

# POWER GENERATION

## GAS ANALYSIS MAGAZINE



ISSUE  
TWO - 2017

SUPPORTING YOUR COMBUSTION  
AND EMISSIONS APPLICATIONS

### NEW PRODUCTS

Solutions for the toughest of  
emissions measurements

### APPLICATION STUDY

Combustion control in coal and  
gas boilers

### EXPERT ADVICE

Advantages of the SERVOTOUGH  
Laser 3 Plus in ammonia slip



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# DEAR READER

WELCOME TO THE LATEST EDITION OF OUR MAGAZINE FOCUSED ON THE POWER MARKET SECTOR.

In this edition, we look at emissions regulations and compliance, a major concern for both public and private power generating utility plants across the globe. Many countries are now enforcing current emissions standards, while others are legislating increasingly stricter ones.

Europe has committed itself to taking on the task of reducing CO<sub>2</sub> emissions by 80-95% below 1990 levels by 2050, which can only happen if the power industry moves to a zero-carbon power supply.

Significant reductions in emissions can be achieved by repurposing the waste heat within the emission stream, producing heat or electricity from generated steam. Co-generation plants use the steam for heating, while combined cycle gas turbines use it for electricity. These are just two examples of effective emissions reduction that also improve plant efficiency. We look at this in greater detail on page four and in our process feature on page 11.

China is determined to become a world leader in emissions reduction and has completely embraced Selective Catalytic Reduction (SCR) as the required post-combustion NO<sub>x</sub> control process for all large power plants. It is looking at further emissions reductions strategies with boiler efficiency and control, as seen on page eight.

We also highlight three key Servomex analyzers used for keeping emissions under control. The NO<sub>x</sub>, SO<sub>2</sub> and HFID are all from our SERVOPRO family of analyzers, and form part of a comprehensive solution for accurate emissions monitoring.

And we'll explore how the SERVOTOUGH Laser 3 Plus analyzers and SERVOTOUGH FluegasExact 2700 can be used in boiler feedback controls for coal and natural gas.

Servomex is continuing to invest in the global power and environmental emissions market and I am personally very pleased to announce we now have a stronger presence in Asia with the arrival of Tao Wee "TW" Loo as our new Business Development Manager for our Power & Environmental Emissions Market serving all of Asia. Find out more about TW on page five.

**Barbara Marshik**  
Power Market Sector Manager.



Email: [bmarshik@servomex.com](mailto:bmarshik@servomex.com)

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## POWER MARKET FOCUS

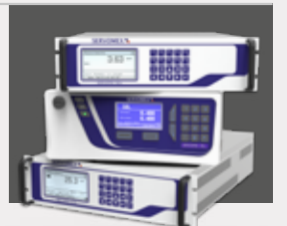
How Europe and China are driving down emissions



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## RELIABLE EMISSIONS MEASUREMENT SOLUTIONS

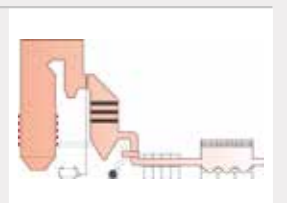
Servomex's comprehensive analyzer suite for monitoring emissions



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## COMBUSTION CONTROL IN COAL AND GAS BOILERS

A comparison of the challenges and solutions for boiler operators



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## KEEP YOUR ANALYZER UP AND RUNNING

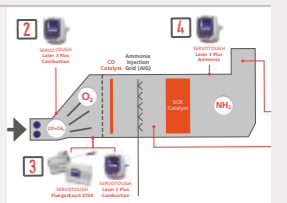
See how our range of spares kits can maximize the SERVOTOUGH FluegasExact 2700's uptime



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## BENEFITS OF COMBINED CYCLE POWER PLANTS

Discover the Servomex solution for the challenges of emissions control in combined cycle power plants



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## USING THE Laser 3 Plus IN AMMONIA SLIP

How our compact TDL analyzer provides a total application solution for your DeNO<sub>x</sub> processes



See our latest product ranges. Analyzer guide starts on page 16

# SEE THE FULL PICTURE ONLINE

## INSIDE SERVOMEX UK

Get an insight into our world-class manufacturing facilities where sensors and analyzers are built to the highest-quality standards



## SERVOMEX OxyDetect

Our non-depleting Paramagnetic oxygen monitor available for safe and hazardous areas – see the benefits



## AMMONIA SLIP CONTROL

See why the SERVOTOUGH Laser 3 Plus Ammonia TDL analyzer is the ideal solution for your DeNO<sub>x</sub> process



## SERVOTOUGH LASER 3 PLUS

See the advantages of Servomex's latest product range as we introduce three new compact TDL analyzers



Watch at [servomex.com/videos](http://servomex.com/videos)

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FOR THE FULL RANGE OF ANALYZERS VISIT [servomex.com/gas-analyzers](http://servomex.com/gas-analyzers)

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## EUROPE AIMS TO CUT CARBON LEVELS

The European Union (EU) is pursuing new initiatives to become the world leader in low carbon emissions. By 2050, it aims to reduce greenhouse gas emissions by 80-95% below 1990 levels.

Power was identified as a segment where significant reductions can occur through energy efficiency, fossil fuel replacement with renewable energy sources like wind and solar, and European grid infrastructure investments.

Programs like the Medium Combustion Plant (MCP) directive affect more than

143,000 medium-sized plants that must now regulate NOx, SO<sub>2</sub> and dust. Combined with tougher Emissions Limit Values (ELVs) in the Large Combustion Plants (LCP) directive, it plays a large part in European emissions reduction.

Any plant with a thermal input rating exceeding 50 Megawatts falls under the new LCP directive and must apply the Best Available Techniques (BAT) provided in the BAT reference (BREF) document to reduce emissions to meet the new emissions requirements.

Daily emissions reporting has been added to ensure that the abatement equipment is functioning properly, limiting undetected excursions as well as new start-up and shut-down emissions measurements.

The BREF includes comments on equipment corrosion or fouling that may occur with various techniques.

Adding analyzers for control of the process can help minimize the impact on the plant emissions and performance.

### SERVOMEX SOLUTIONS FOR EMISSIONS REDUCTION



Highly accurate measurement equipment will be key for maintaining both compliance and equipment whether the emissions reduction was provided by optimizing the combustion process or adding DeNOx equipment.

Servomex has been instrumental in boiler and turbine optimization with the use of

our SERVOTOUGH FluegasExact 2700 Zirconia O<sub>2</sub> analyzer, or the SERVOTOUGH Laser 3 Plus Combustion TDL analyzer for CO, O<sub>2</sub> or CO + CH<sub>4</sub> analysis as feedback control monitors.

Post-combustion control of <3-10mg/ Nm<sup>3</sup> of NH<sub>3</sub> Slip from installed DeNOx SCR and/or SNCR equipment will now be

required as a yearly average or averaged over the sampling period. By using a SERVOTOUGH Laser 3 Plus TDL analyzer, not only will the plant be able to maintain compliance, but the NH<sub>3</sub> signal provides feedback control for dosing, reducing operating costs as well.

#### SERVOTOUGH FluegasExact 2700



#### SERVOTOUGH Laser 3 Plus Combustion



#### SERVOTOUGH Laser 3 Plus Ammonia



Servomex has a wide variety of analyzers that can handle emissions from any fuel, including high-particulate fuels like biomass or coal and cleaner fuels which produce low NOx emissions as seen in natural gas turbines.

Contact us today to discuss your needs. Visit [servomex.com](http://servomex.com)

## CHINA'S DRIVE TOWARDS LOWER EMISSIONS IN ASIA

China is driving emissions reductions in the region with the goal of being the world leader by equipping all large industrial power generating equipment with Selective Catalytic Reduction (SCR) nitrogen oxide reduction or DeNOx equipment.

In the meantime, Beijing and Shanghai have converted all their electrical

generation plants from coal to natural gas; however, the district heating still relies on coal-fired production.

China's new goal is to reduce emissions even further, which will require optimizing the performance of the boiler and equipping them with more efficient low NOx burners.

Other process changes including renewable fuels are also being implemented to produce less NOx and promote lower NOx emissions into the atmosphere.

