

EXPERT PAPER

A highly accurate, versatile analyzer for trace gas applications

The SERVOPRO Chroma offers a single, complete trace gas analysis solution for purity measurements in a number of industries, and is fully configurable for many applications.

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A recognized industry benchmark for trace gas analysis, the SERVOPRO Chroma measures a range of impurities in background gases, from percentage down to low parts-per-billion (ppb) levels.

As a customizable mainframe analyzer based around Gas Chromatography (GC) technology, the Chroma is capable of utilizing Servomex's advanced Plasma Emissions Detection (PED), Flame Ionization Detection (FID) or Thermal Conductivity Detection (TCD) sensing technologies.

This makes it a highly versatile analyzer offering sensitive measurement solutions for a wide range of applications. The levels of accuracy achieved by the Chroma can only be matched by dedicated GC analyzers using a FID, RGD or TCD sensors, so the adaptability of the Chroma offers significant capital savings and integration costs.

For hydrocarbon measurements, Servomex's PED technology is supported by the PlasmaHC system, which enables highly accurate methane and total hydrocarbon measurements without

using a FID. This means that, unlike many competitor technologies, the Chroma has no requirement for fuel and the associated maintenance costs.

The Chroma is also proven to improve argon recovery processes, and has a unique ArgonSep process, which is used to separate argon and oxygen without having to use oxygen scrubbers. This supports an extremely sensitive, maintenance-free measurement.

A standalone system that does not need any third-party software to operate, the Chroma is designed for ease of use, with an intuitive interface and integrated software that provides full access to all functions, measurements and system status.

Separate 4-20mA outputs for each measurement enable delivery of peak impurity values. Comprehensive communications options ensure flexible operation, while internet and Ethernet connectivity allows for remote control and monitoring through a network or web browser.

MEASURES:

- Hydrogen
- Oxygen
- Nitrogen
- Argon
- Methane
- Carbon monoxide
- Carbon dioxide
- Non-methane hydrocarbons
- HC speciation
- Nitrous oxide
- Krypton
- Xenon

BACKGROUND GASES:

- Hydrogen
- Oxygen
- Nitrogen
- Argon
- Helium
- Carbon dioxide
- Nitrous oxide
- Air

SENSING TECHNOLOGY

GAS CHROMATOGRAPHY



PLASMA



THERMAL CONDUCTIVITY



FLAME IONIZATION DETECTOR



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GAS CHROMATOGRAPHY

The Chroma is a configurable mainframe based on Gas Chromatography (GC) principles. GC is an exceptionally accurate method of separating impurities from background gases, measuring concentrations down to low parts-per-billion (ppb) levels.

It is well suited for use in high-purity processes since, unlike most gas analysis techniques, the measurement is made once the impurity of interest

has been separated from the background gas rather than within the background gas.

By introducing a gas sample, the impurities of interest are separated using an inert carrier gas, such as helium or argon. This mobile phase flows through a column, where the component gases are separated due to their interaction with the stationary phase.

The gas content is quantified by a detector at the column outlet.

Each impurity elutes after a different retention time in the column. Impurities are identified by the order in which they elute from the column.

GC process conditions can be varied to suit a variety of applications. The column(s) temperature may be altered, as can the carrier gas flow rates, sample loop size and the type and dimensions of the column itself, to optimize separation.

THREE INNOVATIVE TECHNOLOGIES

DEPENDING ON THE APPLICATION, THE Chroma CAN BE CONFIGURED WITH SERVOMEX'S PED, FID AND TCD SENSOR TECHNOLOGIES.



PLASMA EMISSION DETECTOR

The Chroma uses innovative, non-depleting PED sensor technology that does not require a methanizer. It enables methane and total hydrocarbon measurements without a FID, which means the Chroma has no need for fuel and associated maintenance costs in this application.

Plasma is an ionized gas with a lot of energy – this energy is sufficient to free electrons from their atoms and molecules, allowing ions and electrons to coexist. When energized by plasma, gases produce intense emission spectra which relate directly to specific molecular bonds within the sample gas.

The emission spectra of the gases of interest are isolated using a precision

optical filter, providing a highly selective gas measurement. The Chroma's unmatched sensitivity in nitrogen and argon measurements is made possible by this use of optical filters to achieve sensitivity and selectivity to a dedicated analyte, improving system specifications.

Servomex's PED sensor consists of two elements. A plasma generation mechanism generates a controlled, stable electromagnetic field, which excites the gas to generate the plasma and emit spectral emission lines. A plasma chamber detector cell is tuned to recognize the emission line of a specific gas. This cell is made of quartz, which is transparent to emitted light spectra.

As each gas produces a unique spectra, the PED technique enables a highly

sensitive measurement, capable of reading trace ppb levels.

PED technology is very sensitive and selective to any molecules containing carbon, and so can achieve very low detection limits. Since the sensor requires only a carrier gas, external contamination from air and fuel is removed.

The sensitivity of PED measurements means that it is generally only suitable for trace analysis applications, i.e. <1000 parts per million.

The Chroma has been updated to enhance its operational performance, with an improved Lower Detection Limit for many gases.

