SuperSystems incorporated

Vacuum Furnace Controller
Series 9220

OPERATIONS MANUAL

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Installation Safety Requirements

Safety Symbols

Various symbols are used on the instrument; they have the following meaning:

Caution, (refer to the accompanying documents)

Functional earth (ground) terminal!

The functional earth connection is required for safety purposes and to ground RFI filters.

Personnel

Installation must only be carried out by technically qualified personnel.

Enclosure of live parts

To prevent hands or metal tools from touching parts that may be electrically live (powered), the controller must be installed in an enclosure.

Caution: Live sensors

Do not connect live (powered) sensors to any signal input on the controller. Live sensors are sensors that must be connected to the main's supply. The controller has transient protection circuits connected between the inputs and the earth connection that might be damaged by live (powered) sensors.

Wiring

It is important to connect the controller in accordance with the wiring data given in this handbook. Take particular care not to connect AC supplies to the low voltage power supply input. Use copper wires for 24V DC power supply to the instrument. Ensure that the wiring of installations comply with all local wiring regulations. For example in the United Kingdom use the latest version of the IEE wiring regulations, (BS7671). In the USA use NEC Class 1 wiring methods.

Power Isolation

The installation must include a power isolating switch or circuit breaker. This device should be in close proximity to the controller, within easy reach of the operator and marked as the disconnecting device for the instrument.

Earth leakage current

Due to RFI Filtering there is an earth leakage current of less than 0.5mA. This may affect the design of an installation of multiple controllers protected by Residual Current Device, (RCD) or Ground Fault Detector, (GFD) type circuit breakers.

Over current protection

To protect the internal PCB tracking within the controller against excess currents, the AC power supply to the controller and power outputs must be wired through a fuse or circuit breaker specified in the technical specification.

Voltage rating

The maximum continuous voltage applied between any of the following terminals must not exceed 24V DC

- relay or triac output to logic, DC or sensor connections;
- any connection to ground.

The controller should not be wired to VAC. The 24V DC power supply voltage across the connections and between the power supply and ground must not exceed 2.5kV. Where occasional voltage over 2.5kV are expected or measured, the power installation to both the instrument supply and load circuits should include a transient limiting device.

These units will typically include gas discharge tubes and metal oxide varistors that limit and control voltage transients on the supply line due to lightning strikes or inductive load switching. Devices are available in a range of energy ratings and should be selected to suit conditions at the installation.

Conductive pollution

Electrically conductive pollution must be excluded from the cabinet in which the controller is mounted. For example, carbon dust is a form of electrically conductive pollution. To secure a suitable atmosphere in conditions of conductive pollution, fit an air filter to the air intake of the cabinet. Where condensation is likely, for example at low temperatures, include a thermostatically controlled heater in the cabinet.

Over-temperature protection

When designing any control system, it is essential to consider what will happen if any part of the system should fail. In temperature control applications the primary danger is that the heating will remain constantly on. Apart from spoiling the product, this could damage any process

machinery being controlled, or even cause a fire. Reasons why the heating might remain constantly on include:

- the temperature sensor becoming detached from the process;
- thermocouple wiring becoming a short circuit;
- the controller failing with its heating output constantly on;
- an external valve or contactor sticking in the heating condition;
- the controller set point is set too high;
- the controller is left in manual operation mode with a positive control output setting.

Where damage or injury is possible, we recommend fitting a separate over temperature protection unit with an independent temperature sensor, which will isolate the heating circuit. Please note that the alarm relays within the controller will not give protection under all failure conditions.

Installation requirements for EMC

To ensure compliance with the European EMC directive certain installation precautions are necessary as follows:

- When using relay or triac outputs it may be necessary to fit a filter suitable for suppressing the emissions. The filter requirements will depend on the type of load. For typical applications we recommend Schaffner FN321 or FN612.

Routing of wires

To minimize the pick-up of electrical noise, the wiring for low voltage dc should be routed away from high-current power cables. Where it is impractical to do this, use shielded cables with the shield grounded at one end.

Chapter 1 - OVERVIEW

The 9220 is SSi's temperature controller engineered with a focus on vacuum furnace applications. With 16 PID sets for optimal control and guaranteed soak times on vacuum level, the 9220 can run complex vacuum processes while simplifying the duties of the operator. The 9220 recipe programmer includes 24 independent steps per recipe with operational codes (opcodes) to enable effective process control. Additionally, the 9220 provides full video recorder capabilities utilized through the color touch screen interface. Screen sizes include 3.5", 5.7" and 12.1". Functionality added to the screens include "stylus" notes entry, user defined data points and trend charts for paperless chart recording, zoom and pan touch screen control on the charting screen, and remote data retrieval through Ethernet for setup archiving, recipe management and backup, remote control or remote view.

Approximate Box Dimensions	2.88" x 5.94" x 4.5"
Power Requirements	24VDC / 1.2 AMP Max.
Digital Output Rating	300VAC / 1 AMP
Analog Output Load Rating	500 Ohms (Maximum)
Controller Enclosure Rating	IP10 – hand protected
Number of RS232 Ports	Two (2)
Number of Ethernet Ports	One (1)
Number of RS485 Host Ports	One (1)
Number of RS485 Slave Ports	Two (2)
Number of Internal Relays	Eight (8)
Number of Analog Inputs	Three (3)
Number of Analog Outputs	Two (2)
Number of Digital Inputs	Four (4)
Number of Control Loops	One (1)

The Model 9220 is powered by 24 VDC, not LINE or AC Voltage. Please be careful when connecting power to this controller. Connecting anything other than 24 VDC will cause serious damage.

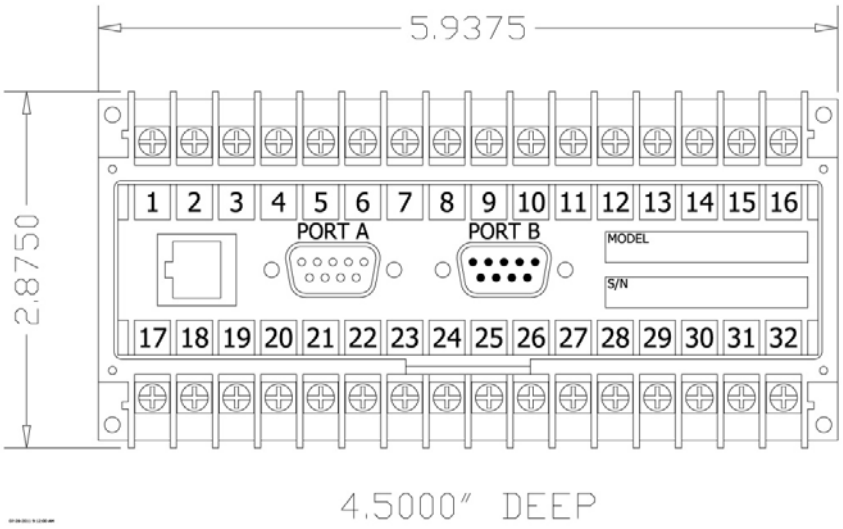
The variety of input and output combinations allows SSi to configure the Model 9220 to control vacuum furnaces (temperature and vacuum gauges).

The product is available in three different screen sizes: 3.5", 5.7" and 12.1".

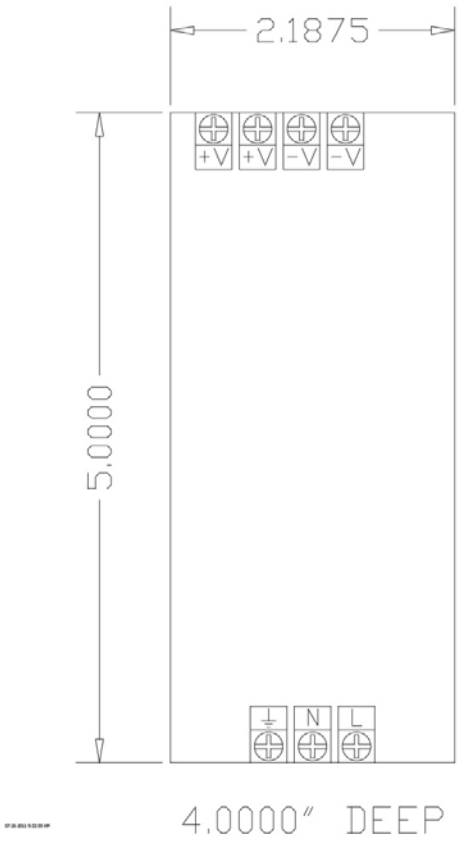
Mounting

The Series 9220 Operator Interface mounts into a panel or on a plate by using the enclosed mounting brackets. A rectangular cutout is required; the size of the cutout is determined by the operator interface size. These units, along with an optional SSi SR3, 6, or 9 analog input board, will mount on a commercially available DIN rail. This can be mounted on the sub-panel on the inside of an enclosure for the convenience of the control system.

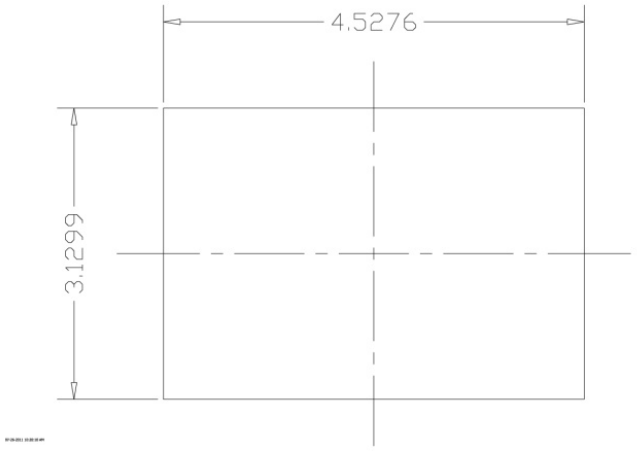
Dimensional Drawings



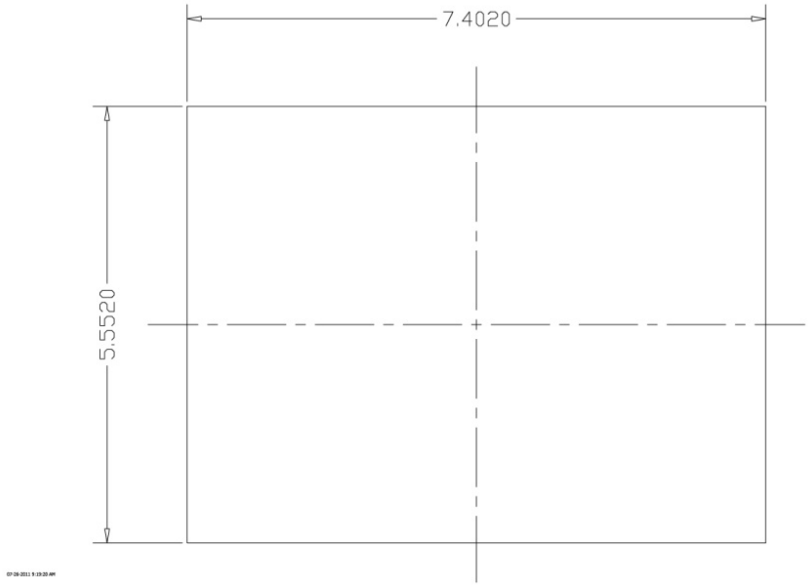
Series 9220 Controller Dimensions



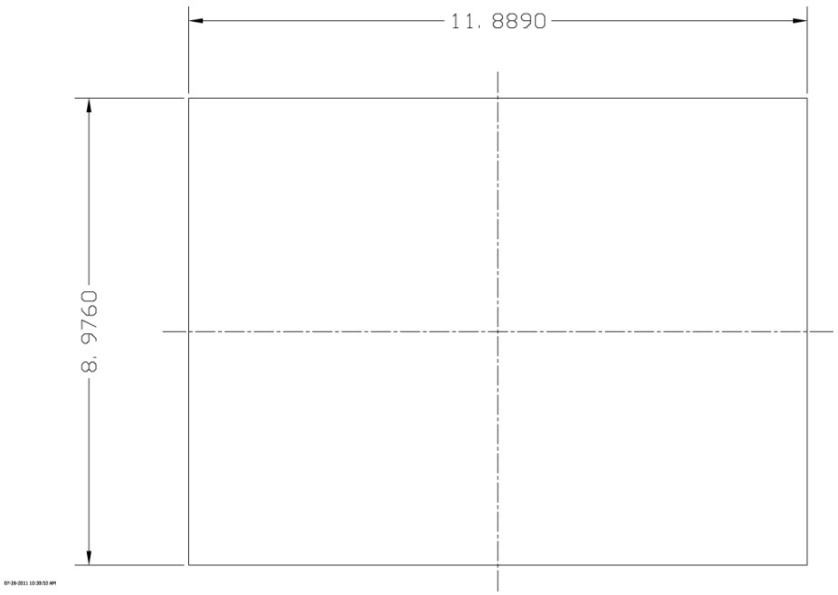
24V DC Power Supply Dimensions



3.5" Operator Interface Cutout dimensions



5.7" Operator Interface Cutout dimensions



12” Operator Interface Cutout dimensions

Wiring

Wiring to the Series 9220 operator interface can be done using 232 or 485 to connectors on the back of the screen, comm1 (232) or comm3 (485). The plug on the back of the operator interface is used to connect 24VDC power. The DB-female 9 port A connection is used to connect the display via 232 to the Series 9220 controller. Terminals 3(-) and 4(+) can be used for 485 communications to the screen. The controller terminals 5(-) and 6(+) are connected via RS485 communication to the single-loop controllers or slaved instrumentation.

Electrical Installation

The Model 9220 requires 24VDC, 4 Watt, 60 Hz, single-phase power. A 24 VDC power supply is required and is generally included as part of the Model 9220 system. This power supply has a universal input that can accept between 60 and 265VAC. Power should be applied in accordance with the electrical drawings that have been supplied or can be referenced on the Super Systems website. Since each installation is unique to the site, the customer is responsible for providing adequate power and making it available to the Model 9220 power supply.

SSi requirement:

MOVs must be wired across the isolation relay coil terminals on all isolation relays that are connected to solenoids. **Further…** MOV's must be connected across the HOT and NEUTRAL wires when the solenoid is wired to them. **IT IS AN ABSOLUTE MUST to have the MOVs at BOTH LOCATIONS.**

Pin Out

SUPER SYSTEMS INC.

1 - 24VDC (COM)	12 - RELAY OUT 5	22 - SLAVE 2 RS485 (+)
2 - 24VDC (+)	13 - RELAY OUT 6	23 - SLAVE 2 RS485 (-)
3 - RS485 RT (-)	14 - RELAY OUT 7	24 - 4-20mA OUT 1 (-)
4 - RS485 RT (+)	15 - RELAY OUT 8 NC	25 - 4-20mA OUT COM (+)
5 - SLAVE 1 RS485 (-)	16 - RELAY OUT 8 NO	26 - 4-20mA OUT 2 (-)
6 - SLAVE 1 RS485 (+)	17 - DIGITAL IN 1	27 - ANALOG IN 3 (-)
7 - RELAY COMMON	18 - DIGITAL IN 2	28 - ANALOG IN 3 (+)
8 - RELAY OUT 1	19 - DIGITAL IN 3	29 - ANALOG IN 2 (-)
9 - RELAY OUT 2	20 - DIGITAL IN 4	30 - ANALOG IN 2 (+)
10 - RELAY OUT 3	21 - DIGITAL IN COM	31 - ANALOG IN 1 (-)
11 - RELAY OUT 4		32 - ANALOG IN 1 (+)

9220 Pin Out

A wiring diagram of the Series 9220 controller can be found in Appendix B – Guide to Building a Recipe.

Ancillary Items

The following items can be included with the Series 9220: a flash card, a flash card reader, a touch screen, an RS232 cable, an RS485 cable, a 24V DC DIN rail mount power supply, and a software CD with Configurator, the Configurator manual, TS Manager, and .NET 2.0. The flash card installs the operator interface and the flash card reader connects to a Windows® based computer.

The operator interface includes connections for a mouse and a keyboard. These may be connected to the operator interface via USB, allowing the operators to use a mouse and keyboard instead of the touch screen.

The following table shows the ancillary items and their part numbers.

Part	Part Number
3.5" Operator Interface	31296
5.7" Operator Interface	31297
12.1" Operator Interface	31299
TS Manager/PC Configurator Software	13339
RS485 comms cable for 12.1" and 5.7 "	20576
RS485 comms cable for 3.5"	20635
SD Card (for 3.5" and 5.7" screens only)	31604
Flash Card Reader	13333
RS232 Cable	33027
24V DC Din Rail Mounted Power Supply	31135; 31137 for 12.1" screens
9220 Controller	13374

Setup

The Series 9220 setup consists of setting the local time if required. As shipped from the factory the communications ports are set at 19200 baud in Modbus mode.

Time will be set for local time in Cincinnati, Ohio (EST /EDT) or time zone of location of city and state on sales order. For instruction on adjusting these values, please see the Furnace Setup section.

Additional Features

The Operator Interface (touch screen) contains a removable compact Flash Card (for 12.1" screens) or SD Card (for 3.5" and 5.7" screens) that can be used to transfer data from the Model 9220 to a computer. It is located on the back of the touch screen (see Flash Card Management section for more details).

Also included is a Utility Software CD that includes SSi's TS Manager. TS Manager is a utility program that can be loaded onto any Windows® based computer (operating Windows XP® or higher). This software will allow the computer to read the data from the TS Flashcard, and allow it to be viewed in a manner that is similar to a strip chart recorder. The screen will need to be connected to the local network (using a static IP address) for communications capabilities. The TS Manager manual can be obtained from the SSi website.

Instrument Start-up

On power-up, the Operator Interface will display a Microsoft Windows desktop screen for a few seconds and then switch to the default Status screen.

SD/Flash Card & Card Reader

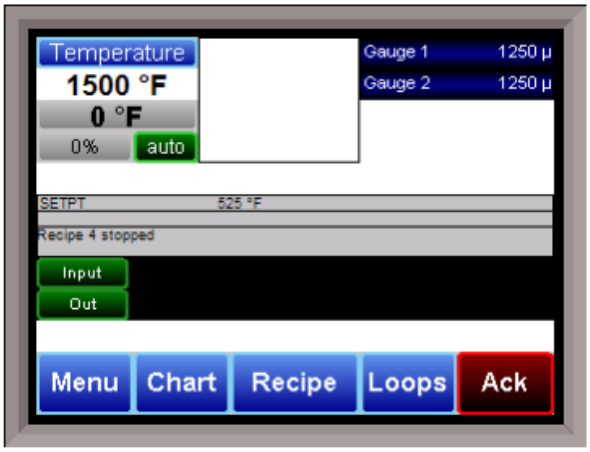
Never remove the SD or Flash Card when the Operator Interface is "ON".

To properly shut down the Operator Interface, press the **Menu** button on the default status screen. Once the menu has been displayed, select the *Shutdown* option. At the prompt, press **Yes** to shut down the Operator Interface. See the Chapter 2 – TOUCH SCREEN MENU section for information on navigating and using the menu system. This will display a conventional Microsoft Windows screen. On 5.7" screens, sliding the black switch to the OFF position (located directly over the green power connector, on the back of the Operator Interface) will turn off the power to the Operator Interface. On 3.5" and 12.1" screens, the power plug must be unplugged from the electrical socket in order to shut down the screen completely.

Warning: Electrical current

Utilize caution when handling electronic components of the controller and touch screen, including Compact Flash cards, SD cards, and power plugs. Power off all electronics before removing or inserting cards or performing other operations involving electronic components.

Once the Operator Interface is turned off, remove the card from the display unit. Press the black release button and the card will pop out of the slot. To replace the card, simply return the card to the slot (if using a Compact Flash card, make sure that the release button is in its UP position), and replace the cover properly. Do not force the card into the slot. Ensure card orientation is correct if card cannot be inserted into slot. To restore power to the unit, move the black switch to the right or ON position or plug the power cable back into the electrical outlet.



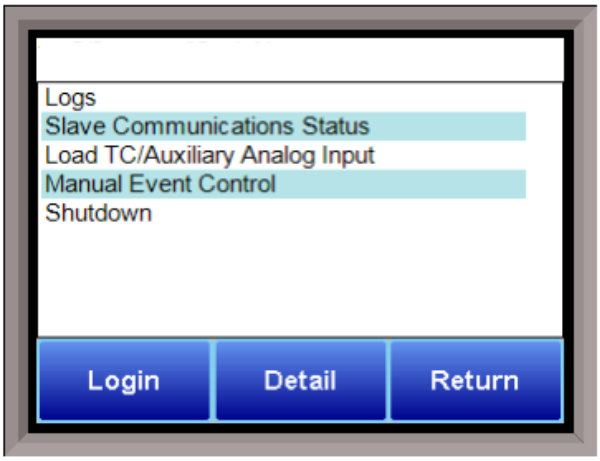
Default Status Screen

The Status Display shows the vacuum and temperature controller information as well as any auxiliary analog inputs, the status of the timer, and an overview of the programmer. There are five active buttons on the Status Display: **Menu**, **Chart**, **Recipe**, **Loops**, and **Ack.**

- The **Menu** button will display the configuration menu.
- The **Chart** button will display the video recorder screen. Use of the Chart Display is explained below.
- The **Recipe** button will switch to the Program Display. This is a companion display to the status screen and is described below.
- The **Loops** button will display the main control loop, Temperature, as well as the timer status and any auxiliary analog inputs.
- The **Ack** (Alarm Acknowledge) button is used to acknowledge an alarm. The alarm message is displayed directly under the recipe display. This is only present when an alarm is going off.

The screen also displays the temperature and pressure information.

Menu



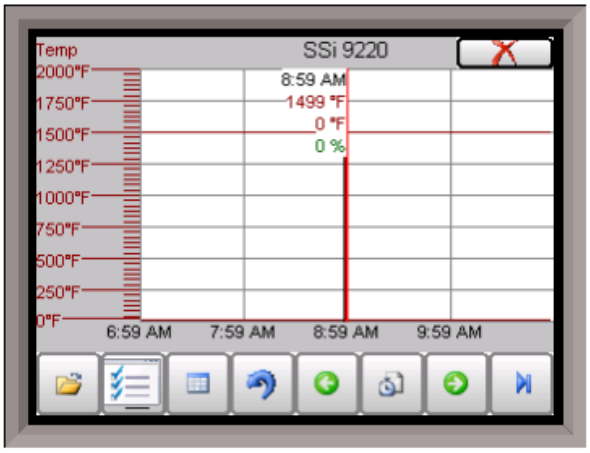
There are three levels of menus in the Series 9220.

- The first level is the *operator level*. These are functions or operations that are typically handled by the furnace operator. This menu is accessed without the need for a pass code.
- The second level is the *supervisor level*. This level requires the entry of a level 1 or a level 2-pass code.
- The third level is the *administrator level*. This requires the level 2-pass code ONLY.

As shipped, the *supervisor* and *administrator* level codes are set as **1** and **2** respectively. The pass codes can be changed at the Passcode and Alarm Screen. *Note: Any level can access a lower level screen. For instance, the Administrator level passcode can access all of the Supervisor and Operator level screens.*

The menu items are explained in detail in *Chapter 2 – Configuration.*

Chart

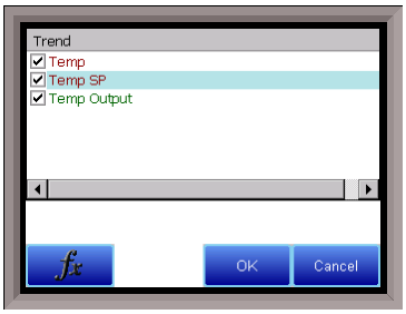


The Chart Display shows between 1 hour and 24 hours of process variable data on the screen and can be scrolled back to view all of the data stored on the hard drive. The vertical timelines change as the time changes on the screen. Any trend charts that have been created through the Configuration menu are accessible here.

The function buttons run along the bottom of the screen.

The folder button -  - stores saved templates. A different chart template can be selected here.

The Trend Lines button -  - will allow the user to select or de-select the trend lines on the trend chart to display. If the checkbox next to each trend line is checked, then that trend line will be displayed.



The Datagrid View button -  - will display a screen with the trend data in a grid format instead of with trend lines. The trend data is shown in 1-minute intervals. Clicking on the **OK** button on this screen will close the screen down and return to the Chart Display screen.

The Refresh button -  - will refresh the screen's trend data if the screen is not in real-time mode.

The left-pointing green arrow button -  - will move the chart's view backward in time by the specified chart interval.

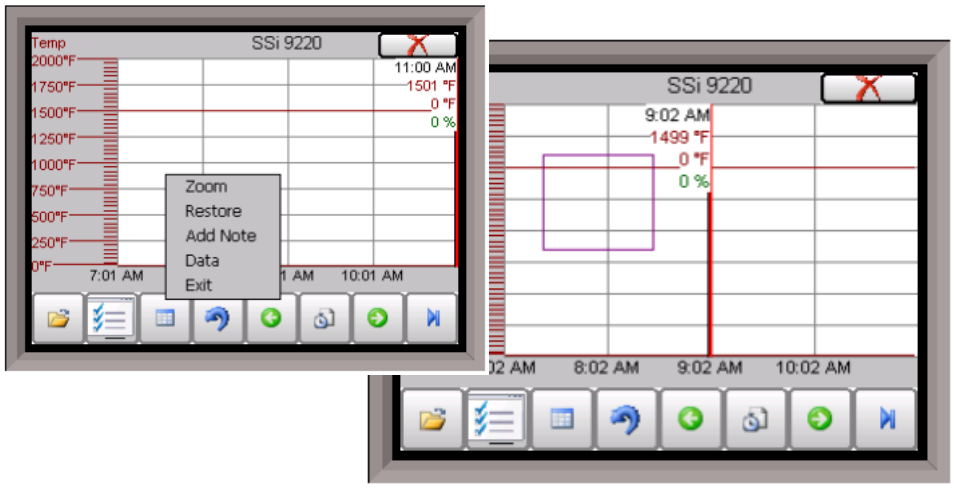
The chart interval button -  - will determine the number of hours displayed on the trend chart. The options are: **1 Hour**, **2 Hours**, **4 Hours**, **8 Hours**, **12 Hours**, or **24 Hours**.

The right-pointing green arrow button -  - will move the chart's view forward in time by the specified chart interval.

The right-pointing arrow with the vertical line next to it button -  - will put the chart into real-time mode if it is not in real-time mode, or take the chart out of real-time mode if it is. When in real-time mode, the chart will automatically be updated once a minute.

Chart Sub Menu

There is a sub-menu available by putting a finger or a stylus anywhere on the chart and holding it there for two seconds.



The sub-menu will have the following options available: **Zoom**, **Restore**, **Add Note**, **Data**, and **Exit**.

The **Zoom** option will allow the user to zoom in on a particular part of the screen. Once this has been selected, the user can take a stylus or a finger and create a box around the desired data. Once the user releases the stylus or finger, a zoom is no longer possible, and the user will need to re-select the option from the sub-menu to zoom in again.

The **Restore** option will back out of any zoom options that have been performed and display the chart screen as it initially was.

The **Add Note** option allows the operator to enter a note on the chart, similar to writing on a paper chart. The note shows up when the chart is printed out using the utility software included with the Series 9220 instrumentation. Pressing the **Add Note** option displays a screen where the operator can enter the operator ID or initials and a note. The user has the option to enter a note using the operator interface keyboard, where he or she will be able to type in the note; or the user can use the Signature mode, which will allow them to write a note using a stylus.

The **Data** option will show the trend data as a data grid instead of the trend lines on a chart. This functionality is exactly the same as if the user pressed the Datagrid View button -  - from the chart screen.

Exit will close out the sub-menu without selecting an item.

Pressing the red 'X' in the top right-hand corner of the screen will take the user back to the status screen.

Recipe

Appendix B, *Building a Recipe,* further explains this feature of the 9220.

Pressing the **Recipe** button on the main status screen displays the recipe screen, which will allow the user to load an existing recipe and start it or see the currently running recipe.

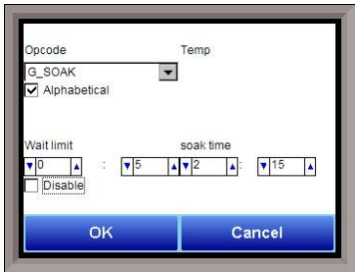
The recipe screen shows the last program loaded into the program run buffer and its status. If the program is running, the active step number is highlighted green. When the step is highlighted green, then the recipe is running on that step. When a step is highlighted yellow, the recipe is in hold on that step. A red **Acknowledge** button in the bottom left corner of the screen displays an alarm condition. *Note – the main status screen will also show the recipe running status, as well as run time and remaining time for the step as well as the entire recipe.*

The recipe screen has a total of seven buttons that will allow the user to load up a recipe, as well as control the recipe and acknowledge an alarm.

- The **Advance** button will advance the recipe to the next step in the recipe. The user will need to confirm the advance command.
- The **Hold** button places the displayed recipe program in hold. Once a decision is made that affects the recipe, it may be continued by pressing the **Resume** button. *Note – When a recipe is put into hold status, the text on the **Hold** button will change to "Resume". When the step is started up again, the text on the button will change back to "Hold".* When a recipe step is in a hold status, the step will be highlighted yellow. The user will need to confirm the hold or resume command.
- The **Stop** button stops the recipe program that is currently running. Stop means exactly that! It stops the program. It is NOT a hold button. See the description for the hold button above. To re-start the program if it has been stopped you must use the **Load** button, enter the recipe number, and then highlight the segment number of the recipe that you want to start with and start the recipe again. The user will need to confirm the stop command.
- The **Soak** button allows you to enter a new value for the time remaining in the current soak or ramp cycle only – future soak or ramp cycle times cannot be modified. The step must be a soak or ramp cycle for a change in soak/ramp time to be adjusted.
- The **Acknowledge** button will acknowledge the alarm. In most cases, it will be acknowledging *end of soak*. The alarm must be acknowledged to allow the program to go to the next step. *Note – The **Acknowledge** button is only visible when an alarm condition is present. Once the condition is acknowledged, the **Acknowledge** button will become invisible again.*
- The **Load** button allows the operator to enter the recipe number to be run and to view the recipe before pushing the **Run** button. Pushing the **Run** button starts the recipe. If a recipe program is running and the operator enters a new recipe program it can be viewed and modified. The recipe does not become active until the **Run** button is pushed. Pressing **Run** places the program currently being viewed in the active memory and will begin to run the

new recipe. To select the recipe to view or edit, click on the recipe number button in the top left corner of the screen. This will display a screen where the user will be able to load up a valid recipe (range **1** – **300**). The program can be started in any step by clicking on the step number button next to the "Step" text and entering the new step number (range **1** – **24**), and then pressing the **Run** key.

While reviewing the program that is about to be run, each step can be modified. Highlight a step number and click on the **Edit** button. The opcode can be changed with the drop down list at the top. This list can be sorted alphabetically by click on the "Alphabetical" checkbox. The parameters of the opcode can be modified on this screen as well. See Chapter 2 – TOUCH SCREEN MENU for details about each opcode. Click on the **OK** button to accept the changes; click on the **Cancel** button to ignore the changes. *Note – Any change to the recipe is a one-time edit, and will not affect the recipe that is saved on the 9220 controller*. Click on the Cancel button on the Load Recipe screen to cancel loading a recipe and return to the main recipe screen.



- The **Return** button returns you to the main status screen.

Loops

This screen will display the program loops for the 9220. One loop can be displayed. The current process variable is displayed at the top, with the loop set point displayed beneath the process variable. The operator can change the process set point by touching the screen area below the large process variable numbers. When pressing the Temperature set point, a numeric keypad is displayed, showing the current value and allowing the operator to enter a new set point by simply pressing on the appropriate numeric keys. Once the correct set point has been entered, press the **OK** key to make the change. When the **OK** key is pressed the display returns to the *Loops* Screen. Another active key within the *Loops* Screen is the **Auto/Man** (Auto/Manual) button. Pressing that button toggles the controller's mode between Auto and Manual. In the manual mode, pressing the percent output button on the *Loops* Screen (next to the **Auto/Man** button) displays a numeric keypad, allowing a % output to control the "loop" in a manual mode to be entered. Any load T/Cs that are actively communicating will be listed in the box to the right of the setpoint/percent output values. If an alarm condition is present, the alarm text will be displayed below the loop information. If the alarm needs acknowledging, then the **Alarm Ack** button will be displayed in the bottom left corner. If the alarm is part of a recipe step, the alarm will need to be acknowledged before the recipe can move to the next step. If a gauge is enabled, its status will be displayed in the top right hand corner.
Pressing **Return** will display the default status screen.

Ack (Alarm Acknowledge)

The **Ack** (Alarm Acknowledge) button will allow the user to acknowledge any alarms that have been configured, or that have been made part of the recipes that run on the Series 9220. If a recipe has an alarm as a step, the alarm must be acknowledged before the recipe will continue to the next step.

Data Logging using Flash Card

NOTE: See Warnings with respect to removing the Flash Card.

The Advantech touch screen Operator Interface, utilizing a card, is able to data log the parameters set up by a qualified SSi technician. Should a customer not take the data

offline in a timely manner, the data will be over-written, the oldest data being over-written first. Here is how it works:,

1. When the Operator Interface detects that there is less than 5% disk space left on the compact flash card, an alarm will be displayed on the main interface screen stating "x% disk space remaining (overwrite at 3%)". In the upper right corner, an ALM is indicated, but because it is not a communications alarm or a 9220 device alarm, the background remains green. This alarm will remain active until more than 5% of disk space is available for writing data log files.

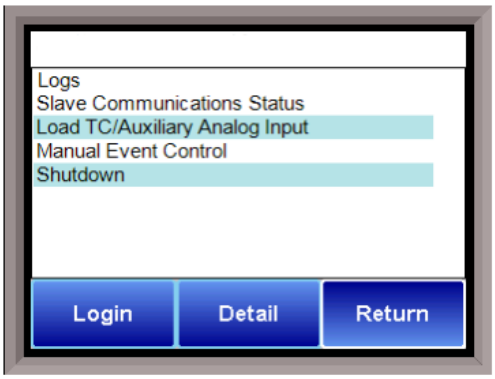
2. If the user does not copy the log data from the disk, it will eventually fall to 2% disk space. At this point, the touch screen will select the oldest compressed file and delete it. It then checks to see if 3% remains. It repeats this procedure until 3% disk space remains. At this point the alarm message changes to "Overwriting data log data!" Because this allows the system to seesaw between 2% and 3%, it will continue to display "Overwriting data log data!" until somebody offloads the files.

Technical concerns and details:
1. If there are not enough compressed files to bring the free space up to 3%, the system will hunt down and kill hourly files. This should only happen if compression would not be running for some reason.
2. If all compressed files and hourly files have been removed and there is still not enough disk space (perhaps a problem with the compact flash card), the data logger will not write to the disk until the condition is remedied. (Alarms continue to display).
3. The data log data alarm is the lowest priority. The alarm priorities are touch screen communications, then 9220 controller/programmer, then disk space.

See the Flash Card Management **Section for more information.**

Chapter 2 – TOUCH SCREEN MENU

Menu (Configuration)



The Configuration Menu is entered through the **Menu** key that is part of the four buttons running along the bottom of the Default Display Screen.
Pressing the **Login** key at the bottom of the screen will allow the user to enter a login user and password. *Note – users can be set up by logging in with the number 2 and selecting the Security menu option*. User names and passwords are case sensitive. There are three levels of security for the menu system: **Operator**, **Supervisor**, and **Administrator**.
Pressing the **Login** button will allow the user to enter a user name and numeric password to log in. When the menu screen is first displayed, the operator-level menu options are visible. The supervisor menu options will be displayed with the login number 1. The Administrator menu options will be displayed with the login number 2.

The list of the operator-level menu options is:

- Logs
- Slave Communications Status
- Load TC/Auxiliary Analog Input
- Manual Event Control
- Shutdown

The list of supervisor-level menu options is:

- Logs
- Slave Communications Status
- Load TC/Auxiliary Analog Input
- Manual Event Control
- Shutdown
- PID Loop Setup
- Recipe Edit
- Load T/C Configuration
- Trend Chart Edit

The list of administrator-level menu options is:

- About
- Maintenance
- Logs
- Slave Communications Status
- Load TC/Auxiliary Analog Input
- Manual Event Control
- Shutdown
- PID Loop Setup
- Recipe Edit
- Load T/C Configuration
- Trend Chart Edit

- Communications Setup
- Slave Instrument Setup
- Zone Assignments
- Furnace Setup
- Default Wait Limits
- Alarm Setup
- Thermocouple Check
- Relay Assignments
- Relay Setpoints
- Analog Input Setup
- Analog Output Setup
- Alarm Polarity
- Event Hold/Reset
- Vacuum Gauge Setup
- Security
- Custom Curves
- Alternate PID Setup
- Aux Analog Input Setup
- Calibration
- Configuration
- T/C Correction Curves
- Aux Setpoint Configuration
- Tuning AssistantDF1 Configuration
- PV Switching
- Vacuum Leak-up Testing
- A/I Module Offset Correction

To select any of the menu options, highlight that item by clicking on it, and click on the **Detail** button.
The **Return** button will return the user to the default display screen.

Maintenance

The Maintenance option will keep track of regular operations performed by the system and put up alerts when the system needs maintenance attention, as determined by the user. There are four options on the Maintenance screen, **Status, Maintenance Report, Edit Current Records,** and **Edit Security Settings**, as well as **Return** which will return the user to the previous screen. **Maintenance events can be set up by using the screen Menu → Configuration → Maintenance, or by using TS Manager.**

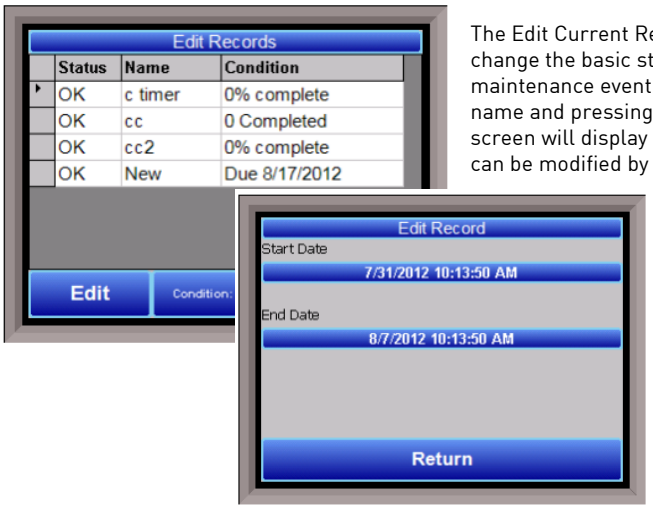
Status

The status screen will keep track of the maintenance events. The status column displays whether the defined events are OK (not due) or Due for maintenance. When an item is due, it will be displayed in red on this screen. Furthermore, it will be shown on the Status Display screen as Due, similar to the way an alarm is shown on the Status Display screen. The Condition column depends on the type of maintenance item (this is determined when it is set up under Menu → Configuration → Maintenance). The option to display only Due items is available by selecting the box in the upper left corner, Show Due Only.

Along the bottom of the screen are the buttons **Complete, Condition:,** and **Return.** The **Condition:** button in the middle can be toggled between Total Remaining, Total Complete, and Percent. This controls how the information in the Condition column is displayed.
Total Remaining:
Total Complete:
Percent:

The **Complete** button is used to acknowledge that maintenance has been performed. To complete an item, first highlight the name of the item by tapping it, and then tap the **Complete** button. This will display the item name and the instructions for maintenance (the name and instructions are determined when the item is set up under Menu → Configuration → Maintenance). Pressing **OK** will reset the maintenance item, changing the Status to OK and restarting the maintenance event. Pressing **Return** from this screen will not change the status of the event.

Edit Current Records

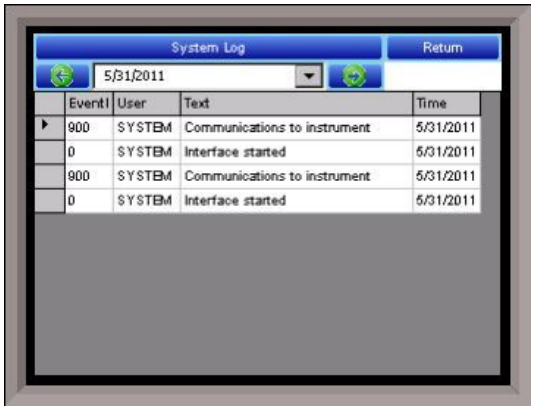


The Edit Current Records screen will allow the user to change the basic start and stop parameters of a maintenance event. This can be done by highlighting the name and pressing the **Edit** button. The Edit Record screen will display the start and stop parameters, which can be modified by tapping the corresponding blue bars.

Edit Security Settings

The Edit Security Settings screen controls what level of clearance must be entered in order to perform maintenance operations. The Allowed Item column has the choices of Complete Maintenance and Edit Maintenance Record. Each can be set to either True or False for the Operator and the Supervisor. If the value is listed as True, this gives permission to perform the corresponding maintenance operation. False hides the maintenance operation from anyone logged in under that passcode level. To change the security settings, highlight the Allowed Item and press the **Toggle Operator** button to toggle the operator column between true and false, or press the **Toggle Supervisor** button to toggle the supervisor column between true and false. Press **Save** to save changes and return to the previous screen. Press **Cancel** to return to the previous screen without saving changes.

Logs



The Logs screen will allow the user to view three different types of logs – **System**, **Alarms**, and **Cycle**.

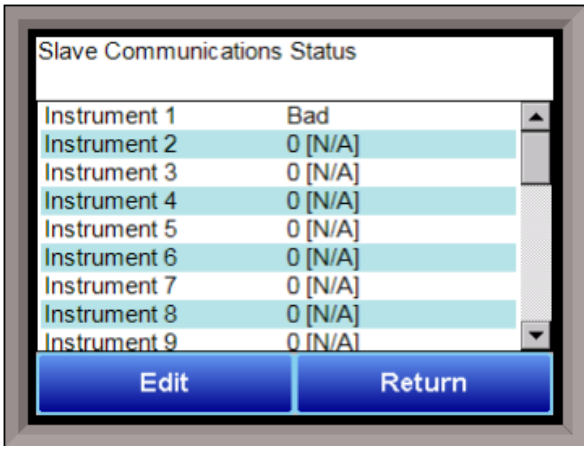
Clicking on the button that displays the log type (**System Log**, **Alarm Log**, or **Cycle Log**) at the top of the screen will allow the user to select the type of log file to view.

The green directional arrows will display the previous items in the log or the next items in the log, if the log items are longer than one screen. The drop down list in between the directional

arrows will allow the user to select the date of the log items to view.

The **Return** button will return the user to the menu screen.

Slave Communication Status

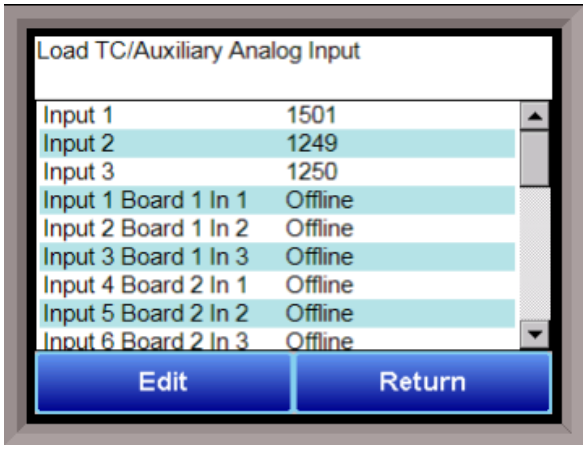


This page is a display of the current process variables of each of the slave instruments communicating with the 9220 controller. These values are display-only, and cannot be modified from this screen. There are five possible messages that can occur to describe the instrument communications status.

- N/A – No instrument is connected
- Bad – No communications exist
- ??? – Communications exist, but there are frequent errors
- ?OK – Communications exist, but there are occasional errors
- OK – Communication is established and working properly

For set-up of the auxiliary instruments go to the menu item "*Slave Instrument Setup*"
The **Return** button will return the user to the menu screen.

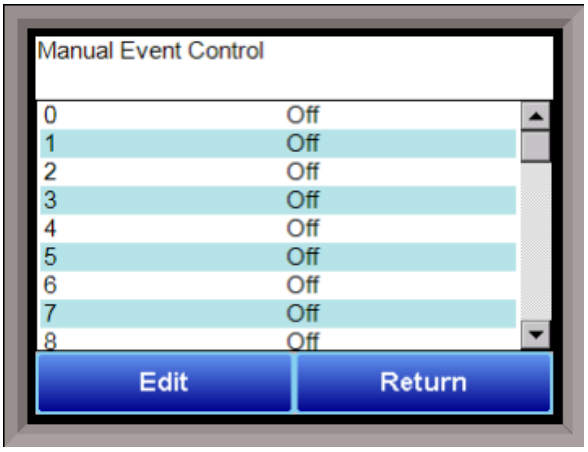
Load TC/Auxiliary Analog Input



The Load TC/Auxiliary Analog Input screen will show the values for the load TCs and the auxiliary analog inputs. These values are display-only, and cannot be modified from this screen. The **Return** button will return the user to the menu screen. To change the load TC/Auxiliary Analog Inputs, select the Aux Analog Input Setup in the menu list.

Manual Event Control

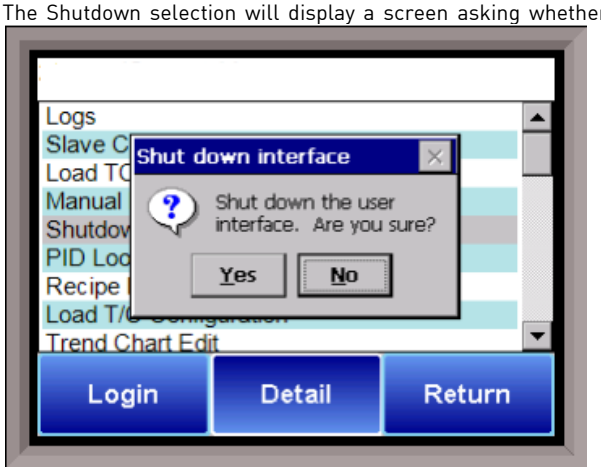
Events are assignable outputs, used in recipes/programs. Typically, they are used to signal the recipe is complete, to turn process gases off and on, and tell the equipment to do a variety of tasks. The Manual Event Control submenu allows the user to force the events off or on.



The Manual Event Control menu option shows the user all of the events (**0** – **47**) and their current status. It also allows the user to manually control the status of any event by clicking on the value. To change the status, highlight the specific event and click on the **Edit** button. The user will be able to select either an **On** value or an **Off** value.
Clicking on the **OK** button will set the value, while clicking on the **Cancel** button will cancel the action.
The **Return** button will return the user to the menu screen.

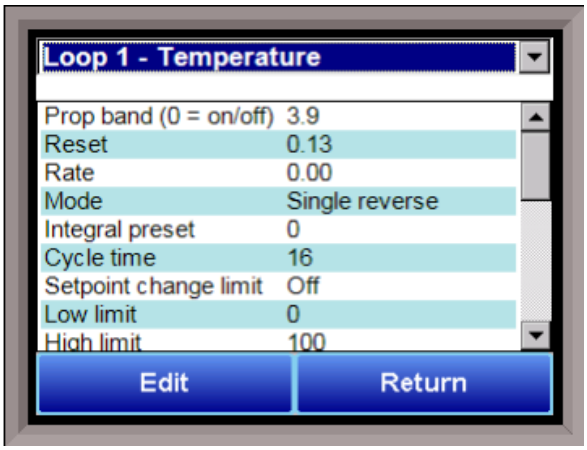
Shutdown

The Shutdown selection will display a screen asking whether or not to shut down the interface of the Series 9220. When the operator interface is shut down, the Series 9220 controller is still functioning. It can be monitored by connecting the Ethernet connection to a laptop computer, using Internet Explorer, and assigning a legitimate IP address. Choosing **Yes** displays a Windows CE desktop screen with the **Start** button in the bottom left-hand corner. The power to the operator interface can now be turned off without upsetting any of the settings. Choosing **No** displays the initial Status Screen. ***Note -Shutting down the Operator Interface does not shutdown the Series 9220 Controller. It will stop any screen charting while the software is shut down.***



PID Loop Setup

PID is the tuning parameters entered for each Process Variable loop.



Prop Band (0 for On/Off)

Proportional Band determines the response to the current error. The Proportional Band is the percent of the range of the process variable that will produce 100% output and is the inverse of the proportional gain. A low Proportional Band value results in a larger change in output for a given error. Conversely, a high Proportional Band value results in a smaller change in output for a given error. If the Proportional Band is too small, control may oscillate or be otherwise unstable. If the Proportional Band is too large the control action may be too sluggish in response to changes within the system. Note: If the Proportional Band is set to 0.0, only on/off control is performed. The range **0** – **3276.0**.

Reset

Reset determines the influence of past errors. The Reset, or integral action (expressed in repeats per minute), sums the error between the process variable and setpoint over time and adds this accumulated output to the proportional output. A "proportional only" controller generally operates with steady-state error because some error is required to produce control output. The goal of integral action is to drive the steady-state error to zero and eliminate this droop. The range **0** – **327.67**.

Rate
Rate adjusts the response to future errors. The Rate, or derivative action (expressed in minutes), is used to predict system behavior and has a dampening effect. The more the controller tries to change the process variable the harder the derivative will work to counter that effort. This dampening effect can be valuable in reducing overshoot but is most often useful when trying to improve control on systems with significant and predicable lag. The range **0** – **327.67**. NOTE: The rate is not typically used for carbon control.

Control Mode
This is the mode of the loop. The values are: **Dual Reverse**, **Single Reverse**, **Dual Direct**, or **Single Direct**.
Dual – This has two output relays which can increase and decrease to achieve the SP.
Single – This has one relay which works in only one direction to achieve the SP.
Direct - If the PV - SP equals a positive number and the output would bring the PV down toward setpoint that is direct.
Reverse – If the PV - SP equals a negative number and the output would bring the PV up toward setpoint then that is reverse

Example: If a 12 mA output drives a 0 degree F temperature (PV) *UP* to a 1200 degree F temperature (SP), this would be *REVERSE*, and since this would take a *SINGLE* output from the controller, the Mode for the Temperature Loop is **Single Reverse**.

Integral Preset
This field provides an offset for the starting point for PID control, also referred to as "Load Line" or "Manual Reset". The range is **–100** to **100**.

Cycle Time
This field is typically set to the valve travel time multiplied by 1.5. The range is **0** – **500**.

Setpoint Change Limit
This is a smart tune feature that inhibits the integral (Reset) until the control output drops below the specified % output after a set point change.
It is used to eliminate overshoot.
The Output percentage selected under this category *must* be above the normal operating output percentage of the furnace at heat.
The options are: **OFF**, **80%**, **70%**, **60%**, **50%**, **40%**, **30%**, or **20%**.
Example: If the furnace runs at 40% output at heat for the maximum load, the setpoint change limit should be set to 60%.

Control Low Limit
This is the low limit for the loop. The range is **–100** to **100**.

Control High Limit
This is the high limit for the loop. The range is **–100** to **100**.

0 Setpoint Stops Control
If the Setpoint is zero, then all outputs are turned off. The option is either **Yes** or **No**.

IN1 high stops control
If input 1's high limit is reached, then all outputs are turned off. The value can either be **Yes** or **No**.

IN2 high stops control
If input 2's high limit is reached, then all outputs are turned off. The value can either be **Yes** or **No**.

IN3 high stops control
If input 3's high limit is reached, then all outputs are turned off. The value can either be **Yes** or **No**.

PID Auto Switch
This is the PID auto switch field. The value can either be **Yes** or **No**.

PID 1 -> 2 Switch Point
This is the PID Switch Point field. It is the point at which the control loop is changed to a different PID set. Loop 1 is assumed to be the "low" loop and Loop 2 is assumed to be the "high" loop. The range is **–300** to **4000**. NOTE: PID switch points are based on Temperature PV, *not* Setpoint or Ramp Temperature.

PID 2 -> 3 Switch Point
This is the PID Switch Point field. It is the point at which the control loop is changed to a different PID set. Loop 2 is assumed to be the "low" loop and Loop 3 is assumed to be the "high" loop. The range is **–300** to **4000**. NOTE: PID switch points are based on Temperature PV, *not* Setpoint or Ramp Temperature.

Setpoint Lower Limit
This is the lower limit of the setpoint. The range is **–300** to **9999**.

Setpoint Upper Limit
This is the upper limit for the setpoint. The range is **–300** to **9999**.

Use input 3/rem SP
This option allows the operator to use input 3 to remotely control the set point. Input 3 can be configured under the Analog Input Setup menu. The choices for this are **Yes** or **No.**

Comment [MS1]: This option is not present on the 9220 I am using. Eliminate?

PV source
This allows the user to configure what information the selected loop is basing control on. By default, Loop 1 is for temperature control and is set to Input1. The options are: **Off**, **Input 1**, **Input 2**, **Input 3**, **Gauge 1 torr**, **Gauge 1 micron**, **Gauge 2 torr**, **Gauge 2 micron**, **Gauge 3 torr**, **Gauge 3 micron**, **Gauge 4 torr**, **Gauge 4 micron**.

Positive Output Accumulator
The Positive Output Accumulator is the sum of the positive outputs (given in percentages up to one decimal place) measured each second. Therefore, if the following outputs are recorded over five seconds:

Output (in %)	Second Passed
100.0	1
99.0	2
99.0	3
98.0	4
97.0	5

Then the value for the Positive Output Accumulator after five seconds will be (100.0 + 99.0 + 99.0 + 98.0 + 97.0) or 493.0.

To reset the Positive Output Accumulator, simply click **Edit** while the Positive Output Accumulator is highlighted and confirm the reset. This will cause the Positive Output Accumulator to be reset to zero and start accumulating values again from that point.

Negative Output Accumulator

The Negative Output Accumulator is the sum of the negative outputs (given in percentages up to one decimal place) measured each second. The sum of the negative values is expressed as a positive value. This means that, if an output of -50% is recorded after one second, a value of 50 will be added to the Negative Output Accumulator. Similarly, if the following outputs are recorded over five seconds:

Output (in %)	Seconds Passed
-20.0	1
-20.0	2
-21.0	3
-21.0	4
-22.0	5

Then the value for the Negative Output Accumulator after five seconds will be (20.0 + 20.0 + 21.0 + 21.0 + 22.0) or 104.

To reset the Negative Output Accumulator, simply click **Edit** while the Negative Output Accumulator is highlighted and confirm the reset. This will cause the Negative Output Accumulator to be reset to zero and start accumulating values again from that point.

Overshoot Control Logic (No/Yes)

Overshoot control logic is activated when a large setpoint change occurs. If the logic is active and a large setpoint occurs, it sets a working setpoint at an appropriate distance from the desired setpoint to prevent the PV from overshooting the desired final setpoint. When the PV reaches or crosses this working setpoint, then the logic exponentially ramps the working setpoint to the desired final setpoint.

Ramp Detect Logic (No/Yes)

The Ramp Detect logic works in conjunction with the instrument recipe programmer. If the control loop is the temperature loop for the recipe programmer, and the OPCODE is a ramp, then the control loop does some special checks. If the Overshoot Control Logic is active, then the final setpoint of the ramp is used to determine the working setpoint band. However, the ramp setpoint is used until the band is reached. Also, once the band is reached, if the ramp is faster than the overshoot logic exponential ramp, then the program is temporarily put on hold as needed to sync the two ramps.

Ramp Level 1 Control (No/Yes) and Ramp Level 2 Control (No/Yes)

Ramp Level 1 and 2 Control are only active if the Ramp Detect logic is active.

Ramp Level 1 Control changes the working PID settings to equivalent PI settings during the ramp until the overshoot logic band is reached.

Ramp Level 2 Control is only active if the Ramp Level 1 control is active.

Ramp Level 2 Control changes the working PID settings to equivalent Prop band only settings during the ramp until the overshoot logic band is reached.

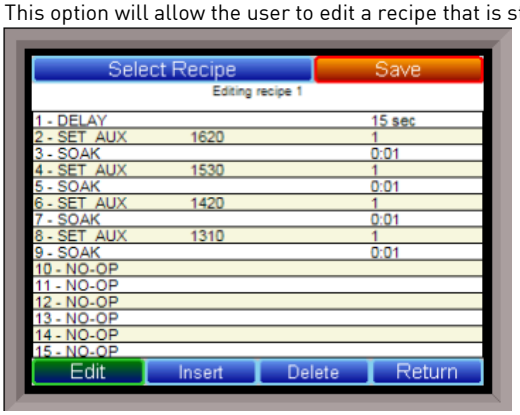
Output rate change limit, %/sec

This option causes the 9220 controller to limit the rate at which the output changes in the furnace. For example, if the output rate change limit is 5% per second, the controller will increase the output at a rate no greater than 5% each second until the output reaches the level needed to reach setpoint. This limit can be useful in cases where (for example) a heating element should not (for operational and safety reasons) heat up to a high output immediately. If the output needs to reach 100% to achieve setpoint, the Output Rate Change Limit will apply the output incrementally, rather than allowing the output to climb to 100% as soon as the heat is turned on.

The **Return** button will return the user to the menu screen.

Recipe Edit

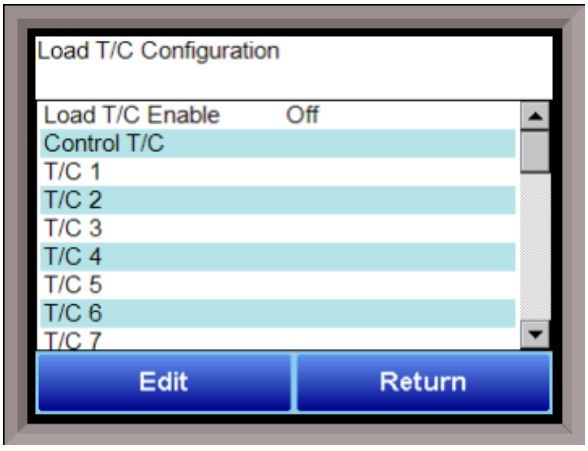
This option will allow the user to edit a recipe that is stored on the 9220 controller.



The **Select Recipe** button will allow the user to select which recipe to load (**1** – **300**). Once the recipe has been selected, the recipe will be displayed on the screen.
The higher recipe steps can be viewed by holding a finger or stylus on the screen and scrolling up or down.
To edit a specific step, highlight that step and press the **Edit** button. This will allow the user to select a different Opcode to use, or to change the information entered for the current Opcode. See Chapter 4 – OPCODES for more information on each Opcode and its purpose.
To insert a step into the program, highlight the step number for the step, and press the **Insert** button. The user will have to confirm the insert. Once this has been confirmed, the user will be able to select the Opcode to use. *Note – Inserting a step will push every step after down one, so an Opcode at step 24 will be lost.*
To remove a step from the recipe, highlight the step number and press the **Delete** button. The user will have to confirm the delete. Once the delete has been confirmed, the step will be deleted and every step after will be moved up one step. Blank step numbers will be replaced with a NO-OP Opcode.
Press the **Save** button to save the changes that have been made. The recipe can be saved as any valid recipe number (**1** – **300**). If the desired recipe number already contains a recipe, the user will have to confirm the save before the old recipe will be overwritten.
If the user wishes to delete an entire recipe, they have one of two options. First, they could load up the desired recipe and change every step to the NO-OP Opcode and save those changes; Or, they could save the 24-step "blank" (NO-OP) program that is loaded up when the *Recipe Edit* screen is first displayed as the desired program number. This will save the "blank" recipe to the desired recipe number location.
The **Return** button will return the user to the menu screen.

