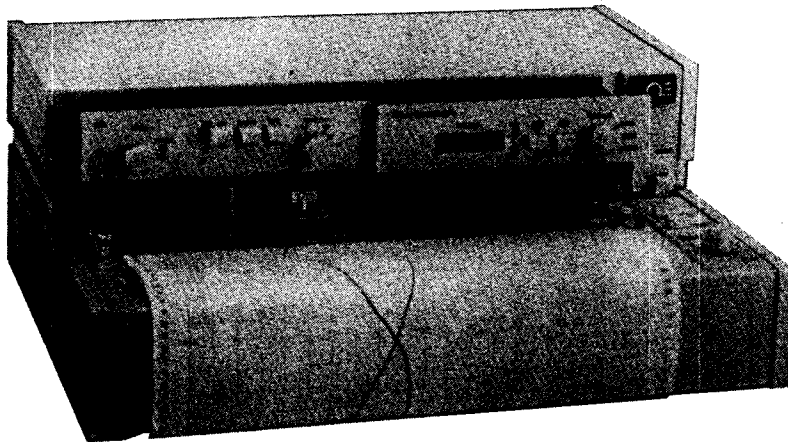


# RD-2010, RD-2020, RD-2030

## Function Recorders - Mainframe



Operator's Manual



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## WARRANTY

OMEGA warrants this unit to be free of defects in materials and workmanship and to give satisfactory service for a period of **13 months** from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product. If the unit should malfunction, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective it will be repaired or replaced at no charge. However, this WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear or which are damaged by misuse are not warranted. These include contact points, fuses, and triacs.

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Direct all warranty and repair requests/inquiries to the OMEGA ENGINEERING Customer Service Department. **BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS).** The assigned AR number should then be marked on the outside of the return package and on any correspondence.

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1. P.O. number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

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**FUNCTION RECORDERS**

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## **SECTION 1 INTRODUCTION**

### **1.1 GENERAL DESCRIPTION**

The RD-2000 Function Recorder System introduces low cost to modular recorders. With a choice of input modules, the RD-2000 can measure temperature from thermocouples, pH, millivolts/volts, or milliamps. To select any input type, simply plug in the appropriate module. The mainframe recorder is available in three varieties; a one pen model with a 100 mm chart, and a 200 mm chart model with either one or two pens. With the two pen model, you can record two completely different input signals, such as temperature and pH, or have two channels record the same type of input signal. Designed for ease of use, the RD-2000 system has all user controls on the main control panel. Select one of 12 chart speeds (from 1 cm/hr to 30 cm/min), chart feed, chart start/stop power and pen lift. For easy paper loading, the control deck unlatches and swings away to reveal the paper feed spindle. A roll of chart paper is dropped into place, and the deck is then lowered and latched.

## **SECTION 2 INSTALLATION**

### **2.1 UNPACKING**

Remove the Packing List and verify that all equipment has been received. If there are any questions about the shipment, please call OMEGA Customer Service Department.

Upon receipt of shipment, inspect the container and equipment for any signs of damage. Take particular note of any evidence of rough handling in transit. Immediately report any damage to the shipping agent.

#### **NOTE**

The carrier will not honor any claims unless all shipping material is saved for their examination. After examining and removing contents, save packing material and carton in the event reshipment is necessary.

### **2.2 CHART PAPER INSTALLATION (See Figure 2-1)**

1. Lift "LOAD" latch and raise top of recorder 90°.
2. Remove "Paper Feed Spool" from inside recorder.
3. Hold paper roll with free end toward you and printed grid "UP". Insert "Paper Feed Spool" from left end through paper roll.
4. Replace roll in recorder, feed end of paper under "Paper Tear-Off Bar" and align sprocket holes in paper with teeth on sprockets.
5. Close and latch top cover. Check that paper is still aligned squarely with the "Tear-Off Bar" and properly positioned on the sprocket teeth.

### **2.3 PEN INSTALLATION**

1. With the pen holder(s) in the "UP" position, remove the cap from a short nib pen and slide pen into the holder as far as possible.
2. On two pen models, insert a long nib pen into the upper pen holder in the same manner. There should be no interference between pens.

