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User's Guide

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CTpH-110V-G-AL, CTpH-220V-G-AL
High Performance Microprocessor-Based pH and Temperature Recorder

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship 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. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. 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 are not warranted, including but not limited to contact points, fuses, and triacs.

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PATENT NOTICE: This product is covered by one or more of the following patents: U.S. PAT. 5,019,838: D311,695/

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The information contained in this document is believed to be correct but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.
WARNING: These products are not designed for use in, and should not be used for, patient connected applications.

⚠ This device is marked with the international hazard symbol. It is important to read the Setup Guide before installing or commissioning this device as it contains important information relating to safety and EMC.

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CTpH-110V-G-AL, CTpH-220V-G-AL

High Performance Microprocessor-Based pH and Temperature Recorder

Operator's Manual

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NEWPORT Electronics, Inc.

Warranty/Disclaimer

NEWPORT ELECTRONICS, INC. warrants this unit to be free of defects in materials and workmanship for a period of one (1) year from date of purchase. In addition to NEWPORT's standard warranty period, NEWPORT ELECTRONICS will extend the warranty period for one (1) additional year if the warranty card enclosed with each instrument is returned to NEWPORT.

If the unit should malfunction, it must be returned to the factory for evaluation. NEWPORT's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by NEWPORT, if the unit is found to be defective it will be repaired or replaced at no charge. NEWPORT's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. 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 NEWPORT's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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2. Model and serial number of product, and

3. Repair instructions and/or specific problems relative to the product.

NEWPORT's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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PATENT NOTICE: This product is covered by one or more of the following patents: U.S. PAT. 5,019,838: D311,695/ CANADA 1,306,452; 1,319,925; 65,619 ⓇOMEGA ENGINEERING, INC./GERMANY M 88 03 842.4/ KOREA 102,879/ROC PATENT NO. 22507/U.K. REGISTERED 1 055 583

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It is the policy of NEWPORT to comply with all worldwide safety and EMC/EMI regulations that apply. NEWPORT is constantly pursuing certification of its products to the European New Approach Directives. NEWPORT will add the CE mark to every appropriate device upon certification.

The following models are available:

PART NUMBER	DESCRIPTION
CTpH-110V-G-AL	110Vac, with Alarms and Relay Contacts
CTpH-220V-G-AL	220Vac, with Alarms and Relay Contacts

The following consumable items are available:

PART NUMBER	DESCRIPTION
PENS	
CT486-PS	Pen Set, Red and Green, package of 1 each
CT486-PS-6	Pen Set, Red and Green, package of 6 each

STANDARD CHART PAPER (double-sided - available as single package of 100 or 6 packages of 100 charts)

PART NUMBER		PART NUMBER	
CTpH-CDC	*100* Charts, 1 Day, °C	CTpH-CDC-6	*600* Charts, 1 Day, °C
CTpH-CWC	*100* Charts, 7 Day, °C	CTpH-CWC-6	*600* Charts, 7 Day, °C
CTpH-CMC	*100* Charts, 32 Day, °C	CTpH-CMC-6	*600* Charts, 32 Day, °C

The following spare parts are available:

PART NUMBER	DESCRIPTION
CT485B-WALLKIT	Anchors, Screws, Inserts and Template
CT485-CABLE-6G	6 Ft. (2 meter) Remote Probe Cable, Gray
CT485-AC-110-G	110Vac Adaptor, 9Vdc output, Black
CT485-ADAP-E-G	220Vac Adaptor, 9Vdc output, Black, European Plug
CT485-ADAP-UK-G	220Vac Adaptor, 9Vdc output, Black, United Kingdom Plug
CT485B-MAG	Magnetic Chart Knob, Tan
CT485B-BULB	Light Bulb Assembly, package of 10
CTpH-Probe	Replacement pH Probe
CTpH-CAL-KIT	Calibration Kit
CTpH-CAL-LABEL	Calibration Lockout Cover Labels (Sheet of 10)
CT485-CAL-LOCK	Calibration Lockout Kit
PHA-4	Buffer solution, pH 4.01
PHA-7	Buffer solution, pH 7.00
PHA-10	Buffer solution, pH 10.00

The following accessories are available:

PART NUMBER	DESCRIPTION
CTpH-BNC	Analog BNC Input Adaptor (Cable), Gray

I ▼ Index

Introduction

1

This Electronic pH and Temperature Chart Recorder with Remote Sensor is an advanced microcomputer controlled measuring and recording instrument.

This Recorder is a class III Equipment, and the ac Power Adapter provides double insulation as means of protection against electric shock.

The recorder affords rapid and precise response, memory and display of peak readings, remote sensing, recording flexibility and simplicity of operation. This compact, portable instrument offers advanced features previously unavailable in its price range.

Features include:

- Continuous Update of Fluid pH and Temperature
- Rapid Response to Changes in Fluid pH and Temperature
- Remote Probe
- Digital Plots in 1.0 °C or 0.1pH Increments
- Memory and Display of Peak Readings
- 1, 7 or 32 Day Charts
- Battery or ac Power Operation With Automatic Battery Power Backup
- Chart Indication for ac Power Failure/ac Power Return
- Audible Alarm with Relay Contact
- Low Battery Indicator
- Portable
- Wall Mount or Benchtop Mount
- Optional Analog Voltage Input Adapter to record an external -296 to 414mV dc signal through a standard BNC connector
- Chart Lighting and back-lit LCD display with use of ac adapter
- Control Panel Lock
- Decorative Foot Cover for wall mounting

These features provide precise documentation, flexibility in application and ease of use, all made possible through the incorporation of advanced electronics.

1.1 Parts of the Recorder - Front and Side Views

FRONT VIEW   SIDE VIEW
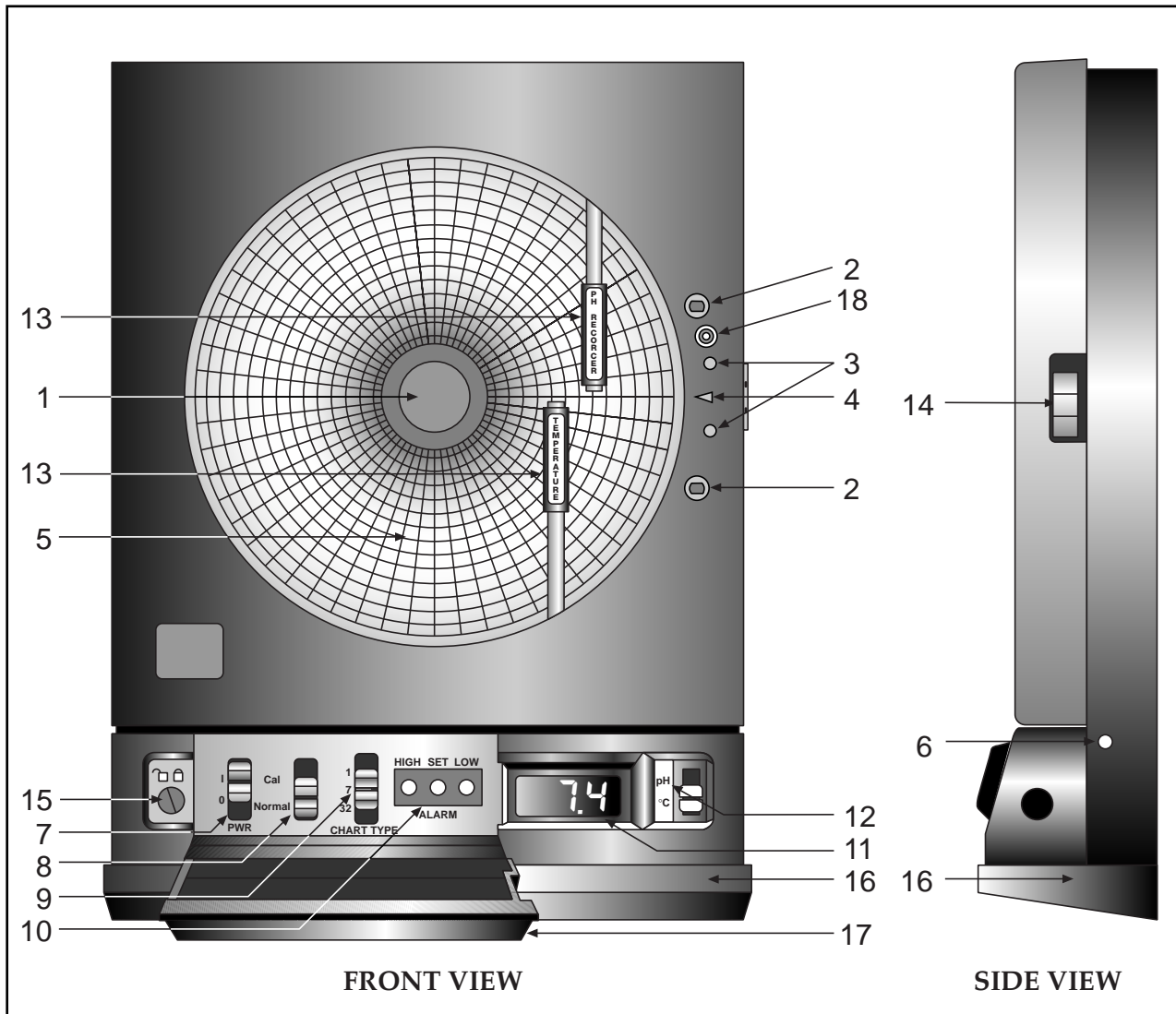
Figure 1-1. Front and Side Views of the Recorder

Item	Description	Function
1	Chart Paper Knob (magnetic)	Holds chart paper in place.
2	Light Bulbs	Lights up the paper in a dark room. Note that the bulbs function only when the recorder is powered by the 9Vdc adapter.
3	Pen Cap Posts	Holds the loose pen caps.
4	Time Set Arrow	Helps align the time on the new chart paper with the actual time.
5	Chart Paper (double sided)	Charts are available for 1, 7, and 32 day recording times. See the inside back cover for a detailed list of paper available.

Item	Description	Function
6	ac Power Jack	Allows the unit to be powered from ac power using the adapter (110 Vac or 220 Vac stepped down to 9 Vdc) supplied.
7	Power Switch	Turns unit ON (l) or OFF (O).
8	Cal/Normal Mode Switch	Selects Cal mode for pH probe calibration, using adjustments on chart base, or normal operation mode.
9	1/7/32 Day Mode Switch	Selects chart type: 1, 7, or 32 day operation.
10	Alarm Display Buttons (HIGH, SET, LOW)	These buttons are accessible behind the control panel door. High and Low buttons: 1. Selects and changes calibration codes. 2. Chooses the high/low alarm limit (for either °C or pH). 3. Selects and changes the alarm limits. 4. Checks alarm limits in operating mode. 5. Low button only: when pressed during power up, disables the alarm function. Set button: 1. Activates calibration mode when pressed during power up. 2. Enters calibration codes in memory. 3. Activates alarm limits. 4. Enters alarm limits in memory. 5. Disables the sounding of the alarm (and activation of the relay) for 10 seconds.
11	LCD Display	Displays temperature and pH values (depending on the setting of Display Selection Switch). (Refer also to item #18)
12	Display Selection Switch	Allows the user to select display pH or fluid temperature in °C . (Refer also to item #11).
13	Pen Arm and Holder (2 each)	Holds and moves the pH and temperature pens.
14	Latch Button	Releases and secures the recorder's door.
15	Control Panel Door Lock	Locks or unlocks the control panel door.
16	Decorative Foot Cover	Stays in place for wall-mounting the recorder. Removed for upright bench-top use.
17	Control Panel Door	Covers the alarm display buttons (High, Set, and Low), power switch, 1/7/32 day mode switch, and Cal/Normal mode switch.
18	Light Bulb Push Button	Turns the light bulbs and LCD back-light on and off with ac adapter only.

