

650 Series Recording Electric Controllers

**Types 650, 652,
T650, T650N**



UNITED ELECTRIC
CONTROLS

Installation and Maintenance Instructions

Please read all instructional literature carefully and thoroughly before starting. Refer to the final page for the listing of Recommended Practices, Liabilities and Warrantees.

The 650 Series Recording Electric Controllers, feature a simple, rugged design which provides optimum performance and dependability in measuring and controlling temperature. The calibrated accuracy and the readability of its unique 6-inch chart make the 650 Series a durable choice for temperature measurement and control of many processes and applications. Electric control is provided by SPDT positive action switches. The basic types of control available in the 650 Series Recording Controllers are as follows:

On-Off Control

- 650 - Single Switch
- 652 - Dual Switch

Thermometers


(No control function)


- T650 - Indicating Pointer
- T650N - No Indicating Pointer


Part I - Installation

Tools Needed

Flathead Screwdriver
Hammer

 THE GREEN INDICATING POINTER AND THE ORANGE SETTING POINTER MUST NOT BE MANIPULATED BY HAND OR ANY TOOLS IN AN ATTEMPT TO SWING THEM UP OR DOWN SCALE. THIS CAN RESULT IN SERIOUS DAMAGE TO THE RECORDER LINKAGE.

 THE CONTROLLER'S ORANGE SET POINTER MUST ALWAYS BE RAISED OR LOWERED BY MEANS OF THE KNOB ON THE LOWER LEFT-CORNER OF THE CHART PLATE. DO NOT ATTEMPT TO ADJUST THE SET POINT KNOB UNTIL CONDUIT KNOCK-OUT HAS BEEN REMOVED, AND PROTECTIVE METAL CLIP HAS BEEN REMOVED. SEE FIGURE 2.

 TO PROTECT DELICATE POINTERS DURING SHIPMENT, FLIPPER PLATE HAS BEEN SECURED WITH METAL CLIP. THIS MUST BE REMOVED BEFORE OPERATING RECORDER.

PREPARING FOR OPERATION


1. The 650 Series enclosure has three (3) knockouts: one on the back and one on each side. Select the knockout desired for wire entry. With the recorder supported on a firm flat surface, place the tip of a screwdriver blade in the knock-out groove and give the screwdriver handle a sharp rap with a hammer. Repeat this around the groove until the hole is clear.
2. Open the recorder door by pressing on the push button latch and swing the door open. Remove the shipping tape from the two scale pointers. Unscrew the two right-hand corner screws of the chart plate. See Figure 3. Swing the chart plate open exposing terminal block, calibration adjustments and working mechanism. Remove the knockout slug.
3. Remove the metal clip from between the thermal assembly zero adjusting screw and the actuating lever. See Figure 2.

Hold the actuating lever while removing the clip, gently releasing the lever. Swing the chartplate closed and tighten the two right-hand corner screws.

4. The orange set pointer may now be raised or lowered by means of the knob without fear of damage. Some spring-like resistance to the open position of the chartplate will be noticed; this is caused by the capillary tubing from thermal assembly exiting at the rear of enclosure. (This capillary tubing has been life-tested for 1000 full chartplate opening and closing cycles without failure.)

MOUNTING

The 650 Series Recording Electric Controllers may be surface or panel mounted.

 MOUNT THE INSTRUMENT IN A LOCATION WHERE VIBRATION, SHOCK, AND AMBIENT TEMPERATURE FLUCTUATIONS ARE MINIMAL. STANDARD UNITS SHOULD NOT BE EXPOSED TO AMBIENT TEMPERATURES BEYOND THE LIMITS OF -40 TO 160°F.

Surface Mounting


The instrument is packaged with three strong mounting ears for surface mounting. See Dimensions section for all pertinent dimensions for surface mounting. Locate the mounting holes on the mounting surface and mount the instrument using 1/4 -20 screws.

Panel Mounting

To panel mount the instrument, cut out the panel per cut-out dimensions shown in Dimensions section. Provide clearance holes in the panel at the four corners of the cut-out as shown in Dimensions section for #8 screws or tap holes for #8 machine screws. Do not jam bulb and capillary tubing, install the instrument in the panel cut-out and secure with a #8 screw at each corner. The door of the instrument must be opened in order to install the mounting screws.

