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MF-9045 INSTRUCTION MANUAL

Dual-Pen Strip-Chart Recorder

Bioanalytical
Systems, Inc

2701 Kent Avenue
West Lafayette
Indiana 47906

MANUFACTURER'S NOTE

This instrument, either wholly or in part, is manufactured for research purposes only. Use for medical diagnosis is not intended, implied or recommended by the manufacturer. Use for this purpose and accountability for the same rests entirely with the user.

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Section 1. INTRODUCTION

The Model MF-8125 Recorder is a multi-range potentiometric, null balance servo recorder which will provide an accurate, permanent, graphic record of the input signal.

This graphic recorder may be used in many different applications in the medical, teaching and industrial fields where a precision instrument is of utmost importance.

Measurement of DC voltage, current, temperature and a variety of other variables is made possible with the use of this recorder.

Section 2. SUPPORT POLICY

2.1 USER UPDATES

To activate your warranty, and receive product update information news and valuable information, fill out and return the Warranty Enrollment Card which was shipped with the instrument. We would like to know who you are and what more you want to know about BAS chromatographic and electrochemical products.

2.2 DAMAGED SHIPMENTS

Breakage of any part of this instrument during shipping should be reported immediately to BAS Customer Service. You must retain the original packing box and contents for inspection by the freight handler. BAS will replace any new instrument damaged in shipping with an identical product as soon as possible after the claim filing date. Claims not filed within 30 days after the shipping date will be invalid.

Do not return damaged goods to Bioanalytical Systems without first contacting Customer Service for a Return Authorization Number (RA#). When a defective part is returned to BAS, the RA# immediately identifies you as the sender, and describes the item being returned. Bioanalytical Systems refuses all unauthorized return shipments.

2.3 PRODUCT WARRANTY

Bioanalytical Systems, Inc. products are fully warranted against defects in material and workmanship. The MF-8125 Recorder is unconditionally warranted for one year from date of shipment, except when failure is due to obvious abuse or neglect, unauthorized tampering, procedures not described in manuals, or improper connection of components.

For any product expressly covered under this warranty, Bioanalytical Systems is liable only to the extent of replacement of defective items. Bioanalytical Systems, Inc. shall not be liable for any personal injury, property damage, or consequential damages of any kind whatsoever. The foregoing warranty is in lieu of all other warranties of merchantability and fitness for a particular purpose.

2.4 SERVICE

Bioanalytical Systems provides a skilled service staff available to solve your technical problems if an equipment-oriented problem should arise. For further details, call customer service personnel (765/463-4527) who may choose to route your problem to the correct individual. Following discussion of your specific difficulties, an appropriate course of action will be described and the problem resolved accordingly. Do not return any products for service until a RETURN AUTHORIZATION NUMBER (RA#) has been obtained. The RA# indentifies you as the sender and describes to us the problem you are having in full detail. Turnaround time on service can be quoted to you at the time your RA# is issued, although we can not determine the actual amount of service required until we have received your unit and diagnosed the problem. All correspondence and shipments should be sent to:

RA #, Service Department
Bioanalytical Systems, Inc.
2701 Kent Avenue
West Lafayette, IN 47906

Section 3. SPECIFICATIONS

3.1 GENERAL

Number of Channels:	Two
Chart Width:	200mm Writing Width
Writing Method:	Disposable fiber-tipped pen with self contained ink supply
Accuracy:	Deadband: less than ± 0.1%. Linearity: less than ± 0.5%. Repeatability: less than ± 0.1%.
Zero Adjust:	Continuous: + 100% to -100%
Power Requirements:	115/230 VAC ± 10%, 50/60 Hz, Single Phase
Wattage:	22.5 watts max
Fuses:	115 VAC—3AG Slo-Blo 0.3a (2) 230 VAC—3AG Slo-Blo 0.15a (2)
Line Filter:	Grounded electrostatically shielded power transformer
Weight:	11 lbs (5 Kg)
Dimensions:	15" (38.1cm) W (incl knob) x 4.38" (11.13cm) H x 10.5" (26.7cm) D
Accessories Furnished:	Pens; One roll chart paper; Operators Manual; Paper-Feed Spool; Two 0.15a Fuses (230 VAC operation)

