Original Operating Instructions
Flame Amplifier

Type: **3001D**

Document: **BA 3001D EN REV.0**

BFI Automation
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1 General aspects

1.1 Introduction

These operating instructions are a helpful guide for ensuring the successful and safe operation of the flame amplifier. They contain important information on how to operate the system safely, correctly and efficiently. Observing the operating instructions will help to prevent hazards, reduce costs of repair and downtimes and increase the reliability and life of the device.

All illustrations and drawings in these operating instructions are shown for illustration purposes and are not authoritative detailed designs.

The operating instructions always have to be accessible at the device. They have to be read and applied by each person who is required to work with/on the device.

This work may involve, for example:

- operation
- troubleshooting during operation
- servicing
- maintenance (upkeep, inspection, repair) and/or
- transport

This should be confirmed by the operating company in writing.

1.2 Warning notes

The following warning notes are used in these operating instructions:

⚠DANGER

This warning level indicates an imminent hazardous situation.

If the hazardous situation is not prevented, this will result in death or severe injury.

Follow the instructions that accompany this warning to prevent the risk of death and severe personal injury.

⚠WARNING

This warning level indicates an potentially hazardous situation.

If the hazardous situation is not prevented, this may result in death or severe injury.

Follow the instructions that accompany this warning to prevent the potential risk of death and severe personal injury.

⚠CAUTION

This warning level indicates an potentially hazardous situation.

If the hazardous situation is not prevented, this may result in slight or moderate injuries.

Follow the instructions that accompany this warning to prevent the injury of persons.

CAUTION

This warning level indicates potential damage to property.

If this situation is not prevented, it may result in damage to property.

Follow the instructions that accompany this warning to prevent damage to property.

NOTICE

A notice indicates additional information that will make the handling of the device easier.

1.3 Copyright protection

These operating instructions have to be treated as confidential. They may only be used by authorised staff. Access by third parties may only be granted upon written agreement of BFI Automation.

All documents are protected in keeping with the German copyright law.

The disclosure and reproduction of documentation, in whole or in part, as well as the exploitation and communication of its content shall not be permitted unless expressly stated otherwise. Offenders are liable for prosecution and the payment of damages.

We reserve all rights to exercise industrial property rights.

1.4 Warranty

Read these operating instructions carefully before operating the flame amplifier !

The manufacturer is not liable for damage or operating malfunctions that result from the operating instructions not being observed.

The operating company has to supplement the operating instructions with operating instructions on the basis of national regulations on accident prevention and environmental protection, including information on supervision and notification requirements with respect to special operating circumstances, e.g. regarding organisation of work, working processes and staff deployed.

The recognised technical rules for safe and professional working also have to be observed in addition to the operating instructions and the regulations on accident prevention applicable to the country and place of use.

The warranty shall become void, for example, in the event of:

- inappropriate use
- use of impermissible equipment
- incorrect connection
- prior works that are not part of the supplied product or service
- non-use of original spares and accessories
- conversion, if this has not been harmonised with BFI Automation
- non-performance of specified maintenance work

NOTICE

It is recommended that the operator of the device concludes a service contract with BFI Automation. This guarantees that the device is regularly checked by our service staff and ensures that any required wearing and spare parts are available without long delivery periods.

1.5 Obligation of the operating company

The flame amplifier may cause hazards if it is operated inappropriately or in an improper condition.

The operating company is under the obligation to operate the machine in proper state only. The operating company has to secure hazardous areas that exist between BFI devices and the customer's own equipment.

The operating company has to appoint and instruct responsible staff:

- Only deploy trained or instructed staff.
- Clearly set out the responsibilities of the staff with regard to operation, set-up, maintenance and repair.
- Regularly check that staff are safety conscious and aware of hazards and are observing the operating instructions.
- Before starting work, staff who are assigned to work with/on the device have to have read and understood the operating instructions, in particular the chapter on "Safety", as well as the relevant regulations.
- The operating instructions and relevant regulations have to be stored in such a way that they are accessible to operating and maintenance staff.
- Set out who will have responsibility for device operation and ensure that this person has the authority to overrule any unsafe instructions of third parties.

NOTICE

Generally valid legal and other binding regulations on accident prevention and environmental protection have to be observed and instructed, in addition to the operating instructions.

1.6 Liability disclaimer

All technical information, data and guidance on device operation that are contained within these operating instructions are, to the best of our knowledge, correct at the time of printing, taking into account our present understanding and experience.

We reserve the right to make technical changes with respect to the further development of the flame amplifier outlined in these operating instructions. No claims can be made based on the specifications, illustrations and descriptions of these operating instructions.

We shall not be liable for damage or operating malfunctions that result from operating errors, inappropriate repairs or the non-observance of the operating instructions. We expressly state that only original spare parts and accessories approved by us may be used. This also applies to the components of other manufacturers that have been used.

The installation or use of non-approved spare and accessory parts and any unauthorized retrofits and modifications are not permitted for safety reasons and exclude any liability by BFI Automation for consequential damages.

BFI Automation is liable for possible errors or omissions with the exclusion of additional claims entered into in the framework of the warranty obligations conceded to in the contract. Claims for damages, on whatever legal basis they may be, shall be excluded.

Translations into foreign languages are carried out in good faith. We cannot accept any liability for translation errors; this also applies where the translation has been carried out or has been commissioned by us. The original text alone shall be binding.

Descriptions and illustrations do not necessarily depict the delivered product or a possible spare parts order. Drawings and graphics are not to scale.

1.7 Declaration of conformity

BFI Automation
Dipl.-Ing. Kurt-Henry Mindermann GmbH
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Germany

Declaration of Conformity in accordance with EC-Directives

This is to confirm that the below described system in its design and type of construction complies with the provisions of the Directive of the Council of the European Communities on the approximation of the laws of the member states relating to

Low-Voltage Directive 2006/95/EU
Explosion Protection Directive 94/9/EU (ATEX 95)
EMC Directive 2004/108/EU

This declaration of conformity of the European Communities is the result of an examination of the TD Department of BFI Automation in accordance with the European Standards. If the system will be changed without our approval this declaration will become invalid.

Description of the system:	Flame Monitoring System 3000/4000
Part type:	3001D (in combination with a BFI flame scanner)
Directives:	2006/95/EC, formerly 73/23/EWG 94/9/EC (ATEX95), formerly ATEX 100a 2004/108/EC, formerly 89/336/EWG
Applicable European Standards:	EN 55022, EN 50082-2 EN 298 / EN 230 EN 50156-1 EN 60664-1 EN 60079-15 (Flame Scanner)
Date / Manufacturer signature:	2009-02-03 *J.-M. Mindermann*
Function of the signatory:	General Manager

1.8 Address of the manufacturer

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2 Safety

2.1 Intended use

The flame amplifier shall be used exclusively to detect flames in combination with a suitable flame scanner. The flame scanner and flame amplifier together constitute a complete flame monitoring system for burners with a random capacity and random fuels in single and multiple burner systems.

