Product Specifications

Model: GD-PID

Version: V1.2

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Taiyuan Tengxing sensor technology Co., Ltd

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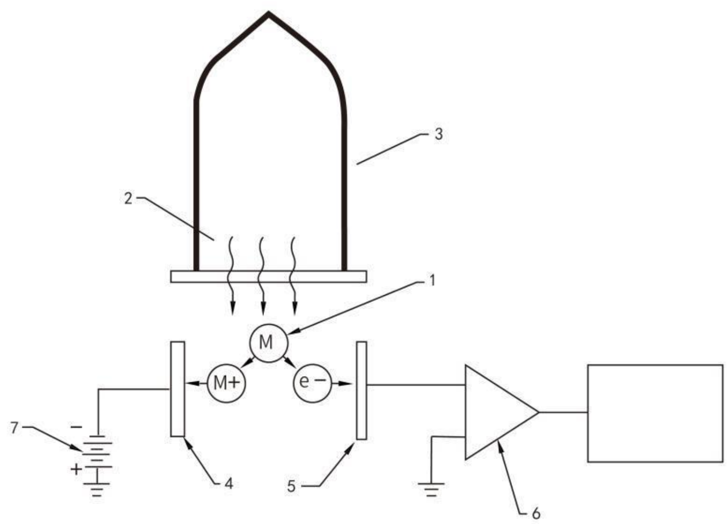
GD-PID Photoion Sensor

1.**Principle**:

Photoionization detectors (PID) are one of the most widely used gas detection technologies. PIDs are widely used in portable instruments to detect a variety of organic compounds and some inorganic gases in ambient air.

A typical PID block diagram is shown below. Easily ionizable molecules (1) are exposed to high energy vacuum ultraviolet radiation (2) generated by a gas discharge lamp (3). Some of the molecules are ionized, i.e., converted into positively charged ions and negatively charged electrons according to the following equation: M+ photon -> M+ + e-.

If the molecule is ionized, the ionization potential (IP) of the molecule M should be less than the energy (E) of the UV photon. In general, the greater the difference between E and IP, the greater the response of the PID sensor. The units of E and IP are usually electron volts (eV). Typical PID lamp photon energies are between 8.3 and 11.7 eV. The GD-PID is equipped with a 10.6 eV photoionization lamp. The electrode pair (4, 5) is located in the ionization region near the lamp window. The polarization electrode (4) is connected to a high voltage DC power supply (7) and the signal electrode (5) is connected to the input of an amplifier (6). The electric field generated by these two electrodes forces electrons and ions to drift toward their respective electrodes, thereby generating a small current. This current is amplified by an amplifier chip and the output analog signal is recorded and/or displayed in digital or analog format. The output signal is proportional to the concentration of ionizable molecules in the PID sensor chamber and thus serves as a measure of concentration. The main air components ($N2$, $O2$ and $CO2$) have a greater ionization potential than the UV lamp and therefore cannot be detected. Therefore, PID is very useful for detecting various volatile organic compounds (VOCs) in ambient air without interference from air components, even low ppb concentrations of VOCs can be detected. The gas sample is usually delivered to the detector chamber by a pump or a diffusion process.



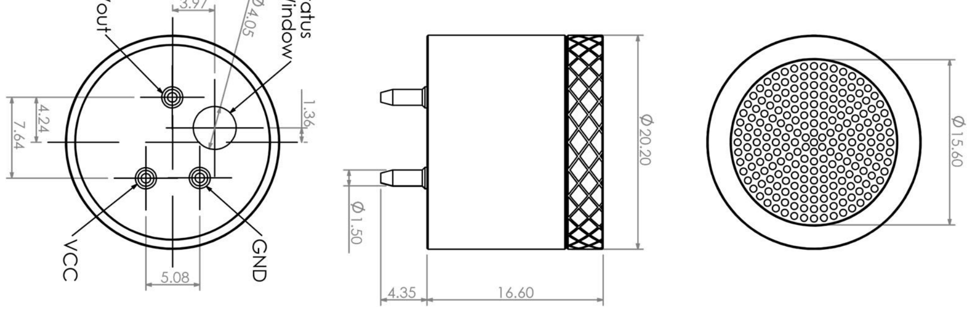
2. Design Overview:

