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Burner control unit PFU 760, 780

OPERATING INSTRUCTIONS

Cert. Version 11.16 · Edition 04.24 · EN · 03250691

CONTENTS

1 SAFETY

1.1 Please read and keep in a safe place

Please read through these instructions carefully before installing or operating. Following the installation, pass the instructions on to the operator. This unit must be installed and commissioned in accordance with the regulations and standards in force. These instructions can also be found at www.docuthek.com.

1.2 Explanation of symbols

1, **2**, **3**, **a**, **b**, **c** = Action

➔ = Instruction

1.3 Liability

We will not be held liable for damage resulting from non-observance of the instructions and non-compliant use.

1.4 Safety instructions

Information that is relevant for safety is indicated in the instructions as follows:

⚠ DANGER
Indicates potentially fatal situations.

⚠ WARNING
Indicates possible danger to life and limb.

⚠ CAUTION
Indicates possible material damage.

All interventions may only be carried out by qualified gas technicians. Electrical interventions may only be carried out by qualified electricians.

1.5 Conversion, spare parts

All technical changes are prohibited. Only use OEM spare parts.

2 CHECKING THE USAGE

PFU

Mounted in a module subrack, for igniting and monitoring gas burners in continuous operation. Monitoring is performed with a flame rod or a UV sensor. When using UV sensors of Type UVS, the PFU may be used for intermittent operation only. This means that operation must be interrupted once within 24 hours.

With UV flame detector UVC 1 (may only be used with PFU 760..U and PFU 780..U), the PFU may also be used for continuous operation. Connection details – see UVC 1 operating instructions.

Ignition and monitoring with a single electrode is possible (single-electrode operation).

The unit may be used in grounded and ungrounded mains.

PFU 760

For directly ignited burners of unlimited capacity. The ignition rating must not exceed max. 350 kW.

PFU 760..K1

As a replacement for automatic burner control unit PFS or PFD 778.

PFU 760..K2

As a replacement for automatic burner control unit PFU 778.

PFU 780

For pilot and main burners of unlimited capacity. The PFU 780 can monitor both burners separately. The ignition rating must not exceed max. 350 kW.

PFU 780..K2

As a replacement for automatic burner control unit PFU 798.

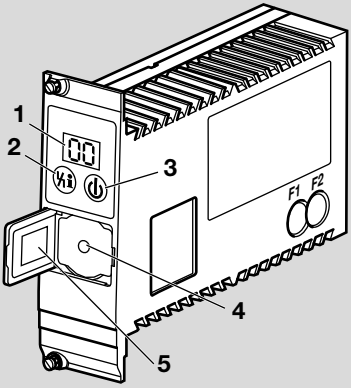
PFU 760 with PROFIBUS DP interface PFA 700

The bus system transfers the control signals for starting, resetting and for controlling the air valve from the control system (PLC) to the PFU. In the opposite direction, the bus system sends information on the operating status. Control signals that are relevant for safety, such as the safety interlocks, purge and digital input, are transferred independently of the bus communication by separate cables.

2.1 Type code

PFU	Burner control unit
7	Series 700
60	Standard version
80	Version for pilot and main burners
L	Air valve control
T	Mains voltage 220/240 V AC, 50/60 Hz, for grounded and ungrounded mains
N	Mains voltage 110/120 V AC, 50/60 Hz, for grounded and ungrounded mains
D	Digital input for high temperature operation
U	Configured and prepared for UVC 1
K1	Replacement for PFS/PFD
K2	Replacement for PFU 778/798

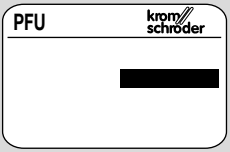
2.2 Part designations



1 LED display for program status and fault messages
2 Reset/Information button
3 On/Off button
4 Connection for opto-adapter
5 Type label

2.3 Type label

Mains voltage – see type label.



➔ Ambient temperature – see page 18 (17 Technical data).

3 INSTALLATION

⚠ CAUTION

Dropping the device can cause permanent damage.

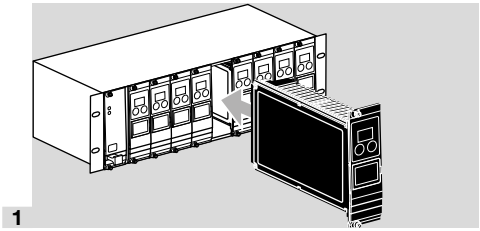
– In this event, replace the entire device and associated modules before use.

➔ Install in clean environment ensuring enclosure IP 54 or higher, whereby no condensation is permitted on the PC boards.

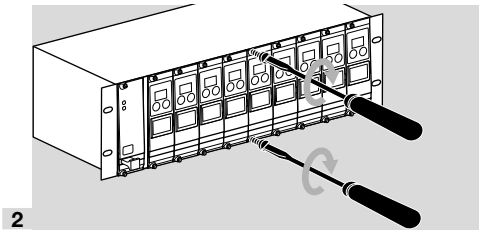
➔ Installation in 19" module subrack with contact guard. We recommend module subrack BGT..1DP700 or BGT..1DP710.

➔ Installation position as required.

➔ Distance between PFU and burner: max. 100 m (328 ft).

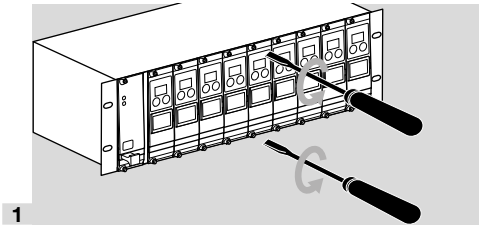


1



2

4 REPLACING THE BURNER CONTROL UNIT



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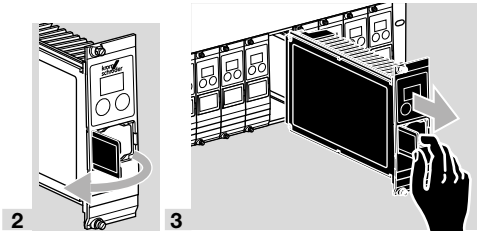


2 3

4 Check the mains voltage.

5 Compare parameter settings of old unit with parameter settings of new unit.

➔ Adjust parameters on new unit if necessary, see page 9 (8 Adjustment).

➔ A password (parameter 50) is required to change the parameters – see order confirmation for password.

6 If parameters have been readjusted, stick the "Important, changed parameters" (accessory) label on the connection diagram of the PFU.

➔ If the PFU is sent to Elster GmbH for inspection without the "Changed parameters" sticker, it is returned with the device parameters which were originally set at the manufacturing plant.

7 Install burner control unit in module subrack, see page 2 (3 Installation).

4.1 PFS, PFD, PFU 778, PFU 798

⚠ CAUTION

Use the specified variants only, when replacing automatic burner control units PFS, PFD, PFU 778 or PFU 798. Otherwise, the existing wiring can be overloaded.

➔ Replacement possibilities:

Old unit		New unit
PFS/PFD 778	→	PFU 760..K1
PFU 778	→	PFU 760..K2
PFU 798	→	PFU 780..K2

PFU 760..K1 replaces PFS/PFD

➔ Remove PFS/PFD (see operating instructions "Process firing system PFx 7xx").

1 Check the mains voltage.

2 Check the setting of switches S1, S3 and S4 on the PFS/PFD and if required, adjust the corresponding parameters on the PFU 760..K1 using BCSoft.

PFS..L/PFD..L: also check the setting of switches S2 and S5. If PFS..L/PFD..L is not equipped with switch S5, set parameter 31 to 0:

PFS/PFD		PFU 760..K1
Switch	Position	Variant
S1	115	PFU 760..N
S1	230[2)]	PFU 760..T

PFS/PFD		PFU 760..K1	
Switch	Position	Value	Parameter
S2[1)]	1	1	30
S2[1)]	2[2)]	0[2)]	30
S2[1)]	3	2	30
S3	1	1	12
S3	2[2)]	0[2)]	12
S3	3[3)]	0[3)]	12
S4	1[2)]	0[2)]	23
S4	2	5	23
S5[1)]	1	1	31
S5[1)]	2[2)]	0[2)]	31

1) Only on PFS..L/PFD..L.

