



Electronic Development Labs, Inc.



**Menu**  
Pressing "SF5" from any screen will display menu screen.

|           |            |            |           |
|-----------|------------|------------|-----------|
| <b>F1</b> | Set Point  | <b>SF1</b> | Setup     |
| <b>F2</b> | Presets    | <b>SF2</b> | User Cal. |
| <b>F3</b> | Set Limits | <b>SF3</b> | PID Info. |
| <b>F4</b> | MFG Info   |            |           |

# Mini-Ultra Bath

## User Manual

HIGH PRECISION STIRRED LIQUID BATH

# Mini Ultra Bath® Operation Manual

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NOTES

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## **Chapter 1**

### **Introduction**

The Mini Ultra Bath line consists of high precision stirred liquid baths covering the following ranges; MUB20130 for operation over the range of  $-20^{\circ}\text{C}$  to  $+130^{\circ}\text{C}$ , and the MUB0250 for operation from ambient to  $250^{\circ}\text{C}$ . These baths will help improve your daily measurement capability without the need for extensive knowledge of temperature metrology and laboratory based measurements. Throughout this manual, you will find not only instructions specific to the Ultra Mini Baths, but many other helpful tips and suggestions regarding temperature measurement and calibration.

### **Features and Capabilities**

The Mini Ultra Bath MUB20130 uses thermoelectric modules for cooling; this eliminates all need for refrigerant or a compressor. These baths have an insertion depth of 6" and have convenient sensor insert bushings to hold the sensors (probes) in place. A bail handle allows for easy portability and can act as a sensor support if needed. The chamber cover has O-ring seals to guard against leaking so these baths can be transported in complete safety. A spare fuse is located in the fuse holder, below the On/Off switch

The central feature of the Mini Ultra Bath, is a three-inch square Aluminum chamber that is six inches long. This chamber has a magnetic stirring system built into the base. The standard chamber cover has four sensor insert bushings. These bushings are available to fit sensors with diameters of 1/8", 3/16", and 1/4".

Sensor insertion depth of up to six inches is possible. For longer insertion depths, we recommend the UB1040 bath.

### **Controller Features**

Mini Ultra Baths use an extremely high quality controller to accurately control and maintain its high precision. The advanced technology features a very stable temperature control utilizing a PID loop. The two-line display allows you to see the set temperature along with the actual reading temperature at all times.

## **General Construction**

Mini Ultra Baths are designed with the technician who is on the go in mind. The finish is a baked epoxy powder coating similar to the type used on automobile frames. The electrical components are commercially available items; no proprietary electronic devices are used in this product. Our goal is to provide a product that functions well and can be maintained for many years to come without the fear of unavailability of parts. These precision baths are 100% designed and built at our facility in Danville VA.

The chamber of the Mini Ultra Bath is hard-anodized Aluminum so it is resistant to the fluids listed in basic operation in chapter 2. The Screw on cover has double O-rings to resist leaks; this cover should be on the bath whenever the bath is not in use. The cover will help prevent the fluid from evaporating or oxidizing, will prevent dirt and contaminants from entering into the bath, and will prevent an inadvertent spill. Never tighten the cover with tools of any kind, it is designed to seat firmly and prevent leaking when tightened by hand, it should be tight, but not forced. When tightening the cover, it should not bottom out on the locking ring, if it does, please check to see that the sensor insert bushing holder is in place.

Although it is unlikely that your Mini Ultra Bath should require servicing, if it does there is an electrical diagram included in Appendix 3. We do not recommend user servicing of the TEM's (thermoelectric modules).

## Chapter 2

### Installation and Setup

Unpack and carefully inspect the Bath for any damage that may have occurred in shipping. **Do Not Plug In the Bath Until It Has Been Inspected.** There should be no loose parts or any bent or damaged surfaces. Make sure there are no stray pieces of packing material anywhere in or on the bath. This is very important as this material could ignite during heat up.

### Connecting to Power Source

The power required for this instrument is nominally 110VAC, 60Hz with a maximum current requirement of 10 Amperes. It should be plugged into a 110VAC outlet capable of supplying the required current. The outlet must be grounded, thus reducing the hazard of electrical shock!

### Basic Operation

The Mini Ultra Bath has an On/Off switch located on the back panel above the power cord. The only user input is through the controller keys. The set point temperature is entered by pushing either the up or down arrow keys on the face of the controller. The bath should be filled to the bottom of the fill indicator, located at the back of the chamber, to a level approximately 3/4" below the neck; this allows room for expansion as the fluid is heated. Depending on the required temperature your choice of fluids will include, water, alcohol, silicone oil, or mineral oil.

### Initial Start up

The initial preprogrammed set point is 10°C; the unit should be operated at this temperature for a period of one hour prior to using this bath. This procedure serves to remove any moisture that may have occurred because of condensation during shipment.

## Soft Keys

All programming functions are performed using the four keys on the front of the controller. The bath is shipped preprogrammed and may be used without any changes other than setting the desired temperature. To set the desired temperature use the up and down arrow keys until the lower display shows the desired temperature. We do not recommend changing any programming in the controller, other than the temperature.

## Rear Panel Fuse

The rear panel fuse is the main power fuse and limits the current to the entire unit. This is a 10 Amp fuse and should not be altered for any reason. It is located in the power entry module on the back of the bath. A spare fuse is included for your convenience and it can be found in the fuse holder. Please refer to figure 1. Fuse Ratings are shown in Appendix 1.

