

Liquid Chromatograph Mass Spectrometer

# LCMS-8060

*UFMS*  
ULTRA FAST MASS SPECTROMETRY



# CHANGES EVERYTHING

Sensitivity

Speed

Solutions

## LCMS-8060

The LCMS-8060 pushes the limits of what we can see. Creating the future of LC/MS/MS analysis can mean making something work with higher sensitivity, go faster or cost less. Sometimes it means trusting answers from one day to another.

### 2015 ● LCMS-8060

A new vision in sensitivity.  
It simply changes everything.

### 2013 ● LCMS-8050

First mass spectrometry company to  
achieve a scan speed of 30,000 u/sec  
and 5msec polarity switching time.  
Increased sensitivity by 30 times.

### 2012 ● LCMS-8040

Increased sensitivity by a factor  
of 5 compared to the LCMS-8030.

### 2010 ● GLOBAL LAUNCH LCMS-8030

First mass spectrometry company  
to achieve a scan speed of  
15,000 u/sec and polarity  
switching time of 15 msec.



 SHIMADZU

# LCMS-8060 Triple Quadrupole Mass Spectrometer

Pushes the limits of what we can see

Sensitivity

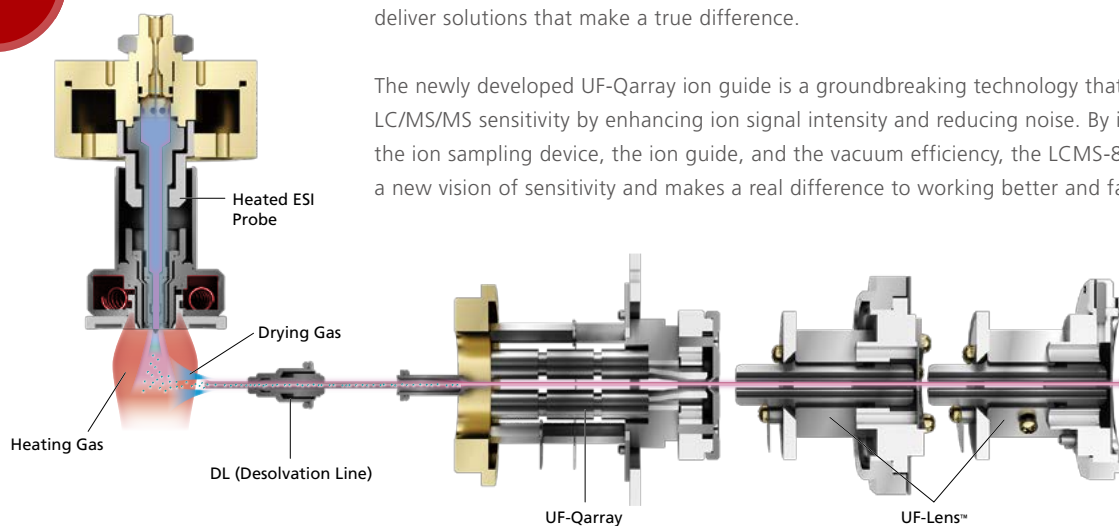
Speed

Solutions

The LCMS-8060 is a ground breaking innovation in mass spectrometry helping to transform LC/MS/MS data quality by developing a new vision of sensitivity and speed.

Shimadzu is the first mass spectrometry company in the world to deliver a triple quadrupole mass spectrometer with the highest sensitivity and ultra-fast technologies to create an innovation that really matters.

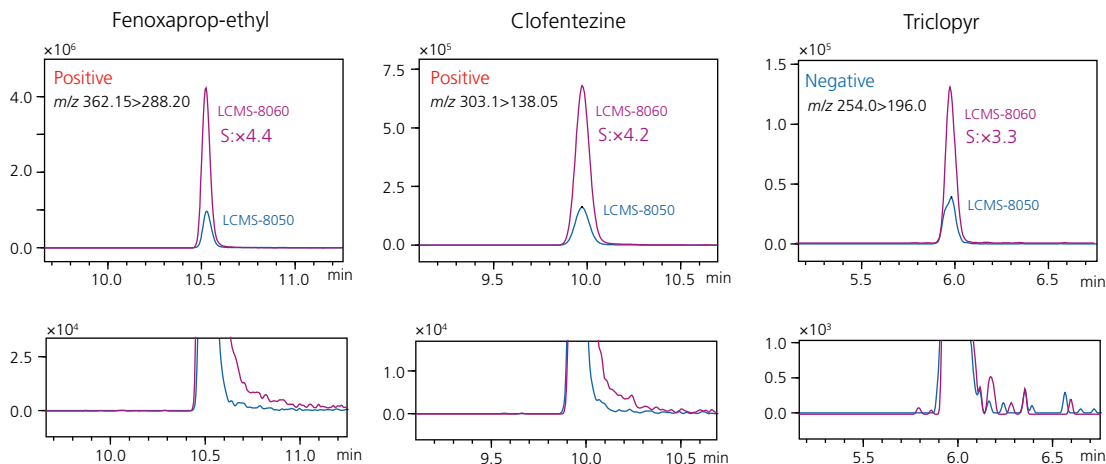
Sensitivity



By redefining the ion focusing capability on the UF-Qarray™, the LCMS-8060 brings a meaningful impact to quantitative detection and opens new opportunities for scientists to deliver solutions that make a true difference.

The newly developed UF-Qarray ion guide is a groundbreaking technology that increases LC/MS/MS sensitivity by enhancing ion signal intensity and reducing noise. By improving the ion sampling device, the ion guide, and the vacuum efficiency, the LCMS-8060 delivers a new vision of sensitivity and makes a real difference to working better and faster.

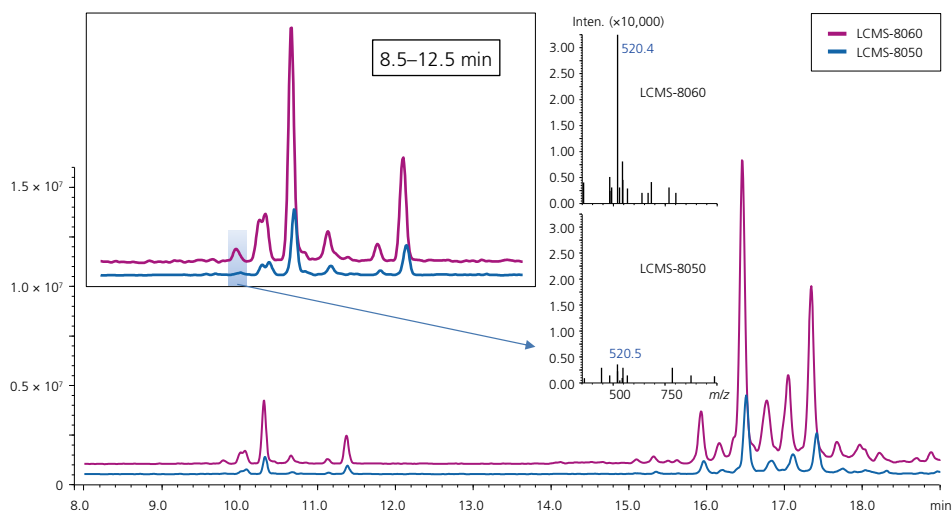




MRM chromatograms: 100 ng/mL neat standard, upper: signal comparison, lower: baseline noise comparison

