IPI InProcess Instruments

Analytical Solutions. Tailor-made.

EDA 407

Quality Control of Electronic and Optoelectronic Devices

- Accurate gas analysis from sealed packages
- In situ optimization of gas compositions
- Intuitive software suite
- Fully computer-controlled gas inlet system

More Information

IPI InProcess Instruments

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Who we are

We are a team formed by the passion for technology and process analytics with a strong background in chemistry, physics, software engineering and system design.

With our knowledge and our unsurpassed commitment to understand you and your requirements, we design, manufacture and deliver high performance instruments to help you analyze, optimize and control your process.

Our process mass spectrometers are the perfect sensors for demanding quality control and online monitoring applications.

With the wide range of customization options of our systems, we can deliver solutions for even the toughest measurement tasks in the most diverse environments.

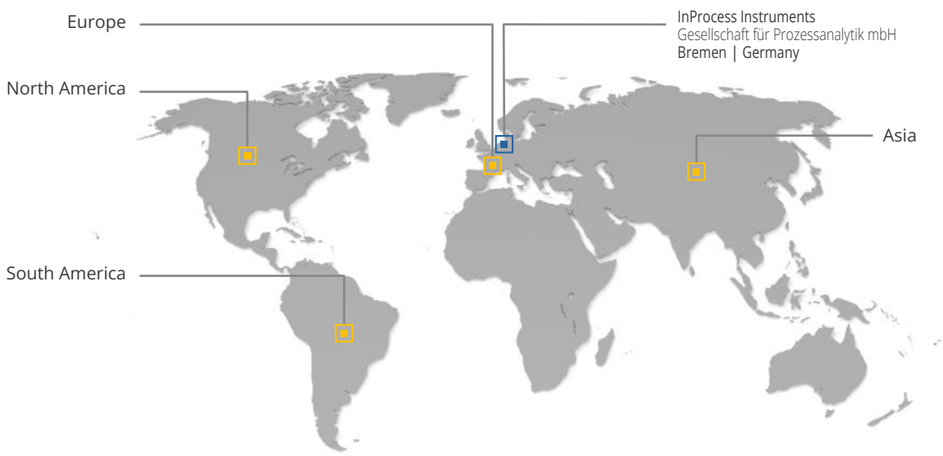
Independent of whether you are running your processes or research experiments in the cleanliness of a pharmaceutical laboratory, in the heat and dust of a steel mill, close to the exhaust plume of a rocket engine or on pitching and rolling ferries on the Baltic Sea, we are able to supply you with a tailored system solution that perfectly fits your requirements.

Over the last 25 years we have built more than 1.000 systems which are currently being used for process analytics at over 300 sites in more than 30 countries.

In close cooperation with our worldwide network of sales representatives and service partners, we ensure that you have access to competent experts in your area whenever needed.

Our focus on customer care and field service puts you and your investment in the center of our activities to guarantee accurate measurements and highest system performance for decades.

We are InProcess Instruments.



> 1.000 Installations

> 300 Customers

> 30 Countries

Areas of Application

Optoelectronics

IPI's EDA 407 Electronic Device Analyzer is able to analyze the gases in hermetically sealed optoelectronic packages by piercing the package in controlled environment or under vacuum conditions.
The high force of the EDA 407 piercing system allows to puncture even devices enclosed in full metal packages. IPI's high performance quadrupole mass analyzer identifies the concentrations of the contained gases and helps you to optimize your production processes.

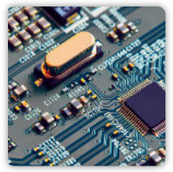
Research and Development

Equipped with an *in situ* chamber the EDA 407 is the perfect tool for the development of optimized gas fillings for any packaged device. Tune the performance of your optoelectronic setups or find out how their performance changes under controlled and variable conditions.