3.2 SERVO SYSTEM

Pen Drive:	Patented (U.S. Patent No. 4,146,828) Pulse Modulated System
Input Type:	Single Ended, Floating
Input Impedance:	2.5 megohms, fixed
Input Filtering:	Filters noise above 3 Hz
Full-Scale Response:	Less than 0.4 seconds

Full-Scale Spans:	12 switch selectable ranges: 1, 2, 5, 10, 20 and 50 mV, and 0.1, 0.2, 0.5, 1, 2, and 5 V
Overshoot:	None. System critically damped
Temperature Comp:	Less than 0.1% per degree C
Calibration:	Front panel all ranges (with external reference)
Overrange Protection:	Shutdown approximately 6 seconds after + or - overrange
Override Event Marker:	Standard-Approximately ± 4% spike
Pen Lift:	Manual external lever

3.3 CHART DRIVE SYSTEM

Chart Drive:	Two-phase stepper motor.
Chart Speeds:	16 switch selectable metric: 1, 2, 3, 6, 10, 15, 20 and 30 cm/min and cm/hr. NOTE: Chart speeds are whole - number reciprocals to facilitate use in sec/cm and min/cm ranges.
Chart-Speed Accuracy:	Less than ± 0.03% error.
Chart Programming:	Contact closure or TTL/CMOS.
Paper Reverse:	External knob.

Section 4. SET-UP PROCEDURE

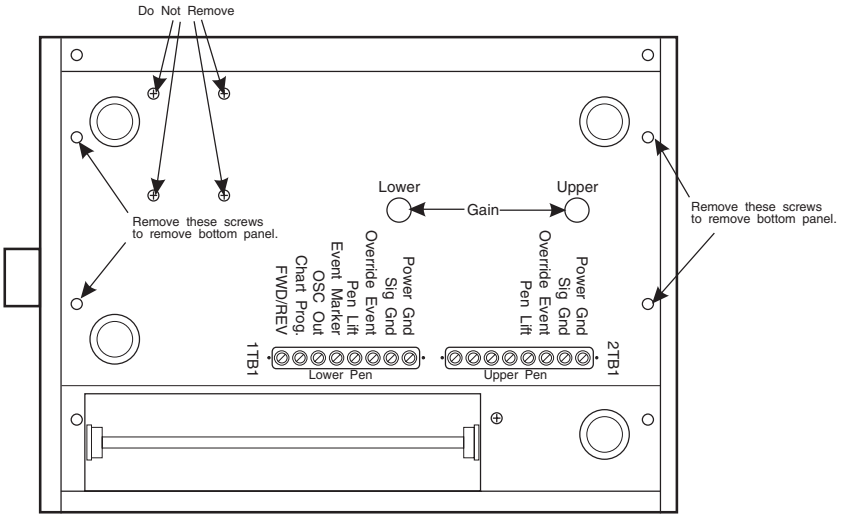
4.1 POWER REQUIREMENTS

Recorders are shipped ready to operate on a nominal AC voltage of 115VAC. To convert to 230VAC usage, do the following. Open the bottom access cover by removing four screws (Figure 4.1).

NOTE: The recorder must be disconnected from the AC power source and caution must be used in removing and replacing the bottom cover to prevent damage to internal wiring and electronic components.

Remove the three screws anchoring the center circuit board, and invert the board. Two fuses, and a switch marked 110/230 are mounted on the circuit board. Replace both fuses with ones marked 0.15A, and put the switch in the 230VAC position. Reinstall the circuit board and the bottom cover.

Figure 4.1 Bottom Panel



4.2 CHART PAPER INSTALLATION

(See Figures 4.1, 4.2 and 4.3)

1. Place the REC/STBY switches in the STBY position.

2. Place the Cm/Min-OFF-Cm/Hr switch in the OFF position.

3. Turn the power ON and place the pens in the LOAD position using the ZERO control (fully clockwise).

4. Unwrap a new roll of paper and make an 8 inch long “V” in the beginning of the paper.

5. Load the chart paper into the rear of the recorder after installing the Paper Feed Spool. (Taped in place on the rear of the recorder).

