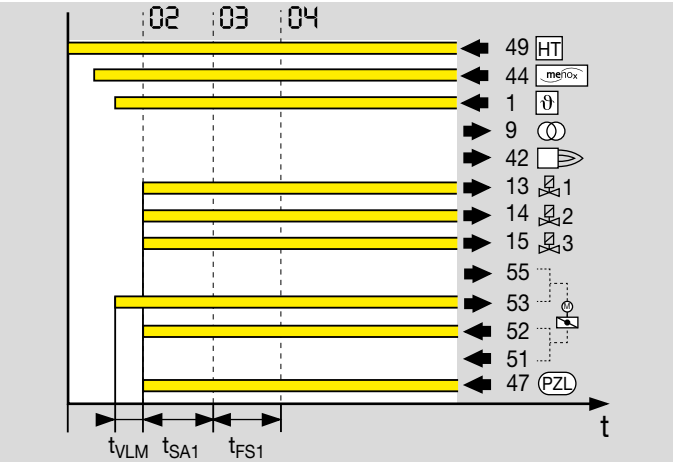


In Flame mode (< 850°C), the burner is started conventionally (as with P78 = 4) with the pre-ventilation time t_{VL} defined in parameter 36. The air control valve is set to the “low” position. Valves V1 and V3 then open. The burner is started with a limited ignition capacity using gas valve V3. After the flame proving period t_{FS1} has elapsed, valve V2 opens to enable the 2nd gas stage and the air control valve is moved to the “high” position.

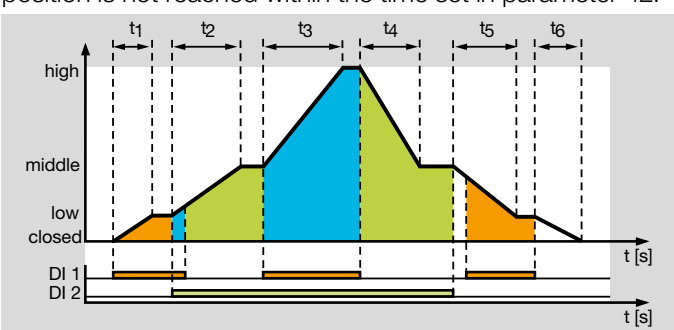


The switchover from flame to menox® mode is performed either immediately or the next time the burner is started depending on the setting made in parameter 64. To switch to menox® mode, the HT signal from the STM (terminal 49) and the menox® signal from a separate control unit (terminal 44) must be applied to the BCU.

In menox® mode (> 850°C), the burner is started with the pre-ventilation time t_{VLM} defined in parameter 28. The air control valve is set to the “middle” position. No ignition using the ignition transformer takes place during safety time t_{SA1}. Gas valves V1, V2 and V3 are opened at the start of the safety time t_{SA1}.



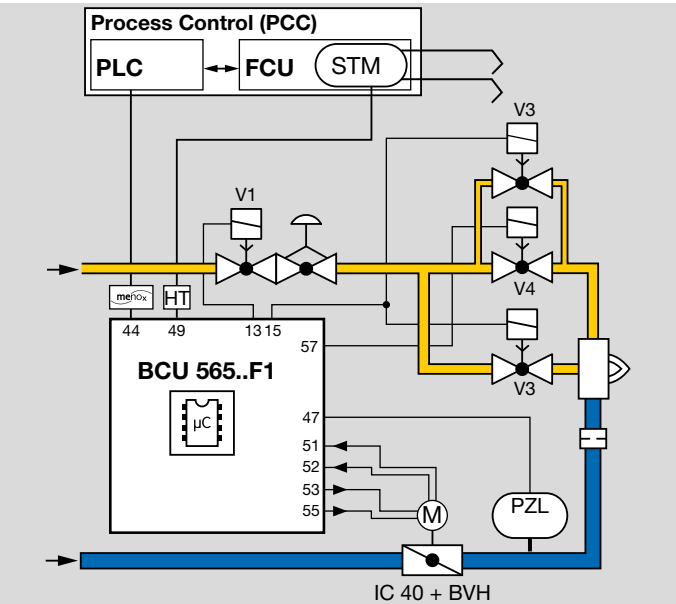
An IC 40 with operating mode 6 is used as the actuator. The relevant position is approached via terminals 53 and 55 of the BCU. The positions are checked by terminals 51 and 52 of the BCU. The BCU signals a fault if the relevant position is not reached within the time set in parameter 42.



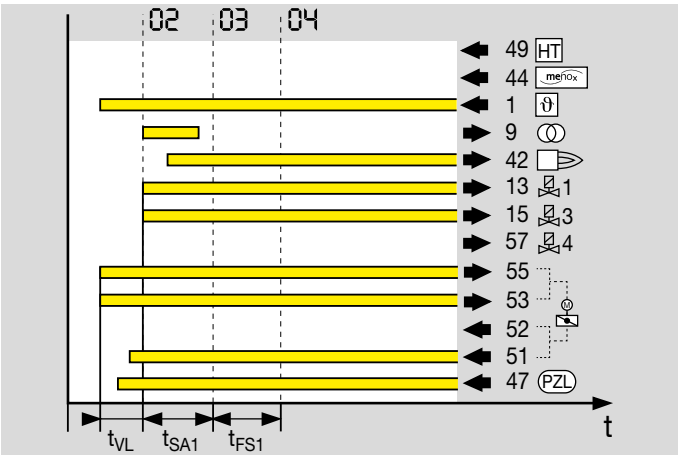
BCU		IC 40 (operating mode 6)	
Signal at terminal		Position	Butterfly valve position
55	53		
OFF	OFF	closed	Closed
ON	OFF	low	Closed
OFF	ON	middle	menox
ON	ON	high	Flame

Wiring of BCU/IC 40, see page 88 (11.6.5 Capacity control), IC 40.

Parameter 78 = 13: menox 1/0 with 2 gas paths. On/Off burner operation with different gas paths in Flame and in menox® mode.

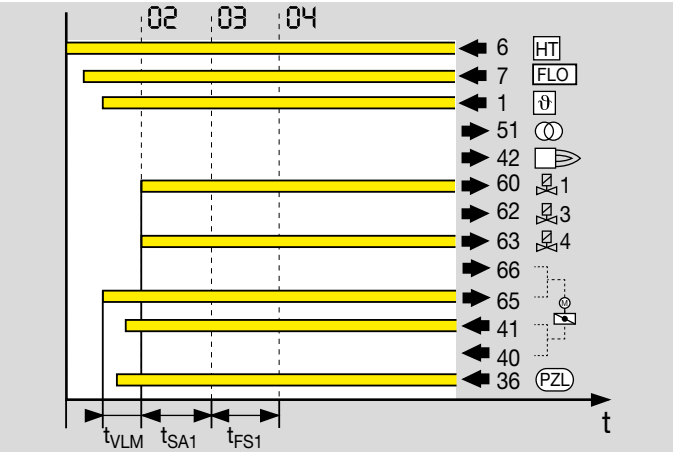


In Flame mode (< 850°C), the burner is started conventionally with the pre-ventilation time t_{VL} defined in parameter 36. The air control valve is set to the “high” position for this purpose.

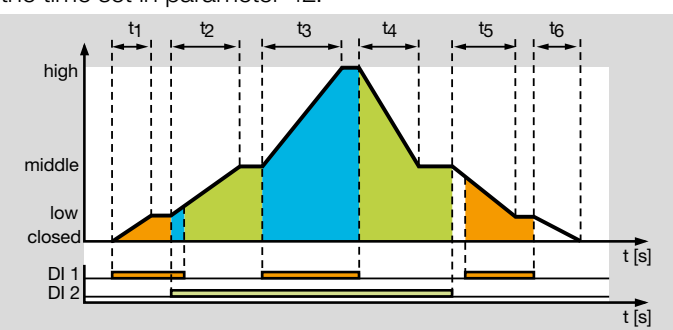


The switchover from flame to menox® mode is performed either immediately or the next time the burner is started depending on the setting made in parameter 64. To switch to menox® mode, the HT signal from the STM (terminal 49) and the menox® signal from a separate control unit (terminal 44) must be applied to the BCU.

In menox® mode (> 850°C), the burner is started with the pre-ventilation time t_{VLM} defined in parameter 28. The air control valve is set to the “middle” position. No ignition using the transformer takes place during safety time t_{SA1}. The gas valves V1 and V4 are opened at the start of the safety time t_{SA1}.



An IC 40 with operating mode 6 is used as the actuator. The relevant position is approached via terminals 53 and 55 of the BCU. The air pressure switch and the position of the IC are checked by terminals 48, 51 and 52 of the BCU. The BCU signals a fault if the desired state is not reached within the time set in parameter 42.



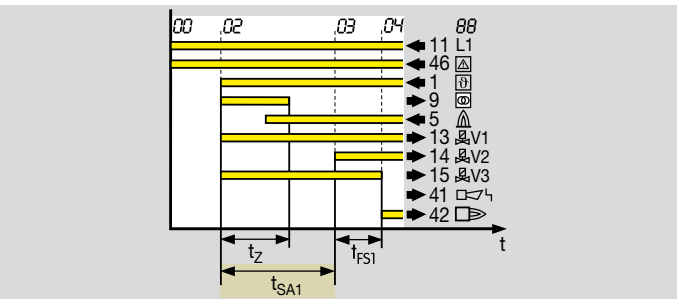
BCU		IC 40 (operating mode 6)	
Signal at terminal		Position	Butterfly valve position
55	53		
OFF	OFF	closed	Closed
ON	OFF	low	Closed
OFF	ON	middle	menox
ON	ON	high	Flame

Wiring of BCU/IC 40, see page 88 (11.6.5 Capacity control), IC 40.

11.3.3 Safety time 1 t_{SA1}

Parameter 94

During safety time 1 t_{SA1}, the flame (pilot flame) is ignited. It can be set to 2, 3, 5 or 10 s.



Safety time 1 starts with the application of the ϑ signal (terminal 1). The valves open at the start of safety time 1. The fuel supply to burner 1 is released so that a flame can form. If no flame is detected at the end of safety time 1, the valves are closed again. Depending on parameter 07 (Burner 1 start-up attempts), the BCU reacts either with an immediate safety shut-down with fault lock-out (P07 = 1) or with one or two additional start-up attempts (P07 = 2 or 3). The BCU will complete a maximum of three start-up attempts.

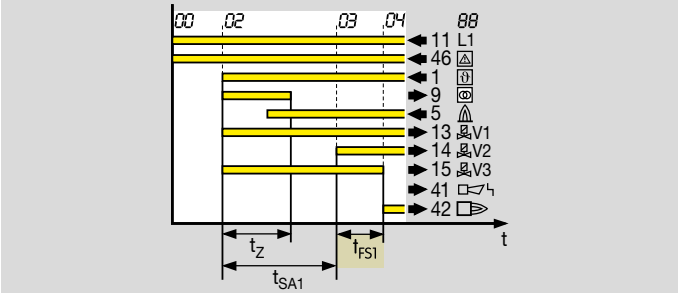
Safety time 1 must be determined on the basis of current national standards and regulations. The burner application and the burner capacity are the main criteria for this.

If the ϑ signal (terminal 1) drops out during safety time 1, the valves will not be switched off until the end of safety time 1.

11.3.4 Flame proving period 1 t_{FS1}

Parameter 95

Flame proving period 1 (t_{FS1}) can be parameterized to enable the flame on burner 1 to stabilize after the elapse of safety time 1. Only when the flame proving period has elapsed will the next program steps be initiated by the BCU. The flame proving period can be set to between 0 and 20 s.



11.4 Behaviour during operation

11.4.1 Restart

Parameter 09

Restart can be programmed for burners which occasionally display unstable behaviour during operation.

This parameter determines whether the BCU initiates an immediate fault lock-out or an automatic restart after a safety shut-down during operation. Excessive restarts, however, can be detected.

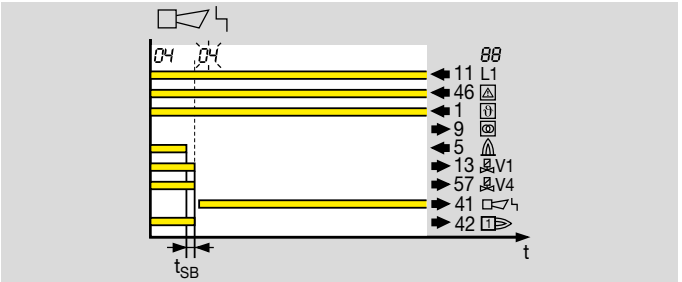
Taking into account national standards and requirements, it must be clarified whether the restart function may be used.

In accordance with EN 746-2, a start-up attempt may be conducted only if the safety of the installation is not impaired.

Multiple start-up attempts are not permitted under NFPA 86. If no flame forms during start-up, this must result in a fault lock-out..

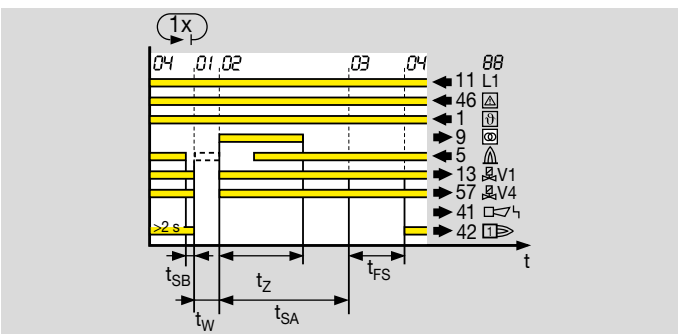
The precondition for an automatic restart is that the burner can restart (as intended in all operating phases). In this case, it must be ensured that the program sequence started by the BCU matches the application.

Parameter 09 = 0: Off.



A safety shut-down with subsequent fault lock-out takes place in the event of flame failure during operation.

Parameter 09 = 1: burner 1. The restart function is active.



If a safety shut-down occurs during operation (minimum operating time of 2 s), the valves are closed and the operation signalling contact is opened within the safety time during operation t_{SB}. The burner control unit then attempts to restart the burner once. If the burner does not function, a safety shut-down with fault lock-out occurs. The display blinks and shows the fault message.

Parameter 09 = 4: max. 5 × in 15 min. for burner 1. The restart function is active and is also monitored for excessive restarts.

In certain conditions, it is possible that the restart function is repeated continuously without a safety shut-down with subsequent fault lock-out being performed. The BCU has a safety shut-down with subsequent fault lock-out option if more than 5 restarts are performed within a period of 15 minutes.

Taking into account national standards and requirements, it must be clarified whether the option may be used.

11.4.2 Minimum operating time t_B

Parameter 61

A minimum operating time (0 to 250 s) may be defined to ensure that the heating equipment operates stably.

If the minimum operating time is active, burner operation will be maintained until the set time has elapsed even if the start-up signal fails.

The minimum operating time starts as soon as the program step for operation/controller enable (display 04) has been reached.

If the start-up signal drops out before the start of operation/controller enable, e.g. during pre-purge, the burner control unit reverts directly to the start-up position (standby) and the burner is not ignited.

The minimum operating time can be cancelled by switching off the BCU or if a safety shut-down occurs.

11.5 Safety limits

Parameters 15, 16 and 19 can be used to adjust the safety limits (low air pressure protection and safety time during operation) to the system requirements.

11.5.1 Low air pressure protection

Parameter 15

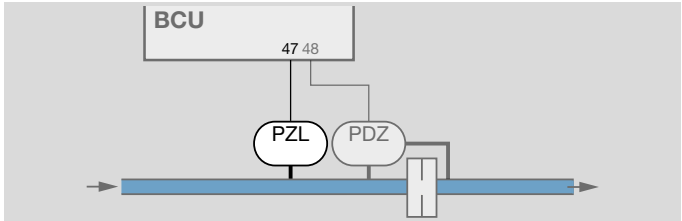
The minimum air pressure is ensured by the $air_{min.}$ air pressure switch connected to terminal 47 while the combustion air fan is running. Activation of the low air pressure protection device and the shut-down properties can be set using parameter 15. If the air pressure falls below the value set on the $air_{min.}$ air pressure switch, the signal to terminal 47 is interrupted and the BCU initiates a reaction depending on parameter 15.