2) Standard setting.

3) This function is not available on PFU 760..K1. We recommend that parameter 12 be set to 0.

3 Check the potentiometer setting for the burner switch-off threshold on the PFS/PFD and if required, adjust the corresponding parameter on the PFU 760..K1 using BCSoft.

PFS/PFD		PFU 760..K1	
Potentiometer	Switch-off threshold µA	Value	Parameter
P1	1–20	1–20	04

4 Check other parameters on the PFU 760..K1 and adjust if necessary:

Parameter	Value	Function
15	1	Flame simulation check on start-up
21	0	Min. burner pause time
22	3, 5, 10[1)]	Safety time on start-up
10	1	Burner start-up attempts
14	1, 2[1)]	Safety time operation V1 + V2
20	0	Min. burner on time
35	0	UVS check, 1 × in 24 hours
33	0	High temperature operation
34	1	Manual mode limited < 5 minutes
45[2)]	0, 1	Multi-flame control
26	0	Gas valve V2 opens with air valve
36	0	Low fire over-run time
32	0	Air valve closed/can be activated in the event of malfunction
42	1	Purge

1) Read out value from PFS/PFD, note and transfer to PFU 760..K1.

2) Multi-flame control:
Parameter 45 = 1.
No multi-flame control:
Parameter 45 = 0.

➔ When replacing PFS..M/PFD..M or PFS..D/PFD..D with PFU 760..D, set parameter 45 to 1.

⚠ WARNING

In the case of multi-flame control, parameter 45 must be set to 1 to ensure that the flames are monitored.

➔ A password (parameter 50) is required to read the parameters – see order confirmation for password.

5 If parameters have been readjusted, stick the "Important, changed parameters" label on the connection diagram of the PFU 760..K1, see page 20 (20 Accessories).

6 Install burner control unit in module subrack, see page 2 (3 Installation).

PFU 760..K2 replaces PFU 778, PFU 780..K2 replaces PFU 798

➔ Only replace PFU 778/798..U with PFU 760/780..U.

➔ Remove PFU 778/PFU 798 (see operating instructions "Automatic burner control unit PFU").

1 Check the mains voltage.

2 Read out and make a note of parameter values from PFU 778/PFU 798 using BCSoft. Then copy the values to PFU 760/780..K2:

Parameter	Value	Function
15	1, 0	Flame simulation check on start-up
22	3, 5, 10	Safety time on start-up, (pilot) burner
23	Accept value	Flame proving period, (pilot) burner
10	1, 2, 3, 4	Start-up attempts, (pilot) burner
14	1, 2	Safety time operation V1 + V2
12	0, 1	Restart, (pilot) burner
16	1, 0	Permanent (pilot) burner
04	1…20	Switch-off threshold, (pilot) burner
33	0, 1, 2, 3, 4	High temperature operation
24[1)]	3, 5, 10	Safety time on start-up, main burner
25[1)]	Accept value	Flame proving period, main burner
30	0, 1, 2, 3	Air valve control
31	0, 1	Air valve can be activated externally on start-up
32	0, 1	Air valve closed/can be activated in the event of malfunction
11[1)]	1, 2, 3, 4	Start-up attempts, main burner
13[1)]	0, 1	Restart, main burner
05[1)]	1…20	Switch-off threshold, main burner

1) Only on PFU 798/PFU 780..K2.

3 Check additional parameter settings on the PFU 760..K2 and adjust if necessary:

Parameter	Value	Function
34	1	Manual mode limited to 5 minutes
35	0	UVS check (1 × in 24 hours)
21	0	Min. burner pause time
20	1	Min. operating time
45[1)]	0, 1	Multi-flame control
26	0	Switchable gas valve V2

Parameter	Value	Function
36	0	Low fire over-run time
42	1	Purge

1) Multi-flame control:
Parameter 45 = 1.
No multi-flame control:
Parameter 45 = 0.

⚠ WARNING
For multi-flame control, parameter 45 must be set to 1, otherwise the flames will not be monitored.

➔ A password (parameter 50) is required to read the parameters – see order confirmation for password.

4 If parameters have been readjusted, stick the "Important, changed parameters" label on the connection diagram of the PFU..K2, see page 20 (20 Accessories).

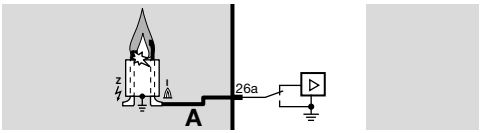
5 Install burner control unit in module subrack, see page 2 (3 Installation).

5 CABLE SELECTION/INSTALLATION

Cable selection

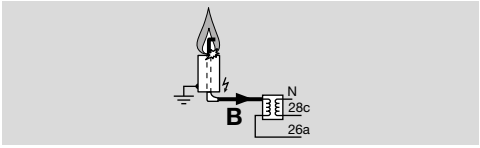
➔ Use mains cable suitable for the type of operation and complying with local regulations.
➔ Signal and control line: max. 2.5 mm².
➔ Cable for burner ground/PE wire: 4 mm².
➔ Use unscreened high-voltage cable for cable types A and B.
Example:
FZLSi 1/7, -50 to +180°C (-58 to +356°F),
Order No. 04250410, or
FZLK 1/7, -5 to +80°C (23 to 176°F),
Order No. 04250409.

A = Ionization cable



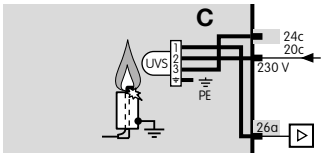
➔ Max. 100 m (328 ft).
➔ Do not lay together with ignition cable.

B = Ignition cable



➔ Recommended cable length < 1 m (3.3 ft), max. 5 m (16.4 ft).

C = UV cable



➔ Max. 100 m (328 ft).
➔ Do not lay together with ignition cable.

PROFIBUS DP cable for interface PFA 700

➔ Only use special PROFIBUS cable (Type A, two core, shielded with foil and woven shield, twisted).
Example: Lapp cable Unitronic, Order No. 2170220T Siemens, 6 x V 1 830-0EH10.
➔ The switch on the PROFIBUS plug must be set to ON for the first and last subscribers; for all other subscribers the switch must be set to OFF.

Cable installation (reduction of EMC)

➔ External electrical interference must be avoided.
➔ Lay cables individually and, if possible, not in a metal conduit.
➔ Do not lay UV/ionization cable and ignition cable together and lay them as far apart as possible.
➔ Use only radio interference suppressed spark plugs.
Example with 1 kΩ resistance:
Right-angle terminal boot, 4 mm, interference-suppressed, Order No. 04115308.
Straight terminal boot, 4 mm, interference-suppressed, Order No. 04115307.
Straight terminal boot, 6 mm, interference-suppressed, Order No. 04115306.

6 WIRING

1 Disconnect the system from the electrical power supply.
2 Wire as shown on the circuit diagram.
➔ Connection only with permanent wiring.
3 Ensure a good PE (ground) wire connection to the PFU and burner.
4 Do not reverse L1 and N.
➔ Ready contact (2a–4a), operation signalling contact (terminals 2c–4c and 6a–6e) and fault signalling contact (2e–4e): max. 1 A, 24 V, not fused internally.
➔ Terminal 20c: sensor voltage or voltage for UV sensor UVS, approx. 230 V AC.
➔ If connecting an ionization electrode (PFU 760: terminal 26a, PFU 780: terminal 18a), take the contact guard into account.

