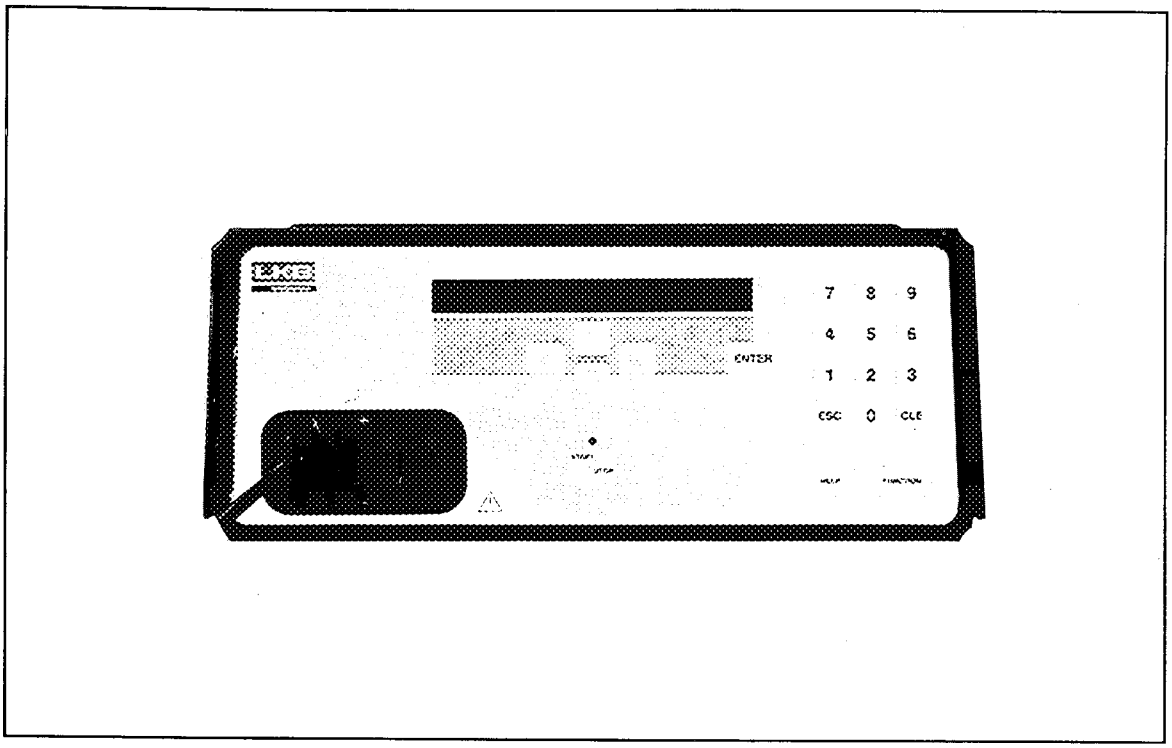
2303 MultiDrive XL
3.5 kV Power Supply



Instruction Manual

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Pharmacia

Pharmacia LKB Biotechnology

CONTENTS

PLEASE READ THIS MANUAL CAREFULLY BEFORE ATTEMPTING TO USE THE INSTRUMENT

This manual describes the installation and use of the Pharmacia LKB 2303 MultiDrive XL 3.5 kV Power Supply. If you have any suggestions that would contribute to the improvement of this manual, or wish to make any other comments regarding its contents, please send them to:-

Pharmacia LKB Biotechnology AB
Division of Electrophoresis
P.O. Box 305
S-161 26 BROMMA
Sweden

Warranty and Liability

Pharmacia LKB Biotechnology AB guarantee that this Power Supply unit has been thoroughly tested before delivery to ensure that it meets its published specifications.

The warranty included in the conditions of delivery is valid only if the unit has been installed and operated according to this instruction manual supplied by Pharmacia LKB Biotechnology AB.

Pharmacia LKB Biotechnology AB will not accept liability for any loss or damage to the instrument, or injury to personnel, however caused, resulting from the faulty or incorrect use of the Power Supply unit.

Note

The symbol  present on the front panel of the instrument is an international symbol meaning "REFER TO OPERATING INSTRUCTIONS".

1. Introduction

The Pharmacia LKB 2303 MultiDrive XL Power Supply unit allows you to carry out electrophoresis and electrofocusing experiments to separate proteins and sequence DNA/RNA in a safe, simple and effective way. It is primarily developed for use with the Pharmacia LKB Macrophor™, Multiphor® and Ultrophor™ instrument systems but it can also be used for separations on other equipment.

The MultiDrive XL Power Supply incorporates microprocessor technology, provides pulse-free DC output and is able to control and supply three electrical parameters: voltage, current and power. A maximum of 3,500 volts can be supplied. You can control the duration of the run by giving values for the following break parameters: time, volt hours, milliamp hours and dI/dt (milliamperes per hour).

You can program up to 9 phases of an electrophoresis experiment and save up to 9 different program methods in the instrument memory for future use. The unit is simple to operate and the 80 character liquid crystal display provides the prompts to guide you through parameter setting. It also displays both the actual and selected voltage, current and power parameters when an experiment is running.

You can set parameters and enter the modes that control electrophoretic runs by pressing the tactile, membrane keys. Both a manual mode and program mode is provided, and you can interrupt an experiment at any stage and then resume it using the same or changed parameters.

An electrophoresis experiment can be run at either constant voltage, constant current or constant power, the power supply being automatically adjusted to compensate for the changing conditions in the electrophoresis medium to maintain the parameter settings selected.

You can connect up to four electrophoresis units to the recessed safety output sockets of the MultiDrive XL Power Supply. The use of coded sleeves fitted on the electrical connectors protects each electrophoresis unit against power overload and is an innovative additional safety mechanism provided for you by this instrument. The 2303 MultiDrive XL Power Supply has been designed to comply with known relevant safety standards and includes the added protection of a safety interlock system for use with the MultiTemp II Thermostatic Circulator. You can thus be assured of complete safety for yourself, the power unit itself and for instruments connected to it.

1.1 How to Use This Instruction Manual

After installing the MultiDrive XL Power Supply as instructed in Section 3, you can jump right in and start parameter setting according to the steps outlined in Section 4, Getting Started. This will allow you to become quickly familiar with the 'feel' of the instrument without first having to read a lot of detailed information.

After you have seen how easy it is to operate the MultiDrive XL, you can then use Sections 5 and onwards as reference material to provide yourself with the in-depth information required to operate the instrument to its full potential.

2. Technical Data

Regulation	Constant voltage or constant current or constant power with automatic cross-over at any preset limit
Output	Voltage: 10-1750 V DC (max. current 400 mA) 10-3500 V DC (max. current 200 mA) Current: 0.5-200 mA (max. voltage 3500 V) 0.5-400 mA (max. voltage 1750 V) Power: 1-200 W All parameters are continuously variable
Accuracy	Voltage: 10-3500 V ± 1% or ± 3 V* Current: 0.5-400 mA ± 1% or ± 0.5 mA* Power: 1-200 W ± 1% or ± 1.0 W* * depending on which has the highest value at a particular point of the range stated
Break parameters	Time: 0.00-23.59 h:m Volt hours: 0-999999 Vh Milliampere hours: 0-9999 mAh Milliamperes/hour -00.0 to -99.9 mA/h
Stability against load variations	Voltage: better than ± 1% Current: better than ± 1% Power: better than ± 1%
Display	LCD display presenting 2 lines of 40 character alpha-numeric text Background lit by LEDs
Keys	All keys are of the tactile membrane type
Power outlet	Four recessed power outlets for high voltage connectors (HVCs) bearing coded sleeves to protect the separation unit against voltage overload

Operational Features

Manual control	A manual mode is available to control an electrophoresis experiment manually
Manual mode	Run parameters: Voltage (V), Current (mA), Power (W) Voltage at the end of the run (Endvolt) Break parameters: Hours & minutes (h:m) Volt hours (Vh) dI/dt (milliamperes per hour, mA/h)
Programmed control	Up to 9 different program methods, each able to automatically control an electrophoresis experiment consisting of up to 9 phases, can be stored and recalled for further use

Program mode	Global parameters:	
	Phase voltage level:	fixed or changing (ramping)
	Gel length:	up to 99 cm
	Voltage units:	V or V/cm
	End of phase 1:	No hold or Autohold
	Run parameters:	V, mA, W
	Break parameters:	h:m, Vh, mAh mA/h for any one phase

Protection

Complete protection against overload conditions including short-circuit of output

Ground leakage detection (>0.5 mA) automatically responds to cut off high voltage supply within 1.0 ms

Optical sensors automatically shut off high voltage supply when an outlet plug is removed

Connection for safety interlock switch that disconnects high voltage power when a switch on the electrophoresis unit is activated

Safety interlock can be connected to the Pharmacia LKB 2219 MultiTemp II Thermostatic Circulator for shut down of MultiDrive XL in case of failure. Cable included

Ambient operating temperature

5 - 40°C: no warm up time

Mains voltage

100-132 V/198-264 V at 50/60 Hz

Power consumption

Max. 300 W

Dimensions

WxHxD: 364x157x265 mm

Weight

7.7 kg

3. Installation and Connection of Equipment

3.1 Connection to the Mains Supply

Before connecting the 2303 MultiDrive XL Power Supply unit to the mains supply, please read this section carefully and carry out steps 1 to 3 below.

1. Check the voltage setting of the Power Supply as shown by the switch located at the top left corner of the rear panel. When the switch is in the upper position the unit is set for operation at between 100-132 V, when the switch is in the lower position the unit is set for operation at between 198-264 V. Refer to Figure 1 showing the rear panel of the MultiDrive XL.

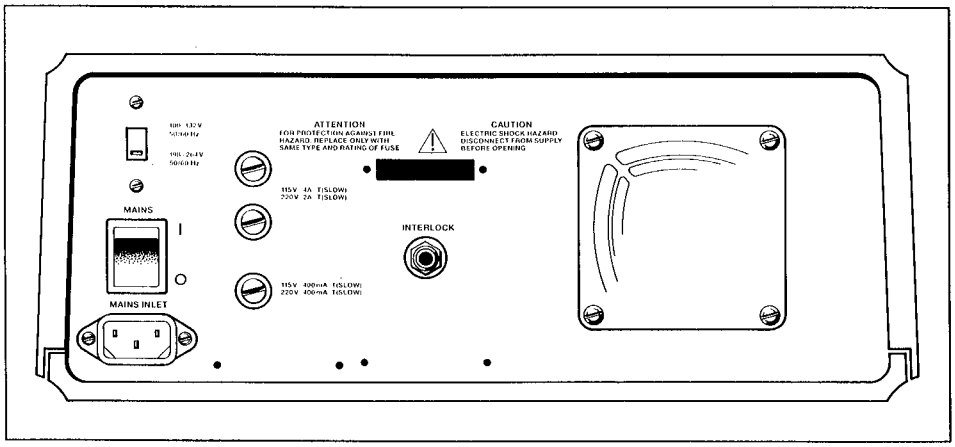


Fig. 1 Rear view of the MultiDrive XL Power Supply unit.

2. Two different cables and fuse kits are supplied with the instrument for use at 100-132 V (USA) and 198-264 V (European) respectively. Keep the cable and fuse kit relevant to your voltage supply and throw away the other cable and fuse kit immediately.