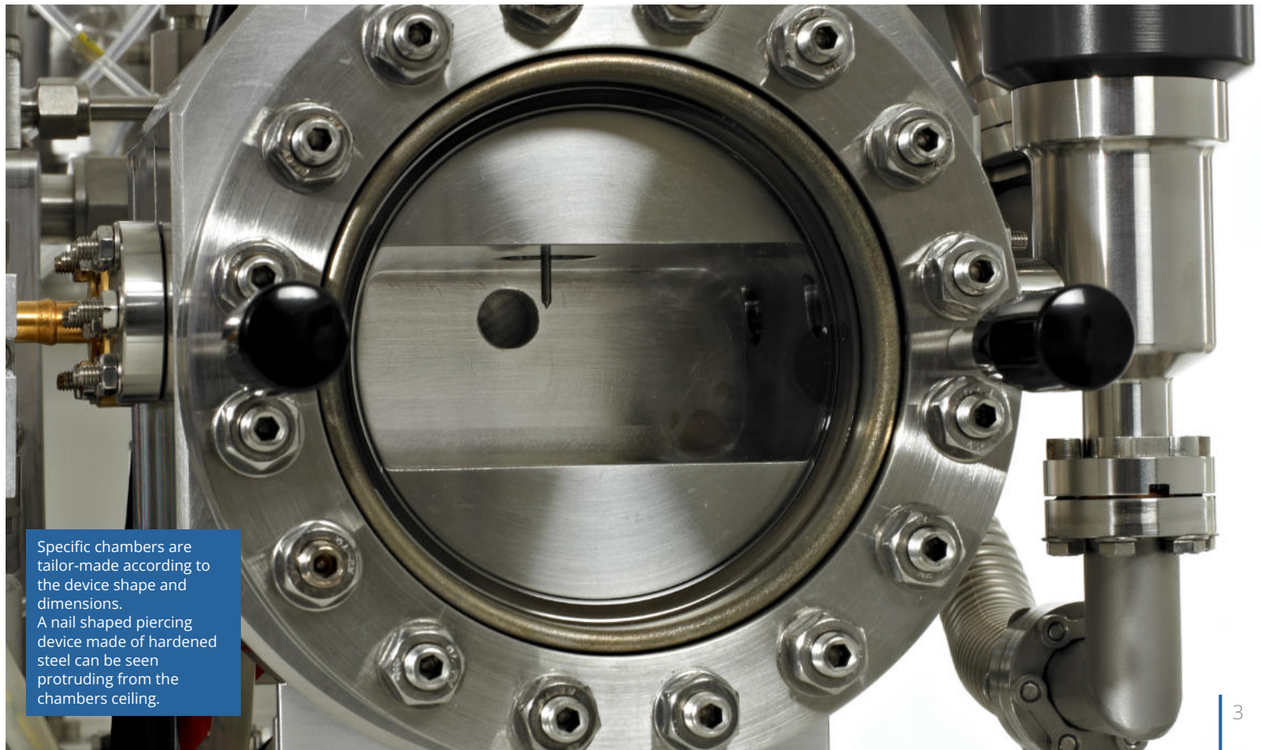
Gas Inclusion Analysis

For all tasks where gases need to be analyzed that exist inside of sealed cavities EDA 407 is the perfect tool. Whether the cavity is enclosed in glass, or the gases are fillings of hermetically sealed containers, the EDA 407 can pierce the cavities, release the gas and determine the concentration of the gas components.

Electronic Components



The Electronic Device Analyzer EDA 407 is also capable of piercing electronic component packages and analyzing the gases trapped inside of these components as part of general quality control processes.



Specific chambers are tailor-made according to the device shape and dimensions.
A nail shaped piercing device made of hardened steel can be seen protruding from the chambers ceiling.

