SHIMADZU

Excellence in Science

Shimadzu's Mass Spectrometry Solutions

LCMS Family Brochure
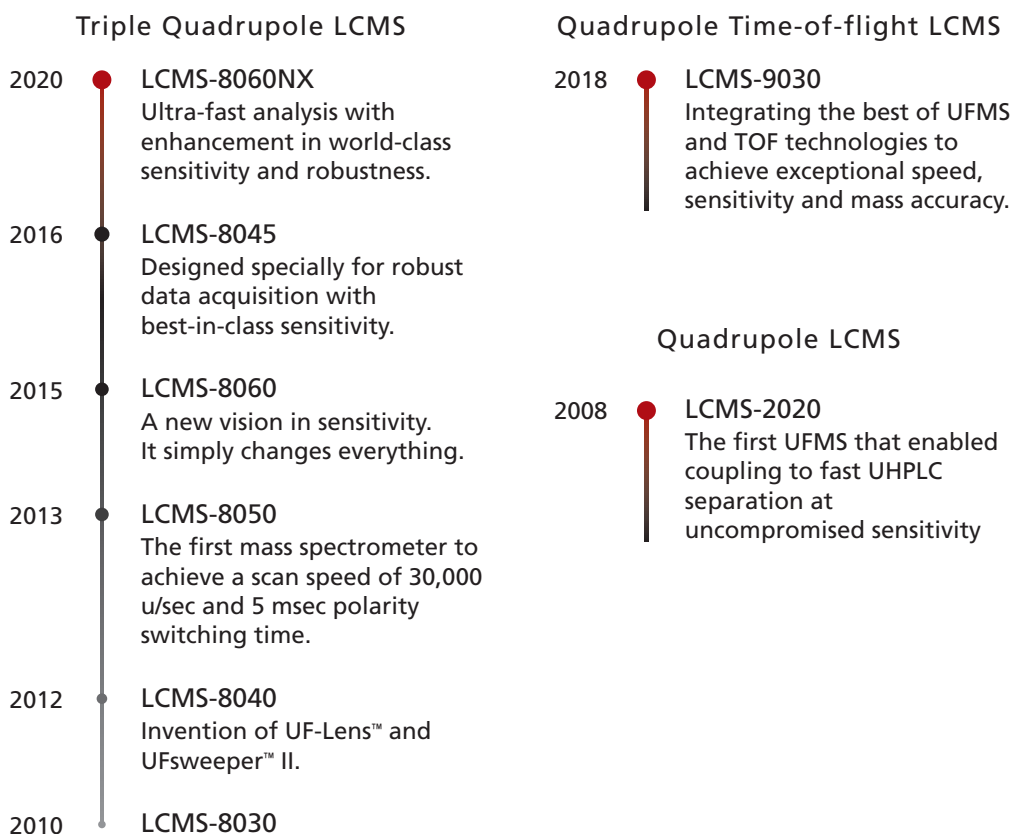
UFMS

ULTRA FAST MASS SPECTROMETRY

Shimadzu's Unique Technologies for Extending High-Speed Capabilities Have Established a New Benchmark in Mass Spectrometry

Being a provider of mass spectrometry devices since 1970, and with the spirit of meticulous engineering, Shimadzu has continued to improve the ion optics, collision cell design and data acquisition systems. Recently, breakthrough technologies such as UF-Lens™, UF-Qarray™ and UFsweeper™ have resulted in dramatic improvement of acquisition speed, which brought about a revolutionary change in the way multi-analyte quantitation can be run. The term Ultra-Fast Mass Spectrometry (UFMS™) was then introduced to describe instruments capable of measuring multitude of compounds without compromising sensitivity. The UFMS technologies deliver shorter pause time in between acquisition cycles and minimal polarity switching time, providing longer time for valuable data collection. With the use of UFMS, it can obtain unrivalled sensitivity and performance especially in challenging application involving multitude of compounds and simultaneous measurements.

This brochure introduces the LCMS lineup of Shimadzu's UFMS series, including single-quadrupole, triple quadrupole, and quadrupole time-of-flight mass spectrometers.

Speed Beyond Comparison
UFMS
ULTRA FAST MASS SPECTROMETRY

Launch History of Shimadzu's UFMS Series

Triple Quadrupole LCMS

2020 ● LCMS-8060NX
Ultra-fast analysis with enhancement in world-class sensitivity and robustness.

