Web Controller Software

Version 2.3

USER MANUAL

⚠
- Read this manual carefully before using the equipment.
- Familiarize yourself with all safety precautions before using the equipment.
- Keep this manual handy for future reference.

ESPEC NORTH AMERICA, INC.

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Disclaimer

ESPEC North America, Inc. assumes no responsibility for accidents or equipment trouble that comes from the failure to observe handling instructions contained in this user manual. Do not perform any operation or handle the chamber in any way that is not described in this manual or that is specifically prohibited. The contents are subject to change without prior notice.

Read this manual thoroughly and familiarize yourself with all safety precautions before using equipment.

Regulatory Compliance

Products with the CE label comply with the Directives and European Standards applicable at the time of certification. Specific Directives and Standards will be listed on provided Declaration of Conformity when applicable.

Contents

1.0 Introduction

This document describes the various features of ESPEC North America's Web Controller, Version 2.3.

1.1 User Accounts

The Web Controller supports various account types with different user access privileges. These account types are: Guest, User, Technician and Administrator. Access privileges associated with these accounts to access the Web Controller pages are outlined in the following table. As illustrated in the table, the Guest account can access the Web Controller home page and monitor page in view mode only. In other words, the Guest account represents a user who is not actually logged into the Web Controller.

User Account Access Privilege

Account Type	Home	Monitor	Constant	Program	Run/Stop	Setup
Guest	Yes	Yes	No	No	No	No
User	Yes	Yes	Yes	No	Yes	No
Technician	Yes	Yes	Yes	Yes	Yes	No
Administrator	Yes	Yes	Yes	Yes	Yes	Yes

The Web Controller ships configured with an administrator account with the following credentials:

- **username**: admin
- **password**: admin

It is recommended that when the administrator logs into the system for the first time, various account types to support users with different access levels should be created; and the administrator's password (in the above credentials) should be changed to a more secure one.

1.2 Web Browser Compatibility

Our Web Controller system supports a number of web browsers that include: Internet Explorer (version 9+), Google Chrome, Mozilla Firefox, Apple Safari and

Opera.

1.3 IP Configuration

The Web Controller ships configured to acquire its network settings automatically from the target network via DHCP. If automatic networking is not desired or the target network policies prevent it then the Web Controller will fall back to static networking with the following settings:

- **IP Address**: 192.168.0.83
- **Net Mask**: 255.255.255.0

One way this will happen is when the Web Controller is connected directly to a PC via a cross-over cable or to a switch without DHCP. If a different static IP address is desired, the user may configure it during the setup wizard or any time there after via the setup screen.

1.4 Web Controller's Terminology

Our Web Controller supports several different process controllers. Each of these process controllers use different naming convention to refer to their operation menu. The following table outlines a common terminology that shares among these process controllers.

Web Controller	P300/ SCP-220	Watlow Controllers	Description
Program	Program	Profile	A series of set points for the chamber to operate.
Time Signal	Time Signal	Profile Event/Event Output	A signal that can be used to turn features on or of manually or during program execution time.

2.0 Accessing the Web Controller

There are two ways to access the Web Controller.

1. The Web Controller can be accessed via the IP address http://ipaddress/. This IP address can be found at two different locations:
   - Each time the Web Controller boots up it will post the IP address to the chamber controller:
     1. On a Watlow F4T, the IP address is shown on the 3rd line of the message screen as depicted in the figure below.

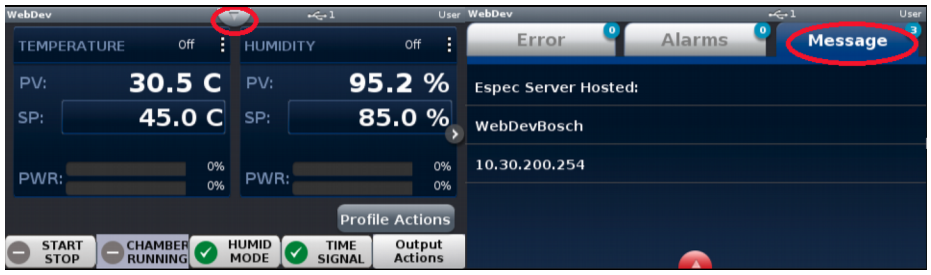


Figure 1: The Watlow F4T message screen

     2. On a P300, the IP address is shown (and configurable) on the "Set LAN" screen as depicted in the figure below.

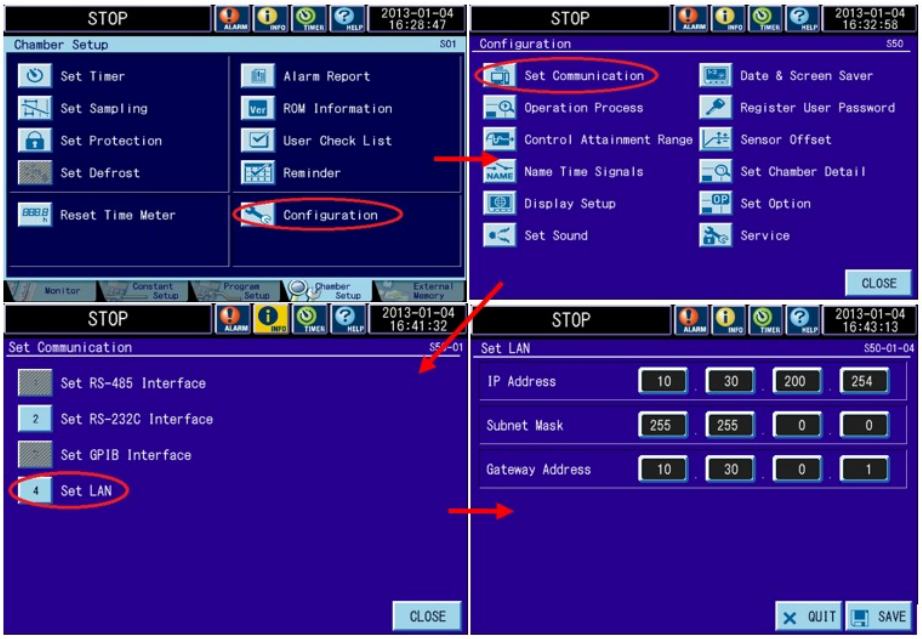


Figure 2: The "Set LAN" screen on the P300

- The IP address can be found via the "ESPEC Web Controller Locator" utility available at: https://espec.com/images/uploads/files/espec_web_controller_locator.exe. The utility will scan for Web Controllers (version 2.0.0 and higher) immediately after launching; the IP addresses are listed in the second column. Clicking on the IP address will open that controller. The hostname will be accessible (that is, clickable) if the computer can resolve it.

Figure 3: ESPEC Web Controller Locator Utility

2. The Web Controller can also be accessed via its hostname http://hostname/

through a web browser on a computer running MS Windows. For Apple or Linux machines, or MS Windows running Apple's bonjour, the Web Controller can be accessed through a web browser using http://hostname.local. There are several ways to find the hostname, each is dependent on whether the Web Controller is shipped with or without the chamber.

- The default hostname of the Web Controller that ships with the chamber is "espec-serial#", where "serial#" is the serial number of the chamber. This serial number can be found on the serial tag on the chamber as illustrated in the following figure. In this case, the Web Controller is accessible via http://espec-06ic515/ with a web browser running on MS Windows. For Apple or Linux computers, the Web Controller is accessible using http://espec-06ic515.local as its hostname. If the Web Controller is shipped without the chamber then the hostname is "espec-default". With this hostname, the Web Controller on an MS Windows platform can be access via http://espec-default. On Apple or Linux machines, we can access the Web Controller via http://espec-default.local.

Figure 4: Example of Serial Tag

- For a Watlow F4T, the hostname can also be found in the same manner as that for the IP address, with the hostname displayed on the second line.
- The hostname can also be found using the "ESPEC Web Controller

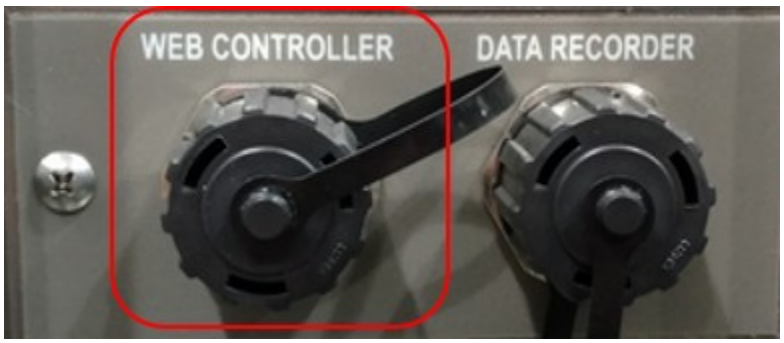
Locator" just like the IP address; the host names are listed in the first column.

3.0 First Time Use

By default the Web Controller is configured to use DHCP; its IP address will be automatically assigned and leased in your network. If DHCP is not available, the Web Controller will use a static IP address 192.168.0.83 with a netmask 255.255.255.0. The following procedure outlines detailed steps on how to connect and configure your Web Controller.

1. Ensure that the Web Controller is switched off.
    1. If the Web Controller was shipped with the chamber, which is installed inside the chamber's electrical box, turn off its power by switching off the main power to the chamber. This process basically involves switching off the chamber's main breaker.
    2. If the Web Controller is the external type, switching off the power can be done by disconnecting the power cord from the unit.

EP/EGN/EWP/EWS/EN Chambers



BT Chambers

2. Connect an Ethernet cable to the chamber, making sure the correct Ethernet port is used as shown in the figure. Connection at the other end of the Ethernet cable is dependent on the target network's administration policy. If you are unsure, try the following substeps (starting from step 1 above) or contact the IT department for assistance.
    1. When the target network policy allows new/unknown devices to obtain a DHCP lease, connect the other end of the Ethernet cable directly to the target network port (switch, hub or a router).
    2. Alternatively if the first option does not work, connect the Web Controller directly to a computer via a cross-over cable. Or, connect both the Web controller and PC using standard Ethernet cables to a switch or a router. This option requires some network configuration on your PC to be on the same subnet of the Web Controller (to be explained in step 5 below).
3. Apply power to the Web Controller and the chamber. If the Web Controller is installed inside the chamber in the electrical box as one unit, turning on the chamber's main power switch (or breaker), or plugging back the main power cord, will be sufficient to supply power to both devices.
4. Allow the Web Controller (and chamber if applicable) time to boot up; five minutes should be sufficient.
5. Access the Web Controller's home page, which will redirect to the initial setup wizard (during first time use).
    1. When connecting through a network which has a DHCP server (most networks) refer to Section 2.0 (Accessing the Web Controller) for further details on how to find/connect to the Web Controller.
    2. If the Web Controller is not part of a network or it is connected directly to a computer via a cross-over cable, or to a switch as outlined in step 2 (above), the Web Controller is accessible via http://192.168.0.83/. In order to access the Web Controller, the computer connected to it must have the same netmask (255.255.255.0) or gateway (192.168.0.1) with an appropriate IP address, such as 192.168.0.84. In this case, you may need to configure your computer to have this static IP address.
6. The Web Controller will prompt for a username and password in order to run the setup wizard.
    - **Username**: "admin"
    - **Password**: "admin"
7. Follow the directions given in the Web Controller.
    1. Before using the Web Controller, you must accept the Software License Agreement.
    2. If the Web Controller was installed into the chamber at the factory the

setup wizard will skip the first step for the controller.

3. It is highly recommended that the password of the admin account be changed when prompted.
4. The wizard can be exited at any time by pressing the “Exit Wizard” button located at the bottom of the page.

8. Once the setup wizard is complete, the system will reboot. The Web controller will be ready for use following this reboot. If the IP address or hostname was changed during setup it may require opening a new browser with a new hostname or IP address.

4.0 Common Page Elements

The Web Controller main page is depicted in the following images. Elements that are common to all display pages are illustrated for both desktop/tablet and mobile versions.

Figure 5: The Desktop page view

Description of elements on the main page:

1. **Navigation bar**: The navigation bar contains links to each page on the Web Controller. On a mobile device, this navigation bar collapses into an expandable menu.
2. **Location bar**: The location bar shows the current Web Controller name (i.e., hostname), which also acts as a drop-down menu to access other controllers. If the Web Controller is part of a network, this menu displays links to all other Web Controllers.
3. **Page contents**: This is where each page will differ, the one shown here is "Home Page". In order to fit the mobile screen shot on one page some of the contents have been removed.
4. **Status bar**: The status bar allows a quick at-a-glance view of the current state of the chamber Note this is at the bottom of the page in the mobile view.
5. **Quick status**: Since the mobile view pushes the status bar to the bottom of the screen the most relevant information is shown in the navigation bar for mobile devices only. The first line gives the chambers current run status (i.e. Standby, Constant, Program, Alarm) and the second line the conditions inside the chamber, such as temperature and humidity (if the chamber has humidity).

5.0 Status Bar

The status bar is included in the display page of Monitor, Constant, Program and Run/Stop. It displays the status of the currently running program in the chamber.

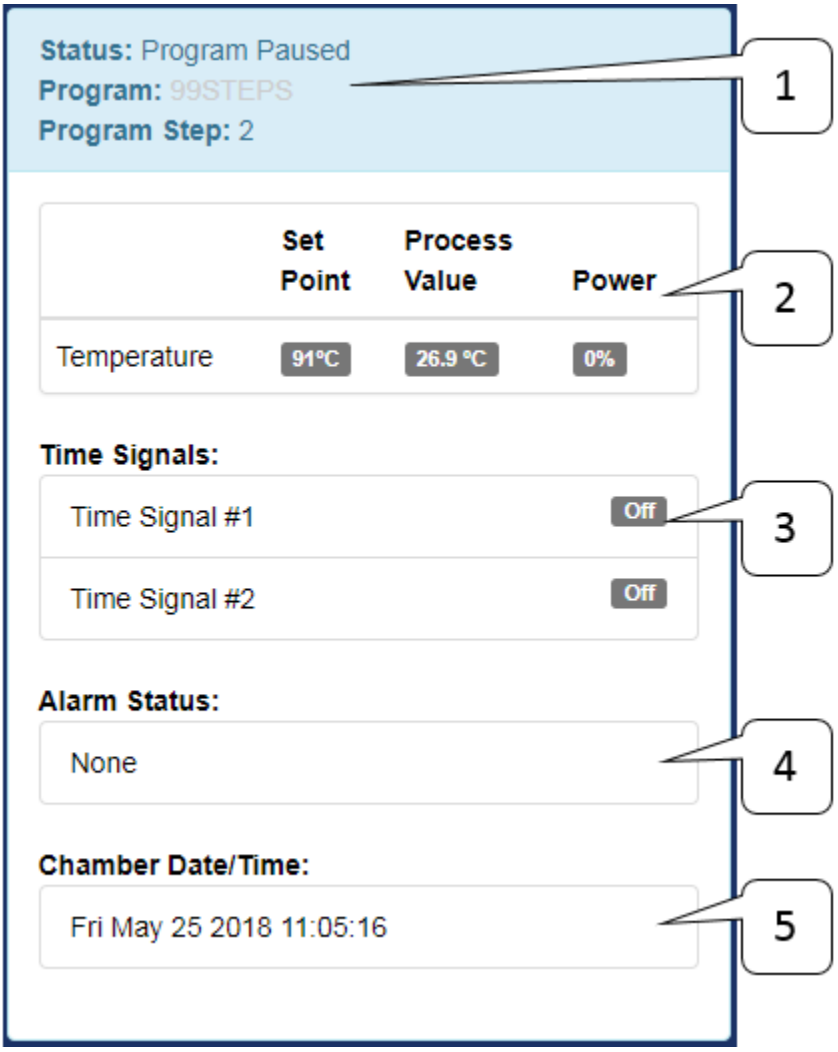


Figure 6: The Status bar

Status bar elements:

1. **Operation Mode**: The current run mode of the chamber.
2. **Control Loops**: The current conditions inside the chamber. If conditioning is not currently enabled the set points will be displayed as off.

3. **Time Signals**: The current time signal status.
4. **Alarm Status**: The currently active alarms that may prevent the chamber from operating. These alarms must be cleared before chamber operation can resume.
5. **Chamber Date/Time**: The current date/time as read from the chamber controller.

The status bar provides a quick at-a-glance view of the currently running program. During operation, the chamber can be in one of four operation states (or modes): Standby, Constant, Program Running, and Alarm. The table below outlines a brief description of each of these operation modes.

Status	Description
Standby	The chamber is currently not running.
Constant	The chamber is currently running a constant set point.
Program Running	The chamber is currently running a program; the current program and step are also listed.
Alarm	The chamber is currently alarmed, this state must be cleared before operation may resume.

6.0 Home Page

The Web Controller home page (or main page) contains six links or pages with different functionality to manage and control the chamber. These six pages have descriptive names that describe their functionality. They are also accessible via the home page menu at the top. This home page will be displayed when you access the Web Controller via its IP address or hostname. Any user may access the Web Controller home page. However, the six links in the home page have different access privilege attached to them. The "Guest" account can only access and view the main and monitor page, while a "User" has an additional privilege to set constant operation values, start or stop a program. A "Technician" may access all the pages except performing a setup configuration in the setup page, while the "Administrator" users will have exclusive access to all of the pages. We will take a look at each of these pages and their associated links in the following sections.

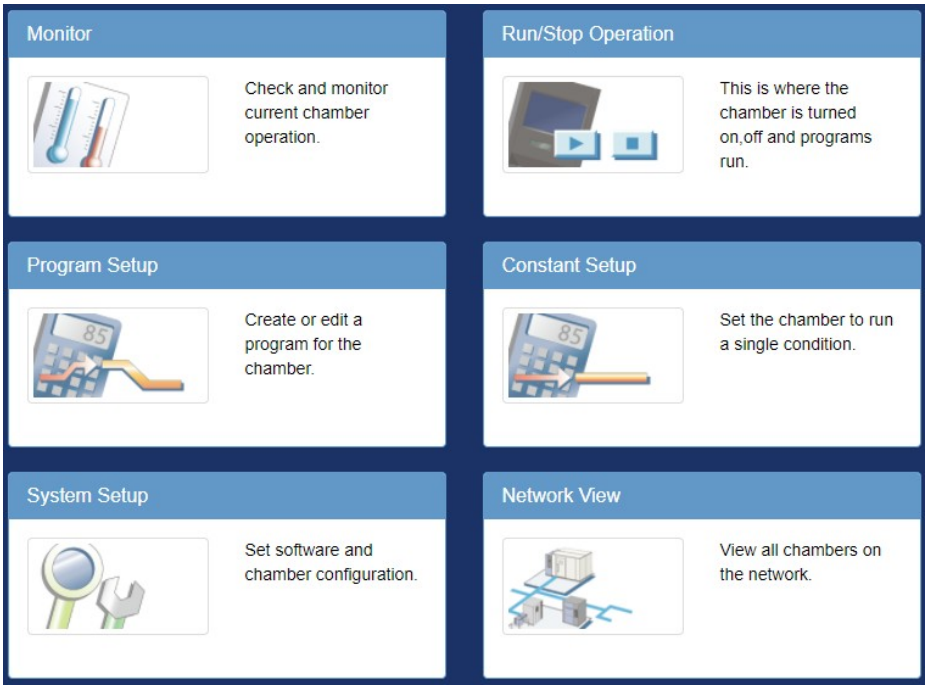


Figure 7: The Home page

7.0 Monitor Page

The Monitor page contains three panels of information about the state of the chamber. The top section is a trend graph of the conditions inside chamber along with other user settable information. The middle is only visible when a program is running and presents the complete state of the running program. The bottom section shows basic operating statistics and a list of past operating modes. This page is accessible by all user account types: “Guest”, “User”, “Technician”, and “Administrator”.

