

PURITY & SPECIALTY

GAS ANALYSIS MAGAZINE

ISSUE
TWO

UHP GASES EDITION

PROCESS STUDY

Solutions for semiconductor wafer manufacture

PRODUCT STUDY

The reliable SERVOPRO NanoChrome is specifically designed for the semiconductor industry

TRACE MOISTURE

See how laser technology supports gas purity

DISCOVER HOW SERVOMEX
SUPPORTS YOUR
ULTRA-HIGH-PURITY GAS AND
SEMICONDUCTOR APPLICATIONS



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THE SOLUTIONS FOR YOUR UHP GAS ANALYSIS

Welcome to this edition of our UHP Gases magazine, which focuses on Servomex's offers to the ultra-high-purity gas and semiconductor manufacture market.

This market is served by Servomex's Purity and Specialty (P&S) Division, which is also responsible for our industrial and medical gas analysis solutions.

Based out of our US Technical Center (US TC) in Woburn, Massachusetts, our team delivers application-based expertise to customers around the world, ensuring you have easy access to the sales and service knowledge you need. Find out more about the P&S team on page 4.

We know how important accurate, stable gas analysis – reaching the lowest available detection limits – is to this market.

Our experts have a wealth of experience in providing gas analysis solutions to the ultra-high-purity gas industry. That's why we've been able to develop a unique, single-supplier solution for this application, covering every essential UHP measurement in the semiconductor sector.

Encompassing trace and ultra-trace measurements for moisture, oxygen, and multiple impurities, we provide standalone solutions or integrated systems that can be customized to meet individual application needs. You can find out more about our total UHP solution in our application focus feature.

There is also a more in-depth look at two of the innovative products that help make up this solution – the highly stable DF-745 moisture analyzer and the reliable SERVOPRO NanoChrome impurities analyzer.

Our versatile SERVOPRO Chroma trace gas analyzer also comes under the spotlight, as we look at the choice of configurable, cutting-edge Gas Chromatography-based technologies available to customers.

UHP gases are essential to semiconductor manufacturing. Our in-depth feature looks at where gas analysis plays a role in this increasingly demanding process, and introduces the range of Servomex products that solve the challenges involved.

Great products provide the most benefit when backed by high-level support, and that's exactly what our global service network provides.

In this issue, we showcase the experts delivering support for customers around the world. We also focus on the commissioning service provided by Servomex, and explain its benefits for analyzer and system performance.

Enjoy your magazine, and if you want to find out more about our offering to the P&S markets, get in touch at: servomex.expert/contact-us

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See how we've optimized our team to provide the best sales and service knowledge to our customers around the world.



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Highly configurable, the SERVOPRO Chroma is ideal for multi-component gas measurements.



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Find out about the DF-745, a moisture analyzer built on laser technology.



P09 THE RELIABLE ULTRA-TRACE GAS ANALYZER

The SERVOPRO NanoChrome is specifically designed for the semiconductor industry.



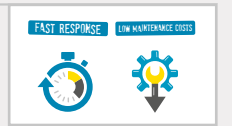
P10 THE COMPLETE SOLUTION FOR UHP GAS ANALYSIS

Discover how Servomex provides a unique, single-supplier for monitoring trace impurities in electronics-grade gases.



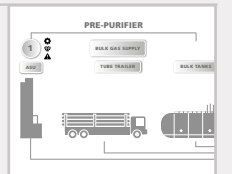
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Laser measurements for trace moisture in pure gases.



P13 SEMICONDUCTOR WAFER MANUFACTURE

See our extensive range of gas analysis solutions for quality control, process control and safety in this process.



P16 SERVICE FOCUS

Meet the latest members of our team providing global support for customers.



See our latest product ranges. Analyzer guide starts on page 17

This magazine is published by Servomex Group Limited, Crowborough, East Sussex, TN6 3FB. Editorial enquiries and feedback should be sent to Colin Jones, Marketing Communications Director. Email: cjones@servomex.com

SEE THE FULL PICTURE ONLINE

SERVOPRO Chroma - UNBOXED

Watch our experts unbox the versatile Chroma, an accurate trace gas analysis solution for industrial gas applications.



SERVOPRO NanoChrome - UNBOXED

The NanoChrome delivers safe, reliable UHP gas analysis for the semiconductor industry. See it unboxed by our experts.



DF-500 RANGE

Servomex's ultra-trace ppt oxygen analyzer range, with updated firmware for lower detection levels.



DF-700 RANGE

Discover all the benefits of our ultra-trace moisture analyzers, monitoring high performance in specialist environments.



Watch at servomex.expert/videos

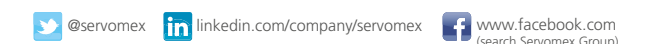
P02



FOR THE FULL RANGE OF ANALYZERS VISIT servomex.expert/gas-analyzers

FOR THE FULL RANGE OF ANALYZERS VISIT servomex.expert/gas-analyzers

P03



PURITY & SPECIALTY MEET THE EXPERTS

OUR TEAM DELIVERS YOUR GAS ANALYSIS SOLUTIONS

MIKE PROCTOR LEADS OUR TEAM PROVIDING PRODUCTS, KNOWLEDGE AND SERVICE TO THE PURITY AND SPECIALTY GAS MARKET. HERE, HE INTRODUCES OUR EXPERTS AND EXPLAINS HOW THEY CAN HELP SUPPORT YOUR PROCESS.



Mike Proctor, P&S Business Unit Director
mproctor@servomex.com

The Purity & Specialty (P&S) Division is responsible for Servomex's gas analysis solutions in the industrial gas, UHP gas and semiconductor markets.

Our P&S team is committed to delivering our expert, application-based knowledge to customers around the world.

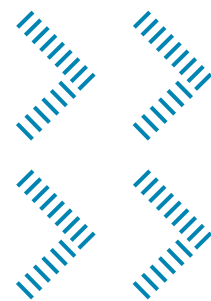
We provide hassle-free access to sales, service and support, with accurate, cost-effective solutions that keep their processes running smoothly and efficiently.

With more than a decade of experience working with Servomex's industrial gas solutions, it's my privilege to lead this expert team dealing with product management, applications, engineering and sales.

I hope this feature helps you understand how we can deliver global support for your process, and leads you to the right person to provide the advice and application knowledge you need – we're waiting to hear how we can help.

1 OUR PRODUCT TEAM THAT SUPPORTS YOUR PROCESS

Our Product Managers are focused on delivering the best products to support your process. They'll ensure your operation gets the precision measurements it needs.



Charles Segar, Product Manager Industrial and Trace Analyzers
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Douglas Barth, Senior Global Product Manager
dbarth@servomex.com

OUR KEY P&S PRODUCTS

See our full P&S product range: [Page 17](#)



DF-500 range



DF-700 range



AquaXact 1688 & Controller



SERVOPRO NanoChrome



SERVOPRO Chroma



SERVOPRO Plasma



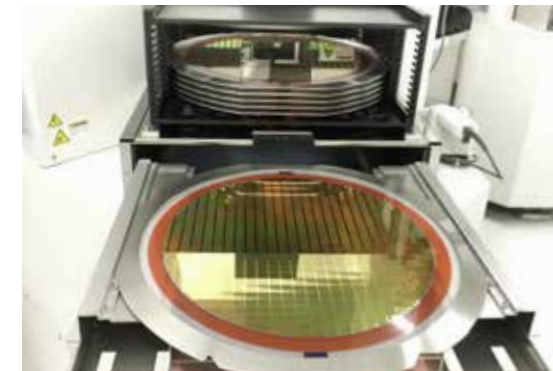
SERVOPRO MonoExact DF150E/DF310E



SERVOPRO MultiExact 4100

2 WE PROVIDE SPECIALIST APPLICATIONS KNOWLEDGE

Want to know the best solution for your application? That's where the applications team come in. Led by Chris Davis, his team use their extensive knowledge of industrial applications and Servomex sensing technology to match our products to your process.



Chris Davis, Applications Manager P&S
cdavis@servomex.com

3 AND HERE'S YOUR SALES TEAM

Led by Luca Marinelli, our P&S sales team understands the specific challenges facing the market in your region. They will work with you to provide the best gas analysis solution for your process, and to ensure access to the expert knowledge, systems and service support you may need for optimum performance.



