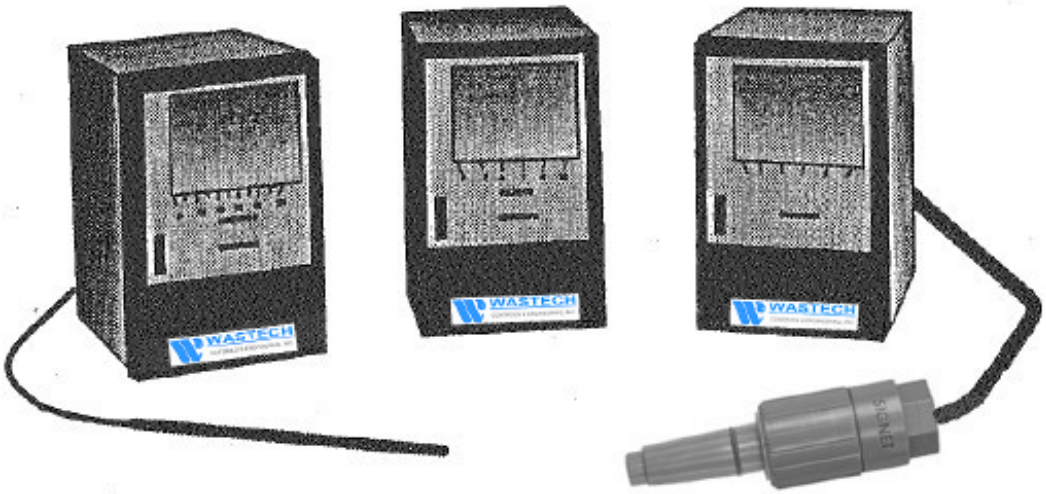
INSTRUCTIONS
800 SERIES
MINIGRAPH RECORDERS



WASTECH

CONTROLS & ENGINEERING, INC.

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INTRODUCTION

The Minigraph® is a miniature strip chart recorder which uses an "inkless writing system". The inkless record uses a metal stylus to tap a dotted line on pressure sensitive chart paper

UNPACKING

On receipt of your recorder, lift the instrument from the shipping carton and remove any packing material. Carefully inspect the recorder for any signs of obvious shipping damage. Immediately report any damage to the carrier. Retain the original shipping container and contact your supplier.

Your recorder is shipped with an accessory package of mounting hardware. Also, depending on model, one of the following probes or transmitter may also be included:

- Type K thermocouple probe with standard two-prong mini-connector.
- Thermistor probe with standard phone plug connector.
- Temperature/Humidity transmitter with interconnecting cable and power supply.
- pH electrode and pH transmitter with interconnecting cable and power supply.
- Clamp on Transmitter with interconnecting cable and power supply.
- Clamp-on transformer with interconnecting cable.

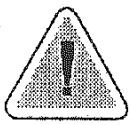
MOUNTING

For best performance and longevity the mounting location should be in a clean environment, free from dust, corrosive fumes, and extremes of heat and humidity

Caution: Do not position the recorder where it may be exposed to large magnetic fields. Avoid positioning the recorder in close proximity to electrical busses or cables carrying large currents. The instrument should be at least 380mm (15 inches) from such hazards.

Portable Use

The accessory package packed with your recorder contains four white. adhesive-backed, polyurethane feet. Remove the protective backing and press one foot in each of the four corners of the bottom of the case. Two plug buttons are included. Press these into the two holes in the top of the case.