PFU 760 and 780 with UV control for continuous operation with UV flame detector UVC 1

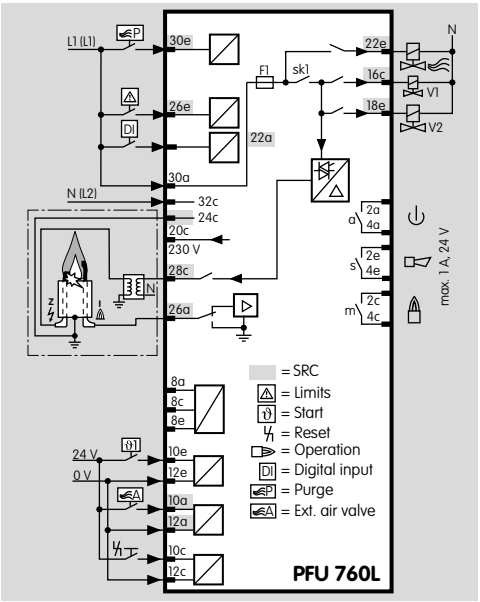
➔ Cable length UVC 1 to PFU: < 100 m (328 ft).

PFU with PROFIBUS DP

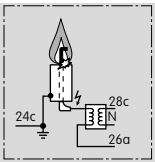
➔ For information, please refer to the documentation on module subrack BGT with fieldbus interface PFA at www.kromschroeder.com.

7 CONNECTION DIAGRAMS

7.1 PFU 760 (PFU 760L)



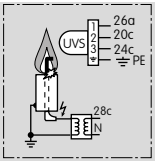
Flame control
Ionization/single-electrode operation:



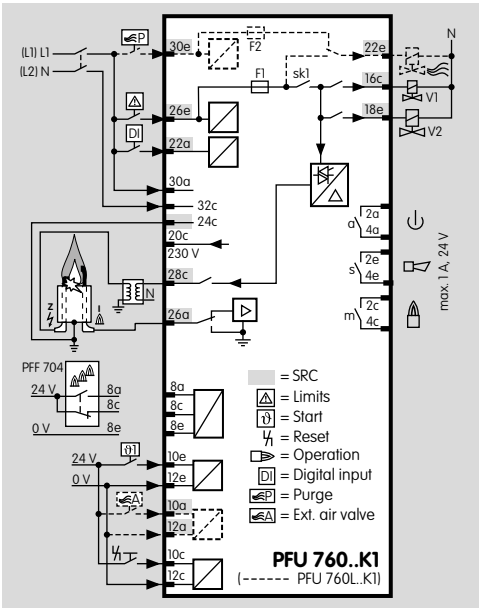
UV sensor:

➔ With UVS 1, 5, 6 or 10.

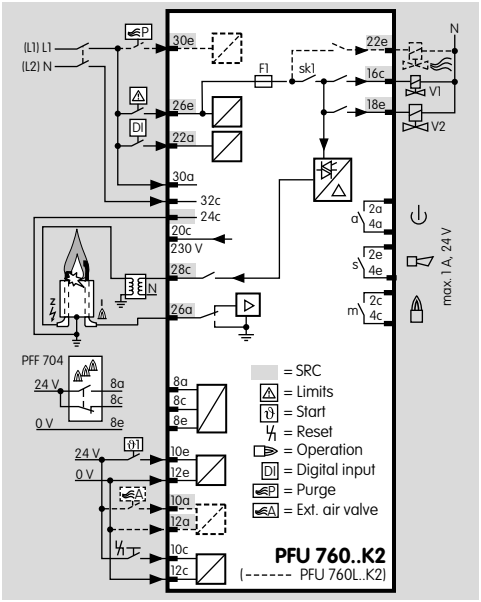
➔ Set switch-off threshold to ≤ 5 µA .



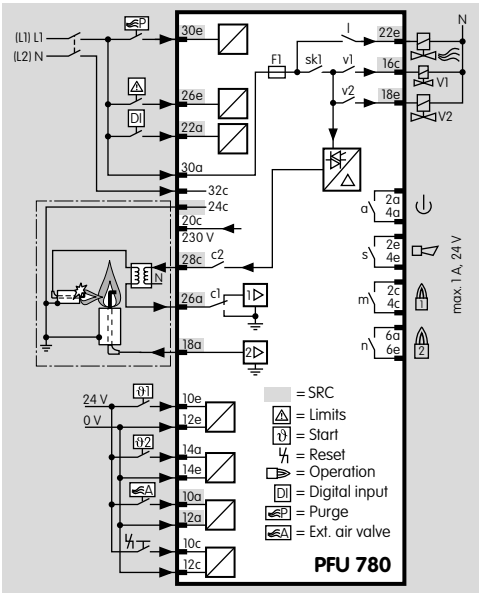
7.2 PFU 760..K1



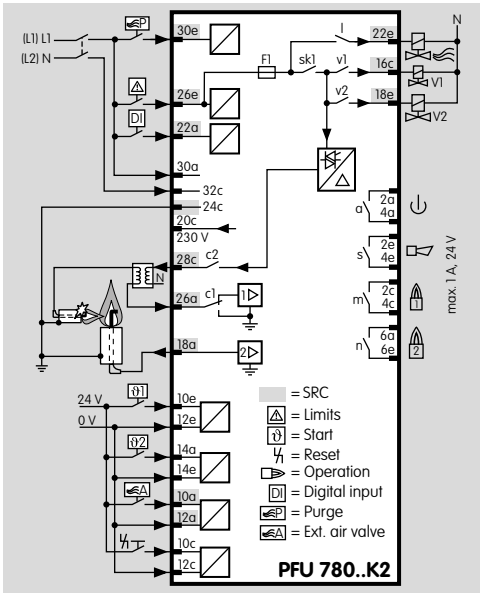
7.3 PFU 760..K2



7.4 PFU 780

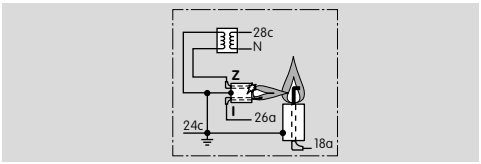


7.5 PFU 780..K2



Flame control

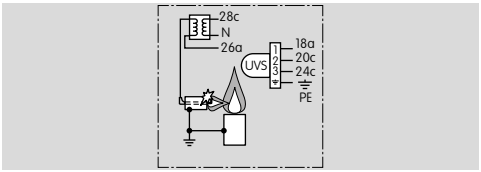
Pilot burner = ionization/main burner = ionization:



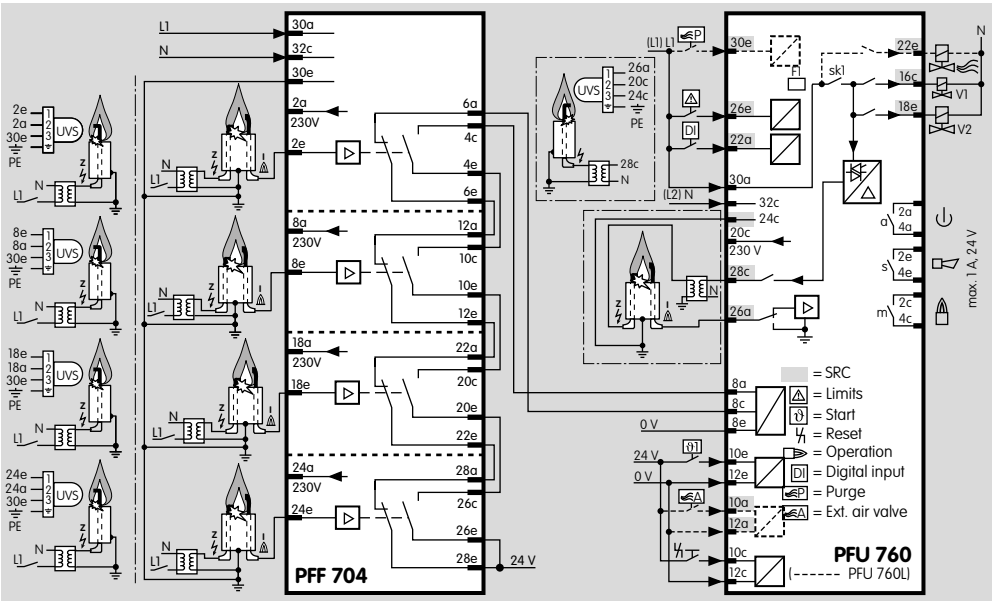
➔ Pilot burner and main main burner with ionization control

Pilot burner = single-electrode operation/main burner = UVS:

➔ Set switch-off threshold for UVS to ≤ 5 µA .