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4 DELIVERED GLOBALLY

Our US Technical Center (US TC) in Woburn, Massachusetts is Servomex's global hub for industrial gas and semiconductor solutions, and is where our DF analyzer range and many of our SERVOPRO analyzers are expertly manufactured.



The engineering team is led by: Bruce Dunbar, Head of Engineering P&S – US TC
bdunbar@servomex.com

Our UK Technical Centre (UK TC) operates world-class manufacturing facilities for our sensor designs, including Paramagnetic, Zirconia and Infrared technology. It is also home to the SERVOPRO Chroma and NanoChrome Gas Chromatography-based analyzers.



The engineering team is led by: Nathan Kettlewell, Head of Engineering P&S – UK TC
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MARKET FOCUS

A BUSY, GROWING ASIAN MARKET



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CHEE WEE YAP, SERVOMEX SALES DIRECTOR AND REST OF ASIA SITE LEADER, TAKES A LOOK AT THE VIBRANT, TECHNOLOGY-DRIVEN ASIAN MARKET

Our dedicated Rest of Asia (ROA) team operates across a large area. The large number of scattered business clusters provides a fascinating, sophisticated and diverse market.

Servomex maintains an active business presence in the region, with prominence in South Korea, Taiwan, Singapore, Japan, and SEA (South East Asia) clusters.

These territories demonstrate the full range and diversity of industries and gas analysis demands to be found in the region:

North Asia territories such as South Korea have a technology-focused economy, with significant contributions from the semiconductor industry

Japan is highly specialized, delivering high-grade industrial products and manufacturing materials

Singapore is a hyper-economy, with a good mix of semiconductor production and petrochemical manufacturing

The SEA clusters (especially Indonesia, Thailand, Malaysia, Vietnam) have a consistent domestic demand from the growing economies which are always hungry for infrastructures, such as power, steel, and cement

As a key market for Servomex P&S business in Asia, China has its own dedicated team, led by our China Sales Director Kevin Xu. The electronics and

telecommunications industry continues to expand rapidly in China, making the country a major player in the semiconductor market.



kxu@servomex.com

Our team serves premium-end customers from South Korea, Singapore and Taiwan, delivering top-tier sub-ppb qualitative analysis products for their micro gas contamination UHP gas applications.

There's also strong demand for traditional gas analysis equipment to control the production of the feedstock bulk gases that support these UHP gases.

The availability of high-tech infrastructures in these regions has led to the constant establishment of high-value pharmaceutical plants which consume medical and pharmaceutical grade industrial gases.

Our industrial gas customer base in the South East Asia region continues to grow organically, with our Singapore core hub providing specialist support for regional customers.

This technical and business hub has successfully delivered numerous system and software solutions to ensure customers can overcome their process challenges.

The hub also operates a full range of service facilities to handle after-sales support and in-house repair for local and regional customers across our entire range of products.

The region's economic and topographic diversity ensures that Servomex will continue to grow in the Asia market. Industrial developments in the region have driven most of the countries to secure their own niche in the manufacturing sector, serving and sustaining their role in the Asian economy.

Servomex will continue to focus on its growth in Asia, expanding our geographical coverage, better serving our install base, and strengthening our offering for mainstream projects.

PRODUCT FOCUS

VERSATILE TRACE GAS ANALYSIS WITH THE SERVOPRO Chroma



The SERVOPRO Chroma can be fitted with a choice of three cutting-edge, Gas Chromatography-based technologies, depending on application. This makes it customizable for multi-component gas measurements in a wide range of applications including medical gas purity, air separation, argon recovery, hydrogen purification and semiconductor wafer manufacture.

It is capable of utilizing Servomex's advanced Plasma Emissions Detector (PED), Flame Ionization Detector (FID), and Thermal Conductivity (TCD) sensing technologies to deliver results at parts-per-billion (ppb), parts-per-million (ppm) and percentage concentration levels. It can use PlasmaHC technology to measure non-methane hydrocarbons and methane without requiring a FID, eliminating maintenance and fuel needs.

In addition, Servomex's ArgonSep system is available to separate argon from

oxygen without the need for scrubbers, providing a measurement that is both sensitive and free from maintenance. One of the most compact and powerful trace analyzers available to the market, the Chroma is 4U rack-mountable for easy integration into gas analysis systems.

A standalone mainframe that does not require third-party software and is designed for easy operation, it has an intuitive user interface and high-resolution color LCD screen. Integrated software provides access to all functions, measurements and system status.

The Chroma provides separate 4-20mA outputs for each measurement, ensuring peak impurity values and chromatogram signals. Its comprehensive digital and analog communications options deliver flexible operation, with internet and Ethernet connectivity for remote control and monitoring via a network or web browser.

THE CHROMA MEASURES TRACE:
 HYDROGEN
 METHANE
 CARBON MONOXIDE
 CARBON DIOXIDE
 NON-METHANE HYDROCARBONS
 NITROGEN
 ARGON

IN BACKGROUND GASES INCLUDING:
 HELIUM
 HYDROGEN
 NITROGEN
 ARGON
 OXYGEN

GAS CHROMATOGRAPHY

This is an exceptionally accurate method of separating gas mixtures, measuring concentrations down to ppb levels.

It is well suited for use in high-purity gas analysis processes, since the measurement is made after the sample has been separated, rather than within the sample.



Watch our new Chroma video online: servomex.expert/video-chroma



MEET MOISTURE CHALLENGES WITH THE HIGHLY STABLE DF-745



Designed for trace and ultra-trace moisture contaminant measurements for LED/LCD manufacturing processes, the DF-745 delivers exceptional operational flexibility in a compact unit. Ideal for ultra-high-purity (UHP) electronic gas checks, the robust analyzer can be moved easily from port to port, virtually eliminating the dry-down times often associated with these applications.

Using industry-leading Tunable Diode Laser (TDL) sensing technology housed in a Herriott cell, the DF-745 has a Lower Detection Limit of just 1 part per billion, and a broad detection range from 0-20 parts per million.

The measurement stability provided by TDL technology ensures the analyzer shows zero drift – reducing calibration requirements – and recovers quickly from upset prone applications. It also means that the ultra-reliable baseline measurements are provided with a fast speed of response.

The Herriott gas cell is virtually immune from mechanical disturbances in the field, prevents loss in mirror reflectivity, and minimizes moisture contact with optical components, ensuring an accurate measurement. Factory pre-calibrated for quick, easy installation, the DF-745 fits

19" rack mount systems and offers RS232 or RS485 serial communications.

Modern LCD and LED manufacturing processes rely on ultra-trace quality measurements for moisture contaminants in UHP electronics grade gases.

The DF-745 delivers the high accuracy and ultra-low detection limits required.

Providing results in multiple background gases, it actively reduces ongoing costs and offers a long, cost-effective lifetime of ownership, without compromising on performance.

1 PPB
ULTRA-TRACE DETECTION LIMIT

ZERO DRIFT
PROVIDED BY THE STABLE MEASUREMENT OF TDL SENSING

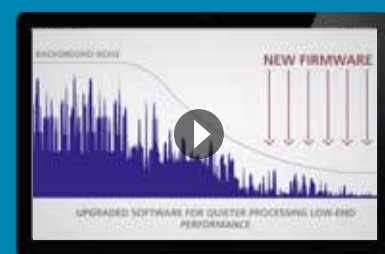
REDUCED CALIBRATION
ULTRA-RELIABLE BASELINE WITH A FAST SPEED OF RESPONSE

THE DF-745 SGM_{Max}

Servomex also offers this specialized DF-745 model for measurements of single and multi-gas specialty gas blends.

Using intelligent, integrated software, it includes a database of 17 standard background gases and blends of up to eight gases, and is configurable for 30 custom gas mixtures.

With the same reliable, stable TDL technology as the standard DF-745, the SGM_{Max} has a broad measurement range of 0-100ppm, with a LDL of 5ppb – the lowest available without using a pump.



