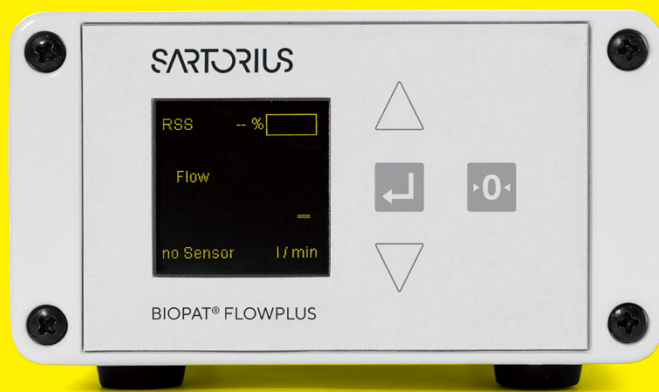


Operating Instructions  
Original Operating Instructions

# BioPAT® Flow

BioPAT® FlowDIN Amplifier Box | BioPAT® Flowplus Amplifier Box | BioPAT® Flow Clamp-on  
Ultrasonic Flow Meter for Single-use Applications



85037-553-37



SARTORIUS



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# 1 About these Instructions

## 1.1 Validity

These instructions are part of the device. These instructions apply to the device and the following versions of the product:

| Signal Amplifier (Amplifier Box)           | Type  |
|--|---|
| BioPAT® FlowDIN                            | BPL0002   |
| BioPAT® Flowplus                           | BPL0003   |
| Clamp-ons                                  |   |
| BioPAT® Flow Clamp-on for Single-use Pipes | BPL0010   BPL0011   BPL0012   BPL0013   BPL0028   |
| BioPAT® Flow Clamp-on for Tubes            | BPL0020   BPL0021   BPL0022   BPL0023   BPL0024   BPL0025   BPL0026   BPL0027   BPL0029   BPL0030   BPL0031   BPL0032 |

### BioPAT® Flowplus Software Version

These operating instructions apply to software versions 3.0.0.0 and higher

## 1.2 Accompanying Documents

- ▶ In addition to these instructions, observe the following documentation:
  - Instructions for the process control or the data processing system
  - Instructions for the system into which the device is integrated
  - Instructions for the tubing
  - Instructions for accessories, e.g., flow sensor holder
  - Documentation of custom modifications (where applicable)

## 1.3 Target Groups

These instructions are designed for the following target groups. The target groups must possess the knowledge listed.

| Target group | Knowledge and Qualifications  |
|--------------|---|
| User         | The user is familiar with the operation of the device and the associated work processes. The user understands the hazards which may arise when working with the device and knows how to prevent them. The user has been trained in the operation of the device. |



| Target group  | Knowledge and Qualifications   |
|---------------|--|
| Administrator | The Administrator is responsible for integrating the device into the production process. The administrator ensures the reliable functioning of the system and device software. The administrator is trained in the operation of the device.                                  |
| Electrician   | A qualified electrician who has the specialized training, knowledge, and experience as well as familiarity with applicable standards and regulations to evaluate the work assigned to him or her and identify possible hazards.  |
| Operator      | The operator of the device is responsible for compliance with safety requirements and workplace safety regulations. The operator must ensure that all persons who work on the device have access to the relevant information and have been instructed in work on the device. |

## 1.4 Symbols Used

### 1.4.1 Warnings in Operation Descriptions

#### **WARNING**

Denotes a hazard that may result in death or severe injury if it is **not** avoided.

#### **NOTICE**

Denotes a hazard that may result in property damage if it is **not** avoided.

### 1.4.2 Other Symbols

- ▶ Required action: Describes activities that must be carried out. The actions in the sequence must be carried out in succession.
- ▷ Result: Describes the result of the activities carried out.
- [ ] Text inside brackets refers to operating and display elements.
- [ ] Text inside brackets indicates status, warning, and error messages.

#### **Figures on the Operating Display**

The figures on the operating display of the device may differ from those in these instructions.

## 2 Safety Instructions

### 2.1 Intended Use

The device is intended for non-invasive volumetric measurement of fluid flows. The flow measurement is based on the ultrasonic transit time method.

The device must be connected to a process controller or a data acquisition system. A suitable sensor device must be connected to the device (BioPAT® Clamp-on see Chapter "15.1 Devices," page 117).

The device is intended exclusively for use in accordance with these instructions. Any further use beyond this is considered **improper**.

If the device is used **improperly**: The device's protective systems may be impaired. This can lead to unforeseeable personal injury or property damage.

#### Operating Conditions for the Device

Do **not** use the device in potentially explosive environments. The device may only be used indoors.

The device may only be used with the equipment and under the operating conditions described in the Technical Data section of these instructions.

#### Foreseeable Misuse

The use of the device is only safe when it is used properly.

The following applications, for example, are **not** permitted:

- Operation outside the permissible ambient conditions
- Use of combustible or explosive substances
- Use of gases
- Use in legal metrology

#### 2.1.1 Modifications to the Device

If the device is modified, for example by attaching extra components: The safety of the device may be impaired or the device compliance may lose its validity.

If you have any queries regarding modifications to the device, contact Sartorius.

## 2.1.2 Repairs and Maintenance on the Device

Device repairs and maintenance may only be carried out by persons with appropriate specialized knowledge. If the device is **not** repaired or serviced by a specialist: The safety of the device may be impaired or the test marks may lose their validity.

We recommend that any repair work, even that not covered by the warranty, is carried out by Sartorius Service or after consulting Sartorius Service.

Only the maintenance tasks described in these instructions should be carried out. For maintenance tasks that need to be carried out by Sartorius Service, contact Sartorius Service.

## 2.1.3 Repairs to the Device

Device repairs may only be carried out by persons with appropriate specialized knowledge of the device. If the device is **not** repaired by a specialist: The safety of the device may be impaired or the test marks may lose their validity.

We recommend that any repair work, even that not covered by the warranty, is carried out by Sartorius Service or after consulting Sartorius Service.

## 2.2 Personnel Qualification

If individuals who do **not** have sufficient knowledge on the safe handling of the device carry out work on the device: Those individuals may injure themselves or other people nearby.

- ▶ Ensure that all persons working on the device possess the necessary knowledge and qualifications (description see Chapter "1.3 Target Groups," page 8).
- ▶ If a particular qualification is required for the actions described: Have these activities carried out by the required target group.
- ▶ If **no** particular qualification is required for the actions described: Have these activities carried out by the "user" target group.

## 2.3 Significance of these Instructions

Failure to follow the instructions in this manual may have serious consequences, e.g., danger to individuals.

- ▶ Read the instructions carefully and completely. The required actions in the instructions build on each other.
- ▶ Ensure that the information contained in these instructions is available to all individuals working on the device.
- ▶ Retain the instructions.
- ▶ If these instructions are lost, request a replacement or download the latest version from the Sartorius website ([www.sartorius.com](http://www.sartorius.com)).

## 2.4 Device Functionality

Damaged equipment or worn-out parts can cause malfunctions or lead to hard-to-detect hazards.

- ▶ Only operate the device when it is safe and in perfect working order.
- ▶ Comply with the maintenance intervals (intervals and maintenance work see Chapter "8.4 Maintenance Schedule," page 85).
- ▶ Have any malfunctions or damage repaired immediately by Sartorius Service.

## 2.5 Electrical Equipment

### 2.5.1 Damage to the Device's Electrical Equipment

Damage to the device's electrical equipment, e.g., damaged insulation, can be life-threatening. Contact with parts under voltage represents a danger to life.

- ▶ If the electrical equipment of the device is defective, cut off the power supply and contact Sartorius Service.
- ▶ Keep live parts away from moisture. Moisture can cause short circuits.
- ▶ Check the device for defects such as loose connections or damage to the insulation (intervals and maintenance tasks see Chapter "8.4 Maintenance Schedule," page 85).

### 2.5.2 Power Supply Unit and Power Supply Cable

Serious injury can result, e.g., from electric shocks, if an unsuitable/ inadequately dimensioned power supply cable or unsuitable power supply unit is used.

The power supply unit must not come into contact with fluids. The ingress of fluids may damage the device. Damage to the AC adapter can be life-threatening.

- ▶ Only use the power supply units and power supply cables specified in these instructions.
- ▶ If the power supply unit or power supply cable needs to be replaced: Contact Sartorius Service. Do **not** repair or modify the power supply unit or power supply cable.
- ▶ If fluids have penetrated into the AC adapter:
  - ▶ Unplug the power cord of the device.
  - ▶ Send the AC adapter to Sartorius Service for inspection.
  - ▶ Do **not** use the power supply unit without having it inspected.

## 2.6 Electromagnetic Compatibility

The use of unauthorized accessories and electrical components, e.g., power supply units or connection cables, may impair the electrical safety of the device.

Possible security risks include for example:

- Risk of fire
- Increased electromagnetic emissions from the device
- Lower resistance of the device to emissions
- If longer connection cables are used than indicated in these instructions or if the connection cables are connected in series:
  - The electromagnetic emissions of the device may increase.
  - The interference resistance of the device to emissions may decrease.
- ▶ If the device is connected to an external voltage source: Check the suitability of the voltage source (see Chapter “14.2 Requirements for External Voltage Source”, page 91).
- ▶ Do **not** use longer connection cables than indicated in the instructions. Longer connection cables can reduce the interference resistance of the device.
- ▶ Do **not** remove the ferrite cores of the connection cables.
- ▶ Do **not** use the device in residential areas.

## 2.7 Damage Caused by Chemical Substances

In case of contact with aggressive chemical substances present in e.g., the operating media or cleaning agents, device components may be damaged or become unusable.

- ▶ Avoid contact with chemicals.
- ▶ Only use suitable cleaning agents (see Chapter “14.2 BioPAT® Flow Clamp-on,” page 104).
- ▶ Only use tubing suitable for the operating medium used.

## 2.8 Damage Caused by Ultrasonic Waves

The BioPAT® Clamp-on generates ultrasonic waves for flow measurement. The ultrasound produced has a very low acoustic output level in all device settings (see Chapter “14.1.9 Acoustic Output Data,” page 103).

According to the current state of knowledge, this ultrasound—with proper use of the device—is harmless to humans, protein solutions (e.g. blood, blood cells), and the environment.

- ▶ Use the device as intended and follow the instructions in this manual.

## 2.9 Conduct in an Emergency

If an emergency occurs, e.g., due to the malfunctions of the device or dangerous situations: People may be injured. The device must be immediately taken out of operation:

- ▶ If the device is connected to the power supply via the AC adapter: Press the ON/OFF [I] button on the back of the device.
- ▶ Secure the device to prevent it from restarting.
- ▶ If the device is connected to an external voltage source: Turn off the external voltage source.
- ▶ Have any malfunctions repaired immediately by Sartorius Service.

## 2.10 Accessories, Consumables, and Spare Parts

The use of unsuitable accessories, consumables, and spare parts can affect the functionality and safety of the device and have the following consequences:

- Danger to personnel
  - Damage to the device
  - Malfunctions of the device
  - Device failure
- ▶ Only use approved accessories, consumables, and spare parts supplied by Sartorius.
  - ▶ Only use accessories, consumables, and spare parts that are in technically perfect condition.

## 2.11 Personal Protective Equipment

Personal protective equipment protects against risks arising from the device. If the personal protective equipment is missing or unsuitable: People may be injured.

| Protective equipment designation | Explanation   Examples  |
|----------------------------------|---|
| Protective work clothing         | Tight-fitting work clothing with low tear resistance, tight sleeves and without any projecting parts.   Protects against getting caught in moving parts or against chemicals, heat, and injuries. |
| Head covering                    | Protects hair from being pulled into moving parts.  |
| Safety gloves                    | Protect against chemicals, heat and injuries.   |
| Safety glasses                   | Protect against harmful influences, e.g., liquids, chemicals, splinters, or particles.  |
| Safety boots                     | Protect against injuries to the feet caused by mechanical effects or against slipping on wet surfaces.  |

- ▶ Wear appropriate personal protective equipment.
- ▶ If the operating area, or the process in which the device is used, requires additional safety precautions: Additionally, wear the appropriate personal protective equipment.

## 2.12 Risk of Explosions and Fire

The device and its accessories are **not** suitable for use in potentially explosive atmospheres. Use in potentially explosive atmospheres can lead to explosions, fires and serious injuries.

- ▶ Do **not** use any explosive substances or oxidizing agents.
- ▶ Do **not** use any flammable materials or gases.

## 2.13 Control and Regulation of Safety Measures

The device must **not** be used as a safety component. If the device is used for the control and regulation of security measures: Serious injury can result.

- ▶ Only use the device for measuring the volumetric fluid flow rate.
- ▶ Do **not** use the device to control, regulate, or monitor safety measures.

## 2.14 Overheating of Device and AC Adapter

The device and the AC adapter can overheat if they are covered or exposed to direct heat or sunlight. Overheated devices and AC adapters can cause damage to the device.

- ▶ Do **not** cover the device.
- ▶ Do **not** expose the device to direct heat and sunlight.

## 3 Device Description

### 3.1 Device Overview

#### 3.1.1 BioPAT® Flowplus

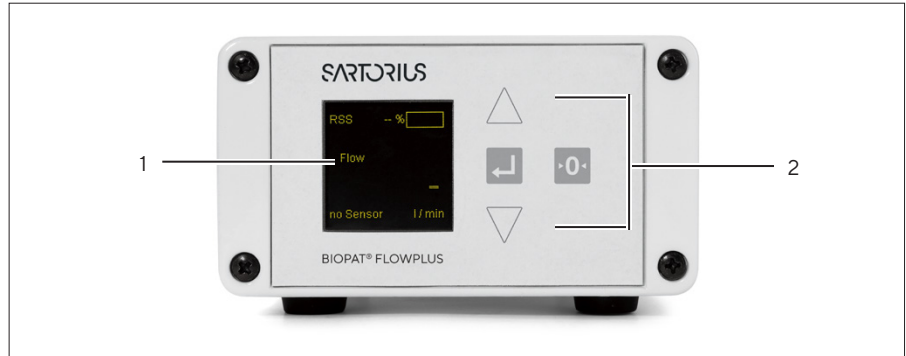


Fig. 1: BioPAT® Flowplus amplifier box front view (example)

| Pos. | Name               |
|------|--------------------|
| 1    | Display            |
| 2    | Operator interface |



## 3.1.2 BioPAT® FlowDIN

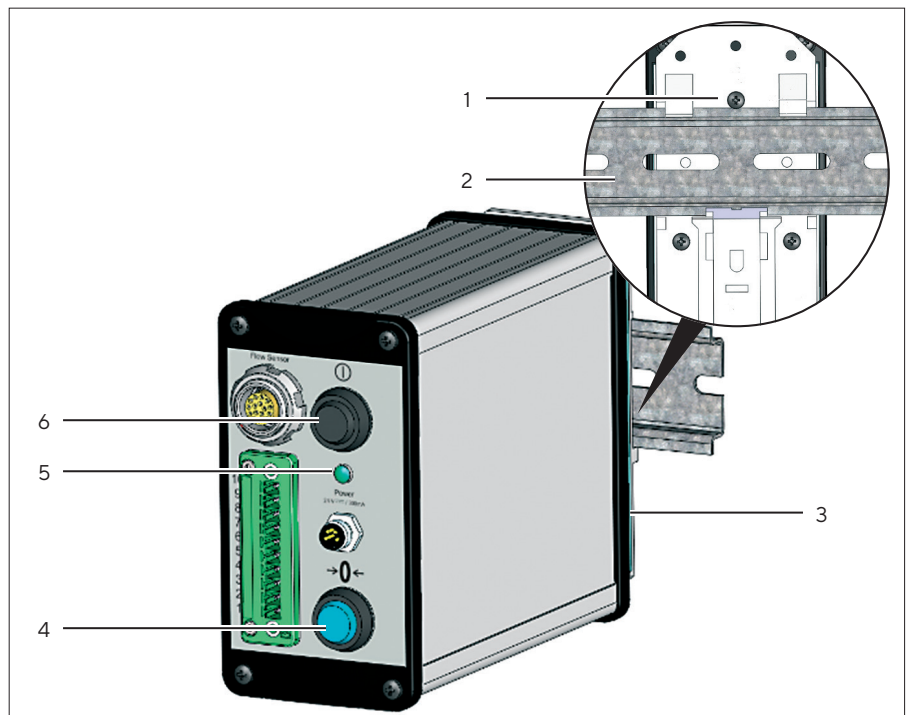


Fig. 2: BioPAT® FlowDIN amplifier box (example)

| Pos. | Name                    | Description   |
|------|-------------------------|---|
| 1    | Mounting adapter        | Adapter plate with spring-loaded locking mechanism.                 |
| 2    | DIN rail                |   |
| 3    | Manufacturer's ID label | Secured to the backside of the device.                              |
| 4    | Operator interface      |   |
| 5    | LED status display      | Illuminated when the device is on or connected to the power supply. |
| 6    | On/Off button           | Switches the device on and off.                                     |

## 3.2 Connections

### 3.2.1 BioPAT® Flowplus

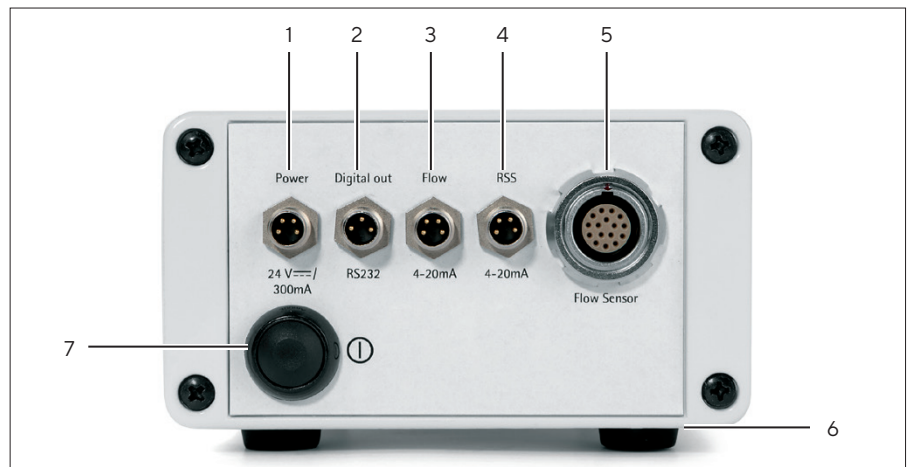


Fig. 3: BioPAT® Flowplus Amplifier Box connections (example)

| Pos. | Name                           | Description  |
|------|--------------------------------|--|
| 1    | Power                          | <ul style="list-style-type: none"> <li>– 4-pin</li> <li>– Accepts the power supply cable of the power supply unit or the analog connection cable.</li> </ul> |
| 2    | Digital out                    | <ul style="list-style-type: none"> <li>– 3-pin</li> <li>– Digital interface RS232.</li> </ul>  |
| 3    | Flow                           | <ul style="list-style-type: none"> <li>– 3-pin</li> <li>– Analog interface for the flow value</li> </ul>   |
| 4    | RSS (Received Signal Strength) | Analog interface for acoustic coupling.  |
| 5    | Flow Sensor                    | <ul style="list-style-type: none"> <li>– 16-pin</li> <li>– Accepts the connection cable of the BioPAT® Clamp-on.</li> </ul>                                  |
| 6    | Manufacturer's ID label        | Secured on the bottom of the device.   |
| 7    | On/Off button                  | Switches the device on and off.  |

### 3.2.2 BioPAT® FlowDIN

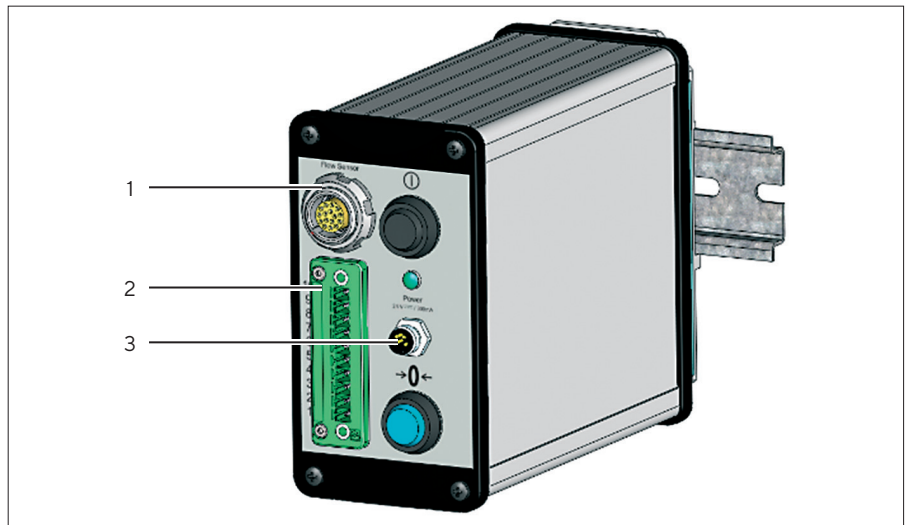


Fig.4: BioPAT® FlowDIN amplifier box connections (example)

| Pos. | Name           | Description  |
|------|----------------|--|
| 1    | Flow Sensor    | <ul style="list-style-type: none"> <li>– 16-pin</li> <li>– Accepts the connection cable of the BioPAT® Clamp-on.</li> </ul>                                  |
| 2    | Terminal block | <ul style="list-style-type: none"> <li>– 10-pin</li> <li>– Digital interface RS232</li> </ul>  |
| 3    | Power          | <ul style="list-style-type: none"> <li>– 4-pin</li> <li>– Accepts the power supply cable of the power supply unit or the analog connection cable.</li> </ul> |

### 3.3 Caps

The device terminals are covered with flexible caps. The caps protect the terminals from dirt or fluid deposits, which can lead to short circuits, corrosion, or malfunction.

### 3.4 Pin Assignment

#### 3.4.1 BioPAT® Flowplus Analog Connections

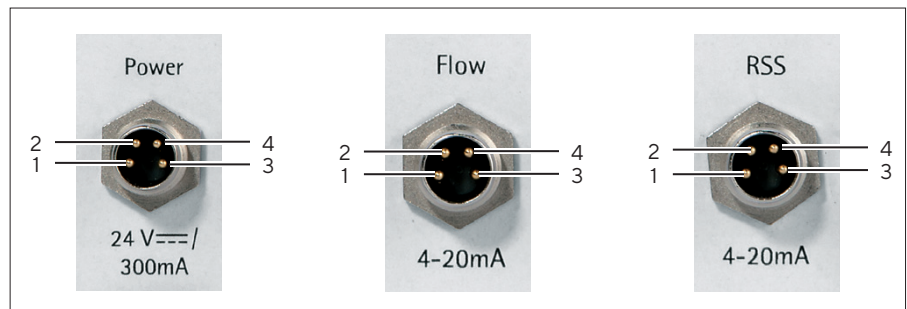


Fig. 5: PIN assignment of the analog terminals [Power], [Flow], and [RSS] (example)

| PIN | Signal at the [Power] terminal | Signal at the [Flow] and [RSS] terminals |
|-----|--------------------------------|--|
| 1   | 24 V (24C_in)                  | 24 V (24C_in)                            |
| 2   | Not used.                      | Flow or RSS current loop (+)             |
| 3   | Ground (GND_in)                | Ground (GND_in)                          |
| 4   | Not used.                      | Flow or RSS current loop (-)             |

#### 3.4.2 BioPAT® Flowplus Digital Connection

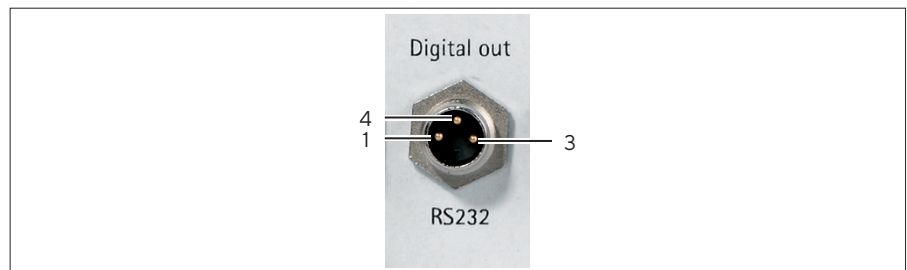


Fig. 6: PIN assignment of the [Digital Out] terminal (example)

| PIN | Signal at the [Digital Out] terminal |
|-----|--------------------------------------|
| 1   | PC_TXD                               |
| 3   | GND                                  |
| 4   | PC_RXD                               |

### 3.4.3 BioPAT® FlowDIN Analog Connection

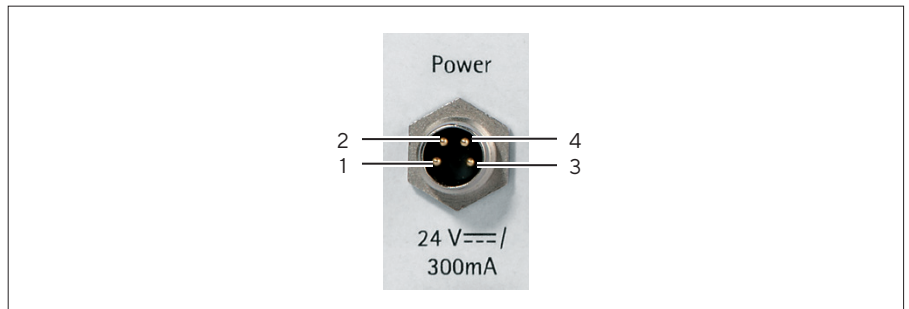


Fig. 7: PIN assignment of the [Power] terminal (example)

| PIN | Signal at the [Power] terminal |
|-----|--------------------------------|
| 1   | 24 V (24C_in)                  |
| 2   | Not used.                      |
| 3   | Mass (GND_in)                  |
| 4   | Not used.                      |

### 3.4.4 BioPAT® FlowDIN Terminal Block

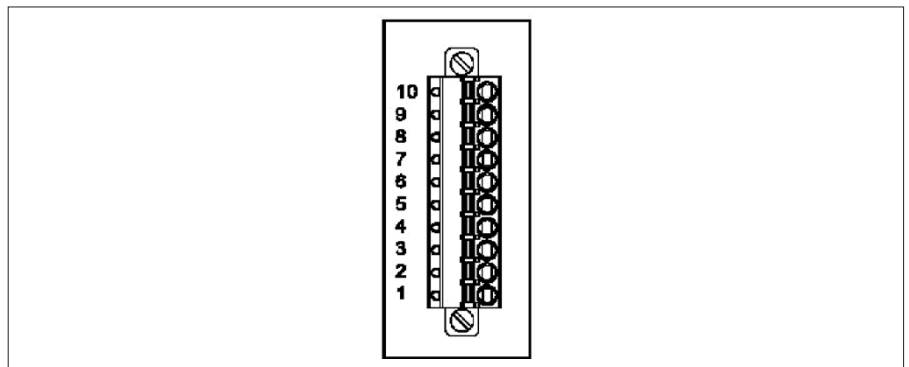


Fig. 8: Terminal block on the BioPAT® FlowDIN amplifier box (example)

| PIN | Signal                | PIN | Signal               |
|-----|-----------------------|-----|----------------------|
| 1   | 24 V <sub>DC</sub>    | 6   | RSS current loop (-) |
| 2   | Ground (GND)          | 7   | PC_TXD               |
| 3   | Flow current loop (+) | 8   | GND                  |
| 4   | Flow current loop (-) | 9   | PC_RXD               |
| 5   | RSS current loop (+)  | 10  | Remote Zero          |

### 3.5 BioPAT® Clamp-on

The BioPAT® Flow Clamp-on has four ultrasonic transducers that are arranged crosswise and conduct the flow measurement (see Chapter “3.4 Operating Principle”).

