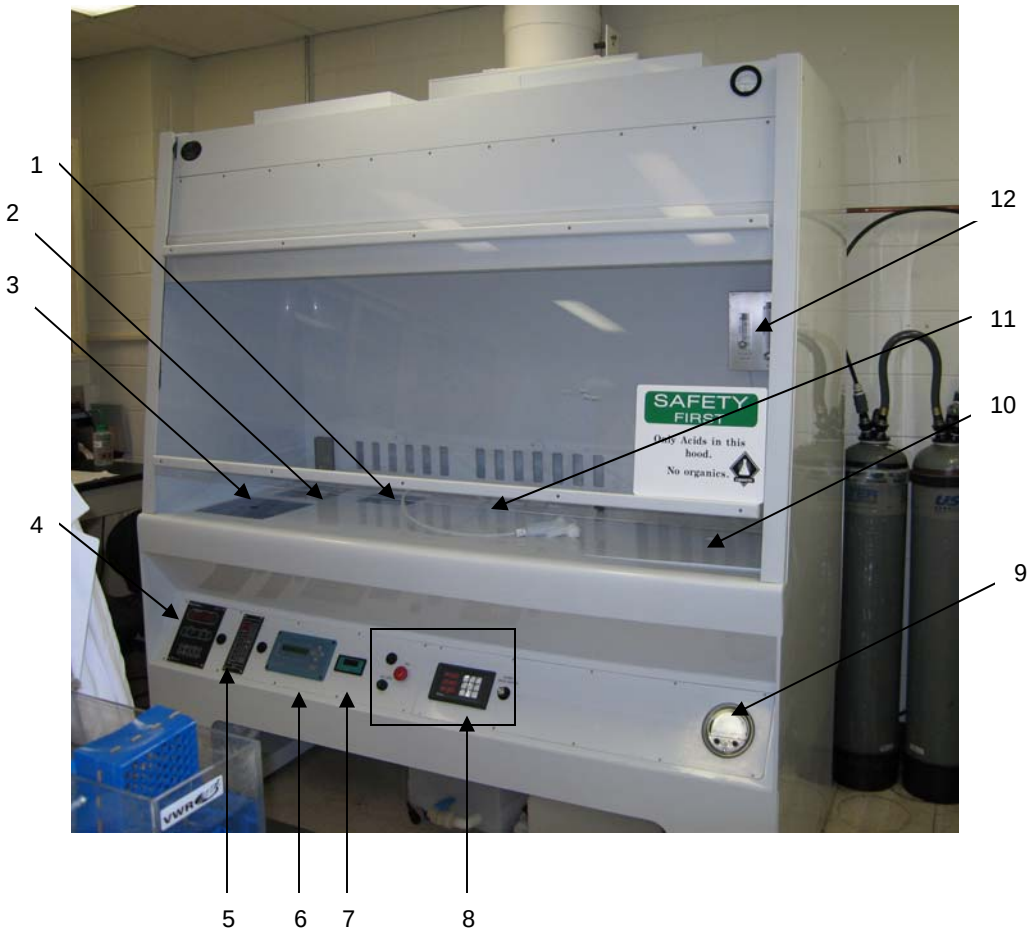
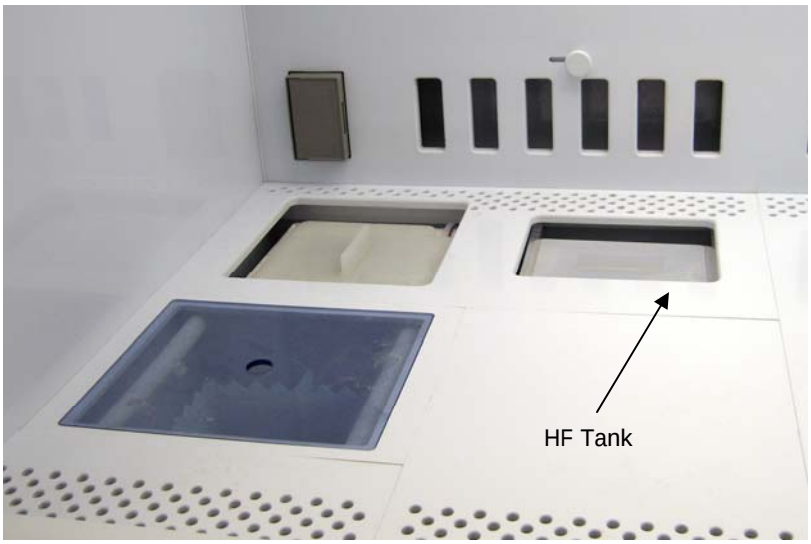
Component Location & Overview