Watch our product video online:
servomex.expert/video-df700series

ULTRA-TRACE GAS ANALYSIS WITH SERVOPRO NanoChrome



PROPEAK FILTERING
HIGHLY SENSITIVE, SELECTIVE AND RELIABLE MEASUREMENTS

PED SENSOR
BETTER PERFORMANCE, SAFETY, STABILITY AND ONGOING COSTS

1 PPB
ULTRA-TRACE DETECTION LIMIT

A high-performance analyzer specifically designed for the semiconductor manufacturing industry, the SERVOPRO NanoChrome offers reliable ultra-trace measurements of impurities in electronic gases.

The NanoChrome is a comprehensive solution for ultra-trace measurements of hydrogen, methane, carbon monoxide, carbon dioxide, nitrogen, argon and non-methane hydrocarbon compounds in a wide range of common background gases.

At its heart is the Plasma Emission Detector (PED) sensor, which offers significant advantages over traditional Flame

Emission Detector (FID) and Reduction Gas Detection (RGD) sensing technologies.

Using a Direct Analysis Methodology, the NanoChrome removes the doubt associated with FID and RGD measurements, and has benefits for performance, safety, stability and ongoing costs.

Advanced signal recovery, using Servomex's patented ProPeak filtering, delivers highly sensitive, selective and reliable measurements.

Neither a methanizer nor a flammable fuel gas are required, so there are appreciable cost benefits for the customer.

General Gas (G-Gas) used in a semiconductor fab before the main purifier, requires a Lower Detection Limit (LDL) of around 10 parts per billion (ppb), which can be achieved with a FID sensor.

However, the Pure Gas (P-Gas) used after the purifier stage has much more demanding requirements, with a LDL of 1ppb or less.

The NanoChrome offers the most stable P-Gas analysis on the market, delivering a sub-ppb measurement of the contaminant gases and hydrocarbons that can be present at ultra-trace levels in semiconductor manufacture.

The NanoChrome can be combined with the DF-500 ultra-trace oxygen analyzer range and DF-700 moisture analyzer range for a comprehensive, reliable UHP gas analysis solution for the semiconductor industry, all from a single supplier.

See pages 10 & 11 to learn more.



Watch our product video online:
servomex.expert/video-nanochrome

A SINGLE-SUPPLIER SOLUTION FOR UHP GAS ANALYSIS



FIXED RACK SYSTEM



PORTABLE CART SYSTEM



INTUITIVE GAS SOFTWARE

Ultra-high-purity (UHP) gases play an essential role in semiconductor wafer fabrication.

Microscopic and sub-microscopic particulates, and vapor phase impurities below 100 parts per trillion by volume (pptv), can disrupt and react within the fabrication processes, creating wafer defects and leading to costly scrap and waste product.

A high-purity, electronic-grade substrate (usually silicon) must be between 9N and 11N (99.9999999% to 99.999999999%) purity. For example, 9N purity silicon can only have a impurities totaling one part per billion (ppb) at most. To ensure gases remain free of contamination, semiconductor manufacturers employ

many resources, including strict gas supplier specifications, multiple gas purification techniques, real-time continuous gas purity monitoring, and post-process inspection, all aimed at delivering ultra-pure gases to the manufacturing process.

Servomex provides an integrated, reliable solution for these UHP gas analysis measurements, seamlessly combining industry-leading technology into a comprehensive system that reaches the lowest available detection limits.

The DF-500 and DF-700 series of analyzers provide accurate, ultra-trace oxygen and moisture measurements, while the remaining impurities can be monitored by the versatile, reliable

SERVOPRO NanoChrome. These analyzers can be easily integrated into a fixed rack or portable cart system, providing a modular, scalable Continuous Quality Control infrastructure for gas distribution systems.

Servomex's Intuitive Gas Software (IGS) provides full control, creating a unique, single-supplier solution that can continuously monitor process gases prior to entering the wafer manufacturing process, measuring every impurity present.

Fully supported by Servomex's global Service Network, this measurement and monitoring system delivers a complete, high-performance, cost-effective solution for UHP gas analysis.

THE SERVOMEX UHP SOLUTION



DF-500 Series

The DF-500 series Coulometric analyzers deliver industry-leading, ultra-trace oxygen measurements at parts-per-trillion (ppt) levels. The DF-550 offers a lower detection limit (LDL) of 200 ppt, while the DF-560 has the lowest available LDL at 45ppt.

NON-DEPLETING, FACTORY-CALIBRATED SENSOR

NEGATES EFFECTS OF UPSET-PRONE APPLICATIONS

MONITORS MULTIPLE BACKGROUND GASES



DF-700 Series

The DF-700 series provides the lowest LDLs for moisture, using Tunable Diode Laser sensing technology to reach an LDL of 100ppt. Configured to suit a range of applications, seven models are available in the range, including the DF-760E combined oxygen and moisture analyzer.

BROAD DETECTION RANGE FOR ULTRA-TRACE MEASUREMENTS

LASER SENSOR IS UNAFFECTED BY GAS CONTAMINANTS

LINE LOCK SYSTEM FOR RELIABILITY AND HIGH ACCURACY



SERVOPRO NanoChrome

The SERVOPRO NanoChrome analyzer provides sub-parts-per-billion measurements for a range of ultra-trace impurities. Its innovative Plasma Emission Detector (PED) sensing technology does not require the use of flammable gas, delivering a safe, stable measurement.

SENSITIVE, NON-DEPLETING PED SENSOR

PATENTED PROPEAK FILTERING SOFTWARE

HIGHLY RELIABLE, ULTRA-TRACE MEASUREMENTS

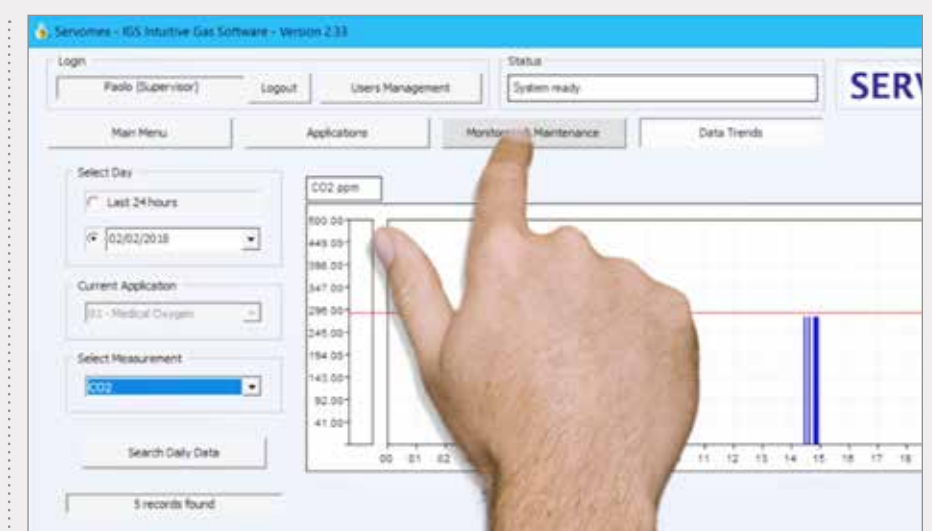
INTUITIVE GAS SOFTWARE

Servomex offers an expertly designed holistic systems solution for the analysis and quality control of UHP gases. The brain of this system is the Intuitive Gas Software (IGS), a modular Windows 10-based package enabling real-time monitoring and reporting.

DEVELOPED TO MEET CUSTOMER REQUIREMENTS

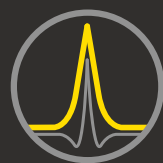
CAN MONITOR A PROCESS CONTINUOUSLY OR ON DEMAND

ALLOWS MULTIPLE OPERATORS TO LOG IN AT THE SAME TIME



Watch our new total UHP solution video to learn more:
servomex.expert/video-totaluhp





LASER MEASUREMENTS FOR TRACE MOISTURE

Tunable Diode Laser Spectroscopy (TDL) technology is the key to Servomex's DF-700 moisture analyzer series and its capability to measure trace moisture in pure gases.

Our TDL moisture sensing is a spectroscopic technique that uses a diode laser as its light source. It uses a robust and simple optical design, with both the sample and reference measured with a single laser source and a single detector.