The GD-PID is designed to be interchangeable with major brands of electrochemical sensors. Therefore, it can be installed in any portable and fixed gas monitor.

range	Optional
resolving power	See product list for details
sensitivity	See product list for details
response time	4-8 Sec (typical value)
linear	0.99
Repetitive accuracy	<1% (depending on specific range)
Working temperature range	-50℃~60℃
Working humidity range	0-95% RH
Range of work pressure	80-120kPa
working voltage	3.2-5.5V
Working current	30mA (typical value)
output signal	0.04-3V
Zero point signal voltage	40-70mV
Storage temperature	0-30 ℃ (depending on specific range)
Sensor lifespan (typical)	5 years
Detector lifespan (typical)	9000 hours
UV lamp lifespan	13000 hours (depending on specific range)

Notes:

1. Models with a range ≥1000ppm have better linear compensation accuracy
2. The lifespan of the 9.8eV ultraviolet lamp is 9000 hours.
3. The lifespan of the 11.7eV ultraviolet lamp is 2000 hours (without moisture) at 0-20 ℃< Sealed storage under 10% RH conditions



2.1 Electrical Characteristics

Power supply voltage: 3.2V~ 5.5V

Current: 24mA~ 36mA

Maximum linear output signal: 2.5V (maximum output 2.9V)

2.2 Physical Characteristics

Weight: < 8g

Packaging type: Urban Technology TM 4P

Position sensitivity: No

Parts available for customer service: lamp, electrode sheet, filter, cover and gasket.

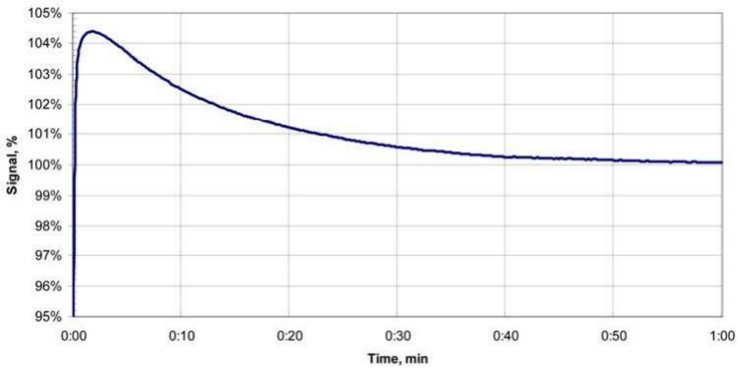
UV lamp life: 6000h or one year

Warranty period: 24 months from the date of shipment (lamp, electrode sheet, filter membrane are not covered by warranty)

3.Application Guide

3.1 Powering up the sensor after storage

If the sensor has been stored for a long time, it may have been exposed to environmental conditions that may cause the sensor to exhibit drift characteristics of the baseline signal. After long storage, it is recommended to power it up for a period of time before use. The PID sensor will self-clean and the baseline signal will drop and stabilize. If the sensor is used daily, the user should let it stabilize before use. The warm-up time depends on the accuracy required.



