Instruction Manual

TD500 Dual-Probe Controller for Beer Fermentation

Version 1.0 (May 2017)

1. Overview

This is a dual-probe, dual-output temperature controller designed for beer fermentation. It comes with two temperature probes. The Probe 1 has stainless steel house with NPT thread or Tri-clamp fitting, which is suitable for directly measuring beer temperature. The Probe 2 is a free-hanging probe for monitoring the temperature of the cooling medium, which can be the air in the fridge or the coolant in the coolant jack. While the control output is mainly determined by the Probe 1 reading, constraints on the output can also be added based on the Probe 2 reading. For example, the user can tell the controller to stop its output if the ambient temperature becomes too low or too high.

The controller has two outputs. one output for heating device and one output for the cooling device. By using both cooling and heating devices, the user can achieve the fermentation temperature no matter what the ambient temperature is.

This dual-probe controller (TD500) has a few advantages over the single probe fermentation controller (TD120): 1) it directly monitors both the beer temperature and the ambient temperature, 2) the second probe allow the user set up constraints on the output based on the ambient temperature. This provides a higher precision control than the single-probe controller.

2. Specifications

Temperature Control Range	-50 ~ 120°C, -58 ~ 248°F
Display Resolution	0.1°C (between -9.9 ~ 99°C) 1°C (between -50 ~ 10°C, 100 ~ 120°C) 0.1°F (between -9.9 ~ 99.9°F) 1°F (between -58 ~ 10°F, 100 ~ 248°F)
Temperature Accuracy	0.5°C or 0.9°F
Temperature Control Mode	On/off control; heating and cooling
Temperature Control Output	10 A, 120 V or 240 V AC *
Audio Alarm	High and Low Limit
Sensor Type	Silicon Band Gap Sensor
Operating Temperature	-20 ~ 50°C
Dimension	91 x 140 x 46 mm
Input Power	85 ~ 242 VAC, 50 / 60 Hz
Probe 1 Cable Length	8 ft (2.4 m)
Probe 2 Cable Length	12 ft (4 m)
Probe 2 Sensor Size (free hanging)	0.25" OD (6.35 mm) x 1" (25 mm) long
Power Cable Length	3 ft (1 m)
Controller Warranty	1 Year

3. Front Panel

Figure 1. Front Panel of TD500.

The Probe 1 is for monitoring the temperature of the object to be controlled, while the Probe 2 is for monitor the ambient temperature. The display window shows the Probe 1 reading (**t1**). To check the Probe 2 reading (**t2**), press the DOWN key once. The display will switch back to **t1** after 5 seconds automatically.

4. Parameters

4.1. Access the Parameters

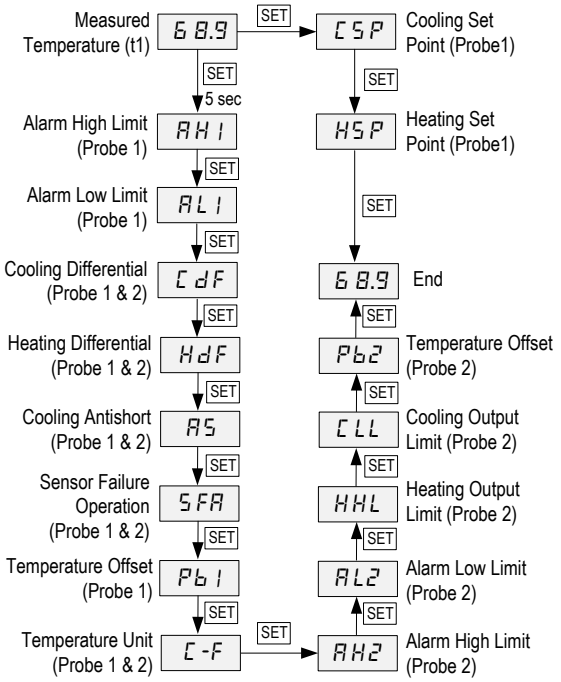


Figure 2. Flow chart of setting up parameters.

