

# News and changes to the G-Flame redesign and development of the firmware

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## 1 General information

The G-Flame redesign includes some changes which are explained below.

- Omission of the mechanical on/off switch and replacement by a magnetic field sensor for the magnetic pen. This prevents malfunctions as no mechanical parts are involved anymore.
- Battery saver is now supported. Due to the omission of the mechanical on/off switch, it is now possible to switch off the unit by software if the battery charging level becomes critical. The battery is protected against deep discharges by doing so.
- Sleep Mode support. As with the various PFE Advanced, the G-Flame now also supports the optional Sleep Mode, which can be activated for an extra charge.
- Adjustable switch-on behaviour when closing the emergency stop contact of the emergency stop switch. In the configuration menu, you can choose between two modes:
  - 1.) When the emergency stop contact is closed, the G-Flame should power-up.
  - 2.) When the emergency stop contact is closed, the G-Flame should not switch on, i.e. remain switched off.

By default, the G-Flame does not power-on when the emergency stop contact closes.

- Internal temperature measurement. If the internal temperature exceeds 70°C, an active flame generation is terminated or is not started at all and a warning message appears in the display.
- Monitoring of both solenoid valves by cross comparison. The microcontrollers in the G-Flame check each other whether the respective magnetic valves are supplied. If a defect is detected, flame generation stops immediately and an error is shown on the display.
- Innovative tilt measurement without electro-mechanical tilt switches. In this case acceleration sensors are used to determine the direction of the weight force and the tilt angle is derived from this.
- Very selective optical flame sensor instead of ionization measurement
- Error Memory

The new menu items are described in detail below.

## 2 Switching off

The device is switched off by activating 'Mode' with the magnetic pen for approx. 1 second. Then you will enter the first menu item and you will see the following display:

Switch off?

The device will be turned off as soon as the sensor area 'On/Off' is being activated with the magnetic pen. You will enter the first main menu item by activating 'Mode'.

I→O

Immediately afterwards, this display appears and the device switches itself off.

### 3 The menu item 'Switch on by Emergency Stop'

You can reach this menu item in the configuration menu of the G-Flame. To access this menu, activate and hold 'Mode' while the unit is switched off and then switch it on.

Enab. Flame | Yes  
Options | No

As soon as you see this display, release 'Mode' again. Skip this menu item by activating 'Up' or 'Mode'.

Switch on by | Yes  
Emerg. Stop | No

Now you can configure the switch-on behavior of the G-Flame when the emergency stop contact is closed.

If you want the G-Flame to power-up as soon as the emergency stop contact is closed, confirm this query with 'Yes' by activating 'Up'. If you do not want this, confirm this query with 'No' by activating 'Down'.

Now skip all further menu items by repeatedly activating 'Mode' until the G-Flame switches to standby mode.

**Note:** When you select that the G-Flame should power-up as soon as the emergency contact is closed safety is still maintained because the device requires an addition positive transition on the selected input before a flame is being generated. If the device runs into an input that is already active during power-on no flame will be generated until the input reaches low and then high again.

### 4 Check flame sensor

F-Sensor, ↑=LSP  
≡

The flame sensor works optically. You see this display. In the bottom line you see a symbol which moves to the left or right. The sensor can be tested really easily with a small flame such as from a lighter. To do

this, slowly approach the flame to the measuring window and then remove it again (distance at the beginning approx. 20 cm). While you are approaching the flame, the symbol must move clearly to the right. When you remove the flame again, the symbol must move strongly to the left.

The sensor works differentially. This means that the deflection decreases when the flame remains close for a longer period of time. If the flame then extinguishes or is removed, the deflection is even more significant in the opposite direction.

The 'Up' and 'Down' keys can be used to output an acoustic signal instead of the symbol on the LCD or to switch back to the display of the symbol. The frequency of the acoustic signal must increase when the flame is approached. Reversely, the frequency must decrease when the distance of the flame increases.

Activate 'Mode' to exit the test menu and continue the startup process.

#### TIP

Check the measuring window of the flame sensor regularly and clean it with a soft and dry cloth if necessary to prevent measuring errors.

## 5 The menu item 'Flame monitoring'

The device has an optical flame monitoring system.

Flame  
monitoring: On

Here the shutoff of the flame effect and of the fuel valves if the flame is not burning is enabled. If no flame is detected for more than a short period of time the valves are closed automatically. The device is terminating the fuel supply for this firing command.

Flame  
monitoring: Off

With this setting the results of the flame monitoring system will be ignored.

### TIP

With every new firing command another attempt will be made to ignite the flame and in this process the fuel valves will be opened for a short period of time. If no flame can be ignited several times one after another you should disable the G-Flame for the reasons of safety either by using the emergency off input or the hazard zones (Advanced wireless module required for this) to prevent that an unnecessary amount of unburned fuel is set free.

### TIP

For the reasons of safety, you should generally enable the flame monitoring system.

Always keep the window of the optical sensor clean and free of grease.