   The correct fuses to be used with the MultiDrive XL Power Supply unit are:

100-132 V supply	2 x 4 A slow fuses
	1 x 400 mA slow fuse
198-264 V supply	2 x 2 A slow fuses
	1 x 200 mA slow fuse

3. Insert the two 2 or 4 A fuses in the top and middle fuse holder respectively and then screw them carefully into position. Insert either the 200 mA or 400 mA fuse into the bottom fuse holder and then screw it carefully into position. Refer to Figure 1.

4. Connect the MultiDrive XL Power Supply unit to the mains socket using the correct cable supplied.

When the MultiDrive XL is switched on the first time after installation, the following two displays are presented:

```
** MULTIDRIVE XL ** 3500 V Power Supply
Version 1.0  Press any key to continue!
```

```
Press Enter to SET REAL TIME     Hr:Min
Exit by ESC !                    00:00
```

When the second display is presented, you can enter the correct time into the instrument memory so that it can be displayed later. See section 5.3, Numeric input. After pressing ENTER to input the time, you then press the ESC button to present the MANUAL/PROGRAM display. The above two displays will not be presented again.
To reset the clock, see Section 5.7, FUNCTION + 4 (Clock).

3.2 Safety Interlock

A Safety Interlock cable is supplied with the MultiDrive XL Power Supply. This is intended for use as a safety interlock between the MultiDrive XL and the Pharmacia LKB MultiTemp II Thermostatic Circulator. If the Thermostatic Circulator fails for any reason, the power supply will be immediately cut off to protect both the gels and ancillary equipment. The jack of the safety interlock cable is plugged into the socket located in the back panel of the MultiDrive XL Power Supply and the other end is connected to the safety switch of the MultiTemp II.

NOTE: We recommend that this safety interlock is connected whenever the MultiDrive XL Power Supply is used in conjunction with the MultiTemp II Thermostatic Circulator. Refer to the LKB MultiTemp Instruction Manual for further details of this safety device.

3.3 Connection of Electrophoresis Units

Up to four electrophoresis units can be supplied with power by the MultiDrive XL unit at one time. Each unit connected is supplied with the same voltage output resulting from the data entered for the manual mode or program method being used to control the electrophoresis run.
When more than one unit is connected, the total value for both current and power used by all the units is entered when parameter setting.

NOTE: All electrophoresis experiments connected to the MultiDrive XL must be run under exactly the same conditions (i.e., the same gel and separation unit must be used) so that the outputs from the MultiDrive XL are equivalent for each experiment.

A coded sleeve MUST be fitted onto the high voltage connector (HVC) of the electrophoresis unit before it is plugged into the Power Supply. See Figure 2.

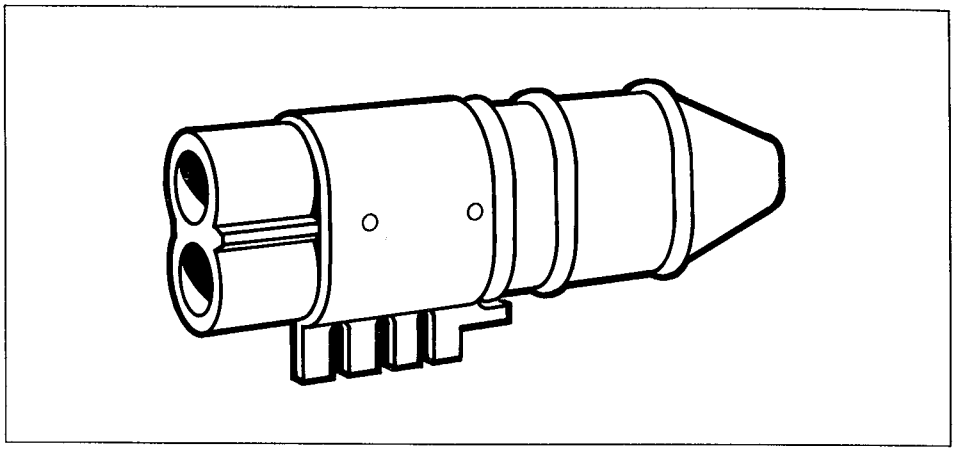


Fig. 2 High voltage connector bearing a coded sleeve

If no coded sleeve is present, then the Power Supply cannot be used and the following error message will be displayed after the START/STOP key is pressed:

```
Error> Illegal Connector !
       Press any key to continue...
```

NOTE: Four HVCs fitted with coded sleeves MUST be plugged into the MultiDrive XL sockets before the MultiDrive XL can supply power. If less than four electrophoresis units are being run at one time, then HVC blanks fitted with correctly coded sleeves must be plugged into the remaining empty sockets. A set of blank HVCs is provided with the instrument.

If no electrophoresis unit is plugged into the Power Supply, the following error will be displayed after the START/STOP key has been pressed and several seconds elapse:

```
Error> Low current ! (0.?)mA
       Press any key to continue....
```

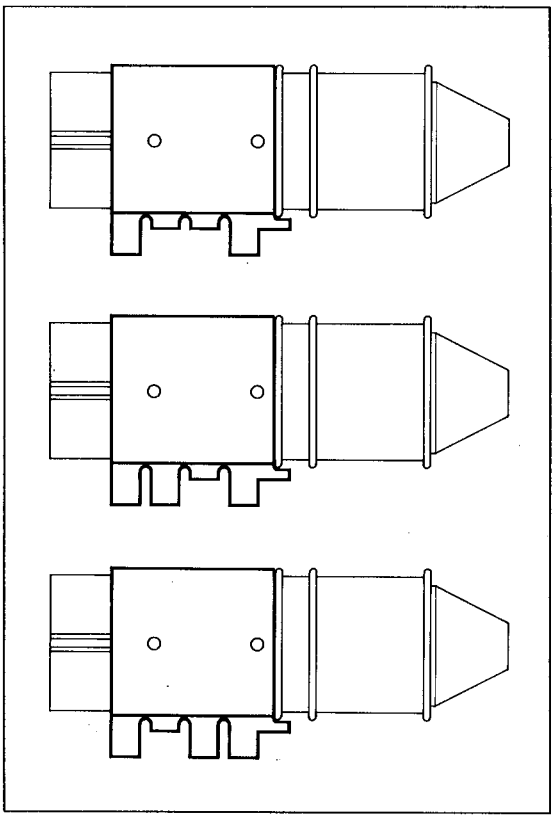
NOTE: 1 An adaptor is available from Pharmacia LKB to allow standard banana plugs to be connected to the MultiDrive XL Power Supply. Such adaptors have a fixed sleeve fitted on them which code for a maximum voltage rating of 500 V (Part No. 18-1004-16).

2 Coded sleeves can be fitted to any AMP male plugs connected to many Pharmacia LKB electrophoresis units presently in use.

3 If, for any reason, an HVC cable is pulled out from the MultidDrive XL while a run is being carried out, then the power from the unit will be automatically cut off and arcing prevented before the metal connectors separate.

3.3.1 Coded sleeves*

Figure 3 shows which voltages the sleeves code for.



Max. voltage: 500 V

Part number: 18-1004-17

Max. voltage: 1,000 V.

Part number: 18-1004-18

Max. voltage: 3,500 V

Part number: 18-1004-19

Fig. 3 The voltage each sleeve codes for

WARNING
Ensure that the HVC you plug into the MultiDrive XL Power Supply is fitted with the coded sleeve corresponding to the maximum voltage rating of the electrophoresis unit to which the cable is attached.

NOTE: 1 All the HVCs (except for the blanks) plugged into the MultiDrive XL should be fitted with IDENTICAL CODED SLEEVES. If this in not the case, then the MultiDrive XL will only supply up to 500 V. For example, if a 3500 V coded sleeve is used together with a 1,000 V coded sleeve, then the maximum voltage supplied will be 500 V.

2 As the coded sleeves supplied with the instrument have all the code pins intact, you may need to modify the sleeve(s) by breaking off one or more of the plastic pins so that the voltage agrees with the electrophoresis unit being used (See Fig.3).

3 You may have to rewire connectors on existing electrophoresis equipment to allow them to be used with the MultiDrive XL Power Supply. If so, then refer to instruction sheet 80-1301-53 which is included with the package of connectors supplied with the instrument or as a spare part.

* patent pending

3.4 Safety Precautions

The voltage supplied by the MultiDrive XL Power Supply unit is capable of delivering a lethal electric shock. The numerous safety devices and circuits built into the instrument prevent this, including a circuit that automatically limits the power outlet from the MultiDrive XL if a power overload is detected. The START/STOP key can also be pressed to halt the supply of power to an electrophoresis unit at any stage of the experiment or operation of the MultiDrive XL Power Supply. Nevertheless, in keeping with good laboratory practice, we advise you to take the following precautions when dealing with the instrument.

1. Regularly check all insulation cables, take care not to damage the unit and allow nothing to come into contact with non-insulated parts of the high voltage circuitry.

2. Ensure that the mains cable is plugged into a fully grounded mains outlet.

3. If an error in the system is detected, the high voltage power supply will be cut off when an electrophoresis run is in progress. See Section 8, Error, Note and Help Messages.

4. Use the correct combination of code plugs to protect the electrophoresis equipment being used.

5. When using the MultiDrive XL in conjunction with the MultiTemp II Thermostatic Circulator, connect the safety interlock cable provided between them.

6. If it is necessary to touch any of the electrical connections, turn off the power supply at source and wait 60 seconds.

7. Allow only authorised service representatives to service or work on the electrical circuitry of the 2303 MultiDrive XL Power Supply unit.

8. If possible, place the Power Supply unit on a shelf above the laboratory bench to avoid the possibility of spilling buffers or other conducting liquids onto the instrument. The Power Supply is protected against spills, but prolonged exposure to liquids and dust may cause ground leakage. Placing the unit on a shelf above a working surface therefore improves operational safety.

9. Allow the fan (situated at the rear of the Power Supply) and the ventilation slots to have free access to a good flow of air.

10. If the casing of the Power Supply unit becomes dirty, clean it with a soft cloth moistened with a detergent diluted with water. The fan filter (Part No. 95 69 1021) must be replaced as soon as the trapped dust prevents the free flow of air. NEVER RUN THE POWER SUPPLY WITHOUT THE FAN FILTER.

4. Getting Started

The following example of using the 2303 MultiDrive XL Power Supply to run an isoelectric focusing (IEF) experiment is included in this Instruction Manual to allow you to become quickly familiar with parameter setting.
An Ampholine® PAG plate, pH range 3.5-9.5 is used as the gel in this example. The following table lists all the parameters and values that need to be set for the four phases of the IEF experiment. The MultiDrive XL PROGRAM mode is used to control the run.

Phase	V	mA	W	Vh
1 Prefocusing Hold-1 Sample application	1500	50.0	30	110
2 Sample run in	200	50.0	30	32
3 IEF	1500	50.0	30	1310
4 Indefinite run time	100	50.0	100	0
Fixed voltage level for each phase Voltage (not V/cm) units used		(See Section 7.2.3, Setting up global parameters)		

Carry out the following steps to set the above parameters and begin the IEF run. It is assumed that you have already entered the real time after first switching on the MultiDrive XL (see Section 3.1, Connection to the Mains Supply), and that you will give the program method a name.

