宜准 INSTRUE

- Wide range measurement from atmosphere to 1.0E-5Pa
- Support local and real time display
- Low maintenance frequency and long working period
- Temperature compensation to eliminate the interference of ambient
- Selectable display unit: Pa, Torr and mBar
- Support RS485 MODBUS data communication
- Support analog voltage signal output
- Support dual programmable setpoint switch outputs
- Support communication with PC application software GaugeReader

WPC400/ PVC410

Integrated Pirani Penning Vacuum Gauge

Operation Manual

INSTRUE, Makes Vacuum Measurement Easier.

1. Model Guidance

Integrated Digital Display Pirani Cold Cathode Vacuum Gauge

WPC 400 X (X for Vacuum Flange，A:KF25，B:KF40，C:CF25，D：CF35)

Integrated Pirani Cold Cathode Transmission Gauge

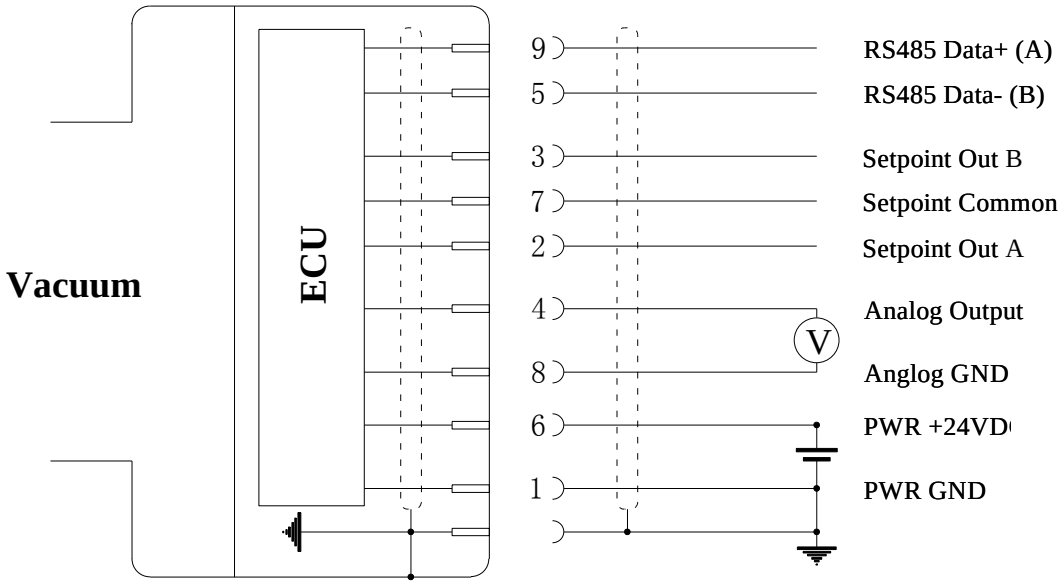
PVC 410 X (X for Vacuum Flange，A:KF25，B:KF40，C:CF25，D：CF35)

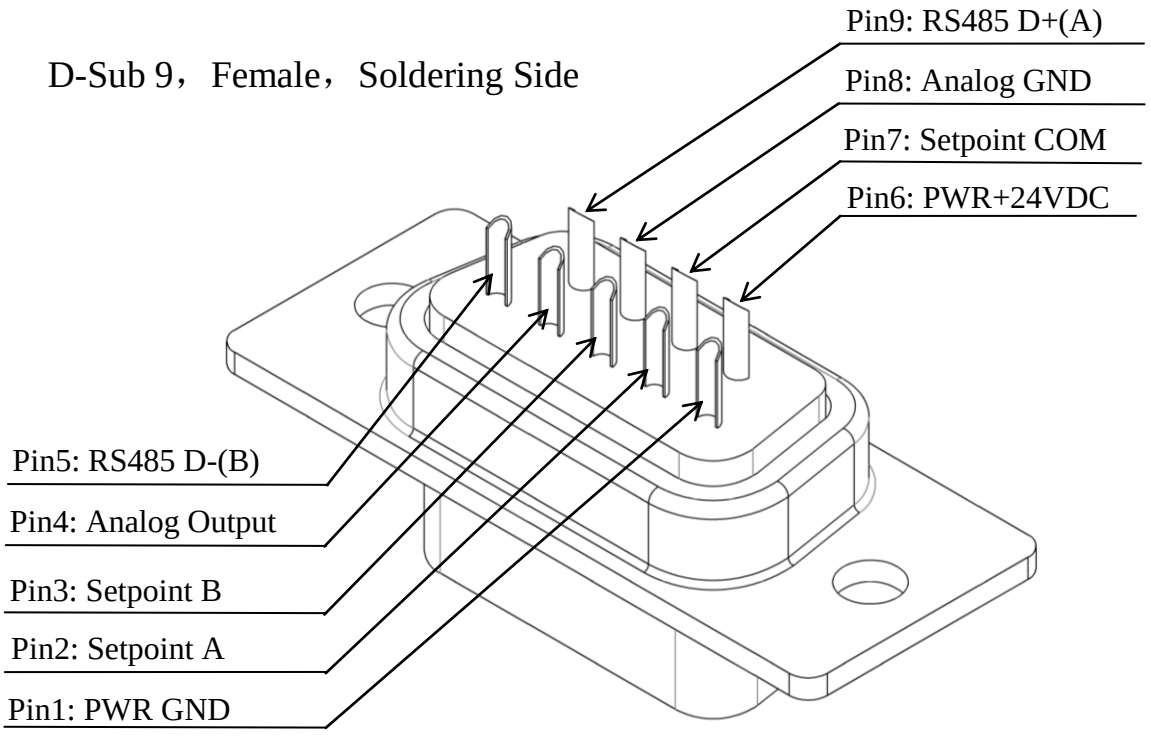
2. Specifications

Parameters	**Technical Data**	
	WPC400	**PVC410**
Measurement Range	1.0×10^{-5} ~$1.0\times10^{+5}$ Pa (Air, N_2)	
Accuracy	1.0×10^{-5} ~1.0×10^{-4} Pa : ±35% 1.0×10^{-4} ~$1.0\times10^{+4}$ Pa : ±25% $1.0\times10^{+4}$ ~$1.0\times10^{+5}$ Pa : ±50%	
Repeatability	1.0×10^{-5} ~$1.0\times10^{+3}$ Pa : ±5% $1.0\times10^{+3}$ ~$1.0\times10^{+5}$ Pa : ±25%	
Pressure withstand	Max. $1.5\times10^{+5}$ Pa	
Response Time	< 100 ms	< 50 ms
Working Environment	0 ºC ~ +45 ºC； 5 ~ 85 %, No Condensation	
Storage Environment	-40 ºC ~ +75 ºC； 5 ~ 90 %, No Condensation	
Signal Output	5-digit LED Display, Unit Optional	NA
	Dual Setpoint Control Relay Output, 60VDC 0.5A	NA
	RS485， 9600 bps，Modbus RTU	
	Analog Output +0.0V~+10.0VDC	
Electrical Interface	DSub9 Male Socket	RJ45 Socket
Power Supply	+16~+32 VDC /0.5A ； Max. 2.5W	
Protection	IP40，IEC529	
Vacuum Flange	Standard DN 25 ISO-KF； Others to be Customized	
Weight and Size	420g (KF25)， 130H X 60W X	310g (KF25)，90H X 41Dia.
Materials in Vacuum	SS304, Kovar Alloy, Tungsten, Glass	

Note : Due to R & D and new product launch, INSTRUE reserves the right to modify this document. Please keep in touch with the original factory!

