THERMOSTAT OPERATORS MANUAL
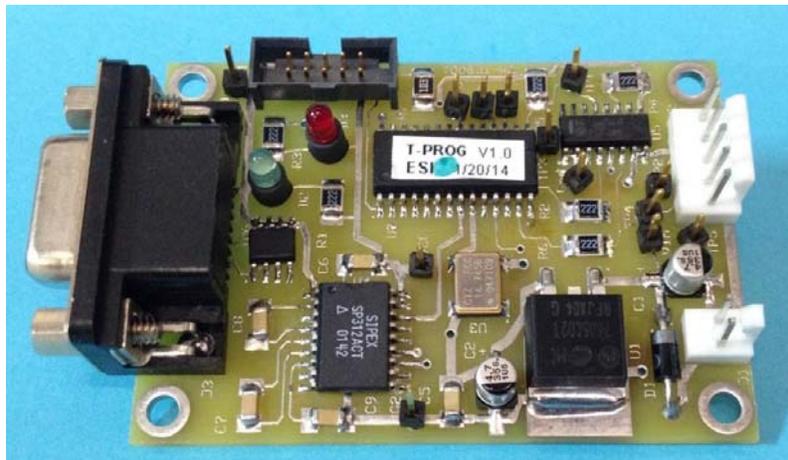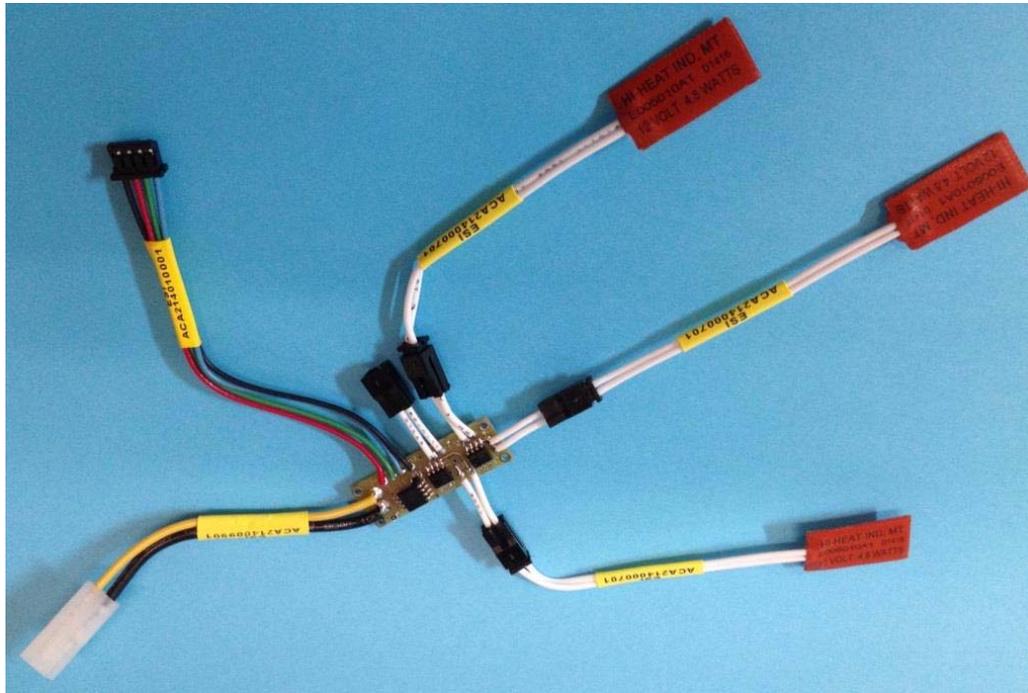
Revision History

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IMPORTANT SAFETY INSTRUCTIONS

Read these operating instructions carefully before using the Thermostat System. Follow the safety instructions listed below. The heaters associated with the thermostat system can cause serious injury. They are capable of extremely high temperatures.

1) DO NOT attach heaters to the thermostat board during programming.

2) Make sure the power is OFF before connecting the thermostat to the thermostat programming board.

3) DO NOT operate heaters in free air. They can generate enough heat to cause injury or damage the heaters themselves.

4) Install the heaters and thermostat in the final unit before applying power.

5) Heaters must be secured to a metal surface shared with the thermostat for proper operation. The thermostat must be able to measure the heat generated as a result of the heaters.

6) The thermostat is factory set to turn the heaters on at 5 degrees C and turn them off at 20 degrees C. The thermostat programmer may be used to change these settings.