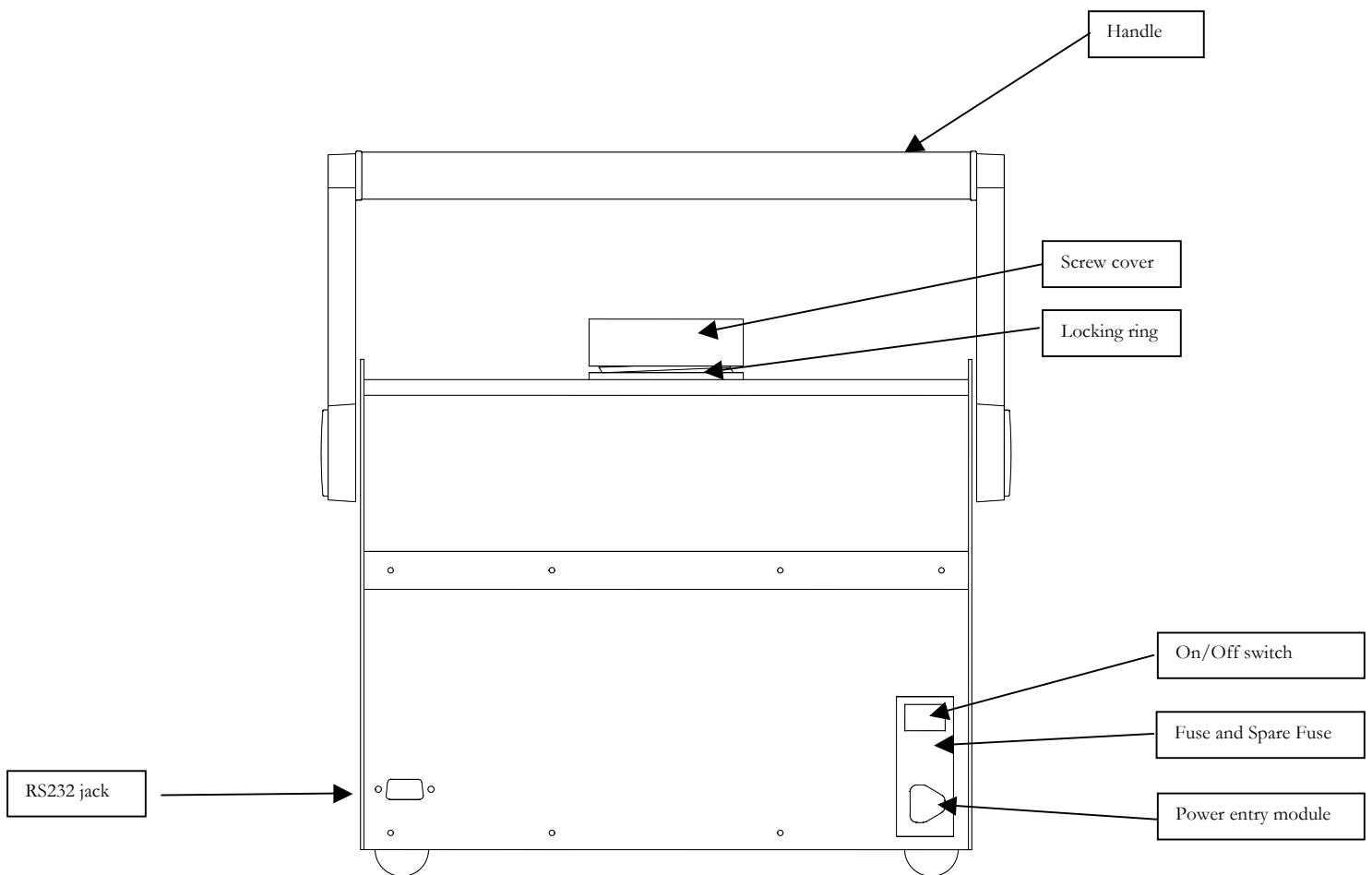


Figure 1

## Chapter 3

### Use and Operation

The first step in using the Mini Ultra Bath is to unscrew the cover that seals the chamber. Once this cover is removed, determine your temperature set point requirement, and fill the bath with a fluid that will handle the temperature. You may set the bath to any temperature between  $-20^{\circ}\text{C}$  and  $+130^{\circ}\text{C}$  with a setting resolution of  $0.1^{\circ}\text{C}$ . To set the desired temperature use the up and down arrow buttons on the controller. Once the temperature is set, sufficient time is required for the bath to reach its set point temperature and stabilize. Stabilization for most temperature ranges is achieved within 30 minutes after reaching the set point.

Looking at the top of the bath you will see a screw on cover that seals the chamber. Please, be aware that when this cover is hand tightened, it will not leak, and if you are using the bath in a heat mode, the fluid will expand and cause an increase of pressure in the chamber. **NOTE:** The bath should never be used with this cover on.

