APEX INSTRUMENTS

STM-6000

OPERATOR'S MANUAL

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Read and understand this manual and its safety instructions before using this product. Failure to do so can result in serious injury or improper execution of sampling procedures.

Follow all relevant instructions to avoid fire, explosions, electric shocks or other hazards that may result in damage to property and/or severe or fatal injuries.
The product shall only be used by persons who have fully read and understood the contents of this user manual.
Ensure that each person who uses the product has read these warnings and instructions and follows them.
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The manufacturer is not liable for cases of material damage or personal injury caused by incorrect handling or non-compliance with the safety instructions. In such cases, the warranty will be voided.

Product Safety and Quality Standards

Apex Instruments products are engineered and assembled to meet or exceed the highest quality and safety standards for portable industrial test equipment.

Our engineering and manufacturing teams stringently follow US National Electrical Code (NFPA 70/NEC 2014) standards for overcurrent protection (Article 240) and copper wire size and insulation (Table 310.15(B)).

The electrical components that make up our consoles, probes, chillers, and umbilical cords such as pumps, wire, switches, connectors and breakers are UL/CE rated and sourced through US domestic suppliers and then assembled and tested for functionality and compliance in our Fuquay-Varina, NC facility.

Apex Instruments is committed to continuous improvement in both the safety and quality of our products.

Warranty Policy

Product Limited Warranty Policy

Apex Instruments, Inc. warrants products to be free from defects in materials and workmanship for a period of one year from date of delivery. During the warranty period, we will repair or replace, at our option, any component that fails due to a defect in materials or workmanship under normal use excluding installation. Items not manufactured by Apex Instruments are subject to original manufacturer's warranty. All returns must be shipped freight prepaid at the purchaser's expense.

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Apex Instruments makes no other warranties, express or implied, including any warranties of merchantability, condition of any kind or fitness for a particular purpose.

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1.0 Preface

1.1 Product Introduction

The STM-6000 Console is the user's control station to operate and capture data necessary for paired sorbent tube sampling according to Appendix K. The basic principle of the console is to regulate the sample flow rate proportionally to the stack gas flow rate and to determine the standardized volume extracted through each sorbent trap. To capture the samples, a pair of diaphragm vacuum pumps work in concert with proportional valves and mass flow sensors. Optical encoders are mounted inside the gas meters to provide digital feedback for the volume sampled. From additional temperature and pressure measurements the sample volume at standard conditions (USEPA 20C° and 760mmHg) is calculated. Figure 1-1 illustrates the Apex Instruments Model STM-6000.

1.2 Purpose of this manual

The purpose of this manual is to provide a basic understanding of the Apex Instruments automated sampling console available for Appendix K Mercury Sampling. The MercSampler Model STM-6000 console is applicable for Mercury Emissions Sampling Using Iodinated Charcoal Traps. For additional information on the applicable Appendix K for complete method descriptions, please visit:

https://www.epa.gov/emc/emc-promulgated-test-methods

1.3 Safety Instructions

1.3.1 Safety information related to the intended use

Source sampling is intended to be performed by technicians who have been trained in source sampling methods. Personnel conducting source sampling are expected to understand basic gas laws and chemistry.

In addition, all technicians should have adequate general safety training to identify, abate, and prevent job related hazards including site specific training.

Please visit the following link for more information on Stack Sampling Safety Procedures and Protocols:

http://www.sesnews.org/

1.3.2 Explanation of safety warnings

“DANGER” indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

“WARNING” indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.

“CAUTION” indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.

“NOTICE” Indicates information considered important, but not hazard-related.

1.3.3 Electrical shock

CAUTION

Use and maintenance of the source sampling console presents potential electrical hazards. Ensure that the console is protected from wet conditions such as rain or process emissions. If the console is wet, do not continue to operate the console until it has been dried off. Do not perform maintenance on this console when it is still plugged into a power source and the main power switch is turned on. Do not continue to use the console if wires are exposed or loose from their connectors.

1.3.4 Weight

CAUTION

Although the source sampling console is lighter than previous versions, the console itself can still present risks due to its weight. When carrying the console, make sure to use proper form to lift using your legs. Lift and carry the console using the provided handles and carrying strap. If a user is not comfortable carrying the console, a partner may provide the necessary assistance in moving the console around.

1.3.5 Elevated surfaces

DANGER

Use of the source sampling console on elevated surfaces also poses risks that range from minor to fatal. Be sure to operate the console on a level, stationary surface. If necessary, secure the console using straps or braces to ensure that vibration or accidental contact does not knock the console off its surface.

1.4 What to do when the console arrives

1.4.1 Unpack and inspect

Unpack the console from its shipping container. Inspect the console for visible damage or missing components. Check the packing list to ensure that everything has arrived.

1.4.2 Become familiar with console operations

Perform mock sample runs to ensure operation of console follows proposed test plan and EPA Method procedures.

1.4.3 Leak checks

Perform the console leak checks as explained in section *3.0 Console Operation*.

1.4.4 Calibration checks (audits)

The source sampling console is sold with a factory calibration at flow rates appropriate for the flow meter component of the console. Apex Instruments suggests performing calibration checks (audits) before and after each testing period and performing a full calibration annually. Ensure that you verify with your local agency for calibration standards.

Perform the console calibration checks as explained in section *5.0 Console Operation*

1.4.5 Test plan and methods

Begin the sampling operation procedures as directed by the method regulations.

1.5 How to Transport and Store the Console

1.5.1 Dimensions

Height: 14” (43 cm)
Width: 17” (43 cm)
Depth: 11” (30.5 cm)
Weight: 29.6 lbs (13.4kg)

1.5.2 Lifting and handling

CAUTION

Avoid dropping the console and other forms of collision during transport.

1.5.3 Storage

Store upright, if possible, in a controlled environment on a shelf or in a rack unit.

1.5.4 Shipping

While the console features a rugged design, the components and integrity of the build are delicate, and thus, the console should be treated as a lab instrument when considering transport. Sudden jarring movements or drops could damage the dry gas meter or cause faults within the electrical subsystem and with various sensors.

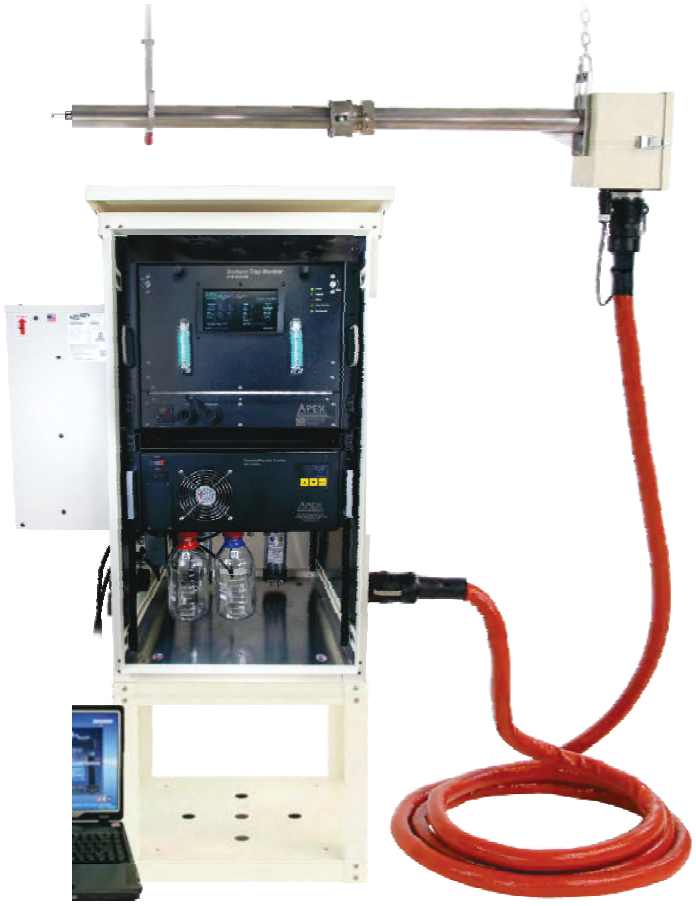
The console should not be shipped independently. Ensure proper shipment of the console by packing it in a foam-lined box or an appropriate shipping container that provides adequate protection.

Introduction

The purpose of this manual is to provide a basic understanding of the Apex Instruments automated sampling console and system components available for Sorbent Trap Monitoring. The STM-6000 console is applicable for Mercury Emissions Sampling Using Iodinated Charcoal Traps. For concise information on the applicable method, please visit http://www.epa.gov for Methods 12b and 30b.

2.0 STM-6000 System Components

The STM-6000 system consists of the Probe, Connection Box, Umbilical/ Heated Sample Line, Climate Control System, Cabinet and Stand



Model STM-6000 System in a CR-20U (front door removed) AC/Heated Cabinet with Stand

2.1 STM-6000 Console

The Console is the operator's control station controlling and capturing data necessary for paired sorbent trap sampling. The basic principle of the console is to control the sample flow rate proportionally to the stack gas flow rate and to determine the standardized volume extracted through each sorbent trap.

To capture the samples, a pair of diaphragm vacuum pumps work in concert with proportional valves and mass flow sensors. Optical encoders are mounted inside the gas meters to provide digital feedback for the volume sampled.

The STM-6000 Console simplifies most sampling requirements by automating data acquisition, sample flow adjustments, leak checks, calculations, temperature control and calibrations.

Data is easily transferred to a Windows-based PC through Ethernet and can be monitored remotely through modbus connectivity. The STM-6000 meter console captures all data necessary for paired sorbent trap sampling in accordance with EPA Method PS12B.

The STM-6000 firmware (embedded software) has been designed to utilize the technical features of the RISC based microchip microcontrollers which provide decision making as well as precise "autonomous" control of the console while the laptop or PC is not connected.

Model STM-6000RM Console

2.1.1 Features and Specifications of Apex Instruments Model STM-6000 Sampling System Components

Features	STM-6000 System Components
Gas Meter	Positive displacement diaphragm meter, 45 lpm maximum and 0.17 Lpm starting flow rate, 0.7L/revolution
Display	800 x 480 Pixels Resolution RGB Color 6" x 3.4" (7" Diagonal)
Dual Sample Pumps	Double-headed, EPDM Diaphragm, Maintenance-free, brushless 12 VDC motor, 220 mbar Ultimate Vacuum at 1 atmosphere, 10,000 hours MBTF
Dual Proportional Valves	Thermally Compensated, 2-way, Normally Closed, Gas Media, Power: 2.0 Watts Max, Vacuum: 0-27 in Hg, Max Inlet Pressure:150 psig
Dual Mass Flow Sensors	Flow Switch, 12~24VDC, 16MA, 0.3MPA, 0.0 to 3.0 L/MIN 1 to 5V Analog Output
Barometric Sensor	Voltage-sensitive orifice (VSO), 12VDC
Dual Vacuum Sensor	0-30 inHg, 0-101 kPa, 2% accuracy
Flow Meter	0.0L to 2.5L
Umbilical Connections	Electrical: 4-pin locking Amphenol connectors Sample Line: ¼" Stainless Steel Quick-Connect or Swagelok fittings
Dimensions	HxWxD 14" x 17" x 11.25" (35.56 cm x 43.18 cm x 28.58 cm)
Power Requirements	120VAC/60Hz standard 2 or more 15A circuits depending upon configuration (240VAC/50Hz optional)
Weight	29.6 lbs (13.4 Kg)

2.2 The Probe

There are 3 types of probes available: 2 Trap Dual Heater, Single Trap Single Heater and the Dual Trap Single Heater Air-Cooled Probes.

HGP Mercury Probe

The heated mercury sorbent trap probes are designed to accept a pair of standard 10mm sorbent traps. The sorbent traps are placed at the probe inlet to prevent HG transport losses during sampling. The traps are sealed in place with compression fittings using glass-filled PTFE ferrules.

The probes are constructed from corrosion resistant tubing. The outer sheath is 2" OD and the inner liners are 1/2" 316 stainless steel. Stainless steel is standard but Alloy C276 is recommended for STM-6000 applications.

The probe is fitted with two heaters; one to heat the traps and the second for heating the portion of the probe outside of the stack.

The heated mercury air cooled probes are for use in high stack temperature environments. These probes feature 2" stainless steel or C276 outer sheaths as a standard with individually controlled heat zones and integrated stack, trap and probe thermocouples.

HGPA Air Cooled Mercury Probe

2.3 Heated Probe Connection Box

The heated probe connection box provides a compact, positive, protective connection point for the umbilical, sampling lines, power connection and thermocouples. The umbilical heat trace neatly fits into the box to provide additional heating for the sample lines to ensure against moisture condensation. The probe sampling tubes are conveniently cleaned by removing the end caps on the sampling "T" fittings and inserting a cleaning brush into the sampling tubes.

2.4 Heated Umbilical Lines

The heated umbilical lines include the self-regulating heater cable, flexible conduit with two replaceable 1/4" PFA sample lines, pass through power and thermocouples for the probe heater. The heated core is insulated with several layers of braided lightweight Pyron OPF yarn which is burn proof and not conductive.

Ends are fitted with cam and groove fittings for easy installation and strain relief. Passing through the fittings on the probe end are the thermocouple connectors, sample lines and heat trace extension with the amphenol power/signal supply external of the fitting.

The opposite end provides the sample lines, electrical power cord, amphenol power/signal cord and male thermocouple jacks which connect to the console.

2.5 TEC-4000Hg ThermoElectric Cooler

The TEC-4000Hg Gas Cooler is specially designed for removing moisture and acid gases from flue gas samples. This gas cooler uses an efficient Thermoelectric system for chilling the gas to a constant dew point.

The cooling system comprises of the cooler, two 18" sorbent canisters for acid and moisture removal, two coated glass condensate collection bottles and an internal temperature controller.

TEC-4000 Cooler

Wall Mount Configuration with door removed.
Environmentally Controlled Cabinet with rack-mounted Console, Cooler, Desiccant Canisters and Sample Bottles

3.0 STM-6000 Software

The STM-6000 includes full setup and configuration options for the console through the Windows-based interface software. Firmware is pre-loaded on the Main and sensor array boards.

Apex Instruments recommends the purchase of a laptop or desktop computer directly through Apex to ensure computer compatibility and proper loading of software. However, if you prefer to use or purchase your own computer please ensure your computer has, as a minimum, the following specifications:

Item	Description	Capacity
CPU	Processor Speed	1GHz+
RAM	Random Access Memory	4MB Minimum
HDD	Hard Drive Capacity	~12MB for Software. Data file storage varies.
O/S	Operating System	Windows 10, 11

3.1 Installing Software

To load STM-6000 software on your laptop or desktop computer, follow these steps:

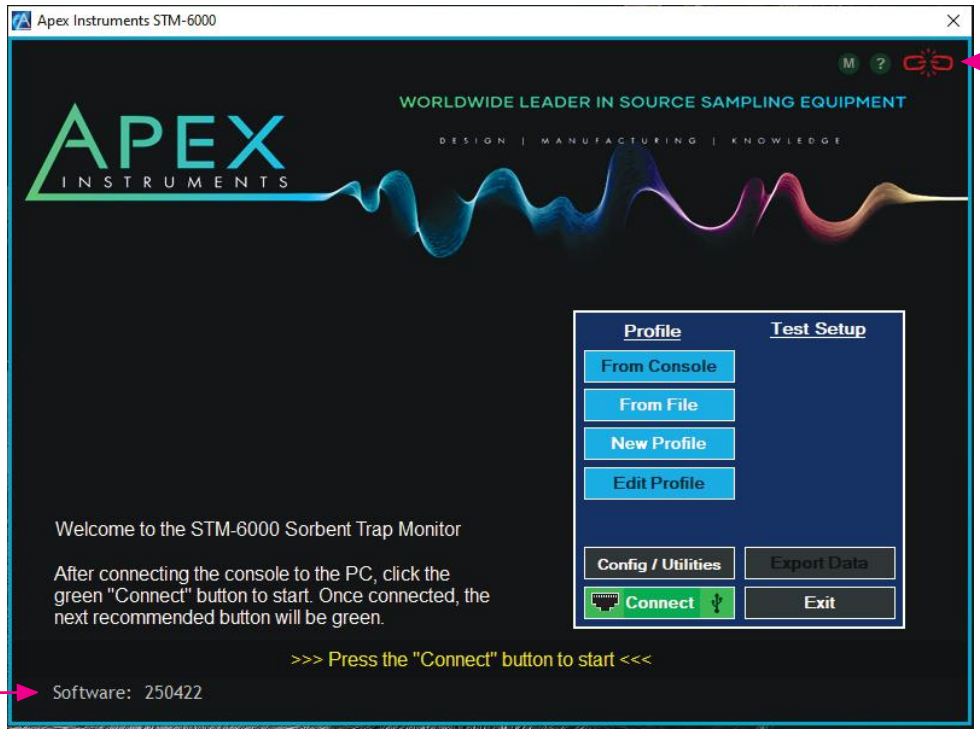
Go to *https://www.apexinst.com/softwareandmanuals* to download the software.

3.2 Software Operation

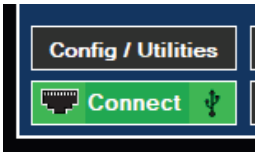
Follow these steps to start the STM-6000 software on a laptop or desktop computer:

Double click the “STM-6000” icon on your desktop. The Initial Main Screen, as shown below, is displayed. Please take a moment to note the version number of the software. It is displayed at the bottom left of the screen. Press the “Connect” button to start as indicated in the instructions on the screen to set up the communications method with the console. NOTE: The connection status is displayed upper right of screen.

Desktop Icon



Initial Main Screen



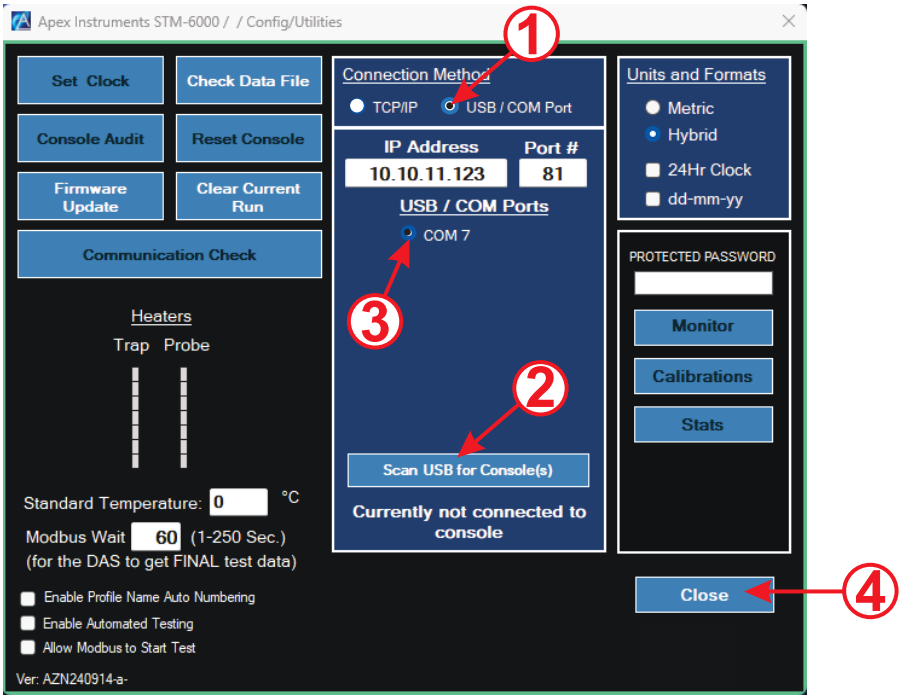
USB and Network direct “Connect” options. Enables the software to find the USB port to the STM6K and then make the connection. No need to use Config/Utilities to scan the USB port and then select it. Config/Utilities must still be used to change the TCP Address.

If you have already setup the communication method, single click the green “Connect” button.
Skip the following section and go to the Test Profile section. Otherwise, follow the instructions to set up the communication between the console and the computer.

3.3 Software Communication Via USB

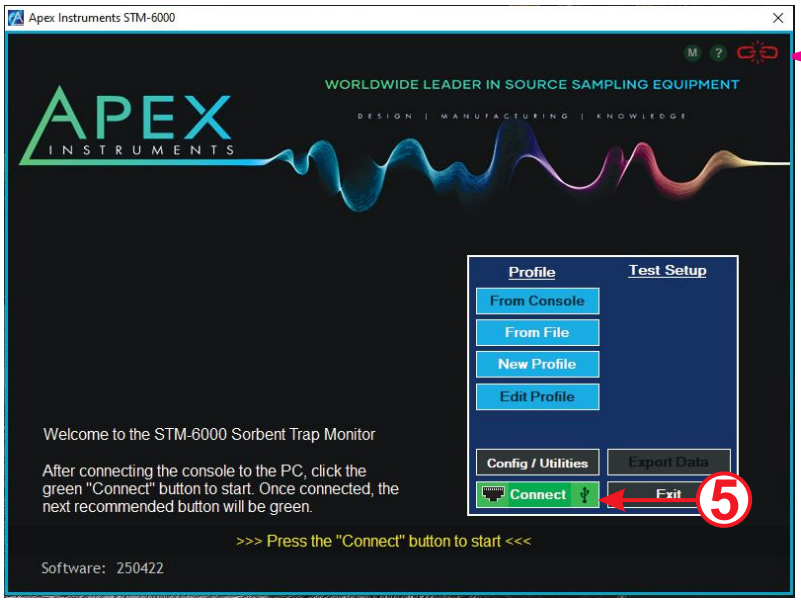
The STM-6000 software communicates via USB or Ethernet (optionally wireless Ethernet). To connect, single click the "***Config/Utilities***" button. The following screen will appear.

USB Connection



Config & Utilities Screen

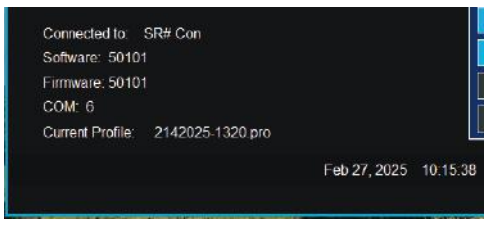
1. To **connect via USB** select the "***USB/COM Port***" button under the "Connection Method" heading.
2. Single click the "***Scan for COM Ports***" button if USB is to be used.
3. Select an available ***COM Port***
4. Single Click "***Close***" button.
5. Select the green "***Connect***" Button on the Main Screen. NOTE: There is a 3 part button. TCP, Connect and USB. Selecting "***Connect***" will connect as configured. A successful connection will show a green connection icon in the upper right of screen.



Connection Status Icon "Connected"

In addition, the Console Serial Number, Software Version, Firmware Version, Connection IP Address or COM (USB) and Current Profile Name will populate on the left side of the Main Screen.

The Date and Time will appear in a band across the bottom of the screen.

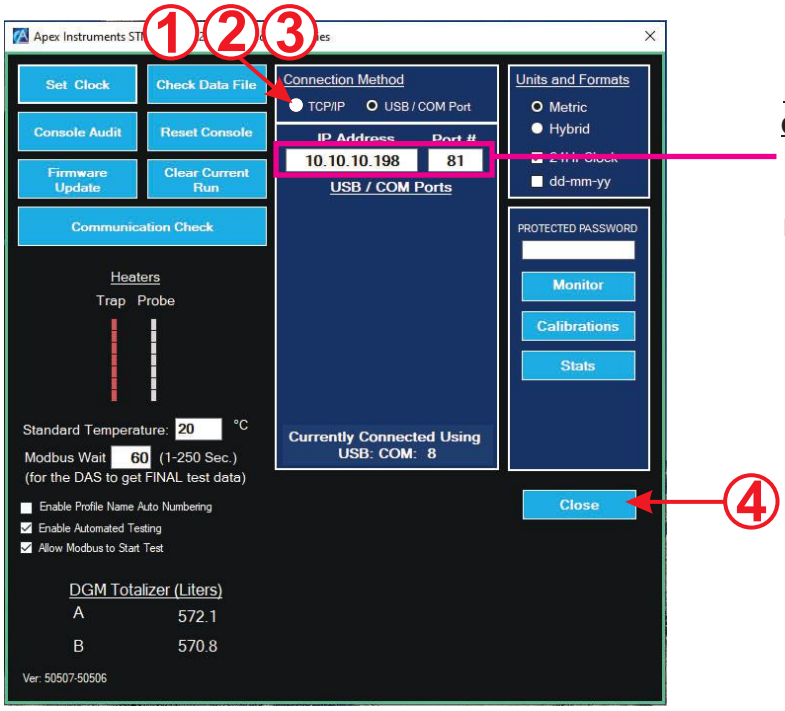


Initial Main Screen (Not Connected to Connected)

3.4 Software Communication via LAN/WAN/Modbus

The STM-6000 software communicates via USB or Ethernet.
To connect single click the "***Config/Utilities***" button.The following screen will appear.

LAN/WAN/Modbus Connection

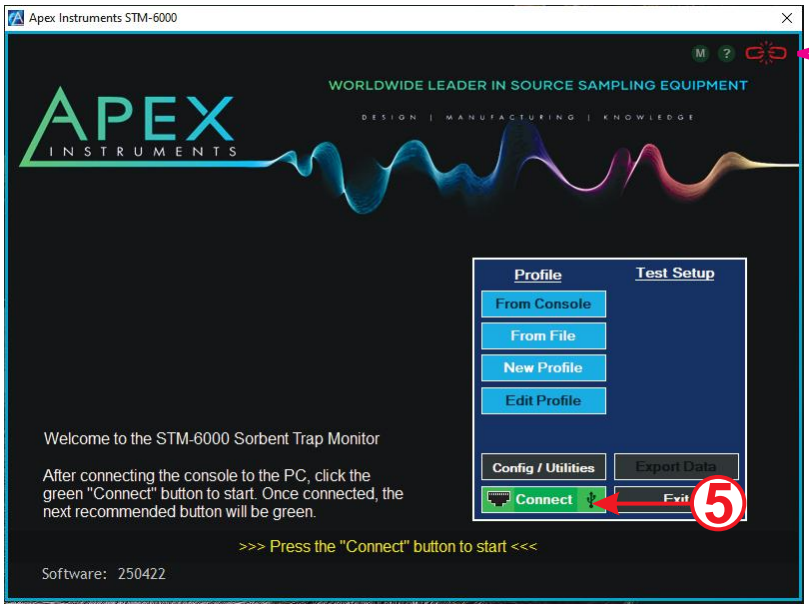


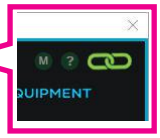
IP Address Entries

Connection Type:	IP Address:	Port:
TCP/IP	192.168.1.2	81
WAN (Remote)	10.10.##.###	81
Modbus	192.168.1.3	502

Config & Utilities Screen

1. To **connect via TCP/IP** with a cable to the console click the **"*TCP/IP***" button and enter **192.168.1.2**, Port **81.**
2. To **connect via WAN** click the ***"TCP/IP***" button and enter **10.10.#.#** and Port **81**.
3. To **connect via Modbus** click the "***TCP/IP***" button and enter **192.168.1.3** and Port **502**.
4. Single Click "***Close***" button.
5. Select the green "***Connect***" Button on the Main Screen. A successful connection will show a green Connection icon in the upper right of screen.

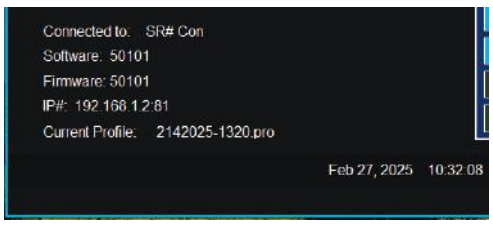




Connection Status Icon "Connected"

In addition, the Console Serial Number, Software Version, Firmware Version, Connection IP Address or COM (USB) and Current Profile Name will populate on the left side of the Main Screen.

The Date and Time will appear in a band across the bottom of the screen.



Initial Main Screen (Not Connected to Connected)

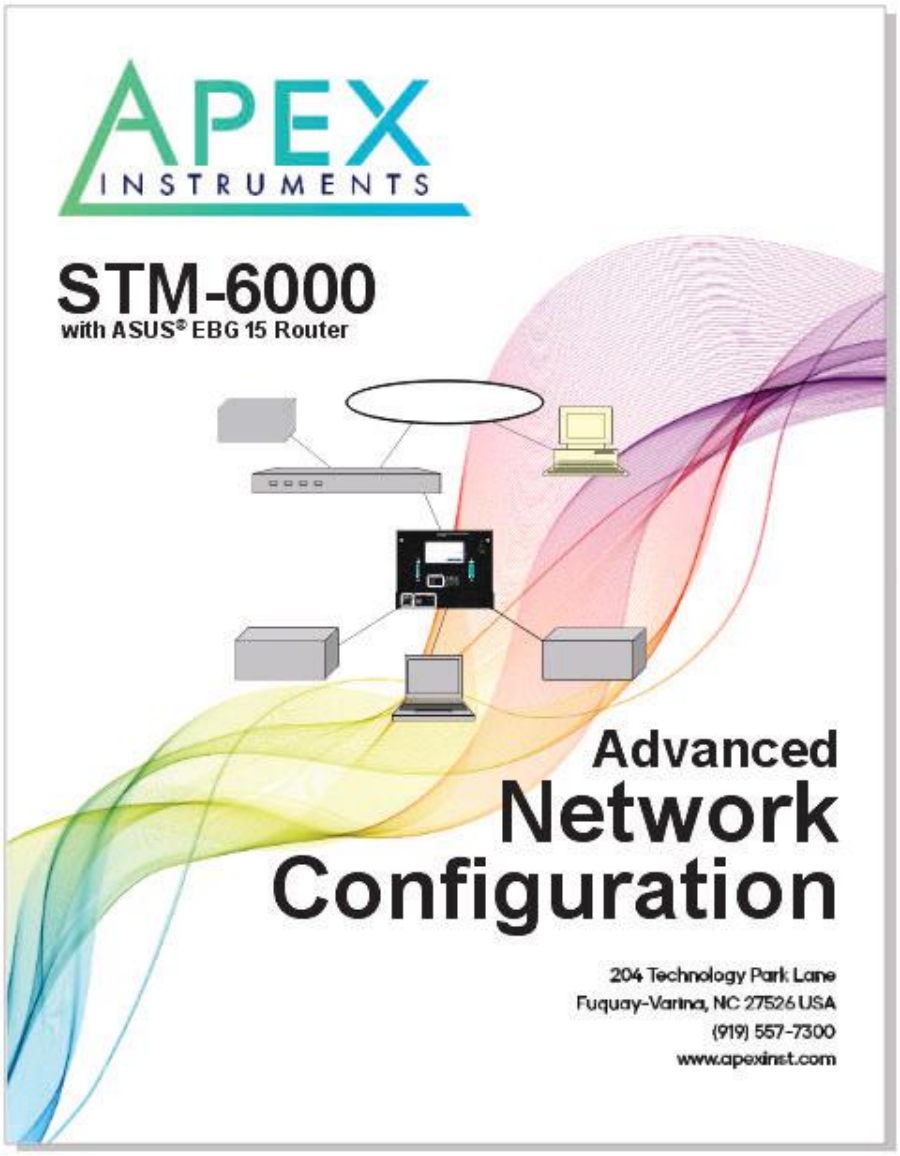
3.5 Software Communication- IP Addresses

Important note: If you experience errors in TCP/IP connection please follow the Advanced Network Configuration manual for the ASUS EBG15 Router.

