microstaq

Innovations that flow

Superheat Controller

Refrigeration Software Application Guide

Contents

INTRODUCTION

This application guide is intended to instruct users about the process of configuring and operating the SHC. This guide also provides the design details of the front end GUI and its interface with the SHC controller. The refrigeration software is called Adaptive Autotune (AAT).

DEFINITIONS

- SEV – Silicon Expansion Valve
- GUI – Graphical User Interface
- SHC – Superheat Controller

CONVENTIONS

The following are the conventions used in this application guide:

- Note will be represented as:

- All warnings and cautions will be represented as:

PURPOSE

The SEV Host application is a Graphical User Interface used to:

- Communicate with the SHC units. Multiple SHC units can communicate with the Host application
- Send commands and configuration details to the SHC units

The SHC cannot send a request to the Host; it will only send the acknowledgement after it receives the setting values from the Host.

FEATURES

This section describes the features of the SHC application.

The SHC application includes the following features:

- Adaptable software to support a range of applications
- Pressure and temperature sensing ability
- Self controller gain adjustments
- Fault detection including sensor faults, high/low superheat
- Serial communication capacity
- Cost reduction through evaporator, condenser
- Cabinet size reduction
- Refrigerant charge reduction capability
- Reliability improvement
- Compact design

HARDWARE AND SOFTWARE REQUIREMENTS

This following table provides the hardware and software requirements for installing and using the SHC application.

Hardware Requirements	System Requirements
♦ Microstaq SHC ♦ SHC Cable or Harness ♦ Isolated USB to RS485 Converter; Mfg: USConverters U- 485G or VirtualSCADA VSU-485G, Details) ♦ Laptop or Desktop PC ♦ Small Flat Tip Screwdriver ♦ Wire Stripper	♦ Microsoft Windows Vista, Windows XP, or Windows 7 operating system

GETTING STARTED

This section provides instructions for installing, setting up, and using the application.

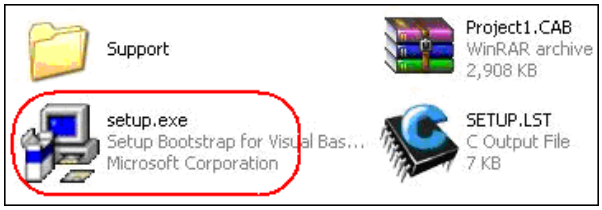
SHC GUI INSTALLATION

This section provides instructions to install the latest version of the Microstaq SHC GUI Software.

To install the SHC GUI software, complete the following steps:

1. Unzip the folder **GUI_Installation.zip**.
2. Double-click **setup.exe**.

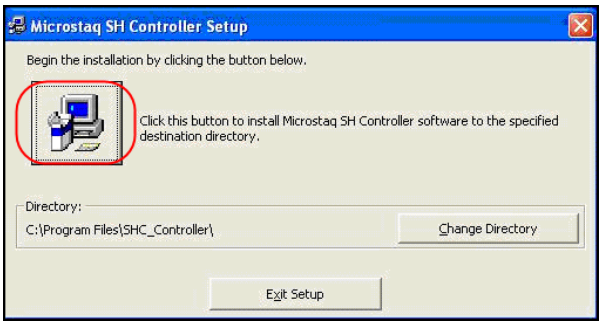
   The **Microstaq SH Controller Setup** window appears.



3. Click **OK**.

4. Click the Setup icon in the Microstaq **SH Controller Setup** window.

   The **Microstaq SH Controller – Choose Program Group** window appears.

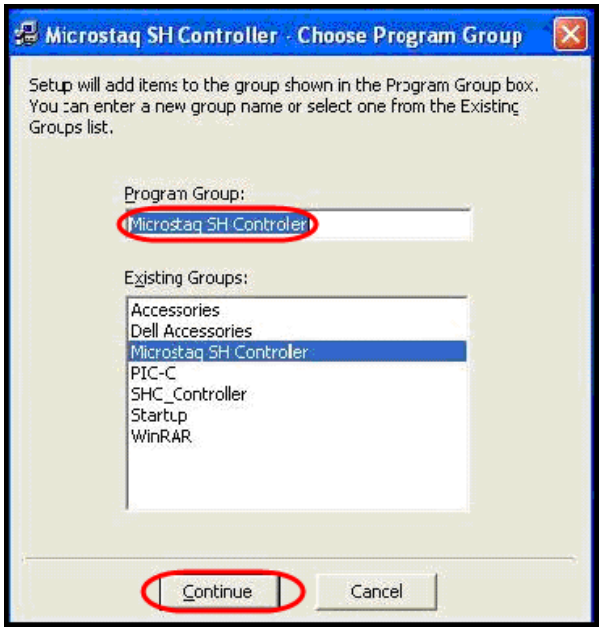


To change the destination directory, click the **Change Directory** button and select a new file location.

