DigiVac
Scientific Measurement & Control

SNAP Vacuum Controller

Vacuum Control and Pressure Regulation in One

Operational Manual

YOU MUST READ THIS MANUAL BEFORE USE

March 2021

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Section 1. Description and Principles of Operation

The ***SNAP Vacuum Controller combines precise vacuum control with pressure regulation all in one without sacrificing flow rate***. Patent pending integrated valve that delivers superior flow rate but with precise proportional control for the rough vacuum range.

Mission control at your fingertips with the SNAP (Simple, Nimble, Automatic Process Controller)

SIMPLE

- Easy set-up and push button process control: Vent, Close Valve, Full Vac (Open)
- Enables use of reliable and long lasting rotary vane oil pumps & dry scroll pumps in applications where diaphragm pumps were previously required
- Keeps vacuum pumps near their base pressure resulting in greater longevity

NIMBLE-MAXIMIZE THROUGHPUT & PUMPDOWN SPEED

- Largest flow paths available to ensure maximum flow for faster evaporation
- Maximize throughput and pump down speed with a 20 mm vacuum path

AUTOMATIC PROCESS CONTROLLER

- Vent your vacuum chamber or equalize your system with the touch of a button instead of pulling hoses or turning valves
- Treat material in chamber more gently by implementing kinder ramp rate controls
- Vacuum Controller with onboard ramp rate recipe control. Program up to 24 recipes based on time and pressure setpoints.
- Dashboard push button control allows you to automatically pump down, vent, or isolate your system with a push of a button
- Ideal for automating and simplifying vacuum chamber pressure control.

PRECISION CONTROL & INTUITIVE DESIGN

- Easy-to-use precise, automated control with realtime graphing of pressure levels, numerical readings, and one-touch start, stop and release buttons
- Innovative valve control performs both proportional throttle vacuum and vent control
- The integrated vent design allows you to quickly vent to atmosphere to stop “bumping” during processing or when the process is complete

Section 2. Unpacking and Inspecting

After the instrument is received, it should be carefully unpacked and inspected for damage during shipment and to confirm that all components are present. *The warranty pertains only to the instrument and does not cover losses in shipping.*

Each SNAP comes with:

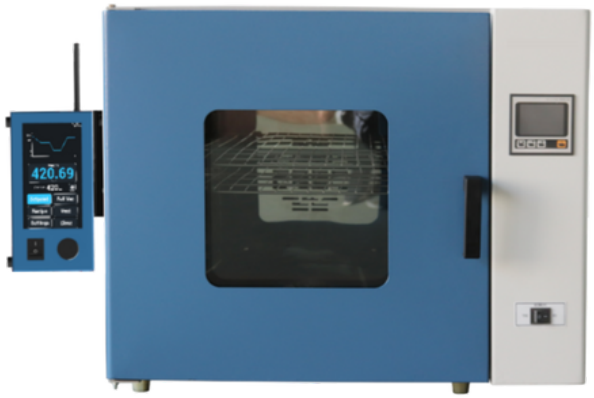
- KF25 vacuum ports for vacuum connection, vent port hose barb, 7” touch screen with knob control, USB output, analog in/out communication, and external sensor upgradability
- Power supply
- Quick start guide
- (optional) 10 Torr Capacitance Manometer
- (optional) Digivac Quantum DPP Sensor
- (optional) RS232 output

Section 3. Installation

Now, it's time to connect the SNAP Vacuum Controller: The only required connections for operation are power, a vacuum pump, and a vacuum system.

Hooking the SNAP up to a system is a simple process:

1.**Mounting:** Find a suitable location for mounting the SNAP. In its standard, landscape mode, SNAP sits on rubber feet. It should be put in a place that easily allows access to the touch screen, but has minimal process vibration. A mounting bracket or pole clamp can be added-on to allow for direct mounting to certain vacuum ovens or rotovaps. These options are best used in SNAP's portrait mode.



2.**Connect to Vacuum Pump:** Connect your vacuum pump to the KF25 input labeled "Vacuum Pump".

3.**Connect to Vacuum System:** Connect your vacuum system to the KF25 vacuum output labeled "System".

4.**Vent Port (optional):** If you would like to use a gas other than ambient air to vent your system, connect that vent gas to the hose barb.. Many customers may choose to vent with dry Nitrogen.

5.**Data Capture (optional):** Attach USB connection for data to a PC or other system.