1.2 Parts of the Recorder - Rear View

Foot Cover Removed
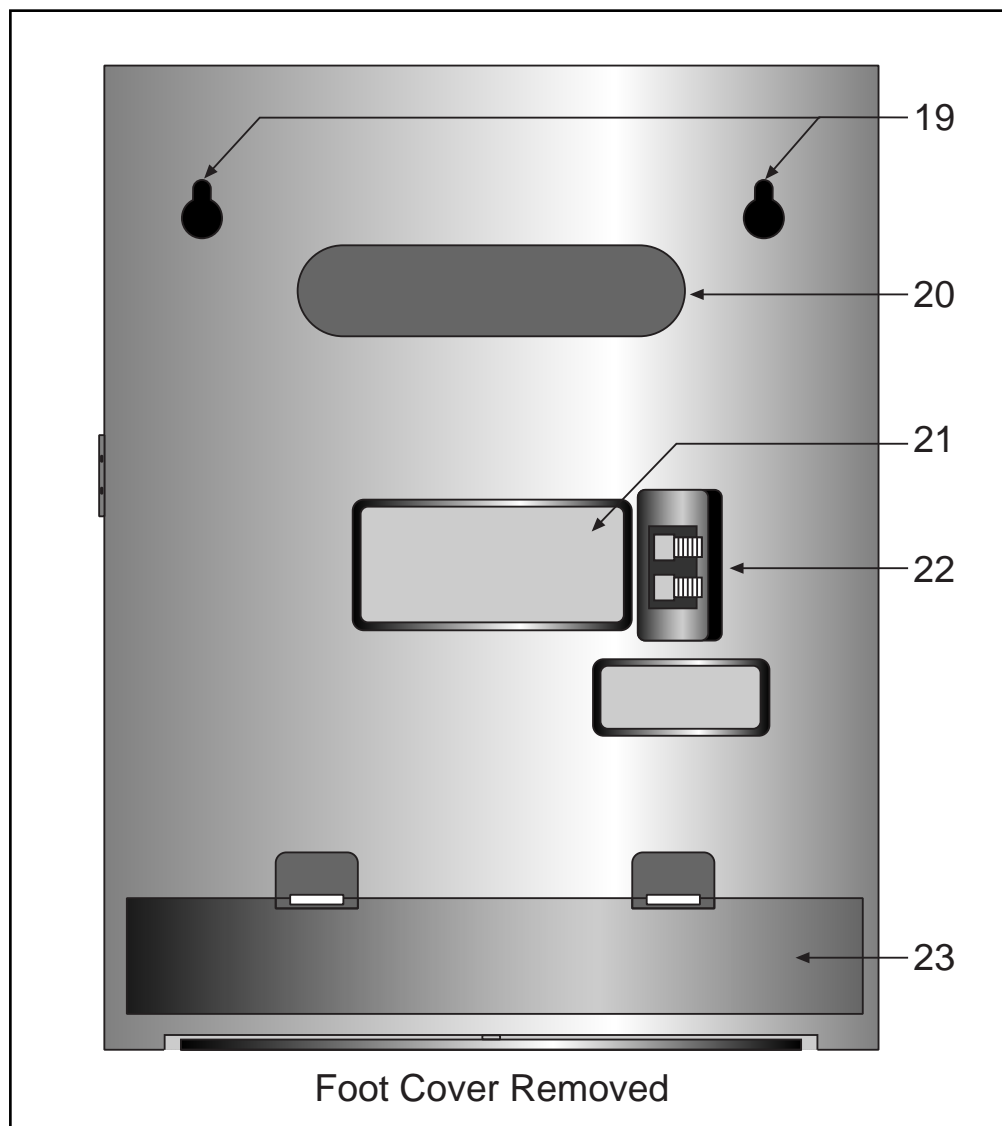
Figure 1-2. Rear View

Item	Description	Function
19	"Keyhole" Slot Mounting Holes	Allows the recorder to be mounted on the wall.
20	Carrying Slot	Allows the user to carry the recorder conveniently.
21	Product Label	Product information label.
22	Alarm/Relay Contacts	Allows the user to hook up an external, dry contact alarm to the recorder.
23	Battery Compartment	Holds 4 "D" size batteries which provide power if the ac adapter is not used, or with adapter, provide power backup in case of ac power failure.

◢2◣ Setting Up the Recorder

Now that you have learned about the different parts of the recorder, you can set it up.

Determine whether you want the recorder wall mounted or sitting on a bench top.

2.1 Placing the Recorder on the Bench Top

Figure 2-1 shows the removal of the decorative foot cover.

1.   Place the recorder on its back (so it is face up).

2.   Remove the clip-on foot cover by lifting up on the cover and releasing it from the stabilizing arm at the bottom of the recorder. This exposes the rubber feet and stabilizing arm. The rubber feet protect the bench top surface.

⚠ **▽CAUTION**

DO NOT ATTEMPT TO SET THE RECORDER UPRIGHT ON THE BENCH WHEN THE CLIP-ON FOOT COVER IS IN PLACE. THE RECORDER WILL TOPPLE OVER.
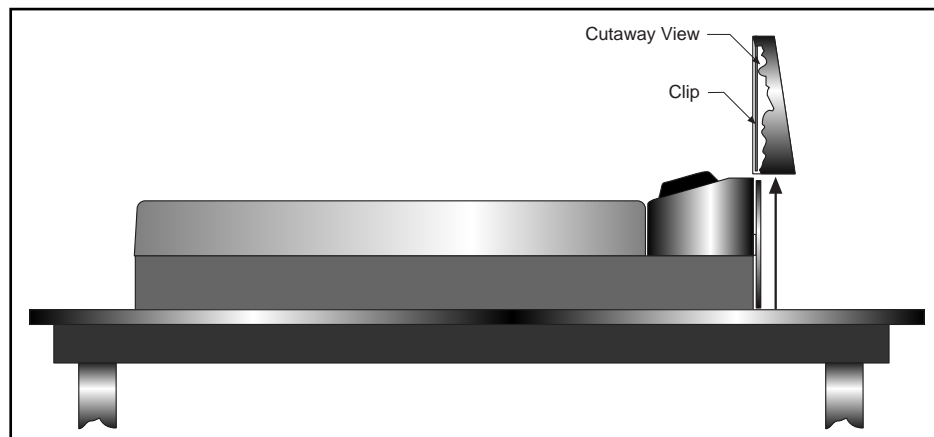

Figure 2-1. Foot Cover Removal

3. Swing out the stabilizing arm and extend it towards you. Figure 2-2 shows how to swing out the stabilizing arm. Make sure the slot in the stabilizing arm extends out the rear of the recorder.
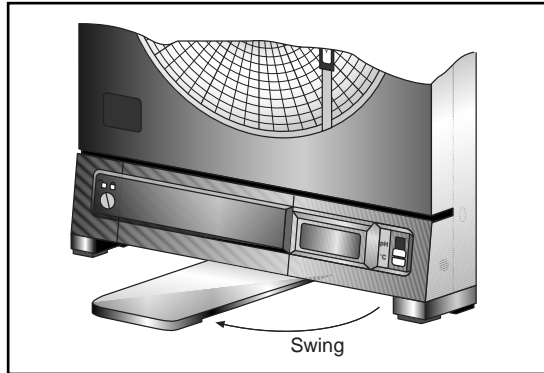

Swing

Figure 2-2. Swiveling Stabilizing Arm

CAUTION

When the recorder is in normal operating position (the door is closed and the control panel door is closed), the stabilizing arm should be pushed to middle position (the bumps on the arm will click in place under the recorder). Refer to Figure 2-3a.

Before opening the door, pull the stabilizing arm out to its full extension position to provide full stabilty. Refer to Figure 2-3b. After closing the door, return the arm to its middle position. Refer to Figure 2-3a.

Note that the arm extends towards the front or rear of the case. If the unit is placed on a bench top snug against the wall, extend the stabilizing arm fully to the front of the unit. Refer to Figure 2-3b.
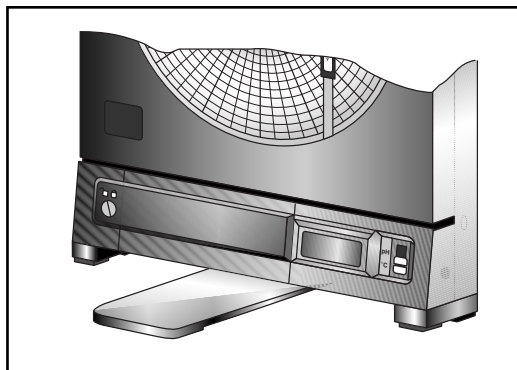

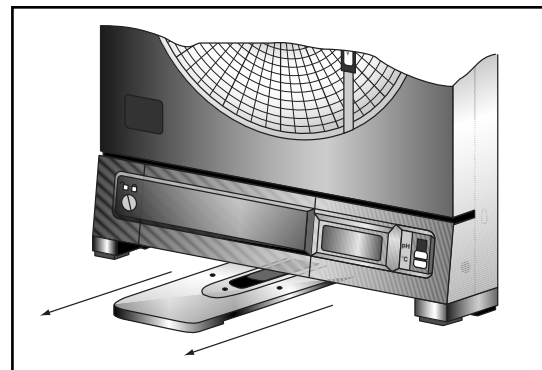**Figure 2-3a. Stabilizing Arm use for Bench Top Use (normal position)**

Figure 2-3b. Stabilizing Arm in Extended Position (position when you open door)

2.2 Mounting the Recorder on the Wall

To mount the recorder on the wall, first locate the wall mounting holes using the template provided in the wall mounting kit. Leave the decorative foot cover (Figure 1-1, item #16) in place*. After drilling the holes, insert the wall anchors and put in the screws, leaving ⅛ inch (3 mm) between the screw heads and the wall. Hang the recorder by positioning the two (2) "keyholes" in the rear cover over the screw heads.

▼
CAUTION

The ac adaptor has a 6 foot (2 meter) cable.

* If the decorative foot cover is not in place, go through the following steps to reinstall the cover (if desired):

1. Place the recorder on the table (so it is front face up).
2. Roughly position the foot cover so the clips are in line with the stabilizing arm. Gently "stretch" the clips out and position over the arm as shown in Figure 2-4a.
3. Once the clips are in place, gently slide down until the foot cover is even with the front of the recorder as shown in Figure 2-4b.