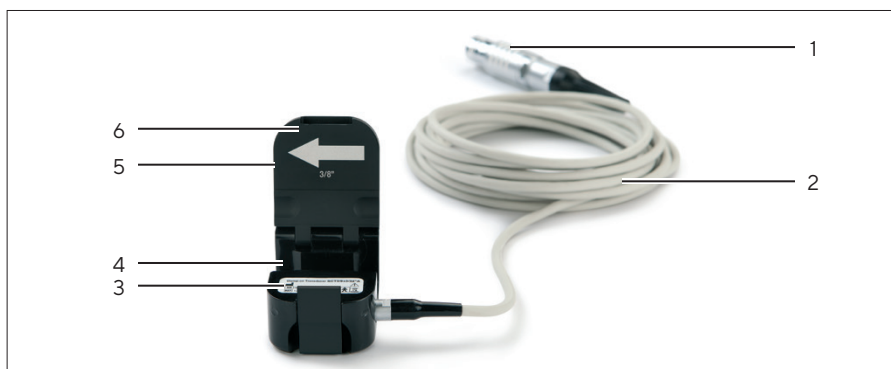


Fig. 9: BioPAT® Clamp-on, lid opened

| Pos. | Designation             | Description   |
|------|-------------------------|---|
| 1    | Plug connector          | <ul style="list-style-type: none"> <li>Has a push-and-pull release device to prevent accidental disconnection of the plug connector.</li> <li>Connects the BioPAT® Clamp-on to the device.</li> </ul> |
| 2    | Connection cable*       |   |
| 3    | Manufacturer's ID label |   |
| 4    | Measurement channel     | Accepts the BioPAT® Flow Pipe or a tube.  |
| 5    | Arrow                   | Indicates the direction of flow.  |
| 6    | Cover                   |   |

\* Available in 2 lengths: 290 and 30 cm

## 3.6 Operating Principle

### 3.6.1 Flow Rate Measurement

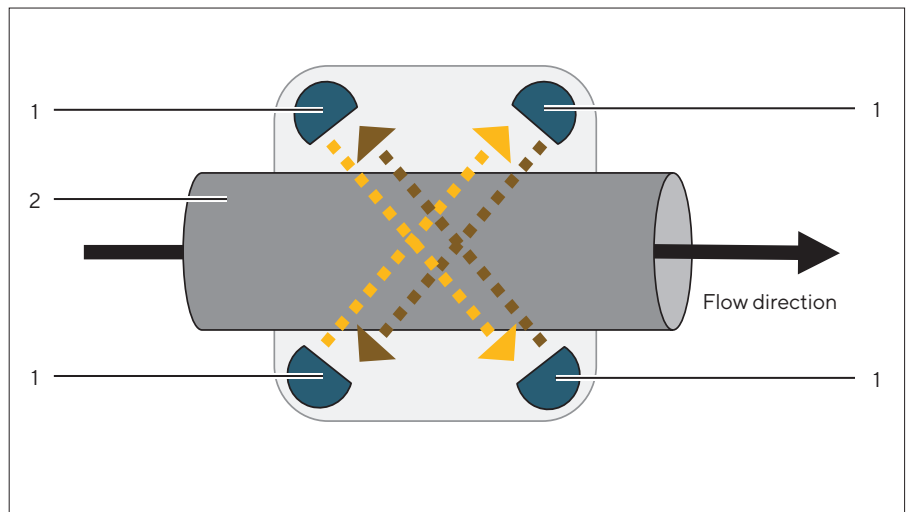


Fig.10: Flow rate measurement in the BioPAT® Clamp-on (example)

| Pos. | Designation                  |
|------|------------------------------|
| 1    | Ultrasound source and sensor |
| 2    | BioPAT® Flow Pipe            |

The four ultrasonic transducers alternately transmit and receive ultrasonic waves in and against the direction of fluid flow. The BioPAT® Clamp-on transmits the measured ultrasonic signals to the device.

The device calculates the fluid flow rate based on the measured transit-time difference: On the basis of the tubing cross-section, the device determines the flow rate in liters per minute.

The transit time of the ultrasonic waves is dependent on the type of fluid.

### 3.6.2 Data Transmission

The device transmits the measured Flow and RSS values to the process controller or the data acquisition system. The device uses so-called "current loops" to transmit measuring signals.

The measurement signals are transmitted as Flow and RSS current loops in a range of 4-20 mA.

## 4 Operating Design

### 4.1 BioPAT® FlowDIN

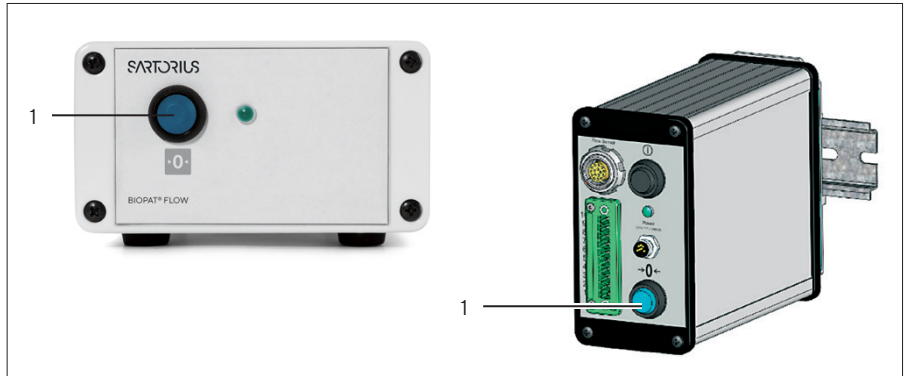


Fig.11: BioPAT® FlowDIN Amplifier Box front side (example)

| Pos. | Name        | Description                                  |
|------|-------------|--|
| 1    | Zeroing key | Sets the zero point for the fluid flow rate. |

### 4.2 BioPAT® FlowPlus

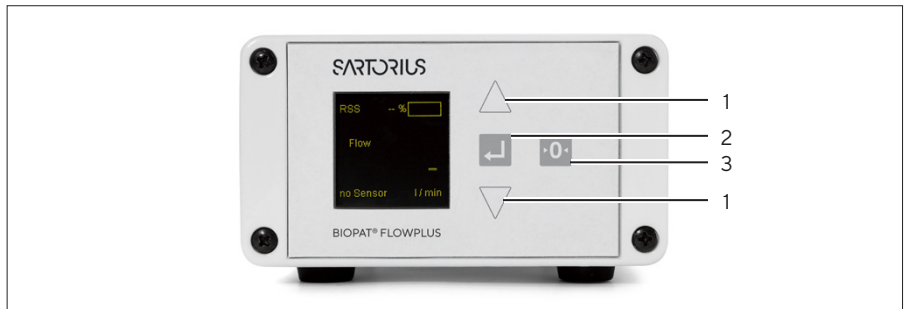


Fig.12: BioPAT® FlowPlus amplifier box front view (example)

| Pos. | Name      | Description   |
|------|-----------|---|
| 1    | Arrow key | <ul style="list-style-type: none"> <li>– Goes back to the previous screen or switches to the next display.</li> <li>– Selects a setting on the current display in the “sel” operating mode. Selectable values are marked with “sel”.</li> </ul> |



| Pos. | Name        | Description   |
|------|-------------|---|
| 2    | Enter key   | <ul style="list-style-type: none"> <li>– Switches to the operating mode “sel”.</li> <li>– Confirms a configured value.</li> <li>– Allows a value to be changed.</li> <li>– Exits the operating mode “sel”.</li> <li>– In the operating mode “Totalizing”: Switches from the status “Hold” to the status “Run” (start).</li> </ul> |
| 3    | Zeroing key | <ul style="list-style-type: none"> <li>– Sets the zero point for the fluid flow rate.</li> <li>– In the operating mode “Totalizing”: Resets the adder.</li> </ul>   |

#### 4.2.1 Navigating in Menus (BioPAT® Flowplus)

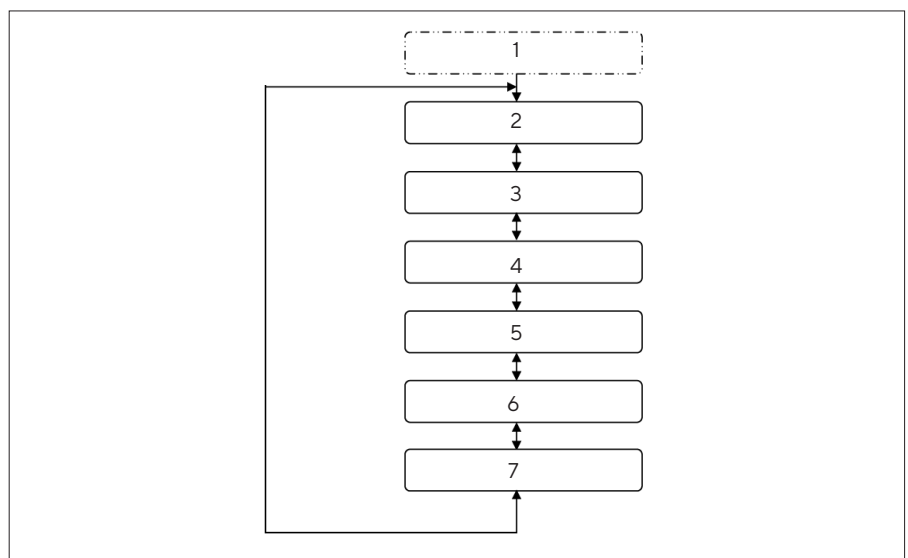


Fig.13: BioPAT® Flowplus menu flowchart

| Pos. | Menu                            | Description  |
|------|---------------------------------|--|
| 1    | Initializing Device             | Device is initialized  |
| 2    | Zero Flow   Measure Flow        | Set flow rate to zero   Measure flow rate  |
| 3    | Start   Stop   Reset Totalizing | <ul style="list-style-type: none"> <li>– Start   Stop   Reset Totalizing</li> <li>– When a valid BioPAT® Clamp-on is connected: This display is accessible.</li> </ul> |

| Pos. | Menu                       | Description  |
|------|----------------------------|--|
| 4    | Set Calibration Table      | <ul style="list-style-type: none"> <li>– Displays a calibration table with available options that are integrated in the BioPAT® Flow Clamp-on.</li> <li>– For configuring the calibration table.</li> <li>– When a valid BioPAT® Clamp-on is connected: This display is accessible.</li> </ul> |
| 5    | Set Calibration Factor     | <ul style="list-style-type: none"> <li>– For configuring the calibration factor.</li> <li>– When a valid BioPAT® Clamp-on is connected: This display is accessible.</li> </ul>   |
| 6    | Adjust Brightness          | Configure brightness   |
| 7    | Display Status Information | Display Status Information   |

**Procedure**

▶ Use the arrow keys to navigate through the menu, e.g., “Zero Flow | Measure Flow” or to enter the desired value.

▷ The menu is shown on the display.

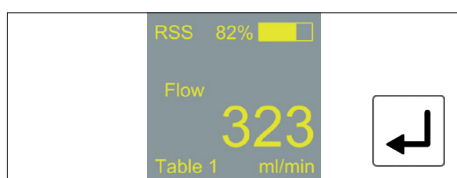
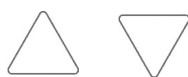
▶ To confirm the selected option: Press Enter.

▷ The device switches to the operating mode “sel”.

▶ Select the desired setting using the arrow keys, e.g. “Measure Flow”.

▶ Press Enter.

▷ The flow rate is measured.



## 5 Installation

### 5.1 Scope of Delivery

#### 5.1.1 BioPAT® Flowplus Scope of Delivery

| Item   | Quantity | Purpose  |
|--|----------|--|
| Device (Amplifier Box)   | 1        |  |
| Operating instructions   | 1        |  |
| AC adapter with country-specific power plug adapter and power cord                             | 1        |  |
| USB   RS232 interface cable  | 1        | Connects the digital terminal [Digital Out] to the process controller or the data acquisition system, e.g. PC.   |
| Cap, mounted on delivery.  | 2-5      | Protects the device terminals.   |
| Analog connection cable with round plug and Cage Clamp terminal block, configured, length: 2 m | 2        | Connects the analog terminals [Power], [Flow] and [RSS] to the control system or the data acquisition system. Transmits the current output signal (4-20 mA). |
| Serial connection cable, with plug and D-sub connector, configured, length: 2 m                | 1        | Connects the digital terminal [Digital Out] to the process controller or the data acquisition system. Transmits the digital RS232 signal.                    |

### 5.1.2 Scope of Delivery of BioPAT® DIN

| Item                      | Quantity | Purpose                        |
|---------------------------|----------|--------------------------------|
| Device (Amplifier Box)    | 1        |                                |
| Operating instructions    | 1        |                                |
| Cap, mounted on delivery. | 2-5      | Protects the device terminals. |

### 5.1.3 Scope of Delivery of BioPAT® Flow Clamp-on

| Item   | Quantity | Purpose |
|--|----------|---------|
| BioPAT® Flow Clamp-on, configured, ready for connection, delivered with connection cable and calibration report. | 1        |         |

## 5.2 Selecting an Installation Site

### Procedure

- Make sure that the following conditions are met at the installation site:

|                                     | Condition  | Characteristics  |
|-------------------------------------|--|--|
| BioPAT® Flowplus<br>BioPAT® FlowDIN | Access to operation-relevant parts   | Convenient and reliable  |
|                                     | Ambient conditions   | Suitability tested (see Chapter “14.1.3 Ambient Conditions,” page 100).  |
|                                     | <b>No</b> exposure to direct heat or sunlight  | Suitability of the site tested.  |
|                                     | <b>No</b> proximity to high frequency devices such as electrosurgical units or radio communication devices | Suitability of the site tested.  |
|                                     | <b>No</b> residential areas  | Suitability of the site tested.  |
| BioPAT® Flowplus                    | Footprint  | <ul style="list-style-type: none"> <li>– Even surface</li> <li>– Sufficient space for the device and peripheral devices (device footprint, see Chapter “14.1.1 Dimensions, Weights, and Materials,” page 100; footprint of peripheral devices, see the manual for the peripheral devices, e.g., the data acquisition system)</li> <li>– Sufficient bearing capacity for the device and peripheral devices (device weight, see Chapter “14.1.1 Dimensions, Weights, and Materials,” page 100; weight of peripheral devices, see the manual for the peripheral devices)</li> </ul> |
| BioPAT® FlowDIN                     | DIN rail in the control box of the process control   | Suitability of DIN rail checked (DIN rail type, see Chapter “14.1.2 Type of Assembly,” page 100).  |
|                                     | Dimensions of the control cabinet (when using the extension cord)  | Suitability of the control box wall tested (for control box wall dimensions, see Chapter “14.1.7 Requirements for the Control Box (BioPAT® FlowDIN Amplifier Box),” page 102).   |

## 5.2.1 Power Supply Overview

### Power Supply of the Device

The device can be powered by an AC adapter or by an external voltage source (permanent connection).

The device must always be connected to a power supply. The device can be powered by the Flow and RSS current loop. The On/Off button is only functional when it is powered via the power supply unit.

### Power Supply of Flow and RSS Current Loop

| Current loop configuration           | Description   |
|--------------------------------------|---|
| “Active” current loop configuration  | The device provides the Flow and RSS current loop with energy.  |
| “Passive” current loop configuration | The Flow and RSS current loop is externally powered. Power is supplied by an external voltage source, process control or data acquisition system. |

### Supply of Flow and RSS Current Loop via the Device

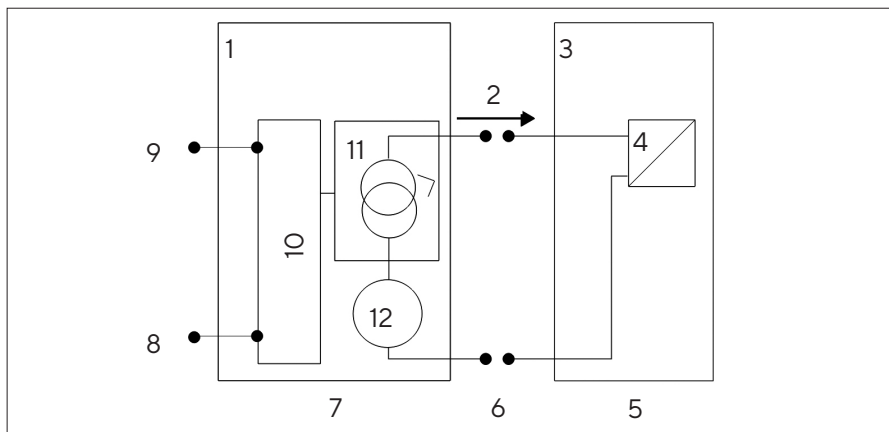


Fig.14: Device in “active” Flow and RSS current loop configuration, flow (example)

| Pos. | Designation                                  |
|------|--|
| 1    | Device                                       |
| 2    | Power output signal ( $I_{\text{Signal}}$ )  |
| 3    | Process control with data acquisition system |
| 4    | Signal converter                             |
| 5    | Supplied “passively”                         |
| 6    | Device in current loop                       |

| Pos. | Designation                                       |
|------|---|
| 7    | Supplied "active"                                 |
| 8    | Ground terminal                                   |
| 9    | Power supply of the device (+24 V <sub>DC</sub> ) |
| 10   | Electronics                                       |
| 11   | Flow current loop                                 |
| 12   | Flow and RSS current loop power supply            |

### External Supply of Flow and RSS Current Loops

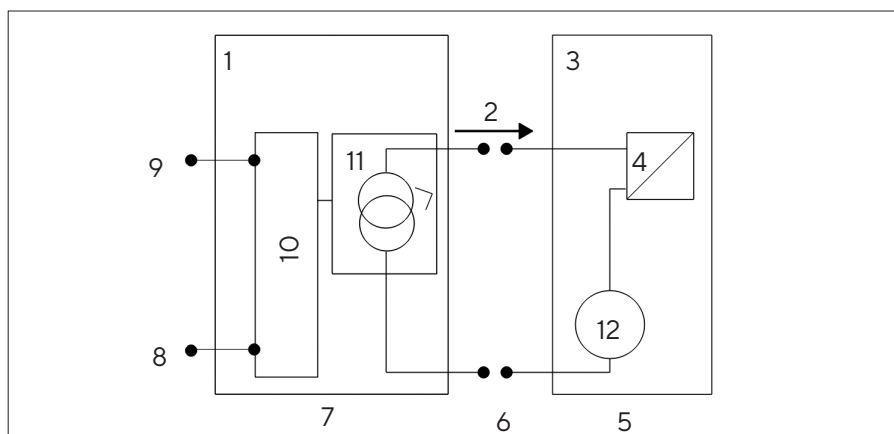


Fig.15: Device in "passive" Flow and RSS current loop configuration, flow (example)

| Pos. | Designation                                       |
|------|---|
| 1    | Device  |
| 2    | Power output signal ( $I_{\text{signal}}$ )       |
| 3    | Process control with data acquisition system      |
| 4    | Signal converter                                  |
| 5    | Supplied "passively"                              |
| 6    | Device in current loop                            |
| 7    | Supplied "active"                                 |
| 8    | Ground terminal                                   |
| 9    | Power supply of the device (+24 V <sub>DC</sub> ) |
| 10   | Electronics                                       |
| 11   | Flow current loop                                 |
| 12   | Flow and RSS current loop power supply            |

## 5.3 Checking Current Loops (BioPAT® Flowplus)

### 5.3.1 Power Supply of Flow and RSS Current Loop via Device

**Required qualifications:** Electrician

**Tools:** Ammeter with measuring range of 0-20 mA (DC)

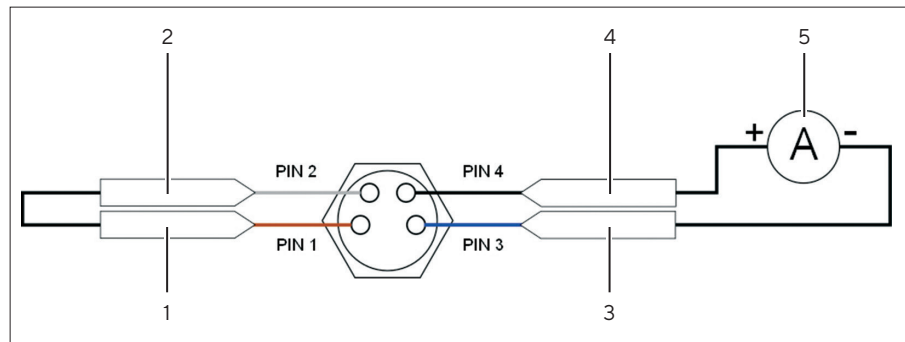


Fig.16: Connect the device to the ammeter at the [Flow] terminal (example)

| Pos. | Signal at the [Flow] and [RSS] terminals | Color of supplied connection cable |
|------|--|------------------------------------|
| 1    | 24 V (24C_in)                            | Brown                              |
| 2    | Flow or RSS current loop (+)             | White                              |
| 3    | Ground (GND)                             | Blue                               |
| 4    | Flow or RSS current loop (-)             | Black                              |
| 5    | Ammeter                                  |                                    |

#### Requirements

- The device is connected to a process controller or a data acquisition system.
- The BioPAT® Clamp-on is connected to the device.
- A flow is measured.

#### Procedure

- ▶ Check the Flow and RSS current loop, one after the other. Carry out the following work steps successively at the [Flow] and [RSS] terminals:
  - ▶ Connect PIN 1 and PIN 2.
  - ▶ Connect PIN 3 to the terminal of the ammeter, e.g. "Return" or "-".
  - ▶ Connect PIN 4 to the terminal of the ammeter, e.g. "Send" or "+".
  - ▶ Check the amperage of the flow and RSS current loops. Observe the tolerance ranges:



| Tolerances for Current Measurement | Current Values                            |
|------------------------------------|---|
| Range of the ammeter               | 0–20 mA DC                                |
| Tolerances                         | Max. 1% + 5 digits when range > 50,000 mA |
|                                    | Internal resistance < 10 Ohm              |

- If the amperage is **not** in the range of 0–20 mA: Check the power supply to the Flow and RSS current loops.

### 5.3.2 Power Supply of Flow and RSS Current Loops via External Voltage Source

Required qualifications: Electrician

Tools: Ammeter with measuring range of 0–20 mA (DC)

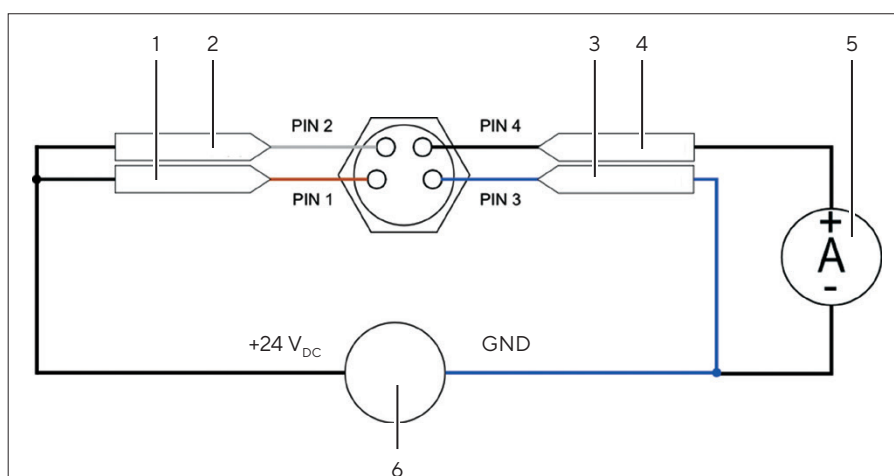


Fig.17: Connect the device to the ammeter at the [Flow] terminal (example)

| Pos. | Signal at the [Flow] and [RSS] terminals | Color of supplied connection cable |
|------|--|------------------------------------|
| 1    | 24 V (24C_in)                            | brown                              |
| 2    | Flow or RSS current loop (+)             | white                              |
| 3    | Mass (GND_in)                            | blue                               |
| 4    | Flow or RSS current loop (-)             | black                              |
| 5    | Ammeter                                  |                                    |
| 6    | External voltage source                  |                                    |

### Requirements

- The device is connected to a process controller or a data acquisition system.
- The BioPAT® Clamp-on is connected to the device.
- A flow is measured.
- The suitability of the external voltage source has been checked (see Chapter “5.4.4 Checking External Voltage Source,” page 42).

### Procedure

- ▶ Check the Flow and RSS current loop, one after the other. Carry out the following work steps successively at the [Flow] and [RSS] terminals:
  - ▶ Connect PIN 1 and PIN 2.
  - ▶ Connect PIN 2 to the “+” terminal of the power supply.
  - ▶ Connect PIN 3 to the terminal of the ammeter, e.g. “Return” or “-”.
  - ▶ Also connect the Flow and RSS current loops to the “-” terminal of the power supply.
  - ▶ Connect PIN 4 to the terminal of the ammeter, e.g. “Send” or “+”.
  - ▶ Check the amperage of the flow and RSS current loops. Observe the tolerance ranges:

| Tolerances for Current Measurement | Current Values                            |
|------------------------------------|---|
| Range of the ammeter               | 0–20 mA (DC)                              |
| Tolerances                         | Max. 1% + 5 digits when range > 50,000 mA |
|                                    | Internal resistance < 10 Ohm              |

- ▶ If the amperage is **not** in the range of 0–20 mA: Check the power supply to the Flow and RSS current loops.

## 5.3.3 Checking the Function of Flow and RSS Current Loops

### Measuring the Voltage

|                          |  |
|--------------------------|--|
| Required qualifications: | Electrician  |
| Tools:                   | <ul style="list-style-type: none"> <li>– Voltmeter with measuring range of 25 V<sub>DC</sub> or higher</li> <li>– Resistance min. 100 Ohm, max. 600 Ohm</li> </ul> |

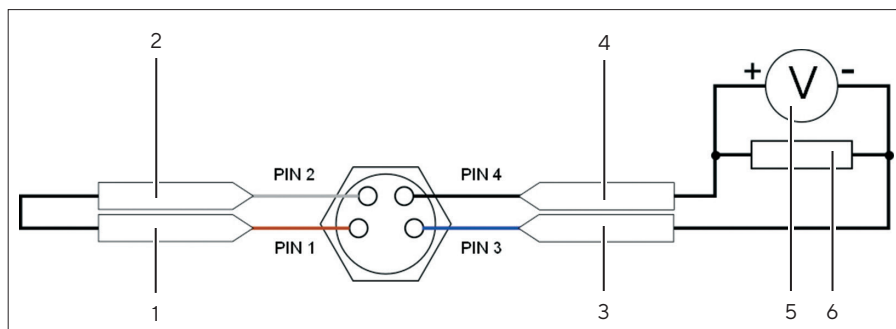


Fig.18: Connect the device to the voltmeter at the [Flow] terminal (example)

| Pos. | Signal at the [Flow] and [RSS] terminals | Color of supplied connection cable |
|------|--|------------------------------------|
| 1    | 24 V (24C_in)                            | brown                              |
| 2    | Flow or RSS current loop (+)             | white                              |
| 3    | Mass (GND_in)                            | blue                               |
| 4    | Flow or RSS current loop (-)             | black                              |
| 5    | Voltmeter                                |                                    |
| 6    | Resistance                               |                                    |

#### Requirements

- The device is connected to a process controller or a data acquisition system.
- The BioPAT® Clamp-on is connected to the device.
- A flow is measured.

#### NOTICE

##### Equipment damage due to overvoltage!

► Overvoltage protection of at least 30 V<sub>DC</sub> is configured for the voltmeter.

#### NOTICE

##### Automatic adjustment of the voltage!

If **no** electrical load or a resistance with a high voltage value is used: The voltage between the Flow and RSS current loop (+) and Flow and RSS current loop (-) is approximately adjusted to the voltage rating (24 V).

