Operational Manual

YOU MUST READ THIS MANUAL BEFORE USE

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Intertek

DigiVac
Scientific Measurement & Control

Table of Contents

 732-765-0900 sales@digivac.com

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Section 1: Overview

The DigiVac FYRA is a digital vacuum control instrument that is highly configurable and capable of driving multiple types of sensors (active, passive, and capacitance manometers). It employs a 3.9" screen to intuitively display and manage multiple sensors and control points.

Its 4 main operational uses are:

1. Display Controller: for 1-4 active and passive vacuum and pressure gauges
2. Vacuum Controller: capable of maintaining vacuum by either throttling a vacuum pump

or venting gas into a vessel

3. Relay controller: capable of turning on/off valves and other gauges based on vacuum level
4. Internet Telemetry Device: capable of both monitoring and alerting users

The DigiVac FYRA has many applications from simple passive sensor monitoring to combining multiple sensors to create a wide range calibration standard, or to control a vacuum pump down. It uses a modular building block approach to build the most efficient configuration for the vacuum application. For example, two chambers can easily be monitored by FYRA when paired with 2 driver cards and gauge tubes.

By default, FYRA has a USB input that allows hardwire digital communication that can be used for logging or control. One of the great values of the FYRA is its extensive sensor compatibility. It has an extensive support matrix that includes most capacitance manometers, active and passive gauges available from Lesker, Agilent, Inficon, Pfeiffer, MKS and Setra. A support matrix is available in Section 8. FYRA was engineered for control and telemetry from the ground up, so configuring USB, Wi-Fi or Internet connectivity is a breeze.

Versatility Within Your Reach

FYRA is configured with sensors based on the accuracy and range required to sense vacuum and display the pressure reading in user selectable units of: Torr, mbar, kilopascal or millitorr. The DigiVac FYRA can be laboratory pole-mounted or sit on a bench top. It has an extensive support matrix that includes most capacitance manometers, active and passive gauges available from Lesker, Agilent, Inficon, MKS and Setra. A support matrix is available in Section 8. To achieve this versatile functionality, FYRA has a modular building block approach that allows the user to select the hardware necessary for their particular application.

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Below we illustrate 4 common configurations:

Configuration	Why	Example Applications
FYRA with 1-to-2-gauge cards and sensors plus 2 valves and valve driver cards: bleed valve and a throttle valve	Simple and safe way to maintain vacuum during distillation while providing a sweep gas to help improve molecular flow • View both condenser and backing pump vacuum measurement • Maintain vacuum level while providing a bleed of inert gas	A distiller is working to optimize efficiency of process by maintaining a vacuum level while providing a continuous flow of sweeping gas to increase molecular flow and decrease oxidation
FYRA with two gauge cards + two capacitance manometers	Simple and safe way to power and read multiple gauges • Easily connect multiple gauges to computer via a single USB cable • Ability to combine 2 capacitance manometers to yield one continuous pressure for the combined ranges	A calibration firm desires a combined reading of vacuum rather than the potential confusion of manual blending multiple gauge readings.
FYRA with one gauge card, gauge, throttle valve driver card, and throttle valve	**Enables vacuum pressure control using a standard solenoid valve for throttling pump suction** • User can maintain vacuum levels or change levels • Extends life of pump by enabling pump to run closer to its base pressure	A researcher or processor wants to maintain a specific pressure such as 10 Torr level in a vacuum oven to avoid removing target terpenes while effectively evaporating solvents (water).
FYRA with one gauge card, gauge, bleed valve driver card and VacStable bleed valve with Wi-Fi	**Enables vacuum pressure control using a small bleed valve** User can maintain vacuum levels or change those levels, and its PID response You can surf over to your gauge, adjust set points, and view your process progress anywhere there is internet	Enables a manufacturer to control optimize their freeze-drying process FYRA configurations to maintain 300 millitorr in batches to improve consistency, and will be able to conduct remote monitoring and capture process data

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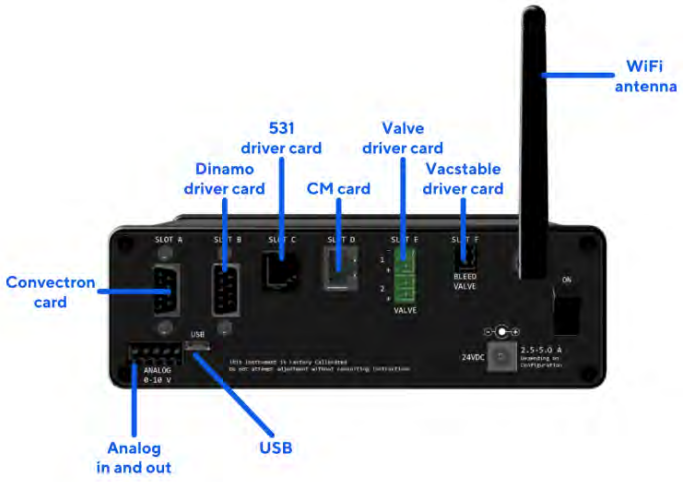
Section 2: Construction

Components of FYRA include:

The control box that all the gauges, valves, display and telemetry interface with and will be programmed and calibrated with cards needed to power and drive a number of gauges/sensors or valves based on the needs of a particular vacuum application.



FYRA controller connections:

- There are 6 slots, 1 display, 1 micro-USB, 2 analog output and 1 analog input and a power connection
- 24-volt DC power supply
- At least one sensor, sensor card and 10' gauge cable

The instrument is housed in a rugged aluminum enclosure. It can either be placed on a desktop or installed on a laboratory stand with optional lab mount.

In general, a working FYRA configuration consists of: FYRA Controller: Aluminum control box, Micro-USB port, two 10-volt DC analog output ports and a 24-volt **DC** power supply.