3. WPC 400：DBSub9 Pin Assignment

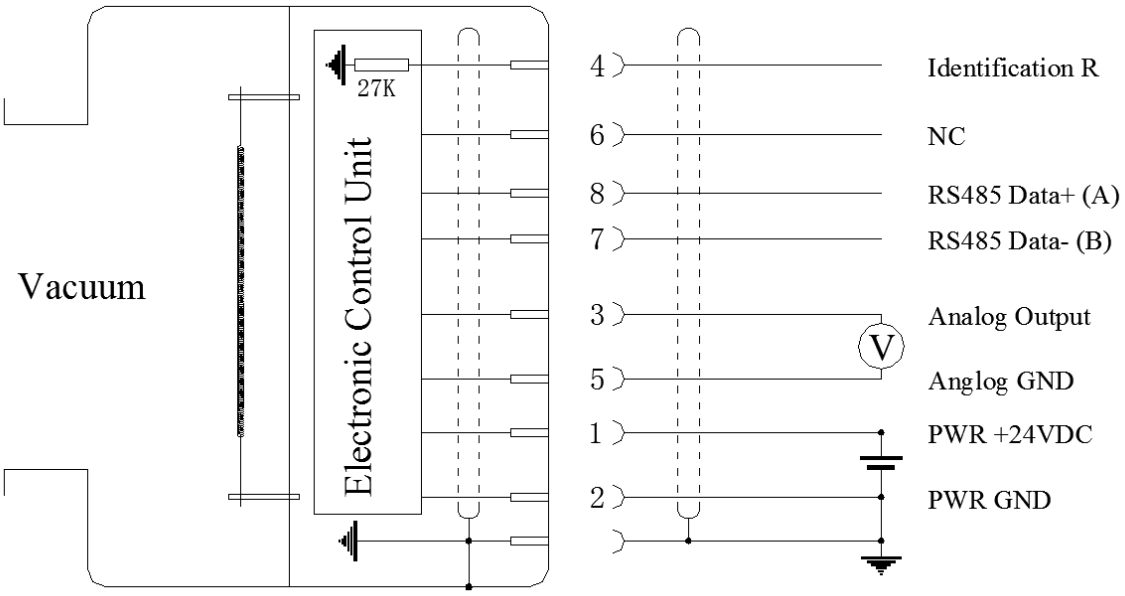




Caution

Pay Attention on D-Sub 9：Male, Female, Socket, Soldering Side.

4. PVC 410：FCC-68 Pin Assignment



FCC-68 Plug Definition

Pin1:+24VDC

Pin2:Power GND

Pin3:Analogy Output

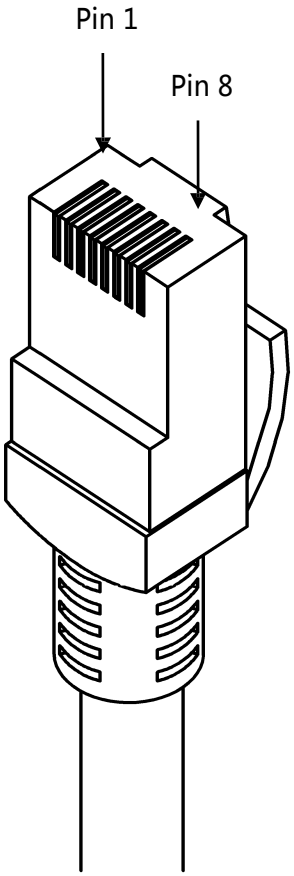
Pin4:Identification 27KΩ

Pin5:Analog GND

Pin6: NC

Pin7: RS485, Data-

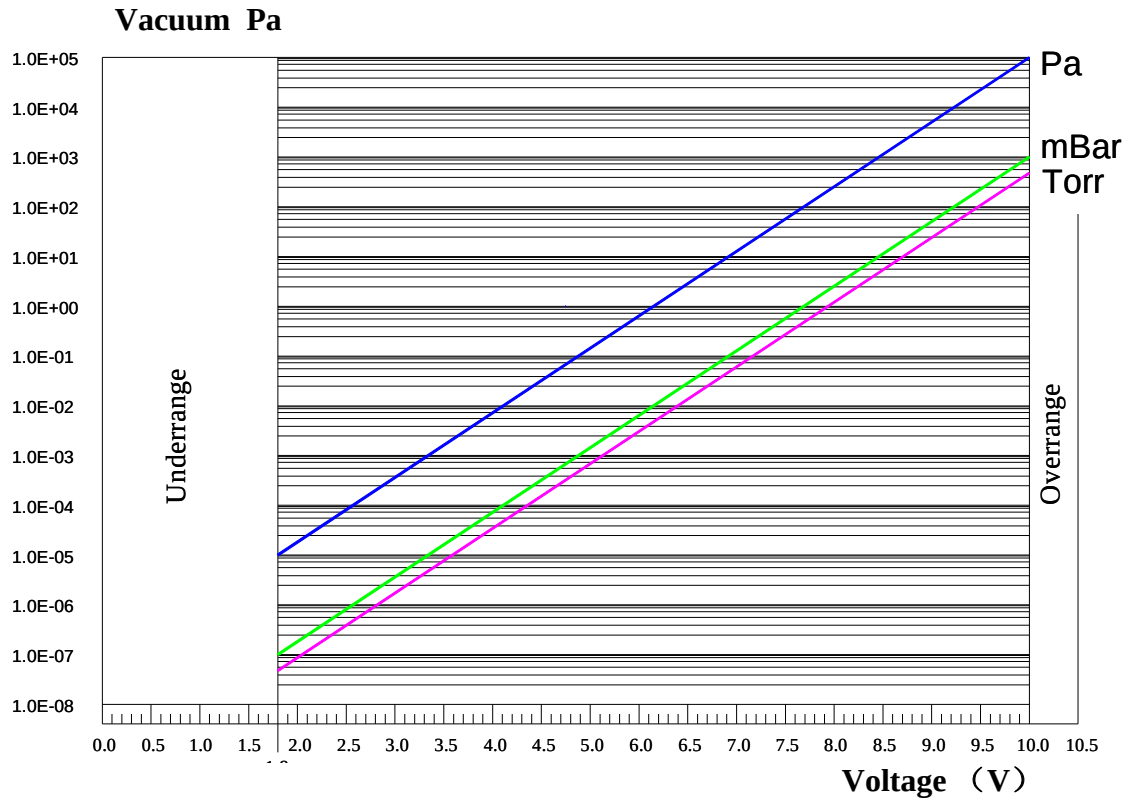
Pin8: RS485, Data+



5. Analog Signal Output

Pin 4 / Pin 8 of the connector provides the analog voltage value of real-time vacuum pressure.

Measuring Signal Range：+1.8V ~ +10.0VDC, 2.5mV resolution.



Relationship between analog voltage output signal and vacuum pressure:

$$P=10^{1.222(U-C)} \Longleftrightarrow U=C+0.818\lg P$$

Here P : Vacuum Pressure
U : Analog Voltage (V)
C : Constant

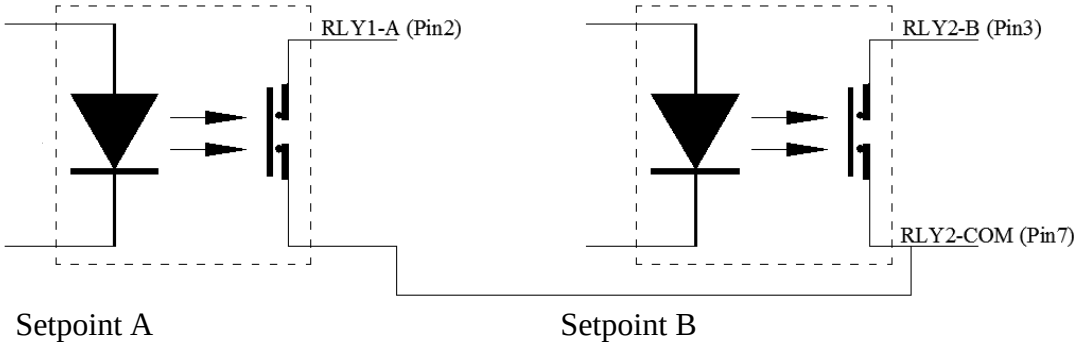
U	P	C
(V)	Pa	5.909
(V)	mBar	7.545
(V)	Torr	7.647

6. Setpoint Switch Setting

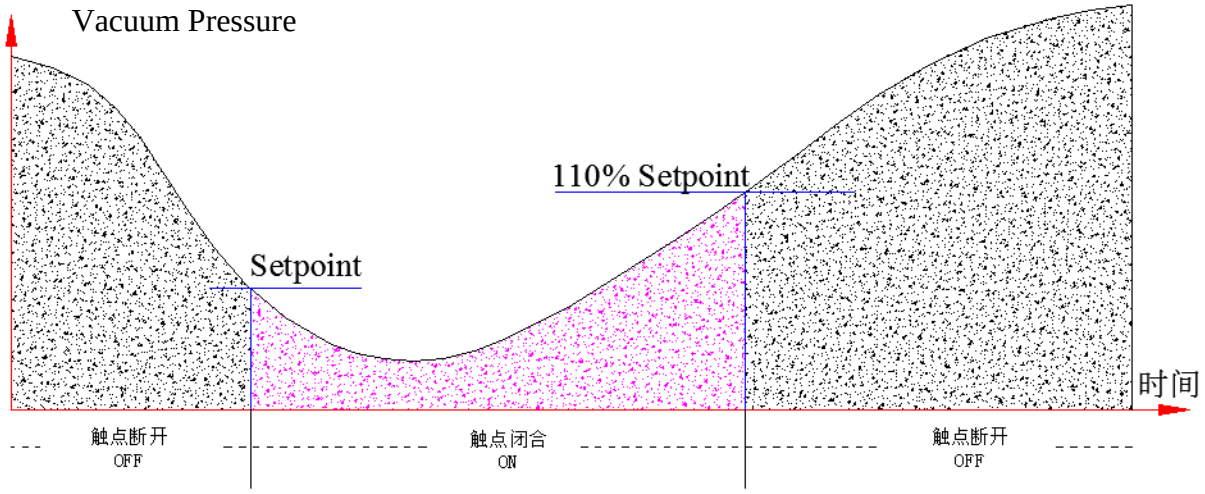
WPC400 has two setpoint switches that can be set independently, and the vacuum pressure at the switching point can be set through the top keys

The set value range of the change-over switch is 5.0e-5 PA ~ 9.9e + 4 PA.