### Procedure

- ▶ Check the Flow and RSS current loop, one after the other. Carry out the following work steps successively at the [Flow] and [RSS] terminals:
  - ▶ Connect PIN 1 and PIN 2.
  - ▶ Connect PIN 3 to the terminal of the voltmeter, e.g. "Return" or "-".
  - ▶ Connect PIN 4 to the terminal of the voltmeter, e.g. "Send" or "+".
  - ▶ Connect the resistor to both connection cables of the voltmeter. Observe Ohm's law when calculating the correct current output signal as resistance.
- ▶ Check the voltage supply to the Flow and RSS current loops. Observe the tolerance ranges:

| Tolerances for Voltage Measurement     | Voltage Values               |
|--|------------------------------|
| Range of the voltmeter                 | 25 V <sub>DC</sub> or higher |
| Resistance, min   max                  | 100 Ohm   600 Ohm            |
| Tolerances                             | At least 1%. 0.1% is ideal   |
| Internal impedance voltmeter, at least | 1 MOhm                       |

- ▶ If the amperage is **not** in the range of 0–20 mA: Check the power supply to the Flow and RSS current loops.

### Converting Measured Voltage

Examples of the voltage conversion for the current output signal

(0–20 mA):

| Voltage [V] | Recommended measuring resistance [Ohm] | Conversion factor for current [V/mA] | Zero point voltage at 4 mA [V] |
|-------------|--|--------------------------------------|--------------------------------|
| 0–2         | 100                                    | 0.1                                  | 0.4                            |
| 0.5         | 250                                    | 0.25                                 | 1.0                            |
| 0–10        | 500                                    | 0.5                                  | 2.0                            |

### Procedure

- ▶ To convert the measured voltage into flow rate: Use the following equation:

$$\text{Flow rate } \left[ \frac{\text{ml}}{\text{min}} \right] = \frac{\text{voltage [V]} - \text{zero point voltage [V]}}{\text{resistance}} * 1000 * \text{current conversion factor } Q_{\text{max}}$$

- To convert the measured voltage into the acoustic coupling: Use the following equation:

$$\text{RSS [\%]} = \frac{\text{voltage [V]} - \text{zero point voltage [V]}}{\text{resistance}} * 0.016 * \text{resistance} * 100$$

## 5.4 Checking Current Loops (BioPAT® FlowDIN)

### 5.4.1 Power Supply of Flow and RSS Current Loop via Device

**Required qualifications:** Electrician

**Tools:** Ammeter with measuring range of 0–20 mA (DC)

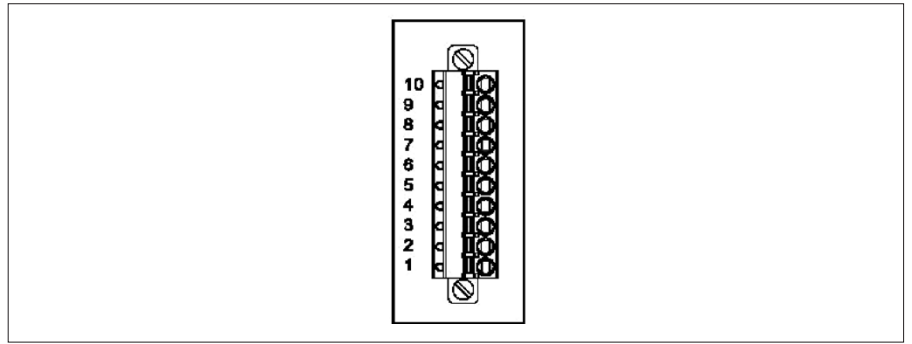


Fig.19: BioPAT® FlowDIN terminal block

| PIN | Signal at terminal block |
|-----|--------------------------|
| 1   | +24 V <sub>DC</sub>      |
| 2   | Ground (GND)             |
| 3   | Flow current loop (+)    |
| 4   | Flow current loop (-)    |
| 5   | RSS current loop (+)     |
| 6   | RSS current loop (-)     |

#### Requirements

- The device is connected to a process controller or a data acquisition system.
- The BioPAT® Clamp-on is connected to the device.
- A flow is measured.

**Procedure**

- ▶ Check the Flow and RSS current loop, one after the other. Carry out the following work steps successively at the [Flow] and [RSS] terminals:
  - ▶ When checking the Flow current loop: Connect PIN 1 and PIN 3.
  - ▶ When checking the RSS current loop: Connect PIN 1 and PIN 5.
  - ▶ Connect PIN 2 to the terminal of the ammeter, e.g. "Return" or "-".
  - ▶ When checking the Flow current loop: Connect PIN 4 to the terminal of the ammeter, e.g. "Send" or "+".
  - ▶ When checking the RSS current loop: Connect PIN 6 to the terminal of the ammeter, e.g. "Send" or "+".
  - ▶ Check the amperage of the current loop. Observe the tolerance ranges:

| Tolerances for Current Measurement | Current Values                            |
|------------------------------------|---|
| Range of the ammeter               | 0-20 mA DC                                |
| Tolerances                         | Max. 1% + 5 digits when range > 50,000 mA |
|                                    | Internal resistance < 10 Ohm              |

- ▶ If the amperage is **not** in the range of 0-20 mA: Check the power supply to the Flow and RSS current loops.

**5.4.2 Power Supply of Flow and RSS Current Loops via External Voltage Source**

**Required qualifications:** Electrician  
**Tools:** Ammeter with measuring range of 0-20 mA (DC)

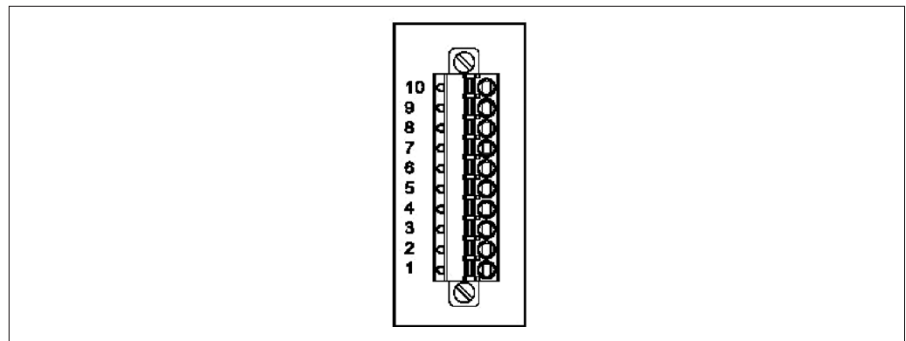


Fig. 20: Terminal block for BioPAT® FlowDIN amplifier box

| PIN | Signal at terminal block |
|-----|--------------------------|
| 1   | +24 V <sub>DC</sub>      |
| 2   | Ground (GND)             |

| PIN | Signal at terminal block |
|-----|--------------------------|
| 3   | Flow current loop (+)    |
| 4   | Flow current loop (-)    |
| 5   | RSS current loop (+)     |
| 6   | RSS current loop (-)     |

### Requirements

- The device is connected to a process controller or a data acquisition system.
- The BioPAT® Clamp-on is connected to the device.
- A flow is measured.
- The suitability of the external voltage source has been checked (see Chapter “5.4.4 Checking External Voltage Source,” page 42).

### Procedure

- ▶ Check the Flow and RSS current loop, one after the other. Carry out the following work steps successively at the [Flow] and [RSS] terminals:
- ▶ When checking the Flow current loop:
  - ▶ Connect PIN 1 and PIN 3.
  - ▶ Connect PIN 3 to the “+” terminal of the power supply.
- ▶ When checking the RSS current loop:
  - ▶ Connect PIN 1 and PIN 5.
  - ▶ Connect PIN 5 to the “+” terminal of the power supply.
- ▶ Connect PIN 2 to the terminal of the ammeter, e.g. “Return” or “-”.
- ▶ Also connect the Flow and RSS current loops to the “-” terminal of the power supply.
- ▶ When checking the Flow current loop: Connect PIN 4 to the terminal of the ammeter, e.g. “Send” or “+”.
- ▶ When checking the RSS current loop: Connect PIN 6 to the terminal of the ammeter, e.g. “Send” or “+”.
- ▶ Check the amperage of the flow and RSS current loops. Observe the tolerance ranges:

| Tolerances for Current Measurement | Current Values                            |
|------------------------------------|---|
| Range of the ammeter               | 0–20 mA DC                                |
| Tolerances                         | Max. 1% + 5 digits when range > 50,000 mA |
|                                    | Internal resistance < 10 Ohm              |

- ▶ If the amperage is **not** in the range of 0–20 mA: Check the power supply to the Flow and RSS current loops.

### 5.4.3 Checking the Function of Flow and RSS Current Loops

#### Voltage

|                          |  |
|--------------------------|--|
| Required qualifications: | Electrician  |
| Tools:                   | <ul style="list-style-type: none"> <li>– Voltmeter with measuring range of 25 V<sub>DC</sub> or higher</li> <li>– Resistance min. 100 Ohm, max. 600 Ohm</li> </ul> |

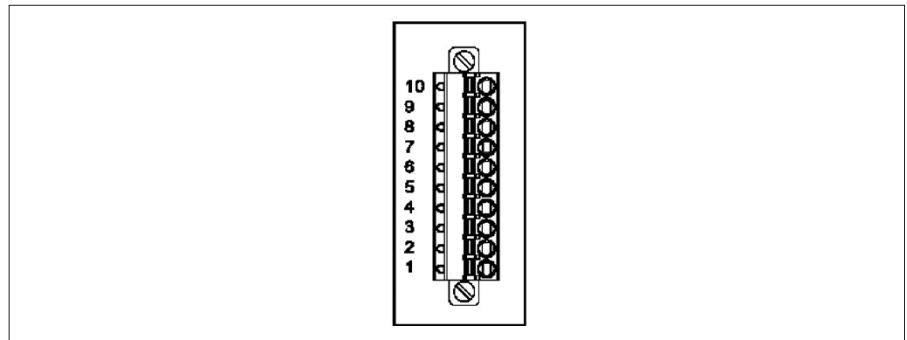


Fig. 21: Terminal block for BioPAT® FlowDIN amplifier box

| PIN | Signal at terminal block |
|-----|--------------------------|
| 1   | +24 V <sub>DC</sub>      |
| 2   | Ground (GND)             |
| 3   | Flow current loop (+)    |
| 4   | Flow current loop (-)    |
| 5   | RSS current loop (+)     |
| 6   | RSS current loop (-)     |

#### Requirements

- The device is connected to a process controller or a data acquisition system.
- The BioPAT® Clamp-on is connected to the device.
- A flow is measured.

#### NOTICE

##### Equipment damage due to overvoltage!

- ▶ Overvoltage protection of at least 30 V<sub>DC</sub> is configured for the voltmeter.

#### NOTICE

##### Automatic adjustment of the voltage!

If no electrical load or a resistance with a high voltage value is used: The voltage between the Flow and RSS current loop (+) and Flow and RSS current loop (-) is approximately adjusted to the voltage (24 V).



### Procedure

- ▶ Check the Flow and RSS current loop, one after the other. Carry out the following work steps successively at the [Flow] and [RSS] terminals:
  - ▶ When checking the Flow current loop: Connect PIN 1 and PIN 3.
  - ▶ When checking the RSS current loop: Connect PIN 1 and PIN 5.
  - ▶ Connect PIN 2 to the terminal of the voltmeter, e.g. "Return" or "-".
  - ▶ When checking the Flow current loop: Connect PIN 4 to the terminal of the voltmeter, e.g. "Send" or "+".
  - ▶ When checking the RSS current loop: Connect PIN 6 to the terminal of the voltmeter, e.g. "Send" or "+".
  - ▶ Connect the resistor to both connection cables of the voltmeter. Observe Ohm's law when calculating the correct current output signal as resistance.
  - ▶ Check the voltage supply to the Flow and RSS current loops. Observe the tolerance ranges:

| Tolerances for Voltage Measurement     | Voltage Values               |
|--|------------------------------|
| Range of the voltmeter                 | 25 V <sub>DC</sub> or higher |
| Resistance, min   max                  | 100 Ohm   600 Ohm            |
| Tolerances                             | At least 1%. 0.1% is ideal   |
| Internal impedance voltmeter, at least | 1 MOhm                       |

- ▶ If the amperage is **not** in the range of 0–20 mA: Check the power supply to the Flow and RSS current loops.

### Converting Measured Voltage

Examples of the voltage conversion for the current output signal

(0–20 mA):

| Voltage [V] | Recommended measuring resistance [Ohm] | Conversion factor for current [V/mA] | Zero point voltage at 4 mA [V] |
|-------------|--|--------------------------------------|--------------------------------|
| 0–2         | 100                                    | 0.1                                  | 0.4                            |
| 0.5         | 250                                    | 0.25                                 | 1.0                            |
| 0–10        | 500                                    | 0.5                                  | 2.0                            |

### Procedure

- ▶ To convert the measured voltage into flow rate: Use the following equation:

$$\text{Flow rate} \left[ \frac{\text{ml}}{\text{min}} \right] = \frac{\text{voltage [V]} - \text{zero point voltage [V]}}{\text{resistance}} * 1000 * \text{current conversion factor } Q_{\text{max}}$$

- ▶ To convert the measured voltage into the acoustic coupling: Use the following equation:

$$\text{RSS [\%]} = \frac{\text{voltage [V]} - \text{zero point voltage [V]}}{\text{resistance}} * 0.016 * \text{resistance} * 100$$

#### 5.4.4 Checking External Voltage Source

The device can be connected to an external voltage source. Connection to an external voltage source is useful if the device is connected to a process controller. This way, the device can be switched on and off centrally.

##### Requirements

The device should **not** be connected to the power supply via the AC adapter.

##### Procedure

- ▶ **NOTICE** Equipment damage and impaired device protection due to improper power supply! The external voltage source must meet the required demands. Unsuitable voltage sources can damage the device irreparably and compromise the protection.
  - ▶ Check whether the external voltage source meets the requirements (see Chapter "14.1.8 Requirements for External Voltage Source," page 103).
  - ▶ If the external voltage source does **not** meet the requirements: Connected the device to the power supply using the AC adapter.

## 5.5 Unpacking

##### Procedure

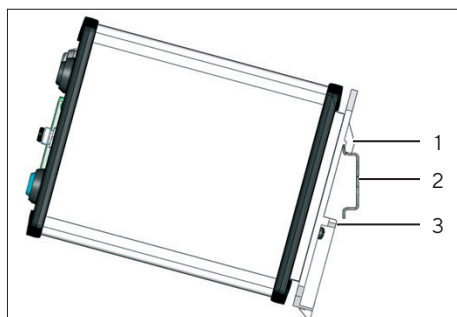
- ▶ Unpack the device.
- ▶ Unpack the BioPAT® Clamp-on and the accessories.

## 5.6 Setting Up BioPAT® Flowplus

##### Procedure

- ▶ Place the device on the bench.
- ▶ If unintentional movement of the device is possible: Additionally secure the device to the bench, e.g., with screws.

## 5.7 Assembling the BioPAT® FlowDIN



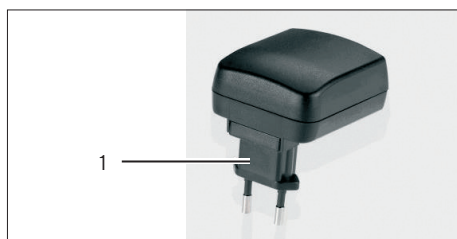
### Procedure

- ▶ Place the upper hook (1) of the mounting adapter on the DIN rail (2) of the control box.
- ▶ Insert the spring-loaded hook (3).
- ▶ Check that the device is securely mounted on the DIN rail.
  - ▶ If required: Slide the spring-loaded bottom hook downwards with a screwdriver until it separates from the DIN rail.
  - ▶ Pull the device off of the DIN rail.
  - ▶ Mount the device again.

## 5.8 Connecting the Power Supply Unit

**Material:** Power supply unit with country-specific power plug adapter and power supply cable (not included in the scope of delivery for the BioPAT® Flow DIN)

### Procedure



- ▶ Check whether the country-specific power plug adapter is suitable for the power outlet.
  - ▶ If required: Disconnect the country-specific power plug adapter from the power supply unit and replace it with the suitable power plug adapter.

- ▶ Connect the power cord to the AC adapter.
- ▶ Remove the cap from the [Power] terminal.
- ▶ Connect the power cord to the [Power] terminal.
- ▶ Plug the power cord adapter into the power outlet.

## 5.9 Connecting the BioPAT® Flowplus

### 5.9.1 Connecting the Device to the Power Supply Unit

The device can be connected to the external voltage source using the [Power], [Flow] and [RSS] terminals.

**Required qualification:** Electrician

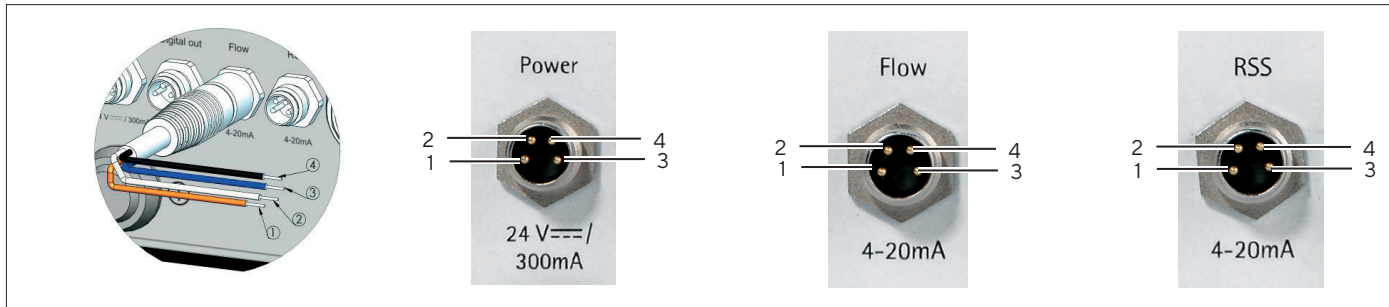


Fig. 22: PIN assignment of the connection cable conductors and the analog terminals of the device (example)

| PIN | Signal at the [Power] Terminal | Signal at the [Flow] and [RSS] Terminals | Color of Supplied Connection Cable |
|-----|--------------------------------|--|------------------------------------|
| 1   | 24 V <sub>DC</sub> (24C_in)    | 24 V <sub>DC</sub> (24C_in)              | brown                              |
| 2   | <b>Not assigned.</b>           | <b>Not assigned.</b>                     |                                    |
| 3   | Mass (GND_in)                  | Mass (GND_in)                            | blue                               |
| 4   | <b>Not assigned.</b>           | <b>Not assigned.</b>                     |                                    |

#### Requirements

- The power supply unit is not connected.
- The suitability of the external voltage source has been checked (see Chapter “5.4.4 Checking External Voltage Source,” page 42).

#### NOTICE

**The device starts up when the ON/OFF button is disabled!**

If the device is connected to the power supply via the [Flow] or [RSS] terminal:

- The ON/OFF button is disabled.
- The device switches on as soon as the terminals are connected to the power supply.

## Procedure

- ▶ Remove the cap from one of the analog terminals of the device:
  - [Power] terminal
  - [Flow] terminal
  - [RSS] terminal
- ▶ Connect the round plug of the analog connection cable to the [Power], [Flow] or [RSS] terminal.
- ▶ **NOTICE** Equipment damage due to opposing voltages at the terminal pins! PIN 1 and PIN 2 are internally bridged. Observe the correct polarity of the terminals (circuit principle, see Chapter “14.4.1 Device Power Supply,” page 109).
- ▶ Connect the Cage Clamp terminals of the analog connection cable to the external voltage source. Observe the PIN number and the conductor color of the supplied connection cable.

## 5.9.2 Setting up the Power Supply for the Flow and RSS Current Loop

### Power Supply via Device

The Flow and RSS current loop can be supplied with power via the [Flow] and [RSS] terminals.

**Required qualifications:** Electrician

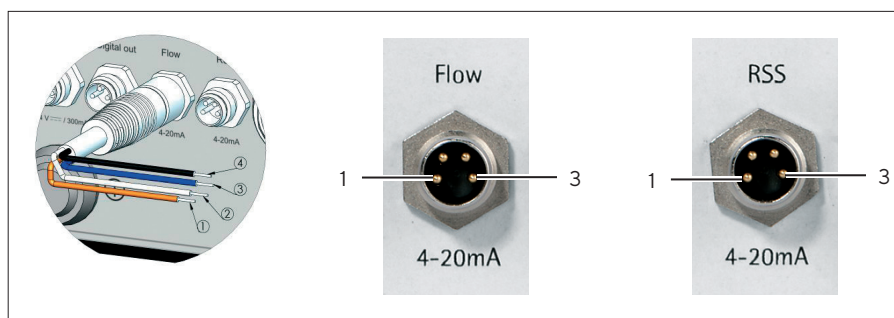


Fig. 23: PIN assignment of the connection cable conductors and the analog terminals of the device

| PIN | Signal at the [Flow] und [RSS] terminals | Color of supplied connection cable |
|-----|--|------------------------------------|
| 1   | 24 V <sub>DC</sub> (24C_in)              | brown                              |
| 3   | Mass (GND_in)                            | blue                               |

**Procedure**

- ▶ Remove the cap from one of the analog terminals of the device:
  - [Flow] terminal
  - [RSS] terminal
- ▶ Connect the round plug of the analog connection cable to the [Flow] or [RSS] terminal.
- ▶ **NOTICE** Equipment damage due to opposing voltages at the terminal pins! PIN 1 and PIN 2 are internally bridged. Observe the correct polarity of the terminals (circuit principle, see Chapter “14.4.2 Power Supply of Flow and RSS Current Loop via Device,” page 111).
- ▶ Connect the Cage Clamp terminals of the analog connection cable to the process control (see process control manual for information on the terminals). Observe the PIN number and the conductor color of the supplied connection cable.

**Power Supply via External Voltage Source or Process Control**

The Flow and RSS current loop can be supplied with power using the [Flow] and [RSS] terminals.

**Required qualifications:** Electrician

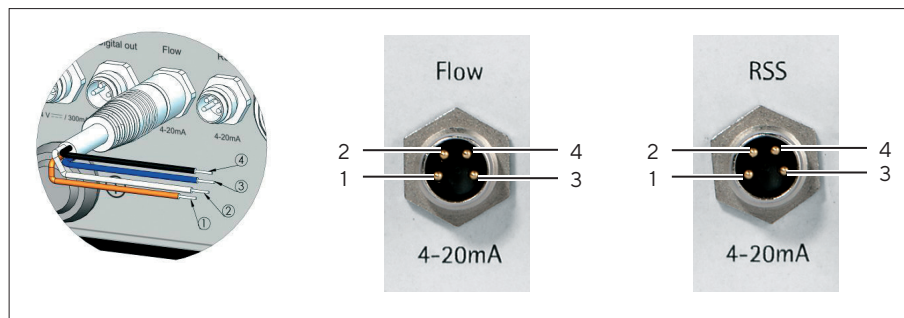


Fig. 24: PIN assignment of the connection cable conductors and the analog terminals of the device

| PIN | Signal at the [Flow] und [RSS] terminals | Color of supplied connection cable |
|-----|--|------------------------------------|
| 1   | 24 V <sub>DC</sub> (24C_in)              | brown                              |
| 2   | Flow or RSS current loop (+)             | white                              |
| 3   | Mass (GND_in)                            | blue                               |
| 4   | Flow or RSS current loop (-)             | black                              |

### Procedure

- ▶ Remove the cap from one of the analog terminals of the device:
  - [Flow] terminal
  - [RSS] terminal
- ▶ Connect the round plug of the analog connection cable to the [Flow] or [RSS] terminal.
- ▶ **NOTICE** Equipment damage due to opposing voltages at the terminal pins! PIN 1 and PIN 4 are internally bridged. Observe the correct polarity of the terminals (circuit principle, see Chapter “14.4.3 Power Supply of Flow and RSS Current Loop via External Voltage Source or Process Control,” page 113).
- ▶ **NOTICE** Equipment damage due to short circuiting! The external voltage source is not connected to the ground terminal (GND). Use cage-clamp terminals to insulate the conductor ends.
- ▶ Connect the Cage Clamp terminals of the analog connection cable to the external voltage source or process control (see process control manual for information on the terminals). Observe the PIN number and the conductor color of the supplied connection cable.

### 5.9.3 Connecting the Analog Interface

Required qualification:

Electrician

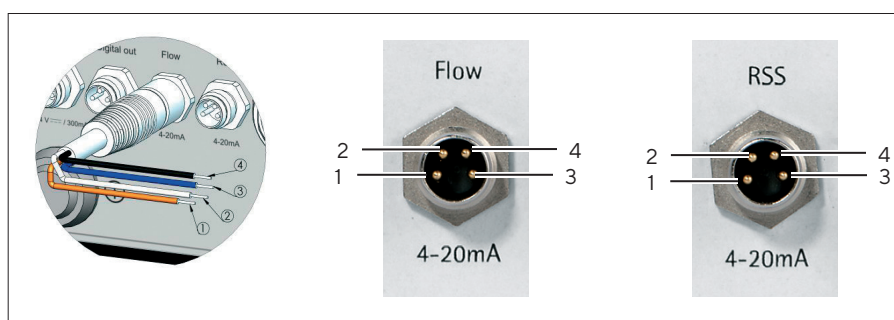


Fig. 25: PIN assignment of the connection cable conductors and the analog terminals of the device

| PIN | Signal at the [Flow] und [RSS] terminals | Color of supplied connection cable | Description   |
|-----|--|------------------------------------|---|
| 1   | Not assigned.                            |                                    |   |
| 2   | Flow or RSS current loop (+)             | white                              |   |
| 3   | Not assigned.                            |                                    |   |
| 4   | Flow or RSS current loop (-)             | black                              | Transmits (+) to process control or data acquisition system |

**Requirements**

- The Flow or RSS current output signal (4–20 mA) should be transmitted through the analog interface to the process controller or the data acquisition system.
- The round plug of the analog connection cable is connected to the [Power], [Flow] or [RSS] terminal.

**Procedure**

- ▶ Connect the Cage Clamp terminals of the analog connection cable to the process control or the data acquisition system (see process control or data acquisition system manual for information on the terminals). Observe the PIN number and the conductor color of the supplied connection cable.

**5.9.4 Connecting the Digital Interface**

**Required qualifications:** Electrician

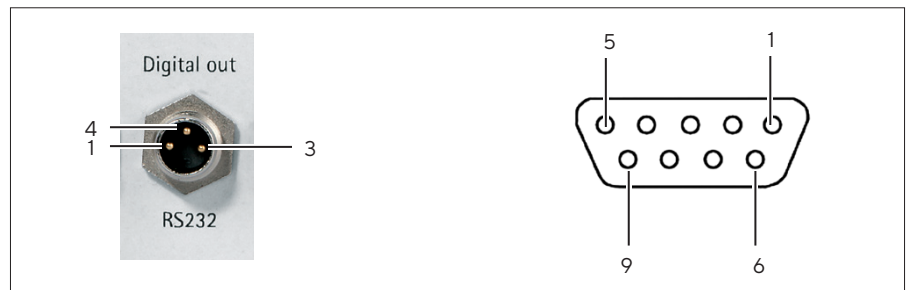


Fig. 26: PIN assignment of the [Digital out] terminal and the D-sub connector of the serial connection cable

| PIN | Signal at the [Digital Out] terminal | Color of supplied connection cable | PIN on the D-Sub connector |
|-----|--------------------------------------|------------------------------------|----------------------------|
| 1   | PC_TXD                               | brown                              | 3                          |
| 3   | GND                                  | blue                               | 5                          |
| 4   | PC_RXD                               | black                              | 2                          |

**Requirements**

The Flow or RSS current output signal (4–20 mA) should be transmitted through the digital interface to the process controller or the data acquisition system.



### Procedure

- ▶ Remove the cap from the [Digital Out] terminal.
- ▶ Connect the serial port cable to the [Digital Out] terminal. Observe the PIN number and the conductor color of the supplied connection cable.
- ▶ Connect the D-Sub connector of the serial connection cable to the process control or the data acquisition system (see process control or data acquisition system manual for information on the terminals).
- ▶ If a USB connection is required:
  - ▶ Connect the D-Sub connector of the serial connection cable to the USB | RS232 interface cable.
  - ▶ Connect the USB | RS232 interface cable to the process control or the data acquisition system (see process control or data acquisition system manual for information on the terminals).
- ▶ Tighten the D-Sub connector firmly.

