Elektro-Automatik

Operating Manual

PS 2000 B TFT Single

DC Power Supply

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1. General

1.1 About this document

1.1.1 Retention and use

This document is to be kept in the vicinity of the equipment for future reference and explanation of the operation of the device. This document is to be delivered and kept with the equipment in case of change of location and/or user.

1.1.2 Copyright

1.1.3 Validity

This manual is valid for the following equipment **with color TFT display**:

Model	Article nr.
PS 2042-06 B	39 200 112
PS 2042-10 B	39 200 113
PS 2042-20 B	39 200 114

Model	Article nr.
PS 2084-03 B	39 200 116
PS 2084-05 B	39 200 117
PS 2084-10 B	39 200 118

1.1.4 Symbols and warnings

Warning and safety notices as well as general notices in this document are shown in a box with a symbol as follows:

	**Symbol for a life threatening danger**
	Symbol for general safety notices (instructions and damage protection bans)
	*Symbol for general notices*

1.2 Warranty

EA Elektro-Automatik guarantees the functional competence of the device within the stated performance parameters. The warranty period begins with the delivery of free from defects equipment.

Terms of guarantee are included in the general terms and conditions of EA Elektro-Automatik.

1.3 Limit of liability

All statements and instructions in this manual are based on current norms and regulations, up-to-date technology and our long term knowledge and experience. EA Elektro-Automatik accepts no liability for losses due to:

- Usage for purposes other than defined
- Use by untrained personnel
- Rebuilding by the customer
- Technical changes
- Use of non authorized spare parts

The actual delivered device(s) may differ from the explanations and diagrams given here due to latest technical changes or due to customized models with the inclusion of additionally ordered options.

1.4 Disposal of equipment

A piece of equipment which is intended for disposal must, according to European laws and regulations (ElektroG, WEEE) be returned to EA Elektro-Automatik for scrapping, unless the person operating the piece of equipment or another, delegated person is conducting the disposal. Our equipment falls under these regulations and is accordingly marked with the following symbol:

1.5 Product key

Decoding of the product description on the label, using an example:

PS 2042 - 10 B

B	Construction/Version: **B** = Second generation
10	Maximum current of the device in Ampere
42	Maximum voltage of the device in Volt
2	Series : **2** = Series 2000
PS	Type identification: **PS** = Power Supply

1.6 Intended usage

The equipment is intended to be used, if a power supply or battery charger, only as a variable voltage and current source, or, if an electronic load, only as a variable current sink.

Typical application for a power supply is DC supply to any relevant user, for a battery charger the charging of various battery types and for electronic loads the replacement of Ohm resistance by an adjustable DC current sink in order to load relevant voltage and current sources of any type.

- Claims of any sort due to damage caused by non-intended usage will not be accepted.
- All damage caused by non-intended usage is solely the responsibility of the operator.

1.7 Safety

1.7.1 Safety notices

Mortal danger - Hazardous voltage

- **Electrical equipment operation means that some parts will be under dangerous voltage. Therefore all parts under voltage must be covered!**
- **All work on connections must be carried out under zero voltage (output not connected to a load which is also a voltage source) and may only be performed by qualified and trained personnel. Improper actions can cause fatal injury as well as serious material damage.**
- **Never touch cables or connectors directly after unplugging from mains supply as the danger of electric shock remains.**

- The equipment must only be used as intended
- The equipment is only approved for use within the connection limits stated on the product label.
- Do not insert any object, particularly metallic, through the ventilator slots
- Avoid any use of liquids near the equipment. Protect the device from wet, damp and condensation.
- For power supplies and battery chargers: do not connect users, particularly low resistance, to devices under power; sparking may occur which can cause burns as well as damage to the equipment and to the user.
- For electronic loads: do not connect power sources to equipment under power, sparking may occur which can cause burns as well as damage to the equipment and to the source.
- ESD regulations must be applied when plugging interface cards or modules into the relative slot
- Interface cards or modules may only be attached or removed after the device is switched off. It's not necessary to open the device.
- Do not connect external power sources with reversed polarity to DC inputs or outputs! The equipment will be damaged.
- For power supply devices: avoid where possible connecting external power sources to the DC output, and never those that can generate a higher voltage than the nominal voltage of the device.
- For electronic loads: do not connect a power source to the DC input which can generate a voltage more than 120% of the nominal input voltage of the load. The equipment isn't protected against over voltage and may be irreparably damaged.
- Always configure the various protecting features against overcurrent, overpower etc. for sensitive sources to what the currently used application requires

1.7.2 Responsibility of the user

The equipment is in industrial operation. Therefore the operators are governed by the legal safety regulations. Alongside the warning and safety notices in this manual the relevant safety, accident prevention and environmental regulations must also be applied. In particular the users of the equipment:

- must be informed of the relevant job safety requirements
- must work to the defined responsibilities for operation, maintenance and cleaning of the equipment
- before starting work must have read and understood the operating manual
- must use the designated and recommended safety equipment.

Furthermore, anyone working with the equipment is responsible for ensuring that the device is at all times technically fit for use.

1.7.3 Responsibility of the operator

Operator is any natural or legal person who uses the equipment or delegates the usage to a third party, and is responsible during its usage for the safety of the user, other personnel or third parties.

The equipment is in industrial operation. Therefore the operators are governed by the legal safety regulations. Alongside the warning and safety notices in this manual the relevant safety, accident prevention and environmental regulations must also be applied. In particular the operator has to

- be acquainted with the relevant job safety requirements
- identify other possible dangers arising from the specific usage conditions at the work station via a risk assessment
- introduce the necessary steps in the operating procedures for the local conditions
- regularly check that the operating procedures are current
- update the operating procedures where necessary to reflect changes in regulation, standards or operating conditions.
- define clearly and unambiguously the responsibilities for operation, maintenance and cleaning of the equipment.
- ensure that all employees who use the equipment have read and understood the manual. Furthermore the users are to be regularly schooled in working with the equipment and the possible dangers.
- provide all personnel who work with the equipment with the designated and recommended safety equipment

Furthermore, the operator is responsible for ensuring that the device is at all times technically fit for use.

1.7.4 User requirements

Any activity with equipment of this type may only be performed by persons who are able to work correctly and reliably and satisfy the requirements of the job.

- Persons whose reaction capability is negatively influenced by e.g. drugs, alcohol or medication may not operate the equipment.
- Age or job related regulations valid at the operating site must always be applied.

