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BIO-RAD

Bio-Rad's Model 3000xi Computer Controlled Power Supply

Instruction Manual

Catalog Number 165-0554 and 165-0555

Bio-Rad Laboratories, 3300 Regatta Boulevard, Richmond CA 94804 • Phone (415) 232-7000

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Section 1
Introduction

1.1 Preface

Bio-Rad's computer controlled Model 3000xi Power Supply is the most powerful electrophoresis power supply available. It produces constant voltage to 3,000 volts, constant current to 300 mA, and constant power to 400 watts. This fully switching, microprocessor controlled unit may be used with any electrophoresis instrument. The high outputs make the Model 3000xi Power Supply ideal for electrofocusing, DNA sequencing, and isotachophoresis. The supply is useful as a general purpose instrument, and is recommended for SDS-PAGE electrophoresis, two-dimensional electrophoresis, native gel electrophoresis, electrophoretic blotting, and DNA/ RNA separations.

The Model 3000xi Power Supply is a fully programmable and computerized instrument that incorporates several unique features. The supply offers four operating modes: standard, time, volt-hour, and step. The operator has a choice of running electrophoresis manually, for a set period of time, or for a set number of volt-hours. These parameters can be combined using the step mode. While operating in any one of the four modes, the user simply enters the desired power conditions and begins the run. The operational parameters are displayed on the LCD. Output voltage, current, and power are displayed on the LED display.

Electrophoresis running conditions can also be programmed. Up to 10 routines can be saved in the Model 3000xi Power Supply's memory, where they can be recalled at any time. This is especially useful when using the special step mode which allows three separate electrophoresis running conditions to be programmed simultaneously. A single gel can then be run safely at three different power conditions without the need for constant monitoring.

1.2 Safety

Caution: The Model 3000xi Power Supply operates at extremely high voltages. It is designed to be operated by knowledgeable and qualified personnel. Read this entire instruction manual thoroughly before using the power supply.

A. The Model 3000xi Power Supply operates at very high voltages. Handle only one lead wire at a time when connecting a load. DO NOT touch the supply with one hand while plugging in a lead wire.

B. Use of the Model 3000xi Power Supply's No Load By-Pass function will inactivate the power supply's No Load safety feature. If the No Load feature is inactivated, the Model 3000xi Power Supply will not detect an interruption in the electrical circuit at the power supply or in the electrophoresis cell. If this occurs the power supply may continue to deliver power, potentially damaging the electrophoresis cell or creating a hazard.

C. The Model 3000xi Power Supply's No Load By-Pass feature should never be used in conjunction with any electrophoretic switching apparatus, such as the Model 760 Pulsewave® switcher, as this may cause serious damage to the power supply.

D. For the internal cooling fan to function properly, the back of the power supply requires 20 cm or more of clearance.

E. Always connect the supply to a separate three-prong, grounded AC outlet.

F. Do not operate the Model 3000xi Power Supply in extreme humidity, or where condensation can short the electrical elements.

G. When operating the power supply in a cold room, wrap in a plastic bag and let it equilibrate to temperature for 2 hours or more. After thermal equilibration, remove the bag and begin operation. Follow the same procedure for re-equilibration to room temperature.

Note: The Model 3000xi Power Supply has been tested for temperatures between 0° and 40° C. It will operate at temperatures below 0° C, but 0-40° C operation is recommended.

