GE Healthcare

Electrophoresis Power Supply EPS 3501 XL

Operating Instructions

Original instructions





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1 Introduction

Purpose of the Operating Instructions

The Operating Instructions provide you with the instructions needed to handle Electrophoresis Power Supply EPS 3501 XL in a safe way.

Prerequisites

In order to operate EPS 3501 XL safely and according to the intended purpose the following prerequisites must be met:

- You should be acquainted with the use of general laboratory equipment and with handling of biological materials.
- You should understand the concepts of electrophoresis.
- You must read the Safety Instructions in Chapter 2 of these Operating Instructions.
- The system should be installed according to the instructions in *Chapter 3* of these Operating Instructions.

In this chapter

This chapter contains important user information and a general description of EPS 3501 XL and its intended use.

1.1 Important user information

Read this before using EPS 3501 XL



All users must read the Safety Instructions in *Chapter 2* of these Operating Instructions before installing, using or maintaining the instrument.

Do not operate EPS 3501 XL in any other way than described in the user documentation. If you do, you may be exposed to hazards that can lead to personal injury and you may cause damage to the equipment.

1 Introduction

1.1 Important user information

Intended use

EPS 3501 XL is a high quality, high precision power supply for electrophoresis applications that require advanced programming and high voltage.

EPS 3501 XL is intended for research use only, and shall not be used in any clinical procedures, or for diagnostic purposes.

Safety notices

These Operating Instructions contain WARNINGS, CAUTIONS and NOTICES concerning the use of the product, with meanings as defined below.



WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury. It is important not to proceed until all stated conditions are met and clearly understood.



CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. It is important not to proceed until all stated conditions are met and clearly understood.



NOTICE

NOTICE indicates instructions that must be followed to avoid damage to the product or other equipment.

Notes and tips

- **Note:** A Note is used to indicate information that is important for trouble-free and optimal use of the product.
- *Tip:* A tip contains useful information that can improve or optimize your procedures.

Typographical conventions

Software texts and commands are identified by **bold italic** text. A colon is used to separate menu levels (e.g. *File:Open* refers to the *Open* option in the *File* menu).

1.2 Regulatory information

This section lists the directives and standards that are fulfilled by EPS 3501 XL.

Manufacturing information

Requirement	Content
Name and address of manufacturer	GE Healthcare Bio-Sciences AB, Björkgatan 30, SE 751 84 Uppsala Sweden
Name and ID of notified body	INTERTEK SEMKO AB, NB 0413
Place and date of declaration	Uppsala, Sweden, May 2009
Identity of person authorized to sign DoC	See EC Declaration of Conformity

CE Conformity

Directive	Title
2006/42/EC	Machinery Directive (MD)
2006/95/EC	Low Voltage Directive (LVD)
2004/108/EC	ElectroMagnetic Compatibility (EMC) Directive

1 Introduction

1.2 Regulatory information

International standards

Standard	Description	Notes
EN 61010-1, IEC 61010-1, CAN/CSA-C22.2 No. 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use	
EN 61326-1	EMC emissions and immunity requirements for electrical equipment measurement, control and laboratory use	Harmonized with 2004/108/EC
EN-ISO 12100-1, 12100-2	Safety of machinery – Basic concepts, general principles and design	Harmonized with 2006/42/EC
EN-ISO 14121-1, 14121-2	Safety of machinery – Principles of risk assessment	Harmonized with 2006/42/EC

CE marking



The CE marking and the corresponding Declaration of Conformity is valid for the instrument when it is:

- used as a stand-alone unit, or
- connected to other CE-marked instruments, or
- connected to other products recommended or described in the user documentation, and
- used in the same state as it was delivered from GE Healthcare, except for alterations described in the user documentation or explicitly authorized by GE Healthcare.

Regulatory compliance of connected equipment

Any equipment connected to EPS 3501 XL should meet the safety requirements of EN 61010-1/IEC61010-1 or relevant harmonized standards. Within the European Union, connected equipment must be CE-marked.

1.3 Instrument

This chapter contains a general description of EPS 3501 XL.

General description

EPS 3501 XL is a high quality, high precision power supply for electrophoresis applications that require advanced programming and high voltage.