The contact capacity of the relay is 60VDC 0.5A, which is normally open. The setting value is defined as that the relay switches to the on state. When the vacuum pressure is lower than this setting value, the output is "on". When the vacuum pressure rises to 110% of the setting value, the signal output is "off".



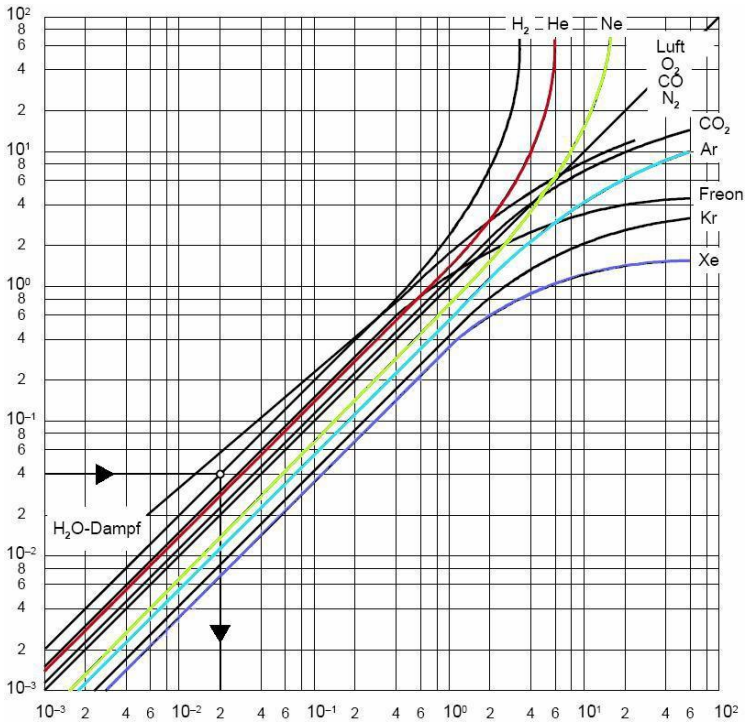
Setpoint Relay Diagram (60VDC/600mA)



Setpoint Diagram

7. Gas Type Dependence

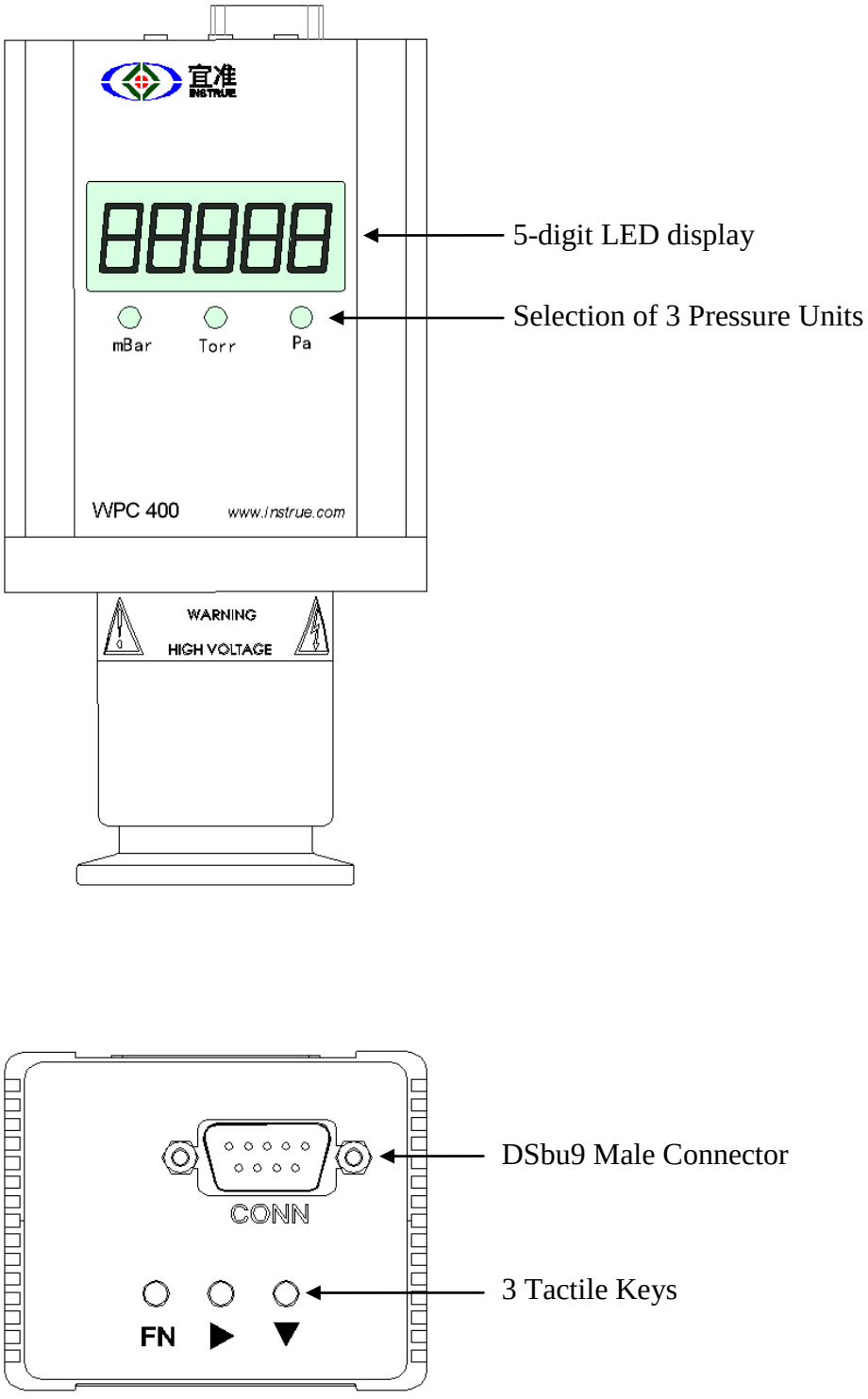
For Pirani portion of WPC400, the measurement is sensitive to the type of gas in the system. The different gases have different masses and hence will take different amounts of heat out of the wire. However, this does mean that if the gauge is calibrated using air or N_2 and is then used to measure a process gas such as Argon, there will be an error in the pressure measurement. The error is reproducible and so in most cases the pressure is accepted as being a relative, but reproducible, measure of pressure.



For cold cathode portion of WPC400, the results of vacuum measurement are related to the gas composition, and the relevant correction factors are shown in the table below.

