# RPG100
# Pirani Vacuum Gauge




## Introduction

The Series RPG100 Pirani vacuum gauge offers a wide measurement range from atmosphere to medium and high vacuum.This Pirani transducer features good accuracy and excellent long-term stability. In addition, it is high performance-price ratio.

The Series Pirani vacuum gauge is a thermal conductivity gauge based on MEMS Pirani chip. The chip is manufactured using microfabrication technology, resulting in excellent accuracy and consistency. It also integrates a temperature sensing circuitry, featuring good sensitivity and repeatability. Compared to the filament Pirani gauges, it is more resistant to contaminants.

The Series Pirani vacuum gauge has analog signal output and RS485 digital communication interface . It can compatible with vacuum gauges from other manufacturers, allowing for plug-and-play without system adjustments or hardware interface changes. As a result, the previously accustomed output curves can be directly obtained.

The Series Pirani vacuum gauge can also output other standard industrial signals according to the customer application requirements.

## Features

- Range from $5x10^{-4}$mbar to 1000mbar
- Good accuracy and repeatability
- Adjustable output curve
- More resistant to contamination due to low operating temperature
- With temperature compensation
- High performance-price ratio

## Applications

- Freeze dryer control
- Mass spectrometer control
- Foreline and roughing pressure measurement
- Low-temperature gas cylinders, gas tanks
- Heat treatment / Vacuum furnace
- System process control



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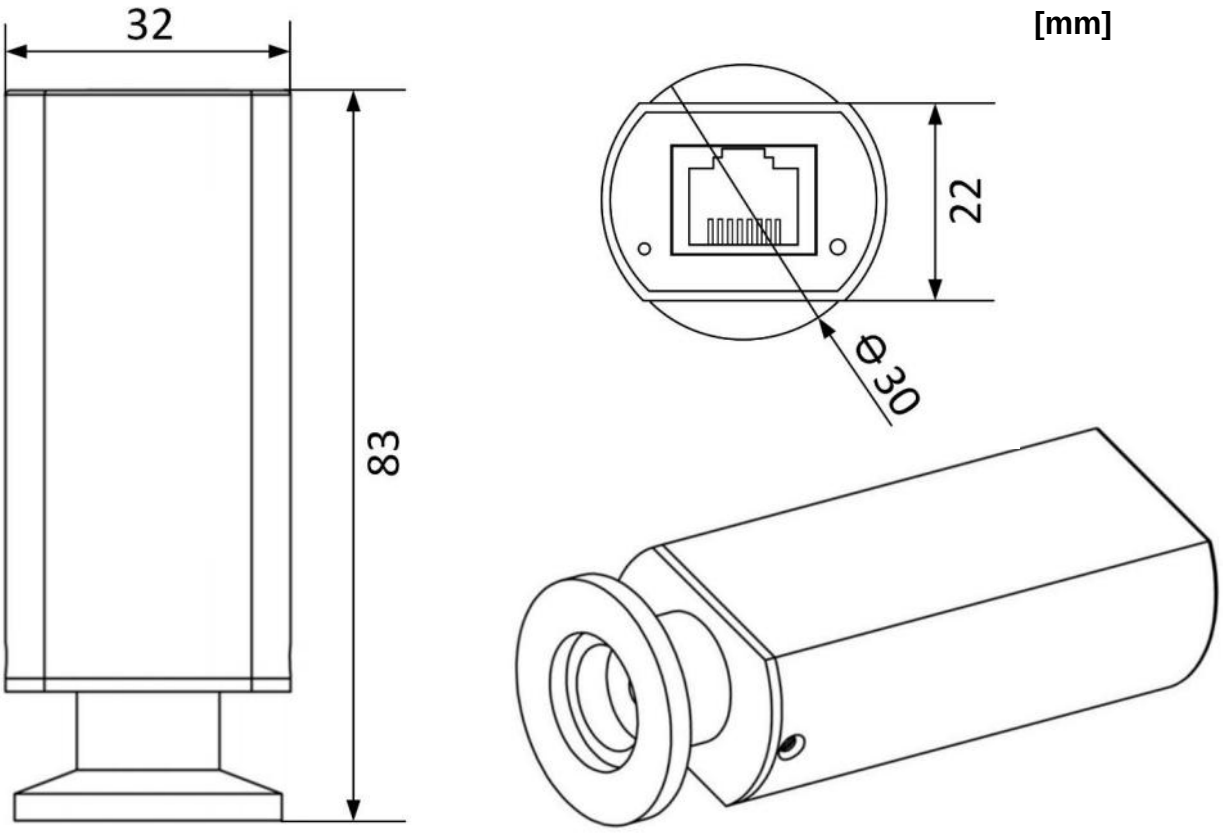
## 1. Specifications