Check the IP Addresses for correctness and match what has been designated for:

Internal Router:	192.168.1.1	Port 81
STM-6000 LAN:	192.168.1.2	Port 81
STM-6000 Modbus:	192.168.1.3	Port 502
Ethernet/WAN:	10.10.11.###	Port 81

NOTE: The MAC address is located on a label on the top of the Router as well as the manufacturer's label on the bottom of the Router.



4.0 STM-6000 Modbus Setup Procedure

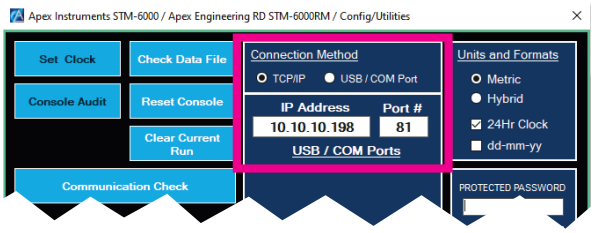
From the Main screen select the ***Config/Utilities*** button.

On the ***Config/Utilities*** screen select the ***Connection Method*** to the console:

Select ***TCP/IP*** radio button

Enter IP Address: 10.10.##.### **Port:** 81

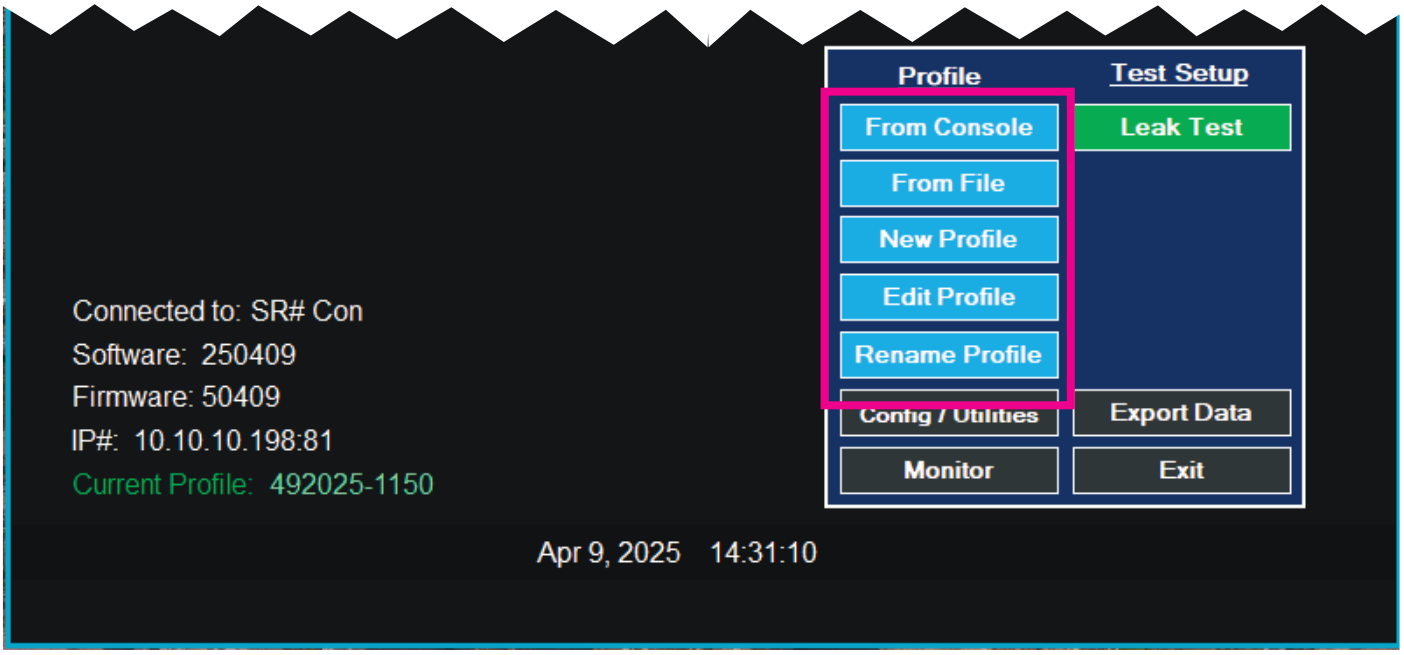
Select the ***Close*** button at the lower right of screen.



On the **Main** screen select the ***Connect*** button.

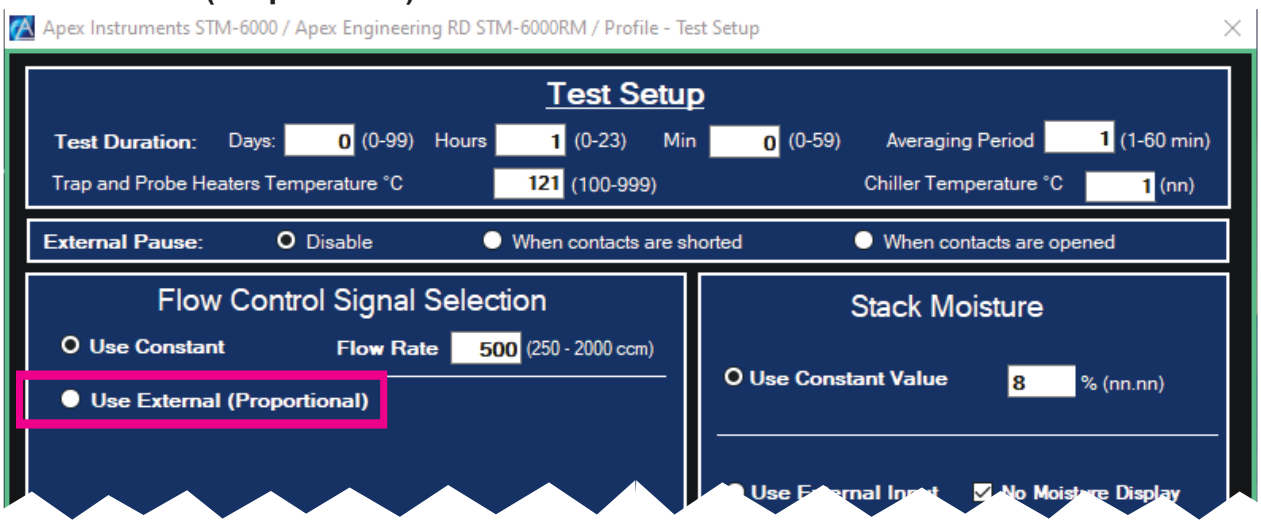
To setup the Modbus test parameters in the software select one of these five options:

Select the ***From Console*** button to use an existing modbus test profile
Select the ***From File*** button to use an existing modbus test profile
Select the ***New Profile*** button to create a new modbus test profile
Select the ***Edit Profile*** button to edit the current (modbus) test profile
Select the ***Rename Profile*** button to rename an existing (modbus) test profile



Enter any desired information on the pages preceding the **Test Setup** screen.

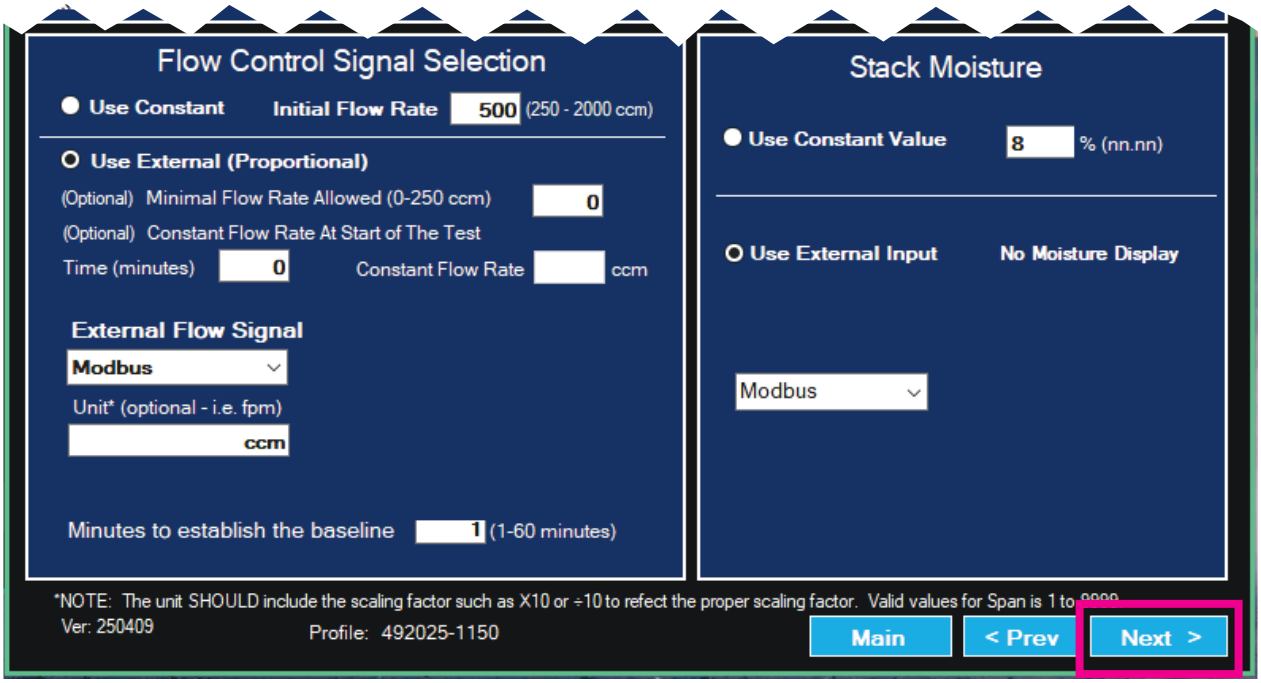
On the **Test Setup** screen, in the **Flow Control Signal** Selection box, select the **Use External (Proportional)** radio button.



The box will populate with various options for controlling the flow using an external input signal. The signal used can be configured for **Current (4-20mA)** or via **Modbus**.

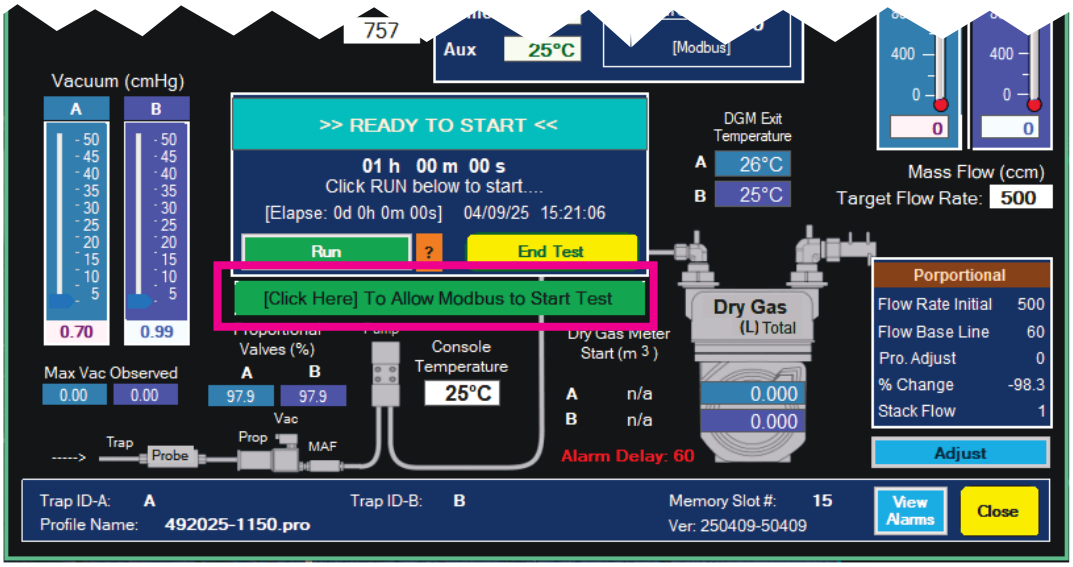
Select **Modbus** in the **External Flow Signal** drop down menu.
The optional **Unit*** field can be left blank or filled with, for example, FPM or CCM.
This unit value will be displayed on the **Monitor Screen** in the **Stack Flow** box.

The **Minutes to establish the baseline** field can be filled with 1 to 60 minutes.
The Stack Moisture signal can also be similarly configured for modbus operation.
Select Next to go to the Sampling Options screen. Save the Profile and return to the Main screen.

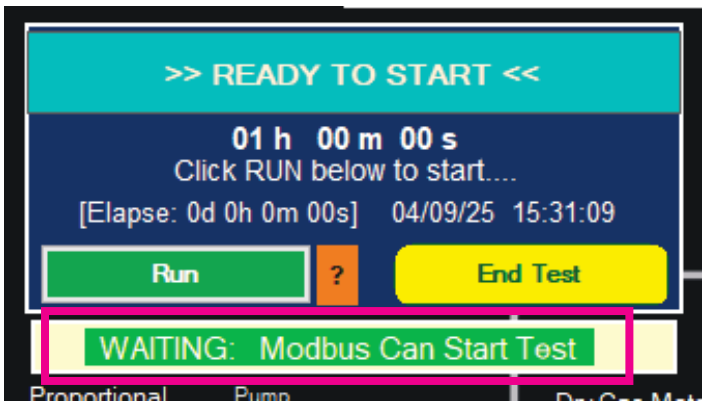


From the Main screen perform:
Leak Test
Set Probe
Select Memory Slot
Trap IDs

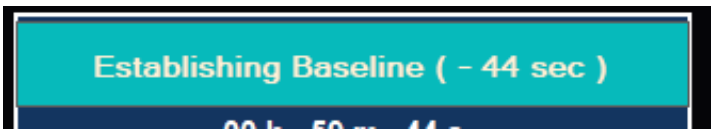
After the performing the pre-test setup the **Monitor** screen appears after the profile has been uploaded. The software is ready for the modbus to control the test. If desired, select the **[Click Here] To Allow Modbus to Start Test** button.



Upon clicking the button a message appears in the upper left of the **Monitor** screen allowing the operator to optionally **Ignore Modbus Commands.** Additionally, at the bottom of the **>>READY TO START<<** box there will be a flashing **WAITING: Modbus Can Start Test.**

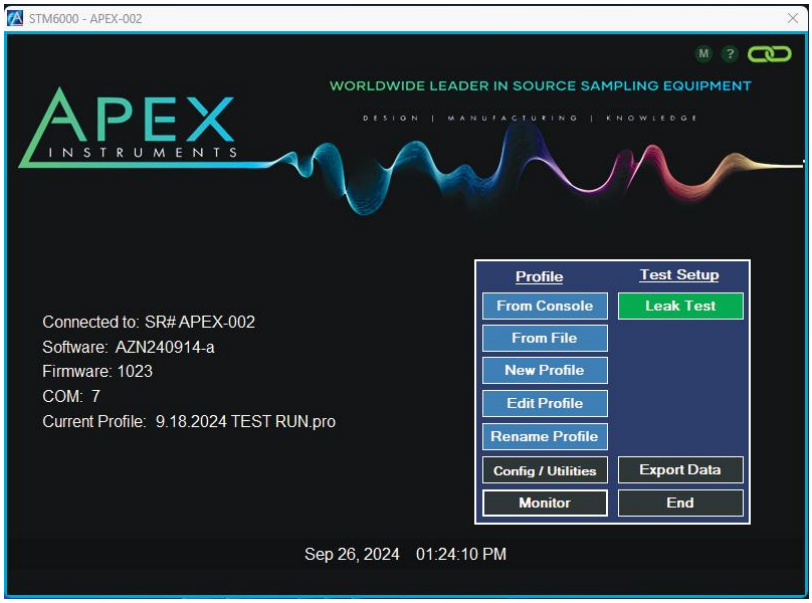


Upon starting the test via modbus the monitor screen will show **Establishing Baseline** with a countdown timer to displaying whatever it was set to (1-60 minutes). After the baseline is complete the console will continue with the test as it has been set up with modbus control.



5.0 Console Test Procedure Overview and Software Flow Summary

When connected the main screen identifies the console and the communication method as shown below:



Main Screen Communication Connected

The following summarizes the steps involved in configuring and running a complete test with the Console.

Main Screen
Profile Options
Load from Flash
Memory Load from File
Load New/Default
Edit Current Profile

Step 1
Load/Edit Profile
Profile Includes:
Test Duration,
Constant vs Proportional Flow Control
Target Flow Rate
Test Site Info
Alarm Configuration, Etc.
Save Profile

Step 2
Pre-Test Leak Check
Max Vacuum and Optional Variable Levels of 5" Hg and 10" Hg
Troubleshoot/repair leaks
Timeout Period
Accept stores value

Step 3
Set Probe
Insert Probe
Confirm Location and Delta P Measurement
Check Temperature
Values and Set Points

Step 4
Start Test
Program prompts the User to Enter Trap ID's and DGM Mechanical Index Readings

Step 5
Real-time Data
View Real-time data and Check for Irregularities
Alarm Actions
Communications

Step 6
End Test
Enter Final Reading of DGM index. Remove Probe from Stack
Prepare for Leak Check

Step 7
Post-Test Leak Check
Automatically Leak Checks to Max Vacuum Logged During Sampling
Optional Higher Vacuum Levels if Selected

Step 8
Export File
Download Selected Data File(s) to Selected Location, such as Jump Drive, Hard Drive, Network, etc.

Import into Spreadsheet/ Database Application

6.0 Test Profile

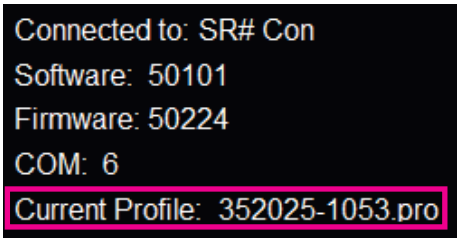
The Test Profile configures the console for running a test. A Test Profile can be loaded in two ways:

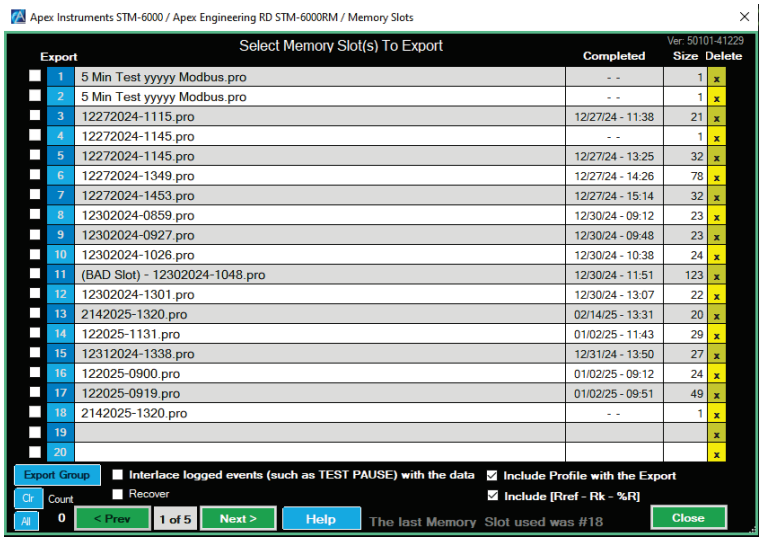
1. From the internal flash memory on the DAC board inside the console.
   Select the "**From Console**" Button
2. From an externally saved file.
   Select the "**From File**" Button

A New profile may be created by selecting the "**New Profile**" Button.
A Test Profile may be edited by selecting the "**Edit Profile**" Button.
A Test Profile may be renamed after it has been uploaded/created by selecting the "**Rename Profile**" Button.

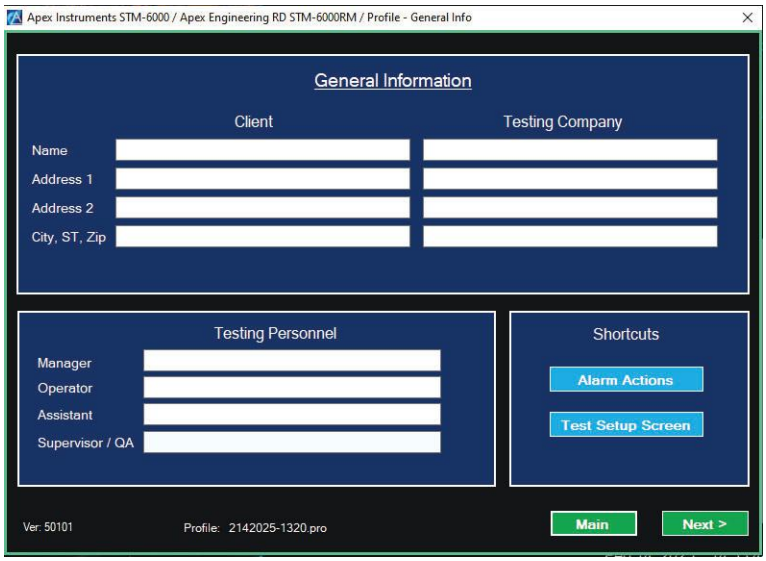
Once loaded this file name is visible on the Main screen. The first screen to appear is the General Information screen shown below. This allows the user to enter the Client's and Operator's information. There are several optional screens in this profile. The user has the option to enter the data and click "***Next***" to cycle through or this information is optional and can be bypassed by clicking the "***Test Setup***" Screen.

Left Side of Main Screen

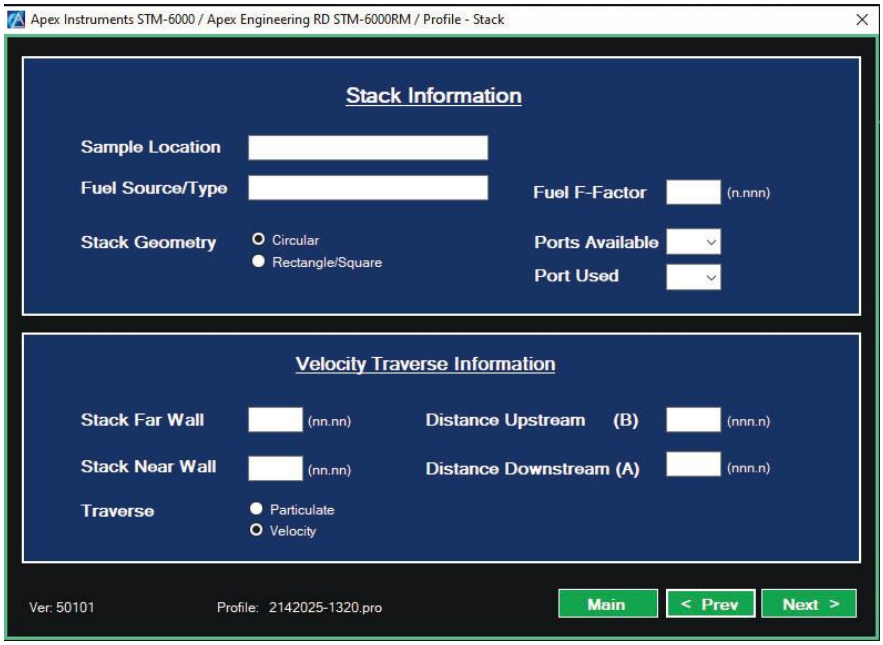




Load Profile from Internal Memory Screen (Console)

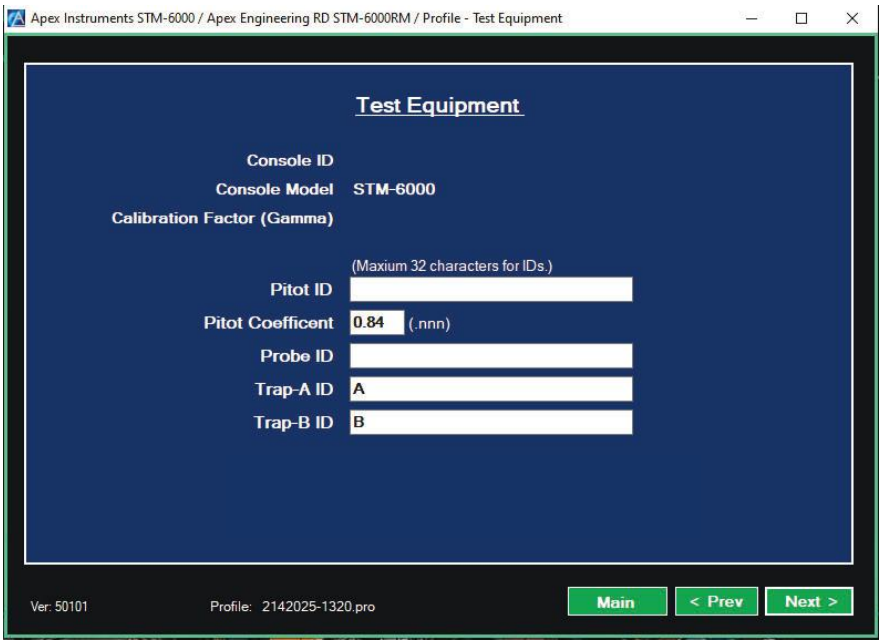


General Test Information Screen



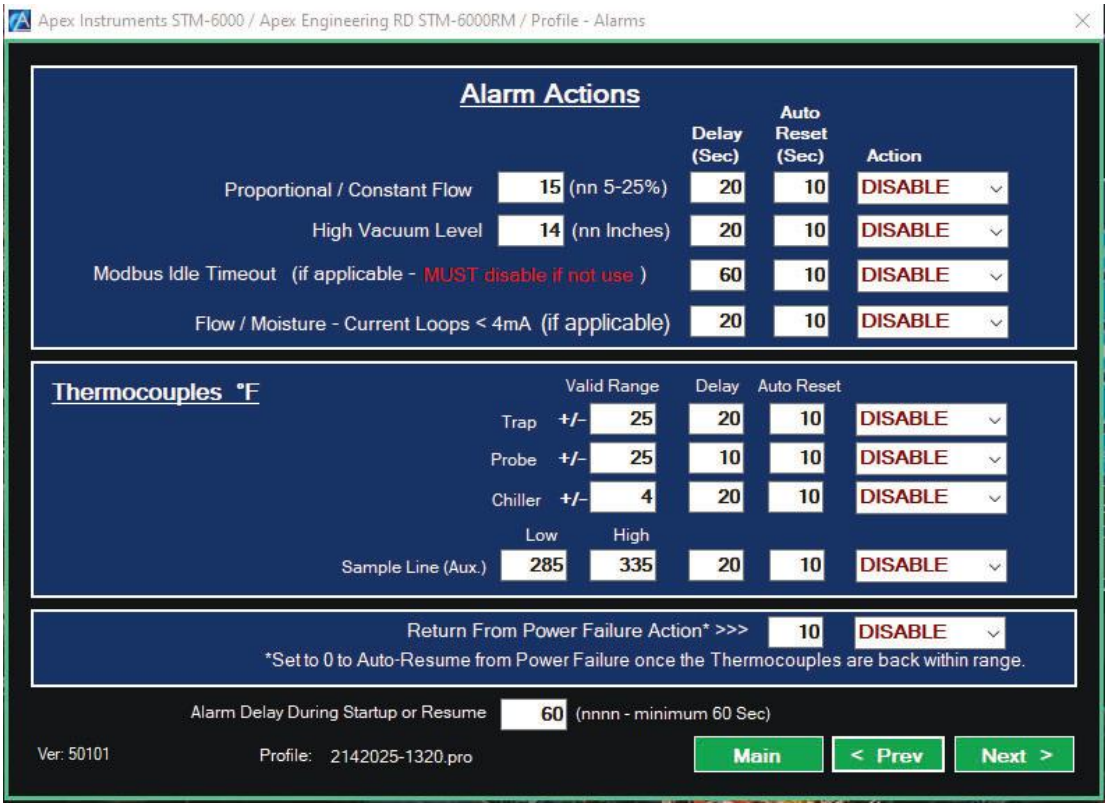
Stack Information Screen

The Stack Information data is optional and is not used in any calculations. It is for descriptive or reporting purposes only.



Test Equipment Information Screen

The Test Equipment information is also optional. However, the Cartridge or Trap IDs are highly recommended to enter. It is optional here because the user is prompted later to enter this information.



Alarm Actions Screen

6.1 Alarm Actions

The Alarm Actions screen allows the user to configure the software to trigger an alarm condition based on several available parameters. Each alarm condition has several parameters that may be set. For each sensor input on the Alarm Actions screen, a valid range or upper limit may be set, depending on the sensor type. Additionally, most alarms feature an auto-reset function, which serves to return the console to a non-alarm state in the case of a non-critical alarm condition.

AUTO-RESET (sec.): Length of time alarm condition must continue before alarm action is performed. For an instant alert, set to zero (0.)

AUTO-RESET (sec.) Length of time elapsed before alarm condition resets. When alarm condition resets, Alarm Piezo output and dry contact will deactivate.

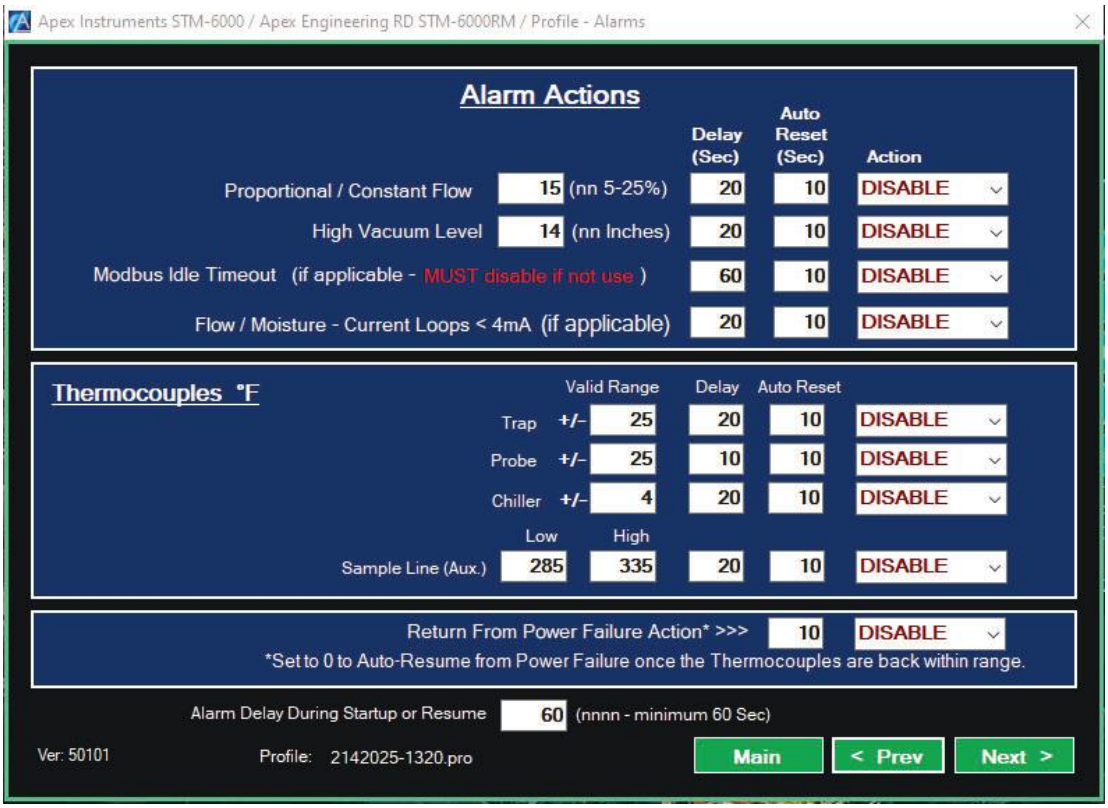
ALARM ACTION: Action performed by the software upon reaching an alarm condition. See table below

RETURN FROM POWER FAILURE ACTION: When the console returns from a power failure, the unit may trigger an alarm. Any available Alarm Action may be used, including END TEST or PAUSE. If ALERT is used, the alarm may be Auto-Reset after a specified interval.