7.1 Graph

Logged data of the chamber's operation is displayed in this panel. By default, the trend graph provides an overview of the chamber's operation of the last 6 hours.

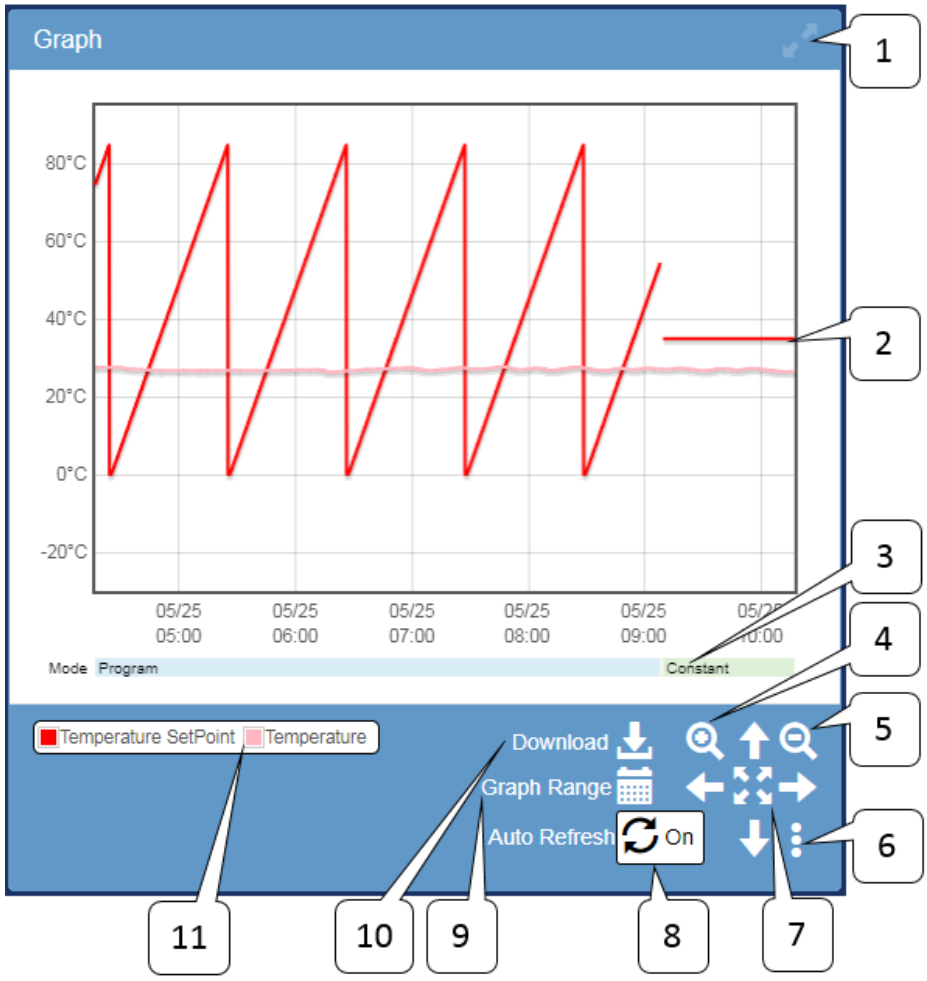


Figure 8: Monitor Page: Graph

Within the graph itself, you can perform the following operations:

1. **Full Screen Toggle**: Clicking this button will expand the graph to fill the browser window.
2. **Graph**: This is an X/Y scatter plot of all the numerical data currently being shown.
3. **Status Graph**: This shows the current operating mode; and other text based

conditions for the chamber.

4. **Zoom In**: Zoom in on the graph.
5. **Zoom Out**: Zoom out of the graph.
6. **User Settings**: When clicking on the three verticle dots, a menu pops up to show a list of options that allow users to configure their graph preferences by checking or unchecking the boxes:
    - **Enable Zoom X(Time) axis**: This toggle zoom button controls the scale of the x-axis.
    - **Enable Zoom Y axis**: This toggle zoom button controls the scale of the y-axis.
    - **Enable Scroll wheel Zoom**: This is the toggle zoom mouse wheel that controls the graph.
    - **Edit Graph Series**: This allows the user to control what is shown on the graph. Available options include:
        - **Operation data**: Information about the operating mode of the chamber.
        - **Control Loop Data**: Information about the state of the control loops.
        - **Time Signal Data**: Information about the state of the time signals on the chamber.
        - **Alarm Data**: Information about the state of the chamber alarms.
7. **Pan/Zoom Extents**: The arrow keys may be used to pan the graph around the available data, and the center button may be used to zoom into all data for various time periods.
8. **Auto Refresh**: Toggle whether or not the graph will update itself with new data, this will move the graph to show the most recent point.
9. **Graph Range**: Toggles controls that allow the user to select the minimum and maximum points on the x axis of the graph. It allows the user to find data from one date to the next.
10. **Download**: Clicking this allows the user to download either all data on the Web Controller or just what is currently being shown.
11. **Legend**: This shows data each color is mapped to; and clicking on the color/name of the series will toggle its visibility.

Additionally there are several controls that are accessed using only the mouse:

1. **Left clicking**: This will show the value of each series on the graph at the nearest date/time to the click.
2. **Left click and drag**: This will zoom to the selected area.
3. **Middle click and drag**: This will pan the graph to show the available data.
4. **Scrolling the mouse wheel**: This will zoom the graph in and out centered

on the cursor; this can be disabled in the user settings for the graph.

7.2 Program Status

The Program Status panel in the following figure will appear in the display when the chamber is running a program. This panel is hidden when the chamber is not running a program.

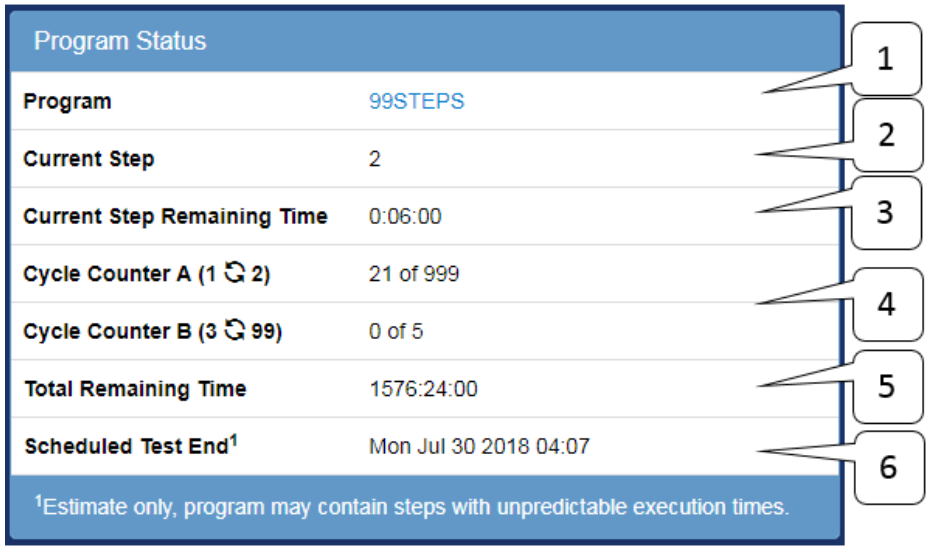


Figure 9: Monitor Page: Program status

Description of elements on the Program Status page:

1. **Program**: Displays program name that is currently running. As shown, program named 99STEPS is being executed. The program name itself has a link that, when clicked, will open the program in edit mode, if you are logged in as an "Administrator" or a "Technician". If a "Guest User" clicks on it, the Web Controller will prompt for a password or ask to log in as a privileged user to turn on the edit mode. This feature is similar to accessing the program in edit mode via the Program Page.
2. **Current Step**: Displays the current step number of the program being executed. As shown in the figure, step 2 is being carried out.
3. **Current Step Remaining Time**: Displays the remaining time in HH:MM:SS on the current step.
4. **Cycle Counter(s)**: For a P300/SCP-220 controller, if the program contains a loop with Counter A, Counter B, or both turned on, the status of the loop will be displayed here. As shown, Counter A containing steps 1 and 2 will be repeated 999 times, with the current loop at 21. As shown in the figure, Counter B loops between step 3 and 99 which has not begun yet. The counter

or loop feature is controller dependent. With the Watlow F4/F4T, information is estimated by watching the running program. This section is hidden when no cycling is used in the program.

5. **Total Remaining Time**: Displays the remaining time of the entire program in HHHH:MM:SS.
6. **Scheduled Test End**: Displays the estimated date/time at which the program will complete.

7.3 Operation Statistics

The operation statistics provides an overview of the Web Controller operation history. Two types of statistics are provided:

1. The percentage of time the chamber is in each operating mode (utilization).
2. A detailed list of when the chamber changed operating modes; this allows the data from each mode to be viewed or downloaded conveniently.

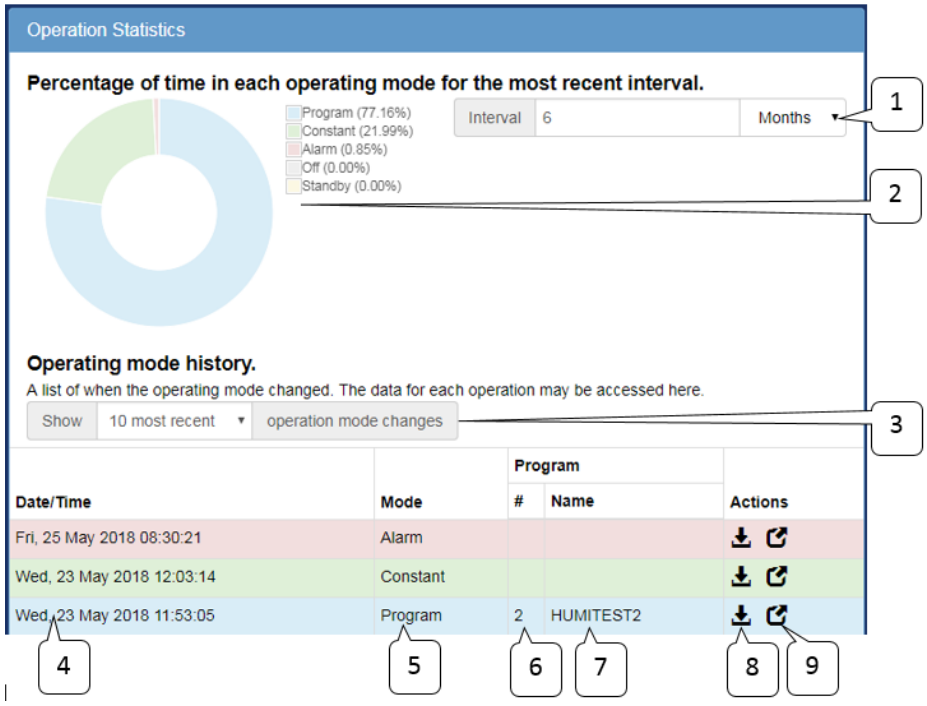


Figure 10: Monitor Page: Statistics

Description of elements and their operation on the Operation Statistics page:

1. **Percentage Interval**: This is a control that will adjust the amount of time used to generate the percentage pie chart shown in callout number 2.
2. **Percentage chart**: This is a chart showing the relative time spent in each mode.
3. **History depth**: This is the number of modes that will be shown on the table.
4. **History Date/Time**: This is the time at which the chamber started to operate in the listed mode.

5. **History mode**: This is the mode in which the chamber was operating for this line of the history. As shown in the figure, the chamber was operating in Program mode.
6. **History program number**: This is the number for the program that was operating (if a program was running) for this line of the history.
7. **History program name**: This is the name for the program that was operating (if a program was running) for this line of the history.
8. **History download data**: Clicking this will download all data for this line of history.
9. **History view data**: Clicking this will open the data for this line of history in a pop up modal for viewing.

8.0 Constant Setup Page

The Constant Page allows setting of the constant set point, time signals, and refrigeration power (for P300/SCP-220 only) for constant mode operation. Constant set point can be updated (or changed) by entering the temperature, humidity (if equipped), product control settings (if equipped) and time signal settings.

The content of the constant page is the same for all the controllers currently supported by the Web Controller. This page is accessible to all user account types except “Guest”.

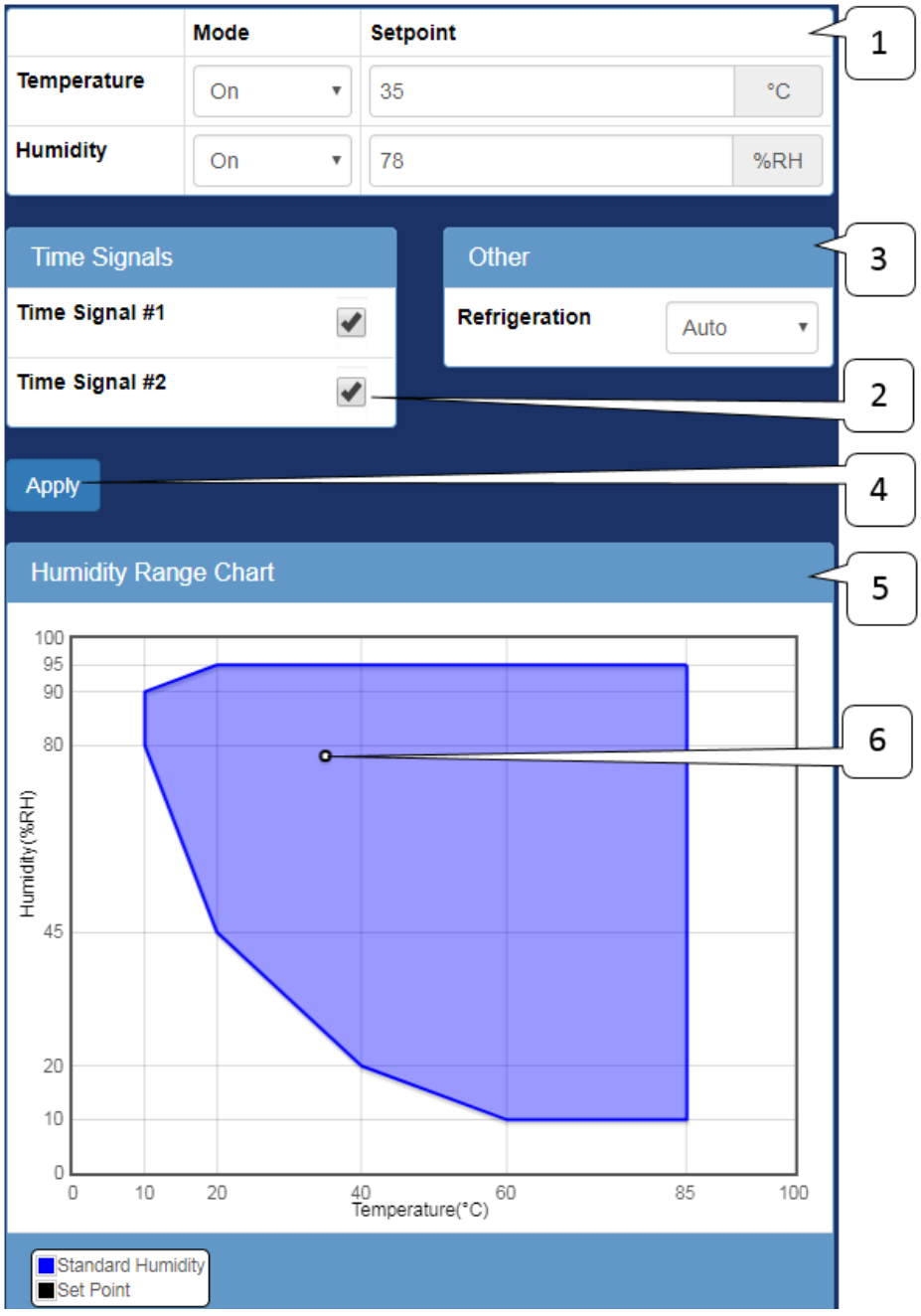


Figure 11: Constant Page

Description of the elements on the Constant Setup Page:

1. **Control Loop Parameters**: This is where each control loop parameters may be entered:
    - **Mode**: The operating mode of the control loops:
        - **On**: The control loop will attempt to reach the set point automatically.
        - **Off**: The control loop will not attempt to control the set point.
        - **Manual**: The control loop will output a specified control power (Watlow F4T only).
        - **Automatic**: The control loop will attempt to reach the set point automatically (Watlow F4T only).
    - **Set point**: The target value that the control loop will try an attain.
    - **Product Control**: (optional) This will intentionally over drive conditions of the air in order to reach the product set point quicker. The available parameters for this feature are:
        - **Enable**: Turn this feature on or off.
        - **+/- Deviation**: The maximum allowable difference between the air and product parameters.
2. **Time Signals**: This is where special features/digital outputs can be enabled/disabled. (The Watlow F4/F4T refers to these as event outputs).
3. **Other**: This is where other features may be controlled. Specifically the manual refrigeration outputs may be set here on the P300/SCP-220. If there are no "other" parameters to be configured this panel is hidden.
4. **Apply**: When clicked the system will apply the new settings to the chamber controller. If there is an asterisk next to Apply then some settings have not been written.
5. **Humidity Range Graph**: This shows the allowable range for humidity operation. On chambers without the humidity option, this portion will be hidden.
6. **Humidity Point**: This shows where the entered temperature/humidity are in relation to the allowable range of operation.

9.0 Program List Page

The program page displays all programs that are available on the chamber controller. Programs can be identified by their name and slot number. An open or unused slot on the list is marked as "EMPTY". The figure shows there are two programs stored on the list, using slot 1 and 2; slot 3 is unused (marked as "EMPTY"). Within this page, we can also manage our programs, such as download, upload, or delete (under the Actions column). To view or edit a program, we click on the program name. To create a new program, we click on the next available slot marked "EMPTY". These features will be discussed in the next section. This page is accessible only by "Technician" and "Administrator" user accounts.