3.2 Signal Range

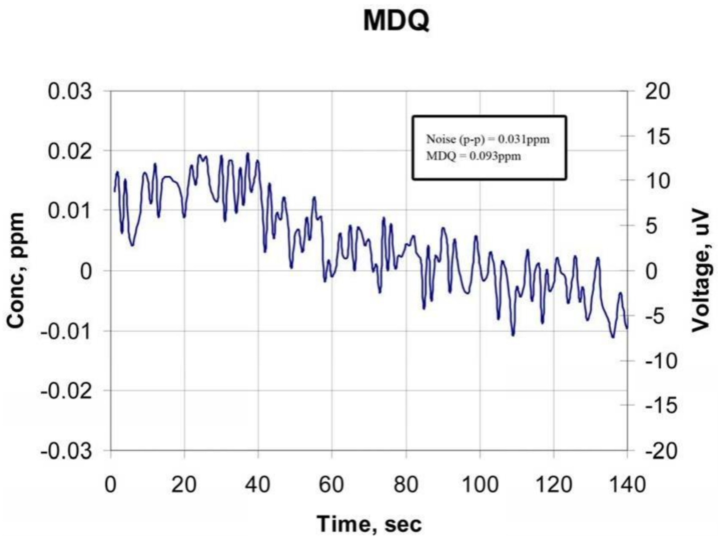
The nominal voltage output range of the sensor is 0.04-2.5V. In the presence of zero gas, the sensor will produce an offset of 0.04-0.010V (see figure below). If the sensor's normal concentration range is exceeded, the maximum signal voltage the sensor may produce is 2.9V. If exposed to extremely high concentrations, the sensor may take a while to recover when the gas is purged.

Isobutylene concentration	Zero gas value	Get V/ppm	Span test gas Isobutylene
0-10000ppm	40~100mV	0.15-0.4 mV	1000ppm
0-6000ppm	40~100mV	0.3-0 .6 mV	1000ppm
0-2000ppm	40~100mV	0.6-1.8 mV	1000ppm
0-1000ppm	40~100mV	1.5-3.6 mV	500ppm
0-200ppm	40~100mV	6-18 mV	100ppm
0-100ppm	40~100mV	15-36 mV	50ppm
0-60ppm	40~100mV	30-60 mV	10ppm
0-20ppm	60~120mV	60-180 mV	10ppm
0-10ppm	60~120mV	150-360mV	5ppm

0-2ppm	60~120mV	0.6-1.2V	1000ppm

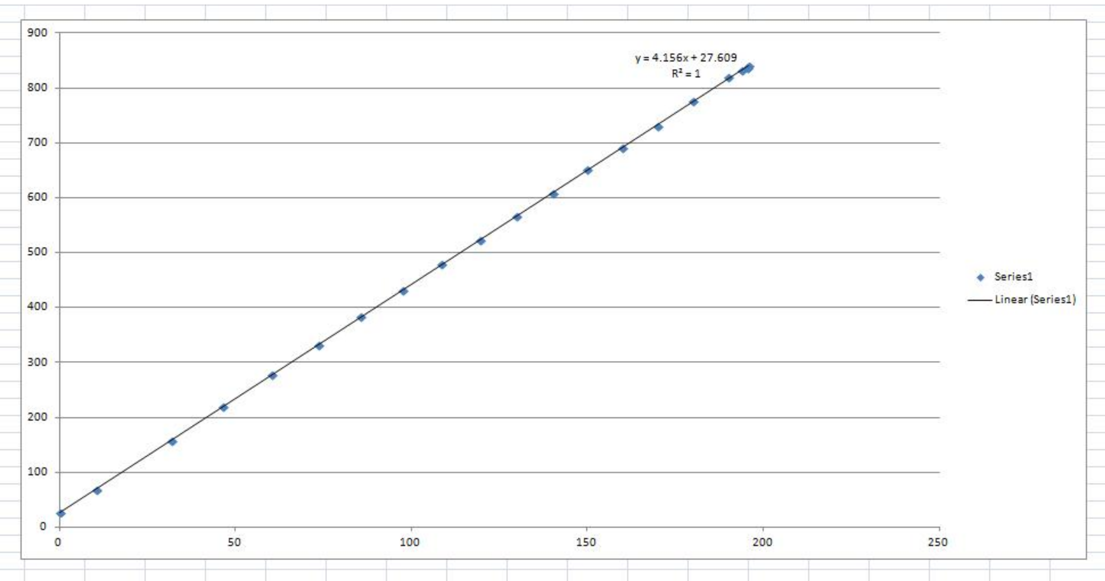
3.3 Minimum Detectability

The minimum detectability (MDQ) of a sensor is based on a 3:1 signal-to-noise ratio. This figure is an example of how MDQ is calculated.