Table of Contents

1.0 Introduction

The Thermostat System is designed to allow a user to determine the temperature range for his thermostat. This is accomplished by a programmable thermostat and a thermostat programmer board. The thermostat programmer board is then controlled by a GUI that allows the user to interact with the thermostat and set the temperature for the heaters to turn on and to turn off.

The following paragraphs will describe the thermostat as well as the thermostat programmer.

2.0 Item Descriptions

There are 3 primary hardware elements to the system:

- Thermostat
- Thermostat Programmer
- Heaters

The Thermostat and Heaters will be installed in the user hardware. The Thermostat Programmer is to be used external to the user final product. If the user wants to set the thermostat to a temperature range different from the factory settings, the Thermostat Programmer must be deployed.

2.1 Thermostat

The Thermostat board is shown in Figure 2.1 below.

Figure 2.1 Thermostat

Heater Interface Connectors

Power Input Connectors

Thermostat Programmer Interface Connector
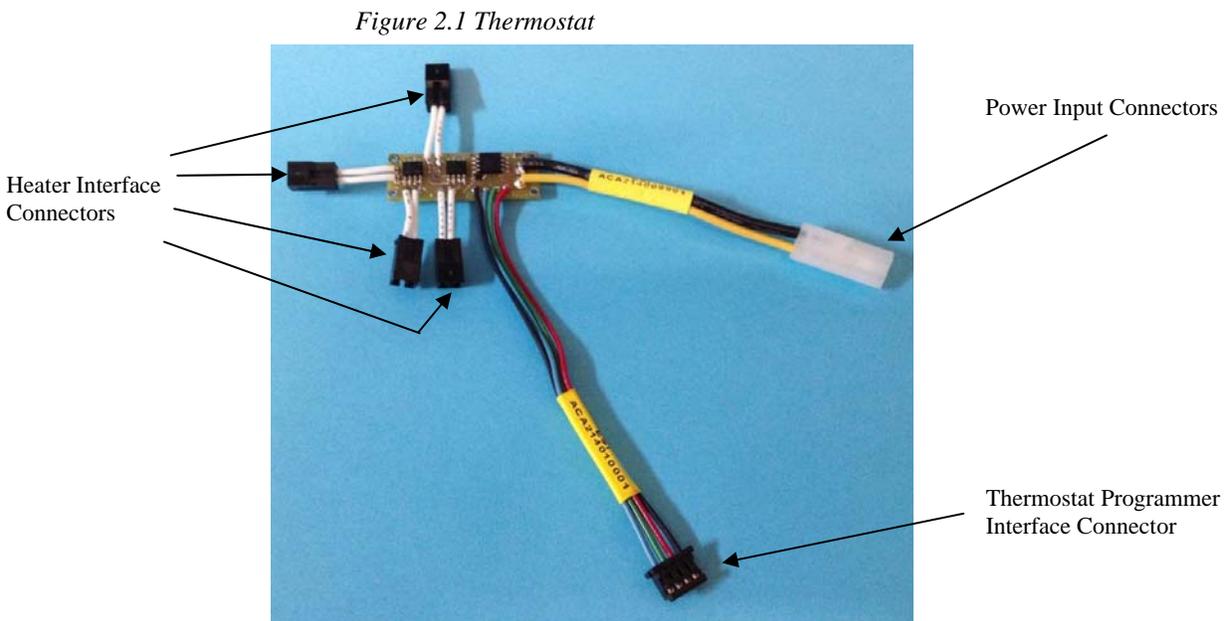
There are several interface cables attached to the Thermostat board as shown above. There can be up to 4 heaters attached to the Thermostat. It is recommended that all heaters be with 4 inches of the Thermostat board and positioned such that the Thermostat can detect the heat rise associated with the heaters being ON. The 4 heater connectors are J2, J3, J4 and J5.

The heaters can be up to 15 watts each but the system, as delivered, is configured with 3 each 4.8 watt heaters for a total heating power of 14.4 Watts and one unused connector. This unused connector may be useful for a customer furnished LED indicator to visually indicate when the heaters are ON. Be sure to use the appropriate value series resistor if an LED is used.

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2.1 Thermostat continued

In addition to the 4 heater interface connectors, there is also an connector interface to power (J1) and to the Thermostat Programmer (J6).

