TEMPERATURE CONVERSION TABLE

ºC	ºF		ºC	ºF		ºC	ºF
0	32		17	62.6		34	93.2
1	33.8		18	64.4		35	95
2	35.6		19	66.2		36	96.8
3	37.4		20	68		37	98.6
4	39.2		21	69.8		38	100.4
5	41		22	71.6		39	102.2
6	42.8		23	73.4		40	104
7	44.6		24	75.2		41	105.8
8	46.4		25	77		42	107.6
9	48.2		26	78.8		43	109.4
10	50		27	80.6		44	111.2
11	51.8		28	82.4		45	113
12	53.6		29	84.2		46	114.8
13	55.4		30	86		47	116.6
14	57.2		31	87.8		48	118.4
15	59		32	89.6		49	120.2
16	60.8		33	91.4		50	122

Formula to convert Celsius to Fahrenheit: (1.8 X ºC) + 32 = ºF

[Example: To convert 25.8ºC to ºF: (1.8 X 25.8ºC) + 32 = 78.4ºF]

Operating instructions

Medusa
Model PHC-300

Precision
Heater and Chiller
Temperature Controller

SEA LIFE SUPPLY
Distributor of
Medusa Aquarium Products

740 Tioga Avenue, Sand City, CA 93955
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Warranty

Medusa Associates, Ltd. warrants its products for parts and labor for a period of one year from the date of shipment. This covers normal use of the equipment only. Any use other than that intended, misuse, abuse, or customer modification will void this warranty. Medusa, at its option, will repair or replace equipment failed because of defects in either workmanship or parts. Shipping to and from the factory will be at the customer's expense. Under no circumstances will Medusa be responsible for any incidental damage or expense resulting from the use of the equipment covered by this warranty.

Specific exclusions

The following events specifically void the warranty.

1. Splashing with or immersion in water
2. Operation in air temperatures above 95ºF
3. Service by unauthorized persons

DANGER- KEEP AWAY FROM WATER

TO REDUCE RISK OF DEATH BY ELECTRICAL SHOCK:

1. FOR INDOOR USE ONLY
2. MOUNT UNIT SECURELY WHERE UNIT CANNOT BE SPLASHED WITH OR IMMERSED IN WATER.
3. UNPLUG UNIT WHEN NOT IN SERVICE OR BEING SERVICED.
4. CONNECT UNIT TO GROUNDED GFI-PROTECTED CIRCUIT ONLY.
5. READ INSTRUCTIONS BEFORE OPERATING
6. UNIT CONTAINS NO USER SERVICEABLE PARTS. UNIT CAN ONLY BE SERVICED BY QUALIFIED PERSONS.

Accessories

A-20: Precision Calibrating Thermometer

Range 66ºF-80ºF. Mercury thermometer with 0.2ºF increments for accurate calibration of Medusa controllers.

A-35: Temperature Sensor:

Used for air or water applications. (Bulb removed for in-air use. Comes with 6 foot cord.

A-50: **RCA Sensor Extender Cord:**

Adds 6 feet of length to temperature sensor A-35.

Troubleshooting

The chiller comes on more than twice per hour, or stays on less than 15 minutes.

Frequent chiller cycling is caused by a narrow temperature set point differential (see "Chiller Turn On Point" on Page 7) or improper temperature probe placement. If the value of C (chiller turn on point) is less than 0.5, the chiller may turn on and off several times per hour which will shorten the life of the chiller and controller. To remedy this condition, increase the value of the chiller turn on point.

Rapid cycling can also occur if the temperature probe is placed in the path of the discharge water from the chiller or is placed too close to a coil or probe of a drop-in type chiller. To remedy this problem, place the probe in a non-turbulent area of the waterbath or aquarium, etc., or place the probe in a 6" long piece of 1/2" PVC pipe to isolate it from water currents.

The chiller is on most of the time or does not keep the tank, waterbath, etc. at temperature.

This is a result of the chiller being the wrong size for the tank, a pump problem, or the chiller not operating at full capacity. If the chiller has worked properly before, clean the condenser and, if required, the cooling coils (see routine maintenance). Check the pump to make sure that it is open and delivering the required flow to the chiller. If this does not help, the chiller needs service.

The temperature on the display does not match the thermometer.

This could be a result of temperature differentials between where the thermometer and temperature probe are located, long term drift in the temperature probe, replacement of the probe, or loss of calibration. Recalibrate the unit according to the directions in the calibration section.

