This manual is intended to assist users of the PID - GH Sensor in becoming familiar with photoionization detectors, including their operating principles, technical features, and specific application characteristics of PID. The manual will guide users on how to incorporate the GH series PID sensors into their products.

Part Number	Measuring Range
322110000	0-10000ppm
322106000	0-6000ppm
322102000	0-2000ppm
322101000	0-1000ppm
322100200	0-200ppm
322100100	0-100ppm
322100060	0-60ppm
322100020	0-20ppm
322100010	0-10ppm
322100002	0-2ppm

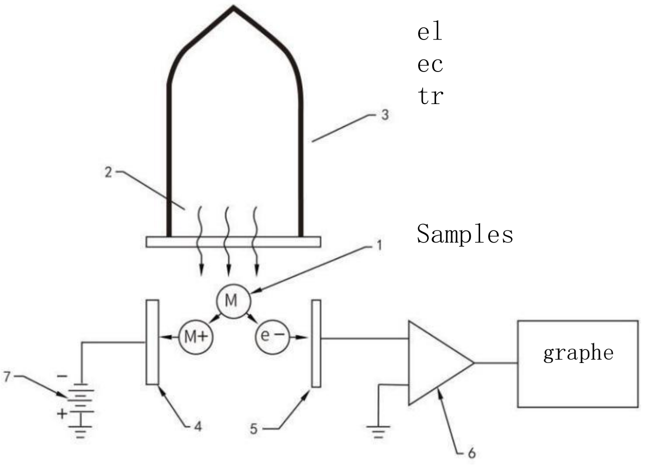
Section 1: Principle

Photoionization detector (PID) is one of the most widely used gas detection technologies. PID is widely used in portable instruments for the detection of various organic compounds and certain inorganic gases in ambient air.

A typical PID block diagram is shown below. Easy to ionize molecules (1) exposed to the high-energy vacuum ultraviolet radiation (2) produced by the gas discharge lamp (3), where some of them are ionized, transforming according to the following equation: M + photon -> M+ + e-, where M+ represents a positively charged ion and e- represents a negatively charged electron.

If the molecule is ionized, the ionization potential (IP) of the molecule M should be less than the energy of the UV photon (E). Usually, the greater the difference between E and IP, the greater the response of the PID sensor. The units of E and IP are usually the electronic volts (eV). The photon energy of typical PID lamps is between 8.3 and 11.7 eV. The GH-PID Sensor is equipped with a 10.6 eV photoionization lamp. The electrode pair (4,5) is located in the ionization zone near the light window. The polarization electrode (4) is connected to high-voltage direct current power supply (7), while the signal electrode (5) is connected to the input of the amplifier (6). The electric field generated by these two electrodes forces the electrons and ions to drift towards their respective electrodes, resulting in a small current. The current is amplified by the amplifier chip, and the output analog signal is recorded and / or displayed in a digital or analog format. The output signal is proportional to the concentration of ionizable molecules in the PID sensor chamber, serving as a measure of their concentration.

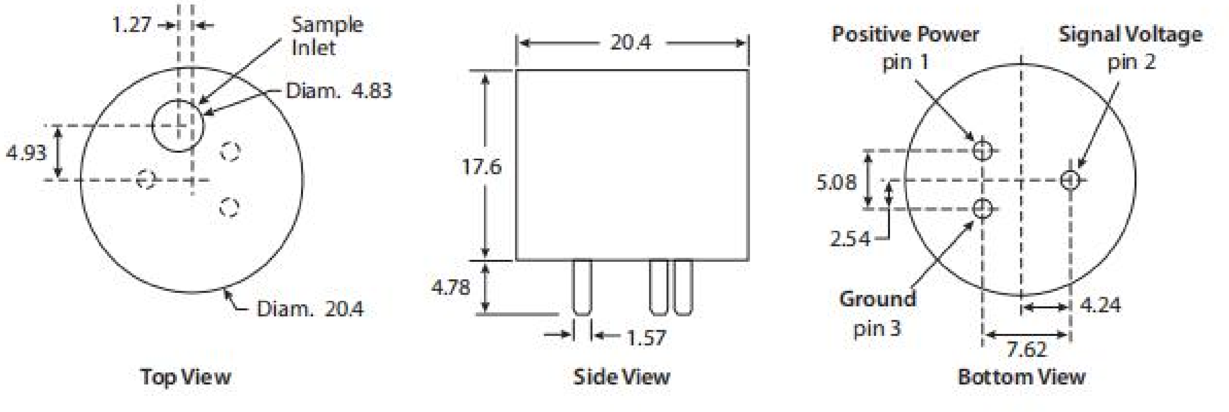
Main air composition (N2、O2And CO2) Have a larger ionization potential than the UV lamp and therefore cannot be detectable. Therefore, without interference from the air composition, PID is very useful for detecting various volatile organic compounds (VOCs) in ambient air, even at low parts per billion (ppb) concentrations. The gas samples are usually delivered to the detector chamber by a pump or diffusion process



