LD8001+

PST PROCESS SENSING TECHNOLOGIES | LDetek A PST BRAND

TRACE SUB PPB/PPT TRACE N2 ANALYSIS IN ARGON OR HELIUM

DESIGN REPORT

The LD8001+ is designed with the plasma emission detector (patented PED) maintained in an optimized controlled vacuum equilibrium to offer an extended collision energy level. The PED arrangement is designed with a valve network that allow to balance between 3 excitation sources. From each of the excitation source, an algorithm measures the PED response delta to convert that signal into a fast and drift free nitrogen reading. This unique design makes the LD8001+ analyser top of the technology to measure trace nitrogen in sub ppb/ppt.

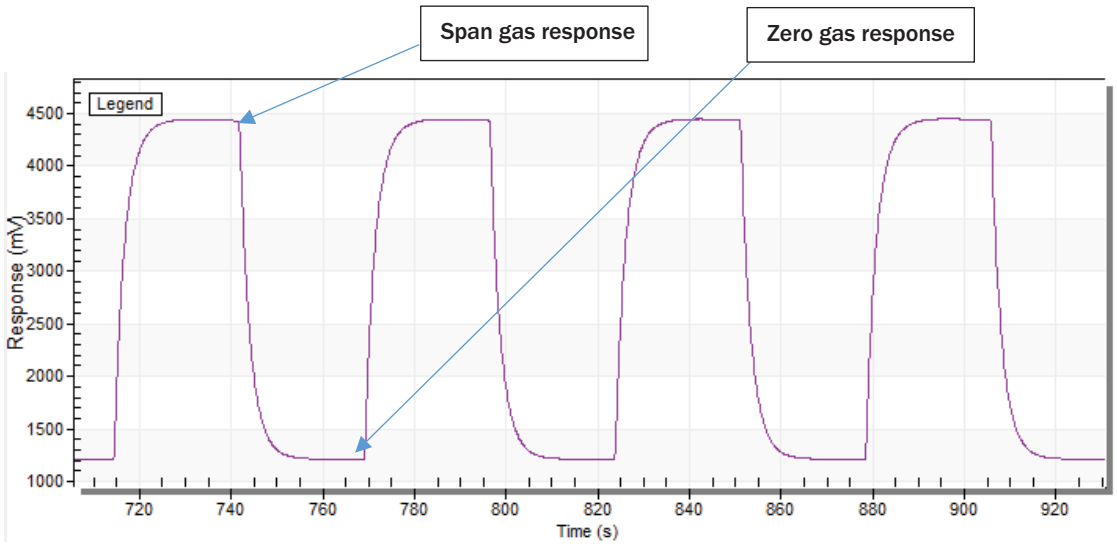
ADVANTAGES OF THE TECHNOLOGY AND ITS DESIGN

- Self canceling effect from gas line contamination & surface absorption
- Fast response time
- Interference free
- Reduce the temperature drifting to minimum value
- Improve the limit of detection down to 0.1ppb trace nitrogen

WORKING CONDITIONS & PERFORMANCES

- Sample pressure: 15-30psig
- Sample gas: Argon or Helium
- Sample gas consumption: 150sccm at 15 psig to 500sccm at 30psig
- Limit of detection (LDL): 0.1ppb Nitrogen
- Stability & Drift: <+/- 0.01% of the measuring scale
- Repeatability & Accuracy: Greater of <+/- 1% of the reading or the ldl
- Response time T90: 1 minute

DETECTION PRINCIPLE



The change in the oscillation is evaluated by switching the gas inside the sensor and by measuring the response delta. For sampling response, the sensor is balanced between a dry gas which is nitrogen free source and the sample source. The difference is then calculated. The same principle is applied for the span gas calibration. However, this time the comparison is between the nitrogen free gas source (zero gas) and a source containing a known nitrogen content (span gas). A cycling time of 30 seconds on each gas is used to compare the response delta.