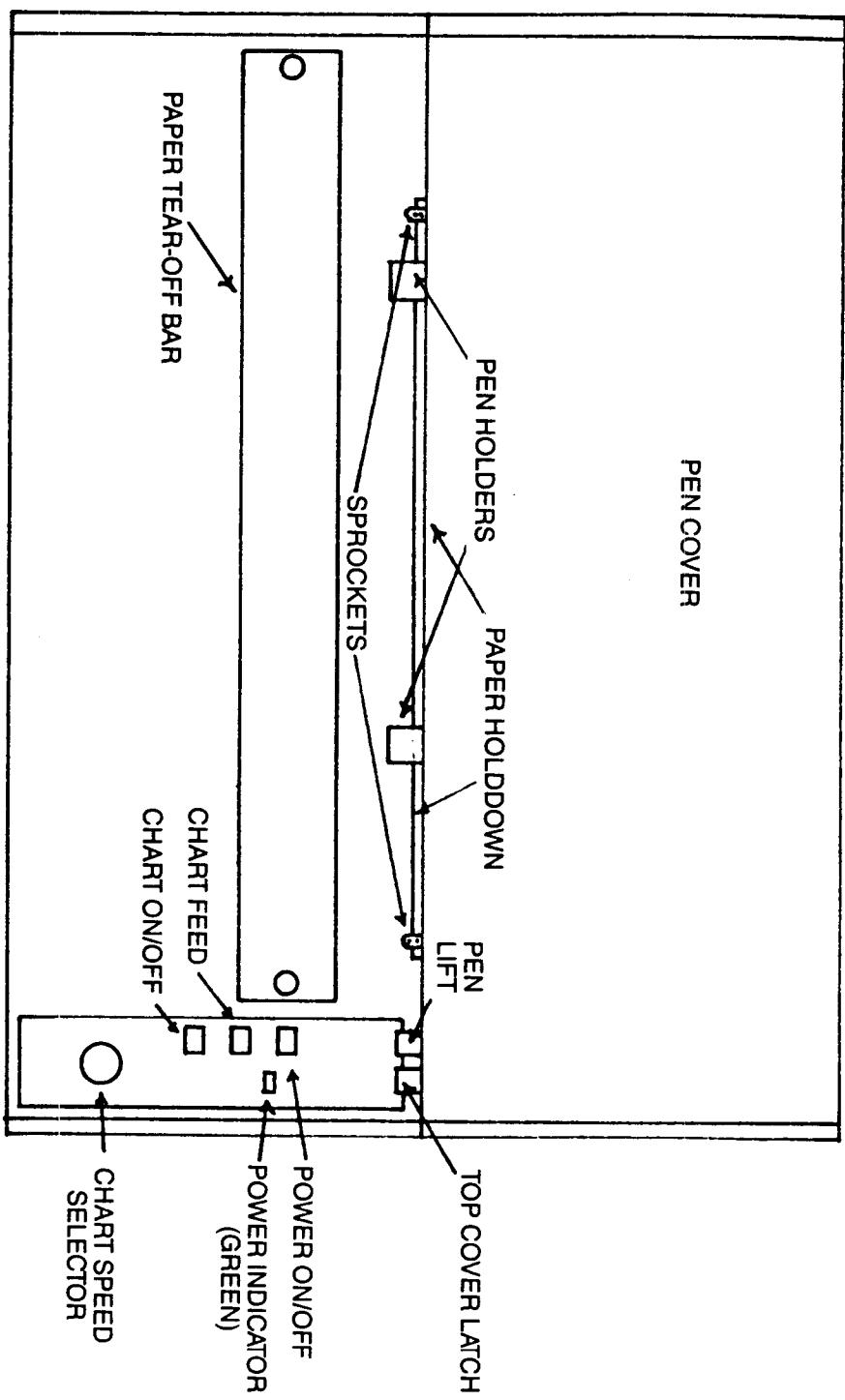


Figure 2-1. RD-2000 Front Panel Control Locations

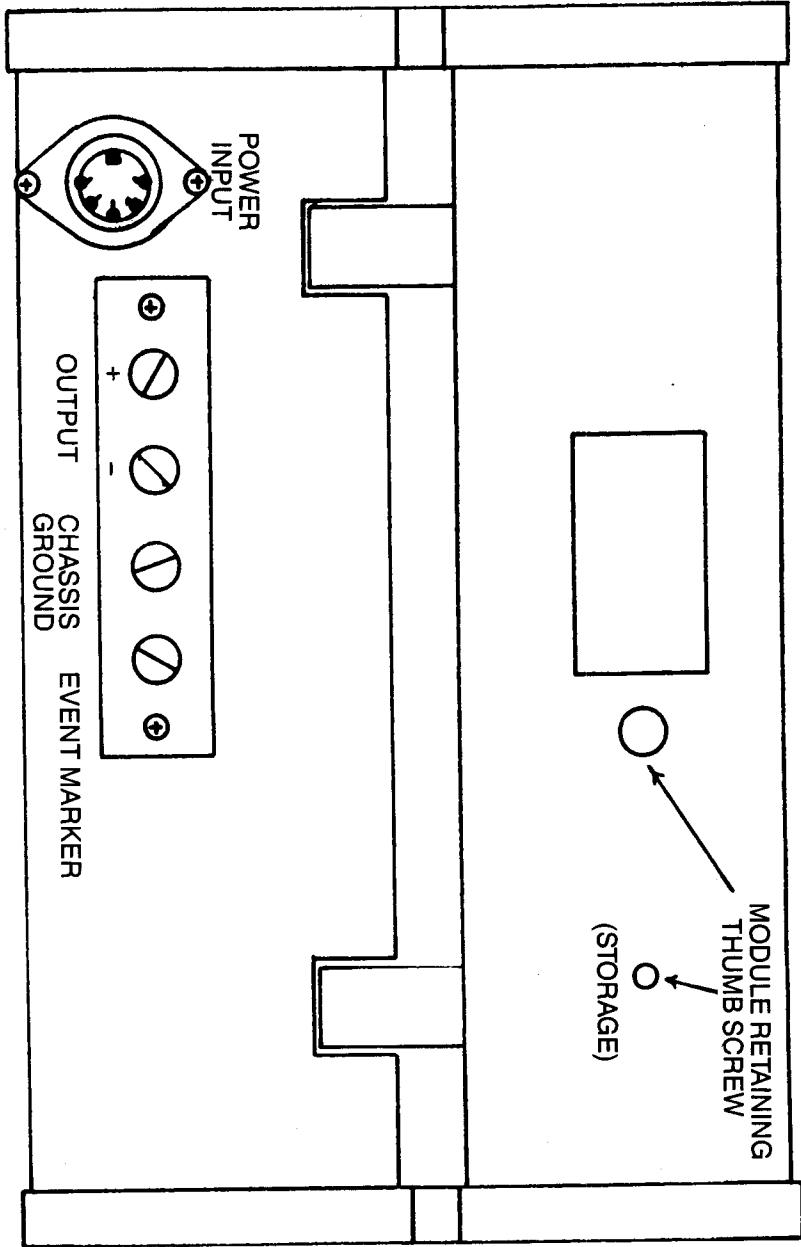


Figure 2-2. RD-2000 Rear Panel

## 2.4 POWER CONNECTIONS (See Figure 2-2)

The RD-2000 recorders are shipped ready to operate via a supplied power pack that gives 12 Vac for input to the connector on the rear of the unit. As an option, units may be dc powered by independent, isolated 12-15Vdc power supplies; one supply for each channel. You can **NOT** use one power supply for a two channel unit. Power connections are made to J2 on the servo board.

For best performance, ground in the power pack for the recorder and the signal source should share a common "Earth" ground. The ground wire in the power pack is connected to the recorder chassis ground ( ) but not to the signal input negative (-). If the signal input source does not have a third wire in its power cord, or if the recorder is not grounded, connect a wire between the recorder chassis ground terminal ( ) and the chassis of the signal source.

In case of large normal-mode signals, particularly 120 Hz, connect the recorder chassis ground terminal ( ) to the normal-mode signal source.

## 2.5 INPUT SIGNAL CONNECTIONS

Refer to Installation/Operation Instructions contained with the Module(s) supplied with your recorder.