Danger for unqualified users

Improper operation can cause person or object damage. Only persons who have the necessary training, knowledge and experience may use the equipment.

Delegated persons are those who have been properly and demonstrably instructed in their tasks and the attendant dangers.

Qualified persons are those who are able through training, knowledge and experience as well as knowledge of the specific details to carry out all the required tasks, identify dangers and avoid personal and other risks.

1.7.5 Alarm signals

The equipment offers various possibilities for signaling alarm conditions, however, not for danger situations. The signals are optical, as text on the display. All alarms will cause the device to switch off the DC output.

The meaning of the signals is as follows:

Signal **OT** (OverTemperature)	• Overheating of the device • DC output will be switched off • Non-critical
Signal **OVP** (OverVoltage)	• Overvoltage shutdown of the DC output occurs due to high voltage being generated by the device or is entering the device from outside • Critical! The device and/or the load could be damaged
Signal **OCP** (OverCurrent)	• Shutdown of the DC output due to excess of the preset limit • Non-critical, protects the load from excessive current drain

1.8 Technical data

1.8.1 Approved operating conditions

- Use only inside dry buildings
- Ambient temperature 0-50 °C
- Operational altitude: max. 2000 m above sea level
- Maximum 80% humidity, not condensing

1.8.2 General technical data

Display: Color TFT display, 320pt x 240pt

Controls: 2 rotary knobs with pushbutton functions, 2 pushbuttons

The nominal values for the device determine the maximum adjustable ranges.

1.8.3 Specific technical data

42 V	Model		
	PS 2042-06 B	*PS 2042-10 B*	*PS 2042-20 B*
AC Input			
Voltage range	90...264 V AC	90...264 V AC	90...264 V AC
Connection	Wall outlet	Wall outlet	Wall outlet
Frequency	45-65 Hz	45-65 Hz	45-65 Hz
Fusing	T 2 A	T 3.15 A	T 6.3 A
Power factor	≈ 0.99	≈ 0.99	≈ 0.99
DC Output			
Max. output voltage U_{Max}	42 V	42 V	42 V
Max. output current I_{Max}	6 A	10 A	20 A
Max. output power P_{Max}	100 W	160 W	320 W
Overvoltage protection range	0...46.2 V	0...46.2 V	0...46.2 V
Overcurrent protection range	0...5.5 A	0...11 A	0...22 A
Voltage regulation			
Adjustment range	0...42 V	0...42 V	0...42 V
Accuracy (1 (at 23 ± 5°C)	< 0.2% U_{Max}	< 0.2% U_{Max}	< 0.2% U_{Max}
Load regulation at 0...100% load	< 0.15% U_{Max}	< 0.15% U_{Max}	< 0.15% U_{Max}
Settling time after load step	< 2 ms	< 2 ms	< 2 ms
Display: Accuracy (3	≤ 0.2% U_{Max}	≤ 0.2% U_{Max}	≤ 0.2% U_{Max}
Ripple (2	< 100 mV_{PP} < 6 mV_{RMS}	< 63 mV_{PP} < 5 mV_{RMS}	< 70 mV_{PP} < 6 mV_{RMS}
Current regulation			
Adjustment range	0...6 A	0...10 A	0...20 A
Accuracy (1 (at 23 ± 5°C)	< 0.3% I_{Max}	< 0.3% I_{Max}	< 0.3% I_{Max}
Load regulation at 0...100% ΔU_{OUT}	< 0.15% I_{Max}	< 0.15% I_{Max}	< 0.15% I_{Max}
Ripple (2	< 10 mA_{RMS}	< 13 mA_{RMS}	< 15 mA_{RMS}
Display: Accuracy (3	≤ 0.2% I_{Max}	≤ 0.2% I_{Max}	≤ 0.2% I_{Max}
Miscellaneous			
Cooling	Fanless, natural convection	Fanless, natural convection	Temperature controlled fan
Noise	-	-	< 40 dbA @ 1 m
Ambient temperature	0..50°C		
Storage temperature	-20...70°C		
Humidity	< 80%, not condensing		
Standards	EN 61010-1		
Overvoltage category	2		
Protection class	1		
Terminals			
Rear side	AC input		
Front side	DC output, USB-B		
Dimensions			
Enclosure (WxHxD)	174 x 82 x 240 mm	174 x 82 x 240 mm	174 x 82 x 267 mm
Total (WxHxD)	174 x 90 x 263 mm	174 x 90 x 263 mm	174 x 90 x 290 mm
Weight	≈ 1.9 kg	≈ 2 kg	≈ 2.6 kg
Article number	39200112	39200113	39200114

(1 Related to the nominal values, the accuracy defines the maximum deviation between an adjusted values and the true (actual) value.
(2 RMS value: LF 0...300 kHz, PP value: HF 0...20MHz.
(3 The display error adds to the error of the related actual value on the DC output.

84 V	Model		
	PS 2084-03 B	*PS 2084-05 B*	*PS 2084-10 B*
AC Input			
Voltage range	90...264 V AC	90...264 V AC	90...264 V AC
Connection	Wall outlet	Wall outlet	Wall outlet
Frequency	45-65 Hz	45-65 Hz	45-65 Hz
Fusing	T 2 A	T 3.15 A	T 6.3 A
Power factor	≈ 0.99	≈ 0.99	≈ 0.99
DC Output			
Max. output voltage U_{Max}	84 V	84 V	84 V
Max. output current I_{Max}	3 A	5 A	10 A
Max. output power P_{Max}	100 W	160 W	320 W
Overvoltage protection range	0...92.4 V	0...92.4 V	0...92.4 V
Overcurrent protection range	0...3.3 A	0...5.5 A	0...11 A
Voltage regulation			
Adjustment range	0...84 V	0...84 V	0...84 V
Accuracy (1 (at 23 ± 5°C)	< 0.2% U_{Max}	< 0.2% U_{Max}	< 0.2% U_{Max}
Load regulation at 0...100% load	< 0.15% U_{Max}	< 0.15% U_{Max}	< 0.15% U_{Max}
Settling time after load step	< 2 ms	< 2 ms	< 2 ms
Display: Accuracy (3	≤ 0.2% U_{Max}	≤ 0.2% U_{Max}	≤ 0.2% U_{Max}
Ripple (2	< 48 mV_{PP} < 4 mV_{RMS}	< 96 mV_{PP} < 24 mV_{RMS}	< 100 mV_{PP} < 6 mV_{RMS}
Current regulation			
Adjustment range	0...3 A	0...5 A	0...10 A
Accuracy (1 (at 23 ± 5°C)	< 0.3% I_{Max}	< 0.3% I_{Max}	< 0.3% I_{Max}
Load regulation at 0...100% ΔU_{OUT}	< 0.15% I_{Max}	< 0.15% I_{Max}	< 0.15% I_{Max}
Ripple (2	< 2 mA_{RMS}	< 3 mA_{RMS}	< 1.5 mA_{RMS}
Display: Accuracy (3	≤ 0.2% I_{Max}	≤ 0.2% I_{Max}	≤ 0.2% I_{Max}
Miscellaneous			
Cooling	Fanless, natural convection	Fanless, natural convection	Temperature controlled fan
Noise	-	-	< 40 dbA @ 1 m
Ambient temperature	0..50°C		
Storage temperature	-20...70°C		
Humidity	< 80%, not condensing		
Standards	EN 61010-1		
Overvoltage category	2		
Protection class	1		
Terminals			
Rear side	AC input		
Front side	DC output, USB-B		
Dimensions			
Enclosure (WxHxD)	174 x 82 x 240 mm	174 x 82 x 240 mm	174 x 82 x 267 mm
Total (WxHxD)	174 x 90 x 263 mm	174 x 90 x 263 mm	174 x 90 x 290 mm
Weight	≈ 1.9 kg	≈ 2 kg	≈ 2.6 kg
Article number	39200116	39200117	39200118