EDA 407

The Standard in Filling Gas Analysis

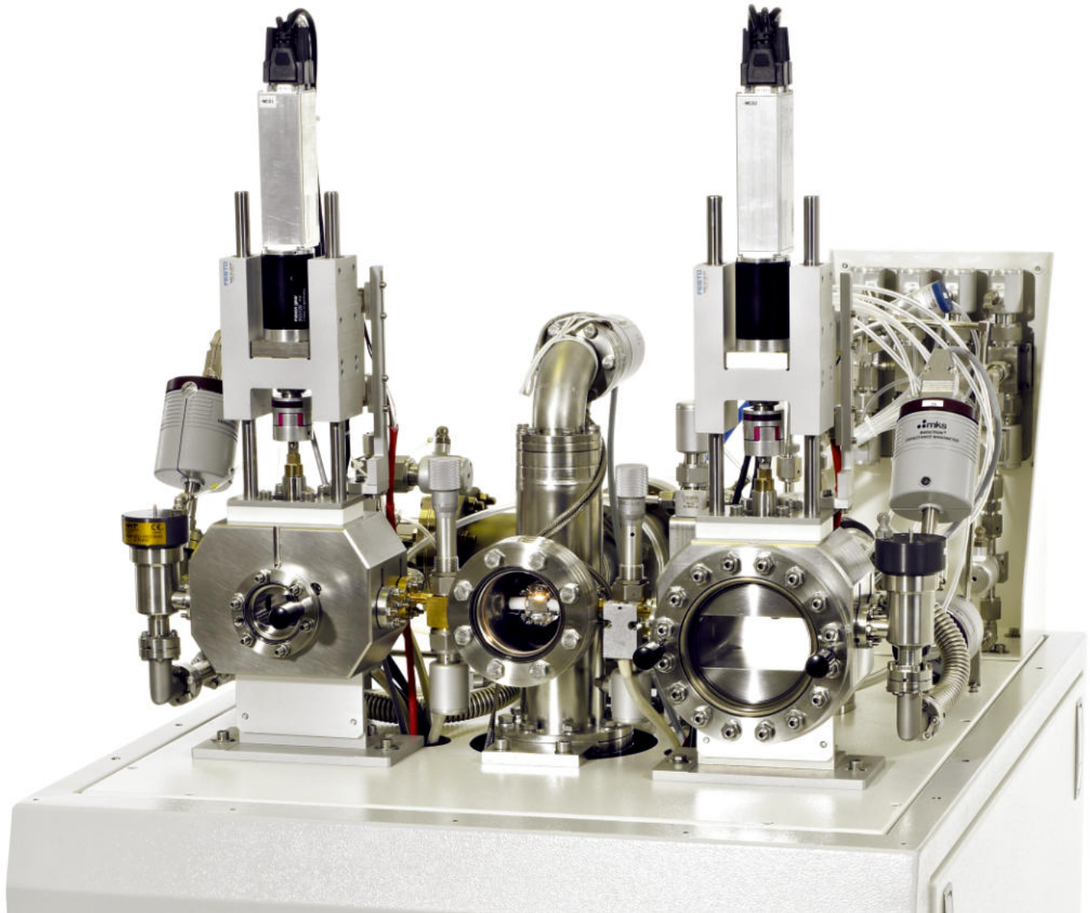
Mass Spectrometry is a well-established and respected analytical technique in all fields of quality control, research and development and industrial process monitoring. It is used throughout the chemical, pharmaceutical, biotechnological and steel industry and many more.

To optimize production processes or tune and stabilize product quality, analytical results must be accurate and reliable. The mass spectrometer is the central component in each of our gas analysis system. IPI's high performance quadrupole mass spectrometers are state-of-the-art analytical components that you can rely on.

Combining first class analytical data acquisition hardware and a sophisticated software suite allows to extract crucial data from production processes and to control them to reach the best solution, product and experimental result.

The outstanding feature of the EDA 407 is the possibility to mount specialized chambers to simulate different environmental conditions and gaseous atmospheres with tunable concentration and humidity that can be monitored *in situ* with the system's mass spectrometer.

Custom-built piercing chambers allow to analyze gas trapped in hermetically sealed packages, containers or cavities with ease.



Software

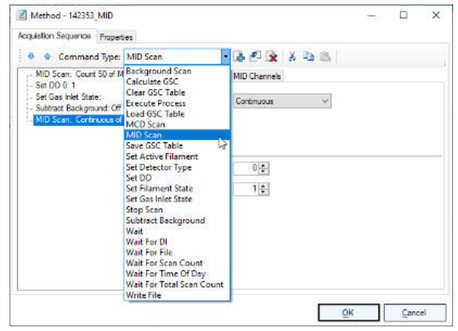
IPI ProxiMass, our user-friendly system control and automation software, allows full software control of the data acquisition and gas handling systems via user definable methods and sequences.