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Introduction

Thank you for selecting the Medusa Model PHC-300 heater-chiller controller. Medusa controllers use high quality components and the most advanced microprocessor circuitry to ensure accurate and reliable temperature control for aquatic and in-air applications requiring both a heater and a chiller*. The Model PHC-300 will support up to a 1/2 hp chiller and 1500 watts of heaters.

The Medusa Models PHC-300 is a multifunctional controller. It is a digital thermometer, activates heaters and chillers to control water or air temperature, and sounds an audible alarm when the temperature varies 2.0°C (or 3.6ºF) from the temperature set point or if the temperature sensor fails. The temperature probe is a very reliable, high accuracy semiconductor probe that can be replaced and recalibrated in the field. LED operating lights indicate the Medusa Model PHC-300's current operation mode:

Program Mode = Yellow Light

Alarm Mode = Red Light

Chiller On = Green Light

Heater On = Orange Light

The actual temperature is displayed on a three digit LED display in Celsius or Fahrenheit units. The heat and cool temperature set points are set by a single digital adjustment with a range of 0ºC to 32ºC or 32º to 90ºF. The heater and chiller turn on points are selectable with 0.1 ºC or 0.1ºF resolution from 0.1º to 1.0ºC or .1º to 1.8ºF deviation from temperature set point. The turn off points are at the temperature set point. If the turn on points are both set to 1.0 degrees, the heater will turn on when the temperature drops to 1 degree below the temperature set point and turn off when the temperature rises to match the temperature set point. The chiller will come on at 1 degree above temperature set point and turn off when the temperature drops to equal the temperature set point.

*The PHC-300 can be used to control air temperature in environmental chambers, etc., by removing the bulb on the sensor.

Routine Chiller Maintenance

Chillers are generally rather maintenance free. The only thing that needs to be done to them is to vacuum the dust from the condenser fins in back of the chiller. That is the part of the unit that looks like a car radiator and should be done at least once a month. If the coils are not kept clean, the cooling capacity will be reduced and the unit may be damaged. If the water flowing through the chiller is not filtered to about 20 microns, there may be some buildup of organic matter inside the chiller. This buildup can only be cleaned as follows:

a) Remove the chiller form the system and flush with fresh water.

b) Completely drain the heat exchanger.

c) Fill the heat exchanger with a 50% Chlorox solution and let stand for 30 minutes.

d) Flush the heat exchanger with fresh water for at least 5 minutes.

e) Completely drain the heat exchanger.

f) Fill the heat exchanger with any dechlorinater and allow to stand for 5 minutes.

g) Flush the heat exchanger with fresh water for at least 2 minutes.

h) Drain the heat exchanger.

i) Replace the chiller into the system.

If in-line filter canisters are used, the cartridges must be cleaned regularly. A dirty cartridge greatly reduces the water flow rates. **A flow meter is recommended to monitor the water flow rate through the chiller and to insure the proper minimum flow.**

Chiller capacity and cycle time

The chillers are rated in BTU's. This stands for British Thermal Units and is the heat required to raise one pound of water one degree Fahrenheit. Sea water weighs about 8.5 pounds per gallon. A 50 gallon tank will contain about 45 gallons or 383 pounds of water and 100 pounds of rock and gravel. This all together will require 450 BTU's to heat or one degree or the removal of 450 BTU's to cool one degree.

There are several sources of heat that increase the temperature of the water. These include the pumps, lighting, and conduction from the air in the room if the room temperature is above that of the tank. These heat sources can be rather significant. A small power head pump or a UV unit produces 50 BTU's, a 600 GPM main pump can produce 350 BTU's, and the lighting can generate over 1000 BTU's. A typical 50 gallon tank without high intensity lighting will have as much as 750 BTU's of heat input without considering conduction from the room.

A typical 1/4 HP chiller will remove 2400 BTU's of heat from the tank per hour while it is running. With the 750 BTU's heat input for a typical 50 gallon tank, there is 1650 BTU's (2400 minus 750) per hour available to reduce the water temperature. This will drop the temperature 3.7 degrees per hour. If the PHC-300 is programmed to turn the chiller on until it lowers the aquarium temperature 1.2° F, the chiller will stay on for 20 minutes. The heat sources heat the tank at a rate of 1.6 degrees per hour giving about 43 minutes to raise the temperature to the point where the chiller comes on.

Important: If the chiller comes on more than twice per hour or stays on less than 15 minutes, there is a problem. Please refer to Troubleshooting on Page 19. **It is critical that the chiller stay turned off for at least 5 minutes before it turns on again** or damage to the chiller and Medusa controller may occur.