Configurable Options Chosen Based on Application Needs:

1. Between 1 and 4 active gauges or capacitance manometers
2. Between 1 and 4 standard 5 volt sensors, such as the DigiVac 775i piezo sensor
3. Between 1 and 4 passive gauges
4. Up to 2 valve control cards to control up to 2 valves each (total of 4) for isolation or vacuum control, or to apply a bleed to maintain a vacuum level
5. The ability to control up to 2 type "C" relays, 24 volts AC on DC, 5 amps
6. A Wi-Fi card that enables connecting to your gauge via Wi-Fi or telnet and enables connectivity to the DigiVac vacuumnetwork.org cloud monitoring service

Consult the DigiVac website www.digivac.com for information about other DigiVac vacuum controllers and gauges.

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Section 3: 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 Display Unit warranty pertains only to the instrument and does not cover losses in shipping.

Each FYRA comes with:

- Controller
- 10' Sensor cable with modular plugs that mate with the ordered driver cards
- If configured for control: valves and their respective driver cards
- 24V DC Power Supply
- Quick Start Guide

Section 4: Installation

The instrument should be placed in a clean, dry environment for best results. The control unit can be placed on a desktop with the rubber feet resting on the table surface.

Lastly, the FYRA can be mounted on a lab pole or lattice system using the optional pole clamp. The gauge tube cable should be identified by wire tags or markings specific to your environment.

The control box can be connected to a computer with a standard micro-B USB cable. The software will automatically download and install. You can then open a simple telenet program like PuTTy and issue commands to read vacuum and assign set point values.

Please use the supplied AC adapter (24 Volts DC 2.5-5.0 amps) with your instrument. Ensure that it is plunged into a grounded outlet. This adapter provides clean short, protected power to protect and insure proper functioning of the internal circuitry.

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Menus

Below is a picture of the home Screen. DigiVac will set the home screen up in the factory with the configuration ordered. There are multiple display configurations that can be switched to in the field that is most useful for your application dependent upon the types of sensors and valves ordered.

The unit is pre-configured for the available features ordered. Below is a screenshot of a unit that has 1 sensor and 1 valve:

By default, the valve is assigned to the sensor connected to slot A.

The screen enables very simple user interaction:

- Using the keypad, type in the setpoint you would like for Upper control, then click on the upper setpoint box.

- Press Clear, then type in the number you would like for the Lower setpoint control then click on the lower setpoint box to set that value.
- Changing measurement units is available from the change unit screen

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Configuration

FYRA can have one, two, or three sensors configured. Make sure the sensors, cables, and slots are labeled and named so that someone less familiar with the system can easily understand what measurement they are seeing.

Additionally, in certain cases sensors may be combined (blended) to achieve a combined virtual sensor composed of 2 or more sensors.

Capacitance Manometer Combination Options

Combination Driver	Sensors combined (blended)
2CM	0.1 Torr + 10 Torr
2CM	10 Torr + 1000 Torr
3CM	0.1 Torr + 10 Torr + 1000 Torr
775i+TC	1 mT to 775 Torr

Section 5: Operation

After installation, the Display Unit is ready for immediate operation.

NEVER DISCONNECT SENSOR OR OUTPUT WIRES WHILE UNIT IS POWERED UP.

Only connect and disconnect cables with the power to the unit unplugged. Make all connections to sensors and relay outputs with the power disconnected. In cases where the system has contaminants (i.e., in metalizing and coating applications), it is often effective to isolate the sensor with a solenoid or manual valve when contamination is most active.

To Use FYRA with relays (24 volts DC max,5 amps): *When configured with Relays*

Install FYRA and the sensor in the vessel closest to the pressure that you care about. Next, wire in the valves. The set point connections are in the back of the unit. There are 2 rows of pins. The top row of pins is for set point 1, and the bottom row of pins is for set point 2.

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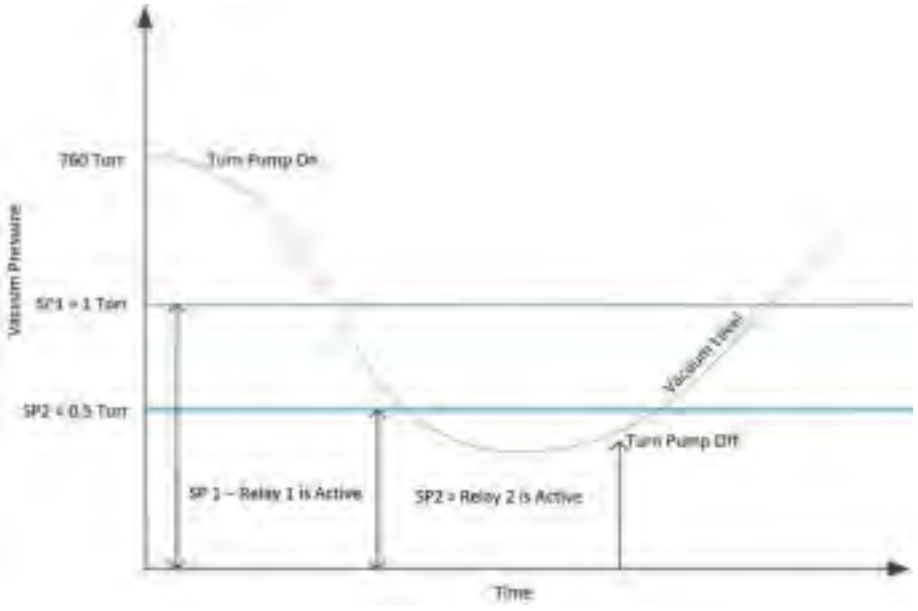
For Relay Control: The top 3 pins are in the order (when configured with relays):

1. **Common** – The common line of a switch

2. **N.C. – Normally closed |** This means that above the set point value there is a current path between the common and the N.C. terminal. Put another way the switch is "ON" between these 2 terminals.
At the set point value and below (higher vacuum, lower pressure) the connection is open. Put another way, the switch is "OFF" between the common and the N.C. connection at higher vacuum (a lower pressure reading).