Load T/C Configuration

Configuration of any analog input device must be completed under this menu item. To set the band difference, use the **Default Wait Limits** menu option. To select one of the load TCs, highlight one of the selections and press the edit button.



Load TC Enable
This value will manually toggle between **on**, **on + alarms**, and **off**.
On – T/C Enabled
On + Alarms – T/C Enabled, Programmer alarm114 provided if out of band (Default wait limits)
Off – T/C not enabled

Control TC
This value allows the user to set the TC to be part of the group of Load TCs that can

hold the program if it is out of band. The values are **active** or **not active** (shown as blank).

TC 1 – 36
This value allows the user to manually turn the T/C from **active** to **not active**, shown as blank, to be part of the group of TCs that can hold the program if it is out of band.

Input 1
This is the control TC.

Input 2
If gauges are used, input 2 may be used for a 10 VDC connection for a gauge. Optionally, input 2 may also be used as a TC input.

Input 3
If gauges are used, input 3 may be used for a 10 VDC connection for a gauge. Optionally, input 3 may also be used as a TC input.

Load T/C Alm Delay (Sec)
This option will allow the user to set a delay time, in seconds, before the load T/C alarm is activated. The range is **0** – **32767**.

SP bump maximum step change
SP bump max total change
SP bump change time (sec)
The SP bump feature will make adjustments to the control set point with the goal of bringing all Load TCs into band. It can bump the setpoint higher or lower. The **SP bump maximum step change** is the maximum interval of degrees that the controller will adjust the setpoint. **SP bump max total change** is the combined total number of degrees that the controller will adjust the setpoint. **SP bump change time (sec)** is the interval of time in seconds between checks to determine the status of the TCs (whether or not they are in band).

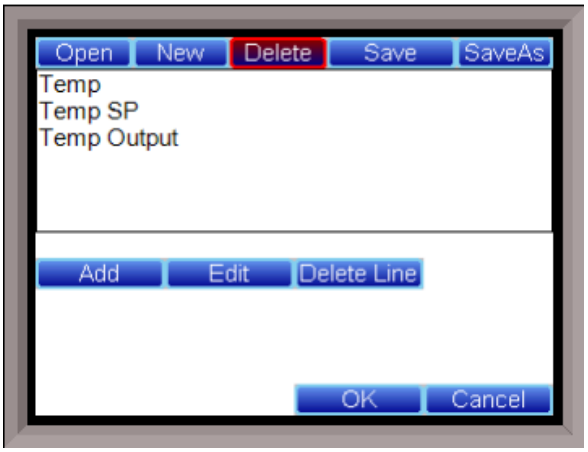
Minimum Load T/Cs for guarantee
This feature sets a minimum number of Load TCs required to be within band for a guaranteed soak to be evaluated as true. For example, if this value is set to 4, and 6 Load TCs are enabled, the controller will begin counting as soon as 4 Load TCs are within band. If the value is set to 0, this feature is disabled. NOTE: Typically, the Control TC would be disabled to prevent undesired results.

Fail guarantee on active T/C bad coms
This feature prevents the soak timer from running when the instrument cannot communicate with the analog input card connected to the Load TCs. As soon as communications are established and the minimum number of Load TCs (set using the Minimum Load T/Cs for Guarantee feature described above) are within band, the soak timer and guaranteed soak will run.

The **Return** button will return the user to the menu screen.

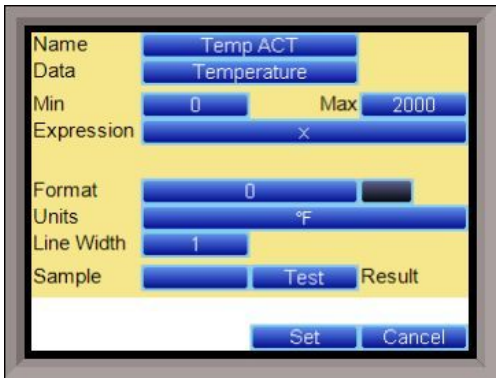
Trend Chart Edit

This menu option will allow the user to add, modify, or delete trend lines in a trend chart file, as well as the trend chart files themselves. The trend lines are the number of variables displayed on one screen. For example this could be a control, overtemp, or load thermocouple on a batch furnace. Or it could be one thermocouple from eight temper furnaces. There is not a maximum for template selections, but the number of variables displayed on one screen must be a consideration in this process.



The buttons across the top of the screen – **Open**, **New**, **Delete**, **Save**, and **Save As** – deal with the trend chart files themselves, not the individual trend lines.
Open will allow the user to select a trend chart file to open up to edit.
New will create a new trend chart file to begin adding trend lines to.
Delete will delete a specified trend chart file.
Save will save all changes to the current trend chart file that have been made.
Save As will allow the user to save the current trend chart file as a new file with a different name.

Once a new trend chart file has been created, or one has been opened, trend lines can be added, modified, or deleted. **Add** will add a new trend line to the file. **Edit** will allow the user to edit the information for a specific trend line. **Delete Line** will delete the specified line from the chart file.
Adding or editing a trend line will involve the following parameters:

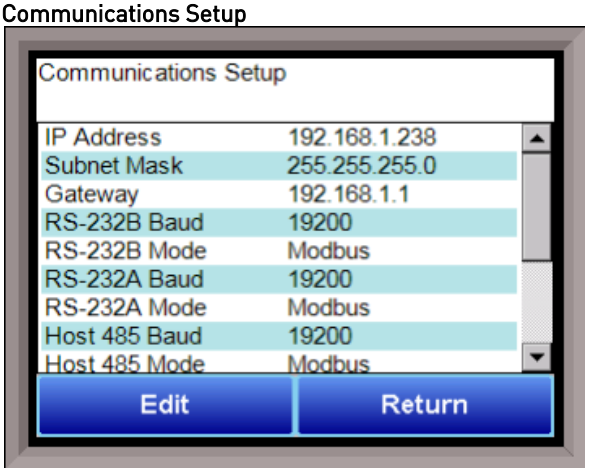


Name – the name of the input, for example "Temp ACT" which would be the actual temperature of the input. It is a good idea to shorten the names so that they still make sense but do not take up as much space.
Data – This will determine where the data is coming from. The user can click on the box to select from the list of data logged points in the 9220. Some of the points have a name, such as "Temperature" or "Temperature SP" while others will show the register in the 9220 that has been logged.
Min – the minimum displayed scale value on a chart.
Max – the maximum displayed scale value on a chart.
Expression – every input requires an expression to be calculated and displayed correctly. This is because the registers in the 9220 hold only integer values, so any value that requires a decimal point needs to be set up properly for the display. For example an expression for temperature would be x (1750 = 1750). For a value such as carbon or millivolts, the expression would be x * 0.01 (150 = 1.50) or x * 0.1 (805 = 80.5).
Format – the value displayed on the chart display of the operator interface. A short custom description can be added here. For example, to display one (1) decimal point, enter a value of "#0.0". For carbon values, enter a value of "#0.00" for 2 decimals. This would display a value like "0.81". Entering "#.00" would display a value of ".81". #0 or 0 will display integer values.
Color – The box next to the format box will allow the user to apply a color to the trend line to differentiate it from other trend lines on the chart.
Units – The type of units used for the trend.
Line Width – a numeric value for the thickness of the trend line. A 1 is a thin line; A higher value = thicker line width.
Sample – a number is entered here to test the expression and verify that formatting is correct.
Test – Press the test button to calculate the expression with the value entered in the sample parameter. For example with an expression of x*.1 and a value of 250 entered in the sample parameter will display a 25.0.
The **Set** button will save the values entered. The **Cancel** button will cancel the information and make no changes.

The **OK** button will close the screen and prompt the user to save any changes if changes have been made.

The **Cancel** button will close the screen and return to the menu screen.

Communications Setup



Note about ADAM module support: Communications with ADAM analog input modules manufactured by Advantech are not supported as of 9220 firmware revision 2.46. To determine the firmware version of your 9225 instrument, use the *About* option in the main menu.

IP Address
This will identify the IP address of the controller. Please consult your Systems Administrator before changing this value as it can affect communications to the 9220 controller or to other devices on your network. This is necessary if the Touchscreen will be communicating to the 9220 over Ethernet communications. The IP address must be in the "xxx.xxx.xxx.xxx" format.

IP Mask
This will identify the Subnet mask of the controller. The Subnet mask must be in the "xxx.xxx.xxx.xxx" format.

IP Gateway
This will identify the IP gateway of the controller. The IP gateway must be in the "xxx.xxx.xxx.xxx" format.

Host 232B Baud
This will set the baud rate for (male DB9) RS-232 communications. This is necessary if the Touchscreen will be communicating through the Com ports. The list of options is:

1200	14400	57600	460800
2400	19200	76800	921600
4800	28800	115200	
9600	38400	230400	

Host 232B Mode
This will set the mode for (male DB9) RS-232 communications. This is necessary if the Touchscreen will be communicating through the Com ports. The list of options is:
Modbus/no PLC
Modbus master/PLC

Host 485 Baud
This will set the baud rate for RS-485 communications. This is necessary if the Touchscreen will be communicating through the Com ports. The list of options is:

1200	14400	57600	460800
2400	19200	76800	921600
4800	28800	115200	
9600	38400	230400	

Host 485 Mode
This will set the mode for RS-485 communications. This is necessary if the Touchscreen will be communicating through the Com ports. The possible settings are MMI, **Modbus** and **Televac MX4A**.

Host 485 Address
This will set the address for RS-485 communications. This is necessary if the Touchscreen will be communicating through the Com ports. The range is **1** – **247**.

Slave 1 Baud
This will set the baud rate for Slave 1 communications. The list of options is:

1200	14400	57600	460800
2400	19200	76800	921600
4800	28800	115200	
9600	38400	230400	

Slave 1 Mode
This will set the mode for Slave 1 communications. This list of options is:
MMI
Modbus
Yokogawa
Modbus Host

Slave 2 Baud
This will set the baud rate for Slave 2 communications. The list of options is:

1200	14400	57600	460800
2400	19200	76800	921600
4800	28800	115200	
9600	38400	230400	

Slave 2 Mode
This will set the mode for Slave 2 communications. This list of options is:
MMI
Modbus
SSi Analog Input Board
Yokogawa

Host 232A Baud
This will set the baud rate for (female DB9) RS-232 communications. This is necessary if the Touchscreen will be communicating through the Com ports. The list of options is:

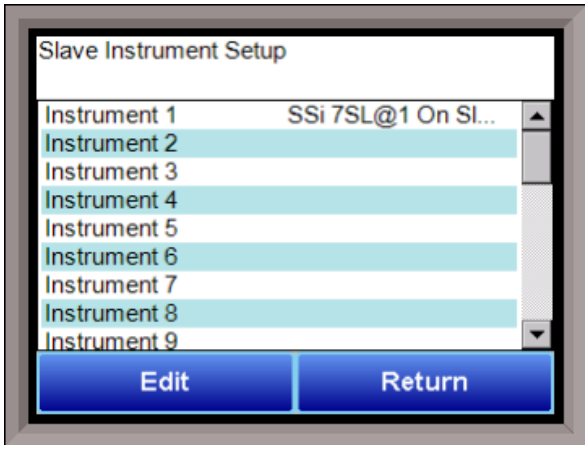
1200	14400	57600	460800
2400	19200	76800	921600
4800	28800	115200	
9600	38400	230400	

RS-232A Mode
This will set the mode rate for (female DB9) RS-232 communications. This is necessary if the Touchscreen will be communicating through the Com ports. This list of options is:
Modbus
Televac
Varian
Leybold

PLC Type
This will set the type of PLC device in use. The list of options is:
Micrologix Modbus
MCMmodule Modbus
DF1 PLC5
DF1 Silk
Passive

The **Return** button will return the user to the menu screen.

Slave Instrument Setup



This screen will allow the user to configure up to twenty-two (22) slave instruments through the 9220 controller. Instruments 21-25 and 27 are reserved. To set up a slave instrument, highlight the instrument number and click on the **Edit** button.

For an instrument to be configured as a slave instrument, it must (1) support communications and (2) have a defined unique serial Address. The User must refer to the specific instrument's User Manual to determine this. Each instrument configured as a Slave to the 9220 controller will require configuring an (1) instrument type, (2) slave address and (3) serial port for which the device is connected. The Port will be assigned according to which terminals the instrument was wired to on the 9220.

The list of available slave instruments will be shown on the screen. The list is color coded by type – Blue for Atmosphere, Red for Temperature, Yellow for Events, and White for User devices. Highlight an instrument to select it as the instrument to use.

The list of controllers includes the following <u>Atmosphere Controllers</u>:

- **SSi AC20**
- **Yokogawa 750**
- **Honeywell UDC3300**

- Dualpro LP1 Modbus
- Dualpro LP2 Modbus
- Dualpro LP1 MMI
- Dualpro LP2 MMI
- Eurotherm 2402
- Eurotherm 2500
- Carbpro v3.5
- Carbpro v3.0
- CarbPC
- 9200 LP1
- IR Base
- MGA
- Honeywell UDC3200

This list of controllers includes the following **Temperature Controllers**:

- SSi 7EK
- Yokogawa 750
- Honeywell UDC3300
- Dualpro LP1 Modbus
- Dualpro LP2 Modbus
- Dualpro LP1 MMI
- Dualpro LP2 MMI
- Eurotherm 2402
- Eurotherm 2500
- Unipro v3.5
- Unipro v3.0
- Carbpro v3.5 Slave
- Carbpro v3.0 Slave
- 10Pro
- DualPro IN C
- 9200 LP1
- 9200 LP2
- 9200 LP3
- 9100 LP2
- Eurotherm 2704 LP1
- Eurotherm 2704 LP2
- Eurotherm 2704 LP3
- VC BASE 1
- VC BASE 2
- VC BASE 3
- VC BASE 4
- AIPC
- SSi 7SL
- SSi eFlo
- UMC800 Lp1
- SSi Quad AO1
- SSi Quad AO2
- SSi Quad AO3
- SSi Quad AO4
- Yokogawa UT350
- Yokogawa 750 Lp 2
- Yokogawa UP350
- Honeywell DCP551

- Ascon 08
- SSi X5
- SSi M4L
- SSi X5/timer
- SSi SPUD
- SSi AIB3
- SSi H_2 cell
- Flow Meter Short
- SSi O_2 remote
- SSi Dual Motor Board
- SSi Smart AIB3
- O_2 Block
- Waukee Valvetronic +
- SSi eSPP
- EL-Flow
- Fuji
- Smart QuadDAC
- SSi Single Gas IR
- Alicat MC

This list of controllers includes the following **Event Controllers**:

- SSi AC E
- Yokogawa 750E
- Mod Mux
- Dualpro E Modbus
- Dualpro E MMI
- Carbpro E v3.5
- Carbpro E v3.0
- Eurotherm 2500
- SSi 8-8
- SSi 9200E
- Micrologix PLC
- MCM Module
- PLC DF1
- SLC DF1

There are also options for 15 **User Devices**.

The number below the list is the address for the slave instrument. The range is **0** – **28**.

**** All devices on the same slave port must utilize the same protocol**
**** An address of zero (0) will disable the instrument** Some controllers (AC20 for example) can provide dual functions (atmosphere and events) and must have the same address assigned for both.**

The slave port is next to the address. The Slave port option can be: **Slave 1 or Slave 2**.

The **OK** button will set the slave instrument, and the **Cancel** button will cancel the setup.

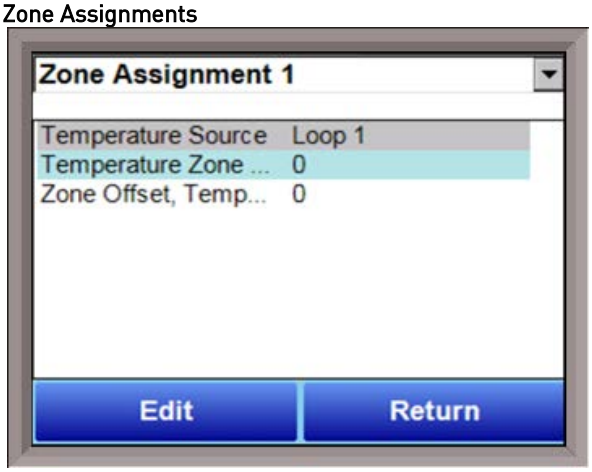
IMPORTANT!

The 9220 will generate a programmer alarm if communications with a slave instrument are lost. The alarm will contain information on the slave instrument number to which communications were lost and

will be displayed in Configurator and on the touch screen's main status screen. (If the alarm is connected to a relay and the relay is wired to an audio device, an audible alarm will be generated.)

The **Return** button will return the user to the menu screen.

Zone Assignments



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***Slave Instrument Setup must be configured prior to Zone Assignment setup**

The zone assignment feature allows the Series 9220 program to change set points on all instruments of a multi-zone furnace. The Series 9220 has up to five temperature zone assignments available (**Zone Assignment 1** – **Zone Assignment 5**). Typically, the first zone is configured to the programmer's temperature instrument. That is the master set point that will be propagated to the other configured zone instrument set points on set point change. For example, the user may want to set 4 temperature zones from a recipe where the programmer temperature instrument is loop 2. In this case, zone 1 would be configured as loop 2. Subsequent zones would be configured as previously configured slave temperature controllers.

If the *ZONE_OFF* (Zone Offset) opcode had been used in the program, the set point sent to the specified zone instrument would have the offset added. For example, a 3-zone pit furnace, where the bottom zone usually has a higher set point. The middle zone and the top zone usually have a lower set point. The bottom zone temperature controller is assigned to zone 1, the middle temperature controllers to zone 2, and the top zone controller to zone 3.

If the first three steps of a program are as shown below, then the bottom zone set point is 1775, the middle zone is 1750, and the top zone is 1800.

Step	Opcode	Temperature	Option
1	*ZONE_OFF*	25	Zone 1
2	*ZONE_OFF*	50	Zone 3
3	*SETPT*	1750	

The first step sets the offset for zone 1 to 25 degrees; therefore, the bottom zone controller would be sent a set point of 1775 when step 3 is executed. Likewise step 2 sets the offset for zone 3 to 50 degrees. The top zone then receives a set point of 1800. The middle zone controller would receive the 1750. The temperature controller displayed on the Status Display is instrument #2. If instrument #2 were the top zone controller then the Status Display would show the 1800-degree set point. The offset is discarded when the program ends. The default value is reloaded by the programmer when the user starts a new program.

When using the multi-zone offset feature, the temperature controller assigned as instruments 1 and 2 should be in zones that will not be offset.

Temperature Source
This will allow the user to set the temperature instrument for the zone assignment. The options are:

Loop 1	**Instrument 6**	**Instrument 14**	**Instrument 22**
Loop 2	**Instrument 7**	**Instrument 15**	**Instrument 23**
Loop 3	**Instrument 8**	**Instrument 16**	**Instrument 24**
Instrument 1	**Instrument 9**	**Instrument 17**	**Instrument 25**
Instrument 2	**Instrument 10**	**Instrument 18**	**Instrument 26**
Instrument 3	**Instrument 11**	**Instrument 19**	**Instrument 27**
Instrument 4	**Instrument 12**	**Instrument 20**	**Instrument 28**
Instrument 5	**Instrument 13**	**Instrument 21**	

Temp Zone Number
This option will allow the user to set the zone number for the assignment. The range is **0** – **5**.

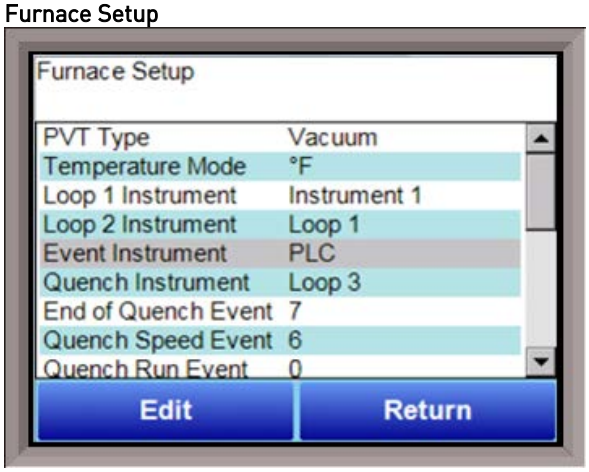
Temp Zone Offset
This option will allow the user to enter an offset for the assignment. The range is **-4000** – **4000**.

Proper configuration of this step will allow the User to accomplish the same offsets as in the original example. For example, if Zone 1 was configured for a Temp Zone Offset of **25** and Zone 3 was configured with a Temp Zone Offset of **50**, the Opcode of

3 *SETPT* 1750

would produce the same results of set points of 1775, 1750, and 1800, respectively. It is important to remember assignments made within this section will always be applied. Therefore, it should be reserved for applications were Zone Offsets are consistent.

Furnace Setup



PVT Type
This value cannot be changed.

Temperature Mode
This allows the operator to choose either degree Fahrenheit or Celsius for the temperature. The options are **°C** or **°F**. Pressing **OK** will set the choice.

Loop 1 Instrument
This is the programmer loop 1 instrument. Since programmer loop 1 is often reserved for atmosphere control, this feature is not usually used with the 9220. The default is Instrument 1. The options are:
Loop 1 – Loop 3
Instrument 1- Instrument 28

Loop 2 Instrument
This is the programmer loop 2 instrument. Programmer loop 2 is reserved for temperature. The setpoint is applied to programmer loop 2 when an opcode is used to set a temperature setpoint. The default for this setting is Loop 1, which is the internal PID loop 1. The internal PID loop 1's PV source is input 1. The options for this setting are :
Loop 1 – Loop 3
Instrument 1 – Instrument 28

Event Instrument
Allows for a slave instrument (or internal) to be the defined event control device. The types of instruments are: **internal or PLC.**

Quench Instrument
Allows for slave instrument (or internal) to be the defined quench control device. This is setup in the configurator furnace setup submenu. It will send the setpoint out to whatever instrument is configured for quench. The types of instruments are: **Loop 1, Loop 2, Loop 3 , Instrument 1 – Instrument 28**.

End of Quench Event
Tells the programmer which event to signal end of quench (related to which relay it is assigned). The default event for this is Event 7, but it can be changed in the furnace setup menu. This event pulses on and off when the quench timer is complete. The list of possible values is: **0 – 15**.

Quench Speed Event
Tells the programmer which event will signal the quench speed. The default event for this is event 6. This event will remain off if quench speed is set to low. It will turn on if quench timer is timing and quench speed is set to high with the opcode. The list of possible values is: **0 – 15**.

Quench Run Event
Tells the programmer which event will signal quench run. The default event for this is 0. This event will stay on when the quench timer is timing. The list of possible values is: **0** – **15**.

Vacuum Gauge on RS-232
Instead of a vacuum gauge coming in on inputs 2 and/or 3, this would allow 232 communications to the 9220 from the vacuum gauge. This is typically reserved for instances where the vacuum instrument supports RS-232 communications. A serial null modem cable (with pins 2/3 switched and pin 5 as a ground) is installed between the vacuum instrument's communication output and Port A of the 9220. Additional settings may be required in the 9220 Port Settings.

Date and Time
This value is the current date and time on the 9220 controller only (not the local computer or the touch screen, if applicable). The time on the controller is displayed in the 24-hour format, so 8 = 8 AM, and 14 = 2 PM. *Note: The date and time of the touch screen can be changed (if necessary) by selecting the date and time in the lower right corner on the touch screen, once the screen software has been shut down and the Windows™ desktop is visible. Then, at the CE screen the date and time can be changed by double taping the time in the bottom right corner and setting it, then select "apply". For this to take effect the screen needs to be rebooted; on the older TPC 642 displays the registry needs to be saved under TPC Configuration icon, the Misc Tab and then reboot the touch screen. The date and time that is recorded on the flash card (and therefore the datalog data) is the date and time of the Advantech display, not the controller*.

Default Hold Time
This value is the default holding time for the furnace. If there is a hold time on for the furnace, this is the amount of time the furnace will stay in hold until an alarm sounds. The range is **0** to **10000** in minutes.

Name
This will allow the user to give the controller a display name.

PV 1, PV 2, and PV 3 Name
These options can be used to change the name of the three PVs in the 9220. The default for PV1 Name is "Temperature 1"; for PV2 name, "Vacuum"; and for PV3 name, "Vacuum GRAMMER".

Clear events/end of recipe
This switch will allow the user to clear the events out at the end of a recipe. The options are either **no** or **yes**.

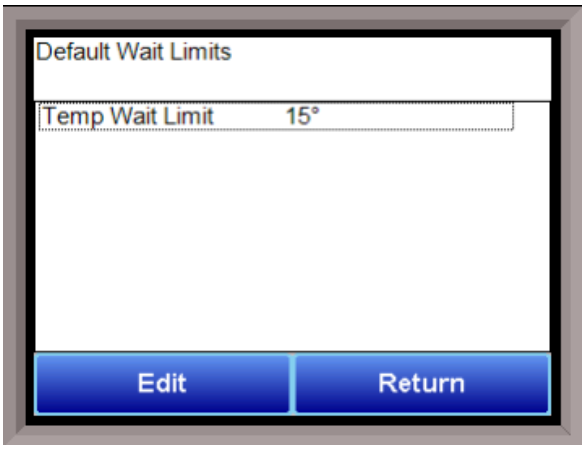
Clear TC SP/End of Recipe
This switch will allow the user to clear the thermocouple setpoint at the end of a recipe. The options are either **no** or **yes**.

Slave Event Boards
This is the number of slaved 9015 controllers to the 9220.

Load TC Auto Check
This feature can be set up using Configurator and is found under Furnace Setup in the dropdown menu. When this opcode is enabled, the controller will review the condition of active load T/Cs and automatically remove any T/C from the active load T/C map if it is suspected to be shorted or open. The 9220 keeps a timer for the highest and lowest active load T/C. The timer is reset at the point when a different T/C reaches a higher or lower reading. If one of the active load T/Cs is determined to be faulty and is removed from the guarantee, the controller will have a record for the amount of time this T/C was the highest or lowest. This amount of

time will be credited to the soak time. As a result, the soak time will not be reset or lose any time because of a malfunctioning T/C when the Auto Check feature is enabled.
The options for this are **off, enabled, enabled auto time adjust last out,** and **enabled auto time adjust all out.** By default, the Auto Check is off.
When **enabled** is selected, the Load TC Auto Check will run expressly as described.
When **enabled auto time adjust last out** is selected, the timer monitoring the T/C condition will reset if the T/C that is considered faulty comes back into band.
When **enabled auto time adjust all out** is selected, the timer monitoring the T/C condition will reset if another T/C reaches a higher or lower temperature than the T/C that is considered faulty, as the case may be.
In all three cases, if the T/C is considered to be malfunctioning, the amount of time that has been recorded for the T/C as the highest or lowest will be credited to the step's soak time.
The **Return** button will return the user to the menu screen.

Default Wait Limits



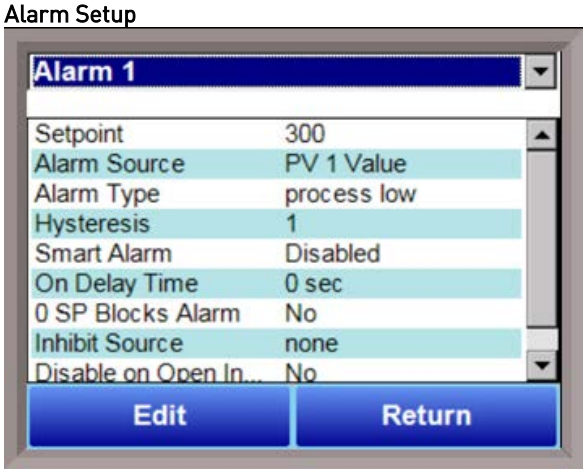
The 9220 controller uses default wait limits in conjunction with recipe programs. The wait limits are in place to help make sure a recipe will not continue to the next step until the process variable is within the specified range. The wait limits are both plus and minus the value of the setpoint specified in the recipe.

Temp Wait Limit
This is the specific wait limit for the temperature PV. The range is: **0** to **4000**.

The **Return** button will return the user to the menu screen.

This assigned Temp Wait Limit will apply to all enabled Load TCs as well as the Control TC.

Alarm Setup



The 9220 controller can be configured to use seven different alarms. Each of the alarms consists of an alarm setpoint, alarm source, alarm type, alarm hysteresis, smart alarm, ON delay time, and a 0 SP blocks alarm value. The alarms come from the factory with a default configuration dependent on the application but also can be modified prior to shipment to your
facility or in the field by a supervisor.

Setpoint
This value is the setpoint for the alarm. Clicking on this value will display an input box from which the user can select a new value. The range is from **–32767** to **32767**.

Alarm Source
This option will indicate the source of the alarm. The options are:
PV 1 Value
PV 2 Value
PV 3 Value
Input 1 Value
Input 2 Value
Input 3 Value
Percent Output 1 Value
Percent Output 2 Value
Percent Output 3 Value

Note that PV Value represents the numerical value displayed on the touch screen. Input Value represents the raw value recorded by the 9220 controller. This value is then converted to a meaningful number to the User via various calculations.

Alarm Type
This value is the type of alarm used. Options are:
Process High
Process Low
Band, Normally Open
Band, Normally Closed
Deviation, Normally Open
Deviation, Normally Closed

Assuming **PV1 Value** was selected above and the 9220 has a temperature SP of 1500 °F:

Process alarms are defined as a set value. For example, the User may not want to allow the front door to open if the furnace is above 150 °F. The alarm is set as a **Process High** of **150**. Disregarding hysteresis (see next point), this alarm will be active when the Loop 1 temperature PV exceeds 150 °F, regardless of temperature SP.

Band alarms are defined as a range around a set point. For example, the User may want to alarm when the furnace temperature deviates by more than 50F. The alarm is set as a **Band, Normally Open** of **50**, Disregarding hysteresis (see next point), this alarm will be active while Loop 1 temperature PV is between 1475 °F – 1525 °F.

Deviation alarms are defined as a (either) positive or negative value differing from set point. For this example, refer to the Quench Oil example used in the next point.

Hysteresis
This value is the Hysteresis value. The Hysteresis is a set number that works with the alarm to help control a motor or pump longer to reach a set amount to come back into band before it will shut off the motor or pump.

Example: Using quench oil as an example, suppose the SP is 200 °F. The alarm is set as a deviation of +10 °F. At 210 °F, the alarm is active and the pump will run to cool the oil. With a hysteresis of 8 °F, the alarm and pump will turn off at 202 °F. It will turn back on when it is 10 °F above setpoint. If the setpoint is still 200 °F, then at 210 °F, it will turn on again.

Clicking on this value will display an input box from which the user can select a new value. The range is from **-32767** to **32767**.

Smart Alarm
This value is a display of the Smart Alarm status. A smart alarm is an alarm that works with a Process Variable (PV), and, when enabled, it will not be armed until the PV is within band of the setpoint. The alarm sounding - if active - will be disabled until within the SP band. When it is in band, the alarm will go active unless on delay time is set.

Example: If the SP is 1700 °F and the band is 10 °F, the alarm will not be active until the PV reaches 1690 °F. The value can be either **disabled** or **enabled**.

On Delay Time
This value is the On Delay Time (in seconds) for the alarm to becoming active. Clicking on this value will display an input box from which the user can select a new value. The range is from **-32767** to **32767**.

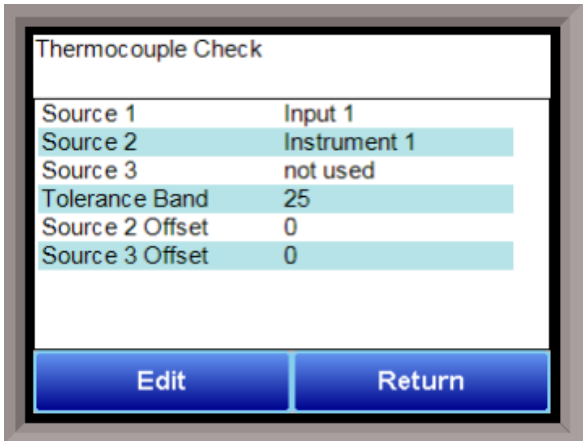
Zero Setpoint Blocks Alarm
This value will allow a 0 setpoint to block an alarm. The options are either **No** or **Yes**. This feature allows alarms to become inactive during idle times (between recipes) of the controller.

Inhibit Source
Alarms can be inhibited in order to prevent false or unnecessary alarm notifications. The Inhibit Source option will allow the user to set the source of the inhibit signal. The options are: **None**, **Input 1 – Input 3**, **Soak timer inactive** (The alarm will not happen if the furnace is in a soak if this option is selected).

Disable on Open Input
An alarm can be disabled when an input is open in order to avoid false or unnecessary alarms. This option will allow the user to specify if the alarm is disabled when the input is open. The options are either **no** or **yes.**

Thermocouple Check

This menu option allows the values between up to three thermocouples to be compared to one another. If the thermocouples go out of band, it is possible to set up an alarm that will alert the operators of this error.



Source 1 – Source 3 This assigns the first, second, and third thermocouples that will be compared. The options are:

Not used
Instrument 1-27
Input 3
Input 2
Input 1

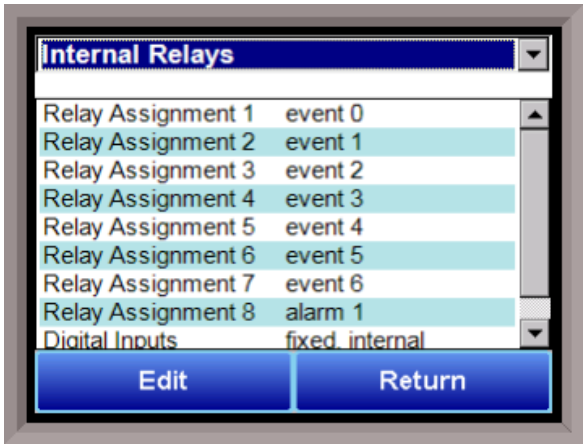
Tolerance Band This allows the operator to set the tolerance band between the thermocouples being compared. The range is **-9999 to 9999.**

Source 2 Offset This allows for an offset to be assigned to the second thermocouple and taken into account when the comparison between values is made. The range is **-9999 to 9999.**

Source 3 Offset This allows for an offset to be assigned to the third thermocouple and taken into account when the comparison between values is made. The range is **-9999 to 9999.**

Relay Assignments

The 9220 controller has the option of using eight (on board) relay outputs, as well as an additional eight relay outputs (from slaved instruments) for four additional modules. All of the relays have a positive common terminal and independent negative terminals. All of the relays are configured in a normally closed position except relay number eight, which has both a normally closed (NC) and a normally open (NO) terminal. These relays can be configured to work with events, alarms, loops, burnoff and alarm combinations.



Depending on the parameters selected within the Furnace & Port Setups of the 9220 controller, these outputs can be either (1) physical terminals on the 9220 controller or (2) bit references passed to an external instrument and/or PLC. In the second example, communications will have to be established between the PLC and 9220 controller (beyond the scope of this manual). Once a specific word has been assigned, bits within the word will turn On/Off in time with the 9220 controller.

Relay Output Terminals:

Relay Output 1 – terminals 7 and 8
Relay Output 2 – terminals 7 and 9
Relay Output 3 – terminals 7 and 10
Relay Output 4 – terminals 7 and 11
Relay Output 5 – terminals 7 and 12
Relay Output 6 – terminals 7 and 13
Relay Output 7 – terminals 7 and 14
Relay Output 8 – terminals 7 and 15 NC
Relay Output 8 – terminals 7 and 16 NO

Relay Output Choices

Loop 1 fwd	Gauge 1 relay SP C	event 35
Loop 1 rev	Gauge 2 relay SP A	event 36
Loop 2 fwd	Gauge 2 relay SP B	event 37
Loop 2 rev	Gauge 2 relay SP C	event 38
Loop 3 fwd	Gauge 3 relay SP A	event 39
Loop 3 rev	Gauge 3 relay SP B	event 40
Programmer Alarm	Gauge 3 relay SP C	event 41
Alarm 1	Gauge 4 relay SP A	event 42
Alarm 2	Gauge 4 relay SP B	event 43
Alarm 3	Gauge 4 relay SP C	event 44
Event 0	event 16	event 45
Event 1	event 17	event 46
Event 2	event 18	event 47
Event 3	event 19	Gauge 1 Relay SP D
Event 4	event 20	Gauge 1 Relay SP E
Event 5	event 21	Gauge 1 Relay SP F
Event 6	event 22	Gauge 2 Relay SP D

Event 7	event 23	Gauge 2 Relay SP E
Event 8	event 24	Gauge 2 Relay SP F
Event 9	event 25	Gauge 3 Relay SP D
Event 10	event 26	Gauge 3 Relay SP E
Event 11	event 27	Gauge 3 Relay SP F
Event 12	event 28	Gauge 4 Relay SP D
Event 13	event 29	Gauge 4 Relay SP E
Event 14	event 30	Gauge 4 Relay SP F
Event 15	event 31	PLC watchdog alarm
Out gas hold	event 32	Load TC Deactivated
Gauge 1 relay SP A	event 33	PV SW State Loop Fwd
Gauge 1 relay SP B	event 34	PV SW State Loop Rev

The **Return** button will return the user to the menu screen.

For example, the a recipe has been created to heat a furnace for a defined amount of time. The User then wants to energize a particular relay to initiate a quench sequence. The User may define **Relay Assignment 1** as **Event 0**. The recipe can then be modified to use the following Opcode:

5 *EVT_OUT* 0-ON

to initiate the quench sequence. This will energize the particular relays (wired to terminals 7 & 8 of the 9220 controller) until an Opcode of:

8 *EVT_OUT* 0-OFF

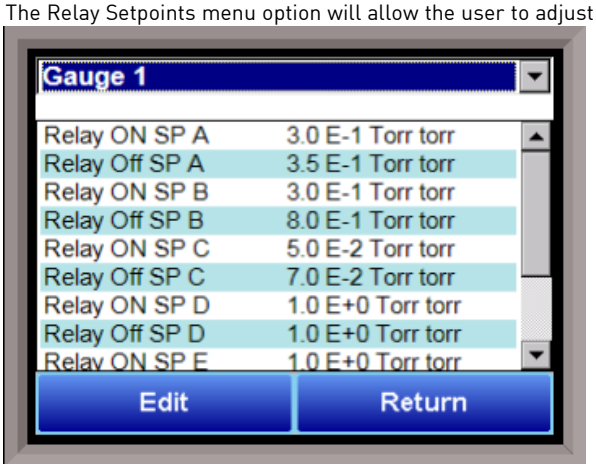
is used to turn off the event. There are other Opcodes that can be used to turn on specific events for a defined amount of time. Events can also be set to automatically turn Off following the completion of a recipe (see **Furnace Setup**).

To make Relay Assignments appear more meaningful, the User can define Event Text for each (see **Configuration**). In the example above, this would allow the User to change the text of **0** to **Quench**, If assigned, the Opcode would then read:

5 *EVT_OUT* Quench-ON

Relay Setpoints

The Relay Setpoints menu option will allow the user to adjust the setpoints that will turn each relay on or off based on the assigned vacuum level. Each gauge can have up to six separate relay setpoints. A lower number value means that there is a harder vacuum in the furnace. As the number increases, the furnace is losing vacuum.



The relay setpoints defined may then be assigned to Relay Assignments on the 9220 controller (see **Relay Assignments**). For example, Gauge 1 may represent the main vacuum gauge for the furnace vacuum level. If the User wants to create a partial pressure environment within the furnace of 200 microns, then **Relay ON SP A** would be set at **2.0 E -1** and **Relay Off SP A** would be set at **2.1 E -1**. (Note: Values

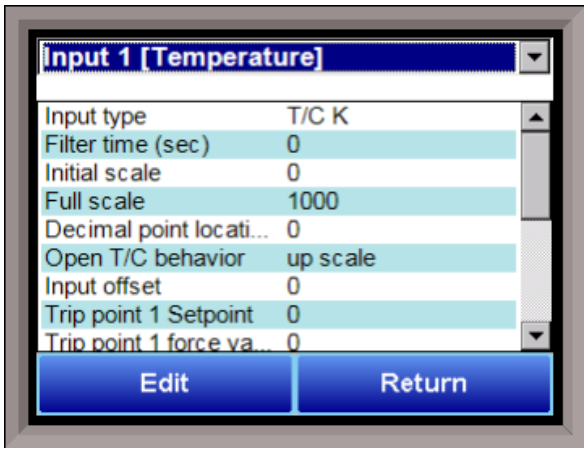
are displayed in Torr, not microns).

In the previous section, the user may then assign **Relay Assignment 2** as **Gauge 1 Relay SP A**. Assuming this were wired to microns. Remember this example has been simplified, there are various safeties that must be considered when wiring such a valve.

NOTE: The values for all six setpoints can be changed on the touch screen or in the recipe editor by using opcodes RLY_SP_M or RLY_SP_T. Setpoints D, E, and F cannot be changed in the recipe editor.

Analog Input Setup

The 9220 controller has three analog inputs. Each of the inputs comes with a factory default configuration dependent on the application. By default, input 1 is the control T/C input. The configuration can be modified prior to shipment to your facility or in the field by a technician or qualified/trained person with the proper security code.



Analog Input Terminals
Analog Input 1 – terminals 31 and 32
Analog Input 2 – terminals 29 and 30
Analog Input 3 – terminals 27 and 28

Input Type

The thermocouple type for most applications can be modified depending on your specific needs. *Note - some of the inputs DO NOT allow the user to modify the Input type*. To change the Input type, first select which input you want to change by selecting it in the pull-down at the top of the screen. The following is a list of the options:

B	S	12.5 volts **
C	T	781.25mv
E	2.5 volts	195.3125 mV
J	1.25 volts	
K	78.125 mV	
N	19.53125 mV	
NNM	4-20 mA *	
R	25 volts **	

*** - When the specified input type is selected, a 250 Ohm resistor will need to be placed on that specific input's terminals for reading this selection. If resistor is not placed on input, then damage could occur to the board.**
**** - When the specified input type is selected, a jumper located inside the case will need to be placed on that specific input for reading this selection. If jumper is not placed on input, then damage could occur to the board.**

Filter time

The filter time is a factory applied averaging tool used to help maintain steady control in high EMI environments. The filter time should not be adjusted without consulting SSI. Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **32767**.

Initial Scale
This is the initial scale value. This could also be referred to as the starting value. For example, the initial value is the value when 0 volts is on the selected input; or on a 4-20 mA input, it would be the value at the selected input of 4 mA. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.

Full scale
This is the full scale value for the analog input. This is preset for thermocouple types. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.

Decimal Point Location
This is the decimal point location value. This will affect the PV value and the location of the decimal when it is displayed. Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **4**.

Open TC Behavior
This is the open TC value. If the TC should fail, these are the options that the controller will display. The options are: **upscale (will display the maximum scale number)**, **down scale(will display the minimum scale point)**, **one trip point (will use the trip point 1)**, and **two trip points (will use which ever trip point is enabled)**.

Input Offset
The input offset value is algebraically added to the input value to adjust the input curve on read-out. The range is **–32768** to **32767**.

TRIP POINT EXPLANATION: Setting a trip point will force the value that the controller uses for calculations to a certain value as assigned by the operator. Once the **Trip Point Setpoint** is reached, the controller will begin reading the value as the **Trip Point Force Value,** regardless of what the actual value is inside the furnace. The **Trip Point Direction** allows the operator to choose whether the controller will alter its reading when the trip point is either above or below the setpoint.

Trip Point 1 Setpoint
This is the trip point 1 setpoint value. The range is **–32768** to **32767**.

Trip Point 1 Force Value
This is the trip point 1 force value. The range is **–32768** to **32767**.

Trip Point 1 Direction
This is the trip point 1 direction. The options are: **input above setpoint** or **input below setpoint**.

Trip Point 2 Setpoint
This is the trip point 2 setpoint value. The range is **–32768** to **32767**.

Trip Point 2 Force Value
This is the trip point 2 force value. The range is **–32768** to **32767**.

Trip Point 2 Direction
This is the trip point 2 direction. The options are: **input above setpoint** or **input below setpoint**.

High Input Limit Setpoint
This is the setpoint for the high input limit. The range is **–32768** to **32767**.

High Input Limit Hysteresis
This is the hysteresis for the high input limit. The range is **–32768** to **32767**.

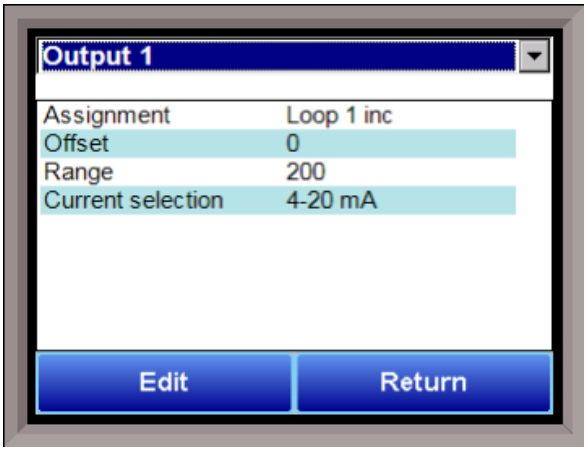
Custom Curve
This will allow the user to set the custom curve to use. The curves are set up through the C*urve Entry* menu option. The options are: **None**, **Curve 1** – **Curve 3**.

T/C Correction Curve
This will allow the user to set the T/C correction curve to use. The curves are set up through the *T/C Correction Curves* menu option. The options are: **None**, **Curve 1** – **Curve 7**.

The **Return** button will return the user to the menu screen.

Analog Output Setup

The 9220 controller has the option of six analog outputs. The outputs are ranged for a 4 – 20 milliamp signal or a 0 – 20 milliamp signal. Each output comes with a factory default configuration dependent on the application. Each output can be modified prior to shipment to your facility or in the field by a supervisor.



Analog Output Terminals
Analog output 1 – terminals 24 and 25
Analog output 2 – terminals 25 and 26

Assignment
The analog output assignment can be modified depending on your system requirements. To change the Assignment first select which analog output you want to change by selecting it in the pull-down menu at the top of the screen. The following is a list of the options:

PV 1 retrans	**Loop 1 inc**	**Loop 2 dec**	**Loop 1 combo**
PV 2 retrans	**Loop 2 inc**	**Loop 2 dec**	**Loop 2 combo**
PV 3 retrans	**Loop 3 inc**	**Loop 3 dec**	**Loop 3 combo**
Input 1 retrans	**Input 2 retrans**	**Input 3 retrans**	**G1 log of torr**
G1 linear torr	**G1 microns**	**G2 log of torr**	**G2 linear torr**
G2 microns	**G3 log of torr**	**G3 linear torr**	**G3 microns**
G4 log of torr	**G4 linear torr**	**G4 microns**	**Programmer ID number**
Setpoint 1 retrans	**Setpoint 2 retrans**	**Setpoint 3 retrans**	**PV SW loop inc**
PV SW loop dec	**PV SW loop combo**	**Programmer Analog out 1-6**	

Combo example for carbon – 4 – 12 mA Air
12 – 20 mA Gas

Offset
This is the starting point, the Process Variable value at which you get 4 milliamps. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.

Range
This is a Process Variable value between 4 and 20 milliamps. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.
Note - The range, although not displayed with a decimal point, contains a decimal point that is dependent on the process variable selected. For example, if the offset is 20 mV for 4 mA, and you want 100 mV to be 20 mA, then your range should be 80. If the process variable is temperature, then the range will be 80, since temperature PVs do not have a decimal. If the PV were % Carbon, then the range will need to include the two decimal points for % Carbon. So, a range of 80 will be entered as 8000.

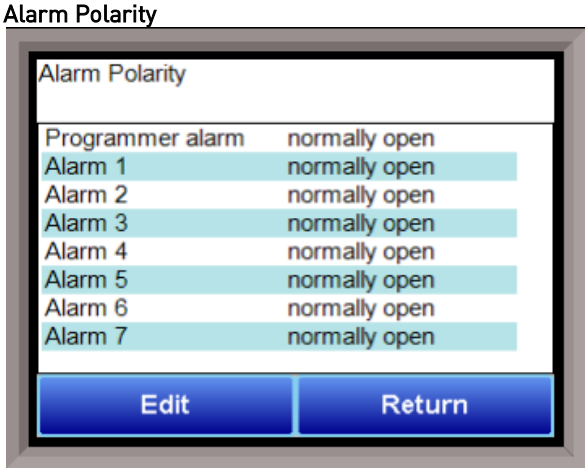
Current Selection
Provides the option of **4-20 mA** or **0-20 mA** control. Clicking on this value will display an input box with a drop-down list from which the user can select either of the two values listed above.

Offset and Range when assigned to a control loop
Inc : 0 = 4mA, 100 = 20mA
Dec : 0 = 4mA, -100 = 20mA

Example: if 4 – 20 mA = 800 mV - 1200 mV
Offset = 800 (starting point)
Range = 400

The **Return** button will return the user to the menu screen.

Alarm Polarity



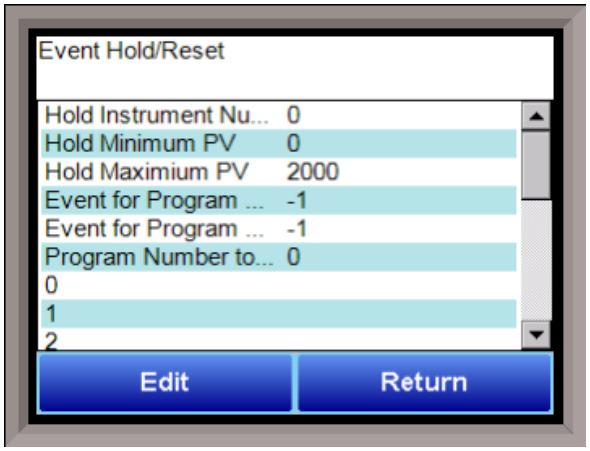
This option allows the user to switch the polarity of the alarm output from Normally Open (active when the output is energized) or Normally Closed (active when the output is not energized).

The alarms to configure are: **Programmer Alarm 1-7**. The options for each alarm are: **Normally Open** or **Normally Closed**.

The **Return** button will return the user to the menu screen.

Event Hold/Reset

The Event Hold/Reset menu option provides the user manual control of actual event outputs. This is useful when testing wiring and field devices.



Hold Instrument Number

Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **25**. This input event will place the recipe into a Hold.

Hold Minimum PV

Clicking on this value will display an input box from which the user can select a new value. The range is **-32768** to **32767**. This is the minimum temperature or vacuum necessary for the Hold Instrument Number feature to place the recipe into a Hold. If the actual value is greater than the entered value, it will allow it to be put into a hold.

Hold Maximum PV

Clicking on this value will display an input box from which the user can select a new value. The range is **-32768** to **32767**. This is the maximum temperature or vacuum necessary for the Hold Instrument Number feature to place the recipe into a Hold. If the actual value is less than the entered value, it will allow it to be put into a hold.

Event for Program Run

Clicking on this value will display an input box from which the user can select a new value. The range is **–1** (Disable) to **15**. This event input will start the recipe defined in the "Program Number to Run".

Event for Program Reset

Clicking on this value will display an input box from which the user can select a new value. The range is **–1** (Disable) to **15**. This event input will reset the recipe that is currently running if the Recipe Hold Output is configured and active.

Program Number to Run

This is the recipe number to run. The range is: **0** – **300**. This is the recipe number that will run when the Input Event, as specified in the "Event for Program Run", turns on.

Event 0 Through Event 15

An event is an input or output variable. The input box for these events has two drop-down lists. The top list contains **active** and **inactive**, and the bottom list contains **closed** and **open.** When this setting is "active", the controller will monitor for that event; when it is "inactive", the controller will not monitor for that event. When this setting is set to Closed, that means the recipe will be held when the event is closed (on). When this setting is set to Open, that means the recipe will held when the event is open (off). This makes for the following combinations:

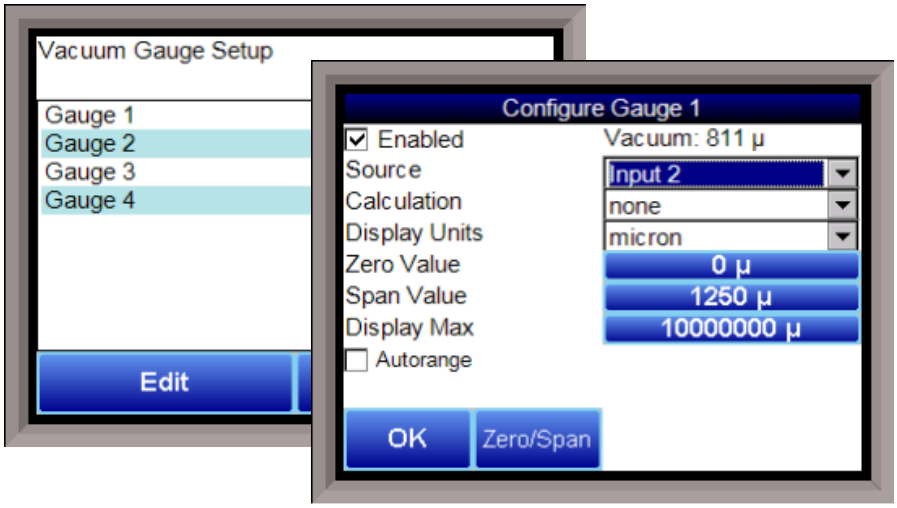
- Active Closed: Event is monitored by controller; recipe is held when event is happening.
- Active Open: Event is monitored by controller; recipe is held when event is not happening.

- Inactive: The event is not monitored by controller (Closed and Open have no bearing on an Inactive setting).

The **Return** button will return the user to the menu screen.

Vacuum Gauge Setup

The Vacuum Gauge Setup menu option will allow the user to set up any vacuum gauges connected to the 9220 controller. The user can setup **Vacuum Gauge 1** – **Vacuum Gauge 4** by selecting the appropriate gauge and pressing **Edit**.



Gauge Enable:
This option will allow the operator to enable or disable the selected gauge. Checking the box will enable the gauge.

Vacuum Source:
This option will allow the user to select how the vacuum source will be read by the 9220. The options are:
Inputs 1-3: Analog inputs to the 9220.
Televac Gauge 1-5, 6-9: Televac vacuum controller. Communications will need to be established between the 9220 and the Televac Controller.
Aux Analog Inputs 1-24: These are from an auxiliary analog input board, such as an SSi SR unit. Communications will need to be established.

Calculation Type:
This option sets the calculation type for the vacuum gauge which will control how the 9220 interprets the signal from the vacuum gauge. Most standard vacuum gauges are included in the drop down menu. However, if the gauge you are using is not included, the drop down menu includes the option of using a custom curve. See the section on Custom Curves for more details on how to use this feature.

Display Units
These are the units of the vacuum gauge. It will change the display units on the Default Status display.

Zero Value

This is the initial value at which the vacuum measurement begins.

Span Value
This is the range.

Display Maximum:
This option will allow the user to set the maximum value for display purposes. The range is: **-10.00** to **10.00** with an exponent range of **–31** to **31**.

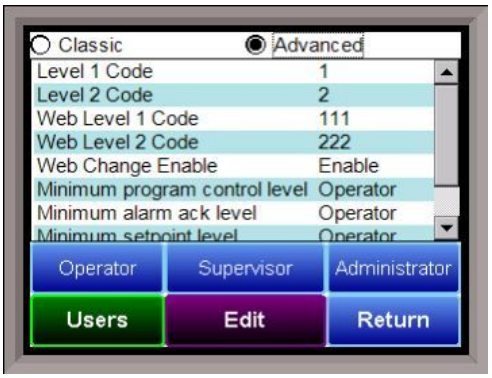
Zero Scale Value:
This option will allow the user to set the zero scale value for the vacuum gauge. The range is: **-10.00** to **10.00** with an exponent range of **–31** to **31**. This value can typically be found in the documentation for the vacuum gauge or controller.

Span Value:
This option will allow the user to set the span value for the vacuum gauge. The range is: **-10.00** to **10.00** with an exponent range of **–31** to **31**. This value can typically be found in the documentation for the vacuum gauge or controller.

Zero/Span
This allows the operator to do a zero and span scaling if there is not a provided calculation or if there is a reason the operator would like to make a more specific scale. The displayed values are dependent on the gauge (Microns, Torr, or Torr/sn). The user can then enter in the Low Vacuum and High Vacuum points as measured by a calibrated vacuum gauge. Afterwards, the user can then enter a voltage (DC) value that correlates to the Low Vacuum reading and a voltage value that correlates to the High Vacuum reading.

Security

This screen will allow the user to set up the security protocols for the system, as well as set up users for the system. *Note – The "Classic" view will hide the **Users** button and only the Level 1 and Level 2 code will be accepted*. By default, the security protocols for the screen are set up as Classic. There are three levels of menus in the 9220 controller - Operator, Supervisor, and Administrator.



Operator Level
These are functions typically handled by a furnace operator and do not require a passcode.

Supervisor Level
These are functions typically used by a supervisor and require a level 1 passcode. The user name for the Level 1 code for Touchscreen is "Supervisor". The "Level 1 Code" range and the "Web Level 1 Code" range is **-32768** – **32767**.

Administrator
These are functions typically used by an administrator and require a level 2 passcode. The user name for the Level 2 code for Touchscreen is "Administrator". The "Level 2 Code" range and the "Web Level 2 Code" range is **-32768** – **32767**.

Minimum Program Control Level

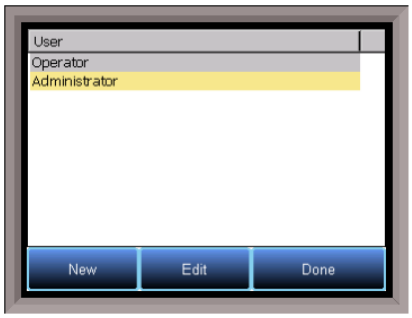
This option will allow the user to determine which security level will be the minimum level for program (recipe) control. The options are: **Operator**, **Supervisor**, or **Administrator**.
Example: If **Supervisor** is selected, then only a supervisor-level or higher can control the program.

Minimum Alarm Acknowledge Level
This option will allow the user to determine which security level will be the minimum level for alarm acknowledgement. The options are: **Operator**, **Supervisor**, or **Administrator**.
Example: If **Supervisor** is selected, then only a supervisor-level or higher can acknowledge an alarm.

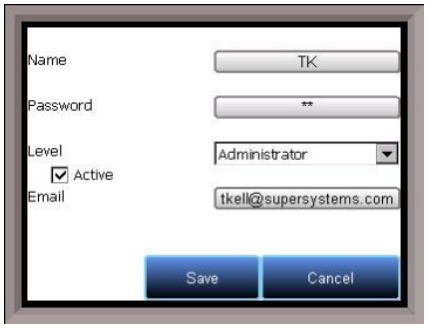
Minimum Setpoint Level
This option will allow the user to determine which security level will be the minimum level for sending a setpoint down. The options are: **Operator**, **Supervisor**, or **Administrator**.
Example: If **Supervisor** is selected, then only a supervisor-level or higher can send a setpoint.