Specifications

Display

Display type	3 digit .3 inch high LED
Display resolution	±0.1 degree C or F
Calibrated display accuracy	± 0.1 degree C or F
Display units	°C or ºF, selectable

Alarms

Deviation to activate alarm	±2.0 degrees C or 3.6ºF
Sensor fail criteria	open or short
Display indications	high temperature = OFL low temperature = UFL sensor failure = SFL

Sensor

Sensor type	semiconductor, voltage output
sensor linearity	±.25 °C 0 to 32°
Sensor drift	.075°C in first 1000 hrs.
Cord	10 foot long with RCA phono jack connector, cord extendable

Control

Heater turn on point	adjustable set point .1 to 1.0°C (.1 to 1.8ºF)
Heater turn off point	temperature set point
Chiller turn on point	adjustable set point .1 to 1.0°C (.1 to 1.8ºF)
Chiller turn off point	temperature set point
Control point drift	±..05° C max
Calibration accuracy	±0.1° ºC

Outputs

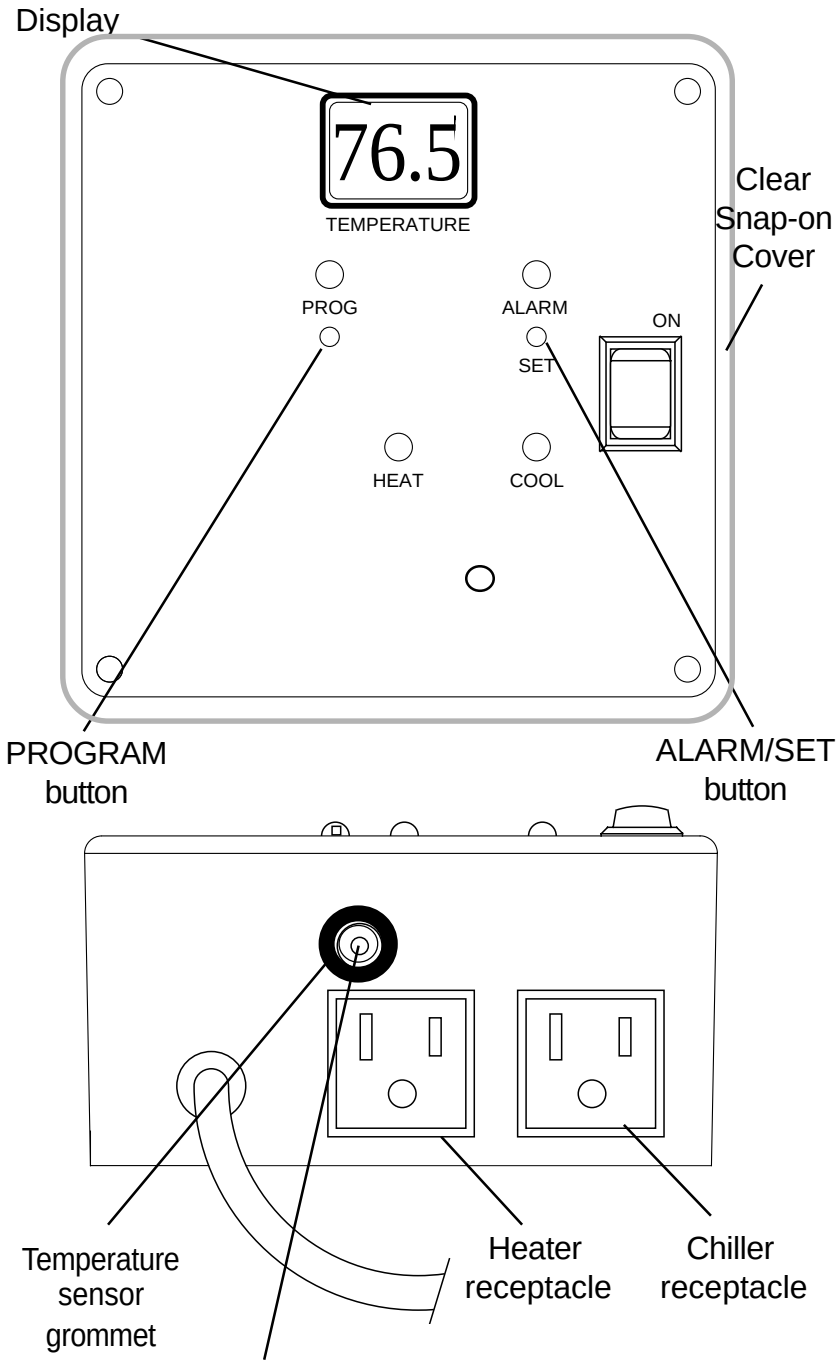
Chiller	15 amps max. load at 115 VAC
Heater	15 amps max load at 115 VAC
Receptacles	NEMA 15P grounded outlets
Power rating	15 amps max., 105-130VAC, 49-61 Hz.