ALARM DELAY (Startup / Resume): When a test run is started or resumed from a pause condition, the alarms will be disabled for a minimum of 60 seconds, in order to prevent false alarm conditions when establishing the flow baseline. This delay may be extended at the user's discretion.

ALARM ACTIONS

ACTION	Description of Action
ALERT	Console Alarm dry contact output will close Console Alarm Piezo output will engage May be Auto-Reset or reset manually by operator
PAUSE	Console Alarm dry contact output will close Console Alarm Piezo output will engage Test will pause until manually resumed by operator May not be Auto-Reset
END TEST	Console Alarm dry contact output will close Console Alarm Piezo output will engage Test will end and unit will wait for post-leak test May not be Auto-Reset
DISABLE	No action

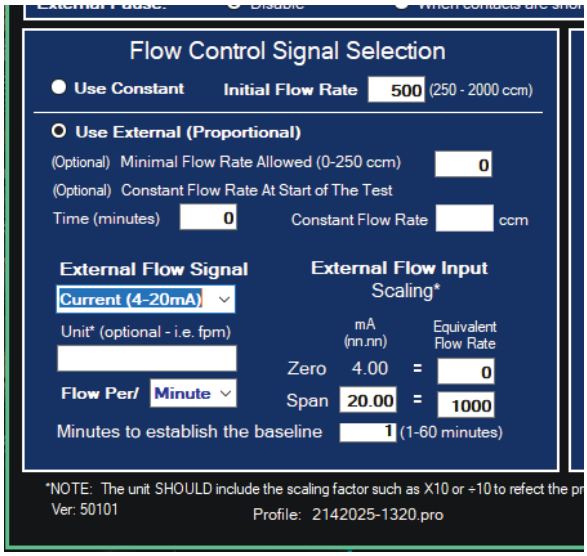


Alarm Actions Screen

6.2 External Flow and External Moisture:

The software is designed to operate with a proportional flow input, which is used to change the target flow rate of the console. The software can accept an analog input signal (4-20 mA) or a digital flow input over Modbus.

In order to use proportional flow, select an initial flow rate and an external flow signal source.



Flow Control Signal Selection (from Test Setup Screen)

In this example, we have selected 500cc / min. and 4-20mA for our external flow signal. The External Flow Input Scaling fields are designed to make the exported data agree with the stack flow data obtained by the plant stack flow monitor. If known, input the correct stack flow value observed when the external flow signal is a nominal zero (4mA). Then input a known current and its corresponding stack flow rate. The Unit field is optional but will be shown in the data. If the exact stack flow is not known, the Span mA may be set to the current external signal and the Span Flow Rate may be set to the current load percentage. If this is done, the Unit field should be set to “percent load” to indicate this situation in the data.

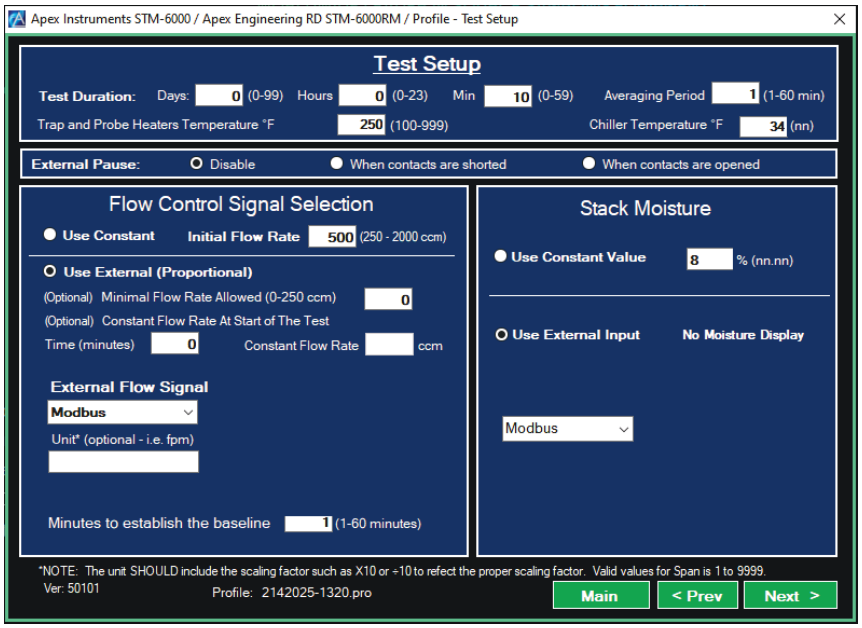
The final field is Minutes to establish the baseline, and should be left at 1 minute unless directed otherwise.

When the software begins sampling, the console will monitor stack flow during the baseline time period and will store the average stack flow in memory. The initial flow rate will be maintained as long as the stack flow is equal to the baseline stack flow. If the stack flow increases, the console sampling flow rate will also increase proportionally.

EXAMPLE: The initial flow rate is set to 500 cc/min. The external signal is set to 4-20mA, zero = 0.0001, span 20.00 = 1000 as pictured above. The unit is set to Kscfm (thousands of standard cubic feet per minute.) When the test begins, the stack flow is 875 Kscfm. The software sets its initial flow rate of 500 cc/min to be equivalent to 875 Kscfm. Over the course of the next hour, the load of the station increases from 87.5% to 91%. The stack flow increases from 875 Kscfm to 910 Kscfm (a 4% increase,) and the software increases its sample flowrate from 500 cc/min to 520 cc/min (also a 4%increase.) In this way, the software maintains proportionality during a sample run.

6.3 Test Setup

The Test Setup screen is the core of the Test Profile. This is where the user selects the test duration, averaging period, target flow rates, flow control method, etc. The External Pause parameters may be selected on this screen.



Test Setup Screen

6.4 Test Parameters:

Duration: Length of time the test is run. Note that this is the total run time, not calendar or clock time. If a test is paused, the unit will ignore the pause time and will continue the test until the entire duration has elapsed. Entered in Days / Hours / Minutes.

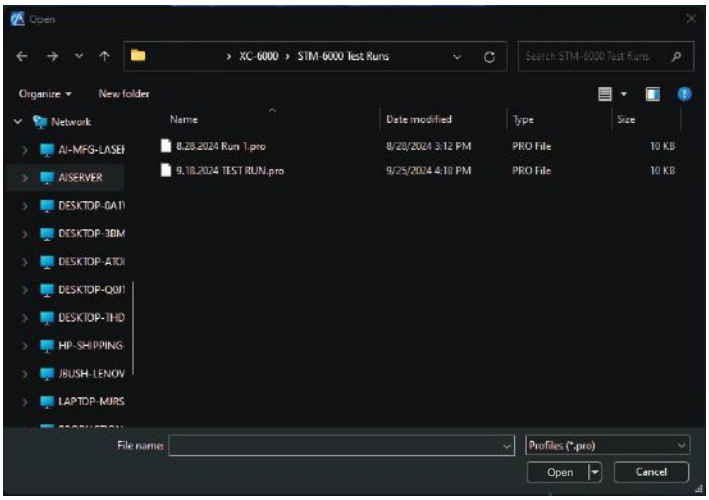
Averaging Period: Duration of block average points are stored in the console internal memory. If a 15-minute averaging period is specified, the unit will average all appropriate data and write data points to storage memory every fifteen minutes. 1-minute averaging times are recommended for shorter runs. For longer runs (greater than 24 hours) longer averaging times may be used.

Trap and Probe Heaters Temperature: Set Point for the console-controlled heaters in the sample probe. This should be set high enough to keep any water vapor or other moisture entrained in the stack without condensing. In a “wet” stack (more than 10% moisture,) trap and probe heaters should be set to well above stack temperature.

Chiller Temperature: This parameter does not control the sample conditioner, but it does provide a reference temperature used in setting the alarm values. Typically 35°F.

External Pause: Determines whether the unit will enter a pause state when the External Pause input is activated. Disable will never pause, When contacts are shorted and when contacts are open will pause when their conditions are met. When the unit is paused, the sample pumps are turned off and the elapsed time counter is not incremented.

Click “Save” to save this to a location on your hard drive. Please note that selecting “Save” does not write any information to the memory of the console. The software profile is not updated until all pre-test preparations are complete. Click “Main” to start the testing protocol.

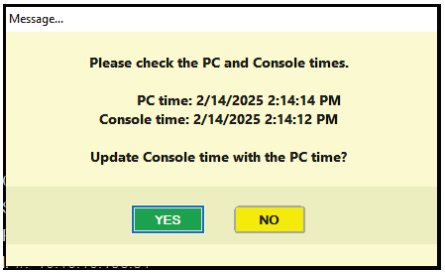


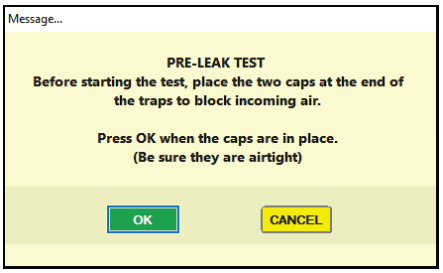
Save Profile Screen

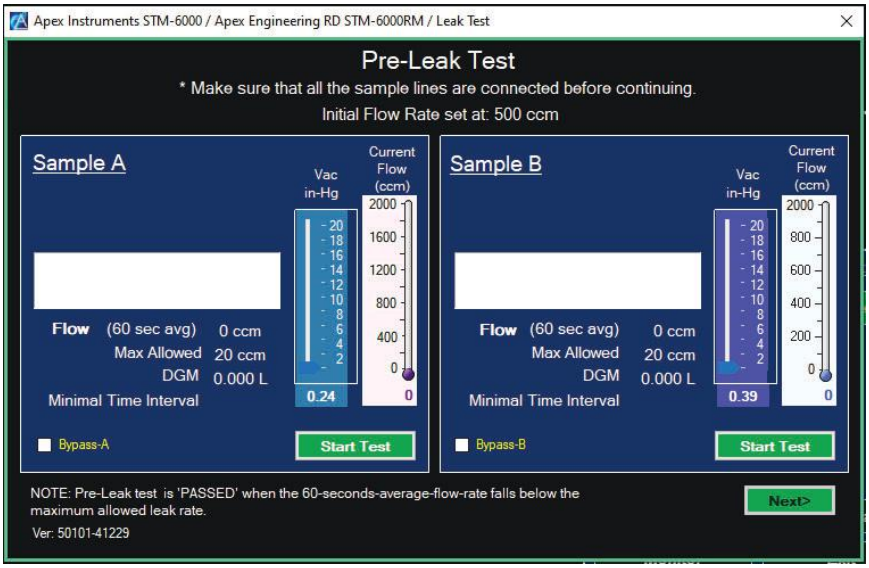
6.5 Pre-Test Leak Check

Once back at the “Main” screen single click the “Pre-Test Leak Check” button. The Update Console Time screen appears. Select “Yes” to synchronize the Console and PC times. The Cap Warning screen will appear cautioning the operator to ensure the sorbent test tubes are inserted in the probe trap receptacles. Plug the ends of the sorbent tubes with clean stoppers. Click the two “Start Test” buttons to individually leak check Side A and B. This is a required leak check performed at maximum vacuum. The leak check vacuum level and flow rate are stored

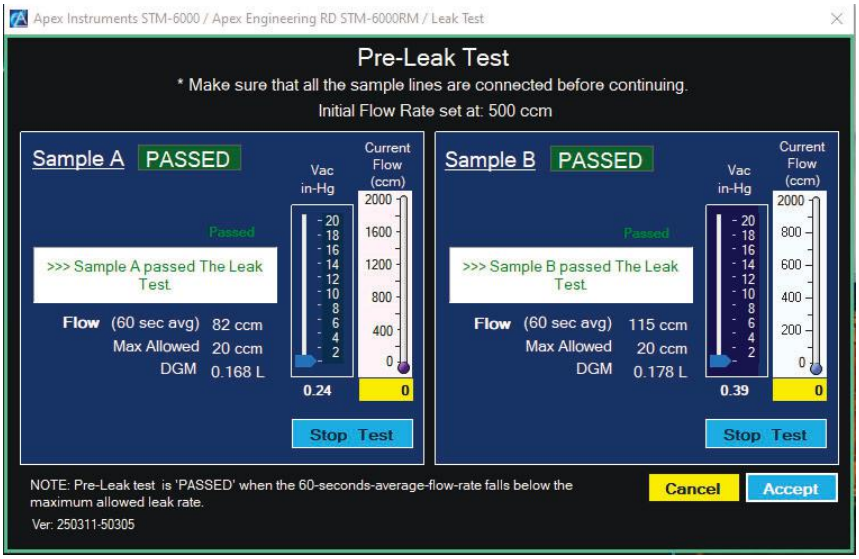
The test can be bypassed for each channel by checking both “Bypass” buttons and then selecting “Next>”. However, this bypass will be logged and stored with the data and may invalidate the test.





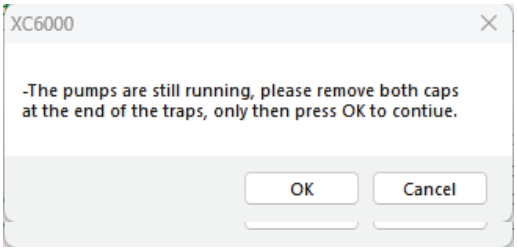


Pre-Leak Test Screen Running



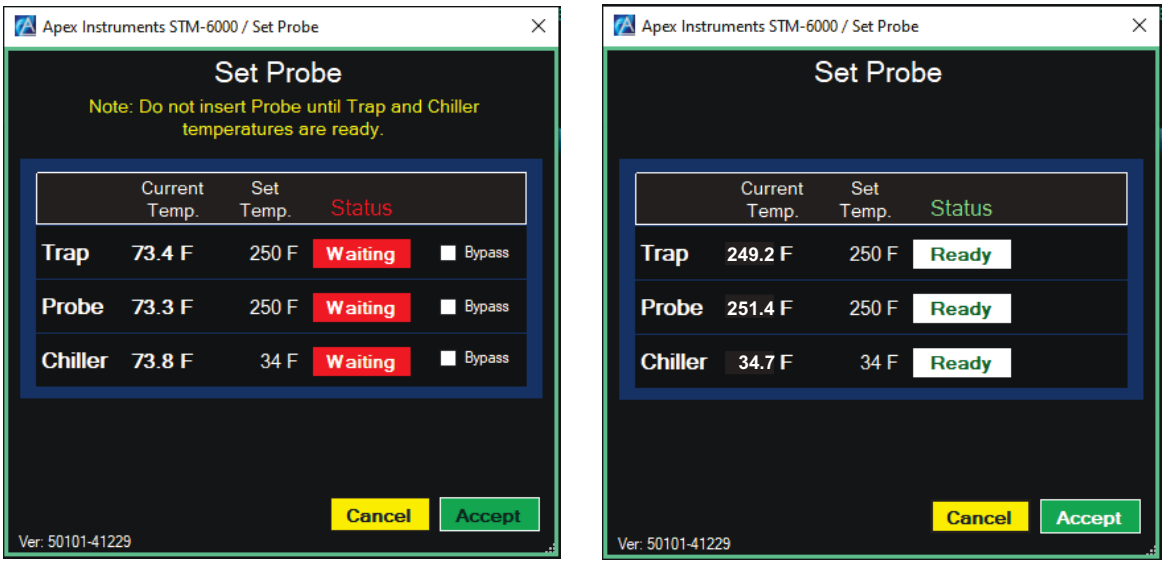
Passed Pre-Leak Test Screen

Once the test has passed click the “Next” button. A notification screen tells you to remove the caps on the traps and press “OK” to continue. The system will automatically switch these off prior to resuming with the Test Setup.



6.6 Set Probe

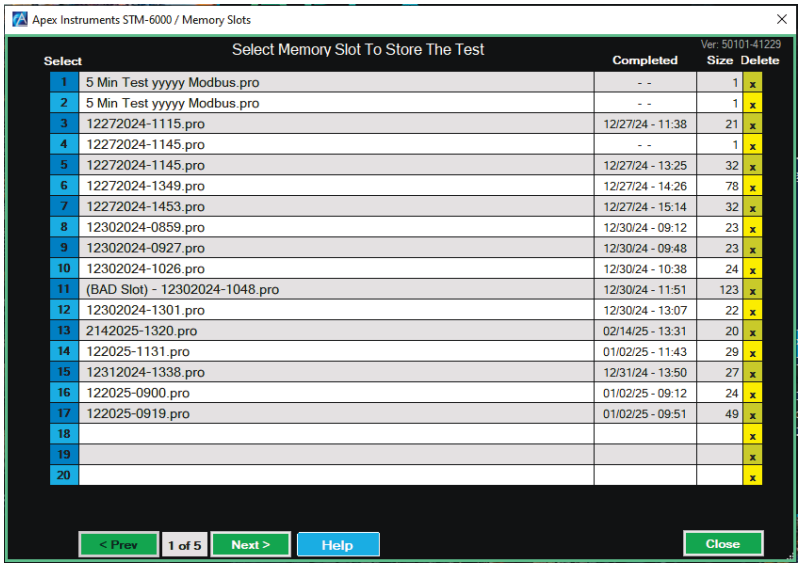
The Set Probe screen prompts the user to insert the probe into the stack when the temperatures are at/near set point. If the internal pitot is being used the current/live delta P reading is shown. There is an option to bypass by selecting “Bypass”. Once the desired temperature is reached the indicator shows “Ready”. Select “Accept” to continue to the Main Screen. Press the “Select Mem Slot” button.



Set Probe Screen

6.7 Test Data Storage Location

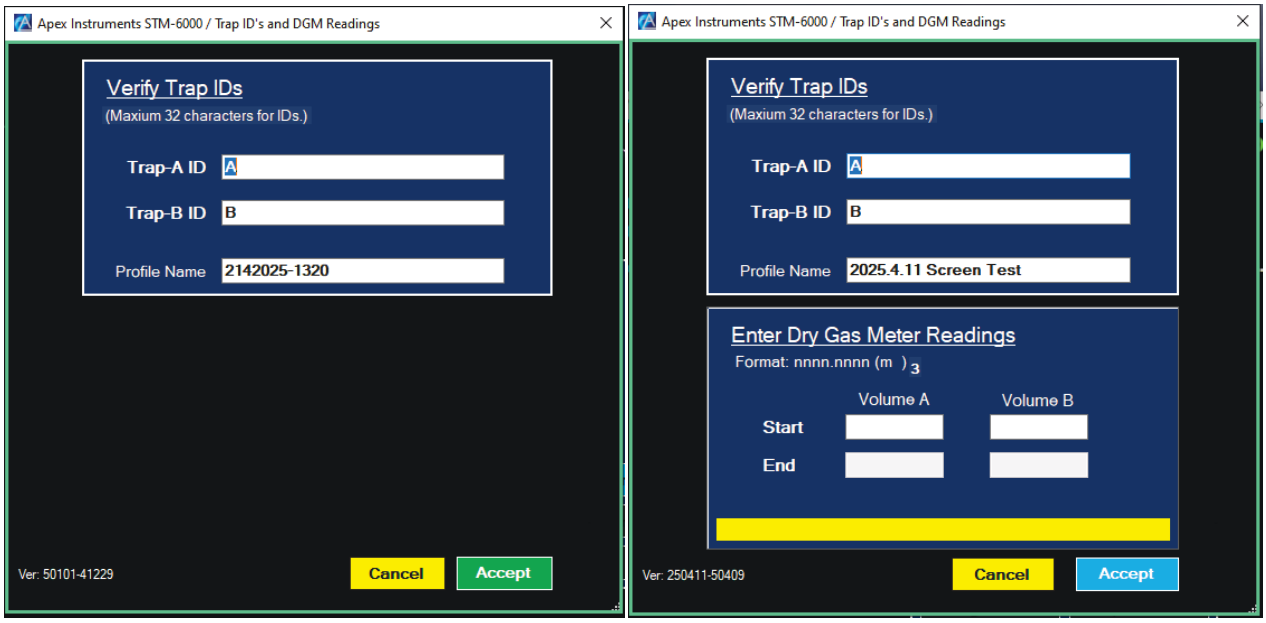
The following prompts the user to select a storage location on the flash memory drive inside the box. Single click the number in the left column corresponding to where the data file is to be stored. The user can select one of up to 99 slots. Click the "<<Previous" or "Next>>" buttons to scroll through to reveal the list. The system will prompt to confirm the case of overwriting data.



Memory Slot Selection for Data Storage Screen

6.8 Trap IDs and DGM Pre-test Volume Input

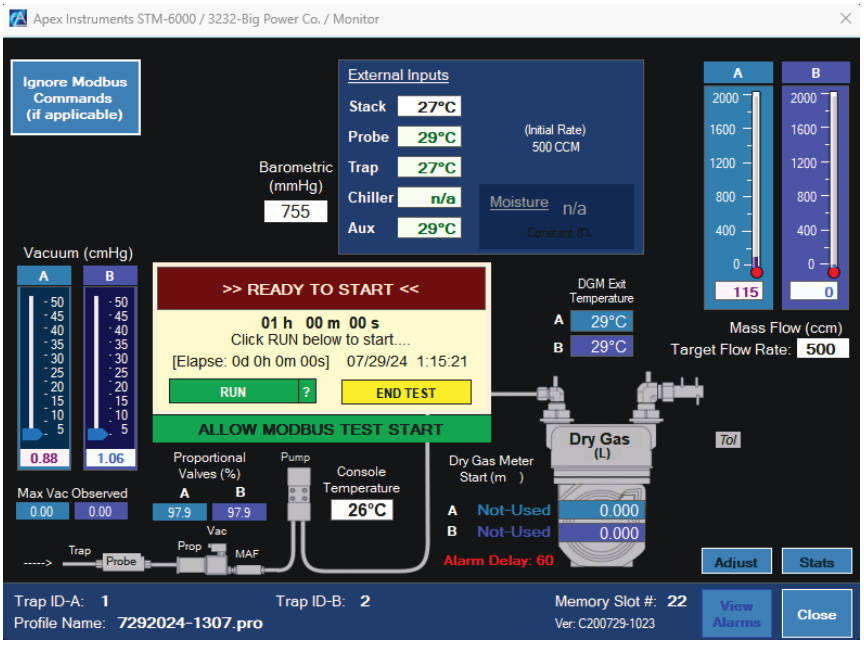
The following prompts the user to enter or confirm the trap IDs. Enter the pre-test dry gas meter readings from the console display if the option to use the DGM readings as a start and finish volume reference was selected.



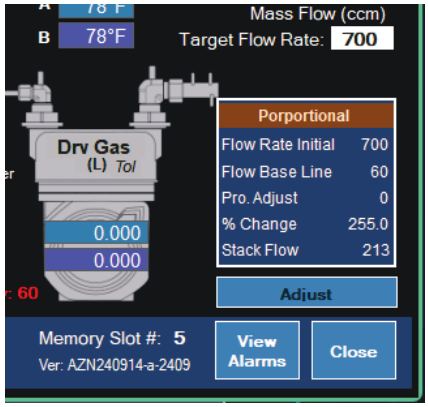
Mechanical DGM Index Screen

6.9 Test Start

After clicking “Accept” on the “Verify Traps ID” screen the “Ready to Start” the test screen appears.

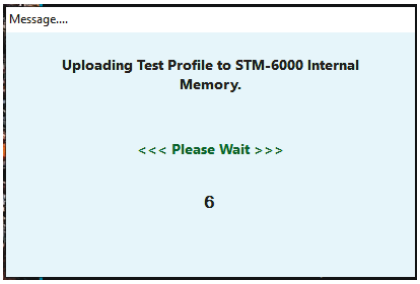


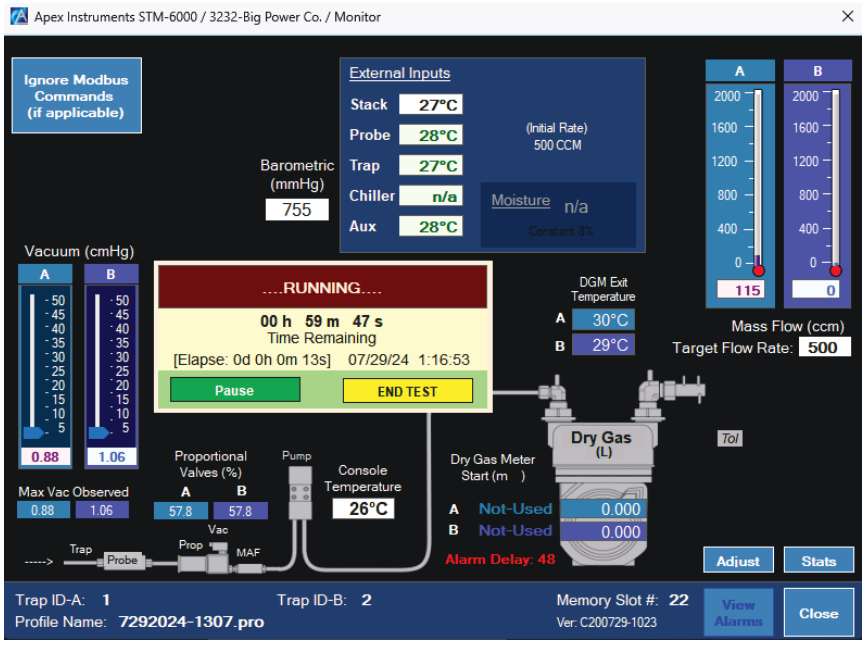
Test Ready to Start Screen



With Proportional Flow Option

To start, click “Run” and the system should indicate flow with the digital rotameters in the top right of the screen. Also, check to ensure the electronic totalizer on the display screen for the gas meter is incrementing.

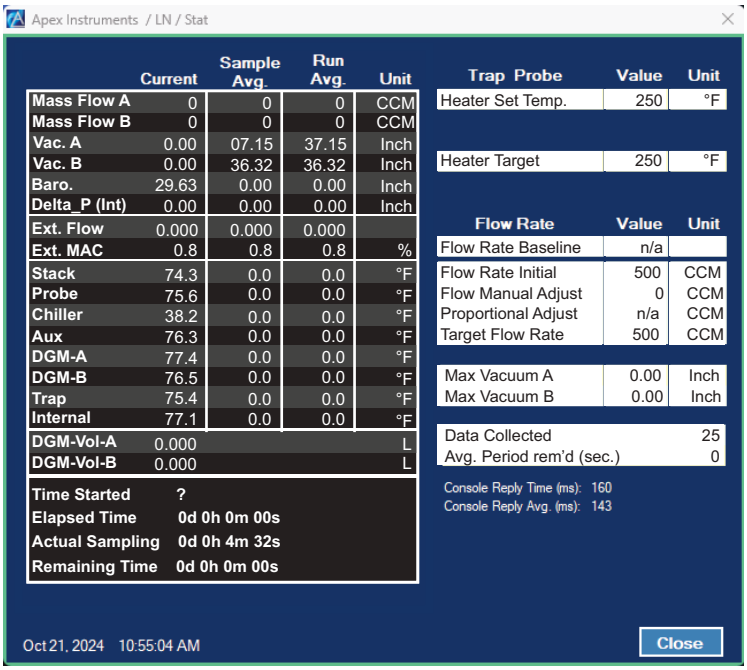




Test Running Screen

6.10 Stat Screen

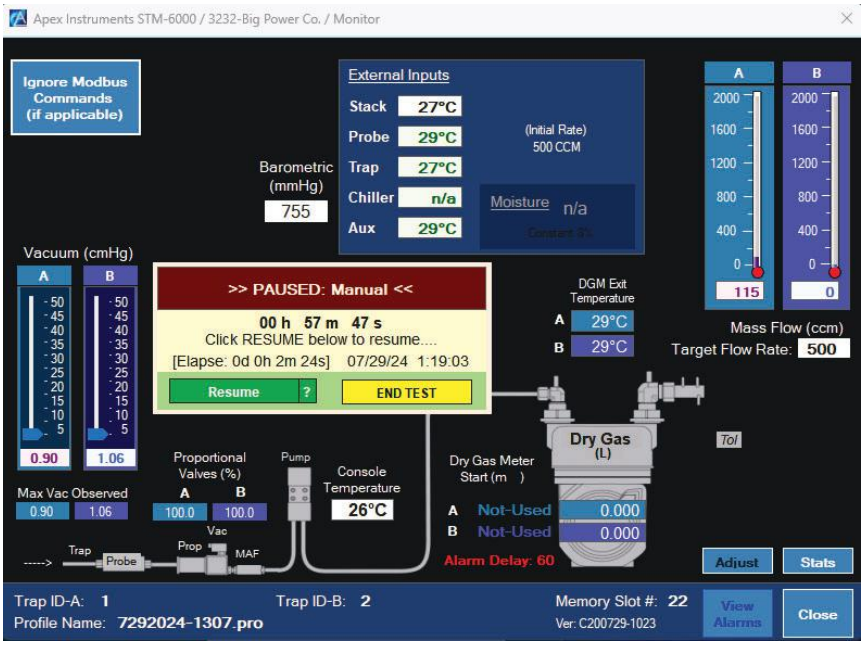
To see a non-graphical representation of the run data screen, go to the “Config/Utilities” screen. Single click the “Stats” button following screen will appear.



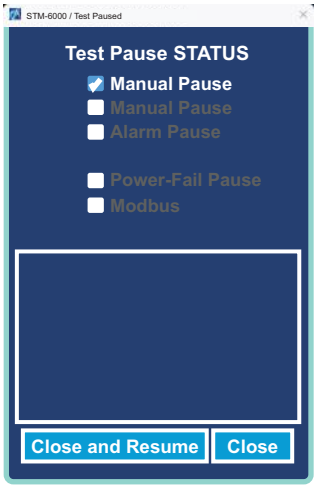
Stat / Sensors Screen

6.11 Pause Test

To pause the test, single click the “Pause” button in the center of the screen. The button will then toggle to “Run” to continue the test. Click on the “?” screen to open the “Test Pause Status” screen.



Test Paused Screen



Test Pause Status Screen

In addition, a remote pause functionality has been integrated into the software. By interfacing with the remote pause connector on the rear panel of the unit, the user may pause the test without the need for a connected PC. The remote pause functionality is discussed in the Test Setup menu.

6.12 Adjust Screen

The software is designed to offer flexibility during testing as well as when creating profiles.
Press the Adjust button to change the trap/probe heater set point or the target flow rate during testing.

Adjust Screen

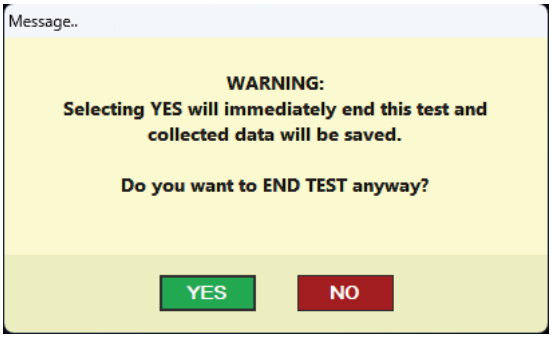
The **Trap Heater Setpoint Adjust** section allows either an arbitrary set point or a set point 0-99°F above the stack temperature to be set. The original set point is stored and may be recalled using this screen as well.