	Gas Type	Calibration Factor C
P_{eff}=C x Indicated Pressure Where	Air, O_2, CO	1.0
	N_2	1.0
	He	5.9
	Ne	4.1
	H_2	2.4
	Ar	0.8
	Kr	0.5
	Xe	0.4

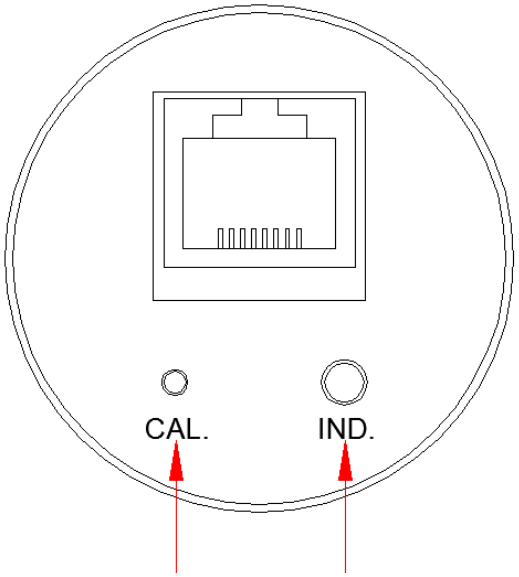
8. WPC400 Panel Demonstration



9. WPC400 Key Operation Instructions

MENU Key	Display	▶ Key	▼ Key
Press 1 & Hold	ATP	Press to calibrate atmospheric pressure	NA
Press 2 & Hold	HUC	Press to implement zero calibration	NA
Press 3 & Hold	—	Press to show SP1 value, then press again to flash one digit which can be changed	Press repeatedly to change the flashing number and set the vacuum pressure of the setpoint
Press 4 & Hold	— —	Press to show SP2 value, then press again to flash one digit which can be changed	Press repeatedly to change the flashing number and set the vacuum pressure of the setpoint
Press 5 & Hold	U	Press the display unit repeatedly to select: Pa, Torr, mbar	NA
Press 6 & Hold	d	Press to select the display format. S is the scientific counting format and N is the floating format	NA
Press 7 & Hold	Ad	Press to show the RS485 address on last two digital LED, and then press repeatedly to flash the digit which can be changed.	Press repeatedly to change the current flashing digit setting (0-9). Address 01 ~ 99 can be set.
Press 8 & Hold	AUT	Select whether the Pirani zero is automatically calibrated. Set 1 as automatic calibration that the zero calibration is implemented when ion gauge reaches high vacuum. Set 0 to turn off the automatic zero calibration function.	NA
Press 9 & Hold	DFL	Restore the factory settings	NA

10. PVC410 Key Operation Instructions



Calibration

- The LED is on after power on and flashes once when RS485 communicates one time.
- CAL. key calibration only calibrates the atmospheric pressure and zero of the Pirani sensor. The calibration and adjustment within the of ion gauge can only be carried out by the original manufacturer, and the user cannot operate.
- Make sure that the device warms up for more than 30 minutes before calibration.
- **Atmospheric calibration:**
  Ensure that the vacuum port is under atmospheric pressure, and insert the CAL. hole with a round rod with a diameter less than 1.5mm, press down and hold it for 3 seconds after feeling the action of the light touch switch, and observe that the IND LED flashes for three times, indicating that the vacuum gauge saves the current measured pressure as the atmospheric pressure as 1.0E + 5 Pa, and completes the atmospheric calibration process.
- **Zero calibration:**
  Ensure that the pressure at the vacuum measuring port is less than 5.0E-3 Pa, insert a round rod with a diameter of less than 1.5mm into the ADJ (CAL) round hole and hold it for 3 seconds after feeling the action of the light touch switch, and observe that the IND (COM) light flashes for three times, indicating that the vacuum gauge takes the current measured pressure as the zero pressure of the Pirani gauge.

  Note: after pressing the calibration button, the vacuum gauge will automatically determine the atmospheric calibration or zero calibration according to the measured pressure range.

11.Probe Cleaning and Repair Kit Replacement

Affected by the process gas medium, the anode rod and cavity of WPC400 and PVC410 cold cathode probes will be gradually oxidized, resulting in the delay of high-voltage discharge, that is, glow discharge cannot be initiated within 1 minute after the vacuum pressure is less than 0.1Pa, therefore, the vacuum pressure shows 1.0E-5Pa, or when the vacuum pressure is less than 1.0e-3pa, the vacuum gauge reading jumps irregularly. It shows that the anode and cavity need to be cleaned, or the anode kit might need to be replaced.

Please clean the probe according to the following steps:

1 Remove the snap ring ① at the edge of KF25 flange with snap ring pliers;

2 Clamp out the anode sleeve cup ② with tweezers;

3 Remove and take out one M2 hexagonal SS screw in the cavity with a 1.3mm hexagonal wrench, and then take out the bottom disk ③ of the cavity with tweezers;

4 Remove and take out 3 M2 hexagonal SS screws ④ with a 1.3mm hexagonal wrench;

5 Clamp any two holes in the anode chassis with tweezers, and pull out the chassis together with the central rod ⑤ with slight force;

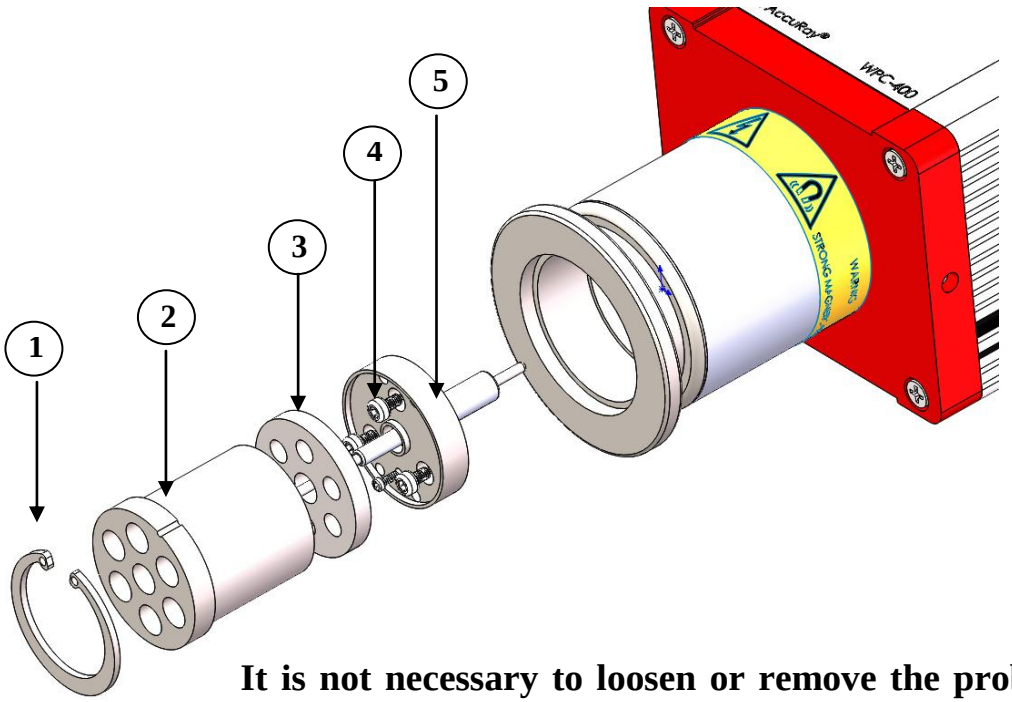
6 Grind and remove the blue and black oxide on the surface of all parts with 800 mesh fine sandpaper;

7 Wipe the grinding powder with cotton swab or non-woven cloth dipped in alcohol;

8 Assemble the probe completely in the reverse order of disassembly.

9 Follow the above steps also for replacing the anode kit.

Note: do not pour alcohol or acetone liquid directly into the probe chamber, otherwise it will cause permanent damage!



Caution

It is not necessary to loosen or remove the probe from the electronic control unit when cleaning the probe or replacing the anode kit, otherwise the internal structure will be damaged!

12. **Installation and Operation**

Caution

When handling vacuum components, take appropriate measures to ensure cleanliness and prevent damages. Ensure that the flange is clean, dry and free of grease.

DANGER

Overpressure in the vacuum system >1.0E+5Pa.
If clamps are opened unintentionally, injury can be caused by catapulted parts. Use the type of clamps which can only be opened and closed by means of a tool .

DANGER

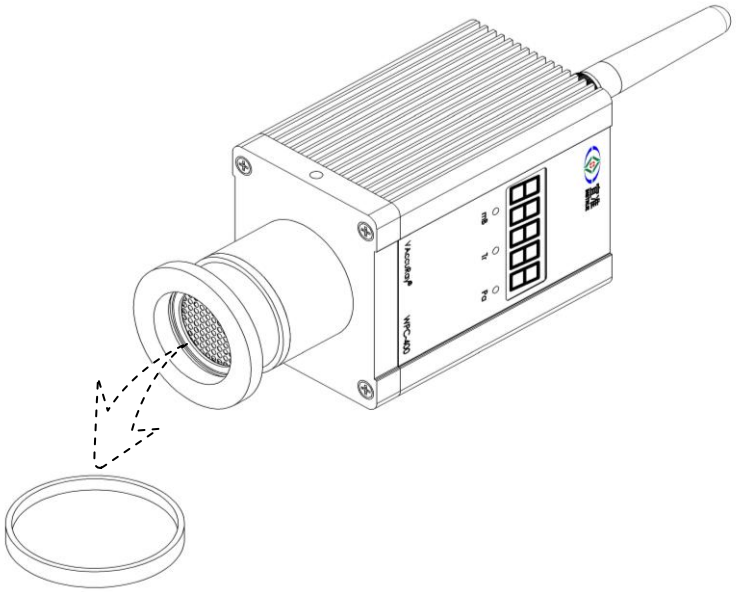
The gauge must be electrically connected to the grounded vacuum chamber. For gauges with KF flanges, use a conductive metallic clamping ring.