INSTALLING BULB LOCATING CAPILLARY TUBING


1. Fully immerse the bulb and six (6) inches of capillary in the control zone. For best control, it is generally desirable to place the bulb close to the heating or cooling source in order to sense temperature fluctuation quickly.


 BE SURE TO LOCATE THE BULB IN AN AREA WHERE IT WILL NOT BE EXPOSED TO TEMPERATURES BEYOND THE INSTRUMENT RANGE LIMIT.

2. Place the remaining capillary adjacent to the control head, so that it will sense the same ambient temperatures. Controller is ambient temperature compensated.

3. Factory calibration, unless otherwise specified allows for six inches of capillary tube in the control zone. If longer lengths are required, recalibration may be necessary. If this is the case, refer to the Maintenance section and follow the procedure entitled: "Correction for Capillary Immersion".


4. "C" style bulbs can be coiled or shaped to fit the installation.


 **WARNING: AVOID SHARP BENDS AND COILS TIGHTER THAN A TWO-INCH RADIUS. DO NOT BEND "B" STYLE BULBS.**


 AVOID BENDING OR COILING THE CAPILLARY TUBING TIGHTER THAN 112 INCH RADIUS. ALWAYS EXERCISE CAUTION WHEN MAKING BENDS NEAR THE CAPILLARY ENDS.

5. If a separable well or union connector is used, follow the separate instructions packaged with these items.

WIRING

 DISCONNECT ALL SUPPLY CIRCUITS BEFORE WIRING UNIT. ELECTRICAL RATINGS STATED IN LITERATURE AND NAMEPLATES MUST NOT BE EXCEEDED. OVERLOAD ON A SWITCH CAN CAUSE FAILURE ON THE FIRST CYCLE.

 WIRE UNITS ACCORDING TO NATIONAL AND LOCAL ELECTRICAL CODES. MAXIMUM RECOMMENDED WIRE SIZE 14 AWG.

 SELECTED 650 SERIES CONTROLLERS ARE EQUIPPED WITH AN AC POWER CORD WITH A POLARIZED OR GROUNDING TYPE PLUG. DO NOT ATTEMPT TO MODIFY OR TAMPER WITH THIS PLUG. IT SHOULD BE USED ONLY WITH AN APPROPRIATE RECEPTACLE.

All 650 Series Controllers are equipped with terminal blocks, which permit quick and easy connection of your power leads for the electric chart drive. All terminals are clearly marked.


To connect signal and power leads, proceed as follows:

1. Unscrew the chartplate right-hand corner screws. See Figure 3. Swing the chartplate open exposing the terminal block.

2. Bring the signal and power leads into the case through the clearance hole and to the terminal block.

3. Remove approximately 1/2 inch of insulation from the end of the wires. If available, attach brass ring or fork type terminals to the stripped portion of the wires, prior to connection to the terminal block.

4. Each position on the terminal block is marked. Connect each wire to the appropriate terminal. Tighten screws securely.

 CHECK TO MAKE SURE THAT SIGNAL AND POWER LEADS ARE CONNECTED TO THEIR PROPER TERMINALS.

5. When all wiring connections have been made and checked, arrange the wiring so as not to interfere with the recorder mechanism on closure of the chartplate. Swing the chartplate shut and tighten the two right-hand corner screws.

CHART MARKING SYSTEM

Pressure-sensitive charts and a sapphire-tipped stylus are standard. In removing or mounting the chart, the pen arm and stylus must be raised by pressing on the tab at the uppermost end of the arm. Even if the recorder is not to be used, a fresh chart should be mounted or some sort of padding placed under the stylus to protect the sapphire tip. To remove and replace the chart, unscrew the hub knob and swing it 90 degrees clockwise, or, to the 3 o'clock position. Press the upper tab on the pen arm, lift the chart forward off the hub and slide down

and away. Do not release the pen arm, but install new chart, Now the pen arm may be gently released, the chart knob rotated counter-clockwise back to the hub. Align the proper chart time with the chartplate index.