The flame amplifier renders available to the burner control the safety-oriented binary signals for "Flame ON/OFF".

On account of the continuous fully electronic self-test of its function, the flame amplifier is approved for continuous operation.

⚠WARNING

Danger when improperly used !

The device may cause hazards if it is not used as intended and/or for any other purposes.

The device has to be used only for the purposes for which it is intended.

The procedures described in the operating instructions have to be observed.

The manufacturer/supplier shall not be liable for damage resulting from use for non-intended purposes. The user/operating company alone shall bear the risk.

2.2 Requirements on persons

NOTICE

Work on/with the device may only be performed by persons authorized to do so based on their training and qualification. Furthermore, such persons have to have been commissioned by the operating company.

Do not allow any persons who are being apprenticed, educated, instructed or on a general training programme to work on the device without the constant supervision of an experienced person.

Persons who are under the influence of drugs, alcohol or medication that affects reactivity shall not be permitted to carry out work on the device.

Connection, set-up, maintenance and repair work may only be carried out by qualified specialist staff.

This device may cause hazards if it is operated inappropriately by untrained staff or if it is not used for its intended purpose.

Generally valid legal and other binding regulations on accident prevention and environmental protection in addition to basic health and safety requirements have to be observed. The operating company has to instruct its staff accordingly.

2.3 Safety instructions

The following instructions on accident prevention have to be observed when operating the flame amplifier.

NOTICE

Only operate the device if it is in a proper state !

- Do not remove or disable safety devices.
- Check for externally noticeable damage and defects prior to using the device ! Immediately notify the appropriate authority/person of any changes that occur (including changes in operating performance). If necessary, stop and secure the device immediately.
- Allow only authorised specialist staff to carry out set-up and/or maintenance work.
- Operating staff have to be informed before maintenance or other special work is carried out.
- Replace worn or defective parts.
- Use suitable maintenance tools only.
- After repair work, refit all safety devices and carry out electrical and mechanical checks.
- Check the operating instructions for details of displays as well as switch-on and switch-off procedures.
- Prior to switching on the device, make sure that no-one can be endangered by the device !
- The operating instructions always have to be kept close to the device and be readily at hand.
- Any non-compliance with the safety instructions outlined in these operating instructions may lead to damage to property, personal injury or even death.

2.4 Safety devices

2.4.1 Fundamental aspects

Check the safety equipment and locking devices on the device for safe operational condition.

Only operate the device if all safety devices are present and enabled. The operating company or operator of the flame amplifier is responsible for the proper operation of the device.

NOTICE

The device has been fitted with warning and danger signs for the protection of operating staff. These signs have to be observed. Damaged or illegible signs have to be replaced immediately.

2.4.2 Safety devices on the flame amplifier

The flame amplifier has been fitted with the following safety devices:

- Housing (protection against accidental contact)
- Flame-proof housing (optional)
- Earth connection of device housing (optional)
- Explosion protection barriers (optional)

2.5 Safety instructions in case of maintenance and troubleshooting

2.5.1 Fundamental aspects

- Deadlines set or indicated in the operating instructions for repetitive checks / inspections shall have to be observed !
- Appropriate workshop equipment is essential for performing maintenance work.
- In conformity with the electrical regulations, work on the electrical equipment of the system may only be carried out by an electrical specialist or by trained staff under the direction and supervision of an electrical specialist.
- The adjustment, maintenance and inspection activities and deadlines stipulated by BFI Automation, including information on the replacement of parts / assemblies, have to be observed! These tasks may only be carried out by authorised specialist staff.
- Operating staff have to be informed before maintenance or other special work is carried out. A supervisor has to be appointed.
- Screw connections which have been loosened during maintenance and servicing work, have to be tightened.
- If maintenance and repairs require safety devices to be dismantled, these devices have to be remounted and checked as soon as the maintenance and repair work has been completed.
- Operating and auxiliary materials as well as exchanged parts have to be disposed of in a safe and eco-friendly way.
- Spare parts supplied by BFI Automation or approved of by BFI Automation only may be used.

2.5.2 Electrical / electronic devices

⚠DANGER

Danger to life caused by electrical current!

Contact with live wires or components presents a danger to life !

Prior to any work on the electrical equipment, disconnect the flame monitoring system from the power supply network !

NOTICE

In keeping with the electrical regulations, work on electrical / electronic parts / components may only be carried out by electrical specialists.

Important rules of conduct

- Check the device in regular intervals. Any defects or faults ascertained have to be corrected immediately. Switch off the device until the defects have been corrected.
- Equipment parts undergoing inspection, maintenance or repair work have to be made de-energised, if required. First check that the disconnected parts are no longer live, then short to earth. Also isolate neighbouring live parts
- If work is required on live parts, a second person has to be assigned who can disconnect the power supply in case of an emergency. Only use insulated tools !
- Fuses must not be repaired or bridged. Only use original fuses with the specified current !

2.5.3 Testing in keeping with the German Workplace Safety Ordinance (BetrSichV)

In case of the coupling or installation of devices from various manufacturers or suppliers, the operating company has to carry out a precise test, prior to start-up, in keeping with the German Workplace Safety Ordinance (BetrSichV) in force and the applicable electrical regulations.

In case of queries, please get in touch with BFI Automation.

2.5.4 Safety test

⚠WARNING

In order to ensure correct operation, the flame scanners as well as flame amplifiers of all applications have to be tested several times by starting and stopping the burner several times. In all cases the flame relay has to be switched off reliably in case of an absent flame. Carry out this test whilst several neighbouring burners are started and stopped and different boiler outputs are used. This is an indispensable pre-requisite for a safe and correct operation of the device !