Methods can be defined in an easy-to-understand user interface which allows the creation of complex sequences that enable the interaction with third-party devices. The methods can also be used to automatically switch between gas streams, purge the gas inlet or perform a calibration.

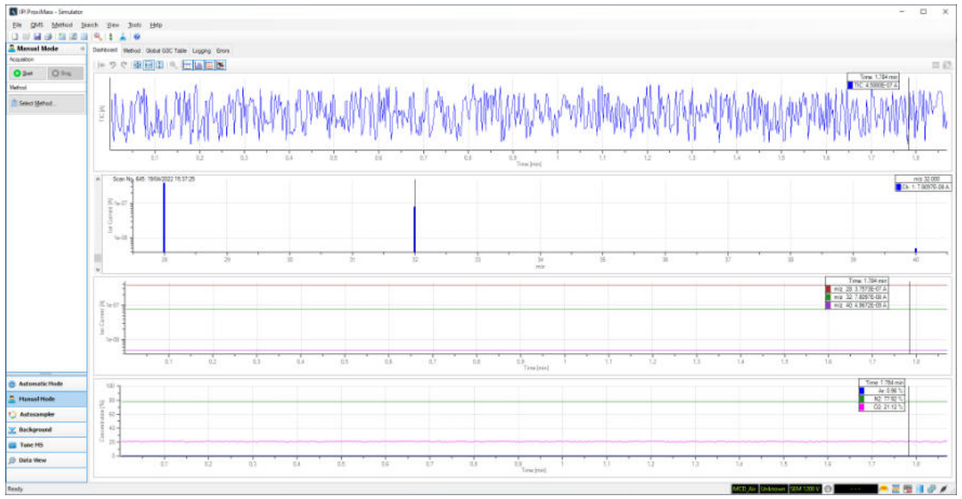
Measurement data are stored with system parameters to a database but may also be saved to CSV files.

IPI ProxiMass offers several software interfaces to connect to third-party software systems or to be integrated into existing control environments.

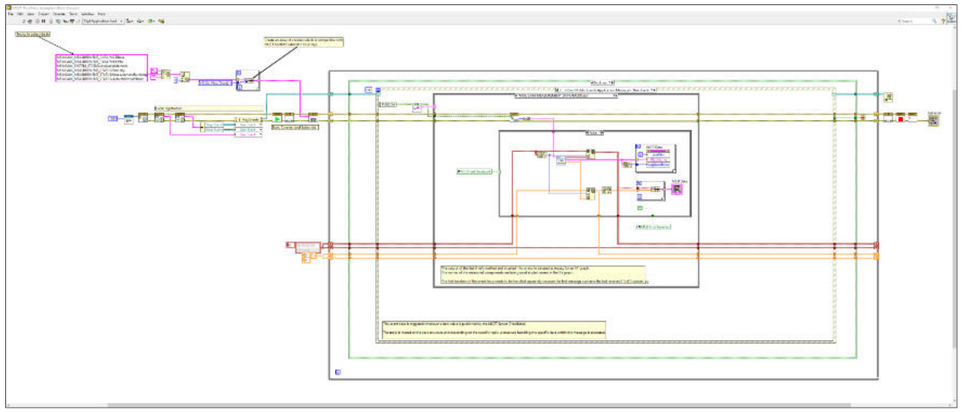
It can act as a Modbus Server or Client, can be integrated with OPC UA over PROFIBUS or PROFINET communication protocol networks or act as an MQTT client, which can be easily addressed and queried for example via python™ or LabVIEW™.



IPI ProxiMass System Control and Automation Software allows the definition of complex methods to automate experimental procedures.



IPI ProxiMass System Control and Automation Software (customizable *Dashboard*).



The MQTT interface is an easy way to control ProxiMass by third-party applications written in python™ or LabVIEW™. (Screenshot of an example VI).

LabVIEW™ is a registered Trademark of National Instruments Corp.

System

Bench Setups

The system design of the EDA 407 is focused on versatility. This unrivaled customizability allows to adapt and tailor nearly every aspect of the device configuration whether the type of mechanical components need to be optimized for special samples in size and volume, or the number of chambers on the bench needs to be increased for high throughput quality control applications.