EPS 3501 XL is primarily designed for techniques using programming in several phases and/or voltage gradients:

- 2-D (Two dimensional) electrophoresis using Multiphor II Electrophoresis System
- IEF (Isoelectric focusing) using Immobiline™ or carrier ampholytes such as CleanGel™ and ExcelGel™
- Flatbed SDS-PAGE (Polyacrylamide Gel Electrophoresis) or flatbed native PAGE

EPS 3501 XL is also suitable for:

- DNA sequencing
- Agarose electrophoresis
- Electroblotting
- DNA pulsed field electrophoresis

Nine programs each with up to nine phases can be saved. Limiting values for voltage, current and power as well as voltage gradients can be programmed for precise control of the electrophoresis. The EPS 3501 XL automatically switches over the controlling parameter according to programmed limits and gradients and conductivity variations in the system.

Two electrophoresis units can be connected to EPS 3501 XL and run with the same programmed method at one time.

Instrument description



Figure 1-1. The main parts of the EPS 3501 XL instrument.

Part	Description
1	Display
2	Keyboard
3	Output sockets

Indicator/Switch	Color	Description
HV ON (indicator lamp)	Green	The HV ON lamp indicates that the high voltage power supply is on.
Power (switch)	-	Switches on/off power to the instrument. Located on the rear panel.

Indicator and switch on the instrument unit

Front panel

The front panel consists of an alphanumeric display, a keyboard with 9 membrane keys, a light emitting diode (LED) that lights when voltage is applied (HV on) and connectors for two electrophoresis units.

Display



Part	Description	Part	Description
1	Mode	5	Breakpoint parameter
2	Voltage	6	Phase number
3	Current	7	Control mode (step)
4	Power	8	Program number

1.3 Instrument

Keyboard

Кеу	Label	Description
set enter	set enter	Press set enter to enter a value or choice, confirm this if valid, and move programming to the next field. Valid values are voltage 35–3 500 V, current 1–400 mA, power 1–200 W, time 0:01–500 h, volthours 1–500 000 Vh, milliampere-hours 1–25 000 mAh. In the <i>RUN</i> mode, pressing set enter shows the programmed parameters for the actual run. In addition, set enter allows you to make changes in the program during a run after first pressing pause continue . After a run, when in <i>END</i> mode, pressing set enter puts the instrument into <i>SET</i> , its programming mode.
	-	Press V/A to change the parameter, value or other choice in the field which is blinking. Numerical values are changed in an accelerating manner when a key is held down. Clicking a key changes the value in preset increments. Parameters or units (e.g. Vh) and choices (e.g. Yes/No) are changed with one key push. The keys can also be used to switch between time and volthours in <i>RUN</i> , <i>PAUSE</i> and <i>END</i> . The values scroll i.e. they automatically change from maximum to minimum value or vice versa.
run	run	Press run to start the run and put the program into RUN mode. The current values for voltage, current and power are shown on the display. The elapsed time, volthours or milliamperehours are also displayed. Switch between these last three parameters with $$.
pause continue	pause continue	Press pause continue to put the instrument in PAUSE mode and switch off the voltage. The display shows the status of the run at the time the key was pressed. pause continue only operates in RUN mode. Time, integrated voltage and integrated current are retained. In the PAUSE MODE mode, set enter can be used to make changes in the program. Return to RUN mode by pressing pause continue or by pressing run .
STOP	STOP	Press STOP to stop the run and put the instrument in END mode. The voltage is switched off and the end parameters are displayed. Switch between time, integrated voltage and integrated current by pressing ▼ /▲. A run cannot be continued after pressing STOP . Press run to run the same method again or press set enter to choose another program, program a new method or make changes in an existing method.

Кеу	Label	Description
Insert delete	insert delete	Press insert delete to insert or delete a phase in a program. This function is activated in <i>SET</i> mode. Note that a program must be completed by answering Yes (Y) to the question " <i>Last Phase?</i> " in <i>SET</i> mode or by pressing exit before you can use the insert delete key.
more	more	Press more to place program in MORE mode. This gives access to some special functions. These include:
		COPY: Copying a program.
		CLEAR: Clearing a program.
		SETUP: Disabling the start current check.
		<i>MORE</i> mode cannot be activated in <i>RUN</i> or <i>PAUSE</i> mode. Leave <i>MORE</i> by pressing exit .
exit	exit	Press exit to stop the execution of an operation, such as the entry of a value. Only values/units that have already been confirmed by set enter are retained when exit is pressed. Note that if a phase contains zeros when pressing exit , that phase will be deleted.
		Press exit to return the instrument to the mode that was left or to the start position in <i>SET</i> .

