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SENOVOL CORPORATION

High Resolution 4-Series PID

Tech Note 230723

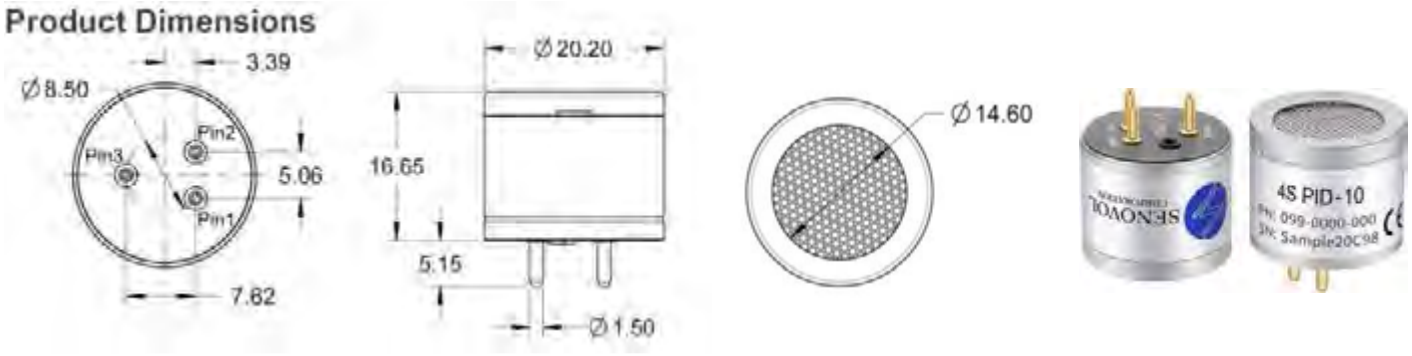
PID sensors are widely popular for detecting volatile organic compounds (VOCs) due to their compact size and affordability. However, the performance of PID sensors, particularly those with high resolution at 1 ppb, is afflicted by various issues that restrict their applicability in scenarios necessitating robust long-term stability, repeatability, and linearity.

Leveraging its proprietary technologies, Senovol Corporation has consistently improved its PID sensors to optimize their performance and cater to a variety of different applications. Our PID sensor's key component, the UV lamp, is engineered without any internal electrodes (metal pieces). This distinctive design ensures that the highly purified rare gases inside the lamp remain uncontaminated throughout its lifespan, even during extreme high-energy plasma discharge when the lamp is lit. Consequently, this optimized UV lamp design offers numerous advantages that significantly enhance the PID's overall performance.

Highlights

1. *High-sensitivity UV lamp*: A high-sensitivity UV lamp ensures a PID sensor's exceptional signal-to-noise ratio.
2. *Consistent sensitivity*: Sensitivity remains constant unless the exterior of the UV lamp window becomes contaminated. In such cases, sensitivity can be restored after cleaning the UV lamp window.
3. *Steady resolution*: If a PID sensor's initial resolution is 1 ppb, it remains consistent throughout the PID's lifespan.
4. *Long UV lamp lifespan:* All of Senovol's 4-series PID sensors guarantee a UV lamp lifespan of 10,000 hours.
5. *Low strike voltage*: The low strike voltage for UV lamp ignition facilitates the on-and-off duty required for a PID gas monitor.