Part II - Operation

Tools Needed

3/8" open end wrench

The 650 Series Controllers are factory calibrated and ready to put into operation. However, there may be adjustments to make depending on the type of controller and its application. For that reason, this part of the manual is divided into sections according to the controller types, so that checks and adjustments may be performed before putting the controller into operation.

SINGLE SWITCH ON-OFF CONTROLLERS

1. If the controller has a power toggle switch (in the upper right-hand corner of the instrument) it is to turn on the chart drive. With other units, the chart drive starts upon applying power.
2. Install a clean chart if necessary. See CHART MARKING SYSTEM.
3. Using the set point control knob, turn the setting knob until the orange pointer is aligned with the desired set point (control point). See figure 3.



IF IT IS DESIRABLE TO CHECK THE ACCURACY OF THE CONTROL SETTING, DISCONNECT ALL POWER FROM THE CONTROL SIGNAL LEADS.

4. Position the set pointer to some point above the temperature the pen is recording. Then open the chartplate and with your finger depress the actuating lever until the pen reaches the set point; listen for the switch to "click".

Indicating lights may be connected to the control signal terminals to indicate when the switch is actuated. If the switch is actuated before the pen reaches the set point temperature, turn adjustment screw clockwise. If the pen exceeds the set point temperature before the switch is actuated, turn screw counter-clockwise.

5. Reconnect control signal leads per Part I -Wiring, turn on power and put unit into operation after adjustments are completed.

MULTY-SWITCH ON-OFF CONTROLLERS

The basic operation of multi-switch controllers is the same as for single switch controllers, except that a second and/or third switch has been added. Switch 2 and/or Switch 3 are standardly factory set within 5% of the scale range to Switch 1. Switches 2 and 3 can be adjusted to operate up to 100% of the range apart from Switch 1. Adjustment of Switches 2 and 3 in relation to Switch 1 is accomplished with their similarly identified adjusting screw. Turning either screw in lowers their operating points, and backing them out raises them. To check any adjustments, repeat Steps 1 through 4 for single-switch controllers. If switches are set within 50 of each other, it is important indicating lights be employed to be certain the correct switch is being checked, i.e. do not rely on the "click" of the switch.

Unless otherwise specified, switches are factory set as follows;

In 2 switch operation, #2 Switch is set on dial & #1 Switch set above #2.

In 3 switch operation, #1 Switch (middle) is on the dial #2 is set below #1 and #3 is set above.

Make any necessary final adjustments, reconnect the control signal leads, and put into operation.

Part III - Maintenance

Tools Needed

1/4" open end wrench

Two 5/16" open end wrenches

The instrument is well sealed with gaskets and the components within the case should not require cleaning. However it may be necessary to lift the pressure writing stylus occasionally to wipe any accumulation of chart surface material away.

If the temperature sensing bulb is located in a process or atmosphere where a build-up of contaminants on the bulb could occur, the bulb should be cleaned periodically. This will prevent the bulb from being insulated from the process temperature, which could cause false temperature readings.

