

FLUKE®

Calibration

7508/7511/7512

Calibration Bath

Users Manual

August 2026 (English)

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Introduction

The Fluke Calibration 7508/7511/7512 Calibration Bath (the Bath, Product, or Instrument) is a precise constant temperature bath. The Product maintains extreme temperature stability with a solid-state *Temperature Controller*.

The user interface (UI) has a color LCD (the display) and full keyboard. Digital remote communications is available with a RS-232 and USB interface.

The Product tank is stainless steel and capacities are:

- 7508 42 liters
- 7511 27 liters
- 7512 42 liters

A standard lid with a rectangular access opening ships with the Product.

Contact Fluke Calibration

Fluke Corporation operates worldwide. For local contact information, go to our website: www.fluke.com.

To register your product, or to view, print, or download the latest manual or manual supplement, go to our website.

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Safety Information

Warning

To prevent possible electrical shock, fire, or personal injury, read the *Safety Information* manual that shipped with the Product.

General safety information is in the printed *7508/7511/7512 Safety Information* document that ships with the Product. It can also be found online at www.fluke.com. More specific safety information is listed in this manual where applicable.

A **Warning** identifies conditions and procedures that are dangerous to the user. A **Caution** identifies conditions and procedures that can cause damage to the Product or the equipment under test.

 Caution

To prevent damage to the Product:

- Close the drain valve on the back of the Product before you fill the tank with fluid.
- Do not fill above the fill line.
- Do not overfill the Bath. Overflowing fluid can damage the electrical system. Make sure to allow for thermal expansion of the fluid as the Bath temperature increases, see [Bath Preparation and Filling](#) and [Thermal Expansion](#).
- Do not exceed the recommended fluid viscosity of any fluid.
- Read [Bath Use](#), before you place the Bath into service.
- Do not change the values of the Bath calibration constants from the factory-set values. Proper Bath operation and safety relies on the correct settings of these parameters.
- The refrigeration system can be damaged or the lifespan shortened if the setpoint temperature is set >60 °C for >1 hour with the refrigeration manually on. Make sure that the refrigeration is off when the Bath is used >40 °C. 40 °C is the limit for the refrigeration system during a steady state of operation. When ramping down, it may come ON around 60 °C to reduce the ramp down time.
- The Factory Reset Sequence should be performed only by authorized personnel if no other action is successful to correct a malfunction, see [Controller Reset](#). You must have a copy of the most recent Report of Test to restore the test parameters.
- Do not operate the Product in an excessively wet, oily, dusty, or dirty environment. Silicone oils require additional ventilation to prevent an oily, dirty environment.
- The Product and any thermometer probes used with the Product are sensitive instruments that are easily damaged. Handle these devices with care. Do not allow them to be dropped, struck, stressed, or overheated.

Cold Baths

Turning the Product on and off frequently adds wear to the compressor. Bath or compressor lifespan can be affected by turning the Product off and on frequently. Fluke Calibration recommends to turn the Bath off if it is not going to be used for the weekend or an extended period of time.

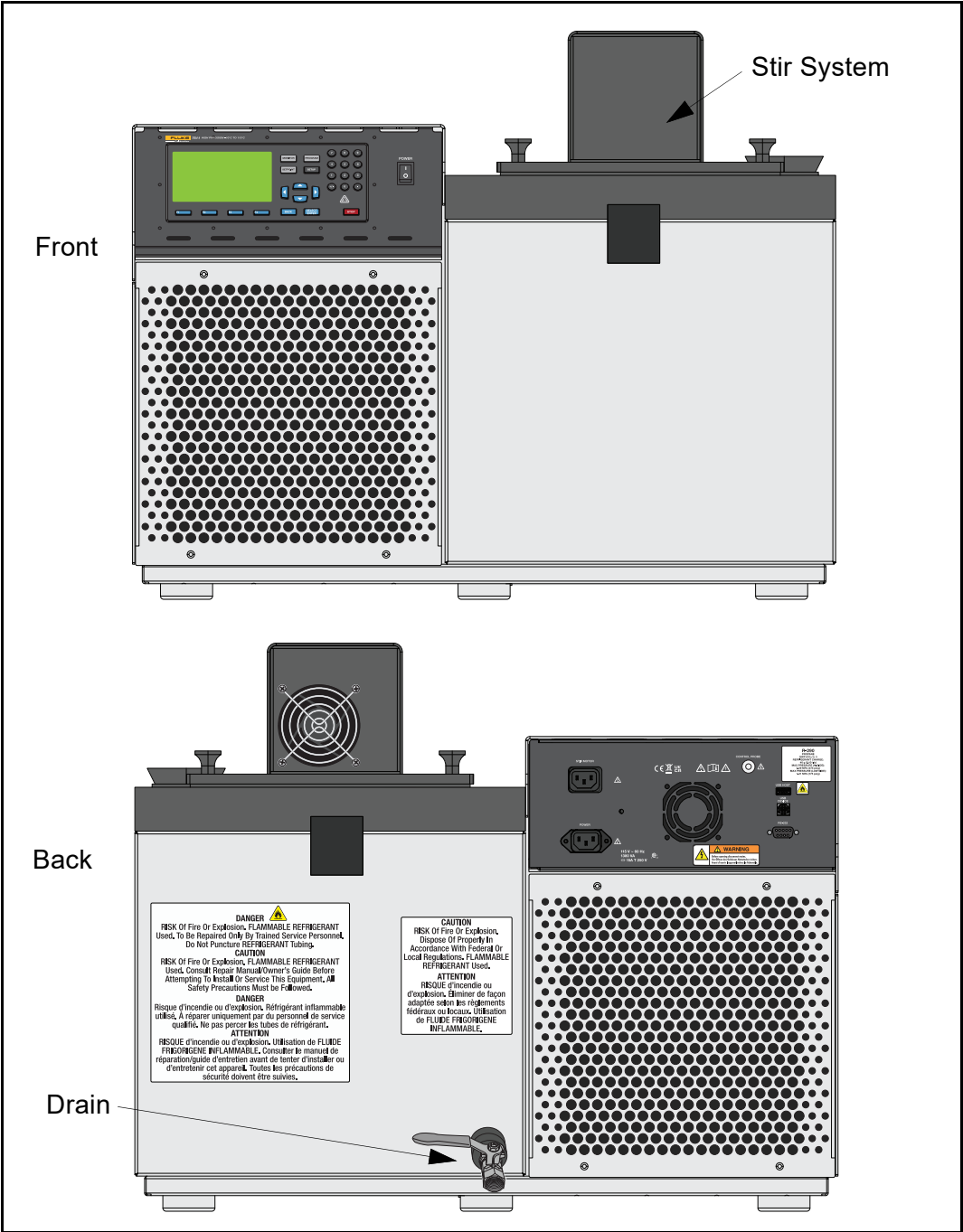
Specifications

Safety Specifications are located in the Safety Specifications section of the 7508/7511/7512 *Safety Information* manual. Complete Product specifications are located at www.fluke.com.

Parts and Controls

Use this section to familiarize yourself with the Product, see [Figure 1](#).

Figure 1. Calibration Bath (7511 Shown)



Front Panel

The front-panel controls and indicators are shown in Table 1.

Table 1. Front Panel

Number	Description
1	Display - Shows the information about the operation of the Product such as the fluid temperature and setpoint.
2	Softkeys - These keys correspond to the display icons directly above each key. The functions change with the status of the display. In many menus F1 is labeled Done . It returns the screen to the first menu. As you type numbers for settings, F4 acts as a backspace key. This deletes the last digit in the number.
3	Mode Keys - MONITOR , SETPOINT , PROGRAM , and SETUP access different groups of settings. Some mode keys light up when the mode is active.
4	Other Keys - Controls used to operate the Product. BACK - Returns the UI to the prior menu. ▲ and ▼ - Use to move the cursor up or down. ◀ and ▶ - Use to move the cursor left or right. Number keys (0-9) - Use the ten number keys to enter decimal numbers. Push SELECT ENTER to save the number. SELECT ENTER - Change a selected item. After the setting is changed, push SELECT ENTER to save the new value. Settings that have only binary states, such as ON or OFF, are changed and saved with a single push.
5	Hot Warning Indicator - This indicator lights up if the fluid temperature is $\geq 50\text{ }^{\circ}\text{C}$. This warns that the bath fluid, tank cover, and area around the tank are hot and should not be touched.
6	STOP - Immediately disables heating and cooling. Does not impact stir motor operation.
7	Power switch.

Rear Panel and Fluid Expansion

See [Table 2](#) to identify the parts of the rear panel. This section explains these parts.

Table 2. Rear Panel (7511 Shown)

Number	Description
1	Temperature Probe Connector
2	USB Host Connection
3	USB Device Connection
4	Optional Serial RS-232 Interface Connection
5	Fan Motor
6	Mains Power Receptacle
7	Stirrer Power Connector

Any liquid expands when heated. To prevent Bath overflow, you must remove the excess fluid prior to heating or there must be a means to allow the fluid to drain out of the Bath tank, see [Figure 1](#).



Warning

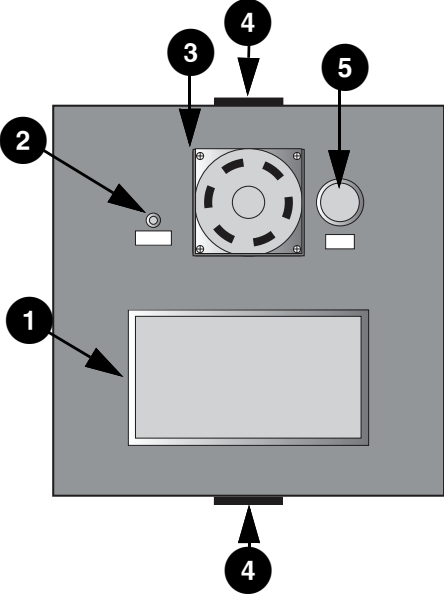
To prevent personal injury:

- Know that the drain tube can be hot.
- Use care when you handle hot fluids, burns can result. Always wipe away spilled fluid.

Bath Tank Lid

The standard lid has a stirring motor with rectangular access opening. Their features are described in [Table 3](#).

Table 3. Tank and Lid

	
Number	Description
1	Access Opening - used to insert the Device Under Test (DUT). For specified control levels, this access opening must be covered to prevent Bath thermal disturbances.
2	Control Temperature Probe Liner. The Control Probe must be inserted in this liner to operate. The control probe provides the temperature feedback signal to the Controller that allows the Bath to maintain a constant temperature. The delicate control probe is a precision thermistor to be handled carefully. Place the probe into the small tube in the top of the lid so that the probe tip is fully immersed in the bath fluid.
3	The Stir Motor is mounted on the lid. This motor drives the Bath stir propellers which mix the Bath fluid. Proper mixing is important for temperature stability and uniformity. The Stir System mixes the fluid in the rear of the Product, see Figure 1 , top right side.
4	Lid Latch (2). These latches attach the Lid to the Bath. There is a latch on the front and back of the lid.
5	Thermometer/Liquid Level Hole - Use this opening to fill or remove the liquid, check the level, and to mount the thermometer. You can drill a hole in the supplied rubber stopper to insert a thermometer into the Bath.

Installation

The subsequent sections provide more detail on Product installation. The Product is shown in [Figure 1](#).

Unpack the Product

When you unpack the Product, remove all of the accessories from the foam then remove the foam. Gently ease the Product from the crate. If you must lift the Bath slightly to release it from the crate, have a second person help you. Carefully slide your hands under the Product and gently lift it just enough to clear the foam and move the Product from the crate. The area that contains the compressor is heavier than the rest of the Bath. Do not attempt to carry the Bath.

If you must move the Bath after installation, empty the bath fluid first.



To prevent personal injury, do not move a bath filled with fluid. The Bath is tall and heavy and personal injury or damage can occur.

Unpack the Bath carefully and inspect it for damage that could have occurred during shipment. If there is shipment damage, notify the carrier immediately. Make sure that all components are present:

- The Bath
- Access Cover
- Thermometer/fill opening cover
- Printed Safety Information document
- Report of Test (store in a safe place)
- Drain Elbow
- Mains Power Cord
- Controller Probe
- USB cable
- Serial communications cable

If missing any item, see [Contact Fluke Calibration](#).

Bath Environment

Locate the Product in an appropriate environment free of dirt, drafts, extreme temperatures, and temperature changes. Place the Product on a level surface. Allow sufficient air circulation around the Product. Leave at least 30 cm (12 in) of clearance.



To prevent personal injury, beware of accidental fluid spills. The top surface of the Product is hot at high temperatures.

Use a fume hood or other adequate ventilation system to remove any vapors given off by hot bath fluid. Silicone oils require additional ventilation to prevent an oily, dirty environment.



To prevent personal injury, once the Product is installed, keep Product movement to a minimum. This Product is not portable. Never move a Product that is full of fluid. This action is extremely dangerous and could result in personal injury to the person moving the Bath.

If the Product must be placed in an area where it must be moved frequently, a specially-designed cart can be used to accommodate the Product. Fluke sells carts to move the Baths. However, even with a cart, never move a Bath full of hot fluid.

The fluid can splash and cause injury or if the Product and cart tip, the fluid could cause damage to the area and cause personal injury. To prevent injury, when you must move the Product, drain the fluid, see [Figure 1](#). The compressor side of the Product is heavier than the tank side. If the Product must be moved, at least two people are required.

Note

If you use the optional Cart accessory, tipping can be an issue.

Bath Preparation and Filling



To avoid Product damage, do not spill fluid on the control panel. Immediately clean up any spills. If necessary, cover the panel while you fill the Bath. Do not overfill.

The Product does not come with bath fluid. Various fluids are available from Fluke Calibration or other sources. Any of the fluids below, or others, can be used as long as they meet necessary temperature ranges:

- Water
- Ethylene glycol/water
- Methanol
- Mineral oil
- Silicone oil

Fluids are discussed in detail in [Heat Transfer Fluid](#).

Before you fill Bath, remove the access cover and make sure the tank contains no foreign matter (for example, dirt or remnant packing material).

 Caution

To avoid Product damage, do not turn on the Product without fluid in the tank.

Fill the Bath with clean, unpolluted fluid. Fill the Bath carefully through the large access opening to a level that allows for stirring and thermal expansion. The fluid should never exceed a height of 3/4 in below the top of the tank. There is a fluid level indicator on the outside of the tank for reference. Refer to the fill level indicator label on the right rear side of the Bath.

Carefully monitor the bath fluid level as its temperature rises to prevent overflow or splashes. Remove excess fluid if necessary and with caution if the fluid is hot, see [Thermal Expansion](#).

Probe

Inspect the Bath Controller probe, see [Temperature Controller](#). It should not be bent or damaged. Use caution when you handle this probe as it contains a precision thermistor sensor and is mechanically shock sensitive. Do not drop, strike, or otherwise physically shock the probe as this can cause a shift in resistance in the probe. Resistance shifts diminish Bath accuracy. If damaged, [Contact Fluke Calibration](#) for replacement information.

Insert the probe into the 1/4-in probe tube at the top of the Product lid. The tip of the probe must be covered by the fluid. Plug the probe connector into the socket labeled **CONTROL PROBE** on the rear of the Product ([Table 2](#), .

Power

To power up the Product:

1. With the Product power OFF, plug the mains power cord into a mains outlet of the proper voltage, frequency, and current capability. Before you energize the Product, check the rear-panel label for the correct voltage and frequency.
2. Make sure the stir motor power cord is plugged into the **STIR MOTOR** socket on the rear of the Bath ([Table 2](#), .
3. Use the **POWER** switch ([Table 1](#), ) to turn on (I) the Product Bath. The Bath fans come on for a few seconds, then the Product turns on, the stir motor starts up, and the display comes up. The Product does not engage its heating or cooling systems until the user selects and accepts a setpoint. The display indicates the actual Bath temperature.

Note

The actual temperature where cooling is required depends on the bath fluid and whether there is a cover over the access well.

For optimum accuracy and stability, allow the Bath adequate stabilization time after it reaches the setpoint temperature.

Bath Use

General

Make sure to select the correct fluid for the temperature range of the calibration. Select bath fluids that operate safely with adequate thermal properties that meet your application requirements. Fluids expand when heated and can overflow if not observed. See [General Operation](#) for information specific to fluid selection and refer to the MSDS (material safety data sheet) specific to the fluid selected.



To prevent personal injury, prepare a place for extracted probes. Probes can be extremely hot or cold when removed from the Bath. The Bath generates extreme temperatures.

Carefully place probes on a heat/cold resistant surface or rack until they are at room temperature. Wipe the probe with a clean soft cloth or paper towel before you insert the probe into another bath. This prevents the mixing of fluids from one bath to another. If the probe was calibrated in liquid salt, carefully wash the probe in warm water and dry completely before you transfer it to another fluid. Make sure that the probe is completely dry before you insert it into hot fluid.

Comparison Calibration

Comparison calibration tests a probe to be calibrated (device under test, DUT) against a reference probe. After you insert the DUT into the Bath, allow sufficient time for the probes to settle and the Bath temperature to stabilize.

A significant benefit of Bath use, instead of a dry-well, to calibrate multiple probes is that the probes do not need to be identically constructed. The Bath fluid lets you calibrate different probe types simultaneously. However, stem effect from different probe types is not totally eliminated. Even though all baths have horizontal and vertical gradients, these gradients are minimized inside the Bath work area. Nevertheless, insert the probes to the same depth in the bath fluid. Make sure to insert all probes deep enough to prevent stem effect. Fluke Calibration recommends a general rule for immersion depth to reduce the stem effect to a minimum: 15 x the diameter of the DUT + the sensor length. **Do not submerge the probe handles.** If the probe handles get too warm during calibration at high temperatures, use a heat shield just below the probe handle. This heat shield can be as simple as aluminum foil slid over the probe before you insert it into the Bath. It can be as complicated as a specially-designed reflective metal apparatus.

