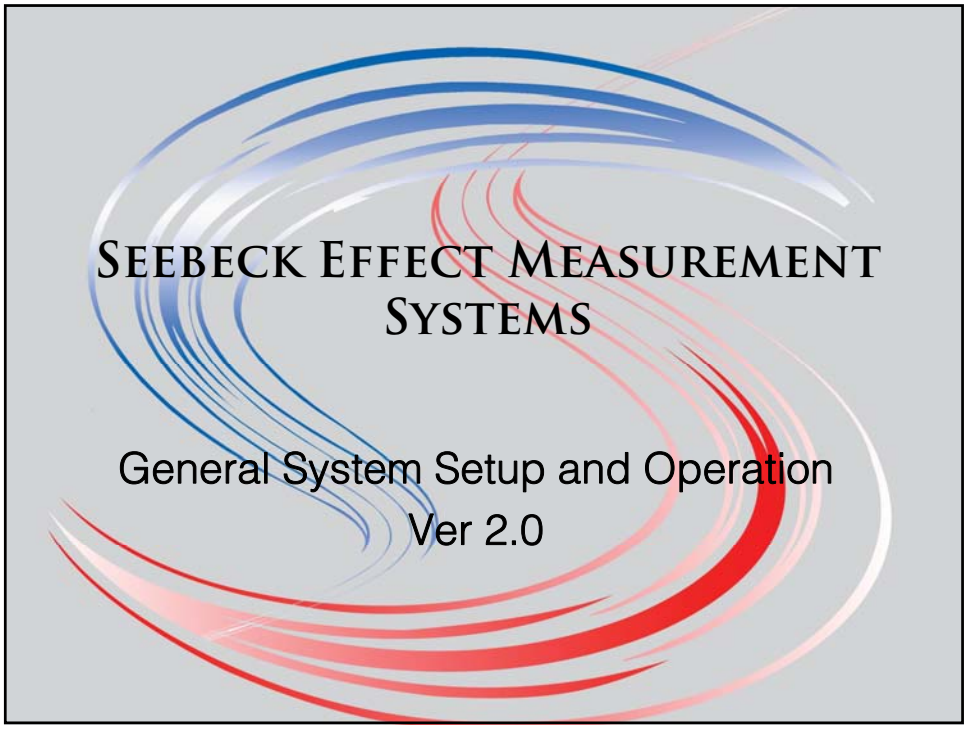


Facilities Requirements: Spatial

- K-20 Controller
  - Width 17 inches
  - Depth 15.5 inches
  - Height 3.5 inches
- Computer *
  - Within 6 ft of Controller
  - Width 30 inches
  - Depth 24 inches
  - Height 18 inches
- Gas Cylinder **
  - Within 4 feet of setup
- Vacuum Pump ***
  - Within 4 feet of setup
  - Width: 8 inches
  - Depth: 28 inches
  - Height: 14 inches
- Vacuum Accessory Kit (opt)
  - Width: 14 inches (36 cm)
  - Length: 8 inches (21 cm)
  - Height: 2 inches (5 cm)
  - Distance from Vacuum Chamber: 2 feet

Facilities Requirements: Spatial

- SB-100 Controller
  - Width 17 inches
  - Depth 15.5 inches
  - Height 3.5 inches
- Vacuum Chamber
  - Width: 2.5 in (6.35 cm)
  - Length: 6.0 in (15.24 cm)
  - Depth at sample mounting end: 0.780 in (1.9 cm)
  - Depth at electrical connection end: 1.45 in (3.7 cm)

Facilities Requirements: Electrical

- K-20 Controller
  - 1 of either 110V/60Hz or 230V/50Hz
- SB-100 Controller
  - 1 of either 110V/60Hz or 230V/50Hz
- Extended Temperature Range Power Supply
  (only used on K-20 controllers pre-2010 that do not have a built in auxilliary power supply)
  - 1 of either 110V/60Hz or 230V/50Hz
- Vacuum Pump
  - 1 of either 110V/60Hz or 230V/50Hz
- Vacuum Accessory Kit
  - 1 of either 110V/60Hz or 230V/50Hz
- Computer
  - 2 to 3 of either 110V/60Hz or 230V/50Hz