In normal display mode, press SET key to access the Cooling Set Point (**CSP**) and Heating Set Point (**HSP**). In normal display mode, press and hold SET key for 5 seconds to access the control parameters. Please see Figure 2 for the flow chart of how to access each parameter.

Please see the Table 1 for the list of parameters. To check and change a parameter:
1) Follow the flow chart in Figure 2 to bring the parameter to the display window.
2) Press the UP or DOWN key briefly so the parameter value will be displayed.
3) Press the UP or DOWN key again to adjust the value. Then press the SET key to save the value. Press the SET key again to go to the next parameter. The device will automatically exit the parameter setting mode if no key is pressed for 10 seconds.

4.2. Parameter Details

Table 1. Parameters Description.

Code		Description	Setting range	Initial	Note
CSP	CSP	Cooling Set Point (Probe 1)	-58 ~ 248ºF -50 ~ 125ºC	67.0	1
HSP	HSP	Heating Set Point (Probe 1)	-58 ~ CSPºF -50 ~ CSPºC	62.0	
AH1	AH1	Alarm High Limit (Probe 1)	-58 ~ 248ºF -50 ~ 125ºC	80.0	2
AL1	AL1	Alarm Low Limit (Probe 1)	-58 ~ AHºF -50 ~ AHºC	45.0	
CdF	CdF	Cooling Differential (Probe 1 & 2)	0 ~ 50.0ºF	3.0	1, 7
HdF	HdF	Heating Differential (Probe 1 & 2)	0 ~ 50.0ºF	1.0	
AS	AS	Cooling Anti-short (Probe 1 & 2)	0 ~ 12 min	6	3
SFA	SFA	Sensor Failure Operation (Probe 1 & 2)	ON, OFF	ON	4
PB1	Pb1	Probe 1 Offset	-10.0 ~ 10.0	0	5
PB2	Pb2	Probe 2 Offset	-10.0 ~ 10.0	0	
C-F	C-F	Temperature Unit (Probe 1 & 2)	C: Celsius F: Fahrenheit	F	6
AH2	AH2	Alarm High Limit (Probe 2)	-58 ~ 248ºF -50 ~ 125ºC	87.0	2
AL2	AL2	Alarm Low Limit for (Probe 2)	-58 ~ AH ºF -50 ~ AH ºC	40.0	
HHL	HHL	Heating Output Limit (Probe 2)	-58 ~ 248ºF -50 ~ 125ºC	80.0	7
CLL	CLL	Cooling Output Limit (Probe 2)	-58 ~ CSP ºF -50 ~ CSP ºC	53.0	
PB2	Pb2	Temperature Offset (Probe 2)	-10.0 ~ 10.0	0	5

Note 1. CSP is the Cooling Set Point, **HSP** is the Heating Set Point. When Probe 1 reading, **t1**, is higher than (**CSP** + **CdF**), controller will send power to the cooling output socket till **t1** drops below CSP. When Probe 1 reading (**t1**) is lower than (**HSP** - **HdF**), the controller will send power to the heating output socket till **t1** rise above **HSP**.

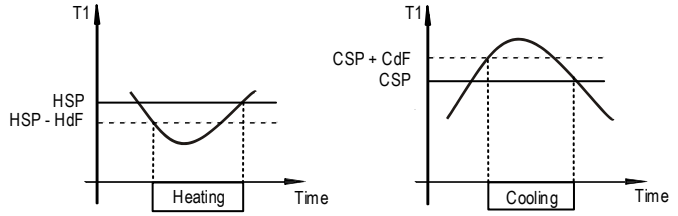


Figure 3. Diagrams that show when the controller will turn on the heating or cooling device.

The value of HSP should be no higher than **CSP**. **CSP** can be set to any value between -58 ~ 248ºF (-50 ~ 125ºC). If the new **CSP** value is set to a value lower than the current HSP, then the HSP will be automatically adjusted to the same value as **CSP** value.