The power connector interface (J1) is a heavy gauge wire(AWG18) and connector capable of handling the current required when there are four 15 watt heaters attached to the Thermostat. All of the current for the 4 heaters must pass through this connector interface.

The Thermostat Programmer connector is a 4 pin Hirose connector. This connector connects the Thermostat to the Thermostat Programmer to allow the custom temperature ON/OFF user settings to be set.

Table 2.1 below presents the mating connectors and contact pins

Table 2.1 Thermostat Mating Connectors

Name	J#	Connector P/N	Manufacturer	Contact P/N	# of Pins
Power Input	J1	03-06-2023	Molex		
			Molex, Female	02-06-1103	2
Heater and LED	J2, J3, J4 and J5	DF3-2S-2C	Hirose		
			Hirose, Male	DF3-2428SC	2
Thermostat Programmer	J6	DF3-4EP-2C	Hirose,		
			Hirose, Male	DF3-EP2428PC	4

2.2 Heater

The heater is shown below in Figure 2.2.1and attached to the thermostat in Figure 2.2.2

Figure 2.2.1 Heater

Figure 2.2.2 Heaters Attached to Thermostat
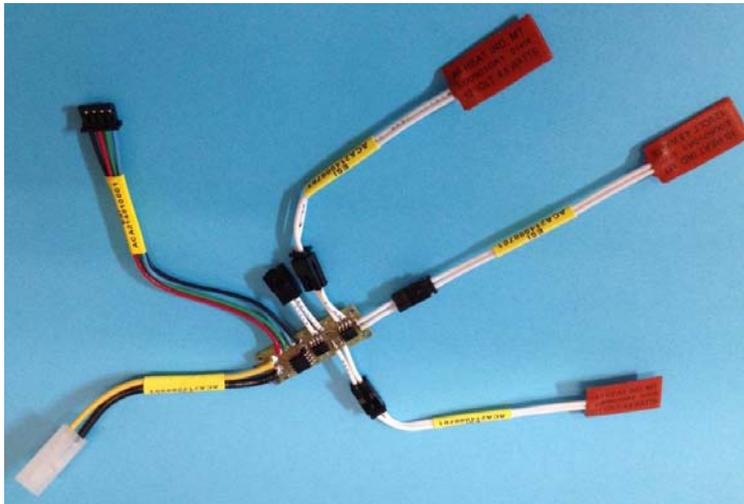
The heaters are purchased and the wiring shortened to 3 inches and terminated with a connector to interface to the thermostat board. The connector information is presented in Table 2.2.

Table 2.2 Heater Connectors

Name	J#	Connector P/N	Manufacturer	Contact P/N	# of Pins
Heater Connector	J1	DF3-2S-2C	Hirose		
			Hirose, Male	DF3-2428SC	2

2.3 Thermostat Programmer

The Thermostat Programming board is shown in Figure 2.3. The Thermostat board provides the hardware interface between the PC Graphical User Interface (GUI) and the Thermostat.