7.6 Multi-flame control



⚠ WARNING

In the case of multi-flame control, parameter 45 must be set to 1 to ensure that the flames are monitored.

→ Notes on parameter adjustment – see page 9 (8 Adjustment).

8 ADJUSTMENT

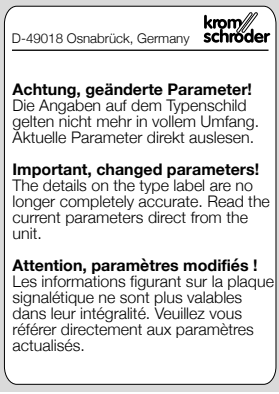
In certain cases, it may be necessary to change the default settings. Using the separate BCSoft software package and a PC opto-adapter, it is possible to modify certain parameters on the PFU, such as the switch-off threshold of the flame amplifier, the behaviour in the event of a flame failure or whether the pilot burner is to burn permanently in the case of pilot and main burner monitoring.

➔ The software package and the adapter are available as accessories – see section entitled „Accessories“.

➔ Parameter list – see Table page 17 (15 Reading off the flame signal and the parameters).

➔ A password (parameter *50*) is required to change the parameters – see order confirmation for password.

➔ Attention! If parameters are changed, stick the supplied adhesive label “Changed parameters” on the connection diagram of the PFU.



➔ If the PFU is sent to Elster GmbH for inspection without the “Changed parameters” sticker, it is returned with the device parameters which were originally set at the manufacturing plant.

➔ When replacing the burner control unit, adjust the parameter settings of the new unit to the parameter settings of the old unit.

➔ If you are using a UV sensor UVS, set the switch-off threshold to≤ 5 µA.

➔ In the case of multi-flame control, check the setting of parameter*45*.

⚠ WARNING

In the case of multi-flame control, parameter *45* must be set to 1 to ensure that the flames are monitored.

➔ The parameters can also be read and changed when the PFU is switched off.

⚠ CAUTION

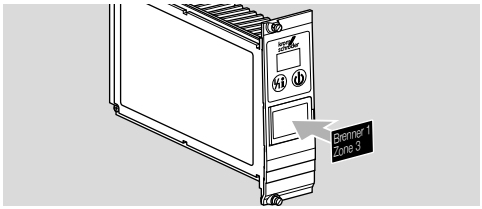
The operator is responsible for ensuring that all parameters and functions are matched to the respective application in accordance with the applicable Directives and Standards.

➔ Changes to the parameters are to be cleared with the persons responsible for the system.

9 IDENTIFICATION

➔ Each burner control unit can be labelled individually.

1 Attach label or sticker to the space provided on the handle of the burner control unit.



➔ The size of this space is 28 × 18 mm (1.10 × 0.71").

10 COMMISSIONING

One to four start-up attempts may be set at the works. This means that, after a failed start-up attempt, the burner control unit PFU can restart the burner/pilot burner or main burner up to three times before it performs a fault lock-out.

➔ During operation, the 7-segment display shows the program status:

0	Start-up position
1	Waiting time
2	Safety time on start-up
3	Flame proving period
4	Operation
5	Waiting time, main burner
6	Safety time on start-up, main burner
7	Flame proving period, main burner
8	Operation, main burner

➔ The program status display may differ depending on the parameter settings.

⚠ CAUTION

Check the system for tightness before commissioning.

1 Close the gas cock.
2 Switch on the system.
3 Check the electrical installation.
4 Switch on the PFU.

⚠ WARNING

The unit is defective if it opens a gas valve during the waiting time (display 1). Remove the unit and return it to the manufacturer.

10.1 PFU 760

1 Apply voltage to terminals 30a and 26e.

2 Switch on the PFU.
➔ The display indicates *0*.

3 Start the program for the burner: Apply voltage to terminals 10e and 12e.
➔ Gas valve V1 opens, the burner ignites and the display indicates *2*.

➔ After the safety time t_{SA} (3, 5 or 10 s) has elapsed, the PFU performs a fault lock-out and the display indicates a blinking *2*.

4 Open the gas cock.
5 Reset the PFU by pressing the Reset/Information button.
6 Start the program for the burner: Apply voltage to terminals 10e and 12e.
➔ The display indicates *2*, gas valve V1 opens and the burner ignites.

➔ After the safety time t_{SA} (3, 5 or 10 s) has elapsed, the display indicates *4* and gas valve V2 opens.

➔ The contact between terminals 2c and 4c closes.
➔ The burner is in operation.

10.2 PFU 780

1 Apply voltage to terminals 30a and 26e.
2 Switch on the PFU.
➔ The display indicates *0*.

3 Start the program for the burner: Apply voltage to terminals 10e and 12e (*ϑ*1).
➔ Gas valve V1 opens, the burner ignites and the display indicates*2*.

➔ After the safety time t_{SA} (3, 5 or 10 s) has elapsed, the PFU performs a fault lock-out and the display indicates a blinking *2*.

4 Open the gas cock.
5 Reset the PFU by pressing the Reset/Information button.
6 Start the program for the burner: Apply voltage to terminals 10e and 12e (*ϑ*1).
➔ Gas valve V1 opens, the burner ignites and the display indicates*2*.

➔ After the safety time t_{SA} (3, 5 or 10 s) has elapsed, the display indicates *4*.

➔ The contact between terminals **2c** and **4c** closes.
➔ The pilot burner is in operation.
7 Start the program for the main burner: Apply voltage to terminals 14a and 14e (*ϑ*2).
➔ The display indicates *6*, gas valve V2 opens and the main burner ignites.

➔ After the second safety time t_{SA} (3, 5 or 10 s) has elapsed, the display indicates *8*.

➔ The contact between terminals 6a and 6e closes.
➔ The main burner is in operation.

10.3 PFU..L with air valve control

These units feature an air valve control which can be used to purge the kiln or furnace or for cooling (in start-up position/standby) and heating (during operation).

Purge:

1 Set input on terminal 30e.
➔ The air valve is opened, regardless of the status of the other inputs. The display indicates *P0*.

➔ All other outputs are disconnected from the electrical power supply.
➔ A central time-delay relay must determine the purge time.

Cooling and heating:

To activate the air valve in the start-up position/ standby or during operation:

1 Apply voltage to terminals 10a and 12a.
➔ The air valve is opened. The display indicates *A* at the first position.

➔ The air valve can be activated externally (parameter 30 = 0).
For further adjustment options, see page 17 (15 Reading off the flame signal and the parameters).
➔ External activation of the air valve can be switched off during start-up (parameter 31 = 0).
➔ If the PFU is switched off, the air valve cannot be activated.

11 HIGH TEMPERATURE OPERATION

PFU 760..D and 780..D

These units are designed for high temperature operation. In high temperature operation, flame control can be interrupted by the digital input (DI). If voltage is applied to the DI (terminal 22a), the gas valves remain open and the flame is no longer monitored by the PFU.

