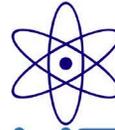


Torion Technologies Inc.



QUANTANALITICA



ANYTIME  
ANYPLACE  
ANYWHERE



TRIDION™-9 GC-TMS

The world's fastest and most portable Gas Chromatograph-Toroidal Mass Spectrometer

# When we say portable we mean portable

## TRIDION™-9 GC-TMS

*Torion Technologies introduces the world's lightest, fastest and most portable capillary gas chromatograph-toroidal ion trap mass spectrometer (GC-TMS).*

Torion's person portable GC-TMS integrates a high speed low thermal mass (LTM) capillary gas chromatograph (GC) with a miniaturized toroidal ion trap mass spectrometer (TMS) to provide a fast, reliable, and easy-to-operate GC-MS.

Samples are injected using a novel CUSTODION™ solid phase microextraction (SPME) fiber syringe. The CUSTODION allows users to collect and concentrate analytes quickly without the need for other extraction equipment or solvents.

The TRIDION-9 GC-TMS is ideal for rapid screening of chemicals such as environmental volatiles and semivolatiles (VOCs/SVOCs), explosives, chemical threats, and hazardous substances.

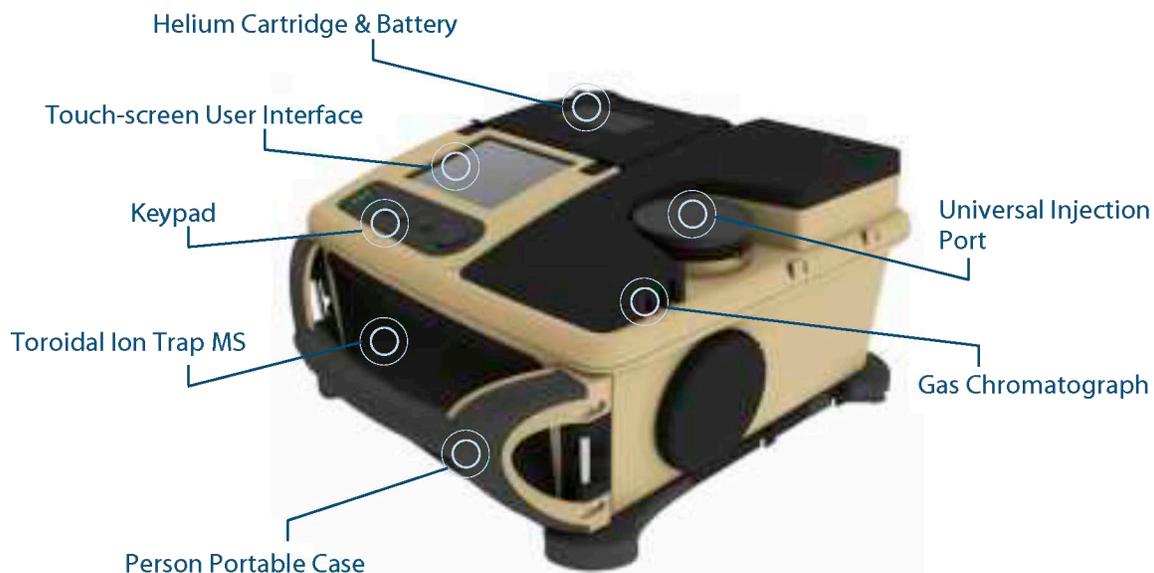
Advanced engineering creates superior technology

- The small diameter LTM capillary GC provides high speed, high resolution separation of chemical analytes.
- Rapid temperature programming delivers analysis times of under 3 min.
- A toroidal ion trap mass analyzer provides sensitive and selective mass-based detection of a wide range of chemicals.
- The TRIDION-9 is easy to operate with a color touch-screen display and simple navigation buttons.



*The TRIDION-9 GC-TMS was engineered for ease of use, speed and portability.*

## A GC-MS designed to carry into the field



### PORTABLE

At a total weight of 32 lbs, including battery and carrier gas cartridge, the TRIDION-9 is the lightest person portable GC-MS in the world. As a fully self-contained field instrument, the TRIDION-9 operates on battery power for up to 2.5 hours, and has an on-board disposable helium carrier gas cartridge capable of up to 150 sample runs.