Figure 2.3 Thermostat Programmer Board

J2: Interface to Thermostat

J2: RS-232 Serial IO to GUI

J1: Power Input
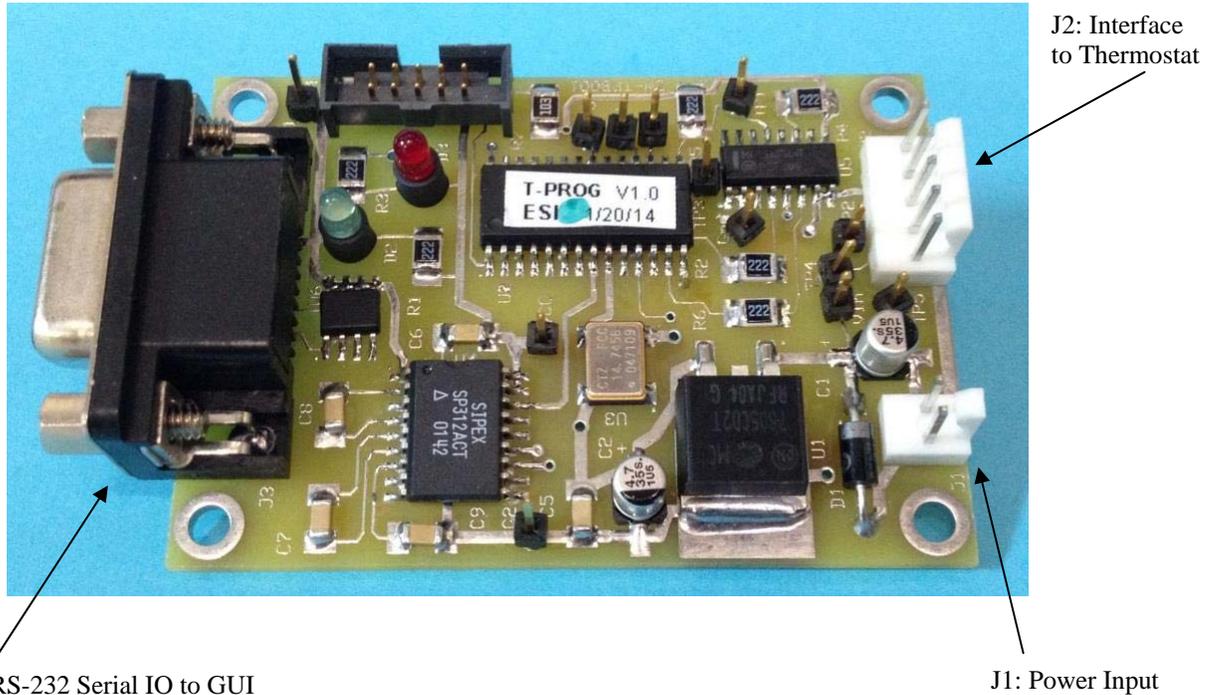
Ultimately, the Thermostat Programmer will be housed in a small chassis. The information provided here is to allow interfacing directly from the Thermostat board to the Thermostat Programming board. The actual operation of the system will be described as part of the GUI discussion in paragraph 3.0. Table 2.3 below presents the Thermostat Programmer board mating connectors.

Table 2.3 Thermostat Programmer mating connectors

Name	J#	Connector P/N	Manufacturer	Contact P/N	# of Pins
Power Input	J1	22-01-3027	Molex		
			Molex, Female	08-50-0114	2
9 Pin D	J2	L717S-DE09P	Amphenol	N/A	N/A
Thermostat Interface	J3	22-01-3057	Molex		
			Molex, Female	08-50-0114	5

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3.0 Graphical User Interface (GUI)

In order to program the Thermostat to turn the heaters on and off, a Thermostat Programmer GUI has been developed. In describing the GUI operation, we will also be describing the operation of the overall Thermostat system. To begin, we will describe the basics of the GUI starting with the menu selections and then the user operation of the system.

A screenshot of the GUI is shown in Figure 3.0.

Figure 3.0 GUI Screenshot
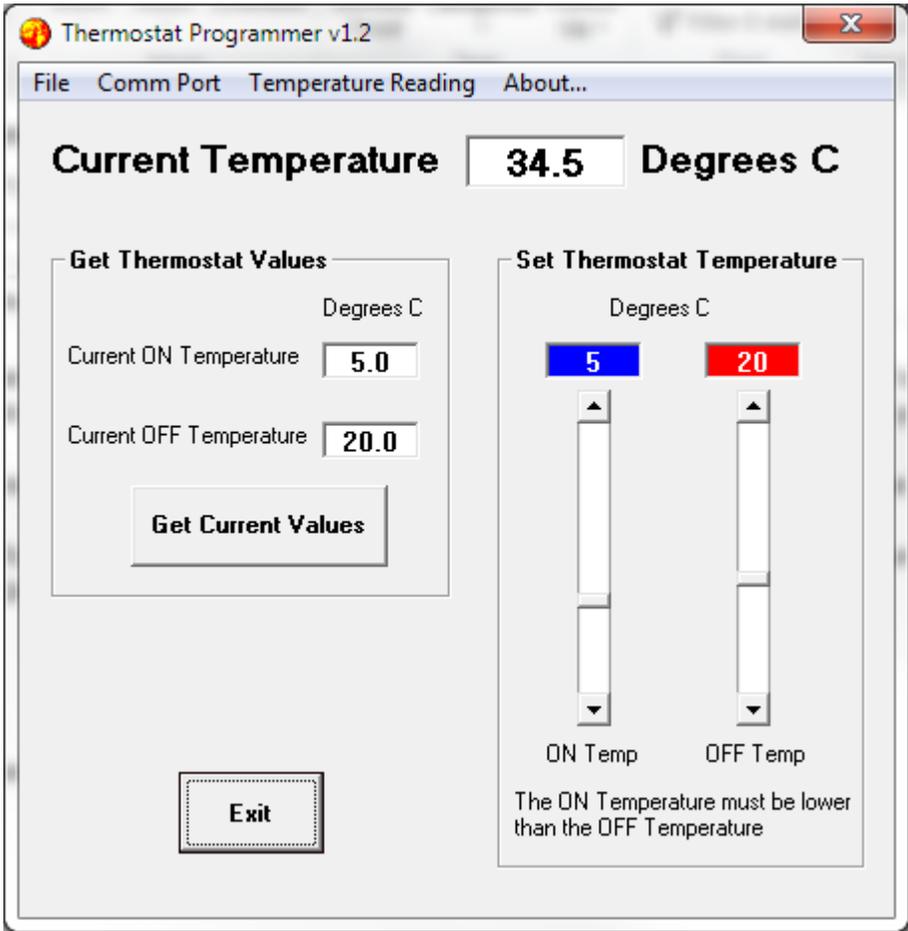
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3.1 Menu Items