TDL sensing offers clear advantages over other measurement techniques, as the moisture sample comes only into contact with a few optical components made from very robust materials.

The technique works according to the fundamental principle of Beer's law (also known as the Beer-Lambert law) which relates the attenuation of light to the properties of the material through

which that light is travelling. Because of this, the moisture reading is stable over time, and is able to operate in non-ideal environments for many years without requiring calibration. Servomex's DF-700 moisture analyzers use an advanced TDL spectroscopy technique, which utilizes additional information buried within the shape of the water IR absorption line. After correction for absolute pressure, this is subtly dependent on the chemical composition of the (host) gas or gas matrix under investigation, providing additional data for increased measurement stability and sensitivity.

In spectroscopy, a longer path length is often used to achieve more measurement sensitivity. In order to make a sensitive laser measurement, Servomex employs a robust Herriott Cell to reflect the laser back and forth numerous times, using

mirrors inside the measuring cell. By making multiple passes, this increases the laser path length, allowing the analyzer to achieve extremely high sensitivity.

The result is an exceptional performance capable of measuring down to sub parts-per-billion levels, allowing analyzers such as the DF-750 and DF-760E to offer an industry-leading lower detection limit of 100 parts per trillion.

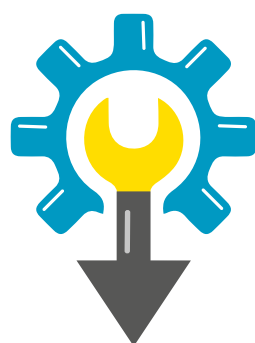
In addition, TDL moisture sensing offers drift-free operation, high accuracy and low maintenance, all achieved through self-correcting optics and laser line locking onto the water peak. The laser line lock system consists of a sealed moisture ampoule; a portion of the laser light is redirected through this, locking the laser wavelength onto the exact moisture line of interest and removing the possibility of significant drift.

SERVOMEX'S TDL SOLUTION

DF-700 SERIES

FAST RESPONSE

LOW MAINTENANCE COSTS



Find out more at: servomex.expert/df-700



SEMICONDUCTOR WAFER MANUFACTURE

The wafer manufacturing process requires the use of ultra-pure gases, as the smallest of impurities can result in major defects in a wafer, causing costly scrap and waste.

To avoid contamination, semiconductor customers employ a variety of resources, including strict gas supplier specifications, multiple gas purification techniques, real-time continuous gas purity monitoring and post-process inspection to ensure ultra-pure gases are delivered to the manufacturing process.

Servomex provides a unique, single-supplier gas analysis solution designed to meet

the requirements of semiconductor wafer manufacture. This comprehensive suite of gas analyzers measures every impurity present in the manufacture process, improving yield and ensuring product purity.

This unique solution can continuously monitor all critical process gases prior to entering the wafer manufacturing process. This includes oxygen (O₂), nitrogen (N₂), hydrogen (H₂), helium (He), argon (Ar), carbon monoxide (CO), carbon dioxide (CO₂) and more. It also enables users to monitor all major process impurities including O₂, moisture (H₂O), methane (CH₄), non-methane hydrocarbons (NMHC)

and many others at part-per-trillion (ppt) detection levels. Servomex also offers the customer a complete turnkey integrated Continuous Quality Control (CQC) system designed to meet specific customer requirements for collecting and trending gas purity data.

Complete with a Servomex-built software package to collect and trend real-time gas analysis data, Servomex is the only company to offer a full suite of technologies and CQC systems to meet every impurity analysis need of the wafer manufacturing process.

SERVOMEX SOLUTIONS FOR UHP ANALYSIS IN WAFER PRODUCTION

DF-550E/560E Series



Oxygen analyzer designed to monitor ppt-level semiconductor UHP gas.

DF-745 SGMMax



Trace moisture measurements of various background gases in semicon fabs.

DF-749/DF-750 Series



Trace/ultra-trace moisture measurements of UHP gases in semicon fabs.

DF-760E



Ultra-trace dual measurement of moisture and oxygen for PCB bulk gases.

SERVOPRO Chroma



Versatile trace gas analyzer platform configurable for a variety of applications.

SERVOPRO NanoChrome



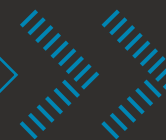
Sub-ppb trace measurement of UHP gases for the semiconductor industry.

SERVOPRO MonoExact DF310E



Advanced touchscreen ppm and % oxygen analyzer for IG applications.