3. **N.O. – Normally open** | This means that above the set point value there is no current path between the common and N.O. connection. Put another way the switch is "OFF" between these 2 terminals.
When the vacuum indication goes below the set point value (higher vacuum, lower pressure) the current path closes. Put another way the switch is "ON" between the common and N.O. connections at absolute pressure readings below the set point value.

Take care to ensure that the wire connections are made fast, and the voltage and current does not exceed 24V DC or 5A. If you need to control a device that draws more power (like a vacuum pump or heater), consider another relay in between the DigiVac FYRA output and the device to be controlled. Below is a description of how relays act as a function of vacuum level.



To Use FYRA as a Throttle Type Regulator:

By default, FYRA will have 2 ports to drive 2 valves on the throttle regulation card. **Note:** the top port is where valve 1 would be connected, with associated set points:

- U1 – for valve 1 upper set point
- L1 - for valve 1 lower set point

By The bottom port is where valve 2 would be connected, with associated set points:

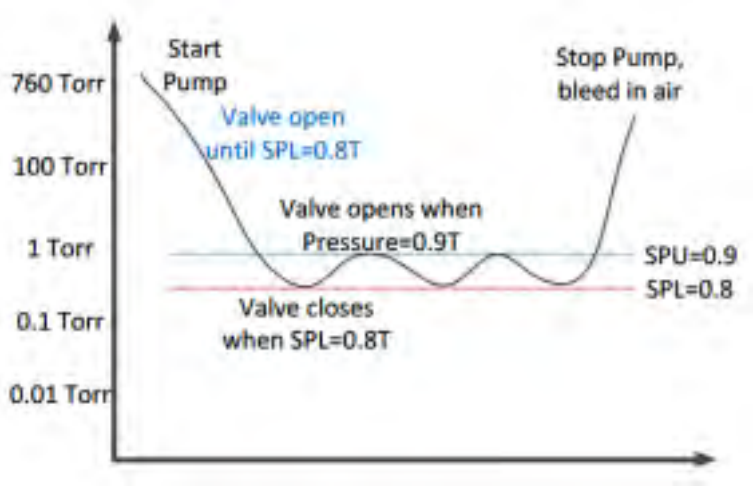
- U2 – for valve 2 upper set point
- L2 - for valve 2 lower set point

Next, plumb the valves in and configure your set points:

1. Install valve between pump and vessel.

Note: The Valve in regulation mode is powered directly by the FYRA, unlike standard relays (which require wiring to a 24V DC or other power source)

2. Install sensor near the vessel to be controlled
3. Set upper and lower set points
   - Click on the Upper Setpoint box
   - Turn encoder knob to adjust value
   - Click in the encoder or press save
   - The same process is repeated for the lower setpoint adjustment
4. Observe control and adjust as necessary



The FYRA vacuum regulator enables maintaining a vacuum pressure between two set-points. The FYRA directly powers a 24-volt DC valve (1 amp or less) by opening a valve until the lower set-point is reached, then closing the valve allowing the system to leak up to reach its upper set-point. When it reaches the upper set-point, the valve will open again. Using upper and lower set-points is an easy way to manually define the **Hysteresis | the acceptable or desired pressure range to control within.** ***The smaller the Hysteresis, the more cycling of the valve but the tighter the control.***

The FYRA vacuum regulator can operate in two different modes. One mode is “above” control in which vacuum will be regulated to keep the vacuum level above the lower setpoint. The other control is “below” control in which the valve will regulate to make sure the pressure is always below the upper setpoint.

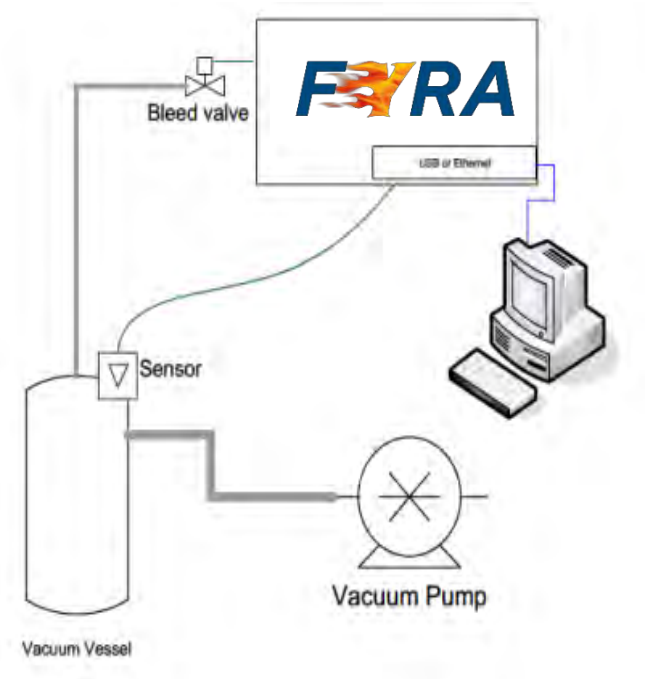
Above the set point is when you want to activate the valve or relay when the vacuum level is above the set point. For example, you may want to turn on a red light on until a target vacuum level is reached. Below the set point means that you want to activate the valve or relay when the vacuum level is below a set point. A good example of this would be turbo pump isolation. The turbo pump should only be connected to the vacuum system when the pressure was below 0.5 Torr for example.

FYRA for mass flow type gas delivery or upstream vacuum control:

FYRA can use venting to either provide a specific flow rate into a chamber, or to maintain a vacuum level by bleeding gas into a chamber. Venting for a specific flow rate (such as 75 sccm) can be achieved through setting the bleed control to flow, and then by manually using the slider bar to set a specific flow rate.

Pressing Start starts the flow at the specified level. Pressing stop closes the VacStable bleed valve and isolates any gas flow to the system. Additionally, you can press the bleed button, and enter in a specific flow rate.

Note: FYRA mass flow indication of sccm (standard cubic centimeters per minute) is approximate when the system is under vacuum. The valve achieves this flow rate through modulating a valve. If the pressure of the vessel is higher than 1 Torr, the flow rate indicated will be much less than the actual flow rate.



