



Model EG-1 Econo Gradient Monitor

Instruction Manual

Catalog Numbers

731-8151

731-8150

BIO-RAD

Warranty

Model _____

Serial Number _____

Date of Delivery _____

Warranty Period _____

Unless otherwise specified, instruments sold by Bio-Rad are under warranty for 1 year against defects in materials and workmanship.

If any defects should occur during this warranty period, Bio-Rad will replace the defective parts without charge. However, the following defects are specifically excluded:

1. Damage caused by improper operation.
2. Repair or modification done by anyone other than Bio-Rad Laboratories or their authorized agent.
3. Deliberate or accidental misuse.
4. Damage caused by disaster.
5. Damage due to use of improper solvent or sample.
6. Damage due to spills.

This warranty does not apply to fittings, tubing, and fuses.

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

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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Section 1

Safety



Disconnect supply before servicing. No user serviceable parts inside. Refer servicing to Bio-Rad service personnel.

This instrument is intended for laboratory use only.

This product conforms to the “Class A” standards for electromagnetic emissions intended for laboratory equipment applications. It is possible that emissions from this product may interfere with some sensitive appliances when placed nearby or in the same circuit as those appliances. The user should be aware of this potential and take appropriate measures to avoid interference.

Section 2 Introduction



Fig. 1.1. Model EG-1 Econo Gradient Monitor.

The Model EG-1 Econo Gradient Monitor is a high quality, easy to use, conductivity and gradient monitor for liquid chromatography. The monitor consists of a control unit and an external flow cell. The flow cell is fitted with luer connectors for rapid tubing connections. It can be connected to the outlet of an Econo-Column® chromatography column or an Econo-Pac® Cartridge.

In the Conductivity mode, the Econo Gradient Monitor functions as a standard conductivity monitor with numerical output in Siemens*. In the Gradient mode, gradient end-points (e.g. buffer A and buffer B) can be programmed, relative gradient progress is displayed on the Bar Graph, numerical output is displayed in Siemens, and full scale output to a chart recorder is automatically adjusted.

The Model EG-1 Econo Gradient Monitor functions as a stand-alone instrument or as an integral part of any chromatography system.

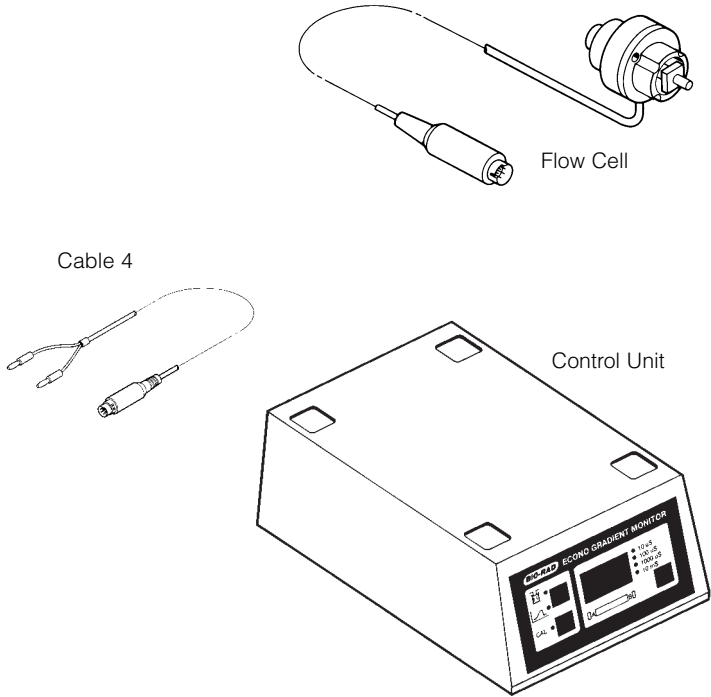
For technical specifications, refer to Appendix C.

*1 Siemen = 1 Mho = 1/Ohm

Section 3 Unpacking

Carefully remove the contents of the shipping box, and check for any obvious damage or problems with the instrument. Figure 2.1 shows the parts included with the Model EG-1 Econo Gradient Monitor. Check off all parts against the supplied packing list.

If any parts are missing or damaged, contact Bio-Rad Laboratories immediately.



Also includes: Instruction Manual, 3 male luer fittings and 3 female luer fittings.

Fig. 2.1. Parts supplied with the Model EG-1 Econo Gradient Monitor.

Note: The Model EG-1 Econo Gradient Monitor requires a power adaptor. If you did not receive one, contact your local Bio-Rad representative.

