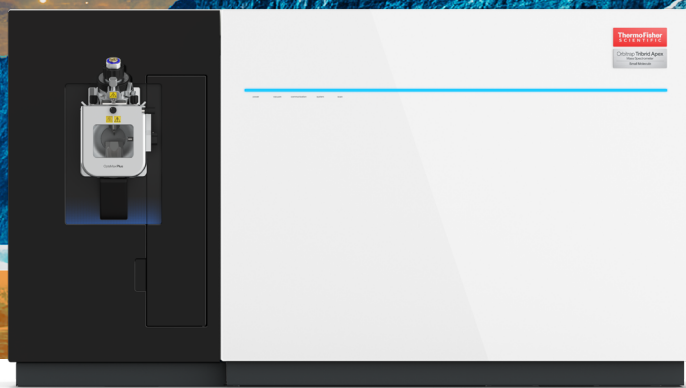




Mass spectrometry



Rise to the molecular challenges of today and tomorrow

Orbitrap Tribrid Apex Small Molecule mass spectrometer

Benefits

- 40% faster polarity switching for better quantitation and reduced analysis time
- Increased sensitivity with up to 10x lower limits of detection for some compounds
- MSⁿ and alternate fragmentation for confident annotation of unknown molecules
- Intelligent data acquisition methods with the Thermo Scientific™ AcquireX™ workflow and real-time library search (RTLS) for comprehensive data
- High versatility with three mass analyzers, high resolution, MSⁿ, and alternative fragmentation for the most challenging samples

Be prepared for the world ahead with our most flexible instrumentation yet—Thermo Scientific™ Orbitrap™ Tribrid™ Apex Small Molecule Mass Spectrometers. Explore new capabilities in metabolomics, lipidomics, and glycomics without compromising ease of use. Quantify more samples at lower concentrations using intelligent acquisition; achieve greater depth with optimal scan efficiency; and characterize small molecules with optional alternate fragmentation and ion manipulation techniques. We're introducing the first commercial IR-laser for more efficient fragmentation of lipids, delivering yet another innovative solution to real experimental problems.

Go deeper with advanced accuracy, accessibility, and adaptability with the Orbitrap Tribrid Apex Small Molecule mass spectrometer.

Key capabilities

- The first small-molecule–dedicated Thermo Scientific™ Tribrid™ system featuring an improved high-sensitivity atmospheric pressure interface that combines an HCTT with a modified electrodynamic ion funnel (EDIF) providing increased ion flux and lower limits of detection across a broader range of molecules
- Unique Thermo Scientific™ Tribrid™ architecture includes a quadrupole mass filter, a dual-pressure linear ion trap, and Thermo Scientific™ Orbitrap™ mass analyzers, allowing unique combinations of high-sensitivity IT analyses, high-resolution OT analyses, and a broad range of MSⁿ acquisition types using a variety of fragmentation techniques
- Active Ion Management (AIM+) technology, which includes the QR5 segmented quadrupole mass filter with hyperbolic surfaces, maximizes ion transmission to achieve unprecedented levels of qualitative and quantitative performance
- Dual Ion Routing Multipoles (IRMs) maximize instrument duty cycle and ion utilization during even the most complex MSⁿ acquisitions
- Improved parallelization of MS and MSⁿ analyses with new maximum injection times, providing extra sensitivity without compromising acquisition rates
- Automated, remote, and hands-free calibration with the Thermo Scientific™ Auto-Ready 2 ion source, allowing the user to spend more time obtaining results and less time on instrument setup
- RTLS enables intelligent MSⁿ data acquisition and improved unknown fragmentation management, significantly increasing analytical performance
- Enhanced vacuum technology improves Orbitrap mass analyzer performance
- Environmentally friendly, oil-free dry pumps are standard for less maintenance and leak-free vacuum performance
- DDA MS/MS acquisition rates of up to 75 Hz with 3,750 resolving power at m/z 200 for the Orbitrap mass analyzer and 100 Hz under select linear ion trap scan conditions and injection times
- New Orbitrap resolutions from 3,750 up to 480,000 FWHM at m/z 200
- Improved linear ion trap electron multiplier detector with significantly longer lifetime and robustness
- Optional laser ion activation—choose between a UV- or IR-laser source to support application-specific orthogonal ion activation
- Multiple fragmentation techniques are available at any MSⁿ stage, with detection in the Orbitrap or the linear ion trap mass analyzers
 - » Resonant collision-induced dissociation (CID) and higher-energy collisional dissociation (HCD)
 - » Optional laser activation with ultraviolet photodissociation (UVPD) or infrared multiphoton dissociation (IRMPD)
- Advanced Peak Determination (APD) for improved precursor annotation in data-dependent experiments
- Intuitive, flexible drag-and-drop instrument method editor simplifies method development and creation of unique analytical workflows
- Extensive pre-built and optimized method templates are fully customizable for a variety of application workflows
- The AcquireX data acquisition workflow provides all-inclusive, automated small molecule sample profiling on an LC timescale
- Streamlined calibration routines with improved Orbitrap calibration for ions with m/z <200

