ACROSS INTERNATIONAL & DigiVac Scientific Measurement & Control

CONCERTO

4 Systems to 1 Pump
Vacuum & Pressure Controller

Operational Manual

YOU MUST READ THIS MANUAL BEFORE USE

June 2020

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1020 Campus Drive, Morganville, NJ 07751

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Section 1. Description and Principles of Operation

The CONCERTO is one of the latest innovations by Across International and DigiVac. The unit is a Solvent Evaporation Vacuum & Pressure Controller that can control up to **FOUR rotary evaporators** or **vacuum ovens/chambers** at once with 1 vacuum pump - ***for the first time ever***.

Mounting is bench top, control is precise, and the design is intuitive. CONCERTO offers a way to control your evaporation process like a symphony.

~ Silver Innovation Award Winner for Instrumentation at PittCon 2020! ~

SIMPLIFY YOUR LAB & CONTROL MORE WITH LESS

- Up to 4 chamber control with only 1 high-end vacuum pump for Rotary Evaporators, Falling Film Systems, Distillation, Drying or Composite systems
- Fine control of target vapor pressure for more precise compound separation through solvent recovery
- Enables using 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

GO BIG OR GO HOME & MAXIMIZE THROUGHPUT

- Largest flow paths available (17.5 mm) to insure maximum flow for faster evaporation

PRECISION CONTROL & INTUITIVE DESIGN

- Ease of use through precise automated control with programmable recipes and graphing of vacuum levels
- Innovative valve control performs both proportional throttle and bleed vacuum control (vent to atmosphere)
- The integrated bleed design allows you to quickly vent to atmosphere to stop bumping during processing or when the process ends
- Numerical readings right on the LCD screen and one touch start, stop and release buttons

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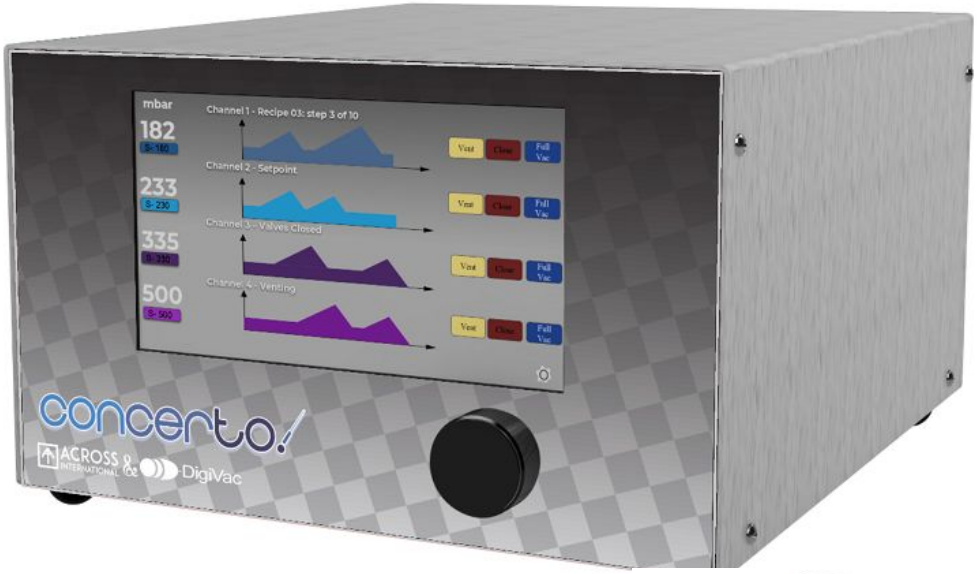
Section 2. Unpacking and Inspecting

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 CONCERTO comes with:

- CONCERTO Aluminum 4 channel vacuum & pressure controller with KF25 vacuum port for vacuum connection, 7” touch screen with knob control, vent port, 3/8" hose barbs (4) for chamber(s) and USB output
- Power cord
- Quick start guide



