

Installation and Setup

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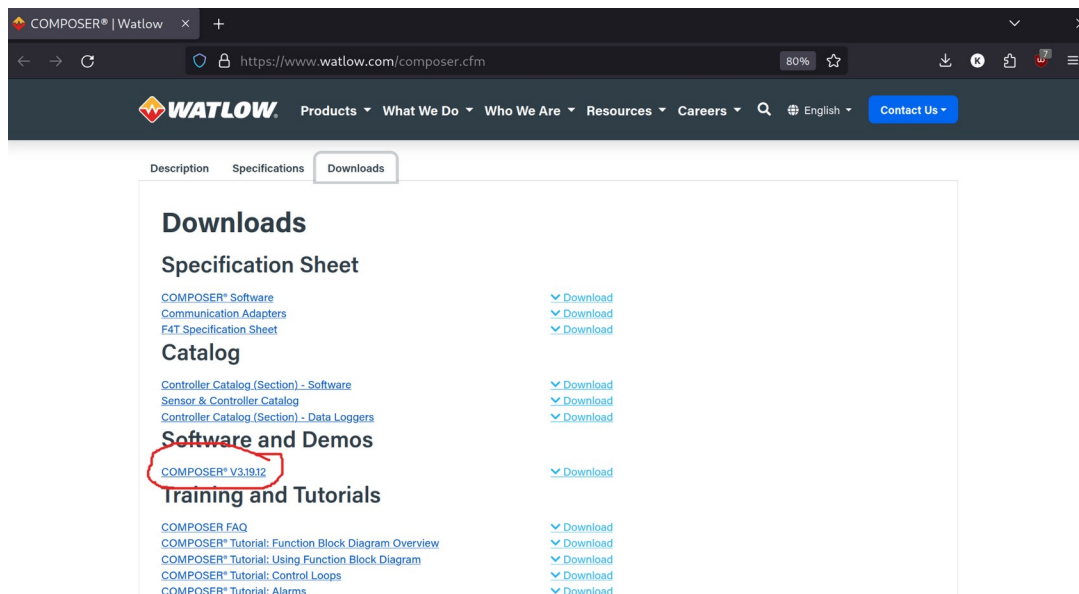
This guide will go over the steps for installing and setting up the necessary programs to control a thermal chamber from an external computer.

Prerequisites:

- Windows Computer (for running .exe programs)
- Internet Connection (both computer and chamber, for executing modbus commands over TCP)