Minimum COF/HF Level
This option will allow the user to determine which security level will be the minimum level for modifying the Carbon Factor or the Hydrogen Factor. The options are: **Operator**, **Supervisor**, or **Administrator**.
Example: If **Supervisor** is selected, then only a supervisor-level or higher can modifying CO Factor or H Factor.

Clicking on the **Operator** button will allow the user to modify which menu options the operator-level users will have access to.
Clicking on the **Supervisor** button will allow the user to modify which menu options the supervisor-level users will have access to.
Clicking on the **Administrator** button will allow the user to modify which menu options the administrator-level users will have access to.



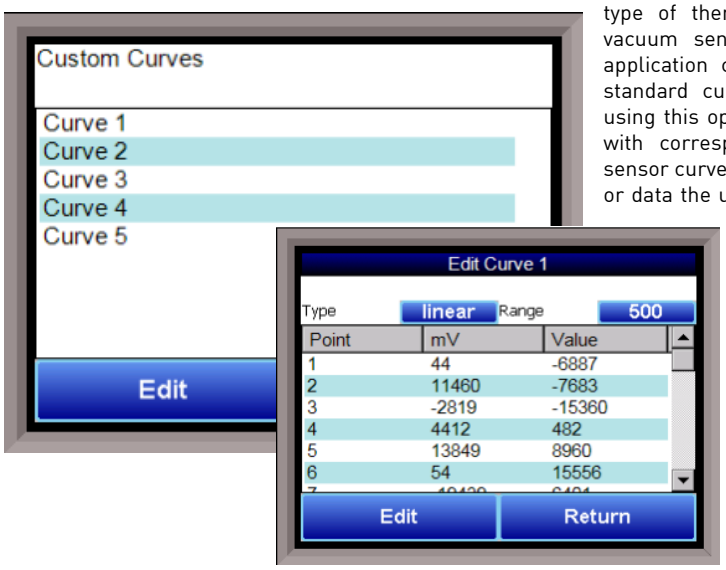
If the "Advanced" option is selected, then clicking on the **Users** button will allow the user to create or modify user information for the Touchscreen. *Note – Once the "Advanced" option is selected, a user name will need to be entered when logging into the menu system. A user name will need to be provided even if the Level 1 or Level 2 code is being used.*
The **New** button will allow the user to create a new user for the Touchscreen. A name, password, security level, and email address can be entered. *Note – The password and email address field can be left blank, if desired.* The "Active" checkbox will keep that user active. An inactive user cannot log into the Touchscreen.
The **Edit** button will allow the user to edit the information for a specific user.
The **Done** button will return the user to the *Security* menu screen.



The **Return** button will return the user to the menu screen.

Curve Entry

Most types of inputs that are used in SSi controllers are already setup with a curve built for most every type of thermocouple available, certain vacuum sensors, etc. However, if an application calls for an input without a standard curve, the curve can be built using this option. Voltages can be paired with corresponding values to create a sensor curve based on a provided equation or data the user manual or technical data for the sensor. This allows the controller to make appropriate readings from the sensor.



The first screen shows that five separate curves can be edited. Selecting one of **Curve 1-5** and pressing **Edit** will display the screen where new curves can be assigned. The type can be toggled between **Linear** and **None.**

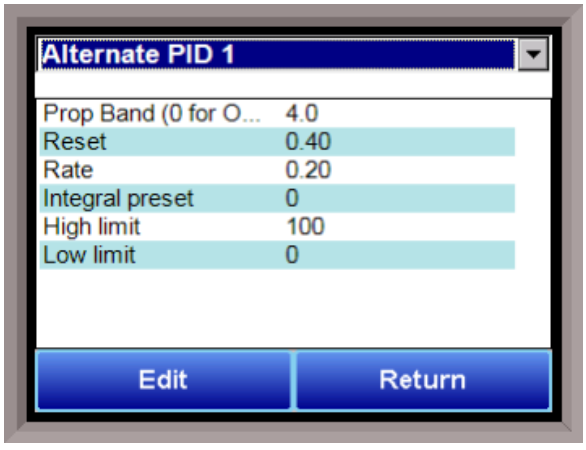
The Range value sets up the range of the curve.

Thirty-two points can be assigned by selecting one of the points and pressing **Edit.** However, not all 32 points have to be used. For points that are not used, they can be left at their default values. This allows the operator to change the **Millivolts** and the corresponding **Value** by clicking on each option. Pressing **OK** will save the point.

The **Return** button will return the user to the menu screen.

Alternate PID Setup

The Alternate PID Setup menu option allows for up to 16 sets of PID values to be used on the first loop via the programmer. Alternate PID's are used and loaded via the Recipe Op-Code PIDLOAD. Loop 1, Set 1-3, etc., are used if the PID Auto Switching is enabled in the PID Loop Setup for that particular loop. There is a choice of PID 1 – 16, and Loop 1-3 Set 1-3.



NOTE: The feature of PID Auto Switch is disabled for the entire duration of a recipe when the opcode PIDLOAD is executed. See the PID Loop Setup section for more information.

Prop Band (0 for On/Off)
This is the proportional band for the PID setup. P = Proportional (Prop Band). This is a field in which you want to stay around the setpoint. The range of values is **–32768.0** to **32767.0**.

Reset
This is the reset value. I = Integral (Reset). This is the actual temperature being monitored over a period of time and then averaged to keep within the Proportional band. The reset is in repeats per minute. This affects the output of the controller. It will be proportional to the amount of time the error is present. This helps to eliminate offset. The range is -**32768.00** to **32767.00**.

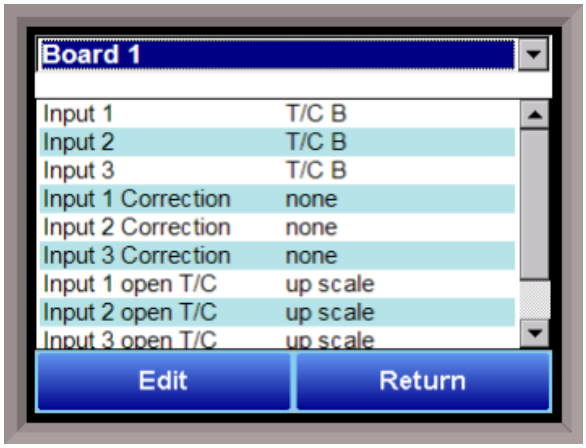
Rate
This is the rate value. D = Derivative (Rate). This is the sudden change or rate in the temperature. This rate is in minutes. This affects the controller output which is proportional to the rate of change of the measurement and will control the amount of output by time restraints. Thus derivative takes action to inhibit more rapid changes of the measurement than proportional action. Derivative is often used to avoid overshoot. The range is -**32768.00** to **32767.00**.

Integral Preset
This is the integral preset value. This field provides an offset for the starting point for PID control, also referred to as "Load Line" or "Manual Reset". The range is **–32768** to **32767**. Typical preset is 0.

High Limit
This is the high limit value. The range is **–32768** to **32767**. A typical value is 100, representing 100% output.

Low Limit
This is the low limit value. The range is **–32768** to **32767**. A typical value is 0, representing 0% output.

Aux Analog Input Setup



The Auxiliary Analog Input Setup menu option allows the user an input selection of three inputs per board, three input corrections per board, and three input open T/Cs per board. This is commonly called an SR Brick. There are eight (8) boards available. It is configurable for voltage of T/C (universal input), and it is typically used for Load T/Cs, Auxiliary Flow Meters, Auxiliary Vacuum Gauges, etc.

Input 1 – **Input 3**
This will select the input types for the board. The options are:

B	**NNM**	**160 mV**	**25 Volt**
C	**R**	**80 mV**	**12.5 Volt**
E	**S**	**40 mV**	
J	**T**	**20 mV**	
K	**2.5 volts**	**4-20 mA/124Ω**	
N	**1.25 volts**	**4-20 mA/62Ω**	

Input 1 Correction – **Input 3 Correction**
This option will set a correction curve for the input. The options for the input corrections are: **not used**, **Curve 1** – **Curve 7**.

Input 1 Open T/C – **Input 3 Open T/C**
This option will allow the user to set the direction of the open T/C for each input. The options are: **Up Scale** or **Down Scale**.

Calibration
The user will need a calibrator capable of outputting a temperature, voltage, and millivolt signal to calibrate the zero, span or cold junction value. The user will need to connect the calibrator to one of the inputs on the data logger for the channel that will be calibrated. It is recommended to let everything (calibrator and data logger) sit for approximately thirty minutes to allow the temperature to achieve equilibrium. Set up the calibrator for the specific thermocouple type, i.e. type K, type J, etc. Then, source a specific temperature, like 1000°F, or millivolt to the connected input. It is recommended that the actual temperature used be similar to an appropriate process temperature. For example, if your equipment normally operates at 1700°F, then perform the cold junction calibration using a 1700 °F signal. It is important to note that when performing a zero or span calibration, *do not use* regular thermocouple wiring. Instead, use any kind of regular sensor wire, or even regular copper wire. To perform the calibrations, the user will need a calibrator that is capable of outputting volts, millivolts, and temperature.

The "Zero/Span" tab will allow the user to perform a zero and span calibration on the selected board.

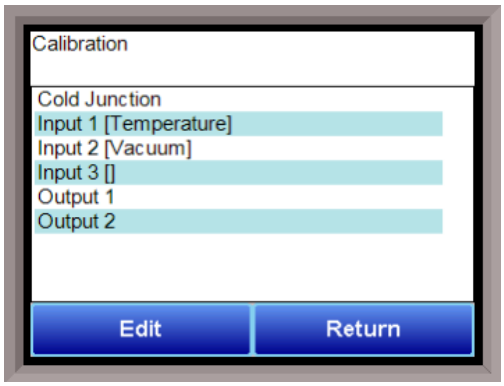
The help button -  - next to the "Range" drop-down list will allow the user to select a range based upon an input type if the range is not known.

Select the input type and click on the **OK** button. The correct millivolt range will be displayed in the drop-down list. Click on the **Cancel** button to cancel this action.

Below is a listing of the suggested ranges for the various TC types.

TC Type mV Range Chart

TC Type	Range in mV
B	17.5
C	65
E	65
J	65
K	65
N	65
NNM	65
R	65



Cold Junction Calibration

NOTE: Perform zero and span calibrations (see previous section) before following this procedure.

The "Cold Junction" option will allow the user to perform a cold junction trim on the 9220 analog input board. To determine if a cold junction adjustment is needed, hook up the calibrator with the appropriate T/C wire attached (reference the specific input under the "Analog Input Setup" menu), then source a temperature to the input. It is best to use an operating temperature to source; for example, if the furnace typically runs at 1700 °F, then 1700 °F should be sourced to the input. Source a range of temperatures – this will help determine whether any difference in readings is linear.

NOTE: This value is NOT the temperature displayed on the "Cold Junction Calibration" menu option – rather, this is the value displayed on the main screen above set point and output.

If the displayed value does not equal the value being sourced, then a Cold Junction Calibration may be necessary. To begin, note the difference between the displayed temperature and the sourced temperature. This is the adjustment that will be made in the "Cold Junction" menu. For example:

Source Temp	Displayed Temp	Difference	Cold Junction Adjustment	Current Temp of Terminals	New Temp of Terminals
1700	1711	11 High	-11	72	61

In this situation, the displayed temperature on the main screen is 11° higher than the sourced input. Therefore, 11° must be subtracted from the current "temperature of terminals" reading. Tap the blue box below "Enter temperature of terminals" and enter the appropriate value (in this case, 61).

Click on the "Calibrate" button to begin the calibration.

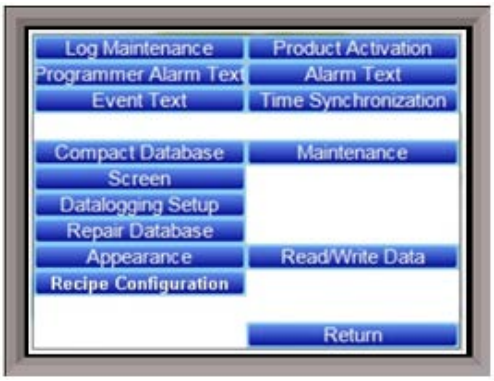
After 30 minutes, verify the calibration by again sourcing a temperature to the input and checking the displayed temperature reading on the main display. It is recommended to perform this calibration check after every cold junction calibration.

Click on the **Return** button to close down the screen.

Inputs 1, 2, 3
To perform an input calibration, select the appropriate input button and press **Edit.** The long blue bar that extends the width of the screen displays the current mV being read. Select **Zero** and input 0 mV with a calibrated mV input source on the appropriate analog input. Press the Calibrate button to begin. To calibrate the Span, press the Span button. The screen will display a desired mV input value based on the Analog Input setup. Source in the millivolt signal as designated on the screen, and allow the sourced signal to settle (reach minimum variation) for a few minutes. Once the signal has settled, press the Calibrate button.

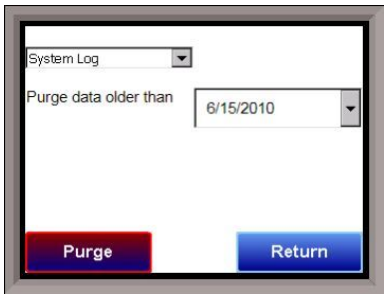
Outputs 1, 2
To calibrate the zero/span range for an output, you must first attach your measuring device, then select prep for Zero. Let the unit output what it has set for the zero measurement, then enter what is being measured coming out of the terminals. Once entered, press **Ready.** Once the controller is ready, press **Calibrate.** To calibrate the span, press the Prep for Span button. The controller will output a signal that will be read by the calibrated measurement device. Once the output has settled, enter the measured value into the numeric entry box and press the Calibrate button.

Configuration
This option will allow the user to set some general configuration settings.
The list of configurable items is:



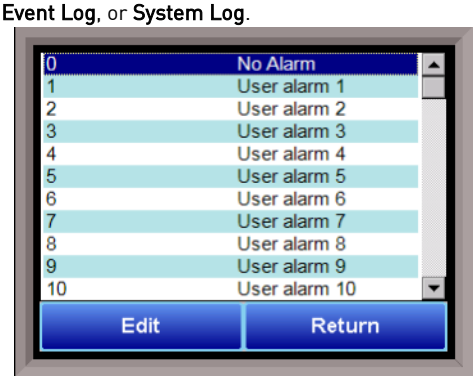
- **Log Maintenance**
- **Programmer Alarm Text**
- **Event Text**
- **Compact Database**
- **Screen**
- **Datalogging Setup**
- **Recipe Configuration**
- **Product Activation**
- **Alarm Text**
- **Read/Write Data**
- **Repair Database**
- **Maintenance**
- **Time Synchronization**
- **Appearance**

After configuration changes are made, a shutdown of the 9220 interface is recommended to store or save the settings and changes made.



Programmer Alarm Text

Log Maintenance
This option will allow the user to purge, or delete, log files, starting from a specific date. All log files from on or before the selected date will be purged. The user can purge log files from the **Alarm Log**, **Event Log**, or **System Log**.



This option will allow the user to modify the text for **Programmer Alarm 1** – **Programmer Alarm 99**. Programmer alarms are internal, non-modifiable alarms that are triggered when a recipe that is running uses the Op-Code Alarm. Each alarm is initially labeled by the text "User Alarm #." However, these labels can be changed to the furnace's setup. To change the text displayed for an alarm, open the Configurator program, open the Settings, and select the controller to edit. Under Alarm Text, double click any alarm number, enter the new text to be displayed, and hit Ok. User Alarm 0 is not an alarm; it is used to turn off a user alarm. It functions the same way as the acknowledge button.

Event Text

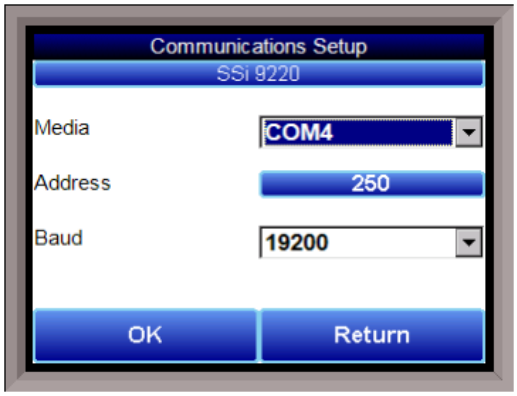
This menu option will allow the user to configure the text for the input and output events for the 9220. Select whether to edit the Input events or the Output Events. *Note – The list of events can take a few seconds to load*. The screen will refresh after the list has been loaded. There are a total of 31 input events, and 47 output events. Highlight the event to be changed and click on the **Edit** button. This action will display the on-screen keyboard, which will allow the user to modify the event text. To save the changes to the event text, click on the **Save** button. Clicking on the **Return** button will not save any of the changes made. *Note: Clicking on the **Save** button will not close the Edit Event Text screen*.

Compact Database

Compacting the database will free up extra space, which will speed up the amount of time it takes the software to communicate with the database.

Screen Communications

This menu option will allow the user to determine how the Touchscreen will communicate with the 9220 instrument.



The Media option will be the type of connection the Touchscreen is using to connect to the 9220. The options are:

- **COM1**
- **COM2**
- **COM3**
- **COM4**
- **Ethernet**

If COM1 through COM4 is selected, the user will have to set the Address and the Baud rate as well. If Ethernet is selected, then user will have to enter the IP address of the 9220 instrument.

The Address option is the slave address of the 9220 instrument for the COM port communications, or the Ethernet IP address for Ethernet communications. For the COM port communications, the address will range from **1** to **250**. For Ethernet communications, the address must be supplied in a 999.999.999.999 format, or it will not be accepted.

The Baud option is the baud rate for the COM port communications. The options are:

- **1200**
- **2400**
- **4800**
- **9600**
- **14400**
- **19200**
- **28800**
- **38400**
- **57600**
- **76800**
- **115200**

The button with the number in the bottom left corner of the screen is the timeout time, in milliseconds, of the communications inter-message timeout.

Datalogging Setup

Note – Contact Super Systems before making any changes on this screen, since any changes made can have an adverse effect on the data being displayed.

This menu option will allow the user to modify which registers in the 9220 that the touch screen will datalog. This list of data values is shown at the top of the screen.

Click on the **Add** button to add a new set of data values, or click on the **Edit** button to edit an existing set of data values. Click on the **Delete** button to delete a set of values. To add or edit data values, enter the initial offset of the register, as well as the number of sequential registers to read for. Clicking on the **Save** button will save the new data value registers. *Note – The **Save** button must be clicked on to save any changes to the datalog data, including resetting the*

configuration. Clicking on the **Cancel** button will cancel the action. Clicking on the **Reset** button will reset the values to the original configuration. *Note: Any changes made to the data values will need a restart of the application before those changes will take effect*.

Descriptions can be added only once the new registers are added and saved and the 9220 interface has been shut down and restarted. Clicking on the **Descriptions** button will display any descriptions for the data values. The default description for a data value is the data value's register. So the default description for data value 102 is "102". Changing this to "Temperature", for example, would make it more descriptive. Register 102 holds the actual temperature value for the 9220. Contact Super Systems for a complete list of 9220 Register Maps.

To add a new description, click on the **Add** button. To insert a new description, click on the **Insert** button. To delete a description, click on the **Delete** button. To edit an existing description, click on the **Edit** button. The Add or Insert feature will only create valid descriptions if there are existing data values without descriptions. Click on the **OK** button to save the description changes. Click on the **Return** button to cancel any changes and return to the previous screen.

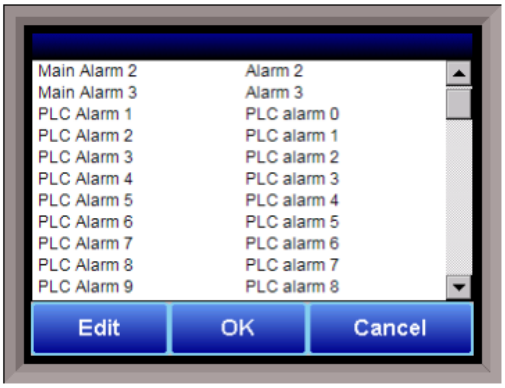
Recipe Configuration

By default, recipes are created and stored by a recipe number. The recipe configuration allows a name to be associated with the recipe number. New recipes are still created by recipe number, and must have a name associated with them if the user chooses the option "Recipes on device access by name". Using this screen, operators can give names to recipes for easy access. The operator must first choose "Recipes on device access by name" from the drop down menu. Next, select the **Maintain Recipes** button. This screen will allow the operator to Edit and name recipes. Recipes can then be found by name under Recipe Edit.

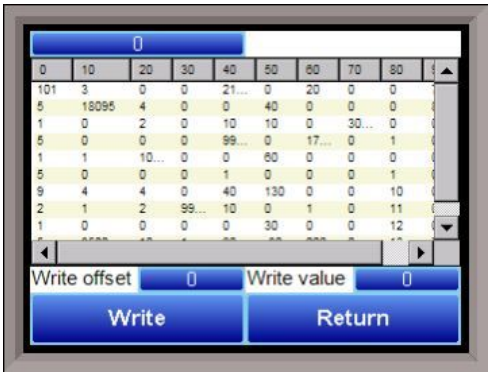
The **Compact Database** button will compact the mb.sdf database file that is located on the Touchscreen. When records are added, space is reserved in the database table for the maximum amount of characters, regardless of the actual number of characters in the record. Once the record is added, this space is not released. Instead, it will still be associated with the record, thereby adding to the total disk space and slowing down the communication time with the database. Compacting the database will free up this extra space, which will speed up the amount of time it takes the software to communicate with the database.

Alarm Text

This menu option will allow the user to configure the text for the alarms on the 9220. Main Alarm 1 through Main Alarm 3 are the 3 internal alarms set up in the Alarm Setup menu. The PLC Alarms are alarms used by the PLC. If communications are present between the PLC and the 9220, these alarms can be given text to match the alarms set up in the PLC. Highlight the alarm to be changed and click on the **Edit** button. This action will display the on-screen keyboard, which will allow the user to modify the alarm text. To save the changes to the alarm text, click on the **OK** button. Clicking on the **Cancel** button will not save any of the changes made.



Read/Write Data



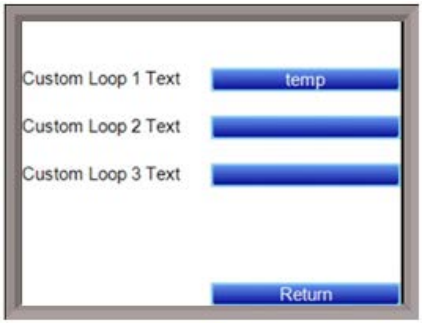
This menu option is protected by a special passcode. Contact SSi at . to obtain this passcode before making any changes.

This menu option is used mainly for technical support reasons. It will read the registers from the 9220 and display those registers on the screen. The user will be able to read from and write to the 9220's registers. When the screen is first displayed, it will read the first 100 registers from the 9220 and display them in a column format. The top of the list will show "0", "10", "20", etc. These are the column headers. Each value in the column will be a logical increment of the header, where the first value in the column equals the header value. For instance, column "0" will start with register 0, which in the picture has a value of "101". The next value down is register 1, which has a value of "5". The next value down is register 2, which has a value of "1", etc. So, column "40", 4 values down is register is register 43, which has a value of "9999".

The number box in the top left of the screen is the beginning register to read from. This will default to 0 when the screen starts. To read registers 100 – 199, edit the value to read "100". *Note – changing the value will automatically begin the read process. This process could take a few seconds to complete*.

The "Write offset" value will allow the user to write a specific value listed in the "Write value" box to the register listed in the "Write offset" box. Click on the **Write** button to write the value to the register. Click on the **Return** button to return to the *Configuration* menu. *Writing to the register should ONLY be done with the assistance and recommendation of SSi.*

Appearance



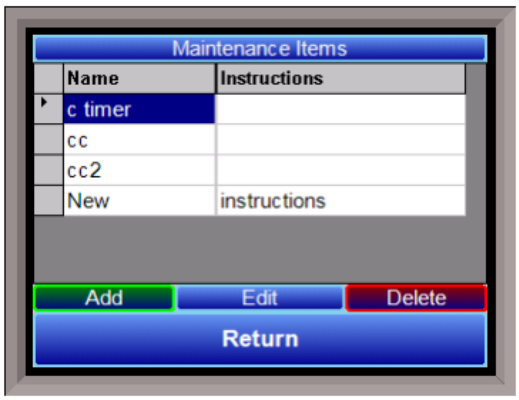
This menu option will allow the user to set custom text for the control loops. The 9220 has only 1 control loop, but will allow you to place text for all 3 analog inputs. To set custom text, select the blue box by the desired loop text you wish to modify. Enter the desired text and press enter.

Time Synchronization

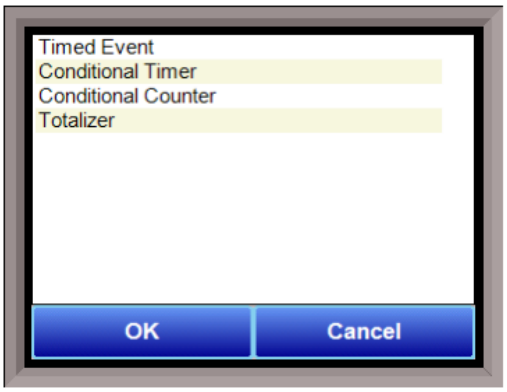
The Time Synchronization menu allows the user to synchronize the time with the 9220 interface with a server setup on the network. This allows the interface's data to match the time of the data collected on a network server. This also will keep the interface's time synchronized with the rest of the network. Ethernet communications will have to be setup with the 9220 interface to allow this option to work properly. To enable this option, the Enable checkbox will have to be selected.

In the Blue box that spans the width of the screen, the name of the server will have to be entered. Select the blue box and type in the name of the server.

Maintenance



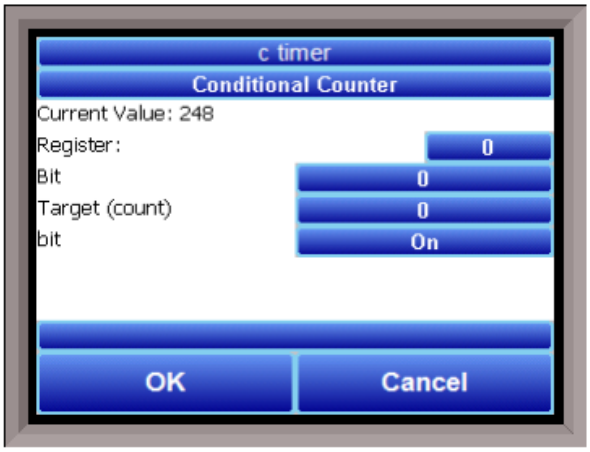
The Maintenance Items option allows the user to set up and edit maintenance events. The **Add** button will add a new maintenance item.
The type of event can be changed by tapping the second blue bar from the top. This will display the options of Timed Event, Conditional Timer, Conditional Counter, and Totalizer. Select the appropriate choice and press **OK** to add a new event. **Cancel** will return to the previous screen without adding a new event.



Timed Event
To set up a timed event, the user first selects the interval by tapping on the corresponding blue bar. The choices are Hourly, Daily, Weekly, Monthly, and Yearly. Once the interval is selected, the user then decides how often this interval will be checked.

Conditional Timer

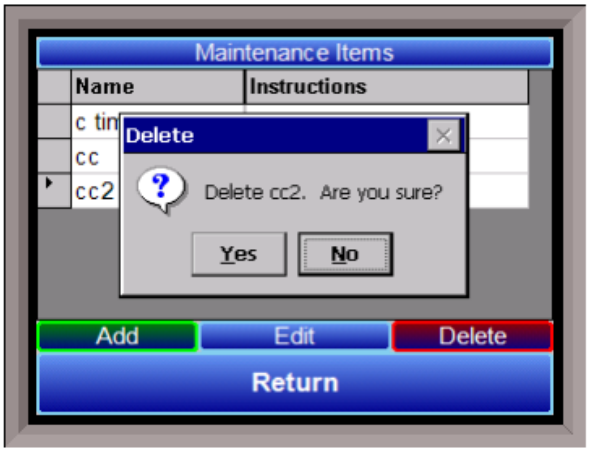
When setting up a conditional timer, the user assigns several parameters. All parameters are changed by tapping on the corresponding blue bar. First the user must assign the Register and/or the Bit. The Bit field does not have to be engaged; the conditional timer can check the entire register instead. The Target determines the amount of time the bit has been on or off until maintenance is needed.



The Conditional Counter counts how many times a bit changes its status. The user assigns the Register, Bit, and Target. Once the Target value is reached, the maintenance item is due. The last field, bit, determines whether the target is counting the bit turning on, the bit turning off, or the bit changing either way.

The Totalizer works by checking the assigned Register every minute. Each minute, the current value of the register is added to the total. Once the Target is reached, the item is due for maintenance.

To delete a maintenance item, simply highlight it, and press delete.



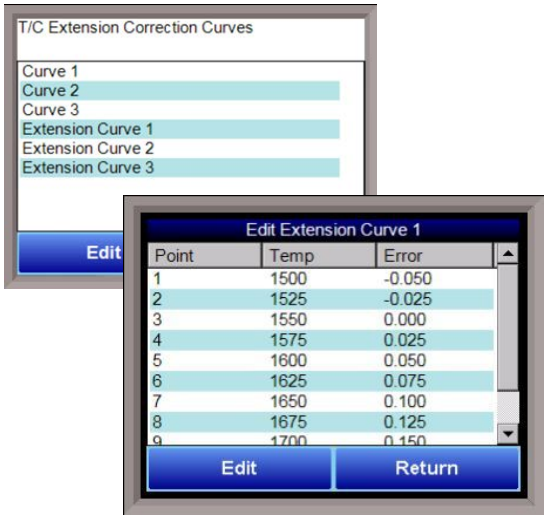
Repair Database

The Time Synchronization menu allows the user to synchronize the time with the 9220 interface with a server setup on the network. This allows the interface's data to match the time of the data collected on a network server. This also will keep the interface's time synchronized with the rest of the network. Ethernet communications will have to be setup with the 9220 interface to allow this option to work properly. To enable this option, the Enable checkbox will have to be selected.
In the Blue box that spans the width of the screen, the name of the server will have to be entered. Select the blue box and type in the name of the server.

Product Activation

The Time Synchronization menu allows the user to synchronize the time with the 9220 interface with a server setup on the network. This allows the interface's data to match the time of the data collected on a network server. This also will keep the interface's time synchronized with the rest of the network.

Ethernet communications will have to be setup with the 9220 interface to allow this option to work properly. To enable this option, the Enable checkbox will have to be selected.
In the Blue box that spans the width of the screen, the name of the server will have to be entered. Select the blue box and type in the name of the server.



T/C Correction Curves

This menu option will allow the user to set up to seven TC correction curves for the 9220 controller. Clicking on a curve will display the curve edit form. *Note: If the first "Temp" value and the first "Error" value are both zero, then the curve will not be set.*

The user can enter up to ten "Temp"/"Error" combinations. The range for the "Temperature" field is **–32768** to **32767**. The range for the "Error" field is **–32768.000** to **32767.000**.

NOTE: Curves are interpolated between points in order to provide a smooth transition between those points. For example:

Point	Temp	Error
1	100	0
2	300	2

In the above setup, temperatures would read as follows:

Actual Temperature	Displayed Temperature
100	100
150	150.5
200	201
250	251.5
300	302

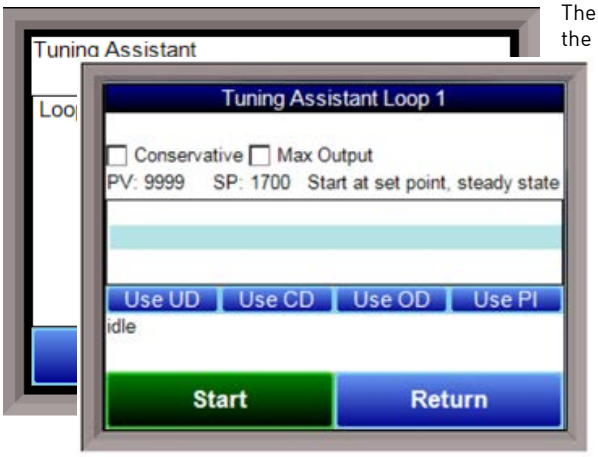
Aux Setpoint Configuration

See the menu option *Slave Instruments* for configuration prior to using *Aux Setpoint Configuration*. This menu option allows for up to 3 slave instruments to have the setpoint retransmitted from one of the

control loops. This menu option is typically used to retransmit an alarm setpoint value to an overtemp controller. The settings are:

Retrans to slave 1-3 (options are Loop 1, Loop 2 or Off)
Setpoint Offset SI 1-3 (range is from -32768-30000)
Setpoint Delay SI 1-3 (range is from -32768-30000)

Tuning Assistant



The Tuning Assistant menu option will allow the user to automatically generate the PID loop settings for Loop 1 in the 9220 controller. Select Loop 1 and click on the **Edit** button to auto tune that loop.

Note: The four buttons at the bottom of the screen: ***Use UD (Under Damped)***, ***Use CD (Critically Damped)***, ***Use OD (Over Damped)***, *and* ***Use PI*** *will be inaccessible until some PID settings are loaded into the PID settings list above the buttons*. The **Return** button in the bottom right of the screen will display the previous screen.

The "Conservative" option will allow the user to minimize, if not remove, the possibility for an overshoot of the setpoint. If a small overshoot is acceptable, leave the "Conservative" checkbox unchecked. If, however, no overshoot is desired, then checking the "Conservative" checkbox will accomplish this.

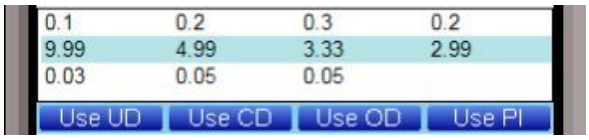
The "Max Output" checkbox allows you to set a maximum output percentage; this feature is useful when output may need to be limited due to physical characteristics of the furnace.

The current PV value, along with the setpoint, is listed above the PID settings list.

Pressing the **Start** button will begin the auto tune process. *Note: The process may take a few seconds to start*. The "Idle" line will change to display the process for the auto tune. The line will display a pointer value.

Note: The ***Start*** *button will be disabled while the tuning is running*. Pressing the **Abort** button will abort the process. If the **Cancel** button is pressed while a tuning is running, a message box will be displayed confirming the action.

When the tuning is finished, the PID settings list will be populated with suggested values and the four buttons underneath will be enabled. The line above the PID settings list will read "Idle" again as well.

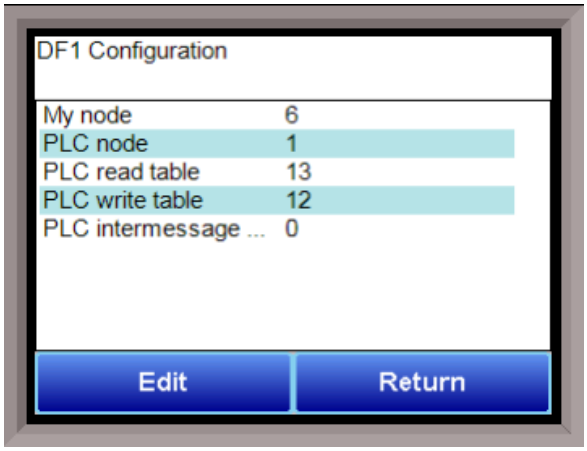


The user has the option to select only one of these sets of values: either the Under Damped set, the Critically Damped set, the Over Damped set, or the PI set. To select the set of values, press the

corresponding button. For example, to select the Critically Damped set of values, press the **Use CD** button.
The under damped values will reach the setpoint faster, but there will be more overshoot involved.
The over damped values will work to minimize the overshoot, but it will be slower than the under damped values.
The critically damped provide a balance between the underdamped and overdamped values with regard to time and overshoot.
The PI values are the proportional band and the reset value (the *P* and the *I* from *PID*).
Once a set of values has been accepted, the user can press the **Return** button to exit the screen. The accepted values can be viewed on the *PID Loop Setup* menu option. In future tuning sessions, the most recent tuning parameters will be retained and adjusted PID sets will be offered.

DF1 Configuration

This option allows the information data from the 9220 to be sent to the PLC DF1 Register map.



My Node:
This option will allow the user to select the node. This node must not exist anywhere else on the computer's network. The range is **0** to **30000**.

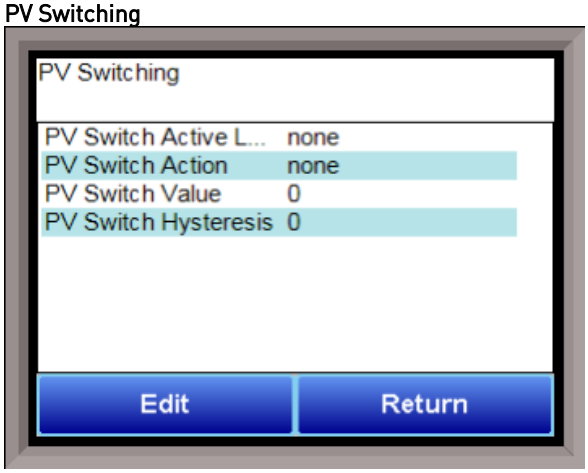
PLC node:
This option will allow the user to select the PLC node. This must be the node address of a PLC. The range is **0** to **30000**.

PLC read table:
This option will allow the user to select the PLC read table. The range is **8** to **255**.

PLC write table:
This option will allow the user to select the PLC write table. The range is **8** to **255**.

PLC Intermessage Delay
This option will allow the user to set the PLC Intermessage Delay in ms. The range is 0 to 30000.

PV Switching



PV Switching allows the 9220 to use two (2) analog inputs as a process variable source, if necessary. It can be customized in any combination of high or low signals for loops 1 or 2. The 9220 controller normally only uses loop 1 for temperature control, so PID loop 2 must be modified so that it has a control source. In order for the PV signal to be switched, *both* PV signals must be above or below the switch point and must satisfy any applicable hysteresis.

PV Switch Active Loop

This field is not modifiable. It will display the current active loop (**Loop 1** – **Loop 2**).

PV Switch Action

This switches the active control loop based on the current PV, PV Switch Value, and PV Switch Hysteresis. For an example, assume the PV Switch Action is **Loop 1 low, Loop 2 high**. Now assume that the PV Switch Value is 1400 and the PV Switch Hysteresis is 50. In this situation, Loop 1 will be used as the control loop until both Loop 1 and Loop 2 PVs are higher than 1400, at which point it will switch to Loop 2 for the control loop. The control loop will continue to be Loop 2 until both PVs fall below 1350 (Switch Value – Hysteresis), at which point control will switch to Loop 1.

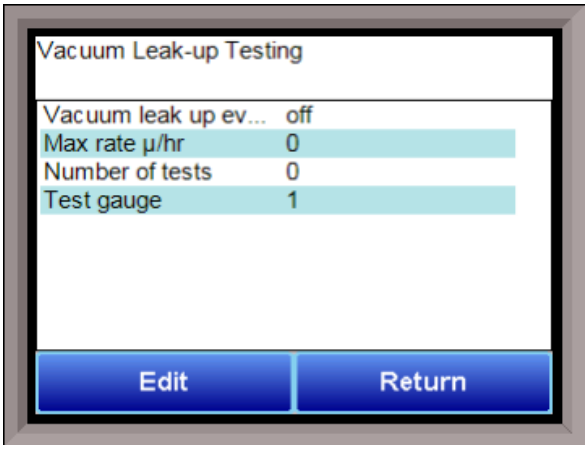
PV Switch Value

This is the switch value. This is the value that will determine when the switch happens. The range is **-300** – **30000**.

PV Switch Hysteresis

This is the hysteresis for the switch. This will help prevent the 9220 from potentially switching back and forth between the two signals. The range is **0** – **30000**.

Vacuum Leak-Up Testing



A vacuum leak-up test will determine if the furnace is leaking at an acceptable low rate, as determined by the operator. NOTE: The **Vacuum Leak-Up Testing** menu allows the user to configure test parameters. However, to perform the actual test, a recipe that uses the **VLUP_chk** opcode must be created and run.

Vacuum leak up event
The event number of the vacuum leak-up test can be assigned in Configurator and entered here. This number will be used in recipes to perform the leak-up test. 0 will disable. Press **Edit** to enter the number.

Max rate µ/hr
This is the maximum tolerable leakage rate of the furnace. A recipe using the **VLUP_chk** opcode will use this number to determine if the test has passed or failed.
Press **Edit** to change the number.

Number of tests
This determines the number of times the controller will perform a vacuum leak-up test before the furnace is considered to have failed. Press **Edit** to change.

Test gauge
This is the vacuum gauge being tested. Press **Edit** to change.

A/I Module Offset Correction

This menu will allow a user to assign offset corrections to analog inputs from load TCs. The menu items are:

Enable offsets for Aux AIB (Options are **Yes** and **No**)
Input 1-40 (can be set in 10ths of a degree)
Input 1-40 Correction (Options are **Not Used** and **Curves 1-3**)

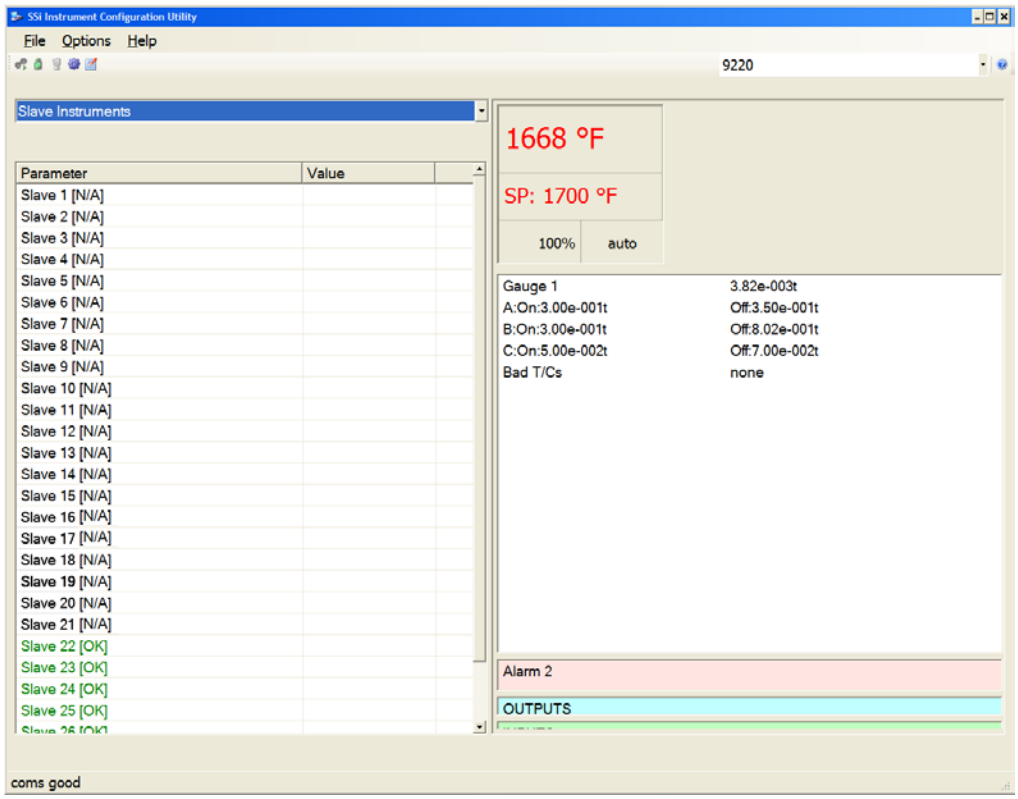
Chapter 3 – CONFIGURATOR MENU

The following section will detail the menus that are found with the Configurator 2.0 software for the 9220 controller.

Slave Instruments

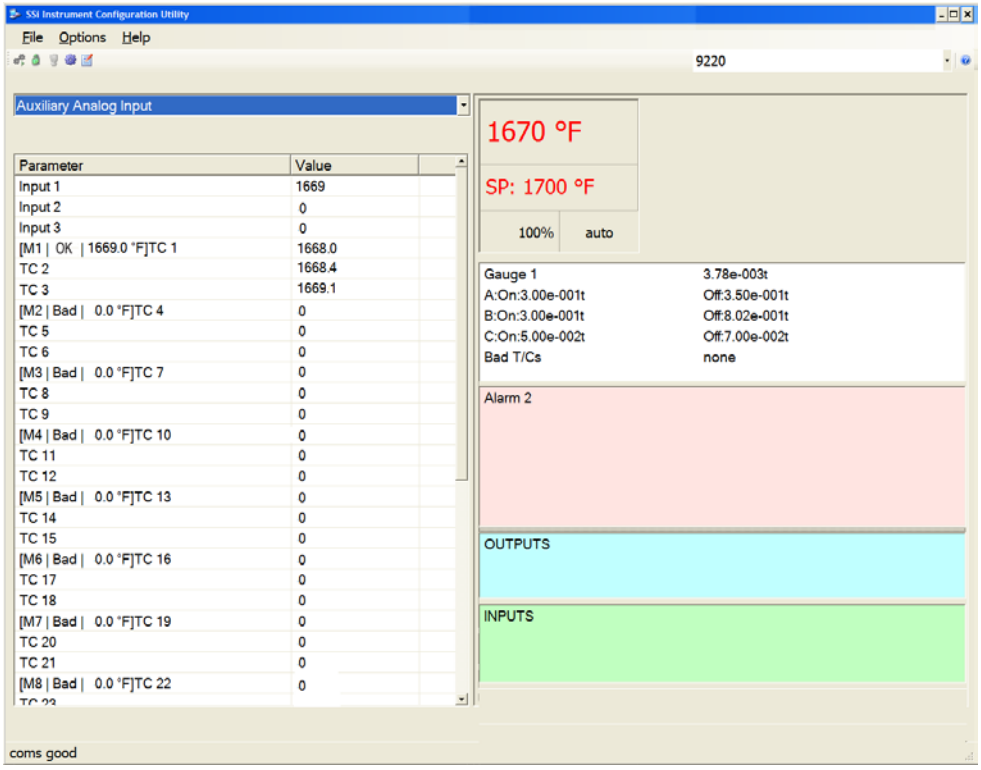
This page is a display of the current process variables of each of the slave instruments communicating with the 9220 vacuum controller. *Note – None of these values can be modified on this screen*.

For set-up of the auxiliary instruments go to the menu item "*Slave Instrument Setup*"

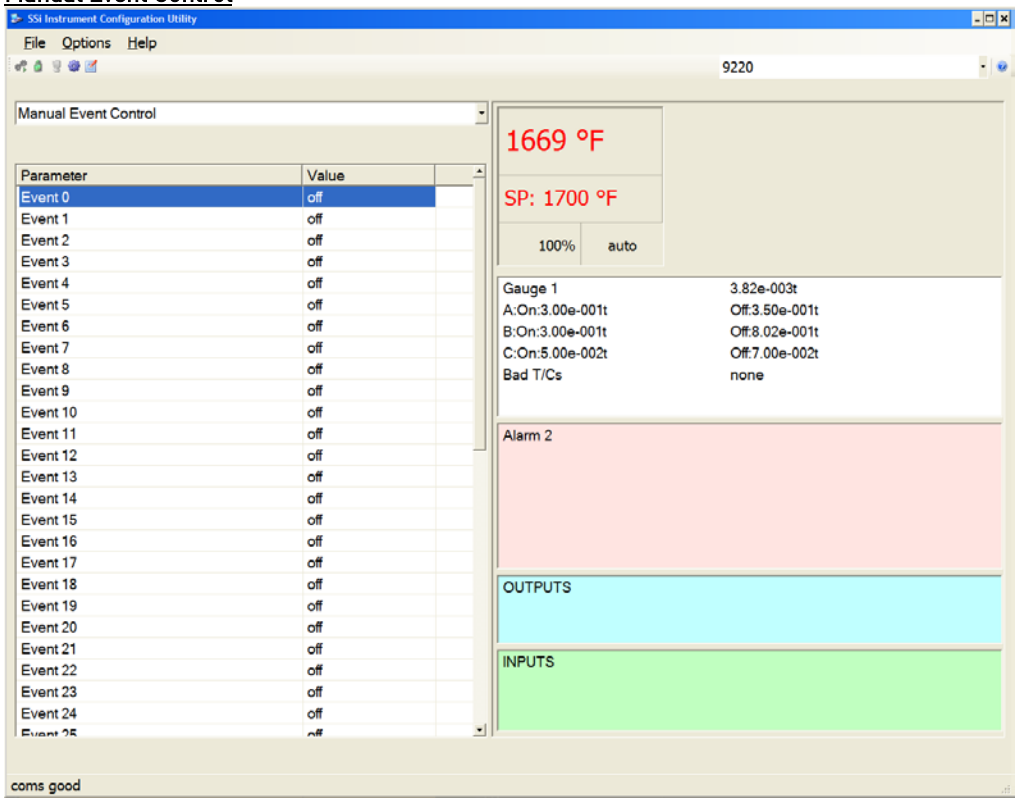


Auxiliary Analog Input

This menu option shows the process variables for the 3 analog inputs of the 9220 vacuum controller. It also shows the input types and any information from attached slave analog input modules. *Note: None of these values can be modified on this screen*. For setup of Auxiliary Analog Input, select Analog Input Setup in the drop-down menu.

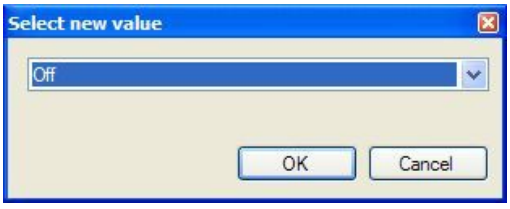

SSI Instrument Configuration Utility
File Options Help
9220
Auxiliary Analog Input
Parameter
Value
Input 1 1669
Input 2 0
Input 3 0
[M1 | OK | 1669.0 °F]TC 1 1668.0
TC 2 1668.4
TC 3 1669.1
[M2 | Bad | 0.0 °F]TC 4 0
TC 5 0
TC 6 0
[M3 | Bad | 0.0 °F]TC 7 0
TC 8 0
TC 9 0
[M4 | Bad | 0.0 °F]TC 10 0
TC 11 0
TC 12 0
[M5 | Bad | 0.0 °F]TC 13 0
TC 14 0
TC 15 0
[M6 | Bad | 0.0 °F]TC 16 0
TC 17 0
TC 18 0
[M7 | Bad | 0.0 °F]TC 19 0
TC 20 0
TC 21 0
[M8 | Bad | 0.0 °F]TC 22 0
1670 °F
SP: 1700 °F
100%
auto
Gauge 1 3.78e-003t
A:On:3.00e-001t Off:3.50e-001t
B:On:3.00e-001t Off:8.02e-001t
C:On:5.00e-002t Off:7.00e-002t
Bad T/Cs none
Alarm 2
OUTPUTS
INPUTS
coms good

Manual Event Control



Events are assignable outputs, used in recipes/programs. Typically, they are used to signal the recipe is complete, to turn process gases off and on, and tell the equipment to do a variety of tasks. The Manual Event Control menu allows the user to force the events off or on.

The Manual Event Control menu option shows the user all of the events (**0** – **47**) and their current status. It also allows the user to manually control the status of any event by clicking on the value. A single click will display an input box that will allow the user to select either an **On** value or an **Off** value.

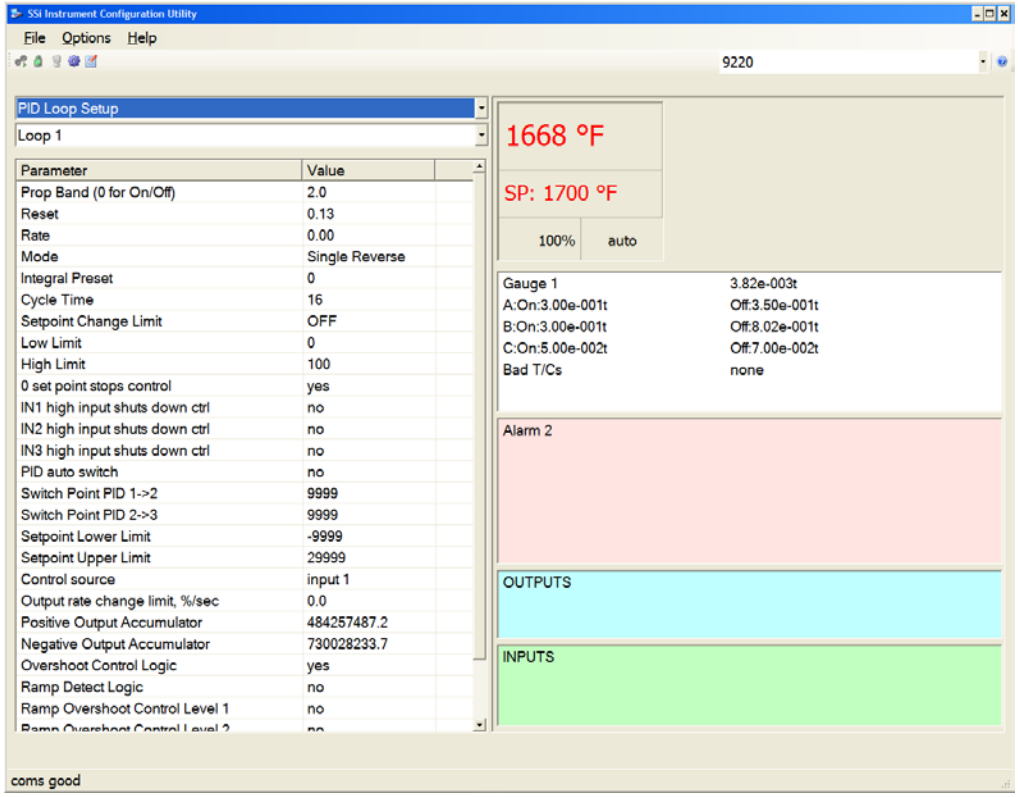


Clicking on the **OK** button will set the value, while clicking on the **Cancel** button will cancel the action.
Clicking on the "Value" section of the "Turn off all events" field will force all of the events to **Off** status. The user will have to confirm this action.
Clicking on the **Yes** button will set the action, while clicking on the **No** button will cancel the action.

Clicking on the "Value" section of the "Turn ON all events" field will force all of the events to **On** status. The user will have to confirm this action.
Clicking on the **Yes** button will set the action, while clicking on the **No** button will cancel the action.

PID Loop Setup

PID is the tuning parameters entered for the Process Variable loop.



Prop Band (0 for On/Off)

Proportional Band determines the response to the current error. The Proportional Band is the percent of the range of the process variable that will produce 100% output and is the inverse of the proportional gain. A low Proportional Band value results in a larger change in output for a given error. Conversely, a high Proportional Band value results in a smaller change in output for a given error. If the Proportional Band is too small, control may oscillate or be otherwise unstable. If the Proportional Band is too large the control action may be too sluggish in response to changes within the system. Note: If the Proportional Band is set to 0.0, only on/off control is performed. The range **0** – **3276.0**.

Reset

Reset determines the influence of past errors. The Reset, or integral action (expressed in repeats per minute), sums the error between the process variable and setpoint over time and adds this accumulated output to the proportional output. A "proportional only" controller generally operates with steady-state error because some error is required to produce control

output. The goal of integral action is to drive the steady-state error to zero and eliminate this droop. The range **0** – **327.67**.

Rate
Rate adjusts the response to future errors. The Rate, or derivative action (expressed in minutes), is used to predict system behavior and has a dampening effect. The more the controller tries to change the process variable the harder the derivative will work to counter that effort. This dampening effect can be valuable in reducing overshoot but is most often useful when trying to improve control on systems with significant and predicable lag. The range **0** – **327.67**. NOTE: The rate is not typically used for carbon control.

Mode
This is the mode of the loop. The values are: **Dual Reverse; gas/air or heat/cool, Single Reverse; heat, dual direct; dew point gas/air,** or **single direct; cool.**
Dual – This has two output relays which can increase and decrease to achieve your SP.
Single – This has one relay which works in only one direction to achieve your SP.
Direct - If the PV - SP equals a positive number and the output would bring the PV down toward setpoint that is direct.
Reverse – If the PV - SP equals a negative number and the output would bring the PV up toward setpoint then that is reverse

Example: If a 12 mA output drives a 0 degree F temp. (PV) **up** to a 1200 degree F temp. (SP) this would be REVERSE and since this would take a SINGLE output from the controller the Mode for the Temperature Loop is **Single Reverse**.

Integral Preset
This field provides an offset for the starting point for PID control, also referred to as "Load Line" or "Manual Reset". The range is **–100** to **100**.

Cycle Time
This field is typically set to the valve travel time multiplied by 1.5.

Setpoint Change Limit
This is a smart tune feature that inhibits the integral (Reset) until the control output drops below the specified % output after a set point change.
It is used to eliminate overshoot.
The Output percentage selected under this category ***must*** be above the normal operating output percentage of the furnace at heat.
Example – if the furnace runs at 40% output at heat for the maximum load, the setpoint change limit should be set to 60%.

Low Limit
This is the low limit field. The range is **–100** to **100**.

High Limit
This is the high limit field. The range is **–100** to **100**.

0 Setpoint Stops Control
If the Setpoint is zero, then all outputs are turned off. The option is either **Yes** or **No**.

IN1 high limit shuts down ctrl
If input 1's high limit is reached, then all outputs are turned off. The value can either be **Yes** or **No**.

IN2 high limit shuts down ctrl
If input 2's high limit is reached, then all outputs are turned off. The value can either be **Yes** or **No**.

IN3 high limit shuts down ctrl
If input 3's high limit is reached, then all outputs are turned off. The value can either be **Yes** or **No**.

PID Auto Switch
This is the PID auto switch field. The value can either be **Yes** or **No**.

PID 1 -> 2 Switch Point
This is the PID Switch Point field. It is the point at which the control loop is changed to a different PID set. Loop 1 is assumed to be the "low" loop and Loop 2 is assumed to be the "high" loop. The range is **–300** to **4000**. NOTE: PID switch points are based on Temperature PV, *not* Setpoint or Ramp Temperature.

PID 2 -> 3 Switch Point
This is the PID Switch Point field. It is the point at which the control loop is changed to a different PID set. Loop 2 is assumed to be the "low" loop and Loop 3 is assumed to be the "high" loop. The range is **–300** to **4000**. NOTE: PID switch points are based on Temperature PV, *not* Setpoint or Ramp Temperature.

Setpoint Lower Limit
This is the lower limit of the setpoint. The range is **–300** to **9999**.

Setpoint Upper Limit
This is the upper limit for the setpoint. The range is **–300** to **9999**.

Control Source
This allows the user to configure what information the selected loop is basing control on. By default, Loop 1 is for temperature control and is set to Input1. The options are: **Off**, **Input 1**, **Input 2**, **Input 3**, **Vac G1 torr**, **Vac G1 micron**, **Vac G2 torr**, **Vac G2 micron**, **Vac G3 torr**, **Vac G3 micron**, **Vac G4 torr**, **Vac G4 micron**.