### Comparison calibrations

The four-sensor insert bushings are designed to center your sensors and keep them properly aligned. You only need to adjust the height of your sensors. Try to always use an insertion depth that will minimize the errors caused by stem conduction. Please note, it is not recommended to have the sensors touch the vented baffle at the bottom of the tank. This recommendation is for thermocouple sensors, typically joined near the tip, and for RTD sensors. Although the output of the thermocouple is given by the entire gradient from the hot end to the cold end, they are less sensitive to conduction error than RTD type devices. It is beyond the scope of this manual to discuss all of the considerations regarding stem conduction and immersion depth, but some practice and experience will produce confident and reliable measurements.

Sensors should be placed in one of the appropriate holes as described in the previous paragraph. A rough comparison reading can be made between the UUT and the display on the front of the controller. Using this method, the uncertainties shown on the specification sheet for overall uncertainties must be used. This value includes the combined uncertainty of the internal reference sensor, the controller indicator, uniformity errors, and stability errors. To reduce this figure, a direct comparison should be made using a calibrated instrument and a reference sensor while readings are being taken for the UUT. This will improve the overall accuracy by virtue of the reference sensor and instrument.

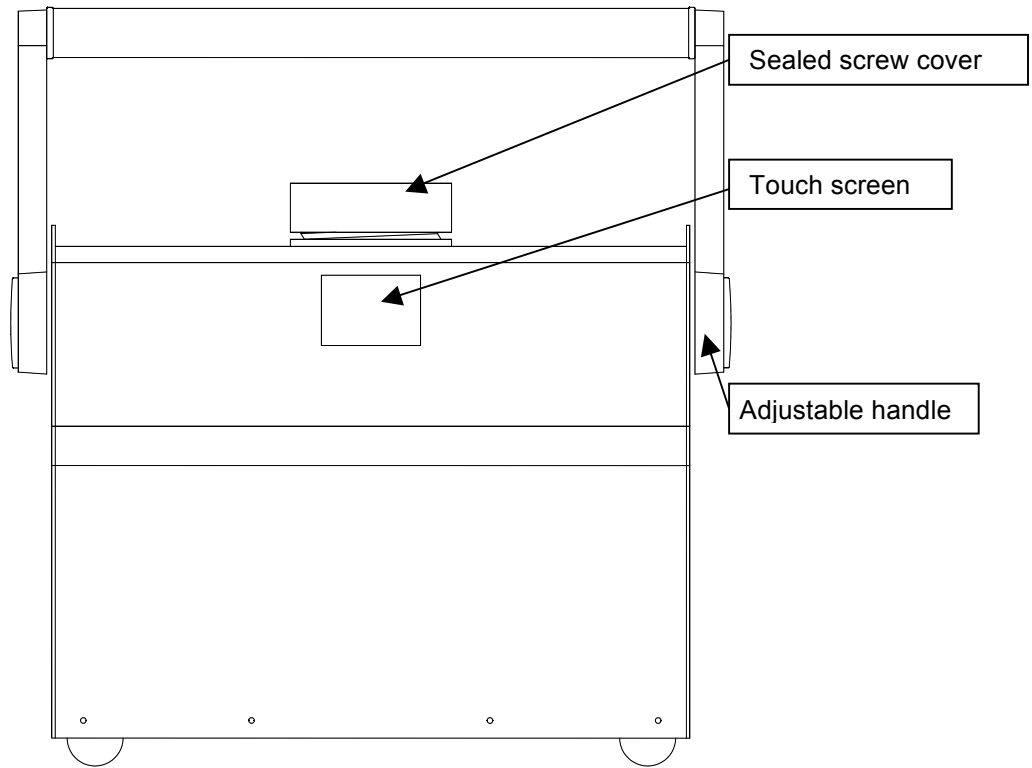
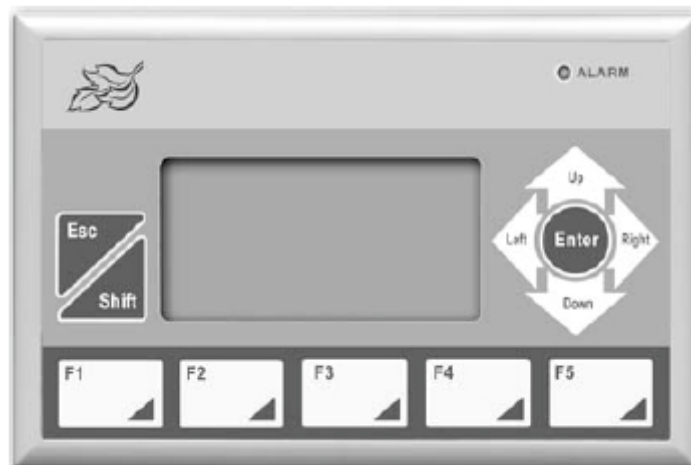