Built on the proven platform of the LCMS-8050, the new patented ion guides developed for the LCMS-8060 greatly improves ion production and collisional focusing without affecting noise. The ion production, transmission and detection of three pesticides (fenoxaprop-ethyl, clofentezine and triclopyr) results in increased

sensitivity compared to previous technologies. The chromatogram for each pesticide has been magnified to show the noise has not increased with a higher ion production. Innovations in ion guide technologies not only delivers new limits of MRM sensitivity but has an impact on full-scan sensitivity.



Comparison between the LCMS-8060 (purple) and LCMS-8050 (blue) for the analysis of lipids (precursor ion scanning at  $m/z$  184-choline-containing phospholipids in positive ion mode)

Lipid profiling on the LCMS-8060 can detect more ion signals with greater precision and with higher confidence. After protein precipitation, the human serum sample was diluted 1000 times by methanol and  $1\mu\text{L}$  was injected onto the LCMS-8050 and

LCMS-8060 systems using a scan speed of 3,000 u/sec. With the LCMS-8060 lower levels of phosphatidylcholine could be detected in a human serum sample following a protein crash sample preparation compared to the LCMS-8050.



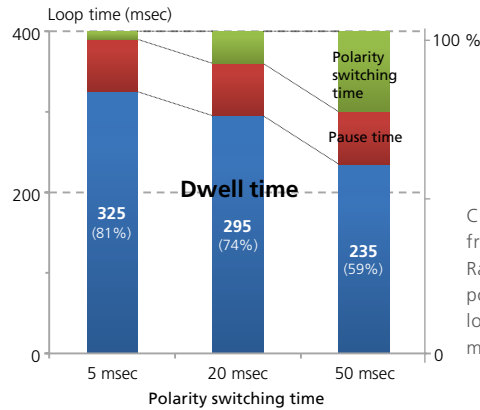
Inspired by the need to balance advanced high speed MS/MS detection technologies with unrivalled LC performance, we were the first mass spectrometry company in the world to deliver a scan speed of 15,000 u/sec and a polarity switching speed of 15 msec. In the LCMS-8060 the scan speed is now increased to 30,000 u/sec and a polarity switching speed of 5 msec making a real difference to working better and faster.

### Fast polarity switching

The LCMS-8060 uses UF Technologies to switch polarity in 5 msec.

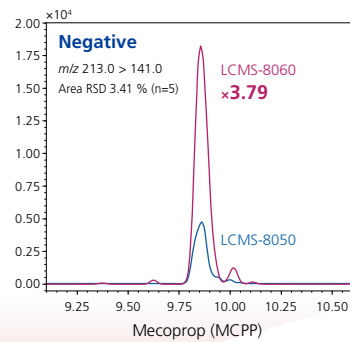
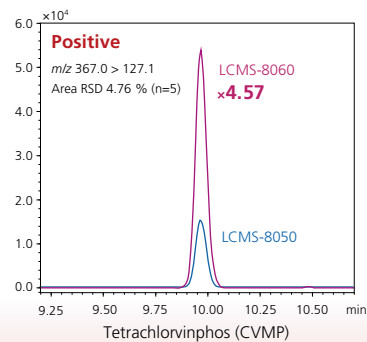
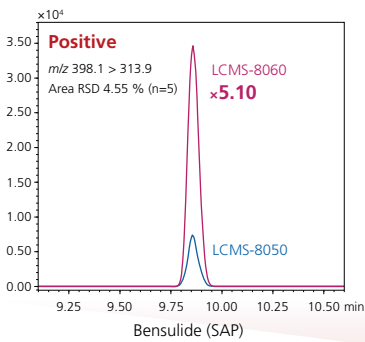
### Detect more

Fast cycle time helps to detect more compounds with greater confidence and precision.

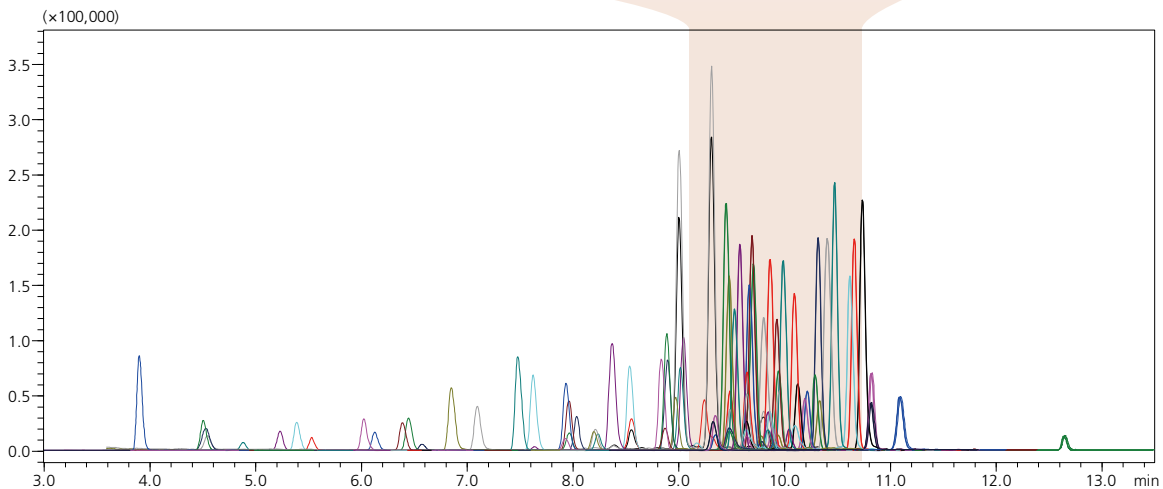


Faster polarity switching time maximizes dwell times and helps to optimize the cycle time of LC/MS/MS methods.