See our analyzers across the process OVERLEAF



PROCESS STUDY

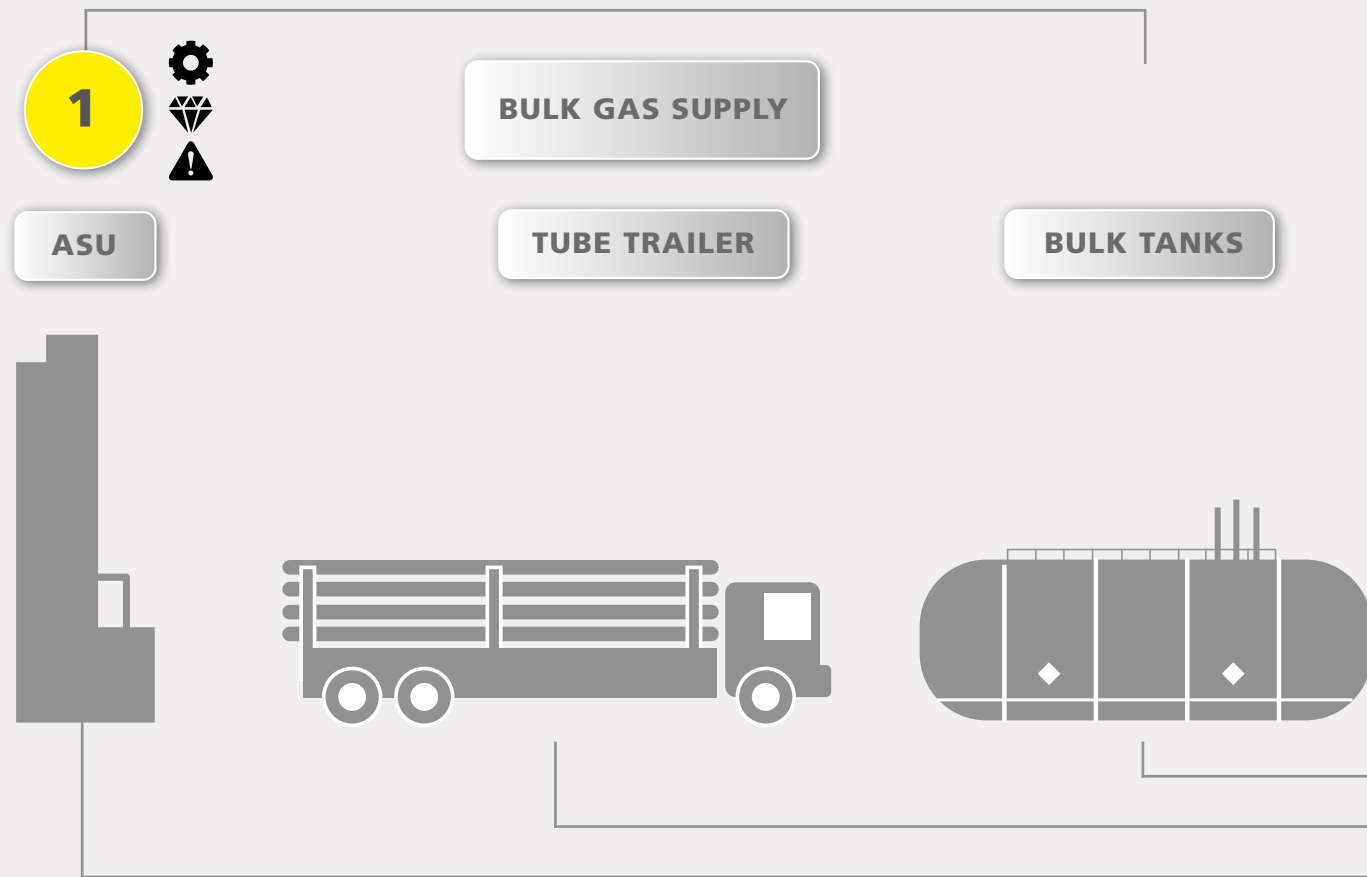


SEMICONDUCTOR MANUFACTURE

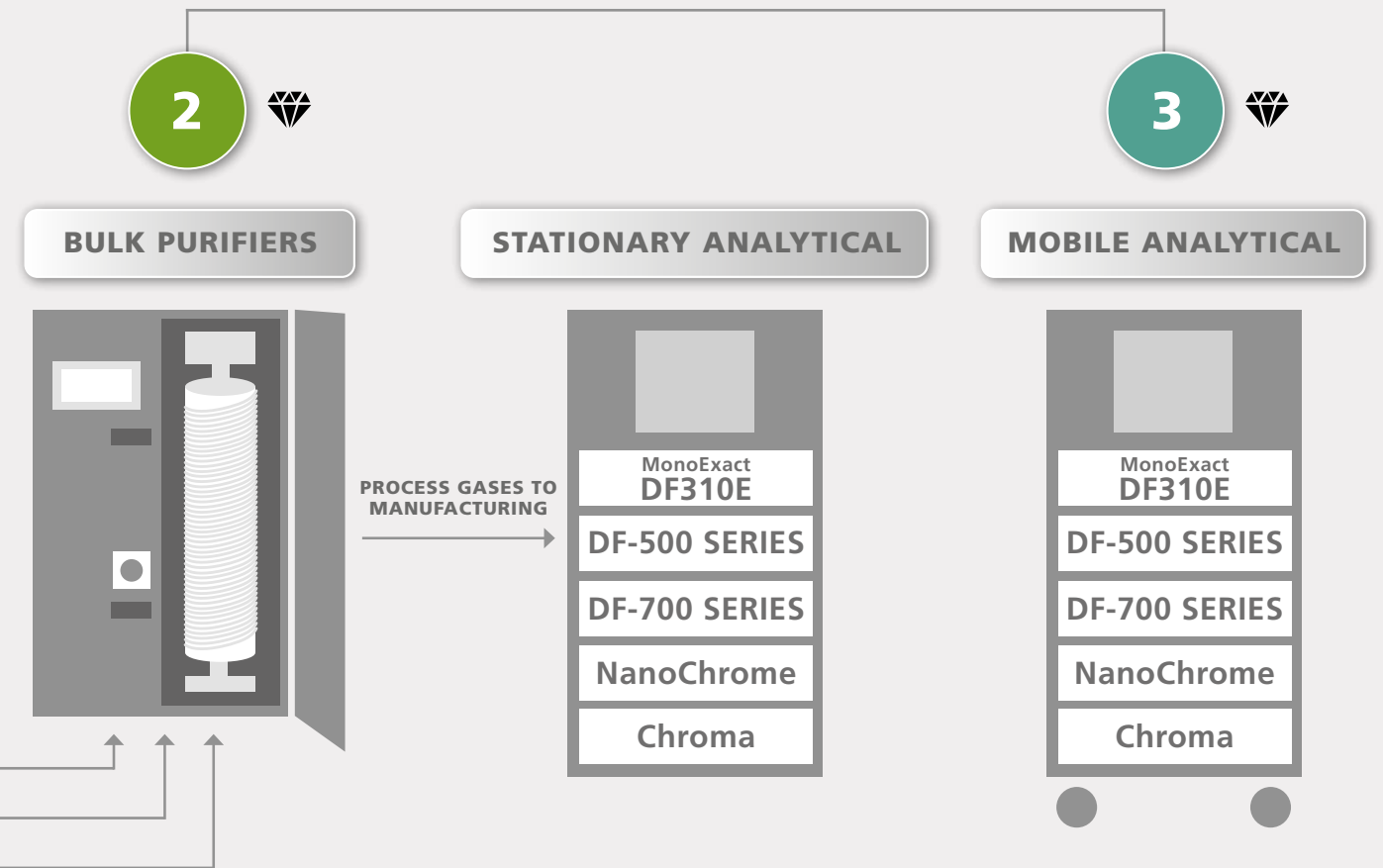
KEY APPLICATION TYPES:



PRE-PURIFIER



POST-PURIFIER



1. PRE-PURIFIER BULK GAS SUPPLY

Gases are supplied to the semiconductor customer from one of a variety of industrial gas suppliers. They are supplied in multiple forms, including from an on-site Air Separation Unit (ASU), bulk tube trailers, and bulk tanks.

These gases are designed to meet a specific purity grade from the industrial gas supplier, but are typically monitored at their point of production or entry into the facility.

A full set of analyzers can typically be found at the ASU location in a control room, operated by the industrial gas company. Some semiconductor end-users may also require a rack of analyzers to be installed at the point of use for the tube trailers or bulk tanks.

2. POST-PURIFIER

Bulk gases are sent through various gas purification techniques. These include bulk (house) purifiers that purify large flows of gas as they enter the building, or point-of-use (POU) purifiers that purify smaller quantities of gas before they enter the process equipment.

Many leading semiconductor companies employ both bulk and POU purifiers to ensure that they have the purest gases prior to entering the process environment.

Stationary analytical systems are installed at multiple locations in a large wafer manufacturing environment. They will typically contain multiple analyzers for each bulk process gas.

It is common to have 10-20 analyzers installed in each stationary analytical system to monitor the bulk gases post-purifier. Each stationary analytical system is integrated and digitally connected to the building management system to collect and trend gas purity data.

3. MOBILE ANALYTICAL CARTS

Widely utilized at most wafer manufacturing locations, mobile analytical carts are used for multiple purposes to ensure the quality of specific gas line installations.

Each new gas line installed in a semiconductor plant must be "qualified" prior to being used in production. This qualification process includes testing of various parameters of the new gas line, including impurity analysis.

A semiconductor plant may have multiple mobile analytical carts so multiple new gas lines and/or process gases can be monitored simultaneously.

In addition, mobile analytical carts are used in lieu of stationary analytical systems during maintenance activities, as the process gas impurities must always be monitored.

APPLICATION MEASUREMENT SOLUTIONS

ASU KEY ANALYZERS
Quality control, process control and safety applications:

- SERVOPRO MonoExact DF310E for O₂
- SERVOPRO MultiExact 4100 for multi-gas analysis
- SERVOPRO Plasma for N₂
- SERVOPRO Chroma for multi-gas analysis
- SERVOPRO FID for hydrocarbons
- AquaXact 1688 for moisture

SEMICONDUCTOR FABRICATION ANALYZERS
Quality control for bulk gases:

- MonoExact DF310E for O₂ impurities
- DF-550E or DF-560E for O₂ impurities
- DF-745, DF-749 or DF-750 for moisture impurities
- DF-760E for O₂ and moisture impurities
- NanoChrome for other impurities such as CH₄, NMHC, CO, CO₂, organics, etc.

TAKING A GLOBAL APPROACH TO CUSTOMER SUPPORT



Support for Servomex's Purity and Specialty gas analysis customers around the world is delivered by our Service Network, overseen by Global Head of Service Mark Calvert.

He is responsible for the co-ordination of Servomex's service teams around the globe, delivering a strategic approach that maintains a consistent, high-quality approach worldwide. This ensures that customer support and service delivery is provided quickly and effectively, wherever it is needed.

Based at the UK Technical Centre in Crowborough, Mark has implemented positive changes to the service team structure to promote an even stronger customer-focused approach.

This has created a robust, integrated service network ready to meet the needs of new and existing customers in growing markets worldwide.

Servomex operates workshops in Houston, Boston and the UK, with service centers and offices around the world. The enhanced global service structure is organized into four key regions:

Service coverage in the EMEA region is provided by a team of 16 service engineers, managed by Service Manager Neil Tiley.



For the Americas, Service Manager Christopher Galley oversees a team of nine from the US Service Center in Texas.



GuangYong Wang is Service Manager for China, and has a team of four supporting our customers in the country.



Service provision elsewhere in the Asia-Pacific region is delivered by a team of 13, guided by Nick Tan, Service Manager Rest of Asia.



"It's key to our strategy that we ensure Servomex provides the very best 'local for local' support, delivering customer assistance for our entire product range, anywhere in the world."

