

Board Configuration

The board operation is controlled through the bank of DIP Switches labeled SW1 located on the component side of the board in the lower left corner. These switches must be set for the cooler to operate properly. The switches numbered 1, 2, and 3 of the DIP switch set the function of the board.

	SW 1	SW2	SW3
Single Channel Cooler with communications	OFF	OFF	OFF
Single Channel Cooler 2 nd board	ON	OFF	OFF
1 st Frozen channel	OFF	OFF	ON
2 nd Frozen channel	ON	OFF	ON
Dual Channel Cooler	OFF	ON	OFF
NJ TC Display	ON	ON	OFF

Display

Single Channel Cooler

Basic Display Description

3 digit plus sign temperature display

Temperature is displayed in tenths of °C

Green LED to display 'Ready' status

Green LED to display 'Water Slip' status

Red LED to display 'TC Fail' status

Detailed Display Description

The digital display shows both temperature and status of the cooler.

The display will display temperature constantly when the impinger temperature is below the user set 'Ready' temperature and no other faults are present. One fault is the 'Water Slip', the sensing of liquid water downstream of the sensor, though the use of a water slip sensor. The other fault would be a 'TC Failure' indicating an open thermocouple sensor.

The display will blink the temperature when impinger temperature is above the user set 'Ready' temperature and no other faults are present. The display switches every second between blank and the temperature, in this condition.

If a 'Water Slip' failure is detected the display will switch between showing the measured temperature and a symbolic "SLP". The display switches every second between "WS" and the temperature.

If a 'TC Failure' is detected the display will switch between showing blank and the letters "tcF".

If both a 'TC Failure' and a 'Water Slip' failure are detected the display will switch between showing the letters "tcF" and a symbolic "SLP". The display switches every second between "tcF" and "SLP".

Detailed LED Description

The LED indicators show the status of the cooler.

The top LED, which is green, will turn on when impinger temperature is below the user set 'Ready' temperature.

The top LED will turn off when impinger temperature is above the user set 'Ready' temperature.

The middle LED, which is green, will turn on there is not a 'Water Slip' failure showing the system is working correctly.

The middle LED will turn off when water is detected.

The bottom LED, which is red, will turn off there is not a 'TC Failure' showing the system is working correctly.

The bottom LED will turn on when an open condition is detected on the thermocouple.

The operation of the 'Ready' and Water Slip' indicators changes if the user selects the relay latching option. Once the 'Ready' temperature is reached for the first time the latching option goes into effect. If an alarm occurs after the first 'Ready' indication the relays will remain off until the user supplies a contact closure to the board to reset the alarm. The LED indicators will blink when the alarm condition has been removed but the relay has not yet been reset.

1st Frozen

Basic Display Description

3 digit plus sign temperature display
Temperature is displayed in tenths of °C
Green LED to display 'Ready' status
Green LED to display 'Valve' status
Red LED to display 'TC Fail' status

Detailed Display Description

The digital display shows both temperature and status of the cooler.

The display will display temperature constantly when impinger temperature is below the user set 'Ready' temperature and no other faults are present. The fault would be a 'TC Failure' indicating an open thermocouple sensor.

The display will blink the temperature when impinger temperature is above the user set 'Ready' temperature and no other faults are present. The display switches every second between blank and the temperature, in this condition.

If a 'TC Failure' is detected the display will switch between showing blank and the letters "tcF".

Detailed LED Description

The LED indicators show the status of the cooler.

The top LED, which is green, will turn on when active impinger temperature is below the user set 'Ready' temperature. Since this is a switching system the 'Ready' indication is tied to the active impinger.

The top LED will turn off when the active impinger temperature is above the user set 'Ready' temperature.

The middle LED, which is green, will turn on the flow control valve is on. The valve is used to switch the flow stream between the cycling impingers. The valve is on when the stream is flowing through the 2nd impinger.

The bottom LED, which is red, will turn off there is not a 'TC Failure' for the 1st frozen impinger only

The bottom LED will turn on when an open condition is detected on the thermocouple.

2nd Frozen

Basic Display Description

3 digit plus sign temperature display
Temperature is displayed in tenths of °C

Detailed Display Description

The digital display shows both temperature and status of the cooler.

The display will display temperature constantly when impinger temperature is below the user set 'Ready' temperature and no other faults are present. The fault would be a 'TC Failure' indicating an open thermocouple sensor.