BCU 565 only: when the combustion air supply (air actuator) is switched off, the “no flow” state (default position) of the air pressure switch (PZL) is checked.

Parameter 15 = 0: Off; the low air pressure protection function is deactivated.

Parameter 15 = 1: with safety shut-down. If there is no signal at the $air_{min.}$ input (terminal 47), a safety shut-down will be performed.

Parameter 15 = 2: with fault lock-out. If there is no signal at the $air_{min.}$ input (terminal 47), a fault lock-out will be performed.



If air flow monitoring during pre-purge is active (P35 = 1 or 2), the “no flow” state of the air flow monitoring pressure switch (PDZ) is also checked.

For further information on the low air pressure protection function ($air_{min.}$, terminal 47, and air flow, terminal 48) during pre-purge, see page 86 (11.6.2 Air flow monitoring during pre-purge).

11.5.2 Delayed low air pressure protection

Parameter 16

This parameter defines whether the gas enable is sent with or without an air pressure switch signal at terminal 47. The parameter can be adjusted if low air pressure protection is active (parameter 15 = 1 or 2).

Parameter 16 = 0: Off. Air pressure monitoring takes place immediately. The gas is only released when the signal is received from the air pressure switch. Parameter 48 (Air actuator control) must be set to 1 for this function (air with 1st gas stage).

Parameter 16 = 1: On. The air pressure is monitored after a delay of up to the maximum running time set in parameter 42 or until the position for maximum capacity is confirmed by the actuator.

11.5.3 Safety time during operation

Parameter 19

Parameter 19 = 1; 2: time in seconds.

The safety time during operation is the time that the BCU needs to stop the fuel supply after a flame failure during operation or an interruption at the safety current inputs (terminals 45 to 51 and 65 to 68). The safety time can be set to 1 or 2 s. Prolonging the safety time during operation increases the installation availability in the case of brief-duration signal fades (e.g. fades of the flame signal).

In accordance with EN 298, the maximum flame failure response time must not exceed 1 s. Specific application standards may permit other values.

Under EN 746-2, the safety time of the installation during operation (total closing time) must not exceed 3 s.

Under NFPA 86, section 8.10.3*, the maximum flame failure response time shall be ≤ 4 s.

The requirements of national standards and regulations must be satisfied.

11.6 Air control

11.6.1 Pre-purge time t_{PV}

Parameter 34

A burner start may only occur if it has been ensured that the concentration of inflammable components in all sections of the combustion chamber and the connected areas as well as the flue gas ducts is less than 25% of the lower flammability limit of the fuel gas. In general, a pre-purge is performed by the protective system (FCU) to ensure compliance with these requirements.

Parameter 34 determines the time for which pre-purge is to occur after a safety shut-down (0 to 6000 s).

With this function, the combustion chamber of the burner can be purged after a safety shut-down in compliance with standards (on the basis of EN 676, EN 746-2, NFPA 85 or NFPA 86, for example), especially on tube firing burners. This task is not implemented by the central protective system but by the BCU 565.

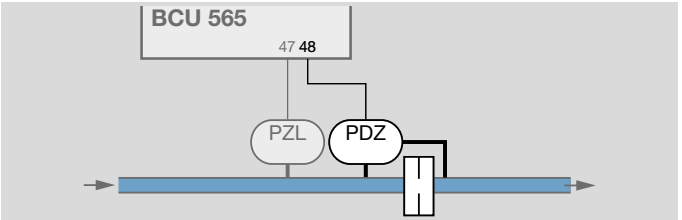
If air monitoring has been activated in parameter 15 or 35, the pre-purge time t_{PV} starts as soon as the air monitor detects an adequate flow for purging, see page 84 (11.5.1 Low air pressure protection).

11.6.2 Air flow monitoring during pre-purge

Parameter 35

Function of the air flow monitoring input (terminal 48)

The air flow is monitored during pre-purge by the differential pressure switch connected to terminal 48. If the air volume and therefore the differential pressure on the air pressure switch falls below the set value, the BCU will perform a safety shut-down or fault lock-out.



When the air actuator is switched off, the “no flow” state (default position) of the differential pressure switch is also checked if air flow monitoring has been activated. Activation of air flow monitoring and the shut-down properties can be set using parameter 35.

Parameter 35 = 0: Off; the air flow monitoring function is deactivated.

Parameter 35 = 1: with safety shut-down. If there is no signal at the input (terminal 48), a safety shut-down will be performed.

Parameter 35 = 2: with fault lock-out. If there is no signal at the input (terminal 48), a safety shut-down with subsequent fault lock-out will be performed.

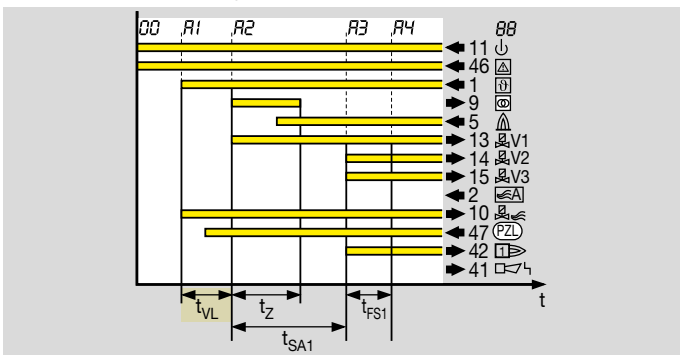
Air flow monitoring is to be set on the basis of the relevant application standard (e.g. EN 676, EN 746-2, NFPA 85 or NFPA 86).

11.6.3 Pre-ventilation time t_{VL}

Parameter 36

This parameter is used to define the length of time during which the air valve is open before the normal start-up. This time may be used for pre-purge. Suitable for burners starting with full air capacity.

The possible settings are from 0 to 10 s in 0.1 s steps, from 10 to 250 s in 1 s steps.



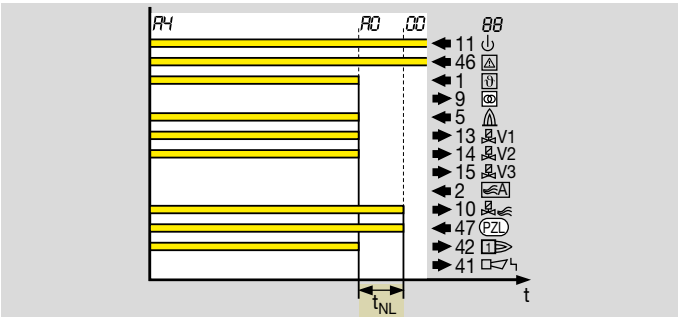
After the start-up signal (ϑ) has been applied and after the flame simulation check and “no flow” state check have been conducted successfully, the air valve is opened. Start-up of the burner commences with no interruption of the air supply after expiry of the programmable pre-ventilation time t_{VL}.

Parameter setting for this example sequence:

P23 = 0; P48 = 1; P36 > 0, see page 84 (11.5.2 Delayed low air pressure protection). The gas valve does not open until the pressure switch has switched.

11.6.4 Post-ventilation time t_{NL}

Parameter 39



The air valve remains open for the programmed time (0 to 3 s) after the start-up signal (ϑ) has been deactivated following a controlled shut-down. The burner control unit closes the air actuator (valve, actuator) after expiry of the post-ventilation time t_{NL}.

11.6.5 Capacity control

Parameter 40

The BCU is fitted with an interface for connecting air actuators.

The BCU..F1/F2 activates a control element via the outputs for capacity control (terminals 53 to 56) for purging, cooling or starting the burner. This control element moves to the required position for the relevant operating situation.

The BCU..F3 activates an air valve for purging, cooling or starting the burner via the output at terminal 10. The required air capacity is released by the air valve.

Using parameter 40, you can set which actuator is used for capacity control (IC 20, IC 40, FS-BLAC actuators or air valve).

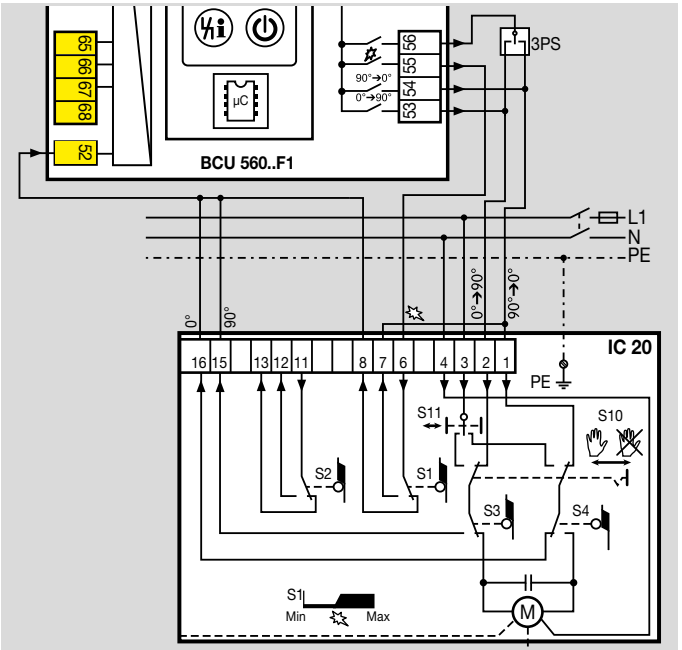
Parameter 40 = 0: Off; no capacity control (no air actuator).

Parameter 40 = 1: with IC 20.

The interface is configured to the requirements of actuators IC 20, IC 20..E, IC 50 or IC 50..E.

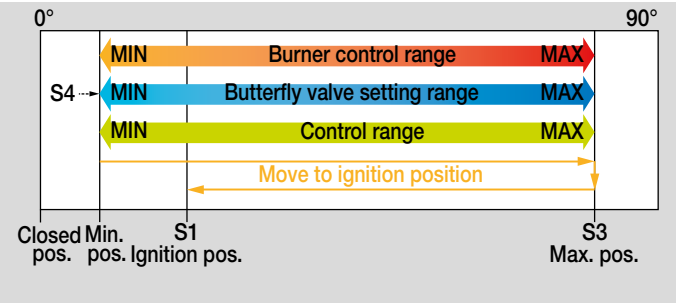
Alternatively, comparable three-point step actuators may be used.

IC 20



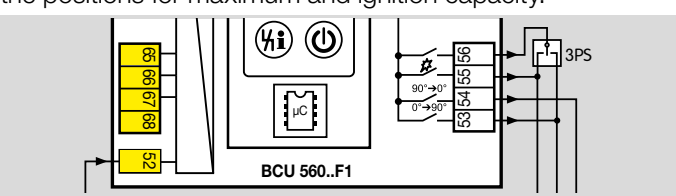
The positions for maximum capacity, ignition capacity and minimum capacity can be set using the actuator. It is checked whether the relevant position has been reached using terminal 52. If the position is not reached within the timeout time of 255 s, the BCU will display fault message *F*c, *F*o or *F*i (maximum, ignition or minimum capacity not reached), see page 61 (10 Fault messages).

In the event of a fault, the actuator is moved to the position set via cam S4 for minimum capacity via the output at terminal 54.

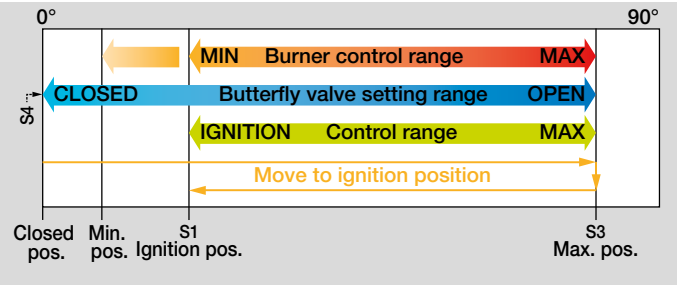


The control system is enabled for operation via the controller enable output (terminal 56). During the controller enable procedure, the actuator can be adjusted infinitely between the positions for maximum and minimum capacity by an external three-point step controller or using bus signals. There is no timeout active in this case.

If bus control is active (parameter 75), the controller enable output (terminal 56) has a different function. The wiring between the BCU and the 3-point step controller can be adjusted so that the control range of the actuator is between the positions for maximum and ignition capacity.



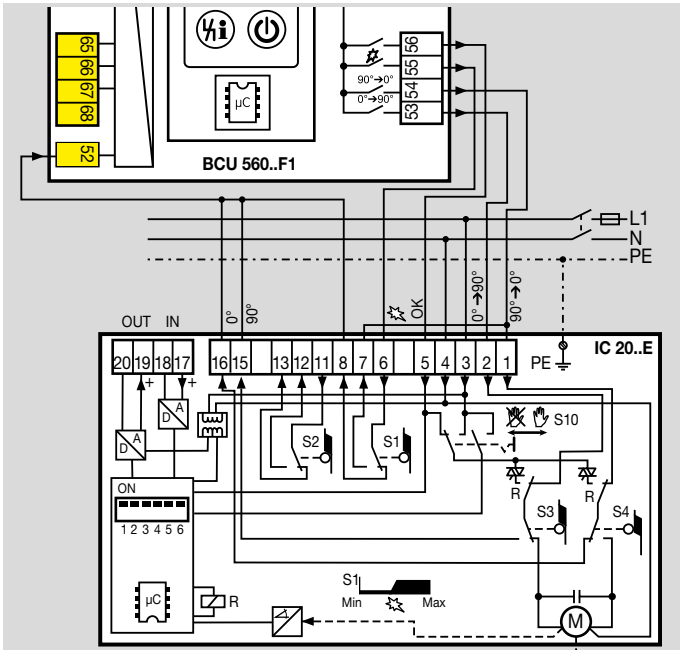
The minimum position which can be reached is the closed position.



Manual mode

In Manual mode, the actuator can be moved between the positions for maximum and minimum capacity in 3-point step operation. No timeout is active when approaching these positions. The controller enable output (terminal 56) is not active and not checked.

IC 20..E



The positions for minimum capacity, maximum capacity and ignition capacity can be set using the actuator. When the appropriate position has been reached, this information is signalled back via terminal 52. If no signal is received that the position has been reached within the timeout time of 255 s, a safety shut-down of the BCU will be performed and a fault message (Rc, Ro or Ri) will be displayed, see page 61 (10 Fault messages). In addition, the actuator will be moved to the set position for minimum capacity using the output at terminal 54.

The control system is enabled during operation via the controller enable output (terminal 56). During the controller enable procedure, the actuator can be adjusted infinitely between the positions for maximum and minimum capacity by a controller (0 (4)–20 mA, 0–10 V) using the setpoint device on terminals 17 and 18 or the bus signal. There is no timeout active in this case.

If bus control is active (parameter 75), the controller enable output (terminal 56) has a different function.