ANALYSER PERFORMANCE RESULTS

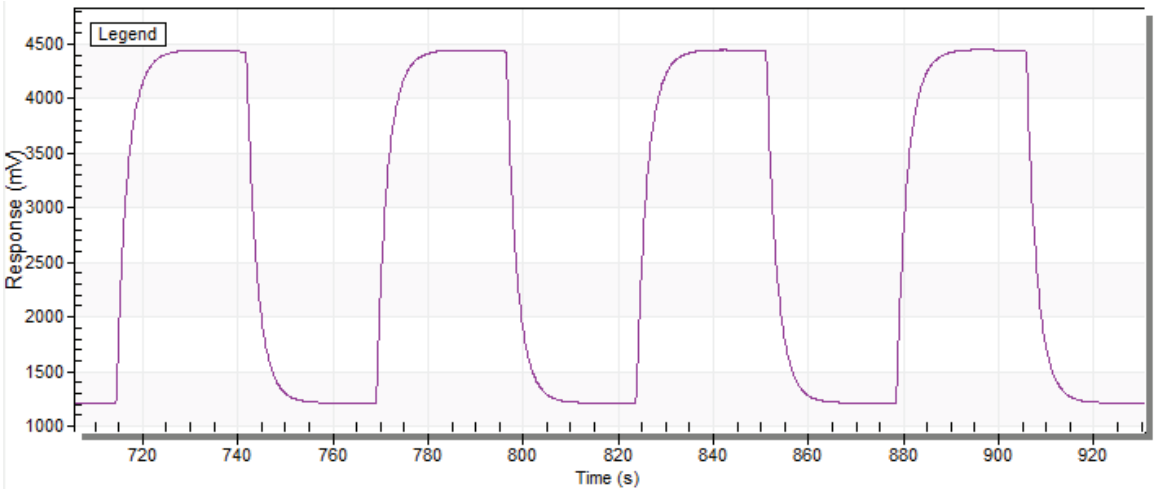
Linearity/Accuracy/Repeatability

The system is fully linear due to the linearization rectification of the sensor. Each system is characterized in function of its full range to ensure the respond is linear. A series of multiple points at different concentration within the scale are performed to achieve a linearization curve having R2 better than 0.99.

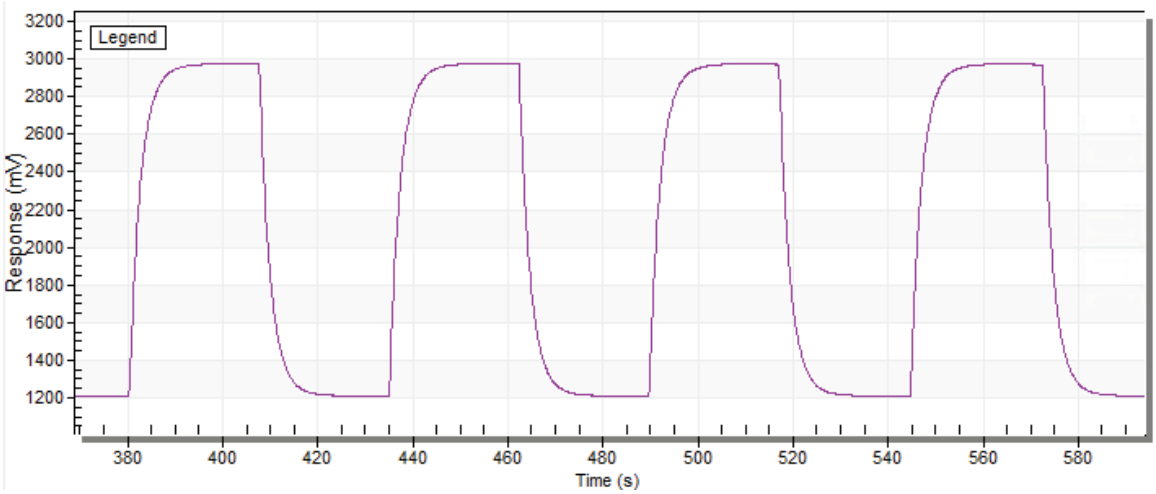
The accuracy/repeatability error of the instrument is less than +/-1% of the reading or its ldl whichever is the higher. In this instance, the table below shows the % deviation for 5 points diluted at different concentrations between 0-1000ppb. For better understanding of the detector response at different concentrations, the raw signal of the algorithm delta calculation from the PED sensor for each of the concentration levels have been included. Each of the figure well represents the response delta between the sample gas and the zero gas. The span calibration performs at 540ppb also appears.