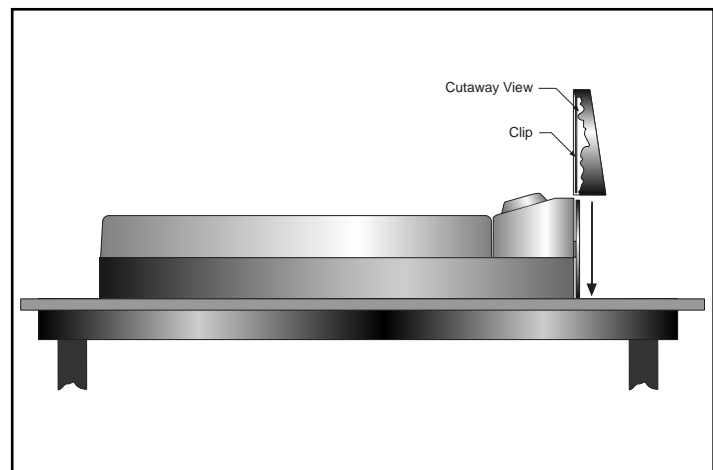**Figure 2-4a. Installing the Foot Cover (Top View)**

Figure 2-4b. Installing the Foot Cover (Side View)

2.3 Using Batteries

The recorder operates on either four "D" size batteries or on ac power. 110Vac and 220Vac adaptors are available.

NOTE

In the event of ac power failure, the unit will switch over to battery power automatically.

Keep a fresh set of batteries in the unit in case of power outage, when it can be especially important to have a record of pH and fluid temperature.

2.3.1 Installing Batteries

You may power the recorder with four "D" size batteries. For adequate performance and battery life, use alkaline batteries. The recorder operates full time on battery power alone for up to one month when using fresh alkaline batteries. When replacing batteries, we recommend that you use Duracell MN1300 "D" size batteries for long life and for best performance at low temperatures.

To install the batteries (refer to Figure 2-5):

Bench Top Set-Up

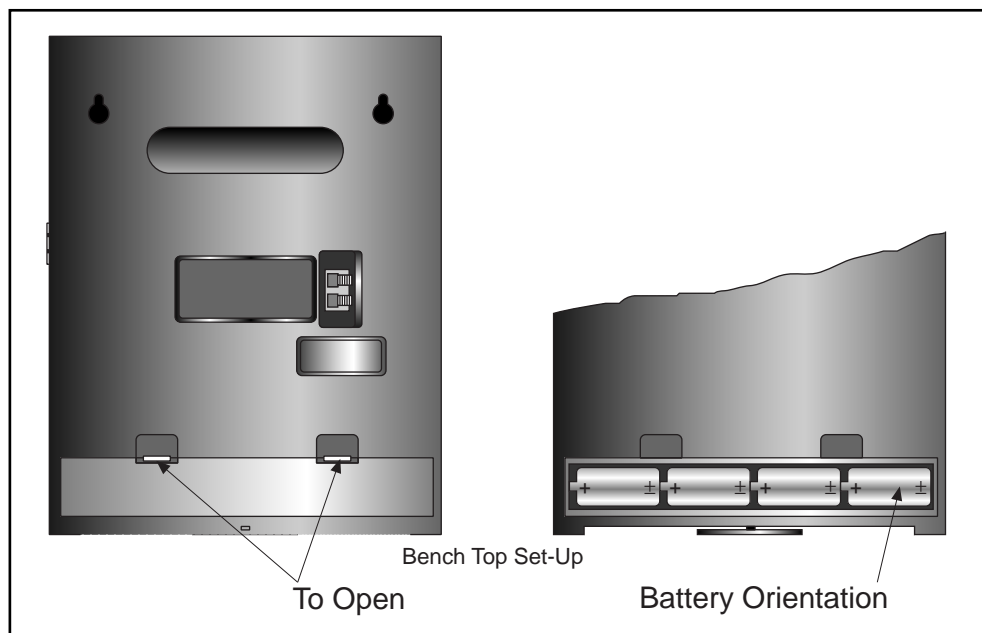To Open   Battery Orientation

Figure 2-5. Battery Compartment and Battery Orientation

1. Open the control panel door.
2. Turn the power switch to "O" position.
3. Place the recorder on a soft surface front face down. Locate the battery compartment at the bottom.
4. Open the battery compartment door by pressing down firmly on the tabs located along the top edge.
5. Remove the battery door.
6. Install the batteries, oriented as shown in Figure 2-5, in the battery compartment.
7. To replace the battery door, first place the bottom edge of the door into the positioning slots in the compartment.
8. Push down on the door to snap the tabs in place.

The recorder continuously monitors the battery voltage. **A "LO BAT" indication in the upper left-hand corner of the main LCD (refer to Figure 2-6) indicates that only one to two weeks of reliable battery operation remain, and that the batteries need replacing within this time frame. Also, if the unit is operating under battery power and the battery voltage is too low to permit reliable operation, the system shuts down and displays "---" in the LCD**. The system may be restarted by changing the batteries or by the re-initiation of ac power. If ac power fails, the circuitry will attempt to automatically switch to battery backup. If viable battery power is available, the system will operate on battery power until the batteries fail or ac power returns. When ac power returns, the recorder will automatically reset itself (refer to Section 8.5).

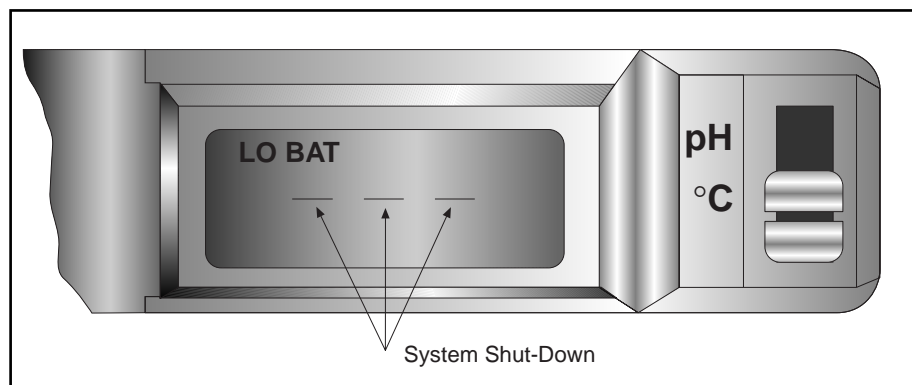**Figure 2-6. Battery Warnings**

2.3.2 Connecting ac Power

The recorder can be ac powered using the 9Vdc, 1Amp ac adaptor supplied. The ac power jack is located on the right side of the unit (refer to Figure 1-1, item #6.). Make sure the power switch on the control panel (refer to Figure 1-1, item #7) is in the "O" position when plugging in the ac adaptor. The adaptor cable is 6 feet (2 meters) long.

2.4 Installing the Chart Paper

The recorder accepts three different types of chart paper. Charts are available for 1, 7 and 32 day recording times. Although chart paper replacing is very simple, you must take care to set the appropriate front panel switches to match the paper being used. Set the chart type and Cal/Normal switches (refer to Figure 2-7) to the following positions for these three (3) modes of operation.

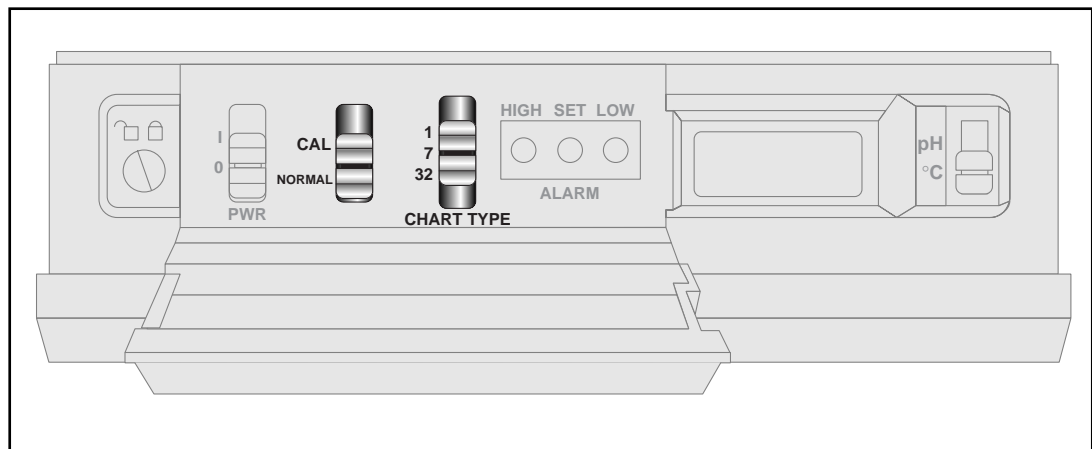| Chart Type Switch (Days)	Paper Type
1	1-day, pH and Celsius paper
7	7-day, pH and Celsius paper
32	32-day, pH and Celsius paper

Figure 2-7. Chart Switches

To change the chart paper:

1a. <u>Table Mounted Recorder</u>:

To balance the recorder, fully extend the stabilizing arm at the bottom of the recorder. Refer to Figure 2-8. Continue to Step 2.
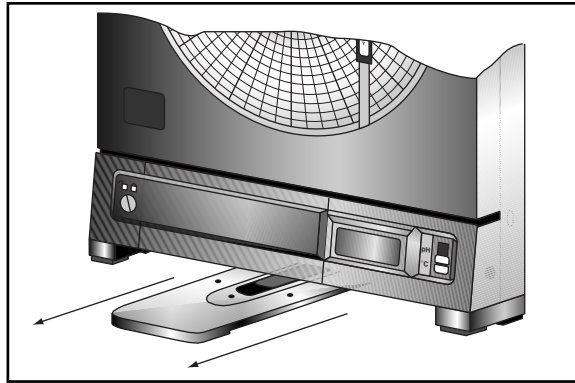

Figure 2-8. Stabilizing Arm Fully Extended

1b. <u>Wall Mounted Recorder</u>:

You can also leave the recorder on the wall if it is easily accessible.

2. Open the door and hold it open with left hand.

3. Remove the magnetic chart paper knob (Figure 2-9, item #2) and used chart paper.

4. Place the new chart paper (Figure 2-9, item #1) on the spindle and rotate it until the current time on the chart paper is aligned with the time arrow on the chart base of the recorder. See Figure 2-9 detail.

5. When the chart paper is correctly oriented, replace the magnetic knob (Figure 2-9, item #2), being careful not to alter the position of the chart paper.

6. Make sure that the "Chart Type" switch, located behind the control panel door, is in the correct position relative to the chart paper used.

NOTE

If the switch is in the wrong position, the chart paper will not rotate at the correct speed and the indicated chart time will not correspond to real time.
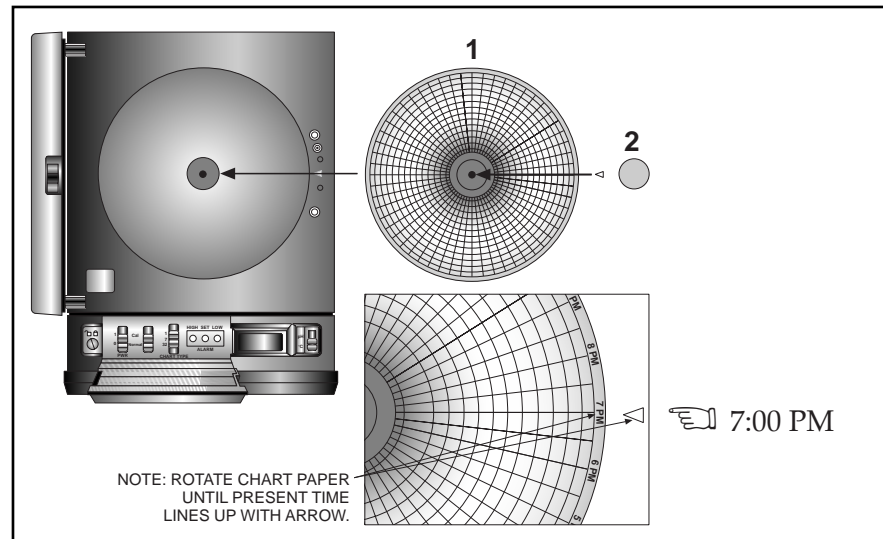
Figure 2-9. Changing Chart Paper and Setting the Time

2.5 Installing and Removing Pens

2.5.1 Installing the Pens

The recorder uses two different colored pens to record information. The green (upper) pen records pH. The red (lower) pen records temperature. Pen life varies with use and climate. Under normal operating conditions, pens last at least one month. We recommend that you install a fresh set of pens after every month of use.