For best results, when you calibrate over a wide temperature range, start at the highest temperature and progress down to the lowest temperature.

To hold the probes in place in the Bath, use probe clamps or drill holes in the access cover. Design other fixtures to hold the probes when necessary. Keep the reference probe and the DUT probe(s) as closely grouped as possible in the Bath work area. Bath stability is maximized when the Bath work area is kept covered.

Calibrate Multiple Probes

Fully loading the Bath with probes increases the temperature stabilization time after you insert the probes. Use the reference probe as the guide and make sure that the temperature is stable before you start calibration.

General Operation

The information in this section is for general information only. Do not use this section as the basis for calibration laboratory procedures. Each laboratory must write their specific procedures.

Heat Transfer Fluid

Many fluids are suited to the Product. When you choose a fluid, consider each of the fluid characteristics discussed in the subsequent sections. See [Table 5](#) to choose the type of fluid best suited for your Product.

Temperature Range

One of the most important characteristic considerations is the Bath fluid temperature range. Few fluids work well throughout the entire Bath temperature range. Bath temperature must be within the safe and useful temperature range of the fluid. The fluid freeze point or the temperature at which the viscosity is too great determines the lower temperature range of the fluid. The upper temperature is usually limited by vaporization, flammability, or chemical breakdown of the fluid. Fluid vaporization at higher temperatures can adversely affect temperature stability because of cool condensed fluid that drips into the Bath from the lid.

To limit Bath temperature, set the safety soft cutout so that the temperature cannot exceed the safe operating temperature limit of the fluid, see [Cutout](#).

Viscosity

Viscosity is the measure of the fluid thickness or how easily the fluid can be poured and mixed. Viscosity affects the temperature uniformity and Bath stability. Lower-viscosity fluids mix well to create a more uniform Bath temperature. This improves Bath response time so the Bath maintains a constant temperature. For good control, the viscosity should be <10 centistokes. 50 centistokes is about the practical upper limit of allowable viscosity. Higher viscosity fluids causes poor control stability due to poor stirring and can overheat or damage the stirring motor.

Viscosity varies greatly with temperature, especially with oils. Viscosity increases as temperature decreases. When fluid viscosity increases, stability performance of the Bath decreases.

Make sure stirring occurs at all temperatures. When you use higher-viscosity fluids, the Controller proportional band (see [Proportional Band](#)) may need to be increased to compensate for the reduced response time. Otherwise, the temperature can oscillate.

Specific Heat

Specific heat is the measurement of how much heat the fluid stores. Specific heat, to a small degree, affects the control stability and heating/cooling rates. Generally, a lower specific heat means the fluid heats and cools quicker. The proportional band can require adjustment depending on the specific heat of the fluid.

Thermal Conductivity

Thermal conductivity is the measurement of how heat flows through the fluid. Thermal conductivity of the fluid affects the control stability, temperature uniformity, and temperature settling time. Fluids with higher conductivity distribute heat quicker, more evenly, and improves Bath performance.

Thermal Expansion

Thermal expansion describes how much the fluid volume changes with temperature. You must consider fluid thermal expansion when operating the Bath. The expansion can also cause loss of valuable bath fluid. Excessive thermal expansion can be undesirable in applications where constant fluid level is important.

Thermal expansion coefficients of several fluids are in [Table 4](#). Fluid manufacturers also provide this information. Thermal expansion coefficients are shown in units of cm/cm/°C. However, the values are the same for any unit of length. Divide the value by 1.8 for °F coefficients.

Use this equation to find the desired depth:

$$D_E = D_S [K(T_E - T_S) + 1]$$

Or

$$D_S = D_E / [K(T_E - T_S) + 1] \text{ where } D_E \leq \text{The Maximum Fill Depth}$$

Where:

K=Expansion coefficient

T_E=Ending temperature

T_S=Starting temperature

D_E=Ending depth

D_S=Starting depth

The maximum-fill depth is typically 1.3 cm to 2.0 cm (about 0.75 in) below the level of the gasket at the top of the Bath tank (not the top of the Bath lid). There is a maximum fluid indicator line on the side of the tank for reference. Use caution with different stirring arrangements to prevent splashes on the Bath lid gasket. Keep fluid level below the lid gasket as it can leak. Hot fluid tends to leak as it hits the gasket area.

Example:

The final depth of Dow Corning 710 silicone oil in the Bath tank is to be 23 cm (9.06 in) when heated from 25 °C to 300 °C. What should the starting depth be?

Expansion coefficient for 710 oil on [Table 4](#), $K = 0.00077 \text{ cm/cm/}^\circ\text{C}$

Ending temperature, $T_E = 300 \text{ }^\circ\text{C}$

Starting temperature, $T_S = 25 \text{ }^\circ\text{C}$

Ending depth, $D_E = 9.055 \text{ in (23 cm)}$

$D_S = 9.055 / [0.00077 (300-25) + 1] = 7.47 \text{ in (18.97 cm)}$

Electrical Resistivity

Electrical resistivity is how well the fluid insulates against electric current flow. In some applications, such as when you measure the resistance of bare temperature sensors, it can be important that little or no electrical leakage occurs through the fluid. In such conditions, choose a fluid with high-electrical resistivity.

Fluid Lifetime

Many fluids degrade over time because of vaporization, water absorption, gelling, or chemical breakdown. Often, the degradation becomes significant near the upper-temperature limit of the fluid, which substantially reduces fluid lifetime.

Safety

With bath fluids, always consider the safety issues. Where there are extreme temperatures, there can be danger to personnel and equipment. Fluids can be hazardous for other reasons. Some fluids are toxic. Contact with eyes, skin, or inhalation of vapors, can cause injury. If hazardous or bothersome vapors are produced, you must use a proper fume hood or adequate ventilation system.



Warning

To prevent personal injury, know that fluids at high temperatures pose danger from burns, fire, or toxic fumes. Use appropriate caution and safety equipment.

Some fluids are flammable and require special fire-safety equipment and procedures. Consider the fluid flash point. The flash point is the temperature where there is sufficient vapor given off that when adequate oxygen is present, and an ignition source is applied, the vapor ignites. This does not necessarily mean that fire is sustained at the flash point.

The flash point can be either of the open cup or closed cup type. Either condition can occur in the Bath environment. The closed cup represents the contained vapors inside the tank and the open cup represents the vapors escaping the tank. Oxygen and an ignition source are less available inside the tank. Since oxygen and an ignition source are less available inside the tank, the closed cup flash point is always lower than the open cup flash point.

Cost

Cost of bath fluids can vary greatly, from low cost for water to expensive for synthetic oils. Cost is important when you choose a fluid.

Commonly Used Fluids

Commonly used fluids and their characteristics are discussed in the subsequent sections.

Water

Water is often used due to its low cost, availability, and its excellent temperature control characteristics. Water has low viscosity, good thermal conductivity, and heat capacity which makes it among the best fluids for stability at lower temperatures. Temperature stability is reduced at higher temperatures because water condenses on the lid, cools, and drips into the Bath. Water is safe and relatively inert. The electrical conductivity of water prevents its use in some applications. Water has a limited temperature range, from a few degrees $>0^{\circ}\text{C}$ to a few degrees $<100^{\circ}\text{C}$. At higher temperatures, evaporation becomes significant. Use only distilled or deionized water in the Bath to prevent mineral deposits. To prevent contamination, consider an algicide chemical added to the water.

Note

Water at temperatures $>75^{\circ}\text{C}$ (167°F) can be unstable.

Ethylene Glycol

Warning

To prevent personal injury, know that ethylene glycol is extremely toxic.

Extend the temperature range of water with a solution of 1 part water and 1 part ethylene glycol (antifreeze). The characteristics of the ethylene glycol-water solution are similar to water but with higher viscosity. Properly dispose of Ethylene glycol in accordance with local environmental and safety standards.

Methanol

Methanol (methyl alcohol) is often used at low temperatures $<0^{\circ}\text{C}$. Methanol is relatively inexpensive, has good control characteristics, and has a low freeze point. Methanol is very toxic so use care when you dispose of this fluid.

Mineral Oil

Warning

To prevent personal injury, use caution with mineral oil since it is flammable and can cause serious injury if inhaled or ingested.

Mineral oil (paraffin oil) is often used at moderate temperatures above the range of water. Mineral oil is relatively inexpensive. At lower temperatures, mineral oil is quite viscous and control can be poor. At higher temperatures, vapor emission becomes significant. The vapors can be dangerous and Fluke Calibration highly recommends the use of a fume hood or adequate ventilation. As with most oils, mineral oil expands as temperature increases. The viscosity and thermal characteristics of mineral oil is poorer than water and temperature stability is not as good. Mineral oil has low electrical conductivity. Use caution with mineral oil since it is flammable and can also cause serious injury if inhaled or ingested.

Silicone Oil

Silicone oils are available that offer a much wider operating temperature range than mineral oil. Like most oils, silicone oils have temperature control characteristics which are somewhat poorer than water. The viscosity changes significantly with temperature and thermal expansion occurs. These oils have high electrical resistivity. Silicone oils are fairly safe and non-toxic but they can be expensive. When used at higher portions of their temperature range for long periods, silicone oils can degrade and eventually breakdown. This limits their usable lifetime depending on the duration spent at high temperature.

Caution

Due to the unique properties of silicone oils and their ability to migrate and creep through seals, adequate ventilation must be used to prevent oil vapors from creating an oily, dirty environment. Oily, dirty environments reduce the lifetime of the electrical components of the Product.

Fluid Characteristics Charts

Table 4 and Table 5 provide help to select a heat exchange fluid media for your constant temperature Bath. These charts provide a visual and numerical representation of most of the physical qualities important to make a selection. The list is not all inclusive. There may be other useful fluids not shown. The charts include information on a variety of fluids which are often used as heat transfer fluid in baths. Because of the temperature range, some fluids are not useful with the Bath.

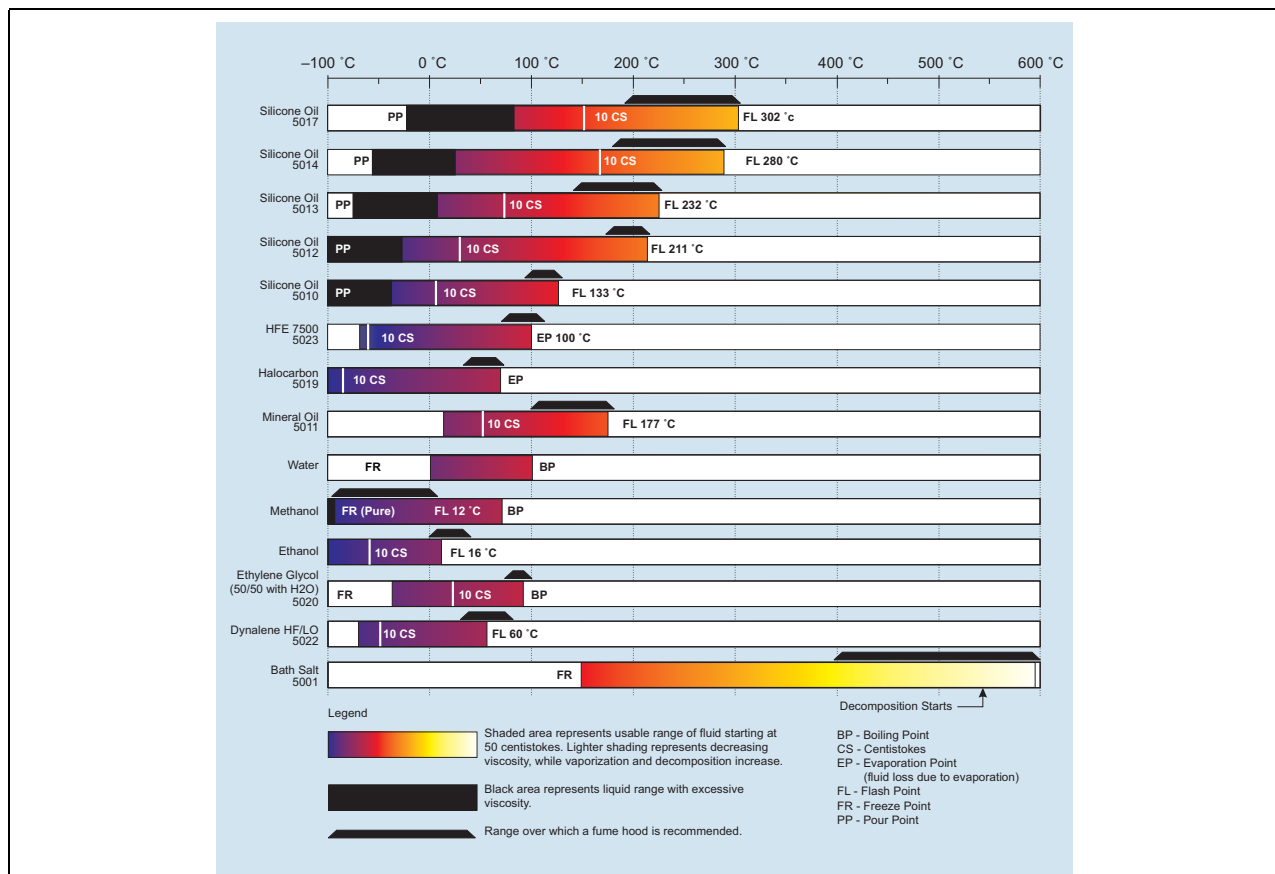
Limitations and Disclaimer

The fluid information given in this manual is intended only as a guideline to choose a fluid. Though every effort has been made to provide correct information, Fluke Calibration cannot guarantee accuracy of data or assure suitability of a fluid for a particular application. Specifications can change and sources sometimes offer differing information. Fluke Calibration cannot be liable for any personal injury or damage to equipment, product, or facilities that result from the use of these fluids. The responsibility to collect correct information, exercise proper judgment, and ensure safe operation is the Product user. Operation near the limits of certain properties such as the flash point or viscosity can compromise safety or performance. Always consider your company safety policies with regard to flash points, toxicity, and other safety issues. It is your responsibility to read the MSDS (material safety data sheets) and act accordingly.

Table 4. Table of Bath Fluids

Fluid	Lower Temp. Limit*	Upper Temp. Limit*	Flash Point	Viscosity (centistokes)	Specific Gravity	Specific Heat (cal/g/°C)	Thermal Conductivity (cal/s/cm/°C)	Thermal Expansion (cm/cm/°C)	Resistivity (10 ¹² Ω-cm)
Halocarbon 0.8 #5019	-100 °C (v)**	70 °C (e)	NONE	5.7 @ -50 °C 0.8 @ 40 °C 0.5 @ 70 °C	1.71 @ 40 °C	0.2	0.0004	0.0011	
Ethanol	-97 °C (fr)	16 °C (fl,cc)	16 °C	1@20 °C	0.809 @ 20 °C	0.61	0.00047	-	-
Methanol	-96 °C(fr)	10 °C(fl,cc)	12 °C	1.3 @ -35 °C 0.66 @ 0 °C 0.45 @ 20 °C	0.810 @ 0 °C 0.792 @ 20 °C	0.6	0.0005 @ 20 °C	0.0014 @ 25 °C	
Water	0 °C (fr)	95 °C (b)	NONE	1 @ 25 °C 0.4 @ 75 °C	1.00	1.00	0.0014	0.0002@25 °C	
Ethylene Glycol —50 % #5020	-30 °C (fr)	90 °C (b)	NONE	7 @ 0 °C 2 @ 50 °C 0.7 @ 100 °C	1.05	0.8@0 °C	0.001	-	-
Mineral Oil No.7 #5011	10 °C (v)	166 °C (fl)	168 °C	15 @ 75 °C 5 @ 125 °C	0.87 @ 25 °C 0.84 @ 75 °C 0.81 @ 125 °C	0.48 @ 25 °C 0.53 @ 75 °C 0.57 @ 125 °C	0.00025 @ 25 °C	0.0007 @ 50 °C	5 @ 25 °C
Silicone Oil Type 200.05 #5010	-40 °C (v)**	130 °C (fl, cc)	133 °C	5 @ 25 °C	0.92 @ 25 °C	0.4	0.00028 @ 25 °C	0.00105	1000 @ 25 °C 10 @ 150 °C
Silicone Oil Type 200.10 #5012	-30 °C (v)**	209 °C (fl, cc)	211 °C	10 @ 25 °C 3 @ 135 °C	0.934@25 °C	0.43 @ 40 °C 0.45 @ 100 °C 0.482 @ 200 °C	0.00032 @ 25 °C	0.00108	1000 @ 25 °C 50 @ 150 °C
Silicone Oil Type 200.20 #5013	10 °C (v)	230 °C (fl, cc)	232 °C	20 @ 25 °C	0.949 @ 25 °C	0.370 @ 40 °C 0.393 @ 100 °C 0.420 @ 200 °C	0.00034 @ 25 °C	0.00107	1000 @ 25 °C 50 @ 150 °C
Silicone Oil Type 200.50 #5014	30 °C (v)	278 °C (fl, cc)	280 °C	50 @ 25 °C	0.96 @ 25 °C	0.4	0.00037 @ 25 °C	0.00104	1000 @ 25 °C 50 @ 150 °C
Silicone Oil Type #5017 710	80 °C (v)	300 °C (fl, oc)	302 °C	50 @ 80 °C 7 @ 204 °C	1.11@25 °C	0.363@ 40 °C 0.454@ 100 °C 0.505@ 200 °C	0.00035 @ 25 °C	0.00077	100 @ 25 °C 1 @ 150 °C
Heat Transfer Salt #5001	180 °C (fr)	550 °C	NONE	34 @ 150 °C 6.5 @ 300 °C 2.4 @ 500 °C	2.0 @ 150 °C 1.9 @ 300 °C 1.7 @ 500 °C	0.33	0.0014	0.00041	1.7 Ω/cm³
*Limiting Factors — b - boiling point e - high evaporation fl - flash point fr - freeze point, v - viscosity — Flash point test oc = open cup cc = closed cup **Very low water solubility, ice forms as a slush from condensation below freezing.									