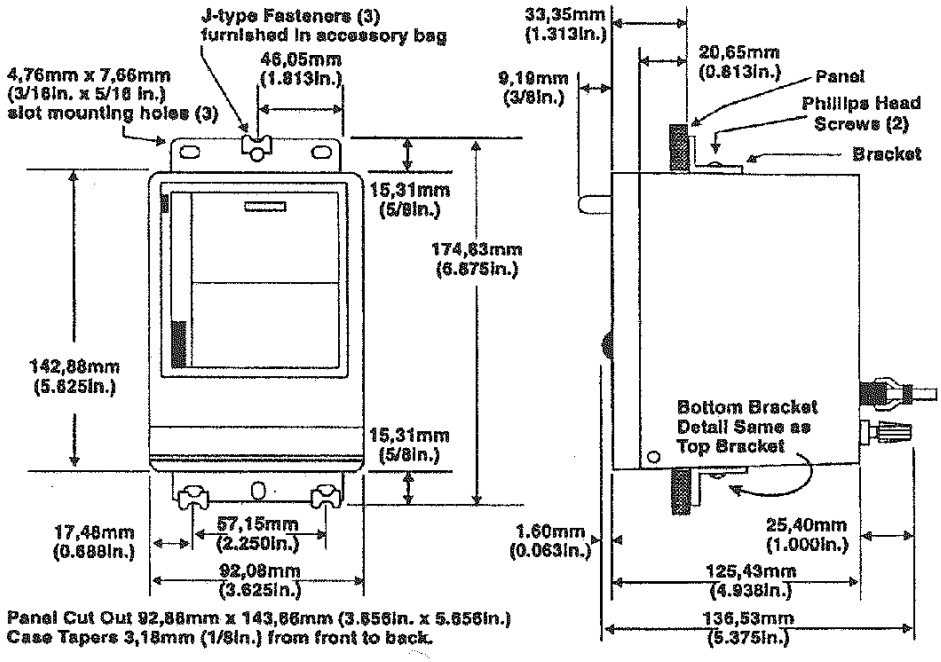
Caution: Be careful when moving the instrument from place to place. Make sure that power is turned off and all connector plugs are disconnected before moving the instrument. Risk of personal injury and damage to the instrument may result if these precautions are not followed.

Panel Mount

Prepare the hole in the panel per the diagram as shown on page 4. Cutout size is 92,86mm x 143,66mm (3.656in. x 5.656 in.). Make sure the hole is clean and free of burrs. The furnished 'L' brackets can accommodate one, two, or three mounting screws to secure the brackets to the back of the panel board. Holes in the panel board should be large enough to allow free passage of a standard 6-32 screw. If desired the J-type fasteners (supplied) can be placed over the appropriate hole(s) in the 'L' bracket to allow mounting without additional hardware. Otherwise, install appropriate sized washers and nuts to secure the 'L' brackets.

Carefully slide the instrument into the prepared hole. While supporting the instrument, secure it into place with the four screws provided (two on top, two on the bottom).

Panel Mounting Diagram



Panel Cut Out 92,88mm x 143,66mm (3.656in. x 5.656in.)
Case Tapers 3,18mm (1/8in.) from front to back.

Wiring

Warning: Do not apply power to the instrument or to the device or process to be recorded until all connections are made to the instrument. Failure to observe this precaution may expose you to the risk of electrical shock and possible injury.

Temperature Types

Insert the plug end of the sensor into the indicated socket on the rear of the instrument. Making sure that the lead wire is not kinked or in a location where the wire may be a hazard to people or equipment, place the probe in the desired location for measuring temperature Plug the power cord into the appropriate power socket, again making sure that the cord is not kinked or in a location where the wire may be a hazard to people or equipment.

AC Voltage Types

Danger: Because the instrument may be connected to potentially lethal voltages and currents, be sure that all high voltage wiring is properly insulated and all electrical codes followed. Failure to take these precautions could result in severe or fatal injury.

With all power disconnected to the wiring, connect the AC input wiring to the binding posts on the rear of the instrument making sure that the AC input wiring is not kinked or in a location where the wire may be a hazard to people or equipment. Plug the power cord into the appropriate power socket, again making sure that the cord is not kinked or in a location where the wire may be a hazard to people or equipment.

AC Current Types

Warning: The clip on transformer is rated for 750 VAC maximum at 60Hz for indoor use only. Although the transformer housing is insulated, the use of rubber gloves and any other appropriate protective gear is required when installing the transformer on powered lines. It is recommended to work only on power lines when power is turned off.

Select the current range desired using the selector dial mounted on the side of the instrument.

Plug the transformer cable plugs into the sockets provided. Mount the transformer on the power lead to be measured making sure that the transformer lead wire is not kinked or in a location where the wire may be a hazard to people or equipment. Plug the power cord into the appropriate power socket, again making sure that the cord is not kinked or in a location where the wire may be a hazard to people or equipment.