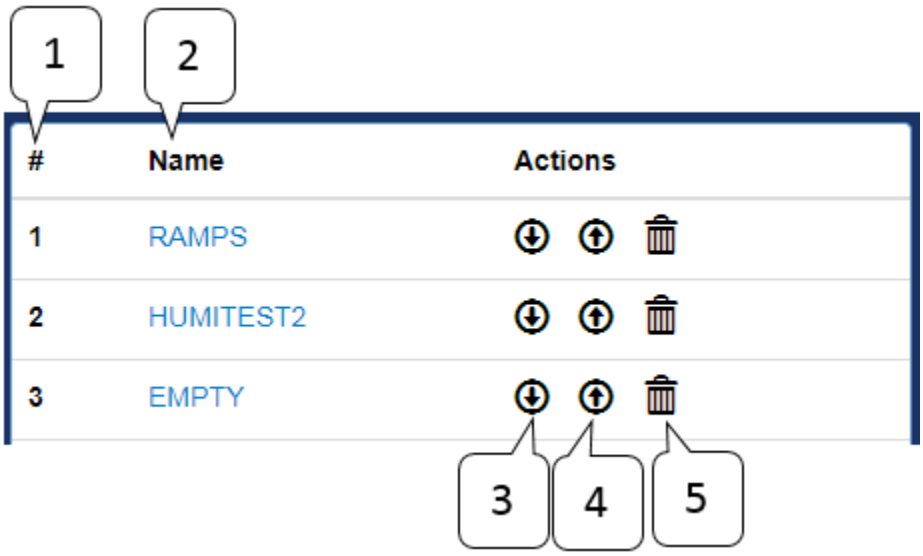


Figure 12: Program list page

Here is a brief description of the elements on this page:

1. **Program Slot Number**: Displays slot number for each program stored on the list. ESPEC P300 and Watlow F4/F4T have 40 available slots, whereas ESPEC SCP-220 has only 30. Slots 1-20 are usable for creating programming profiles; slots 21-30 are reserved slots for read-only.
2. **Program Name**: Displays the name of a program. The word `EMPTY` indicates an open slot; no program has occupied this slot yet. To view or edit the program, click on its name to launch the program editor. To create a new program, click on any `EMPTY` slot will launch the program editor.

3. **Download Program**: To download a program and store it on your computer, click on the download arrow on a slot. Program will be saved as a JSON file.
4. **Upload Program**: To upload a program from your computer into a particular slot, click on the upload arrow on that slot.
5. **Delete Program**: To delete a program from a particular slot, click on the trash icon on that slot.

10.0 Program Edit Page

Program viewing or editing is done on this page. Each supported chamber controller has its own version of this page, but some common elements shared between them are presented here. The following sections will provide details on how to create a program for a particular controller. To launch the program edit page, click on the program name on the list (see Section 9.0) or click on `EMPTY`. The following figure shows the program editing page after clicking on a program named PGM-1.

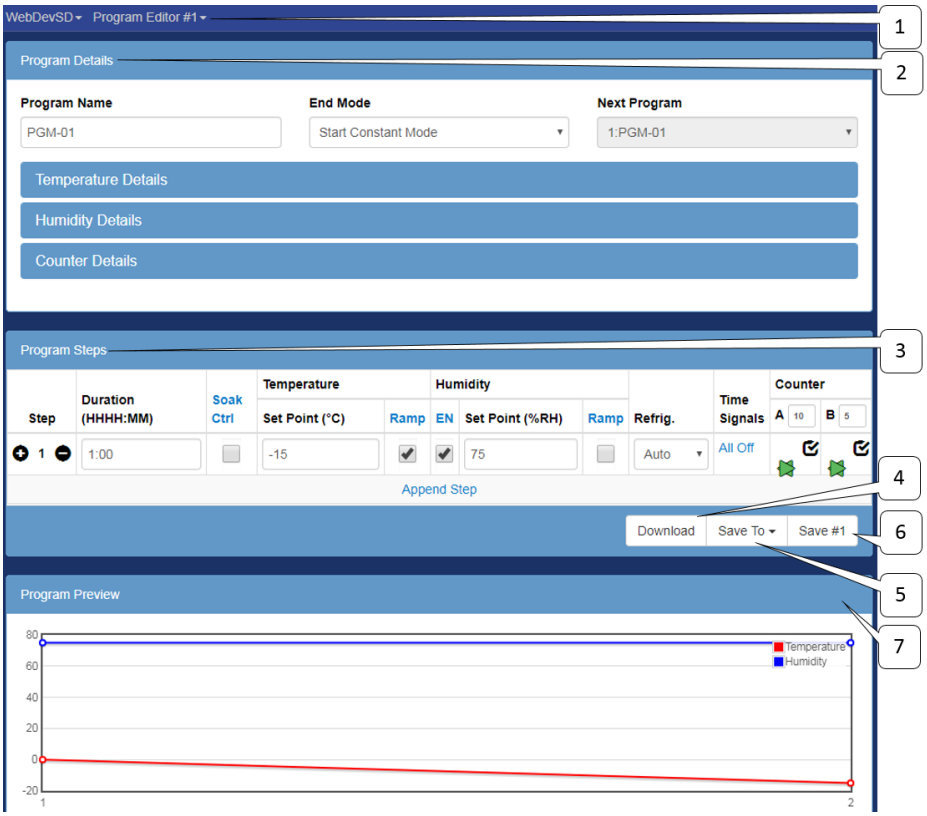


Figure 13: Program edit page common elements

Here is a list of the common elements referenced by the callout labels shown in the above figure.

1. **Program Selector**: The Program Editor has a dropdown menu that displays the slot list and all the programs stored on it. We can access any program on the list by clicking on its name; this action will leave the current program editing page.

2. **Program Details**: This section is where various program wide settings are entered; an example of this being the program's name.
3. **Program Steps**: This is the programming core, where a program is created and how each step of a program gets added, removed or edited.
4. **Download**: This will save the current program to the users computer.
5. **Save To**: This will save the current program to a different slot than the one being edited (or used).
6. **Save #**: This will save the current program to the current slot. In other words, this will save changes to the current program.
7. **Program Preview**: Displays the operation output of the program being edited. It is a graph of what the program looks like when it executes.

10.1 Program Edit Page for Watlow F4T

The following procedure is used to edit a program for the Watlow F4T:

1. Enter the program name, guaranteed soak deviation, and data logging settings in the *Program Details* panel.
2. Complete each program step; that is, fill in each program step in the *Program Steps* panel.
    1. Select a step mode (if an instant set point change is not desired).
    2. Enter step duration (not applicable for Jump, Ramp: Rate, or End mode steps).
    3. Enter the loop details, enable guaranteed soak, set point, etc.
    4. Enter the time signal settings.
3. Repeat item 2 for each step.
4. Once the program is complete there are several options:
    1. Download: Download the program to the computer as a JSON file.
    2. Save To: Save the program to a slot any of the slots the chamber has.
    3. Save #(slot): Save the program to the active slot.

10.1.1 Program Details

For a Watlow F4T model, the Program Details page displays a Program Name, Data Logging option, Temperature and Humidity Guaranteed Soak (GS) Deviation option. An existing program name can be edited in the Name field. The Web Controller will flag an error message if a character other than standard English alphabet is used.

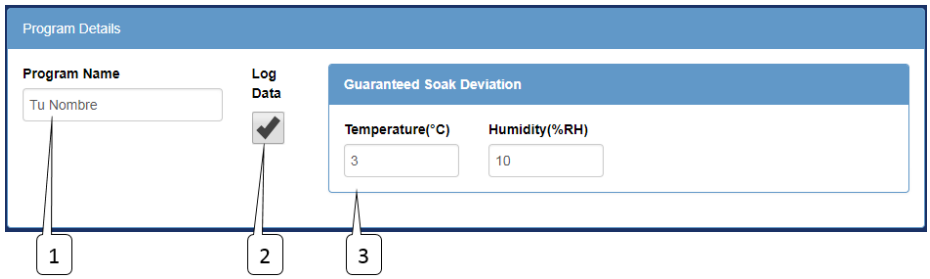


Figure 14: F4T program edit details

Element details are listed as follows:

1. **Program Name**: Program name; alpha-numeric characters are required.
2. **Log Data**: Log data on the controller for Watlow F4Ts that have this feature installed (optional).
3. **Guaranteed Soak Deviation**: How close the set point must be to the process value for the step duration timer to count down.

10.1.2 Program Steps

If an existing program is selected from the Program Page for editing, the Program Steps page will display the program steps as depicted in the following figure. As shown, the program contains five steps. To edit a step, fill in the values or parameters in the column fields. To remove a step, click on the (-) button next to the step number. To insert or add a new step, click on the (+) button next to the step number. A copy of the current step will be inserted below it.

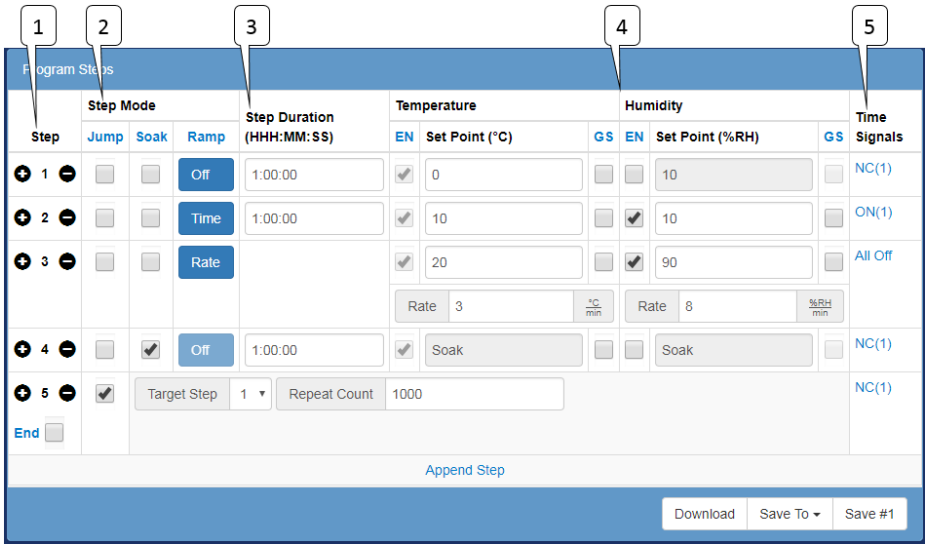


Figure 15: F4T program edit page steps

To create a new program, click the next EMPTY name under the Name column. A new Program Steps page will display the program steps starting at step 1 with the rest of the fields empty. The Program Name field will be blank, and a new name must be entered. There are seven step types (or modes): Ramp Time, Ramp Rate, Soak, Wait, Instant Change, Jump and End.

Column description of the program step:

1. **Step**: The first column indicates the step of the program. Program will be executed sequentially starting from step 1 to the last step. A step can be inserted or removed using the (+) or (-) buttons, respectively. The (+) button will insert a new step right below the current step where (+) is clicked. In addition, the "Append Step" button can be used to insert a new step; this new step will be placed as the last step. On the last step, only the option to set the end condition is available; when selected, the standard parameters

will be replaced with the option to stop the chamber when the program ends, including any Temperature or Humidity loop modes.

2. **Step Mode**: The building blocks of programs or profiles are based on the step types. They can be used to create simple or complex profiles involving inputs and outputs. The properties of these step types are outlined as follows:
    - **Jump**: Instead of changing the set point the program will jump to a specified step a specified number of times, as shown on Step 5 in the figure.
    - **Soak**: Instead of changing the set point the program will maintain the previous set point for a specified "Step Duration", as shown on Step 5 in the figure.
    - **Ramp**:
        - **Off**: The set point will be changed instantly.
        - **Time**: The set point will be ramped to the new set point over the given duration.
        - **Rate**: The set point will be ramped at a given rate, as shown on Step 3 in the figure.
3. **Step Duration**: The duration of the step are in HH:MM:SS. If a value is greater than 60 minutes or seconds, the Web Controller will convert the value using the following formats: 90 becomes 0:01:30, 90:00 becomes 1:30:00, etc.
4. **Temperature, Humidity, etc**: This is a control loop, configurable with the following parameters:
    - **EN**: Enable the loop for this step.
    - **Set Point**: The temperature/humidity to go to during this step.
    - **GS**: Enable Guaranteed Soak for this step; this prevents the duration timer from counting down until the process value is within the deviation set in the program details section.
    - **Rate**: This parameter is only visible if the step is set to have a Ramp Rate; it specifies the rate at which the working set point will change in order to achieve the specified set point.
    - **Mode**: This parameter is only visible if the final steps end checkbox is selected; it specifies what each loop (Temperature, Humidity) will do when a program ends.
        - **User**: Run the constant set point.
        - **Hold**: Hold the last set point that the program was at.
        - **Off**: Disable the loop. This should not be used as the loop will need to be manually re-enabled.
5. **Time Signals**: This button will show the settings for each available time signal.
    - **NC**: No change; do not change the state of this time signal.

- **On**: Turn the time signal on.
- **Off**: Turn the time signal off.

10.1.3 Program Preview

When a program is loaded into memory (or a new program is being created), the Web Controller renders the steps of the program and displays them in a graphical form. The following figure displays example of a graph from the program. The conditions prior to starting a program are assumed to be 0 degrees and 0%RH when rendering this graph.

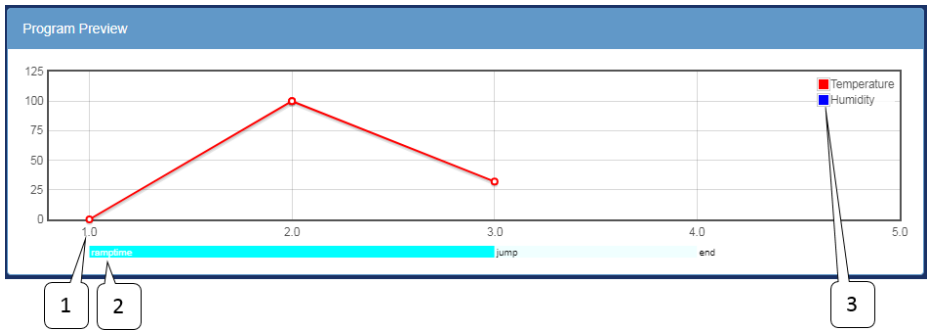


Figure 16: F4T program edit page preview

Description of elements on the graph:

1. **Program Step**: The X axis is the program step number.
2. **Step Type**: The type of each program step.
3. **Preview Legend**: The legend for the preview graph.

10.2 Program Edit Page Watlow F4

This page is the Watlow F4 version of the program editor. The following procedure is used to edit a program for the Watlow F4:

1. Enter the program name, in the *Program Details* panel.
2. Complete each program step; that is, fill in each program step in the *Program Steps* panel.
    1. Select a step mode.
    2. Enter step duration (not applicable for Jump, Ramp:Rate, or End mode steps).

3. Enter the loop details, enabled guaranteed soak, set point, etc.
4. Enter the time signal settings.

3. Repeat item 2 for each step.
4. Once the program is complete there are several options:
    1. Download: Download the program to the computer as a JSON file.
    2. Save To: Save the program to a slot any of the slots the chamber has.
    3. Save #(slot): Save the program to the active slot.

10.2.1 Program Details

For a Watlow F4 model, the Program Details page displays a program name. If a new program is being created, a default program name, called PROFILE, will be displayed. If an existing program is open for editing, program name will be displayed in this filed, as shown in the figure. Program name can be edited by typing the new name in this field. Ten alpha-numeric characters are allowed for a program name. Alphabets are entered in capital letters. If more than ten characters are used, the Web Controller will only use the first ten characters. The Web Controller will flag an error message if a character other than standard English alphabet is used.

Figure 17: F4 program edit page details

10.2.2 Program Steps

If an existing program is selected from the Program Page for editing, the Program Steps page will display the program steps as depicted in the following figure, which contains three steps. To edit a step, fill in the values or parameters in the column fields. To remove a step, we simply click the (-) button next to the step number.

All programs must have an end step. Therefore, if you start a new program, the first step will contain an end step in the Step Type field. In order to begin programming, you must add a new step, either by clicking on "the Append Step" button (in the middle and at the bottom of the page) or the (+) button next to the step number. Once your program contains two steps, you can modify the first step to your specific or required step type. There are six step types (or modes): Autostart, Ramp Time, Ramp Rate, Soak, Jump and End.

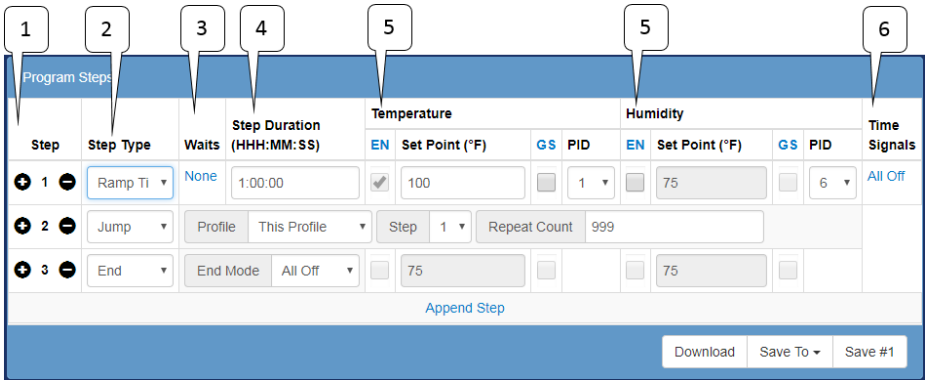


Figure 18: F4 program edit page steps

Description of Watlow F4 step types:

1. **Step**: The first column indicates the step of the program. Program will be executed sequentially starting from step 1 to the last step. A step can be inserted or removed using the (+) or (-) buttons, respectively. The (+) button will insert a new step right below the current step where (+) is clicked. In addition, the "Append Step" button can be used to insert a new step; this new step will be placed as the last step.
2. **Step Mode**: The building blocks of programs or profiles are based on the step types. They can be used to create simple or complex profiles involving inputs and outputs. The properties of these step types are outlined as follows:
   - **End**: All programs must have an end step, this tells the controller what to do when the program ends. There are four options.

    - **Hold**: Continue to operate with the current control parameters.
    - **Control Off**: Disable the control loops.
    - **All Off**: Disable all outputs (control loops and time signals)
    - **Constant**: Run the constant control loop set points.
  - **Auto Start**: Set this program to wait until a specified time to run.
  - **Ramp Time**: Change the control loop set point gradually over a specified time interval.
  - **Ramp Rate**: Change the control loop set point at a specified rate. This is only available with single loop controllers such as temperature only chambers.
  - **Jump**: Instead of changing the set point the program will jump to a specified step a specified number of times. (see step 3 in the screen shot)
  - **Soak**: Instead of changing the set point the program will maintain the previous set point for a specified "Step Duration".
3. **Waits**: If set this step will wait until a specified condition is met before executing. These conditions may be a specific analog value or a specific state on one of the digital inputs (when they are configured as wait events).
4. **Step Duration**: The duration of the step are in HH:MM:SS (hours, minutes, seconds). If a value is greater than 60 minutes or seconds, the Web Controller will convert the value using the following formats: 90 becomes 0:01:30, 90:00 becomes 1:30:00, etc.
5. **Temperature, Humidity (or any control loop)**: This is a control loop, the following parameters can be set:
  - **EN**: Enable the loop for this step.
  - **Set Point**: The temperature/humidity to go to during this step.
  - **GS**: Enable Guaranteed soak for this step; this prevents the duration timer from counting down until the process value is within +/- the deviation set on the controller.
  - **Rate**: The rate at which the working set point will change in order to achieve the specified set point. This is only available with single loop controllers such as temperature only chambers.
  - **PID**: This is the PID set that will be used to achieve the desired set point.
6. **Time Signals**: This button will show the settings for each available time signal.