Section 2: Design Overview

The GH-PID Sensor profile design can be interchangeable with major brands of gas sensors. Therefore, it can be mounted in any portable and stationary gas monitor.

The sensor consists of a plastic housing with a removable cover at the top and three pins at the bottom for electrical connections at the bottom.



The uses of these pins are as follows:

•Positive supply voltage (3.3 to 5.5 V DC) is supplied to the sensor via pin 1.

•Common or ground is provided to the sensor through pin 3

• The signal voltage is transmitted to the external electronic device through the pin 2

In the plastic cover, there is an opening as the inlet to the analytical gas (designated as the "sample port" on the chart). Under this cover there are two filters that prevent the liquid and particles from entering the inside of the sensor.

Photoionization PID sensors and the associated electronic circuits are located in the shell.

This series of PID sensors consists of a super-compact UV lamp with a nominal photon energy of 10.6 eV and a PID sensor unit.

Section 3: Performance Parameters

3.1 Function

Target gas: volatile organic compounds and other gases with an Ionization Potential <10.6 eV.

Light energy: 10.6 eV

Range and the minimum detection amount

Part Number	Measuring Range	Sample Concentration	Minimum Detection Limit
322110000	0-10000ppm	10000ppm	1000ppb
322106000	0-6000ppm	6000ppm	500ppb
322102000	0-2000ppm	2000ppm	200ppb
322101000	0-1000ppm	1000ppm	100ppb
322100200	0-200ppm	200ppm	20ppb
322100100	0-100ppm	100ppm	10ppb
322100060	0-60ppm	60ppm	5ppb
322100020	0-20ppm	20ppm	2ppb
322100010	0-10ppm	10ppm	1ppb
322100002	0-2ppm	2ppm	0.5ppb

T90 Response Time <3 seconds (diffusion mode)

Temperature Range: -20℃ ~ 60℃

Output varies with temperature: + 5%

Relative humidity range: 0 ~ 90% no condensation

Humidity response: <1% full scale @ 90% R.H.

Humidity quenching effect: <15% @ 90% R.H.

On-board Filter: Remove liquid and particles

3.2 Electrical Characteristics

Power Supply Voltage: 3.2V~ 5.5V

Current: 24 mA ~ 36 mA

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

3.3 Physical Characteristic

Weight: <8g

Packaging Type: urban technology tm 4 p

Position-sensitive: No

Components for customer service: lights, electrodes, filters, covers, and gaskets.

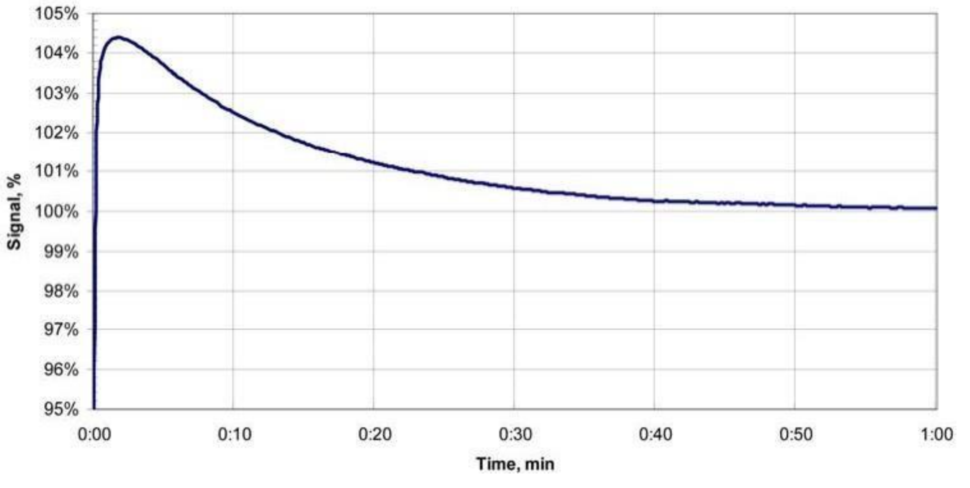
Ultraviolet lamp tube life: 8000h or one year

Warranty Period: 24 months from the date of shipment (lamp, electrode piece, filter film are not within the warranty scope.