Another factor that affects MDQ is the nature of the compound being ionized. The sensitivity of the sensor can vary significantly from compound to compound, depending on the compound's ionization potential and some other properties. For example, if the sensor responds twice as well to some compounds as it does to isobutylene, you should expect to get twice the MDQ. For compounds to which the sensor is less sensitive, the MDQ will vary proportionally.

Depending on the target compound, the linearity of the sensor can vary. Generally, the more responsive the sensor is to a compound, the narrower the linear range will be. If higher accuracy is required, the linearity of the sensor should be measured over the range of this particular target compound. Another way to improve measurement accuracy is to calibrate the sensor at concentrations within the desired measurement range.

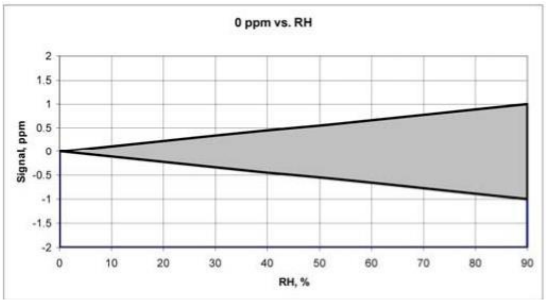


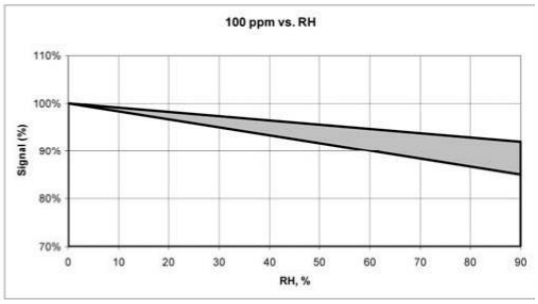
Range: 200ppm PID sensor standard curve (worst case linearity is + 5%)

3.4 Effect of Humidity

There are two phenomena related to moisture: humidity effect and humidity quenching effect In case of humidity response, pure hydrocarbon-free (HCF) air is applied to the sensor and some humidity is present in the sample. The maximum expected shift does not exceed ± 1.0 ppm (isobutylene). To improve the accuracy of low-level measurements, it is recommended to zero the sensor to the same level as the expected relative humidity (RH) in the sample. On the other hand, the humidity quenching effect reduces the sensitivity of the sensor at high relative humidity.

For example, the response to 100ppm isobutylene at 90%RH will be reduced by 8%-15% relative to dry air (RH=0). The effect of extended immersion in high humidity conditions (90% relative humidity at 40° C) on the response value is shown in the figure below. Long-term exposure to high humidity and temperature has little effect





3.5 Calibration

Before calibration is performed, the sensor should be allowed to stabilize. During calibration, there should also be a stabilization period when the zero and span gases are applied to the sensor.

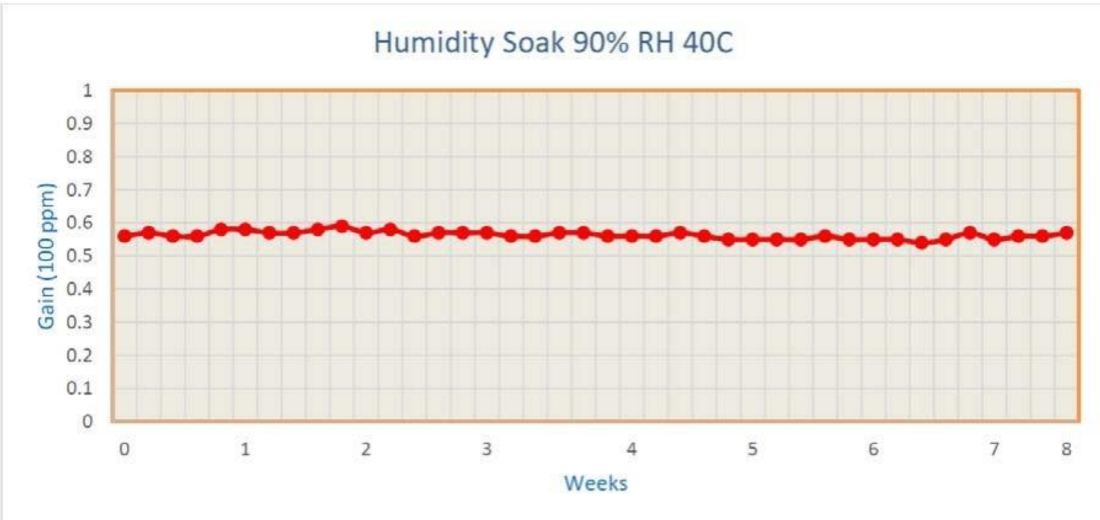
In general, it is recommended to calibrate the sensor frequently. However, if the sensor is used in a relatively clean environment, the calibration period can be longer. Depending on the environment and the accuracy required, calibration work can be changed from once a month to every six months.