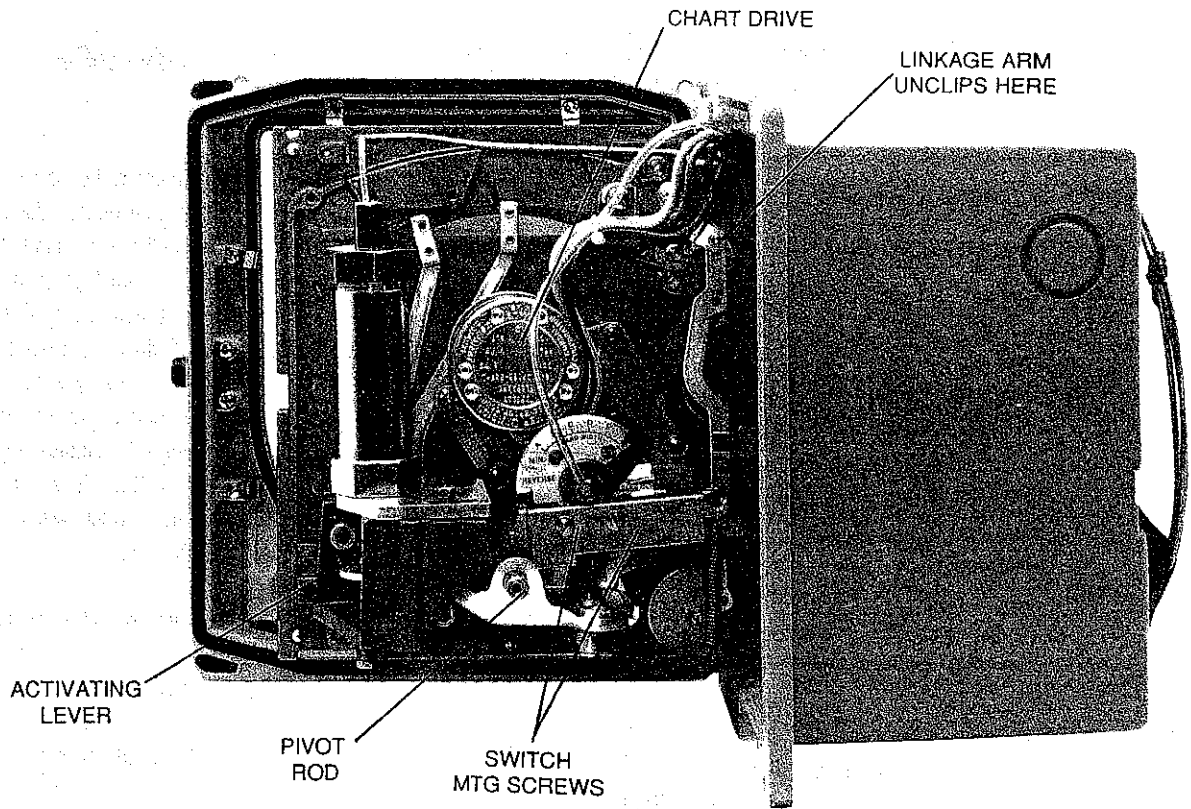


Figure 1: View of internal components

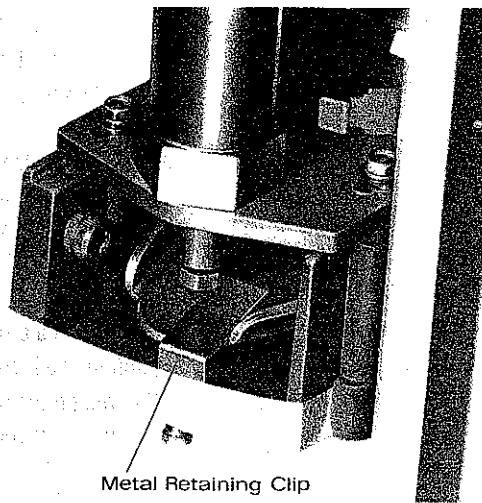


Figure 2: Remove metal retaining clip and tape before operation

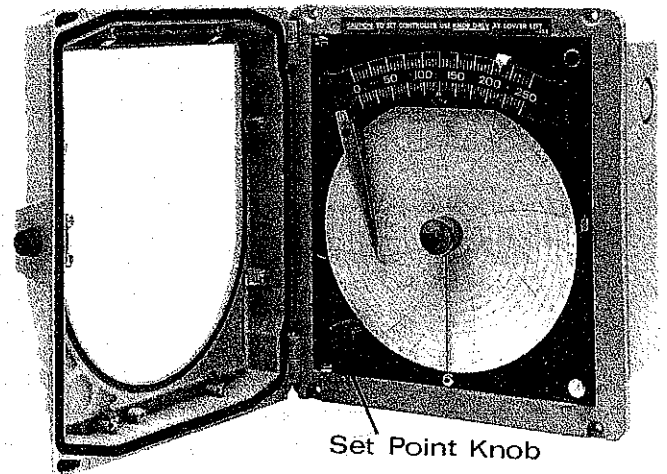


Figure 3

CAPILLARY IMMERSION CHART

Range		Capillary Length
°F	°C	Feet
-180 to 120	-115 to 50	2.0
-125 to 350	-85 to 175	2.5
-125 to 500	-85 to 260	1.0
-20 to 100	-30 to 38	4.0
20 to 120	-5 to 50	3.0
0 to 250	-20 to 120	2.5
0 to 400	-20 to 200	2.0
50 to 650	10 to 340	2.0
50 to 1000	10 to 540	2.5