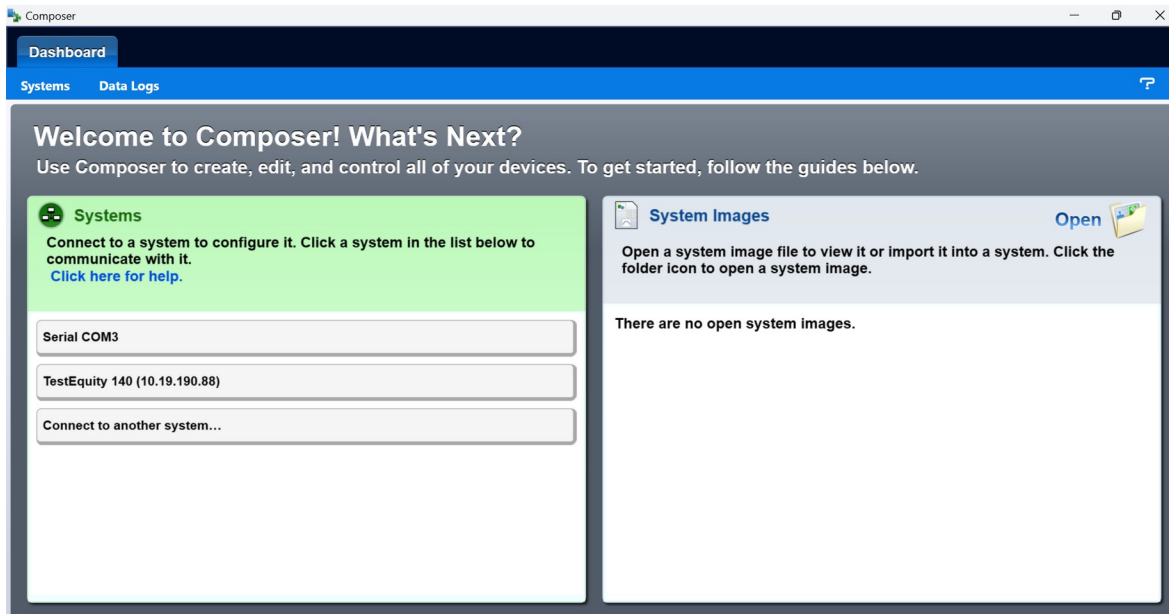
Program Installation

- 1) Go to the Composer download page at <https://www.watlow.com/composer.cfm>, the **Composer** app will be under **Downloads** → **Software and Demos**.

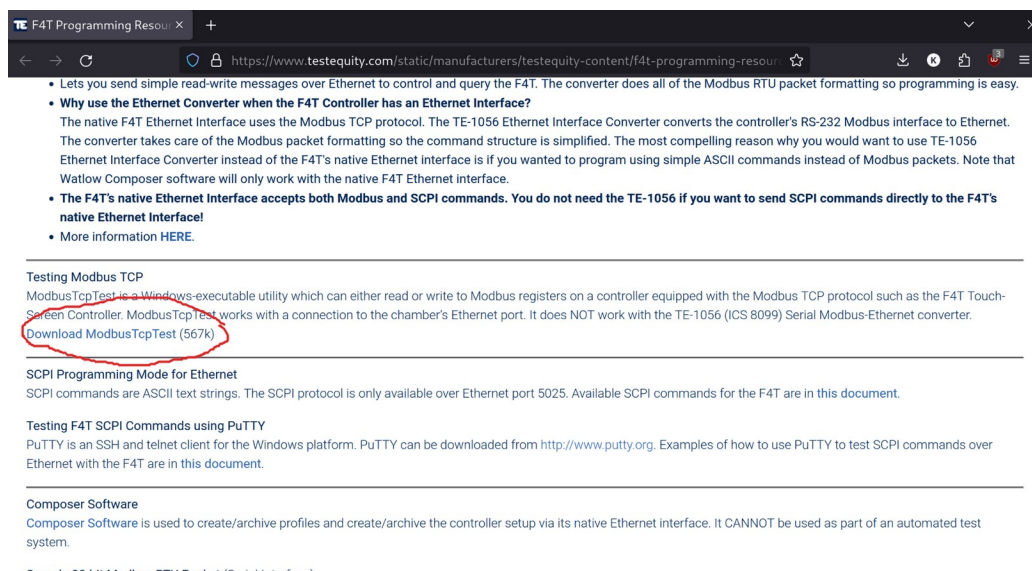


- 2) Once downloaded, run Composer. If met by Windows warning, click on “More info” and then “Run anyway”.

- 3) Follow the prompts to install Composer and dependencies.
- 4) Once finished, Composer should be ready to run. Below is a screenshot of the home screen that you should be greeted with.