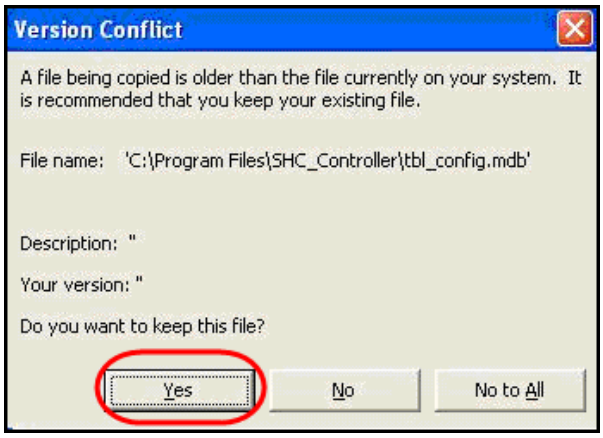
Click **Exit Setup** to cancel the installation.

5. In the **Program Group** field, change the name if you do not want to overwrite the previous software installation.
6. From the **Existing Groups** list, select the relevant program group.
7. Click **Continue**.

   The installation begins.



If there is a mismatch in the software version the **Version Conflict** window might appear. Click **Yes** multiple times to keep existing files, until you see the setup completion message.



8. Click **OK**.

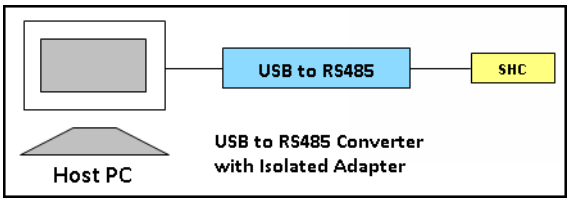
   You have now successfully installed the SHC GUI software.

After the installation is complete, the shortcut to the application will be available in **Start>Programs>Microstaq SH Controller**.

GUI-SHC SETUP

The following diagram describes the GUI - SHC setup environment.

GUI - SHC Set-up Diagram



The **Host PC** and the **SHC** is connected to the **USB to RS485** converter using the attached cables.

Ensure the SHC is tested for the functioning of the RS485 port and the latest release of the SHC firmware is loaded, before you make the connections. The RS485 requires a built-in isolated adapter.

See the **USB to RS485 Converter Box COM 1 Communication Setup** section for setting up a COM1 communication port for the USB connection.

USB TO RS485 CONVERTER BOX COM 1 COMMUNICATION SETUP

This section provides instructions to setup the USB to RS485 Converter Box COM 1 Communication.

If this is the first time you are using the USB to RS485 Converter with your PC, download the drivers from the following site (for VSU-485G):

http://www.virtualscada.com/PRODUCTS/download/VSU-485G%20Driver.zip

To install the drivers and setup the USB to RS485 Converter COM 1 Communication, complete the following steps:

1. Unzip the downloaded file.

   If you are using a different isolated RS485 adapter, download drivers from either the vendor's Website or the CDROM.

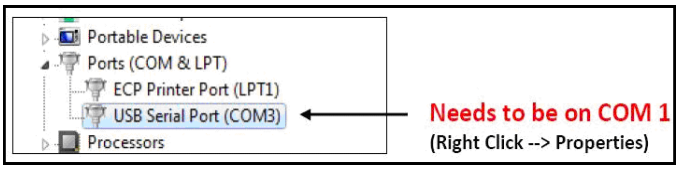
2. Plug in the USB to RS485 Converter to the PC.
3. When prompted for the device driver location, navigate to the location of the downloaded driver files.

   The computer system will update the driver list and install the USB converter automatically. A new virtual com port will now be available on the PC.
4. Following these steps to check if the USB driver is installed successfully:
   a. Navigate to the **Control Panel**.
   b. Double-click **System**.
      The **System Properties** window appears.
   c. Click the **Hardware** tab.
   d. Click the **Device Manager** button.
      The Device Manager window appears.
   e. Double-click **Ports (COM & LPT)**.
      The sub-list of ports is displayed.
   f. Unplug the USB device.
      If one of the communication port(s) disappears from the **Ports (COM & LPT)** list, it indicates that the driver has been installed successfully.
5. Plug in the USB device again and make a note of the COM port on which the device is installed.