6. Feed the "V" through the space between the paper holddown and the chassis, and under the Tear-Off bar, using the paper advance/rewind knob to assist loading.

7. Check for proper hole and slot engagement with the sprockets to ensure that the paper is not cocked. The chart grids should be parallel with the paper Tear-Off bar and the paper should move smoothly and freely.

Figure 4.2 Control locations

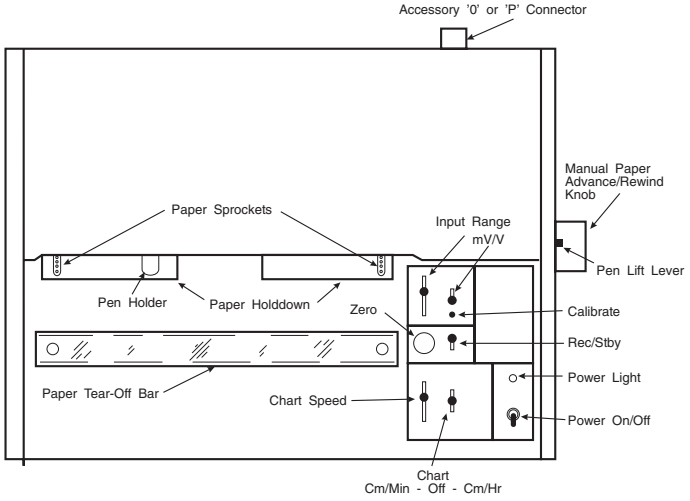
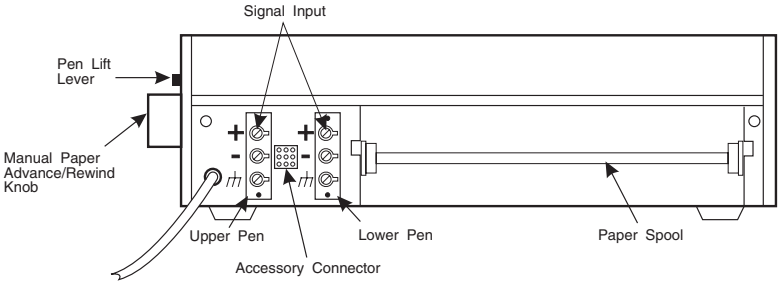


Figure 4.3 Rear panel.



4.3 PEN INSTALLATION

1. With the pen holders in the LOAD or UP position, remove the cap from the short nib pen and slide the pen into the holder as far as possible. Insert the long nib pen into the upper pen holder in the same manner. There should be no interference between the pens.

4.4 GROUNDING

Always connect the detector (or other signal source) and the recorder to the same power line. This can best be accomplished with a multi-outlet power strip. If the two instruments are connected to separate power lines, excess pen vibration might occur due to ground loops.

4.5 INPUT SIGNAL CONNECTIONS

1. Electrical connections are made as follows (Figure 4.3): Signal source Positive to recorder (+) terminal. Signal source Negative to recorder (-) terminal. An LC-44 detector has a grounding jumper that connects to the ground connector on the recorder's terminal strip (just below the negative terminal). If you also are connecting the detector to a computer workstation or integrator, ground the detector at either the recorder or the computer/integrator, but not at both.

   BAS-200, UV-116, and FL-45 detectors do not use the ground terminal on the chart recorder. These detectors only have (+) and (-) connections.

2. Right-hand zero is standard on this recorder. However, either right or left-hand zero may be used. To shift to left-hand zero with an LC-44 detector, reverse the OXD/RED switch on the detector. To shift to left-hand zero on a BAS-200 chromatograph, reverse the +/- sign in the detector control screen.

