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# **Model 200/2.0 Power Supply**

## **Instruction Manual**

**Catalog Numbers  
165-4761 and 165-4762**

**BIO-RAD**

For Technical Service Call Your Local Bio-Rad Office or in the U.S. Call **1-800-4BIORAD** (1-800-424-6723)

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## Note

To insure best performance from the Model 200/2.0 Power Supply, become fully acquainted with these operating instructions before use.

**Model** \_\_\_\_\_

**Catalog No.** \_\_\_\_\_

**Date of Delivery** \_\_\_\_\_

**Warranty Period** \_\_\_\_\_

**Serial No.** \_\_\_\_\_

**Invoice No.** \_\_\_\_\_

**Purchase Order No.** \_\_\_\_\_

## Warranty

Bio-Rad Laboratories warrants the Model 200/2.0 Power Supply against defects in materials and workmanship for 1 year. If any defects occur in the instrument during this warranty period, Bio-Rad Laboratories will repair or replace the defective parts free. The following defects, however, are specifically excluded:

1. Defects caused by improper operation.
2. Repair or modification done by anyone other than Bio-Rad Laboratories or an authorized agent.
3. Use of spare parts supplied by anyone other than Bio-Rad Laboratories.
4. Damage caused by accident or misuse.
5. Damage caused by disaster.
6. Corrosion due to use of improper solvent or sample.

For any inquiry or request for repair service, contact Bio-Rad Laboratories after confirming the model and serial number of your instrument.

# Section 1

## Introduction

### 1.1 General Information

Bio-Rad's Model 200/2.0 microprocessor controlled power supply provides constant voltage to dual output jacks under a variety of operating conditions. Voltage is continuously adjustable from 5 to 200 volts, producing up to 200 watts of power. Current limits can be set from 0.01 to 2.0 amperes to control the current generated. Although the power supply is especially useful in blotting applications, it is also useful for nucleic acid electrophoresis and for applications using the Mini-PROTEAN® II vertical electrophoresis cell.

Features of the Model 200/2.0 power supply include:

- 3-digit LED display to show operating and limit parameters
- 3-speed adjustment buttons to quickly adjust running parameters
- Two operating modes: standard, to run electrophoresis manually; and time, to run for a set time period
- Constant current operation using the continuously adjustable current limit function
- Automatic switching to constant current operation when the current exceeds the current limit
- Automatic no-load sensing
- Continuous monitoring of load resistance, power output, and volt-hours during the run

### 1.2 Safety

**Caution:** The Model 200/2.0 power supply is to be operated only by qualified personnel. Read this entire instruction manual thoroughly before using the power supply.

1. For the internal cooling fan to function properly, the sides of the power supply require 6 cm or more of clearance. Do not block the fan.
2. Always connect the supply to a separate 3-prong, grounded AC outlet. Handle only one lead wire at a time when connecting a load to the power supply.
3. Do not operate the Model 200/2.0 power supply in extreme humidity ( $\geq 95\%$ ), or where condensation can short the electrical elements.
4. When operating the power supply in a coldroom, wrap it in a plastic bag and let it equilibrate to temperature for 2 hours or more. After thermal equilibration, remove the supply from the bag and begin operation. Follow the same procedure for re-equilibration to room temperature.