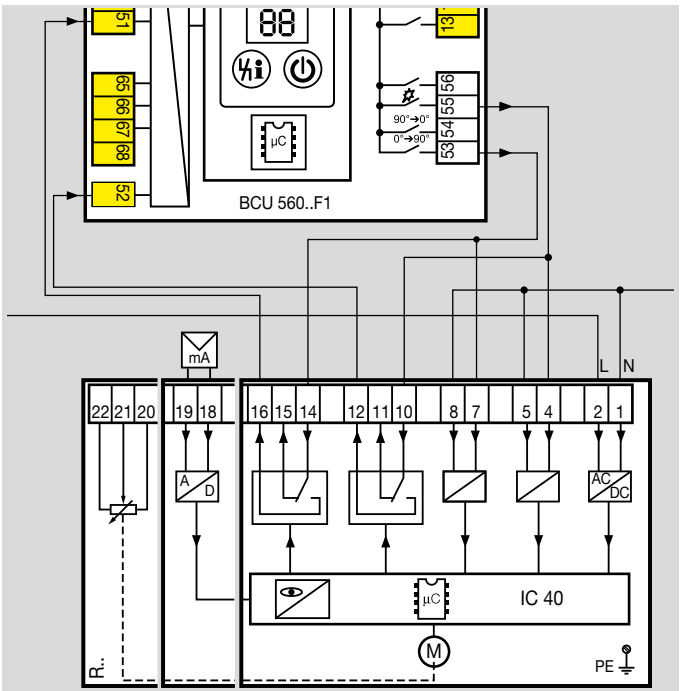
Manual mode

In Manual mode, the actuator can be moved between the positions for maximum and minimum capacity in 3-point step operation. No timeout is active when approaching these positions. The controller enable output (terminal 56) is not active and not checked.

IC 40

Parameter 40 = 2: with IC 40.

To ensure that the actuator IC 40 can be operated on the BCU..F1, P40 = 2 (capacity control) must be set. The operating mode of actuator IC 40 may be parameterized to 11 or 27.



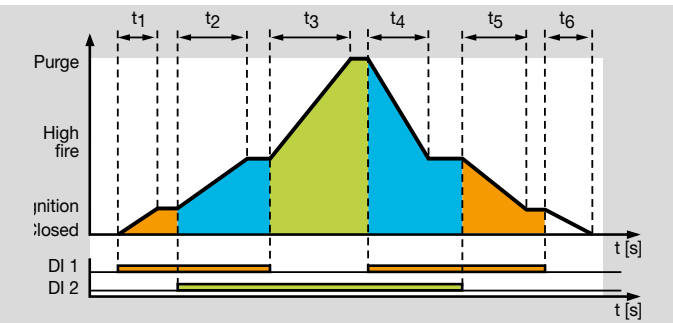
The positions for maximum capacity and ignition capacity can be set using the actuator. Terminal 51 checks whether the position for maximum capacity has been reached. Terminal 52 checks the position for ignition capacity. If the position is not reached within the timeout time of 255 s, a safety shut-down of the BCU will be performed. A fault message(Ac, Ao or Ai) will be displayed, see page 61 (10 Fault messages).

If a controller enable is active, the control system is enabled for operation via the outputs at terminals 53 and 55.

Operating mode 11

Operating mode 11 allows cyclic operation (ON/OFF and OFF/Low/High/OFF).

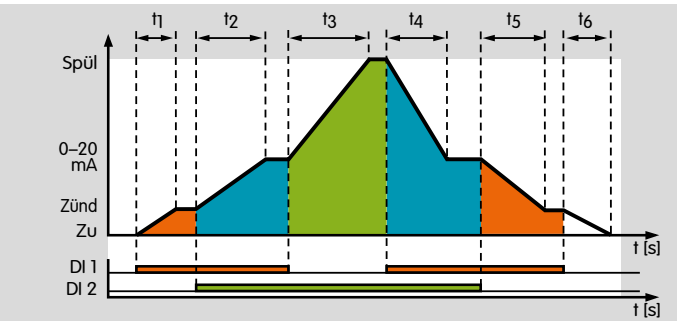
The actuator IC moves to the “High fire” position during the controller enable procedure. There is no timeout active in this case.



BCU		IC 40 (operating mode 11)	
Signal at terminal		Position	Butterfly valve position
55	53		
OFF	OFF	Closed	Closed
ON	OFF	Ignition	Minimum/Ignition capacity
ON	ON	High-fire rate	High-fire rate
OFF	ON	Purge	Maximum capacity

Operating mode 27

During the controller enable procedure, the actuator IC 40 can be adjusted infinitely between the positions for maximum and minimum capacity using its analogue input (terminals 18 and 19). There is no timeout active in this case.



BCU		IC 40 (operating mode 27)	
Signal at terminal		Position	Butterfly valve position
55	53		
OFF	OFF	Closed	Closed
ON	OFF	Ignition	Minimum/Ignition capacity
ON	ON	0–20 mA	Any position between minimum and maximum capacity
OFF	ON	Purge	Maximum capacity

Fault

In the event of a fault, there will be no signal at terminals 53 and 55 so that the actuator moves to the closed position. When approaching the closed position, no timeout of 255 s is active since no feedback input is checked. This may result in a situation where the program is continued in the case of a request for the closed position, without the butterfly valve being closed. The outputs at terminals 56

(controller enable) and 54 (closed position) on the BCU are non-functional and are not activated.

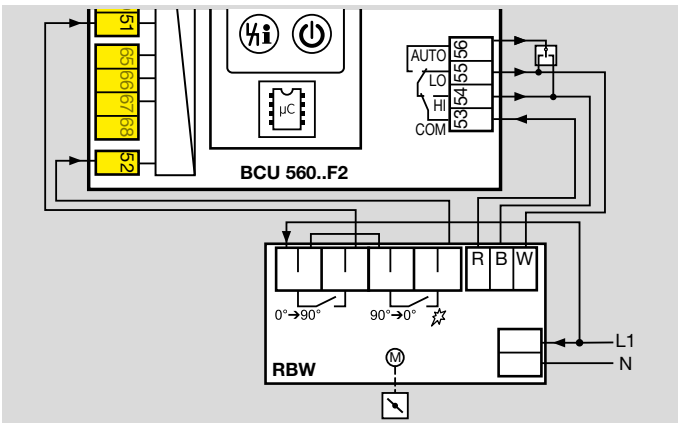
Manual mode

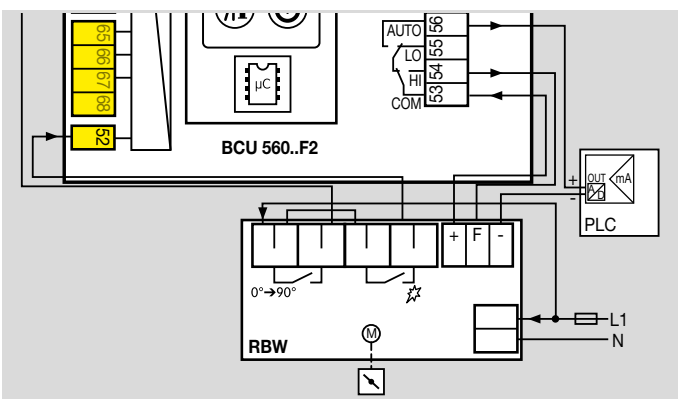
In Manual mode, no external controller is enabled. The actuator can be moved to the positions for maximum capacity or ignition capacity by the user. 3-point step operation is not possible. No timeout is active when approaching these positions.

FS-BLAC

Parameter 40 = 3: with FS-BLAC.

The actuator can be moved to the positions for maximum capacity (contact COM to HI) and minimum capacity (contact COM to LO) using the interface and by closing the various contacts.





The FS-BLAC actuator reports that it has reached the position for maximum capacity via a signal to terminal 51. The actuator reports that it has reached the position for minimum capacity via a signal to terminal 52. The simultaneous activation of terminals 51 and 52 results in a fault lock-out of the BCU.

If parameter 41 = 0, the system monitors the movement to the positions for maximum and minimum capacity with a timeout time of 255 s. Reaching the relevant position immediately triggers the program continue switch conditions. If reaching the position is not signalled within the timeout time of 255 s, a safety shut-down of the BCU will be performed. A fault message (Ac or Ao) will be displayed, see page 61 (10 Fault messages).

If parameter 41 = 1, the system does not monitor whether the positions for minimum and maximum capacity are reached. In this case, a running time of up to 250 s must be defined using parameter 42, see page 96 (11.6.7 Running time). The program continue switch conditions are then controlled dependent on this time.

If a fault occurs, the actuator is moved to the position for minimum capacity.

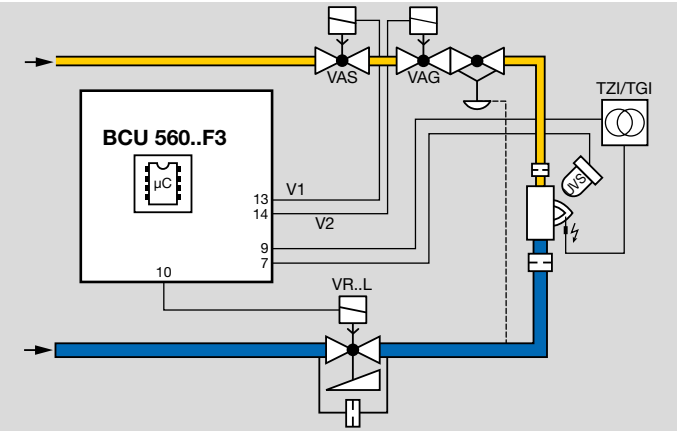
Manual mode

In Manual mode, no external controller is enabled during the controller enable procedure. The actuator can be moved to the positions for maximum capacity or ignition capacity by the user. 3-point step operation is not possible. No timeout is active when approaching these positions.

Parameter 40 = 5: with air valve.

The positions for maximum capacity and ignition capacity can be set using the air valve. If the air valve is closed, the

ignition capacity is reached; if it is open, the maximum capacity is reached.



Parameter 42 (Running time) can be used to adjust the behaviour in the case of slow opening and closing air valves so that the system can be set to ignition position before a start-up is initiated, see page 96 (11.6.7 Running time). Parameter 41 (Running time selection) must be set to 1 to adjust this behaviour.

11.6.6 Running time selection

Parameter 41

Parameter 41 = 0: Off; checking the positions for minimum/maximum capacity. A signal that the positions for minimum and maximum capacity have been reached is returned and monitored with a timeout time of max. 255 s. When the position has been reached, the BCU will initiate the next program step.

Parameter 41 = 1: On; for approaching the positions for minimum/maximum capacity. The running time set using parameter 42 is activated for approaching these positions, see page 96 (11.6.7 Running time). After this time has elapsed, the BCU will initiate the next program step.

Parameter 41 = 2: On; for approaching the position for maximum capacity. The running time set in parameter 42 is activated for approaching the position for maximum capacity. After this time has elapsed, the BCU will initiate the next program step. Approaching the position for minimum capacity is signalled and monitored.

Parameter 41 = 3: On; for approaching the position for minimum capacity. No signal is returned that the position for minimum capacity has been reached. The running time set in parameter 42 is activated for approaching the position for minimum capacity. After this time has elapsed, the BCU will initiate the next program step. Approaching the position for maximum capacity is signalled and monitored.

11.6.7 Running time

Parameter 42

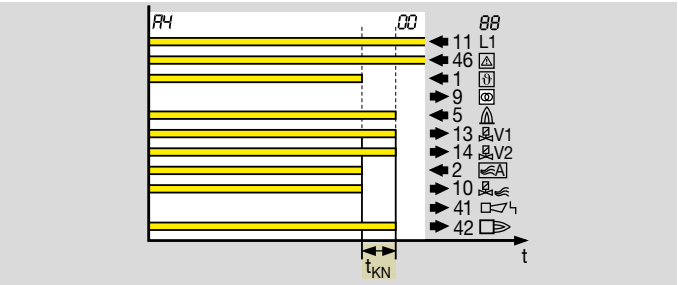
This parameter can be used to adjust the behaviour in the case of slow opening and closing air valves. The running time starts when the air actuator is switched off. A restart of the burner after a controlled shut-down, a start-up attempt, restart, cooling or purging is delayed until the end of the running time. After the running time has elapsed, the burner is started if the start-up signal (ϑ) is applied.

The time should be adjusted such that the system can be set to ignition position, i.e. that the air actuator is closed before a start-up is initiated.

11.6.8 Low fire over-run

Parameter 43

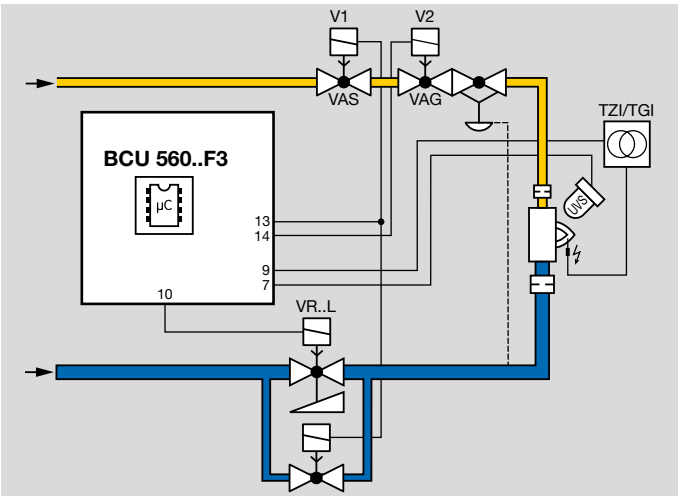
The low fire over-run (t_{KN}) is applicable to systems with a pneumatic air/gas ratio control system and On/Off control. Using the low fire over-run function reduces the O_2 content in the furnace atmosphere.



Parameter 43 = 0: Off. No low fire over-run is performed. The gas circuit is closed immediately owing to a quick closing gas valve in the case of On/Off control. The air circuit is closed more slowly. The air flowing in during this time increases the O_2 content in the combustion chamber.

Parameter 43 = 1 (only for BCU..F1/F2): up to minimum capacity. The burner is not immediately switched off after the start-up signal ϑ (terminal 1) has been removed. During low fire over-run, the control element is moved to the position for minimum capacity and the gas valves remain open until the flame fails or the position for minimum capacity is reached. If the flame is extinguished, this does not result in a fault.

Parameter 43 = 2, 3, 4, 5, 10, 20, 30 or 40 (only for FCU..F3): time in seconds. During this time, the gas valve remains open. The air valve is closed with deactivated start-up signal (ϑ).



This means that the burner is initially adjusted down to low fire and then switched off completely. Flame control is still operational. It must be ensured that no excess gas occurs.

11.6.9 Controller enable signal delay time t_{RF}

Parameter 44 (only on BCU..F1/F2)

The controller enable signal is delayed by 0, 10, 20 or 30 up to 250 s using parameter 44.

If the BCU has successfully started the burner, after the elapse of the safety time and the flame proving period, if parameterized, the controller enable signal to the external temperature controller is delayed. The BCU shows program status *H4*. After the elapse of the delay time t_{RF}, the burner operation signalling contact (terminals 17, 18) is closed and the controller enable output (terminal 56) activated. The display changes to *04*.

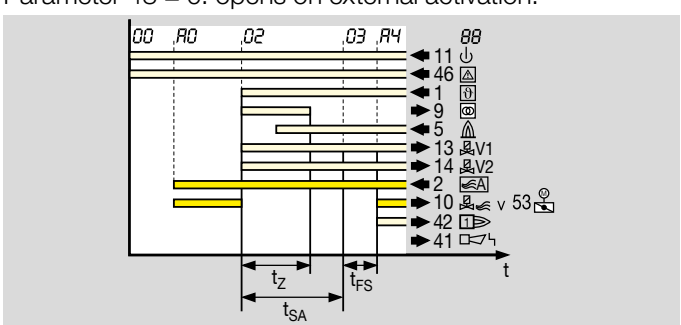
11.6.10 Air actuator control

Parameter 48

In cyclic operation, parameters 48 and 49 on BCU..F1, F2 and F3 determine the behaviour of the air actuator during burner start.

The air actuator can be activated externally via the input at terminal 2 for cooling the burner in the start-up position (standby). This function is not available during burner start-up and during operation.