Table 5. Various Bath Fluid Properties



Characteristic	Description
Temperature Range	The temperature scale is in degrees Celsius. The shaded bands indicate the general range of application of the fluid. Qualities that include pour point, freeze point, important viscosity points, flash point, boiling point, and others can be shown.
Freezing Point	The freezing point of a fluid limits stirring. As the freezing point approaches, high viscosity can also limit performance.
Pour Point	This represents the handling limit for the fluid.
Viscosity	Points shown are at 50 centistokes and 10 centistokes viscosity. When viscosity is >50 centistokes, stirring is poor and the fluid is unsatisfactory for Bath applications. Optimum stirring generally occurs at ≤10 centistokes.
Flash Point	The point at which ignition can occur. The point shown can be either the open or closed cup flash point. Refer to the flash point discussion in Safety .
Boiling Point	At or near the boiling point of the fluid, temperature stability is difficult to maintain. Fuming or evaporation is excessive. Large amounts of heater power could be required because of the heat of vaporization.
Decomposition	The temperature can reach a point at which decomposition of the fluid begins. To further increase the temperature can accelerate decomposition to the point of danger or impracticality. Silicone oils can oxidize, which causes the fluid to thicken. Replace at the first sign of viscosity increase.

Stirring

Stirring of the fluid is important for stable temperature control. The fluid must be mixed well for good temperature uniformity and fast Controller response. The stirrer is precisely adjusted for optimum performance.

Power

Product power is provided by an ac mains supply of 115 VAC (10 %), 60 Hz, 12 A, (230 V ac [± 10 %], 50 Hz, 6.39 A, or 208/230 V ac, 60 Hz, 6.39 A). These are configured at the factory when you purchase the Product. Power passes through a filter to prevent the transmission of switching spikes to other equipment.

When you turn ON the power switch, the upper control fan and the condenser fan comes on for 5 seconds to 10 seconds and then the stir motor and display splash screen comes on. The display indicates that the outputs are **Disabled**, and you must enable the system to go to the necessary setpoint.

Heater

The Temperature Controller precisely controls the Bath heater to maintain a constant Bath temperature. To control the power, the Bath periodically switches on a triac that turns the heater on for a certain interval. The Bath turns on a solid state relay to access an additional heater (Hi Heat) as needed.

The heater has two automatic power level settings. The **HIGH** heater power setting quickly heats up the fluid to the designated operating temperature. The **HIGH** setting can also be necessary for Bath control at elevated temperatures when the compressor is still enabled (20 °C to 40 °C). The **LOW** setting controls the Bath at lower temperatures. When the heater operates at the **HIGH** setting (instead of **LOW**), the proportional band could need to increase (typically by a factor of four) to compensate for the increase in power gain. Otherwise the temperature could oscillate. The **High** heat setting is an automatic process of the Instrument.

Note

The PBan does not automatically change with the temperature.

Fluid Drain

Use the drain on the rear of the Product to remove bath fluid. During operation, the drain must remain closed. See the detail in [Figure 1](#).

Temperature Controller

A unique hybrid digital/analog Temperature Controller (the Controller) controls the Bath temperature. The Controller combines tight control stability of an analog Temperature Controller with the flexibility and programmability of a digital controller.

Bath temperature is monitored with a linearized thermistor sensor in the control probe. The signal is electronically compared with the programmable reference signal, amplified, and then passed to a pulse-width modulator circuit that controls the amount of power applied to the heater.

The Bath operates within the temperature range given in the specifications. To protect against solid-state relay failure or other circuit failure, the microcontroller automatically turns off the heater with a second mechanical relay if Bath temperature exceeds a user settable soft cutout temperature. See [Cutout](#). As a second protection device, the Controller has a separate thermocouple temperature monitoring circuit that shuts off the heater if the temperature exceeds the hard cutout setpoint.

Use the front panel to operate and program the Controller. See [Table 1](#), [Controller Operation](#), and [Digital Communication Interface](#).

Use the Controller to set Bath temperature with high resolution, set the soft cutout, adjust the proportional band, monitor heater output power, and program the Controller configuration and calibration parameters. The Controller shows temperature units of degrees Celsius or degrees Fahrenheit, see [Temperature Scale Units](#). Once set to a new setpoint and the Product is engaged, the Bath heats or cools to the new temperature. Once the Bath reaches the new temperature, it usually takes 15 minutes to 25 minutes for the temperature to become stable. There can be a small overshoot or undershoot of about 0.2 °C.

Controller Operation

Use the display and control panel to:

- Monitor the Bath temperature
- Set the temperature setpoint in °C or °F
- Monitor heater output power
- Adjust controller proportional band
- Set cutout setpoint
- Program:
 - Probe calibration parameters
 - Operating parameters
 - Serial and USB interface configuration
 - Controller calibration parameters

To prepare for calibration:

1. Place the reference probe in the Bath work area.
2. Place the DUT in the Bath work area as close as possible to the reference probe. Do not touch the probe to the Bath tank surface areas. Stay 25 mm (1 in) away from bottom or sides of the tank.

Menu Guide

The menus are:

- Monitor Menu
- Setpoint Menu
- Program Menu
- Setup Menu

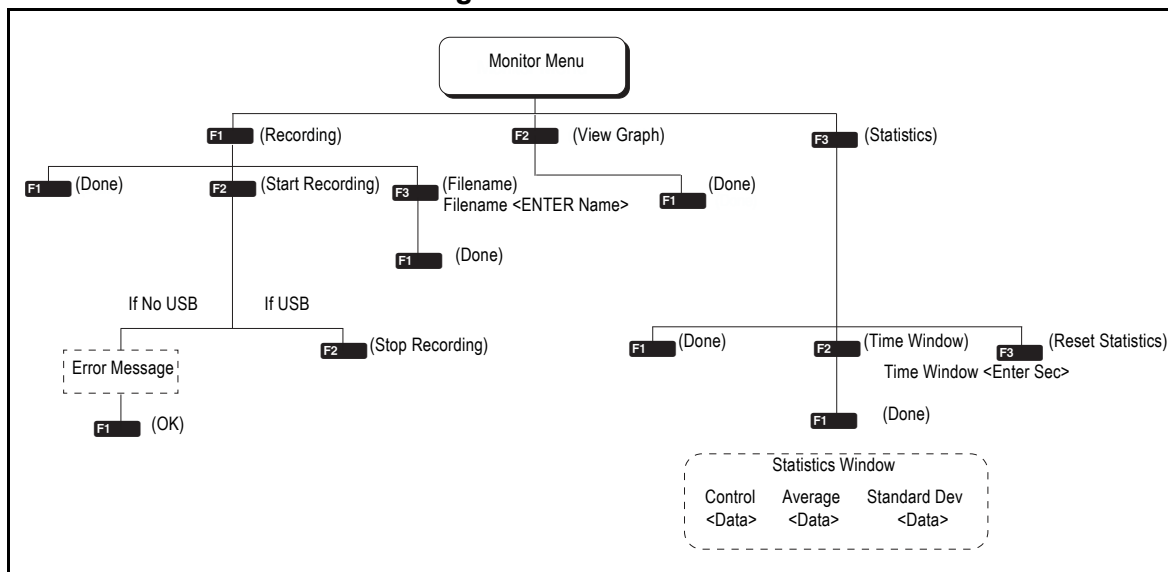
Most of these menus contain a softkey labeled **Done**. This returns the menu system to the home screen of the active mode. Push **BACK** to move to the prior menu.

Some menus require the password before settings can be changed. The menus are explained in detail in the subsequent sections.

Monitor Menu

Use the Monitor menu to view and record temperature data. The Monitor menu is explained in this section, see [Figure 2](#) and [Table 6](#).

Figure 2. Monitor Menu



Push **MONITOR** to enter monitor mode and use the softkeys (**F1** through **F3**) to access various submenus and functions. The Monitor menu has a top-level menu followed by other submenus.

On the submenus, push **F1** (**Done**) to close the current screen.

Table 6. Monitor Menu Top Level

Softkeys	Description
F1 Recording	Shows the Recording submenu. Use Recording to save readings to a USB memory device. The memory device must be Linux-compatible and formatted as FAT32, see Table 7 .
F2 View Graph	Shows the View Graph submenu. View Graph plots control temperatures over time. The graph scales automatically to best fit the data, see Table 8 .
F3 Statistics	Shows the Statistics submenu. Statistics shows the moving average and standard deviation of temperature readings, see Table 9 .

Table 7. Monitor Menu/Recording Submenu

Softkey	Description
F1 Done	Push to escape the Recording menu.
F2 Start Recording (and Stop Recording)	Start Recording and Stop Recording enables or disables temperature recording. Insert a memory device into the USB host port and set the filename before you turn on recording. Start Recording changes to Stop Recording after it is activated.
F3 Filename	Specify the filename for recording data to the memory device. The filename can have up to 20 characters. The extension <i>.txt</i> is automatically added to the filename when the file is created.

Table 8. Monitor Menu/View Graph Submenu

Softkey	Description
F1 Done	Push to escape the View Graph submenu
F2 View Graph	Shows a graph of the Control temperature plotted over time.

Table 9. Monitor Menu/Statistics Submenu

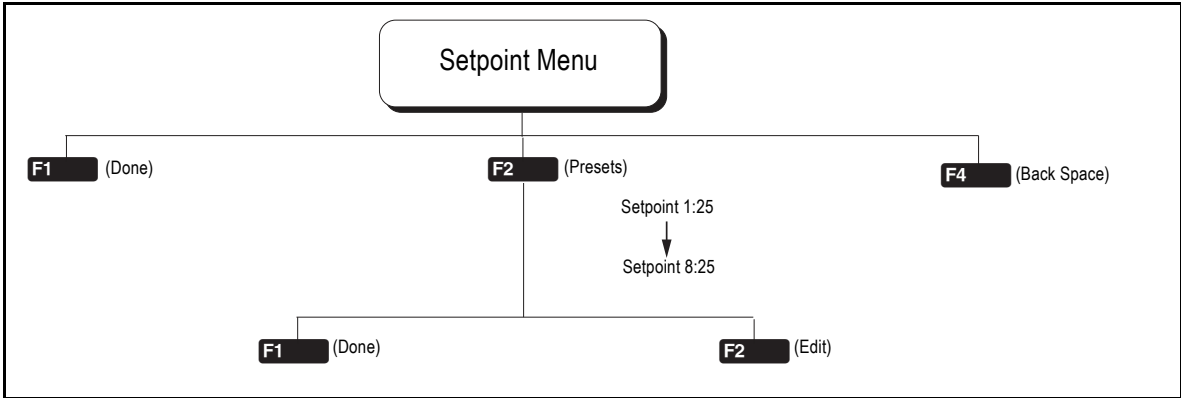
Softkey	Description
F1 Done	Push to escape the Statistics submenu
F2 Time Window	Select the time window for the moving average and standard deviation.
F3 Reset Statistics	Clear the statistical buffers and set a new starting point for subsequent statistics.

Setpoint Menu

Use Setpoint menu to set the temperature of the Product. The Setpoint menu is explained in this section, see [Figure 3](#) and [Table 10](#).

On the submenus, push **F1** (Done) to close the current screen.

Figure 3. Setpoint Menu



Push **SETPOINT** to enter the Setpoint menu and push the softkeys (**F1** through **F3**) to access various submenus and functions.

To change the setpoint:

1. Use the number keys to type in a new temperature.
2. Push **SELECT ENTER** to save the temperature.
3. Push **SELECT ENTER** again to enable temperature control.
4. Push **F1 Done** to complete the entry. You can also push **F2 Edit** to change the entry.

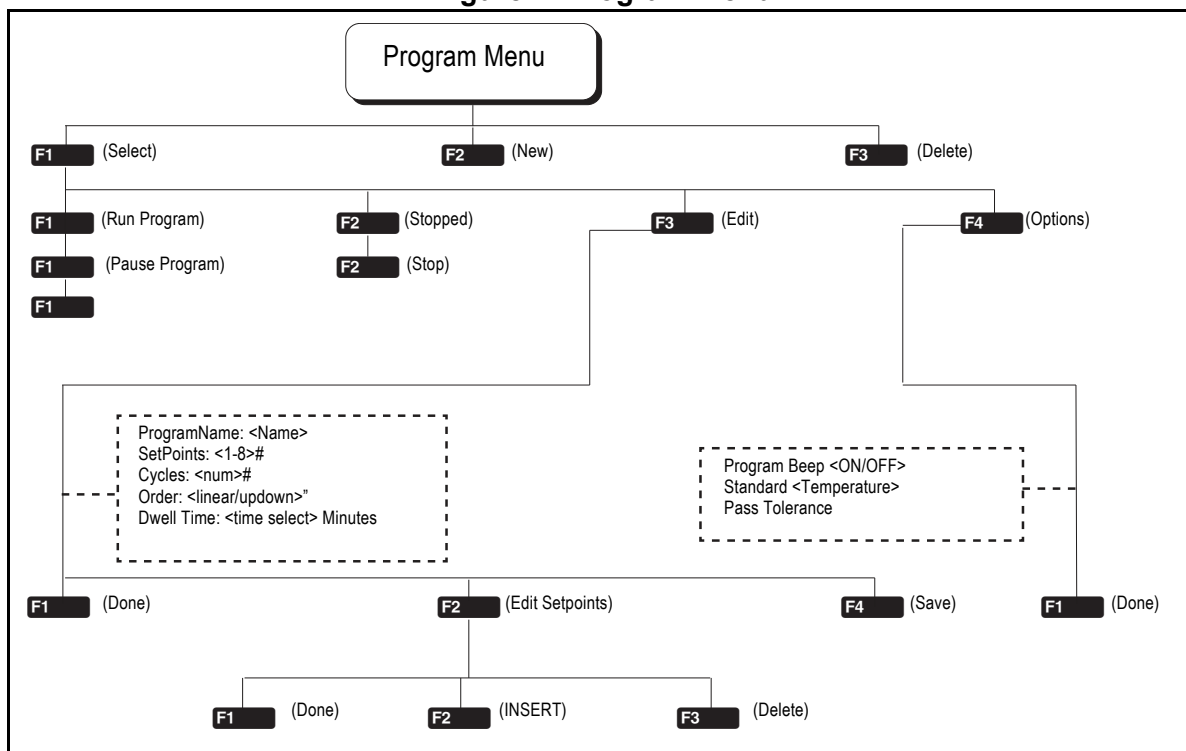
Table 10. Setpoint Menu Top Level

Softkey	Description
F1 Done	Push after you change the setpoint (see the procedure above) to escape the Setpoint menu. After a setpoint update or you accept the existing setpoint, push SELECT ENTER or F1 to engage the heating/cooling system.
F2 Presets	Access the Presets screen. Use this screen to select a preset for recall or edit. Push ▼ or ▲ to move the focus to one of the presets in the list and push SELECT ENTER to recall that setpoint. Or push STOP to disengage the heating/cooling system.
F4 Backspace	Use to edit or change an entry.

Program Menu

Use the Program menu to create and run an automatic setpoint program. The Program menu is explained in this section, see [Figure 4](#).

Figure 4. Program Menu



Push **PROGRAM** to enter the Program menu and push the softkeys (**F1** through **F3**) to access various submenus and functions, see [Table 11](#).

Table 11. Program Menu Top Level

Softkeys	Description
F1 Select	Push or to select a program and then push F1 Run Program to accept the entry. F2 STOPPED Program is not running - this function appears if the Program is selected but not running, see Table 12 .
F2 New	Creates a new program.
F3 Delete	Removes the selected program.

The Program Menu/Select Submenu is in [Table 12](#).