The EDA 407 is a highly customizable solution for all tasks in quality control of device packaging or research and development, when it comes to tune the filling gas of hermetically sealed devices to extend lifetime or increase overall performance.

EDA systems are designed together with the customer which allows us to build a one-of-a-kind customized system well prepared for decades of operation.

The adaptable platform that can be customized to the specific requirements of the samples to be analyzed or the environments to be optimized. In conjunction with its customized gas inlet system it can be tailored to a wide variety of process gases, pressures and gas flows.

The *in situ* chambers adopted for the customer can be used to analyze the performance of the sample device in different gaseous environments.

The piercing chambers and the piercing devices are extremely robust and can easily withstand the high forces required to pierce even devices with thick metal wall enclosures.

Piercing Chambers

When configuring an EDA system for quality control tasks in device packaging applications, piercing chambers will be designed according to sample geometries and packaging parameters. This allows to optimize the mechanical piercing system in force and travel to gain access to the gas fillings of even thick-walled device packages.

The piercing systems utilize high performance stepper motors to control the positions of the piercing devices and to guarantee reproducible results in quality control applications.

In Situ Chambers

The gas filling of a device package can alter the lifetime or degrade the performance of the sample device in specific environmental conditions. Therefore, before selecting the right composition of these gas filings it is crucial to understand how changes in the gas composition, quality or humidity can alter the performance of the device inside the enclosure.

EDA 407 *in situ* chambers allow the device under investigation to be operated in controlled environments with an open enclosure.

The chambers can be equipped with a variety of electrical and optical vacuum feedthroughs to operate the device under investigation in different gas atmospheres while monitoring its performance.

Customizable gas inlet and mixing systems allow the user to change gas compositions including the percentage of humidity of the ambient atmosphere.

InProcess Instruments has a strong background in designing and building of automated and remotely controllable gas delivery systems.

This knowledge combined with the analytical capabilities of the EDA 407 mass spectrometer system allows to optimize and customize the EDA with your special sample and application needs in mind.

Two mounting positions for *in situ* and piercing chambers are foreseen in the standard setup. The artist rendering shows the EDA 407 equipped with two different piercing chambers optimized for two different sample types.

Two examples for different piercing devices used quality control of electronic device packaging applications.

The piercing devices can easily puncture electronic device packages to release the filling gas.