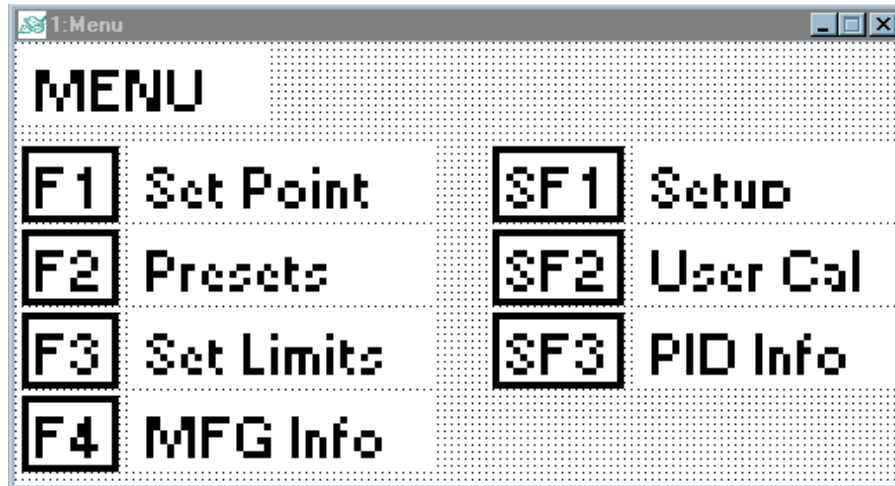
Figure 2  
FRONT VIEW

### Touch screen operation



## MENU

This page displays the Menus for the Mini Ultra Bath MUB-20130.



Press **SF5** from any screen and the instrument will display this Menu screen.

Press **F1**, “*Set Point*”, to display the Set Point screen.

Press **F2**, “Presets,” to display Preset 1 screen

Press **F3**, “Set Limits” to access MUB High and Low limits. (Password required)

Press **F4**, “MFG Info,” to display Part Number, Serial Number, Unit ID, etc.

Press **SF1**, “Setup,” to set Temperature Unit and Unit ID Number. (Password required)

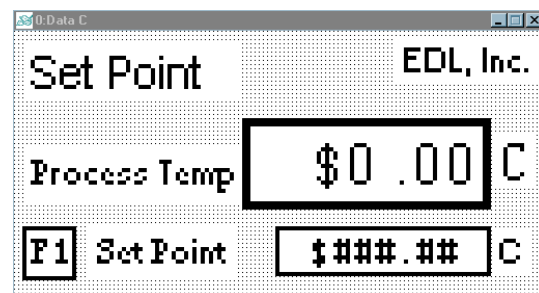
Press **SF2**, “User Cal,” to access calibration values. This will provide a two-point calibration. (Password required)

Press **SF3**, “PID Info,” to display PID information, Input Filter settings, and control offsets.

### Procedure for setting MUB Set Point

Press **F1**, “*Set Point*”, to show the Numeric Entry screen. The screen displays the minimum and maximum allowed values at the top (the actual limits are Min: -20.00 Max: 130.0).

In the center of the screen, the current Set Point is displayed. To enter a new number into the Numeric Entry screen, you must highlight each digit of the number using the blinking block cursor. Once selected, each digit can be changed one of two ways:



- by pressing the UP/DOWN keys of the **Graphic Interface (GI)**
- by pressing one of the function keys (F1-F5 see table at bottom of page).



Numeric Entry Screen

After you have changed the digit to the appropriate number, press the RIGHT/LEFT keys of the **GI** to advance to the next digit.

When you have finished, press the ENTER key. If the number entered is Out Of Range, an error message is briefly displayed on the **GI**. If the number is within range, it is immediately written to the **MUB** temperature controller, the Numeric Entry screen closes, and the prior screen is displayed. To cancel this operation, press the ESC key.

| Key | No Shift Key | Shift Key |
|-----|--------------|-----------|
| F1  | 1            | 6         |
| F2  | 2            | 7         |
| F3  | 3            | 8         |
| F4  | 4            | 9         |
| F5  | 5            | 0         |

*Note:* The entered temperature should be displayed in the Set point display.

The **MUB** should proceed to the new set point.

## Procedure for MUB Preset-1 Temperatures

Page 1 of 2, **MUB** preset temperature pages. To view the second page simply press the down arrow. All units are in Celsius.

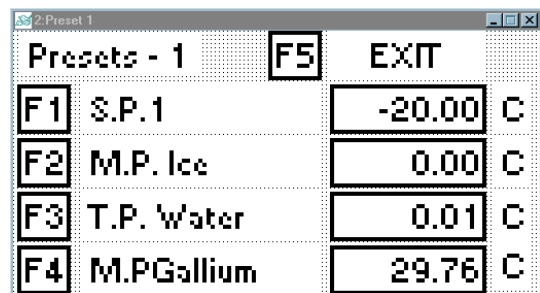
Select the desired set point from the choices displayed by pressing the corresponding function switch.

F1 Set Point 1

F2 Melting Point of Ice

F3 Triple Point of Water

F4 Melting Point of Gallium



Press **F5**, “Exit,” to return to the set point page. Note the entered temperature should appear in the “Set Point” readout.

The **MUB** should proceed to the new set point.

## Procedure for MUB Preset-2

### Temperatures

Page 2 of 2, **MUB** preset temperature pages. To view the first page simply press the up arrow. All units are in Celsius.

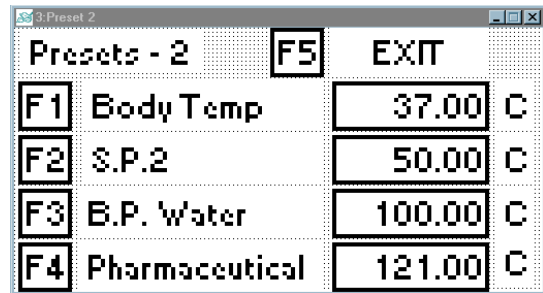
Select the desired set point from the choices displayed by pressing the corresponding function switch.