CORRECTION FOR CAPILLARY IMMERSION

If the length of capillary immersed in the process differs from the amount immersed in the factory calibration bath, a calibration shift will occur. (Unless otherwise specified factory calibration is performed with 6 inches immersed.) This error may be corrected as follows:

1. Move set pointer to highest temperature setting.
2. Note pen reading with the head and sensor at room temperature.
3. Loosen the two thermal assembly #8 hex head mounting screws.
4. Reposition the thermal index against the calibrations of the pen and control capillary length. See Capillary Immersion Chart. Move to the left if capillary is to be added to the process, or to the right if capillary is removed from the process.
5. Tighten the two thermal assembly mounting screws.
6. Note change in pen reading (if any).
7. Turn zero adjustment to bring pen reading back to the original reading noted in step 2. Turning in lowers reading.

ZERO ADJUSTMENT

This adjustment is used to correct for any difference between the process temperature and the pen position on the chart. To check the accuracy of the pen position, use a test thermometer of known accuracy. Its probe should be placed next to the center of the sensing bulb in the process. Allow the process temperature to stabilize before making comparisons. If there is a difference between the pen reading and the test thermometer reading, correction can be made using the zero adjustment screw (Fig 6). To increase the pen reading, turn the adjustment screw out (clockwise). To loosen the pen reading, turn the zero adjustment screw in (counter-clockwise). One full turn of the screw equals approximately 10% of the range.

Part IV - Replacement Parts

Tools Needed

- 1/4" Open end wrench
- Screwdriver
- 7/64" Allen wrench
- 1/16" Allen wrench

SINGLE SWITCH

1. Disconnect all power to the instrument.
 2. Swing open chart plate fully, remove wire guard support screw (located at the lower left of the wire guard), loosen top screw, and swing wire guard out of the way towards enclosure.
- NOTE:** Before attempting to replace switch a visual note should be made of the arrangement of insulators and the switch plunger.
3. Remove the two switch mounting screws (1/4" open end wrench is required for this operation) and lift switch out of the way.
 4. Re-assemble new switch and insulators in proper sequence and secure firmly with mounting screws.
 5. Rotate wire guard back in place and secure with original set screw.
 6. Continue with steps 1 through 5 in Part 11 -Operation, Single Switch On-Off Controllers.

MULTI-SWITCH RECORDERS

1. Disconnect all power to the instrument.
 2. Swing open chart plate fully, remove wire guard support screw (located at the lower left of the wire guard) and swing wire guard out of the way towards enclosure.
 3. Unhook extension spring that holds switch bank in contact with cam, un-clip front linkage arm only at the top (Fig. 6).
- NOTE:** Before attempting to remove the switch bank assembly the relative position of the white teflon spacer on pivot rod should be noted.
4. Remove the two Allen Head cap screws (Fig. 6). Push pivot rod down and slide entire mechanism to the right.
 5. When mechanism is removed with a small Screwdriver remove the "E" ring on the front linkage arm that is attached to the black cam follower. The switch bank assembly should now be free of the recorder except for the electrical lead wires. Reconnect linkage arm with "E" ring in the same manner, to the new switch bank. Be sure bend in linkage is to the left.
 6. Remove pivot completely from assembly and lift old switch bank out of the way. Align new switch bank with flipper plate pivot holes. Re-insert pivot rods & spacers so that threaded hole on end of pivot rod is accessible in order to re-connect wire guard.