⚠ WARNING

High temperature operation is only permitted if the temperature in the furnace chamber is so high that the gas is reliably combusted.
In countries where EN 746/NFPA 86 is applicable, if the furnace wall temperature is greater than or equal to 750°C (1400°F), the flame may be monitored by a fail-safe temperature monitoring device that complies with the standard.
Only if the temperature is greater than or equal to 750°C (1400°F) may voltage be applied to the DI input (terminal **22a**).
Comply with the local safety regulations.

Activating high temperature operation

1 Apply voltage to terminal **22a**.

➔ Two dots will appear in the display to indicate that the flame control has been disabled.

Ending high temperature operation

➔ High temperature operation is ended and there is a flame, the PFU will react depending on its parameter setting:
Parameter 33 = 2:
The PFU switches off the burner and restarts with flame simulation check (recommended in the case of UV control with UVS).
Parameter 33 = 3:
The burner remains in operation and the PFU monitors the flame again (recommended in the case of ionization control or UV control in continuous operation with UVC).

➔ High temperature operation is ended and there is no flame: The PFU performs a fault lock-out.

➔ If a restart has been programmed, the PFU will start one of a possible four start-up attempts (depending on the setting).

12 CHECKING THE FUNCTION

➔ In the case of multi-flame control, the function for each burner must be checked.

1 During operation with two electrodes or UV control, disconnect the spark plug from the flame rod or black out the UV sensor.
During single-electrode operation, close the manual valve.

⚠ WARNING

Danger of death!
If the PFU is used in single-electrode operation, high voltage is supplied to the spark plug upon restart.

➔ The PFU performs a fault lock-out:
The gas valves are disconnected from the power supply. The fault signalling contact between terminals **2e** and **4e** closes. The display blinks and displays the current program status.

➔ If start-up attempts (parameter 11) or a restart (parameters 12 and 13) are programmed, the PFU will initially restart and will then perform a fault lock-out.

➔ The flame must go out.

➔ If the flame does not go out, there is a fault.

2 Check the wiring – see page 5 (6 Wiring).

⚠ WARNING

The fault must be remedied before the system may be operated without supervision.

13 MANUAL MODE

PFU 760 and 780

A burner can be started in Manual mode for adjustment or for fault-finding:

1 Apply voltage to terminals **30a** and **26e**.

2 Switch on the PFU while holding the Reset/Information button. Hold the button until both dots in the display start to blink.

➔ If you press the Reset/Information button, the current step in Manual mode is shown. After the button has been held for 1 second, the next step will be shown.

PFU 760, PFU 760L

1 Press the button for 1 second.

➔ The display indicates step *01*.

➔ The PFU will start to purge the burner – display *P.0.*.

⚠ WARNING

The pre-purge time is not included in the program. Maintain state *P.0.* until the combustion chamber has been adequately ventilated.

2 Press the Reset/Information button for 1 s.

➔ The display indicates step *0.2.*.

➔ The PFU will start the first stage of the burner.

➔ The display runs to *.3* (an *R* rather than a *0* appears in the first place of the display if the air valve is activated).

➔ After 3 seconds in this position, the µA value for the flame signal is displayed instead of the program status.

3 Press the Reset/Information button for 1 s.

➔ The display indicates step *0.3.*.

➔ The PFU will start the second stage of the burner.

➔ The display runs to *0.4.* (*A.4.*).

➔ After 3 seconds in this position, the µA value for the flame signal is displayed instead of the program status.

PFU 760..L

The air valve is activated externally (parameter 30 = 0).

a Press the Reset/Information button for 1 s.

➔ The display indicates step *0.4.*.

b Press the Reset/Information button for 1 s.

➔ The PFU opens the air valve and indicates *A.4.*.

➔ Each time the button is pressed, the valve is closed or opened again.

➔ After 3 seconds in this position, the µA value for the flame signal is displayed instead of the program status.

The air valve opens as controlled by the program (parameter *30* = *1* or *2*).

➔ The air valve opens as controlled by the program with valve V1 or with valve V2.

a Press the Reset/Information button for 1 s.

➔ The display indicates step *A.4.*.

b Press the Reset/Information button for 1 s.

➔ The PFU will start the shut-down procedure.

➔ The unit is back in its default condition – display *0.0.*.

PFU 780

1 Press the Reset/Information button for 1 second – display *0.1.*.

➔ The PFU will start to purge the burner – display *P.0.*.

⚠ WARNING

The pre-purge time is not included in the program. Maintain state *P.0.* until the combustion chamber has been adequately ventilated.

2 Press the Reset/Information button for 1 second – display *0.2.*.

➔ The PFU will start the pilot burner – the display runs to *.4* (an *A* rather than a *0* appears in the first place of the display if the air valve is activated).

➔ After 3 seconds in this position, the µA value for the flame signal is displayed instead of the program status.

3 Press the Reset/Information button for 1 second – the display indicates *0.3.*.

➔ The PFU will start the first stage of the main burner – the display runs to *0.8.* (*A.8.*).

➔ After 3 seconds in this position, the µA value for the flame signal is displayed instead of the program status.

PFU 780..L

The air valve is activated externally (parameter *30* = *0*).

a Press the Reset/Information button for 1 s – the display indicates *0.4.*.

➔ The PFU opens the air valve. The display indicates *A.8.*.

➔ Each time the button is pressed, the valve is closed or opened again.

The air valve opens as controlled by the program (parameter *30* = *1*, *2* or *3*).

➔ The air valve opens controlled by the program with valves V1 or V2 or when it reaches the operating position.

a Press the Reset/Information button for 1 second – the display indicates *0.4.*.

➔ The PFU will start the shut-down procedure – the display runs to *0.0.*.

b Press the Reset/Information button for 1 second – the display indicates *0.0.*.

➔ The unit is back in its default condition.

PFU 760, PFU 780

➔ If a fault occurs, the PFU display will blink with the current fault message.

1 Press the Reset/Information button briefly.

➔ The PFU will be reset and will return to its start-up position. The display indicates **0.0.**. The burner can be restarted.

Burner operation in Manual mode
Limited in time:

➔ If parameter 34 is set to 1, the burner operating time in Manual mode is limited to 5 minutes.

➔ Five minutes after the last time the button is pressed, the PFU closes the valves and moves abruptly back to its start-up position – the display indicates 0.0.

Unlimited in time:

➔ If parameter 34 is set to 0, the time limitation will be removed. Emergency operation is now possible, for example in the event of a lengthy bus fault.

Flame signal display

➔ After approx. 3 seconds of burner operation, the flame signal will be displayed instead of the operating status.

Flame simulation

➔ If there is flame simulation during start-up or when the main burner is started, the flame signal is displayed immediately.

Ending manual operation

1 Switch off the PFU.

14 ASSISTANCE IN THE EVENT OF MALFUNCTION

⚠ WARNING

Electric shocks can be fatal!
To avoid harm to persons and damage to the unit, please observe the following:
– Before working on possible live components, ensure the unit is disconnected from the power supply.
– Fault-clearance must only be undertaken by authorized trained personnel.
– Faults may be cleared only using the measures described below.

➔ Do not carry out repairs on the PFU on your own as this will cancel our guarantee. Unauthorized repairs or incorrect electrical connections, e.g. the connection of power to the outputs, may cause gas valves to open and destroy the PFU. In this case, fail-safe operation can no longer be guaranteed.

➔ (Remote) resets may only be conducted by authorized trained personnel with continuous monitoring of the burner to be reset.

➔ In the event of an installation fault, the burner control unit closes the gas valves, the display blinks and shows the current program status.

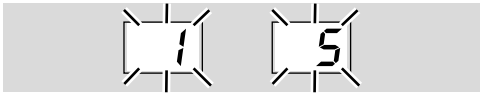
1 Reset, the PFU restarts.

➔ The PFU can only be reset when the display is blinking, not when the flame signal or a parameter is being displayed. In this case press the Reset/Information button until the display starts to blink or switch the unit off and on again. The PFU can now be reset.