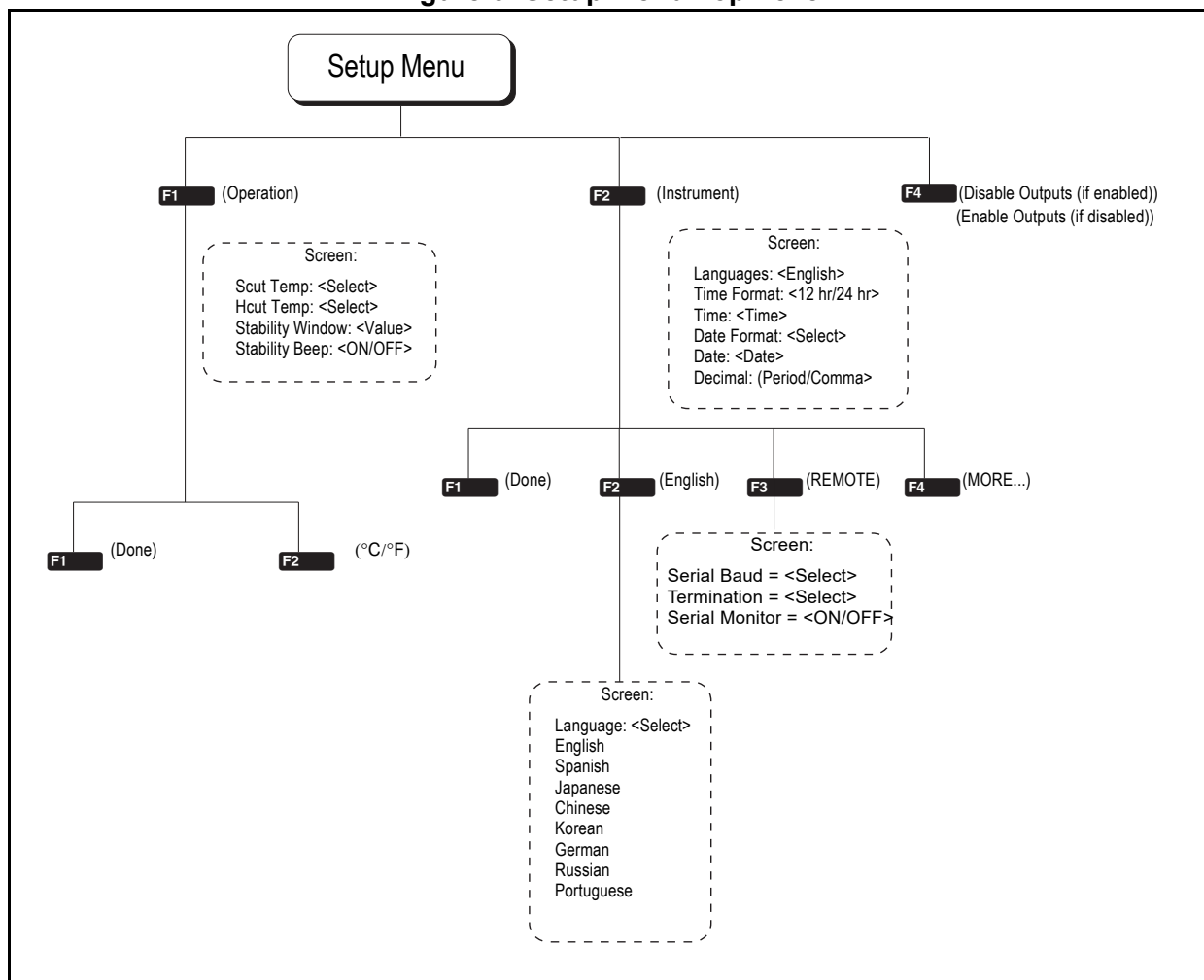
Table 12. Program Menu/Select Submenu

Softkeys	Description
F1 Run Program	Starts the selected program. This function shows only if a program is not running.
F2 Stopped	Stopped shows to notify you that the current program has halted. When the program runs, this changes to Stop Program . Once stopped, the program cannot be continued. F1 Pause Program also shows. Push F1 Pause Program to pause the program that is currently running. This function shows only if a program is running. Unlike Stop Program, after the program is paused, it can be continued later.
F3 Edit	Push to change the editable parameters in the selected program. These parameters are: Program Name identifies the selected or running program. Setpoints indicates the number of defined setpoints. It cannot be changed directly. Use F2 Edit Setpoint to add, delete, or change setpoints. Push  or  and then  to select a setpoint to change. Cycles defines the number of cycles completed before the program finishes. Order controls the order of the setpoints. If Order is Linear, the program setpoints step from first to last in one cycle. The next cycle starts over with the first setpoint. If Order is Up/Down, the sequence is from first to last, then backwards last to first to complete one cycle. Dwell Time is number of minutes the temperature is held at each setpoint before it advances to the next setpoint. The timer begins when the control indicator changes to Stable and the ready indicator is green. Push F4 Save to store any edits made.
F4 Options	Options lets you change these parameters of the Program: Program Beep if ON, the Product beeps when the program finishes. Standard determines the source for the reference temperature. If Standard is Reference (and a reference probe is connected and configured), the recorded reference temperature comes from the reference probe. Otherwise, the reference is from the internal control sensor. Pass Tolerance specifies the maximum acceptable difference between the DUT temperature and the reference temperature. Push F1 Done to store any edits made.

Setup Menu

The largest menu is the Setup menu. The Setup menu contains operator preferences and Product settings, many of them changeable. The Setup menu and its submenus are explained in this section, see [Figure 5](#).

Figure 5. Setup Menu Top Level



Push **SETUP** to enter the Setup menu and push the softkeys (**F1** through **F2**) to access various submenus and functions, see Table 13 through Table 20. Also see Figure 5 through Figure 10.

Table 13. Setup Menu Top Level

Softkeys	Description
F1 Operation	Leads to a screen where you can view or edit settings related to temperature control: • Hard Cutout Temperature The hard cutout is a safety device that prevents overheating of the Product and bath fluid in the event of Product malfunction. If the fluid temperature exceeds the hard cutout temperature, power is immediately removed from the heating and cooling devices. Temperature control can only resume after you go to the Setpoint Menu and accept an existing setpoint or change the setpoint and then push Select/Enter or F1 (Done). The hard cutout is factory set, about 15 degrees above the maximum Bath setpoint. <i>Note</i> <i>The conditions that triggered the cutout must have been removed to re-enable unit.</i> Set the soft cutout temperature at 5 °C above the maximum temperature at which the Product is operated and no higher than the maximum safe temperature of the bath fluid. • Stability Window controls when the control indicator becomes Stable and the ready indicator turns green. The control temperature must remain near the setpoint within the Stability Window tolerance for at least 1 minute. • Stability Beep controls whether the beeper sounds when the control indicator changes to Stable.
F2 Instrument	View or change configuration and user preferences from this screen. • Language selects the language for the user interface. Options are English, French, German, Portuguese, Spanish, Russian, Simplified Chinese, Japanese, and Korean. • Time Format selects the format for the time shown on the display. Options are 24-hour and 12-hour format. • Time changes the clock time. • Date Format selects the format of dates shown on the display. Options are YYYY-MM-DD (default), MM-DD-YYYY, DD.MM.YYYY, DD/MM/YYYY, and YYYY/MM/DD. • Date changes the clock date. • Decimal selects the decimal character used in numbers shown on the display. Options are period and comma. Push F1 (Done) to save changes.

Table 14. Setup Menu/Operation Submenu

Softkeys	Description
F1 Done	Push to save changes and escape the Operation submenu.
F2 °C/°F	Select Fahrenheit or Celsius. Note that Fahrenheit is only available in some regions of the world.

Table 15. Setup Menu/Instrument Submenu

Softkeys	Description
F1 Done	Push to save changes and escape the Instrument submenu.
F2 Language	Use to select or change the user interface language. Options are: • English • French • German • Portuguese • Spanish • Russian • Simplified Chinese • Japanese • Korean
F3 REMOTE	Change settings these related to the remote interface: • Serial Baud select the bit rate for the RS-232 port from a drop down menu. • Termination selects the line termination characters for transmitted messages. The options are CR, LF, and CR/LF. • Serial Monitor turns on automatic transmission of temperature readings. The fluid temperature is sent at intervals of one second. Temperature is in °C or °F and depends on the temperature unit setting. Serial Monitor is always OFF after power on
F4 More...	Access the Setup Menu/MORE... submenu, see Figure 6 and Table 16 .

Figure 6. Setup Menu/MORE...Submenu

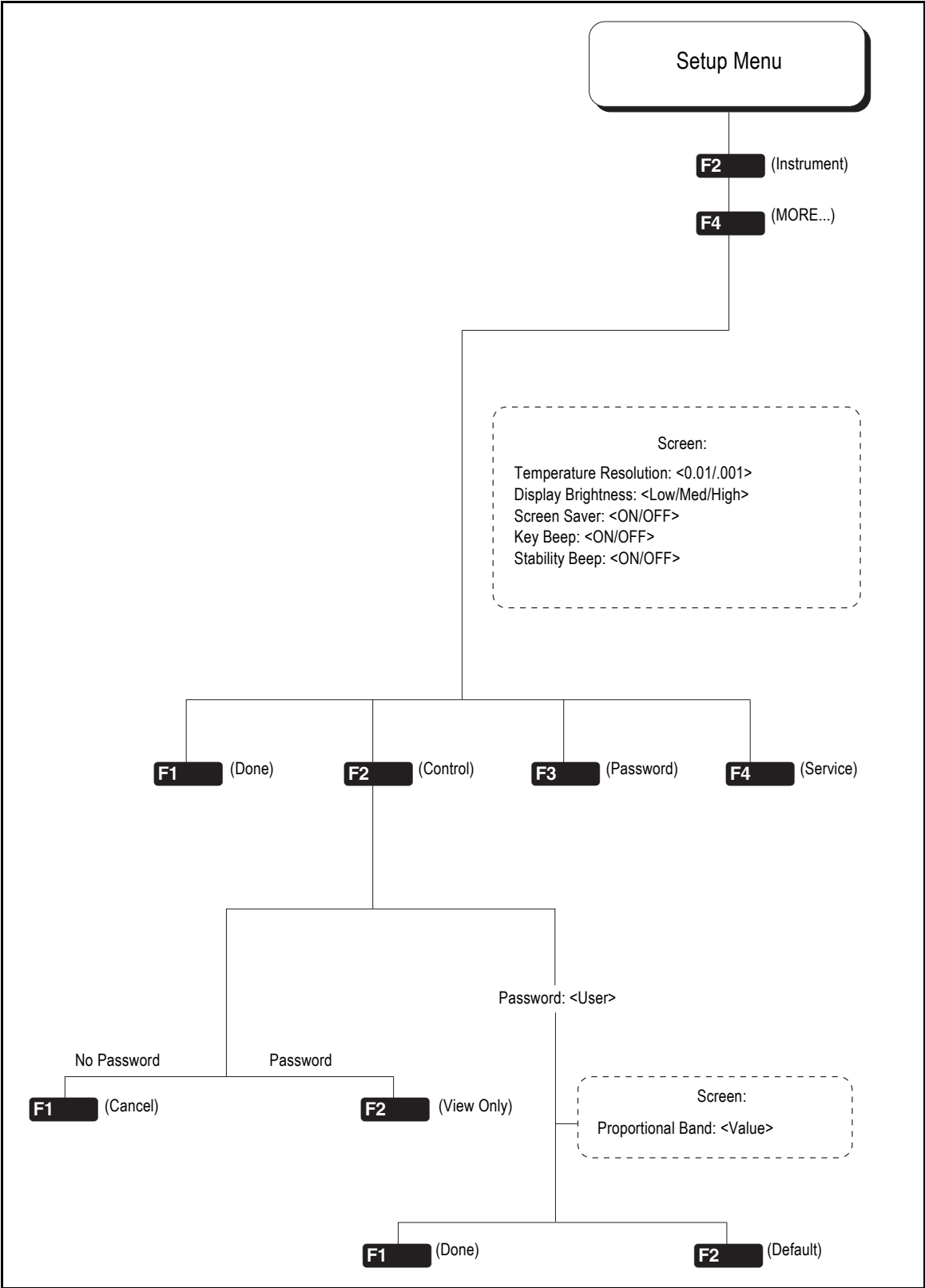


Table 16. Setup Menu/MORE... Submenu

Softkeys	Description
F4 MORE...	• Temperature Resolution selects the number of decimal places in temperatures shown on the display. • Display Brightness sets the brightness of the backlight, which could need to be adjusted depending on ambient light (low, medium, and high). • Screen Saver causes the display to dim after a period of time without operator actions. Push any key to return the screen to full brightness. The Product continues to operate and control temperature while the display is dark. • Key Beep controls whether the Product beeps each time a key is pushed. • Stability Beep controls whether the Product beeps when the ready indicator turns green. This setting is also located in the Setup Operation menu.
F1 Done	Push to escape back to the Setup main menu.
F2 Control	Changes temperature control parameters. Depending on the fluid used, the Product achieves slightly better temperature stability after fine-tuning the control parameters. This should only be done by a knowledgeable technician. Incorrect values could cause the Bath temperature to oscillate or drift. Control can also change the control parameters back to factory default values. Proportional Band controls the gain of the control function. A larger value decreases gain and a smaller proportional band increases gain. Push F2 Default to change the control parameters back to factory default values.

Table 16. Setup Menu/MORE... Submenu (cont.)

Softkeys	Description
F3 Password	Changes the user password or turns Product security ON or OFF. To return to the default password, push F2 Default. The default password is 1234. The password is required to access this menu. The password is the security code required by any protected menu, including this one. IMPORTANT: Do not lose your password. If you lose your password, Contact Fluke Calibration. Security determines which menus and functions require the password. Regardless of the Security setting, these menus are protected: • Setup > Instrument > More... > Control • Setup > Instrument > More... > Password • Setup > Instrument > More... > Service > System Status > Update Firmware • Setup > Instrument > More... > Service > Bath Calibration • Setup > Instrument > More... > Memory > Clear Settings • Setup > Instrument > More... > Memory > Clear Data When Security is ON, these additional menus are protected: • Program > Select > Edit • Program > Select > Options • Program > New • Program > Delete • Program > Reports > Delete • Setup > Operation • Setup > Instrument
F4 Service	Enters the Service submenu, see Figure 7 and Table 17. View or change the Product details: • Model (number) • Serial Number • Bath Calibration (the date the Product was last calibrated) • Input Calibration (the date the Probe was last calibrated)

Figure 7. Setup Menu/Service Submenu

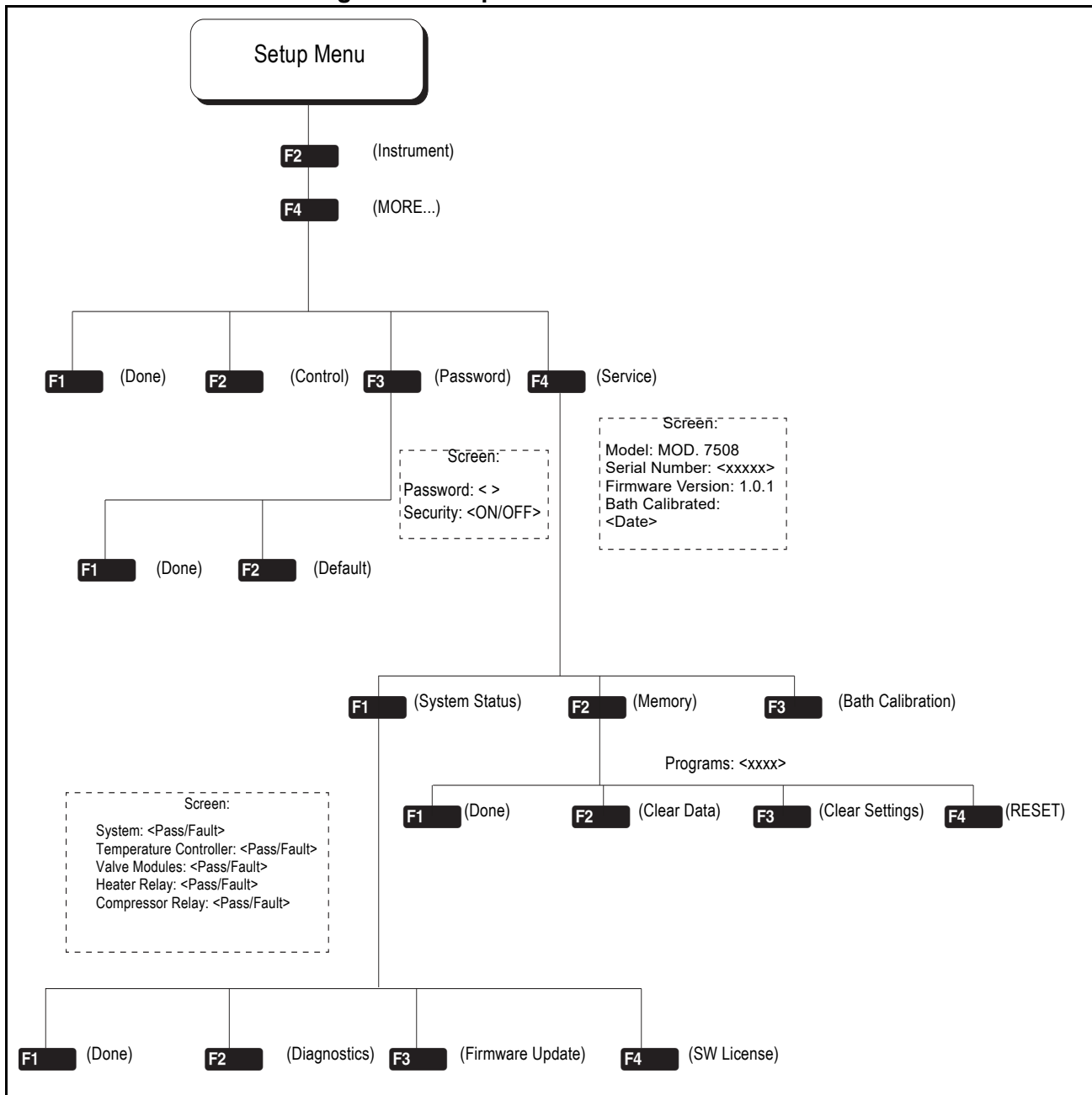


Table 17. Setup Menu/Service Submenu

Softkeys	Description
F1 System Status	View information about the condition of the Product. The System Status screen shows the results of the latest self-check. The System Status shows self test results for: • System • Temperature Controller • Valve Modules • Heater Relay • Compressor Relay See the Setup Menu/System Status Submenu in Figure 9 and Table 19.
F2 Memory	Manage data stored in memory. The Memory screen shows how many user-defined programs and test reports are stored in memory. • Push F2 Clear Data erases all setpoint programs and test reports from memory. The default setpoint program remains in memory. This function requires the password. • F3 Clear Settings to change Product settings to factory defaults. The settings affected are preset setpoints, operation settings, and Product settings. Password settings, control parameters, and calibration parameters are not affected. This function requires the password.
F3 Bath Calibration	Push to see the Bath Calibration submenu. Adjust the temperature accuracy of the Product. This menu requires the password to change any of the settings, see Figure 8 and Table 18.