H. Do not store any item on top of the power supply.

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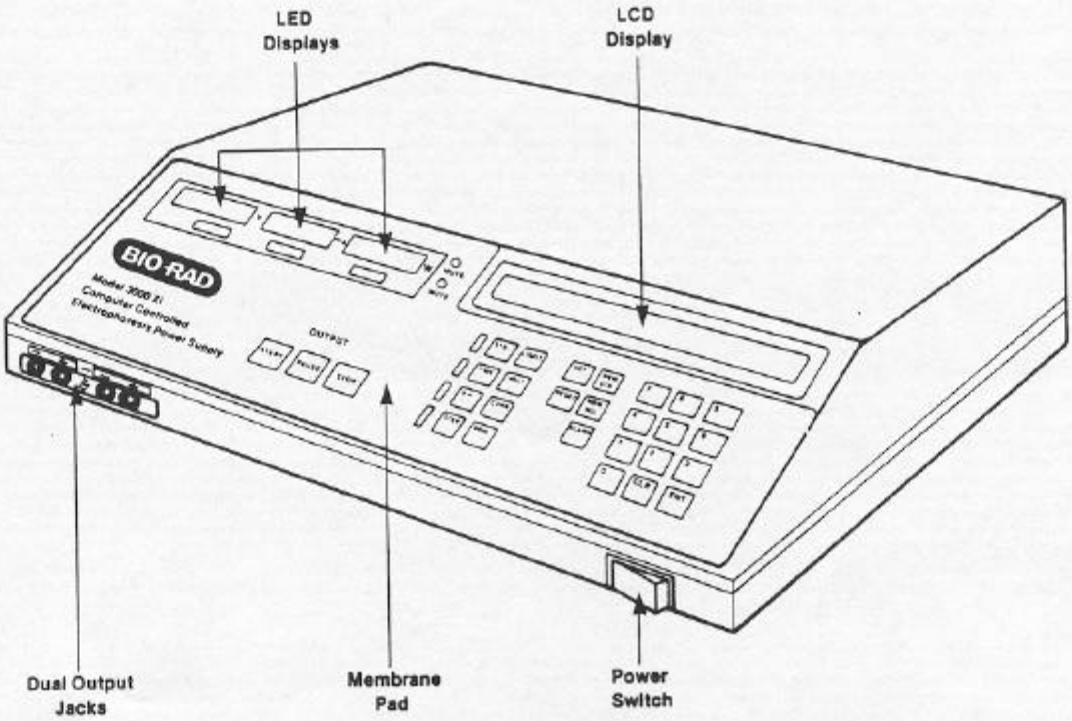
1.3 Specifications

Output	Voltage:	25-3,000 volts DC	
	Current:	0-300 milliamps	
	Power:	0-400 watts	
Output terminals	Dual output jacks in parallel.		
Limits	Voltage:	50-3,000 volts, 1 V step	
	Current:	10-300 milliamps, 1 mA step	
	Power:	10-400 watts, 1 W step	
	Automatic crossover upon reaching limit.		
Set point accuracy (Output and Limit)	Voltage:	±1%	500-3,000 VDC
		± 5 V	50-500 VDC
	Current:	±1%	100-300 mA
		±3 mA	1-100 mA
	Power:	±1%	100- 400 W
		±2 W	1-100 W
Overload and short protection	Circuit breaker		
Leakage detection	Lamp and alarm >500 µA		
No load detection	Lamp and alarm > 6 million Ω		
Operating temperature	0-40° C		
Line voltage (frequency)	Two versions:		
	90 - 130 VAC	(47-63 Hz)	
	200 - 260 VAC	(47-63 Hz)	
Line regulation	± 0.5% at 2,000 VDC		
Load regulation	±1% with 100% change in load		
RMS ripple and noise	Less than 2% at 3,000 VDC and 400 W		
Drift	± 0.5% after 30 minutes		
Accuracy of LED displays	Voltage	±1%	500-3,000 volts
		± 5 V	50-500 volts
	Current	±1%	100-300 milliamps
		±3 mA	1-100 milliamps
	Power	±1%	100-400 watts
		±2 W	1-100 watts
Dimensions (W x H x D)	40 x 32 x 11.5 cm		
Weight	9.7 kg		

