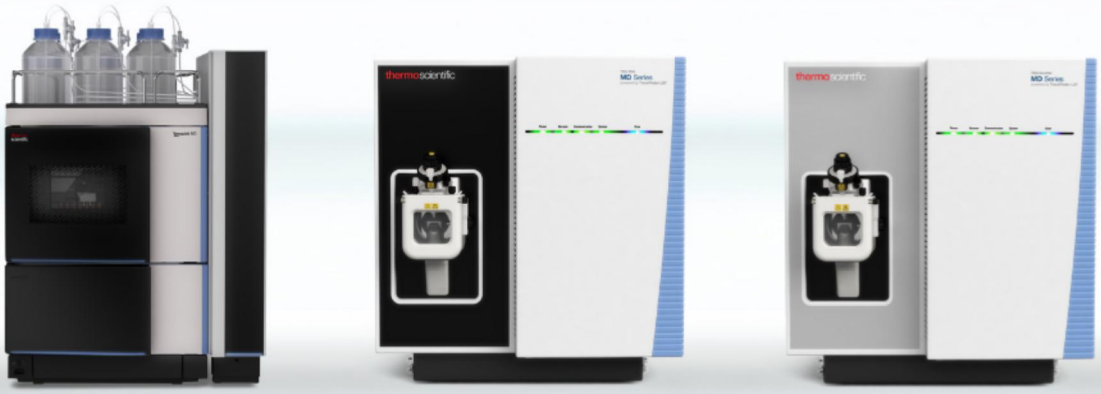
ThermoFisher SCIENTIFIC

Clinical Mass Spectrometry

# Be sure

## LC-MS/MS *in vitro* diagnostic systems

For *In Vitro* Diagnostic Use



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# Increase efficiency, productivity, and cost savings

## Leading the way in clinical mass spectrometry

Comprehensive and reliable LC-MS systems powered by a complete suite of software conforming to *in vitro* diagnostic (IVD) requirements with an optional laboratory information system (LIS) connection enabling clinical diagnostic laboratories to fulfill scientific and operational needs based on clinical relevance

Liquid Chromatography-Mass Spectrometry (LC-MS) represents a powerful technology that is complementary to chemistry and immunoassay techniques typically used in clinical research and diagnostics. LC-MS offers the advantages of greater specificity, speed, and analyte range coupled with a lower cost per sample and reduced sample volumes.

Performing laboratory developed tests (LDTs) by LC-MS enables clinical diagnostic laboratories to replace expensive chemistry or immunoassays run on random-access automated lines with more economic batch testing.

Positive immunoassay screens are typically followed by LC-MS confirmation and quantitation. However, when positivity rates are high, switching solely to identification and quantitation by LC-MS often makes economic and operational sense.

LC-MS medical devices offer a range of sensitivity options along with "middleware" capabilities of bidirectional communication with the Laboratory Information System (LIS).

The portfolio of Thermo Scientific™ LC-MS Medical Devices provides laboratories with a comprehensive and flexible choice of platforms suited to sensitivity requirements, powered by a complete software suite, to ensure confident results and data integrity.

### Our heritage– over 75 years of MS innovation

**1948** Ludolf Jenkel constructs a 60" Magnet Sector MS and forms Mes und Analysen-Technik (MAT).

**1967** Finnigan Instruments founded by Bob Finnigan, Mike Story, R. Hein, and W. Files.

**1968** First commercial analytical quadrupole, the Finnigan 1015, is released.

**1978** First QQQ marketed by Triple quad team (Bob Finnigan, Mike Story, T.Z. Chu).

**1981** Finnigan Instruments acquires MAT, becoming Finnigan MAT.

**1983** First commercial ion-trap system introduced by Finnigan MAT.

**1987** Finnigan, acquired by Thermo Electron, launches the MAT 90—the first MS on the market completely controlled by computers.

**1991** Thermo Electron introduces the first commercial high-flow API source.

**2002** Rods used in quadrupoles evolved from hyperbolic to segmented enabling greater sensitivity.

**2005** The Thermo Scientific™ LTQ Orbitrap™, the first commercial mass spectrometer with an Orbitrap analyzer, is launched.

**2009** The Thermo Scientific™ LTQ Velos is launched, the industry's fastest and most sensitive ion trap mass spectrometer.

**2017** Evolution of quadrupole technology with launch of the Thermo Scientific™ TSQ Quantis™ and TSQ Altis™ mass spectrometers.

**2019** Three Class I listed medical devices—Thermo Scientific™ Vanquish™ MD HPLC, TSQ Quantis™ MD, and TSQ Altis™ MD series mass spectrometers are launched.

# Sensitive, flexible solutions for IVD use

## Flexible LC-MS options to meet sensitivity and throughput needs

The comprehensive portfolio of Thermo Scientific LC-MS Medical Devices for laboratory developed tests offers the clinical diagnostic laboratory unique choices to address sensitivity needs. This portfolio consists of a High Pressure Liquid Chromatography (HPLC) system and two Mass Spectrometers (MS) differentiated by sensitivity:

### HPLC system

- Thermo Scientific™ Vanquish™ MD HPLC system

### Mass spectrometer options

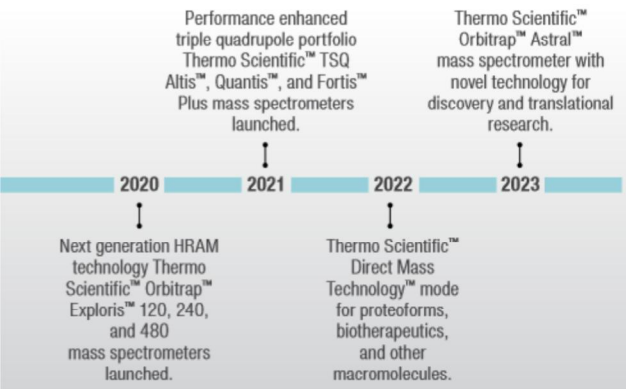
- Thermo Scientific™ TSQ Quantis™ MD Series triple-stage quadrupole mass spectrometer
- Thermo Scientific™ TSQ Altis™ MD Series triple-stage quadrupole mass spectrometer