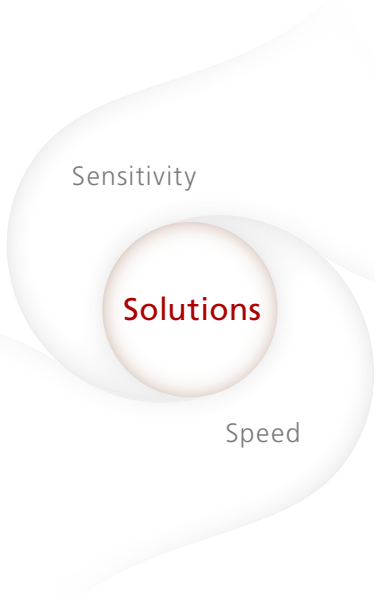
Comparing the differed polarity switching times from 5, 20 to 50 msec. Ratio of dwell time (blue), pause time (red) and polarity switching time (green) in 400 msec of loop time when 65 of MRMs are simultaneously monitored.



Dwell time 2 msec, Loop time 400 msec



MRM chromatograms of 105 pesticides (300 pg/mL each) using a polarity switching speed of 5 msec and a sampling window of 65 compounds in 400 msec loop time



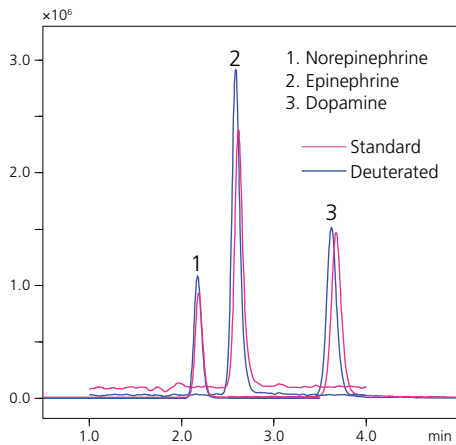
## Solving Complex Problems

### High-sensitivity quantitation of intact catecholamines (CAs) in human plasma.

In clinical research, plasma catecholamines and their O-methylated metabolites (metanephrines) are measured as biomarkers for diseases such as hypertension, pheochromocytoma or neuroblastoma.

It is a challenging assay as the low physiological levels of CAs, physicochemical properties, and potential interferences require high sensitivity and specificity.

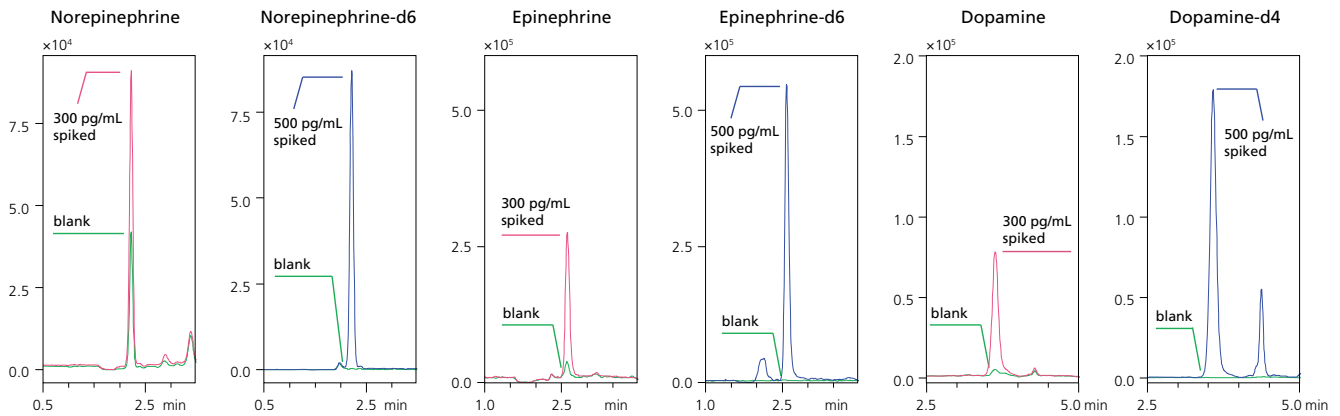
We developed a SPE-LC/MS/MS assay by using LCMS-8060 to detect catecholamines at ultra-high sensitivity without matrix interferences. As the measurement cycle time was 12 mins including the column re-equilibration the LCMS-8060 assay opens new possibilities for multiplexed sample analysis and higher sample throughput.



Representative MRM chromatograms of 3 catecholamines

Quantitative range of neat and matrix-matched calibration curves

Compound name	Neat standard curve		Matrix-matched	
	Range (pg/mL)	Linearity (r <sup>2</sup> )	Range (pg/mL)	Linearity (r <sup>2</sup> )
Norepinephrine-d6 (158.1 > 111.1)	2.5 – 2000	0.9999	2.5 – 2000	0.9997
Epinephrine-d6 (190.1 > 172.1)	10 – 2000	0.9999	10 – 2000	0.9994
Dopamine-d4 (158.1 > 95.1)	5 – 2000	0.9999	10 – 2000	0.9995



Detection of Norepinephrine, Epinephrine and Dopamine and their deuterated internal standards in plasma

Expand your capabilities in quantitation

# Ultra sensitive detection in bioanalysis

Bringing together ultra fast scanning technologies with high sensitivity pushes the limits of what we can see.

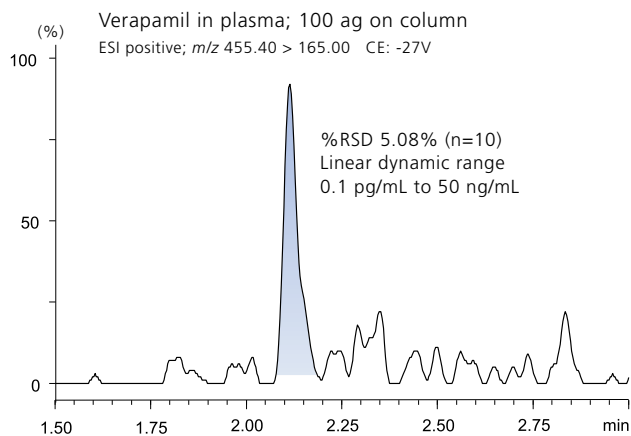
The LCMS-8060 is built for high data quality and drives confidence and consistency 24/7.





The triple quadrupole LCMS-8060 has an advanced ion guide design to increase ion production and detection and makes a meaningful impact on high sensitivity detection.