If increased transformer sensitivity is required, the power line to be measured may be looped through the transformer more than once. When this is done the full scale on the instrument is divided by the number of turns through the transformer. Use the following formula to calculate the scale:

$$\frac{\text{(Full Scale of Selected Range)}}{\text{(Number of Conductor Passes)}} = \text{Expanded Full Scale Value}$$

Remember that the number of conductor passes are the number of times the wire goes through the transformer, not the number of loops.

Accuracy of the AC Current readings is ±3% of full scale with the current conductor centered in the transformer jaws. Movement of the conductor within the jaws can create an additional error of up to 3%. At line frequencies other that 60 Hz additional error can exist ranging from ±2% to ±15% depending on the amperage range selected and the input frequency. Errors for the various inputs are as follows:

Selected Range	Operating Frequency	Additional Error
0 - 5 A	40 - 1000 Hz	±15%
0 - 10 A	40 - 1000 Hz	±4%
0 - 25 A	40 - 800 Hz	±2%
0 - 50 A	40 - 800 Hz	±2%
0 - 100 A	30 - 1000 Hz	±3%
0 - 250 A	30 - 1000 Hz	±3%

DC Current Types

Secure the leads from the current source to the binding posts. Be sure to observe proper polarity. Make sure that the current lead wires are not kinked or in a location where the wires may be a hazard to people or equipment. Plug the power cord into the appropriate power socket, again making sure that the cord is not kinked or in a location where the wire may be a hazard to people or equipment.

Chart Paper Installation

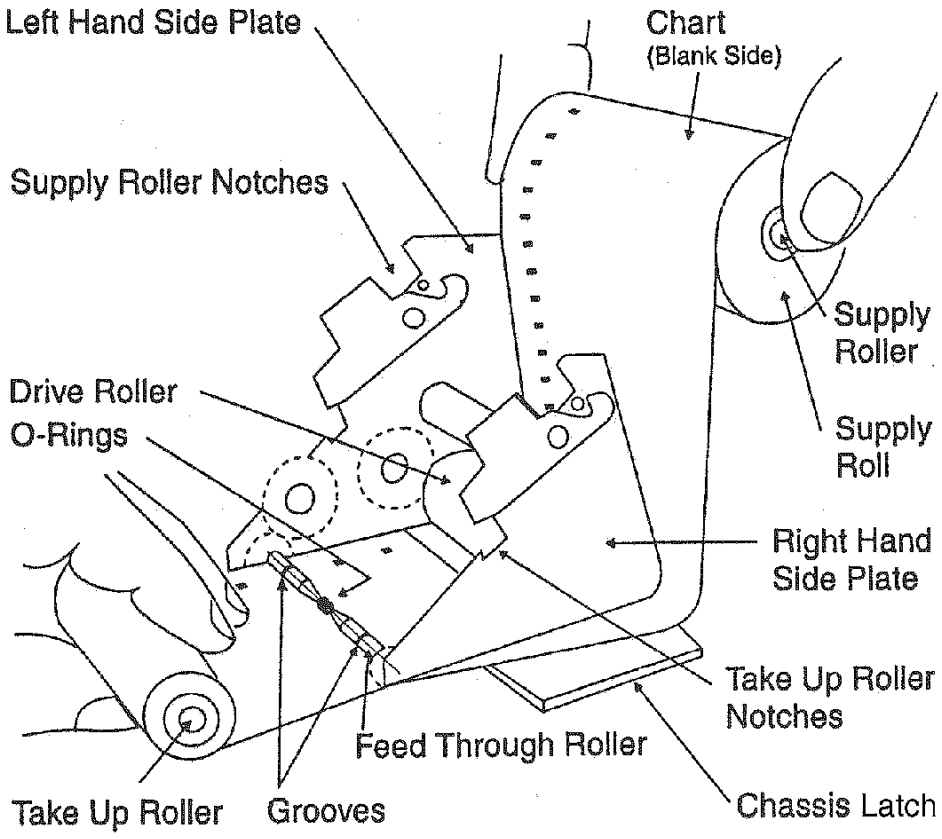
Either of two methods may be used to handle the recorded portion of the chart. The Reroll method routes the chart onto a roller for storage or review at a later time. The Feed Through / Tear Off method routes the chart upwards through the top of the door so that it may be easily viewed during recording and, if desired, torn off from the rest of the chart.