### FAST

The TRIDION-9 is designed for rapid instrument startup and sample analysis. The system is ready for sample analysis in ~5 min from a "cold start". Using a high speed GC temperature ramp rate of ~2°C/sec, run-to-run cycle times are typically ~5 min, allowing for analyses of ~12 samples per hour.



### EASY

With an on-board color touch screen, the user interface directs the operator through sample introduction and analysis. The on-board library automates target compound deconvolution and identification. The results are displayed on-screen for quick and easy data interpretation.



### RELIABLE

Everything from the ruggedized GC-TMS design to the impact-resistant case allows the TRIDION-9 to operate under harsh conditions as reliably as a laboratory instrument. An automated performance calibration routine calibrates the instrument to provide reproducible, reliable performance.

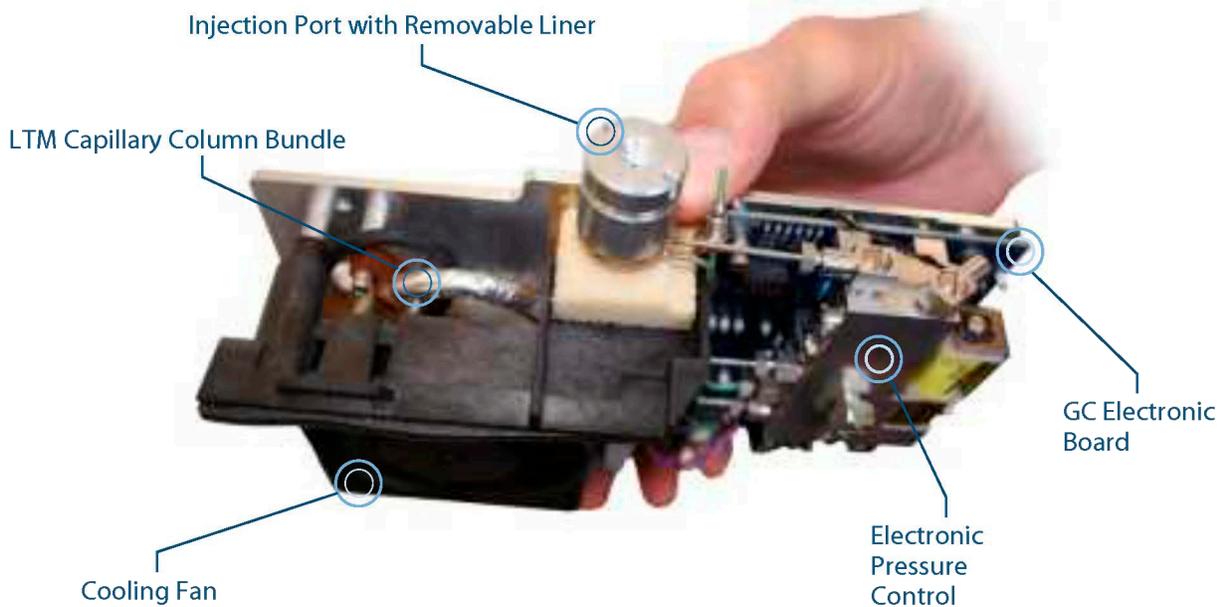
# Innovative engineering created a GAS CHROMATOGRAPH so small it can fit in your hand