Boiler optimization with feedback control is crucial right now, and Servomex has the perfect suite of analyzers to support these processes, backed up by a talented and experienced team of experts.



### SERVOMEX'S EXPERT TEAM FOR ASIA

Servomex's strong support for the power and environmental emissions market in the Asia-Pacific region has been reinforced by the recent appointments of Tao Wee "TW" Loo as the Power and Environmental Emissions Business Development Manager for the Asia-Pacific region, and Sherwin Sun as the new China Sales Manager.

With a strong engineering background and extensive business experience, TW is establishing a closer working relationship with our power and environmental emissions market customers providing

support and solutions that will meet their needs.

Sherwin is responsible for leading the China sales team, and has a decade of sales experience in the environmental emissions market.

With several recent product launches providing more advanced solutions to gas analysis applications, the team is also focused on providing support to those Servomex customers in Asia who are looking to upgrade their existing installations.



Tao Wee Loo - Business Development Manager



Sherwin Sun - China Sales Manager

Let us help you cut emissions for your process.

Contact the Asia Pacific Business Centre:  
[asia\\_sales@servomex.com](mailto:asia_sales@servomex.com)

Email: [tloo@servomex.com](mailto:tloo@servomex.com) or [ssun@servomex.com](mailto:ssun@servomex.com)

# PRODUCT NEWS

## SOLUTIONS FOR THE TOUGHEST EMISSIONS MEASUREMENTS



Servomex offers a comprehensive suite of analyzers for advanced combustion control and emissions monitoring, covering a broad range of gas components and ranges supporting the ever-tightening regulatory environment seen worldwide.

The new SERVOPRO NOx analyzer combines a high dynamic range and rapid response time. This provides an ideal solution for turbine emissions monitoring, not only during operation but also at start-up and shut-down, measuring NO or NO/NO<sub>2</sub>/NOx

concentrations in four user-selectable ranges, from 0-3 parts-per-million (ppm) to 0-3,000ppm.

Ideal for ultra-low sulfur dioxide emissions measurements, the SERVOPRO SO<sub>2</sub> provides a 0-20ppm analysis range using Ultraviolet (UV) Fluorescence technology for a highly acute analyzer with low cost of ownership.

For industrial emissions or vehicle/engine certification applications that require heated gas analysis of total hydrocarbons (THC), methane, and non-methane

hydrocarbons (NMHC) or volatile organic carbons (VOC) the heated SERVOPRO HFID delivers a reliable, accurate analytical solution with a high dynamic range from 0-30ppm up to 0-30,000ppm as methane.

Together, they join Servomex's existing SERVOPRO 4900 multi-gas analyzer, offering a comprehensive line of accurate emissions monitoring solutions for NO, NO<sub>2</sub>, NOx, O<sub>2</sub>, SO<sub>2</sub>, CO, CO<sub>2</sub> and hydrocarbons (methane, total hydrocarbons, and non-methane hydrocarbons), with a low cost of ownership over the lifetime of the products.

### SERVOPRO NOx



This analyzer is ideal for continuous monitoring of industrial stationary source emissions, especially gas turbines, and is sensitive enough for ambient air monitoring.

Chemiluminescence Detection (CLD) combined with a long-lasting detector makes this analyzer the best long-term solution for NO or NO/NO<sub>2</sub>/NOx analysis.

The standard analyzer can also be equipped with the Servomex Paramagnetic O<sub>2</sub> sensor, and a heated version is available for vehicle or engine certification testing.

Using a non-depleting photodiode to detect chemiluminescent light, the fast response time of the analyzer also makes it a perfect solution for applications requiring low-level NOx emissions detection, like gas turbine emission control and engine/vehicle certification testing.

SENSING TECHNOLOGY



Control your NOx: [servomex.com/nox](http://servomex.com/nox)

### SERVOPRO SO<sub>2</sub>



SO<sub>2</sub>

The analyzer uses pulsed Ultraviolet (UV) Fluorescence technology to deliver a reliable, continuous measurement of ultra-low sulfur dioxide for emissions and ambient air monitoring, and slots seamlessly into analyzer racks, making it easy to integrate with existing emissions monitoring systems.

It is fitted with a "kicker" to remove polycyclic aromatic hydrocarbons from

the sample before analysis, ensuring an accurate reading. With the long-lasting UV source the analyzer runs longer, providing low maintenance requirements and low cost of ownership.

SENSING TECHNOLOGY



Get ultra-low SO<sub>2</sub> measurements: [servomex.com/so2](http://servomex.com/so2)

### SERVOPRO HFID



THC CH<sub>4</sub> NMHC

Using a heated-oven Flame Ionization Detection (FID) technology and an integral non-methane cutter the SERVOPRO HFID analyzer delivers a high-performance fast analysis of THC, methane and NMHC, spanning a high dynamic range from ppm to percent level concentration measurements.

The heated oven keeps the sample gas at 190°C preventing the loss of heavier hydrocarbon within the sample stream due to condensation, providing a more accurate measurement.

SENSING TECHNOLOGY



Real-time hydrocarbon analysis: [servomex.com/hfid](http://servomex.com/hfid)

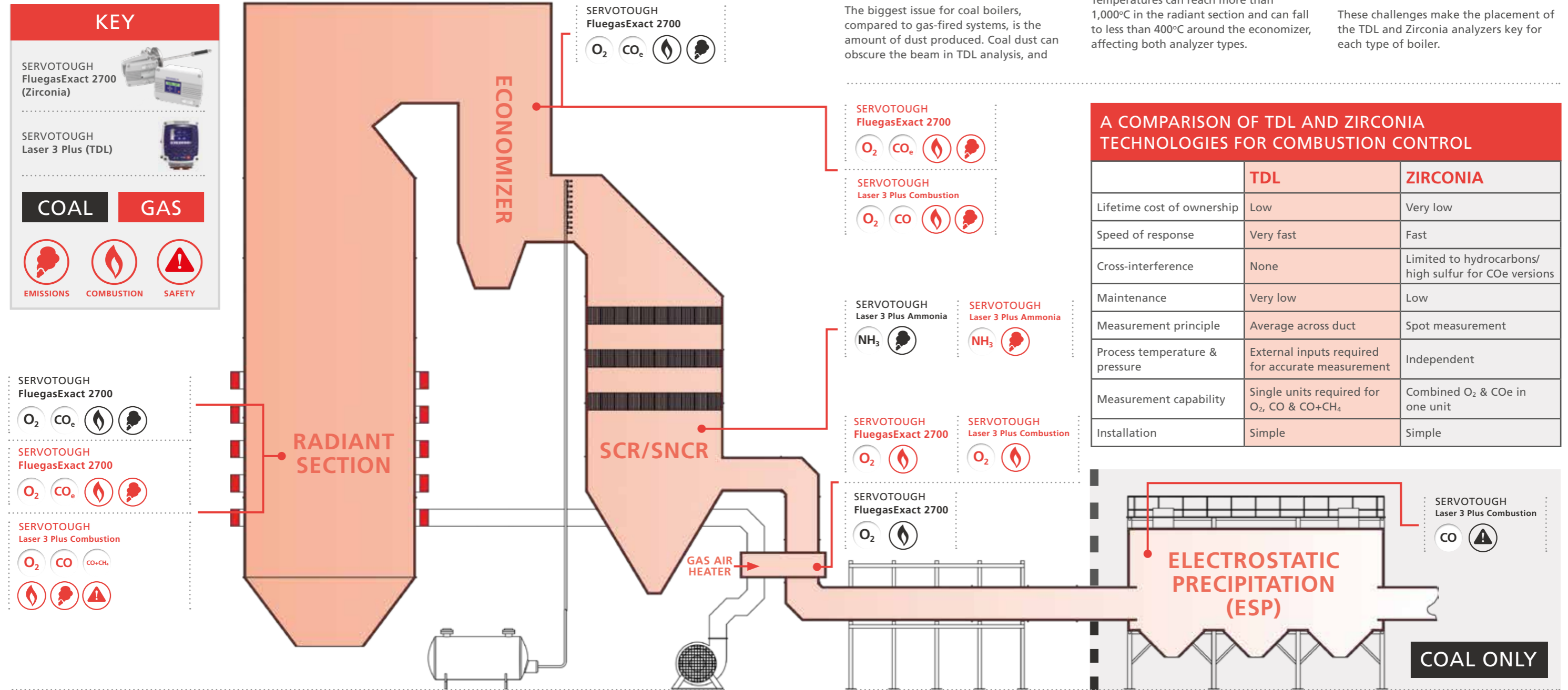
*"The NOx, SO<sub>2</sub> and HFID analyzers make a significant impact on the Servomex solution portfolio for emissions control and monitoring, adding support for a diverse range of stationary/ industrial and mobile source emissions applications."*