Output sockets

There are two sets of output sockets to allow two electrophoresis units to be connected and run at the same time.

0 · 0	
0.0	

Output socket	Label	Color	Voltage
Positive	+	Red	0 and +1750 V
Negative	-	Black or blue	0 and –1750 V

1 Introduction

1.3 Instrument

2 Safety instructions

This chapter describes safety compliance, safety labels, general safety precautions, emergency procedures, power failure and recycling of EPS 3501 XL.

2.1 Safety precautions

Introduction

The EPS 3501 XL is powered by mains voltage and handles liquids that may be hazardous. Before installing, operating or maintaining the equipment, you must be aware of the hazards described in this manual. Follow the instructions provided to avoid personal injury or damage to the equipment.

The safety precautions in this section are grouped into the following categories:

- General precautions
- Personal protection
- Installing and moving the instrument
- System operation
- Maintenance

General precautions



WARNING

Do not operate the EPS 3501 XL in any other way than described in the EPS 3501 XL User Manual.



WARNING

Operation and user maintenance of EPS 3501 XL should be performed by properly trained personnel only.



WARNING

Do not use any accessories not supplied or recommended by GE Healthcare.

WARNING

Do not use EPS 3501 XL if it is not working properly, nor if it have suffered any damage, for example:

- damage to the power cord or its plug
- damage caused by dropping the equipment
- damage caused by splashing liquid onto items not supplied or recommended by GE Healthcare.



WARNING

Operation and user maintenance of EPS 3501 XL should be performed by properly trained personnel only.



WARNING

EPS 3501 XL is a high voltage instrument that can cause fatal electrical shock if the safety features are disabled. The safety lid must be securely closed before starting a protocol.



WARNING

The instrument covers must not be opened by the user. It contains electrical circuits which can give a lethal electric shock. Service and planned maintenance should be performed by personnel authorized by GE Healthcare.

Personal protection



WARNING

Always use appropriate personal protective equipment during operation and maintenance of EPS 3501 XL.

Installing and moving the instrument



WARNING

Supply voltage. Make sure that the supply voltage at the wall outlet corresponds to the marking on the instrument, before connecting the power cord.



WARNING

Protective ground. The EPS 3501 XL must always be connected to a grounded power outlet.



WARNING

Power cord. Only use power cords delivered or approved by GE Healthcare.



WARNING

Access to power switch and power cord. Do not block the rear panel of the instrument. The Power switch must always be easy to access. The power cord must always be easy to disconnect.

System operation



WARNING

Hazardous biological agents during run. When using hazardous biological agents, flush the entire system tubing with bacteriostatic solution followed by a neutral buffer and finally distilled water, before service and maintenance.



WARNING

Avoid spilling liquids on the body of the instrument. If large volumes of liquid have penetrated the casing of the instrument and come into contact with the electrical components, immediately switch off the instrument and contact an authorized service technician.

Maintenance



WARNING

Do not remove the main cover. There are no user serviceable components inside, and you can be exposed to high voltage.

2 Safety instructions

2.2 Labels

2.2 Labels

This section describes the safety labels and labels concerning hazardous substances that are attached to EPS 3501 XL.

Labels on the instrument

Rear panel labels

The illustration below shows an example of the identification label that is attached to EPS 3501 XL.



Front panel labels



Symbols used in safety labels

Label	Meaning
	Warning! Read the user documentation before using the system. Do not open any covers or replace parts unless specifically stated in the user documentation.

Label	Meaning				
	Indicates that hazardous voltages are generated inside the instrument.				
C	The system complies with the requirements for electromagnetic compliance (EMC) in Australia and New Zealand.				
CE	The system complies with applicable European directives.				

Labels concerning hazardous substances

Label	Meaning
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of equipment.
20)	This symbol indicates that the product contains hazardous materials in excess of the limits established by the Chinese standard SJ/ T11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in Electronics.

2.3 Emergency procedures

This section describes how to do an emergency shutdown of EPS 3501 XL. The section also describes the result in the event of power failure.