## High-Sensitivity Quantitation of Verapamil in Plasma

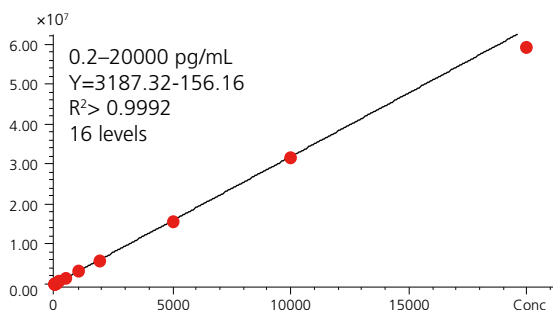
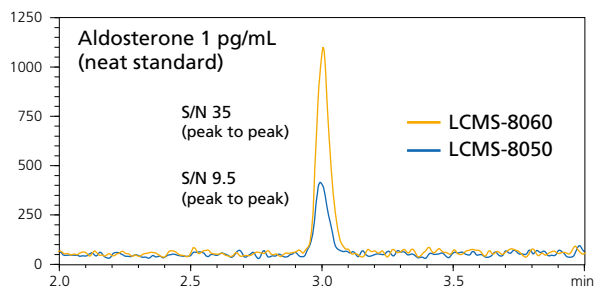
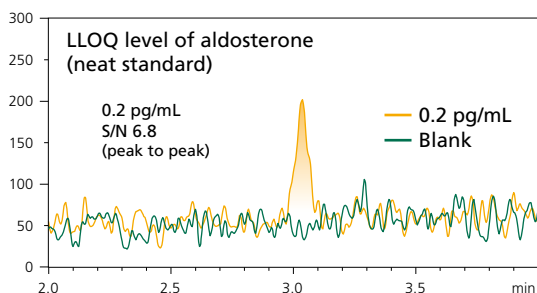


Precision and accuracy of verapamil

Actual Conc. (ng/mL)	Calculated Conc. (ng/mL)	Area RSD (% , n=3)	Accuracy (%)
0.0001	0.000100	2.97	100.3
0.0005	0.000508	6.15	101.7
0.001	0.000942	5.32	94.3
0.005	0.00491	3.54	98.9
0.01	0.00949	2.94	95.0
0.05	0.0511	2.14	102.4
0.1	0.0996	1.18	99.8
0.5	0.522	0.63	104.5
1	1.01	0.26	100.8
5	5.28	0.43	105.6
10	10.0	0.60	100.0
50	48.8	0.33	97.8

- Verapamil spiked into a plasma crash sample can be quantified at 100 ag on column with a precision of 5.08% for multiple injections (n=10).
- The LCMS-8060 also delivers a linear dynamic range from 0.1 pg/mL to 50 ng/mL.

## High-Sensitivity Quantitation of Steroid Hormones



Lv	Actual conc. (pg/mL)	Mean area (n=5)	RSD (n=5, %)	Calc. conc. (pg/mL)	Accuracy (%)
1	0.2	448	13.2	0.190	94.8
2	0.5	1597	3.8	0.550	110.0
3	1	3225	2.5	1.06	106.1
4	2	6085	1.4	1.96	97.9
5	5	16398	2.0	5.19	103.9
6	10	31448	1.1	9.92	99.2
7	20	63339	1.2	19.9	99.6
8	50	158487	1.1	49.8	99.5
9	100	322774	0.9	101	101.3
10	200	602459	0.3	189	94.5
11	500	1556542	0.5	488	97.7
12	1000	3284586	2.1	1031	103.1
13	2000	5883876	0.5	1846	92.3
14	5000	15641489	0.3	4907	98.1
15	10000	31567190	1.0	9904	99.0
16	20000	59328173	2.6	18613	93.1

- Aldosterone was detected at a lower concentration of 0.2 pg/mL using neat standards and the calibration curve was linear from 0.2 to 20,000 pg/mL.

Expand your capabilities in quantitation

## Ultra sensitive peptide analysis and lipid profiling

Advanced design, fast workflows and added business value  
help the LCMS-8060 deliver on a broad range of applications.

The challenge in peptide analysis and lipid profiling is to  
generate high data quality in complex samples.

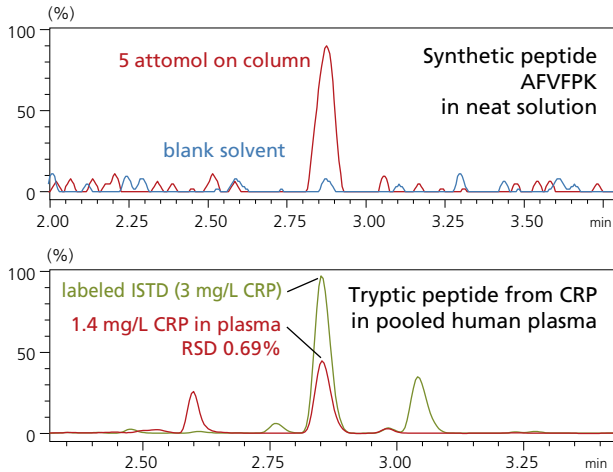
For research use only. Not for use in diagnostic procedures.



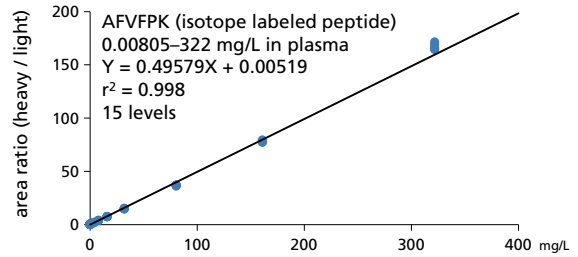
## High-Sensitivity Peptide Detection

High sensitivity and fast scanning capabilities has opened up new workflows for quantitative proteomics.

In the detection of the tryptic peptide AFVFPK (from C-reactive protein, CRP) as a biomarker for inflammation 3 mg/L is reported as an average level of CRP in plasma. The LCMS-8060 delivers a highly sensitive detection of AFVFPK with the lowest calibration curve point at 0.008 mg/L.