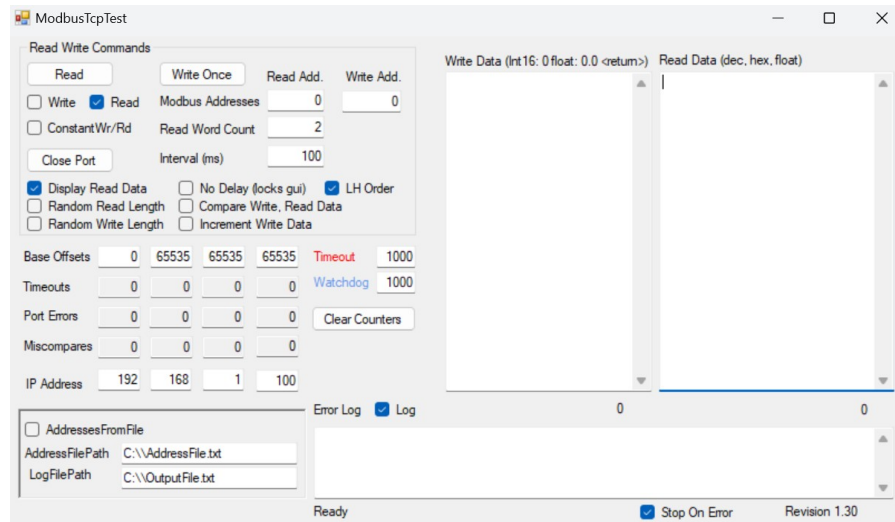


- 5) Next, download the Modbus TCP client from <https://www.testequity.com/static/manufacturers/testequity-content/f4t-programming-resources> under “Testing Modbus TCP”.



6) Extract the files.

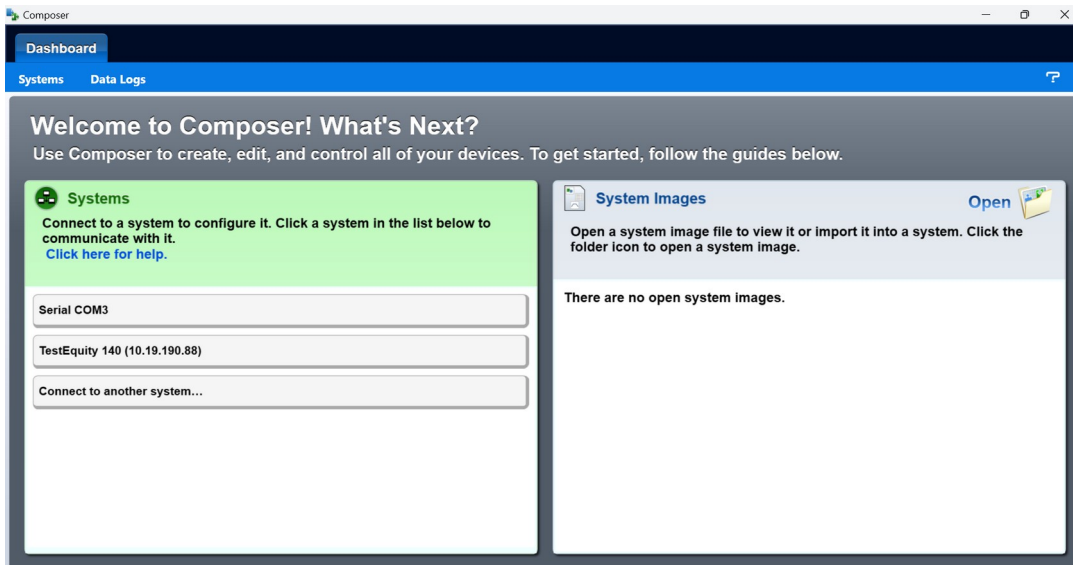
7) Run ModbusTcpTest. Below is the interface that you should see.