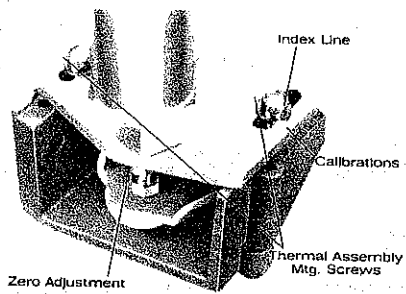


Figure 4

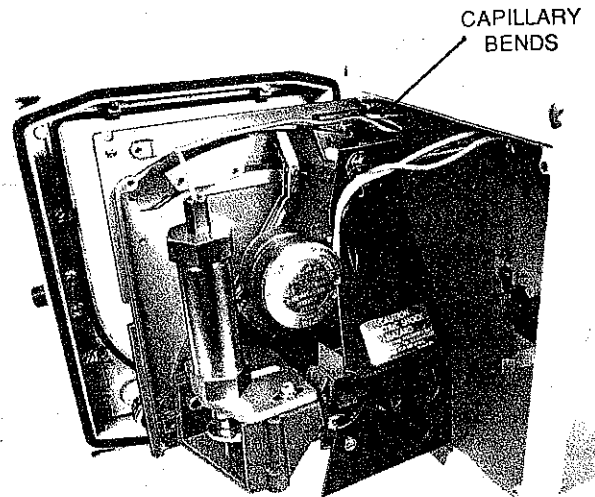


Figure 5

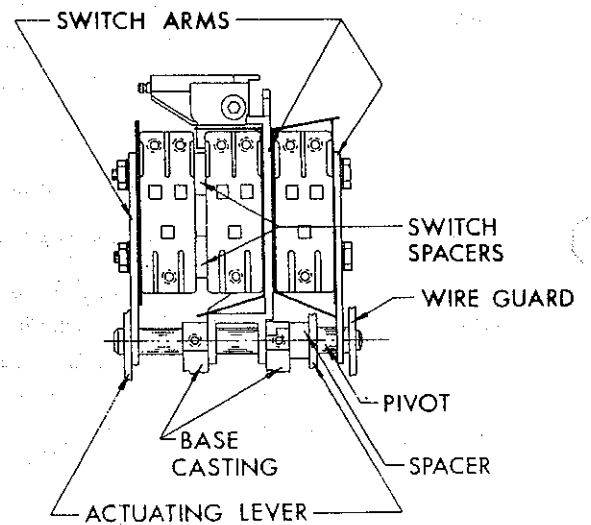
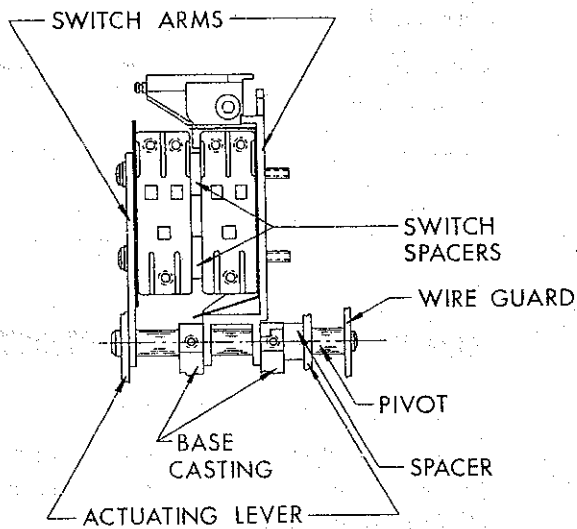


Figure 6

7. Install new switch bank assembly into position and secure with cap screws. Reclip linkage arm at the top.
8. Transfer one lead wire at a time from old to new switches or potentiometers closely observing terminal locations and color coding on wires.
9. Re-connect extension spring that secures switch bank to cam.
10. Rotate wire guard back in place and secure with original screw.
11. Refer to Part II - Operation, Multi-Switch On-Off Controllers.

Prior to removing the installed thermal assembly, please take note of

THERMAL ASSEMBLY REPLACEMENT

the special bends in the capillary (Fig. 5), as well as the tie-down points on the capillary involved in a properly installed thermal assembly. The replacement unit is supplied properly formed by UE for ease of replacement.

Remove the enclosure backplate and gasket (#8 slotted head screws). Carefully pull capillary out of guide in housing and remove the slotted capillary seal and washer.

Swing open chart plate fully and remove capillary guide screws and washer (#8 slotted screw upper right and #8 socket head screw near lower left of enclosure). Remove the two #8 hex head mounting screws. See Figure 4. Carefully remove the thermal assembly. The replacement assembly is factory calibrated and all that is necessary is to reverse the procedure to install the new assembly properly.

Be sure that the index line on the thermal assembly mounting plate is aligned with the arrow head on the base assembly. Follow instructions in Part 11 - Operation for applications requiring 6-inch capillary immersion; for longer capillary immersion refer to Part III - Maintenance, Correction for Capillary Immersion.