Section 4: The Application Guide

4.1 The sensor is powered on after storage

If the sensor is stored for a long time, it may have been exposed to environmental conditions, possibly causing it . The sensor exhibited the drift characteristic of the baseline signal. After storage for a long time, it is recommended to power it on for a period of time,The PID sensor will clean itself, and the baseline signal will drop and stabilize. If the sensor is used daily, the user should make it stable before using it. The preheating time depends on the required accuracy.



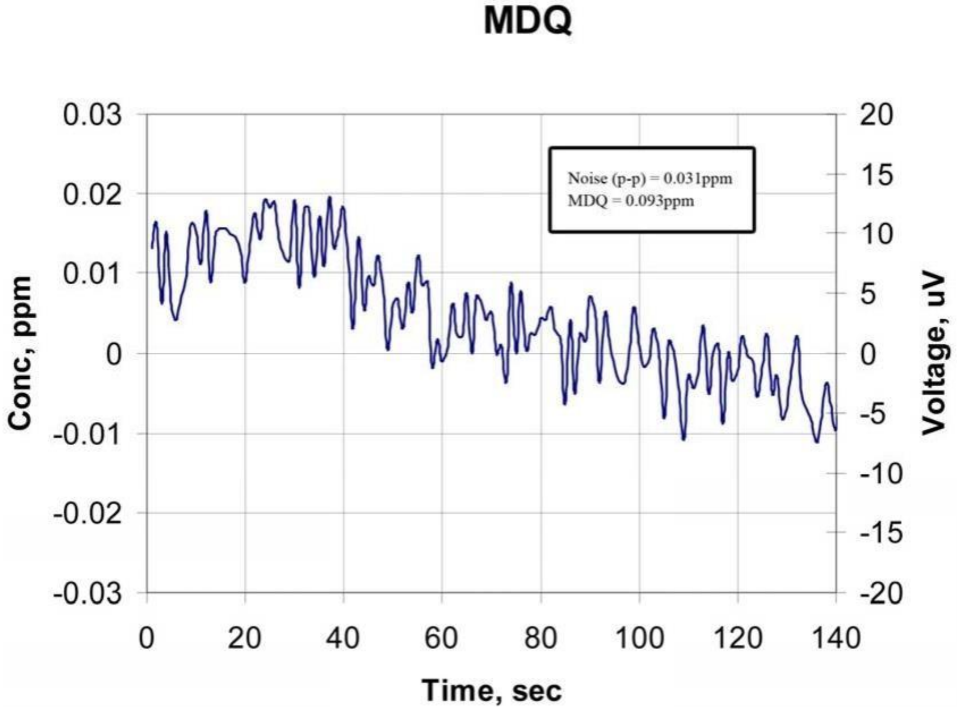
4.2 Signals Range

The rated voltage output range of the sensor is 0.04 to 2.5 V. With zero gas, the sensor will produce an offset of 0.04 to 0.010 V (see the figure below). If the normal sensor concentration range is exceeded, the maximum signal voltage possible for the sensor is 2.9V. If exposed to extremely high concentrations, it may take some time for the sensor to recover during gas purification.

Sensor	Isobutene Concentration	Zero Gas Value	V / Ppm	Span Test Gas Isobutene
322110000	0-10000ppm	40 ~ 100 mV	0.15-0.4 mV	1000ppm
322106000	0-6000ppm	40 ~ 100 mV	0.3-0 .6 mV	1000ppm
322102000	0-2000ppm	40 ~ 100 mV	0.6-1.8 mV	1000ppm
322101000	0-1000ppm	40 ~ 100 mV	1.5-3.6 mV	500ppm
322100200	0-200ppm	40 ~ 100 mV	6-18 mV	100ppm
322100100	0-100ppm	40 ~ 100 mV	15-36 mV	50ppm
322100060	0-60ppm	40 ~ 100 mV	30-60 mV	10ppm
322100020	0-20ppm	60 ~ 120 mV	60-180 mV	10ppm
322100010	0-10ppm	60 ~ 120 mV	150-360mV	5ppm
322100002	0-2ppm	60 ~ 120 mV	0.6-1.2V	1ppm