### Tip

The driver for the connection cable with D-Sub male connector adapter can be downloaded online. The download link is on the adapter label of the D-sub connector adapter.

## 5.9.5 Checking Unused Terminals

The **unused** terminals must be covered with the flexible caps. For additional protection, e.g., extensive dust exposure, the **unused** terminals can be protected with screw caps.

Material:                      Screw caps, if necessary

### Procedure

- ▶ Make sure the caps are securely attached to the terminals.
  - ▶ If required: Secure the caps in place.
- ▶ If the terminals are to be protected using screw caps:
  - ▶ Remove the flexible caps.
  - ▶ Close the terminals with the screw caps.

## 5.10 Connecting the BioPAT® FlowDIN

### 5.10.1 Connecting the Digital Interface

The serial connection cable with 10-pin terminal block is fully wired and ready for serial communication.

**Required qualifications:**

Administrator

**Material:**

Serial connection cable, with plug and D-sub connector, configured, length: 2 m (**not** included in the scope of delivery)

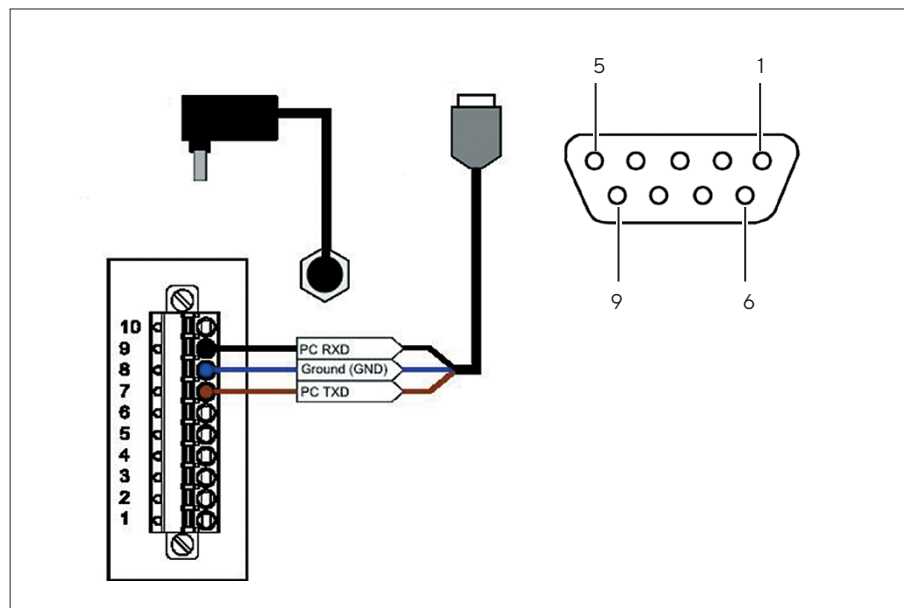


Fig. 27: Connecting the serial port cable and PIN assignment of the D-Sub connector of the serial port cable

| PIN | Signal at terminal block | PIN on the D-Sub connector |
|-----|--------------------------|----------------------------|
| 7   | PC_TXD                   | 3                          |
| 8   | GND                      | 5                          |
| 9   | PC_RXD                   | 2                          |

#### Procedure

- ▶ Screw the terminal block of the serial port cable into the terminal block of the device.
- ▶ Connect the D-sub connector of the connection cable to the process control or the data acquisition system (see process control or data acquisition system manual for information on the terminals). Observe the PIN number.

## 5.10.2 Connecting the Device to an External Voltage Source

The device can be connected to the external voltage source via the analog [Power] terminal or the terminal block.

### Power Supply of the Device via the [Power] Terminal

**Required qualifications:** Electrician

**Material:**

- Analog connection cable with round plug and Cage Clamp terminal block, configured, length: 2 m (**not** included in the scope of delivery)
- Serial connection cable, with plug and D-sub connector, configured, length: 2 m (**not** included in the scope of delivery)

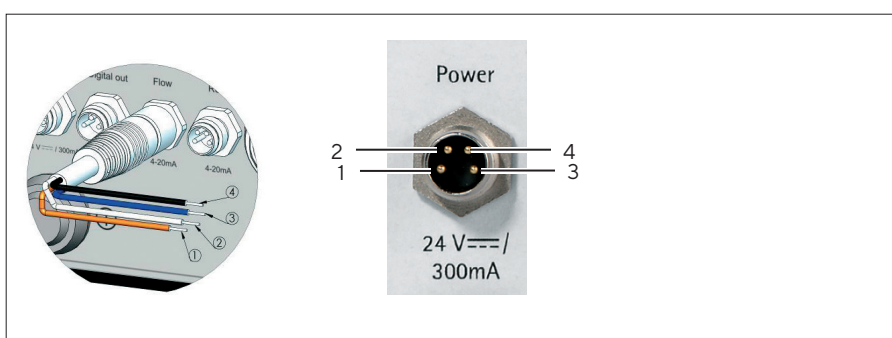


Fig.28: PIN assignment of the connection cable conductors and the [Power] terminal

| PIN | Signal at the [Power] terminal |
|-----|--------------------------------|
| 1   | 24 V <sub>DC</sub> (24C_in)    |
| 2   | Not assigned.                  |
| 3   | Mass (GND_in)                  |
| 4   | Not assigned.                  |

### Requirements

- The power supply unit is **not** connected.
- The suitability of the external voltage source has been checked (see Chapter “5.4.4 Checking External Voltage Source,” page 42).

### Procedure

- ▶ Remove the cap from the [Power] terminal.
- ▶ Connect the round plug of the analog connection cable to the [Power] terminal.
- ▶ **NOTICE** Equipment damage due to opposing voltages at the terminal pins! PIN 1 and PIN 2 are internally bridged. Observe the correct polarity of the terminals (circuit principle, see Chapter “14.4.1 Device Power Supply,” page 109).
- ▶ Connect the Cage Clamp terminals of the analog connection cable to the external voltage source. Observe the PIN number of the serial connection cable.

## Power Supply of the Device via the Terminal Block

|                          |  |
|--------------------------|--|
| Required qualifications: | Electrician  |
| Material:                | Connection cable with a conductor cross-section of max. 1.5 mm <sup>2</sup> , 2 pieces |

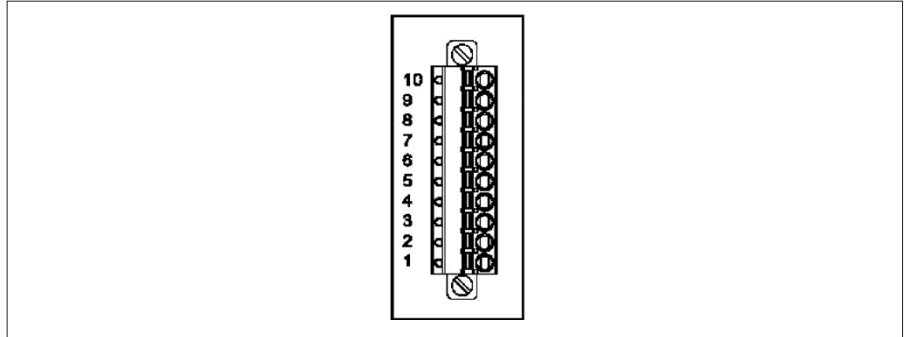


Fig.29: Terminal block for BioPAT® FlowDIN amplifier box

| PIN | Signal at terminal block |
|-----|--------------------------|
| 1   | +24 V <sub>DC</sub>      |
| 2   | Ground (GND)             |

### Requirements

- The power supply unit is not connected.
- The suitability of the external voltage source has been checked (see Chapter “5.4.4 Checking External Voltage Source,” page 42).

### NOTICE

#### The device starts up when the ON/OFF button is disabled!

When the device is connected to the power supply via the terminal block:

- The ON/OFF button is disabled.
- The device switches on as soon as the terminals are connected to the power supply.

### Procedure

- ▶ **NOTICE** Equipment damage due to opposing voltages at the terminal pins! PIN 1 and PIN 2 are internally bridged. Observe the correct polarity of the terminals (circuit principle, see Chapter “14.4.1 Device Power Supply,” page 109).
- ▶ Connect external power source leads to the terminal block. Pay attention to the correct PIN number.

### 5.10.3 Setting up the Power Supply for the Flow and RSS Current Loop

**Required qualifications:** Electrician

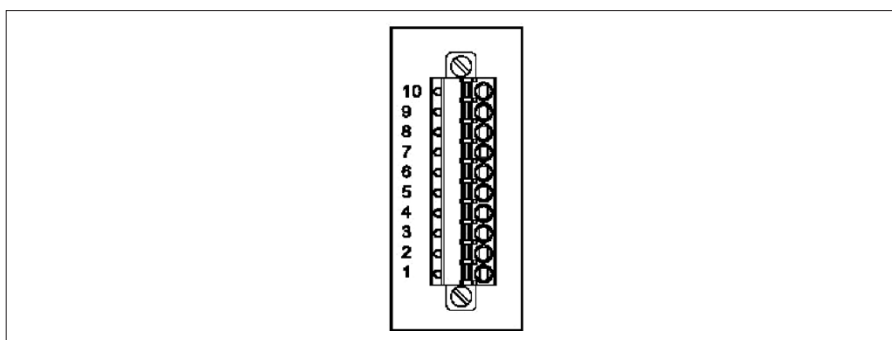


Fig.30: Terminal block for BioPAT® FlowDIN amplifier box

| PIN | Signal at terminal block |
|-----|--------------------------|
| 3   | Flow current loop (+)    |
| 4   | Flow current loop (-)    |
| 5   | RSS current loop (+)     |
| 6   | RSS current loop (-)     |

#### Procedure

- ▶ **NOTICE** Damage to device due to opposing voltages at the terminal pins. Observe the correct polarity of the terminals (for the terminal connection principle, see Chapter “14.4.2 Power Supply of Flow and RSS Current Loop via Device,” page 111 and Chapter “14.4.3 Power Supply of Flow and RSS Current Loop via External Voltage Source or Process Control,” page 113).
- ▶ Connect the process control leads to the terminal block. Pay attention to the correct PIN number.

### 5.10.4 Connecting the Extension Cord for the BioPAT® Clamp-on

The extension cord for the BioPAT® Clamp-on makes it possible to connect the BioPAT® Clamp-on to the device outside the control box.

**Required qualifications:** Administrator

**Material:** Extension cord for BioPAT® Clamp-on, configured, (**not** included in the scope of delivery)

#### NOTICE

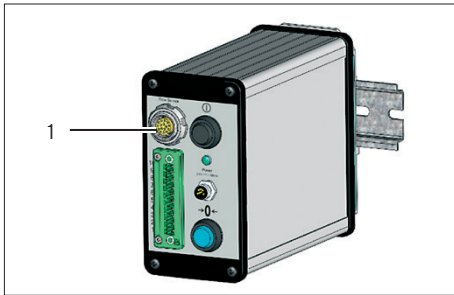
Equipment damage due to use of multiple extension cords! Only use one extension cord to connect the BioPAT® Clamp-on.

**Requirements**

The device is installed in a control box.

**Procedure**

- ▶ Remove the cap from the [Flow Sensor] terminal (1).
- ▶ Connect the male connector of the extension cord to the [Flow sensor] terminal.
- ▶ Lead the extension cord through the control cabinet cutout.
- ▶ Cover the extension cord plug with the yellow anti-dust cap or use suitable accessories to cover the plug.
- ▶ The connector is protected from dust and dirt.



**5.10.5 Setting up External Zeroing**

**Remote Zeroing**

The device has an integrated “Remote Zero” option for remote zeroing. The remote zeroing pulse is generated by a switching contact, which affects a DC pulse at PIN 10 of the terminal block.

Zeroing takes place on the trailing edge of the remote 24 V<sub>DC</sub> zeroing impulse with a duration of at least 500 ms. Zeroing is possible only if the coupling is sufficient. The time interval between two pulses must be at least 2000 ms.

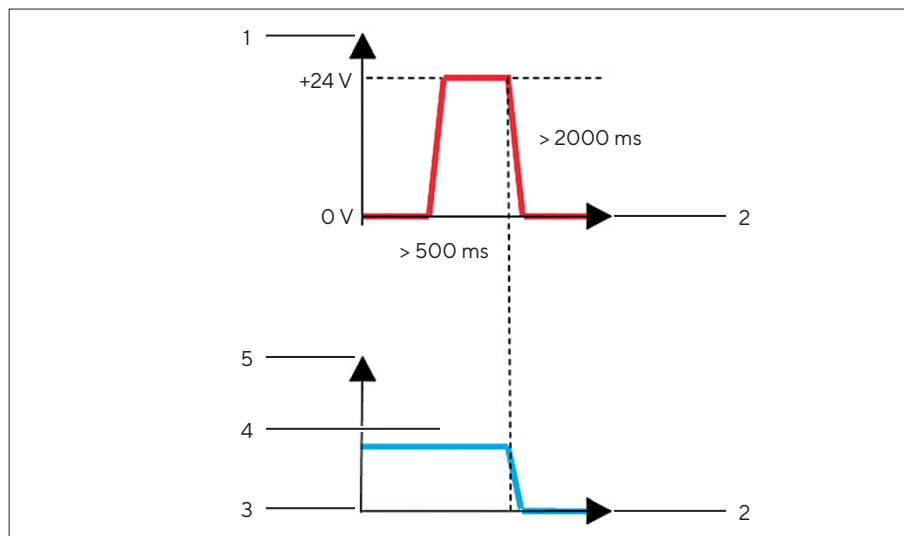


Fig. 31: Remote zeroing pulse induces zeroing

| Pos. | Description                             |
|------|---|
| 1    | Voltage at PIN 10 of the terminal block |
| 2    | Time [ms]                               |
| 3    | No flow [ml/min]                        |
| 4    | Configured zero point                   |
| 5    | Flow [ml/min]                           |

## Remote Zeroing when Power is Supplied via AC Adapter

Required qualifications: Electrician

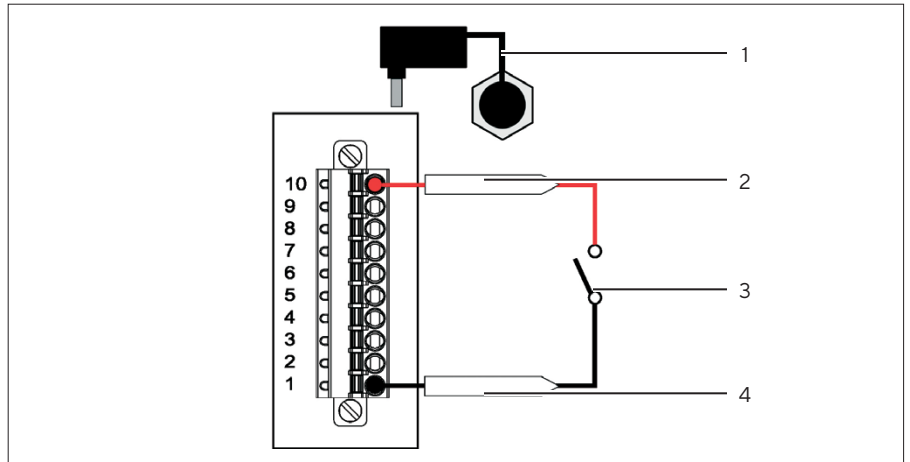


Fig.32: Remote zeroing when power is supplied via AC adapter

| Pos. | Designation           | Description                       |
|------|-----------------------|-----------------------------------|
| 1    | AC Adapter            | Connected to the [Power] terminal |
| 2    | Remote Zero           | Terminal lead to PIN 10           |
| 3    | Remote control switch |                                   |
| 4    | +24 V <sub>DC</sub>   | Terminal lead to PIN 1            |

## Procedure

- ▶ **NOTICE** Damage to device due to opposing voltages at the terminal pins. Observe the correct polarity of the terminals.
- ▶ Connect the [+24 V<sub>DC</sub>] terminal to the [Remote Zero] terminal using a remote control switch.

## Remote Zeroing When Power is Supplied via an External Voltage Source

Required qualifications: Electrician

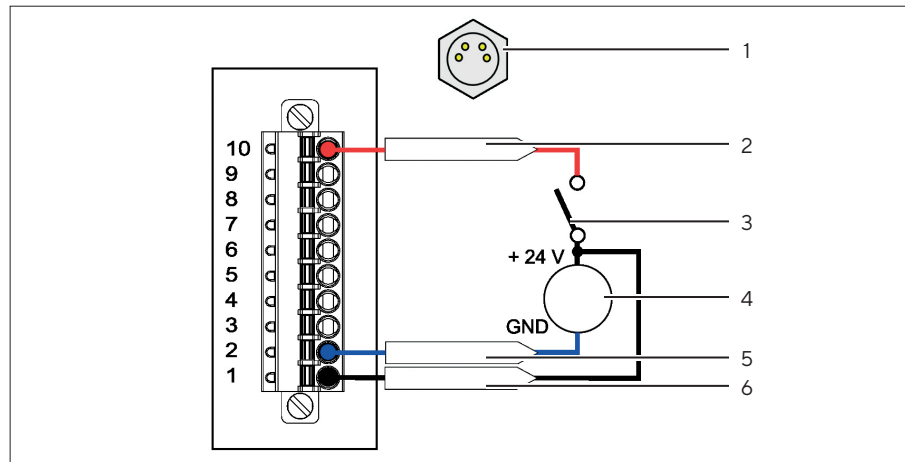


Fig. 33: Remote Zeroing When Power is Supplied via an External Voltage Source

| Pos. | Designation             | Description              |
|------|-------------------------|--------------------------|
| 1    | External voltage source | Connected to the device. |
| 2    | Remote Zero             | Terminal lead to PIN 10  |
| 3    | Remote control switch   |                          |
| 4    | External voltage source |                          |
| 5    | Ground (GND)            | Terminal lead to PIN 2   |
| 6    | +24 V <sub>DC</sub>     | Terminal lead to PIN 1   |

### Requirements

The suitability of the external voltage source has been checked (see Chapter “5.4.4 Checking External Voltage Source,” page 42).

### Procedure

- ▶ **NOTICE** Damage to device due to opposing voltages at the terminal pins. Observe the correct polarity of the terminals.
- ▶ Connect the [+24 V<sub>DC</sub>] terminal to the [Remote Zero] terminal using a remote control switch.
- ▶ Connect the [GND] terminal to the ground terminal (GND) of the external power source.



## 5.11 Checking System Settings for Digital Interface

### 5.11.1 Checking Initialization Parameters

The device can communicate with a host system via the asynchronous serial communication interface. The digital interface (Digital Out) must be initialized with the following parameters:

- 38,400 baud
- 8 data bits
- 1 start bit
- 1 stop bit
- Parity: none
- No hardware (CTS/RTS) or software (Xon | Xoff) handshake

**Required qualifications:** Administrator

#### Requirements

The device is connected to the process controller or the data acquisition system via the digital interface (Digital Out).

#### Procedure

- ▶ Check the parameters for the digital interface (Digital Out). Refer to the instructions on the process control or data acquisition system.
  - ▶ If required: Configure the parameters.

### 5.11.2 Checking Data Transmission via Digital Interface

#### Commands for Digital Interface

Data transmission takes place without a host system request. The following commands are available for the digital interface (Digital Out).

Every command must be sent with a line break <CR>. The delay time between two commands must be 1 second.

| Command | Meaning                                |
|---------|--|
| I<CR >  | Dummy instruction (stop communication) |
| R<CR>   | Reboot (restart communication)         |
| Z<CR>   | Zeroing                                |

| Command             | Meaning   |
|---------------------|---|
| S<CR>               | <p>Sensor and device status information request</p> <p>The sensor and device status information consists of an ASCII data text string with the following information:</p> <ul style="list-style-type: none"> <li>– Serial number of the BioPAT® Clamp-on (16 bytes)</li> <li>– Tubing size (16 bytes)</li> <li>– Space as a separator</li> <li>– Tubing type of the selected calibration table (16 bytes)</li> <li>– Space as a separator</li> <li>– Operating medium of the selected calibration table (8 bytes)</li> <li>– Temperature of the selected calibration table (6 bytes)</li> <li>– Space as a separator</li> <li>– Number of calibration tables (6 bytes)</li> <li>– <math>Q_{max}</math> of the selected calibration table (8 bytes) &lt;CR&gt; and &lt;LF&gt;</li> <li>– Serial number of the flowmeter (16 bytes)</li> <li>– Space as a separator</li> <li>– SW version number (16 bytes)</li> <li>– The data string ends with &lt;CR&gt; and &lt;LF&gt;</li> </ul> |
| T1<CR>...<br>T7<CR> | <p>Requirement for setting   Using the calibration table number 1-7</p> <p>When requesting a <b>non</b>-existent calibration table, the calibration table is <b>not</b> changed.</p>  |
| Cx.yz<CR>           | <p>Setting the calibration factor (values between 0.50 and 1.50 with two decimal places, e.g. C1.10 &lt;CR&gt;)</p>   |

**Required qualifications:** Administrator

#### Procedure

- ▶ Check the commands. Refer to the host system instructions to do this.

#### Meaning of the Bytes in the ASCII Data String

Every 100 ms (10 Hz), the following ASCII data string is transmitted via the digital interface (Digital Out):

ee\_ss\_aaa\_p.pp\_ffffff\_mmmmmmm\_ssssss\_tttttt\_<CR><LF>

| Byte | Meaning   | Note   |
|------|---|--|
| ee   | Hexadecimal error messages<br>Available error codes<br>00 means <b>no</b> error |  |
| " "  | Space as a separator between the various parameters (hex 0x20)                  | The underscore is used to represent the space character. |

| Byte   | Meaning  | Note                           |
|--------|--|--------------------------------|
| ss     | Hexadecimal status information   |                                |
| aaa    | Acoustic coupling   RSS in %<br>Range 0 to 100%  |                                |
| p.pp   | Calibration factor   |                                |
| ffffff | Average flow, calculated over 100 ms in ASCII (range: -999999 ml/min to +999999 ml/min) including calibration factor | Additional characters possible |
| mmmmm  | Average flow, calculated over 1 s in ASCII (range: -999999 ml/min to +999999 ml/min) with applied calibration factor | Additional characters possible |
| sssss  | Average flow, calculated over 10 s in ASCII (range: -999999 ml/min to +999999 ml/min) including calibration factor   | Additional characters possible |
| ttttt  | Plate temperature in °C ( $38 \pm 38$ °C)  |                                |
| <CR>   | 0x0d line break  |                                |
| <LF>   | 0x0a line feed   |                                |

Additional characters in the data string:

In addition to numeric values, some data strings can contain the following characters:

- A minus sign for negative values or to show hidden values (hex "0x2D").
- "^" character: Indicates an overflow (hex: "0x5E").
- "v" character: Indicates an underflow (hex: "0x76").

#### Procedure

- ▶ Check the ASCII data strings. Refer to the host system instructions to do this.

### 5.11.3 Programming Applications

**Required qualifications:** Administrator

#### Procedure

- ▶ When programming your own applications, make sure to take the error and status bytes into account. This is required for proper system evaluation.
- ▶ For flow distortions, e.g., in the form of bubbles in the tubing, the average flow values may be distorted.

## 5.12 Data Transmission via Digital Interface

### 5.12.1 Examples of Output Strings

| Output string                                     | Meaning   |
|---|---|
| "00 00 100 0.99 7195 7193 6897 +41" <CR><LF>      | BioPAT® Clamp-on functioning properly, calibration factor 0.99; Calibration Table 1                                 |
| "00 04 100 1.00 -3588 -3590 -3589 +43" <CR><LF>   | BioPAT® Clamp-on functioning properly, calibration factor 1.00; Calibration Table 2, with negative flow values      |
| "00 04 100 1.34 -4804 -4805 -4805 +43" <CR><LF>   | BioPAT® Clamp-on functioning properly, calibration factor 1.34; Calibration Table 2, with negative flow values      |
| "00 40 100 1.00 0 0 0 +43" <CR><LF>               | BioPAT® Clamp-on connected, after stable zeroing  |
| "00 24 34 0.99 ----- +43" <CR><LF>                | BioPAT® Clamp-on connected, insufficient acoustic coupling   RSS value  |
| "1A 41 --- +77" <CR><LF>                          | BioPAT® Clamp-on connected, overtemperature error 77°C on the printed circuit board inside the device (data hidden) |
| "00 40 75 1.01 ^^^^^^ ^^^^^^ ^^^^^^ +29" <CR><LF> | Status: Flow out of range: Flow rate exceeds +999999 mL/min; calibration factor 1.01                                |
| "00 40 89 1.50 vvvvvv vvvvvv vvvvvv +29" <CR><LF> | Status: Flow out of range: Flow rate exceeds -999999 mL/min; calibration factor 1.50                                |
| "00 E0 --- +35" <CR><LF>                          | BioPAT® Clamp-on disconnected   |

All output strings end in <carriage return> <line feed> and are shown in quotation marks ("""). These output strings are transmitted cyclically at intervals of 10 Hz.

The serial interface parameters (initialization parameters) must be set correctly.

Do **not** use invalid characters. This can lead to a system crash and require the system to be rebooted after previously shutting down.

## 5.12.2 Example of Responses to Serial Commands

| Response strings |       |       |       |               |
|------------------|-------|-------|-------|---------------|
| "00 44 100 1.00  | 0     | 0     | 0     | +41" <CR><LF> |
| "00 44 100 1.00  | 0     | 0     | 0     | +41" <CR><LF> |
| "00 60 0 1.00    | ----- | ----- | ----- | +41" <CR><LF> |
| "00 60 0 1.00    | ----- | ----- | ----- | +41" <CR><LF> |
| "00 60 0 1.00    | ----- | ----- | ----- | +41" <CR><LF> |
| "00 40 100 1.00  | 2     | 0     | 0     | +41" <CR><LF> |
| "00 40 100 1.00  | 2     | 43    | 67    | +41" <CR><LF> |
| "00 40 100 1.00  | 3     | 36    | 67    | +41" <CR><LF> |

The example shows a change in the calibration table. Calibration table selection is only possible for BioPAT® Clamp-ons with more than one calibration table.

- The example shows a change from Calibration Table 1 to Calibration Table 2. The change is carried out using the command "T2" <CR>.
- The status bit changes from 44 to 40.
- The mean value memory is deleted, omitting the first 3 strings.

## 5.12.3 Examples of Status Information

### Status Information When BioPAT® Clamp-on is Connected

When the BioPAT® Clamp-on is connected: Status information "S" <CR> is requested:

```
"83599          3/8" x 3/32"    PVC    Cell suspension
    37 °C        6    10000" <CR><LF>
"59915          V3.0.0.0      " <CR><LF>
```

The sensor information corresponds to the currently selected calibration table. The data in the first and second lines have the following meaning:

| Line entry                         | Meaning   |
|------------------------------------|---|
| 83599                              | BioPAT® Clamp-on serial number                                      |
| $\frac{3}{8}$ " x $\frac{3}{32}$ " | Tubing dimensions   |
| PVC                                | Tubing material of the selected calibration table                   |
| Cell suspension                    | Operating medium of the selected calibration table                  |
| 37 °C                              | Calibration temperature of the selected calibration table           |
| 6                                  | Number of calibration tables pre-programmed in the BioPAT® Clamp-on |

| Line entry | Meaning   |
|------------|---|
| 10000      | Flow range of the selected calibration table ( $Q_{\max}$ ) |
| 59915      | Device serial number  |
| V3.0.0.0   | Software version  |

#### Status Information Without BioPAT® Clamp-on Connected

If no BioPAT® Clamp-on is connected: Status information "S" <CR> <LF> is requested:

```
"-----"
<CR><LF>
"59916 V3.0.0.0 " <CR><LF>
```

The sensor information in the first line is hidden. The data in the second line have the following meaning:

| Line entry | Meaning              |
|------------|----------------------|
| 59915      | Device serial number |
| V3.0.0.0   | Software version     |

## 6 Process Preparation

### 6.1 Checking Process Parameters

The BioPAT® Flow Clamp-on is supplied from the factory with three standard calibration tables. These calibration tables are saved in the BioPAT® Flow Clamp-on calibration report and contain the following values:

- Medium: Water
- Temperature: 9°C, 22°C, 32°C
- Tubing material: BioPAT® Flow Pipe (size)

#### Procedure

- ▶ Check whether the process parameters correspond to one of the calibration tables in the calibration report. Operating outside of the conditions specified in the calibration tables can reduce the accuracy of the flow measurement.
  - ▶ Select the most suitable calibration table.
  - ▶ If required: Add a new calibration table. Please contact Sartorius Service in this regard.