3 Technical data

3.1 General characteristic features

- Self-control to verify flawless function of the device in keeping with European standards EN 230, EN 298 and TRD 411 to 414.
- Two externally selectable sensitivity and time levels
- Fully electronic construction
- Tested by the German Technical Inspection Association TÜV
- Approved of by DIN DVGW and DIN CERTCO
- Suitable for safety related applications up to SIL 3 (according to IEC 61508)

3.2 Electrical system, mechanical system, function

two switch-OFF time	adjustable in six steps (1 to 6 seconds)	
two sensitivity ranges	adjustable in 99 steps	
switch-ON treshold	adjustable in 64 steps (25 to 75 %)	
switch-OFF treshold	< 25%	
flame relay	two changeover contacts (1 changeover contact potential-free internal 1 amp fuse)	
flame intensity display	0 to 100 %	by bar graph
flame intensity output	0 (4) to 20 mA	(Ra < 360 ohm)
flame evaluation display	000 – 999	LED-seven segment
impulse dividing ratio	1:1 , 1:2 , 1:4	
switching treshold - pre-alarm warning	50%	
pre-alarm warning	+ 24 V DC, 100 mA	short-circuit-proof
time level selection II	+ 24 V DC, 40 mA	
quantisation changeover	jumpers	
active-ON time II	+ 15 V DC, 10 mA	

status indicators	
time level I or II ON	green LED
pre-alarm warning ON	yellow LED
evaluation and monitor channel. ON	yellow LED

connected load		+ 24 V DC, 500 mA
current consumption		approx. 300 mA (plus flame scanner)
range of operating temperature		-20 degrees to +60 degrees C
		(-4 degrees to +140 degrees F)
applies for the safety circuit		VDE 0110, class C, 250 V
maximum switching voltage	250 V	ohmic load
maximum switching current	1 amp	ohmic load
maximum switching power		300 VA

3.3 Weight

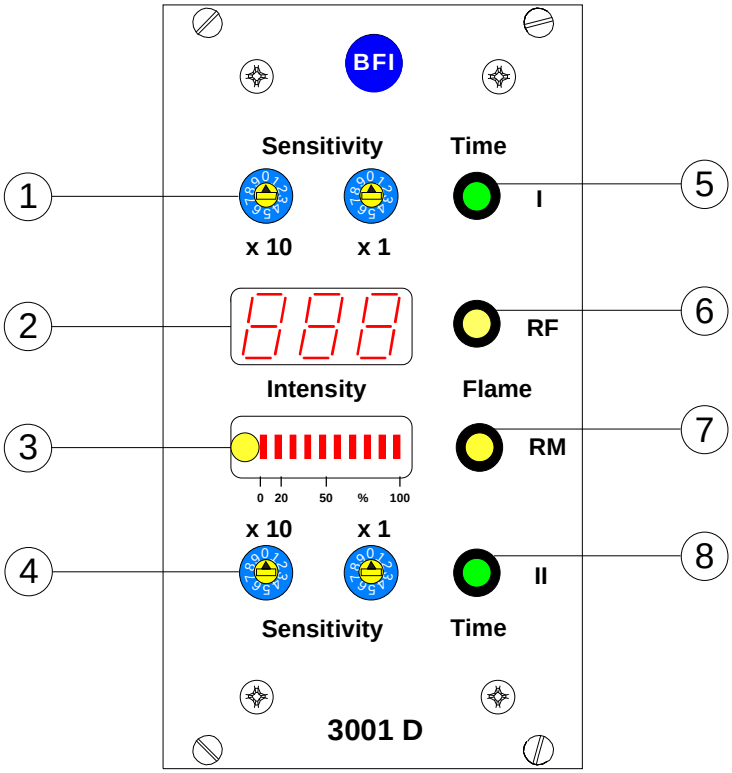
Weight	approx. 0,7	kg

3.4 Dimensions

All slide-in modules of series 3000 completely pluggable for use in card magazines in keeping with German standard DIN 41494 (19" standard).

Width	70.78	mm = 14 TE
Height	128.70	mm = 3 HE
Depth:	188.00	mm

3.5 Adjustment and display elements



1 Rotary switch - setting – sensitivity I (x10 + x1)
2 Flame evaluation display
3 Bar-graph display - analogue output / LED pre-alarm
4 Rotary switch - setting - sensitivity II (x10 + x1)
5 LED display - time I / sensitivity I active
6 LED display - RF status evaluation channel
7 LED display - RM status monitor channel
8 LED display - time II / sensitivity II active