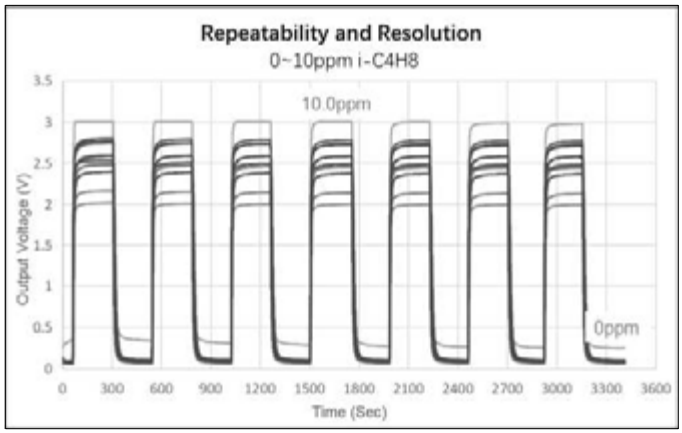
Product Dimensions



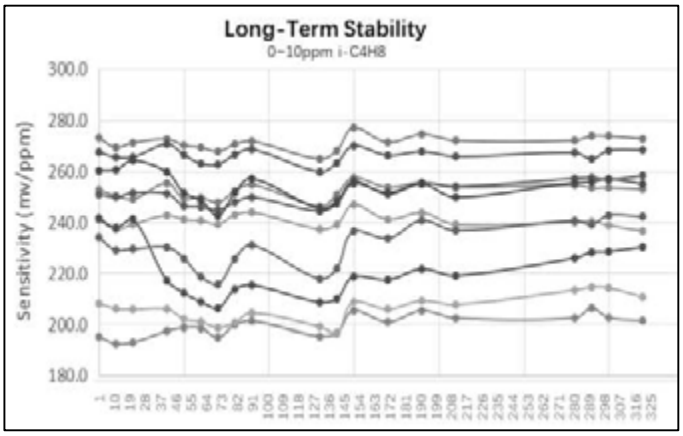
Bottom View | Side View | Top View

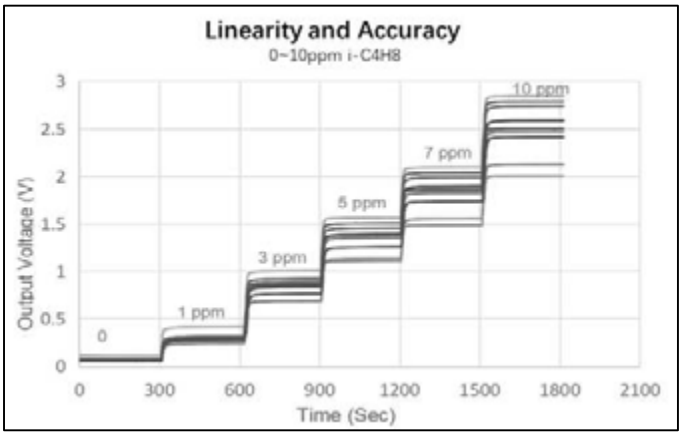
All dimensions in mm

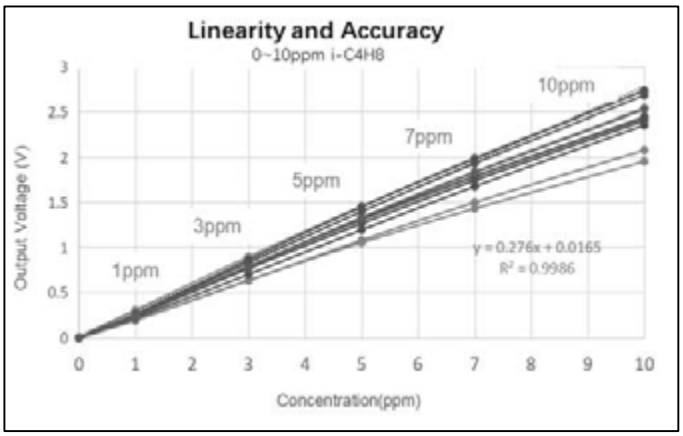
Performances (Model: 4PID-10, Description: 4-Series PID, Detection Range 0~10ppm, Resolution 1ppb)



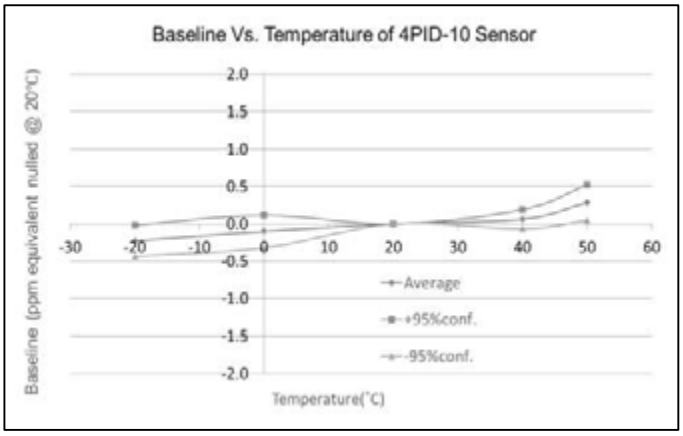
SN \ Time	1st	2nd	3rd	4th	5th	6th	7th	Avg	STDEV	RSD
#1	243	242	242	241	241	241	241	241	0.9	0.4%
#2	196	194	194	193	193	193	192	193	1.1	0.6%
#3	210	209	208	207	207	206	206	207	1.5	0.7%
#4	254	252	251	251	251	251	250	251	1.2	0.5%
#5	241	240	239	238	238	238	237	238	1.4	0.6%
#6	274	272	271	271	270	270	269	271	1.6	0.6%
#7	245	242	240	239	239	238	238	239	2.5	1.1%
#8	268	267	267	266	266	266	265	266	1.0	0.4%
#9	233	231	230	230	229	229	229	230	1.3	0.6%
#10	252	251	251	250	250	250	250	250	0.6	0.3%
#11	267	264	263	262	261	261	260	262	2.4	0.9%
AVG	244	242	241	241	240	240	240	241	1.4	0.6%