Section 4 Description and Features

The Model EG-1 Econo Gradient Monitor consists of a control unit and a flow cell. The control unit houses the electronics and user interface. The flow cell connects to the control unit and is external for flexible placement.

The following tables and illustrations describe the features of the Model EG-1 Econo Gradient Monitor.

4.1 Front Panel Functions

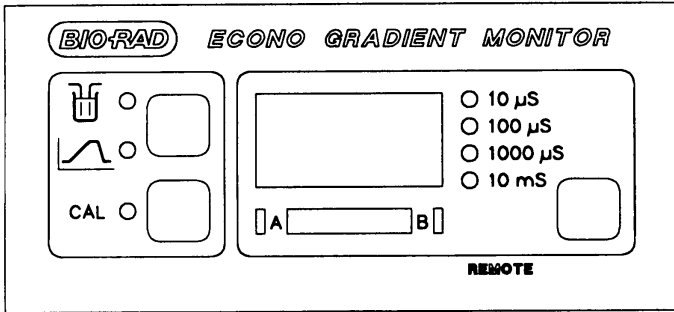


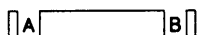


Fig. 3.1. Front panel controls.

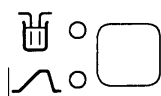
Display	Function
<ul style="list-style-type: none"> ○ 10 μS ○ 100 μS ○ 1000 μS ○ 10 mS 	<p>Range Selector</p> <p>In the Conductivity mode, the Range Selector allows the user to select one of four range settings between 10 micro-Siemens and 10 milli-Siemens full scale. The strip chart recorder output will be scaled accordingly.</p>
	<p>3-Digit Display</p> <p>The 3-digit display shows conductivity in Siemens, in accordance with the range selected.</p>

Display	Function
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Bar Graph

In the Conductivity mode, the Bar Graph provides a graphic representation of the buffer conductivity relative to the lower and upper limits of the selected range. In the Gradient mode, the Bar Graph provides an indication of the buffer conductivity relative to buffer A and B. A flashing red LED at either end of the Bar Graph indicates an out of range condition.



Mode Selector

Allows selection of Conductivity or Gradient mode.



Gradient Calibration

For use only in the Gradient mode. The Gradient Calibration key activates a routine which allows the user to enter conductivity values for buffer A and buffer B by passing the desired "A" and "B" solutions through the flow cell. The values for A and B are automatically established as "0" and 100% full scale and chart recorder output is scaled accordingly.

4.2 Rear Panel Sockets

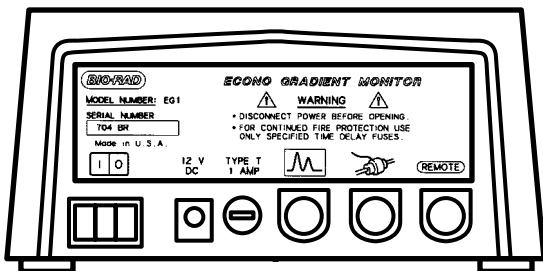






Fig. 3.2. Rear panel sockets.

The rear panel of the Model EG-1 Econo Gradient Monitor control unit contains an On/Off power switch and four sockets for electrical connections (see Figure 3.2). A brief description of each socket follows.

	Display	Function
	Power Entry	For connection of the 12 VDC power adaptor.
	Signal Output Socket	For connection of chart recorders, integrators and computers to the Model EG-1 Econo Gradient Monitor using standard Bio-Rad cables. See Section 4.2 and Appendix B.
	Flow Cell Socket	For connection of the flow cell's Signal Cable.
	Remote Socket	This feature is not implemented in the Model EG-1.

4.3 Flow Cell

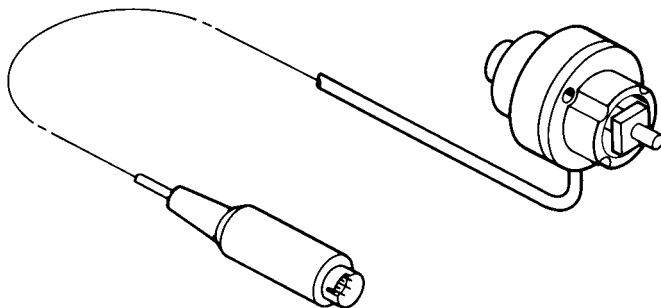




Fig. 3.3. The flow cell.

Inlet/Outlet Ports	A male and a female luer fitting on either end of the flow cell allow rapid tubing connection. The flow cell can be used with flow in either direction. Note: the luer fittings may be unscrewed and replaced with 1/4"-28 threaded flat-bottom fittings.
Signal Cable	For connection of the flow cell to the  socket on the rear panel of the control unit.

