Revision

3

THERMO TECHNOLOGIES

USDT 2005 Analog Differential Controller

Note: The information supplied in this manual is for guidance only - no part of this may be used for any agreement, whether express or implied, or to form any contract. Thermo Technologies reserves the right to change specifications without prior notice.

The control unit has the following functions:

- 2 inputs for temperature sensors
- Suitable for sensors of type Thermistor and PT1000
- Adjustable (70 ^{o}F to 210 ^{o}F) overheating protection
- Adjustable (4 ^{o}F to 24 ^{o}F) temperature difference delta T
- Manual override of pump for system testing
- Symbolic display of all parameters
- Indications of current state of pump
- System status and diagnostic displays
- Collector sensor surge protection

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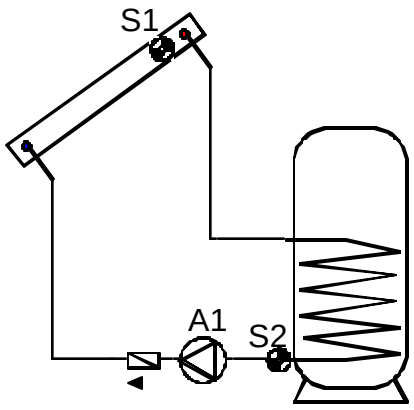
Installation and User's Guide

Introduction

The USDT 2005 unit is an analog temperature differential controller. It can be used in a wide range of applications. At the factory, it is set to control a simple solar water heating system.

Solar System Control (S) Mode

In this program mode, it ensures that the collected energy from the sun is transferred efficiently, and harnessed under optimum conditions. It monitors the collector temperature (T_{KS}) and the return temperature (T_{BS}, bottom of the storage tank). The solar loop circulation pump runs while the collector temperature exceeds the return temperature by an adjustable temperature difference ?T. To avoid overheating, the circulation pump stops if the return temperature (T_{BS}) reaches the adjustable high limit (T_{MAX}) temperature. The temperature hysteresis (a lagging in the set-point) may over-ride ?T to avoid pump cycling.

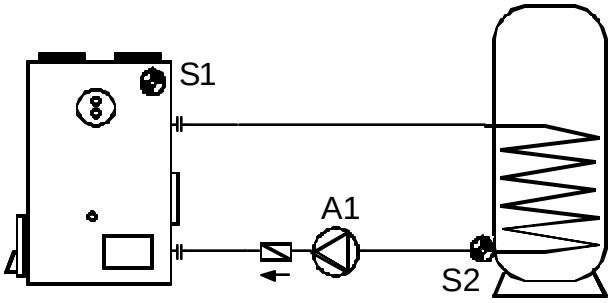


A1 (ON) only when S1 > (S2 + diff) & S2 < max

The pump A1 runs only when the temperature at the collector sensor **location S1** is higher than the return temperature at **location S2** by at least ?T. The pump stops if ?T is less than the preset value or, the if the temperature at location S2 (storage tank) has reached the **T_{MAX}**

Boiler Control (L) Mode

The User can switch USDT 2005 to operate a boiler circulator. In boiler mode (L), the pump runs only when boiler temperature at S1 location is higher than the minimum set point dialer and the ?T condition is satisfied.



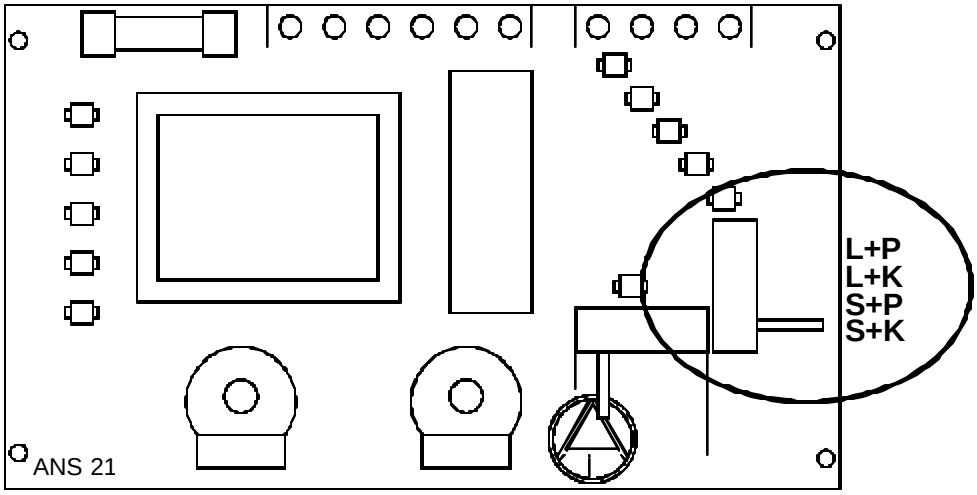
A1 (ON) only when S1 > max & S1 > (S2 + diff)

Note: The maximum temperature dialer (**max)** serves as the minimum starting temperature, **T_{MIN}** in the boiler mode. User must change the switch position on the back of the circuit board to use the USDT 2005 as a boiler controller. Details will follow.

