Models DTT-84, DTT-94

Installation Instructions, Operational Tests and Troubleshooting Guide

Symbol of Reliability
DTT Solar Controls

DESCRIPTION

The DTT-84 and DTT-94 Delta-T® solar controls have been specifically designed to regulate solar thermal collector systems. These systems include: open loop without freeze protection, closed loop with a heat exchanger, drain back systems and re-circulating freeze protected systems.

Each controller has six BIT switches for quick adaptation to more specifically match the controlled system and collector environment. The DTT-84 is meant for hard-wired installation to the power supply and pump; the DTT-94 has an easy plug-in line cord to the power supply and an outlet for the pump power supply.

Each controller model requires two SAS-10 (10,000 Ohm) thermistor temperature sensors for operation. The collector sensor doubles as the freeze re-circulation sensor making a third sensor obsolete.

This installation guide should be carefully followed for ease of installation and trouble-free operation.

CONTROL INSTALLATION

These controllers conform to the National Electric Code and prevailing local codes and should be installed by a qualified electrician.

CAUTION: Turn off electricity at the main fuse box before proceeding with installation of the DTT-84.

Mounting

Mount the controller on a wall indoors where it will be away from weather and electric sources, including the pump that it controls. The control should be mounted on the pre-fabricated mounting hooks at the top and bottom of the control box as seen in the DTT-94 below.

PICTURE 1. DTT-94

Power Wiring

This controller works with 120 VAC power. See the controller layout in figure 1. The DTT-94 is pre-wired for ease of wall plug-in operation. For the DTT-84 verify the correct voltage, disconnect the power and make the following connections:

1. Connect hot lead (120 VAC-black) to power terminal strip position 5.
2. Connect switched power out (120 VAC hot to pump) to position 2 (Normally open –N/O).
3. Connect each neutral (white) wire to either position in 3 and 4.
4. Connect protective ground wires (green or bare) to ground screw.
5. If desired to power a device 'on' when the differential is 'off', connect to N/C power terminal position 1.

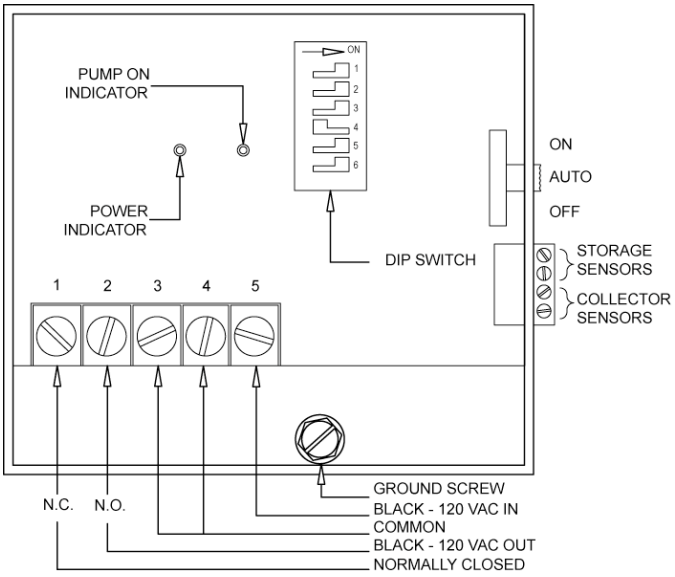

FIGURE 1. CONTROLLER LAYOUT

Option Switch Settings and Functions

*See DIP Switch Designations in figure 2.

Switch 1 is factory set to 'on'. This means the pump will turn off when the storage tank temperature reaches either 180ºF or 160ºF, depending on what is set for switch 4. In the 'off' position, there is no high limit shutoff.

Switch 2 is factory set to 'on'. This allows the collector fluid to circulate when the temperature gets below 42ºF to prevent freezing. This switch overrides switch 3.

Switch 3 is factory set to 'on'. While on, the pump will shut off whenever the collector fluid temperature gets below 80ºF to prevent further cooling of the stored liquid.