To install pens:

1. Make sure the power switch on the front panel is in "O" position. The front panel is located under the control panel door. The recorder door should be closed.

NOTE

The control panel door opens easily by gently gripping the recessed area at the right side and slowly pulling down.

2. Examine the location of the pen arms through the window in the recorder door.

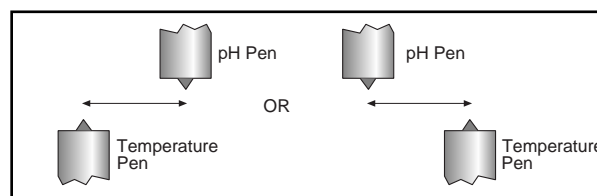   a. If the pen arms are offset as shown in Figure 2-10, continue to Step 3:

Figure 2-10. Offset Alignment of Pens (for ease of pen installation)

b.   If the pen arms are vertically aligned as shown in Figure 2-11, do the following and then proceed to Step 3.
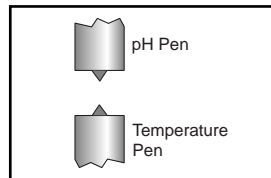

Figure 2-11.   Vertical Alignment of Pens (pens can't be inserted)

(The pen arms must be offset sufficiently to allow for clearance before insertion or removal is attempted. The pens must be moved electrically.)

- Make sure the recorder door is closed and a piece of chart paper is installed on the spindle on the chart base.
- Turn the unit back on by moving the power switch to "|" and wait for the pens to be far enough apart to remove a used pen one at a time or to insert a new pen one at a time.

CAUTION

DO NOT ATTEMPT TO OFFSET THE PENS MANUALLY (BY HAND). THE DRIVE MECHANISM COULD BE DAMAGED. DO NOT ATTEMPT TO CHANGE THE PENS WHILE THEY ARE IN MOTION.

- Turn off the unit (PWR switch position in "O" position) to stop the pen movement.

3.   Open the recorder door by applying downward pressure on the latch button (refer to Figure 1-1, item #14).

4.   Remove the pens from the package and the cap from each pen.

We recommend that you put the pen caps on special posts located on the chart base of the recorder near the light bulbs. Figure 2-12 shows the location of the posts.
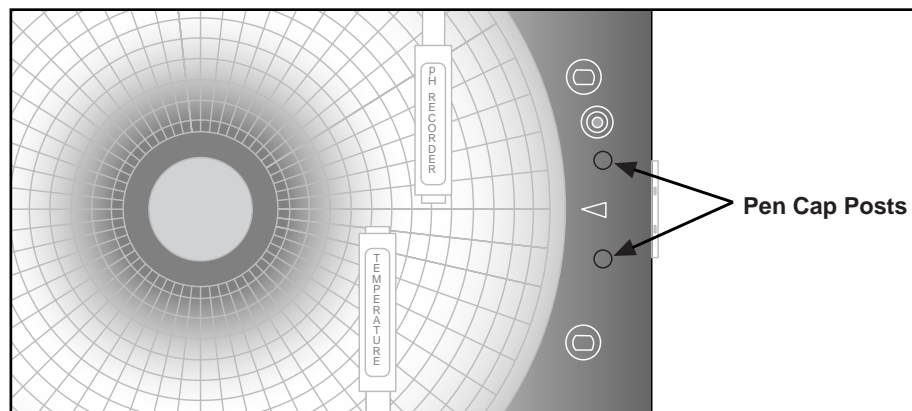

Figure 2-12.   Post Location for Pen Caps

5. Insert the red pen fully into the lower (temperature) holder, and the green pen fully into the upper (pH recorder) holder.

If you installed the pens correctly, you will hear a click as they position themselves in the holders. Figure 2-13 shows how to insert the pens.
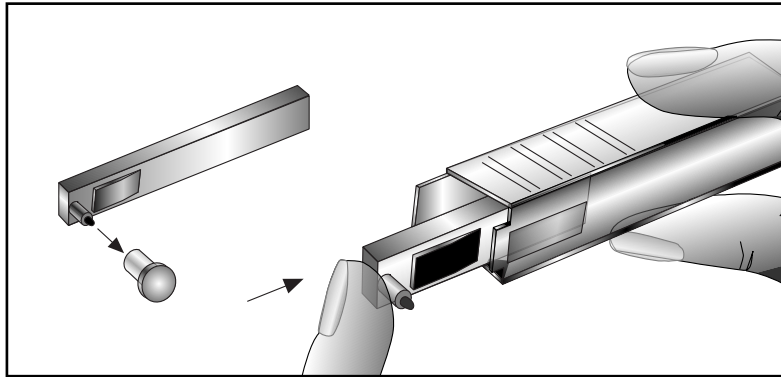
6. Close the recorder door.

Figure 2-13. Pen Installation

2.5.2 Removing the Pens

1. Check to see that the pens are offset as shown in Figure 2-10. Otherwise, you can damage the arm and drive mechanism if you try to remove them.

⚠ CAUTION

DO NOT ATTEMPT TO OFFSET THE PENS MANUALLY (BY HAND). THE DRIVE MECHANISM COULD BE DAMAGED. DO NOT ATTEMPT TO CHANGE THE PENS WHILE THEY ARE IN MOTION.

2. Perform Step 2b in Section 2.5.1 to offset the pens.

3. With a screwdriver in one hand, push on the rectangular area of the pen shown in Figure 2-14. Using the other hand, release the pen from the spring clip attached to the pen holder.
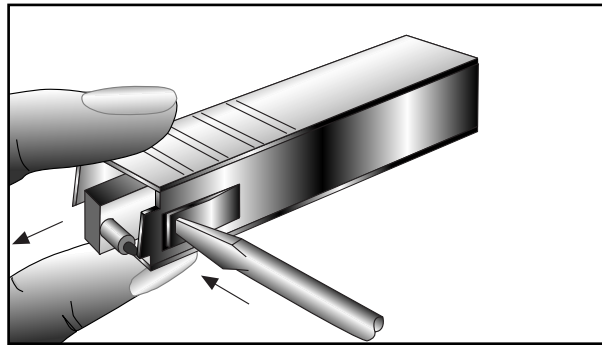
Figure 2-14. Pen Removal

4. At the same time, slide the pen out from the pen holder.

5. Install new pens following Section 2.5.1, Steps 3 through 6.

2.6 Installing the pH/Temperature Probe

The pH/temperature probe can either be directly attached to the recorder using its own attached cable or be extended by using the remote probe cable.

2.6.1 Using the Probe

1. Install the connector into the socket at the side of the recorder. Make sure the probe cable is untwisted.

2.6.2 Using the Remote Probe Cable

1. Connect the end of the cable **with** the arrow to the cable on the probe. Line up the two arrows as shown in Figure 2-15 before mating the two cables.

2. Connect the other end of the remote probe cable (**without** the arrow) to the socket at the side of the recorder.
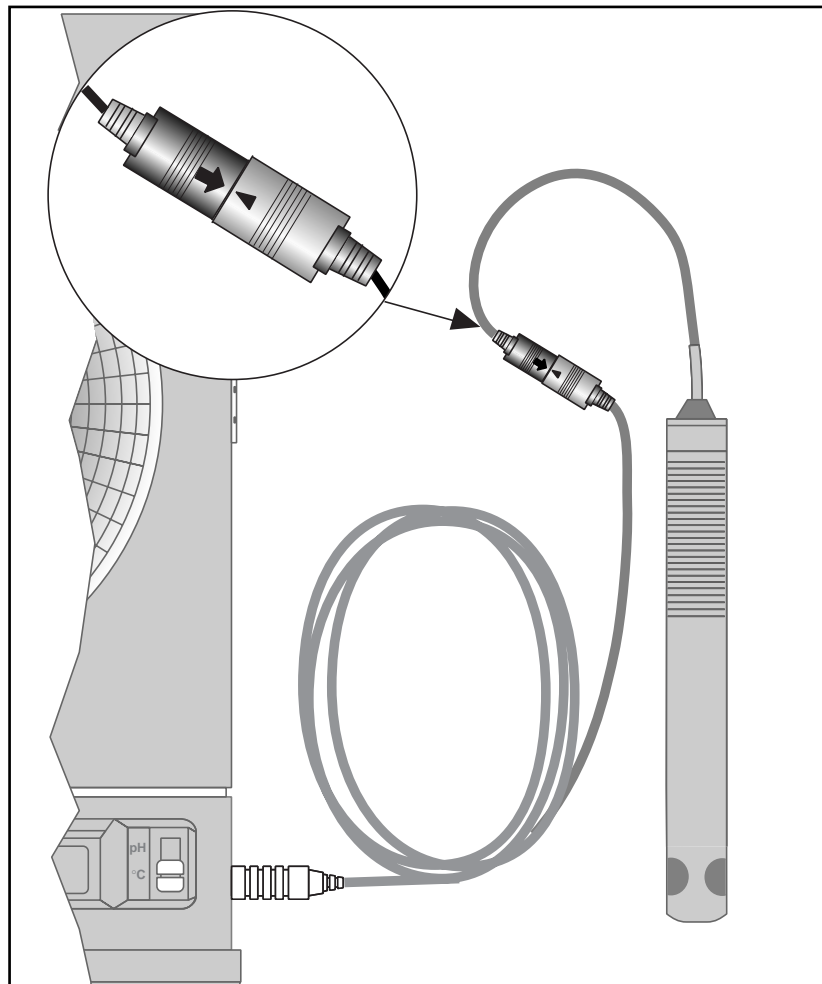

Figure 2-15. Using the Remote Probe Cable

3 ▼ Powering Up the Recorder

3.1 Turning on the Recorder

Open the control panel door by gently gripping the recessed area at the right side of the door and slowly pulling down.