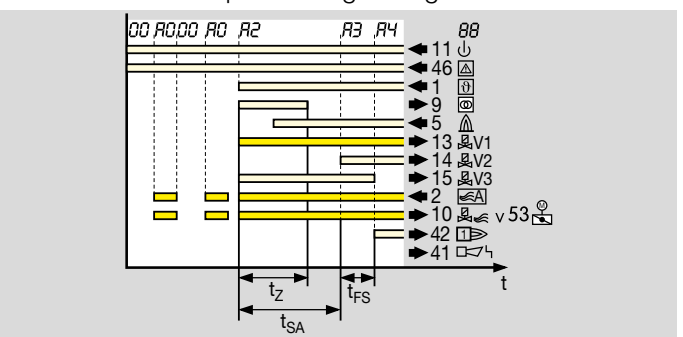
Parameter 48 = 0: opens on external activation.



This setting together with parameter 49 = 0, see page 100 (11.6.11 Air actuator on start-up can be activated externally), is required for burners on which the air/gas ratio is controlled by a pneumatic air/gas ratio control system and which need to be started at low-fire rate, e.g. on two-stage-controlled burners, see page 9 (1.1.2 Two-stage-controlled burner). In this case, activation of the air actuator during burner start via the input at terminal 2 must be prevented.

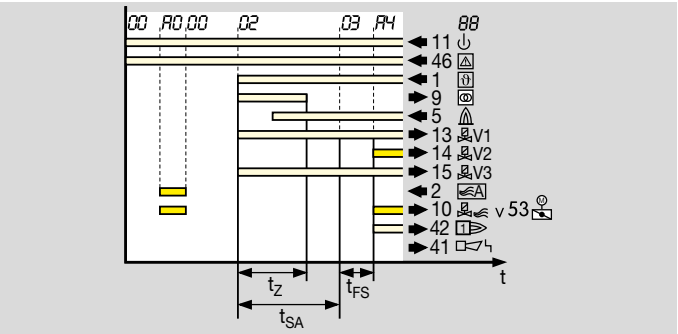
External control allows switchover between low fire and high fire during operation.

Parameter 48 = 1: opens with gas stage 1.



The air valve opens at the same time as the first gas stage (with V1).

Parameter 48 = 2: opens with operating signal.



The air valve opens simultaneously with the second gas stage/operating signal.

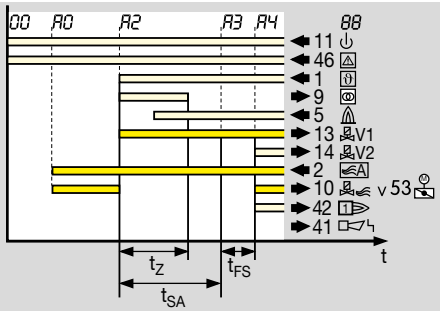
Parameter 48 = 3: controller enable after operating signal or in standby. This parameter is used to activate modulating capacity control on BCU..F1 and F2. The controller enable signal is issued via the output at terminal 56 in the start-up position (standby) and during operation.

Cooling is then only possible in the start-up position/standby. The air actuator can be opened via the input at terminal 2 for this purpose.

11.6.11 Air actuator on start-up can be activated externally

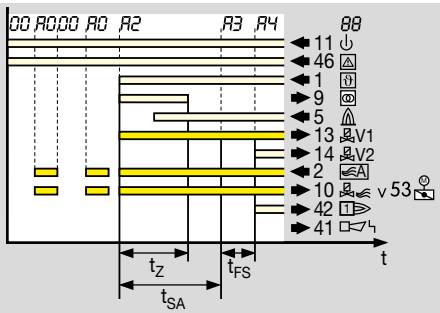
Parameter 49

Parameter 49 = 0: cannot be activated.



During start-up, the air actuator remains closed. The air actuator cannot be activated externally.

Parameter 49 = 1: can be activated externally.



The air actuator can be activated externally via the input at terminal 2 during start-up. Parameter 48 must be set to 0 for this purpose, see page 98 (11.6.10 Air actuator control).

11.6.12 Air actuator in the event of fault

Parameter 50

This parameter decides whether the air actuator can be activated externally via the input at terminal 2 in the event of a fault lock-out.

Parameter 50 = 0: cannot be activated. The air actuator remains closed in the event of a fault lock-out. It cannot be activated externally via terminal 2.

Parameter 50 = 1: can be activated externally. The air actuator can be activated externally via the input at terminal 2 during a fault, e.g. for cooling.

11.6.13 Capacity control (bus)

Parameter 75

Controlling the burner capacity using the fieldbus is only possible with bus module BCM 500 connected and enabled (P80 = 1 or 2).

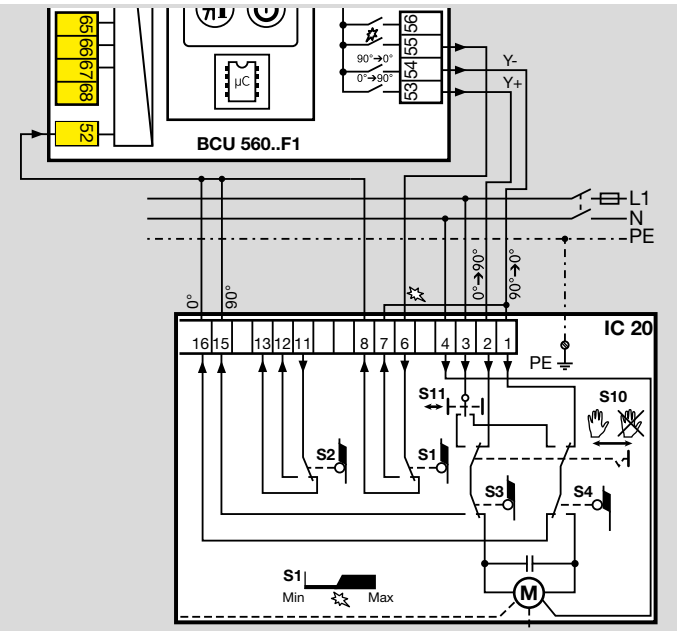
Output terminal 56 is no longer available for controller enable if bus control is active.

Parameter 75 = 0: Off. No capacity control possible using the fieldbus.

Parameter 75 = 1: MIN. to MAX. capacity; standby in position for MIN. capacity. The control range while the burner is operating is between the positions for minimum capacity (S4) and maximum capacity (S3). The burner is ignited in the position for ignition capacity (S1). When the burner is switched off, the actuator is moved to the position for minimum capacity (S4).

This operating mode can be achieved with an FS-BLAC actuator or with a comparable three-point step actuator.

If the air supply is stopped on a heated furnace with the burner switched off, the controls may be damaged by the hot furnace atmosphere as a result of the lowest possible position of the butterfly valve, limited by S4.



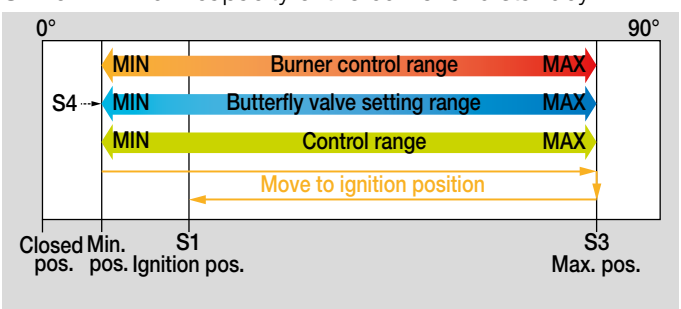
IC 20

Switching cam setting for ignition capacity, minimum and maximum capacity as well as pre-purge and standby:

S1: for ignition capacity of the burner.

S3: for maximum capacity of the burner and pre-purge.

S4: for minimum capacity of the burner and standby.



Parameter 75 = 2: MIN. to MAX. capacity; standby in CLOSED position. The control range while the burner is operating is between the positions for minimum capacity (S2) and maximum capacity (S3). The burner is ignited in the position for ignition capacity (S1). When the burner is switched off, the actuator is moved to the closed position (S4).

This operating mode can be achieved with an actuator IC 20 or alternatively with a comparable three-point step actuator.

If the air supply is stopped on a heated furnace with the burner switched off, the controls are protected from the hot furnace atmosphere as a result of the butterfly valve being in the closed position (limited by S4). Check whether the burner can cope without cooling in this situation.

IC 20

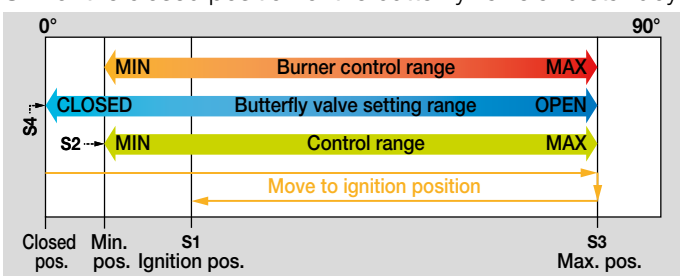
Switching cam setting for ignition capacity, minimum and maximum capacity as well as pre-purge and standby:

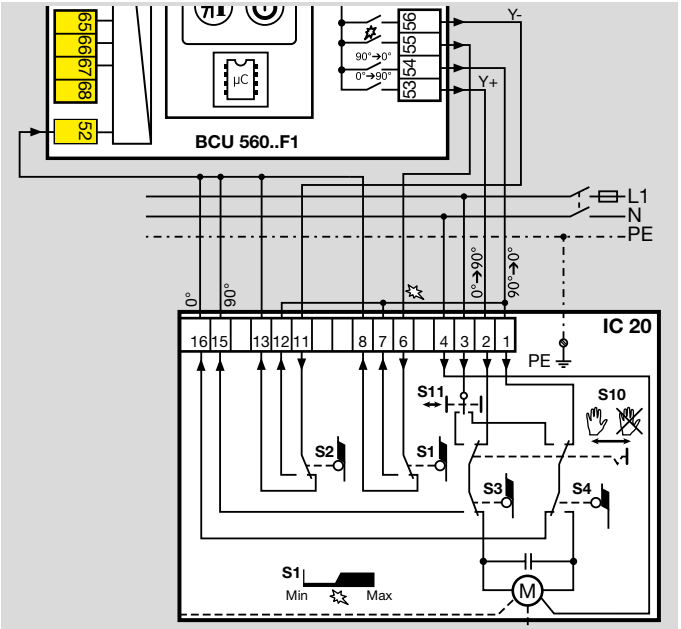
S1: for ignition capacity of the burner.

S2: for minimum capacity of the burner.

S3: for maximum capacity of the burner and pre-purge.

S4: for the closed position of the butterfly valve and standby.





Parameter 75 = 3: IGNITION to MAX. capacity; standby in CLOSED position. The control range while the burner is operating is between the positions for minimum capacity (S1) and maximum capacity (S3). The burner is ignited in the position for minimum capacity (S1). When the burner is switched off, the actuator is moved to the closed position (S4).

This operating mode can be achieved with an IC 20, FSBLAC actuator or alternatively with a comparable three-point step actuator.

If the air supply is stopped on a heated furnace with the burner switched off, the controls are protected from the hot furnace atmosphere as a result of the butterfly valve being in the closed position (limited by S4). Check whether the burner can cope without cooling in this situation.

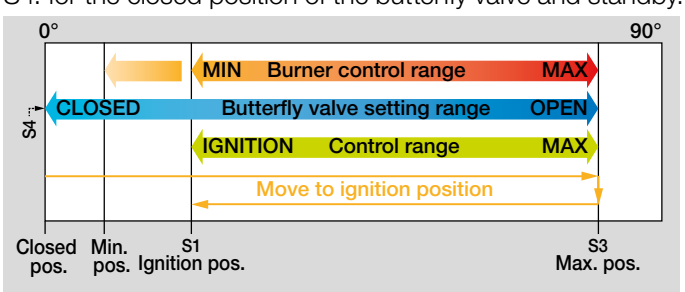
IC 20

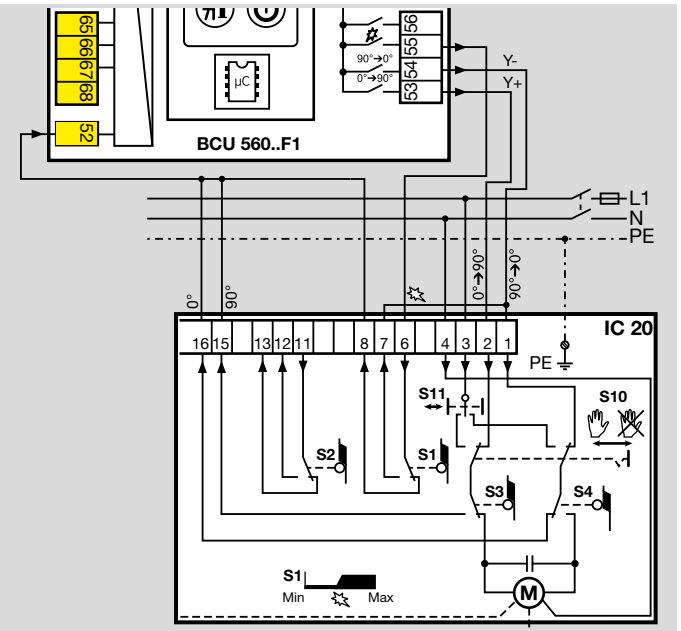
Switching cam setting for ignition capacity, minimum and maximum capacity as well as pre-purge and standby:

S1: for minimum capacity and ignition capacity of the burner.

S3: for maximum capacity of the burner and pre-purge.

S4: for the closed position of the butterfly valve and standby.

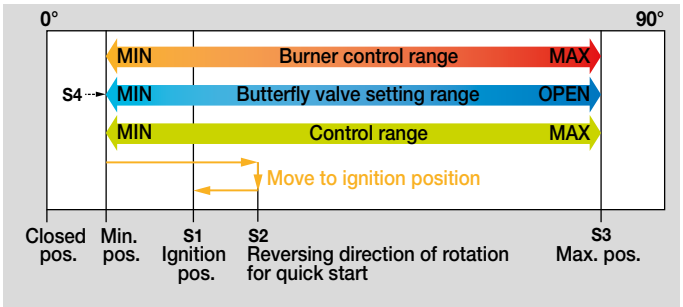


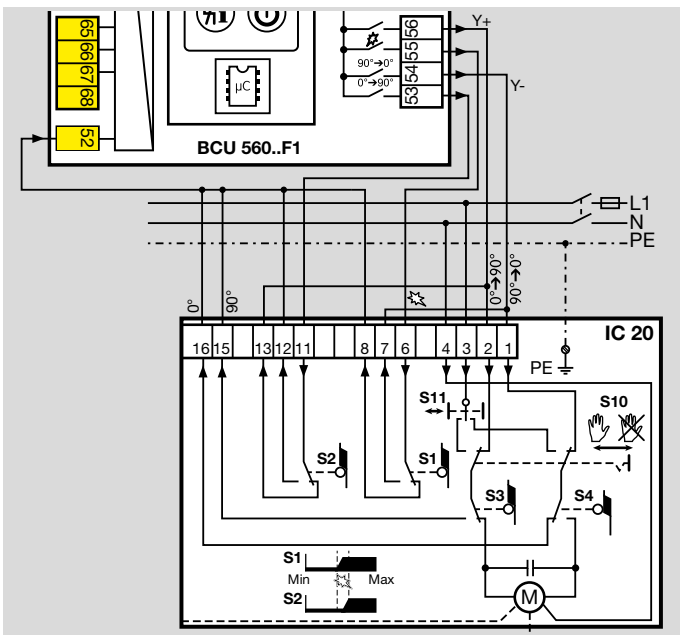


Parameter 75 = 4: MIN. to MAX. capacity; standby in position for MIN. capacity; burner quick start. The control range while the burner is operating is between the positions for minimum capacity (S4) and maximum capacity (S3). The burner is ignited in the position for minimum capacity (S1). Switching cam S2 (reverse direction of rotation) ensures that the position for ignition capacity is approached without pre-purging first (quick start). When the burner is switched off, the actuator is moved to the position for minimum capacity (S4).