Output rate change limit, %/sec
This option causes the 9220 controller to limit the rate at which the output changes in the furnace. For example, if the output rate change limit is 5% per second, the controller will increase the output at a rate no greater than 5% each second until the output reaches the level needed to reach setpoint. This limit can be useful in cases where (for example) a heating element should not (for operational and safety reasons) heat up to a high output immediately. If the output needs to reach 100% to achieve setpoint, the Output Rate Change Limit will apply the output incrementally, rather than allowing the output to climb to 100% as soon as the heat is turned on.

Positive Output Accumulator
The Positive Output Accumulator is the sum of the positive outputs (given in percentages up to one decimal place) measured each second. Therefore, if the following outputs are recorded over five seconds:

Output (in %)	Second Passed
100.0	1
99.0	2
99.0	3
98.0	4
97.0	5

Then the value for the Positive Output Accumulator after five seconds will be (100.0 + 99.0 + 99.0 + 98.0 + 97.0) or 493.0.

To reset the Positive Output Accumulator, simply click the Positive Output Accumulator field and confirm the reset. This will cause the Positive Output Accumulator to be reset to zero and start accumulating values again from that point.

Negative Output Accumulator

The Negative Output Accumulator is the sum of the negative outputs (given in percentages up to one decimal place) measured each second. The sum of the negative values is expressed as a positive value. This means that, if an output of -50% is recorded after one second, a value of 50 will be added to the Negative Output Accumulator. Similarly, if the following outputs are recorded over five seconds:

Output (in %)	Seconds Passed
-20.0	1
-20.0	2
-21.0	3
-21.0	4
-22.0	5

Then the value for the Negative Output Accumulator after five seconds will be (20.0 + 20.0 + 21.0 + 21.0 + 22.0) or 104.

To reset the Negative Output Accumulator, simply click the Negative Output Accumulator field and confirm the reset. This will cause the Negative Output Accumulator to be reset to zero and start accumulating values again from that point.

Overshoot Control Logic (No/Yes)

Overshoot control logic is activated when a large setpoint change occurs. If the logic is active and a large setpoint occurs, it sets a working setpoint at an appropriate distance from the desired setpoint to prevent the PV from overshooting the desired final setpoint. When the PV reaches or crosses this working setpoint, then the logic exponentially ramps the working setpoint to the desired final setpoint.

Ramp Detect Logic (No/Yes)

The Ramp Detect logic works in conjunction with the instrument recipe programmer. If the control loop is the temperature loop for the recipe programmer, and the OPCODE is a ramp, then the control loop does some special checks. If the Overshoot Control Logic is active, then the final setpoint of the ramp is used to determine the working setpoint band. However, the ramp setpoint is used until the band is reached. Also, once the band is reached, if the ramp is faster than the overshoot logic exponential ramp, then the program is temporarily put on hold as needed to sync the two ramps.

Ramp Level 1 Control (No/Yes) and Ramp Level 2 Control (No/Yes)

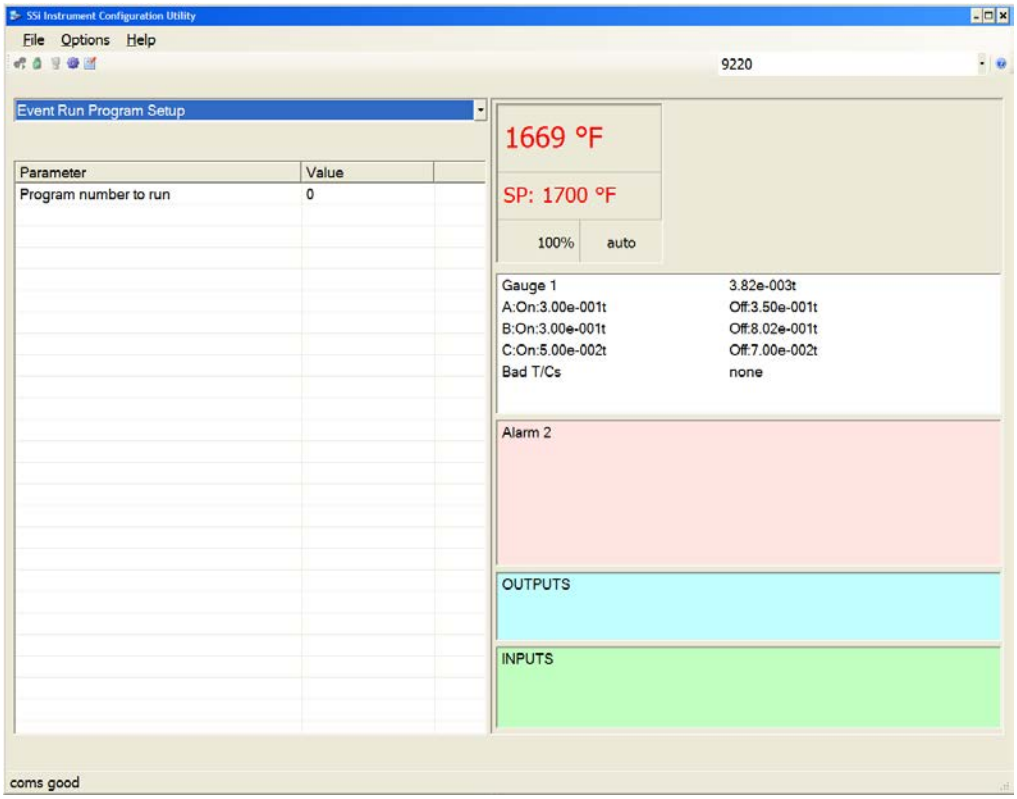
Ramp Level 1 and 2 Control are only active if the Ramp Detect logic is active.

Ramp Level 1 Control changes the working PID settings to equivalent PI settings during the ramp until the overshoot logic band is reached.

Ramp Level 2 Control is only active if the Ramp Level 1 control is active.

Ramp Level 2 Control changes the working PID settings to equivalent Prop band only settings during the ramp until the overshoot logic band is reached.

Event Run Program Setup



Event run program setup is used to start a program that is stored in the 9220 vacuum controller (zero for buffered) or by a defined event input.

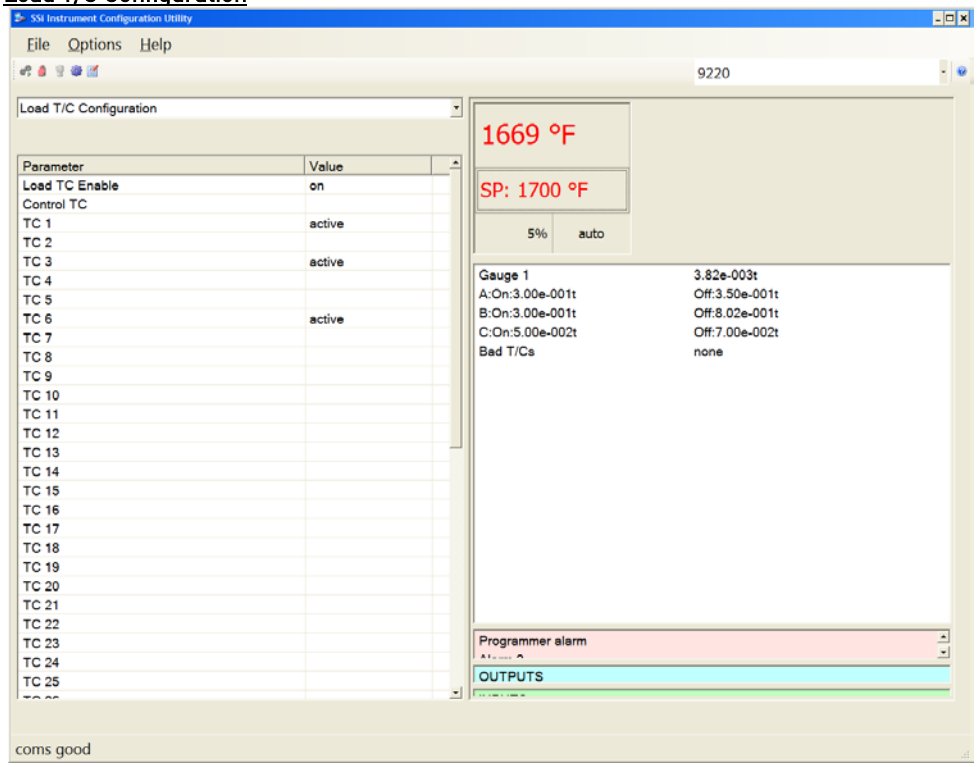
*Program must be configured under the menu option *Event Control*

*Used to define an event input to initiate a program start and to define which program to start (zero starts the last program run) from the contact closure. The range of programs to run is 0 to 300.

WARNING

If a JUMP (to another program) is used, the program that will run would be the program jumped to, not the first program run. If you stop a program in a GOSUB, the program that will be run will be the GOSUB.

Load T/C Configuration



Configuration of any analog input device must be completed under this menu item.

Load TC Enable:
This value will manually toggle between **on**, **on + alarms**, and **off**.
On – T/C Enabled
On + Alarms – T/C Enabled, Programmer alarm114 provided if out of band (Default wait limits)
Off – T/C not enabled

Control TC:
This value allows the user to set the TC to be part of the group of Load TCs that can hold the program if it is out of band. The values are **active** or **not active**, shown as blank.

TC 1 – 27, 31:
This value allows the user to manually turn the T/C from **active** to **not active**, shown as blank, to be part of the group of TCs that can hold the program if it's out of band. These TCs will be compared to the Control TC. If a TC is enabled and goes out of band in a recipe, the recipe will stop.

Analog Input 1-3
Analog inputs 1-3 can also be used to compare against the control TC. However, Analog input 1 is setup as the Control TC, so it cannot be compared to itself.

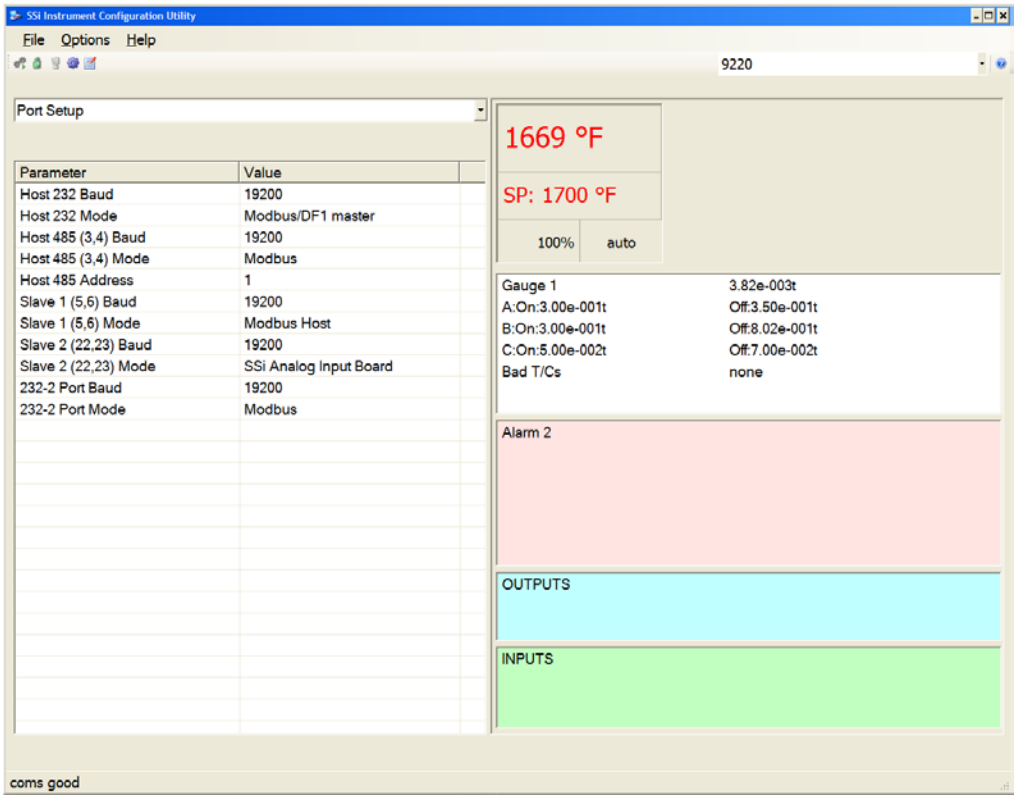
Load TC Alarm ON Delay:
This is the amount of time the alarm will delay before turning on if there is a load TC out of band with the Control TC. The range is **0** to **500**, measured in seconds.

SP bump maximum step change
SP bump max total change
SP bump change time (sec)
The SP bump feature will make adjustments to the control set point with the goal of bringing all Load TCs into band.. It can bump the setpoint higher or lower. The **SP bump maximum step change** is the maximum interval of degrees that the controller will adjust the setpoint. **SP bump max total change** is the combined total number of degrees that the controller will adjust the setpoint. **SP bump change time (sec)** is the interval of time in seconds between checks to determine the status of the TCs (whether or not they are in band).

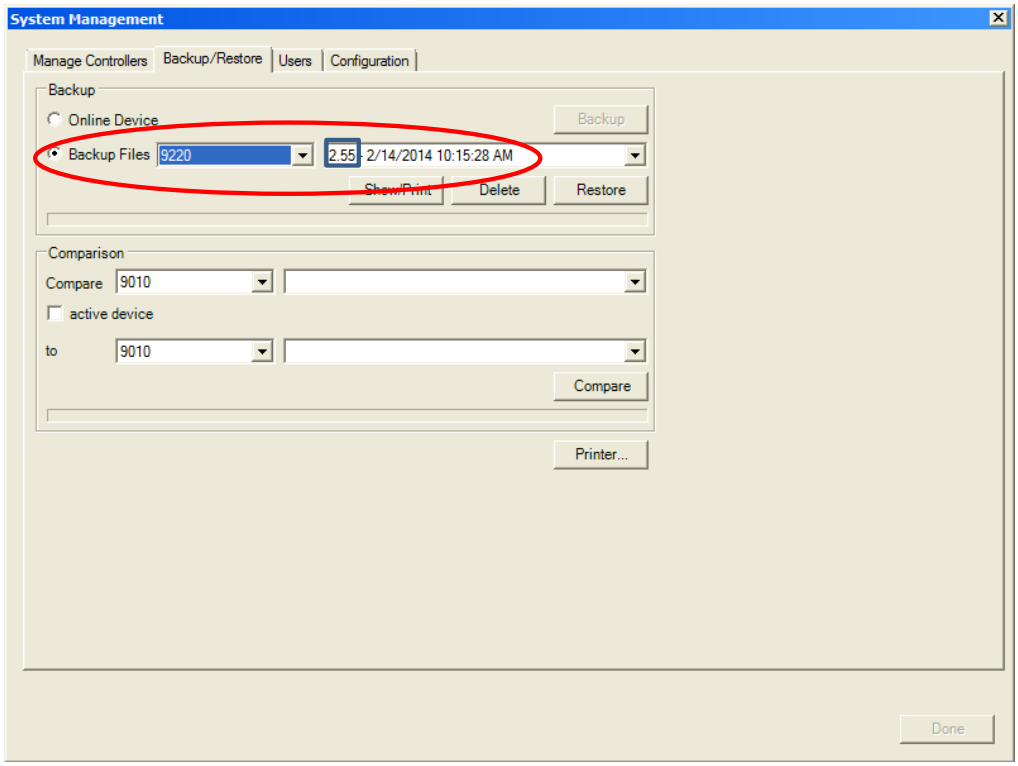
Minimum Load T/Cs for guarantee
This feature sets a minimum number of Load TCs required to be within band for a guaranteed soak to be evaluated as true. For example, if this value is set to 4, and 6 Load TCs are enabled, the controller will begin counting as soon as 4 Load TCs are within band. If the value is set to 0, this feature is disabled. NOTE: Typically, the Control TC would be disabled to prevent undesired results.

Fail guarantee on active T/C bad coms
This feature prevents the soak timer from running when the instrument cannot communicate with the analog input card connected to the Load TCs. As soon as communications are established and the minimum number of Load TCs (set using the Minimum Load T/Cs for Guarantee feature described above) are within band, the soak timer and guaranteed soak will run.

Port Setup



Note about ADAM module support: Communications with ADAM analog input modules manufactured by Advantech are not supported as of 9220 firmware revision 2.46. To determine the firmware version of your 9220 instrument, perform a controller data backup using the System Management -> Backup/Restore menu in Configurator. Select **Backup -> Online Device**. Once the backup is performed, check the **Backup Files** list for the 9220 as shown in the screen shot. The firmware revision level will be shown.



Host 232 Baud
This will set the baud rate for RS-232 communications. The list of options is:
9600 **19200** **115200**

Host Mode
This will set the mode rate for RS-232 communications. This list of options is:
Modbus **Modbus/DF1 Master**

Host 485 Baud
This will set the baud rate for RS-485 communications. The list of options is:
1200 **14400** **57600**
2400 **19200** **76800**
4800 **28800** **115200**
9600 **38400**

Host 485 Mode
This will set the mode for RS-485 communications. The possible settings are **Modbus**, and **Televac MX4A**.

Host 485 Address
This will set the address for RS-485 communications. The range is **1** – **247**.

Slave 1 Baud
This will set the baud rate for Slave 1 communications. The list of options is:

1200	14400	57600
2400	19200	76800
4800	28800	115200
9600	38400	

Slave 1 Mode
This will set the mode for Slave 1 communications. This list of options is:
MMI
Modbus
Yokogawa
Modbus Host

Slave 2 Baud
This will set the baud rate for Slave 2 communications. The list of options is:

1200	14400	57600
2400	19200	76800
4800	28800	115200
9600	38400	

Slave 2 Mode
This will set the mode for Slave 2 communications. This list of options is:
MMI
Modbus
N/A
SSi Analog Input Board
Yokogawa

232-2 Port Baud
This will set the baud rate for RS-232 communications. The list of options is:

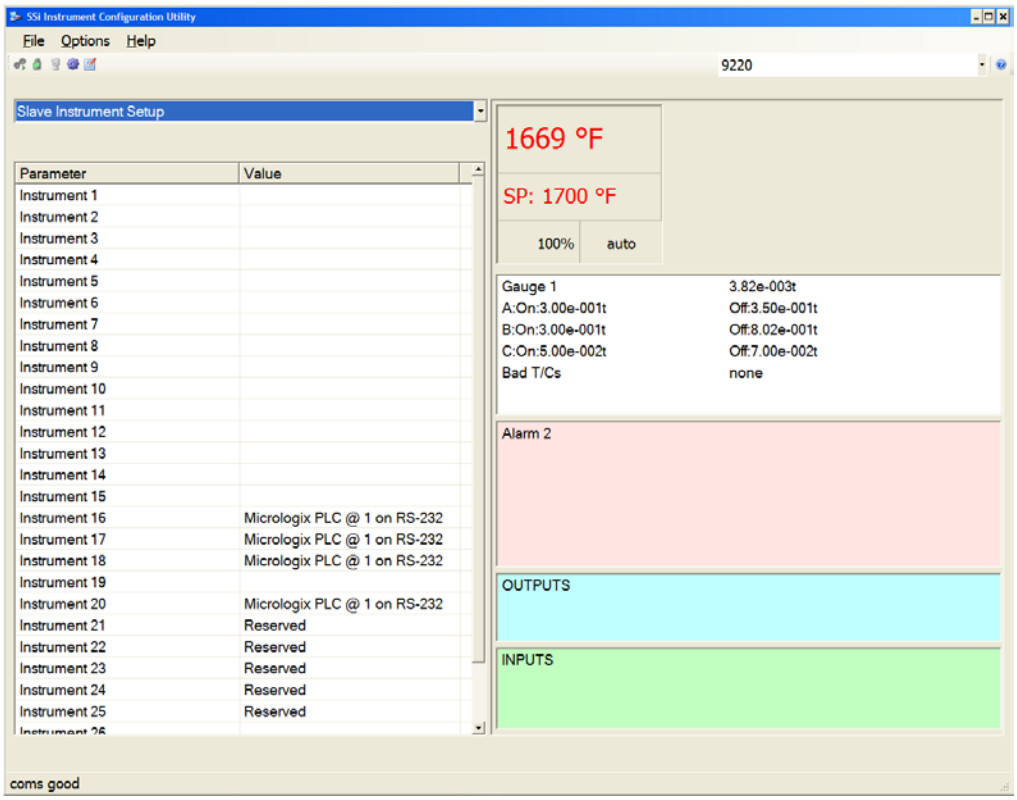
9600	19200	115200

232-2 Port Mode
This will set the mode for RS-232 communications. The list of options is:

Modbus	Cal Terminal	Televac	Varian

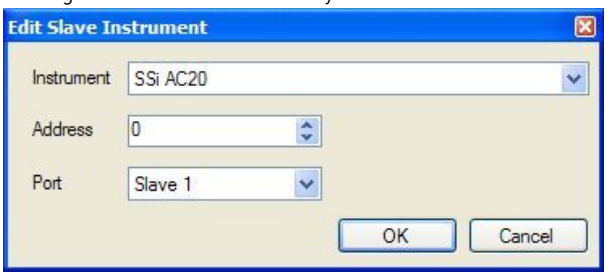
The **Return** button will return the user to the menu screen.

Slave Instrument Setup



** All devices on the same slave port must utilize the same protocol
** An address of zero (0) will disable the instrument** Some controllers (AC20 for example) can provide dual functions (atmosphere and events) and must have the same address assigned for both.

Clicking on the "Value" field for any instrument will allow the user to select the slave instrument.



Instrument:
This value will allow the user to select the slave instrument type.

List of Instruments:
The following is the list of instruments available as slave instruments:

SSi AC20	[T]Eurotherm 2500	SSi Quad AO2
[A]Yokogawa 750	Unipro v3.5	SSi Quad AO3
[A]Honeywell UDC3300	Unipro v3.0	SSi Quad AO4
[A]Dualpro LP1 Modbus	[T]Carbpro v3.5 Slave	Yokogawa UT350
[A]Dualpro LP2 Modbus	[T]Carbpro v3.0 Slave	Yokogawa 750 Lp 2
[A]Dualpro LP1 MMI	10Pro	Yokogawa UP350
[A]Dualpro LP2 MMI	Dualpro IN C	Honeywell DCP551
[A]Eurotherm 2404	[T]9200 LP1	Ascon 08
[A]Eurotherm 2500	[T]9200 LP2	SSi AC E
[A]Carbpro v3.5	[T]9200 LP3	Yokogawa 750E
[A]Carbpro v3.0	9100 LP2	Mod Mux
CarbPC	Eurotherm 2704 LP1	Dualpro E Modbus
[A]9200 LP1	Eurotherm 2704 LP2	Dualpro E MMI
IR Base	Eurotherm 2704 LP3	Carbpro E v3.5
MGA	VC Base 1	Carbpro E v3.0
SSi 7EK	VC Base 2	Eurotherm 2500
[T]Yokogawa 750	VC Base 3	SSi 8-8
[T]Honeywell UDC3300	VC Base 4	SSi 9200 E
[T]Dualpro LP1 Modbus	AIPC	Micrologix PLC
[T]Dualpro LP2 Modbus	SSi 7SL	MCM Module
[T]Dualpro LP1 MMI	SSi Flow Board	PLC5 DF1
[T]Dualpro LP2 MMI	UMC800 LP1	SLK DF1
[T]Eurotherm 2404	SSi Quad AO1	

Address:
This value allows the user to select the address that corresponds with the controller selected, with a range of 0 to 249.

Port:
The options for this field can either be **Slave 1** or **Slave 2**

Slave 1 – terminals 5(-), 6(+)

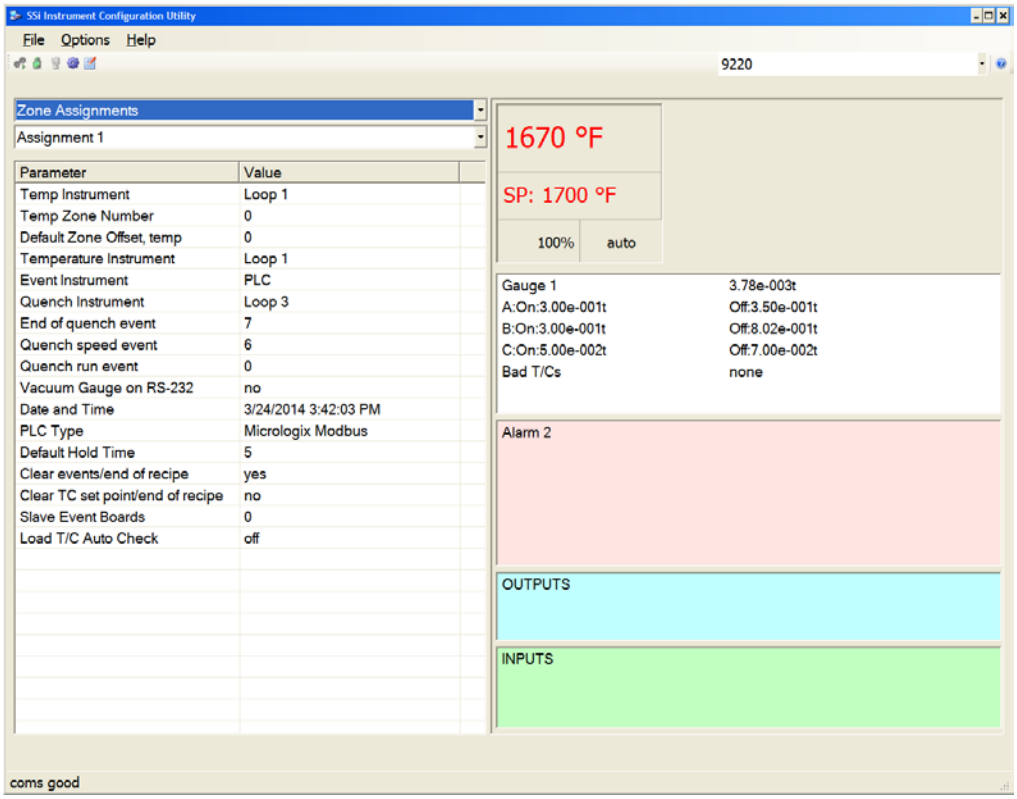
Slave 2 – terminals 22(+), 23(-)

RS-232

IMPORTANT!

The 9220 will generate a programmer alarm if communications with a slave instrument are lost. The alarm will contain information on the slave instrument number to which communications were lost and will be displayed in Configurator and on the touch screen's main status screen. (If the alarm is connected to a relay and the relay is wired to an audio device, an audible alarm will be generated.)

Zone Assignments



WARNING: This screen should not be changed without consulting SSi at .

***Slave Instrument Setup must be configured prior to Zone Assignment setup**

The zone assignment feature allows the Series 9220 program to change set points on all instruments of a multi-zone furnace. The Series 9220 has up to five temperature zone assignments available (**Zone Assignment 1** – **Zone Assignment 5**). Typically, the first zone is configured to the programmer's temperature instrument. That is the master set point that will be propagated to the other configured zone instrument set points on set point change. For example, the user may want to set 4 temperature zones from a recipe where the programmer temperature instrument is loop 2. In this case, zone 1 would be configured as loop 2. Subsequent zones would be configured as previously configured slave temperature controllers.

If the *ZONE_OFF* (Zone Offset) opcode had been used in the program, the set point sent to the specified zone instrument would have the offset added. For example, a 3-zone pit furnace, where the bottom zone usually has a higher set point. The middle zone and the top zone usually have a lower set point. The bottom zone temperature controller is assigned to zone 1, the middle temperature controllers to zone 2, and the top zone controller to zone 3.

If the first three steps of a program are as shown below, then the bottom zone set point is 1775, the middle zone is 1750, and the top zone is 1800.

Step	Opcode	Temperature	Option
1	*ZONE_OFF*	25	Zone 1
2	*ZONE_OFF*	50	Zone 3
3	*SETPT*	1750	

The first step sets the offset for zone 1 to 25 degrees; therefore, the bottom zone controller would be sent a set point of 1775 when step 3 is executed. Likewise step 2 sets the offset for zone 3 to 50 degrees. The top zone then receives a set point of 1800. The middle zone controller would receive the 1750. The temperature controller displayed on the Status Display is instrument #2. If instrument #2 were the top zone controller then the Status Display would show the 1800-degree set point.

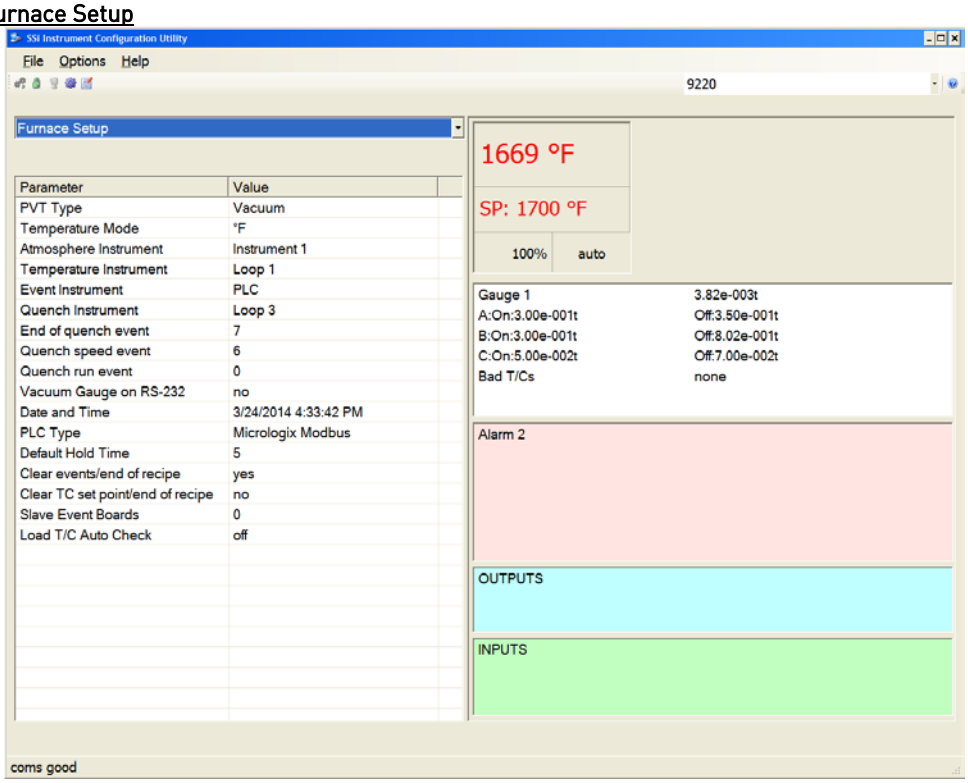
Assignments:
The zone assignment number, with a choice of **Assignment 1** through **Assignment 5**.

Temp Instrument Number:
The slave instrument number assigned to a temperature controller, with a range of **1** to **28**.

Temp Zone Number:
This option will allow the user to set the zone number for the assignment with a range of **0** to **5**.

Default Zone Offset, temp:
This option will allow the user to enter an offset for the assignment with a range of **–32000** to **32000**.

Furnace Setup



The Furnace Setup menu option is an administrative access only option. Do not make any adjustments on the screen without first contacting Super Systems Inc..

PVT Type:
The PVT type is the mode the device runs in (Carbon, Dewpoint, etc.). The mode selected determines the calculations and scaling for the Process Variable. The PVT type will always be **Vacuum** for the 9220.

Temperature Mode:
This value determines the specific temperature scale to be used. It can be either **°F** or **°C**.

Atmosphere Instrument:
The 9220 does not control atmosphere.

Temperature Instrument:
Allows for a slave instrument (or internal) to be the defined temperature control device. The types of instruments are: **Internal Loop 1** – **Internal Loop 3**, **Instrument 1** – **Instrument 25**.

Event Instrument:
Allows for a slave instrument (or internal) to be the defined event control device. The types of instruments are: **Internal**, **PLC.**

Quench Instrument:
Allows for slave instrument (or internal) to be the defined quench control device. The types of instruments are: **Internal Loop 1** – **Internal Loop 3**, **Instrument 1** – **Instrument 25**.

End of Quench Event:
Tells the programmer which event to signal end of quench (related to which relay it is assigned). The list of possible values is: **0** – **14**.

Quench Speed Event:
Tells the programmer which event will signal the quench speed. The list of possible values is: **0** – **14**.

Quench Run Event:
Tells the programmer which event will signal quench run. The list of possible values is: **0** – **14**.

Vacuum Gauge on RS-232:

This value determines if there is a vacuum gauge on the RS-232 port. The list of options are either **No** or **Yes**.

Date and Time:
This value is the current date and time on the 9220 controller only (not the local computer or the touch screen, if applicable). Clicking on the "Value" column will allow the user to set a new date and time on the controller. *Note: The date and time of the touch screen can be changed (if necessary) by selecting the date and time in the lower right corner on the touch screen under the menu. This can be reached by going through the menu, and shutting down the software. Then, at the CE screen the date and time can be changed by double taping the time in the bottom right corner and setting it, then select "apply". For this to take effect the screen needs to be rebooted; on the older TPC 642 displays the registry needs to be saved under TPC Configuration icon, the Misc Tab and then reboot the touch screen. The date and time that is recorded on the flash card (and therefore the datalog data) is the date and time of the Advantech display not the controller*.

PLC Type:
This value defines the type of PLC being used. The options are: **Micrologix Modbus**, **MCMmodule Modbus**, **DF1 PLC5**, **DF1 Slik, Modbus TCP, Passive**.

Default Hold Time:
This value is the default holding time for the furnace. The range is **0** to **10000**.

Clear events/end of recipe:
This switch will allow the user to clear the events out at the end of a recipe. The options are either **no** or **yes**.

Clear TC set point/end of recipe
This switch will allow the user to clear the T/C set point out at the end of a recipe. The options are either **no** or **yes**.

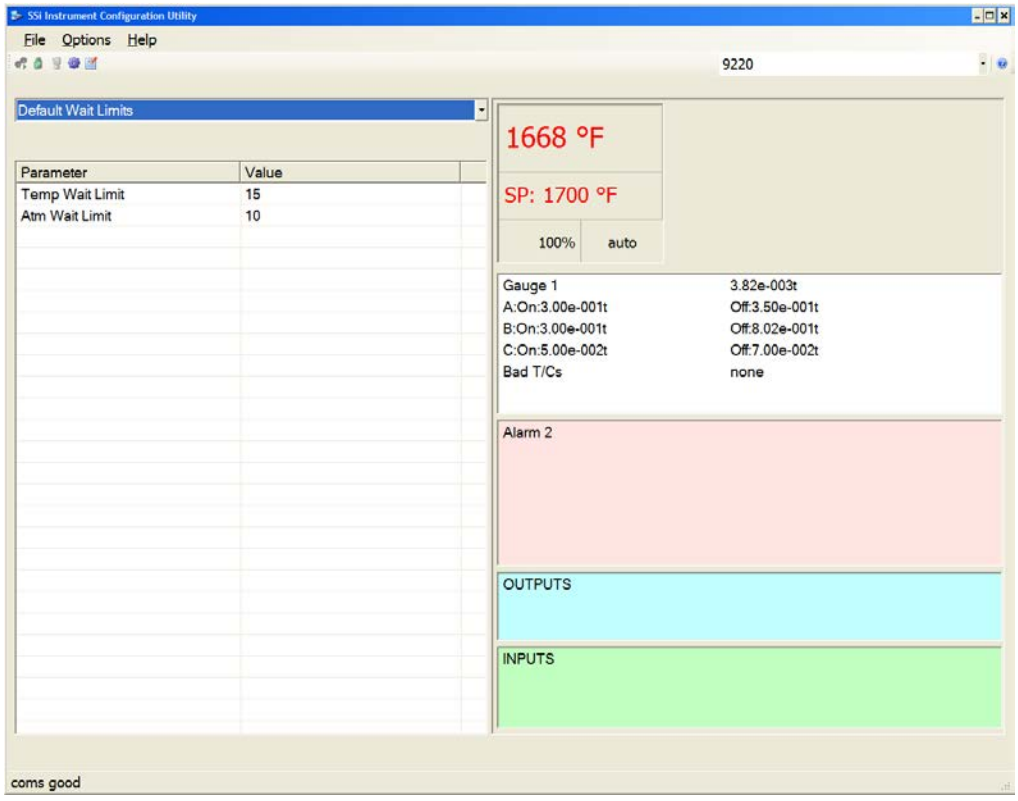
Slave Event Boards
This is the amount of slaved 9015 controllers to the 9220.

Load T/C Auto Check

This will monitor the Load TCs, and if there is a Load TC that is significantly out of band and most likely giving erroneous measurements, the controller will automatically disregard that Load TC when checking for band status (whether or not the Load TCs are in band with the control TC). The controller will check once per minute.

Default Wait Limits

The 9220 vacuum controller uses default wait limits in conjunction with recipe programs. The wait limits are in place to help make sure a recipe will not continue to the next step until the temperature, atmosphere or both are within the specified range. The wait limits are both plus and minus the value of the setpoint specified in the recipe. You can define specific wait limits per program that supersede the defaults with the specific wait limit OP CODE per program (SETWAIT).



Factory Default configuration:

Carbon:

Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	0.10

Dewpoint:

Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	10

%O2:

Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	1.0

MV:

Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	10

Multiloop:

Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	10

Vacuum:

Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	10

IR + Probe:

Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	10

Nitrider:

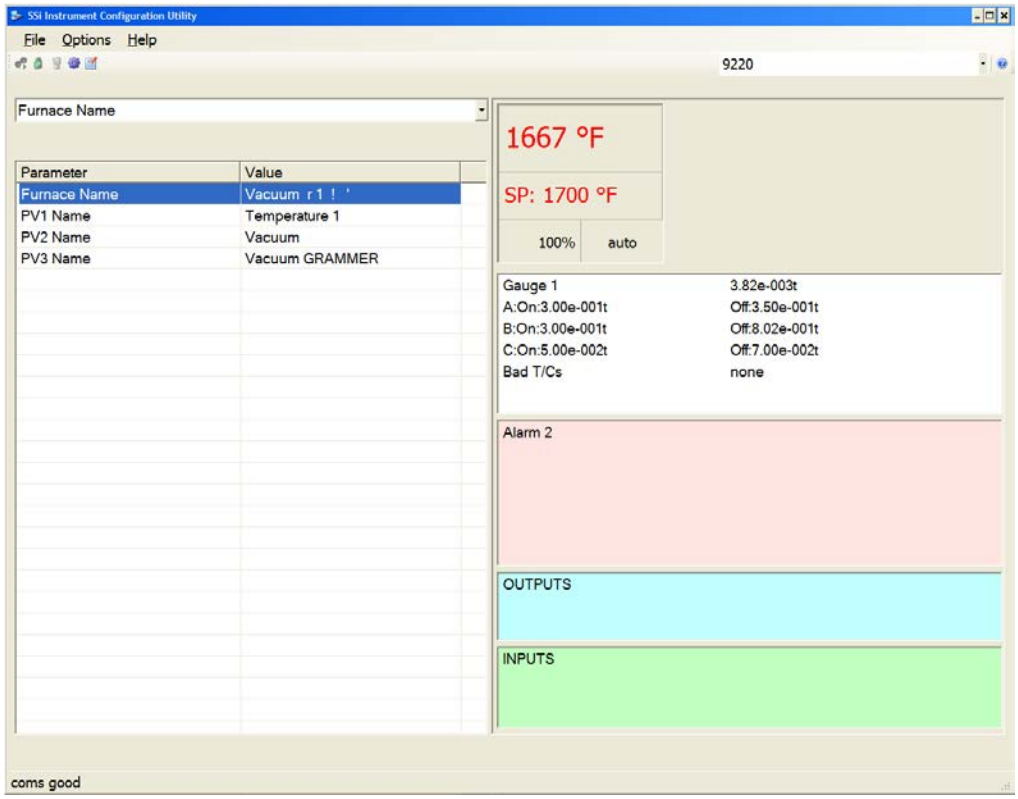
Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	1.0

%C Dual Temp:

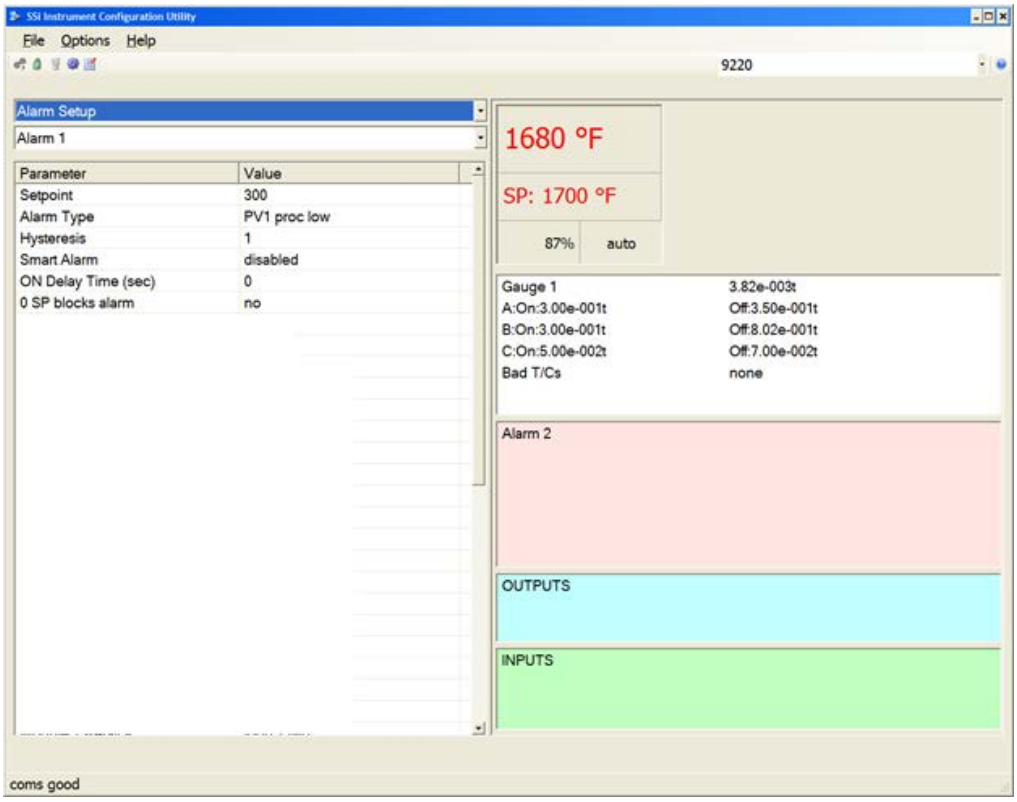
Parameter	*Value*
Default Wait Limit for Temperature	15
Default Wait Limit for Atmosphere	10

Furnace Name

This page allows the user to enter a furnace name and the process variable (PV) names you wish to be displayed. Clicking on any of the values will display an input box. The user can enter the desired text then press **OK**. All values have a maximum length of twenty (20) characters.



Alarm Setup



The 9220 controller can be configured to use seven different alarms and a Thermocouple Check. Each of the alarms consists of an alarm setpoint, alarm type, alarm hysteresis, smart alarm, ON delay time, and a 0 SP blocks alarm value. The alarms come from the factory with a default configuration dependent on the application but also can be modified prior to shipment to your facility or in the field by a supervisor.

Setpoint:
This value is the setpoint for the alarm. Clicking on this value will display an input box from which the user can select a new value. The range is from –9999.00 to 9999.00.

Alarm Type:
This value is the type of alarms used. Clicking on this value will display an input box with two (2) drop-down lists from which the user can select a new value.
The values in the first (top) list box are:

- PV 1 Value
- PV 2 Value
- PV 3 Value
- Input 1 Value
- Input 2 Value
- Input 3 Value
- PO1 Value
- PO2 Value

P03 Value

The values in the second (bottom) list box are:

Process High
Process Low
Normally Open
Normally Closed
Outside Deviation
Within Deviation

Hysteresis:
This value is the Hysteresis value. The Hysteresis is a set number that works with the alarm to help control a motor or pump longer to reach a set amount to come back into band before it will shut off motor or pump.

Example: Using quench oil as an example, suppose the SP is 200 ◦F. The alarm is set as a deviation of +10 ◦F. At 210 ◦F, the alarm is active and the pump will run to cool the oil. With a hysteresis of 8 ◦F, the alarm and pump will turn off at 202 ◦F. It will turn back on when it is 10 ◦F above setpoint. If the setpoint is still 200 ◦F, then at 210 ◦F, it will turn on again.

Clicking on this value will display an input box from which the user can select a new value. The range is from **0** to **9999**.

Smart Alarm:
This value is a display of the Smart Alarm status. A smart alarm is an alarm that works with a Process Variable (PV), and, when enabled, it will not be armed until the PV is within band of the setpoint. The alarm sounding - if active - will be disabled until within the SP band. When it is in band, the alarm will go active unless on delay time is set.

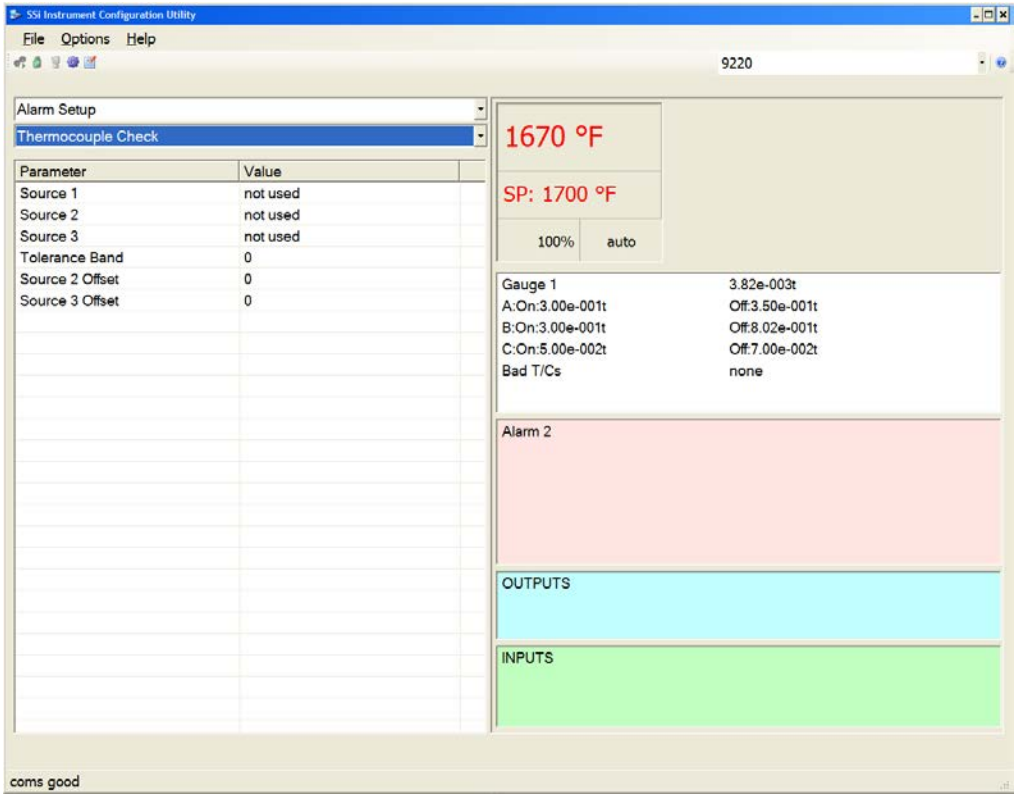
Example: If the SP is 1700 and the band is 10 degrees the alarm will not be active until the PV reaches 1690. The value can be either **disabled** or **enabled**.

ON Delay Time:
This value is the ON Delay Time. Clicking on this value will display an input box from which the user can select a new value. The range is from **0** to **9999**.

0 SP Blocks Alarm:
This value will allow a 0 setpoint to block an alarm. The options are either **no** or **yes**.

Thermocouple Check

This menu option allows the values between up to three thermocouples to be compared to one another. If the thermocouples go out of band, it is possible to set up an alarm that will alert the operators of this error.



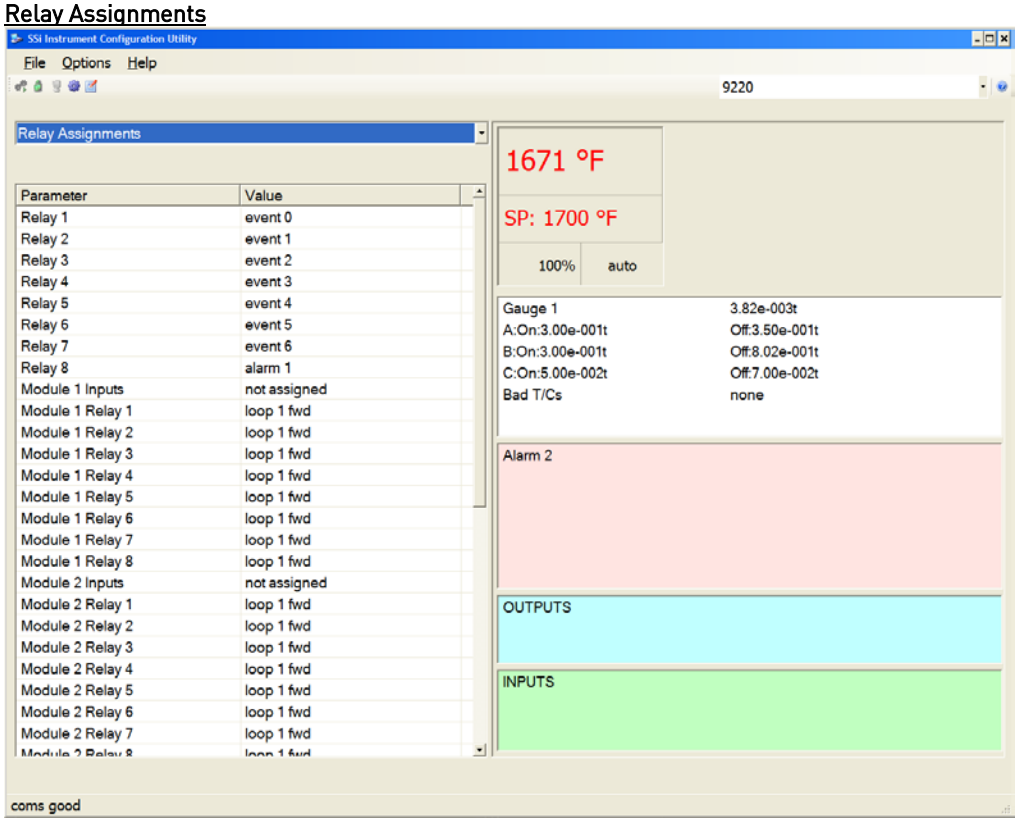
Source 1 – Source 3:
These are the values for the first, second, and third source. The options are: **not used**, **Instrument 1** – **Instrument 27**, **n/a**, or **Input 3** – **Input 1**.

Tolerance Band:
This is the tolerance band for the thermocouple. The range is **–9999** to **9999**.

Source 2 Offset:
This is the offset for source 2. The range is **–9999** to **9999**.

Source 3 Offset:
This is the offset for source 3. The range is **–9999** to **9999**.

Relay Assignments



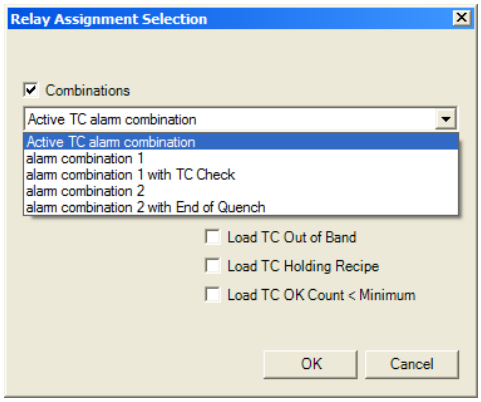
The 9220 controller has the option of using eight relay outputs as well as eight relay outputs (internally in the instrument) for four additional (slaved instrument) modules. All of the relays have a positive common terminal and independent negative terminals. All of the relays are configured in a normally closed position except relay number eight, which has both a normally closed (NC) and a normally open (NO) terminal. These relays can be configured to work with events, alarms, loops, burnoff and alarm combinations.

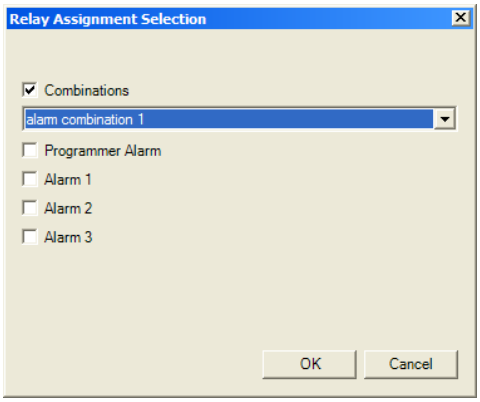
Relay Output Terminals:
Relay Output 1 – terminals 7 and 8
Relay Output 2 – terminals 7 and 9
Relay Output 3 – terminals 7 and 10
Relay Output 4 – terminals 7 and 11
Relay Output 5 – terminals 7 and 12
Relay Output 6 – terminals 7 and 13
Relay Output 7 – terminals 7 and 14
Relay Output 8 – terminals 7 and 15 NC
Relay Output 8 – terminals 7 and 16 NO

Relay Output Choices:

Loop 1 fwd	Gauge 1 relay SP C	event 35
Loop 1 rev	Gauge 2 relay SP A	event 36

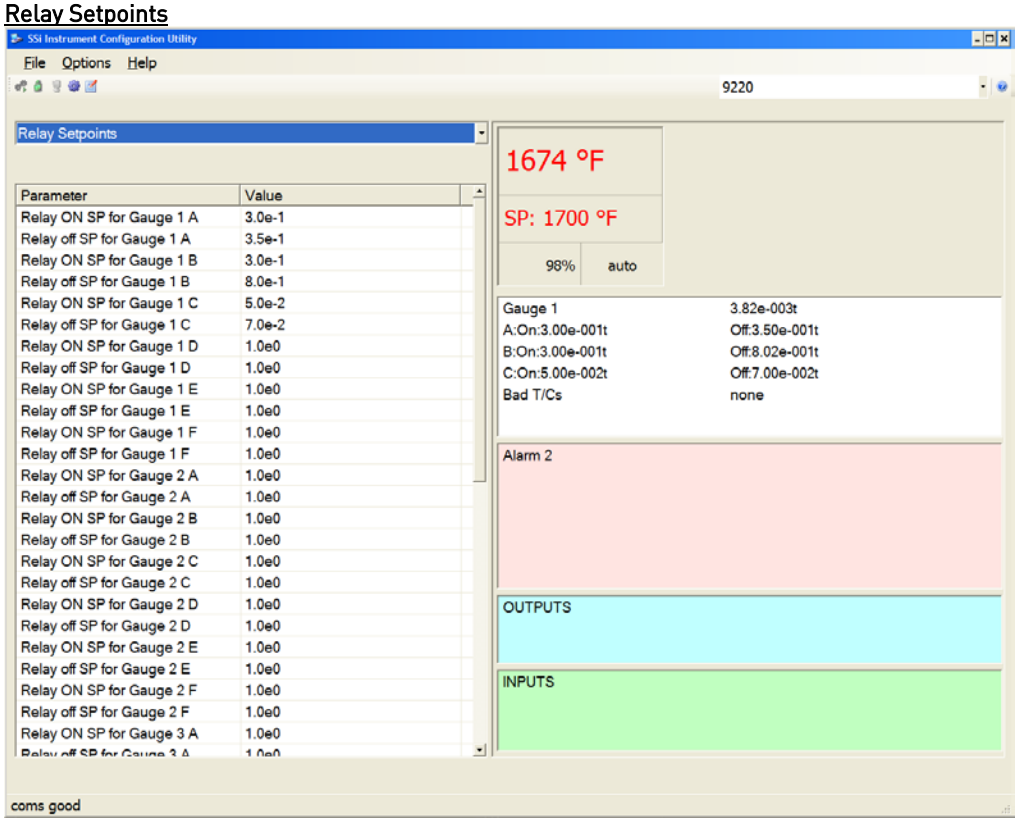
Loop 2 fwd
Loop 2 rev
Loop 3 fwd
Loop 3 rev
Programmer Alarm
Alarm 1
Alarm 2
Alarm 3
Event 0
Event 1
Event 2
Event 3
Event 4
Event 5
Event 6
Event 7
Event 8
Event 9
Event 10
Event 11
Event 12
Event 13
Event 14
Event 15
Out gas hold
Gauge 1 relay SP A
Gauge 1 relay SP B
Gauge 2 relay SP B
Gauge 2 relay SP C
Gauge 3 relay SP A
Gauge 3 relay SP B
Gauge 3 relay SP C
Gauge 4 relay SP A
Gauge 4 relay SP B
Gauge 4 relay SP C
event 16
event 17
event 18
event 19
event 20
event 21
event 22
event 23
event 24
event 25
event 26
event 27
event 28
event 29
event 30
event 31
event 32
event 33
event 34
event 37
event 38
event 39
event 40
event 41
event 42
event 43
event 44
event 45
event 46
event 47
Gauge 1 Relay SP D
Gauge 1 Relay SP E
Gauge 1 Relay SP F
Gauge 2 Relay SP D
Gauge 2 Relay SP E
Gauge 2 Relay SP F
Gauge 3 Relay SP D
Gauge 3 Relay SP E
Gauge 3 Relay SP F
Gauge 4 Relay SP D
Gauge 4 Relay SP E
Gauge 4 Relay SP F
Load TC Deactivated
PV SW State Loop Fwd
PV SW State Loop Rev





The "Alarm Combination" option will allow the user to select the specific combination of alarms to use.

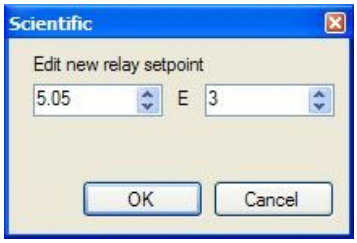
Relay Setpoints



This option is typically used for vacuum applications.

The 9220 controller offers the user three pairs of configurable vacuum setpoints for each input. Each pair of setpoints allows the user to configure both **ON** and **OFF** trigger points. The values entered are in scientific units based on input configuration.