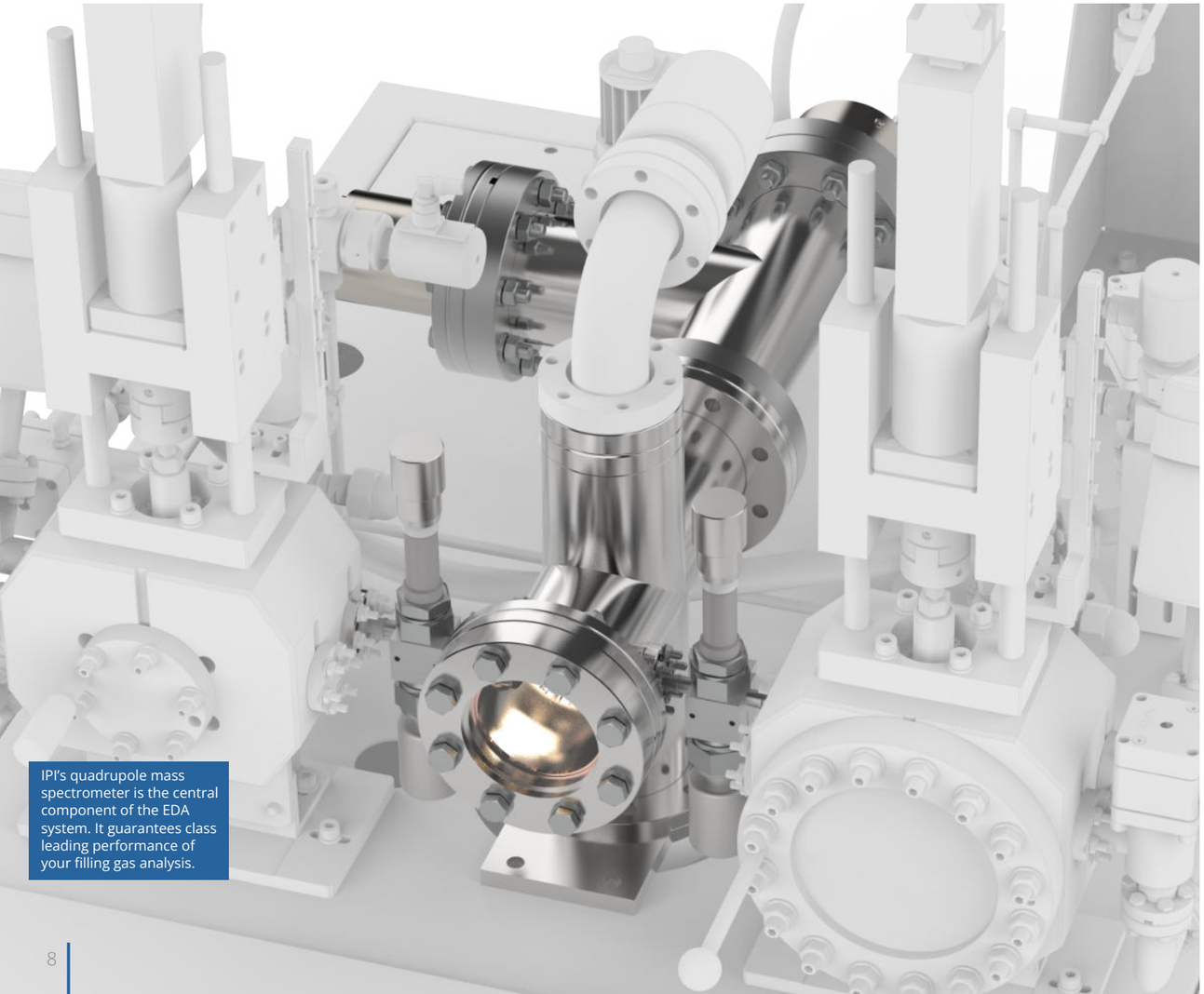
The Quadrupole Mass Spectrometer

The quadrupole mass spectrometer (QMS) is the central part of the EDA 407 analytical system. It is mounted in between the two piercing or *in situ* chambers. Two special fine dosing valves with shut-off functionality are used to transfer the gases released from the samples in the two chambers to the ion source of the mass spectrometer.

In the ion source, electrons emitted from one of the two filaments will ionize the gas atoms and molecules. These ions are then accelerated towards the quadrupole mass filter which uses alternating fields of high voltages to filter the ion beam according to the mass (*m*) to charge (*z*) ratio of the ions. This results in only ions with a specific *m/z* ratio reaching the detector system.

IPI quadrupole mass spectrometers are equipped with two different detector types. A Faraday detector for high intensities resulting from high gas loads and a secondary electron multiplier (SEM) for low gas loads. The combination of both detectors makes the QMS of the EDA one of the most versatile mass spectrometer solutions available.

The overall system design with easy access to all serviceable parts is one of the main advantages of IPI products because it guarantees an up-time focused maintenance and service schedule. This allows you to concentrate on your projects or quality control tasks.



IPI's quadrupole mass spectrometer is the central component of the EDA system. It guarantees class leading performance of your filling gas analysis.

Sensitivity

The sensitivity of any mass spectrometer strongly depends on the configuration of its ion source. When comparing sensitivity values of different mass spectrometers in data sheets, it is therefore crucial to check how the ion source configurations of the instruments differ. For example, an open or gas-tight ion source configuration yields different sensitivity values.

The EDA 407 is equipped with a gas-tight ion source connected to the two inlet valves which transfer the gas from the *in situ* or piercing chambers to the ion source of the mass spectrometer.

An additional option for the ion source are beam guiding magnets which focus the emitted electrons from the filaments into the formation volume to significantly increase the electron density and therefore the sensitivity of the ion source. You select all options in the initial project phase when you define the customized analytical configuration with our application experts.

Figures 1 and 2 show examples of mass spectra of ambient air which demonstrate the sensitivity of the mass spectrometer with Faraday and SEM detector.