(1 Related to the nominal values, the accuracy defines the maximum deviation between an adjusted values and the true (actual) value.
(2 RMS value: LF 0...300 kHz, PP value: HF 0...20MHz.
(3 The display error adds to the error of the related actual value on the DC output.

1.8.4 Views

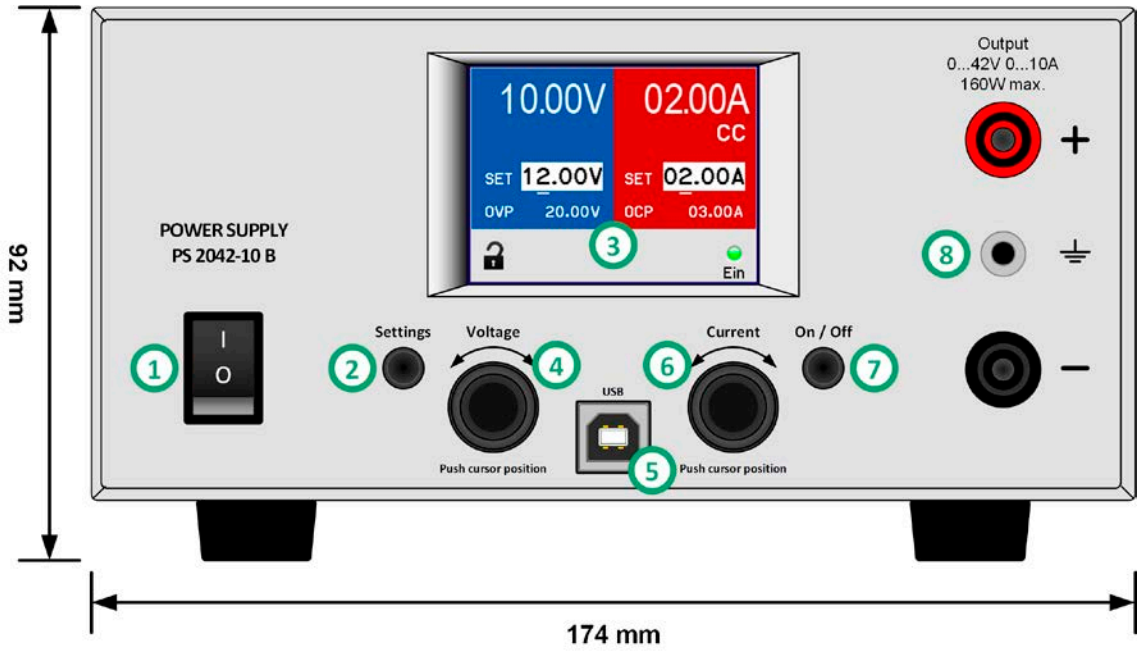


Figure 1 - Front side

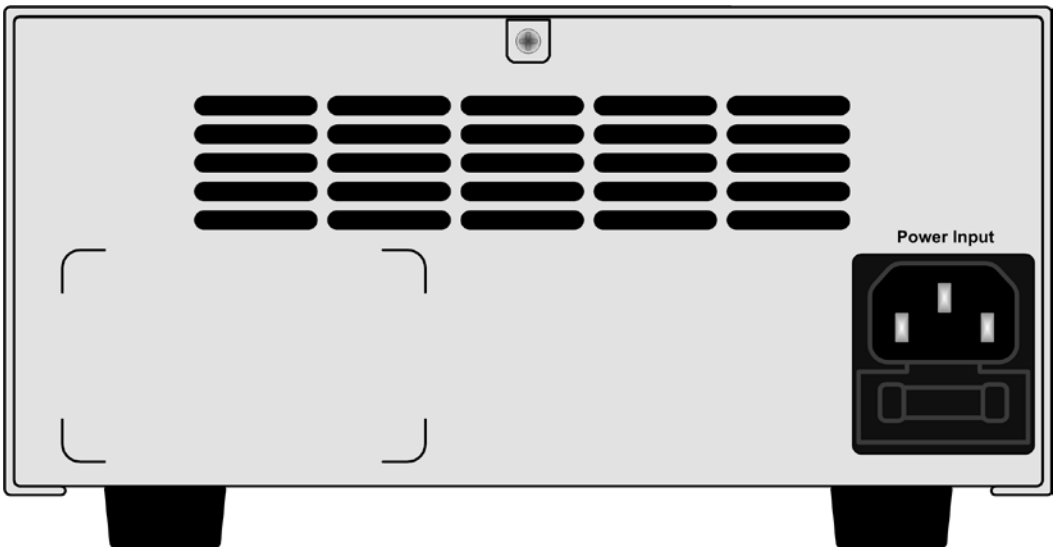


Figure 2 - Rear side 100 W / 160 W

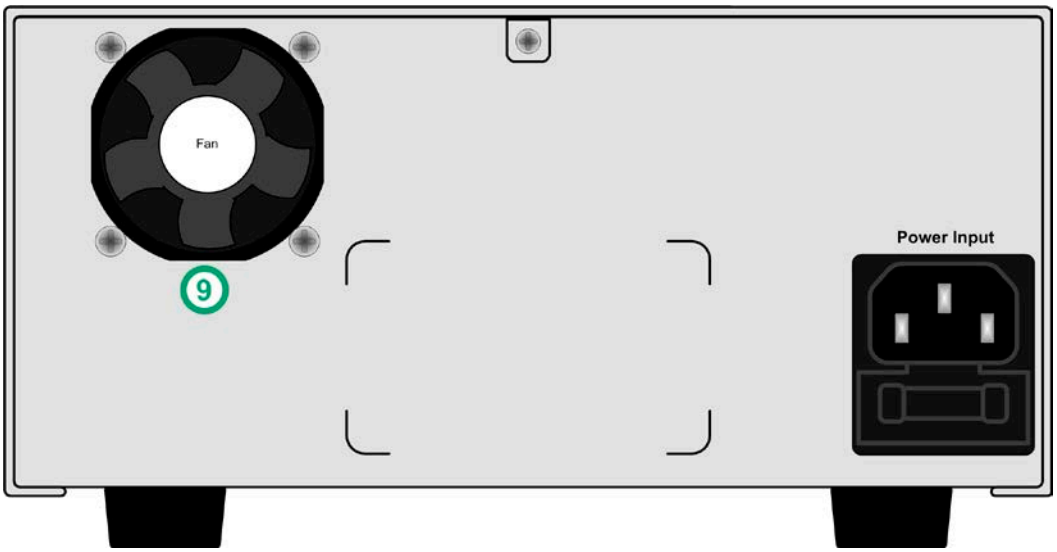


Figure 3 - Rear side 320 W

Overview

For a detailed description of the display and its layout see section *«1.9.4. The control panel (HMI)».*

(1)	**Power switch** Used to power the device on and off.
(2)	**Pushbutton “Settings”** Used for access to the setup menu while the DC output is switched off.
(3)	**Color display** Used for display of set values, menus, actual values and status.
(4)	**Rotary knob with push button function** Turn: adjustment of the voltage set value or selection of parameters in the menu Push: selection of the decimal position (cursor) of the currently assigned value
(5)	**USB port** Used to connect the device to a PC or other control hardware to establish communication and remote control
(6)	**Rotary knob with push button function** Turn: adjustment of the current set value or adjustment of parameter value in the menu Push: selection of the decimal position (cursor) of the currently assigned value
(7)	**Pushbutton “On/Off”** Used to switch the DC output oon or off, unless the HMI is fully locked or remote control is active. Is also used to acknowledge, i. e. clear alarms before the DC output on again.
(8)	**DC output connectors** Red and black safety sockets which allow for the use of specific 4 mm safety plugs, plus a 4 mm PE socket which can be used to ground any of the output poles and/or external hardware.
(9)	**Fan** Only present with 320 W models. The fan is used to cool the device by exhaustion of warm air out of the rear. It’s temperature controlled.

1.9 Construction and function

1.9.1 General description