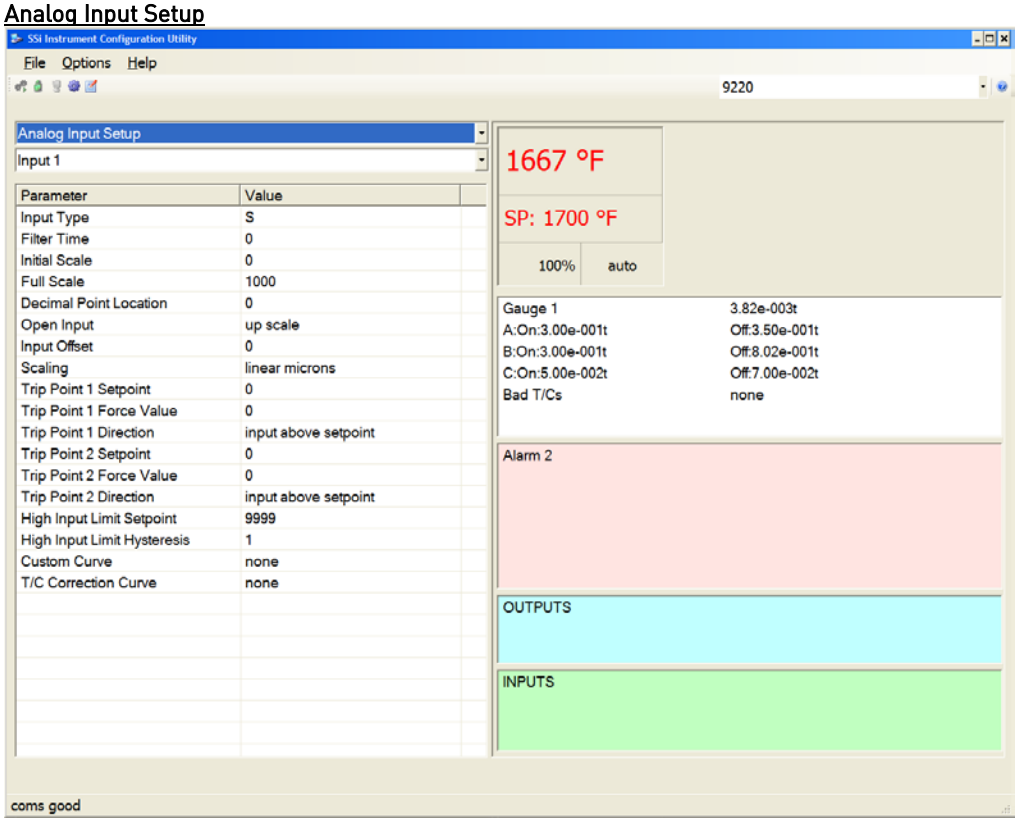
The relay setpoints can only be used once the relays are assigned as such in the *Relay Assignments* menu option.



The left box has a range of **–10.00** to **10.00**, and the right box has a range of **–31** to **31**.

NOTE: The values for all six setpoints can be changed in Configurator or in the recipe editor by using opcodes RLY_SP_M or RLY_SP_T. Setpoints D, E, and F cannot be changed in the recipe editor.

Analog Input Setup



The 9220 controller has three analog inputs. Each of the inputs comes with a factory default configuration dependent on the application It can be modified prior to shipment to your facility or in the field by a technician or qualified/trained person with the proper security code.

Analog Input Terminals

Analog Input 1 – terminals 31 and 32
Analog Input 2 – terminals 29 and 30
Analog Input 3 – terminals 27 and 28

Input Type:
The thermocouple type for most applications can be modified depending on your specific needs. Please note that in some applications, some of the inputs DO NOT allow the user to modify the Input type. To change the Input type, first select which input you want to change by selecting it in the pull-down menu just below the main menu list. Clicking on the Value will display an input box, and then you can use the pull-down menu to select the desired parameter. Once selected, click *OK* and the displayed Input type under Value will be the current type. The following is a list of the options:

B	S	12.5 volts **
C	T	781.25mv
E	2.5 volts	195.3125 mV
J	1.25 volts	
K	78.125 mV	
N	19.53125 mV	
NNM	4-20 mA *	
R	25 volts **	

*** - When the specified input type is selected, a 250 Ohm resistor will need to be placed on the terminals of specific input for reading this selection. If resistor is not placed on input terminals, then damage could occur to the board.**
**** - When the specified input type is selected, a jumper located inside the case will need to be placed on that specific input for reading this selection. If jumper is not placed on input, then damage could occur to the board.**

Filter time:
The filter time is a factory applied averaging tool used to help maintain steady control in high EMI environments. The filter time should not be adjusted with consulting SSI. Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **32767**.

Initial Scale:
This is the initial scale value. This could also be referred to as the starting value. For example, the initial value is the value when 0 volts is on the selected input; or on a 4-20 mA input, it would be the value at the selected input of 4 mA. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.

Full scale:
This is the full scale value for the analog inputs. This is preset for thermocouple types. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.

Decimal Point Location:
This is the decimal point location value. Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **4**.

Open TC:
This is the open TC value. Clicking on this value will toggle between **upscale (will display the maximum scale number)**, **down scale (will display the minimum scale point)**, **one trip point (will use the trip point 1)**, and **two trip points (will use which ever trip point is enabled)**.

Input Offset:
The input offset value is algebraically added to the input value to adjust the input curve on read-out. The range is –10 to 10.

Scaling:
This is the scaling value. The options are: **Linear Microns**, **Log Torr**, or **Auto Scale**.

TRIP POINT EXPLANATION: Setting a trip point will force the value that the controller uses for calculations to a certain value as assigned by the operator. Once the **Trip Point Setpoint** is reached, the controller will begin reading the value as the **Trip Point Force Value,** regardless of what the actual value is inside the furnace. The **Trip Point Direction** allows the operator to choose whether the controller will alter its reading when the trip point is either above or below the setpoint.

Trip Point 1 Setpoint:
This is the trip point 1 setpoint value. The range is **–32768** to **32768**.

Trip Point 1 Force Value:
This is the trip point 1 force value. The range is **–32768** to **32768**.

Trip Point 1 Direction:
This is the trip point 1 direction. The options are: **input above setpoint** or **input below setpoint**.

Trip Point 2 Setpoint:
This is the trip point 2 setpoint value. The range is **–32768** to **32768**.

Trip Point 2 Force Value:
This is the trip point 2 force value. The range is **–32768** to **32768**.

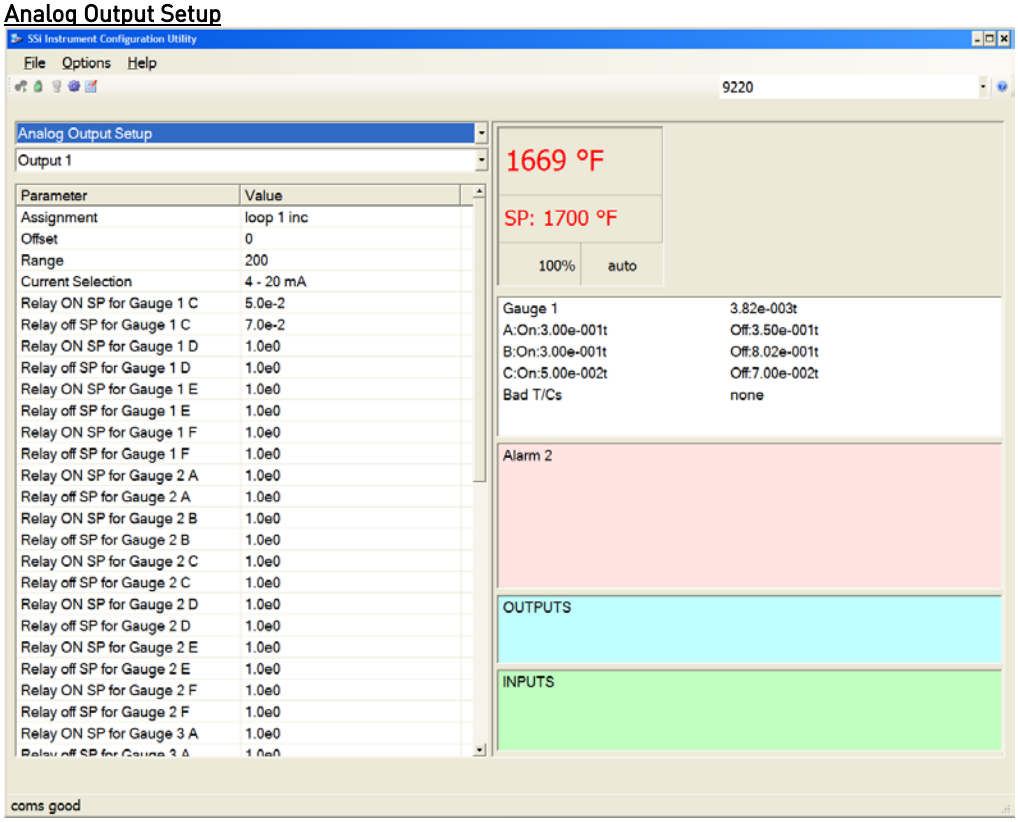
Trip Point 2 Direction:
This is the trip point 2 direction. The options are: **input above setpoint** or **input below setpoint**.

High Input Limit Setpoint:
This is the setpoint for the high input limit. The range is **–32768** to **32768**.

High Input Limit Hysteresis:
This is the setpoint for the high input limit. The range is **–32768** to **32768**.

Custom Curve:
This will allow the user to set the custom curve to use. The options are: **None**, **Curve 1** – **Curve 3**.

Analog Output Setup



The 9220 controller has two analog outputs. The outputs can be configured for 0 – 20 milliamp signal or a 4 – 20 milliamp signal. Each output comes with a factory default configuration dependent on the application. Each output can be modified prior to shipment to your facility or in the field by a supervisor.

Analog Output Terminals:
Analog output 1 – terminals 24(-) and 25(+)
Analog output 2 – terminals 25(+) and 26(-)

Assignment:
The analog output assignment can be modified depending on your system requirements. To change the Assignment first select which analog output you want to change by selecting it in the pull-down menu just below the main menu list. Clicking on this value will display an input box, and then you can use the pull-down menu to select the desired parameter. Once selected click **OK** and the displayed assignment under Value will be the current assignment type. The following is a list of the options:

PV 1 retrans	PV3 retrans	Gauge 1 linear torr	Gauge 4 log of torr
Loop 1 inc	Loop 3 inc	Gauge 1 microns	Gauge 4 linear torr
Loop 1 dec	Loop 3 dec	Gauge 2 log of torr	Gauge 4 microns
Loop 1 combo	Loop 3 combo	Gauge 2 linear torr	Programmer ID num
PV 2 retrans	Input 1 retrans	Gauge 2 microns	SP1 retrans
Loop 2 inc	Input 2 retrans	Gauge 3 log of torr	SP2 retrans

Loop 2 dec	Input 3 retrans	Gauge 3 linear torr	SP3 retrans
Loop 2 combo	Gauge 1 log of torr	Gauge 3 microns	PV switch loop inc
PV switch loop dec	PV switch loop combo	Programmer Analog Out 1	Programmer Analog Out 2
Programmer Analog Out 3	Programmer Analog Out 4	Programmer Analog Out 5	Programmer Analog Out 6
Disabled			

NOTE: The 'Disabled' setting allows the external device to write directly to the output register of the 9220's internal Digital Analog Converter.

Combo example for carbon – 4 – 12 mA Air
12 – 20 mA Gas

Offset:
This is the starting point, the Process Variable value at which you get 4 milliamps. Normally, when scaling a control output, this would be the low range and is set up for 0. This value can vary depending on the scaling needs. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.

Range:
This is a Process Variable value between 4 and 20 milliamps. Normally, when scaling a control output, this would be the low range and is set up for 100. This value can vary depending on the scaling needs. Clicking on this value will display an input box from which the user can select a new value. The range is **–32768** to **32767**.

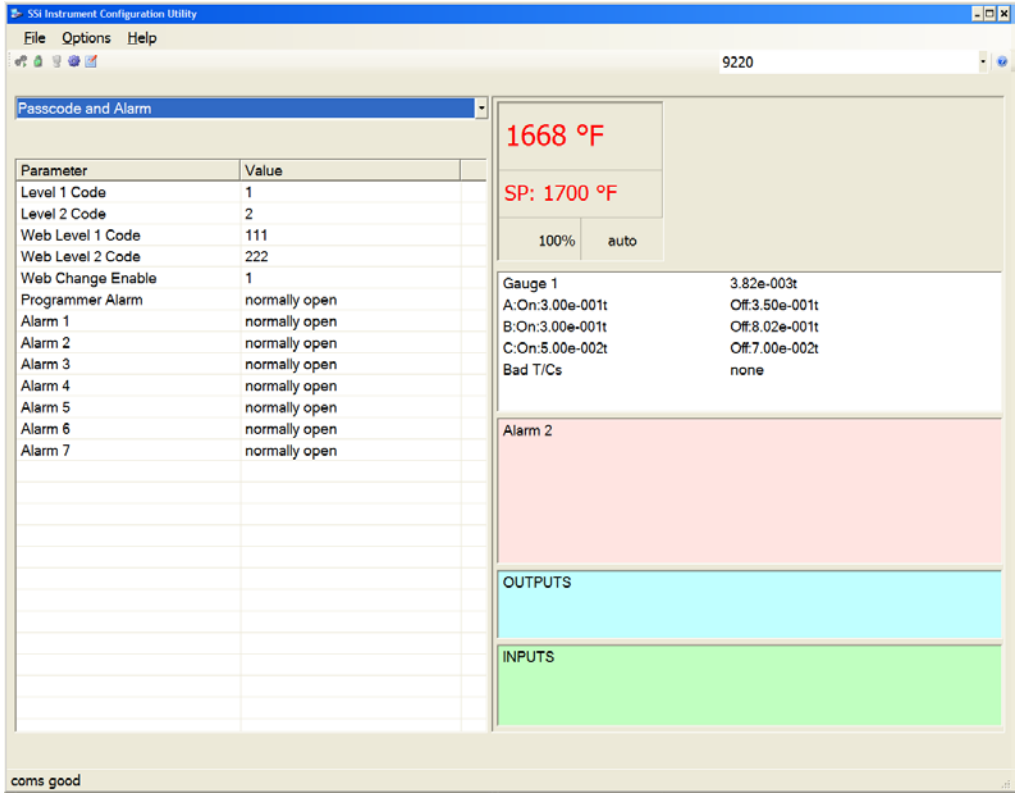
Current Selection:
Provides the option of **4-20 mA** or **0-20 mA** control. Clicking on this value will display an input box with a drop-down list from which the user can select either of the two values listed above.

Offset and Range when assigned to a control loop:
Inc -- 0 = 4mA, 100 = 20mA
Dec -- 0 = 4mA, -100 = 20mA

Example: if 4 – 20 mA = 800 mV - 1200 mV
Offset = 800 (starting point)
Range = 400

Passcode and Alarm

There are three levels of menus in the 9220 vacuum controller - Operator, Supervisor, and Administrator



Operator Level:

These are functions typically handled by a furnace operator and do not require a passcode. When an operator is logged in, the lock on the toolbar will be blue, .

Supervisor Level:

These are functions typically used by a supervisor and require a level 1 passcode. When a supervisor is logged in, the lock on the toolbar will be gold, . To change the level 1 passcode, or the web level 1 passcode, click on the "Level 1 Code" value (range is **–32768** to **32767**) or the "Web Level 1 Code" value (range is **0** to **9999**) and an input box will be displayed where the user can select a new value.

Administrator:

These are functions typically used by an administrator and require a level 2 passcode. When an administrator is logged in, the lock on the toolbar will be green, . To change the level 2 passcode or the web level 2 passcode, click on the "Level 2 Code" value (range is **–32768** to **32767**) or the "Web Level 2 Code" value (range is **0** to **9999**) and an input box will be displayed where the user can select a new value.

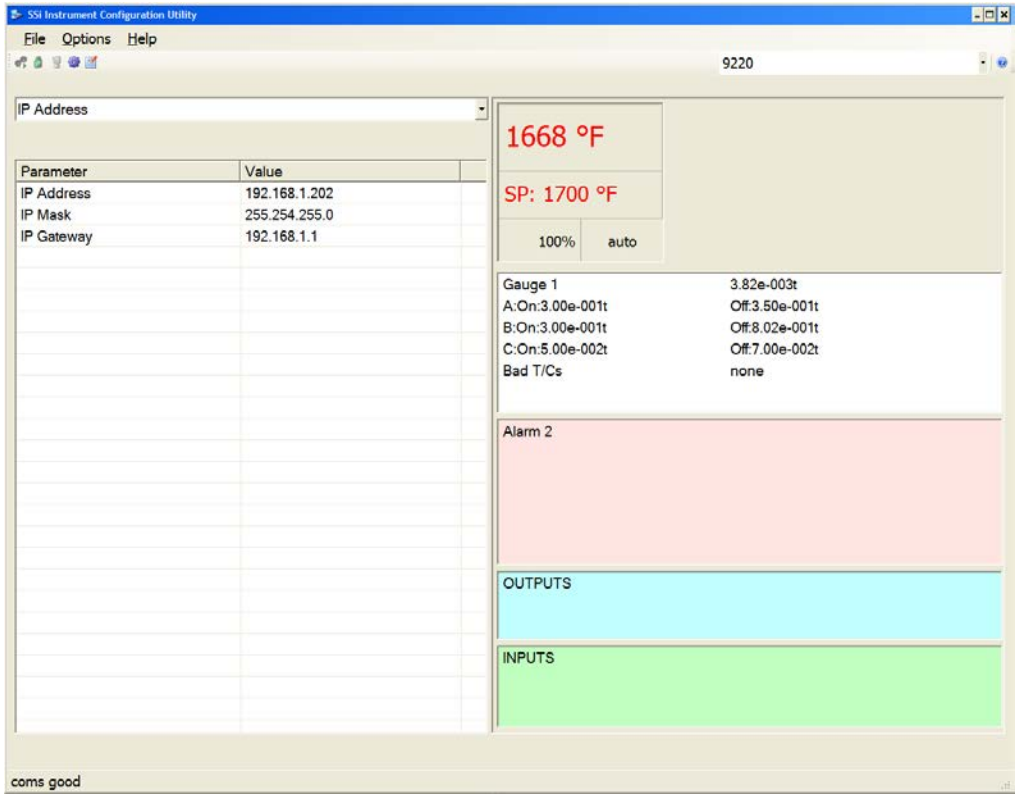
Programmer Alarm:
Also available in this menu option is the availability to change the status of the relay contact with relation to alarms. As shipped, the relay contact is open with no alarm. The user can choose either **normally open** or **normally closed**.

Alarms 1-7:
The user can choose either **normally open** or **normally closed**.

IP Address

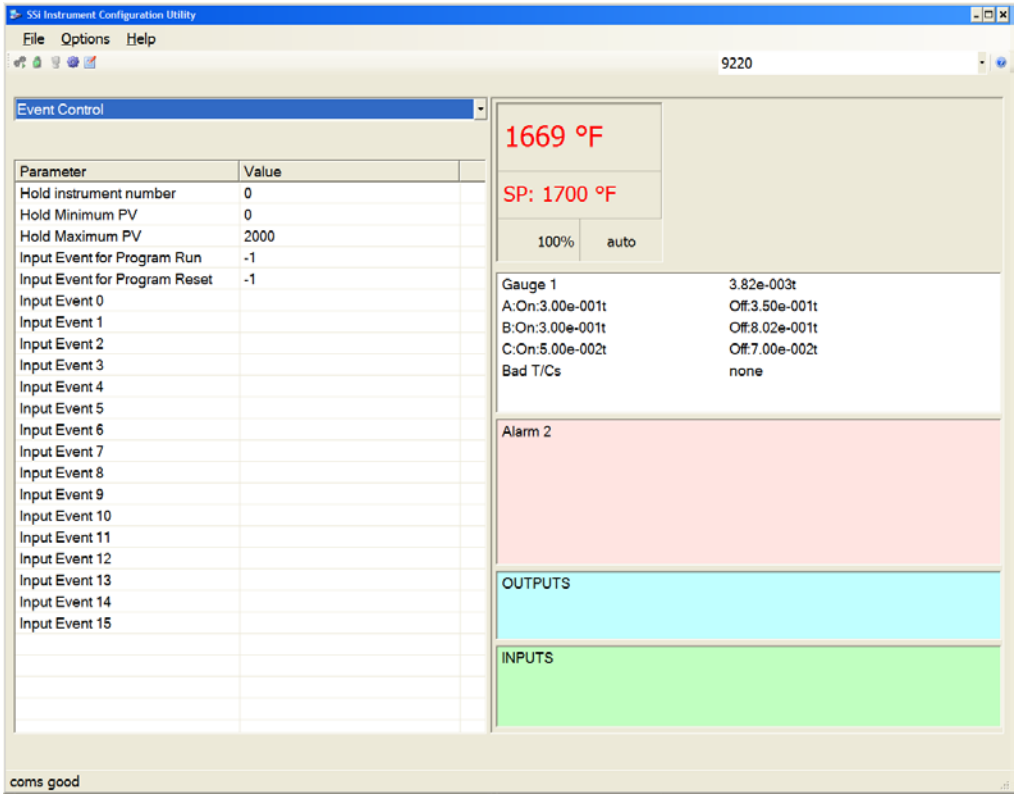
The IP Address menu item is a display of the current IP Address, IP Address Mask, and the IP Address Gateway of the controller.

This page allows the user to change the IP Address, IP Address Mask, and IP Address Gateway for the instrument. Modification of the screen should not be done if an existing SuperDATA or data collection system is in use. In certain applications, IP Addresses are assigned to specific equipment. Improper changes may results in a loss of data to SuperDATA (or equivalent). Contact Super Systems with any questions. Clicking on any of the values will bring up an input box that will allow the user to edit all of the values. The range is **0** to **255**. ***NOTE:*** *If the IP address of the controller is changed, then Configurator will no longer be able to communicate to the controller unit until the IP address for Configurator to instrument has been changed in the System Settings menu option (*  *). Once the IP address has been changed to the new value using this menu option, if the device is configured to communicate to Configurator 2.0 using the "Ethernet" connection, the communications will show as "bad comms" in the lower left corner of the application window until the device IP address has also been revised in the device Settings – Manage Controllers tab.*



Event Control

The Event Control provides the user manual control of actual event outputs. This is useful when testing wiring and field devices.



Hold Instrument Number:
Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **25**.

Hold Minimum PV:
Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **4000**.

Hold Maximum PV:
Clicking on this value will display an input box from which the user can select a new value. The range is **0** to **4000**.

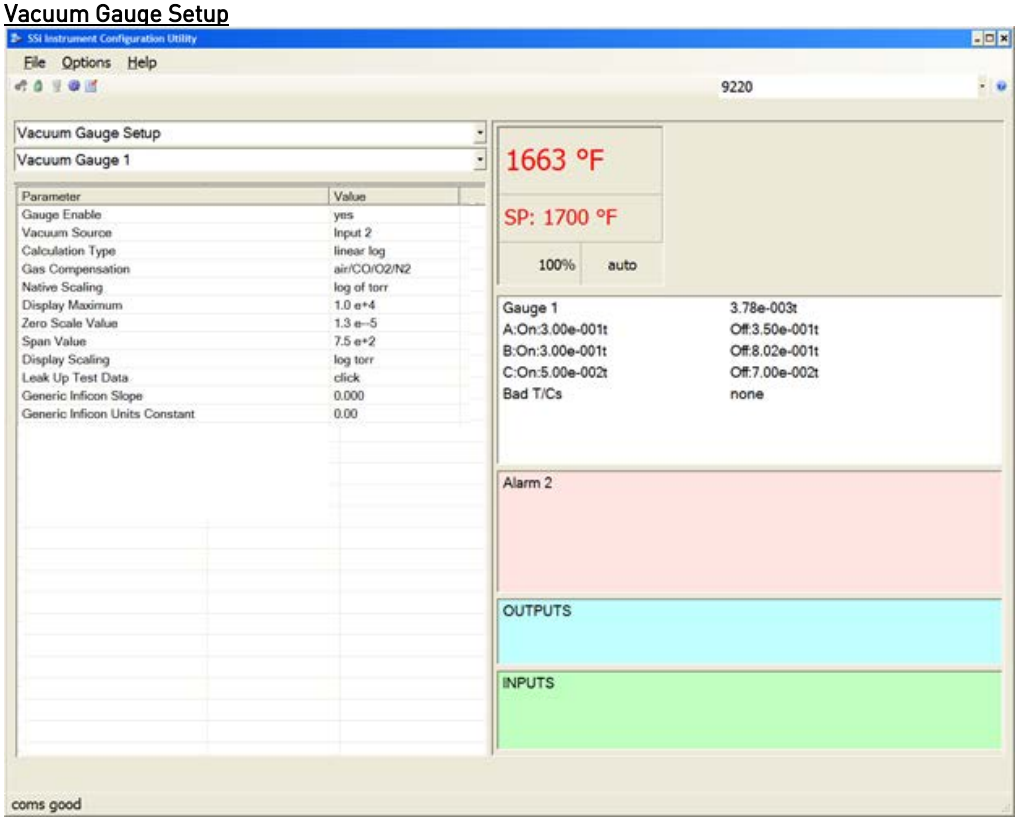
Input Event for Program Run:
Clicking on this value will display an input box from which the user can select a new value. The range is **–1** to **15**. This event input will start the recipe defined in the "Program Number to Run".

Input Event for Program Reset:
Clicking on this value will display an input box from which the user can select a new value. The range is **1** to **15**. This event input will reset the recipe that is currently running if the Recipe Hold Output is configured and active.

Event 0 Through Event 15:
An event is an input or output variable. The input box for these events has two drop-down lists. The top list contains **active** and **inactive**, and the bottom list contains **closed** and **open**. The top list contains active and inactive, and the bottom list contains closed and open. When this setting is "active", the controller will monitor for that event; when it is "inactive", the controller will not monitor for that event. When this setting is set to Closed, that means the recipe will be held when the event is closed (on). When this setting is set to Open, that means the recipe will held when the event is open (off). This makes for the following combinations:

- Active Closed: Event is monitored by controller; recipe is held when event is happening.
- Active Open: Event is monitored by controller; recipe is held when event is not happening.
- Inactive: The event is not monitored by controller (Closed and Open have no bearing on an Inactive setting).

Vacuum Gauge Setup



The Vacuum Gauge Setup menu option allows the users the ability to set up four different vacuum gauges, which can be selected from the lower drop-down list.

Gauge Enable:
This value will enable or disable the selected gauge. The options are either **No** or **Yes**.

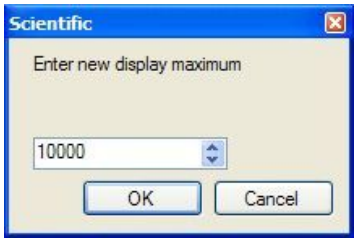
Vacuum Source:
This value will allow the user to select the source of the gauge. The options are: **Input 1** – **Input 3**, **Televac Gauge 1** – **Televac Gauge 4**.

Calculation Type:
This option sets the calculation type for the vacuum gauge which will control how the 9220 interprets the signal from the vacuum gauge. Most standard vacuum gauges are included in the drop down menu. However, if the gauge you are using is not included, the drop down menu includes the option of using a custom curve. See the section on Custom Curves in the Touch Screen section for more details on how to use this feature.

Gas Compensation:
This value will allow the user to select the type of gas compensation for the gauge. The options are: **air/CO/O2/N2**, **Helium**, **Neon**, **Argon**, **Krypton**, **Xeon**, **H2**, **CO2**, **Water Vapor**, or **Freon 12**.

Native Scaling:
This value will set the native scaling for the gauge. The options are: **torr**, **microns**, **millibars**, **bars**, **pascals**, **kilopascals**, or **log of torr**.

Display Maximum:
This value will set the maximum display value for the gauge. Clicking on this value will display an input box for the user to set the new maximum.



The left number box has a range of **–10.00** to **10.00**, and the right number box has a range of **–31** to **31**.

Zero Scale Value:
This value will set the zero scale value for the gauge. Clicking on this value will display an input box for the user to enter the zero scale value that is identical to the input box from the "Display Maximum" menu description.

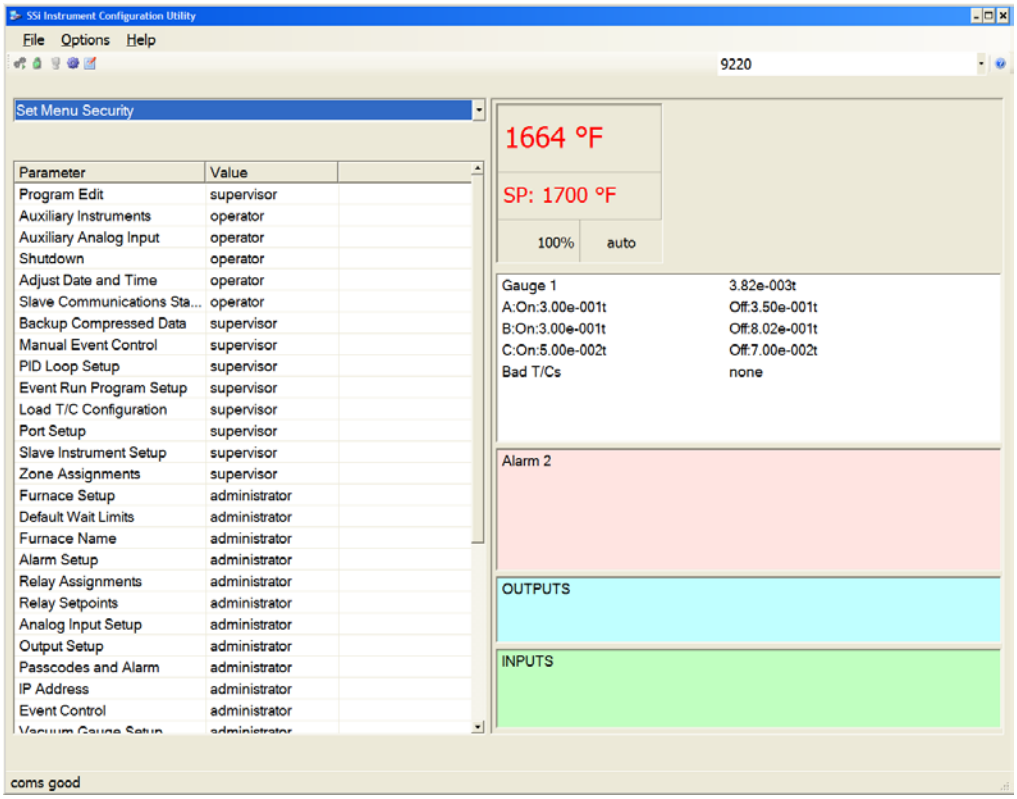
Span Value:
This value will set the span value for the gauge. Clicking on this value will display an input box for the user to enter the span value that is identical to the input box from the "Display Maximum" menu description.

Display Scaling:
This value will set the scaling for the display. The list of options is: **log torr**, **torr**, **microns**, **millibars**, or **pascals**.

Leak Up Test Data:
Clicking the "click" button for this option will open a new window showing stored Leak Up Test Data associated with the currently selected gauge.

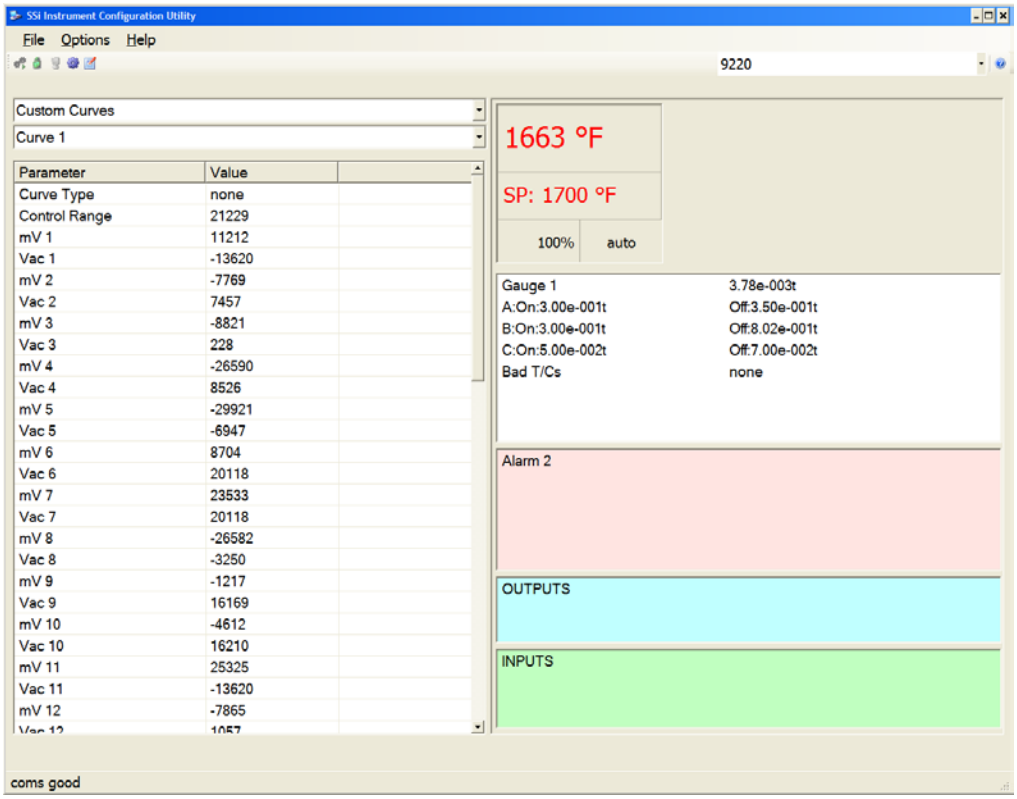
Generic Inficon Slope and
Generic Inficon Units Constant:
These values are specific to Inficon gauges. Consult Inficon product documentation for more details.

Set Menu Security



The Set Menu Security menu option is a feature that is used to limit access to certain menu options and parameters that are vital to successful operation and communication of your instrument. This page comes pre-configured by Super Systems Inc. and should not be adjusted without consulting SSI. The options are **operator**, **supervisor**, or **administrator**.

Custom Curves



Custom Curves is typically used for Vacuum and Nitriding applications. Most types of inputs that are used in SSi controllers are already set up with a curve built for most every type of thermocouple available, certain vacuum sensors, etc. However, if an application calls for an input without a standard curve, the curve can be built using this option. Voltages can be paired with corresponding vacuum values to create a sensor curve based off of a provided equation or data. This allows the controller to make appropriate readings from the sensor. It allows the user to enter custom flow curves and vacuum gauge curves for Curve 1 through Curve 5.

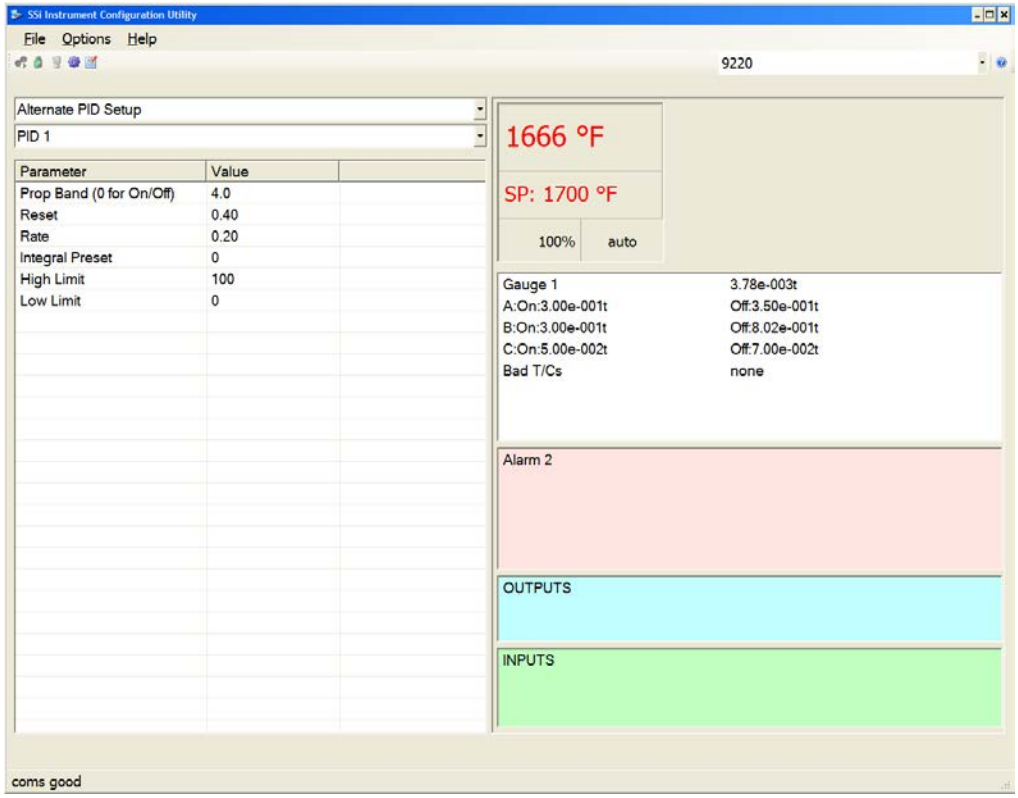
Curve Type:
This is the type of curve. The options are **none** or **linear**.

Control Range:
This is the control range for the curve. The range is **0** to **32000**.

mV*X*(1 – 32):
Clicking on this value will display an input box from which the user can select a new millivolt value. The range is from **0** to **32000**.

Vac*X* (1 – 32):
Clicking on this value will display an input box from which the user can select a new vacuum value. The range is from **0** to **32000**.

Alternate PID Setup



The Alternate PID Setup menu option allows for up to 16 sets of PID values to be used on all three loops via the programmer. PID 1-16 can be loaded via a recipe using the PIDLOAD opcode. See the opcodes section for more information.

This menu option is typically used for vacuum applications with the programmer.
There is a choice of PID 1 – 16, and LP1 Set 1 – LP3 Set 3.

NOTE: The feature of PID Auto Switch is disabled for the entire duration of a recipe when the opcode PIDLOAD is executed. See the PID Loop Setup section for more information.

Prop Band (0 for On/Off):
This is the proportional band for the PID setup. The range of values is **–1.0** to **999.0**.

Reset:
This is the reset value. This is the reset value. I = Integral (Reset). This is the actual temperature being monitored over a period of time and then averaged to keep within the Proportional band. The reset is in repeats per minute. This affects the output of the controller. It will be proportional to the amount of time the error is present. This helps to eliminate offset. The range is **0.00** through **10.00**.

Rate:
This is the rate value. This is the rate value. D = Derivative (Rate). This is the sudden change or rate in the temperature. This rate is in minutes. This affects the controller output which is proportional to the rate of change of the measurement and will control the amount of output by time restraints. Thus derivative takes action to inhibit more rapid changes of the measurement than proportional action. Derivative is often used to avoid overshoot. The range is **0.00** through **10.00**.

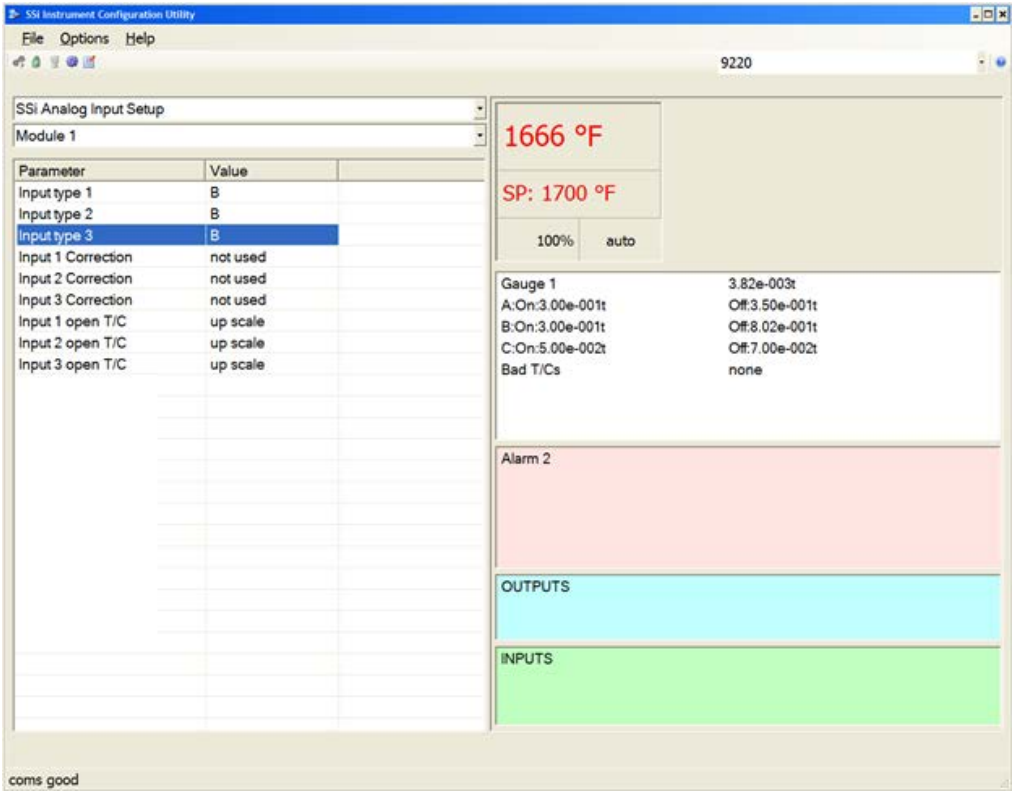
Integral Preset:
This is the integral preset value. This field provides an offset for the starting point for PID control, also referred to as "Load Line" or "Manual Reset". The range is **–100** to **100**.

High Limit:
This is the high limit value. The range is **–100** to **100**.

Low Limit:
This is the low limit value. The range is **–100** to **100**.

SSi Analog Input Setup (SRX Box)

The SSi Analog Input Setup menu option allows the user an input selection of three inputs per board, three input corrections per board, and three input open T/Cs per board. There are eight (8) boards available. It is configurable for voltage of T/C (universal input), and it is typically used for Load T/Cs and Auxiliary Flow Meters.



Clicking on any of the values will display an input box from which the user can select the input type from a drop-down list with the following values:

B	S	4 – 20 mA/124Ω **
C	T	4 – 20 mA/62Ω **
E	2.56 volts *	25.6 volts *
J	1.28 volts	12.8 volts *
K	160 mV	
N	80 mV	
NNM	40 mV	
R	20 mV	

*** - When the specified input type is selected, a jumper located inside the case will need to be placed on the 10:1 and 4-20 jumper pins on that specific input for reading this selection. If jumper is not placed on input, then damage could occur to the board.**

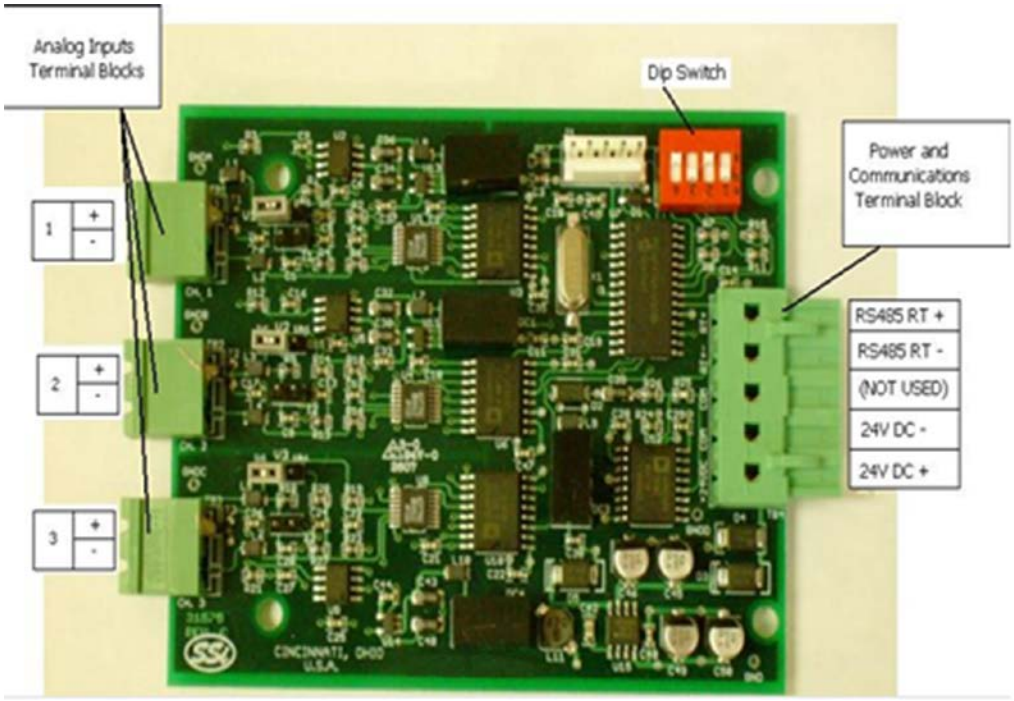
**** - When the specified input type is selected, a jumper located inside the case will need to be placed on the 10:1 jumper pins on that specific input for reading this selection. If jumper is not placed on input, then damage could occur to the board.**

The corrections can either be **not used**, or **Curve 1** – **Curve 3**. The curves are set up using the *TC Extension Correction Curves* menu option. When creating curves in the *TC Extension Correction Curves*

menu, the curves will be labeled Aux Curve 1- Aux Curve 3. When selecting these curves in the *SSi Analog Input Setup* menu, the corresponding curves are labeled Curve 1- Curve 3, not Aux Curve 1- Aux Curve 3.

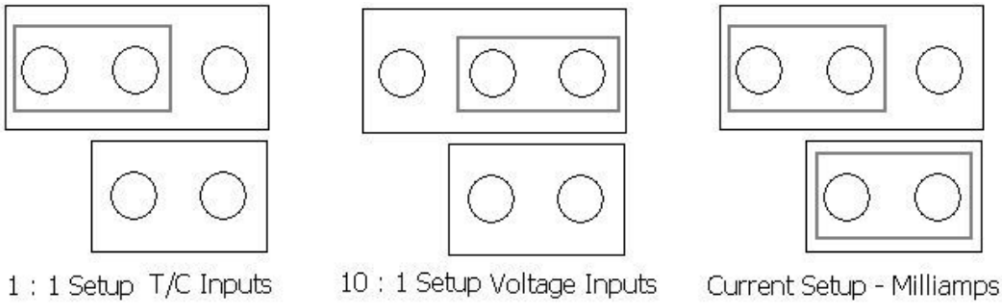
SSi Analog Input Board (SR)

The Super Systems, Inc. Part Number 31611 Analog Board contains a group of three channels isolated from the main DC power source. Each input is fully isolated. The board can be connected to thermocouples, voltage sources from 20mV full scale to 1.28 Volts full scale, voltage sources from 0 V full scale to 10 V DC full scale, or 4 – 20 mA current loops.

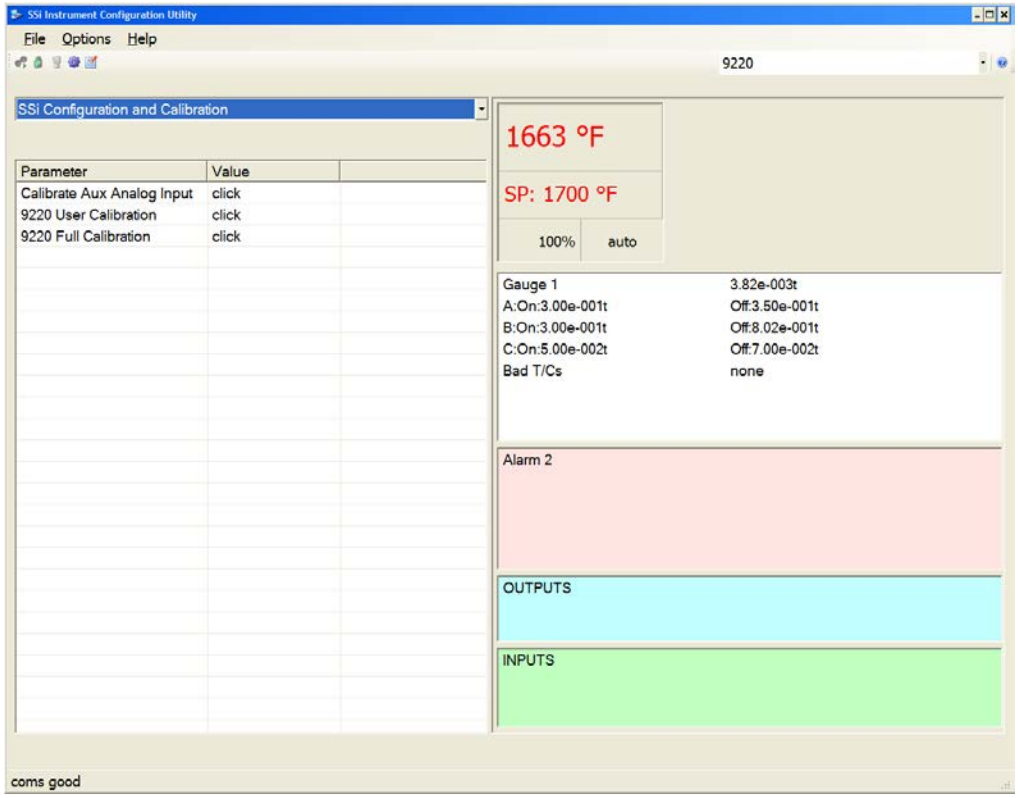


Adding a Jumper to an Input

When measuring a 4-20mA current signal or a voltage signal, such as a thermocouple, a jumper must be placed on the corresponding two or three-position header. For example, Input 1 would need to have a jumper placed between the pins labeled "I1" before connecting a 4-20mA signal. Failure to add the jumper will result in damage to the circuit board. The jumper may already be present at each of the three headers, but unless it is attached across both pins (not just one) it will not be connected.



SSi Configuration and Calibration



Overview

The series 9220 can be calibrated using the Instrument Configurator software supplied with the system. Before performing this procedure on a newly installed controller, the unit needs to be powered on for at least 30 minutes for a warm up period.

The series 9220 has three analog inputs. Each range has a zero and span calibration value. A cold junction trim value must be calibrated for thermocouple inputs. There are two analog outputs each with a zero and span value.

Equipment needed

A certified calibrator(s) with the ability to source and read millivolts, milliamps and thermocouples is required. The appropriate connection leads are also required. The operator interface method requires a PC with the Configurator software loaded. An Ethernet crossover cable is required.

Notes

Input 1 – terminals (-) 31 and (+) 32
Input 2 – terminals (-) 29 and (+) 30
Input 3 – terminals (-) 27 and (+) 28
Output 1 – terminals (-) 24 and (+) 25
Output 2 – terminals (-) 25 and (+) 26

Calibrate Aux Analog Input

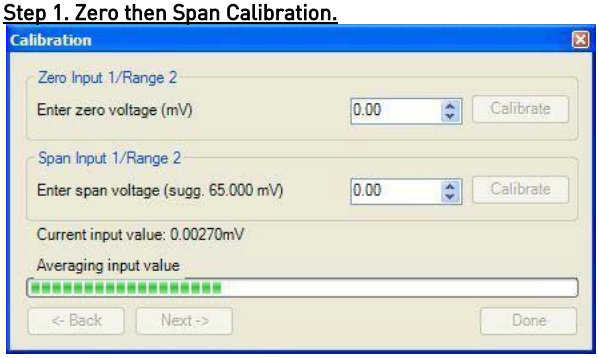
If an SSi analog input board is set up, then this menu option will be visible. For information on how to calibrate an SSi analog input board, see the **Calibrate Aux Analog Input** section located at the end of this section.

User Calibration

NOTE: This section details how to calibrate the 9220 inputs. For instructions on calibrating an SSi analog input board, see the **Full Calibration** section.

Click on the "click" value next to the "9220 User Calibration" field to start the user calibration. The Calibration screen will be displayed. For complete calibration of Analog Inputs start with step #1, Zero and Span Calibration. The Cold Junction Calibration should be performed **AFTER** the user has calibrated all of the inputs and, if needed, outputs.

Step 1. Zero then Span Calibration.



The second screen (Zero/Span Calibration), and all of the subsequent screens, will allow the user to zero and span calibrate the inputs and outputs for the 9220 controller (cold junction calibration will be performed as a final step).

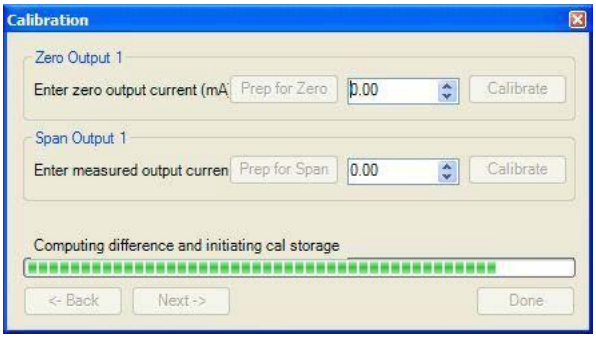
For a zero calibration, a value of 0 mV will need to be sourced to the input or inputs.

In the "Zero Input X/Range Y" section, enter the zero voltage and click on the Calibrate button. This will calibrate the zero range. The progress of the calibration will be shown in the progress bar at the bottom of the screen.

For a span calibration, a value of 90% of the full range (or the adjusted value) will need to be sourced to the input or inputs.

In the "Span Input X/Range Y" section, enter the span voltage that you are sourcing in and click on the Calibrate button. A suggested value will be supplied. This will calibrate the span range. The progress of the calibration will be shown in the progress bar at the bottom of the screen. Repeat these steps for all of the inputs.

Clicking on the Next -> button will display the next screen(s) for the user calibration. Clicking on the <- Back button will display the previous screen(s).



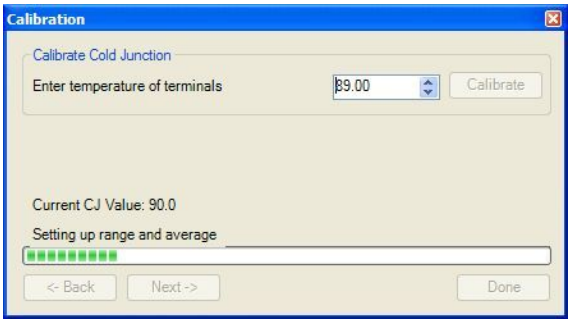
To calibrate the zero range for the outputs, you must first attach your measuring device.
In the "Zero Output X" section, click on the Prep for Zero button. Let the unit output what it has set for the zero measurement, then enter what you are measuring coming out of the terminals. Once entered, click on the Calibrate button and let the procedure finish. The progress of the calibration will be shown in the progress bar at the bottom of the screen.

In the "Span Output X" section, click on the Prep for Span button. Let the unit output what it has set for the span measurement, then enter what you are measuring coming out of the terminals. Once entered, click on the Calibrate button and let the procedure finish. The progress of the calibration will be shown in the progress bar at the bottom of the screen. Repeat these steps for all of the outputs.
Once all of the inputs and outputs have been calibrated, return to the first screen for cold junction calibration, if necessary.

Step 2. Cold Junction Calibration.

NOTE: Perform zero and span calibrations (see previous section) before following this procedure.
The "Cold Junction" option allows the user to perform a cold junction trim on the 9220 analog input board.

To determine if a cold junction adjustment is needed, hook up the calibrator with the appropriate T/C wire attached (reference the specific input under the "Analog Input Setup" menu), then source a temperature to the input. It is best to use an operating temperature to source; for example, if the furnace typically runs at 1700 °F, then 1700 °F should be sourced to the input. Source a range of temperatures – this will help determine whether any difference in readings is linear.



NOTE: This value is NOT the temperature displayed on the "Cold Junction Calibration" menu option – rather, this is the value displayed on the main screen along with set point and output.

If the displayed value does not equal the value being sourced, then a Cold Junction Calibration may be necessary. To begin, note the difference between the displayed temperature and the sourced temperature. This is the adjustment that will be made in

the "Cold Junction" menu. For example:

Source Temp	Displayed Temp	Difference	Cold Junction Adjustment	Current Temp of Terminals	New Temp of Terminals
1700	1711	11 High	-11	72	61

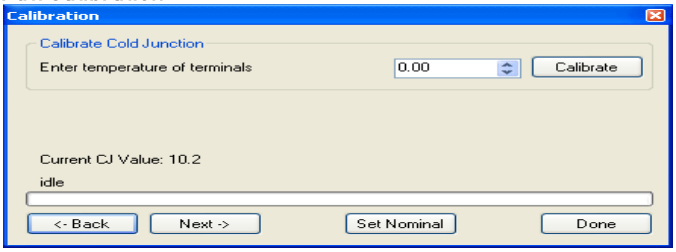
In this situation, the displayed temperature on the main screen is 11° higher than the sourced input. Therefore, 11° must be subtracted from the current "temperature of terminals" reading. Use the up and down arrows to adjust the "Enter temperature of terminals" input box to the appropriate value (in this case, 61).

Click on the "Calibrate" button to begin the calibration.

After 30 minutes, verify the calibration by again sourcing a temperature to the input and checking the displayed temperature reading on the main display. It is recommended to perform this calibration check after every cold junction calibration.

Click on the **Done** button to close down the screen.

Full Calibration



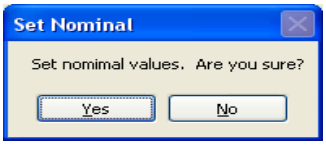
NOTE: Full calibration is performed by SSi. The below information is provided for reference only.

The *Calibration* screen for the Full Calibration menu option is identical in function and layout to the User Calibration's *Calibration* screen. The only difference is the Full Calibration's *Calibration* screen contains more screens. This list of screens is listed below in sequential order. Screens only found in the Full Calibration menu option are displayed in *Italics*. Screens only found in the User Calibration menu option are displayed in **bold**.

1. Cold Junction
2. *Zero/Span Input 0/Range 0*
3. *Zero/Span Input 0/Range 1*
4. *Zero/Span Input 0/Range 2*
5. *Zero/Span Input 0/Range 3*
6. *Zero/Span Input 1/Range 0*
7. Zero/Span Input 1/Range 1
8. *Zero/Span Input 1/Range 2*
9. *Zero/Span Input 1/Range 3*
10. *Zero/Span Input 2/Range 0*
11. *Zero/Span Input 2/Range 1*
12. *Zero/Span Input 2/Range 2*
13. Zero/Span Input 2/Range 3
14. **Zero/Span Input 3/Range 2**

15. *Zero/Span Input 1 Range Jumper*
16. *Zero/Span Input 2 Range Jumper*
17. *Zero/Span Input 3 Range Jumper*
18. Zero/Span Output 1
19. Zero/Span Output 2

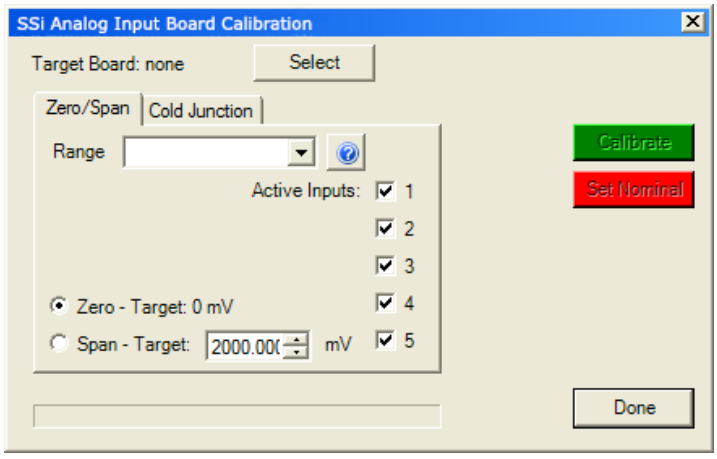
The *Calibration* screen for the Full Calibration menu option also has a **Set Nominal** button, which will set nominal values for the current screen. The user will have to confirm the action.