In addition, the new portfolio of Thermo Scientific LC-MS Medical Devices for IVD use enables laboratories to:

- Future-proof your lab addressing *in vitro* diagnostic requirements
- Eliminate the need to purchase additional software by including Thermo Scientific™ TraceFinder™ software
- Overcome the limitation of manual data entry with an optional bidirectional LIS connection

| Vanquish MD HPLC System | Mass Spectrometer Sensitivity |
|---|---|
| Enhanced sensitivity with good throughput | TSQ Altis MD Series Mass Spectrometer |
| Outstanding separation and good throughput meeting sensitive requirements for everyday use | TSQ Quantis MD Series Mass Spectrometer |

MS Sensitivity




# Addressing *in vitro* diagnostic requirements

## Protecting today's investment for tomorrow's testing

| LC-MS medical device usage | Liquid Chromatography System | Mass Spectrometers | |
|---|---|---|---|
| | Vanquish MD HPLC System | TSQ Altis MD Series Mass Spectrometer | TSQ Quantis MD Series Mass Spectrometer |
| **Intended use** | Separate drugs or compounds in human specimens. For *in vitro* diagnostic use only by trained, qualified laboratory personnel. | Identify and quantify inorganic and organic compounds in human specimens. For *in vitro* diagnostic use only by trained, qualified laboratory personnel. | |
| **Indications for use** | Used by clinical diagnostic laboratories as a component of a LDT method or workflow. | Used by clinical diagnostic laboratories as a component of a LDT method or workflow. | |
| **Contraindications of use** | For *in vitro* diagnostic tests only. The Vanquish MD HPLC is to be operated only with hardware or software approved for *in vitro* diagnostic application. | For *in vitro* diagnostic applications only. The TSQ Altis MD Series and TSQ Quantis MD Series mass spectrometers are to be operated only with hardware or software labeled for *in vitro* diagnostic use. | |
| **Limitations of use** | Compatible with the following instruments from Thermo Fisher Scientific:<br>• TSQ Altis MD Series mass spectrometer and<br>• TSQ Quantis MD Series mass spectrometer. | Compatible with the following instrument from Thermo Fisher Scientific: Vanquish MD HPLC. | |

**As a component of an LDT method or workflow, validation of the LDT method or workflow is the responsibility of the clinical laboratory.**

Our family of liquid chromatography-mass spectrometry (LC-MS) instruments for *in vitro* diagnostics provides clinical labs with consistent reliable results, and faster turn-around time. These comprehensive LC-MS platform solutions enable accurate results, facilitate cost savings, and allow clinical laboratories to achieve organizational and scientific goals while ensuring confidence in results of LDTs.

# Benefits of LC-MS for clinical mass spectrometry

**Superior specificity, selectivity, sensitivity:** Compared to traditional immunoassays, LC-MS enables accurate results, and reduces false positives and negatives.

**Speed and high throughput capability:** LC-MS enables faster turnaround times in clinical laboratories.

**Comprehensive and flexible:** LC-MS allows different assays to be run on a single LC-MS system.

**Cost Savings and increased productivity:** Compared to immunoassays, LC-MS methodology reduces costs associated with testing kits, consumables and sample and potential labor costs.

# Why choose LC-MS medical devices for *in vitro* diagnostic use

**Compliance:** Thermo Scientific™ class 1 medical devices:

- Comply with ISO 13485 and FDA 21 CFR 820 standards
- Streamline clinical workflows and auditing capabilities with dedicated, integral software

**Regulatory trends:** The global clinical diagnostics market favors LC-MS medical devices conforming to FDA and EU regulations to perform LDTs.

**Connectivity:** A middleware software (B-Link® Universal LIS/LIMS Connector) delivers bidirectional communication between acquisition/data processing software and the Laboratory Information System (LIS).

**Risk control:** Thermo Fisher Scientific offers:

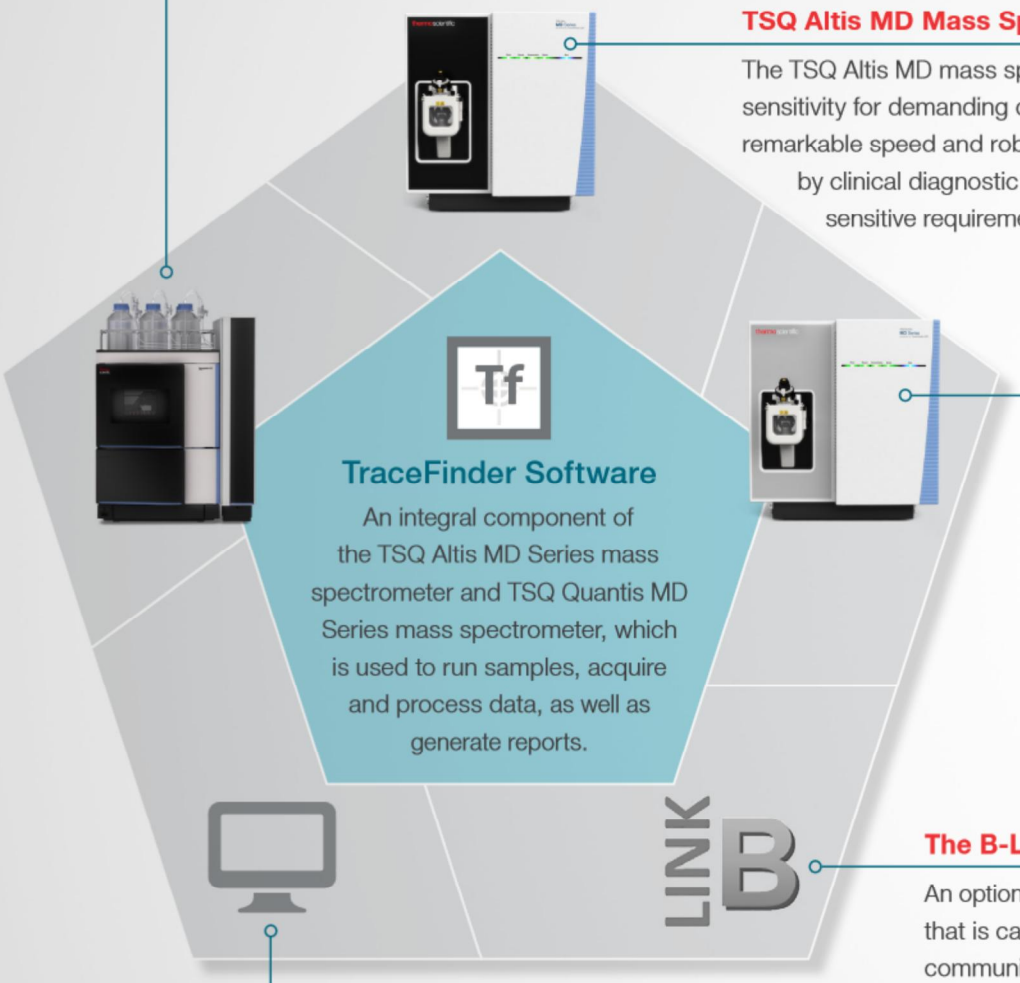
- Thorough validation and verification process
- Medical device-certified service engineer
- Quality tracking in place to ensure the highest instrument performance
- All the validations are done during manufacturing process