## 6 Tilting of the G-Flame

In general, the G-Flame can also be operated at an angle.

The following notes only refer to firmware versions V2.51, V2.52 and V2.53:

However, it should be noted that the tilt sensor does not work correctly at an angle of approx.  $\pm 90^\circ$  for technical reasons. Therefore, it should be switched off when the tilt setpoint plus set angle tolerance comes close to  $90^\circ$ . This applies equally to both the pan and tilt angles. As a rule of thumb, the range from  $-85^\circ$  to  $-95^\circ$  and  $+85^\circ$  to  $+95^\circ$  should not be used (always related to the setpoint plus set tolerance).

There is a similar problem with  $\pm 180^\circ$ . Here it is the reversal of the sign that is to be avoided. A programming of for example  $-160^\circ$  with a tolerance  $\pm 20^\circ$  would still be feasible.  $-160^\circ$  with a tolerance  $\pm 21^\circ$  should be avoided. This problem also affects both the pan and tilt angles.

## 7 Tilt sensors with firmware version V2.51, V2.52 and V2.53

### 7.1 Introduction into the tilt measurement by utilizing acceleration sensors

The G-Flame has a special tilt sensor system, which is not only able to detect the exceeding of the  $45^\circ$  angle, but also with an angle freely programmable by the user within wide limits and a tolerance in degrees also freely programmable by the user.

This inclination sensor technology works with so-called acceleration sensors. The acceleration due to gravity, i.e. the weight force, is measured. Additional accelerations, as they occur during movements due to acceleration (positive acceleration) and deceleration (negative acceleration) are also recorded and are regarded as disturbance variables. I.e. these movements are undesirable and must be

avoided if you want to use this tilt sensor technology. Vibrations also count as undesirable disturbance variables, since these also superimpose the weight force.

This technology is also used in smartphones, e.g. to measure the orientation of the device and to show an image correctly rotated on the display. An acceleration sensor is also evaluated by means of an algorithm in a step counter in a smartphone or smartwatch.

The tilt sensor in the G-Flame detects all three axes: X, Y and Z. The Z axis is basically the vertical. X and Y represent, in simplified terms, pan and tilt.

The acceleration is measured in g.

1 g corresponds to the acceleration due to gravity of 9.81 m/s<sup>2</sup>.

If the device is vertical, then +1 g is measured on the Z axis and 0 g on the X and Y axes.

If the device is tilted slightly, the value on the Z-axis decreases and the values on the X- and/or Y-axis increase above 0 g or decrease below 0 g into the negative, depending on the direction in which the device is tilted.

The two ratios between the Z and X axes and the Z and Y axes allow the tilt angles in the pan and tilt directions to be calculated using the arc tangent function.

The result of these calculations is a pan angle and a tilt angle.

The device will only ever display these angles, because the g-values are not very informative for the user.

The value range for both angles is -180° to +180°.

If both angles are 0°, the device is absolutely vertical.

Attention! Due to mathematical laws, this tilt sensor is not suitable for angles close to +90° or -90°. Strong angular deflections can occur here and we recommend switching off the tilt sensor system if the device is to be used in this angle range.

Attention! The angle range between -175° and +175° should also be avoided due to the sign change and the tilt sensor system should not be used here.

With the inclination sensors in the G-Flame, it is completely normal that measurement deviations in the range of a few degrees occur, because sensors are used which are not highly precise. High precision sensors cost a lot and would drastically increase the purchase price of the G-Flame.

Nevertheless, in order to measure as accurately as possible, the tilt sensor system is calibrated by the manufacturer before delivery. Should deviations occur due to aging, then this calibration can also be repeated.

Pan:	-001°
Tilt:	+002°

The device shows you the calculated pan and tilt angles in degrees here. The displayed values should not change more than +/- 1°. Otherwise you have to stop the unwanted movements or vibrations. Confirm your selection with 'Mode'. This will also take you to the next menu item.

## 7.2 The menu item 'Store Pan/Tilt Angles'

Here you can now specify whether the angles currently measured (not visible) should be saved and used for the tilt sensor system and any shutdowns due to out-of-tolerance conditions:

Store Pan/Tilt  
Angles? On

Here you save the angles measured in the background. The relevant measurement takes place at the exact moment you activate 'Mode' and exit the menu item. At the same time, you activate the angle monitoring by means of acceleration sensor with this setting.

Store Pan/Tilt  
Angles? Off

If you make this selection and confirm it with 'Mode', the tilt sensor measurement by acceleration sensors is deactivated.

## 7.3 The menu item 'Pan/Tilt Sensor Tolerance'

This menu item only appears if you have previously activated the tilt sensor system using acceleration sensors.

You must now specify the allowed tolerance for the maximum permitted deviation from the stored angles.

You will see e.g. the following display in the LCD:

Pan/Tilt Sensor  
Tolerance:  $\pm 10^\circ$

Here the tolerance would be  $\pm 10^\circ$ . The lowest possible setting is  $\pm 3^\circ$ . The largest possible tolerance is  $\pm 30^\circ$ .