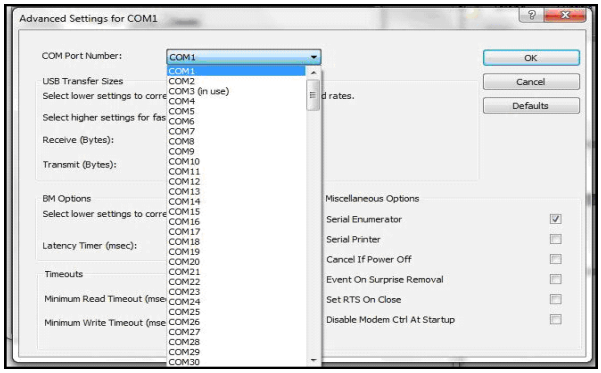
   The Microstaq SHC GUI requires that the converter be installed on COM 1. If you see that the device is already on COM 1, skip to step 12.

6. In the **Device Manager** window, double-click **Ports (COM & LPT)**.
   The sub-list of devices is displayed.

   If the device is not installed on COM1, right click the device and select Properties.



7. In the **Properties** window, click the **Port Settings** tab.
8. Click the **Advanced** button.
   The **Advanced Settings** window appears.
9. From the **COM Port Number** drop-down list, select **COM 1**.
10. Click **OK**.
11. Click **OK** in the **Properties** window.



The old COM port number may still be displayed in the Device Manager, but this is simply a display issue. Unplug and plug-in the device to the PC again and the screen should refresh to show the USB device now on COM 1.

12. Make note of the physical USB port on which the device is plugged in (on the PC).

Make sure you use the same port whenever the RS485 adapter is plugged into the computer.

RS485 COMMUNICATION INTERFACE SETUP

To setup the RS485 Communication Interface, complete the following steps:

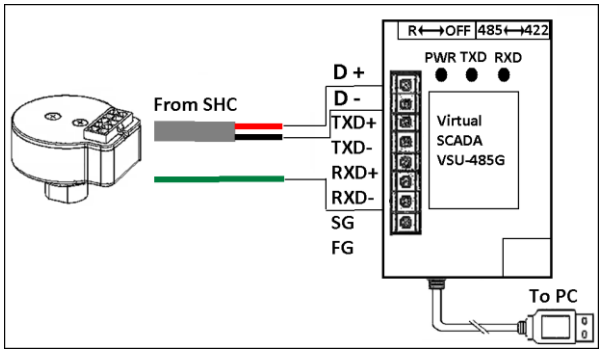
1. Make sure the SHC is connected to the refrigeration system.
2. Power the controller by connecting **red** and **black (**18 AWG) wires to 12VDC or 24VAC, 50 Hz power supply.
3. Locate the network cable and signal ground wire (green) coming out of the controller.

The network cable is a gray cable that has two wires (red and black) inside.

4. Connect the three wires (red, black, and green) to the converter as shown in the Communication Interface diagram.

   The **red** network wire should be connected to the **D+** port, the **black** network wire should be connected to the **D-** port, and the **green** ground wire should be connected to the **SG** port (signal ground).
5. Loosen the terminals on the converter before inserting the wires using a flat-tip screwdriver to.
6. Tighten each terminal after inserting the wires.

Communication Interface



7. Connect the USB cable from the converter into the USB port of the PC, after all the wires are connected to the converter.

   Use the same USB port that was used during the initial setup.

Make sure the two black switches on the converter are set to “R” and “485”.

Ensure no SHC wires come in contact with metal or earth (ground).

Wrap all exposed wires with an electrical tape.

Microstaq recommends that the length of the wire between the transformer and controller should be up to 20 feet for 18 AWG wires and up to 40 feet for 16 AWG wires.

USING THE SHC GUI

This section provides information on the features of the Host application.

MAIN SCREEN

When host application is launched, the GUI main screen appears. This screen provides options to create and load the configuration from the file, and can directly enter manufacturing tests.

To view the main screen, complete the following steps:

1. Select **Start>All Programs>SHC Controller**.

   The main screen appears.

MANUFACTURING TESTS

The Manufacturing Tests feature is used only to obtain the manufacturing ID of the controller. Do not access any other features other than the ones mentioned in this guide.