Figure 8. Setup Menu/Service/Bath Calibration Submenu

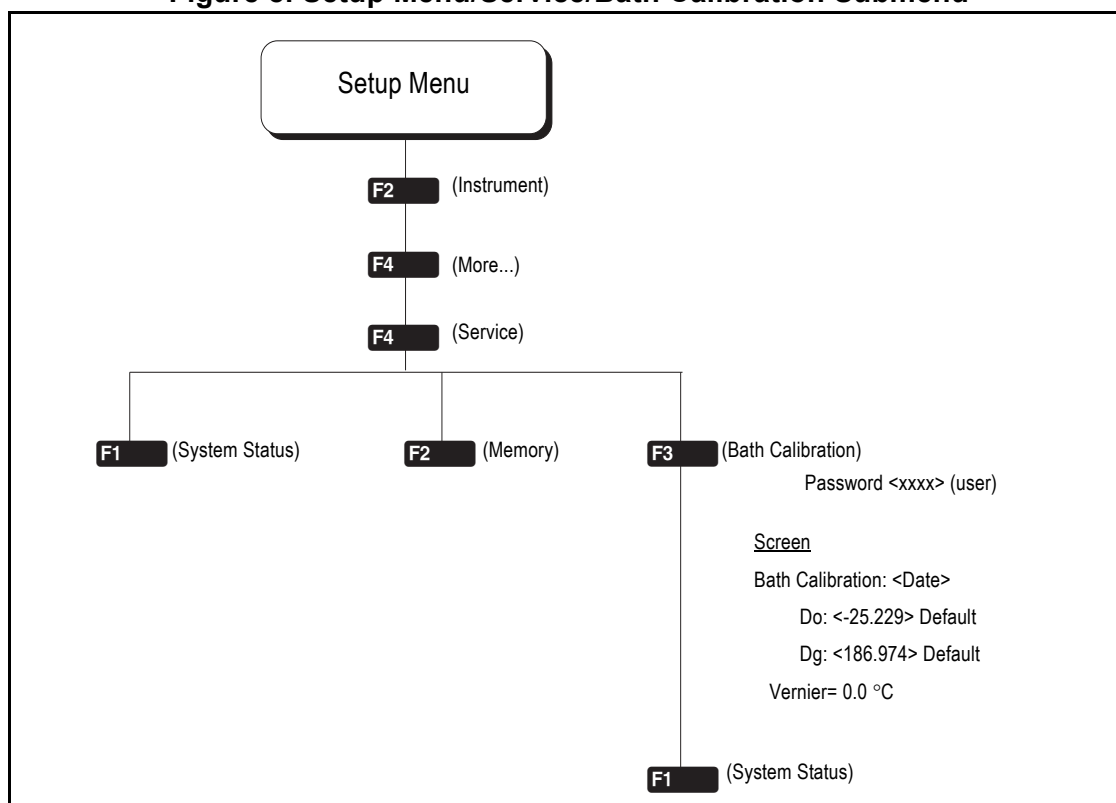


Figure 9. Setup Menu/System Status Submenu

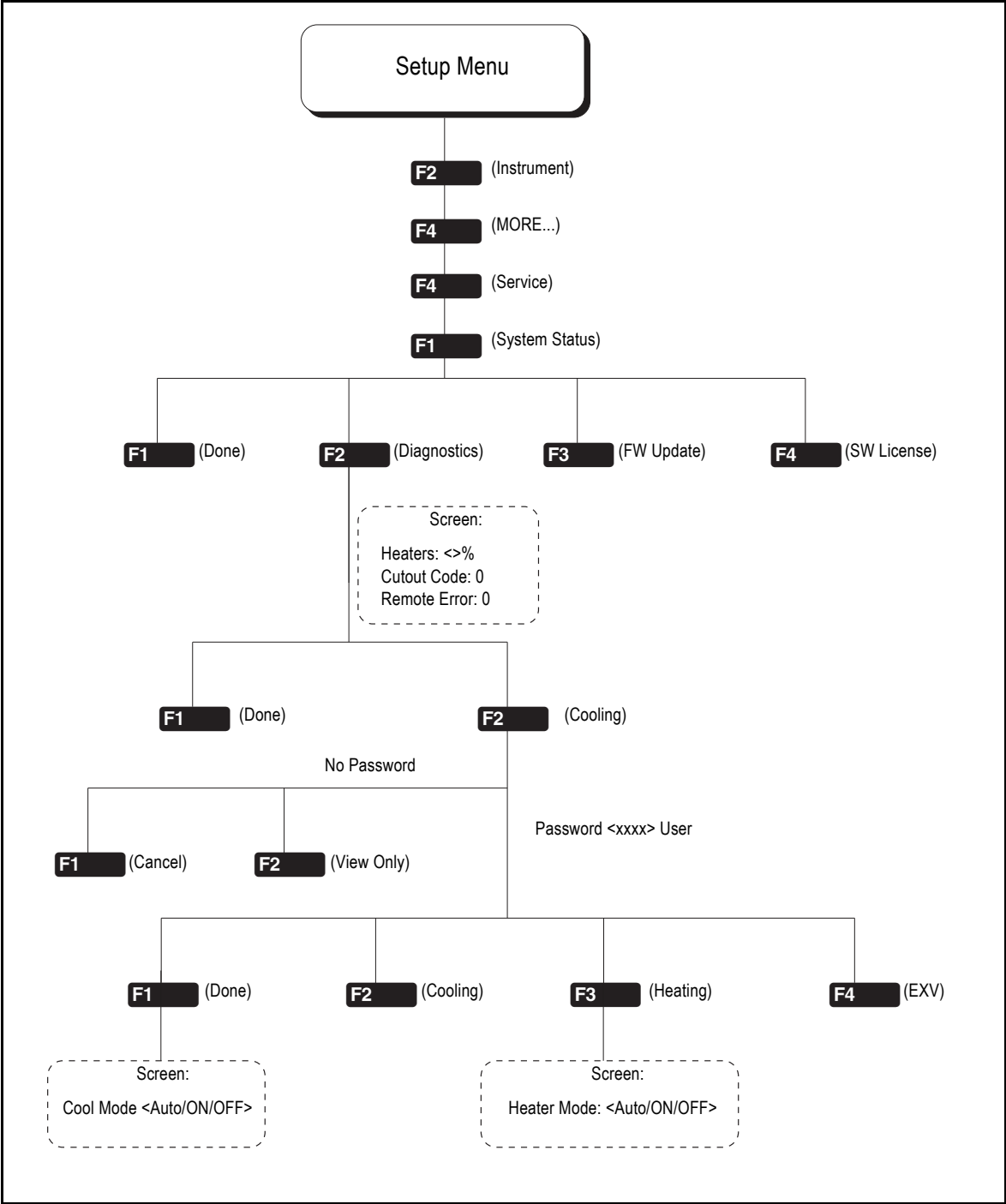


Table 18. Setup Menu/Service/Bath Calibration Submenu

Softkeys	Description
F3 Bath Calibration	The Bath controller gives access to these Bath calibration constants. These values are factory-set. Only adjust these parameters if the controller memory fails to restore these values to the factory settings. A list of these constants and their values are in the Report of Test with the manual.  Caution Follow the Calibration procedure exactly. The correct parameter settings are important to the safety and proper operation of the Product. The screen shows: • Bath Calibration is the date the Product was calibrated, see Calibration Procedure. • Do: This probe parameter refers to the temperature that the control probe output would be 0. Default is -25.229 and adjusts the zero point based on a calculation. • Dg: This probe parameter refers to the temperature span of the probe between 0 % and 100 % output. Default is 186.974 and is used to adjust the slope of the measured value based on a calculation. • Vernier: Default is 0.00000, used to fine tune the Bath temperature when at steady state.
F1 System Status	Push to return to the Setup Menu/System Status Submenu, see Figure 9 and Table 19 .

Table 19. Setup Menu/System Status Menu

Softkeys	Description
F1 Done	Push to escape the System Status submenu and save changes.
F2 Diagnostics	Push to view data about Product operation. The diagnostics indicators can be helpful when the Product is serviced and to troubleshoot issues. These items show under Diagnostics: • Heating is the relative size of the signal that controls the heating devices. • Cutout Code indicates the specific cause of a cutout event. This number is normally 0. • Remote Error shows the latest error message if any occurred at the time of remote operation. See the Setup Menu/Diagnostics/Cooling Submenu in Figure 10 and Table 20.
F3 FW Update	Push to get the latest Product firmware. A valid firmware update file must be stored on the memory device plugged in to the USB host port.
F4 SW License	Push to view the software license.

Figure 10. Setup Menu/Diagnostic/Cooling Submenu

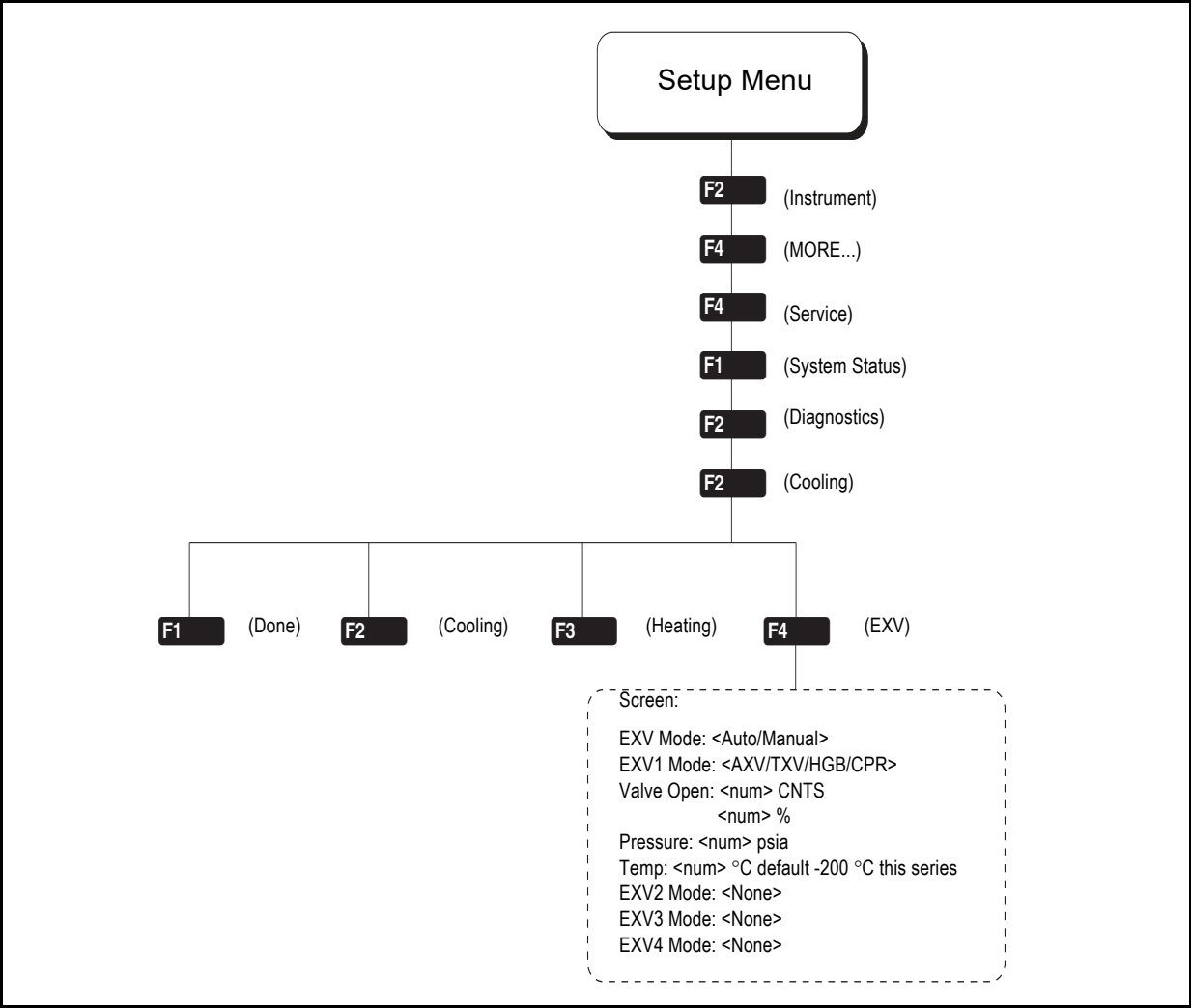


Table 20. Setup Menu/Diagnostic/Cooling Submenu

Softkeys	Description
F1 Done	Push to escape the Setup Menu/Diagnostic Submenu and save changes.
F2 Cooling	Push to see and adjust the cooling status (AUTO/ON/OFF). Normally, in AUTO, the user can turn the cooling ON or OFF when necessary. This can be useful for the service technician for test and evaluation. If the Bath temperature is >60 degrees, cooling override turns off after 5 minutes to avoid damage to the compressor.
F3 Heating	Push to see and adjust the heating status (AUTO/ON/OFF). Use to override the heating system to Turn HIGH HEAT ON or to turn HIGH HEAT OFF. It has no impact on the 500 W heater used for general control. This can be useful for the service technician for test and evaluation.
F4 EXV	Push to see or set EXV (Electronically Controlled Valve) settings. From here, you can: - Set the EXV to Auto or Manual. - Reads the EXV1 Mode to Automatic Expansion Valve (AXV), Thermal Expansion Valve (TXV), Hot Gas Bypass (HGB), or Crankcase Pressure Regulator (CPR). - Valve Open indicates the number of counts that the valve is from Full Open (0 to 500 steps). Counts may be changed by user when in Manual Mode. - Read Pressure in psia. - Read the Temperature If additional valves are necessary, use the subsequent valve notations. In this series, only 1 valve is used, and it is always referred to as AXV. These indicate EXV2: NONE, which means that it is not seen by the main controller. - EXV2 Mode - EXV3 Mode - EXV4 Mode

Bath Temperature

The Bath temperature is user selectable within the unit temperature range. The temperature units are selectable in °C or °F, and the resolution of the measured value is also user selectable in two places or three decimal places (0.0x/0.00x). The temperature can be calibrated for better accuracy with a two-point calibration formula, and for very small trim adjustments there is a vernier adjustment that is also user accessible.

The temperature control has two cutout types in these products. The first is the hard cutout and is a safety feature of the instrument. It is factory set, usually about 15 °C above the maximum temperature setting and is necessary in the event of a product component failure. The second type of cutout is a soft cutout and is user selectable. The soft cutout is a firmware cutout and is generally set to about 5 °C above the maximum unit temperature by default. This cutout can limit the heating of the instrument to lower values, for example when a fluid with a low flash point, like Ethanol is used, this soft cutout can be set to just above room temperature. If a heat-sensitive test piece is in the Bath, the soft cutout can be used to limit the temperature to not harm the test piece. The subsequent sections describe specifics of these features.

Temperature Setpoint

Set the Bath temperature to any value within the range as given in the specifications with a high degree of resolution. You must know the temperature range of the particular bath fluid and only use the Bath well below the upper temperature limit of the fluid. Additionally, set the soft cutout temperature to below the upper limit of the fluid.

To set the Bath temperature:

1. Push **SETPOINT** to enter the setpoint.
2. Enter a new temperature or push **SELECT ENTER** to use the existing temperature setpoint to engage the system.

Programmable Setpoints

The controller stores eight setpoint temperatures into memory. Quickly recall these setpoints to set the Bath to a previously-programmed temperature setpoints.

To set the Bath temperature:

1. Push **SETPOINT** to enter the setpoint.
2. Enter a new temperature or push **SELECT ENTER** to use the existing temperature setpoint to engage the system, for example:

25.00 C *Bath temperature in degrees Celsius*

To set a programmable setpoint:

1. Push **SETPOINT** to enter the setpoint.
2. Push **F2** (**Presets**) and select preset 1.
3. Push **F2** (**Edit**) and edit the preset value.
4. Push **F1** (**Done**).

Setpoint Value

After you select the setpoint memory and push **F2** (**Edit**), adjust the setpoint value in increments of 0.01 ° or 0.001 ° (C or F) depending on the resolution setting. The setpoint value shows the temperature units at the right, for example:

C 40.00 *Setpoint 4 value in °C*

To enter a setpoint value, push **SELECT ENTER** or **F1** (**Done**) to engage the system to the setpoint, or push **MONITOR** or **SETUP** to exit without engaging the system.

Setpoint Vernier

The setpoint value can only be set with a resolution of 0.01 or 0.001, depending on the resolution setting. Use the setpoint vernier to fine tune the temperature slightly below or above the setpoint by small amounts with high resolution.

To access the vernier setting, push **SETUP** > **F2** (**Instrument**) > **F4** (**MORE...**) > **F4** (**Service**) > **F3** (**Calibration**), see [Figure 8](#) and [Table 18](#).

Temperature Scale Units

Set the Product to show all temperature scale units to degrees Celsius (°C) or Fahrenheit (°F).

To change the temperature to degrees Fahrenheit or degrees Celsius:

1. Push **SETUP**.
2. Push **F1** (**Operation**).
3. Push **F2** (°C or °F).
4. Push **MONITOR** to see units in the selected measurement unit.

Note

In some regions, the Product may not have this option.

Heater Power

The temperature Controller pulses the heater on and off to control Bath temperature. The total power applied to the heater is determined by the duty cycle or ratio of heater on time to the pulse cycle time. Watch the display to see the duty cycle percentage. The heating amount, once known, can tell the user if the Bath heats up to the setpoint, cools down, or controls at a constant temperature.