Barbara Marshik - Power Market Segment Manager. Email: [bmarshik@servomex.com](mailto:bmarshik@servomex.com)



Find out more about the SERVOPRO range of analyzers: [servomex.com/servopro](http://servomex.com/servopro)

## MOUNTING/INSTALLATION POSITIONS FOR COAL AND GAS FIRED BOILERS



## CHALLENGES OF COAL VS GAS BOILERS

The biggest issue for coal boilers, compared to gas-fired systems, is the amount of dust produced. Coal dust can obscure the beam in TDL analysis, and

causes abrasion to the probe (for Zirconia analyzers) or insertion tubes (for TDL).

Temperatures can reach more than 1,000°C in the radiant section and can fall to less than 400°C around the economizer, affecting both analyzer types.

Emission levels of NO<sub>x</sub> are typically much higher for coal-based boilers, due to the nitrogen bound within the coal.

These challenges make the placement of the TDL and Zirconia analyzers key for each type of boiler.

## COMBUSTION CONTROL IN COAL AND GAS BOILERS

In a coal-fired power plant, pre-heated air and pulverized coal are fed to the boiler where combustion takes place.

As combustion processes are by nature variable and coal quality is never consistent, variable amounts of excess air are required to ensure

complete combustion. Too much air, and combustion efficiency will drop, producing lower levels of CO but higher levels of NO<sub>x</sub> toxic emission gases.

NO<sub>x</sub> emissions are also created at higher temperatures as a by-product of the combustion process where excess nitrogen (N<sub>2</sub>) in the air reacts with O<sub>2</sub>, as well as reacting with any elemental nitrogen that may be resident in the fuel.

This temperature variation affects the production of CO<sub>2</sub>, CO and NO<sub>x</sub> differently, so by controlling the combustion process the boiler efficiency increases.

### DID YOU KNOW...

Recovering waste heat in a gas turbine combined cycle is 50-75% more efficient than using separate generators.

## BURNER MONITORING

Monitoring above the burners, in the radiant section, can help detect any burner issues. The correct product for this challenging measurement will depend on the fuel type, dust loading and process temperature.

A SERVOTOUGH Laser 3 Plus can be installed on the duct to measure O<sub>2</sub> and another for CO for combustion control

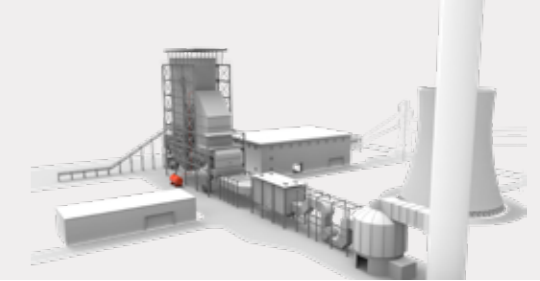
purposes. While it provides a more sensitive measurement by taking an average reading across the duct, TDL is less effective at detecting individual burner issues.

However, this averaging effect alleviates issues associated with gas stratification in the duct, and general burner issues can be detected early.

SERVOTOUGH FluegasExact 2700 units can be placed above each burner to measure

O<sub>2</sub>, for combustion control, and COe, for direct detection of burner issues.

The SERVOTOUGH Laser 3 Plus Combustion can also be used to detect flame-out conditions in natural gas fired boilers, using its dual CO+CH<sub>4</sub> measurement. Although it is very fast, the extractive sampling technology of the FluegasExact 2700 means it is not fast enough to be used as a safety device.



# MAXIMIZE YOUR ANALYZER UPTIME WITH SPARES KITS



Servomex spares kits provide the parts you need to minimize system downtime and keep your analyzer operating in the most demanding conditions.

The SERVOTOUGH FluegasExact 2700 monitors oxygen and combustibles in the harshest environments, for example measuring high dew point, acid gas rich samples in high-temperature incinerators.

It is rugged and reliable, but when parts inevitably need replacing, it is also quick and easy to maintain.

We provide comprehensive spares kits with everything you need to complete a repair or replacement, from main parts, like PCBs or filters, to ancillary items such as seals, gaskets and anti-seize compounds.

Base spares kits are offered at the point of sale and ensure you'll have the critical spares on your shelf should a part need replacing, reducing your analyzer downtime.

For example, the popular FluegasExact 2700 base pack includes parts vital to the heating system, spare main filter, fuses,

and flange gaskets in case a sensor head is ever removed from the process.

Packs of common consumable items – including mounting gaskets or aspirator and flame arrestor seals – are also available, allowing you to hold stock for when it's needed.

The FluegasExact 2700 manual has a full list of available spares and recommended quantities, depending on the number of units in use. This allows you to select the parts you need more easily.

You can also download quick reference spares sheets from the Servomex website, which show compatibility for previous and current 2700 variants. These can be conveniently stored or placed near the analyzer for quick reference.

And, if you don't have the parts you need, our network of Business Centers holds extensive stocks of all key spare parts, enabling them to provide a 48-hour despatch on all stocked spares, so you get the parts quickly.

## FLUEGASEXACT 2700 SPARES BASE PACK

**THERMOSTAT AND THERMISTOR KIT** ✓

**FILTER/FLAME ARRESTOR** ✓

**ASPIRATOR KIT** ✓

**ASPIRATOR AND FILTER/FLAME ARRESTOR SEALS KIT** ✓

**ANSI 4" 150LB GASKET KIT** ✓

**CONTROLLER/SENSOR HEAD FUSE KIT** ✓

**ANTI-SCUFF GREASE (ROCOL ASP)** ✓

Download the full FluegasExact 2700 spares list: [servomex.com/downloads/spares](http://servomex.com/downloads/spares)

### SPARES



HEALTH CHECK



ON-SITE SERVICE SUPPORT



SERVICE CONTRACTS



COMMISSIONING



SERVICE CENTER SUPPORT



RENTAL EQUIPMENT



TRAINING



CALIBRATION KITS



# THE BENEFITS OF COMBINED CYCLE POWER PLANTS

POWER PLANTS ARE CONSIDERED ONE AREA WHERE SIGNIFICANT DECREASES IN EMISSIONS CAN BE ACHIEVED BY APPLYING A COMBINATION OF THE BEST AVAILABLE CONTROL TECHNOLOGIES ALREADY IN USE BY THE MARKET

## CONTROL IN COMBINED CYCLE POWER PLANTS

Following the industrial trend, power utilities are using exhaust gas recycling to reap the highest overall benefit, producing steam for secondary electrical generation while increasing plant efficiency, and in the process greatly reducing NOx, CO, volatile organic compounds (VOC) and particulate matter (PM) emissions.

NOx and CO reduction is key for Gas Turbine Combined Cycle (GTCC) plants and, in some cases, all that is needed is lean-burn air/fuel ratio control, plus a dry low-NOx (DLN) combustor, which premixes the fuel and air for a more even heat production.

Post-combustion technologies designed to lower NOx and other emissions include Selective Catalytic Reduction (SCR), Selective Non-Catalytic Reduction (SNCR), selective CO and NOx catalyst reduction, or the addition of fogging (water or steam injection).

The technology used depends on the turbine size, the regulatory requirements, and the environmental impact.

Advanced operational control using sensors or analyzers located in and around the heat recovery steam generator (HRSG) housing is used to balance operational efficiency against regulatory emissions, but because there is not much room inside or

out of the HRSG, analyzers need to be as compact as possible.

Extractive-based analyzers face a number of obstacles when deployed in a GTCC plant.