12.1 Mounting orientation

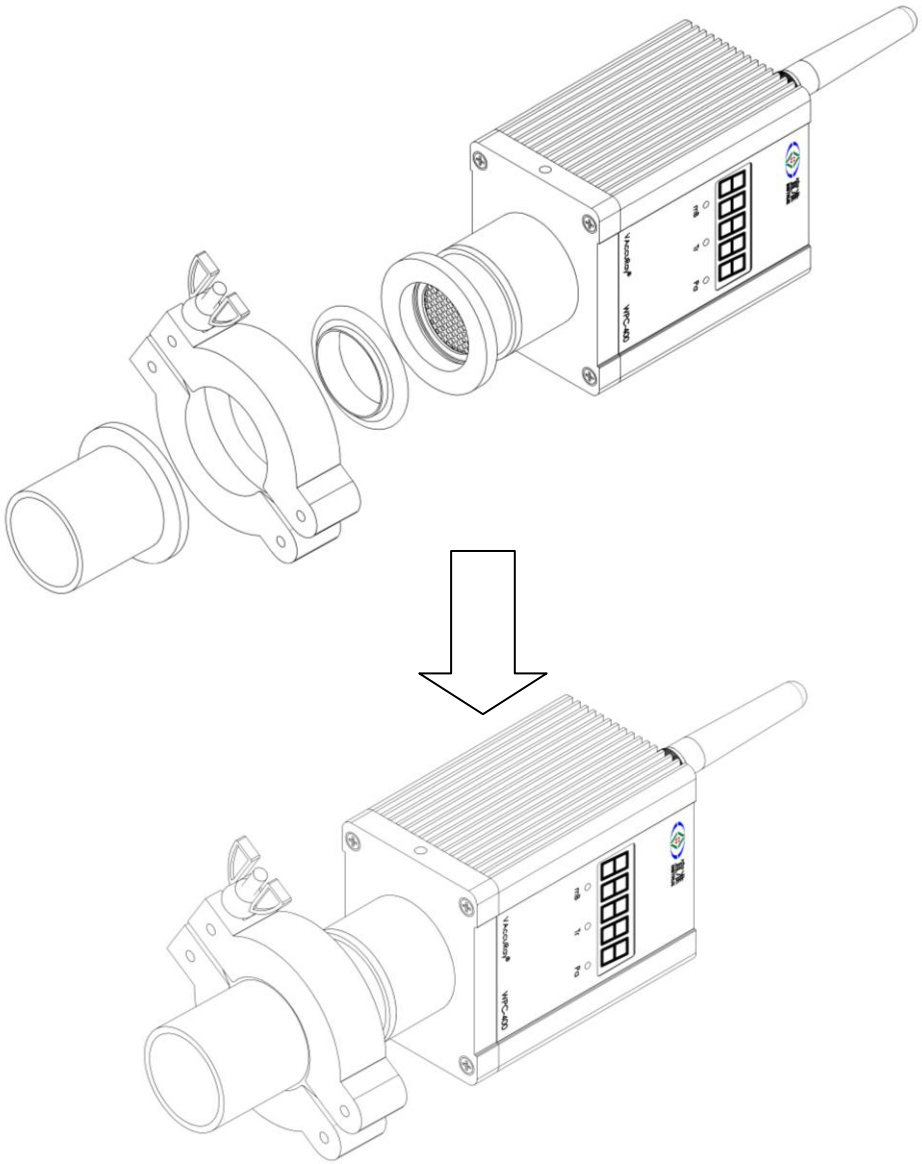
The installation position can be freely selected. The preferred position is a horizontal to vertical position so that condensate and particles do not penetrate the measurement chamber.

Procedure

Step 1. Remove the protective cover and keep it for maintenance use.



Step 2. Make the flange connection to the vacuum system, preferably without applying vacuum grease.



☞ When installing the gauge, make sure that the area around the connector is accessible for the tools required for adjustment.

☞ When installing the gauge, allow for installing/deinstalling the connectors and accommodation of cable loops.

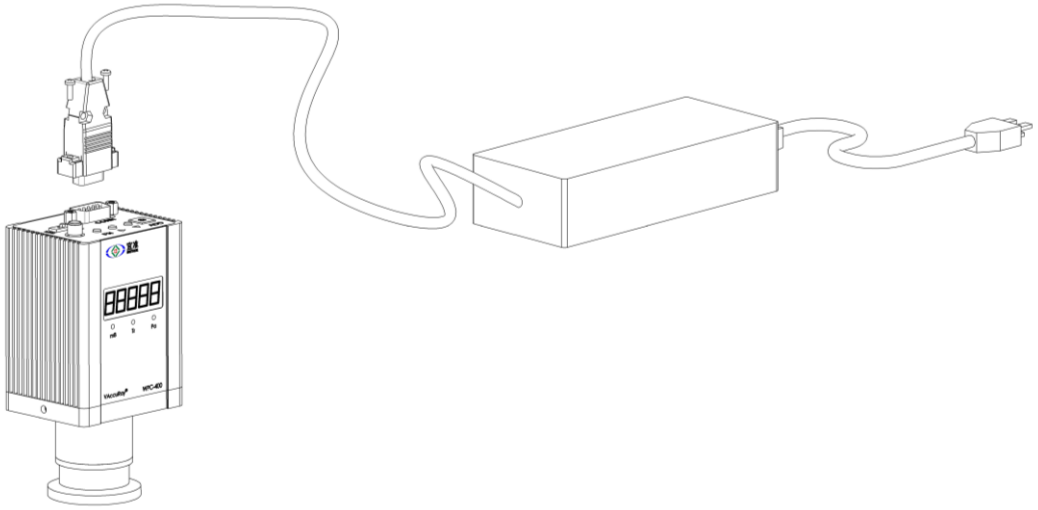
☞ When installing the gauge, make sure that it’s easy to read the LED display, and to reach the push buttons.

12.2 Electrical Connection and Operation

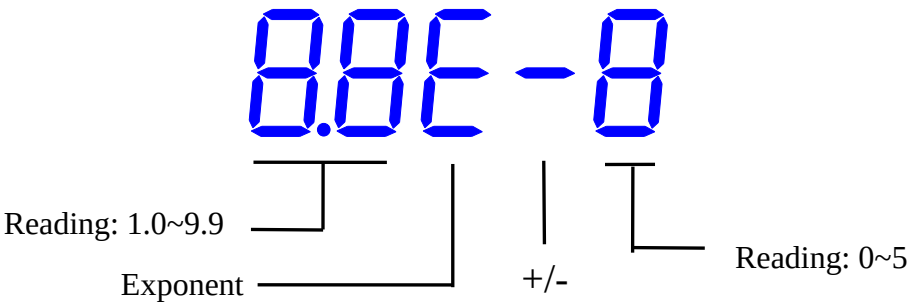
12.2.1 Standalone Mode

WPC 400 has its own LED display and programming keys, only +24VDC is needed to work as an independent vacuum meter.

Power Connection



When powered on, the build-in 5-digit LED will display “PC400” for 3 seconds, then start indicating the gauge pressure with format of “8.8E±8”. The default unit is Pascal, although you can select Torr or mBar by three programming keys.



The reading ranges from 1.0E+5 Pa to 1.0E-5 Pa.

12.2.2 Use with INSTRUE WGC-150 Vacuum Gauge Controller

If the WPC-400 is used with an Instrue vacuum gauge controller WGC-150, a corresponding cable is needed (Type CBL001). The cable permits supplying the WPC-400 with +24VDC power, transmitting measurement values and gauge statuses, and making parameter settings through RS485.