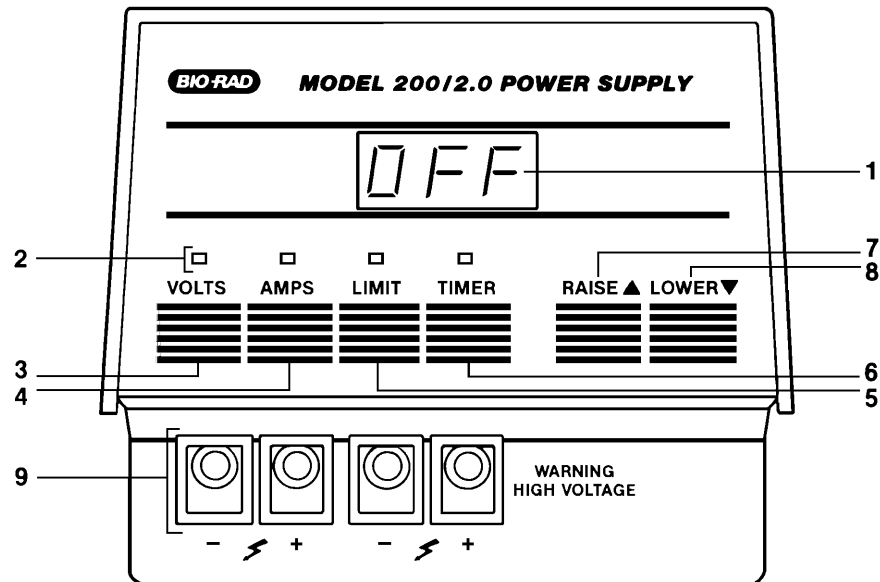
**Note:** The Model 200/2.0 power supply will perform at temperatures between 0° and 35 °C. It has also passed tests for operation with humidity between 0 and 95% under conditions where condensation is absent. Operating the power supply outside of these conditions is not recommended, and will void the warranty.

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

## 1.3 Specifications

<b>Output voltage</b>	5-200 volts DC, continuously adjustable
<b>Output current</b>	0.01-2.0 A, continuously adjustable
<b>Output terminals</b>	Floating dual output jacks in parallel
<b>Set limits</b>	Current: 0.01-2.0 A, 0.01 A steps, fully adjustable Power: 200 watts maximum output  Automatic crossover upon reaching limit.
<b>Timer control</b>	0.1-99.9 hours, 0.1 H steps, continuously adjustable
<b>Set point resolution</b>	Voltage: $\pm 1$ V, 5-200 VDC Current limit: $\pm .01$ A, .01-2.0 A Time set: + 0.1 H, 0.1-99.9 hours
<b>Readout accuracy</b>	Voltage: + 1 V Current limit: + .05 A Timer: 2 seconds per hour
<b>Overload and short protection</b>	Fuse
<b>No load detection</b>	LED display and alarm
<b>Operating temperature</b>	0-35 °C
<b>Operating humidity</b>	0-95%, in the absence of condensation
<b>Line voltage (frequency)</b>	
100/120 V model	90 - 132 VAC (47-63 Hz)
220/240 V model	198 - 264 VAC (47-53 Hz)
<b>Line regulation</b>	$\pm 3\%$ or less
<b>Load regulation</b>	$\pm 5\%$ or less
<b>RMS ripple and noise</b>	Less than 5% at 100 VDC and 1 A. Less than 7% at any load (not exceeding current limit)
<b>Drift</b>	$\pm 1$ volts
<b>Dimensions (W x L x H)</b>	16.5 x 31 x 13.5 cm
<b>Weight</b>	5.45 kg

## 1.4 Diagram of Front Panel Membrane Control Pad



## 1.5 Description of Membrane Control Pad

- 1. LED display** Displays the current limit, voltage, and timer parameters while they are being set. Displays the operating parameters of current, current limit, voltage, time, load resistance, power output, and volt-hours during a run.
- 2. Mode indicator lights** When a function button is pressed, the indicator light above it will illuminate, indicating that the LED is displaying that parameter. When the power supply is operating at constant current, the light above LIMIT will be flashing.
- 3. VOLTS** Press this button to set the voltage or to view the operating voltage.
- 4. AMPS** Press this button to view the operating current. Press this button and then either RAISE or LOWER to observe load resistance, power output, and volt-hours during a run.
- 5. LIMIT** Press this button to set or view the current limit.
- 6. TIMER** Press this button to set or view the timer.
- 7. RAISE** Press this button to adjust the voltage, current limit, or timer parameters upward.
- 8. LOWER** Press this button to adjust the voltage, current limit, or timer parameters downward.
- 9. Output terminals** Connect the leads to the electrophoresis apparatus here.