Chromatogram of tryptic digested peptide derived from CRP using conventional flow rate



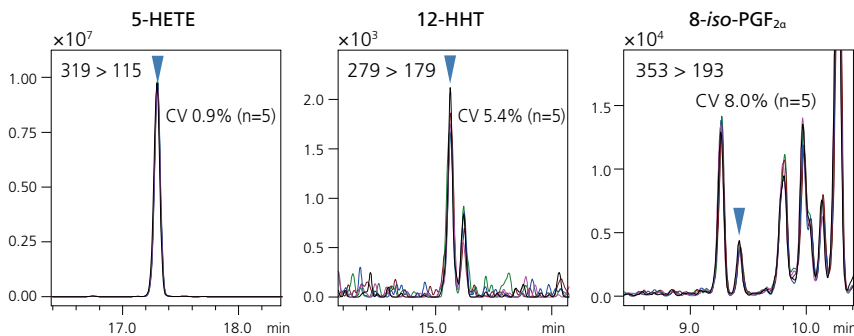
Spiked conc. (mg/L, in plasma)	Calculated conc. (mg/L, in plasma)	Accuracy (%)	RSD (% , n=5)
0.00805	0.00929	115	7.1
0.0161	0.0181	112	8.2
0.0322	0.0356	111	5.2
0.322	0.320	99	1.2
3.22	3.01	93	0.7
32.2	29.8	93	1.0
322	337	105	0.9

Quantitative results of AFVFPK (isotope labeled peptide) spiked into tryptic digested plasma

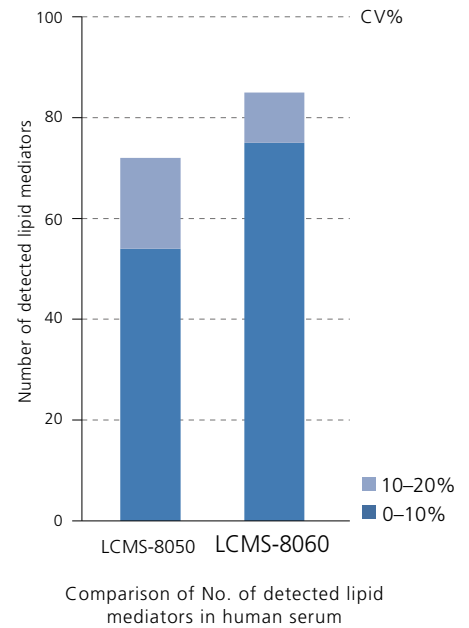
## Lipid Mediator Profiling

Lipid mediators represent a class of bioactive lipids that are produced locally through specific biosynthetic pathways in response to extracellular stimuli. Lipid mediators are involved in many physiological processes, and their dysregulations have been often linked to various diseases such as inflammation, infertility, atherosclerosis, ischemia, metabolic syndrome, and cancer. To help further our understanding of lipid mediators in the disease process we have created a method package designed to detect lipid mediators derived from arachidonic acid cascade.

Using the lipid mediator method package the LCMS-8060 detected arachidonic acids metabolites in human serum over a wide dynamic range from sub nM to  $\mu$ M concentrations. 5-HETE has shown the highest concentration which was 1  $\mu$ M and the lowest was 12-HHT (0.5 nM). In case of 8-iso-PGF<sub>2 $\alpha$</sub> , its concentration was 0.1 nM.



MRM chromatograms of 5-HETE, 12-HHT and 8-iso-PGF<sub>2 $\alpha$</sub>



Expand your capabilities on Quan/Qual  
Quan/Qual approaches  
using ultra fast capabilities

Shimadzu is a global leader in ultra fast capabilities in mass spectrometry creating methods that are designed to overcome real-world obstacles and deliver better data.



## High Sensitive and High Speed Forensic Screening

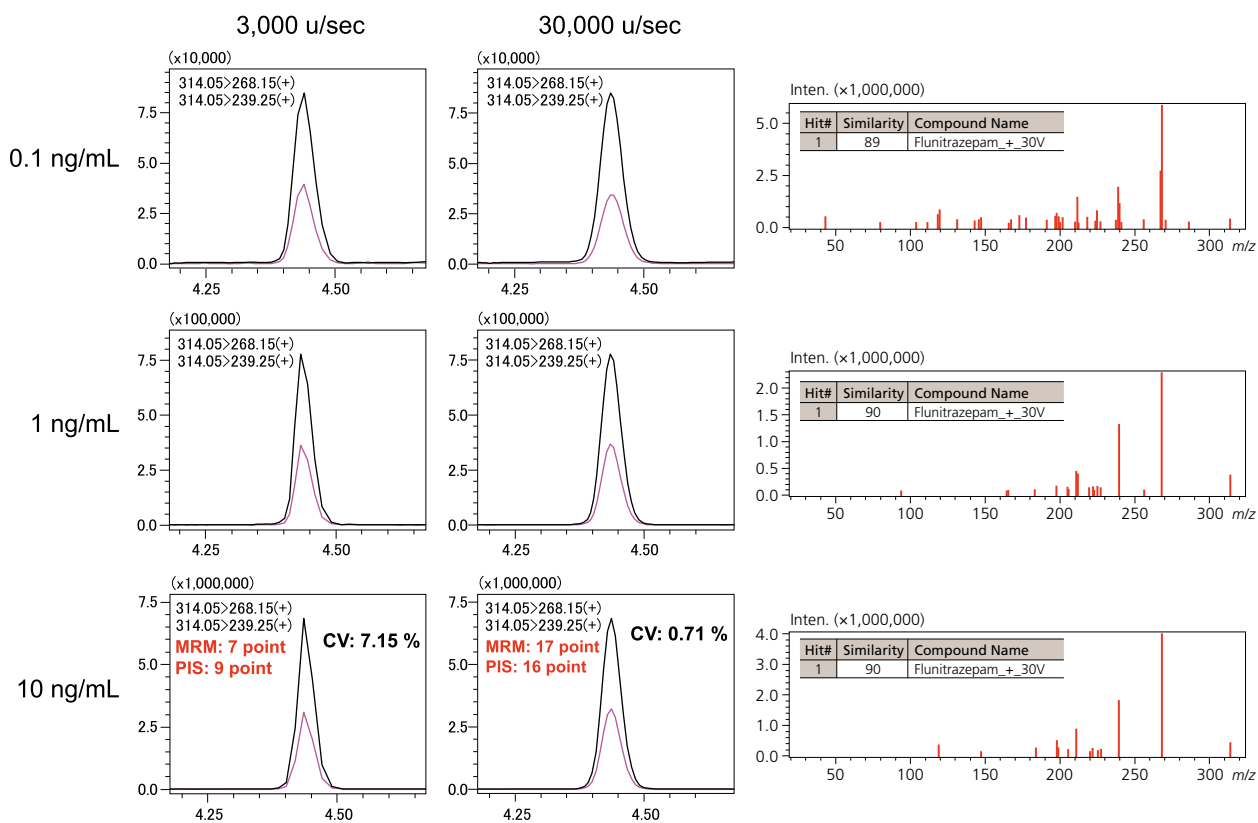
Ultra fast capabilities help to reshape workflows and help productivity by bringing together definitive quantitation and information rich MS/MS spectra in a single analysis. The LCMS-8060 can quickly switch between a full scan analysis and

precise quantitation using the Synchronized Survey Scan™ (SSS) mode. This mode automatically performs product ion scanning once a pre-defined threshold has been exceeded. Qual/Quan methods can support a maximum of 1000 events in a single SSS methods.