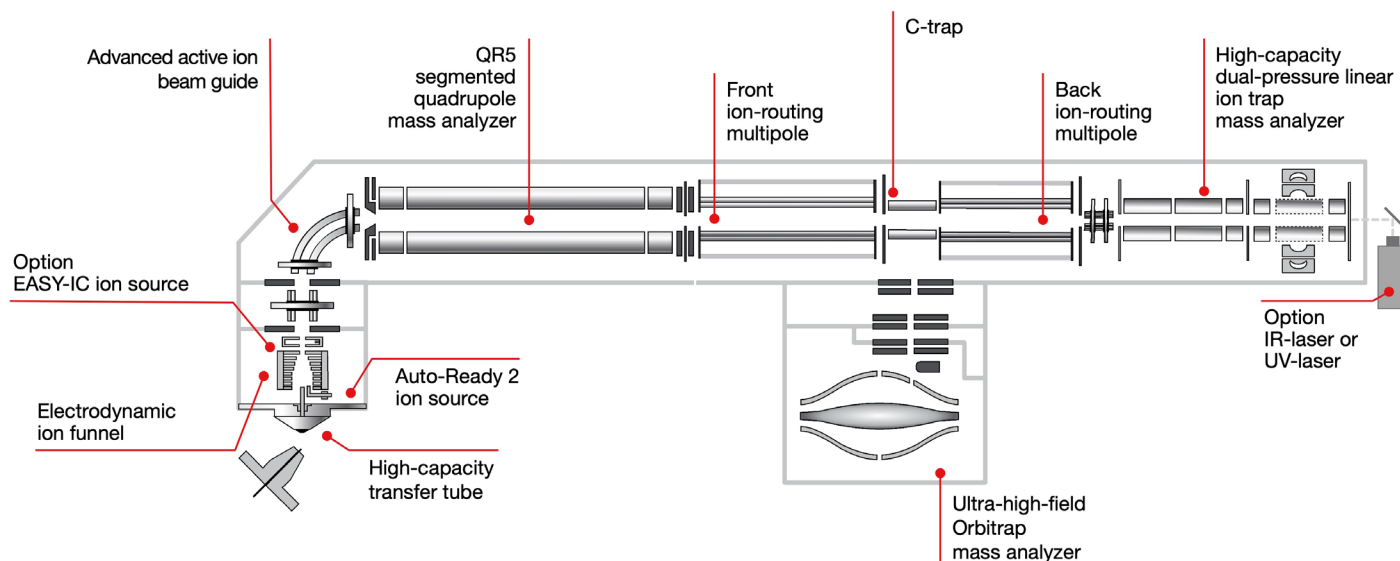


Figure 1. Orbitrap Tribrid Apex Small Molecule mass spectrometer ion path.

Hardware features

Active Ion Management (AIM+) technology

AIM+ maximizes ion transmission, from injection to detection, using a novel hardware design for precise management of electrical fields and removal of noise to achieve unprecedented levels of quantitative performance.