The menu bar is shown below indicating each of the basic menu categories.

File	Comm Port	Temperature Reading	About...
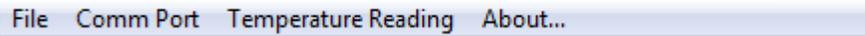
3.1.1 File Menu

The File Menu has a single menu item "Exit" as shown below. When the "Exit " menu item is clicked, the application terminates. The application also terminates when the "exit" button is clicked.

File
Exit
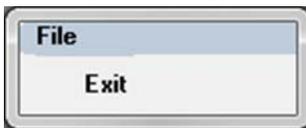
3.1.2 Comm Port

The Comm Port menu item has several menu items as shown below.

There are a total of 16 Comm Ports available for selection and only those that are available as serial communications ports are shown in bold and the others are "grayed" out.

To select an available Comm Port, simply click on the desired Comm Port and a check mark will be displayed next to the chosen comport.

The selected Comm Port is stored in the computer and when the application is restarted, the originally selected Comm Port will once again be selected. To change Comm Ports, simply click on a new Comm Port and it will replace the one previous stored.
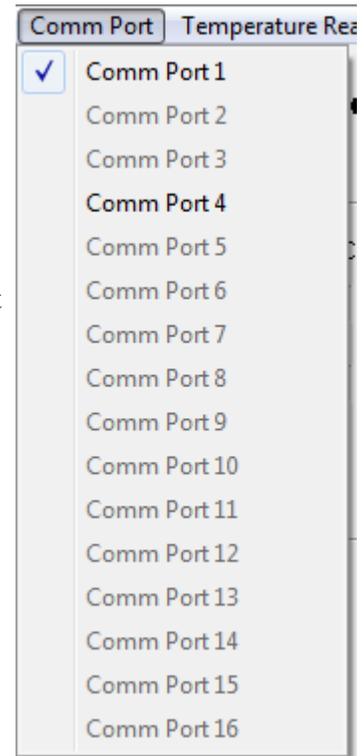
Comm Port	Temperature Rea
✓ Comm Port 1	
Comm Port 2	
Comm Port 3	
Comm Port 4	
Comm Port 5	
Comm Port 6	
Comm Port 7	
Comm Port 8	
Comm Port 9	
Comm Port 10	
Comm Port 11	
Comm Port 12	
Comm Port 13	
Comm Port 14	
Comm Port 15	
Comm Port 16	

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3.1.3 Temperature Reading

The Temperature Reading Menu has two main menu items: "Format" and "Disable/Enable Continuous Update" as shown below

3.1.3.1 Continuous Update

When the menu item "Disable Continuous Update" is shown, the GUI will automatically query the Thermostat Programmer board and the Thermostat and retrieve the latest Thermostat ON Temperature, OFF Temperature and Current Temperature. These displays are further discussed in paragraph 3.2 Controls and Indicators.

When the menu item "Enable Continuous Update is shown, the GUI will not update the ON Temperature, OFF Temperature and Current Temperature unless the "Get Current Values" button is clicked in the main GUII.