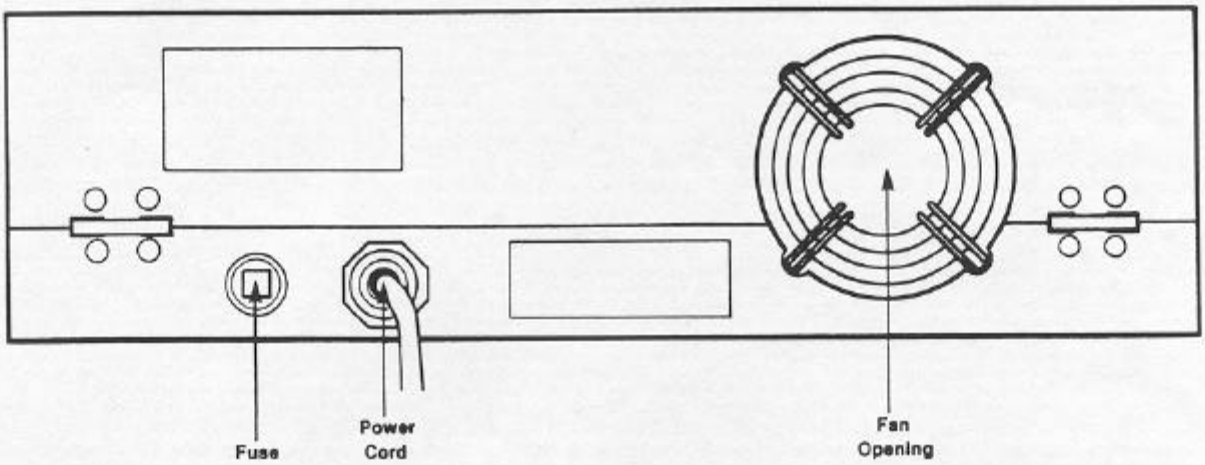
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1.4 Diagram of Major Parts

Model 3000xi Power Supply, Front

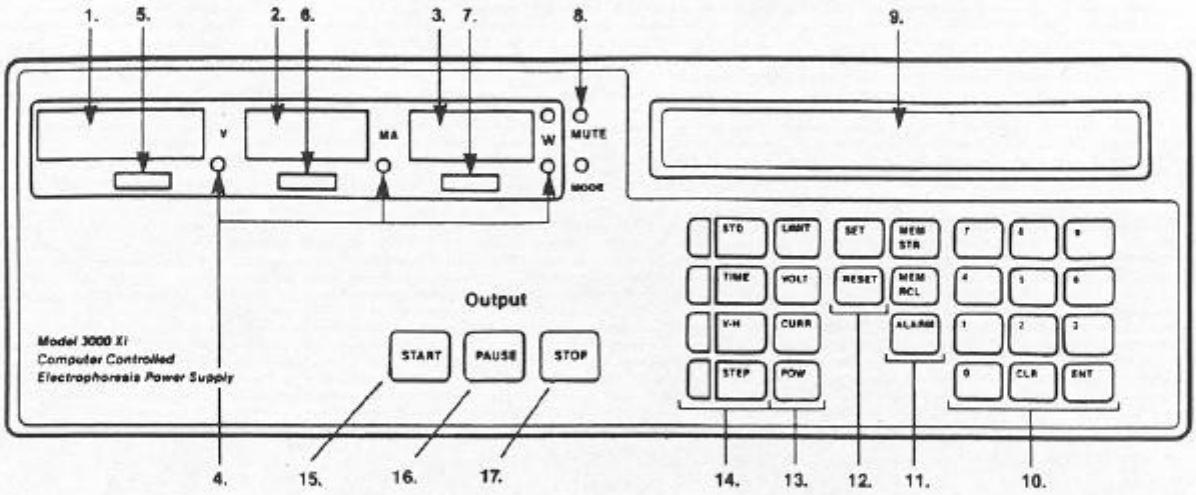


Model 3000xi Power Supply, Rear



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Model 3000xl Power Supply, Membrane Pad



1.5 Description of Membrane Pad

1.	LED display, Voltage	Displays the operating voltage in volts when the supply is connected to a load.
2.	LED display, Current	Displays the operating current in milliamps when the supply is connected to a load.
3.	LED display, Power	Displays the operating power in watts when the supply is connected to a load.
4.	Mode Indicator lamps	Appropriate light illuminates when supply is programmed to run as constant voltage, current, or power.
5.	No Load	The lamp will illuminate if the power supply indicator detects a resistance of greater than 6 million Ω. The supply will shut down and an alarm will sound. If the No Load detection is turned off, the No Load lamp will continue to flash throughout the run until the power supply is turned off. With the No Load detection deactivated, resistance of greater than 6 million Ω will not cause the supply to shut down or the alarm to sound.
6.	Overload	The lamp will illuminate if the unit is directly shorted at the output. The supply will shut down and an alarm will sound.
7.	Ground Leak indicator lamp	When the power supply detects ground leakage of greater than 100 µA, the unit shuts down, the light illuminates, and the alarm sounds.
8.	Alarm Mute indicator lamp	When the alarm is switched to the off position, the indicator will illuminate.
9.	LCD screen	Several parameters are displayed in this area :

A. All voltage, current, and power limits that are programmed into the supply are displayed in the upper left area of the LCD screen.