Ion source

Thermo Scientific™ OptaMax™ Plus ion source

- Enhanced stability—the new heater and sprayer design significantly enhances heat transfer, offering superior electrospray stability across a broad temperature range
- User-friendly design—experience enhanced ease of use with adjustable and reproducible movement, simplifying our workflow
- Versatile flow rate compatibility—supports a wide range of flow rates from 1–2,000 $\mu\text{L}/\text{min}$, providing flexibility for various applications
- Optional Atmospheric Pressure Chemical Ionization (APCI) probe—the optional APCI probe is compatible with flow rates from 100–2,000 $\mu\text{L}/\text{min}$ and can be upgraded with Atmospheric Pressure Photoionization (APPI) capabilities for expanded functionality

Auto-Ready 2 ion source

- Integrated source with dedicated emitter and ion transfer tube simplifies maintenance and calibration
- System checks and calibrations can be triggered on demand or scheduled without disruption to your LC-MS configuration
- Calibration and maintenance results are controlled and reported directly in the instrument control software interface
- Internal Thermo Scientific™ Pierce™ FlexMix™ Calibration Solution consumable lasts ≥ 3 months with weekly mass calibration and monthly system calibration, plus intermittent checks

New generation ion optics and mass analyzers

The first small-molecule–dedicated Tribrid system that utilizes an HCTT and EDIF.

High-capacity transfer tube

- Increases ion flux into the vacuum system for improved sensitivity
- Offers vent-free maintenance

Electrodynamic ion funnel

- A modified ion funnel captures the ions under more gentle conditions, improving the transfer of labile compounds while maintaining optimal transmission
- Automatic tuning results in broad ion transmission curves with reduced ion losses, increasing sensitivity

Advanced active ion beam guide (AABG)

- AABG with an axial field and low-pass filter prevents neutrals and high-velocity clusters from entering the quadrupole mass filter

QR5 segmented quadrupole mass filter with hyperbolic surfaces

Next-generation quadrupole mass filter with 5.25 mm field radius delivers industry-leading ion transmission across m/z 50–2,000 range for efficient precursor selection with m/z 0.4–2,000 isolation width.

Front ion-routing multipole

- Ion storage capabilities
- HCD on MS²
- Efficient and reliable ion transfer between the ion-routing multipole, Orbitrap mass analyzer, and linear ion trap mass analyzer

Orbitrap mass analyzer

- Next-generation, ultra-high-field Orbitrap mass analyzer
- Low noise detection pre-amplifier
- Automatic calibration of all ion transfer parameters

Dual-pressure linear ion trap mass analyzer

- MSⁿ, $n = 1$ through 10, using any available fragmentation technique
- Precursor isolation width range from 0.2–2,000 m/z for precursors from 50–2,000 m/z for normal mass range isolations
- CID and UVPD or IRMPD fragmentation techniques
- Low-pressure cell for improved scan rates, resolving power, and mass accuracy
- Dual-dynode detector with high linear dynamic range for improved quantification and increased lifetime and robustness

Vacuum system

- Multiple turbomolecular pumps create vacuum stages ranging from >1 Torr down to $\sim 1 \times 10^{-10}$ Torr
- Stainless steel and aluminum high-vacuum analyzer chambers
- Enhanced vacuum technology reduces the pressure in the ultra-high vacuum region to $<10^{-10}$ Torr
- Improved vacuum management and UHV pump design for optimal UHV pressures and noise characteristics

Analog inputs

- Channel 1 analog input (0–10 V); channel 2 analog (0–2 V)

Optional hardware

Thermo Scientific™ EASY-IC™ ion source (recommended)

- Generates internal calibrant ions for real-time mass calibration of spectra in positive and negative modes
- Provides <1 ppm RMS drift over 24 hours, measured with Pierce FlexMix calibration solution

Thermo Scientific™ UV-laser source (recommended)

- Class 1 laser MS system incorporating a Class 4, 213 nm wavelength CryLaS™ laser system with 2.5 kHz repetition rate, delivering >1.2 μJ per pulse
- Performs dissociation of precursors at any stage of MSⁿ, with detection in either the ion trap or Orbitrap mass analyzer
- Compact size, located entirely within the footprint of the instrument

Thermo Scientific™ IR-laser source

- Class 1 laser MS system incorporating a Class 4, 10.6 μm wavelength Coherent™ CO₂ laser system with 30 W continuous wave output
- Enables precursor dissociation with IRMPD at any MSⁿ stage, with detection in either the ion trap or Orbitrap analyzer
- Incorporated design, fully contained within the instrument's footprint

Thermo Scientific™ FAIMS Pro Duo interface

- Performs online gas-phase fractionation based on differential ion mobility
- Offers optimized performance for 100 nL/min to 1 mL/min flow rates

Field upgradeability

All options on the Orbitrap Tribrid Apex Small Molecule mass spectrometer are field upgradeable with the EASY-IC ion source and UV-laser or IR-laser.