Environmental

Ambient temperature	0 to 35 degrees C.
Relative humidity	0-90% non-condensing

Line Cord

6' long, #14 wire, grounded plug



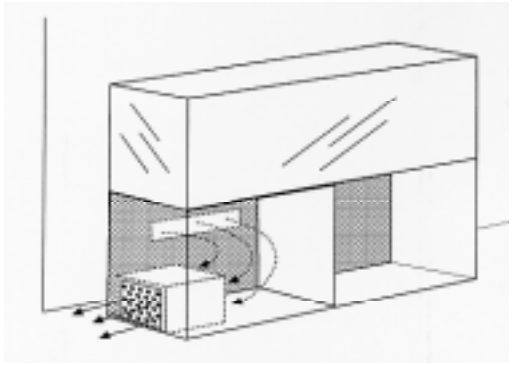


Figure 4: If the chiller is placed inside the cabinet, it must be properly vented. Cut a hole in the rear of the cabinet about the same size as the back of the chiller to let air in. Next, cut a vent hole in the end of the cabinet slightly smaller than the front dimension of the chiller and push the chiller up tight against the hole to blow out warm air. Note partition between the chiller and the sump area.

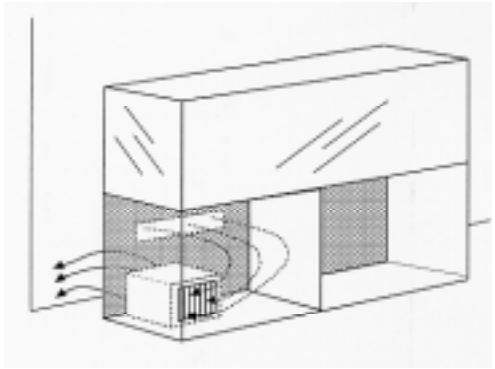


Figure 5: Vent holes for the incoming and outgoing air are cut in the rear of the cabinet and the chiller is pushed up against the vent hole as in Figure 4. Important: If the cabinet is closer than 6" from the wall this method is not recommended. Furthermore, it is not recommended that a chiller be put in a backless cabinet if the cabinet is closer than 12" from the wall.

Venting the chiller

For optimal chiller performance, the chiller should be installed outside of the aquarium cabinet. If a sump or wet dry filter system is installed in the cabinet, the chiller and controller must be placed outside of the cabinet to prevent corrosion damage unless a partition is installed (see Figs. 1 and 2 on page 14). If the chiller is to be placed inside the cabinet, special care must be taken to remove the heat produced by the chiller. (A 1/4 hp chiller will produce as much heat as a 1,000 watt electric space heater!) Failure to remove this heat will cut down on the cooling capacity of the chiller and shorten its life. The air temperature inside a properly vented cabinet should be no warmer than 5ºF above room temperature. **Small computer type fans are insufficient to remove the heat produced by chillers.**

Figure 3. Recommended method for venting a chiller is locating the chiller and controller outside the cabinet in a well-ventilated area. Controller should be mounted in an area where it will not be splashed with water and where the display can be conveniently viewed. Front and back of chiller should be no closer than 6" from a wall or solid surface.

Installation

1. Place the Medusa Model PHC-300 Controller in a dry location where it will not be subject to water splash and where room temperatures do not exceed 35ºC (95ºF). Mount the controller to a vertical surface by placing screws through the flange holes on the back of the controller.

2 . Plug the heater into the left receptacle on the bottom of the Medusa controller. If the heater has a built-in thermostat, set the heater thermostat several degrees above the desired target temperature so it does not override the temperature set point of the Medusa controller.

3. Plug the chiller (or other cooling device) into the right receptacle on the bottom of the Medusa controller. If the chiller has a built-in thermostat, set the chiller thermostat several degrees below the desired target temperature so it does not override the temperature set point of the Medusa controller.

4. Insert the sensor wire jack into the RCA receptacle on the bottom of the controller if it is not already installed.

   For waterbaths: Place the temperature sensor in the most tur bulent area of the water bath.