The biggest challenge comes from corrosion of the probe due to the high shear forces and the fluctuating temperatures and pressures coming from the exhaust gas exiting the turbine.

Analyzers placed farther downstream will benefit from lower and less turbulent flows; however the time lag of the analyzer response may now pose a problem, especially when used for safety purposes during the turbine start-up.

## SERVOMEX ANALYZER SOLUTIONS FOR POST-COMBUSTION EMISSIONS CONTROL

### SERVOTOUGH SpectraScan 2400



Revolutionary inline real-time analysis of hydrocarbon components.

### SERVOTOUGH Laser 3 Plus Combustion



Full-featured compact TDL monitor providing fast, accurate combustion gas measurements, optimized for O<sub>2</sub>, CO and CO+CH<sub>4</sub>.

### SERVOTOUGH Laser 3 Plus Ammonia



High-accuracy TDL measurements of NH<sub>3</sub>, optimized specifically for ammonia slip DeNOx applications.

### SERVOTOUGH FluegasExact 2700



Advanced flue gas analyzer for combustion process analysis of oxygen and combustibles in challenging locations.

### SERVOPRO 4900

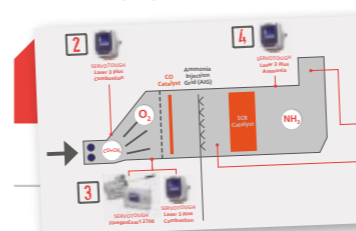


High-performance continuous emissions monitoring analyzer certified for multi-gas measurement of flue gases, pollutants and reference oxygen in regulatory environments.

### SERVOPRO NOx



Chemiluminescence Detector analyzer for key emissions applications involving ultra-low NO, NO<sub>2</sub> and NOx.

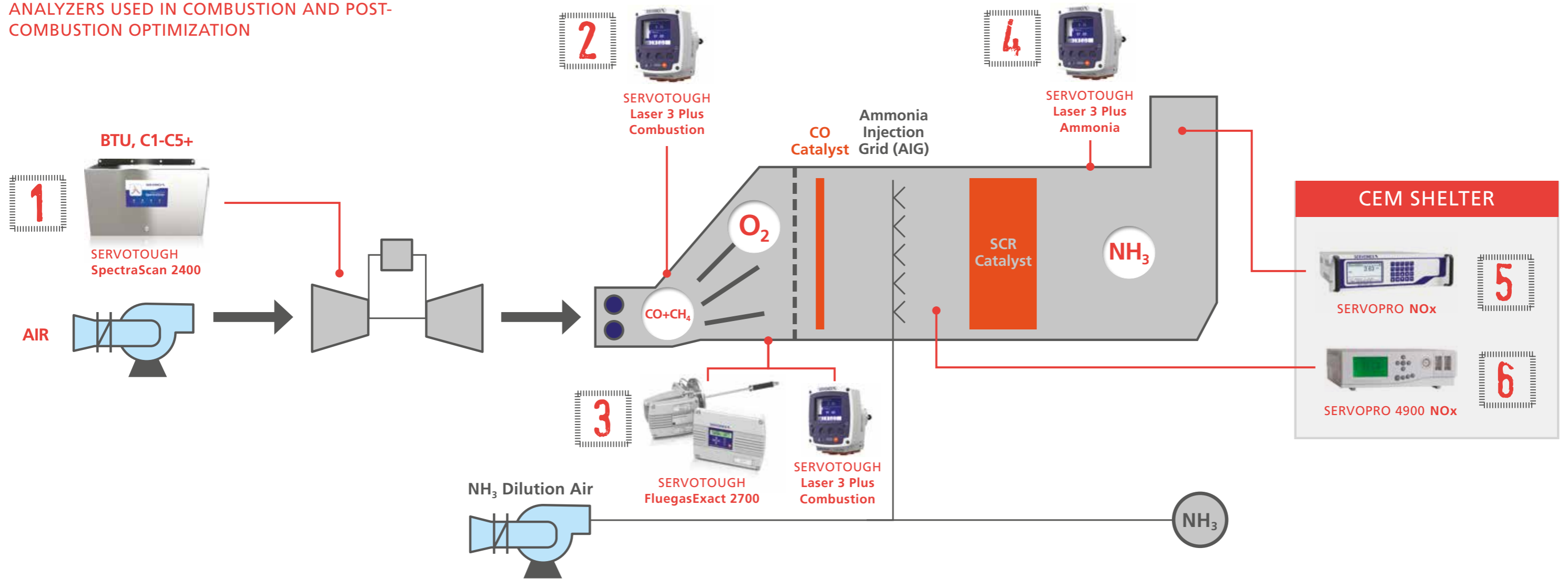


See our analyzers across the process **OVERLEAF**

# PROCESS STUDY

# THE BENEFITS OF COMBINED CYCLE POWER PLANTS

## ANALYZERS USED IN COMBUSTION AND POST-COMBUSTION OPTIMIZATION



Properties of the incoming natural gas fuel can be used to optimize the combustion process along with monitoring the fuel/air ratio, especially when using a DLN combustor. This is important with the advent of fracking, as pipeline gas quality had been very predictable, but now propane or ethane increases are unexpectedly seen.

The SERVOTOUGH SpectraScan 2400 analyzer [1] provides BTU, caloric value and Wobbe index information allowing for rapid adjustments ensuring that the turbine is not running too hot.

Extreme care is needed upon start-up of the GTCC in order to not damage the steam turbine (ST) equipment. Therefore,

the plant generally starts in a simple cycle mode using the gas turbine (GT) only until it is fully up and running. Only then will the ST be turned on, allowing the plant to now function as a GTCC plant.

The SERVOTOUGH Laser 3 Plus CO + CH<sub>4</sub> Combustion analyzer provides the CH<sub>4</sub> signal for safe operation during start-up, providing significant saving in the amount of air required to flush the HRSG. Once the turbine is operational, the CO signal is then used to monitor fuel combustion efficiency [2].

On the air inlet side, the open path Tunable Diode Laser (TDL) SERVOTOUGH Laser 3 Plus Combustion analyzer for O<sub>2</sub> or the SERVOTOUGH FluegasExact 2700

provides fast response for measuring or determining the fuel/air ratio needed in the feedback control [3]. Where the shear forces are high due to the turbine flow, the Laser 3 Plus analyzer is the best option for an accurate, long-lasting analyzer.

Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR), uses NH<sub>3</sub> and O<sub>2</sub> to reduce any NOx present in the turbine exhaust into N<sub>2</sub> and water. Most GT use SCR; however both processes rely on accurate NH<sub>3</sub> dosing levels to remove NOx and limit the amount of NH<sub>3</sub> that gets past the catalyst (called NH<sub>3</sub> slip).

Monitoring prevents downstream equipment fouling from acid formation or particulate from reactions with ammonia.

Gas Turbines with SCR for NOx control are generally permitted an NH<sub>3</sub> slip of <10ppm, with many countries requiring <5ppm and even some <2ppm. Monitoring is done using the SERVOTOUGH Laser 3 Plus Ammonia, which provides low level NH<sub>3</sub> detection with a fast response, even when high dust is present [4].

Running the GT only during the start-up process means that NOx emissions are high until the ST process begins, so any

delay reducing the GT exhaust emissions to minimum allowable limits could put the plant permit at risk.

The analyzers used must be fast and accurate throughout the GTCC plant start-up, operation and shut-down, tracking the NOx concentration spikes accurately as well as at the low permitted values of 2-3ppm for NOx in order to maintain compliance.

The SERVOPRO NOx chemiluminescent analyzer provides a rapid NOx response

with high accuracy from the lowest range of 0-3ppm (as NO) all the way up to 3000ppm (as NO) with the same analyzer [5].

The more economical SERVOPRO 4900 multi-gas NOx analyzer [6] can be used for higher levels of NO or NOx for feedforward control.

When combined with the SERVOPRO NOx, they can be used to monitor the actual NOx reduction capabilities of the SCR, to look at the destruction efficiency.