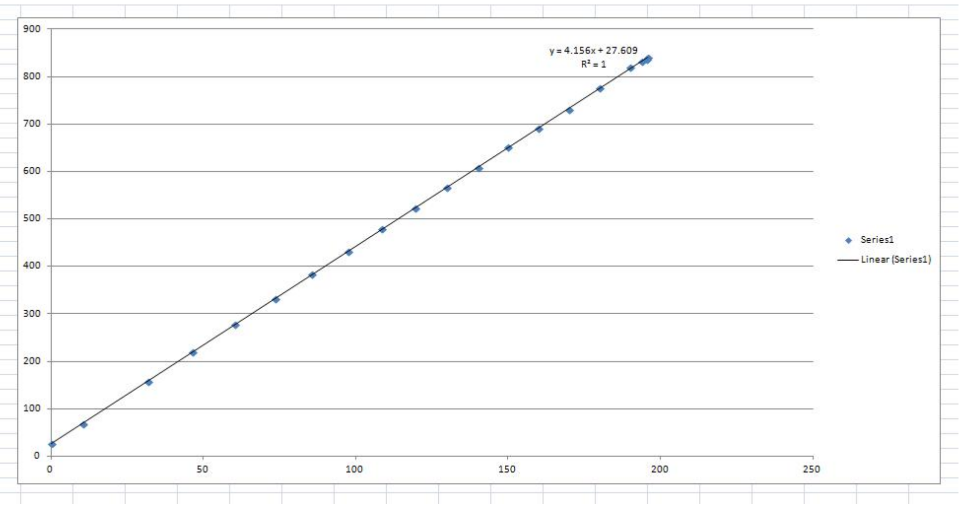
4.3 Minimum Detection

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



Another factor that affects MDQ is the nature of the ionized compound. Based on the basis of the ionization potential of the compounds and some other properties, the sensor sensitivity varies significantly between different compounds. For example, if the sensor responds twice as much to some compounds, it should expect twice the MDQ. For compounds with low sensor sensitivity, the MDQ will vary proportionally.

The linearity of the sensor may vary depending on the target compound. Usually, the larger the sensor response to the compound, the narrower the linear range. If higher accuracy is required, the linear properties of the sensor should be actually measured within the range of this specific target compound. Another way to improve the measurement accuracy is to calibrate the sensor concentration within the desired measurement range.



Range:200ppm, PID Sensor standard curve(Worst-case linearity of + 5%)

4.5 The Effect of Humidity

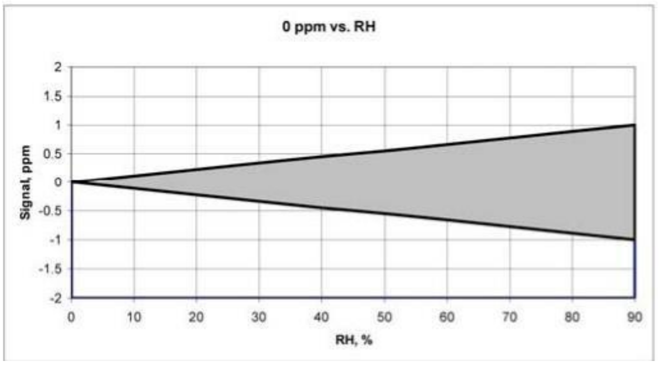
There are two phenomena related to moisture: humidity influence and humidity quenching effect.

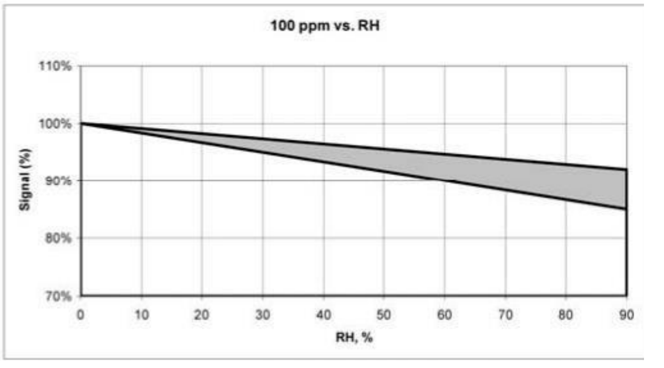
In a humidity response, pure hydrocarbon-free (HCF) air is applied to the sensor with some humidity in the sample. The maximum expected displacement does not exceed ± 1.0 ppm (isobutene). To improve the precision of the low-level measurements, it is recommended to zero the sensor to the same level as 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 100p pm isobutylene decreases at 90% RH relative to dry air (RH = 0).