Clicking on the **Yes** button will set the nominal values, and clicking on the **No** button will cancel the action.
Click the **Done** button to close the screen down.

Calibrate Aux Analog Input

NOTE: This section details how to calibrate an SSi analog input board, **not the 9220 inputs themselves**.
For instructions on calibrating the 9220 inputs through Configurator, see the **User Calibration** section.



If an SSi analog input board is applicable, then this menu option will be visible. The Calibration menu screen will allow the user to calibrate the zero, span, and cold junction trim value for all of the inputs on each board.
The **Select** button will allow the user to select one of the current boards to calibrate.
Select the appropriate board and click on the **OK** button. Clicking on the **Cancel** button will not select the board to calibrate. *Note: A board must be selected for calibration to begin.*

The user will need a thermocouple calibrator capable of sourcing a thermocouple signal to calibrate the zero, span or cold junction value. It is recommended to let everything (calibrator and datalogger) sit for approximately thirty minutes to allow the temperature to achieve equilibrium. Set up the calibrator for the specific thermocouple type, i.e. type K, type J, etc. Then, source a specific temperature, like 1000°F, or millivolt to the connected input. It is recommended that the actual temperature used be similar to an appropriate process temperature. For example, if your equipment normally operates at 1700°F, then perform the cold junction calibration using a 1700 °F signal. It is important to note that when performing a zero or span calibration, ***do not use*** **regular thermocouple wiring. Instead, use any kind of regular sensor wire, or even regular copper wire.** To perform the calibrations, the user will need a calibrator that is capable of outputting volts, millivolts, and temperature.
The "Zero/Span" tab will allow the user to perform a zero and span calibration on the selected board.
The help button -  - next to the "Range" drop-down list will allow the user to select a range based upon an input type if the range is not known.

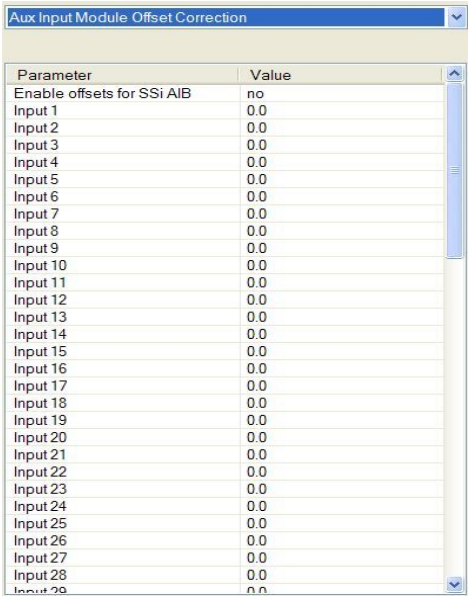
Select the input type and click on the **OK** button. The correct millivolt range will be displayed in the drop-down list. Click on the **Cancel** button to cancel this action.

Below is a listing of the suggested ranges for the various TC types.

TC Type mV Range Chart

TC Type	Range in mV
B	20mV
C	40mV
E	80mV
J	80mV
K	80mV
N	80mV
NNM	80mV
R	40mV
S	20mV
T	20mV

Aux Input Module Offset Correction



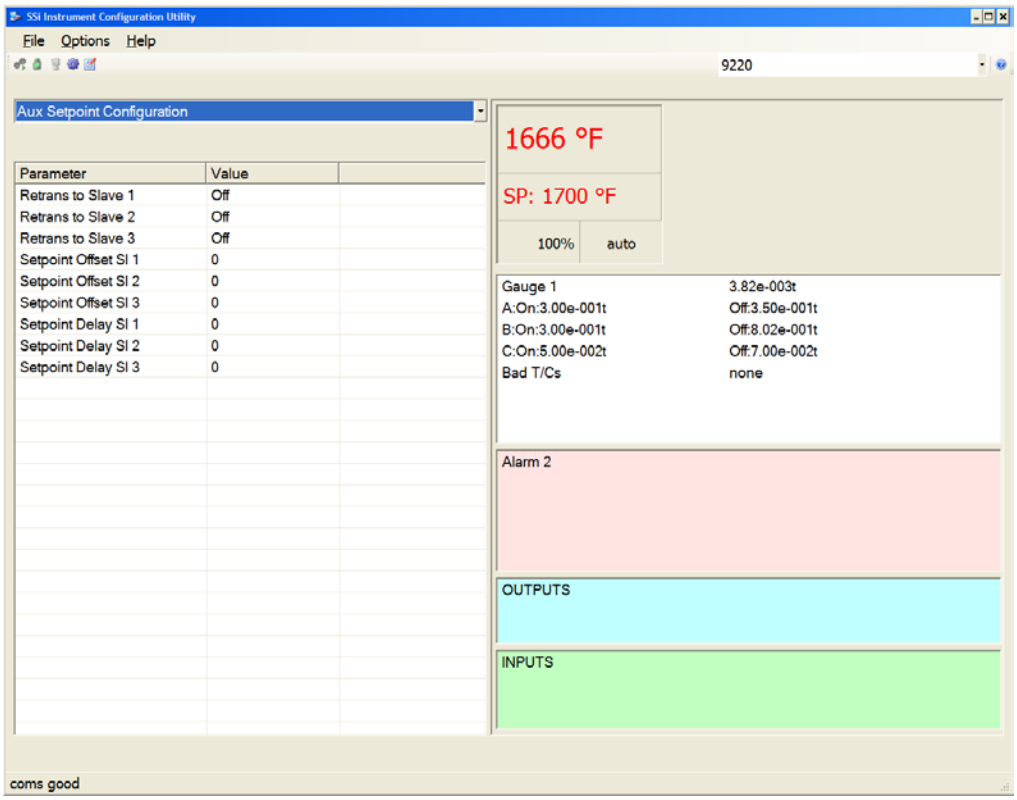
This menu option will allow the user to enter offsets for the auxiliary inputs and apply any correction curves as needed. Adding an offset using this option will apply the offset to the entire curve, shifting each point by the same amount. First, A/I Offsets must be enabled by changing the value of the first row to Yes. Then, clicking on the value next to the appropriate input will display the option to enter an offset for that input. The offset can be in degrees + or -, and it is typically used to compensate for incorrect T/C wires.

Enable Offsets for SSi AIB
This will enable the use of offsets for any analog input boards. The options are: **Yes** or **No**.

Input 1 – **Input 40**
This is where the actual offsets will be entered for each input. The range is **-50.0** – **50.0**.

Input 0 Correction – **Input 39 Correction**
This is where any correction curve can be applied for each input. *Note – The input names for the corrections are offset by 1, so Input 0 is actually Input 1, Input 39 is actually Input 40, etc*. The options are: **Not Used**, **Curve 1**, **Curve 2**, or **Curve 3**.

Aux Setpoint Configuration



See the menu option *Slave Instruments* for configuration prior to using *Aux Setpoint Configuration*. This menu option allows for up to 3 slave instruments to have the setpoint retransmitted from one of the three control loops. This menu option is typically used to retransmit an alarm setpoint value to an overtemp controller.

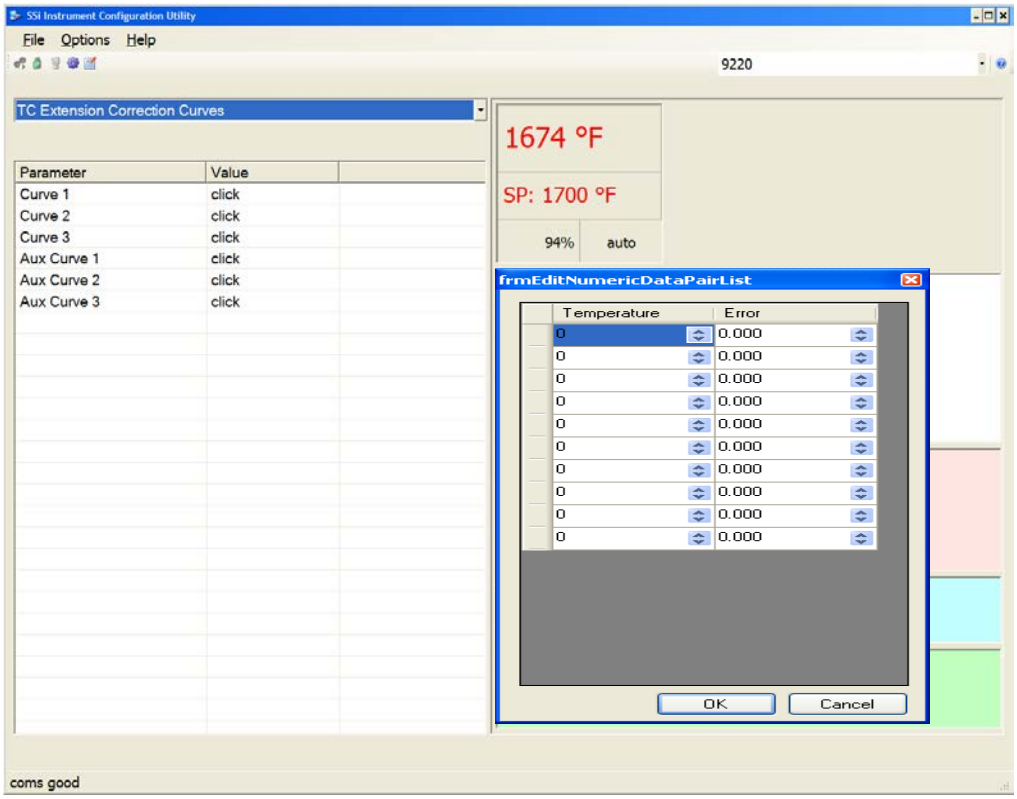
Offset:
Carbon - 1 = 0.01
Temperature – 1 = 1

Delay:
This is measured in seconds
Clicking on the values for "Retrans To Slave 1", "Retrans to Slave 2", or "Retrans to Slave 3" will display an input box with a drop-down list from which the user can select the new value. The options are:

Off
Loop 1
Loop 2
Loop 3

Clicking on any of the values for "Setpoint Offset SI 1", "Setpoint Offset SI 2", "Setpoint Offset SI 3", "Setpoint Delay SI 1", "Setpoint Delay SI 2", or "Setpoint Delay SI 3" will display an input box from which the user can select the new value. The range is **–32768** to **32767**.

TC Extension Correction Curves



This menu option will allow the user to set up to three TC correction curves for the 9220 controller. The error offsets applied here will only affect the corresponding temperature value. Once the curve has been completed, it can be applied to an input by using the SSi Analog Input Setup option in Configurator. Clicking on the "click" value for a curve will display the curve edit form. *Note: If the first "Temperature" value and the first "Error" value are both zero, then the curve will not be set.* The user can enter up to ten "Temperature"/"Error" combinations. The range for the "Temperature" field is **–300** to **9999**. The range for the "Error" field is **–30.000** to **30.000**.

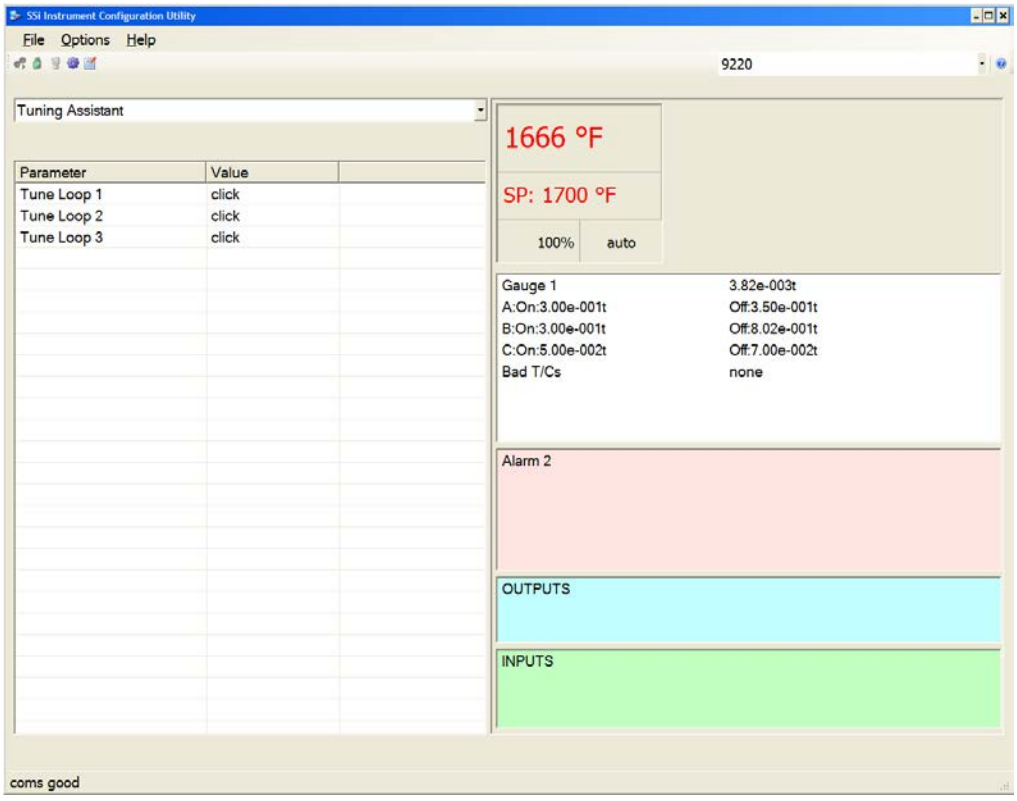
NOTE: Curves are interpolated between points in order to provide a smooth transition between those points. For example:

Point	Temp	Error
1	100	0
2	300	2

In the above setup, temperatures would read as follows:

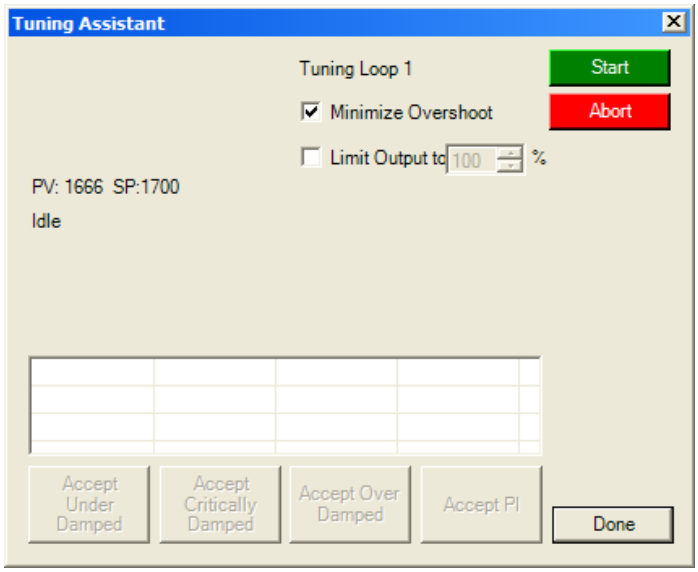
Actual Temperature	Displayed Temperature
100	100
150	150.5
200	201
250	251.5
300	302

Tuning Assistant



The tuning assistant will allow the user to automatically generate the PID settings for a specific loop. Click on the "click" value to start the tuning assistant. *Note: It is recommended to change the*

temperature setpoint immediately prior to initiating an auto tune. The tuning assistant will begin tuning once there is a 10% range difference between the actual temperature and the setpoint.



The user can select the loop to tune from the Tuning Assistant. Loop 1 is the primary temperature loop; Loops 2 and 3 can be tuned if necessary. When you select "click" to open the Tuning Assistant, you will see which loop you are tuning as well as the PV and SP. When "Minimize Overshoot" is checked the Tuning Assistant will suggest more conservative PID values in an effort to control overshoot. The "Limit Output to x%" checkbox allows you to set a maximum output percentage; this feature is useful when output may need to be limited due to physical characteristics of the furnace.

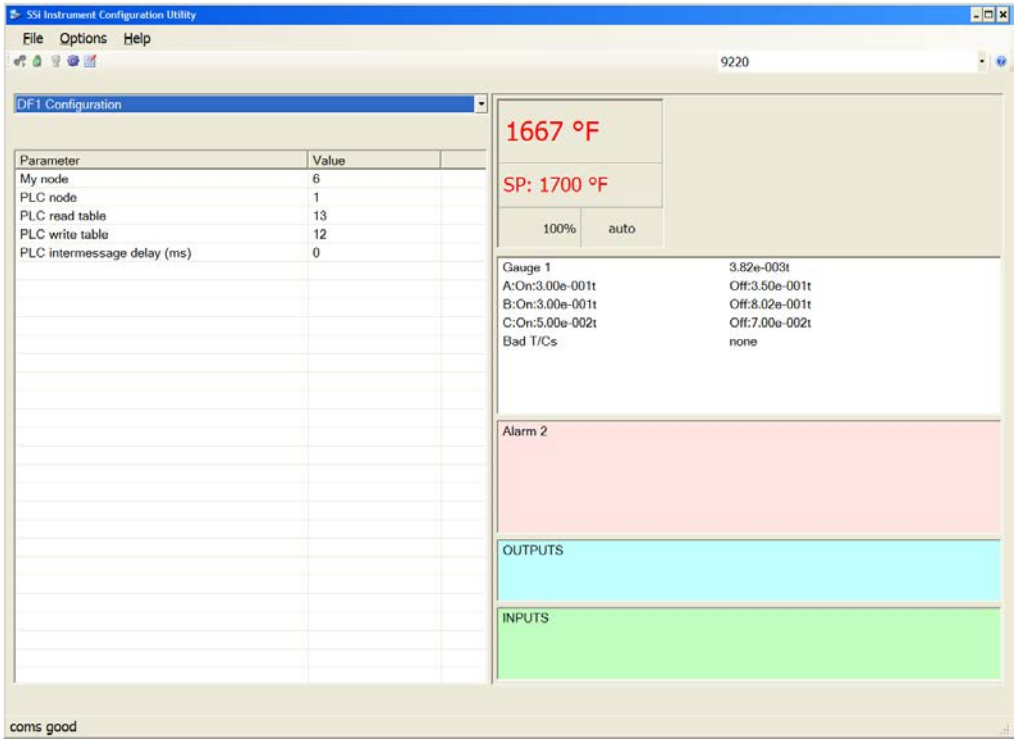
Click on the **Start** button to begin the auto tune process. *NOTE: The process may take up to 30 seconds to start depending on the difference between actual temperature and setpoint not being within 10%*. Once the process has started, the "Idle" line will change to "Tuning: Pointer xx". This means that the tuning process is working. When the tuning is finished, the "Tuning: Pointer xx" line will read "Idle" again, and the list underneath will be populated with suggested PID settings. *NOTE: Clicking on the **Done** button while the tuning is in progress will close down the screen, but the user will have to confirm the action. However, clicking on the **Abort** button will simply abort the calibration process.*

Each column for the PID settings relates to the button below. For example, the second column is the PID settings for the Critically Damped values. The user can accept only one set of numbers. To select a set of values, click on the corresponding button. For example, to accept the critically damped values, click on the **Accept Critically Damped** button.

The under damped values will reach the setpoint faster, but there will be more overshoot involved. The over damped values will work to minimize the overshoot, but it will be slower than the under damped values. The critically damped values are considered the "optimum" values because they are a balance between the under damped and over damped values with regards to time and overshoot. The PI values are just the proportional band and the reset value (the *P* and the *I* from *PID*). This could be applicable in an atmosphere loop, where the rate will not have much effect.

Once a set of values has been accepted, the user can press the **Done** button to exit the screen. The accepted values can be viewed on the *PID Loop Setup* menu option. In future tuning sessions, the most recent tuning parameters will be retained and adjusted PID sets will be offered.

DF1 Configuration



My Node:
This option will allow the user to select the node. This node must not exist anywhere else on the computer's network. The range is **0** to **30000**.

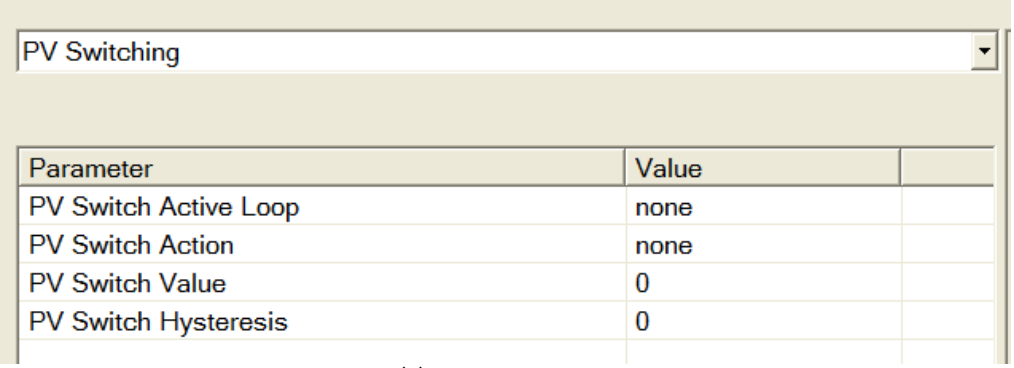
PLC node:
This option will allow the user to select the PLC node. This must be the node address of a PLC. The range is **0** to **30000**.

PLC read table:
This option will allow the user to select the PLC read table. The range is **8** to **255**.

PLC write table:
This option will allow the user to select the PLC write table. The range is **8** to **255**.

PLC intermessage delay (ms)
Gives the ability to put a delay in the communications between the controller and PLC if needed.

PV Switching



PV Switching allows the 9220 to use two (2) analog inputs as a process variable source, if necessary. It can be customized in any combination of high or low signals for loops 1 or 2. The 9220 controller normally only uses loop 1 for temperature control, so PID loop 2 must be modified so that it has a control source. In order for the PV signal to be switched, *both* PV signals must be above or below the switch point and must satisfy any applicable hysteresis.

PV Switch Active Loop
This field is not modifiable. It will display the current active loop (**Loop 1** – **Loop 2**).

PV Switch Action
This switches the active control loop based on the current PV, PV Switch Value, and PV Switch Hysteresis. For an example, assume the PV Switch Action is **Loop 1 low, Loop 2 high**. Now assume that the PV Switch Value is 1400 and the PV Switch Hysteresis is 50. In this situation, Loop 1 will be used as the control loop until both Loop 1 and Loop 2 PVs are higher than 1400, at which point it will switch to Loop 2 for the control loop. The control loop will continue to be Loop 2 until both PVs fall below 1350 (Switch Value – Hysteresis), at which point control will switch to Loop 1.

PV Switch Value
This is the switch value. This is the value that will determine when the switch happens. The range is **-300** – **30000**.

PV Switch Hysteresis
This is the hysteresis for the switch. This will help prevent the 9220 from potentially switching back and forth between the two signals. The range is **0** – **30000**.

Vacuum Leak-Up Testing

A vacuum leak-up test will determine if the furnace is leaking at an acceptable low rate, as determined by the operator.

Vacuum leak up event
The event number of the vacuum leak-up test can be assigned in Configurator and entered here. 0 will disable. Press **Edit** to enter the number.

Max rate µ/hr
This is the maximum tolerable leakage rate of the furnace. Press **Edit** to change the number.

Number of tests
This determines the number of times the controller will perform a vacuum leak-up test before the furnace is considered to have failed. Press **Edit** to change.

Test gauge
This is the vacuum gauge being tested. Press **Edit** to change.

Generic Instrument Setups

The generic instrument's data will be stored in certain registers on the host instrument, such as the 9220 controller. Each instrument is allotted a certain set of registers, starting with register 1000. To determine the beginning register, use the following calculation: (100 * generic instrument's number (1 – 16)) + 900. Therefore, instrument 1 would begin at register 1000: (100 * 1) + 900. Instrument 7 would begin at register 1600: (100 * 7) + 900. Each instrument is allotted 100 registers, therefore, instrument 1's allotment is from register 1000 to 1099 on the 9220 controller, instrument 2's allotment is from register 1100 to 1199 on the 9220 controller, etc.

The *Generic Instrument Setups* menu is split into three parts: Configure Generic Instruments, Configure IP Addresses, and Configure Block Writes.

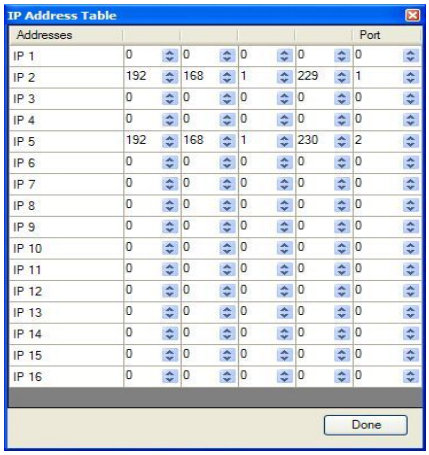
Configure Generic Instruments

This screen is where the user can configure the main sections for each generic instrument. The drop-down box in the top left will select the generic instrument to set up. The options are: **Instrument 1** – **Instrument 16**.

The three reads can be set up in the grid in the top of the form. The Instrument Register field will be the register in the 9220 controller. The range is **0** – **32767**. The Count field will be the number of successive registers to read. The range is **0** – **100**. The Storage Offset field will be the offset in the generic instruments registers (1000 – 1099 for Instrument 1, 1100 to 1199 for Instrument 2, etc). The range is **0** – **99**.

The setup for the PV (Process Variable), SP (Setpoint), and Out (Output) can be done in the grid in the bottom of the form. The Offset field is the instrument's offset. The range is **0** – **32767**. The Instrument Register field is the register in the 9220 controller. The range is **0** – **32767**. The Input Type field will determine what kind of type the value will be. The options are: **Integer**, **Big Endian**, **Big Endian Byte Swap**, **Little Endian**, or **Little Endian Byte Swap**. The Exponent field will determine if there is an exponent value. Checking the checkbox will indicate that there is an exponent. The Input Scalar field will determine the input scalar range. The range is **-128** – **127**. The Output Type will determine what kind of the output value will be. The options are: **Integer**, **Big Endian**, **Big Endian Byte Swap**, **Little Endian**, or **Little Endian Byte Swap**. The Exponent field will determine if there is an exponent value. Checking the checkbox will indicate that there is an exponent. The Output Scalar field will determine the Output scalar range. The range is **-128** – **127**.

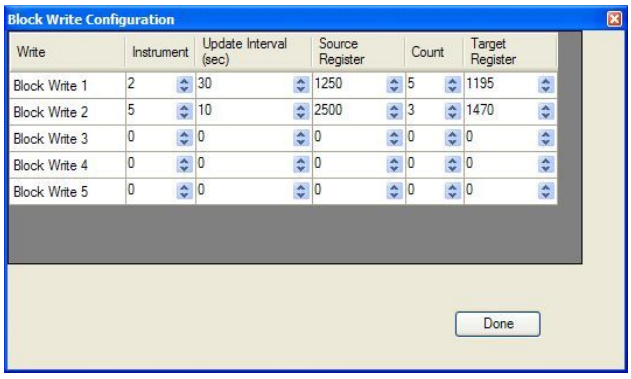
Click on the **Done** button to close down the screen and save the changes, or select a new instrument to configure another instrument.



Configure IP Addresses

This screen will allow the user to set up the IP addresses for each of the generic instruments, as well as assign a port number for the instrument. The first four columns in the grid are for the IP address. The IP address follows the standard format, i.e., 192.168.1.230. To use this IP for instrument 5, **192** would be entered in the first column, **168** would be entered for the second column, **1** would be entered for the third column, and **230** would be entered in the fourth column. The port number would be entered in the fifth column, which also has the "Port" heading. The IP address columns have a range of **0** – **255**, and the Port column has a range of **0** – **32767**.

Configure Block Writes



This screen will allow the user to configure up to five (5) block writes for the instruments.

The Instrument field is the instrument to use the write for. The range is **0** – **32**. The Update Interval field is the update time, in seconds, to perform the write. The range is **0** – **300** seconds. The Source Register field is the 9220 register where the values will come from. The range is **0** – **32767**. The Count field is the number of successive registers to read. The range is **0** – **80**. The Target Register field is the 9220 register to put the count into. The range is **0** – **32767**.

Instrument Calculation

General Description

The Instrument Calculation allows for fifty (50) lines of program and fifty (50) program variables. Program variables allow for storage on intermediate results of calculations.

A program variable is designated by a v followed by a number from **0** to the number of variables – 1.

A Lower or Upper case "V" is valid, as well as leading zeroes. The following are all considered the same variable: V3, v3, v0003.

The 9220's Modbus registers can be used as input variables in the equations without restriction. To protect the instrument, Modbus registers are restricted as output registers.

Modbus registers are designated by an upper or lower case "M" followed by a number.

Note – The standard Modbus routine is called to retrieve the Modbus variable, therefore a 0x8000 (-32768) will be returned for an invalid register.

Note – Modbus registers are stored with integer values, so adjustments will need to be made for decimal values.

If the instrument can have external analog input boards, or the instrument is a Video Recorder or DAQ, these inputs can be accessed directly as A1 through A40. By using the "A" designation, the Modbus register number is not needed and the variable is scaled to the correct value (decimals included) based on the input type specified.

In a Video Recorder, the slave instrument data slots can be defined as variables D1 through D32. D31 and D32 are extra slots and have no restrictions as output variables. D1 through D30 are shared with the first ten (10) slave instruments in groups of three (3) – PV, SP, PO – and caution should be used when assigning as outputs.

A line in the program of the instrument calculation must start with a variable or a keyword.

Variables must be followed by an equal sign (=) and then an expression. The expression can be a simple assignment (V1 = 3) or a variable operation variable as described below (V1 = M225 * 0.1).

Keywords *MUST* be entered in capital letters only.

The list of valid keywords is: **IF**, **ELSE**, **ENDIF**, **QUE**, **RLY**, and **END**. "IF" must be followed by an expression which is a variable, relationship operator, then variable.

The list of valid relationship operators is: **>** (Greater Than), **<** (Less Than). **=** (Equals), **>=** (Greater Than or Equal To), **<=** (Less Than or Equal To), **!=** (Not Equal To), and **==** (Equal To). *Note – The "=" and "==" relationship operators are identical*.

The list of valid bitwise operators is: **&** (AND), **|** (OR), **^** (XOR), **<<** (Left Shift), and **>>** (Right Shift).

The result of the "IF" relationship test determines if the lines following the "IF" statement will be executed or not.

The "ELSE" and "ENDIF" must be on a line by themselves. "ELSE" will toggle the program based on the result of the "IF" test. "ENDIF" will close out the "IF".

Example:
IF V1 >= 30
V3 = V2 * 1.5
ELSE
V3 = 5
ENDIF

In this example, if the value in V1 is greater than or equal to 30, then the value of V3 will be the value of V2 multiplied by 1.5. If the value in V1 is less than 30, the value of V3 will be 5.

EVERY "IF" must have a closing "ENDIF". However, the "ELSE" is optional.

The "QUE" is used to send data to a slave instrument and must have three (3) variables separated by spaces. The first is the slave instrument number, the second is the register number, and the third is the data to send.

Example:
QUE 3 1129 V1

This example will send the value of V1 to register 1129 on instrument 3.

The "RLY" is used to control a relay if the relay assignment is 999. The "RLY" must be followed by a variable which is the relay number (**1** – **8**) and a relationship expression.

Example:
RLY 5 M554 < 2

This example would turn Relay 5 ON if the communication status for instrument 5 was bad.

The "END" keyword will stop the lines from running, and start over from line 1.

There are a few functions that are available as well. The list of valid functions is: **FSIN** (Sine), **FCOS** (Cosine), **FEXP** (Exponent), **FLOG** (Logarithm), **FLN** (Natural Logarithm), **FSQRT** (Square Root), **FABS** (Absolute Value), and **FPOW** (Power). The Sine and Cosine functions need to have the parameter in radians. A function must be in all caps and begin with an "F" and have a pair of parenthesis. An undefined function returns the value of the expression in the parenthesis. *Note – A pair of parenthesis by themselves is considered an undefined function*.

The instrument calculation has limited parsing ability. This is kept to variables, operation, variable – i.e. V1 = 12.25 * V2. Another example is M128 = V1/100.

A negative sign (-) in front of the number is considered part of the number – i.e. V1 = -2.55 + V2.

A variable to the parser is one of the following: a program variable (Vxx), a Modbus register (Mxxx), a number, or a function.
Example:
V1 = (V2 * 1.35) + (V3 * V4)
This example will multiple V2 by 1.35 and multiply V3 and V4 together, and add those two results and store that value in V1.

The maximum length of a program line is thirty-one (31) characters.

The following are the valid mathematical operators: + (Addition), - (Subtraction), * (Multiplication), / (Division), and % (Modulo Divide – integer only).

The difference between Division and Modulo Division is that Modulo will always return an integer value.

Example:
11 / 4 = 2.75
11 % 4 = 2 (The .75 will not be returned)

Calculation Time In MS (0 to Disable)
This is the calculation time for the calculations. This will specify the delay between executing a line. Each line has the same delay between them, even if they are blank. A value of zero (0) will keep the calculations from being performed. The range is **0** – **10000**.

Configure Instrument Calculations
This option will display the screen where the calculations can be entered.

To edit a line, click on the **Edit** button. This will bring up the keyboard, which will allow the user to change the text for the calculation. If **Edit** is clicked on a blank line, a new calculation can be entered.

To insert a blank line in between lines, select the line *BELOW* where the inserted line is going to go and click on the **Insert** button.

To delete a line, highlight the line and click on the **Delete** button.

To erase a line, highlight the line and click on the **Clear** button.

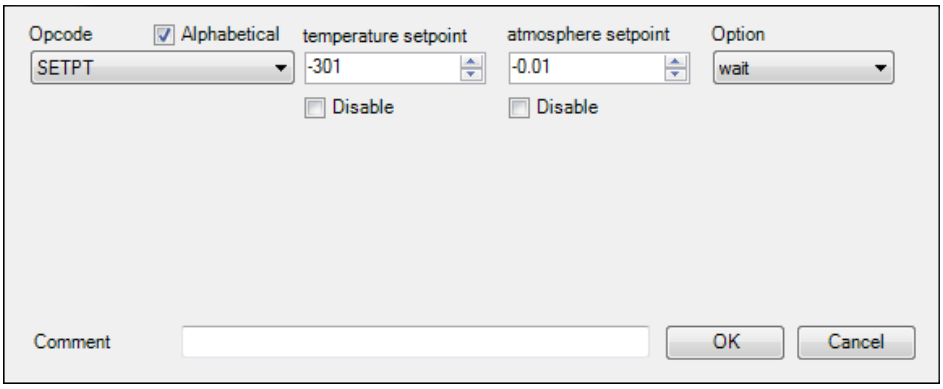
Programmer Description

The Series 9220 Recipe Programmer provides a convenient operator interface and recipe programmer.

The programmer uses enhanced opcodes that reduce the number of steps required for a program. Each step may consist of: an opcode, a temperature value column, an atmosphere value column, and an option value column. The opcode determines how and if each of the three values is used.

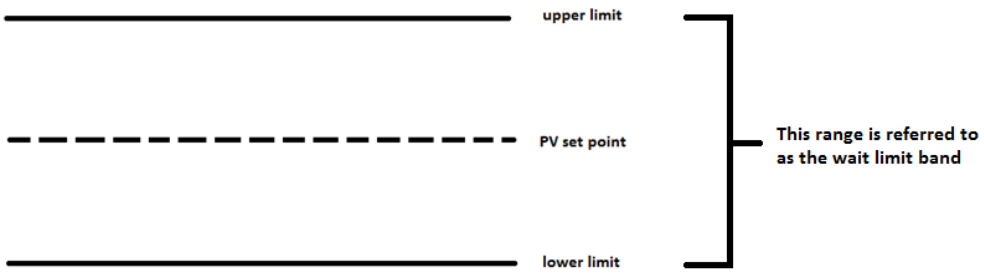
An explanation of wait, wait up, and wait down options can be found at the end of this chapter.

Each opcode will be listed in the following format for readability:
Opcode
Temperature Value Column Atmosphere Value Column Option Value Column
Description



Wait

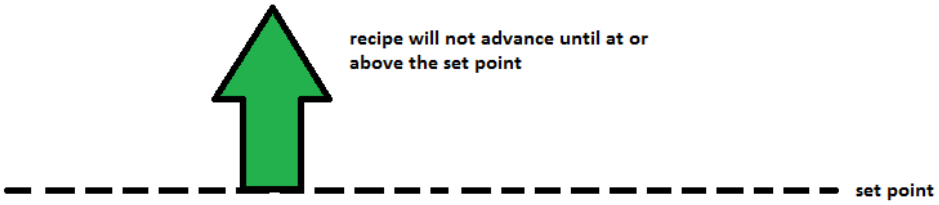
When using the option **wait** with a set point Opcode, the recipe will not advance to the next step until the PV value falls within the **wait limit band**. The upper limit of this band is value of the PV set point plus the wait limit. The lower limit of this band is the value of the PV set point minus the wait limit. The wait limit band is the range between the upper limit and the lower limit. The recipe will then continue to the next step.



For example, assume the PV is temperature with a 1500° set point and a wait limit of 15°. Using the SETPT opcode, if the option is wait, the recipe will not advance until the temperature PV is 1485°-1515°.

Wait Up

When using the option **wait up** with a set point opcode, the recipe will not advance to the next step until the PV value reaches or exceeds the set point. The recipe will then continue to the next step.

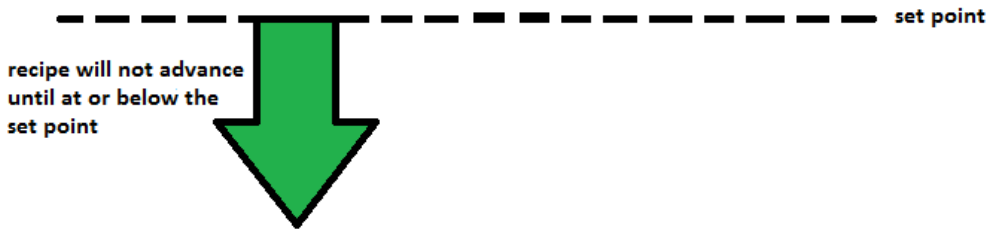


Opcode assigned to wait up

For example, if the PV is temperature with a set point of 1500° and the wait limit is 15°, the recipe will not advance until the PV is at or above 1485°.

Wait Down

When using the option **wait down** with a set point opcode, the recipe will not advance to the next step until the PV value reaches or falls below the set point. The recipe will then continue to the next step.

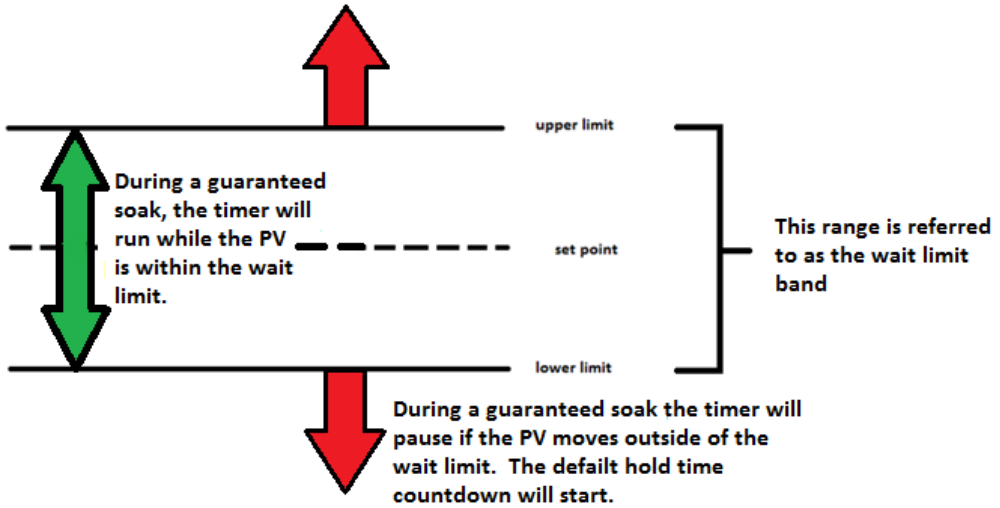


Opcode assigned to wait down

For example, if the PV is temperature with a 1500° set point and the wait limit is 15°, the recipe will not advance until the PV is at or below 1515°.

Wait in a Guaranteed Soak

During a **guaranteed soak** in a recipe the timer will continue to count down while the PV value is within the **wait limit band**. If the value of the PV moves outside of this range, the timer will pause until the PV value falls back within the **wait limit band**.

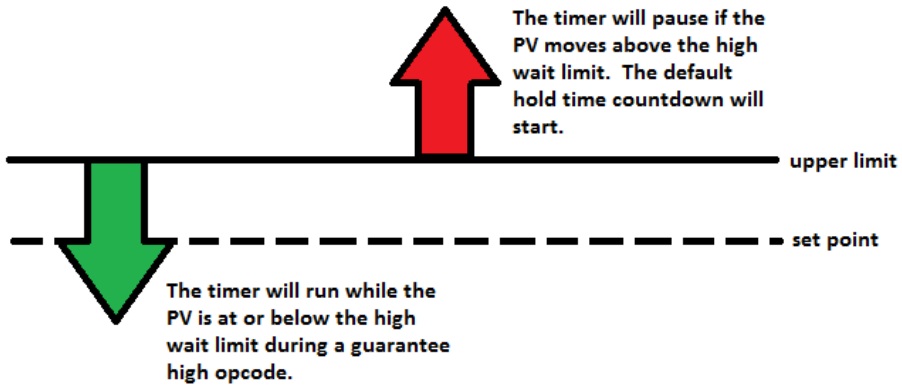


If the PV value moves outside of the **wait limit band,** the recipe will pause and a new timer will begin. This timer is called the **Default Hold Time** and can be found and adjusted in the **Menu** under **Furnace Setup**. This timer will keep track of the amount of time the PV value has been outside of the **wait limit.** If the PV value fails to move back into the **wait limit band** within the **Default Hold Time**, the programmer alarm will be activated. Once the PV value moves back within the **wait limit band**, the soak timer will resume.

For example, if the PV is temperature with a set point of 1500° and the wait limit is 15°, the recipe timer will run only while the temperature is 1485°-1515°. If the PV moves outside of this range, the recipe timer will pause and the Default Hold Time countdown will begin. The recipe timer will resume once the PV moves back into the range of 1485°-1515°.

Guarantee High Assignment

An opcode with a **GH** prefix stands for **guarantee high**. During a recipe, a **guarantee high** will allow the recipe timer to run only while the PV is at or below the **upper limit**. The **upper limit** is the value of the **set point** plus the **wait limit.**



Opcode with a guarantee high

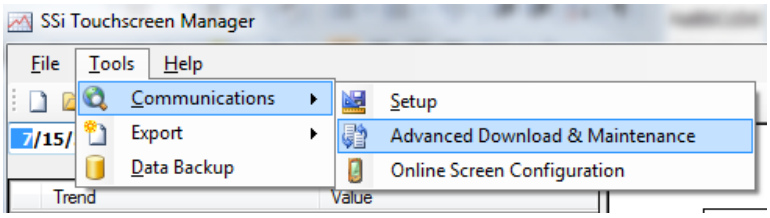
If the PV moves above the **upper limit,** the recipe will pause and a new timer will begin. This timer is called the **Default Hold Time** and can be found and adjusted in the **Menu** under **Furnace Setup.** This timer will keep track of the amount of time the PV has been above the **upper limit**. If the PV fails to move below the **upper limit** within the **Default Hold Time,** the programmer alarm will be activated. Once the PV moves below the **upper limit**, the recipe timer will resume.

For example, if the PV is temperature with a 1500° set point and the wait limit is 15°, the recipe timer will continue to run as long as the PV is at or below 1515°. If the PV moves above 1515°, the recipe timer will pause and the Default Hold Time countdown will begin. The recipe timer will resume once the PV moves back to 1515° or below.

Flash Card Management

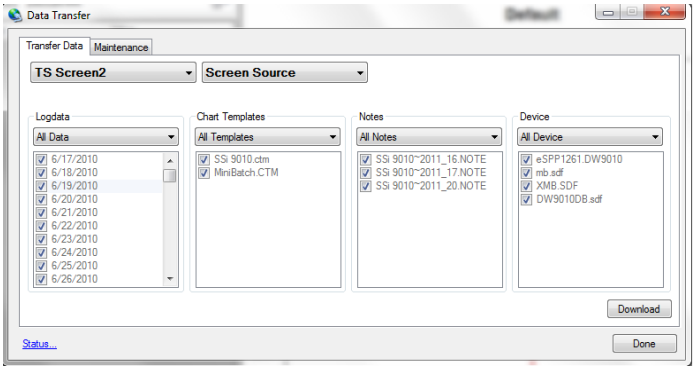
This section will show the user how to pull logged data from the operator interface using TS Manager software loaded onto a PC.

From the TS Manager home screen, select Tools → Communications → Advanced Download & Maintenance



The Transfer Data tab is used to download data from the selected touch screen. The specified recorder is identified on the drop down list from the main TS Manager Screen.

There are 2 ways to synchronize data. This can be done using the Screen as the source of the data (network connection) or Disk source (flash card from the screen). *Note: Users can also download data from the main TS Manager screen using the "Download Data" button on the top right corner.*

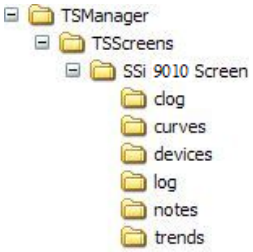


Synchronization will pull all Log Data, Chart Templates, Notes, and Devices that were entered on the screen onto the computer that is running TS Manager. The data will be stored in the TSManager directory under the screen name.

Log Data – Users can use the drop down list to select: All Data, Selected Data, or Skip. The check boxes are used to select which data gets included for the download when the Selected Data is selected, or which data gets skipped when the Skip option is selected.

Chart Templates – User can use the drop down list to select: All Templates, Selected Templates, or Skip. The check boxes are used to select which templates get included for the download when the Selected Templates is selected, or which templates get skipped when the Skip option is selected.

Notes - User can use the drop down list to select: All Notes, Selected Notes, or Skip. The check boxes are used to select which notes get included for the download when the Selected Notes is selected, or which notes get skipped when the Skip option is selected.

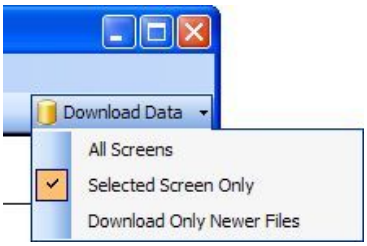


Devices – Users can use the drop down list to select: All Device, Selected Device, or Skip. The check boxes are used to select which devices get included for the download when the Selected Device is selected, or which devices get skipped when the Skip option is selected.

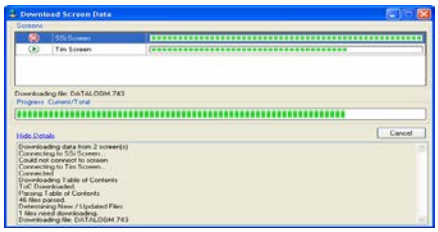
The **Download** button 

is used to start the synchronization process.

Note: A file that is downloaded will overwrite any existing file.



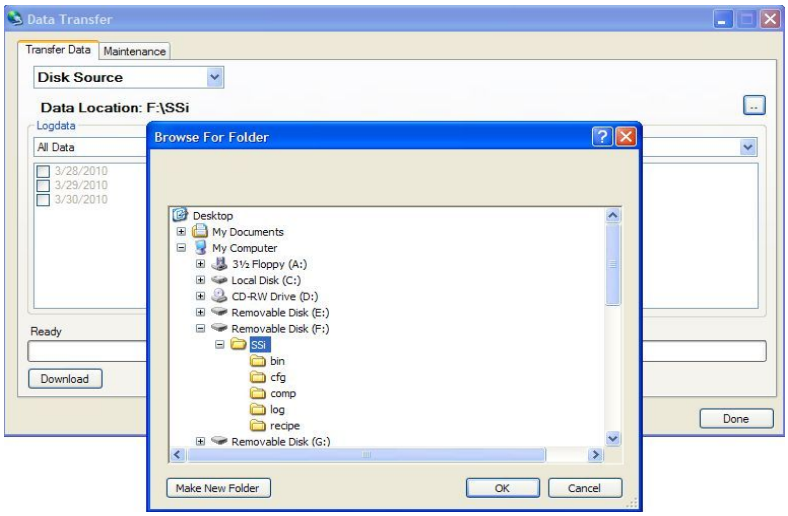
Download Data button on TS Manager main screen. Clicking on the down arrow will give the user the ability to: download data from all of the touch screen definitions, download data from the selected screen, only download newer files. Clicking on the button will begin the download progress.



If there are multiple screens, then each screen will be displayed along with the progress of each download. Clicking on the "Show Details" link will expand the screen and show any download details. The link will then say "Hide Details", which will shrink the screen and not provide any details. If there are any errors with downloading, then there will be an "X" next to the screen with the issue. The error will be listed in the details section. If the download is successful, then the download screen will close when the download is finished.

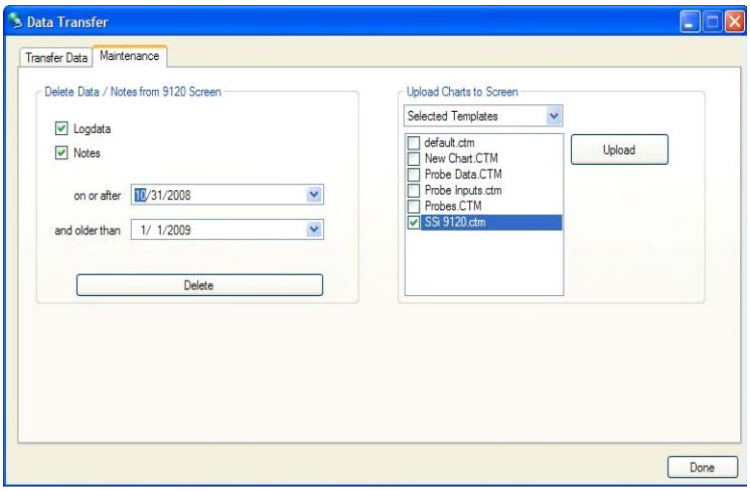
Flash Card Synchronization

When synchronizing from a flash card, the flash card needs to be retrieved from the touch screen. **The screen should be turned off before pulling the flashcard**.



The storage location of the flash card should be selected using the period button [..] on the Data Transfer screen's Transfer Data tab. *Note: The main location for the flash drive should be selected.*

The Maintenance tab is used to delete logged data or notes either from the video screen directly or on the flash card. Logged data and notes can be removed to create additional free space on the storage card. All data that is synchronized with TS Manager maintains a backup of the data in the ..TSManager\TSScreens\"Screen Name"\Log, Clog and notes directories.



To delete the log data, select the "Logdata" option, and to delete the notes, select the "Notes" option. One or both options may be selected at the same time. The data will be deleted by a date range, which means the user will have to select a beginning date for the date range and an ending date for the date range. The "on or after" drop-down list is the beginning date for the date range, and the "and older than" drop-down list is the ending date for the date range. Clicking on the **Delete** button will delete the selected files from the screen. The user will have to confirm the delete. The user will also be able to upload chart files to the instrument. In the "Upload Charts to Screen" section, the drop-down list has the options for "All Templates" or "Selected Templates". Click on the **Upload** button to upload the desired chart files. This feature is useful

if the user modifies the chart files on the local computer and wishes to update the chart files on the touch screen without having to enter the modifications again.
The **Done** button will close out the screen.

Temperature Value Column	Atmosphere Value Column	Option Value Column
ALARM		
N/A	**N/A**	**User Alarm Number**

The alarm function (referred to as a User Alarm) is used to notify the operator that an operation is complete or that a manual action is required. An alarm must be acknowledged at the touch screen interface or Configurator prior to the recipe advancing to the next step.
If Programmer Alarm Text has been defined for the User Alarms, the custom text will appear in place of the User Alarm number on the recipe display screen. See Configuration section.

By use of the touch screen's Menu -> Configuration -> Programmer Alarm Text feature, the Operator can assign specific text to any alarm. The custom text will appear on the touch screen's recipe viewer to notify the Operator of what is to occur. For example, "End of Cycle" or "Furnace Ready to Quench"

It is important to note that defining Alarm Text at the touch screen will not assign the same text to Configurator. This must be accomplished by entering custom text in Configurator's Settings-> select Manage Controller -> Alarm Text
.
User Alarm 0 is used to turn off a user alarm. Its function is the same as the acknowledge button and should not be used for normal operation requiring an Operator to acknowledge the alarm.

A User Alarm can be assigned to a relay as a PROGRAMMER ALARM (see Relay Assignments) to energize a relay. This relay may be used to enunciate an alarm horn, turn on a stack light, etc.

BRANCH		
True Step Number	**False Step Number**	**N/A**

The Branch opcode can change program flow based upon an inquiry opcode. The True Step Number is the program step to go to if the inquiry is evaluated as true; and the False Step Number is the program step to go to if the inquiry is evaluated as false. This opcode should be placed in the step immediately following the inquiry step.
The True Step Number ranges from 1 – 24.
The False Step Number ranges from 1 – 24.

DELAY		
N/A	**N/A**	**Delay Time**

This opcode is used when a short delay is needed. The Delay Time is in seconds, from 1 - 500 seconds.

DEV_AL		
Temperature Dev/Band	**N/A**	**Loop**

The deviation alarm opcode is used to define a deviation value and turn the temperature ~~or vacuum~~ deviation alarm~~s~~ ON or OFF. The Temperature Dev/ Band will define the allowable deviation band from set point. The Loop will determine which type of deviation alarm to use
.
The Temperature Dev/Band ranges from -301 (Disable) – 30000 and represents the same units used to define the Loop 1 parameter.

The Loop options are (note: 9220 controllers do not support Atmosphere deviation bands and thus should not be used):

- Off
- T. Bnd (Temperature Band)

- A. Bnd (Atmosphere Band)
- A. Bnd, T. Bnd (Atmosphere Band and Temperature Band)
- T. + Dev (Temperature + Deviation), T. – Dev (Temperature – Deviation)
- A. Bnd, T. + Dev (Atmosphere Band and Temperature + Deviation)
- A. Bnd, T. – Dev (Atmosphere Band and Temperature – Deviation)
- A. + Dev (Atmosphere + Deviation)
- A. + Dev, T. Bnd (Atmosphere + Deviation and Temperature Band)
- A. + Dev, T. + Dev (Atmosphere + Deviation and Temperature + Deviation)
- A. + Dev, T. – Dev (Atmosphere + Deviation and Temperature – Deviation)
- A. – Dev (Atmosphere – Deviation)
- A. – Dev, T. Bnd (Atmosphere – Deviation and Temperature Band)
- A. – Dev, T. + Dev (Atmosphere – Deviation and Temperature + Deviation)
- A. – Dev, T. – Dev (Atmosphere – Deviation and Temperature – Deviation).
- There is also an option for Smart Temp and Smart Atm

The Smart Temp alarm appears as a check box on the recipe editor (this option appear in Configurator, but not the touch screen). When selected, the alarm will not become active until the Temperature comes within the defined band, then leaves the band.

For example, an Opcode of:

DEV_AL15°F N/A T.bnd Smart Alarm = OFF

will activate a deviation alarm anytime the Furnace Temperature PV differs from Temperature SP by more than +/-15°F. With a SP of 1900°F, the alarm will be active anytime the Furnace Temperature PV is less than 1885°F or greater than 1915°F.

However, if the Smart Alarm is turned ON, the alarm will not become active until the Furnace Temperature PV has reached 1886-1914°F. From that point, the alarm will only become active should it leave the band.

The temperature band/deviation limit can also be changed by the SET_WAIT opcode.

DOW_INQ
N/A N/A Day
This opcode checks the real time clock for the day of the week. The time and date must be correct on the 9220 controller – the screen time and date will not be used. An DOW_INQ must be true prior to advancing to the next step within the recipe.

This is useful for performing operations on a weekly basis on a specific day—for example, automatically turning a furnace heating on/off before someone comes in on Monday.

The Day is the day of the week, i.e. Sunday, Monday, Tuesday, Wednesday, Thursday, Friday, or Saturday.

EVT_IN
Temperature Setpoint N/A Event
This opcode waits for an input event to be turned ON or OFF depending on the Event value selected.
If the Temperature Setpoint is specified, it is considered a set point and will be sent to the appropriate controller.
The Temperature Setpoint ranges from -301 (Disable) – 30000.
The Event options are: Event 0 ON/OFF – Event 47 ON/OFF.
If Event Text has been defined for the Event Inputs, the custom text will appear in place of the Event Input number. See Configuration section.

By use of the touch screens Menu -> Configuration Event Text feature, the Operator can assign specific text to any event. The custom text will appear on the touch screen's recipe viewer to notify the Operator of what is to occur. For example, "Vacuum Acceptable" or "Furnace Ready to Quench".
It is important to note that defining Event Text at the touch screen will not assign the same text to Configurator. This must be accomplished by entering custom text in Configurator's Settings -> select Manage Controller -> Input Event Descriptions.

EVT_OUT
Temperature Setpoint N/A Event
This opcode waits for an output event to be turned ON or OFF depending on the Event value selected.
If the Temperature Setpoint is specified, it is considered a set point and will be sent to the appropriate controller.
The Temperature Setpoint ranges from -301 (Disable) – 30000.
The Event options are: Event 0 ON/OFF – Event 47 ON/OFF.
If Event Text has been defined for the Event Outputs, the custom text will appear in place of the Event Output number. See Configuration section.

By use of the touch screens Menu -> Configuration Event Text feature, the Operator can assign specific text to any event. The custom text will appear on the touch screen's recipe viewer to notify the Operator of what is to occur. For example, "Partial Pressure" or "Gas Fan Quench".

It is important to note that defining Event Text at the touch screen will not assign the same text to Configurator. This must be accomplished by entering custom text in Configurator's Settings -> select Manage Controller -> Output Event Descriptions.

An Event Output can be assigned to a relay as an EVENT (see Relay Assignments section) to energize a relay. This relay may be used to enunciate an alarm horn, turn on a stack light, etc.

G_SOAK
N/A Wait Limit Soak Time
This is a guaranteed soak opcode. The temperature process value must be within the deviation band to allow the soak timer to run. If the temperature process value goes out of the deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

If Load TCs are DISABLED (see sections on Load T/C Configuration or Opcode LTC_SET), the Control TC is the only TC considered to count against the Soak Timer.

If Load TCs are ENABLED (see sections on Load T/C Configuration or Opcode LTC_SET), the Control TC and any selected Load TCs are considered to count against the Soak Timer.

If any enabled TCs are out of band, text will appear on the touch screen indicating "Recipe Holding for Load T/Cs".

The Wait Limit is the wait time, in Hours: Minutes format. This is the duration of time the recipe will wait before alarming if the process value goes out of band. The Hours range from 0 – 533, and the Minutes range from 0 – 59. While the alarm is active, a Programmer Alarm can be assigned to specific relay (see sections on Relay Assignments) to enunciate an alarm horn or stack light.

The Soak time is the total time, in Hours:Minutes format, for the soak to run. The Hours range from 0 – 166, and the Minutes range from 0 – 59.

GDELAY

N/A **N/A** **Delay Time**

This opcode is a guaranteed short delay. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The time is expressed in seconds, not hours & minutes.