(Accuracy and repeatability are typical values measured with $N_2$ gas at ambient temperature after zero adjustment)

| Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|
| Sensor Type | MicroPirani (MEMS Thermal Conductivity) | | | | - |
| Measurement range | $5x10^{-4}$ | | 1000 | mbar | $N_2$/Air |
| Output voltage | 1.9 | | 10 | V | Standard model or Factory settings |
| Output curve | Logarithmic curve | | | | |
| Accuracy | | ±50% | | mbar | $5x10^{-4}$ ~ $1x10^{-3}$ |
| | | ±15% | | mbar | $1x10^{-3}$ ~ 100 |
| | | ±50% | | mbar | 100 ~ 1000 |
| Resolution | | 16 | | bit | |
| Repeatability | | ±2% | | Reading | $1x10^{-3}$ ~ 100mbar |
| Response time | | 0.1 | | s | |
| Supply voltage | 9 | 24 | 30 | V | |
| Operating current | | 30 | | mA | |
| Identification | | 27 | | KΩ | Factory settings |
| Operating temperature | 0 | | 40 | ℃ | |
| Storage temperature | -20 | | 65 | ℃ | |
| Overpressure limit | | | 6 | bar | |
| Probe material | 304 stainless steel | | | | Factory settings |

## 2. Dimensions

**[mm]**

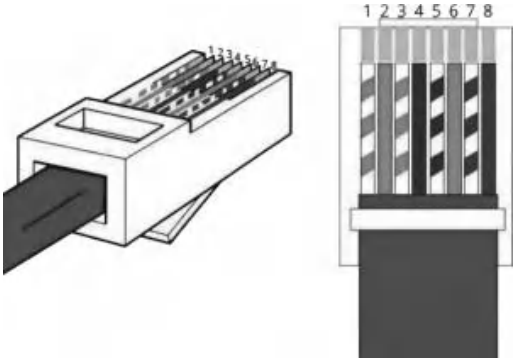





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## 3. Pin assignment

| | |
|---|---|
| **Pin1** | Power + (9~30VDC) |
| **Pin2** | Power GND |
| **Pin3** | Analog signal output |
| **Pin4** | 27KΩ identification |
| **Pin5** | Analog Signal GND |
| **Pin6** | NC |
| **Pin7** | RS485, DATA- |
| **Pin8** | RS485, DATA+ |




## 4. Digital Signal Output

The product adopts the standard Modbus RTU protocol. The default communication parameters are as follows:

- Default address: 255 (0xFF)
- Baud Rate: 9600
- Data Bits: 8
- Stop Bits: 1
- Parity: None

### 4.1. Register Types

The series uses the holding register in Modbus RTU to read the air pressure value and set the Modbus address of the sensor. The default Modbus address bit for sensor is 255.