Emergency procedures

In an emergency situation, do as follows to stop the run:

Step	Action
1	Switch off power to the instrument by pressing the Power switch to the 0 position. If required, disconnect the mains power cord. The run is interrupted immediately.

Power failure

The result of a power failure depends on which unit that is affected.

Power failure to	will result in
EPS 3501 XL	The run is interrupted immediately, in an undefined state

2.4 Built-in safety features

The power supply has the following built-in safety functions:

Function	Description		
Functional earth leakage	Should the power supply be connected to an electrophoresis unit that has a leakage path to earth, the EPS 3501 XL will detect this fault and turn off the high voltage.		
Start current check	The power supply checks that the resistance is not higher than a specified limit at a low safety voltage (<40V). If this resistance is too high, the high voltage is turned off.		
	Too high resistance can be caused by for example:		
	- an electrophoresis unit incorrectly connected		
	- use of buffer with exremely low conductivity		
	This function can be disabled to perform certain applications, see <i>Electrophoresis Power Supply EPS 3501 XL User Manual</i> .		

Function	Description
Sudden load change detection	This function prevents accidents under running conditions due to a break in the electrical circuit such as a bad connection to the electrophoresis unit. The high voltage is turned off in such an event.
	An error messages is shown on the display in the event of a sudden load change.

2.5 Recycling information

The equipment shall be decontaminated before decommissioning and all local regulations shall be followed with regard to scrapping of the equipment.

Disposal, general instructions

When taking EPS 3501 XL out of service, the different materials must be separated and recycled according to national and local environmental regulations.

Recycling of hazardous substances

EPS 3501 XL contains hazardous substances. Detailed information is available from your GE Healthcare representative.

Disposal of electrical components

Waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of equipment.



2 Safety instructions2.5 Recycling information

3 Installation

EPS 3501 XL is delivered in protective packing material and shall be unpacked with great care.

Any equipment connected to EPS 3501 XL must fulfill applicable standards and local regulations.

For detailed information on Installation, see *Electrophoresis Power Supply EPS 3501 XL User Manual*.

3.1 Site requirements

Parameter	Requirement
Electrical power	100-240 V, 50-60 Hz
Ambient temperature	4°C to 40°C
Placement	Stable laboratory bench
Humidity	0 to 95 %, non-condensing

3.2 Unpacking

- Check the equipment for damage before starting assembly and installation.
- Document any damage and contact your local GE Healthcare representative.

Remove straps and packing material and stand equipment upright before starting installation.

3.3 Transport

Before moving the system: disconnect all connected cables.

3.4 Connections

Communication

Connect EPS 3501 XL according to the electrical drawings in Appendix A.

Connect the leads from the electrophoresis unit to the output sockets on the EPS 3501 XL front panel (red to red, and black or blue to blue), see *Section 1.3*. The red lead is the positive and black or blue is the negative.

0 + 0	
0.0	

Electrical power

Connect the power cord to a grounded power outlet specified in Section 3.1.

Select the appropriate voltage range, 100–120 or 220–240 V, using the switch on the rear panel.



NOTICE

If the power supply is connected to 220-240 V with the range set to 100–120 V, the instrument can be severely damaged.

Local regulation for Great Britain

This appliance must be earthed.

The wires in the mains lead are colored in accordance with the following code:

Color	Meaning
Green and yellow	Earth
Blue	Neutral
Brown	Live

If the plug provided is unsuitable for your socket outlets, the plug must be cut off and suitable plug fitted. The cut-off plug should be disposed of and must not be inserted into any 13 amp socket as this can result in electric shock. The plug or adapter of the distribution panel should be provided with 13 amps fuse. As the colors of the wires in the mains lead of this appliance may not correspond with colored markings identifying the terminals in your plug, proceed as follows:

- The green and yellow wire must be connected to the terminal in the plug which is marked with the letter E or by the earth symbol, or colored green, or green and yellow.
- The blue wire must be connected to the terminal which is marked with the letter N or colored black.
- The brown wire must be connected to the terminal which is marked with the letter L or colored red.
- **Note:** After replacing or changing a fuse, the fuse cover in the plug must be replaced with a fuse cover which corresponds to the colour of the insert in the base of the plug or the word that is embossed on the base of the plug, and the appliance must not be used without a fuse cover.
- Note: Only 13 Amps fuse approved to B.S 1362 A.S.T.A. should be used.