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FYRA | PID Tuning

Access the PID tuning variables, by selecting the gear in the lower left:

- Click on PID
- Set the variables by toggling to the desired numerical value using the plus and minus button

PID overview:

PID control is largely used in industry and refers to the variables in the control equation "**P**roportional," "**I**ntegral," and "**D**erivative."

A simple method of tuning is to set the **Integral** and **Derivative** terms to zero and the **Proportional** term to a small value. This should result in stable operation with a large residual Error.
Double the **P term** and make some large changes to the set-point and look for oscillations in the vacuum level. Keep doubling and disturbing the set-point until oscillations are seen. Once oscillations are seen, drop the **P term** back to about 40% of the current value.
Increase the **I term** slowly until the vacuum level is either stable at the set-point or oscillating slightly around it.
Leave **D** alone if response is acceptable or increase **D** to remove unwanted overshoot/undershoot.
To improve the overshoot/undershoot situation slowly increase the **D** term, disturb the set-point and repeat until satisfactory response is observed.

- **P**: is implemented as a proportional gain (not as a proportional band). Larger values of **P** yield smaller error with less stability. The range is 0.01 to 99.99 with units of %.
- **I**: is also a gain. Larger values of **I** will yield faster response with less stability. The range is 0.00 to 99.99 with units resets/minute
- The **D** Range is 0.00 to 99.99 with units of minutes.

Here are the recommended PID tuning steps:

1. To Start

a. Start with P=0.14, I = 0.08, d=0 S=Set Point (1 Torr default)
b. Increase "P" until oscillations observed at about 10% of average reading (not Set Point. the reading will likely still be lower than set point)
c. Set P=P/2 (half the oscillation value of "P" obtained above)
d. Start with I=P/4 (at this point the vacuum level should be approaching the set point)

2. Tuning

a. If oscillations are greater than desired, decrease “P” 10-20% at a time
b. If Vacuum Level is less than the set point, increase I in increments of 20% until convergence at the set point

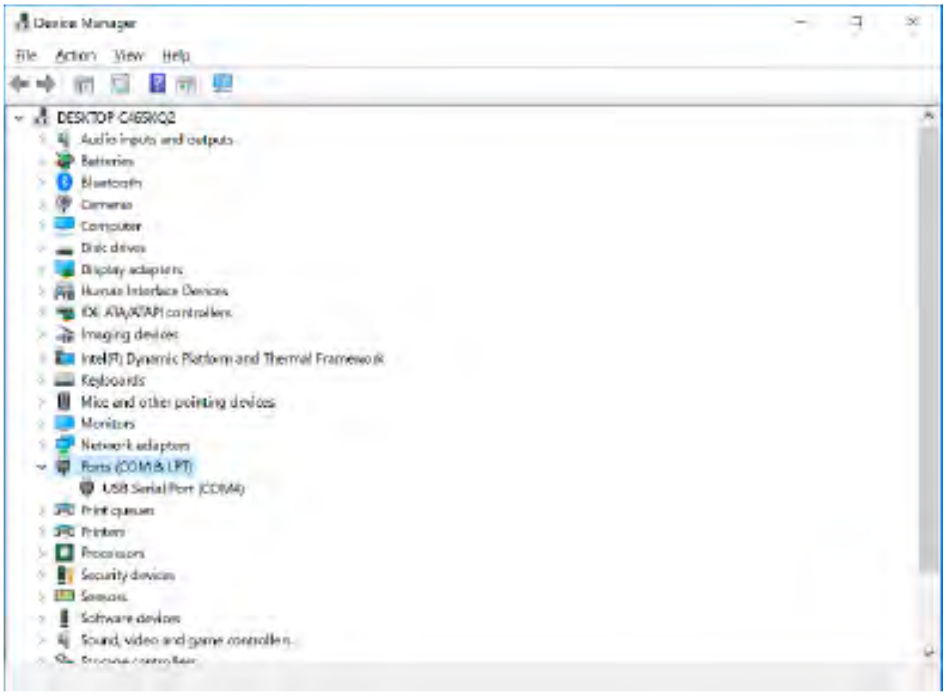
3. PID Tricks

a. If greater then preferred oscillations are occurring when I>P, try setting I=P

Communication: USB Connectivity

FYRA can display vacuum readings on a desktop in real time. To view your vacuum pressures on your desktop, you first must download PuTTY. Once the software is installed on your computer, follow the instructions on the next page.