"As part of this, I've been encouraging more global collaboration between our teams, so that we all share our knowledge and promote best practice."

Mark Calvert, Global Head of Service. Email: mcalvert@servomex.com

Servomex Service Network offers your business a full range of service products developed to ensure optimum process performance.



Find out more at: servomex.expert/service

> P&S PRODUCT GUIDE

Servomex has set the standard for gas analysis in the industrial gas (IG) market for the last 60 years. From air separation to gas bottling and transportation, Servomex has pioneered monitoring technologies and ground-breaking systems solutions that deliver accurate sensitivity, unparalleled performance and reduced cost of ownership.

It offers the most extensive range of analyzer technologies available from a single gas analysis manufacturer, ensuring delivery of the precise, correct solution for every point in your process.

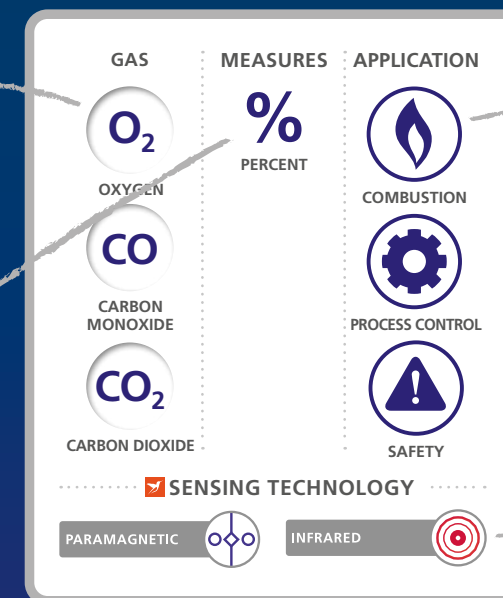
Leading the field in measurement sensitivity, Servomex offers accurate, stable monitoring from percent levels down to the very lowest ultra-trace levels demanded by the semiconductor market. When these exceptional technology range and measurement capabilities are combined, Servomex is unique in offering a genuine 'all of market' solution to the IG Industry.

FIND YOUR PRODUCT NOW

> HOW TO GUIDE

Some analyzers are optimized for single gas measurements while others monitor multiple gas types.

We offer all measurement ranges from percentage to ultra trace parts per trillion analysis.



We identify which application types the analyzer is suitable for operating in.

The Hummingbird sensing technologies used are listed.

For the full range of Servomex analyzers, visit servomex.expert/gas-analyzers

SERVOMEX AquaXact 1688

SAFE AREA

A FAST, ACCURATE AND RESILIENT MOISTURE MEASUREMENT SOLUTION

The AquaXact 1688 is a rugged ultra-thin film Aluminum Oxide moisture sensor that enables the measurement of moisture in a wide variety of gas phase process applications, such as glove boxes, air separation units, natural gas processing, transportation, and instrument air, with no calibration required after sensor replacement or dry-out.



FEATURES AND BENEFITS

- Functions as a standalone 4-20 mA transmitter or remotely interfaces with our digital controller, MonoExact DF310E and MultiExact 4100
- NIST-traceable field-replaceable sensor element, for hassle-free recalibration
- Stainless steel, weatherproof casing (Class 1 Div 2 in 2019) enables operation in ambient temperatures ranging from -10°C to +70°C

APPLICATIONS

- Glove boxes
- Solder reflow ovens
- Compressed air generation
- Ethylene production

GAS	MEASURES	APPLICATION
H ₂ O WATER	DEW POINT ppmv	PROCESS CONTROL

ALUMINUM OXIDE

SENSING TECHNOLOGY

SERVOPRO MonoExact DF310E

SAFE AREA

NEXT-GENERATION DIGITAL OXYGEN ANALYZER DESIGNED FOR INDUSTRIAL GAS APPLICATIONS

Designed specifically for accurate measurements of oxygen in industrial gas applications, the MonoExact DF310E is a next-generation digital oxygen analyzer that combines precise, trace-level measurement with a new icon-driven guided user interface (GUI) and advanced digital communications.



FEATURES AND BENEFITS

- Advanced touchscreen GUI for intuitive setup and operation
- Back-compatible with the DF-310E platform's wiring inputs and gas connections
- Paramagnetic sensor capable for % level O₂ measurements
- AquaXact Aluminum Oxide sensor is optional for simultaneous O₂ and H₂O monitoring
- RS232, RS485, Modbus, PROFIBUS, and Ethernet Modbus TCP/IP

APPLICATIONS

- Air separation units
- Medical/industrial gases
- Specialty gas blending

GAS	MEASURES	APPLICATION
O ₂ OXYGEN	% PERCENT	PROCESS CONTROL
H ₂ O WATER	ppm TRACE ppb ULTRA TRACE	QUALITY

COULOMETRIC

PARAMAGNETIC

SENSING TECHNOLOGY

SERVOMEX AquaXact 1688 Controller

SAFE AREA

DIGITAL CONTROLLER PLATFORM FOR THE AQUAXACT 1688

Built specifically to work in harmony with the AquaXact 1688 ultra-thin film Aluminum Oxide moisture transmitter, this digital controller provides a high-clarity color touchscreen display, alarms, relays and advanced communication protocols, and allows easy sensor tip replacement in the field.



FEATURES AND BENEFITS

- Dew point and ppmv H₂O measurements
- Dense Al₂O₃ pore structure and geometry provides the AquaXact sensor with greater stability and reduced drift over 12 months
- Compact footprint for easy integration into your system
- Advanced digital communications including Modbus, Ethernet Modbus TCP/IP and PROFIBUS

APPLICATIONS

- Air separation units
- Glove boxes
- Instrument air units
- Refining gases

GAS	MEASURES	APPLICATION
H ₂ O WATER	DEW POINT ppmv	PROCESS CONTROL

ALUMINUM OXIDE

SENSING TECHNOLOGY

SERVOPRO 4200/4210

SAFE AREA

GAS ANALYZER SUITABLE FOR FLAMMABLE GAS MIXTURES

The 4200/4210 multi-gas analyzer is designed to monitor flammable gas samples including H₂/CO, 'HyCO' or 'Syngas' mixtures for trace level contaminants and percent level components. The 4200/4210 offers oxygen control using Servomex's unique Paramagnetic cell, trace level measurement of CO, CO₂, N₂O and CH₄ and percent levels of CO, CO₂, CH₄ using Photometric sensor technology.



FEATURES AND BENEFITS

- Meets the requirements of EN 61010-1:2010 and EN 61326-1:2013
- Measures up to four gases simultaneously
- RS232/RS485 and Modbus communications

APPLICATIONS

- Product quality validation in hydrogen plants
- HyCO process control
- Bottling/filling plants producing flammable gas blends

GAS	MEASURES	APPLICATION
MULTIPLE	% PERCENT ppm TRACE	PROCESS CONTROL QUALITY

GAS FILTER CORRELATION

INFRARED

PARAMAGNETIC

SENSING TECHNOLOGY

SERVOPRO MonoExact DF150E

SAFE AREA

TOUCHSCREEN PPM OXYGEN ANALYZER FOR GENERAL INDUSTRIAL APPLICATIONS

Using a new and improved digital touchscreen with icon-driven guided user interface (GUI) for easier operation, the MonoExact DF150E combines the reliability of Servomex's tried and tested Coulometric oxygen sensor with a user-friendly package.



FEATURES AND BENEFITS

- Updated digital sensor includes new operation and maintenance features that reduce cost of ownership
- Back-compatible with DF-150E platform, including hardware wiring inputs and gas inlets
- Servomex proprietary software makes reporting and parameter control simple

APPLICATIONS

- Glove boxes
- Heat treating
- Solder reflow ovens
- Industrial gas production

GAS	MEASURES	APPLICATION
O ₂ OXYGEN	ppm TRACE ppb ULTRA TRACE	PROCESS CONTROL QUALITY

COULOMETRIC

SENSING TECHNOLOGY

SERVOPRO FID

SAFE AREA

TRACE HYDROCARBON ANALYZER IDEAL FOR AIR SEPARATION UNITS (ASU) SAFETY AND QUALITY CONTROL APPLICATIONS

A Flame Ionization Detector analyzer designed to assure safe operation for cryogenic ASU, the FID ensures the level of Total Hydrocarbons (THC) is maintained below flammable limits, as well as providing quality control in pure O₂, N₂, Ar, air, He and CO₂.