## Torion's Low Thermal Mass (LTM) Capillary Gas Chromatograph

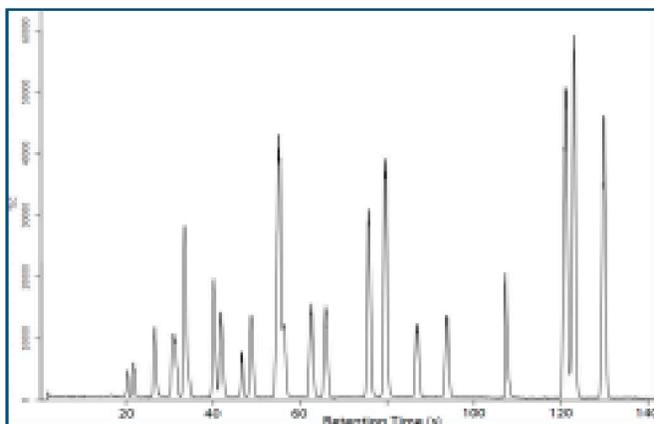
Don't let the size fool you. Although it was built for portability and speed this LTM capillary GC provides equivalent chromatographic resolution and performance to a laboratory capillary GC.

The miniature size is achieved by replacing a conventional convectively-heated column oven with a low thermal mass (LTM) column bundle with direct-contact electrical resistive heating. The LTM GC uses a small diameter, metal capillary GC column that is bundled with resistive heating and temperature-sensing wires that are braided together with insulator strands. This design provides for greater heating and cooling speeds and very low power consumption.

Column heating requires considerably less operating power than a conventional GC, which extends the battery-powered TRIDION-9 GC-TMS operating time. The powerful combination of direct resistive heating and rapid temperature ramp rates allows the GC to handle the most challenging analytical tasks quickly, while separating analytes in just seconds.

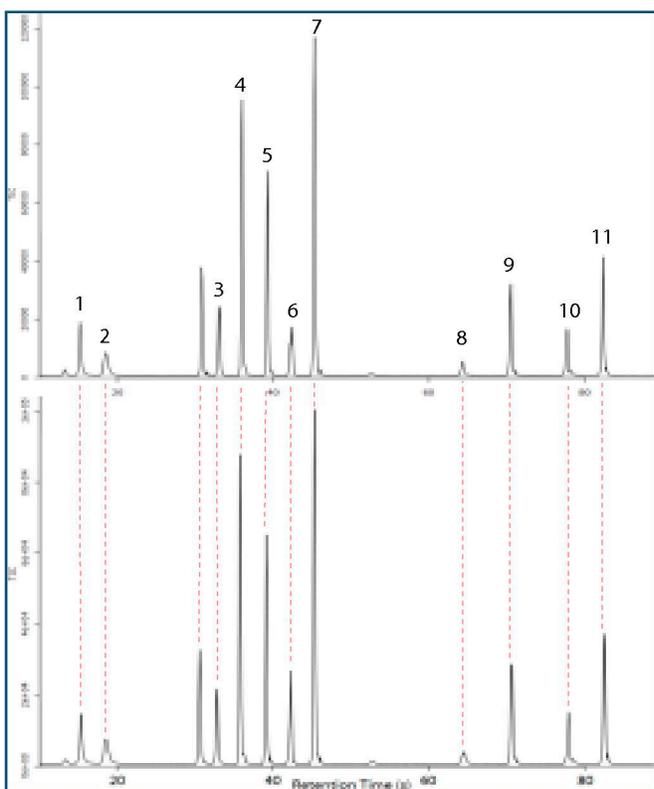


*The TRIDION-9 Low Thermal Mass Capillary GC is fast and operates reliably.*



## High speed, high resolution

TRIDION-9 GC temperatures can be programmed at a ramp rate of up to 2.5°C per sec. Temperature programming from 50°C to 300°C can be done in less than 2 min, while still maintaining excellent chromatographic resolution. The figure to the left shows ~2 min, high resolution separation of 25 EPA 624 compounds.



## Run-to-run reproducibility

The miniaturized electronic pressure control (EPC) system stabilizes helium flow, which increases chromatographic performance and reproducibility. MS reproducibility is also improved because constant helium flow into the ion trap is maintained. High run-to-run reproducibility allows for accurate target compound identification. In trial tests, retention time reproducibility for 11 peaks was  $\leq 2.58\%$  RSD over 80 analytical runs. Data is shown in the table below.