1. Go to your device manager and review your COM port



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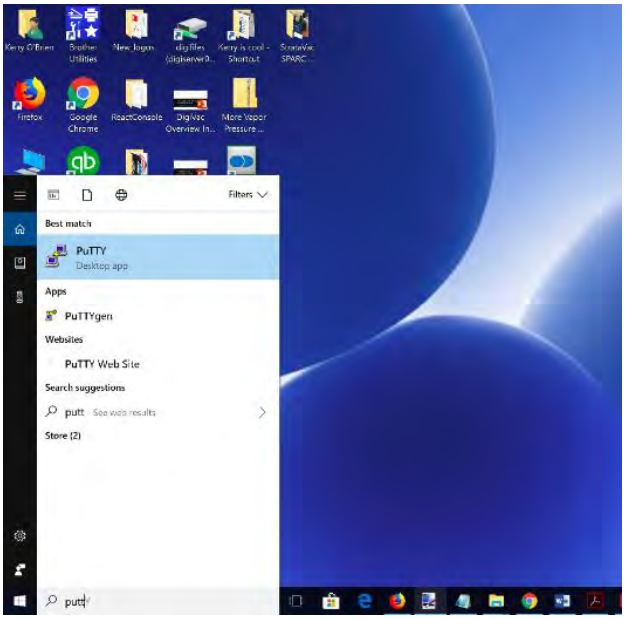
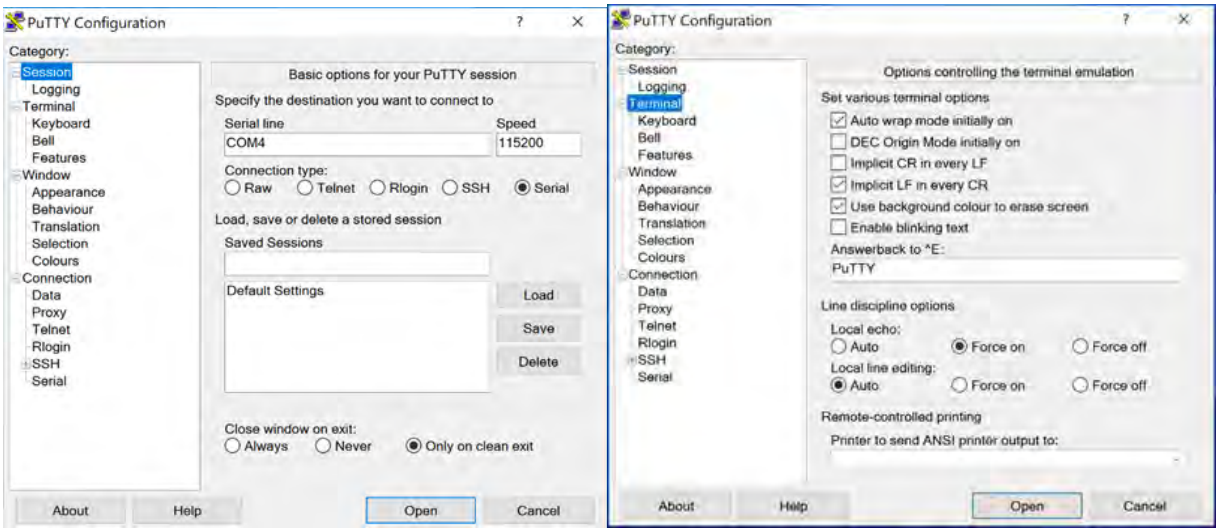
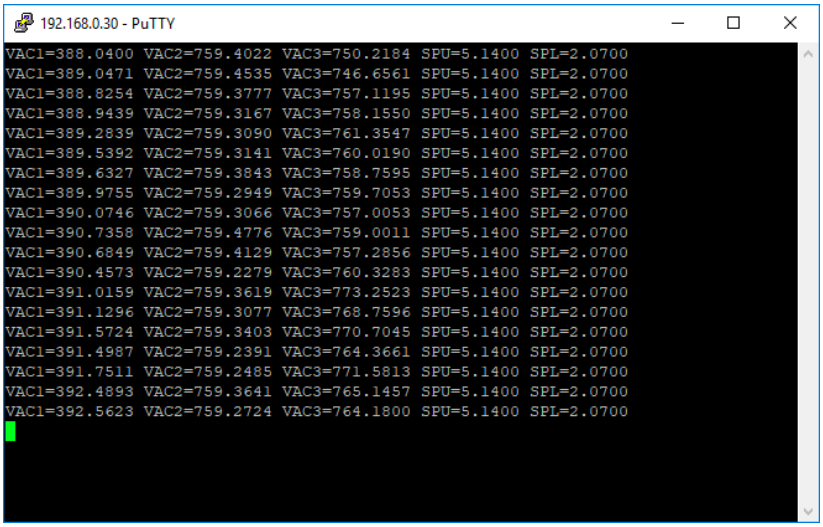
2. Open PuTTY on your desktop



3. Select "serial" as your connection type and set the speed to 115200



4. Under “Category” on the left, select “terminal” then select various terminal options. Still on this screen, select “force on” as the local echo line display. Click open.



5. View your vacuum on your desktop!

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FYRA Command-line "Cheat Sheet"

SENSOR AND VALVE CONTROLS

Sensors:

A? . . . . . Get all the sensor device info
A1? . . . . . Get sensor 1 device
A2? . . . . . Get sensor 2 device
A3? . . . . . Get sensor 3 device
A4? . . . . . Get sensor 4 device
Vac? . . . . . Get vacuum reading of blended gauge. See note below. *
**This is only applicable if using a blended gauge*
Vac1? . . . . . Get vacuum reading of sensor 1
Vac2? . . . . . Get vacuum reading of sensor 2
Vac3? . . . . . Get vacuum reading of sensor 3
Vac4? . . . . . Get vacuum reading of sensor 4

Bleed Valves:

P? . . . . . Get the P term
P=2.35 . . . . Set the P term
I? . . . . . Get the I term
I=16.78 . . . . . Set the I term
D? . . . . . Get the D term
D=8.07 . . . . . Set the D term
SPB? . . . . . Get control setpoint for bleed valve
SPAB? . . . . . Get control device for bleed valve
SPB = 10 . . . . . Set the bleed control point to 10

Throttle Valves:

SP1U? . . . . . Get the upper setpoint for Control 1
SP1U=1 . . . . . Set the upper setpoint at 1
SP1L? . . . . . Get the lower setpoint for Control 1
SP1L=.2 . . . . . Set the lower setpoint at 0.2
SP2U? . . . . . Get the upper setpoint for Control 2
SP2U=1 . . . . . Set the upper setpoint at 1
SP2L? . . . . . Get the lower setpoint for Control 2
SP2L=.2 . . . . . Set the lower setpoint at 0.2

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UNITS, TIMING, MODE AND MORE VALVES:

More Valve Controls:

SPAT1? . . . . . Get control device for Control 1
SPAT2? . . . . . Get control device for Control 2
SPA1? . . . . . Get control device for Control 1
SPA2? . . . . . Get control device for Control 2
SPA3? . . . . . Get control device for Control 3
SPA4? . . . . . Get control device for Control 4
SPF? . . . . . Get SCCM of flow
SPF=100 . . . . . Set flow to 100 SCCM
SPS? . . . . . Get setpoint for Dinamo Valve
SPS=10 . . . . . Set setpoint for Dinamo Valve

Units:

U? . . . . . .Get the current units. See below for information on response. *
*Response will be "U=0", "U=1" or "U=2". 0 = Torr, 1 = mBar, 2 = kPa
U = 0 . . . . . Set the units as Torr
U = 1 . . . . . Set the units as mBar
U = 2 . . . . . Set the units as kPa

Timing:

T? . . . . . Get the current data rate for DVCUP
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*
*Mode can either be Automatic (data is sent at specified T rate), or Manual (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 6: Control Options

DINAMO | Overview

The Patent-Pending DINAMO is designed and manufactured by DigiVac. It is two valves within one module, giving operators twice the control. The DINAMO valve is a dual valve that can deliver both proportional throttle control and proportional bleed control. Each valve has a stepper motor controlled proportional bellows valve that can be opened fully for maximum throughput or can be opened very slowly for precise control.