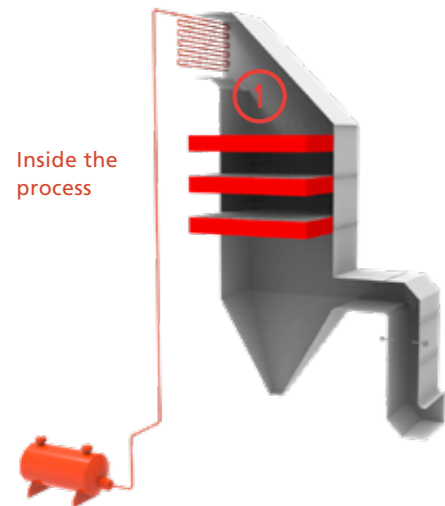
Find out more at [servomex.com](http://servomex.com) or contact your nearest business center

## ADVANTAGES OF THE Laser 3 Plus IN AMMONIA SLIP

OPTIMIZED FOR THE PRECISE, STABLE AND RELIABLE MEASUREMENT OF PPM AMMONIA, THE SERVOTOUGH Laser 3 Plus Ammonia PROVIDES THE TOTAL APPLICATION SOLUTION FOR YOUR AMMONIA SLIP DeNOx PROCESS

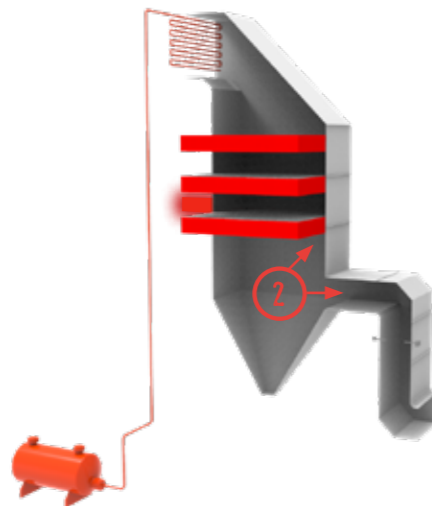


### EXCESS NOx



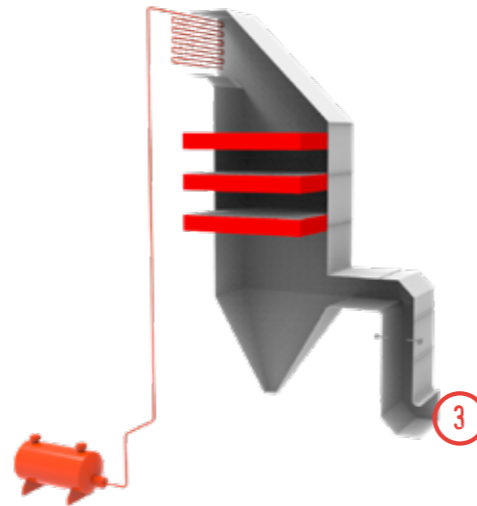
1. Combustion processes produce harmful NOx emissions, which are controlled by using ammonia to lower NOx output. If the process is overdosed with ammonia, this is called ammonia slip.

### EXCESS AMMONIA LEADING TO AMMONIUM BISULFATE BULD UP



2. Excess ammonia can contaminate the flue gas, reduce the value of the fly ash, and causes a damaging build-up of ammonium bisulfate in the catalyst.

### AMMONIA SLIP

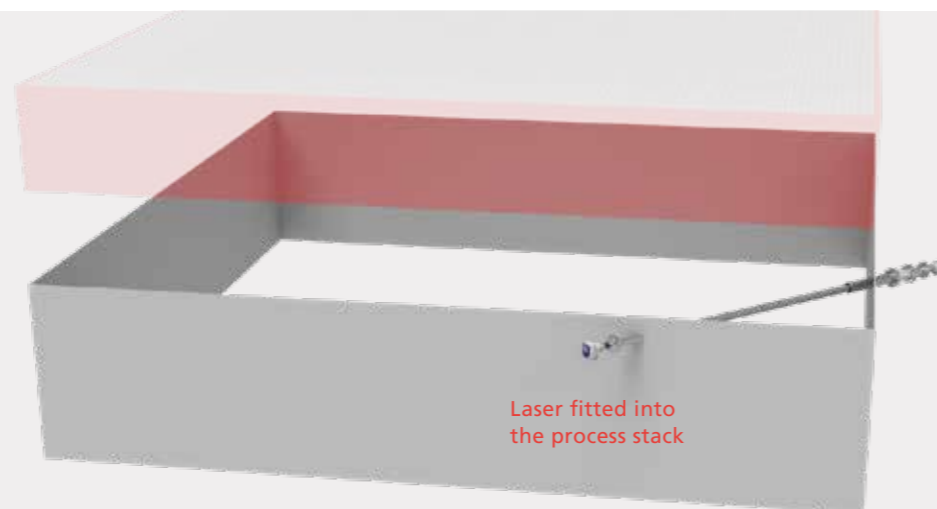


3. So, it is important to control the level of ammonia slip between 2-3ppm ammonia to ensure NOx reduction and prevent acid and particulate formation associated with excess ammonia.

### TDL ANALYZERS VS EXTRACTIVE SYSTEMS

Tunable Diode Laser (TDL) gas analyzers have taken over from extractive systems as the industry standard for ammonia slip monitoring. As there is no physical interaction with the process, TDL can offer a highly stable, fast measurement response.

Not all TDL solutions are robust or effective enough for this process, but the Laser 3 Plus Ammonia is specifically designed for the ammonia slip DeNOx process, meeting the challenges of high dust levels while providing a highly sensitive measurement.



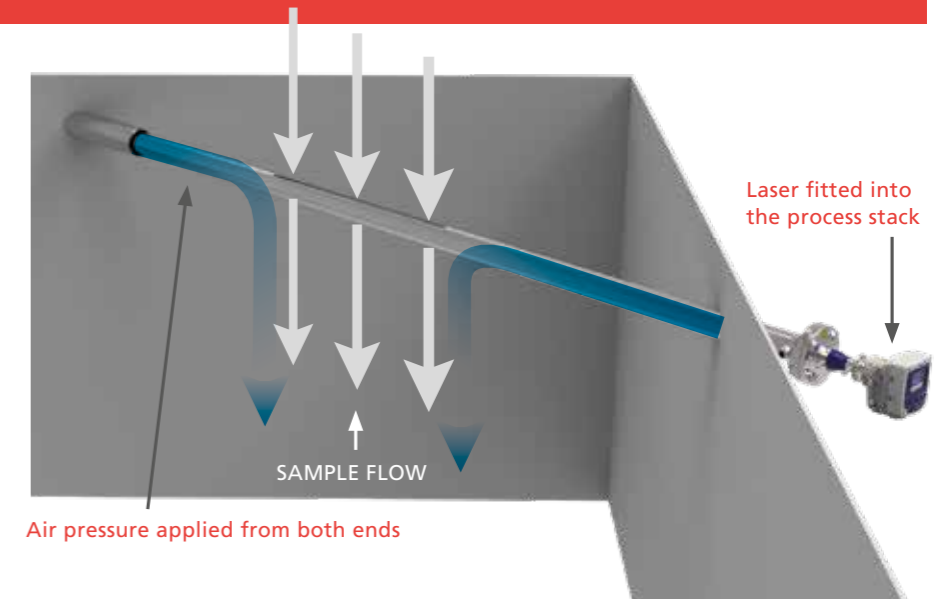
Laser fitted into the process stack

### SERVOMEX'S FIXED PIPE SOLUTION

The Laser 3 Plus is unaffected by the hot, dusty DeNOx environments, and uses a bright laser with unique optics that minimize the light loss experienced by other products.

Servomex's fixed pipe solution minimizes contact with the sample stream by deflecting dust around the laser tube and also around the beam itself. When this strong signal is processed using the Laser 3 Plus's advanced 2F waveform processing, it produces a stable, highly accurate measurement.

In addition, the Laser 3 Plus offers the longest intervals between calibrations or cleaning on the market, making it an ideal system where analyzer downtime is critical.