# Choose from a unique portfolio of compatible devices

## A choice of flexible options to meet a wide range of sensitivity and productivity needs for LDTs

### Vanquish MD HPLC System

The powerful, robust single channel Vanquish MD HPLC system, with a compact footprint and excellent reproducibility, meets analytical needs, as well as space and budget limitations.




### TSQ Altis MD Mass Spectrometer

The TSQ Altis MD mass spectrometer provides enhanced sensitivity for demanding quantitative analyses with remarkable speed and robustness. It is designed to be used by clinical diagnostic laboratories to address their more sensitive requirements for laboratory developed tests.

### TSQ Quantis MD Mass Spectrometer

The TSQ Quantis MD mass spectrometer provides the sensitivity needed for routine quantitative analyses with remarkable speed and robustness. It is designed to be used by clinical diagnostic laboratories to meet their routine requirements for laboratory developed tests.

### The B-Link Connector

An optional downloadable software package that is capable of providing bi-directional communication between TraceFinder platform software and the preferred diagnostic laboratories or other middleware. It is installed on the same computer as TraceFinder software.

### TSQ II Altis MD and TSQ II Quantis MD Software

An integral component of the TSQ Altis MD and TSQ Quantis MD mass spectrometers, which is used to “tune” the mass spectrometer, enable diagnostic capabilities, and develop test methods.

# Vanquish MD HPLC system

The Vanquish MD HPLC is the ideal chromatographic separations system for laboratories where analyte resolution is critical. This small, powerful system meets analytical needs, as well as space and budget limitations with the throughput, speed, and sample capacity to boost workflow productivity for laboratory developed tests.

- Increased analytical speed and reliability—necessary for targeted quantitation analyses performed by clinical laboratories focused on laboratory developed tests
- Greater flexibility—industry leading 2 x 3 solvent channels for maximized method flexibility
- Higher confidence—excellent flow accuracy and precision by ultra-precise piston drives
- Outstanding robustness—enabled by highest system up-time and low total cost of ownership