### 6.2 Connecting the BioPAT® Clamp-on

#### Procedure

- ▶ Remove the cap from the [Flow Sensor] terminal.
- ▶ When the device is connected without an extension cord: Connect the plug connector (1) to the [Flow Sensor] terminal.
- ▶ When the device is connected with an extension cord: Remove the anti-dust cap from the extension cable plug and connect the plug connector (1) to the extension cable plug.



## 6.3 Inserting the BioPAT® Flow Pipe or Tubing in the BioPAT® Clamp-on

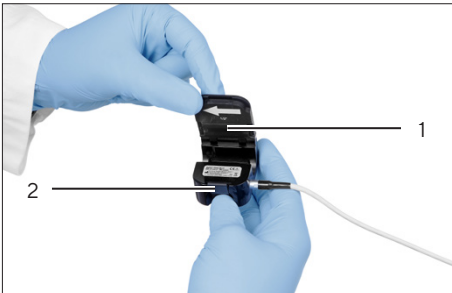
### 6.3.1 Inspecting the BioPAT® Clamp-on

#### Requirements

The BioPAT® Flow Clamp-on does **not** have tubing or a BioPAT® Flow Pipe inserted.

#### Procedure

- ▶ Open the snap lid (2) and lift up the lid (1) of the BioPAT® Clamp-on.

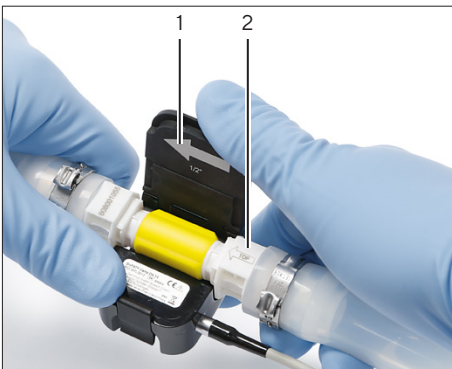


- ▶ Inspect the measurement channel (1) for contamination and residue. Contamination and residue in the measurement channel can adversely affect the acoustic coupling.
  - ▶ If required: Clean the BioPAT® Clamp-on (see Chapter “8.2 Cleaning the Device Surfaces and BioPAT® Clamp-on”, page 84).
- ▶ Check that the tubing or the BioPAT® Flow Pipe to which the BioPAT® Clamp-on is connected is clean. Dirty tubing or BioPAT® Flow Pipes can impair acoustic coupling.
  - ▶ If required: Clean the tubing or the BioPAT® Flow Pipe with a damp cloth.

### 6.3.2 Inserting the BioPAT® Flow Pipe in the BioPAT® Clamp-on

#### Procedure

- ▶ Insert the BioPAT® Flow Pipe into the BioPAT® Clamp-on. Make sure that the BioPAT® Flow Pipe is in the correct position in the BioPAT® Clamp-on:
  - The arrow inside the lid (1) and the arrow on the BioPAT® Flow Pipe (2) are pointing in the same direction.
  - The “TOP” marking (2) on the BioPAT® Flow Pipe is pointing up.







- ▶ Push the tubing into the measurement channel on both sides. The tubing must lie completely in the measurement channel.



- ▶ Close the lid.
- ▶ Close the snap lid and let it engage.

### 6.3.3 Inserting Tubing in the BioPAT® Clamp-on

#### Procedure

- ▶ Select a suitable installation position (see Chapter “14.2.4 Position of the Flow Sensor (Recommendation)”, page 107).
- ▶ To ensure optimum measurement conditions, check the following conditions:
  - To prevent bubbles accumulating in the measurement channel: The BioPAT® Clamp-on is below the highest point of the tubing.
  - The minimum distance between the inlet of the BioPAT® Flow Clamp-on and potential sources of interference (pump, valves, etc.) has been complied with (minimum distance see Chapter “14.2.5 Installing the Flow Sensor (Recommendations)”, page 107).
  - The tubing is straight in the inlet region.
  - The minimum length of the tubing in the straight inlet section has been complied with (minimum length of inlet section see Chapter “14.2.5 Installing the Flow Sensor (Recommendations)”, page 107).
- ▶ Insert the tubing in the BioPAT® Clamp-on (installation process is the same as Chapter “6.3.2 Inserting the BioPAT® Flow Pipe in the BioPAT® Clamp-on”, page 64).

## 6.4 Switching on the Device

### 6.4.1 Switching on the BioPAT® FlowDIN

---

#### NOTICE

##### The device starts up when the ON/OFF button is disabled!

If the device is connected via the [Flow] or [RSS] terminal or the terminal block is connected to the power supply:

- The ON/OFF button is disabled.
  - The device switches on as soon as the terminals are connected to the power supply.
- 

#### Procedure

- ▶ If the device is connected to the power supply via an AC adapter or the [Power] terminal: Press the ON/OFF button [I].
  - ▷ The device is switched on.
  - ▷ The LED status indicator lights up.
- ▶ If the device is connected to the power supply via the [Flow] or [RSS] terminal or the terminal block:
  - ▷ The device switches on as soon as it is connected to the power supply.
  - ▷ The LED status indicator lights up.
- ▷ Device initialization starts.
- ▶ Wait until initialization has ended. This may take a few seconds.
- ▶ Pay attention to the process control or data acquisition system display. The device automatically begins transmitting measured values.
- ▷ A measured value appears, although there is no flow.

### 6.4.2 Switching on the BioPAT® Flowplus

---

#### NOTICE

##### The device starts up when the ON/OFF button is disabled!

If the device is connected to the power supply via the [Flow] or [RSS] terminal:

- The ON/OFF button is disabled.
  - The device switches on as soon as the terminals are connected to the power supply.
- 

#### Procedure

- ▶ If the device is connected to the power supply via an AC adapter or the [Power] terminal: Press the ON/OFF button [I].
  - ▷ The device is switched on.
  - ▷ The LED status indicator lights up.
- ▶ If the device is connected to the power supply via the [Flow] or [RSS] terminal:
  - ▷ The device switches on as soon as it is connected to the power supply.
  - ▷ The LED status indicator lights up.

- ▷ Device initialization starts. The message `Initializing Device` appears on the display.
- ▷ Wait until initialization has ended. This may take a few seconds.
- ▶ Pay attention to the device display. The device automatically begins transmitting measured values.
- ▷ A measured value appears on the display, although there is no flow.

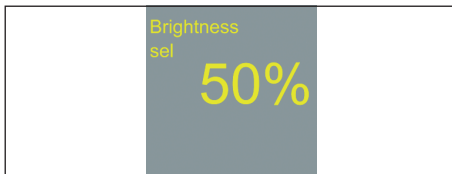
## 6.5 Adjusting the Brightness (BioPAT® Flowplus)

The device display is set to a brightness of 50% by default.

### Procedure



- ▶ Select the menu "Adjust Brightness" using the arrow keys.
- ▶ To switch to the operating mode [sel]: Press Enter.



- ▷ The display reads [sel].
- ▶ Select the desired brightness using the arrow keys.
- ▶ To confirm the selection: Press Enter.

## 6.6 Parameter List for the BioPAT® Flowplus

| Parameter          | Setting values      | Explanation                      |
|--------------------|---------------------|----------------------------------|
| Calibration factor | 0.50-1.50           | Adjustment in increments of 0.01 |
| Display brightness | 25%, 50%, 75%, 100% |                                  |

# 7 Operation

## 7.1 Overview of Operation and Data Transmission

| Operation   Data Transfer   | BioPAT® Flowplus   | BioPAT® FlowDIN                                       |
|---|--|---|
| Output of process and measured values   | Display of process control or data acquisition system, device display        | Display of process control or data acquisition system |
| Zeroing   | Zeroing key  | Zeroing key or remote zeroing                         |
| Configuring the measured values   | Process control or data acquisition system, operator interface of the device | Process control or data acquisition system            |
| Transmission of measured values to process control or data acquisition system | Analog interface (Flow) or digital interface (Digital Out)                   | Digital interface (Digital Out)                       |

## 7.2 Changing Settings in Parallel (BioPAT® Flowplus)

If settings are changed in parallel, e.g., changing the calibration table on the device and changing the calibration factor via the digital interface (Digital Out):

- The changes immediately take effect on the measurements.
- The changes are **not** immediately displayed on the display.
- When switching back to another display and the display is “flashed”: The changes are displayed.

## 7.3 Data Transmission via Analog Interface

### 7.3.1 Checking Flow Values

The analog interface (Flow) consists of a 4-20 mA current loop. The power output signal of the Flow current loop is transmitted to the data acquisition system or process control.

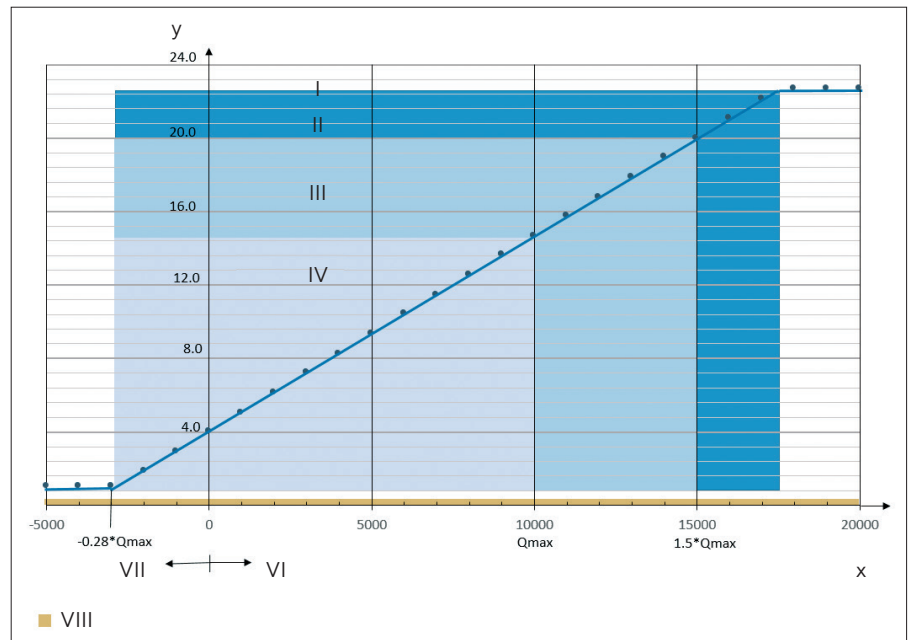


Fig. 34: Flow rate and power output signal for flow sensor with standard flow range of 10,000 mL/min

| Pos. | Designation              |
|------|--------------------------|
| x    | Flow rate Q [ml/min]     |
| y    | Power output signal [mA] |
| I    | Exceeded range           |
| II   | Reserve range            |
| III  | Extended range           |
| IV   | Nominal range            |
| VI   | Supply                   |
| VII  | Return                   |
| VIII | Faulty range             |

| Power output signal for flow value [mA] | Meaning  |
|---|--|
| 0                                       | There is a malfunction.  |
| > 0.5 - < 1                             | There is a malfunction.  |
| 0.2 - 0.5                               | There is a malfunction.  |
| 1 - 4                                   | <ul style="list-style-type: none"> <li>– Negative flow rate</li> <li>– The negative flow is cut to a power output signal of 1 mA.</li> <li>– The current output signal of 1 mA corresponds to a negative flow of 28% of the calibration table nominal flow range.</li> </ul> |
| 4                                       | Zero flow with proper zeroing  |
| 20                                      | The flow corresponds to 1.5 times the maximum nominal flow rate $Q_{max}$ in the calibration table. The conversion factors are calculated according to the table "Current conversion factors".   |
| 20-23                                   | There is a malfunction.  |

#### Requirements

The device is connected to the data acquisition system or process control via the analog interface (Flow).

#### Procedure

- ▶ Check the current output signal for the flow value.
- ▶ If there is a fault: Remedy the fault (see Chapter "9.4 Missing or Incorrect Current Output Signals", page 89).

### 7.3.2 Converting the Current Output Signal into a Flow Rate

#### Procedure

- ▶ If the current output signal needs to be converted into a flow rate: Use the following equation:

| Calibration factor                 | Equation  |
|------------------------------------|---|
| With configured calibration factor | Flow rate [ml/min] = current output signal [mA] - 4 mA) * analog current conversion factor  |
| Without calibration factor         | Flow rate [ml/min] = $\frac{(\text{current output signal [mA]} - 4\text{mA}) * \text{analog current conversion factor}}{\text{calibration factor}}$ |

### Calculating the Analog Current Conversion Factor

The analog current conversion factor is dependent on the maximum flow rate of the flow sensor ( $Q_{\max}$ ). The  $Q_{\max}$  value is specified in the calibration report.

When the BioPAT® Flowplus device is connected: The  $Q_{\max}$  value is displayed in the “Calibration Table” menu.

| Standard Flow Rate $Q_{\max}$ [ml/min]<br>with Calibration Factor of 1.00 | Analog Current Conversion Factor<br>[(ml/min)   mA] | Max. Reflux [ml/min] at 1 mA |
|---|---|------------------------------|
| 4000  | 375.0   | -1125                        |
| 6000  | 562.5   | -1688                        |
| 8000  | 750.0   | -2250                        |
| 10000   | 937.5   | -2813                        |
| 20000   | 1875.0  | -5625                        |
| 50000   | 4687.5  | -14063                       |
| 100000  | 9375.0  | -28125                       |

The analog current conversion factor is a fixed value and is based on the maximum flow range of a calibration table when the calibration factor is set to 1.50.

The analog current conversion factor is **not** dependent on the calibration factor actually selected.

#### Procedure

- If the current conversion factor needs to be converted into a flow rate: Use the following equation:

$$\begin{aligned} \text{Analog current conversion factor} &= (\text{max. calibration factor}) * \frac{\left(Q_{\max} \left[\frac{\text{ml}}{\text{min}}\right] - 4 \text{ mA}\right)}{\text{current output signal [mA]} - 4 \text{ mA}} \\ &= \frac{1.5 * Q_{\max} [\text{ml/min}]}{16 [\text{min} * \text{mA}]} \end{aligned}$$

## 7.4 Selecting Calibration Table

A calibration table contains calibration parameters such as fluid, temperature, or tubing types.

The BioPAT® Flow Clamp-ons are supplied with three standard calibration tables for the following temperature ranges for water (or aqueous solutions):

- Cooled: 4–14°C
- Room temperature: 17–27°C
- Heated: 27–37°C

The calibration table should be adapted to the process conditions without impairing the measurement accuracy. The calibration factor remains unchanged when the calibration table is changed.

The device is set to Calibration Table 1 by default. When the device is switched on or off, or when the BioPAT® Clamp-on is reconnected to the device: The calibration table will be reset to Calibration Table 1.

The available calibration tables depend on the BioPAT® Clamp-on.

### 7.4.1 BioPAT® FlowDIN

#### Requirements

A BioPAT® Clamp-on is connected to the device.

#### Procedure

- ▶ Select the calibration table in the process control or data acquisition system. Refer to the instructions on the process control or data acquisition system.

### 7.4.2 BioPAT® Flowplus

#### Requirements

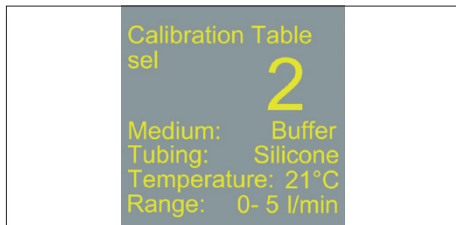
A BioPAT® Clamp-on is connected to the device.

#### Procedure

- ▶ Select the "Calibration Table" menu using the arrow keys.
- ▶ To switch to the operating mode [sel]: Press Enter.
- ▶ The display reads [sel].
- ▶ Use the arrow keys to select the desired calibration table, e.g. Calibration Table 2.
- ▶ Verify that the displayed calibration parameters match the process parameters:
  - Deviating calibration and process parameters can reduce the measurement accuracy.
  - The higher value of the flow range (Range) indicates the maximum flow rate ( $Q_{\max}$ ) of the BioPAT® Clamp-on.
- ▶ To confirm the selection: Press Enter.

#### Tip

- ▶ If the calibration table has been changed: Adjust the zero point. This will increase the measurement accuracy.





## 7.5 Selecting the Calibration Factor

The BioPAT® Clamp-on is calibrated for specific process parameters. The calibration factor can be used to change the gradient of the calibration curve. The calibration factor changes the flow rate according to the following equation:

$$\text{Flow rate}_{\text{calibration factor}} = \text{calibration factor} * \text{flow rate}_{\text{(measured in the clamp-on transducer)}}$$

The internally derived flow value is multiplied by the calibration factor. The result is displayed as the current flow value on the various interfaces.

The device is set by default to the Calibration Factor 1.00. When the device is switched on or off, or when the BioPAT® Clamp-on is reconnected to the device: The calibration factor will be reset to calibration factor 1.00.

### 7.5.1 BioPAT® FlowDIN

#### Requirements

A BioPAT® Clamp-on is connected to the device.

#### Procedure

- ▶ Change the calibration factor in the process control or data acquisition system. Refer to the instructions on the process control or data acquisition system.

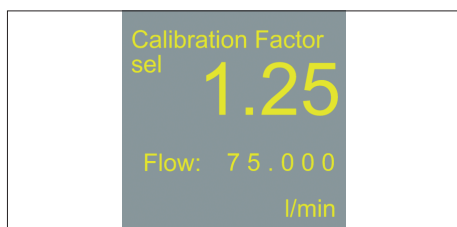
### 7.5.2 BioPAT® Flowplus

#### Requirements

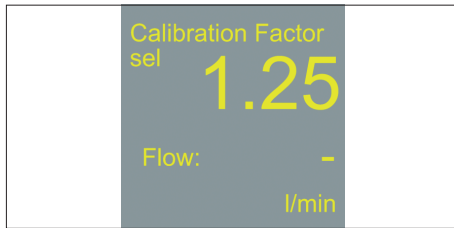
A BioPAT® Clamp-on is connected to the device.

#### Procedure

- ▶ Select the “Calibration Factor” menu using the arrow keys.
- ▶ To switch to the operating mode [sel]: Press Enter.



- ▷ The display reads [sel].
- ▶ Use the arrow keys to select the desired calibration factor (for parameters, see Chapter “6.6 Parameter List for the BioPAT® Flowplus”, page 67)
- ▶ To confirm the selection: Press Enter.
- ▷ Changing the calibration factor has an immediate effect on the flow rate and the analog and digital output value.



- ▶ If **no** flow value is displayed: The acoustic coupling is inadequate.
- ▶ If required: Check the acoustic coupling.

## 7.6 Checking the Acoustic Coupling

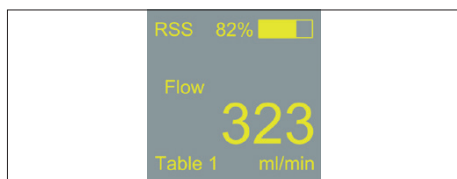
The strength of the ultrasonic signal (RSS value) received is an indicator of the quality of transmission of the ultrasound signal. This also makes the RSS value an indicator for the acoustic coupling of the tubing. Sufficient acoustic coupling is an important prerequisite for accurate measurements.

Display of the RSS value in the process control:

The software generates the RSS value linearly using 0–100% scaling for a 4–20 mA input. The current output signal of the RSS value can be interpreted as follows:

| Power output signal for RSS value [mA] | Meaning  |
|--|--|
| 0                                      | Line break, short circuit, or leakage current  |
| 0.2–0.5                                | Error or invalid and not yet recognized BioPAT® Clamp-on   |
| 4                                      | Coupling<br>RSS value of 0%<br><b>No</b> reception of the ultrasonic signal  |
| 4 – 12                                 | RSS value smaller than 50%<br>The measured value is considered imprecise and does <b>not</b> appear on the various interfaces. |
| 12                                     | RSS value of 50%<br>Good reception of the ultrasonic signal  |
| 20                                     | RSS value of 100 %<br>Excellent reception of the ultrasonic signal   |

### Display of the RSS value on the device (BioPAT® Flowplus):



If a BioPAT® Flow Clamp-on with a BioPAT® Flow Pipe or tubing is installed: The RSS value is shown in the display, e.g. 82%.

### Requirements

A BioPAT® Clamp-on is connected to the device.

A BioPAT® Flow Pipe or tubing is inserted in the BioPAT® Flow Clamp-on.

### Procedure

- ▶ Fill the tubing with fluid. Refer to the system instructions to do this.
- ▷ The RSS value increases.
- ▶ **NOTICE** Fluid movements in the tubing can cause measurement display errors! Ensure that the fluid in the tubing remains stationary.
  - ▶ If required: Wait until the fluid in the tubing is **no longer** in motion.
- ▶ Check the RSS value.
  - ▶ If the RSS value is greater than 50%: The acoustic coupling is sufficient.
  - ▶ If the RSS value is less than 50%: Ensure the following conditions have been met:

| Description  | Action                                  | Chapter, page        |
|--|---|----------------------|
| The tubing is too large.                             | Replace the tubing.                     | 6.3.3, 65            |
| There is <b>no</b> fluid in the measurement channel. | Remove the tubing and prepare it again. | 6.3.3, 65<br>7.6, 74 |
| Bubbles are visible in the tubing.                   | Check the process conditions.           | 9.2.1, 88            |

- ▶ Check the RSS value again.

## 7.7 Setting the Zero Point

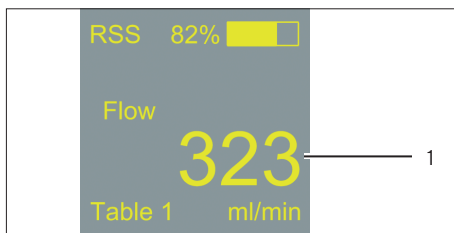
The zero point must be set when the following conditions apply:

- When the BioPAT® Clamp-on is connected to the device
- When a new measurement is started
- When a new calibration table is selected

### 7.7.1 Zeroing Using the Device Zeroing Key (BioPAT® Flowplus)

#### Procedure

- ▶ Guide the fluid into the tubing (see instructions for the connected system for details of how to fill the tubing). **No** acoustic coupling can take place without fluid.
- ▶ **NOTICE** Temperature differences between the fluid and the temperature range of the selected calibration table can impair the measurement accuracy! The temperature profile of the BioPAT® Clamp-on and the fluid must match.
  - ▶ Select the suitable calibration table for the fluid (see calibration table for information on calibration temperature).
  - ▶ Wait until the BioPAT® Clamp-on reaches the temperature level of the fluid. This may take a few minutes.
  - ▶ If required: Check the temperature, e.g., using special measuring instruments.
- ▶ **NOTICE** Incorrect zeroing due to movement of fluid in the tubing! Ensure that the fluid in the tubing remains stationary.
  - ▶ If required: Wait until the fluid in the tubing is **no longer** in motion.
- ▶ **NOTICE** Incorrect zeroing if acoustic coupling is insufficient! If coupling is lower than 50%, the zero point **cannot** be adjusted.
  - ▶ Check the acoustic coupling (see Chapter 7.6, page 74).
- ▶ If the BioPAT® Flowplus device is connected: The flow rate (1) is shown on the display.
- ▶ Check the flow value.



- ▶ Hold down the zeroing key until the flow rate is reset to zero.
- ▶ If zeroing does **not** take place: Check the acoustic coupling (see Chapter 7.6, page 74).
- ▶ The system is ready for carrying out the process.

## 7.7.2 Remote Zeroing (BioPAT® FlowDIN)

If the device is connected to an external control system: The zeroing must be set at the external control system.

### Requirements

- Remote zeroing has been set up on the operating display of the control system.
- The connected system is ready for use.

### Procedure

- ▶ If the device is connected to an external control system: Activate the flow controller (see instructions for the external control system).
- ▶ Completely fill the tubing with the fluid (see instructions for the external control system for details of how to fill the tubing). **No** acoustic coupling can take place without fluid.
- ▶ **NOTICE** Incorrect zeroing if acoustic coupling is insufficient! If coupling is lower than 50%, the zero point **cannot** be adjusted.
  - ▶ If the device is connected to an external control system: Zeroing is interrupted and an error message is displayed (see instructions for the external control system for details of the error message). Follow the prompts on the controller of the external control system, e.g.:  
Cancel the process; fill the tubing and repeat the process.
  - ▶ Check the acoustic coupling (see Chapter 7.6, page 74).
- ▶ **NOTICE** Temperature differences between the fluid and the temperature range of the selected calibration table can impair the measurement accuracy! The temperature profile of the BioPAT® Clamp-on and the fluid must match.
  - ▶ Select the suitable calibration table for the fluid (see calibration table for information on calibration temperature).
  - ▶ Wait until the BioPAT® Clamp-on reaches the temperature level of the fluid. This may take a few minutes.
- ▶ If required: Check the temperature, e.g., using special measuring instruments.
- ▶ **NOTICE** Incorrect zeroing due to movement of fluid in the tubing! Ensure that the fluid in the tubing remains stationary.
  - ▶ If required: Wait until the fluid in the tubing is **no longer** in motion.
- ▶ Check the flow value.
- ▶ Set the zero value on the operating display.
- ▷ The system is ready for carrying out the process.

## 7.8 Monitoring the Flow Value and RSS Value

The flow value is calculated based on the calibration table and the calibration factor.

- If the flow value (ml/min) is greater than  $\pm 999$  ml/min: The measurement parameter is changed to “L/min”.
- If the acoustic coupling is insufficient (RSS value < 50%):
  - The device will deactivate the transmission of the flow value signal.
  - **No** flow rate is displayed.
- If the RSS value rises to at least 50%: The device will reactivate transmission of the flow value signal.

### Procedure

- ▶ Monitor the RSS value and flow rate in the process.
- ▶ If changes occur, such as fluctuating values: Check whether corrective measures are required (measures, see Chapter “9.2 Missing or Erratic Flow and RSS Values”, page 87).

## 7.9 Data Transmission through Analog Interfaces Alone (BioPAT® FlowDIN)

If only the analog interfaces are used for data transmission: Only the RSS value and the flow rate are available. Given this mode of operation, there are **no** options for:

- Changing the calibration factor. The calibration factor is set to 1.00 by default.
- Selecting a new calibration table. Calibration Table 1 is the default.
- Checking the maximum flow rate  $Q_{max}$  of the BioPAT® Clamp-on. The analog interface is displayed according to the  $Q_{max}$  value of the selected calibration table.
- When the BioPAT® FlowDIN device is connected: Zeroing is carried out via the analog interface. Manual zeroing via the operator interface is still possible.

### Procedure

- ▶ If the analog current output signal is converted into a flow value: Observe the calibration factor.
- ▶ If the analog current output signal is converted into a flow value: Pay attention to the  $Q_{max}$  value of the BioPAT® Clamp-on.

## 7.10 Totalizing Measured Values (BioPAT® Flowplus)

### 7.10.1 Starting Totalizing

#### Requirements

A BioPAT® Flow Clamp-on is connected to the device.