This operating mode can be achieved with an actuator IC 20 or alternatively with a comparable three-point step actuator.

If the air supply is stopped on a heated furnace with the burner switched off, the controls may be damaged by the hot furnace atmosphere as a result of the lowest possible position of the butterfly valve, limited by S4. If pre-purge is active, considerably lower air capacity than the maximum air capacity will be used for purging.





IC 20

Switching cam setting for ignition capacity, minimum and maximum capacity and reverse direction of rotation to approach the position for ignition capacity:

S1: for ignition capacity of the burner.

S2: for reversing the direction of rotation to approach the position for ignition capacity.

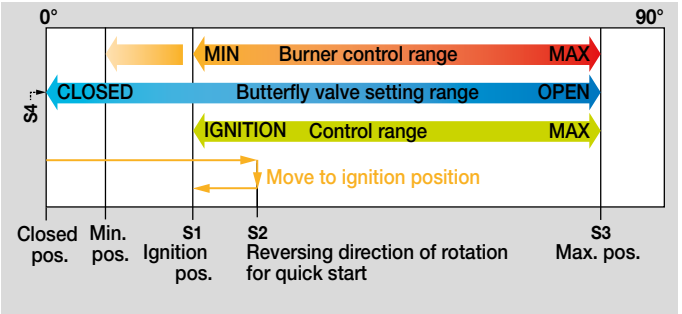
S3: for maximum capacity of the burner and pre-purge.

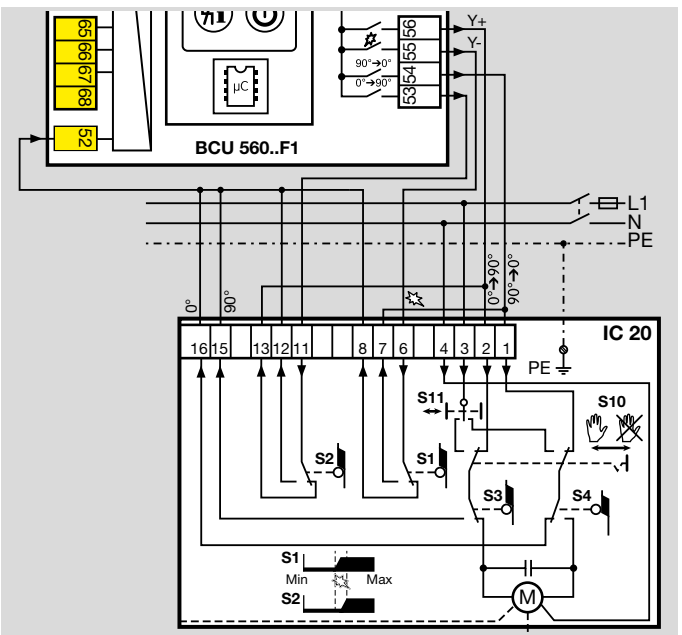
S4: for the closed position of the butterfly valve and standby.

Parameter 75 = 5: IGNITION to MAX. capacity; standby in CLOSED position; burner quick start. The control range while the burner is operating is between the positions for ignition capacity (S1) and maximum capacity (S3). The burner is ignited in the position for ignition capacity (S1). Switching cam S2 (reverse direction of rotation) ensures that the position for ignition capacity is approached without pre-purging first (quick start). When the burner is switched off, the actuator is moved to the closed position (S4).

This operating mode can be achieved with an actuator IC 20 or alternatively with a comparable three-point step actuator.

If the air supply is stopped on a heated furnace with the burner switched off, the controls are protected from the hot furnace atmosphere as a result of the butterfly valve being in the closed position (limited by S4). Check whether the burner can cope without cooling. If pre-purge is active, considerably lower air capacity than the maximum air capacity will be used for purging.





IC 20

The position for maximum capacity is achieved by the controller enable output (terminal 56).

Switching cam settings S1, S2, S3 and S4:

S1: for minimum capacity and ignition capacity of the burner.

S2: for reversing the direction of rotation to approach the position for ignition capacity. The actuator will move to the position for ignition capacity without reaching the position for maximum burner capacity.

S3: for maximum capacity of the burner and pre-purge.

S4: for the closed position of the butterfly valve and standby.

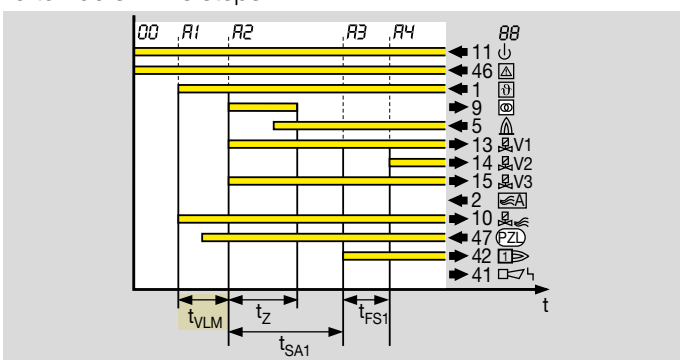
11.7 menox®

11.7.1 menox pre-ventilation time t_{VLM}

Parameter 28

This parameter is used to define the time during which the air valve is open in menox® mode before the normal start-up. Suitable for burners starting with full air capacity.

The possible settings are from 0 to 10 s in 0.1 s steps, from 10 to 250 s in 1 s steps.



After the start-up signal (ϑ) has been applied and the “no flow” state check has been conducted successfully, the air valve is opened. Start-up of the burner commences with no interruption of the air supply after expiry of the programmable pre-ventilation time t_{VLM}.

Parameter setting for this example sequence:

P06 = 5; P16 = 0, see page 84 (11.5.2 Delayed low air pressure protection). The gas valve does not open until the pressure switch has switched.

If the menox® pre-ventilation time t_{VLM} (P28) is greater than the running time (P42) and there is no signal from the pressure switch at terminal 47 after expiry of the running time (P42), the BCU performs a shut-down depending on parameter 15 (Low air pressure protection).

11.7.2 Switchover to menox® operating mode

Parameter 64

As soon as there is a signal at the menox® input (terminal 44), the BCU can switch to flame or menox® mode immediately or upon the next burner start.

Switchover from Flame mode to menox® mode

Parameter 64 = 0: on next burner start. As long as the start-up signal is present, the burner control unit will remain in Flame mode. The switchover to menox® mode does not take place until the next burner start.

Parameter 64 = 1: immediately. The switchover to menox® mode takes place immediately. The start-up signal must be applied to terminal 1. The burner in Flame mode is switched off and restarted in menox® mode.

Switchover from menox® mode to Flame mode

Parameter 64 = 0: on next burner start. As long as the start-up signal is present, the burner control unit will remain in menox® mode. The switchover to Flame mode does not take place until the next burner start.

Parameter 64 = 1: immediately. The switchover to Flame mode takes place immediately. The start-up signal must be applied to terminal 1. The burner in menox® mode is switched off and restarted in Flame mode.

11.8 Valve check

11.8.1 Valve proving system

Parameter 51

Parameter 51 is used to define whether and at what time in the BCU program sequence the valve check is activated. This allows either the tightness of the gas solenoid valves and the pipework between them to be checked (tightness test) or the closed position of a solenoid valve (proof of closure function) to be checked. If the proof of closure function is activated, the closed position of the gas solenoid valve on the inlet side is checked using a POC switch.

Parameter 51 = 0: Off. No valve check is activated.

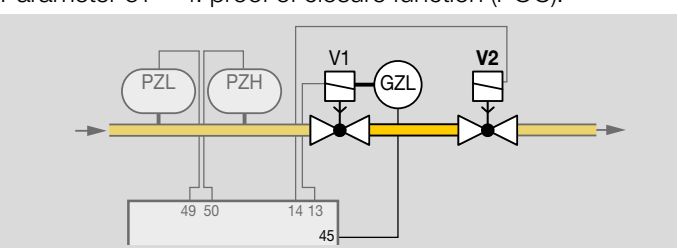
Parameter 51 = 1: tightness test before start-up.

Parameter 51 = 2: tightness test after shut-down. With this setting, a tightness test is also performed after a fault is reset and after mains on.

Parameter 51 = 3: tightness test before start-up and after shut-down.

An additional bypass valve must be installed in gas sections with an air/gas ratio control. This valve allows the closed air/gas ratio control to be bypassed during the tightness test.

Parameter 51 = 4: proof of closure function (POC).

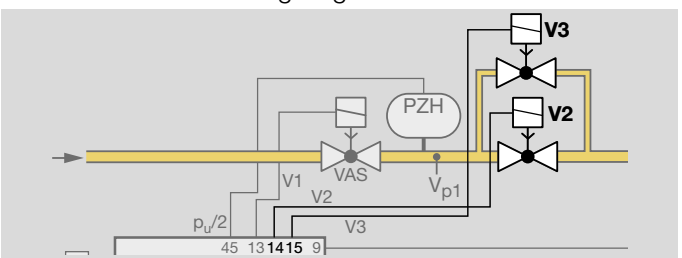


A signal is sent to the BCU via the POC switch on the gas solenoid valve on the inlet side before burner start-up stating that the valve is closed. After burner start-up, the signal must drop out to indicate to the BCU that the valve is open.

11.8.2 Relief valve (VPS)

Parameter 52

A valve connected to terminal 14 or 15 can be selected to act as a relief valve during a tightness test.



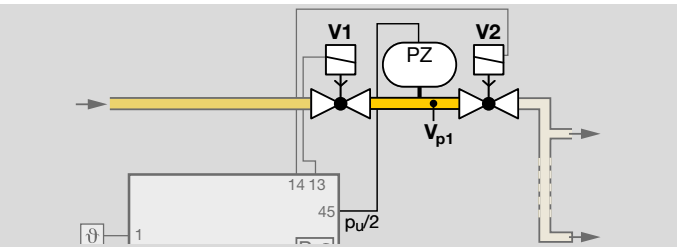
Parameter 52 = 2: V2. The valve on terminal 14 acts as the relief valve.

Parameter 52 = 3: V3. The valve on terminal 15 acts as the relief valve.

11.8.3 Measurement time for V_{p1}

Parameter 56

The required measurement time must be determined according to the requirements of the appropriate application standards, e.g. EN 1643.



The required measurement time for the tightness test of V_{p1} can be set using parameter 56. The possible settings are 3 s, 5 to 25 s (in 5 s steps) or 30 to 3600 s (in 10 s steps).

See also page 46 (6.1.5 Measurement time tM).

11.8.4 Valve opening time t_{L1}

Parameter 59

This parameter is used to define the opening time for the valves (2 to 25 s) which are opened to fill or discharge the test volume between the gas valves. If the preset opening time t_L = 2 s is inadequate (e.g. if slow opening valves are used) to fill the test volume or reduce the pressure between the valves, bypass valves can be used instead of the main valves.

On condition that the gas volume which flows into the combustion chamber is no larger than 0.083% of the maximum flow rate, the opening time of the bypass valves may be longer than the 3 s permitted by the standard (EN 1643:2000).

11.9 Behaviour during start-up

11.9.1 Minimum pause time t_{MP}

Parameter 62

A minimum pause time t_{MP} (0 to 3600 s) can be defined to achieve stable operation of the burners. If the post-ventilation time set using parameter 39 has elapsed and no signal (ϑ) is received at terminal 1 (burner shut down), a restart and cooling are prevented for the duration of the minimum pause time t_{MP}.

If a signal is applied to terminal 1 (burner start-up) or terminal 2 (cooling) during the minimum pause time, status display Delay *H0* will appear.

11.10 Manual mode

If the Reset/Information button is pressed for 2 s during switch-on, the BCU reverts to Manual mode. Two dots flash on the display. The BCU is now operating in Manual mode independently of the status of the inputs for start-up signal (terminal 1), controlled air flow (terminal 2) and remote reset (terminal 3). The functions of the safety-relevant inputs such as controller enable/emergency stop (terminal 46) are retained. The manual start-up of the BCU can be initiated in Manual mode by pressing the Reset/Information button. Each time the button is pressed again, the BCU moves to the next step of the program sequence and stops there, for example for adjusting an actuator or the gas/air mixture.

IC 20, IC 40 and FS-BLAC actuator

Following controller enable (status display 04), a connected actuator can be opened and closed as required. By holding the button, the actuator is first opened further. The BCU indicates Ao with blinking dots. Once the button has been released, the actuator stops in the relevant position. Pressing it again will result in closing the actuator to the position for minimum capacity. The BCU indicates Ac with blinking dots. A change of direction takes place each time the button is released and pressed again. When the actuator has reached its final position, the dots disappear.

11.10.1 Operating time in Manual mode

Parameter 67

Parameter 67 determines when Manual mode is terminated.

Parameter 67 = 0: Manual mode is not limited in time.

If this function has been selected, operation of the burner may be continued manually in the event of failure of the control system or the bus activation.

Parameter 67 = 1: the BCU will terminate Manual mode 5 minutes after the last time the button is pressed. It then moves abruptly back to the start-up position (standby).

If the unit is switched off or a power failure occurs, Manual mode on the BCU will be terminated regardless of parameter 67.

11.11 Functions of terminals 50, 51, 65, 66, 67 and 68

The BCU is informed via terminal 50 by a separate automation system that purging is currently being performed.

Terminals 51, 65, 66, 67 and 68 can each be assigned a logical AND gating with one of the inputs for the safety functions (terminals 46–50) using an appropriate parameter. If AND gating is required, the input concerned can be enabled.

Terminal 51 can also be used as a feedback input for the maximum capacity position when operated with IC 40/FS-BLAC.

11.11.1 Function of terminal 50

Parameter 68

The BCU..F1, F2 or F3 supports centrally-controlled pre-purge or post-purge. In the case of multiple burner applications, burners with mechanical combustion air supply are used. The air for combustion and pre-ventilation is supplied by a central fan controlled by a separate automation system. The automation system sends a signal to terminal 50 during purging. At this point, the BCU opens the air actuator (actuator, air valve) regardless of the status of the other inputs. The display indicates *P0*.

Parameter 68 = 23: purge with Low signal

Parameter 68 = 24: purge with High signal

11.11.2 Function of terminal 51

Parameter 69

Parameter 69 = 0: Off

Parameter 69 = 8: AND with input at terminal 46 (emergency stop)

Parameter 69 = 9: AND with input at terminal 47 ($air_{min.}$ pressure switch)

Parameter 69 = 10: AND with input at terminal 48 (air flow pressure switch)

Parameter 69 = 13: max. capacity position feedback (IC 40/FS-BLAC), see page 88 (11.6.5 Capacity control), FS-BLAC.

11.11.3 Function of terminal 65

Parameter 70

Parameter 70 = 0: Off

Parameter 70 = 8: AND with emergency stop (terminal 46)

Parameter 70 = 9: AND with $air_{min.}$ (terminal 47)

Parameter 70 = 10: AND with air flow monitoring (terminal 48)

11.11.4 Function of terminal 66

Parameter 71

Parameter 71 = 0: Off

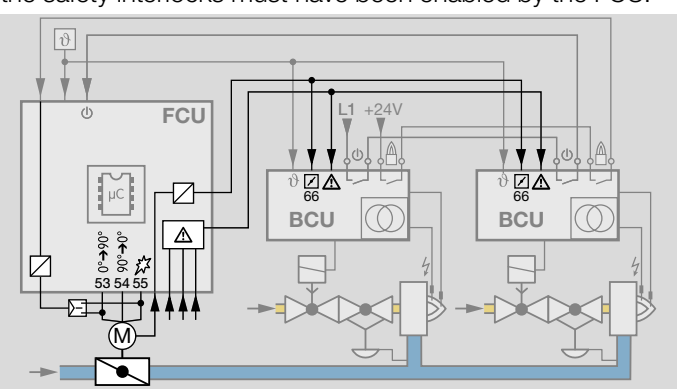
Parameter 71 = 8: AND gating with emergency stop (terminal 46)

Parameter 71 = 9: AND gating with $air_{min.}$ (only on BCU 565, terminal 47)

Parameter 71 = 10: AND gating with air flow monitoring (only on BCU 565, terminal 48)

Parameter 71 = 20: LDS ignition position check

The BCU does not perform a burner start-up, restart or start-up attempt until the butterfly valve is in ignition position. To ensure that the burners only start with the start fuel flow rate, the FCU issues an enable signal to start the burner via terminal 66 to the BCU with setting P71 = 20. In addition, the safety interlocks must have been enabled by the FCU.