The Delay Time is from 1 – 500 seconds.

GHDELAY

N/A **N/A** **Delay Time**

This opcode is a guaranteed high short delay opcode. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The time is expressed in seconds, not hours & minutes. The temperature process value must be below the high limit deviation band to allow the delay timer to run. If the temperature process value goes out of the deviation band, then the delay timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Delay Time is from 1 – 500 seconds.
By default, the defined DEFAULT WAIT LIMITS (see section XXX) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GHSOAK

N/A **Wait Limit** **Soak Time**

This is a guaranteed soak high opcode. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The temperature process value must be below the high limit deviation band to allow the delay timer to run. If the temperature process value goes out of the deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Wait Limit is the wait time, in Hours: Minutes format. This is the duration of time the recipe will wait before alarming if the process value goes out of band. The Hours range from 0 – 533, and the Minutes range from 0 – 59.

The Soak time is the total time, in Hours:Minutes format, for the soak to run. The Hours range from 0 – 166, and the Minutes range from 0 – 59.

By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GHZDELAY

N/A **N/A** **Delay Time**

This is a guaranteed high short delay opcode for a zone. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The time is expressed in seconds, not hours & minutes. The temperature process value must be below the high limit deviation band to allow the delay timer to run. If the temperature process value goes out of the deviation band, then the delay timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.
The Delay Time is from 1 – 500 seconds.
By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GHZSOAK

N/A Wait Limit Soak Time

This is a guaranteed soak high opcode for a zone. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The temperature process value must be below the high limit deviation band to allow the soak timer to run. If the temperature process value goes out of the deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Wait Limit is the wait time, in Hours: Minutes format. This is the duration of time the recipe will wait before alarming if the process value goes out of band. The Hours range from 0 – 533, and the Minutes range from 0 – 59.

The Soak time is the total time, in Hours:Minutes format, for the soak to run. The Hours range from 0 – 166, and the Minutes range from 0 – 59.

The band limit can be changed by the SET_WAIT opcode.

By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GLDELAY

N/A N/A Delay Time

This opcode is a guaranteed low short delay opcode. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The time is expressed in seconds, not hours & minutes. The temperature process value must be above the lower limit deviation band to allow the delay timer to run. If the temperature process value goes out of the deviation band, then the delay timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Delay Time is from 1 – 500 seconds.

By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GLSOAK

N/A Wait Limit Soak Time

This is a guaranteed soak low opcode. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The temperature process value must be above the lower limit deviation band to allow the soak timer to run. If the temperature process value goes out of the deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Wait Limit is the wait time, in Hours: Minutes format. This is the duration of time the recipe will wait before alarming if the process value goes out of band. The Hours range from 0 – 533, and the Minutes range from 0 – 59.

The Soak time is the total time, in Hours:Minutes format, for the soak to run. The Hours range from 0 – 166, and the Minutes range from 0 – 59.

By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GLZDELAY

N/A N/A Delay Time

This is a guaranteed low short delay opcode for a zone. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The time is expressed in seconds, not hours & minutes. The temperature process value must be above the lower limit deviation band to allow the soak timer to run. If the temperature process value goes out of the deviation band, then the delay timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Delay Time is from 1 – 500 seconds.

By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GLZSOAK

N/A Wait Limit Soak Time

This is a guaranteed soak low opcode for a zone. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The temperature process value must be above the lower limit deviation band to allow the soak timer to run. If the temperature process value goes out of the deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Wait Limit is the wait time, in Hours: Minutes format. This is the duration of time the recipe will wait before alarming if the process value goes out of band. The Hours range from 0 – 533, and the Minutes range from 0 – 59.

The Soak time is the total time, in Hours:Minutes format, for the soak to run. The Hours range from 0 – 166, and the Minutes range from 0 – 59.

By default, the defined DEFAULT WAIT LIMITS (see sections on Default Wait Limits) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GOSUB

N/A N/A Recipe Number

The go to subroutine opcode is used to call a program to run and then return to the calling program. This is used to execute standard routines that can be used by many programs. GOSUBs can be stacked up to eight (8) levels.

The difference between a JUMP and a GOSUB is that GOSUB will return to the original program when the called program completes. A JUMP will not return to the original program.

The Recipe Number is the recipe (program) to run. The range is 1 – 300.

GRAMP

Temperature Setpoint N/A Time

This is a guaranteed ramp opcode. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The process value must be within the deviation band to allow the ramp timer to run. If the process value goes out of the deviation band, then the ramp timer will stop, holding at the current temperature SP until the process value comes back into the deviation band before starting up again.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

The Time is the total time for the program to reach the desired setpoint(s), in Hours:Minutes format. The Hours range from 0 – 166, and the Minutes range from 0 – 59.

default, the defined DEFAULT WAIT LIMITS (see section XXX) will be used as the +/- band. If a SET_WAIT Opcode has been used during the current recipe, those values will become active.

GRAMPR

Temperature Setpoint	Option	Decimal Rate

This is a guaranteed ramp opcode at a rate of degrees per minute. With respect to which Control and Load TCs are considered, this Opcode behaves the same as a G_SOAK Opcode. The process value must be within the deviation band to allow the ramp timer to run. If the process value goes out of the deviation band, then the ramp timer will stop, holding at the current temperature SP until the process value comes back into the deviation band before starting up again.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

The Option Decimal will alter the decimal point in the rate. The range is -1 (disable) – 2.

The Rate will be the rate of degrees per minute to change the temperature until the setpoint is reached. The range is 0.01 – 300.00.

GTCINQDEL

Delay Time	T/C	Option

This is a guaranteed TC inquiry short delay opcode. It is used to verify that the selected TC (note: only one TC may be selected) is within the set wait limits around the setpoint for the user defined time period.

The Delay Time is the time in seconds the selected TC must be within band before moving to the next step in the recipe. The range is 0 – 500.

The T/C is the Control T/C or Load T/C to use. The options are: Control T/C, T/C 1 – T/C 24
.
The Option will allow the user to wait for the T/Cs to come within the set wait limits around the setpoint. The options are: Wait, Wait Up, or Wait Down.

- Wait: The timer waits until the selected T/C is within the +/- deviation from SP
- Wait Up: The timer waits until the selected T/C is above the lower deviation limit
- Wait Down: The timer waits until the selected T/C is below the upper deviation limit

GZ_SOAK

N/A	N/A	Soak Time

This is a guaranteed soak opcode for a zone. The temperature process value must be within the deviation band to allow the soak timer to run. If the temperature process value goes out of the deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.
The Soak time is the total time, in Hours:Minutes format, for the soak to run. The Hours range from 0 – 166, and the Minutes range from 0 – 59.
The band limit can be changed by the SET_WAIT opcode.

GZ_SOAKSB

N/A	N/A	Soak Time

This is a guaranteed soak opcode for a zone with the set point bump feature enabled, which are explained under the Zone/Load TC Setup menu in the Configurator Section. The temperature process value must be within the deviation band to allow the soak timer to run. If the temperature process value goes out of the

deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.
NOTE: To adjust the control T/C a zone must be configured to define it. To do this, go to the Zone Assignments menu, set the Zone 1 Temperature Source to Loop 1 and the Temp Zone Number to 1.

GZDELAY

N/A	**N/A**	**Delay Time**

This is a guaranteed short delay opcode for a zone. The temperature process value must be within the deviation band to allow the delay timer to run. If the temperature process value goes out of the deviation band, then the soak timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.
The Delay Time is from 1 – 500 seconds.

GZRAMP

Temperature Setpoint N/A Time

This is a guaranteed ramp opcode for a zone. The process value must be within the deviation band to allow the ramp timer to run. If the temperature process value goes out of the deviation band, then the ramp timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

GZRAMPR

Temperature Setpoint Option Decimal Rate

This is a guaranteed ramp opcode for a zone at a rate of degrees per minute. The process value must be within the deviation band to allow the ramp timer to run. If the temperature process value goes out of the deviation band, then the ramp timer will stop and wait until the temperature process value comes back into the deviation band before starting up again.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

The Option Decimal will alter the decimal point in the rate. The range is -1 (disable) – 2.

The Rate will be the rate of degrees per minute to change the temperature until the setpoint is reached. The range is 0.01 – 300.00.

HIGH_AL

Temperature Setpoint N/A N/A

This opcode is used to enable a high limit alarm should the Control TC exceed a defined temperature. This Opcode can be placed at any location within the recipe and remains active until the program ends. If the Control TC exceeds this temperature, text will appear on the touch screen indicating "High Temperature". This may be helpful in brazing cycles where it is possibly damaging for parts to exceed a certain temperature.

While the alarm is active, a Programmer Alarm can be assigned to a specific relay (see sections on Relay Assignments) to enunciate an alarm horn or stack light.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

Both the text and alarm remains active until the program ends.

HIGH_PO

Temperature PO Value N/A N/A

This opcode is used to enable a high limit alarm should ~~on~~ the temperature percent output exceed a defined maximum. This Opcode can be placed at any location within the recipe and remains active until the program ends. If the Temperature Percent Output exceeds this value, text will appear on the touch screen indicating "High Temperature % Output". This may be helpful during times of Peak Demand when trying to reduce electrical consumption.

While the alarm is active, a Programmer Alarm can be assigned to a specific relay (see sections on Relay Assignments) to enunciate an alarm horn or stack light.

The Temperature PO Value is the high limit point for the temperature percent output. The range is -101 (disable) – 100.

Both the text and alarm remain active until the program ends.

ID_INC

N/A	N/A	N/A

This opcode increments the integer ID number by one. This Opcode can be used with ID_INQ and ID_SET to repeat defined sequences or help with Load Tracking. Refer to opcode ID_INQ for a specific example.

ID_INQ

ID Number Value **N/A** **Option**

This opcode is used to compare the ID value to the value in the temperature data. The LIMIT opcode immediately following this opcode sets a time limit on the wait. A BRANCH opcode immediately following this opcode can be used to change the program flow based on the inquiry results.

The ID Number Value is the ID to compare. The range is -301 (disable) – 30000.

The Option will determine how to compare the ID value against the value in the temperature data. The options are: Equal, High, or Low.

This Opcode, coupled with ID_INC and ID_SET can be helpful when wanting to repeat a defined sequence for a certain number of cycles. For example:

1.	ID_SET	0	N/A	N/A
2.	ID_INC	N/A	N/A	N/A
3.	SOAK	N/A	N/A	0:45
4.	ID_INQ	10	N/A	EQUALS
5.	BRANCH	6	2	N/A
6.	SOAK	N/A	N/A	0:30

The above Opcodes will repeat steps 2-5 ten times. On the tenth time, the recipe will advance to step 6 and continue. This sequence could be useful when trying to evacuate & backfill a chamber multiple times prior to heating.

ID_SET

ID Number Value **N/A** **N/A**

This opcode is used to set the ID number to the value specified in the temperature data. The ID number is provided as a feature to track loads or jobs, and it is not used by any controller.

This Opcode can be used with ID_INC and ID_INQ to repeat defined sequences or help with Load Tracking. Refer to ID_INQ for a specific example.

The ID Number Value is the value to set. The range is -301 (disable) – 30000.

JUMP

N/A **N/A** **Recipe Number**

The JUMP opcode is used to go to another program when no return is needed. The difference between a JUMP and a GOSUB is that GOSUB will return to the original program when the called program completes. A JUMP will not return to the original program.

The Recipe Number is the recipe number to go to. The range is 1 – 300.

LIMIT

N/A **N/A** **Time Limit**

This Opcode is used to place a time limit on a wait or inquiry step. This opcode should be placed in the step immediately following the Wait or Inquiry step. Once the recipe reaches the Wait or Inquiry step, a timer initiates. Should the timer run out before the wait or inquiry is satisfied, an alarm occurs. If the timer expires, text will appear on the touch screen indicating "Limit Alarm".

While the alarm is active, a Programmer Alarm can be assigned to a specific relay (see sections on Relay Assignments) to enunciate an alarm horn or stack light.

The Time Limit is the total time, in Hours:Minutes format, for the program to wait. The Hours range from 0 – 8, and the Minutes range from 0 – 59.

Both the text and alarm remains active until the program ends.

LOW_AL
Temperature Setpoint N/A N/A

This opcode is used to enable a low limit alarm should the Control TC exceed a defined temperature minimum. This Opcode can be placed at any location within the recipe and remains active until the program ends If the Control TC drops below this temperature, text will appear on the touch screen indicating "Low Temperature".

While the alarm is active, a Programmer Alarm can be assigned to a specific relay (see sections on Relay Assignments) to enunciate an alarm horn or stack light.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

Both the text and alarm remains active until the program ends.

LOW_PO
Temperature PO Value N/A N/A
This opcode is used to enable a low limit alarm should the temperature percent output drop below a defined minimum. This Opcode can be placed at any location within the recipe and remains active until the program ends. If the Temperature Percent Output drops below this value, text will appear on the touch screen indicating "Low Temperature % Output".

While the alarm is active, a Programmer Alarm can be assigned to a specific relay (see sections on Relay Assignments) to enunciate an alarm horn or stack light.

The Temperature PO Value is the high limit point for the temperature percent output. The range is -101 (disable) – 100.

Both the text and alarm remains active until the program ends.

LTC_SET
T/C Map T/C Map Load TC Enable
This opcode sets the active load T/C map for the furnace. Checking the box next to the T/C number selects the T/C. The options are off, on, or on + alarms.

This Opcode is the same as Zone/Load TC Setup via the Menu options (see sections on Zone/Load TC Setup) except that it selects thermocouples from the recipe. This may be helpful when certain recipes require three Load TCs and other require six Load TCs.

LTCMINCNT

N/A	N/A	Number

This opcode sets the active load T/C minimum number. The options are 0 (disable) – 49.

MEVT_IN_0

Temperature Setpoint	Event Mask	Event ON/OFF Bitmap

This opcode waits for multiple input events 0 through 15.
The Temperature Setpoint is an optional setpoint to send down. The range is -301 (disable) – 30000.

The Event Mask is the events to enable, which is the events affected. The options are: 0 – 15. Selecting (via a checkmark) enables the respective event. The user can then define if the selected events should be on or off via the Event On/Off Bitmap.

The Event ON/OFF Bitmap field will allow the user to select the bitmap for the event ON/OFF, which will set the final condition of the events in the event mask. The opcode ignores the bits not in the enabled events and waits on the bits specified in the bitmap. The options are: 0 – 15. Selecting (via a checkmark) waits for the respective Input to be ON. Not selecting waits for the respective Input to be OFF.

MEVT_IN_1

Temperature Setpoint	Event Mask	Event ON/OFF Bitmap

This opcode waits for multiple input events 16 through 31.

The Temperature Setpoint is an optional setpoint to send down. The range is -301 (disable) – 30000.

The Event Mask is the events to enable, which is the events affected. The options are: 0 – 15. Note – Even though the events listed are 0 – 15, they correspond to 16 – 31. Selecting (via a checkmark) enables the respective event. The user can then define if the selected events should be on or off via the Event On/Off Bitmap.

The Event ON/OFF Bitmap field will allow the user to select the bitmap for the event ON/OFF, which will set the final condition of the events in the event mask. The opcode ignores the bits not in the enabled events and waits on the bits specified in the bitmap. The options are: 0 – 15. Note – Even though the events listed are 0 – 15, they correspond to 16 – 31. Selecting (via a checkmark) waits for the respective Input to be ON. Not selecting waits for the respective Input to be OFF.

MEVT_OUT_0

Temperature Setpoint	Event Mask	Event ON/OFF Bitmap

This opcode will set multiple output events 0 through 15.

The Temperature Setpoint is an optional setpoint to send down. The range is -301 (disable) – 30000.

The Event Mask is the events to enable, which is the events affected. The options are: 0 – 15. Selecting (via a checkmark) enables the respective event. The user can then define if the selected events should be on or off via the Event On/Off Bitmap.

The Event ON/OFF Bitmap field will set the final condition of the events in the event mask. The opcode will ignore the bits not in the mask and either set or reset the bits depending upon their states in the bitmap. The options are: 0 – 15. Selecting (via a checkmark) waits for the respective Input to be ON. Not selecting waits for the respective Input to be OFF.

MEVT_OUT_1

Temperature Setpoint	Event Mask	Event ON/OFF Bitmap

This opcode will set multiple output events 16 through 31.

The Temperature Setpoint is an optional setpoint to send down. The range is -301 (disable) – 30000.

The Event Mask is the events to enable, which is the events affected. The options are: 0 – 15. Note – Even though the events listed are 0 – 15, they correspond to 16 – 31. Selecting (via a checkmark) enables the respective event. The user can then define if the selected events should be on or off via the Event On/Off Bitmap.

The Event ON/OFF Bitmap field will set the final condition of the events in the event mask. The opcode will ignore the bits not in the mask and either set or reset the bits depending upon their states in the bitmap. The options are: 0 – 15. Note – Even though the events listed are 0 – 15, they correspond to 16 – 31. Selecting (via a checkmark) waits for the respective Input to be ON. Not selecting waits for the respective Input to be OFF.

MEVT_OUT_2

Temperature Setpoint	**Event Mask**	**Event ON/OFF Bitmap**

This opcode will set multiple output events 32 through 47.

The Temperature Setpoint is an optional setpoint to send down. The range is -301 (disable) – 30000.

The Event Mask is the events to enable, which is the events affected. The options are: 0 – 15. Note – Even though the events listed are 0 – 15, they correspond to 32 – 47. Selecting (via a checkmark) enables the respective event. The user can then define if the selected events should be on or off via the Event On/Off Bitmap.

The Event ON/OFF Bitmap field will set the final condition of the events in the event mask. The opcode will ignore the bits not in the mask and either set or reset the bits depending upon their states in the bitmap. The options are: 0 – 15. Note – Even though the events listed are 0 – 15, they correspond to 32 – 47. Selecting (via a checkmark) waits for the respective Input to be ON. Not selecting waits for the respective Input to be OFF.

NO-OP

N/A	**N/A**	**N/A**

This is a no operation code, and it does nothing. It is used as a place holder on programs that are less than 24 steps.

OG_holdt

N/A	**Torr**	**Level Option**

This opcode will monitor the vacuum level ~~a~~ setpoint to keep the vacuum level under a certain point. When the actual vacuum level is at or above the setpoint, the recipe will be put in a hold. This Opcode can be placed at any location within the recipe and remains active until (1) another gauge is selected, (2) the Level Option of OFF is selected or (3) the program ends. When the vacuum falls below the setpoint, the hold will be removed.

The gauge can be changed during a cycle or turned off completely but the programmer can only monitor one vacuum gauge at a time.

Torr Level is the vacuum setpoint in Torr.

OGholdm

N/A	**Micron**	**Level Option**

This opcode will monitor the vacuum level ~~a~~ setpoint to keep the vacuum level under a certain point. When the actual vacuum level is at or above the setpoint, the recipe will be put in a hold. This Opcode can be placed at any location within the recipe and remains active until (1) another gauge is selected, (2) the

Level Option of OFF is selected or (3) the program ends. When the vacuum falls below the setpoint, the hold will be removed.

The gauge can be changed during a cycle or turned off completely but the programmer can only monitor one vacuum gauge at a time.

Micron Level is the vacuum setpoint in Micron.

PIDLOAD
Loop 2 Loop 1 N/A
This opcode will load an alternate PID set from the controller memory (note: Loop 2 is not available in 9220 controller; this, should not be used). Loop 1 should be used as the Temperature Loop.

The Loop 1 field is the alternate PID loop to use for loop 1. A value of 0 will disable the loop PID. The range is 0 – 16.

The Loop 2 field is the alternate PID loop to use for loop 2. A value of 0 will disable the loop PID. The range is 0 – 16.

The alternate PID loops can be set up on the Alternate PID Setup screen. See the Alternate PID Setup section for more information.

NOTE: The feature of PID Auto Switch is disabled for the entire duration of a recipe when the opcode PIDLOAD is executed. See the PID Loop Setup section for more information.

PLC_SET_VAL
Value Write Location Option
This opcode will set specially configured values in a slave PLC. Registers to be written to must be described via the Configurator's Recipe Management Group Opcode Control interface. The temperature data is the value to write. The atmosphere data is the Write location. This can be:

Quench SP
Endo SP
Ammonia SP
N2 SP
Methanol SP
Quench Sec
Drain Sec
T.C. Endo SP
T.C. N2 SP
FNC NH3 SP
T.C. Time
PLC Quench SP
Quench Type

The options are: **Wait**, **Wait up**, or **Wait Down**.

PO_INQ
Temperature PO Value N/A Option
The percent output inquiry is used to test the actual percent output of the temperature controller.

The Temperature PO Value is the temperature percent output to test against. The range is -101 (disable) – 100.

The Option value will determine how the test will conclude. The options are: Wait (Equals the specified value), Wait Up (Reach or Exceed the specified values), or Wait Down (Reach or Be Less than the specified values).

The LIMIT opcode immediately following this opcode sets a time limit on the wait.

A BRANCH opcode immediately following this opcode can be used to change the program flow based on the inquiry results.

QTCSET
Temperature Setpoint N/A N/A
This is the quench setpoint opcode. This will allow the user to set the setpoint for a quench cycle.

The Temperature Setpoint is the setpoint to send down. The temperature setpoint is not sent down if the internal 9220 quench timer is timing. It will wait for the quench timer to time out before sending. This allows the opcode to be put at the beginning of a recipe and not affect the quench temperature set point of a load already quenching.

A Quench Instrument must be defined in Furnace Setup for this to properly work properly.

The range is -301 (disable) – 30000.

QUENCH
Temperature Time Speed
This opcode is used to start a quench cycle. The quench cycle is independent of any program that is running. A new recipe can be started while the quench timer is active.

The Temperature is the quench temperature controller set point. The quench temperature controller must be defined as a slave instrument in the Slave Instrument Setup menu and configured in the Furnace Setup menu as ***Instrument # 4***. The range is **-301** (disable) – **30000**.

The quench cycle starts when the opcode is executed. The set point is sent to the quench temperature controller, the timer is started, and the high-speed event is turned on if it is selected. Once the quench timer has timed out, the quench speed changes to an idle speed, and the end of quench cycle event pulses on and off.

The Time is the quench time in minutes. The range is **-1** (disable) – **9999**.

The Speed is used to trigger an Event (#6, by default, which can be changed in the Furnace Setup menu).

While this quench cycle is active, there are three events that can be triggered:

- Quench speed event (Default: #6)
- Quench run event (Default: #0)
- End of quench event (Default: #7)

All of these events must be configured in the Furnace Setup menu.

Quench Speed Event
While the quench timer is active, if a high speed was selected, the quench speed event will be on. This Event can control the agitator speed, high or low. This Event will remain off if the quench speed is set to low.

Quench Run Event
While the quench timer is active, the Quench Run Event is on.

End of Quench Event
When the End of Quench Alarm is activated at the end of the quench cycle, the user must acknowledge the alarm. While the End of Quench Alarm is active, the End of Quench Event will be on.

Refer to Furnace Setup for proper use of Events with respect to Quench Event setup.

RAMP
Temperature Setpoint N/A Time
This opcode changes the temperature set point linearly over time.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

The Time is the total time for the program to reach the desired setpoint(s), in Hours:Minutes format. The Hours range from 0 – 166, and the Minutes range from 0 – 59.

The band limit can be changed by the SET_WAIT opcode.

RAMPR
Temperature Setpoint Option Decimal Rate
This opcode changes the temperature set point at a rate of degrees per minute.

The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is -301 (disable) – 30000.

The Option Decimal will alter the decimal point in the rate. The range is -1 (disable) – 2.

The Rate will be the rate of degrees per minute to change the temperature until the setpoint is reached. The range is 0.01 – 300.00.

RESET
Recipe Number Recipe Step N/A
This opcode is used to clear all stacks and timers and start a program. The RESET is useful in a weekend shut down program to restart the normal operating program.

The Recipe Number is the program number to start once everything has been reset. The range is 1 – 300.

The Recipe Step is the step number in the program to start at. The range is 1 – 24.

RLY_INQ
Off step number On step number Option
The relay inquiry is used to check the relays using the relay setpoint RLY_SP_M or RLY_SP_T opcodes. This Opcode must immediately follow a Relay Setpoint Opcode.

The Off step number determines what the next recipe step will be when this Relay Setpoint is off. The On step number determines what the next recipe step will be when this Relay Setpoint is on.

The Option value will determine which vacuum relay is selected. If the relay is ON, the program moves to the ON step number. If the relay is OFF, the program moves to the OFF step number.

The LIMIT opcode immediately following this opcode sets a time limit on the wait.

A BRANCH opcode immediately following this opcode can be used to change the program flow based on the inquiry results.

RLY_SP_M
Off setpoint **On setpoint** **Option**
This opcode determines the relay setpoint in microns to be used in conjunction with the RLY_INQ Opcode and must precede the RLY_INQ.

The options are used to select the gauge and setpoint.

RLY_SP_T
Off setpoint **On setpoint** **Option**
This opcode determines the relay setpoint in Torr to be used in conjunction with the RLY_INQ Opcode and must precede the RLY_INQ.

The options are used to select the gauge and setpoint.

RUN_SLAVE
Recipe Number **Recipe Step** **Slave Instrument**
This opcode will start a recipe on the specified slave SSI recipe programmer instrument.

The Recipe Number is the program number to start on the slave instrument. The range is 1 – 300.

The Recipe Step is the program step to start on in the slave instrument. The range is 1 – 24.

The Slave Instrument is the slave instrument to select to start the recipe on (SSi recipe programmers only). The options are: 1 – 25.

SET_AUX
Setpoint Value **N/A** **Slave Instrument**
This opcode sends a setpoint down to an auxiliary instrument.
The Setpoint Value is the setpoint to send down. The range is -301 (disable) – 30000.
The Slave Instrument is the slave instrument to send the setpoint down to (SSi recipe programmers only).
The options are: 1 – 25.

SET_PCL
Output Limit **N/A** **Loop**
This sets the PID change limit. It will limit the percentage output of the controller as the target temperature is reached.
Output Limit determines the percent per minute that the temperature can change.
Loop assigns the corresponding loop.

SET_WAIT
Temperature Setpoint **N/A** **Speed**

This opcode sets the band limits for the wait option or inquiry opcodes.
The Temperature Setpoint specifies the temperature band (i.e. +/- the value). The range is **-301** (disable) – **30000**.
The Speed is the speed to use. Upper and lower limits can be set together using **Ctrl & Load**, **Ctrl**, **or Load;** they can also be set independently using **Ctrl & Load (+), Ctrl (+), Load (+), Ctrl & Load (-), Ctrl (-), or Load (-).**

SETDAC

Output Level **N/A** **Output**

This opcode is used to set an analog output to the specified value. The output must be assigned as a Programmer DAC when SETDAC is called in a recipe. The Programmer DAC assignment is done in the Analog Output Setup menu on the 9220 touch screen or in Configurator. The Analog Output Setup menu contains Offset and Range settings, which will be proportionally applied to the 4-20mA output range.
The range for output level is **-301 (disable) to 32767.**
The range for output is **1 to 6.**

SETOUTPT

Output Level **N/A** **Output**

This opcode is used to write a value to a configured analog output. The output is configured in the Relay Assignments menu (Programmer DAC 1 – 6). The Output Level is the output value that will be written to the analog output; the range is determined by the output range defined in the Analog Output Setup's Range field for that output. The Output field defines which analog output (**1 - 6**) to send the value to.

SETPT

Temperature Setpoint **N/A** **Option**

This opcode is used to set the temperature set point.
The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is **-301** (disable) – **30000**.
The Option will wait for the setpoints to be reached: **Blank** (Don't Wait), **Wait**, **Wait Up**, or **Wait Down**. *Note – The Blank option is an actual blank line, not the word "Blank".*

SOAK

N/A **N/A** **Soak Time**

This opcode is an unconditional soak for the time (in hours and minutes) specified. The programmer will hold for the time specified, and nothing except the operator pausing the recipe will put the program in a hold state.
The Soak time is the total time, in Hours:Minutes format, for the soak to run. The Hours range from **0** – **166**, and the Minutes range from **0** – **59**.

TC_CHK

Source 1 **Source 2** **Source 3**

This opcode will check a TC.
Source 1 will determine the first source to check. The options are: **Not Used**, **Instrument 1** – **Instrument 25**, and **Input 1** – **Input 3**.
Source 2 will determine the second source to check. The options are: **Not Used**, **Instrument 1** – **Instrument 25**, and **Input 1** – **Input 3**.
Source 3 will determine the third source to check. The options are: **Not Used**, **Instrument 1** – **Instrument 25**, and **Input 1** – **Input 3**.

TC_INQ

Temperature Level **T/C** **Option**

The temperature inquiry is used to wait for the actual control temperature to reach the value specified.
The Temperature Level is the specified level to wait for. The range is **-301** (disable) – **30000**.
The T/C is the Control T/C or Load T/C to use. The options are: **Control T/C**, **T/C 1** – **T/C 24**.
The Option is the wait options: **Wait**, **Wait Up**, or **Wait Down**.
The default band can be set under the Configuration Menu and is typically 15 degrees. The band limit can be changed by the S*ET_WAIT* opcode.
The *LIMIT* opcode immediately following this opcode sets a time limit on the wait.
A *BRANCH* opcode immediately following this opcode can be used to change the program flow based on the inquiry results.

timeEvt

N/A **Delay Time** **Option**

This opcode will turn ON or OFF a specified event for the specified amount of time.
The Delay Time is the time in seconds. The range is: **0** – **500**.
The Option is the event to turn ON or OFF. The options are: **Event 0 ON** or **OFF** – **Event 47 ON** or **OFF**.

TOD_INQ

N/A **N/A** **Time**

This opcode is a time of day inquiry that would be used to start a process or subroutine at a specific hour and minute. The time and date must be correct on the 9220 controller – the screen time and date will not be used.
The Time is the time to check, in Hours:Minutes format. The Hours range from **0** – **23**, and the Minutes range from **0** – **59**.

TZ_INQ

Temperature Level **N/A** **Option**

The zone temperature inquiry is used to wait for the actual control zone temperature to reach the value specified.
The Temperature Level is the specified level to wait for. The range is **-301** (disable) – **30000**.
The Option is the wait options: **Wait**, **Wait Up**, or **Wait Down**.
The default band can be set under the Configuration Menu and is typically 15 degrees. The band limit can be changed by the S*ET_WAIT* opcode.
The *LIMIT* opcode immediately following this opcode sets a time limit on the wait. A *BRANCH* opcode immediately following this opcode can be used to change the program flow based on the inquiry results.
This opcode is identical to the *TC_INQ* opcode, except that it will deal with zones.

VAC_INQ_M_1-4

N/A **Micron Level** **Option**

The vacuum inquiry is used to determine the vacuum value of the gauge (1-4) being tested.
The Micron Level is the vacuum level in microns that the actual value will be compared to.
The Option value will determine how the test will conclude. The options are: **Wait** (Reach within band), **Wait Up** (Reach or Exceed the specified values), or **Wait Down** (Reach or Be Less than the specified values).
The LIMIT opcode immediately following this opcode sets a time limit on the wait.
A BRANCH opcode immediately following this opcode can be used to change the program flow based on the inquiry results.

VAC_INQ_T_1-4

N/A **Torr Level** **Option**

The vacuum inquiry is used to determine the vacuum value of the gauge (1-4) being tested.
The Torr Level is the vacuum level in Torr that the actual value will be compared to.
The Option value will determine how the test will conclude. The options are: **Wait** (Reach within band), **Wait Up** (Reach or Exceed the specified values), or **Wait Down** (Reach or Be Less than the specified values).
The LIMIT opcode immediately following this opcode sets a time limit on the wait.
A BRANCH opcode immediately following this opcode can be used to change the program flow based on the inquiry results.

VLUP_chk

Pass Step Number **Retry Step Number** **Fail Step Number**

A vacuum leak-up test will determine if the furnace is leaking at an acceptable low rate, as determined by the operator. This rate and other testing details can be assigned in the Vacuum Leak Up Testing menu on the touchscreen or Configurator.
The Pass Step Number determines the next step in the recipe if the furnace passes the test.

The Retry Step Number determines the next step in the recipe if the furnace fails the test but will retry.
The Fail Step Number determines the next step in the recipe if the furnace has retried the maximum number of times and still fails.
For example, in the following recipe step:

VLUP_chk 5 1 10

If the furnace passes the leak-up test, the recipe will proceed to step 5. If the furnace does *not* pass, the recipe will return to step 1 as many times as assigned in the Vacuum Leak Up Testing menu. If the furnace does not pass after the maximum specified attempts, the recipe will proceed to step 10.

Z_SETPT
Temperature Setpoint **N/A** **Option**
This opcode is used to set the temperature set point for a zone.
The Temperature Setpoint is the setpoint to send for the temperature process variable. The range is **-301** (disable) – **30000**.
The Option will wait for the setpoints to be reached: **Blank** (Don't Wait), **Wait**, **Wait Up**, or **Wait Down**. *Note – The Blank option is an actual blank line, not the word "Blank".*

ZONE_OFF
Temperature Value **N/A** **Zone**
The Zone Offset opcode is used to set a temperature offset to be added to the set point sent to a specific zone. The same loop (furnace) can have different offsets for each zone. The zones must be defined in the zone configuration.

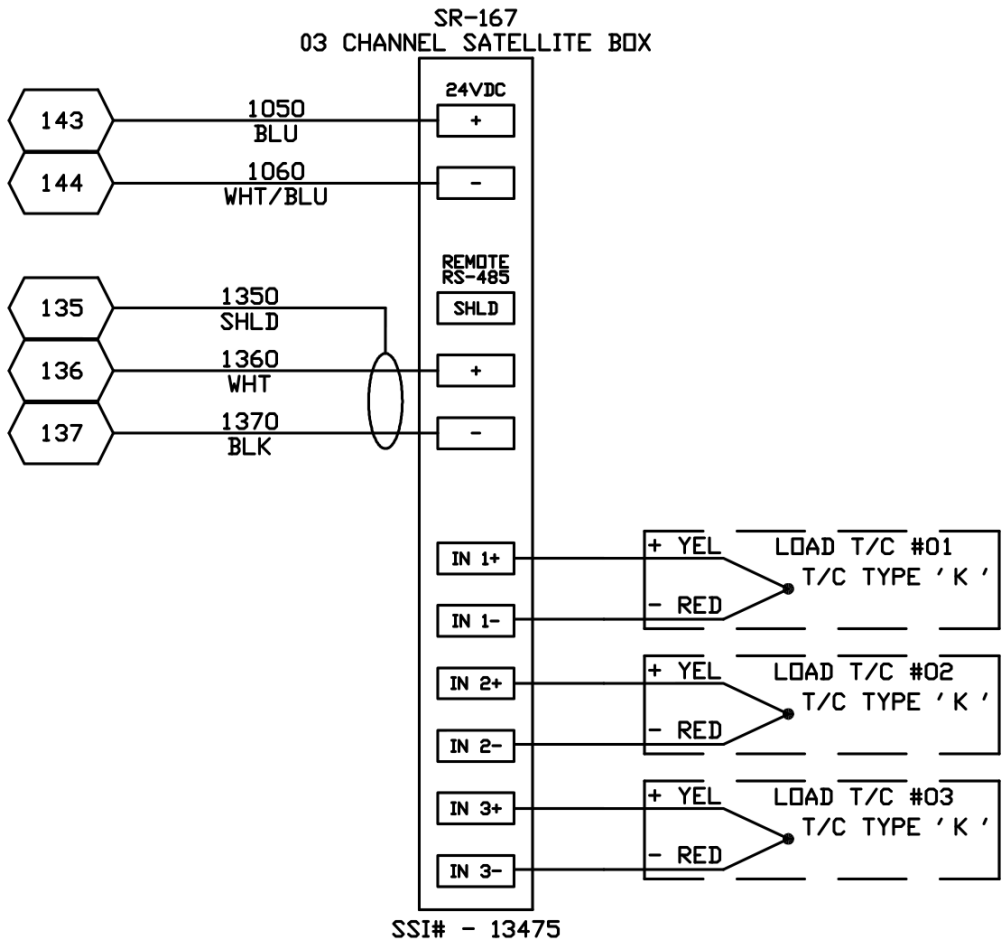
For example, a pit furnace has three zones: top, middle, and bottom.
The zones could be defined as:

- top = zone 1
- middle = zone 2
- bottom = zone 3

If the *ZONE_OFF* opcode is used in a program with Temperature Value = 50 and Zone = 1 and a setpoint of 1700, then:
- A set point of 1750 would be sent to the top zone (Zone 1)
- A set point of 1700 would be sent to the middle zone (Zone 2)
- A set point of 1700 would be sent to the bottom zone (Zone 3)

The offset from ZONE_OFF is discarded when the program ends. The default value is reloaded by the programmer when the user starts a new program.
The Temperature value is the offset value to send to the specified zone. The range is **-301** (disable) – **30000**.
The Zone is the specific zone to send the offsets to. The options are: **Zone 1** – **Zone 5**.

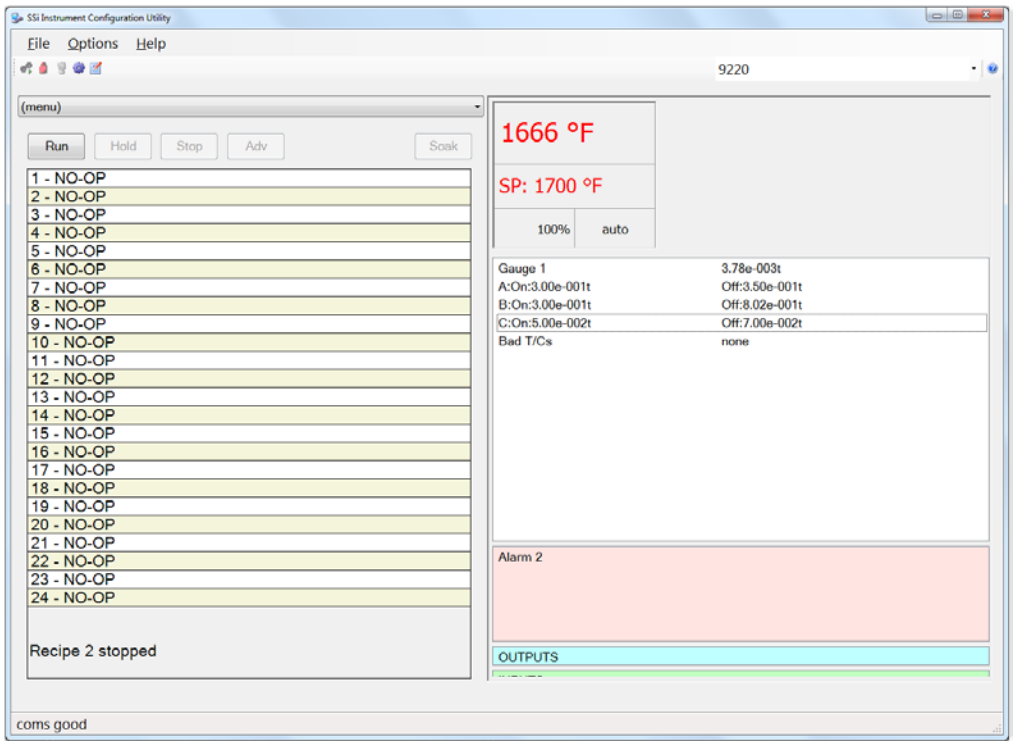
Appendix A – Wiring Diagram of Series 9220


SR-167
03 CHANNEL SATELLITE BOX
24VDC
+
-
REMOTE
RS-485
SHLD
+
-
143
144
135
136
137
1050
BLU
1060
WHT/BLU
1350
SHLD
1360
WHT
1370
BLK
IN 1+
IN 1-
IN 2+
IN 2-
IN 3+
IN 3-
+ YEL
- RED
LOAD T/C #01
T/C TYPE 'K'
+ YEL
- RED
LOAD T/C #02
T/C TYPE 'K'
+ YEL
- RED
LOAD T/C #03
T/C TYPE 'K'
SSI# - 13475

Appendix B – Guide to Building a Recipe

The SSi 9220 is a multi-loop programmable vacuum recipe controller. The 9220 can control multiple loops (partial pressure vacuum level, vacuum setpoints, temperature) and has several assignable relay outputs (Events, End Of Cycle, Alarms, etc…) that can be set up in a recipe to process work.
Things to understand before creating recipes:

1) Know how the furnace works. Have an understanding of not only what is happening to the work but also how the furnace operates.
2) Know the limitations of the furnace.
3) Know what should be accomplished with the recipe.



Sample Recipe Structure for a 9220 for a Single Chamber Vacuum Furnace

	Opcode	Description			Option	Comment
1	EVT_IN	wait for event input			0-ON	
2	RAMPR	ramp at rate (temp)	1550 °F		50 °/min	
3	G_SOAK	guaranteed soak (temperature)			0:30	
4	RAMPR	ramp at rate (temp)	1950 °F		15 °/min	
5	RLY_SP_M	relay setpoint (microns)	440 m	400 m	Gauge 1 - S...	
6	EVT_OUT	event output	1950 °F		1-ON	
7	G_SOAK	guaranteed soak (temperature)			0:20	
8	EVT_OUT	event output	125 °F		3-ON	
9	TC_INQ	temperature inquiry	125 °F	Control ...	wait	
10	SOAK	soak			0:40	
11	EVT_OUT	event output			4-ON	
12	EVT_OUT	event output			2-ON	
13	EVT_IN	wait for event input			5-ON	
14	EVT_OUT	event output			5-ON	
15	ALARM	user alarm			user alarm 1	

The Recipes in the 9220 operate from the top to the bottom. This means that if something happens in Step 4, but the recipe is in Step 2, the operation for Step 4 will not turn on until that point is reached. This also means that if the recipe is in Step 4, anything from Step 1 through Step 4 is currently active, on, or present, unless it has been turned off within the recipe or turned off manually.
What is going on in this recipe?

1) Most likely, the furnace is already in a "Cycle Running" condition, from a Cycle Start button being pressed or some other variable that has started this furnace into cycle. In Step 1, the recipe is waiting on an event input to turn on. It appears that this event input is a heat enable input (vacuum level achieved, heating system active, etc...). The recipe continues to Step 2.

2) In Step 2, the recipe is setting the Temperature . This particular recipe is ramping the furnace at a controlled rate to 1550°F. The recipe continues to Step 3.

3) In Step 3, the recipe is doing a guaranteed soak. This means that the furnace has to be at the Setpoint or within its Deviation Band for the soak timer to time out. The recipe then continues to Step 4.

4) In Step 4, the recipe is again setting the Temperature. It is again ramping the furnace at a controlled rate to a temperature. The recipe continues to Step 5.

5) At Step 5, the recipe is setting the partial pressure range. This range is the control range of a vacuum level that the controller will attempt to maintain in the furnace. Once the range is specified, the recipe continues to Step 6.

6) Step 6 in the recipe is calling for a partial pressure in the furnace. Most likely, one of the assignable relay outputs is assigned as a partial pressure control relay. This relay will be energized between the range specified in the recipe at Step 5 and de-energized outside of the range specified in the recipe. Once this output turns on, it continues to Step 7.

7) Step 7 is another guaranteed soak in the furnace. Once the soak timer has timed out, the recipe will advance to Step 8.

8) The recipe has now entered into quench. The recipe has set the furnace temperature to 125°F, and has turned on an event output. This event output is most likely tied to a series of logic that will turn on cooling water, turn on the cooling fan, close the vacuum valve, turn off the vacuum pump, etc...

9) Step 9 of the recipe is a TC Inquiry. This verifies that the furnace temperature has achieved its temperature setpoint before advancing.

10) In Step 10, the controller is again in a soak segment. This is to ensure that the load has properly cooled through. Once the quench time is complete, the recipe advances.

11) Since the next few steps are event outputs, the controller will advance rather rapidly until it gets to the step for the Event Input, where it will wait for something to happen. Most likely, Step 11 and Step 12 are outputs that are ending the quench, and opening up the vent valve in the furnace so that the furnace pressure will equalize to the outside air.

12) In Step 13, the recipe is in an Event Input. It is most likely waiting for the furnace to be vented. This could be through a 1 atmosphere switch. This step could also be done with a Delay Timer instead of an Event Input, if the time to vent the furnace is known.

13) In Step 14, the recipe is mostly complete. The furnace has vented, so most likely this step is turning on the work bell to let the operator know that the recipe has completed.

14) Step 15 is holding the work bell on until the operator can come to the furnace, acknowledge that the work is done, and unload the work from the furnace. Once the Alarm has been acknowledged (by pressing the Acknowledge button on the screen), the recipe has completed.

Sample Recipe Structure for a 9220 for a Multi Chamber Vacuum Furnace

	Opcode	Description			Option	Comment
1	SETPT	set point	1250 °F		wait	
2	EVT_OUT	event output			0-ON	
3	EVT_IN	wait for event input			0-ON	
4	SETPT	set point	1250 °F		wait	
5	RLY_SP_M	relay setpoint (microns)	315 m	335 m	Gauge 1 - S...	
6	EVT_OUT	event output			1-ON	
7	SOAK	soak			1:00	
8	EVT_OUT	event output			5-ON	
9	EVT_OUT	event output			3-ON	
10	EVT_IN	wait for event input			0-ON	

The Recipes in the 9220 operate from the top to the bottom. This means that if something happens in Step 4, but the recipe is in Step 2, the operation for Step 4 will not turn on until that point is reached. This also means that if the recipe is in Step 4, anything from Step 1 through Step 4 is currently active, on, or present, unless it has been turned off within the recipe or turned off manually.
What is going on in this recipe?

1) In Multi-Chamber vacuum furnaces, the hot zone of the furnace is usually kept at a hot temperature to minimize downtime in running the furnace. At this point, the furnace is most likely in an Automatic running condition. The work has been loaded in a loading zone of the

furnace, and the sequence that matches the vacuum levels to allow the work to transfer into the hot zone has already been started. The recipe is selected and ran.

2) Step 1 starts the recipe by setting the furnace temperature to 1250°F.

3) In Step 2, the recipe is turning on an event output. This could be telling the motion sequence that the hot zone (and recipe) is ready for work, which will also allow the work to be transferred into the hot zone.

4) In Step 3, the recipe is waiting on an event input. This is most likely some sort of trigger that the work is transferring. This event input holds the recipe so that if the transfer sequence takes some time (chambers to pump down and equalize, valves opening and closing, doors opening and closing, etc…), the recipe will not have already advanced and starting timing out.

5) In Step 4, the recipe is again setting the Temperature, however the recipe has a wait condition. Since the cold load will drag the temperature of the furnace down, the recipe should not continue until the furnace temperature has recuperated. Once the furnace temperature has come back to setpoint, the recipe will advance to Step 5.

6) At Step 5, the recipe is setting the partial pressure range. This range is the control range that the controller will attempt to maintain of a vacuum level in the furnace. Once the range is specified, the recipe continues to Step 6.

7) Step 6 in the recipe is calling for a partial pressure in the furnace. Most likely, one of the assignable relay outputs is assigned as a partial pressure control relay. This relay will be energized between the range specified in the recipe at Step 5 and de-energized outside of the range specified in the recipe. Once this output turns on, it continues to Step 7.

8) Step 7 is a soak segment in the recipe. Once the soak timer has timed out, the recipe will advance to Step 8.

9) The recipe has completed is timing/temperature portion, and has now progressed to move the work out of the hot zone and into the next appropriate zone. Step 8 and Step 9 are most likely telling the motion control that the work is complete in the hot zone and where to move the work (oil quench, gas quench, etc…). This step could also ring a work bell that will tell the operator that the work is done in the hot zone so that they may watch the work transfer, press an acknowledge button that will allow the work to transfer, etc…

10) Step10 of the recipe is another event input, the same as used above in Step 3. This is most likely to hold the conditions of Step 8 and Step 9 on until the work has started to move to the correct location. Once Step 10 has completed, the recipe is complete.

Sample Recipe Structure for a 9220 for a Vacuum Temper Furnace

	Opcode	Description			Option	Comment
1	RAMPR	ramp at rate (temp)	1350 °F		20 °/min	
2	TC_INQ	temperature inquiry	1350 °F	Control ...	wait	
3	SOAK	soak			1:00	
4	EVT_OUT	event output	200 °F		1-ON	
5	TC_INQ	temperature inquiry	200 °F	Control ...	wait	
6	EVT_OUT	event output			1-OFF	
7	EVT_OUT	event output			2-ON	
8	ALARM	user alarm			user alarm 1	
9	NO-OP	no opcode				

The Recipes in the 9220 operate from the top to the bottom. This means that if something happens in Step 4, but the recipe is in Step 2, the operation for Step 4 will not turn on until that point is reached. This also means that if the recipe is in Step 4, anything from Step 1 through Step 4 is currently active, on, or present, unless it has been turned off in the recipe, or manually.
What is going on in this recipe?

1) In a Vacuum Temper Furnace, the sequence usually starts by an operator pressing a Cycle Start button. This initiates a sequence that pumps the furnace down to a certain vacuum level, then backfills the furnace to a slightly positive pressure of some gas (Nitrogen, Hydrogen, Argon, etc...) and enables the heating circuit. In this case, the 9220 Controller is most likely setup so that the recipe will not run until this sequence has completed.

2) Step 1 starts the recipe by setting the furnace temperature with a controlled ramp rate. Once the recipe has controlled the temperature up to its setpoint, the recipe will advance to Step 2.

3) In Step 2, the recipe is verifying the actual temperature in the furnace. If the actual temperature is at setpoint or within a deviation band of the setpoint the recipe will advance to Step 3.

4) The recipe is in a soak at Step 3. After the soak timer has completed, the recipe will advance to Step 4.

5) In Step 4, the recipe has gone into a cooling or quench segment. The recipe has set the temperature to 200°F and has turned on an event output. This event output is most likely turning on the cooling/quench sequence.

6) At Step 5, the recipe is verifying that the furnace temperature has achieved its cooled setpoint. Once it has been reached, the recipe will progress.

7) In Step 6, the recipe is turning off the cooling/quench output.

8) By Step 7, the work has completed processing. This step is most likely turning on a work bell and preventing the furnace from running again until the next load is ready.

9) Step 8 is holding the work bell on until the operator can come to the furnace, acknowledge that the work is done, and unload the work from the furnace. Once the Alarm has been acknowledged (by pressing the Acknowledge button on the screen), the recipe has completed.

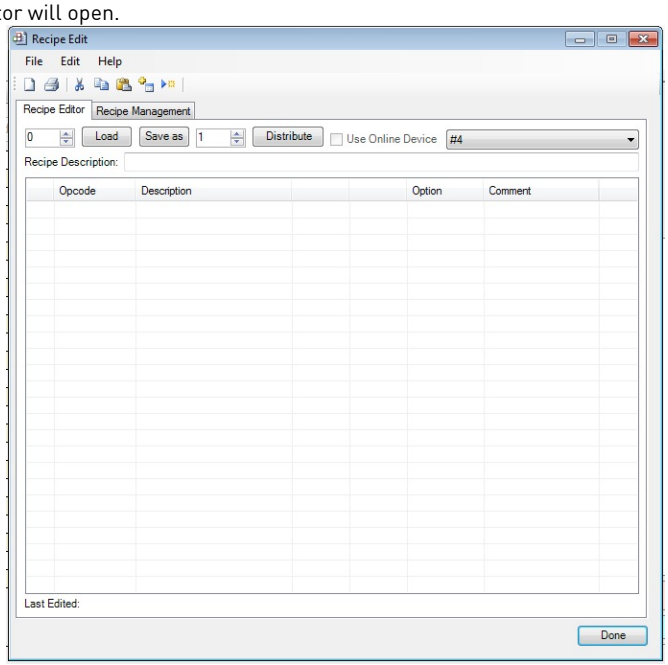
Building a Recipe

Recipes can be built through the 9220 touchscreen interface or through SSi Configurator. This guide will use Configurator, but the touchscreen interface functions in the same manner.

Start by opening Configurator. Log in by clicking the padlock icon in the upper left hand corner of the screen. After logging in, the padlock icon will change color, signifying a successful login.

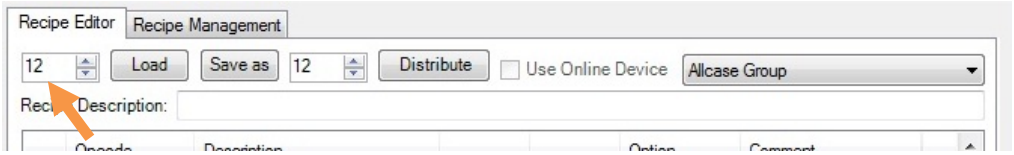
To start to build or modify recipes, click the Recipe Editor icon in the upper left hand corner of the screen.

The Recipe Editor will open.



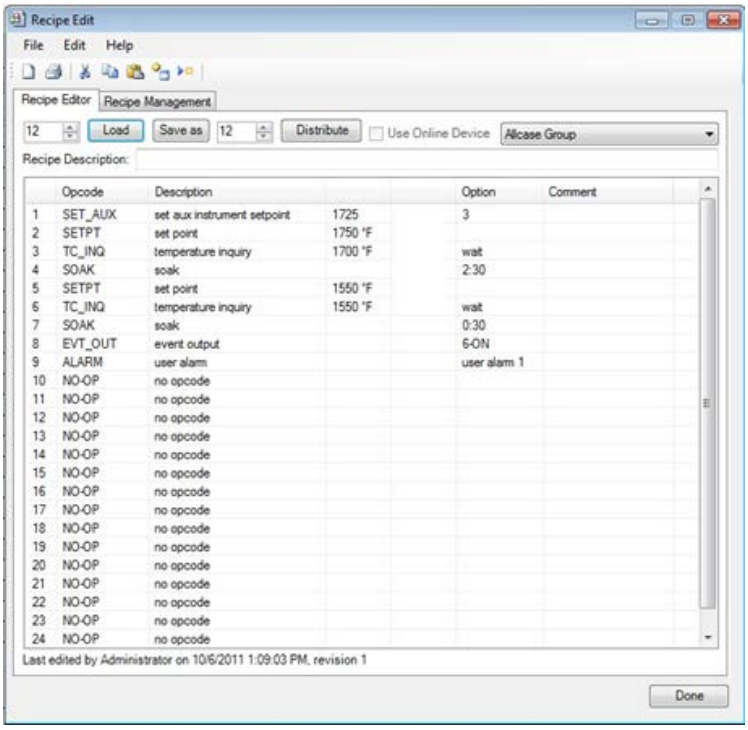
First, start by choosing the correct Recipe Group. To do this, click the drop down box near the upper right hand corner of the screen.

Once the correct recipe group has been selected, type or click the Up or Down arrows in the Load Entry Box, near the upper left hand corner to change the number.

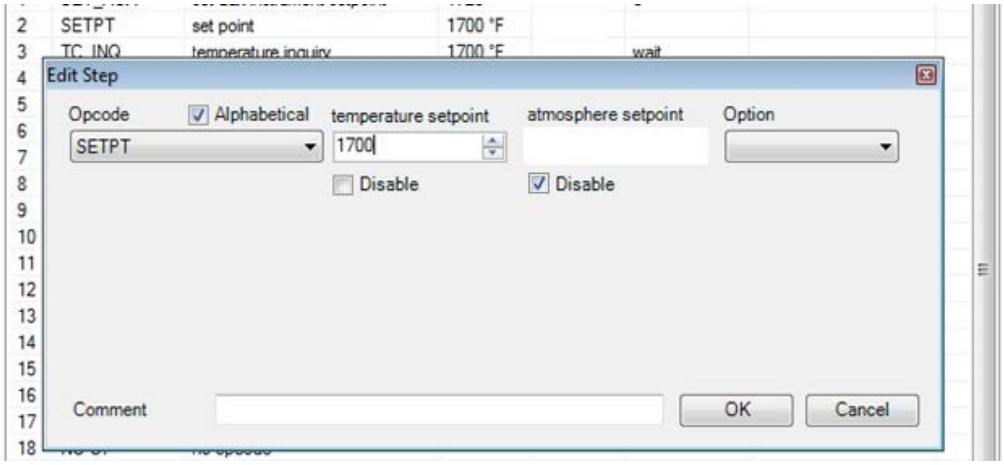


Once the correct recipe number is selected, click the Load button. If a recipe has already been created under that recipe number, it will appear in the Recipe Box. If a recipe has not

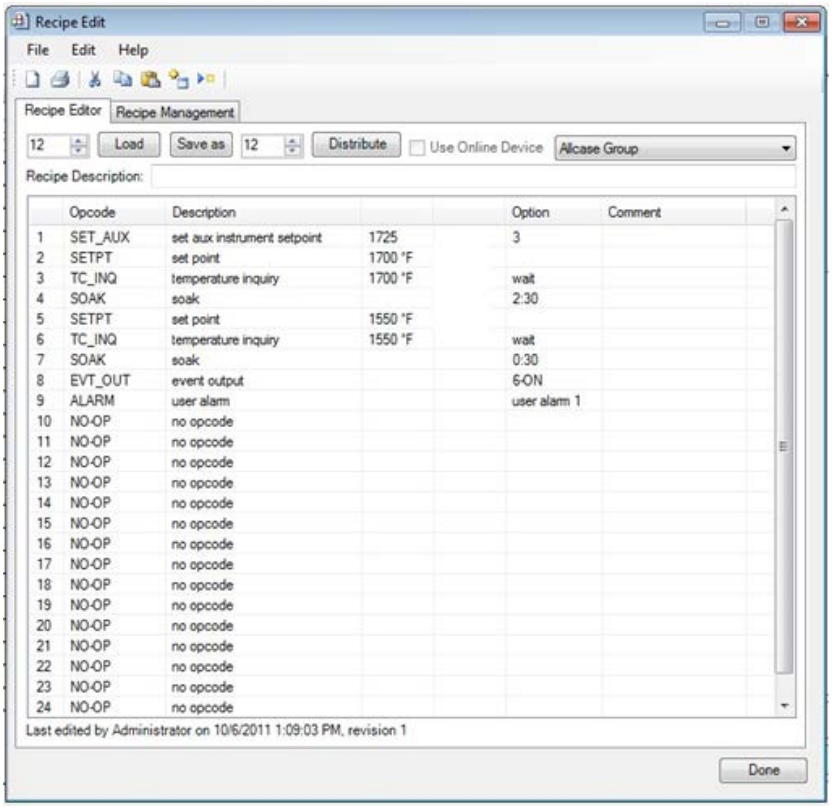
yet been created, the Recipe Box will remain empty. In the example seen below, a recipe has already been created for Recipe #12.



Before adjusting the recipe, the operator must first understand what needs to be modified. For example, if the temperature needs to be adjusted at the beginning of the recipe, double click on the line for SETPT. The SETPT Edit Step box will appear.