Section 5 Setting Up

5.1 Flow Cell Installation

Place the flow cell as close as possible to the column outlet and/or any other detection devices (e.g. a UV flow cell, if used) and connect the flow cell's Signal Cable to the flow cell  socket on the rear panel of the control unit.

If the monitor is to be used in conjunction with the Model EM-1 Econo UV Monitor, connect the gradient monitor flow cell directly to the inlet or outlet port of the portable optics module for optimal detection.


If the Econo Gradient Monitor is to be used with other UV monitors, the flow cell should be placed as close as possible to the UV detection device.

5.2 Connecting the Model EG-1 Econo Gradient Monitor to Recording Equipment


The Model EG-1 Econo Gradient Monitor is shipped with System Cable 4, which connects the Econo Gradient Monitor to channel 2 of the



Model 1327 Econo Recorder. The cable also connects the Econo Gradient Monitor to other recording devices which use banana plug connectors.

Connecting the Model EG-1 Econo Gradient Monitor to a Model 1327 (dual pen) Econo Recorder

The Model EG-1 Econo Gradient Monitor must be connected to channel 2 of the Model 1327 Econo Recorder. Use System Cable 4 to connect the Econo Gradient Monitor to the banana plug signal inputs on the rear panel of the Econo Recorder. Plug the 8-pin mini-DIN end of cable 4 to the  socket on the rear panel of the Econo Gradient Monitor. Insert the black banana plug into the ground \perp input and the red banana plug into the voltage \surd input for channel 2 of the Model 1327 Econo Recorder.

Connecting the Model EG-1 Econo Gradient Monitor to Other Chart Recorders

Use System Cable 4 to connect the Model EG-1 Econo Gradient Monitor to recording devices which accept banana plugs. Insert the 8-pin connector into the signal output  socket on the rear panel of the Model EG-1 Econo Gradient Monitor. At the other end of the cable are two banana plugs. The red plug is the positive output, and the black plug is the negative, or ground. These plugs should fit directly into the input sockets of most chart recorders.

The signal output  socket on the rear panel of the Model EG-1 Econo Gradient Monitor is an 8-pin circular mini-DIN and is intended for use with Econo System components. For those wishing to interface the Model EG-1 Econo Gradient Monitor with equipment such as integrators or chart recorders which do not utilize banana plug connectors, System Cable 7 (available separately) may be used. System Cable 7 has an 8-pin mini-DIN at one end, for connection to the Model EG-1 Econo Gradient Monitor, and loose wires at the other. See Appendix B for the pin configuration of the 8-pin mini-DIN signal output  socket.

Section 6 General Operation

1. Make sure all the electrical connections and plumbing have been done properly (See Section 4). Allow the monitor to warm up for approximately 10 minutes.
2. The Econo Gradient Monitor powers up in either the Conductivity mode or the Gradient mode. Use the Mode Selector key to select the desired mode.



6.1 Conductivity Mode

In the Conductivity \square mode, the numerical LED displays the conductivity (in Siemens) of the solution in the flow cell, and the LED indicator light indicates the range selected. The Bar Graph \square gives an indication of the conductivity relative to the range setting currently chosen (thereby giving an indication of the relative position of the chart recorder pen).

- 10 μ S
- 100 μ S
- 1000 μ S
- 10 mS



1. Press the Range Selector key to select a range which will include the expected maximum conductivity of the solutions to be used.
2. If the monitor is connected to a strip chart recorder, set the recorder range to 1 V. The full scale reading on the recorder corresponds to the selected range setting on the monitor.

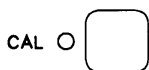
An out of range condition is indicated by a flashing numerical “999” display and flashing red LED’s at either end of the Bar Graph.

6.2 Gradient Mode

In the Gradient \square mode, the numerical LED displays the conductivity (in Siemens) of the solution in the flow cell. The range is automatically determined based on the conductivity values for buffers A and B (entered during calibration). Full scale output to a chart recorder or integrator is adjusted automatically, assuring the gradient trace will not move off the top of the chart paper. Once the gradient monitor is calibrated, the Bar Graph \square will indicate buffer conductivity relative to the conductivity values for buffer A and B.

Calibrating Gradient End Points

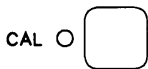
The gradient monitor should be calibrated every time the buffers are changed, if a new batch of buffers is prepared, or if the buffers are one day or more old.