Caution: Before changing chart paper or changing output methods, remove all signal and power inputs to the instrument.

To gain access to the chart drive components, press down on the door release latch and carefully swing the door downward.

Reroll Method

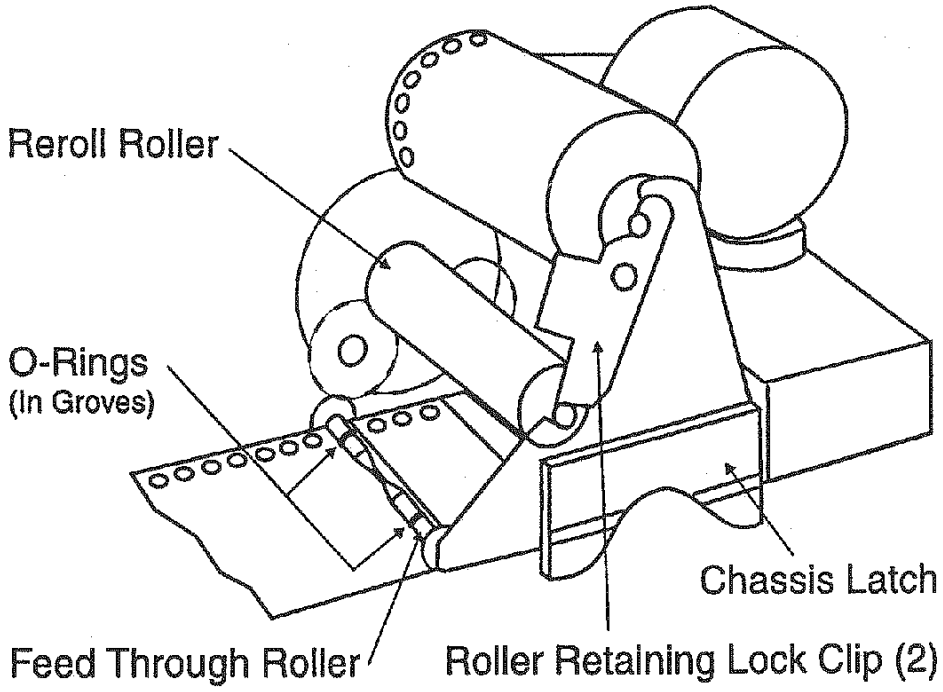
1. Flip chassis latch outward.
2. Flip roller retaining locking clips upwards to release rollers.
3. Remove supply roller from instrument and insert it into the core of a new roll of chart paper. If replacing an empty roll, remove and retain the cardboard sleeve.
4. Place empty cardboard sleeve onto the reroll roller.
5. Tape free end of chart paper to the cardboard sleeve. Perforations in the chart paper must be at the geared end of the roller. Roll the chart a few turns onto the roller, keeping the paper straight and taut.
6. Hold the reroll roller in your left hand and the supply roller in your right so that the blank side of the chart paper is facing upward between the rollers. Slide the chart paper under the right side plate and maneuver the chart perforations over the sprockets on the drive roller.
7. Press the supply roll tension arm toward the left side plate, then seat the supply roller in its notches. Then seat the reroll roller in its notches. Snap the roller retaining locking clips to lock the rollers in place.
8. Take up slack by advancing the reroll roller.
9. Press down on the right hand side plate and flip up the chassis latch (press latch until it snaps into place). Close the door. Reconnect signal and power connections. Use the thumbwheel on the outside of the door to advance the chart as desired.



Reroll Method Chart Paper Installation

Feed Through / Tear Off Method

1. Flip chassis latch outward.
2. Roll the O-rings from the center of the feed through roller to fit into the groove on each side of the roller.
3. Flip up roller retaining lock clips.
4. Remove Supply roller from instrument. Slide the supply roller into the perforated end of a roll of chart paper.
5. Hold the loose end of the chart paper in your left hand and the supply roll in your right hand so that the blank side of the chart paper is facing upward between your left hand and the roller. Slip the chart paper under the right hand side plate. Carefully maneuver the chart paper so that the perforations fit into the sprocket and drive rollers.
6. Press the supply roll tension arm toward the left side plate. Set the supply roller pins into the notches of the side plates and snap the roller retaining lock clips down into the locked position.
7. Pull the chart paper out from the supply roll until it extends out beyond the top of the door.
8. Press down on the right hand side plate. Flip the chassis latch up (press latch against the side plate until it snaps into place). Close the door. Reconnect signal and power cables. Rotate the thumbwheel on the outside of the door to advance the chart paper as desired.