10.2.3 Program Preview

When a program is loaded into memory (or a new program is being created), the Web Controller renders the steps of the program and displays them in a graphical form. A plot of the program is depicted in the following figure. The conditions prior to starting a program are assumed to be 0 degrees and 0%RH when rendering this graph.

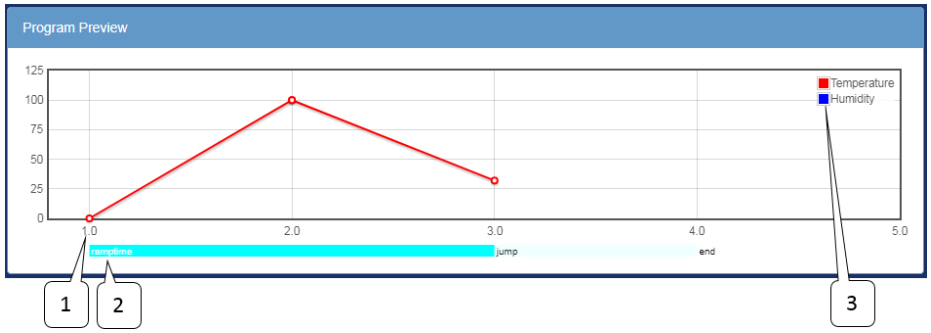


Figure 19: F4 program edit page preview

Description of elements on the graph:

1. **Program Step**: The X axis is the program step number.
2. **Step Type**: The type of each program step.
3. **Preview Legend**: The legend for the preview graph.

10.3 Program Edit Page P300/SCP-220

This page is where P300/SCP-220 version of the program editor. The following procedure is used to edit a program for a P300/SCP-220:

1. Enter the program name, and end mode in the *Program Details* panel
2. Complete each program step; that is, fill in each program step in the *Program Steps* panel.
    1. Enter step duration (not applicable for Jump, Ramp:Rate, or End mode steps).
    2. Enter the loop details, enabled guaranteed soak, set point, etc.
    3. Enter the time signal settings.
3. Repeat item 2 for each step.
4. Enter the desired cycle counter values using either the sliders on the right side of the program steps panel, or the sub panel in the *Program Details* panel.

5. Once the program is complete there are several options:
    1. Download: Download the program to the computer as a JSON file.
    2. Save To: Save the program to a slot any of the slots the chamber has.
    3. Save #(slot): Save the program to the active slot.

10.3.1 Program Details

If an existing program is open, the Program Details page will display the program name in the Program Name field, along with execution (operation) mode in the End Mode field, and a program to be executed following the current program (in the Next Program field) as depicted in the figure. This page also displays program configuration options for Temperature, Humidity and Counter (to be discussed below). Execution modes available at the end of a program are:

- **Off**: Turn the chamber off.
- **Start Constant Mode**: Run the first constant mode.
- **Hold Last Step**: Hold the set point(s), time signal(s) and refrigeration settings from the last step executed.
- **Start Next Program**: Start the next program that is specified by the Next program drop down menu.
- **Standby (P300 only)**: Stop operation but leave the chamber display on.

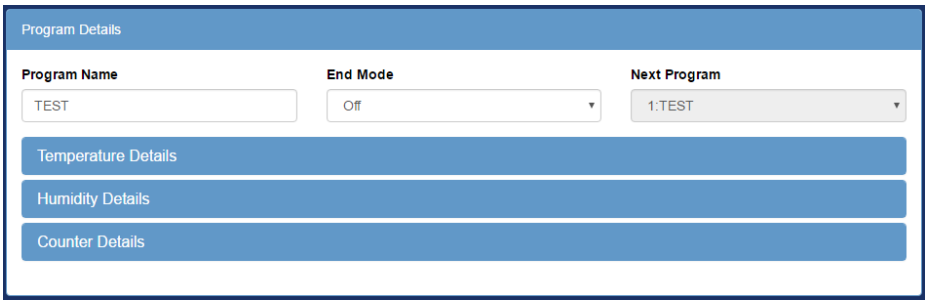


Figure 20: P300 program edit page details

If a new program is being created, the Program Name field will be left blank, and a new name for the program can be entered. An existing program name can also be edited.

10.3.1.1 Temperature/Humidity Details

Current settings of the temperature, humidity and counter displayed as drop-down tabs are available for viewing via the click of a mouse button. Each of these tabs displays information as illustrated in the following three figures.

To view the temperature detail, click on the Temperature Details tab. A drop-down view and description of the temperature will be displayed; click it again to close the view tab. The Humidity and Counter Details tabs may be viewed in the same way. It should be noted that the Program Details page of the SCP-220 only has the Counter Details page available for viewing and editing.

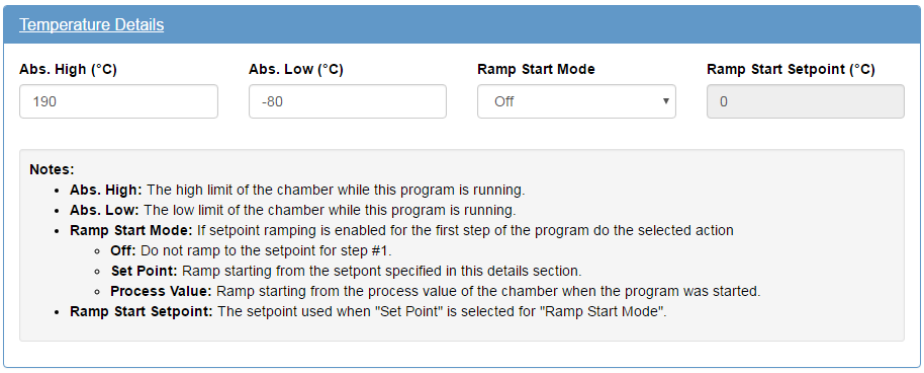


Figure 21: P300 program edit page temperature/humidity details

10.3.1.2 Counter Details

The unique feature of the counter is that it allows a certain step (or a range of steps) to be repeated multiple times within the program. The counter allows a program to contain fewer instructional steps. Two separate counters are available: Counter A and Counter B. As shown in the figure (Counter B), the Start Step field (bottom left) represents the step number to begin the loop. The End Step field (bottom right) represents the step number to end the loop. The Cycles field (top center) represents the number of times the loop will repeat.

A program may contain a loop configured to run within a loop, such as Counter A executes inside Counter B. Two loops can be configured to run separately, repeating separate step numbers. The P300 controller supports a maximum number of 999 cycles, while the SCP-220 supports a maximum number of cycles of 99 times.

There are two ways to program the loop(s). The first is via the Counter Details page as described above. The second method involves “dragging” the loop arrows with the mouse button, to be explained next.

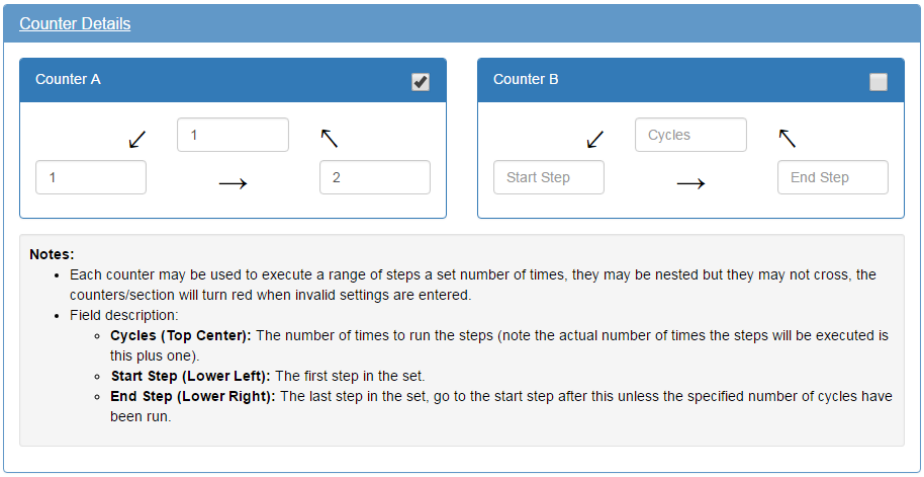


Figure 22: P300 program edit page counter details

10.3.2 Program Steps

The program steps are edited in the second section; element details are shown below.

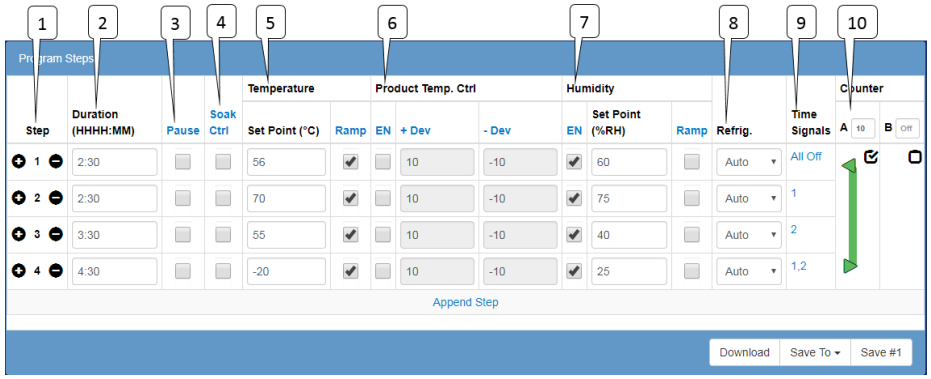


Figure 23: P300 program edit page steps

1. **Step**: The first column indicates the step of the program. Program will be executed sequentially starting from step 1 to the last step. A step can be inserted or removed using the (+) or (-) buttons, respectively. The (+) button will insert a new step right below the current step where (+) is clicked. In addition, the "Append Step" button can be used to insert a new step; this new step will be placed as the last step.
2. **Duration**: The duration of the step in HHHH:MM. If a value is greater than 60 minutes, the Web Controller will convert it using the following format: 90 becomes 01:30.
3. **Pause**: When enabled the program will pause execution once this step is complete.
4. **Soak Ctrl**: When soak control (guaranteed soak) is enabled the step will wait until the set point(s) have been attained before the duration counter starts to count down.
5. **Temperature**: The temperature control loop settings.
   - **Set Point**: The temperature to go to during this step
   - **Ramp**: When enabled the set point will be gradually changed from the previous steps set point to this steps set point over the duration of the step. When disabled the set point will be set immediately go to this steps set point when the step begins.
6. **Product Temp. Ctrl (Optional)**: Control the product temperature not the air temperature.

- **EN**: Enable or disable product temperature control.
- **(+) Dev**: The allowable positive deviation between the product and air temperatures (must be positive).
- **(–) Dev**: The allowable negative deviation between the product and air temperatures (must be negative).

7. **Humidity (Optional)**: The humidity control loop settings.
   - **EN**: Enable or disable humidity control for this program step.
   - **Set Point**: The humidity set point for this step.
   - **Ramp**: When enabled the set point will be gradually changed from the previous steps set point to this steps set point over the duration of the step. When disabled the set point will be set immediately go to this steps set point when the step begins.
8. **Refrig.**: Configure how the refrigeration system will behave during this step. It can be setup for automatic cooling power, a manual cooling power percentage, or completely disabled.
9. **Time Signals**: Turn each time signal on or off for each step.
10. **Counter**: The counter is used to repeat a specified number of steps. Both counter A and counter B can be set by enabling the check box in their respective column then dragging the start and end arrows to the desired step. The counter (number of times to repeat the steps can be adjusted in the text box in each column.

10.3.3 Program Preview

When a program is loaded into memory (or a new program is being created), the Web Controller renders the steps of the program and displays them in a graphical form. A plot of the program is shown in the following figure. The conditions prior to starting a program are assumed to be 0 degrees and 0%RH when rendering this graph.

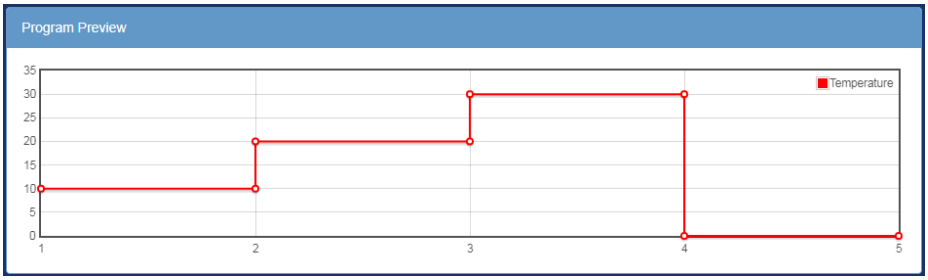


Figure 24: P300 program edit page preview

11.0 Run/Stop Page

The chamber has three operation modes which can be managed via the Run/Stop page. These are Standby, Constant and Program, all displayed as individual panels. In a Standby mode, the chamber is off. In this mode, the Standby panel will have a check mark in the checkbox. The "Stop Operation" button in the Standby panel can be used to stop a running program thereby causing the chamber to be in a standby mode. The "Stop Operation" button can also be used to stop the chamber from running in a constant mode.

The Program panel has more operation modes. A running program can be paused via the "Pause" button; it can be resumed via the "Continue" button. Program's instructional steps can be stepped through using the "Next Step" button. A new program can be loaded via the drop-down menu in the Program panel.

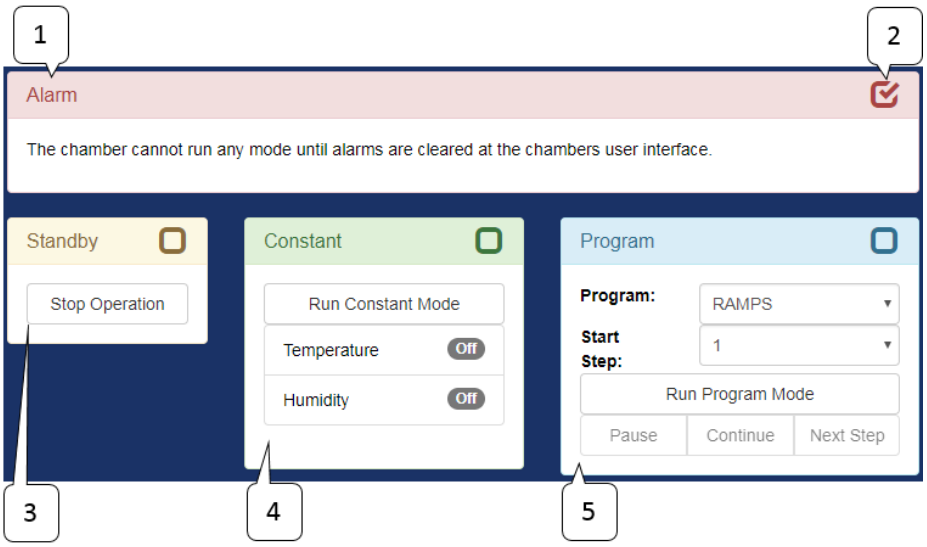


Figure 25: Run/Stop page

Description of the chamber's operation state:

1. **Alarm Panel**: This panel is only shown when there is an active alarm. No other controls on this screen will function until the alarm(s) causing this have been cleared at the chamber.
2. **Active Mode**: This checkbox in the top right of each panel denotes which of the modes is currently active.
3. **Standby Panel**: This panel indicates that the chamber is not running.

- **Stop Operation**: Pressing this button will put the chamber into standby mode.

4. **Constant Panel**: This panel indicates that the chamber is running a constant set point.
   - **Run Constant Mode**: Pressing this button will put the chamber into constant mode.
5. **Program Panel**: This panel indicates that the chamber is running a program.
   - **Program**: This drop down selects which program to run.
   - **Start Step**: This drop down selects which step the selected program will be started on.
   - **Run Program Mode**: Pressing this button will start the program selected on the *Program* drop down on the selected *Start Step*.
   - **Pause**: Pressing this will pause the running program.
   - **Continue**: Pressing this will cause a paused program to resume execution.
   - **Next Step**: Pressing this will force the running program to advance to its next step.

Executing a new program from the Standby or Constant mode:

1. Ensure the chamber is in Standby or Constant Mode.
2. Click the Program list in the Program panel and select a new program from the list.
3. Click the "Run Program Mode" button.

Executing a new program while Chamber is in Program Mode:

1. Click the "Stop Operation" button in the Standby panel.
2. Click the Program list in the Program panel and select a new program from the list.
3. Click the "Run Program Mode" button.

12.0 Network Page

If the Web Controller is connected to a local network and there are other controllers on this network, the Network page will provide an option to access and control those controllers. By default, the Network page displays all compatible chambers that the Web Controller can locate on the network. As shown in the following figures, our Web Controller detects other controllers that are part of the local network, displaying their current operation mode, program and step number. The display is configurable with Panel view or List view as depicted in the figures. If any changes are made to the layout and saved, the display will be loaded based on the saved configuration. This page is accessible by all user types: “Guest”, “User”, “Technician”, and “Administrator”.

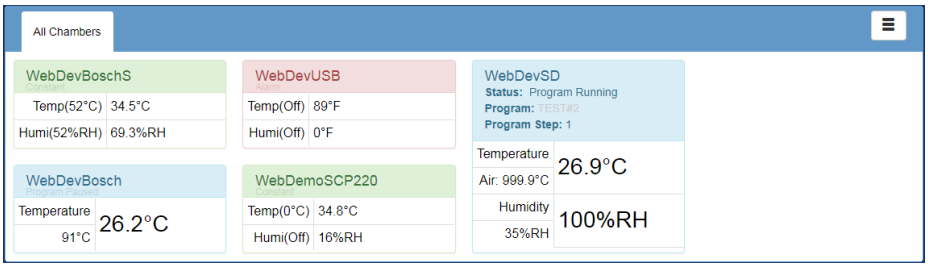


Figure 26: Panel view

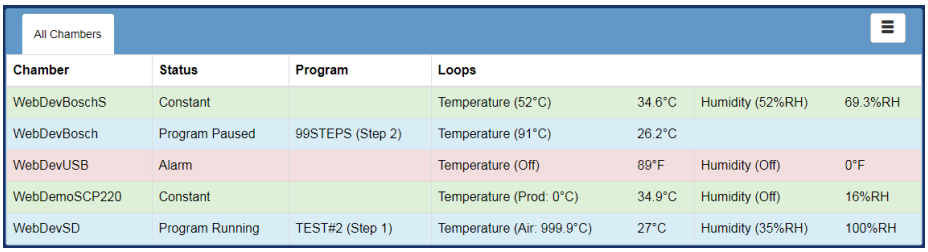


Figure 27: List View

Click on any of the listed chambers to navigate to that page directly. Note that each of these chambers are unique web servers and each will require the user to log in manually.