To conduct manufacturing tests, complete the following steps:

1. In the main screen, click **Manufacturing Tests**.

   The configuration screen appears.

2. Click **Pre-wire Bond**.

   The **Pre-wire bond** screen appears.

3. Click the **MAN ID** button.

   The Man ID section appears.

4. Type 1 and 0 in the **Enter Man Site ID** and **Enter Man rack ID** fields respectively.

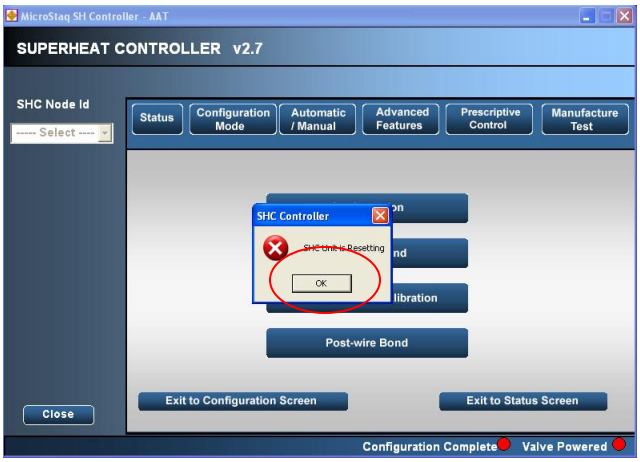
5. Click **SUBMIT**.

6. Note down the 16-digit Manufacturing (Man) ID number. This ID is unique and provided with each SHC controller's calibration,

7. Click **OK** and then click **Back** to get the screen below.

8. Click the **Exit to Configuration Screen** button.

   The **SHC Unit is Resetting** message appears.



9. Click **OK**.

   You have now completed the manufacturing tests.

CREATE CONFIGURATION

The Create Configuration feature is used to establish communication with an SHC, which has a new Man ID.

To create a configuration, complete the following steps:

1. In the main screen, click **Create Configuration**.

A message appears.

2. Click **No**.

   The **Node ID Writing** screen appears.

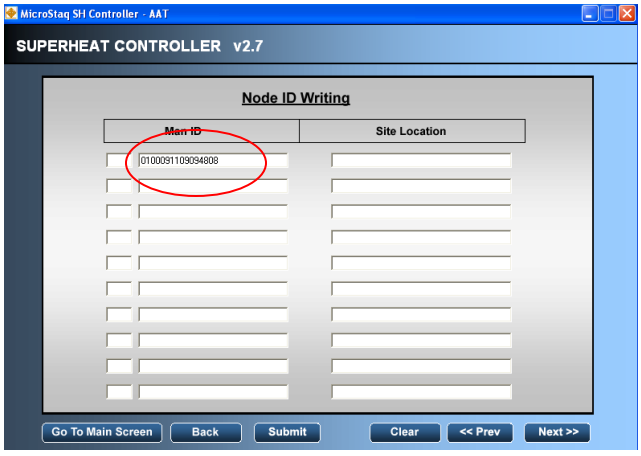
3. In the first **Man ID** field, enter the 16-digit manufacturing ID, which was noted down in Step 5 of the previous section.

4. Click **Submit**.

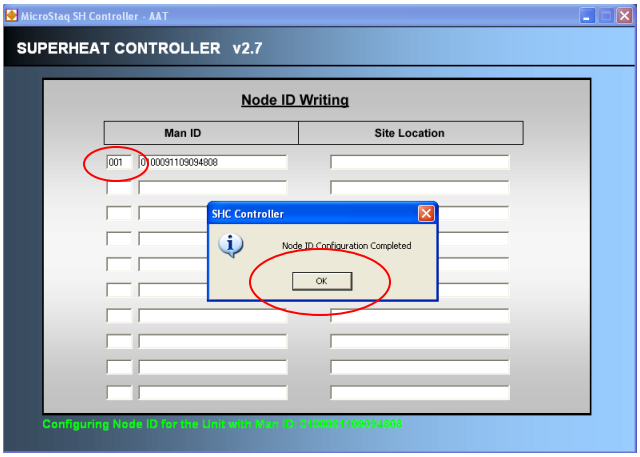
   The **Node ID Configuration Completed** message appears.

If the 16-digit number entered is correct, the SHC will be assigned a new Man ID. A Node ID will also be assigned (i.e., 001).

The **Site Location** fields are for reference, if you have multiple SHCs running. It is not mandatory to compete these fields.