## Section 2 Operation

### 2.1 Standard Mode Operation

General Application: The standard mode is used in blotting applications and in nucleic acid electrophoresis experiments where timing the run is not important. In this mode, the supply is programmed to run at constant voltage within set current limits.

#### Set the Current Limit

1. Press LIMIT. The red indicator light above the button should be on. The LED should read 2.00.
2. Press and hold LOWER. Release when the current limit shown in the LED reaches the desired setting. If the desired limit is overrun, use RAISE to adjust the limit upward.
3. The current limit default is 2.0 amperes. If a current limit is not set, the power supply will default to this limit for voltages set below 100 V. If the voltage is set above 100 V, the power supply will automatically adjust the current limit based on its 200 watt output capability. The adjusted current limit will be determined by the equation:

$$\text{limit} = \frac{200 \text{ watts}}{\text{volts}}$$

4. The current limit can be adjusted during the run by pressing LIMIT and adjusting the parameter with either RAISE or LOWER.

#### Set the Voltage

1. Press VOLTS. The red indicator light above the button should be on. The LED should read OFF.
2. Press and hold RAISE until the LED displays the desired voltage setting. The power supply starts running as soon as a voltage reading is shown on the LED display. If the desired setting is overrun, use LOWER to adjust the setting downward.
3. If a voltage is set that generates a current exceeding the current limit set, the power supply will automatically switch to operating at constant current when it reaches the current limit. The red indicator light above LIMIT will flash. The voltage displayed on the LED will be the actual voltage, rather than the set voltage. The display reverts to actual voltage 5 seconds after the voltage has been set. When a current limit above 1.0 amperes is set, the power supply will automatically adjust the current limit downward if a voltage that would exceed the 200 watt output limit of the power supply is set. If the set voltage is reduced, the power supply will automatically return to the original current limit that was set.
4. The voltage can be adjusted during a run by following steps 1 and 2 above.



## Turn the Power Supply Off

There are three different ways to turn the power supply off.

1. Press VOLTS. The red indicator light should be on. Press LOWER until the LED display reads OFF. Using this method preserves the volt-hour reading until the voltage is reset, but resets all of the other functions to their default values.
2. An alternative method to turn the power supply off is to press VOLTS. The red indicator light should be on. Press RAISE and LOWER simultaneously. The LED will display OFF. If the load has already been disconnected, the LED will display OFF for 1 second, then the decreasing voltage will be shown until it reaches 30 volts. Below 30 volts, OFF will be displayed. Using this method preserves the volt-hour reading as long as RAISE is not held down long enough to reset the voltage.
3. The third method to turn the power supply off is to turn the power switch off. This automatically resets all functions to their default values, including the volt-hour integration data. Note: The power supply left on with no load attached consumes approximately 12 watts of power (equivalent to a night light).

## 2.2 Time Mode Operation

General Application: The Model 200/2.0 power supply can operate at constant voltage or constant current for a set time. The power supply automatically shuts off and the alarm sounds when the set time has elapsed.

1. Set the current limit as in Section 2.1.
2. Set the timer.
  - Press TIMER. The red indicator light above the button should be on, and the LED display should read 00.0.
  - Press and hold RAISE until the LED display reads the correct time. The timer displays tenths of hours. It may be necessary to use both RAISE and LOWER to reach the desired setting.
3. Set the voltage as in Section 2.1.
4. The timer begins to count as soon as the voltage is above zero, and will count down from the set time to zero. When the timer reaches zero, the alarm will sound, and the power supply will shut off. The LED display will read OFF.
5. To turn the alarm off, press any one of the function buttons.
6. Turn the power switch off, if desired.

## 2.3 Checking and Changing Operating Parameters

General Application: The current, voltage, current limit, time remaining (if the timer has been set), resistance load, power output, and volt-hours can be checked during a run to monitor the progress of the experiment or to troubleshoot. The current limit, operating voltage, and set time may be changed at any time during a run.