Facilities Requirements: Gas

- Regulator Requirements
  - Max Inlet Pressure: 3000 psi (26.7 mPa)
  - Maxi Flow Rate (at 2500 psi (17.2 mPa) , N2): 4600
  - Flow Coefficient (C_v): 0.06 without outlet valve
  - Operating Temp: -26 to 74 °C
  - Porting: 1/4" NPT female
  - Porting Configuration: 2 High, 2 low
  - Delivery Press. Range: 100 - 2500 psi (0.68 – 17.2 mPa)
  - Delivery Press. Gauge: 0 - 3000 psi (0 – 26.7 mPa)
  - Cylinder Press. Gauge: 0 - 3000 psi (0 – 26.7 mPa)
- Gas Requirements
  - Pre-purified Grade
  - 99.998% minimum purity
  - Minimum 1800 psi (12.4 mPa) supplied pressure from the tank
  - Tank pressure recommended to be at least 2640 psi (18.2 mPa)

NOTE: Poorly regulated gas pressure can result in damage to the thermal stage or poor cool down performance

Facilities Requirements: Chemical

- Oil Pump – refer to the user manual for your pump for specifics
- Vacuum Grease
- Thermal Grease – Dow Corning 340 or an equivalent thermal grease

Computer Requirements

- Operating System
  - Windows only
  - See next slide for more info
- Processor (min)
  - 1.2 GHz Celeron Pentium
- Memory (min)
  - 128 MB RAM
- Hard Drive (min)
  - 1 GB free space
- Floppy Drive
- 16 X CD-ROM Drive
- SVGA Monitor
- Mouse and Keyboard
- Communication Ports
  - At least 2 free RS232 Serial Port or 2 free USB port with serial/USB adaptor
- Recommended Software
  - Microsoft Excel
  - Adobe Reader
- Printer – not required but recommended

Computer Requirements

	32-Bit Computer	64-Bit Computer
Windows 95/98	Compatible	Not Compatible
Windows 2000	Compatible	Not Compatible
Windows XP	Compatible	Not Compatible
Windows Vista	Compatible	Not Compatible
Windows 7	Compatible with Windows XP Emulator on Vista Ultimate only, Serial to USB Converter required	Compatible with Windows XP Emulator on Vista Ultimate only, Serial to USB Converter required

Vacuum Pump Requirements

- Primary Pump:
  - recommend Alcatel Model 2005SD
    - 120 L/min.
    - 3.8 cu.ft./min.
    - with mist eliminator
  - *Any vacuum pump that a customer has that has the same or better specifications can be used. The connection to the vacuum chamber is done through a barbed fitting – so a simple heavy duty tubing connection works well.*
    - *We do not hold responsibility for non-MMR supplied pumps integrating into any setup.*

Understanding What Ships

- Typical Seebeck System includes:
  - Seebeck Chamber
  - K-20 Controller
  - SB-100 Controller with special ribbon cable
  - Filter/Dryer Setup
  - High Pressure Tubing
  - Two thermal stages
  - Sample Mounting Stage (s) – temperature dependent
  - Small Kit of extra o-rings, screw driver, Tygon tubing, etc

Understanding What Ships

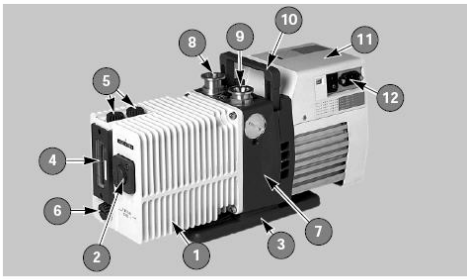
- Optional Items Ordered with Systems:
  - Vacuum Pump (s)
  - Vacuum Accessory Kit
  - Sample Mounting Kit
  - Regulator
  - Computer
  - Extra Thermal Stages
  - Extra sample mounting stages
- Optional Accessories:
  - Hall Add-on
  - Magnets for Hall System

Local Safety and Facilities Requirements

- Every building and company has different rules and regulations for building safety and facilities requirements. This document does not assume any knowledge of those requirements. It is the end user's responsibility to understand what his local requirements are and to ensure that the installation conforms to these requirements.