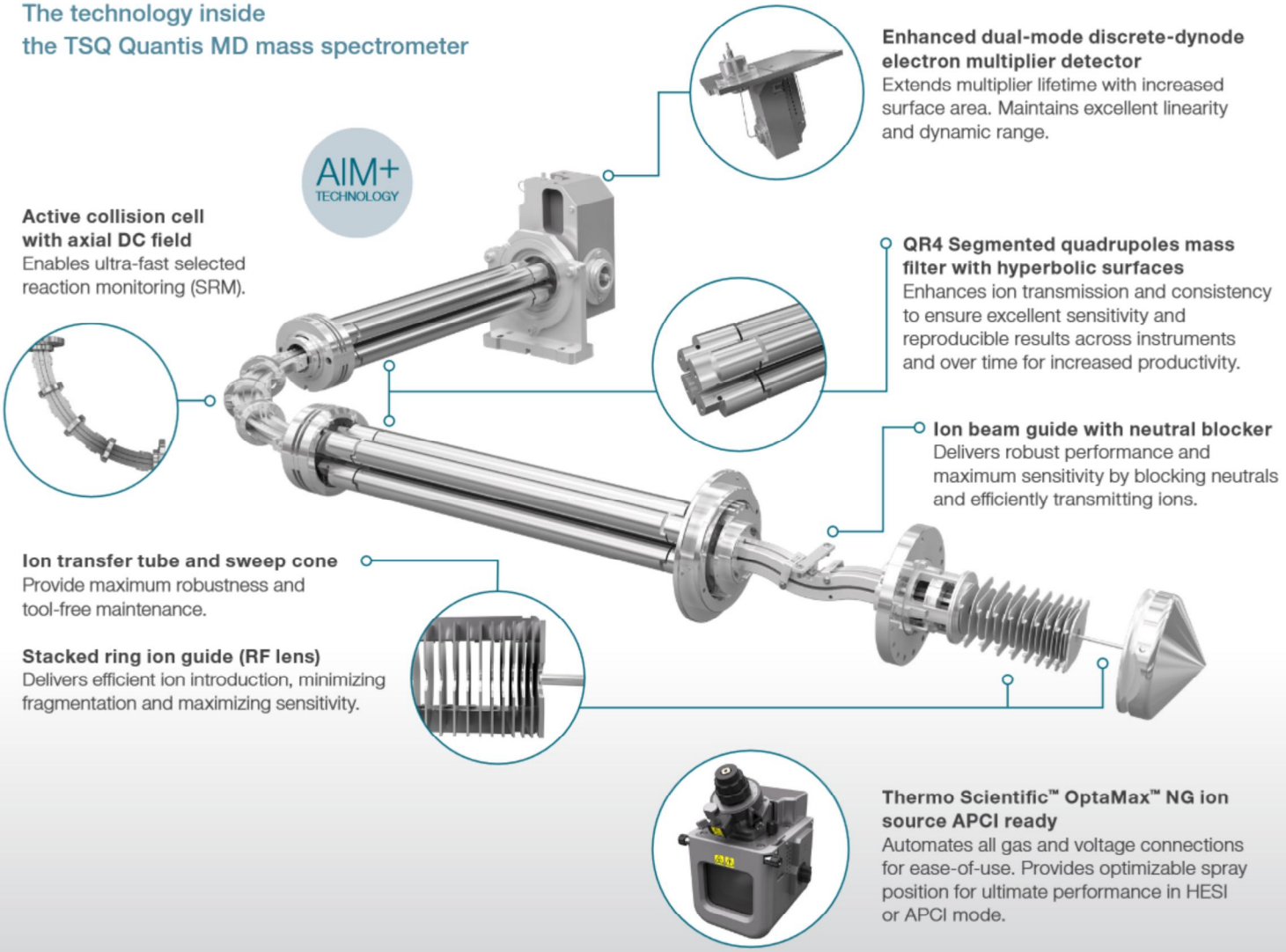
# TSQ Quantis MD mass spectrometer


## Compliance with sensitivity for remarkable speed and robustness in diagnostic laboratories

The TSQ Quantis MD mass spectrometer addresses everyday routine analyses of IVD tests, delivering confident quantitation that achieves sensitivity with speed and robustness.

With Thermo Scientific™ Active Ion Management (AIM+) technology, the TSQ Quantis MD mass spectrometer confidently delivers routine analyses day after day.

## The technology inside the TSQ Quantis MD mass spectrometer




**Enhanced dual-mode discrete-dynode electron multiplier detector**
Extends multiplier lifetime with increased surface area. Maintains excellent linearity and dynamic range.

**Active collision cell with axial DC field**
Enables ultra-fast selected reaction monitoring (SRM).

**QR4 Segmented quadrupoles mass filter with hyperbolic surfaces**
Enhances ion transmission and consistency to ensure excellent sensitivity and reproducible results across instruments and over time for increased productivity.

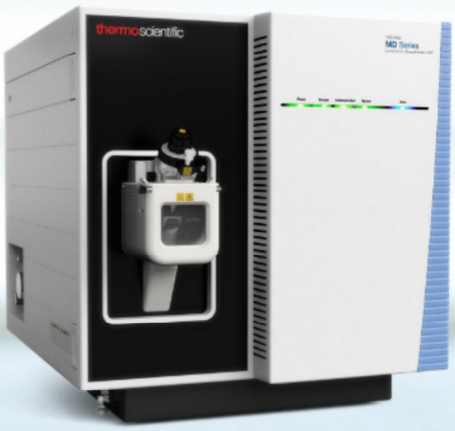
**Ion beam guide with neutral blocker**
Delivers robust performance and maximum sensitivity by blocking neutrals and efficiently transmitting ions.

**Ion transfer tube and sweep cone**
Provide maximum robustness and tool-free maintenance.

**Stacked ring ion guide (RF lens)**
Delivers efficient ion introduction, minimizing fragmentation and maximizing sensitivity.

**Thermo Scientific™ OptaMax™ NG ion source APCI ready**
Automates all gas and voltage connections for ease-of-use. Provides optimizable spray position for ultimate performance in HESI or APCI mode.