2016 ● LCMS-8045
Designed specially for robust data acquisition with best-in-class sensitivity.

2015 ● LCMS-8060
A new vision in sensitivity. It simply changes everything.

2013 ● LCMS-8050
The first mass spectrometer to achieve a scan speed of 30,000 u/sec and 5 msec polarity switching time.

2012 ● LCMS-8040
Invention of UF-Lens™ and UFsweeper™ II.

2010 ● LCMS-8030

Quadrupole Time-of-flight LCMS

2018 ● LCMS-9030
Integrating the best of UFMS and TOF technologies to achieve exceptional speed, sensitivity and mass accuracy.

Quadrupole LCMS

2008 ● LCMS-2020
The first UFMS that enabled coupling to fast UHPLC separation at uncompromised sensitivity

Triple Quadrupole LCMS

The simplest and most common form of a tandem MS (MS/MS) system is the triple quadrupole mass spectrometer (TQMS). It consists of three quadrupoles arranged in series with the first and third quadrupole acting as MS1 and MS2 filters, respectively, and collision-induced dissociation (CID) taking place in the second quadrupole. Shown in the schematic below is the measurement mode termed multiple reaction monitoring (MRM), which can achieve the highest sensitivity among all instrument types. With selectivity, specificity and sensitivity with minimal background, TQMS is an excellent instrument for quantitative analysis and is commonly employed for routine targeted analyses, and its duty efficiency is maximized by implementation of the UFMS technologies.

Quadrupole 1	Quadrupole 2	Quadrupole 3

Selected Ion Monitoring   CID   Selected Ion Monitoring
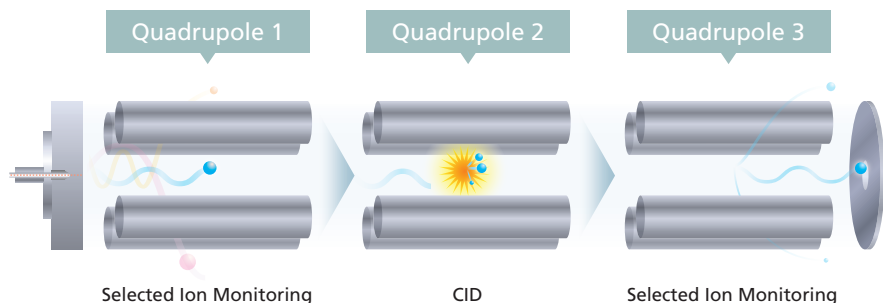
Quadrupole mass analyzers use a set of four parallel electrode rods to form an electric field. The electric field is oscillated to allow targeted m/z to resonate and pass through.
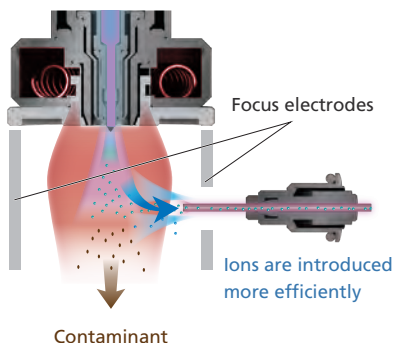
LCMS-8060NX
Enhanced performance   Sensitivity and Robustness
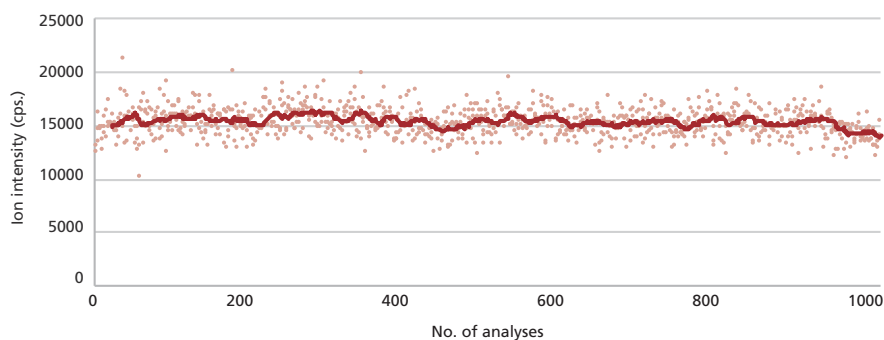
ANALYTICAL INTELLIGENCE

The LCMS-8060NX manifests the crowning achievement of Shimadzu's TQMS range. On top of the architecture of the LCMS-8060, it further added the flexibility to optimize parameters to achieve unsurpassed sensitivity, and the workflow is now supported by Analytical Intelligence for minimum human intervention. New ion optic components including the IonFocus™ unit, UF-Qarray II and UF-Lens II all increase robustness without compromising high ion transmission rate.