Switch 4 is factory set 'off' and is the high limit temperature setting. When off, there is a 180ºF high limit and when on, there is a 160ºF high limit. This setting is off when switch one is off.

Switch 5 and 6 work together and are both factory set 'on'. With both 'on', the pump will turn on at 9ºF and off at 4ºF temperature differentials. Both switches 'off' turn the pump on at 18ºF and off at 5ºF temp differentials. The on settings will benefit those in milder climates while the off settings will benefit those in the colder climate areas.

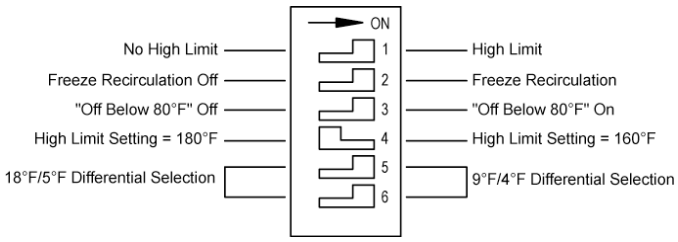

FIGURE 2. DIP SWITCH SETTINGS

SENSOR INSTALLATION

*See Sensor Positions in figure 3.

The sensor leads are 24 GA CLASS 2 wiring and carry 4 VDC. Use a conductor 18-24 GA zip or bell wire to run from the sensor location to the controller. Shielded sensor wire is not necessary.

Slide pipe clamp over sensor and pipe and tighten. Use caution not to damage sensor from over tightening. Install insulation over the sensor and pipe combination to ensure accurate fluid temperature readings; wrap the insulation with duct tape to secure.

Collector Sensor

Attach one SAS-10 sensor to the outlet of the collector array as close to the collector as possible. This is the high temperature sensor and also doubles as the freeze re-circulating sensor.

The collector sensor will undoubtedly be exposed to weather and must be completely isolated from the environment to better detect the outlet temperature of the collector fluid. Cover this sensor with waterproof thermal insulation to avoid bad readings.

Storage Sensor

This sensor is the low temperature differential and must be attached as low as possible to the bottom of the storage tank. If there is no stud for the sensor, install at supply pipe on the tank. This is the high limit shutoff sensor.

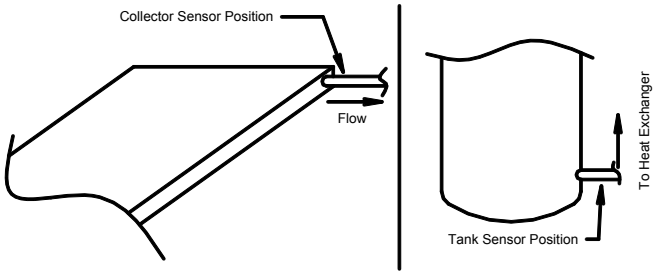

FIGURE 3. SENSOR POSITIONS

CAUTION: The high limit function is not UL approved as a temperature-limiting device. Water leaving the storage tank hotter than 180ºF may cause unsafe pressure and temperature in the water storage tank. It may be necessary to add a redundant temperature limit control in the system to prevent risk of water overheating.

Protection of Sensors and Sensor Wiring

The failure of sensors and sensor wiring can cause apparent controller failure.

To prevent sensor failures:

1. Follow installation instructions of sensors detailed above.
2. Make sure the sensors are thermally isolated from the ambient and away from vents or other thermal sources

To prevent wire failures:

1. Use caution when stapling wires. The insulation can be broken causing a short or open.
2. Use caution when pulling wires through metal flashing as wire may be easily stripped or shorted by sharp metal objects.
3. Use conduit for all buried wires.

CONTROLLER SETUP

Before putting the controller into operation, perform the 'Control Power Test' and the 'Sensor Operation Test', outlined below, to verify components are working properly.

The sensors are connected to the controller by way of the four-pin, plug-in connector. Use the steps below and figures 1 and 4 to connect the sensors to the controller.