1. *HF tank* (T-923). All hydrofluoric acid work occurs in this polypropylene tank.
2. *Heated quartz bath* (T-926). This bath is designed to heat acid solutions to a temperature range between 30-180°C with a ± 1°C tolerance.
3. *Quick dump rinser* (T-987). The quick dump rinser can be operated on either a preset count mode or a rinse to resistivity mode. The rinser has several adjustable flow valves located underneath the work surface to adjust and balance the slow flow DI, the fast flow DI, DI sprays and nitrogen agitation.
4. *Temperature controller/timer* for the heated quartz bath.
5. *Controller* for quick dump rinser.
6. *Resistivity monitor* for quick dump rinser.
7. *pH monitor* for the quick dump rinser.
8. *Operator switch panel*. This panel contains red indicators for alarms and system status information along with on/off buttons for various hood systems, such as the lights.
9. *Photohelic differential pressure gauge*. This gauge monitors the pressure in the fume hood's exhaust. Normal gauge readings are between .25 and .50 inches w.g. Electrical shutdown will occur if the exhaust pressure goes outside the specified operational range. The alarm can be silenced, but electrical service will not be restored until the problem is fixed.
10. *Sink* with removable cover.
11. *Spray bar* containing hoses for nitrogen and deionized water. The nitrogen spray gun is on the left; the deionized water spray gun is on the right.
12. *Nitrogen flowmeters* for the quick dump rinser, heated quartz bath, and nitrogen spray gun.

Directions for Using the HF-Tank (T-923)

Overview:
The T-923 tank is an ambient temperature bath that is made of polypropylene. This tank has been designated for hydrofluoric acid work only. All HF work done in the fume hood must be done in this tank. Refer to the picture below for its location within the fume hood.

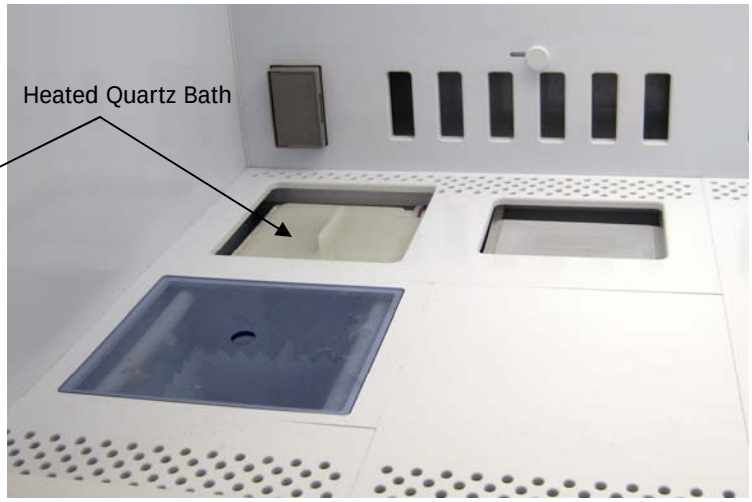


Directions:

1. Turn on the fume hood lights.
2. Sample may be removed from the HF tank to be rinsed in either the sink or the quick dump rinser.
3. To drain the hydrofluoric acid from the tank, press the T-923 Drain button on the operator switch panel. The red indicator light next to the button should be on.
4. After the acid has drained from the tank, use the deionized water gun to thoroughly rinse tank.
5. Close the HF tank drain by pressing the T-923 Drain button again. The red indicator light next to the button should be off.
6. Put the cover back over the HF tank.
7. Turn off the fume hood lights.

Directions for Using Heated Quartz Bath (T-926)

Overview:
The T-926 tank has been designed to rapidly heat chemical solutions, such as H_2SO_4 and H_2O_2, in an ultra-clean environment. The operating temperature range of the dump rinser is 30-180°C with a tolerance of ±1°C. The temperature inside the tank is monitored using a Teflon encapsulated J-type thermocouple that is immersed directly in the solution. The tank itself consists of a 99.997% quartz vessel with grid heaters bonded to the outside of the quartz vessel and sealed in a protective polypropylene housing.