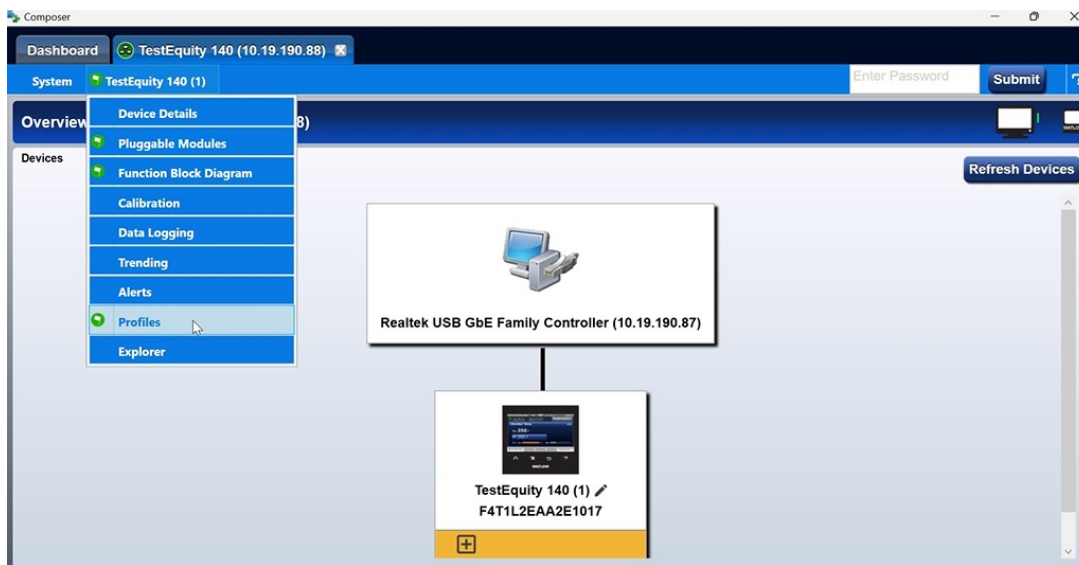
8) Installation complete!

Setup

Open Composer to verify that you are able to connect. On the home screen, you should see your thermal chamber, named “TestEquity 140 (Chamber_IP)”. If not, see the Troubleshooting section for possible issues.

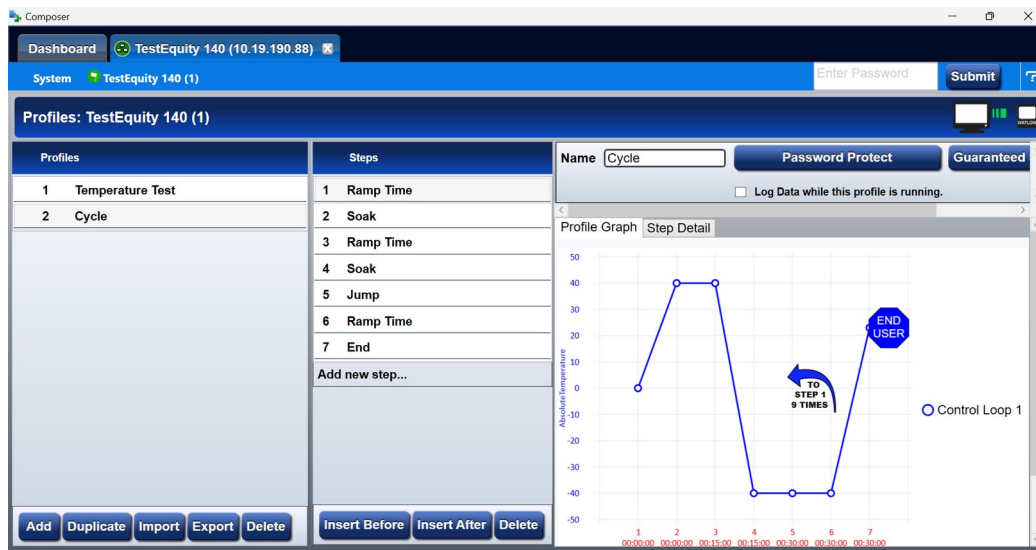


The Composer app allows you to create profiles. Once you have connected to the chamber, click on it at the top of the screen, navigate to the “Profiles” button, and click it to enter the profile editor.



If no profiles exist for your chamber, click “Add” in the bottom left to create one, and start adding steps with “Insert [Before/After]”. The steps needed for thermal cycling are ramp time (setting temperature), soak (wait time), jump (looping), and end (finishing options). Below is a profile that has been configured for thermal cycling. The parameters for each step were adapted from the Thermal Stress Tests presentation, found at:

https://indico.cern.ch/event/1391087/contributions/5903189/attachments/2844553/4973234/ThermalStressTests_trackerWeek_April.pdf.