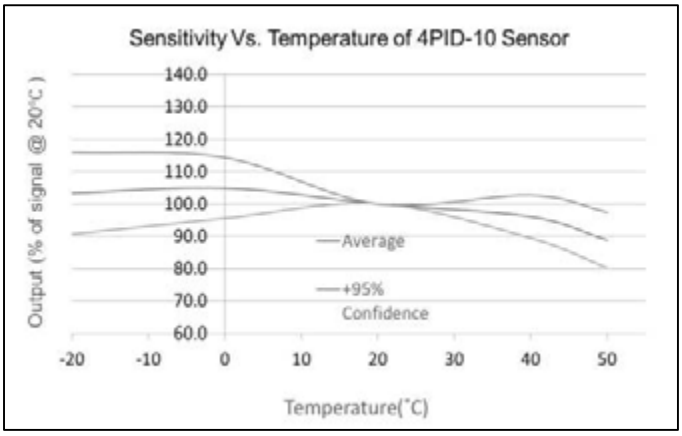




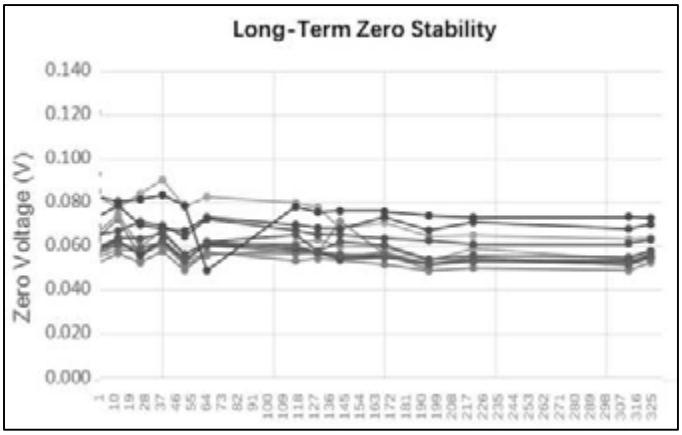


SN \ ppm	0	1	3	5	7	10	R^2
#1	0.0000	0.2426	0.7793	1.3003	1.7786	2.4468	**0.9986**
#2	0.0000	0.1894	0.6331	1.0496	1.4289	1.9522	**0.9999**
#3	0.0000	0.3010	0.8943	1.4555	1.9904	2.7339	**0.9998**
#4	0.0000	0.1894	0.6296	1.0772	1.4970	2.0765	**0.9994**
#5	0.0000	0.2380	0.7868	1.3322	1.8382	2.5387	**0.9999**
#6	0.0000	0.2338	0.7710	1.2895	1.7636	2.4145	**0.9999**
#7	0.0000	0.2596	0.8621	1.4455	1.9807	2.7282	**1.0000**
#8	0.0000	0.2342	0.7871	1.3097	1.7882 1.9294	2.4368	**0.9999**
#9	0.0000	0.2547	0.8267	1.3958	1.9294	2.6785	**0.9996**
#10	0.0000	0.2131	0.6981	1.1916	1.6735	2.3539	**0.9997**
#11	0.0000	0.2381	0.7611	1.2611	1.7388	2.4026	**0.9995**
#12	0.0000	0.2288	0.7801	1.3237	1.8277	2.5256	**0.9999**
AVG	**0.0000**	**0.2352**	**0.7675**	**1.2860**	**1.7696**	**2.4407**	**1.0000**





Temp & Humid \ SN	25°C 0%RH		40°C 90%RH (46g/m³ H2O)				50°C 90%RH (75g/m³ H2O)			
	Baseline (V)	Sensitivity (mV/ppm)	Baseline (V)	Sensitivity (mV/ppm)	Baseline change(mV)	Sensitivity change	Baseline (V)	Sensitivity (mV/ppm)	Baseline change(mV)	Sensitivity change
#1	0.063	247.6	0.182	232.4	0.119	93.9%	0.183	222.2	0.120	89.7%
#2	0.054	197.2	0.079	188.0	0.025	95.3%	0.092	175.6	0.038	89.0%
#3	0.083	273.1	0.130	256.2	0.047	93.8%	0.221	245.2	0.138	89.8%
#4	0.052	205.8	0.071	195.4	0.019	95.0%	0.074	178.3	0.022	86.6%
#5	0.066	255.3	0.101	247.4	0.035	96.9%	0.123	237.5	0.057	93.0%
#6	0.059	242.6	0.084	233.6	0.025	96.3%	0.091	219.5	0.032	90.5%
#7	0.057	272.6	0.090	264.0	0.032	96.8%	0.112	251.9	0.054	92.4%
#8	0.065	216.9	0.082	206.2	0.017	95.1%	0.112	193.5	0.047	89.2%
#9	0.056	270.6	0.085	264.5	0.029	97.7%	0.108	251.0	0.052	92.8%
#10	0.073	230.0	0.098	217.7	0.025	94.7%	0.105	201.7	0.032	87.7%
#11	0.059	251.1	0.094	243.3	0.035	96.9%	0.122	231.4	0.063	92.1%
#12	0.083	259.6	0.108	249.0	0.025	95.9%	0.136	233.7	0.053	90.0%
AVG	**0.064**	**243.5**	**0.100**	**233.1**	**0.036**	**96%**	**0.123**	**220.1**	**0.059**	**90%**