1. Press the CAL key once. The gradient mode, “A” LED, and CAL indicator lights will flash.





2. Pass buffer A through the flow cell using a pump or syringe until the conductivity reading stabilizes. (A flashing CAL indicates the monitor is calibrating.)
3. Press the CAL key to accept the conductivity value for buffer A. The gradient mode, “B” and CAL indicator lights will immediately begin to flash.



4. Pass buffer B through the flow cell until the conductivity reading stabilizes. (A flashing CAL indicates the monitor is calibrating.)

5. Press the CAL key to accept the conductivity value for buffer B.

Note: *If the 3-digit display reads "Err", the conductivity values for buffer A and B are too close together to use the Gradient mode. Press the  Mode Selector key to cancel calibration and use the Conductivity mode.*

When steps 1-5 above are complete, the Bar Graph  will indicate the buffer conductivity in the flow cell relative to the conductivity values set for buffer A and B. The gradient monitor output is automatically calibrated to 0 to 1 V based on the values set for buffer A and B. (Insure that the recorder input is set to 1V full scale.)

If the conductivity of the buffer in the flow cell falls outside the values set for buffers A and B, a red indicator light will appear on the Bar Graph.

Section 7 Care and Maintenance

The Model EG-1 Econo Gradient Monitor requires very little maintenance to assure reliable operation. Following are general procedures for maintenance of the control unit and flow cell.

Model EG-1 Econo Gradient Monitor Control Unit and Flow Cell:

The control unit may be left on continually (power consumption is negligible).

Although the cases are chemical resistant, spills and splashes may cause precipitates to form on the component cases. Use a squirt bottle and soapy water to wash down the outer cases of the instrument.

Flow Cell

Clean the outside surface of the flow cell as described above.

The flow cell should be cleaned periodically with 1 M NaOH at 1 ml/min for 5 min. (SDS, 1 M HCl, 1 M NaOH, EtOH, and acetone will not harm the Model EG-1 Econo Gradient Monitor flow cell.)

When the flow cell is not in use, disconnect, and clean out dissolved salts using a syringe filled with deionized water.

Store the flow cell by injecting a dilute solution (15-25%) of ethanol or isopropanol into the cell to prevent microbial growth. Use the end caps provided to seal the flow cell's inlet and outlet ports. Always rinse the flow cell with water prior to the introduction of aqueous buffers. To prevent the formation of salt crystals and solute deposits, do not allow the flow cell to dry out.

Section 8 Troubleshooting

Problem	Possible Cause	Solution
Baseline drift or noisy signal	Bubbles in flow cell	Use degassed buffers. Check for loose plumbing connections
	Dirty flow cell	Clean flow cell; insure that buffers are free of particulate material (See Section 6)
	Bubbles passing through flow cell	Use degassed buffers. Check for loose plumbing connections
	Column not equilibrated or dirty	Equilibrate and/or regenerate column

Problem	Possible Cause	Solution
Larger or smaller than expected gradient profile	Chart recorder input voltage set incorrectly	Check chart recorder settings (See Sections 4.2 and 5)
	If using Gradient mode, buffer A and B values not set correctly	Re-calibrate the gradient mode
Ghost peaks appear in gradient profile	Charged sample detected (e.g. protein)	No problem
	Air bubbles passing through flow cell	Use degassed buffers. Check for loose plumbing connections
Chart recorder not responding	Chart recorder is not connected properly	Check connections (See Sections 3.2 and 4.2)
	Full scale of recorder set too high	Set recorder range to 1 V
	Recorder has bottomed out	Readjust pen position
	Flow cell not connected in-line	Check flow cell plumbing
No power	Faulty power connection	Check power cable connection
	Blown fuse	Check fuses (See Appendix A)
	Unit not switched on	Check power on/off switch on rear panel
Conductivity measurements with same buffer appear to decrease over time	Dirty flow cell	Clean flow cell (See Section 6)

Appendix A

Fuse Replacement

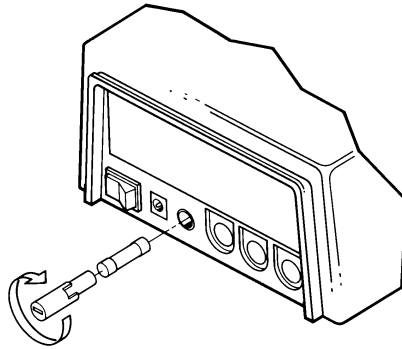



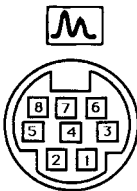
Figure A. Fuse removal.