The laboratory power supplies of the series PS 2000B are very compact and rugged devices and incorporate interesting features within small dimensions. The contactless design makes them ideally suited for operation in schools, educational facilities, workshops or laboratories.

The series offers three power classes of 100W, 160W and 320W.

Apart from standard functions of power supplies the user can lock pushbuttons and knobs against unintentional use or define thresholds for an automatic output cut-off in case of overcurrent or overvoltage.

All models feature a built-in USB interface, which can be used to remotely control and monitor the device by a PC.

1.9.2 Scope of delivery

1 x Power supply device

1 x USB stick with documentation and software

1 x Mains cord

1.9.3 Optional accessories

For these devices the following accessories are available:

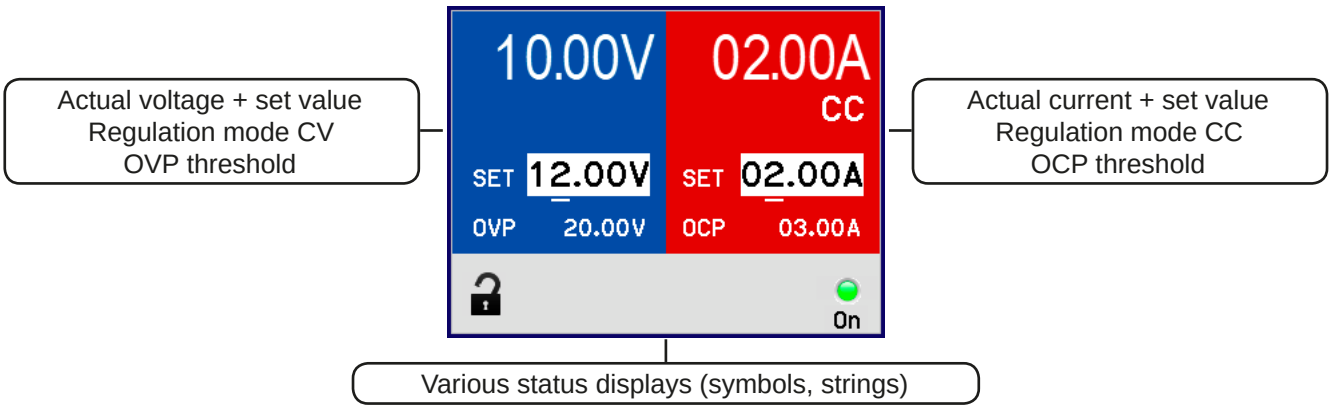
Multi Control license Ordering numbers Single license: 33 100 229 5 pack of licenses: 33 100 230	The device is delivered with an USB stick that contains the Windows remote control software EA Power Control. In its basic version it can already control multiple PS 2000 B devices in separate windows and also run a semi-automatic control called Sequencing, plus record data (Logging). The optional license unlocks two additional features. The first is Multi Control, an app that allows for the parallel and simultaneous remote control of up to 20 units in one window, plus Sequencing for any number of units or groups of units. The second feature is the Graph, an XY plot that records device data (set values, actual values) visually.

1.9.4 The control panel (HMI)

The HMI (**H**uman **M**achine **I**nterface) consists of a display, two rotary knobs and two pushbuttons.

1.9.4.1 Display

The graphic display is divided into three areas. In normal operation the upper part (⅔) is used to show actual and set values and the lower part (⅓) to display status information:



- **Actual / set values area (blue / red)**

In normal operation the DC output values (large numbers) and set values (small numbers) for voltage and current.

