

Product Backgrounder

Sionex Corporation makes sensor hardware and software products that it sells to original equipment manufacturers (OEMs) building systems for threat detection (the military and homeland security), medical diagnostics, process control and monitoring markets. The products are based on Sionex's patented microDMx™ technology, which offers rapid identification of chemicals at minute (parts per trillion) levels in a very small, highly portable form factor. Sionex products are designed to be quickly and easily integrated by OEMs into end-user systems.

Sionex offers three types of products:

- Sensor products in which microDMx technology is used to detect target compounds.
- Products that use microDMx technology as a pre-filter to a discrete detection technology such as mass spectrometry and ion mobility spectroscopy, increasing the sensitivity and accuracy of the paired technology.
- Software-only products that support the microDMx technology sensor and pre-filter platforms.

The company's microDMx™ technology is based on differential mobility spectroscopy, which identifies and detects chemicals based upon a specific chemical's ion mobility in a low and high electric field. microDMx technology has been proven in the marketplace by the launch of products by major corporations incorporating Sionex products. Among these are:

- ThermoFisher, which has incorporated a Sionex product at the core of its next-generation explosive detector, the EGIS Defender™, for airport security.
- Varian Instruments Inc., which sells a detector based on a Sionex product, the microDMD™, for its Gas Chromatographic instrument, the CP4900. The CP4900 detects trace levels of sulfur for quality-control in natural gas for pipeline companies.
- General Dynamics, which is using Sionex's sensor and board kit product, *for its* JUNO™, a portable chemical warfare agent detector for use in the battlefield to protect troops in combat.

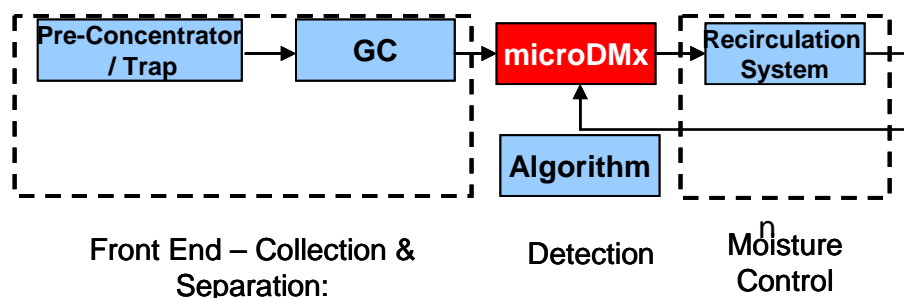
The microDMx sensor has several features that make it an excellent sensor.

- It is quantitative and has extremely sensitive detection limits, in the parts-per-trillion range;
- It is highly selective since each chemical or group of chemicals has a unique signature in the microDMx spectra due to different chemicals having their own unique differential ion mobility;
- Additionally, the microDMx can simultaneously detect chemical ions in both the positive and negative ion ranges thereby improving its selectivity.

Sensor Products

The microAnalyzer™

There is an increasing need to move the detection of chemical compounds from centralized labs to distributed chemical detection in the field at the point of sampling. The challenge is to detect chemicals at ever lower concentrations, in the field, with high levels of selectivity, particularly in the presence of either a complex gas matrix or interferences. The new Sionex microAnalyzer was developed to meet this need in a form that enables OEMs to easily integrate it into specific applications. The microAnalyzer combines a gas chromatograph column with its microDMx technology. Sensitivity depends on the application, but the microAnalyzer has been shown to detect chemicals in the sub-parts-per-trillion (ppt) range.



Concentration range:	Down to ppt
Column:	Oven-less GC column
Carrier / transport gas:	Recirculated air, no external gases required
Analysis time:	Seconds to minutes depending upon application