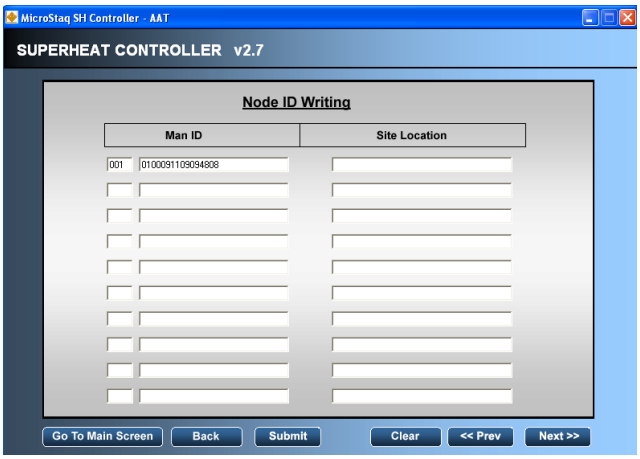


5. Click **OK**.



6. Click the **Go To Main Screen** button.

   The Node ID will be populated from the text file.



7. Select the SHC Node ID **001** to establish communication and access the menu options.

The **SHC Not Configured** message appears.

8. Click **OK**.

   You have created a configuration.

CONFIGURATION MODE

In the configuration mode, all details of the SHC are displayed. Use this feature to set the details for Supply Power, Refrigerant, and Units and Superheat set point.

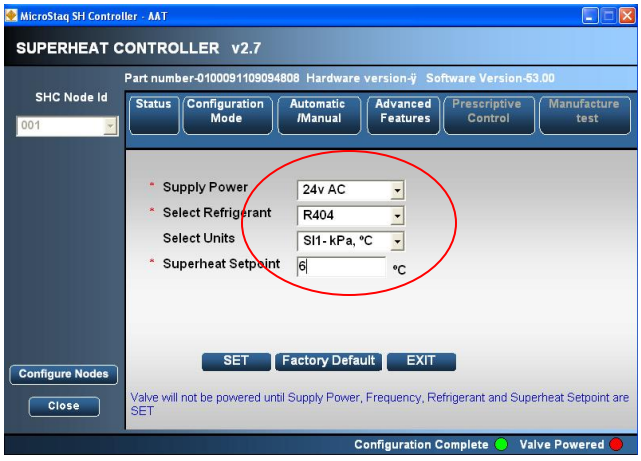
When you click the **Configuration Mode** tab, three options are provided to process the SHC configuration:

- SET – This will send the typed values to the SHC
- Factory Default – This will set the default factory values and send the data to the SHC
- EXIT – Exits the present mode without sending any data to the SHC

To set values for the SHC in Configuration Mode, complete the following steps:

1. Click the **Configuration Mode** tab.

   The **Configuration Mode** screen appears.



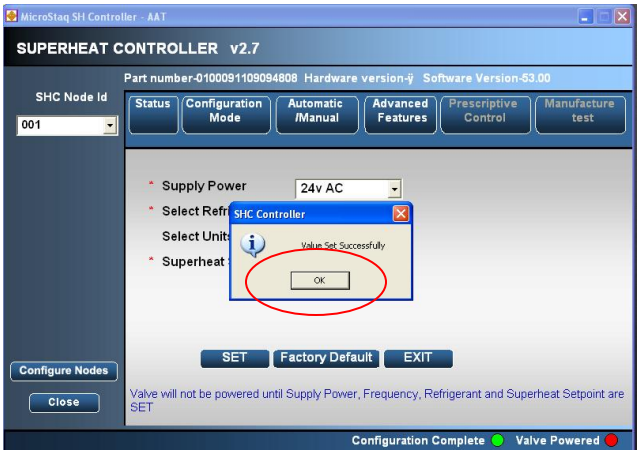
2. From the **Supply Power** drop-down list, select the appropriate supply voltage.
3. From the **Select Refrigerant** drop-down list, select the appropriate refrigerant.
4. From the Select Units drop-down list, select the appropriate value.
5. In the Superheat Setpoint field, enter the appropriate temperature.
6. Click **SET and in the pop-up that appears, click SET again**.

   After the configuration process is complete, the **Configuration Complete** and the **Valve Powered** LED turns green.

   If the configuration is not completed then the **Configuration Complete** LED will be red.

7. Click **OK**.

   You have set the values successfully.



CHECKING THE STATUS

When you select this option, a command is sent to the SHC and it will return the status information of the SHC.