IonFocus Unit

Focus electrodes

Ions are introduced more efficiently

Contaminant

Signal stability over 1000 injections of a tough biological matrix
(2x diluted urine, 10 µL injection)

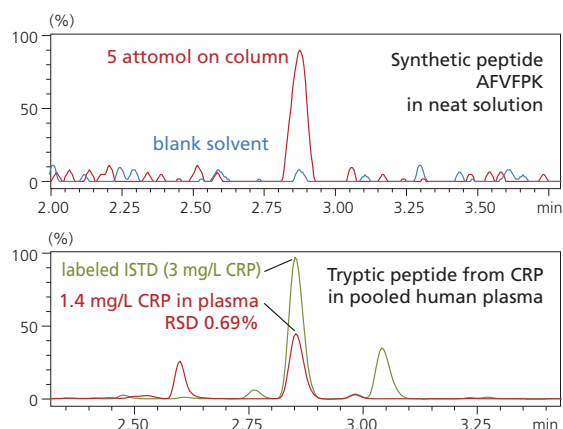Ion intensity (cps.)

No. of analyses

LCMS-8060
Changes Everything

The LCMS-8060 is the cornerstone model in the UFMS series. It delivers world-class sensitivity and excellent quantitation performance. Sensitivity is maintained even in the most difficult matrices, suitable for drug discovery, manufacturing, clinical research, food safety, environmental, or drugs-of-abuse analysis.

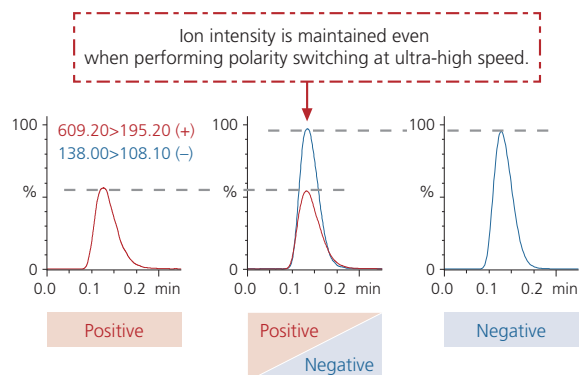High-throughput detection of a proteotypic peptide of C-Reactive Protein using conventional flow rate.

5 attomol on column

blank solvent

Synthetic peptide AFVFPK in neat solution

labeled ISTD (3 mg/L CRP)

1.4 mg/L CRP in plasma RSD 0.69%

Tryptic peptide from CRP in pooled human plasma

LCMS-8050
Speed and Sensitivity Beyond Comparison

The LCMS-8050 is the high-sensitivity UFMS model that remains to be the fastest TQMS instrument on market today with 5 msec polarity switching time and 555 MRM/sec. It reveals the ideal balance of good data quality, high throughput and affordability for a wide range of challenging and routine applications.

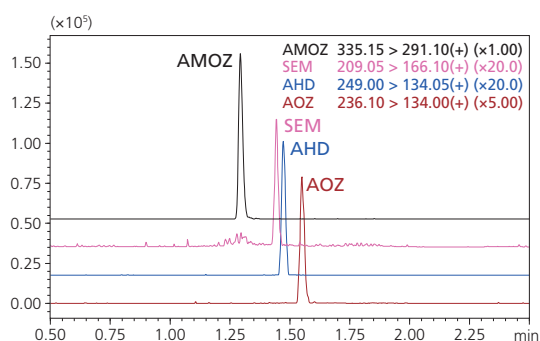Comparison of measurement with and without ultra-fast polarity switching (5 msec)

Ion intensity is maintained even when performing polarity switching at ultra-high speed.