Vacuum Pump Setup

- This is specific to the type of pump sold from MMR Technologies.
  - There may be differences in other models.
- Unpacking
  - Do not destroy or toss out packing until the pump is performing
  - Pumps do not ship filled with oil



1. Oil case
2. Gas ballast control
3. Base
4. Oil level sight glass
5. Filling plugs
6. Draining plug
7. Frame
8. Inlet end fitting
9. Exhaust end fitting
10. Fold-away handle
11. Electric motor
12. IEC electric socket

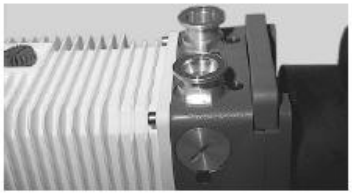
- Most pumps need an overnight operation burn in period.

Vacuum Pump Setup

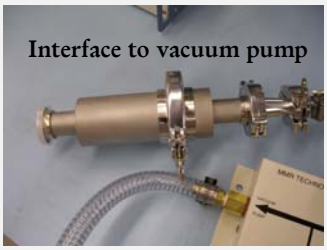
- Fill the pump with oil
  - Undo the fill plug
  - Place a funnel in the fill plug position
  - Fill with the oil provided in the pump box (or a recommended oil) until full – per the levels recommended in the manual
  - Ensure the plug is secured after filling

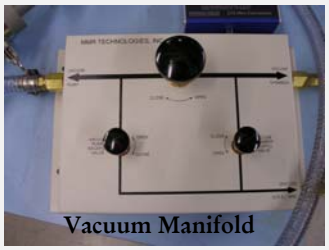
Vacuum Pump Setup

- Setup the Inlet and Exhaust port settings to be on the top of the unit
- Remove the covers the pump was shipped with



Vacuum Accessory Kit Setup





Vacuum Pump Setup

- Install the vacuum accessory kit **Interface** to the inlet of the pump.
  - Ensure the o-rings are in place
  - Ensure there is a good fitting of the two components
  - Tighten the clamp until it is finger tight

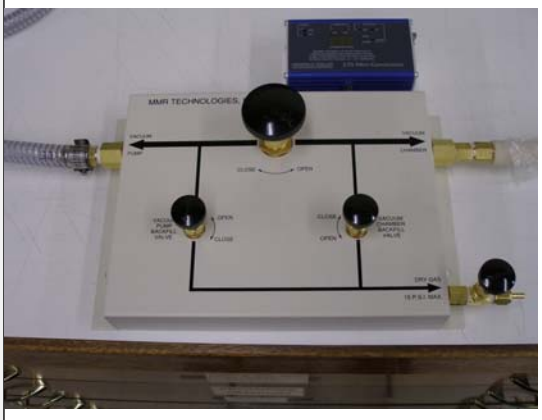
Vacuum Pump Setup

- Install the Oil Mist eliminator on the Exhaust Port
  - Ensure that o-rings are used
  - Ensure the two components fit well together
- This pump prefers an open air location – not a cabinet or closed environment

Vacuum Pump Setup

- Verify the voltage setting on the pump
  - Set this to the correct local voltage settings to avoid damage to the pump!
- Install the power cord into the back of the pump
- Plug the pump in, and flip the power on.

Vacuum Pump Setup



- With the vacuum accessory kit set to closed in all positions, run the pump for at least 1 hour before opening the kit to the instrument.