3.5 Spare parts and accessories

For correct up to date information on spare parts and accessories visit: www.gelifesciences.com\2DE

3 Installation

3.5 Spare parts and accessories

4 Operation

4.1 Operation overview

The operation of the EPS 3501 XL is described in the following sequence.

- 1 Programming or editing a method.
- 2 Editing a method.
- 3 Running a method.

Programming and running are discussed in more detail in the following sections. Blinking characters in the display are shown as bold characters in this manual.

4.2 Starting the instrument

Turn on the instrument by pressing the Power switch to the I position.

When the power supply is turned on, the display shows the start position in *SET* mode. The previous program set is shown and that program number is blinking.



If the power supply is turned on for the first time or if the program has been cleared, (see *Optional programming, on page 34*) the default way of controlling is step ([), the breakpoint parameter is time (h), the alarm is off and the values are all zero.

4.3 Setting up a run

Programming a method

Choosing a program

Up to nine programs, each with up to nine phases, can be entered. Press **set enter** to confirm the program shown by the number on the display or use $\sqrt{}$ keys to choose another. Confirm with **set enter**.



Step	Action	Selection ¹
1	Choose Program number.	2
2	Choose STEP or GRADIENT mode.	STEP
3	Confirm Phase number.	1
4	Set Voltage limit (in Step mode) or Voltage endpoint (in Gradient mode).	1000 V
5	Set Current limit.	10 mA
6	Set Power limit.	10 W
7	Choose Breakpoint unit (h , Vh or mAh) or no breakpoint (OFF).	Vh, OFF
8	Set Breakpoint	1000 Vh
9	Is this the last phase (<i>Last Phase ?</i>)? Choose Yes (<i>Y</i>) or No (<i>N</i>)?	
10	Choose Alarm Off (N) or On (Y).	Y
11	The program is ready.	

¹ Selection made in this example.

Figure 4-1. Step-by-step summary of programming.

Choosing step or gradient programming

Press set enter to confirm STEP (\int) or use \sqrt{A} keys to choose GRADIENT (/). Confirm with set enter.

Note that your choice of gradient or step programming applies for all phases within the program and you will only be asked to choose one of them when programming the first phase.

Choosing step means that voltage, current and power limiting values are programmed. The electrophoresis will be controlled by one of these limiting values, which means that it is run at either constant voltage, current or power. The EPS 3501 XL automatically switches over the controlling parameter according to programmed limits and conductivity variations in the system. Thus the controlling parameter can switch within a phase.



Table 4-1 and *Figure 4-2* illustrate a step program. The programming and running of this application are shown as *Figure 4-1* and *Figure 4-5*.

No.	Description	No.	Description
Α	Phase 1	D	Phase 4
В	Phase 2	E	Voltage (V)
С	Phase 3	F	Time (h)

Figure 4-2. Programming the voltage limiting profile in **STEP** mode. The parameters shown are the same as those listed in *Table 4-1*.

Table 4-1. The parameters of a step program.

Phase number	Voltage (V)	Current (mA)	Power (W)	Volthours (Vh)
1	1000	10	10	1000
2	500	10	5	120
3	2000	20	15	1000
4	3500	30	25	1500

Choosing gradient (\int), means that a **voltage endpoint** for the actual phase is programmed together with **current and power limiting values**. A linear voltage gradient is made with zero (for the first phase) or the programmed endpoint of the phase before (for the next phases) as starting point and the programmed endpoint as

endpoint. The electrophoresis will be controlled by this voltage gradient provided the limiting current or power is not attained. The EPS 3501 XL thus automatically switches over the controlling parameter according to the programmed limits and conductivity variations in the system.



No.	Description	No.	Description
Α	Phase 1	D	Phase 4
В	Phase 2	E	Voltage (V)
С	Phase 3	F	Time (h)

Figure 4-3. Programming the voltage limiting profile in *GRADIENT* mode. The parameters shown are the same as those listed in *Table 4-2*.