➔ If the PFU does not react even though all faults have been remedied, remove the unit and send it to the manufacturer for inspection.

? Faults

! Cause
- Remedy



? The display blinks and indicates 1 on the burner/pilot burner
or
5 on the main burner.

! The PFU has detected an incorrect flame signal without the burner having been ignited (extraneous signal).

! The UV tube in the UV sensor UVS or flame detector UVC 1 is defective (service life ended) and permanently indicates an extraneous signal.
- UVS:
  Replace UV tube, Order No.: 04065304 – see operating instructions for UV sensor UVS.
  UVC 1:
  Replace UV tube with bracket, Order No.: 74960684 – see operating instructions for UV flame detector UVC 1.

! Flame signal through ceramic insulation.
- Increase value of parameter 04 or 05 to adjust the switch-off threshold of the flame amplifier.

PFU 780:

! The flame amplifier of the main burner can "see" the pilot flame.
- Position the UV sensor/flame rod so that it "sees" only the main flame.
- Set parameter 16 to 0 (interrupted pilot burner).

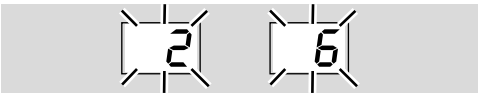
? Start-up – no ignition spark – the display blinks and indicates 2.

! The ignition cable is too long.
- Shorten it to 1 m (max. 5 m).

! Gap between spark electrode and burner head is too great.
- Adjust gap to max. 2 mm.

! Ignition cable not contacting in the terminal boot/ ignition transformer.
- Screw the cable on firmly.

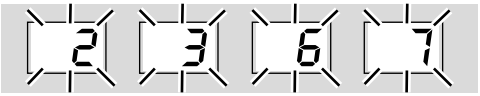
! Ignition cable has short-circuited to ground.
- Check installation, clean the spark electrode.



? **Start-up – no gas supply – the display blinks and indicates**
2 on the burner/pilot burner
or
6 on the main burner.

! The gas valve V1 (on the burner/pilot burner) or V2 (on the main burner) does not open.
- Check voltage supply to the gas valve.

! There is still air in the pipe, e.g. after installation work has been carried out or if the system has not been in operation for a long period.
- "Purge" the pipeline and reset the system several times.



? **Start-up – flame burning – nevertheless, the display blinks and indicates**
2 (A2) or 3 (A3) on the burner/pilot burner or
6 (A6) or 7 (A7) on the main burner.

! Flame failure on start-up.
- Read off flame signal (parameter 01 or 02, see page 17 (15 Reading off the flame signal and the parameters).
  If the flame signal is lower than the switch-off threshold (parameter 04 or 05), this may be attributable to the following causes:

! The set value for the cut-off sensitivity is too high.

! Short-circuit on the ionization electrode as the result of soot, dirt or moisture on the insulator.

! Flame rod not correctly positioned at the flame edge.

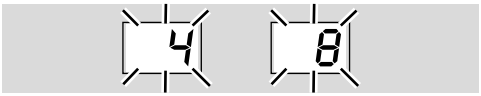
! Gas/air ratio incorrect.

! Flame not contacting burner ground as the result of excessively high gas or air pressure.

! Burner or PFU not (adequately) grounded.

! Short-circuit or discontinuity on the flame signal cable.

! Soiled UV sensor.
- Remedy fault.



? **Operation – flame burning – burner interrupted – the display blinks and indicates**
4 (A4) on the burner/pilot burner or
8 (A8) on the main burner.

! Flame failure during operation.
- Read off flame signal (parameter 01 or 02, see page 17 (15 Reading off the flame signal and the parameters).
  If the flame signal is lower than the switch-off threshold (parameter 04 or 05), this may be attributable to the following causes:

! The UV tube in the UV sensor UVS or flame detector UVC 1 is defective (service life ended) and permanently indicates an extraneous signal.

! The set value for the cut-off sensitivity is too high.

! Short-circuit on the flame rod as the result of soot, dirt or moisture on the insulator.

! Flame rod not correctly positioned at the flame edge.

! Gas/air ratio incorrect.

! Flame not contacting burner ground as the result of excessively high gas or air pressure.

! Burner or PFU not (adequately) grounded.

! Short-circuit or discontinuity on the flame signal cable.

! Soiled UV sensor.
- Remedy fault.

? **The display blinks and indicates 10.**

! Actuation of the remote reset input is faulty.

! Too many remote resets. More than 5 resets have been conducted within the last 15 minutes, either automatically or manually.

! Consecutive fault caused by a previous fault whose actual cause has not been remedied.
- Pay attention to previous fault messages.
- Remedy cause.

→ The cause will not be remedied by performing a reset every time a fault lock-out occurs.
- Check whether remote reset complies with standards (EN 746 allows resetting only under supervision) and correct if necessary.

→ The PFU may only be reset manually under supervision.
- Press the Reset/Information button on the PFU.

? **The display blinks and indicates *28*.**

! An internal device error occurred.
- Remove the PFU and return it to the manufacturer.

? **The display blinks and indicates *29*.**

! An internal device error occurred.
- Reset the unit.

? **The display blinks and indicates *30*.**

! Abnormal data change in the parameters set for the PFU.
- Reset the parameter to its original value using the BCSoft software.
- Establish the cause of the fault to avoid repeat faults.
- Ensure that the cables have been installed properly – see page 5 (5 Cable selection/ installation).
- If the measures described above do not help, remove the unit and return it to the manufacturer for inspection.

? **The display blinks and indicates *31*.**

! Abnormal data change in the parameters set for the PFU.
- Reset the parameter to its original value using the BCSoft software.
- Establish the cause of the fault to avoid repeat faults.
- Ensure that the cables have been installed properly – see page 5 (5 Cable selection/ installation).
- If the measures described above do not help, remove the unit and return it to the manufacturer for inspection.

? **The display blinks and indicates *32*.**

! Supply voltage too low.
- Operate the PFU in the specified mains voltage range (mains voltage +10/-15%, 50/60 Hz).

! An internal device error occurred.
- Remove the unit and return it to the manufacturer for inspection.

? **The display blinks and indicates *33*.**

! Faulty parameterization.
- Check parameter settings using BCSoft.

! An internal device error occurred.
- Remove the unit and return it to the manufacturer for inspection.

? **The display blinks and indicates *35*.**

! Short-circuit on air valve output (terminal 22e).
- Check the wiring.
- Then check the safety function – see page 17 (14.1 Checking the safety function).

! An internal device error occurred.
- Remove the unit and return it to the manufacturer for inspection.

? **The display blinks and indicates *36*.**

! Short-circuit on ignition transformer or gas valve output (terminal 16c, 18e or 28c).
- Check the wiring – see page 6 (7 Connection diagrams).
- Then check the safety function – see page 17 (14.1 Checking the safety function).

! An internal device error occurred.
- Remove the unit and return it to the manufacturer for inspection.

? **The display blinks and indicates *51*.**

! Safety interlock failure, no voltage at terminal **26e**.

- Check safety interlocks.

? **The display blinks and indicates *52*.**

! The PFU is being permanently reset.

- Apply voltage to terminal **10c** only for reset, approx. 1 s– see page 6 (7 Connection diagrams).

? **The display blinks and indicates *53*.**

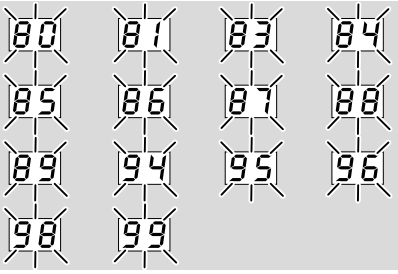
! The actual time between two starts is less than the min. time.

- Comply with the min. timing cycle of 10 s.