Turn the recorder on by moving the power switch located on the control panel to the "|" position. Refer to Figure 3-1 for the location of the switch.
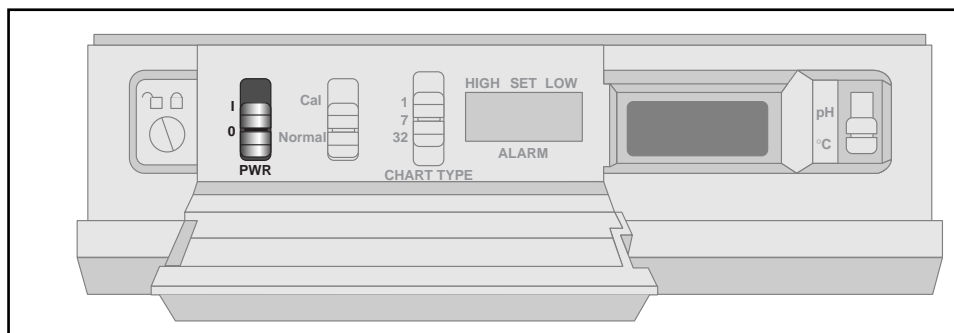

Figure 3-1. Power Switch

You then hear 1 beep and the LCD display shows the following:

Figure 3-2. First LCD Display

The displays in Section 3.2 come up quickly once you turn on the recorder. Be prepared to write down the codes as you see them on the recorder display. You can then compare the codes your recorder displayed with the probe label as described below. After the two groups of codes are displayed, the recorder continues with its sequence, and the pens move. More details are provided in Sections 3.3 and 3.4.

3.2 Recording the Code Numbers

A two-character temperature code made up of numbers and/or letters 0, 1, 2, 3, ... , 8, 9, a, b, and c appears. An example is shown in Figure 3-3; the numbers will vary:
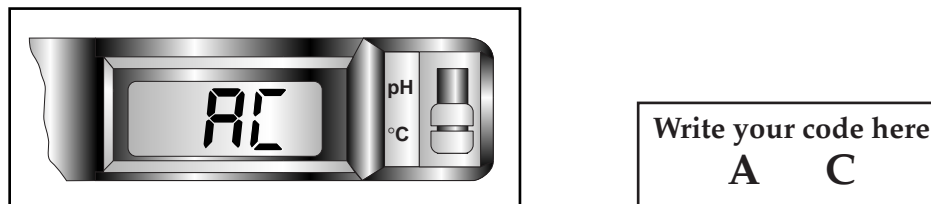

Write your code here
A   C

Figure 3-3. Temperature Code

Then, a single-character pH code, a number or letter 0, 1, 2, 3, ... , 8, 9, a, b, or c, appears. An example is shown in Figure 3-4; the numbers will vary:
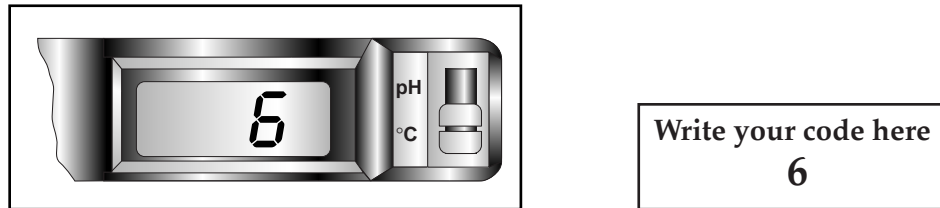

Write your code here
6

Figure 3-4. pH Code

3.3 Final Display Mode

After the pH and temperature codes appear, the LCD displays the current fluid temperature in °C or the fluid pH, depending on the position of the display selection switch (refer to Figure 3-8).
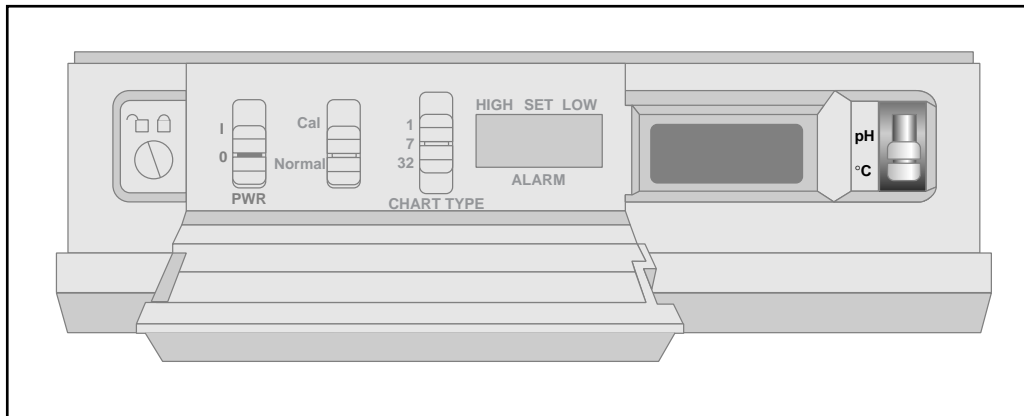

Figure 3-8. Display Selector Switch

Initially, the pH recorder pen moves to the right a short distance and then moves to the left to the zero position. The temperature pen follows. Then, both pens, one at a time, move to the positions which correspond to the current temperature and pH.

At this point, the recorder is ready to use.

▼ 4 Alarm Operation

4.1 Alarm Description

The chart recorder is equipped with an alarm system which is activated when the sensor conditions exceed user-set limits. The system consists of a built-in audible piezo-electric beeper and a set of normally open dry relay contacts for activating an external alarm. The contacts are rated for 1 amp at 35Vdc or 1 amp at 35Vac. The contact terminals are mounted on the rear of the recorder (refer to Figure 4-1). In addition, the LCD display will flash upon alarm activation.
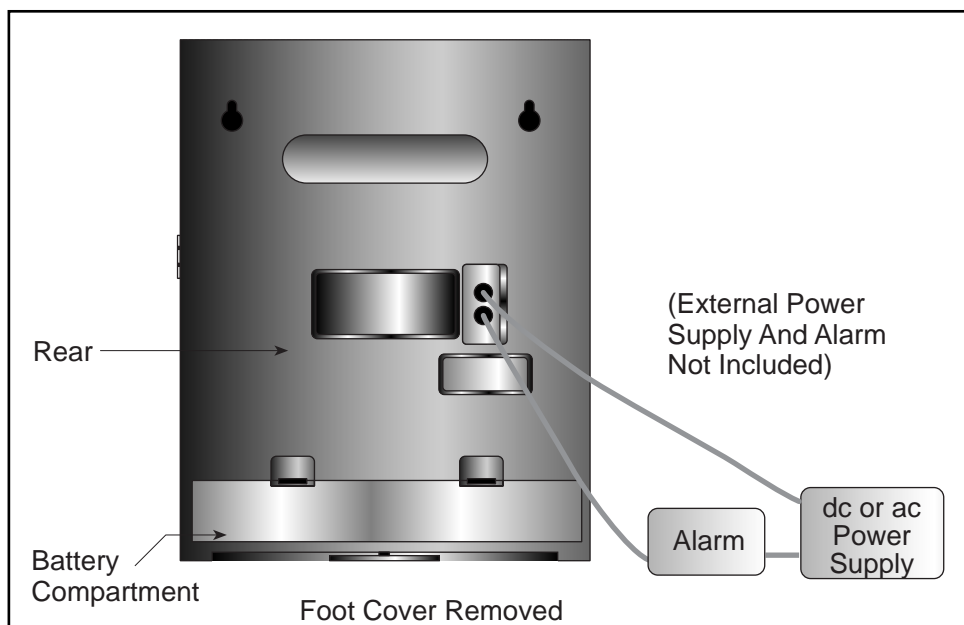

Figure 4-1. Alarm/Relay Contacts Location

4.2 Checking Alarm Limits

WAIT UNTIL THE UNIT HAS STABILIZED AND THE PENS STOP MOVING BEFORE PRESSING ANY KEYS ON THE KEYBOARD.

- Depending on the Display Selection Switch position, the display will be in °C or pH for the alarm limit viewing.

- The word 'hi' and the high limit value of the alarm may be seen on the display after pressing the "HIGH" button on the front panel.

- The word 'lo' and the low limit value of the alarm may be seen on the display after pressing the "LOW" button on the front panel.

▼ **NOTE**

The alarm limits are stored in permanent EEPROM memory and will not be lost even if power is interrupted and battery backup fails.

4.3 Unlocking/Locking the Control Panel Door

To access the Alarm Display Buttons (Figure 1-1, item #10) under the control panel door, you may have to unlock the door. You'll find the control panel door lock to the left of the control panel. Refer to Figure 4-2.

Figure 4-2. Location of the Door Lock

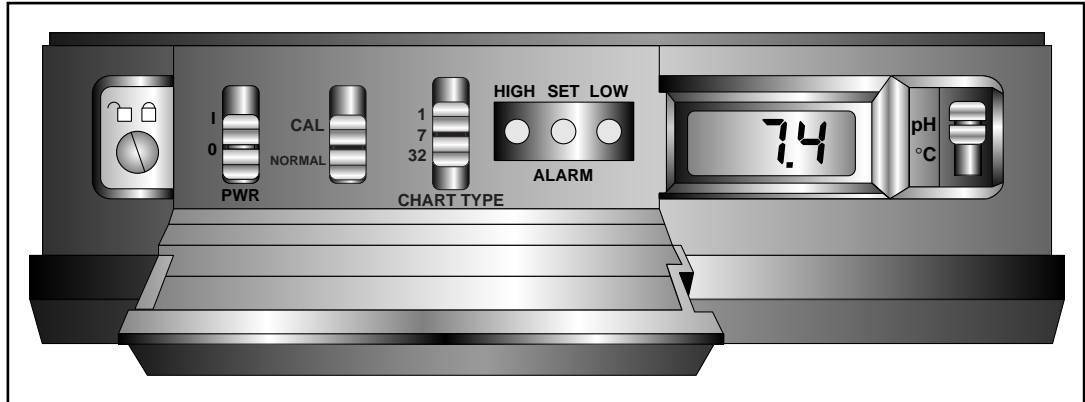### 4.3.1 Unlocking the Control Panel Door

Use a small screwdriver to turn the lock to the left as far as it will go. Figure 4-3 shows the unlocked position.
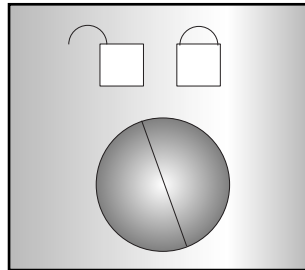

Figure 4-3. Door Unlock Position

4.3.2 Locking the Control Panel Door

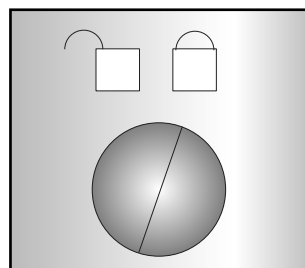Use a small screwdriver to turn the lock to the right as far as it will go. Figure 4-4 shows the locked position.

Figure 4-4. Door Lock Position

4.4 Setting/Changing Alarm Limits

To set the alarm limits on the alarm recorder:

1. Set the display selection switch (Figure 1-1, item #12) to pH or °C, depending on the parameter for which you would like to set the alarm limits. Refer to Figure 3-8 for the location of the switch.