11.11.5 Function of terminal 67

Parameter 72

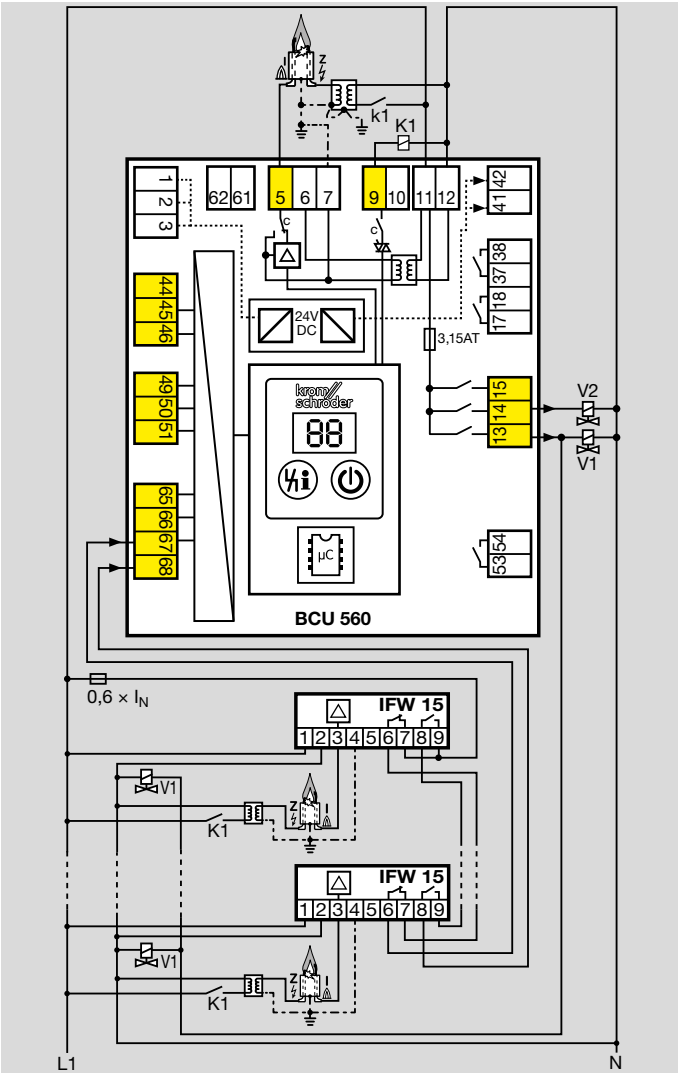
Parameter 72 = 0: Off

Parameter 72 = 8: AND gating with emergency stop (terminal 46)

Parameter 72 = 9: AND gating with $air_{min.}$ (only on BCU 565, terminal 47)

Parameter 72 = 10: AND gating with air flow monitoring (only on BCU 565, terminal 48)

Parameter 72 = 21: multi-flame control start-up conditions (only on BCU 560)



11.11.6 Function of terminal 68

Parameter 73

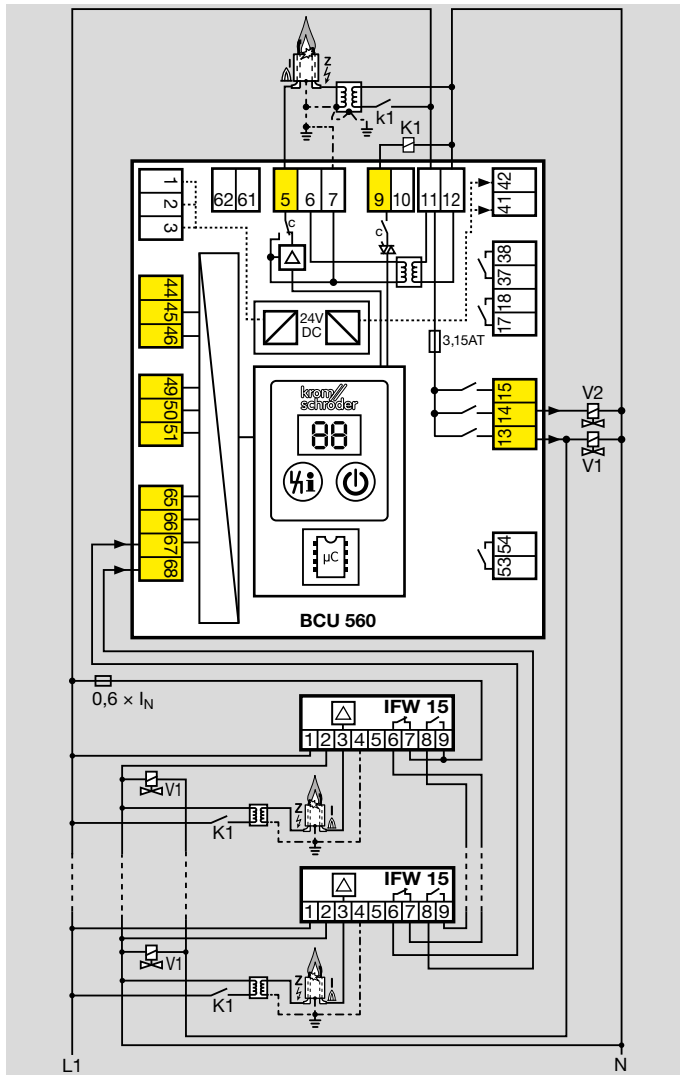
Parameter 73 = 0: Off

Parameter 73 = 8: AND gating with emergency stop (terminal 46)

Parameter 73 = 9: AND gating with $air_{min.}$ (only on BCU 565, terminal 47)

Parameter 73 = 10: AND gating with air flow monitoring (only on BCU 565, terminal 48)

Parameter 73 = 22: multi-flame control operating conditions (only on BCU 560)



11.12 Password

Parameter 77

The password is designed to protect the parameter settings. To prevent changes to parameter settings, a password is stored in parameter 77 (0000 to 9999). Changes to parameter settings can only be made once this number has been entered. The password can be changed using BCSoft. Note the effect of parameter settings on the safe functioning of your system.

11.13 Fieldbus communication

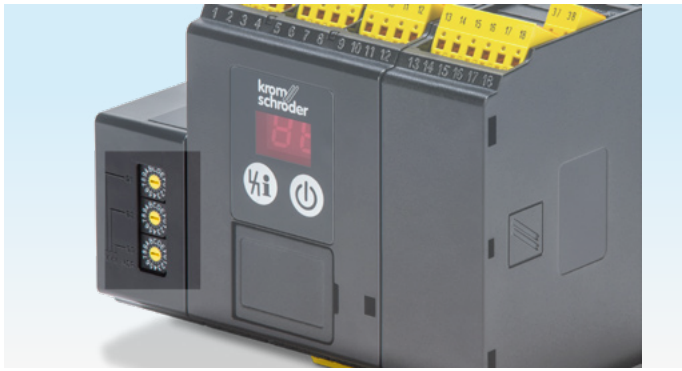
Parameter 80

Fieldbus communication can be enabled using parameter 80 when bus module BCM 500 is connected.

A device name/network name must be entered in the automation system/BCSoft for the unique identification of the control unit (BCU/FCU) in the fieldbus system.

Parameter 80 = 0: Off. Parameterization access using BCSoft via Ethernet is still possible.

Parameter 80 = 1: with address check. The device name/network name on delivery, for example for the BCU 560, is “not-assigned-bcu-560-xxx”. The expression “not-assigned-” must be deleted or may be replaced with an individual name. The sequence xxx must be identical to the address set on the BCM 500 using the code switches (xxx = address in the range 001 to FEF).



Parameter 80 = 2: no address check. The device name/network name can be selected as specified by the automation system.

12 Selection

Option	BCU	
Series	560	565
Mains voltage	Q, W	Q, W
Valve proving system	C0, C1	C0, C1
Capacity control	F0, F1, F2, F3	F1, F2, F3
Ionization or UV control in case of operation with gas	U0	U0
Digital input	D0, D1, D2	D0, D1, D2
Connection terminals	K0, K1, K2	K0, K1, K2
Packaging	-E	-E

Order example

BCU 560WC1F0U0D1K1-E

12.1 Type code

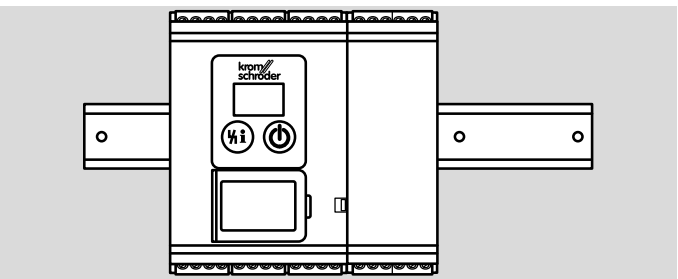
BCU	Burner control unit
5	Series 500
60	Standard version
65	Extended air control
Q	Mains voltage: 120 V AC, 50/60 Hz
W	Mains voltage: 230 V AC, 50/60 Hz
C0	No valve proving system
C1	Valve proving system
F0	No capacity control
F1	Modulating with IC interface
F2	Modulating with FS-BLAC interface
F3	Air valve control
U0	Ionization or UV control in case of operation with gas
D0	No high temperature operation
D1	High temperature operation
K0	No connection plugs
K1	Connection plugs with screw terminals
K2	Connection plugs with spring force terminals
-E	Individual packaging

13 Project planning information

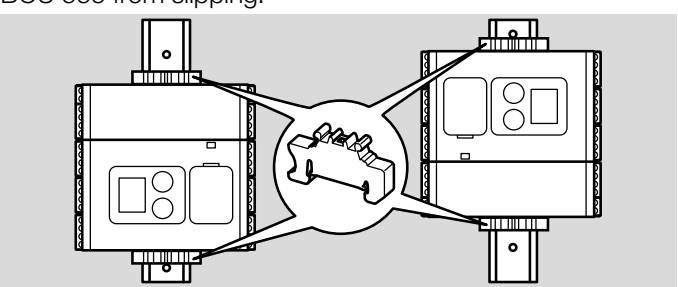
13.1 Installation

Installation position as required.

The BCU 560, BCU 565 mounting is designed for horizontally aligned 35 × 7.5 mm DIN rails.



If the DIN rail is aligned vertically, end clamps are required (e.g. Clipfix 35 by Phoenix Contact) to prevent the BCU 560, BCU 565 from slipping.



Environment

Install in a clean environment (e.g. a control cabinet) with an enclosure ≥ IP 54, whereby no condensation is permitted.

13.2 Commissioning

Do not start the BCU 560, BCU 565 until the parameter settings and wiring are correct and the faultless processing of all input and output signals complies with the local standards.

13.3 Electrical connection

The BCU is designed for connection to a 1-phase system. All inputs and outputs have a one-phase mains supply. Other connected burner control units must use the same phase of the mains supply.

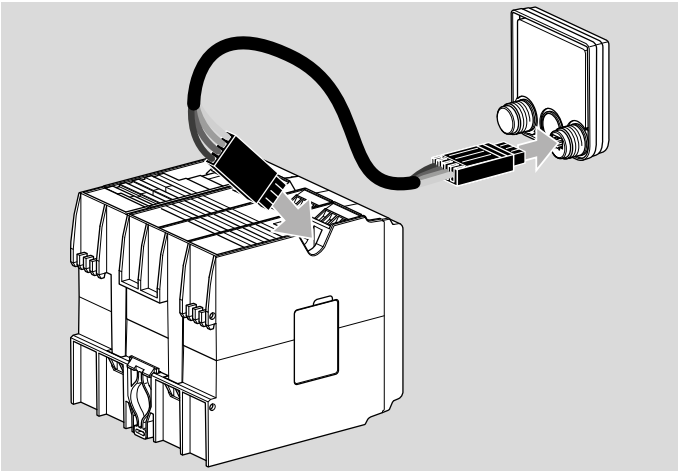
The national standards and safety requirements must be satisfied. If the BCU is operated in ungrounded/IT systems, an insulation monitoring device must be provided to isolate it from the mains in the event of a fault. The cabling of the safety circuits (e.g. pressure switches, gas valves) outside enclosed installation spaces must be protected from mechanical damage and stress (e.g. vibration or bending) as well as short circuits, short circuits to ground and cross-circuits.

Signal and control line for screw terminals max. 2.5 mm^2 (AWG 12), for spring force terminals max. 1.5 mm^2 (AWG 16).

Do not route BCU cables in the same cable duct as frequency converter cables or cables emitting strong fields.

External electrical interference must be avoided.

13.3.1 OCU



Cables for signalling and telecommunications systems are recommended for wiring the supplied plug connectors:

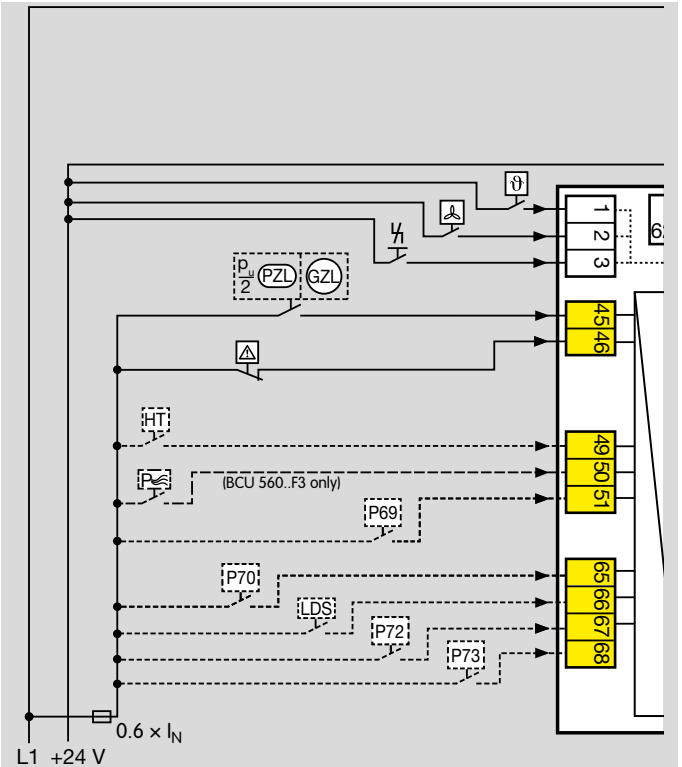
cable length: max. 10 m, 4-pin,
min. 0.25 mm^2 (AWG 24),
max. 0.34 mm^2 (AWG 22).

13.3.2 Safety current inputs

Actuation of the safety current inputs only with switchgear featuring mechanical contacts. If switchgear with semiconductor contacts is used, the safety current inputs must be connected using relay contacts.

To safeguard the safety current inputs, the fuse must be designed so that the sensor with the lowest switching capacity is protected.

The cabling outside enclosed installation spaces must be protected from mechanical damage and stress (e.g. vibration or bending) as well as short-circuits, short-circuits to ground and cross-circuits.



Calculation

I_N = current of the sensor/contactor with the lowest switching capacity

Suitable fuse = 0.6 × I_N

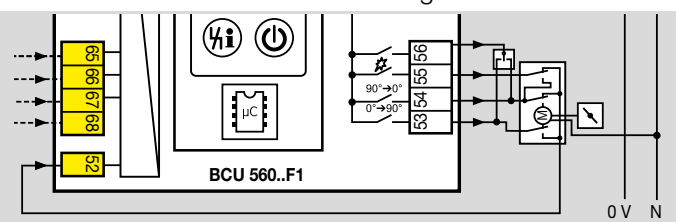
13.4 Actuators

If actuators are used, the start gas rate of the burners must be limited for SIL 3 applications in compliance with the standard.