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B. The chosen operational mode, either constant voltage, current, or power is displayed in the upper right portion of the screen.

C. When an electrophoresis run is in progress, the word "run" is displayed in the lower left area of the LCD. If the run is interrupted using the pause button, the word "pause" is shown.

D. The time of a run is always monitored during operation. In the standard operating mode the LCD will display a T=0:00 at the beginning of a run and the elapsed time at the end. In the time mode the display will show a T= 0:00/ 1:00. The time value on the right is programmed into the supply, and the value to the left will count to the set value when the run is started. Time values are displayed in the lower central region of the LCD screen.

E. Volt-hour values are monitored during operation. Volt-hour values are recorded in the lower right of the LCD in the format of either V*H = 0 or V*H = 0 / 0 depending on which operation mode is chosen (standard or volt- hour).

F. When step mode operation is used, the LCD will show which step is in progress or which is being programmed.The format is S=1/3, S=2/3, or S=3/3. In step mode programming, the LCD is used for deciding volt-hour or time control.

G. At the end of a run, the final power conditions will be displayed in the limit area of the LCD. The format is FINAL 305 V 30 mA 9 W. Final values for all parameters in a three step program are obtained by pressing the STEP key.

H. In memory mode operations, the LCD is used to enter or recall a storage cell.

I. If the Pause Button is pressed while turning on the power supply, the LCD will prompt the user to press CLR to turn the No Load detection off.

10. Numeric Pad — All numbers are entered using the membrane pad. Included in this cluster are the clear (CLR) and enter (ENT) keys which are used for clearing a numeric entry and for entering values.

11. MEM STR, MEM RCL and ALARM — Used for saving power supply operating programs. Pressing MEM STR, results in a message on the LCD screen, "Memory Number ? [0] - [9]". The same message will appear if memory recall (MEM RCL) is chosen. Values are entered through the numeric pad.

The alarm can be disabled using the Alarm on/off key.

12. SET and RESET — Following selection of a mode, the Set key is used to identify the parameter to be changed. To change from the standard mode to the time mode, the sequence TIME, SET, 100, ENT is entered. This identifies the new mode, then sets the time for 1 hour.

RESET is used to clear the constant running condition to zero. It also is used to clear previous programs from step registers.

13. LIMIT — Used in setting the constant running condition and the voltage, current, and power limits for all operational modes.

14. OPERATION MODE — Used to set either standard, time, volt-hour, or step operation. The chosen mode is indicated by the lamp to the left of the keys.

15. START — Press to begin a run. The LED displays volts, current, and power. Set parameters are displayed on the LCD. Time and volt-hour clocks begin counting.

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16. PAUSE — Press to interrupt the run to manipulate the load. All parameters freeze. After re-starting, the supply resumes operation. Time and Volt-Hour begin counting from the pause point. If Pause is pressed while switching on the power supply, the supply will prompt the user to disable the No Load detection feature.

17. STOP — Press to stop the run. The LCD displays final power conditions, time and volt-hours are reset to zero.

Section 2 Operation

2.1 Start Up

A. Turn the power supply on. The LED flashes 20 volts, 0 milliamps, and 0 watts. The alarm sounds and the no-load indicator lamp is illuminated.

B. If desired, turn the alarm off by pressing the Alarm on/off key. The mute light on the upper left side of the LED display will illuminate. Remember to turn the alarm on before starting your electrophoretic run.

C. The operating mode automatically defaults to standard (STD) and the conditions displayed on the LCD reflect the last experiment's parameters.

2.2 Standard Mode Operation

General Application: The standard mode is used for the most basic electrophoretic experiments. The supply is programmed to run in either constant voltage, current, or power within set limits.

A. Press STD. Make sure the indicator light is on.

B. Use the following procedure to set current, voltage, and power limits.

1. Press LIMIT then SET. Values on the top left of the LCD will flash. Press VOLT. Only the voltage limit value flashes. Input 1,000 using the numeric pad. The new voltage limit will read 1,000.