For example, when **CSP** = 67.0ºF, **HSP** can be set to any value between -58ºF and 67.0ºF. If you set it to 55.0ºF, the HSP will be set to 55.0ºF automatically.

Small cooling and heating differentials setting (**CdF** and **HdF**) give tight control; large differentials reduce the frequency of cycling the power too frequently. It will extend the life of relay and compressor.

Note 2. Each probe has two alarm settings. Probe 1 is controlled by **AH1** and AL1; Probe 2 is controlled by **AH2** and **AL2**. **AH1** and **AH2** are the high limit temperature alarms for Probe 1 and Probe 2; **AL1** and **AL2** are the low limit temperature alarms for Probe 1 and Probe 2. For example, when measured temperature **t1** is higher than AH1, the high limit alarm will be on; when the measured temperature **t1** is lower than AL1, the low limit alarm will be on.

When alarm is on, the display will be flashing between the **t1** temperature and alarm type. To mute the alarm when it is on, press the Up key momentarily. If the measured value gets out of the alarm zone then gets back to the alarm zone again, the alarm will be on again. To disable the alarm, set **AH1** = **AL1** or **AH2** = **AL2**.

Note 3. The Cooling Anti-Short (**AS**) is the delay time to prevent the cooling device (typically a compressor) being rapidly cycled on and off. When a compressor is being used with the controller as a cooling device, it should not be turned on when it is at high pressure (just after turned off); otherwise, its life may be shortened. This function only applies to the cooling output socket. The anti-short timer starts when the cooling socket is dis-engaged, it establishes a minimum time after which the cooling socket can be energized again. The delay overrides any load demand and does not allow the NO contacts to close until the anti-short-delay-time has elapsed. This time delay allows the compressor to release the refrigerant pressure through its evaporator. It is typically set to 4 - 6 minutes.

Note 4. The **SFA** defines how the controller reacts to a sensor failure from Probe 1. It can be set to **ON** or **OFF**. This parameter does not apply to Probe 2.

SAF = **ON**, controller will continue to operate on Probe 2 reading. When Probe 1 fails, the build-in buzzer will go off; the display will flash “Err” and “---” alternately; the controller will use Probe 2 reading as Probe 1 reading and

continue to operate as a single-probe controller. All the functions or parameters related to Probe 2 are disabled, including parameter **AH2**, **AL2**, **HHL**, and **CLL**.

SFA = **OFF**, controller will stop sending power. When Probe 1 fails, the build-in buzzer will go off; the display will flash "Err" and "---" alternately, and both the heating and the cooling outputs will be disabled.

In the case of Probe 2 failure, the build-in buzzer will go off, the display will flash "Err" and the Probe 1 readying alternately. The controller will work as a single-probe controller, but all the functions and parameters related to Probe 2 will be disabled, including parameter **AH2**, **AL2**, **HHL**, and **CLL**.

Note 5. PB1 and **PB2** are input offsets to compensate the error in the probe readings. **PB1** is for Probe 1 and **PB2** is for Probe 2. For example, if Probe 1 reads 33ºF in an ice bath whose temperature is verified to be 32ºF, set Pb1 = -1 will make the controller show 32ºF.

Note 6. C-F determines the temperature display unit on the controller. It can be set to C (Celsius, ˚C) or F (Fahrenheit, ˚F).

Note 7. Both **HHL** and **CLL** are output-restriction parameters that depends on the Probe 2 reading. If Probe 2 fails, these two parameters, HHL and CLL, will be ignored.

Parameter **HHL** defines the Heating High Limit of the ambient temperature (Probe 2). If Probe 2 reads a temperature **t2** that is higher than **HHL**, the heating output will be disabled even if the controller calls for power to the heating device based on the Probe 1 reading. When Probe 2 reading **t2** drops back below (**HHL - HdF**), the output restriction will be removed. Please see Figure 4 for a diagram showing when does the restriction condition apply. The **HHL** can only be triggered when the controller calls for heating; when it is triggered, the display will show current **t1** and **HHL** alternatively.