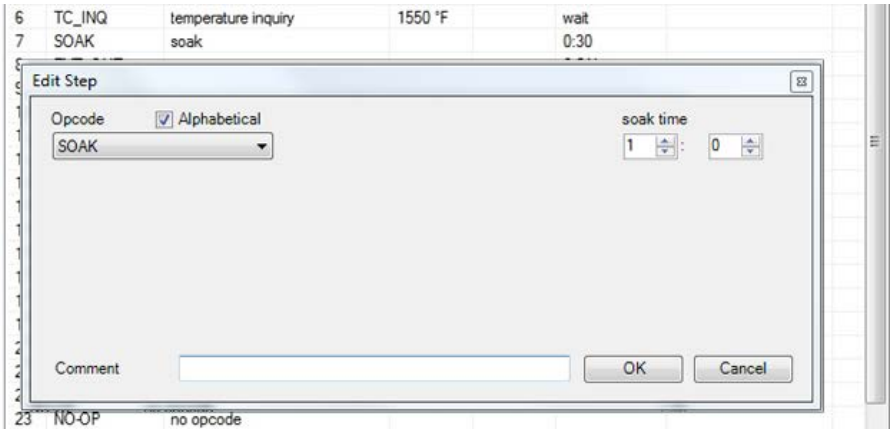


Under the Temperature Setpoint text in the upper middle portion of the Edit Step box, there is a numeric entry box. To modify this setpoint, either the Up or Down arrows can be pressed, or the desired temperature can be entered into the box from a keyboard. Once the correct setpoint has been entered, press the OK button in the bottom right corner of the Edit Step box.

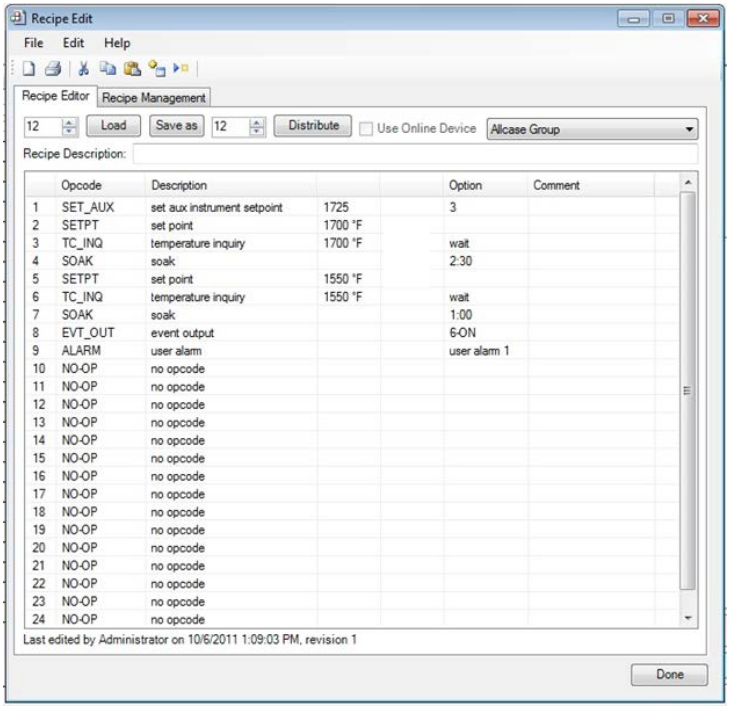


Here, the Temperature setpoint has been modified.

If the SOAK time is not long enough, this time can be increased. To do this, double click on the line with the SOAK Opcode. The Edit Step box will appear.



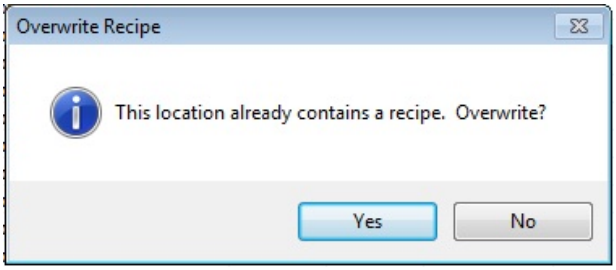
Under the Soak Time in the upper right hand corner, there are two numeric entry boxes. The left most numeric entry box is for time in hours. The right most numeric entry box is for time in minutes. To modify these times, either the Up or Down arrows can be pressed, or the desired time can be entered into the boxes from the keyboard. Once the correct time has been entered, press the OK button in the bottom right corner of the Edit Step box.



Here, SOAK time has been modified.

If this Recipe is now correct, it is time to save this recipe. There are two options for doing this.

1) To permanently save Recipe #12 with the modifications, click the Save As button. A pop up box will appear if there is a recipe already saved to the existing recipe number (if there is no recipe saved to that number, the pop up box will not appear).

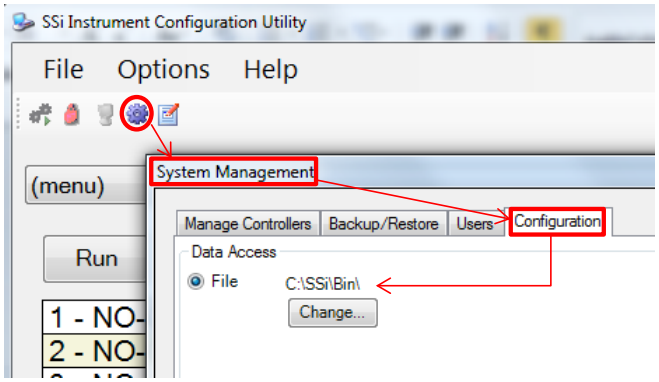


To permanently modify Recipe #12, click the Yes button.

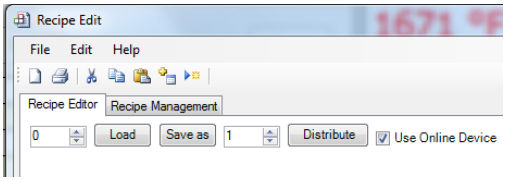
2) To save the modified recipe as a new recipe number, in the Save As numeric entry box, 

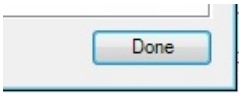
press the Up or Down arrows, or enter in the desired recipe number. Once the appropriate recipe number has been selected, click the Save As button (a pop up confirmation box may appear; if it does, simply choose "Yes" to overwrite the existing recipe). The mouse pointer on the screen will change to a Busy pointer  as the recipe is saving.

IMPORTANT: The recipe will be saved to the folder defined under Settings → Configuration → Data Access. In order to save the recipe to the controller, you must first be logged into the controller using the login () button.



Second, when the **Recipe Edit** window is open, "Use Online Device" must be checked in the window before the recipe is saved.



Once the mouse pointer returns to normal, click the Done button at the bottom right hand corner of the Recipe Editor box. 

Now that the recipe has been modified completely, or a new recipe has been built, the operator can Log Out by again clicking the padlock icon. After successfully logging out, the padlock icon will change back to a blue color. Exit Configurator by clicking the "X" button at the top right corner of the screen, or by clicking File → Close at the top left corner of the screen.

Appendix C – Factory Default Settings for the 9220 Controller

Field	Factory Default Valve
PID Loop 1 Setup	
Prop Band (0 for On/Off)	3.9
Reset	0.13
Rate	0.00
Mode	Single Reverse
Integral Preset	0
Cycle Time	16
Setpoint Change Limit	OFF
Low Limit	0
High Limit	100
0 set point stops control	yes
IN1 high input shuts down ctrl	no
IN2 high input shuts down ctrl	no
IN3 high input shuts down ctrl	no
PID auto switch	no
Switch Point PID 1->2	9999
Switch Point PID 2->3	9999
Setpoint Lower Limit	-9999
Setpoint Upper Limit	29999
Control source	input 1
Output rate change limit, %/sec	0.0
Positive Output Accumulator	481120475.3
Negative Output Accumulator	730028233.7
Overshoot Control Logic	no
Ramp Detect Logic	no
Ramp Overshoot Control Level 1	no
Ramp Overshoot Control Level 2	no
PID Loop 2 Setup	
Prop Band (0 for On/Off)	3.9
Reset	0.13
Rate	0.00
Mode	Single Reverse
Integral Preset	0
Cycle Time	16
Setpoint Change Limit	OFF
Low Limit	0
High Limit	100
0 set point stops control	no
IN1 high input shuts down ctrl	no
IN2 high input shuts down ctrl	no
IN3 high input shuts down ctrl	no
PID auto switch	no
Switch Point PID 1->2	9999
Switch Point PID 2->3	9999
Setpoint Lower Limit	-9999
Setpoint Upper Limit	29999
Control source	off
Output rate change limit, %/sec	0.0

Field	Factory Default Valve
Positive Output Accumulator	1997974.9
Negative Output Accumulator	1057613520.7
Overshoot Control Logic	no
Ramp Detect Logic	no
Ramp Overshoot Control Level 1	no
Ramp Overshoot Control Level 2	no
PID Loop 3 Setup	
Prop Band (0 for On/Off)	3.9
Reset	0.13
Rate	0.00
Mode	Single Reverse
Integral Preset	0
Cycle Time	16
Setpoint Change Limit	OFF
Low Limit	0
High Limit	100
0 set point stops control	no
IN1 high input shuts down ctrl	no
IN2 high input shuts down ctrl	no
IN3 high input shuts down ctrl	no
PID auto switch	no
Switch Point PID 1->2	9999
Switch Point PID 2->3	9999
Setpoint Lower Limit	-9999
Setpoint Upper Limit	29999
Control source	off
Output rate change limit, %/sec	0.0
Positive Output Accumulator	423147159.5
Negative Output Accumulator	4968729.8
Overshoot Control Logic	no
Ramp Detect Logic	no
Ramp Overshoot Control Level 1	no
Ramp Overshoot Control Level 2	no
Event Run Program Setup	
Program number to run	0
Load TC Setup	
Load TC Enable	off
Control TC	
TC 1	
TC 2	
TC 3	
TC 4	
TC 5	
TC 6	
TC 7	
TC 8	
TC 9	
TC 10	
TC 11	
TC 12	

Field	Factory Default Valve
TC 13	
TC 14	
TC 15	
TC 16	
TC 17	
TC 18	
TC 19	
TC 20	
TC 21	
TC 22	
TC 23	
TC 24	
TC 25	
TC 26	
TC 27	
TC 28	
Analog Input 1	
Analog Input 2	
Analog Input 3	
TC 29	
TC 30	
TC 31	
TC 32	
TC 33	
TC 34	
TC 35	
TC 36	
TC 37	
TC 38	
TC 39	
Load TC Alarm ON Delay (sec)	0
SP bump maximum step change	0
SP bump max total change	0
SP bump change time (sec)	0
Minimum Load T/Cs for guarantee (0 to disable)	0
Fail guarantee on active T/C bad coms	no
Port Setup	
Host 232 Baud	19200
Host 232 Mode	Modbus/DF1 master
Host 485 (3,4) Baud	19200
Host 485 (3,4) Mode	Modbus
Host 485 Address	1
Slave 1 (5,6) Baud	19200
Slave 1 (5,6) Mode	Modbus Host
Slave 2 (22,23) Baud	19200
Slave 2 (22,23) Mode	SSi Analog Input Board
232-2 Port Baud	19200
232-2 Port Mode	error
Slave Instrument Setup	
Instrument 1	

Field	Factory Default Valve
Instrument 2	
Instrument 3	
Instrument 4	
Instrument 5	
Instrument 6	
Instrument 7	
Instrument 8	
Instrument 9	
Instrument 10	
Instrument 11	
Instrument 12	
Instrument 13	
Instrument 14	
Instrument 15	
Instrument 16	Micrologix PLC @ 1 on RS-232
Instrument 17	Micrologix PLC @ 1 on RS-232
Instrument 18	Micrologix PLC @ 1 on RS-232
Instrument 19	
Instrument 20	Micrologix PLC @ 1 on RS-232
Instrument 21	
Instrument 22	
Instrument 23	
Instrument 24	
Instrument 25	
Instrument 26	
Instrument 27	
Instrument 28	
Zone 1 Assignment	
Temp Instrument	Loop 1
Temp Zone Number	0
Default Zone Offset, temp	0
Zone 2 Assignment	
Temp Instrument	Loop 1
Temp Zone Number	0
Default Zone Offset, temp	0
Zone 3 Assignment	
Temp Instrument	Loop 1
Temp Zone Number	0
Default Zone Offset, temp	0
Zone 4 Assignment	
Temp Instrument	Loop 1
Temp Zone Number	0
Default Zone Offset, temp	0
Zone 5 Assignment	
Temp Instrument	Loop 1
Temp Zone Number	0
Default Zone Offset, temp	0
Furnace Setup	
PVT Type	Vacuum
Temperature Mode	°F

Field	Factory Default Valve
Atmosphere Instrument	Instrument 1
Temperature Instrument	Loop 1
Event Instrument	PLC
Quench Instrument	Loop 3
End of quench event	7
Quench speed event	6
Quench run event	0
Vacuum Gauge on RS-232	no
Date and Time	invalid
PLC Type	Micrologix Modbus
Default Hold Time	90
Clear events/end of recipe	yes
Clear TC set point/end of recipe	no
Slave Event Boards	0
Load T/C Auto Check	off
Wait Limits	
Temp Wait Limit	15
Atm Wait Limit	10
Furnace Name	
Furnace Name	Vacuum r 1 ! '
PV1 Name	Temperature 1
PV2 Name	Vacuum
PV3 Name	Vacuum GRAMMER
Alarm 1 Setup	
Setpoint	300
Alarm Type	PV1 proc low
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0
0 SP blocks alarm	no
Alarm 2 Setup	
Setpoint	301
Alarm Type	PV2 proc low
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0
0 SP blocks alarm	no
Alarm 3 Setup	
Setpoint	1400
Alarm Type	PV2 proc high
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0
0 SP blocks alarm	no
Alarm 4 Setup	
Setpoint	9999
Alarm Type	PV1 proc high
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0

Field	Factory Default Valve
0 SP blocks alarm	no
Alarm 5 Setup	
Setpoint	9999
Alarm Type	PV1 proc high
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0
0 SP blocks alarm	no
Alarm 6 Setup	
Setpoint	9999
Alarm Type	PV1 proc high
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0
0 SP blocks alarm	no
Alarm 7 Setup	
Setpoint	9999
Alarm Type	PV1 proc high
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0
0 SP blocks alarm	no
Thermocouple Check	
Setpoint	9999
Alarm Type	PV1 proc high
Hysteresis	1
Smart Alarm	disabled
ON Delay Time (sec)	0
0 SP blocks alarm	no
Relay Assignments	
Relay 1	event 0
Relay 2	event 1
Relay 3	event 2
Relay 4	event 3
Relay 5	event 4
Relay 6	event 5
Relay 7	event 6
Relay 8	alarm 1
Module 1 Inputs	not assigned
Module 1 Relay 1	loop 1 fwd
Module 1 Relay 2	loop 1 fwd
Module 1 Relay 3	loop 1 fwd
Module 1 Relay 4	loop 1 fwd
Module 1 Relay 5	loop 1 fwd
Module 1 Relay 6	loop 1 fwd
Module 1 Relay 7	loop 1 fwd
Module 1 Relay 8	loop 1 fwd
Module 2 Inputs	not assigned
Module 2 Relay 1	loop 1 fwd
Module 2 Relay 2	loop 1 fwd

Field	Factory Default Valve
Module 2 Relay 3	loop 1 fwd
Module 2 Relay 4	loop 1 fwd
Module 2 Relay 5	loop 1 fwd
Module 2 Relay 6	loop 1 fwd
Module 2 Relay 7	loop 1 fwd
Module 2 Relay 8	loop 1 fwd
Module 3 Inputs	not assigned
Module 3 Relay 1	loop 1 fwd
Module 3 Relay 2	loop 1 fwd
Module 3 Relay 3	loop 1 fwd
Module 3 Relay 4	loop 1 fwd
Module 3 Relay 5	loop 1 fwd
Module 3 Relay 6	loop 1 fwd
Module 3 Relay 7	loop 1 fwd
Module 3 Relay 8	loop 1 fwd
Module 4 Inputs	not assigned
Module 4 Relay 1	loop 1 fwd
Module 4 Relay 2	loop 1 fwd
Module 4 Relay 3	loop 1 fwd
Module 4 Relay 4	loop 1 fwd
Module 4 Relay 5	loop 1 fwd
Module 4 Relay 6	loop 1 fwd
Module 4 Relay 7	loop 1 fwd
Module 4 Relay 8	loop 1 fwd
Relay Setpoints	
Relay ON SP for Gauge 1 A	3.0e-1
Relay off SP for Gauge 1 A	3.5e-1
Relay ON SP for Gauge 1 B	3.0e-1
Relay off SP for Gauge 1 B	8.0e-1
Relay ON SP for Gauge 1 C	5.0e-2
Relay off SP for Gauge 1 C	7.0e-2
Relay ON SP for Gauge 1 D	1.0e0
Relay off SP for Gauge 1 D	1.0e0
Relay ON SP for Gauge 1 E	1.0e0
Relay off SP for Gauge 1 E	1.0e0
Relay ON SP for Gauge 1 F	1.0e0
Relay off SP for Gauge 1 F	1.0e0
Relay ON SP for Gauge 2 A	1.0e0
Relay off SP for Gauge 2 A	1.0e0
Relay ON SP for Gauge 2 B	1.0e0
Relay off SP for Gauge 2 B	1.0e0
Relay ON SP for Gauge 2 C	1.0e0
Relay off SP for Gauge 2 C	1.0e0
Relay ON SP for Gauge 2 D	1.0e0
Relay off SP for Gauge 2 D	1.0e0
Relay ON SP for Gauge 2 E	1.0e0
Relay off SP for Gauge 2 E	1.0e0
Relay ON SP for Gauge 2 F	1.0e0
Relay off SP for Gauge 2 F	1.0e0
Relay ON SP for Gauge 3 A	1.0e0

Field	Factory Default Valve
Relay off SP for Gauge 3 A	1.0e0
Relay ON SP for Gauge 3 B	1.0e0
Relay off SP for Gauge 3 B	1.0e0
Relay ON SP for Gauge 3 C	1.0e0
Relay off SP for Gauge 3 C	1.0e0
Relay ON SP for Gauge 3 D	1.0e0
Relay off SP for Gauge 3 D	1.0e0
Relay ON SP for Gauge 3 E	1.0e0
Relay off SP for Gauge 3 E	1.0e0
Relay ON SP for Gauge 3 F	1.0e0
Relay off SP for Gauge 3 F	1.0e0
Relay ON SP for Gauge 4 A	1.0e0
Relay off SP for Gauge 4 A	1.0e0
Relay ON SP for Gauge 4 B	1.0e0
Relay off SP for Gauge 4 B	1.0e0
Relay ON SP for Gauge 4 C	1.0e0
Relay off SP for Gauge 4 C	1.0e0
Relay ON SP for Gauge 4 D	1.0e0
Relay off SP for Gauge 4 D	1.0e0
Relay ON SP for Gauge 4 E	1.0e0
Relay off SP for Gauge 4 E	1.0e0
Relay ON SP for Gauge 4 F	1.0e0
Relay off SP for Gauge 4 F	1.0e0
Input 1 Setup	
Input Type	S
Filter Time	0
Initial Scale	0
Full Scale	1000
Decimal Point Location	0
Open Input	up scale
Input Offset	0
Scaling	linear microns
Trip Point 1 Setpoint	0
Trip Point 1 Force Value	0
Trip Point 1 Direction	input above setpoint
Trip Point 2 Setpoint	0
Trip Point 2 Force Value	0
Trip Point 2 Direction	input above setpoint
High Input Limit Setpoint	9999
High Input Limit Hysteresis	1
Custom Curve	none
T/C Correction Curve	none
Input 2 Setup	
Input Type	12.5 volts
Filter Time	0
Initial Scale	0
Full Scale	1250
Decimal Point Location	0
Open Input	up scale
Input Offset	0

Field	Factory Default Valve
Scaling	linear microns
Trip Point 1 Setpoint	0
Trip Point 1 Force Value	0
Trip Point 1 Direction	input above setpoint
Trip Point 2 Setpoint	0
Trip Point 2 Force Value	0
Trip Point 2 Direction	input above setpoint
High Input Limit Setpoint	9999
High Input Limit Hysteresis	1
Custom Curve	none
T/C Correction Curve	none
Input 3 Setup	
Input Type	12.5 volts
Filter Time	0
Initial Scale	0
Full Scale	1250
Decimal Point Location	0
Open Input	up scale
Input Offset	0
Scaling	linear microns
Trip Point 1 Setpoint	0
Trip Point 1 Force Value	0
Trip Point 1 Direction	input above setpoint
Trip Point 2 Setpoint	0
Trip Point 2 Force Value	0
Trip Point 2 Direction	input above setpoint
High Input Limit Setpoint	9999
High Input Limit Hysteresis	1
Custom Curve	none
T/C Correction Curve	none
Output 1 Setup	
Assignment	loop 1 inc
Offset	0
Range	200
Current Selection	4 - 20 mA
Output 2 Setup	
Assignment	PV1 retrans
Offset	0
Range	3000
Current Selection	4 - 20 mA
Passcodes	
Level 1 Code	1
Level 2 Code	2
Web Level 1 Code	111
Web Level 2 Code	222
Web Change Enable	1
Programmer Alarm	normally open
Alarm 1	normally open
Alarm 2	normally open
Alarm 3	normally open

Field	Factory Default Valve
Alarm 4	normally open
Alarm 5	normally open
Alarm 6	normally open
Alarm 7	normally open
IP Address	
IP Address	192.168.1.202
IP Mask	255.254.255.0
IP Gateway	192.168.1.1
Event Control	
Hold instrument number	0
Hold Minimum PV	0
Hold Maximum PV	2000
Input Event for Program Run	-1
Input Event for Program Reset	-1
Input Event 0	
Input Event 1	
Input Event 2	
Input Event 3	
Input Event 4	
Input Event 5	
Input Event 6	
Input Event 7	
Input Event 8	
Input Event 9	
Input Event 10	
Input Event 11	
Input Event 12	
Input Event 13	
Input Event 14	
Input Event 15	
Vacuum Gauge 1 Setup	
Gauge Enable	yes
Vacuum Source	Input 2
Calculation Type	none
Gas Compensation	air/CO/O2/N2
Native Scaling	microns
Display Maximum	10000000 µ
Zero Scale Value	0 µ
Span Value	748170 µ
Display Scaling	log torr
Leak Up Test Data	click
Generic Inficon Slope	0.000
Generic Inficon p Constant	0.00
Vacuum Gauge 2 Setup	
Gauge Enable	no
Vacuum Source	Input 3
Calculation Type	none
Gas Compensation	air/CO/O2/N2
Native Scaling	microns
Display Maximum	10000000 µ

Field	Factory Default Valve
Zero Scale Value	0 µ
Span Value	748170 µ
Display Scaling	log torr
Leak Up Test Data	click
Generic Inficon Slope	0.000
Generic Inficon p Constant	0.00
Vacuum Gauge 3 Setup	
Gauge Enable	no
Vacuum Source	Input 2
Calculation Type	Inficon Pirani eq
Gas Compensation	air/CO/O2/N2
Native Scaling	log of torr
Display Maximum	1.0 e+4
Zero Scale Value	1.3 e--5
Span Value	7.5 e+2
Display Scaling	log torr
Leak Up Test Data	click
Generic Inficon Slope	0.000
Generic Inficon p Constant	0.00
Vacuum Gauge 4 Setup	
Gauge Enable	no
Vacuum Source	Input 2
Calculation Type	Inficon Pirani eq
Gas Compensation	air/CO/O2/N2
Native Scaling	log of torr
Display Maximum	1.0 e+4
Zero Scale Value	1.3 e--5
Span Value	7.5 e+2
Display Scaling	log torr
Leak Up Test Data	click
Generic Inficon Slope	0.000
Generic Inficon p Constant	0.00
Menu Security	
Program Edit	supervisor
Auxiliary Instruments	operator
Auxiliary Analog Input	operator
Shutdown	operator
Adjust Date and Time	operator
Slave Communications Status	operator
Backup Compressed Data	supervisor
Manual Event Control	supervisor
PID Loop Setup	supervisor
Event Run Program Setup	supervisor
Zone/Load TC Setup	supervisor
Port Setup	supervisor
Slave Instrument Setup	supervisor
Zone Assignments	supervisor
Furnace Setup	administrator
Default Wait Limits	administrator
Furnace Name	administrator

Field	Factory Default Valve
Alarm Setup	administrator
Relay Assignments	administrator
Relay Setpoints	administrator
Analog Input Setup	administrator
Output Setup	administrator
Passcodes and Alarm	administrator
IP Address	administrator
Event Control	administrator
Vacuum Gauge Setup	administrator
Programmer Setup	administrator
Recipe Transfer	administrator
User Calibration	administrator
Full Calibration	administrator
Set Menu Security	administrator
Read/Write Raw Data	administrator
Tuning Assistant	administrator
Curve Entry	operator
ADAM Correction	operator
Aux SP Configuration	operator
Generic Instrument Setup	operator
Curve 1 Entry	
Curve Type	none
Control Range	21229
mV 1	11212
Vac 1	-13620
mV 2	-7769
Vac 2	7457
mV 3	-8821
Vac 3	228
mV 4	-26590
Vac 4	8526
mV 5	-29921
Vac 5	-6947
mV 6	8704
Vac 6	20118
mV 7	23533
Vac 7	20118
mV 8	-26582
Vac 8	-3250
mV 9	-1217
Vac 9	16169
mV 10	-4612
Vac 10	16210
mV 11	25325
Vac 11	-13620
mV 12	-7865
Vac 12	1057
mV 13	14592
Vac 13	-8731
mV 14	228

Field	Factory Default Valve
Vac 14	38
mV 15	8683
Vac 15	2
mV 16	32236
Vac 16	30689
mV 17	23533
Vac 17	20120
mV 18	-27094
Vac 18	-3250
mV 19	-1217
Vac 19	16169
mV 20	-4612
Vac 20	16210
mV 21	25325
Vac 21	-13620
mV 22	-7825
Vac 22	1057
mV 23	14592
Vac 23	-8731
mV 24	228
Vac 24	38
mV 25	8683
Vac 25	4
mV 26	32236
Vac 26	30689
mV 27	23533
Vac 27	20120
mV 28	-27094
Vac 28	-18610
mV 29	21229
Vac 29	-12827
mV 30	-32287
Vac 30	551
mV 31	10987
Vac 31	-24987
mV 32	16371
Vac 32	10747
Curve 2 Entry	
Curve Type	linear
Control Range	-13214
mV 1	-23350
Vac 1	8673
mV 2	4
Vac 2	-6855
mV 3	-6947
Vac 3	9728
mV 4	-5376
Vac 4	289
mV 5	-5120
Vac 5	-7811

Field	Factory Default Valve
mV 6	-15497
Vac 6	-7744
mV 7	1057
Vac 7	14592
mV 8	8677
Vac 8	0
mV 9	8677
Vac 9	0
mV 10	-15131
Vac 10	-6864
mV 11	-26673
Vac 11	5101
mV 12	1575
Vac 12	-7811
mV 13	-15497
Vac 13	-7735
mV 14	1057
Vac 14	14592
mV 15	1846
Vac 15	1313
mV 16	14592
Vac 16	54
mV 17	1313
Vac 17	14592
mV 18	-6947
Vac 18	9728
mV 19	-6912
Vac 19	1569
mV 20	14592
Vac 20	-6947
mV 21	9728
Vac 21	-6912
mV 22	-223
Vac 22	-6657
mV 23	12484
Vac 23	-15131
mV 24	11054
Vac 24	-12315
mV 25	-7447
Vac 25	10008
mV 26	32010
Vac 26	-19406
mV 27	-15458
Vac 27	-30281
mV 28	3011
Vac 28	-15223
mV 29	8744
Vac 29	20118
mV 30	17
Vac 30	10880

Field	Factory Default Valve
mV 31	20118
Vac 31	16169
mV 32	-4612
Vac 32	16210
Curve 3 Entry	
Curve Type	linear
Control Range	3089
mV 1	10880
Vac 1	20118
mV 2	16169
Vac 2	-4612
mV 3	-4782
Vac 3	-13214
mV 4	-13620
Vac 4	-7442
mV 5	7441
Vac 5	10752
mV 6	20118
Vac 6	10521
mV 7	8683
Vac 7	-30727
mV 8	-8935
Vac 8	228
mV 9	-26590
Vac 9	8526
mV 10	5
Vac 10	13881
mV 11	-15360
Vac 11	-5334
mV 12	-26582
Vac 12	-3250
mV 13	-1217
Vac 13	16169
mV 14	-4612
Vac 14	16210
mV 15	25325
Vac 15	-13620
mV 16	-7577
Vac 16	1057
mV 17	14592
Vac 17	-8731
mV 18	228
Vac 18	38
mV 19	8683
Vac 19	2
mV 20	32236
Vac 20	30689
mV 21	23533
Vac 21	20120
mV 22	10948

Field	Factory Default Valve
Vac 22	16371
mV 23	10747
Vac 23	-961
mV 24	21229
Vac 24	-4801
mV 25	-13214
Vac 25	-28982
mV 26	8674
Vac 26	4
mV 27	-6855
Vac 27	-6947
mV 28	9728
Vac 28	-5376
mV 29	1057
Vac 29	-5120
mV 30	-7811
Vac 30	-4745
mV 31	-26533
Vac 31	-15282
mV 32	-18646
Vac 32	21229
Curve 4 Entry	
Curve Type	linear
Control Range	10987
mV 1	-24987
Vac 1	16371
mV 2	10747
Vac 2	-961
mV 3	21229
Vac 3	-4801
mV 4	-13214
Vac 4	-15670
mV 5	8674
Vac 5	4
mV 6	-6855
Vac 6	-6947
mV 7	9728
Vac 7	-5376
mV 8	289
Vac 8	-5120
mV 9	-7811
Vac 9	8567
mV 10	5
Vac 10	-8903
mV 11	228
Vac 11	38
mV 12	8677
Vac 12	6
mV 13	-8903
Vac 13	228

Field	Factory Default Valve
mV 14	38
Vac 14	8677
mV 15	-1
Vac 15	10981
mV 16	20120
Vac 16	-15131
mV 17	-6866
Vac 17	-5681
mV 18	6370
Vac 18	2599
mV 19	12925
Vac 19	-24908
mV 20	-19517
Vac 20	-15479
mV 21	-30457
Vac 21	11809
mV 22	14592
Vac 22	-6947
mV 23	9728
Vac 23	-5376
mV 24	33
Vac 24	-18688
mV 25	21229
Vac 25	11212
mV 26	-13620
Vac 26	-7174
mV 27	273
Vac 27	-15232
mV 28	10538
Vac 28	-961
mV 29	21229
Vac 29	-4801
mV 30	-13214
Vac 30	9674
mV 31	4579
Vac 31	-32764
mV 32	10948
Vac 32	16169
Curve 5 Entry	
Curve Type	none
Control Range	-13620
mV 1	-7369
Vac 1	17
mV 2	-15232
Vac 2	10534
mV 3	-961
Vac 3	21229
mV 4	-4801
Vac 4	-13214
mV 5	-13620

Field	Factory Default Valve
Vac 5	-7352
mV 6	1041
Vac 6	-15232
mV 7	10534
Vac 7	-961
mV 8	21229
Vac 8	25325
mV 9	-13108
Vac 9	-1334
mV 10	-15133
Vac 10	-15574
mV 11	-7202
Vac 11	28961
mV 12	-8822
Vac 12	228
mV 13	8683
Vac 13	16383
mV 14	8924
Vac 14	20120
mV 15	9924
Vac 15	8683
mV 16	14
Vac 16	-11315
mV 17	-4732
Vac 17	-26533
mV 18	-5042
Vac 18	-26590
mV 19	8526
Vac 19	-30095
mV 20	10981
Vac 20	20120
mV 21	-7683
Vac 21	-2819
mV 22	-15616
Vac 22	-7174
mV 23	31521
Vac 23	-8822
mV 24	228
Vac 24	8683
mV 25	16383
Vac 25	8924
mV 26	20120
Vac 26	9924
mV 27	8683
Vac 27	14
mV 28	-11315
Vac 28	-4732
mV 29	-26533
Vac 29	-5042
mV 30	-26590

Field	Factory Default Valve
Vac 30	8526
mV 31	-30085
Vac 31	10981
mV 32	20120
Vac 32	-7683
Alternate PID 1 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 2 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 3 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 4 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 5 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 6 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 7 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40

Field	Factory Default Valve
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 8 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 9 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 10 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 11 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 12 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 13 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 14 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20

Field	Factory Default Valve
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 15 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 16 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 17 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 18 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 19 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 20 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 21 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0

Field	Factory Default Valve
High Limit	100
Low Limit	0
Alternate PID 22 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 23 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 24 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Alternate PID 25 Setup	
Prop Band (0 for On/Off)	4.0
Reset	0.40
Rate	0.20
Integral Preset	0
High Limit	100
Low Limit	0
Analog Input 1 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale
Analog Input 2 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale

Field	Factory Default Valve
Analog Input 3 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale
Analog Input 4 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale
Analog Input 5 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale
Analog Input 6 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale
Analog Input 7 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale

Field	Factory Default Valve
Analog Input 8 Setup	
Input type 1	B
Input type 2	B
Input type 3	B
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 1 open T/C	up scale
Input 2 open T/C	up scale
Input 3 open T/C	up scale
ADAM Offset	
Enable offsets for SSi AIB	no
Input 1	0.0
Input 2	0.0
Input 3	0.0
Input 4	0.0
Input 5	0.0
Input 6	0.0
Input 7	0.0
Input 8	0.0
Input 9	0.0
Input 10	0.0
Input 11	0.0
Input 12	0.0
Input 13	0.0
Input 14	0.0
Input 15	0.0
Input 16	0.0
Input 17	0.0
Input 18	0.0
Input 19	0.0
Input 20	0.0
Input 21	0.0
Input 22	0.0
Input 23	0.0
Input 24	0.0
Input 25	0.0
Input 26	0.0
Input 27	0.0
Input 28	0.0
Input 29	0.0
Input 30	0.0
Input 31	0.0
Input 32	0.0
Input 33	0.0
Input 34	0.0
Input 35	0.0
Input 36	0.0
Input 37	0.0
Input 38	0.0

Field	Factory Default Valve
Input 39	0.0
Input 40	0.0
Input 0 Correction	not used
Input 1 Correction	not used
Input 2 Correction	not used
Input 3 Correction	not used
Input 4 Correction	not used
Input 5 Correction	not used
Input 6 Correction	not used
Input 7 Correction	not used
Input 8 Correction	not used
Input 9 Correction	not used
Input 10 Correction	not used
Input 11 Correction	not used
Input 12 Correction	not used
Input 13 Correction	not used
Input 14 Correction	not used
Input 15 Correction	not used
Input 16 Correction	not used
Input 17 Correction	not used
Input 18 Correction	not used
Input 19 Correction	not used
Input 20 Correction	not used
Input 21 Correction	not used
Input 22 Correction	not used
Input 23 Correction	not used
Input 24 Correction	not used
Input 25 Correction	not used
Input 26 Correction	not used
Input 27 Correction	not used
Input 28 Correction	not used
Input 29 Correction	not used
Input 30 Correction	not used
Input 31 Correction	not used
Input 32 Correction	not used
Input 33 Correction	not used
Input 34 Correction	not used
Input 35 Correction	not used
Input 36 Correction	not used
Input 37 Correction	not used
Input 38 Correction	not used
Input 39 Correction	not used
Auxiliary Setpoint Configuration	
Retrans to Slave 1	Off
Retrans to Slave 2	Off
Retrans to Slave 3	Off
Setpoint Offset Sl 1	0
Setpoint Offset Sl 2	0
Setpoint Offset Sl 3	0
Setpoint Delay Sl 1	0

Field	Factory Default Valve
Setpoint Delay Sl 2	0
Setpoint Delay Sl 3	0
TC Extension Correction Curves	
Curve 1: Point 1 Temp	0
Curve 1: Point 1 Offset	0.000
Curve 1: Point 2 Temp	0
Curve 1: Point 2 Offset	0.000
Curve 1: Point 3 Temp	0
Curve 1: Point 3 Offset	0.000
Curve 1: Point 4 Temp	0
Curve 1: Point 4 Offset	0.000
Curve 1: Point 5 Temp	0
Curve 1: Point 5 Offset	0.000
Curve 1: Point 6 Temp	0
Curve 1: Point 6 Offset	0.000
Curve 1: Point 7 Temp	0
Curve 1: Point 7 Offset	0.000
Curve 1: Point 8 Temp	0
Curve 1: Point 8 Offset	0.000
Curve 1: Point 9 Temp	0
Curve 1: Point 9 Offset	0.000
Curve 1: Point 10 Temp	0
Curve 1: Point 10 Offset	0.000
Curve 2: Point 1 Temp	0
Curve 2: Point 1 Offset	0.000
Curve 2: Point 2 Temp	0
Curve 2: Point 2 Offset	0.000
Curve 2: Point 3 Temp	0
Curve 2: Point 3 Offset	0.000
Curve 2: Point 4 Temp	0
Curve 2: Point 4 Offset	0.000
Curve 2: Point 5 Temp	0
Curve 2: Point 5 Offset	0.000
Curve 2: Point 6 Temp	0
Curve 2: Point 6 Offset	0.000
Curve 2: Point 7 Temp	0
Curve 2: Point 7 Offset	0.000
Curve 2: Point 8 Temp	0
Curve 2: Point 8 Offset	0.000
Curve 2: Point 9 Temp	0
Curve 2: Point 9 Offset	0.000
Curve 2: Point 10 Temp	0
Curve 2: Point 10 Offset	0.000
Curve 3: Point 1 Temp	0
Curve 3: Point 1 Offset	0.000
Curve 3: Point 2 Temp	0
Curve 3: Point 2 Offset	0.000
Curve 3: Point 3 Temp	0
Curve 3: Point 3 Offset	0.000
Curve 3: Point 4 Temp	0

Field	Factory Default Valve
Curve 3: Point 4 Offset	0.000
Curve 3: Point 5 Temp	0
Curve 3: Point 5 Offset	0.000
Curve 3: Point 6 Temp	0
Curve 3: Point 6 Offset	0.000
Curve 3: Point 7 Temp	0
Curve 3: Point 7 Offset	0.000
Curve 3: Point 8 Temp	0
Curve 3: Point 8 Offset	0.000
Curve 3: Point 9 Temp	0
Curve 3: Point 9 Offset	0.000
Curve 3: Point 10 Temp	0
Curve 3: Point 10 Offset	0.000
DF1 Setup	
My node	6
PLC node	1
PLC read table	13
PLC write table	12
PLC intermessage delay (ms)	0
PV Switch Setup	
PV Switch Active Loop	none
PV Switch Action	none
PV Switch Value	0
PV Switch Hysteresis	0
Generic Instrument Configuration	
Instrument 1 Register Read 1	0
Instrument 1 Count 1	0
Instrument 1 Storage 1	0
Instrument 1 Register Read 2	0
Instrument 1 Count 2	0
Instrument 1 Storage 2	0
Instrument 1 Register Read 3	0
Instrument 1 Count 3	0
Instrument 1 Storage 3	0
Instrument 1 Register Read 4	0
Instrument 1 Count 4	0
Instrument 1 Storage 4	0
Instrument 1 PV Memory	0
Instrument 1 PV Register	0
Instrument 1 PV In Scale	0
Instrument 1 PV Out Scale	0
Instrument 1 SP Memory	0
Instrument 1 SP Register	0
Instrument 1 SP In Scale	0
Instrument 1 SP Out Scale	0
Instrument 1 Output Memory	0
Instrument 1 Output Register	0
Instrument 1 Output In Scale	0
Instrument 1 Output Out Scale	0
Instrument 2 Register Read 1	0

Field	Factory Default Valve
Instrument 2 Count 1	0
Instrument 2 Storage 1	0
Instrument 2 Register Read 2	0
Instrument 2 Count 2	0
Instrument 2 Storage 2	0
Instrument 2 Register Read 3	0
Instrument 2 Count 3	0
Instrument 2 Storage 3	0
Instrument 2 Register Read 4	0
Instrument 2 Count 4	0
Instrument 2 Storage 4	0
Instrument 2 PV Memory	0
Instrument 2 PV Register	0
Instrument 2 PV In Scale	0
Instrument 2 PV Out Scale	0
Instrument 2 SP Memory	0
Instrument 2 SP Register	0
Instrument 2 SP In Scale	0
Instrument 2 SP Out Scale	0
Instrument 2 Output Memory	0
Instrument 2 Output Register	0
Instrument 2 Output In Scale	0
Instrument 2 Output Out Scale	0
Instrument 3 Register Read 1	0
Instrument 3 Count 1	0
Instrument 3 Storage 1	0
Instrument 3 Register Read 2	0
Instrument 3 Count 2	0
Instrument 3 Storage 2	0
Instrument 3 Register Read 3	0
Instrument 3 Count 3	0
Instrument 3 Storage 3	0
Instrument 3 Register Read 4	0
Instrument 3 Count 4	0
Instrument 3 Storage 4	0
Instrument 3 PV Memory	0
Instrument 3 PV Register	0
Instrument 3 PV In Scale	0
Instrument 3 PV Out Scale	0
Instrument 3 SP Memory	0
Instrument 3 SP Register	0
Instrument 3 SP In Scale	0
Instrument 3 SP Out Scale	0
Instrument 3 Output Memory	0
Instrument 3 Output Register	0
Instrument 3 Output In Scale	0
Instrument 3 Output Out Scale	0
Instrument 4 Register Read 1	0
Instrument 4 Count 1	0
Instrument 4 Storage 1	0

Field	Factory Default Valve
Instrument 4 Register Read 2	0
Instrument 4 Count 2	0
Instrument 4 Storage 2	0
Instrument 4 Register Read 3	0
Instrument 4 Count 3	0
Instrument 4 Storage 3	0
Instrument 4 Register Read 4	0
Instrument 4 Count 4	0
Instrument 4 Storage 4	0
Instrument 4 PV Memory	0
Instrument 4 PV Register	0
Instrument 4 PV In Scale	0
Instrument 4 PV Out Scale	0
Instrument 4 SP Memory	0
Instrument 4 SP Register	0
Instrument 4 SP In Scale	0
Instrument 4 SP Out Scale	0
Instrument 4 Output Memory	0
Instrument 4 Output Register	0
Instrument 4 Output In Scale	0
Instrument 4 Output Out Scale	0
Instrument 5 Register Read 1	0
Instrument 5 Count 1	0
Instrument 5 Storage 1	0
Instrument 5 Register Read 2	0
Instrument 5 Count 2	0
Instrument 5 Storage 2	0
Instrument 5 Register Read 3	0
Instrument 5 Count 3	0
Instrument 5 Storage 3	0
Instrument 5 Register Read 4	0
Instrument 5 Count 4	0
Instrument 5 Storage 4	0
Instrument 5 PV Memory	0
Instrument 5 PV Register	0
Instrument 5 PV In Scale	0
Instrument 5 PV Out Scale	0
Instrument 5 SP Memory	0
Instrument 5 SP Register	0
Instrument 5 SP In Scale	0
Instrument 5 SP Out Scale	0
Instrument 5 Output Memory	0
Instrument 5 Output Register	0
Instrument 5 Output In Scale	0
Instrument 5 Output Out Scale	0
Instrument 6 Register Read 1	0
Instrument 6 Count 1	0
Instrument 6 Storage 1	0
Instrument 6 Register Read 2	0
Instrument 6 Count 2	0

Field	Factory Default Valve
Instrument 6 Storage 2	0
Instrument 6 Register Read 3	0
Instrument 6 Count 3	0
Instrument 6 Storage 3	0
Instrument 6 Register Read 4	0
Instrument 6 Count 4	0
Instrument 6 Storage 4	0
Instrument 6 PV Memory	0
Instrument 6 PV Register	0
Instrument 6 PV In Scale	0
Instrument 6 PV Out Scale	0
Instrument 6 SP Memory	0
Instrument 6 SP Register	0
Instrument 6 SP In Scale	0
Instrument 6 SP Out Scale	0
Instrument 6 Output Memory	0
Instrument 6 Output Register	0
Instrument 6 Output In Scale	0
Instrument 6 Output Out Scale	0
Instrument 7 Register Read 1	0
Instrument 7 Count 1	0
Instrument 7 Storage 1	0
Instrument 7 Register Read 2	0
Instrument 7 Count 2	0
Instrument 7 Storage 2	0
Instrument 7 Register Read 3	0
Instrument 7 Count 3	0
Instrument 7 Storage 3	0
Instrument 7 Register Read 4	0
Instrument 7 Count 4	0
Instrument 7 Storage 4	0
Instrument 7 PV Memory	0
Instrument 7 PV Register	0
Instrument 7 PV In Scale	0
Instrument 7 PV Out Scale	0
Instrument 7 SP Memory	0
Instrument 7 SP Register	0
Instrument 7 SP In Scale	0
Instrument 7 SP Out Scale	0
Instrument 7 Output Memory	0
Instrument 7 Output Register	0
Instrument 7 Output In Scale	0
Instrument 7 Output Out Scale	0
Instrument 8 Register Read 1	0
Instrument 8 Count 1	0
Instrument 8 Storage 1	0
Instrument 8 Register Read 2	0
Instrument 8 Count 2	0
Instrument 8 Storage 2	0
Instrument 8 Register Read 3	0

Field	Factory Default Valve
Instrument 8 Count 3	0
Instrument 8 Storage 3	0
Instrument 8 Register Read 4	0
Instrument 8 Count 4	0
Instrument 8 Storage 4	0
Instrument 8 PV Memory	0
Instrument 8 PV Register	0
Instrument 8 PV In Scale	0
Instrument 8 PV Out Scale	0
Instrument 8 SP Memory	0
Instrument 8 SP Register	0
Instrument 8 SP In Scale	0
Instrument 8 SP Out Scale	0
Instrument 8 Output Memory	0
Instrument 8 Output Register	0
Instrument 8 Output In Scale	0
Instrument 8 Output Out Scale	0
Instrument 9 Register Read 1	0
Instrument 9 Count 1	0
Instrument 9 Storage 1	0
Instrument 9 Register Read 2	0
Instrument 9 Count 2	0
Instrument 9 Storage 2	0
Instrument 9 Register Read 3	0
Instrument 9 Count 3	0
Instrument 9 Storage 3	0
Instrument 9 Register Read 4	0
Instrument 9 Count 4	0
Instrument 9 Storage 4	0
Instrument 9 PV Memory	0
Instrument 9 PV Register	0
Instrument 9 PV In Scale	0
Instrument 9 PV Out Scale	0
Instrument 9 SP Memory	0
Instrument 9 SP Register	0
Instrument 9 SP In Scale	0
Instrument 9 SP Out Scale	0
Instrument 9 Output Memory	0
Instrument 9 Output Register	0
Instrument 9 Output In Scale	0
Instrument 9 Output Out Scale	0
Instrument 10 Register Read 1	0
Instrument 10 Count 1	0
Instrument 10 Storage 1	0
Instrument 10 Register Read 2	0
Instrument 10 Count 2	0
Instrument 10 Storage 2	0
Instrument 10 Register Read 3	0
Instrument 10 Count 3	0
Instrument 10 Storage 3	0

Field	Factory Default Valve
Instrument 10 Register Read 4	0
Instrument 10 Count 4	0
Instrument 10 Storage 4	0
Instrument 10 PV Memory	0
Instrument 10 PV Register	0
Instrument 10 PV In Scale	0
Instrument 10 PV Out Scale	0
Instrument 10 SP Memory	0
Instrument 10 SP Register	0
Instrument 10 SP In Scale	0
Instrument 10 SP Out Scale	0
Instrument 10 Output Memory	0
Instrument 10 Output Register	0
Instrument 10 Output In Scale	0
Instrument 10 Output Out Scale	0
Instrument 11 Register Read 1	0
Instrument 11 Count 1	0
Instrument 11 Storage 1	0
Instrument 11 Register Read 2	0
Instrument 11 Count 2	0
Instrument 11 Storage 2	0
Instrument 11 Register Read 3	0
Instrument 11 Count 3	0
Instrument 11 Storage 3	0
Instrument 11 Register Read 4	0
Instrument 11 Count 4	0
Instrument 11 Storage 4	0
Instrument 11 PV Memory	0
Instrument 11 PV Register	0
Instrument 11 PV In Scale	0
Instrument 11 PV Out Scale	0
Instrument 11 SP Memory	0
Instrument 11 SP Register	0
Instrument 11 SP In Scale	0
Instrument 11 SP Out Scale	0
Instrument 11 Output Memory	0
Instrument 11 Output Register	0
Instrument 11 Output In Scale	0
Instrument 11 Output Out Scale	0
Instrument 12 Register Read 1	0
Instrument 12 Count 1	0
Instrument 12 Storage 1	0
Instrument 12 Register Read 2	0
Instrument 12 Count 2	0
Instrument 12 Storage 2	0
Instrument 12 Register Read 3	0
Instrument 12 Count 3	0
Instrument 12 Storage 3	0
Instrument 12 Register Read 4	0
Instrument 12 Count 4	0
Instrument 12 Storage 4	0

Field	Factory Default Valve
Instrument 12 PV Memory	0
Instrument 12 PV Register	0
Instrument 12 PV In Scale	0
Instrument 12 PV Out Scale	0
Instrument 12 SP Memory	0
Instrument 12 SP Register	0
Instrument 12 SP In Scale	0
Instrument 12 SP Out Scale	0
Instrument 12 Output Memory	0
Instrument 12 Output Register	0
Instrument 12 Output In Scale	0
Instrument 12 Output Out Scale	0
Instrument 13 Register Read 1	0
Instrument 13 Count 1	0
Instrument 13 Storage 1	0
Instrument 13 Register Read 2	0
Instrument 13 Count 2	0
Instrument 13 Storage 2	0
Instrument 13 Register Read 3	0
Instrument 13 Count 3	0
Instrument 13 Storage 3	0
Instrument 13 Register Read 4	0
Instrument 13 Count 4	0
Instrument 13 Storage 4	0
Instrument 13 PV Memory	0
Instrument 13 PV Register	0
Instrument 13 PV In Scale	0
Instrument 13 PV Out Scale	0
Instrument 13 SP Memory	0
Instrument 13 SP Register	0
Instrument 13 SP In Scale	0
Instrument 13 SP Out Scale	0
Instrument 13 Output Memory	0
Instrument 13 Output Register	0
Instrument 13 Output In Scale	0
Instrument 13 Output Out Scale	0
Instrument 14 Register Read 1	0
Instrument 14 Count 1	0
Instrument 14 Storage 1	0
Instrument 14 Register Read 2	0
Instrument 14 Count 2	0
Instrument 14 Storage 2	0
Instrument 14 Register Read 3	0
Instrument 14 Count 3	0
Instrument 14 Storage 3	0
Instrument 14 Register Read 4	0
Instrument 14 Count 4	0
Instrument 14 Storage 4	0
Instrument 14 PV Memory	0
Instrument 14 PV Register	0

Field	Factory Default Valve
Instrument 14 PV In Scale	0
Instrument 14 PV Out Scale	0
Instrument 14 SP Memory	0
Instrument 14 SP Register	0
Instrument 14 SP In Scale	0
Instrument 14 SP Out Scale	0
Instrument 14 Output Memory	0
Instrument 14 Output Register	0
Instrument 14 Output In Scale	0
Instrument 14 Output Out Scale	0
Instrument 15 Register Read 1	0
Instrument 15 Count 1	0
Instrument 15 Storage 1	0
Instrument 15 Register Read 2	0
Instrument 15 Count 2	0
Instrument 15 Storage 2	0
Instrument 15 Register Read 3	0
Instrument 15 Count 3	0
Instrument 15 Storage 3	0
Instrument 15 Register Read 4	0
Instrument 15 Count 4	0
Instrument 15 Storage 4	0
Instrument 15 PV Memory	0
Instrument 15 PV Register	0
Instrument 15 PV In Scale	0
Instrument 15 PV Out Scale	0
Instrument 15 SP Memory	0
Instrument 15 SP Register	0
Instrument 15 SP In Scale	0
Instrument 15 SP Out Scale	0
Instrument 15 Output Memory	0
Instrument 15 Output Register	0
Instrument 15 Output In Scale	0
Instrument 15 Output Out Scale	0
Instrument 16 Register Read 1	0
Instrument 16 Count 1	0
Instrument 16 Storage 1	0
Instrument 16 Register Read 2	0
Instrument 16 Count 2	0
Instrument 16 Storage 2	0
Instrument 16 Register Read 3	0
Instrument 16 Count 3	0
Instrument 16 Storage 3	0
Instrument 16 Register Read 4	0
Instrument 16 Count 4	0
Instrument 16 Storage 4	0
Instrument 16 PV Memory	0
Instrument 16 PV Register	0
Instrument 16 PV In Scale	0
Instrument 16 PV Out Scale	0

Field	Factory Default Valve
Instrument 16 SP Memory	0
Instrument 16 SP Register	0
Instrument 16 SP In Scale	0
Instrument 16 SP Out Scale	0
Instrument 16 Output Memory	0
Instrument 16 Output Register	0
Instrument 16 Output In Scale	0
Instrument 16 Output Out Scale	0
Generic Block Write Table	
Block Write 1 Instrument	0
Block Write 1 Interval	0
Block Write 1 Data Start	0
Block Write 1 Data Target	0
Block Write 1 Count	0
Block Write 2 Instrument	0
Block Write 2 Interval	0
Block Write 2 Data Start	0
Block Write 2 Data Target	0
Block Write 2 Count	0
Block Write 3 Instrument	0
Block Write 3 Interval	0
Block Write 3 Data Start	0
Block Write 3 Data Target	0
Block Write 3 Count	0
Block Write 4 Instrument	0
Block Write 4 Interval	0
Block Write 4 Data Start	0
Block Write 4 Data Target	0
Block Write 4 Count	0
Block Write 5 Instrument	0
Block Write 5 Interval	0
Block Write 5 Data Start	0
Block Write 5 Data Target	0
Block Write 5 Count	0
Block Write 6 Instrument	0
Block Write 6 Interval	0
Block Write 6 Data Start	0
Block Write 6 Data Target	0
Block Write 6 Count	0
Block Write 7 Instrument	0
Block Write 7 Interval	0
Block Write 7 Data Start	0
Block Write 7 Data Target	0
Block Write 7 Count	0
Block Write 8 Instrument	0
Block Write 8 Interval	0
Block Write 8 Data Start	0
Block Write 8 Data Target	0
Block Write 8 Count	0
Block Write 9 Instrument	0

Field	Factory Default Valve
Block Write 9 Interval	0
Block Write 9 Data Start	0
Block Write 9 Data Target	0
Block Write 9 Count	0
Block Write 10 Instrument	0
Block Write 10 Interval	0
Block Write 10 Data Start	0
Block Write 10 Data Target	0
Block Write 10 Count	0
Block Write 11 Instrument	0
Block Write 11 Interval	0
Block Write 11 Data Start	0
Block Write 11 Data Target	0
Block Write 11 Count	0
Block Write 12 Instrument	0
Block Write 12 Interval	0
Block Write 12 Data Start	0
Block Write 12 Data Target	0
Block Write 12 Count	0
Block Write 13 Instrument	0
Block Write 13 Interval	0
Block Write 13 Data Start	0
Block Write 13 Data Target	0
Block Write 13 Count	0
Block Write 14 Instrument	0
Block Write 14 Interval	0
Block Write 14 Data Start	0
Block Write 14 Data Target	0
Block Write 14 Count	0
Block Write 15 Instrument	0
Block Write 15 Interval	0
Block Write 15 Data Start	0
Block Write 15 Data Target	0
Block Write 15 Count	0
Block Write 16 Instrument	0
Block Write 16 Interval	0
Block Write 16 Data Start	0
Block Write 16 Data Target	0
Block Write 16 Count	0
Generic IP Address Table	
IP Address 1 Octet 1	0
IP Address 1 Octet 2	0
IP Address 1 Octet 3	0
IP Address 1 Octet 4	0
IP Address 1 Port	0
IP Address 2 Octet 1	0
IP Address 2 Octet 2	0
IP Address 2 Octet 3	0
IP Address 2 Octet 4	0
IP Address 2 Port	0

Field	Factory Default Valve
IP Address 3 Octet 1	0
IP Address 3 Octet 2	0
IP Address 3 Octet 3	0
IP Address 3 Octet 4	0
IP Address 3 Port	0
IP Address 4 Octet 1	0
IP Address 4 Octet 2	0
IP Address 4 Octet 3	0
IP Address 4 Octet 4	0
IP Address 4 Port	0
IP Address 5 Octet 1	0
IP Address 5 Octet 2	0
IP Address 5 Octet 3	0
IP Address 5 Octet 4	0
IP Address 5 Port	0
IP Address 6 Octet 1	0
IP Address 6 Octet 2	0
IP Address 6 Octet 3	0
IP Address 6 Octet 4	0
IP Address 6 Port	0
IP Address 7 Octet 1	0
IP Address 7 Octet 2	0
IP Address 7 Octet 3	0
IP Address 7 Octet 4	0
IP Address 7 Port	0
IP Address 8 Octet 1	0
IP Address 8 Octet 2	0
IP Address 8 Octet 3	0
IP Address 8 Octet 4	0
IP Address 8 Port	0
IP Address 9 Octet 1	0
IP Address 9 Octet 2	0
IP Address 9 Octet 3	0
IP Address 9 Octet 4	0
IP Address 9 Port	0
IP Address 10 Octet 1	0
IP Address 10 Octet 2	0
IP Address 10 Octet 3	0
IP Address 10 Octet 4	0
IP Address 10 Port	0
IP Address 11 Octet 1	0
IP Address 11 Octet 2	0
IP Address 11 Octet 3	0
IP Address 11 Octet 4	0
IP Address 11 Port	0
IP Address 12 Octet 1	0
IP Address 12 Octet 2	0
IP Address 12 Octet 3	0
IP Address 12 Octet 4	0
IP Address 12 Port	0

Field	Factory Default Valve
IP Address 13 Octet 1	0
IP Address 13 Octet 2	0
IP Address 13 Octet 3	0
IP Address 13 Octet 4	0
IP Address 13 Port	0
IP Address 14 Octet 1	0
IP Address 14 Octet 2	0
IP Address 14 Octet 3	0
IP Address 14 Octet 4	0
IP Address 14 Port	0
IP Address 15 Octet 1	0
IP Address 15 Octet 2	0
IP Address 15 Octet 3	0
IP Address 15 Octet 4	0
IP Address 15 Port	0
IP Address 16 Octet 1	0
IP Address 16 Octet 2	0
IP Address 16 Octet 3	0
IP Address 16 Octet 4	0
IP Address 16 Port	0

Revision History

Rev.	Description	Date	MCO #
-	Initial Release	12-27-2007	N/A
A	Added "Auto Tuning" section	01-04-2008	2058
B	Updated RAMPR opcode to include optional decimal place factor; Added GDELAY, GHDELAY, and GLDELAY opcodes	12-12-2008	2072
C	Added "Configurator 2.0 Menus" section, Updated the Opcodes and modified the format of the Opcodes	5-23-2011	
D	Updated screen shots and touch screen menus, configurator menus, wiring diagrams, layout; majority of manual is new content	5-8-2012	2101
E	Revised multiple sections of manual, including Configurator and Touch Screen content as well as controller opcodes. Some changes were functional updates; some changes were for clarification.	4-15-2014	2129
F	Added clarification of curve interpolation, added leak-up testing explanation, updated some menu information, corrected cold junction calibration instructions, added note that PIDLOAD opcode disables PID autoswtich feature.	10-21-2016	2144