### Table

11 Compounds were analyzed on 3 different TRIDION instruments. GC retention times are compared for >80 analytical runs.

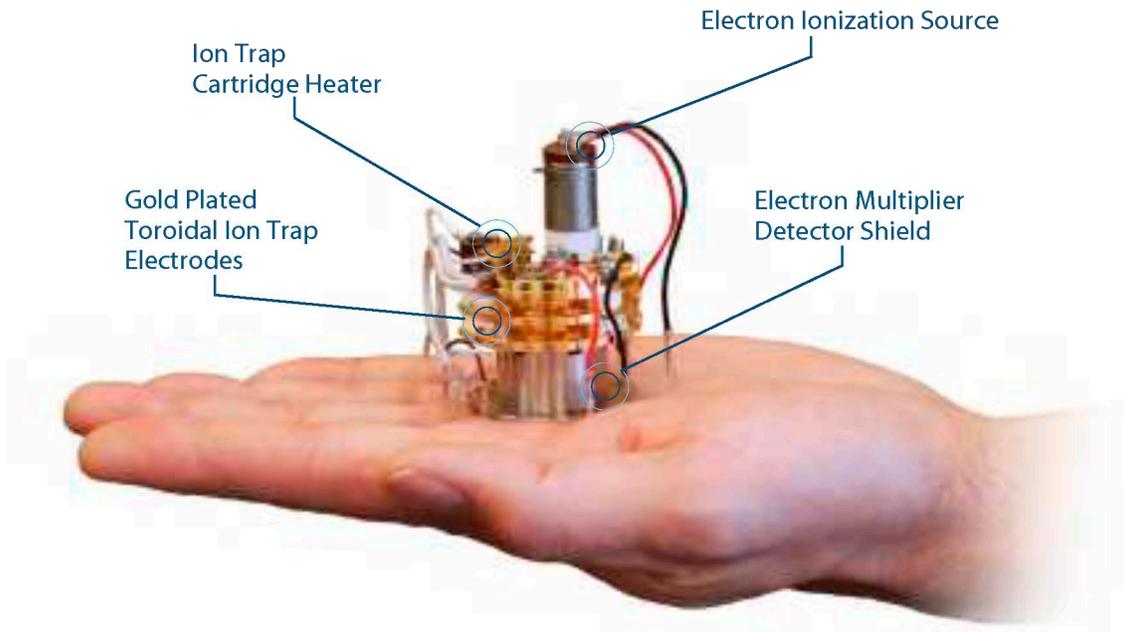
	Instrument 1		Instrument 2		Instrument 3	
	RT Ave	% RSD	RT Ave	% RSD	RT Ave	% RSD
1. Methylene Chloride	12.532	1.594	13.576	1.726	12.013	2.141
2. Methyltertbutylether	14.541	1.571	15.955	2.048	14.016	2.052
3. Methylcyclohexane	32.05	0.724	31.077	2.583	32.237	1.091
4. Toluene-d8	35.564	0.731	34.464	2.024	35.678	1.005
5. Perchloroethylene	39.982	0.891	38.621	1.418	38.805	0.943
6. Bromopentafluorobenzene	43.993	1.034	42.743	2.107	41.388	0.878
7. Bromoform	47.217	1.203	45.882	0.654	43.701	0.779
8. 1,2-Dibromotetrafluorobenzene	67.216	1.476	65.639	2.4	61.83	0.397
9. Methyl Salicylate	73.331	1.56	71.874	0.248	67.301	0.34
10. Tetrabromoethane	81.042	1.508	79.139	0.257	74.209	0.306
11. Pentadecane	93.095	1.59	92.188	0.281	86.654	0.263

# True portability is achieved with a Miniaturized MASS SPECTROMETER

## Torion's Toroidal Ion Trap Mass Spectrometer (TMS)

Torion's innovative TMS ion trap configuration is ideally suited for miniaturization compared to other types of mass spectrometers, such as conventional cylindrical ion traps or linear quadrupole traps. Every component of the TMS has been designed to maximize signal and minimize noise. The novel TMS configuration allows for an adequately large trapping volume despite its miniaturized size. This allows for high ion counts that result in good sensitivity, low noise levels and excellent spectral quality.