2.1.3.2 Format

Also included in this menu is the ability to select temperature readings to be shown in either Fahrenheit or Centigrade. The menu item below shows Fahrenheit as the format for all temperature readings and settings. Note the check mark next to Fahrenheit in the submenu.
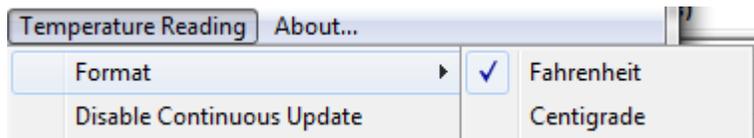
To change to Centigrade, simply click on the submenu "Centigrade" item and Centigrade will be used for all temperature readings and settings. The menu below shows the Centigrade submenu item selected.
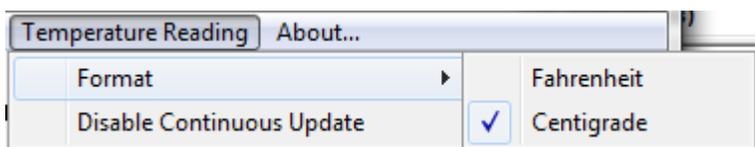
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3.1.4 About...

The About Menu will immediately display the "About" form. This form provides pertinent information about Graflex, Inc.

To close the "About" form either click the close control at the upper right hand corner of the form or select "Exit" from the File menu. Either will close the "About" form and not affect the main application.

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3.2 Controls and Indicators

The controls and indicators necessary to easily program a Thermostat are shown once again on the main GUI display.

This section will briefly describe each of the control and indicator areas on the display: Current Temperature, Get Thermostat Values, Set Thermostat Values and the "Exit" button.
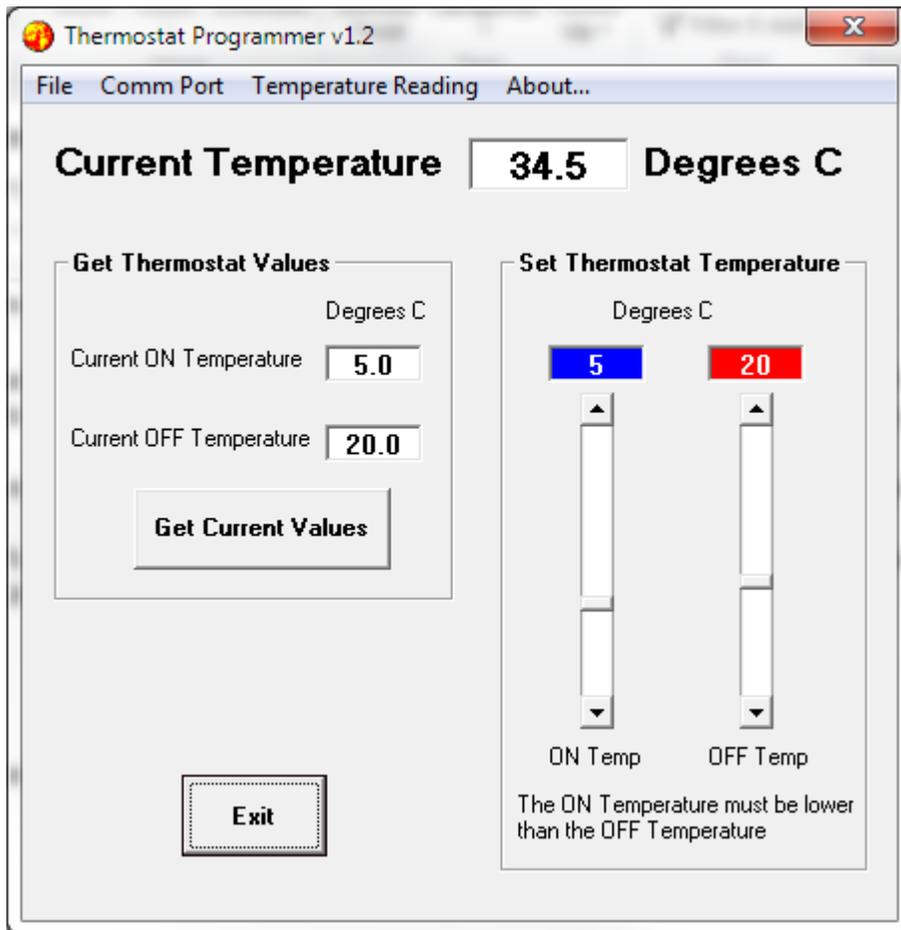
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3.2.1 Current Temperature

The Current Temperature display may be shown in either Fahrenheit or Centigrade.

If the Temperature Reading menu item "Format" submenu item "Fahrenheit" is checked the current temperature will be shown Fahrenheit.