NOTE: Some manufacturers recommend overnight burn in period. Read the operators manual for your pump.

Gas Setup

- The nitrogen gas cylinder should be installed according to local safety and facilities rules, close to the equipment
  - Must have a higher pressure than 1800 PSI (12.4 mPa)
  - Within 4 feet (1.2 meters)
  - Secured to the wall or bench per local regulations

Note: Larger initial tank pressures mean longer run time without needing to replace the tank.

Gas Setup

- Remove the cap and ensure that the tank has not been tampered with
  - Typically the cover lid should be turned counterclockwise to remove.
- Remove any protective plastics or other covering from the cylinder an inspect the threads to ensure they are not damaged

The Gas Regulator

- It is fundamentally important to the performance of the MMR system, and to not damaging the system that the regulator used be of high precision or accuracy, capable of fine control for the gas pressure going into the system.

- If your regulator lacks fine control, you may want to find an intermediate flow gauge to give precision control over the gas going into the thermal stage

NOTE: Poorly regulated gas pressure can result in damage to the thermal stage or poor cool down performance

Gas Setup

- Make sure that the regulator outlet valve (A) is shut. Screw it clockwise until it seats. Do not over tighten it or you can damage the valve seat.
- Make sure that the regulator control valve (B) is shut. Screw it counterclockwise until it is almost completely unscrewed.
- Screw the regulator onto the tank by hand until it is almost finger tight.
- Tighten the regulator firmly with a wrench

Install the Filter and Gas Lines

- Each filter type has different tubing and adaptors specific to the filter connections
  - 5-foot length connects to the regulator (using a conversion piece included in the tubing kit) to the inlet of the filter
  - The outlet of the filter is connected to another piece of tubing – remove end cap from tubing so gas may flow freely
  - Connect pieces finger tight only – using tools can break the connections and void warranty on those parts.

Gas Purity and The Filter/Dryer

- It is critical, for the longevity of the thermal stage, and for operation meeting the specifications stated for the thermal stage that the gas meet the purity requirements and that the filter/dryer be used to remove any residual contaminants. Failure to have both the proper quality of gas, the correct pressure of gas supplied, and the filter/dryer may result in damage to the stage not covered under warranty, and reduced performance and lifetime of the thermal stage.

Using the Gas for the First Time

- Open the tank valve slowly (counterclockwise). Watch the tank pressure on the regulator (C).
- Slowly turn the regulator control valve (B) until the regulator pressure (D) is at the desired level.
- Open the regulator outlet valve (A). You can regulate flow with this valve, but the ultimate pressure depends on the setting of the regulator control valve!
- Check your system for leaks using Snoop (a commercial product) or some soapy water.

Disconnecting a Regulator

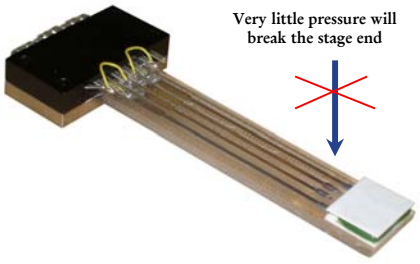
- Shut the tank valve on the gas cylinder.
- Slowly open the outlet valve (A) on the regulator .
- Watch the pressure gauges C and D drop to zero.
- Open the regulator control valve (B) (turn it clockwise) to ensure that all pressure has been released.
- If you were using a corrosive gas, purge the system with a dry inert gas.
- Using a wrench (not pliers!) disconnect the regulator from the gas cylinder. Replace the protective cylinder cap immediately.
- If your regulator was used with a corrosive gas, purge it again with dry air or nitrogen in the hood for several minutes.
- If your cylinder is empty, it must be properly labeled and then returned to the manufacturer or distributor (in many cases, this is your school or company stockroom). Do not store empty gas cylinders in the laboratory.

Reminder: Make sure the tank valve is closed whenever you are not dispensing gas through the regulator.