Diluted concentrations (ppb)	Analyser reading (ppb)	Delta (ppb)	Accuracy (% of reading)
1000.0	995.0	-5.0	-0.5
540.0	540.0	0	0
250.0	252.2	+2.2	+0.88
100.0	100.0	0	0
1.0	1.1	+0.1	Ldl 0.1ppb

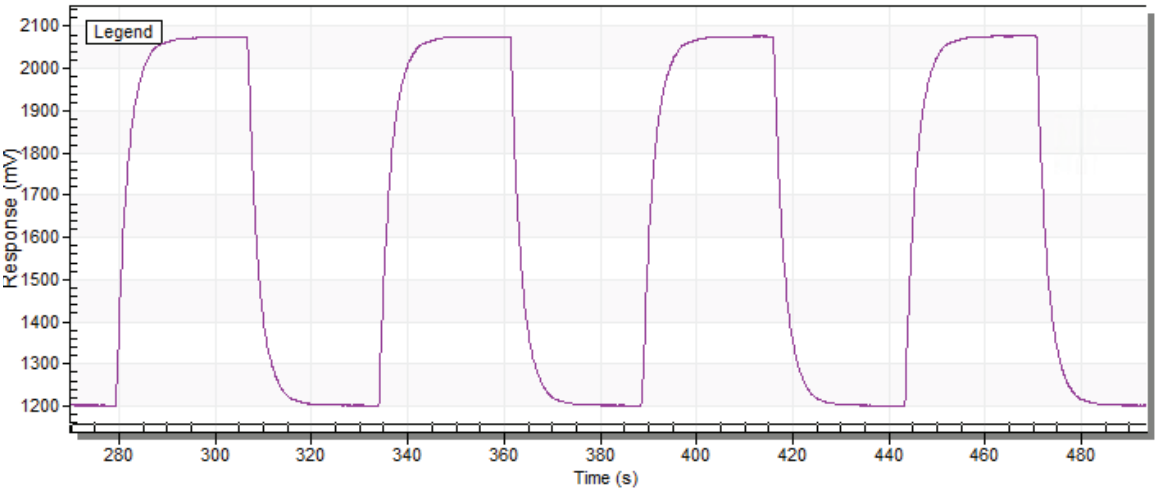
Sample: 1000ppb Reading: 995.0ppb



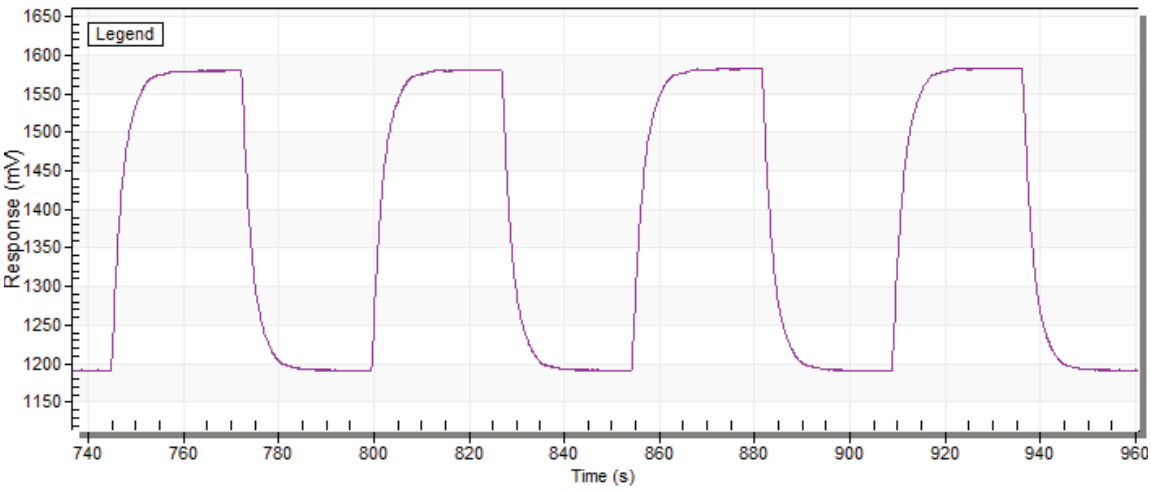
Sample: 540ppb (Span Calibration point)