• **Pump Side:** One side of the valve will be connected to a vacuum pump to modulate the suction to a vessel. The internal vacuum flow paths have a minimum internal diameter of 20mm.

• **Vacuum Side:** The vacuum side of the DINAMO has a minimum orifice size of 12.5mm -which is sufficient conductance to pull most systems well down into the medium vacuum region.

• **Bleed Side:** The bleed side of the valve has a minimum orifice size of 1/4", which is generally sufficient to bring larger systems greater than 100 Liters up to Atmosphere.

This valve is ideal for low-vacuum processes. Key benefits of this valve include precise control, quiet flow control, low power, faster pump down, and higher throughput. It can be used for soft start, throttling and isolation. Furthermore, it can be used to gently bleed in air or another inert gas to bring a vessel back up to atmospheric pressure to help avoid disturbing or making the contents of the vessel turbulent.

DINAMO | 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 Display Unit Warranty pertains only to the instrument and does not cover losses in shipping.

Each DINAMO comes with:

- Dinamo Valve with two KF25 fittings and a hose barb, two cables to plug into FYRA
- FYRA controller unit w/ Display
- 24V power supply
- 775i Sensor (installed in Dinamo valve) and M12 4 pin sensor cable

DINAMO | Installation

Locate the valve in a clean and dry environment for best results. Hooking the DINAMO up to a system is a simple, two-step process:

1. Take the hose connected to your pump. Make sure the hose ends in a KF25 fitting. Using a clamp, attach the hose to the port labeled “To Pump”.
2. Take the hose coming off your system, it should also end in a KF25 fitting, and attach it to the port labeled “To System”.

Now, it's time to set up the FYRA:

1. Connect the Dinamo valves to FYRA according to the labels on the ends of the cables. The cables plug into the back of the black box unit. Cable ends are marked "T" and "B", "T" connector (Top) goes into the top slot of the valve card, "B" connector (Bottom) goes into the bottom slot of the valve card on the rear of the unit.
2. Plug the 775i sensor into the FYRA controller using the provided cable. There are two M12 style cables, make sure you are using the 4-pin sensor cable. You must push the cable down and turn (Clockwise to install) at the same time. Cable is keyed to prevent incorrect insertion.
3. Connect the display to the main unit using the 12 pin M12 cable. Push and turn at the same time, cable is keyed for alignment.
4. Connect the main unit to power using the 24V power supply and power on the unit by hitting the switch in the back

DINAMO | Controlling with DINAMO Valve when paired with a DigiVac Controller

After installation, the unit is ready for immediate operation. This section will go over how to operate, and control, with your DINAMO Valve. The Dinamo valve offers a few different control features.

OVERVIEW OF OPERATIONAL DINAMO MODES

- **CLOSE |** This closes both vacuum and bleed valves
- **VENT** | This closes the valve on the vacuum side and opens the valve on the bleed side venting the system up to Atmosphere
- **FULL VAC** | This closes the bleed channel and opens the vacuum channel allowing you to fully pump down your system.

Controlling at a set-point

Modulate your process with a push of a button: CLOSE, VENT, FULL VAC, or by Set-point.

1. The button highlighted on the screen is the mode you are in. Shown Below. The number is the current set-point.
2. Click on the set-point button and you will be brought to a set-point adjustment screen
3. Type in the set-point value you would like to achieve, then click on the set-point box on the left-hand side of the screen. You will see the number move into the set-point box. Press SAVE to save this set point. When you return to the main screen you will see the updated set-point in the Proportional box on the screen.
4. You are now ready to begin controlling

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DINAMO | Communicating with the FYRA

FYRA will come configured to connect your wireless network. Communicating with the FYRA vacuum controller will only require a few steps:

1. Search for a Wi-Fi network called "K19E22"
2. Connect to it and navigate to 192.168.4.1 using a web browser
3. Access IP Address and note IP Address provided by unit. If not provided, contact DigiVac
4. Connect back to your own Wi-Fi
5. Open Putty and select telnet
6. Enter in the IP Address provided by the unit and then click start
7. A terminal window should open with communication from the device streaming across

For more information on this process your view this Wi-Fi addendum.

DINAMO Specifications

Range of control: 5 millitorr to 800 Torr **Standard Measurement/Control Range with 775i:** 1 Torr to 775 Torr **Can be configured to cover the full range of vacuum with multiple sensors**
Accuracy, control: +/- 5% of reading
Time to convergence: within 5% after disturbance <30 seconds
Integral sensor: SEN-775i, other options available for control at desired range
Integral Sensor Accuracy: +/- 2 Torr
Integral Sensor: (775i-isolated Piezo) range 0.5-775 Torr
Power: 4 wire unipolar stepper drive
Enclosure: Open
Certifications: CE, UL, CSA
Wetted Surface: Aluminum **Orifice:** 19mm

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Section 7: Factory Repairs and Calibration

The vacuum gauge assembly is designed to provide years of trouble-free service, and the liberal internal use of plug-in components makes it easily repairable. No field servicing of the unit is recommended, other than replacement of the gauge tube, but factory servicing and calibration are available at a nominal cost. At minimum, DigiVac recommends annual calibrations to keep your controller at top performance and stated accuracy specifications.
We are here to help. Phone: 732-765-0900 Email: sales@digivac.com

Cleaning:

Unplug the valve from the gauge unit and the pump and pour some isopropyl alcohol into one side. Allow it to soak for about an hour, placing your hand over the flange and shaking the valve periodically to agitate the solvent. Flip it on a paper towel to let it drain.