The **Adjust Flow Rate** section allows the flow rate to be increased or decreased from the original target flow rate. Positive numbers between 0 and 999 add to the flow rate, while negative numbers between -1 and -998 reduce the flow target.

After changing any parameters on the **Adjust Screen,** press the **Apply New Temperature** and /or **Apply New Flow Rate** buttons, and then close the screen by pressing the **Close** button.

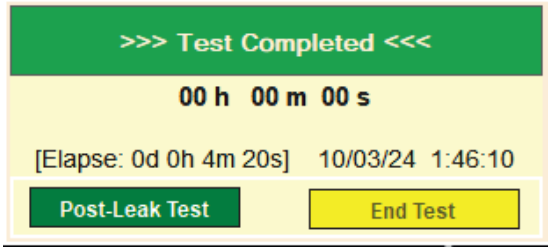
6.13 End Test

To end the test there are two options. The user can wait until the system times out and automatically stops the test. Second, the user can end the test early by single clicking the "End Test" button in the center of the graphical run data screen. The system will prompt the user to confirm this action.



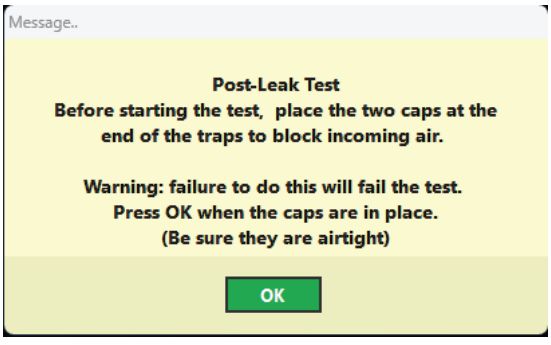
End Test Early Prompt

The Test ends and following inset prompt on the Test screen informs the user to perform a Post-Leak Test

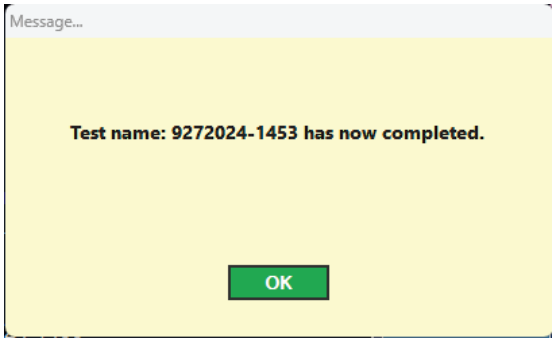


End Test Confirmation Prompt

The following prompt informs the user the Post-Test Leak test is next and to remove the probe from the stack and plug the ends of the traps.



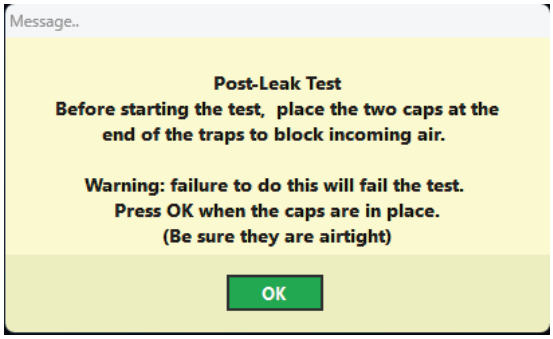
Initial Post-Test Leak Check Prompt



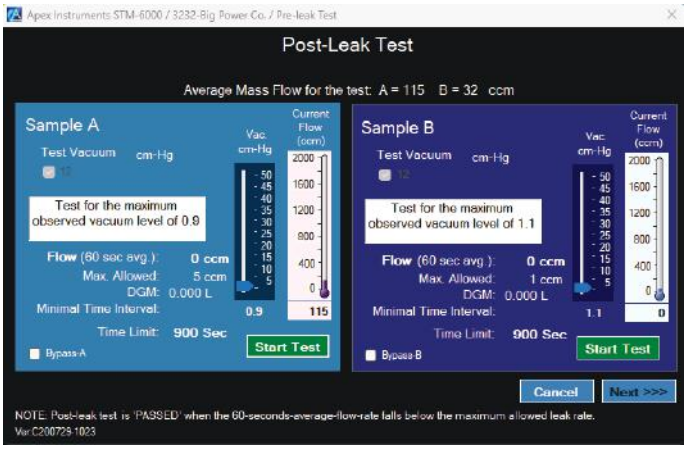
Post-Test Leak Check and Test Completed

6.14 Post-Test Leak Check

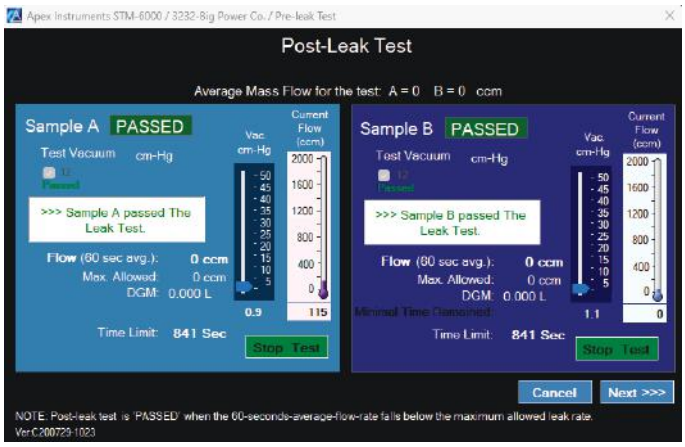
The following screen displays the status of the leak test and allows the user to start/ pause the leak check. The system has logged the highest vacuum achieved for both flow channels A and B as displayed in the center box and will control the vacuum level to just over those levels. Just like with the Pre-Test Leak Test, the user can bypass this step but no leak check data will be stored. However, if no Post-Leak is performed the sample run data will be invalid.



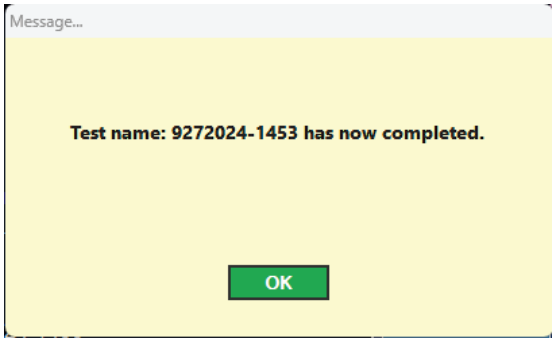
Post-Test Leak Test Message Screen



Initial Post-Test Leak Test Screen



Running Post-Leak Test Screen



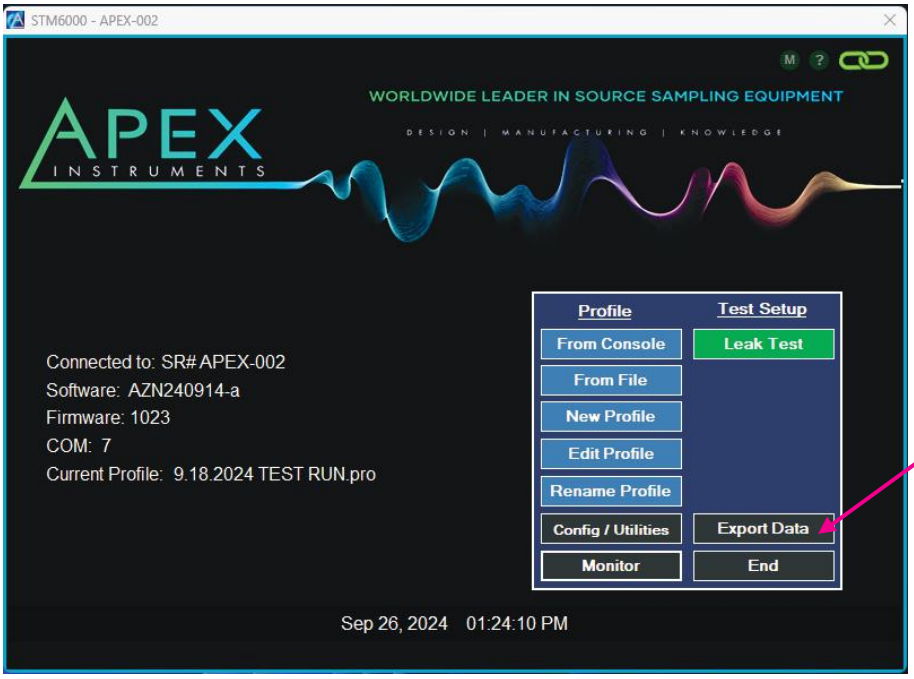
Save Data to Memory Prompt

After both flow channels have passed. Click the “Next>>>” button and cycle off the pumps and the system will inform the user it is storing the leak check data into the pre-selected Test Memory Slot.

The console will automatically perform a countdown reset after the data has been downloaded to the memory slot and then return to the main screen.

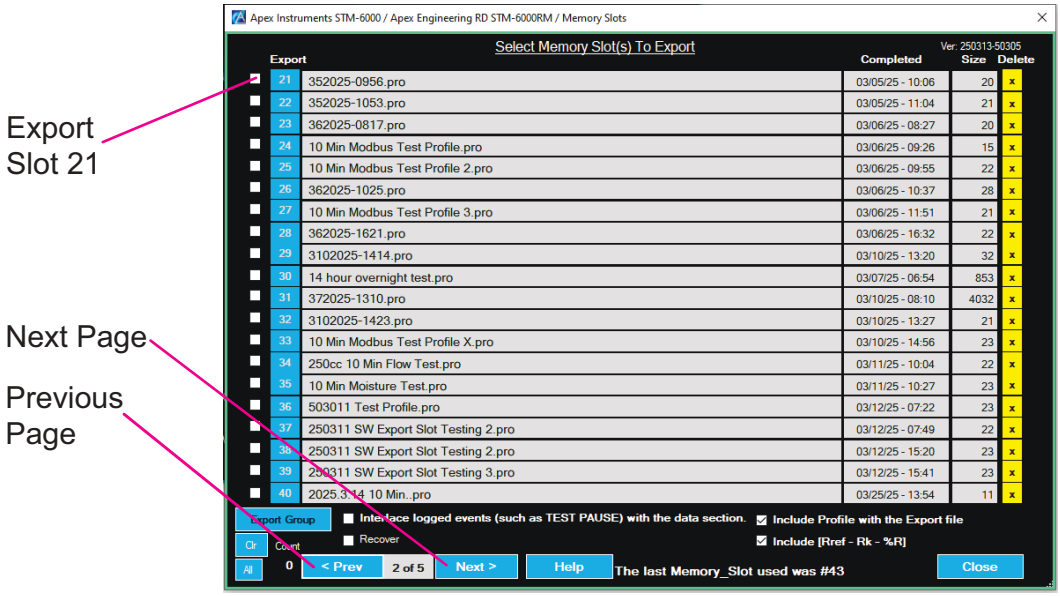
6.15 Export Data

The system will now go back to the main screen. To export and view the data file(s), Click on the Export Data button.



ExportData to File from main screen

Now select test data to export.

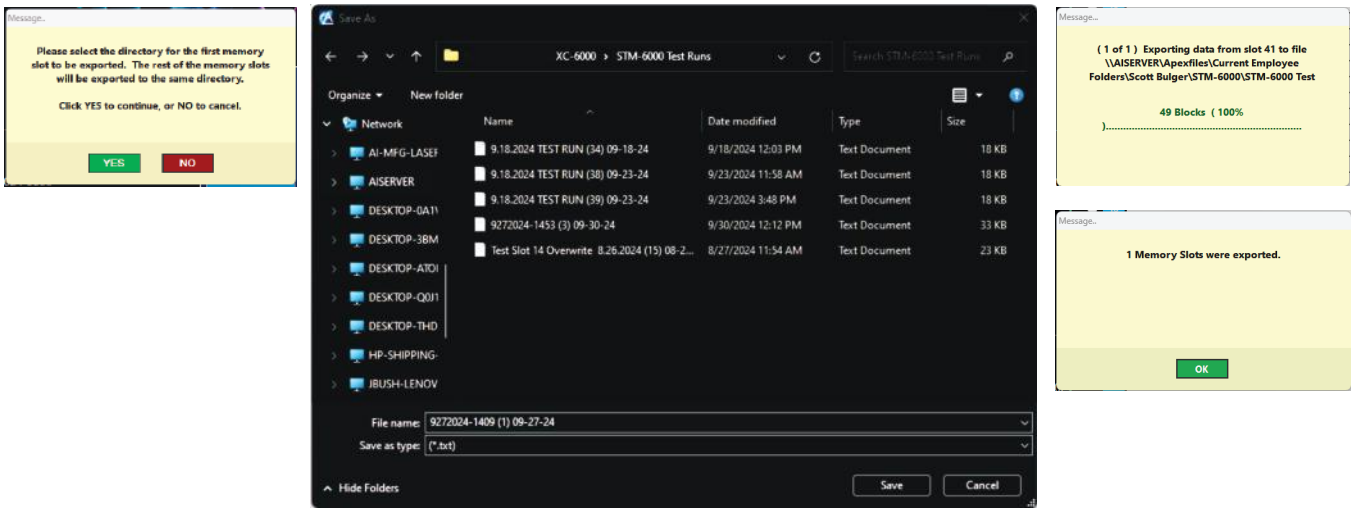


ExportData from Memory Slot

Click on the button corresponding to the slot number of the test to be exported. The software supports 99 memory slots, which may be accessed 20 at a time using the **Previous** and **Next** buttons.

6.15 Export Data (continued)

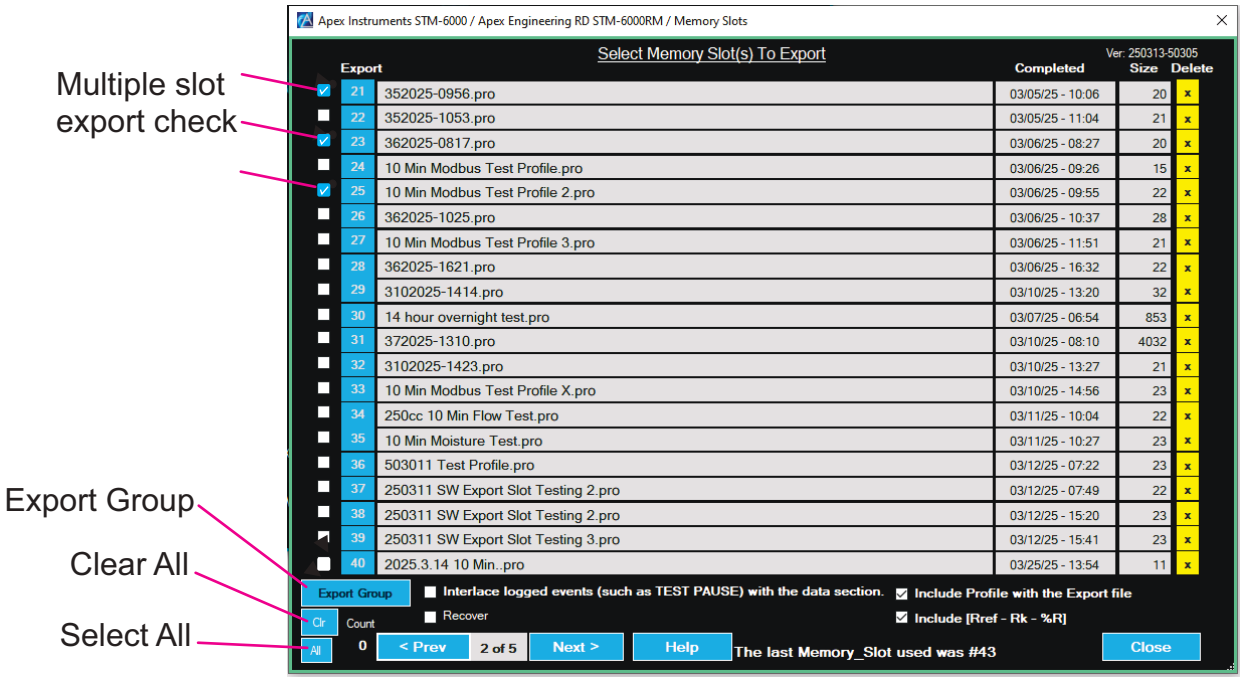
Once the slot number button is pressed, the following dialog box will prompt the user to save the file to a local or network location. A text file (.txt) and a comma separated value (.csv) file will be generated at this user-specified location. The text file can be viewed in various applications such as Notepad, Word Pad, Word, Excel, etc. The CSV file is formatted to be opened in a spreadsheet application such as Excel.



Export Data Path Screen

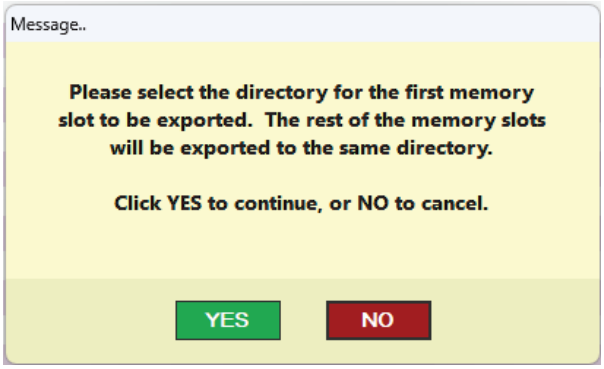
6.16 Multi-File Export

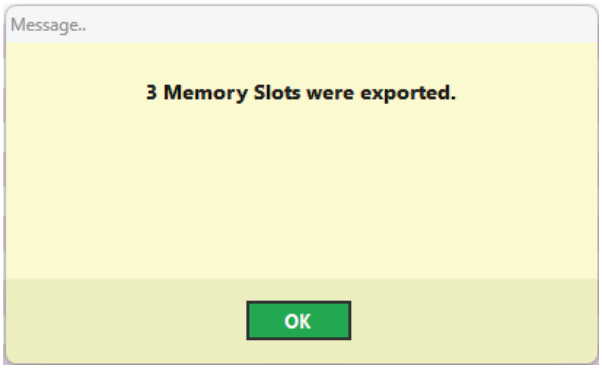
The software also supports multi-file export, which will export a group of completed test profiles to a folder on the local hard drive. To use multi-file export, select the Multiple Slot Export check boxes next to the slots desired. To select all available slots, press the **ALL** button. To clear all selected slots, press the **CLR** button.



6.16 Multiple File Export (continued)

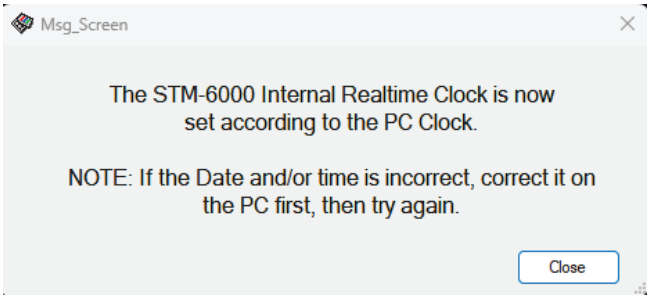
After the slots are selected, press the **Export Group** button. The software application will prompt the user for a directory as in single file export. With a multiple file export, all slots will be exported to the directory selected for the first slot. Exported files will be named based on their profile name, and all will be given unique file names.





6.17 Set Clock

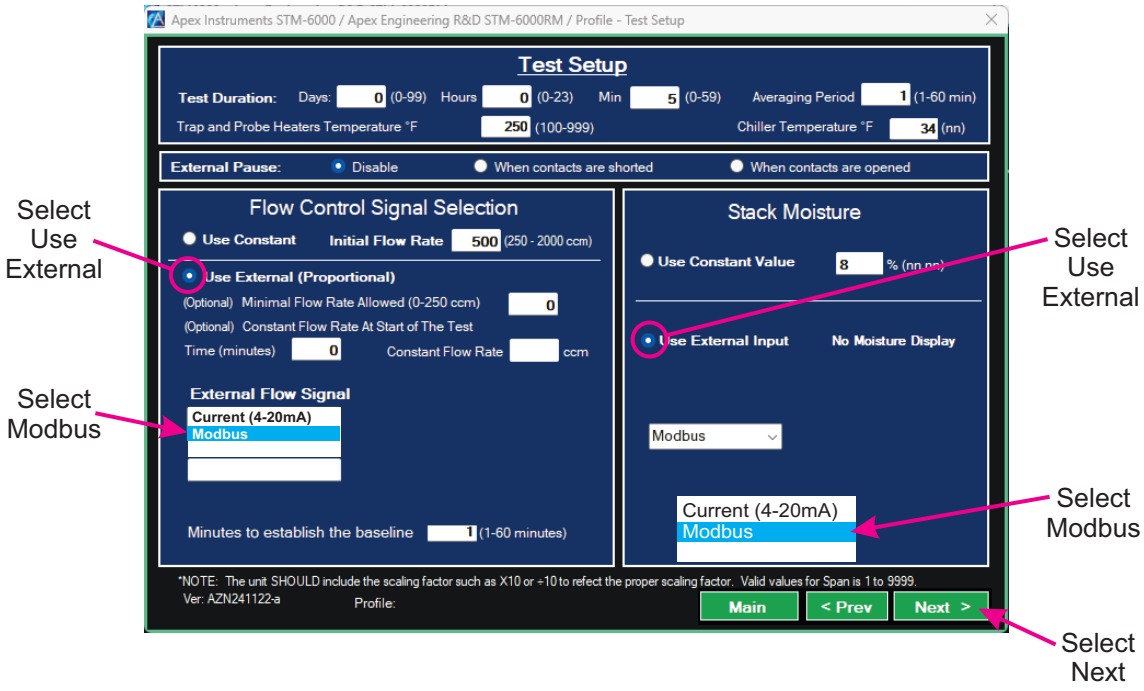
The Config/Utilities screen has various other functions built-in. The “Set Clock” button automatically synchronizes the console time with the clock time of the computer connected.



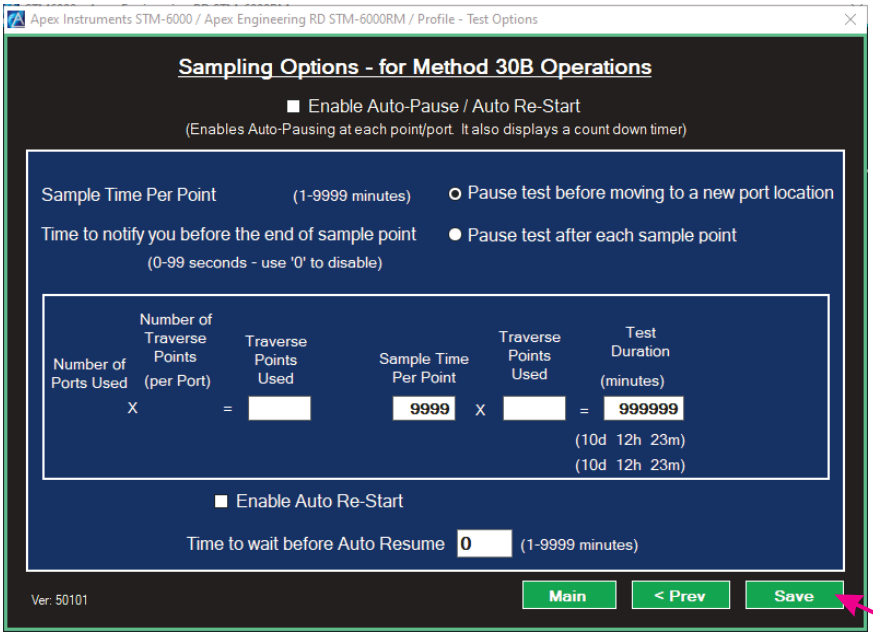
Set Console Clock Confirmation Screen

6.18 Modbus Setup Quick Overview

To setup Modbus operation from the Main Screen select the Edit Profile or New Profile button. Enter the information for General Information, Stack Information, Test Equipment and Alarm Actions for each screen. Select the buttons as shown below to setup the Modbus on the Test Setup screen.



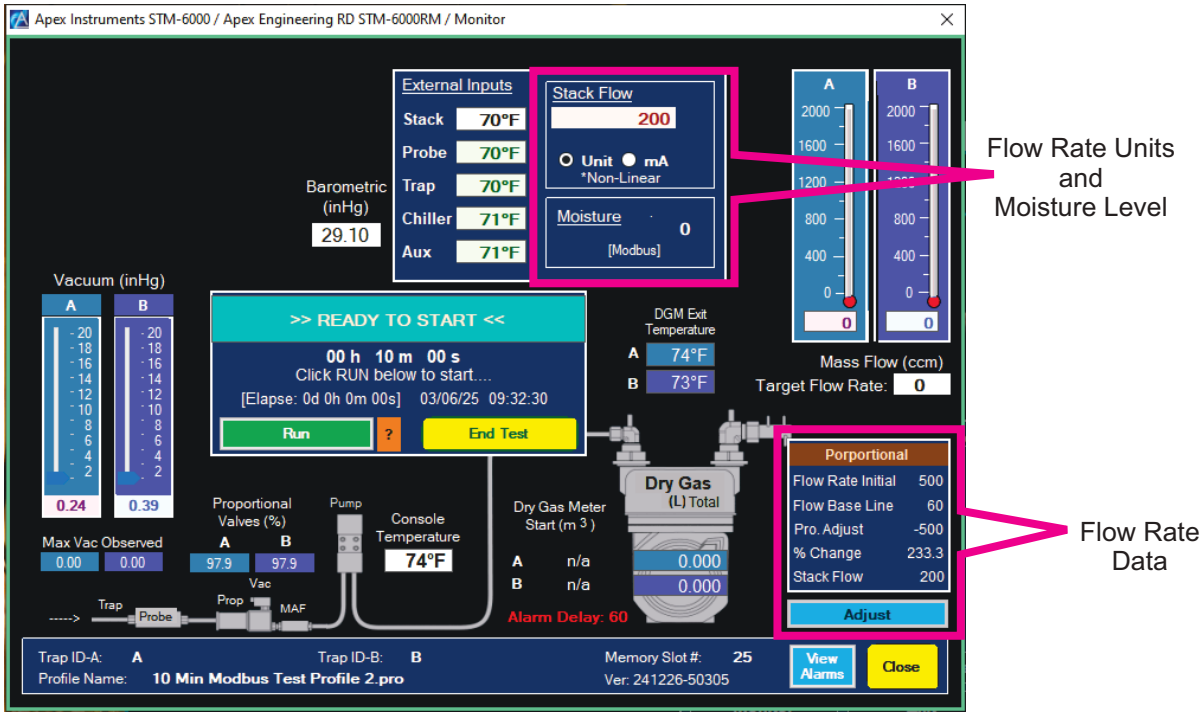
Select Next to proceed to the Sampling Options- for Method 30B Operations screen and select Save to save the Test Profile to a file and location of your choosing.



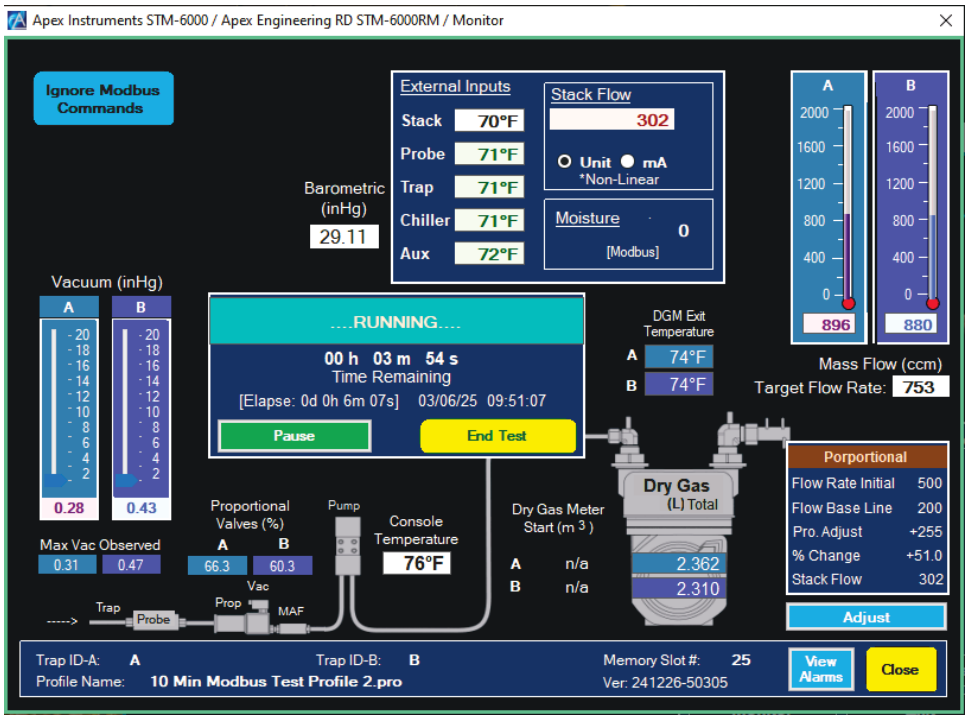
4.21 Modbus Operation

Testing Screen Examples

Pre-Test Screen



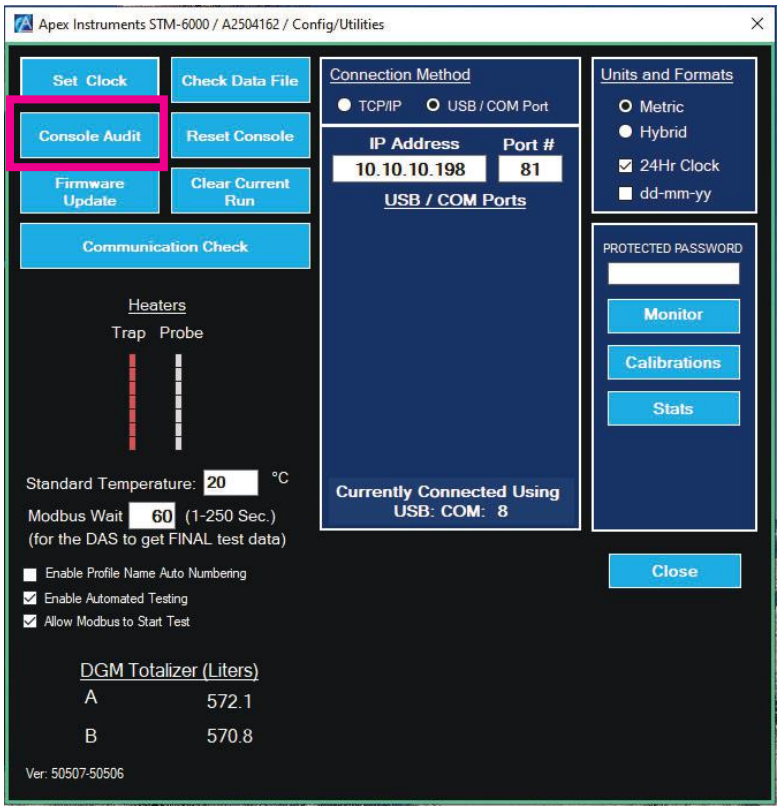
Running Test Screen



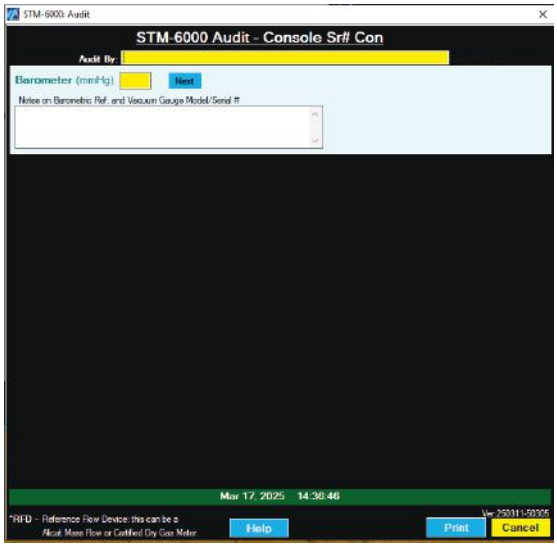
7.0 Console Calibration Checks (Audits)

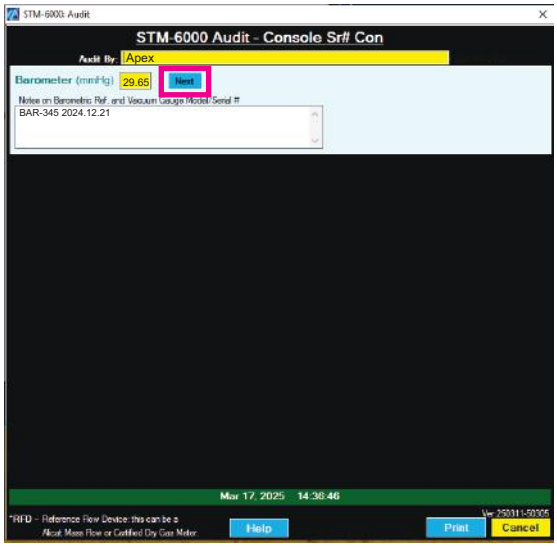
The source sampling console is sold with a factory calibration at flow rates appropriate for the flow meter component of the console. Apex Instruments suggests performing calibration checks before and after each testing period and performing a full calibration annually. Ensure that you verify with your local agency for calibration standards.