   For aquariums: Place temperature sensor on or near the bot tom of the aquarium away from water currents.

   For in-air use: Use in-air sensor A-40 (your Medusa controller is supplied with the A-30 submersible temperature sensor).

5. Plug the controller power cord into a standard 15 amp grounded GFI-protected wall receptacle and press the controller power switch to the "on" position. The display should now be illuminated.

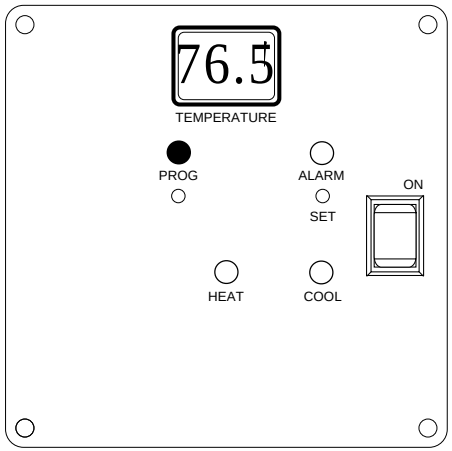
Programming

Programming the controller involves setting the desired temperature set point, the turn on and turn off points, and, if required, calibrating the temperature. Prior to programming, turn the PHC-300 on and let it warm up for 10 minutes.

Note: To prevent damage to the controller and to reduce the risk of shock, *never* press programming buttons when your hands are wet.

Programming Temperature Set Point

1. To enter the programming mode, press the PROG button.



The display will show the current temperature set point and the PROG light will come on. To change the **temperature set point** (the desired temperature you wish to maintain), press the ALARM/SET button. Pressing it once will cause the set temperature to increase by one tenth degree. If the ALARM/SET button is held in, the set temperature will increase at a .2 degree per second rate. After 5 seconds the rate will increase at a 2 degree per second rate. When the set temperature reaches 50°, it will 'roll over' to 0° C. When the desired temperature is displayed, press the PROG button to go to the next programming function.

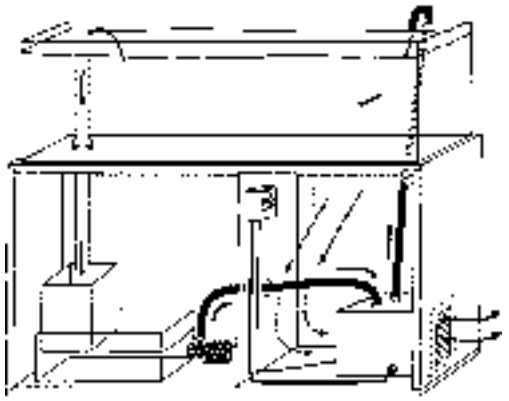


Figure 1. Preferred method for plumbing the chiller to the aquarium. An external pump circulates sump water through the chiller up to the tank. Temperature sensor can be internally mounted in the chiller or placed near the bottom of the aquarium away from water currents.

Note: In either installation, the chiller and controller are placed in a well-ventilated area partitioned off from the sump to prevent corrosion from high humidity or salt-laden air.

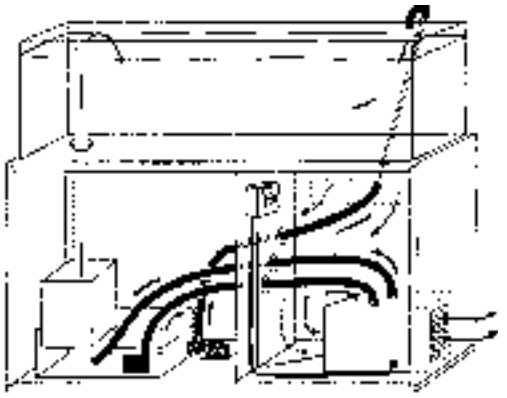


Figure 2. A submersible pump pumps sump water through the chiller back to the sump. Place the temperature sensor into the aquarium away from water currents for maximum accuracy.

TABLE 2
TANK SIZE IN GALLONS
PULL DOWN*

H P	10°F	15°F	20°F	° *temp*
1 / 6	50	40	30	*gallons*
1 / 5	75	60	55	
1/4	120	100	80	
1/3	220	185	140	
1/2	320	250	185	

*Pull down is the maximum reduction in aquarium temperature that your system will need.