609.20>195.20 (+)
138.00>108.10 (−)

Positive

Positive / Negative

Negative

LCMS-8045
Best-in-class Sensitivity

The LCMS-8045 was designed to be robust and indeed it is the workhorse machine for the most routine applications of food safety and forensic toxicology. The heated ESI probe, high-temperature heat block, heated desolvation line, drying gas and focusing optics all act to minimize contamination for the best-in-class sensitivity achieved. It withstands long periods of continuous operation in laboratories in demand of reliable data.

MRM chromatogram of nitrofuran metabolites spiked in fish (0.5 ng/mL)

AMOZ	335.15 > 291.10(+)	(×1.00)
SEM	209.05 > 166.10(+)	(×20.0)
AHD	249.00 > 134.05(+)	(×20.0)
AOZ	236.10 > 134.00(+)	(×5.00)

LCMS-8040
Enhanced Sensitivity

The LCMS-8040 is the long-proven UFMS providing acquisition speed of 555 MRM/sec and 15 msec polarity swithing time. It is equipped with UF-Lens and UFsweeper II collision cell, the hallmark technologies underlying fast ion transmission and high sensitivity.

MRM chromatogram of 100 fg verapamil and warfarin on column.

Verapamil 455.25>165.05 (+)

Warfarin 307.20>161.05 (-)
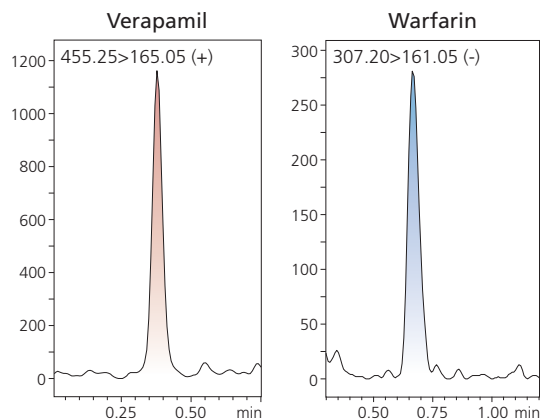
LabSolutions Connect™

The Gateway to Better Results and Workflow

Optimization of MRM parameters is a mandatory process to achieve high sensitivity in analyses, and it can be a complicated workflow if a laboratory works with multitude of new compounds or projects. LabSolutions Connect provides the automation platform with a sophisticated algorithm to standardize the process and to manage the results in a compound database. It also assists LCMS method creation using the information stored in the database and subsequent batch analysis.
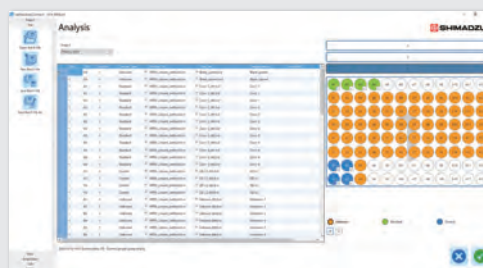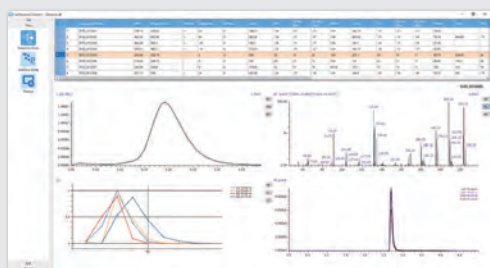
1. Reviewing optimization results
   - Hundreds of compounds can be processed simultaneously.
   - Automatically determines the LC retention time.
2. Method file creation and batch analysis
3. Project-based file management
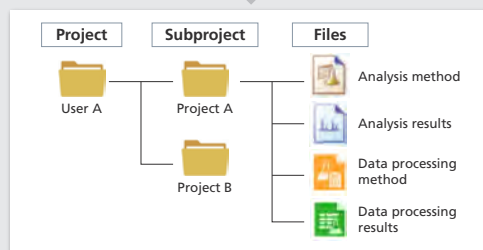
LabSolutions Insight™

Rethinking Quantitative Data Review

LabSolutions Insight has powerful data mining and analytics capabilities for efficient processing of LC-MS/MS results to generate quantitative outcome. It is designed to support review-by-exception (flagging) that dramatically saves the time of manual data review, and it has the flexibility to accommodate various reporting workflows with multiple result files. Moreover, LabSolutions Insight now has the added capability to work seamlessly with the LabSolutions™ DB/CS environment to assure data integrity.