From the ***Config/Utilities*** screen select the ***Console Audit*** button.



Fill in the Information highlighted in yellow along with the notes for the reference device used. Select Next for Results.



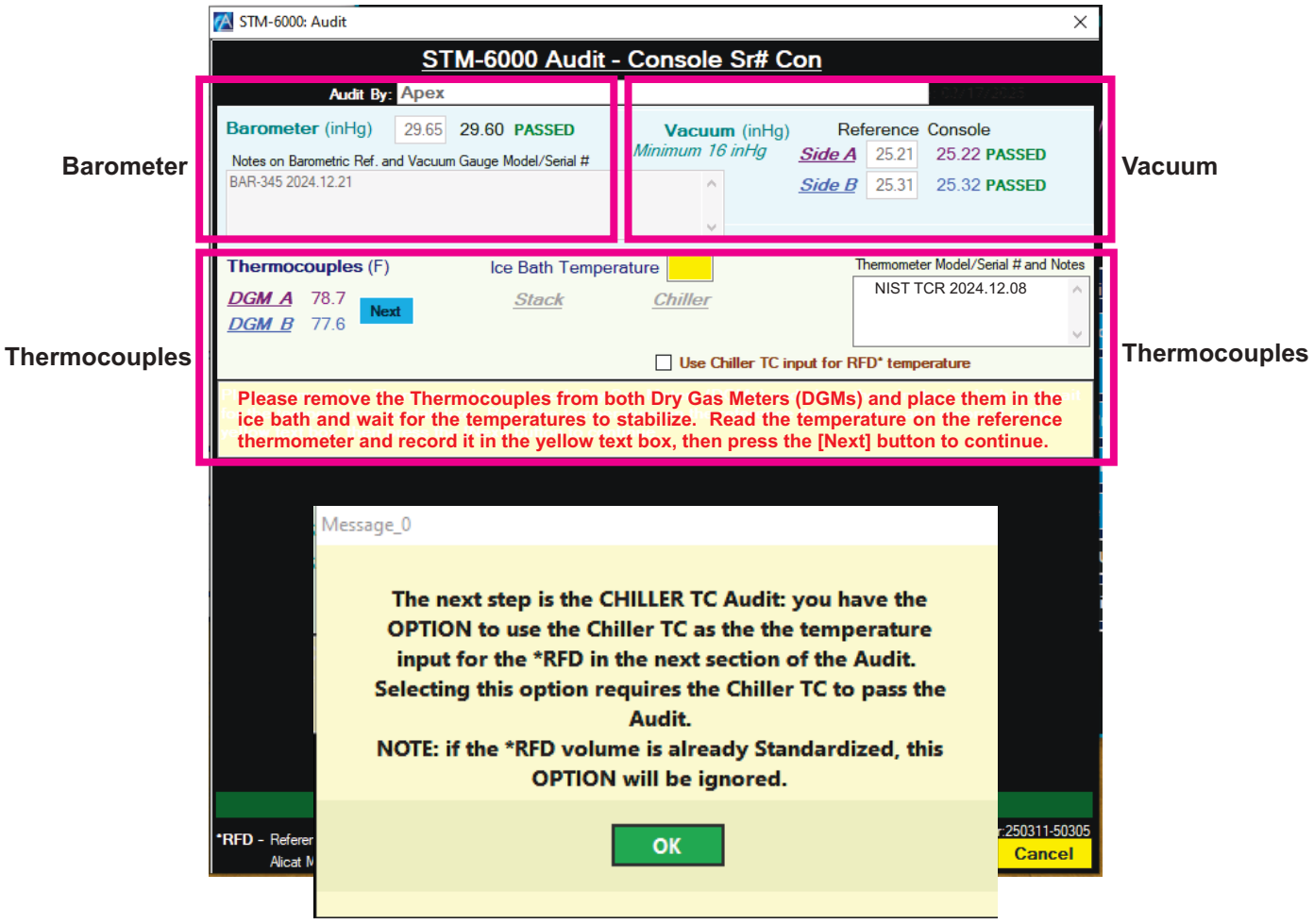


7.0 Console Calibration Checks (Audits) continued

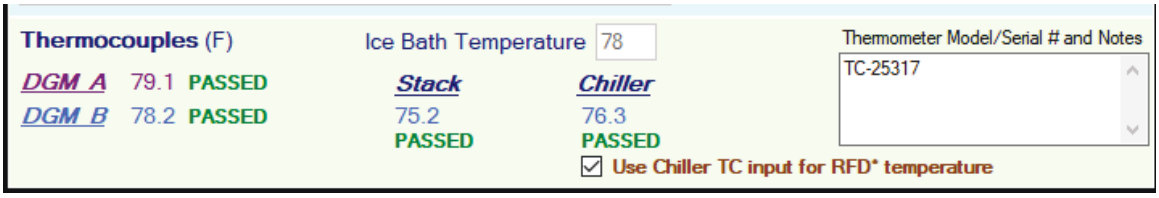
Use a NIST traceable Barometer or known accurate source to determine Barometric Pressure.

Use a NIST traceable vacuum gauge on the A and B Channel inlets. Run the console and record the reading of the NIST device. Repeat for channel B. The software determines if the readings are within EPA regulation.

Use a NIST traceable Thermocouple Simulator or select to use the chiller TC for RFD Temperature. If the chiller is selected to use as the RFD the Chiller TC must pass audit. Follow the instructions on each screen an proceed through the thermocouple calibration checks.



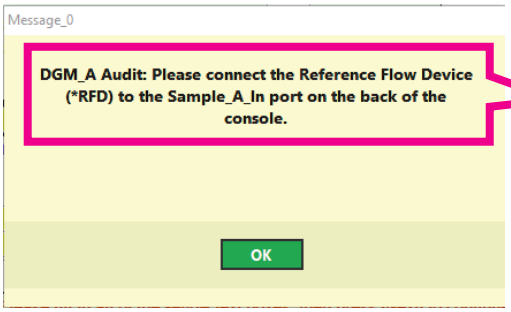
After each test is conducted and the value meets EPA regulations a “PASSED” or “FAILED” will be displayed adjacent to the value.



If the audit has FAILED at this point, it will be necessary to either continue with the remainder of the audit or cancel and restart after corrections have been made to the failed value(s) in the audit.

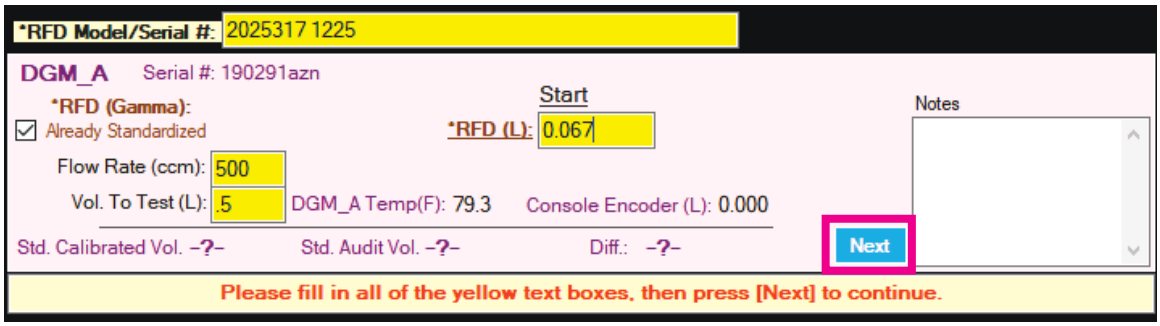
7.0 Console Calibration Checks (Audits) continued

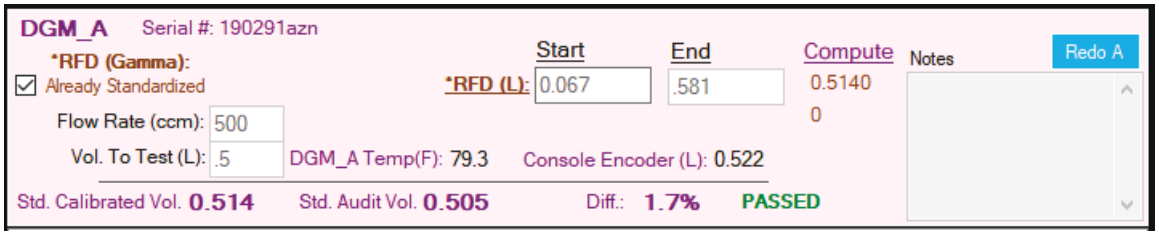
Dry Gas Meter Calibration Checks- follow the on screen instructions.



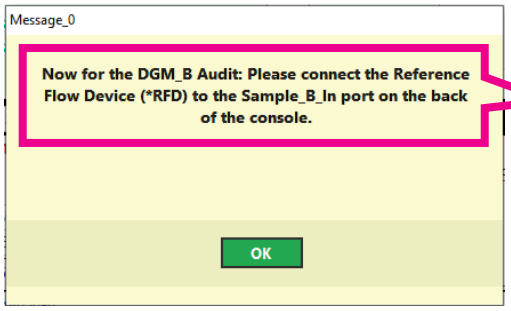
DGM_A Audit: Please connect the Reference Flow Device (*RFD) to the Sample_A_In port on the back of the console.

Enter the values in the yellow fields and select ***Next***.
After the test completes it will provide a PASSED/FAILED.



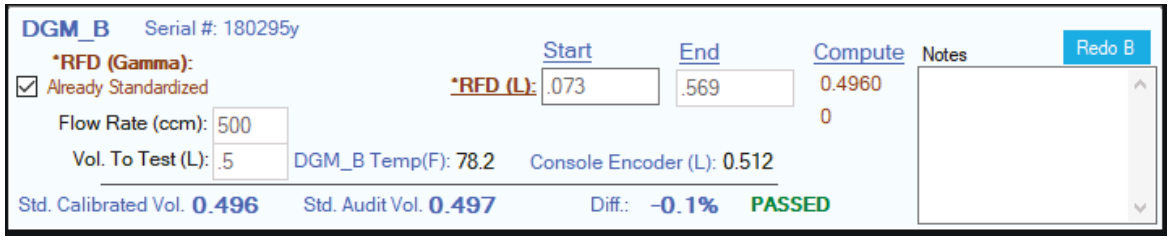


NOTICE **If the DGM audit fails there is an option to Redo A or Redo B by selecting the Redo button.** Redo A Redo B



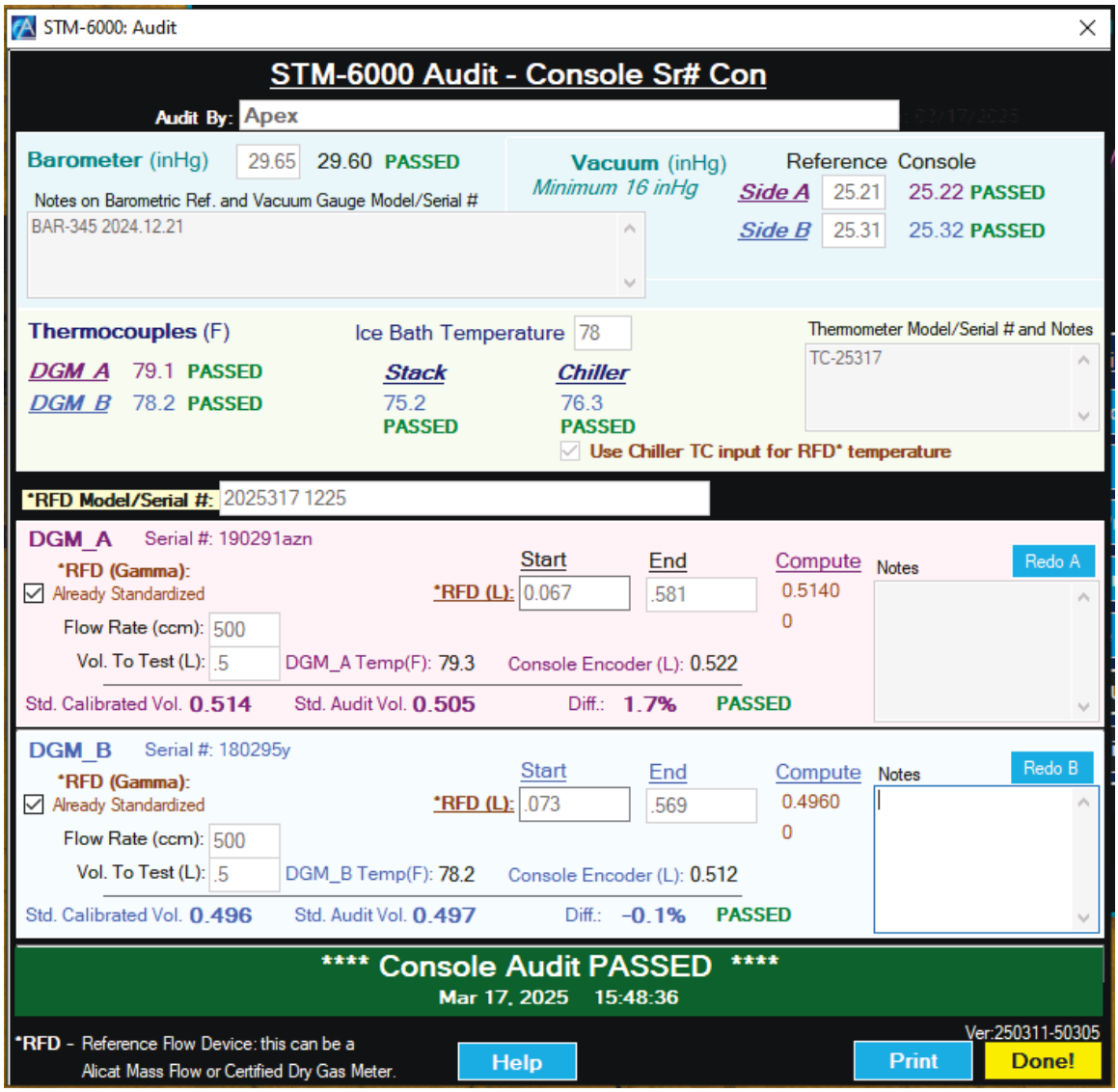
Now for the DGM_B Audit: Please connect the Reference Flow Device (*RFD) to the Sample_B_In port on the back of the console.

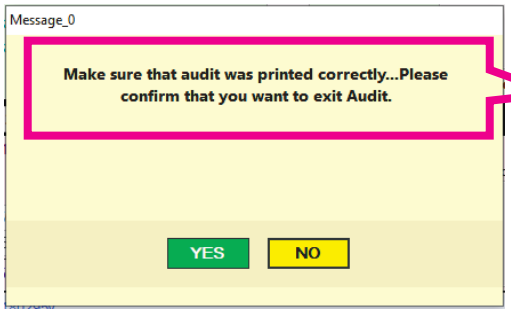
Enter the values in the yellow fields and select ***Next***.
After the test completes it will provide a PASSED/FAILED.



7.0 Console Calibration Checks (Audits) continued

After Channel B has completed its test the following screen will populate. After successfully completing the audit the operator may save and print the file. If the test has FAILED the operator must make the necessary corrections, after diagnosis, and repeat the test as necessary until the console passes audit.



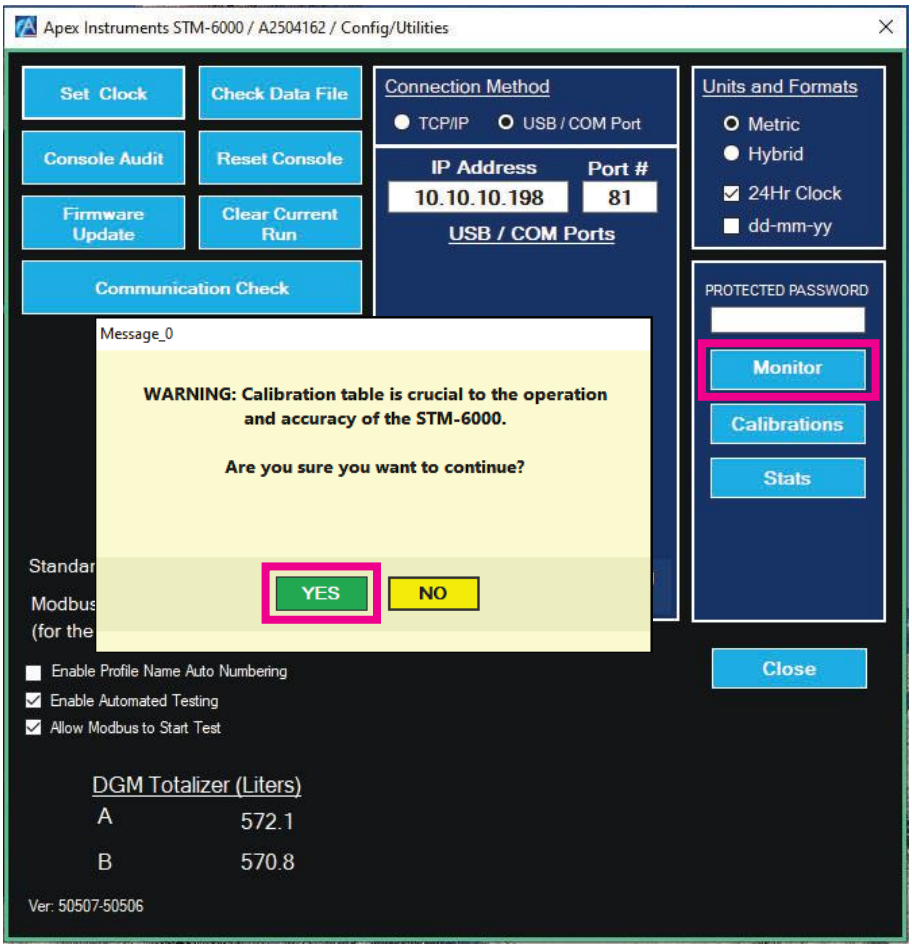


Make sure that audit was printed correctly...Please confirm that you want to exit Audit.

8.0 Calibrations

Performing pre-test and post-test calibrations is essential to the operation and reporting accuracy of the equipment.

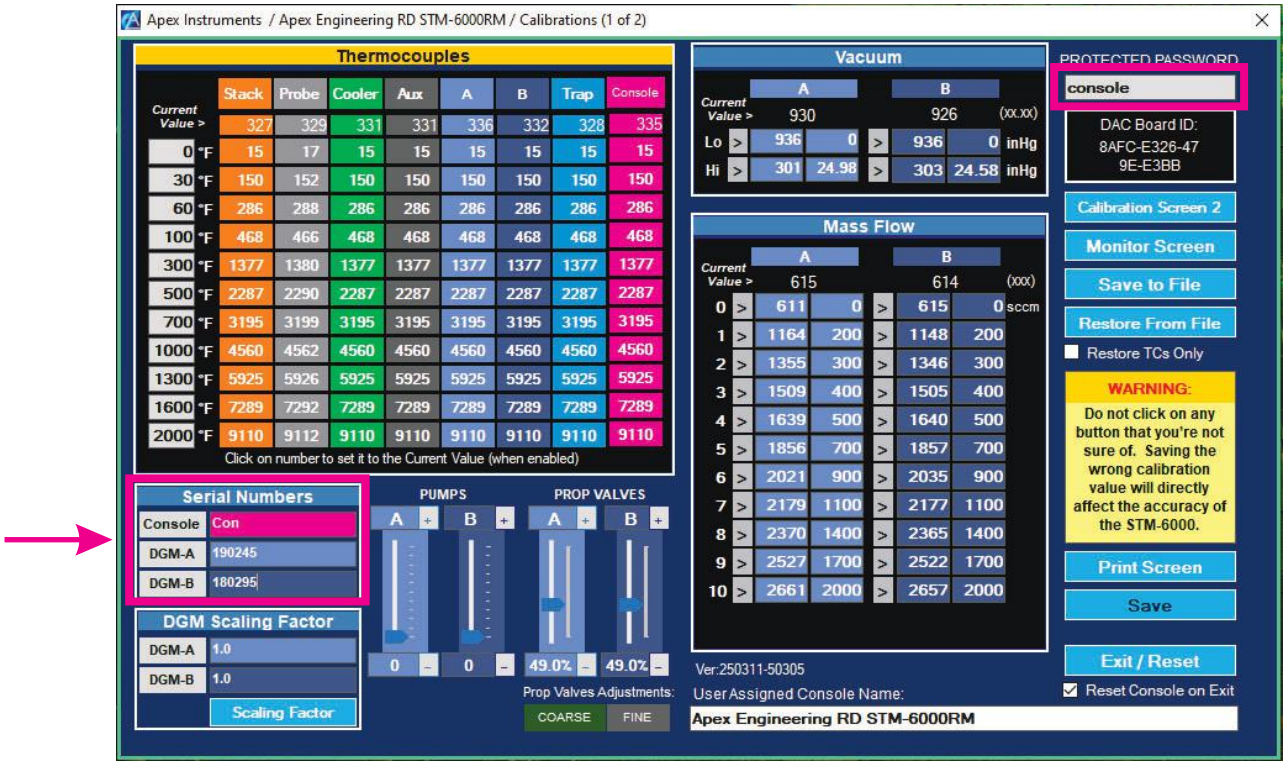
On Main Screen select ***Config/Utilities***
Select the ***Calibrations*** button.
A warning message will appear.
Select ***Yes***



Type in ***enable*** into the password field.
This allows access to:

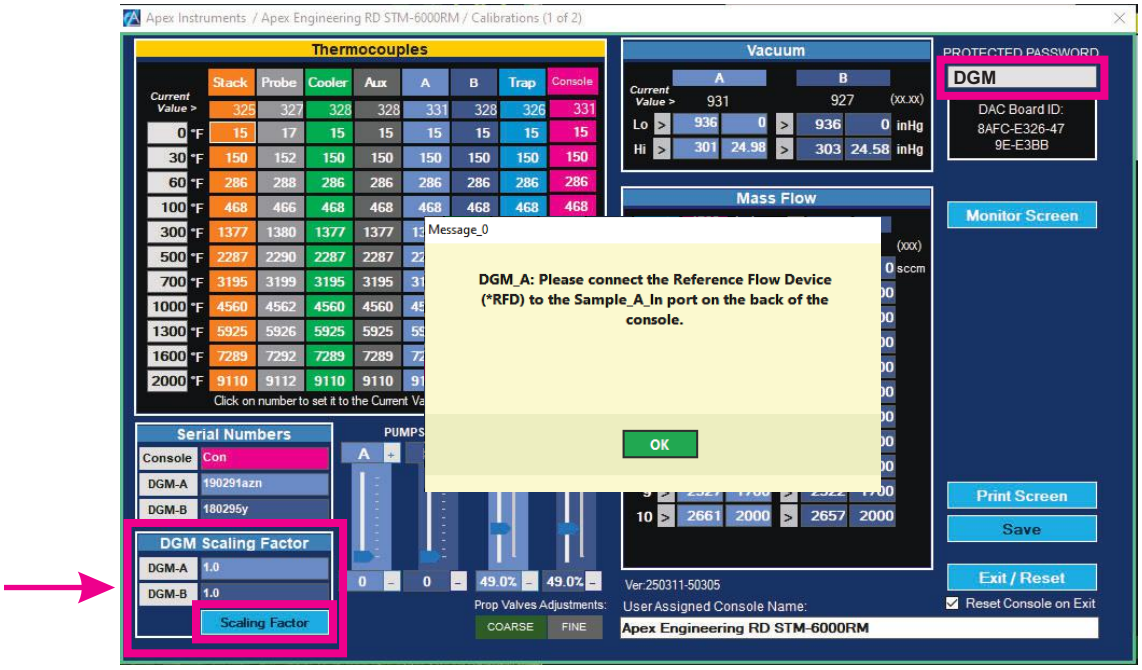
- Thermocouple
- Vacuum
- Mass Flow
- Pumps
- Proportional Valves
- User Assigned Console Name

In order to change the ***Serial Numbers*** of the Dry Gas Meters type ***console*** into the ***PROTECTED PASSWORD*** field. Type in the desired ***Serial Numbers*** in their respective fields.

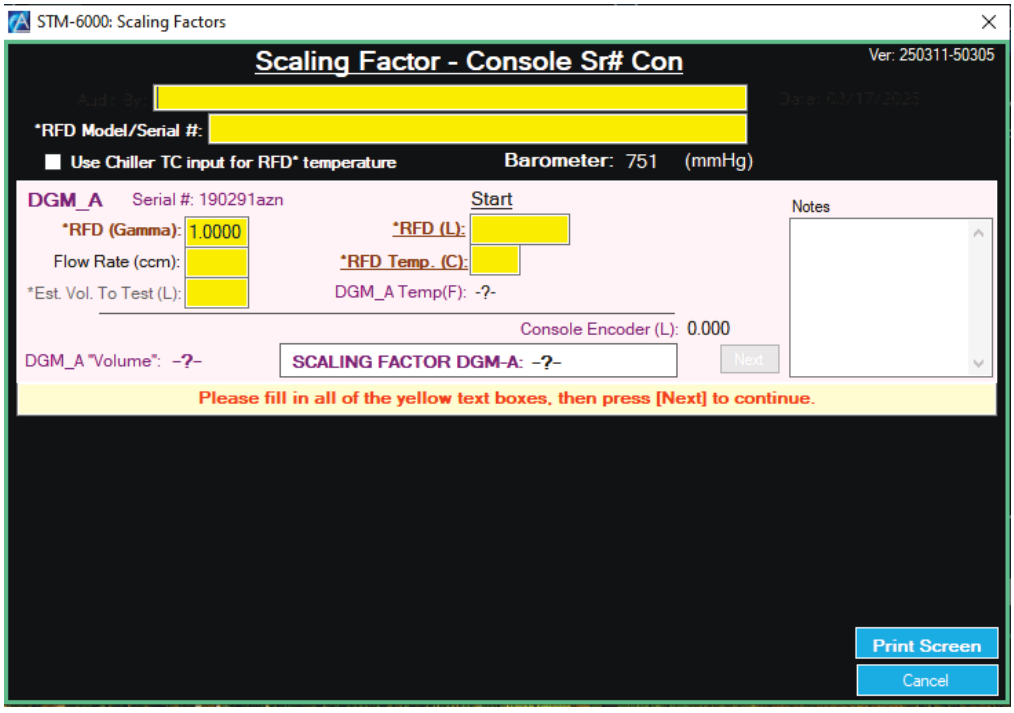


In order to change the ***DGM Scaling Factor*** of the DGM's type ***DGM*** into the ***PROTECTED PASSWORD*** field. Type in the desired scaling factor in their respective field.

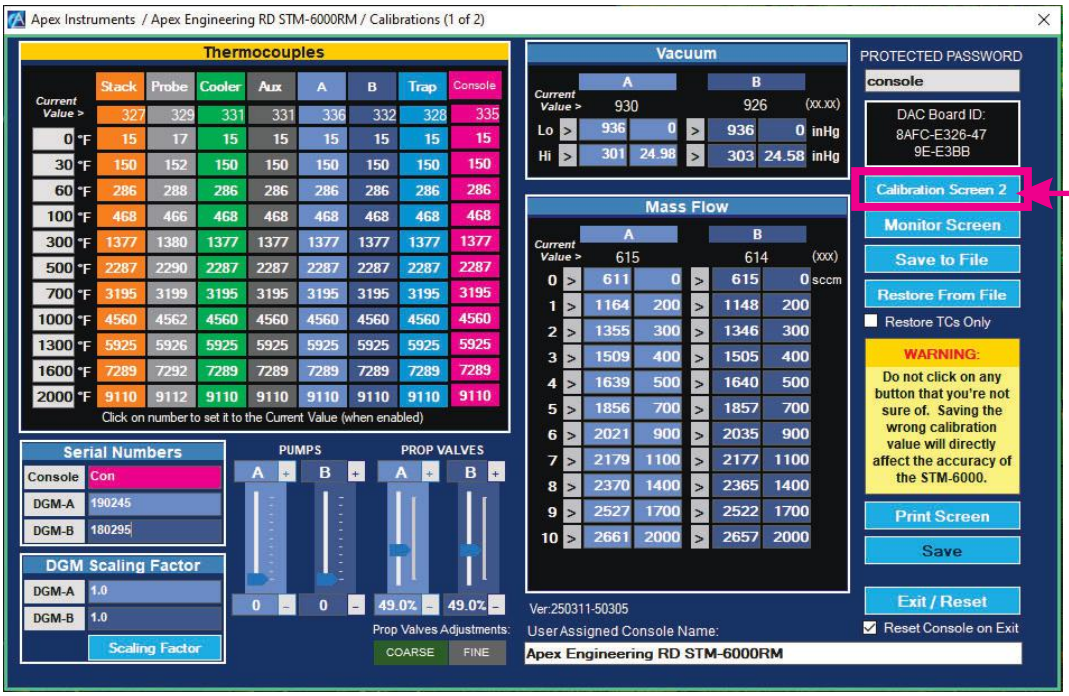
Select the ***Scaling Factor*** button to determine the Scaling Factor by running a test on Channel A and/or B.