For the first time, our Orbitrap Tribrid Apex Small Molecule mass spectrometer hardware and software are field-upgradeable to the Thermo Scientific™ Orbitrap™ Tribrid™ Apex MultiOmics Mass Spectrometer for large molecule work.

This upgrade includes:

- Large molecule mode and templates, DIA support, charge-state filtering above 2, and an expanded mass range
- Compatibility with the Thermo Scientific™ EASY-ETD™ ion source, PTCR, Native MS, and Direct Mass Technology field upgrades

Software features

Data system

- High-performance PC with Intel™ microprocessor
- High-resolution LED color monitor
- Microsoft™ Windows™ 11 operating system

Thermo Scientific™ Xcalibur™ software

- Xcalibur software is the control software for the next-generation Thermo Scientific™ mass spectrometer portfolio
- Accelerates familiarization and reduces training needs

Orbitrap Tribrid Apex MS instrument control software

- Tune application for instrument calibrations and check diagnostics and manual data acquisition
- Method editor with a comprehensive application-specific template library, method setup supported by tooltips, and a drag-and-drop user interface to facilitate method development

Optional software

Thermo Scientific™ Compound Discoverer™ software

Platform for small-molecule structural identification and comparative data analysis.

Operation modes

Flexible acquisition modes

Supports both data-dependent acquisition (DDA) for automated, high-throughput identification and targeted MS/MS (tMS²) for enhanced sensitivity and quantitative precision.

Top speed

Maximizes the number of high-quality MSⁿ spectra in each cycle by intelligently scheduling MS and data-dependent MSⁿ scans based on a user-defined time between adjacent survey spectra.

TopN

Enables a user-defined maximum number of high-quality MSⁿ spectra from each cycle.

Dynamic maximum injection time

Maximizes the amount of high-quality data acquired by synchronizing operations of ion injection, ion transfers within the instrument, and operation of the linear ion trap and Orbitrap mass analyzers.

Advanced peak determination

Precursor annotation algorithm for improved charge state assignment to increase the number of precursors available for data-dependent analysis.

Exclusive technologies

Dynamic scan management

Enables intelligent, real-time scheduling, parallelization, and prioritization of acquisition events, and selection, sorting, and routing of precursors to different fragmentation modes and analyzers based on user-selected parameters, including precursor m/z , intensity, and/or charge.

Multiple dissociation options

Precursor dissociation can be performed in the ion-routing multipoles (HCD), the linear ion trap (CID and optional UVPD or IRMPD), with product ion detection in the linear ion trap, or Orbitrap mass analyzer at any stage of MSⁿ analysis.

Automatic gain control

Helps ensure that the ion-routing multipole is always filled with the optimum number of ions for any acquisition type.

Real-time library search

Intelligent acquisition provides higher confidence with real-time spectral matching against a local, customizable spectral library for decision-based triggering of MSⁿ acquisition events. It enables library-directed MSⁿ data acquisition to increase confidence in annotation, including structurally related compounds, and improve structure assignment of isomeric species, unknown characterization, and other applications.

Precursor fit filter

Allows selection of precursors with defined specificity.

Advanced data-dependent experiments

Universal method

Powered by Dynamic Maximum Injection Time, helps ensure the best results from samples with unknown concentrations.

Product-ion-triggered MSⁿ

Fragment-ion- or neutral-loss-triggered MSⁿ experiment, including at the same MSⁿ level.

Isolation offset

Custom centering of the precursor isolation window, optimized for broad isotopic distributions.