The display will blink the temperature when impinger temperature is above the user set 'Ready' temperature and no other faults are present. The display switches every second between blank and the temperature, in this condition.

If a 'TC Failure' is detected the display will switch between showing blank and the letters "tcF".

Detailed LED Description

The 2nd frozen impinger does not have any LED indication

Dual Channel Cooler

Basic Display Description

3 digit plus sign temperature display
Temperature is displayed in tenths of °C
Green LED indicate 1 channel displayed
Green LED indicate 2 channel displayed

Detailed Display Description

The digital display shows both temperature and status of the cooler. The display can be set to constantly switch between the two channels or to work with an external dry contact to select channel to be displayed.

The display functions the same for both channels.

The display will display temperature constantly when impinger temperature is below the user set 'Ready' temperature and no other faults are present. One fault is the 'Water Slip', the sensing of liquid water downstream of the sensor, though the use of a water slip sensor. The other fault would be a 'TC Failure' indicating an open thermocouple sensor.

The display will blink the temperature when impinger temperature is above the user set 'Ready' temperature and no other faults are present. The display switches every second between blank and the temperature, in this condition.

If a 'Water Slip' failure is detected the display will switch between showing the measured temperature and a symbolic "SLP". The display switches every second between "SLP" and the temperature.

If a 'TC Failure' is detected the display will switch between showing blank and the letters "tcF".

If both a 'TC Failure' and a 'Water Slip' failure are detected the display will switch between showing the letters "tcF" and a symbolic "SLP". The display switches every second between "tcF" and "SLP".

The single 'Water Slip' alarm will be displayed on both channels.

A single channel, channel 1, can be constantly displayed by selecting the switch option in set up and omitting the switch.

Detailed LED Description

The LED indicators show the current channel being displayed.

The top LED, which is green, will turn on when channel 1 is displayed.

The lower LED, which is green, will turn on when channel 2 is displayed.

NJ Thermocouple Display

Basic Display Description

3 digit plus sign temperature display

Temperature is displayed in tenths of °C

Green LED indicate 1 channel displayed

Green LED indicate 2 channel displayed

Detailed Display Description

The digital display shows both temperature and status of the cooler.

The display can be set to constantly switch between the two channels or to work with an external dry contact to select channel to be displayed.

The display functions the same for both channels.

The display will display temperature constantly when impinger temperature is below the user set 'Ready' temperature and no other faults are present. One fault is the 'Water Slip', the sensing of liquid water downstream of the sensor, through the use of a water slip sensor. The other fault would be a 'TC Failure' indicating an open thermocouple sensor.

The display will blink the temperature when impinger temperature is above the user set 'Ready' temperature and no other faults are present. The display switches every second between blank and the temperature, in this condition.

If a 'Water Slip' failure is detected the display will switch between showing the measured temperature and a symbolic "SLP". The display switches every second between "SLP" and the temperature.

If a 'TC Failure' is detected the display will switch between showing blank and the letters "tcF".

If both a 'TC Failure' and a 'Water Slip' failure are detected the display will switch between showing the letters "tcF" and a symbolic "SLP". The display switches every second between "tcF" and "SLP".

The single 'Water Slip' alarm will be displayed on both channels.

A single channel, channel 1, can be constantly displayed by selecting the switch option in set up and omitting the switch.

Detailed LED Description

The LED indicators show the current channel being displayed.

The top LED, which is green, will turn on when channel 1 is displayed.

The lower LED, which is green, will turn on when channel 2 is displayed.

Outputs

Single Channel Cooler

The impinger temperature is available as a voltage output equal to $0.1 \text{ V} / ^\circ\text{C}$. Analog out 1 is controlled by the temperature measured from thermocouple #1.

Each control board has two field replaceable relays.

Relay 1 is activated when the impinger temperature is below the user set 'Ready' temperature. The relay does not deactivate until the impinger temperature rises to $0.5 \text{ }^\circ\text{C}$ above the 'Ready' temperature. This hysteresis is set to avoid relay chatter when the impinger is near the set temperature.

Relay 2 is activated when the 'Water Slip' sensor is dry and the system is working properly. The relay is off when water is detected at the sensor.

Both relays have two sets of contacts. The standard factory wiring uses one set to operate a sample pump. The second set of contacts is available for field wiring by the user.