While the DC output is switched on, the actual regulation mode CV or CC is displayed above to the corresponding set value, as shown in the figure above with example **CC**.

The set values can be adjusted by rotating the knobs below the display, whereas pushing the knobs is used to select a particular digit. Logically, the values are increased by clockwise turning and decreased by anti-clockwise turning.

General display ranges:

Value	Unit	Range	Description
Actual voltage	V	0.3-115% U_{Nom}	Actual value of DC output voltage
Set value of voltage	V	0-100% U_{Nom}	Set value for limiting the DC output voltage
Actual current	A	0.3-100% I_{Nom}	Actual value of DC output current
Set value of current	A	0-100% I_{Nom}	Set value for limiting the DC output current
Limit settings	A, V	0-100% I_{Nom}	Limit the set value ranges of voltage and current
Protection settings	A, V	0-110% I_{Nom} / U_{Nom}	OCP (overcurrent) and OVP (overvoltage)

- **Status display (lower part)**

This area displays various status texts and symbols:

Display	Description
	The HMI is locked
	The HMI is unlocked
Remote	The device is under remote control via USB
Alarm	Alarm condition which has not been acknowledged or still exists.

1.9.4.2 Rotary knobs

As long as the device is in manual operation the two rotary knobs are used to adjust set values as well as setting up parameters in the menu. For a detailed description of the individual functions see section *«3.4. Manual operation»*.

1.9.4.3 Button function of the rotary knobs

The rotary knobs also have a pushbutton function which is used anywhere during value adjustment to shift the cursor as shown:

1.9.4.4 Resolution of the displayed values

In the display, set values can be adjusted with a fixed step width. The number of decimal places depends on the device model. The values have 3 or 4 digits.

Adjustment resolution and number of digits of set values in the display:

Voltage, OVP		
Nominal	**Digits**	**Step width**
42 V	4	0.01 V
84 V	4	0.01 V

Current, OCP		
Nominal	**Digits**	**Step width**
3 A / 5 A / 6A	3	0.01 A
10 A / 20 A	4	0.01 A

2. Installation & commissioning

2.1 Storage

2.1.1 Packaging

It's recommended to keep the complete transport packaging for the lifetime of the device for relocation or return to Elektro-Automatik for repair. Otherwise the packaging should be disposed of in an environmentally friendly way.

2.1.2 Storage

In case of long term storage of the equipment it's recommended to use the original packaging or similar. Storage must be in dry rooms, if possible in sealed packaging, to avoid corrosion, especially internal, through humidity.

2.2 Unpacking and visual check

After every transport, with or without packaging, or before commissioning, the equipment should be visually inspected for damage and completeness using the delivery note and/or parts list (see section *«1.9.2. Scope of delivery»*). An obviously damaged device (e.g. loose parts inside, damage outside) must under no circumstances be put in operation.

2.3 Installation

2.3.1 Safety procedures before installation and use

- Before connecting to the mains ensure that the connection is as shown on the product label. Overvoltage on the AC supply can cause equipment damage.
- In case the load is also a voltage source (motor, battery etc.) make sure before connecting it, that the source can not generate a voltage higher than 1.1 * rated voltage of your particular device model or install measures which can prevent damaging the device by overvoltage from outside.

2.3.2 Preparation

Mains connection for a PS 2000 B series device is done via the included 1.5 meters long 3 pole mains cord.

Dimensioning of the DC wiring to the load has to reflect the following:

- The cable cross section should always be specified for at least the maximum current of the device.
- Continuous operation at the approved limit generates heat which must be removed, as well as voltage loss which depends on cable length and heating. To compensate for these the cable cross section should be increased and/or the cable length reduced.

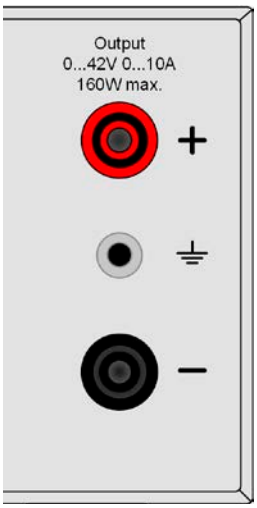
2.3.3 Installing the device

- Select the location for the device so that the connection to the load is as short as possible.
- Leave sufficient space behind the equipment, minimum 10 cm, for ventilation of warm air that will be exhausted
- Never obstruct the air inlets on the sides!

2.3.4 Connection to DC loads

- Connection of loads which are also voltage sources and can probably generate voltages higher than 110% nominal of the device model isn't allowed!
- Connection of voltage sources with reversed polarity isn't allowed!

The DC output is located on the front of the device and isn**'t** protected by a fuse. The cross section of the connection cable is determined by the current consumption, cable length and ambient temperature.



The DC output sockets are so-called safety sockets which allow for the use of so-called safety plug where the protective plastic sleeve is either rigid or retractable. Alternatively, standard laboratory cables with 4 mm Büschel plugs can be used. Those are not suitable for currents higher than 10 A, so that the 20 A model requires to make custom cables using higher cross section lead and special 4 mm banana plugs which are rated for 20 A.

For cables **up to 5 m** and average ambient temperature up to 50°C, we recommend:

up to **3 A**: 0.75 mm² up to **10 A**: 1.5 mm²

up to **20 A**: 2.5 mm²

per lead (multi-conductor, insulated, openly suspended). If the cables are long then the cross section must be increased to avoid voltage loss and overheating.

2.3.5 Grounding of the DC output

The metal socket between the DC plus and minus output is connected to PE and be used to ground any of DC output poles by direct connection or to ground hardware which is connected as load.

2.3.6 Connecting the USB port

The device features an integrated USB port on the front. It can be connected to a PC or other suitable control applications (PLC) via a standard USB cable (not included), in order to remotely control and/or monitor the unit.

2.3.6.1 Driver installation (Windows)

On the initial connection with a PC the operating system will identify the device as new hardware and will try to install a driver. The required driver is for a Communication Device Class (CDC) device and is usually integrated in current operating systems such as Windows 7 or 10. But it's strongly recommended to use and install the included driver installer (on USB stick) to gain maximum compatibility of the device to our softwares.

2.3.6.2 Driver installation (Linux, MacOS)

We can't provide drivers or installation instructions for these operating systems. Whether a suitable driver is available is best found out by searching the Internet. With newer versions of Linux or MacOS, a generic CDC driver should be "on board".

2.3.6.3 Alternative drivers

In case the CDC drivers described above are not available on your system, or for some reason do not function correctly, commercial suppliers can help. Search the Internet for suppliers using the keywords "cdc driver windows" or "cdc driver linux" or "cdc driver macos".