The TRIDION-9 mass analyzer operates at  $\sim 175^{\circ}\text{C}$ . Because the ion trap is heated and operates under vacuum the electrodes stay cleaner longer. This reduces the need for frequent maintenance, while increasing mass spectral quality and reproducibility. Performing at an elevated temperature also leads to long-term MS resolution stability. The TRIDION-9 TMS provides better than unit mass resolution over the 45-500 amu mass range.

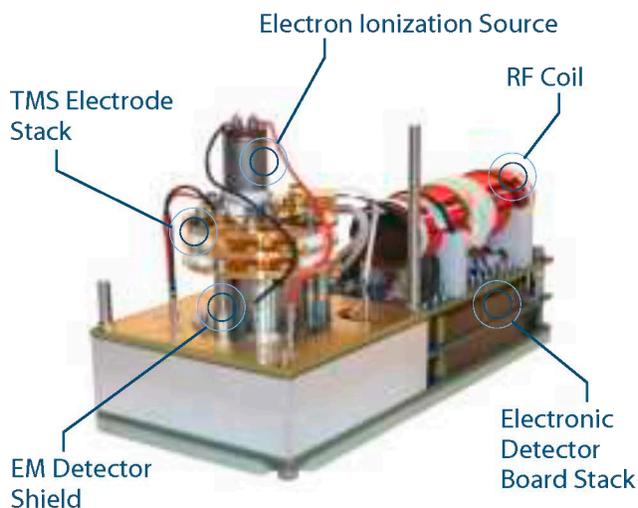


*The TRIDION-9 TMS detector is miniaturized for portability and reliability.*

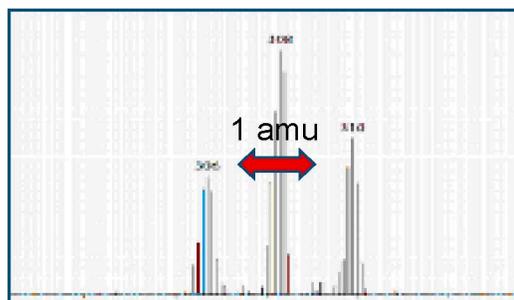
## Toroidal ion trap technology allows for miniaturization

Ion traps are geometrically compact compared to other mass analyzers. The compact toroidal geometry is ideal for miniaturization because:

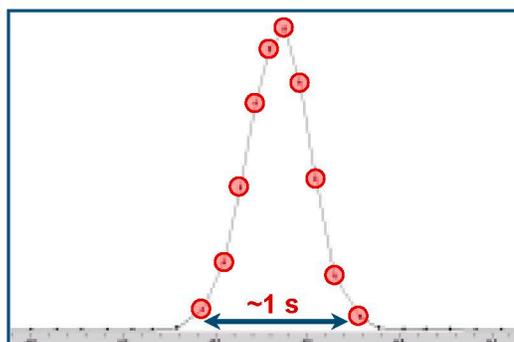
- Smaller ion traps can operate at high pressure ( $\sim 10^{-3}$  Torr), so vacuum requirements are less stringent, allowing for smaller pumps which reduces both size and weight.
- Less stringent vacuum requirements allow the TRIDION-9 to operate off battery power for longer than any other field portable MS.



Torion's removable Ion Trap TMS Assembly



**Mass range and resolution.** The TRIDION-9 has a mass spectral range of 45 - 500 m/z, with better than unit mass resolution to 300 amu and nominal unit mass resolution to 500 amu. In the figure above, the resolution of 1,2-Dibromotetrafluorobenzene is shown where resolution at mass 308 is 0.5 m/z FWHM.



**Built for speed.** Most chromatographic peaks on the TRIDION-9 are  $\sim 1$  sec wide, meaning 60 compounds can be fully resolved and analyzed in 1 min. The scan rate of the MS is also fast at  $\sim 10 - 15$  scans per sec. This provides multiple scans across the narrow chromatographic peaks resulting in excellent mass spectral quality.