Chroma Performance Specification Update

	Impurity	Background Gas	Lowest Range	Previous LDL	New LDL
Ar Plasma	N ₂	He, Ar, O ₂ , H ₂	0-1ppm	50ppb (5% FR)	5ppb (0.5% FR)
	H ₂ , O ₂ , CH ₄ , CO, CO ₂ & NMHC	He, N ₂ , Ar, O ₂ , H ₂	0-1ppm	50ppb (5% FR)	25ppb (2.5% FR)
	N ₂	He, Ar, O ₂ , H ₂	0-10ppm	150ppb (1.5% FR)	50ppb (0.5% FR)
	H ₂ , O ₂ , CH ₄ , CO, CO ₂ & NMHC	He, N ₂ , Ar, O ₂ , H ₂ , CO ₂	0-10ppm	150ppb (1.5% FR)	100ppb (1.0% FR)
He Plasma	N ₂ , Ar	He, N ₂ , O ₂ , H ₂ , CO ₂	0-1ppm	50ppb (5% FR)	5ppb (0.5% FR)
	Ne	He	0-1ppm	50ppb (5% FR)	5ppb (0.5% FR)
	H ₂ , O ₂ , CH ₄ , CO, CO ₂ & NMHC	He	0-1ppm	50ppb (5% FR)	7.5ppb (0.75% FR)

FR = Fullscale Range



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THREE INNOVATIVE TECHNOLOGIES

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FLAME IONIZATION DETECTOR

The FID sensor is designed to measure Hydrocarbons (HC) down to ppb levels, in processes where HC contamination is possible, such as in air separation plants, product pipelines and cylinder filling stations. HC speciation may be analyzed when used with gas chromatography.

It works on the principle of detecting ions formed in the combustion of organic compounds in a sample, producing charged molecules that cause electrical conduction between two electrodes.

The ions are attracted to a collector plate and induce a current upon hitting the plate. The FID measures this conduction and produces an output which is directly

proportional to the concentration of HC in the sample.

By utilizing a methanizer, this technology can be also used to measure ppm concentrations of CO to comply with the European Pharmacopeia requirements.

THERMAL CONDUCTIVITY DETECTOR

The Chroma's Thermal Conductivity Detector consists of an electrically heated Wheatstone bridge in a temperature-controlled cell. Carrier gas is passed over the reference arm of the bridge and the column effluent passes over the sample arm of the bridge.

When the column effluent is only carrier gas, the heat loss from the sample arm

of the bridge matches the heat loss from the reference arm.

When an analyte elutes, this affects the thermal conductivity of the effluent and will change the heat loss from the sample arm of the bridge, and hence its electrical resistance. This change is measured as a signal.

For medical gas applications, the Chroma uses TCD to provide a nitrogen assay and for the determination of carbon dioxide (CO₂) impurity in nitrous oxide (N₂O). The nitrogen assay measurement meets the European Pharmacopeia's required concentration limit of greater than 99.5% purity and the US National Formulary requirement of 99%.

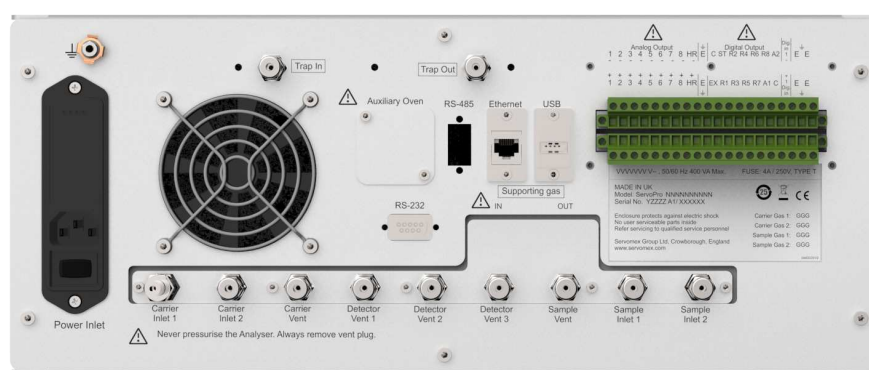
KEY APPLICATIONS

The versatility of the Chroma makes it a popular choice for a range of air separation unit (ASU) processes. The needs of most ASU applications will be met by a single 4U rack analyzer configuration, which ensures the Chroma is a compact and cost-effective solution for plant operators.

In addition, Servomex's global integrated Systems Engineering teams have the capability to build an entire system around the Chroma, or to assimilate it within an existing system.

Other important applications include medical uses, hydrogen production,

semiconductor manufacture, steel-making, helium plants and carbon dioxide recovery.



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AN EXAMPLE OF A MGAQ (Medical Gas Analysis and Quality Control) SYSTEM



SERVOPRO Chroma

MEASURES:

H₂, Ne, O₂, N₂, Ar, CH₄, CO₂ and NMHC impurities in H₂, O₂, N₂, Ar and He

The Chroma is a key component in Servomex's specialist multi-gas monitoring solution for medical gases. The Medical Gas Analysis and Quality Control (MGAQ) system is designed to meet European and US Pharmacopeia standards.

Using industry-leading measurement technology, MGAQ systems are configured as either manual or

fully automated solutions. They are precision-designed for minimal sample volume, delivering efficient analysis and fast, on-the-spot readings, with full traceability for quality control purposes.

The expert Servomex systems team can provide fully integrated measurement solutions in off-the-shelf or bespoke designs, with measurements for

nitrogen, oxygen, nitrous oxide, medical air and carbon dioxide.

MGAQ systems are developed to minimize user interaction while increasing productivity and maintaining traceability. Servomex's digital sensor technology is linked to a software package to produce detailed analysis, data collection and quality control.

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