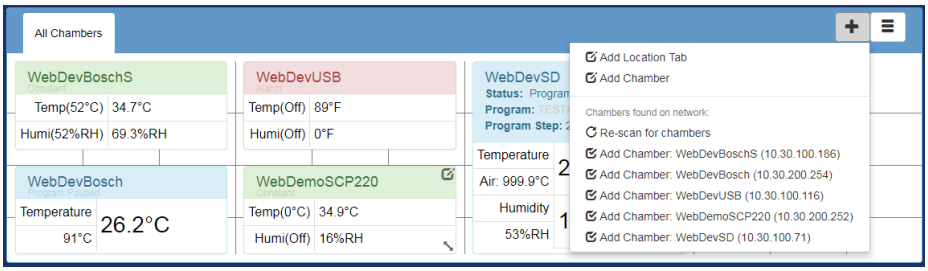


Figure 28: Network edit view

The layout and contents of either the Panel or List view may be edited:

1. Place the page in edit mode by "Enable Layout Changes" from the menu found in locations tab bar.
2. Drag chambers into desired position.
   - **Panel View**: The panels may be dragged into there desired location on the grid. They may also be resized using the arrow button on the bottom right.
   - **List View**: The list may be reordered by dragging each chamber into its desired location.
3. Add new chambers/location tabs.
   - Clicking the plus button on the locations tab bar allows the user to add location tabs, manually add new chambers, and add chambers that have already been found on the network.
4. Remove chambers/location tabs.
   - Chambers/Location tabs may be deleted from the page by clicking the edit button that is shown when hovering over each element, and clicking the delete button.
5. Save changes by by selecting "Save layout changes" from the menu found in the locations tab bar.

13.0 Setup Page

The Setup Page can only be accessed by an administrator to apply different settings to the Web Controller. All configuration settings are accessible on this page, including network and e-mail settings. This section is divided into subsections to provide detailed explanation on each of them. The following figure depicts the main Setup Page. Configuration tabs are available on the left pane. If any one of them is clicked, its panel will be displayed on the right.

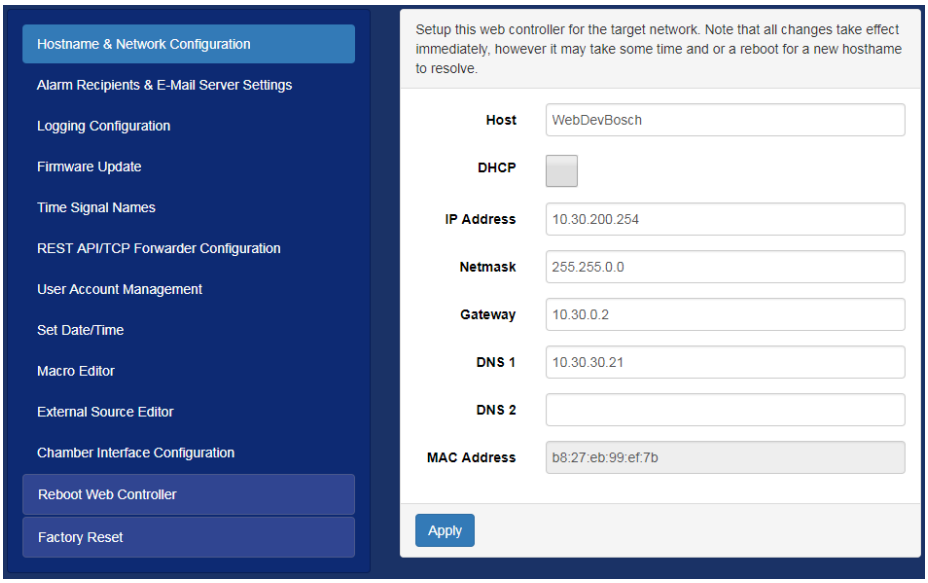


Figure 29: Setup page

13.1 Hostname & Network Configuration

This tab allows us to manage hostname and network configuration. By default, the Web Controller uses DHCP for its network, with an IP address assigned by the DHCP server. It is possible to configure and assign a static IP address to the controller so that it will have a consistent IP address. Simply check off the DHCP box and enter the desired IP address in the IP Address field, and click Apply. A unique and descriptive hostname may be applied to the controller as well. These settings will take effect immediately.

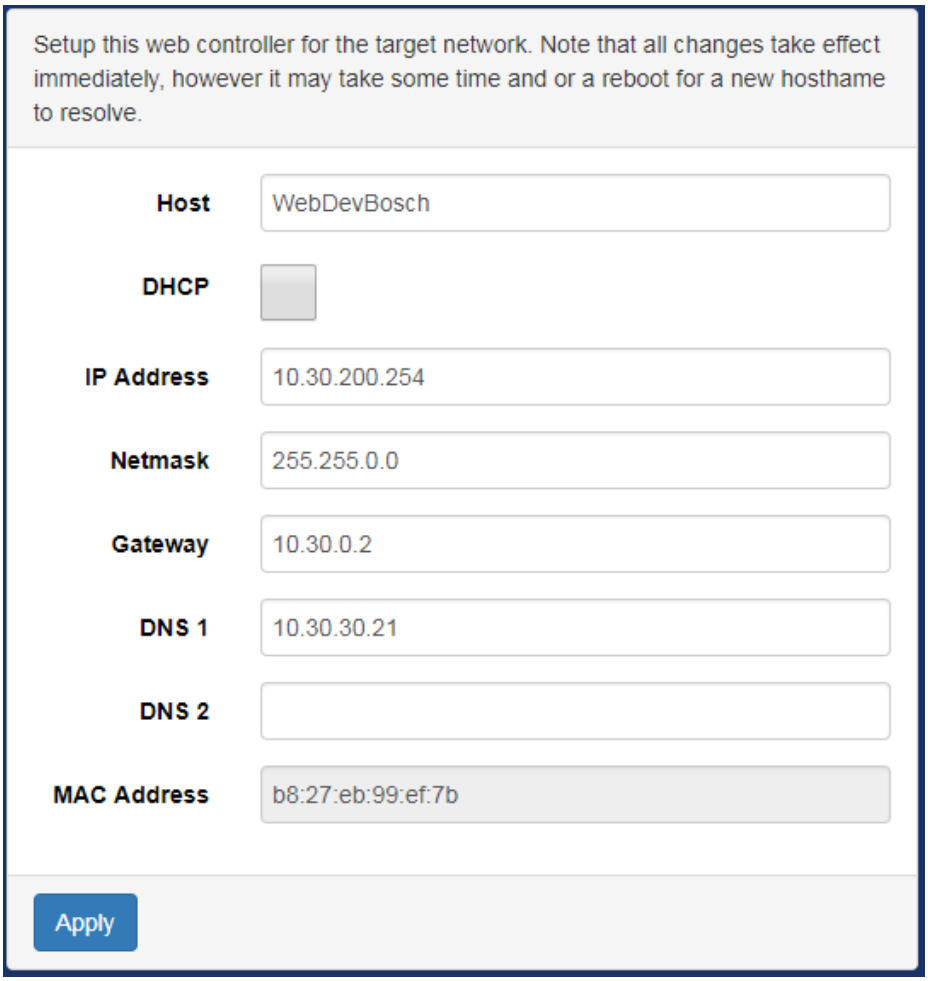


Figure 30: Setup page: network configuration

13.2 Alarm Recipients & E-Mail Server Settings

On this page, we can configure the Web Controller to notify us of the chamber's condition when an alarm went off. To set up for an e-mail notification, enter your e-mail address in the Alert Addresses field and click Apply. The "Send Test Message" button can be used to test sending a message to your e-mail address. Multiple e-mails can be used, but each line must contain only one e-mail address. To expand the field, click and drag the lower-right corner. Note that the SMTP password is only required when it is being changed.

Figure 31: Setup page: email configuration

13.3 Logging Configuration

This tab can be used to manage a data logging scheme. The current log can be cleared using the Clear Log button. Different sampling frequency can be set by entering a new number in the Sample Frequency field and click Apply. A reboot is required for the new frequency to take effect.

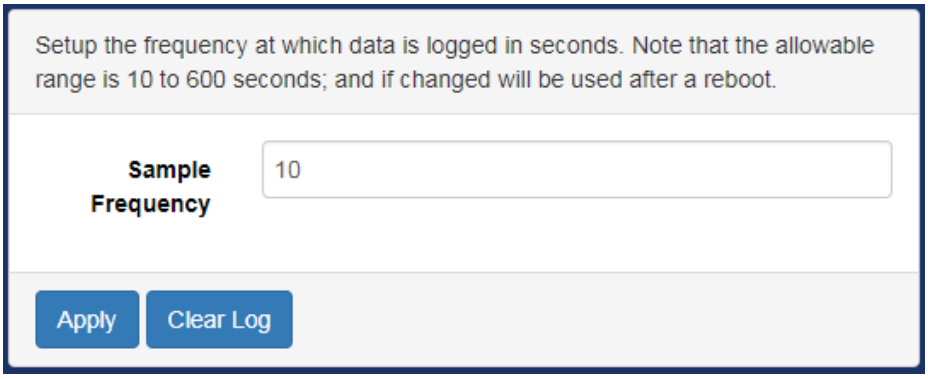


Figure 32: Setup page: login configuration

Description of Logging Configuration:

1. To update the sample frequency enter a new value between 10-600 seconds and click Apply. After receiving the green success response restart the Web Controller via the “Reboot Web Controller” button at the bottom of the page.
2. To clear the data log press the “Clear Log” button.

13.4 Firmware Update

The Firmware Update page provides the option to apply update to the Web Controller firmware revision. Before performing an update you should have an update package provided by ESPEC stored on your local computer. To update the Web Controller, click “Upload Firmware” and then click “Browse” to locate and upload the update package, then click “Submit” to perform the update. Note: The Web Controller will reject any package not signed by ESPEC North America.

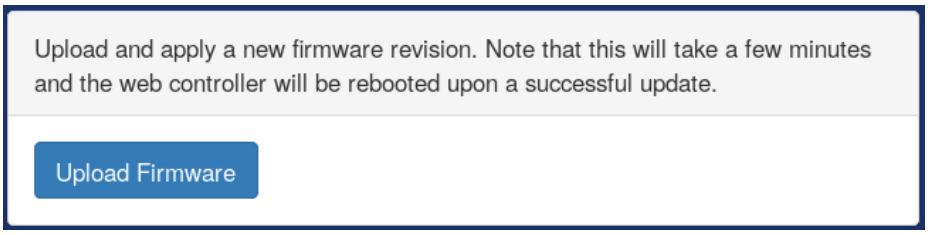


Figure 33: Setup page: Firmware update

13.5 Time Signal Names

This section will allow custom names to be applied to each time signal.

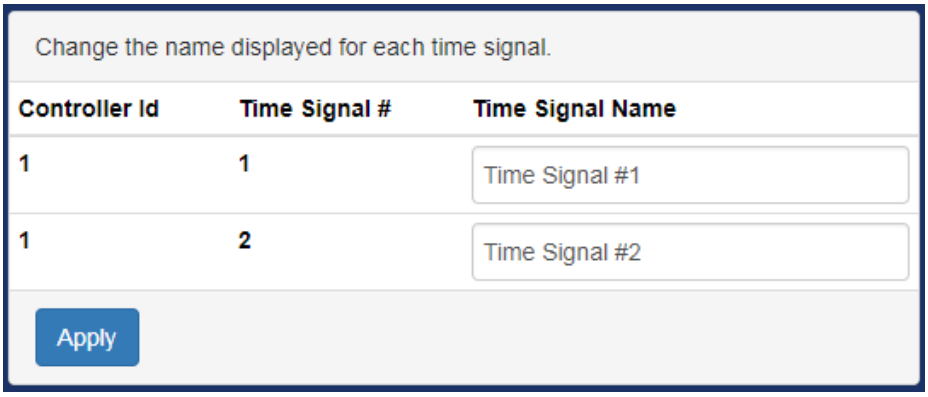


Figure 34: Setup page time signal names

13.6 REST API/TCP Forwarder Configuration

The REST API and TCP tab provide an advanced configuration to control the Web Controller. REST API allows for a standard universal way to interact with the Web Controller and chamber. It supports three security modes: Off, No Authentication and HTTP basic Authentication. On this page, the security of the REST API can be adjusted, in addition to enabling or disabling the TCP Forwarder. The TCP forwarder allows a direct access to the chamber controller via the Web Controller. The REST API may be browsed by disabling authentication and navigating to "/api/v1.0/" and following the various URIs given at each address. Note: Each controller has its API and therefore a TCP forwarder for each controller must be setup separately.

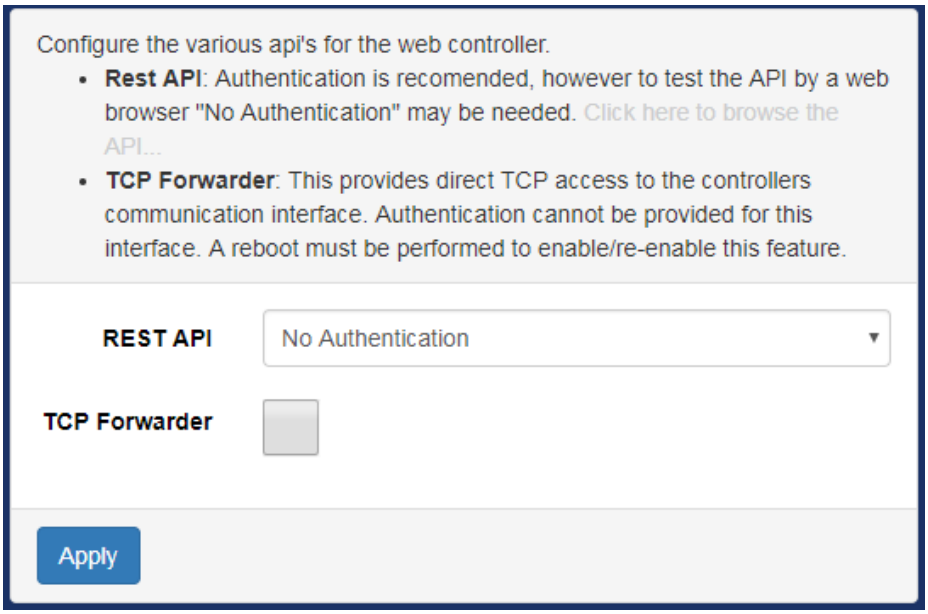


Figure 35: Setup page api configuration

Description of the REST API security modes:

- **REST API**: This allows for a standard universal way to interact with the Web Controller and chamber. Refer to Section 14.1 (14.1 REST API) for documentation. It supports three security modes:
  - **Off**: Do not allow any access.
  - **No Authentication**: Allow all access.
  - **HTTP Basic Authentication**: Use HTTPs built in basic authentication.

- **TCP Forwarder**: This allows direct access to the chamber controller through the Web Controller. Refer to Section 14.2 (14.2 TCP Forwarder) for documentation.

13.7 User Account Management

The account management tab allows the system administrator to manage user accounts and access privileges to the controller, with three different account types: User, Technician and Administrator. To create a new user account, click on the Add User button, enter username and password (twice), then click and select account type on the list from under the Type field. An account can be removed by clicking on the X button.

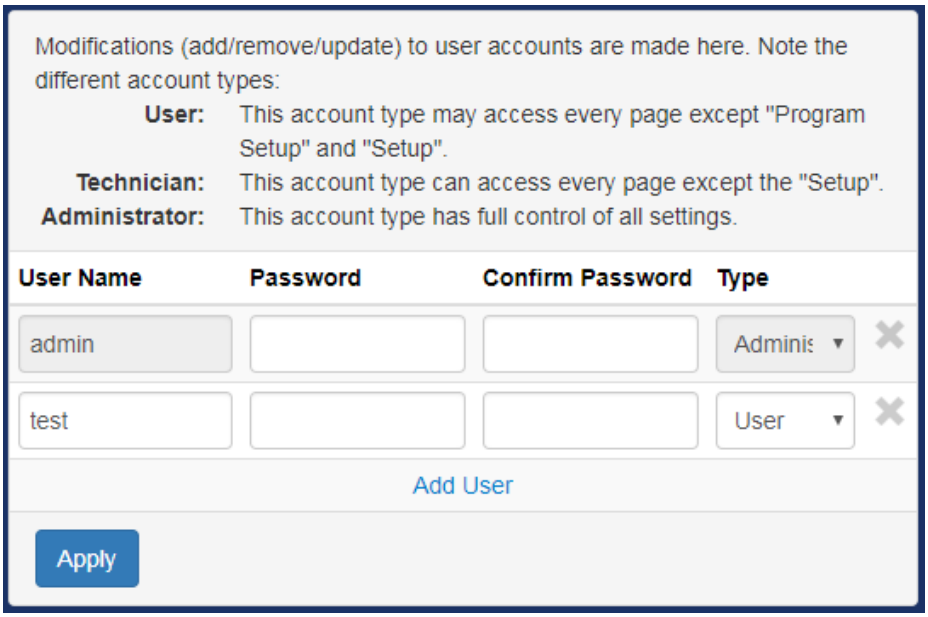


Figure 36: Setup page user account management

13.8 Set Chamber Date/Time

On this page, the chamber controller's and Web Controller's (server) date/time can be set both manually and to the user's device (computer, phone, etc) time. Note that the Server Date/Time and Server Network Time Protocol Server's do not need to be correct since log or display date/time are read from the chamber's controller.