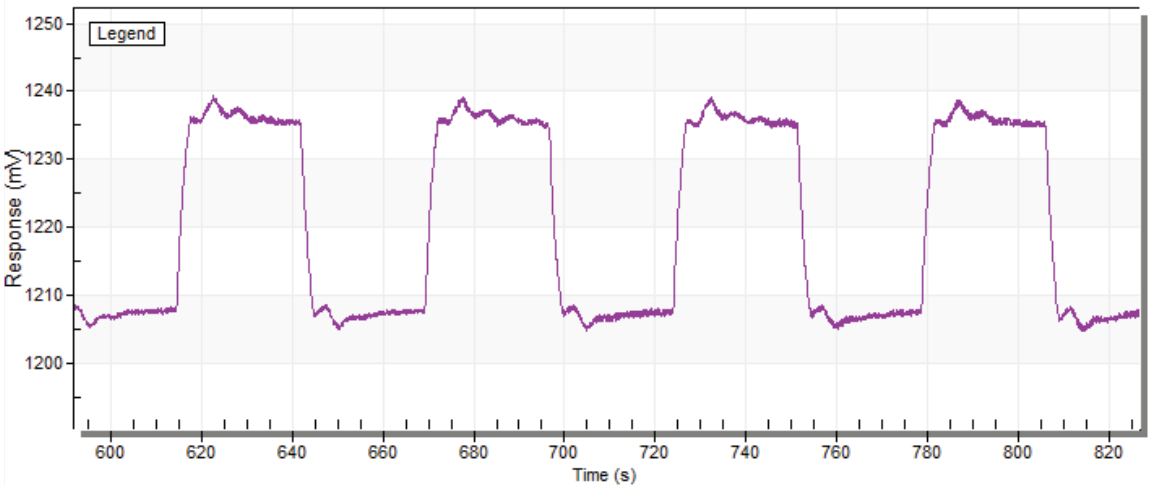
Sample: 250ppb Reading: 252.2ppb



Sample: 100ppb Reading: 100.0ppb

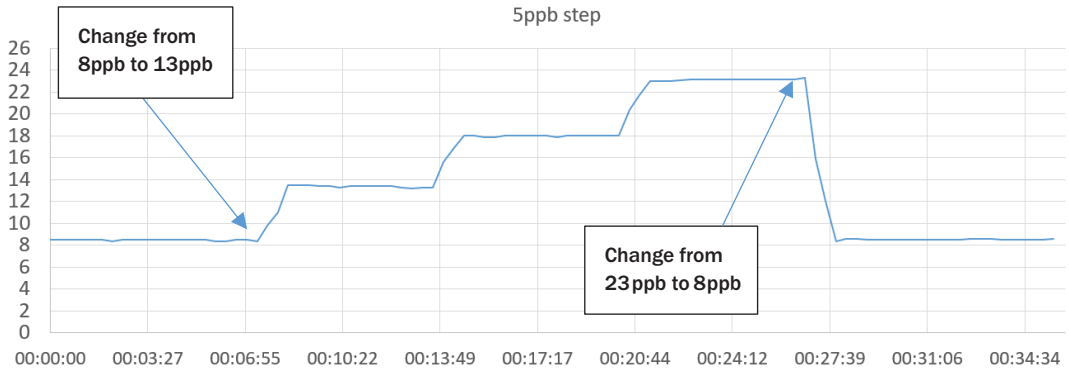


Sample: 1ppb Reading: 1.1ppb



Response Time

Using a dilution system, a series of multiple step changes of 5ppb nitrogen in balance Argon have been performed every 6 minutes. The response time T90 evaluation between every step is about 1 minute in both ways. The same response time apply to both directions (up and down).