F1 Body Temperature

F2 Set Point 2

F3 Boiling Point of Water

F4 Pharmaceutical Standard



Press **F5**, “Exit,” to return to the set point page. Note the entered temperature should appear in the “Set Point” readout.

The **MUB** should proceed to the new set point.

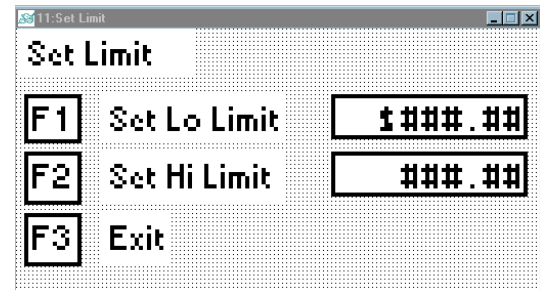
### Procedure for MUB Set Point Limits

Press **F1**, “Set Lo Limit,” to show the Numeric Entry screen.

The screen displays the minimum and maximum allowed values at the top (the actual limits are Min: -20.00 Max: 130.0). In the center of the screen, the current value of is displayed. To enter a new number into the Numeric Entry screen, you must highlight each digit of the number using the blinking block cursor. Once selected, each digit can be changed one of two ways:

- by pressing the UP/DOWN keys of the **GI**
- by pressing one of the function keys (F1-F5 see table 1).

After you have changed the digit to the appropriate number, press the RIGHT/LEFT keys of the **GI** to advance to the next digit.



Numeric Entry Screen

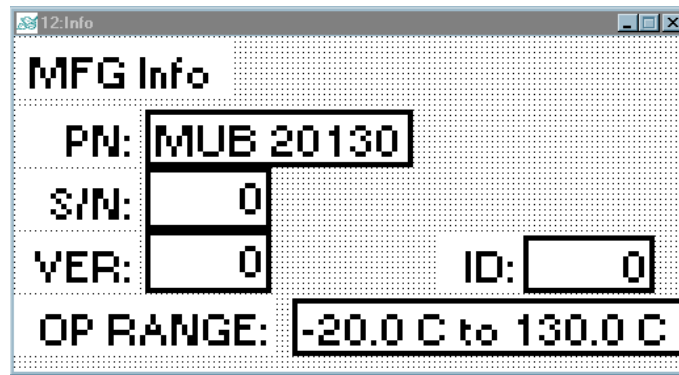
When you have finished, press the ENTER key. If the number entered is Out Of Range, an error message is briefly displayed on the **GI**. If the number is within range, it is immediately written to the PLC register, the Numeric Entry screen closes, and the prior screen is displayed. To cancel this operation, press the ESC key

| Key | No Shift Key | Shift Key |
|-----|--------------|-----------|
| F1  | 1            | 6         |
| F2  | 2            | 7         |
| F3  | 3            | 8         |
| F4  | 4            | 9         |
| F5  | 5            | 0         |

Press **F2**, “*Set Hi Limit*,” and repeat item 2 & 3.

Press **F3**, “*Exit*,” to return to “**Set Point**.”

## MUB MFG Info



**PN:** Part Number of Mini Ultra Bath.

**S/N:** Serial Number of this instrument.

**VER:** Software Version of the Controller.

**ID:** User assigned ID Number (Set by user on Setup page.)

**OP RANGE:** Operating Range of this instrument.

## Procedure for MUB Setup

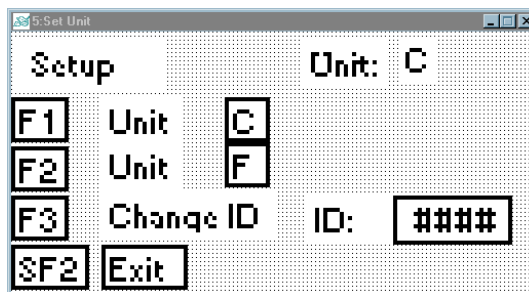
### CAUTION

This device is designed to function in Celsius. Fahrenheit can be selected, however, the presets, calibration, and PID loop values are selected to work in Celsius and do not convert when Fahrenheit is selected. Set Point will accurately display the PV and SP in Fahrenheit but all other displays will be unusable.

Press **F1**, “*Unit C*,” to set Celsius as the unit of measure.

Press **F2**, “*Unit F*,” to set Fahrenheit as the unit of measure.

Press **F3**, “*Change ID*” to input your chosen ID number. The Numeric Entry screen is displayed. The screen displays the minimum and maximum allowed values at the top (the actual limits are Min: 0000 Max: 9999). In the center of the screen, the current value of the ID is displayed. To enter a new number into the Numeric Entry screen, you must highlight each digit of the number using the blinking block cursor. Once selected, each digit can be changed one of two ways:



- by pressing the UP/DOWN keys of the **GI**
- by pressing one of the function keys (F1-F5).

After you have changed the digit to the appropriate number, press the RIGHT/LEFT keys of the Graphic Interface (**GI**) to advance to the next digit.

When you have finished, press the ENTER key. If the number entered is Out Of Range, an error message is briefly displayed on the **GI**. If the number is within range, it is immediately written to the ID number, the Numeric Entry screen closes, and the prior screen is displayed. To cancel this operation, press the ESC key, the entered ID should be displayed in the Setup display.



Numeric Entry Screen

Press **SF2**, “*Exit*,” to return to the menu.