### 4.2. Holding Register Function Definitions

| **Holding register (read/write) Code: 03** | | |
|---|---|---|
| Modbus address | Description | Data Type |
| 0x0000 | 1. Stores air pressure value, unit Pa. To convert to actual air pressure value, divide by 1000.<br>2. Big-endian storage (high-order byte stored at low-order address, low-order byte stored at high-order address)<br>3. Example: If the read value is 0x05F5E100, the converted air pressure value is 100000Pa | 32-bit integer |
| 0x0001 | | |
| 0x0005 | 1. Store sensor manufacturing year and month information<br>2. Example: If the read value is 0x1904, the sensor was manufactured in April 2025 | 16-bit unsigned integer |
| 0x0006 | 1. Stores sensor production batch and Modbus address information.<br>2. Example: If the read value is 0x0104, the sensor was produced in the first batch in April 2025, and the factory-set Modbus address information address is 04<br>3. The sensor's default Modbus address is 0xFF, i.e., 255. | 16-bit unsigned integer |

### 4.3. Communication Examples

**1. Write sensor address (use function code 10 to change address, function code 06 is not supported)**



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| Instruction | Slave address | Function code | Register start address high eight bits | Register start address low eight bits | Number of registers high eight bits | Number of registers low eight bits | Number of bytes | Data4 | Data3 | Data2 | Data1 | CRCL | CRCH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Example | 0XFF | 0X10 | 0X00 | 0X05 | 0X00 | 0X02 | 0X04 | 0X00 | 0X00 | 0X00 | 0X01 | 0XC5 | 0XBB |

**Note: Data1 is the device's Modbus bus address.**

Slave response:

| Instruction format | Slave address | Function code | Register start address high eight bits | Register start address low eight bits | Number of registers high eight bits | Number of registers low eight bits | CRCL | CRCH |
|---|---|---|---|---|---|---|---|---|
| Example | 0XFF | 0X10 | 0X00 | 0X00 | 0X00 | 0X02 | 0X54 | 0X16 |

**Note: No information to be parsed in the slave response**

**2. Reading Air Pressure Value (Using Function Code 03)**

Master Sends Command:

| Instruction format | Slave address | Function code | Register start address high eight bits | Register start address low eight bits | Number of registers high eight bits | Number of registers low eight bits | CRCL | CRCH |
|---|---|---|---|---|---|---|---|---|
| Example | 0XFF | 0X03 | 0X00 | 0X00 | 0X00 | 0X02 | 0XD1 | 0XD5 |

**Note: 0xFF is the device's general address. If the device's Modbus bus address is known, it can be used directly.**

Slave response:

| Instruction format | Slave address | Function code | Return Number of bytes | Data4 | Data3 | Data2 | Data1 | CRCL | CRCH |
|---|---|---|---|---|---|---|---|---|---|
| Example | 0XFF | 0X03 | 0X04 | 0X00 | 0X01 | 0X00 | 0X05 | 0XC1 | 0XD7 |

Where 00 01 00 05 is the air pressure data, with the most significant byte first and the least significant byte last. 00 01 00 05H is 65541 in decimal. Actual air pressure value = 65541 * 0.001 = 65.541 (Pa).

## 5. Analog Signal Output

The analog signal output can be remotely transmitted to external devices such as PLCs, DCS systems, and recorders. The voltage output range is adjustable. The typical vacuum degree and analog signal correspondence are shown below.

### 5.1. Output Voltage and Formula 1

$$P = 10^{\frac{U-c}{1.286}}$$

Where:

*U*——Voltage output

*P*——Different vacuum degree units

*c*——Constant used for different vacuum degree units, as shown in the table below:

| *U* | *P* | *c* |
|---|---|---|
| V | mbar | 6.143 |
| V | Torr | 6.304 |
| V | mTorr/micron | 2.448 |
| V | Pa | 3.572 |

### 5.2. Output Voltage and Formula 2

$$P = 10^{U-c}$$

Where:

*U*——Voltage output

*P*——Different vacuum degree units

*c*——Constant used for different vacuum degree units, as shown in the table below:



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| *U* | *P* | *c* |
|---|---|---|
| V | mbar | 6 |
| V | Torr | 6.125 |
| V | mTorr/micron | 3.125 |
| V | Pa | 4 |