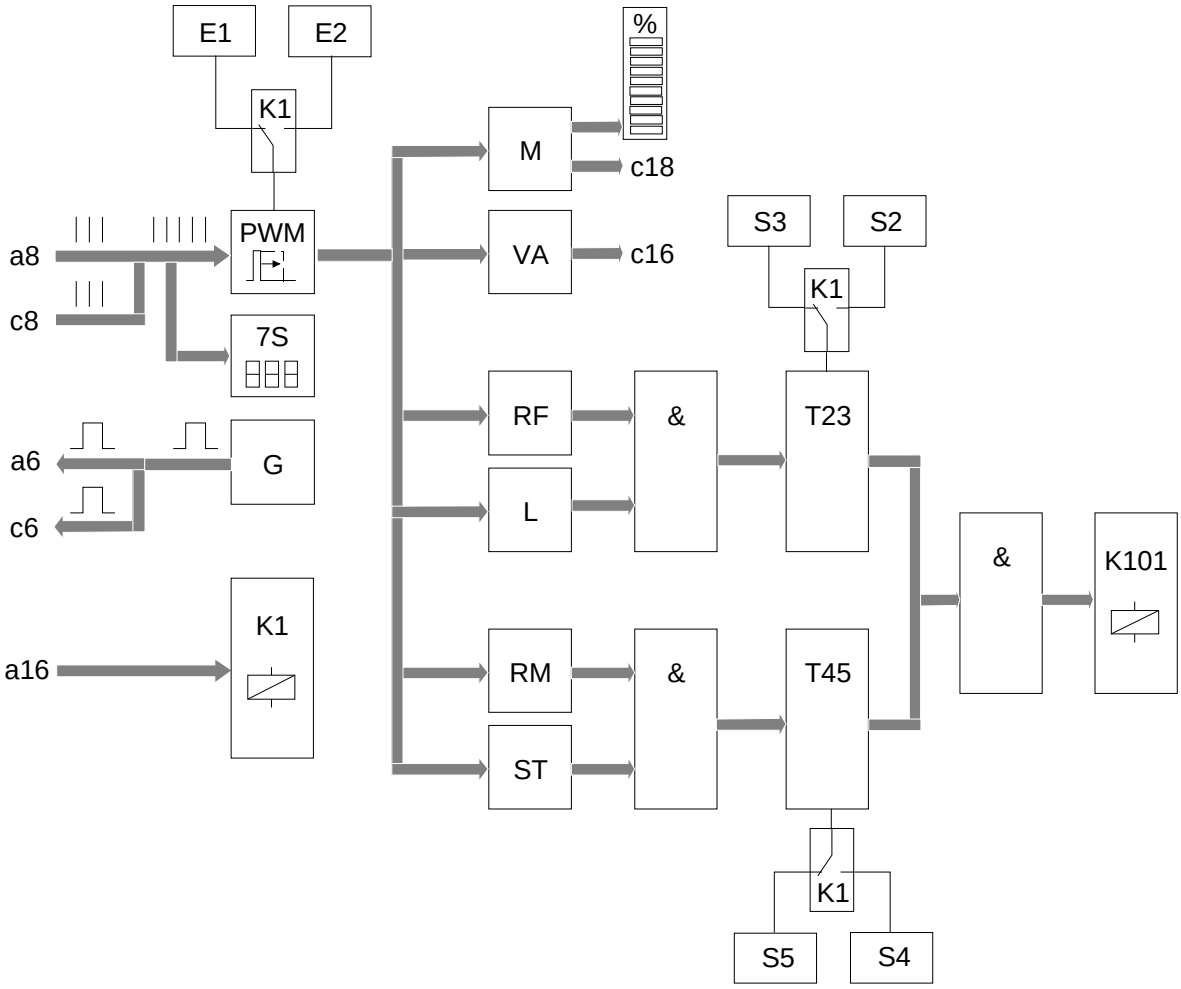
3.6 Device design

The system slide-in module of the flame amplifier is based on a signal processor circuit with fail-safe self-monitoring system and has been approved for continous operation in keeping with European standards EN 240 and 298 as well as in conformity with TRD 411-414. Every failure of component part will cause the safe switching-OFF of the flame relay.

The flame scanner signal (see separate operating instructions of the flame scanner) reaches the sensitivity controllers in the form of a pulse telegram through a filter and pulse shaper stage. Depending on the channel selected, the requested pulse width is set. Subsequently the flame signal is distributed to three different function channels.

1 Measurement channel (M)
2 Monitor channel (RM)
3 Evaluation channel (RF)

3.7 Block diagram



E1	sensitivity 1	S2	DIP switch S2 (RF2).
E2	sensitivity 2	S3	DIP switch S3 (RF1).
PWM	pulse width modulation	S4	DIP switch S4 (RM2).
G	self-test pulse	S5	DIP switch S5 (RM1).
K1	Relay switch-over	T23	switch-OFF time RF (1 - 6 s).
M	measurement channel	T45	switch-OFF time RM (1 - 6 s).
VA	pre-alarm early warning	K101	flame relay (2 changeover contacts).
RF	evaluation channel	a8/c8	input flame signal.
L	switch-ON threshold	a6/c6	output self-test pulse.
RM	monitor channel	a16	external input changeover.
ST	self-test	c18	output 0/4 ... 20 mA.
%	bar-graph display	c16	output pre-alarm warning
7S	LED-seven segment		

4 Transport, installation and connection

NOTICE

All installation and connection work may be carried out by qualified and approved specialist staff only !

Observe the legal stipulations and adjustment instructions of the plant operator !

4.1 Scope of delivery

- Flame amplifier 3001D
- Operating instructions
- Backpanel with screw terminal (optional)
- Pin connector (optional)
- Connection cable (optional)
- 19" rack (optional)
- Wall-mounted housing (optional)
- Flame-proof housing (optional)

Refer to the order papers for the exact scope of delivery and compare with the delivery note.

Checking for completeness

Check the entire delivery for completeness against the accompanying delivery note. Please refer to our terms of sale and delivery otherwise.

Report any damage

After arrival of the device and accessories, notify the shipping agent, the insurance company and BFI Automation immediately in case of any damage caused by transport or inadequate packaging.

Take steps to minimise and prevent further damage.

Report the insurance case to the insurance company without delay and transmit the full claim documents at once in order to expedite the claims settlement (at the latest in sufficient time before the expiry of any periods of preclusion and/or limitation relating to the compensation claims against third parties).

4.2 Packaging

The flame amplifier is shipped in different packagings.

The most frequently used packaging materials are cardboard and plastics (foils, foamed material). The packaging material also includes materials added to the packed goods as protection against moisture (e.g. bags with silicagel).

NOTICE

Packaging has to be disposed of in an environmentally friendly way and in accordance with the relevant provisions on disposal.

4.3 Forwarding instructions

NOTICE

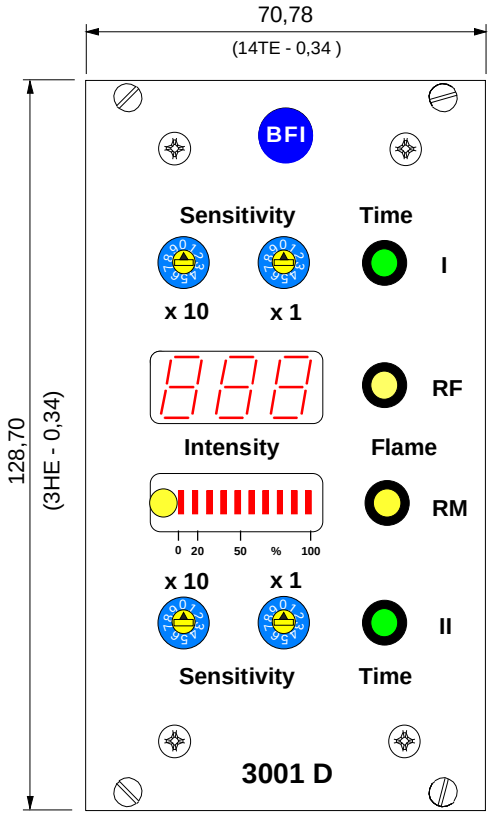
Do not drop the device during transport and do not subject to heavy impacts.

4.4 Weight - flame amplifier

0.7 kg

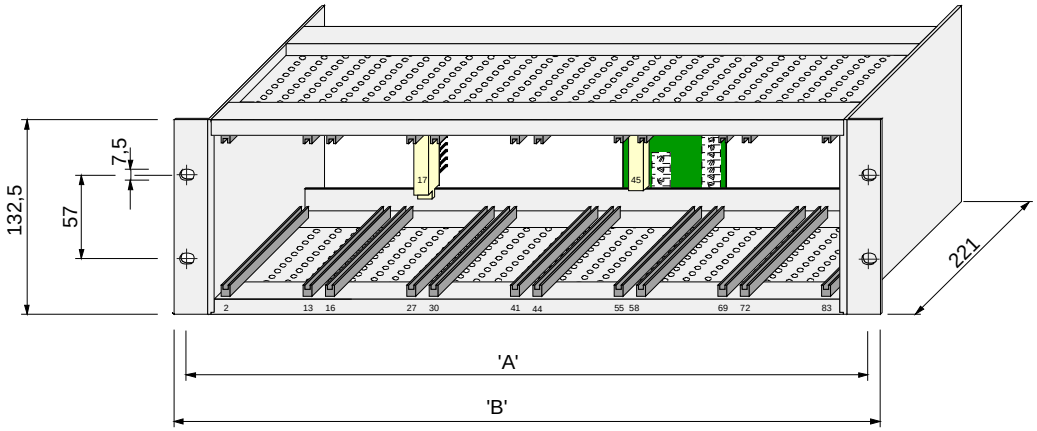
4.5 Space requirement

See following illustration, depth 188 mm.