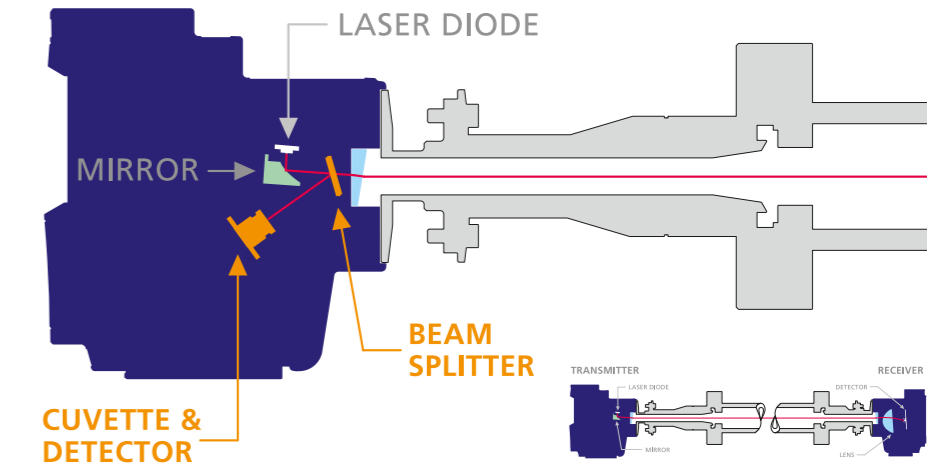


### SERVOMEX'S LINE LOCK SOLUTION

Incorrect measurements can threaten compliance with NOx emissions legislation, leading to heavy fines.

The Laser 3 Plus Ammonia provides a stable, reliable measurement, optimized for measuring 0-5ppm ammonia.

While traditional signal lock measurements use less stable water lines, the Laser 3 Plus Ammonia uses Servomex's unique 'line lock' cuvette system, which provides an absolute signal reference for ammonia. So it never loses its lock on the ammonia reading, providing an accurate measurement at all times.



*"Servomex's systems engineering capability enables us to manufacture a complete analyzer system optimized for each specific customer process. Our global service network ensures your process is protected at all times, for complete peace of mind, while training packages are also available for your in-house teams."*

Rhys Jenkins - Product Manager - Process Photometric Analyzers. Email: rjenkins@servomex.com



Control your DeNOx process today: [servomex.com/ammoniaslip-l3plus](http://servomex.com/ammoniaslip-l3plus)



# POWER PRODUCT GUIDE

Power generation is a demanding and competitive industry – producing energy for a global market is a complicated balancing act between process efficiency, emissions control, safety requirements and cost control.

Servomex offers a comprehensive gas analysis that enables the world's power producers to optimize their processes, meet legally binding emissions targets and raise profitability.

By working with industry regulators, Servomex ensures its gas analyzers meet the global compliance standards and the specific demands of power generation applications throughout the world.

Supported by a global service and support network, Servomex analyzers are used with confidence in power stations, incinerators and co-generation plants internationally.

For the full range of Servomex analyzers, visit [servomex.com/gas-analyzers](http://servomex.com/gas-analyzers)

## SERVOTOUGH Oxy 1800



### ACCURATE AND STABLE SAFE AREA O<sub>2</sub> ANALYZER

Designed to reliably measure percent O<sub>2</sub> in many safety critical industrial applications, the Oxy 1800 is a stable, accurate and highly specific O<sub>2</sub> analyzer for safe area use.

- Internal/external use (IP66/NEMA 4X rated)
- Special version for solvent bearing samples
- Range of alarm outputs aids integration with other systems

GAS	MEASURES	APPLICATION
O <sub>2</sub> OXYGEN	% PERCENT	 PROCESS CONTROL  SAFETY

SENSING TECHNOLOGY  
PARAMAGNETIC

## SERVOTOUGH Oxy 1900



### AWARD-WINNING PARAMAGNETIC DIGITAL O<sub>2</sub> ANALYZER DESIGNED FOR HAZARDOUS AREA USE

Offering an exceptional range of industry-standard options and three unique, ground-breaking functions, the Oxy 1900 O<sub>2</sub> gas analyzer sets new standards of flexibility, stability and reliability from a single, cost-effective unit.

- Can be used in Safe Area to Zone 1/Div 1 hazard rated locations
- Heated sample cell allowing simplified sample system requirements
- Unique Servomex Flowcube flow sensor technology for improved safety

GAS	MEASURES	APPLICATION
O <sub>2</sub> OXYGEN	% PERCENT	 PROCESS CONTROL  SAFETY

SENSING TECHNOLOGY  
PARAMAGNETIC

## SERVOTOUGH OxyExact 2200



### HIGH-SPEC PROCESS O<sub>2</sub> ANALYZER OFFERS SAFE OR HAZARDOUS AREA CONTROL WITH UP TO SIX TRANSMITTERS

The OxyExact 2200 high specification O<sub>2</sub> analyzer offers an unrivaled combination of precision, flexibility and performance for optimum process and safety control. The OxyExact can be configured with a safe or hazardous area control unit with up to six transmitters.

- Zone 1 certified to ATEX Cat 2, IECEx and FM/CSA Class 1 Div 1
- Three enclosure systems allow sampling of any flammable gas up to 100% O<sub>2</sub> and pressures of up to 40psi
- High temperature version eliminates the need to condense hot sample prior to analysis

GAS	MEASURES	APPLICATION
O <sub>2</sub> OXYGEN	% PERCENT	 PROCESS CONTROL  SAFETY

SENSING TECHNOLOGY  
PARAMAGNETIC

## SERVOTOUGH SpectraScan 2400



### REVOLUTIONARY INLINE REAL-TIME ANALYSIS OF HYDROCARBON COMPONENTS C1-C6

A real time optical analyzer utilizing the Precise field proven optical bench, the SpectraScan 2400 delivers a breakthrough capability in the continuous analysis of light hydrocarbons C1-C6.

- North American Cat 1, Div 2 ATEX Cat 3 IECEx Zone 2
- Tunable band-pass filter enables simultaneous scanning of selected wavelength bands for gases including methane, ethane, propane and iso-Butane
- Unique tunable filter process with IR photometer technology delivers industry-leading interference compensation

GAS	MEASURES	APPLICATION
CO CARBON MONOXIDE	% PERCENT	 PROCESS CONTROL  QUALITY
CO <sub>2</sub> CARBON DIOXIDE	CV CALORIFIC VALUE	
C1-C6		
H <sub>2</sub> S HYDROGEN SULFIDE		

SENSING TECHNOLOGY  
SPECTROSCOPIC

## SERVOTOUGH SpectraExact 2500



### RUGGED PHOTOMETRIC GAS ANALYZER FOR DEMANDING PROCESS APPLICATIONS

Servomex's iconic industry-leading photometric analyzer delivers flexible single and multi-component gas analysis capability for corrosive, toxic and flammable sample streams. The SpectraExact 2500's reliable, accurate and stable real-time online process analysis makes it ideal for a range of process, combustion and emissions gas analysis applications.

- IECEx and North American hazardous area approvals
- Easy integration with DCS – from 4-20mA to Modbus TCP
- Sample cell and electronics segregated – for easy maintenance and safe operation

GAS	MEASURES	APPLICATION
TOXIC	% PERCENT	 PROCESS CONTROL
FLAMMABLE	ppm TRACE	
CORROSIVE		

SENSING TECHNOLOGY  
GAS FILTER CORRELATION INFRARED

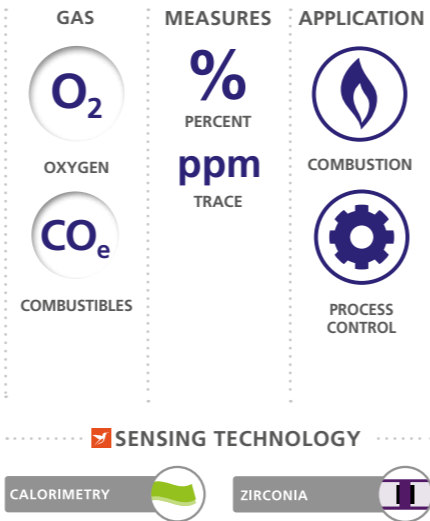
## SERVOTOUGH FluegasExact 2700



### ADVANCED FLUE GAS ANALYZER FOR HIGH-TEMPERATURE MEASUREMENT OF O<sub>2</sub> AND COMBUSTIBLES

Designed to measure O<sub>2</sub> and CO<sub>e</sub> in flue gases for improved combustion efficiency and reduced emissions, the FluegasExact 2700 gas analyzer is designed to suit the most demanding needs of combustion efficiency applications in the Power Generation and Process Industries.