CHART DRIVE REPLACEMENT

1. To replace chart drive disconnect all power to the instrument. Unscrew chart knob and loosen 1/16 Allen set screw on chart drive hub. Slide hub off motor shaft.
2. Swing chart plate to a fully open position. Remove the lower wire guard screw, loosen top screw, and swing the wire guard towards the recorder enclosure.
3. Cut the two (white) motor lead wires approximately 3" from motor.
4. Remove the two attaching screws and lock washers, securing the chart drive to its mounting bracket.
5. Remove chart drive from instrument.

6. Mount new chart drive using same mounting screws and lock washers.
7. Replacement chart drives are provided with extra length lead wires; shorten these wires by cutting them to a convenient length for splicing to the original chart drive wires. (These were cut prior to removing old chart drive.) Approximately 1/2" of insulation should be removed from end of each wire. Splicing nuts are provided to complete this operation.
8. Rotate wire guard back in place and secure with original screw.
9. Replace chart hub on motor shaft and secure with Allen head screw.
10. Re-connect power to instrument.

PEN SUB-ASSEMBLY

1. To replace pressure writing pen assembly, the sensing element must be stabilized in a constant well circulated bath at any convenient temperature within the range of the recorder.

NOTE: If temperature baths are not available, a constant room temperature may be used, provided room temperature is within the range of the recorder.

- a. Note position of pen tip on chart or loosen chart hub and rotate chart slightly using resultant scribed line as reference when calibrating new pen assembly.
- b. Remove pen arm by removing pen arm mounting screw (seen through hole in upper portion of pen arm). Retain pen arm mounting screw.
- c. Mount new pen assembly and secure with screw; if pen is not recording correct temperature insert small screwdriver into hole on pen arm and loosen screw. Align pen tip to desired temperature, hold securely while retightening screw.

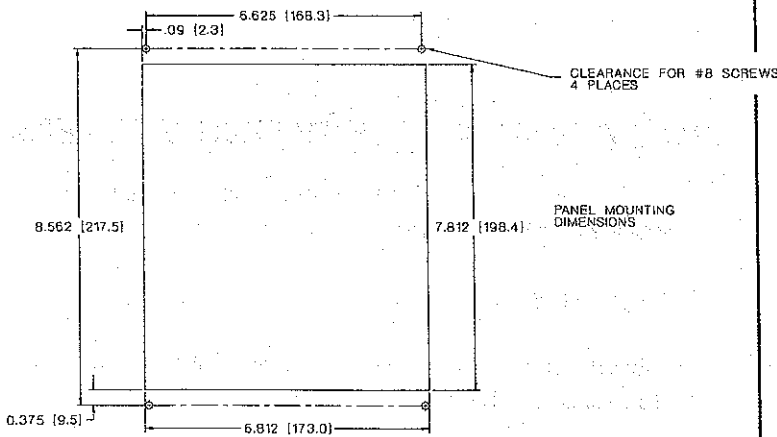
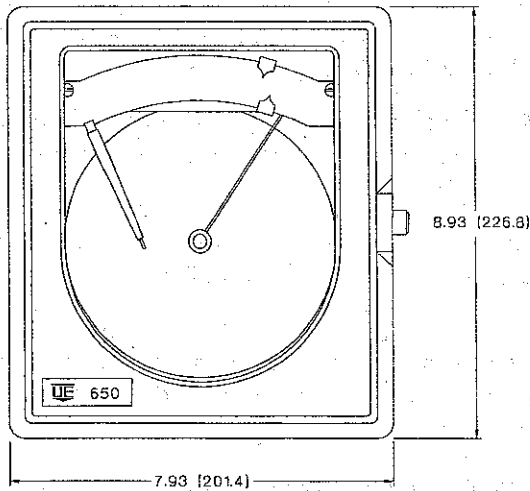
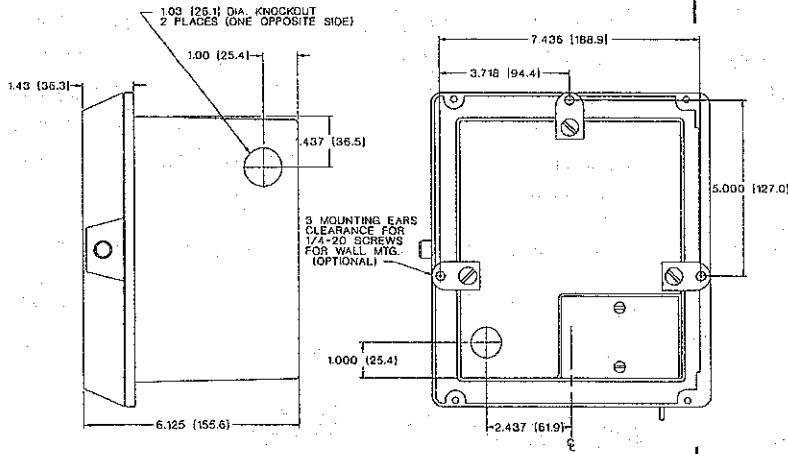
CONVERSION OF WRITING SYSTEM