Purging the Lines

- Each time a tank is changed or the system is opened up, the gas lines and filter need to purge for at least 5 minutes at 500 psi (3.5 mPa) before connection to the refrigerator
- If a line is to be left open, immediately place a plug or cap on the end of the tubing or refrigerator
- At the end of the purge, either connect immediately to the refrigerator or recap to avoid line contamination or filter material destruction

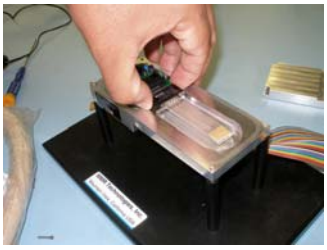
Refrigerator Handling



- Refrigerators are FRAGILE:
  - They will break if dropped or banged against a surface
- When mounting samples, it takes no pressure to place a sample on the end with some thermal grease. Too much pressure will damage the thermal stage and void the warranty

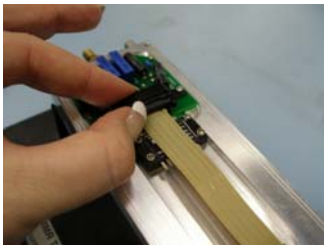
Refrigerator Installation

- Verify the o-rings are in good shape
  - Apply a light layer of vacuum grease
- Gently slide the connector pins onto the stage
- Use the screws to align the stage
- Tighten the screws crosswise until the stage is evenly and tightly connected

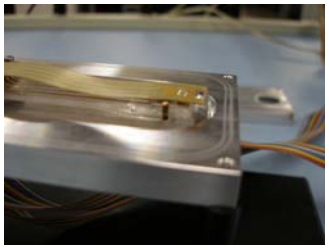


Installing the Sample Mounting Stage

- Ensure the connector is open
- Take either the Kapton Harness or Ceramic harness and slide gently but firmly into the connector
- Push the connector closed to secure the harness



Installing the Sample Mounting Stage



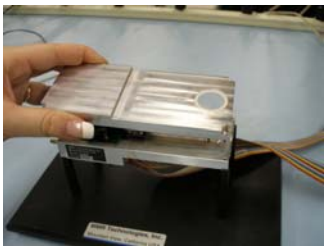
- Ensure the connector looks secure
- Ensure that the harness is holding onto the thermal stage by the appropriate clip
- BE CAREFUL – when placing the clips around the thermal stage, pressing down on the stage may result in damage or breakage

Connecting the Vacuum Chamber

- Ensure that the gaskets are in good shape with a thin layer of grease.
- Place the lid on the chamber and fasten the four screws down evenly

Attach the high pressure tubing to the gas inlet

- Run the gas at 500 psi for 5 minutes to purge out moisture



Connecting the Vacuum Chamber

- Ensure the ribbon cable (labeled chamber) is connected underneath the chamber
- Attach the vacuum hose
- Attach the high pressure tubing to the gas inlet
  - Run the gas at 500 psi for 5 minutes to purge out moisture

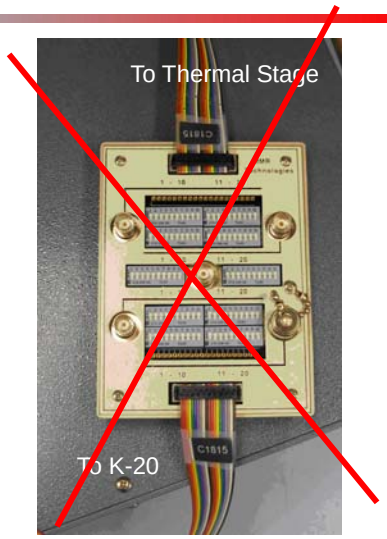
K-20 and SB-100 Setup

- Verify the voltage setting on the rear of the controllers
- Ensure the K-20 and SB-100 are powered off
- Connect the power cords to the rear of the K-20 and SB-100
- Plug the power cords into the wall
- From the ribbon cable connected to the chamber, connect one side to the refrigerator port of the K-20 and the other to the Seebeck Stage port of the SB-100