# TSQ Altis MD mass spectrometer

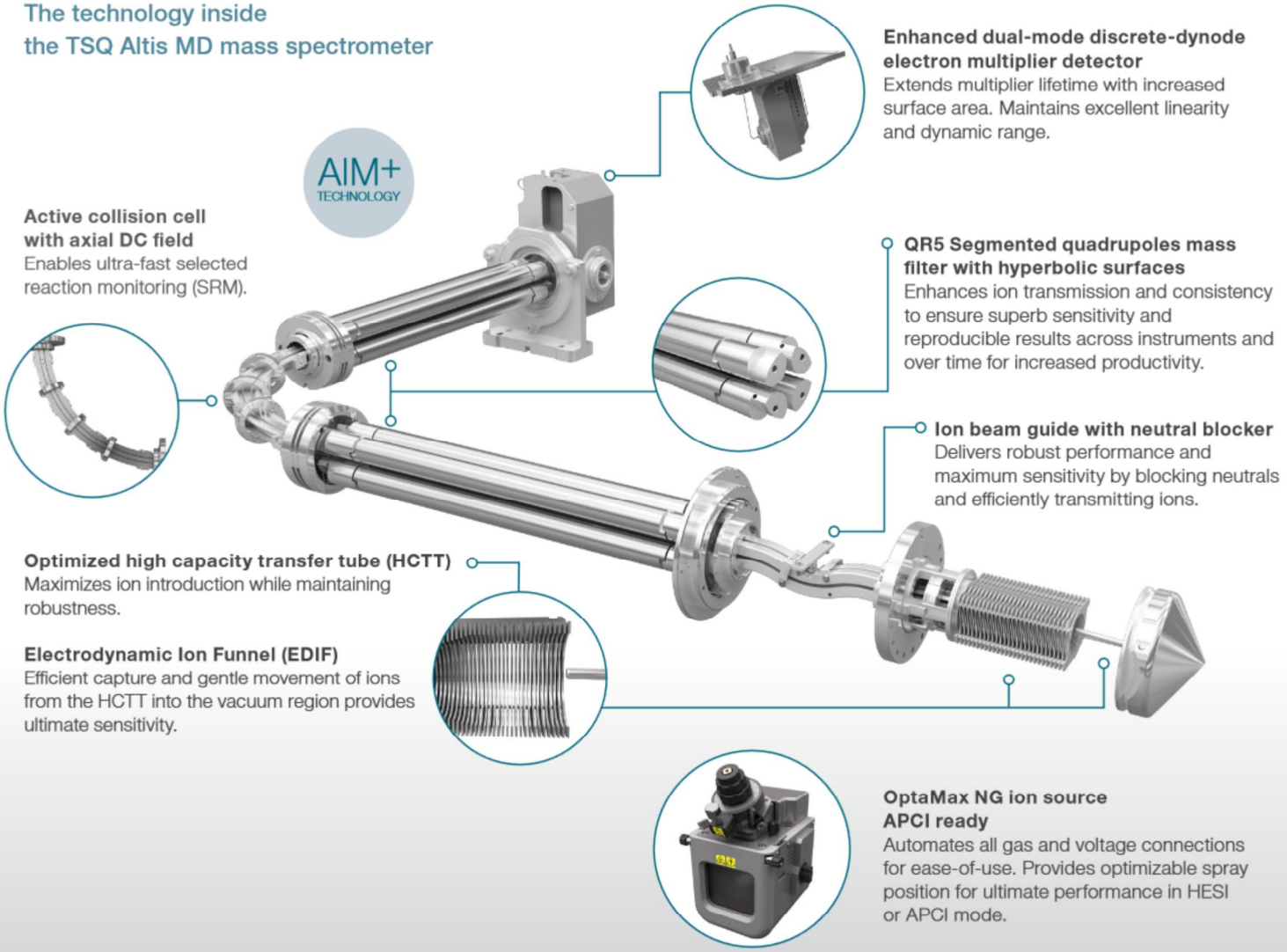



## Enhanced sensitivity with remarkable speed and robustness for laboratory developed tests

The TSQ Altis MD mass spectrometer is used to address challenging analyte requirements for IVD tests and delivers the ultimate sensitivity for demanding quantitative analyses with remarkable speed.

With AIM+ technology, the TSQ Altis MD confidently delivers ultimate performance in human specimens at low levels of analyte.

## The technology inside the TSQ Altis MD mass spectrometer




**Enhanced dual-mode discrete-dynode electron multiplier detector**
Extends multiplier lifetime with increased surface area. Maintains excellent linearity and dynamic range.

**Active collision cell with axial DC field**
Enables ultra-fast selected reaction monitoring (SRM).

**QR5 Segmented quadrupoles mass filter with hyperbolic surfaces**
Enhances ion transmission and consistency to ensure superb sensitivity and reproducible results across instruments and over time for increased productivity.

**Ion beam guide with neutral blocker**
Delivers robust performance and maximum sensitivity by blocking neutrals and efficiently transmitting ions.

**Optimized high capacity transfer tube (HCTT)**
Maximizes ion introduction while maintaining robustness.

**Electrodynamic Ion Funnel (EDIF)**
Efficient capture and gentle movement of ions from the HCTT into the vacuum region provides ultimate sensitivity.

**OptaMax NG ion source APCI ready**
Automates all gas and voltage connections for ease-of-use. Provides optimizable spray position for ultimate performance in HESI or APCI mode.

# Features enabling reliability, speed, and quantitation

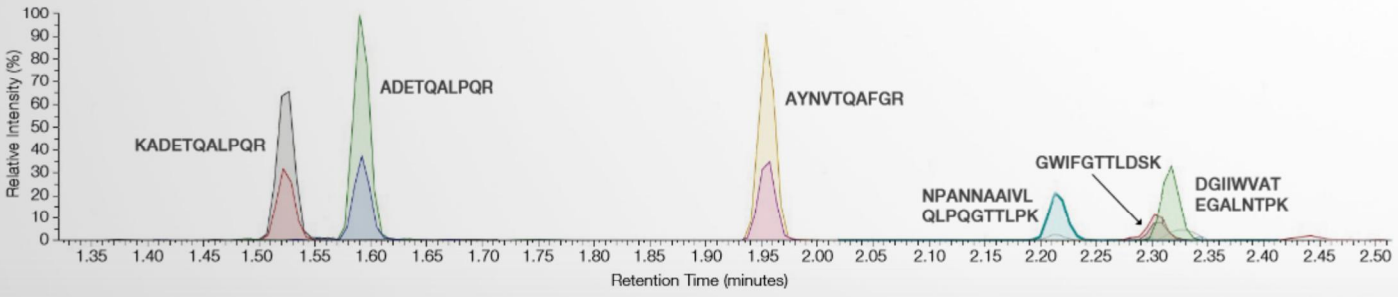
## Robust and reliable on-column detection of compounds

The Vanquish MD HPLC System, along with TSQ Altis MD Series mass spectrometers, enables sensitive quantitative data for everyday analysis of clinically relevant analytes. The performance data shown in the chromatograms represent six peptides detected for SARS-CoV2 proteins. The LOQ and LODs for the peptides demonstrate the analytical performance of the instrument, which may be found in Technical Note 000055.