To illustrate voltage gradient programming, the programming for the IEF part of a 2-D electrophoresis with ImmobilineTM DryStrip Gels is shown in *Table 4-2* and *Figure 4-3*. Note that the first phase is a very steep gradient to reach the 500 V start level (0–500 V, within 1 Vh). The next phase is actually a step since the endpoint for phase 2 is 500 V which is the same as the endpoint for phase 1. Phase 3 is the "real" gradient, the voltage is changed from 500 to 3500 V in 5 hours. The last phase is a step again, the endpoint voltage is the same as for the phase before and the voltage will remain on 3500 V for 9.5 hours.

Phase number	Voltage (V)	Current (mA)	Power (W)	Volthou	irs (Vh)
1	500	1	5	0:01 ¹	1 ¹
2	500	1	5	5	2500
3	3500	1	5	5	10000
4	3500	1	5	9.5	33250

Table 4-2. The parameters of a gradient program.

¹ The ramping from 0 to 500 V should be done as quickly as possible. The smallest possible time that can be set is 1 minute and the smallest possible Vh that can be set is 1 Vh. Vh was chosen for this program as breakpoint unit.

Choose phase number

Choose phase number with \checkmark and confirm with **set enter**. For a new program the default phase number is 1. If the first phase has been programmed and the question "*Last phase*?" is answered by No (*N*), the default number is 2 and so on.

Setting voltage, current and power

The display will now flash for the set voltage limit (*STEP* mode) or voltage endpoint (*GRADIENT* mode). Using the \checkmark keys, select the voltage limit or voltage endpoint desired for the run. Confirm with **set enter**.

Repeat the same procedure for limiting current and limiting power.

Programmable values for voltage are 35-3500 V; current, 1-400 mA; power, 1-200 W.

Setting breakpoint

Choose between automatic or manual break. For automatic break, choose breakpoint unit in either hours (h), volthours (Vh) or milliamperehours (mAh). Select the correct unit or, for manual break, choose "*OFF*" with \sqrt{A} . Confirm with **set enter**.

Note that the breakpoint unit is valid for all phases within the program and you will only get this question when programming the first phase, see "Other phases" bypass in *Figure 4-1*.

If h, Vh or mAh is chosen, the display will flash for the break value for the actual phase. Set the value with \checkmark and confirm with **set enter**. Programmable values for time are 0:01-500 h, volthours, 1-500 000 Vh, milliamperehours, 1-25 000 mAh.

If **OFF** is chosen, you have to break the electrophoresis manually by pressing **STOP** and only one phase can be entered. The program will go back to the start position and the program number will flash.

Last Phase?

After programming the breakpoint you are asked if this is the last phase or not. Select Yes (Y) or No (N) with \sqrt{A} and confirm with set enter.

If **Y** is selected, no more phases will be added and the alarm question will be shown, see below.

If **N** is selected, the next phase number for the program will be shown on the display together with zero values for all parameters. Program the next phase according to *Setting voltage, current and power, on page 32* and *Figure 4-1* step 4. Up to nine phases can be programmed.

Choosing alarm

The alarm can be set separately for each phase. The following question is shown:

Alarm Phase 1? Select Yes (Y) or No (N) with V/ and confirm with set enter.

If Y is selected in a 4 phase program this will be indicated by changing from - - -

to **1** - - - after "*Phase*" on the lower row in the display. Then you will be asked about an alarm for the next phase. After answering **Y** or **N** for the last phase, the start position in the *SET* mode will be shown. If alarm is selected for a phase a small "**A**" appears on the right of the phase number, i.e. **2** Z^A .

Back to start position

The program is now back to the start position in the *SET* mode with the program number flashing. It is possible to go back to this position at any stage during programming in *SET* mode by pressing **exit** or **STOP**. Note that the program is automatically saved with all choices that have been confirmed by **set enter** when **exit** or **STOP** is pressed. If a phase containing invalid values (zeros) is left, this phase will be deleted.

Disabling the start current check

See Optional programming, on page 34 if you want to use this feature.

Editing a program

Changing a parameter value

To change a parameter value, move to the start position in *SET* mode by pressing **exit** or **set enter** and choose program number as described in *Choosing a program, on page 28.* If the programming mode (step or gradient) is changed it will be changed for all the phases within the program.

Select phase number by \checkmark and move in the program with set enter to the value to be changed. Change with \checkmark and confirm with set enter. Press exit.

Inserting and deleting a phase

Inserting and deleting a phase is described schematically in Figure 4-4.