Reviewing quantitative results facilitated by color-coded flags
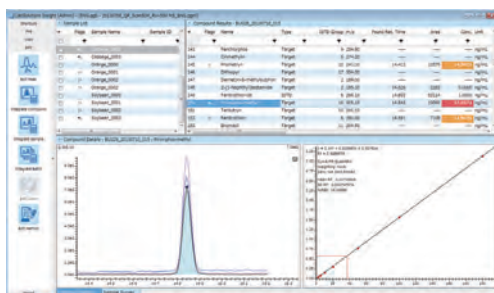
LabSolutions Insight Library Screening
'MRM & Product Ion Scan', or 'MRM Spectrum Mode'

This optional license addendum to LabSolutions Insight is fully recommended for scientists undergoing known-unknown screening for forensic toxicology, veterinary drugs and pesticides. The Library Screening option adds the library search capability to further increase the identification confidence of the quantitative signal, provided that the data contains either product ion scan or multitude of MRM transitions (MRM spectrum mode).
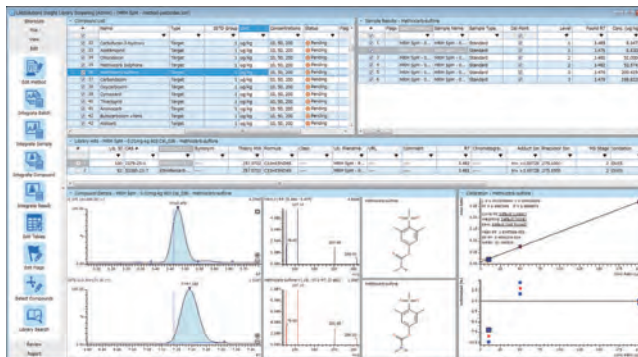
LC/MS/MS Method Packages and MRM Libraries
Validated, Turn-key Methods to Support Sophisticated Analyses

Shimadzu offers a wide variety of method packages containing LC separation conditions, retention times and validated MRM parameters for large numbers of compounds. Laboratories can skip time-consuming method development steps, lowering the implementation barrier.

|	Description	Flyer code	Description	Flyer code
Method Packages	Residual Pesticides	C146-E348	Cell Culture Profiling	C146-E279
	Veterinary Drugs	C146-E161	D/L Amino Acids	C146-E336
	Water Quality Analysis	C146-E180	Short Chain Fatty Acids	C146-E355
	Rapid Toxicology Screening	C146-E224	Mycotoxins	C146-E351
	Primary Metabolites	C146-E227	Aminoglycoside Antibiotics	C146-E352
	Lipid Mediators	C146-E381	Restricted Chemicals in Textiles	C146-E382
MRM Libraries	Metabolic Enzymes in Yeast	C146-E275	Phospholipid Profiling	C146-E314

Note: Check your local sales office to learn which packages are compatible with each LCMS model.

Traverse MS
Multivariate Analysis Software

Traverse MS data analysis software enables multivariate analysis of high complexity data in the field of metabolomics. Both Shimadzu GCMS and LCMS MRM data can be analyzed to align, identify, and quantitate component peaks. Large sample sets can be displayed graphically, statistical analysis can be performed, and metabolite pathways can be mapped.

* Traverse MS is provided by Reifycs Inc.
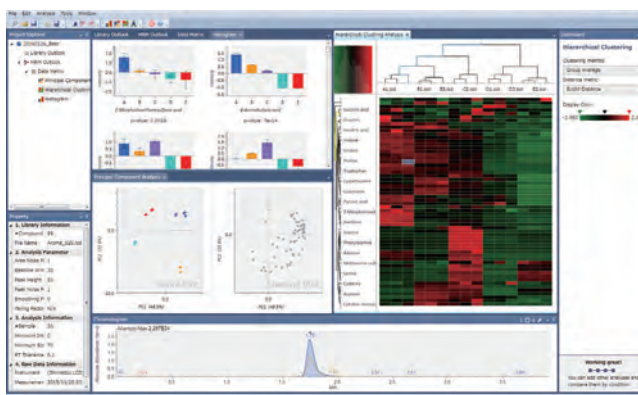
Single Quadrupole LCMS

LCMS-2020
Speed is Power – Seeing is Believing

This ultra-fast single quadrupole MS serves as the ideal detector for HPLC or UHPLC for quick assessment of impurities and accelerating target purification. Like other UFMS families, the LCMS-2020 is fast, robust and sensitive.