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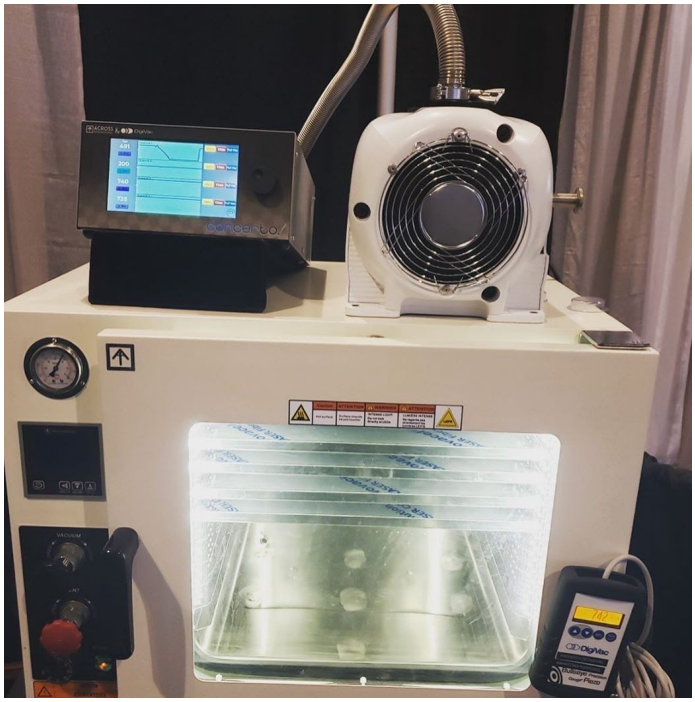
Section 3. Installation

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

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



1. **Location:** Find a suitable location for Concerto. It sits on rubber feet, and should be put in a place that easily allows access to the touch screen, but has minimal process vibration.
2. **Vacuum Pump:** Connect your Vacuum pump to the Concerto KF25 vacuum port. Using a clamp, attach the hose to the port labeled "Vacuum Pump".
3. **Connect to Vacuum System Channels:** The hose barbs are for connecting to the systems that are to be controlled. Each system should be connected to a different channel. Connect the system via a hose with 10mm or ⅜" I.D., and preferably use a hose clamp. Tighten gently.

   Note: you don't need to connect to all 4 channels. Use 1, 2, 3 or 4 channels. Users can hook up 1-4 units as they wish.

4. **Vent Port:** The Vent hose barb does not need to be connected. If you would like a gas other than ambient air to vent to your system, then connect that vent gas here. Many customers may choose dry Nitrogen.
5. **Data Capture:** Attach USB connection for data to a PC or other system.
6. **Power:** Plug in to Power and turn on

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Section 4. Controlling with the CONCERTO

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

CONCERTO 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 bleed in an inert gas**
4. **Close all valves and isolate the system**
5. **Full Vacuum**

Review a video of the CONCERTO Home Screen here

Please Note: Each of these features work independently between channels.

Which means you could have a recipe control running on one channel (rotary evaporator) and be running a set-point on another channel.

If bumping occurs in one channel, you can independently vent that channel to atmosphere without affecting the other channels.

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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 ATM or supplied gas pressure to control the system's vacuum level to the chosen set point (desired pressure level).

CLOSE CONTROL MODE (Isolate)

This mode isolates the system by closing both the vacuum port and the vent valve.

The system is isolated from both ATM and the vacuum pump with this mode activated.

FULL VAC

This mode fully closes the vent port and opens the vacuum port allowing you to fully pump down the system.

VENT

This mode closes the valve on the vacuum side and opens the valve on the bleed channel quickly venting the system up to Atmosphere (ATM). This mode is very helpful to stop bumping in a rotary evaporator.

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Controlling at a Set-Point

1. You can either control in setpoint mode or in one of the modes outlined above. The button highlighted on the screen is the mode you are in.
2. There's a button that is below the vacuum reading. It says "S-XX" and then lists the set point. You can adjust it how you'd like
3. Dial in 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

CONCERTO ships with PID variables that are optimized for average vacuum hose lengths for 20 and 50 liter vessels. The CONCERTO 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.

Each channel has its own P, I and D variables. Access to these variables is hidden behind the graph. The first part of this video brings you to the PID screen. To change a channel's PID values:

- Click on graph
- Click on gear icon (to the left of vent)
- 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: The unit ships with default PID variables of P = 0.25 ; I = 0.75 ; D = 3
If you get lost in PID, consider changing it back to those.