Note: Either an ARROW or NUMERIC KEY can be used to select the required option presented on a display. If the number representing the position of the required option, incrementing 1,2,3,etc. from left to right, is pressed, then there is no need to press ENTER afterwards as the next display is automatically presented. However, if an ARROW key is used to select the required option, the ENTER key must be pressed to allow you to proceed. In the following instructions, the quickest input method is used: NUMERIC keys are used to jump to the required options.

How to access a method

```
Main>Manual PROGRAM
Use programmed methods
```

1. Press NUMERIC KEY 2 to select the PROGRAM option:

```
Program>EDIT Run Stop
Edit a method
```

2. Press '1' or ENTER:

```
Edit>Method:
Existing methods=
```

3. Press the NUMERIC KEY 1, for example, to acess method number 1 and press ENTER:

Edit 1> ENTER Save Delete Name Setup
Enter Parameters for this Method

How to set phase parameters

1. Press '1' or ENTER:

Phase	V	mA	W	h:m	Vh	mAh
1 of 1	0000	000.0	000	00:00	000000	0000

2. Press the NUMERIC KEYS 1,5,0,0, in succession and then either ENTER or press the RIGHT ARROW:

Phase	V	mA	W	h:m	Vh	mAh
1 of 1	1500	000.0	000	00:00	000000	0000

3. Repeat step 2 but press the relevant numeric keys to input the Phase 1 values for mA, W, h:m and Vh as shown in the above table (enter 5,0,0 for 50.0 mA):

Phase	V	mA	W	h:m	Vh	mAh
1 of 1	1500	050.0	030	00:00	000110	0000

4. Press ENTER twice when the blinking cursor in located on the rightmost zero:

Add a New Phase ? Yes
No YES

5. Press '2' or ENTER:

Phase	V	mA	W	h:m	Vh	mAh
2 of 2	0000	000.0	000	00:00	000000	0000

6. Input values for phase 2, as shown in the above table, in a similar way as instructed for phase 1:

Phase	V	mA	W	h:m	Vh	mAh
2 of 2	0200	050.0	030	00:00	000032	0000

7. Press ENTER twice when the cursor in located on the rightmost zero:

Add a New Phase ? Yes
No YES

8. Press '2' or ENTER:

Phase	V	mA	W	h:m	Vh	mAh
3 of 3	0000	000.0	000	00:00	000000	0000

9. Input values for phase 3, as shown in the above table, in a similar way as instructed for phase 1:

Phase	V	mA	W	h:m	Vh	mAh
3 of 3	1500	050.0	030	00:00	001310	0000

10. Press ENTER twice when the cursor in located on the rightmost zero:

```
Add a New Phase ? Yes
No YES
```

11. Press '2' or ENTER:

```
Phase  V    mA    W  h:m    Vh    mAh
4 of 4 0000 000.0 000 00:00 000000 0000
```

12. Input values for phase 4, as shown in the above table, in a similar way as instructed for phase 1:

```
Phase  V    mA    W  h:m    Vh    mAh
4 of 4 0100 050.0 100 00:00 000000 0000
```

Leaving the break parameter values at zero means that the IEF experiment will keep running indefinitely according to the parameters set for phase 4 until you attend the instrument and manually end the run by pressing the STOP key.

13. Press ENTER <u>once</u> when the cursor in located on the rightmost zero and then ESC (see step 6, Section 7.2.1, Entering phase parameters):

```
Method 1                    h:m   Vh   mAh
Phases 4 mA/h(not set)      00:00 1452 0000
```

14. Press ENTER or ESC:

```
Edit 1>.Enter SAVE Delete Name Setup
Save (or copy) this Method
```

How to set up global parameters

1. Press NUMERIC KEY 5 to select SETUP:

```
Setup 1> VOLT-LEVEL Length Units Hold-1
Setup Global Parameters for Method
```

2. Press '1' or ENTER:

```
Edit Setup 1: Voltage level = Fixed
FIXED Changing
```

3. Press '1' or ENTER as the unit is already FIXED for the voltage level:

```
Setup 1> VOLT-LEVEL Length Units Hold-1
Setup Global Parameters for Method
```

4. Press NUMERIC KEY 3 to select UNITS:

```
Note>Sample Length Undef. Unit: Volt
Press any key to continue...
```

5. Press ENTER as Volts are the required units:

```
Setup 1> Volt-Level Length UNITS Hold-1
Choose Units of Voltage (V or V/cm)
```

6. Press NUMERIC KEY 4 to select HOLD-1:

```
Edit Setup 1 : HOLD-1 = No Hold
NO HOLD  Autohold
```

7. Press NUMERIC KEY 2 to select AUTOHOLD:

```
Setup 1> Volt-Level  Length  Units  HOLD-1
Automatic Hold after First Phase
```

The IEF run will now automatically stop after phase 1 to allow you to apply your sample to the gel.

8. Press ESC:

```
Edit 1> Enter  Save  Delete  Name  SETUP
Setup Global Parameters for Method
```

How to name your method

1. Press NUMERIC KEY 4 to select NAME:
   (See Section 7.2.2, Naming a method)

```
Edit name 1:[                                    ] ( )
1ABCDE 2FGHIJ 3KLMNO 4PQRST 5UVWXY 6more
```

2. To build up the name 'IgG4', for example, proceed as follows.
   Press NUMERIC KEY 2:

```
Edit name 1:[2                                   ] (2)
1F 2G 3H 4I 5J
```

3. Press NUMERIC KEY 4:

```
Edit name 1:[I                                   ] ( )
1ABCDE 2FGHIJ 3KLMNO 4PQRST 5UVWXY 6more
```

4. Press the UP ARROW until a lower case 'g' appears in the rounded brackets and press the RIGHT ARROW to move the cursor one position to the right:

```
Edit name 1:[Ig                                  ] ( )
1ABCDE 2FGHIJ 3KLMNO 4PQRST 5UVWXY 6more
```

5 Press NUMERIC KEY 2 twice:

```
Edit name 1:[IgG                                 ] ( )
1ABCDE 2FGHIJ 3KLMNO 4PQRST 5UVWXY 6more
```

6. Press the DOWN ARROW until the number '4' appears in the rounded brackets:

```
Edit name 1:[IgG4                                ] (4)
1ABCDE 2FGHIJ 3KLMNO 4PQRST 5UVWXY 6more
```

7. Press ENTER:

```
Edit 1> Enter  Save  Delete  NAME  Setup
Name this Method
```

How to save your program method

1. Press NUMERIC KEY 2 to select SAVE:

```
Edit 1>Save:
Existing methods =
```

2. Press NUMERIC KEY 1 and then ENTER:

```
Edit 1> Enter  SAVE  Delete  NAME  Setup
Save (or copy) this Method
```

How to load and run your program

1. Press ESC:

```
Program>EDIT Run Stop
Edit a method
```

2. Press NUMERIC KEY 2 to select RUN:

```
Run>Method:
Existing methods = 1
```

3. Press NUMERIC KEY 1:

```
Run>method:1 IgG4
Existing methods = 1
```

4. Press ENTER:

```
Select Type of Start:Direct Start
DIRECT START  Delayed Start
```

5. Press ENTER:

```
Method 1 IgG4 loaded!
Run by START        End by ESC
```

6. Press START/STOP ; actual/set parameters will be displayed:

```
Phase        V          mA        W
1/4      0034/1500  008.4/50.0  004/030
```

7. Press RIGHT ARROW KEY to display break parameters:

```
Phase    h:m              Vh              mAh
1/4   00:00/00:00  000003/000110  0000/0000
```

8. Press RIGHT ARROW KEY to display time information:

```
Phase  Method 1  Time: run/ left/ now
1/4        IgG4       00:01/??.??/15:23:07
```

Where ??.?? refers to the fact that zero time was entered as the phase 4 break parameter. Similar information can be displayed for phases 2,3, and 4 while they are being run.

5. Instrument Description

The front panel of the MultiDrive XL Power Supply unit incorporates the display, all the keys needed to set parameters and operate the instrument, and the recessed sockets into which the electrophoresis units are plugged. The front view of the Power Supply is shown in Figure 4. A detailed description of the display and functional keys is given below.

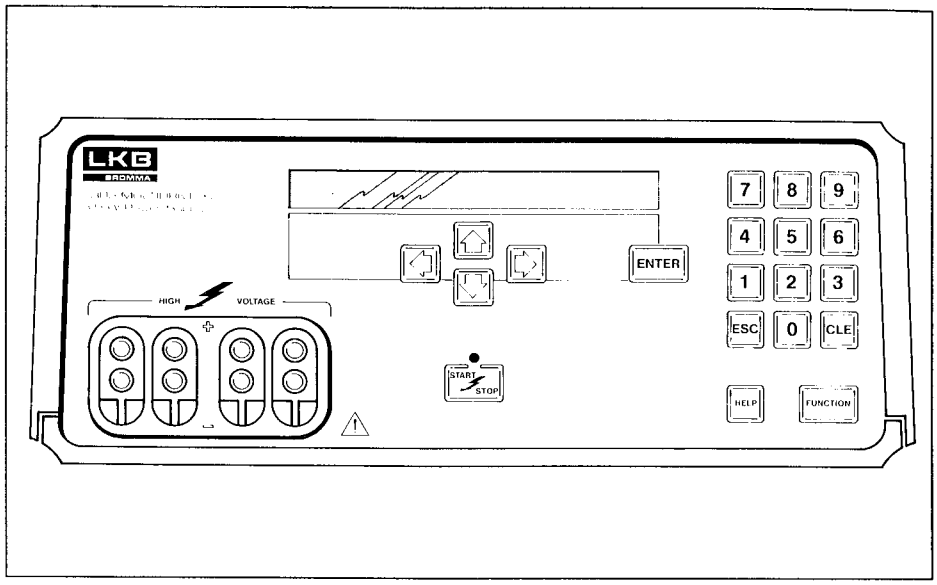


Fig. 4 Front view of the MultiDrive XL Power Supply unit

5.1 Arrow Keys

The RIGHT and LEFT ARROW keys allow you to select manual and program options, experimental parameters and other information displayed on the screen. On pressing the right arrow key once quickly, a manual or program option immediately to the right of the last option selected will be highlighted in CAPITAL LETTERS. On pressing the right arrow key repeatedly, each option to the right will be highlighted consecutively in capital letters. When the end of the line has been reached then the highlight will wrap around to the first option presented to the left of the display and again keep jumping to the right for as long as you keep your finger on the arrow key. The same sequence of events happens when you press the left arrow key but with the highlight moving in the opposite direction.

When jumping between options requiring numeric input, a flashing rectangular cursor will position itself on the rightmost digit to indicate where you can start using the numeric keys.

The RIGHT and LEFT ARROW keys are also used to increment and decrement the method number (1-9) when the FUNCTION and '0' keys have been pressed to allow parameter checking of stored programs. See Section 5.7, Function.

The UP and DOWN arrow keys can be used to carry out four different operations.

1. To select a character when naming a method after the NAME option has been entered
2. To rapidly jump up and down the phase list when in the INPUT mode
3. To select a stored method when in the EDIT, SAVE and DELETE modes (the RIGHT and LEFT keys can be used in the same way)
4. To increment and decrement the phase number (1-9) when the FUNCTION and '0' keys have been pressed to allow parameter checking of stored programs.

Further details are given in the relevant sections dealing with the operations listed above.