Type	Event#	+/-	Compound Name <i>m/z</i>	Time (1.099 min - 6.690 min)
MRM	11	+	Flunitrazepam 314.05>268.15	
└ Product Ion Scan	12	+	> 20.00 : 324.00	
MRM	13	+	Nimetazepam 296.05>250.20,	
└ Product Ion Scan	14	+	> 20.00 : 306.00	
MRM	15	+	Estazolam 295.05>267.15, 29	
└ Product Ion Scan	16	+	> 20.00 : 305.00	
MRM	17	+	Triazolam 343.05>308.20, 34	
└ Product Ion Scan	18	+	> 20.00 : 353.00	
MRM	19	+	Alprazolam 309.10>281.10, 3	
└ Product Ion Scan	20	+	> 20.00 : 319.00	

Data acquisition method setting of Synchronized Survey Scan using MRM as survey and product ion scan as dependent event

Quan/Qual method set up for the analysis of benzodiazepines in blood. The SSS method in rapid toxicology screening method package combines MRM and MRM triggered product ion scanning for 161 compounds.



Data acquisition method setting of synchronized survey scan using MRM as survey and product ion scan as dependent event

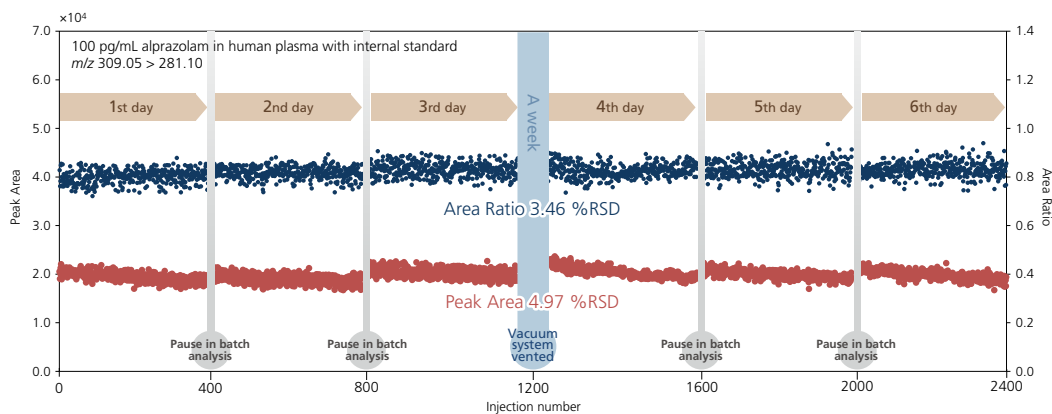
Blood samples were spiked with flunitrazepam at three concentration levels (0.1, 1.0 and 10 ng/mL) and pretreated by a simplified QuEChERS method. Flunitrazepam was precisely detected at two different scan speeds 3,000 u/sec and 30,000 u/sec. At a scan speed of 30,000 u/sec the LCMS-8060 acquires more data

points over a peak without loss of mass accuracy or quantitative precision. In the case of the lower calibration standard at a concentration of 0.1 ng/mL the data quality of the product ion spectrum was still maintained at 30,000 u/sec.

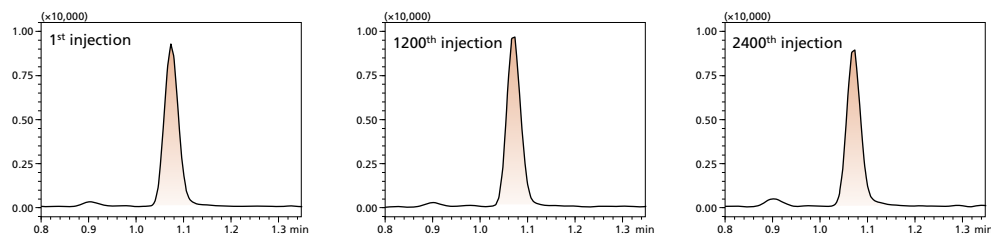
# Engineered for Robustness and Easy Operation/Maintenance

The robustness of the LCMS-8060 and modified ion optics was also assessed by injecting 2400 samples of femto-gram levels of alprazolam spiked into protein-precipitated human plasma extracts over a 6 day period (over 400 samples were injected each day). The RSD of peak area response was 5% over this test period, using

a deuterated internal standard (alprazolam-d5) the RSD was 3.5%. As part of the robustness test the vacuum system was vented to model a transient power failure with no effect on signal response or baseline noise level.



Long term stability study on LCMS-8060



MRM chromatograms for the 1st, 1200th and 2400th measurements of alprazolam

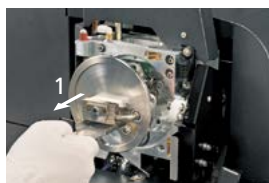
Intraday and Interday variations on LCMS-8060

Compound	Intraday Variation (%RSD)						Interday Variation (%RSD)		
	1st day	2nd day	3rd day	4th day	5th day	6th day	Days 1-3	Days 4-6	6 Day Total
Alprazolam	5.04	4.94	5.06	5.38	4.55	4.83	3.19	1.63	2.74
Alprazolam-d5 (ISTD)	5.04	4.68	5.48	5.31	4.26	4.91	2.62	1.89	2.18
Area ratio (Alprazolam / Alprazolam-d5)	3.48	3.11	3.48	3.44	3.71	3.54	1.79	0.26	1.40

## Easy System Maintenance Reduces Downtime

As with Shimadzu's other triple quad systems, maintaining the LCMS-8060 is simple. Replacing the desolvation line (DL) and ESI capillary is quick and easy. Additionally, the design allows users to replace the DL without breaking vacuum, providing greater uptime and usability.

### Steps for DL Replacement

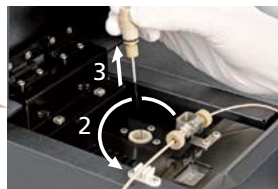


## Newly Designed Ionization Unit

Designed without cables or tubes, removing the new ionization unit is simple: release a one-touch lever to open the unit and lift it out. In addition, no tools are needed to detach the needles fitted in APCI and DUIS™ units, allowing for easy maintenance.