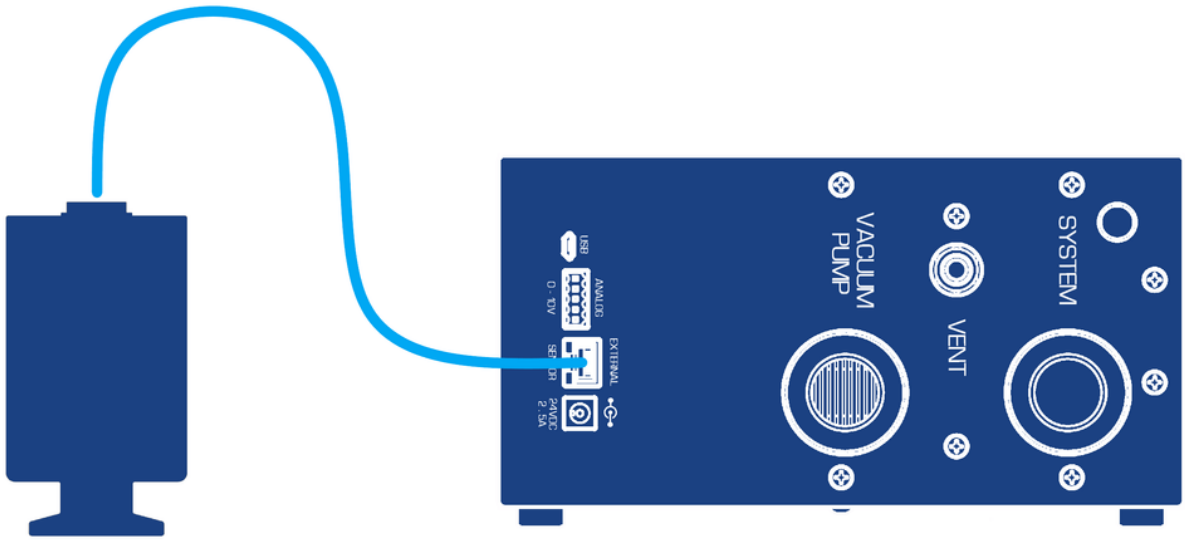
6.**Analog In/Out (optional)**: Connect to a PLC and use specified voltages to control.

7.**External Sensor (optional)**: Connect an external sensor(e.g. 10 Torr Capacitance Manometer for improved accuracy

8.**Power**: Plug in to Power and turn on

Installation note for Optional External Sensor:

Mount the sensor closest to the location where you want to control. The reading you see on the screen will show you the reading of the external sensor. Operate the unit according to the directions in the next section just as you would with the internal sensor.



Section 4. Controlling with the SNAP

After installation, the unit is ready for immediate operation. This section will go over how to control channels with your SNAP, focusing on the different display buttons.

SNAP is feature-rich with multiple control options. It is the ***1st touch screen vacuum controller with onboard recipes.***

Watch a video of the feature-set here.

Control Set Options:

1. **Recipe Control**
2. **Set-Point Control**
3. **Vent to ATM (Bleed Control) or ability to vent with an inert gas**
4. **Close all valves and isolate the system**
5. **Full Vacuum**

RECIPE CONTROL

This mode is a highly innovative feature that allows users to set recipes based on their desired process parameters.

Watch this video on how to select recipes easily here

SET POINT CONTROL

This mode uses both vacuum pump suction and ambient air/supplied gas pressure to control the system's vacuum level to the chosen set point (desired pressure level).

CLOSE (Isolate)

This mode isolates the system by fully closing both the vacuum and the vent ports. The system is isolated from both Atmosphere (ATM) and the vacuum pump with this mode activated.

FULL VAC

This mode fully closes the vent port and fully opens the vacuum port, allowing rapid and complete pumpdown of the system.

VENT

This mode fully closes the vacuum port and fully opens the vent port, allowing for rapid and complete ventilation of the system to Atmosphere (ATM). This mode is very helpful to stop bumping in a rotary evaporator or when your process is complete.

Controlling at a Setpoint

1.***Note: You can either control in setpoint mode or in one of the modes outlined on pg. 8*
The button highlighted on the screen is the mode you are in; Ex. you can set the mode to **Setpoint** and push the dial in to activate the icon for setting the set point

2. Once activated the Icon is a button that is located below the vacuum reading.
It says **"S-XX"** and then lists the current set point.

3.You can adjust it how you'd like. Turn the Dial to the desired setpoint, then **Push the Dial** in, to save the set-point or press the **SAVE** button on the screen. When you return back to the home screen you will see the updated setpoint on the screen.

