

IonFlow Bipolar electrophoretic equipment

IBP - 5 series

User's Manual

SUPERTECH

The choice of the different IonFlow models

In our choice there are three different electrophoretic (iontophoretic, ionophoretic) systems. This manual describes the **IonFlow Bipolar** iontophoretic equipment. Our other electrophoretic products are **IonFlow Modular**, and **IonFlow Pro** families. All of them are up-to-date, easy to use, highly reliable, microprocessor-controlled constructions. We manufacture three different ionophoretic families, because the three product lines are optimized for different application fields. Please read through the appropriate descriptions for the details.

IonFlow Bipolar: Single-channel, high-voltage, general purpose electrophoretic equipment for microelectrode research applications

IonFlow Modular: Multichannel, modularly expandable version of **IonFlow Bipolar**, with an additional current compensating channel (for multibarrel electrodes)

IonFlow Pro: High-voltage electrophoretic equipment for all general human dental, and cosmetic applications

The following sections of this manual deal with **IonFlow Bipolar**.

General description of the IonFlow Bipolar

IonFlow Bipolar is a single-channel, high-voltage, general purpose electrophoretic equipment for microelectrode research applications.

IonFlow Bipolar is optimized to apply tracer solutions in tissues, and tissue slices. Furthermore it is very effective for in-vivo, and in-vitro situations, and for single cell experiments. **IonFlow Bipolar** can be used efficiently to apply tracers, drugs, and any other solutions from micropipettes.

The electrophoresis (which collective word covers the effects of ionophoresis and electro-osmosis) offers a comfortable opportunity to pass medicines, and/or other chemical substances into any conductive organs (e.g. the human body through the surface of the skin, or directly into tissue cultures) in correctly measured small quantities with electric current. During ionophoresis the ions move due to an electric potential field. The non-ionic substances can be passed similarly with electro-osmosis. The substances, which are designed in the pharmaceutical factories for human electrophoretic purposes meet these requirement. The solutions used in research labs should be designed according to these facts. The quantity of substances passed from the electrode can be controlled exactly by two parameters: the current and time of the electrophoresis.

Our electrophoretic equipments offer high accuracy due to their microprocessor-based, fully digital internal electronic design. Since we use state-of-the-art electronic components, and extremely thorough quality checking during the manufacturing

process, the reliability of our products is delicious. **IonFlow Bipolar** has got menu-driven internal software (firmware), so it is very easy to learn how to use it.

The power supply of **IonFlow Bipolar** is a highly sophisticated floating power supply. It is designed for such applications, where a signal recording task is running simultaneously with another microelectrode, which is located close to the electrophoretic electrode. The floating power supply is necessary to avoid the hum noise from the sensitive recording amplifiers.

Specifications

The selectable ranges of the output current: 0-1 μ A
0-100 μ A
0-10 mA

Compliance voltage of the current generator: 120 V

Worst-case error of the output current generator: < 5 %

The output current can be set independently for the positive, and for the negative polarity, with scaled, 10-turn, precision helical potmeters

Resolution of the helical potmeters: 0.1 %

True output current indicator: there is a floating LCD digital panelmeter, with backlight, on the front plate. It shows the real output current in the percents of the actual range (full scale readout is 100.0 %).

Resolution of the true output current indicator: 0.1 %

Worst-case error of the true output current indicator: < 5 %

Worst-case error of the timing parameters generated by the built-in microcontroller with firmware: < 0.2 %

Mains supply voltage: 115 VAC, or 230 VAC. It should be specified in the order. The actual supply voltage is sealed at the back side of the equipment.

Tolerance of the mains supply voltage referring to the nominal value: 10 %

Mains frequency: 50 – 60 Hz

Internal power supplies: mains frequency power supply with isolation voltage security of 4 kV (guaranteed by the manufacturer of the mains transformer), and an additional internal floating power source with isolation capacitance < 10 pF

Display: 2 x 16 characters alphanumeric LCD with bright green backlight

Programming: three function-buttons, and a Start push-button on the front plate, in menu system

Automatic internal diagnostic algorithm in the software

Flash program memory

Non-volatile EEPROM memory to store the parameters used last time

Dimensions of the instrument: 290 x 250 x 90 mm

Weight: 2.0 kg

Security rules

IonFlow Bipolar is supplied from the 230 VAC, or 115 VAC / 50 Hz mains system. They are dangerous voltages! All general electrical security precautions should be kept in mind during the usage of the equipment!

The current generator end-stage of the **IonFlow Bipolar** is a very dangerous electronic circuit! On one hand, a good current source should have a compliance voltage high enough to pass the current through on high impedance output loads. On the other hand, a high compliance voltage will be a serious danger to the user of the equipment, because the output wires are driven by the compliance voltage! And the top of all that, the output current of this equipment can be adjusted up to 10 mA. It is a very dangerous level of current, since the human heart can be forced to stop even with 1, or 2 mA. The actual compliance voltage is high enough to pass this current through the human body. The output wiring are made by the user, or by an authorized technician. The professional quality, and the electric security of the external wiring, and the external circuitry are not the responsibility of Supertech Ltd. The electrical security aspects of the **IonFlow Bipolar** are completely under the sole responsibility of the user!

Front panel controls

On the left side there is a 3-position switch. You can choose the actual range of current with this switch. The numbers written to the three positions are the full scale values of the ranges.

Next to the range selector switch there are the potmeters signed Negative, and Positive. They are used to set the values of the current, respectively. The potmeters can be used to trim the currents in the actual range. The full scale value is generated by the current generator end-stage, when the potmeter shows 10 (in the small window), and 0 (on the rotary dial).