A sensitivity value of 1.0E-4 A/mbar was derived from the intensities of both nitrogen peaks in the Faraday spectrum and the pressure measured in the analysis chamber. With non-standard ion source configurations, the sensitivity can easily be increased up to 9.0E-4 A/mbar.

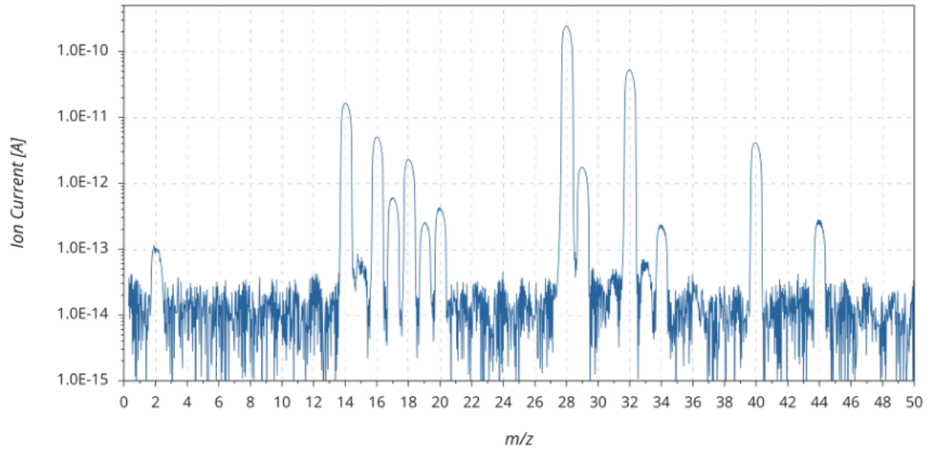


Fig 1: Mass spectrum of ambient air recorded with the system's Faraday detector.

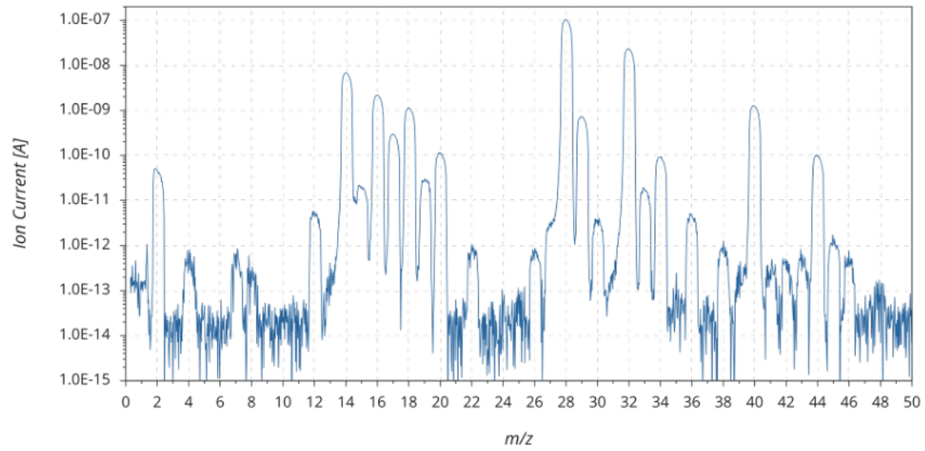


Fig 2: Mass spectrum of ambient air recorded with the system's secondary electron multiplier (SEM).

Resolution

The fully digital electronics of the EDA 407 analyzer – unique on the market – perfectly reduce the well-known zero blast effect and ensure a clear distinction of the hydrogen peak from the background.

(Left) IPI's fully digital electronics allow for automated tuning procedures an unattended system control.

The resolution value of a quadrupole mass spectrometer is one of the most important performance indicators.
The resolution defines the capability of a spectrometer for a specific application or to perform a specific measurement task.
The EDA 407 offers class leading analytical performance also in this respect with a resolution of 280 at *m/z* 28.

Figure 3 displays how the intensities of nitrogen depend on the peak full width at half maximum (FWHM).

It is clearly visible that the spectrometer is fully usable also with parameter settings yielding peak widths way below the unit resolution of 0.7 u.