13.4.1 IC 20

The BCU..F1 checks the position to which the actuator IC 20 has moved using terminal 52 (feedback) by lifting the signal to terminal 53, 54 or 55, see page 137 (21.9 Lifting).

To ensure this check is possible, BCU..F1 and actuator IC 20 or equivalent three-point step actuators must be wired as shown in the connection diagram.



13.5 Parameter chip card

The parameter chip card must be installed in the unit for the BCU 560, BCU 565 to operate. The parameter chip card contains the valid parameter settings for the BCU 560, BCU 565. If aBCU 560, BCU 565 is replaced, the parameter chip card can be removed from the old unit and inserted into the new BCU 560, BCU 565. The BCU 560, BCU 565 must be disconnected from the electrical power supply for this purpose. The valid parameters are then adopted by the new BCU 560, BCU 565. The old device and the new BCU 560, BCU 565 must have an identical type code.

13.6 Overload protection

To protect the unit against overload by frequent cycling, only a specific number of start-up attempts can be carried out by the BCU. The maximum number of start-up attempts per minute depends on the safety time t_{SA} and the ignition time t_Z.

t_{SA} [s]	t_Z [s]	Cycle lock [s]
3	2	12
5	3	13
10	6	16

If too many start-up attempts are made, 53 flashes on the display to indicate a fault.

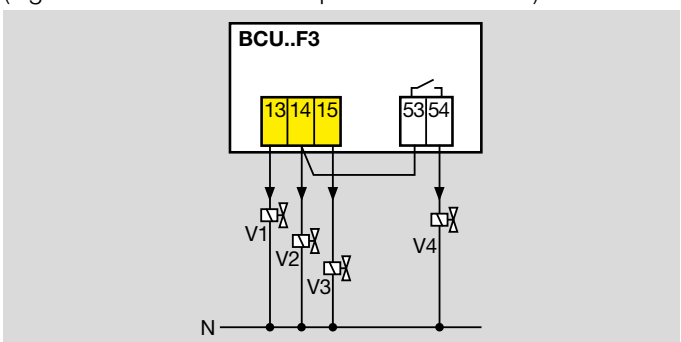
13.7 Calculating the safety time t_{SA}

See adlatus app Safety time on start-up: adlatus.org

13.8 Fourth or switchable gas valve on BCU.. F3

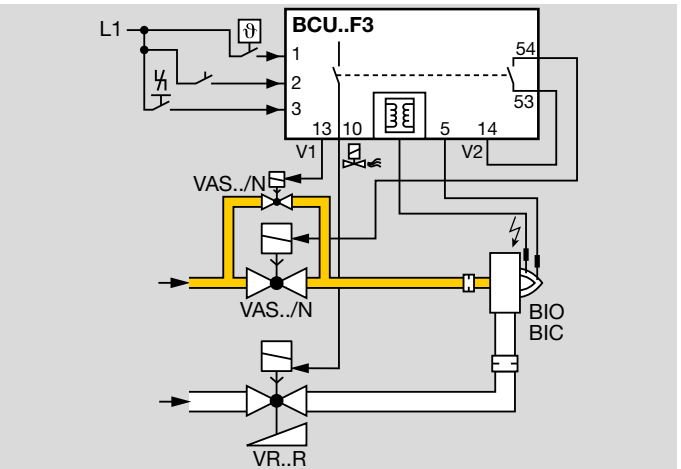
Units with air valve control have an additional contact (terminal 53/54), which closes at the same time as the air valve.

This can be used to activate a fourth gas valve. To do this, the output of a gas valve must be used as auxiliary energy (e.g. V2 as a result of the required flame control).



The following application describes a two-stage-controlled burner without a pneumatic air/gas ratio control system. V2 and the air valve are activated simultaneously.

V2 must not be activated during purging.



14 Accessories

14.1 BCSoft

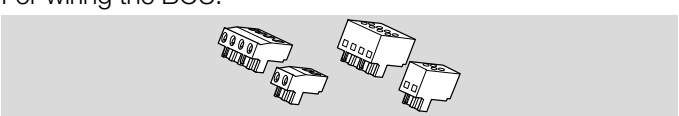
The current software can be downloaded from our Internet site at www.docuthek.com. To do so, you need to register in the DOCUTHEK.

14.1.1 Opto-adapter PCO 200

Including BCSoft CD-ROM,
Order No.: 74960625.

14.2 Connection plug set

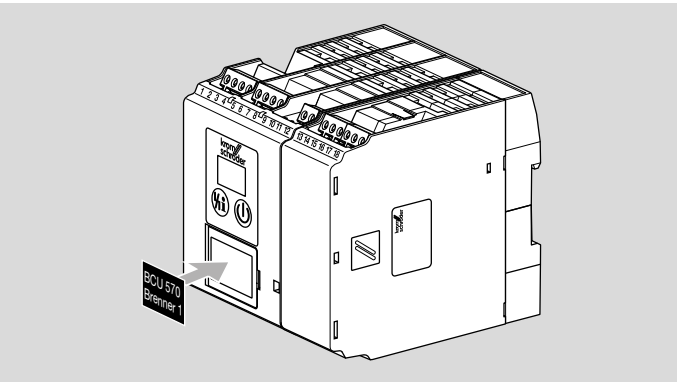
For wiring the BCU.



Connection plugs with screw terminals
Order No.: 74923998.

Connection plugs with spring force terminals
Order Order No.: 74924000.

14.3 Stickers for labelling



For printing with laser printers, plotters or engraving machines, 27 × 18 mm or 28 × 17.5 mm.
Colour: silver.

14.4 OCU

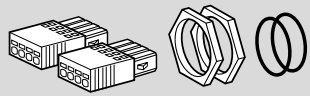
For installation in the control cabinet door in standard grid dimensions. The program step/status or fault messages can be read on the OCU. In Manual mode, the OCU can be used to proceed through the sequence of operating steps.

For details, see page 124 (15 OCU).

Type	Languages	Order No.
OCU 500-1	German, English, French, Dutch, Spanish, Italian	84327030
OCU 500-2	English, Danish, Swedish, Norwegian, Turkish, Portuguese	84327031
OCU 500-3	English, US English, Spanish, Brazilian Portuguese, French	84327032
OCU 500-4	English, Russian, Polish, Croatian, Romanian, Czech	84327033

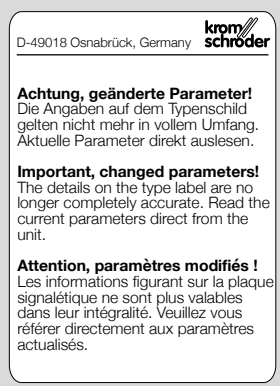
14.4.1 Accessories set BCU 5xx/OCU

With 2 nuts (M22 x 1.5) and 2 O-rings to secure the OCU to a control cabinet door and 2 plugs for the electrical connection to the BCU. A 4-pin signal and control cable is required for the electrical connection. The maximum cable length must not exceed 10 m, the cable diameter must be between 0.25 mm² (AWG 24) and 0.34 mm² (AWG 22).



Accessories set BCU 5xx/OCU (spare part), Order No. 74966337.

14.5 “Changed parameters” stickers



Affix on the connection diagram of the BCU 560, BCU 565 following changes to device parameters set at the factory.

100 pcs, Order No.: 74921492.

15 OCU

15.1 Application

The OCU is an external operator-control unit which can be connected to a control unit of the FCU 500/BCU 500 series. The external operator-control unit OCU is installed in the door of a control cabinet. Thus, the control cabinet does not need to be opened to read out process values, statistics, flame signal intensities or parameter values, to change settings on the OCU or to control or adjust connected valves in Manual mode.

15.2 Function

The OCU features an illuminated plain-text display. The lighting is switched on when a control key is pressed and switches off automatically after 5 minutes. In case of a fault lock-out or safety shut-down of the control unit, the OCU light starts blinking.

You can choose between the indicating ranges “status display” and “Service mode”.

The status display shows the program status or a fault message which has occurred in text form with the appropriate code.

The Service mode allows you to read out process values, parameter settings, information on the OCU or the statistics. In addition, you can operate connected control units in Manual mode. There are five control keys for the OCU and the control unit connected to it:

	Use the ON/OFF key to switch the control unit on or off.
	Use the Reset key to reset the control unit to its starting position in the event of a fault.
	Starting from the status display, you can use the OK key to change to Service mode.
	By holding down the key for a certain time, you can change directly to the status display.
	In Manual mode, those keys can be used to open and close an activated valve.

15.2.1 Manual mode

In Manual mode, the control unit works with capacity control (FCU..F1/F2 or BCU..F1/F2) regardless of the status of its inputs. The inputs for start-up signal (terminal 1), controlled air flow (terminal 2) and remote reset (terminal 3) are ignored. The function of the controller enable/emergency stop input (terminal 46) is retained.

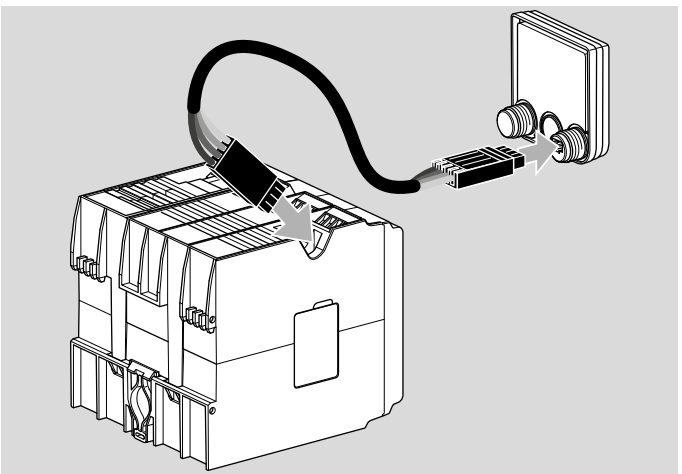
The positions for maximum capacity, minimum capacity and ignition capacity of an actuator can be adjusted using the OCU. The OCU supports the process by means of a cyclic, automatic repeat approach to the selected position. The actuator can be moved within the menu to make changes to the cam settings.

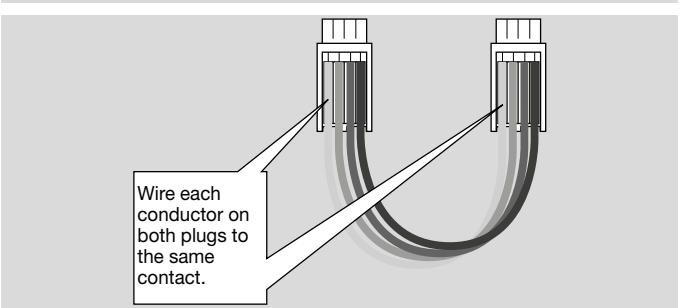
After start-up has been completed, the navigation keys can be used, for example, to open or close a valve in program step *04*.

15.3 Electrical connection

The OCU is to be connected to the control unit using the two plugs provided.

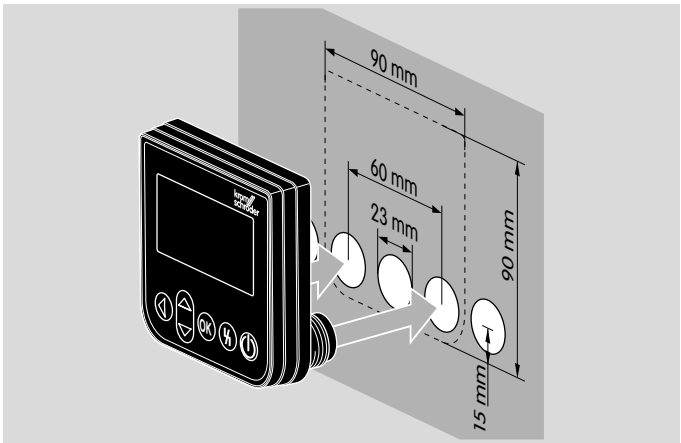
Required signal and control line:
cable length max. 10 m, 4-pin, min. 0.25 mm^2 (AWG 24), max. 0.34 mm^2 (AWG 22).





15.4 Installation

The threaded adapters of the OCU are suitable for 23 mm boreholes which are drilled at intervals of 30 mm.



15.5 Selection

The OCU can be supplied with various language kits.

Type	Languages	Order No.
OCU 500-1	German, English, French, Dutch, Spanish, Italian	84327030
OCU 500-2	English, Danish, Swedish, Norwegian, Turkish, Portuguese	84327031
OCU 500-3	English, US English, Spanish, Brazilian Portuguese, French	84327032
OCU 500-4	English, Russian, Polish, Croatian, Romanian, Czech	84327033

15.6 Technical data for OCU

Ambient conditions

Avoid direct sunlight or radiation from red-hot surfaces on the unit.

Avoid corrosive influences, e.g. salty ambient air or SO_2.

This unit is not suitable for cleaning with a high-pressure cleaner and/or cleaning products.

Ambient temperature: -20 to +60°C.

Enclosure, mounted in the control cabinet door:
IP 65 for external part,
IP 40 for internal part.

Mechanical data

Number of operating cycles of the control keys: 1000.

Weight: 120 g.

Electrical data

Required signal and control line:
cable length max. 10 m, 4-pin,
min. 0.25 mm^2 (AWG 24),
max. 0.34 mm^2 (AWG 22).

16 BCM 500

16.1 Application

The bus module BCM 500 is used as a communication interface for devices of the BCU/FCU 500 product family for connection to a fieldbus communication system (Profinet or Modbus TCP). Networking via the fieldbus enables the FCU or BCU to be controlled and monitored by an automation system (e.g. PLC).

16.2 Function

The bus system transfers the operating status, the level of the flame signal and the current program step from devices of the BCU/FCU/FDU 500 product family (with BCM) to the automation system (PLC).

16.3 Electrical connection

Use only cable and plug components which comply with the appropriate PROFINET or Modbus TCP specifications.

Use shielded RJ45 plugs.

Cable length between 2 fieldbus subscribers: max. 100 m.

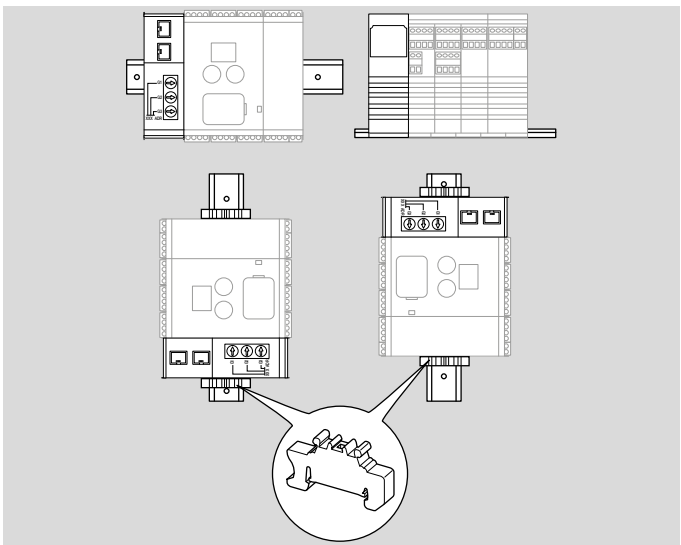
Installation guidelines

For PROFINET, see www.profibus.com,
for Modbus TCP, see www.modbus.org.

16.4 Installation

Installation position: vertically upright, horizontal or tilted to the left or right.

The BCM mounting is designed for horizontally aligned 35 × 7.5 mm DIN rails.