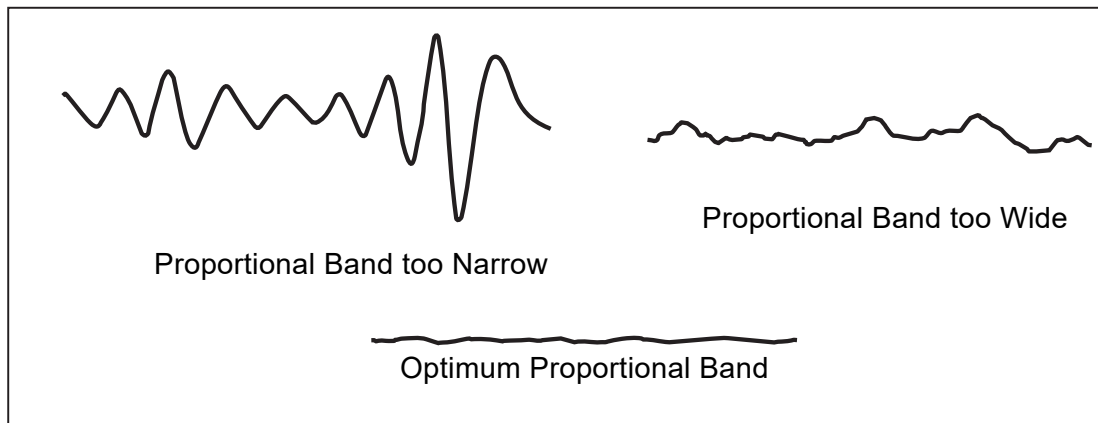
Heater power shows on the display at all times.

Proportional Band

In a proportional controller like the Product heater, heater output power is proportional to the Bath temperature over a limited range of temperatures around the setpoint. This temperature range is the *proportional band*. At the bottom of the proportional band, heater output is 100 %. At the top of the proportional band, heater output is 0 %. As the Bath temperature rises above the setpoint, heater power reduces, which usually lowers the temperature. These actions maintain a fairly-constant temperature.

Temperature stability of the Bath depends on the width of the proportional band, see [Figure 11](#). If the band is too wide, the Bath temperature deviates excessively from the setpoint due to varying external conditions. This is because the power output changes a minor amount with temperature, and the controller does not respond well to changing conditions or noise in the system. If the proportional band is too narrow, Bath temperature can oscillate because the controller overreacts to temperature variations. For best control stability, the proportional band must be set for optimum width.

Figure 11. Bath Temperature Fluctuations at Various Proportional Band Settings



Optimum proportional band width depends on factors that include:

- fluid volume
- fluid characteristics (viscosity, specific heat, thermal conductivity)
- heater power setting
- operating temperature
- stirring

The proportional band width can require adjustment for best Bath stability when any of these conditions change. Of these conditions, the most significant factors that affect the optimum proportional band are heater power setting and fluid viscosity. The proportional band should be wider when you use the higher power setting so that the change in output power per change in temperature remains the same.

Easily adjust the proportional band from the front panel. You can set the width to discrete values in the selected temperature units. Monitor the stability with a high-resolution thermometer or with the controller percent output power display to determine the optimum proportional band setting. Narrow the proportional band to the point where the temperature begins to oscillate and then increase the band width from this point to 3 or 4 times wider. [Table 21](#) lists typical proportional band settings for optimum performance with a variety of fluids at selected temperatures.

Table 21. Proportional Band - Fluid Table

Fluid	Temperature	Proportional Band	Expected Stability
Water	30.0 °C	0.061 °C	±0.001 °C
Water	60.0 °C	0.061 °C	±0.001 °C
Eth-Gly 50 %	35.0 °C	0.10 °C	±0.001 °C
Eth-Gly 50 %	60.0 °C	0.10 °C	±0.001 °C
Eth-Gly 50 %	100.0 °C	0.10 °C	±0.007 °C
Oil	35.0 °C	0.20 °C	±0.003 °C
Oil	60.0 °C	0.30 °C	±0.002 °C
Oil	100 °C	0.30 °C	±0.003 °C

Note

For expected stability, see the specific model specification in the Product Specifications at www.fluke.com.

Cutout

The Bath has an adjustable heater cutout device that shuts off heater power if the Bath temperature exceeds a set value. The cutout protects against software or hardware fault, shorted heater triac, or user error while it also protects the heater and Bath materials from excessive temperatures. Most importantly, the cutout keeps Bath fluids from heating beyond safe operating temperatures. This prevents hazardous vaporization, breakdown, or ignition of the fluid. Soft cutout temperature is programmable by the operator from the front panel. Always set the soft cutout below the upper temperature limit of the fluid and no more than 5 degrees above the upper temperature limit of the Bath.

If the cutout activates due to excessive Bath temperature, then power to the heater and compressor shuts off, and the Bath cools until it reaches a few degrees below the cutout set-point temperature. At this point, the Product can be re-enabled.

Bath Calibration Menu

Refer to [Figure 8](#) and [Table 18](#) for this section.

Calibration Parameters

The Bath controller gives access to these Bath calibration constants, see [Figure 8](#) and [Table 18](#).

These values are factory-set and must not be altered. Only adjust these parameters if the controller memory fails to restore these values to the factory settings. A list of these constants and their values are in the Report of Test with the manual.

Caution

Follow the Calibration procedure exactly. The correct parameter settings are important to the safety and proper operation of the Product.

Hard Cutout

The factory-set parameter, CTO, sets the calibration of the over-temperature hard cutout. Adjust CTO with an internal potentiometer. These instruments are set to approximately 125 °C at the factory.

Hard Cutout Test

Because the soft cutout is always set to a lower temperature than the hard cutout, there is a serial command that can turn off the soft cutout to specifically test the hard cutout. Use SOUR:CUT:MODE 0. Set this command to 1 or power cycle the Bath to re-enable the soft cutout.

Warning

To prevent personal injury, fire, or damage to the Product, do not change these values from the factory settings.

Digital Communication Interface

The Product can connect to a computer, communicate with, and be controlled by other equipment through the RS-232 serial interface or USB interface options. Use the remote communication equipment to:

- Set Bath temperature
- Monitor the temperature
- Access all controller functions

Serial Communications

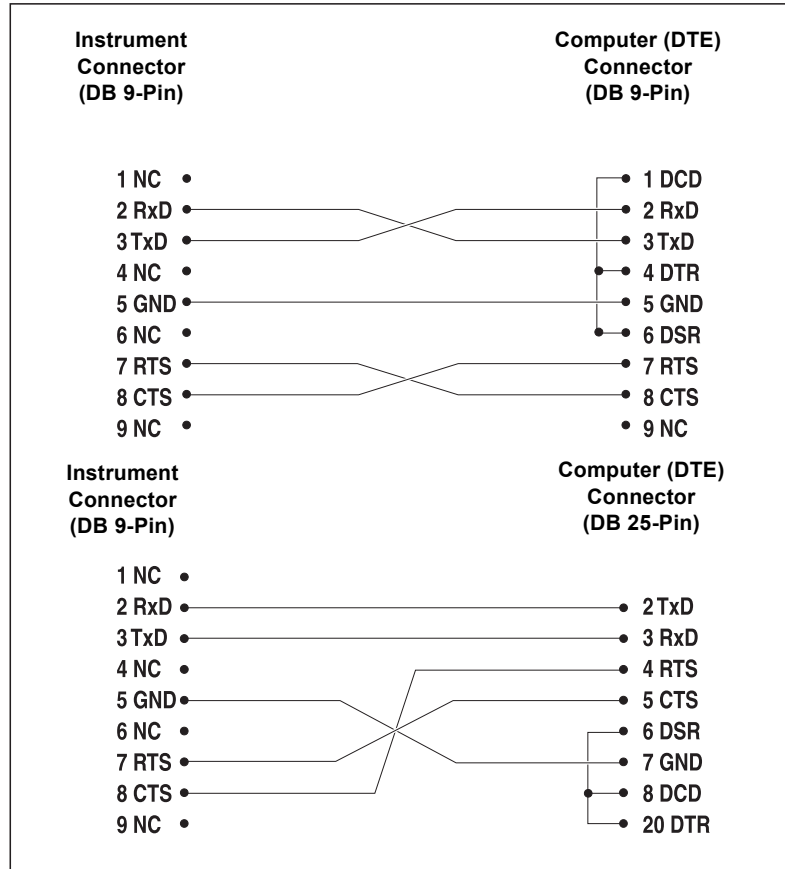
The RS-232 serial interface and USB serial interface allows serial digital communications over fairly-long distances (15.24 m). The serial interface can access any of the Controller functions, parameters, and settings discussed in [Controller Operation](#), with the exception of the BAUD Rate parameter. The serial interface operates with 8 data bits, 1 stop bit, and no parity.

When the serial monitor is set to on, once the cable has been attached and the interface set up properly, the Product immediately starts to transmit temperature readings at the programmed rate. With the serial interface, the setpoint and other commands can be sent to the Product you can set the Bath and view or program various Product parameters. All commands are ASCII character strings terminated with a carriage-return character (CR, ASCII 13), see [Interface Commands](#).

Wiring

The RS-232 serial communications cable attaches to the Product through the DB-9 connector on the rear panel. [Figure 12](#) shows the connector pin-out and suggested cable wiring. To eliminate noise, the serial cable should be shielded with low resistance between the connector (DB-9) and the shield.

Figure 12. RS-232 Cable Wiring for IBM PC and Compatibles



Setup

The Product BAUD rate and other configuration parameters must be programmed before Product serial interface use. Program these parameters from the Serial Interface menu.

Use this path **SETUP** > **F2** (Instrument) > **F3** (Remote) to enter the serial parameter program mode.

The serial interface parameters menu contains parameters that determine serial interface operation:

- BAUD rate
- Termination
- Serial Monitor

BAUD Rate

BAUD rate is the first parameter in the Serial Interface Parameter menu. The BAUD rate setting determines the serial communications transmission rate. Program the Bath BAUD rate RS-232 serial communications to 2400, 4800, 9600, 17.2 K, 34.4 K BAUD. Use this path **SETUP** > **F2** (Instrument) > **F3** (Remote) to enter the BAUD Rate menu.

Serial Termination

The serial termination parameter lets you select the command string termination using **CR**, **LF** or **CR/LF** for each communications command or string.

Serial Monitor

The serial monitor starts or stops the control temperature output through the USB or RS-232 connection.

If the serial monitor is ON, the Instrument outputs the control sensor temperature at a constant specified output frequency with the RS-232 or the USB connection. If the serial monitor is OFF, output is terminated.

Interface Commands

The various commands that access the Bath controller functions from the digital interfaces are in [Table 22](#). All commands are ASCII character strings terminated with a carriage-return character (CR, ASCII 13). Use the commands with the RS-232 serial interface or the USB serial interface. The interface makes no distinction between upper and lower case letters, use either. Abbreviate commands to the minimum number of letters that determine a unique command. Use a command to set or show a parameter, depending on whether or not a value is sent with the command following a = character string. For example, **SOUR:SPO?** <CR> returns the current setpoint and **SOUR:SPO 50** <CR> sets the setpoint to 50.00 degrees.

In the list of commands, characters or data within brackets, [and], are optional for the command. Do not include the brackets in the serial string. A slash, /, denotes alternate characters or data. Numeric data, **n**, can be entered in decimal or exponential notation. Characters are shown in lower case although upper case can be used. Spaces can be added within command strings but are ignored. Use backspace (BS, ASCII 8) to erase the previous character. A terminating CR is implied with all commands.

Table 22. Interface Command Summary

Command	Protection	Description
*CLS	N/A	Clear the status registers and error queue.
*ESE <n> DEFault *ESE?	N/A	Set the Event Status Enable Register. This register determines which bits of the Standard Event Status Register are summarized in bit 5 of the Status Byte Register, see *ESR? and *STB?. <n> is a numeric value. Range: {0 – 255} Default: 0
*ESR?	N/A	Read and clear the Standard Event Status Register. The response is an integer ranging from 0 to 255, which is the decimal representation of the 8 bits of the register, see IEEE 488.2. Bit 0: Operation complete. Bit 3: Device-specific error. Bit 4: Execution error. Bit 5: Command error. Bit 7: Power on. Bits are set when the corresponding events occur. The register is reset to 0 after it is read.
*IDN?	N/A	Read the product information.
*OPC *OPC?	N/A	Operation complete.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
*RST	N/A	Reset operational settings to defaults: Control disabled, see OUTPut:STATe Setpoint 25.0 °C / 77 °F (SOURce:SPOint) Control sensor Internal (SOURce:SENSe:ROUTe) Ramp enable OFF (SOURce:RAMP:ENABLE) Stability beep ON (SOURce:STABility:BEEPer) Stability window 0.05 °C / 0.09 °F (SOURce:STABility:LIMit) Program stopped (PROGram:STATe)
*SRE <n> DEFault *SRE?	N/A	Read or set the Service Request Enable Register. This register determines which bits of the Status Byte Register are summarized in bit 6 of the Status Byte Register (*STB?). <n> is a numeric value. Range: {0 – 255} Default: 0
*STB?	N/A	Read the Status Byte Register. The response is an integer ranging from 0 to 255, which is the decimal representation of the 8 bits of the register. Bits summarize enabled bits of status registers as explained in IEEE 488.2 and SCPI. Bit 2: The error queue contains one or more error messages, see SYSTem:ERRor?. Bit 3: An unmasked bit of the Questionable Status Event Register is asserted, see STATus:QUEStionable? and STATus:QUEStionable:ENABLE. Bit 5: An unmasked bit of the Standard Event Status Register is asserted, see *ESR? and *ESE. Bit 6: An unmasked bit of the Status Byte Register is asserted, see also *SRE. Bit 7: An unmasked bit of the Operation Status Event Register is asserted, see STATus:OPERation? and STATus:OPERation:ENABLE.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
*TST?	N/A	Read the self-test result. The response is 0. (Provided for compatibility.)
*VER	N/A	Read product Version
*WAI	N/A	Wait to continue.
CALibration:DATE[:UNIT] <year>,<month>,<day> CALibration:DATE[:UNIT]?	prot	Set the control sensor calibration date. <year>,<month>,<day> are the numbers of the year, month, and day. Year range: {2000 – 2099} Month range: {1 – 12} Day range: {1 – 31}
CALCulate:AVERage:CLEar	N/A	Clear the average and standard deviation of the control temperature, reference reading, and DUT reading.
CALCulate:AVERage:WINDow <n> CALCulate:AVERage:WINDow?	N/A	Set the statistics time window. <n> is the time in seconds. Range: {10, 60, 300} Default: 10
CALCulate1:AVERage[:AVERage]?	N/A	Read the reference reading moving average. The temperature scale of temperature readings is °C or °F depending on the Temperature Unit setting. Resolution: 0.0001
CALCulate1:AVERage:SDEViation?	N/A	Read the reference reading standard deviation. The temperature scale of temperature readings is °C or °F depending on the Temperature Unit setting. Resolution: 0.0001

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
DISPlay:BRIGhtness <n> DISPlay:BRIGhtness?	N/A	Set the display brightness. <n> is the fractional brightness. The given number is rounded to the nearest discrete value. Range: {0.4, 0.7, 1.0} Default: 1.0
DISPlay:DATE:FORMat `` '<format>' ' DISPlay:DATE:FORMat?	N/A	Set the date format for the graphical user interface. <format> is a text string representing the format. Range: {"MM-DD-YYYY", "DD.MM.YYYY", "DD/MM/YYYY", "YYYY/MM/DD", "YYYY-MM-DD"} Default: "YYYY-MM-DD"
DISPlay:DECimal:FORMat <boolean> DISPlay:DECimal:FORMat?	N/A	Set the decimal format for the graphical user interface. <boolean> is 1 (comma, ',') or 0 (period, '.'). Default: 0 (period).
DISPlay:LANGuage <language> DISPlay:LANGuage?	N/A	Set the language for the graphical user interface. <language> is one of the following: Range: {ENGLISH, FRENCH, GERMAN, SPANISH, PORTUGUESE, RUSSIAN, CHINESE, KOREAN, JAPANESE} Default: ENGLISH
DISPlay:LANGuage:CATalog?	N/A	Read the list of available languages. The response is a list of character strings separated by commas: ENGLISH,CHINESE,SPANISH,FRENCH,GERMAN,RUSSIAN,JAPANESE,KOREAN,PORTUGUESE

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
DISPlay:SAVer <n> DISPlay:SAVer?	N/A	Set the screen saver time. <n> is the time in minutes. A value of 0 disables the screen saver. Range: {0, 10, 30, 60} Default: 0
DISPlay:TEMPerature:DIGits <n> DISPlay:TEMPerature:DIGits?	N/A	Set the resolution for temperature readings on the display. <n> is the number of decimal places. Range: {2, 3} Default: 2
DISPlay:TIME:FORMat 12 24 DISPlay:TIME:FORMat?	N/A	Set the time format for the shown clock. Default: 24
FETCh?	N/A	Read the Control Sensor probe temperature. The response is temperature in units according to the system temperature unit setting, °C or °F.
INITiate	N/A	No action. (Provided for compatibility)
INITiate:CONTinuous 1 INITiate:CONTinuous?	N/A	Read the trigger state. The response is 1. (Provided for compatibility)
OUTPut:DATA?	N/A	Read the control heating output. The response the heating amount in percent. A negative number indicates cooling. Resolution is 0.1.
OUTPut:STATe <boolean> DEFAULT OUTPut:STATe?	N/A	Set the control enable. <boolean> is 1 or 0 (ON or OFF). 1 enables heating, cooling, and control. 0 disables the system. Default: 0