3.6 Span Drift

The response of the sensor to the gas may change over time. The general name for this phenomenon is "span drift". The main cause of this deviation is the contamination of the lamp window. If the sensor is used for ionization of ambient air or samples containing heavy compounds and/or particles, the lamp window will be susceptible to contamination.

The window contamination rate is related to the state of the sample gas, that is, the severity of contamination by chemicals and particles. Contamination of the lamp window will cause part of the UV light to be blocked, thereby reducing the sensitivity of the PID sensor. In this case, more frequent calibration and regular cleaning of the lamp window are required.

Most volatile organic compounds (such as isobutylene, benzene, etc.) do not contaminate the window and the drift is very small. Typically, the span drift does not exceed 10-15% (per month of continuous operation). Under favorable conditions, a span drift of between 15% and 30% is possible over a 6 month period. However, some compounds (such as silicones) deposit on the lamp window at a faster rate. In this case, a span drift of 10-20% may occur within 8 hours.



3.7 Sensor Life

The sensor has a typical service life of 3 years; however, there are several components that require periodic replacement, depending on the frequency of use and the samples applied to the sensor. These include the lamp, filters (2), PID sensor electrodes, diaphragms and covers.

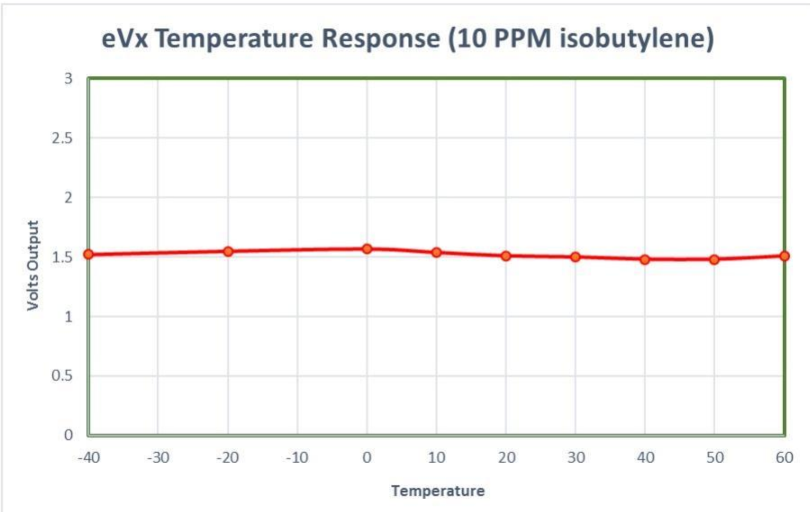
The UV lamp has an irreversible internal degradation over time, but this is negligible within 4000 hours. The lamp windows can also become contaminated over time if exposed to samples containing heavy compounds and/or particles. Periodic calibration of the sensor will compensate for lamp degradation as described in Section 4.7. If the sensor is used to measure low levels of contamination in pure gases, it will last as long as the lamp, i.e. >4000 hours, without the need for lamp cleaning or sensor servicing. All replacement parts including lamp, electrode assembly, cover, diaphragms and filters are listed in the Appendix.