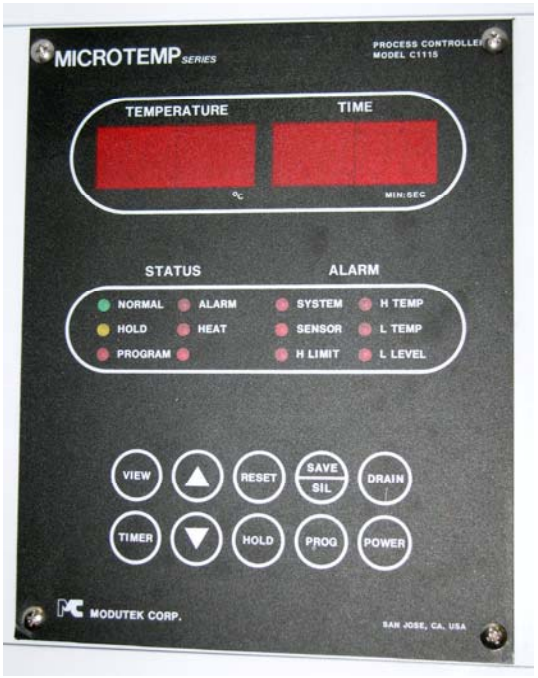
General Guidelines:

1. Do not use HF acid or any caustic solution that attacks quartz.
2. Use care when adding or removing items from the bath. Do not bang items against the side of the tank to dislodge excess liquid when removing items.
3. Do not operate system unless solution level is to the chemical fill line.

Directions:

1. Remove the tank cover.
2. Fill tank with desired chemical solution. Solution should touch the chemical fill line in the tank.
3. Turn on the nitrogen gas to the heated quartz tank. The flow meter for the nitrogen gas is located on the back panel of the fume hood. Adjust the flow meter to approximately 0.02 lpm or one bubble or less every second.
   Note: This will also enable to the nitrogen gas flow to the quick dump rinser.
4. Operate the temperature controller/timer
   a. Press the power button on the temperature controller/timer.
   b. Create the appropriate temperature program. General guidelines are given for how to program the controller in the following pages.
   c. Press the Save/Sil key to save the temperature program.
   d. Press the Reset key to exit the program mode. This will allow you to monitor the bath temperature.
   e. When the desired temperature is reached, press the Timer key to start or stop the clock.
5. To clean the tank
   a. Drain the quartz heated bath, press and hold the drain button. In order for the drain function to work, the solution temperature must have cooled to below the program setpoint.
   b. Rinse the tank using the deionized water spray gun.
   c. Close the tank drain by pressing the drain button.
   d. Place the cover back over the bath.
6. Press the power button on the temperature controller/timer to turn off the bath.

Temperature Controller/Timer Overview



Status LEDs:

- *Normal* – Indicates that the system is operating within defined parameters
- *Hold* – Indicates that the system is in its Standby mode. In this mode, all normal monitoring functions are operable, but the heater is non-operable. The only way to exit this mode is to press the Reset button.
  Note: The unit is initially in this mode after startup or after a power failure. In this mode, the display reads HOLD.
- *Program* – Indicates that the system is in the program mode. Input tuning and setup parameters can be entered while in this mode.
- *Alarm* – Indicates that an alarm condition has occurred and that the system is operating under special conditions. The conditions for operation are dictated by the type of alarm. The only way to exit this mode is to clear the alarm. Alarms are indicated by both a visual display (LED light) and an audio tone.
- *Heat* – Indicates that the heater is on.
  Note: When the temperature nears the programmed setpoint, this LED will continually cycle on and off.

Alarm LEDs:

- *System* – Indicates an internal malfunction within the temperature controller.
- *Sensor* – Indicates that one of the system thermocouples (includes sensors to prevent unsafe temperatures) are open or not connected. When an open circuit is detected, the heater is disabled and the alarm is activated. The display will alternatively flash the temperature and OP for open sensor.
- *H Limit* – Indicates that the bath temperature has reached an excessive temperature (205 ± 10°C) and will disable the master switch for the temperature controller and illuminates the H Limit LED alarm light. The power to the temperature controller will remain off until the problem is corrected.
  Note: This sensor is powered by an independent power supply and remains on at all times, even when the temperature controller has been powered off. It is also independent of the program entered in the temperature controller.
- *H Temp* – Indicates that the temperature has exceeded the high temperature alarm setpoint.
- *L Temp* – Indicates that the temperature has fallen below the low temperature alarm setpoint. The display will alternatively flash the bath temperature and the code LO.
  Note: This alarm will not work until after the system has warmed up. Upon initial start-up of the system, the low temperature alarm remains inactive until the system has exceeded the low alarm temperature.
- *L Level* – Indicates that the liquid level switch detects a low fluid condition. The display will alternatively flash the temperature and LL for low level. The heater is also disabled.