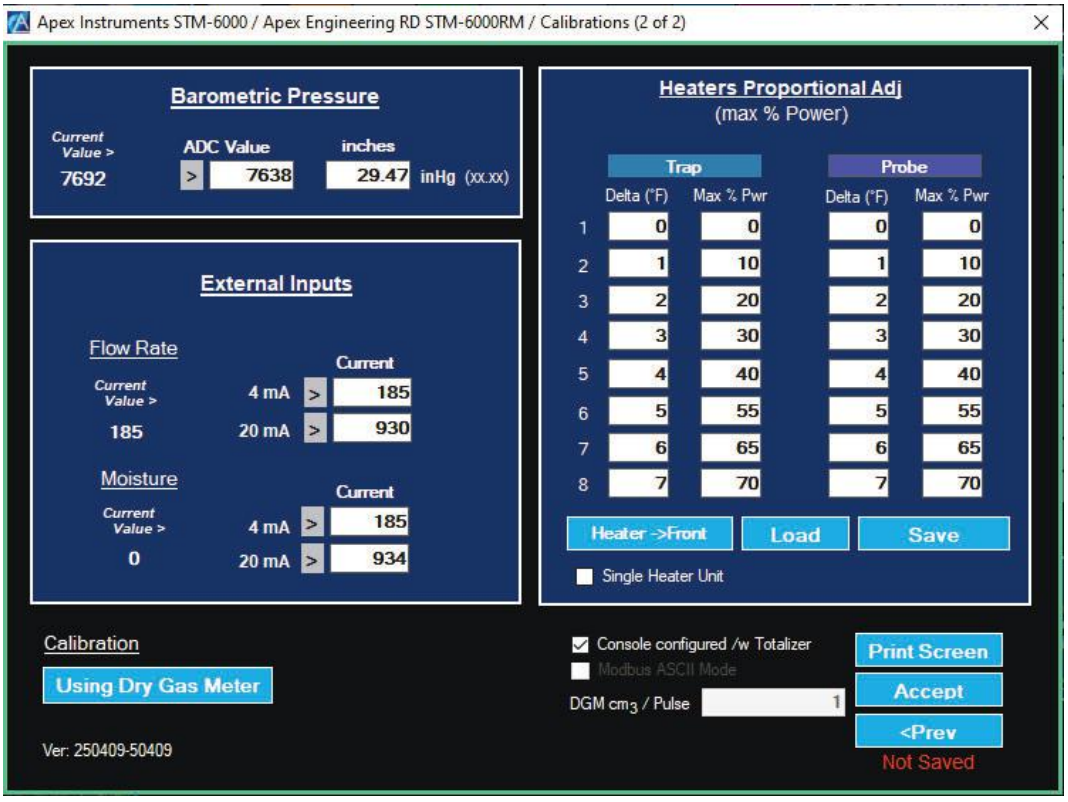
Scaling Factor determination test screen for Channel A.



To access the ***Calibrations Screen 2*** type enable into the ***PROTECTED PASSWORD*** field and select the ***Calibration Screen 2*** button.

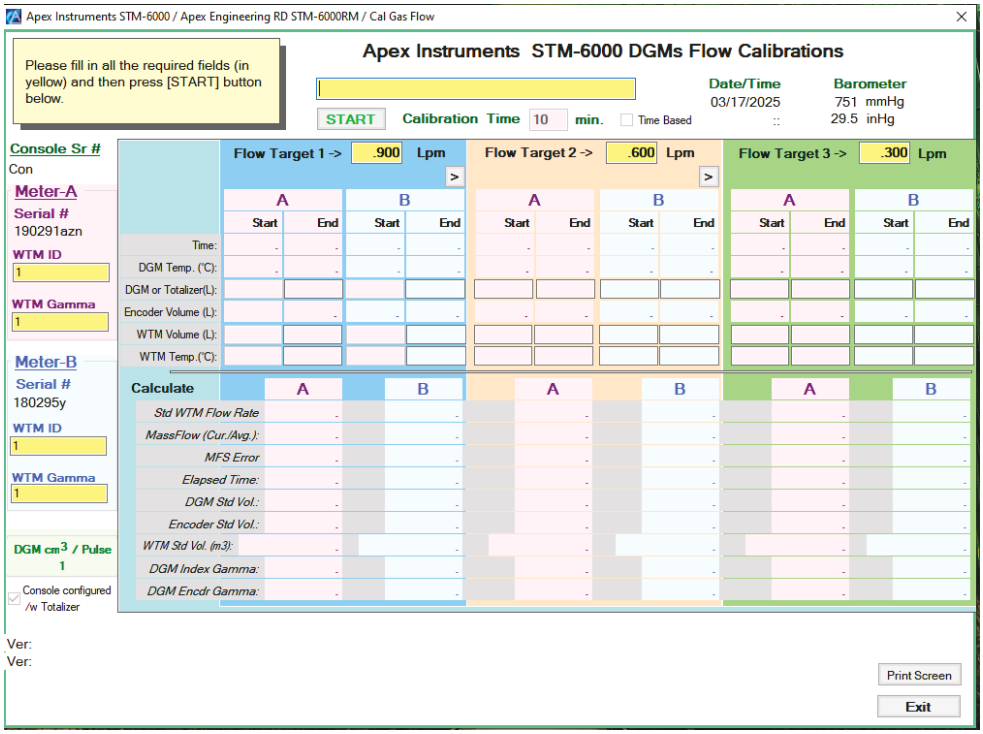


Calibration Screen 2 provides access to Barometric Pressure, Heaters Proportional Adjustments, External Inputs and DGM Calibration.



NOTICE **Only NIST certified instruments and qualified technicians should attempt to calibrate the DGMs utilizing this segment of the calibrations.**

To calibrate the DGMs select ***Using Dry Gas Meter*** button.



9.0 Sorbent Traps

The system is designed to capture mercury in a pair of glass tubes called sorbent traps. These traps are partially filled with activated charcoal (carbon) and are divided into two or more sections by fiberglass or glass wool insulation. The stack gas is drawn through the sorbent trap and any mercury present in the gas stream is captured by the sorbent.

The “front” section is designed to capture all of the mercury from the source. The second section is a buffer, and is designed to capture any mercury that escapes the first section. In most testing, exceeding a certain amount of mercury in this section will invalidate test results. The third section (if present) is the “spike” section. A known mass of mercury is deposited in this section, and acts as a control to ensure that the first two sections are working properly. When the contents of the third section are analyzed after the sample collection, the results should show the mass of mercury to be the same both before and after sample collection on this section. In most testing, failure to recover the spike will invalidate test results.

For RATA testing, baseline testing, and engineering studies, two-section traps are generally used. Consult with your local environmental regulatory body to determine the trap types required for your application.

Three-Section Sorbent Trap with caps

To insert traps into the Apex mercury probe, loosen and remove the trap nuts and PTFE ferrules from the end of the probe and store them in a safe place. Examine the ferrules for any scoring, nicks, or distortion. If the ferrules appear worn, misshapen, or damaged replace with new ferrules before continuing.

Inserting the traps into the probe

Consult the chain-of-custody forms for the traps to be used, and select the trap with the lower serial number. Place a PTFE ferrule on the trap, and place this trap in the A-side probe tube. Thread the trap nut on the end of the trap and tighten hand-tight only.

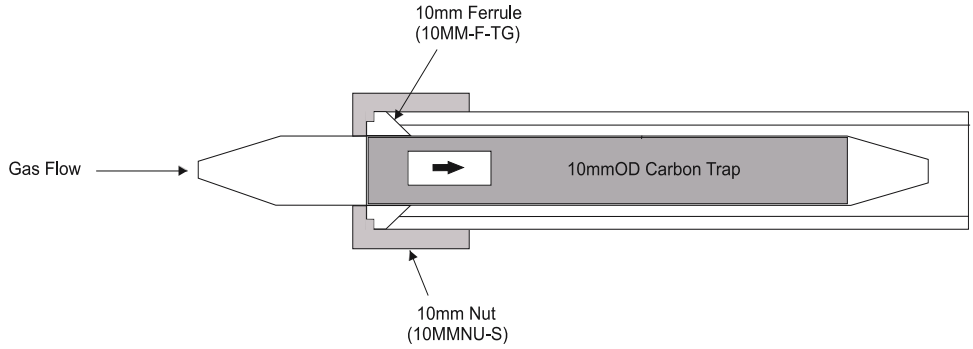
Over-tightening the trap nut can cause damage to the ferrule, and may cause the trap to break. If the trap cannot be leak-tested both before and after the sample run, the data from that trap will be considered invalid. Place the trap with the higher serial number in the B-side sample tube with a PTFE ferrule and trap nut, and hand-tighten the trap nut.

Traps correctly inserted

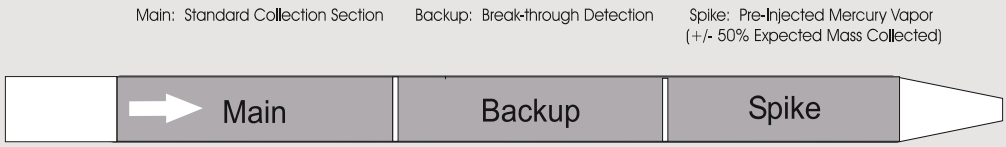
Place the rubber caps over the ends of the traps. When the leak test begins, the vacuum will seat the caps on the traps. Do not push the caps all the way on to the traps.

Always keep spare ferrules (10M-F-TG,) trap nuts (10MMNU-S,) and caps (9531K22) on hand! It may be a long way down the stack if you drop one!

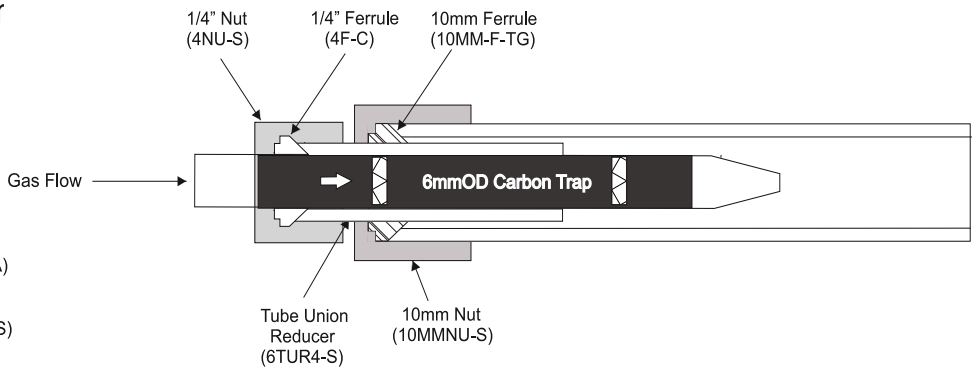
Large Trap (Standard)



Sorbent Trap Sections



Small Trap Adapter HGP-STA (Optional)



Small Trap Adapter (HGP-STA)
Includes:

Qty	Part#
1	6TUR4-S (Includes 4NU-S)
3	4F-C

Appendix 1

Replacement Parts

PCB6KDISPLAY-K2	DISPLAY, REPLACEMENT KIT STM-6000
STM-6KVSO-A	MANI-VSO ASSEMBLY, STM-6000 G2
DGM-SK25EX-100	DRY GAS METER, SK25,W/100
SSR-AD25-RS	RELAY, SSR, 25A 4-32 VDC,
EL-DIR-EBG15STM	ROUTER, ASUS EBG15 for XC-6000/XD-5000
PCBPCB-LEDVER3-COMP	PCB BOARD, COMPLETED, LED, VERSION 3 USED IN STM-6000
M-PS-XLG-100-12	POWER SUPPLY, 100-305V, 100W 12VDC SINGLE OUTPUT LED
PCB-STM6K-MAIN-COMP	STM-6000 MAIN BOARD
PCBSAB-6K	TC8 ASSEMBLY VAC, PRESS, W/ LUER
EL-CAT61FTBLUSLM	CABLE, CAT6A, 1FT BLUE, UTP, 30AWG, 10G, RJ45, SLIMRUN
EL-CAT62FTBLUSLM	CABLE, CAT6A, 2FT BLUE, UTP, 30AWG, 10G, RJ45, SLIMRUN
EL-CAT61FTORGSLM	CABLE, CAT6A, 1FT ORANGE, UTP, 30AWG, 10G, RJ45, SLIMRUN
M-CBR10A-M	BREAKER SWITCH, 10A, MAGNETIC, PANEL MOUNT
M-CBR15A-M	BREAKER SWITCH, 15A, MAGNETIC, PANEL MOUNT
F-DFG-6TO2-5-2.5-LV	FLOWMETER,0-2.5 LPM,1/8IN FNPT NO VALVE
EL-670-OA938	FAN, AC FANS 92MM 115VAC 50CFM
09362-F/45	FILTER, FAN, FOAM FILTER MEDIA, 3-5/8 IN.
09362-G	GUARD, FAN, INNER GUARD, 92 MM.
FG-92MM	FAN GUARD, 92 MM, STEEL (WIRE)
EC-C13-515-14-6	POWER CORD, IEC, 14AWG, 110V
DIF-N70	FILTER, INLINE, DISPOSABLE
L-4411724	PANEL LATCH, PAWL POSITION “B”

Appendix 2

Upgrading Firmware

From time to time, Apex Instruments may release updated device firmware for the STM-6000 console. These firmware upgrades may add additional functionality or capabilities to the console, and may be required in order to use the latest version of the monitor / control client software. If the STM-6000 software displays a message regarding your firmware revision number, please contact Apex Instruments to get more information.

Current software and firmware versions may be obtained from Apex Instruments.

The STM-6000 firmware may be programmed using a PC and USB A to USB C Cable. PLEASE NOTE: The most current version of the STM-6000 firmware at the time of shipment are installed along with the Apex software. Please ensure the latest version of Apex STM-6000 software is on the console before attempting to upgrade the firmware.

If you are familiar with the firmware bootloader or already have the bootloader configured follow the steps below, otherwise, proceed to the next page.

If loading a subsequent firmware file follow the steps below:

Turn on the console and connect the STM-6000 software.

Go to the "**Config/Utilities**" screen.

Select the "**Firmware Update**" button.

Select "**YES**" on the message screen.

The **dsStudioPro** program will open.

Select the Firmware Hex file from the C:\ by clicking on the "**...**" symbol in the upper right side of the window.

Select and Open the file and the "**Application**" field will populate with the hex file address you have selected.

Double-click "**Write**" from the banner.

After 10 to 15 seconds the progress bar will advance to its end.

"**Write successfully completed**" will appear in the lower messaging window.

The console display will flicker and then reset.

Confirm the new firmware version in the lower right of the Console display.

If the numbers match the firmware has been successfully installed.

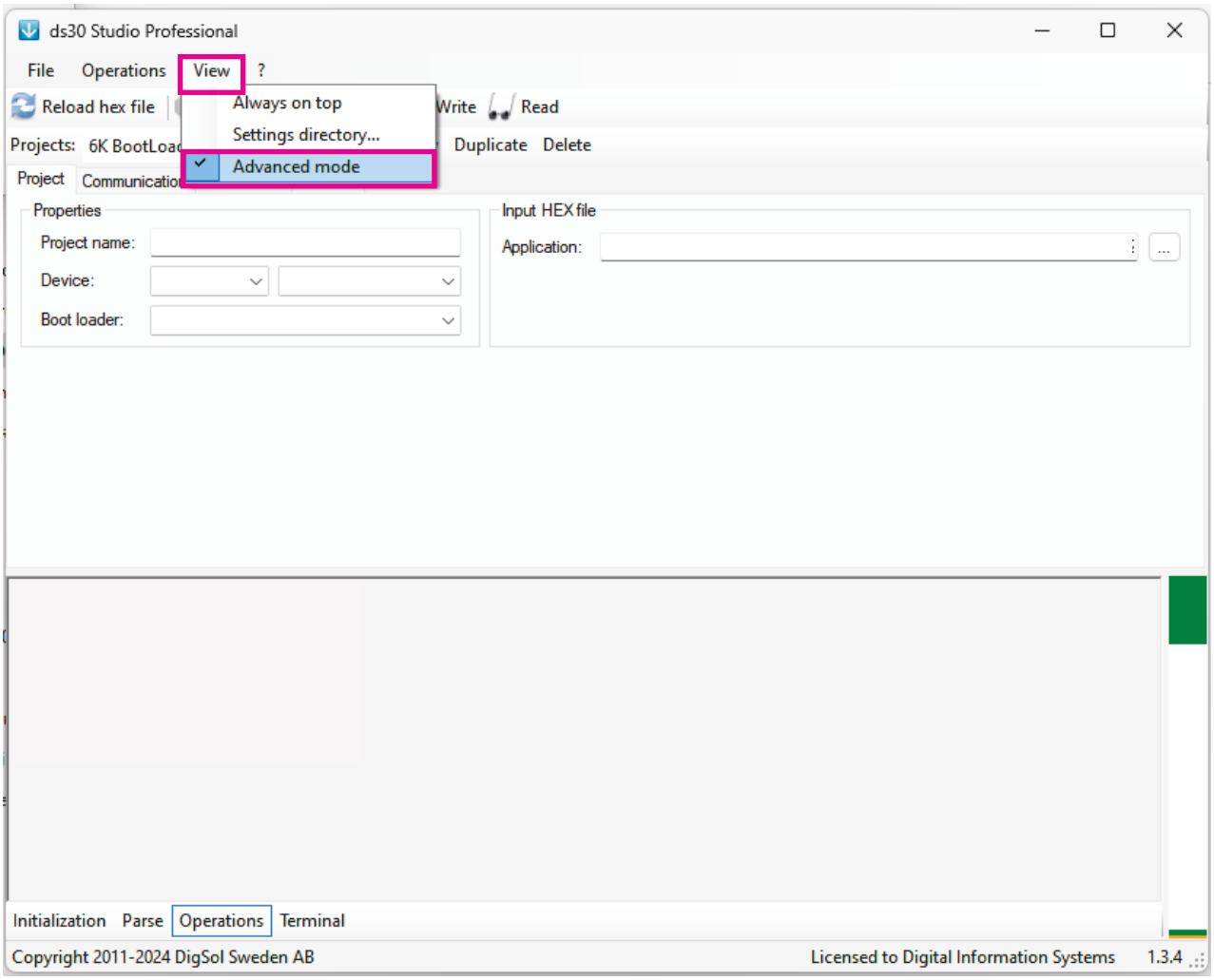
.

Copy File: ds30StudioPro.exe

Save file to your PC on the C:/ in a folder labeled “APEX”

Open: ds30StudioPro.exe

Select Advanced Mode: (see pic)

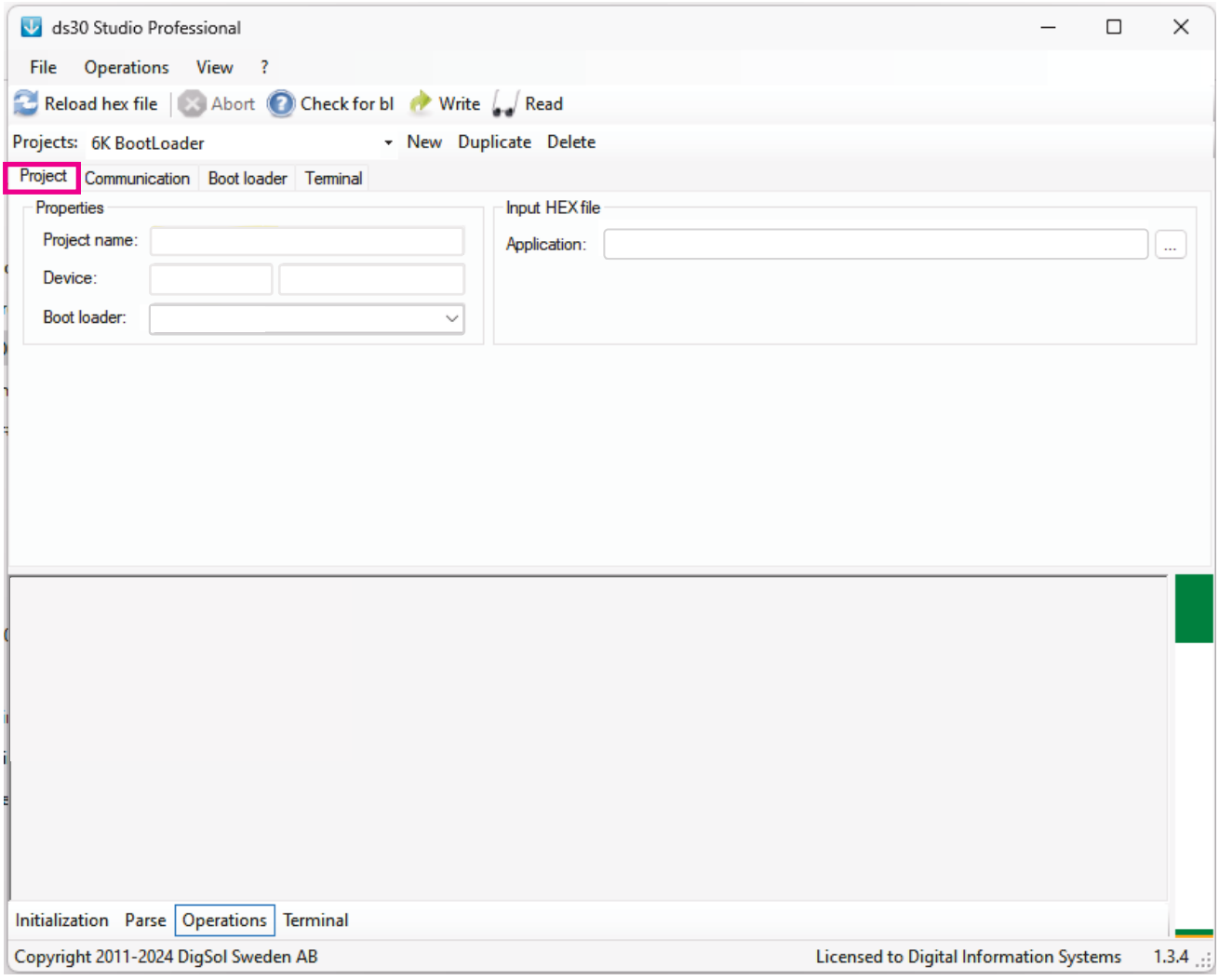


Make a note of these version numbers. The new software CD will list the version included.

Once connected, enter the Config / Utilities screen and then the Calibration screen. Enter the word “enable” (no quotes all lowercase) into the protected password space on the Calibration screen. Press the “Save to File” button. Choose a location for your saved table, and give it a unique name.

NOTICE **Always save the STM-12B calibration table to a file before upgrading the console firmware.**

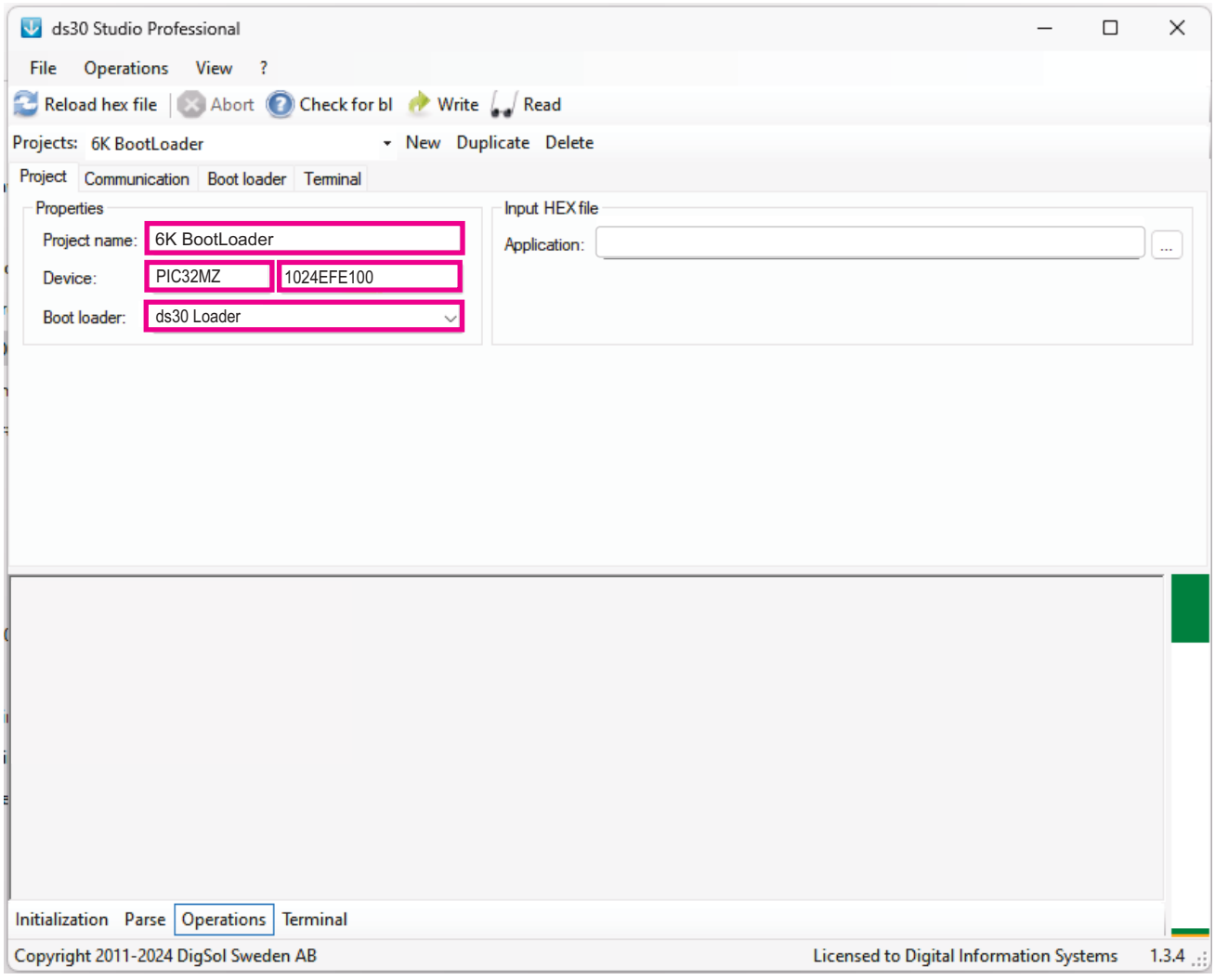
Select the Project Tab



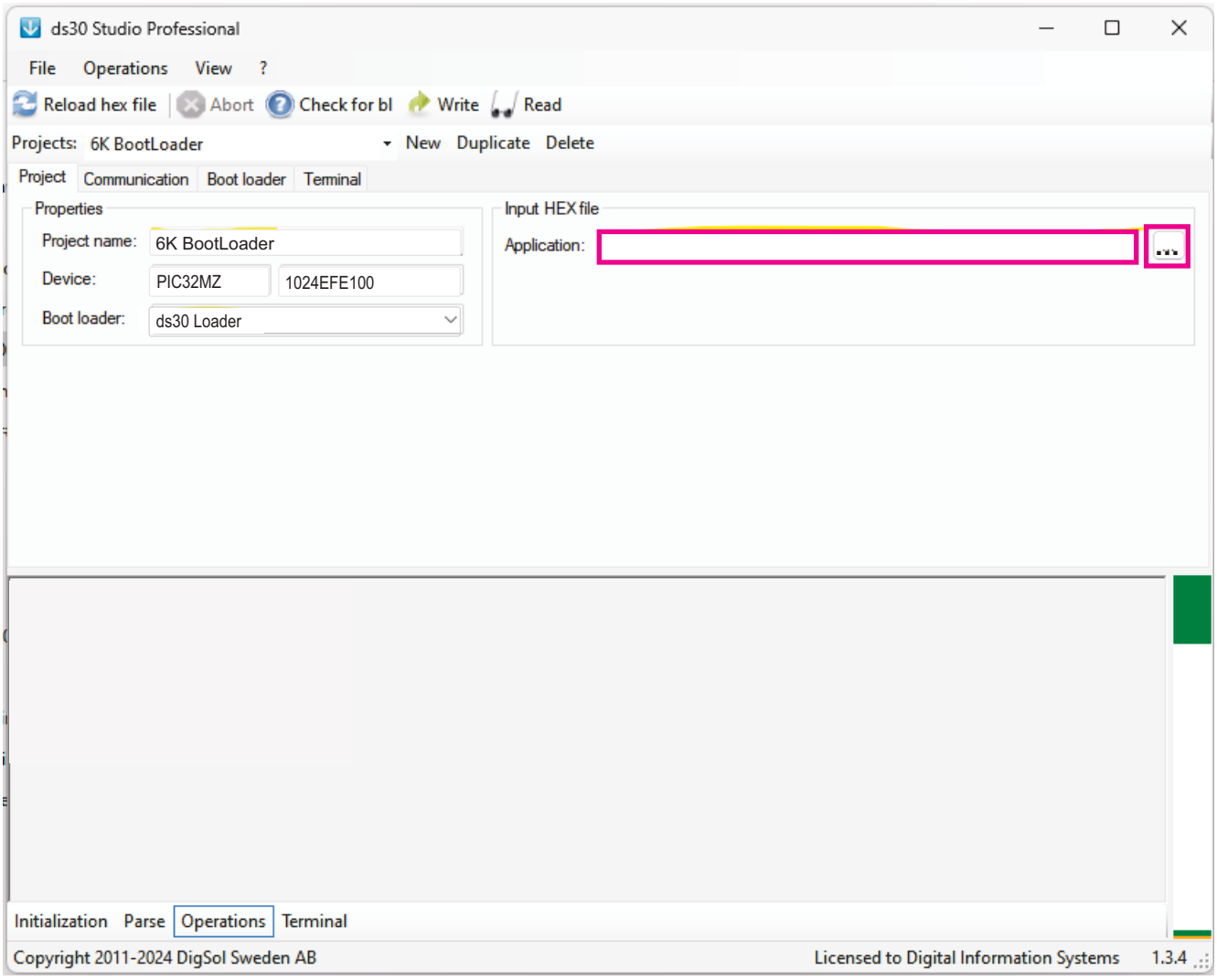
Project Name: (your choice)

Device: PIC32MZ (second device field may vary by console)

Boot Loader: ds 30 Loader



Click the ... symbol to select your hex file.