3.8 Balancing Gas Effect

The balancing gas of the sample affects the sensor response to target compounds. This is primarily the effect of the balancing gas on the absorbance of UV radiation. In a less transparent gas matrix (e.g. oxygen, methane), the sensor will respond less to the same compound than in a more transparent background gas (e.g. nitrogen, helium). Equilibrium gas properties will also affect the MDQ characteristics of the sensor. Better MDQ can be obtained in UV gases with less absorbance.

3.9 Temperature Effects

The normal operating range of the sensor is from -20^{o} C to 60^{o} C. The sensor will operate safely to -30° C without damage to the sensor, however, the performance of the sensor cannot be guaranteed at extreme temperatures. Changes in ambient temperature have little effect on the performance of the sensor. The temperature dependence curve is shown in the figure below. From -20° C to 60° C, the difference from the typical temperature profile is less than + 5%



3.10 Response Factors

The ratio of the sensitivity of isobutylene to the sensitivity of the target compound is called the response factor (RF). For example, the sensitivity of the sensor to isobutylene is 1mV/ppm and to benzene is 2mv/ppm. This means that the RF for benzene is equal to 0.5. Response factors vary somewhat between different

PID detector designs. Response factors are available from various reliable literature sources.

Response factor tables allow the user to measure the concentration of various gases without actually calibrating the sensor to the target gas.

When using response factor tables, the following facts and guidelines should be kept in mind:

1. Each response factor is determined under laboratory conditions with isobutylene as the reference compound and dry air as the balance gas.

2. Depending on the measurement conditions (sample humidity, background gas, and lamp conditions), the actual value of the response factor may vary in the customer's application.

3. When calibration with the actual target compound is not feasible, the response factor should be used for approximate measurements.

4. For best accuracy, the instrument should be calibrated with the target compound under application conditions. Some gases, although they have response factors, are often unstable and can cause photochemical reactions in the PID detector. This reaction can lead to some unpredictable results. NH3 is an example.

3.11 Response Time (T90/T10)

The time it takes for the signal to go from 0% to 90% of the target gas is called the T90 response time, and the sensor's response time is < 3s. Note that the response time is based on the sensor's response, not the sample detection system.

3.12 Electrical Characteristics

The electronic part of the sensor consists of a blocking circuit, a lamp power supply circuit, a PID sensor bias voltage circuit, and an amplifier circuit. The power supply voltage is between 3.2V and 5.5V. The current consumed by the sensor is constant, ranging from 24mA to 36mA. The power consumed by the sensor will vary with the power supply voltage. The signal output of the sensor is typically between 0.04V and 2.5V. If the normal concentration range of the sensor is exceeded, the maximum signal voltage that the sensor may produce is 2.9V.

3.13 Maintenance of the sensor

The rugged design of the sensor provides trouble-free operation during its lifetime. However, in certain circumstances, maintenance may be required. This is maintenance that needs to be performed by the customer and is not covered by the warranty. Parts that may require cleaning or replacement over time include the UV lamp, detector unit, filters (2), diaphragms and covers.

Window contamination can degrade the performance of the sensor in a polluted environment. One sign of this problem is a higher baseline noise for a properly calibrated sensor. Another way to detect this condition is to measure the sensitivity of the sensor in mV/ppm during calibration. The sensor will still be usable but with a lower sensitivity than this. However, in this case the MDQ of the sensor will be higher than stated in the specification. When this condition is noticed, the lamp window may need cleaning.

4.Precautions for use

Warning: All maintenance procedures must be performed on a clean surface using clean tools. Avoid touching the lamp window and metal parts of the electrode assembly with bare fingers. Fingerprints left on these parts may adversely affect the operation of the sensor. Latex gloves are preferred, but if not used, your hands must be clean and free of oils, lotions, etc. When holding the lamp, you can use its glass body as well as its edges.