Performance specifications

Orbitrap mass range	<i>m/z</i> 40–2,000 (dependent on mass range and MS ⁿ order)
Orbitrap resolution	Standard resolution settings from 3,750–480,000 (FWHM) at <i>m/z</i> 200, with isotopic fidelity up to 240,000 FWHM
Acquisition rate*	Orbitrap MS/MS acquisition rates up to 75 Hz when measured using a data-dependent experiment with Pierce FlexMix calibration solution, MS and HCD MS/MS resolution setting of 3,750 at <i>m/z</i> 200, with a maximum ion fill time of 8 ms. Linear ion trap MS/MS acquisition rates up to 100 Hz using Pierce FlexMix calibration solution and HCD MS/MS ion trap detection <i>m/z</i> range less than 200, with an MS/MS maximum ion fill time of <5 ms.
Orbitrap mass accuracy*	External calibration achieves <3 ppm RMS drift over 24 hours, measured with Pierce FlexMix; internal calibration achieves <1 ppm RMS drift over 24 hours, measured with Pierce FlexMix
MS/MS Electrospray Ionization (ESI) ion trap sensitivity	2 µL of a 50 fg/µL solution of reserpine (100 fg total) injected at a flow rate of 500 µL/min produces a minimum S/N of 200:1 for the transition of the isolated protonated molecular ions at <i>m/z</i> 609 to the largest two product ions, <i>m/z</i> 397 and <i>m/z</i> 448, when the mass spectrometer is operated at unit resolution in the full scan MS/MS mode, <i>m/z</i> 165–615; the test requires the HESI II probe
Dynamic range	>5,000 within a single Orbitrap mass spectrum
MS scan power	Collects MS ⁿ , for n = 1–10, detected in the ion trap mass analyzer
Synchronous precursor isolation	Samples up to 20 precursors per MS ⁿ scan
Precursor multiplexing Quadrupole isolation range	Up to 20 precursors can be multiplexed using the quadrupole mass filter and front ion-routing multipole to perform selected ion monitoring or tandem MS Standard quadrupole with 5.25 mm field radius isolates from <i>m/z</i> 50–2,000 with isolation width of <i>m/z</i> 0.4–3,000
Polarity switching	One full experimental cycle acquired in <0.77 seconds equals >1.3 Hz, where the cycle consists of acquiring one full MS scan in positive and negative polarity at a resolving power setting of 60,000, running Pierce FlexMix with an average injection time of 2 ms

Optional performance specifications

UVPD option efficiency	Exposure of 100 ms dissociates the isolated caffeine molecular ion (<i>m/z</i> 195) to generate the <i>m/z</i> 138 product ion with a relative abundance of ≥25% to the precursor measured in the linear ion trap, using Pierce FlexMix calibration solution infused at 6 µL/min
IR option efficiency	Exposure to 25% NLP at q = 0.25 causes isolated MRFA 2+ molecular ion (<i>m/z</i> 262) to generate a series of fragments that have a summed relative abundance >50% to the precursor when measured in the linear ion trap with a scan range of 110–600 <i>m/z</i> using Pierce FlexMix calibration solution infused at 6 µL/min

*Under defined conditions

Installation requirements

Power

- 230 V AC $\pm 10\%$ single-phase, 50/60 Hz, with ground, 2 outlets at 15 A each
- 120 or 230 V AC single-phase with earth group for the data system

Gas

- Ultra-high purity helium (99.999%) with less than 1 ppm each of water, oxygen, and total hydrocarbons
- High-purity nitrogen (99.5% pure, flow rate 15 L/min) gas supply for the API source and IRM

Dimensions (W x D x H)

- 1270 x 805 x 703 mm (50 x 31.7 x 27.7 in.) without either laser option

Weight

- 312 kg (678 lb) without data system, vacuum rough pumps, and optional items

Environment

- System averages 2,800 W (10,000 Btu/h) output when considering air conditioning needs
- Operating environment must be 16–26 °C (59–78 °F) and relative humidity must be 50–80% with no condensation
- Optimum operating temperature is 18–21 °C (65–70 °F)

EASY-IC/ion source options

- Nitrogen supply for EASY-IC/ETD ion source options: Ultra-high purity nitrogen (UHP, 99.999%) with less than 1 ppm each water and oxygen

FAIMS Pro Duo interface option

- Nitrogen supply for FAIMS Pro Duo interface is 99.5% pure nitrogen at >20 L/min (100 psi)

 Learn more at thermofisher.com/TribridApexSmallMolecule

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