# SECTION 3 OPERATION

## 3.1 RECORDING PROCEDURE

1. Insure that "POWER" switch is OFF (UP). Connect power pack to rear of recorder (DIN connector). Plug other end of the power pack into 115 V ac, 60 Hz source.
2. With the chart paper and pen(s) installed, follow instructions contained with Module(s) supplied with your recorder.

### CAUTION

DO NOT install or remove plug-in modules when power is ON since serious damage to the recorder could result.

## 3.2 SPECIAL FEATURES/OPTIONS

### 3.2.1 Override Event Marker—Standard

Produces approximately a  $\pm 2\%$  "glitch" in the analog trace when a contact closure is made between "EVENT" and "-" (Signal Ground).

### 3.2.2 Paper Tear-Off Bar—Standard

Removeable clear plastic tear-bar:

To Remove: Model RD-2010—Pull snap-lock UP; LIFT end of bar and remove tab from slot.

Model RD-2020/2030—Pull snap-locks UP at ends of bar and remove.

To Install: Model RD-2010—Insert tab in slot; lower bar; align snap-lock with hole and press into place.

Model RD-2020/2030—Align snap-locks with holes and press into place.

### 3.2.3 Auxiliary Battery Pack (Options B1 and B2)

Allows complete operation of the recorder for approximately 5 to 8 hours without ac power. Batteries recharge when unit is connected to ac power. (Recorder POWER switch does NOT have to be ON). Batteries are contained inside the recorder chassis.