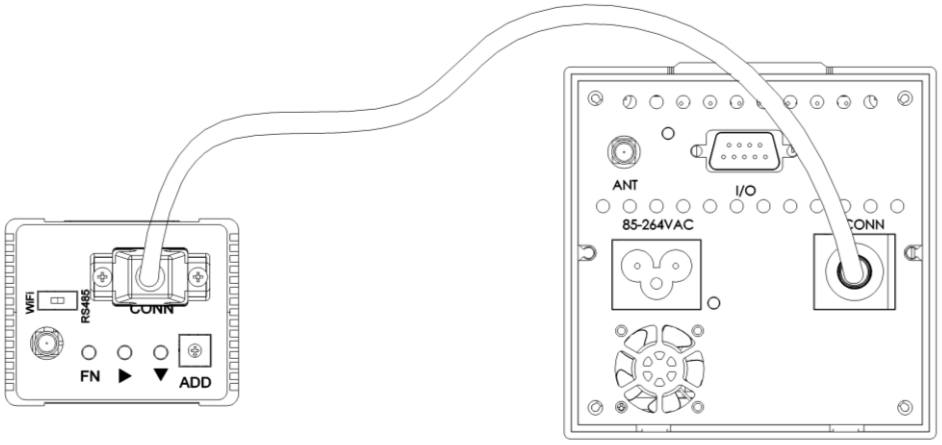
The cable between WPC-400 and WGC-150 has several options in length.

Procedure

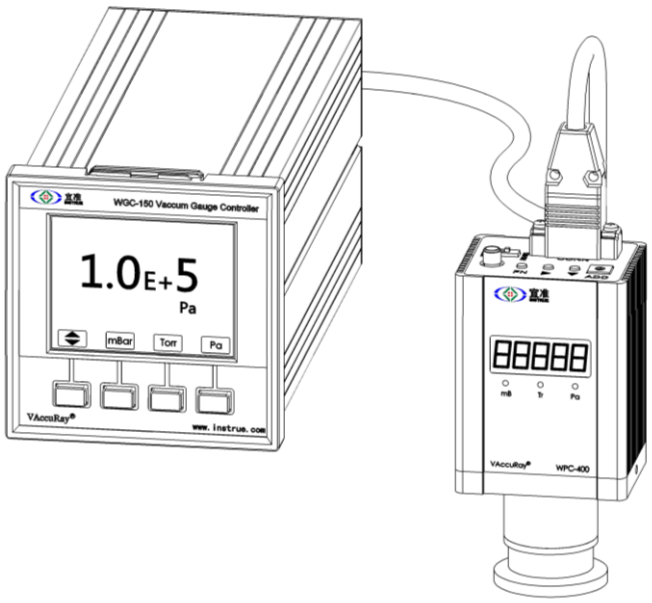
Step 1. Plug the D-Sub9 connector into the corresponding socket on top of WPC-400, and secure it with the locking screws.

Step 2. Plug the DIN-4Pin connector to the relevant socket on back of WGC-150.

Step 3. Plug the power cord into a main AC85~264V/0.5A socket.

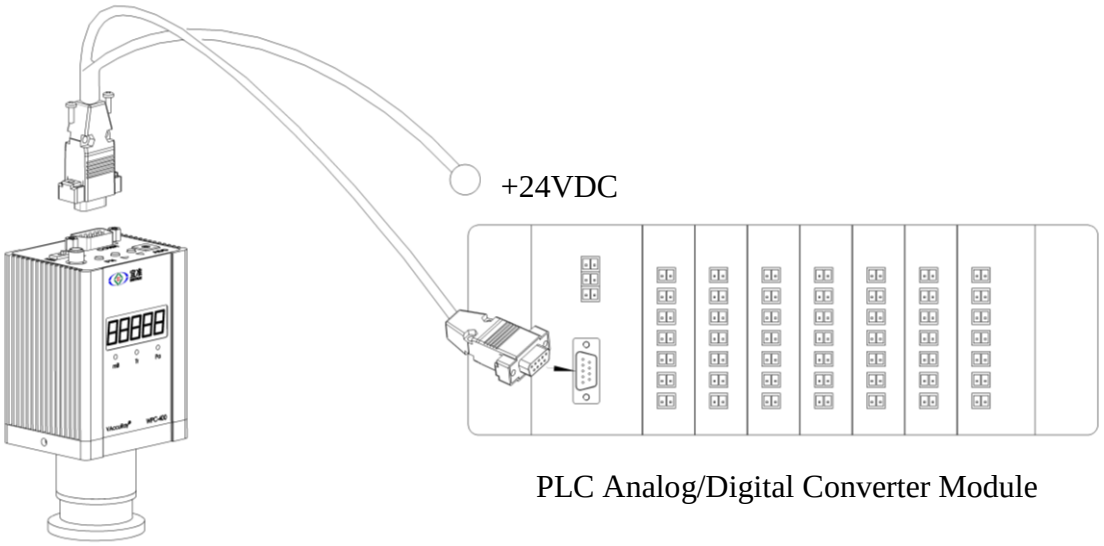


If only one WPC-400 is used with WGC-150, please set the address ADD=0.



12.2.3 Use with Analog Signal Converter

In the case that a kind of PLC analog module is used to read the pressure, the WPC-400 needs a +24VDC power supply, and D-Sub 9 Pin4 / Pin8 are led to PLC analog input terminals. Here a shielded coaxial cable is strongly recommended.



PLC Analog/Digital Converter Module

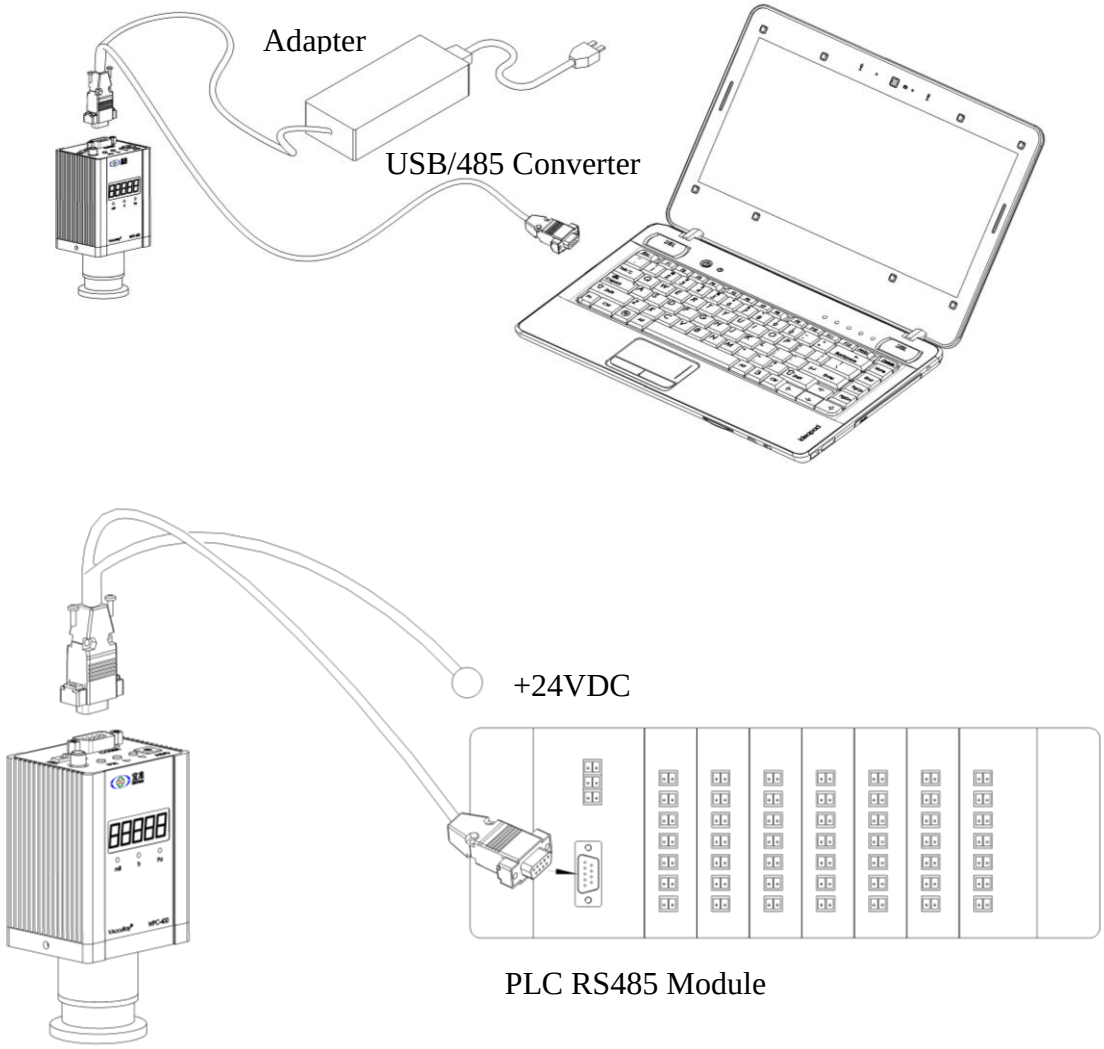
12.2.4 Use with RS485 Communication

Before starting to communicate with the WPC 400 via RS485, please be sure the address is set correctly as your system topology design.