### 5.3. Output Voltage and Formula 3

$$P = 10^{U-c}$$

Where:
*U*——Voltage output
*P*——Different vacuum degree units
*c*——Constant used for different vacuum degree units, as shown in the table below:

| *U* | *P* | *c* |
|---|---|---|
| V | mbar | 5.5 |
| V | Torr | 5.625 |
| V | mTorr/micron | 2.625 |
| V | Pa | 3.5 |

### 5.4. Output Voltage and Formula 4

$$P = 10^{U-c}$$

Where:
*U*——Voltage output
*P*——Different vacuum degree units
*c*——Constant used for different vacuum degree units, as shown in the table below:

| *U* | *P* | *c* |
|---|---|---|
| V | mbar | 5 |
| V | Torr | 5.125 |
| V | mTorr/micron | 2.125 |
| V | Pa | 3 |

### 5.5. Output Voltage and Formula 5

$$P = 10^{U-c}$$

Where:
*U*——Voltage output
*P*——Different vacuum degree units
*c*——Constant used for different vacuum degree units, as shown in the table below:

| *U* | *P* | *c* |
|---|---|---|
| V | mbar | 5.875 |
| V | Torr | 6 |
| V | mTorr/micron | 3 |
| V | Pa | 3.875 |

## 6. Calibration

The vacuum gauge is calibrated at the factory, but due to vibration during transportation or contamination during long-term operation, the vacuum gauge may drift. If a large deviation in the vacuum gauge measurement value is found, zero-point and full-scale calibration can be performed. In addition, the thermal conductivity of gas under medium and high vacuum is related to the type of gas. Different types of gases have different thermal conductivity coefficients for the sensor. The vacuum gauge is calibrated with standard nitrogen at the factory. Therefore, when measuring the vacuum of gases other than air or nitrogen, the sensor needs to be calibrated by the original manufacturer.

### 6.1. Zero-Point Calibration

Install the vacuum gauge on the vacuum system, preferably in the same environment as the vacuum gauge. Power on the vacuum gauge to preheat it and run it continuously. At the same time, evacuate the vacuum system to below 0.0001Pa and wait for 5 minutes. When the vacuum gauge reaches thermal equilibrium, zero-point calibration can be performed. The specific operation is as follows.


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a) Insert a pin into the zeroing and full-scale adjustment holes, press and hold the button until the red light illuminates, then release the button;
b) Press the button briefly once. The red light will flash 3 times and then turn off;
c) The indicator light will automatically return to a solid green state. At this point, the vacuum gauge zeroing operation is complete and it is ready for normal operation.