### 3.2.4 Set Point Alarms (Options A1 and A2)

Provides a contact closure or break when the input signal exceeds a high or low set point level. Each point, high or low, is adjustable over the entire chart range.

#### HI/LO SET POINT ALARMS:

The user may present chart boundary limits thru the HI/LO set point controls. When the recording pen exceeds these limits, a relay is activated to provide a dry contact signal.

This alarm system is easily calibrated without the need for external reference signals. The module zero control is used to position the recording pen to the desired signal limit (e.g. 90% chart reading) and then the HI limit control is turned clockwise until the HI alarm relay activates. A low limit (e.g. 10% chart reading) is set by positioning the recording pen to 10% grid mark and adjusting the low alarm control counter clockwise until the low alarm relay activates.

Thus any recorded signal between 10% and 90% is treated as within process specification but any signals above 90%, or below 10% activates the alarm system for fault conditions.

#### SPECIFICATIONS:

<b>HI LIMIT RANGE:</b>	100% to 0% (of chart)
<b>LOW LIMIT RANGE:</b>	0% to 100% (of chart)
<b>RELAYS:</b>	DPDT 110 V ac 0.5 A, 24 V dc-1 A (resistive load)
<b>REFERENCE:</b>	System servo potentiometer
<b>HOOK UP:</b>	Barrier strip
<b>INSTALLATION</b>	Factory installed option only

### 3.2.5 Electric Chart Fast Advance

Advances paper at highest speed (30 cm/min) when "CHART FEED" switch is held depressed. "CHART" switch need NOT be ON.

## SECTION 4 THEORY OF OPERATION

The input signal is conditioned by the plug-in module and then applied to the pulse servo amplifier which continuously compares it to the feedback signal developed by the servo potentiometer.

The difference between these two signals is a positive or negative error signal that is amplified and used to drive the servo motor, which is coupled to the servo potentiometer, in a direction as to reduce the error signal to zero. Since the recorder pen is mechanically coupled to the servo motor and servo potentiometer, its position on the chart represents an accurate and continuous record of the input signal (see Figure 4-1).

### 4.1 PEN DRIVE SYSTEM

A DC servo motor is used to control the servo potentiometer and recorder pen by means of a gear driven servo drum assembly. The pen is attached to a drive cable which is wrapped around and secured to the drum. As the drum rotates, the pen is moved across the chart in proportion to the amount of drum rotation.

This recorder uses a Pulse Modulated Servo to achieve greater accuracy, linearity and less deadband than conventionally driven recorders.