2. Press CURR. Observe the flashing milliamp area on the LCD. Input 200.

3. Press POW. Input 50. The upper limits are now set at 1,000 volts, 200 milliamps, and 50 watts.

4. To change any individual parameter press either VOLT, CURR, or POW. The appropriate area will flash. Set the new parameter(s).

5. Press ENT. The limits for this example are now set. To reset limits after pressing enter, return to number 1 (above).

Note: Do not press ENT after entering voltage, current, or power limits. This results in setting each limit independently. To reset limits, press LIMIT, SET, and begin the process again. Press ENT only after all limit values have been entered.

6. If one of the running parameter's limits is reached during an experiment, the Model 3000xi Power Supply automatically switches to another mode (volts, current, watts). The electronic alarm sounds, if not disabled, and the set running parameter limit remains constant and flashes on the LED.

C. To set a constant running parameter, press either VOLT, CURR, or POW. For example, Press CURR. The upper right portion of the LCD will flash, "CONST = CURR• _____mA". Input 30, and press ENT. The supply is now programmed to run at 30 mA constant current.

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Note: Always press ENT after setting the running condition. The power supply will not allow further input until this task is complete.

D. Attach the leads of the electrophoresis cell to the power supply. Press START. The word "run" appears on the lower left of the LCD. Time is monitored in minutes and the volt-hour integration begins.

E. To interrupt the run, press PAUSE. The word "pause" appears on the lower left of the LCD. Any manipulation of the electrophoretic cell can be done in the PAUSE mode. All run parameters are frozen. Press START and the run proceeds from the point of interruption.

Note: If a change in the running parameters is required, press STOP. The final power conditions and values for elapsed time and volt-hours are displayed on the LCD. Be sure to record pertinent running information (i.e. elapsed time and volt-hours) before interrupting. Pressing START to continue resets time and volt-hours to zero.

If the electrophoretic cell is disconnected from the supply, the supply behaves as if the run were manually stopped.

F. Press STOP to end the run. Final values of all running parameters are displayed on the LCD. These values will remain until another program is entered. Press STD to return to the original program.

G. To run other experiments with the same limits, press RESET. The limit parameters remain fixed and the constant running conditions are returned to zero. Enter the new running parameter.

2.3 Memory Mode Operation

General Application: To store any program in one of the power supply's 10 memory cells for later recall and use.

A. To store the standard mode program set in Section 2.2, press MEM STR. The LCD will display "MEMORY NUMBER? [0] - [9]". Input 0.

B. The original standard mode program is displayed with the message "M-0" on the lower left of the LCD.

C. To recall the program, press MEM RCL. The LCD will ask for the cell number. Press 0 and the original program appears. To run, simply connect the electrophoretic cell and press START.

Note: Make sure all programs are properly recorded. If a new program is saved in an occupied cell, the previous contents of the cell are erased.

All programs are stored in the power supply's memory as long as the internal battery is functioning. Approximate battery life is 5-10 years. See Section 3, Troubleshooting, for replacement procedure.

2.4 Time Mode Operation

General Application: The Model 3000xi Power Supply can operate in any mode for a set period of time. The power supply displays the running time and automatically shuts down when the set time has elapsed. The alarm also sounds.

A. Press TIME. Make sure the indicator light is on. Press TIME again. The lower portion of the LCD will flash T=0:00/0:00.

B. Press SET. Input 4 hours by pressing 400. Check the LCD to confirm. If an error occurred, press RESET. The entered value resets to zero. Input the correct time, confirm, and press ENT. The time values now display T=0:00/4:00. The time on the left is the elapsed time and the one to the right is the set time.

C. Set limits and running parameter as outlined in Section 2.2, B and C. Constant voltage, current, and power can all be run in the time mode.

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D. For practice, enter this program into memory. Press MEM STR, and choose cell number 1. Confirm the program's storage by the message "M=1" displayed in the lower left of the LCD.

E. Plug in the leads from an electrophoresis cell and press START. The "run" message appears on the lower left. As the run proceeds, the left side of the time will count in minutes. After 4 hours, the alarm will sound and the supply shuts off. Final power conditions will be displayed on the LCD. Elapsed time and total volt-hours are also indicated.