### Torion's Automated Advanced TMS Functions

The TRIDION-9's on-board automated functions, based on novel advanced algorithms, operate the TRIDION-9 at ideal settings at all times.

- **AutoTune:** The AutoTune function automatically optimizes filament emission, signal resolution and EM detector optimization.
- **AutoCal:** The Mass and GC retention scales are automatically calibrated when running the AutoCal function.
- **Autolon:** This function automatically adjusts the ionization time based on the concentration of analyte(s) in the TMS. This results in consistent ion loading of the trap and a reduction of space charge effects. Ultimately this leads to improved and consistent mass resolution and sensitivity.



# Anytime, Anyplace, Anywhere

## Take the TRIDION-9 to the samples...wherever they are

The powerful combination of the person portable TRIDION-9 GC-TMS and the CUSTODION SPME Syringe provides users the capability to collect and analyze a sample at any location. Identification of target chemical compounds is straight-forward, accurate and rapid. Torion's TRIDION-9 system is ideally situated for a variety of applications:

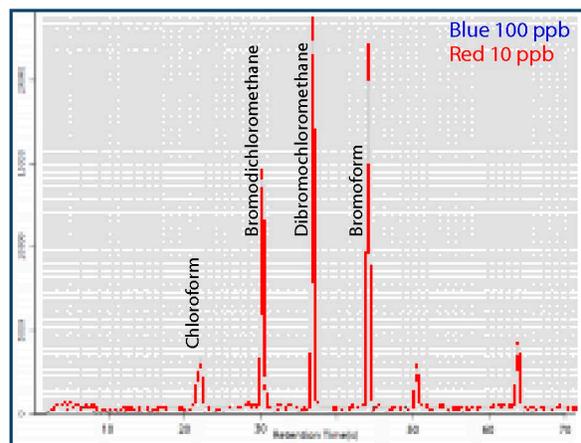
- Environmental
- Food safety
- Flavors/fragrances
- Forensics/drugs of abuse
- Chemical/petrochemical
- Military
- Security
- Hazardous materials
- First response
- Industrial



### Environmental Water Monitoring

Because of its portability and speed the TRIDION-9 is ideally suited for analysis of water samples in the field. For example, National Drinking Water Standards currently regulate the maximum total cumulative concentration for the four Trihalomethanes (THMs) (chloroform, bromodichloromethane, dibromochloromethane, and bromoform) at < 80 ppb. As shown in the figure to the right, the TRIDION-9 can detect the individual THMs at < 10ppb. The SPME/GC/TMS method can be used to rapidly determine compliance of drinking water and ground water samples in the field at the source in less than 1 min.

The combination of SPME and the TRIDION-9 to collect and analyze samples in the field allows users to screen samples that may guide further sampling activities. Rapid analytical results can facilitate time critical decision making at the sample's location.



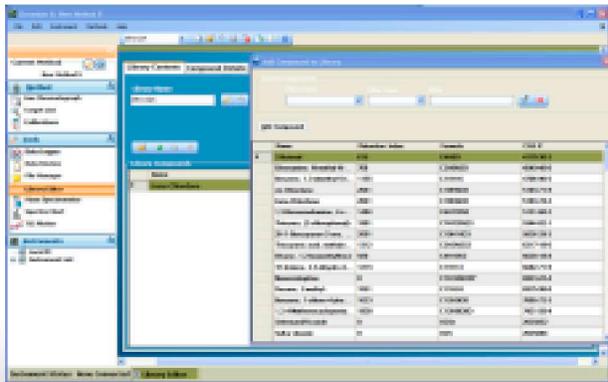
#### THMs in water

The THMs were extracted from water using a PDMS/DVB SPME phase. The SPME was exposed to the headspace of the sample vial for 5 min at ambient temperature.