Feed Through / \Tear Off Method Chart Paper Instalation

Conversion From One Method to the Other

The only difference in the setup between the two methods is the position of the O-rings on the feed through roller, and the use (or not) of the reroll roller.

For Feed Through, the O-rings are in the grooves toward the ends of the feed through roller, and the reroll roller is not used.

For Reroll, the O-rings are in the narrow part at the center of the feed through roller, and the reroll roller is used.

Review of a Rerolled Chart

1. Open the case door. Grasp both edges of the chart paper and pull it out for review.
2. To return the chart paper to the reroller, rotate the reroll flange until the chart paper is returned to the reroll spool. Close the door. Press inward on the thumbwheel and rotate until the tension on the chart paper is correct.

Operation and Maintenance

Warning: Disconnect power and signal lines before servicing or cleaning the instrument. Do not disturb parts or wiring during cleaning.

The Minigraph® is designed for long trouble free operation and should require little attention during use. Periodic inspections are recommended to check for low chart paper supply, accumulation or dirt, loose hardware, damaged wiring, loose connections, or worn parts. If operational problems are encountered, refer to the "Troubleshooting Chart" on Page 10.

Exterior Cleaning

Light dirt marks van be removed from the case finish with a damp, lint free cloth or sponge. Heavier dirt smudges can be removed with any commercially available liquid detergent. Grease stains should be removed by using a lint free cloth damped with naptha (use a clean portion of the cloth for each application to prevent spreading the stain). A mild soap or detergent may be used on the front windows.

Interior Cleaning

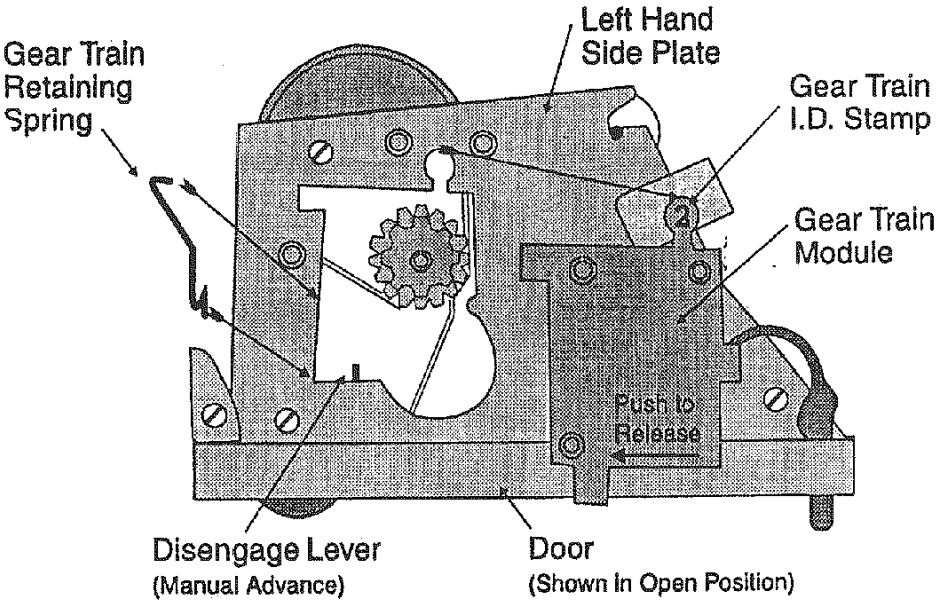
Remove chart paper, the removable rollers, and the rear train module. Clean with a soft bristle brush or a low vacuum system. A mild soap or detergent may be used on the removable rollers.

Changing Gear Trains (Optional)

If the existing chart speed is not suitable for a particular application, an optional gear train can be purchased and then installed by a simple operation. Refer to diagram on next page for mechanical relationships.