2.5 Volt-Hour Mode Operation

General Application: During an electrophoresis experiment, the Model 3000xi Power Supply continuously integrates the voltage as a function of time and reports this value in volt-hours. This parameter is useful for monitoring the progress of the experiment, especially when the voltage varies continuously, as in electrofocusing. By integrating the area under the curve, the power supply provides greater accuracy in reporting actual run conditions. The Model 3000xi Power Supply can also be pre-programmed to terminate a run after a specified number of volt-hours, providing better control over run to run reproducibility.

A To set the supply in the volt-hour operation mode, press V•H. The indicator lamp illuminates. Press V•H again. V*H = 000/ 000 appears in the lower area of the LCD.

B. Press SET and input 750. Check the LCD to confirm. Press ENTER.

C. Set limits and running parameters as outlined in Section 2.2, B and C. Constant voltage, current, and power can all be run in the volt-hour mode.

D. Store this new program in memory cell 3. Press MEM STR, 3.

E. Press START. As the run progresses, the power supply integrates the voltage as a function of time. Actual volt-hours measured during the run are reported on the left and the programmed number on the right, V*H = 750/ 750.

F. When the set number of volt-hours is reached, the power supply turns off and sounds the electronic alarm. As in all operating modes, the final run parameters are displayed on the LCD.

G. To use these running conditions in another experiment, recall program 3 by pressing MEM RCL, 3.

2.6 Step Mode Operation

General Application: The step mode allows up to three different sets of running conditions to be programmed and run in sequence. The supply automatically switches from one program to another. Either the time or volt-hour mode can be used with the step function. This mode is ideal for electrophoresis experiments that require continuous power condition adjustments like discontinuous SDS-PAGE and electrofocusing.

A. Press STEP. If the LCD displays a previous experiment's program where the message "S = 2/3" or "S = 3/3" appears in the lower left, press STEP until "S = 1/3" is displayed. Press RESET.

Note: In the step mode the Reset key is used to clear all information from the LCD. Pressing RESET while in S = 1/3 clears 1/3, 2/3, and 3/3. Pressing RESET while in S = 2/3 clears 2/3 and 3/3. A cleared cell is indicated by the message "END OF STEP S= / ". CLEAR ALL STEPS BEFORE BEGINNING A PROGRAMMING SEQUENCE BY RETURNING TO S = 1/3 AND PRESSING RESET.

B. Press SET to begin programming the first step (S = 1/3). The power supply will ask for the operating mode. Only time or volt-hours can be used. Press TIME. Both the STEP and TIME indicator lamps will illuminate.

C. Press TIME again. Press SET and input the running time desired for the first step (S=1/3). Press ENT.

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D. Set limits and running parameters as outlined in Section 2.2, B and C. Constant voltage, current, and power can all be run in this mode. Programming S = 1/3 is now complete.

E. Press STEP. The power supply is ready for programming step 2 of 3. Press SET. Press the V•H key to program this step in the volt-hour mode. Enter the desired number of volt-hours by pressing V•H, SET. Press ENT.

F. Set limits and running parameters as in S = 1/3.

Note: If the experiment requires only a two step function, save the program to memory cell 3. Return to S = 1/3 and begin the run. If the experiment requires a third step, continue with programming.

G. To program S = 3/3, press STEP, SET. Choose either time or volt-hour mode. Set limits and running parameters as in previous steps.

H. The power supply is now fully programmed to run a single electrophoresis experiment under three different sets of running conditions in succession.

I. Review the three steps by pressing STEP. With each push of the step key, the LCD will display each programmed step. If a parameter needs changing, make adjustments at this point. When all editing is complete, save the program to memory cell 4. A three step program can be saved no matter which step is showing on the LCD display. When the program is recalled, the last step saved is displayed.

J. Press STEP to return to step 1/3. Connect the leads of the electrophoresis apparatus and press START. The experiment will progress through each step automatically, sounding the alarm at each step change. At each change, the time and volt-hour values will reset.

Note: The power supply can be started on any step. Make sure S = 1/3 is displayed on the LCD before beginning the experiment.