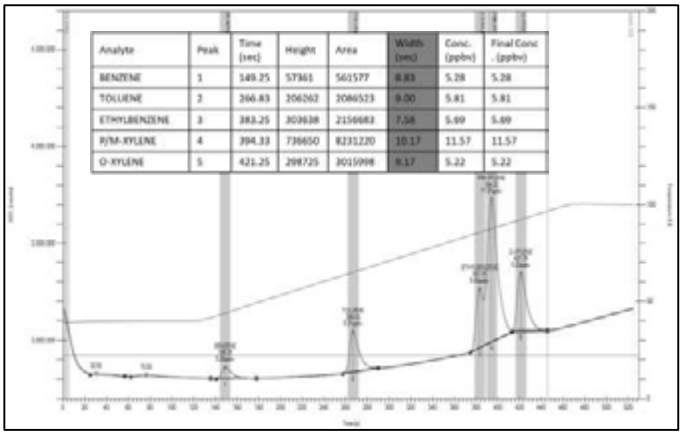


To sum up, the 4PID-10 exhibits the following characteristics:

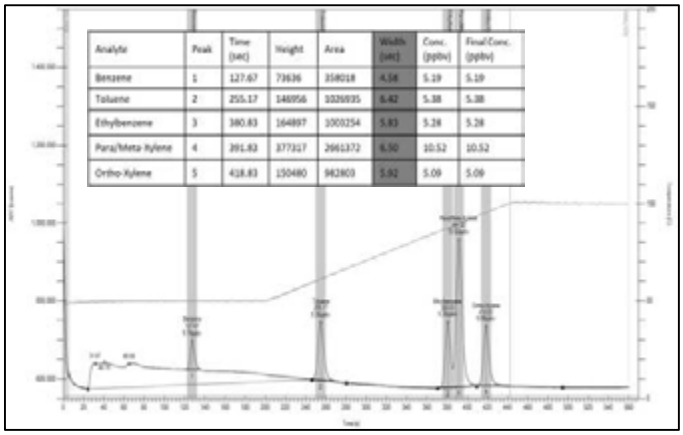
1. It maintains a stable resolution of 1 ppb.
2. The repeatability is within ±1% Relative Standard Deviation (RSD).
3. It demonstrates high linearity with a coefficient of determination (R^2) greater than 0.999.
4. In extreme temperature conditions, the zero drift is less than ±0.5 ppm, and the sensitivity variation is less than ±20%.
5. It boasts excellent long-term stability.

References

1. One of the customers manufactures portable gas chromatography (GC) devices shared the following data with us. The customer compared the 4PID-10 with a competitor's PID sensors. The data obtained clearly indicates that the 4PID-10 exhibits significantly superior sensitivity, baseline stability, and signal-to-noise ratio in comparison to the competitor's sensors.



Analyte	Peak	Time (sec)	Height	Area	Width (sec)	Conc. (ppbv)	Final Conc. (ppbv)
BENZENE	1	149.25	57361	561577	8.83	5.28	5.28
TOLUENE	2	266.83	206262	2086523	9.00	5.81	5.81
ETHYLBENZENE	3	383.25	303638	2156683	7.58	5.69	5.69
P/M-XYLENE	4	394.33	736650	8231220	10.17	11.57	11.57
O-XYLENE	5	421.25	298725	3011998	9.17	5.22	5.22



Analyte	Peak	Time (sec)	Height	Area	Width (sec)	Conc. (ppbv)	Final Conc. (ppbv)
Benzene	1	127.67	73636	358018	4.58	5.19	5.19
Toluene	2	255.17	148956	1026935	6.42	5.38	5.38
Ethylbenzene	3	380.83	164807	1003254	5.83	5.28	5.28
Para/Meta Xylene	4	391.82	377317	2961372	6.50	10.52	10.52
Ortho-Xylene	5	418.83	150480	982803	5.92	5.09	5.09

2. A customer, specialized in producing PID monitors for air quality monitoring, conducted a comprehensive comparison between the 4PID-10 and a competing PID device. The customer graciously shared the results of their evaluation, demonstrating that the 4PID-10 exhibits superior overall performance in this comparison.