5.2 ENTER

Each time a manual or program option has been selected using the RIGHT or LEFT ARROW keys, or numeric input carried out, the ENTER key must be pressed to allow the instrument software to process the selected information and present the next display.
When the ENTER key has been pressed to input numeric data, the cursor then jumps to the next numeric option in the same way as when using the right arrow key.

If so desired, the ENTER key can be pressed sequentially to present each display in a selected program method sequence. However, when in the EDIT mode a method number must be entered in response to the following prompt to allow the program to proceed:

```
Edit> Method:
Existing methods = 1  3 4
```

It may also be necessary to press the ESC key to exit from some sequence of a program method. See Section 5.4, ESC(ape), below for further details.

5.3 Numeric Input

The NUMERIC keys are used to carry out two different operations. Firstly, they can be used to select an option presented on a display. Although not displayed, the options are represented by the numbers 1,2,3, etc. incrementing from left to right. When a number is pressed, the relevant option is selected and the next display is automatically presented (ENTER does not have to be pressed as after using a right or left arrow key to select an option).

Secondly, the 10 NUMERIC keys are used to achieve numeric input. When the rectangular cursor is flashing on the rightmost digit of the selected numerical option, you can press one or more of the numeric keys in sequence to input the value required. The number you press will appear in the position where the cursor is flashing while at the same time displacing the number that was previously there one position to the left. In this way you can input the whole number you have chosen for the particular numeric option selected. If you make a mistake while inputting the number then you simply start inputting the same number again or press the CLE key before resuming numeric input.

Once the correct number has been input, and depending on which operational mode you have selected, either the ENTER key or the RIGHT and LEFT arrow keys can be pressed to enable you to move to the next numeric option and to present the next display in the method sequence. The correct keys to use when in different modes are described in Section 7, Instrument Operation.

NOTE: If you come back to a value to change it, then all the digits except the first one input will immediately revert back to zero.

5.4 ESC(ape)

The ESC key is used to move one level back up through the selected manual or program method display sequence. This enables you both to complete parameter setting in the various program modes and to escape from presented information from which you cannot proceed by pressing the ENTER key. An example of the latter is when you wish to proceed after entering all the setup parameters by escaping from the following display:

```
Setup 2> Volt-Level Length Units HOLD-1
Automatic Hold after First Phase
```

5.5 CLE(ar)

The CLE key is normally used to delete the present parameter value indicated by the cursor before inputting a new value or moving to the next parameter. However, if for any reason the software becomes inoperable and none of the Power Supply keys function, the CLE key is also used in the following procedure to reset the unit.

1. Switch off the mains supply to the MultiDrive XL unit by means of the switch on the back panel of the instrument.
2. Press the CLE key and then while keeping this key pressed down switch the MultiDrive XL unit back on.

NOTE: Although this procedure will reset the instrument, ALL PROGRAMS STORED IN THE INSTRUMENT MEMORY WILL BE ERASED and will have to be input and stored once again if so desired.

5.6 HELP

At selected stages of parameter setting, if you are uncertain what to do, you can press the HELP key to display text which will help you to decide how best to proceed. See Section 8, Error, Notes and Help Messages, for a list of sections that can provide you with more detailed information related to the HELP message displayed.

NOTE: Help text is presented on the top line of the display and the message 'Press any key to exit !' is presented on the bottom line. If the help text consists of more than one line, then you will be asked to 'HELP for More, Any Other Key to Exit !'. In this case you need to press the HELP key one or more times to display the complete help text.

5.7 FUNCTION

The FUNCTION key, when used in combination with a NUMERIC key, can be used to carry out several functions as described below. The FUNCTION mode can be entered at any time except when a run has expired. To enter the FUNCTION mode, the FUNCTION key alone must first be pressed to present the following display:

```
Arrows:Check  0:dI/dt  1:Stop-ph  2/3:Log
4:Clock  5:Auto(1)  6-8:nc  9:TEST  ...ESC
```

Where:

Check Allows you to rapidly check the parameters set for each phase of stored program methods.
The UP and DOWN arrows can be used to increment and decrement the phases (max. 9) of each successive program method.
The RIGHT and LEFT arrows can be used to jump directly to the first phase of each stored method.
Both sets of arrow keys proceed in a 'wrap around' fashion.

dI/dt Allows you to set the mA/h break parameter for a manual run or for any one phase of a program method. (If you try to use this break parameter in more than one phase, only the last input will be accepted). As the slope is negative (i.e., the current is decreasing) at the end of an electrofocusing run, this means that the mA/h value is also negative. For example, if you set the mA/h value at -2.1, the phase will end when the current decreases at a rate of less that 2.1 mA per hour.
This option can only be accessed when a manual electrophoresis experiment is running or when in the phase of a program method where you want to use this break parameter.

Stop-ph Allows you to break (stop) the present phase and proceed automatically to the next phase.

Log Number 2 allows you to rapidly check the total run parameters set for the present run. Number 3 allows you to do the same for the last run completed.

Clock Allows you to set and enter the real time into the Power Supply at any stage of instrument operation.

Auto(1) Allows you to set or delete automatic jumping of the cursor to the next character when entering a name in the EDIT mode. See Section 7.2.2, Naming a method. (0)=OFF (1)=ON

6-8 No function available

TEST This is an instrument test function and is FOR USE BY AUTHORISED SERVICE PERSONNEL ONLY.

A more detailed explanation of each of these functions is given below along with the displays that are presented. After you have selected your option or input a numeric value, press ENTER or ESC where appropriate to return to the function mode display. If you want to escape from the function mode display then press the ESC key.

FUNCTION + UP or DOWN ARROW (Check)

A typical example of a display presented when an UP or DOWN arrow is pressed to present the parameters set for a program method phase is:

```
1 NAME  Chg  Hld L12 mA/h-00.0 mAh0000
1/3  U1500 I050 P030  t01:00  Vh000110
```

Where:

1	=	stored program method number plus up to 8 characters of a defined name
Chg	=	changing voltage level (see Section 7.2.3) `Fix`, fixed voltage level, is the alternative here
Hld	=	automatic hold set for the end of the first phase `NoH`, no automatic hold, is the alternative here
L12	=	length of gel is 12 cm
1/3	=	first phase of 3 phases programmed
U1500	=	voltage set at 1500 V with the setup units as voltage Note: if the units are V/cm then a typical display would present: E0350 if the V/cm was set at 350V with a gel length of 10 cm resulting in an output voltage of 3500 V
I050	=	current set at 50 mA
P030	=	power set at 30 W
mAh	=	milliampere hours break parameter not set
mA/h	=	dI/dt break parameter not set
t	=	time break parameter set at 1 hour
Vh	=	volt hours break parameter set at 110

When the UP and DOWN arrows are pressed repeatedly, the parameters set for each phase of each stored program method will be displayed successively either in a incremental or decremental order respectively.

The above display is also typical of that displayed when a RIGHT or LEFT arrow key is pressed as the use of these keys will display the FIRST PHASE ONLY of each program method stored when repeatedly pressed. Again, the methods displayed will be presented in either an incremental or decremental order depending on which key is pressed.

If no parameters have been stored for a particular method number, then the following typical display will be presented:

```
Method 5 ... is not Defined ... Yet!
```

FUNCTION + 0 (dI/dt)

On pressing FUNCTION and then the `0` key, the following typical display is presented when either a manual or progammed electrophoresis experiment is running:

```
Enter -di/dt !      Actual = -02.1
Exit by ESC !               -00.0
```

When in the MANUAL mode, you can now input the mA/h value you want.

NOTE: The dI/dt (mA/h) value is calculated every 6 minutes.

If FUNCTION + '0' are pressed when in the PROGRAM phase where you want to use this break parameter, then the following typical display is shown:

```
Enter -di/dt for Phase 5 in Edit
Exit by ESC !              -00.0
```

The cursor will be blinking on the last zero ready for your numeric input.

Note: This mA/h break parameter can be set for any one phase of a program method and, like all other parameters, is saved with the method.

FUNCTION + 1 (Stop-ph)

This function can be used to stop a phase at any point when it is running. It acts as a manual break and instructs the MultiDrive XL to proceed to the next phase (if any).
On pressing FUNCTION and then '1' , the following display is presented:

```
Stop Present Phase ? No
NO Yes
```

The option now valid is highlighted in capital letters on the bottom line of the display. To change the option, press the appropriate LEFT or RIGHT ARROW key and then press ENTER (or press NUMERIC key `1` or `2`).
If YES is selected, then an additional display will appear:

```
Press Enter to Stop Present Phase
Exit by ESC !
```

If ENTER is pressed, the next program phase (if any) will be run, the displays of which can be recalled by pressing ESC.

If the phase stopped was the last phase, then a display similar to the following will be presented:

```
Method 1 NAME EXPIRED:
After 02:60 (H:M)    Continue by ENTER
```

FUNCTION + 2 or 3 (Log)

On pressing FUNCTION and then '2', the following typical display is presented (see Section 6.2, Break Prameters):

```
Present Totals
t02:00 Vh006000 mAh0100 Wh0110 mA/h+12.4
```

This displays the total values for the break parameters valid for the electrophoresis run presently being carried out at the time the '2' key was pressed. Watt hours cannot be set but can be used for documentation purposes.

NOTE: The dI/dt value (mA/h) is calculated every 6 minutes.

On pressing the '3' numeric key, the following typical display is presented:

```
Last Run Ended at 05:32:51 with ...
t14:00 Vh002000 mAh0700 Wh0140 mA/h-02.2
```

This displays the total values for the break parameters for the last electrophoresis run carried out.

Function + 4 (Clock)

The MultiDrive XL clock is not powered by battery and therefore the real time must be entered each time the instrument is switched on.
On pressing FUNCTION and then '4', the following display will be presented:

Press Enter to SET REAL TIME Hr:Min
Exit by ESC ! 00:00

You can then set the real time and enter it to allow the instrument to display, for example, running times and total run times.

Function + 5 [Auto(1)]

On pressing FUNCTION and then '5', the following display will be presented:

Skip Auto Increment in Edit name ? No
NO Yes

The option now valid is highlighted in capital letters on the bottom line of the display. To change the option, press the appropriate LEFT or RIGHT arrow key and then press ENTER (or press NUMERIC key `1` or `2`). The default option is No (that is, the cursor will automatically jump one character to the right when naming a program method).

5.8 START/STOP

If you want to start an electrophoresis run when in the manual mode, or in the program mode after the selected program method has been loaded and the 'Direct Start' option chosen, you will be prompted by the display to 'Run by START'. You can then press the START/STOP key to initiate the electrophoresis run.

The START/STOP key is also used to FREEZE a method which is running. This allows you to either change or adjust some aspects of the electrophoresis experiment or to change parameters before continuing the run by pressing the START/STOP key again.

NOTE: 1 As a safety precaution, this key can be pressed to halt the power supply to an electrophoresis run at any stage of the experiment or operation of the MulitiDrive XL Power Supply. If you want to cancel the electrophoresis run when in the program mode, then the STOP option is selected when the program mode display is presented.

2 When the green LED is ON, this indicates that high voltage is being supplied and that a run is in progress. When the LED is FLASHING, this indicates that high voltage supply is cut off but that the run can be continued from where it was interrupted. When the LED is OFF, this indicates that the high voltage is cut off and that the run has been terminated.