### TIP

If this menu item is active, the current angles are measured continuously and checked with the set tolerance. If the tolerance is exceeded, this is indicated by the red 'Fault' LED. At the same time, you will hear an acoustic signal in this case. This allows you to determine whether your settings are suitable. Excessive movements or vibrations would also cause a tolerance exceedance to be displayed.

### TIP

This setting applies equally to pan and tilt. A tolerance is exceeded as soon as the pan or tilt angle is out of tolerance.

### TIP

The set tolerance should not be too narrow but also not too wide. Values between  $5^\circ$  and  $10^\circ$  have proven to be good. Ultimately, you must decide which tolerance is suitable according to your application.

### WARNING



Avoiding  $90^\circ$  and  $180^\circ$  in angle measurements

For mathematical reasons, angle measurement using accelerometer technology is not suitable for angles around  $90^\circ$ . In addition, the transition between  $+180^\circ$  and  $-180^\circ$  is also not detected correctly.

- The tilt sensor technology cannot be used if  $85^\circ$  to  $95^\circ$  degrees are reached by the stored angles plus tolerance.
- The transition between  $+180^\circ$  and  $-180^\circ$  must also be avoided.
- In these cases, switch off the tilt sensor system and monitor the tilt using other methods.

## 8 Tilt sensors with firmware V2.54 or higher

The tilt sensor system was changed with firmware version 2.54. Internally, the new technology with acceleration sensors described in the section above is still used. From now on, however, a fixed angle of 45° is always set. This corresponds to the original solution with the conventional tilt sensors. The menu items that are no longer required have been removed.

This change is intended to ensure more stable operating conditions and largely prevent even moderate shocks and vibrations from irritating the tilt measurement and causing unjustified deactivations.

45° Tilt Switch:  
On

You can switch the tilt sensor on and off in this menu item as before. In this example, the tilt is monitored.

45° Tilt Switch:  
Off

The function is switched off here. This may be necessary in the presence of strong shocks or vibrations.

## 9 The menu item 'Shutdown if Battery < 10%'

Optionally the device can power-down itself if the battery is almost completely discharged. This is a useful function to prevent damages due to deep discharges when the receiver was forgotten to be switched off. How the receiver will behave can be determined here:

Shutdown if  
Batt. < 10%: On

In this mode the device will switch off itself as soon as the battery is discharged below 10%. It is necessary that the battery will be recharged within the next weeks to prevent damages due to further self-discharge.

Shutdown if  
Batt. < 10%: Off

Here the device will operate until the battery is completely discharged. Deep discharges can occur if the device is not switched off in time.

Voltage drops that are caused by driving heavy loads e.g. magnetic valves do not lead to an early power-off failure. Only if the accumulator voltage drops below the 10% level for more than one minute the power-down sequence will be initiated.

Please make sure that the device is recharged after automatic power-off within the next days to prevent possible damages by the self-discharge effect of the batteries that could lead to a deep discharge.

### TIP

For automatic power-down it is necessary that the device is in receiving mode.

## 10 Storage of errors in the error memory, available with firmware version 2.54 or higher

To make troubleshooting easier, a function has been implemented that stores or logs all relevant events and all errors that can be detected by the device in an internal memory.

These events are saved in sequence. There is no date and time stamp. However, after an application, you can trace which events were stored in the last operating phase or the previous operating phases at any time.

To display the error memory, you must activate 'Mode' continuously when switching on until a menu appears. Then navigate to the last menu item by activating 'Mode' several times in succession.

When you have reached the error memory, you will see the following message in the display, for example:

```
On 14 | -- -- --
000: POWER_ON
```

'On 14' is the start-up counter. This begins with 00. In this example, 15 start-ups took place (0-14). A maximum of 50 start-ups can be logged. If the value 49 is reached, the device jumps back to 00.

By activating 'Up', you can jump to the past and display the events. Use 'Down' to jump back to the present.

With '-- -- -- --', diagnostic information is displayed for some events, such as the values of certain variables, which are only of interest to the manufacturer's technicians and can make troubleshooting easier.

'000' is the event counter. This always starts with 000 for each start-up and is incremented by 1 with each event.

The example above shows the event "POWER\_ON". This is the designation for switching on the device.

The following list shows all possible events:

FLAME_DUR	Flame switch-off because flame duration limit exceeded
QUOTA_EXC	Flame switch-off because flame quota exceeded
OVER_TILT	Flame switch-off because tilt exceeded
OVER_TEMP	Flame switch-off due to overtemperature
FW_MISMAT	Firmware version check returned an error, the firmware versions in the microcontrollers do not match.
NO_FLAME	Flame shutdown because the flame sensor did not detect a flame
ACCU_LOW	Battery voltage too low to start device
VALVE_ERR	Magnetic valve error
ACCU_SAV	Device shutdown because battery state of charge < 10% and battery saver enabled