K. At the end of the run, the power supply turns off, sounding the electronic alarm. As with all operating modes, the final run parameters are displayed on the LCD. To obtain the final power conditions, elapsed time, and number of volt-hours of all steps, press STEP to view 1/3, 2/3, and 3/3.

2.7 No Load By-Pass Operation

Electrophoretic applications which have an internal resistance of greater than 6 million ohms, i.e., high voltage focusing of 1-2 tube gels, will activate the Model 3000xi Power Supply's No Load safety feature. When activated, this safety feature immediately stops delivery of power during the run. With the No Load By-Pass feature, experiments with high resistance can be run without interruption.

Warning: Use of the Model 3000xi's No Load By-Pass function will inactivate this power supply's No Load safety feature. If the No Load feature is inactivated, the Model 3000xi Power Supply will <u>not</u> detect an interruption in the electrical circuit at the power supply or in the electrophoresis cell. If this occurs the power supply may continue to deliver power, potentially damaging the electrophoresis cell or creating a hazard.

Note: The Model 3000xi Power Supply's No Load By-Pass feature should <u>not</u> be used in conjunction with any electrophoretic switching apparatus, such as the Model 760 Pulsewave switcher, as this may cause serious damage to the power supply.

A. To activate the No Load By-Pass feature, hold the Pause button down while switching on the power supply. The LCD display asks you whether you want the No Load detection on or off.

B. Press the CLR button to turn off the No Load detection. The red "No Load" light will continue to flash on and off throughout the run. At the end of the run, the power supply will automatically revert to the No Load detection "on" status.

C. To start another electrophoresis run using the No Load By-Pass feature, turn off the power supply and repeat the procedures given in steps A and B.

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Section 3
Troubleshooting

Condition	Cause	Remedy
1. With the power supply on, the ON/OFF lamp fails to illuminate and output is not displayed.	1a. Power cord is not properly connected.	1a. Check connections.
	1b. The circuit breaker has tripped.	1b. Reset switch.
2. With the power supply on, no output is displayed, and No Load light illuminates. Alarm sounds.	2a. The electrophoresis cell (load) is not connected or the resistance is too high (> 6 million ohms).	2a. Check the electrophoresis cell for circuit interruption.
		2b. Check electrophoresis buffers for conductivity.
		2c. If resistence is too high use the No Load By-Pass feature.
3. The No Load light continues to flash on and off during the run, however the alarm does not sound and the power supply continues to run.	3a. The No Load detection feature has been deactivated.	3a. Refer to Section 2.7 for description of No Load By-Pass feature.
4. With the power on, the Overload light illuminates. Alarm sounds, unit shuts down.	4a. Supply has detected a direct short at the output.	4a. Turn power supply off. Disconnect load and check both load and power supply circuits for continuity.
5. With the power on, the GND Leak light illuminates. Alarm sounds, unit shuts down.	5a. Supply has detected a ground leak of > 100 µA.	5a. Turn power supply off. Disconnect load and check load for ground leakage.
6. Output values on LED are unstable.	6a. Interference with another electrical apparatus plugged into the same circuit.	6a. Connect supply to separate outlet.
	6b. Supply was not allowed to warm up.	6b. Follow warm up procedure.
7. Desired output is not achieved on the LED. Alarm sounds and output LED flashes.	7a. The limit setting was set too low.	7a. Reset the limits on the LCD.
8. Circuit breaker trips frequently.	8a. Abnormality inside unit.	8a. Contact Bio-Rad or technical representative.
9. Memory mode malfunctions; LCD display shows "Replace Battery".	9a. Life of internal battery exceeded.	9a. Contact Bio-Rad's Instrumentation Service Department to order a new battery. The replacement procedure will be included with the battery.

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10. Power supply does not start.	10a. Circuit breaker tripped.	10a. Reset breaker. Test supply with a different load.
	10b. Power supply was overloaded. Electrophoresis buffer incorrectly prepared.	10b. Check conductivity of electrophoresis buffer. Remake buffer.
	10c. Supply was set to run above set limits.	10c. Reset limits or change the constant running conditions.
	10d. Running conditions were incorrectly entered.	10d. Press ENTER to program running condition into the supply. Unit will not operate until this function is completed.

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