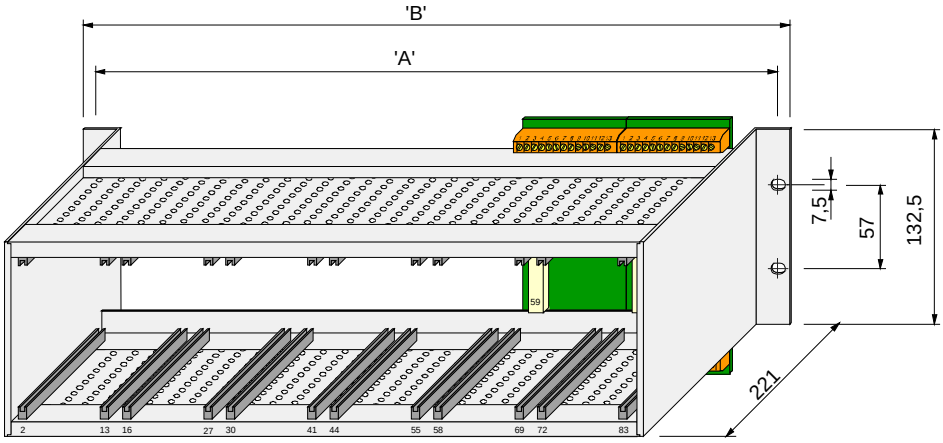


4.6 Installation

4.6.1 19”-built-in housing (rack mount installation)



4.6.2 19”-built-on housing (wall mount installation)



4.6.3 Dimensions for 19”-built in/on housing

All dimensions ± 0.4 mm	**14 TE** for 1 slide-in module	**28 TE** for 2 slide-in modules	**42 TE** for 3 slide-in modules	**56 TE** for 4 slide-in modules	**84 TE** for 6 slide-in modules
Dimension "A"	110.3	181.4	252.6	323.7	465.9
Dimension "B"	127.1	198.2	269.4	340.5	482.7

4.7 Connection

4.7.1 Electrical connection

⚠DANGER

Danger to life caused by electrical current !

The safety instructions and local safety regulations have to be observed during connection !

For connection data, please refer to the chapter titled "Technical data" as well as to the following terminal diagram.

Ensure that the available supply voltage complies with the voltage indicated on the type plate (24 VDC).

Prior to connection, check the device and the connecting cables for visible damage.

Push the flame amplifier into the 19" rack and connect the connecting cable up to the rack.

Various connection possibilities are available:

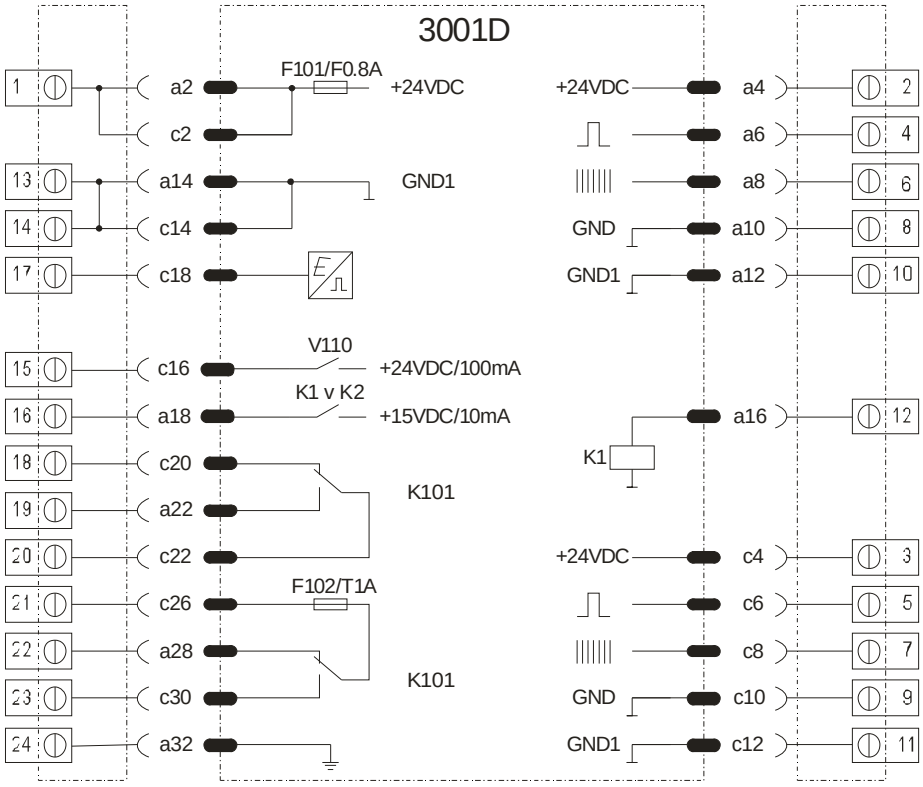
- Backpanel R (screw terminal on the rear)
- Backpanel F (screw terminal on the front)
- Pin connector

  - Flat-Pin 2.8 mm
  - Maxi-Termipoint
  - wire wrap

NOTICE

Prior to the connection of the flame sensor to the flame amplifier, observe the separate operating instructions of the flame scanner !

4.7.2 Terminal diagram



Backpanel	3001D	function
1	a2	Power supply input +24 VDC
2	a4	scanner 1 - Power supply +24 VDC
3	c4	scanner 2 - Power supply +24 VDC
4	a6	scanner 1 - self-test pulse
5	a6	scanner 2 - self-test pulse
6	a8	scanner 1 - flame signal
7	c8	scanner 2 - flame signal
8	a10	scanner 1 - signal GND
9	c10	scanner 2 - signal GND
10	a12	scanner 1 - Power supply GND1
11	c12	scanner 2 - Power supply GND1
12	a16	external changeover time II / sensitivity II +24VDC/40mA
13	a14	Power supply input GND 1
14	c14	analogue output GND1
15	c16	pre-alarm warning +24VDC / 100mA
16	a18	message „Time II ON“ +15VDC / 10mA
17	c18	analogue output + 0/4-20mA
18	c20	auxiliary circuit flame “OFF“
19	c22	auxiliary circuit flame “ON“
20	c22	auxiliary circuit lead
21	c26	safety circuit lead
22	a28	safety circuit flame “OFF“
23	c30	safety circuit flame “ON“
24	a32	protective ground wire / earth

4.8 Storage

Do not unpack the packed flame amplifier and accessories.