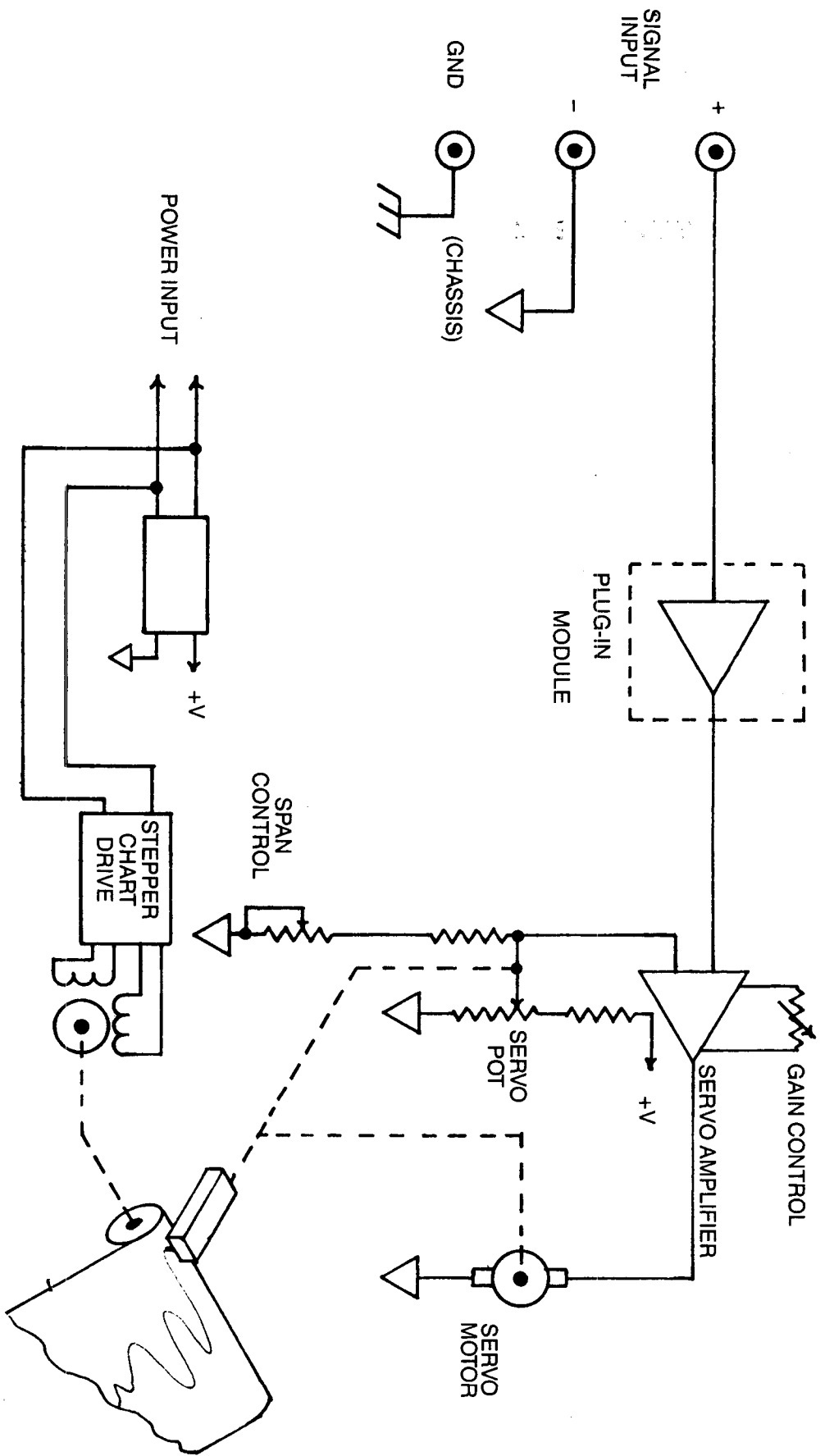


Figure 4-1. RD-2000 Block Diagram

## 4.2 CHART DRIVE SYSTEM

In this simple, reliable system, an internal oscillator generates pulses which are divided by integrated circuit logic. The chart speed switch merely selects the appropriate pulse rate to drive the stepper motor at the desired speed. (The oscillator frequency is not a function of line frequency, and therefore chart speeds are completely independent).

## 4.3 DC POWER SUPPLY

AC line voltage is reduced to 12 V ac by a stepdown transformer in the power pack and converted to DC by solid state rectifiers and regulators in the recorder. A stable DC voltage, generated by a voltage reference integrated circuit, is used as a reference for the servo potentiometer.

# SECTION 5 CALIBRATION

This recorder is designed to be simple, reliable, easy to maintain and repair. Therefore, the procedure presented here will be as simple, clear and brief as possible. For special problems, we recommend that you contact the OMEGA Customer Service Department.

## CAUTIONS

DO NOT install or remove plug-in modules when power is on since serious damage to the recorder could result.

The calibration of the Pen Drive System covered in this section must be performed by a qualified technician. The technician must be aware of voltages which may cause an electrical shock.

## NOTE

Procedure given is for a single pen recorder. Calibration of dual channel models is identical except procedure must be duplicated for the second channel.

## 5.1 EQUIPMENT REQUIRED

100  $\pm$ 0.1% DC Millivolt Source and RD-EXT (Extender Module)