Further details of starting, freezing and stopping a run when in the manual and program modes are given in Section 7, Instrument Operation.

6. Choosing Electrical and Break Parameters

6.1 Electrical Parameters

The MultiDrive XL Power Supply can be set to supply constant voltage or constant current or constant power. Optimum conditions are achieved by the automatic crossover between voltage, current and power during the running of an electrophoresis experiment. A brief discussion on the use of these three electrical parameters is given below based on Ohm`s law, I = V/R, and the definition of power (in Watt units) as P = I x V.

NOTE: The values input for V, mA and W depend on both the type of experiment and the electrophoresis equipment used. Please refer to the relevant literature supplied with your electrophoresis equipment, and the application notes describing the experiment you want to run for the recommended values.

6.1.1 Constant voltage

Many experiments in gel electrophoresis are run in the constant voltage mode. Electrophoretic migration is a function of the voltage gradient in the gel and thus running at constant voltage will provide a constant migration rate. This is usually the case with continuous buffer systems and when there is direct contact between buffer and gel. The resistance of the system does not change markedly during the run and the results are reproducible. However, use of Vh or mAh integration will ensure reproducible results even if the voltage varies - see Section 6.2, Break Parameters.

Set the limiting value for the voltage you want kept constant. The other two parameters are set at a maximum value which allows them to fluctuate according to the physical characteristics of the gel in order to maintain constant voltage, this being the limiting parameter set.

NOTE: If a failure of the thermostatic circulator occurs during a run of this type, the temperature would rise, the resistance decrease and the current may reach an undesirable level. This fact should be taken into consideration when setting the maximum current level.

6.1.2 Constant current

If the voltage drop is not maintained constant in all parts of the electrophoresis system (electrodes, buffers, wicks and gel), changes in resistance which usually occur in the system will alter the voltage gradient over the separation medium. Changes in resistance may also be caused by changes in temperature. By using constant current, the voltage gradient used for separation is made independent of external resistance changes.

Methods where changes in resistance occur (such as discontinuous electrophoresis or isotachophoresis) must be run at constant current in order to reduce the running time and hence diffusion. Any increase in resistance that occurs will be compensated for by a proportionate rise in voltage. Thus shorter run times and sharper zones will be produced.

Constant current is recommended whenever a discontinuous buffer is used, and for continuous buffer systems where wicks make contact with the gel.

Set the limiting value for the current level you want kept constant. The other two parameters are set at a maximum value which allows them to fluctuate according to the physical characteristics of the gel in order to maintain constant current, this being the limiting parameter set.

NOTE: If the gel dries during a run, the resistance of the system will increase and the voltage may also increase to an undesirable level. This fact should be taken into consideration when setting the maximum voltage level.

6.1.3 Constant power

If there is a considerable increase in the resistance in the electrophoresis system, optimal results can be obtained by running the experiment at constant power. Overheating can thus be avoided and a minimum separation time obtained by using the optimal voltage throughout the whole run. In electrofocusing, the increase in resistance is quite large and because of this it is essential to run at constant power. The amount of power that can be fed into the system is dependent on the cooling efficiency of the system. The better cooling the higher the applied power and thus the shorter the experimental time. This, of course, is true for all electrophoretic techniques.

Set the limiting value for the power you want kept constant. The other two parameters are set at a maximum value which allows them to fluctuate according to the physical characteristics of the gel in order to maintain constant power, this being the limiting parameter set.

A graphical representation of the changes in power, voltage and current that may occur during a typical isoelectric focusing run is given below in Figure 5.

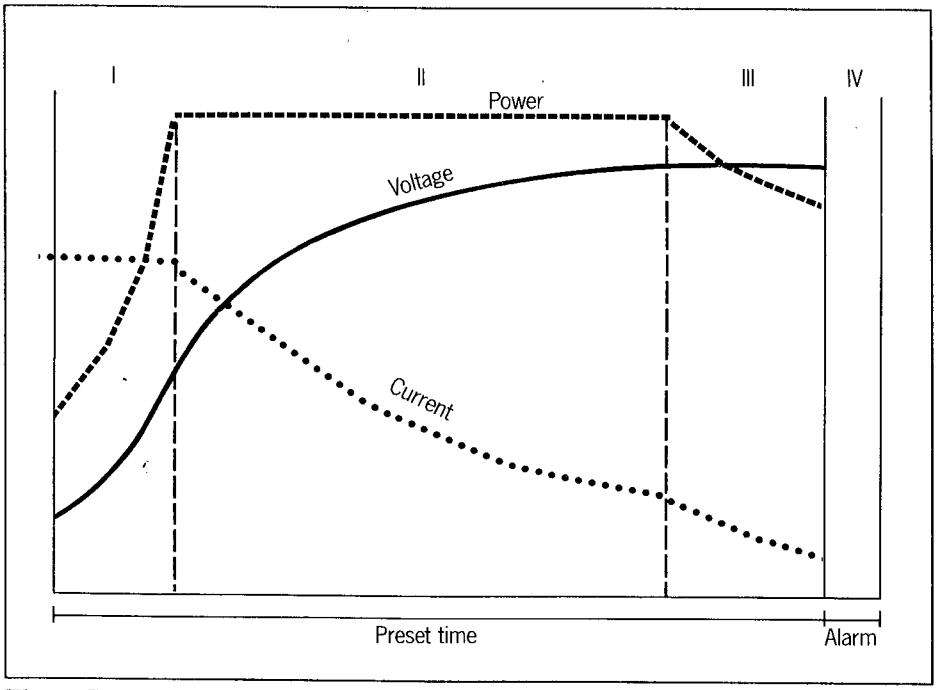


Fig. 5 Power fluctuations which occur during a typical IEF run

6.2 Break parameters

With MultiDrive XL, you can choose one or more of the following break parameters to control the duration of each phase of a program method:

time (h:m)
volt hour (Vh) integration
milliampere hour (mAh) integration
dI/dt as the change in mA with respect to time (mA/h)

Although you can input a value for all the break parameters in each phase (except dI/dt which can be used in one phase only) the phase will end when the value for the 'limiting' parameter is reached. That is, the first break parameter value arrived at; time, Vh or mAh.

The optimal break parameter for your method will depend on the electrophoretic technique you want to run and on the extent to which you can control other run parameters of your experiment such as temperature and gel thickness. The following discussion can help you to choose the optimal break parameter for your experiment.

6.2.1 General principles

Vh is generally recommended when the inter-electrode distance (gel length) and the temperature can be precisely controlled, for example, by the MultiTemp II Thermostatic Circulator (code no. 2219). Vh integration will compensate for differences in cross-sectional area and ionic strength.

mAh integration is recommended when the cross-sectional area and ionic strength can be well controlled and for accurate measurement in blotting experiments. mAh integration will compensate for differences in temperature.

The use of dI/dt is recommended when you want the equilibrium of an isoelectric focusing (IEF) experiment to be indicated and hence the end of a run. This parameter is thus best used in the last phase of the experiment.

Technique	Vh	mAh	dI/dt
IEF	X		(X)[1]
PAGE	X[2]	X[3]	
Agarose		X	
Electrophoretic transfer		X	

[1] Can be used as a guiding parameter when defining the running conditions for a new experiment, i.e., to determine when equilibrium has been reached.
[2] Vh is best used here if temperature is strictly controlled.
[3] mAh is best used here if ionic strength and gel thickness is strictly controlled.

PAGE = Polyacrylamide gel electrophoresis (regardless of buffer system used)

6.2.2 Choosing break parameters for IEF

To determine when a protein has reached its isoelectric point (pI), the protein is applied on both sides of its estimated pI in a pH gradient. Equilibrium is indicated when the protein bands coalesce (1). The extent of focusing is defined in Vh since electrophoretic mobility is directly proportional to the magnitude and duration of the applied electric field. The number of volt hours needed to achieve equilibrium varies for different proteins.

Using Vh integration, reproducible results are obtained even if voltage, current, power, ionic strength and cross-sectional area vary. Vh integration will not compensate for differences in gel porosity, viscosity, temperature, slope of the pH gradient, or inter-electrode distance (see 'Changing gel dimensions reproducibly' later in this section).

6.2.3 Choosing break parameters for PAGE

The end-point of PAGE separations (regardless of buffer system used) is usually determined with the aid of tracking dyes. Bromophenol blue and pyronine Y, the most commonly used dyes in acidic and basic protein separations respectively, are added to the sample prior to electrophoresis. The coloured band migrates in front of the proteins and when it reaches the end of the gel the separation is stopped.

The migration rate of proteins varies according to the separation conditions of PAGE. The field strength, temperature, cross-sectional area, gel porosity and viscosity will affect the migration rate most markedly. The choice of using either Vh or mAh integration will depend on which of these conditions you can most effectively control. When cross-sectional area and ionic strength are easily controlled, mAh integration should be used to compensate for eventual variations in temperature and field strength. Conversely, if temperature and electrode difference (gel length) is well controlled, Vh integration should be used to compensate for eventual variations in ionic strength, cross-sectional area and field strength.

6.2.4 Choosing break parameters for electrophoretic transfer

Completion of electrophoretic transfer of proteins from a gel to a membrane can only be determined empirically, for example, by staining the gel to see if any residual protein remains. This, however, will not indicate the amount of protein bound to the membrane since many proteins can migrate through the membrane into solution.

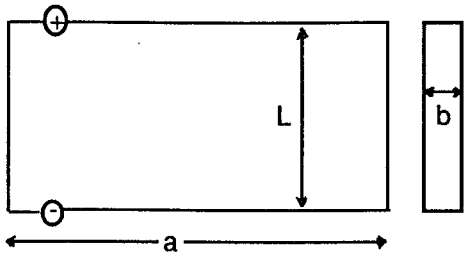
For reproducible results, mAh integration is recommended for tank blotting techniques since this measurement will not be affected by variations in temperature or field strength. Moreover, with low voltage and high current, mAh is more accurately measured.

6.2.5 Choosing break parameters for agarose gel electrophoresis

Agarose gel electrophoresis is often performed with paper wicks to supply buffer to the gel during electrophoresis. During the run, the wicks tend to dry. This causes an increased resistance and voltage drop across the wicks, and hence a decreased field strength in the gel. Using mAh integration, this process will not affect the reproducibility of results.

6.2.6 Changing gel dimensions reproducibly

The following instructions show how you can adjust the electrical conditions and break parameter values reproducibly when you change the dimensions of your gel or transfer 'sandwich'. This could save you experimental time.



a = gel width
b = gel thickness
L = gel length
c = cross-sectional area (b x a)
y = area L x a

If you change the dimensions of your gel from '1' (old value) to '2' (new value), the electrical conditions and break parameter values can be adjusted using the following relationships:

Electrical conditions	Break parameter values
$V_2 = V_1 \times (L_2/L_1)$	$mAh_2 = mAh_1 \times (c_2 \times L_2/c_1 \times L_1)$
$I_2 = I_1 \times (c_2/c_1)$	$Vh_2 = Vh_1 \times (L_2/L_1)^2$
$P_2 = P_1 \times (y_2/y_1)$	where V = voltage, I = current, P = power

References

1) T. Låss and I. Olsson, Electrophoresis 2 (1981) 235-239.

2) C. Jägersten, A.Edström, B.Olsson, Electrophoresis 9 (1988) 662-665.