Warning: Disconnect power and signal lines before servicing the instrument.

1. Remove the gear train retaining spring from the left hand side plate.
2. Gently move the gear train in the direction of the arrow embossed on the gear train plate. Lift the gear train module out from the top. **DO NOT FORCE** or lift from the bottom.
3. Insert the bottom of the new gear train module with the disengage lever between the side plates. Slide the gear train module in the direction opposite of the direction indicated by the arrow embossed on the gear train plate.
4. Replace the gear train retaining spring.
5. Reconnect all signal and power lines to instrument. Check for proper operation.



Gear Train Removal / Installation

Accessories

Charts

Six in a box. All charts are 65mm (2 9/16 in.) wide, 19m (63 ft.) long, with 54mm (2 1/8 in.) active recording width.

Part Number	Major Div.	Minor Div.	Recommended for Input Type Number(s)
651-691630	8	40	01-20
651-691760	10	50	01-04, 01-11, 01-12, 03-11, 02-24, 02-05
651-691770	15	75	04-04, 04-05, 04-06, 03-01
651-691950	10	47	04-01
651-691650	12	60	
651-220920	14	70	

Sensors

Part Number	Description
753-170000	Thermocouple, Type K, General Purpose
753-180000	Thermocouple, Type K, Air Probe
753-190000	Thermocouple, Type K, Surface
753-200000	Thermocouple, Type K, Penetration
753-250000	Thermistor, General Purpose
753-260000	Thermistor, General Purpose
753-270000	Thermistor, Surface
753-280000	Thermistor, Surface
753-290000	Thermistor, Air Probe
753-300000	Thermistor, Air Probe
753-310000	Thermistor, Tubular
753-320000	Thermistor, Tubular

Gear Trains

Part Number	Ratio	Chart Speed w/ 2rpm motor	
651-691030	1:2	12.7 mm/h	(½ in/h)
651-691040	1:1	25.4 mm/h	(1 in/h)
651-691050	2:1	50.8 mm/h	(2 in/h)
651-691060	3:1	76.2 mm/h	(3 in/h)
651-691070	4:1	101.6 mm/h	(4 in/h)

Troubleshooting

Every effort has been made to manufacture, calibrate, and test your instrument to assure years of trouble free performance. If you suspect a problem with your instrument, refer to the Troubleshooting Chart below. If your symptom is listed, make the checks and remedies suggested before calling for service.

Troubleshooting Chart

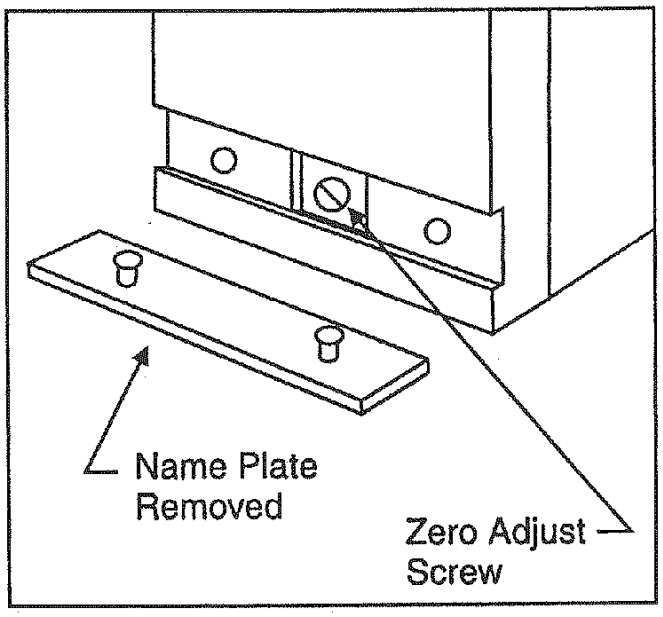
Symptom	Possible Cause	Check/Remedy
Inoperative chart drive system.	Loss of power.	Check power source, connector(s), and wiring.
Chart will not feed through slot at the top of the case (Feed Through / Tear Off mode).	Chart, rollers, or gear train incorrectly installed. Gear train not engaging drive roller.	See charting and gear train instructions. Check gear train spring tension.
Chart bunches across writing table (Reroll mode).	O-rings not positioned correctly on the feed through roller.	Roll O-rings outward until they sit firmly into the roller grooves.
Inoperative recording system.	Reroll roller not engaging drive gear.	Lift roller retaining lock clips and move roller to reroll roller notches in side plates.
Record on chart above or below zero without input signal.	Source failure or faulty connection. Open of defective measuring circuit.	Check signal input and all connections.
Movement will not adjust to zero reference point.	Movement out of adjustment. (Thermocouple instruments are set up for ambient temperature.) Bent stylus or defective movement. Defective circuit component.	Adjust mechanical zero adjustment. Contact your supplier for instructions on how to receive Factory Service.
Record on chart below zero with input signal.	Reversed signal polarity.	Correct signal polarity.
Instrument produces continuous trace with sluggish response.	Bent stylus.	Contact your supplier for instructions on how to receive Factory Service.
Erratic stylus deflection.	Intermittent connection of defective measuring circuit. Improper analog input or external interference.	Check all connections. Check signal source and environmental conditions.