2. Open the control panel door (unlock it, if necessary).

3. Press the "SET" button to activate the display to set either the high OR low alarm limit. At this time, "SE" is displayed. Figure 4-5 shows the location of the Alarm Display Buttons.
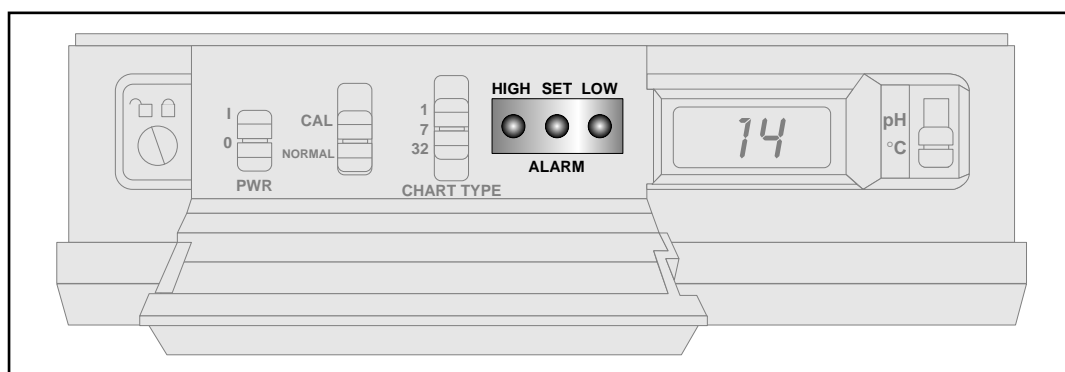

Figure 4-5. Alarm Display Buttons (HIGH/SET/LOW)

4. Release the "SET" button. The display will alternately flash "hi" and "lo" repeatedly.

5a. To change the high alarm limit:

• Press and hold the "HIGH" button for 4 seconds, then release.

  'hi' is displayed and then the current high alarm limit is displayed.

• Press the "HIGH" or "LOW" button to respectively increase or decrease the value.

• Press the "SET" button to lock in the value(s); the display now shows "SA".

• Continue to step 6.

5b. To change the low alarm limit:

• Press and hold the "LOW" button for 4 seconds, then release.

  'lo' is displayed and then the current low alarm limit is displayed.

• Press the "HIGH" or "LOW" button to respectively increase or decrease the value.

• Press the "SET" button again to lock in the value(s); the display now shows "SA".

NOTE

If, after about 15 seconds, you don't press the "SET" button to enter the desired value, the alarm recorder returns the display to the normal operation.

You can double check your limits at any time by pressing the "HIGH" and "LOW" buttons.

6. Go through steps 1-5 to check and/or change the limits for the other parameters. For example, if you already checked or changed °C, you may check or change pH if you choose.

7. After you are all done with the changes, close and lock the control panel door, if necessary.

4.5 Turning the Alarm Off

If the high or low alarm limit for pH or temperature is exceeded, you will hear the alarm. In addition, if the unit is operating under battery power and the batteries are about to fail, you will hear the alarm.

The alarm will stay on even after the condition which caused the alarm disappears. Refer to the example below:

pH High Limit	Actual pH	Alarm Sounding
7.5	7.4	OFF
7.5	7.5	ON (pH rises)
7.5	7.4	ON (pH drops) ***

***The alarm stays on even though the pH drops below the limit. The alarm recorder will not reset automatically.

1. Unlock the control panel door if necessary.

2. After the alarm becomes activated, the "SET" button must be pressed to disable it.

   The message "AO" appears in the display. The alarm is disabled for 10 seconds. After 10 seconds, the alarm may activate again, but only if an alarm condition is present.

   If the alarm is activated and you wish to change the alarm limits:

a. Press the "SET" button for 5 seconds.

   First "AO", then "SE" message will appear in the display.

b. You can now proceed with the changing the alarm limits as described in Section 4.4.

c. After you are all done with the changes, lock the control panel door if necessary.

4.6 Disabling the Alarm

1. Unlock the control panel door if necessary.

2. On power up, when you hold the "LOW" button down, an "AO" message appears in the display and the beeper sounds. <u>This will disable the alarm function.</u>

    (This action sets the high pH limit to 12.1, the low pH limit to 0.1, the high temperature limit to 99, and the low temperature limit to 01. Since these limits are outside the normal measuring range of the alarm recorder, the alarm function is effectively disabled.)

    The alarm limits are set this way when you receive the unit. <u>If the alarm is disabled, you must re-initialize the instrument</u>. After you are done with the changes, lock the door if necessary.

3. To verify the settings after re-initializing is completed, press the "LOW" button to get the low value, and the "HIGH" button to get the high value.

Notes

▼5 Calibrating the Recorder

5.1 Factory Calibration Information

The recorder is factory calibrated during final assembly by calibrating the sensor (shipped with the recorder) to known temperature and pH standards. This technique avoids tracking and positioning errors due to temperature changes and mechanical shock. However, if the pH readings drift or appear out of calibration, follow Section 5.2 to recalibrate your recorder.

5.2 Changing Calibration Codes

To change the calibration codes:

1. Open the control panel door (unlock it, if necessary).

2. Turn the power switch to the off ("O") position.

3. Press and hold down the "SET" button while turning on the power switch. This button is one of three Alarm buttons shown in Figure 4-5.

After you hear an audible beep, you will see the following display:

Figure 5-1. First Display

Then "CH" appears on the display.

4. At this time, release the "SET" button.

A 2-character **temperature calibration code "AC"** should now appear in the display with the first character blinking. Refer to Figure 5-2.
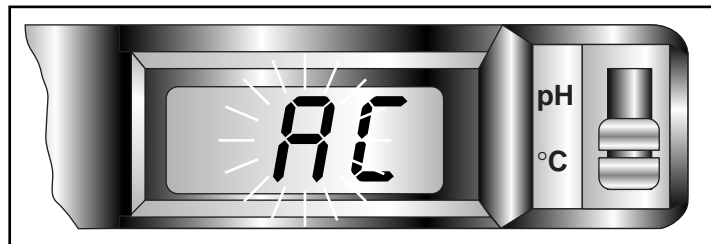

Figure 5-2. Temperature Code - First Character Blinking

5a. <u>If the first character is correct</u>,

   press the "SET" button and go to step 6.

5b. <u>If the first character is not correct</u>,
   press the "HIGH" button to increase the value of the character or the "LOW" button to decrease the value of the character. When this character is correct, press the "SET" button.

6. The second character should now be blinking. Refer to Figure 5-3. If it is not, press the "SET" button until it does.
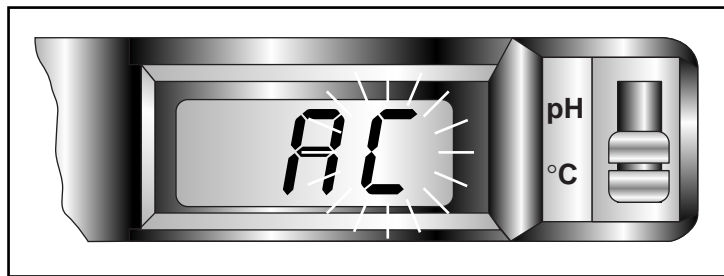

Figure 5-3. Temperature Code - Second Character Blinking

7a. <u>If the second character of the temperature calibration code is correct</u>,
   press the "SET" button and go to step 8.

7b. <u>If the second character is not correct</u>,
   press the "HIGH" button to increase the value of the character or the "LOW" button to decrease the value of the character. When this character is correct, press the "SET" button.

8. A single character **pH calibration code "6"** should be blinking in the display. Refer to Figure 5-4. If it is not, press the "SET" button again.
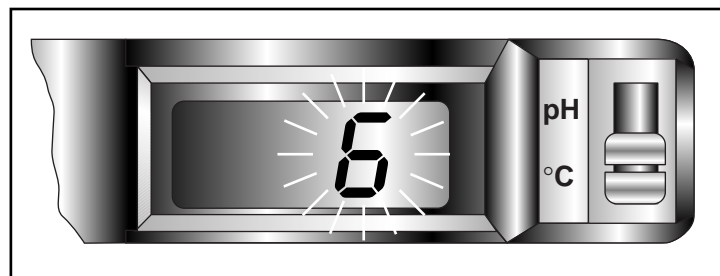

Figure 5-4. Blinking pH Code

9a. <u>If the pH code is correct</u>,

   press the "SET" button and go to step 10.

9b. <u>If the pH code is not correct</u>,

> press the "HIGH" button to increase the value of the character or the "LOW" button to decrease the value of the character. When this character is correct, press the "SET" button to lock in the values.

At this time, you see the temperature and pH codes on the display as you entered them. This way, you can verify that you entered them correctly.

10. The unit should now automatically go through the power up sequence as described in Chapter 3. If it does not, hold down the "SET" button until it does.

While the unit goes through the power up sequence, observe the display to see that the calibration values are what they should be and that they have been entered correctly.

11. <u>If either the temperature or pH code is incorrect</u>,

> repeat steps 1-10. After you are all done with the changes, lock the control panel door, if necessary. Refer to Section 4.3 for details.

5.3 Calibrating pH Readings

In order to calibrate the pH readings you need 7.00 and 4.00 buffer solutions. See accessories list for ordering information. Start by turning the unit ON and observing the Display power up routine. After you hear a beep, you will see the display "LO BAT.-188", than the temperature code "Ac", followed by pH code "6".

Put the display switch on pH.

Immerse the probe in 7.00 buffer solution as shown in figure 5-5. then wait one minute for the pens to stop moving. Observe the display: it should read 7.0. If it does not, turn the calibration switch to "CAL" and open the door.

When the probe pens stop moving, turn the "CAL" adjustment to display 7.0, than put the sensor in 4.00 buffer solution and wait one minute. If the display doesn't read 4.0, turn the "Slope" adjustment to bring it to 4.0.

Repeat these steps until the readings are correct in both 7.00 and 4.00 buffer solutions. Now the recorder is calibrated.