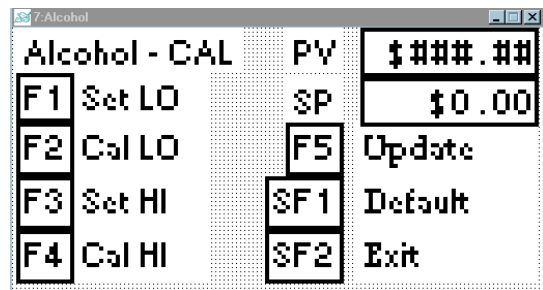
| Key | No Shift Key | Shift Key |
|-----|--------------|-----------|
| F1  | 1            | 6         |
| F2  | 2            | 7         |
| F3  | 3            | 8         |
| F4  | 4            | 9         |
| F5  | 5            | 0         |

## Calibration Procedure for MUB filled with Denatured Alcohol

Press **F1**, “*Set LO*,” to initiate the low point sensor cal cycle. Note the *SP* readout changes to -10.0° C. Wait until the indicated temperature measured with the SPRT and reference instrument reaches a stable state.

Press **F2**, “*Cal LO*,” to put the bath in LO Point Cal mode.

Press **F5**, “*Update*,” to show the update screen. Enter the temperature displayed on the reference instrument and press “Enter” when complete. Note the entered temperature should match the *PV* readout.



Press **F3**, “*Set HI*,” to initiate the high point sensor cal cycle. Note the *SP* readout changes to 30.0° C. Wait until the indicated temperature measured with the SPRT and reference instrument reaches a stable state.

Press **F2**, “*Cal HI*,” to put the bath in HI Point Cal mode.

Press **F5**, “*Update*,” to show the update screen. Enter the temperature displayed on the reference instrument and press “Enter” when complete. Note the entered temperature should match the *PV* readout.

Press **SF2**, “*Exit*,” to return to “Set point.”

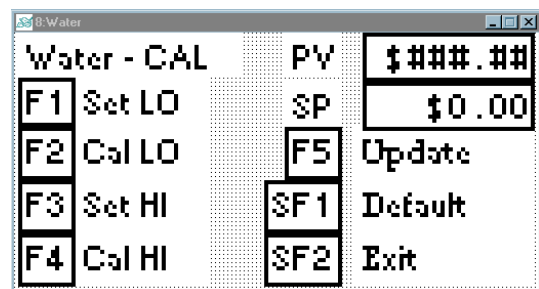
*NOTE: Press SF1, “Default,” to restore factory default calibration values if desired*

## Calibration Procedure for MUB filled with Water

Press **F1**, “*Set LO*,” to initiate the low point sensor cal cycle. Note the *SP* readout changes to 5.0° C. Wait until the indicated temperature measured with the SPRT and reference instrument reaches a stable state.

Press **F2**, “*Cal LO*,” to put the bath in LO Point Cal mode.

Press **F5**, “*Update*,” to show the update screen. Enter



the temperature displayed on the reference instrument and press “Enter” when complete. Note the entered temperature should match the *PV* readout.

Press **F3**, “*Set HI*,” to initiate the high point sensor cal cycle. Note the *SP* readout changes to **80.0° C**. Wait until the indicated temperature measured with the SPRT and reference instrument reaches a stable state.

Press **F2**, “*Cal HI*,” to put the bath in HI Point Cal mode.

Press **F5**, “*Update*,” to show the update screen. Enter the temperature displayed on the reference instrument and press “Enter” when complete. Note the entered temperature should match the *PV* readout.

Press **SF2**, “*Exit*,” to return to “Set point.”

*NOTE:* Press **SF1**, “*Default*,” to restore factory default calibration values if desired

## Calibration Procedure for MUB filled with Silicon - SF10

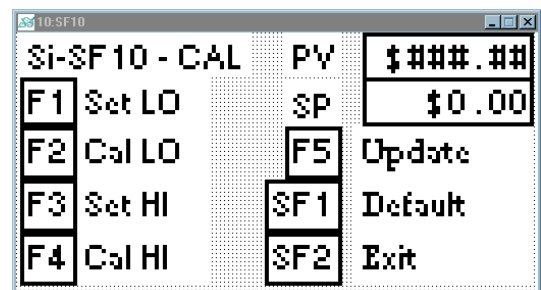
Press **F1**, “*Set LO*,” to initiate the low point sensor cal cycle. Note the *SP* readout changes to **10.0° C**. Wait until the indicated temperature measured on the SPRT and reference instrument reaches a stable state.

Press **F2**, “*Cal LO*,” to put the bath in LO Point Cal mode.

Press **F5**, “*Update*,” to show the update screen. Enter the temperature displayed on the reference instrument and press “Enter” when complete. Note the entered temperature should match the *PV* readout.

Press **F3**, “*Set HI*,” to initiate the high point sensor cal cycle. Note the *SP* readout changes to **110.0° C**. Wait until the indicated temperature measured on the SPRT and reference instrument reaches a stable state.

Press **F2**, “*Cal HI*,” to put the bath in HI Point Cal mode.