If the DIN rail is aligned vertically, end clamps are required (e.g. Clipfix 35 by Phoenix Contact) to prevent the control unit from slipping.

Install in a clean environment (e.g. a control cabinet) with an enclosure ≥ IP 54, whereby no condensation is permitted.

16.5 Selection

BCM	Bus module
500	Series 500
S0	Standard communication
B2	PROFINET
B4	Modbus TCP
/3	Two RJ45 sockets
-3	Three-point step control via bus

BCM..B2, Order No.: 74960663
BCM..B4, Order No.: 74960688

16.6 Technical data for BCM

Electrical data

Power consumption: 1.2 VA.

Power loss: 0.7 W.

Mechanical data

Dimensions (W × H × D):
32.5 × 110 × 100 mm (1.28 × 4.53 × 3.94 inches),
H = 115 mm (4.5 inches) incl. DIN rail.

Weight: 0.3 kg.

Ambient conditions

Icing, condensation and dew in and on the unit are not permitted.

Avoid direct sunlight or radiation from red-hot surfaces on the unit.

Note the maximum medium and ambient temperatures!

Avoid corrosive influences, e.g. salty ambient air or SO_2.

Ambient temperature:
-20 to +60°C (-4 to +140°F).

Transport temperature = ambient temperature.

Storage temperature:
-20 to +60°C (-4 to +140°F).

Enclosure: IP 20 pursuant to IEC 529.

Installation location: min. IP 54 (for installation in a control cabinet).

Permitted operating altitude: < 2000 m AMSL.

17 Technical data

17.1 Electrical data

Mains voltage

BCU..Q: 120 V AC, -15/+10%, 50/60 Hz, ±5%,

BCU..W: 230 V AC, -15/+10%, 50/60 Hz, ±5%.

Type of network

For grounded or ungrounded mains. The national standards and safety requirements must be satisfied. If the BCU is operated in ungrounded/IT systems, an insulation monitoring device must be provided to isolate it from the mains supply on all poles in the event of a fault. The cabling of the safety circuits (e.g. pressure switches, gas valves) outside enclosed installation spaces must be protected from mechanical damage and stress (e.g. vibration or bending) as well as short circuits, short circuits to ground and cross-circuits.

Power consumption

At 230 V AC approx. 6 W/11 VA,

at 120 V AC approx. 3 W/5.5 VA.

Signal inputs

Rated value	120 V AC	230 V AC
Signal “1”	80–132 V	160–253 V
Signal “0”	0–20 V	0–40 V
Current at “1”	max. 5 mA*	
Power loss	0.08 W/0.2 VA	0.15 W/0.4 VA

** The signal inputs are activated by pulses. The stated current corresponds to the peak value.*

Signal outputs (contact rating)

- Valve outputs V1, V2 and V3 (terminals 13, 14 and 15): max. 1 A each, cos $\phi \geq 0.6$.
- Actuator outputs (terminals 53, 54 and 55): max. 1 A each, cos $\phi = 1$.
- Ignition transformer (terminal 9): max. 2 A.
- Total current for the simultaneous activation of the valve outputs (terminals 13, 14 and 15), the actuator (terminals 53–56) and the ignition transformer: max. 2.5 A.
- Signalling contact for fault signals (terminals 17, 18) and operating signals (terminals 37, 38): max. 1 A (external fuse required).
- 24 V DC outputs for fault and operating signals (terminals 41, 42): max. 0.1 A.

Number of operating cycles

The fail-safe outputs (valve outputs V1, V2 and V3), as well as the air valve output on BCU 5xx..F3, are monitored for correct functioning and are thus not subject to a max. number of operating cycles.

Actuator (terminals 53, 54 and 55): max. 1,000,000,

signalling contact for operating signals: max. 1,000,000,

signalling contact for fault signals: max. 10,000,

On/Off button: max. 10,000,

Reset/Information button: max. 10,000.

Device fuses

Fuses, replaceable,

F1: T 3.15A H, F2: T 2A H, pursuant to IEC 60127-2/5.

Flame control

With UV sensor or flame rod,

for continuous operation (intermittent operation with UVS).

Flame signal current:

Ionization control: 2–25 µA,

UV control: 5–25 µA.

Signal line for flame signal current:

max. 100 m (328 ft).

17.2 Mechanical data

Weight: 0.7 kg.

Connections

- Screw terminals:
  nominal cross-section 2.5 mm^2,
  wire cross-section (rigid): min. 0.2 mm^2, max. 2.5 mm^2,
  AWG: min. 24, max. 12.
  Contact rating: 12 A.
- Spring force terminals:
  nominal cross-section 2 × 1.5 mm^2,
  wire cross-section: min. 0.2 mm^2, max. 1.5 mm^2,
  AWG: min. 24, max. 16.
  Contact rating: 10 A (UL: 8 A),
  to be observed in case of daisy chain.

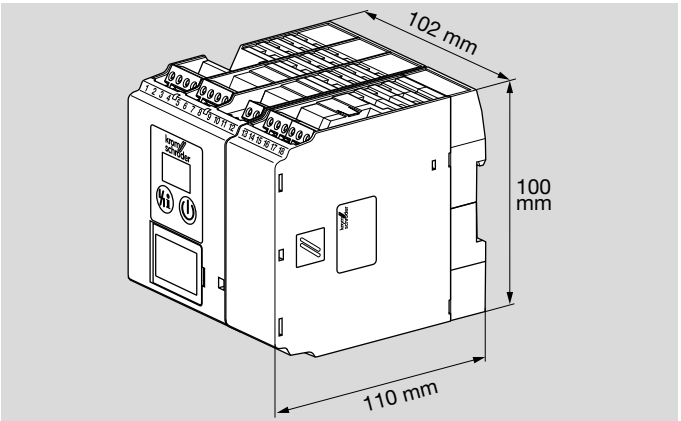
17.3 Ambient conditions

Ambient temperature:
-20 to +60°C (-4 to +140°F),
no condensation permitted.

Enclosure: IP 20 pursuant to IEC 529.

Installation location: min. IP 54 (for installation in a control cabinet).

17.4 Dimensions



17.5 Safety-specific characteristic values

Certificates – see www.docuthek.com.

For systems up to SIL 3 pursuant to EN 61508.

Pursuant to EN ISO 13849-1, Table 4, the BCU 560, BCU 565 can be used up to PL e.

Suitable for Safety Integrity Level	Up to SIL 3
Diagnostic coverage DC	97.2%
Type of subsystem	Type B to EN 61508-2:2010
Mode of operation	High demand mode pursuant to EN 61508-4:2010
Mean probability of dangerous failure PFH_D	11.5 x 10^{-9} 1/h on BCU 56x..F1 11.5 x 10^{-9} 1/h on BCU 56x..F2 14.5 x 10^{-9} 1/h on BCU 56x..F3
Mean time to dangerous failure $MTTF_d$	$MTTF_d = 1/PFH_D$
Safe failure fraction SFF	99.4%

Mean probability of dangerous failure PFH_D of individual safety functions

Valve proving system	5.5 x 10^{-9} 1/h
Safety interlocks (limits)	5.5 x 10^{-9} 1/h
Emergency stop with optional input	5.4 x 10^{-9} 1/h
Low air pressure protection	5.5 x 10^{-9} 1/h
Low air pressure protection with optional input	5.4 x 10^{-9} 1/h
Air flow monitoring	7.2 x 10^{-9} 1/h
Air flow monitoring with optional input	7.1 x 10^{-9} 1/h
Flame control	6.5 x 10^{-9} 1/h
Multi-flame control	6.6 x 10^{-9} 1/h
Approaching position for ignition capacity with F1/IC 20	5.6 x 10^{-9} 1/h
Approaching position for ignition capacity with F2/FS-BLAC	5.9 x 10^{-9} 1/h
Approaching position for ignition capacity with F3	5.3 x 10^{-9} 1/h

SIL 3 is only achieved in conjunction with IC 20 or FS-BLAC actuators if a separate gas valve is used to limit the pilot gas rate, see page 73 (11.3.2 Burner application), parameter 78 = 1.

Relationship between the Performance Level (PL) and the Safety Integrity Level (SIL)

PL	SIL
a	–
b	1
c	1
d	2
e	3

Max. service life under operating conditions:
20 years after date of production.

For a glossary of terms, see page 136 (21 Glossary).

18 Converting units

See www.adlatus.org

19 Maintenance

The fail-safe outputs (valve outputs V1, V2 and V3) of the power module are monitored for correct functioning. In the event of a fault, the system is set to a safe status using a second shut-down path (isolation of the valve outputs from the mains). In the event of a defect (e.g. fault 36), the power module must be replaced.

See www.partdetective.de (optimized for smartphones) for a replacement/order option for the power module.

The device and user statistics can be displayed using the operator-control unit OCU or engineering tool BCSoft for further diagnostics and troubleshooting. The user statistics can be reset using engineering tool BCSoft.

20 Legend

Symbol	Description
	Ready for operation
	Safety interlocks (limits)
	Safety limits (limits during start-up = LDS), control element position check
	Controlled air flow
	Remote reset
	Gas valve
	Air valve
	Air/gas ratio control valve
	Burner
P	Purge
A	External air control
	Burner flame signal
	Burner operating signal
	Fault signal
	Start-up signal
menox	menox® input
HT	Input for high temperature operation
PZ	Pressure switch for tightness control (TC)
PZH	Pressure switch for maximum pressure
PZL	Pressure switch for minimum pressure
PDZ	Differential pressure switch
Pxx	Input signal depending on parameter xx

Symbol	Description
M	Actuator with butterfly valve
GZL	Valve with proof of closure switch
	Fan
	Three-point step switch
	Input/Output, safety circuit
TC	Tightness control
$p_u/2$	Half of the inlet pressure
p_u	Inlet pressure
p_d	Outlet pressure
V_{p1}	Test volume
I_N	Current consumption of sensor/contactor
t_L	Tightness control opening time
t_M	Measurement time during tightness test
t_P	Tightness control test period (= 2 x t_L + 2 x t_M)
t_{PN}	Post-purge time
t_{FS}	Flame proving period
t_{MP}	Minimum pause time
t_{NL}	Over-run time
t_{SA}	Safety time on start-up
t_{SB}	Safety time during operation
t_{VZ}	Pre-ignition time
t_{GV}	Fan run-up time
t_E	Switch-on delay time
t_{PV}	Pre-purge time
t_{RF}	Controller enable signal delay time

21 Glossary

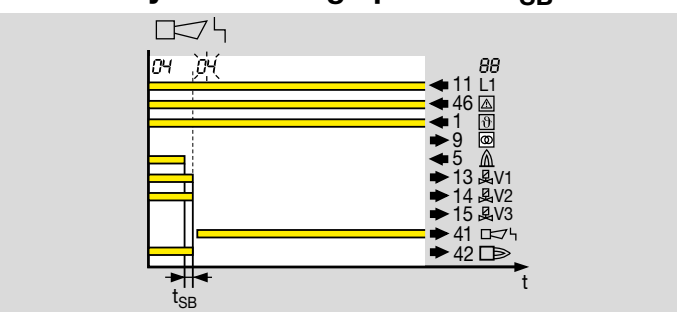
21.1 Waiting time t_W

In standby, the waiting time t_W starts to elapse in the background. During this time, a self-test is conducted to detect errors in internal and external circuit components. The burner will not be started during the waiting time. Any burner start will be delayed by the BCU 560, BCU 565 until the waiting time has elapsed

21.2 Safety time on start-up t_{SA1}

This refers to the period of time between switching on and switching off of the gas valve, when no flame signal is detected. The safety time on start-up t_{SA1} is the minimum operating time of the burner 1 and burner control unit.

21.3 Safety time during operation t_{SB}



In the event of a flame failure during operation or an interruption of the safety current inputs, the fuel supply is interrupted within the safety time t_{SB}.

The default safety time during operation t_{SB} in accordance with EN 298 is 1 s. Under EN 746-2, the safety time of the installation during operation (including closing time of the valves) must not exceed 3 s. Note the requirements of the standards!

Under NFPA 86, section 8.10.3*, the maximum flame failure response time shall be ≤ 4 s.

21.4 Safety interlocks (Limits)

The limiters in the safety interlock (linking of all the relevant safety control and switching equipment for the use of the application, e.g. safety temperature limiter, minimum/maximum gas pressure) must isolate input (⚠) from the voltage supply.

21.5 Safety shut-down

The burner control unit performs a safety shut-down immediately after receiving a signal from a safety device or after a fault is detected (e.g. flame or air pressure failure). The safety shut-down prevents operation of the burner by closing the fuel shut-off valves and deactivating the ignition device.

For this, the BCU 560, BCU 565 disconnects the gas valves and the ignition transformer from the electrical power supply. The operation signalling contact and the controller enable signal are deactivated. The fault signalling contact remains open. The display blinks and displays the current program step.

After a safety shut-down, the BCU 560, BCU 565 can restart automatically.

21.6 Fault lock-out

A fault lock-out is a safety shut-down with subsequent lock-out. The system can only be restarted following manual reset. The protective system cannot be reset by mains failure.

In the event of a fault lock-out of the BCU 560, BCU 565, the fault signalling contact closes, the display blinks and shows the current program step. The gas valves are disconnected from the electrical power supply. The fault signalling contact opens if the mains voltage fails.

In order to restart, the BCU 560, BCU 565 can only be reset manually using the button on the front panel, the OCU or the remote reset input (terminal 3).

21.7 Warning signal

The BCU 560, BCU 565 reacts to operating faults, e.g. in the case of permanent remote resets, with a warning signal. The display blinks and shows the corresponding warning message. The warning signal ends once the cause has been eliminated.

The program sequence continues. No safety shut-down or fault lock-out occurs.

21.8 Timeout

For some process faults, a timeout phase elapses before the BCU 560, BCU 565 reacts to the fault. The phase starts as soon as the BCU 560, BCU 565 detects the process fault and ends after 0 to 250 s. A safety shut-down or fault lock-out is then performed. If the process fault ends during the timeout phase, the process continues as before.

21.9 Lifting

After positioning the actuator IC 20, the BCU 560, BCU 565 checks by means of brief lifting whether its feedback input (terminal 52) has been activated by the correct output signal from the actuator. The signal of the relevant control output (ignition, OPEN, CLOSE) is switched off briefly for this purpose. While the signal is switched off, the BCU 560, BCU 565 may not detect a signal at the feedback input.

21.10 Safe failure fraction SFF

Fraction of safe failures related to all failures, which are assumed to appear

see EN 13611/A2

21.11 Diagnostic coverage DC

Measure of the effectiveness of diagnostics, which may be determined as the ratio between the failure rate of detected dangerous failures and the failure rate of total dangerous failures

NOTE: Diagnostic coverage can exist for the whole or parts of a safety-related system. For example, diagnostic coverage could exist for sensors and/or logic system and/or final elements. Unit: %

see EN ISO 13849-1

21.12 Mode of operation

IEC 61508 describes two modes of operation for safety functions. These are low demand mode and high demand or continuous mode.

In low demand mode, the frequency of demands for operation made on a safety-related system is not greater than

one per year and is not greater than twice the proof-test frequency. In high demand mode or continuous mode, the frequency of demands for operation made on a safety-related system is greater than one per year or greater than twice the proof-test frequency.

see EN 61508-4

21.13 Probability of dangerous failure PFH_D

Value describing the likelihood of dangerous failure per hour of a component for high demand mode or continuous mode. Unit: 1/h

see EN 13611/A2

21.14 Mean time to dangerous failure $MTTF_d$

Expectation of the mean time to dangerous failure

see EN 61508

For more information

The Honeywell Thermal Solutions family of products includes Honeywell Combustion Safety, Eclipse, Exothermics, Hauck, Kromschröder and Maxon. To learn more about our products, visit ThermalSolutions.honeywell.com or contact your Honeywell Sales Engineer.

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