Plumbing the chiller

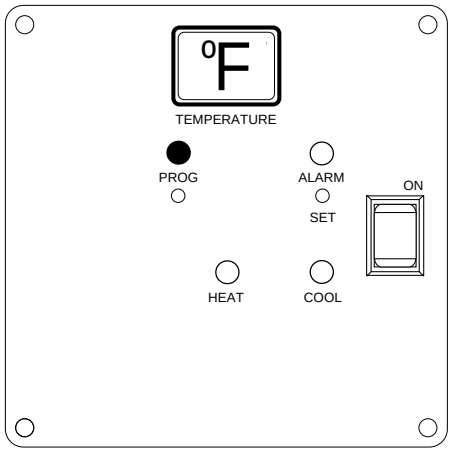
There are two different ways to plumb a flow-through chiller. The recommended method is putting the chiller in line with the water return to the tank. This does not require an additional pump and allows for the best temperature control. All filtering should occur before the water enters the chiller. This will reduce organic buildup inside the chiller.

The second method pumps water through the chiller from and back into the sump. This requires an additional pump and reduces the accuracy of the temperature control. It may increase the organic buildup inside the chiller if the water entering the sump is not pre-filtered. **The Medusa temperature sensor should be placed towards the bottom of the aquarium away from water flow.**

Flow requirements

The direction and volume of flow through the chiller needs to be correct for proper operation. The flow rate through the chiller determines the temperature difference between the water flowing into and out of the unit. Too low of a flow will result in cold water being returned to the tank. This will produce cold currents and temperature separation in the tank and may cause discomfort to the tanks occupants. Low flow will also reduce the efficiency of the chiller and may reduce its life.

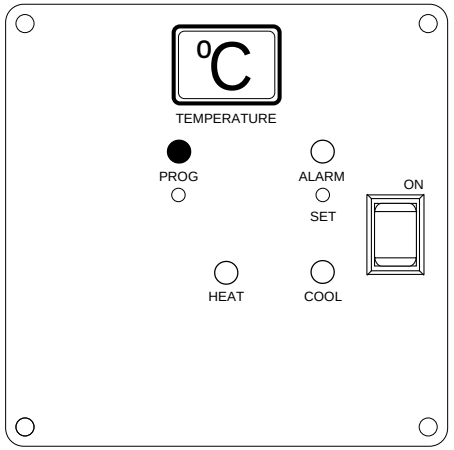
Display units °C or °F



Display indication for degrees Fahrenheit.

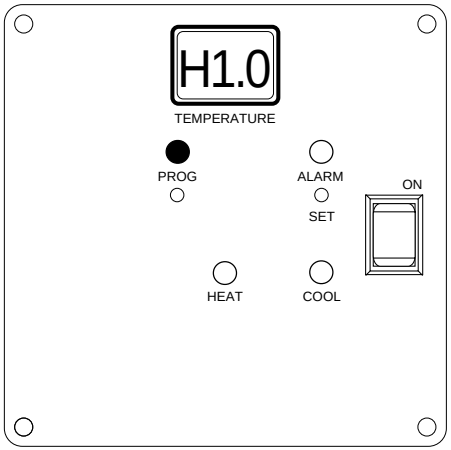
2. The display shows the **display units**. Pressing the ALARM/SET button will cause the units to change.

When the desired display units are shown, press the PROG button to move to the next programming function, selection of heat or cool operation.



Display indication for degrees Celsius.

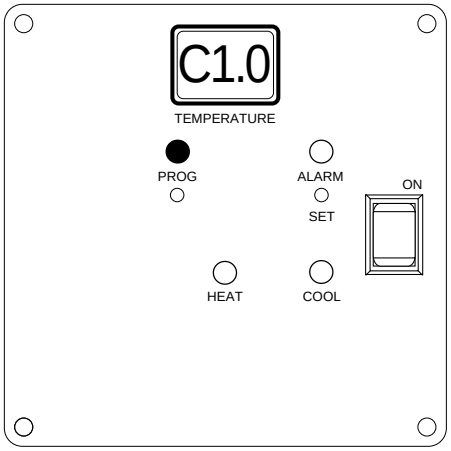
Programming Temperature Differentials



Display indication for heater turn on point.

Heater Turn On Point

2. The display shows the heater turn on point. Pressing the ALARM/SET button will cause the value to change. The value is the temperature deviation below the temperature set point at which the heater turns on. (The heater will turn off at the temperature set point). When the value is set, press the PROG button to move to the next programming function, chiller turn on point.



Display indication for chiller turn on point.

Chiller Turn On Point

3. The display shows the chiller turn on point. Pressing the ALARM/SET button will cause the value to change. The value is the temperature deviation above the temperature set point at which the chiller turns on. The chiller will turn off at the temperature set point. When the value is set, press the PROG button to move to the next programming function, calibration.