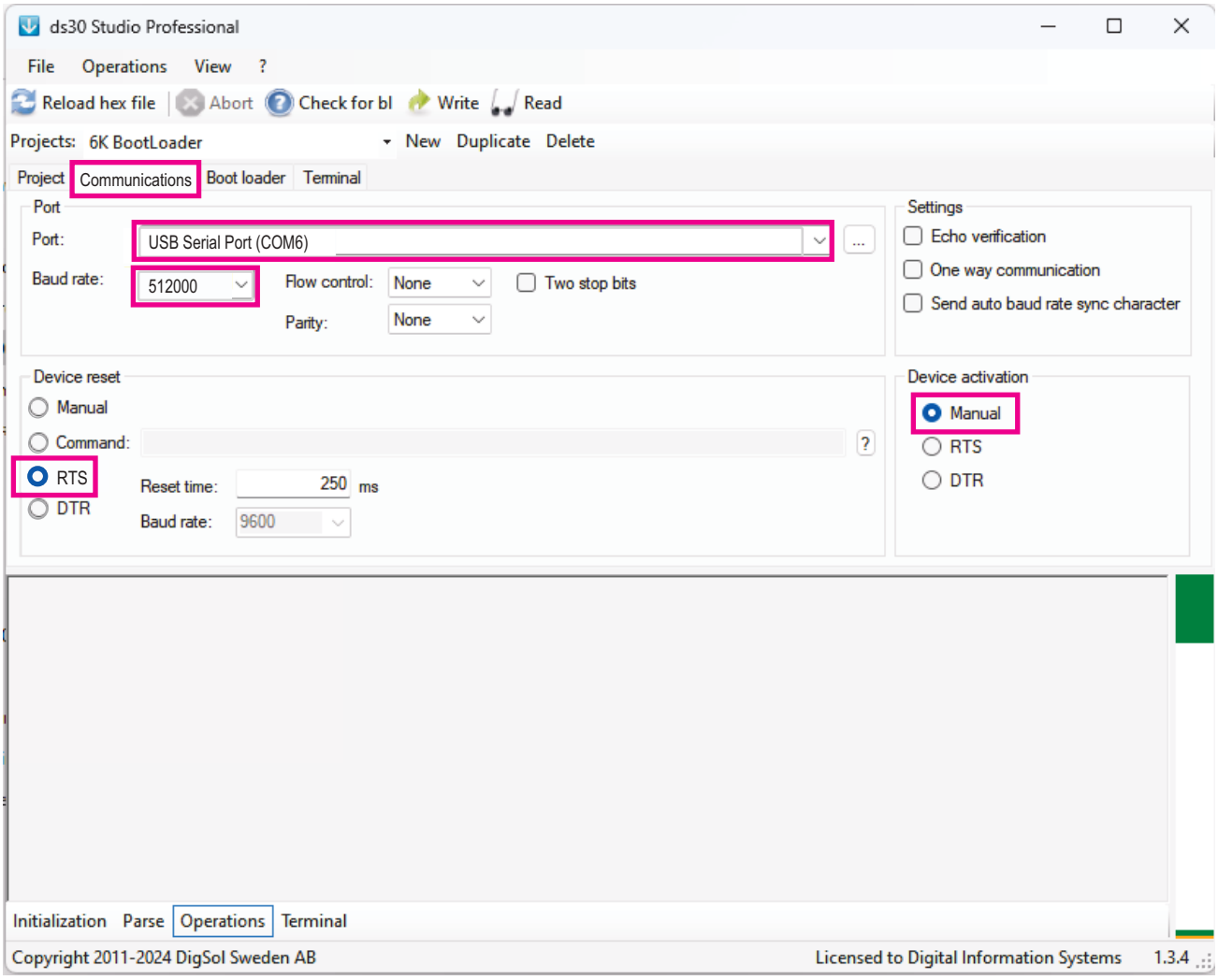
Select the **Communications** Tab

Choose the correct **COM** port (Look at the STM-6000 software **Config/Utility** screen to verify COM port)

Select the **Baud rate**: **512000**

Select **Device Reset** mode: **RTS**

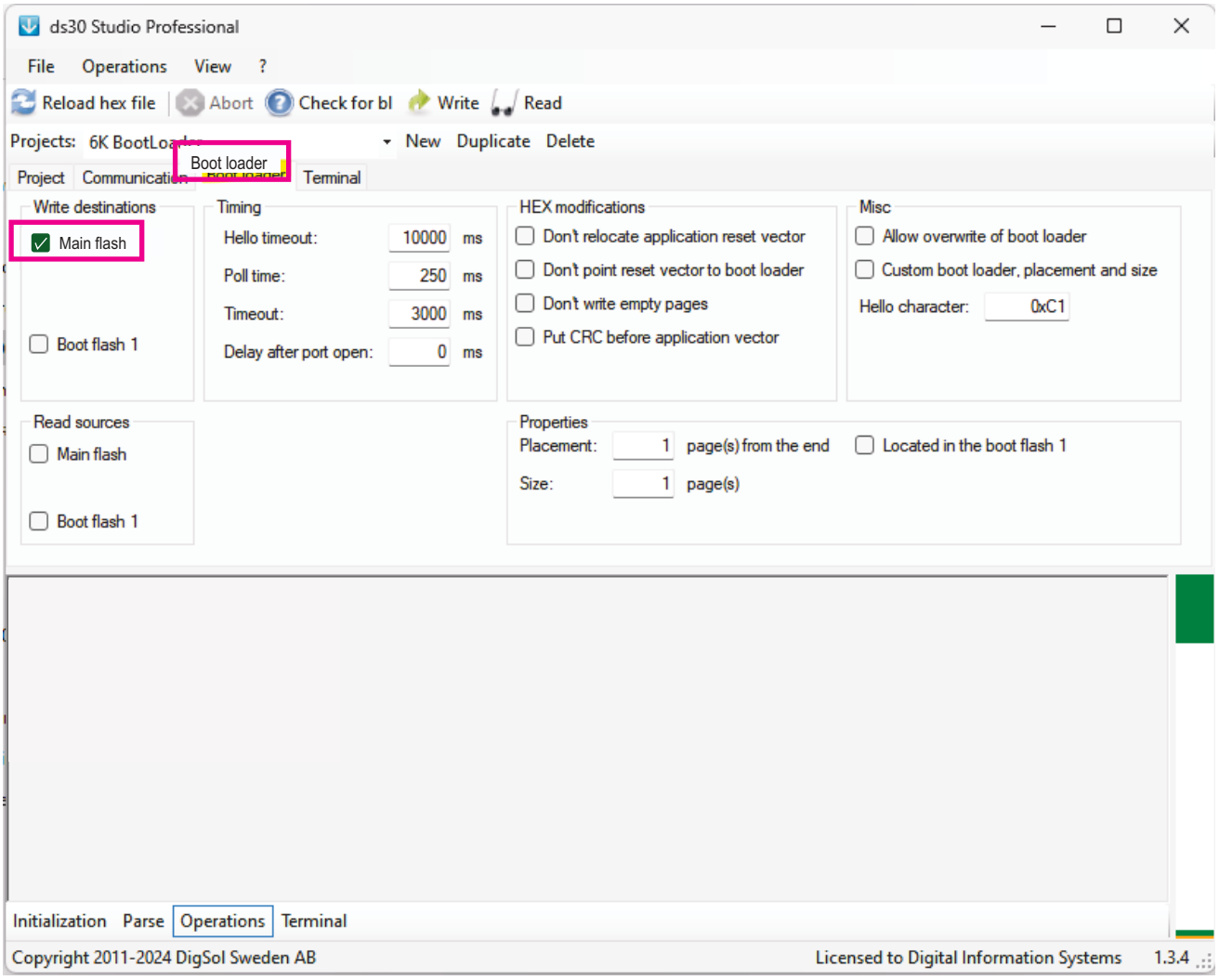
Verify **Manual Button** is selected in **Device activation** box



Select **Boot Loader** Tab

Check the box next to **Main Flash** in the **Write Destinations** Box.

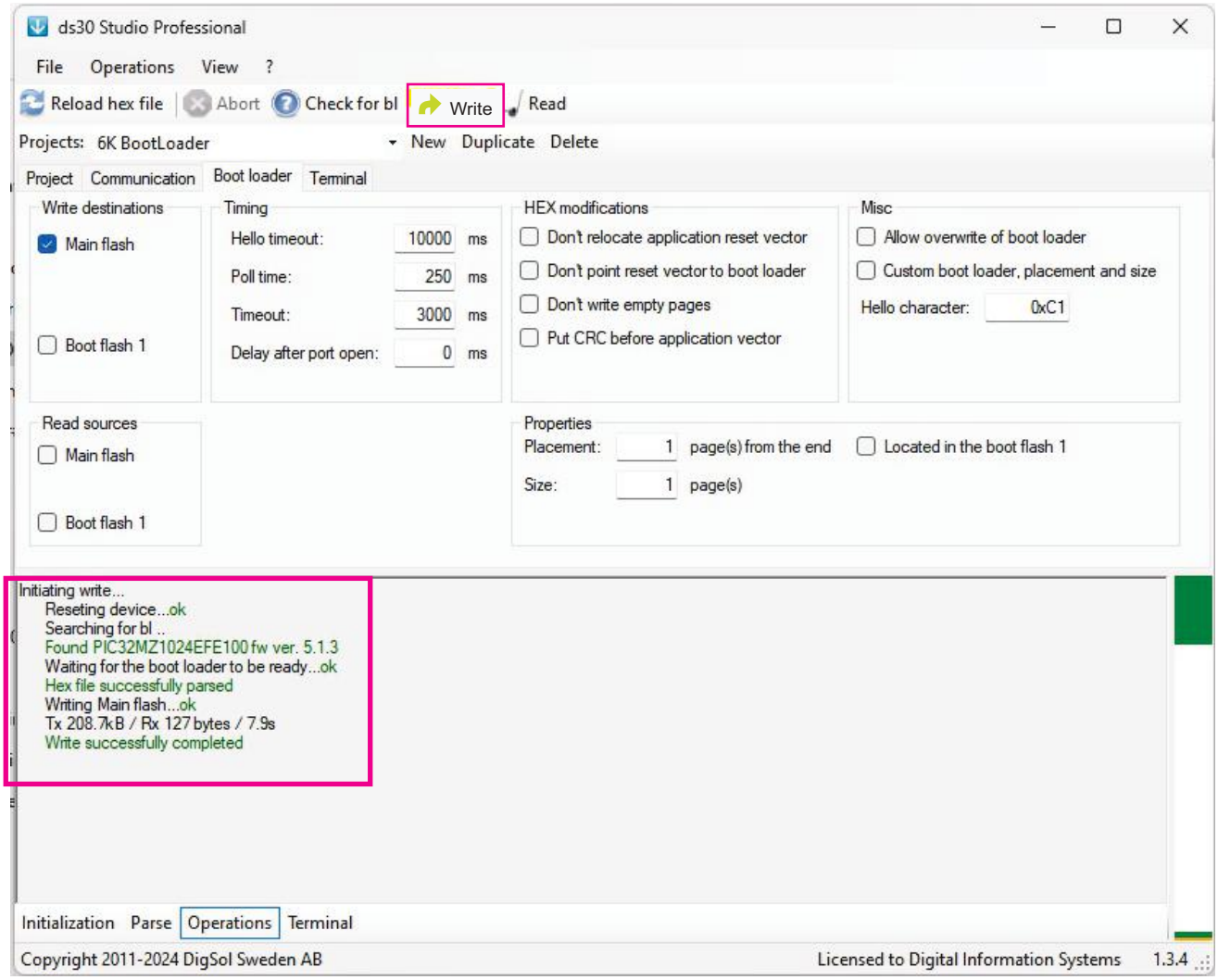
Proceed to the next page.



Press the **Write** button

The write process will begin and notify you when the write process was successful.

The new upgraded Firmware Version will appear on the console and the software.



The writing process should take between 45 and 60 seconds. If you receive an "**Error**" repeat the process. Ensure the version number displayed matches the version number of the supplied firmware update.

Appendix 3

Electrical Subsystem

The Source Sampler Console is factory-configured for 115 VAC / 60 Hz electrical power. Configuration for 220 VAC / 50 Hz operation is an available option.

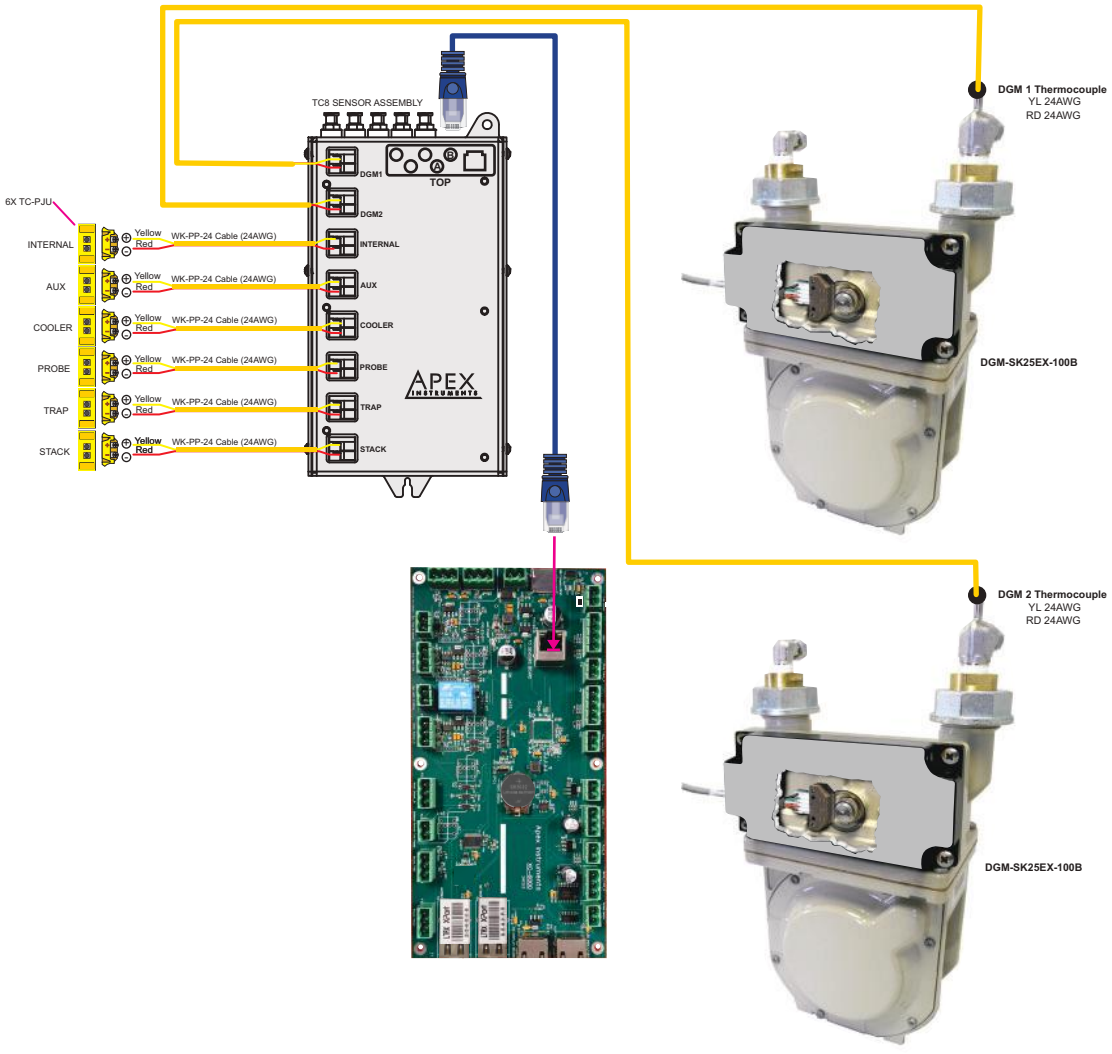
The AC electrical subsystem provides switch power to each circuit, controlled by two switches: MAIN and PROBE.

All circuits are protected by a MAIN 15 Amp (10 Amp for the 220V system) circuit breaker.

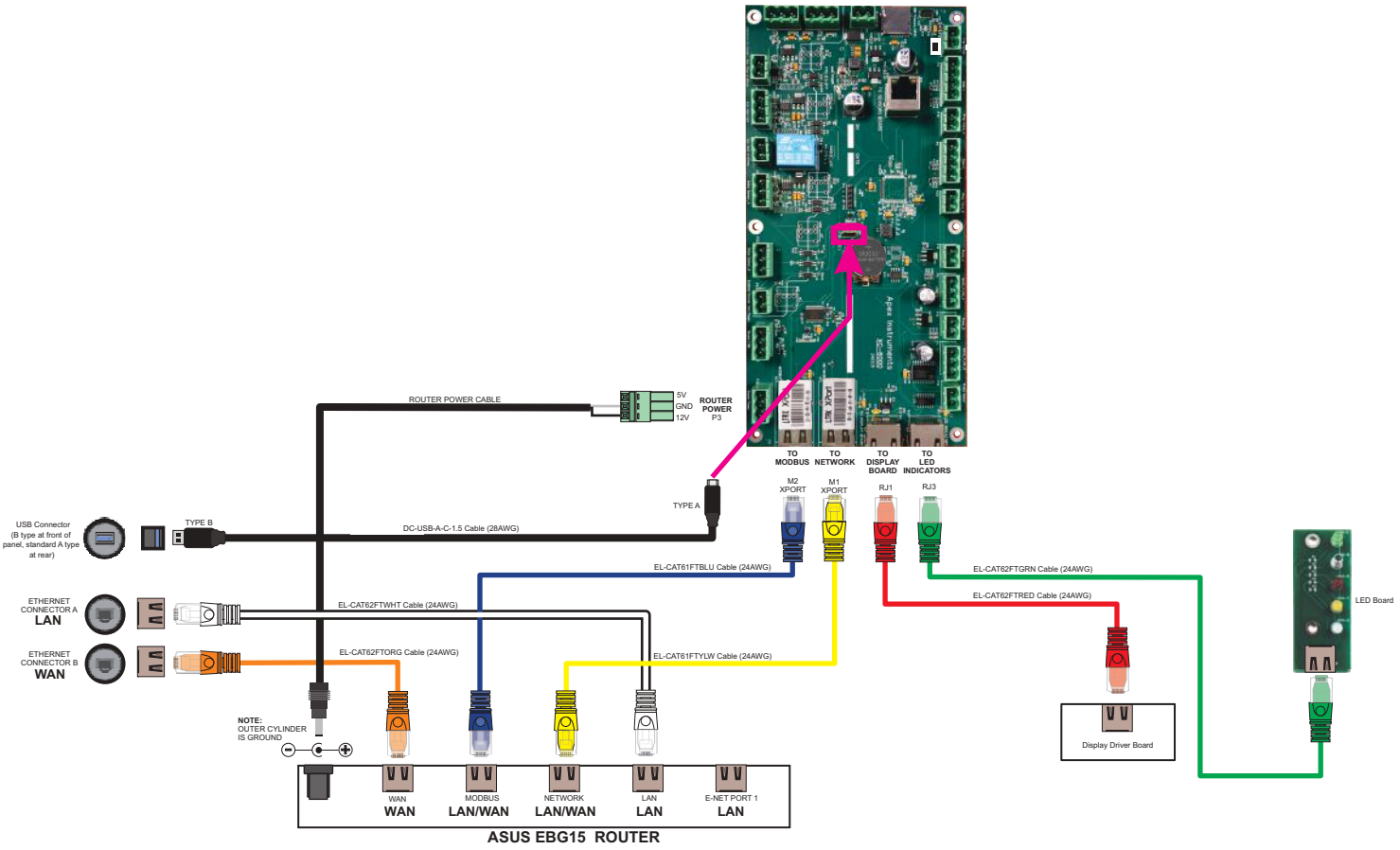
Additionally, the probe is protected by a 10 Amp breaker. These circuit breakers detect and interrupt overload and short circuit conditions, providing an important safety factor. If the circuit breaker opens, or “trips,” indicating interruption of the circuit, investigate and repair the electrical fault, then reset the breaker by pressing the circuit breaker switch.

Two custom-designed and manufactured circuit boards, a Data Acquisition and Control (DAC) board and Thermocouple (TC-MUX) board, are utilized.

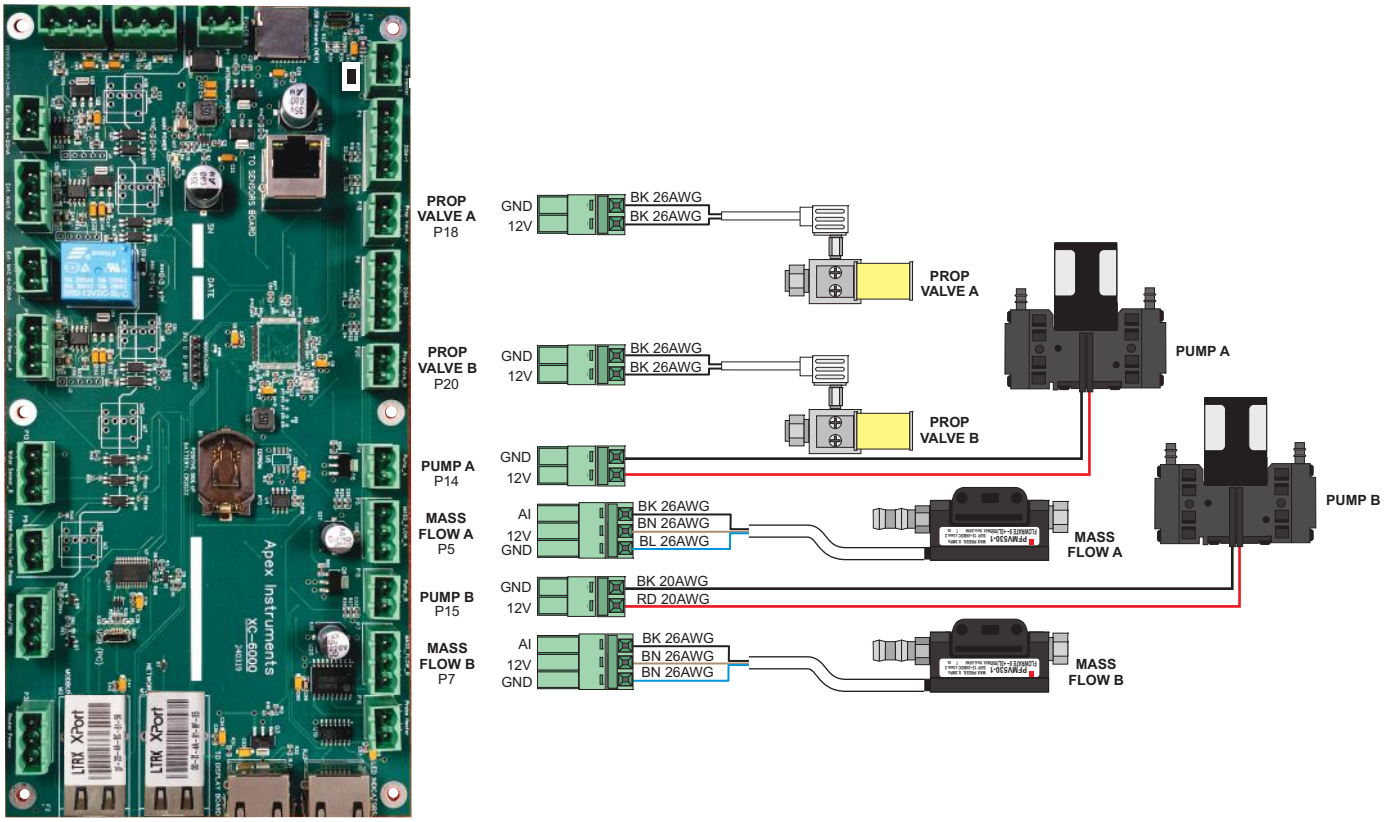
Temperature



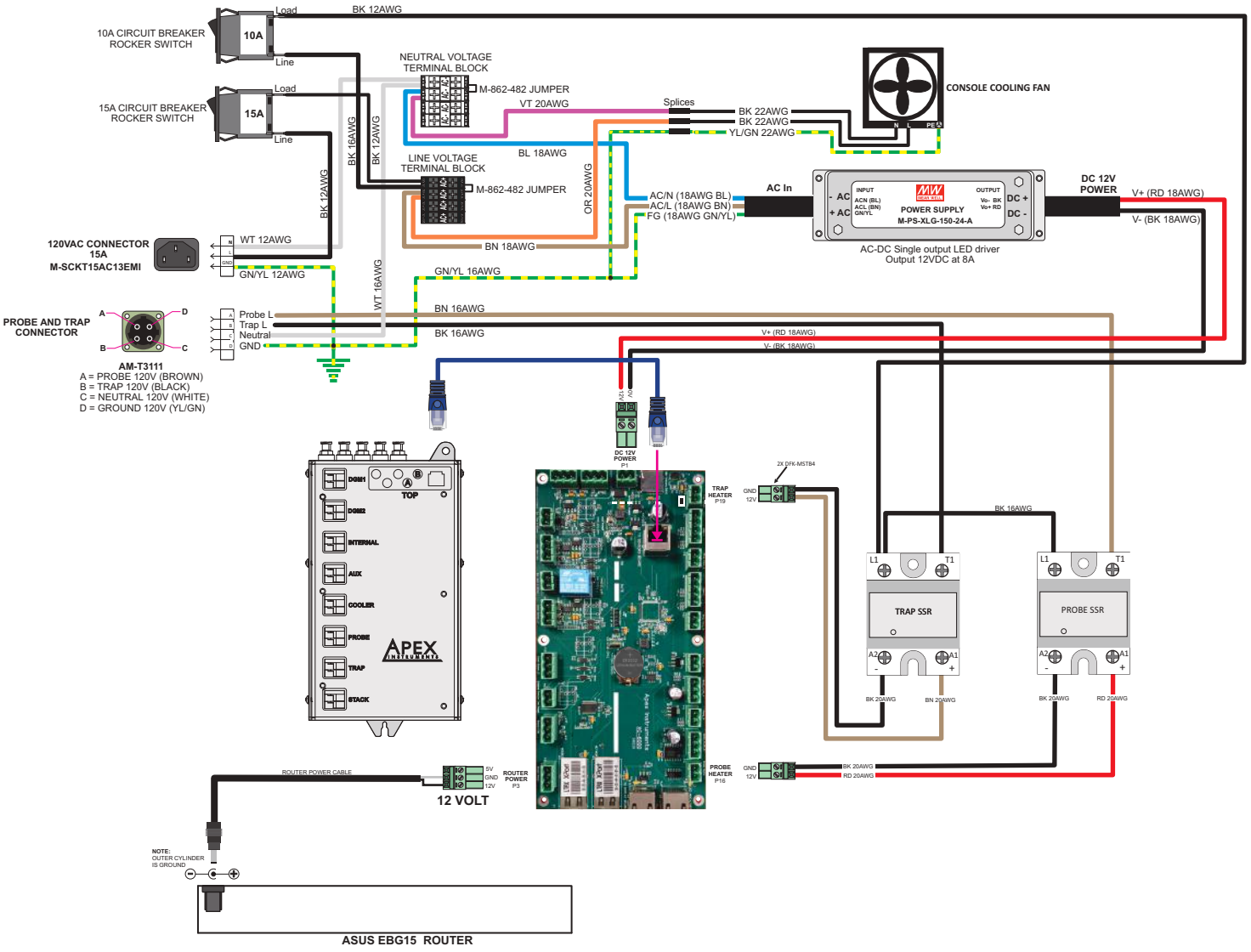
Communications



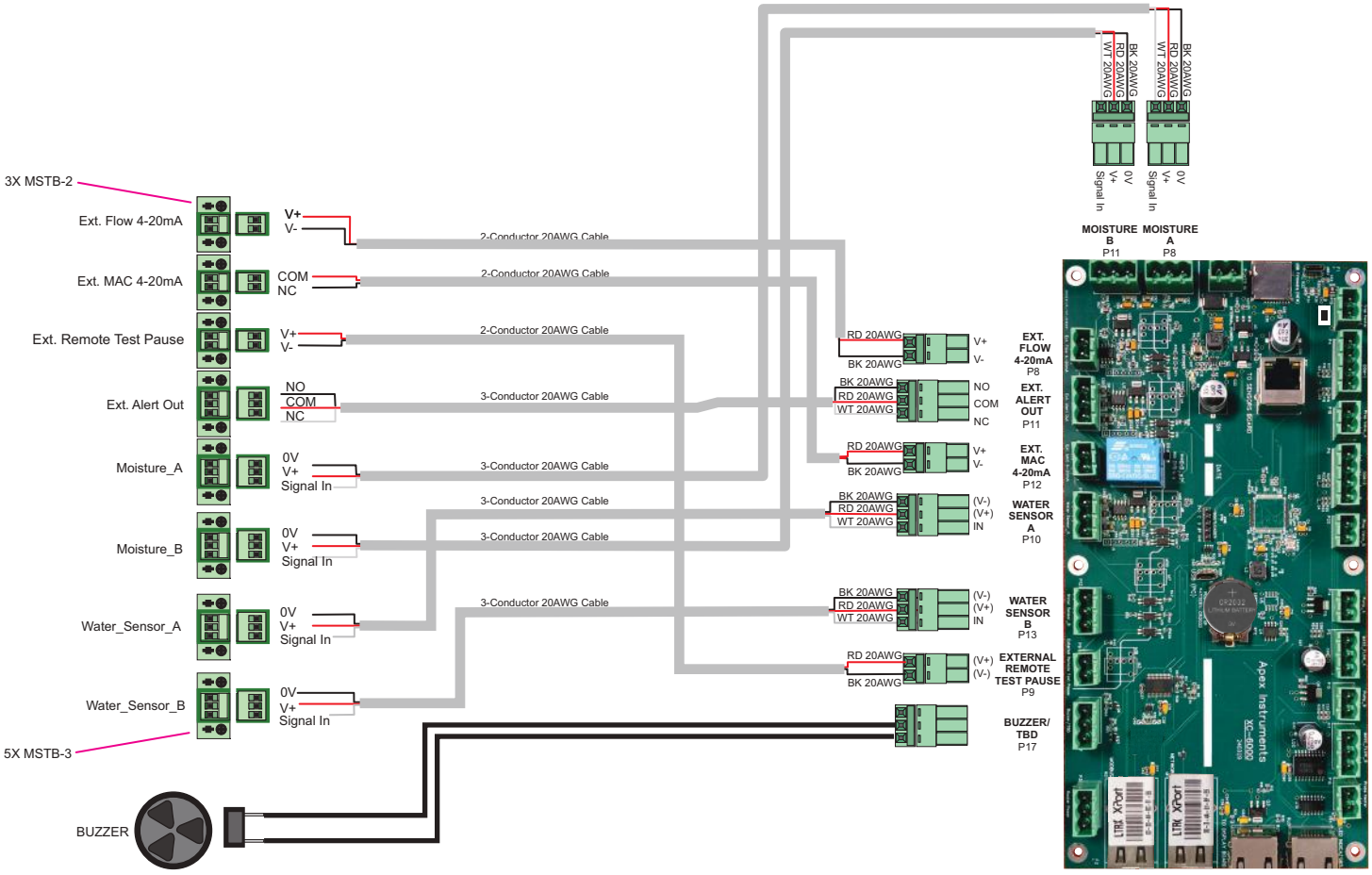
Maniviso Flow Control



Electrical Power



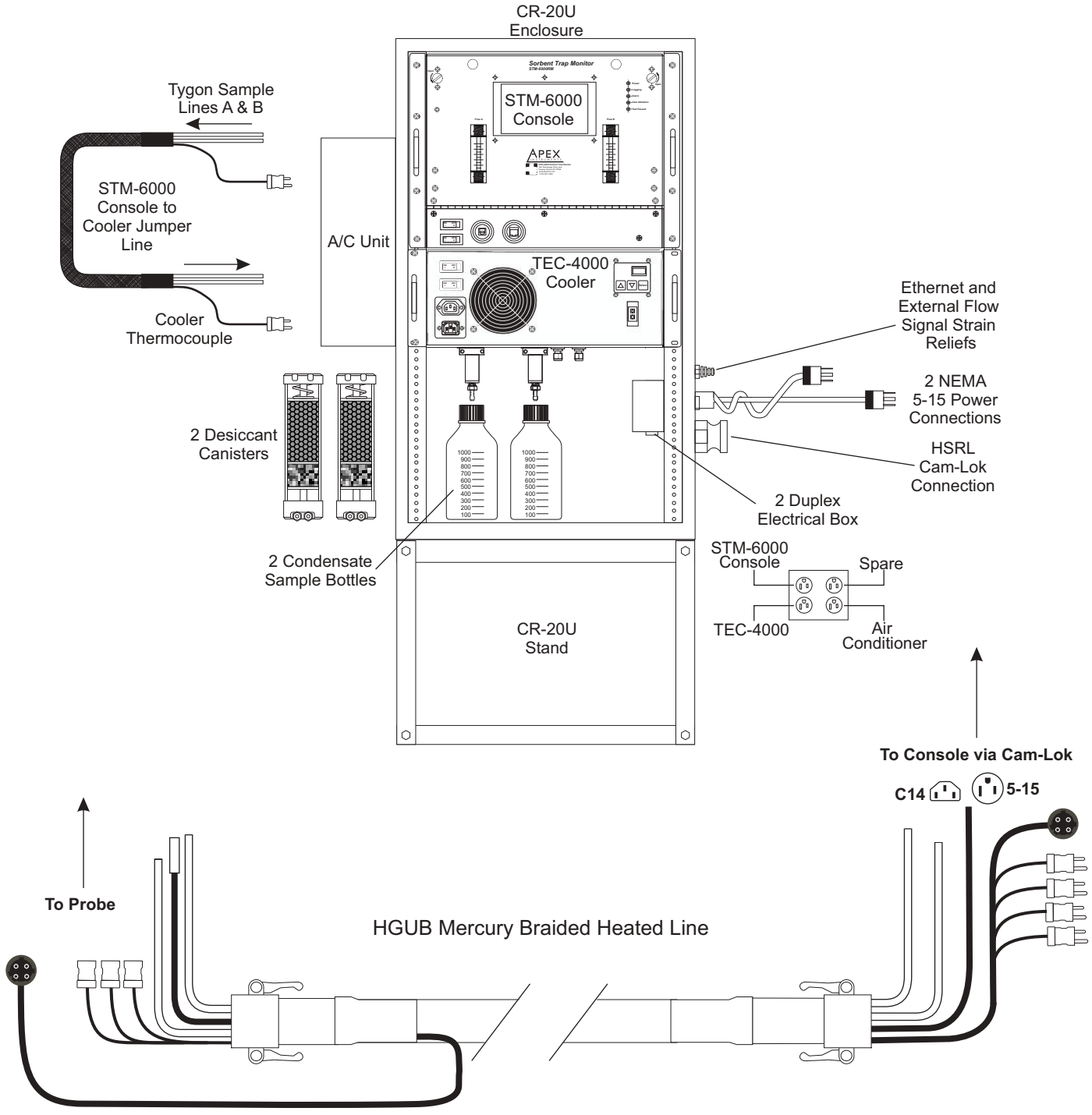
Alarms


3X MSTB-2
Ext. Flow 4-20mA
V+
V-
2-Conductor 20AWG Cable
Ext. MAC 4-20mA
COM
NC
2-Conductor 20AWG Cable
Ext. Remote Test Pause
V+
V-
2-Conductor 20AWG Cable
Ext. Alert Out
NO
COM
NC
3-Conductor 20AWG Cable
Moisture_A
0V
V+
Signal In
3-Conductor 20AWG Cable
Moisture_B
0V
V+
Signal In
3-Conductor 20AWG Cable
Water_Sensor_A
0V
V+
Signal In
3-Conductor 20AWG Cable
Water_Sensor_B
0V
V+
Signal In
5X MSTB-3
BUZZER
RD 20AWG
BK 20AWG
V+
V-
EXT. FLOW 4-20mA P8
BK 20AWG
RD 20AWG
WT 20AWG
NO
COM
NC
EXT. ALERT OUT P11
RD 20AWG
BK 20AWG
V+
V-
EXT. MAC 4-20mA P12
BK 20AWG
RD 20AWG
WT 20AWG
(V-)
(V+)
IN
WATER SENSOR A P10
BK 20AWG
RD 20AWG
WT 20AWG
(V-)
(V+)
IN
WATER SENSOR B P13
RD 20AWG
BK 20AWG
(V+)
(V-)
EXTERNAL REMOTE TEST PAUSE P9
BUZZER/ TBD P17
BK 20AWG
RD 20AWG
WT 20AWG
0V
V+
Signal In
MOISTURE B P11
MOISTURE A P8
Apex Instruments
XC-6000