Current Temperature | 92.3 | **Degrees F**

While if the Temperature Reading menu item "Format" submenu item "Centigrade" is checked the current temperature will be shown Centigrade.

Current Temperature | 34.5 | **Degrees C**

3.2.2 Get Thermostat Values Frame

The "Get Thermostat Values " frame contains two displays and one button. The displays "Current ON Temperature" and Current OFF Temperature will display the temperature in either Fahrenheit or Centigrade depending on the "Format" submenu item selection.

Get Thermostat Values
Degrees F
Current ON Temperature | 41.0
Current OFF Temperature | 68.0
Get Current Values

Get Thermostat Values
Degrees C
Current ON Temperature | 5.0
Current OFF Temperature | 20.0
Get Current Values
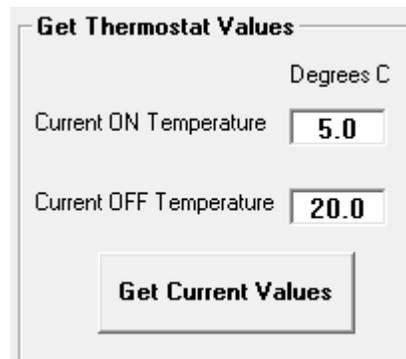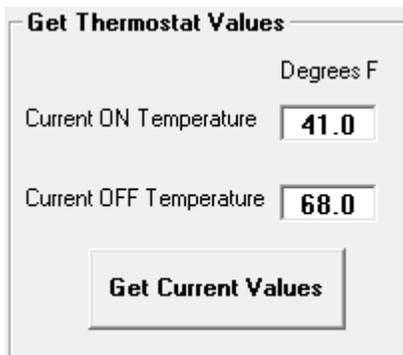
When the "Get Current Values" button is clicked, the GUI will query the Thermostat Programmer board and the Thermostat and retrieve the latest Thermostat ON Temperature, OFF Temperature and Current Temperature.

If the menu item "Disable Continuous Update" is shown, the GUI will automatically query the Thermostat Programmer board and the Thermostat and retrieve the latest Thermostat ON Temperature, OFF Temperature and Current Temperature and not require the "Get Current Values" button to be clicked.

3.2.3 Set Thermostat Temperature Frame

Like the Current Temperature, the temperature values displayed in the "Set Thermostat Temperature" frame may be in either Fahrenheit or Centigrade depending upon the on the "Format" sub-menu item selection as shown below.
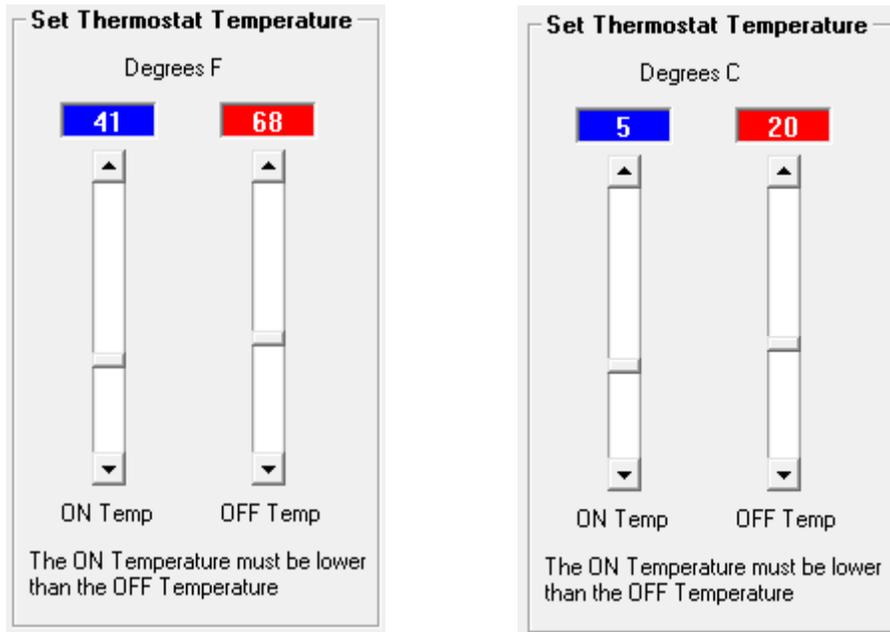
There are two vertical sliders on the frame; one to adjust the temperature the heaters will turn on (ON Temp) and one to adjust the temperature the heaters will turn off (OFF Temp). The OFF temperature must be higher than the ON temperature for the thermostat to work properly.