The following conditions apply to storage:

- Store in a dry place. Maximum relative humidity 60 %. Make sure that packages are not stored in the open. In addition, It has to be assured that the floor in the storage area will remain dry throughout the storage period.
- Protect from direct sunlight. Storage temperature: 15 degrees to 25 degrees C (59 degrees to 77 degrees F).
- Store in a dustfree location.
- Avoid mechanical vibrations and damage.

5 Description

5.1 Functional description

Flame amplifier, type 3001, evaluates the pulses of the flame scanner and uses the information to activate the flame relay in case of an adequate flame signal. The intensity of the flame signal is indicated by means of the bar-graph displays on the front panel. If all bar-graphs are lit, this corresponds to an output signal of 20 mA. In addition, the flame amplifier generates all signals which are required for self-tests.

The self-test and failsafe flame amplifier 3001D consists of two separate signal processing channels of different design. Internal and external disturbances of any kind lead to immediate actuation of the safety logic.

Two independent monitoring levels (time I, time II) can be selected by means of external control signals. Every level is described by its sensitivity setting and switch-OFF time. A fuel or load related optimisation of flame monitoring is thus ensured in an easy way. The connection of a second flame scanner in parallel or alternating operation is possible.

The output signal of the flame scanner reaches the sensitivity controllers in the form of a pulse telegram through a filter and pulse shaper stage. Two rotary switches per level are available, with which the requested signal can be enhanced. The flame signal is distributed to three different function channels.

- Measurement channel (M)
- Monitor channel (RM)
- Evaluation channel (RF)

5.1.1 Measurement channel (M)

The analogue measurement channel consists of an attenuation filter with signal limiter and downstream voltage-to-current converter. The converter supplies the internal analogue intensity display and the remote display instrument with 0 to 20 mA or 4 to 20 mA through output terminals.

The digital measurement channel feeds the three digit 7-segment indicator and displays the impuls output of the flame scanner. The momentary value will be refreshed once per second. The value of the displayed signal is equivalent to the flame intensity of the combustion process within the observed flame measurement spot and is not depending on the sensitivity setting of the flame amplifier. The impuls value is affected mainly by the following parameters:

- Flame Scanner Output
- Type of fuel
- Speed of the combustion process (mixing)
- Air to fuel ratio
- Flue gas recirculation
- Flame temperature

5.1.2 Monitor channel (RM)

The monitor channel processes the flame signal of the flame scanner. It comprises all periodic self-tests of the system required for continuous operation. In case of a failure of the flame monitoring system, the control logic responds immediately and the monitor channel RM switches-OFF. In case of a flame and system failure, the burner operation is interrupted within the safety switch-OFF time set (S4 / S5). The operating condition is indicated by the RM LED. The RM monitor channel has to be switched on for burner operation.

5.1.3 Evaluation channel (RF)

The evaluation channel processes the flame signal of the flame scanner. The switch-OFF times are selected by the DIP switches (S2 / S3). Moreover, the evaluation channel monitor the switch-ON threshold (cf. also chapter 5.1.4). The operating condition is indicated by the RF LED. The RF evaluation channel has to be switched on for burner operation.

NOTICE

The flame relay K101 is energized on only, if RM and RF are switched on at the same time.

When the burner is started, the RM and RF channels may respond at different times.

When the burner is stopped, the RM and RF channels may respond at different times. The safety switch-OFF times for operation must not be exceeded.

5.1.4 Variable switch-ON threshold (hysteresis)

The switch-ON threshold of the evaluation channel is variable and can be set by means of DIP switch S1. The adjustable range is between 25 and 75% of the analogue flame signal. The device has been factory set to 25%. A higher switch-ON threshold may sometimes be used to block out light from neighbour burners.

⚠WARNING

A continuous signal from neighbour flames of more than 25% of the analogue flame signal is a safety risk and must not be turned off by a raised switch-ON threshold.

Given a raised switch-ON threshold, the switch-OFF threshold remains firmly on 25%.

After having changed the switch-ON threshold, stop the burner and check whether the switch-OFF threshold falls short safely, and the flame relay is switched off.

5.1.5 Fixed switch-OFF threshold

The switch-OFF threshold of both channels has been defined at 25% and cannot be changed.

5.1.6 Pre-alarm warning

An pre-alarm warning indicates unfavourable combustion processes before the system is switching-OFF completely. The switch threshold is fixed to 50% of the analogue output signal. This function is used to reliably indicate continuous aggravation of the flame signal by soiling of the lens (flame scanner), change of the flame / fuel quality or raising of the flame. The availability of the plant is thus improved.

The MA LED is used as a indicator. A 24 V / 100 mA output is available for external processing.

5.1.7 Safety switch-OFF times

The safety switch-OFF times of the operating process can be set by means of DIP switches S2 to S5 (cf. chapter 6).

The following allocation applies:

S2 - RF channel on time 2

S3 - RF channel on time 1

S4 - RM channel on time 2

S5 - RM channel on time 1

The switch-OFF times can be set to between 1 and 6 seconds. The flame amplifier has been pre-set to 1 second in the works of the manufacturer.

NOTICE

The operating company shall have to ensure that the switch-OFF times allocated to the various fuels are not exceeded !

By means of an external 24 VDC signal, two independently set switch-OFF time can be switched over. If this switch-over is used, make sure that the shorter switch-OFF time is allocated to channel 1 (Time 1), thus ensuring that the shorter time is used in case of a loss of the 24 VDC switch-over signal.

The switch-over of the range selection is carried out by applying a direct voltage of the pin connector a16 (+24 VDC / 40 mA). The auxiliary voltage can be tapped at pin connector c4. The range switchover is locked internally and range 1 or 2 switched on is indicated by the respective green LED lighting up on the front panel.

NOTICE

A change of the switch-OFF times may only be carried out with the acceptance of an approval expert !

Please observe that the switch-OFF time of the RM monitor channel has to be set separately from the RF evaluation channel.

5.1.8 Signal outputs

The potential-free relay contact for the "Flame on / off" message is internally protected by a fine wire fuse (T 1 amp). This prevents a fusing of contacts. When the device has been plugged-out, the fuse is accessible and can be replaced, if and when necessary.

When the burner has been switched off, the RF and RM LEDs must no longer be lit. The analogue signal on the bar-graph display has to have dropped to below 25%.