7. Instrument Operation

The 2303 MultiDrive XL Power Supply unit can be operated in two modes - MANUAL and PROGRAM. The MANUAL mode is used, for example, when you want to constantly monitor and perhaps change the parameters of an an electrophoresis run, or when the run consists of only one phase.

The PROGRAM mode is used to set parameters for an electrophoresis run which consists of more than one phase, and which can be left to run automatically, over night for instance. As up to 9 program methods, each comprising up to 9 phases, can be stored in the instrument memory, any one of these can be recalled quickly and used to control an electrophoresis experiment without further parameter setting.

See Section 6, Choosing Electrical and Break Parameters; the relevant literature supplied with your electrophoresis equipment, and the application notes describing the experiment you want to run before deciding what electrical values to input.

7.1 MANUAL mode

After switching on the MultiDrive XL Power Supply you will be presented with the following display with the MANUAL mode highlighted:

```
Main> MANUAL Program
Operate the Power Supply Manually
```

If you have already been using the MultiDrive XL in the PROGRAM mode, use the ESC key to return to the program selection level and then press the LEFT arrow key to present the above display.

1. Press the ENTER key to present the first MANUAL parameter setting display which allows the following three run parameters to be set:

```
Manual>    V          mA        W
Act/Set 0000/0000  000.0/000.0  000/000
```

   The figures to the left of the backslash symbol, /, are the ACTUAL values for the electrical parameters being supplied to the electrophoresis units by the MultiDrive XL when a run is under way. The figures to the right of the slash symbol are those you set by inputting your chosen values by means of the numeric keys. See Section 5.3, Numeric Input.

2. Press the RIGHT arrow key or ENTER to proceed to the next display and set the break parameter:

```
Manual> ENDVOLT    h:m          Vh
Act/Set    0000  00:00/00:00  000000/000000
```

   The ENDVOLT option allows you to input the voltage you want the electrophoresis gel to be supplied with after the 'limiting' break parameter has taken effect. This is useful in an electrofocusing experiment, for example, as it minimises diffusion of protein bands after they have been focused until you return to the instrument.

There are three options for setting the break parameter which ends the MANUAL electrophoresis experiment - time (h:m), Volt Hours (Vh) and dI/dt (-mA/h).
The dI/dt break parameter can only be set when the MANUAL mode is running but it is not displayed like the other break parameters. See Section 5.7, Function + 0 (dI/dt) for further details.

The maximum value for h:m is 23:59.
The maximum value for Vh is 999999
The limit for -mA/h is -99.9

Note: If a value is given for all three options then the experiment will stop when the 'limiting' value is reached.

3. Press the right arrow key or ENTER to proceed to the next display after inputting the desired values:

```
Manual>
Run by START          Exit by ESC
```

4. Press the START/STOP key to begin the electrophoresis run using the values set for the break parameters displayed. A display similar to the following will appear:

```
Manual> ENDVOLT   h:m          Vh
Act/Set   1500  00:00/01:10 000002/001310
```

5. To see the Volt, mA and Watt parameter display, press the LEFT arrow key to scroll back to the previous display in the sequence. For example:

```
Manual>      V          mA        W
Act/Set   0498/3000  054.0/075.0  097/160
```

The RIGHT and LEFT arrow keys can be used in this way to display the run parameters you want to see. The display is updated every second.

If you want to return to the first display of this sequence, to reset parameters before beginning a run for example, then press ESC and follow the above procedure to change the relevant values.

6. A run can be FROZEN before either the set time or Vh parameter has been reached simply by pressing the STOP/START key. If this is done, the following display will appear:

```
FROZEN> Continue by START   Exit by ESC
Press ENTER to change parameters
```

If you want to change any of the parameters after freezing a run, then this can be done after ENTER has been pressed. For example:

```
FROZEN> ENDVOLT   h:m          Vh
Act/Set   1500  00:03/06:30 000030/018500
```

The LEFT arrow key can be used to return and change run parameters:

```
FROZEN>    V          mA        W
Act/Set  0000/3000  000.0/075.0  000/160
```

You can then resume the electrophoresis run by pressing the START/ STOP button once again or press the ESC key to carry out some other function. If the START/STOP key is pressed then the following display is presented again:

```
FROZEN> Continue by START   Exit by ESC
Press ENTER to change parameters
```

However, before the run continues you are given the option of resetting the actual time, Vh and and mA/h values to zero or restarting the run with the break parameters values valid at the time of interruption:

```
Clear Break Values ? No
NO  Yes
```

After you have made your choice and pressed ENTER, the manual run will resume and the appropriate parameter display presented again.

NOTE: 1 The above display will only be presented if a value is entered for the time and/or Vh break parameters.

2 If you had set the dI/dt break parameter before freezing the run, on entering a response to the 'Clear Break Values' display, the following message will be displayed:

```
Note> di/dt SET !    Use Func.0 to change
Press any key to continue....
```

This reminds you that you can change the -mA/h value if you want to before restarting the manual run. Note that if this break parameter was set for the previous manual run then it is valid for every subsequent manual run until made non-operational by use of the FUNCTION + '0' keys.

7. When a manual run has ended by one of the break parameters having been reached, then a display will be presented to say that the run has expired and show the ENDVOLT value that ended the run:

```
Manual EXPIRED: (ENDVOLT Act/Set)
                Continue by ENTER
```

7.2 PROGRAM Mode

A flow diagram of the levels and options inherent in the PROGRAM mode is given below in Figure 6 to help you to become quickly familiar with the program structure and to help you set parameters.

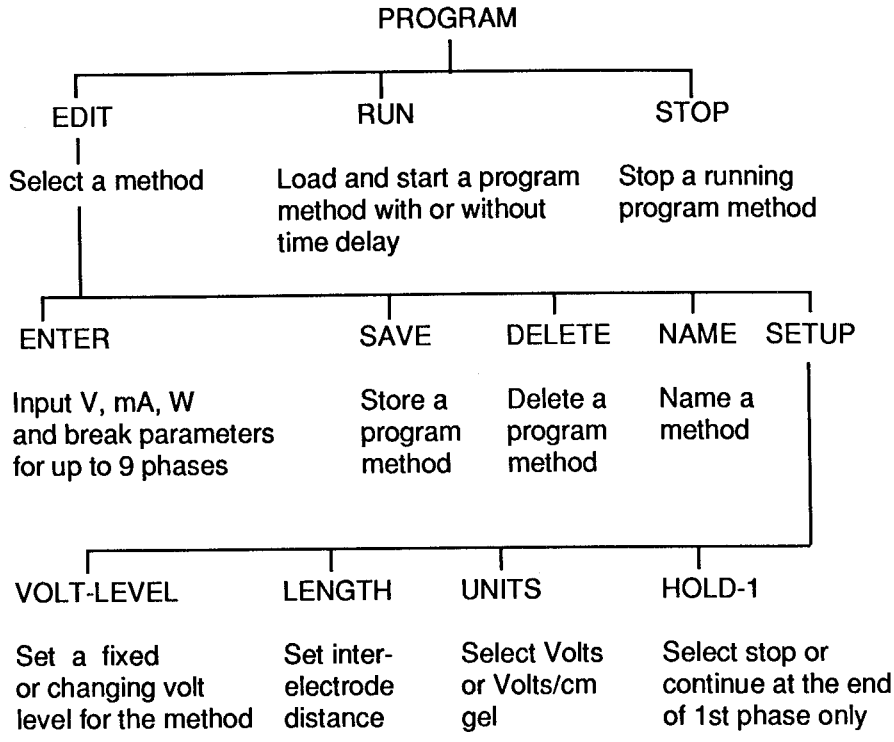


Fig. 6 Flow diagram of the levels and options of the PROGRAM mode

When a menu is displayed for each of the three levels shown in Figure 6, you can either jump between options by using the RIGHT and LEFT ARROW keys which have a 'wrap around' mode of action, or use a NUMERIC key to present the first display of the option selected. The options are identified by the numbers 1,2,3,etc., incrementing from left to right on the display. If the arrow keys are used then ENTER must be pressed afterwards, but if a numeric key is pressed, the next display is automatically presented.
Only one option selection method, an ARROW key plus ENTER, is used in the follow examples.

NOTE: 1 A program method can be edited and saved while a MANUAL electrophoresis run is in progress.

2 When moving around the program using the ENTER and ARROW keys, the mode or option currently operational will be highlighted in capital letters.

1. If the PROGRAM option is not highlighted when the main display is presented, then press the RIGHT arrow key to select it:

Main> Manual PROGRAM Use programmed methods

2. Press ENTER to display the PROGRAM mode options:

```
Program> EDIT  Run  Stop
Edit a method
```

7.2.1 Entering phase parameters

The EDIT option is always highlighted when the program mode is first entered as shown in the above display:

1. Press ENTER to enable a method number to be input:

```
Edit> Method:
Existing methods =
```

2. Input a method number (1 to 9; 0 is not accepted and will produce a warning beep) and press ENTER to enable the program to proceed. The edit mode display will be as follows if 1 is entered:

```
Edit 1> ENTER  Save  Delete  Name  Setup
Enter Parameters for this Method
```

3. Press ENTER to begin parameter setting:

```
Phase    V    mA    W    h:m    Vh     mAh
1 of 1  0000  000.0  000  00:00  000000  0000
```

You can now enter values for the voltage, current and power break parameters you want to use for up to 9 phases of an electrophoresis run. Enter the values you want for each of these parameters by using the numeric keys. See Section 5.3, Numeric Input, for further details.
The ENTER key can be used to jump to the right option only, whereas the RIGHT and LEFT ARROW keys can be used to jump from option to option in both directions.

NOTE: The dI/dt break parameter [-mA/h, see Section 5.7, Function + 0 (dI/dt) for further details] can also be set for any one phase if a value is input before you add a new phase (see below). If a program method is running and a -mA/h value is entered, then it is valid for the present phase only. The dI/dt break parameter is stored along with other parameters when a method is saved.

If the FUNCTION and '0' are pressed to enter a -mA/h value, then the following typical display is presented:

```
Enter -di/dt for Phase 1 in Edit
Exit by ESC !          -00.0
```

4. When the blinking cursor positions itself over the total phase number (e.g, 1 of 1), press ENTER to enter the values input for the phase displayed. The following display will then be presented:

```
Add  a New Phase ? Yes
No YES
```

5. If you want to include another phase in a program method then press ENTER as the YES option is already highlighted. You can then start parameter setting for the next phase:

```
Phase  V    mA    W  h:m    Vh     mAh
2 of 2 0000 000.0 000 00:00 000000 0000
```

This sequence of events will continue until you have set the parameters of each phase (up to a max. of 9 phases) you want included in the program method.

NOTE: When more than one phase has been entered, the UP and DOWN arrow keys can be used to scan rapidly up and down the phases set. This is useful if you want to quickly check the parameters set for each phase of the current method.

When you no longer want to add another phase, there are two ways of returning to the EDIT menu depending on which key you press when the cursor positions itself over the displayed total phase number:

The shorter route:

6. When the cursor positions itself over the total phase number after parameter setting for the last phase is complete, press ESC to display the following typical information on the complete method setup:

```
Method 1                    h:m    Vh    mAh
Phases 5 mA/h(?) -22.2 06:30 18500 160
```

where ? = is the phase number for which -mA/h is active (if any).