Next to the potmeters there is the true output current indicator. It is a 7-segment digital LCD panelmeter, with backlight. This panelmeter is supplied from a dedicated floating power supply (part of the internal power supply unit). In this way the user always can monitor the real output current, independently of any internal, or external circumstances. The true output current indicator shows the real output current in the percents of the actual range (full scale readout is 100.0 %).

The equipment is assembled with a 2 x 16 character green LCD display, and a user-friendly 4-button keypad on its front plate. The development strategy of the firmware was to design an easy-to-use user interface, while highly professional capabilities are activated behind the simple menu system.

On the front panel of the **IonFlow Bipolar** there are only four push-buttons to program the parameters, and control the equipment, but with them you can do (nearly all) what you would like to do.

Up and Down buttons:

Up and Down button is used to navigate in menus, and to modify parameter values up or down, respectively. Use them to choose from the menu items, and configure the values. Where you see the cursor you can adjust the appropriate menu point, or you can set that numeric value what is under the cursor.

F (Function) button:

F button has got two functions according to the actual situation. Use it in the menu as enter, during the programming, and parameter setup actions. When you are in a programming phase, and the Function button works as enter, the microprocessor automatically saves the newly selected value, if the numeric parameter is valid, after the keypress. Furthermore, Function button is used to cancel a function if the function is running actually. When a function is running, the F button can be used as escape to inactivate the function, to leave the actual task completely, and to jump to the Function Choice menu.

Start button:

START event means a keypress on Start button, or a TTL rising edge appearing on Start input. The two source of the START event can be used together or independently any time (they are in logical OR relation). Start button is used to start the output sequence in the *Positive Timer*, *Negative Timer*, and in the *Programmable Alternating* functions (see their descriptions later). These functions can be interrupted temporarily with Start button (and they can be restarted again with it). In the *Positive External Control*, and in the *Negative External Control* functions the Start button serves as a direct manual control signal to the current generator end-stage (in logical OR relation with the signal at the Start for Processor input).

There is a green LED on the front plate signed as Active. It shows, when the current generator end-stage is passing any current to the output.

Connectors at the back side

On the back plate of the **IonFlow Bipolar** there is the AC input plug at the left side. Connect it to the 115 VAC, or 230 VAC mains system with the appropriate cable. The actual supply voltage is sealed next to the AC input connector. **NEVER** connect the equipment to other supply voltage, than the sealed value, because in such a case the equipment will be destroyed!

The mains switch is also located at the left side of the back plate. If the **IonFlow Bipolar** is switched off, it is necessary to wait until the power supply loses all its energy. It is prohibited to switch the equipment on again, without waiting enough, otherwise a faulty reset condition would happen, even, the internal software (firmware) can be destroyed! The enough time before the **IonFlow Bipolar** can be switched on again after switching off, if the last screen content (not the backlight, but the letters) disappears completely, and 10 seconds more is spent.

The connectors of the high voltage output section are signed with a black square around them. They are that connectors, what you should use the most carefully you can (see the Security rules above).

The Applicator Pipette Output, and the Reference Connector are the output points of the current generator end-stage. The polarity, what you select in the software is the polarity of the Applicator Pipette Output, referring to the Reference Connector.

The Floating Shield is an optional connector. There are equipment versions assembled with, and there are versions manufactured without it. There is a special internal electrostatic, and electromagnetic shield built onto the floating power supply (which is running on high frequency). If the Floating Shield connector is present on the back side, it means, that the special shield is connected to this banana connector, and not connected to anywhere else, so you should connect the shield to the central Ground point (or any other Ground potential chosen by you). If the Floating Shield connector is not present on the back side, it means, that the special shield is connected to the internal, low frequency Ground point of the equipment, and you should not take care of it.

The most right input is the Start for Processor BNC connector. TTL High-level is the active state at this input. In the *Positive External Control*, and in the *Negative External Control* functions the Start for Processor signal serves as a direct external control signal to the current generator end-stage (in logical OR relation with the Start button). In the *Positive Timer*, *Negative Timer*, and in the *Programmable Alternating* functions the Start for Processor input is an alternative source of a START event (see its definition above). If there is no signal source connected to the Start for Processor input, the microcontroller realizes a TTL Low-level, as an inactive state.

Functions in the firmware

After switching the **IonFlow Bipolar** on, the microprocessor loads the default setup values saved last time, and checks that parameter values. If the parameters seem to be valid, the processor tries to start the function used last time.

There are enhanced protection features built into the firmware. If any malfunction appears, the fault is described on the LCD screen to inform the user about the details.

Operating modes:

In all operating functions the timing parameters are generated by the built-in microcontroller, but the selection of the range, and the setting of the currents are carried out with the appropriate analogue controls.

Positive External Control:

free control capability from an external device (such as a computer), or from the Start push-button on the front panel. The Start for Processor signal (TTL High-level) at the back plate serves as a direct external control signal to the current generator end-stage (in logical OR relation with the Start button)

Negative External Control:

same as Positive External Control function, with opposite polarity of output current

Positive Timer:

Programmable interval timer running in software in the range of 10 sec to 990 sec, with 10 sec of resolution. The polarity of the output current is positive

Negative Timer:

same as Positive Timer function, with opposite polarity of output current

Programmable Alternating:

continuous, square wave, alternating current is flowing at the output. The positive, and the negative period in the cycle can be programmed in the range of 1 sec to 59 sec, with 1 sec of resolution. The positive, and the negative current amplitudes can be set independently of each other.

Warranty

We give you full warranty service, including rest parts for the period of 3 years by default. Longer warranty periods can also be defined and agreed (the actual conditions should be discussed before placing the order).

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