1. Press AMPS to view the operating current. The red indicator light above the button should be on, and the operating current will be shown on the LED display.
2. Press VOLTS to view the operating voltage. The red indicator light above the button should be on, and the operating voltage will be registered on the LED display. To alter the voltage, follow the procedure in Section 2.1.

3. Press **LIMIT** to view the set current limit. The red indicator light above the button should be on, and the set limit will be shown on the LED display. To adjust the current limit, follow the procedure in Section 2.1.
4. Press **TIMER** to view the remaining time on the timer. The red indicator light above the button should be on, and the time remaining will be shown on the LED display. To change the time remaining for the run, follow the steps detailed in Section 2.2, item 2.
5. To view the resistance load, power load, and volt-hours settings, press **AMPS**, and then press either **RAISE** or **LOWER**. The indicator light above **AMPS** will go off, and the LED display will alternately flash **rLD** and the resistance value in thousands of ohms. Press **RAISE** or **LOWER** again, and the LED display will alternately flash **PLD** and the power output in watts. Press **RAISE** or **LOWER** again, and the LED display will alternately flash **E-H** and the volt-hour reading in thousands of volt-hours.

## Section 3 Blotting Applications

### 3.1 Required Steps for Proper Blotting Results

Observe the following guidelines to avoid mishaps that may result in serious damage to the instrument or injury to the operator:

1. Read the Trans-Blot® cell instruction manual before beginning electrophoretic transfers.
2. Do not attempt high intensity transfers or overnight runs until you are completely familiar with your system.
3. Pre-equilibrate electrophoresis gels in transfer buffer before beginning transfer to remove contaminating electrophoresis buffer salts or neutralization salts that will increase the conductivity of the transfer buffer. The length of time required for pre-equilibration depends on the gel thickness, and can range from 20 minutes for 0.75 mm thick SDS polyacrylamide gels to 1 hour for 3-6 mm thick DNA agarose gels. The gel can be pre-equilibrated in a shorter time if the pre-equilibration buffer is changed several times.
4. Use the General Guide to Transfer Buffers and Running Conditions (Table 1) as a guideline in setting current limits on the power supply. Unless proper current limits have been set, uncontrolled conductivity changes may result in full power being delivered to the Trans-Blot cell. This is a safety hazard due to the excessive heat (power). In this situation, the transfer buffer may boil and evaporate, causing the gel holder and electrode cards to deform.
5. Operating the Trans-Blot cell in the coldroom is an inadequate means of controlling transfer buffer temperature. For high power applications, efficient heat removal is obtained only by using the Super Cooling Coil connected to a refrigerated recirculating bath capable of 200-300 watt heat extraction at ambient evaporation temperature.
6. Place a stirring bar inside the Trans-Blot cell and stir during transfer to help maintain uniform buffer conductivity and temperature.
7. Buffer preparation is extremely important. Do not pH adjust transfer buffers unless specifically indicated in the instruction manual. Use only high quality, reagent grade methanol. Do not reuse transfer buffers.

8. Sponge pads can not dissipate heat as effectively as Scotch Brite® gel pads. For high power, high intensity applications, it is advisable to use gel pads in place of sponge pads to minimize localized heating effects.
9. Do not increase voltage settings beyond those indicated in Table 1 for overnight operation. If overnight transfers at low voltages are ineffective for your application and you must increase the voltage, you must also decrease the transfer time and/or provide external cooling.