The status of the following parameters are displayed:

Parameter	Description
Measured Pressure	The measured the pressure at the exit of the evaporator where the SHC is located.
Target pressure	An average pressure value where the system should operate within a pre-defined dead band.
Measured Temperature	Measured external temperature at the evaporator exit
Calculated Superheat	Run-time superheat value
Target Superheat	Target superheat value to be reached.
Valve Command	The percentage opening of the valve.
Status (Normal State, Manual Mode, Cleaning Cycle)	Provides status of the SHC

Parameter	Description
Alarm (blank if no failure, otherwise displays fault condition)	Lists any fault condition in the system (for example: pressure sensor is bad,)

To check the status of the SHC, complete the following steps:

1. Click the **Status** tab.

   All parameters with their status appear.
2. From the **Select Status Refresh frequency in sec** drop-down list, select the required status refresh frequency.
3. Click the **Log Status Data** button to save the status details in a file.
4. Select a file path to save the file.
5. Click the **Extract Log Data** button to save the status log details in a file **datalog.txt**, located in the SHC Controller Folder.

   The status screen is displayed.

SELECTING AUTOMATIC/MANUAL MODE

You can select automatic or manual mode based on how you want to control the valve command and frequency.

In the automatic mode, the control loop is constantly running and the valve-command is adjusting based on various system parameters such as temperature, and pressure. The frequency is the frequency of the PWM signal.

Values have to be manually entered when you select the manual option.

Ensure that the frequency is always set to 20 Hz (for 50 Hz AC transformer) and 24 Hz (for 60 HZ AC transformer).

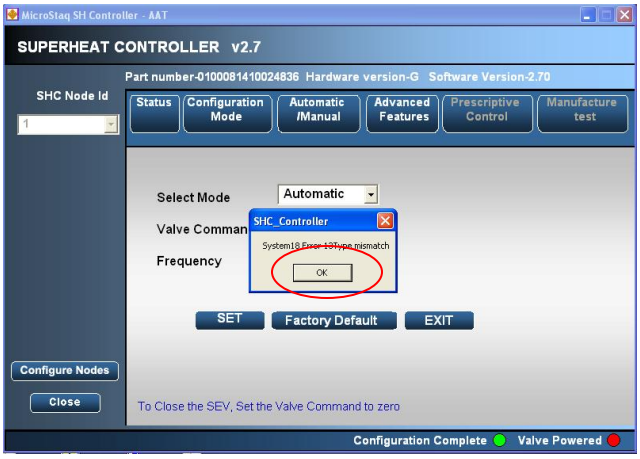
Once the values are set, they are sent to the SHC. Here the valve is opened to a fixed value. If the valve command is set to zero, the **Valve Powered** LED will turn red.

If you see a **13Type mismatch** error message, it means that the configuration of all parameters in **Configuration Mode**, **Automatic/Manual**, and **Advanced Features** are not set or completed.

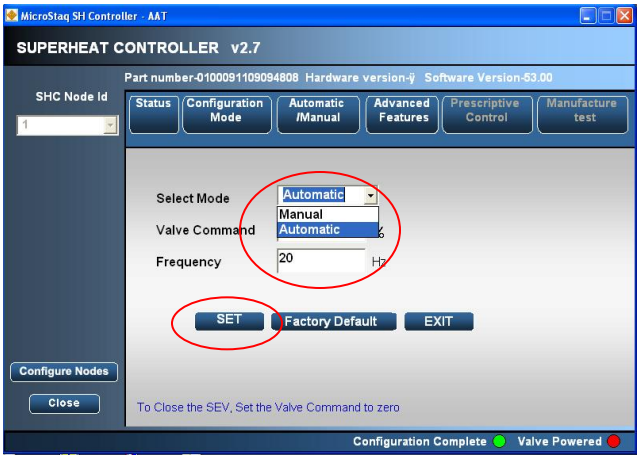
To set automatic or manual mode for the SHC operation, complete the following steps:

1. Click the **Automatic/Manual** tab.

   If you see a 13Type mismatch error message click **OK** and continue to Step 2



2. From the **Select Mode** drop-down list, select **Automatic** or **Manual**.
3. In the **Valve Command** field, enter the appropriate command.
4. In the **Frequency** field, type the appropriate frequency.
5. Click the **SET** button.