1. Unplug the connector from the controller unit and orient it as shown in figure 4.
2. First connect the two lead-in wires from the collector sensor to positions 1 and 2 by sliding the wire into the retainer and tightening the screw.
3. Repeat step 2 for the storage tank sensor, inserting wires into slots 3 and 4.
4. Replace connector into slot and press firmly.

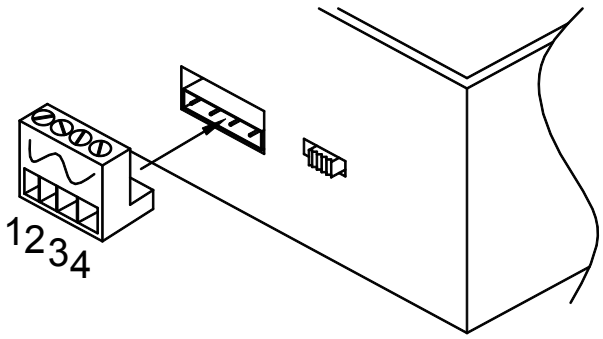

FIGURE 4. SENSOR TO CONTROL SETUP

Control Operation

After following the setup instructions and performing the component tests under the 'TROUBLESOOTING' header, the controller is ready to be put into operation. The function switch on the right side of the controller

should be set in the center, 'AUTO', position for automatic pump control. When the switch is in the 'ON' position, the pump(s) will run continuously, regardless of temperature difference. With the switch in the 'OFF' position, the pump(s) will not run.

TROUBLESHOOTING

Heliotrope Thermal Delta-T® controllers are simple, trouble-free, and very reliable. All controls shipped by Heliotrope Thermal have gone through a rigorous quality control process. Field experience has shown these controllers have a low failure rate. Performing the following simple tests can identify most failures. If the control and sensors pass the tests, suspect a malfunction in the solar collector system.

Control Power Test

This test will verify the controller receives power.

Disconnect the sensors from the right side of the controller. If bench testing a DTT-84, a test line cord must be connected to power terminal strip positions 5 and 4 (see figure 1). Connect protective ground to the green ground screw. For both models, plug the line cord into a 120 VAC outlet. **CAUTION: HIGH VOLTAGE IS NOW PRESENT ON THE TERMINAL STRIP.**

If the left (power) LED indicator comes on, the controller is receiving power. If not, consult the manufacturer.

On/Off Test

This test verifies the controller will turn on and off. Switch the controller 'ON,' power is applied to the Normally Open relay point, terminal 2. This may be verified with an AC voltmeter across terminals 2 and 3. If a pump is connected, it should turn on.

With the switch in the 'OFF' position, power is applied to the normally closed relay point, terminal 1. This may be verified with a voltmeter across terminals 1 and 3.

When the switch is 'ON', the pump LED indicator should be on. If not, consult the manufacturer.

Basic Function Test

This test verifies the BIT settings are working correctly. The BIT switches (figure 2) for a particular function must be on to test for that function.

Place BIT switches 1 on and 2 off (remaining switches can be either on or off.) Switch controller to 'AUTO.' Allow the sensors to come to thermal equilibrium (about one half hour.) Short the screws in positions (see figure 4) 1 and 2 and the controller should turn on. Next, place the collector sensor in a cup of hot water; this should turn the controller on. With the storage sensor screws shorted (positions 3 and 4), the controller should turn off. If the controller does not respond to these tests, consult the manufacturer.

Sensor Operational Test

Thermistor Sensors

The SAS-10 thermistor sensors should be checked before connecting them to the controller and activating the system. This test requires the use of a multi-meter.

All SAS-10 sensors manufactured by Heliotrope Thermal are compatible and should one fail, only that one need be replaced. These sensors have a negative temperature coefficient as shown in table 1 below.