4.You are now ready to begin controlling vacuum

Setting PID Variables to Optimize Performance

SNAP ships with PID variables that are optimized for average vacuum hose lengths for 20 and 50 liter vessels. The SNAP is capable of controlling much smaller and larger vessels, but may require some PID tuning to optimize the control.

For more background on PID check out this white paper **Here**.

You can access PID variables from the Setpoint (S - xxx) button when in Setpoint mode.
To adjust:

- Click on S - xxx button
- Click on PID
- To put in a different number, input that number in the dialogue box
- Touch the value box of the variable you want to change (P, I, D)
- Click OK
- Your new PID variable is set.

***Note: In general, if you seem to be hunting around the set point, but never hitting it, reduce P. If you can't seem to ever get to your set point, increase P. There are dissertations in the art of tuning PID, so feel free to leverage them, or call us to help.*

Using Recipe Mode

To control in Recipe mode, press the Recipe button.

Recipe quick keys:

- **Play** shall run/resume the selected recipe
- **Pause** shall pause the selected recipe and maintain the current pressure level. When play is then pressed, the selected recipe will pick up from it left off and resume
- **Stop** shall end the selected recipe, reset the clock, and maintain the current pressure level. When play is then pressed, the selected recipe will start at step 1
- If during a process, set point, recipe, vent, close, or full vac is pressed, the current recipe will be **paused**. Recipes operate in a radio button configuration – **when a mode is selected, all others modes are not active**

Play, Pause and Stop are only associated with recipes (i.e. only work in recipe mode)

Creating Custom Recipes (up to 24)

1.From the home screen, press the **GEAR ICON** 

2.Select the recipe number to edit, then press **EDIT RECIPE**.

3.Customize the selected recipe by **TIME** (base of **seconds** or **minutes**) and **PRESSURE** (in Torr) and whether you want to **RAMP** or **HOLD**

Time/Pressure: to input the the time and pressure, use the dial pad to enter the desired points then press the step row or column you what the digit to reside in

RAMP: pressure will ascended for a duration of time expressed. Ex. You want to go from 60 Torr to 40 Torr in 2 minutes. SNAP will moderate pressure down to the new set-point so the pressure change is spread out linearly over the 2 minutes. The setpoint ramp is a $y=mx+b$ function where $m = dP/dT$.

HOLD: Pressure change will go quickly to the next pressure point and hold for the specified time. When the recipe ends, it maintains the final setpoint of the recipe.

Watch a video on creating custom recipes **here**

USB Operation

The SNAP can be easily remote controlled via USB by simply connecting a cable to the Micro-USB interface.

USB has configurable baud rates of 9600, 19200, 115200

When connecting SNAP to a windows PC, the drivers will automatically install and then a terminal session may be initiated. Below is a summary of the commands.

******Note**: recipes can currently only be input and activated from the touch screen, but set points may be activated by command line if you are in set-point mode only (not available in Recipe mode).*