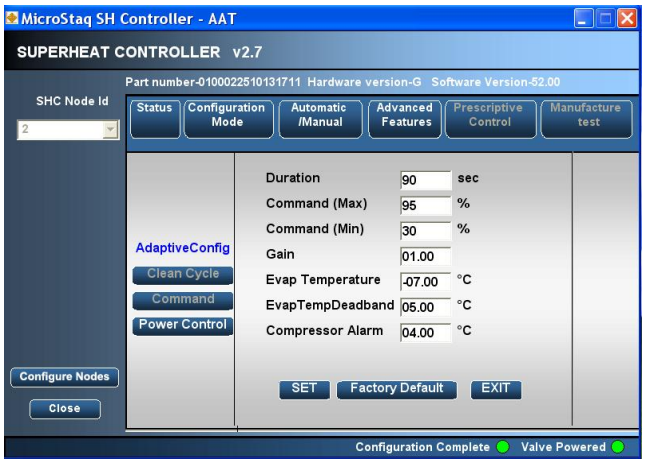
6. Click **OK**.

   You have now configured automatic/manual mode for the SHC operation.

USING ADVANCED FEATURES

Advanced features include handling Configuration, cleaning cycle, Command and Power control.

To view the Advanced Features screen click the **Advanced Features** tab.



ADAPTIVE CONFIGURATION

The adaptive configuration feature allows you to set the following parameters:

- **Duration**: This is the time interval during which the software computes the next action to take on the valve opening.
- **Command (max)**: This is the maximum valve opening we can have for that particular valve.
- **Command (min)**: This is the minimum valve opening we can have for that particular valve.
- **Gain:** This determines how fast or slow we adjust the valve opening to system changes. Larger value corresponds to a faster response while a smaller value corresponds to a slower response.
- **Evap temperature:** This is the evaporator saturation temperature that we desire the system to maintain for that particular application. Example: for medium temp applications this will correspond to 20F, and for low temp applications this will correspond to -20F.
- **Evap deadband:** This is the operating dead band within which we use the control parameters to maintain case temperature.
- **Compressor alarm:** This is the superheat value below which the software closes the valve to prevent flooding.

To set the adaptive configuration parameters, complete the following steps:

7. Click the **Advanced Features** tab.

   The advanced features are displayed.
8. Click the **AdaptiveConfig** button.
9. Enter the following recommended values in the corresponding fields:

Duration	90 seconds
Command (max)	95
Command (min)	30
Gain	1
Evap temperature	20 F*
Evap temp deadband	10 F
Compressor alarm	5 F**

*: This value may vary according to the application, see the below table:

Refrigeration type	Evap temperature (F)
Air Conditioning	40
Reach-in Refrigerator	20
Reach-in Freezer	-20
Walk-in Refrigerator	25
Walk-in Freezer	-20

** This value may vary according to the application. However, it has to be less than the Superheat set point by few degrees

10. Click the **SET** button.
11. In the **Authorization Code** field, type **sa15**.
12. Click the **Authorize** button.

CLEAN CYCLE

The function of this feature is to dither the valve so that debris collected will be washed away. This feature enables you to select the cleaning cycle time interval.

To configure the clean cycle, complete the following steps:

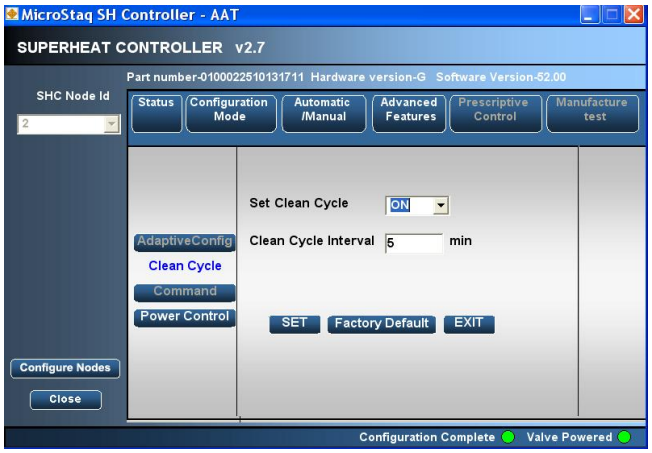
1. Click the **Advanced Features** tab.

   The advanced features are displayed.
2. Click the **Clean Cycle** button.
3. From the **Set Clean Cycle** drop-down list, select **ON**.
4. In the **Clean Cycle Interval** field, type the required time interval.

The recommended value of Clean cycle is 8 mins.