The WPC 400 can be used with any kind of PLC which has a standard RS485 interface.

The WPC-400 can also be used with a regular Win XP\Win7_32\Win7_64 based computer, a USB\RS485 converter is normally needed in this case. INSTRUE provides PC software Gauge Reader for this application.

The controlling host sends its commands to the individually addressed devices connected to the RS485 Modbus. In replay the device returns the data requested via bus to the host.



RS485 Setting： 9600 baut rate，8 data bits, 1 stop bit, No parity

12.2.5 Use with Wireless Communication

Before starting to communicate with the WPC 400 via wireless, please be sure the tip switch on the top is on WL side, and the ADD is set correctly as your system topology design.

The WPC-400 can be used with INSTRUE WGC-150 via wireless communication. In this case, WPC-400 and WGC-150 must be set at same address, and the WGC-150 should be set at Wireless mode through the front key operation.

The WPC-400 can also be used with a regular Win XP\Win7_32\Win7_64 based computer, an INSTRUE USB Wireless Transceiver (refer to 3.2.6) is required. INSTRUE provides PC software Gauge Reader (refer to 3.2.6) for this application.

Procedure

Step 1. A two-wire cable is required to supply the WPC-400 with +24VDC\GND power. An antenna needs to be installed.

Step 2. Install the software driver for USB Wireless Transceiver, and also install the INSTRUE Gauge Reader application software.

Step 3. Open the Gauge Reader, click the function selections, then Start

For those who want to design their own software interface, you need to know the Instrue RS485\Wireless communication protocols, and dynamic link libraries, and embed them to your own software.

12.2.6 Gauge Reader Application Software

For use with RS485 and Window based PC, a RS485\USB converter is normally needed. You can follow the coming-with instruction to install a related driver.

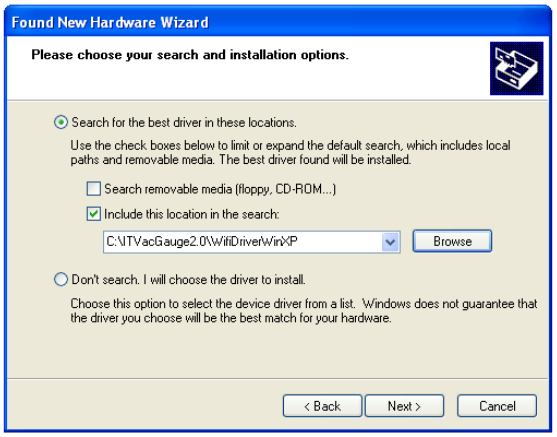
For use with wireless transceiver and Window based PC, please install the transceiver USB driver.

Install USB transceiver driver

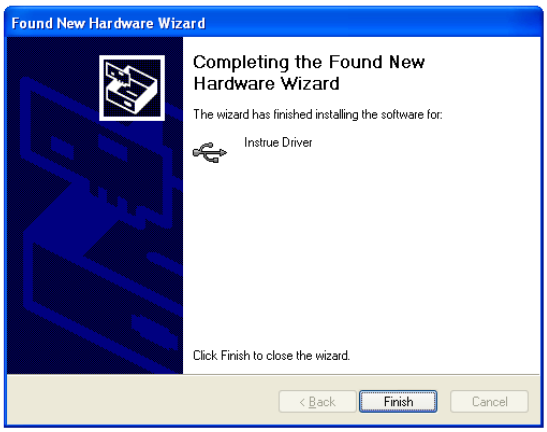
Step 1. Copy the "IT VacGAuge 2.0" folder to a temporary folder of your computer.

Step 2. Plug in the transceiver module in the computer USB port, the computer will pop up a window: Found New Hardware Wizard. Click "Install from a list or specific location", then Next.

Step 3. Click Browse and find the IT VacGAuge 2.0 folder, then Next.



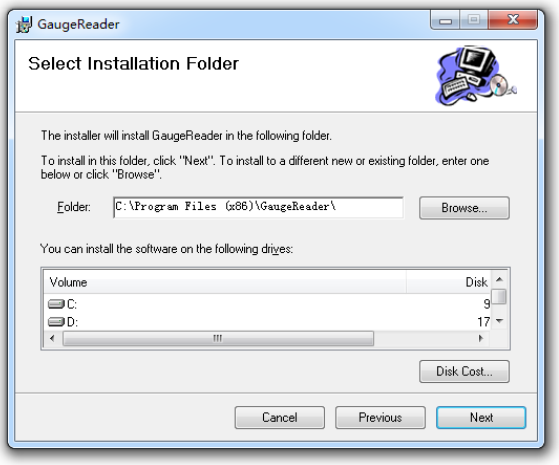
Step 4. Click Finish to complete the driver installation.



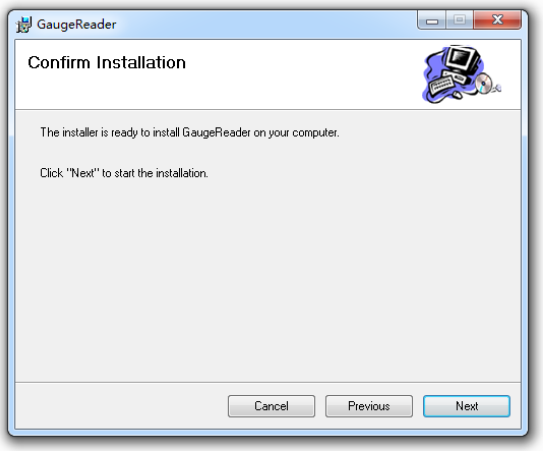
Install INSTRUE “Gauge Reader 2.0”

Step 1. Double click the file GaugeReader.msi, then Next.

Step 2. Click the Browse and find a target folder path you want install the application software, then Next.

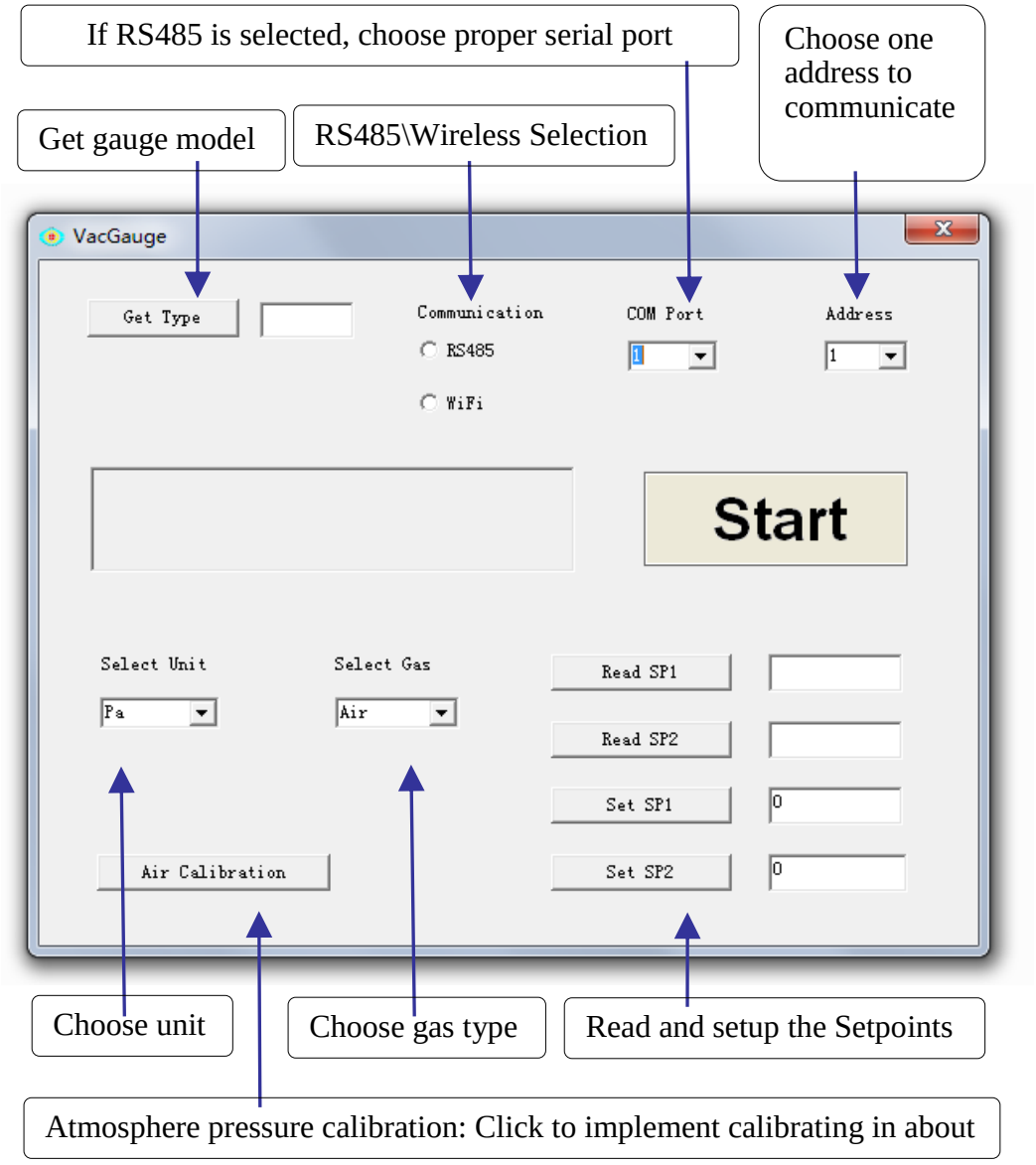


Step 3. Then Next



Start using GaugeReader

Find the file VacGauge.exe in your target folder path, double click, then start to use it.