#### NOTICE

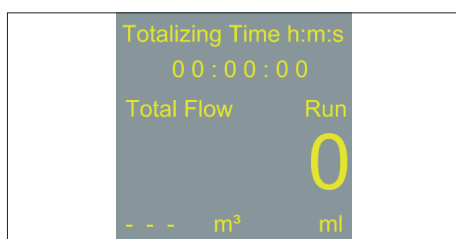
**Totalizing will be interrupted if a new calibration table is selected!**

If a new calibration table is selected: Totalization will be interrupted. Other menu options are available during the current totalizing process.

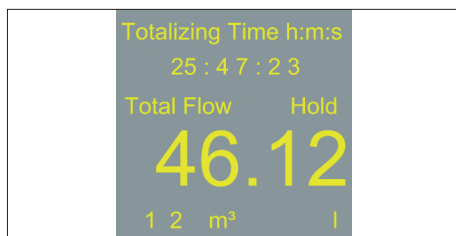
▶ Do **not** change the calibration table during the totalizing process.

#### Procedure

- ▶ Select the menu “Start Reset Totalizing” using the arrow keys.
- ▷ The totalizing time and the total flow are at zero.
- ▷ The display shows the status [Run].



- ▶ To begin totalizing: Press Enter
- ▷ The display shows the status [Hold].



- ▷ The totalizing time and the total flow value are shown on the display; e.g. 25:47:23. The unit is shown in the line above [h: m: s].

## 7.10.2 Display of the Total Flow

|   | Flow rate | Displayed unit | Digits | Comment   |
|---|-----------|----------------|--------|---|
| Total flow                                | <1 L      | ml             | 3      |   |
|   | = or >1 L | L              | 3      |   |
|   | > 999.9   | L              | 4      | Display of 1 m <sup>3</sup> (bottom left of display) totalizer continues. |
| Total flow, maximum displayed             | 999.9     | L              | 4      |   |
| m <sup>3</sup> display, maximum displayed | 999       | m <sup>3</sup> | 3      |   |

## 7.10.3 Automatic Interruption of the Totalizing Process

### Insufficient Acoustic Coupling or Modification of the Calibration Table

If the acoustic coupling is insufficient (RSS value < 50%) or the calibration table was changed during the totalizing process:

- An exclamation point (1) appears on the display. The exclamation point indicates that the displayed totalized volume may deviate from the total real flow due to changes in the fluid or the calibration.
- The totalizing time is stopped. The total flow remains unchanged.

When the acoustic coupling is again sufficient (RSS value ≥ 50%):

- Totalizing is continued. The totalizing time continues.
- The total flow increases.
- The exclamation point (1) is displayed until zeroing again.

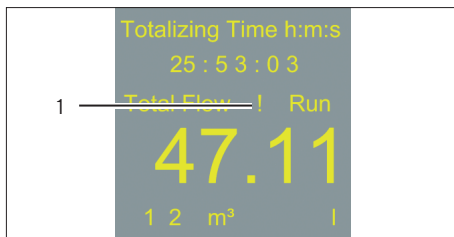
### Exceeding the Limit Values for Totalizing Time and Total Flow

If the limit values are reached:

- The totalizer stops.
- The display shows the data string [OVR] (overrun).
- The totalizing time and the total flow are stopped.

### Procedure

- ▶ Check whether the totalizing time or total flow limit values were exceeded.
  - ▶ If required: Reset the totalizer (see Chapter “7.10.5 Resetting the Totalizer”, page 81).





### BioPAT® Clamp-on Disconnected

If a BioPAT® Clamp-on is disconnected during totalizing:

- Totalization will be interrupted.
- The data are deleted.

#### Procedure

- ▶ Connect the BioPAT® Clamp-on.
- ▶ Restart totalizing

### 7.10.4 Interrupting Totalizing

#### Procedure



- ▶ To interrupt the totalizing process: Press Enter.
- ▷ The following elements are shown on the display:
  - The display shows the status [Run].
  - The current total flow is displayed.
  - The totalizing time blinks.
- ▶ To continue totalizing: Press Enter.
- ▷ The following elements are shown on the display:
  - The totalizing time stops blinking.
  - The display shows the status [Hold].
  - The totalizing time and the total flow are continued.

### 7.10.5 Resetting the Totalizer

The totalizing process can be reset at any time, e.g., during a procedure or during an interruption.

#### Procedure



- ▶ Select the menu “Reset Totalizing” using the arrow keys.
- ▶ To reset the totalizer: Press the zeroing key.
- ▷ If the display shows the status [Run]: The totalizing process is set to zero and restarted.
- ▷ If the display shows the status [Hold]: The totalizing process is set to zero.

## 7.11 Checking Status Information

Status information such as the software version or the device serial number can be accessed through the digital interface (Digital Out).

### 7.11.1 BioPAT® FlowDIN

The status information is displayed in the process control or the data acquisition system.

#### Procedure

- ▶ Check the status information. Refer to the instructions on the process control or data acquisition system.

### 7.11.2 BioPAT® Flowplus

#### Procedure

- ▶ Select the “Status Information” menu using the arrow keys.
- ▶ The status information is shown on the display:



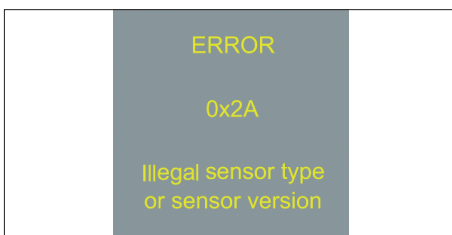
| Display | Meaning                               |
|---------|---------------------------------------|
| SW      | Software version of the device        |
| SN      | Device serial number                  |
| CT      | Serial number of the BioPAT® Clamp-on |

## 7.12 Checking Error Messages (BioPAT® Flowplus)

If an error is detected: An error message appears.

#### Procedure

- ▶ Check the error code and the error message on the display (see Chapter 9.6, page 93).



## 7.13 Ending the Process

### 7.13.1 Removing the BioPAT® Flow Pipe or Tubing from the BioPAT® Clamp-on

#### Procedure



- ▶ Open the snap lid and fold up the BioPAT® Clamp-on lid.



- ▶ If using a BioPAT® Flow Pipe: **NOTICE** Risk of damage to the BioPAT® Clamp-on from improper handling! Hold the BioPAT® Clamp-on firmly at the top and bottom, and remove the tubing from the measurement channel of the BioPAT® Clamp-on.
- ▶ If using tubing: Remove tubing.

## 7.14 Switching Off the Device

#### Requirements

The process is ended.

#### Procedure

- ▶ If the device is connected to the power supply via an AC adapter or the [Power] terminal: Press the ON/OFF button [I].
  - ▷ The device is switched off.
  - ▷ The LED status indicator goes off.
- ▶ **NOTICE** The device starts up when the ON/OFF button is disabled! If the device is connected to the power supply via the [Flow] or [RSS] terminal or the terminal block: The ON/OFF button is disabled. If the device is connected to the power supply: The device turns on.
  - ▶ Turn off the external voltage source.
  - ▷ The LED status indicator goes off.
- ▷ The BioPAT® Clamp-on is reset to factory settings:
  - Calibration Table 1
  - Calibration factor 1.00

## 8 Cleaning and Maintenance

### 8.1 Selecting Cleaning Agents

#### Procedure

- ▶ **NOTICE** Equipment surfaces can be damaged by unsuitable cleaning agents and disinfectants! If cleaning agents and disinfectants are used:
  - ▶ Only use cleaning agents or disinfectants that are compatible with the housing material and which have a neutral pH value (see Chapter "14.3 Suitable Cleaning and Disinfecting Agents", page 108).
  - ▶ Comply with the concentrations and exposure times of cleaning and disinfecting agents recommended by the manufacturer.
  - ▶ **Never** use abrasive or corrosive cleaning agents, e.g., scouring agents.
- ▶ Use a slightly damp cloth for cleaning purposes. In the case of particularly heavy contamination, use mild soapy water.
- ▶ If a "low-level disinfection" is required: Use an aqueous 70% isopropanol solution.

### 8.2 Cleaning the Device Surfaces and BioPAT® Clamp-on

#### Requirements

- The process is ended.
- The device is switched off and disconnected from the power supply.

#### Procedure

- ▶ If the device is to be cleaned:
  - ▶ **NOTICE** Equipment damage due to ingress of fluids! Use only a slightly damp cloth. Do not immerse the plug connector of the connection cable in fluid or moisten it.
- ▶ If the BioPAT® Clamp-on is to be cleaned:
  - ▶ **NOTICE** Damage to the BioPAT® Clamp-on due to mechanical cleaning, sterilization, or ultrasonic cleaning! Only clean the BioPAT® Clamp-on by hand. The BioPAT® Clamp-on should not be cleaned in an ultrasonic bath.
- ▶ Wipe the surfaces of the device and the BioPAT® Clamp-on.
- ▶ If the connection cables are dirty: Wipe the connection cables.
- ▶ **NOTICE** Equipment damage due to wet plug connectors! Do not plug the connectors of the connection cables into the device when they are wet. Allow the wet surfaces of the plug connectors to dry.

## 8.3 Checking the BioPAT® Flow Clamp-on for Damage

### Procedure

- ▶ **NOTICE** Damage to the BioPAT® Flow Clamp-on due to mechanical influences or wear! Check the BioPAT® Flow Clamp-on for damage and wear, e.g., cracks or breakage.
  - ▶ If required: Replace the BioPAT® Flow Clamp-on.
- ▶ Check the flow rate sensor in the measurement channel for damage.
  - ▶ If required: Replace the BioPAT® Flow Clamp-on.

## 8.4 Maintenance Schedule

| Interval    | Component                                 | Action   | Chapter, Page      | Target Group          |
|-------------|---|--|--------------------|-----------------------|
| 24 months   | Check the device's electrical components. | Please contact Sartorius Service.  |                    |                       |
|             | Device and accessories                    | Please contact Sartorius Service.  |                    |                       |
|             | Power Supply of the Device                | Check the Flow and RSS current loops.  | 5.3, 32<br>5.3, 32 | Qualified Electrician |
| As required | BioPAT® Flow Clamp-on                     | Perform a calibration. Please contact Sartorius Service in this regard. Recommended every 24 months. |                    |                       |

## 9 Malfunctions

### 9.1 General Malfunctions

| Malfunction  | Cause   | Correction  | Chapter, page          | Target group |
|--|---|---|------------------------|--------------|
| The device is switched on. The LED status indicator is <b>not</b> lighting up. | The AC adapter is disconnected.                               | Connect the AC adapter.   | 5.8, 43                | User         |
|  | The external voltage source is <b>not</b> properly connected. | Turn the device off.<br>Check the connection to the external voltage source.<br>If required: Disconnect the device from the external voltage source and connect it again. | 7.14, 83<br>5.10.2, 51 | Electrician  |
|  |   | Check the adequacy of the external voltage source.<br>If required: Connected the device to the power supply using the AC adapter:   | 5.2.1, 30<br>5.8, 43   | Electrician  |
|  |   | If the device malfunctions again:<br>Service the device.  | 8.4, 85                | User         |
| The device is very warm.   | The workplace is inappropriate.                               | Switch the device off and let it cool.<br>Check the conditions at the workplace.<br>If the device is covered: Remove the cover.   | 7.14, 83               | User         |

## 9.2 Missing or Erratic Flow and RSS Values

| Malfunction  | Cause  | Correction  | Chapter, page      | Target group |
|--|--|---|--------------------|--------------|
| The RSS value changes unexpectedly.                        | The flow values displayed are averages. The device has <b>no</b> memory holding time for insufficient acoustic couplings. If a coupling fails, the flow values will only be correct again once a complete averaging interval (approx. 10 seconds) has elapsed. | Ignore the displayed flow value for approx. 10 seconds and then read it again.  |                    | User         |
|  |  | When the flow value is transmitted by the digital interface (Digital Out): Ignore the flow value for 10 seconds.                            |                    | User         |
|  | The process parameters do <b>not</b> match the selected calibration table.   | Check the selected calibration table and the calibration parameters.<br>If required: Select a suitable calibration table..                  | 7.4, 71<br>7.5, 73 | User         |
|  | The BioPAT® Flow Pipe is defective or contaminated.  | Check tubing for deformations and deposits.<br>If required: Replace the BioPAT® Flow Pipe.  | 6.3.2, 64          | User         |
| The RSS value fluctuates.                                  | There are small bubbles in the fluid.  | Check the process conditions. Identify and troubleshoot the cause of the bubble formation.  | 9.2.1, 88          | User         |
| The RSS value is consistently low.                         | There are large bubbles or there is foaming in the fluid.  | Check the process conditions. Identify and troubleshoot the cause of the bubble formation.  | 9.2.1, 88          | User         |
| The flow value is displayed and hidden.                    | There are bubbles in the fluid.  | Check the process conditions. Identify and troubleshoot the cause of the bubble formation.  | 9.2.1, 88          | User         |
| <b>No</b> flow value and <b>no</b> RSS value is displayed. | <b>No</b> BioPAT® Clamp-on is detected.  | Check the connection of the BioPAT® Clamp-on.   |                    | User         |
|  |  | If an extension cord is connected to the BioPAT® Clamp-on: Check the extension cord for damage.<br>If required: Replace the extension cord. |                    | User         |
|  | The acoustic coupling is inadequate.   | Check the acoustic coupling.  | 7.6, 74            | User         |
| There is <b>no</b> flow. A flow value is displayed.        | The zero point is <b>not</b> set correctly.  | Adjust the zero point.  | 7.7, 76            | User         |

## 9.2.1 Checking Process Conditions

The presence of bubbles in the fluid or foam impedes the measurement of the flow rate.

### Procedure

- ▶ Check the position of the BioPAT® Clamp-on and the inlet section of the tubing (for information on the position and inlet section, see Chapter “6.3 Inserting the BioPAT® Flow Pipe or Tubing in the BioPAT® Clamp-on”, page 64).
  - ▶ If required: End the process (Chapter 7.13, page 83) and adjust the position of the BioPAT® Flow Clamp-on.
- ▶ Reduce the pump speed.
- ▶ Check the suitability of the fluid (see Chapter “6.1 Checking Process Parameters”, page 63).
- ▶ To prevent further ingress of air. Fill the tubing with fluid.

## 9.3 Display Malfunctions (BioPAT® Flowplus)

| Malfunction   | Cause   | Correction  | Chapter, page         | Target group |
|---|---|---|-----------------------|--------------|
| The display is blank or frozen.                     | The AC adapter is disconnected.                               | Connect the AC adapter.   | 5.8, 43               | User         |
|   | The external voltage source is <b>not</b> properly connected. | Disconnect the device from the external voltage source.<br>Connect the device to the external voltage source. | 5.9, 44<br>5.10.2, 51 | Electrician  |
|   |   | If the device malfunctions again:<br>Service the device.  | 8.4, 85               | User         |
| Data and process values are missing on the display. | The display needs to be updated.                              | Use the arrow keys to jump to the next screen and back.   |                       | User         |



## 9.4 Missing or Incorrect Current Output Signals

### 9.4.1 Analog Interface "Flow"

| Malfunction   | Cause  | Correction   | Chapter, page       | Target group |
|---|--|--|---------------------|--------------|
| There is <b>no</b> current output signal (0 mA).    | There is a power failure, line break.  | Check the electrical lines.  |                     | Electrician  |
|   | The Flow current loop is <b>not</b> supplied by the external voltage source voltage. | Check the Flow current loop.   | 5.3, 32<br>5.4, 37  | Electrician  |
| There is a current output signal of > 0.5 - < 1 mA. | The output signal is <b>undefined</b> .  |  |                     |              |
| There is a current output of 0.2-0.5 mA.            | The acoustic coupling is inadequate.   | Check the acoustic coupling.   | 7.6, 74             | User         |
|   | The BioPAT® Clamp-on is <b>not</b> recognized.                                       | Check the connection of the BioPAT® Clamp-on.  | 6.2, 63             | User         |
|   |  | If an extension cord is connected to the BioPAT® Clamp-on: Check the extension cord.   | 5.10.4, 53          | User         |
|   |  | Check the adequacy of the BioPAT® Clamp-on connection cable. Refer to the $Q_{max}$ value of the connection cable in the calibration report. |                     | User         |
|   | There is a circuit failure.  | Check the device connection.   | 5.9, 44<br>5.10, 50 | Electrician  |
| There is a device error.                            | Please contact Sartorius Service.  |  | Sartorius Service   |              |
| There is a current output of > 20 mA.               | The flow value is above the max. permissible flow range.                             | Reduce the flow (change process parameters; see manual on process control or data processing system).  |                     | User         |
|   |  | Check the max. flow range of the BioPAT® Clamp-on. Refer to the calibration report.  |                     | User         |

## 9.4.2 Analog Interface “RSS”

| Malfunction   | Cause   | Correction   | Chapter, page       | Target group      |
|---|---|--|---------------------|-------------------|
| There is <b>no</b> current output signal (0 mA).    | There is a power failure, line break.   | Check the electrical lines.  |                     | Electrician       |
|   | The RSS current loop is <b>not</b> supplied by the external voltage source voltage. | Check the RSS current loop.  | 5.3, 32<br>5.4, 37  | Electrician       |
| There is a current output of 0.2 - 0.5 mA.          | The BioPAT® Clamp-on is not recognized.   | Check the connection of the BioPAT® Clamp-on.  | 6.2, 63             | User              |
|   |   | If an extension cord is connected to the BioPAT® Clamp-on: Check the extension cord.   | 5.10.4, 53          | User              |
|   |   | Check the adequacy of the BioPAT® Clamp-on connection cable. Refer to the $Q_{max}$ value of the connection cable in the calibration report. |                     | User              |
|   | There is a circuit failure.   | Check the device connection.   | 5.9, 44<br>5.10, 50 | Electrician       |
|   | There is a device error.  | Please contact Sartorius Service.  |                     | Sartorius Service |
| There is a current output signal of > 0.5 - < 4 mA. | The output signal is <b>undefined</b> .   |  |                     |                   |

## 9.4.3 Digital Interface “Digital Out”

| Malfunction   | Cause   | Correction   | Chapter, page | Target group |
|---|---|--|---------------|--------------|
| The correct zero point value is <b>not</b> being displayed. | The calibration factor is <b>incorrect</b> .                      | Adjust the calibration factor.   | 7.5, 73       | User         |
|   | The tubing used does <b>not</b> match the calibration parameters. | Check tubing and the calibration parameters of the selected calibration.<br>If required: Connect new tubing. |               | User         |

| Malfunction   | Cause   | Correction  | Chapter, page           | Target group  |
|---|---|---|-------------------------|---------------|
|   | The temperature range is <b>incorrect</b> .   | Check the temperature of the fluid. The temperature should be in the temperature range defined in the calibration report.<br>If required: Adjust the temperature of the fluid. Refer to the instructions on the process control or data acquisition system. |                         | User          |
|   | Zeroing did <b>not</b> work properly.   | Adjust the zero point.  | 7.7, 76                 | User          |
| <b>No</b> information is being displayed.                           | The serial connection cable is defective.   | Check the serial connection cable for damage, e.g. cracks.<br>If required: Replace the serial connection cable.   |                         | User          |
|   | The serial cable is <b>not</b> connected properly.  | Disconnect the serial cable and connect it again.   | 5.9.4, 48<br>5.10.1, 50 | Electrician   |
|   | The adapter of the connection cable with D-Sub male connector adapter is unsuitable.                        | Check the adapter of the connection cable.<br>If required: Replace the adapter.   |                         | Administrator |
|   | An unsuitable driver is installed on the adapter of the connection cable with D-Sub male connector adapter. | Download driver again.<br>The download link is on the adapter label of the D-sub connector adapter.   |                         | Administrator |
|   | The PC program <b>cannot</b> correctly read the serial port of the device.                                  | Check the PC connection.  |                         | Administrator |
|   | The parameters of the digital interface are <b>incorrect</b> .  | Check the parameters.   | 5.11, 57                | Administrator |
|   | The buffer of the serial communication device needs to be updated.  | Update the buffer of the serial communication device.   |                         | Administrator |
|   | A NULL-MODEM cable is installed.  | Replace the NULL-MODEM cable with a standard modem cable.   |                         | Administrator |
|   | The connection has been lost.   | Restart the connection with the command "R".  |                         | Administrator |
| Other commands are used than those specified in these instructions. | Check the commands used.  |   | Administrator           |               |

## 9.5 Status Messages (Display or Process Control)

During transmission in an output string, the bit value is converted into a hexadecimal value by the digital interface.

| Output string to a digital interface (Digital Out)                  | Output signal to an analog interface |                 | BioPAT® Flowplus display          | Cause   | Correction   | Chapter, page       | Target group |
|---|--------------------------------------|-----------------|-----------------------------------|---|--|---------------------|--------------|
| Status byte "ss"  | Flow [mA]                            | RSS [mA]        |                                   |   |  |                     |              |
| Bit 7 = 1   | <0.5                                 | <0.5            | Flow rate: -<br>RSS value:<br>XX  | The BioPAT® Clamp-on has been disconnected from the device.                                     | Connect the BioPAT® Clamp-on.  | 6.2, 63             | User         |
|   |                                      |                 | Flow rate: XX<br>RSS value:<br>XX |   | Check the connection cable of the BioPAT® Clamp-on.<br>If required: Replace the BioPAT® Clamp-on.              | 6.2, 63             | User         |
| Bit 6 = 1   | Flow value<br>XX                     | RSS value<br>XX |                                   | Settings were made when the <b>uncalibrated</b> transit time value was between -3000 and +3000. | Turn the device off. The settings are deleted.<br>Turn the device off again.                                   | 7.14, 83<br>6.4, 66 | User         |
| Bit 5 = 1   | < 0.5                                | RSS value<br>XX | Flow rate: -<br>RSS value:<br>XX  | The acoustic coupling is insufficient (RSS value < 50%).  | Check the acoustic coupling.   | 7.6, 74             | User         |
| Bit 4, 3 and 2 are set according to the selected calibration table. | n/a                                  | n/a             | Calibration table 1-7             | The wrong calibration table has been selected.  | Verify that the correct calibration table has been selected.<br>If required: Select another calibration table. | 7.4, 71             | User         |
| Bit 1 = 1   | < 0.5                                | RSS value<br>XX | Flow rate: -<br>RSS value:<br>XX  | The displayed flow is invalid.  | Check the acoustic coupling.   |                     | User         |

| Output string to a digital interface (Digital Out) | Output signal to an analog interface |                 | BioPAT® Flowplus display         | Cause                        | Correction  | Chapter, page | Target group |
|--|--------------------------------------|-----------------|----------------------------------|------------------------------|---|---------------|--------------|
| Bit 0 = 1  | < 0.5                                | RSS value<br>XX | Flow rate: -<br>RSS value:<br>XX | The temperature is too high. | Adjust the temperature. Refer to the instructions for the measuring system. |               | User         |

## 9.6 Error Messages (Display or Process Control)

| Output string to a digital interface (Digital Out) | Output signal to an analog interface |          | BioPAT® Flowplus Display      | Cause                                | Correction                 | Target group      |
|--|--------------------------------------|----------|-------------------------------|--------------------------------------|----------------------------|-------------------|
| Status byte "ee"                                   | Flow [mA]                            | RSS [mA] | Error message with error code |                                      |                            |                   |
| 01   | < 0.5                                | < 0.5    | 01                            | FLASH error during startup test      | Contact Sartorius Service. | Sartorius Service |
| 02   | < 0.5                                | < 0.5    | 02                            | FLASH error during runtime test      | Contact Sartorius Service. | Sartorius Service |
| 08   | < 0.5                                | < 0.5    | 08                            | RAM error during RAM runtime test    | Contact Sartorius Service. | Sartorius Service |
| 0F   | < 0.5                                | < 0.5    | 0F                            | Task processing error                | Contact Sartorius Service. | Sartorius Service |
| 19   | < 0.5                                | < 0.5    | 19                            | EEPROM test error (flow rate sensor) | Contact Sartorius Service. | Sartorius Service |
| 1A   | < 0.5                                | < 0.5    | 1A                            | Plate temperature errors (> 75°C)    | Contact Sartorius Service. | Sartorius Service |
| 1B   | < 0.5                                | < 0.5    | 1B                            | +15 V test error                     | Contact Sartorius Service. | Sartorius Service |
| 1C   | < 0.5                                | < 0.5    | 1C                            | -15-V test error                     | Contact Sartorius Service. | Sartorius Service |

| Output string to a digital interface (Digital Out) | Output signal to an analog interface |       | BioPAT® Flowplus Display | Cause  | Correction                 | Target group      |
|--|--------------------------------------|-------|--------------------------|--|----------------------------|-------------------|
| 21   | < 0.5                                | < 0.5 | 21                       | EEPROM CRC error (flow sensor)                             | Contact Sartorius Service. | Sartorius Service |
| 22   | < 0.5                                | < 0.5 | 22                       | EEPROM factor inconsistent (flow sensor)                   | Contact Sartorius Service. | Sartorius Service |
| 27   | < 0.5                                | < 0.5 | 27                       | EEPROM <b>not</b> consistent (flow sensor)                 | Contact Sartorius Service. | Sartorius Service |
| 29   | < 0.5                                | < 0.5 | 29                       | Additional values <b>not</b> equal in EEPROM (flow sensor) | Contact Sartorius Service. | Sartorius Service |
| 2A   | < 0.5                                | < 0.5 | 2A                       | Sensor type or sensor version <b>not</b> allowed           | Contact Sartorius Service. | Sartorius Service |
| 2B   | < 0.5                                | < 0.5 | 0x2B                     | Process parameters <b>not</b> correct                      | Contact Sartorius Service. | Sartorius Service |
| 2E   | < 0.5                                | < 0.5 | 0x2E                     | CRC in burst table <b>not</b> correct                      | Contact Sartorius Service. | Sartorius Service |

## 9.7 Restarting the System

**Required qualifications:** Electrician

### Procedure

- ▶ Disconnect the measuring instrument (ammeter or voltmeter) from the device.
- ▶ Reconfigure the power supply for the Flow and RSS current loop (see Chapter 5.9.2, page 45 and Chapter 5.10.3, page 53).

# 10 Decommissioning

## 10.1 Decommissioning

### Requirements

The process is ended.

### Procedure

- ▶ Switch off the device.
- ▶ Clean the device.
- ▶ Decontaminate the device and the accessories properly. Follow the decontamination instructions (see Chapter 13.1, page 98).

# 11 Transport

## 11.1 Transporting the Device

### Procedure

- ▶ Decommission the device.
- ▶ Transport the device.



# 12 Storage and Shipping

## 12.1 Storage

### Procedure

- ▶ Decommission the device.
- ▶ Clean the device.
- ▶ Store the device according to the ambient conditions (see Chapter 14.1.3, page 100).

## 12.2 Shipping-related Tasks | Returns

Defective devices or parts can be sent back to Sartorius. Returned devices must be clean, decontaminated, and properly packed.

Transport damage as well as measures for subsequent cleaning and disinfection of the device or parts by Sartorius shall be charged to sender.

Devices contaminated with hazardous materials, e.g., harmful biological or chemical substances, will **not** be accepted for repair or disposal. The devices must be decontaminated before shipping (for decontamination, see Chapter "13.1 Information on Decontamination", page 98).

---

### **WARNING**

#### **Risk of injury from contaminated devices!**

Devices contaminated with hazardous materials (NBC contamination) will **not** be accepted for repair or disposal.

- ▶ Observe the information on decontamination (see Chapter 13.1, page 98).

---

### Procedure

- ▶ Decommission the device.
- ▶ Contact Sartorius Service for instructions on how to return devices or parts (please refer to [www.sartorius.com](http://www.sartorius.com)).
- ▶ Pack the device and its parts properly for return.

# 13 Disposal

## 13.1 Information on Decontamination

The device does not contain **any** hazardous materials that would necessitate special disposal measures.

The cultures and media (e.g., acids, bases) used during the processes are potentially hazardous materials that could cause biological or chemical hazards.