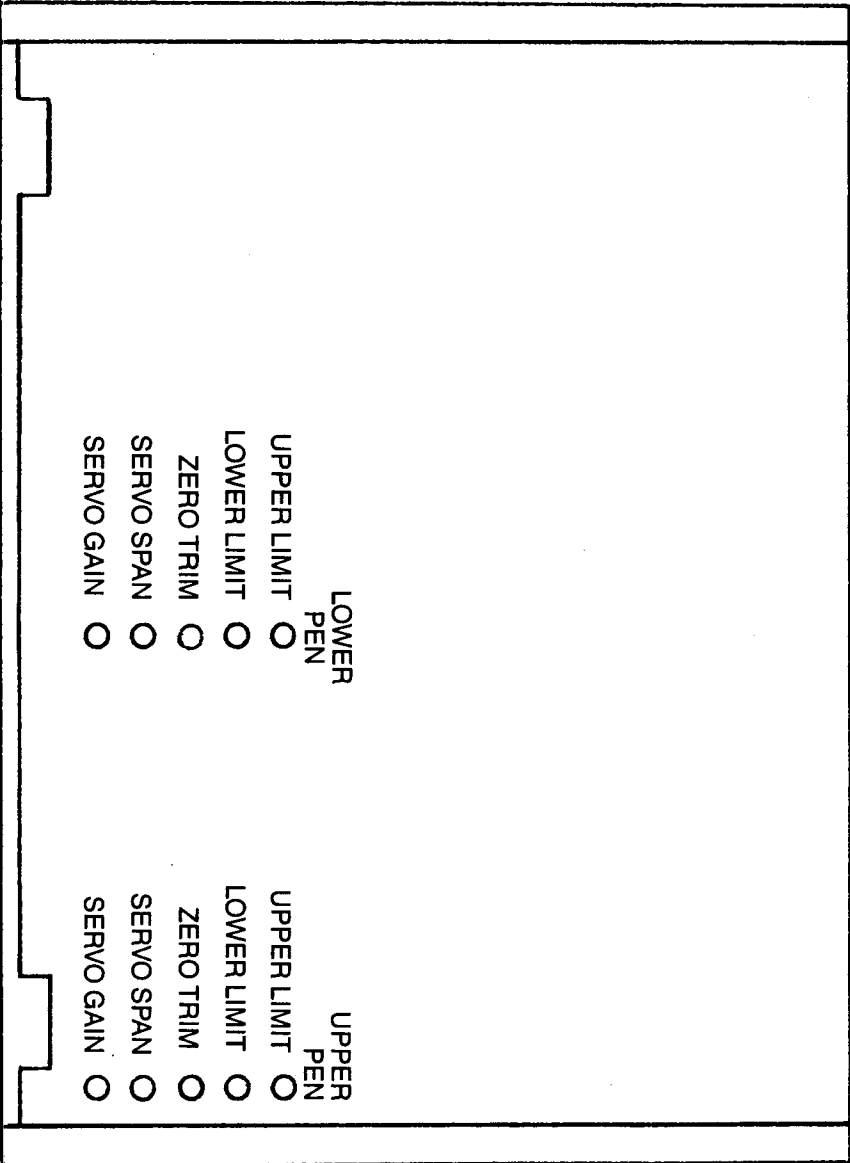
## 5.2 PRELIMINARY SET-UP (See Figures 3-1 & 5-1)

1. Turn recorder over and turn "UPPER LIMIT" control fully clockwise (viewed from front of unit). Turn "LOWER LIMIT" control fully counterclockwise (viewed from front of unit).
2. Turn recorder right side up. Set POWER switch to OFF (UP).
3. Set CHART SPEED switch to 10 cm/min.
4. Set CHART switch to OFF (UP)
5. Install extender module, paper and pen(s) if not previously done
6. Connect power pack to rear of recorder (DIN connector). Connect other end to 115 V ac, 60 Hz source
7. Turn recorder POWER switch ON (DOWN)

## 5.3 GAIN ADJUST

The GAIN adjustment controls the servo loop gain of the recorder. If set too high, the pen will "buzz". If set too low, the pen will be sluggish.

1. Check that the pen is DOWN and turn CHART switch ON (DOWN)
2. Zero pen to approximately mid-scale
3. Adjust GAIN control clockwise (CW) until the pen "buzzes", then turn back counterclockwise (CCW) until the "buzzing" just stops plus 1/8 turn



(FRONT)

Figure 5-1. RD-2000 Calibration Control Locations

#### 5.4 ZERO TRIM

Adjust the servo (pen) to ZERO with a zero input signal. Set pen to ZERO grid line using ZERO TRIM control with zero (short) input to the recorder.

#### 5.5 SPAN ADJUST

Provides adjustment so that a calibrated full scale input signal will move the pen the full width of the chart.

1. Input a  $100 \pm 0.1\%$  DC Millivolt signal to the servo input
2. Adjust the SPAN control to position the pen exactly on the 100% grid line
3. Remove the 100 millivolt signal

#### 5.6 UPPER LIMIT

Provides electronic shutdown of the pen drive when an overrange condition exists.

1. Adjust pen to right edge of the left sprocket holes
2. Position pen half-way between the left edge of the chart grid and the sprocketed holes using the UPPER LIMIT control

#### 5.7 LOWER LIMIT

1. Adjust pen to the left edge of the right sprocket holes
2. Position the pen half-way between the right edge of the chart grid and the sprocket holes using the LOWER LIMIT control