3. This instrument requires a DC voltage input, as provided by all BAS instruments. Signal sources with current outputs will require a shunt resistor across the (+) and (-) input terminals. Ohms Law may be used to compute the proper value for a given input range. The formula is: $R = E / I$

   Where: E is the recorder span (range) selected in Volts, I is the maximum current signal to be recorded in Amps, and R is the resistance of the shunt resistor in Ohms.

Section 5. RECORDING PROCEDURE

With chart paper and pens installed and the recorder plugged into the proper AC source (corresponding to the voltage conversion slide switch inside the recorder), perform the following steps for routine recording:

1. Check that the REC/STBY switches are in the STBY position and the power is ON.

2. Set the REC/CAL switches to REC.

3. Set the INPUT RANGE and mV/V switches to the desired input range (span).

4. Set the CHART SPEED and CM/MIN-OFF-CM/HR switch to the desired chart speed.

5. Adjust pens to the proper zero position using the ZERO controls.

6. Set the REC/STBY switches to REC and proceed with your recording.

NOTE 1: When switching from one input range (span) to another, the pen zero should be checked and adjusted if necessary.

NOTE 2: "OSC OUT" and "CHART PROG" terminals of Terminal board 1TB1 (on bottom of recorder) must be jumpered together, unless remote chart control is used, or the chart drive WILL NOT function. The recorder is shipped with these terminals jumpered together.

NOTE: The paper may be manually positioned as desired at any time using the advance/rewind knob on the right side of the recorder.

Section 6. SPECIAL FEATURES

NOTE: See Figure 4.1 for connections, where appropriate.

6.1 SEPARATE-PEN EVENT MARKER

Uses a separate pen assembly to provide a short mark at the left edge of the chart when a contact closure is made between "EVENT MARKER" and "SIG GND" of 1TB1 on the bottom panel. The short pen can be force-fit into the event marker. We recommend, however that the Override Event Marker (below) be used for marking the start of chromatograms.

6.2 REMOTE CHART ON/OFF

Provides the ability to turn the chart on and off from a remote location when a contact closure is made or broken between "OSC OUT" and "CHART PROG" of 1TB1 on the bottom panel.

NOTE: The jumper between "OSC OUT" and "CHART PROG" must be removed for remote operation and reinstalled for normal operation.

6.3 ELECTRIC PEN LIFT

Raises the pens off the chart when a contact closure is made between "PEN LIFT" and "SIG GND" of 1TB1 on the bottom panel.

6.4 OVERRIDE EVENT MARKER

Produces approximately a ±4% deflection in the analog pen trace when a contact closure is made between "OVERRIDE EVENT" and "SIG GND" of 1TB1 (Lower Pen) and of 2TB1 (Upper Pen). This feature is useful for marking the start of a chromatogram via a signal from the autosampler.

NOTE: DO NOT connect to "PWR GND" terminal as damage may occur.

6.5 REMOTE CHART PROGRAMMING/TTL

The recorder chart drive system is designed to operate from an external frequency source, including TTL levels. The chart can be run at time rates other than those built into the recorder. This mode can be obtained by applying a pulse train (see below) to the "CHART PROG" and "PWR GND" terminals of 1TB1 on the bottom of the recorder.

NOTE: The jumper between "CHART PROG" and "OSC OUT" must be removed for remote programming.

Pulse Train Specifications: 0 (low) state voltage is +0.5 Volts or less 1; (high) state voltage is +5 to +15 Volts maximum. Minimum pulse width is 100 microseconds.

Chart Speed Formula: CHART SPEED = $\frac{F}{250\ Hz} \times S$

F = External frequency in Hz

S = Selected chart speed

When the external frequency is set to 250 Hz, the chart drive will run at speeds marked on the front panel selector switch.

If the external frequency is decreased by 10% of the standard 250 Hz rate, the actual chart speed will be 10% slower than the setting on the front panel selector switch.

EXAMPLE: The selector is set at 30 Cm/Min and the external frequency is changed to 225 Hz (a 10% decrease). The chart will now run at 27 Cm/Min.

NOTE: Change of external frequency affects all selector speeds by the same factor.