Similarly, **CLL** is the Cooling Low Limit of the ambient temperature (Probe 2). If Probe 2 reads a temperature **t2** that is lower than **CLL**, the cooling output will be disabled even if the controller calls for power to the cooling device based on the Probe 1 reading. When Probe 2 reading **t2** rise above **CLL** and reaches (**CLL + CdF**), the output restriction will be removed. The **CLL** can only be triggered when the controller calls for cooling; when it is triggered, the display will show current **t1** and **CLL** alternatively. Please note that the cooling anti-short delay time (**AS**) also applies to situations where cycling the cooling output is caused by ambient temperature moves up and down around **CLL**.

Normally in situations where both heating and cooling devices are employed, the user should keep **CLL** < **HSP** < **CSP** < **HHL**. Please see Figure 5 for how should the **CLL** and **HHL** be set up typically. But **HHL** doesn't have to be greater than **CLL** in situations where only one output socket is used. Please see Application Example 8.1 for details. The flow chart in Figure 6 shows how does the controller decide on whether to send power based on the sensor input from Probe 1 and Probe 2.

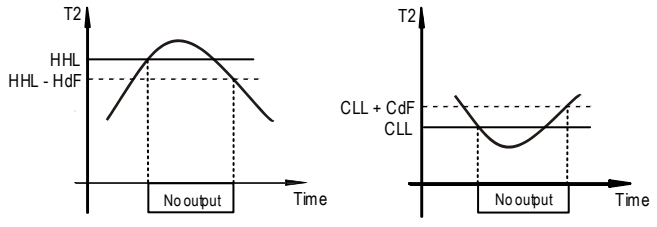


Figure 4. Power output will be restricted when the Probe 2 reading (**t2**) is higher than **HHL** (left) or lower than **CLL** (right).

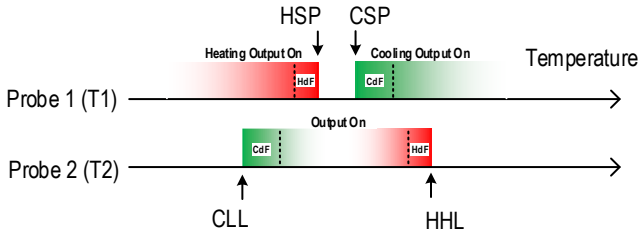


Figure 5. Use **HHL** and **CLL** to limit the output.

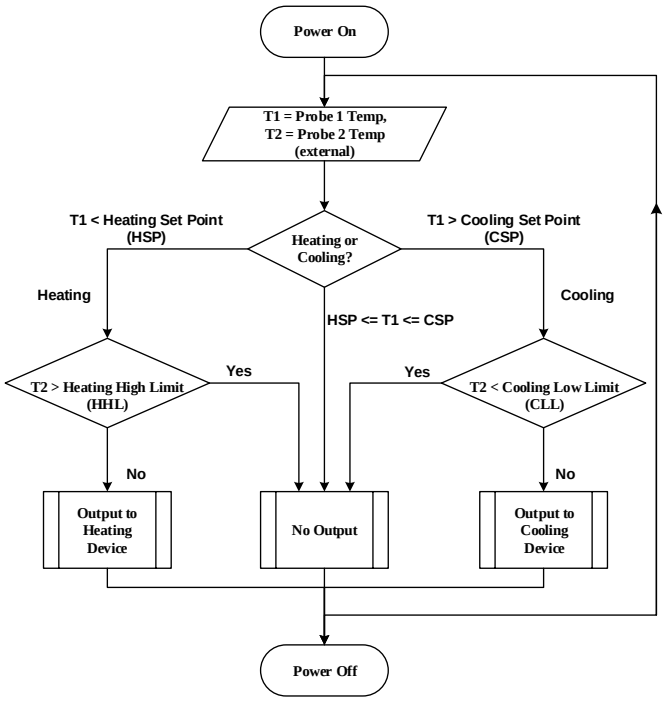
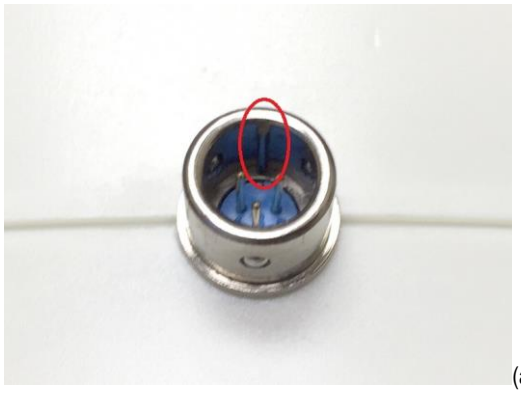