If the device has come into contact with hazardous substances: Steps must be taken to ensure proper decontamination and declaration.

### Procedure

- ▶ If the device has come into contact with hazardous substances: Decontaminate the device. The operator of the device is responsible for adhering to local government regulations on the proper decontamination and declaration for transport and disposal.

## 13.2 Dismounting

### 13.2.1 BioPAT® Flowplus

#### Procedure

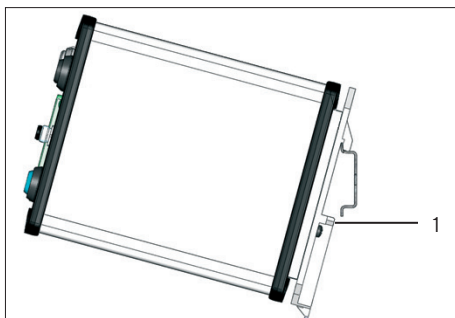
- ▶ Decommission the device.
- ▶ Disconnect all connection cables from the device and the process control, e.g., power supply cable, analog connection cable.
- ▶ If the device is safeguarded against shifting: Remove the safeguard.

## 13.2.2 BioPAT® FlowDIN

**Required qualifications:** Electrician

### Procedure

- ▶ Decommission the device.
- ▶ Disconnect all connection cables from the device and the process control, e.g., power supply cable, analog connection cable.
- ▶ Slide the spring-loaded bottom hook (1) downwards with a screwdriver until it separates from the DIN rail.
- ▶ Pull the device off of the DIN rail.



## 13.3 Disposing of Device and Parts

### 13.3.1 Information on Disposal

The device and the device accessories must be disposed of properly by disposal facilities.

The packaging consists of environmentally friendly materials that can be used as secondary raw materials.

The consumables are designed and intended for single-use.

### Hazardous Substances

The BioPAT® Clamp-on contains lead-based components. The BioPAT® Clamp-on must be delivered to an approved disposal center for hazardous substances.

### Requirements

The device has been decontaminated.

### Procedure

- ▶ Dispose of the device. Follow the disposal instructions on our website ([www.sartorius.com](http://www.sartorius.com)).
- ▶ Dispose of the packaging in accordance with local government regulations.
- ▶ Dispose of the consumables in accordance with local government regulations.

# 14 Technical Data

## 14.1 Device

### 14.1.1 Dimensions, Weights, and Materials

|                   |      | BioPAT® Flowplus | BioPAT® FlowDIN |
|-------------------|------|------------------|-----------------|
|                   | Unit | Value            | Value           |
| Dimensions        |      |                  |                 |
| Length            | mm   | 110.0            | 65.0            |
| Width             | mm   | 140.0            | 150.0           |
| Height            | mm   | 65.0             | 110.0           |
| Weight            | g    | 500.0            | 650.0           |
| Materials         |      |                  |                 |
| Housing: Aluminum |      | x                | x               |

### 14.1.2 Type of Assembly

|  |      | BioPAT® Flowplus | BioPAT® FlowDIN |
|--|------|------------------|-----------------|
|  | Unit | Value            | Value           |
| Type of assembly                             |      |                  |                 |
| Table-top mounting                           |      | x                | -               |
| DIN rail assembly                            |      | -                | x               |
| DIN rail                                     |      |                  |                 |
| Hat rail Type O, in accordance with EN 50022 |      |                  |                 |
| Dimensions (length   width)                  | mm   | -                | 35.0   7.5      |

### 14.1.3 Ambient Conditions

|                              | Unit | Value     |
|------------------------------|------|-----------|
| Air pressure                 | kPa  | 70 – 106  |
| Installation location        |      |           |
| Usual laboratory rooms       |      |           |
| Height above sea level, max. | m    | 2000      |
| Temperature                  |      |           |
| Operation                    | °C   | +10 – +40 |
| Storage                      | °C   | -20 – +45 |
| Transport                    | °C   | -20 – +55 |

|                                    | Unit | Value   |
|------------------------------------|------|---------|
| Relative humidity (non-condensing) |      |         |
| Operation                          | %    | 30 – 75 |
| Storage, transport                 | %    | 10 – 96 |

#### 14.1.4 Electrical Specifications

|                         | Unit            | BioPAT® Flowplus | BioPAT® FlowDIN |
|-------------------------|-----------------|------------------|-----------------|
|                         |                 | Value            | Value           |
| External voltage source |                 |                  |                 |
| Voltage                 | V <sub>DC</sub> | 24 ±10%          | 24 ±10%         |
| Electricity, min.       | mA              | 300              | 300             |
| Power consumption       |                 |                  |                 |
| Typical                 | W               | 3                | 3               |
| Max.                    | W               | 8                | 8               |
| IP protection class     | IP              | 65               | 20              |

#### 14.1.5 Connections

|   | BioPAT® Flowplus | BioPAT® FlowDIN |
|---|------------------|-----------------|
|   | Value            | Value           |
| Round plug  |                  |                 |
| 3- and 4-pin circular industrial connector M8   | x                | x               |
| Round plugs according to IEC/EN 61076-2-104 (2008)  | x                | x               |
| Manufacturer: Hirschman (ELST 3308RVFM805   ELST 4408RVFM805) or Binder Cage Clamp connector 768/718 (WAGO 222-412) | x                | x               |
| Connection cable with 4-pin plug connector  | x                | x               |
| Interface types   |                  |                 |
| Number of digital interfaces RS232, (RxD, TxD, GND)   | 1                | -               |
| Number of analog interfaces 0–20 mA   | 2                | -               |
| Number of digital inputs for remote zeroing via current impulse   | -                | 1               |
| Input for remote zeroing via current impulse  | -                | x               |
| Current pulse for voltage   | -                | 24 (±10%)       |
| Internal current consumption, max.  | -                | 25              |

## 14.1.6 Data Transmission

|   |      | BioPAT® Flowplus | BioPAT® FlowDIN  |
|---|------|------------------|------------------|
|   | Unit | Value            | Value            |
| Interface data transfer rates (digital interface)   |      |                  |                  |
| Frequency for sending data strings and reception of RSS value, flow value, status and error information, device temperature | s    | 0.1              | 0.1              |
| Average times for display of the flow values in the data string   |      | 0.1   1.0   10.0 | 0.1   1.0   10.0 |
| Frequency at which display is updated   | s    | 1.0              | -                |
| Interface data transfer rates (analog interface)  |      |                  |                  |
| Output current, nominal   | mA   | 0 - 20           | 0 - 20           |
| Zero value for flow rate and acoustic coupling  | mA   | 4                | 4                |
| Output current, max.<br>1 kOhm ± 5% at 24 V   | mA   | 23               | 23               |
| Resolution  | Bit  | 16               | 16               |
| Passive or active   |      |                  |                  |
| Accuracy of the digital to analog conversion  | %    | ≤ 1              | ≤ 1              |

## 14.1.7 Requirements for the Control Box (BioPAT® FlowDIN Amplifier Box)

|   | Unit | Value       |
|---|------|-------------|
| Extension cord for BioPAT® Clamp-on   |      |             |
| Length  | m    | 1.0         |
| Connection plug   |      |             |
| Connection plug on the extension cord: FK-MCP 1.5/10-STF-3.81 for device connection (female connector on the device: DFK-MC 1.5/10-GF-3.81) |      |             |
| Connector socket for connection in control box: Lemo PFG.2B.316. CLLD72   |      |             |
| Thickness of the control box wall, max.   | mm   | 6.5         |
| Size of control box frame (L   W)   | mm   | 13.6   15.1 |

### 14.1.8 Requirements for External Voltage Source

|  | Unit     | Value             |
|--|----------|-------------------|
| Voltage  | $V_{DC}$ | 24 ( $\pm 10\%$ ) |
| Current at voltage 24 ( $\pm 10\%$ ), min.   | mA       | 300               |
| Current at voltage 24 ( $\pm 10\%$ ), max.   | A        | 6.5               |
| Protection against short circuits  |          |                   |
| Includes separate switch   |          |                   |
| Length of cable for external voltage source, max.  | m        | 30                |
| Meets all national requirements for electromagnetic compatibility and complies with the national electrical safety regulations |          |                   |

### 14.1.9 Acoustic Output Data

|                       | Unit | BioPAT® Flowplus<br>Value | BioPAT® FlowDIN<br>Value |
|-----------------------|------|---------------------------|--------------------------|
| Thermal index (TI)    |      | <1.0                      | <1.0                     |
| Mechanical Index (MI) |      | <1.0                      | <1.0                     |

### 14.1.10 AC Adapter (BioPAT® Flowplus)

|   | Unit     | Value             |
|---|----------|-------------------|
| Type: Friwo FW 7660, GPP 10, part no. 1827497 |          |                   |
| Dimensions without country-specific adapter   |          |                   |
| Length  | mm       | 58.0              |
| Width   | mm       | 150.0             |
| Height  | mm       | 40.0              |
| Country-specific mains adapter                |          |                   |
| For countries: EURO, GB, USA   JAPAN          |          |                   |
| Other countries: Available upon request       |          |                   |
| Input   |          |                   |
| Voltage                                       | $V_{AC}$ | 100 – 240         |
| Electricity                                   | mA       | 250               |
| Frequency                                     | Hz       | 50/60             |
| Output  |          |                   |
| Voltage                                       | $V_{DC}$ | 24 ( $\pm 10\%$ ) |
| Electricity                                   | mA       | 420               |
| Power consumption                             | W        | 10                |
| Fuse: <b>None</b>                             |          |                   |

## 14.2 BioPAT® Flow Clamp-on

### 14.2.1 Dimensions, Weights, Materials

|   | Unit | Value |
|---|------|-------|
| Dimensions (BioPAT® Clamp-on <math>\frac{1}{2}</math>'' x <math>\frac{1}{8}</math>'') |      |       |
| Length  | mm   | 33.0  |
| Width   | mm   | 45.0  |
| Height  | mm   | 25.0  |
| Length of connection cable  | m    | 2.9   |
| Weight, incl. connection cable  |      |       |
| BioPAT® Clamp-on with inner diameter <math><\frac{1}{2}</math>'')                     | g    | 52.0  |
| BioPAT® Clamp-on with inner diameter = <math>\frac{1}{2}</math>'')                    | g    | 72.0  |
| Material  |      |       |
| Housing: Epoxy resin, aluminum, brass   |      |       |

### 14.2.2 Electrical Data, Resolution

|  | Unit   | Value |
|--|--------|-------|
| Resolution   | ml/min | 1.0   |
| Measurement range (dependent on BioPAT® Clamp-on, see calibration table) |        |       |
| IP protection class  | IP     | 65    |
| Number of stored calibration tables                                      |        | 7     |



### 14.2.3 Measurement Accuracy

#### Reference conditions

|  | Unit | Value   |
|--|------|---------|
| Fluid types: Water*  |      |         |
| Calibration Table 1, room temperature  | °C   | +22 ± 5 |
| Calibration Table 2, cooled fluids   | °C   | +9 ± 5  |
| Calibration Table 3, heated solutions  | °C   | +32 ± 5 |
| Ambient temperature  | °C   | +20 ± 5 |
| Straight inlet section: 10 × tubing inner diameter, fully developed flow profile |      |         |
| Hose system: Raumedic ECC bloodline PVC  |      |         |
| Fluid pressure: Open end at tubing outlet  |      |         |
| Calibration factor   |      | 1.00    |

For the Clamp-ons BPL0030, BPL0031, and BPL0032 with cable length 30 cm, only the temperature conditions in calibration table 1 apply.

- \* The measurement accuracy of the BioPAT® Flow sensors remains unaffected by changes in homogeneity, turbidity and viscosity of the flowing liquids, for the large majority of the solutions | suspensions used in biomanufacturing processes.

The stated accuracy has been confirmed for:

- Aqueous solutions, e.g. buffer solutions with approx. density < 1.01 g/ml or conductivity < 20 mS/cm (equiv. to ~175 mM NaCl)
- Protein suspensions (BSA 200 g/L)
- Particles suspensions (diatomaceous earth 50 g/L)
- Cell suspensions (baker's yeast 80 g/L dry weight)

For more challenging solutions, for example, high concentration buffers, it is recommended to carry out preliminary studies, in order to assess if the standard calibration tables are suitable for the specific application. If not, it is recommended to use a customized calibration table (BPL0056, See Order Information) or a dynamic correction factor. For more information, please contact our technical support.

## BioPAT® Flow Clamp-ons on Flow Pipe

|                           |       | BPL0010                     | BPL0028                     | BPL0011                       | BPL0012                        | BPL0013                        | BPL0030   | BPL0031                     | BPL0032                      |
|---------------------------|-------|-----------------------------|-----------------------------|-------------------------------|--------------------------------|--------------------------------|---|-----------------------------|------------------------------|
|                           | Unit  | Value                       | Value                       | Value                         | Value                          | Value                          | Value   | Value                       | Value                        |
| Size                      |       | ¼"                          | ¾"                          | ½"                            | ¾"                             | 1"                             | ¼"  | ¾"                          | ½"                           |
| Q <sub>max</sub>          | L/min | 4.167                       | 10                          | 20                            | 50                             | 76.670                         | 2   | 6.667                       | 11.111                       |
| System accuracy           |       |                             |                             |                               |                                |                                |   |                             |                              |
| 3–30 % Q <sub>max</sub>   | L/min | 0.06                        | 0.09                        | 0.18                          | 0.45                           | 0.69                           | 0.06  | 0.09                        | 0.18                         |
| 30–100 % Q <sub>max</sub> | L/min | 5%*                         | 3%*                         | 3%*                           | 3%*                            | 3%*                            | 5%*   | 3%*                         | 3%*                          |
| Calibration points        | L/min | 1.250  <br>2.084  <br>2.917 | 3.000  <br>5.000  <br>7.000 | 6.000  <br>10.000  <br>14.000 | 15.000  <br>25.000  <br>35.000 | 22.532  <br>38.448  <br>53.868 | 0.100  <br>0.833  <br>1.333  <br>2.000  <br>2.500 | 0.167  <br>4.167  <br>8.333 | 0.333  <br>7.500  <br>15.000 |

\* of current value

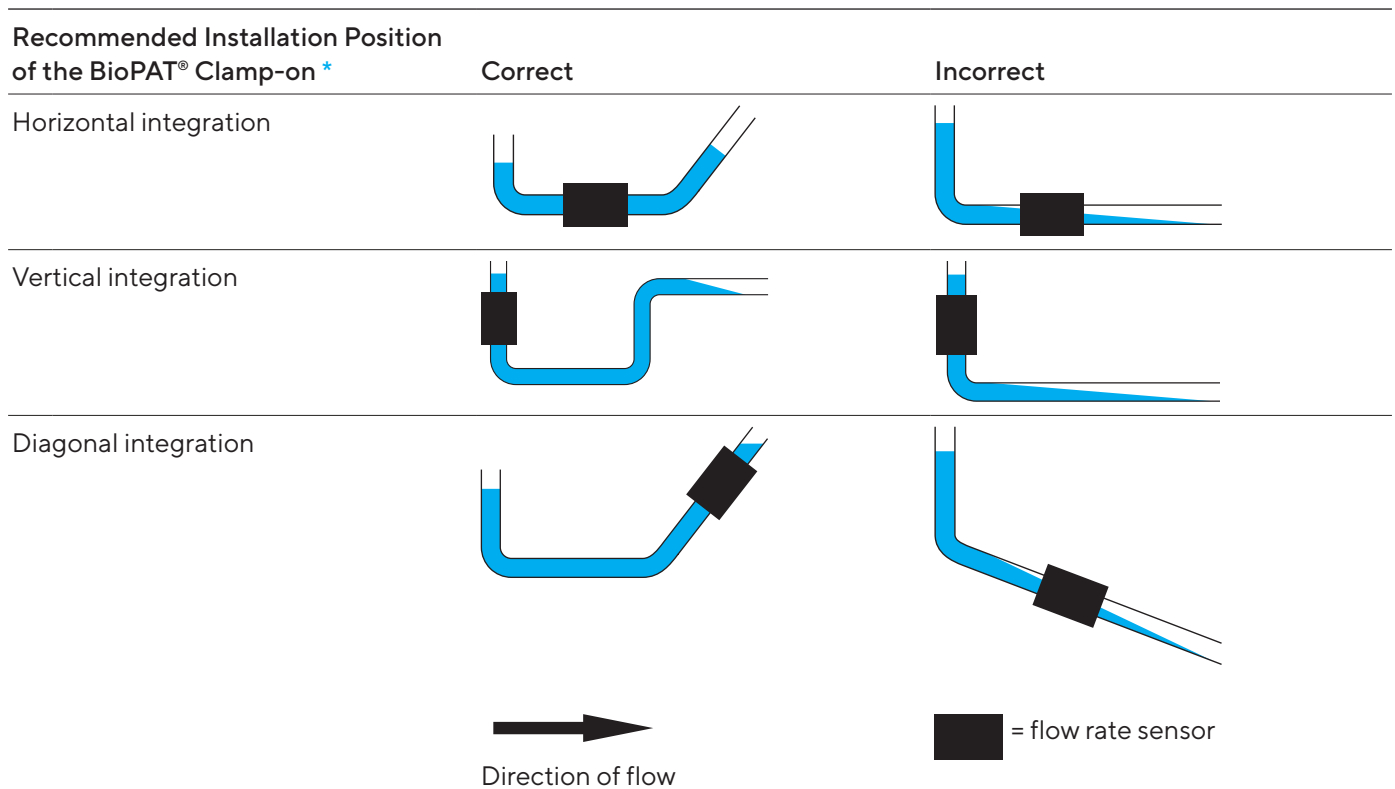
Q<sub>max</sub> = upper limit of measuring range, maximum flow rate

The system accuracy is calculated as 1-Sigma accuracy (mean deviation to reference measurement + 1 standard deviation) and is valid for the usage of any clamp-on transmitter with any single-use flow pipe component, providing the good practices for integration were complied with. The integration into bioprocessing systems and respective single-use assemblies can have a detrimental impact on the accuracy of the measurement. Please consult the good practices for installation and operation (see Operating instructions) or contact our technical support.

## BioPAT® Flow Clamp-on on Tubing

|   | Unit  | Value  |
|---|-------|--|
| Flow equalization shift within 2 hours, maximum | L/min | 0.03   |
| Accuracy  |       |  |
| at a flow value of ≤ 1.0 L/min                  | L/min | ± 0.07 ± flow equalization shift             |
| at a flow value of > 1.0 L/min                  |       | ± 7% of the read-off flow equalization shift |

### 14.2.4 Position of the Flow Sensor (Recommendation)



\* Especially when the integration of BioPAT® Flow is planned next to a pump, the recommended position for the sensor is on the suction side. This avoids loss of signal quality due to localized and temporary presence of air bubbles on the discharge side of the pump.

### 14.2.5 Installing the Flow Sensor (Recommendations)

|  | Unit | Value |
|--|------|-------|
| Inlet region upstream of BioPAT® Clamp-on  |      |       |
| Minimum distance from potential sources of interference such as revolving, spinning, or rotating movements | cm   | 15    |
| Minimum length of inlet region upstream of BioPAT® Clamp-on  |      |       |
| When using 1" and 3/4" Flow Pipe, at least: 15 × inner diameter of the Flow Pipe                           |      |       |
| When using 1/2", 3/8", and 1/4" Flow Pipe, at least: 10 × inner diameter of the Flow Pipe                  |      |       |

## 14.3 Suitable Cleaning and Disinfecting Agents

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For the device (BPL0002, BPL0003):

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70% isopropyl alcohol

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For BioPAT® Clamp-on:

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70% isopropyl alcohol

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Bacillol®\* AF, Bacillol® AF Tissues, Bacillol® Tissues, Bacillol® Wipes

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\* Bacillol® is a registered trademark of Paul Hartmann AG.

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## 14.4 Circuit Diagrams

### 14.4.1 Device Power Supply

#### BioPAT® Flowplus

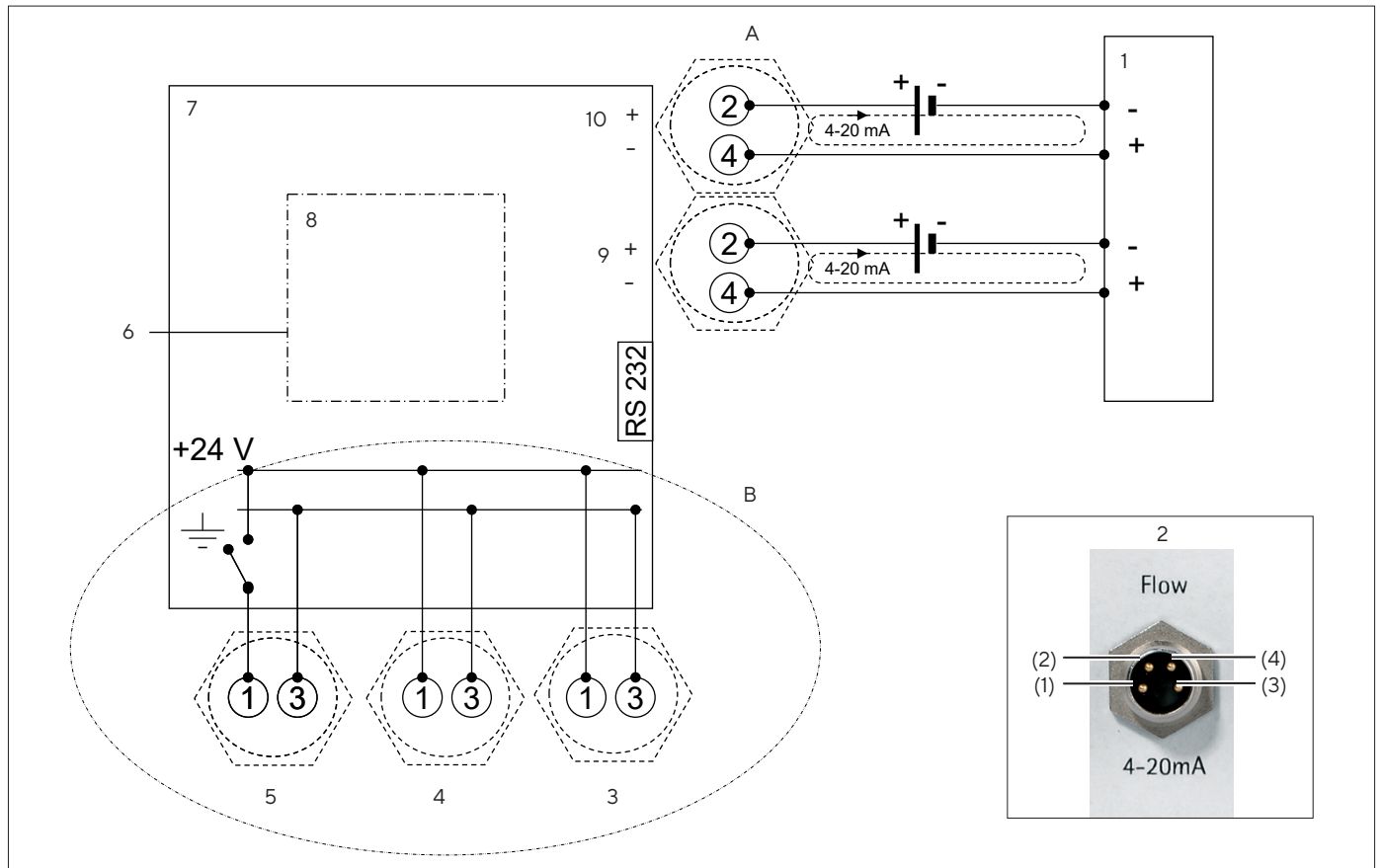


Fig.35: Circuit diagram with focus on device power supply (example)

| Pos. | Name   |
|------|--|
| A    | Power supply of Flow and RSS current loops   |
| B    | Power supply of flowmeter                    |
| 1    | Process control with data acquisition system |
| 2    | [Flow] terminal with PIN numbers (example)   |
| 3    | [RSS] terminal                               |
| 4    | [Flow] terminal                              |
| 5    | [Power] terminal                             |
| 6    | BioPAT® Clamp-on                             |
| 7    | Flow meter                                   |
| 8    | Digital electronics                          |
| 9    | Flow socket process control                  |
| 10   | RSS socket process control                   |

BioPAT® FlowDIN

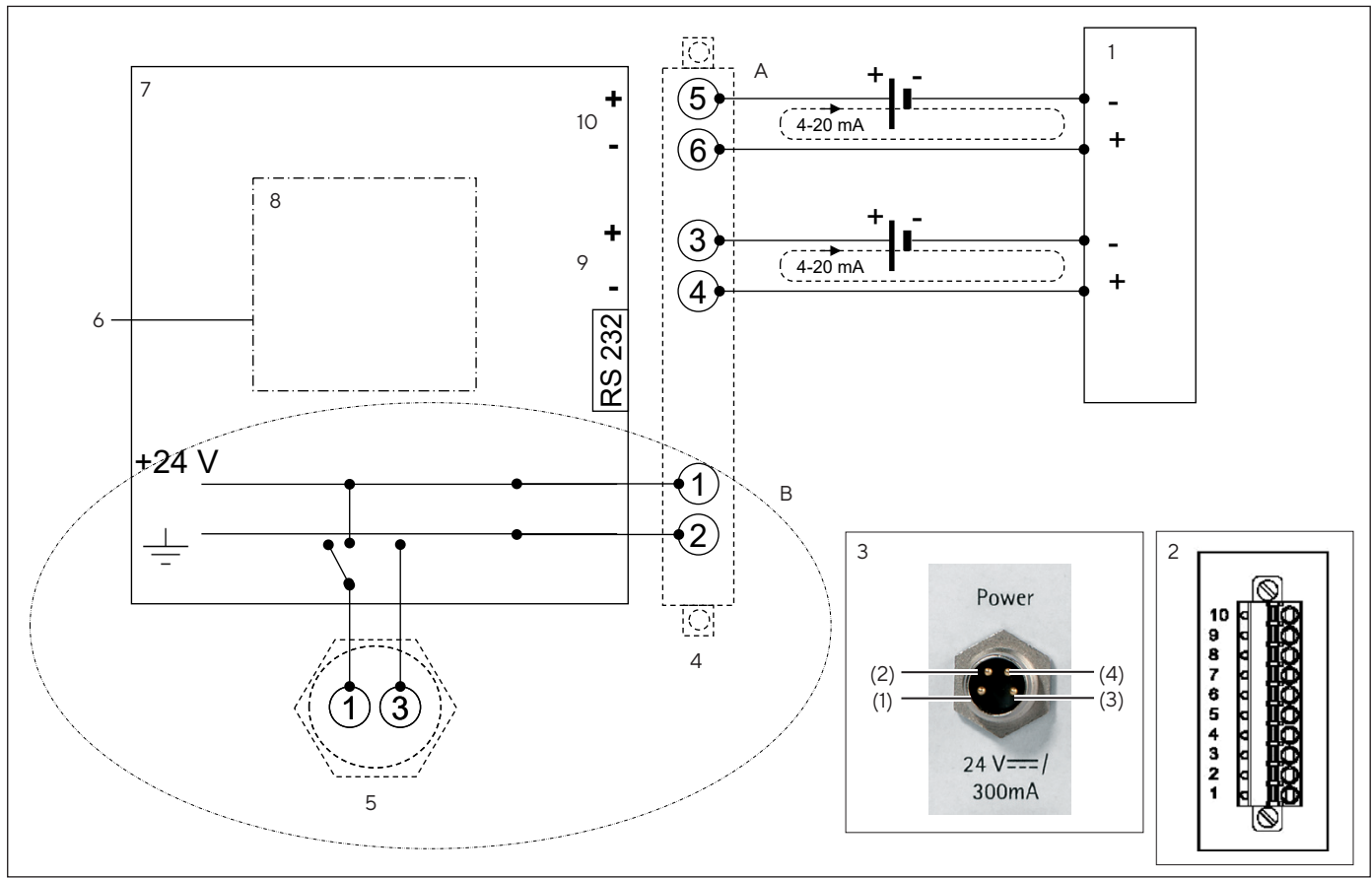


Fig.36: Circuit diagram with focus on device power supply (example)

| Pos. | Name  |
|------|---|
| A    | Power supply of Flow and RSS current loops                      |
| B    | Power supply of flowmeter                                       |
| 1    | Process control with data acquisition system                    |
| 2    | Device terminal block   |
| 3    | Device terminal block   |
| 4    | Example of PIN assignment of "Power" terminal, with PIN numbers |
| 5    | [Power] terminal  |
| 6    | BioPAT® Clamp-on  |
| 7    | Flow meter  |
| 8    | Digital electronics   |
| 9    | Flow socket process control                                     |
| 10   | RSS socket process control                                      |