? **The display blinks and indicates *83*.**

! The UV sensor connections for ionization and N are confused; the UV sensor is signalling a negative flame signal.

- Check the UV sensor connections and undo the pole reversal.



? **The display blinks and indicates *80*– *99*.**

! System fault – the PFU has performed a safety shut-down. The cause may be a unit defect or abnormal EMC influence.

- Ensure that the ignition cable has been installed properly – see page 5 (5 Cable selection/installation).
- Ensure that the EMC regulations for the system are satisfied – particularly for systems with frequency converters – see page 5 (5 Cable selection/installation).
- Reset the unit.
- Pull burner control unit out of module subrack and then reinsert.
- Check mains voltage and frequency.
- If the measures described above do not help, the unit has probably suffered a hardware defect – remove the unit and return it to the manufacturer for inspection.

? **PFU does not start even though all faults have been remedied and the PFU has been reset.**

- Remove the unit and return it to the manufacturer for inspection.

? **Start – no ignition spark and no gas supply – the display blinks and indicates *F1*.**

! One of the external flame detectors PFF detects an extraneous signal (an incorrect flame signal).

- Eliminate extraneous signal.

! Incorrect voltage supply to terminal 8a (24 V in standby).

- Supply terminal 8a with 24 V.

! Parameter 45 has been set incorrectly.

- Check whether multi-flame control is required. If not, set parameter 45 to 0.

? **Flame failure of an external flame detector – the display blinks and indicates *F2*.**

! One of the external flame detectors does not detect a flame signal during the safety time.

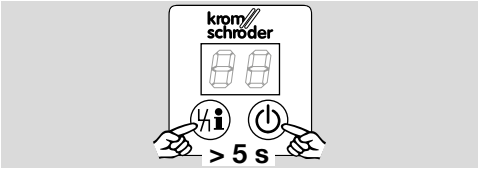
? **– the display blinks and indicates *F3*?**

- One of the external flame detectors does not detect a flame signal during the flame proving period.

? **– the display blinks and indicates *F4*?**

- One of the external flame detectors does not detect a flame signal during operation.

- Check voltage supply to terminal 8c.



? The display is not lit and nothing is indicated.

! The PFU has performed a safety shut-down due to external interference during use.
- Ensure that the ignition cable has been installed properly – see page 5 (5 Cable selection/installation).
- Check the connection between burner ground (PE) and burner control unit.
- Adjust ignition gap on burner to max. 2 mm.
- Interruptions to the power supply are to be avoided as far as possible.
- Ensure that the entire system complies with the requirements of the EMC Directive.
- Press the Reset/Information button and the On/Off button together for at least 5 s.
- If these measures do not help, remove the unit and return it to the manufacturer for inspection.

14.1 Checking the safety function

⚠ WARNING
Risk of explosion!
If the safety function is not checked, the gas valves might remain open allowing non-combusted gas to escape.

1 Close the manual valve.
2 Start the burner control unit several times and check that it operates safely – see also the section entitled “Checking the function”.
The unit is defective if it opens a gas valve during the waiting time (display *1*).
3 If the behaviour is incorrect, remove the unit and return it to the manufacturer for inspection.

15 READING OFF THE FLAME SIGNAL AND THE PARAMETERS

1 Press the Reset/Information button for 2 s. The display changes to parameter *01*.
2 Release the Reset/Information button. The display stops at this parameter and indicates the related value.
3 Press the Reset/Information button again for 2 s. The display changes to the next parameter. All parameters can be recalled one after the other in this way.
➔ If the button is pressed only briefly, the display indicates what parameter is currently being displayed.
➔ The normal program status is displayed again approx. 60 seconds after the last time the button is pressed.

Parameters	
No.	**Name Value**
01	Flame signal, burner/pilot burner (*0–30* µA)
02	Flame signal, main burner (*0–30* µA)
03	Program status when the most recent fault occurred (*00–08* or *A0–A8*)
04	Switch-off threshold, burner/pilot burner (*1–20* µA)
05	Switch-off threshold, main burner (*1–20* µA)
10	Max. number of start-up attempts, burner/pilot burner (**1–4**)
11	Max. number of start-up attempts, main burner (*1–4*)
12	Restart burner/pilot burner: *0* = Immediate fault lock-out, *1* = Restart.
13	Restart, main burner: *0* = Immediate fault lock-out, *1* = Restart.
14	Safety time during operation for V1 and V2 (*1*; *2* s)
15	Flame simulation check in start-up position/standby: *0* = Flame simulation check only on start-up, *1* = Flame simulation check in start-up position/standby.
16	Permanent pilot burner: *0* = Pilot burner interrupted, *1* = Pilot burner switches on and off depending on *91*
20	Minimum operating time t_B: *0–250* s, values over *99* are displayed with a dot, e.g. 150 = display *15.*
21	Minimum burner pause time t_P: *0–250* s
22	Safety time on start-up, burner/pilot burner (*3*; *5*; *10* s)
23	Flame proving period, burner/pilot burner (*0–25* s)
24	Safety time on start-up, main burner (*3*; *5*; *10* s)
25	Flame proving period, main burner (*0–25* s)
26	Gas valve control V2: *0* = With operating signal, *1* = With air valve during operation.
30	Air valve control: *0* = No program control, *1* = Air valve opens with V1, *2* = Air valve opens with V2, *3* = Air valve opens with operating signal.

Parameters	
No.	**Name Value**
31	Behaviour of the air valve at start-up: 0 = The air valve cannot be activated between start-up signal and operating signal, 1 = The air valve can always be activated.
32	Behaviour of the air valve in the event of a malfunction: 0 = Cannot be activated, 1 = Can be activated.
33	When high temperature operation is ended: 2 = Burner interrupted and the unit restarts, 3 = Burner remains in operation.
34	Burner operation in Manual mode unlimited/limited: 0 = Unlimited burner operation, 1 = Burner operation limited to 5 minutes.
35	Automatic UVS sensor check, 1 x in 24 hours: 0 = Function inactive, 1 = Function active.
36	Low fire over-run time (gas over-run time) t_{NG} 0-60 s
42	Purge: 0 = Without signal at the purge input (terminal 30e), 1 = With signal at the purge input (terminal 30e).
45	Digital input 2: 0 = Multi-flame control off, 1 = Multi-flame control on.
R061	Minimum operating time t_B 0-6000 = Time in seconds
81	Last fault
82	Second to last occurring fault
83	Third to last occurring fault
84	Fourth to last occurring fault
...	
90	Tenth to last occurring fault

16 LEGEND

	Safety interlocks (limits)
	Burner start-up signal
	Digital input
	Ignition transformer
	Gas valve
	Air valve
	Purge
	External air valve control
	Burner operating signal
	Fault message
	Reset
	Ignition/High voltage
I	Ionization
	Input/Output, safety circuit

17 TECHNICAL DATA

Ambient conditions

Condensation and dew in and on the unit are not permitted. Avoid direct sunlight or radiation from red-hot surfaces on the unit.
Avoid corrosive influences, e.g. salty ambient air or SO_2.
Ambient temperature: -20 to +60°C (-4 to +140°F).
No condensation permitted.
Enclosure: IP 00, after installing in a module subrack BGT..1DP700 or BGT..1DP710 according to the instructions, the front corresponds to IP 20 pursuant to IEC 529.
Permitted operating altitude: < 2000 m AMSL.

Mechanical data

Number of operating cycles:
max. 1,000,000 for 1 A resistive load.
Mains switch: 1000,
Reset/Information button: 1000.
Weight: approx. 0.65 kg (1.43 lb).