7. Press ENTER or ESC to return to the edit mode display.

The longer route:

6. When the cursor positions itself over the total phase number after parameter setting for the last phase is complete, press ENTER and select NO from the following display:

```
Add a New Phase ? NO
NO Yes
```

7. Press ENTER to present the next display (5 phases for example):

```
ESC or For Phase 5/5 do:Insert
INSERT  Delete
```

8. Press the ESC key which will again display the last phase, for example:

```
Phase  V    mA    W   h:m    Vh     mAh
5 of 5 1500 030.0 050 01:00 001500 0030
```

9. Press ESC to display the following typical information on the complete method setup:

```
Method 1                    h:m    Vh    mAh
Phases 5 mA/h(?) -22.2 06:30 18500 160
```

where ? = is the phase number for which -mA/h is active (if any).

10. Press ENTER or ESC to return to the edit mode display.

NOTE: 1 If you set parameters for all 9 phases then on pressing ENTER to accept the last phase, the following display will be presented:

```
ESC or FOR Phase 9/9 do: End_Enter
END_ENTER  Delete
```

Press ENTER or ESC to proceed as shown in steps 9 and 10 above.

2 If you return to check or edit a program, both the UP and DOWN ARROWS can be used to scan quickly through the phases.

3 If you want to maintain the supply of a constant voltage after an electrophoresis run, for example, when electrofocusing where you want to minimize the separated protein bands from diffusing until you attend the electrophoresis unit, either set no break parameter or set one at its maximum value.

4 If no values are entered for a phase, after the ESC key is pressed the following message will appear where ? = the relevant phase:

```
Note> V, mA or W = 0 in phase ? !
        Press any key to continue...
```

You can also INSERT (if total phases <9) or DELETE one or more phases where appropriate when setting up a program method which has not yet been saved, or after recalling a stored program method.

To INSERT a new phase:

1. When in the edit mode, use the UP or DOWN arrow key to return to the phase in front of which you want to insert the new phase.

2. Position the blinking cursor over the total phase number by use of the RIGHT and/or LEFT arrow key and press ENTER to present the following typical display:

```
ESC or For Phase 3/6 do: Insert
INSERT  Delete
```

3. Press ENTER to display a new phase ready for parameter setting:

```
Phase  V     mA     W   h:m    Vh     mAh
3 of 7 0000  000.0  000 00:00  000000 0000
```

4. Complete parameter setting and when the cursor is again over the total phase number press ESC twice to proceed in the same way as outlined in steps 6 and 7 of 'The Shorter Route' described above in this section (unless you want to insert another phase in the same method).

To DELETE a phase:

1. When in the edit mode, use the UP or DOWN arrow key to return to the phase you want to delete.

2. Position the blinking cursor over the total phase number by use of the RIGHT and/or LEFT arrow key and press ENTER to present the following typical display:

```
ESC or For Phase 3/6 do: Insert
INSERT  Delete
```

3. Select DELETE and Press ENTER to delete phase 3 and present the following typical display:

Phase	V	mA	W	h:m	Vh	mAh
2 of 5	2500	050.0	075	01:00	002500	0050

4. Locate the cursor over the total phase number press ESC twice to proceed in the same way as outlined in steps 6 and 7 of 'The Shorter Route' described above in this section (unless you want to delete another phase in the same method).

7.2.2 Naming a method

1. Select the NAME option if you want to give your method a name:

```
Edit 1> Enter Save Delete NAME Setup
Name this method
```

2. Press ENTER to present the next display

```
Edit name 1: [                                ] ( )
1ABCDE 2FGHIJ 3KLMNO 4PQRST 5UVWXY 6more
```

The name you input will appear character by character within the square brackets. Up to 20 alphanumeric characters can be selected to build up the name you want, although some displays will show only the first 8 characters due to lack of space.

The current character appears in the position selected for that character within the square brackets, and within the round brackets.

There are 2 methods of inputting the required character; both can be used together to build up a name. Method 2 gives you a greater character range.

Method 1.

a) Press the number which presents the list containing the letter you want. For example, if you want to select 'R', press number 4. The following display will appear:

```
Edit name 1: [4                               ] (4)
1P 2Q 3R 4S 5T
```

b) Press number 3 to select R and move the cursor one position to the right. The display will then return to the list of letters to allow you to select the next character.

```
Edit name 1: [R                               ] ( )
1ABCDE 2FGHIJ 3KLMNO 4PQRST 5UVWXY 6more
```

NOTE: The cursor will move automatically one place to the right after a character has been selected only if this operation is set as the default option in response to the FUNCTION + '5' display. See Section 5.7, Function + 5 [Auto(?)]. If this automatic step function is not operational, you must carry out the additional step:

c) Press the RIGHT arrow key to shift to the next character and continue in the above manner to build up the name you want.

If you select '6more', then you can select from the following characters:

1Z 2/ 3- 4) 5, 6& 7% 8$ 9# 0Space

If you want to change a character within a name, use the RIGHT and LEFT arrow keys to relocate the cursor at the position you want.

d) Press ENTER to return to the initial edit mode display when you have finished inputting your method name.

NOTE: If you have overwritten an existing name but want to recall it before ENTER has been pressed, press the CLE key.

Method 2.

a) Press the DOWN arrow key to scroll forward through the available characters (much greater selection than for Method 1) which will appear in succession in the current position selected for the character within the square brackets, and within the round brackets.
Press the UP arrow key to scroll backward through the character list.
The cursor is first positioned on the space between 'z' and '!' and the characters available to you are:

!"#$%&'()*+,-./01234567890:;<=>@ABCDEFGHIJKLMNOPQRSTUV
WXYZ [\]^_'abcdefghijklmnopqrstuvwxyz !"#&.....etc.

b) When you have selected the character you want, press the RIGHT arrow to shift one character to the right, select the next character and continue this procedure until you have built up the name you want.
If you want to change a character within a name, use the RIGHT and LEFT arrow keys to relocate the cursor at the position you want, and then select the new character.

c) Press ENTER to return to the edit mode display when you have finished inputting your method name.

NOTE: If the program mode has been used before and the method has already been given a name, then on entering the number in response to the method prompt a typical display will be:

```
Edit 1: NAME
Existing methods = 1 2  4   6
```

If a method has not been given a name, then this will be stated on relevant displays as '(NoName?)' where '?' is the method number.

If a name is already used, or if a named program is recalled and saved under a different method number then the following typical message will be displayed:

```
Note> Name Used !  Saved as: (NoName?)
        Press any key to continue...
```

where ? is the method number the program is stored under.

NOTE: If you want to change just one character when editing a name, place the cursor on the character you want to change and then use the UP and DOWN arrows to select the required character.

7.2.3 Setting up global parameters

1. Select the SETUP option from the edit mode display:

Edit 1> Enter Save Delete Name SETUP Setup Global Parameters for Method

2. Press ENTER:

Setup 1> VOLT-LEVEL Length Units Hold-1 Set Voltage Level During a Phase

The global parameters are defined below:

VOLTAGE LEVEL: Either a FIXED or CHANGING (or ramping) mode can be selected to connect one phase to the next in an electrophoresis run. If the FIXED option is selected then the voltage remains at the max. set level throughout a phase but then changes abruptly to that set for the next phase in the run. If the CHANGING option is selected then a smooth, gradual change of voltage occurs during and between phases. See Figure 7.

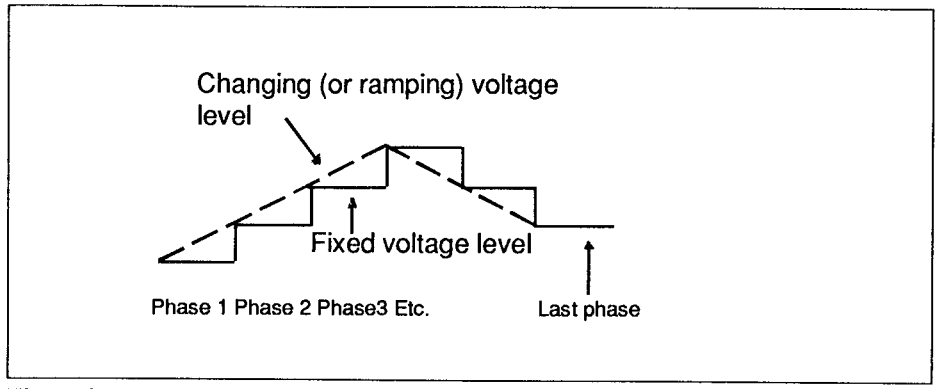


Fig. 7 A graphical representation of the fixed and changing levels of the voltage set for the program phases

LENGTH: An option for use when voltage units required = V/cm. The inter-electrode distance is set here, max. length 99 cm.

UNITS: The voltage can be expressed as either Volts or Volts/cm.

HOLD-1: You can choose whether to;
i) interrupt an electrophoresis run at the end of the first phase in order to apply the samples to the gel for example.
ii) allow the first phase to continue automatically to the second phase without interruption.

3. Press ENTER:

Edit Setup 1: Voltage level = Fixed FIXED Changing

4. Select the required option, press ENTER and then select LENGTH:

Setup 1> Volt-Level LENGTH Units Hold-1 Set Length of Specimen

5. Press ENTER:

```
Edit Setup 1: Length of Specimen [cm]
   Enter Length [0..99] 00
```

6. Input the inter-electrode distance, press ENTER and then select UNITS:

```
Setup 1> Volt-Level Length UNITS Hold-1
Choose Units of Voltage (V or V/cm)
```

7. Select the required voltage units and press ENTER.

NOTE: 1 If no gel length has been set then the following message will appear:

```
Note> Sample Length Undef.  Unit: Volt
Press any key to continue...
```

If this happens then return to LENGTH and input the inter-electrode distance if the required voltage units are V/cm.

2 If V or V/cm are changed from one to the other, then the voltage units displayed for each phase of the relevant program method will automatically be recalculated to the correct value. For example, if gel length = 10 cm and the voltage is 1000 V in a phase, the latter value will be automatically changed to 100 V/cm if the units are changed from V to V/cm.

3 If the units are V/cm and the gel length is changed from a set length to zero, the units (and value) automatically change to V.

4 If you try to save a program method in which V/cm is chosen and one or more phases exceeds the set voltage (max. 1750 V at max. current of 400 mA; max. 3500 V at max. current 200 mA) according to the calculation V/cm x inter-electrode distance, then the following message will appear:

```
Note> Voltage out of range !
   Press any key to continue...
```

8. Select HOLD-1:

```
Setup 1> Volt-Level Length Units HOLD-1
Automatic Hold after First Phase
```

9. Press ENTER:

```
Edit Setup 1 : Hold-1 = No Hold
NO HOLD  Autohold
```

10. Select the required option, press ENTER and then ESC to return to the EDIT mode display.

7.2.4 Saving and deleting program methods

When you have finished parameter setting for a particular program method, you can save it for further use. A method must be saved before it can be run. Up to 9 methods can be stored in the MultiDrive XL memory. (A '0' input is not accepted in the save and delete modes and will result in a warning beep.)