MAX set point protects the solar system from overheating. It turns off the circulator if the boiler contribution to the storage tank is not satisfied.

Selection of Operation Mode

If you are using USDT 2005 for a solar system, you don't need to change anything. To use the unit as a boiler controller, change the miniature switch level to the desired position as shown below. The switch is located on the right side of the circuit board:



Change the switch position only when the unit is not energized. It is possible to damage the control unit if the mode change is performed under voltage.

Switch Positions:

- **S+K** Solar systems with KTY (2000 ohm) sensors
- **S+P** Solar systems with PT 1000 (1000 ohm) sensors
- **L+K** Boiler control with KTY (2000 ohm) sensors
- **L+P** Boiler control with PT 1000 (1000 ohm) sensors

The impedance characteristics of sensors temperature dependencies are represented in the following table:

T	0	10	20	25	30	40	50	60	70	80	90	100°C
R(KTY)	1630	1772	1922	2000	2080	2245	2417	2597	2785	2980	3182	3392 W
R(PT)	1000	1039	1078	1097	1117	1155	1194	1232	1271	1309	1347	1385 W

SPECIFICATION

Supply Voltage	120 V AC
Fuse	3.15 A
Phantom Load	max. 2 W
Hysteresis	6 degrees
Delta T	4 – 24 ^{o}F
Overheating Range	100 – 200 ^{o}F

INSTALLATION

Note: This installation procedure is for guidance only, and the installer should verify its suitability. Make sure that the solar/boiler system is physically installed, manually tested, and is ready for controlled operation.

The following safety precautions are strongly recommended:

1. Before attempting to install and operate the unit read this instruction manual carefully.

2. Only suitably qualified personnel should carry out installation and any maintenance required.

3. It is recommended that the unit be connected to the power supply via a suitably 6 amps isolating switch.

4. ***WARNING: When the unit is connected to the 115-volt power supply and the cover is opened, high voltage circuits will be exposed.*** Therefore, when installing the unit ensure all required connections are made and the cover is attached to the controller box before turning the power on. Ensure that all the connections are secure. If any maintenance work is required ensure that the unit is isolated from the power supply before removing the cover. ***Never leave the unit unattended if the cover has been removed and the power supply is connected.***

5. Do not exceed unit ratings of 2.15 amps (1/6 HP or 245 Watts pump).

6. It is advisable to route power cables away from sensor cables.

Sensor installation: Temperature sensors may be installed in fluid lines by mounting in a tee or strapping it to the piping directly. For the system to function correctly, it is very important that the sensors are located and installed properly. Make absolutely sure that they are pushed completely into the optional sensor pockets (Thermowell is not supplied). Sensors must be well insulated in order to prevent them from being influenced by the ambient temperature.

When used outdoors, no water should be allowed to get into the immersion sleeves (lasting impedance change). Generally, sensors should not be exposed to moisture (e.g. condensation) as this can diffuse through the cast resin and damage the sensor. Heating at approx. 195 °F for one hour may possibly save the sensor.

When sensors are used in open loops or swimming pools, make absolutely sure that immersion sleeves (sensor pockets) are corrosion-resistant.

- **Collector sensor (red cable with protective terminal box):** Insert the sensor jacket into a thermowell (sensor pocket), or strap it to the collector outlet pipe (flat plat collectors) that projects from the collector housing. The best practice is to install a suitable sensor pocket into a T-piece on the collector return outlet, to house the collector sensor. Protect sensor cable from UV and moisture.

- **Storage tank installation (white cable):** The sensor required for the solar loop is installed in the lower part of the storage tank. If there is no provision for a tank sensor, it is advisable to push the sensor beneath the insulation – keeping it close to the inner tank wall at the desired tank location.