RS232 Operation

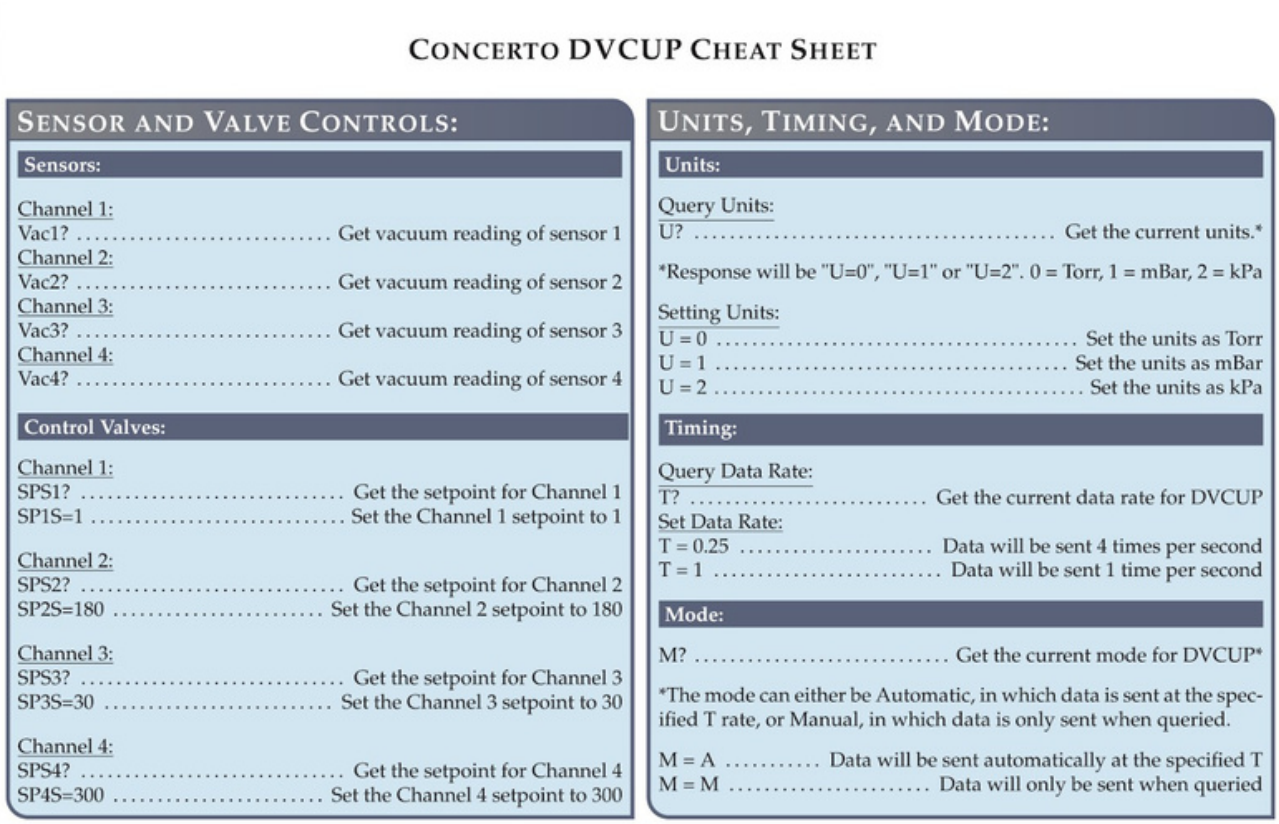
The SNAP can be easily remote controlled via RS232.

SNAP features USB connectivity as standard equipment and can be outfitted with an optional RS-232 (serial) module, allowing data monitoring/collection as well as full process control of all SNAP user functions.

The RS-232 port is bi-directional with user-settable baud rates of 9600, 19200 or 115200, with 8 data bits, no parity and one stop bit (independent UART channels are used for USB and RS-232).

The user connection is a 9-pin d-sub female connector installed on the rear panel. Free communications programs such as PuTTy or Docklight combined with our robust DVCUP command set can be used to log SNAP serial data or add automation to your vacuum process.

***Note**: that while USB is standard on SNAP, only one optional communication module can be installed; either WiFi or Serial RS-232.*



CONCERTO DVCUP CHEAT SHEET

SENSOR AND VALVE CONTROLS:

Sensors:

Channel 1:
Vac1? ..... Get vacuum reading of sensor 1
Channel 2:
Vac2? ..... Get vacuum reading of sensor 2
Channel 3:
Vac3? ..... Get vacuum reading of sensor 3
Channel 4:
Vac4? ..... Get vacuum reading of sensor 4

Control Valves:

Channel 1:
SPS1? ..... Get the setpoint for Channel 1
SP1S=1 ..... Set the Channel 1 setpoint to 1

Channel 2:
SPS2? ..... Get the setpoint for Channel 2
SP2S=180 ..... Set the Channel 2 setpoint to 180

Channel 3:
SPS3? ..... Get the setpoint for Channel 3
SP3S=30 ..... Set the Channel 3 setpoint to 30

Channel 4:
SPS4? ..... Get the setpoint for Channel 4
SP4S=300 ..... Set the Channel 4 setpoint to 300

UNITS, TIMING, AND MODE:

Units:

Query Units:
U? ..... Get the current units.*

*Response will be "U=0", "U=1" or "U=2". 0 = Torr, 1 = mBar, 2 = kPa

Setting Units:
U = 0 ..... Set the units as Torr
U = 1 ..... Set the units as mBar
U = 2 ..... Set the units as kPa

Timing:

Query Data Rate:
T? ..... Get the current data rate for DVCUP
Set Data Rate:
T = 0.25 ..... Data will be sent 4 times per second
T = 1 ..... Data will be sent 1 time per second

Mode:

M? ..... Get the current mode for DVCUP*

*The mode can either be Automatic, in which data is sent at the specified T rate, or Manual, in which data is only sent when queried.