Mass chromatogram of PEG-400
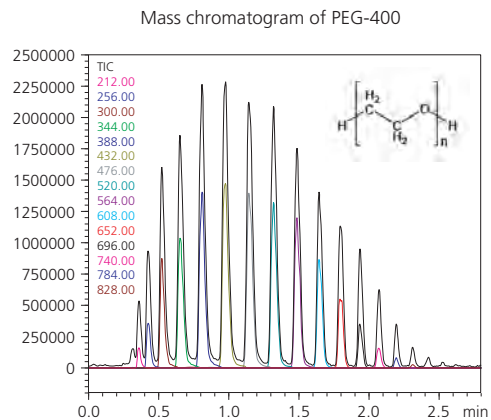
The optional software Open Solution™ Purification facilitates complex purification processes by intuitive user interface and extensive automation of analysis, fractionation and purity assessment.
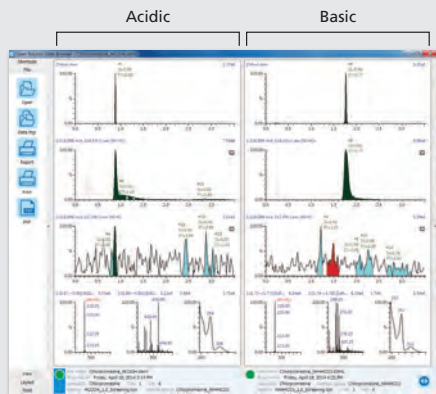

1. Analysis
   - Automatically performs separations under multiple conditions.
   - Displays a comparison of results from multiple methods.
2. Fractionation
   - Automatic creation of a batch queue by loading the result files for the purification work.
   - Color coding for fraction purity.
3. Purification Results
   - Display fractionation results from any networked PC.
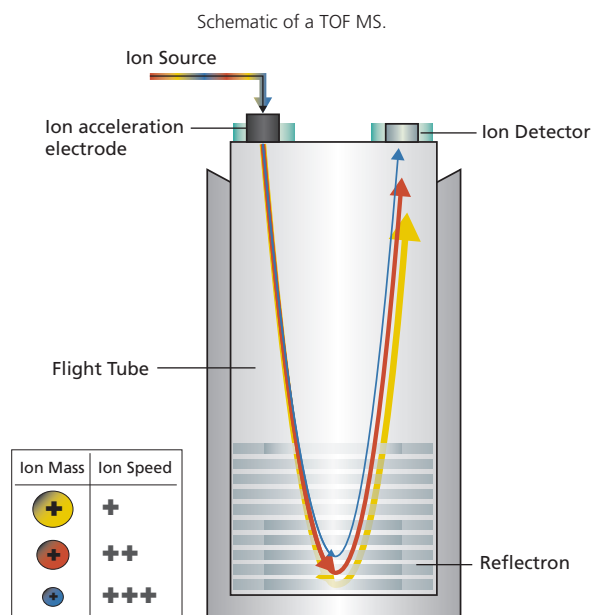   - Click on the well to display MS and/or UV spectra.
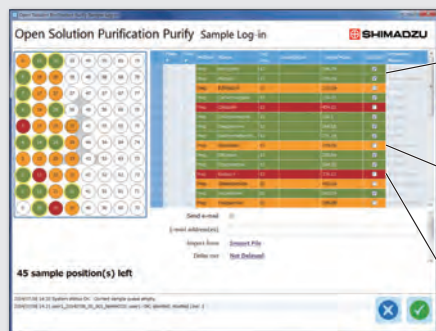
OK

Impurities might be present.