Temperature vs. Resistance Chart		
°F	°C	Θ (Ohms)
OPEN		∞
32	0	32,630
41	5	25,380
50	10	19,890
59	15	15,710
68	20	12,490
77	25	10,000
86	30	8,057
95	35	6,531
104	40	5,326
113	45	4,368
122	50	3,601
131	55	2,985
140	60	2,487
149	65	2,082
158	70	1,751
176	80	1,255
194	90	917
212	100	680
SHORT		NONE

TABLE 1. TEMPERATURE VS. RESISTANCE CHART

To start the test, first set the multi-meter to read Ohms, or resistance measurement. Make sure the meter is working properly to perform this test, i.e. fresh batteries, etc. Connect the meter leads to the two wire leads from the sensor. Compare the multi-meter values with the numbers in table 1.

If there is an open circuit, check the following:

1. The sensor lead-in wire to the sensor for a break in the wire. This would usually be found around sharp metal corners or edges such as roof flashing.
2. The sensor lead-in wire where it connects to the sensor leads for possible disconnection.

If there is a short circuit, check the following:

1. A nail or staple through the sensor wire shorting the leads.
2. Insulation that has been scraped off the sensor wires around sharp metal edges such as roof flashing.
3. At the sensor where it is connected to the sensor lead-in wire to determine if the sensor itself is shorted.

If the multi-meter indicates a large variation in the resistance reading relative to what temperature the sensor should be reading from table 1, then a sensor failure may have occurred. To further test this sensor, remove it from its position and submerge it into a glass of ice water allowing at least 30 minutes for it to come to equilibrium. Make sure there is ample ice and water in the mixture to maintain freezing temperature. If the sensor has a large variation from the Table 1 value for 32ºF, the sensor is faulty.

If still not satisfied with results, place the sensor somewhere indoors with a known working sensor. Again, allow 30 minutes for equilibrium, and then measure the

resistance. A large variation from table 1 and the working sensor reading would prove a faulty sensor.

If the sensor appears to be working after testing, check the system plumbing and insulation.

Defective Controllers or Sensors

Any control or sensor that has been installed one year or less and found to be defective after following the troubleshooting procedures and performing the operational tests, should be returned to the distributor from whom it was purchased or returned to Heliotrope Thermal for repair or replacement.

If the control has been in operation for longer than one year, return the controller, postage paid, directly to Heliotrope Thermal. The control will be repaired or replaced and returned within reasonable time, and an appropriate charge will be made.

Special Applications

For assistance with special applications or unusual installations, please call or write Heliotrope Thermal.

WARRANTY INFORMATION

Heliotrope Thermal Limited One Year Warranty and Limited Subsequent Nine Year Warranty

Heliotrope thermal expressly warrants the Delta-T product (Products) to be free from defects in material and workmanship, and malfunctions and failure to perform, under normal use and service, for a period of one (1) year from date of installation, provided that said products have been installed in accordance with Heliotrope Thermal's Installation Instructions. This warranty applies to the first retail buyer and to any subsequent owners.

In the event that evidence cannot be provided to indicate the date of installation, then the period of time shall be eighteen (18) months from the date of manufacture.

If a defect in material or workmanship becomes evident within one (1) year, Heliotrope Thermal will repair, or, at Heliotrope Thermal's option, replace the defective product within a reasonable time and without charge for parts, transportation within the U.S. or labor. In such event, the duration of this warranty is extended while the Product is not functioning.

If the Product contains a defect that cannot be repaired after a reasonable number of attempts to do so, you, the buyer, may elect either a refund of its purchase price, or a replacement without charge. A replacement may consist of a new or factory rebuilt product of at least the same quality. A new warranty shall apply to any replacement.

To obtain service on the Product, just notify Heliotrope Thermal by phone at (510) 237-9614, or by letter to 4910 Seaport Ave., Richmond, CA, 94804, or the installing contractor. Provide proof of purchase and date. Should service be requested and no defect found in the Product, then a reasonable charge will be made for the service.