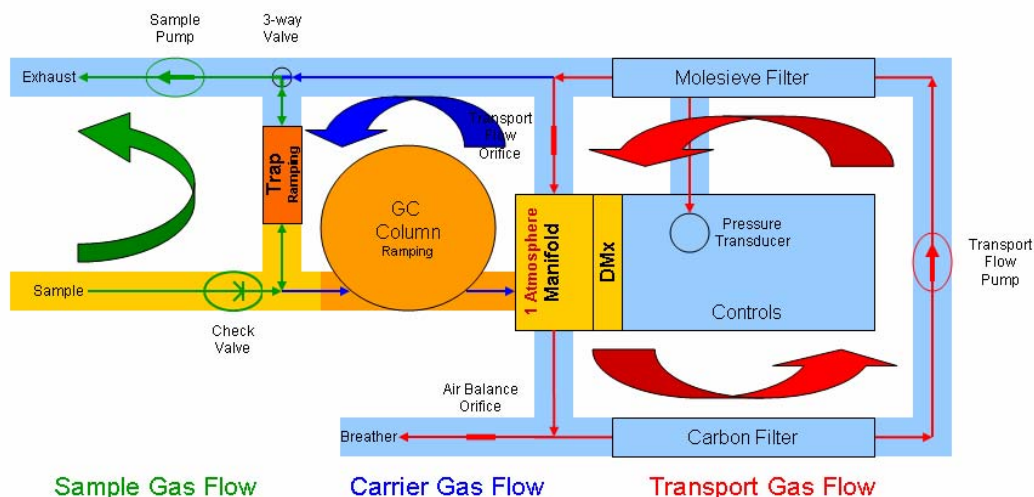
With the addition of the gas chromatographic (GC) separation module, the microDMx™ detector can operate in extremely complex chemical environments where the background matrix may contain many potential interferences or moisture. The GC module adds another dimension of chemical discrimination to the detection data, thereby enabling the identification of the target compounds with extreme confidence and reliability.

Key benefits of the microAnalyzer include:

- Orthogonal detectors (GC column, microDMx) to improve selectivity in complex environments. Typical sensitivity is the sub-ppt range.
- Air based sampling system for the GC eliminates the need for costly transport gases enabling low cost of ownership
- Speed of analysis is faster than a traditional analytical GC due to the selectivity of the microDMx sensor. Typical analysis times are between 30 seconds and 5 minutes.

- Flexible to meet application needs: it is designed to allow different traps and GC columns to tailor it for a specific application. It also is designed to facilitate the replacement of consumables such as the mole sieve.
- Its small physical size allows it to be used in space constrained environments
- The microAnalyzer is designed to enable derivative products to be developed that can be more tailored to a specific application. Depending upon the application, these derivative products may consume less power, be smaller, etc.

The microAnalyzer Design



The Sionex microAnalyzer has a GC separation module as the heart of the system, while the brain of the system is the microDMx detection technology. Incorporating these two independent but complementary technologies enables the system to take advantage of the benefits of each. Conventional GC separations are fairly lengthy and are not well suited to fast detection requirements; typical GC separations are up to 20-30 minutes in length. However, since the microDMx detection technology separates chemical species by ions, not time as a GC, the separation task is shared between the GC and microDMx. This enables extremely fast GC separations because the GC is not required to bear the analytical burden of identifying the compound. Rather, the GC and microDMx are used orthogonally to determine a chemical species. This results in a fast highly selective and highly sensitive platform.

The sampling system incorporated into the microAnalyzer utilizes a pre-concentrator which allows extremely low concentrations of compounds to be detected. The entire system operates in a fully automatic manner in which the sample is taken into the pre-concentrator for a specific time; the sample is subsequently thermally desorbed into the gas chromatographic separation module and transferred to the microDMx for specific detection. Increasing the sampling time through the trap allows the concentration effect to be increased thus optimizing the performance for given concentration range. An

embedded Digital Signal Processor (DSP) in the microAnalyzer is in control of all the method functions including trapping time, desorption temperature and time, GC temperature profile and the microDMx detection parameters such as RF field strength, compensation voltage, temperatures, etc.

Another drawback to a conventional GC is that it requires the use of a carrier gas (typically helium or nitrogen) which is supplied from a gas cylinder. The novel Sionex approach in the microAnalyzer uses re-circulated and conditioned air as both the carrier gas for the GC module and the transport gas for the microDMx sensor. The recirculation system uses ambient air which is conditioned through two filters, both contained within the main housing of the microAnalyzer. Estimates for the filter lifetime are between 12 and 24 months of continuous operation.