### ● Steps for ESI Capillary Replacement



ESI (standard)



APCI (optional)



DUIS (optional)

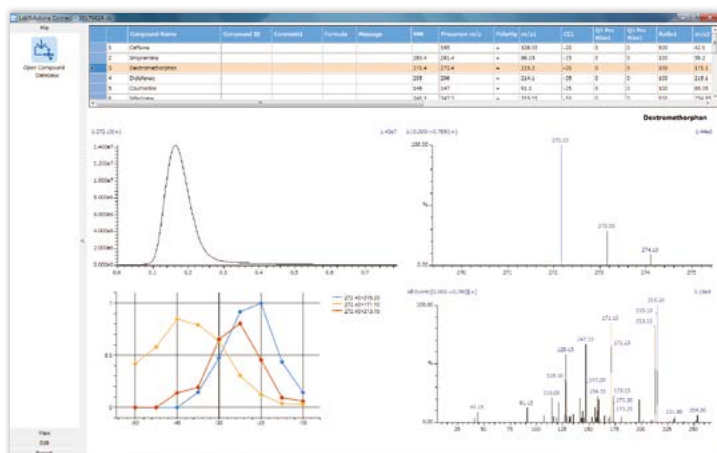


# Smart Software for Anyone Doing LC-MS/MS LabSolutions Connect™

LabSolutions Connect is the smart way to work for all routine laboratories. Simplifying workflows to run samples on the LC-MS/MS with tools to help MRM optimization.

## Get Better Results

Laboratories with the need for expanding target compound panels or building up new methods also need to consider how to get the highest sensitivity without manual compound optimization. The automated MRM optimization tool, which is part of the LabSolutions Connect platform, delivers MRM transitions for quantitation and for MRM Spectrum for library searchable identification.



### MRM Data Review

A simple graphical interface showing the collision energy profiles for multiple product ions

## Tablet-like UI for Sample Analysis

In routine laboratories, the sample to result cycle time defines efficiency and productivity. To help reduce the sample to result cycle time and open LC-MS/MS technology to everyone the user experience has been redefined making running samples easy. LabSolutions Connect is designed with an intuitive layout to show the sample list as a simple table and the position of the sample in the autosampler tray.



### Designed for Everyone in The Lab

By redesigning the user experience, analytical scientists across multiple disciplines can run sample lists, check the sample vials are in the right position and see the status of the instrument in one smart layout.

Its simple, intuitive and streamlines workflows in any laboratory environment.



# LabSolutions Insight™ Rethinking Quantitative Data Review

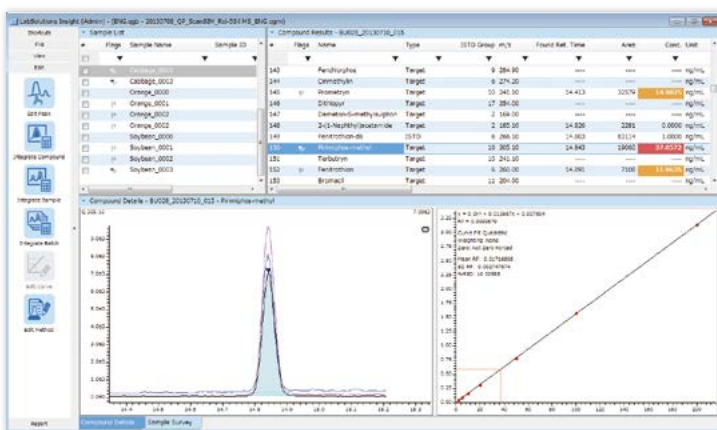
LabSolutions Insight has powerful data mining and analytics capabilities for reviewing LC-MS/MS results. It is designed to support review-by-exception enabling quality rules to identify exceptions quickly. LabSolutions Insight now has the added capability to work seamlessly with the LabSolutions DB/CS environment and audited regulatory requirements, it also has the

flexibility to adapt to different reporting workflows with multiple results files.

The new Insight software also supports library identification by either full scan or MRM spectrum mode helping to provide tools for both quantitation and identification in one workspace.

## Brings A New Way to Review Actionable Data

LabSolutions Insight enables quantitative data to be reviewed in different ways, each connected workspace environment helps to check peak integration, find outliers, show chart trends and calibration curve data. Visualizing data, finding specific information, sorting actionable data is made easy by applying filters to each field in the table.



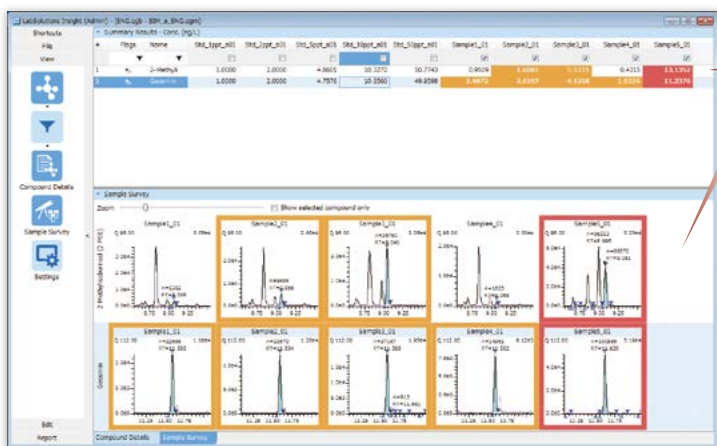
### LabSolutions Insight

Finds actionable data faster.

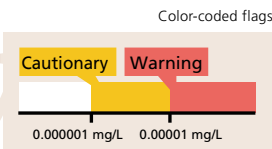
LabSolutions Insight has a panel of quality rules that can be set-up to find outliers at the touch of a single click. Outliers are color coded and can be easily visualized, sorted and reported.

## Survey Panel View to Quickly Review Actionable Data

Checking and reviewing individual data files can have a marked impact on laboratory productivity. Survey mode helps to change productivity by simply visualizing positive samples, outliers or simply to check data quality. As Insight uses dock-able pane technology, the survey mode screen can be shared on multiple monitors helping to improve productivity and data quality review for large panels of target compounds.



Sample Survey View



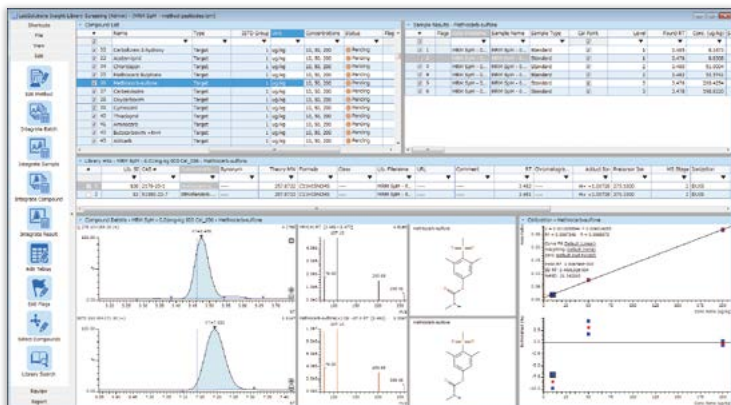
### Color Coded Review

By supporting a range of quality rules, samples can be flagged if the concentration is considered cautionary or as a warning. But the possibilities can be focused to specific needs highlighting retention time variation, ion ratio tolerance outside a set range, calibration curve regression outside an expected range. The list of quality rules helps to find actionable data quickly.