M = A ..... Data will be sent automatically at the specified T
M = M ..... Data will only be sent when queried

Section 5. Troubleshooting

Observation	Possible Causes
System does not light up	Verify the system is plugged in, and all the cords are tight
System takes too long between set points	Take SNAP out of the configuration Time how long it takes for system without Snap to get from the first vacuum level to the second vacuum level • Re-install the SNAP and run same test • If the last 2 test are close, that means the SNAP is performing as it should. If the last 2 tests are different, it means the SNAP is not performing optimally. **Please consult your vendor for technical assistance.**

My readings are erratic	Check reading with another gauge to see if the readings are indeed erratic. If the other gauge does not show erratic readings, consult your vendor.
My SNAP is really noisy	The valves might make a whiny or buzzing sound at startup. This is normal.
My Snap can't seem to run wild swinging all over the place, and can't seem to hit a set point.	Adjust PID variables, probably reduce variable "P"
My Snap seems to be "breathing"	The base pressure of the pump is probably high as well. This can be solved by resetting the PID. If SNAP is controlling too aggressively, try setting P=p/2. Want to learn more see our white paper on PID

Section 6. Servicing and Maintenance

Sensor and Plumbing

In many cases, a sensor may become fouled with oil or other foreign matter. It is often possible to restore the functionality of contaminated probes with cleaning. If the contaminant is known, the SNAP plumbing should be filled with a fluid that is known to be a solvent to that contaminant. Ethanol/alcohol are very powerful solvents and are highly effective against some contaminants.

After cleaning with solvents, the plumbing should be completely dried or flushed with a volatile solvent to assure that it is dry prior to reinstalling it. If this is not done, contamination of the system may result.

Maintenance

Your vacuum instrument should give you many years of trouble-free service. There are no regularly scheduled maintenance intervals. If consistent accuracy is required, it is recommended that the SNAP and power supply be returned for an annual calibration check.

Notes on calibration

There is inherent drift in all sensors. Repeatability is specified in the datasheet, but the specification is typically a worst case scenario as drift is not easily predicted and depends on the operating environment. Depending on your accuracy requirements, it makes sense to set up a calibration interval to obtain as found data, and get a fresh calibration. Having this information will allow you to determine the optimal calibration interval. The accepted interval is 1 year, but depends on the accuracy you require and what you have defined in your standard operating procedures (SOPs).

Note the sensors have excellent accuracy by themselves. Additional accuracy is gained by calibrating the sensor controller (sensor is integral on SNAP) to the sensor. The sensor itself cannot be calibrated, but the sensor-controller pair is. See our blog on sensor interchangeability effects on accuracy for the Bullseye Precision Gauge Piezo for more information.

Section 7. Specifications

Valves	Wetted materials: 304 Stainless Steel, Viton, and PTFE (teflon)
Range of control	2 Torr to 775 Torr
Accuracy, control	+/- 5% of
Time to converge within 5% after disturbance	reading <30
Integral sensor	seconds SEN-775i
Integral Sensor Accuracy	+/- 2 Torr
Integral Sensor Range	0.5-775 Torr
Vacuum Path Orifice	Minimum orifice of 20mm
Minimum Bleed Valve Orifice	¼" or 6.35mm hose barb I.D.
Power	100-240VAC 50/60Hz
Dual Vacuum Control	Proportional throttle and proportional bleed control (vent to atmosphere) delivered from an integral dual valve module per channel
External Sensor	Upgrade to a 10 torr capacitance manometer for improved accuracy
Output	Ability to be controlled remotely via USB or analog in/out for integration into larger systems
Recipes	Program ramps and holds vacuum at different duration and vacuum levels
Enclosure	9 ¼" width, 4 ¼" depth, 4 ¾" height
Certifications	CE, UL, CSA, (planned for 1H 2022) RoHS

Section 8. Understanding Torr

This instrument and many similar instruments are calibrated in Torr.

The pressure of the atmosphere is 14.696 or approximately 14.7 pounds per square inch at
sea level. One TORR is an absolute pressure of one millimeter of mercury. A milliTorr is equal to one thousandth of a TORR. A MICRON is the same as a milliTorr.

This pressure is due to the weight of all of the air in the earth's atmosphere above any particular square inch. This 14.696 PSI is equivalent to the pressure produced by a mercury column of approximately 29.92 inches high or .76 meters (~ 3/4 of a yard) or 760 millimeters of mercury.

Atmospheric pressure varies greatly with altitude. It decreases approximately 1 inch of mercury per thousand feet of altitude. It also varies widely with local weather conditions. (Variations of one half inch in a single day are common.)

The word “vacuum” means pressure lower than atmosphere or "suction." However, in describing negative pressure, the atmosphere is only a satisfactory reference if we are dealing with values of vacuum down to about 27 inches of mercury. Below that, it is much more useful to talk in terms of absolute pressure, starting from absolute zero

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