In order to indicate the flame intensity externally, 0 to 20 mA or 4 to 20 mA are available at the pin connectors c18 (+) and c14 (-). The device has been factory set to 0 to 20 mA, and the two bridges X4 and X6 are closed. If 4 to 20 mA are required, the bridges X4 and X6 have to be opened. The permissible load must not exceed a maximum of 360 ohm.

The pin connector a18 (+15 VDC, 10 mA maximum) can be set to handle two different signals. The information Time 1 or Time 2 active (factory setting) or the Safety channel feedback can be used.

A short-circuit-proof output on pin connector c16 (+24 VDC, 100 mA maximum load) is used for the pre-alarm warning.

5.1.9 Impuls divider

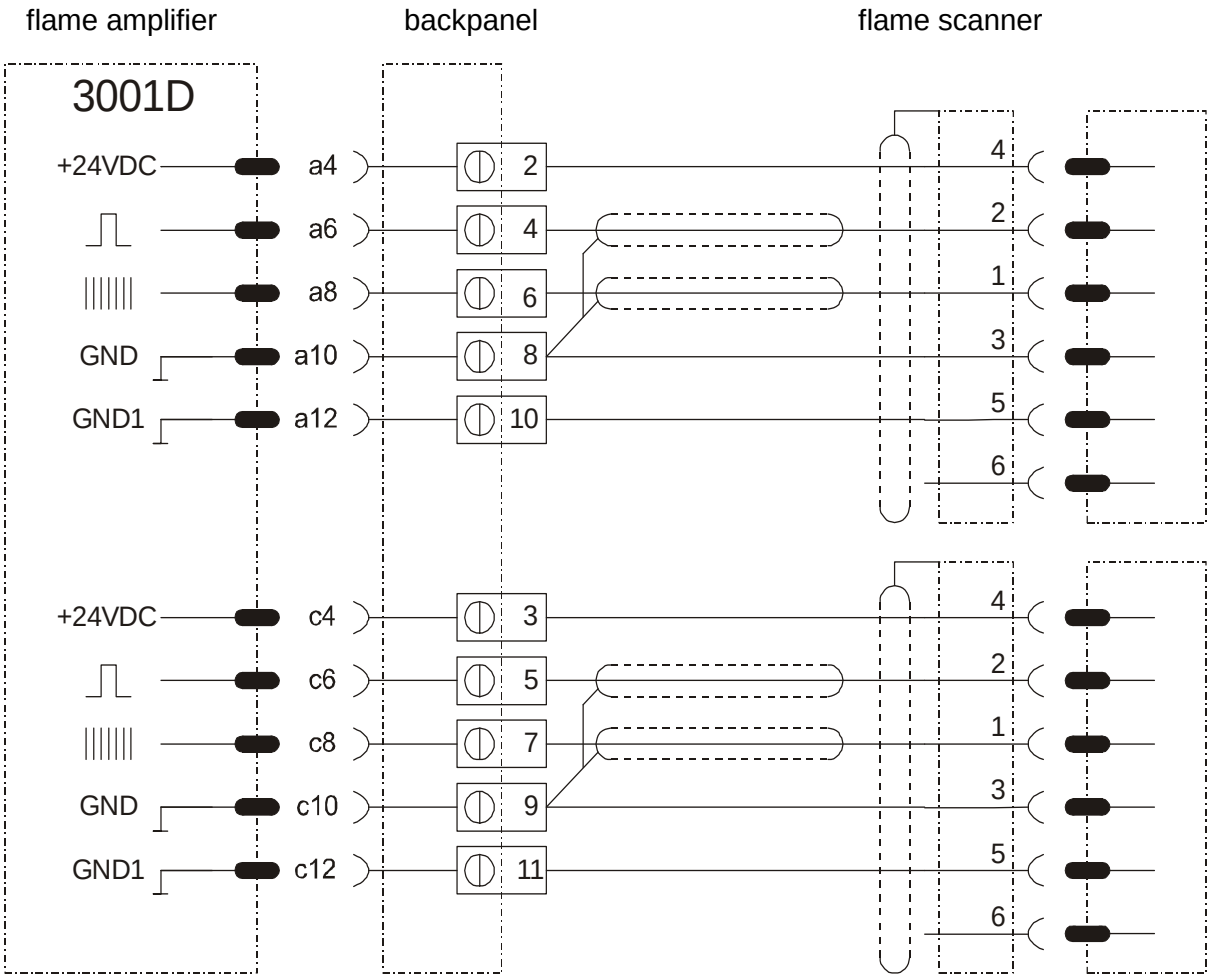
The flame amplifier is equipped with an adjustable reduction of the input signal. Set an impuls divider ratio in three steps with jumper T, 1:1, 1:2 and 1:4. The flame amplifier processes the proportionately reduced signal.

NOTICE

The flame signal will be reduced after increasing the dividing factor. The digital indicator sisplays the reduced impuls value of the input signal after dividing stage.

5.1.10 Parallel connection of flame scanners

The flame amplifier has been designed for the connection of two flame scanners in parallel operation. The pin connectors a4, a6, a8, a10 and a12 are used to connect a flame scanner. The pin connectors c4, c6, c8, 10 and c12 are used to connect the second flame scanner.



6 Operation of the flame amplifier

NOTICE

All installation and connection work may be carried out by qualified and approved specialist staff only !

Prior to initial operation, all regulations and adjustment parameters set up by the operating company of the burner have to be observed !

For the operation of the flame amplifier, please observe the separate operating instructions of the flame scanner !

6.1 Connection of the flame amplifier

NOTICE

Prior to the connection of the flame scanner and a slide-in power supply unit to the flame amplifier, observe the separate operating instructions of the flame scanner and of the slide-in power supply unit !

6.2 Testing the flame amplifier

In order to ensure a correct operation, flame amplifier as well as flame scanner have to be tested several times in case of all applications by starting and stopping the burner several times (the flame relay has to be switched off reliably in all cases in which the flame is absent). Carry out this test whilst several neighbouring burners are started and stopped and different boiler outputs are used. This is an indispensable pre-requisite for a safe and correct operation of the device !

6.3 Initial operation of the flame amplifier

The flame amplifier provides the flame scanner with operating voltage and the self test pulse, and ensures the evaluation of the flame scanner signals. All safety-related functions are carried out by the self-checking flame amplifier. After correct installation and wiring, the system is operational immediately. The respective status indicator (green LED) lights up at the slide-in power supply unit (optional, type 3002) and on the flame amplifier. The RM and RF LEDs as well as the bar graph indicator for the intensity are off.