3. Operation and application

3.1 Personal safety

- In order to guarantee safety when using the device, it's essential that only persons operate the device who are fully acquainted and trained in the required safety measures to be taken when working with dangerous electrical voltages
- For models which accept dangerous voltages, a protection against unwanted physical contact has to be installed on the DC output

3.2 Operating modes

A power supply is internally controlled by different control or regulation circuits, which shall bring voltage and current to the adjusted values and hold them constant, if possible. These circuits follow typical laws of control systems engineering, resulting in different operating modes. Every operating mode has its own characteristics which is explained below in short form.

- *Unloaded operation isn't considered as a normal operation mode and can thus lead to false measurements, for example when calibrating the device*
- *The optimal working point of the device is between 50% and 100% voltage and current*
- *It's recommended to not run the device below 10% voltage and current, in order to make sure technical values like ripple and transient times can be met*

3.2.1 Voltage regulation / Constant voltage

Voltage regulation is also called constant voltage operation (CV).

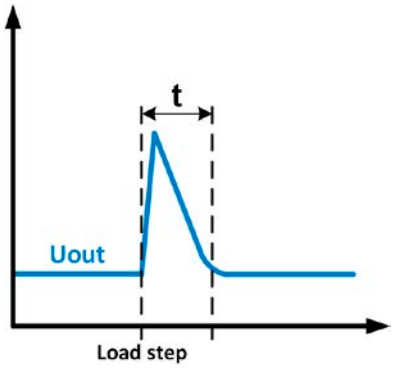
The DC output voltage of a power supply is held constant on the adjusted value, unless the output current reaches the adjusted current limit. In this case the device will automatically change to constant current operation. Then the output voltage can't be held constant anymore and will sink to a value resulting from Ohm's law.

While the DC output is switched on and constant voltage mode is active, the condition "CV mode active" will be indicated on the display by the abbreviation **CV** and also stored as status which can be read via the digital interface.

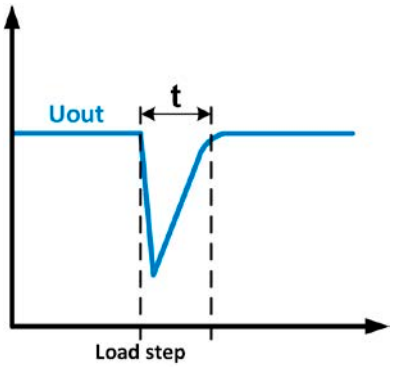
3.2.1.1 Transient time after load step

For constant voltage mode (CV), the technical date "Settling time after load step" (see *1.8.3*) defines a time that is required by the internal voltage regulator to settle the output voltage after a load step. Negative load steps, i.e. high load to lower load, will cause the output voltage to overshoot for a short time until compensated by the voltage regulator. The same occurs with a positive load step, i.e. low load to high load. There the output collapses for a moment. The amplitude of the overshoot resp. collapse depends on the device model, the currently adjusted output voltage and the capacity on the DC output and can thus not be stated with a specific value.

Depictions:



Example for neg. load step: the DC output will rise above the adjusted value for a short time. t = transient time to settle the output voltage.



Example for pos. load step: the DC output will collapse below the adjusted value for a short time. t = transient time to settle the output voltage.

3.2.2 Current regulation / constant current / current limitation

Current regulation is also known as current limiting or constant current mode (CC).

The DC output current is held constant by the power supply, once the output current to the load reaches the adjusted limit. Then the power supply automatically switches The current flowing from the power supply is determined by the output voltage and the load's true resistance. As long as the output current is lower than the adjusted current limit, the device will be in constant voltage mode. If, however, the actual current reaches the set value of current the device will switch automatically to current limiting.

While the DC output is switched on and constant current mode is active, then the condition "CC mode active" will be indicated on the display by the abbreviation **CC** and also stored as status which can be read via the digital interface.

3.2.3 Power limitation

Devices of this series don't feature a power regulation, only a power limitation. In order to prevent the device from supplying more than the rated power, **the set values of voltage and current limit each other**.

It means, when adjusting the current or voltage manually or also in digital remote control, the opposite set value is always adjusted automatically according to formulas $U_{SET} = P_{MAX} / I_{ADJ}$ and $I_{SET} = P_{MAX} / U_{ADJ}$. Thus, for example, both set values can't be set to 100% at the same time.

3.3 Alarm conditions

This section only gives an overview about device alarms. What to do in case your device indicates an alarm condition is described in section «3.6. Alarms and monitoring».

As a basic principle, all alarm conditions are signaled optically (text in the display), as well as status readable via the digital interface.

3.3.1 Overtemperature

An overtemperature alarm (OT) can occur from an excess temperature inside the device and causes it to stop supplying power temporarily. This can occur due to a defect of the internal fan regulation (320 W models only) or due to excessive ambient temperature.

After cooling down, the device will automatically continue to work, while the previous condition of the DC output remains and the alarm doesn't require to be acknowledged.

3.3.2 Overvoltage

An overvoltage alarm (OVP) will switch off the DC output and can occur if

- the power supply itself, as a voltage source, generates an output voltage higher than set for the overvoltage alarm threshold (OVP, 0...110% U_{Nom}) or the connected load somehow returns voltage higher than set for the overvoltage alarm limit.
- the OV threshold has been adjusted too close above the output voltage. If the device is in CC mode and if it then experiences a negative load step, it will make the voltage rise quickly, resulting in an voltage overshoot for a short moment which can already trigger the OVP.

This function serves to warn the user of the power supply that the device has probably generated an excessive voltage which could damage the connected load application.

- The device isn't fitted with protection from external overvoltage
- The changeover from operation mode CC -> CV can generate voltage overshoots

3.3.3 Overcurrent protection

An overcurrent alarm (OCP) will switch off the DC output and can occur if

- the actual current in the DC output exceeds the adjusted OCP limit.

This function serves to protect the connected load application so that this isn't overloaded and possibly damaged due to an excessive current.

3.4 Manual operation

3.4.1 Switching the device on

The device should, as far as possible, always be switched on using the toggle switch on the front of the device. After switching on, the display will first show the manufacturer's logo, name and address, followed by device type, firmware version(s), serial number and item number. The latest set values are restored.