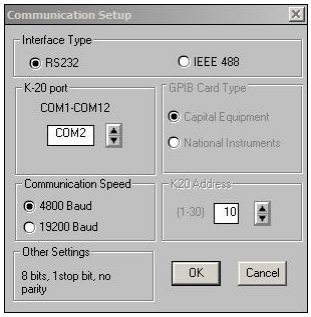
Note: The Seebeck system has a unique ribbon cable – each connector is clearly labeled

Circuit Breakout Box

- Never used or shipped with a Seebeck System



K-20 Software Installation – Windows XP



- Place the CD into the computer
- Run the Setup.exe program
- Follow the on-screen directions.
- Once the software is installed, power the K-20 controller up.
- Verify the Com Settings for the K-20
- Exit the software

SB-100 Software Installation

- Place the CD into the computer
- Run the Setup.exe program
- Follow the on-screen directions.
- Once the software is installed, power the SB-100 controller up.
- Verify that the Com settings for the K-20 are the same in the SB-100 software as were determined correct for the K-20 software
- Exit the Software

Windows 7 Software Installation

- From Windows 7 desk top,
  - Select Start
  - All Programs
  - Windows Virtual PC
  - Windows XP Mode
- From Windows Virtual XP desk top

NOTE: Make sure you have connected the USB-RS232 adapter to the computer before the next step.

  - On the Tab located at the top of the desktop select USB
    - Click on the first USB-Serial Controller (Attached)
- On the Tab located at the top of the desktop select USB
  - Click on the second USB-Serial Controller (Attached)
    - You will notice that the (Attached) will change to (Release)

NOTE: This requires Windows 7 Professional or Ultimate Edition

Determining the Comm Ports Being Used

- This next part is for the initial set up. If you have already set the com ports up then Click on the Seebeck Icon on the Windows Virtual XP desk top.
- If not follow steps below.
  - Click on Start
  - Select Control Panel
  - System
  - Hardware Tab
- Device Manager
  - Ports (COM & LPT)
  - Verify and note what COM's are assigned to each port
    - USB-to-Serial Bridge (COMx)
    - USB-to-Serial Bridge (COMx)

Selecting the Comm Port in the Software

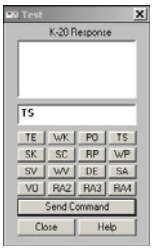
- Return to the main desktop
  - Click on Seebeck Icon
    - Click on the top Icon labeled (Communication Setup)
  - Change the K-20 port to reflect the noted com port(x)
  - Change the SB-100 port to reflect the noted com port(x)
- NOTE: You may need to reverse the com Ports(x)
- At this point you can communicate with the K-20 and SB-100

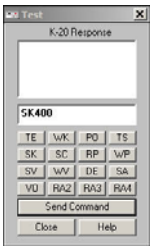
Testing the Temperature Setup

- Turn the gas on to at least 1800 PSI (12.4 MPa)
  - This may not go above 1950 PSI (13.4 MPa)

  NOTE: Crude input pressure control will result to poor temperature control results and possible damage to the thermal stage.
- Verify that all cable connections are secure
- Turn on the vacuum pump and open the vacuum accessory kit to evacuate the chamber
  - Wait until the vacuum chamber reaches a pressure of at least 8 milliTorr