Note that you must first enter a phase before it can be inserted or deleted:

- 1 If needed, change program number by entering the start position in SET mode with set enter or exit, changing the number with ∇ and confirming by set enter.
- 2 Bypass the mode question with set enter.

3 Change to the desired phase number by $\mathbf{v}_{\mathbf{A}}$ and confirm with set enter.

Choose to delete the phase shown on the display or insert a new phase with this phase number by pressing $\sqrt{}$ and confirm with **set enter**.

If **Delete** is chosen, the selected phase will be deleted and the program will move back to the position with the phase number blinking. Note that by deleting a phase, the numbers of the following phases will decrease by 1.

If **Insert** is chosen, the program will enter the same position and the new phase can be programmed as a new phase (see *Programming a method, on page 28* and *Figure 4-1*, steps 4-8). After entering the breakpoint, the question "**Last Phase?**" will be bypassed and the starting point for the next phase will be entered. Note that by inserting a new phase the number for the old phase with that number and the numbers for the following phases will increase by 1.

Adding a phase after the last phase is done by entering the last phase as above, moving to the question "*Last Phase?*" and answering No (*N*). The program will jump to the start position for programming a phase with the phase number blinking. Proceed with programming as described for a new program.

It is not possible to insert or delete a phase for a running program.

Editing a running program See Section 4.5.

Copying and clearing a program

See Optional programming, on page 34.

Optional programming

MORE mode contains three special functions:

- **COPY**: Copying a program.
- CLEAR: Clearing a program.
- **SETUP**: Disabling the start current check.

For more information regarding these functions, refer to *Electrophoresis Power Supply EPS 3501 XL User Manual.*

Choosing run parameters

EPS 3501 XL is an automatic cross-over power supply that allows the user to set limits for voltage, current and power. It is also possible to program linear voltage gradients. During electrophoresis, only one of the parameters is limiting at a time. The limiting parameter determines, together with the conductivity in the electrophoresis system, the values for the other two parameters.

For information about selecting parameter values, refer to *Electrophoresis Power Supply EPS 3501 XL User Manual.*

4.4 Preparations before start

Connect the leads from the electrophoresis unit (red to red, and black or blue to blue). Red is positive and black or blue negative. Up to two electrophoresis units can run at the same voltage at one time. Remember to double the maximum current and power conditions if two units are to be run. Voltage will be the same regardless of the number of units. The current should also be doubled if two gels are run on the same unit.

4.5 Performing a run

Running a program is described schematically in Figure 4-5.

Choosing a program

Press **set enter** and select the program you wish to run by pressing \checkmark until the value is correct. (Omit this step if you have just programmed or edited a method as described in *Programming a method*, on page 28 and *Editing a program*, on page 33.)

Running

Press **run** to start the electrophoresis. Information about the status of the start current check will be displayed for a few seconds. The display will then show current values for voltage, current and power and one of elapsed time, volthours or milliamperehours. You can switch between showing the elapsed time, volthours or milliamperehours by \checkmark . The parameter controlling the electrophoresis is underlined.

A light emitting diode shows when voltage is applied (HV on).

If no current is displayed or if "*HALT: Low start current*" is shown, check the electrical connections to the electrophoresis equipment.



Step	Action
1	Choose Program number.
2	Choose STEP or GRADIENT mode.
3	Choose Phase number. Press Insert delete.
4	Choose Insert or Delete.
5α	Program a new phase 2.
5b	Back to new Phase 2 start position. Old phase 2 is deleted.

Figure 4-4. Inserting and deleting a phase in a program.

Pausing

You can interrupt the electrophoresis for sample loading and/or changing the program by pressing **pause continue**. Voltage will no longer be supplied, the **HV on** LED goes off, and you may safely load your samples. The display shows the status of the run when **pause continue** was pressed.

Switch between time, integrated voltage and integrated current for the phase running when **pause continue** was pressed with \sqrt{A} .

When sample loading is complete, press either **pause continue** again or **run** to continue the run from where it was interrupted.

Editing a running program when in PAUSE

When in the **PAUSE** mode you can also press **set enter** to make changes in the program. This mode is called the **P-SET** mode. When the **P-SET** mode is entered you can make changes as described in *Changing a parameter value, on page 33*. It is not possible to insert or delete a phase for a running program. The **P-SET** mode is the same as the **SET** mode apart from restrictions in setting the breakpoint. Naturally, it is not possible to enter a time, integrated voltage or current that is already passed.