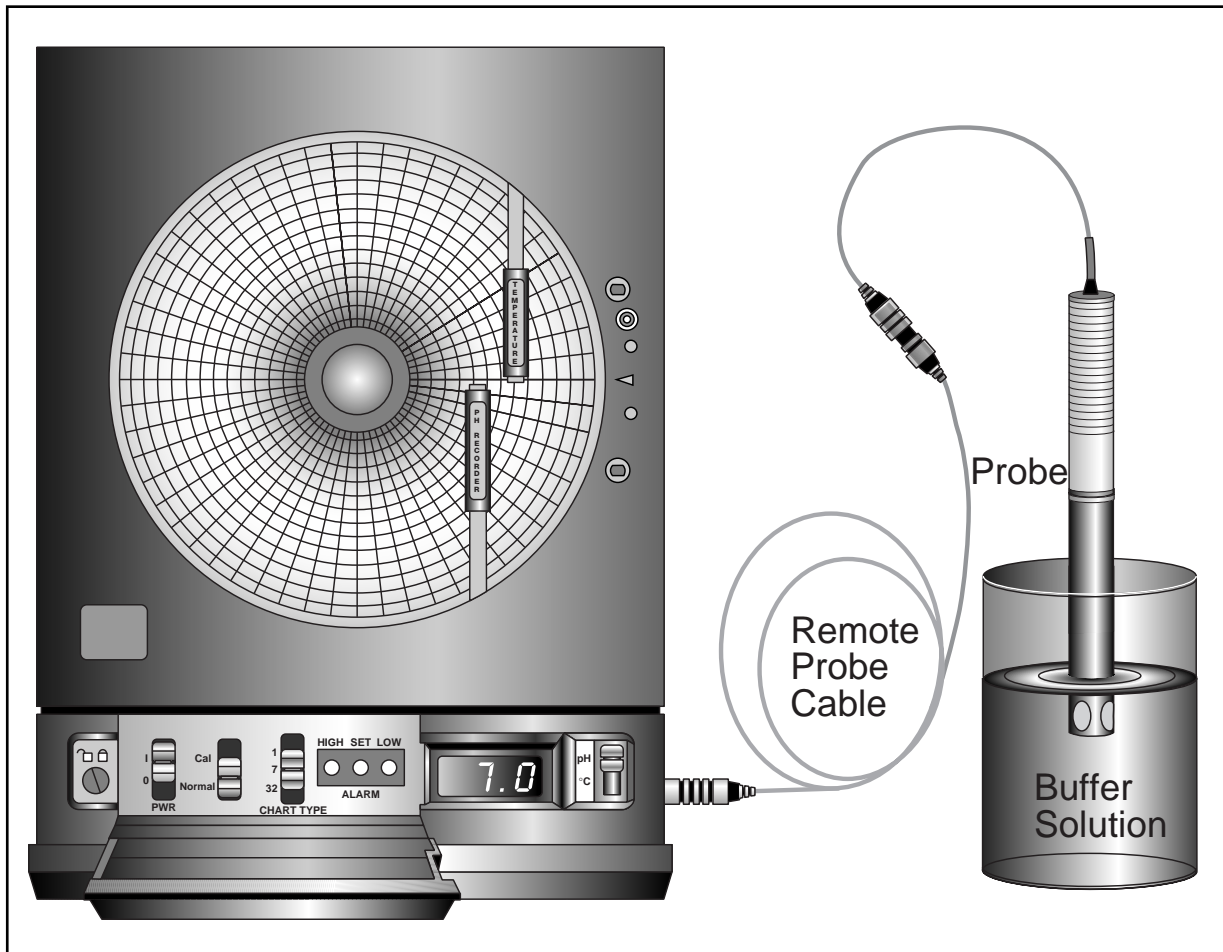Close the door and put the calibration switch on "NORMAL".
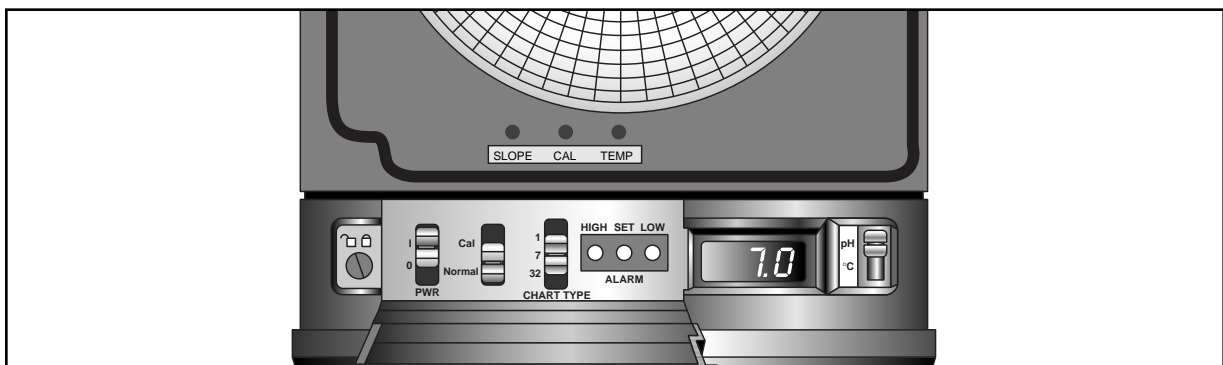
Figure 5-5. Calibration Setup

Figure 5-6.

6 ▼ Using the Cal-Lock Kit

The CT485B-CAL-LOCK kit that comes with the Recorder is used to preserve and protect the settings that were entered into the unit during the calibration process. The CT485B-CAL-LOCK cover shields the HIGH, SET and LOW calibration buttons to prevent any additional button pressing. This method is more "permanent" than using the control panel door lock. Here's the procedure:

▼ **WARNING** ▼

USE EXTREME CAUTION WHEN USING THE GLUE. READ THE WARNING LABEL ON THE TUBE.

1. Calibrate the Recorder.
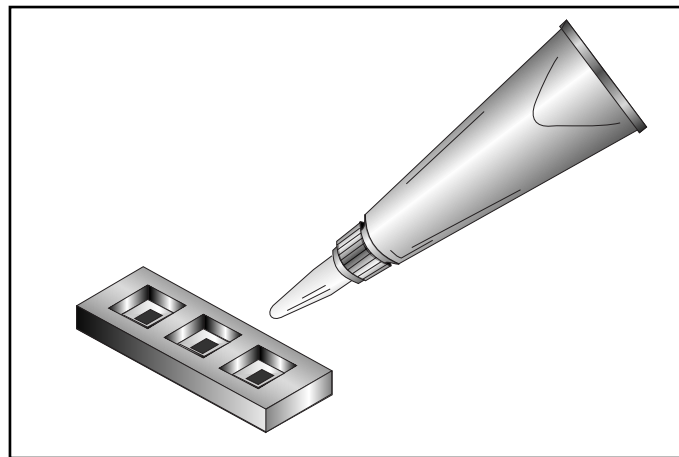2. Apply a small amount of glue to the back of the cover. Refer to Figure 6-1.

Figure 6-1. Glue Application

▼ **CAUTION** ▼

DO NOT LET GLUE COME IN CONTACT WITH BUTTONS.

3.   Place cover over calibration buttons.
4.   Fill in the label information.
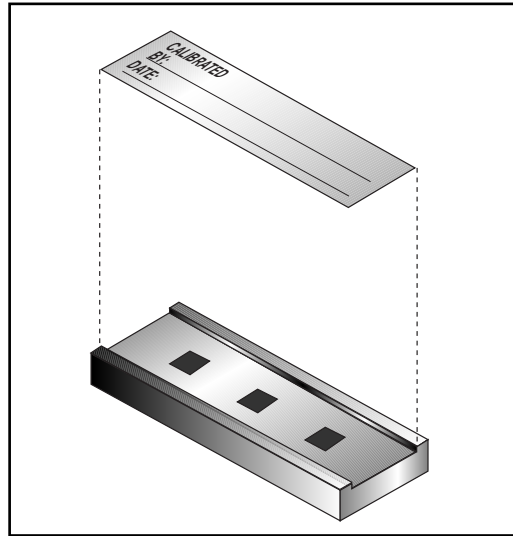5.   Apply label to cover as shown in Figure 6-2.

Figure 6-2. Label Application

NOTE

An additional label is supplied for future calibrations. A damaged label or removal of the label implies that the calibration of the recorder may have been altered.

Using the BNC Input Adapter (Optional)

Use the optional BNC input adapter to record pH from a standard BNC probe without temperature compensation. pH will be recorded per the following table of inputs:

0 pH	1 pH	2 pH	3 pH	4 pH	5 pH	6 pH
414mV	355mV	296mV	237mV	177mV	118mV	59mV

7 pH	8 pH	9 pH	10 pH	11 pH	12 pH
0mV	-59mV	-118mV	-177mV	-237mV	-296mV

⚠

CAUTION

INPUT VOLTAGES GREATER THAN SPECIFIED MAY DAMAGE THE RECORDER.
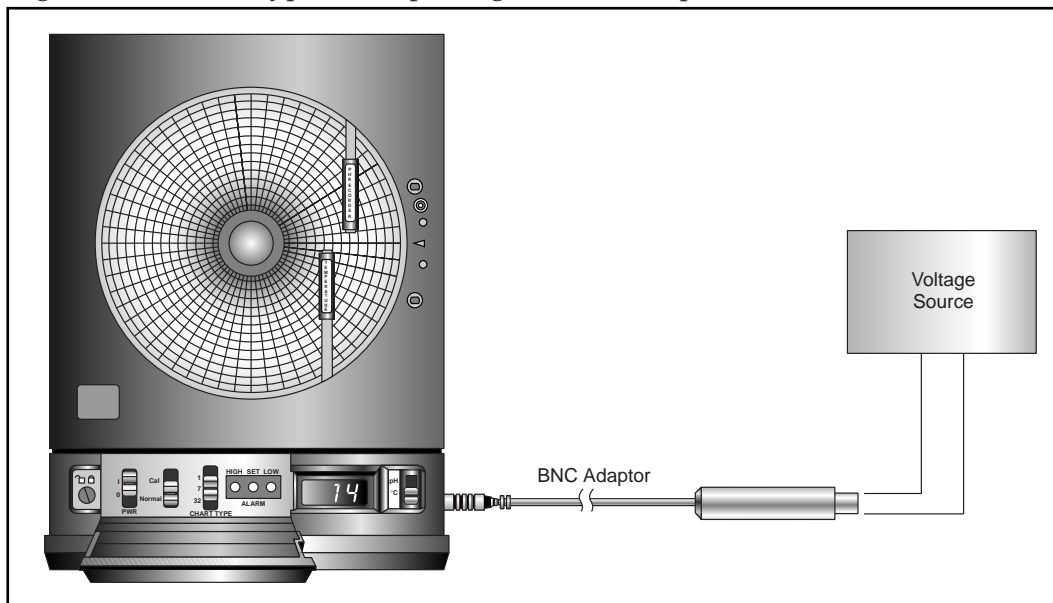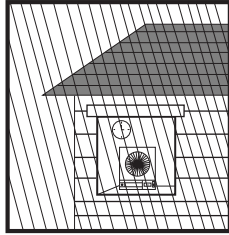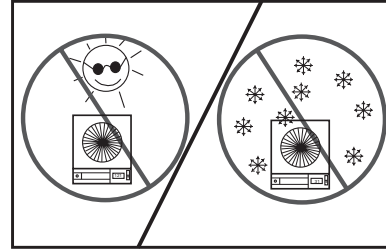
Figure 7-1 shows a typical setup using the BNC adapter.

Figure 7-1. BNC Adapter Setup

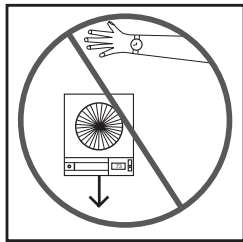# Notes

8 Maintaining the Recorder
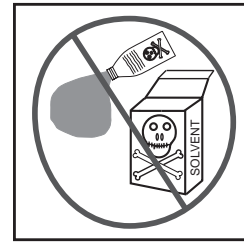
8.1 General Considerations

Keep the recorder in a dry place. If it gets wet, wipe the case as soon as possible to get rid of any moisture.
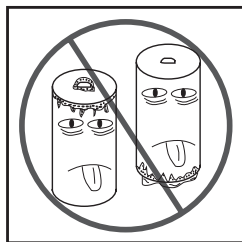

Do not expose the recorder to temperatures other than those stated in the specifications (Chapter 11). The recorder can operate in temperatures as high as 120°F (49°C) or as low as 32°F (0°C).
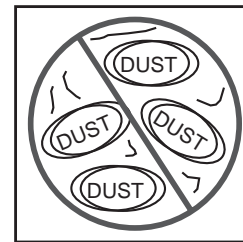

Handle the recorder carefully (DO NOT DROP IT).

Do not use strong cleaning solvents or alcohol when cleaning the outer case. Refer to Section 8.3 for more details.

Do not use old or weak batteries in the recorder. It is important to change the batteries monthly or when you see the LO BAT indicator (refer to Section 2.3.1).

Keep the recorder away from excessive dirt and dust.