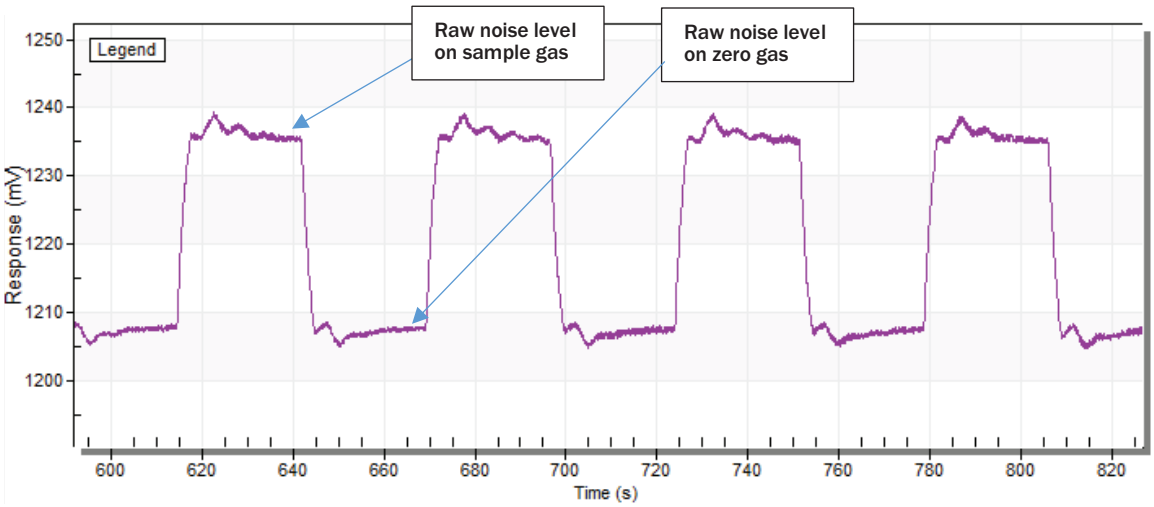
Detection limit (LDL)

Using a 2ppb Nitrogen in Argon gas source, the raw response delta measured by the plasma sensor was 28mV.

The raw signal baseline noise is evaluated at 0.5mV. For instance, the noise level used for the limit of detection is evaluated at 3 times its raw value. Giving 1.5mV.

LDL Calculation:

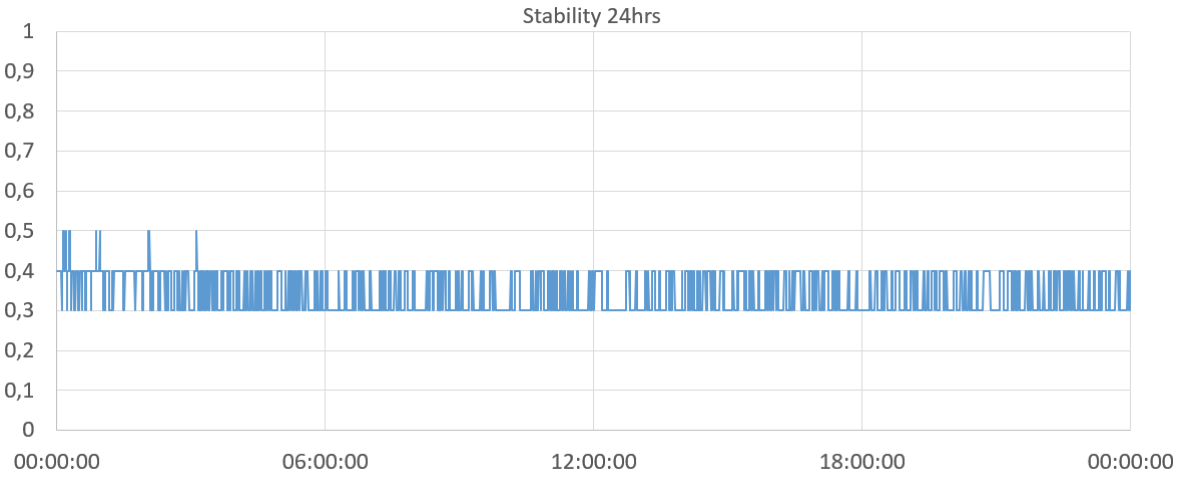
(2ppb * 1.5 mV)/28mV gives an LDL of 0.1ppb