Press exit or pause continue to go back from *P-SET* to *PAUSE*. Press run or pause continue to proceed with the electrophoresis.



Step	Action
1	Choose Program number.
2	Start the run.
3	During a run you can view the settings. It is also possible to interrupt the run and make changes in the program.
4	Stop the run manually.
5	The run is stopped automatically.

Figure 4-5. Running, viewing and pausing a program.

View programmed values

It is also possible to view the programmed values during a run by pressing **set enter**. Note that no values can be changed here. Only one phase is shown at one time. Switch to another phase by using \sqrt{A} . The display returns automatically to show **RUN** values after 5 s. Alternatively use **exit** or **run**.

Stopping the run and viewing end parameter values

When the programmed time, volthours or milliamperehours for the last phase is attained, the program will enter the *END* mode. It is also possible to break the run manually by pressing **STOP**.

In both cases, the voltage, current and power will go to zero as indicated by the **HV on** LED switching off. The end parameter values are displayed. Switch between total elapsed time, integrated voltage or integrated current for all phases in the program by $\sqrt{}$.

An alarm will sound at the end of each phase if selected in the program. You can stop the alarm after the last phase by pressing **STOP**. A run cannot be continued after pressing **STOP**. Disconnect the leads and proceed with post-electrophoretic techniques. Since diffusion will begin as soon as the voltage is turned off, you should remove the gel and begin staining, blotting or autoradiography immediately. 4 Operation4.5 Performing a run

5 Maintenance

5.1 General

No user maintenance is required for Electrophoresis Power Supply EPS 3501 XL.



NOTICE

Cleaning. Keep the instrument dry and clean. Wipe regularly with a soft damp tissue and, if necessary, a mild cleaning agent. Let the instrument dry completely before use.



WARNING

Electrical shock hazard. All repairs should be done by service personnel authorized by GE Healthcare. Do not open any covers or replace parts unless specifically stated in the user documentation.

5 Maintenance

5.1 General

6 Troubleshooting

If an error that can be corrected by the user occurs, either during a run or when switching on the power supply, the program enters the *HALT* mode and the output is switched off. Four different types of errors can cause *HALT*. The following table shows the error message on the display, the cause and the actions necessary.

Error message	Cause	Action
HALT: Low start current!	The current is less than the lower limit. This can be due to incorrect connection of the electrophoresis equipment or due to use of buffers with extremely low conductivity.	 Check connections and/or buffers. Press more, switch off the start current check in the MORE mode. See Electrophoresis Power Supply EPS 3501 XL User Manual for more information.
HALT: Ground leakage current	The current to ground leakage in the electrophoresis unit is too high.	Check the electrophoresis unit.
HALT: Mains Voltage too low!	The mains voltage is too low, refer to Electrophoresis Power Supply EPS 3501 XL User Manual .	Check voltage selector. Check mains voltage
HALT: Mains fail Program stopped	Mains power failure for more than 7 secs.	Press pause continue to continue running a program or STOP to interrupt the run.

If a serious error occurs, the program enters the *FAIL* mode. The output is switched off and an error message is shown in the display.

FAIL:Code No: xxx Call service

Please note the error code number and contact your GE Healthcare representative.

6 Troubleshooting

7 Reference information

7.1 Specifications

Parameter	Value
Ingression protection	IP20
Supply voltage	100-240 V ~, 50 to 60 Hz
Power consumption	Max 260 W
Dimensions ($H \times W \times D$)	95 × 250 × 315 mm
Weight	3.8 kg
Ambient temperature	+4 to +40 °C
Relative humidity tolerance	0 to 95%
Atmospheric pressure	84 to 106 kPa (840 to 1060 mbar)
Acoustic noise level	< 70 dB A

7.2 Literature

For further information regarding Electrophoresis Power Supply EPS 3501 XL, refer to the Electrophoresis Power Supply EPS 3501 XL User Manual.

7.3 Ordering information

For ordering information visit www.gelifesciences.com/2DE.

7 Reference information

7.3 Ordering information

Appendix A Electrical and communication connections



Part	Description
1	Power switch
2	Power inlet
3	Voltage range switch

Appendix A Electrical and communication connections

For local office contact information, visit www.gelifesciences.com/contact

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