### Analytical properties: Determined LODs and LOQs for targeted peptides

| Peptide sequence | | LOD | LOQ | Linearity Range |
|---|---|---|---|---|
| | | (fmol on column) | | |
| Samples in nasal fluid | KADETQALPQR | 0.25 | 0.5 | 0.5–100.0 |
| | ADETQALPQR | 0.25 | 0.5 | 0.5–100.0 |
| | AYNVTQAFGR | 0.25 | 0.5 | 0.5–50.0 |
| | NPANNAAIVLQLPQGTTLPK | 2.50 | 5.0 | 5.0–50.0 |
| | GWIFGTTLDSK | 5.00 | 10.0 | 10.0–100.0 |
| | DGIIWVATEGALNTPK | 2.50 | 2.5 | 2.5–50.0 |
| Samples in saliva | KADETQALPQR | 0.25 | 1.0 | 1.0–50.0 |
| | ADETQALPQR | 0.25 | 0.5 | 0.5–100.0 |
| | AYNVTQAFGR | 0.25 | 0.5 | 0.5–25.0 |
| | NPANNAAIVLQLPQGTTLPK | 2.50 | 2.5 | 2.5–50.0 |
| | GWIFGTTLDSK | 5.00 | 10.0 | 10.0–100.0 |
| | DGIIWVATEGALNTPK | 2.50 | 5.0 | 5.0–50.0 |

Thermo Fisher Scientific does not recommend or suggest analysis of the analytes described herein using its systems. Performance in an individual laboratory may differ from what is presented in this document due to factors, including but not limited to laboratory methods, materials used, operator technique, and system conditions. It is the laboratory's responsibility to validate performance of any assay it intends to utilize in its facility and to comply with all applicable laws and policies.




**A chromatographic trace demonstrating the separation of the targeted peptides. Each peptide has a less abundant isotope-labeled standard with near identical retention times (±0.01 minutes).**

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# Highly targeted, sensitive and confident detection

## Monitoring multiple compounds in a fast and sensitive way

A workflow to describe a targeted approach for the simultaneous detection of respiratory diseases using immunoprecipitation and selected reaction monitoring (SRM) is shown to be able to distinguish between different disease virus types. A fast, 5-minute LC gradient achieved reliable detection of all target peptides. Full analytical performance data may be found in Technical Note 000749.

### Analytical properties: Determined LODs and LOQs for targeted peptides

| Peptide sequence | | LOD | LOQ | Linearity Range |
|---|---|---|---|---|
| | | (fmol on column) | | |
| SARS-CoV-2 | GFYAEGSR | 0.10 | 0.25 | 0.25–100 |
| | LNQLESK | 0.05 | 0.05 | 0.05–100 |
| | ADETQALPQR | 0.25 | 0.25 | 0.25–100 |
| Influenza A | SALILR | 0.50 | 0.50 | 0.50–100 |
| | EGYSLVGIDPFK | 0.10 | 0.25 | 0.25–100 |
| | GVFELSDEK | 0.25 | 0.25 | 0.25–100 |
| Influenza B | TIYFSPIR | 0.10 | 0.25 | 0.25–100 |
| | GGGTLVAEAIR | 0.10 | 0.10 | 0.10–100 |
| HCoV-229E | AVAAALK | 1.00 | 1.00 | 1.00–100 |
| | FLEELNAFTR | 0.25 | 0.50 | 0.50–100 |
| RSV | DQLLSSSK | 0.50 | 0.50 | 0.50–100 |
| | NQDLYDAAK | 1.00 | 1.00 | 1.00–100 |

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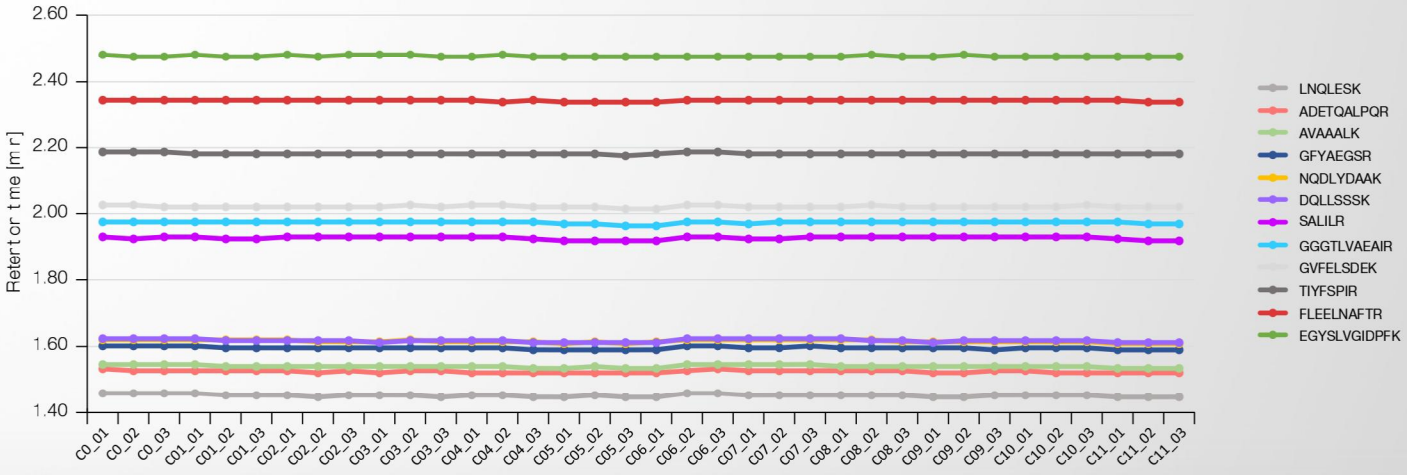


**Analytical properties: Variation of detected retention time determined to be less than ±0.01 minutes.**

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# Comprehensive software to perform LDTs with confidence