Sionex microAnalyzer

microAnalyzer Applications

Current customers have begun evaluating the use of the microAnalyzer in a variety of applications in four primary markets:

- Threat Detection
- Process Control
- Monitoring
- Medical Diagnostics

The Sionex Value Added Component SVAC™

The SVAC is a sub-system utilizing Sionex's DMS technology that allows for easy integration by our customers. The SVAC contains the detector and electronic boards as

well as sample pumps, flow controllers and operational software. The SVAC is also a platform that can be used as a standalone evaluation product and as a detector for GC front-ends.



Sionex Value Added Component

SVAC Applications

The SVAC has been incorporated by Varian Corporation in its CP4900 DMD MicroGC for monitoring petroleum industry processes to detect one or more chemicals. ThermoFisher has incorporated the SVAC in its EGIS™ Defender system, designed to detect narcotics and explosives in transportation or other homeland security applications.



CP4900 DMD MicroGC



EGIS™ Defender

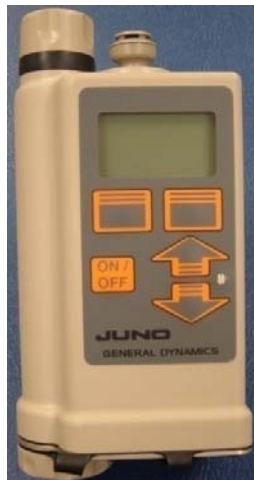
Sensor and board kit

The Sionex sensor and board kit is designed to be integrated by customers who possess a high level of engineering, design and computer engineering resources. Companies that have experience with ion mobility technologies and a strong data-processing capability will find the kit has all the necessary hardware and basic firmware to integrate the technology into a product design.



Sionex sensor and board kit

The sensor and kit have been adopted by General Dynamics in the Juno™ a hand-held battery operated Chemical Warfare Agent (CWA) detector developed under the auspices of the JCAD II Increment program.



General Dynamics Juno™

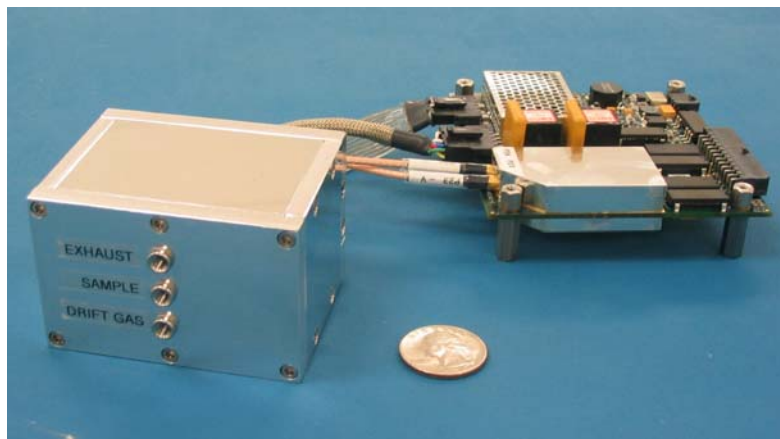
Pre-Filter Products

DMS/IMS²

Differential Mobility Spectroscopy (DMS) and Ion Mobility Spectroscopy (IMS) offer the greatest sensitivity at the fastest time over any other detection technology used today in applications that require fast actionable information.

DMS and IMS are complementary technologies. IMS measures the time it takes a certain chemical ion to move through a DC uniform low electric field. Whereas IMS measures velocity in a given electric field, DMS measures the change of velocity, or mobility, in both a low and a high electric field.

The Sionex DMS/IMS² detector enables identifying and confirming compounds in the presence of interferences or complex matrices in seconds. The dual DMS/IMS² detector provides data that is two-dimensional, yields greater sensitivity, and results in fewer false positives in contrast to the standalone IMS or DMS detectors.



DMS/IMS²

DMS/IMS² Applications

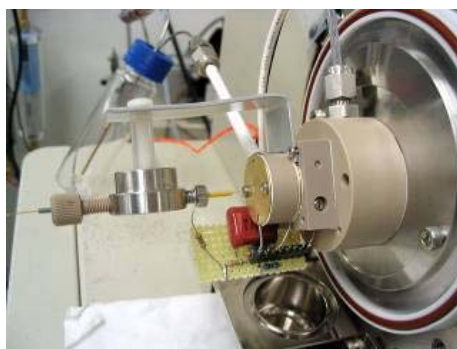
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- Medical Diagnostics

Mass Spectrometry pre-filter

DMS as a pre-filter to MS provides several advantages to current MS detectors. The instrument sensitivity of the MS is increased because the DMS pre-filter or ion filtration reduces chemical noise. In other words, only the desirable ions are permitted to the MS. Another advantage is that DMS pre-filters ions based on ion shape. This allows for greater information of the targeted chemical species. Further, the use of DMS pre-filtering in a MS allows for the use of gas phase modifiers or dopants.