Keypad:

- *View* – Used to view the process setpoint and timer preset. When pressed, the process setpoint is displayed in the process display and the timer preset is displayed in the timer display.
- *Timer* – This is a multi-function key used to start/stop and reset the timer. This key works only when the system is in Normal mode.
  - *Timer Start* – Starts the countdown timer
  - *Timer Stop* – Stops the countdown timer and freezes the display
  - *Timer Reset* – Resets the timer, inserts the pre-set time into the display, and continues counting down.
- ▲, *Up Arrow* – Used in the Program mode to increase the numeric value shown in the display. Holding the key down will activate the automatic, rapid increase of the numeric value.
- ▼, *Down Arrow* – Used in the Program mode to decrease the numeric value shown in the display. Holding the key down will activate the automatic, rapid decrease of the numeric value.

- *Reset* – This is a multi-function key that resets a number of functions. Its actions are dependent on the current state of the temperature controller.
  - *Hold Mode* – When the system is in Hold mode, pressing the reset key returns the system to Normal mode.
  - *Program Mode* – When the system is in the Program mode, pressing the reset key returns the system to Normal mode.
- *Hold* – Places the temperature controller in Hold mode and deactivates the heat output.
- *Save/Sil* – This is a dual function key.
  - *Save* – Used to save the temperature controller setup parameters. It is only active in the Program mode.
  - *Silence* – Used to silence the audio tone for the timer and any alarm conditions. Pressing this button will also cancel any alarms flashing in the display.
- *Prog* – This is a multi-function key and its actions vary depending on what mode the system is in:
  - *Normal/Hold/Alarm Mode* – Used to request access to the Program mode.
  - *Code Mode* – Used only if access code has been setup for entering the Program mode. By default, no access code is required to enter the Program mode.
  - *Program Mode* – When the system is Program mode, this key is used to step through the setup parameters.
- *Drain* – Used to activate the drain. The drain key is operable only when the process temperature is below the dr (drain setpoint) setting.
- *Power* - Used to turn on/off the temperature controller/timer.

How to Set Program Parameters

The parameters below can be accessed when the system is in the Program Mode. Pressing the PROG key on the keypad will cause the listing to advance to the next parameter. The Up and Down arrows are used to change the value for each parameters. The parameters are listed below in the order they will appear on the controller. Once the parameters have been set to the desired values, press the SIL/SAVE key.

Code	Description	Setting Range	Units
CS	Clock Setpoint	00:00 to 99:59	Min : Sec
PA	Pre-warn Offset	00:00 to 00:59	Seconds
PS	Process Setpoint	0.0 to 199.9	Degrees C
HI	High Alarm Setpoint	0.0 to 199.9	Degrees C
LO	Low Alarm Setpoint	0.0 to 199.9	Degrees C
dr	Drain Setpoint	0.0 to 199.9	Degrees C
AC1	Access Code	0 to 1999	
Cr	Cycle Rate	1 to 19	Seconds
Pb	Proportional Band	0.0 to 19.9	Degrees C
rE	Reset	0.0 to 19.9	Minutes
rA	Rate	0.0 to 19.9	Minutes
CA/OF	Calibration/Offset	± 9.9	Degrees C