## Easy to use, built-in mass spectrometry software

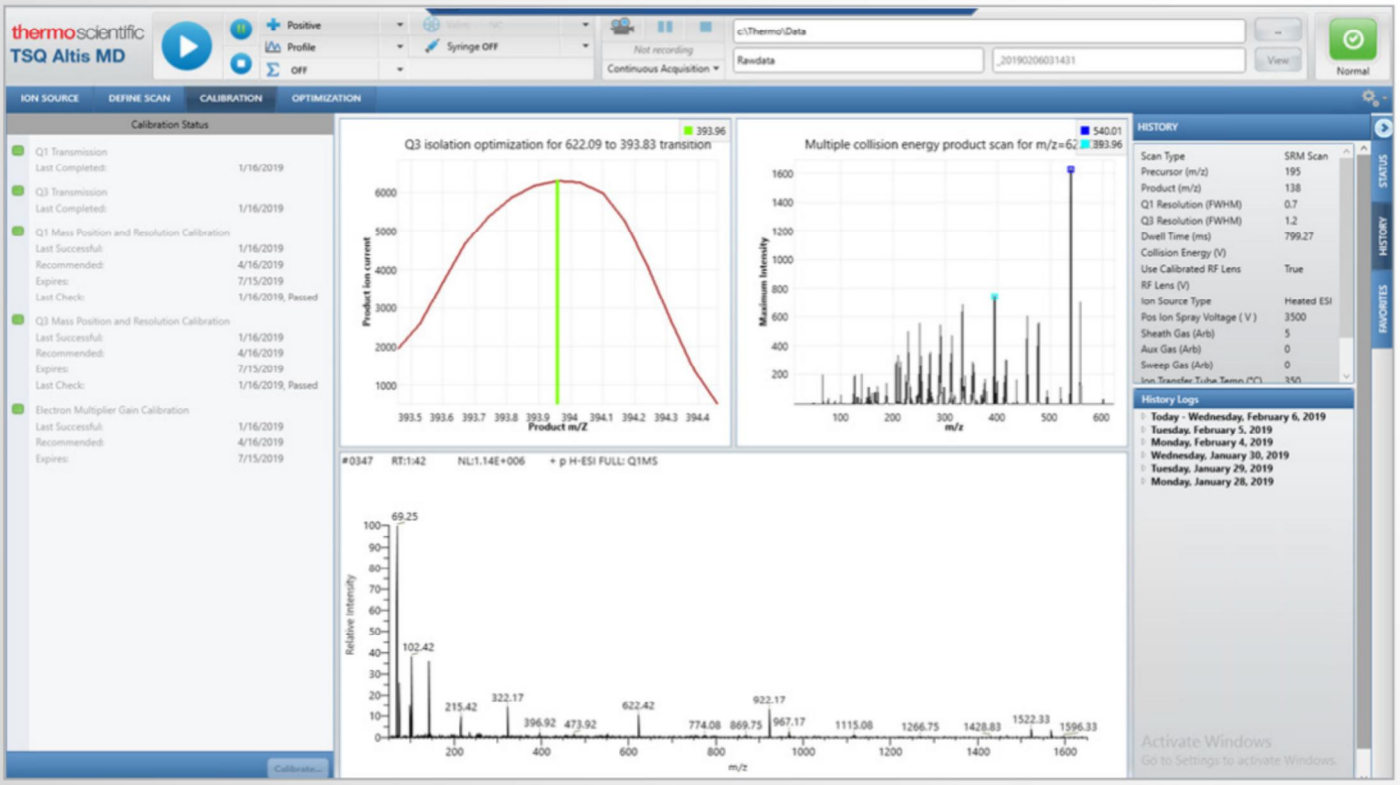
"Tune" the mass spectrometer and optimize analyte parameters with the integral TSQ II Altis MD and Quantis II MD Software. Control of the mass spectrometer is conveniently provided through two application packages: **Tune and Method Editor.**

### Key features of Tune software

- Constantly monitor instrument parameters and operating status
- Tune and calibrate are critical features for maximum performance
- Easily troubleshoot using diagnostic functions
- Generate reports for diagnostic purposes

### Key features of Method Editor software

- Set up and run experiments using optimized scan types established in Tune mode
- Design customized sequences of scans for complicated samples
- Specify peripheral device controls




**Tune software—calibrate the instrument for maximum performance with a variety of scan types, scan modes, ion polarities, scan rates, and resolution settings.**

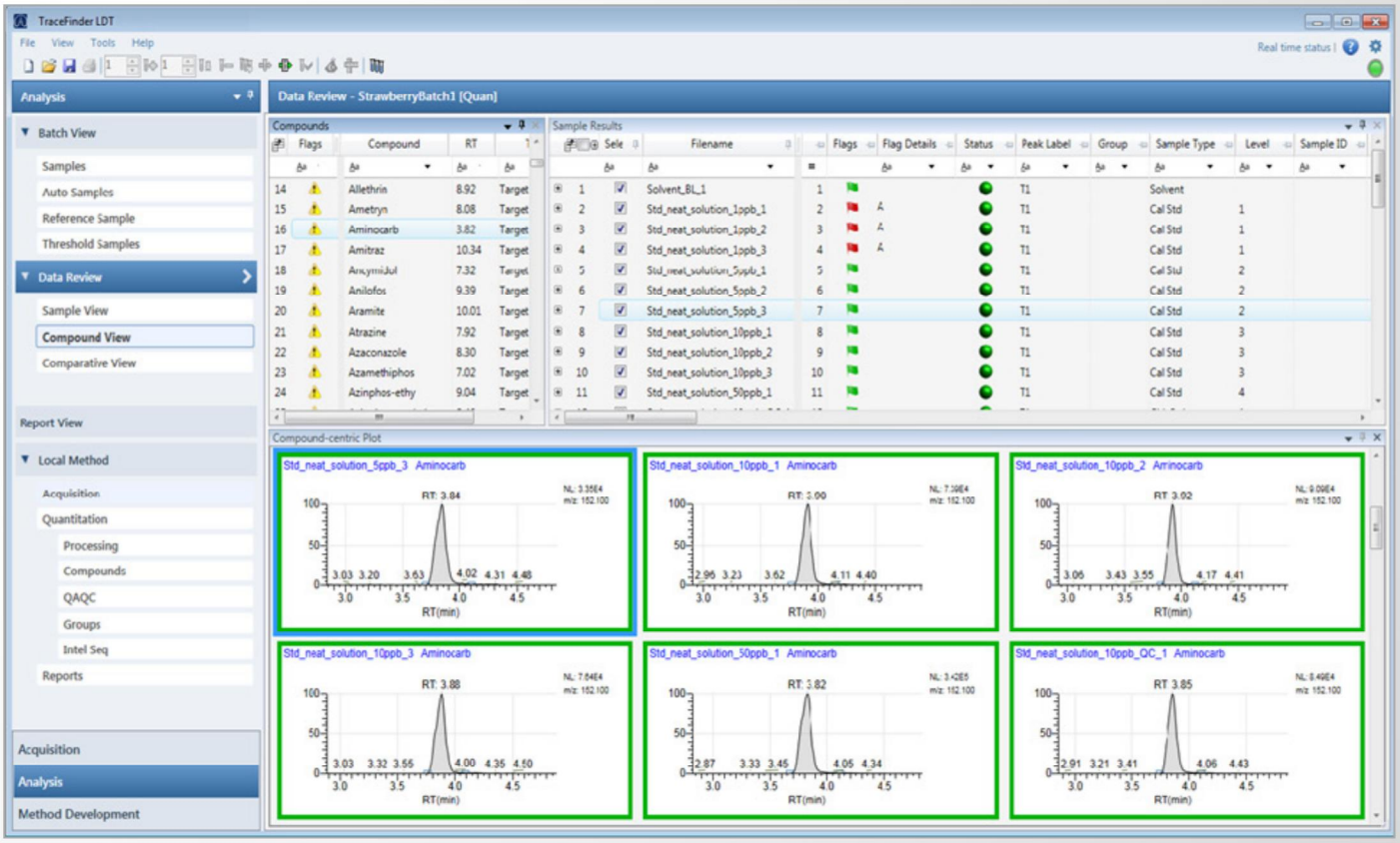
# Software for IVD LC-MS systems to maximize productivity and minimize risk