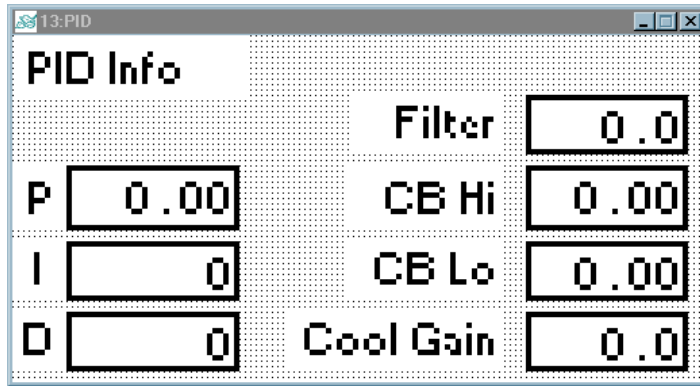


Press **F5**, “*Update*,” to show the update screen. Enter the temperature displayed on the reference instrument and press “Enter” when complete. Note the entered temperature should match the *PV* readout.

Press **SF2**, “*Exit*,” to return to “Set point.”

*NOTE:* Press **SF1**, “*Default*,” to restore factory default calibration values if desired

## PID Info



## Definitions

**P** Proportional value in unit of measure.

**I** Integral value in seconds

**D** Derivative value in seconds

**Filter** Input filter setting in seconds

**CBHi** Cutback value for Heat settings

**CBLo** Cutback value for Cool settings

**CoolGain** Gain difference between heating and cooling proportional value.

## Chapter 4

### Improving your Measurements

This chapter contains fundamental information that will help you to improve your temperature measurements.

### Comparisons

The International Temperature Scale of 1990 (ITS 90) is defined by a series of highly reproducible fixed temperature points. These points are based on the inherent properties of specific materials such as the Triple Point of Water (TPW), Freezing Point of Elements such as Aluminum, and the vapor pressure of an elemental gas. As you can imagine these are expensive and difficult to achieve and are not required for most applications. They are the defining points on the scale and uncertainties of less than 1mK are quite obtainable. Next, in the dissemination chain are full size stirred liquid baths; these baths provide excellent stability and uniformity and are capable of overall uncertainties of between 1mK and 10mK. Liquid baths with the proper sensor and reference instrument are highly reliable and are an excellent temperature source. They too are quite expensive and require sophisticated measuring equipment to realize their true accuracy potential. A more practical solution to daily calibrations when the highest accuracy is not required, is the portable stirred liquid bath. They are clean, efficient, accurate, and require less experience than the preceding calibration techniques.

The following recommendations will help maximize the use of your Mini Ultra Bath.

1. Stem conduction errors are related to immersion depth and should always be considered. Generally, sensors should be placed into the bath as deep as possible and all measurements should be made at full depth. Thermocouples are less sensitive to conduction errors and it is recommended to have the sensor immersed in the hole about seven times the sensor diameter. RTD Sensors usually have long cylindrically shaped elements, which are positioned further from the tip of the element; this makes the RTD more sensitive to its position in the bath.
2. If an external reference is to be used it should be placed at the same depth as the unit under test (UUT). By using an external reference, the inaccuracies in the internal sensor

and controller display are removed. The uncertainty contributed by those components is shifted to your calibrated reference sensor and instrument.

3. Time is often neglected during precision temperature measurements; allow enough time for the bath and the sensor to reach equilibrium. A reading cannot be obtained until a steady state condition is reached and will be shown by stability in both the reference and the UUT readings. Stable readings for the bath are usually achieved in less than 30 minutes after reaching your set point.
4. Sensors must be clean, dry, and free of any type of coating; oxides and other contaminants can impede heat flow, or contaminate your bath fluid during calibration. The result will be unreliable readings and reduced life expectancy for the fluid.

## Chapter 5

### Trouble Shooting

The Mini Ultra Bath is a high precision portable stirred liquid bath that can suit the needs of metrology calibration and industrial requirements. For better serviceability, we have chosen standard industrial components based on past performance and commercial availability. This manual describes the use of the product, but also includes specifications, parts list, and an electrical diagram. In addition, the factory provides complete support for this product. Technician level personnel are available to assist in trouble shooting the device; laboratory and engineering personnel are available to assist you with issues regarding calibration.

The stirring paddle is below the vented baffle at the bottom of the tank. If you move the baffle and stop the paddle, the best way to get it restarted is to shut the bath off and center the paddle with a non magnetic rod, then restart the bath and push the baffle back into place.

# Appendix One

## Mini Ultra Bath Specifications

### Physical

- Dimensions.....300mm (12”) deep x 250mm (10”) wide x 350mm (14”) tall
- Weight .....21 lbs
- Surface.....Epoxy Powder Coat
- Materials.....Aluminum, and Stainless Steel
- Sensor insert bushings sizes......125”, .187”, and .250” diameter

### Electrical

- Power.....110 VAC, 10 Amp 60HZ
- Heaters .....110 VAC 250 Watts
- Main Fuse.....250VAC-10 Amp
- Power Relay.....250VACC-25 Amp (overrated for extended service)

### Accuracy Specifications

- Range.....-20°C to +130°C
- Resolution.....0.01°C
- Stability & Uniformity.....at -10.00°C and 80.00°C~0.020°C (over 10 min. period)

(Note: Absolute accuracy may be improved by using remote reference.)