After correct detection of the flame to be monitored, the RF and RM LEDs have to be lit. These LEDs have to be allocated to the "Flame on" and "Flame off" safety circuit. The safety circuit is connected by means of the pin connectors c28, a28 and c30. The flame intensity is displayed by a bar-graph display. One bar represents 2.0 mA (0 - 20 mA) or 1.6 mA (4 - 20 mA).

NOTICE

The flame intensity indicator must be in the range between 50% and 100% !

If the output signal is lower than 50 %, monitoring may become instable. The flame relay is switched off at 25 %. By means of the pre-set pre-alarm warning, a warning signal may be generated at a threshold to be set. An overoscillation in the range of 20 to 25 mA is permissible.

6.4 Factory setting of the flame amplifier

All sensitivity settings have set to the maximum value (99). The setting (00) is not permitted.

All safety switch-OFF times have been set to 1 s.

The switch-ON threshold is set to 25% and the pre-alarm warning to 50%.

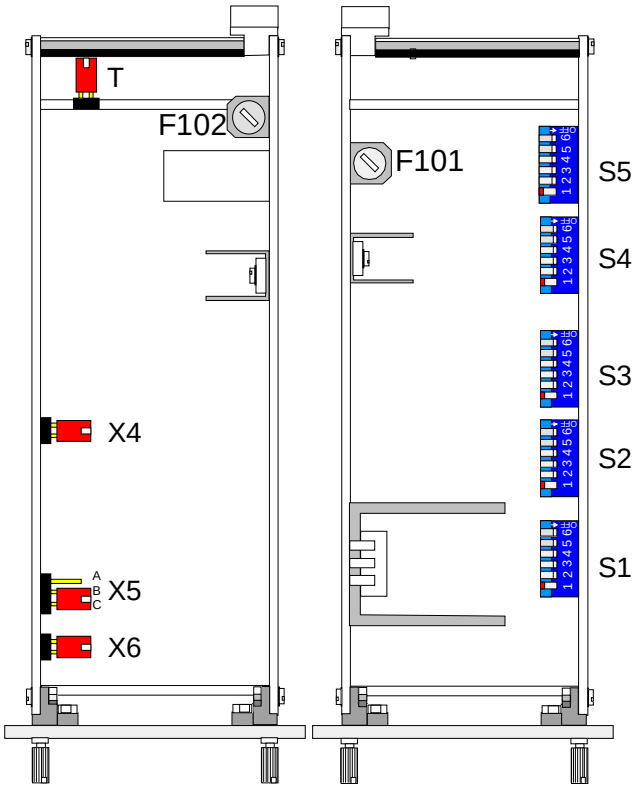
The switch-ON delay time corresponds to half the switch-OFF time (X5, B-C closed, near front panel).

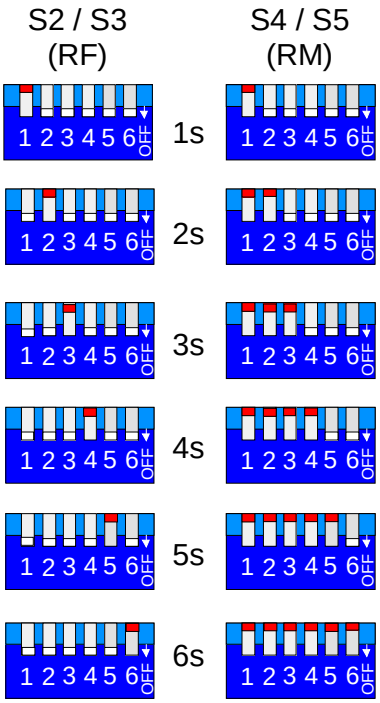
The analogue output has been set to 0 - 20 mA (X4 and X6 closed).

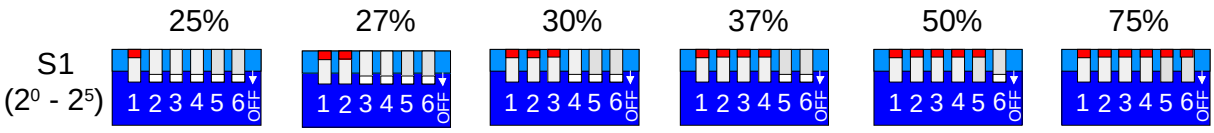
The impulse dividing ratio has been set to 1:1.

6.5 Operation settings

Prior to the initial operation, check the setting of the switch-ON times and adjust, if and when necessary. DIP switches S2 to S5 are accessible on the upper side of the device. For this purpose pull the flame amplifier out of the 19" rack.







S1	switch-ON threshold
S2	switch-OFF time RF2
S3	switch-OFF time RF1
S4	switch-OFF time RM2
S5	switch-OFF time RM1
X4	switchover 0 to 4 ... 20 mA
X5	switchover – switch-ON delay
X6	switchover 0 to 4 ... 20 mA
F101	fuse - voltage supply
F102	fuse - relay contact
T	Impulse dividing ratio 1:1 , 1:2 , 1:4

7 Maintenance and servicing

The flame amplifier requires no maintenance.

For cleaning, use a moist cloth to wipe the front panel from the outside only.

8 Failures

Problem:	Display:	Cause:	Remedy:
No flame - *ON* signal after the burner has been started	No analogue signal LED RF *OFF* LED RM *OFF* LED time I / time II *OFF*	Flame amplifier is not operational	Check power supply Check fuse F101 (F 0.8 amps) Replace flame amplifier Check electrical connection
	Analogue signal < 25 % LED RF + RM *OFF*	Flame signal too low	Check flame scanner Check / set sensitivity
	Analogue signal 25 - 75 % LED RF *OFF* LED RM *ON*	Flame signal below the switch-on threshold	Increase sensitivity Reduce switch-on threshold
	Analogue signal 25 - 100 % LED RF *ON* LED RM *OFF*	Self-test error	Check / set switch-off times Check cable shield Replace flame scanner Replace flame amplifier Check installation including cable routes for EMC sources High voltage / radio
	Analogue signal 25 - 100 % LED RF + RM *ON*	Relay contact or wiring problem	Check fuse F102 (T 1 amp) Check electrical connection
Burner trips	Analogue signal falling. Below 25 %, switch off RF + RM.	No flame, weak flame signal	Check flame Check flame scanner Check flame scanner alignment, sight tube and lens Increase sensitivity setting Replace flame scanner Replace flame amplifier Check electrical connection
	Analogue signal > 25 % RF *ON* RM goes off	Self-test error	Check cable shield Check flame scanner cable for EMC interfering source

9 Order data

Flame amplifier 3001D is available from BFI Automation GmbH under the following order data:

Flame amplifier 3001D Part-No.: G 601.D