# Compound Identification LabSolutions Insight Library Screening

LabSolutions Insight offers MS/MS library search capabilities. Instrument parameters and MS/MS library spectra are available to deliver faster data acquisition, higher data quality, and enhanced identification. Shimadzu's LabSolutions Insight software offers easy viewing of the compounds of interest, including structural information, retention time and library similarity score.

LabSolutions also enables you to produce high-quality results without the need to define a threshold value to trigger a spectrum, decreasing the chance of false negative reporting. This feature, MRM Spectrum Mode, acquires all compound fragments of interest in MRM mode and can be used to create accurate spectra from even trace concentrations.



## Example of the screening of veterinary drugs using MRM spectrum mode

In MRM Spectrum Mode, known compound fragments are selectively acquired using multiple MRM channels, enhancing signal for low abundance analytes. Shimadzu's ultra-fast quadrupole technology makes this a practical approach for large panels of analytes.

## LC/MS/MS Method Packages and MRM Libraries

Shimadzu offers a wide variety of method packages containing LC separation conditions and a number of predetermined MRM conditions. Laboratories can bypass time-consuming method development steps and realize results sooner.



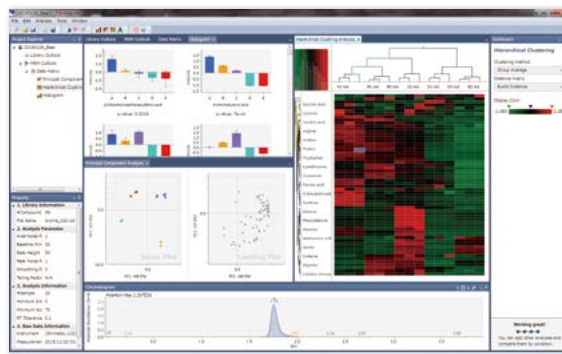
	Description	Flyer code
Method Packages	Residual Pesticides	C146-E306
	Veterinary Drugs	C146-E387
	Water Quality Analysis	C146-E180
	Rapid Toxicology Screening	C146-E224
	Primary Metabolites	C146-E227
	Lipid Mediators	C146-E381
	Cell Culture Profiling	C146-E279
	D/L Amino Acids	C146-E336
	Short Chain Fatty Acids	C146-E355
	Mycotoxins	C146-E351
	Forensic Toxicology Database	C146-E344
	Aminoglycoside Antibiotics	C146-E352
Restricted Chemicals in Textiles	C146-E382	
Bile Acids	C146-E386	
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 Reifycys Inc.



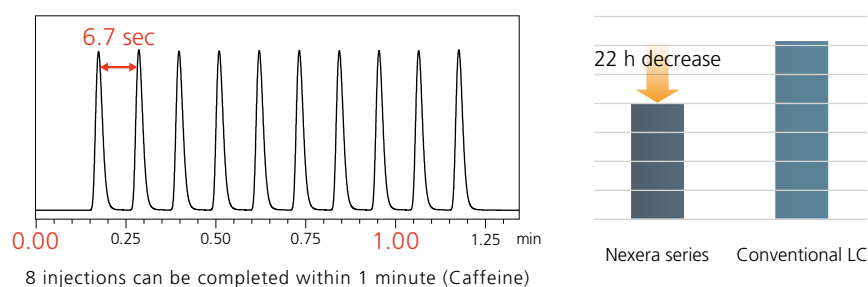
# Nexera™ UHPLC

Our unique approach to delivering high-quality, high-speed LC-MS/MS analysis is combining the Nexera UHPLC and LCMS-8060 as a seamlessly integrated system.

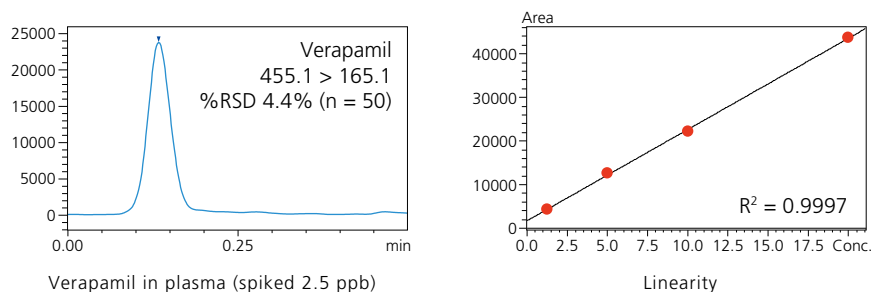


## Analysis Cycle Time Less Than 10 Seconds

The SIL-40 autosampler can process the entire injection cycle time in as little as seven seconds, twice as fast as the previous model. In addition, continuous analysis can be carried out on up to 44 MTPs (using 3 PLATE CHANGERS). Together these features dramatically increase analysis throughput.

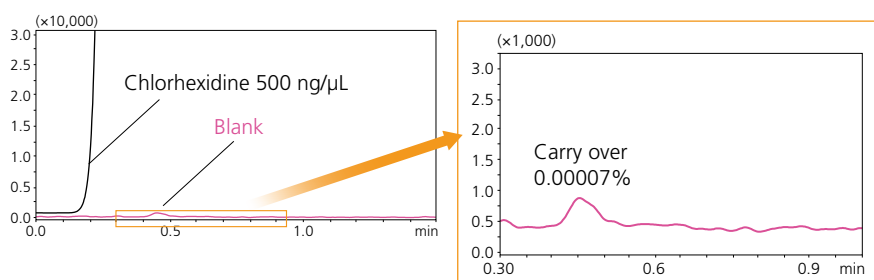


Pharmacokinetic analysis requires not only speed but also high reliability at low concentrations. With its ultra-fast injection and ultra-low carryover, the SIL-40 autosampler delivers high reproducibility and reliability, even during an ultra-fast 30-second analysis.



## Ultra-low Carryover

The Nexera boasts ultra-low carryover, even on a high-sensitivity LC-MS/MS. This reduces time spent on rinsing, resulting in a shorter overall analysis time.



After analysis of Chlorhexidine, the carryover to a blank solution is negligible.

Rinse Conditions: Normal

LCMS, UF-Qarray, UF-Lens, Synchronized Survey Scan, DUIS, LabSolutions Connect, LabSolutions Insight, GCMS and Nexera are trademarks of Shimadzu Corporation.  
Traverse MS is a trademark of Reifycs Inc.



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