Figure 6. A flow chart shows how does the controller works based on its temperature readings from Probe 1 and Probe 2.

6. How to install the sensor to the unit.

The connector of sensor contains a slot for fitting pin connection. It also has a spring lock to prevent disconnections from accidental pulling on the cable. To install the sensor to the controller: 1) identify the key on the male connector (Figure 7, a) and the notch on the female connector (Figure 7, b); 2) hold the tail of the female connector, align the notch and the key, and push the female connector forward (Figure 7, c). To remove the connector, hold the spring-loaded collar on the female connector and pull it back. Please see Figure 8.


(a)


(b)


(c)

Figure 7. Install the sensor.

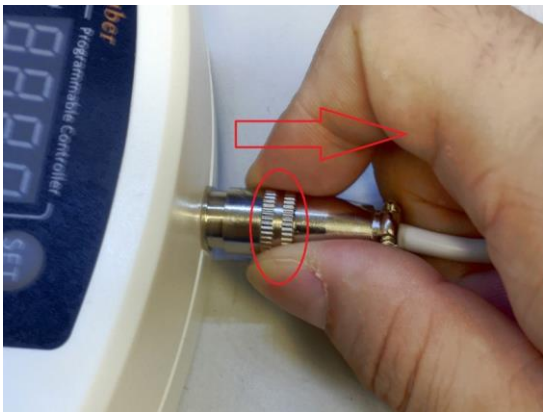


Figure 8. Remove the sensor.

7. FAQs

1) Error message "Err" and "---".

If the display shows "Err" and alarm buzzer is ringing, the controller has detected a sensor error. There could be a bad cable connection, bad sensing element, or simply no sensor is connected. You can mute the buzzer by pressing the up-arrow key. When the display shows "---", it means there is no reading from the current probe input channel.

2) How to mute the buzzer.

To mute the buzzer, press the UP key.

8. Application Example

8.1 Use TD500 for beer fermentation.

In this application, a carboy of wort is put in a chest freezer to ferment. The freezer is plugged to the cooling socket of the TD500 controller. No light bulb is employed as the heating device. Probe 1 is dropped to into the carboy to monitor wort temperature, and Probe 2 is left in the chest freezer to monitor the air temperature inside the freezer.

So here are the parameters we need to change from their default values: **CSP** = 66°F, **CdF** = 1°F, **AS** = 4 min, and **CLL** = 50°F.

When this fermentation system works, controller energize the freezer when the wort temperature is higher than 66°F. As the freezer starts working, the temperature inside drops fast. Soon the air temperature in the freezer has been much lower than the wort temperature. Once the freezer temperature drops below 50°F, which is the **CLL** in this case, the controller will stop sending power to the freezer so the air temperature in the freezer won't dip too low.

Auber Instruments Inc.
5755 North Point Parkway, Suite 99,
Alpharetta, GA 30022
www.auberins.com
E-mail: info@auberins.com Tel: 770-569-8420