> *A PS 2000 B device doesn't restore the DC output condition. It will always come up with DC off.*

3.4.2 Switching the device off

Cutting the AC supply, no matter if caused by using the power supply or a blackout, doesn't leave the device enough time to store the latest values. It's practically powered down immediately. Thus the device stores the set values and all settings automatically when they are altered, but only in intervals of 10 seconds. It means, if you would have changed some settings in the menu, you should wait at least 10 seconds after leaving the menu and before switching the device off.

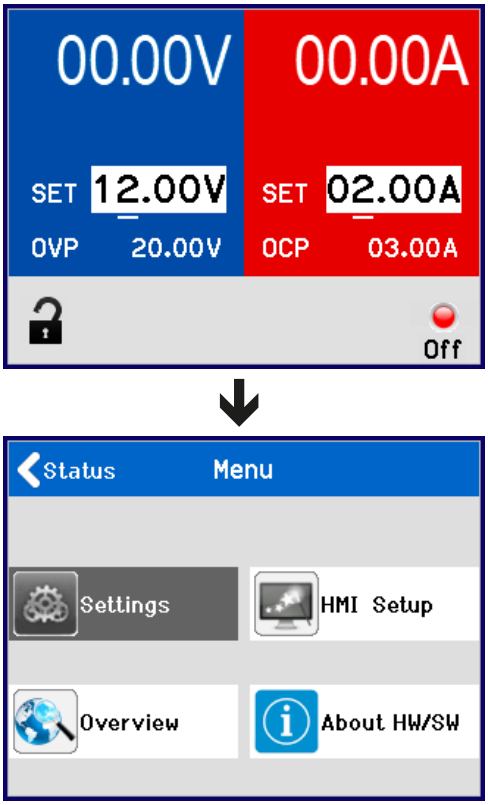
3.4.3 Configuration via menu

The setup menu serves to configure some operating parameters which are not changed frequently. These can be set by pressing button **Settings**, but only while the DC output is **switched off**.

Menu navigation is done using the rotary knobs, their pushbutton function and the **Settings** button. Following is defined:

- **Settings** button: open menu or leave menu
- Left knob (turn): select a menu item or parameter
- Left knob (push): enter selected menu or leave sub menu
- Right knob (turn): adjust the selected value
- Right knob (push): move cursor

The setup menu has two levels. In order to leave the 2. level to the 1. level and instead of exiting the menu, you can select the item **Menu** in the upper left corner and push the knob.



3.4.3.1 Menu “Settings”

This menu is for all settings related to the DC output values:

Group	Description
Presets	Allows for adjustment of the set values of voltage and current, alternatively to the adjustment in the main screen of the display.
Protection	Allows for adjustment of protection thresholds (here: OVP, OCP). These are the same values as shown in the main display page, but here they are adjustable. Also see section *«3.3. Alarm conditions»*
Limits	Allows for adjustment of limits for set values. Also see section *«3.4.4. Adjustment limits»*

3.4.3.2 Menu “About HW/SW...”

This menu page displays an overview of device relevant data such as serial number, article number and firmware versions.

3.4.3.3 Menu “HMI Setup”

These settings refer exclusively to the control panel (HMI).

Element	Description
Language	Selection of the display language between German and English. Default setting: **English**
Backlight	The choice here is whether the backlight remains **Always on** or if it should be dimmed to 0% brightness when no input via push buttons or rotary knob is done for 60 s. As soon as manual input is done, the backlight returns automatically. The setting doesn’t apply to remote control, so the display could remain dark as long as the device is remotely controlled. Default settings: **Always on**
Brightness	Adjustment of the backlight brightness between **0%** (almost black) and **100%** (maximum, clearly readable).
HMI Lock Setup	See *«3.4.7 Control panel (HMI) lock» on page 23.* Default settings: **Lock all**, **No**
Enable PIN	Belongs to **HMI Lock**. Activates the PIN (personal identification number) which has been set up with **Change PIN**.
Change PIN	Belongs to **HMI Lock**. Define a PIN or change it.
Lock HMI?	Locks the HMI when **Yes** has been selected and after leaving the setup menu.

3.4.4 Adjustment limits

Adjustment limits only affect the set values, no matter if during manual adjustment or remote control!

Defaults are that the set values of voltage and current are adjustable from 0 to 100% of the rated value. This may be obstructive in some cases, especially for protection of applications against overvoltage which may occur when accidentally adjusting the voltage too high. Therefore upper limits for current (I) and voltage (U) can be set which limit the range of the set value adjustment.

► How to configure the adjustment limits

1. While the DC output is switched off, press button **Settings**.
2. In the menu use the left knob to navigate to **Settings** and press the left knob.
3. In menu **Settings** use the left knob again to select **U-max** (upper limit of voltage) or **I-max** (upper limit of current). Adjust the value as desired.

   The limits can only be equal to or higher than the related set value. Thus it might be required to turn down the set value before you can finally turn the limit down to the desired level. The set values are accessible on the same menu page.
4. Leave the setup menu.

3.4.5 Manual adjustment of set values

Adjustment of voltage and current is the fundamental operation of this series' power supplies. In manual control, the set values can only be adjusted with the rotary knobs.

When adjusting the set values, an upper limit could interfere. Also see section «3.4.4. Adjustment limits». Once a limit is reached, the main screen will show a note like "Limit: U-Max" for 1.5 seconds above the set value.

► How to adjust values with the rotary knobs

1. With the main display being shown, it means no menu mode is active, turn the left-hand knob to adjust the output voltage and the right-hand knob to adjust the output current. This doesn't depend on DC output condition. Both set values affect each other (see section *«3.2.3. Power limitation»* for the background). If you would, for example, turn up the voltage then the current value would automatically start to decrease at some point until the max. adjustable voltage is reached. The same would happen vice versa when starting to turn the current set value again. The voltage value would then immediately start to decrease while the current value increases at the same time.
2. Selecting a digit is done by pushing the rotary knob which shifts the cursor from right to left (selected digit will be underlined).

3.4.6 Switching the DC output on or off

The DC output of the device can be manually or remotely switched on and off. In manual operation this can be restricted by the control panel being locked.

► How to manually switch the DC output on or off

1. As long as the control panel (HMI) isn't fully locked (see *«3.4.7. Control panel (HMI) lock»* about the HMI lock options) press button **On/Off**. Otherwise you are asked to disable the HMI lock, which is done by pushing the knob as confirmation. If the PIN has been activated in menu **HMI Setup**, you would then be asked to enter the PIN to complete the unlocking process.
2. The **On/Off** button toggles the DC output condition between on and off, as long as a change isn't restricted by any alarm or the device being in remote control. The DC output condition is indicated by the LED (green = on, red = off) and a text **On** or **Off** in the status area of the display.