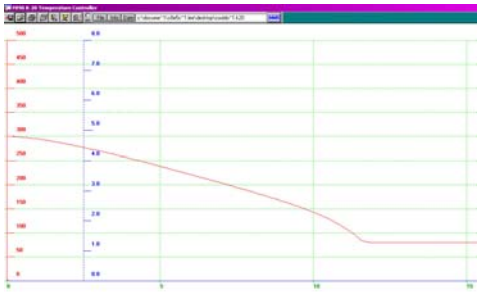
Testing the Temperature Setup





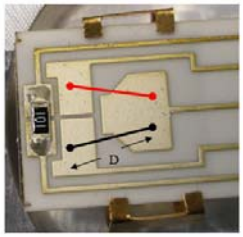
- Start the K-20 Software
- In the command box, type TS
  - Confirm the sensor is correct type – this should give a feedback of Pt RTD
- Set the temperature to go to 400K with the gas flowing
- Allow the setup to run with the gas flowing at 1800 psi (12.4 MPa) for 15 minutes
- Set the temperature to go back to room temperature

Testing the Temperature Setup



- Set the temperature to go to 80K
  - Should occur in under 20 minutes
  - If it stalls, go through the clogging procedure
- Once at 80K, set to go back to room temperature (300K)
- If complete, you can shut off the gas flow and vacuum.

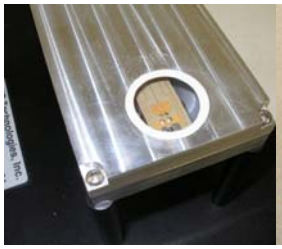
The Standard Sample

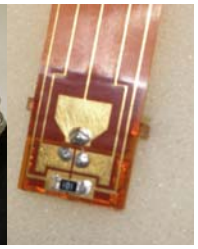


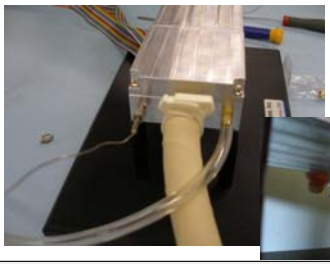
- Two wires are bonded onto the two sides of the mounting stage – they are of the same material
  - When this sample is run the data should give a straight line

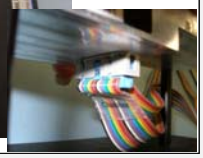
Setting up the Experiment

- Mount the C3058 standard sample in the Seebeck chamber with the low impedance board, 1000 gain.
- Put the lid on the chamber and ensure it is tightened down correctly.
- Make sure that the connections are made to the chamber:
  - Vacuum pump line
  - Gas Lines
  - Back flow meter
  - Electrical Lead (ribbon cable)
- Ensure that the Seebeck chamber is under vacuum – 8 milliTorr



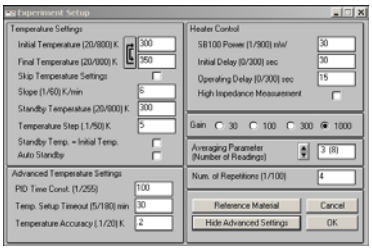


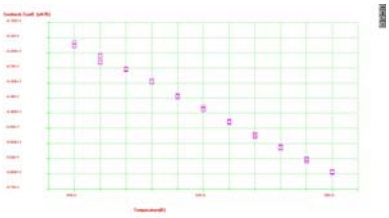


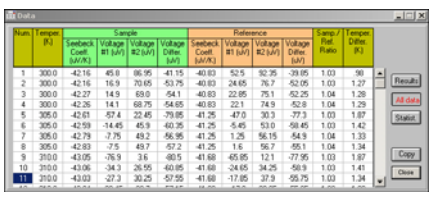


Setting up the Experiment

- Open the SB-100 Software
- Setup the experiment per the settings shown
- The data should give a straight line graph with a coefficient of ~ 1







Some words of Operating Caution

- Never release vacuum pressure to the vacuum chamber if the thermal stage is outside the range of -10°C to 50°C.
- Never disconnect the cables from the thermal stage if the K-20 is powered on.
- Ensure that the thermal stage is well flushed before cooling, after every time the gas lines are opened to the environment (changing tanks, disconnecting gas lines).
- Wearing clean gloves while handling the stage can reduce pump down time to the required vacuum level.

THANK YOU FOR YOUR TIME AND ATTENTION

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