The effect of the prolonged immersion under high humidity conditions (90% relative humidity at 40℃) is shown in the figure below. Long-time exposure to high humidity and temperature had almost no effect.





4.6 Calibration

The sensor should be allowed to stabilize prior to the calibration. During the calibration period, there should also be a stabilization period when the zero gas and the span gas are applied to the sensor.

Usually, it is recommended to calibrate the sensors more often. However, if the sensor is used in a relatively clean environment, the calibration period can be much longer. Depending on the required environment and accuracy, the correction work can be changed from monthly to every six months.

4.7 Span Drift

The response of the sensors to the gas may vary over time. The general term for this phenomenon is "span drift". The main reason for this deviation is the contamination of the lamp windows.

If the sensor is applied to ambient air or to ionsamples containing heavy compounds and / or particles, the lamp window will be susceptible to contamination. The correlation of the window contamination rate with the sample gas state, i. e., that is contaminated with chemicals and particles order of severity. Contamination of the windows causes cause blocking of UV blocking, which reducing the sensitivity of the PID sensor. In this case, more frequent calibration and regular cleaning of the lamp windows are required.

Most volatile organic compounds (such as isobutylene, benzene, etc.) do not pollute the window, and the drift is very small. Generally, the span drift does not exceed 10 ~15% (monthly continuous operation). Under favorable conditions, the span drift may be between 15% and 30% during the 6-month period. However, some compounds (such as silicone) are much faster . Of the velocity of was deposited on the light window. In this case, the span drift may reach up to 10 – 20% within 8 hours.

4.8 Sensor Life

The service life of the sensor is generally 3 years; however, several components need to be replaced regularly, depending on Frequency used and the samples applied to the sensor. These include lights, filters (2), PID sensor electrodes, separator, and covers.

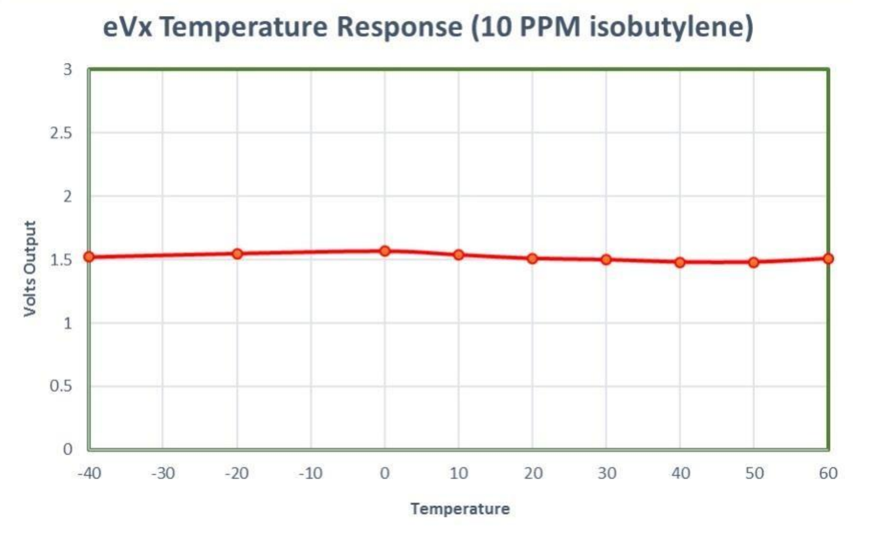
Over time, the UV lamp has an irreversible internal degradation, but within 4,000 hours is negligible. If exposed to samples containing heavy compounds and / or particles, the lamp windows are also contaminated over time. As described in Section 4.7, the periodic calibration of the sensor will compensate for the lamp attenuation. In compliance with The fruit sensor is used to measure low levels of contamination in pure gas, and it will last as long as the lamp, or> 4,000 hours, without cleaning the lamp or repairing the sensor. All replacement parts including lamps, electrode components, covers, separator, and filters are listed in the Appendix.