FEATURES AND BENEFITS

- Electrical safety to IEC 61010-1. In compliance with Low Voltage, EMC and applicable Directives
- Excellent output resolution over three operating ranges
- Electronic flow controllers for air, fuel and sample for no dependency to atmospheric pressure variations and inlet pressure variation

APPLICATIONS

- Cryogenic air separation
- Process control
- Food gas manufacture
- Product validation

GAS	MEASURES	APPLICATION
THC TOTAL HYDROCARBONS	ppm TRACE	SAFETY QUALITY

FLAME IONIZATION DETECTOR

SENSING TECHNOLOGY

SERVOPRO Chroma

SAFE AREA

HIGHLY VERSATILE TRACE GAS ANALYZER PLATFORM CONFIGURABLE TO A WIDE RANGE OF APPLICATIONS

Offering a unique, non-depleting plasma emission detector, the Chroma analyzer is one of the most versatile gas analyzers for trace gas measurement available. Most applications will be satisfied by a single 4U rack analyzer configuration, making the Chroma a compact, cost-effective solution for continuous process control or quality monitoring.



FEATURES AND BENEFITS

- Fully automated – tune to the application – system for unique simplicity of use
- Standalone systems requires no third-party software or computer to operate
- For THC measurements the PlasmaHC system requires no FID and therefore no H₂ fuel gas

APPLICATIONS

- Medical gas production
- Air separation plants
- Cryogenic truck loading station
- High purity gas production

GAS	MEASURES	APPLICATION
MULTIPLE	% PERCENT ppm TRACE ppb ULTRA TRACE	QUALITY PROCESS CONTROL

SENSING TECHNOLOGY

GAS CHROMATOGRAPHY	PLASMA
FLAME IONIZATION DETECTOR	THERMAL CONDUCTIVITY

SERVOPRO MultiExact 4100

SAFE AREA

A SOPHISTICATED, NEXT-GENERATION MULTI-GAS ANALYZER PROVIDING A HIGHLY ADAPTABLE ANALYSIS SOLUTION

The MultiExact 4100 is a high-performance multi-gas analyzer designed to provide up to four simultaneous gas stream measurements including: O₂ (trace, control, and purity), CO₂, CO, N₂O, CH₄ (trace) and H₂O.



FEATURES AND BENEFITS

- Comprehensive solution for industrial and medical gas manufacture and for pharmacopeia applications
- Integrated support for the AquaXact 1688 Aluminum Oxide moisture transmitter
- Uses ultra-stable, non-depleting digital sensing technologies that help extend maintenance intervals

APPLICATIONS

- Product purity on air separation plant
- Process control on air separation plant
- Monitor trace CO₂ on scrubbed air inlet to air separation process
- Validation of medical O₂, N₂ and air

GAS	MEASURES	APPLICATION
MULTIPLE	% PERCENT ppm TRACE	PROCESS CONTROL QUALITY

SENSING TECHNOLOGY

GAS FILTER CORRELATION	ZIRCONIA
PARAMAGNETIC	ALUMINUM OXIDE
INFRARED	

SERVOPRO Plasma

SAFE AREA

RELIABLE MONITORING OF NITROGEN IN ARGON AND HELIUM, OPTIMIZED FOR AIR SEPARATION UNIT (ASU) PLANT OPERATIONS

Specifically designed for the continuous monitoring of N₂ in Ar or He or both, the Plasma's unique plasma emission detector provides an accurate, highly stable and reliable measurement ideal for the requirements of ASU plant operators.



FEATURES AND BENEFITS

- Electrical safety to IEC 61010-1: Ed 3. In compliance with Low Voltage, EMC and applicable Directives
- Wide measurement range – 0-1ppm, 0-10ppm, 0-100ppm (higher on request)
- Electronic flow control system for low flow consumption and reading stability

APPLICATIONS

- Argon production
- Track loading
- Pure gas bottling
- Specialty gas laboratories

GAS	MEASURES	APPLICATION
N ₂ NITROGEN	ppm TRACE	QUALITY

SENSING TECHNOLOGY

PLASMA

SERVOPRO MultiExact 5400

SAFE AREA

DIGITAL MULTI-GAS ANALYZER, OPTIMIZED FOR WIDE RANGE OF AIR SEPARATION UNIT (ASU) MEASUREMENTS

Combining industry-leading performance and a range of new and enhanced functions as standard, the MultiExact 5400 offers air separation plants a multi-gas analyzer specifically optimized to industry requirements – with industry leading, non-depleting technologies for ultra-stable, accurate and selective measurements.



FEATURES AND BENEFITS

- IEC 61010-1. European Pharmacopeia compliant. US Pharmacopeia compliant (O₂). In compliance with Low Voltage, EMC and applicable Directives
- Measures trace level with accuracy and reliability
- Options include digital communication options, an integrated valve block function and unique Servomex Flowcube flow sensor technology

APPLICATIONS

- Product purity on air separation plant
- Process control on air separation plant
- Validation of medical O₂, N₂ and air

GAS	MEASURES	APPLICATION
MULTIPLE	% PERCENT ppm TRACE	PROCESS CONTROL QUALITY

SENSING TECHNOLOGY

PARAMAGNETIC	ZIRCONIA
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SERVOPRO NanoChrome

SAFE AREA

SUB-PPB TRACE MEASUREMENT OF H₂, CH₄, CO, CO₂, N₂, Ar AND NMHC FOR THE SEMICONDUCTOR INDUSTRY

Incorporating the latest advances in gas sensing technology and signal processing methodology, the NanoChrome revolutionizes ultra-trace purity measurements for the semiconductor industry.



FEATURES AND BENEFITS

- In compliance with Low Voltage, EMC and applicable Directives
- New PED Sensor technology enables sub-ppb measurements of H₂, CH₄, CO, CO₂, N₂, Ar and NMHC
- Enables unique total Servomex solution for UHP gas analysis

APPLICATIONS

- Semiconductor production – quality control measurements
- Semiconductor production – stationary analytical systems
- UHP gas production – quality control measurements

GAS	MEASURES	APPLICATION
MULTIPLE	ppb ULTRA TRACE ppt ULTRA TRACE	QUALITY

SENSING TECHNOLOGY

GAS CHROMATOGRAPHY	PLASMA
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SERVOFLEX Micro i.s. 5100

PORTABLES

INTRINSICALLY SAFE ANALYZER MEASURES O₂, CO OR CO₂

Designed for the measurement of toxic and flammable gas samples, the intrinsically safe Micro i.s. 5100 is a unique analyzer certified to Zone 0 and Zone 1 and suitable for measuring percent levels of O₂, CO and CO₂.



FEATURES AND BENEFITS

- Intrinsically safe design to ATEX and IEC standards ensures safety operation in hazardous environments
- Ergonomic design ensures easy operation on the move
- Available in non-pump or pump versions with optional sample conditioning kit

APPLICATIONS

- Hazardous area combustion optimization
- Refineries – catalytic cracker regeneration
- Process monitoring
- Inerting applications

GAS	MEASURES	APPLICATION
O ₂ OXYGEN	% PERCENT	COMBUSTION
CO CARBON MONOXIDE		PROCESS CONTROL
CO ₂ CARBON DIOXIDE		SAFETY

SENSING TECHNOLOGY

PARAMAGNETIC	INFRARED
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SERVOFLEX MiniMP 5200

PORTABLES

BENCHTOP ANALYZER OFFERING SINGLE OR DUAL MEASUREMENTS OF O₂ AND CO₂

The only truly portable battery-powered gas analyzer with MCERTS certification, the MiniMP 5200 is designed to offer single or dual measurement of O₂ and CO₂ by utilizing Servomex's advanced Paramagnetic and Infrared sensing technologies.