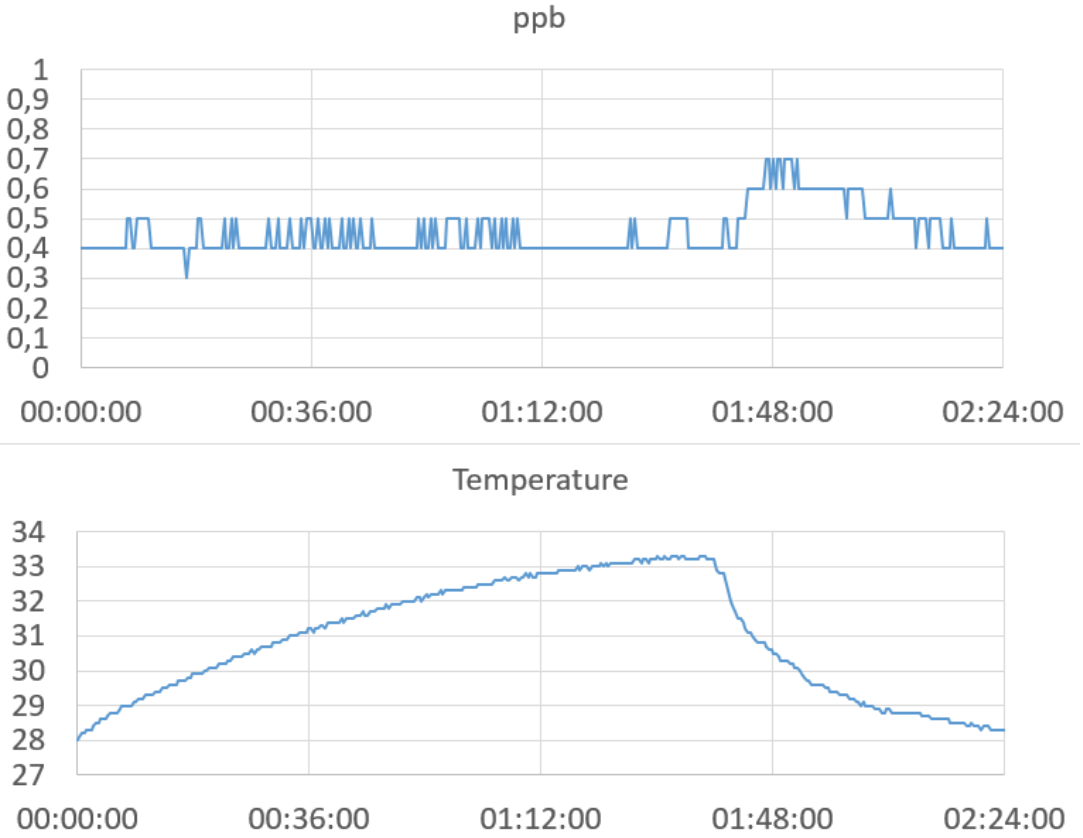
Stability/drift

To evaluate the stability and drift of the unit, a gas source containing 0.5ppb nitrogen in a balance of Argon has been connected as sample gas. The average deviation obtained on a 24-hour period was 0.1ppb while the maximum deviation was 0.2ppb.

Considering an average deviation of 0.1ppb on a measuring scale of 1000ppb, the stability offers by the analyser is better than 0.01%.



Additional results were obtained to demonstrate the stability of the measurement within a certain temperature deviation. A temperature change of 5 Celsius degree has involved a slight reading variation of 0.3ppb. The test has been repeated with the same range of deviation resulting in a maximum temperature deviation of 0.06ppb per Celsius degree.



MAINTENANCE

The system is built to be resistant and simple of operation with minimum interventions. A routine maintenance interval every 5 years for replacing the internal gas purifier and the diaphragm of the valve is required. The unit has been designed in a way that replacing those components is very easy.

CONCLUSION

LDetek is proud to offers with its LD8001+ series a high-class rackmount gas analyser configured for measuring sub ppb/ppt trace nitrogen analysis down to 0.1ppb in Argon or Helium.