The relays can be selected to operate either in automatic reset or latching by the user.

1st Frozen

The impinger temperature is available as a voltage output equal to $0.1 \text{ V} / ^\circ\text{C}$.

Analog out 1 is controlled by the temperature measured from thermocouple #1.

Each control board has two field replaceable relays.

Relay 1 is activated when the active impinger temperature is below the user set 'Ready' temperature. The relay does not deactivate until the impinger temperature rises to 0.5 °C above the 'Ready' temperature. This hysteresis is set to avoid relay chatter when the impinger is near the set temperature. The source for the 'Ready' relay will change depending on which of the impingers, 1st or 2nd frozen, is active.

Relay 2 controls the valve used to control the sample flow to the frozen impingers. The relay is activated when the 2nd frozen impinger is active.

Both relays have two sets of contacts. The standard factory wiring uses one set of contacts. The second set of contacts is available for field wiring by the user.

2nd Frozen

The impinger temperature is available as a voltage output equal to 0.1 V / °C. Analog out 1 is controlled by the temperature measured from thermocouple #1.

Each control board has two field replaceable relays.

Relay 1 is activated when the 2nd frozen impinger temperature is below the user set 'Ready' temperature. The relay does not deactivate until the impinger temperature rises to 0.5 °C above the 'Ready' temperature. This hysteresis is set to avoid relay chatter when the impinger is near the set temperature.

Relay 2 is not used

Neither relay is factory wired.

Dual Channel Cooler

The impinger temperatures are available as a voltage output equal to 0.1 V / °C. Analog out 1 is controlled by the temperature measured from thermocouple #1. Analog out 2 is controlled by the temperature measured from thermocouple #2.

Each control board has two field replaceable relays.

Relay 1 is activated when the impinger temperature channel 1 is below the user set 'Ready' temperature. The relay does not deactivate until the impinger temperature rises to 0.5 °C above the 'Ready' temperature. This hysteresis is set to avoid relay chatter when the impinger is near the set temperature.

Relay 2 is activated when the impinger temperature channel 2 is below the user set 'Ready' temperature. The relay does not deactivate until the impinger

temperature rises to 0.5 °C above the 'Ready' temperature. This hysteresis is set to avoid relay chatter when the impinger is near the set temperature.

The unit can be set to have the 'Water Slip' input to control the relays in several ways. The 'Water Slip' can;

- Control Relay1 in conjunction with 'Ready' on channel 1

- Control Relay2 in conjunction with 'Ready' on channel 2

- Control Relay2 alone

Both relays have two sets of contacts. The standard factory wiring uses one set to operate a sample pump. The second set of contacts is available for field wiring by the user.

NJ Thermocouple Display

The impinger temperatures are available as a voltage output equal to 0.1 V / °C.

Analog out 1 is controlled by the temperature measured from thermocouple #1.

Analog out 2 is controlled by the temperature measured from thermocouple #2.

Each control board has two field replaceable relays.

Relay 1 is activated when the impinger temperature channel 1 is below the user set 'Ready' temperature. The relay does not deactivate until the impinger temperature rises to 0.5 °C above the 'Ready' temperature. This hysteresis is set to avoid relay chatter when the impinger is near the set temperature.

Relay 2 is activated when the impinger temperature channel 2 is below the user set 'Ready' temperature. The relay does not deactivate until the impinger temperature rises to 0.5 °C above the 'Ready' temperature. This hysteresis is set to avoid relay chatter when the impinger is near the set temperature.

The unit can be set to have the 'Water Slip' input to control the relays in several ways. The 'Water Slip' can;

- Control Relay1 in conjunction with 'Ready' on channel 1

- Control Relay2 in conjunction with 'Ready' on channel 2

- Control Relay2 alone

Both relays have two sets of contacts. The standard factory wiring uses one set to operate a sample pump. The second set of contacts is available for field wiring by the user.

Switch Inputs

Single Channel Cooler

There are two dry contact inputs for each board labeled External Switches.

External Switch 1 will force the relays off even when there is no water present and the impinger temperature is below 'Ready'. This can be used to keep the sample pump from turning on as soon as the cooler is ready to allow for other portions of the system to become ready for sampling.

External Switch 2 will reset the latched alarms. This switch is only active when the Relay = Latch option is selected in set up.