The DMS pre-filtering to MS provides effective ion pre-separation of ions of volatile and nonvolatile chemicals for ions from 30Da to 1600Da, including peptides. Sionex retains the rights to MS that are 75 pounds and lighter and for applications in the Threat detection segments.



DMS/MS Pre-filter

Mass Spectrometry pre-filter applications

Sionex uses DMS as a pre-filter with “portable mass spectrometers” in the target market segments of threat detection and homeland security.

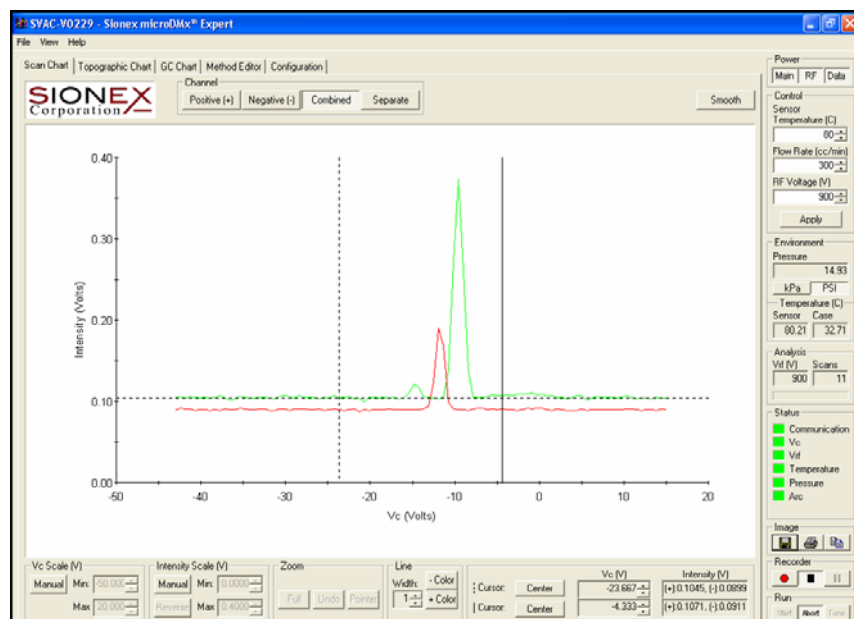
Our hypothesis: pre-filtering will restore some of the analytical space that is lost due to miniaturization and therefore increase capability of miniature mass specs.

Software Products

Sionex offers customized software development services to assist OEM customers in integrating its products into end-user systems and developing the systems themselves. As part of that support, Sionex has developed two advanced software products.

Expert™

The Expert software is designed as a tool to facilitate and support application development, production, diagnostics/troubleshooting, and data capture. It is used as a user interface to SVAC technology platform devices.



The Sionex SVAC Expert application provides the following basic features:

- The ability to create and edit method files for Scanning, Stepping, and GC modes of operation.
- Store and recall method files.
- Record data into text files and AIA files.
- Displays the spectrometer output to the operator in chart and topographic formats.
- Displays the Chromatographic chart for GC type methods.
- Perform diagnostics by manipulating I/O and Analog outputs and monitoring voltage levels.

Total Ion Flow modeling software

The Total Ion Flow software is designed as a tool to facilitate and support ionization optimization projects, radioactive and non-radioactive, by modeling ion flow to establish ion transmission efficiency and formation of discrete, positive, negative and neutral ion fragments generated. The software allows Sionex to optimize current detector design for optimal detection performance.

ABOUT SIONEX CORPORATION

Sionex Corporation provides breakthrough chemical and biological sensor chips and subsystems based on its proprietary microDMx detection technology. Sionex maintains its worldwide headquarters and laboratories in Bedford, Massachusetts. The Company is privately held and was founded in 2001 with patented technology exclusively licensed from the Charles Stark Draper Laboratory. Additional information about Sionex Corporation is available at www.sionex.com.

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