IMPORTANT: The chiller must be off for at least 5 minutes before it turns on again. (15 minutes is preferable). If it does not stay off for at least 5 minutes, increase the value of the chiller turn on point. For aquariums, make sure the temperature probe is located towards bottom of aquarium away from water currents.

About Chillers

Chillers come in several sizes rated in horsepower. Table 1 shows the typical cooling power and required flow-rate for the most common chiller sizes. The value of interest in the table is the heat capacity. This is specified in British Thermal Units, BTU for short.

TABLE 1

HP	BTU*	FLOW**
1/6	1,550	3 GPM
1/5	2,350	4.5 GPM
1/4	3,000	6 GPM
1/3	4,000	8 GPM
1/2	6,000	12 GPM

* The BTU ratings are nominal, manufacturer's ratings will vary.

** Flow rate is determined for 1°F difference between in and out flows. GPM = gallons per minute.

The heat capacity required for any tank is a function of the amount and type of lighting, the pumps used, the type and size of tank, the temperature of the room, and the size and type of additional equipment such as UV sterilizers and protein skimmers. Table 2 shows the average tank size for different chiller sizes and required temperature decrease. This is a general guide only. **If there is any question, select the next bigger chiller size.**

Selecting a chiller

To use Table 2, select the degrees you wish to lower your tank temperature from the top line and follow the column down to the size of your tank in gallons. Now follow this row to the HP column to find the size chiller you need.

Example: If you have a 100 gallon tank and you wish to lower it 15° then you would need a 1/4 hp chiller.

Aquarium Use

Chiller and controller placement

The chiller and controller must be placed in a well ventilated area. They cannot go into a closed cabinet. All of the heat removed from your tank plus the heat generated by the compressor in the chiller is released by the chiller. This means that a 1/4 hp chiller will need to eliminate over 5,000 BTU's from its area. To put this into perspective, a home central heating unit generates 25,000 to 50,000 BTU's. It is not recommended that a chiller be installed inside a cabinet that contains a sump or wet/dry filter unless a partition is installed as in Figs. 1 and 2 on page 14. It is best to have the chiller free- standing outside the cabinet to allow the maximum air flow. The air flowing through the chiller and around the controller MUST NEVER EXCEED 35ºC OR 95ºF.

The controller needs to be mounted to a vertical surface where it will not be splashed with water. It must never be laid on the cabinet floor. It should be placed so that the display and programming buttons are easily accessible.

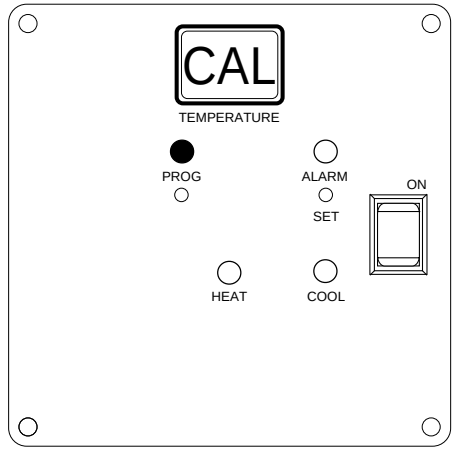
Note: To prevent damage to the controller and to reduce the risk of shock, *never* press programming buttons when your hands are wet.

Probe placement

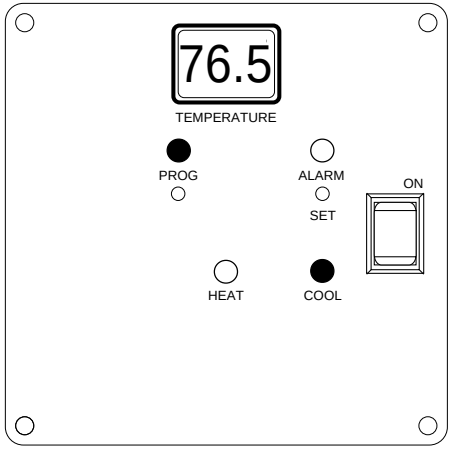
The placement of the temperature probe is critical to the proper operation of the controller. If the probe is installed directly in the chiller, the only thing to check is that the flow direction is correct. With drop-in probe or coil units, the temperature probe should be located in the tank as far away as possible from the discharge into the tank. If the chiller circulates water through the sump instead of being in line to the tank, the temperature probe should be placed as for a drop-in unit.