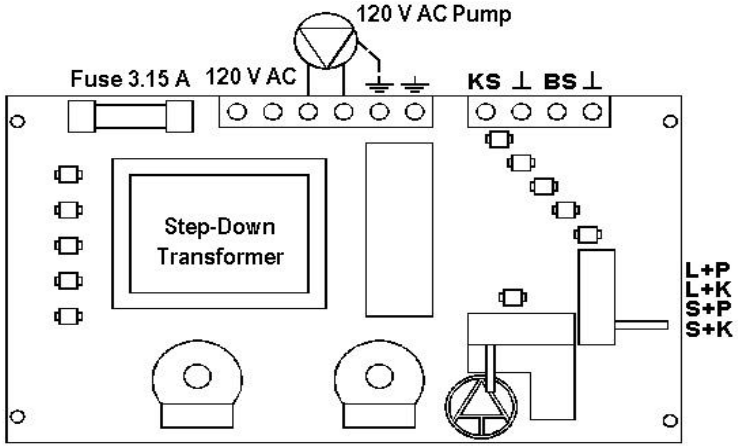
- **Pool sensor installation:** Place a heat conductive T-piece on the suction line directly at the pool outlet and screw in the sensor with an immersion sleeve (check corrosion resistance of the material used). Another possibility would be to attach the sensor at the same place with clips or adhesive tape, using appropriate thermal insulation against environmental influences.

- **Sensor cable extension:** Sensor cables (22/4 AWG telephone cable) can be extended up to 150 ft. A connection between the sensor and extension can be established as follows:

Cut supplied heat shrinkable tubing to desired length (about ½ "). Slide tubing over one end of wire to be sliced after removing enough outer insulation to accept the tubing. Then splice wire and slide tubing over the splice. Heat gently all around until tubing shrinks tight.

Slide larger tubing (about ¾ ") over the entire completed splice. Heat gently all around until tubing shrinks tight. This connection can then be drawn gently into the pipe work. You need only two wires for sensor cable; the other two wires are spare wires. Do not overheat tubing! Remove heat as soon as tubing shrinks tight, as material will continue to shrink. With flame source, use even back and forth motion all around tubing. A heat gun may be used, if available. Let tubing cool for maximum strength.

Controller unit installation: For viewing comfort, the controller unit should be positioned at eye level. It is always good practice to keep electronic equipment away from cold, and heat, as extremes of temperature may reduce the lifetime of the device. It is also good practice to keep electronic equipment away from heavy electrical loads, switches or contactors as these may cause electrical and electromagnetic interference when switched on or off.



Base of the unit to be mounted at the eye-level and wired as shown above

Undo the four screws at the corners of the housing. The control electronics are mounted on the enclosure cover. Using proper fixing, the controller enclosure can be screwed to the wall with cable entry grommets downwards.

Caution: Controller wiring should only be done when the unit is not energized. It is possible to damage the control unit if it is assembled under voltage. Miniaturized terminal blocks are used for making wiring connections. The wire is held in place within the terminal with a screw that provides excellent contact without damage to the wire.

Cable Connection: A small blade screwdriver may be used to fasten miniaturized terminal block screws while the corresponding wire is inserted.

Use up to an 18 AWG stranded wire to connect the sensor cables to the unit. The **KS** terminal should be connected to the **collector sensor** (higher temperature); the **BS** terminal is designated for the **return sensor** (lower temperature).

Power Connections: A small blade screwdriver may be used to fasten miniaturized terminal block screws while the corresponding wire is inserted.

NOTE 1: ***Always disconnect the controller from power supply before opening the housing.***

NOTE 2: The controller should be properly grounded. ***Flexible wires, 18/3 AWG (gauge/conductor), simplify connection to the terminals.*** *The power terminal block will accommodate wire sizes to 14 AWG. All other connections should be secured and adequately tightened, as loose power connections will over-heat, and may cause fire.*

NOTE 3: It is important that the specified output loads (245 Watts) are not exceeded. Where these loads expect to exceed, external relays must be used. Always keep power cables away from sensor cables and other low voltage signal cables.

NOTE 4: To protect against lightning damage, the system must be grounded according to local regulations. Sensor failures due to the weather or electrostatic are mostly due to poor grounding.

TROUBLESHOOTING

Problem: Nothing happens when unit is powered-up.
Cause/Remedy: The fuse could be blown – check and replace if necessary. If the fuse blows again, then the pump draws more current than the unit is design to supply. Use an auxiliary relay or contact your product supplier.

Problem: One or more LED's is fluctuating.
Cause/Remedy: This indicates a system alarm warning, which may be caused by a sensor fault:

- Lower Collector LED blinks ➔ Collector sensor cable is short circuited
- Lower Storage Tank (70 ^{o}F) LED blinks ➔ Return sensor cable is short circuited
- Upper Collector LED blinks ➔ Collector sensor cable is open
- Upper Storage Tank (200 ^{o}F) LED blinks ➔ Return sensor cable is open