The zero-blast effect normally leads to a high signal at the very beginning of the spectrum with tailing up to m/z 4 which normally makes it very difficult to resolve peaks of H_2 and He.

The results in figure 4 impressively show the capabilities of the EDA 407 analyzer even for hydrogen containing applications because of its unmatched fully digital electronics.

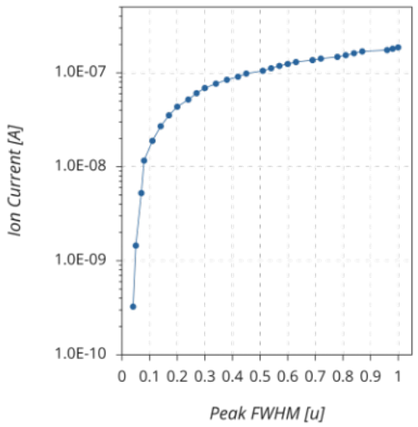


Fig. 3 (right): Dependence of the peak intensities (*m/z* 28, $^{14}N_2^+$) from the selected system resolution.

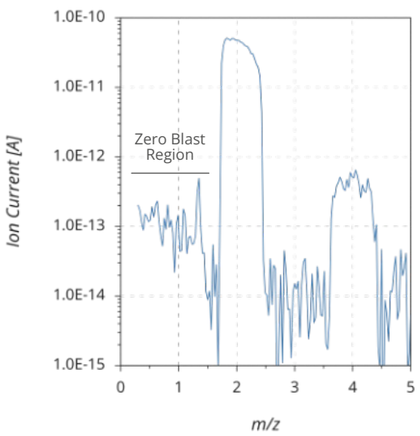


Fig. 4 (left): Strongly reduced Zero Blast below *m/z* 1.5 suitable for applications in hydrogen related research.

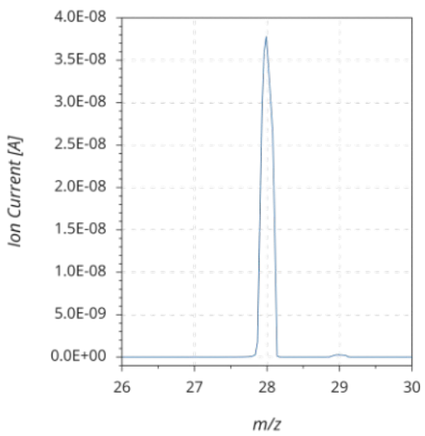


Fig. 5 (right): Example spectrum of nitrogen (*m/z* 28, $^{14}N_2^+$) with a FWHM of 0.2 u taken from the dataset of Fig. 4.

Analytical Specifications

Detection Limits	SEM: < 10 ppb (without peak interference)
Reproducibility	Main components (> 1000 ppm) < 0.5 % Side components (> 100 ppm) < 1.0 %
Mass Range	1 – 300 u, 1 – 512 u
Mass Resolution	Unit resolution

Technical Specifications

Number of Channels		Up to 1024 channels per run
Gas Connections	Calibration Gas	Individually customized for the specific application.
Device Chamber	Piercing Chamber In Situ Chamber	Vacuum chamber size and volume according to sample requirements Project specific design
Communication Interfaces		Ethernet to PC, IoT-enabled OPC UA, PROFIBUS, PROFINET, MQTT, others on request
Dimensions	System Electronics Rack	700 x 1270 x 920 mm (w x h x d), 28 x 50 x 36 in. (w x h x d) 600 x 1700 x 810 mm (w x h x d), 27 x 67 x 32 in. (w x h x d)

System Requirements

Gas Quality (Calibration Gas)	Temperature Humidity Particles	> Dew point Not condensing < 4 µm particle size
Environmental Conditions (During Operation)	Temperature Humidity	+15 to +35 °C (59 to 95 °F) < 75 %, not condensing
Power		230 VAC, 50 Hz, 1.2 kVA (115 VAC, 50/60 Hz on request)
Cooling		Closed cycle water cooling with external chiller Optional: forced air cooling
Exhaust		KF16 high vacuum flange for connection to customers exhaust system
Compressed Air		Min. 6 bar, filtered and oil-free