CS/Clock Setpoint – Value for the countdown timer.
PA/Pre-warn Offset – Time at which the audio warning begins that notifies the user that the countdown period has almost expired.
PS/Process Setpoint – Control temperature for bath
HI/High Alarm Setpoint – If bath temperature reaches or exceeds this point, then the high temperature alarm will be activated.
LO/Low Alarm Setpoint – If the temperature of the bath reaches or goes below this point, then the low temperature alarm will be activated.
dr/Drain Setpoint - Allows a specific setpoint to be set for system draining. Once the solution temperature goes below this value, the bath is drained.
AC1/Access Code – Code used to gain entry to the programming mode of the temperature controller. This value is left at 0.
Cr/Cycle Rate – Rate at which the heater will cycle on and off.
Pb/Proportional Band – Determines the cycling range for the controller.
rE/Reset – Sets the integration time for the second mode of the PID control scheme. This parameter is eliminated if set to 0.0.
rA/Rate – Sets the differentiation constant for the third mode of the PID control scheme. This parameter is eliminated if set to 0.0.
CA/OF – Calibration/Offset – Used to offset the cumulative error resulting from the true bath temperature and the temperature signal generated by the controller. This fixed offset correction is used for internal compensation and will affect all readings from the process thermocouple.

General Programming Guidelines

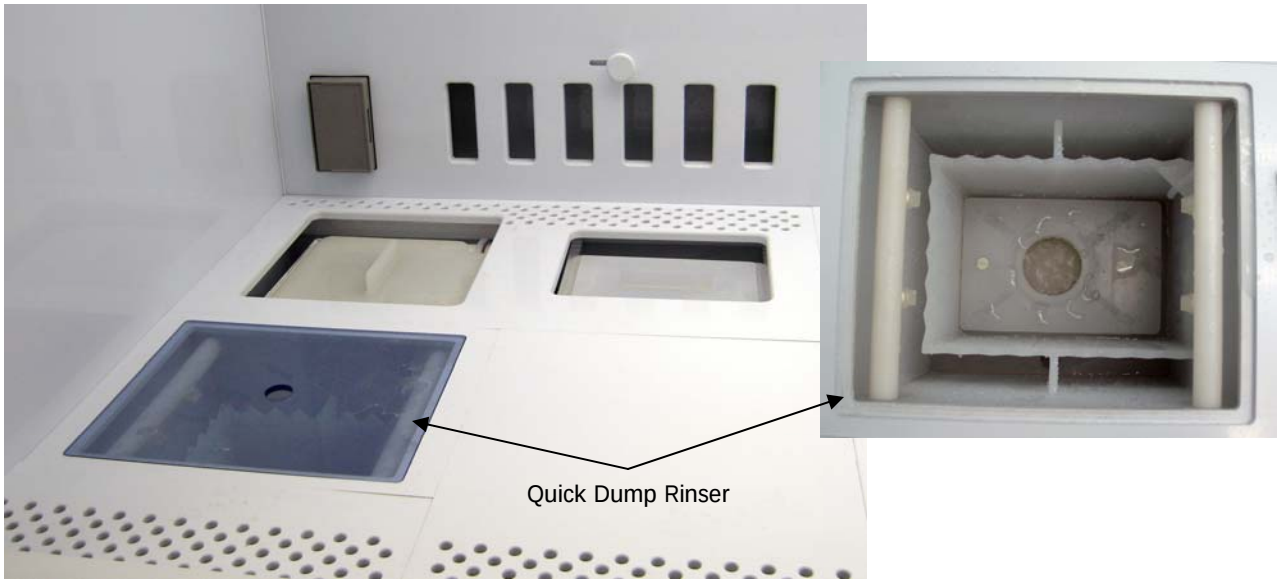
- There is a +2 degree offset between the true bath temperature and what is reported by the temperature controller. To correct for this offset, set the CA/OF value to +2 degrees.
- The high alarm and low alarm setpoints should be set at least five degrees on either side of the process setpoint.
- Below are some initial temperature control settings. These settings are meant to be a general guideline and may need to be refined for a particular application. For more information about tuning, please refer to the manual.
    - Cr: Set to 10 seconds.
    - Pb: Set to 10% of the process setpoint.
    - rE: .5
    - rA: 0

  Note: The values for rE and rA can be left at zero depending on how accurate the temperature control needs to be. As a general rule, without these settings, the temperature of the bath will be controlled at ~1 degree below the setpoint temperature. Adjusting rE and rA will allow for a tighter control around the setpoint.