- ATEX Cat. 3, IECEx Zone 2 & North America Class I, Div 2
- Unique Flowcube flow sensor technology enables positive flow conditions to be validated
- Sulfur-resistant combustibles sensor enables sensor to operate at elevated sulfur levels



## SERVOTOUGH LaserExact 2950



### EXTRACTIVE TDL TRACE MULTI-GAS ANALYZER, DESIGNED FOR MEASURING TRACE GASES OFFLINE

Specifically designed for extractive trace analysis applications, the LaserExact 2950's TDL technology offers unsurpassed low ppb detection limits for most gases, making it ideal for the measurement of trace gases offline.

- Zone 2/Div 2 hazard rated locations and use without purge
- Advanced multipass cell delivers ppb or low ppm detection limits
- Innovative PeakLock pattern recognition line tracking eliminates drift over extended operational periods



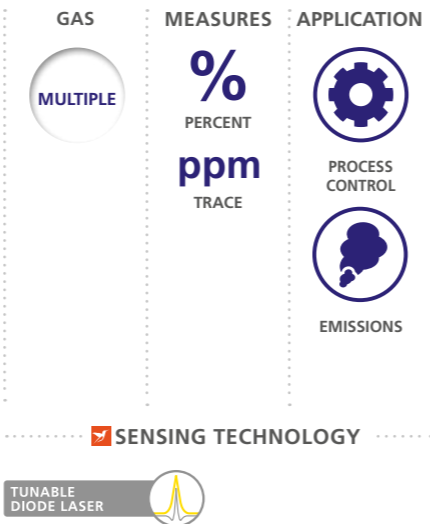
## SERVOTOUGH LaserSP 2930



### HIGH-SENSITIVITY CROSS-STACK TDL ANALYZER

A high performance gas analyzer designed for continuous in-situ monitoring, the LaserSP 2930 delivers a fast response time and highly stable performance. Suitable for measuring a range of gases including HCl, HF, H<sub>2</sub>O, H<sub>2</sub>S, HCN, and other hydrocarbons, the LaserSP is ideal for a wide range of process, combustion control and emissions applications.

- Designed for Zone 1 and Zone 2 hazard rated (gas/dust) locations
- In-situ with no sample conditioning delivers reliable operation
- Wavelength Modulated Spectroscopy provides wide dynamic range and lowest cross interference



## SERVOTOUGH DF-140E



### RELIABLE RESULTS IN A TESTING RANGE OF ENVIRONMENTS

The DF-140E allows for reliable oxygen measurement in a wide variety of environments, including outdoors and in explosive environments with a NEMA 7 remote sensor enclosure. Using the revolutionary non-depleting E-Sensor, the DF-140E delivers reliable readings without frequent recalibration and periodic sensor replacement.

- Long-term reliability and stability with minimal maintenance
- Durability – can be used in Class 1, Div 1 or 2 areas
- STAB-EL option allows for accurate measurement in the presence of acid gases



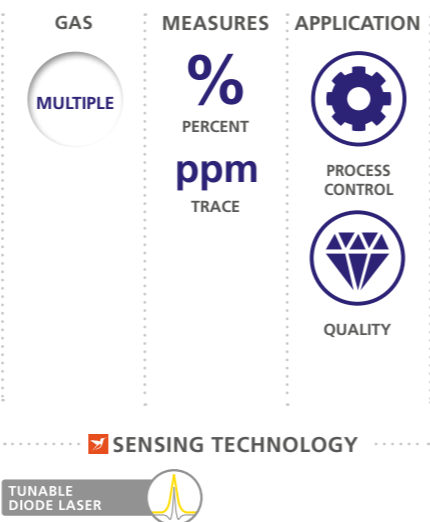
## SERVOTOUGH LaserCompact 2940



### SHORT PATH LENGTH TDL ANALYZER

Optimized for measurement across pipes and along short measurement cells and able to measure through very thin nozzles, reducing or even eliminating consumption of purge gas, the LaserCompact 2940 delivers the fast response time, highly stable performance and minimum sample conditioning advantages of TDL technology.

- ATEX, IECEx and North American hazardous area approvals. ATEX Cat 3 (Gases) and Cat 2 (Dusts) IECEx Zone 2 and Zone 21. CSA Divisions and Zones (Gas and Dust)
- Line width correction delivers accurate measurement with variations in matrix
- In-situ with low purge gas consumption



## SERVOTOUGH DF-320E



### HIGH RELIABILITY TRACE AND PERCENT O<sub>2</sub> MEASUREMENTS IN HAZARDOUS AREA LOCATIONS

Designed for use in harsh and hazardous areas, the DF-320E uses Servomex's unique, non-depleting Coulometric sensor technology to give highly stable O<sub>2</sub> measurements, making it ideal for applications including hydrogen, propene and polyethylene production, oil refining and petrochemical process monitoring.

- Ideal analytical solution for applications including H<sub>2</sub>, C<sub>3</sub>H<sub>6</sub> and PE production, oil refining, and petrochemical process monitoring
- Microprocessor-driven for easy configuration and maintenance
- Coulometric sensor delivers accurate results with no sensor drifting, false low readings, or frequent calibration requirements



## SERVOTOUGH DF-340E



### HIGH SENSITIVITY TRACE/ PERCENT COULOMETRIC OXYGEN ANALYZER CERTIFIED FOR HAZARDOUS AREA USE

Designed for heated or external locations, the DF-340E remains stable in changing sample and flow rate conditions, and is designed to provide measurements of trace or percent level oxygen in pure gas streams and multi-gas backgrounds. It is ideal for upset prone conditions.

- Coulometric sensing ideal for upset prone applications and compensates for sample and flow rate fluctuations
- Suitable for outdoor installation, with NEMA 4-rated sensor enclosure options
- Multiple background gas stream monitoring, with simplified ongoing maintenance requirements

GAS	MEASURES	APPLICATION
<chem>O2</chem> OXYGEN	ppb ULTRA TRACE ppm TRACE	PROCESS CONTROL QUALITY

#### SENSING TECHNOLOGY

COULOMETRIC

## SERVOTOUGH Laser 3 Plus Ammonia



### WORLD-LEADING NH<sub>3</sub> MEASUREMENT, OPTIMIZED FOR AMMONIA SLIP DeNOx APPLICATIONS

This TDL analyzer specifically optimized for ammonia slip measurement provides all the benefits of Servomex's TDL technology in a compact, light unit, offering unparalleled installation flexibility plus cost and performance benefits.

- High measurement reliability utilizing Servomex's own line lock cuvette technology
- ATEX, IECEx and North American hazardous area approvals
- A compact analyzer specifically optimized for the fast, accurate and responsive measurement of NH<sub>3</sub>
- Ideal for slip ammonia application on power plants and fired heaters

GAS	MEASURES	APPLICATION
<chem>NH3</chem> AMMONIA DeNOx	ppm TRACE	PROCESS CONTROL EMISSIONS

#### SENSING TECHNOLOGY

TUNABLE DIODE LASER

## SERVOTOUGH Laser 3 Plus Process



### THE WORLD'S SMALLEST TDL GAS ANALYZER, OPTIMIZED FOR PROCESS O<sub>2</sub> AND CO MEASUREMENTS

All the benefits of Servomex's TDL technology in a small, light unit offering unparalleled installation flexibility plus cost and performance benefits. Optimized for the fast, accurate and responsive measurement of process oxygen in hot or hazardous conditions.