1st Frozen

There are two dry contact inputs for each board labeled External Switches.

External Switch 1 will force the changeover of active impingers in the frozen system. The switch is not active during the changeover period when both impingers are cooling.

External Switch 2 has no associated function.

2nd Frozen

External Switches have no associated functions.

Dual Channel Cooler

There are two dry contact inputs for each board labeled External Switches.

External Switch 1 will select the channel to be displayed. This switch is only active when the Display = Switch option is selected in set up. An open connection between the terminals displays channel 1; a contact closure displays channel 2.

External Switch 2 has no associated function.

NJ Thermocouple Display

There are two dry contact inputs for each board labeled External Switches.

External Switch 1 will select the channel to be displayed. This switch is only active when the Display = Switch option is selected in set up. An open connection between the terminals displays channel 1; a contact closure displays channel 2.

External Switch 2 has no associated function.

Calibration

Overview

Each board must be calibrated before use. The calibration consist of several steps including setting the Cold Junction temperature, calibrating the thermocouple input for channel 1 and 2, and calibrating the voltage output 1 and 2.

A volt meter and a thermocouple calibrator are required for the operations. The cold junction temperature should be set first prior to the thermocouple calibration.

Cold Junction Temperature

Turn both #5 and #6 switches to the 'ON' position of the DIP Switch labeled SW1. The display will toggle between a label of 'cJt' and the value of the board temperature. The label 'cJt' will be displayed for 1 second followed by the value of the board temperature for 3 seconds.

Measure the temperature of the board near the thermocouple connectors. Adjust the displayed temperature using the 'UP' or 'DOWN' buttons. When the temperature displayed matches the measured value; move switches #5 and #6 to the 'OFF' position to record the value.

Analog Calibration (Voltage output calibration)

Move switch #6 to the 'ON' position of the DIP Switch labeled SW1 to begin calibration. The front digital display will go blank. The back indicator LED lights will be lit and display the calibration stage.

Voltage Output Calibration

Voltage 1

Connect negative probe of the volt meter to 'Analog Output' connector CN11 to pin 1 'COMM'.

Connect positive probe of the volt meter to 'Analog Output' connector CN11 to pin 3 'AN1(+)'.

Set the voltmeter range to +/- 2.000 VDC, 1 mV resolution.

Voltage 1 Zero is the first step; The top light is on solid and the next three lights will blink.

LED indicators in order top to bottom

CAL : CHANNEL : IN / OUT : HIGH / LOW

SOLID

BLINK

BLINK

BLINK

The volt meter will display the voltage associated with 0.0 °C. Adjust the output voltage using the 'UP' and 'DOWN' buttons. Press the 'NEXT' button when the voltage output measures 0.000 +/- 0.005 VDC.

Voltage 1 Span is the second step; The top light is on solid and the next two lights will blink and the bottom light is on solid.

LED indicators in order top to bottom
CAL : CHANNEL : IN / OUT : HIGH / LOW
SOLID
BLINK
BLINK
SOLID

The volt meter will display the voltage associated with 20.0 °C. Adjust the output voltage using the 'UP' and 'DOWN' buttons. Press the 'NEXT' button when the voltage output measures 1.000 +/-0.005 VDC.

Move the positive probe of the volt meter to 'Analog Output' connector CN11 to pin 2 'AN2(+)'.

Voltage 2 Zero is the third step; the top and second lights are on solid and the lower two lights will blink.

LED indicators in order top to bottom
CAL : CHANNEL : IN / OUT : HIGH / LOW
SOLID
SOLID
BLINK
BLINK

The volt meter will display the voltage associated with 0.0 °C. Adjust the output voltage using the 'UP' and 'DOWN' buttons. Press the 'NEXT' button when the voltage output measures 0.000 +/-0.005 VDC.

Voltage 2 Span is the fourth step; the top and second lights are on solid the next light will blink and the bottom light is on solid.

LED indicators in order top to bottom
CAL : CHANNEL : IN / OUT : HIGH / LOW
SOLID
SOLID
BLINK
SOLID

The volt meter will display the voltage associated with 20.0 °C. Adjust the output voltage using the 'UP' and 'DOWN' buttons. Press the 'NEXT' button when the voltage output measures 1.000 +/-0.005 VDC.