Repeat this procedure on the other side of the valve as well. Let the valve air-dry completely before energizing. **Consult factory for cleaning instructions if required.**

Section 8: Understanding Torr

The Display Unit are calibrated in microns or "millitorr." What are microns and how do they relate to other measures of pressure and vacuum?
Microns are not really a measure of vacuum at all, but rather of absolute pressure. The pressure of the atmosphere is 14.696 or approximately 14.7 pounds per square inch (PSI) at sea level. This pressure is due to the weight of all the air in the earth's atmosphere above any 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 (about 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 1/2 inch in a single day are common.) The word vacuum means pressure lower than atmosphere. 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 better to talk in terms of absolute pressure, starting from absolute zero, which is the approach that DigiVac takes with our display instruments.
One TORR is an absolute pressure of one millimeter of mercury. A millitorr is equal to one thousandth of a TORR. A MICRON equals a millitorr. The full scale reading of a DigiVac gauge is 1999 microns and is equivalent to 1.999 TORR of approximately 2/760 of atmospheric pressure. This is less than .1 inches of mercury, and less than .05 PSI.

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Section 9: Attachments and Illustrations

Gauges/Sensors Supported by FYRA

Description	Manufacturer	Supported Part Numbers	Sensor Interface	Number Supported	Required Card	Required Adapter	Driver
DPCP Quantum	DigiVac	SEN-DPCP-11101117	FCC68	3	AG-CM-STR	none	DCP
DCP Quantum	DigiVac	SEN-DCP-11101117	FCC68	3	AG-CM-STR	none	DCP
DPP Quantum	DigiVac	SEN-DPP-11136119	FCC68	3	AG-CM-STR	None	P25
DPP Quantum	DigiVac	SEN-DPP	9-pin D-sub	3	AG-CM-STR	ADP-DB9	925
KJLC Pirani	Lesker	PIR-xx-x	FCC68	3	AG-CM-STR	none	Pir
KJLC Cold Cathode	Lesker	CCG-xx-x	FCC68	3	AG-CM-STR	none	CC
KJLC Cold Cathode Pirani	Lesker	CCPG-xx-x	FCC68	3	AG-CM-STR	none	CCP
PVG-500 Pirani	Agilent	PVG500xxxxx	FCC68	3	AG-CM-STR	none	PV5
PVG-550 Pirani	Agilent	PVG550xxxxxxx	FCC68	3	AG-CM-STR	none	P55
IKR251 Cold Cathode	Pfeiffer	PT R25 500	Hirschmann	3	AG-CM-STR	CM-HIR-STR	ihr
FRG-700 Inverted Magnetron Pirani	Agilent	FRG70xxxxx	FCC68	3	AG-CM-STR	none	F70
PCG-750 Pirani Capacitance Diaphragm Gauge	Agilent	PCG75xxxxxxxx	FCC68	3	AG-CM-STR	none	P75
PKR251 Inverted Magnetron Pirani	Pfeiffer	PT R26 000	Hirschmann	3	AG-CM-STR	CM-HIR-STR	P25
MPG400/401 Inverted Magnetron Pirani	Inficon	351-xxx	FCC68	3	AG-CM-STR	none	iP4
PSG5xx ATM to Medium Vacuum Gauge	Inficon	350-xxx	FCC68	3	AG-CM-STR	none	Pir
Gemini MAG500 Cold Cathode	Inficon	3MAx-xxx-x0xQ	FCC68	3	AG-CM-STR	none	CC
Gemini MPG500 Cold Cathode Pirani	Inficon	3MBx-xxx-x0xP	FCC68	3	AG-CM-STR	none	CCP
PCG550 Pirani Capacitance Diaphragm Gauge	Inficon	3PCx-01x-000x	FCC68	3	AG-CM-STR	none	P75
531 or 536 thermocouple vacuum gauge tube	Agilent	SEN-53x-xxxx	US-08	3	531-STR	none	TC

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Gauges/Sensors Supported by FYRA Cont.

Description	Manufacturer	Supported Part Numbers	Sensor Interface	Number Supported	Required Card	Required Adapter	Driver
Sky Ambient Capacitance Manometer	Inficon	3xx-00x	DB15	3	AG-CM-STR	CM-DB15-STR	CM
Sky 45 Capacitance Manometer	Inficon	3CC1-x5xx30x	DB15	3	AG-CM-STR	CM-DB15-STR	CM
Sky 100 Capacitance Manometer	Inficon	3CD1-x5x-230x	DB15	3	AG-CM-STR	CM-DB15-STR	CM
Sky 200 Capacitance Manometer	Inficon	3CF1-x5x-2300	DB15	2	AG-CM-STR	CM-DB15-STR	CM
Stripe Capacitance Manometer	Inficon	3CC9-x5x-2380	DB15	3	AG-CM-STR	CM-DB15-STR	CM
626 Capacitance Manometer	MKS	626Cxxxyz	DB15	3	CM-STR-DS	CM-DB15-STR	CM
AA01A Capacitance Manometer	MKS	AA01AxxTxxx3x00xxx	DB15	3	AG-CM-STR	CM-DB15-STR	CM
722B Capacitance Manometer	MKS	722BxxTxx2FA	DB9	3	AG-CM-STR	CM-DB9-STR	CM
730B Capacitance Manometer	Setra	730G-xxxx-A-xx-2C-D9-X	DB9	3	AG-CM-STR	CM-DB9-STR	CM
Porter Capacitance Manometer	Inficon	3CAx-x5x-0000	FCC68	3	AG-CM-STR	none	CM
CDG500	Agilent	CDG500Txxxxxxxx	DB15	3	AG-CM-STR	CM-DB15-STR	CM

*note "x", "y", or "z" in part number means the part number can contain any option in that place