**Table 1. General Guide to Transfer Buffers and Running Conditions**

TRANSFER	BUFFER	BLOT MEDIA	POWER RANGES						
			Low Field, Uncooled Lengthy or Overnight		Standard Field Cooling Optional Runs 5 Hours		High Intensity Field Cooling Required to 0-4 °C, Runs 30 Minutes to 4 Hours		
O-Farrell two-dimensional SDS-Protein (Laemmli, etc.)	25 mM Tris, pH 8.3 192 mM glycine, 20% (v/v) methanol	Nitrocellulose, DEAE	30 V	0.1 A	60 V	0.21 A	100 V	0.36 A	
							150 V	0.55 A	
							200 V	0.82 A	
	25 mM Tris, pH 8.3 192 mM glycine, (no methanol)	Zeta-Probe® membrane	30 V	0.1 A	60 V	0.21 A	100 V	0.36 A	
							150 V	0.55 A	
							200 V	0.82 A	
	25 mM sodium phosphate, pH 6.5 or	DBM, DPT	15 V	0.32 A	40 V	1.01 A	70 V	1.86 A	
	10 mM sodium borate, pH 9.2	DBM, DPT	15 V	0.19 A	50 V	0.72 A	70 V	1.03 A	
							90 V	1.45 A	
Native gels Acidic or neutral proteins	25 mM Tris, pH 8.3 192 mM glycine, (no methanol)	Nitrocellulose, Zeta-Probe membrane, DEAE	30 V	0.1 A	60 V	0.21 A	100 V	0.36 A	
							150 V	0.55 A	
							200 V	0.82 A	
	25 mM sodium phosphate, pH 6.5 or	DBM, DPT	15 V	0.32 A	40 V	1.01 A	70 V	1.03 A	
	10 mM sodium borate, pH 9.2	DBM, DPT	15 V	0.19 A	50 V	0.72 A	70 V	1.03 A	
							90 V	1.45 A	
Isoelectric focusing Native gels - basic proteins, acid urea gels	0.7 % acetic acid	Nitrocellulose, Zeta-Probe membrane, DEAE	30 V	0.16 A	70 V	0.49 A	100 V	0.55 A	
							150 V	0.85 A	
DNA, RNA	10 mM Tris, pH 7.8 5 mM sodium acetate 0.5 mM EDTA	Zeta-Probe membrane, DEAE	30 V	0.28 A	60 V	0.60 A	80 V	0.83 A	
							100 V	1.03 A	
	50 mM Tris, pH 8.3 50 mM boric acid 1.0 mM EDTA	Zeta-Probe membrane	20 V	0.12 A			80 V	0.45 A	
	25 mM sodium phosphate, pH 5.5	DBM, DPT	15 V	0.22 A	40 V	0.68 A	60 V	1.09 A	
							85 V	1.57 A	
	10 mM sodium acetate, pH 4.0	DBM, DPT	20 V	0.15 A	70 V	0.54 A	100 V	0.8 A	
							125 V	1.03 A	

## Section 4

### Troubleshooting Guide

<b>Condition</b>	<b>Cause</b>	<b>Remedy</b>
1. With the power supply on, the LED fails to illuminate.	1a. Power cord is not properly connected.	1a. Check connections.
	1b. The fuse has blown.	1b. Replace fuse.
2. With the power supply on, and the current limit and voltage set, there is not current registered when AMPS is pressed.	2a. The electrophoresis cell (load) is not connected	2a. Check the electrophoresis cell for circuit interruption.
		2b. Check to see that electrophoresis cell leads are plugged in.
3. During run, the LED flashes nLD and the alarm sounds.	3a. The supply has detected a sudden interruption of the circuit and turned off.	3a. Turn power supply off. Disconnect load and check for broken wires.
		3b. Check the electrophoresis cell for circuit interruption.
		3c. Check to see that electrophoresis cell leads are plugged in.
4. Desired voltage is not displayed on the LED. Indicator light above LIMIT is flashing.	4a. The power supply is operating at constant current. The voltage was set too high for the set current limit.	4a. Reset the voltage, if desired. Can reset the current limit, if 4b does not apply.
	4b. The power supply is operating at constant current. Conductivity of buffer is too high.	4b. Remake the buffer.
5. Fuse blows frequently.	5a. Abnormality inside unit.	5a. Contact Bio-Rad or technical representative.
6. LED displays OFF, alarm is sounding.	6a. Timer has counted down and shut off power supply.	6a. Press one of the buttons to turn off alarm. Reset current limit, voltage, and timer, if desired.

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