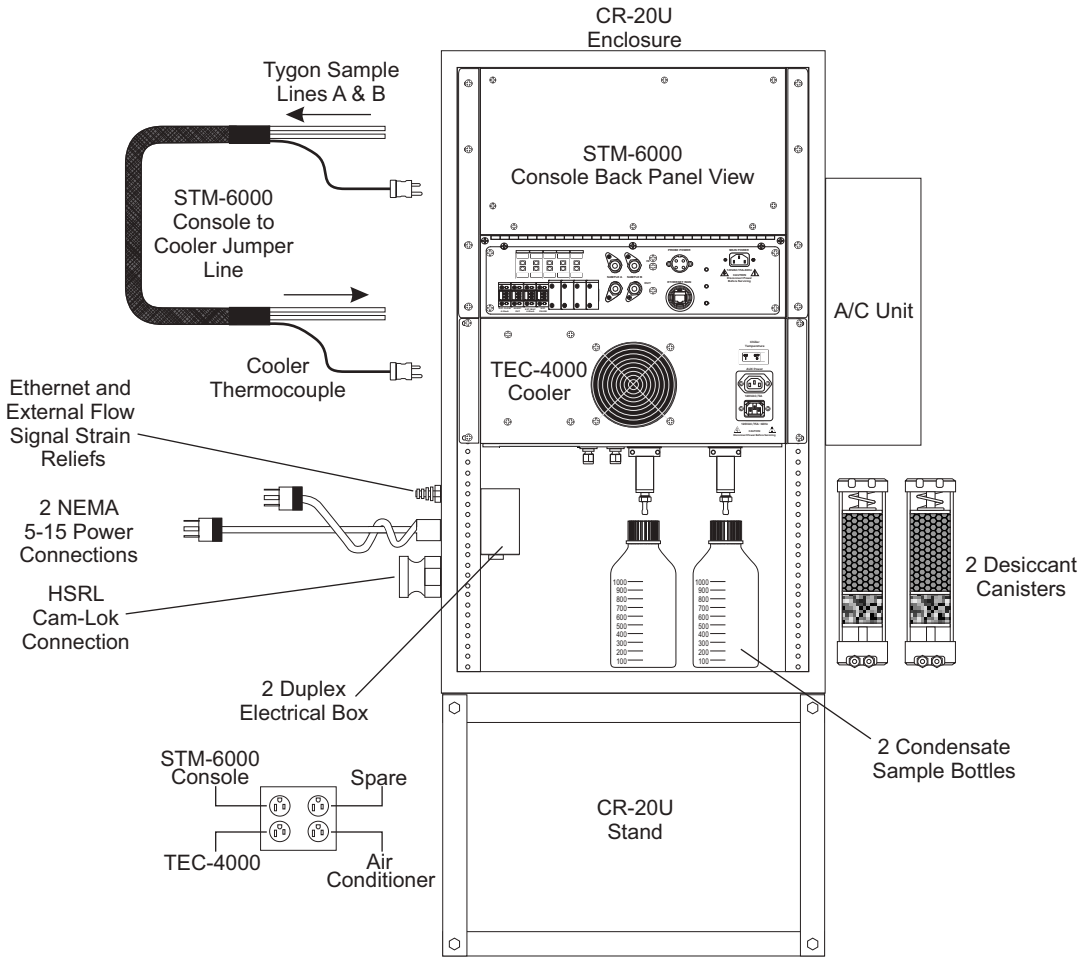
Appendix 4

Console Drawing Package

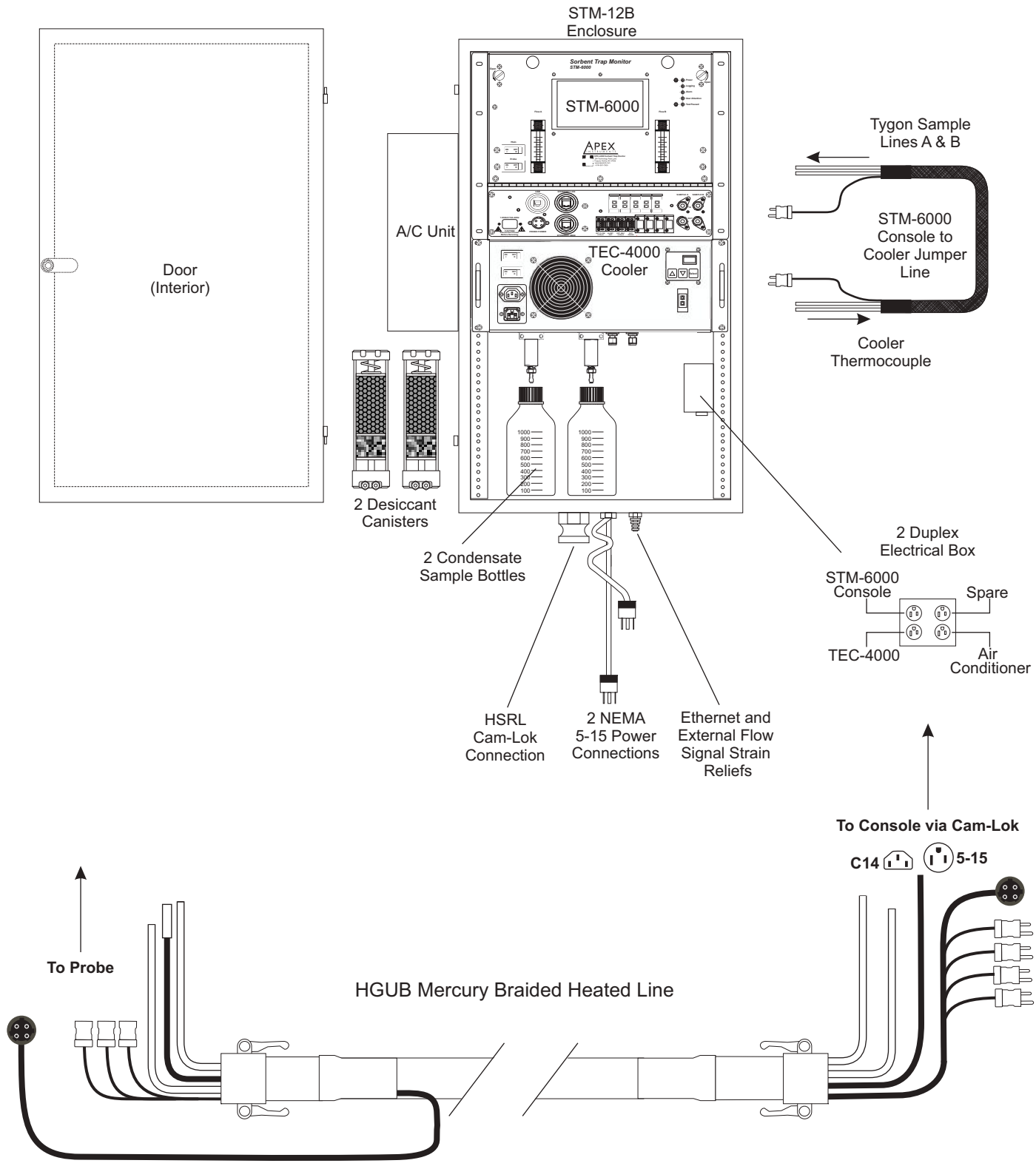
STM-6000RM
(Front View- Door Removed)



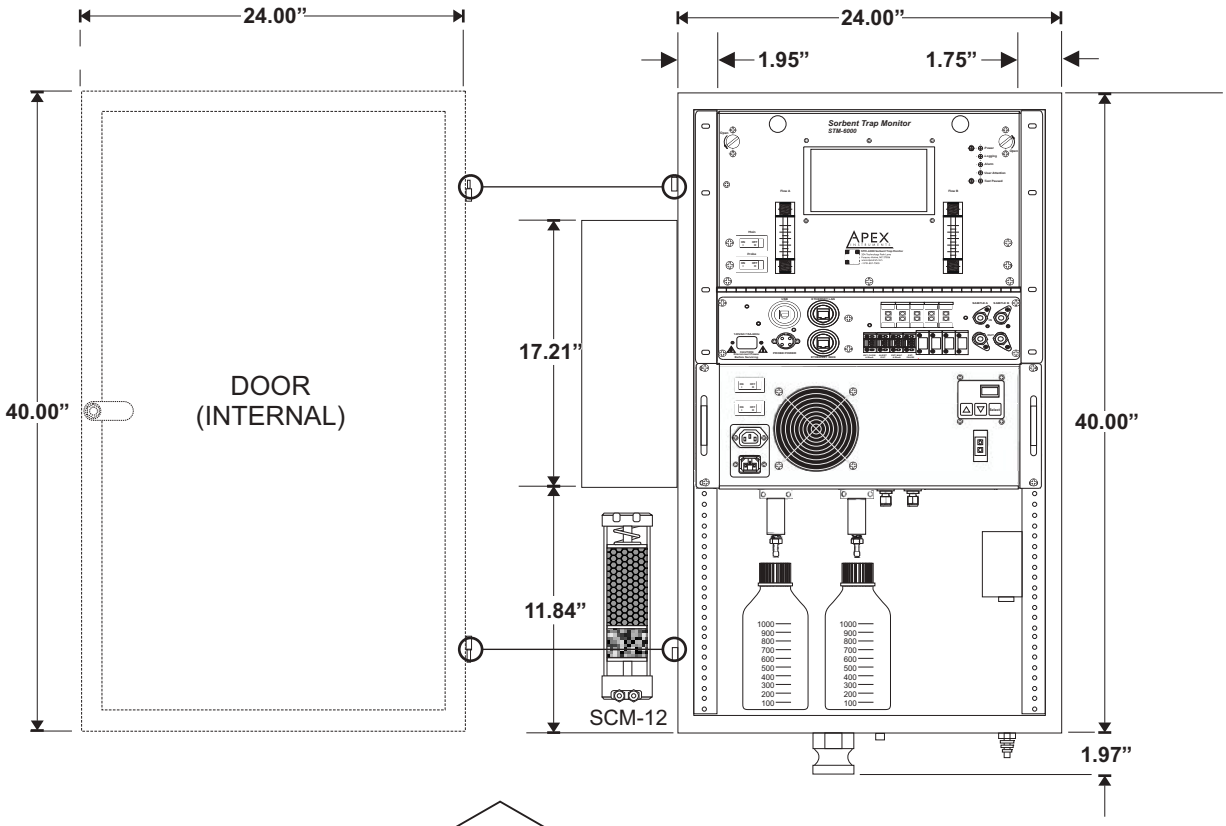
STM-6000RM
(Rear View- Door Removed)

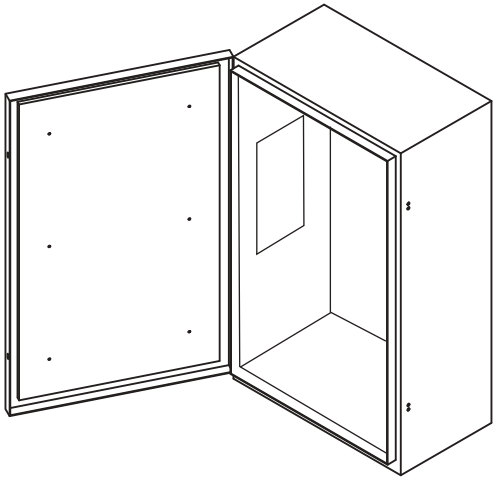


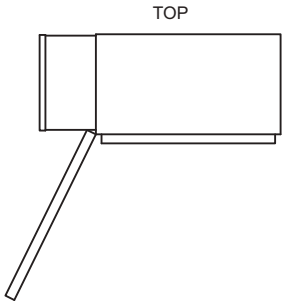
STM-6000WM
(Front View)

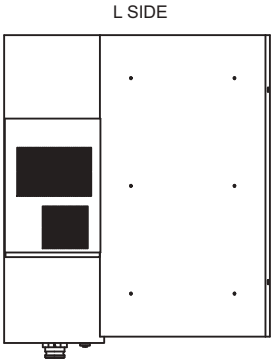


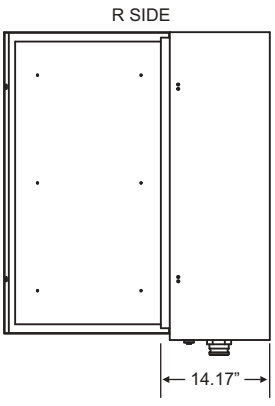
STM-6000WM
(Front View)

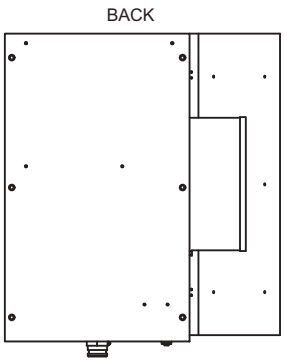


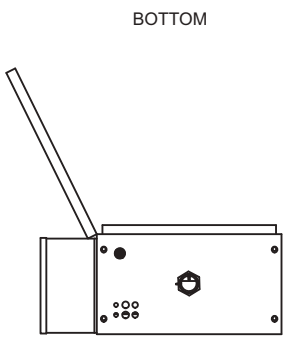




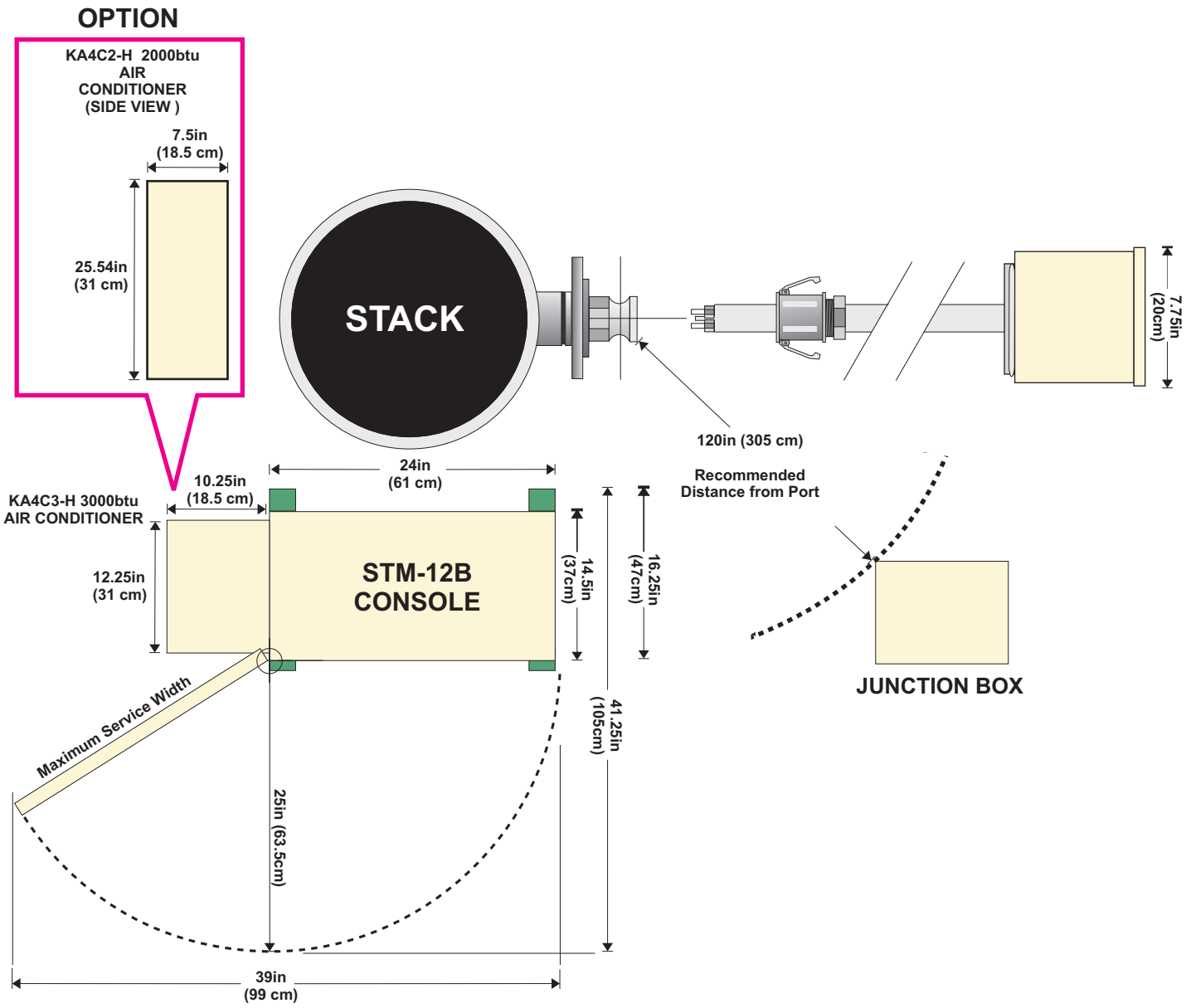




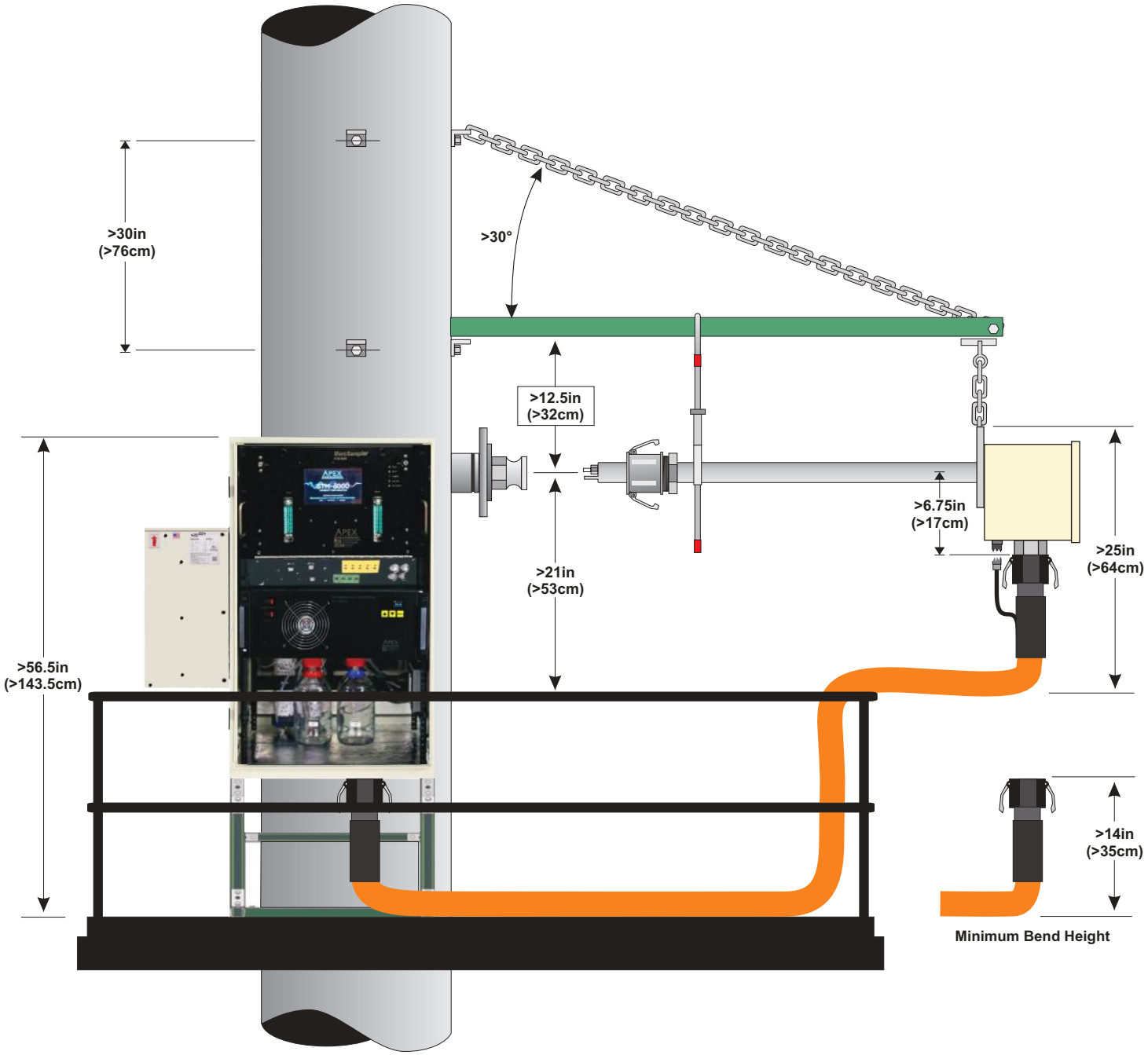




CRITICAL DIMENSIONS
Top View

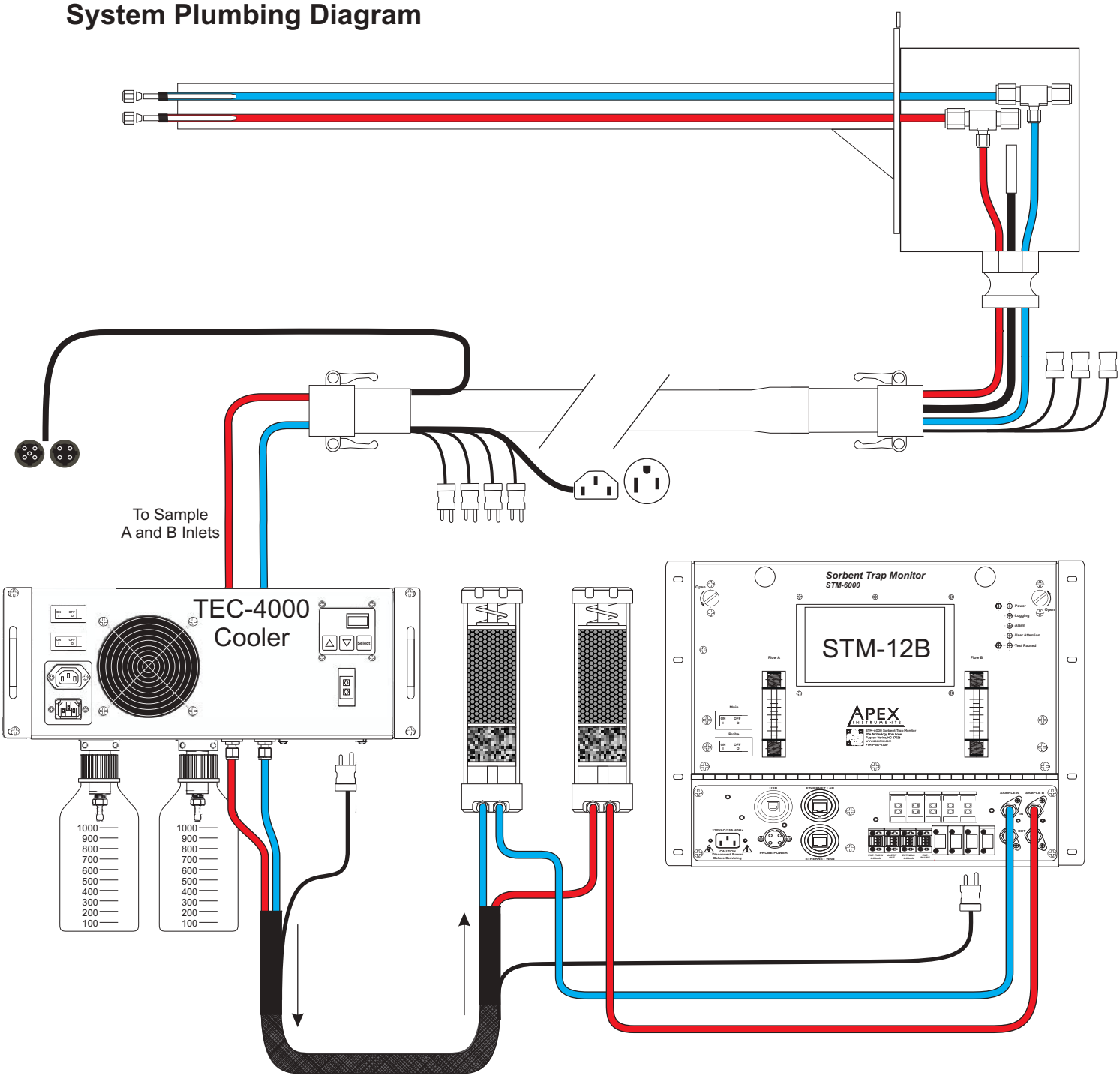


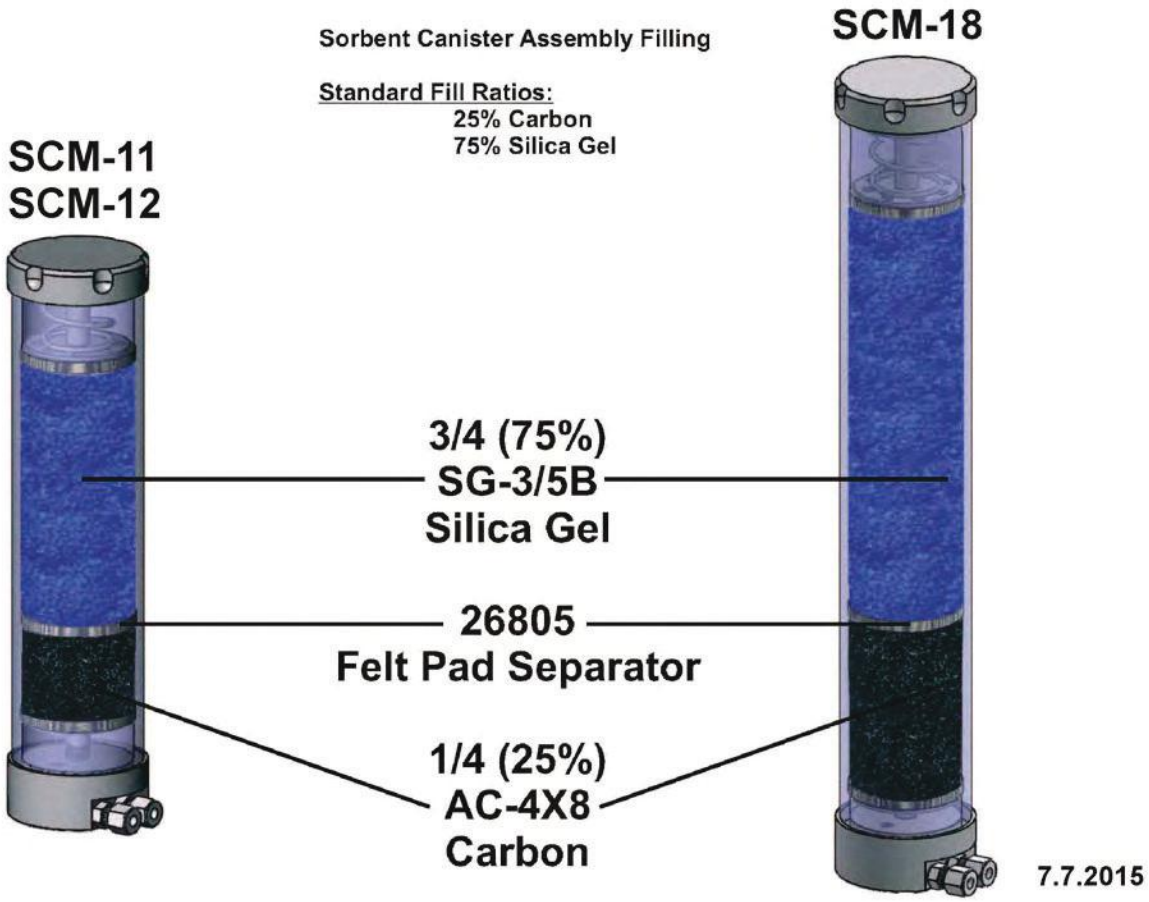
CRITICAL DIMENSIONS
Front View



Appendix 5

System Plumbing Diagram



Appendix 6

Sorbent Canister Assembly Fill Ratios