# Instant Results

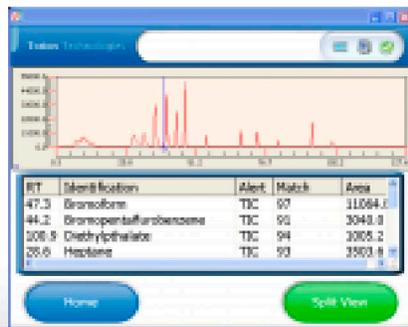
## Identify trace compounds even in complex mixtures with CHROMION™ automated target compound libraries

Speed matters when making time critical decisions. Now rapid and reliable identification can be performed in the field. The TRIDION-9 on-board library identifies target compounds in an easy-to-understand table that is displayed on the instrument's touch screen. Torion's easy-to-use CHROMION PC software allows users to custom build target compound libraries. Torion's unique deconvolution algorithms ensure reliable identification of even co-eluting compounds in complex mixtures. CHROMION software works in conjunction with the extensive NIST Library database, so unknown peaks can be easily identified. CHROMION was designed with the end user in mind. Everything from creating a new GC program to viewing a data file with the background subtracted is simple and intuitive.



### CHROMION's capabilities include:

- Full Instrument Control
- Instrument Monitoring
- Library Customization
- Target Compound Identification
- Unknown Peak Identification
- Quantitation with Internal or External Standards
- Data Review including:
  - Total Ion Chromatograms
  - Reconstructed Ion Chromatograms
  - Background Subtraction
  - Spectra Averaging
  - Selected Ion Plotting

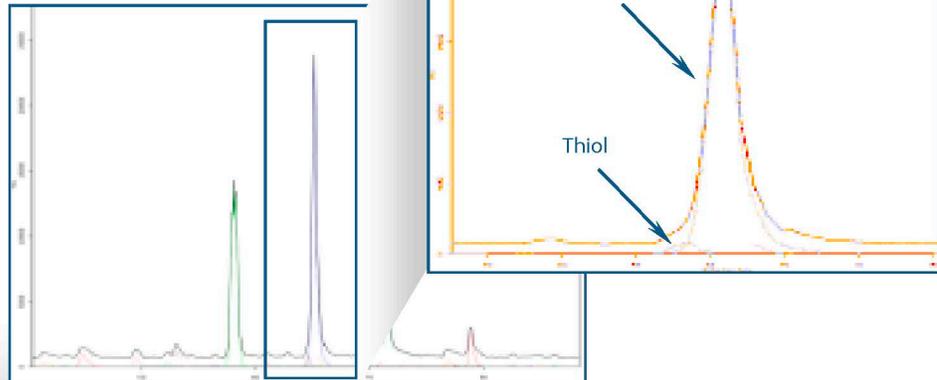


### TRIDION's target compound identification display:

- Names identified compounds
- Displays GC retention times
- Lists alert level for each compound
- Calculates match quality
- Shows unidentified compounds

### TRUE DECONVOLUTION

Complex mixtures of compounds can be separated and identified with Torion's sophisticated deconvolution algorithm. Peaks that chromatographically co-elute are separately identified by target ions in their mass spectrum and peak shape. On the right, shown in red, is a VX breakdown product (Thiol) that co-elutes with Tabun. Although Thiol is hidden under the Tabun chromatographic peak, the VX threat is identified.



# Simplicity enhances portability

## CUSTODION™ SPME Syringe

Solid phase microextraction (SPME) is an innovative sampling technology that is quick, easy and reliable. SPME is a solvent-free technique that combines sample extraction, collection and concentration of analytes all in one simple step. Analytes can be extracted from gas, liquid and dissolved solid samples. The SPME fiber coating retains chemical compounds from the sample matrix. The fiber coating is typically an immobilized polymer, a solid adsorbent or a combination of the two.

Following sample collection, the SPME fiber is inserted directly into the heated injection port of the GC. Analytes are thermally desorbed in the injector, separated in the GC column, and detected by the TMS. CUSTODION SPME Syringes can be reliably used for on-site field sampling or in-laboratory applications. A variety of SPME phases are available to specifically target different groups of analytes for maximum extraction efficiency.



Not only is SPME a flexible tool to use for sampling, but Torion also designed the CUSTODION Syringe to house the SPME fiber with safety and simplicity in mind. With a click of the plunger the SPME fiber is exposed and retracted, as easy as clicking a ball point pen. Users wearing thick protective gloves can still easily operate the CUSTODION Syringe. The CUSTODION Syringe is universal and can be used with any laboratory GC.