The recommended maximum chart speed for start-stop operation is 30 Cm/Min. If the frequency is "swept" (no start-up), it is possible to run faster than 30 Cm/Min: however. sweep rates must be gradual enough to assure accurate mechanical tracking.

6.6 PAPER TEAR-OFF BAR

Removable clear plastic tear-off bar.

To Remove:	Pull UP snap-lock at each end of bar and remove.
To Install:	Insert tabs in holes in platen and press snap-locks DOWN.

6.7 FORWARD/REVERSE CHART DRIVE

Allows remote forward and reverse chart drive.

Forward:	Pin 8 of 1A1-TB1 open
Reverse:	Pin 8 jumpered to Pin 1 (Pwr Gnd) of 1A1-TB1

Section 7. OPERATIONAL TIPS AND MAINTENANCE

Chart paper and pens have been carefully matched for optimum writing and minimum "bleed". Substitutions could cause improper writing. Keep pen tips covered when not in use to prolong writing life.

NOTE: If the pen is left uncapped for long periods and dries out, it may be revitalized by dipping in water for a few seconds.

Allow recorder to warm-up for about 30 minutes if high accuracy/stability recording is desired.

Firm tension on paper roll, and correct alignment of the chart paper holes on the sprocket teeth, are required for proper chart feed.

The exterior surfaces of the recorder should be cleaned periodically by wiping with a soft damp cloth. Water may be used to remove ink, etc.; however, solvents should NOT be used as they may damage or destroy the finish

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Section 8. TROUBLESHOOTING

The modularity and simplicity of this recorder make it possible to isolate the problem area in many cases. Once you have done this, a quick call to BAS will bring you needed advice or replacement parts.

The following chart will give you suggestions on how to solve the most common recorder problems.

SYMPTOM	PROBABLE CAUSE	REMEDY
Pilot light does not light and recorder is inactive.	1. AC power source disconnected.	1. Connect AC power source.
	2. Fuse(s) blown.	2. Replace fuse(s) (inside).
	3. Conversion switch in wrong position.	3. Check switch (inside).
Pilot light on, but recorder inactive.	1. Signal input leads disconnected.	1. Check input connections.
	2. Gain set too low.	2. Adjust gain.
	3. Defective pulse servo PCB.	3. Contact BAS.
	4. Defective servo motor.	4. Contact BAS.
	5. Servo shut down	5. Turn OFF. Turn ON.
	6. Connectors on control panel not connected.	6. Remove bottom cover and reconnect.
Noise on pen trace.	1. Noisy input signal.	1. Check signal source.
	2. Extremely noisy power line.	2. Check power line.
	3. Gain too high.	3. Adjust gain.
	4. Recorder ground not connected.	4. Provide common ground for 3rd wire in power cords.
Pen trace has isolated steps.	1. Pen carriage slide rod dirty.	1. Contact BAS.

	2. Defective servo motor.	2. Contact BAS.
	3. Defective servo potentiometer.	3. Contact BAS.
Pen will stop moving but will catch up if physically pushed.	1. Defective servo motor.	1. Contact BAS.
Pen writes poorly.	1. Ink supply depleted.	1. Replace pen.
	2. Pen tip dried out.	2. Revitalize by dipping in water for a few seconds.
Chart drive inoperative.	1. Loose or defective connections.	1. Check stepper/control panel connections.
	2. Missing jumper.	2. Install between “OSC OUT” & “CHART PROG” on 1TB1.
	3. Defective chart drive motor.	3. Contact BAS.
	4. Detective stepper chart drive circuit.	4. Contact BAS.
	5. Gear train binding.	5. Contact BAS.
No chart drive in a particular chart speed.	1 Defective component on circuit board.	1. Contact BAS.

Section 9. ACCESSORIES

ITEM	PART NUMBER
Chart Paper, 10 Rolls	MF-8080
Short Pens (Channel 1)	
Blue (6)	MF-8126
Red (6)	MF-8127
Black (6)	MF-8128
Green (6)	MF-8129
Long Pen (Channel 2)	
Red (6)	MF-8130