Temperature Calibration

4. The controllers are calibrated at the factory. There is no need to calibrate the unit unless the temperature sensor is replaced or to compensate for electronic drift. If calibration is required, refer to the calibration section on Page 10. Press the PROG button to exit the programming mode. The yellow light should now be off indicating programming is complete.



Display indicating calibration mode.

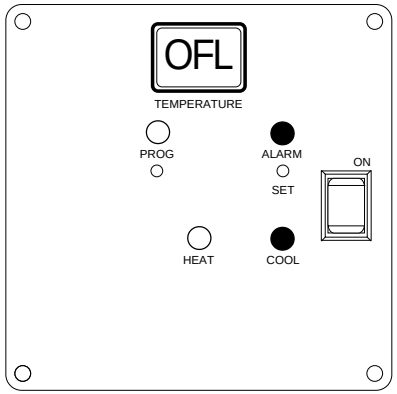


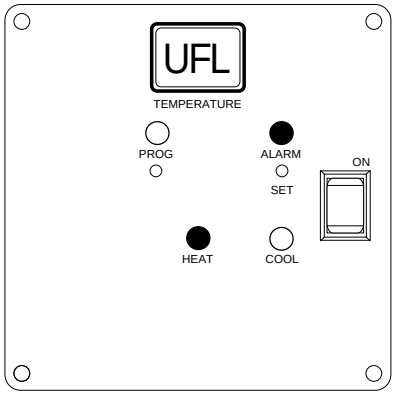
The yellow PROG light is off indicating normal operating mode with the display showing temperature at the temperature sensor.

Alarms

There are three alarm conditions for the controller. When an alarm condition is detected, the display shows the condition and the audible alarm sounds. **To silence the alarm, press the ALARM/SET button**. The ALARM light will be lit any time an alarm condition exists.

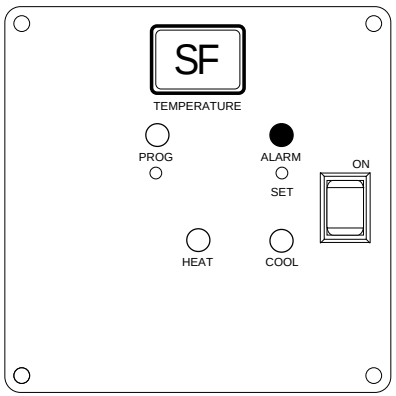
The indication 'OFL' shows that the temperature at the temperature sensor is more than 2.0ºC (3.6ºF) above the set temperature. The display will alternately show the measured temperature for one second then the alarm condition.





The indication 'UFL' shows that the temperature at the temperature sensor is more than 2.0ºC (3.6ºF) below the set temperature. The display will alternately show the measured temperature for one second then the alarm condition.

The indication 'SF' shows that the temperature sensor has failed or become disconnected. This will be a constant indication until the fault is corrected. When 'SF' is indicated, both the heater and chiller are disabled.

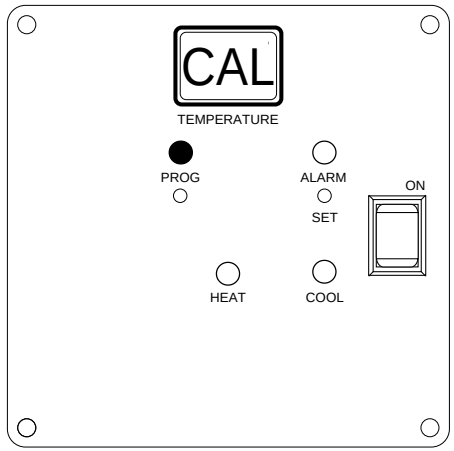


Calibration

If the temperature sensor is replaced, or to compensate for electronic drift, the unit must be calibrated. First, put the Medusa temperature sensor in the air or water to be controlled. Then, measure the actual temperature at the temperature sensor with an accurate thermometer. It should be noted that inexpensive digital thermometers are only accurate to at best 2 degrees F. Accurate calibration thermometers are available from your Medusa dealer.

1. Press the PROG button to enter the programming mode. Adjust the set point temperature to be the same as the actual temperature measured at the sensor location.

2. Press the PROG button four times to get to the calibration function as indicated by the display showing 'CAL'.



3. Press the ALARM/SET button and, while holding it down, press the PROG button. Release both buttons. The display should show the calibration temperature measured by the calibration thermometer. Now the unit is calibrated **but the temperature set point needs to be reset to the desired target temperature.** Refer to the programming section number 1 on Page 5 for details.