Thermocouple Inputs

Thermocouple1 -20°C is the fifth step; the top and third lights are on solid and the second and bottom lights are blinking.

LED indicators in order top to bottom
CAL : CHANNEL : IN / OUT : HIGH / LOW
SOLID
BLINK
SOLID
BLINK

The volt meter will display the maximum voltage output, approximately 3.6 VDC.
The volt meter can be disconnected.

Disconnect the thermocouple(s) from the control board. The thermocouples should be labeled on any unit with multiple sensors to insure correct reassembly after calibration.

Connect the thermocouple calibrator to 'TC1' connector CN9. Set calibrator to -20.0°C; K thermocouple. Allow 30 seconds, 15 LED blinks, for calibrator output and control board input to stabilize.

Press the 'UP / TAKE' button to record the input value. The board will automatically move to the next step.

Thermocouple1 20°C is the sixth step; the top, third and bottom lights are on solid and the second light is blinking.

LED indicators in order top to bottom
CAL : CHANNEL : IN / OUT : HIGH / LOW
SOLID
BLINK
SOLID
SOLID

Set calibrator to 20.0°C; K thermocouple. Allow 30 seconds, 15 LED blinks, for calibrator output and control board input to stabilize.

Press the 'UP / TAKE' button to record the input value. The board will automatically move to the next step.

Thermocouple2 -20°C is the seventh step; the top, second and third lights are on solid and the bottom light is blinking.

LED indicators in order top to bottom
CAL : CHANNEL : IN / OUT : HIGH / LOW
SOLID
SOLID

SOLID
BLINK

Connect the thermocouple calibrator to 'TC2' connector CN10. Set calibrator to -20.0°C; K thermocouple. Allow 30 seconds, 15 LED blinks, for calibrator output and control board input to stabilize.

Press the 'UP / TAKE' button to record the input value. The board will automatically move to the next step.

Thermocouple 1 20°C is the eighth step; all four lights are on solid.

LED indicators in order top to bottom

CAL : CHANNEL : IN / OUT : HIGH / LOW

SOLID

SOLID

SOLID

SOLID

Set calibrator to 20.0°C; K thermocouple. Allow 30 seconds for calibrator output and control board input to stabilize.

Press the 'UP / TAKE' button to record the input value.

The board will automatically move to the first step, Voltage 1 zero.

Move switch #6 to the 'OFF' position of the DIP Switch labeled SW1 to exit calibration and return to operation. The front digital display will return to being active and the back indicator LED lights not be lit. The updates are automatically saved.

Board Configuration (Parameter Set Up)

Overview

Move switch #5 to the 'ON' position of the DIP Switch labeled SW1 to begin board configuration.

The display will toggle between the label for each menu item and the value for that specific item. The label will be displayed for 1 second followed by the value which is displayed for 3 seconds.

Press the "Next" button to navigate through the menu items. The button will only move to the next item. The items are displayed in a cyclical fashion so you will be able to come back around to any item as needed.

The "UP" and "DOWN" buttons are used to adjust the value of the menu item. The values have maximum and minimum ranges. Pressing the "UP" button when the maximum value is displayed will change the value to the minimum value. Conversely pressing the "DOWN" button when the minimum value is displayed will change the value to the maximum value.

Move switch #5 to the 'OFF' position of the DIP Switch labeled SW1 to exit board configuration and return to operation. The updates are automatically saved.

Single Channel Cooler with communications

DIP Switch 1, 2 and 3 are OFF, OFF and OFF.

Menu Item	Display	Range
Set Point 1	SP1	-10 to 25 °C
Ready 1	rd1	-10 to 25 °C
Relay Control	rLY	Reset or Latch
Modbus ID	I d	1 to 255

Set Point 1 is the temperature the cooler will try to maintain the impinger at during operation.

Ready 1 is the temperature that impinger must be below to turn on the relay and external equipment (i.e. sample pump)

Relay Control determines if the control relays reset automatically or latch on alarm. Choose "Reset", displayed as "rSt", to have the relays reset automatically. Choose "Latch", displayed as "LAt", to have the relays latch on alarm. An external switch is required to reset the alarms.

Modbus ID is the address used in serial communication to the unit.

Single Channel Cooler 2nd channel

DIP Switch 1, 2 and 3 are ON, OFF and OFF.