Here, we will cover the different steps and their parameters. To start, the Ramp Time step allows you to specify a temperature and the time interval that the temperature should change over. A ramp time of zero will tell the chamber to climb/drop to the set point as fast as it can. When running this step, the chamber essentially sets the temperature and immediately skips to the next step because there is no time allotted for ramping. Guaranteed soak enable should be off here, this is will be useful on soak steps. Power acts as the physical Conditioning switch (on the face of the chamber) on/off values if you have the switch set to Event 1.

Composer

Dashboard TestEquity 140 (10.19.190.88)

System TestEquity 140 (1) Enter Password Submit

Profiles: TestEquity 140 (1)

Profiles	Steps
1 Temperature Test	1 Ramp Time
2 Cycle	2 Soak
	3 Ramp Time
	4 Soak
	5 Jump
	6 Ramp Time
	7 End
	Add new step...

Add Duplicate Import Export Delete Insert Before Insert After Delete

Name Cycle Password Protect Guaranteed

☐ Log Data while this profile is running.

Profile Graph Step Detail

Step 1 Type Ramp Time

Time Hours Minutes Seconds

0 : 0 : 0

Temperature Set Point 40.0 C

Guaranteed Soak Enable Off

Event Outputs

Power Event 2 Event 3 Event 4

On Off Off Off

The soak step allows you to set options for the wait periods. Soak time represents how long you want the chamber to stay at the set temperature. Because there is no ramp time, the soak time will start as soon as the temperature has been set and starts changing, which will greatly reduce the time that the chamber is actually spending at -40C or 40C. The guaranteed soak enable option fixes this by pausing the soak time until the chamber temperature is within an acceptable range of the set temperature. This range can be specified by the guaranteed soak deviation button in the top right.

Enter Password Submit

Name Cycle Password Protect Guaranteed

☐ Log Data while this profile is running.

Profile Graph Step Detail

Step 2 Type Soak

Time Hours Minutes Seconds
0 : 15 : 0

Temperature
Guaranteed Soak Enable
On

Event Outputs
Power On Event 2 Off Event 3 Off Event 4 Off
Event 5 Off Event 6 Off Event 7 Off

Insert Before Insert After Delete

Enter Password Submit

Name Cycle Password Protect Guaranteed Soak Deviation

☐ Log Data while this profile is running.

Profile Graph Step Detail

Step 2 Type Soak

Time Hours Minutes Seconds
0 : 15 : 0

Temperature
Guaranteed Soak Values
5.0 C
OK

Event Outputs
Power On Event 2 Off Event 3 Off Event 4 Off
Event 5 Off Event 6 Off Event 7 Off

Insert Before Insert After Delete

The jump step acts as a looping step by allowing you to jump back to a certain step some number of times. We want 10 cycles total, so we specify 9 jumps back to step 1.

Steps

1	Ramp Time
2	Soak
3	Ramp Time
4	Soak
5	Jump
6	Ramp Time
7	End

Add new step...

Insert Before Insert After Delete

Name Cycle Password Protect Guaranteed

☐ Log Data while this profile is running.

Profile Graph Step Detail

Step 5 Type Jump

Jump
Jump to Step
Step 1 Ramp Time
Number of Times
9

Event Outputs
Power On Event 2 Off Event 3 Off Event 4 Off
Event 5 Off Event 6 Off Event 7 Off

The end step allows you to set the behaviors that the chamber should follow when a cycle ends. This will also affect cycle termination behaviors because a termination essentially just executes the end

step. The temperature end actions determine the how temperature is regulated when a cycle ends.