### 6.2. Full-scale calibration

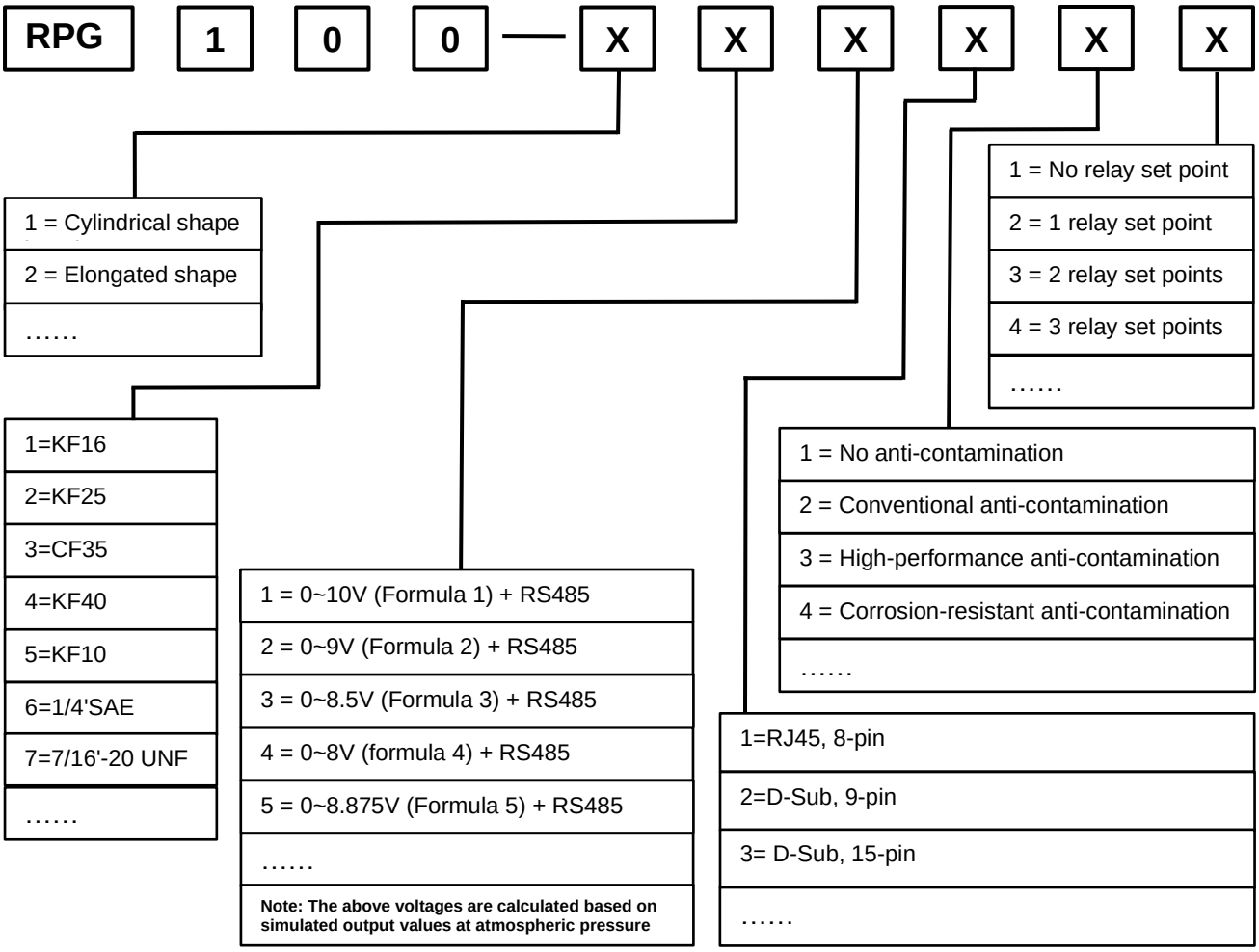
Power on the vacuum gauge under atmospheric pressure to preheat it. It is best to do this under the same environment as the vacuum gauge is used in, and wait 5 minutes until the vacuum gauge reaches thermal equilibrium. Then, the full-scale calibration operation can be performed. The specific operation is as follows:

a) Insert a pin into the zeroing and full-scale adjustment holes, press and hold the button until the red light illuminates. Continue pressing the button until the green light illuminates, then release the button;
b) Press the button briefly once. The green light will flash 3 times and then turn off;
c) The indicator light will automatically return to a solid green state. At this point, the vacuum gauge full-scale calibration operation is complete and it is ready for normal operation.

## 7. Indicator Light Status Description

Solid green light – Vacuum gauge is in normal working condition.
Red light is always on—the vacuum gauge is malfunctioning, and the processing circuit MCU has not entered normal working state.
Indicator light off – Vacuum gauge power supply abnormal.
Red light flashes 3 times – Vacuum gauge completes zero-point calibration.
Green light flashes 3 times – Vacuum gauge completes full-scale calibration.

## 8. Ordering Information






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he standard model of this series of Pirani vacuum gauges is RPG100-211121. If there are other non-standard models, please consult with RQ for definition.

## 9. Revision History

| Product Datasheet Version Control (RPG100) | | | |
|---|---|---|---|
| Version | Modification Time | Modification Content | Modifier |
| V1.0 | 2024.06 | Initial Version | YSC |
| V2.0 | 2025.06 | Optimized Product Appearance and Analog Signal Output | YSC |
| V3.0 | 2026.01 | Optimized Analog and Digital Output Information | YSC |

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