Menu Item	Display	Range
Set Point 1	SP1	-10 to 25 °C
Ready 1	rd1	-10 to 25 °C
Relay Control	rLY	Reset or Latch

Set Point 1 is the temperature the cooler will try to maintain the impinger at during operation.

Ready 1 is the temperature that impinger must be below to turn on the relay and external equipment (i.e. sample pump)

Relay Control determines if the control relays reset automatically or latch on alarm. Choose "Reset", displayed as "rSt", to have the relays reset automatically. Choose "Latch", displayed as "LAt", to have the relays latch on alarm. An external switch is required to reset the alarms.

1st Frozen

DIP Switch 1, 2 and 3 are OFF, OFF and ON.

Menu Item	Display	Range
Set Point 1	SP1	-10 to 25 °C
Ready 1	rd1	-10 to 25 °C
Cycle Time	CYC	1 to 18 Hours
Crossover Time	Cot	15 to 45 minutes

Set Point 1 is the temperature the cooler will try to maintain the impinger at during operation.

Ready 1 is the temperature that impinger must be below to turn on the relay and external equipment (i.e. sample pump)

Cycle Time is the length of the frozen period for each impinger.

Crossover Time is the period of time that both impingers are active to allow the thawed impinger to cool to freeze prior to switch over.

2nd Frozen

DIP Switch 1, 2 and 3 are OFF, OFF and ON.

Menu Item	Display	Range
Set Point 1	SP1	-10 to 25 °C
Ready 1	rd1	-10 to 25 °C

Set Point 1 is the temperature the cooler will try to maintain the impinger at during operation.

Ready 1 is the temperature that impinger must be below to turn on the relay and external equipment (i.e. sample pump)

Note all timing is controlled by the 1st frozen control board.

Dual Channel Cooler

DIP Switch 1, 2 and 3 are OFF, ON and OFF.

Menu Item	Display	Range
Set Point 1	SP1	-10 to 25 °C
Ready 1	rd1	-10 to 25 °C
Set Point 2	SP2	-10 to 25 °C
Ready 2	rd2	-10 to 25 °C
Display	dSP	Toggle or Switch

Water Slip	UJS	1, 2 or 3
Modbus ID	I d	1 to 255

Set Point 1 is the temperature the cooler will try to maintain impinger #1 at during operation.

Ready 1 is the temperature that impinger #1 must be below to turn on the relay #1 and external equipment (i.e. sample pump)

Set Point 2 is the temperature the cooler will try to maintain impinger #1 at during operation.

Ready 2 is the temperature that impinger #2 must be below to turn on the relay #2 and external equipment (i.e. sample pump)

Display set the method to control the channel display of data. Toggle, shown as “toG”, will display each channel for 10 seconds constantly switch between the two. Switch, shown as “SUJ”, will allow the user to select the channel displayed through an external switch.

Water Slip set the relay used to alarm for water present at the Water Slip sensor. Setting of 1 will have the water slip sensor control relay #1 with ready for channel #1. Setting of 2 will have the water slip sensor control relay #2 with ready for channel #2. Setting of 3 will have the water slip sensor control relay #2 alone; the channel 2 ready alarm is ignored.

Modbus ID is the address used in serial communication to the unit.

NJ Thermocouple Display

DIP Switch 1, 2 and 3 are ON, ON and OFF.

Menu Item	Display	Range
Ready 1	rd1	-10 to 25 °C
Ready 2	rd2	-10 to 25 °C
Display	dSP	Toggle or Switch
Water Slip	UJS	1, 2 or 3

Ready 1 is the temperature that impinger #1 must be below to turn on the relay #1 and external equipment (i.e. sample pump)

Ready 2 is the temperature that impinger #2 must be below to turn on the relay #2 and external equipment (i.e. sample pump)

Display set the method to control the channel display of data. Toggle, shown as “toG”, will display each channel for 10 seconds constantly switch between the two. Switch, shown as “SUJ”, will allow the user to select the channel displayed through an external switch.

Water Slip set the relay used to alarm for water present at the Water Slip sensor. Setting of 1 will have the water slip sensor control relay #1 with ready for channel #1. Setting of 2 will have the water slip sensor control relay #2 with ready for channel #2. Setting of 3 will have the water slip sensor control relay #2 alone; the channel 2 ready alarm is ignored.