1. Disconnect unit from power source.
2. Remove the fuse cover with a small-blade screwdriver or similar tool.
3. Pull the fuse holder out of the fuse compartment and, if necessary, replace the fuse. Use 5 mm x 20 mm fuse, type T, 1A.
4. Reinsert the fuse holder, with fuse, into the fuse compartment.

Appendix B

Rear Panel Connections

The signal output  socket is an 8-pin circular mini-DIN. The following information is provided for those wishing to interface the Model EG-1 Econo Gradient Monitor with equipment such as integrators or chart recorders which do not utilize banana plug connectors.



Pin configuration

Pin	Function
1	No Contact
2	No Contact
3	No Contact
4	No Contact
5	Chart Recorder (+)
6	Chart Recorder (-)
7	No Contact
8	No Contact

Appendix C

Technical Specifications

General

Operating mode	Conductivity, in units of Siemens (See Section 1)
Operating temperature	4-40 °C
Sensitivity ranges (full scale)	0-10 μ S, 0-100 μ S, 0-1000 μ S, 0-10mS
Output signal	0-1 Volt
Power requirements	90-264 V, 50-60 Hz (depending upon power adaptor used)
Power consumption	20W maximum
Noise	Short Term: < 0.1 μ S Long Term: < 0.5 μ S
Linearity	+/-0.5 % full scale
Accuracy	+/-2 % full scale
Drift	< 0.5 μ S/hour/°C
Dimensions	
Control Unit:	15.60 x 22.86 x 8.89 cm (W x L x H)
Flow Cell:	3.1 cm diameter by 3.8 cm length
Weight	Control Unit: 600g
Case Material	Chemical and fire resistant polypropylene
Regulatory	CSA: C22.2 No. 151-M1986
Compliance:	TÜV: EN61010-1:1993 CE: EN55011: 1991 Class A EN50082-2:1995

Flow cell

Type	Flow through, externally mounted
Temperature compensation	0-60 °C
Internal volume	8 μ l, swept volume
Cell constant	Approximately 40*
Maximum operating pressure	60 psi, 4 bar, or 0.41 mPa
Cable length	1.22 M
Wetted Parts	Titanium, Kel-F and Tefzel
Fittings	Removable luer (Will also accept 1/4"-28 flat bottom fittings)

* Most applications do not require an exact cell constant. If it is necessary to determine the exact cell constant, Bio-Rad's Conductivity Standard, catalog number 167-0445, can be used.

Appendix D

Ordering Information

Model EG-1 Econo Gradient Monitor

- 731-8151 **Econo Gradient Monitor, Model EG-1**, with 100-120 V power adaptor (catalog number 731-8270) and flow cell (catalog number 731-8155)
- 731-8150 **Econo Gradient Monitor, Model EG-1**, requires power adaptor, includes flow cell (catalog number 731-8155)
- 731-8155 **Flow Cell, Model EG-1**, 1 cell
- 731-8270 **Power Adaptor**, 100-120 V, for USA, Canada, Japan, Mexico, Taiwan, Latin America
- 731-8271 **Power Adaptor**, 220-240 V, for Europe (except the UK) and other countries not specifically listed
- 731-8272 **Power Adaptor**, 220-240 V, for UK, Australia, New Zealand

Cables

- 731-8264 **System Cable 4**, 8-pin mini-DIN to banana plugs (for connection of Econo Gradient Monitor to Model 1327 Recorder or other recording devices which accept banana plug connectors)
- 731-8267 **System Cable 7**, 8-pin mini-DIN to breakout, for connection of Econo Gradient Monitor to recording devices which do not use banana plug connectors.

Tubing

- 731-8210 **Silicone Tubing**, 0.8 mm ID, 0.8 mm wall, 10 m
- 731-8211 **Silicone Tubing**, 1.6 mm ID, 0.8 mm wall, 10 m
- 731-8212 **Silicone Tubing**, 3.2 mm ID, 0.8 mm wall, 10 m
- 731-8214 **Tygon Tubing**, 0.8 mm ID, 0.8 mm wall, 10 m
- 731-8215 **Tygon Tubing**, 1.6 mm ID, 0.8 mm wall, 10 m
- 731-8207 **PharMed[®] Tubing**, 0.8 mm ID, 1.0 mm wall, 10 m
- 731-8208 **PharMed Tubing**, 1.6 mm ID, 1.0 mm wall, 10 m
- 731-8209 **PharMed Tubing**, 3.2 mm ID, 1.0 mm wall, 10 m

Fittings

- 731-8220 **Low Pressure Fittings Kit**, includes over 17 different fittings and stopcocks (250 fittings total)

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