Electrical data

Mains voltage:
PFU..T: 220/240 V AC, -15/+10%, 50/60 Hz,
PFU..N: 110/120 V AC, -15/+10%, 50/60 Hz,
for grounded or ungrounded mains. Voltage for valves = mains voltage.
Input voltage of signal inputs:

Rated value	110/120 V AC	220/240 V AC
Signal “1”	80–132 V	160–264 V
Signal “0”	0–20 V	0–40 V
Frequency	50/60 Hz	50/60 Hz

Rated value	24 V DC
Signal “1”	24 V, ±10%
Signal “0”	< 1 V

24 V input current: Signal “1” = typ. 5 mA.
Power consumption:
8 VA plus inherent consumption of the ignition transformer.
Inherent consumption of ignition transformer:

TZI 5-15/100QE TZI 5-15/100QT		
Input	120 V AC	0.9 A at 50 Hz
		0.6 A at 60 Hz
Output	5000 V AC	15 mA at 50 Hz,
		11 mA at 60 Hz.

TZI 5-15/100WE		
Input	230 V AC	0.4 A at 50 Hz,
		0.3 A at 60 Hz.
Output	5000 V AC	15 mA at 50 Hz,
		10 mA at 60 Hz.

TZI 8-20/19QE TZI 8-20/19QT		
Input	120 V AC	1,9 A at 50 Hz,
		1.4 A at 60 Hz.
Output	8000 V AC	20 mA at 50 Hz,
		16 mA at 60 Hz.

TZI 8-20/19WE		
Input	230 V AC	1,0 A at 50 Hz,
		0.7 A at 60 Hz.
Output	8000 V AC	20 mA at 50 Hz,
		16 mA at 60 Hz.

TZI 8-12/100QE TZI 8-12/100QT		
Input	120 V AC	1,2 A at 50 Hz,
		0.9 A at 60 Hz.
Output	8000 V AC	12 mA at 50 Hz,
		9 mA at 60 Hz.

TZI 8-12/100WE		
Input	230 V AC	0.6 A at 50 Hz,
		0.4 A at 60 Hz.
Output	8000 V AC	12 mA at 50 Hz,
		9 mA at 60 Hz.

TZI 8-20/33QE TZI 8-20/33QT		
Input	120 V AC	1,7 A at 50 Hz,
		1.3 A at 60 Hz.
Output	8000 V AC	20 mA at 50 Hz,
		16 mA at 60 Hz.

TZI 8-20/33WE		
Input	230 V AC	1,0 A at 50 Hz,
		0.7 A at 60 Hz.
Output	8000 V AC	20 mA at 50 Hz,
		16 mA at 60 Hz.

Output current: max. 2 A per output, but total current for valves and ignition transformer:
max. 2.5 A. Operation and fault signalling contacts: dry contact (floating), max. 1 A, 24 V, not fused internally.
Flame control:
sensor voltage: approx. 230 V AC,
sensor current:: > 1 µA.
Length of sensor cable:
max. 100 m (328 ft).
Fuse in unit:
F1: 3.15 A, slow-acting, H,
pursuant to IEC 127-2/5,
F3: 3.15 A, slow-acting, H,
pursuant to IEC 127-2/5.
Fail-safe inputs and outputs:
All the inputs and outputs marked “ ” (see page 6 (7 Connection diagrams)) may be used for safety tasks.

PFF 704

Power consumption: 10 VA.
Ionization voltage: 230 V AC.
Max. flame signal cable length: 100 m (328 ft).
Cut-off sensitivity of the flame amplifiers: adjustable between 1 µA and 10 µA (factory default setting: 1 µA).
Max. contact rating: 2 A.
Fine-wire fuses:
2 A, semi time-lag, E pursuant to DIN 41571.
Weight: approx. 0.51 kg (1.12 lb).

PFR 704

Input voltage:
110/120 V AC, -15/+10%, 50/60 Hz,
220/240 V AC, -15/+10%, 50/60 Hz
or
24 V AC/DC, ±10%.
Current per relay: 25 mA.
Contact rating of floating outputs: max. 2 A, 264 V (not fused internally).
Weight: 0.17 kg (0.375 lb).

PFP 700
Power consumption: 25 VA.
Output load:
24 V DC, 600 mA, short circuit-proof.
Fine-wire fuse: 0.315 A, slow-acting pursuant to DIN 41571.
Weight: approx. 0.75 kg (1.65 lb).

18 DESIGNED LIFETIME

Max. service life under operating conditions:
20 years after date of production, plus max. 6 months in storage prior to first use.

19 LOGISTICS

Transport
Protect the unit from external forces (blows, shocks, vibration).
Transport temperature: see page 18 (17 Technical data).
Transport is subject to the ambient conditions described.
Report any transport damage on the unit or packaging without delay.
Check that the delivery is complete.

Storage
Storage temperature: see page 18 (17 Technical data).
Storage is subject to the ambient conditions described.
Storage time: 6 months in the original packaging before using for the first time. If stored for longer than this, the overall service life will be reduced by the corresponding amount of extra storage time.

20 ACCESSORIES

20.1 BCSoft
The current software (Version 3.xx) can be downloaded from our Internet site at www.docuthek.com. To do so, you need to register in the DOCUTHEK.

20.2 Opto-adapter PCO 200
Including BCSoft CD-ROM,
Order No.: 74960625.

20.3 “Changed parameters” stickers

Affix on the connection diagram of the PFU 760, 780 following changes to device parameters set at the factory.
100 pcs, Order No.: 74921492.

20.4 Device master data files (GSD)
The GSD file can be downloaded from our Internet site at www.docuthek.com. Log on to the Docuthek and then choose document type “Software”.
GSD file on CD,
Order No.: 74960436.

21 CERTIFICATION

21.1 Certificate download

Certificates – see www.docuthek.com

21.2 Declaration of conformity

CE

We, the manufacturer, hereby declare that the products PFU 760 and PFU 780 comply with the requirements of the listed Directives and Standards.

Directives:

– 2014/30/EU – EMC
– 2014/35/EU – LVD

Regulation:

– (EU) 2016/426 – GAR

Standards:

– EN 298:2012
– EN 61508:2002, 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

Scan of the Declaration of conformity (D, GB) – see www.docuthek.com

21.3 SIL

SIL

For systems up to SIL 3 pursuant to EN 61508.

Safety-specific characteristic values	
Diagnostic coverage DC	97.9%
Type of subsystem	Type B to EN 61508-2, 7.4.3.1.4
Mode of operation	High demand mode pursuant to EN 61508-4, 3.5.12
Mean probability of dangerous failure PFH_D	1.34×10^{-9} 1/h
Mean time to dangerous failure $MTTF_d$	$MTTF_d = 1/PFH_D$
Safe failure fraction SFF	99.2%

FM approved

FM APPROVED

Factory Mutual Research Class: 1997. Suitable for applications pursuant to NFPA 86.

21.4 AGA approved

AGA

Australian Gas Association, Approval No.: 5597

21.5 UKCA certified

UK CA

Gas Appliances (Product Safety and Metrology etc. (Amendment etc.) (EU Exit) Regulations 2019)
BS EN 298:2012

21.6 Eurasian Customs Union

EAC

The products PFU 760, PFU 780 meet the technical specifications of the Eurasian Customs Union.

21.7 REACH Regulation

The device contains substances of very high concern which are listed in the Candidate List of the European REACH Regulation No. 1907/2006. See Reach list HTS at www.docuthek.com.

21.8 China RoHS

Directive on the restriction of the use of hazardous substances (RoHS) in China. Scan of the Disclosure Table China RoHS2, see certificates at www.docuthek.com.

22 DISPOSAL

Devices with electronic components:
WEEE Directive 2012/19/EU – Waste Electrical and Electronic Equipment Directive

At the end of the product life (number of operating cycles reached), dispose of the packaging and product in a corresponding recycling centre. Do not dispose of the unit with the usual domestic refuse. Do not burn the product.
On request, old units may be returned carriage paid to the manufacturer in accordance with the relevant waste legislation requirements.

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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