## Quantitate with the integral TraceFinder software

TraceFinder software provides a seamless approach to high-throughput quantitation. Automate and accelerate the processes of creating methods, loading samples, generating data, manually reviewing and editing results, and finalizing the data review and reporting process for a quick start-up. Comprehensive processing methods provide improved handling of ion ratio calculations, reviewing, reporting, and comparison of mass spectra and data integration.

### Key features

- Manage user-based permissions, data repositories, and auditing
- One software to acquire, process and report out data
- Develop instrument methods, and set processing, error flag parameters, and report options
- Use acquisition mode for creating and submitting samples
- Utilize results mode for batch views, data review, local method views, and report views




TraceFinder software—provides comprehensive processing methods and improved handling of ion ratio calculations, reviewing, reporting, comparison of mass spectra and data integration.

# Bi-Directional LIS Connection

## Expedited by the optional B-Link LIS/LIMS Connector

B-Link® is a Universal LIS/LIMS Connector validated for TraceFinder software. Comprised of a downloadable software package of "middleware" capable of providing bi-directional communication between TraceFinder software and the LIS, the B-Link LIS/LIMS Connector software is installed on the TSQ Altis MD Series data system or TSQ Quantis MD data system—there is no need for any additional hardware.

**This turnkey middleware solution facilitates data-sharing between:**

- The LIS/LIMS and B-Link (ASTM-1394-91 and ASTM 1381-95); and,
- B-Link and TraceFinder software (.csv)

Since the .csv input and output of the mass spectrometer do not conform to the requirements of the typical Laboratory Information System, laboratories performing LC-MS are often challenged by data management issues, such as:

- Downloading test requests to the mass spectrometer
- Uploading test reports to the Laboratory Information System

The B-Link LIS/LIMS Connector resolves these data management issues by converting data to the appropriate format and providing bi-directional communication

- Between LIS/LIMS and B-Link Connector
- Between B-Link Connector and TraceFinder software


# Specialized support designed for regulated labs from day one

## Keep your laboratory operating at peak performance

There's no time for downtime in your lab. Customers worldwide who depend on maximum availability of lab instruments for critical operations choose the Unity™ Lab Services Perform Service Plan to minimize disruption and stay focused on making accurate and effective decisions for patient care.

**The Perform Warranty lifts your service level above the factory warranty with these benefits and more:**

- Our fastest on-site response with two business days or less* for unplanned events
- Preventive maintenance (PM) scheduled on your timeline to minimize disruptions and ensure adherence to your compliance protocols
- A designated regulatory-certified FSE** team that knows your lab, procedures, and business, ensuring the highest quality of service possible with the highest levels of regulatory rigor
- Keep operators at peak performance through a robust e-learning portal
- Personalized onboarding and quarterly service consultations help to increase the predictability of your operations
- Flexibility for fit-for-purpose modifications to standard operational qualification (OQ) and requalification (RQ) testing to ensure we are meeting your compliance needs


* Two-business-day response times apply to corrective maintenance repairs. Preventive maintenance events are pre-scheduled upon request.

**Included with purchase of any LC-MS medical device for IVD use.

# Clinical diagnostics
# LC-MS/MS IVD systems

Thermo Fisher Scientific products are distributed globally so uses, applications, and availability of product in each country depend on local regulatory marketing authorization status.

Find out more at **thermofisher.com/IVDMS**

**IVD In Vitro Diagnostic Medical Device***

Liquid chromatography tandem mass spectrometry systems enable in vitro quantification of a variety of compounds in biological matrices. The performance data presented in this paper is for illustrative purposes only and may not represent the performance that laboratories will obtain. Thermo Fisher Scientific does not recommend or suggest analysis of the analytes described herein using its systems. Performance in an individual laboratory may differ from what is presented in this document due to factors, including but not limited to laboratory methods, materials used, operator technique, and system conditions. It is the laboratory's responsibility to validate performance of any assay it intends to utilize in its facility and to comply with all applicable laws and policies.

*Not for Clinical Diagnosis.


**BR73061-EN 0723M**