- Useable with PPE and safety equipment
- Prevents overloading of the GC column and MS detector
- Extends life of the GC column
- Reduces frequent ion trap cleaning
- Eliminates sample to sample carryover

## CALION™ PV Mixes

Torion's CALION PV Mixes (calibration and performance validation standards) are easy-to-use and reliable for field applications. CALION mixes contain standard compounds that are carried in solidified liquid particles, where the compounds maintain equilibrium between the solid particles and the vial's headspace. CUSTODION SPME sampling of the headspace results in collection of analytes on the SPME fiber from the vapor phase. The collected standards are then injected into the TRIDION-9 GC-TMS for analysis. CALION PV Mixes are used for instrument calibration, including both mass and retention time calibrations. The combination of CUSTODION SPME sampling with CALION standards provides robust and rapid capability for in-field calibration of the TRIDION-9 GC-TMS. No need to worry about spilling liquid standards in the field or laboratory.



# New TRIDION™ -9 GC-TMS Specifications

## System

Dimensions	15" x 15.5" x 9" (38.1 cm x 39.4 cm x 22.9 cm)
Weight	32 lbs (14.5 kg), including battery
Color Options:	Yellow, black, green, tan, and grey
Operating Temperature	5° to 40°C continuous operation with vent ports closed Up to 45°C continuous operation with vent ports open
Operating Humidity	Up to 100% RH non-condensing
Power Supply	Rechargeable Lithium Ion batteries or AC converter (100-120V/220-240V, 50/60Hz, 2.0A) with power source and level indicators
Sample Introduction	Solid phase microextraction (SPME); small volume direct liquid injection
Carrier Gas	High purity (99.5%) or Ultra-high purity (99.995%) helium
User Interface	Color touch screen with on-board operating menus and navigation key pad
User Software	CHROMION for methods and library development, as well as data processing and evaluation
Training	Beginner/Advanced operator and maintenance courses available
Communication Interface	Ethernet or RF (2.4 GHz) Wireless
Battery Lifetime	Rechargeable, up to 2.5 hours lifetime
Helium Cylinder Lifetime	Typically 100 - 150 analyses per disposable cylinder
SPME Lifetime	Over 50+ analyses (depending on sample type)
Display	5.7" color touch-screen display
Operating System	Windows CE Operating System
Data Format	net.CDF or .d compatible software
Detection Limit	PPB to PPM for most analytes
Peak Power	~120 W peak power; ~60 W average power
Memory	On-board removable SD flash card; standard and On-the-go mini USB ports

## Low Thermal Mass (LTM) Capillary Gas Chromatograph (GC)

LTM Column (standard)	MXT-5, 5 m x 0.1 mm x 0.4 µm $d_r$ ; other phases and columns available
Temperature Program	Adjustable between 40° to 300°C
Temperature Ramp Rate	Up to 2.5°C/sec or 150°C/min
Split/Splitless Injection	Splitless or selectable split; (~30:1), (~150:1) and (~200:1)
Septum Purge	5 mL/min
Programmable Flow Rate	Electronic pressure programming using a variable flow orifice

## Toroidal Ion Trap Mass Spectrometer (TMS)

Mass Analyzer	Toroidal ion trap
Mass Range	45-500 $m/z$
Resolution	Better than unit mass resolution from 45 - 300 amu and nominal mass resolution up to 500 amu
Ionization Mode	In-trap electron impact ionization
Detector	Electron multiplier - novel dual rectangular configuration
Vacuum	Dual stage vacuum system: diaphragm roughing and turbo molecular pumps; nominal operating pressure $10^{-3}$ to $10^{-4}$ Torr.
Heated Ion Trap	Adjustable from 100° to 180°C

## Chemical Libraries

Target Analysis	CHROMION deconvolution software automated on TRIDION GC-TMS; user defined target libraries using GC retention times and mass spectral data; NIST Library search software.
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