Zero Adjustment

Check and adjust the mechanical zero of instrument as follows:

Warning: Disconnect power and signal lines before servicing the instrument.

1. Make sure that the instrument is in proper operating position.
2. Connect the instrument power. Do not connect the signal input. Connect a short piece of copper wire across the signal input connections.
3. With the chart drive motor running, manually advance the chart a short distance.
4. The recorded trace should register on the zero reference line of the chart, or in the case of thermocouple inputs the recorded trace should indicate the temperature of the instrument (normally ambient). If not, pry off the name plate on the front of the case.
5. Carefully rotate the Zero Adjust Screw with a nonmagnetic screwdriver until the recorded trace is correct.
6. Remove all power to the instrument. Remove the short wire previously installed across the input. Reconnect the signal input connections. Reconnect power to the instrument.



Specifications

Accuracy: ±2% of full scale for DC and Temperature inputs, ±3% for AC inputs
Response time: 1 second zero to full scale.
Recording rate: 30 dots per minute.
Record density: varies with chart speed, 30 dots per inch typical.
Power requirements: 120 VAC, 60 Hz, 3 W; 240 VAC, 60 Hz, 3W; or 12 VDC @ 20 mA.

Model Identification

Model 1 2 □□ · □□ · □□ · □□

Input Type and Scale Range *

01-04 = DC Current 0 to 1 mA
01-20 = DC Current 4 to 20 mA
01-11 = DC Voltage 0 to 100 mV
01-12 = DC Voltage 0 to 1 V
02-05 = Type K Thermocouple 0 to 200°F
02-12 = Type K Thermocouple 0 to 1000°F
02-15 = Type K thermocouple 0 to 2000°F
02-20 = Type K Thermocouple 0 to 500°C
02-24 = Type K Thermocouple 0 to 100°C
02-26 = Type K Thermocouple 0 to 300°C
03-01 = Thermistor -20 to +130°F
03-09 = Thermistor 0 to 100°C
03-11 = Thermistor 0 to 100°F
04-01 = AC Current 0 to 5, 10, 25, 50, 100, 250A selectable
04-04 = AC Voltage 0 to 150 V
04-05 = AC Voltage 0 to 300 V
04-06 = AC Voltage 0 to 600 V

Motor Selection

05 = 1 rpm, 120 VAC 60Hz 3W
07 = 1 rpm, 240 VAC 50Hz 3W
08 = 1 rpm, 12 VDC @ 20mA
09 = 2 rpm, 120 VAC 60Hz 3W
11 = 2 rpm, 240 VAC 50Hz 3W
13 = 2 rpm, 12 VDC @ 20mA

Gear Train Selection

03 = 1:2 ratio - (½ in. per hour - 62 Days @ 2 rpm)
04 = 1:1 ratio - (1 in. per hour - 31 Days @ 2 rpm)
05 = 2:1 ratio - (2 in. per hour - 15 Days @ 2 rpm)
06 = 3:1 ratio - (3 in. per hour - 10 Days @ 2 rpm)
07 = 4:1 ratio - (4 in. per hour - 7 Days @ 2 rpm)