8.2 Light Bulb and Push Button Information

You may notice that the light bulbs flicker slightly while the pens are moving. The flickering stops once the pens are stationary.

The light bulbs on the chart base of the recorder are long-life specialty bulbs. Even though they last a very long time, they will burn out eventually. Always replace both bulbs. The part number for ordering 10 bulb/holder assemblies is listed on the inside back cover. One extra pair of bulb assemblies is supplied with the recorder.

When removing the bulbs, grasp the bulb holder that contains the bulb and pull it out. Do not pull on the bulb itself. When reinserting the new bulbs in the sockets, orient the bulbs to fit as shown in Figure 8-1.
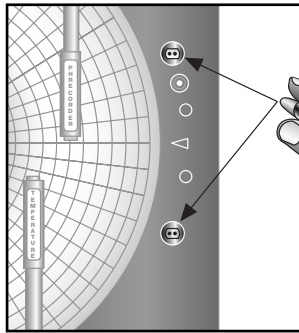

Figure 8-1. How to Hold the Bulb Assembly and Where the Bulbs are Located

NOTE

In the event that the ac power to the recorder is cut off (e.g., blackout), the recorder will continue to operate with the 4 "D" size backup batteries. The bulbs operate on ac power only.

The recorder is equipped with a push button located on the chart base. This push button turns on and off the light bulbs which are used for illuminating the chart. The push button also turns on and off the backlighting for the LCD display. One press of the push button turns on the bulbs and a second press turns them off. Figure 8-2 shows the location of the push button.
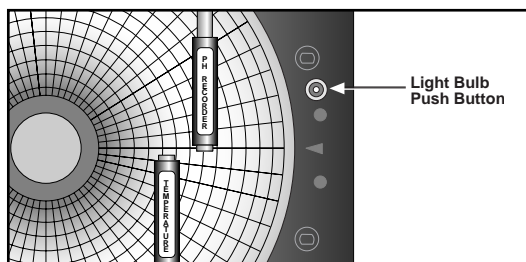

Light Bulb
Push Button

Figure 8-2. Push Button Location

8.3 Case Care

The case, front window and pen arms of the recorder should be cleaned with a mild soap solution. Under **no** circumstances should you use an alcohol or solvent based cleaner anywhere on this recorder.

8.4 Storage of Chart Paper

For optimum performance, store the chart paper in the plastic bag provided. Store the paper in rooms that have humidity levels <u>lower</u> than 80% relative humidity.

8.5 Power Failure Mode (Chart Paper Indication)

The chart paper indicates when the ac power failure occurred, the battery back up period and when the ac power returns. It is important to have fresh "D" size batteries in the recorder for battery backup so you have continuous recording. Figure 8-3 shows an example of chart paper with the power failure lines.

Figure 8-3. ac Power Failure Indication on Chart Paper

Notes

9 ▼ Troubleshooting the Recorder

Table 9-1 contains a brief troubleshooting guide.

Table 9-1. Troubleshooting Guide

If this occurs	Perform these steps
? Recorder appears not to function at all.	Make sure POWER switch is in the "l" (ON) position.
	Make sure the ac adaptor is securely plugged into the wall and into the power jack on the recorder.
	If using fresh batteries, make sure they are inserted correctly.
	If using old batteries, replace with a fresh set of alkaline batteries.
? Chart paper appears not to turn, or to turn at the wrong speed.	Make sure the magnetic chart knob is in place.
	Make sure the "CHART TYPE" 1/7/32 switch is in the correct position.
? The pens do not appear to be leaving traces on the paper.	Make sure the door is completely closed and the latch button is in the uppermost position. It may be necessary to squeeze the case slightly to close the latch completely.

Table 9-1. Troubleshooting Guide (Cont'd)

If this occurs	Perform these steps
? The pens do not appear to be leaving traces on the paper.	Make sure the pens are fresh. Remove a pen and test it on a piece of chart paper. Insert new pens if necessary.
	Check that the pens are locked firmly in position in their holders.
	Make sure pen caps are removed (and secured on the cap posts as recommended).
? Bulbs don't light.	Bulbs are blown. Replace them with new bulbs.
	The chart recorder is operating off batteries. Switch over to ac power if you wish to light up the paper.
? Display "E6"	E6 occurs when one or more pen arms are jammed. Check that the pens have been installed correctly, and that the chart paper knob is holding the paper down correctly.

Technical Details

10.1 Sensors and Measurement

The recorder has an external plug-in temperature/pH sensor. A six-foot (1.83 meter) remote probe cable is provided to allow remote sensing of both pH and temperature.

Unlike many circular recorders, this unit utilizes electronic probe to measure both fluid pH and temperature. The temperature probe is a 1000 ohm RTD, which when excited with constant current develops a voltage closely proportional to temperature. The pH probe consists of two components, the glass bulb and the reference component. These two compartments develop a voltage depending upon the pH of the solution in which the probe is immersed.

Applied to a preamplifier, this voltage can be sent over standard wire for virtually unlimited length.

The electronically-conditioned output of both probes are fed to a microprocessor via an analog-to-digital converter. The processor linearizes and temperature compensates the output of the pH circuit employing a "look-up table" approach. The results of the processor calculations are then used to update the front panel display and to position the pen arms on the chart paper.

10.2 Pen Arm Drive

This recorder utilizes a motor-driven lead screw pen arm drive located in the door of the unit. This provides several advantages over conventional pivot arm mechanisms. First, the recorder pens move along straight, radial lines as the pH and temperature change. Thus, the time scales on the chart paper are straight lines and are much easier for the user to interpret than the swooping arcs produced by a conventional recorder. Second, the placement of the recorder pen arms directly opposite one another allows the pen tips to be placed very close together. This minimizes time offset between information recorded by the pH and temperature pens, making the charts easier to interpret. Finally, the location of the drive mechanism in the door provides an automatic pen lift when changing the chart paper.

The position of the pen arms on the lead screw mechanism is controlled by optical encoders. On power up or system reset, the pen arms move to the zero position. This is detected by a photo interrupter, to provide absolute positional information to the microprocessor.

From this point, a count wheel mounted on the lead screw provides positional information relative to the zero position. There are 32 counts for each division on the chart paper.

As with all positioning mechanisms, an error may appear in the tracking over a period of time. To minimize this error, several steps have been taken. First, a deadband for pen movement of $\frac{1}{2}$ chart division has been programmed in to minimize pen motion without affecting usable chart resolution. Second, **whenever you change chart paper, a magnetic switch detects the opening of the door and initiates a system reset, thus re-zeroing the pens and eliminating any accumulated errors**.

10.3 Chart Paper Drive Mechanism

The recorder incorporates a stepper motor to impart rotational motion to the chart paper. A novel feature of the unit is its **ability to utilize 1, 7 or 32 day chart paper simply through front panel switching.** This capability is provided by a special digital timing circuit which precisely controls the stepping rate of the magnetic armature in the motor.

10.4 Power Supply Supervision

The recorder contains power supply monitoring and switching circuitry which enables it to be used in a variety of circumstances. Under ordinary circumstances, the unit will be powered by 110 or 220 Vac with the ac adaptor provided. This is the preferred mode of operation. **The recorder can also operate via 4 "D" size batteries installed in the rear of the unit which will power the unit up to 30 days.**

The system may be restarted by changing the batteries or by the re-initiation of ac power. If ac power fails, the circuitry will attempt to automatically switch to battery backup. If viable battery power is available, the system will operate on battery power until the batteries fail or ac power returns. When ac power returns, the recorder will automatically reset itself (refer to Section 8.5).

Typically, the unit will operate with fresh alkaline batteries for about 1 month. It should be noted that to conserve battery power, the system timing turns the sensors on and updates the display and pen position only once every 0.5, 3.5 or 16 minutes while in the 1, 7 or 32 day modes respectively. However, the display remains in continuous operation during battery operation. You should be aware, then, that during battery operation it is possible for the display and pens to lag behind actual ambient conditions by up to 0.5, 3.5, or 16 minutes to save power. Only when using the ac adaptor do the pens constantly update for changes in ambient conditions.

▼ 11 Specifications

General

Measurement Input:	pH and temperature, with plug-in external sensor Removable for remote location

pH

Range:	0.2 to 12.0 pH
Accuracy:	±0.1 pH
Probe:	Solid State In Line or submersion PPS (Ryton)
Response Time:	30 seconds for 90% of change
Display Resolution:	0.1 pH

Temperature

Range:	0.2 to 80 °C
Accuracy:	±3°C
Sensor:	1000 ohms RTD (incorporated in CTpH-Probe)
Display Resolution:	1°C

Display

Types:	2½ digit LCD, 0.5" high; low battery and parameter indication, and Back Light with ac adapter only
Display Modes	User-switchable between °C and pH for continuous display; max/min storage for both temperature and pH

Electronics

Type:	Microprocessor-controlled. HI & LO Peak Hold for both temperature and pH; re-initializes position at every chart change (every time door is opened)

Chart Paper

Type:	8 inch (200mm) circular, double-sided, with linear radial divisions; 1, 7 and 32 day

Chart Drive

Type:	Stepper Motor
Ranges:	1, 7, 32 day; switchable
Accuracy:	1% of rotation
Chart Paper Hold Down:	Magnetic hub lock

Recording Pens

	Type:	Disposable fiber-tip; green for pH, red for temperature

Pen Drive

	Type:	Motorized linear screw drive
	Deadband:	1°C, 0.1 pH
	Zero:	Automatic zero during chart change or power interruption
	Pen Arms:	Clear plastic to allow full chart viewing
	Pen Lift:	Automatic upon door opening; pens are door mounted and lift away from the chart whenever the door opens.

Alarms

	Alarms:	User-selectable for high or low temperature and pH
	Audible Alarm:	Integral piezo-electric beeper
	Alarm Relay Contacts:	Normally Open, Single Pole, Single Throw (SPST) 1A 35Vdc or ac.

Operating Conditions (Recorder)

	Temperature:	32° to 120°F (0° to 49°C)
	Humidity:	0% to 90% RH, non-condensing

Operating Conditions (Remote Probe)

	Temperature:	0° to 80°C
	pH:	0 to 12 pH

Power (Recorder)

dc:	Four (4) "D" size alkaline batteries; greater than 1 month continuous operation in 32 day mode; bulbs will not light on battery power. Recommended battery type: Duracell Type MN1300 "D" size batteries for best performance at low temperatures.
ac:	110Vac or 220Vac 50/60 Hz stepped down to nominal 9Vdc using ac adaptor provided
Power Requirements:	300 mA "normal" during pen movement for battery (dc power); 500 mA "normal" during pen movement for ac power using ac adaptor. (Note: The light bulbs draw 200 mA of current).
ac Power Jack Voltage:	8.3 to 12.4 Vdc, (nominal 9Vdc) 1A max. An ac adaptor is supplied

Mechanical

Dimensions: (H x W x D)	13$\frac{3}{16}$" x 10$\frac{11}{16}$" x 2$\frac{5}{8}$" (33.5 x 27.1 x 6.7 cm)
Weight:	Approx. 7 lbs, including alkaline batteries
Mounting:	"Keyhole" slots for wall mounting; foot cover for benchtop use
Case:	Rugged ABS plastic, color: gray
Miscellaneous:	Swing-out stabilizing arm for bench top use, decorative foot cover for wall mounting, and 10 ft remote probe cable for remote sensing.

Notes