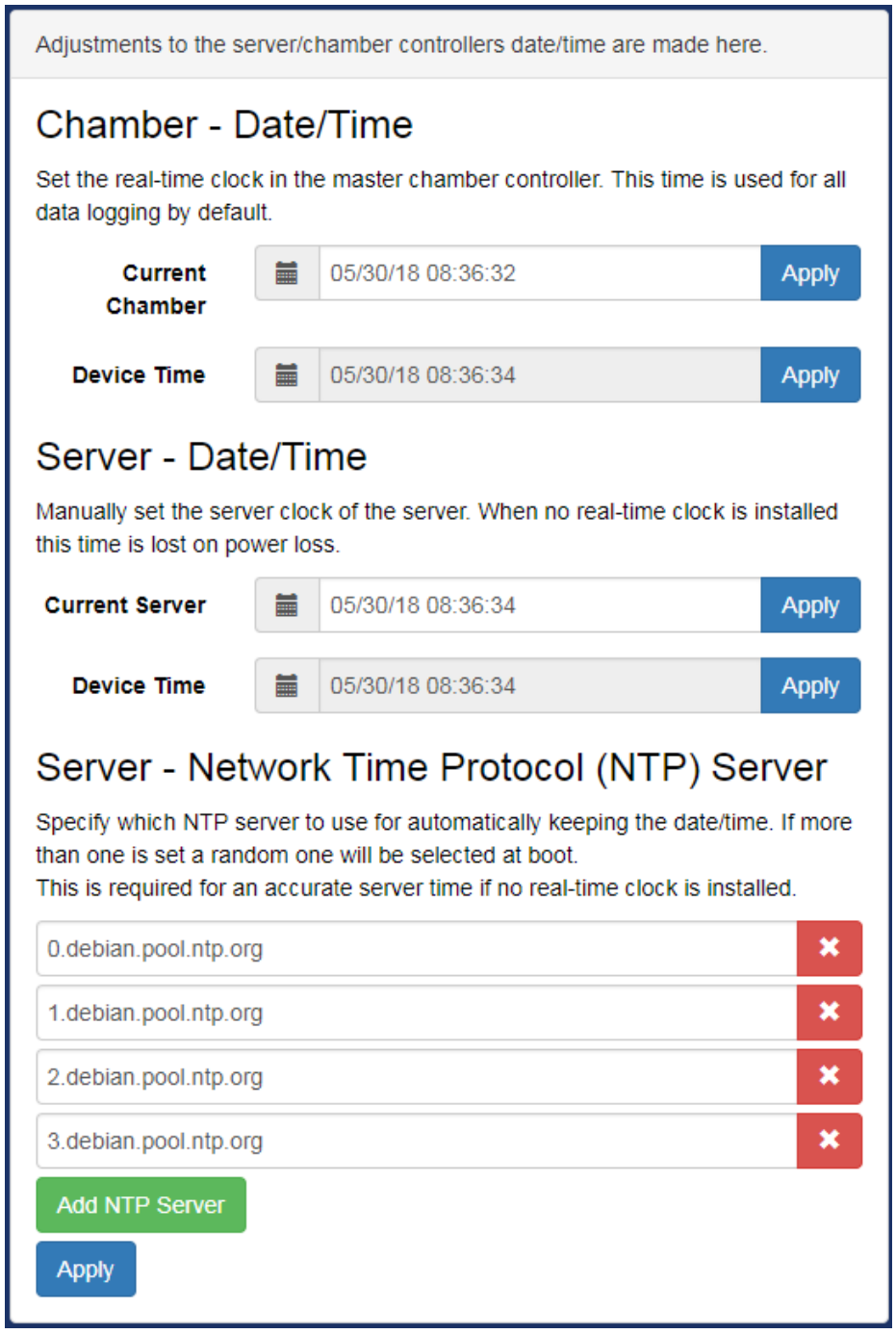


Figure 37: Setup page date/time setup

13.9 Macro Editor

The macro editor allows the creation of custom actions that may be triggered either manually or when the chamber has reached a specified state. Refer to Section 15.0 (15.0 Macros) for detailed documentation and usage of the macro editor.

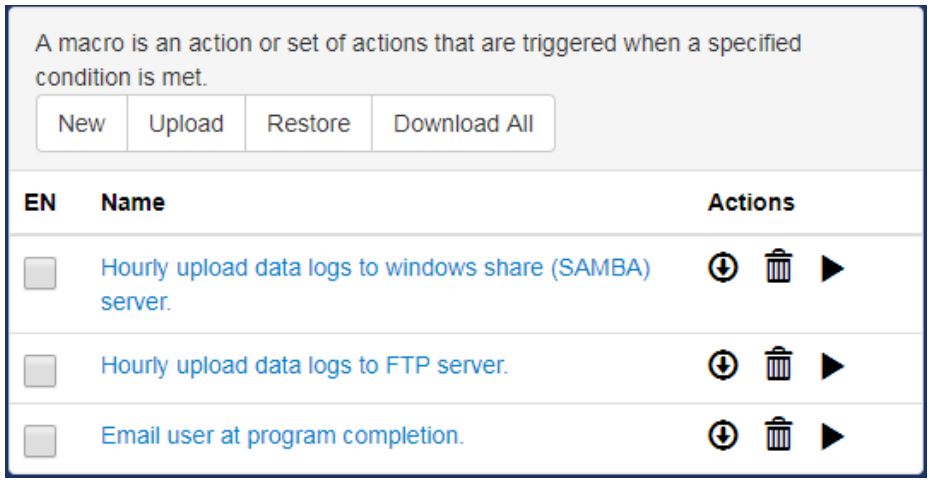


Figure 38: Setup page macro editor

13.10 External Source Editor

Through the external source editor, additional parameters from external devices can be read and written to the Web Controller. Communication interface currently supported is Modbus TCP/RTU. New parameters may be uploaded from an external source and written to the Web Controller via the "Upload" button. New parameters may be created via the "New" button. Current parameters on the Web Controller may be download via the "Download All" button. We can also restore parameters to the Web Controller via the "Restore" button. Refer to Section 16.0 (16.0 External Sources) for details on the use of external source editor.

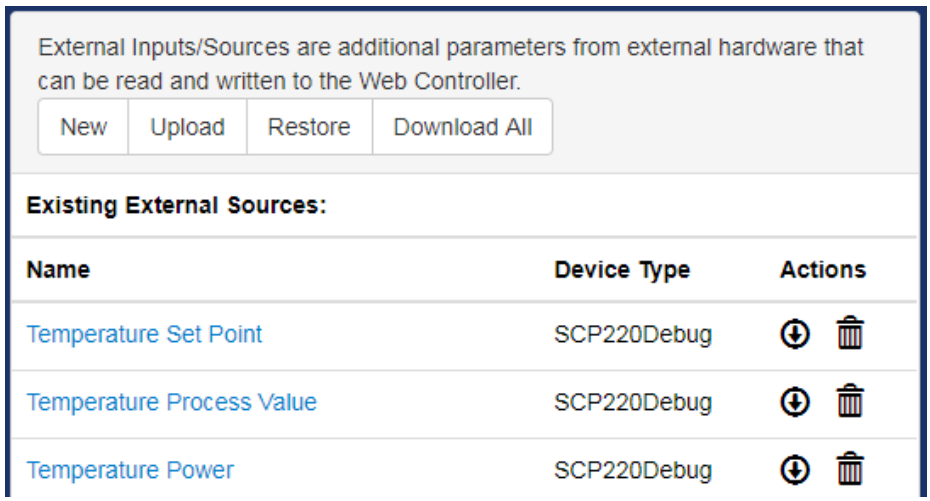


Figure 39: Setup page external source editor

13.11 Chamber Interface Configuration

The Chamber Interface Configuration tab allows us to configure the Web Controller to communicate with the attached chamber. As shown in the following figure, the Web Controller is configured to communicate with the ESPEC P300 chamber. Four different controllers are currently supported by the Web Controller: ESPEC P300/SCP-220, Watlow F4 and Watlow F4T. There are two different ways to configure the Web Controller to communicate with the chamber and its controller:

- **Quick Chamber Configuration**: This configuration method can be done by entering the specific parts of the chamber model and controller type, including various options. Click and select the appropriate model from the Model drop-down list as well as the environmental type, such as Temperature or Temperature and Humidity; click and select the appropriate controller from the Controller drop-down list. Other options associated with the chamber and controller operation can be selected from the checkbox under Options. Click the Apply button to apply the current settings. Chamber communication will take effect immediately.
- **Configuration File**: This is used to upload and download custom configurations that cannot be made using the *Quick Chamber Configuration*.

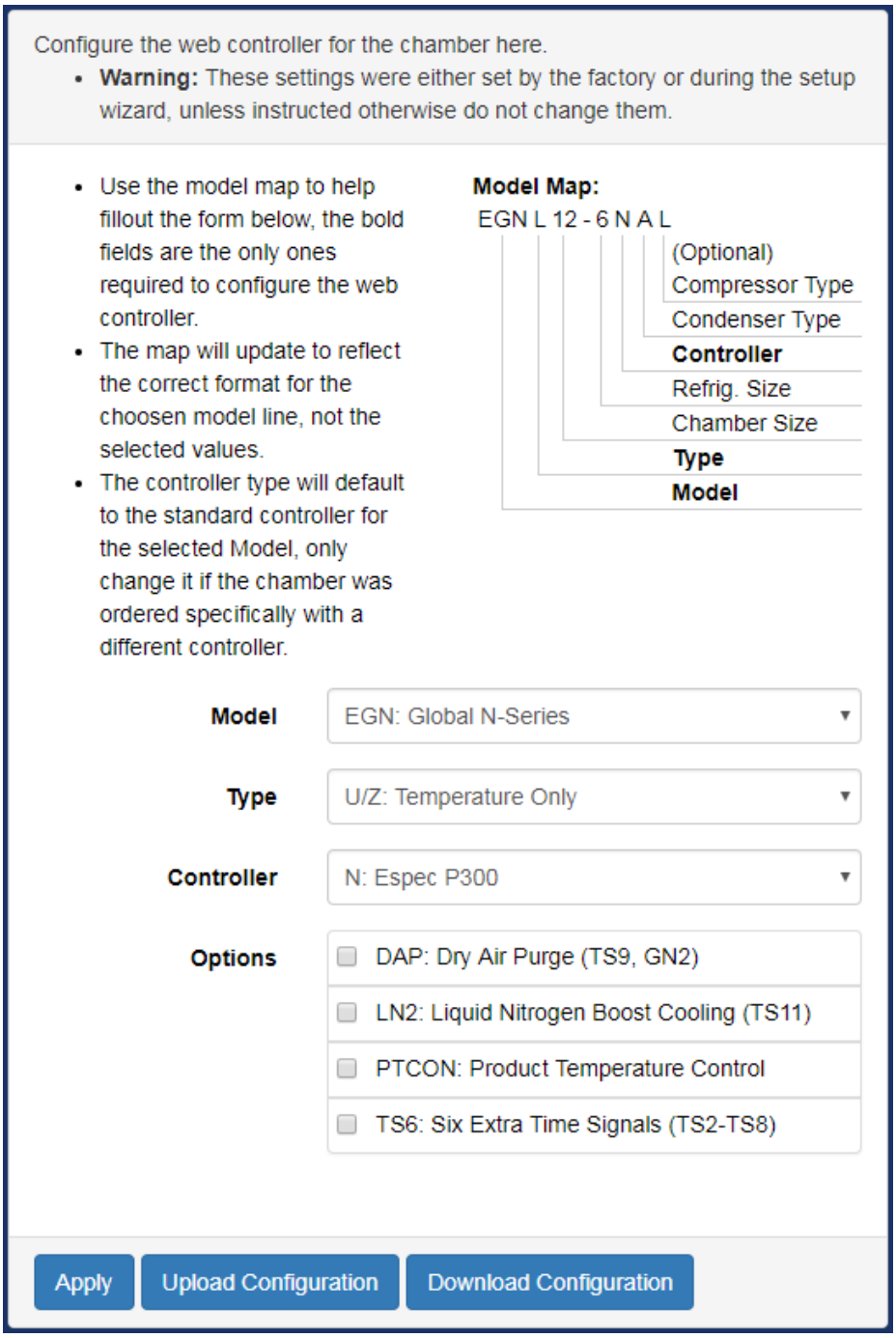


Figure 40: Setup page chamber interface configuration

14.0 Programming Interfaces

The Web Controller provides several interfaces for other software to read and write the parameters from and to the chamber.

14.1 REST API

The REST API may be browsed by disabling authentication and navigating to "/api/v1.0/" and following the various URIs given at each address. For full documentation see: https://bitbucket.org/especnorthamerica/especweb/wiki/RESTful_API_documentation

14.2 TCP Forwarder

This feature allows a user to connect directly to the controller through the web server. As each controller has its own interface they must be described separately.

14.2.1 Communication Protocol for the Watlow F4T, F4

The communication protocol provided for the Watlow F4T is Modbus TCP port 502. Due to its slow performance, the Modbus TCP interface is not recommended to use for communicating with the Web Controller. The Watlow F4T's own Modbus TCP interface should be used instead.

14.2.2 Communication Protocol for the P300/SCP-220

Direct communication with the P300/SCP-220 via raw data through the Web Controller can be achieved using the raw TCP protocol. The TCP forwarder listens for a raw TCP stream on port 10001. To establish communication, with PuTTY terminal emulator installed on your MS Windows system and launched, enter the hostname or IP address of the Web Controller in the HostName field and set 10001 for port communication, as depicted in the following figure.

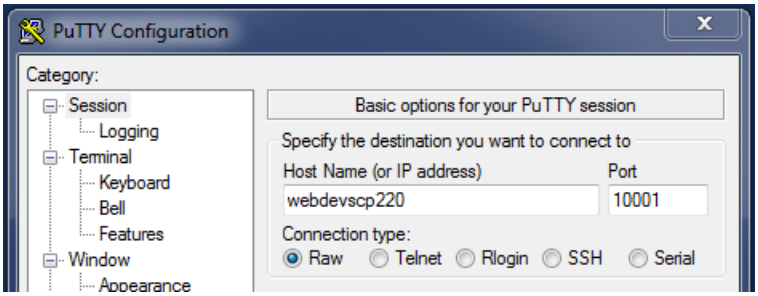


Figure 41: PuTTY setup for raw TCP communication

Two types of data transmission exist in this protocol: Command data and Response data.

1. **Command Data**: The command data consists of two types: Monitor commands and Setting commands. The monitor commands are used to monitor the conditions of the chamber, while the setting commands are used to change or configure the settings of the chamber, such as temperature and humidity.
2. **Response Data**: The response data are basically data returned (responded) by the controller in response to the command data.

The command data sent from the computer to the controller has a specific syntax based on a two-component format: command data and delimiter. The response data sent from the controller also contains a two-component format: response data and delimiter. The delimiter is the carriage return (CR) character followed by a line feed (LF), abbreviated as CRLF.

A brief overview of these two data types is outlined below. Refer to the "P300 or SCP-220 Controller Communications Option Manual" for complete details on them.

1. The command data format will be as follows: [command data][delimiter]
   - [command data] is any command found in the "P300 or SCP-220 Controller Communications Option Manual".
   - [delimiter] is CRLF. The effect of pressing the Enter key on the keyboard produces the CRLF on the terminal.
2. Each command will return a Response in the following format: [response data][delimiter]
   - [response data] can be any of the following:
     1. If the command data is issued to query for a data, response data will return the data in the format described in the "P300 or SCP-220 Controller Communications Option Manual".
     2. If the command data is issued to set a parameter in the controller,

response data will return “OK: [command data]” where [command data] is the command that prompted the response.

3. If there was an error executing the command, the controller will return “NA: [error message]”. Error messages and there meanings are listed in the “P300 or SCP-220 Controller Communications Option Manual”. In addition to the error messages listed in the manual, this interface also adds the error message “NA: SERIAL TIMEOUT” when the chamber Controller takes too long to respond to the command data.

- [delimiter] is CRLF.

3. The interface will timeout after one hour of no activity.

The following figure illustrates the use of a command data to display the ROM information of the controller and its temperature setting. As shown in the figure, to monitor the ROM of the controller, type “ROM?” (or “rom?”) and press Enter. To monitor the temperature setting, type “TEMP?” (or “temp?”) and press Enter.

Figure 42: Example of PuTTY command data and response data

15.0 Macros

Macros are a series of scripted actions that can be triggered automatically by the chamber's state or manually by a user. These macros can conduct various tasks ranging from sending email notification to a user regarding test completion to synchronization of operation between multiple chambers. A new macro script can be created by clicking on the New button in the macro editor panel, refer to Section 13.9 (13.9 Macro Editor (#markdown-header-139-external-sources)). Various parameters can be configured as shown in the following figure. Various actions that can trigger a macro script will be explained in the following subsection.

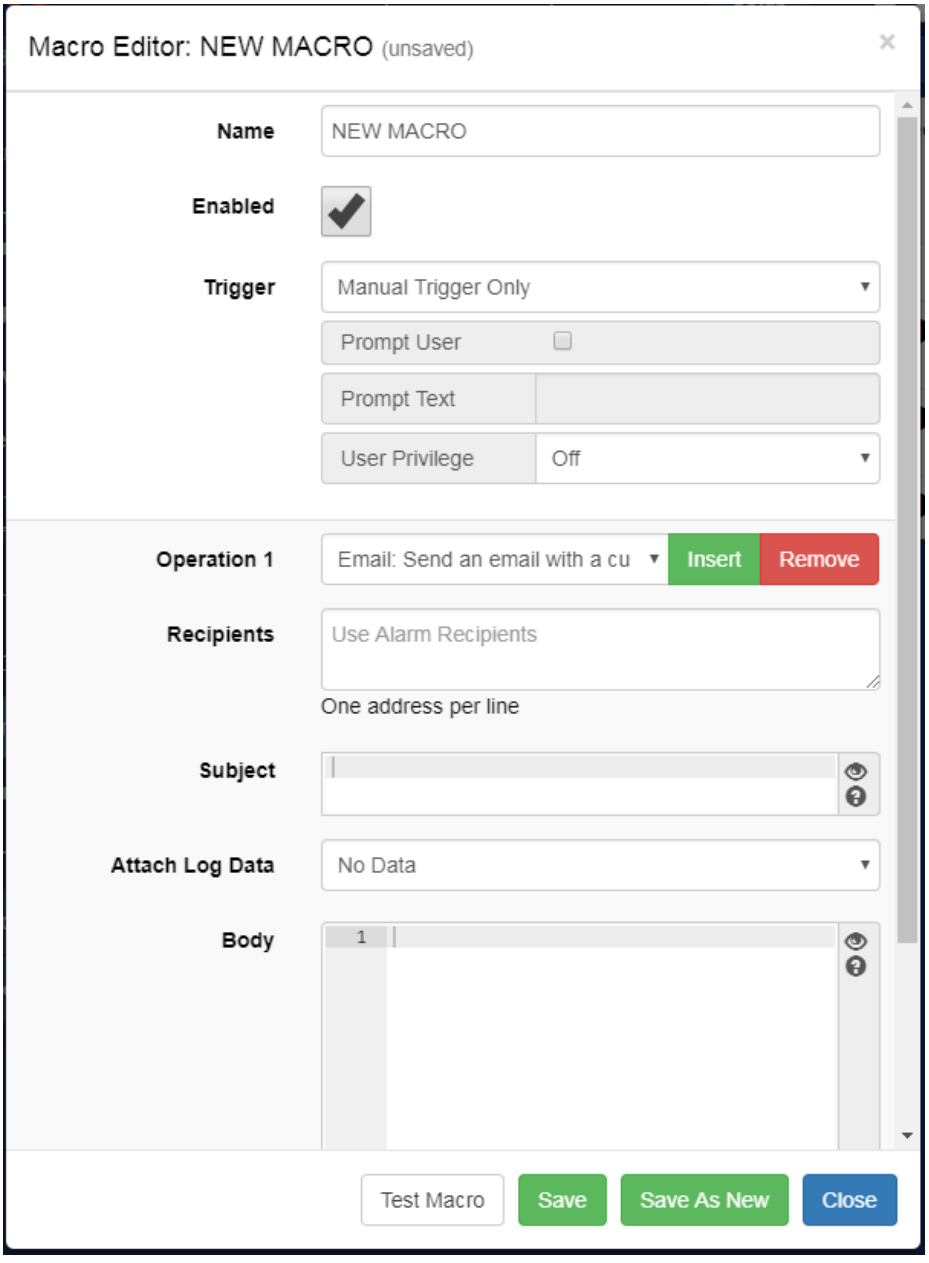


Figure 43: Macro editor page

15.1 Triggers

A macro may be triggered by any of the following actions:

- **Manual Trigger Only**: The macro must be manually triggered by a user or api request.
  - **Prompt User**: When enabled the user will be prompted for input when triggering this macro.
  - **Prompt Text**: The text that the user is presented with the prompt.
  - **User Privilege**: The minimum account type a user has to be in order for them to trigger this macro.
- **Always Trigger**: The macro will run every time; this is not recommended.
- **Operation Mode Change Trigger**: The macro will run when the operating mode has changed to meet the specified criteria.
  - **Condition**: How did the operation mode change?
    - **ANY**: Any change involving the specified mode will cause a trigger.
    - **Changed from**: Any time the chamber was running the specified mode but no longer is will cause a trigger.
    - **Changed to**: Any time the chamber was not running the specified mode but now is will cause a trigger.
  - **Mode**: The operating mode to check against.
  - Example trigger for constant mode start:

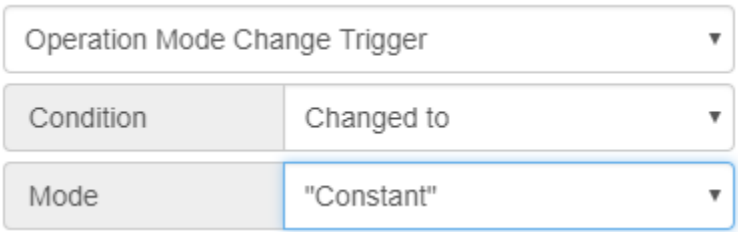


Figure 44: Operation mode change trigger

- **Date and/or Time Trigger**: The macro will run at a specified time. When the date/time matches the configured “Month”, “Day of the Month”, “Year”, “Day of the Week”, “Hour”, “Minute”, and “Second” the macro will fire.
  - Example trigger for running a macro once a minute:

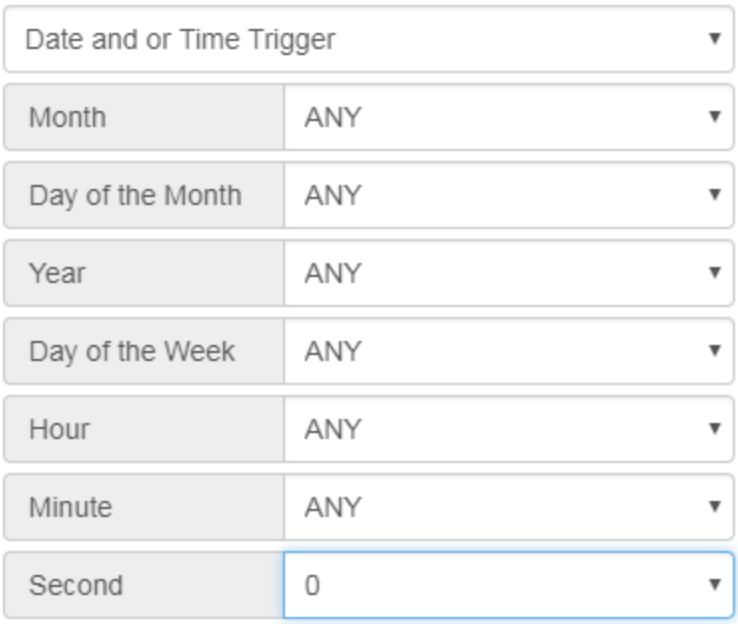


Figure 45: Date and/or time trigger

- **Program Change Trigger**: The macro will run when a programs execution state has changed.
  - **Condition**: How did the program state change?
  - **Program Number**: When the specified program state change condition is met and this program number is involved then trigger.
  - **Step Number**: When the specified program state change condition is met and this program step number is involved then trigger.
  - Example trigger for running a macro when program 1 step 5 completes:

Figure 46: Program change trigger

- **Alarm Change Trigger**: The macro will run when the state of an alarm has changed.
  - **Condition**: Specifies how the alarm state has changed ie: cleared, triggered, either
  - **Alarm**: The specific alarm to monitor.
  - Example trigger for running a macro if the chamber overheats:

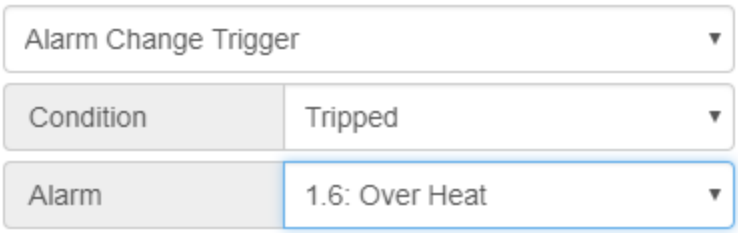


Figure 47: Alarm change trigger

- **Time Signal Change Trigger**: The macro will run when the state of a time signal has changed.
  - **Condition**: Specifies how the time signal state has changed ie: enabled, disabled, either.
  - **Time Signal**: The specific time signal to monitor.
  - Example trigger for running a macro when time signal 1 is enabled:

Figure 48: Time signal change trigger

- **Control Loop Parameter Trigger**: The macro will run when a control loop parameter has changed.
  - **Control Loop**: The control loop to monitor.
  - **Parameter**: The parameter of the control loop to monitor.
  - **Operation**: The type of change to look for.
  - **Value**: The value to compare the parameter against.
  - Example trigger for running a macro when chamber reaches 100 degrees:

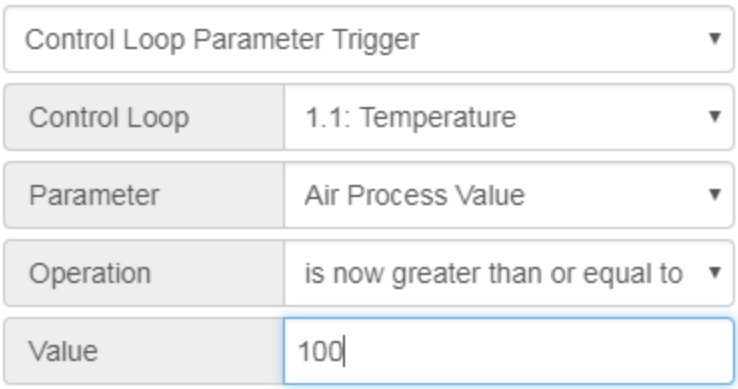


Figure 49: Control loop parameter trigger

- **External Equipment Source Trigger**: The macro will run when an external sources value has changed.
  - **External Source**: The external source to monitor.
  - **Operation**: The type of change to look for.
  - **Value**: The value to compare the source against.
  - Example trigger for running a macro when the external source value changes:

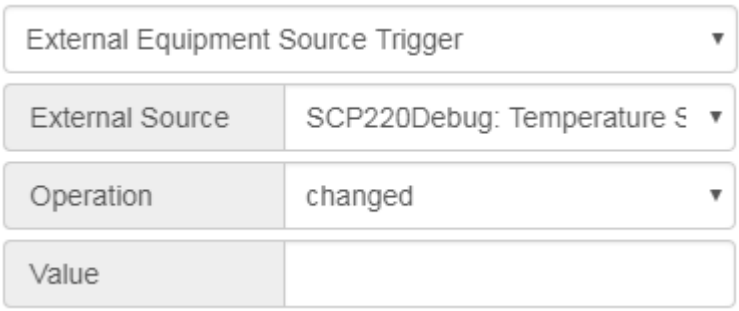


Figure 50: External equipment source trigger

- **Custom Trigger**: The macro will run when a user's specified template evaluates to true. For full documentation on what is available when written templates see the help on the server itself as each install will be different.

15.2 Available Operations

A macro may consist of any combination of the following operations:

- **Email**: Send an email with a custom message/subject/attachment. The attachment will consist only of logged chamber data in csv format.

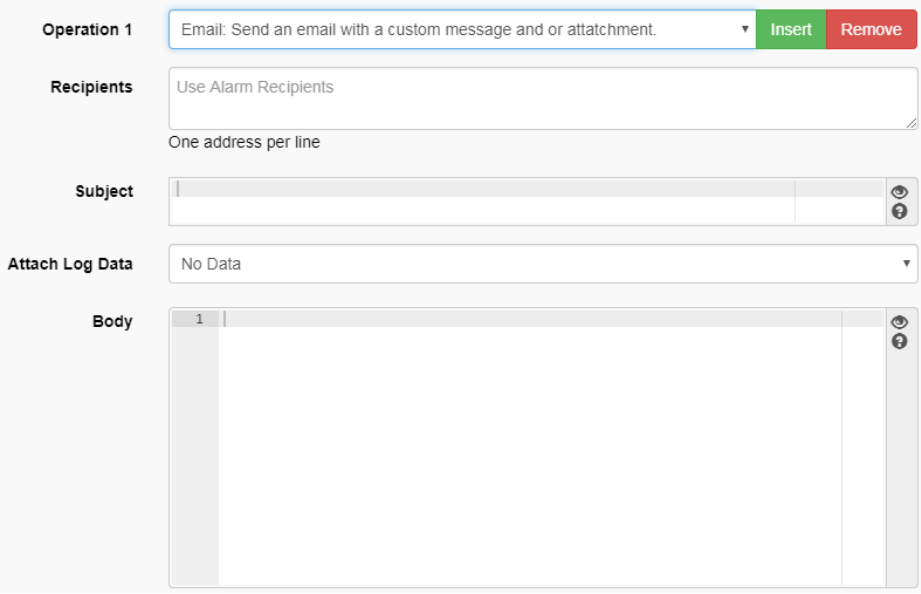


Figure 51: Email attachment

  - **Recipients**: Email addresses for the recipients of the email; for multiple addresses use one address per line. If this is left empty the configured alert addresses will be used.
  - **Subject**: Subject of the email to be sent. This field allows templating.
  - **Attach Log Data**: The data to attach as a csv file.
    - **File Name**: The file name to give the data when there is some. This field allows templating.
  - **Body**: The message body; when html is used this is automatically detected and the message is sent as an html message. This field allows templating.

- **FTP**: Upload log data in csv format to a standard ftp server/encrypted ftp server. Note that SFTP (secure shell file transfer protocol) is not supported at this time.

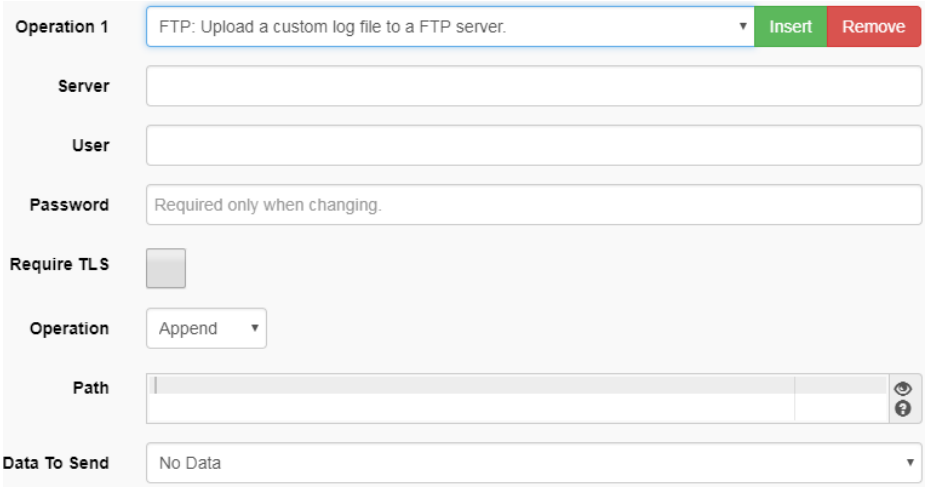


Figure 52: Upload custom log file

- **Server**: The host name or ip address of the ftp server.
- **User**: The name for the user who will be authenticated with the server.
- **Password**: The password for the given user; if this is not provided the stored password will be used.
- **Require TLS**: Force the connection to the server to be encrypted with TLS.
- **Operation**: What action should be taken if a file already exists?
  - **Append**: Append the new data to the end of the file on the server.
  - **Overwrite**: Remove the existing file and replace it with the new one.
- **Path**: The path that the data file will be stored at on the server. This field allows templating.
- **Data To Send**: The query used to generate the csv data that will be placed on the server.
- **File Name**: The name of the file that the data will be saved to.

- **SAMBA**: Upload log data in csv format to a windows network server.

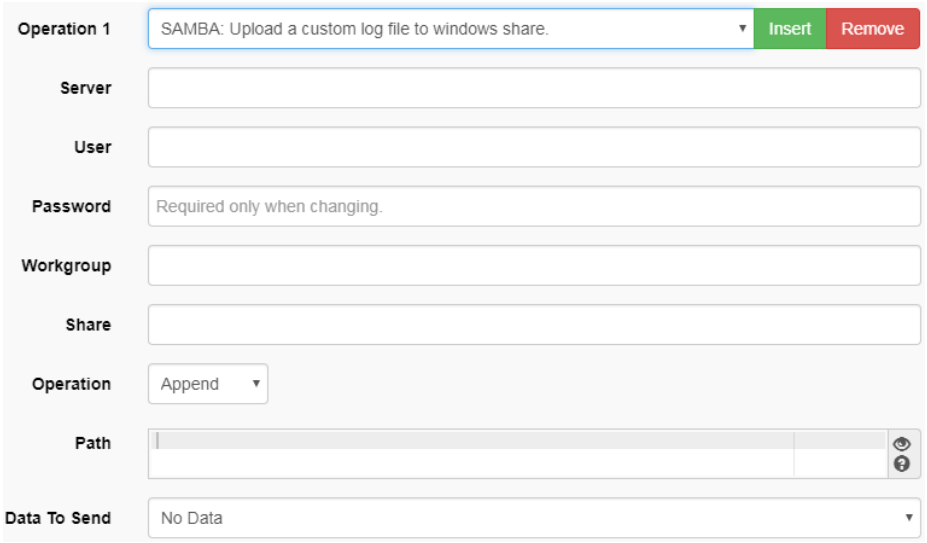


Figure 53: Upload via Samba

- **Server**: The host name or ip address of the windows/samba server.
- **User**: The name for the user who will be authenticated with the server.
- **Password**: The password for the given user; if this is not provided the stored password will be used.
- **Workgroup**: The workgroup that the user belongs to.
- **Share**: The name of the share that the data will be saved on.
- **Operation**: What action should be taken if a file already exists?
  - **Append**: Append the new data to the end of the file on the server.
  - **Overwrite**: Remove the existing file and replace it with the new one.
- **Path**: The path that the data file will be stored at on the server. This field allows templating.
- **Data To Send**: The query used to generate the csv data that will be placed on the server.
- **File Name**: The name of the file that the data will be saved to.

- **HTTP**: Issue an http request to a server.

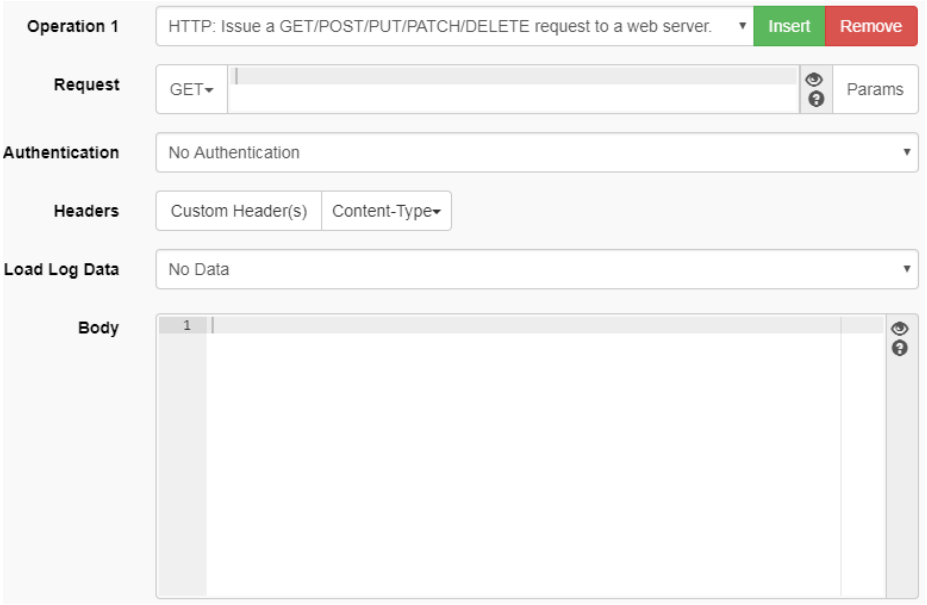


Figure 54: Using GET via HTTP

- **Request**: The URI and type of request that will be issued. There are three parts to this field:
  - **Method**: The HTTP method to be used when performing the request. The available methods are: GET, HEAD, POST, PUT, DELETE, PATCH.
  - **URI**: The address that this request will be issued against. This field allows templating.
  - **Params**: The URL encoded params that are added to the end of the URI. Each key/value field allows templating.
- **Authentication**: The authentication method to use with the request. Available options are: "No Authentication", "HTTP Basic Authentication", "HTTP Digest Authentication".
- **Headers**: The headers to be used with the request.
- **Load Log Data**: The logged chamber data made available to the template for the request body.
- **Body**: The request request body. This field allows templating.

- **Wait**: Wait for a specified time or for an additional trigger to occur.

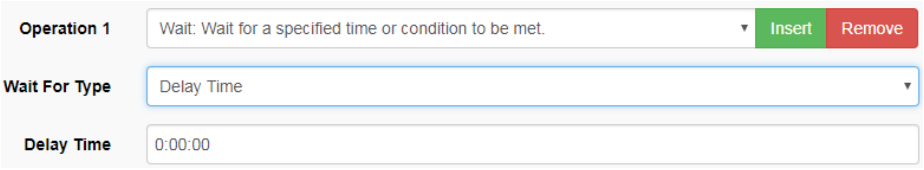


Figure 55: Using WAIT via HTTP

- **Wait For Type**: The type of wait this operation is. The available options are: “Delay Time”, and “Chamber Condition”
- **Delay Time**: The amount of time to delay when *Wait For Type* is *Delay Time*.
- **Trigger**: The condition that the chamber must be in order for the delay to finish when *Wait For Type* is *Chamber Condition*. This field behaves exactly the same way as the macro trigger.

- **Return JSON**: Respond to the request that triggered this macro with json formatted data.