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
<pre> PROGram[:SElected]:DEFine " '<name>' ' [, <n>...] PROGram[:SElected]:DEFine? </pre>	cond	Create a new program. Equivalent to the command PROG:EXPL:DEF. <name> is a character string consisting of 1 to 14 characters. Character range: {'0' – '9', 'A' – 'Z', 'a' – 'z', '-', '.', '/', '_}' The name must be different from any existing program, otherwise error -282, <i>Illegal program name</i>, is reported. <n> are values of program parameters. If values are omitted, default values are stored. Parameters are as followings: <pre> <CYCL> ,<ORD> ,<DWEL> ,<RRAT> ,<RREN> ,<POIN> ,<SPO1> [, <SPO2>...] </pre> See command PROG:SEL:NUMB for ranges and defaults of parameters. The new program is selected as the active program, see PROG:SEL:NAME. The query command returns the parameter values of the selected program.
<pre> PROGram[:SElected]:NAME " '<name>' ' PROGram[:SElected]:NAME? </pre>	N/A	Select a program for editing and execution. <name> is a character string matching the name of an existing program. If no program exists with the given name, error -282, <i>Illegal program name</i>, is reported.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
PROGrama[:SElected]:NUMBer <variable>,<n> DEFault MINimum MAXimum PROGrama[:SElected]:NUMBer? <variable>	cond	Set a parameter of the selected program. The program is previously selected by the command PROG:SEL:NAME or PROG:SEL:DEF. If a program has not been selected, error -282, <i>Illegal program name</i>, is reported. <variable> is the name of the program variable. If the variable name is invalid, error -283, <i>Illegal variable name</i>, is reported. <n> is the value of the program variable. Program variable names, ranges, and defaults are: CYCL: {1 – 99}, 1 ORD: {0 (Linear), 1 (Up/Down)}, 0 DWEL: {1 – 900}, 10 RRAT: {0.01 – 5.0}, 1.0 RREN: {0, 1}, 0 POIN: {1, 8}, 1 SPO<n>: {<MIN> – <MAX>}, 25.0 The value of RRAT (ramp rate) has unit °C/min. or °F/min depending on the system unit setting. The value of TOL (Pass Tolerance) has unit °C or °F depending on the system unit setting. The values of SPO<n> (setpoints) have unit °C or °F depending on the system unit setting. The minimum and maximum value are model dependent, see command SOUR:SPO.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
PROGram[:SElected]:STATe RUN PAUSE CONTinue STOP 0 1 PROGram[:SElected]:STATe?	N/A	Change the execution state of the selected program. The program is previously selected by the command PROG:SEL:NAME or PROG:SEL:DEF. If a program has not been selected, error -282, <i>Illegal program name</i>, is reported. A program can be in three states: STOPPED, RUNNING, or PAUSED. If a program is STOPPED, send the parameter RUN to change its state to RUNNING. If a program is RUNNING, send PAUSE to change its state to PAUSED or send STOP to change its state to STOPPED. If a program is PAUSED its state can be changed to RUNNING by sending CONT or STOPPED by sending STOP. Parameter value 0 is equivalent to STOP. 1 is equivalent to RUN. If the requested action is not allowed from the present state, error -221, <i>Settings conflict</i> is reported. The query command returns the state of program execution. Possible responses are RUNNING, PAUSED, or STOPPED.
PROGram:BEEP <boolean> DEF PROGram:BEEP?	cond	Enable program beep. Default: 1
PROGram:CATalog?	N/A	Read a list of all defined programs. The response is a series of program names separated by commas.
PROGram:DELeTe:ALL	prot	Delete all programs. All programs are deleted except one, which is replaced with the default program.
PROGram:EXPLicit:DEFine " '<name>' '[,<n>...] PROGram:EXPLicit:DEFine?	cond	Equivalent to the command PROG:SEL:DEF.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
PROGram:EXPLicit:DELeTe `` '<name>' '	cond	Delete a program. <name> is a character string that matches the name of an existing program. If no program exists with the given name, error -282, <i>Illegal program name</i> , is reported. If the specified program is the only defined program, it is replaced by the default program.
PROGram:EXPLicit:EXECute `` '<name>' '	N/A	Execute a program. <name> is a character string matching the name of an existing program. If no program exists with the given name, error -282, <i>Illegal program name</i> is reported. The program state must be STOPPED or PAUSED, otherwise error -284, <i>Program currently running</i> is reported.
READ?	N/A	Equivalent to FETCh?
[SOURce:]CUTout:CLEar	N/A	Reset the cutout condition and event. The cutout can only be reset if the fluid temperature is below the cutout temperature ([SOURce:]CUTout:STATe? is 0). Otherwise an execution error is produced. The command clears the cutout event, see [SOURce:]CUT:EVENT?.
[SOURce:]CUTout:EVENT?	N/A	Read the latest cutout event. The response is an event code number: 0: no event 1: software cutout tripped 2: hardware cutout tripped The cutout event memory is reset when the cutout is cleared, see [SOURce:]CUTout:CLEar or temperature control is disabled (OUTPut:STATe 0).
[SOURce:]CUTout:LEVel <n> DEFault [SOURce:]CUTout:LEVel?	cond	Set the temperature cutout setpoint. <n> is the cutout setpoint in °C or °F depending on the system unit setting. The range and default depends on the model.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
[SOURce:]CUTout:STATe?	N/A	Read the cutout tripped state. The response is 0 (normal) or 1 (tripped).
SOURce:HCUTout:LEVel?	N/A	Read the Hard cutout Temperature.
[SOURce:]LCONstants:PBAND <n> DEFault [SOURce:]LCONstants:PBAND?	prot	Set the control loop proportional band. <n> is the proportional band in °C. The range and default depends on the model.
SOURce:SENSe[1]:CALibration:R0 n DEFault SOURce:SENSe[1]:CALibration:R0?	prot	Used when RTD is used as the control Probe. Set the accuracy adjustment of the internal control sensor R0 value in W, at 0°C. <n> is the ohms adjustment at 0°C (regardless of the system unit setting). Range: {90.0 – 110.0} Default: 100.578 Resolution: 0.001
SOURce:SENSe[1]:CALibration:ALPh a n DEFault SOURce:SENSe[1]:CALibration:ALPh a?	prot	Set the slope adjustment of the internal control sensor ALPHA in W, over Sensor Range °C. <n> is the ohms adjustment for the slope over the probe range (regardless of the system unit setting). Range: {0.0 – 9.9999999} Default: 0.0038573 Resolution: 0.0000001
SOURce:SENSe[1]:CALibration:DO n DEFault SOURce:SENSe[1]:CALibration:DO?	prot	Used when thermistor is used as the control probe. Set the accuracy adjustment of the internal control sensor D0 value at 0°C. Like R0 in RTD system. <n> is the adjustment at 0°C (regardless of the system unit setting). Range: {-999.9999 – 999.9999} Default: -25.2290 Resolution: 0.0001

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
SOURce:SENSe[1]:CALibration:Dg n DEFault SOURce:SENSe[1]:CALibration:Dg?	prot	Set the slope adjustment of the internal control sensor Dg over Sensor Range °C. Like ALPHA in a RTD system. <n> is the adjustment for the slope over the probe range (regardless of the system unit setting). Range: {-999.9999 – 999.9999} Default: 186.9740 Resolution: 0.0001
SOURce:SENSe[1]:AVERage[:AVERage]?	N/A	Read the internal control sensor temperature moving average. The response is temperature in °C or °F depending on the system unit setting. Resolution: 0.0001
SOURce:SENSe[1]:AVERage:SDEVIation?	N/A	Read the internal control sensor temperature standard deviation. The response is temperature in °C or °F depending on the system unit setting. Resolution: 0.0001
SOURce:SENSe[1]:DATA? [TEMPerature]	N/A	Read the internal control sensor temperature. The response is temperature in °C or °F depending on the system unit setting. Resolution: 0.001

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
[SOURce:]SPoint <n> DEFault MINimum MAXimum [SOURce:]SPoint? [MINimum MAXimum]	N/A	Set the control setpoint. <n> is the setpoint temperature in °C or °F depending on the system unit setting. Resolution is 0.001. Range and default are: Bath, °C: {-*tl – *th}, 25.0 Bath, °F: {-*tl – *th}, 77.0 Resolution: 0.001 For the product to control at the setpoint, control must be enabled, see command OUTP:STAT.
[SOURce:]SPoint:DEFine<index> <n> DEFault MINimum MAXimum [SOURce:]SPoint:DEFine<index>?	N/A	Set the temperature of a preset setpoint. <index> is the preset index, ranging from 1 to 8. <n> is the setpoint temperature in °C or °F depending on the system unit. The range and default depends on the model, see command SOUR:SPO.
[SOURce:]SPoint:SElect <index>	N/A	Set the control setpoint from a preset. <index> is the preset index, ranging from 1 to 8.
[SOURce:]STABility:BEEPer <boolean> [SOURce:]STABility:BEEPer?	N/A	Set the stability beeper enable. <boolean> is 1 (ON) or 0 (OFF). Default: 1 (ON)
[SOURce:]STABility:CONDition?	N/A	Read the stability indicator. The response is 1 (stable) or 0 (unsettled).
[SOURce:]STABility:DATA?	N/A	Read the control stability measure. The response is the measured variability of the output temperature in °C or °F depending on the system unit setting.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
[Source:]STABility:LIMit <n> DEFault [Source:]STABility:LIMit?	cond	Set the stability limit for the stability indicator. <n> is the limit of temperature variability in °C or °F depending on the system unit setting. °C range: {0.001 – 5.0} °F range: {0.002 – 9.0} °C default: 0.05 °F default: 0.09
STATus:OPERation[:EVENT]?	N/A	Read and clear the Operation Event Register. This command can be used to ensure that the latest reading is only queried once. The register is reset to 0 when STATus:OPERation?, MEASure? or *CLS is received. The register is set to 16 when a new reading is completed.
STATus:OPERation:CONDition?	N/A	Read the Operation Condition Register. (Basic model) The response is 0 indicating that measuring is not active.
STATus:OPERation:ENABle <n> STATus:OPERation:ENABle?	N/A	Set the Operation Status Enable Register. This register determines which bits of the Operation Event Register are summarized in bit 7 of the Status Byte Register, see STATus:OPERation? and *STB?. <n> is a positive integer ranging from 0 to 255. The register always reverts to 0 at power on.
STATus:PRESet	N/A	Configure the status system with default settings.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
STATus:QUESTionable[:EVENT]?	N/A	Read and clear the Questionable Event Register. The response indicates whether an out-of-range reading occurred. (Standard model) The response is 0.
STATus:QUESTionable:CONDition?	N/A	Read the Questionable Condition Register. (Basic model) The response is 0.
STATus:QUESTionable:ENABle <n> STATus:QUESTionable:ENABle?	N/A	Set the Questionable Status Enable Register. <n> is a positive integer ranging from 0 to 255. This register determines which bits of the Questionable Event Register are summarized in bit 3 of the Status Byte Register, see STATus:QUESTionable? and *STB?. The register always reverts to 0 at power on.
SYSTem:BEEPer:IMMediate	N/A	Beep the beeper
SYSTem:BEEPer:KEY <boolean> DEFault SYSTem:BEEPer:KEY?	N/A	Set the key beeper enable. <boolean> is 1 (ON) or 0 (OFF). Default: 1 (ON).
SYSTem:CODE:VERSion?	N/A	Read the firmware version. The response is a comma separated list of version numbers of the primary (out-guard) application, secondary (in-guard) firmware, operating system kernel, and framework library (QT).

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
SYSTem:COMMunicate:SERIal:BAUD <baud> SYSTem:COMMunicate:SERIal:BAUD?	N/A	Set serial interface baud rate. <baud> is the frequency in bits per second. Range: {1200, 2400, 4800, 9600, 19200, 38400} Default: 9600
SYSTem:COMMunicate:SERIal:EOL LF CR CRLF SYSTem:COMMunicate:SERIal:EOL?	N/A	Set the line terminator. Default: CRLF
SYSTem:COMMunicate:SERIal:FEED <boolean> SYSTem:COMMunicate:SERIal:FEED?	N/A	Enable automatic printing of the output temperature, reference temperature, and DUT temperature. <boolean> is 1 (ON) or 0 (OFF). Default: 0 (OFF). The setting always reverts to OFF at power on. Data is printed once per second. Temperatures are printed in unit of °C or °F depending on the system unit setting.
SYSTem:COMMunicate:SERIal:LINefe ed <boolean> SYSTem:COMMunicate:SERIal:LINefe ed?	N/A	Enable CR/LF terminator. <boolean> is 1 (ON) or 0 (OFF). This command is provided for backwards compatibility. This command is coupled with SYSTem:COMMunicate:SERIal:EOL. 0 (OFF) sets the terminator to CR. 1 (ON) sets the terminator to CRLF. The query returns 0 if the terminator is CR and 1 otherwise.

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
SYSTem:DATE <year>,<month>,<day> SYSTem:DATE?	cond	Set the date of the internal real-time clock. <year>,<month>,<day> are the numbers of the year, month, and day. Year range: {2000 – 2099} Month range: {1 – 12} Day range: {1 – 31}
SYSTem:ERRor[:NEXT]?	N/A	Read the most recent error from the error queue. The error queue is cleared when power is switched off.
SYSTem:KLOCK <boolean> SYSTem:KLOCK?	N/A	Lock the front panel keys. <boolean> is 1 (locked) or 0 (unlocked). Default: 0 (unlocked) The state always reverts to unlocked at power on.
SYSTem:PASSword:CDISable [<password>]	N/A	Disable access to password protected setting commands. <password> is optional, but if supplied it must match the user password.
SYSTem:PASSword[:CENable] <password>	N/A	Enable password protected setting commands. <password> is the four-digit User password or service password. (Password protected command are identified with <i>prot</i> or <i>cond</i> in the Protected column of the table.)
SYSTem:PASSword:CENable:STATe?	N/A	Read the access state of password protected commands. The response is 1 if protected commands are unlocked or 0 if commands are locked.
SYSTem:PASSword:NEW <password> DEFault	prot	Set a new password. <password> is a four-digit positive integer. Range: {0000 – 9999} Default: 1234

Table 22. Interface Command Summary (cont.)

Command	Protection	Description
SYSTem:PASSword:PROTectiOn <boolean> SYSTem:PASSword:PROTectiOn?	prot	Set the password protection level. <boolean> is 0 (low) or 1 (high). Default: 0 (low)
SYSTem:TIME <hour>,<minute>,<second> SYSTem:TIME?	cond	Set the time of the internal real-time clock. <hour>,<minute>,<second> are the numbers of the hour, minute, and second in 24-hour time. Hour range: {0 – 23} Minute range: {0 – 59} Second range: {0 – 59}
SYSTem:VERSion?	N/A	Read the SCPI version number (1999.0)
UNIT:TEMPerature C CEL F FAR DEFault UNIT:TEMPerature?	cond	Set the system temperature unit setting. The temperature unit can be locked to °C by the UNIT:TEMP:LOCK command. In that case an error is reported if an attempt is made to set the unit to °F. Default: C

Power Control Functions

The digital interface can control the heating and cooling functions so that the Product can be remotely operated at any temperature within the range of the Bath.

Heater power and the cooling is available from the parameters section of the menu. An electronically controlled valve (EXV) is used to control cooling capacity.

Heater Control

The heater is controlled automatically and has a **High** and **Low** heat. The processor adjusts this heat depending on the setpoint temperature and the actual temperature - steady state operation or ramping in temperature. The high heat can be manually overridden from the user interface in the diagnostics section, see [Figure 10](#) and [Table 20](#).

Cooling Control

The microprocessor determines when to have the compressor ON, and what the pressure in the system should be and adjusts for it automatically.

Calibration Procedure

Note

Consider this procedure a general guideline. Each laboratory should write their own procedure based on their equipment and their quality program. Each procedure should have an uncertainty analysis based on the laboratory equipment and environment.

In some instances, it can be necessary to calibrate the Bath to improve the temperature setpoint accuracy. To calibrate, adjust the controller probe calibration constants Do and Dg so that the temperature of the Bath (measured with a modified thermometer) agrees more closely with the Bath setpoint. The thermometer used must be able to measure the bath fluid temperature with higher accuracy than the desired accuracy of the Bath. Use a good thermometer and carefully follow procedures to calibrate the Bath to an accuracy of better than 0.1 °C over a range of 50 degrees.

Calibration Points

When you calibrate the Bath, adjust Do and Dg to minimize the setpoint error at each of two different Bath temperatures. Use any two reasonably-separated Bath temperatures for the calibration. However, best results are obtained when you use Bath temperatures that are just within the most useful operating range of the Bath, see [Figure 8](#) and [Table 18](#).

Note

For best results, use temperature points >0 degrees C. The farther apart the calibration temperatures, the greater the calibrated temperature range, and the calibration error.

If, for example, 20 °C and 80 °C are chosen as the calibration temperatures, the Bath can achieve an accuracy of ± 0.2 °C over the range 20 °C to 80 °C. Choosing 30 °C and 70 °C allows the Bath to possibly have a better accuracy of ± 0.05 °C over the range 30 °C to 70 °C, but outside of that range, the accuracy may be only ± 0.5 °C.

Measure the Setpoint Error

The first step in the calibration procedure is to measure the temperature errors (including sign) at the two chosen calibration temperatures.

1. Set the Product to the lower setpoint, t_L .
2. Wait for the Product to reach the setpoint and allow 15 minutes to stabilize at that temperature.
3. Check the Product stability with the thermometer.
4. When both the Product and the thermometer have stabilized, measure the Bath temperature with the thermometer and compute the temperature error (the actual Bath temperature minus the setpoint temperature, err_L). For example, set the Product to 20 °C. The Bath reaches a measured temperature of 19.7 °C giving an error of -0.3 °C.
5. Set the Product for the upper setpoint, t_H , and after the Product stabilizes, measure the Bath temperature and compute the error, err_H . For example set the Product to 80 °C. If the thermometer measured 80.1 °C, this would mean an error of +0.1 °C.

Compute Do and Dg

Before you can compute the new Do and Dg values, you must know the current values. Access the Probe Calibration menu from the controller panel or inquire through the digital interface to find these values. Keep a record of these values in case they need to be restored in the future. To compute the new Do' and Dg' values, enter the old values for Do and Dg, the calibration temperature setpoints, t_L and t_H , and the temperature errors, err_L and err_H , into these equations,

$$Do' = \frac{err_L(t_H - Do) - err_H(t_L - Do)}{t_H - t_L} + Do$$

$$Dg' = \left[\frac{err_H - err_L}{t_H - t_L} + 1 \right] Dg$$

For example, if Do and Dg were previously set for -25.229 and 186.9740, respectively, and the data for t_L , t_H , err_L , and err_H were as given above, then the new values Do' and Dg' are computed as -25.831 and 188.20, respectively. Enter the new values for Do and Dg into the controller. Check the calibration by setting the temperature to t_L and t_H and measuring the errors again. Repeat the calibration procedure when necessary to further improve accuracy.