4.9 Balanced Gas Effect

The equilibrium gas of the sample influences the response of the sensor to the target compound. This is mainly to balance the effect of the gas on the absorbance of ultraviolet radiation. In a less opaque gas matrix (eg., oxygen, methane), the sensor responds less to the same compound than in the less opaque background gas (eg., nitrogen, helium). Balanced gas characteristics Can also affect the MDQ characteristics of the sensor. In UV gases with less absorbance, better results can be obtained MDQ 。

4.10 Temperature Effect

The normal operating range of the sensor is from-20 C to 60 C. The sensor will operate safely up to the-30℃ without causing damage to the sensor, however, at extreme temperatures, the performance of the sensor cannot be guaranteed. The change of the ambient temperature has very little effect on the performance of the sensor.Temperature correlation curves are shown in the figure below. From – 20℃ to 60℃, the difference from the typical temperature profile is less than + 5%



4.11 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 G H PID-Sensor sensor has a sensitivity of 1 mV / ppm for isobutene and 2 mv / ppm for benzene. This means that the RF of benzene equals 0.5. The response factors show some differences between the different PID detector designs. Response factors are available from a variety of reliable literature sources.

The response factor table allows the user to measure the concentration of the various gases without having to actually calibrate the sensor to the target gas. When using the response factor table, keep in mind the following facts and guidelines:

1, The reaction factors were measured under laboratory conditions with isobutylene as the control compound and dry air as the equilibrium gas.

2. The actual value of the response factor may vary in customer applications depending on the measurement conditions (the sample humidity, the background gas and the lamp condition).

3. When calibration with actual target compounds is not feasible, response factors should be used for approximate measurement.

4.To obtain the best accuracy, the instrument should be calibrated with the target compound under the applied conditions. Certain gas despite having response factors, they are often unstable and can cause photochemical reactions in the PID detector. This response can lead to some unpredictable results. NH_3 Is an example of this.

4.12 Response Time (T90 / T10)

The time taken for the signal to go from 0% to 90% of the target gas is called T90 response time and the GH PID-Sensor sensor-time <3s. Note that the response time is based on the sensor response, rather than on the sample detection system.

4.13 Electrical Characteristics

The electronic portion 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 3.2 V and 5.5 V. The current consumed by the sensor was constant, ranging from 24 mA to 36 mA. The power consumed by the sensor will vary with the supply voltage. The signal output of the sensor is typically between 0.04 V and 2.5 V. If the normal sensor concentration range is exceeded, the maximum signal voltage possible for the sensor is 2.9V.

4.14 Maintenance of Sensors

The rugged design of the sensor provides a fault-free operation process during its life cycle. However, in some cases, maintenance may be required. This is the maintenance that the customer needs himself, and is not covered by the warranty. Parts that may need to be cleaned or replaced over time include UV lamps, detector units, and filters(2), the partition plate and the cover.

In a polluted environment, window pollution reduces the sensor performance.

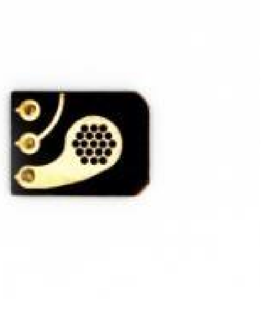
One indication of this problem is that a properly calibrated sensor has higher baseline noise. Another way to detect this condition is to measure the sensitivity of the sensor as a mV / ppm during the calibration period. The Sensors are still usable, but the sensitivity is lower than this phenomenon. However, in this case, the MDQ of the sensor will be higher than the value specified in the specification. Light windows may need to be cleaned when this is noted.

Precautions for use

Warning: All maintenance procedures must be performed with clean tools on clean surfaces. Avoid touching the lamp window and the metal portion of the electrode assembly with bare fingers. Fingerprints left on these components may adversely affect the operation of the sensor. Latex gloves are preferred, but if not used, your hands must be clean, without oil, lotion, etc. When holding the lamp, use its vitreous or its edges. All GH-PID Sensor sensors contain five user-replaceable components:

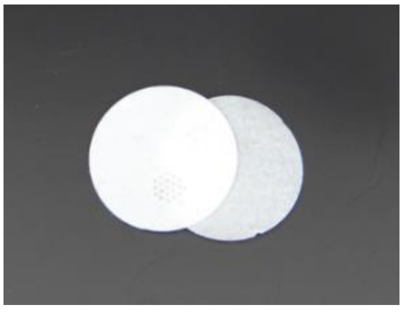
top cap

pad



Carbon fiber electrode sheet

10.6eV Light



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