### Heat up / Cool down Rates

- Heat-up .....Approx. 2.5°C/minute
- Cool down.....1.0°C/minute

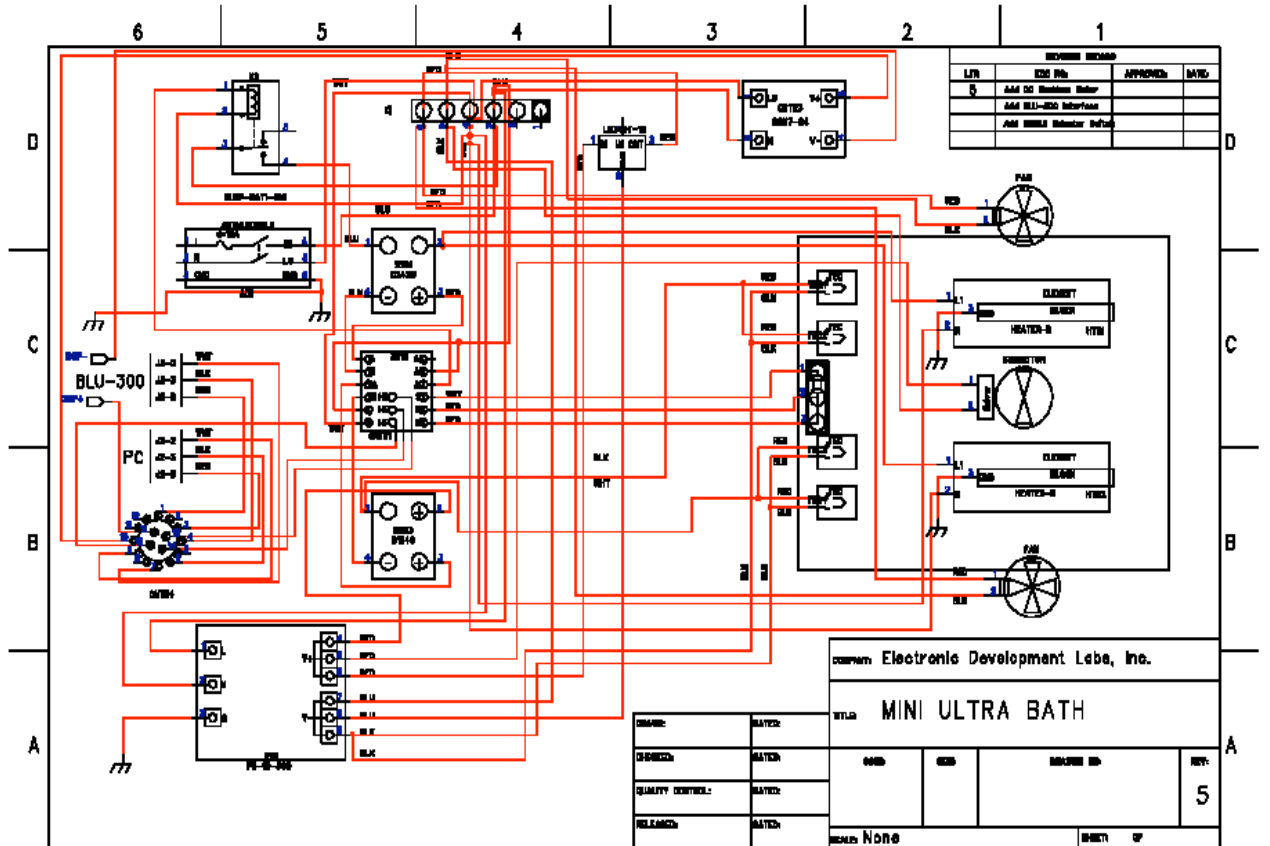
## Appendix 2

### Uncertainties

The uncertainties associated with the testing of this unit follow the NIST Guidelines for Evaluating and Expressing Uncertainty (Technical Note 1297). Type A uncertainties are combined with Type B uncertainties, where Type A is statistical data representing the measurements and Type B is based on scientific judgment of all relevant information concerning the testing. It is also assumed that uniform distribution exists for the measurement data. The two types of data are combined using the root sum squares method (RSS).

# Appendix 3

## Electrical Diagram



## Appendix 4

### Parts List

MUB-20130 .....Base Price: \$3 692.00

|                          | <b><u>Price:</u></b> |
|--------------------------|----------------------|
| Sensor insert bushings:  |                      |
| 1/8" bore                | \$17.00              |
| 3/16" bore               |                      |
| 1/4" bore                |                      |
| <br>                     |                      |
| Calibration of MUB-20130 | \$250.00             |

### **Standard Replacement Parts:**

Controller  
Solid State Relay 25 Amp  
DPDT Rocker Switch  
Power cord 110 VAC 10 Amp  
Fans 76 CFM 12Vdc 92mm SQ  
Strip Heaters 110 VAC 125 Watt  
Fuses 10 Amp (5 pack)  
Motor  
Power supply  
Screw on cover  
Sensor insert bushing holder

### **Part #**

EEC-CNTRLR32162  
ECR-SLDSTTRELAY  
SWR-RKRDPDT  
EHP-PWRCRD10  
EHF-76CFM12VDC  
EHH-ST110V125W  
EHU-FS10A5X20-5

### **Price:**

\$493.50  
\$48.16  
\$3.15  
\$3.68  
\$26.28  
\$24.00  
\$6.55 (5 pack)  
\$98.00  
\$370.00  
\$65.00  
\$65.00

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