Directions for Using Quick Dump Rinser (T-987)

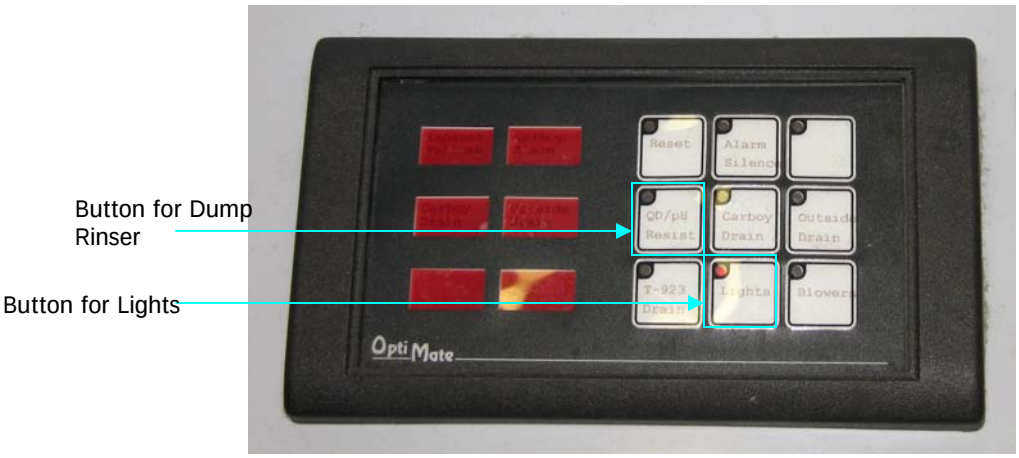
Dump Rinser Overview

This tank is a self-contained unit capable of implementing several different dump rinsing techniques: time, liquid level, resistivity, or combinations of all three. The program is selected during the setup procedure.



Directions

1. Turn on the lights to fume hood and turn on the power to the dump rinser and conductivity/resistivity meter controls by pressing the QD/pH Resist button.



2. Select the desired dump rinser program and adjust the program parameters. All of the programs use a dump period, which is the amount of time that the dump door is open. However, the techniques used to determine when the tank is full and when a run is completed varies.
   a. Timed Fill - In the timed fill mode of operation, the fill period (FP) parameter is used to specify the amount of time the fill valve is activated before proceeding to the dump cycle.
   b. Liquid Level Fill - Uses a liquid level signal to terminate the fill cycle. The fill valve will remain open until the correct liquid level is achieved.
   c. Resistivity Override - A resistivity override can be used with either fill method. The resistivity measured on the Thornton 200CR is checked at the end of the last fill period. If the desired resistivity has been achieved, the system stops and indicates that rinsing is complete. If the desired value has not been reached, than an additional cycle is run and the resistivity is tested again. This process continues until the desired value is reached or the Reset key is pressed.

Program Number	Function
0	Timed Fill
1	Timed Fill with Resistivity Override
2	Liquid Level Fill
3	Liquid Level Fill with Resistivity Override

3. To start the selected program, press the Start button.
4. An alarm sounds when the program is complete. Press the Stop/Reset button to silence the alarm.
5. When finished, turn off the power to the dump rinser. This will turn off the water fill valve and empty the dump rinser.

Rinse Controller Overview

Status LEDs:

- *Run* – Indicated the system is in Run mode and is running the selected program. The display will indicate the number of cycles remaining.
- *Halt* – Indicates the system has been stopped. All outputs are deactivated.
- *Lockout* – Indicates that an interlock is open. This will stop all Dump Rinser functions and disable all outputs. When the interlock is closed, the system will continue from the point the problem occurred.
- *Setup* – Indicates that the system is in Setup mode. In this mode, the system parameters are selected.

Keypad:

- *Open* – Used to manually dump the tank. The tank is closed again by pressing the Reset key.
- *Setup* – Allows the user to both adjust and program the unit. The Code Prompts that will appear in the display are defined below. The code will alternatively flash with the selected value to indicate the parameter that is being viewed. To move between parameters, press the Setup button. To exit the Setup mode, the Stop/Reset key is pressed. When exiting, the unit automatically saves all changes.

Code	Description	Range
CD	Access Code Required	1
CY	Number of cycles	0 – 99 cycles
FP	Fill period	0 – 99 seconds
DP	Drain period	0 – 99 seconds
DD	Dump delay	0 – 99 seconds
SD	Start delay	0 – 99 seconds
AD	Auto dump period	0 – 99 minutes
AC	Access code	Set Value to 1
PC	Period count	L = Long (min) S = Short (sec)
PN	Program number	0 - 3

The PC selection will determine whether the Fill Period (FP) is counted in minutes or seconds.