1. Select the SAVE option from the edit mode display:

Edit 1> Edit SAVE Delete Name Setup Save (or copy) this Method

2. Press ENTER to present the next display:

Edit 1> Save: Existing methods =

3. Press 1 and then ENTER to save method 1 in location 1 of the MultiDrive XL memory.

   The location of any existing program methods is shown on the bottom line of this display. The current method can be stored under any location number. This feature is useful if you want to store methods which differ only in a few parameters. In this case, store the original method under a different method number and then recall it to change only those parameters you want.

   NOTE: 1 If a method already exists under a number (other than the one you are editing) which you have just input, then after ENTER has been pressed the following display will be presented:

Method exists ! Overwrite ? No NO Yes

   If you do not want to overwrite the existing stored method then press ENTER. If you do, select YES and then press ENTER.

   2 You cannot save more than one program bearing the same name. See the note at the end of Method 2, Section 7.2.2, Giving your method a name.

   3 If you use the ESC key to escape from the edit mode after setting or changing method parameters but without carrying out a save function, the following prompt will be displayed:

Exit without saving changes ? No NO Yes

   If this happens, select the appropriate response and press ENTER.

If you want to delete a stored program method then proceed as follows.

1. Select the DELETE option from the edit mode display:

Edit 1> Edit Save DELETE Name Setup Delete a method

2. Press ENTER to present the next display, for example:

```
Edit 4> Delete:
Existing methods = 1 2 3 4   6   8 9
```

3. Input the method number you want to delete (its name will also appear if it has one) and press ENTER. The following prompt will then appear:

```
Deleting x !  Are You Sure ? No
NO  Yes
```

   where 'x' is the method number.

4. Select the appropriate response and press ENTER.

7.2.5 Running a program method

To start an electrophoresis run using a stored program method:

1. Select the RUN option from the program mode display:

```
Program> Edit  RUN  Stop
Load a Method to be Run
```

2. Press ENTER to present the next display:

```
Run> Method :
Exsiting methods = 1 2 3 4   6   8 9
```

3. Press the number of the program method you want to run. If the method has a name then this will also be displayed.

4. Press ENTER after the number has been input, 3 for example, to present the next display:

```
Select Type of Start:  Direct Start
DIRECT START   Delayed Start
```

   You now have the option of starting the run at once or entering a delay time before the run commences.

5. Press ENTER if you want to start a run without a delay time:

```
Method 3 NAME  loaded!
Run by START          End by ESC
```

6. Press the START/STOP button to begin the electrophoresis run. A display of the actual and set parameters will then be presented for each phase in turn:

```
Phase     V            mA          W
1/5   1234/2000   054.0/075.0   097/160
```

   Use the RIGHT arrow key to display the break parameter values:

```
Phase     h:m              Vh              mAh
 1/5   00:00/00:20  000000/000110   0000/0000
```

Use the RIGHT arrow key again to display the run time parameters:

```
Phase  Method 3    Time: run/ left/ now
 1/5    NAME        02:20/02:18/14:31:55
```

7. If you want to enter a time delay before starting a run then select the DELAYED START option and press ENTER to present the next display:

```
Enter Delay Time (00:00..23:59)     Hr:Min
Exit by ESC!       14:32            00:00
```

8. Input the delay you want to use and press ENTER:

```
Method 3 NAME  Delayed :  Hr:Min:Sec
Exit by ESC!      14:32      00:01:59
```

The time delay displayed will decrement every second until it has expired after which the running display is presented as shown in step 6 above.

NOTE: If you attempt to load and run a method while one is already operational, then you will be warned:

```
Note> Running Method 3 NAME
Proceed by ENTER        Exit by ESC
```

When the run has ended, a display similar to the following will be presented:

```
Method 1  NAME   EXPIRED:
After 02:35  (H:M)     Continue by ENTER
```

7.2.6 Stopping a running program method

To stop a program method (e.g., number 3) from running, proceed as follows.

1. Return to the program mode display by pressing the ESC key and select the STOP option:

```
Program> Edit  Run  STOP
Stop a Running Method
```

2. Press ENTER to present the next display:

```
Note> Running Method 3 NAME
Proceed by ENTER        Exit by ESC
```

3. Press ENTER to display the next prompt:

```
Method 3 : NAME will STOP  No
NO  Yes
```

4. Select the appropriate response and press ENTER. If YES was entered, the following display will be presented and the START/STOP LED will go out to confirm this action:

```
Note> Method 3 : NAME STOPPED!
   Press any key to continue...
```

5. Press any key. This will return you to the program mode display again.

[**NOTE:** A phase can also be terminated at any time. See Section 5.7, FUNCTION + 1 (Stop-ph)].

8. Error, Note and Help Messages

8.1 Error Messages

The following list comprises the two-line error messages which are programmed to appear in response to particular errors occurring in the MultiDrive XL Power Supply unit or connected equipment. A brief statement recommending what action you ought to take in response to each message is also given.

Fatal Error> Program out of sequence !
RESET SYSTEM to continue...

Possible hardware problem. Switch OFF instrument and then ON again while keeping the CLE key depressed. If this message appears several times, contact your authorised Pharmacia LKB service representative.

Error> Found in Hardware D301 !
Press any key to continue...

If this message appears several times, contact your authorised Pharmacia LKB service representative.

Error> Ground Leakage Detected !
Press any key to continue...

The high power supply from the MultiDrive XL is cut off immediately. Switch off the instrument and check the insulation of the cables and connected equipment. If this message appears several times, contact your authorised Pharmacia LKB service representative.

Error> External Device is off !
Press any key to continue...

Check that the interlock connectors are plugged in correctly to MultiDrive XL and that the cable is connected to MultiTemp II.

Error> Illegal Connector !
Press any key to continue...

Check that the correct type of connectors are plugged firmly into the MultiDrive XL Power Supply.

Error> Unsafe Connector (code=x<y) !
Press any key to continue...

This indicates that the connectors are fitted with the wrong code sleeves for the voltage set. Either change the code sleeves or change the set voltage whichever is appropriate.

Error> In Cable-Code-LED !
Press any key to continue...

If this message appears several times, contact your authorised Pharmacia LKB service representative.

Error> Low current ! (0.?)mA
Press any key to continue...

where actual current (I) is <0.5 mA

Check that all cables to the MultiDrive XL Power Supply are connected correctly.

Error> Can't reach Voltage !
Press any key to continue...

Check that all the cables are connected correctly and that the mains voltage supply is up to full power. This message may result from a short-circuit somewhere. If this message appears several times, contact your authorised Pharmacia LKB service representative.

Error> (code=xy) Unknown !
Press any key to continue...

If this message appears several times, contact your authorised Pharmacia LKB service representative.

8.2 Notes

The following are a selected number of 'Note' messages that will appear when you have input data not accepted by the MultiDrive XL software program (the numeric values displayed will depend both on the electrical configuration of the instrument - See Section 2, Technical Data - and on your response to various options).

For example, when entering parameter values:

Note> Voltage > 3500 not accepted.
Press any key to continue...

Note> V/cm > 220 not accepted.
Press any key to continue...

Note> Current > 200.0 not accepted.
Press any key to continue...

Note> Power > 200 not accepted.
Press any key to continue...

Note> Value out of Range ! Try again !
Press any key to continue...

When trying to run in the wrong mode:

Note> A programmed Method is Running !
Press any key to continue...

Note> Running in Manual Mode !
Press any key to continue...

When trying to stop a method that is not running:

Note> Not running !
Press any key to continue...

Note: If a key is pressed which has no function in the present operational mode (e.g., pressing a letter key when numeric input is required), the instrument will emit a beep after a note or error message appears. If no corrective action is taken, this beep will be emitted at increasing time intervals up to a time period of 3 minutes after which it will repeat the same series of beep emissions for a further 3 minutes `ad infinitum` until any key is pressed in response to the message displayed.

8.3 Help Messages

As stated in Section 5.6, Help, you can press the HELP key if you are uncertain what to do when parameter setting. A 'Help' message will then be displayed. It begins with an identity number and the text will help you decide how best to proceed. A list of the 'Help' identity numbers is given on the next page along with the corresponding sections in this Instruction Manual which can provide you with more detailed information related to the 'Help' message if you require it.

HELP No.	Section(s)	HELP No.	Section(s)
HELP 00>	5.1 - 5.4	HELP 51>	5.7
HELP 01>	5.1 - 5.4, 7.1	HELP 52>	2, Output
HELP 02>	7.1	HELP 53>	2, Output
HELP 03>	7.1, 5.8	HELP 54>	2, Output
HELP 04>	5.1 - 5.4	HELP 55>	7.2.5
HELP 05>	7.2.1	HELP 56>	2, Output
HELP 06>	7.2.1	HELP 57>	-----
HELP 07>	7.2.1	HELP 58>	7.1
HELP 08>	7.2.2	HELP 59>	-----
HELP 09>	7.2.4		
HELP 10>	7.2.4	HELP 60>	-----
HELP 11>	------	HELP 61>	-----
HELP 12>	7.2.5	HELP 62>	7.2.4
HELP 13>	7.2.3	HELP 63>	7.2.1
HELP 14>	7.2.3	HELP 64>	-----
HELP 15>	7.2.3	HELP 65>	2, Output
HELP 16>	7.2.6	HELP 66>	2, Output
HELP 17>	5.1 - 5.3	HELP 67>	7.2.4
HELP 18>	7.2.6	HELP 68>	7.2.4
HELP 19>	7.2.3, 5.1 - 5.3	HELP 69>	-----
HELP 20>	7.2.1, 5.1 - 5.3	HELP 70>	-----
HELP 21>	7.2.1, 5.1 - 5.3	HELP 71>	7.2.5
HELP 22>	7.2.1, 5.1 - 5.3	HELP 72>	7.1
HELP 23>	-----	HELP 73>	-----
HELP 24>	5.5, 5.1 - 5.3		
HELP 25>	7.2.5		
HELP 26>	5.7, Function + 4	HELP 80>	5.7
HELP 27>	7.2.5	HELP 81>	5.7
HELP 28>	7.2.5	HELP 82>	5.7
HELP 29>	7.2.5	HELP 83>	5.7
HELP 30>	7.2.5	HELP 84>	5.7
HELP 31>	5.8	HELP 85>	5.7
		HELP 86>	-----
		HELP 87>	-----
		HELP 88>	-----
HELP 40> through to HELP 50>	8.1	HELP 89>	-----
		HELP 90>	-----
		HELP 91>	5.7

9. Spare Parts and Accessories

Part Number	Product
18-1002-72	High voltage connector (set of 4)
18-1004-16	Banana plug adaptor (coded for 500 V max.)
18-1004-17	HVC coded sleeve for 500 V max.
18-1004-18	HVC coded sleeve for 1000 V max.
18-1004-19	HVC coded sleeve for 3500 V max.
18-1004-20	HVC sleeve, uncoded (HVC blank)
90 02 5938	Instruction Manual for the MultiDrive XL Power Supply
90 01 8472	Safety interlock cable (for connecting the MultiTemp Thermostatic Circulator)
95 83 0014	Fuse 2 A/EU (pkg/10)
95 83 0044	Fuse 4 A/US (pkg/10)
95 83 0074	Fuse 200 mA/EU (pkg/10)
95 83 1021	Fuse 400 mA/US (pkg/10)
95 88 1002	Fuse cap/EU
95 88 1003	Fuse cap/US
95 69 1021	Air filter

Pharmacia LKB Biotechnology
S-751 82 Uppsala, Sweden

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