THIS COMPLETES CALIBRATION OF THE MAINFRAME

## SECTION 6 SPECIFICATIONS

### 6.1 GENERAL

<b>NUMBER OF CHANNELS:</b>	Model RD-2010—One Model RD-2020—One Model RD-2030—Two
<b>CHART WIDTH:</b>	Model RD-2010—100 mm Writing Width Model RD-2020—200 mm Writing Width Model RD-2030—200 mm Writing Width
<b>WRITING METHOD:</b>	Disposable fiber tipped pen with self-contained ink supply
<b>ACCURACY:</b>	Overall $\pm 0.5\%$
<b>POWER REQUIREMENTS:</b>	12 V ac RMS, 60 Hz or 12-15 V dc Maximum 30 watts
<b>WEIGHT:</b>	Model RD-2010—5 lb (2.27 Kg) Model RD-2020—7 lb 4 oz (3.3 Kg) Model RD-2030—7 lb 8 oz (3.4 Kg)
<b>DIMENSIONS:</b>	Model RD-2010: 7.5" (19.1 cm) W $\times$ 4.15" (10.5 cm) H $\times$ 9.22" (23.4 cm) D Model RD-2020: 12.19" (30.96 cm) W $\times$ 4.15" (10.5 cm) H $\times$ 9.22" (23.4 cm) D Model RD-2030: 12.19" (30.96 cm) W $\times$ 4.65" (11.8 cm) H $\times$ 9.22" (23.4 cm) D
<b>ACCESSORIES FURNISHED:</b>	Pen(s); One Roll Chart Paper; Paper Feed Spool; Instruction Manual; Power Pack

## 6.2 SERVO SYSTEM

<b>PEN DRIVE:</b>	Pulse Modulated System
<b>FULL SCALE RESPONSE:</b>	Less than 0.5 second
<b>OVERSHOOT:</b>	None. System critically damped
<b>CALIBRATION:</b>	100 mV with external reference
<b>OVER/UNDER RANGE PROTECTION:</b>	Electronic Limit
<b>OVERRIDE EVENT MARKER:</b>	Standard—Minimum +2% spike
<b>PEN LIFT:</b>	Manual external lever

## 6.3 CHART DRIVE SYSTEM

<b>CHART DRIVE:</b>	Two Phase Stepper Motor
<b>CHART SPEEDS:</b>	12 switch selectable metric: 1, 2, 5, 10, 20 and 30 cm/minute and cm/hour. NOTE: Chart speeds are whole number reciprocals to facilitate use in seconds/cm and minutes/cm ranges.
<b>CHART SPEED ACCURACY:</b>	Less than $\pm 0.1\%$ error

## 6.4 ACCESSORIES

MODULES, PLUG-IN	PART NUMBER
Millivolt	RD-MV
Current	RD-I
Temperature	RD-TC
pH	RD-PH
Extender	RD-EXT

### CHART PAPER

#### Model RD-2010

Paper, Roll, 100 mm Chart $\times$ 30 Meters Long	0100-0011
pH Paper, Roll, 100 mm Chart $\times$ 30 Meters Long	0100-0041

#### Models RD-2020 and RD-2030

Paper, Roll, 200 mm Chart $\times$ 25 Meters Long	0100-0026
pH Paper, Roll, 200 mm Chart $\times$ 25 Meters Long	0100-0042