- High safety integrity utilizing Servomex's own line lock cuvette technology
- ATEX, IECEx and North American hazardous area approvals. Approved for process Zone 2. SIL 2 assessed and CE marked
- Quick and easy installation by one person with on-board display negating the need for laptop configuration
- Suitable for a range of combustion and process control applications

GAS	MEASURES	APPLICATION
<chem>O2</chem> OXYGEN	% PERCENT	PROCESS CONTROL
<chem>CO</chem> CARBON MONOXIDE	TRACE	COMBUSTION

#### SENSING TECHNOLOGY

TUNABLE DIODE LASER

## SERVOTOUGH Laser 3 Plus Combustion



### THE REVOLUTIONARY COMPACT COMBUSTION ANALYZER OPTIMIZED FOR CO, O<sub>2</sub>, OR CO + CH<sub>4</sub> MEASUREMENTS

Containing all the benefits of Servomex's TDL technology in a light, compact unit, with unmatched installation flexibility plus cost and performance benefits, this analyzer is optimized for fast, accurate and responsive measurements in combustion and process control, making it a must for safety applications.

- High safety integrity utilizing Servomex's own line lock cuvette technology
- Compact size means quick and easy installation by one person with on-board display negating the need for laptop configuration
- ATEX, IECEx and North American hazardous area approvals. Approved for process Zone 2. SIL 2 assessed and CE marked
- Optimized for combustion processes

GAS	MEASURES	APPLICATION
<chem>O2</chem> OXYGEN	% PERCENT	PROCESS CONTROL
<chem>CO</chem> CARBON MONOXIDE	ppm TRACE	COMBUSTION
<chem>CO+CH4</chem> CARBON MONOXIDE + METHANE		

#### SENSING TECHNOLOGY

TUNABLE DIODE LASER

## SERVOPRO 4900



### CONTINUOUS EMISSIONS MONITORING (CEMS) ANALYSIS OF MULTIPLE FLUE GAS COMPONENTS

The 4900 is specifically designed for Continuous Emissions Monitoring, where legislation requires the measurement of several gas components in flue gas. The 4900 offers multi-gas capability for pollutants, greenhouse gases and reference O<sub>2</sub>, including CO, CO<sub>2</sub>, NO, SO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O.

- MCERTS/TÜV approved measurements
- Low maintenance and cost of ownership
- Easy integration with other systems

GAS	MEASURES	APPLICATION
MULTIPLE	% PERCENT ppm TRACE	EMISSIONS

#### SENSING TECHNOLOGY

GAS FILTER CORRELATION INFRARED  
PARAMAGNETIC

## SERVOPRO NOx



### CHEMILUMINESCENCE DETECTOR (CLD) ANALYZER FOR KEY EMISSIONS APPLICATIONS INVOLVING ULTRA-LOW NO, NO<sub>2</sub> AND NOx

Utilizing Chemiluminescence detection technology to measure NO or NO/NO<sub>2</sub>/NOx concentrations in industrial gas and vehicle emission applications, the versatile SERVOPRO NOx can be calibrated for four measurement ranges starting from ultra-low to high ppm and is easy to install and operate.

- Multiple range NOx emissions monitoring solution with a fast response
- Non-depleting light-based measurement and electronic flow control keeps costs low
- Heated version available for wet to dry conversion option

GAS	MEASURES	APPLICATION
<b>NO</b> NITRIC OXIDE	<b>ppm</b> TRACE	PROCESS CONTROL
<b>NO<sub>2</sub></b> NITROGEN DIOXIDE		EMISSIONS
<b>NOx</b> NITROGEN OXIDES		QUALITY

**SENSING TECHNOLOGY**  
CHEMILUMINESCENCE

## SERVOFLEX Micro i.s. 5100



### INTRINSICALLY SAFE ANALYZER MEASURES OXYGEN, CARBON MONOXIDE OR CARBON DIOXIDE

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 O<sub>2</sub>, CO and CO<sub>2</sub>.

- 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

GAS	MEASURES	APPLICATION
<b>O<sub>2</sub></b> OXYGEN	<b>%</b> PERCENT	COMBUSTION
<b>CO</b> CARBON MONOXIDE		PROCESS CONTROL
<b>CO<sub>2</sub></b> CARBON DIOXIDE		SAFETY

**SENSING TECHNOLOGY**  
PARAMAGNETIC    INFRARED

## SERVOPRO SO<sub>2</sub>



### USES PROVEN PULSED UV FLUORESCENCE TECHNOLOGY TO DELIVER A PRECISE AND RELIABLE MEASUREMENT OF ULTRA-LOW SULFUR DIOXIDE IN EMISSIONS AND AMBIENT AIR

For industrial applications that require ultra-low emissions monitoring of sulfur dioxide, this robust analyzer is designed to slot seamlessly into rack systems, making it easy to integrate with existing emissions monitoring systems to provide unrivaled performance.

- Ultra-long-lasting UV light source
- Removable flash memory stores up to 10 years of data
- Operation over wide temperature range reduces cost of ownership

GAS	MEASURES	APPLICATION
<b>SO<sub>2</sub></b> SULFUR DIOXIDE	<b>ppm</b> TRACE <b>ppb</b> ULTRA TRACE	PROCESS CONTROL
		EMISSIONS
		QUALITY

**SENSING TECHNOLOGY**  
UV FLUORESCENCE

## SERVOFLEX MiniMP 5200



### BENCHTOP ANALYZER OFFERING SINGLE OR DUAL MEASUREMENTS OF OXYGEN AND CARBON DIOXIDE

The only truly portable battery powered gas analyzer with MCERTS certification, the MiniMP is designed to offer single or dual measurement of O<sub>2</sub> and CO<sub>2</sub> by utilizing Servomex's advanced Paramagnetic and Infrared sensing technologies.

- EN15267-3 (MCERTS V3.3, Annex F) makes the MiniMP ideal for source testers that require reference O<sub>2</sub> analysis for CEMS verification
- Li-ion battery system offers unique true portability
- Non-depleting sensor design ensures long service with minimal calibration

GAS	MEASURES	APPLICATION
<b>O<sub>2</sub></b> OXYGEN	<b>%</b> PERCENT	EMISSIONS
<b>CO<sub>2</sub></b> CARBON DIOXIDE		PROCESS CONTROL
		QUALITY

**SENSING TECHNOLOGY**  
PARAMAGNETIC    INFRARED

## SERVOPRO HFID



### HIGH-PERFORMANCE FAST ANALYSIS OF TOTAL HYDROCARBONS, METHANE AND NON-METHANE HYDROCARBONS

Using a highly sensitive Flame Ionization Detector (FID) for measuring volatile hydrocarbon concentrations in industrial or vehicle emission applications, the HFID utilizes an internally heated oven set to 190°C to maintain the sample gas above its dew point, for optimum performance in total hydrocarbon analysis (THC).

- Four user-definable measurement ranges, reconfigurable in the field
- High-accuracy, gas-selective FID technology for maximized uptime
- Heated oven for maximum stability and "hot/wet" sampling

GAS	MEASURES	APPLICATION
<b>THC</b> TOTAL HYDROCARBONS	<b>ppm</b> TRACE	PROCESS CONTROL
<b>CH<sub>4</sub></b> METHANE		EMISSIONS
<b>NMHC</b> NON-METHANE HYDROCARBONS		QUALITY

**SENSING TECHNOLOGY**  
FLAME IONIZATION DETECTOR

## SERVOFLEX MiniHD 5200



### 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 O<sub>2</sub>, CO and CO<sub>2</sub> within common gas mixtures. The MiniHD 5200 utilizes Servomex's non-depleting Paramagnetic and Infrared sensors to give dependable and accurate results.

- 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 O<sub>2</sub>, CO and CO<sub>2</sub> levels with no background interference

GAS	MEASURES	APPLICATION
<b>O<sub>2</sub></b> OXYGEN	<b>%</b> PERCENT	COMBUSTION
<b>CO</b> CARBON MONOXIDE		PROCESS CONTROL
<b>CO<sub>2</sub></b> CARBON DIOXIDE		SAFETY

**SENSING TECHNOLOGY**  
PARAMAGNETIC    INFRARED

# POWER GENERATION

## WE'RE READY TO HELP

WHATEVER YOUR POWER REQUIREMENTS, WHEREVER YOU ARE



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A MEASURABLE ADVANTAGE

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