No target peaks exist.
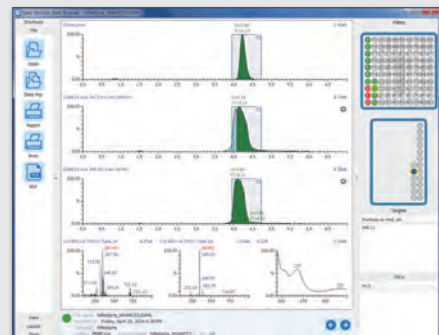
Quadrupole Time-of-flight LCMS

Shimadzu's quadrupole time-of-flight (Q-TOF) LCMS uses a hybrid of technologies. Ions generated at the ion source are first focused into a 'beam' and transmitted through the quadrupole, using the proven UFMS technologies such as UF-Lens and UFsweeper collision cell. On the other end, the new TOF technology analyzes the ions in 'pulses', measuring the time taken for the ions to travel through a high vacuum chamber (flight tube) to resolve and determine their masses. High mass resolution and mass measurement accuracy achieved in this way are the key features of Q-TOF LCMS. It is used extensively for structural elucidation of unknown compounds in not only the chemical industry but also in food safety, clinical toxicology, environmental monitoring and biomedical research.
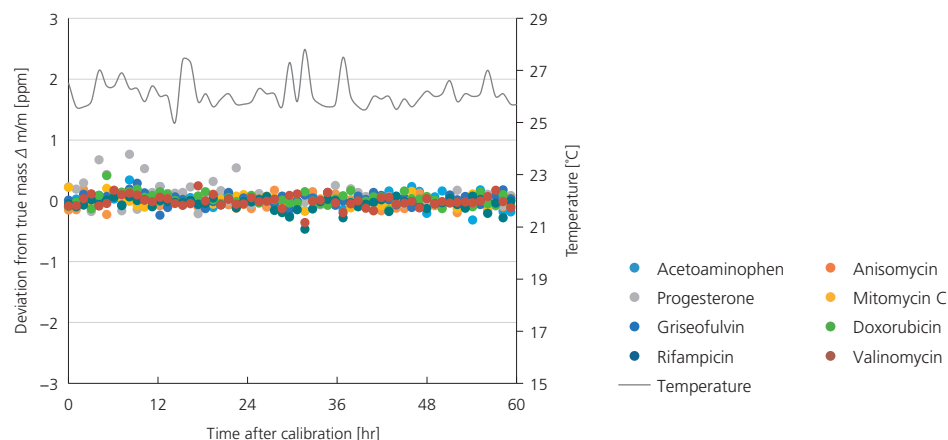
Schematic of a TOF MS.

Ion Source

Ion acceleration electrode

Ion Detector

Flight Tube

Ion Mass	Ion Speed
+	+
+	++
+	+++

Reflectron

LCMS-9030
Effortless Performance

Mass measurement accuracy is the key performance attribute underlying all application fields using high-resolution accurate-mass (HRAM) instruments. The LCMS-9030 delivers the accuracy needed for high-confidence identification of unknown compounds at an unprecedented level of stability. This is made possible by new technologies implemented in the Intelligent Temperature Control System and the UF-FlightTube™ that accurately offset the changes occurring to both internal and external environments. With the LCMS-9030, Shimadzu aims to totally refashion the HRAM user experience, enabling scientists to run more samples at longer calibration intervals with greater confidence and ease.
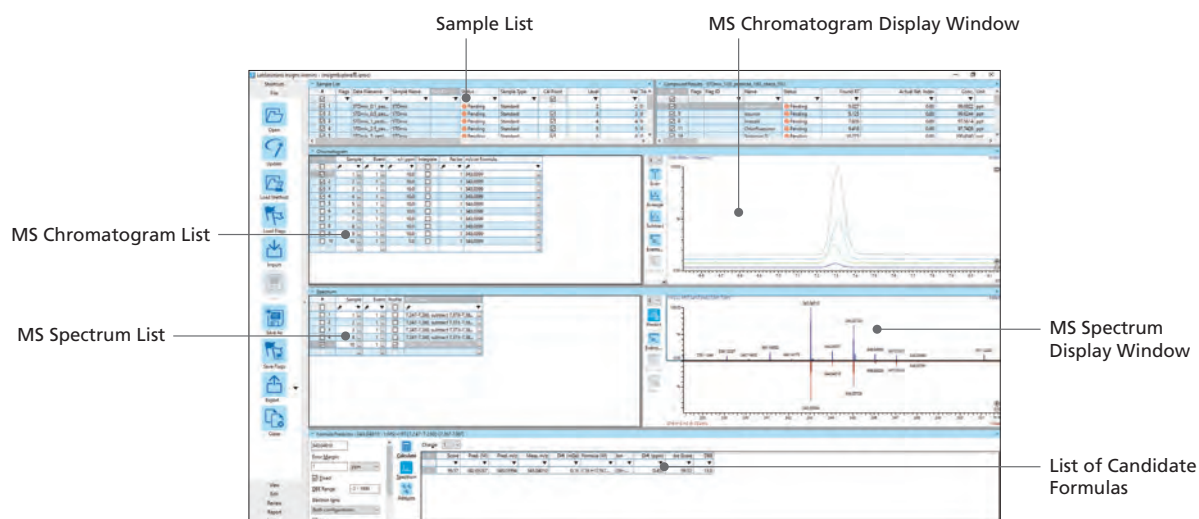
Mass measurement accuracy of 8 compounds measured over 24 hours by external calibration