The default ON temperature is 41 degrees Fahrenheit (5 degrees Centigrade) and the default OFF temperature is 68 degrees Fahrenheit (20 degrees Centigrade).

3.2.4 Exit Button

The "Exit" button shown below will terminate the application in the same manner as the File menu item "Exit". The application may also be terminated by clicking the Close control at the top left corner of the application.

4.0 Operation

If the factory settings of 5 degrees Centigrade for the heaters to turn on and 20 degrees Centigrade for the heaters to turn off are acceptable, then go to paragraph 4.2. Otherwise the following paragraph 4.1 will describe how to program the thermostat.

4.1 Thermostat Programming

Figure 4.1 below illustrates the components needed to program the Thermostat. The Graflex Thermostat Programming Chassis houses the Thermostat Programmer board and internal cabling. The Graflex Thermostat Programming Chassis is supplied with a power supply and power cable as well as the Interface cable for attaching to the Thermostat board.

Make sure the Power Supply is not plugged into the wall until all of the components are wired.

Do Not attach heaters when programming the Thermostat. Heaters must not be powered in a "free air" configuration

Figure 4.1 Thermostat Programmer Block Diagram

Hardware Configuration for Thermostat Programming
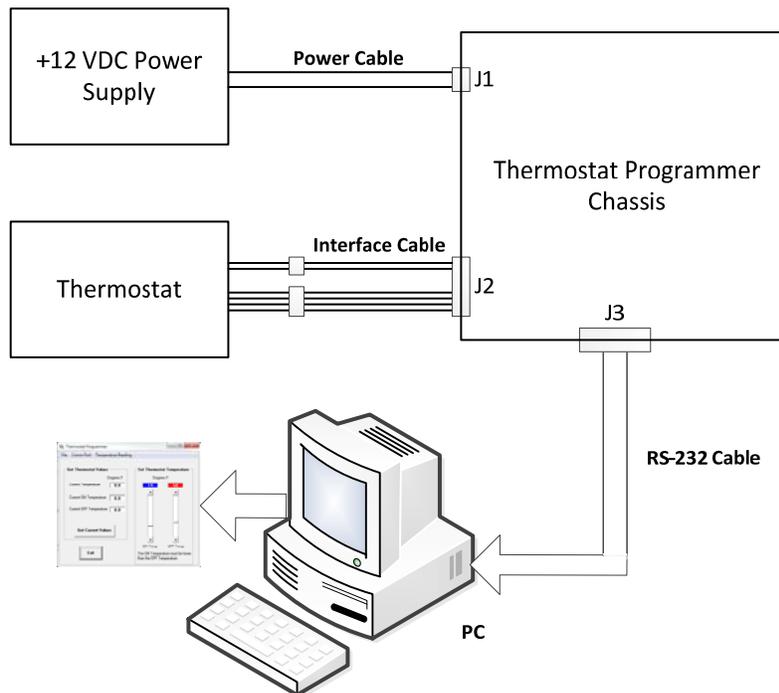
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Once the system has been configured for programming, apply power to the +12 VDC power supply and open the Thermostat Programmer v1.2 GUI.

Set the Temperature Reading menu item for continuous updates to read "Disable Continuous Update" and the following displays should be updating and displaying factory settings:

- Current Temperature: the actual current temperature
- Current ON Temperature: 5 degrees C or 41 degrees F
- Current OFF Temperature: 20 degrees C or 68 degrees F

Adjust the ON Temp and OFF Temp sliders until the desired ON and OFF temperatures are set. The temperature values are automatically stored in the Thermostat's memory.

Power the system off and remove the Thermostat from the programming environment. The Thermostat is now ready for installation

4.2 Thermostat and Heaters

The Thermostat and Heaters are now ready for installation. To mount the Thermostat:

- Determine the location of the Thermostat and mark the mounting hole locations.
- Drill and tap the mounting hole locations
- Secure the Thermostat to the surface either directly or via small standoffs.

To mount the heaters:

- Locate the proper location for the Heaters to be mounted
- Make sure the heater cables are long enough to attach to the Thermostat.
- Peel the protective backing off of the Heaters and attach them to the desired surface.

Interface the Thermostat and Heaters:

- The +12 VDC power must be off
- Connect the heaters to the Thermostat
- Attach a power cable to the Thermostat
- Apply power on