- ▲, *Up Arrow* – Used as a multi-function key. Its function varies with the current system mode.
    - Setup Mode – Pressing this key will cause the display to advance. Pressing the key once and releasing will allow the accurate setting of the least significant digit. Holding the key will activate the automatic, rapid incrementing of the display.
    - Ready Mode – Pressing this key will allow the system to be placed in an auto fill (AF) mode. A single fill cycle will be done if the system is operating under a timed program. If a liquid level program is being used, the tank will be filled to the liquid level switch. If the tank is already full, this command will be ignored.
- ▼, *Down Arrow* – Used in the setup mode. Pressing this key will cause the value in the display to decrease. Pressing the key once and releasing will allow the accurate setting of the least significant digit. Holding the key down will activate the automatic, rapid decrementing of the display.
- *Start* – Used to activate the dump rinser. Pressing this key will start the system if it was reset or will allow the system to continue if it was halted.

- *Stop/Reset* – Used as a multi-function key. Its function varies with the current system mode.
    - Run Mode – If the system is in the Run mode but has not completed all of the cycles, pressing Stop/Reset will place the system in the Halt condition. This stops the program and holds it until restarted by pressing the Start or Reset key as described below.
    - Halt Mode – The system can be place in the Halt mode by pressing the Stop/Reset key once. Pressing Stop/Reset again will reset the system.
    - Setup Mode – If the system is in the Setup mode, pressing Stop/Reset will cause the system to return to the Reset state in preparation for a new cycle run.

Conductivity/Resistivity Instrument Overview

The Thornton 200CR is an analytical and process control instrument used to measure solution properties. It has the following measurement modes: resistivity, conductivity, °C, °F, total dissolved solids, % rejection, difference and ratio, %HCl, %NaOH, and %H_2SO_4.

Keypad
- *Measure Mode* – Used to access different measurement modes.
- *Setpoints* – Used for programming setpoints
- *Relays* – Used to program relays.
- *Outputs* – Used for programming outputs.
- *Calibrate* – Used to perform calibration.
- *Menus* – Used to access all other menus, such as cell constants, security, compensation, and averaging.
- *OK/Next* – Used to accept a selection and proceed to the next menu level.

Measurement Process
The 200CR is capable of processing two measurements, a primary and secondary, from each of the two channels. A total of four different measurements can be processed per cycle. The measurements are designated as follows:

A = channel A primary measurement
a = channel A secondary measurement
B = channel B primary measurement
b = channel B secondary measurement.

Each of the four measurements can be programmed as the following:
- *Resistivity (Ω–cm)* – This measurement can be displayed with a multiplier in front of the units: K for kilo or 1,000 and M for Mega or 1,000,000. The display can also be set for a fixed range (Ω–cm, KΩ–cm, or MΩ–cm) or allowed to auto range.
- *Conductivity* – This is the reciprocal of the resistivity. This measurement can be expressed either in S/cm or S/m. If S/m if chosen for display, a Σ is used in place of the S to clearly distinguish between the two. This measurement can be displayed with a multiplier in front of the units: m for milli or .0001 and μ for micro or .000001.
- *Total Dissolved Solids (TDS)* – This is the equivalent of sodium chloride (NaCl) required to produce the measured conductivity – approximately 0.46 ppm TDS per μS/cm. If some other conversion is desired, the cell constant will need to be adjusted. Refer to Chapter 9 in the manual. TDS is measured in parts per billion, parts per million, or parts per thousand. Due to space limitations, the following abbreviations are used to display TDS units:

  PB = parts per billion
  PM = parts per million
  PK = parts per thousand
- *Temperature* – Temperature can be measured in either degrees Celsius or degrees Fahrenheit.
- *% Rejection* – This is measured in conductivity and is used to determine the ratio of impurities removed from product water to the total impurities in the incoming feed water. The %Rejection calculation is [1-(Product/Feed)]*100.
- *Difference (A – B or B – A)* – The difference measurement is calculated as:

  Difference on channel A = A – B

Difference on channel B = B -A

- *Ratio (A/B or B/A)* – The ratio measurement is calculated as:

  Ratio on channel A = A/B

  Ration on channel B = B/A

- *Concentrations* - All concentrations (%HCl, %NaOH, and $\%H_2SO_4$) are displayed as percent weight.