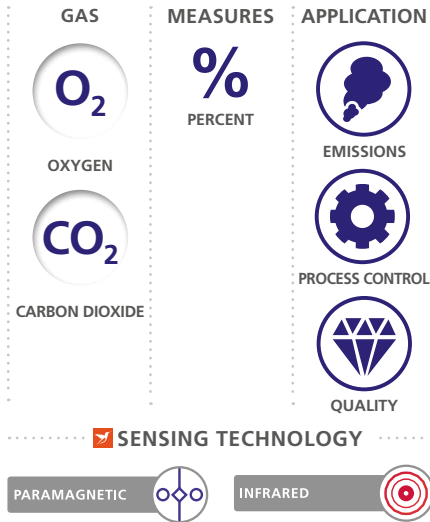


FEATURES AND BENEFITS

- EN15267-3 (MCERTS V3.3, Annex F) makes the MiniMP ideal for source testers that require reference O₂ analysis for CEMS verification
- Li-ion battery system offers unique true portability
- Non-depleting sensor design ensures long service with minimal calibration

APPLICATIONS

- Laboratories and research
- Air separation and gas bottling plants
- Transfilling
- Combustion analysis



SERVOFLEX MiniHD 5200

PORTABLES

PORTABLE GAS ANALYZER FOR MEASUREMENT OF COMMON GAS MIXTURES

Designed for use in field locations or light industrial applications, the MiniHD 5200 portable gas analyzer is a rugged, heavy duty analyzer designed to accurately measure the levels of O₂, CO and CO₂ within common gas mixtures. The MiniHD 5200 utilizes Servomex's non-depleting Paramagnetic and Infrared sensors to give dependable and accurate results.

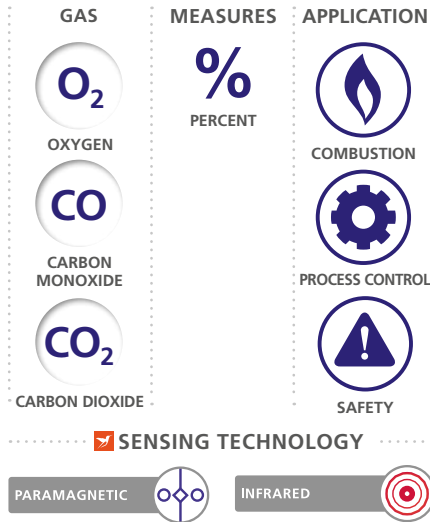


FEATURES AND BENEFITS

- Robust IP65 construction meets the demanding needs of field location analysis
- Long life Li-ion rechargeable batteries and range of sampling options ensure ease of use
- Accurate measurement of O₂, CO and CO₂ levels with no background interference

APPLICATIONS

- Physiology studies
- Universities
- Combustion optimization
- Medical gas verification



GAS DETECTION OxyDetect

SERVOMEX

NON-DEPLETING PARAMAGNETIC O₂ MONITOR DESIGNED FOR LIFE SAFETY APPLICATIONS

Life safety monitor designed for safe area or hazardous area environments, utilizing superior performance of award-winning, non-depleting Hummingbird Paramagnetic O₂ sensing technology.

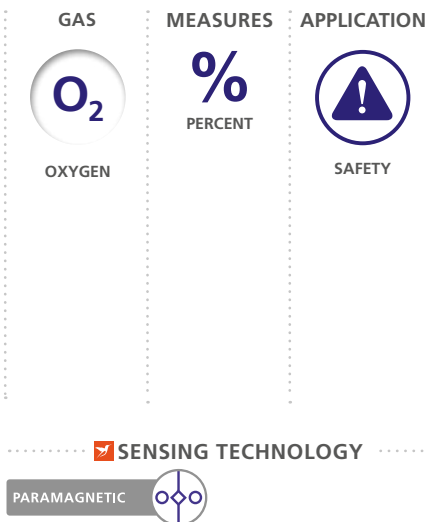


FEATURES AND BENEFITS

- IP66 (indoor use only)
- The most reliable O₂ detector on the market
- No more false readings or false alarms caused by depleting cell technologies
- SIL 2 compliant

APPLICATIONS

- Pharmaceutical plants
- Helium production and storage
- Semiconductor facilities
- Laboratories and universities



DELTA F DF-500 Range

HIGH PURITY

LEADING ULTRA-TRACE PPT O₂ ANALYZER RANGE

Verified by independent experts as measuring O₂ to the lowest ppt levels available, the DF-500 analyzer range delivers the premium performance in ultra-trace O₂ measurement. Consisting of the DF-550E NanoTrace and DF-560E NanoTrace II, the NanoTrace series delivers exceptional O₂ measurements at trace and ultra-trace ppt levels.

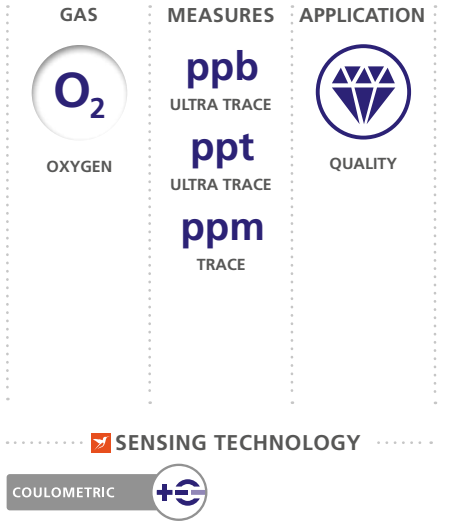


FEATURES AND BENEFITS

- The industry standard for the reliable measurement of O₂ in semiconductor manufacture
- Fast response and quick upset recovery ensures ultimate performance
- Options include flexible configurations and hand-carry portable option

APPLICATIONS

- Continuous quality control monitoring
- Inert gases control checks for electronics grade gases
- Post purifier quality certification
- Leak detection for electronics grade gases



DELTA F DF-700 Range

HIGH PURITY

TUNABLE DIODE LASER (TDL) TRACE MOISTURE ANALYZER RANGE

A sophisticated process moisture analyzer range which offers users the comprehensive solution for trace and ultra-trace moisture measurement, the DF-700 series combines the latest TDL Absorption Spectroscopy technology, a robust measuring cell and a true baseline reference for highly accurate moisture measurement.

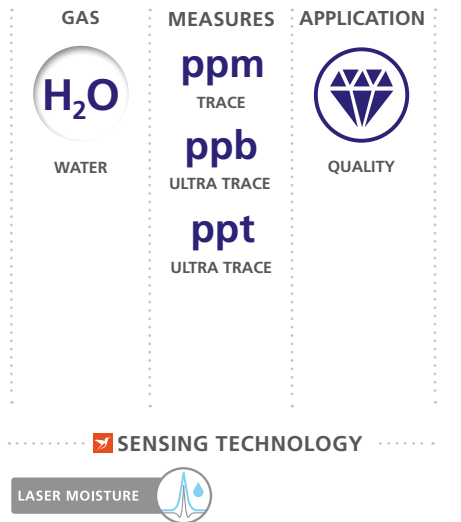


FEATURES AND BENEFITS

- Exceptional range from 100 ppt to 20 ppm moisture level readings depending on the model
- Only true Laser Absorption Spectroscopy technology in the market space which is unaffected by gas contaminants that plague CRDS laser systems
- TDLAS line lock technology keeps the laser on the moisture peak centroid measuring the entirety of the moisture's mass under the Voigt curve

APPLICATIONS

- 730: Quality control of HCl gas
- 740: Analysis of electronics-grade NH₃ specialty gas
- 745: Inert gases leak detection for LED and LCD plants
- 745 SGMMax: Specialty gas cylinder quality control
- 749: HP bulk gases used in semiconductor applications
- 750: Bulk UHP gas CQC for semiconductor fabs
- 760: O₂ and H₂O monitoring in UHP bulk gases used in semiconductor applications



SEE THE FULL PICTURE OF GAS ANALYSIS ONLINE



Find out more about our analyzers, learn about our technologies, and see inside our state-of-the-art manufacturing facilities with our range of videos.

We have a growing lineup of short, informative videos showcasing the benefits of our product range. You can also discover what goes on behind the scenes at our UK and US technical centers, and take a tour of our systems engineering facility.

Watch all of these videos and more at: servomex.expert/videos

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