## 14.4.2 Power Supply of Flow and RSS Current Loop via Device

## BioPAT® Flowplus

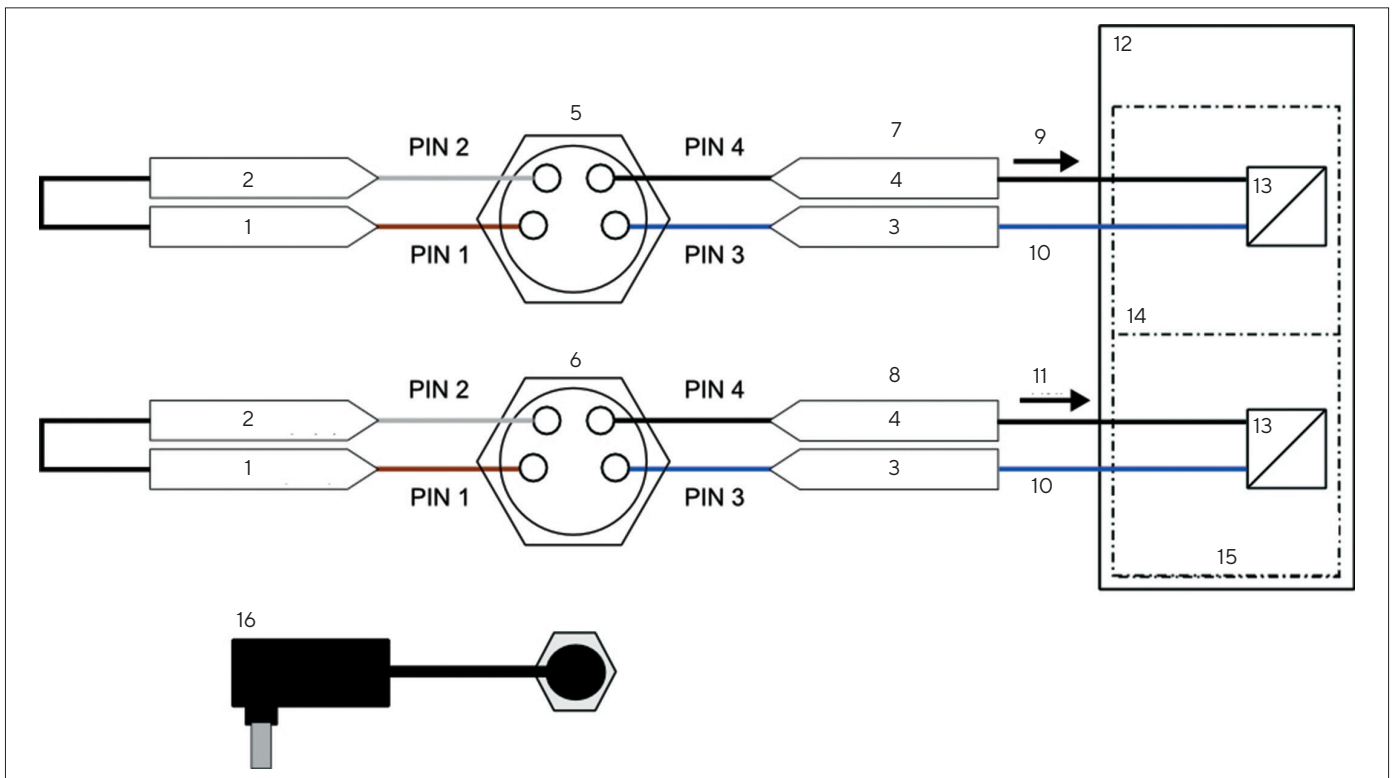


Fig. 37: Power supply of Flow and RSS current loops and the device via the AC adapter

| Pos. | Name   | Description                                     |
|------|--|---|
| 1    | +24 V <sub>DC</sub> (INT)                    |   |
| 2    | Flow or RSS current loop (+)                 |   |
| 3    | Mass (GND <sub>in</sub> )                    |   |
| 4    | Flow or RSS current loop (-)                 |   |
| 5    | [RSS] terminal                               |   |
| 6    | [Flow] terminal                              |   |
| 7    | Analog RSS current output signal             | 0 - 20 mA                                       |
| 8    | Analog flow current output signal            | 0 - 20 mA                                       |
| 9    | I <sub>RSS</sub>                             |   |
| 10   | GND  | Ground terminal                                 |
| 11   | I <sub>Flow</sub>                            |   |
| 12   | Process control with data acquisition system |   |
| 13   | Signal converter                             |   |
| 14   | RSS signal                                   |   |
| 15   | Flow signal                                  |   |
| 16   | AC Adapter                                   | Connected to the [Power] terminal of the device |

BioPAT® FlowDIN

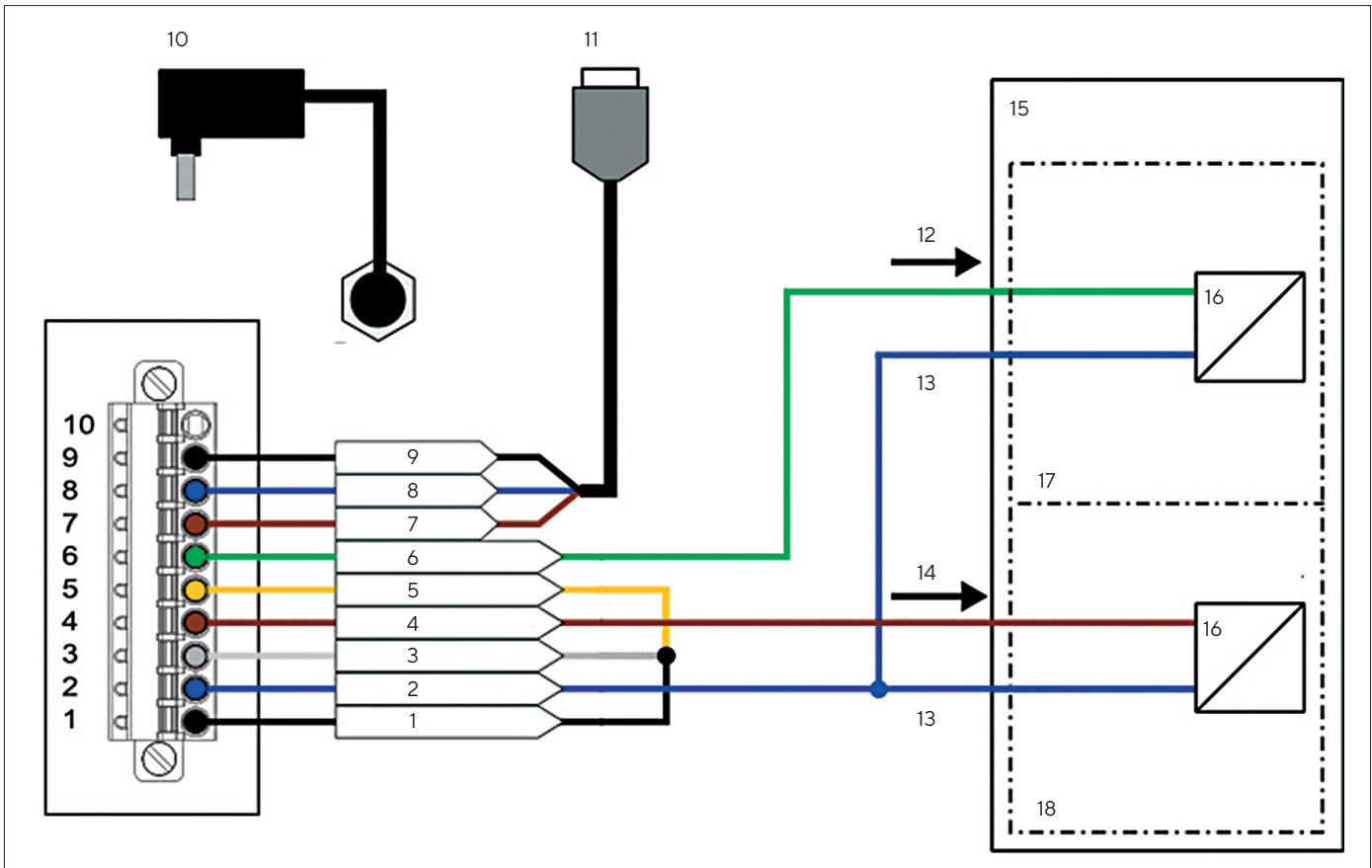


Fig.38: Power supply of Flow and RSS current loops and the device via the power supply unit

| Pos. | Name   | Description                                     |
|------|--|---|
| 1    | +24 V <sub>DC</sub>  |   |
| 2    | Ground (GND)   | Ground terminal                                 |
| 3    | Flow current loop (+)  |   |
| 4    | Flow current loop (-)  |   |
| 5    | RSS current loop (+)   |   |
| 6    | RSS current loop (-)   |   |
| 7    | PC TXD   |   |
| 8    | Ground (GND)   |   |
| 9    | PC RXD   |   |
| 10   | AC Adapter   | Connected to the [Power] terminal of the device |
| 11   | Serial cable with D-sub connector<br>(not included in the scope of delivery) | Transmits the digital RS232 signal              |
| 12   | I <sub>RSS</sub>   |   |
| 13   | GND  | Ground terminal                                 |
| 14   | I <sub>Flow</sub>  |   |



| Pos. | Name   | Description |
|------|--|-------------|
| 15   | Process control with data acquisition system |             |
| 16   | Signal converter                             |             |
| 17   | RSS signal                                   |             |
| 18   | Flow signal                                  |             |

#### 14.4.3 Power Supply of Flow and RSS Current Loop via External Voltage Source or Process Control

##### BioPAT® Flowplus

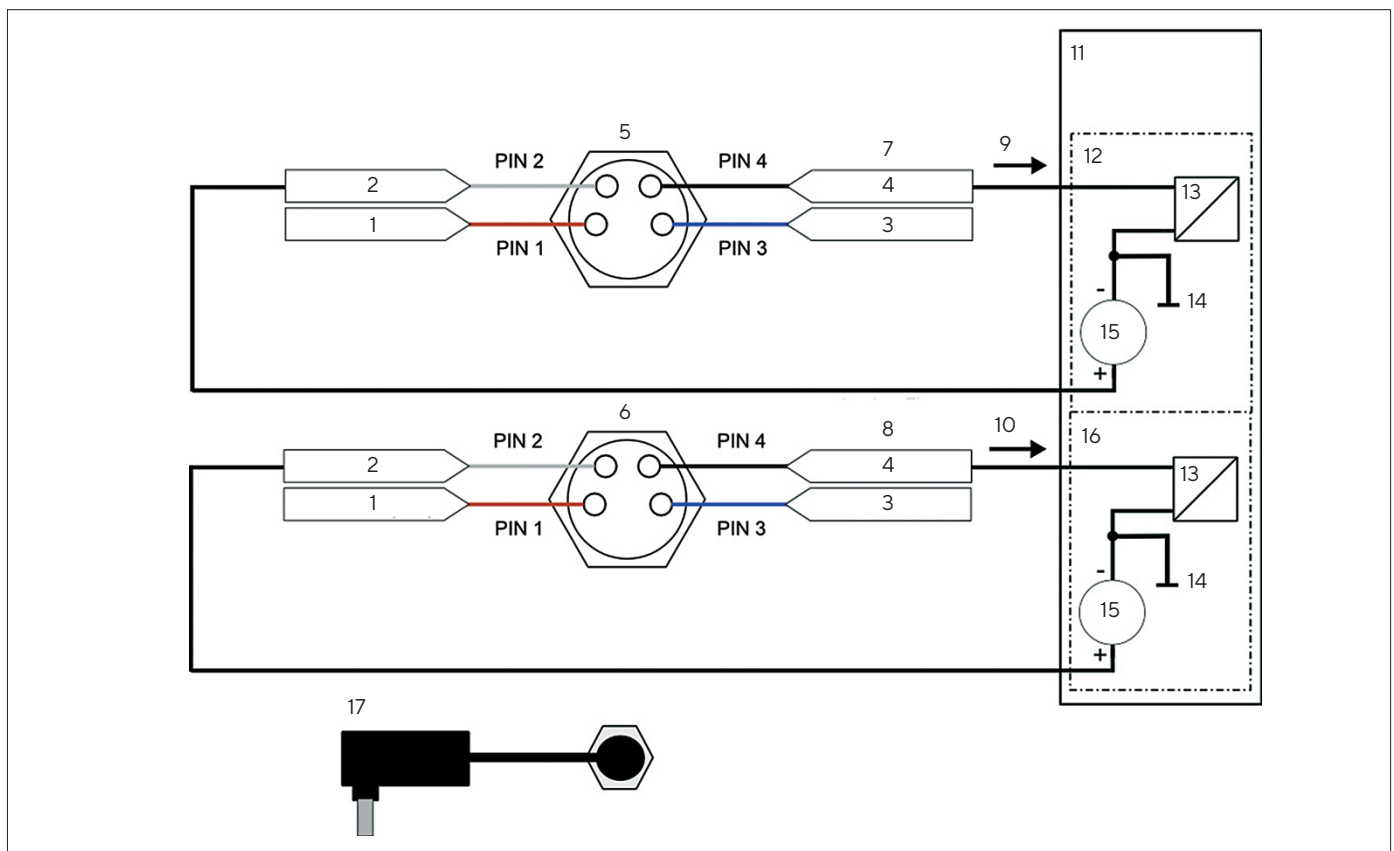


Fig. 39: Power supply of Flow and RSS current loop via the external voltage source of the process control, power supply of the device via the AC adapter

| Pos. | Name                         | Description |
|------|------------------------------|-------------|
| 1    | +24 V <sub>DC</sub> (INT)    |             |
| 2    | Flow or RSS current loop (+) |             |
| 3    | Mass (GND <sub>in</sub> )    |             |
| 4    | Flow or RSS current loop (-) |             |
| 5    | [RSS] terminal               |             |
| 6    | [Flow] terminal              |             |



| Pos. | Name   | Description                                     |
|------|--|---|
| 1    | AC Adapter   | Connected to the [Power] terminal of the device |
| 2    | Serial cable with D-sub connector<br>( <b>not</b> included in the scope of delivery) | Transmits the digital RS232 signal              |
| 3    | Flow current loop (+)  |   |
| 4    | Flow current loop (-)  |   |
| 5    | RSS current loop (+)   |   |
| 6    | RSS current loop (-)   |   |
| 7    | PC TXD   |   |
| 8    | Ground (GND)   |   |
| 9    | PC RXD   |   |
| 10   | $I_{RSS}$  |   |
| 11   | GND  | Ground terminal                                 |
| 12   | $I_{Flow}$   |   |
| 13   | Process control with data acquisition system   |   |
| 14   | RSS signal   |   |
| 15   | Signal converter   |   |
| 16   | Flow signal  |   |
| 17   | +24 V <sub>DC</sub>  | External voltage supply of the process control  |

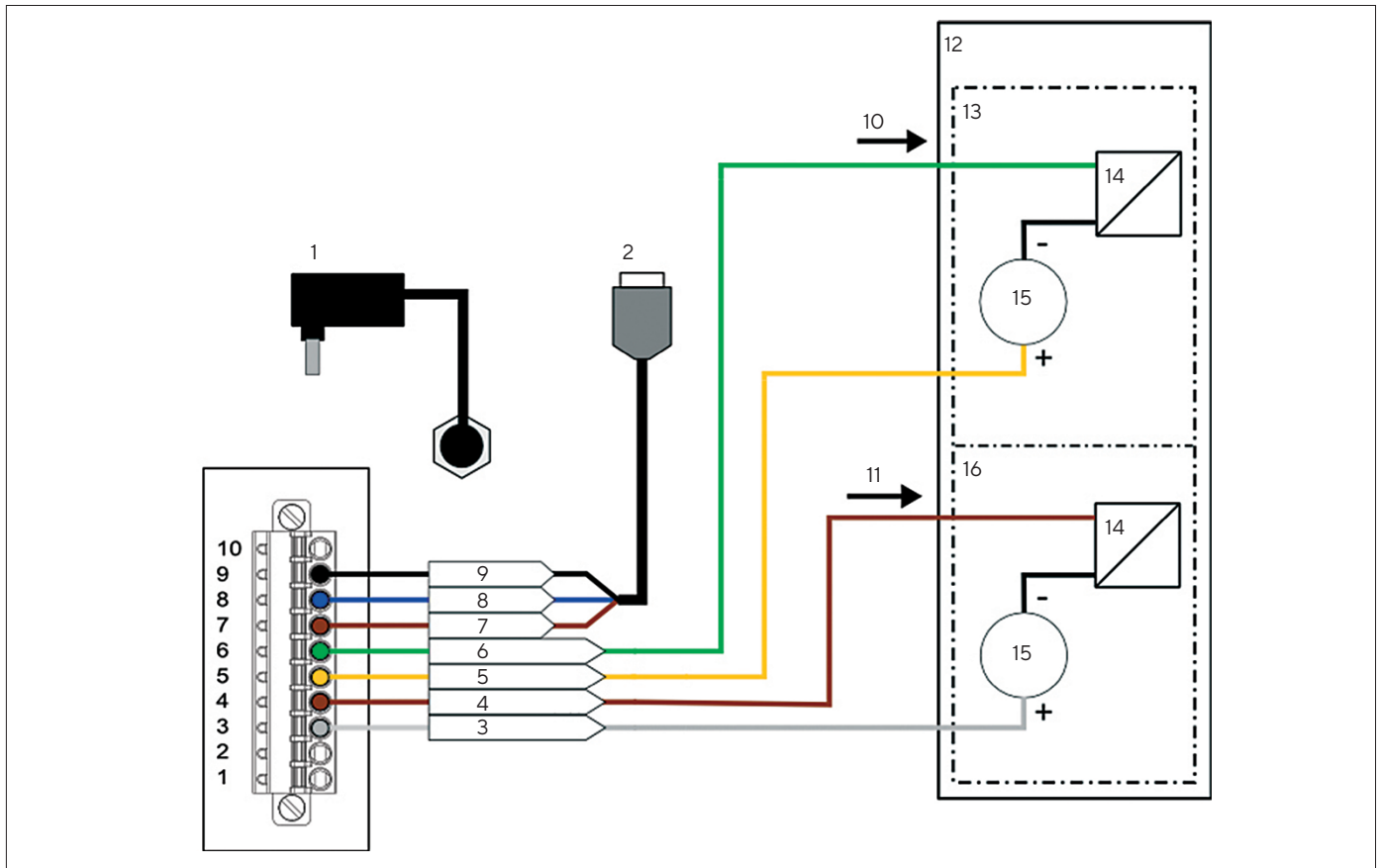


Fig.41: Power supply of Flow and RSS current loop via the signal processing cards of the process control, power supply of the device via the AC adapter

| Pos. | Designation  | Description                                     |
|------|--|---|
| 1    | AC Adapter   | Connected to the [Power] terminal of the device |
| 2    | Serial cable with D-sub connector<br>(not included in the scope of delivery) | Transmits the digital RS232 signal              |
| 3    | Flow current loop (+)  |   |
| 4    | Flow current loop (-)  |   |
| 5    | RSS current loop (+)   |   |
| 6    | RSS current loop (-)   |   |
| 7    | PC TXD   |   |
| 8    | Ground (GND)   |   |
| 9    | PC RXD   |   |
| 10   | $I_{RSS}$  |   |
| 11   | $I_{Flow}$   |   |
| 12   | Process control with data acquisition system                                 |   |
| 13   | RSS signal   |   |
| 14   | Signal converter   |   |
| 15   | +24 V <sub>DC</sub>  | External voltage supply of the process control  |
| 16   | Flow signal  |   |

# 15 Ordering Information

## 15.1 Devices

This table contains an excerpt of devices that can be ordered. For information on other products, please contact Sartorius.

| Item  | Quantity | Order number |
|---|----------|--------------|
| Signal amplifier  |          |              |
| BioPAT® Flowplus Benchtop w/display, 1 ch.                                  | 1        | BPL0002      |
| BioPAT® FlowDIN for DIN rail, 1 ch.   | 1        | BPL0003      |
| BioPAT® Clamp-on for Single-use Pipe, incl. standard calibration tables     |          |              |
| BioPAT® Flow Clamp-on ¼" pipe-L   | 1        | BPL0010      |
| BioPAT® Flow Clamp-on ⅜" pipe-L   | 1        | BPL0011      |
| BioPAT® Flow Clamp-on ½" pipe-L   | 1        | BPL0012      |
| BioPAT® Flow Clamp-on 1" pipe-L   | 1        | BPL0013      |
| BioPAT® Flow Clamp-on ¾" pipe-L   | 1        | BPL0028      |
| BioPAT® Flow Clamp-on ¼" pipe-S   | 1        | BPL0030      |
| BioPAT® Flow Clamp-on ⅜" pipe-S   | 1        | BPL0031      |
| BioPAT® Flow Clamp-on ½" pipe-S   | 1        | BPL0032      |
| BioPAT® Clamp-on for standard tubing, including standard calibration tables |          |              |
| BioPAT® Flow Clamp-on ⅛" × ¼" tub.-L  | 1        | BPL0020      |
| BioPAT® Flow Clamp-on 1/64" × 17/64" tub.-L                                 | 1        | BPL0021      |
| BioPAT® Flow Clamp-on 3/16" × 5/16" tub.-L                                  | 1        | BPL0022      |
| BioPAT® Flow Clamp-on ¼" × 3/8" tub.-L                                      | 1        | BPL0023      |
| BioPAT® Flow Clamp-on 3/8" × ½" tub.-L                                      | 1        | BPL0024      |
| BioPAT® Flow Clamp-on ½" × ¾" tub.-L  | 1        | BPL0025      |
| BioPAT® Flow Clamp-on ½" × 7/8" tub.-L                                      | 1        | BPL0026      |
| BioPAT® Flow Clamp-on ¾" × 1" tub.-L  | 1        | BPL0027      |
| BioPAT® Flow Clamp-on 1" × 1-¼" tub.-L                                      | 1        | BPL0029      |

## 15.2 Consumables

This table contains an excerpt of the consumables that can be ordered. For information on other products, please contact Sartorius.

| Item                                     | Quantity | Order number |
|--|----------|--------------|
| Single-use pipes                         |          |              |
| BioPAT® Flow Pipe ½" HB                  | 10       | BPL0101      |
| BioPAT® Flow Pipe ¾" HB                  | 10       | BPL0111      |
| BioPAT® Flow Pipe ¼" HB                  | 10       | BPL0121      |
| BioPAT® Flow Pipe 1" TC                  | 10       | BPL0131      |
| BioPAT® Flow Adapter 1" to ¾" TC 1" - ½" | 10       | BPL0141      |
| BioPAT® Flow Pipe ¾" HB                  | 10       | BPL0151      |

## 15.3 Spare Parts | Accessories

This table contains an excerpt of spare parts that can be ordered. For information on other products, please contact Sartorius.

| Item  | Quantity | Order number |
|---|----------|--------------|
| Connection cable RS232 for BioPAT® Flow - 2 m                                     | 1        | BPL0200      |
| Analog cable 4-20 mA for BioPAT® Flow - 2 m                                       | 1        | BPL0201      |
| Clamp-on DINrail extension cord - 1 m   | 1        | BPL0202      |
| Serial cable for BioPAT® FlowDIN, with plug and D-sub connector, configured - 2 m | 1        | BPL0203      |
| USB <> RS232 interface cable for BioPAT® Flow                                     | 1        | BPL0204      |
| FW7660/24 switch-mode power supply  | 1        | BPL0207      |
| Adapter for switch mode - Europe (Type C)   | 1        | BPL0208      |
| Adapter for switch mode - UK (Type G)   | 1        | BPL0209      |
| Adapter for switch mode - US   Japan (Type A&B)                                   | 1        | BPL0210      |
| Adapter for switch mode - IEC (Type D&M)  | 1        | BPL0211      |
| Extension cord (BioPAT® FlowDIN - 2.65 m)   | 1        | BPL0212      |
| Adapter for switch mode - Australia (Type I)                                      | 1        | BPL0215      |

## 15.4 Services

| Item                                     | Quantity | Order number |
|--|----------|--------------|
| BioPAT®Flow customized calibration table | N/A *    | BPL0056      |

\* Depending on the number of newly ordered clamp-ons. For already existing clamp-ons at customer site, please contact the Sartorius Service.

Additional information needs to be provided. Please contact our technical support for details.

## 16 Sartorius Service

Sartorius Service is at your disposal for queries regarding the device. Please visit the Sartorius website ([www.sartorius.com](http://www.sartorius.com)) for information about the service addresses, services provided, or to contact a local representative.

When contacting Sartorius Service with questions about the system or in the event of malfunctions, be sure to have the device information, e.g., serial number, close at hand. This information can be found on the manufacturer's ID label.

## 17 Conformity Documents

The attached documents declare the conformity of the device with the designated directives or standards.



Original

# CE EU-Konformitätserklärung EU Declaration of Conformity

Hersteller **Sartorius Stedim Biotech GmbH**  
Manufacturer 37070 Goettingen, Germany

erklärt in alleiniger Verantwortung, dass das Betriebsmittel  
*declares under sole responsibility that the equipment*

Geräteart Durchflussmessgerät + Clamp-on Durchflussmesser  
Device type *Flow meter + Clamp-ons*

Artikel **BPL0002 | BPL0003 + BPL0010 ... BPL0013, BPL0020 ...BPL0032**  
Article

Modell **BioPAT® Flowplus | BioPAT® FlowDIN + BioPAT® Flow Clamp-ons**  
Model

in der von uns in Verkehr gebrachten Ausführung allen einschlägigen Bestimmungen der folgenden Europäischen Richtlinien entspricht und die anwendbaren Anforderungen folgender harmonisierter Europäischer Normen einschließlich deren zum Zeitpunkt der Erklärung geltenden Änderungen erfüllt:

*in the form as delivered fulfils all the relevant provisions of the following European Directives and meets the applicable requirements of the harmonized European Standards including any amendments valid at the time this declaration was signed listed below:*

2014/30/EU Elektromagnetische Verträglichkeit / *Electromagnetic compatibility*  
EN 61326-1:2013



2011/65/EU Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten (RoHS) / *Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)*  
EN 50581:2012

Die Person, die bevollmächtigt ist, die technischen Unterlagen zusammenzustellen:  
*The person authorised to compile the technical file:*

Sartorius Stedim Biotech GmbH  
Regulatory Affairs BPS  
37070 Goettingen, Germany

Jahreszahl der CE-Kennzeichenvergabe / *Year of the CE mark assignment:* **19**

Sartorius Stedim Biotech GmbH  
Goettingen, 2019-01-22; 2021-06-11 (Revised)

|  |   |
|--|---|
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| Dr. Jennifer Neff  | Zafir Asghar  |
| Head of Regulatory Affairs BPS   | Project Manager – Product Compliance  |
| Regulatory Affairs BPS   | Regulatory Affairs BPS  |

Doc: 2055614-02 SSB16CE003-02.de,en 1/2 PMF: 2055613 2055614\_02\_SSB16CE003-02.de,en\_BioPAT Flow\_Flowplus\_FlowDIN.doc\_Clamp on.docx



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