► How to remotely switch the DC output on or off via the digital interface

1. See the programming guide on the included USB stick if you are creating custom software or refer to the documentation of the included LabView VI set or further documentation provided by EA Elektro-Automatik.

3.4.7 Control panel (HMI) lock

In order to avoid the accidental alteration of a value during manual operation, the rotary knobs and the buttons can be locked so that no action is accepted without prior unlocking.

► How to lock the HMI

1. While the DC output is switched off, press button **Settings**.
2. In the menu use the left knob to navigate to **HMI Setup** and press the knob.
3. In menu **HMI Setup** use the knob to select and configure the lower four parameters related to the HMI lock. For details about the single parameter see section *«3.4.3.3. Menu "HMI Setup"».*
4. The HMI lock is activated with **Lock HMI? = Yes** and leaving the menu. The active lock is indicated by symbol  .

Alternatively to the simple lock, which can be unlocked very easily by every person and thus offers no protection against intentional misuse, a PIN can set up and activated, which then is requested to be entered every time the HMI is going to be unlocked.

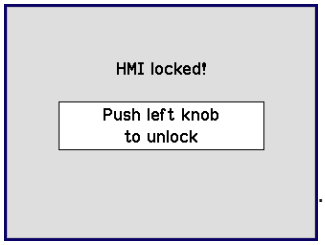
► How to lock the HMI with PIN

Don't activate the PIN lock if you are unsure about the current PIN! It can be changed, but only if the current PIN is entered. Resetting the device via remote command will also reset the PIN to the default 0000.

1. In the menu where you configured the HMI lock select parameter **Enable PIN** and set the parameter to **Yes** with the right-hand knob.
2. In order to change the PIN prior to activation select **Change PIN** and the left knob to access the next screen where you are requested to enter the former PIN 1x and the new PIN 2x and confirm every step with the left knob.
3. The HMI lock is activated with **Lock HMI? = Yes** and leaving the menu. The active lock is indicated by symbol  .

If an attempt is made to alter something whilst the HMI is locked, a requester appears in the display asking if the lock should be disabled.

► How to unlock the HMI

1. Turn one of the rotary knobs or press any button (except for **On/Off** when lock mode **On/Off possible** has been set).
2. This request pop-up will appear: 

.
3. Unlock the HMI by pressing the left knob within 5 seconds, otherwise the pop-up will disappear and the HMI remains locked. In case the additional PIN code lock has been activated in the menu **HMI Setup**, another requester will pop up, asking you to enter the PIN before it finally unlocks the HMI.

3.5 Remote control

3.5.1 EA Power Control

The included USB stick contains the Windows software EA Power Control which can remotely control the device. Also see the user manual of the software.

3.5.2 Programming

Programming details and the communication protocol are to be found in the programming documentation which is supplied on the included USB stick or which is available as download from the EA Elektro-Automatik website.

3.5.3 EasyPS2000

The Windows software EasyPS2000, as offered for the former PS 2000 B design generation with blue LCD, is still available and can also be used with the new design generation with color TFT, but it would still depict the counterfeit of the old design.

3.6 Alarms and monitoring

3.6.1 Device alarm and event handling

A device alarm incident will usually lead to DC output switch-off and the appearance of a text message in the display to make the user aware. Some alarms must be acknowledged. If the condition persists, the display remains and the alarm can only be acknowledged after elimination of the cause.

► How to acknowledge an alarm in the display (during manual control)

1. Once an alarm is indicated, the user can try to acknowledge and delete the alarm by pressing button **On/Off**.

In order to acknowledge an alarm during remote control, see the programming guide.

These device alarms are configurable:

Alarm	Meaning	Description	Range	Indication
OVP	**O**ver**V**oltage **P**rotection	Triggers an alarm if the DC output voltage reaches the defined threshold. The DC output will be switched off..	0 V...1.1*U_{Nom}	Display, digital interface
OCP	**O**ver**C**urrent **P**rotection	Triggers an alarm if the DC output current reaches the defined threshold. The DC output will be switched off..	0 A...1.1*I_{Nom}	

These device alarms can’t be configured and are based on hardware:

Alarm	Meaning	Description	Indication
OT	**O**ver**Tem-perature**	Triggers an alarm if the internal temperature exceeds a certain limit. The DC output will be switched off.	Display, digital interface

► How to configure the device alarms

1. While the DC output is switched off, press button **Settings**.
2. In the menu use the left knob to navigate to **Settings** and press the knob.
3. In menu **Settings** use the left knob again to select **OVP** (threshold of the overvoltage protection) or **OCP** (threshold of the overcurrent protection). Adjust the value as desired.

These protection threshold are always adjustable in their full range of 0...110% of the rated value. The device permanently compares the actual voltage and current on the DC output against these thresholds and thus an OVP alarm could also occur while the DC output is switched off. In this situation the voltage that triggers the OVP must come from outside and could damage the device.

4. Service and maintenance

4.1 Maintenance / cleaning

The device needs no maintenance. Models with a fan may require cleaning the fan. The frequency of cleanse is depending on the ambient conditions. The fan serves to cool the components which are heated by the inherent high dissipation of energy. A heavily dirt filled fan can lead to insufficient airflow and therefore the DC output would switch off too early due to overheating or possibly lead to defects.

Cleaning the internal fan can be performed with a vacuum cleaner or a brush and from the outside.

4.2 Fault finding / diagnosis / repair

If the equipment suddenly performs in an unexpected way, which indicates a fault, or it has an obvious defect, this can not and must not be repaired by the user. Contact the supplier in case of suspicion and elicit the steps to be taken.

It will then usually be necessary to return the device to Elektro-Automatik (with or without warranty). If a return for checking or repair is to be carried out, ensure that:

- the supplier has been contacted and it's clarified how and where the equipment should be sent.
- the device is in fully assembled state and in suitable transport packaging, ideally the original packaging.
- a fault description in as much detail as possible is attached.
- if shipping destination is abroad, the necessary customs papers are attached.

4.2.1 Replacing a defect mains fuse

The device is protected by a fusible which is inside a fuse holder on the rear of the device. The fuse rating is printed next to the fuse holder. Replace the fuse only with one of same size and rating.

4.2.2 Firmware updates

Firmware updates should only be installed when they can eliminate existing bugs in the firmware in the device or contain new features.