Types of Active Gauges Supported

Name		Electrical Interface	Equation
PiR	**PVG500 Pirani Active Gauge**	**FCC68 (RJ45)**	$p = 10^{((V-c)/1.286)}$ **c=6.304**
CCP	**MPG 500 Cold Cathode Pirani Active Gauge**	**FCC68 (RJ45)**	$p = 10^{(1.667 \times V-d)}$ **d=11.46**
CC	**MAG 500 Cold Cathode Active Gauges**	**FCC68 (RJ45)**	$10^{(0.75*(V-c))}$ **c=12.826**

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Sensor Options

Sensor ID	Gauge Name	Description
0.1	0.1 Torr ambient capacitance diaphragm gauge	0.1 Torr gas independent gauge for high accuracy measurement
1	1 Torr ambient capacitance diaphragm gauge	1 Torr gas independent gauge for high accuracy measurement
10	10 Torr ambient capacitance diaphragm gauge	10 Torr gas independent gauge for high accuracy measurement
100	100 Torr ambient capacitance diaphragm gauge	100 Torr gas independent gauge for high accuracy measurement
1,000	1,000 Torr ambient capacitance diaphragm gauge	1,000 Torr gas independent gauge for high accuracy measurement
CC	Cold Cathode Gauge	Cold cathode inverted magnetron high vacuum gauge
CCP	Cold Cathode + Pirani Combination Gauge	Combination cold cathode inverted magnetron Pirani gauge
PiR	Pirani Gauge	Advanced digital Pirani gauge with stainless steel sensor cell

Inficon SKY Capacitance Manometers supported

STRATAVAC Sensor ID	Electrical Interface	Description	Equation
0.1	*DB-15	0.1 Torr gas independent gauge for high accuracy measurement	P=V/100
1	*DB-15	1 Torr gas independent gauge for high accuracy measurement	P=V/10
20	*DB-15	20 Torr gas independent gauge for high accuracy measurement	P=2 x V
50	*DB-15	50 Torr gas independent gauge for high accuracy measurement	P=5 x V
10	*DB-15	10 Torr gas independent gauge for high accuracy measurement	P=V
100	*DB-15	100 Torr gas independent gauge for high accuracy measurement	P=V x 10
1,000	*DB-15	1,000 Torr gas independent gauge for high accuracy measurement	P= V x 100

*Requires ADP-DB15-STRC Adaptor

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Other Types of Active Gauges Supported

Name		Electrical Interface	Equation
523	**MKS 523C Cold Cathode Gauge	DB-9	$p = 10^{(2 \times V-8)}$
P25	MPG400/401 Cold Cathode Pirani Gauge	FCC68 (RJ45)	$p = 10^{(1.667 \times V-d)}$ d=11.46

**Support with ADP-DB9-523-STR Adaptor

MKS Capacitance Manometers supported

Sensor ID	Electrical Interface	Description	Equation
1	**DB-9	722B 1 Torr gas independent gauge for high accuracy measurement	P=V/10
20	**DB-9	722B 20 Torr gas independent gauge for high accuracy measurement	P=2 x V
50	**DB-9	722B 50 Torr gas independent gauge for high accuracy measurement	P=5 x V
10	**DB-9	722B 10 Torr gas independent gauge for high accuracy measurement	P=V
100	**DB-9	722B 100 Torr gas independent gauge for high accuracy measurement	P=V x 10
1,000	**DB-9	722B 1,000 Torr gas independent gauge for high accuracy measurement	P= V x 100
0.1	*DB-15	A-Baratron AA01 0.1 Torr gas independent gauge for high accuracy measurement	P=V/100
1	*DB-15	A-Baratron AA01 1 Torr gas independent gauge for high accuracy measurement	P=V/10
20	*DB-15	A-Baratron AA01 20 Torr gas independent gauge for high accuracy measurement	P=2 x V
50	*DB-15	A-Baratron AA01 Torr gas independent gauge for high accuracy measurement	P=5 x V
10	*DB-15	A-Baratron AA01 10 Torr gas independent gauge for high accuracy measurement	P=V
100	*DB-15	A-Baratron AA01 100 Torr gas independent gauge for high accuracy measurement	P=V x 10
1,000	*DB-15	A-Baratron AA01 1,000 Torr gas independent gauge for high accuracy measurement	P= V x 100

*Requires ADP-DB15-STR Adaptor **Requires ADP-DB9-STR Adaptor

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SPECIFICATIONS

Power:	24Vdc,2.5-5A powered by an external power supply rated 100-240V~,50-60Hz 1.5A with 24Vdc,5A,120W output
Vacuum Interface:	As ordered
Sensor Cable Length:	Dependent on sensor(s) installed
Range:	Dependent on sensor(s) installed
Units:	Torr, mBar, kPa, microns
Mount:	Bench Top; pole mount
Display:	3.9" touch screen
Dimensions, control box:	1.7"H x 3.52" W x 5.35" Deep
Controls:	5-amp, 24 Volt DC (when ordered)
Telemetry Options:	Micro USB, WIFI is optional
Flow rate:	25 to 3627 sccm, +/- 15% calibrated in air
Bleed vacuum control	10 millitorr to 10 Torr
Throttle vacuum range	0.001 - 760 Torr
TC	Excites the sensor at 160-460 milliamps it returns a signal at 3-14DC
Capacitance Manometer	Excites the sensor at 24v DC. Sensor returns a 0- 10V linear signal.
Convectron Gauge	Excites the sensor with a max of 12v DC sensor returns a nonlinear signal from 3.75V-5.75V proportional to pressure
Bellows and Plunger	Same card which can support up to two24V valves each valve drawing up to 45watts
Dinamo Valve	Driven by two 24V PWM stepper motor divers
Analog input	0~10V DC, input impedance 300K
Analog output	0~10V DC
Environment	Clean dry environment 0 - 50 C
Certifications/Conformity	CE, CSA, RoHs, Pending ETL certification by Intertek

Section 10: Terms of Use, Limited Warranty, and Liability Waiver

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