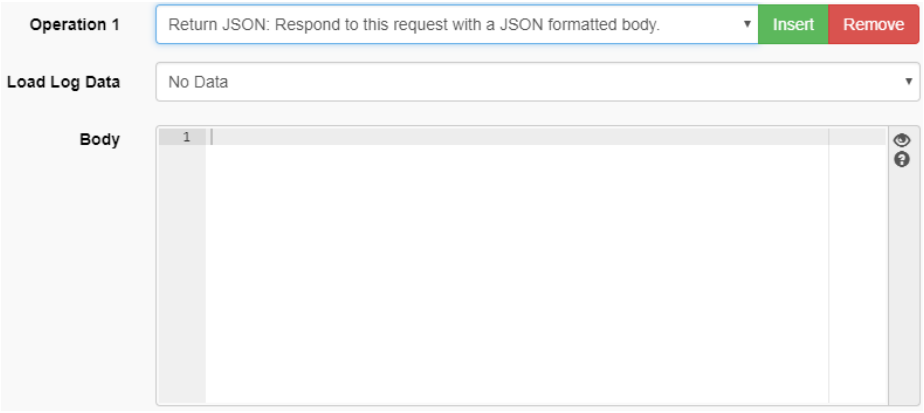


Figure 56: JSON file and its format

- **Load Log Data**: The data to be made available to the template for the response body.
- **Body**: The response body. This field allows templating.

- **Return CSV**: Respond to the request that triggered this macro with log data in CSV format.

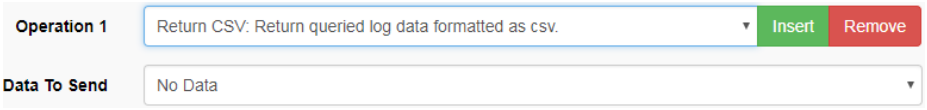


Figure 57: CSV file and its format

- **Data To Send**: The query used to generate the csv data that will be returned as a csv file.
- **File Name**: The name of the file that the is returned as a response.

15.3 Templates

Some fields allow templates to be used to generate data dynamically based on the current chamber state. These templates use the jinja2 template engine; a basic overview is provided here but for full details see the jinja2 docs website: http://jinja.pocoo.org/docs/2.9/templates/#synopsis. These fields all have additional controls on the right side as shown below:

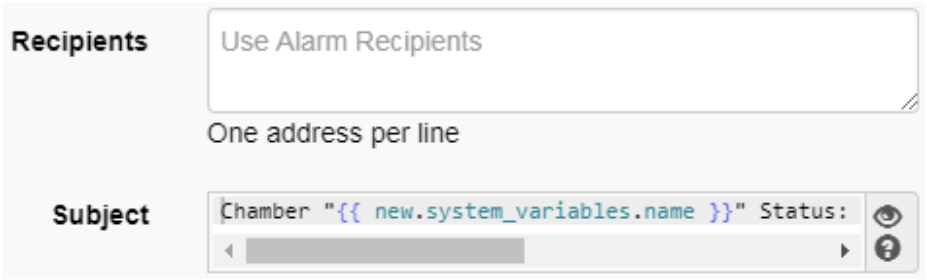


Figure 58: Template fields versus standard fields

- The *Recipients* field shown here is an example of a non template field.
- The *Subject* field shown here is an example of a template field.
  - The eye in the top right of the field will render the field with the current chamber state for debugging.
  - The question mark will open a dialog with full information on how templating works and what data is available to that specific field. Use this dialog for documentation as what is available varies by chamber configuration.
  - When typing in template fields autocomplete is enabled and will try to provide suggestions for the data available.

15.3.1 Displaying Variables

To insert data into a string simply enter the data name inside the double curly brackets like this: `{{ variable }}`. Here is an example of data insertion and its format. Multiple data insertion must be entered in separate curly brackets.

Example: Data insertion template

```
The chamber mode is: {{ new.operations.mode }}
The temperature is: {{ new.loops[0].processValue.air }}{{ new.loops[0].units }}
```

Example: Results

```
The chamber mode is: Constant
The temperature is: 100°C
```

15.3.2 Filters

Filters are used to apply specific formatting to variables by adding a pipe followed by the filter name when displaying a variable `{{ variable | filter }}`. In addition to the built-in filters, documented on the jinja2 docs website, several custom ones are included here for reference:

- **datetime**: Convert a datetime object into a nicely formatted string.
  - Arguments: Python datetime string as documented here: https://docs.python.org/2/library/datetime.html#strftime-and-strptime-behavior.
  - Example: `{{ new.operations.datetime | datetime('%m/%d/Y %H:%M:S') }}`
- **timestamp**: Convert a datetime to an epoch (seconds since 0:00:00 Jan 1, 1970).
  - Arguments: None
  - Example: `{{ new.operations.datetime | timestamp }}`
- **tojson**: Convert an object to json.
  - Arguments: None
  - Example: `{{new | tojson}}`

15.3.3 Flow Control

Loops and if statements may also be used to conditionally render elements using the curly bracket and percent characters `{% if condition %} Condition is True {% endif %}`

If statements:

```
{% if condition %}
    contents
{% endif %}

{% if condition %}
    contents
{% else %}
    contents
{% endif %}

{% if condition %}
    contents
{% elif condition %}
    contents
{% else %}
    contents
{% endif %}
```

Loops:

```
{% for item in items if condition %}
    contents
{% endfor %}

{% for item in items %}
    contents
{% endfor %}
```

15.3.4 Chamber State Variables

The following is a list of possible chambers state variables and their meaning.

- **old** and **new**: State of the chamber before and after the database was updated; both have the exact same structure.
  - *Type*: Dictionary
  - *keys*:
    - **alarms**: A list of chamber alarms and their state.
      - *Type*: List
      - *keys for each element*:

    - **controller**: The database id of the controller this alarm is on. *type: int*
    - **id**: The database id for this alarm. *type: int*
    - **name**: The name of the alarm. *type: string*
    - **number**: The number of the alarm. *type: int*
    - **triggered**: The state of the alarm. *type: bool*
- **controllers**: A list of chamber pid controllers and their state.
  - *Type*: List
  - *keys for each element*:
    - **datetime**: The current datetime. *type: datetime*
    - **program**: The currently running program. *type: int*
    - **program_details**: Miscellaneous controller specific program status information. *type: string*
    - **program_name**: The name of the currently running program. *type: string*
    - **program_step**: The currently running program step number. *type: int*
    - **program_time**: The time remaining on the program. *type: string*
    - **program_time_step**: The time remaining on the current program step. *type: string*
    - **status**: The current controller run status. *type: string*
- **events**: A list of time signals (events) and their status.
  - *Type*: List
  - *keys for each element*:
    - **N**: The number for the time signal on the controller. *type: int*
    - **controller**: The database id of the controller that this time signal is on. *type: int*
    - **id**: The database id for this time signal. *type: int*
    - **manual**: When true this time signal is user settable. *type: bool*
    - **name**: The name of the time signal. *type: string*
    - **status**: The state of the time signal.
      - *type*: Dictionary
      - *keys*:
        - **constant**: The constant mode state of the time signal. *type: bool*
        - **current**: The current state of the time signal. *type: bool*
    - **valid**: If this is False error occurred while reading this from the controller. *type: bool*

- **external_sources**: A list of values read in from external equipment sources.
  - *Type*: List
  - *keys for each element*:
    - **value**: The current value of the external source. *type: varies*
    - **name**: The name of this external source. *type: string*
    - **units**: The units of this external source. *type: string*
- **loops**: A list of pid control loops and there status.
  - *Type*: List
  - *keys for each element*:
    - **N**: The number for the pid loop on the controller. *type: int*
    - **controller**: The database id for the controller that this pid loop is on. *type: int*
    - **deviation**: PTCON/Cascade pid loops only. The allowable difference between the product and air process values.
      - *Type*: dictionary
      - *keys*:
        - **positive**: The allowable positive difference between the product and air processValues. *type: float*
        - **negative**: The allowable negative difference between the product and air processValues. *type: float*
    - **enable**: State of the control loop on/off for further details see mode.
      - *Type*: dictionary
      - *keys*:
        - **constant**: The constant mode settings for this parameter. *type: bool*
        - **current**: The current state of this parameter. *type: bool*
    - **enable_cascade**: PTCON/Cascade pid loops only. State of the product control mode for the loop.
      - *Type*: dictionary
      - *keys*:
        - **constant**: The constant mode settings for this parameter. *type: bool*
        - **current**: The current state of this parameter. *type: bool*
    - **id**: The database id for this pid loop. *type: int*
    - **mode**: The current control mode of the loop.
      - *Type*: dictionary
      - *keys*:
        - **constant**: The constant mode settings for this parameter.

type: string
- **current**: The current state of this parameter. *type: string*
- **name**: The name of the pid loop. *type: string*
- **power**: The pid loop output power.
  - *Type*: dictionary
  - *keys*:
    - **constant**: The constant mode settings for this parameter. *type: float*
    - **current**: The current state of this parameter. *type: float*
- **processValue**: The current conditions inside the chamber for this pid loop.
  - *Type*: dictionary
  - *keys*:
    - **air**: The current conditions for the air inside the chamber. *type: float*
    - **product**: PTCON/Cascade pid loops only. The current conditions of the product inside the chamber. *type: float*
- **range**: The allowable control range of the pid loop.
  - *Type*: dictionary
  - *keys*:
    - **max**: The maximum setValue of the pid loop. *type: float*
    - **min**: The minimum setValue of the pid loop. *type: float*
- **setValue**: The condition the pid loop will attempt to attain.
  - *Type*: dictionary
  - *keys*:
    - **air**: PTCON/Cascade pid loops only. The current target for the air inside the chamber. *type: float*
    - **product**: PTCON/Cascade pid loops only. The current target for the product inside the chamber. *type: float*
    - **constant**: The constant mode settings for this parameter. *type: float*
    - **current**: The current state of this parameter. *type: float*
- **units**: The units for the pid loop parameter. *type: float*
- **user_settable**: Specifies if the loops parameters may be modified by the user. *type: bool*
- **valid**: When this is False there was an error reading the state from the chamber. *type: bool*

- **operations**: The operation status of the chamber.
  - *Type*: Dictionary

        - *keys*:
            - **datetime**: The current datetime of the chamber. *type: datetime*
            - **mode**: The current run mode of the chamber.
            - **program**: The current program state of the chamber.
                - *Type*: Dictionary
                - *keys*:
                    - **name**: The name of the currently running program. *type: string*
                    - **number**: The number of the currently running program. *type: int*
                    - **step**: The current running program's current step. *type: int*
                    - **time_end**: The estimated end time of the currently running program
                    - **time_step**: The remaining time in the current program step.
                    - **time_total**: The remaining time of the program.
    - **programs**: A list of programs on the chamber.
        - *Type*: List
        - *keys for each element*:
            - **controller**: The database id of the controller that this program is on. *type: int*
            - **id**: The database id of this program. *type: int*
            - **name**: The name of this program. *type: string*
            - **number**: The number for this program in its process controller. *type: int*
    - **refrigerators**: A list of the refrigeration systems and their status.
        - *Type*: List
        - *keys for each element*:
            - **controller**: The database id of the controller that this refrigerator is on. *type: int*
            - **id**: The database id of this refrigerator. *type: int*
            - **mode**: The current mode of this refrigerator. *type: string*
            - **valid**: When this is false an error occurred reading the state from the chamber. *type: bool*
- **query**: The results of a data log query.
    - *Type*: Dictionary
    - *keys*:
        - **datetime_success**: The datetime of the last successful operation

accessing the database. *type: datetime*
    - **results**: The results of the data log query on "HTTP" and "Return JSON" operations. This is formatted as a list of dictionaries for each row with keys corresponding to the requested columns.
- **request_args**: The arguments passed to the macro by a user triggered macro.
- **results**: The results of the http request. If the response body was json then this will be a dictionary; if it was anything else this will be a string.

15.4 Included Examples of Macros

The Web Controller will be shipped with three examples of macros.

1. Hourly upload data logs to a windows (SAMBA) server.
2. Hourly upload data logs to a FTP server.
3. Email user at program end.

16.0 External Sources

External equipment sources are other devices that can communicate using an industry standard protocol such as Modbus TCP. The Web Controller can display or log the configured parameters read from these devices. Once data has been read it is then passed to a value parser so that complex structures may be properly handled.

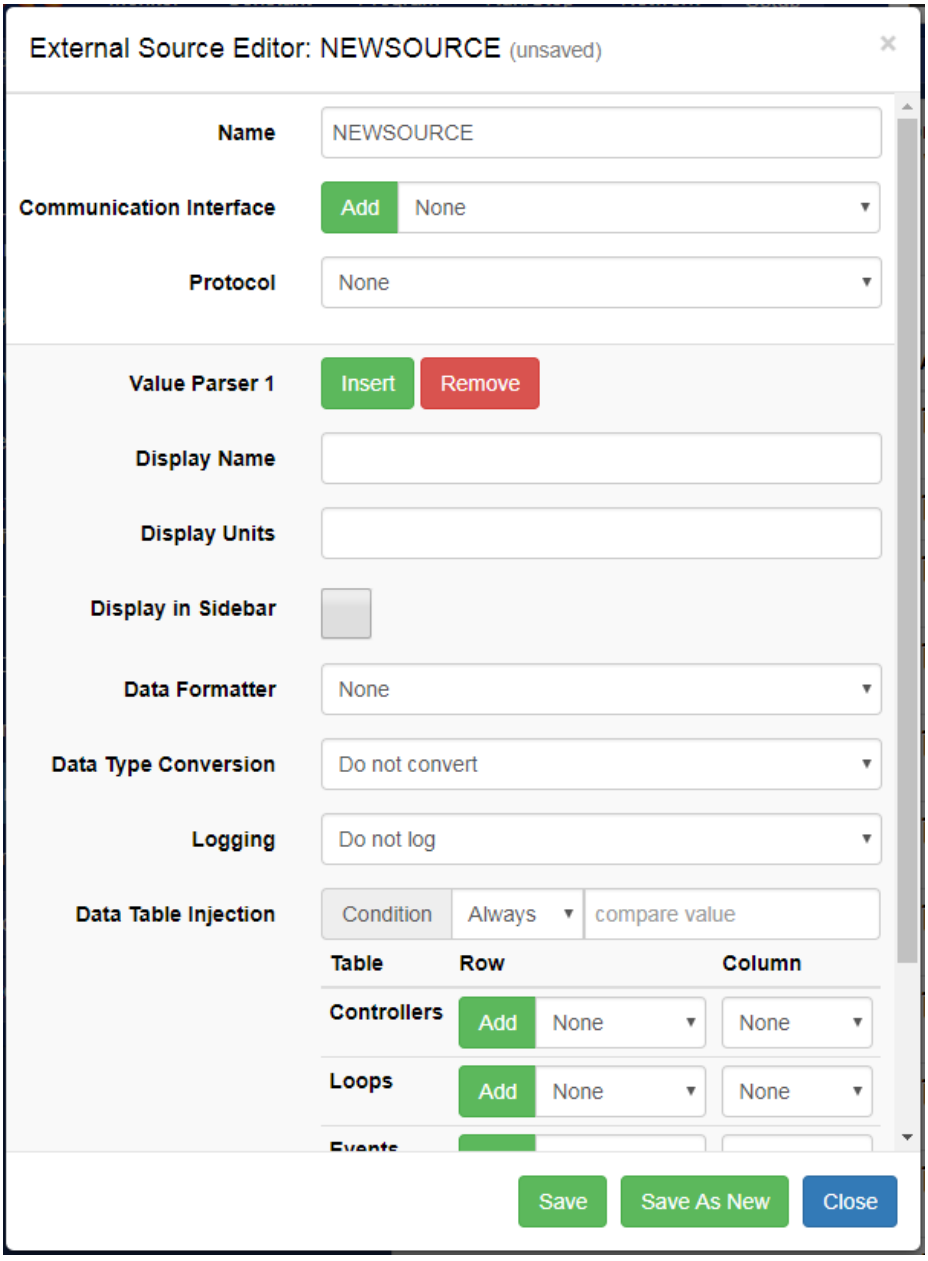


Figure 59: External source editor

16.1 Available Protocols

The Web Controller currently supports Modbus RTU and TCP protocol communication. Other protocol types will be included in the future release of the Web Controller.

16.1.1 Modbus RTU/TCP

Currently the Web Controller can only read data from Modbus devices that use only input and holding registers. The following parameters are required:

- **register**: The Modbus register to read from.
- **address**: The address of the Modbus device to read from. This is required for TCP in case in Modbus gateway is being used.
- **type**: The type of register to be read from and how it should be interpreted (data type).
- **count**: The number of registers to read from.
- **low_word_first**: The order of 32bit Modbus registers.
- **scalar**: The multiplication factor for reading fixed point numbers.

The following figure illustrates how these parameters are handled.

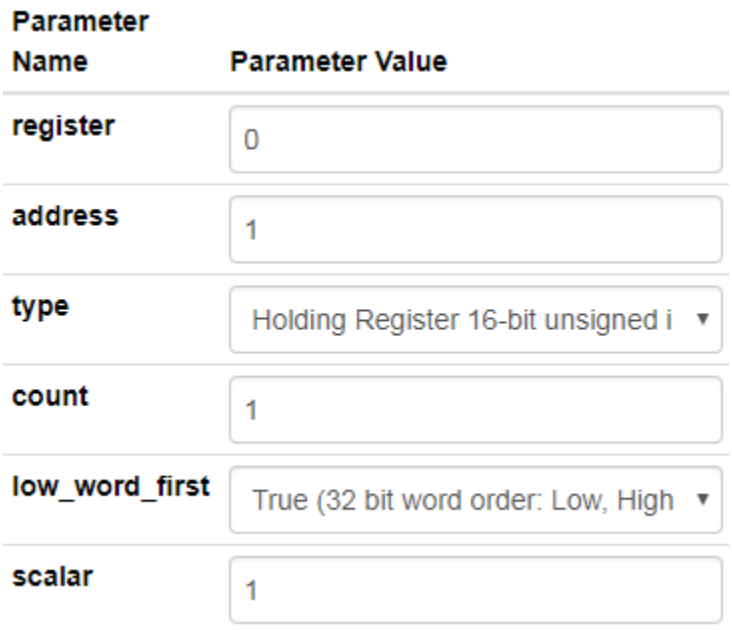


Figure 60: Parameter information

16.2 Value Parser(s)

After data has been read from a device, the Web Controller will first parse the data before storing it. The following list describes how parsing is done by the Web Controller.

- **Display Name**: This is the name used to display the data in the web server's status bar.
- **Display Units**: This is the units that will be used to display the data in the web server's status bar.
- **Display in Sidebar**: Checking this will cause the data to be displayed in the status bar.
- **Data Formatter**: In cases where the raw data is not in the correct format there are a few methods available to correct that:
  - **Lookup Table**: Use the data as a key in a dictionary lookup.
  - **Compare with true/false lookup**: See if the data meets a specified condition and choose a formatted value for each case.
  - **Override Value**: Ignore the read value and specify a new one.
- **Data Type Conversion**: Convert (cast) the value from one data type to another, supported data types: boolean, integer, float, string.
- **Logging**: Specify if the data is to be logged and if it is what type of data column it will need to be.
- **Data Table Injection**: Inject the data into the chamber state database back-end; to make the data look as if its one of the natively supported structures (control loop, time signal, alarm etc). This is an advanced feature and contact with support may be needed to use it.

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Operation Manual

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