12.2.7 RS485 MODBUS RTU Communication Protocol

1) Communication Setup：

Baud rate：9600 Start Bit：1 Data Bit：8 Stop Bit：1
Checkout bit：No

2) Instruction format：

a. Read instruction：

- Upper computer sends instructions to vacuum gauge：

Add	Command	Register Hi	Register Low	Data Word（Hi 8bit）	Data Word（Low 8bit）	CRC Check（Low8bit）	CRC Check（Hi 8bit）
1-99	03	00	XX	00	XX	XX	XX

- Return Instruction：

Add	Command	Data Byte	Data	CRC Check（Low 8bit）	CRC Check（Hi 8bit）
1-99	03	XX	XX Byte	XX	XX

b. Write Instruction:

- Upper computer sends instructions to vacuum gauge：

Add	Command	Register Hi	Register Low	Data Length（Hi 8bit）	Data Length（Low 8bit）	Data Byte	Highest Data Byte
1-99	16	00	XX	00	02	4	Bit31-24

Data Mid Byte	Data Mid Byte	Data Mid Byte	CRC Check（Low 8bit）	CRC Check（Hi 8bit）
Bit23-16	Bit15-8	Bit7-0	XX	XX

- Return Instruction：

Add	Command	Register Hi	Register Low	Data Length（Hi 8bit）	Data Length（Low 8bit）	CRC Check（Low 8bit）	CRC Check（Hi 8bit）
1-99	16	00	XX	00	02	XX	XX

3) Register address table：

Register address （16hexadecimal）	Data byte length	Storage content
01	2	Gauge Ch1: Vacuum data of scientific counting format
03	2	Gauge CH2: Vacuum data of scientific counting format
11	2	Gauge Ch1: Vacuum data of floating point format
13	2	Gauge CH2: Vacuum data of floating point format
21	2	Set Point 01: Floating Format
23	2	Set Point 02: Floating Format
25	2	Set Point 03: Floating Format
27	2	Set Point 04: Floating Format
29	2	Set Point 05: Floating Format
2B	2	Set Point 06: Floating Format
31	1	Set Point 01 correspond Gauge 1：Gauge Ch1；2：Gauge Ch2
32	1	Set Point 02 correspond Gauge 1：Gauge Ch1；2：Gauge Ch2
33	1	Set Point 03 correspond Gauge 1：Gauge Ch1；2：Gauge Ch2
34	1	Set Point 04 correspond Gauge 1：Gauge Ch1；2：Gauge Ch2
35	1	Set Point 05 correspond Gauge 1：Gauge Ch1；2：Gauge Ch2
36	1	Set Point 06 correspond Gauge 1：Gauge Ch1；2：Gauge Ch2
40	1	Implement Calibration: 1：Gauge Ch1 atmosphere 2：Gauge Ch1 Zero 4：Gauge Ch2 atmosphere 8：Gauge Ch2 Zero

Data display format：

Scientific count format

For example, the vacuum gauge display data is 1.2E+3, and the ASCII code stored in the register is the corresponding data, that is, 0x31, 0x32, 0x2b, 0x33.

For example, the vacuum gauge displays the data 1.0E-1, and the data stored in the register are 0x31, 0x30, 0x2d and 0x31.

Floating format

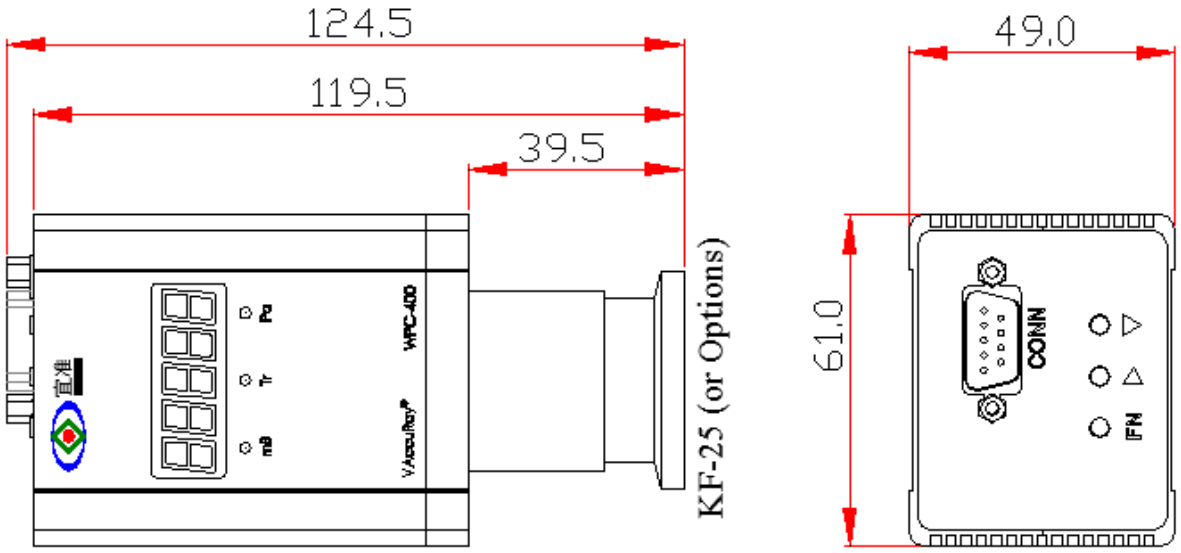
The 32 bit floating number is stored in the register.

Vacuum gauge address setting：

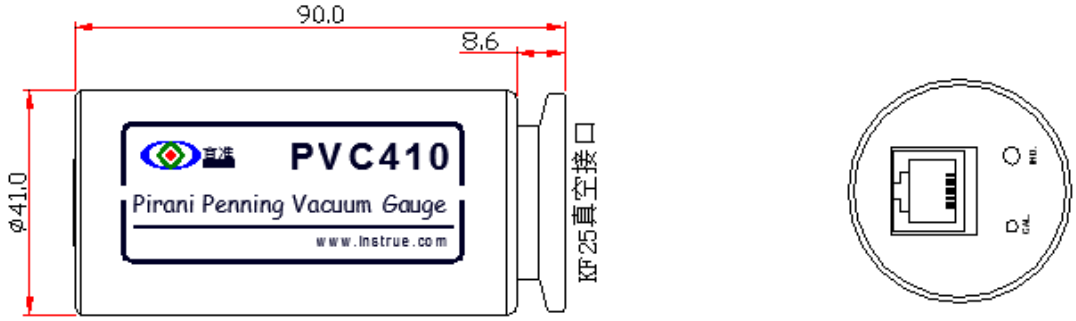
Through Gauge Reader 3.0 application software interface, you can set the vacuum meter local address, factory address set to 01.

13. 详细尺寸

WPC400外形尺寸图 （mm）



PVC410 外形尺寸图 （mm）



14. Returning the Product

Contaminated products (e.g. Radioactive, toxic, caustic or biological hazard) can be detrimental to health and environment.

Products returned to INSTRUE should be preferably be free of harmful substances. Adhere to the following regulations of all involved countries and forwarding companies and enclose a duly completed declaration of contamination.

Disposal

Before beginning to work, find out whether any parts are contaminated. Adhere to the relevant regulations and take the necessary precautions when handling contaminated parts!

Disposal of mechanical and electric components, fluid etc may be detrimental to the environment. Adhere to the relevant local regulations.