Off – Temp Regulation Off, copies set point from before cycle

User – Temp Regulation Auto, copies set point from before cycle

Hold – Temp Regulation Auto, copies set point from current temp

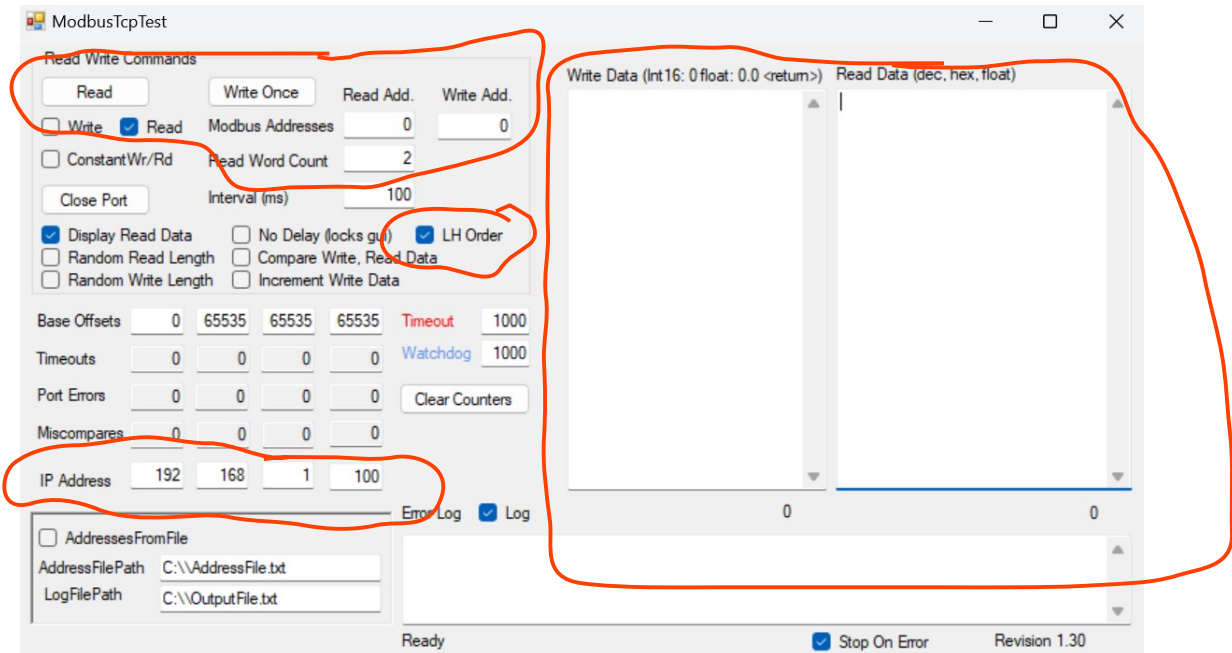
The event outputs allow you to leave the chamber's compressor on or off when the cycle ends. **DO NOT LEAVE THE COMPRESSOR ON WITHOUT TEMPERATURE REGULATION!!!** This causes the inside of the chamber to heat indefinitely as the compressor runs and does not make any attempt to cool.

The screenshot shows a software interface for configuring a step. At the top, there are two tabs: 'Profile Graph' and 'Step Detail', with 'Step Detail' being the active tab. Below the tabs, the configuration for 'Step 7' is shown. The 'Type' is set to 'End'. Under the 'Temperature' section, the 'End Action' is set to 'User'. Below this, the 'Event Outputs' section contains seven dropdown menus arranged in two rows. The first row contains 'Power' (set to 'On'), 'Event 2' (set to 'Off'), 'Event 3' (set to 'Off'), and 'Event 4' (set to 'Off'). The second row contains 'Event 5' (set to 'Off'), 'Event 6' (set to 'Off'), and 'Event 7' (set to 'Off'). A scrollbar is visible at the bottom of the window.

Step 7 Type: End			
Temperature End Action: User			
Power	Event 2	Event 3	Event 4
On	Off	Off	Off
Event 5	Event 6	Event 7	
Off	Off	Off	

Now that we have our profiles set up, we can focus on remote control via the Modbus Protocol over TCP. We will now take a look back at the ModbusTcpTest program.