- Acetoaminophen
- Anisomycin
- Progesterone
- Mitomycin C
- Griseofulvin
- Doxorubicin
- Rifampicin
- Valinomycin
- Temperature

LabSolutions Insight Explore™
Software for Both Qualitative and Quantitative Analysis

LabSolutions Insight Explore offers an intuitive and full-featured quantitative environment with significant qualitative enhancements. A sophisticated peak detection algorithm detects chromatographic features based on their accurate mass. Resulting peak displays enable ranked formula prediction with theoretical spectral matching. With this integrated platform, scientists can leverage on the sensitivity, mass measurement accuracy and acquisition speed of the LCMS-9030 to provide an unambiguous answer to challenging analyses.

Sample List · MS Chromatogram Display Window · MS Chromatogram List · MS Spectrum List · MS Spectrum Display Window · List of Candidate Formulas

Optional licenses are available to add extended capabilities. The Library Screening option is needed to identify compounds via library search. The CSD option gives support to perform high quality deconvolution of multivalent ions, such as for proteins and oligonucleotides, by the novel algorithm developed by Positive Probability Ltd as opposed to the classical ReSpect algorithm implemented by default.

Exact Mass Database for Endogenous Metabolites
Ready-to-use Methods for Metabolomics

This database contains multiple ready-to-use methods for comprehensive analysis of metabolites, specially targeting for those requiring optimized LC conditions for isomeric resolution. Recommended pretreatment protocols are also included for various sample matrices. The database is compatible with the Multi-omics Analysis Package (sold separately) that enables graphical presentation of metabolite quantities on the metabolic pathway map as well as network analysis and statistical analysis. These features provide a foundational starting point for exploring deeper into the metabolome for biomedical researches.

POWERED BY
GARUDA
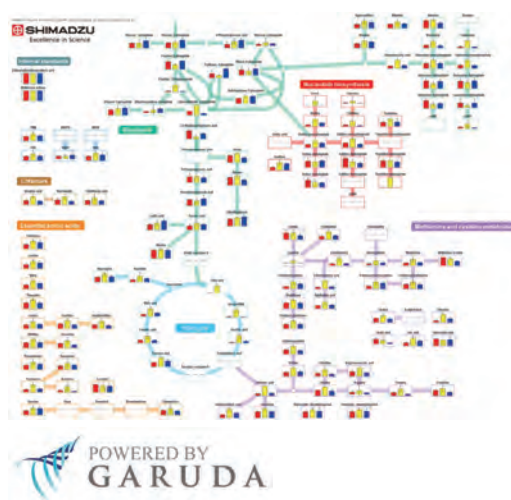
Ionization Unit Compatibility Table

	LCMS-2020	LCMS-8040	LCMS-8045	LCMS-8050	LCMS-8060	LCMS-8060NX	LCMS-9030
ESI	●	●					
APCI	●	●	●	●	●	●	●
DUIS™	●	●	●	●	●	● with IonFocus	●
Heated-ESI			●	●	●	●	●
Heated-ESI with IonFocus						●	
Micro-ESI			●	●	●	●	●
Probe-ESI (DPiMS™)	●		●	●	●	●	

More Resources

Celebrating 50 Years of MS Innovation
- Looking Back on 50 Years

Click on the image or read the QR code
to download the PDF and learn more.

Fundamental Guide to
Liquid Chromatography
Mass Spectrometry (LCMS)

Click on the image or read the QR code
to download the PDF and learn more.

►
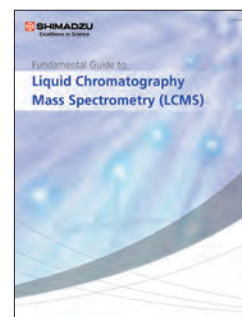
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