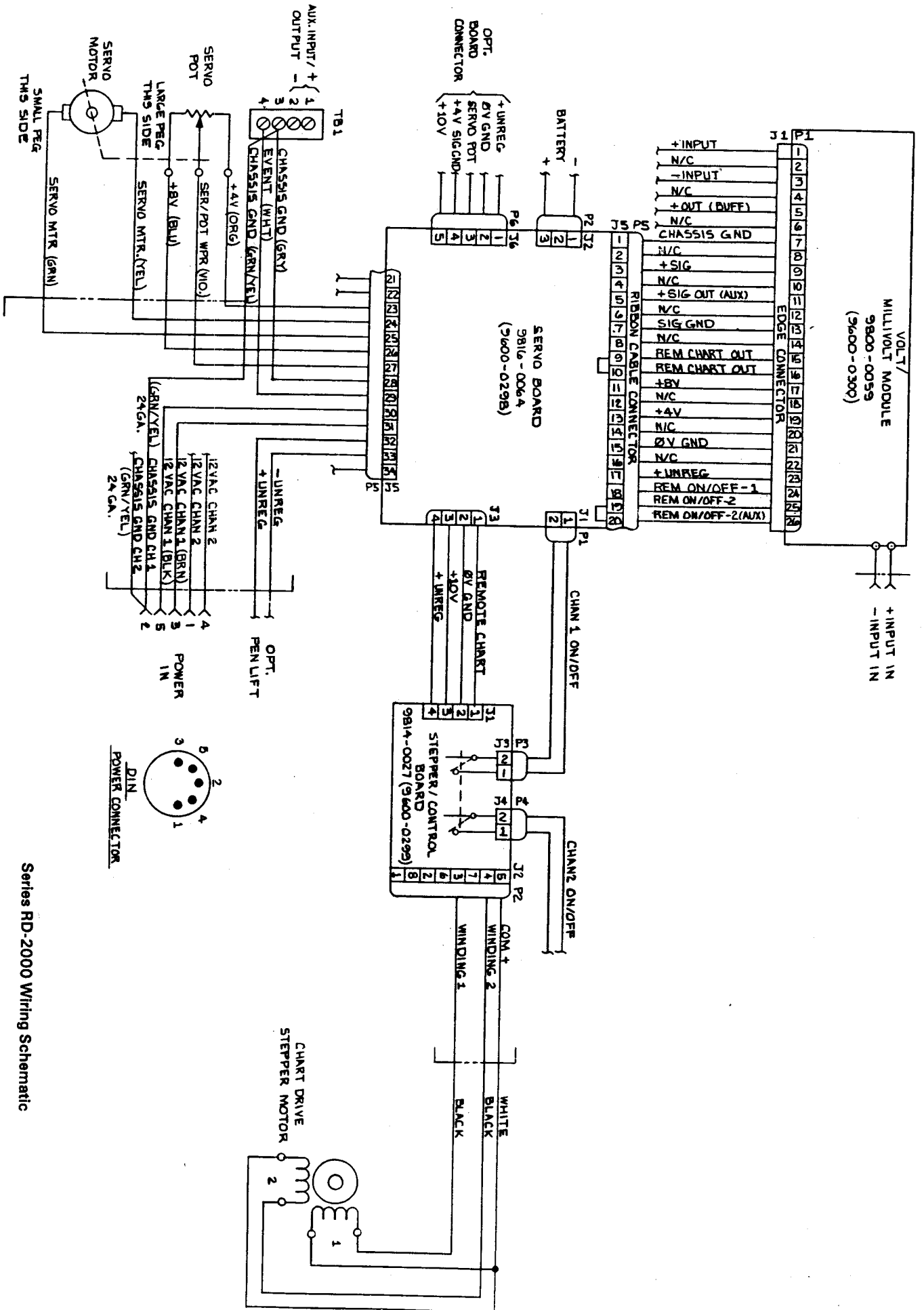
### PENS

Short Nib, BLUE	0100-0105
Short Nib, RED	0100-0106
Short Nib, BLACK	0100-0107
Short Nib, GREEN	0100-0108
Long Nib, BLUE (Model 2030 Only)	0100-0109
Long Nib, RED (Model 2030 Only)	0100-0110
Long Nib, BLACK (Model 2030 Only)	0100-0111
Long Nib, GREEN (Model 2030 Only)	0100-0112

## 6.5 REPLACEMENT PARTS

Pulse Servo PCB Assembly	
Model RD-2010	9816-0064
Model RD-2020/2030	9816-0065
Stepper/Control Panel PCB Assembly	9814-0027
Tear-Off Bar Assembly	
Model RD-2010	9501-1580
Model RD-2020/2030	9501-1579
Pen Carriage	9501-1562
Servo Drum Assembly	
Model RD-2010	9501-1552
Model RD-2020/2030	9501-1529
Knob, Chart Speed Selector	9501-1535-03
Chart Roll Assembly (Paper Feed Spool)	
Model RD-2010	9501-1531
Model RD-2020/2030	9501-1530
Sprocket Assembly	
Model RD-2010	9501-1523
Model RD-2020/2030	9501-1524
Servo Motor Pinion Gear	
Model RD-2010	9050-0126
Model RD-2020/2030	9050-0144
Pen Cable	6030-0001
Power Pack, 115 V ac, 60 Hz	5610-0021
Fuse, 1 Amp MB, 5 mm, × 20 mm	5120-0016
Potentiometer, Servo	
Model RD-2010	4750-0059
Model RD-2020/2030	4750-0037
Motor, Chart Drive	3525-0016
Motor, Servo Drive	
Model RD-2010	3510-0010
Model RD-2020/2030	3510-0013
Thumb Screw, Nylon, Module Retaining	2801-0128
Push-Button, Power ON/OFF	2405-0028
Push-Button, Chart Advance	2405-0028
Push Button, Chart ON/OFF	2405-0028
Alarm Modules* for	
Model RD-2010	9501-1660
Model RD-2020	9501-1695
Model RD-2030	9501-1658

\*Each Alarm Module has two relays; one high, one low.



Series RD-2000 Wiring Schematic

# Where Do I Find Everything I Need for Process Measurement and Control? OMEGA...Of Course!

## **TEMPERATURE**

- Thermocouple, RTD & Thermistor Probes, Connectors, Panels & Assemblies
- Wire: Thermocouple, RTD & Thermistor
- Calibrators & Ice Point References
- Recorders, Controllers & Process Monitors
- Infrared Pyrometers

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- Flexible Heaters
- Laboratory Heaters

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- Pumps & Tubing
- Air, Soil & Water Monitors
- Industrial Water & Wastewater Treatment
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