5. Click the **SET** button.
6. In the **Authorization Code** field, type **sa15**.
7. Click the **Authorize** button.

   You have now configured the clean cycle.



MAX. COMMAND

The function reflects the percentage of valve opening.

The valid range for this value is from 0 to 95%.

1. Click the **Advanced Features** tab.

   The advanced features are displayed.
2. Click the **Command** button.
3. In the **Max. Command** field, type the appropriate value.

The recommended starting value for Max. Command is 50.

4. Click the **SET** button.
5. In the Authorization Code field, type sa15.
6. Click the **Authorize** button.

   You have now configured the Max Command.

POWER CONTROL

This feature is currently disabled and always need to be OFF.

To configure the compressor, complete the following steps:

1. Click the **Advanced Features** tab.

   The advanced features are displayed.
2. Click the Power Control button and select OFF.

3. Click the **SET** button.
4. In the **Authorization Code** field, type **sa15**.
5. Click the **Authorize** button.

OPERATING THE SHC

Use an external power source to power the SHC.

To operate the SHC, complete the following steps:

1. Switch on the refrigeration system, before powering the SHC.
2. Switch on the power to the SHC.
3. Open the GUI.

   In the **Main Screen**, observe the Superheat Control for 10 minutes to decide if the superheat is in control or not.

TROUBLESHOOTING

This section provides instructions to troubleshoot the system for various conditions such as:

a) The measured superheat is very high for a long duration (example 30 minutes).

b) Compressor is flooding.

c) Case temperature is not well maintained and superheat control is not tight.

Data and tools required for troubleshooting software:

a) PT chart for various refrigerants.

b) Calculate Operating pressure range. The operating range is defined as (Evap temperature + Evap temperature dead band) to (Evap temperature – Evap temperature dead band).

Example: Evaporator temperature: 20F

Evaporator temperature dead band: 10F

Operating temperature range is from 10 F to 30F which corresponds to (for refrigerant R404) a pressure range from 42.4 psig to 68.4 psig. Since the software displays always in Absolute pressure terms, the values will range from 57.1 psi to 73.1 psi.

1. The system case temperature is not well maintained or Superheat control is not tight.

- If the system compressor is off for a while and the measured pressure is within the operating pressure range. This means that the values entered in the **Evap temperature** or **Evap TempDeadband** fields* are not right.

    a. Wait until the compressor is back to on and record the measured pressure

    b. Use the refrigerant chart to determine the corresponding evaporator temperature and enter this value in the **Evap temperature*** filed

    If the pressure is still off, proceed to step “c”.

    c. Reduce the **Evap TempDeadband*** value

- If the compressor is on for a while and the measured pressure is above or below the operating pressure range**.** This means that the value entered in the **Evap temperature** filed* is not right.

    a. Use the refrigerant chart to determine the corresponding evaporator temperature for the current measured pressure and enter this value in the **Evap temperature*** filed

    If the pressure still off, proceed to step b

    b. Increase the **Evap TempDeadband*** value

- If the system compressor (in normal operation) cycles very quickly (less than 3 minutes) and superheat is always very high or very low.

    a. Reduce the **Duration***

- If none of the above and Superheat control is not tight or the case temperature is not well maintained and

    - the valve command change is big, then Reduce the **Gain***

    a. the valve command change is small, then Increase the **Gain***

2. If the system compressor suffers from flooding you may try one (or combination) of the following

    a. Increase the compressor alarm value*

    b. Decrease the Command (Max) value *

    c. Increase the superheat set point **

3. If the system experiences very high superheat you may try one (or combination) of the following

    a. Decrease the superheat set point**

    b. Increase the gain*

    c. Increase the Command (Max)* value

*Adaptive Config tab

** Configuration Mode tab, Superheat Setpoint

IMPORTANT NOTES

Remember the following key points while operating the SHC:

- This controller works fine also with refrigeration system equipped with solenoid on suction, liquid or both lines and system with evaporator pressure regulator (EPR).
- Ensure the controller is switched OFF before switching to the other expansion valve. This will restrict the SHC from reading false data when it’s not operating. If you do not ensure it will take more time to converge to the right control action.
- The values of **Evap temperature** and **Evap TempDeadband** prevent the software from running when the compressor is in OFF state. If compressor is in the OFF state and the value entered is incorrect, the software could incorporate wrong values. This will have adverse an effect when the system is switched ON.
- The software often opens up the valve if the evaporator is starving. So if the user sees an unusual spike in valve opening please don’t be alarmed.