The fields that you need to concern yourself with are circled below. Upon opening the program, change the default IP Address to that of the thermal chamber. To execute a command, enter the proper read/write address (register), enter any input values, and click the read/write button. The Low High Order toggle here should match the order specified by your chamber (found in Menu > Settings > Network > Ethernet > Modbus Word Order). Below are some tips for using the software.

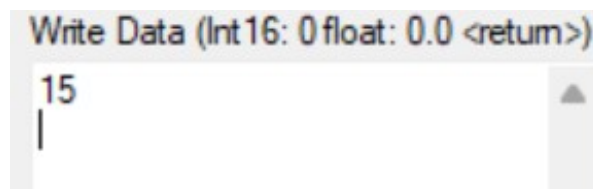


- Executing a read/write command will show the connection to the chamber at the bottom of the screen

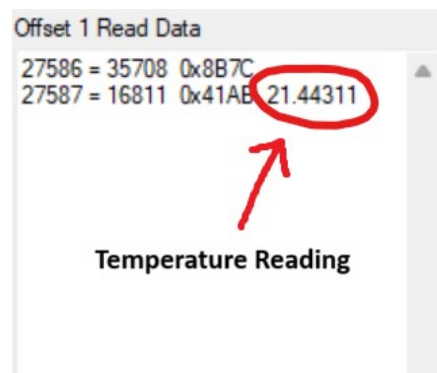
IP Address 10.19.190.88 Open

- At least one of the write/read checkboxes must be checked, to switch you must check both boxes and uncheck the box not in use

- Write data must be followed by a new line using the <Enter> key

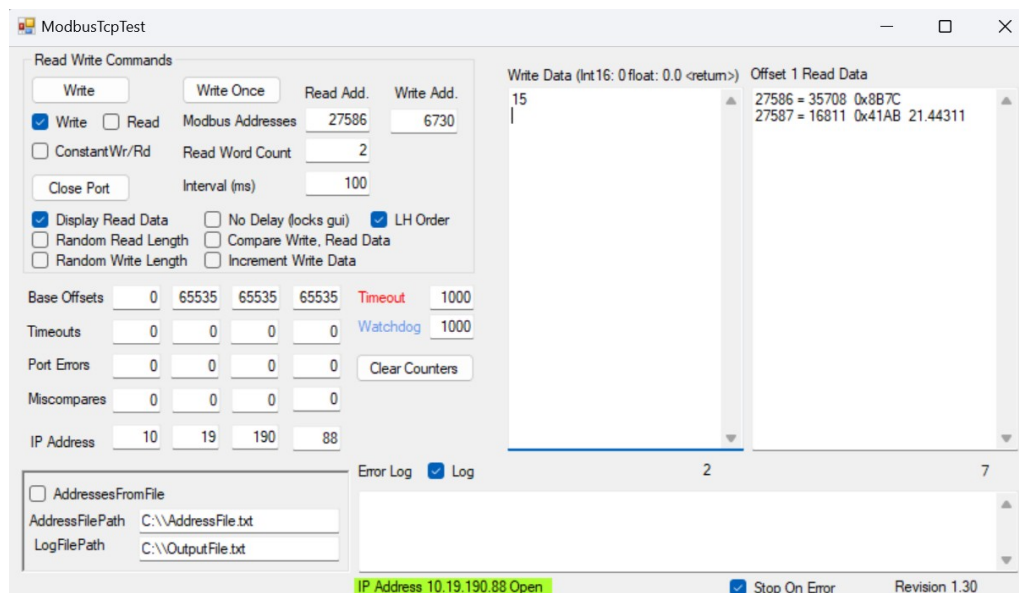


- Temperature read data is displayed in Fahrenheit by default, but this can be changed with a write command (see Modbus Operation)



- If you disconnect from the thermal chamber, the “Close Port” button should be pressed to reset the connection. Executing a command without doing so may cause errors

Here is a sample screenshot of what the app will look like when operating:



With installation and setup now complete, all that needs to be learned are what read/write registers (Modbus Addresses) to use and the different input/output types. Consult the F4T manual at page 232 for all of the registers.