To convert from pressure sensitive system to ink cartridge, use conversion kit 6361-30 as follows:

1. Remove pressure writing pen.
2. Unscrew chart knob and replace pressure sensitive chart with ink chart and tighten chart knob.
3. Install ink pen arm.

To convert from ink writing to pressure sensitive, use conversion kit 6361-17 and follow the instructions above.

Dimensions



RECOMMENDED PRACTICES

United Electric Controls Company recommends careful consideration of the following factors when specifying and installing UE pressure and temperature units. Before installing a unit, the installation and Maintenance instructions provided with unit must be read and understood.

- To avoid damaging unit, proof pressure and max temperature limits stated in literature and on nameplates must never be exceeded, even by surges in the system. Operation of the unit up to proof pressure or max temperature is acceptable on a limited basis (i.e. start-up, testing) but continuous operation must be restricted to the designated adjustable range. Excessive cycling at proof pressure or maximum temperature limits could reduce sensor life.

- A back-up unit is necessary for applications where damage to a primary unit could endanger life, limb or property. A high or low limit switch is necessary for applications where dangerous runaway condition could result.

- The adjustable range must be selected so that incorrect, inadvertent or malicious setting at any range point cannot result in an unsafe system condition.

- Install unit where shock, vibration and ambient temperature fluctuations will not damage unit or affect operation. Orient unit so that moisture does not enter the enclosure via the electrical connection.

- Unit must not be altered or modified after shipment. Consult UE if modification is necessary.

- Monitor operation to observe warning signs of possible damage to unit, such as drift in set point. Check unit immediately.

- Preventative maintenance/periodic testing is necessary for critical applications where damage could endanger property/ personnel.

- For all applications, a factory set unit should be tested before use.

Electrical ratings stated in literature and on nameplate must not be exceeded. Overload on a switch can cause damage, possible on the first cycle. Wire unit according to local and national electrical codes, using wire size recommended in installation sheet.

- Use only factory authorized replacement parts and procedures.

- Do not mount unit in ambient temp. exceeding published limits.

- For remote mounted temperature units, capillary lengths beyond 10 feet can increase chance of error, and may require re-calibration of set point and indication.

LIMIT WARRANTY

UE warrants that the product thereby purchased is, upon delivery, free from defects in material and workmanship and that any such product which is found to be defective in such workmanship or material will be repaired or replaced by UE (F.O.B. UE); provided, however, that this warranty applies only to equipment found to be so defective within a period of 12 months after installation by buyer but not to exceed 18 months after delivery by the seller. Except for the limited warranty of repair and replacement stated above, UE disclaims all warranties whatsoever with respect to the product, including all implied warranties of merchantability or fitness for any particular purpose.

LIABILITY LIMITATION

The sole and exclusive remedy of buyer for any liability or seller for any claim, including incurred in connection with (I) breach of any warranty whatsoever expressed or implied, (II) a breach of contract, (III) a negligent act or acts (or negligent failure to act) committed by seller, or (IV) an act for which strict liability will be imputed to seller, is limited to the limited warranty or repair and replacement stated herein. In no event shall the seller be liable for any special, indirect, consequential or other damages or like general nature, including, without limitation, loss of profits or production, or loss or expenses of any nature, incurred by the buyer or any third party.



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