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.

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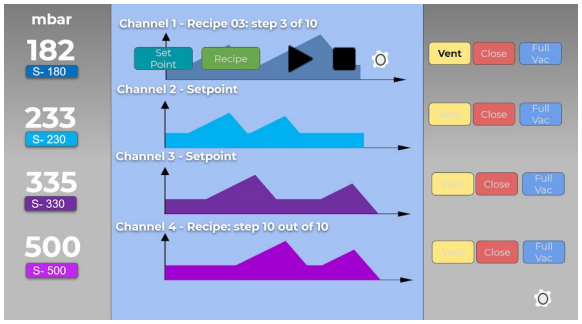
Using Recipe Mode



- Vent, Close, Full Vac, Set Point and Recipe are in a radio button configuration – when one is pressed, all others (modes) are not active
- To enter in Recipe mode, press the Recipe button

Recipe quick keys:

- Play shall continue recipe
- Pause shall stop the clock and maintain the current pressure level
- Stop shall reset the clock, maintain the current pressure level. When play is then pressed, the 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.Recipe are in a radio button config – when one is pressed, 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 10)

1. From homescreen press the gear icon on the bottom right of screen 
2. **Choose the Recipe Number to Customize:** Then Click on **EDIT RECIPE**. Once you indicate the Recipe # click on **EDIT RECIPE** button again to set it, then the customize recipe screen will show up
3. Customize recipe by **TIME** (in minutes) and **PRESSURE** (in Torr) and whether you want to **RAMP** or **HOLD**

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RAMP: pressure will change over the time frame in a ramp-wise fashion). **Example:** You want to go from 60 Torr to 40 Torr in 2 minutes. CONCERTO 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 recipe ends, it maintains the final set-point of the recipe.

Watch a video on creating custom recipes here

USB Operation

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

When connecting CONCERTO 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).

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. Calibration

The CONCERTO can be calibrated in the field provided that an accurate vacuum instrument standard exists.

Typically, that instrument standard should be 4x as accurate, or at the very least much more accurate than the CONCERTO.

The standard should resolve to better than +/- 0.5 Torr.

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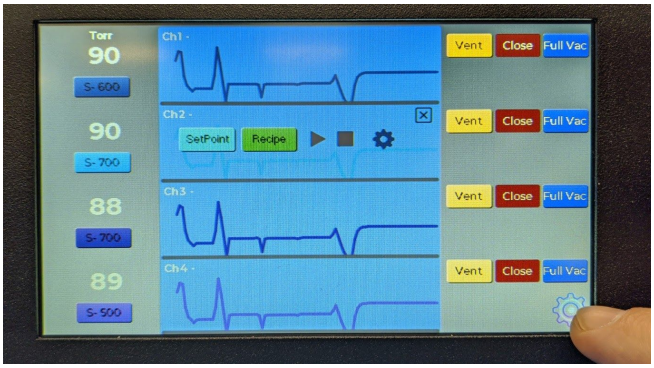
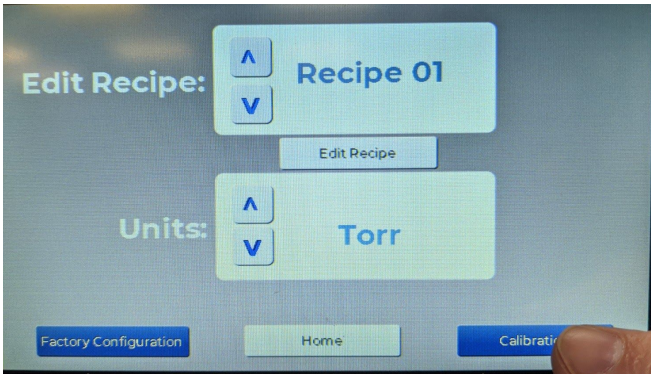
To calibrate all 4 channels of the CONCERTO:

1. Click the Settings button, as shown in the image.



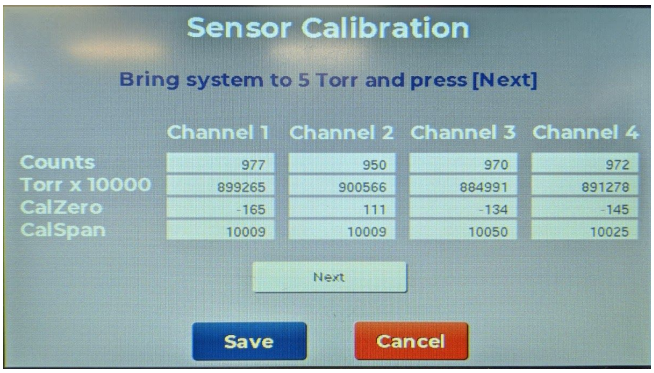
2. Next, click on calibration, as shown in the image.

3. Then, set the Manifolds to 5 Torr, as shown in the image.



4. Once it's at 5 Torr, press Next. Then it will ask you to go to 700 Torr, press Next.

5. Finally, follow the remaining instructions displayed on the screen.



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Section 6. 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 CONCERTO out of the configuration Time how long it takes for system without CONCERTO to get from the first vacuum level to the second vacuum level • Re-install the CONCERTO and run same test • If the last 2 test are close, that means the CONCERTO is performing as it should. If the last 2 tests are different, it means the CONCERTO 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 CONCERTO is really noisy	CONCERTO motors might make a whiny or buzzing sound at startup. This is normal.
My Concerto 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 Concerto seems to be "breathing"	The base pressure of the pump is probably high as well. This can be solved by resetting the PID. The Concerto is trying to aggressively, try setting P=p/2 for that channel. Want to learn more see our white paper on PID

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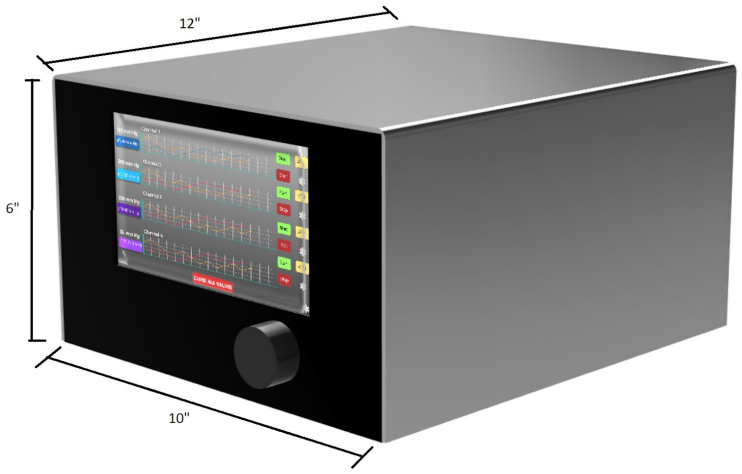
Section 7. Servicing and Maintenance

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 CONCERTO 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 CONCERTO 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 CONCERTO) 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.

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Section 8. Specifications

Valves	Wetted materials All 316 Stainless, Viton and 6061 Aluminum
Range of control	2 Torr to 775 Torr
Accuracy, control	+/- 5% of reading
Time to converge within 5% after disturbance	<30 seconds
Integral sensor	SEN-775i
Integral Sensor Accuracy	+/- 2 Torr
Integral Sensor Range	0.5-775 Torr
Vacuum Path Orifice	Minimum orifice of 12.5mm
Minimum Bleed Valve Orifice	3/8“ or 10mm hose barb
Power	Auto sensing 110V/220V 50/60 Hz power supply
Dual Vacuum Control	Proportional throttle and proportional bleed control (vent to atmosphere) delivered from an integral dual valve module per channel
4 Channels	Individually control vacuum and bleed valves for each of 4 channels with dedicated isolated sensors
Output	Ability to be controlled remotely via USB for integration into larger systems
Recipes	Program ramps and holds vacuum at different duration and vacuum levels
Enclosure	10" width, 12" depth, 6" height
Certifications	CE, UL, CSA, (planned for 1H 2020) RoHS

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Section 9. 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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