In no event shall Heliotrope Thermal be liable for the following: 1. Conditions resulting from a defect in a component or part that does not make up the Heliotrope Thermal Product. 2. Conditions resulting from a significant departure from Heliotrope Thermal's Installation Instructions. 3. Conditions resulting from any misuse, abuse, negligence, weather damage, accident or alteration. 4. Consequential damages such as: damage to your property, loss of time, inconvenience or loss of use of the Product or any incidental expenses resulting from any breach of the express warranty. Conditions that may occur in the normal operation of the Product shall not be invoked by Heliotrope Thermal to reduce or defeat the coverage of this warranty.

Heliotrope Thermal's liability under this warranty shall be in lieu of all warranties of fitness and in lieu of all warranties of merchantability. Heliotrope Thermal shall not be liable for any incidental or consequential damages covered by a defective product. The maximum liability under this warranty shall not exceed the contract price of the Product. Some states do not allow the exclusion or limitations of incidental or consequential damages, and some states do not allow limitations on implied warranties, such as that of fitness and of merchantability. Therefore the above exclusions and limitations do not apply to you. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state.

Unless otherwise explicitly agreed in writing, it is understood that these are the only written warranties given by Heliotrope Thermal, and Heliotrope Thermal neither assumes nor authorizes anyone to assume for it any other obligation or liability in connection with the Product.

In addition to the preceding warranty, Heliotrope Thermal warrants the Product when a defect becomes evident after the first year warranty has expired. Heliotrope Thermal will repair or replace the defective Product for a reasonable charge, not to exceed 40% of the most recent List Price of the identical Product or its successor at the time of return, during the next four (4) years, and for a reasonable charge, not to exceed 50% of the most recent List Price of the identical Product or its successor at the time of return, during the next five (5) years. The product should be returned, freight prepaid, to Heliotrope Thermal, 4910 Seaport Ave., Richmond, CA, 94804, along with the proof of installation date. If this proof is not provided, the date of manufacture will be used. Should required service fee not be included with return or should defect be caused by a significant departure from Heliotrope Thermal's Installation Instructions, misuse, abuse, negligence, weather damage, accident or alteration, the replacement will be returned C.O.D. with appropriate reasonable service and shipping charges.

DELTA – T SOLAR CONTROL TROUBLESHOOTING GUIDE

Problem	Solution
1. The pump turns on only when the controller is set to “ON” and not when it is set to “AUTO”.	Verify there are two (2) 10 kOhm thermistor sensors installed: one sensor on the hot collector return and the other on the bottom of the storage tank. The storage tank sensor is a separate sensor than the one that comes with the storage tank. DO NOT hook up the tank’s existing sensor or heating element wiring to the controller. For glycol systems, set bit switches 5 and 6 to “OFF”, or in the right position. For direct water circulation, set bit switches 5 and 6 to “ON”.
2. The pump is on even when it is cloudy.	Verify the collector hot return temperature is greater than the tank temperature for the set differential. If true, this is normal operation. Switching bit switches 5 and 6 sets the temperature differentials (see controller manual).
3. The high temperature limit on the tank shuts off the power to the heating element but the collector loop pump keeps running.	Tank high limit power shut off switches typically come on at around 170°F. Turn the high limit switch (bit switch 1) on the controller to “ON” and set the high limit (bit switch 4) to 160°F
4. The pump turns on when there is no sun and it is cold outside.	A switch is factory set to “ON” to avoid freezing in pipes for systems not containing glycol. If you have a direct water system, it is normal operation. If you have a system containing glycol, turn this function off by switching bit switch 2 to the right, or “OFF” position. Set bit switch 3 to the right. This will not allow the pump to run at temperatures below 80°F (This does not disable freeze protection).
5. There is no place to hook up a redundant freeze control sensor.	The collector sensor doubles as the freeze protection sensor. The DTT controllers are not built to control a truly redundant freeze control sensor and the wiring instructions are beyond the scope of this guide.

HELIOTROPE THERMAL
4910 SEAPORT AVE., RICHMOND, CA. 94804
TEL: 510-237-9614 FAX: 510-237-7018
info@heliotropethermal.com