Calibration Example

The Bath is for use between 25 °C and 75 °C and it is necessary to calibrate the Bath as accurately as possible for operation within this range. The current values for Do and Dg are -25.229 and 186.374, respectively. The calibration points are chosen to be 25.00 °C and 75.00 °C. The measured Bath temperatures are 24.869 °C and 74.901 °C respectively. Refer to [Figure 13](#) to apply equations to the example data and to compute the new probe constants.

Figure 13. Calibration Example

$$Do = -25.229$$

$$Dg = 186.974$$

$$t_L = 25.00\text{ }^{\circ}\text{C}$$

$$\text{measured } t = 24.869\text{ }^{\circ}\text{C}$$

$$t_H = 75.00\text{ }^{\circ}\text{C}$$

$$\text{measured } t = 74.901\text{ }^{\circ}\text{C}$$

Compute errors,

$$\text{err}_L = 24.869 - 25.00\text{ }^{\circ}\text{C} = -0.131\text{ }^{\circ}\text{C}$$

$$\text{err}_H = 74.9014 - 75.00\text{ }^{\circ}\text{C} = -0.099\text{ }^{\circ}\text{C}$$

Compute Do ,

$$Do' = \left[\frac{(-0.131)(75.0 - (-25.229)) - (-0.099)(25.0 - (-25.229))}{75.0 - 25.0} \right] + (-25.229) = -25.392$$

Compute Dg ,

$$Dg' = \left[\frac{(-0.099) - (-0.131)}{75.0 - 25.0} + 1 \right] * 186.974 = 187.094$$

Maintenance

The Product uses a battery to maintain operation parameters. Regularly make sure that all operation and calibration parameters are accurate to ensure proper operation of the Bath, see [Drain the Bath](#).

Warning

To prevent possible electrical shock, fire, or personal injury, disconnect the mains power cord before Product service.

- If the mains power cord becomes damaged, replace it with a mains power cord of the appropriate gauge wire for the current of the Bath. If there are any questions, contact a Fluke Calibration service center, see [Safety Information](#).
- Do not use the Product for anything other than its intended purpose. Bath operation can be impaired or safety hazards can arise.

 Caution

To avoid Product damage:

- Do not operate the Product in dirty or dusty environments.
- Wipe the Product clean with a damp cloth and mild detergent. Do not use harsh chemicals on the surface which can damage the paint. Before you use another cleaning or decontamination method, except those recommended, check with a Fluke Calibration service center to make sure that the proposed method does not damage the equipment, see [Safety Information](#).
- The stirring motor must be clean to allow proper cooling. Normally, only the outside surfaces require any attention. If the inside of the motor becomes loaded with oily dust, blow it out with compressed air. Follow normal safety procedures when you use pressurized gases.
- Keep the Bath fluid level full. Changes in fluid level depend upon several factors specific to the conditions in which the Product is used. Check the Bath weekly and make adjustments as required.
- Keep the condenser coil clean.
- Check the fluid at least every month for the first year and regularly thereafter. This fluid check provides a baseline to know how the Product operates with clean, usable fluid. Once some fluids are compromised, fluid breakdown can occur rapidly. Pay particular attention to the viscosity of the fluid. A significant change in viscosity indicates that the fluid is contaminated, is in use outside of its temperature limits, contains ice particles, or is close to chemical breakdown. Heat transfer medium lifetime depends upon the type of medium and the conditions used. Once you gather this data, outline a specific maintenance schedule for the Product. See [General Operation](#) for more information about the different types of fluids used in the Product.
- Keep all applicable MSDS sheets for all fluids used in the Bath near the Product. For Bath fluid spills inside or on the Product, take the appropriate decontamination steps as outlined by the national safety council.
- Check the over-temperature cutout every 6 months to see that it works properly. To check and set the user-selected cutout, follow the directions in [Cutout](#). Set the Bath temperature higher than the cutout. Check to see that the display indicates that the temperature decreases.

 Warning

To prevent possible personal injury, or Product damage:

- When you check the over-temperature cutout, do not exceed Bath fluid temperature limits. To exceed the temperature limits of the Bath fluid could cause harm to the operator, lab, and Product.

- **With silicone oil, the Product requires periodic maintenance. Silicon oil condenses on the Product in normal operation due to the outgassing of the oil. How often and how long the Product operates at higher temperatures determines how often to do maintenance. Wipe down the oily areas of the Product with a mild degreaser. Do not spray the degreaser directly on the Product. Spray the degreaser on a cloth and wipe the Product down with the cloth. Repeat the process as necessary to keep the oil from collecting on the Product. If oil collects on the Product, it can run into the Bath and collect on the interior and cause internal damage that might affect the lifetime of the Product.**

Drain the Bath

The drain is on the rear of the Product, see [Figure 1](#). Turn the Drain Valve to drain the fluid. A drain elbow is supplied with the accessories to attach a drain tube to the drain valve.

Warning

To prevent possible personal injury:

- **Always use a container that can hold the entire load of fluid. Fluid volume for the 7508 and 7512 is 42.3966 liters (11.2 gallons). You must use an adequate size, heat-proof fluid container.**
- **Use safety equipment as appropriate.**

When you drain low viscosity fluids like water, drain the fluid at room temperature and use care for fluids that can have corrosive or damaging effects on the surrounding facility or equipment.

When you drain high viscosity fluids, the fluid should be of sufficiently low viscosity to drain efficiently. Some oils such as 710 silicone oil need to be heated to 80 °C to drain efficiently. Fluid viscosity affects how rapidly the fluid drains and how well the fluid flows off of the Bath walls.

Warning

To prevent possible personal injury, comply with local and national safety codes. Use personal protective equipment (approved rubber gloves, face protection, and flame-resistant clothes).

Replace the Controller Battery

The Product Controller uses a coin cell battery to support the non-volatile memory. If the Product is unable to save a new user-entered parameters through a power cycle, the coin cell battery (CR2032) must be replaced.

To test the battery:

1. Enter a new parameter (non-default value) into one of the parameter locations. For example, make the PBan = 0.125.
2. Turn Product power off and unplug the Product from mains power.
3. Wait at least 10 seconds and then plug power back in, and restart the Product. If the parameter has changed back to default values (PBan is no longer 0.125), it is likely that the coin cell battery is weak or dead.
4. Replace the battery.

To replace battery:

1. Turn off the Product and remove it from mains power.
The battery is located on the controller PCA inside the top cover in the electrical box.
2. Remove the 6 screws that hold the top electrical cover in place.
3. Remove the top electrical cover.
4. The coin cell battery is on a PCA located on the bottom of the box, near the front of the Instrument.
5. Replace the battery with a new CR2032 coin cell battery,
6. Reinstall the cover.
7. Replace the 6 screws.
8. Reconnect the Product to mains power,
9. Turn on the Product.
10. Make sure that the controller will hold a parameter change in the menu through a power cycle by repeating the test above.
11. If the Product fails the test, [Contact Fluke Calibration](#).

Controller Reset

Use the controller reset function if the controller malfunctions. There are 2 methods to reset the controller:

- Initiate reset with menu option **F4** (RESET Controller) in the Setup menu, see [Figure 6](#).
- Use the serial command *RST, see [Table 22](#).

Prior to RESET launch, record all parameters that you wish to save. Once launched, the existing parameters are replaced with factory default values. Old settings are replaced.

When the RESET is initiated, the Product disables itself, replaces parameter values, and power cycles the internal PCAs. This process can take a few minutes. The product remains disabled until the user goes in and re-enables the product with the new setpoint.

The process has four steps:

1. Cycle the power to the EXV controller. It then RESETs itself.
2. Update all variables to default values in the controller.
3. Cycle power to the controller.
4. Reread the new values back into the interpreter controller to verify reset variables.

To perform the RESET:

1. From the Setup Menu screen, go to **Setup>F2 (Instrument)>F4 (more)>F4 (Service)>F2 (memory)>Add F4 (Reset Controllers)**.
2. Or use Serial command: *RST

What to Expect From the RESET Action

There will be a user delay while the interpreter board controller updates all variables to the factory default values.

Note

Any new parameters that the user wants to keep should be recorded prior to this event and reinstalled after its completion.

The user delay is followed by a power cycle to the different internal PCAs. All of the variable changes are verified. The Product is reset to the default 23 °C control point and is then disabled.

This process takes a few minutes, with a momentary lapse in control data such as temperature updates and controller output status.

Parameters to be RESET, and the default condition

Interpreter Controller settings:

Disable unit

Reset soft cutout

Stability window to 0.05 °C

Enable stability beeper

Set point to 25 °C

Stop programs that are running

Clear monitor screen

Clear statics screen

Since all the **thermistor-based** operating variables are basically the same across all models, the controller settings can be reset to factory settings as follows:

En	0	Controller disabled
D0	d0 = -25.2290	d0 to Default
Dg	dg = 186.9740	dg to default
PBan	pr = 0.061	Pban to default
Units	u=c	Units to default
Vernier	v = 0.0000	Vernier to 0.000
Set Point	s = 25.0	SPO to default
Scan fcn	sc = off	Scan Fcn to OFF
Scan rate	sr = 1.0	Scan Rate to High Nominal
Reset Cut Mode	cm =reset	Reset the cutout Mode
Sampling	sa = 0	Set Sampling to 0 (off)
Cutout	c=115.0/r	Set Soft Cut to 115 / reset
Duplex	du = Half	This may be reset for the controller.
Linefeed	lf = ON	This may be reset for the controller.

Controller settings for the **RTD-based** machines can be factory reset as follows:

R0	r0 = 100.324	R0 to default
Alpha	al = 0.0038433	Alpha to default
C0	c0 = 0.0002	C0 to default
Cg	cg = 406.25	cg to default
PBan	pr = 0.061	PBan to default
Units	u=c	Units to C
Vernier	v = 0.0000	Vernier to 0.0000
Set Point	s = 25.0	SPO to 25.0
Scan fcn	sc = off	Scan Fcn OFF
Scan rate	sr = 1.0	Scan Rate to High Nominal
Reset Cut Mode	cm = Reset	Cutout Mode OFF
Sampling	sa = 0	Sampling to 0 (off)
Hgb	hgb = AUTO	HGB to Auto
Cutout	c=115.0/r	Set Soft Cut to 115 / reset
Duplex	du = half	This may be reset for the controller.
Linefeed	lf = ON	This may be reset for the controller.

Product Disposal

Dispose of the Product in a professional and environmentally sound manner:

- Delete personal data on the Product before disposal.
- Remove batteries that are not integrated into the electrical system before disposal and dispose of batteries separately.
- If this Product has an integral battery, put the entire Product in the electrical waste.

Troubleshooting

[Table 23](#) contains information to troubleshoot the Product. This information pertains to a number of Calibration Bath models and certain specifics may not pertain to your model.

If the Product appears to function abnormally, this section can help you find and solve the issue. If a problem arises, read this section carefully and attempt to understand and solve the problem. If the probe seems faulty or the problem cannot otherwise be solved, [Contact Fluke Calibration](#) for assistance. Make sure to have the model number and serial number of your Product available.

Table 23. Troubleshooting

Problem	Causes and Solutions
The heater duty cycle or power bar shows 100%, temperature does not increase.	The display does not show cutout or show an incorrect temperature, but the controller otherwise appears to operate normally. The problem can be either insufficient heating, no heating at all, or too much cooling. • The heater power setting is too low, especially at higher operating temperatures. • One or more burned out heaters can also cause this problem. If the heaters seem to be burned out, Contact Fluke Calibration for assistance.

Table 23. Troubleshooting (cont.)

Problem	Causes and Solutions
The display indicates Cutout and the heater does not operate	The display indicates Cutout on the top right of display power bar reads 0%. • If the process shown temperature seems grossly in error, consult the problem: <i>The display indicates Cutout and an incorrect process temperature.</i> • Normally, the cutout disconnects power to the heater when the Bath temperature exceeds the cutout setpoint. This causes the temperature to drop down to a safe value, see Cutout. Check that the Hard cutout setpoint is adjusted to 10 °C or 20 °C above the maximum Bath operating temperature. Check that the soft cutout temperature is 10 degrees above the current display temperature or 5 degrees above (minimum). • To re-enable the heating system after a cutout, you must go to the setpoint screen and enter the temperature, or enable or push F1 (Done). For the unit to operate, it must have cooled below the cutout trigger point. • If the cutout activates when the Bath temperature is well below the cutout setpoint, or the cutout does not reset when the Bath temperature drops and the Product system is re-enabled, then the cutout circuitry or the cutout thermocouple sensor may be faulty or disconnected. Contact Fluke Calibration.

Table 23. Troubleshooting (cont.)

Problem	Causes and Solutions
The display indicates Cutout and an incorrect process temperature	The problem can be that the Product temperature measure circuit is not functioning properly. - A problem could exist with the memory back-up battery. If the battery voltage is insufficient to maintain the memory, data can become scrambled and cause problems. A nearby large static discharge can also affect data in memory. Make sure that the parameters on the Report of Test are accurate. Cycle the power off, disconnect the Bath from ac, and then restart the Bath. - The controller may need to be reset. Do the Controller Reset sequence. - You must reprogram each of the controller parameters and calibration constants. The values can be found on the Report of Test that ships with the Product. - If initializing the memory does not remedy the problem, there could be a failed electronic component. Contact Fluke Calibration.
The process temperature shown is in error and the controller remains in the cooling or the heating state at any setpoint value	Possible causes can be either a faulty control probe or erroneous data in memory. - The probe might be disconnected, burned out, or shorted. The Probe is inside the stirrer motor cover. - Check that the probe is connected properly. Check the probe with an ohmmeter to see if it is open or shorted. The probe is a thermistor. The resistance should read approximately 3 kΩ between pins 3 and 4, 12 kΩ between pins 1 and 4, and 9 kΩ between pins 1 and 3 at room temperature (25 °C). If the probe appears to be defective, Contact Fluke Calibration. - If the problem is not the probe, erroneous data in memory can be the cause. Re-initialize the memory as discussed in the problem <i>The display indicates Cutout and an incorrect process temperature</i>. If the problem remains, the cause can be a defective electronic component, Contact Fluke Calibration.

Table 23. Troubleshooting (cont.)

Problem	Causes and Solutions
The controller controls or attempts to control at an inaccurate temperature	The controller operates normally except when controlling at a specified setpoint. At this setpoint, the temperature shown does not agree with the temperature measured by a reference thermometer to within the specified accuracy. This problem can be caused by an actual difference in temperature between the points where the control probe and thermometer probe measure temperature, by erroneous bath calibration parameters, or by a damaged control probe. • Make sure that the Bath has an adequate amount of fluid in the tank and that the stirrer operates properly. • Make sure that the thermometer probe and control probe are both fully inserted into the Bath to minimize temperature gradient errors. • Make sure that the calibration parameters are all correct according to the Report of Test. If not, re-program the constants. The memory backup battery could be weak and cause errors in data as described in the problem: <i>The display indicates Cutout and an incorrect process temperature.</i> • Make sure that the control probe has not been struck, bent, or damaged. If the cause of the problem remains unknown, Contact Fluke Calibration.

Table 23. Troubleshooting (cont.)

Problem	Causes and Solutions
The controller does not maintain controller parameters or parameters are reset each time the power to the unit is removed	<i>Note</i> <i>Before you do the memory check, you must record the controller calibration parameters (found in the CAL menu) and any user-adjusted parameters that you have changed (such as the programmable setpoints and proportional band).</i> Memory Check The easiest way to check the ability of the battery to maintain controller parameters, is to do a memory check. 1. Change a Controller parameter to a non-default value (PBan=0.125). 2. Save the value. 3. Power off the Product. 4. Disconnect the Product from ac power for 10 seconds. 5. Reconnect the ac power and power on the Product. 6. Recheck the Controller parameters to see if they have changed back to default values. 7. If the previous change is lost and a default value is in its place, replace the coin battery on the controller board. 8. Reprogram the calibration and user-adjustable parameters into the controller.
The controller shows that the output power is steady but the process temperature is unstable	Possible causes are an improper proportional band setting for the fluid in use. • If the Bath temperature does not achieve the expected degree of stability when measured with a thermometer, try to adjust the proportional band, maybe wider, as discussed in Proportional Band. • Make sure the fluid has not deteriorated or is not too thick.

Table 23. Troubleshooting (cont.)

Problem	Causes and Solutions
The controller alternately heats for a while then cools	The Bath is unstable and the duty cycle is not constant. The proportional band being too narrow typically causes this oscillation. Increase the width of the proportional band until the temperature stabilizes as discussed in Proportional Band.
The controller erratically heats then cools, control is unstable	If both the Bath temperature and output power do not vary periodically but in a very erratic manner, the problem can be excess noise in the system. Noise due to the control sensor should be <0.001 °C. However, if the probe is damaged or has developed an intermittent short, erratic behavior can exist. The probe is located inside the stirrer motor cover. • Make sure for a damaged probe or poor connection between the probe and Bath. • Intermittent shorts in the heater or controller electronic circuitry can also be a possible cause.
The Bath does not achieve low temperatures	Too much heating or not enough cooling can cause this problem. Check that the Power Indicator shows that the controller is attempting to cool. The heaters can be disabled as a test by temporarily disabling the heaters on the display in the Diagnostics section >heaters. Insufficient cooling can be caused by lack of refrigerant in the system. The system pressure can be monitored from the Diagnostics > EXV section in the user interface.

